

REPORT ON EXISTING RELAXED SEISMIC ASSESSMENT APPROACH FOR HERITAGE STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Date: 3.9.2026

Prepared by the Working Group

BUILDING CODES AND ISCARSAH PRINCIPLES: HARMONIZATION OF SAFETY ISSUES

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Disclosure:

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Executive Summary

Safety and authenticity are the key criteria in the assessment and retrofit of heritage structures. Safety criteria are also related to existing structures in general, as well as to new structures. However, preservation of authenticity is only related to heritage structures.

Engineers are mostly trained for new structures and tend to apply the respective safety requirements to heritage structures as well. This approach often results in excessive interventions, leading to unexpected behaviour and loss of authenticity.

Many countries have regulations governing existing structures in general, and, more specifically, heritage structures. Those regulations allow a more relaxed assessment approach for heritage structures than for new ones, thereby enabling preservation of authenticity. It should be emphasised that the limitations for applying the relaxed approach, outlined in the documents, must be carefully considered.

Relaxation options comprise relaxation on the demand or capacity side, on performance objectives, and by allowance for partial strengthening. The aforementioned division is not always strict in that a certain relaxation option may implicitly include one or two other options.

The Report intends to provide information on relaxation possibilities within the set of regulatory documents analysed by the Working Group. The set comprises documents related to existing structures in general, heritage structures, or both. Relaxation possibilities for existing structures in general can be applied to heritage structures with respect to safety, but with additional consideration of authenticity.

The information provided cannot be applied directly and requires further exploration tailored to the specific case. Selection and justification of any relaxed assessment approach should be supported by transparent documentation of assumptions, accepted risks, performance objectives and expected conservation benefits. Consultation between engineers, heritage professionals, owners and competent authorities is essential.

If authorities prioritise, or are required to maintain, authenticity over modern seismic safety and major physical interventions by relying on relaxed seismic demands and unconservatively estimated material capacities, ethical responsibilities toward public safety must still be met. For large gathering spaces (e.g., churches, mosques, theatres) that do not satisfy modern design safety levels, administrative risk mitigation becomes mandatory. This must include strictly limiting the number of concurrent visitors (similar to COVID-19 occupancy limits) and placing clear warning notices at all entrances informing the public of the seismic risks. In some countries, alternative modern strengthening and load reduction strategies might be acceptable under predefined conditions.

In countries with no specific regulations for existing and, more specifically, heritage structures, the Report may provide support to engineers in changing or improving the situation.

The terms *heritage structures*, *historic structures* and *historical structures* are used in literature as equivalents or semi-equivalents. The term “heritage structures” is used here, being more related to value rather than time. However, the terms “historic” and “historical” are retained as-is when cited from the documents.

Table of Contents

Executive Summary	2
1 Introduction	4
1.1 Regulatory documents	4
1.2 Relaxed approach	5
1.3 Purpose and background	6
2 Relaxed approaches	7
2.1 Relaxation on the demand side	7
2.1.1 Relaxation of the seismic forces to be used for the assessment/retrofit design	8
2.1.2 Relaxation of the earthquake return period to be considered during the assessment/retrofit design	10
2.2 Relaxation on the capacity side	12
2.2.1 Relaxation of the limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress	13
2.2.2 Relaxation of the limits related to the deformation capacity of the building materials, for example, permissible strain	15
2.2.3 Relaxation of the limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement	16
2.3 Relaxation related to performance objectives	17
2.3.1 Specific performance targets for heritage buildings related to risk categories and damage levels	18
2.3.2 Performance targets permitted to vary as a function of occupancy type/designation	21
2.3.3 Performance targets permitted to vary as a function of limitations placed on the number of occupants in the building	23
2.4 Relaxation by partial strengthening	24
2.4.1 Allowance for partial strengthening	25
2.4.2 Mitigation of vulnerabilities prioritised and implemented gradually over time	28
3 Limitations on the relaxed approach	30
4 Directions for future research	31
References	33
Bibliography	36
Annex 1 Overview of Seismic Relaxation Possibilities	38
Annex 2 Glossary of abbreviations	39
Annex 3 Individual reports on regulatory documents	40

1 Introduction

The assessment of a damaged heritage structure requires anamnesis, diagnosis, therapy (if any) and monitoring. In line with the ISCARSAH Guidelines [9], the mentioned phases have the following meaning:

- The first phase, **anamnesis and physical examination**, accounts for the case history of a building, including past traumas, interventions, and modifications; it also extends to the subsequent structural data acquisition campaigns and all the investigations (laboratory, field and other) necessary to derive conclusions on diagnosis, assessment and therapy.
- The second phase, **diagnosis and assessment of structural performance**, is oriented to identify the causes of damage and decay and to characterise the structure's conservation condition. This phase also involves the evaluation of the performance of the structure in its current state and the identification of the intervention needs.
- The third phase, **therapy**, involves the design of alternative intervention schemes and the assessment of their efficiency, the identification of the optimal solutions and the detailed definition of the intervention strategies with the necessary design details and specifications of materials and techniques.
- The fourth phase, **control**, includes the necessary quality control checks and monitoring campaigns to be implemented for verification purposes before, during and after the execution of the intervention. It also includes a detailed maintenance plan.

The assessment of heritage structures without obvious wear or damage may also be performed for the sake of safety evaluation, understanding the current state and taking decisions on interventions if necessary.

Structural analysis at different levels of complexity is needed throughout this most often cyclic process.

The safety of the heritage structure is assessed by using various models and their calibration against the requirements set by legally binding regulatory documents. Regarding the safety aspect, the procedure for heritage structures is equivalent to the assessment of existing structures in general. However, in the specific case of heritage structures, it is necessary to keep their authenticity as well.

The Report provides a concise overview of possibilities for a more relaxed assessment approach for heritage structures with reference to existing structures in general as well. Using a relaxed approach for heritage structures has limitations which should be carefully considered.

1.1 Regulatory documents

Legally binding regulatory documents (e.g. codes and standards) are, in many countries, addressed only to new structures.

A heritage structure might not meet the safety requirements set in those regulatory documents without significant interventions.

However, excessive interventions often have a paramount negative impact, such as:

- Loss of authenticity;
- Change of structural system, consequently leading to different and often unpredictable behaviour.

In some countries, there are regulatory documents (codes, standards, guidelines, etc.) addressed to existing structures in general, and more specifically to heritage structures. Legality of their use is in some cases regulated by the law (mandatory documents), in other cases, they are nonmandatory but under certain conditions accepted by the authorities, and in the third group are nonmandatory documents used as guidelines, but still not accepted by the authorities.

The aforementioned regulatory documents provide a certain relaxed approach compared to the one set for new structures.

Twenty-two regulatory documents referred to in the Report are listed at the end. In summary, their features are as follows:

- Legal status
 - 14 mandatory documents ([2], [3], [4], [5], [7], [11], [14], [17], [19], [20], [22], [23], [26] and [27]);
 - 4 nonmandatory documents accepted under certain conditions by the authorities ([10], [15], [21], and [24]);
 - 4 nonmandatory documents used as guidelines, still not accepted by the authorities ([8], [9], [18], and [25]).
- Referring to existing structures in general, heritage structures or both
 - 9 documents refer to existing structures in general ([2], [5], [11], [17], [19], [24], [25], [26], and [27]);
 - 6 documents refer to heritage structures ([8], [9], [14], [15], [18], and [23]);
 - 7 documents refer both to existing structures in general and more specifically to heritage structures ([3], [4], [7], [9], [20], [21], and [22]).

The regulatory documents for existing structures in general are included here because the safety aspects explained there apply to heritage structures, as well. Authenticity should be considered additionally.

The analysed set of documents, as listed in the References, is not exhaustive. Other relevant documents for additional reading are listed in the Bibliography.

1.2 Relaxed approach

The Report on relaxation for the assessment of heritage structures, compared with the requirements for new structures, is focused on the seismic aspect.

A relaxed approach refers to the application of less stringent safety requirements for heritage structures in order to ensure the preservation of their historical values. A relaxed approach does not imply acceptance of unsafe conditions, but rather the adoption of proportionate safety objectives that balance life safety, heritage significance and conservation requirements.

According to regulatory documents in some countries, the relaxed approach may refer to the following:

- Relaxation on the demand side;
- Relaxation on the capacity side;
- Relaxation related to performance objectives;
- Relaxation by partial strengthening.

Relaxation possibilities are subject to limitations which need to be carefully checked before being applied. There is a well-appreciated fine line between preserving structural authenticity and protecting human life. Because most large historic structures in seismic zones possess significantly high mass and unreinforced, brittle material in nature, a clear balance must be used between preservation and the risks of an unacceptable low structural capacity. Leaving a building vulnerable to catastrophic failure during a design-level earthquake while it holds a large number of occupants is unacceptable. Facilities like hospitals, theatres, mosques, churches, and similar high-occupancy spaces must satisfy strict safety criteria in accordance with local legislation. Structures utilising the relaxed assessments, with or without minor structural upgrades, must rely on restricted public access and transparent hazard communication to properly inform users at the entrance and maintain a proportional level of safety, all in accordance with the local legislation.

Each relaxation possibility is elaborated further with references to the regulatory documents supporting its application in practice.

Furthermore, a collapsed heritage structure, even if rebuilt using similar materials and traditional techniques, is no longer fully authentic. A massive seismic failure destroys the majority of the original material. Total reconstruction inevitably replaces the unique internal arrangements, such as hidden timber lintels unobservable from the exterior, the specific (horizontal) iron cramps and vertical dowels that may have been originally used between the building stones, and centuries of historical wear and tear will be mostly lost.

1.3 Purpose and background

The Report is meant to provide support to engineers with the assessment of heritage structures, considering the safety and authenticity issues, and more specifically, in the following aspects:

- Struggling with regulatory documents for new structures, when these are required for all structures;
- Support in the assessment of heritage structures by balancing safety and authenticity;
- Having an overview of possibilities used in different countries;
- Having support for changes or improvements to regulatory documents in their own countries.

The background of the Report is the analysis of relaxation possibilities in twenty-two regulatory documents addressing existing structures in general, heritage structures or both.

A broader analysis of the aforementioned regulatory documents is elaborated in the respective individual reports available in Annex 3.

The aforementioned regulatory documents are used in ten individual countries (Croatia, Greece, Iran, Italy, Japan, Portugal, Romania, Switzerland, Turkey and the USA), one is an EU document (applicable also in Bosnia and Herzegovina, and elsewhere), and three are international documents.

2 Relaxed approaches

The concept of relaxation may be presented as follows:

- The intervention on a heritage structure must improve seismic safety without necessarily bringing it to the level required for new buildings [14].
- Throughout Croatia, for example, buildings designed before 1964 may be assessed using a reduced seismic-resistance criterion of 75% of that required for new structures [2], regardless of whether they are located in the earthquake-affected counties. Within the post-earthquake reconstruction framework, buildings of greater importance should achieve the resistance required for new structures, or at least 75% of that level, while residential buildings should generally achieve a minimum of 50%; for smaller houses, a resistance level of 75% is required. These differentiated requirements reflect both economic considerations and the importance factor assigned to each building, enabling the level of intervention to be proportionate to its use, occupancy and consequences of failure. [2]. In New Zealand, all existing buildings are required to meet the seismic capacity of one-third of the seismic capacity of new buildings [27].
- In Greece, for example, the minimum mandatory requirements of capacity that must be met by the existing structures may, under certain conditions, be reduced. The mandatory minimum requirements that must be met before and after the intervention are determined in relation to the type of structure, its use, its importance, the time of its construction and the Codes in force at the time [7].
- Controlled derogations and alternative solutions are possible, provided that an adequate level of safety is ensured, granting significant flexibility to designers in identifying solutions compatible with conservation requirements [22, 23].
- Performance levels of retrofitting are based on the importance class, occupancy type, or designation of the existing building, etc. [2, 3, 5, 7, 11, 22, 24, etc.].

Further information on relaxation possibilities is grouped by the relaxation type and the orientation of the referenced document (heritage structures only, existing structures in general, and both).

2.1 Relaxation on the demand side

Seismic demand is reduced before assessing capacity. Mechanisms vary by jurisdiction: Italy applies a hazard fraction ($\alpha = 0.4\text{--}0.8\times$); China reduces the fortification intensity by one degree ($\sim 50\%$ base shear); Spain applies a seismic coefficient of $0.6\text{--}0.8\times$, and similar values are obtained in Portugal, but making use of two cumulative normatives. In all cases, the lateral force requirement can be halved relative to new construction, other than New Zealand, where it is one-third (i.e. 34% of the New Building Standard), while respecting the prescribed limitations.

2.1.1 Relaxation of the seismic forces to be used for the assessment/retrofit design

Documents specifically related to heritage structures [14, 15, 18, 23]

Relaxation of seismic forces is not specified. However, **specific analyses and appropriate considerations may justify** different approaches to safety [8, Section 2.8].

The Directive, in section 2.2 “Criteria for the assessment of seismic safety and effectiveness of the intervention“, provides for **relaxation mainly on the demand side. The actions can be different from those for new structures.** Use of **local seismic response** analysis is recommended in section 3.1 to avoid overestimation resulting from generic soil classifications [14].

Base shear coefficient $C_0=0.2$ for heritage structures for moderate earthquakes. Coefficients $C_0=0.2$ and $C_0=1.0$ have to be applied for standard existing structures, for moderate and significant earthquakes, respectively [15].

Seismic forces are relaxed relative to the codes for new structures. If the conventional seismic force leads to interventions that cause unacceptable, irreversible changes to the building’s architecture or decoration, the design seismic force may be reduced by applying a factor less than one. **This reduction must not lower the seismic performance below a mutually agreed “minimum acceptable level”** between the restoration architect and structural engineer. The acceptable level and reduction factor must be approved by the competent authorities and be determined by balancing the safety benefits against the costs of losing architectural or cultural integrity [18].

Seismic force level: **base shear capped** at $0.75 \times \text{CBC}$; near-fault amplification waived for Risk Category I–III with fundamental period ≤ 0.5 seconds. Prescriptive Seismic Force Resisting System (SFRS) detailing (CBC/ASCE 7 Chapter 12) is not required where rational evaluation under §8-706 demonstrates adequate load path and stability. Equivalent safety to the objectives of CBC; CHBC art. 8-412 allows alternative seismic systems without meeting prescriptive CBC requirements. The CHBC does not list approved alternative systems. Instead, §8-105.2 establishes a **performance equivalency framework** under which virtually any seismic system can be used, provided equivalent safety is demonstrated. As the document states, “The intent of the CHBC is to save California’s architectural heritage by recognising the unique construction problems inherent in historical buildings and by providing a code to deal with these problems.” This is addressed primarily by expressly affording the engineer the ability to use alternative approaches while “providing reasonable safety for the building occupants....” The CHBC sets forth that 75 per cent of the wind and seismic forces in the regular code for new buildings be used, but alternative approaches beyond that are still allowed, particularly if evaluation and strengthening are not triggered by ordinance [23].

Documents related to existing structures in general [2, 5, 19, 24, 26]

The seismic forces can be reduced because there’s an initiative to partially fix the structures to improve seismic resistance. It can be thought of as seismic force reduction or return period relaxation, but in the end it gives smaller seismic forces depending on the importance factor according to the Eurocode 1998-1 (less important buildings with 50% of the seismic forces from the return period of 475 years, class III buildings with 75% of the seismic forces and class for 100%, as new structures). At present, the law is valid only in the areas affected by the recent earthquakes. Importance classes are in accordance with EN 1998-1, except for significantly

damaged structures, which, concerning their repair, should be treated as class III buildings, no matter of their usage. Significantly damaged structures are those belonging to grades 3 and 4 of the European Macroseismic Scale (EMS-98) classification [2, 3, 4].

Seismic forces are related to performance requirements and compliance criteria defined in the standard and national annexes. The three limit states (near collapse, significant damage and damage limitation) refer to different return periods (2475, 475 and 225 years, respectively) and consequently to higher or lower seismic forces. The national authorities decide whether all three limit states shall be checked, or two of them, or just one of them. Thus, depending on the requirements given in National Annexes, seismic forces may or may not be relaxed compared to the requirements for new structures [5].

SIA 269/8 permits the reduction of demand **based on residual life and occupancy** of the building [19].

While there is no reduction factor for seismic forces that is applied, for example, to seismic design forces for new buildings per se, **seismic forces for existing buildings may be relaxed relative to those used for new buildings by use of a relaxed seismic hazard level**; e.g., BSE-2E (5% in 50 years), one of the standard hazard levels for existing buildings, is lower than those required for new construction (1% probability of collapse in 50 years). The standard accepts a higher collapse risk for existing buildings compared to new constructions, justified by their shorter remaining service life. The specific amount of the reduction in seismic forces will vary as a function of the shape of the hazard curve for the site; the spectral ordinates are capped at 100% of those required for new construction. Additionally, even lower seismic hazards can be selected (e.g. BSE-1E or 20% in 50 years) at the discretion of the owner and approval of the authority having jurisdiction [24].

The **assessment and strengthening phases are divided**. For the mandatory assessment phase, the **safety requirements relating to 90% of seismic action**, defined in the NP EN1998-3:2017 standard (which already reduces the seismic action of existing structures to 75% or 89% respectively for Type 1 or Type 2 earthquakes, when compared to new structures) are verified. If the structure is not compliant, it is mandatory to prepare a seismic strengthening project under the same standard for 100% of the seismic action defined in NP EN1998-3:2017 standard (reduced when compared with new structures) [26].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 22, 27]

Starting from the seismic forces provided in EC8, the Greek code (KADET) for example, **defines three performance levels and nine levels of ratios between the ground acceleration to be adopted in the design of interventions and the reference ground acceleration (according to EC8)**. However, the selection of the performance level and the value of $a_g/a_{g,ref}$ is subject to rules set by the Authorities [7].

The IEBC allows **reduced seismic forces for existing buildings** compared to new construction. Typical reduction factor: Base shear demand for existing buildings undergoing alterations, repairs, or changes of occupancy may be reduced to 75% of the IBC-required value (new structures). This reduction recognises that retrofitting existing structures to full new-building standards is often impractical, while still ensuring safety [22].

In New Zealand, seismic demand is not reduced before capacity is assessed. Demand and probable capacity are determined separately and compared to derive a %NBS (National Building Standard) rating. The statutory threshold of 34%NBS applies to existing buildings generally and is not a heritage-specific demand reduction. Higher strengthening objectives may be adopted depending on the building, risk and project objectives, but that is the owner's discretion. Further,

in New Zealand, seismic demand and building capacity are assessed separately and compared at the end of the assessment, with %NBS used as the statutory threshold. Capacity is assessed using probable material properties rather than dependable or characteristic values. More importantly, %NBS is a performance rating rather than merely a universal lateral-force multiplier [27].

2.1.2 Relaxation of the earthquake return period to be considered during the assessment/retrofit design

Documents specifically related to heritage structures [8, 14, 18, 23]

Relaxation is not specified. However, **specific analyses and appropriate considerations may justify different approaches to safety** [8, Section 2.8].

The earthquake return period is considered. Some interpolation formulas are provided to consider return periods different from those currently available. **The relaxation must be expressed either in terms of return period or, indirectly, in terms of seismic safety index.** The Directive, in sub-section 2.2 “Criteria for the assessment of seismic safety and effectiveness of the intervention”, requires:

- 1) The estimation of the seismic safety index in the current situation.
- 2) The estimation of the seismic safety index to which the building can be brought with interventions compatible with the protection needs:

a) if the seismic safety index that can be achieved, which takes into account the seismic hazard of the site, the characteristics of the building and its intended use, is greater than or equal to one, the improvement intervention is fully satisfactory, also from the point of view of safety, assessed through a quantitative procedure;

b) if the seismic safety index that can be achieved is lower than the desirable one, or if too invasive interventions would be necessary, the designer can justify the intervention also by using qualitative assessments, which must be translated into quantitative terms, adequately justified in an explanatory report to integrate the calculation report

The nominal life of an historic building should be sufficiently long to ensure its preservation over time, including against seismic actions with a long return period. However, assessing and strengthening the building to this level may be burdensome, and the required interventions may be too invasive. Where seismic improvement, rather than full upgrading, is permitted, the project may therefore adopt **a shorter reference period**, V_R , corresponding to a shorter return period, T_R , of the design peak ground acceleration (PGA) for a relevant limit state. In fact, assuming a Poisson model for seismic hazard, the two parameters are related by the following relationship:

$$T_R = -\frac{V_R}{\ln(1 - P_{VR})}, \text{ where } P_{VR} \text{ is the exceedance probability in the reference period.}$$

From the previous relationship, it is possible to define a seismic safety index, given by the ratio between the return period of the seismic action (PGA) leading to the generic limit state and the corresponding reference return period. For a listed building, it is sufficient to demonstrate that the planned intervention determines an appreciable increase in the aforementioned seismic index, relaxing the reference return period, e.g. pursuant to the so-called seismic improvement intervention established by Italian legislation regarding cultural heritage in seismic zones (Articles 29 of the Italian State Law “Code of Cultural Heritage and Landscape”, Legislative Decree 22 January 2004, n. 42).

An interpretation in terms of relaxation of the reference period or life of the intervention is also possible. Relaxing the reference period means that **more extensive interventions can be postponed over time**; at the end of the reference period, a new assessment will need to be performed, and consequently, new interventions may be necessary. However, it will then be possible to exploit advances in knowledge and technological progress, e.g., in terms of understanding seismic hazard, the ability to assess the vulnerability of the building, and the availability of less invasive intervention techniques.

For **example**, for the life safety limit state, a reference period of 50 years and a probability of exceedance, $P_{VR}=10\%$, correspond to a return period of approximately 475 years. In order not to compromise the value of the cultural asset, the reference period of the intervention may be reduced to 40 years. Retaining the same 10% probability of exceedance reduces the corresponding return period to approximately 380 years and consequently reduces the design seismic action. It is understood that before the adopted 40-year reference period expires, the building's seismic safety should be reassessed using improved knowledge and investigation and further improvement measures implemented where necessary, potentially using more effective and less invasive technologies available at that time [14].

While the geographical seismic hazard level and regional macro-zonation parameters remain unaltered, the actual seismic demand imposed on the structure is calibrated through performance-based adjustments. The document does not mathematically reduce the official earthquake return period, but it permits a controlled relaxation of the analytical demand to prevent over-designing interventions on historic substance [18].

No specific methodologies pertaining to the earthquake return period are set forth, but neither are any ruled out [23].

Documents related to existing structures in general [2, 5, 24, 27]

In relation to the seismic forces, the applicable return periods are the following: (i) **95 years** for importance classes I and II, and Significant Damage Limit State, (ii) **225 years** for importance class III, Significant Damage Limit State and Damage Limitation Limit State, and (iii) the same as for new structures for importance class IV [2, 3, 4].

While new buildings are designed for specific performance targets (e.g., immediate occupancy, life safety, collapse prevention) using well-defined return periods (e.g., 475 years for No-Collapse limit state), for existing buildings, the return period is 2475 years; however, the probability of exceedance is 2% in 50 years. It should be noted that if such an approach is explicitly allowed by the national annexes, it does not necessarily represent a relaxation compared to the requirements of EN 1998-1, given that the SDLS in EN 1998-3 is functionally equivalent to the No-Collapse requirement defined in EN 1998-1. Eurocode EN 1998-3 also authorises the selection of return periods depending on the adopted assessment programme [5].

Relaxation of the earthquake return period is related to the relaxation of seismic forces. The NA-PT to NP EN 1998-3:2017 prescribes 975 years for NC, 308 years for SD, and 73 years for DL. Note that historic structures are many times classified as importance class III, for which the NA-PT requires verification of all three limit states, including NC — implying a higher seismic demand associated with the longer return period [5 – Portuguese NA].

Relaxation of the earthquake return period is permitted as described in Section 2.1.1 [24].

The New Zealand Guidelines **do not provide a heritage-specific relaxation** of the earthquake return period. Existing buildings are generally assessed using the applicable new-building ultimate limit state seismic demand, with the result expressed as %NBS. A lower strengthening

target, therefore, represents acceptance of a lower capacity relative to that demand rather than adoption of a shorter return period [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 10, 20, 21, 22]

In the Greek code, relaxation of the earthquake return period **is related to the relaxation of seismic forces** [7].

The remaining working life determined at the assessment is considered as a reference period for an existing structure for serviceability and fatigue, while the design working life is often considered as a reference period for a new structure. A shorter reference period can be reasonable for the ultimate limit states [10, Section F.2.1]. Reliability requirements for an existing structure, as well as for a new structure, may adequately be expressed in terms of the **reliability index**. An illustration of target reliability level and reference period, depending on limit states, reversibility, inspectability and consequences of failure is presented in Table F.1 [10, Section F.2.1].

There are four design earthquake levels: (i) DD-1, 2% probability of exceedance in 50 years, return period 2,475 years, (ii) DD-2, 10% probability of exceedance in 50 years, return period 475 years (standard design earthquake for new buildings), (iii) DD-3, 50% probability of exceedance in 50 years, return period 72 years, and (iv) DD-4, 68% probability of exceedance in 50 years, return period 43 years. No relaxation is defined either for newly built or existing masonry buildings in the Turkish Building Earthquake Code[20].

In the Guideline, in section 6.8.4, performance levels are defined in Table 6.3, which allows the use of higher performance levels for universally important structures, while they can be reduced for local structures. However, depending on the interventions, it allows engineers to decide to use different (higher or lower) performance levels by assessing at least two different performance levels under different earthquake return periods [21].

The IEBC does not explicitly relax the return period but does so implicitly by permitting a reduction in seismic design forces as outlined above and also by reference to ASCE-41, for example, for lower-risk category buildings [22].

2.2 Relaxation on the capacity side

Rather than requiring material upgrades, EN 1998-3 and ASCE 41-23 introduce Confidence Factors (CF) or kappa (κ) factors that penalise assessed capacity when material data is limited. This quantifies uncertainty without mandating physical intervention: the engineer documents what is known, and the factor adjusts accordingly. Note that κ is a penalty on capacity, not a relaxation.

No jurisdiction reviewed requires existing heritage materials to be upgraded to meet new-construction minimum strengths, provided as-found strength is documented through in-situ testing (core sampling, flat-jack tests, prism tests, push tests, or visual grading). Mean, not characteristic, strengths govern in all Performance-Based Engineering (PBE) frameworks.

The average concrete strength $f_c \geq 13.5$ MPa, for existing RC structures, compared with $f_c \geq 21$ MPa for new structures, is acceptable in Japan for structural analysis. Additional tests should be performed if the strength is lower than 13.5 MPa.

2.2.1 Relaxation of the limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress

Documents specifically related to heritage structures [14, 15, 18, 23]

To assess seismic safety and plan improvement interventions of historic buildings, it is necessary to achieve **adequate knowledge of the structure**, which allows for the identification of the characteristics of the elements that determine its structural behaviour. This can be obtained at various levels of detail, based on criteria such as the accuracy of surveys and historical investigations, the recognition of the use of best practices, the identification of the level and type of damage, the ability to reconstruct the history of the structure in relation to seismic events, and possibly the results of experimental investigations.

The above corresponds to the application of an epistemic or model safety coefficient, which will be as close to unity as the level of knowledge acquired is extensive. Model uncertainty can be taken into account through a **confidence factor**, which is reduced to a unitary value in the presence of an extensive or exhaustive knowledge path, for example, in terms of anamnesis, investigations, surveys, and tests on materials. Where the safety format allows, low values for the confidence factor relax limits related to the capacity (strength of the building materials, for example) [14].

As per the Japanese Guidelines for Seismic Evaluation of Existing Reinforced Concrete Buildings, the **structure's seismic resistant capacity index** (I_s), indicating the seismic capability of a building, is calculated as the product of three indexes that consider the strength and deformation capacity, irregularity, and age of the building. Thus $I_s = E_0 \times SD \times T$, where E_0 represents the structural index of the building calculated from the product of strength index C and ductility index F , SD is the index accounting for unbalanced distribution of stiffness both in the horizontal plane and along the height, and T is the index that considers the deterioration of strength and ductility due to building age. For the seismic index $I_s \geq 0.6$, the existing structure is considered safe; for $I_s < 0.6$, retrofit is required; and for $I_s < 0.3$, there is a risk of collapse. Seismic index for designated cultural properties balances safety with authenticity. Thresholds and applications are **adapted to heritage contexts**. Quantitative baseline is always supplemented by qualitative cultural and historical considerations [15].

The requirement for sectional force and moment capacity is fundamentally relaxed relative to the codes for new buildings. MP025-2004 opposes the mechanical application of modern strength demands to historic structures, as this would lead to intrusive interventions that destroy the original structural fabric and material authenticity [18].

Limits are set forth, **but testing and alternative approaches are permitted to be used**. No minimum material strength upgrade is required; existing f_c , f_m , timber species as-is; strength from in-situ test or historical records may be used. Limits on strength are imposed for certain existing materials if testing is not used to establish actual strengths [23].

Documents related to existing structures in general [5, 19, 24, 27]

The use of **Confidence Factors** (CF) in EN 1998-3 approves calibration of structural capacity based on the achieved Knowledge Levels (LC1–LC3), rewarding the accuracy of historical and material investigations [5].

It is possible to use the mean strength from in-situ testing instead of calculating the characteristic strength [5, BS EN 1998-3].

Force/moment capacity is relaxed relative to the codes for new buildings [19].

Limits are detailed in the material chapters of ASCE 41 (Chapters 9-13). Strength is used in linear procedures, while deformation is used in nonlinear procedures. Performance-based design uses expected material strength values for ductile materials based on their age and condition, which may be greater than the nominal strengths typically used in new construction. ASCE 41 recognises that the **capacity of existing building materials is dependent on many other factors (e.g. detailing), which could impact this potential relaxation**. Components that are expected to have ductile mechanisms (called deformation-controlled) are assigned prescriptive m-factors to adjust the component strength based on the expected ductility capacity. Components that are expected to have brittle mechanisms (called force-controlled) have more limited adjustments to component strengths. Despite the terminology, deformation-controlled components are evaluated for strength limits when using linear procedures. The extent of m-factor adjustment is based on the selected performance level(s). All that said, these limits are typically not relaxed relative to the limits for new buildings due to the structure being existing. The **Knowledge Factor**, κ (kappa), reduces usable capacity to account for uncertainty in the as-found condition, which, itself, is a penalty and not a relaxation. Investing in Comprehensive Data Collection raises κ to 1.0, eliminates the penalty, and allows the full relaxations to work in the heritage building's favour. Material testing is typically destructive (e.g. concrete coring), minor-destructive (e.g. flat jack testing). Therefore, the impact and location of tests should be carefully considered [24].

For example, the New Zealand Guidelines for the Seismic Assessment of Existing Buildings (equivalent to ASCE41) provide default **probable material properties** for use in assessing existing buildings. Where **on-site testing** has been undertaken, measured values may be used instead. The Guidelines use probable rather than characteristic or dependable material properties. In addition, a strength-reduction factor, $\phi = 1.0$, is generally used for flexural capacity [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 10, 20, 21, 22]

The provisions of the Greek code include the documentation of the existing masonry structures through careful in situ observation and application of NDT, MDT, sampling and laboratory testing of masonry materials for the determination of their mechanical properties. Levels of data reliability are defined, depending on the level of completeness and accuracy of the documentation, and leading to corresponding safety factors. The Code provides semi-empirical equations for the estimation of the compressive strength of three types of masonry (one, two or three leaf masonry), as well as for their shear strength, modulus of elasticity, etc. The basic parameters that are taken into account in the calculations are the geometrical characteristics of masonry (dimensions of masonry units, thickness of mortar joints, thickness of exterior leaves and intermediate leaf), the mechanical properties of constituent materials, the volume fraction of mortar (as percentage of the masonry volume), the degree of elaboration (level of rugosity) of stones (e.g., rubble or perfectly cut stones), and the quality of the filling material in case of three leaf masonry. In some cases of small buildings of no cultural value, the Code allows the use of default values for the compressive strength of constituent materials [7].

Proof loading or load testing as a special kind of quantitative inspection may prove that a particular structural component is fit for use [10, Section C1.2]. Quantitative inspection provides information on the real parameters of the existing structure, which may or may not be favourable [10].

As an example, in the Turkish Building Earthquake Code, for existing masonry, material properties could be either obtained by unit and mortar tests or wall specimen tests in the

laboratory (TS EN 1052). The minimum limits for the units that are going to be used, f_c , are given as 5 MPa for URM and 10 MPa for RM. If the mortar compression tests can be done, depending on the mortar strength, the minimum of 1 MPa of masonry characteristic compressive strength can be determined by using Table 11.2. However, for the upgraded properties, no definition or improvement ratio is defined [20].

In the Guideline, the mechanical properties of existing masonry are given in Table 6.1 with minimum and maximum values referring to the literature (Magenes and Penna, 2009). However, no minimum limits are defined in relation to in-situ tests [21].

One of the optional methodologies in Appendix A **sets forth strength limits for materials** such as URM that are not commonly used in modern construction. Values set for new structures are typically comparable, but some are relaxed, and some are increased [22].

2.2.2 Relaxation of the limits related to the deformation capacity of the building materials, for example, permissible strain

Documents specifically related to heritage structures [14, 23]

Relaxation of limits is not specified. However, subsection 4.1.7 provides **further guidance for the mechanical characterisation of materials** [14].

No limits are provided in the CHBC as neither deformation nor strain of materials is mentioned; this is therefore left to the engineer's discretion and represents relaxation relative to that required for new buildings [23].

Documents related to existing structures in general [24, 27]

Limits are detailed in the material chapters of ASCE 41 (Chapters 9-13). Deformations (rotations, total deflections, and inelastic deflections) are used in nonlinear procedures, while strength is used in linear procedures. It appears that deformation capacity is intended to be greater than would be permitted in the codes that govern new construction. However, the deformation capacity permitted is related to the performance level actually used as the basis for the retrofit design/assessment, the selection of which may have flexibility in some instances. Regardless, deformation capacity limits are not a function of whether a building is new or existing [24].

The New Zealand Guidelines for the Seismic Assessment of Existing Buildings adopt a broadly similar approach to ASCE 41, using strength-based acceptance criteria in force-based procedures and deformation-capacity limits where nonlinear or displacement-based response is explicitly assessed [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [10, 21]

Besides commonly used ultimate limit states and serviceability limit states, **specific serviceability limit states** for preserving the heritage value of the structures, such as

deformation against artistic paintings and materials, shall be considered [10, Section I.6.2]. This is an additional requirement not comparable with the codes for new structures [10].

The **strain levels are referred to as nonlinear analysis** and limited to not exceed the CD level or 20% exceedance for the CP level. Although the strain limits of exceedance are defined, no limit is given for strain levels [21].

2.2.3 Relaxation of the limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement

Documents specifically related to heritage structures [15, 18, 23]

For reinforced concrete and steel-framed buildings, the guideline for the no-collapse limit deformation angle in modern reinforced concrete and steel-framed building design is 1/75. Adopting a deformation angle greater than this requires special investigation or research. The same approach should be applied to setting the no-collapse limit deformation angle for cultural heritage buildings. For masonry buildings, while no guideline for the limit deformation angle has yet been proposed, it should be set according to the structural characteristics. However, depending on the structural characteristics, seismic performance may also be verified using methods other than deformation angle, such as verifying wall stress. Japanese guidelines allow for relaxed interstory drift limits for heritage structures. Interstory drift for **timber structures** beyond **1.67%** for the IO limit state and **3.33%** for the LS limit state indicates that strengthening is essential for seismic safety. Respective limitations for new **timber** buildings are **0.667-0.833%** and **3.33 %** [15].

Displacement capacity and ductility **requirements are implicitly adapted**, recognising that traditional masonry and historic structural systems cannot meet the rigid deformation criteria set for modern structures. The assessment focuses on validating the existing non-linear reserves and structural redundant mechanisms rather than forcing compliance with new building codes [18].

No displacement limits are provided in the CHBC as deformation of materials is not mentioned; this is therefore left to the engineer's discretion and represents relaxation relative to that required for new buildings [23].

Documents related to existing structures in general [5, 19, 24, 27]

The chord rotation, being the fundamental measure of deformation capacity for seismic assessment of existing structures, is relaxed compared to the code for new structures. Larger rotations are allowed than EN 1998-1 would permit [5].

In a displacement-based design, the **maximum displacement capacity is relaxed** compared to the capacity necessary for new construction [19].

ASCE 41 **does not use story drift as its primary acceptance criterion**. ASCE 7 (new construction) checks a single global metric — story drift Δ vs Table 12.12-1 (2.0–2.5%). ASCE 41 replaces this with component-level criteria: m-factors (linear procedures) or plastic/chord rotation limits (nonlinear procedures). Story drift appears in ASCE 41 only as a secondary global stability check. [24].

In New Zealand, **no comparable general increase in permissible drift** is provided for existing buildings; deformation capacity is assessed according to the probable behaviour of the particular structural system [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 20, 21, 22]

The limits are explained for example, in Chapter 7 of the Greek code (at the level of structural members). However, **these limits are not relaxed compared to the codes for new structures** [7].

In the Turkish Building Earthquake Code, regardless of the performance level and whether it's newly built or existing masonry, drift is defined as 0.7% for URM, RM with 50% reduced elasticity and multiplied by R/I, which is equivalent to 1.75 % min. (URM, R=2.5) [20].

In the Guideline, drift ratios are specifically defined for performance levels as 0.7% for CD and 1% for CP [21].

Story drift: approximately $\times 1.3$ of standard ASCE 7 limits. Wood-framed structures with soft, weak, or open-front wall lines: retrofitted stories are capped at 2.5% drift vs. 2% drift required for new structures. This 2.5% drift is also calculated at 75% of IBC (new building) forces. The ' $\times 1.3$ ' figure approximates the inverse of the 0.75 force reduction ($\times 1/0.75 \approx \times 1.33$), rounded when combined with the 2.5% limit [22].

2.3 Relaxation related to performance objectives

No jurisdiction reviewed requires heritage buildings to achieve Collapse Prevention (CP) performance. Life Safety (LS) is universally accepted as the maximum reasonable target. New Zealand accepts as low as 34% value required by the New Building Standard (NBS). Turkey maps this to its Controlled Damage (KH) performance level at the DD-3 earthquake (72-year return period).

Performance objectives are addressed in many documents, but they are not always necessarily relaxed for heritage structures or existing structures in general.

Limitations on the number of occupants and appropriate warning signs might be necessary while considering possible performance objectives.

The selection of performance objectives for heritage structures is not solely a technical engineering decision. It typically requires balancing life safety, heritage significance, conservation objectives and acceptable risk through consultation among engineers, heritage professionals, owners and competent authorities.

A prudent engineer will informally review the collapse risk where known vulnerabilities exist (e.g. unreinforced parapets, heavy overhanging elements).

2.3.1 Specific performance targets for heritage buildings related to risk categories and damage levels

Documents specifically related to heritage structures [9, 14, 23]

The adequate performance of the structure must be **evaluated considering three different but intimately related targets**: (1) the safety of people, (2) the safeguarding of valuable immovable cultural and artistic content, and (3) the integrity of the structure itself as a cultural heritage object with the least possible alterations [9].

In Italy, conservation matters must be **discussed with the Superintendence for Cultural Heritage office**, in order to reconcile quantitative and qualitative judgement criteria (structural, conservation, historical, archaeological, etc.). Sometimes a minimum percentage of improvement is specified, e.g. 10% for instance, for some types of public buildings, etc. The Directive introduces the Limit State of Damage to Artistic Assets (SLA) to protect cultural contents using criteria different from life safety. Performance objectives are defined to include the preservation of artistic assets, allowing higher levels of structural damage if this ensures the protection of cultural contents [14].

The only performance target stated or alluded to is: “a reasonable level of safety for building occupants and access for persons with disabilities.” Notably also, “Qualified historical buildings or properties may have their existing use or occupancies continued if such use or occupancy conformed to the code or to the standards in effect at the time of construction, and such use or occupancy does not constitute a distinct hazard to life safety as defined in the CHBC.” A distinct hazard relates to an immediate hazard, not a potential seismic event. This is therefore left to the engineer's discretion and represents a relaxation relative to that required for new buildings [23].

Documents related to existing structures in general [2, 5, 11, 17, 19, 24, 25, 27]

The performance objectives for existing structures are related to **the levels of retrofitting based on the importance class**. The required resistance levels for existing buildings are grouped based on the importance factor (EN 1998-1): classes 1 and 2 need to reach 50% of the resistance of new buildings, class 3, 75%, and class 4, 100%. Significant Damage Limit State needs to be checked for importance classes 1 and 2. More important buildings need to be checked for Damage Limitation Limit State as well. There is no specific target for heritage structures [2].

EN 1998-3 describes various options for performance objectives that can be achieved through retrofitting, including life safety, damage limitation, and operational continuity. The standard allows flexibility in selecting the appropriate retrofit strategy based on the building type, seismic risk, and desired performance. Three main performance objectives can be targeted in retrofit design based on the importance and use of the building:

- Limit State of Near-Collapse Requirement (Collapse Prevention);
- Limit State of Significant Damage Limitation (Life Safety);
- Limit State of Damage Limitation (Immediate Occupancy or Operational Continuity) [5].

No specific consideration has been given to heritage buildings. **However, Chapter 7 of the code, which addresses confined masonry structures**, bears a limited resemblance to certain historic buildings due to similarities in construction materials. The provisions of the code appear to be intended primarily for new constructions. These include requirements related to the building geometry such as permissible height and number of stories, mandatory horizontal and

vertical ties and their methods of interconnection, plan limitations with respect to length-to-width ratios and symmetrical layout, the introduction of seismic separation joints, allowable overhangs and cantilevered projections in upper floors, foundation requirements based on local soil conditions, maximum permitted opening-to-wall area ratios and their minimum distances from wall corners, specifications for construction materials and execution of structural and non-structural elements and walls, methods of interlocking structural and non-structural masonry walls, as well as requirements for windcatchers, chimneys, roof systems, and their connections. **Although the code is primarily directed at future buildings, its provisions may also be applied as benchmarks for assessing the reliability of existing structures** [11].

P100-3 describes a **range of target performance objectives, expressed through seismic risk classes and limit-state considerations**, rather than a single mandatory retrofit objective. The document defines different acceptable performance outcomes for existing buildings by classifying them into seismic risk classes (Rs I–Rs IV), which correspond to varying expectations of damage, safety, and collapse prevention under the design earthquake. Retrofit objectives may therefore aim to improve the building's risk class, reduce vulnerability, or achieve minimum life-safety and collapse-prevention performance, rather than requiring full equivalence with new-construction performance. P100-3 defines performance targets for existing buildings primarily in terms of life safety, collapse prevention, and reduction of seismic risk under the design earthquake, rather than full compliance with the performance expected of new construction. These targets are expressed through limit-state verification and seismic risk classes, which allow controlled structural damage provided that overall stability and vertical load-bearing capacity are maintained. Retrofit objectives may therefore aim at improving a building's seismic risk class or achieving minimum acceptable performance, rather than equivalence with new buildings [17].

The code requires **checks for the “service limit state” apart from the “ultimate limit state” only for buildings belonging to building class III** (vital infrastructure function/considerable environmental risk). For the service limit state check of existing structures belonging to class III, the code considers a reduction in the demand of 50% compared to the demand for new structures and a minimum compliance factor of 0.7 [19].

Target performance objectives are not defined as a function of whether a structure is a heritage structure or not. **Structural performance levels are defined based on** immediate occupancy, damage control, life safety, limited safety, and collapse prevention. The basic performance objective for existing buildings is life safety at BSE-1E (20% in 50 years) and collapse prevention at BSE-2E (5% in 50 years). Typical new buildings (designed to the regular code for new buildings) are not designed using the equivalent performance objective system, although some new buildings are permitted to be designed using performance objectives. As such, there is no relaxation afforded to existing buildings with respect to performance objectives [24].

The document discusses various performance objectives and how a design professional may discuss the objectives with a building stakeholder. However, the document does not prescribe a methodology for achieving those performance objectives but rather **refers the reader to performance-based U.S. standards (ASCE 41)** [25].

For example, in New Zealand, the guideline on the Seismic Assessment of Existing Buildings assesses the probable life-safety performance of an existing building at the ultimate limit state and expresses the result **as a percentage of the New Building Standard (%NBS)** for a comparable new building on the same site. The applicable seismic demand reflects the building's importance level and use. Buildings assessed below 34%NBS may be classified as earthquake-prone, while any strengthening objective above this statutory threshold is determined for the particular project. No separate performance target is prescribed for heritage buildings, although their cultural significance may influence the selection and extent of strengthening interventions [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 10, 20, 22]

For historic structures, **decisions on the target performance level and on the return period/probability of exceedance to be adopted in design are made in collaboration with the Competent Public Authority** (depending on several parameters, such as the Values of the structure, its structural state, its intended use, etc.). The information included in the Code is taken as a basis for the selection of the seismic forces to be accounted for. The following is included in Section 2.3 of the Code (2.3.1 General): a) for serving wider socio-economic needs, three Performance (target behaviour) Levels are established along with nine levels of seismic design, b) each performance objective for assessment or redesign (Table 2.1) is a combination of a performance level and a seismic action, with a given "tolerable probability of exceedance during the technical life of the building" (design earthquake). In Table 2.1, the set of potential performance objectives is included for redesigning a structure in accordance with this Code. Table 2.1 summarises the correlation of the performance level of the structural system with the corresponding normalised horizontal ground acceleration. Indicatively, it is mentioned that for new structures, a B1 design objective is foreseen according to Table 2.1. In the commentary of the same section of the Code, Table C 2.1 and additional comments explain further the approach. Table C 2.1 gives the correlation of the return period with the probability of exceeding the seismic action, along with the corresponding normalised horizontal ground acceleration.

It is explained that the minimum tolerable performance objectives for the assessment or redesign of existing buildings are set out in accordance with Annex 2.1. They can in any case be defined differently from time to time on a case-by-case basis by the Public Authority, within a relevant Ministerial Decision. In special cases, the Public Authority can additionally define assessment or redesign objectives for the non-load-bearing structural system.

In this case, the same public authority also defines the verification criteria for meeting the respective objectives. In general, the performance objective for re-evaluation (either assessment or redesign) is chosen by the project owner of the CH asset, and it cannot be lower than the one set by the Public Authority. When defining the objectives, the following criteria should be taken into account (among others): Social importance of the building (e.g. temporary construction, ordinary residences, public gathering areas, emergency management areas, high risk facilities, etc.) [7].

The integrity of the existing structure should be respected during any intervention [10, Section I.1]. The **assessment of a heritage structure encompasses two aspects**: its structural performance, familiar to engineers, and its value as a cultural resource. These two aspects shall both be taken into account in any decision involving possible structural interventions and should therefore be carried out in tandem [10, Section I.2.1]. **Performance targets regarding the interventions are**: a) strengthening to improve the ultimate limit state performance of specific structural elements or the overall structure, b) enhancement of some aspect of elemental or overall serviceability performance, c) remedies to compensate for the effects of current or anticipated structural deterioration, d) preventive measures to avoid or minimize future structural deterioration [10, Section H.1].

In the Turkish Building Earthquake Code, for example, all masonry types are to be defined to satisfy defined performance levels, regardless of their features, function or importance [20].

In the Guideline, in section 6.8.4, performance levels are defined in Table 6.3, which allows the use of higher performance levels for universally important structures, while it can be reduced for local structures. However, depending on the interventions, it allows engineers to decide to use different (higher or lower) performance levels by assessing at least two different performance levels under different return periods of earthquakes [21].

IEBC Chapter 3 references ASCE 41 for seismic evaluation methodology. Table 304.3.2 of the IEBC sets the performance objectives to be used for different risk categories of buildings in ASCE 41. At lower risk categories, this involves a collapse prevention (CP) check at BSE-2E (~975-year earthquake). The Life Safety (LS) check at BSE-1E (~225-year earthquake) is not mandated. High occupancy (Risk Category III) historic/ heritage structures target "Damage Control" and "Limited Safety" for BSE-1E and BSE-2E, respectively, while a historic/ heritage structure that has a critical occupancy (Risk Category IV), for example, a historic building that serves as a hospital, would target "Immediate Occupancy" and "Life Safety" for these same return periods [22].

2.3.2 Performance targets permitted to vary as a function of occupancy type/designation

Documents specifically related to heritage structures [14, 18, 23]

Relationships between the reference period and the occupancy type are sometimes reported, for instance, in the Italian code, which is specific to historic buildings. For cultural heritage assets exposed to seismic activity, the reference seismic safety level varies based on the specific characteristics of the structures and their use, and therefore on the more or less serious consequences of their damage due to a seismic event. To this end, it is necessary to define:

- the **nominal life** (V_N) to which the safety assessment is based and for which seismic improvement interventions are possibly planned; in particular, it can be related to the characteristics of the cultural asset, also based on knowledge of the artefact;
- the **use class** (C_U), consistent with the different classes defined as follows: Class I – occasional or unused use; Class II – frequent use with normal crowding; Class III – very frequent use and/or with significant crowding; Class IV – strategic/critical building and very frequent use and/or with significant crowding.

The seismic actions on the building are therefore assessed in relation to a reference period (VR) redefined as follows: $V_R = V_N C_U$ [14].

Under MP025-2004, performance targets and the proportionality of structural interventions vary based on the historic monument's specific function, occupancy type, and the public or cultural interest it serves. The methodology avoids the direct transfer of prescriptive safety thresholds and building classifications intended for modern structures. The exposure of occupants and the presence of movable cultural assets are evaluated qualitatively as input parameters for defining the target structural performance. On this basis, the structural engineer (expert), together with the conservation architect, determines the **minimum acceptable structural safety level for the specific case**. The resulting retrofit objectives are therefore building-specific and consistent with both safety requirements and conservation constraints, limiting interventions that would unnecessarily affect the historic fabric [18].

No stated limits on performance targets with respect to typical occupancies, but a short paragraph applies to historic high-rise buildings, so occupancy numbers are implicitly involved for just that. A change in occupancy is expressly permitted without requiring the building to comply with all new construction requirements in the regular code, but, for example, the number of exits required by the regular code for the new occupancy must be provided [23].

Documents related to existing structures in general [5, 11, 17, 19, 24, 27]

The performance targets in EN 1998-3: Eurocode 8 – Part 3 are **permitted to vary based on the occupancy type or designation of the building**. The performance objectives may differ

depending on the importance of the building and its intended use. Critical buildings (such as hospitals, emergency services, or civil defence facilities) are subject to higher performance targets to ensure operational continuity and minimal disruption after an earthquake. Non-critical buildings may focus more on life safety and damage limitation, where the goal is primarily to prevent collapse and minimise damage to the structure. The occupancy type influences the level of safety and functionality required, meaning that more essential buildings are expected to perform at a higher standard during seismic events. The type of occupancy will clearly affect the reference period, or lifespan of the planned intervention. However, no specific targets are defined for historic buildings, as structural safety is only one of many criteria used to determine the nominal life of the intervention [5].

It is referred to as **building classifications due to their importance or use**. Buildings of very high importance, which must remain operational after an earthquake, such as hospitals, fire stations, power plants, airports, and hazardous facilities. Buildings of high importance, such as public facilities including schools, stadiums, cinemas, and other venues accommodating more than 300 people. Buildings of ordinary (medium) importance, such as residential, commercial, and office buildings. Buildings of low importance, such as warehouses or temporary structures, with a service life of less than two years [11].

P100-3 allows **performance targets for existing buildings to vary as a function of occupancy type and importance**, through the use of importance classes and associated performance expectations, even though it does not define bespoke performance objectives for each occupancy in the manner of new-building design codes. Buildings with higher importance or occupancy-related consequences (e.g. essential facilities, high-occupancy buildings) are subject to stricter assessment expectations and more demanding target outcomes, while buildings of lower importance may be assessed against minimum life-safety and collapse-prevention objectives [17].

The **minimum levels of safety, as well as the proportionality of the retrofit measures, depend on the building class**. The code expands the three building classes used in the standard for new structures into five building classes. For building classes I (residential/industrial buildings, car parks, bridges with secondary importance) and II (shopping centres, public administration buildings, tall chimneys, etc.), the minimum safety level of an existing structure is defined as 25% of the equivalent of a new structure. For building classes II-s, II-i and III (e.g., schools, nurseries, hospitals, bridges, retaining walls with important function, construction works, equipment and installations for risk protection in the case of catastrophe), the minimum safety level of an existing structure is defined as 40% of the equivalent of a new structure. Similarly, the range for which interventions are required, as far as proportional, varies according to these two categories of building classes [19].

When the basic performance objective is selected, the performance levels vary by risk category (as defined in ASCE 7 or the applicable code). In other words, **for a building with a higher risk category—which is a function of building occupancy and use—the required performance level is required to be higher**. There is therefore no relaxation afforded to existing buildings with respect to performance objectives [24].

In New Zealand, the seismic demand used for **%NBS assessment reflects the building's importance level**, which is determined by use, occupancy and consequences of failure. Heritage designation alone does not change the importance level or prescribe a separate performance target [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 10, 22]

The importance category of the building is accounted for while selecting the performance level. **In the importance categorisation, the occupancy is also considered [7].**

An alternative approach to construction intervention, which may be appropriate in some circumstances, is to control or modify the risk. **Various measures to control the risk environment** include imposing load restrictions, altering aspects of the structure's use, and implementing some form of in-service monitoring and control regime [10, Section 4.7.3].

There are **lower targets for buildings with lower occupancy** or occupancies with less associated risk (i.e. an office has lower assumed risk than a childcare facility) [22].

2.3.3 Performance targets permitted to vary as a function of limitations placed on the number of occupants in the building

Documents specifically related to heritage structures [9, 14, 18, 23]

Parallel measures, such as restricted use or provision of alternate escape routes, should be adopted to limit the consequences of a failure on people. In addition, it may be possible to place valuable movable cultural contents in a nearby building or building part, providing appropriate safeguards [9, Section 3.1].

In the case of historic buildings, the **limitations on occupancy can be included among the judging criteria**, analysed and discussed with the Cultural Heritage Superintendence office. In some cases, it is possible to decide to downgrade a building, for example, the weekly use of a church can be reduced to avoid invasive interventions. Italian regulations suggest considering the relocation of strategic functions (e.g., schools, hospitals) to avoid excessively invasive interventions on historic structures [14].

The **proportionality of the mitigation measures** is determined considering the building's function, occupancy, and the public or cultural significance of its use. Within the multi-criteria assessment framework, the exposure of occupants and the presence of movable cultural assets are treated as qualitative parameters for establishing the target level of risk mitigation, ensuring that the proposed interventions remain consistent with both the building's use and its heritage value [18].

A short paragraph **applies to historic high-rise buildings**, so occupancy numbers are implicitly involved for just that. A change in occupancy is expressly permitted without requiring the building to comply with all new construction requirements in the regular code, but, for example, the number of exits required by the regular code for the new occupancy must be provided. No specific occupant limits or relaxation to them are provided [23].

Documents related to existing structures in general [5, 11, 17, 19, 24, 27]

EN 1998-3 permits variation in performance targets based on the importance and use of the building, **which can include limitations on the number of occupants**. However, this is not directly framed in terms of the "number of occupants" alone, but rather through the building's Importance Class, as defined in EN 1998-1 and referred to in EN 1998-3. [5].

These cases are **referred to as building classifications due to their importance or use**. Buildings of very high importance, which must remain operational after an earthquake, such as hospitals, fire stations, power plants, airports, and hazardous facilities. Buildings of high importance, such as public facilities including schools, stadiums, cinemas, and other venues accommodating more than 300 people. Buildings of ordinary (medium) importance, such as residential, commercial, and office buildings. Buildings of low importance, such as warehouses or temporary structures, with a service life of less than two years [11].

The **performance targets for seismic retrofitting are governed by the building's Importance Class**, which reflects factors such as occupancy level, building function, consequences of failure, and the need for post-earthquake functionality. Performance objectives are therefore defined in relation to structural behaviour, seismic risk class, and importance category, rather than by temporary or administrative occupancy restrictions. Consequently, a building with low occupancy and limited consequences of failure may be assigned a lower Importance Class, allowing retrofit objectives to focus on minimum life-safety or collapse-prevention performance rather than more stringent targets [17].

The **proportionality of the measures depends on the number of occupants** in the building. The number of occupants in the building is accounted for in the estimation of the risk reduction due to retrofit according to the building type [19].

The **number of occupants in some cases changes the risk category of the building**. For example, university buildings with occupant loads of greater than 500 or all buildings with occupant loads greater than 5000 are considered Risk Category III, which has a higher basic performance objective. Thus, limiting occupancy (e.g., below 500 occupants for university buildings) may reduce the risk category, thereby relaxing minimum performance requirements. There is therefore no relaxation afforded to existing buildings with respect to performance objectives [24].

In New Zealand, for example, a genuine change in occupancy or use **may alter the building's importance level and** hence the applicable seismic demand. A temporary or administrative restriction on occupant numbers does not automatically justify a lower assessment target unless it changes the classification required by the applicable standards and legislation [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7, 10, 22]

The importance category of the building in the Greek code, for example, is accounted for in selecting the performance level. **In the importance categorisation, the occupancy is also considered** [7].

Various measures to control the risk, as mentioned in Section 4.7.3, may implicitly include limitation of the number of occupants [10].

By **limiting the occupancy**, the risk category and consequently the performance targets can be reduced [22].

2.4 Relaxation by partial strengthening

Partial strengthening and gradual implementation of the retrofit are often considered simultaneously and allowed due to financial restrictions and occupancy limitations. Additional reasons are to allow gradual monitoring of the structure and to implement new knowledge.

Periodic reassessment and monitoring should accompany phased interventions to ensure that residual risks remain understood and acceptable throughout the implementation period.

2.4.1 Allowance for partial strengthening

Documents specifically related to heritage structures [8, 9, 14, 18, 23]

At times, the difficulty of evaluating the real safety levels and the possible benefits of interventions may suggest “an observational method”, i.e. an **incremental approach**, starting from a minimum level of intervention, with the possible subsequent adoption of a series of supplementary or corrective measures [8, Section 3.8].

A **step-by-step procedure of structural conservation** begins with a minimum level of intervention, followed by the possible adoption of subsequent supplementary or corrective measures. When the complexities of the problem prevent clear and reliable solutions without extensive intervention, the incremental approach may be the best course of action [9, Section 4.6].

For listed buildings, Italian regulations admit the **implementation of improvements, repairs**, or local interventions, while the adaptation of new buildings to standards is not even contemplated (paragraph 4 of Article 29 of Legislative Decree No. 42 of January 22, 2004, “Code of Cultural Heritage and Landscape”). This means that, if the achievable seismic safety index is lower than the desired one, or if excessively invasive interventions would be necessary, the designer can justify a partial strengthening intervention also using qualitative assessments, which must be translated into quantitative terms, adequately justified in an explanatory report supplementing the calculation report. In fact, the goal is to avoid unnecessary work, thus favouring the principle of minimal intervention, but also to highlight cases where more decisive action is appropriate. The most general Italian regulations, valid for any existing building even if not listed, specify what is meant by local interventions and repairs, which are those that affect individual structural elements and that, in any case, do not reduce pre-existing safety conditions [Ministry of Infrastructure and Transport. (2018). Technical standards for construction (Decree of January 17, 2018). Official Gazette of the Italian Republic, No. 42 (February 20, 2018). Rome, Italy. On the other hand, improvement interventions are such because they determine an **upgrade in terms of seismic behaviour and safety**, which, however, must be demonstrated on the basis of safety index calculations before and after the intervention. The safety evaluation approach in this case is performance-based, linked to parameters such as the nominal life of the intervention or the earthquake return period. [14].

There is the concept of a **mutually agreed minimum acceptable safety level** rather than rigid numerical thresholds. The justification and proportionality of the structural interventions depend on the specific cultural and historical value of the monument. MP025-2004 does not strictly apply the safety categories or deterministic percentages designed for new buildings; instead, it requires the structural engineer (expert) and the restoration architect to jointly define the minimum intervention necessary, ensuring that the structural reliability is balanced against the preservation of cultural heritage [18].

The document states, “**Nothing in these regulations shall prevent voluntary and partial seismic upgrades when it is demonstrated** that such upgrades will improve life safety and when a full upgrade would not otherwise be required.” Its express encouragement of preservation and alternative approaches that provide a reasonable level of safety could also be interpreted as intended to encourage partial strengthening where that would achieve the intended ends [23].

Documents related to existing structures in general [2, 17, 19, 24, 25, 27]

Importance classes I and II – 95 y.r.p. for the Significant Damage limit state in [2,3,4] are just checked for SD, not for Damage limitation. This relatively loose rule **allows for partial repair** of the damaged structure while still obeying the law. Usually, it can be enough just to ensure that there's some kind of flexible diaphragm to prevent out-of-plane failure mechanisms in the load-bearing walls, or minimally invasive strengthening of load-bearing walls, most commonly by using FCRM systems. Local repair can also be a sufficient measure in some cases [2].

P100-3 **implicitly allows partial strengthening by permitting targeted, risk-based interventions and less stringent performance objectives than those for new construction**, while maintaining the same seismic hazard level and focusing on life safety and collapse prevention rather than full code compliance. P100-3 does not expressly use the term partial strengthening, but it clearly allows this approach through its performance-based and risk-oriented framework for existing buildings. The document permits strengthening measures that are targeted to the most critical vulnerabilities identified through assessment (R1, R2, R3), rather than requiring comprehensive upgrading to new-building standards: (i) interventions aimed at reducing seismic risk or improving the seismic risk class, without eliminating all deficiencies, (ii) strengthening to achieve minimum acceptable performance objectives (life safety/collapse prevention), rather than full equivalence with new building; (iii) acceptance of controlled damage and residual vulnerabilities, provided collapse is prevented under the design earthquake, (iv) retrofit strategies that focus on key structural weaknesses, as illustrated by the informative retrofit guidance (e.g. Annex F), rather than global or uniform strengthening. However, the code does not allow partial strengthening by reducing the seismic hazard level or earthquake return period, which remains the one defined in P100-1; any “partiality” arises from capacity-side performance objectives, not from reduced demand [17].

The requirements for partial retrofits are outlined in section 2.4.5. In short, **a partial retrofit must not exacerbate or create seismic vulnerabilities**. It is up to the building authority to determine if a partial retrofit will be accepted. It is not common for jurisdictions to accept partial seismic retrofits unless the retrofit is initiated on a voluntary basis [24].

The document is a resource for design professionals that outlines considerations for implementing incremental seismic rehabilitation such that seismic improvement can be programmed and funded over time. While the document appears to intend that full strengthening will eventually be achieved, partial strengthening, at least in interim states, is allowed without any stated time limits. While the document explicitly promotes incremental retrofits that are implemented over time, it does not specifically promote incremental retrofits for the purpose of achieving only an “incomplete” retrofit. “Because the premise of incremental seismic rehabilitation assumes that the building will be opportunistically upgraded over a period of time, there will be interim stages when the building is in a “partial” state of seismic upgrade. This requires that the design professional understand the potential consequences of prioritisation and phasing of work. **The overarching design consideration for incremental seismic rehabilitation is to “do no harm” to the building.** Each increment of work must improve the overall seismic performance of the building, and no increment should leave the building in a condition that is more vulnerable than it was when work was initiated. Understanding the consequences of phasing and effectively staging rehabilitation increments for improved performance will likely require additional analyses of the partially upgraded building and multiple iterations in the design process” [25].

In New Zealand, strengthening objectives are commonly stated as a target %NBS. For an earthquake-prone building, the statutory work must be sufficient for the building or relevant part to no longer be earthquake-prone; higher targets may be adopted voluntarily. Partial or staged

strengthening may be undertaken, but each stage should avoid creating or worsening seismic weaknesses and must satisfy applicable Building Act and Building Code requirements [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [3, 4, 7, 10, 22]

Importance class I and II – 95 y.r.p. for Significant Damage limit state in [2,3,4] are just checked for SD, not for Damage limitation. This relatively loose rule **allows for partial repair** of the damaged structure while still obeying the law. Usually, it can be enough just to ensure that there's some kind of flexible diaphragm to prevent out-of-plane failure mechanisms in the load-bearing walls, or minimally invasive strengthening of load-bearing walls, most commonly by using FCRM systems. Local repair can also be a sufficient measure in some cases [3, 4] (n.b. the same principle as with document [2]).

In Chapter 1 of the Code, it is explicitly written: It is the responsibility of the Project Owner to select the target performance objective (for assessment or redesign), which cannot be lower than the minimum defined by the Public Authority. However, **in the case of historic structures, respective decisions may be made (on a case-by-case basis) in collaboration with the Competent Public Authority.**

Whenever necessary, a series of emergency measures to stabilise and protect the structure from aftershocks and rainwater is first carried out. Two basic categories of interventions are defined, namely, those aiming at the reinstatement of the pre-damage state (repair) and the strengthening interventions. All intervention techniques are presented, and guidance is provided for their design, whereas the conditions and the limitations of their use are also provided. In many cases of heritage structures, based on the combined provisions of Sections 1.2.3c, 2.4.2, 8.2a, a partial intervention is adopted, which must include at least the restoration (complete repair) of any pre-existing significant damage (or deterioration) in primary load-bearing elements. Thus, local repair of existing roofs and floors and of their connections with the walls, together with interventions to repair the masonry material (e.g., local re-pointing of the faces of the external leaves, cracks stitching and grouting, local reconstructions, etc.) are prioritised. If repair interventions are not sufficient to achieve the target resistance, strengthening interventions are adopted, aiming at improving the characteristics of the material (e.g., mass homogenization of the masonry through the application of grouts) as well as at improving the behaviour of the entire structure (e.g., enhancing the diaphragm action of floors and the roof, addition of struts, ties, circumferential confinement of buttresses, etc.) [7, Section 8.9]. The Code further underlines that, when strengthening of the masonry material is necessary, interventions aimed at strengthening the body of the masonry are applied in priority (e.g., homogenization of its mass using grouting), given the frequent construction typologies of historical masonries (two- or three-leaf). At a subsequent stage, if these interventions are not sufficient for the targeted resistance to be reached, additional interventions applied to the faces of the masonry elements to strengthen the masonry material may be sought (various types of reinforced hydraulic mortars) [7, Sections 8.9.2, 8. 9.4, 8.9.7 and 8.9.8].

When more time is required to define an optimum conservation strategy, the intervention should adopt an **incremental or step-by-step approach** beginning with a minimum level of intervention, with the possible adoption of subsequent supplementary or corrective measures [10, Section I.9.3].

Some of the recommended methodologies in Appendix A **target the elimination of specific vulnerabilities** and, in that way, only actually require partial strengthening of the building. Appendix A methodology 2's requirements for retrofit of reinforced concrete and reinforced masonry wall buildings with flexible diaphragms only require that anchorage between the

diaphragms and walls, having a specific capacity, be installed and that the diaphragm itself be retrofitted to develop these anchorage forces back. Since the walls in these structures are not required to either be analysed or strengthened, methodology 2 clearly requires only partial strengthening. Similarly, Appendix A methodology 3 is intended only to strengthen cripple walls and anchor sill plates in wood-framed residential structures without addressing any portion of the superstructure. Appendix A methodology 4 addresses only “soft-story” behaviour and is also only intended to remedy short, weak, or open wall lines in residential buildings, and while it requires that the upper stories be considered in analysis, no modification outside of the target story is required [22].

2.4.2 Mitigation of vulnerabilities prioritised and implemented gradually over time

Documents specifically related to heritage structures [9, 14, 15, 23]

The post-earthquake structural interventions aimed to repair damaged structures **can be regarded as a phase of a unique maintenance project across a time horizon** involving their past and future life. The concept of structural maintainability is implicit in the traditional methods for post-earthquake repair since all historical structures in seismic zones have experienced repeated repair or strengthening operations over their history. The structural maintainability approach highlights the need for minimising the intervention from a mechanical point of view, thus avoiding strong alterations of the structural response, a condition that ensures more reliable structural responses to future earthquakes [9, Section 4.3].

In the Italian guidelines, three different limit states have been defined for the seismic safety of cultural heritage: ultimate limit state for the protection of human life; serviceability limit state related to damage; and limit state for damage to artistic heritage. The seismic protection levels, associated with the different limit states, are defined by appropriate probabilities of exceedance during the reference period of the building (V_R), which takes into account the characteristics of the cultural heritage (nominal life) and the exposure associated with the function performed (use class). The comparison between seismic action and capacity on a single structure is performed by defining a seismic safety index, IS , which has a different purpose in a territorial-scale analysis or in the design of an overall or local seismic improvement or repair intervention.

When designing seismic improvement, the value of the seismic safety index should not be considered as a parameter for a mandatory assessment, but rather as an important quantitative element to be taken into account in an overall qualitative assessment, which considers conservation needs, the desire to protect the structure from seismic damage, and safety requirements, in relation to its use and function. In particular, if $IS < 1$, it is necessary to evaluate the nominal life (V_N) corresponding to a unitary safety index, in order to determine future assessments and any further interventions that may become necessary upon expiration of the nominal life. All of this must be described in an explanatory report of the solutions adopted in the project, especially if the structural assessment has integrated the calculation models through qualitative assessments. It is implicit in the improvement intervention. The **idea behind the concept of improvement is to intervene partially while waiting for less invasive technologies**. This is stated in several points of the Directive [14].

There is a subsection in the guidelines discussing “**gradual strengthening**”. Examples of gradual strengthening include the following: (i) a seismic assessment determined that horizontal reinforcement and the addition of earthquake-resistant walls were necessary, but only the horizontal reinforcement of the ceiling and roof was carried out in conjunction with the roof replacement, (ii) When replacing the roof, the amount of roofing soil on the tiled roof was reduced to reduce the roof load, (iii) replacing the base of the earthen walls with structural plywood would

satisfy the earthquake resistance requirements with minimal impact on the design, but since the earthen walls will not be demolished this time, the necessary strengthening will be added, although this will have an impact on the design, and these will be corrected during future fundamental repairs, (iv) strengthen only areas that are particularly vulnerable to earthquake damage, such as brick chimneys and gable walls, (v) add supplementary strengthening, such as footing only in areas where strengthening can be carried out without demolition, such as under the floor [15].

The document does not expressly discuss the topic, but also **no language prohibiting gradual implementation is set forth**. Its express encouragement of preservation and alternative approaches that provide a reasonable level of safety could be interpreted as intended to encourage gradual implementation, where that would achieve the intended ends [23].

Documents related to existing structures in general [17, 25, 27]

P100-3 does not explicitly state that seismic mitigation may be phased or implemented gradually over time; however, **it implicitly allows prioritisation of vulnerabilities** through its assessment and classification framework. By identifying and ranking deficiencies via performance indicators (R1, R2, R3) and seismic risk classes (Rs I-Rs IV), the document enables authorities and owners to prioritise high-risk buildings or critical vulnerabilities first, which in practice supports staged or incremental intervention. While the code itself remains technically focused and neutral on scheduling, it clearly provides the analytical basis for phased risk-reduction strategies, rather than requiring immediate, comprehensive upgrading [17].

Though nonmandatory, the document seeks to provide “authority” for prioritised and gradually implemented strengthening. The **document discusses three types of prioritisation**: structural priority (which prioritises specific high-impact vulnerabilities), use priority (which prioritises higher occupancy loads or critical functions), and integration priority (which prioritises opportunistic work). “Structural priority is influenced by relative impact on overall seismic performance. Deficiencies that will result in damage with a high consequence of casualties, property loss, or loss of use should be mitigated first. Similarly, rehabilitation measures that will have a large impact on reducing potential damage (and consequences resulting from that damage) should be implemented first.” “Use priority is influenced by the importance of current building use and occupancy. Buildings with higher occupant loads, critical functions, or high-value equipment or property should be rehabilitated first. Similarly, important portions of a building, such as assembly areas and elements of the egress system (e.g., corridors, stairs, lobbies), should be rehabilitated before other less critical areas.” “Integration priority is influenced by the potential for integrating rehabilitation measures into other building maintenance or capital improvement projects that are routinely scheduled. Integration priority is opportunistic in that seismic rehabilitation work is accomplished when other work is being undertaken, or when portions of the building are otherwise vacant. This reduces the cost of the seismic rehabilitation action by taking advantage of construction mobilisation, access to the area of work, and disruption of occupancy and use that would have occurred anyway” [25].

Seismic strengthening, for example in New Zealand, may be planned and implemented in stages, particularly for complex heritage buildings, but staging does not remove statutory earthquake-prone building deadlines. Eligible Category 1 heritage buildings may apply for an extension of up to 10 years to complete the required seismic work [27].

Documents related to both existing structures in general and, more specifically, to heritage structures [7]

For example, in Chapter 1 of the Greek code, it is explicitly written: “It is the responsibility of the Project Owner to select the target performance objective (for assessment or redesign), which cannot be lower than the minimum defined by the Public Authority.” However, **in the case of historic structures, respective decisions may be made (on a case-by-case basis)** in collaboration with the Competent Public Authority [7].

3 Limitations on the relaxed approach

Throughout this Report, the availability of a relaxed approach is repeatedly qualified with some form of the statement that limitations “must be carefully checked/considered before being applied” (Executive Summary; Section 1.2; Section 2; Annex 1 notes). This chapter consolidates, across the twenty-two regulatory documents reviewed, the recurring categories of limitation that determine when the relaxed approach should not be used, or should be used only in a restricted form.

- **Irreplaceable heritage content.** Where a structure protects valuable movable cultural or artistic content (e.g. frescoes, cladding, fixed artworks), several documents either restrict relaxation or introduce a separate, non-relaxable limit state. The ICOMOS/ISCARSAH Guidelines recommend relocating valuable movable content where feasible as an alternative to structural intervention [9, Section 3.1]. The Italian Directive introduces a dedicated Limit State of Damage to Artistic Assets (SLA), which is not subject to the same relaxation logic applied to life-safety limit states [14].
- **Occupancy and importance ceilings.** Relaxation is consistently curtailed, or removed altogether, for buildings of the highest importance or risk class. Under EN 1998-1/EN 1998-3, importance class IV buildings must reach 100% of new-building resistance, with no relaxation afforded [2, 3, 4]. Under the IEBC/ASCE 41 framework, Risk Category IV heritage buildings (e.g. a historic building serving as a hospital) are targeted at “Immediate Occupancy” and “Life Safety” performance rather than the more permissive levels available to lower-risk buildings [22].
- **A non-negotiable safety floor.** Even the most permissive documents set an absolute minimum below which relaxation is not available. Japan’s seismic index thresholds treat $I_s < 0.3$ as a collapse risk requiring intervention regardless of heritage status [15]. New Zealand’s 34%NBS threshold operates as a statutory floor: strengthening objectives may be negotiated above it, but a building assessed below it is classified as earthquake-prone irrespective of heritage designation [27].
- **Already-damaged structures are excluded from the most permissive tier.** Croatia’s post-earthquake framework requires that significantly damaged structures (EMS-98 grades 3 and 4) be treated as importance class III for repair purposes, regardless of their ordinary usage classification — removing access to the lower-tier relaxation otherwise available to less important buildings [2, 3, 4].

- **Mandatory competent-authority approval.** None of the documents treats relaxation as self-executing; each requires some form of sign-off proportional to the reduction in safety margin. Examples include review by the Superintendence for Cultural Heritage in Italy [14], joint determination by the structural engineer and restoration architect subject to authority approval under MP025-2004 in Romania [18], and case-by-case decisions in collaboration of the structural engineer with competent public authority in Greece's KADET [7].
- **Time-bound relaxation with a re-assessment trigger.** Where relaxation is achieved by shortening the reference period rather than reducing forces outright, the documents that allow this expressly require reassessment at expiry. The Italian Directive's shortened reference period (e.g. 40 years instead of 50) requires the building's seismic safety to be reassessed before that period elapses, using improved knowledge and, where necessary, less invasive technologies developed in the interim [14].
- **Partial strengthening must not create new vulnerabilities.** Every document that permits partial or staged strengthening pairs that permission with a "do no harm" constraint. ASCE 41 requires that a partial retrofit not exacerbate or create seismic vulnerabilities, subject to the building authority's acceptance [24]. FEMA P-420 frames this as the overarching design consideration for incremental seismic rehabilitation: each increment must improve overall seismic performance, and no increment may leave the building more vulnerable than before work began [25].

These categories are not exhaustive, and their relative weight varies by jurisdiction and by the specific heritage significance of the structure in question. They are offered here as a checklist of recurring considerations rather than a substitute for the case-by-case, multi-disciplinary judgement that every document in this Report ultimately requires.

4 Directions for future research

The Report represents a useful comparative resource that may be synthesised beyond country-by-country descriptions and extended in ways to help its practical application.

Future research and elaboration may comprise:

- Common trends;
- Major differences;
- Best practices;
- Benefits and limitations of different approaches;
- Benefits and limitations of traditional and modern strengthening techniques;
- Practical advice for vulnerable building types and elements (e.g. unreinforced masonry, gables, chimneys, belfry towers, minarets, etc.);

- Consideration of timber and earthen structures, and ancient monuments built in dry masonry;
- Case studies;
- Recommendations for practising engineers, heritage professionals, and jurisdictions drafting or revising regulatory provisions for heritage structures;
- Proposed classification of different relaxation possibilities to be adopted internationally;
- Proposed harmonisation with EN 1998 and similar regulatory documents.

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- Ministry of Housing and Urban-Rural Development of the People's Republic of China. *GB 50011-2010 建筑抗震设计规范* [Code for Seismic Design of Buildings]. Beijing (CN): China Architecture & Building Press; 2010.
- Ministry of Housing and Urban-Rural Development of the People's Republic of China. *GB/T 50165-2020 混凝土结构设计规范* [Code for Design of Concrete Structures]. Beijing (CN): China Architecture & Building Press; 2020.
- Ministry of Land, Infrastructure, Transport and Tourism. *建築物の耐震改修設計指針 (MLIT Guidelines)* [Guidelines for Seismic Retrofit Design of Buildings]. Tokyo (JP): MLIT; 2017.
- Ministry of Land, Infrastructure, Transport and Tourism. *建築基準法 (BSL)* [Building Standard Law]. Tokyo (JP): Government of Japan; 2000.
- National Land Development Technology Research Center. *Guidelines for Seismic Performance Evaluation of Unreinforced Brick Buildings and Reinforced Concrete Buildings under the Urban Building Act*. Tokyo: National Land Development Technology Research Center; 1998.
- Railway Technical Research Institute. *Handbook for Repair and Reinforcement of Brick, Stone, and Unreinforced Concrete Structures*. Tokyo: Railway Technical Research Institute; 1987.
- Türkiye's High Council for the Conservation of Cultural Property. Principle Decision No. 2878 on the Strengthening and Reconstruction of Registered Immovable Cultural Property. Official Gazette of the Republic of Türkiye, No. 32428 (Jan 13, 2024).
- United States General Services Administration. *GSREB: General Services Regulations for Federal Buildings*. Washington (DC): U.S. Government Publishing Office; 2020.

Annex 1 Overview of Seismic Relaxation Possibilities

Relaxation possibilities are **subject to limitations** which must be carefully checked before being applied.

Table 1: Availability of seismic relaxation possibilities per reference documents

Reference	Jurisdiction	Relaxation possibilities									
		Demand side		Capacity side			Performance objectives			Partial strengthening	
		Section									
		2.1.1	2.1.2	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2
		Seismic forces	Return period	Strength	Strain	Drift	Risk cat. and damage level	Occupancy type	Number of occupants	Allowance	Gradual implementation

Documents specifically related to heritage structures

[8]	International	Yes (1)	Yes (1)							Yes	
[9]	International						Yes (2)		Yes (2)	Yes	Yes
[14]	Italy	Yes	Yes	Yes			Yes (2)	Yes (2)	Yes (2)	Yes	Yes
[15]	Japan	Yes		Yes (1)		Yes					Yes
[18]	Romania	Yes	Yes	Yes		Yes (1)		Yes (2)	Yes (2)	Yes (1)	
[23]	USA	Yes		Yes			Yes (2)	Yes (2)	Yes (2)	Yes	Yes (1)

Documents related to existing structures in general

[2]	Croatia	Yes	Yes				Yes (2)			Yes (1)	
[5]	EU	Yes (2)	Yes (2)	Yes		Yes	Yes (2)	Yes (2)	Yes (2)		
[11]	Iran						Yes (2)	Yes (2)	Yes (2)		
[17]	Romania						Yes (2)	Yes (2)	Yes (2)	Yes (1)	Yes (1)
[19]	Switzerland	Yes		Yes		Yes	Yes	Yes (2)	Yes (2)	Yes (1)	
[24]	USA	Yes (1)	Yes (1)				Yes (2)	Yes (2)	Yes (2)	Yes	
[25]	USA						Yes (2)			Yes	Yes
[26]	Portugal	Yes									
[27]	New Zealand			Yes (2)	Yes (2)		Yes	Yes (1)	Yes (2)	Yes	Yes (2)

Documents related to both existing structures in general and, more specifically, to heritage structures

[3]	Croatia	Yes	Yes							Yes (1)	
[4]	Croatia	Yes	Yes							Yes (1)	
[7]	Greece	Yes	Yes (1)				Yes (2)	Yes (2)	Yes (2)	Yes (1)	Yes (1)
[10]	International		Yes				Yes (2)	Yes (2)	Yes (2)	Yes	
[20]	Turkey			Yes (2)							
[21]	Turkey		Yes (2)	Yes (2)	Yes (2)	Yes (2)	Yes (2)				
[22]	USA	Yes	Yes (1)			Yes	Yes	Yes (2)	Yes (2)	Yes	

Notes:

1. Yes, but not explicitly
2. Considered, but not necessarily relaxed

Annex 2 Glossary of abbreviations

The glossary is limited to the abbreviations used in the document.

Abbreviation	Definition /Note
alpha (α)	Hazard Reduction Factor (Italy NTC), multiplier on seismic demand
BSE	Basic Safety Earthquake (ASCE 41)
BSO	Basic Safety Objective (ASCE 41)
CBC	California Building Code
CHBC	California Historical Building Code
C0	Base Shear Coefficient (Japan)
CF	Confidence Factor, penalises assessed capacity when material data is limited
CP	Collapse Prevention, performance level
DL	Damage Limitation, performance level equivalent to Immediate Occupancy or Operational Continuity
DT	Destructive tests
EMS-98	European Macroseismic Scale
$f_{ck} / f_c / F_c$	Concrete Compressive Strength (European / US / Japanese notation respectively)
f_m	Masonry Compressive Strength
KF / kappa (κ)	Knowledge Factor (ASCE 41)
KH/SH	Kontrollü Hasar (<i>Controlled Damage</i>) / Sınırlı Hasar (<i>Limited Damage</i>) (Turkey)
IO	Immediate Occupancy, performance level
Is	Seismic Index (Japan)
IS	Seismic Safety Index (Italy)
LD	Limited Damage, performance level equivalent to Life Safety
LS	Life Safety, performance level and Limit State
MDT	Minor-destructive tests
NC	Near Collapse or No Collapse, performance level equivalent to Collapse Prevention
NDT	Non-destructive tests
PBE	Performance-Based Engineering
PGA	Peak Ground Acceleration
RM	Reinforced Masonry
SD	Significant Damage, performance level
SFRS	Seismic Force Resisting System (ASCE 7)
SLA	Limit State of Damage to Artistic Assets (Italy)
URM	Unreinforced Masonry

Annex 3 Individual reports on regulatory documents

Individual reports provide a more detailed elaboration of regulatory documents. Besides the general information (title, publisher, jurisdiction, status, etc.), the following topics have been analysed:

- Scope of document;
- Type of document;
- Ethos;
- Relaxation;
- Quality control, safety and reporting;
- Emergency stabilisation.

Individual reports are available on the Iscarsah website.

REPORT ON EXISTING RELAXED SEISMIC ASSESSMENT APPROACH FOR HERITAGE STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Annex 3

Individual reports on regulatory documents

Prepared by the Working Group

BUILDING CODES AND ISCARSAH PRINCIPLES: HARMONIZATION OF SAFETY ISSUES

Individual reports comprise a wider elaboration on regulatory documents. Besides the general information (title, publisher, jurisdiction, status, etc.), the following topics have been analysed:

- Scope of document;
- Type of document;
- Ethos;
- Relaxation;
- Quality control, safety and reporting;
- Emergency stabilisation.

The following regulatory documents are analysed in the individual reports.

1. [omitted]*

2. Ministry of Spatial Planning, Construction and State Property of Croatia. *Tehnički propis o izmjenama i dopunama tehničkog propisa za građevinske konstrukcije* [Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures]. Zagreb (HR): Government of Croatia; 2025 (n.b. used in Croatia, mandatory document related to existing structures in general).

3. Croatian Parliament. *Zakon o obnovi objekata oštećenih potresom* [Law on Rehabilitation of Buildings Damaged by Earthquake]. *Narodne novine*, No. 21/2023. Zagreb (HR): Government of Croatia; 2023 (n.b. used in Croatia as a mandatory document related to both existing structures in

general and, more specifically, heritage structures; the document can be used only in counties affected by earthquake damage, not in the whole country).

4. Croatian Parliament. *Program mjera obnove zgrada oštećenih potresom [Program of Rehabilitation Measures for Buildings Damaged by Earthquake]*. Narodne novine, No. 154/2024. Zagreb (HR): Government of Croatia; 2024 (n.b. used in Croatia, mandatory document related to both existing structures in general and more specifically to heritage structures).

5. European Committee for Standardization (CEN). *EN 1998-3: Eurocode 8: Design of Structures for Earthquake Resistance – Part 3: Assessment and Retrofitting of Buildings*. Brussels (BE): CEN; 2025 (n.b. used in the EU, mandatory document related to existing structures in general).

6. [omitted]*

7. Ministry for Climate Crisis and Civil Protection; Earthquake Planning and Protection Organization of Greece. *Κώδικας Αξιολόγησης και Δομικών Επεμβάσεων σε Τοιχοποιίες (KADET) [Code for the Assessment and Structural Interventions of Masonry Structures (KADET)]*. Athens (GR): Government of Greece; 2023 (n.b. used in Greece, mandatory document related to both existing structures in general and more specifically to heritage structures).

8. International Council on Monuments and Sites (ICOMOS). *ICOMOS Charter – Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage*. Paris (FR): ICOMOS; 2003 (n.b. nonmandatory document still not accepted by the authorities, related to heritage structures).

9. International Council on Monuments and Sites (ICOMOS); International Scientific Committee on the Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH). *ICOMOS/ISCARSAH Guidelines for the Analysis, Conservation and Structural Restoration of Architectural Heritage*. ISCARSAH; 2024 (n.b. used internationally, nonmandatory document still not accepted by the authorities, related to heritage structures).

10. International Organization for Standardization; Technical Committee ISO/TC 98, Bases for Design of Structures; Subcommittee SC 2, Reliability of Structures. *ISO 13822:2010 Bases for Design of Structures – Assessment of Existing Structures, Annex I (informative) – Heritage Structures*. Geneva (CH): ISO; 2010 (n.b. used internationally, nonmandatory document, but under certain conditions accepted by the authorities, related to both existing structures in general and more specifically to heritage structures).

11. Building and Housing Research Centre of Iran. *Iranian Code of Practice for Seismic-Resistant Design of Buildings (Standard No. 2800, 5th Edition)*. Tehran (IR): BHRC; 2026 (n.b. used in Iran, mandatory document related to design of new structures and evaluation of existing structures in general).

12. [omitted]*

13. [omitted]*

14. Presidenza del Consiglio dei Ministri. *Direttiva del Presidente del Consiglio dei Ministri 9 febbraio 2011 Valutazione e riduzione del rischio sismico del patrimonio culturale con riferimento alle Norme tecniche per le costruzioni di cui al D.M. 14/01/2008 [Guidelines for the Evaluation and Reduction of*

Seismic Risk of Cultural Heritage with Reference to the Technical Standards for Construction under Ministerial Decree 14/01/2008]. *Gazzetta Ufficiale della Repubblica Italiana*, n. 47 del 26/02/2011 – suppl. ord. n. 54. Rome (IT): Governo d'Italia; 2011 (n.b. used in Italy, mandatory document related to heritage structures).

15. Agency for Cultural Affairs. *重要文化財（建造物）耐震診断・耐震補強の手引* [Guidelines for Seismic Assessment and Reinforcement of Important Cultural Properties (Buildings)]. Tokyo (JP): Government of Japan; 2017 (n.b. used in Japan, nonmandatory document but under certain conditions accepted by the authorities, related to heritage structures).

16. [omitted]*

17. Ministerul Dezvoltării Regionale și Administrației Publice. *Cod de proiectare seismică – Partea a III-a – Prevederi pentru evaluarea seismică a clădirilor existente, indicativ P100-3/2019* [Seismic Design Code – Part III – Provisions for the Seismic Assessment of Existing Buildings, Indicative P100-3/2019]. *Monitorul Oficial al României*, partea I, nr. 1003. Bucharest (RO): Government of Romania; 2019 (n.b. used in Romania, mandatory document, related to existing structures in general).

18. Ministry of Public Works; Ministry of Culture and Religious Affairs. *MP025-2004 Metodologie pentru evaluarea riscului și propunerile de intervenții necesare la structurile construcțiilor monumente istorice în cadrul lucrărilor de restaurare ale acestora* [Methodology for Risk Assessments and Proposals for the Necessary Interventions in the Structures of Historical Monuments in the Framework of Their Restoration Works]. Order No. 743/19.04.2004, Construction Bulletin No. 21/2005. Bucharest (RO): Government of Romania; 2004 (n.b. used in Romania, nonmandatory document still not accepted by the authorities, related to heritage structures).

19. Swiss Society of Engineers and Architects (SIA); Société Suisse des ingénieurs et des architectes. *SIA 269/8:2017 Maintenance des structures porteuses – Séismes* [Maintenance of Load-Bearing Structures – Earthquakes]. Zurich (CH): SIA; 2017 (n.b. used in Switzerland, mandatory document related to existing structures in general).

20. Disaster and Emergency Management Presidency (AFAD). *Türkiye Bina Deprem Yönetmeliği* [Turkish Building Earthquake Code]. Ankara (TR): AFAD; 2018 (n.b. used in Turkey, mandatory document related to both existing structures in general and more specifically to heritage structures).

21. Istanbul Governor; General Directorate of Foundations. *Tarihi Yapılarda Deprem Riskinin Azaltılmasına İlişkin Kılavuz* [Guideline for the Mitigation of Earthquake Risk on Historical Buildings]. Istanbul (TR): Government of Turkey; 2018 (n.b. used in Turkey, nonmandatory document but under certain conditions accepted by the authorities, related to both existing structures in general and to heritage structures).

22. International Code Council. *International Existing Building Code (IEBC), 2020*. Washington (DC): ICC; 2020 (n.b. used in the USA, mandatory document related to both existing structures in general and to heritage structures).

23. International Code Council. *California Historical Building Code (CHBC)*, 2022. Washington (DC): ICC; 2022 (n.b. used in the USA, mandatory document related to heritage structures owned by the State of California, nonmandatory for other buildings).
24. American Society of Civil Engineers. *Seismic Evaluation and Retrofit of Existing Buildings (ASCE/SEI 41-23)*. Reston (VA): ASCE; 2023 (n.b. used in the USA, nonmandatory document, but under certain conditions accepted or required by the authorities, related to existing structures in general).
25. U.S. Federal Emergency Management Agency. *FEMA P-420: Engineering Guideline for Incremental Seismic Rehabilitation*. Washington (DC): FEMA; 2009 (n.b. used in the USA, nonmandatory document related to existing structures in general).
26. Ministério das Infraestruturas e da Habitação. *Portaria n.º 302/2019 [Ministerial Order No. 302/2019]*. Lisbon (PT): Governo de Portugal; 2019 (n.b. used in Portugal, mandatory document, related to existing structures in general).
27. New Zealand Society for Earthquake Engineering. *NZSEE 2017: The Seismic Assessment of Existing Buildings – Technical Guidelines for Engineering Assessments*. Wellington (NZ): NZSEE; 2017 (n.b. used in New Zealand, mandatory document, related to existing structures in general).

* Several initially planned documents have not been analysed. However, the initial numbering has been kept for consistency with the numbering of individual reports on the regulatory documents.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

TECHNICAL REGULATION ON REVISIONS AND AMENDMENTS OF TECHNICAL REGULATION FOR BUILDING STRUCTURES

(CROATIAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: David Anđić
2. Date of the report
A: 27.04.2025.
3. Title of the document analysed
A: Tehnički propis o izmjenama i dopunama tehničkog propisa za građevinske konstrukcije (Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures)
4. Publisher
A: Ministry of Spatial Planning, Construction and State Property
5. Date of issue
A: 17.1.2022.
6. Country of publication
A: Croatia
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: Existing
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: New requirements are added for the reconstruction/retrofit of residential, multi-residential, and business buildings, as well as family houses designed before October 8, 1964 (before the first seismic codes in ex-Yugoslavia) It states that during reconstruction, the structural damage index (IZO) should achieve a minimum of 0.75. It means that after the reconstruction/retrofit the building must have 75% of the resistance of the new structure. Also, there's the appendix that is used along with Zakon o obnovi objekata oštećenih potresom (Law on Rehabilitation of Buildings Damaged by Earthquake) that prescribes levels of retrofit for buildings damaged during earthquake.
12. Chapters/sections of the document with the research topic described
A: Articles 1.-4.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
A: No, it is generally for existing buildings.
- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?
A: Historic/heritage construction is included in the existing buildings.
- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?
A: No, it's broader, for all existing buildings.
1. If so, how is historic/heritage defined and what type of official designation is required?
A: It's not.
2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?
A: No.
- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?
A: Yes, it's applicable to all existing buildings.
- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?
A: Whole document is developed for existing structures.
- c. Does the document appear to be based primarily on or derived from some other document?
i. If so, identify the source document.
A: Italian NTC 2018 (followed after the original NTC 2008 issued after the L'Aquila earthquake in 2007)

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?
A: Yes, it's required.
- i. If a Standard, are jurisdictions required to accept its use and application?
A: Yes.
- ii. Do jurisdictions routinely accept the use of the Standard?
A: Yes, it's required according to the Law.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- b. Is the document for guidance only?

A: No, it's mandatory.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: It's a Standard.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: It specifies methodology for types of construction works depending on the level of retrofit. Somewhat general. Not overly specific.

- b. If so, is the methodology for assessment or for retrofit design?

A: It's for construction.

- c. Is the methodology recommended or required?

A: It's recommended. You can use other methods if they are justified and well explained.

- i. Is the recommended or required methodology primarily a checklist?

A: It's a list of possible retrofitting techniques.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: Yes, just mentions strengthening techniques, not calculations.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Yes, but there are more options to choose from.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: No, this is not mentioned in this document.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: No.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes this is primarily the point of this document. Generally for existing buildings that are involved in retrofitting, according to the Building Act and also for existing buildings that were damaged in earthquakes according to the Zakon o obnovi objekata oštećenih potresom (Law on Rehabilitation of Buildings Damaged by Earthquake)

- i. Identify the reasoning provided as to why the document allows for relaxation

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: It's economic, and it's based on the importance factor. More important buildings are required to reach the resistance of new buildings, whereas less important buildings must reach half of that resistance.

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: It's not stated clearly.

- iii. Identify the ways that the document allows for relaxation

A: The needed resistance levels of existing buildings are divided based on the importance factor (EN 1998-1) – classes 1 and 2 need to reach 50% resistance of new buildings, class 3 – 75% and class 4 – 100%.

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: The relaxation is on the demand side.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, same as in previous answer.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: No, this document on deals with seismic actions.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: No.

- 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: It's according to the code (EN 1998-3), depends on the knowledge level.

- 2. If so, identify which.

A: No.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: No.

- 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No.

2. If so, identify which.

A: No:

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: No.

2. If so, identify which.

A: No.

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No.

- i. If so, provide specifics.

A: No.

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Yes, through the levels of retrofitting based on the importance class.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: There's no specific target for heritage structures.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: It's described in the 16.a.iii.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes.

1. If so, provide specifics.

A: It's described in the 16.a.iii.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: No, it's based on the importance class, but you can say that it's partially based on the number of occupants in the building.

1. If so, provide specifics.

A: Consequence classes in EN 1990 are connected to the importance factor EN1998.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, "partial" here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: No.

- i. If so, provide specifics.

A: No.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: It doesn't state in that particular way, but it states that it must reach certain percentage of seismic resistance of new structure so I'd say that all vulnerabilities should be strengthened to that minimal level.

- i. If so, provide specifics.

A: Governing vulnerability must be addressed and retrofitted so the governing damage mechanism is limited to the minimal level.

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No.

- i. If so, provide specifics.

A: No.

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: Not in this document, but in the Zakon o obnovi objekata oštećenih potresom (Law on Rehabilitation of Buildings Damaged by Earthquake)

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: No.

- b. Does the document anywhere state the required scope of the maintenance plan?

A: It is connected to Technical Regulation for Building Structures and there are rulebooks that need to be followed, but in general, for new and for existing buildings, there's no difference.

- i. If so, provide specifics.

A: No.

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes, but it's in the Technical Regulation for Building Structures.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If so, provide specifics.

A: Prescribed time intervals between visual inspections is 1 year for basic inspection and 10 years (5 years for some special structures) for main inspection. Also, supplementary and extraordinary inspections are included. The point of basic inspection is in determining the general condition of the structure. It must include a review of available documentation and a visual inspection of the condition of the main elements of the structure that are essential for load-bearing capacity and fire resistance of the entire structure, as well as for the proper functioning of the building (joints of the main load-bearing elements, supporting elements, main supports, ties, etc.), the failure of which could jeopardize the safety of the building's users and/or cause significant material damage. Main inspection is more thorough basic inspection.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No.

- i. If so, provide specifics.

A: No.

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No.

- i. If so, provide specifics.

A: No.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

LAW ON REHABILITATION OF BUILDINGS DAMAGED BY EARTHQUAKE

(CROATIAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: David Anđić
2. Date of the report
A: 27.06.2025.
3. Title of the document analysed
A: Zakon o obnovi objekata oštećenih potresom (Law on Rehabilitation of Buildings Damaged by Earthquake)
4. Publisher
A: Croatian Parliament (NN 21/2023)
5. Date of issue
A: 22.02.2023.
6. Country of publication
A: Croatia
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: both
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document

A: This Law regulates the manner and procedure for the recovery, removal of buildings damaged or destroyed due to a natural disaster or catastrophe declared in the affected areas by the earthquakes on March 22, 2020, and December 28 and 29, 2020. It covers the construction and equipping of replacement family houses, the construction of multi-family and residential-commercial buildings, the residential accommodation of persons affected by these disasters, financial aid, and the designation of competent authorities, deadlines for action, and other related matters.

Chapters/sections of the document with the research topic described

A: Articles 1.-115.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

12. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes, it is generally for existing buildings, but has some provisions for listed structures as well as for structures inside a conservation (protected) zones of the cities.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: Historic/heritage construction is included in the existing buildings and has some added requirements.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No, it's broader, for all existing buildings, but has parts only for heritage.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: Two types of different heritage buildings – individually protected buildings (most important) and heritage buildings within the protected zone (city centers and similar).

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Yes, it's for all existing buildings.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes, it's applicable to all existing buildings.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: Whole document is developed for existing structures.

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: Not aware of other document that served as a template.

13. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: Yes, it's required.

- i. If a Standard, are jurisdictions required to accept its use and application?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Yes.

- ii. Do jurisdictions routinely accept the use of the Standard?

A: Yes, it's required it's the Law.

- b. Is the document for guidance only?

A: No, it's mandatory.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: It's the Law.

14. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: It does not, but it points the reader towards Program of Rehabilitation Measures for Buildings Damaged by Earthquake issued by Croatian Government (NN 28/2023) that gives procedures and methods.

- b. If so, is the methodology for assessment or for retrofit design?

A: It's for construction.

- c. Is the methodology recommended or required?

A: It's just the act of building the structure or retrofitting it, no methodologies for design are commented.

- i. Is the recommended or required methodology primarily a checklist?

A: No.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No calculations.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: No, it's general Law.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: No, this is not mentioned in this document as this is not that type of document.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: No.

15. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No, but it directs the reader towards the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures that does this.

- i. Identify the reasoning provided as to why the document allows for relaxation
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.
- ii. Identify what the document set forth as the reasons why relaxation is sought
A: It's not stated clearly.
- iii. Identify the ways that the document allows for relaxation
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.
- iv. Identify if the document provides for relaxation primarily on the "demand side", the "capacity side", or both.
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
A: No, this document on deals with seismic actions.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
A: No.
 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
A: It's according to the code (EN 1998-3), depends on the knowledge level.
 2. If so, identify which.
A: No.
- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: No.

2. If so, identify which.

A: No:

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: No.

2. If so, identify which.

A: No.

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No.

- i. If so, provide specifics.

A: No.

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: No.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: There's no specific target for heritage structures.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes.

1. If so, provide specifics.

A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures

1. If so, provide specifics.

A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, "partial" here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: No.

- i. If so, provide specifics.

A: No.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No.

- i. If so, provide specifics.

A: -

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No.

- i. If so, provide specifics.

A: No.

16. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: It does, it states what is the minimum experience of structural engineer and architect involved in the retrofitting and also states that either one of the entrusted professionals holds the license to work with heritage issued by the Ministry of Culture.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: 5 years of experience and license for working on heritage.

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No, it gives the scope of the retrofit, depending on the occupancy and importance class and also depending on whether the building is individually protected, in the zone or not protected.

- i. If so, provide specifics.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: If this is the right answer than regular existing buildings should be retrofitted only in the structural part, whereas protected heritage in the zone must be retrofitted also in the structural part, but with certain rules that must be followed (the Law directs the reader to the Program of Rehabilitation Measures for Buildings Damaged by Earthquake) and the latest – individually protected heritage must be retrofitted in every aspect, not just structurally.

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes, but it's in the Technical Regulation for Building Structures.

- i. If so, provide specifics.

A: Prescribed time intervals between visual inspections is 1 year for basic inspection and 10 years (5 years for some special structures) for main inspection. Also, supplementary and extraordinary inspections are included. The point of basic inspection is in determining the general condition of the structure. It must include a review of available documentation and a visual inspection of the condition of the main elements of the structure that are essential for load-bearing capacity and fire resistance of the entire structure, as well as for the proper functioning of the building (joints of the main load-bearing elements, supporting elements, main supports, ties, etc.), the failure of which could jeopardize the safety of the building's users and/or cause significant material damage. Main inspection is more thorough basic inspection.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: Yes.

- i. If so, provide specifics.

A: If the structure is near collapse or partially collapsed the inspection engineer can give direction to tear the building down without surveying the building from the inside and without the need to make a existing condition drawings of the building. It's a safety measure

17. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No. But there's a publication from the Ministry of Culture and Media (<https://min-kulture.gov.hr/istaknute-teme/obnova-nakon-potresa-25146/popisi-procjene-steta-i-provedba-hitnih-mjera-zastite-na-potresom-pogodjenim-podrucjima/nuzne-hitne-mjere/25283>)

- i. If so, provide specifics.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

[A: Temporary bracings, supports, usage of temporary ties etc.](#)

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

PROGRAM OF REHABILITATION MEASURES FOR BUILDINGS DAMAGED BY EARTHQUAKE

(CROATIAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: David Anđić
2. Date of the report
A: 27.06.2025.
3. Title of the document analysed
A: Program mjera obnove zgrada oštećenih potresom (Program of Rehabilitation Measures for Buildings Damaged by Earthquake)
4. Publisher
A: Croatian Parliament (NN NN 154/2024)
5. Date of issue
A: 27.12.2024.
6. Country of publication
A: Croatia
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: both
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document

A: This Measures Program (hereinafter: Program) is established in accordance with the provisions of Articles 13 and 14 of the Law on the Reconstruction of Buildings Damaged by the Earthquake in the areas of the City of Zagreb, Krapina-Zagorje County, Zagreb County, Sisačko-Moslavačka County, and Karlovac County (Official Gazette, No. 21/23 – hereinafter: the Law). It defines the retrofitting measures for buildings related to the restoration of public buildings, multi-family residential buildings, commercial buildings, mixed-use residential-commercial buildings, and family houses, as well as residential accommodation, in the areas of the City of Zagreb, Krapina-Zagorje County, Zagreb County, Sisačko-Moslavačka County, and Karlovac County.

Chapters/sections of the document with the research topic described

A: Whole document.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

12. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes, it is generally for existing buildings, but has some provisions for listed structures as well as for structures inside a conservation (protected) zones of the cities.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: Historic/heritage construction is included in the existing buildings and has some added requirements.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No, it's broader, for all existing buildings, but has parts only for heritage.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: Two types of different heritage buildings – individually protected buildings (most important) and heritage buildings within the protected zone (city centers and similar).

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Yes, it's for all existing buildings.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes, it's applicable to all existing buildings.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: Whole document is developed for existing structures.

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: Not aware of other document that served as a template.

13. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: Yes, it's required, but it's not the code nor standard but addition to the Law on Rehabilitation of Buildings Damaged by Earthquake.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If a Standard, are jurisdictions required to accept its use and application?

A: Yes.

- ii. Do jurisdictions routinely accept the use of the Standard?

A: Yes, it's required it's the Law.

- b. Is the document for guidance only?

A: No, it's mandatory.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: It's the Law so yes.

14. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: It does

- b. If so, is the methodology for assessment or for retrofit design?

A: It's for assessment (rapid assessment), also for „finding“ (originally called „nalaz“) as a next step in the assessment of the damage structures.

- c. Is the methodology recommended or required?

A: It's required, the whole protocol is required.

- i. Is the recommended or required methodology primarily a checklist?

A: In the beginning stages yes (rapid assessment and „finding“), later it's more expditive in the Assessment of the existing structural condition report and in the retrofit project, but in the document the reader is directed to the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No calculations, just description of the damage and possible solutions.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: It's somewhat prescriptive, but you have more options and always can invent something that you think is applicable, you're not obliged to use given example remedies.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: No, this is not mentioned in this document as this is not that type of document.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: No.

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

15. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: No, but it directs the reader towards the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures that does this.

- i. Identify the reasoning provided as to why the document allows for relaxation
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.
- ii. Identify what the document set forth as the reasons why relaxation is sought
A: It's not stated clearly.
- iii. Identify the ways that the document allows for relaxation
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.
- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures.
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
A: No, this document on deals with seismic actions.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
A: No.
 - 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: It's according to the code (EN 1998-3), depends on the knowledge level.

2. If so, identify which.

A: No.

ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: No.

2. If so, identify which.

A: No:

x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: No.

2. If so, identify which.

A: No.

b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No.

i. If so, provide specifics.

A: No.

c. Does the document describe any or a variety of options for the target "performance objectives" to be achieved by the retrofit?

A: No.

i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: There's no specific target for heritage structures only depending on the importance factor according to Eurocode 1998-3.

ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures

iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. If so, provide specifics.
[A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures](#)
- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?
[A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures](#)
 1. If so, provide specifics.
[A: It's been said in the explanation for the Technical Regulation on Revisions and Amendments of Technical Regulation for Building Structures](#)
- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, "partial" here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]
[A: No.](#)
 - i. If so, provide specifics.
[A: No.](#)
- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?
[A: No.](#)
 - i. If so, provide specifics.
[A: -](#)
- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?
[A: No.](#)
 - i. If so, provide specifics.
[A: No.](#)

16. Quality control, safety and reporting
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- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?
[A: It does, it states what is the minimum experience of structural engineer and architect involved in the retrofitting and also states that either one of the entrusted professionals holds the license to work with heritage issued by the Ministry of Culture.](#)
 - i. If so, provide specifics (i.e. type of attestation required and other requirements).
[A: 5 years of experience and license for working on heritage.](#)
- b. Does the document anywhere state the required scope of the maintenance plan?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No, it gives the scope of the retrofit, depending on the occupancy and importance class and also depending on whether the building is individually protected, in the zone or not protected.

i. If so, provide specifics.

A: If this is the right answer than regular existing buildings should be retrofitted only in the structural part, whereas protected heritage in the zone must be retrofitted also in the structural part, but with certain rules that must be followed and the latest – individually protected heritage must be retrofitted in every aspect, not just structurally. It is stated in the part 6. Conservation guidelines, special conditions, and consents for the protection of cultural heritage for buildings that are individually protected cultural goods and/or are located within cultural-historical zones that are protected, and are undergoing reconstruction through structural renovation or complete restoration.

c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No.

i. If so, provide specifics.

A: -

d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: Yes.

i. If so, provide specifics.

A: If the structure is near collapse or partially collapsed the inspection engineer can give direction to tore the building down without surveying the building from the inside and without the need to make a existing condition drawings of the building. It's a safety measure stated in the Law on Rehabilitation of Buildings Damaged by Earthquake

17. Emergency stabilization

a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No. But there's a publication from the Ministry of Culture and Media (<https://min-kulture.gov.hr/istaknute-teme/obnova-nakon-potresa-25146/popisi-procjene-steta-i-provedba-hitnih-mjera-zastite-na-potresom-pogodjenim-podrucjima/nuzne-hitne-mjere/25283>) that is published specially for heritage buildings.

i. If so, provide specifics.

A: Temporary bracings, supports, usage of temporary ties etc.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

**EN 1998-3: EUROCODE 8: DESIGN OF STRUCTURES FOR EARTHQUAKE RESISTANCE
- PART 3: ASSESSMENT AND RETROFITTING OF BUILDINGS**

(EUROPEAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Naida Ademović
2. Date of the report
A: May, 2025
3. Title of the document analysed
A: EN 1998-3: Eurocode 8: Design of structures for earthquake resistance - Part 3: Assessment and retrofitting of buildings
4. Publisher
A: European Committee for Standardization (CEN)
5. Date of issue
A: June 2025
6. Country of publication
A: Belgium
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory in Bosnia and Herzegovina, but accepted by authorities. Mandatory in EU countries with some country-specific details and national annexes.
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: Reinforced concrete, steel, and masonry structures
9. Status of the structure addressed (existing, historic, both)
A: Existing
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: EN 1998-3: Eurocode 8 – Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings provides rules, criteria, and methods for the seismic assessment and retrofitting of existing buildings. It outlines performance objectives, levels of seismic action, and verification procedures to evaluate whether a structure meets safety requirements or requires strengthening. The document covers primarily reinforced concrete, steel, and masonry structures and is intended to support engineers in evaluating structural safety and designing appropriate interventions to improve seismic resilience.
12. Chapters/sections of the document with the research topic described
A: 1. General ✓ Scope, normative references, and definitions. ✓ Establishes the applicability of the standard for seismic assessment and retrofitting. 2. Performance Requirements and Compliance Criteria

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- ✓ Defines **fundamental requirements** (state of damage in the structure through three Limit States (LS): Near Collapse (NC), Significant Damage (SD), and Damage Limitation (DL) connected with a specific return period for the seismic action.
- ✓ Introduces **compliance criteria** for existing buildings under seismic actions, method of analysis, verification, and detailing procedures.

3. Information for the Structural Assessment

- ✓ Required input data
- ✓ Knowledge levels: definitions, values of confidence factors (CF), identification of the knowledge levels, applications of CF
- ✓ Introduces inspection, testing, and **knowledge levels** (KL1, KL2, KL3) that influence safety margins.

4. Seismic Action

- ✓ Defines seismic action and seismic load combinations and provides the connection to EN 1998-1:2004.
- ✓ Defines structural modeling
- ✓ Identifies methods of analysis and their applicability (linear force analysis and modal response spectrum analysis **as linear methods**, non-linear static (pushover) analysis and non-linear time history dynamic analysis **as non-linear methods**, and q -factor approach)
- ✓ Provides criteria for selecting the appropriate method
- ✓ Provides information regarding safety verifications
- ✓ A detailed summary of criteria for analysis and safety verification is provided in a tabular manner

5. Decisions for Structural Interventions

- ✓ Provides criteria for structural intervention (technical criteria, type of intervention, non-structural elements, and justification of the selected intervention type)

6. Design of Structural Interventions

- ✓ Provides required steps for the retrofitting design procedure (conceptual design, analysis, and verification)

Annex A to C. Specific Provisions for Materials

Annex A. Reinforced Concrete Structures

- ✓ Identification of geometry, details, and materials
- ✓ Capacity Models for Assessment for various load-bearing elements in relation to the various limit states
- ✓ Capacity Models for Strengthening (concrete jacketing, steel jacketing, FRP plating and wrapping)

Annex B. Steel Structures

- ✓ Identification of geometry, details, and materials
- ✓ Requirement on geometry and materials of new or modified parts
- ✓ System retrofitting as a function of the type of steel frames

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- ✓ Member assessment and retrofitting taking into account member deformation capacities and type of member element (beams, columns, bracings, connection retrofitting)

Annex C. Masonry Structures

- ✓ Identification of geometry, details, and materials
- ✓ Defines methods of analysis (linear methods: static and multi-modal; nonlinear methods: static and dynamic)
- ✓ Defines Capacity models for assessment, taking into account models for global assessment (LS of Near Collapse, LSs of Near Collapse (NC), Significant Damage (SD), and Damage Limitation (DL))
- ✓ Defines structural interventions by outlining various repair and strengthening techniques, including crack repair, reinforcement and strengthening of wall intersections, stiffening of horizontal diaphragms, tie beams, and strengthening through the use of steel ties. Additionally, it addresses the strengthening of rubble core masonry (multi-leaf), strengthening with reinforced concrete jackets or steel profiles, and the application of polymer grid jackets.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: No.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: N/A

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: N/A

1. If so, how is historic/heritage defined and what type of official designation is required?

A: N/A

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: N/A

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: Yes.

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: There is a tight connection to EN 1998-1:2004. Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions, and rules for buildings.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: No

- i. If a Standard, are jurisdictions required to accept its use and application?

A: N/A

- ii. Do jurisdictions routinely accept the use of the Standard?

A: N/A

- b. Is the document for guidance only?

A: No.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: It is a **standard** that provides **specific rules and methods** for the seismic **assessment and retrofitting of existing buildings**. While it can offer guidance, the document is primarily intended to be used as a **technical standard** for ensuring that existing buildings are evaluated and, if necessary, strengthened to meet seismic safety requirements.

However, in terms of its mandatory application:

- ✓ It is **non-mandatory** unless **adopted by a national authority** (as part of national building codes).
- ✓ However, it is generally accepted and used **widely** as the basis for seismic assessments and retrofitting.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes.

- b. If so, is the methodology for assessment or for retrofit design?

A: **Key methodologies outlined in the document include:**

1. **Seismic assessment procedures:** The document defines specific **analytical methods** and **performance criteria** for evaluating the seismic safety of existing buildings. These include both linear and nonlinear analysis approaches, such as:

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- ✓ linear force analysis
- ✓ modal response spectrum analysis
- ✓ non-linear static (pushover) analysis
- ✓ non-linear time history dynamic analysis
- ✓ *q*-factor approach

2. **Assessment of structural components:** Specific capacity models are provided for evaluating the **seismic performance** of different materials and structural elements in relation to the various limit states, such as reinforced concrete, masonry, and steel.
3. **Retrofit strategies:** The document identifies various **retrofit techniques** to improve the seismic performance of buildings depending on the construction material, including the use of:

Reinforced Concrete Structures

- ✓ Provides Capacity Models for Strengthening for various strengthening techniques: concrete jacketing, steel jacketing, FRP plating, and wrapping

Steel Structures

- ✓ System retrofitting as a function of the type of steel frames (moment-resisting frames and braced frames)
- ✓ Member assessment and retrofitting taking into account member deformation capacities and type of member element (beams, columns, bracings, connection retrofitting)

Masonry structures:

- ✓ Defines structural interventions by outlining various repair and strengthening techniques, including crack repair, reinforcement and strengthening of wall intersections, stiffening of horizontal diaphragms, tie beams, and strengthening through the use of steel ties. Additionally, it addresses the strengthening of rubble core masonry (multi-leaf), strengthening with reinforced concrete jackets or steel profiles, and the application of polymer grid jackets.

4. **Performance levels:** It defines **performance objectives** and the corresponding seismic actions and design levels that the structure should meet during assessment and retrofitting.

- c. Is the methodology recommended or required?

A: The methodology is required.

- i. Is the recommended or required methodology primarily a checklist?

A: The methodologies in EN 1998-3 **are required** for seismic assessment and retrofitting unless there is a specific national provision or exception

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No, the methodology outlined in EN 1998-3: Eurocode 8 – Part 3: Assessment and retrofitting of buildings is **not just conceptual**. It provides specific steps, calculations, and procedures that are required for seismic assessment and retrofitting of buildings.

Specific Steps: The standard includes detailed procedures for performing seismic assessments, such as guidelines for:

- ✓ Collecting structural data (e.g., material properties, structural configuration)
- ✓ Conducting inspections and tests on existing buildings
- ✓ Selecting appropriate seismic actions based on location and building type
- ✓ Performing structural analysis using specific methods like linear elastic, pushover, and time-history analysis

Required Calculations: The document outlines required calculations to evaluate whether the building meets seismic safety performance objectives. These include methods to calculate force distributions, displacement responses, and the capacity of structural elements under seismic loading.

Design Rules: EN 1998-3 specifies detailed design rules for strengthening or retrofitting buildings. These rules are not only conceptual but involve technical steps and calculations, such as how to apply reinforced concrete jackets, steel ties, and other reinforcement methods to enhance seismic performance.

Clear Guidelines for Intervention: The standard goes beyond high-level concepts by giving exact guidance on the implementation of structural interventions like tie beams, stiffening diaphragms, and retrofitting techniques.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: The methodology in EN 1998-3 is prescriptive, providing specific instructions and required steps that engineers must follow when assessing and retrofitting buildings for seismic safety.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: The methodology in EN 1998-3 is **quantitative**, as it provides specific calculations that engineers need to perform for both seismic assessment and retrofitting, ensuring buildings meet the necessary seismic safety requirements.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: EN 1998-3 provides **specific analytical approaches** tailored to structure type, material, and configuration, offering engineers methods that depend on the unique characteristics of the building. This ensures that each structure is assessed and retrofitted appropriately based on its specific needs and conditions.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes, some relaxation is provided in relation to EN 1998-1. Eurocode 8 – Part 3: *Assessment and Retrofitting of Buildings* introduces an additional limit state compared to EN 1998-1. The provided return periods also differ between the two documents, which is due to variations in the specified exceedance probabilities and the corresponding number of years. See point 16 c, ii.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: The document allows for relaxation due to the definition of the Significant Damage (SD) limit state. Under this condition, the structure is significantly damaged but retains some residual lateral strength and stiffness, and vertical elements are still capable of sustaining vertical loads. While non-structural components are damaged, partitions and infill walls have not failed out-of-plane. The structure exhibits moderate permanent drifts and can withstand moderate aftershocks, though it is likely to be uneconomical to repair.

This condition acknowledges that although full serviceability is lost, complete collapse is avoided, allowing for reduced performance demands compared to more stringent limit states, thereby justifying the permitted relaxation in requirements.

Accordingly, the use of the Damage Limitation Limit State (DLLS) and the Significant Damage Limit State (SDLS), as allowed by the **applicable national annexes** to EN 1998-3, may be regarded as a type of regulatory relief for the evaluation of existing structures, especially in situations where verification against the Near Collapse Limit State (NCLS) is not necessary.

The national annexes may allow for different verification approaches, including the use of all three limit states, verification of only two, or, in some cases, verification of a single limit state. This flexibility enables adaptation to national regulatory frameworks and engineering practice, but it also highlights the importance of clearly understanding the equivalence or divergence from EN 1998-1 requirements when assessing the implications of such choices.

It should be stated, since the **SDLS in EN 1998-3** is functionally equivalent to the **No-Collapse requirement defined in EN 1998-1**, it should be noted that even if such an approach is expressly permitted by the national annexes, it does not necessarily represent a relaxation of the requirements of EN 1998-1.

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: These conditions collectively justify a relaxation of performance requirements, as full structural integrity is not expected, but life safety and collapse prevention are still achieved.

- iii. Identify the ways that the document allows for relaxation

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: The document allows for relaxation under the Limit State of Significant Damage (SD) for existing buildings by accepting that the structure retains some residual lateral strength and stiffness and that its vertical elements can still support vertical loads. Non-structural components are damaged, but partitions and infills have not failed out-of-plane. Moderate permanent drifts are acceptable, and the structure can withstand moderate aftershocks. Additionally, the structure is considered uneconomical to repair, justifying a more flexible approach to performance requirements.

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: This is on the demand side

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, seismic forces used in retrofitting existing buildings are generally relaxed, not because their return periods are longer, but because design codes often allow force reduction factors or alternative performance-based approaches for practical retrofit strategies. The values for the probability of exceedance (P_R) and the reference return period (T_L) for a given level of seismic action differ, with existing buildings having a higher return period (T_R). This is due to the different values of probability and the associated number of years, which results in a higher return period for existing buildings compared to new structures.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, it affects the return period. The relaxation permits the use of longer return periods for evaluating existing buildings. The goal is to balance life safety with the practical and economic challenges of upgrading older structures. While new buildings are designed for specific performance targets (e.g., immediate occupancy, life safety, collapse prevention) using well-defined return periods (e.g., 475 years for no collapse), for existing buildings, the return period is 2475 years; however, the probability of exceedance is 2% in 50 years.

1. The comparison of annual exceedance probabilities for **near-collapse** LS in existing and new buildings for **no-collapse** LS reveals a significant difference in risk tolerance. For existing buildings, a 2% probability of exceedance over 50 years corresponds to a return period of approximately 2475 years, resulting in an annual exceedance probability (AEP) of about 0.0404%. In contrast, new buildings are designed with a 10% probability of exceedance over the same 50-year period, corresponding to a return period of roughly

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

475 years and an AEP of approximately 0.211%. This indicates that new buildings are designed to withstand less rare but more likely extreme events compared to existing buildings, which are evaluated against rarer events but may have lower safety expectations due to practical constraints in retrofitting.

2. A limit state corresponding to **significant damage** with a 10% probability of exceedance in 50 years and a return period of 475 years is **explicitly defined only in Eurocode 8 Part 3 (EN 1998-3) for the assessment and retrofit of existing buildings**. This limit state does not exist in the seismic design provisions for new structures under Eurocode 8 Part 1 (EN 1998-1), which instead focuses on ultimate limit states such as collapse prevention and damage limitation using different return periods and performance objectives. The application of the **Significant Damage Limit State (SDLS)** and the **Damage Limitation Limit State (DLLS)**, as permitted by the relevant national annexes to EN 1998-3, may be considered a form of regulatory relief for the assessment of existing structures, particularly when verification against the **Near Collapse Limit State (NCLS) is not required**.

However, it should be noted that if such an approach is explicitly allowed by the national annexes, it does not necessarily represent a relaxation compared to the requirements of EN 1998-1, given that the SDLS in EN 1998-3 is functionally equivalent to the No-Collapse requirement defined in EN 1998-1.

3. The annual exceedance probability comparison for the **damage limitation** LS level shows differing expectations for existing and new buildings. For existing buildings, a 20% probability of exceedance over 50 years corresponds to a return period of approximately 225 years, yielding an AEP of about 0.444% per year. In contrast, new buildings are evaluated using a 10% exceedance probability over just 10 years, resulting in a shorter return period of 95 years and a significantly higher AEP of about 1.05% per year. This indicates that damage-limiting performance is expected to be triggered more frequently in new buildings, likely reflecting a more serviceability-oriented design philosophy and shorter-term performance expectations.
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: N/A

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
2. If so, identify which.
A: N/A
- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?
A: N/A
 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 2. If so, identify which.
A: N/A
- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?
A: N/A
 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 2. If so, identify which.
A: N/A
- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?
A: N/A
 - i. If so, provide specifics.
A: N/A
- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?
A: EN 1998-3 describes various options for performance objectives that can be achieved through retrofitting, including life safety, damage limitation, and operational continuity. The standard allows flexibility in selecting the appropriate retrofit strategy based on the building type, seismic risk, and desired performance.
 - i. Provide specifics as to what the stated performance targets are for historic/heritage structures.
A: N/A
 - ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.
A: EN 1998-3 outlines **three main performance objectives** that can be targeted in retrofit design, based on the importance and use of the building, as indicated in

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

sections a, iv the values of return periods, probability of exceedance, and reference return period for existing buildings are different concerning the new buildings.

1. LS of Near-Collapse Requirement (Collapse Prevention):

- Ensures that the structure will **not collapse**, as the vertical elements are still capable of sustaining vertical loads.
- The structure is not able to survive another earthquake, even of moderate intensity.
- Minimum performance level for **life safety**.

2. LS of Significant Damage Limitation (Life Safety): only applicable for existing structures, is the same as no collapse for new structures

- Aimed at avoiding loss of life, even though the structure is **significantly damaged**.
- Vertical structural elements remain **stable**, and **local collapses** are prevented.
- Partitions and infills have not failed out-of-plane.
- The structure can sustain after-shocks of moderate intensity; however, uneconomical to repair.
- Applied where **higher performance** is needed due to occupancy or use.

3. LS Damage Limitation (Immediate Occupancy or Operational Continuity):

- Intended for buildings where **continued functionality** is critical after a seismic event (e.g., hospitals, emergency services).
- **Minimal structural and non-structural damage** is permitted.
- Applied selectively based on the **importance class** of the building.
- The damage could be economically repaired.
- The structure does not need any repair measures.

iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes

1. If so, provide specifics.

A: Yes, the performance targets in EN 1998-3: Eurocode 8 – Part 3 are permitted to vary based on the occupancy type or designation of the building. The performance objectives may differ depending on the importance of the building and its intended use. For example:

Critical buildings (such as hospitals, emergency services, or civil defense facilities) are subject to higher performance targets to ensure operational continuity and minimal disruption after an earthquake.

Non-critical buildings may focus more on life safety and damage limitation, where the goal is primarily to prevent collapse and minimize damage to the structure.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

The occupancy type influences the level of safety and functionality required, meaning that more essential buildings are expected to perform at a higher standard during seismic events.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Yes, **EN 1998-3 permits variation in performance targets** based on the **importance and use** of the building, which can include **limitations on the number of occupants**. However, this is not directly framed in terms of the “number of occupants” alone, but rather through the building’s **Importance Class**, as defined in **EN 1998-1** and referred to in **EN 1998-3**.

1. If so, provide specifics.

A:Specifics:

The **performance targets** for seismic retrofitting are influenced by the **Importance Class of the structure**, which is linked to:

- Occupancy level
- Function of the building
- Consequences of failure
- Post-earthquake functionality

For example:

- **Importance Class I:** Buildings with **low occupancy or minor consequences** in case of collapse (e.g., storage buildings) → may be designed for **lower performance targets**.
- **Importance Class II:** Standard residential and commercial buildings → typically target **life safety**.
- **Importance Class III and IV:** Buildings with **large numbers of occupants** or **critical post-earthquake functions** (e.g., schools, hospitals, emergency facilities) → must meet **higher performance objectives**, such as **damage limitation** or **immediate occupancy**.
Thus, **if a building has a limited number of occupants and poses a low risk in case of collapse**, it may be assigned a lower Importance Class, allowing for a **reduced retrofit performance level**, such as "No Collapse" only, instead of more stringent objectives.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: While EN 1998-3 does not explicitly use the term "partial strengthening," it implicitly allows it by offering flexibility in the choice of performance objectives and recognizing that existing buildings need not meet all the criteria required for new construction.

- i. If so, provide specifics.

A: Specifics are:

In „Additional Information“ specific to Eurocode 1998-3 states:

"The choice of the Limit States to be checked, as well as the return periods of the seismic action ascribed to the various Limit States, may depend on the adopted program for assessment and retrofitting."

This indicates that:

1. **Limit States (LS)**, such as **Damage Limitation (DL)** or **No Collapse (NC)**, do not need to be fixed for all retrofitting projects.
2. The **intensity of the seismic action** (i.e., the **return period** of the design earthquake used) can also be **adjusted** depending on the goals and context of the retrofitting.

Clause 1.1(4)P:

"Reflecting the basic requirements of EN 1998-1:2004, this Standard covers the seismic assessment and retrofitting of buildings made of the more commonly used structural materials: concrete, steel, and masonry."

- ✓ **This confirms the standard is focused on assessment and retrofitting, without requiring total conformity with new-build codes.**

In Annex B (Informative), STEEL AND COMPOSITE STRUCTURES, B1. Scope states:

"Seismic retrofitting may be either local or global".

- ✓ **This clause recognizes that retrofitting may be local in scope — i.e., partial — rather than comprehensive.**
- ✓ **Local interventions might target specific critical weaknesses such as soft stories, irregularities, or deficient joints.**

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No.

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: In EN 1998-3: 2005, the document does not explicitly suggest that the mitigation of vulnerabilities can be prioritized and implemented gradually over time. The standard does not lay out a direct path for phased retrofitting over time.

- i. If so, provide specifics.

A: N/A

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

17. Quality control, safety and reporting

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?
A: No.
 - i. If so, provide specifics (i.e. type of attestation required and other requirements).
A: N/A
- b. Does the document anywhere state the required scope of the maintenance plan?
A: No.
 - i. If so, provide specifics.
A: N/A
- c. Does the document anywhere state the required or mandatory minimum contents of the report?
A: No.
 - i. If so, provide specifics.
A: N/A
- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?
A: No.
 - i. If so, provide specifics.
A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?
A: No.
 - i. If so, provide specifics.
A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

CODE FOR THE ASSESSMENT AND STRUCTURAL INTERVENTIONS OF MASONRY STRUCTURES (KADET)

(GREEK DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Miltiadou-Fezans Androniki and Vintzileou Elizabeth
2. Date of the report
A: 2 August 2025
3. Title of the document analysed
A: Greek Code for the assessment and structural interventions of masonry structures (KADET)
4. Publisher
A: Ministry for Climate Crisis and Civil Protection- Earthquake Planning and Protection Organization
5. Date of issue
A: 18 April 2023
6. Country of publication
A: Greece
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: Masonry, made of blocks (stone, bricks or adobe) and mortar. Timber-reinforced masonry is also included
9. Status of the structure addressed (existing, historic, both)
A: Both. The Code is not meant exclusively for monuments and historical constructions. However, the mechanics of masonry being valid irrespective of the monumentic values of the structure, most of the provisions of the Code are applicable to CH structures too. In addition, where appropriate, specific rules applicable to CH buildings are included.
10. Type of action addressed (seismic, other actions, general)
A: General, including seismic actions
11. General description of the document
A: This Code deals with the assessment of the bearing capacity of existing masonry buildings, and their repair or upgrading to withstand normal and seismic actions. The provisions of the Code include the documentation of the existing masonry structures (through careful in situ observation and the application of NDT, MDT and DT testing methods), as well as the estimation of the mechanical properties of masonry. Levels of data reliability are defined, depending on the level of completeness and accuracy of the documentation, and leading to corresponding safety factors. Repair and strengthening techniques are described, while methods for the design thereof are also provided. Furthermore, the Code provides guidance for the modelling and analysis of the structures before and after the application of intervention techniques. Moreover, the code provides criteria for the assessment of the capacity of existing masonry structures, while the minimum capacity requirements the redesigned structure shall comply with, are given. Those requirements are set for the structure

as a whole, for parts of it, or for individual structural members, as appropriate. The Code prescribes the contents of the Engineering Study to be submitted to the Authorities, while provisions for the adequate construction (expertise of the staff, responsibilities of the Contractor, etc.), quality assurance and maintenance plans are also included.

12. Chapters/sections of the document with the research topic described

A: The detailed contents of the Code are given herein

SYMBOLS

CHAPTER 1: SCOPE – FIELD OF APPLICATION – OBLIGATIONS AND RESPONSIBILITIES

- 1.1 Scope
- 1.2 Field of application
- 1.3 Obligations and responsibilities of parties responsible for the design and execution of projects, as well as those of users

CHAPTER 2: BASIC PRINCIPLES, CRITERIA AND PROCEDURES

- 2.1 Basic assessment principles
- 2.2 Basic redesign principles
- 2.3 Objectives for assessment and redesign
- 2.4 Structural intervention measures
- 2.5 Analysis methods for assessment and redesign
- 2.6 Compliance criteria for the assessment and redesign

APPENDIX 2.1 Minimum tolerable performance objectives for the assessment or redesign

CHAPTER 3: INVESTIGATION, DOCUMENTATION

- 3.1 General
- 3.2 Survey and mapping of the load-bearing system
- 3.3 Historic record
- 3.4 Recording of wear and damage (pathology)
- 3.5 Exploratory works
- 3.6 In situ measurement of strength of materials
- 3.7 Monitoring the behavior of the structure
- 3.8 Laboratory tests
- 3.9 Tests on scaled models of buildings
- 3.10 Data reliability level (d.r.l.)

APPENDIX 3.1 Supplementary information for selecting the default values by the designer

CHAPTER 4: BASIC DATA FOR THE ASSESSMENT AND REDESIGN

- 4.1 The rationale of verification checks and the inequality of safety
- 4.2 Data reliability levels (d.r.l.)
- 4.3 Additional provisions
- 4.4 Basic variables
- 4.5 Partial safety factors (psf)
- 4.6 Global behavior factor q

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

4.7 Local ductility factors m

4.8 Seismic interaction of adjacent buildings or complexes

[APPENDIX 4.1 - Values of the normalised base shear under earthquake loads](#)

[APPENDIX 4.2 - Rationale of performance-based verification checks](#)

CHAPTER 5: NUMERICAL ANALYSIS BEFORE AND AFTER THE INTERVENTION

5.1 General principles

5.2 Seismic actions for the analysis

5.3 General requirements for numerical modelling and verification checks

5.4 (Equivalent) elastic static analysis

5.5 Modal response spectrum analysis (elastic dynamic)

5.6 Inelastic static analysis

5.7 Inelastic dynamic analysis (response history analysis)

[APPENDIX 5A. - APPROXIMATE ANALYSIS](#)

[APPENDIX 5B. - VERIFICATION CHECK AGAINST OUT-OF-PLANE WALL LOADS IN BUILDINGS WITH DEFORMABLE DIAPHRAGMS](#)

CHAPTER 6: BASIC MODELS FOR MASONRY BEHAVIOUR

6.1 Introduction

6.2 Unreinforced masonry under compression

6.3 Unreinforced masonry under tension

6.4 Unreinforced masonry under out-of-plane bending

6.5 Unreinforced masonry under shear

6.6 Masonry with horizontal tie beams

CHAPTER 7: DETERMINATION OF STRUCTURAL ELEMENTS BEHAVIOUR

7.1 Introduction

7.2 Structural elements subjected to vertical axial force and in-plane shear force

7.3 Walls subjected to out-of-plane bending under vertical axial load

7.4 Deformation capacity

7.5 Behaviour factor q , ratio $r=V_{el}/V_y$ and ductility factors for global and member displacement

7.6 Behaviour of damaged, unrepaired elements

CHAPTER 8: REPAIR/RETROFIT, DESIGN

8.1 Introduction

8.2 General principles, recommendations

8.3 Materials, techniques

8.4 Safety factors, uncertainties

8.5 Interfaces, connections etc

8.6 Durability issues

8.7 Interventions to reinforced concrete, steel, timber and other elements

8.8 Repair interventions

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

8.9 Strengthening interventions

CHAPTER 9: VERIFICATION CHECKS

- 9.1 Scope
- 9.2 Compliance criteria
- 9.3 Consideration of ductile behaviour

CHAPTER 10: REQUIRED CONTENTS OF THE ENGINEERING STUDY

- 10.1 Assessment phase
- 10.2 Redesign phase

CHAPTER 11: CONSTRUCTION – QUALITY CONTROL – MAINTENANCE

- 11.1 Construction
- 11.2 Quality assurance
- 11.3 Maintenance

APPENDIX X (INFORMATIVE): How existing masonry buildings are composed (materials, construction typologies of masonry, horizontal bearing systems, etc.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: The Code is not meant exclusively for monuments and historical constructions (CH structures). However, the mechanics of masonry being valid irrespective of the monumentic values of the structure, most of the provisions of the Code are applicable to CH structures too. In addition, where appropriate, specific rules applicable to CH buildings are provided.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No

- 1. If so, how is historic/heritage defined and what type of official designation is required?

A: No, the Code is not applicable only to buildings listed by the Authorities as historical constructions or monuments to be protected by the state.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Please, refer to the reply in (i)

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: The document was developed specifically for existing masonry structures, including historic structures. Where appropriate, specific rules applicable to CH structures are also given. Additionally, in the first chapter of the document (1.2.1.d) it is clarified that "Although the provisions of this Code are applicable to all categories of masonry buildings, the seismic assessment of the bearing capacity and intervention in monuments and listed buildings, often requires additional provisions and different approaches and is subject to limitations which depend on the particularities of these buildings". Such additional provisions are set in collaboration with the Competent Public Authority (The Ministry of Culture, in Greece). It should also be noted that the Ministry of Culture encourages Structural Engineers to apply the Code in their studies for the retrofit of historical structures. As those studies have to be approved by the local Services of the Ministry or by its Central Councils, detailed check thereof ensures their compliance with the international rules for interventions to CH structures.

- c. Does the document appear to be based primarily on or derived from some other document?

No. It is the produce of work of a team of experts appointed to prepare a Code from scratch.

- i. If so, identify the source document.

A: N/A

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: It is a Code and, hence, it is a law (this is the status of Codes in Greece). Its application is compulsory for all existing masonry structures. As aforementioned, it may be applicable to historical structures as well, based on specific provisions included in several of the Chapters of the Code. For example, regarding the knowledge level and the necessary investigations to reach an exhaustive documentation of the structural system, specific rules applicable to CH structures are given in the Code. Furthermore, the application of some intervention

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

techniques to CH structures is restricted or even prohibited (e.g., RC jackets). Moreover, it is explicitly stated (see §1.2.1.d) that additional provisions and different approaches may be adopted depending on the particularities of each building, in collaboration with the Competent Public Authority.

- i. If a Standard, are jurisdictions required to accept its use and application?

A: N/A (it is a Code)

- ii. Do jurisdictions routinely accept the use of the Standard?

A: N/A

- b. Is the document for guidance only?

A: No, it is mandatory as already explained above

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: N/A

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes

- b. If so, is the methodology for assessment or for retrofit design?

A: For Both

- c. Is the methodology recommended or required?

A: Required

- i. Is the recommended or required methodology primarily a checklist?

A: No

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Yes

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: Yes

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: Yes

16. Relaxation

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: In Chapter 1, Section “1.1.3 Mandatory provisions”, it is stated that:

(a) (In the Commentary of the paragraph on the criteria for evaluating the seismic capacity of an existing structure) “The minimum mandatory requirements of capacity that must be met by the existing structures, **may, under conditions, be reduced in relation to the provisions prescribed by current Codes** for the design of new structures at the time of the assessment.

(b) (In the Commentary of the paragraph on the minimum mandatory capacity requirements of existing redesigned structures or their portions, members, etc.,) “The **mandatory minimum capacity requirements that must be met by the existing redesigned structures, may, under certain conditions, be reduced in relation to the provisions of the Codes that are currently in force** for the design of new structures at the time of the intervention.

(c) As in case (a) of assessment, **the mandatory minimum requirements that must be met before and after the intervention are determined in relation to the type of structure, its use, its importance, the time of its construction and the Codes in force at the time**

(d) (In the Commentary of the paragraph on the compliance of this Code with other Codes (for materials, loads, etc.), “This Code is related both to the currently applicable Seismic Code (in Greece) and to the currently applicable Codes and Standards for the design of structures with specific materials, which also include the corresponding specific criteria, as well as detailed and practical dimensioning rules.

For structures that have been built on the basis of previous versions of the Codes, **even constructed without Seismic Design (i.e., using traditional construction rules), it is possible that the full compliance to the current requirements is practically inapplicable.**

Any provision for partial satisfaction of the requirements of the above Codes, or satisfaction of the requirements of previous ones, is made either with an explicit reference to this Code or with a relevant decision of the Public Authority.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: There are two reasons for the relaxation provided in the Code: (a) In case of historical constructions or monuments or for buildings belonging to urban nuclei (although not individually listed) the full application of the Code provisions to make them compliant with current codes may be impossible without significant alteration of their structural system and Values, (b) in this country, with frequent occurrence of earthquakes, the State sets a minimum level of repair/strengthening of structures for

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

which the owners are subsidized. This level usually accepts the upgrading of structures to the requirements of a seismic Code one generation younger than the Code applied for the design of the original structure. Of course, the owner is free to further upgrade his/her property to meet the current Code requirements, if this is feasible. In case of historical constructions or monuments, the limitations of §(a) govern.

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: This is not explicitly mentioned in the Code.

- iii. Identify the ways that the document allows for relaxation

A: As aforementioned, in Chapter 1 of the Code, there is a provision for partial satisfaction of the Code provisions regarding the **mandatory minimum capacity requirements**, and in Chapter 2, **the notion of the minimum tolerable performance objectives is introduced**

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: The document provides for relaxation on the demand side (as explained herein), under the condition that an improvement in the behaviour is achieved and that the owner explicitly agrees on such a relaxation.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, as presented herein, starting from the seismic forces as provided in EC8, the Code defines three performance levels and nine levels of ratios between the ground acceleration to be adopted in the design of interventions and the reference (according to EC8) ground acceleration. As aforementioned, though, the selection of the performance level and the value of $a_g/a_{g,ref}$ is subject to rules set by the Authorities.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, as presented herein, respecting the aforementioned rules.

Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: No

Capacity side

- vii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: No

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 2. If so, identify which.
A: N/A
- viii. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?
A: No
 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 2. If so, identify which.
A: N/A
- ix. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?
A: Yes, in Chapter 7 of the Code (at the level of structural members)
 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: No
 2. If so, identify which.
A: N/A
- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?
A: There is not any specific provision in the Code. It is up to the responsible Engineer to propose such relaxation (to be submitted for approval by the competent Authority)
 - i. If so, provide specifics.
A: N/A
- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?
A: Yes, multiple.
 - i. Provide specifics as to what the stated performance targets are for historic/heritage structures.
A: For historical structures, decisions on the target performance level and on the return period/probability of exceedance to be adopted in design are made in collaboration with the Competent Public Authority (depending on several parameters, such as the Values of the structure, its structural state, its intended use, etc.). The information included in the Code, and presented herein, is taken as a basis for the selection of the seismic forces to be accounted for.

SUBGROUP:**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS**

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing, but not specifically to historic structures.

A: The following is included in Section 2.3 of the Code (2.3.1 General): a) For serving wider socio-economic needs, three Performance (target behaviour) Levels are established along with nine levels of seismic design. b) Each performance objective for assessment or redesign (Table 2.1) is a combination of a performance level and a seismic action, with a given "tolerable probability of exceedance during the technical life of the building" (design earthquake). In the following Table. 2.1, the set of potential performance objectives is included for redesigning a structure in accordance with this Code. The Table 2.1 summarizes the correlation of the performance level of the structural system with the corresponding normalized horizontal ground acceleration. Indicatively, it is mentioned that for new structures a B1 design objective is foreseen according to Table. 2.1

Table 2.1. Performance objectives for the assessment or redesign of the load-bearing structural system

$\alpha_g / \alpha_{g,ref}$	Structural Performance Level		
	A "Limited Damage"	B "Significant Damage"	Γ "Near Collapse"
1.80	A0	B0	C0
1.30	A1 ⁺	B1 ⁺	C1 ⁺
1.00	A1	B1	C1
0.75	A2 ⁺	B2 ⁺	C2 ⁺
0.60	A2	B2	C2
0.45	A3 ⁺	B3 ⁺	C3 ⁺
0.35	A3	B3	C3
0.25	A4 ⁺	B4 ⁺	C4 ⁺
<0.25	A4	B4	C4

In the commentary of the Same Section of the Code, Table C 2.1 and additional comments explain further the approach. Table C 2.1 gives the correlation of the return period with the probability of exceeding the seismic action, along with the corresponding normalized horizontal ground acceleration.

Return Period (years)	Probability of exceeding the seismic action within the nominal life of 50 years	$\alpha_g / \alpha_{g,ref}$
2475	2%	1.80
975	5%	1.30
475	10%	1.00
225	20%	0.75
135	30%	0.60
70	50%	0.45
40	70%	0.35
20	90%	0.25
<20	>90%	<0.25

It is explained that the **minimum tolerable performance objectives for the assessment or redesign of existing buildings are set out in accordance with Annex 2.1**. They can in any case be defined **differently from time to time by the Public Authority, with a relevant Ministerial Decision**. In special cases, the Public Authority can additionally define assessment or redesign objectives for the non-load-bearing structural system.

In this case the same Authority also defines the verification criteria for meeting the respective objectives. In general, **the performance objective for re-evaluation (either assessment or redesign) is chosen by the project owner, and cannot be lower than the one set by the Public Authority**. When defining the objectives, the following criteria should be taken into account (among others):

- Social importance of the building (e.g. temporary construction, ordinary residences, public gathering areas, emergency management areas, high risk facilities).
- Available financial means of the respective social group at the given period

However, in cases of structural additions, changes of use, etc. the necessary strengthening of the existing structure takes precedence over the addition, change of use, etc.

A nominal technical life equal to the contractual life of 50 years is generally accepted, regardless of the estimated "real" residual life of the building. An exception to this rule is allowed only under absolutely exceptional conditions of a fully guaranteed residual life, at the discretion and approval of the Public Authority, in which case the seismic actions of Chapter 4 of the Code are modified accordingly.

APPENDIX 2.1

MINIMUM TOLERABLE PERFORMANCE OBJECTIVES FOR THE ASSESSMENT OR REDESIGN

The minimum tolerable objectives for the assessment or redesign of existing buildings, as prescribed in § 2.2, are defined according to the importance category of the building as follows:

Table TA.2.1. Minimum tolerable objectives for the assessment or redesign of existing buildings

Importance Category	Objectives
I	C2
II	C1
III	B1
IV	B1 and A2 (both objectives to be satisfied)

It is in any case considered that the following applies: $A1 > A2$, $B1 > B2$, $C1 > C2$, $A1 > B1 > C1$ and $A2 > B2 > C2$

Specifically, for each existing building that belongs to the importance category I and II, every structural intervention for seismic upgrading of the building is acceptable, that alternatively:

- satisfies its minimum tolerable objectives of Table TA.2.1, or
- ensures, by computational means, that the capacity of the building is **upgraded by at least one basic class as outlined in Table 2.1** of § 2.2 (Performance Level B – “Significant Damage”) compared not only to the one that the building belonged before the intervention but also to the minimum basic seismic class of Table TA.2.2. The documentation of the classification of the building in the basic seismic class must be carried out on the basis of a full static and seismic design of the building and exclusively through the relevant provisions of this Code, adopting the same assumptions before and after the intervention (such as for example analysis methodology, data reliability levels, etc.).

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Table TA.2.2. Minimum basic seismic classes of existing buildings of importance I and II.

Applied Design and Construction Codes	Minimum Basic Seismic Class of Building
≤1985	B3
1985<...≤1995	B3 ⁺
1995<...	B2 ⁺

In the case of a building that has been designed and/or constructed in different time periods, the initial period of design of the building will be considered in Table. TA.2.2. In the event that the period of the building's design cannot be established, the period of construction initiation will be considered as such.

For every **existing building** of importance class III and IV, any structural seismic upgrading intervention is acceptable provided that it ensures the minimum tolerable objectives in accordance to the provisions of Table. TA2.1.

The above importance categories are defined as follows:

Table TA.2.3. Building Importance Categories

Importance Category	Buildings
I	Buildings of low importance in terms of public safety such as: farm buildings and farm warehouses, sheds, stables, cowsheds, piggeries, chicken farms, etc.
II	Ordinary buildings such as: residences and offices, industrial - craft buildings, hotels (which do not include conference rooms), hostels, boarding schools, exhibition spaces, dining and entertainment places (pastry shops, cafes, bowling, billiards, electronic games, restaurants, bars, etc.), banks , medical offices, markets, supermarkets, shopping malls, shops, pharmacies, barbershops, hairdressers, gyms, libraries, factories, car maintenance and repair shops, paint shops, carpentry, research laboratories, food processing plants, dry cleaners, computer centers, warehouses, car park buildings, gas stations, wind turbines, public service and local government offices that do not fall under category IV, etc.

III	Buildings that house facilities of very high economic importance, as well as buildings of public gatherings and in general buildings in which many people are present during large periods every 24 hours, such as: airport halls, conference areas, buildings housing computing centres, special industries, educational buildings, classrooms, tutoring schools, kindergartens, concert venues, courtrooms, temples, sports venues, theatres, cinemas, entertainment centres, passenger lounges, psychiatric hospitals, institutions for people with special needs, institutions for the chronically ill, homes for the elderly, nurseries, kindergartens, playgrounds, reformatories, prisons, water and waste treatment facilities, etc.
IV	Buildings whose operation, both during the earthquake and after the earthquake, is of vital importance, such as: telecommunications, power generation buildings, hospitals, clinics, rural clinics, health centres, refineries, power plants, fire and police stations, public staff buildings that deal with earthquake emergencies. Buildings that house works of unique artistic value, such as: museums, museum warehouses, etc.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: No. The importance category of the building is accounted for in selecting the performance level. In the importance categorization, the occupancy is also considered.

1. If so, provide specifics.

A: N/A

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: There is no such explicit indication. See reply in (iii) above

1. If so, provide specifics.

A: N/A

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Not in an explicit way. In Chapter 1, it is explicitly written: It is the responsibility of the Project Owner to select the target performance objective (for assessment or redesign), **which cannot be lower than the minimum defined by the Public Authority.**

However, in the case of Historical structures, respective decisions may be made (on a case-by-case basis) in collaboration with the Competent Public Authority.

If so, provide specifics.

A: N/A

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No, this may be a proposal of the Responsible Engineer

- i. If so, provide specifics.

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: Yes. In Chapter 1 (section 1.2.2.f): "The provisions of this Code assume that the collection of data and tests for the documentation of materials of the load-bearing structural system, etc. are carried out by experienced personnel and that the Designer who is responsible for the assessment, the potential design of the retrofit and the execution of the project has the appropriate experience in the type of structures being strengthened and/or repaired." Additionally, Chapter 11 gives details about the need for qualified contractors and workmanship for the execution of the project.

- i. If so, provide specifics (i.e., type of attestation required and other requirements).

A: In the commentary of the aforementioned section 1.2.1 (f) it is written:

"The Code assumes that there will be a guarantee against poor workmanship or errors due to inexperience, which are an important cause of structural failure.

Precisely to ensure against such errors, the Code can only be applied by persons who possess the formal and essential qualifications (education, experience, ability) for this purpose, as determined by decision of the Public Authority."

- b. Does the document anywhere state the required scope of the maintenance plan?

A: In Chapter 10, section 10.2.5 and then in Chapter 11, section 11.3.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If so, provide specifics.

A: In section 10.2.5 **Technical report for inspection methods and maintenance** and in Section 11.3 **Maintenance, the scope of the maintenance plan and its importance are included.**

“ In a separate section of the intervention implementation technical report or in a separate document, provisions should be included for the required maintenance measures after the completion of the intervention works and for the entire duration of the expected technical service life of the project.

This report must be submitted to the Client upon project completion.”

In the commentary, it is explained that, among other pieces of information, this report must include details on:

- Periodic inspection
- Periodic checks for the durability of the intervention constructions
- Periodic checks, especially in the case of structures with high importance (e.g., schools, hospitals, etc.)

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes

- i. If so, provide specifics.

A: Chapter 10 “Required Contents of the Design” contains detailed information

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: Yes, in Chapter 11 “Construction, Quality Control - Maintenance

- i. If so, provide specifics.

A: From the beginning of the works and throughout the construction period, the Contractor must, at own expense, take and maintain all necessary safety and protection measures for the project and personnel, in accordance with the applicable regulations, e.g. Presidential Decree 305 of 29.8.96, "Minimum safety and health requirements to be applied to temporary or mobile construction sites in compliance with Directive 92/57/EEC."

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No, it contains general instructions for the need for such emergency measures.

- i. If so, provide specifics.

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

ICOMOS CHARTER – PRINCIPLES FOR THE ANALYSIS, CONSERVATION AND STRUCTURAL RESTORATION OF ARCHITECTURAL HERITAGE (2003)

(INTERNATIONAL DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Mustafa Humo
2. Date of the report
A: 2.6.2025
3. Title of the document analysed
A: ICOMOS Charter – Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage
4. Publisher
A: ICOMOS (International Council on Monuments and Sites)
5. Date of issue
A: October 2003
6. Country of publication
A: International
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory and not accepted by authorities
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: All structures
9. Status of the structure addressed (existing, historic, both)
A: Historic
10. Type of action addressed (seismic, other actions, general)
A: General
11. General description of the document
A: These Recommendations are intended to be useful to all those involved in conservation and restoration problems, but cannot in any way replace specific knowledge acquired from cultural and scientific texts. Recommendations are desirable and necessary to both ensure rational methods of analysis and repair methods appropriate to the cultural context.
12. Chapters/sections of the document with the research topic described
A: Section 2.8: Often, the application of the same safety levels as in the design of new buildings requires excessive, if not impossible, measures. In these cases, specific analyses and appropriate considerations may justify different approaches to safety. Section 3.5: Each intervention should be in proportion to the safety objectives set, thus keeping intervention to the minimum to guarantee safety and durability with the least harm to heritage values. Section 3.8: At times the difficulty of evaluating the real safety levels and the possible benefits of interventions may suggest “an observational method”, i.e. an incremental approach, starting from a

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

minimum level of intervention, with the possible subsequent adoption of a series of supplementary or corrective measures.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: The whole document is developed specifically for historic/heritage buildings

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No

1. If so, how is historic/heritage defined and what type of official designation is required?

A: N/A

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: N/A

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: No

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: N/A

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: No

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: No

- i. If a Standard, are jurisdictions required to accept its use and application?

A: N/A

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

- ii. Do jurisdictions routinely accept the use of the Standard?

A: N/A

- b. Is the document for guidance only?

A: Yes

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: No

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes

- b. If so, is the methodology for assessment or for retrofit design?

A: Both for assessment and for retrofit.

- c. Is the methodology recommended or required?

A: Recommended.

- i. Is the recommended or required methodology primarily a checklist?

A: No

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: Conceptual only

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: No

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: No

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: No

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes

- i. Identify the reasoning provided as to why the document allows for relaxation

A: Structures of architectural heritage, by their very nature and history (material

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

and assembly), present a number of challenges in diagnosis and restoration that limit the application of modern legal codes and building standards.

- ii. Identify what the document set forth as the reasons why relaxation is sought
A: Often, the application of the same safety levels as in the design of new buildings requires excessive, if not impossible, measures (sect. 2.8).
- iii. Identify the ways that the document allows for relaxation
A: Specific analyses and appropriate considerations may justify different approaches to safety (sect. 2.8).
- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.
A: Both, but not specified in detail.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: N/A
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: N/A
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
A: N/A

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
A: No
 - 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 - 2. If so, identify which.
A: N/A
- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?
A: No
 - 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

2. If so, identify which.

A: N/A

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: No

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

2. If so, identify which.

A: N/A

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No

- i. If so, provide specifics.

A: N/A

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: No

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: N/A

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: N/A

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: N/A

1. If so, provide specifics.

A: N/A

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: N/A

1. If so, provide specifics.

A: N/A

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes

- i. If so, provide specifics.

A: At times the difficulty of evaluating the real safety levels and the possible benefits of interventions may suggest “an observational method”, i.e. an incremental approach, starting from a minimum level of intervention, with the possible subsequent adoption of a series of supplementary or corrective measures (sect. 3.8).

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No

- i. If so, provide specifics.

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: No

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: N/A

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No

- i. If so, provide specifics.

A: N/A

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No

- i. If so, provide specifics.

A: N/A

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No

- i. If so, provide specifics.

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

ICOMOS/ISCARSAH GUIDELINES FOR THE ANALYSIS, CONSERVATION AND STRUCTURAL RESTORATION OF ARCHITECTURAL HERITAGE (2024)

(INTERNATIONAL DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Mustafa Humo
2. Date of the report
A: 2.6.2025
3. Title of the document analysed
A: ICOMOS/ISCARSAH Guidelines for the Analysis, Conservation and Structural Restoration of Architectural Heritage, 2nd Edition
4. Publisher
A: ICOMOS/ISCARSAH
5. Date of issue
A: April 2024
6. Country of publication
A: International
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory and not accepted by authorities
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: All structures
9. Status of the structure addressed (existing, historic, both)
A: Historic
10. Type of action addressed (seismic, other actions, general)
A: General
11. General description of the document
A: The document is an extension of the ICOMOS/ISCARSAH Principles, where the approach to the assessment of historic/heritage structures is elaborated in detail.
12. Chapters/sections of the document with the research topic described
A: Section 1.4: Limitations of codes and conventional methods. Proposed approach. Section 3.1: Aim of diagnosis and assessment of the structural performance. Section 4.3: Repairability. Pre- and post-natural hazards structural maintainability. Section 4.6: Incremental approach.

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: Yes, as a whole

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No

1. If so, how is historic/heritage defined and what type of official designation is required?

A: N/A

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: N/A

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: No

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: N/A

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: Yes, the document is an extension of the ICOMOS/ISCARSAH Principles, where the approach to the assessment of historic/heritage structures is elaborated in detail.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: No

- i. If a Standard, are jurisdictions required to accept its use and application?

A: N/A

- ii. Do jurisdictions routinely accept the use of the Standard?

A: N/A

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

- b. Is the document for guidance only?

A: Yes

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: No

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes

- b. If so, is the methodology for assessment or for retrofit design?

A: Both for assessment and for retrofit.

- c. Is the methodology recommended or required?

A: Recommended.

- i. Is the recommended or required methodology primarily a checklist?

A: No

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Yes

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: No

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: Yes

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes

- i. Identify the reasoning provided as to why the document allows for relaxation

A: Understanding the response of historic structures is often a challenging endeavour requiring sufficient knowledge on the nature of the materials (namely masonry, timber, earth, concrete, iron, steel, etc.), the variability of the material properties, the internal morphology of the structural members, the complex

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

geometries and construction details, the influence of historical actions and the impact of past interventions (sect. 1.4).

- ii. Identify what the document set forth as the reasons why relaxation is sought
A: The uncritical application of available codes and standards not intended for heritage structures may lead to erroneous conclusions on their structural performance and intervention needs (sect. 1.4).
- iii. Identify the ways that the document allows for relaxation
A: It must be noted that, in some cases, the protection of the structure's cultural value **may require the acceptance of safety levels lower** than those implicit in building design codes for modern or existing buildings. No absolute value is given to safety, allowing a compromise with conservation needs which is not different conceptually than that required for existing non-heritage structures in which safety levels are defined as a compromise with construction costs and expected losses. In these cases, **parallel measures** such as restricted use or provision of alternate escape routes should be adopted to limit the consequences of a failure on people. In addition, it may be possible to **place valuable movable cultural contents** in a nearby building or building part, providing appropriate safeguard (sect. 3.1).
- iv. Identify if the document provides for relaxation primarily on the "demand side", the "capacity side", or both.
A: Refers to both, but not specified in detail.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: Not specified.
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: Not specified.
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
A: Not specified.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
A: No
 - 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: N/A

2. If so, identify which.

A: N/A

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: No

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

2. If so, identify which.

A: N/A

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: No

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

2. If so, identify which.

A: N/A

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: Yes

- i. If so, provide specifics.

A: **Parallel measures** such as restricted use or provision of alternate escape routes should be adopted to limit the consequences of a failure on people. In addition, it may be possible to **place valuable movable cultural contents** in a nearby building or building part, providing appropriate safeguard (sect. 3.1).

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Yes

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: The adequate performance of the structure must be evaluated considering three different but intimately related targets: (1) the safety of people, (2) the safeguarding of valuable immovable cultural and artistic content, and (3) the integrity of the structure itself as a cultural heritage object with the least possible alterations.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: N/A

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Not specified.

- 1. If so, provide specifics.

A: N/A

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Not specified.

- 1. If so, provide specifics.

A: N/A

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes

- i. If so, provide specifics.

A: A step-by-step procedure of structural conservation begins with a minimum level of intervention, followed by the possible adoption of subsequent supplementary or corrective measures. When the complexities of the problem prevent clear and reliable solutions without extensive intervention, the incremental approach may be the best course of action (sect. 4.6).

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: Yes

- i. If so, provide specifics.

A: The post-earthquake structural interventions aimed to repair damaged structures can be regarded as a phase of a unique maintenance project across a time horizon involving their past and future life. The concept of structural maintainability is implicit in the traditional methods for postearthquake repair since all historical structures in seismic zones have experienced repeated repair or strengthening operations over their history. The structural maintainability approach highlights the

need for minimizing the intervention from a mechanical point of view, thus avoiding strong alterations of the structural response, a condition that ensures more reliable structural responses to future earthquakes (sect. 4.3).

17. Quality control, safety and reporting
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- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: Yes

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: The success of interventions in heritage buildings is seriously compromised if such interventions are not entrusted to professionals with the necessary qualifications across the different phases of the study. Professionals making up the multidisciplinary team should possess the necessary qualifications in terms of training and experience in their areas of expertise (ch. 5).

- b. Does the document anywhere state the required scope of the maintenance plan?

A: Yes, but not in detail

- i. If so, provide specifics.

A: Furthermore, intervention projects should also include detailed maintenance plans with all the necessary specifications that may be required to preserve the structure in a satisfactory condition. It is also noted that maintenance of non-structural elements and systems (roof condition, drainage, climatic control...) may be necessary to ascertain a proper structural condition (ch. 5).

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes

- i. If so, provide specifics.

A: The report should include a description of the alternative intervention solutions envisaged, along with the pros and cons of each, which can involve a case-by-case considerations on their compliance with the structural requirements and their impact on the heritage values. The criteria and procedures considered in the evaluation of the alternative solutions and the selection of the optimal one should be also clearly explained. Such a detailed analysis justifies the final proposal and provides the best guarantee of the quality of the project.

The application of the incremental approach, whenever adopted, must be clearly described along with the methods or strategies proposed for its application. Uncertainties in the data used and/or difficulties in modelling the complex nature of the structure may affect the reliability of the analysis. In such cases, the nature of the resulting uncertainties should be made clear. The degree of caution being

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

exercised in assessing the present safety of the structure should also be made clear (ch.6).

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: Yes

- i. If so, provide specifics.

A: Stabilization operations should be oriented to reduce the risk with respect to public safety, avoid collapse and limit fast damage progress. Moreover, accessibility to the various parts of the structure has to be ensured, thus enabling the application of urgent measures, thorough inspection by the multidisciplinary team and later interventions if needed (sect. 2.3.3).

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

ISO 13822 (2010): BASES FOR DESIGN OF STRUCTURES – ASSESSMENT OF EXISTING STRUCTURES

ANNEX I (informative) – HERITAGE STRUCTURES

(INTERNATIONAL DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Mustafa Humo
2. Date of the report
22.6.2025
3. Title of the document analysed
A: ISO 13822 (2010): Bases for Design of Structures – Assessment of Existing Structures; Annex I (informative) – Heritage Structures
4. Publisher
A: ISO – International Organization for Standardization, prepared by Technical Committee ISO/TC 98, <i>Bases for design of structures</i> , Subcommittee SC 2, <i>Reliability of structures</i> .
5. Date of issue
A: August, 2010
6. Country of publication
A: International
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory and not accepted by authorities. Its application depends on local regulations, building codes, or project-specific requirements.
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: Applicable to existing structures of any material, although specific adaptation can be required depending on the type of material, such as concrete, steel, timber, masonry, etc.
9. Status of the structure addressed (existing, historic, both)
A: Both.
10. Type of action addressed (seismic, other actions, general)
A: Provides principles regarding actions and environmental influences. Further detailed considerations are necessary for accidental actions such as fire and earthquake.
11. General description of the document
A: ISO 13822:2010 is applicable to the assessment of any type of existing structure that was originally designed, analysed, and specified based on accepted engineering principles and/or design rules, as well as structures constructed on the basis of good workmanship, historical experience, and accepted professional practice. The document has 11 chapters and 8 annexes (A-I).
12. Chapters/sections of the document with the research topic described
A: Chapter 1, Scope. Section 4.1, Objectives (objectives of the assessment of an existing structure in terms) Section 4.2, Procedure

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Section 4.5.4, Decisions on immediate actions
Section 4.6.6, Verification
Section 4.7.3, Control of risk
Chapter 5, Data for assessment
Section 5.1, General
Section 7.2, Reliability assessment
Section 7.3, Limit states
Section 7.4, Plausibility check
Section 7.5, Target reliability level
Section 8.1, Assessment of safety
Section 8.2, Assessment of serviceability
Chapter 9, Interventions
Chapter 10, Report
Section 10.6, Inspection and maintenance plan
Annex C, Updating of measured quantities,
Annex E (informative), Assessment of time-dependent reliability
Annex F (informative), Target reliability level
Section F.1, General
Section F.2, Reliability requirements
Annex G (informative), Test report format
Section G.4, Table of contents
Annex H (informative), Design of upgrading
Section H.1, Reasons for upgrading
Annex I (informative), Heritage structures
Section I.2.1, Assessment of heritage structures
Section I.2.2, Heritage value
Section I.2.3, Limitation of structural intervention
Section I.4.1, Objectives (performance levels)
Section I.4.4.5, Immediate actions
Section I.4.5.12, Verification
Section I.6.2, Limit states
Section I.7.3, Target reliability level
Section I.8, Assessment based on satisfactory past performance
Section I.9, Interventions
Section I.9.3, Incremental approach
Section I.10, Report
Section I.10.1, Report contents

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
[A: The standard is also applicable to heritage structures, provided additional considerations shown in Annex I \(ref. Chapter 1\).](#)
 - i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?
[A: A relatively small and informative portion is dedicated to historic/heritage construction.](#)
 - ii. Is the document specified to be applicable only to officially designated historic/heritage structures?
[A: No.](#)
 - 1. If so, how is historic/heritage defined and what type of official designation is required?
[A: N/A](#)
 - 2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?
[A: N/A](#)
- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?
[A: Yes, the standard provides general requirements and procedures for the assessment of existing structures \(buildings, bridges, industrial structures, etc.\) \(ref. Chapter 1\).](#)
 - i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?
[A: The document was developed as a whole specifically for existing structures, and a small, informative portion is addressed to heritage structures.](#)
- c. Does the document appear to be based primarily on or derived from some other document?
 - i. If so, identify the source document.
[A: The document is based on ISO 2394:1998, General principles on reliability for structures.](#)

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?
A: The document is a standard, and it is not required to be used.
 - i. If a Standard, are jurisdictions required to accept its use and application?
A: No, jurisdictions are not required to accept its use and application, except when specifically decided.
 - ii. Do jurisdictions routinely accept the use of the Standard?
A: Not routinely. There is information that the Standard is legally acceptable in certain cases; however, there is no specific information available for individual countries.
- b. Is the document for guidance only?
A: No.
 - i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?
A: N/A

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?
A: Assessment procedure composed of steps a) to f) is recommended: a) specification of the assessment objectives, b) scenarios, c) preliminary assessment, d) detailed assessment, e) results of assessment, and f) repetition of the sequence if necessary (ref. Section 4.2).
- b. If so, is the methodology for assessment or for retrofit design?
A: For assessment. Retrofit (intervention) is briefly addressed in Chapter 9 for existing structures, and in more detail in Section I.9 for heritage structures.
- c. Is the methodology recommended or required?
A: Required (provided that the standard is applicable).
 - i. Is the recommended or required methodology primarily a checklist?
A: No.
 - ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?
A: No.
 - iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?
A: It is prescriptive.
 - iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?
A: No.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: Yes.

Annex E: Assessment of reliability and remaining working life of existing structures, effect of time variations both in strength and load characteristics.

Annex F: The target reliability level used for verification of an existing structure can be determined based on calibration with the current code, the concept of the minimum total expected cost, and/or the comparison with other social risks. The requirements should also reflect the type and importance of the structure, possible failure consequences and socio-economic criteria. It said **for heritage structures** that the target reliability level chosen for verification should balance safety considerations with the protection of heritage value (ref. Section I.4.5.12).

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes

- i. Identify the reasoning provided as to why the document allows for relaxation

A: **To retain authenticity and integrity**, the structure shall be preserved, as far as possible, with its original materials and structural concept (ref. Section I.2.2).

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: **Current codes** are normally design codes and therefore they may not be appropriate for use directly for assessment of existing structures. However, they should be considered for the assessment. As discussed in Clause 7 and Annex F, **reduced service life and target reliability level may be considered** for an existing structure. Furthermore, refined analyses, testing and a consideration of the actual behaviour of a structure may help in this respect (ref. Section 5.1).

An **over-cautious approach** to structural assessment should be avoided because it can lead to unnecessary structural interventions and **result in loss** or major alteration of heritage character-defining elements and, ultimately, in the loss of authenticity and historic significance of the cultural resource. Furthermore, excessive scope of intervention can add **unnecessary cost** and compromise the viability of a conservation project, and eventually jeopardize the existence of a cultural resource (ref. Section I.2.3).

- iii. Identify the ways that the document allows for relaxation

A: Although in ISO 2394 the performance requirements of safety and serviceability for the assessment **of existing structures** are, in principle, the same as for the design of new structures, there are some fundamental differences between these

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

two activities affecting the differentiation in structural reliability, namely the following:

- a) **Economic** considerations: The incremental cost between acceptance and upgrading the existing structure can be very large, whereas the incremental cost of increasing the safety of a structural design is generally very small, consequently, conservative generic criteria are used in design standards.
- b) **Social** considerations: These include disruption (or even displacement) of occupants and activities, as well as heritage values, considerations that do not affect the structural design of new structures.
- c) **Sustainability** considerations: Reduction of waste and recycling, considerations of less importance in the design of new structures.

As a consequence, the goal of “minimum structural intervention”, which makes as much use as possible of the existing materials in the structure, applies to most existing structures of normal occupancy and use (ref. Section F.1).

Partial safety factors given in current codes may be modified to take into account the inspection and test results (concerning, for example, quality of workmanship, conditions of maintenance and strength variation of materials) (ref. Section 7.3).

In some cases, the protection of heritage value can require the acceptance of a different reliability level, **lower than that implicit in accepted design codes**. In these cases, **parallel measures such** as restricted use or provision of an alternate escape route should be adopted to limit the consequences of a failure on people of cultural contents (ref. sect. I.7.3).

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: Primarily on the „demand side“ by introducing **target reliability levels** from 0,0 to 4,3 depending on the following limit states: serviceability (reversible, irreversible), fatigue (inspectable, not inspectable), and ultimate (very low, low, medium or high consequence of failure) (ref. Section F.2.1).

Further on, economic, social and sustainability considerations **affect the differentiation in structural reliability** between the design of existing and new structures (ref. Section F.1).

The reliability index is a function of failure probability corresponding to a specified reference period. The **remaining working life** determined at the assessment is considered as a **reference period** for an existing structure for serviceability and fatigue, while **the design working life** is often considered as a reference period for a new structure (ref. Section F.2.1).

The reliability level for **verification on heritage structure shall balance** safety and serviceability considerations with the protection of heritage value (ref. Section I.4.5.12).

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

Info: The **Reliability Index** is a measure of safety or risk, often used in structural engineering and other fields. It indicates how far the mean value of a system's performance (e.g., factor of safety) is from the failure point, in terms of standard deviations. A higher Reliability Index generally implies a safer or more reliable system.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Not specified.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: The remaining working life determined at the assessment is considered as a reference period for an existing structure for serviceability and fatigue, while the design working life is often considered as a reference period for a new structure. **A shorter reference period** can be reasonable for the ultimate limit states (ref. Section F.2.1).

Reliability requirements for an existing structure, as well as for a new structure, may adequately be expressed in terms of the **reliability index**. Table F.1: Illustration of target reliability level and reference period, depending on limit states, reversibility, inspectability and consequences of failure (ref. Section F.2.1).

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: Yes. This International Standard provides principles regarding actions and environmental influences. Further detailed considerations are necessary for accidental actions such as fire and earthquake (ref. Chapter 1).

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: Yes. Proof loading or load testing as a special kind of quantitative inspection may prove that a particular structural component is fit for use (ref. Section C1.2).

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: Possibly, but not necessarily.

2. If so, identify which.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Quantitative inspection provides information on the real parameters of the existing structure, which may be favourable.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: Besides commonly used ultimate limit states and serviceability limit states, specific serviceability limit states for preserving the heritage value of the structures, such as deformation against artistic paintings and materials, shall be considered (ref. sect. I.6.2).

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: No.

2. If so, identify which.

A: N/A

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

2. If so, identify which.

A: N/A

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: Yes.

- i. If so, provide specifics.

A: In some cases, the protection of heritage value can require the acceptance of a different reliability level, **lower than that implicit in accepted design codes**. In these cases, **parallel measures such as** restricted use or provision of an alternate escape route should be adopted to limit the consequences of a failure on people of cultural contents (ref. sect. I.7.3).

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Yes.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: The integrity of the existing structure should be respected during any intervention (ref. Section I.1).

The assessment of a heritage structure includes two aspects: that concerning its **structural performance**, familiar to engineers, and that concerning its **value as a**

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

cultural resource. These two aspects shall both be taken into account in any decision involving possible structural interventions and should therefore be carried out in tandem (ref. Section I.2.1).

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing, but not specifically to historic structures.

A: Performance targets regarding the interventions are: a) strengthening to improve the ultimate limit state performance of specific structural elements or the overall structure, b) enhancement of some aspect of elemental or overall serviceability performance, c) remedies to compensate for the effects of current or anticipated structural deterioration, d) remedies to compensate for the effects of current or anticipated structural deterioration (ref. Section H.1).

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes.

- 1. If so, provide specifics.

A: An alternative approach to construction intervention, which may be appropriate in some circumstances, is to control or modify the risk. **Various measures to control the risk** environment include imposing load restrictions, altering aspects of the use of the structure, and implementing some form of in-service monitoring and control regime (ref. Section 4.7.3).

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Yes, but this is not specified in detail.

- 1. If so, provide specifics.

A: Various measures to control the risk, as mentioned in Section 4.7.3, may implicitly include limitation of the number of occupants.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes.

- i. If so, provide specifics.

A: When more time is required to define optimum conservation strategy, the intervention should adopt an **incremental or step-by-step approach** beginning with a minimum level of intervention, with the possible adoption of subsequent supplementary or corrective measures (ref. Section I.9.3).

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No.

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No.

- i. If so, provide specifics.

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: No.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: N/A

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No.

- i. If so, provide specifics.

A: The scope of the maintenance plan is not stated. However, it is said that in all cases, an inspection and maintenance plan during the remaining working life should be specified depending on the results of assessment and the utilisation plan and submitted to the client (ref. Section 10.6).

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes.

- i. If so, provide specifics.

A: Aspects of the final report, which should be issued upon completion of the assessment, are the following: a) conclusions, b) sufficient/insufficient reliability, c) recommendations for intervention, d) inspection and maintenance plan, e) documented information (ref. Chapter 10).

The required content of the report is the following: a) scope of assessment, b) description of the structure, c) investigation, d) analysis, e) verification, f) discussion of evidence, g) review of intervention options, h) conclusions and recommendations, i) reference documents and literature, j) annexes (e.g. drawings, photos, laboratory reports, calculations, etc.) (ref. Section G.4).

In addition to the report format presented in Annex G, the following points should be added for heritage structures: a) historical report, b) heritage records, c)

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

inspection methodology and results, d) monitoring methodology and results, e)

heritage considerations, f) limitations of assessment (ref. Section I.10.1).

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No.

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: Yes.

- i. If so, provide specifics.

A:

When the preliminary inspections and/or checks clearly indicate that the structure is in a potentially dangerous condition, it is necessary to report to the client that interventions should be taken immediately to reduce the danger with respect to public safety (ref. Section 4.5.4).

When character-defining elements are in immediate danger, this should be reported to the client and to any heritage resource manager. Any interim interventions necessary to ensure the stability of the structure shall not cause damage to heritage character (ref. Section I.4.4.5).

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

Iranian building codes and standards; “Iranian Code of Practice for seismic resistant Design of buildings”; (Standard No. 2800, 4th Edition)

(IRANIAN DOCUMENT)

Note: All answers are based on the content of the fourth version of Regulation 2800 - changes have been made in the draft of the fifth edition, which are mainly in detail, and there have been no significant changes to the general themes discussed in this questionnaire.

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Fatemeh Mehdizadeh Saradj
2. Date of the report
A: 06 March 2025. Resumed 28 August 2025.
3. Title of the document analysed
A: Iranian building codes and standards; "Iranian Code of Practice for seismic resistant Design of buildings"; (Standard No. 2800, 4th Edition),
4. Publisher
A: Building and Housing Research Centre
5. Date of issue
A: 13 September 2014 – New version to be released – Draft for review on March 2025
6. Country of publication
A: Iran
7. Status of legal validity (mandatory, non-mandatory and not accepted by authorities, non-mandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General contemporary structures, Non-structural elements, confined masonry,
9. Status of the structure addressed (existing, historic, both)
A: Existing
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: This regulation aims to determine the requirements for the design, construction, and maintenance of buildings that are earthquake-resistant and protect people's lives in the face of earthquakes.
12. Chapters/sections of the document with the research topic described

[A: Chapter 1: General Introduction; Chapter 2: Earth Movement; Chapter 3: Seismic Design Criteria for Building Structures; Chapter 4: Seismic Design Criteria for Non-structural Components; Chapter 5: Seismic Design Criteria for Non-structural Structures; Chapter 6: Geotechnical requirements; Chapter 7: Regulations for confined masonry buildings](#)

[Appendix 1: Relative Earthquake Hazard Rating in Cities and Important Places of Iran; Appendix 2: Guide to Performing Nonlinear Analysis; Appendix 3: Δ-P Effect; Appendix 4: Diaphragms; Appendix 5: Soil-Structure Interaction; Appendix 6: Seismic Design and Implementation of Non-Structural Architectural Components](#)

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: No

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: The document has not been developed for historic construction, and has not mentioned historic construction in any part of it.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No

1. If so, how is historic/heritage defined and what type of official designation is required?

A: NA

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: NA

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: No

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: We might be able to conclude some regulations for the assessment of existing structures, but the document does not have any intention in this regard

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: According to the rumours, it has been adapted from FEMA & ASCE-7. However, I have not checked or compared them.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: It is a code and standard mainly for constructing future buildings and not for assessing or retrofitting projects.

- i. If a Standard, are jurisdictions required to accept its use and application?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Yes

- ii. Do jurisdictions routinely accept the use of the Standard?

A: Yes

- b. Is the document for guidance only?

A: No, it is mandatory

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: Yes, it is adopted as a standard and code

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes, it represents all the required dimensions for better resistance.

- b. If so, is the methodology for assessment or retrofit design?

A: In fact, the methodology is aimed at the newly built structures, while it can be used for either assessment or retrofit design.

- c. Is the methodology recommended or required?

A: Required

- i. Is the recommended or required methodology primarily a checklist?

A: It is more design guidelines.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: It is suggesting specific steps and presents formulas for calculations.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Yes, it presents all the required information as tables and formulas.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: Yes, it presents all the criteria for various groups of buildings.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: I have not seen any analytical approach suggested for any structure type or construction material, except the chapter related to confined masonry.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Yes, there are cases where it is mandatory to comply with specific criteria, and there are exceptions.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: Mainly in places where the risk is higher, such as components located under structural components, they must be able to withstand the vertical positional changes caused by the rotation of their support. This can be compared with other places where more relaxed principles can be applied.

- ii. Identify what the document sets forth as the reasons why relaxation is sought

A: Ref. p.64 of the document: In false ceilings with an area of less than 15 square meters, earthquake calculations are not required. It has not identified the reason and just mentioned the dimensions of the areas.

- iii. Identify the ways that the document allows for relaxation

A: Mostly depending on the dimensions of the architectural space or construction elements: for example on p. 64: In false ceilings with an area of more than 250 m², it is mandatory to foresee seismic joints and isolate the false ceiling by implementing internal walls up to the ceiling joists, unless it can be shown by analytical methods that the false ceiling is capable of absorbing the necessary displacements. In these cases, it is mandatory to limit the length-to-width ratio of the different sections of the false ceiling to 0,4.

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: The answer to the above questions proves that the relaxation is primarily based on the capacity side.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: No, as far as I realized.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: No, as far as I realized. However, at the very beginning of the regulations and in the first chapter, the earthquakes based on the regulations are named as follows: A - Design earthquake, the probability of which is 10 per cent in 50 years. The return period of this earthquake is 475 years. B - Operation earthquake, the probability of which is 99,5 per cent in 50 years. The return period of this earthquake is about 10 years.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No, as far as I realized

In the third chapter, on page 25 of the regulations, it is mentioned that the calculation of the building against wind and earthquake forces is done separately and in each structural member, the effect of each which is more, would be the criterion for action. The vertical component of the earthquake force is also mentioned in the regulations for structural and non-structural members, and on page 60 of the regulations, regarding non-structural members, it is emphasized that the vertical component of the earthquake force should be given to the member simultaneously with the lateral force and be used in different loading combinations.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: According to my understanding, most of the assigned limitations are based on the deformation.

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: Mostly for the design of future construction.

2. If so, identify which.

A: The document states the effect of stress on the displacement limit, accommodating the changes by multiplying the formula in a specific coefficient (p.46).

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: The ultimate goal of the code is for buildings of medium, high, very high importance and tall buildings. In all of them, minimising life-threatening injuries and maintaining their operability after the earthquake is emphasised. The code is used for the design and construction of reinforced concrete, steel, wood and masonry buildings. It does not include special structures such as dams, bridges, marine structures and nuclear power plants.

Following this, architectural considerations such as determining the limits of openings and cantilevers, and structural considerations such as observing physical order in plan and height - and/or -determining the distance between the centre of mass and the centre of rigidity on each floor in each extension, by less than 5 per cent of the building's dimensions in the same extension- are proposed. Another division is based on the structural system, such as load-bearing wall system, structural frame system, torsion frame system, dual or combined system, cantilever column system, and other structural systems.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Therefore, it can be realised that no special attention has been paid to specific building materials separately. In general, it is stated in the first chapter that this regulation is used for the design and implementation of reinforced concrete, steel, wooden and masonry buildings.

1. Are any of these relaxed relatives to the codes that govern requirements in new or recent construction?

A: Applies to the new constructions only.

2. If so, identify which.

A: In the form of changing coefficients, as I mentioned VIII-2.

- x. Are any limits related to the displacement capacity of the structure, for example, inter-story or building drift or displacement, outlined in the document?

A: Yes, Interstory drift is addressed in the classification of buildings based on structural regularity in pages 6 to 11 of the code. The characteristics of **plan irregularities** are defined and illustrated with graphical figures, including geometric irregularity, torsional irregularity, diaphragm discontinuity, out-of-plane irregularity, and non-parallel lateral-force-resisting systems. The characteristics of **vertical irregularities** are also presented with graphical figures, including geometric irregularity, mass irregularity, discontinuity in the lateral-force-resisting system, weakness in lateral strength, and stiffness irregularity.

Such irregular buildings are subject to construction limitations, for example: a maximum of three stories in regions of low seismic hazard, or conditional permission for construction only on sites with suitable geotechnical properties and stability. Furthermore, in pages 45 to 48, the code specifies allowable limits for **story drift** (relative lateral displacement between the centres of mass of floors above and below), with different threshold values established for buildings of varying materials and importance categories.

1. Are any of these relaxed relatives to the codes that govern requirements in new or recent construction?

A: Nothing mentioned about relaxations or exceptions.

2. If so, identify which.

A: N/A

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: I have not realised such relaxation

- i. If so, provide specifics.

A: N/A

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No explicit reference is made to **retrofitting**; however, the provisions of the code can also be applied for retrofit purposes.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: No specific consideration has been given to heritage buildings. However, Chapter 7 of the code, which addresses **confined masonry structures**, bears a limited resemblance to certain historic buildings due to similarities in construction materials.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: The provisions of the code appear to be intended primarily for new constructions. These include requirements related to the building geometry such as permissible height and number of stories, mandatory horizontal and vertical ties and their methods of interconnection, plan limitations with respect to length-to-width ratios and symmetrical layout, the introduction of seismic separation joints, allowable overhangs and cantilevered projections in upper floors, foundation requirements based on local soil conditions, maximum permitted opening-to-wall area ratios and their minimum distances from wall corners, specifications for construction materials and execution of structural and non-structural elements and walls, methods of interlocking structural and non-structural masonry walls, as well as requirements for windcatchers, chimneys, roof systems, and their connections.

Although the code is primarily directed at future buildings, its provisions may also be applied as benchmarks for assessing the reliability of existing structures.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: These cases are referred to as building classifications due to their importance or use.

1. If so, provide specifics.

A: Buildings of **very high importance**, which must remain operational after an earthquake, such as hospitals, fire stations, power plants, airports, and hazardous facilities.

Buildings of **high importance**, such as public facilities including schools, stadiums, cinemas, and other venues accommodating more than 300 people.

Buildings of **ordinary (medium) importance**, such as residential, commercial, and office buildings.

Buildings of **low importance**, such as warehouses or temporary structures, with a service life of less than two years.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Yes, exactly, as mentioned above.

1. If so, provide specifics.

A: Specified in the response 16.c.iii.1.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: There is no such degradation in this building code.

- i. If so, provide specifics.

A: N/A

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No retrofitting actions are proposed in the code.

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No, as far as I have realised.

- i. If so, provide specifics.

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: Heritage structures are not mentioned anywhere in this building code.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: N/A

- b. Does the document anywhere state the required scope of the maintenance plan?

A: Not any.

- i. If so, provide specifics.

A: N/A

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No mention of any report.

- i. If so, provide specifics.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: N/A

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No mention of safety issues for workmanship anywhere in the document.

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: Heritage structures are not mentioned anywhere in this building code.

- i. If so, provide specifics.

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

GUIDELINES FOR THE EVALUATION AND REDUCTION OF SEISMIC RISK OF CULTURAL HERITAGE (2011)

(ITALIAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Rosario Ceravolo
2. Date of the report
A: 11/05/2025
3. Title of the document analysed
A: Direttiva del Presidente del Consiglio dei Ministri 9 febbraio 2011 Valutazione e riduzione del rischio sismico del patrimonio culturale con riferimento alle Norme tecniche per le costruzioni di cui al D.M. 14/01/2008. (G.U. n. 47 del 26/02/2011 - suppl. ord. n. 54), hereinafter referred to as " Directive ". The guidelines from which the Directive derives is available in English translation, namely: "Guidelines for the evaluation and reduction of seismic risk of cultural heritage", issued by the Italian Ministry for Cultural Heritage.
4. Publisher
A: Gazzetta Ufficiale (Official Gazette of the Italian Republic, containing the text of new laws).
5. Date of issue
A: 26/02/2011
6. Country of publication
A: Italy
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: The status is mandatory for all listed buildings (all buildings and manufacts that are at least 70 years old and those that are listed by a specific decree). The Directive is nonmandatory but accepted by authorities for possible application to all existing masonry buildings.
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: The principles stated in it are general, but specific provisions are only for masonry.
9. Status of the structure addressed (existing, historic, both)
A: Historic
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: This Directive provides indications for the assessment and reduction of the seismic risk of the protected cultural heritage, in accordance with the provisions of the "Cultural Heritage and Landscape Code", Legislative Decree 22 January 2004, n. 42 (hereinafter Cultural Heritage Code), which establishes in article 4 that the functions of protection of cultural heritage are attributed to the State and exercised by the Ministry for Cultural Heritage and Activities. As regards interventions on protected assets, article 29 of the Cultural Heritage Code, in paragraph 4 specifies that, for assets located in areas declared subject to seismic risk according to current legislation, the restoration includes the intervention of structural and/or seismic "improvement" (in Italian "miglioramento" or

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

increase in safety, without necessarily reaching safety levels expected for new buildings, as opposed to "adeguamento" or "retrofitting" intervention), and in paragraph 5 it provides that the Ministry defines, also with the cooperation of the regions and with the collaboration of the universities and competent research institutes, guidelines, technical standards, criteria and intervention models regarding the conservation of cultural heritage. It is worth specifying that the concept of "improvement" intervention (partial intervention) for existing buildings has firstly been introduced in Italy in the seventies (following Law no. 64, of 2 February 1974).

12. Chapters/sections of the document with the research topic described
--

A:

The various chapters of this document provide indications for defining the seismic action, in relation to the hazard of the site and the intended use of the manufact, and the capacity of the structure, through correct knowledge and modeling.

Chapter 2 indicates the safety requirements to be considered for architectural assets of historical and artistic value. The reference limit states are appropriately redefined, which do not only refer to the needs of safeguarding the artifact and the safety of people (Limit State of Life Protection, LLS) and functionality (Limit State of Damage, DLS), but also to damage to the assets of artistic value contained therein (Limit State of Damage to Artistic Assets, ALS). The levels of seismic protection are also suggested, in relation to the conservation needs and conditions of use.

Chapter 3 provides indications for an accurate definition of the seismic action, which are particularly useful since, although it is possible to limit to improvement or upgrade interventions (i.e. partial strengthening intervention, which corresponds to relaxation of seismic standards valid for nonlisted buildings), a comparison is required between the seismic action that brings the artifact to the SLV and that expected on the site with a pre-established probability of occurrence (in a reference period defined on the basis of the characteristics of the building and its use).

Knowledge of the building or manufact (Chapter 4) must be acquired, in accordance with the provisions of the program for monitoring the state of conservation of listed architectural assets (Annex A), developed by the Ministry for Cultural Heritage and Activities - General Directorate for Architectural and Landscape, and aimed at acquiring knowledge of the Italian cultural heritage.

Chapter 5 illustrates different options for modeling the structural behavior of a historic masonry building. In particular, for the assessment of seismic safety, three different evaluation levels (ELs) of increasing completeness are identified, applicable respectively:

EL1) for the assessments of seismic safety to be carried out on a territorial scale on all cultural assets;
EL2) for the assessments to be adopted in the presence of local interventions on limited areas of the manufact (e.g. repair or local intervention);

EL3) for the design of interventions that affect the overall structural functioning (seismic improvement interventions) or when an accurate assessment of the seismic safety of the artifact is required.

Finally, Chapter 6 describes the criteria to be followed for seismic improvement, that is, for the reduction of vulnerabilities ascertained following knowledge, modeling and observation of any damage; for each problem, the possible intervention techniques are also indicated, which are

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

critically examined in relation to their effectiveness and their impact on conservation (non-invasiveness, reversibility and durability) and costs.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: It is declared in the title and in the preface.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: The document as a whole has been specifically conceived for historic/heritage constructions, in compliance with the Cultural Heritage Code law approved in 2004.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: The document does not apply exclusively to officially designated historic/heritage structures. The Directive has been drafted with the aim of specifying a path of knowledge, evaluation of the level of safety with respect to seismic actions and design of any interventions, conceptually similar to that envisaged for non-listed buildings. As such, it can be applied to any existing masonry buildings and manufactures, with whose more general seismic standards it has been effectively harmonized.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: n.a.

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: n.a.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: This statement is reported in the Italian national technical code for construction in general (NTC 2018). In particular, among the references of NTC 2018, Section 12 states: "... in addition to these code and unless they conflict with them, the following documents may be used, which constitute references of proven validity:

- Guidelines for the evaluation and reduction of seismic risk of cultural heritage and subsequent amendments of the Ministry for Cultural Heritage, subject to the opinion of the Higher Council of Public Works on the document itself. Etc."

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: No, it was specifically developed for historic structures.

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: The Directive follows a previous version approved in 2007 with the same title, which in turn derives from the guidelines issued by the Italian Ministry for Cultural Heritage, namely: "Guidelines for the evaluation and reduction of seismic risk of cultural heritage" (2006).

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: It is a code to be applied to historic/heritage constructions by law.

- i. If a Standard, are jurisdictions required to accept its use and application?

A: n.a.

- ii. Do jurisdictions routinely accept the use of the Standard?

A: n.a.

- b. Is the document for guidance only?

A: No

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: n.a.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes, many methodologies are set forth, both for investigations and for seismic assessment.

- b. If so, is the methodology for assessment or for retrofit design?

A: both for assessment, according to different levels and scales, and for retrofit.

- c. Is the methodology recommended or required?

A: It is required.

- i. Is the recommended or required methodology primarily a checklist?

A: The general methodology is not simply a checklist.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: Specific steps and calculations are also required.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: A general methodology must be followed, but it provides many options to be justified according to the cases. It is not prescriptive, but choices must be justified. The calculation of safety levels is anyway required for all relevant structural elements.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: Safety levels are not prescribed, but must be calculated, discussed and reconciled with other qualitative judgment criteria.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: Yes, many methodologies are described, also based on the assessment level required. There are also some attachments to the main document that describe methodologies that can be used for masonry historic buildings, towers, churches, bridges, etc.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: In Italy, the relaxation of seismic safety requirements in listed buildings is declared by the Cultural Heritage Code ("Cultural Heritage and Landscape Code", Legislative Decree 22 January 2004, n. 42). Article 29 of this law establishes that the conservation of cultural heritage is ensured through an activity of study, prevention, maintenance and restoration. In particular, for real estate in areas at risk of earthquakes, restoration must also include a structural **improvement** intervention. This means that the intervention on a heritage structure must improve seismic safety ("miglioramento sismico" in Italian) without necessarily bringing it to the level required for new buildings ("adeguamento sismico").

- i. Identify the reasoning provided as to why the document allows for relaxation

A: Because the code must comply with the Cultural Heritage Code law. In this regard, it must be said that in Italy there is an obligation to conserve cultural heritage, pursuant to Article 9 of the Constitution, which states that the Republic protects the landscape and the historical and artistic heritage of the Country, promoting the development of culture and scientific and technical research.

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: Cultural Heritage and Landscape Code", Legislative Decree 22 January 2004, n. 42

- iii. Identify the ways that the document allows for relaxation

A: The Directive, in sub-section 2.2 "Criteria for the assessment of seismic safety and effectiveness of the intervention", requires:

- 1) The estimation of the seismic safety index in the current situation;
- 2) The estimation of the seismic safety index to which the building can be brought with

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

interventions compatible with the protection needs:

- a) if the seismic safety index can be achieved, which takes into account the seismic hazard of the site, the characteristics of the building and its intended use, is greater than or equal to one, the improvement intervention is fully satisfactory also from the point of view of safety, assessed through a quantitative procedure;
- b) if the seismic safety index that can be achieved is lower than the desirable one, or if too invasive interventions would be necessary, the designer can justify the intervention also by using qualitative assessments, which must be translated into quantitative terms, adequately justified in an explanatory report to integrate the calculation report.

Specifically, the seismic safety is assessed: with respect to at least three limit states (ULS, DLS, ALS); using a set of importance factors defined for each limit state, depending on the use category and importance category; introducing confidence factors, conventionally applied to material resistance, to take into account the level of depth of the investigations (referred to as "level of knowledge"), which implicitly fosters experimental investigations. Finally, to assess the seismic safety index, numerous options are available that allow for a closer approach to the specific structure and the assessment purposes (multiscale or multilevel approach):
Level 1. Rapid analyses for specific typologies (buildings, towers, bridges, churches, and other buildings with large halls);
Level 2. Local analyses (on individual elements);
Level 3. Standard global analyses.

- iv. Identify if the document provides for relaxation primarily on the "demand side", the "capacity side", or both.
A: The Directive, in sub-section 2.2 "Criteria for the assessment of seismic safety and effectiveness of the intervention", provides for relaxation mainly on the demand side.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: The actions can be different from those for new constructions.
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: Yes, it is the earthquake return period to be considered. Some interpolation formulas are also supplied in order to consider return period different from those

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

currently available. The relaxation must be expressed either in terms of return period and, indirectly, in term of seismic safety index.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: No specific static checks are required if the static actions are not modified to the detriment of safety as a result of new interventions.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: Limits related to capacity are generally harmonized with the code for existing buildings (NTC 2018).

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: The reference values for material strength are not modified, however a safety (or confidence) coefficient is applied which depends on the extent and exhaustiveness of the experimental and cognitive investigations (level of knowledge).

2. If so, identify which.

A: material strength, e.g. masonry strength.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: In principle no, however sub-section 4.1.7 provides further guidance for the mechanical characterization of materials.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: n.a.

2. If so, identify which.

A: n.a.

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: Not specifically, for displacement capacity the Directive is harmonized with NTC 2018 (e.g., sections for existing masonry buildings).

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: n.a.

2. If so, identify which.

A: n.a.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: Yes.

- i. If so, provide specifics.

A: The Directive mentions the case of buildings of historical-artistic interest in which strategic or relevant functions are carried out (hospitals, schools, barracks, etc.). The adoption of the improvement (i.e. relaxation) in principle consists simply in accepting a shorter nominal life for the building, but it is clear that if this falls below certain limits, the annual probability of occurrence of the earthquake that leads to the life protection limit state could be too high, in addition to the problem of having to proceed in a short time to a new verification; considering the consequences of a possible collapse, it is therefore believed that, above a certain level of risk (too short nominal life), the possibility of relocating the relevant and/or strategic functions must be seriously considered.

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: No, in Italy conservation matters must be discussed with the Superintendence for Cultural Heritage office, in order to reconcile quantitative and qualitative judgement criteria (structural, conservation, historical, archaeological, etc.).

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: n.a.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: Sometimes it is specified a minimum percentage of improvement, e.g. 10% for instance for some types of public buildings, fundings etc..

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes, there are different classes of use, but this affects the denominator of the safety index, and it is a target that holds for any type of building, listed and non-listed ones.

1. If so, provide specifics.

A: NTC 2018, and consequently the Directive itself, refers also to buildings of strategic interest and of the infrastructural works in which their functionality during seismic events assumes a fundamental importance for the objectives of civil protection, as well as for buildings and infrastructural works that

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

assume importance as the consequence of an eventual collapse, but this distinction holds for all buildings, listed and non-listed ones.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Yes, it is implicit in codes, both NTC 2018 and the Directive.

1. If so, provide specifics.

A: In case of historic buildings, these limitations can be included among the judging criteria, analysed and discussed with the Cultural Heritage Superintendence office. In some cases it is possible to decide to downgrade a building, for example, the weekly use of a church can be reduced, to avoid invasive interventions.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes, partial strengthening is the rule for listed buildings, as said before.

- i. If so, provide specifics.

A: n.a.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: Not specifically.

- i. If so, provide specifics.

A: n.a.

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: Yes, it is implicit in the improvement intervention. The idea behind the concept of improvement is to intervene partially while waiting for less invasive technologies. This is stated in several points of the Directive.

- i. If so, provide specifics.

A: see above

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: No

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: In Italy, the requirement is to have passed the state exam as an engineer, architect, or conservator, depending on the type of intervention in question (structural, restoration, artistic, etc.), but this is not defined in the technical codes and standards.

- b. Does the document anywhere state the required scope of the maintenance plan?

A: Yes

- i. If so, provide specifics.

A: There is a sub-section, 4.1.9 "Monitoring, dedicated to monitoring and maintenance plans".

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No

- i. If so, provide specifics.

A: n.a.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: In Italy, there are separate regulations and standards for these activities.

- i. If so, provide specifics.

A: See point 18 Emergency stabilization.

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: Not specifically. In Italy there is a set of rules and operating procedures that the Fire Brigade follows in the post-earthquake context, in agreement with the LEGISLATIVE DECREE 8 March 2006, n. 139 Reorganization of the provisions relating to the functions and duties of the National Fire Brigade, pursuant to Article 11 of Law 29 July 2003, n. 229.

The main objective is the protection of human life, the safeguarding of property and the environment, especially after an earthquake. Interventions include rescue, evacuation, search and recovery, and assistance to the population.

- i. If so, provide specifics.

A: The documents and standards in question are available to the fire brigade offices.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

GUIDELINES AND CASE STUDIES FOR SEISMIC ASSESSMENT AND REINFORCEMENT OF IMPORTANT CULTURAL PROPERTIES (BUILDINGS)

(JAPANESE DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

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BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Tatsuya Kumamoto Councilor, Department of Cultural properties, Agency for Cultural Affairs, Japan
2. Date of the report
A: 6.7.2025
3. Title of the document analysed
A: Guidelines and case studies for seismic assessment and reinforcement of important cultural properties (buildings)
4. Publisher
A: Agency for Cultural Affairs, Japan
5. Date of issue
A: First edition September 2013 Revised edition March 2017
6. Country of publication
A: Japan
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory but published by authorities
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: Timber and other structures (stone/brick masonry, reinforced concrete)
9. Status of the structure addressed (existing, historic, both)
A: Important cultural properties, national treasures
10. Type of action addressed (seismic, other actions, general)
A: Seismic action
11. General description of the document
A: 11. General description of the document The purpose of guidelines is to apply appropriate seismic assessment and reinforcement to important cultural properties. These guidelines are the revised edition of the first edition which was published in 2013, including measures of fall prevention of ceiling and earthquake resistance measures for non-wood structures newly. The reason added above things is to have been recognized necessity of earthquake damage, which is fall of ceiling and the collapse of masonry structures, when Kumamoto earthquake happened in 2016. Guidelines are composed of seismic assessment, reinforcement for earthquake, measures except for reinforcement and subsidy project, mainly explaining seismic assessment and reinforcement for earthquake. Guidelines are systematically summarized to promote seismic measures smoothly and properly. Seismic assessment is to understand the earthquake resistance of the structure in the current situation and judge to satisfy demanded earthquake resistance. Seismic assessment includes

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

investigations and analysis of the structure. It can take appropriate reinforcement by doing suitable analysis for each structure. As for reinforcement of earthquakes, counterplan adding new seismic parts to structures and exchanging original members to high-seismic members is carried out. Conducting appropriate reinforcement contributes to life saving occurring earthquakes, reduction of earthquake damage and reduction of restoration work.

12. Chapters/sections of the document with the research topic described
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A: All chapters

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BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
A: Yes
 - i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?
A: The document states that it is for heritage structures, but it is applicable to other traditional structures as well.
 - ii. Is the document specified to be applicable only to officially designated historic/heritage structures?
A: No. Discussed above.
 - 1. If so, how is historic/heritage defined and what type of official designation is required?
A: N/A
 - 2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?
A: N/A
- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?
A: Yes. Answered above.
 - i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?
A: No.
- c. Does the document appear to be based primarily on or derived from some other document?
 - i. If so, identify the source document.
A: No.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?
A: No.
 - i. If a Standard, are jurisdictions required to accept its use and application?
A: N/A
 - ii. Do jurisdictions routinely accept the use of the Standard?
A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- b. Is the document for guidance only?

A: Yes.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: Yes.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: Yes.

- b. If so, is the methodology for assessment or for retrofit design?

A: For assessment.

- c. Is the methodology recommended or required?

A: Recommended.

- i. Is the recommended or required methodology primarily a checklist?

A: No. It describes general approaches to the structural analysis of timber, masonry and RC heritage structures.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Yes.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: Yes.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: Yes. It describes general approaches to the structural analysis of timber, masonry and RC heritage structures.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: No.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: N/A

- ii. Identify what the document set forth as the reasons why relaxation is sought

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BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: N/A

- iii. Identify the ways that the document allows for relaxation

A: N/A

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: N/A

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: No.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: N/A

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: N/A

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: No.

- 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

- 2. If so, identify which.

A: N/A

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: No.

- 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

- 2. If so, identify which.

A: N/A

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No. But it mentions typical allowable storey drifts of each structural types (timber (1/30) and rc(1/75)).

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

2. If so, identify which.

A: N/A

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No

- i. If so, provide specifics.

A: N/A

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: No

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: N/A

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: N/A

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: No.

1. If so, provide specifics.

A: N/A

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: No.

1. If so, provide specifics.

A: N/A

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: No

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If so, provide specifics.

A: N/A

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No. It just describes general concepts for strengthening.

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: Yes. In the guidelines, there is a subsection discussing "gradual strengthening".

- i. If so, provide specifics.

A: The subsection is translated as follows.

Examples of gradual strengthening include the following:

- A seismic assessment determined that horizontal reinforcement and the addition of earthquake-resistant walls were necessary, but only the horizontal reinforcement of the ceiling and roof was carried out in conjunction with the roof replacement.
- When replacing the roof, the amount of roofing soil on the tiled roof was reduced to reduce the roof load.
- Replacing the base of the earthen walls with structural plywood would satisfy the earthquake resistance requirements with minimal impact on the design, but since the earthen walls will not be demolished this time, the necessary strengthening will be added, although this will have an impact on the design, and these will be corrected during future fundamental repairs.
- strengthen only areas that are particularly vulnerable to earthquake damage, such as brick chimneys and gable walls.
- Add supplementary strengthening, such as footing only in areas where strengthening can be carried out without demolition, such as under the floor.

17. Quality control and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: No

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A:

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No.

- i. If so, provide specifics.

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BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: N/A

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No

- i. If so, provide specifics.

A: N/A

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No

- i. If so, provide specifics.

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

COD DE PROIECTARE SEISMICĂ – PARTEA a III-a – PREVEDERI PENTRU EVALUAREA SEISMICĂ A CLĂDIRILOR EXISTENTE, INDICATIV P100-3/2019

(Seismic Design Code - part III – Provisions for the seismic assessment of existing buildings, indicative P100-3/2019)

(ROMANIAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
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2. Date of the report
20/01/2026
3. Title of the document analysed
Cod de proiectare seismică – Partea a III-a – Prevederi pentru evaluarea seismică a clădirilor existente, indicativ P100-3/2019
Seismic Design Code - part III – Provisions for the seismic assessment of existing buildings, indicative P100-3/2019
4. Publisher
Ministerul Dezvoltării Regionale și Administrației Publice, Document publicat în Monitorul Oficial al României, partea I, nr. 1003 bis / 13.XII.2019
5. Date of issue
13/12/2019
6. Country of publication
Romania
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
Reinforced concrete, steel, and masonry structures
9. Status of the structure addressed (existing, historic, both)
Existing
10. Type of action addressed (seismic, other actions, general)
Seismic
11. General description of the document

The Romanian Seismic Design Code P100-3 – “Seismic Design Code, Part III: Provisions for the Seismic Assessment of Existing Buildings” establishes a comprehensive national framework for evaluating the seismic performance of existing buildings. The code is intended to assess the susceptibility of buildings to damage under severe earthquake actions and, where necessary, to provide a technical basis for decisions regarding structural intervention aimed at reducing seismic risk. P100-3 applies to existing buildings of all structural types and construction periods located on the territory of Romania. The code may also be applied to historic and heritage buildings, provided that its provisions are compatible with conservation principles and relevant heritage-specific regulations.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

The assessment process defined by P100-3 is structured, performance-based, and graduated according to the level of available information. It integrates qualitative and quantitative evaluation methods and introduces clearly defined levels of knowledge regarding the building (from limited to complete knowledge), which directly influence the analytical approach and confidence factors used in the evaluation.

A key feature of the code is the use of three complementary seismic performance indicators: R1, expressing the degree of compliance with seismic design and structural configuration rules; R2, reflecting the observed level of structural degradation and damage; R3, representing the calculated level of seismic structural safety based on analytical verification. These indicators are used collectively to assign the building to one of four seismic risk classes (Rs I to Rs IV), which describe the expected behaviour of the building during the design earthquake and the associated risk to occupants and assets.

P100-3 does not impose mandatory intervention solutions but instead provides a rational and transparent basis for deciding whether seismic strengthening, repair, or other measures are necessary. When interventions are required, the code supports the development of technically justified solutions that may exceed minimum requirements if this leads to improved safety and performance

12. Chapters/sections of the document with the research topic described
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The chapters of the document are:

1. General: defines the scope, objectives, terminology, and regulatory context of the seismic assessment of existing buildings under the P100-3 code
2. Seismic Assessment: establishes the overall seismic assessment process, including its objectives, stages, and the three assessment methodologies corresponding to different levels of complexity and available information
3. Performance Assessment: defines seismic performance objectives, seismic risk classes, and the criteria used to determine the necessity and extent of structural intervention
4. Information for Seismic Assessment: the chapter specifies the types and quality of information required for assessment, introducing levels of knowledge and confidence factors that govern the depth and reliability of the evaluation
5. Qualitative Assessment: addresses the qualitative evaluation of structural configuration, seismic design deficiencies, and existing damage in order to establish vulnerability indicators
6. Quantitative Assessment: regulates the analytical evaluation of seismic performance through structural modelling, load combinations, and verification at ultimate and serviceability limit states
7. Soil and Foundation Assessment: This chapter covers the evaluation of foundation systems and ground conditions, including soil–structure interaction and geotechnical influences on seismic response
8. Assessment Conclusions: provides guidance for special cases and atypical situations requiring adapted or non-standard seismic assessment approaches

Annex A – Seismic Hazard

Annex B – Concrete Structures

Annex C – Steel Structures

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

[Annex D – Masonry Structures](#)

[Annex E – Non-structural Components](#)

[Annex F – \(informative\) Guide to Seismic Rehabilitation of Existing Buildings](#)

[Annex G – \(informative\) Comments](#)

[Annex H – \(informative\) Examples of Calculations of Structural Intervention Works for Existing Seismically Vulnerable Buildings](#)

[Annex I – \(informative\) Guide to Preparing the Seismic Technical Expertise Report for Buildings](#)

[Annex J – \(informative\) Examples of Seismic Assessment Reports](#)

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

[The document explicitly states that it may be applied to historic/heritage buildings and recognizes their special nature, while placing a clear condition on compatibility with heritage-specific regulations](#)

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

[No. The document was not developed specifically for historic/heritage construction; rather, heritage buildings are explicitly acknowledged within a general framework intended for all existing buildings, with a limited but clear carve-out recognizing their special status.](#)

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

[No](#)

1. If so, how is historic/heritage defined and what type of official designation is required?

[P100-3 does not define historic or heritage buildings and does not require any formal designation for its applicability; heritage status is determined exclusively by external legal frameworks, to which the code explicitly defers. Historic or heritage buildings are defined as all structures officially included in the National List of Historical Monuments of Romania, either individually or as part of protected ensembles or sites. Additionally, the definition includes constructions located within officially designated protected built zones, as established by national legislation such as Law No. 5/2000 and the relevant urban planning methodologies. Only buildings recognized through these formal designations are subject to the provisions of the document.](#)

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

No, the document does not provide explicit guidance for buildings that are not officially designated as historic or cultural heritage. Its provisions apply only to those structures formally recognized through official listings or located in legally defined protected built zones. Buildings without such designation are expected to follow general seismic or structural codes applicable to existing constructions (P100-3).

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

Yes. The document explicitly states that it is intended to be applicable to the broad class of existing buildings and, at the same time, it recognizes that certain sub-categories of existing buildings—such as historic/heritage structures—may have a special nature requiring adapted application.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

Yes. The document as a whole was developed specifically for existing structures. Historic or heritage buildings are addressed only as a subset of the broader category of existing structures, as the document contains no heritage-specific chapters or methodologies and does not redefine conservation principles, instead incorporating such buildings within the general assessment framework and deferring to external conservation regulations where applicable.

- c. Does the document appear to be based primarily on or derived from some other document?
i. If so, identify the source document.

Yes. The document clearly appears to be based primarily on, and derived from, Eurocode 8 – Part 3, with national adaptations.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

No. The document is not a heritage-specific standard or code that is mandatorily required for assessment or retrofitting projects involving historic or heritage construction.

- i. If a Standard, are jurisdictions required to accept its use and application?

N/A (jurisdictions within Romania are required to accept the use of P100-3 where seismic assessment of existing buildings is mandated by law, while jurisdictions outside Romania have no obligation to do so, and heritage authorities may condition its application on compliance with conservation regulations)

- ii. Do jurisdictions routinely accept the use of the Standard?

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

N/A (within Romania, jurisdictions routinely accept and apply P100-3 as the standard framework for seismic assessment of existing buildings, including in heritage contexts subject to additional conservation requirements.)

- b. Is the document for guidance only?

No. P100-3 is a normative national seismic assessment code, not a guidance-only document, although it includes informative annexes intended to support professional application.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

P100-3 functions as a legally recognized technical regulation (code) within the national construction regulatory system. Its acceptance by jurisdictions does not depend on being adopted as a voluntary standard (e.g., SR/EN), but on its formal approval and citation in the national regulatory framework governing construction safety and seismic risk.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

Yes, P100-3 explicitly defines and regulates specific seismic assessment methodologies, organized into three levels of increasing complexity, forming the core methodological framework of the document rather than serving as optional guidance.

- b. If so, is the methodology for assessment or for retrofit design?

P100-3 provides methodologies primarily for the seismic assessment of existing buildings, while including limited, informative guidance on retrofit strategies to support post-assessment decision-making rather than detailed retrofit design methodologies.

- c. Is the methodology recommended or required?

The methodology is required.

- i. Is the recommended or required methodology primarily a checklist?

No (but includes checklists as supporting tools, the required methodology is a comprehensive assessment framework that relies on qualitative judgment and quantitative analysis rather than being primarily checklist-based)

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

No, the methodology is not just conceptual, it provides specific procedures that are required for seismic assessment of buildings.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

The methodology is prescriptive, providing specific instructions and required steps that engineers must follow when assessing and retrofitting buildings for seismic safety.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

The methodology is quantitative, as it provides specific calculations that engineers need to perform for seismic assessment.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

P100-3 defines differentiated analytical approaches depending on the structural system, construction material and configuration, allowing engineers to evaluate buildings using methods appropriate to their specific characteristics and conditions. Three seismic evaluation methodologies are provided, from simple to complex, depending on the information available, the importance and the location of the building being evaluated.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

Yes, implicitly, but not as an explicit or blanket relaxation.

P100-3 is intended for existing buildings and therefore adopts a performance-based assessment framework that differs from the prescriptive requirements for new construction, recognizing that existing structures often cannot meet all current design and detailing rules; accordingly, it evaluates seismic performance relative to expected behaviour under the hazard defined in P100-1 and focuses on life-safety, collapse prevention, and risk reduction, rather than requiring full compliance with the design requirements applicable to new or recently constructed buildings.

- i. Identify the reasoning provided as to why the document allows for relaxation

P100-3 allows a relaxation of design conditions relative to codes for new buildings because it is specifically intended for the seismic assessment of existing structures, where full compliance with current design and detailing rules is often unrealistic. The code adopts a performance- and risk-based approach, focusing on life safety, collapse prevention, and reduction of seismic vulnerability rather than strict equivalence with new construction. It introduces a staged assessment process and building-specific indicators (R1, R2, R3) to reflect the wide variability, uncertainty, and physical limitations inherent to existing buildings. As a result, P100-3 defines minimum acceptable performance levels for existing structures instead of imposing the full requirements applicable to new buildings.

- ii. Identify what the document set forth as the reasons why relaxation is sought

P100-3 sets forth that relaxation is sought because existing buildings were designed under earlier or different regulatory frameworks, often lack ductile detailing and complete documentation, and may exhibit material degradation or accumulated damage that make full compliance with new-building design requirements impractical.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

P100-3 therefore adopts a performance- and risk-based assessment approach that evaluates expected seismic behaviour and focuses on life safety, collapse prevention, and vulnerability reduction rather than strict adherence to the prescriptive rules applicable to new buildings.

iii. Identify the ways that the document allows for relaxation

P100-3 allows for relaxation by adopting a performance-based assessment framework that evaluates existing buildings according to their expected seismic behaviour rather than requiring full compliance with the prescriptive design and detailing rules applicable to new construction. It introduces graded assessment levels, levels of knowledge, and specific performance indicators, which explicitly account for uncertainty, variability, and physical limitations inherent to existing buildings. Seismic risk classes define acceptable minimum performance levels focused on life safety and collapse prevention, rather than equivalence with new buildings. In addition, retrofit measures are presented as informative strategies aimed at risk reduction, not as mandatory design requirements.

iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

P100-3 provides for relaxation on both the demand side and the capacity side, with a stronger and more explicit emphasis on the capacity side.

P100-3 defines seismic demand using the same hazard framework as that for new buildings (via P100-1), so the seismic action itself is not fundamentally reduced; however, the way demand is verified is adapted through performance-based checks rather than strict prescriptive compliance. On the capacity side, the code explicitly allows existing buildings to demonstrate acceptable performance without meeting all strength, ductility, and detailing requirements applicable to new construction, using indicators (R1, R2, R3), risk classes, confidence factors, and minimum acceptable performance levels. Overall, relaxation is achieved primarily by accepting lower or differentiated capacity relative to new buildings, while maintaining a consistent reference seismic demand.

Demand side

v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

No, the seismic forces themselves are not relaxed. P100-3 uses the same seismic hazard definition and design ground motions as those governing new construction, as specified in P100-1, so the seismic demand is not reduced relative to new or recent buildings.

vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

No, the earthquake return period is not relaxed.

P100-3 requires seismic assessment and retrofit decisions to be based on the same reference seismic hazard and return period used for new or recent construction, as defined in P100-1.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

No, the other actions are not relaxed.

P100-3 does not introduce reduced values for non-seismic actions; instead, it consistently relies on the actions and combinations defined in the applicable Romanian and Eurocode-based regulations for both new and existing buildings, with no explicit relaxation provided.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

No. P100-3 does not set material strength limits; material capacities are taken from the applicable design standards, with adjustments reflecting uncertainty and degradation rather than altered stress limits.

The use of *mean strengths* material in quantitative assessment under P100-3 does not represent a relaxation of material strength limits relative to new construction, but a methodological adaptation appropriate for existing buildings, where material properties can be estimated from in-situ testing and uncertainty is addressed through *levels of knowledge and confidence factors* rather than through partial safety factors.

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

No

2. If so, identify which.

N/A

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

No. P100-3 does not set specific permissible strain or deformation-capacity limits for building materials; such limits are taken from the applicable material design standards, with performance assessed at the structural level rather than through modified material strain criteria.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

No

2. If so, identify which.

NA

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

Yes, but only indirectly and at the structural performance level, not as fixed prescriptive limits. P100-3 does not set explicit prescriptive limits for interstory or global displacements; instead, displacement capacity is addressed implicitly through performance-based limit-state verification and seismic risk classification focused on acceptable damage and collapse prevention.

- 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

No

- 2. If so, identify which.

NA

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

No. The code bases assessment and retrofit decisions solely on structural performance under the design seismic action, using performance indicators and seismic risk classes; measures like occupancy limitations or improved egress may be considered in broader risk management or regulatory decisions, but they do not modify the seismic demand or capacity criteria established by P100-3.

- i. If so, provide specifics.

N/A

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

Yes. P100-3 describes a range of target performance objectives, expressed through seismic risk classes and limit-state considerations, rather than a single mandatory retrofit objective. The document defines different acceptable performance outcomes for existing buildings by classifying them into seismic risk classes (Rs I–Rs IV), which correspond to varying expectations of damage, safety, and collapse prevention under the design earthquake. Retrofit objectives may therefore aim to improve the building’s risk class, reduce vulnerability, or achieve minimum life-safety and collapse-prevention performance, rather than requiring full equivalence with new-construction performance.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

N/A

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

P100-3 defines performance targets for existing buildings primarily in terms of life safety, collapse prevention, and reduction of seismic risk under the design earthquake, rather than full compliance with the performance expected of new construction. These targets are expressed through limit-state verification and seismic risk classes, which allow controlled structural damage provided that overall stability and vertical load-bearing capacity are maintained. Retrofit objectives may therefore aim at improving a building's seismic risk class or achieving minimum acceptable performance, rather than equivalence with new buildings.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

Yes (indirectly)

- 1. If so, provide specifics.

P100-3 allows performance targets for existing buildings to vary as a function of occupancy type and importance, through the use of importance classes and associated performance expectations, even though it does not define bespoke performance objectives for each occupancy in the manner of new-building design codes. Buildings with higher importance or occupancy-related consequences (e.g. essential facilities, high-occupancy buildings) are subject to stricter assessment expectations and more demanding target outcomes, while buildings of lower importance may be assessed against minimum life-safety and collapse-prevention objectives.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

Yes (indirectly)

- 1. If so, provide specifics.

The performance targets for seismic retrofitting are governed by the building's Importance Class, which reflects factors such as occupancy level, building function, consequences of failure, and the need for post-earthquake functionality. Performance objectives are therefore defined in relation to structural behaviour, seismic risk class, and importance category, rather than by temporary or administrative occupancy restrictions. Consequently, a building with low occupancy and limited consequences of failure may be assigned a lower Importance Class, allowing retrofit objectives to focus on minimum life-safety or collapse-prevention performance rather than more stringent targets.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, "partial" here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

P100-3 implicitly allows partial strengthening by permitting targeted, risk-based interventions and less stringent performance objectives than those for new construction, while maintaining the same seismic hazard level and focusing on life safety and collapse prevention rather than full code compliance.

- i. If so, provide specifics.

P100-3 does not expressly use the term partial strengthening, but it clearly allows this approach through its performance-based and risk-oriented framework for existing buildings. The document permits strengthening measures that are targeted to the most critical vulnerabilities identified through assessment (R1, R2, R3), rather than requiring comprehensive upgrading to new-building standards:

- interventions aimed at reducing seismic risk or improving the seismic risk class, without eliminating all deficiencies;
- strengthening to achieve minimum acceptable performance objectives (life safety / collapse prevention), rather than full equivalence with new building;
- acceptance of controlled damage and residual vulnerabilities, provided collapse is prevented under the design earthquake;
- retrofit strategies that focus on key structural weaknesses, as illustrated by the informative retrofit guidance (e.g. Annex F), rather than global or uniform strengthening.

However, the code does not allow partial strengthening by reducing the seismic hazard level or earthquake return period, which remain those defined in P100-1; any “partiality” arises from capacity-side performance objectives, not from reduced demand.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

No

- i. If so, provide specifics.

NA

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

No (not expressly—but yes, implicitly)

- i. If so, provide specifics.

P100-3 does not explicitly state that seismic mitigation may be phased or implemented gradually over time; however, it implicitly allows prioritisation of vulnerabilities through its assessment and classification framework. By identifying and ranking deficiencies via performance indicators (R1, R2, R3) and seismic risk classes (Rs I–Rs IV), the document enables authorities and owners to prioritise high-risk buildings or critical vulnerabilities first, which in practice supports staged or incremental intervention.

While the code itself remains technically focused and neutral on scheduling, it clearly provides the analytical basis for phased risk-reduction strategies, rather than requiring immediate, comprehensive upgrading.

17. Quality control and reporting

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

No, not explicitly for heritage structures.

P100-3 does not expressly state that assessment or intervention works on historic or heritage buildings must be entrusted to professionals with specialized heritage qualifications. The document addresses professional competence in general terms, implicitly assuming that seismic assessment and retrofit are carried out by appropriately qualified engineers, as required by the broader Romanian regulatory framework.

However, when referring to historic or monument buildings, P100-3 explicitly conditions its application on compliance with specific heritage regulations, which in practice require the involvement of specialized professionals (e.g., conservation experts, heritage architects, or engineers experienced with historic structures). Thus, while the requirement for specialized expertise is not stated directly in P100-3, it is implicitly enforced through reference to external heritage legislation and procedures.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

Certification issued by the Ministry of Culture is generally required for the various specialities and components of the construction.

Structural technical assessments prepared by experts certified by the Ministry of Culture must also be reviewed and endorsed by specialists certified by the same ministry in the relevant conservation and restoration fields—such as mural painting, wood painting, stone decoration, stucco, and wood restoration—depending on the specific heritage components present.

For the engineer responsible for evaluating mechanical resistance and stability, an additional certification is required from the relevant ministry overseeing construction quality assurance, Ministry of Development, Public Works and Administration.

- b. Does the document anywhere state the required scope of the maintenance plan?

No

- i. If so, provide specifics.

NA

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

Yes.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

P100-3 explicitly states the **mandatory minimum contents** of the seismic assessment (expert) report. The document specifies that the report must include, at a minimum, information on the building description and history, data collection and level of knowledge, applied assessment methodology, qualitative and quantitative evaluation results (including indicators R1, R2, R3), seismic risk classification (Rs), conclusions on seismic performance, and recommendations regarding the need for intervention. These requirements are set out in the normative text and detailed further through **model structures and guidance in the annexes**, ensuring consistency and completeness of submitted reports.

i. If so, provide specifics.

The framework content of the technical expert report for the seismic assessment of existing buildings includes:

1. General Information on the Technical Expertise

- 1.1 Title page and signatures
- 1.2 Copy of the technical expert's certification
- 1.3 Executive (summary) report

2. Seismic Assessment Report

- 2.1 Purpose of the expertise
- 2.2 Applicable technical regulations and standards
- 2.3 Activities carried out in preparing the expertise
- 2.4 Data forming the basis of the technical expertise
- 2.5 Site characterization
- 2.6 Description of the building
- 2.7 Level of knowledge
- 2.8 Assessment methodology
- 2.9 Degree of compliance with seismic design requirements (R1)
- 2.10 Degree of structural damage and degradation (R2)
- 2.11 Degree of seismic structural safety (R3)
- 2.12 Serviceability Limit State (SLS) checks
- 2.13 Summary of assessment results
- 2.14 Proposed intervention measures

3. Conclusions

Annexes

The annexes include supporting documentation forming the basis of the technical expertise, such as building surveys, photographic documentation, calculation notes, test and measurement reports, geotechnical studies, and surveys of structural and non-structural degradation.

The Code also provides a model structure for the *Synthesis Report*.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

No. Any safety measures for inspections or works are therefore governed by separate occupational health and safety legislation, construction safety regulations, and emergency management procedures, not by P100-3 itself.

i. If so, provide specifics.

N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

No

i. If so, provide specifics.

NA

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

MP 025-2004 – METODOLOGIE PENTRU EVALUAREA RISCULUI ȘI PROPUNERILE DE INTERVENȚII NECESARE LA STRUCTURILE CONSTRUCȚIILOR MONUMENTE ISTORICE IN CADRUL LUCRARILOR DE RESTAURARE ALE ACESTORA

(Methodology for Risk Assessment and Proposed Interventions for the Structural Components of Listed Historic Buildings within Restoration Works)

(ROMANIAN DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:
 BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
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 ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
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 NEWER BUILDINGS

1. Author of the report
Imola KIRIZSÁN
2. Date of the report
30/07/2025
3. Title of the document analysed
MP 025-2004 – Methodology for Risk Assessment and Proposed Interventions for the Structural Components of Listed Historic Buildings within Restoration Works (English Translation)
4. Publisher
Methodology initiated by the Ministry of Public Works (at the time, MLPTL), with the approval of the Ministry of Culture and Religious Affairs, through Order No. 743/19.04.2004 and published in the Construction Bulletin No. 21/2005. https://www.mdlpa.ro/userfiles/reglementari/Domeniul_XXV/25_20_MP_025_2004.pdf
5. Date of issue
2004
6. Country of publication
Romania
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
Not mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
The document addresses various structural materials, including masonry, timber, reinforced concrete, steel, and mixed structures. In addition to the material types, it specifically analyses different structural typologies of the historical monument/listed buildings, such as churches, towers, enclosure walls, and secular buildings. These structural types reflect the unique constructive features and damage patterns of historic monument constructions
9. Status of the structure addressed (existing, historic, both)
Existing: listed historic building/historic monuments
10. Type of action addressed (seismic, other actions, general)
Seismic, other actions – in general
11. General description of the document
This document provides a technical overview of the Romanian regulatory framework for the seismic assessment of existing buildings, with particular focus on historical monuments, in accordance with P100 – Seismic Design Code. According to Article 1.1(8) of P100-3, the provisions may also apply to listed historic buildings, as long as they do not contradict the specific normative documents related to heritage preservation.

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

The necessity of a specific approach to interventions on historic monuments arises from their cultural significance, which requires ensuring structural safety without compromising their architectural, typological, and material authenticity. The document highlights three major objectives of this regulation:

- assessing compliance with the “strength and stability” requirement under seismic, environmental, and anthropogenic actions;
- supporting technical proposals for intervention works as part of restoration projects;
- designing seismic interventions in a manner that integrates structural performance with heritage conservation principles.

Furthermore, P100-3 aligns with international seismic codes and recommends updating the design return period from 50 to 475 years, consistent with Eurocode provisions. However, it also acknowledges that full compliance with performance standards might lead to irreversible changes that are unacceptable in heritage conservation. In such cases, moderate and reversible solutions are recommended, even if they result in lower seismic performance, provided the monument’s identity is preserved.

The methodology described in MP025/2004 complements P100-3 by offering detailed guidance for the seismic evaluation and retrofitting of heritage structures. It emphasizes:

- recognition of construction typologies and materials specific to historic buildings (churches, towers, walls, secular buildings);
- identification and classification of damage in order to define suitable intervention strategies;
- implementation of proportional retrofit measures, ensuring that interventions improve seismic safety while respecting the limitations imposed by the historical fabric;
- a combined approach involving structural analysis, typological assessment, and damage mapping.

Together, these normative documents offer a coherent and technic framework for engineers and approval authorities, promoting safety, reversibility, and authenticity in seismic interventions on historic monuments.

12. Chapters/sections of the document with the research topic described
--

A: The chapters of the document are:

1. Chapter 1. General framework and principles of structural assessment
2. Chapter 4 Information Required for Structural Safety Assessment
3. Chapter 5 Qualitative Assessment of the Building Condition (Diagnosis)
4. Chapter 6 Analytical Evaluation of the Seismic Safety of Historic Monuments
5. Chapter 7 Intervention Works on Historical Monument /Listed Historic Buildings

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
Applicable to the listed historic buildings (historic monuments).

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

Yes

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

Yes

- 1. If so, how is historic/heritage defined and what type of official designation is required?

It must be included in an official register and classified as a historic monument,

- 2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

For buildings without such designation, the general provisions applicable to existing structures are applied.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

No

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

The document is dedicated to existing buildings, specifically those that are listed as historic monuments. It is mentioned in the preamble that it refers to historic monument buildings, and it is a methodology complementary to P100 – Seismic Design Code, 3 Provisions for the Seismic Assessment of Buildings.

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

In the preamble confirms that the document is based on international doctrines and regulations (e.g., the Venice Charter, Council of Europe Recommendations, Eurocode 8, ICOMOS guidelines) P100 – Romanian Code for Seismic Design of Buildings, and is developed to address the special nature of historic monument structures, which require different and more careful seismic safety approaches than modern buildings due to their cultural value and unique characteristics. It also shows that national efforts build on international experience but fill a local regulatory gap.

The norms and guidelines referenced and applied in this document reflect the state of knowledge and regulatory framework valid at the time of its issuance, namely in the year 2004.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

This is a methodology specifically for existing structures, especially for heritage structures, defined as structural interventions on historical monuments/ listed historic buildings. Its use may be encouraged or required by certain authorities or projects, but it does not have the strict regulatory status of a mandatory code or standard.

- i. If a Standard, are jurisdictions required to accept its use and application?

It may be recommended or encouraged but is not legally mandatory in all jurisdictions. In the case of seismic assessment of existing buildings, P100 – Code for Seismic Design of Buildings – Part 3: Assessment and Intervention on Existing Buildings is applied. Additionally, C247-2022 – Standard for Technical Expertise of Constructions provides guidelines addressing the types of technical assessments required.

For buildings listed as historic monuments, the primary legal framework is the Law 422/2001 on the Protection of Historical Monuments and Sites.

This methodology aims to establish a connection between specific regulations in the construction sector and the protection of historic monuments, ensuring that interventions respect both structural safety requirements and cultural heritage preservation.

The body of standards developed by ASRO (the Romanian Standards Association) constitutes the official set of rules used in planning and construction in Romania and, as such, establishes key guidelines for the development of the built environment. Practical applicability, methodological freedom, and responsibility toward society are of major importance.

Publications include Romanian standards (SR) and European standards adopted as national standards (SR EN), as well as other European technical specifications. Standards and regulations are developed by ASRO technical committees in accordance with a formally recognized process that complies with international requirements and are reviewed periodically (typically every five years) to ensure their relevance and accuracy.

These standards and regulations are prescriptive documents. Standards define construction practices and document validated technical knowledge, thus contributing to the safety, functionality, durability, and economic viability of structures and facilities. Technical regulations govern the legal and procedural framework for contractual relations and implementation phases in the construction sector.

- ii. Do jurisdictions routinely accept the use of the Standard?

Not always. Performance requirements are typically formulated in the project specifications. Moreover, the acceptance and implementation of the methodology

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

depend significantly on the certified expert evaluating the building, as they are responsible for proposing appropriate intervention solutions in accordance with both structural and heritage-related considerations.

- b. Is the document for guidance only?

Yes

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

No, its use is not formally mandatory; however, certain public authorities — such as the Ministry of Culture or its subordinated institutions (e.g., county cultural directorates or the National Institute of Heritage) — may require the application of this methodology in specific projects involving officially listed historical monuments. In such cases, the use of MP025/2004 becomes a practical requirement for project approval, especially in procedures involving expert assessments and proposed retrofit solutions.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

Yes. The document sets forth a specific methodology intended for the seismic assessment and intervention on historical monument buildings. It provides a structured approach for evaluating structural safety, defining performance objectives, and designing appropriate intervention measures, in accordance with both national regulations (such as Law No. 422/2001 on the Protection of Historical Monuments and complementary technical codes like P100- Seism Designs Code, no 3, provisions for the assessment of existing buildings).

- b. If so, is the methodology for assessment or for retrofit design?

For both assessment and the design of structural interventions.

- c. Is the methodology recommended or required?

It is recommended

- i. Is the recommended or required methodology primarily a checklist?

No

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

No

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

Yes, in terms of structural analysis methods and for estimating the proportionality of interventions.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

Yes.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

The methodology is not purely conceptual. It provides specific calculation methods, including standard calculation methods: simplified static methods and medium-complexity static analysis; advanced calculation methods: linear and nonlinear dynamic analysis (e.g., time-history methods).

These are to be selected based on the characteristics of the structure, including its level of degradation, and the type of intervention proposed.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

Yes. the document allows for relaxation of assessment and retrofit requirements considering the specific nature of heritage structures, their fragility, and the need to preserve cultural and architectural values without causing irreversible alterations.

- i. Identify the reasoning provided as to why the document allows for relaxation

Relaxation is permitted because the rigid application of codes intended for new or modern buildings may result in disproportionate or inappropriate interventions that could irreversibly compromise the integrity of heritage structures. The inherent variability in materials, construction techniques, and structural complexity of historic buildings requires a more flexible and context-sensitive approach. The methodology MP025-2004 explicitly states in its Preamble the need for a distinct conceptual framework when assessing and intervening on historic monuments. It emphasizes that the cultural significance of such buildings requires conservation efforts that do not undermine their architectural, typological, or material authenticity. This more relaxed approach—relative to modern codes—is developed in the following chapters:

- **Chapter 5 – Qualitative Assessment (Diagnosis):** Encourages a case-specific understanding based on historical materials and techniques, rather than standardized evaluation procedures.
- **Chapter 6 – Analytical Evaluation of Seismic Safety:** Recognizes that seismic performance must be interpreted in light of a historic structure's limitations, prioritizing proportional and minimally invasive interventions over full code compliance.
- **Chapter 7 – Intervention on Historical Monuments:** Advocates for conservation-focused solutions, favoring reversible, non-invasive, and compatible techniques instead of prescriptive code-based retrofitting typically required for new buildings. In summary, the document justifies a relaxed, flexible methodology in both

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

assessment and intervention design for heritage structures, in contrast to the stricter provisions of modern building codes (e.g., P100-1/2013).

- ii. Identify what the document set forth as the reasons why relaxation is sought

The document identifies the primary motivation for seeking relaxation as the need to prevent irreversible alterations to the structure and appearance of historic monuments. Furthermore, it acknowledges that the typically high costs of intervention, combined with the relatively low risk to human life, support a proportional adaptation of safety requirements, in line with the cultural and historical value of the building.

- iii. Identify the ways that the document allows for relaxation

In well-justified cases, the seismic performance level may be allowed to be lower than the standard requirement, provided that necessary measures are taken to prevent loss of human life due to partial or total collapse of the building.

If the conventional seismic force leads to interventions that cause unacceptable, irreversible changes to the building's architecture or decoration, the design seismic force may be reduced by applying a factor less than one. This reduction must not lower the seismic performance below a mutually agreed "minimum acceptable level" between the restoration architect and structural engineer. The acceptable level and reduction factor must be approved by the competent authorities and be determined by balancing the safety benefits against the costs of losing architectural or cultural integrity.

Relaxation occurs through acceptance of lower seismic safety levels than those mandated for new constructions, application of reduction coefficients to seismic forces (e.g., $\gamma_{red} < 1$), and the possibility of limiting building use or changing its function to reduce risks.

- iv. Identify if the document provides for relaxation primarily on the "demand side", the "capacity side", or both.

Capacity side.

The relaxation applies to both demand side — by reducing the seismic design forces or limiting occupancy — and capacity side — by accepting lower structural capacity levels or using reduction coefficients on resistance.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

Yes

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

Yes

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

No

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

Yes, force/moment capacity.

- 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

Yes

- 2. If so, identify which.

In a force-based design, the maximum force/moment capacity is relaxed compared to the capacity necessary for a new construction.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

Yes.

- 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

No

- 2. If so, identify which.

NA

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

Implicitly yes, by reducing the need for reaching the requirements for new structures.

- 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

No

- 2. If so, identify which.

NA

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

Yes.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If so, provide specifics.

The proportionality of actions depends on the building occupancy and the building remaining life. Specific rules apply that allow the even further reduction of the demand for buildings satisfying specific criteria regarding occupancy and the possible effect on neighbouring structures.

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

Yes

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

The seismic performance level of the monument after the intervention works, including some common cases where the design to reach the performance goals might cause irreversible changes to the monument that are not acceptable because they harm its integrity, originality, or cultural value. According to modern rules, in these situations it is better and widely accepted to use moderate and reversible intervention methods. These methods do not significantly change the monument’s original character, even if they provide a lower seismic performance level than usually required.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

No

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

Yes, the minimum levels of safety, as well as the proportionality of the retrofit measures depend on the building class.

- 1. If so, provide specifics.

The code expands the three building classes used in the standard for new structures into five building classes. For building classes I the minimum safety level of an existing structure is defined as 30% of the equivalent of a new structure. For building classes II-s, the minimum safety level of an existing structure is defined as 40% of the equivalent of a new structure.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

The proportionality of the measures depends on the number of occupants in the building.

- 1. If so, provide specifics.

The number of occupants in the building is accounted for in the estimation of the risk reduction due to retrofit according to the building type.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

There is the concept of the minimum required strengthening, as described in 16c-iii.

- i. If so, provide specifics.

See 16c-iii

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

No

- i. If so, provide specifics.

NA

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

No

- i. If so, provide specifics.

NA

17. Quality control and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

NA

- b. Does the document anywhere state the required scope of the maintenance plan?

No

- i. If so, provide specifics.

NA

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

Yes

- i. If so, provide specifics.

Structural interventions within restoration works will be carried out based on specialized projects that include a technical assessment of the respective construction. The assessments will have a minimum content as follows:

- architectural drawings and surveys;

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- structural drawings and surveys;
- drawings and surveys of damages and deteriorations;
- photographic survey;
- technical report;
- structural calculation notes;
- results of laboratory tests or in-situ non-destructive tests of the component materials;
- geotechnical study and, where applicable, hydrogeological study;
- drawings illustrating the intervention solutions.

Generally, two structural intervention solutions will be presented: a minimal solution and a maximal solution. These will explicitly include the concepts underlying their development, the calculation notes regarding requirements and capacities, along with the interpretation of the seismic risk after interventions.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

Not directly

- i. If so, provide specifics.

NA

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

No

- i. If so, provide specifics.

NA

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

SIA 269/8:2017 MAINTENANCE DES STRUCTURES PORTEUSES – SÉISMES (MAINTENANCE OF LOAD-BEARING STRUCTURES – EARTHQUAKES)

(SWISS DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

1. Author of the report
Savvas Saloustros
2. Date of the report
22/05/2025
3. Title of the document analysed
SIA 269/8:2017 Maintenance des structures porteuses – Séismes (Maintenance of load-bearing structures – Earthquakes)
4. Publisher
Swiss Society of Engineers and Architects (SIA) Société Suisse des ingénieurs et des architectes
5. Date of issue
01/12/2017
6. Country of publication
Switzerland
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
Reinforced concrete, masonry, steel, mixed steel-concrete, timber, geotechnical structures
9. Status of the structure addressed (existing, historic, both)
Existing
10. Type of action addressed (seismic, other actions, general)
Seismic
11. General description of the document
SIA 268/9 describes the methodology used for computing the capacity of existing structures under seismic actions, and for assessing the proportionality of retrofit measures related with the improvement of their seismic performance. In a nutshell:

- [The principal idea of the risk-based seismic assessment procedure according to SIA 269/8 is that existing structures may comply with lower performance limits than new structures.](#)
- [In essence, the performance ultimate limit state is assessed by personal risk criteria derived from natural and man-made disaster prevention.](#)
- [Criteria of acceptable individual and collective risks to persons are lower bounds for seismic safety.](#)
- [The examination procedure acts as an efficient filter to limit interventions to structures with unacceptable high risks.](#)
- [The concept is focused on regions of low to medium seismicity where it often allows to accept the existing state of a structure as sufficiently safe without any intervention.](#)

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

In more detail, SIA 269/8 is based on a risk-based assessment for defining the minimum requirements for retrofit and the proportionality of retrofit actions for a further improvement of the safety above this limit. Key component to this methodology is the compliance factor.

The compliance factor a_{eff} measures up to what level the existing building complies with the requirements of the seismic design for new buildings. This compliance factor is calculated as the ratio between the capacity of the existing structure over the demand for a new structure. Compliance factor above 1 means that an existing structure meets the requirements for a new structure.

According to the building class, a minimum compliance factor is defined. The definition of this minimum compliance factor, ranging from 0.25 to 0.40, is based on an individual risk criterion. The individual risk criterion is obtained from societal studies and is defined as the acceptable probability to be killed by the consequences of an earthquake of an individual person staying all year around inside a building. For Switzerland, this probability is selected as equal to 10^{-5} and corresponds to a compliance factor of 0.25.

It is necessary to execute all interventions to achieve the minimum compliance factor.

Once the minimum compliance factor is achieved, interventions are implemented to reach as close to a compliance factor of 1, as far as they are proportional. The proportionality of seismic safety measures is assessed by comparing their cost with the risk reduction they generate. The definition of the proportionality is based on the collective risk criterion, which is the amount of costs the society is willing to pay to reduce the probability of death caused by the collapse of a building over all relevant earthquake scenarios.

The estimation of the proportionality of the interventions is based on the comparison between the actual costs of the intervention with what is considered as proportional costs. If the actual costs are lower than the proportional costs, then the intervention must be implemented.

The proportional costs accounts are computed accounting for the following factors: i) reduction in personal risk due to the intervention, ii) the total investment cost related with the reduction of the personal risk, iii) the remaining life of the structure. Apart from the risk reduction to persons, the estimation of the proportionality of the costs can account for risk reduction of: i) damage to the structure, ii) valuable goods in the structure, iii) interruption of production in the structure, iv) interruption of infrastructure function.

12. Chapters/sections of the document with the research topic described
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A: The chapters of the document are:

1. Terminology
2. Basic principles

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

3. Seismic action
4. Structural analysis and verifications
5. Reinforced concrete structures
6. Masonry structures
7. Steel and timber structures
8. Geotechnical aspects, foundations
9. Seismic evaluation and recommendation of interventions
10. Proportionality of interventions

Here we focus on the description of chapters 9 and 10.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
No. Applicable to all existing structures, independently on their historic value.
 - i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?
No
 - ii. Is the document specified to be applicable only to officially designated historic/heritage structures?
No
 1. If so, how is historic/heritage defined and what type of official designation is required?
NA
 2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?
NA
- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?
Yes
 - i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?
Yes, the whole document
- c. Does the document appear to be based primarily on or derived from some other document?
 - i. If so, identify the source document.
It complements the rest of the SIA 269 codes related with existing structures

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

This is a standard specifically for existing structures (no distinction between heritage/non-heritage)

- i. If a Standard, are jurisdictions required to accept its use and application?

Extract from the SIA website <https://www.sia.ch/en/cms/services/standards-regulations>:

"The SIA's body of standards is the authoritative set of rules for planning and construction in Switzerland and as such establishes key guidelines for designed living environments. Practical suitability, ensured methodological freedom and responsibility towards society have paramount importance.

Publications include standards and regulations, along with adopted European standards (SN EN) and European technical specifications (SNR CEN/TS). Standards and regulations are developed by SIA commissions according to a formally recognised process compliant with international stipulations, and reviewed every five years to ensure their currentness.

*Standards and regulations are prescriptive publications. Standards define building practice codes and document robust knowledge. Hence they contribute to the safety of structures and facilities along with their functionality, durability and economic viability. **Regulations govern contractual relationships and specific procedures in the construction sector.**"*

Translated extract from the Federal Office of Culture

<https://www.bak.admin.ch/bak/fr/home/baukultur/qualitaet/normen/sia-normen.html>:

"SIA standards are applied in construction and planning. They are not laws, but private standards that only have legal value within the framework of contractual agreements, in accordance with the Code of Obligations."

- ii. Do jurisdictions routinely accept the use of the Standard?

Yes

- b. Is the document for guidance only?

NA, see above

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?
The document is based on standard methodologies for the seismic assessment, i.e. force-based or displacement-based assessment. It specifies the use of nonlinear structural analysis for the assessment of the seismic performance of existing structures.
- b. If so, is the methodology for assessment or for retrofit design?
For both assessment and retrofit design.
- c. Is the methodology recommended or required?
It is required.
 - i. Is the recommended or required methodology primarily a checklist?
No
 - ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?
No
 - iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?
Yes, in terms of structural analysis methods and for estimating the proportionality of retrofit measures.
 - iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?
Yes.
 - v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?
The standard recommends the use of nonlinear numerical analysis (pushover).

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?
Yes.
 - i. Identify the reasoning provided as to why the document allows for relaxation
The document is based on the concept that once a minimum level of safety is guaranteed, any additional intervention to improve safety up to the level of safety for a new building should be taken as far as it is proportional. The proportionality of seismic safety measures is assessed by comparing their cost with the risk reduction they generate.
 - ii. Identify what the document set forth as the reasons why relaxation is sought
Not mentioned explicitly in the document. By definition, the reason for relaxation is that the cost of retrofit is not proportional to the reduction in personal risk.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- iii. Identify the ways that the document allows for relaxation
[The document allows for relaxation regarding the level of improvement of the structural capacity.](#)
- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.
[Capacity side.](#)

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
[No.](#)
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
[A: No.](#)
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
[A: Not applicable. The code is related to seismic actions.](#)

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
[Yes, force/moment capacity.](#)
 - 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
[Yes](#)
 - 2. If so, identify which.
[In a force-based design, the maximum force/moment capacity is relaxed compared to the capacity necessary for a new construction.](#)
- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?
[Yes, displacement capacity.](#)
 - 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
[Yes](#)
 - 2. If so, identify which.
[In a displacement-based design, the maximum displacement capacity is relaxed compared to the capacity necessary for a new construction.](#)

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?
Implicitly yes, by reducing the need for reaching the requirements for new structures.
 - 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
Yes.
 - 2. If so, identify which.
In a displacement-based design, the maximum displacement capacity is relaxed compared to the capacity necessary for a new construction (see code description below).
- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?
Yes.
 - i. If so, provide specifics.
The proportionality of actions depends on the building occupancy and the building remaining life. Specific rules apply that allow the even further reduction of the demand for buildings satisfying specific criteria regarding occupancy and the possible effect on neighbouring structures.
- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?
Only for building belonging to building class III (vital infrastructure function/considerable environmental risk) the code requires checks for the “service limit state” apart from the “ultimate limit state”.
 - i. Provide specifics as to what the stated performance targets are for historic/heritage structures.
NA
 - ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.
For the service limit state check of existing structures belonging to class III, the code considers a reduction in the demand of 50% compared to the demand for new structures and a minimum compliance factor of 0.7.
 - iii. Are the performance targets permitted to vary as a function of occupancy type/designation?
Yes, the minimum levels of safety, as well as the proportionality of the retrofit measures depend on the building class.
 - 1. If so, provide specifics.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

The code expands the three building classes used in the standard for new structures into five building classes. For building classes I (residential/industrial buildings, car parks, bridges with secondary importance) and II (shopping centers, public administration buildings, tall chimneys etc.) the minimum safety level of an existing structure is defined as 25% of the equivalent of a new structure. For building classes II-s, II-i and III (e.g., schools, nurseries, hospitals, bridges, retaining walls with important function, construction works, equipment and installations for risk protection in the case of catastrophe) the minimum safety level of an existing structure is defined as 40% of the equivalent of a new structure. Similarly, the range for which interventions are required as far as proportional vary according to these two categories of building classes (see below).

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

The proportionality of the measures depends on the number of occupants in the building.

- 1. If so, provide specifics.

The number of occupants in the building is accounted for in the estimation of the risk reduction due to retrofit according to the building type.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

There is the concept of the minimum required strengthening, as described in 16c-iii.

- i. If so, provide specifics.

See 16c-iii

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

No

- i. If so, provide specifics.

NA

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

No

- i. If so, provide specifics.

NA

17. Quality control and reporting

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?
No
 - i. If so, provide specifics (i.e. type of attestation required and other requirements).
NA
- b. Does the document anywhere state the required scope of the maintenance plan?
No
 - i. If so, provide specifics.
NA
- c. Does the document anywhere state the required or mandatory minimum contents of the report?
No
 - i. If so, provide specifics.
NA

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?
No
 - i. If so, provide specifics.
NA

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

TURKISH BUILDING EARTHQUAKE CODE

(TURKISH DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: AFAD (Disaster of Emergency Management Presidency)
2. Date of the report
A: 2018
3. Title of the document analysed
A: Turkish Building Earthquake Code
4. Publisher
A: AFAD (Disaster of Emergency Management Presidency)
5. Date of issue
A: 2018
6. Country of publication
A: Turkey
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: The document is mandatory for the design of earthquake resistant structures of all types. Although it has chapters of reinforced concrete, steel, timber and masonry structures, there are more detailed and specific structural codes for timber and steel design. The code also defines the rules for the assessment of existing structures and limited definitions exist for masonry structures as well.
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: It has design sections for reinforced concrete, steel and light steel structures, seismically isolated building, prefabricated structures, masonry (brick, stone or mixed with rc) and timber structures. In the document, assessment criteria are defined only for RC, steel and non-historical masonry structures.
9. Status of the structure addressed (existing, historic, both)
A: The document defines the new design criteria for all type of structures and assessment criteria for the reinforced concrete, steel, prefabricated and masonry buildings.
10. Type of action addressed (seismic, other actions, general)
A: The code mainly refers to seismic actions but not excluding other external actions such as wind, snow etc. Detailed explanations of defining loads are given in the code.
11. General description of the document
A: TBEC 2018 provides seismic design and assessment rules for new and existing buildings, including masonry structures. It includes performance-based evaluation methods and distinguishes between ordinary and historic structures.
12. Chapters/sections of the document with the research topic described

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A:

- Chapter 1: Scope and Definitions
- Chapter 7: Assessment and Strengthening of Existing Buildings
- Chapter 8: Masonry Structures
- Annexes (e.g., material properties, analysis methods)

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: The document specifically states that it cannot be applied to 'historical masonry' structures.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: It excludes the historic masonry structures where it defines the design and assessment of existing structures. However, the section where it defines the material properties (Section 11), behavior factors, capacity calculation and performance criteria of new masonry structures are frequently referenced by engineers.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: It refers to new built masonry structures.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: There is no definition for historic structures

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Although it does not refer to historic structures, the material properties of panels are defined with brick, stone and hollow section modern units with mortar classes.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: There is no specific directive for existing structures. However, the performance criteria are generally referenced by engineers while dealing with both existing non-historic and historic buildings as well.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: The document is for design and assessment, and it has only one section for masonry structures that defines design and assessment criteria.

- c. Does the document appear to be based primarily on or derived from some other document?
- i. If so, identify the source document.

A: The material properties of wall panels are in line with Eurocode definitions. The shear capacity calculation that considers the axial load contribution and behavior factors are alike Eurocode. However, the knowledge level does not exist in TBEC, in place, in situ material tests are advised or higher reduction coefficients are used for mechanical properties.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: It excludes the historic masonry

- i. If a Standard, are jurisdictions required to accept its use and application?

A: Although the code excludes the historic masonry, in many cases the jurisdiction asks for the assessment in line with the code.

- ii. Do jurisdictions routinely accept the use of the Standard?

A: In many cases assessments are asked to be done according to the code and/or if the assessment is done with another approach, the results are compared with the code approach.

- b. Is the document for guidance only?

A: It is a mandatory code

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: In many cases the assessment and interventions developed according to the code are accepted by jurisdictions.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: The document defines linear analysis, nonlinear analysis (Single mode pushover, multi-mode pushover and time history) method for masonry. However, the performance criteria are only applicable with the outcome of linear analysis as all the capacity definitions are based on force-based relations. The performance levels are defined by the ratio of the panels that exceed their capacity to a certain amount of earthquake forces that are carried by those walls.

- b. If so, is the methodology for assessment or for retrofit design?

A: The given methodology is both for the design (capacity design) and for the assessment

- c. Is the methodology recommended or required?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: It is mandatory for non-historic masonry

- i. Is the recommended or required methodology primarily a checklist?

A: There is no checklist

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: Capacity calculations, safety coefficients depending on the knowledge level, behavior factors, performance criteria are defined with corresponding calculations.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: No, it is definite for non-historical masonry

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: It is clear, definitive and exact

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: The analysis method, material properties, capacity calculations and assessment criteria are all defined for non-historic structures

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: No relaxation is defined

- i. Identify the reasoning provided as to why the document allows for relaxation

A: -

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: -

- iii. Identify the ways that the document allows for relaxation

A: -

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: -

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: -

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: -

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: -

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: -

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: -

2. If so, identify which.

A: -

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: -

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: -

2. If so, identify which.

A: -

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A:

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: -

2. If so, identify which.

A: -

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: -

- i. If so, provide specifics.

A: -

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: It does not specify which type of structure should satisfy a specific performance but defines 'limited damage' and 'controlled damage' levels.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: no

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: The defined performance targets are 'limited damage' and 'controlled damage'. Performance levels are described depending on the shear capacity exceedance of panels and their ratio of exceedance to the total earthquake forces.

Limited damage level is described as if no wall exceeds their shear capacity, the controlled damage level is defined as, if only the panels that could carry in total maximum 40% of the earthquake forces. If the ratio of exceedance is more than 40%, it falls into 'collapse state'.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: No relation is defined related with the type of structure or function

1. If so, provide specifics.

A: -

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: -

1. If so, provide specifics.

A: -

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, "partial" here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A:

- i. If so, provide specifics.

A: -

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A:

- i. If so, provide specifics.

A: -

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: -

- i. If so, provide specifics.

A: -

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: -

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: -

- b. Does the document anywhere state the required scope of the maintenance plan?

A: -

- i. If so, provide specifics.

A: -

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: -

- i. If so, provide specifics.

A: -

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: -

- i. If so, provide specifics.

A: -

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: -

- i. If so, provide specifics.

A: -

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

GUIDELINE FOR THE MITIGATION OF EARTHQUAKE RISK ON HISTORICAL BUILDINGS

(TURKISH DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: ISCARSAH Turkey
2. Date of the report
A: 30.06.2025
3. Title of the document analysed
A: Guideline for the Mitigation of Earthquake Risk on Historical Buildings
4. Publisher
A: Istanbul Governor & General Directorate of Foundations
5. Date of issue
A: 2018
6. Country of publication
A: Turkey
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory but accepted by authorities
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: The document addresses all types of historical buildings by means of documentation, investigation and intervention issues. However, the section which refers to structural analysis, it mentions only masonry structures and give overall explanations about modelling techniques for different type of structures.
9. Status of the structure addressed (existing, historic, both)
A: The document is for the documentation, assessment, investigation and interventions for existing historic buildings.
10. Type of action addressed (seismic, other actions, general)
A: The document is a comprehensive guideline that has chapters starting from the basics such as conservation aspects and terms, data collection and documentation, historical structural types to more detailed topics such as structural analysis and assessment, interventions and post disaster risk management issues.
11. General description of the document
A: The document is a guideline that is focused on historical masonry. It covers the documentation, data collection (by means of mechanical, ndt, mdt or dt tests etc.), analysis and intervention methods and contains overall information about post-disaster management as well. The structural analysis section of the document (Section 6 – Structural Modelling and Assessment) propose material properties for masonry wall types depending on the previuos academic studies and propose performance level criteria for specific type of structures depending on their values of conservation.

12. Chapters/sections of the document with the research topic described

A: The most relevant section of the document is Section 6 – Structural Modelling and Assessment.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: The document itself is published by specially focusing on existing historical structures. It has sections for the specific documentation techniques to structural analysis approaches considering the masonry structure morphologies and conservation aspects.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: The document is specific to historic, heritage structures and covers all types of structures in documentation, testing and intervention. However, the structural analysis part suggests approaches and performance levels for masonry structures only.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: It's not a compulsory document and is rather asked by authorities to be referred to while assessing historical structures.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: In Section 6, modelling techniques are conceptually explained without any governing equations. The modelling techniques such as 'simple wall models' (shell elements), 'diagonal compression elements' (frame elements), 'equivalent frame model' (frame/pier elements), and finite element models.

Although there is no design specifications are given, the material properties of the most frequent masonry types are given, referring to (Magenes, Penna 2009), having the parameters of elastic and shear modulus, unit weight, compressive and shear strength.

Conceptual explanations are given for the assessment approaches (analysis methods), and for detailed explanations, it refers to TBEC (Turkish Building Earthquake Code). It gives explanations about analysis methods that can be applied for masonry buildings, such as 'linear single or multi modal static analysis' (6.5.1), linear time history analysis (6.5.2), and nonlinear analysis (6.5.3). Following section 6.5.4, that has suggestion about which analysis method could be more preferable and reliable for different types of structures, it explains and gives details about the mechanism analysis

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

method, which is based on simple force equilibria of rigid elements and gives simple case applications supported with example calculations.

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: The document is for historic structures and doesn't give any different approaches for new design or reconstruction of masonry/historical masonry

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: The document only refers to historic existing buildings and propose methods for specifically for those kind of structures.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: The document is mainly for existing historical masonry buildings. The specific analysis and assessment information is given for masonry (stone and brick)

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: The document was prepared with the contribution of different academician and professionals. It has references where the material mechanical properties are defined. The most significant part of the document is the defined performance levels which is uniquely derived from performance analysis approach combined with masonry behaviour experiences. (Table 6.3. & Table 6.4.)

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: It is a guideline and the section 6 has propose performance criterias for the assessment of existing structures.

- i. If a Standard, are jurisdictions required to accept its use and application?

A: -

- ii. Do jurisdictions routinely accept the use of the Standard?

A: -

- b. Is the document for guidance only?

A: The document is a guideline that is generally asked by experts to be used in the analysis.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: Mostly, the application or checks according to the guidelines are requested by jurisdictions.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: The document defines performance level criterias and possible expected performance levels for different type of structures depending on their national and international importance by means of heritage value.

The proposed performance levels are defined mostly for linear analysis. The performance criteria are given below.

Limited Damage : 1) Linear analysis are used

- a) The capacity of the elements are not exceeded under the combined actions of vertical loads and non-reduced earthquake forces (behaviour factor =1)
- b) Drift ratio of 0.3% is not exceeded under the influence of non-reduced earthquake forces (behaviour factor =1)

Controlled Damage : 1) Linear analysis are used

- a) The capacity of the elements is not exceeded under the influence of reduced earthquake forces (behaviour factor ≤ 3)
- b) Drift ratio of 0.7% is not exceeded under the influence of non-reduced earthquake forces (behaviour factor =1)

2) Non-Linear analysis is used

- a) Drift ratio of 0.7% is not exceeded under the influence of non-reduced earthquake forces (behaviour factor =1)
- b) Deformation capacity of the elements is not exceeded

Collapse Prevention : 1) Linear analysis are used

- a) The capacity of the elements is allowed to exceed 50% of its capacity under the influence of reduced earthquake forces (behaviour factor ≤ 3)
- b) Drift ratio of 1% is not exceeded under the influence of non-reduced earthquake forces (behaviour factor =1)

2) Non-Linear analysis is used

- a) Drift ratio of 1% is not exceeded under the influence of non-reduced earthquake forces (behaviour factor =1)

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

b) Deformation capacity of the elements is allowed to exceed 20% of their capacity

- b. If so, is the methodology for assessment or for retrofit design?

A: The given methodology is for assessment. Although there is a subsequent chapter for the intervention techniques, there is no proposal for retrofit design.

- c. Is the methodology recommended or required?

A: Because it is a guideline, the methodology is a recommendation.

- i. Is the recommended or required methodology primarily a checklist?

A: The context of the guideline is to provide guidance to the experts, starting from understanding the building documentation, through structural analysis and intervention, and risk management. However, the solid proposals for structural analysis are given in Chapter 6 and only define the analysis methods with performance level criteria.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: The guideline proposes the definition of performance levels depending on the analysis methods (linear or non-linear).

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Although the documentation defines performance levels, the capacity calculations are not referred. So, the common practice is to calculate capacities depending on TBEC-2018, as it is also referred to for earthquake calculations.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: Only the performance levels are defined with a general statement of linear and non-linear analysis, which can be differentiated in itself.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: The definition of performance levels is given regardless of masonry types, and no other structural stability checks are given in detail with the exception of mechanism analysis that can be performed for out-of-plane behaviour.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: There is no specific relaxation for the analysis. However, a table is given to increase mechanical properties of structural materials depending on either qualitative observations

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

or structural interventions such as injection or TRM (textile reinforced mortar) applications.
The table is given below.

Wall Arrangement	Good Binding Mortar	Well-Aligned Joints	Wall with Transverse Connections	Wall with Mortar Injection	Wall Strengthened with Reinforced Plaster
Rubble stone masonry wall	1.5	1.3	1.5	2.0	2.0
Rough-cut stone masonry wall	1.4	1.2	1.5	1.7	2.0
Well-connected ashlar stone masonry wall	1.3	1.1	1.3	1.5	1.5
Soft stone (limestone, tuff) masonry wall	1.5	-	1.5	1.7	2.0
Smooth ashlar stone, plastered masonry wall	1.2	-	1.2	1.2	1.2
Lime mortar brick masonry wall	1.3	-	1.3	1.5	1.5
Cement mortar semi-hollow brick masonry wall	1.3	-	-	-	1.3
Solid brick wall with less than 45% void ratio	1.3	-	-	-	1.3
Mortarless vertical-jointed brick wall with <45% voids	1.3	-	-	-	1.3
Concrete block wall with 45–65% void ratio	1.3	-	-	-	1.3
Grouted concrete block masonry wall	1.3	-	-	-	1.3

- i. Identify the reasoning provided as to why the document allows for relaxation
A: The reason of using better material properties could be related with different type of walls which might exhibit higher structural parameters and can be recognized by visually.
- ii. Identify what the document set forth as the reasons why relaxation is sought
A: The relaxation can be beneficial for decreasing the interventions for qualitatively better structures.
- iii. Identify the ways that the document allows for relaxation
A: The document offers to improve mechanical properties.
- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: The improvement is suggested for the material properties that affects the 'capacity'.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: The seismic demand is not defined in the guideline and addressed to TBEC-2018 spectrum for seismic forces definition. Even the load combinations are not defined so the engineers can consider the proper combinations including dead, live, weather and seismic loadings.

The only relaxation that can be interpreted as in the demand side is allowing engineers to choose different performance levels for different return periods of earthquakes.

Proposed earthquake and performance levels are given in the chart below.

Performance levels depending on their values	Local value structures (Grup I)	International value historical buildings	
	DD-3 (50%/50, 72 years return period) Limited Damage (LD)	DD-2 (50%/10, 475 years return period) Limited Damage (LD)	DD-1 (50%/2, 2475 years return period) Limited Damage (LD)
Local value structures (Grup II)	DD-3 (50%/50, 72 years return period) Controlled Damaged (CD)	DD-2 (50%/10, 475 years return period) Controlled Damaged (CD)	DD-1 (50%/2, 2475 years return period) Controlled Damaged (CD)
	DD-3 (50%/50, 72 years return period) Collapse Prevention (CP)	DD-2 (50%/10, 475 years return period) Collapse Prevention (CP)	DD-1 (50%/2, 2475 years return period) Collapse Prevention (CP)

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: There is no specific recommendation for the retrofitted structures. Only different assessment levels are given depending on the value of the structures.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: There is no explanation or masonry, historical building specific load considerations. The engineers are addressed to existing design codes for other action loads.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: Capacity and deformation limitation are given related to the performance levels. The criteria are given in the previous sections.

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: These limitations exhibit high similarity with the Turkish Code (TBEC-2018), which only refers to the design of new masonry buildings. Although there is no performance-based design criterion in TBEC-2018, the limitation of the drift ratio is given as 0.7% which falls into the CD level in the guideline. The guideline (which is expected to have relaxed criteria) gives no permission for the exceedance of the capacity for CD level, whereas TBEC-2018 allows the exceedance of 40% of the walls that contribute to the earthquake force resistance. However, considering the material reduction factor given in TBEC, which is 2, the governing equation for the capacity calculation gives very close results compared to the guideline.

2. If so, identify which.

A: If it is needed, summarise the relaxation levels of the code, which is for a new design and the guideline that refers to the existing masonry, the criteria fall into the same level of capacity and demand, except that given permission to choose different earthquake and performance levels for historical masonry.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: The strain levels are referred to non-linear analysis and limited to not exceed for CD level or 20% exceedance for the CP level. Moreover, in the guideline, there is no definition for permissible strain levels.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: There is no similar explanation in the new design code (TBEC)

2. If so, identify which.

A:

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: In the guideline, for each performance level, different limits for drift ratios are given from 0.3% to 1% for LD to CP levels. The given drifts are for the building; there is no limitation for interstory drift ratios.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A:

2. If so, identify which.

A:

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: There is no caution for such actions.

- i. If so, provide specifics.

A:

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Different expected performance levels are given in the guideline. So, the chosen performance levels are accepted for the target performance as a common application.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: The decision is left to engineer depending on the value of the structure and it is proposed for existing historical buildings.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A:

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: The performance is only limited with its not clearly defined local and/or international 'historic value', regardless of any function or occupancy.

1. If so, provide specifics.

A:

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: No

1. If so, provide specifics.

A:

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

A: Although the document intends to propose minimum intervention, there is no specific definition for 'partial strengthening'. Even though there is no check for any vulnerable elements that may cause a risk to stability.

- i. If so, provide specifics.

A:

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No vulnerability definition exists.

- i. If so, provide specifics.

A: -

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No.

- i. If so, provide specifics.

A: -

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: The document advises to work with professionals but it's not a mandatory document and no licensing system is valid.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: -

- b. Does the document anywhere state the required scope of the maintenance plan?

A: Although there is an item related to maintenance, the scope or the variety of maintenance is not defined. The importance of maintenance is stressed with a paragraph only.

- i. If so, provide specifics.

A: -

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No

- i. If so, provide specifics.

A: -

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

- i. If so, provide specifics.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A:

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: The last chapter of the guideline (Disaster and Emergency Management Focused on Earthquake)

- i. If so, provide specifics.

A: The chapter contains shoring and supporting systems to stabilize the existing situation of the building and prevent further damage. The design, shape and sizes of the elements are defined by prepared charts. Depending on the span, height of the structure, shoring and supporting systems are defined. Mostly timber elements are defined, and connection details are provided as well.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

INTERNATIONAL EXISTING BUILDING CODE (IEBC) 2021

(US DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Terrence Paret/Veronica Timpane
2. Date of the report
A: August 7, 2025
3. Title of the document analysed
A: 2021 International Existing Building Code
4. Publisher
A: International Code Council
5. Date of issue
A: December 2020
6. Country of publication
A: USA
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: Both
10. Type of action addressed (seismic, other actions, general)
A: General; includes specific provisions for seismic, wind, snow, alterations, repair, etc.
11. General description of the document
A: Provisions for work performed on existing structures intended to either allow relaxed compliance or mandate full compliance with current building codes, depending on the nature, cause and extent of the intended work.
12. Chapters/sections of the document with the research topic described
A: All chapters are potentially relevant, but of particular relevance are Section 304: Structural Design Loads and Evaluation and Design Procedures, Chapter 12: Historic Buildings, and Appendix A: Guidelines for the Seismic Retrofit of Existing Buildings

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes, there is a chapter dedicated to historic structures

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: The document was originally developed for generic existing structures. Since its original writing, the treatment of historic structures has varied, sometimes only warranting mention in a small subsection. The chapter dedicated to historic structures was added relatively recently. Portions of the document define/carve out exemptions/ alternative compliance pathways for historic/ heritage construction.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: Relative to the provisions in the document that specifically relate to historic structures, yes.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: Historic structures are required to be either:

- Listed on the United States National Park Service's National Register of Historic Places (National Register)
- Certified as eligible for listing on the National Register by relevant authorities
- Designated historic by state or local law
- Certified as a „contributing resource“ to a National Register, state or locally designated historic district

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Historic structures not satisfying any of the four bulleted requirements above would be required to be treated as generic existing buildings without any special consideration given to preservation/conservation/relaxation.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: Yes, it was developed specifically for a broad class of existing structures. Over time, newer editions of the document gradually came to address the subclass of historic structures. Currently, there is a chapter specifically applicable to historic structures with various other references to them scattered around the document.

- c. Does the document appear to be based primarily on or derived from some other document?
 - i. If so, identify the source document.

A: The document has a long history. In the western United States, existing and historic buildings used to be regulated by the Uniform Code for Building Conservation (UCBC) and by Section 104 of the Uniform Building Code (UBC). In the 1990s, UBC Chapter 34 of the became the repository for the regulatory language for existing and historic buildings and generally permitted repairs to be made “in-kind”, but following the Northridge earthquake, engineers in California sought to develop regulations for existing buildings to require seismic improvements if they were damaged by an earthquake. and, in the course of various attempts to update these documents, the IEBC was eventually formulated.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: Yes

- i. If a Standard, are jurisdictions required to accept its use and application?

A: Yes, although it can be locally amended to incorporate local issues

- ii. Do jurisdictions routinely accept the use of the Standard?

A: Yes

- b. Is the document for guidance only?

A: No

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: N/A since its adoption is required.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: There are various types of “methodologies” in the document, presented with varying degrees of detail. In its main portion, the document sets forth methodologies for

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

determining if seismic strengthening may be “triggered” by other work that may be planned, for example, consequent to repair of damage that has occurred, and consequent to alterations. While specifics for these “triggering” methodologies, such as the “loss of capacity” in case of damage or the “increase in demand” in case of alteration that requires strengthening, are provided, neither guidance nor any method for calculating these differences is provided in the document.

In addition, one of the appendices, Appendix A, „Guidelines for the Seismic Retrofit of Existing Buildings“, contains methodologies for assessing different types of construction independent of damage they may have experienced. The four sub-chapters address:

- 1) Unreinforced masonry buildings
- 2) Reinforced concrete and reinforced masonry wall buildings with flexible diaphragms
- 3) Cripple walls and sill plate anchorage in light, wood-frame residential buildings
- 4) Wood-frame residential buildings with soft, weak, or open front walls

- b. If so, is the methodology for assessment or for retrofit design?

A: The methodologies in Appendix A typically provide analysis and design requirements. In some cases, provisions for assessment of the condition of existing materials are provided as well, such as in methodology 1, which includes testing requirements and suggested material strengths for unreinforced masonry.

- c. Is the methodology recommended or required?

A: The methodologies that relate to triggering of strengthening are required to be followed but the Appendix A methodologies are recommended as a way to ensure compliance with the relaxed requirements allowed by this standard for some types of work and may or may not be adopted universally.

- i. Is the recommended or required methodology primarily a checklist?

A: No.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: The methodologies to trigger strengthening in the main text of the document are prescriptive. They define levels of damage (by associated “loss of capacity”), increases in demand, or other specific actions, such as changing a building’s use, and require that the engineer must bring the structure into compliance with full current code provisions if any of those have occurred.

The Appendix A methodologies are more varied. Methodology 3 is fully prescriptive to the point where it is intended to be implemented by a contractor without the involvement of an engineer. Methodology 1 has prescriptive requirements such as where and how many tests shall be done to determine building material condition

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

and what strengths shall be used for existing and new materials. Methodology 4 has a prescriptive option which sets out details down to bolt size and spacing.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: The trigger methodologies in the main text of the document require calculations but do not spell out how the calculations are to be performed. For example, though the trigger based on damage requires calculation of loss of capacity, the document does not inform the user how to calculate loss of capacity for any material or structural system. In contrast, Appendix A methodologies 1, 2, and 4 all tell the engineers the specific calculations that need to be performed.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: The trigger methodologies are universal for all existing buildings. The Appendix A methodologies depend on the configuration and construction materials of the structure as outlined above.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: The preamble language in the document essentially states that its goal is to provide less stringent criteria for existing buildings than for newly constructed ones, but in reality, for typical existing buildings, this is a glass half full or glass half empty situation. The IEBC purports that its purpose is to allow for relaxation of compliance with current building codes when work is being performed, however, its inclusion of requirements that trigger complete seismic upgrades when certain other work is being performed is the opposite of relaxation since it actually can result in very extensive disruption that extends far beyond the zone originally contemplated for the work. It is true that triggered complete seismic upgrades may in some cases be based on lower seismic forces than would be required for a newly constructed building, but the presence of these triggers is itself not a relaxation; rather, the triggers create a requirement to upgrade that would not otherwise exist.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: The purpose for the document and for the relaxation is stated to be “to encourage the use and reuse of existing buildings while requiring reasonable upgrades and improvements”.

- ii. Identify what the document sets forth as the reasons why relaxation is sought

A: The document states that “rehabilitation is often cost-prohibitive because compliance with all the requirements for new constructions could require extensive

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

changes that could go well beyond the value of the building or original scope of the alterations”... and that “to ensure that new construction [within an existing building] complies with the current building codes and that existing conditions are maintained, at a minimum, to their current level of compliance or are improved as required to meet basic safety levels... this code allows for options for controlled departure from full compliance with the Code dealing with new construction, while maintain basic levels for fire safety, structural and life safety features of the rehabilitated building.”

- iii. Identify the ways that the document allows for relaxation

A: Relaxation with respect to seismic safety is provided primarily by reducing the forces required on the demand side and by waving some prescriptive requirements for new construction. However, as noted above, for non-historic existing buildings, the incorporation of explicit triggers for seismic strengthening when the extent of damage repair or alterations exceed certain thresholds first creates the requirement for upgrading. Relaxation it allows is secondary to that. For historic buildings, the relaxation allowed by the document is somewhat greater in that damage repair is not a trigger for seismic strengthening.

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: Ostensibly, the document allows for demand side relaxation (as compared to design requirements for new construction in the current code) by allowing some existing structures to be analyzed for reduced seismic forces. However, as noted above, the document is also responsible for introducing the requirement that some structures be upgraded, as well as a methodology by which existing buildings are required to be analyzed and strengthened when undergoing unrelated work, so this “demand side” relaxation from current code requirements is actually relaxation from a more stringent requirement that this document created.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: The force reduction is stated as 75% of current code values. This is an effective relaxation of the return period, but not an explicit one. There is an alternate approach that allows for the use of ASCE 41 with a shorter return period earthquake in lieu of this 75% force reduction.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: Upgrades are not required if gravity load is not increased by more than 5%. If work does not change the live load on an element, existing elements are allowed to be evaluated and designed for the live load they were originally designed for rather than what would be required in new codes. Reduced wind loads are also allowed for some situations.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: One of the optional methodologies in Appendix A sets forth strength limits for materials.

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: They are typically comparable, but some are relaxed and some are strengthened. The central focus seems to be on providing design loads and assessment/design procedures for materials and systems not commonly used in modern construction.

2. If so, identify which.

A: One of the methodologies in Appendix A is for strengthening unreinforced masonry bearing wall buildings. Some examples of adjustments relative to current code include the capacities of crosswalls used to support seismic load from masonry. When such walls consist of plywood sheathing installed directly to wood studs, these walls are given a strength of 1.2 times the value specified in the current building code, while drywall or plaster applied on top of sheathing on wood studs is given half the value specified in the current building code.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: No.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

2. If so, identify which.

A: N/A

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Yes, the optional methodologies for strengthening unreinforced masonry structures and for wood-framed residential buildings with soft, weak, or open front walls invoke drift limits.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: Some of the unreinforced masonry drift limits are more strict.

2. If so, identify which.

A: Drift limits for new braced frames, moment frames, and shear walls in unreinforced masonry retrofits are capped at 1.5% rather than the 2.5% typical for such systems in current code. Moment frames in the same line with masonry wall lines are capped at 0.75% drift.

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: Yes, though not for seismic forces.

- i. If so, provide specifics.

A: Non-structural provisions allow for relaxation of requirements when buildings are converted from another occupancy into museums. Structurally, the code permits operational controls as a means of limiting gravity loads.

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: An optional way of complying with the IEBC is to use ASCE 41's retrofit methodology with certain target „performance objectives“. These objectives are defined as a function of the occupancy and use of the building, which in this methodology is called the „Risk Category“ of the building.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: With reference to ASCE-41 (which is an option allowed by the IEBC), historic/ heritage structures with relatively typical occupancy (Risk Category I and II) and use target „Life Safety“ performance for a 225 year earthquake and „Collapse Prevention“ with a 975 year earthquake. High occupancy (Risk Category III) historic/ heritage structures target „Damage Control“ and „Limited Safety“ for these same return periods, respectively, while a historic/ heritage structure that has a critical occupancy (Risk Category IV), for example a historic building that serves as a hospital, would target „Immediate Occupancy“ and „Life Safety“ for these same return periods.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: With reference to the optional use of ASCE-41 to comply with IEBC provisions, the performance targets for non-historic existing structures depend on where a project falls in the trigger methodologies. If the scope of work under consideration does not trigger seismic upgrades, the performance targets for non-historic existing building are the same as those for historic/ heritage structures, see above. If the scope of work triggers upgrade requirements, the performance targets are the same as they would be for new building.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes.

1. If so, provide specifics.

A: There are lesser targets for buildings with lower occupancy or occupancies with less associated risk (i.e. an office has lower assumed risk than a childcare facility).

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Yes.

1. If so, provide specifics.

A: If you limit occupancy you can remove yourself from the higher risk categories, which reduces your performance targets.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes, some of the recommended methodologies in Appendix A target the elimination of specific vulnerabilities and in that way only actually require partial-strengthening of the building.

- i. If so, provide specifics.

A: Appendix A methodology 2’s requirements for retrofit of reinforced concrete and reinforced masonry wall buildings with flexible diaphragms only requires that anchorage between the diaphragms and walls and having a specific capacity be installed and that the diaphragm itself be retrofitted to develop these anchorage forces back. Since the walls in these structures are not required to either be analyzed or strengthened, methodology 2 clearly requires only partial-strengthening. Similarly, Appendix A methodology 3 is intended only to strengthen cripple walls and anchor sill plates in wood-framed residential structures without addressing any portion of the superstructure. Appendix A methodology 4 addresses

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

only “soft-story” behavior and is also only intended to remedy short, weak, or open wall lines in residential buildings, and while it requires that the upper stories be considered in analysis, no modification outside of the target story is required.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: In the majority of cases, but not all.

- i. If so, provide specifics.

A: If the trigger methodologies require that a building be brought into compliance with new code forces, the retrofit must then address all vulnerabilities in the structure. Similarly, if the trigger methodologies require that a building be brought into conformance with reduced code forces, the full building must also be retrofitted, but that reduced force level, and addressing all vulnerabilities unless it is one of the three types of structures with a partial strengthening methodology in Appendix A (see above for specifics).

However, nothing in the code prohibits partial upgrade if retrofit is being implemented optionally rather than being forced by a code trigger.

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No

- i. If so, provide specifics.

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: No different qualifications or specialized expertise are required to work on heritage structures than would be required for any other structure, new or existing.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: N/A

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No.

- i. If so, provide specifics.

A: N/A

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes.

- i. If so, provide specifics.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: When a building qualifies as „historic“ for the purposes of the document, a report shall be written by a design professional that identifies safety features that have been done in compliance with the historic provisions and how complying with the typical existing building requirements instead would damage the historic features. For buildings in high-seismic regions, this report needs to also include a structural evaluation that describes the vertical and horizontal elements of the lateral force-resisting system, any strengths and weaknesses therein, and each feature that is not in compliance with the strict requirements provides an equivalent level of safety by other means.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No.

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: Not explicitly.

- i. If so, provide specifics.

A: Conditions deemed to be „unsafe“ by local officials must be remedied. The code also allows for emergency repairs to be performed without permits. No specific consideration is given to heritage structures in either of these provisions.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

2022 CALIFORNIA HISTORICAL BUILDING CODE

(US DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Terrence Paret/Alan Dreyfuss
2. Date of the report
A: June 30, 2025
3. Title of the document analysed
A: 2022 California Historical Building Code
4. Publisher
A: International Code Council
5. Date of issue
A: July 2022
6. Country of publication
A: USA
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory only for State of California-owned qualified historic buildings; voluntary for all other owners
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: not limited but contains dedicated provisions for masonry, adobe, wood, concrete, steel and iron, hollow clay tile
9. Status of the structure addressed (existing, historic, both)
A: historic only
10. Type of action addressed (seismic, other actions, general)
A: seismic
11. General description of the document
A: The purpose of the CHBC is to provide regulations for the preservation, restoration, rehabilitation, relocation or reconstruction of buildings or properties designated as qualified historical buildings or properties. It is a unique code in that it is the only U.S. State code developed specifically for and entirely for historic structures. It is fundamentally performance-based in that it provides great latitude to the designer and to the jurisdiction.
12. Chapters/sections of the document with the research topic described
A: all, the document is dedicated to historic structures

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: Yes

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: Yes

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: It can be used for any designated or eligible "qualified" historic structure (as defined within the document) on a voluntary basis but is required to be used for State of California-owned designated qualified or eligible structures.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: Defined intentionally broadly. "Any building, site, object, place, location, district or collection of structures and their associated sites, deemed of importance to the history, architecture or culture of an area by an appropriate local, state or federal governmental jurisdiction. This shall include historical buildings or properties on, or determined eligible for, national, state or local historical registers or inventories, such as the National Register of Historic Places, California Register of Historical Resources, State Historical Landmarks, State Points of Historical Interest, and city or county registers, inventories or surveys of historical or architecturally significant sites, places, or landmarks."

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: N/A, see a.ii.1

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: No. Its intent is stated as "The intent of the CHBC is to facilitate the preservation and continuing use of qualified historical buildings or properties..."

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No. Developed specifically for historic structures.

- c. Does the document appear to be based primarily on or derived from some other document?
- i. If so, identify the source document.

A: No, it was developed in California.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: It is a Code [The California Historical Building Code] but unique among California codes, it is also written into law (the Health and Safety Code).

- i. If a Standard, are jurisdictions required to accept its use and application?

A: Yes, though most local jurisdictions are relatively unfamiliar with it and try to enforce the use of the code for regular buildings (new construction) in lieu of the CHBC

- ii. Do jurisdictions routinely accept the use of the Standard?

A: Mixed, usually has to be negotiated.

- b. Is the document for guidance only?

A: No, though it can be used purely as guidance by owners other than the State of California.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: N/A. Adoption is not optional.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: "Approaches" rather than methodologies and at a very conceptual level. There is an overarching ethos that any reasonable approach alternative that provides an equivalent level of safety as the regular code can be used.

- b. If so, is the methodology for assessment or for retrofit design?

A: Potentially for both if they are required (but also for repairs, alterations, additions as necessary for preservation, restoration, rehabilitation, moving or continued use). Notably though, "qualified historical buildings or properties may have their existing use or occupancies continued if such use or occupancy conformed to the code or to the standards in effect at the time of construction, and such use or occupancy does not constitute a distinct hazard to life safety as defined in the CHBC." A distinct hazard relates to an immediate hazard, not, for example, a potential seismic event. So, no assessment or retrofit is required by the CHBC without some triggering event.

- c. Is the methodology recommended or required?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: The main “approach” for assessment and retrofit is not required and is not “triggered” by any provision in the CHBC. It can only be triggered by some other ordinance or requirement. Notably, “qualified historical buildings or properties may have their existing use or occupancies continued if such use or occupancy conformed to the code or to the standards in effect at the time of construction, and such use or occupancy does not constitute a distinct hazard to life safety as defined in the CHBC.” A distinct hazard relates to an immediate hazard, not a potential seismic event. So, no assessment or retrofit is required by the CHBC without some triggering event.

- i. Is the recommended or required methodology primarily a checklist?

A: No.

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: Generally true with some exceptions. For example, h/t (height-to-thickness) limits for masonry walls are provided, as are strength limits for wood diaphragms, adobe, and other archaic materials, but testing and alternative approaches to those set forth are permitted. Wind and seismic loads utilized can be 75 percent of those in the regular code, however, these provisions are not “triggered” except by some authority outside the CHBC.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: No. The CHBC is very general and “performance based”.

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: No, however in the structural chapter (which is not triggered), a design base shear of 75 percent of that set forth in the regular code is allowed, though alternative approaches can still be used.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: No.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes. Its allowance for alternative approaches is spelled out throughout the document.

- i. Identify the reasoning provided as to why the document allows for relaxation

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: The document states “The intent of the CHBC is to save California's architectural heritage by recognizing the unique construction problems inherent in historical buildings and by providing a code to deal with these problems.”

- ii. Identify what the document sets forth as the reasons why relaxation is sought

A: To promote preservation.

- iii. Identify the ways that the document allows for relaxation

A: Primarily by expressly affording the engineer the ability to use alternative approaches while “providing reasonable safety for the building occupants...”

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: Potentially both.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes. One approach sets forth 75 percent of the wind and seismic forces in the regular code but alternative approaches beyond that are still allowed.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Not explicitly mentioned but not ruled out.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: Yes

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: Yes, but testing and alternative approaches are permitted to be used.

- 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A because the materials whose capacities are tabulated are not permitted in the regular code for new buildings.

- 2. If so, identify which.

A: masonry and adobe; wood diaphragms

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: None provided. Deformation and strain are not mentioned.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: Since there are no stated limits, it would appear that these are completely relaxed.
2. If so, identify which.
A: N/A
- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?
A: None provided. Displacement and drift are not mentioned.
 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: Since there are no stated limits, it would appear that these are completely relaxed.
 2. If so, identify which.
A: N/A
- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?
A: None specifically mentioned but none ruled out.
 - i. If so, provide specifics.
A: None mentioned
- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?
A: Yes.
 - i. Provide specifics as to what the stated performance targets are for historic/heritage structures.
A: There is just one: “a reasonable level of safety for building occupants and access for persons with disabilities.” Notably also, “Qualified historical buildings or properties may have their existing use or occupancies continued if such use or occupancy conformed to the code or to the standards in effect at the time of construction, and such use or occupancy does not constitute a distinct hazard to life safety as defined in the CHBC.” A distinct hazard relates to an immediate hazard, not a potential seismic event.
 - ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.
A: N/A
 - iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Not specifically. Again, performance targets also would not apply if the building were not required to be assessed or retrofitted.

1. If so, provide specifics.

A: N/A

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Not specifically, but a short paragraph applies to historic high rise buildings, so occupancy numbers are implicitly involved for just that. A change in occupancy is expressly permitted without requiring the building to comply with all new construction requirements in the regular code, but, for example, the number of exits required by regular code for the new occupancy must be provided.

1. If so, provide specifics.

A: N/A

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes, the document states, “Nothing in these regulations shall prevent voluntary and partial seismic upgrades when it is demonstrated that such upgrades will improve life safety and when a full upgrade would not otherwise be required.” Its express encouragement of preservation and alternative approaches that provide a reasonable level of safety also could be interpreted as intended to encourage partial strengthening where that would achieve the intended ends.

- i. If so, provide specifics.

A: N/A

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: Definitely not. Its ethos is definitely quite opposite.

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: Not expressly but also no language prohibiting gradual implementation. Its express encouragement of preservation and alternative approaches that provide a reasonable level of safety could be interpreted as intended to encourage gradual implementation where that would achieve the intended ends

- i. If so, provide specifics.

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: Yes, with respect to conduction of a “structural survey”

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: “an architect or engineer knowledgeable in historic structures”

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No

- i. If so, provide specifics.

A: N/A

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes, when the structural adequacy of the structure is required by an ordinance to be assessed a structural survey is to be performed.

- i. If so, provide specifics.

A: “The survey shall evaluate deterioration or signs of distress. The survey shall determine the details of the structural framing and the system for resistance of gravity and lateral loads. Details, reinforcement and anchorage of structural systems and veneers shall be determined and documented where these members are relied on for seismic lateral resistance. The results of the survey shall be utilized for evaluating the structural capacity and for designing modifications to the structural system to reach compliance with this code.”

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: Yes.

- i. If so, provide specifics.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: 1) For “unsafe buildings” as defined in the CHBC, the CHBC is “applicable to work necessary to correct the unsafe conditions. Work to remediate the buildings of properties need only address the correction of the unsafe conditions, and it shall not be required to bring the entire qualified historical building or property into compliance with regular code.”

2) “Where an emergency is declared and a qualified historical building or property is declared an imminent threat to life and safety, the state agency assessing such a threat shall consult with the State Historical Building Safety Board before any demolition is undertaken....” No similar language is provided where no state agency is involved.

3) “Repairs to any portion of a qualified historical building or property may be made in-kind with historical materials and the use of original or existing historical methods of construction, subject to conditions of the CHBC.”

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

SEISMIC EVALUATION AND RETROFIT OF EXISTING BUILDINGS (ASCE/SEI 41-23)

(US DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Terrence Paret/Hayley Proctor/Katelyn Dill
2. Date of the report
A: June 30, 2025
3. Title of the document analysed
A: Seismic Evaluation and Retrofit of Existing Buildings (ASCE/SEI 41-23)
4. Publisher
A: American Society of Civil Engineers (ASCE)
5. Date of issue
A: December 2023
6. Country of publication
A: United States
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory except where specified by code or ordinance. "The evaluation and retrofit requirements are intended to be used for either mandatory Requirement by an Authority Having Jurisdiction or for voluntary applications."
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: Existing but does not exclude historic
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: This document is a standard that addresses the evaluation and retrofit of existing buildings for seismic hazards. It "describes deficiency-based and systematic procedures that use performance-based principles to evaluate and retrofit existing buildings to withstand the effects of earthquakes."
12. Chapters/sections of the document with the research topic described
A: The document applies to all existing buildings, not specifically historic structures. Commentary Section C1.1 discusses the application of the standard to historic buildings in general terms.

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: No

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: Neither. It was developed for the broad class of existing buildings and only mentions historic construction is passing.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No

1. If so, how is historic/heritage defined and what type of official designation is required?

A: N/A

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Not really, see 13.b.

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes, the document states that it is intended to be applicable to all buildings, including historic structures. It recognizes, though essentially parenthetically, that there may be additional challenges in evaluation and retrofit work for historic buildings that may require adjustments to performance criteria and different techniques to be used for certain evaluation and retrofit tasks.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: The document was developed for all existing buildings, and there is not a specific section for historic structures

- c. Does the document appear to be based primarily on or derived from some other document?
- i. If so, identify the source document.

A: Yes, ASCE 41-13 and onward are a combination of ASCE/SEI 31-03: Seismic Evaluation of Existing Buildings and ASCE/SEI 41-06: Seismic Rehabilitation of Existing Buildings. Reaching back to shortly before the earliest edition of ASCE 41 in 2006, the immediate predecessor document was FEMA-356 Prestandard and Commentary for the Seismic Rehabilitation of Buildings (2000). The predecessor

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

document to this was FEMA-273 NEHRP Guidelines for the Seismic Rehabilitation of Buildings (1997).

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?
A: The document is a Standard that can be required to be used (or specified as an alternative option) by various codes and/or ordinances. For example, the Federal Government (via another document entitled RP10) essentially requires the use of ASCE 41 for seismic assessment of all buildings occupied by the government. These codes and ordinances are typically focused on a broader class of existing buildings than historic or heritage structures.
 - i. If a Standard, are jurisdictions required to accept its use and application?
A: It depends. The Federal Government is required to accept its use for its buildings, but other jurisdictions that are not required to accept its use often do.
 - ii. Do jurisdictions routinely accept the use of the Standard?
A: Yes
- b. Is the document for guidance only?
A: No
 - i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?
A: N/A: it is a Standard.

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?
A: The document “describes deficiency-based and systematic procedures that use performance-based principles to evaluate and retrofit existing buildings to withstand the effects of earthquakes”. There are multiple methodologies set forth in the document, including checklists for very basic evaluations, linear elastic procedures, non-linear static procedures and non-linear dynamic procedures.
- b. If so, is the methodology for assessment or for retrofit design?
A: Both
- c. Is the methodology recommended or required?
A: There are limits regarding the applicability of each of the procedures but ASCE 41, when required to be used, requires the use of the procedures set forth in the document.
 - i. Is the recommended or required methodology primarily a checklist?
A: It depends. The most basic level of evaluation is a checklist. However, for more advanced levels of evaluation and all levels of retrofit, the methodology is not a checklist.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: No. The various methodologies are prescriptive and step-by-step in nature.

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: Yes

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: Yes.

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: Yes, for each type of analysis (linear elastic, response spectrum, pushover, and response history), the document describes the limitations and benefits of use for various types and configurations of buildings.

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes, but in some important respects, the relaxation is fictitious. While the document states that it aims for relaxation in comparison to the code for design of new buildings by using lower return period seismic hazards, it is unclear if that is true in practice for a variety of reasons that are far beyond the scope of this survey. As one example of this, new buildings that are designed per the current building code for new construction have been found to fail the ASCE 41 requirements when those requirements are applied to them, which means that the requirements for existing buildings using this Standard may in reality be higher than those required by current code for new buildings in certain cases – despite the document’s ostensible intent. In order to determine if ASCE 41 realized actual relaxation for any building, one would likely have to study that building in depth using both ASCE 41 and the code governing new construction. The complexity of the procedures renders simplified judgements about relaxation offered by ASCE 41 moot, despite that certain provisions such as definition of a “basic performance objective” (which is more relaxed than the performance objective for a new building) and its allowance for the selection of “limited [lower] performance objectives” appear to promise substantial relaxation.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: There appears to be an implied understanding that some existing buildings may be able to achieve the desired level of safety without full compliance with all the requirements in the current code governing new construction, however the likelihood of most unstrengthened existing buildings “passing” any of the ASCE 41

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

tests is minimal. Moreover, there appears to be an implicit bias that more sophisticated and complex analysis than is required by the code for new construction will reduce the need for conservatism in assessment and design.

- ii. Identify what the document sets forth as the reasons why relaxation is sought
- iii. A: The “basic performance objective” for existing buildings in ASCE 41 “accepts a lower level of safety and a higher risk of collapse than what is provided by similar standards for new buildings.” The document outlines that the reasons for accepting a somewhat greater risk in existing buildings are: 1) “...to ensure that recent buildings are not immediately rendered deficient whenever the code changes”; 2) the remaining life of the existing building is likely less than a new building; and 3) “the cost of achieving the higher level of certainty in performance that comes with “new building equivalence” is often disproportionate to the incremental benefit.”

Identify the ways that the document allows for relaxation

A: The document ostensibly provides multiple avenues for relaxation, though as noted, some are fictitious and relaxation manifested in one aspect of a methodology may be more than reversed out back by other aspects. That said, different performance objectives, seismic demands with different return periods from those in the code, etc. appear on their face to provide for some relaxation.

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: Both, often in combination. In ASCE 41, a “performance objective” is a pairing of a seismic hazard level (demand side) and a target performance level (capacity side). Changes to either or both of these change the performance objective of a retrofit.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, seismic forces may be relaxed for specified seismic hazard level; e.g., BSE-2E (5% in 50 years), one of the standard hazard levels for existing buildings, has ground motions approximately 75% as large as those required for new construction. The actual reduction in seismic forces, however, will vary as a function of the shape of the hazard curve for the site; the spectral ordinates are capped at 100% of those required for new construction.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: Yes, see 16.a.v., but in ASCE 41 this is a complex question.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Yes, load combinations are $1.1(D+L+S) + 1.0E$ for linear procedures and $1.0(D+L+S) + 1.0E$ for nonlinear procedures with live load taken as 25% of the unreduced live load used in design of new buildings and snow load is taken as either 0 or 15% of the snow load used in design of new buildings. Therefore, for linear procedures, the load combination becomes $1.1D+0.275L+0.165S+1.0E$. This is in contrast to load combination $1.2D+0.5L+0.2S+1.0E$ often used for the design of new buildings. Wind is not considered.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: Yes, these are detailed in the material chapters of ASCE 41 (Chapters 9-13). Strength is used in linear procedures while deformation is used in nonlinear procedures.

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: Performance-based design uses expected material strength values which are greater than the nominal strengths typically used in new construction. ASCE 41 recognizes that the capacity of existing building materials is dependent on many other factors (e.g. detailing), which could impact this potential relaxation. Components that are expected to have ductile mechanisms (called deformation-controlled), are assigned prescriptively m-factors to adjust the component strength based on the expected ductility capacity. Components that are expected to have brittle mechanisms (called force-controlled), have more limited adjustments to component strengths. Despite the terminology, deformation-controlled components are evaluated for strength limits when using linear procedures. The extent of m-factor adjustment is based on the selected performance level(s).

2. If so, identify which.

A: Member strength (Depends on considerations above)

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: Yes, these are detailed in the material chapters of ASCE 41 (Chapters 9-13). Deformation is used in nonlinear procedures while strength is used in linear procedures.

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: Yes, it appears that deformation capacity is intended to be greater than would be permitted in the codes that govern new construction, however the deformation capacity permitted is related to the performance level actually

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

used. It is also not straightforward because effective deformation capacity may be derivative of overall drift limits.

2. If so, identify which.

A: Rotation, total deflection, inelastic deflection, etc. (Depends on considerations above)

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: Most displacement capacities are limited on a component level rather than a global structural limit. However, peak transient story drift is limited to less than 6% (unless it can be demonstrated that the structure will remain stable past 6% drift).

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: Yes, these are related to the different performance levels specified

2. If so, identify which.

A: Interstory drift, global building drift, component deformations, etc. (Depends on considerations above)

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No, unless limiting the occupancy changes the risk category of the building.

- i. If so, provide specifics.

A: N/A

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Yes

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: N/A, target performance objectives are not defined as a function of whether a structure is historic or not.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: See attached table below

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Table 2-1. Structural Performance Levels.

Structural Performance Level	Designation	Post-Earthquake Damage State Description
Immediate Occupancy	S-1	The structure remains safe to occupy and essentially retains its pre-earthquake strength and stiffness.
Damage Control	S-2	A damage state between Performance Levels S-3 and S-1. Acceptance criteria for evaluation or retrofit based on the Damage Control Structural Performance Level shall be taken as halfway between those for Immediate Occupancy and Life Safety.
Life Safety	S-3	The structure has damaged components but retains a margin of safety against the onset of partial or total collapse.
Limited Safety	S-4	A damage state between Performance Levels S-3 and S-5. Acceptance criteria for evaluation or retrofit based on the Limited Safety Structural Performance Level shall be taken halfway between those for Life Safety and Collapse Prevention.
Collapse Prevention	S-5	The structure has damaged components and continues to support gravity loads but retains no margin against collapse.
Structural Performance Not Considered	S-6	Used where an evaluation or retrofit does not address the structure.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: Yes

1. If so, provide specifics.

A: When the basic performance objective is selected, the performance levels vary by risk category (as defined in ASCE 7 or the applicable code). In other words, for a building with a higher risk category—which is a function of building occupancy and use—the required performance level is higher.

Table 2-3. Basic Performance Objective for Existing Buildings (BPOE).

Risk Category	BSE-1E	BSE-2E
I and II	Life Safety Structural Performance Life Safety Nonstructural Performance (3-C)	Collapse Prevention Structural Performance Hazards Reduced Nonstructural Performance* (5-D)
III	Damage Control Structural Performance Position Retention Nonstructural Performance (2-B)	Limited Safety Structural Performance Hazards Reduced Nonstructural Performance* (4-D)
IV	Immediate Occupancy Structural Performance Position Retention Nonstructural Performance (1-B)	Life Safety Structural Performance Hazards Reduced Nonstructural Performance* (3-D)

*Compliance with ASCE 7 provisions for new construction is deemed to comply.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: Yes.

1. If so, provide specifics.

A: In cases where the number of occupants changes the risk category of the building. For example, university buildings with occupant loads of greater than 500 or all buildings with occupant loads greater than 5000 are considered Risk Category III, which has a higher basic performance objective as seen above.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes

- i. If so, provide specifics.

A: The requirements for partial retrofits are outlined in section 2.4.5. In short, a partial retrofit must not exacerbate or create seismic vulnerabilities. It is up to the building authority to determine if a partial retrofit will be accepted. It is not common for jurisdictions to accept partial seismic retrofits unless the retrofit is initiated on a voluntary basis.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No

- i. If so, provide specifics.

A: N/A

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: No

- i. If so, provide specifics.

A: N/A

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: ASCE 41 doesn't explicitly cover heritage structures. It asserts that the different procedures and requirements should be applied by a “design professional”. Many sections of ASCE 41 also specify that a design review should be conducted by qualified engineers with language such as “an independent third-party engineer with experience in seismic design”, “experienced in the design and analysis of buildings incorporating seismic isolation”, etc. but specialized qualification and expertise with respect to preservation/conservation is not mentioned anywhere.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: Specific qualifications of a “design professional” are not detailed in ASCE 41, but it states a design professional is “The individual in responsible charge of the evaluation or retrofit design being performed using this standard.” It can be inferred that this

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

role requires licensure and seismic design experience, but not necessarily experience with heritage structures.

- b. Does the document anywhere state the required scope of the maintenance plan?

A: This document vaguely discusses maintenance plans for various components of retrofits such as base isolation units and dampers

- i. If so, provide specifics.

A:

- 14.2.3.8: "Seismically isolated buildings shall have a monitoring, inspection, and maintenance plan for the isolation system established by the design professional responsible for the structure including minimum requirements provided by the isolation system device manufacturer."
- 15.2.3.3: "The registered design professional (RDP) responsible for design of the structure shall establish an inspection, maintenance, and testing schedule for each type of damping device to ensure that the devices respond in a dependable manner throughout their design life. The degree of inspection and testing shall reflect the established in-service history of the damping devices and the likelihood of change in properties over the design life of the devices."
- 15.6.4: "The RDP shall establish maintenance and testing schedules for energy dissipation devices to obtain reliable responses of the devices over the design life of the structure. The degree of maintenance and testing shall reflect the established in-service history of the devices."

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No

- i. If so, provide specifics.

A: N/A

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

- i. If so, provide specifics.

A: N/A

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No

- i. If so, provide specifics.

A: N/A

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

FEMA P-420: ENGINEERING GUIDELINE FOR INCREMENTAL SEISMIC REHABILITATION

(US DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more "performance" than "prescriptive"; and some set forth clearer reasoning as to "relaxation" than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a "first pass" at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Terrence Paret/Hayley Proctor
2. Date of the report
A: June 30, 2025
3. Title of the document analysed
A: FEMA P-420: Engineering Guideline for Incremental Seismic Rehabilitation
4. Publisher
A: U.S. Federal Emergency Management Agency (FEMA)
5. Date of issue
A: May 2009
6. Country of publication
A: United States
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Nonmandatory guideline
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: Existing
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: This document is a resource for design professionals that outlines considerations for implementing incremental seismic rehabilitations. It is a companion to a series of nontechnical FEMA Incremental Seismic Rehabilitation (ISR) manuals for building stakeholders; these manuals outline considerations for specific building uses such as schools, hospitals, office buildings, multifamily apartment buildings, retail buildings, and hotels and motels. This document focuses on existing buildings and does not discuss considerations specific to historic buildings. Additionally, this document only discusses considerations and possible frameworks that engineers may rely on when performing incremental seismic rehabilitations and does not prescribe a methodology for seismic evaluation or retrofit of buildings.
12. Chapters/sections of the document with the research topic described
A: None

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
A: No
 - i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?
A: No
 - ii. Is the document specified to be applicable only to officially designated historic/heritage structures?
A: No
 - 1. If so, how is historic/heritage defined and what type of official designation is required?
A: N/A
 - 2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?
A: N/A
- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?
A: Yes, this document is specific to existing structures
 - i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?
A: Yes, this document is specific to existing structures
- c. Does the document appear to be based primarily on or derived from some other document?
 - i. If so, identify the source document.
A: No

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?
A: No
 - i. If a Standard, are jurisdictions required to accept its use and application?
A: N/A
 - ii. Do jurisdictions routinely accept the use of the Standard?
A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- b. Is the document for guidance only?

A: Yes

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: No

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: No

- b. If so, is the methodology for assessment or for retrofit design?

A: N/A

- c. Is the methodology recommended or required?

A: N/A

- i. Is the recommended or required methodology primarily a checklist?

A: N/A

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A: N/A

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A: N/A

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A: N/A

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A: N/A

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: No, this document does not outline a methodology, so there is no discussion of relaxation in an engineering sense. This document does refer to other documents that use performance objectives, which could be used to relax certain requirements (e.g.: ASCE 41). A second aspect of inferred relaxation stems from the facts that the document is intended to promote and facilitate incremental interventions with the justification that incremental interventions are better than delayed or no intervention, while incremental approaches are not normally explicitly permitted by building codes.

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARS AH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. Identify the reasoning provided as to why the document allows for relaxation
A: N/A
- ii. Identify what the document set forth as the reasons why relaxation is sought
A: N/A
- iii. Identify the ways that the document allows for relaxation
A: N/A
- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.
A: N/A

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: N/A
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
A: N/A
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
A: N/A

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
A: N/A
 - 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 - 2. If so, identify which.
A: N/A
- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?
A: N/A
 - 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: N/A
 - 2. If so, identify which.
A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

A: N/A

- 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A: N/A

- 2. If so, identify which.

A: N/A

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No

- i. If so, provide specifics.

A: N/A

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Yes, this document discusses various performance objectives and how a design professional may discuss the objectives with a building stakeholder. However, the document does not prescribe a methodology for achieving those performance objectives but rather refers the reader to performance-based U.S. standards (ASCE 31 and 41).

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: N/A

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: N/A

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: N/A

- 1. If so, provide specifics.

A: N/A

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A: N/A

- 1. If so, provide specifics.

A: N/A

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed;

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: The situation is nuanced. While the document explicitly promotes incremental retrofits that are implemented over time, it does not specifically promote incremental retrofits for the purpose of achieving only an “incomplete” retrofit. That said, by referencing “performance-based” documents like ASCE-41, it could be viewed as allowing retrofits that are less stringent than the seismic design requirements for new construction.

- i. If so, provide specifics.

A: “Because the premise of incremental seismic rehabilitation assumes that the building will be opportunistically upgraded over a period of time, there will be interim stages when the building is in a “partial” state of seismic upgrade. This requires that the design professional understand the potential consequences of prioritization and phasing of work.

The overarching design consideration for incremental seismic rehabilitation is to “do no harm” to the building. Each increment of work must improve the overall seismic performance of the building, and no increment should leave the building in a condition that is more vulnerable than it was when work was initiated.

Understanding the consequences of phasing, and effectively staging rehabilitation increments for improved performance, will likely require additional analyses of the partially upgraded building and multiple iterations in the design process.”

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No

- i. If so, provide specifics.

A: Because this document is only a guideline, it does not prescribe that all vulnerabilities be addressed.

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: Yes, the document discusses three types of prioritization: structural priority (which prioritizes specific high-impact vulnerabilities), use priority (which prioritizes higher occupancy loads or critical functions), and integration priority (which prioritizes opportunistic work).

- i. If so, provide specifics.

A: “Structural priority is influenced by relative impact on overall seismic performance. Deficiencies that will result in damage with a high consequence of casualties, property loss, or loss of use should be mitigated first. Similarly, rehabilitation measures that will have a large impact on reducing potential damage (and consequences resulting from that damage) should be implemented first.”

“Use priority is influenced by the importance of current building use and occupancy. Buildings with higher occupant loads, critical functions, or high-value equipment or property should be rehabilitated first. Similarly, important portions of a building, such as assembly areas and elements of the egress system (e.g., corridors, stairs, lobbies), should be rehabilitated before other less critical areas.”

“Integration priority is influenced by the potential for integrating rehabilitation measures into other building maintenance or capital improvement projects that are routinely scheduled. Integration priority is opportunistic in that seismic rehabilitation work is accomplished when other work is being undertaken, or when portions of the building are otherwise vacant. This reduces the cost of the seismic rehabilitation action by taking advantage of construction mobilization, access to the area of work, and disruption of occupancy and use that would have occurred anyway.”

17. Quality control, safety and reporting

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?
A: No
 - i. If so, provide specifics (i.e. type of attestation required and other requirements).
A: N/A
- b. Does the document anywhere state the required scope of the maintenance plan?
A: N/A
 - i. If so, provide specifics.
A:
- c. Does the document anywhere state the required or mandatory minimum contents of the report?
A: No
 - i. If so, provide specifics.
A: N/A
- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?
A: No
 - i. If so, provide specifics.
A: N/A

18. Emergency stabilization

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No

- i. If so, provide specifics.

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

PORTARIA No. 302/2019

(PORTUGUESE DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report
A: Alexandre A. Costa
2. Date of the report
A: 24/02/2026
3. Title of the document analysed
A: Portaria n.º 302/2019
4. Publisher
A: Ministry of Infrastructures and Housing
5. Date of issue
A: 12/10/2019
6. Country of publication
A: Portugal
7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)
A: Mandatory
8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)
A: General
9. Status of the structure addressed (existing, historic, both)
A: Existing (no distinction)
10. Type of action addressed (seismic, other actions, general)
A: Seismic
11. General description of the document
A: Summarizes the requirements where the vulnerability seismic assessment report of existing structures should be performed.
12. Chapters/sections of the document with the research topic described
A: Article 1

ISCARSAH WORKGROUP:
BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES
SUBGROUP:
**ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT
APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR
NEWER BUILDINGS**

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?
A: No
 - i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?
A: No
 - ii. Is the document specified to be applicable only to officially designated historic/heritage structures?
A: No
 - 1. If so, how is historic/heritage defined and what type of official designation is required?
A:
 - 2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?
A:
- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?
A: No
 - i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?
A:
- c. Does the document appear to be based primarily on or derived from some other document?
 - i. If so, identify the source document.
A:

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?
A: It is a standard.
 - i. If a Standard, are jurisdictions required to accept its use and application?
A: Always applicable.
 - ii. Do jurisdictions routinely accept the use of the Standard?
A: Yes

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- b. Is the document for guidance only?

A: No

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A:

15. Ethos

- a. Does the document set forth or identify or reference any specific methodology?

A: No

- b. If so, is the methodology for assessment or for retrofit design?

A: No

- c. Is the methodology recommended or required?

A: No

- i. Is the recommended or required methodology primarily a checklist?

A:

- ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?

A:

- iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?

A:

- iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?

A:

- v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?

A:

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Yes

- i. Identify the reasoning provided as to why the document allows for relaxation

A: The document states that, for the vulnerability seismic assessment phase, the seismic demand of 90% of the actions defined in NP EN1998_3:2017 (which is reduced when compared to NP EN1998-1:2010)

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: N/A

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- iii. Identify the ways that the document allows for relaxation
[A: Reduce seismic demand for assessment.](#)
- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.
[A: Demand](#)

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
[A: Yes](#)
- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?
[A: The document no. However, it refers NP EN1998-3:2017, where returning periods are lower for severe damage limit state when compared to NP EN1998-1:2010 \(according to National Annex\).](#)
- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?
[A: N/A](#)

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?
[A: No](#)
 - 1. Are these relaxed relative to the codes that govern requirements in new or recent construction?
[A:](#)
 - 2. If so, identify which.
[A:](#)
- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?
[A: No](#)
 - 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
[A:](#)
 - 2. If so, identify which.
[A:](#)
- x. Are any limits related to the displacement capacity of the structure, for example, interstory or building drift or displacement, set forth in the document?

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: No

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?

A:

2. If so, identify which.

A:

- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?

A: No

- i. If so, provide specifics.

A:

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: No

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A:

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A:

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A:

1. If so, provide specifics.

A:

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

A:

1. If so, provide specifics.

A:

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, “partial” here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: No

- i. If so, provide specifics.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A:

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A:

- i. If so, provide specifics.

A:

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A:

- i. If so, provide specifics.

A:

17. Quality control, safety and reporting
--

- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: No

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A:

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No

- i. If so, provide specifics.

A:

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: No

- i. If so, provide specifics.

A:

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: No

- i. If so, provide specifics.

A:

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- i. If so, provide specifics.

A:

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BUILDING CODES AND ISCARSAR PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

REPORT ON THE ANALYSIS OF REGULATORY DOCUMENTS

THE SEISMIC ASSESSMENT OF EXISTING BUILDINGS – TECHNICAL GUIDELINES FOR ENGINEERING ASSESSMENTS

(NEW ZEALAND DOCUMENT)

Overview:

- a. One of the challenges to developing a scope of relevant information to be collected from the document review is that the set of documents currently within our purview is highly varied. It includes both codes and guidance documents; documents developed primarily for new construction, or for the broader inventory of existing structures, or explicitly for heritage structures, or for some combination of those, etc. One of our hurdles is to understand which category each of the documents fits into.
- b. A second challenge is that some of the documents in the set might primarily address assessment, others primarily retrofitting, and others both.
- c. A third challenge is that some of the documents are more philosophical than methodological; some are more “performance” than “prescriptive”; and some set forth clearer reasoning as to “relaxation” than others.

The questions below are meant only to suggest the type of information we should be seeking to glean from the documents in a “first pass” at review. Based on this, perhaps a follow-up review of a more limited set of documents would be needed.

Legend:

A: ... Indicates the place to write the answer

ISCARSAH WORKGROUP:

BUILDING CODES AND ISCARSAH PRINCIPLES - HARMONIZATION OF SAFETY ISSUES

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Author of the report

A: Jitendra Bothara

2. Date of the report

A: 29 June 2026

3. Title of the document analysed

A: New Zealand Society for Earthquake Engineering. The Seismic Assessment of Existing Buildings – Technical Guidelines for Engineering Assessments. Wellington, New Zealand; July 2017, Version 1.

4. Publisher

A: Developed jointly by the New Zealand Society for Earthquake Engineering (NZSEE), the Ministry of Business, Innovation and Employment (MBIE), the Earthquake Commission (EQC), the Structural Engineering Society New Zealand (SESOC), and the New Zealand Geotechnical Society (NZGS).

5. Date of issue

A: July 2017 (Version 1).

6. Country of publication

A: New Zealand.

7. Status of legal validity (mandatory, nonmandatory and not accepted by authorities, nonmandatory but accepted by authorities)

A: The NZSEE Guidelines are technical guidance rather than legislation. However, their assessment methodology is incorporated into New Zealand's statutory earthquake-prone building framework established under the Building Act 2004, as amended by the Building (Earthquake-prone Buildings) Amendment Act 2016, together with the Building (Earthquake-prone Buildings) Regulations 2016 and the Earthquake-prone Building Methodology. Their use is therefore required for assessments undertaken under that framework. This report describes the statutory framework applicable at the date of the report. The Building (Earthquake-prone Buildings) Amendment Bill 2025 proposes substantial changes to this framework, but these are outside the scope of the present review.

8. Type of structure addressed (general, masonry, timber, adobe, rammed earth, reinforced concrete, steel, iron, other)

A: Existing buildings of all eras, construction types and materials. Detailed material guidance is provided for reinforced concrete, structural steel, moment-resisting frames with infill panels, unreinforced masonry, timber, geotechnical matters, and secondary structural and nonstructural elements.

9. Status of the structure addressed (existing, historic, both)

A: Existing buildings generally. Heritage buildings are included because they are existing buildings, but no separate heritage category or heritage-specific assessment method is provided.

10. Type of action addressed (seismic, other actions, general)

A: Seismic actions.

11. General description of the document

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: The Guidelines provide the principal technical methodology for assessing existing buildings within New Zealand's statutory earthquake-prone building framework.

The Guidelines comprise Part A, which sets out the objectives and principles; Part B, which provides the Initial Seismic Assessment methodology; and Part C, which provides the quantitative Detailed Seismic Assessment methodology. The assessment considers load paths, member strength and deformation capacity, likely inelastic mechanisms, global structural response, geotechnical effects, and secondary structural and critical nonstructural elements. The results are expressed as an earthquake rating in terms of the percentage of New Building Standard (%NBS), referenced to the minimum performance expected of a comparable new building on the same site. The Guidelines also outline principles for seismic improvement but are primarily assessment guidelines rather than a comprehensive retrofit design standard.

12. Chapters/sections of the document with the research topic described

A: Part A (Assessment Objectives and Principles) is most relevant, particularly Sections A1 (Introduction and scope), A3 (assessment basis and earthquake rating), A4 (assessment objectives and principles), A5 (regulatory applications), A6 (%NBS and earthquake rating), A8 (reporting), and A10 (improving seismic performance). Part B covers the Initial Seismic Assessment. Part C covers Detailed Seismic Assessment, especially Sections C1 to C3 and the material-specific Sections C5 to C10. Section C4 is dedicated for Geotechnical considerations.

13. Scope of the document

- a. Does the document anywhere state that it is intended to be applicable to historic/heritage construction and recognize the special nature of this class of structures?

A: No. The Guidelines do not separately identify or provide heritage-specific assessment provisions.

- i. Was the document as a whole developed specifically for historic/heritage construction or is there just a relatively small portion carved out for historic/heritage construction?

A: No. They were developed for existing buildings generally.

- ii. Is the document specified to be applicable only to officially designated historic/heritage structures?

A: No.

1. If so, how is historic/heritage defined and what type of official designation is required?

A: Not applicable. Heritage status is not defined in the Guidelines.

2. If specified to be applicable only to officially designated historic/heritage structures, does it provide alternative direction for historic/heritage structures that are not officially designated as such?

A: Not applicable. The assessment framework applies to existing buildings regardless of whether they are formally listed as heritage.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- b. Does the document anywhere state that it is intended to be applicable to a broad class of existing structures (not specifically historic structures) and recognize the special nature of this class of structures?

A: Yes. The Guidelines expressly state that they are specifically for the seismic assessment of existing buildings of all eras, construction types and materials. They recognise that assessment of an existing building is an investigative process and is not simply a reverse application of the design procedure for a new building.

- i. Was the document as a whole developed specifically for existing structures (not specifically historic structures) or is there just a relatively small portion carved out for existing structures?

A: The whole document was developed specifically for existing buildings.

- c. Does the document appear to be based primarily on or derived from some other document?

- i. If so, identify the source document.

A: The Guidelines are not derived from a single source document. However, they draw on New Zealand seismic loading standard (NZS 1170.5), relevant New Zealand material standards, the 2006 NZSEE assessment guidelines, international references including ASCE 41, experience gained since 2006, and the research and experience from the 2010–2016 New Zealand earthquakes.

14. Type of document

- a. Is the document a Standard or Code that is required to be used on assessment/retrofitting projects involving historic/heritage construction?

A: No. They are technical guidelines rather than a Standard or Code.

- i. If a Standard, are jurisdictions required to accept its use and application?

A: Not applicable.

- ii. Do jurisdictions routinely accept the use of the Standard?

A: Not applicable, as the Guidelines are not a formal Standard or Code. Their acceptance and statutory use are addressed under Q14(b).

- b. Is the document for guidance only?

A: The NZSEE Guidelines are technical guidance. However, the July 2017 Version 1 of *The Seismic Assessment of Existing Buildings – Technical Guidelines for Engineering Assessments*, including its subsequent amendments, must be used for engineering assessments undertaken to determine earthquake-prone building status under the statutory framework. Outside this statutory process, the Guidelines are widely used as technical guidance for the seismic assessment of existing buildings.

- i. Are jurisdictions required to accept its use and application, even if it is not adopted as a Standard or Code?

A: Yes. Territorial authorities must accept engineering assessments that satisfy the Earthquake-prone Building Methodology, which refers to the Guidelines as the technical basis for those assessments.

15. Ethos

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

- a. Does the document set forth or identify or reference any specific methodology?
A: Yes. It provides two principal assessment methodologies: the qualitative Initial Seismic Assessment (ISA) and the more comprehensive quantitative Detailed Seismic Assessment (DSA). The DSA may use force-based, displacement-based and nonlinear analytical procedures, selected to suit the structural system, available information and likely response mechanisms.
- b. If so, is the methodology for assessment or for retrofit design?
A: Primarily for assessment. Part A also provides principles for defining and evaluating seismic improvement, while the detailed design of new strengthening elements must comply with the Building Code and relevant current standards.
- c. Is the methodology recommended or required?
A: Required for statutory EPB assessments. For other assessments, it is recognised professional guidance, subject to the purpose of the assessment and any applicable current guidance.
 - i. Is the recommended or required methodology primarily a checklist?
A: No. Although the ISA uses structured steps and checklists, the methodology depends on holistic engineering assessment and judgement.
 - ii. Is the recommended or required methodology conceptual only, laying out no specific steps or calculations that are required?
A: No. It gives specific procedures, calculations, acceptance criteria and reporting requirements.
 - iii. Is the recommended or required methodology prescriptive in that it tells the engineer what to do?
A: Yes, to a significant extent. It identifies the assessment steps, information requirements, demand and capacity calculations, treatment of likely mechanisms and reporting format, while requiring engineering judgement.
 - iv. Is the recommended or required methodology quantitative in that it tells the engineer the calculations that need to be performed?
A: Yes. The DSA is quantitative and provides procedures for determining probable member and system capacities, earthquake demand, displacement capacity, likely governing mechanisms and the resulting %NBS.
 - v. Does the recommended or required methodology describe any particular analytical approach that the engineer can use as a function of structure type or configuration, construction materials, or anything else?
A: Yes. It provides different procedures and acceptance criteria for reinforced concrete, steel, infilled frames, unreinforced masonry, timber, geotechnical issues and secondary structural/nonstructural elements. The analytical method is selected according to the structural system, configuration, likely mechanism and available information.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

16. Relaxation

- a. Does the document anywhere state or imply that it is intended to allow for relaxation of any aspect of assessment/retrofit design requirements relative to the codes that govern new or recent construction?

A: Not expressly. The Guidelines describe their approach as an assessment of the probable performance of an existing building rather than as a general relaxation of new-building requirements. They permit the use of probable material properties and member capacities, together with the actual deformation capacity and likely inelastic response of the existing structure. Seismic demand and capacity are assessed separately, and the resulting earthquake rating is expressed as %NBS.

- i. Identify the reasoning provided as to why the document allows for relaxation

A: Existing buildings physically exist and their as-built characteristics, actual materials, detailing, deterioration and load paths can be investigated. The Guidelines therefore seek a realistic estimate of probable behaviour and life-safety risk, rather than applying all conservative assumptions and prescriptive detailing requirements used for new design.

- ii. Identify what the document set forth as the reasons why relaxation is sought

A: The approach enables proportionate assessment and management of seismic risk within the existing building stock, identifies buildings presenting significant life-safety risk, and supports practical and targeted seismic improvement.

- iii. Identify the ways that the document allows for relaxation

A: The principal allowances include the use of probable material properties and member capacities; strength-reduction factors typically taken as 1.0, subject to more conservative treatment of brittle mechanisms; explicit consideration of actual deformation capacity and likely inelastic mechanisms; expression of performance as %NBS; and targeted improvement of identified vulnerabilities.

- iv. Identify if the document provides for relaxation primarily on the “demand side”, the “capacity side”, or both.

A: Primarily on the capacity side. The Guidelines permit assessment using probable material properties, member capacities, deformation capacities and likely inelastic response. They do not generally reduce the site seismic demand or earthquake return period solely because a building is existing or heritage. The 34%NBS threshold relates to the statutory classification and remediation of earthquake-prone buildings rather than to a reduction in assessment demand.

Demand side

- v. Are the seismic forces to be used for the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: No general reduction factor is applied to the seismic forces solely because a building is existing or heritage. Seismic demand and probable capacity are determined separately and compared to derive %NBS. A strengthening design may

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

be undertaken to a selected target %NBS, but this is a target performance level rather than a reduction in the demand used for assessment.

- vi. Is the earthquake return period to be considered during the assessment/retrofit design relaxed relative to the codes that govern seismic requirements in new or recent construction?

A: No general shorter return period is prescribed solely because a building is existing or heritage. The earthquake demand is related to the applicable new-building reference requirements, including importance level and site hazard, and the building capacity is then expressed relative to that demand as %NBS.

- vii. Are the other actions (wind, vertical loads, etc.) to be used for the assessment/retrofit design relaxed relative to the codes that govern relevant requirements in new or recent construction?

A: No. The Guidelines are concerned with seismic assessment. Other actions and the design of new work remain subject to the Building Code and applicable standards.

Capacity side

- viii. Are any limits related to the capacity (strength, not deformation) of the building materials, for example, maximum stress, set forth in the document?

A: Yes. The material-specific sections provide procedures for determining probable strength capacities of existing members and connections.

1. Are these relaxed relative to the codes that govern requirements in new or recent construction?

A: In comparison with new-building design, the assessment capacity is generally less conservative because probable material properties and probable member capacities are used, rather than design values used for new construction. This is an assessment of expected existing capacity rather than a relaxation of minimum material quality requirements.

2. If so, identify which.

A: Examples include the use of probable or estimated mean material strengths and measured material properties where suitable investigation and testing are available. Probable capacities are typically calculated using a strength-reduction factor of 1.0, but more conservative treatment is required for brittle mechanisms. The applicable provisions vary with the material, action and failure mechanism.

- ix. Are any limits related to the deformation capacity of the building materials, for example, permissible strain, set forth in the document?

A: Yes. The Guidelines provide deformation and ductility acceptance criteria for different materials, elements and expected mechanisms, particularly within the material-specific sections and the assessment procedures in Section C2.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: They are not universally relaxed merely because the building is existing. The criteria aim to estimate probable deformation capacity of the as-built element, which may differ from the prescriptive deformation or detailing limits used for new construction.
2. If so, identify which.
A: The permitted deformation depends on the structural material, detailing, failure mechanism and analysis procedure. Examples include plastic or chord rotations, strain limits and member deformation capacities for concrete, steel, masonry and timber systems. Brittle or force-controlled mechanisms receive more restrictive treatment.
- x. Are any limits related to the displacement capacity of the structure, for example, interstorey or building drift or displacement, set forth in the document?
A: Yes. Global displacement capacity, interstorey displacement, displacement compatibility and stability are considered as part of the DSA.
 1. Are any of these relaxed relative to the codes that govern requirements in new or recent construction?
A: No general increase in permissible drift is provided solely because the building is existing. The assessment determines the probable displacement capacity of the actual structural system and checks gravity-load stability, compatibility and other life-safety consequences.
 2. If so, identify which.
A: No universal relaxed drift ratio is specified. Material- and mechanism-specific displacement limits are used, and limited departures from new-building drift expectations may be considered only where adequate lateral and vertical load-carrying capacity and compatibility are demonstrated.
- b. Does the document provide for relaxation of either demand or capacity contingent on other actions taken, for example, if limitations on occupancy or the addition of alternative escape routes are provided?
A: Not as a general mechanism within the Guidelines. Occupancy, use and consequences of failure influence the applicable importance level, assessment scope and regulatory requirements. The %NBS is determined against the seismic demand corresponding to that importance level. However, the Guidelines do not generally permit a direct reduction in demand or increase in capacity merely because occupancy is restricted or an alternative escape route is provided.
 - i. If so, provide specifics.
A: A genuine and legally recognised change in use or occupancy may alter the applicable importance level and therefore the reference seismic demand.

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

Administrative measures or informal occupancy restrictions are not substitutes for structural capacity in determining %NBS.

- c. Does the document describe any or a variety of options for the target “performance objectives” to be achieved by the retrofit?

A: Yes. Seismic performance is expressed as %NBS. Where a building or building part is classified as earthquake-prone, the statutory objective is to complete seismic work so that it is no longer earthquake-prone. Subject to any other applicable Building Act requirements, any higher improvement objective is generally selected by the owner.

- i. Provide specifics as to what the stated performance targets are for historic/heritage structures.

A: No separate target is prescribed for heritage buildings. Heritage significance may influence the selection of an intervention through planning, conservation and owner decisions, but the seismic assessment criteria are those for existing buildings generally.

- ii. Provide specifics as to what the stated performance targets are for existing structures if the document applies to the existing but not specifically to historic structures.

A: The Guidelines express seismic performance as %NBS but do not prescribe a single improvement target for all existing buildings. Under the statutory framework, a building or building part assessed below 34%NBS may be classified as earthquake-prone if the consequences-of-failure criterion is also satisfied. Where a building or building part is classified as earthquake-prone and strengthening is undertaken, the work must ensure that it is no longer earthquake-prone. A higher improvement objective may be selected by the owner or required under other applicable Building Act provisions.

- iii. Are the performance targets permitted to vary as a function of occupancy type/designation?

A: The percentage threshold itself does not vary with occupancy or designation. However, %NBS is calculated relative to the seismic demand applicable to the building's importance level, which reflects its use, occupancy and consequences of failure.

1. If so, provide specifics.

A: Buildings with higher occupancy, post-disaster functions or greater consequences of failure may have a higher importance level and therefore a higher reference seismic demand. The 34%NBS threshold itself remains unchanged. The criteria for importance levels are defined by the New Zealand Building Code and associated standards.

- iv. Are the performance targets permitted to vary as a function of limitations placed on the number of occupants in the building?

SUBGROUP:

ANALYSIS OF REGULATORY DOCUMENTATION TO CHARACTERIZE THE MORE RELAXED ASSESSMENT APPROACH FOR EXISTING AND ESPECIALLY HISTORIC STRUCTURES VERSUS THE APPROACH FOR NEWER BUILDINGS

A: Indirectly and case by case. Occupant numbers may affect importance level, change-of-use requirements and the statutory assessment of whether failure could cause injury or death to persons in or near the building.

1. If so, provide specifics.

A: The Guidelines do not provide a general formula for lowering the performance target merely because an owner imposes an occupancy limit. A genuine and legally recognised restriction or change in the building's use or occupancy may alter the applicable importance level and therefore the reference seismic demand, subject to acceptance by the territorial authority. An informal or temporary occupancy cap would not, by itself, justify reclassification.

- d. Does the document anywhere expressly allow for partial strengthening? [For the purpose of this question, "partial" here is intended to have broad meaning, for example, targeting only the high consequence vulnerabilities and leaving some vulnerabilities unaddressed; strengthening to a reduced seismic force level or earthquake return period; strengthening to a less stringent performance level whether measured by stress, strain, drift or displacement relative to requirements for new construction.]

A: Yes, in the broad sense used in this questionnaire.

- i. If so, provide specifics.

A: The Guidelines permit targeted seismic improvement addressing identified governing vulnerabilities. An owner may, for example, secure high-risk elements such as parapets or façades as an early or separate intervention. Such work does not necessarily remove the building's earthquake-prone status. If an EPB notice applies, the required seismic work must still be completed within the statutory timeframe so that the building or part is no longer earthquake-prone. The work is undertaken through the building-consent process.

- e. Does the document anywhere state that implementation of seismic retrofitting of the structure is permitted only if all vulnerabilities will be strengthened?

A: No.

- i. If so, provide specifics.

A: The Guidelines do not require every vulnerability to be addressed before seismic improvement can proceed. Targeted work may address selected high-risk vulnerabilities, provided it does not reduce the building's existing performance and that load paths, structural interactions, compatibility and temporary stability are considered. This does not remove any separate obligation under an EPB notice.

- f. Does the document anywhere expressly suggest that mitigation of vulnerabilities can be prioritized and implemented gradually over time?

A: Yes, but mainly as a risk-management and improvement principle rather than as a fully prescribed staged-retrofit programme.

- i. If so, provide specifics.

A: Part A states that assessment information should enable owners to prioritise mitigation works, and it permits targeted or staged seismic improvement. Each stage should avoid creating or worsening vulnerabilities, and temporary stability during construction must be managed. The Guidelines themselves do not prescribe a universal timetable for staged completion. However, where a building or building part is subject to an earthquake-prone building notice, the Building Act requires the specified seismic work to be completed within the timeframe stated in that notice.

17. Quality control, safety and reporting
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- a. Does the document anywhere state that the assessment and interventions on heritage structures should be entrusted to professionals with the necessary qualifications and expertise?

A: Yes, for all existing-building seismic assessments, not specifically for heritage structures.

- i. If so, provide specifics (i.e. type of attestation required and other requirements).

A: For statutory EPB assessments, the assessment must be overseen and signed off by a suitably qualified structural engineer who is chartered under the Chartered Professional Engineers of New Zealand Act 2002, or equivalent, and has relevant competence in earthquake engineering and assessment of existing buildings. Similar competence is also expected for other assessments and peer review.

- b. Does the document anywhere state the required scope of the maintenance plan?

A: No. The Guidelines do not prescribe a heritage conservation maintenance plan or a general post-retrofit maintenance-plan scope.

- i. If so, provide specifics.

A: Not applicable. Ongoing inspection or maintenance may be recommended for particular identified issues, but no standard minimum maintenance-plan contents are specified.

- c. Does the document anywhere state the required or mandatory minimum contents of the report?

A: Yes.

- i. If so, provide specifics.

A: Part A, Section A8, sets out the expected contents of assessment reports, including the purpose and scope, information reviewed, assumptions and limitations, assessment methodology, structural system and load paths, identified vulnerabilities, earthquake rating and governing elements, significant life-safety hazards, uncertainties, further investigations and recommendations. An Assessment Summary Report format is also provided. For statutory earthquake-prone building assessments, the report and summary information submitted to the territorial authority must also satisfy the requirements of the Earthquake-prone Building Methodology.

- d. Does the document anywhere state any safety measures for workers or experts that will enter the structure for inspection or work, especially for partially damaged or structurally unsafe-unstable structures?

A: The Guidelines contain limited provisions relevant to safety during investigation and construction, but they are not an emergency inspection safety manual.

- i. If so, provide specifics.

A: Section A10.2.6 requires designers, owners and contractors to consider temporary stability because strengthening work may temporarily reduce capacity, and to manage risks to workers and the public in accordance with health and safety requirements and good risk-management practice. Detailed procedures for entering damaged or unstable buildings are outside the scope of this document.

18. Emergency stabilization

- a. Does the document contain guidance or rules regarding emergency stabilization (assessment and construction works) for heritage structures, damaged or undamaged by a recent disastrous event (e.g. earthquake, flood, etc.)?

A: No. The document does not provide a dedicated methodology for emergency stabilisation of heritage or disaster-damaged buildings.

- i. If so, provide specifics.

A: Not applicable. New Zealand has separate guidance for post-earthquake building safety evaluation and emergency management. The reviewed Guidelines address ordinary seismic assessment and temporary stability during planned improvement works rather than rapid post-disaster stabilisation.