SLOVENSKI STANDARD
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Ohranjanje kulturne dediščine - Zgodovinske lesene konstrukcije - Smernice za ocenjevanje lokacije

Conservation of cultural heritage - Historic Timber Structures - Guidelines for the On Site Assessment

Erhaltung des kulturellen Erbes - Historische Holzkonstruktionen - Leitlinien für die Bewertung vor Ort

Conservation du patrimoine culturel - Structures en bois du patrimoine - Lignes directrices relatives à l'évaluation sur site

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Conservation of cultural heritage - Historic Timber Structures - Guidelines for the On Site Assessment

Conservation du patrimoine culturel - Structures en bois présentant un intérêt historique - Lignes directrices relatives à l'évaluation in-situ

Erhaltung des kulturellen Erbes - Historische Holzkonstruktionen - Leitlinien für die Bewertung vor Ort

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (prEN 17121:2017) has been prepared by Technical Committee CEN/TC 346 “Conservation of Cultural Heritage”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

Introduction

The survey of existing buildings to determine their suitability for continuing use or for a change of use has been considered by ISO 13822. Annex I of that standard considers heritage structures. The purpose of this document is to consider condition survey and diagnostic methods for assessing heritage loadbearing timber structures with a view to establishing safe working loads or determining the need for strengthening or repair in order to ensure their continuing use and to establish generally accepted standards for the conduct of such an assessment.

Heritage structures are important historic artefacts, which differ from other existing structures in that because a greater value is placed on their fabric because of their historical significance. It is necessary to gather data in order to be able to assess the ability of such a structure to carry the required loads and continue to be in use both now and for the foreseeable future, and to identify those areas of the structure that require repair or strengthening. Both the conduct of the survey, assessment and any subsequent repair or strengthening that may be necessary should involve minimum intervention. This may justify greater expense both in the survey, diagnosis and assessment of the structure and in the consideration of the repair methods that might be employed. The best possible assessment of their state of condition and of their existing structural characteristics should be made, which might require the use of more precise methods than those that are used for other existing structures, with a cost that could not otherwise be justified. Moreover, planning of intervention works (repair or strengthening) should only be carried out to a heritage structure as a last resort, having minimal impact on the building fabric (the original materials, structural systems and techniques).

An important part of the work involves the documentation and understanding of the history of a structure and of its loads in order to be able to assess the historical significance of either the overall structure or of any of its components. Historical significance of a structure may relate to the history of the structure itself or that of the building which it is a part of. Such understanding requires an interdisciplinary approach and for structural engineers to work in collaboration with architects, historians, archaeologists, conservation specialist, wood specialists and any other profession that can be helpful to the assessment procedure.

Because of the many uncertainties that the construction of heritage buildings often present, their assessment needs to be divided into a number of phases. The first preliminary phase should comprise a visual survey combined with a desk study. This preliminary study should provide a general description of the structure with a note of areas of concern that require more detailed study and which possibly require immediate action. It should also identify features of historical significance.

The desk study should provide information that will help in determining the history of the structure both to assist in the diagnosis of its behaviour and to determine its historical significance. This stage should be carried out by or in collaboration with a conservation specialist. National legislations and national registers define at country level what is considered historic or heritage structure.

In some cases, where the problems are simple and obvious, the preliminary, visual survey might be all that is required, but in general a more detailed survey will be needed and the preliminary survey should lead to a preliminary structural analysis and to recommendations for carrying out the more detailed investigation.

A preliminary report should be prepared and include a description of the structural behaviour noting those members that are carrying the larger stresses.

Briefly, the steps required for the examination and assessment of an historic timber structure are as follows:

a) **First phase, preliminary assessment** dealt with in detail in Clause 4 of this standard. This includes:

   1) A ***desk survey***, which should provide information that will help in determining the history of the structure and, if possible, the correspondent load history. This should also clearly indicate the intentions of the building owner so that the intended ultimate load and environmental conditions are known.

   2) A ***visual survey***. This is simply to obtain an overview of the structure that is sufficient to plan the next stage, identifying what provisions need to be made to gain access to the timbers.

   3) A ***measured survey*** to determine the overall disposition of the structural members and locate the main problems. This survey should include principal dimensions and the nominal sizes of all members. It should also note any obvious signs of damage, decay or structural distress, which will need to be investigated in more detail at a subsequent stage.

   4) A ***preliminary structural analysis*** to determine the overall forces and general levels of stress within the structure.

   5) A ***preliminary report*** should be prepared which includes a general description of the structure and its existing condition, with a note of areas of concern which require more detailed study and which possibly require immediate safety measures and actions. A description of the pathology, the service conditions, the structural behaviour identifying the vulnerable areas, members and connections which are carrying the larger stresses and/or deformations, noting any problems and/or defects within the structure and a general preliminary assessment of the present condition of the structure, and guidelines/proposals for the continuation of the investigation. These guidelines will specify any additional survey work that may be necessary (this might be needed simply to provide the client with a more accurate estimate of costs.) This would indicate any aspects of the structure which require further investigation and the methods recommended. It will draw upon the four tasks already carried out, identify the aspects of structure that need to be preserved for their heritage value.

b) **Second phase, detailed survey** dealt with in detail in Clause 5.

   1) A ***detailed survey*** as indicated in the preliminary report. This should include the measurement of areas of biological attack and damage, the assessment of timber grades and the results of non-destructive methods where appropriate. It will also consider the adequacy of joints.

   2) A ***diagnostic report*** on the condition of the structure and causes of distress with proposals for remedial measures where necessary. This may imply a new structural analysis considering the data gathered in the detailed survey.

Although the list above suggests a linear process, it is essential to recognize that conservation work frequently involves iterations. For example, the preliminary visual survey might raise questions that could be answered by a more thorough desk survey, able to document changes that have been observed in the structure. Iterations between structural analysis and repair strategy stages are also often required.

A holistic approach is always required, considering and assessing the structure as a whole, rather than just the individual members and joints.

1 Scope

This standard provides information on the criteria to be used in the assessment of load-bearing timber structures in heritage buildings. It is intended for all those concerned with the conservation of heritage buildings which contain wooden elements, from the building owners or authorities who are responsible for them to the specialists employed. It should also help decision-making regarding the need for immediate measures. Its aim is to guarantee that condition survey and assessment provide the necessary data for historical analysis, structural safety assessment and planning of intervention works.

The guidelines can be also applied to any kind of timber member, except the structural members made of engineered panels, such as glued laminated timbers.

This standard applies to roof structures and to 'heavy' timber frames with non-structural infilling. It excludes both light stud structures, which often rely upon a boarded cladding for lateral stability, and log buildings.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 335, *Durability of wood and wood-based products - Use classes: definitions, application to solid wood and wood-based products*

EN 1995-1-1, *Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings*

EN 13183-2:2002, *Moisture content of a piece of sawn timber - Part 2: Estimation by electrical resistance method*

EN 13183-3:2005, *Moisture content of a piece of sawn timber - Part 3: Estimation by capacitance method*

EN 16085, *Conservation of Cultural property - Methodology for sampling from materials of cultural property - General rules*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
alteration
any change in condition to wood (biological, mechanical, chemical) or to metallic materials occurring after their installation

3.2
action
any agent (forces, deformations, etc.) which directly or indirectly produces stresses and/or strains into a building structure and any phenomenon (chemical, biological, etc.) which affects the materials which compose it

3.3
assessment
set of activities performed in order to verify the reliability of an existing structure for future use

3.4
biological damage
damage caused by living organisms such as fungi and insects

Note 1 to entry: In load-bearing timber structures, the damage is considered in terms of reduction of the effective cross section.

3.5
bridle joint
timber joint used for joining two timbers at their ends

Note 1 to entry: It is essentially a mortice and tenon joint where the mortice is open along one side. It is found at the apex of a roof for joining pairs of rafters or for joining lengths of plates together, such as wall plates or arcade plates.

3.6
condition survey
on-site non-destructive inspection to assess to determine the present condition of the structure

3.7
critical area/zone
part of a timber element over a length of 150 mm, or equal to the depth of the member, whichever is the greater, which is considered to be relevant to the structural performance of the structure because of defects, position, state of preservation and also stress conditions as determined by static analysis

3.8
critical cross-section
cross-section which is representative of a critical zone. All the defects, alterations, damage and other characteristics that are present in the critical zone and have an influence on its strength are attributed to the critical section

3.9
damage
alteration that reduces significance or stability

3.10
defects (of wood)
wood growth features which can negatively influence strength and stiffness and/or the general structural behaviour (e.g. the efficiency of joints) of timber members

3.11
diagnosis
process of identifying the present condition of a structure and determining the nature and causes of any change, as well as the conclusions drawn

3.12
dovetail
joint formed by one or more tapered projections (tenons) on one piece that interlock with corresponding notches or recesses (mortises) in another

3.13
effective cross-section
part of the cross-section of a timber member which is assumed in good state to resist the stresses

3.14
in-situ load testing (proof-loading)
test of the structure or part thereof by loading to evaluate its behaviour or mechanical properties, or to predict its load-bearing capacity

3.15
jupiter joint
timber joint used to prevent timbers from sliding over each other where a series of saw-tooth-like notches are made in the mating faces and facing in opposite directions from both ends

3.16
lap dovetail joint
timber joint used between tie beams and wall plates with the former above the latter, therefore both the dovetail in the end of the tie beam and corresponding recess in the wall plate are relatively shallow compared with the depths of the two timbers

3.17
lap joint
simplest joint between two timbers where both timbers are reduced in depth so that there is a flush surface

Note 1 to entry: The most common type is where timbers cross each other

3.18
mechanical damage
damage caused by internal or external mechanical actions

3.19
mortice (mortise)
hole or recess cut into a part, designed to receive a corresponding projection (a tenon) on another part, so as to join or lock the parts together

3.20
mortice and tenon joint
basic joint in much carpentry. A tongue, called the tenon, is formed at the end of the joining member and this is held in a slot, called a mortice, in the foundation member. Normally the tenon is formed with shoulders on both sides. However, in some cases there is only a shoulder on one side with the other side flush with the surface of the member. This arrangement is called a bare-faced tenon. For a joint where the joining member is designed to take tension the tenon will be formed with a half dovetail. The mortice will need to be correspondingly deeper and the joint held together with a wedge

3.21
notched lap joint
timber joint in which a notch is cut in the tenon of the joining timber, which engages with a similar notch in the recess formed in the foundation timber

Note 1 to entry: The purpose is to allow a tension force to be developed in the joining timber; this joint is commonly used at the ends of braces

3.22
rot
decomposition of wood by fungi or other microorganisms, resulting in softening and progressive loss of mass and strength, and often a change of texture and colour