GUIDELINE FOR A FIRST EVALUATION OF LARGE-SPAN TIMBER ROOF STRUCTURES

This guideline gives an overview concerning all items to be considered when a structure has to be evaluated.

While reading the guideline it is easily evident that an evaluation is often asked too much of a person who is not or hardly familiar with timber structures. Nevertheless this outline is useful also for people who are no experts but responsible for the quality of a timber construction because it shows what has to be checked, looked upon and be measured. They can use the guideline like a checklist and as information what has to be done and by whom.

The Guideline is written especially for members of local building authorities, people responsible for the supervision of buildings as well as owners or users of large-span timber roof structures.

For structural engineers who do not regularly examine timber structures, this guideline should be a basic tool.

In the case that damage is suspected the checklist helps to make an educated guess of the type of damage or – favourably – also to eliminate the presence of damage. If damage in the construction is suspected, it is highly important to consult an expert who is familiar with damages and repairs of timber structures.

1. CHECK OF THE TECHNICAL DOCUMENTATION

The realisation of a structure begins with the structural design in line with codes and standards followed by the erection according to the technical documentation. The planning and constructing phase therefore is the first possible source for hidden faults possibly leading to later damages. The following details should be checked:

- plausibility of the structural design
- construction drawings
- laying drawings of roofing elements
- inspection reports
- certificates of conformity
- conformity of main structural parts with standards and technical approvals
- existence of a special structure for which a special technical approval is required
- check whether the special technical approval was given
- compliance of existing structure with construction drawings
- information about the erection phase e.g. weather conditions
- if necessary production data of the glulam manufacturer regarding the bonding procedure

2. IDENTIFY THE USE OF THE BUILDING

How to construct a building also depends on the intended use and the pertaining climatic conditions. In heated halls like gymnasiums or production halls e.g. the expected humidity of the timber will be less than in unheated storehouses. The geographical position also plays an important role. Therefore the following points should be checked:

- use of the building
- allocation to a service class with regard to climatic exposure within the building
- assumed actions like dead and live load with regard to the use of the building
- change of use

3. DETECT CONSTRUCTIONAL ALTERATIONS

If they are not correctly adapted to the construction, alterations of the original construction may cause damages after a shorter or longer period of time. These points should be checked out carefully:

- construction drawings in comparison with actual status
- alterations like an overgrown (“green”) roof, ventilation and heat insulation
- closing of a formerly open building
- additional holes in beams
- additional loads

4. CHECK THE GEOMETRY OF THE BUILDING

Weaknesses can often be located when the dimensions are carefully measured. Such an inspection therefore is indispensable during the first evaluation of the construction.

- detect precamber and deformations by looking accurately from a short distance
- check planeness and straightness
- find out deflections and deformations with laser measurement
- level the points from which vertical measures have been taken
- measure the warping of a beam with ruler over height and length
- detect inclination with ruler and water level

5. VISUAL INSPECTION FROM NEARBY

There are weak points or significant modifications in a construction which only can be detected when they are visually inspected close by. Looking from the bottom to the top of a structure is completely insufficient. The following points are examples:

- water stains:
    - detect the source of the moisture, check the actual state of the timber and the glue lines
    - measure the depth of increased moisture content
- drainage:
    - existing and working heating of down pipes
    - heated gutters in the roof
    - heated down pipes outside the building
    - height of rainwater outlets and manner of water flow
    - blocked drains
    - emergency drains
    - inlets for water
- corrosion of metal parts
- discoloration
- fungi
- changes of sound while tapping the timber
- finish of components located in moist conditions:
    - estimate the effectiveness of the finish and its influence on the moisture content
    - measure the moisture gradient

6. DETECTING CRACKS

In timber there are always cracks. They are caused by the ambient climate. However, cracks may not exceed certain dimensions. In the end only the expert is able to assess the particular case.

- record depth, width, length, number and distribution of the cracks:
    - mark the ends of a crack with a pencil
    - measure the maximum depth with a thickness gauge of 0,1 mm
    - when cracks are more than 90 mm deep or exceed 1/6 of without or 1/8, respectively, of the member width of components without or with stresses perpendicular to the grain, an expert should be consulted
- document date of measurement and timber moisture content
- measurement of timber moisture content with sufficiently long insulated electrodes:
    - especially at facade transitions inside and outside
    - at deep and high points of the construction
    - moisture content differences in the structural element

7. BOUNDARY CONDITIONS WITH RESPECT TO BUILDING PHYSICS

Especially high moisture contents are causes for damages in timber structures. The following points therefore are to be considered:

- air-tightness of the building envelope
- facade connections
- member moisture content
- roof space with convection from inside
- connections of the vapour barrier
- check of the building’s climate

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