REHABILITATION AND ROBUSTNESS OF EXISTING TIMBER FLOORS

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Present practice in rehabilitation of timbre floors

ISO 13822 for assessment of existing of structures

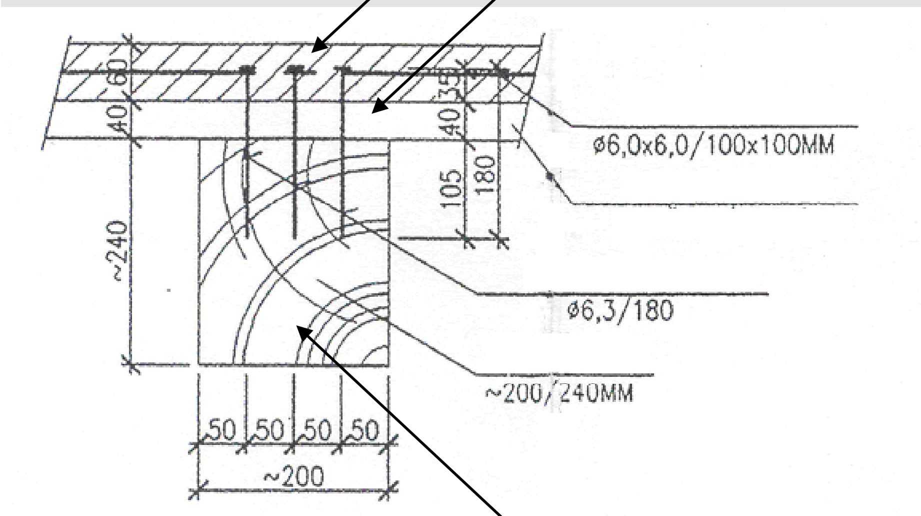
Robustness of timbre floors

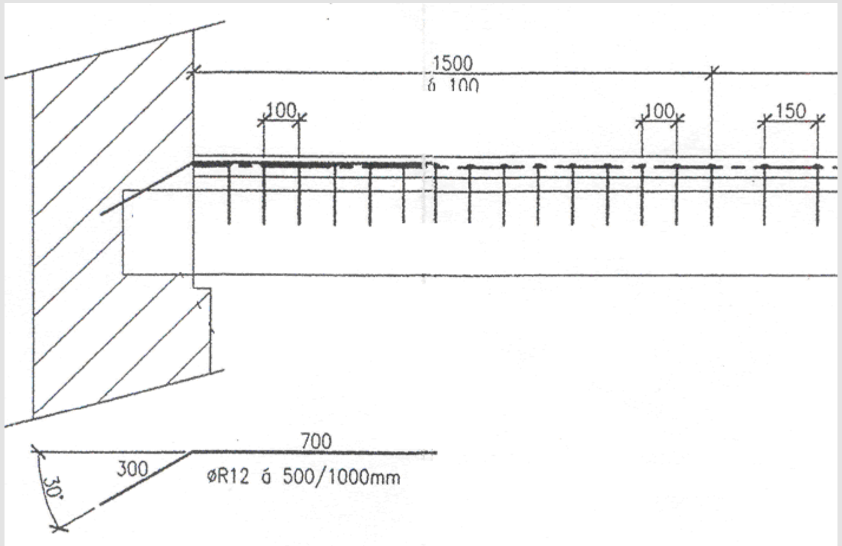
Concluding remarks

An example of strengthening of existing timber floor

new concrete layer

existing timber boards





existing timber beams

Existing timber floor composed of timber beams covered by timber boards having the thickness of 40 mm is strengthened by a new concrete layer of 60 mm reinforced by wire meshes. The connection among timber beams, boards and concrete slab is provided by common nails.

Problems in timber floors rehabilitation

- existing boards on timber beams carrying new concrete layer, the degree of composite action between timber and concrete rather ambiguous

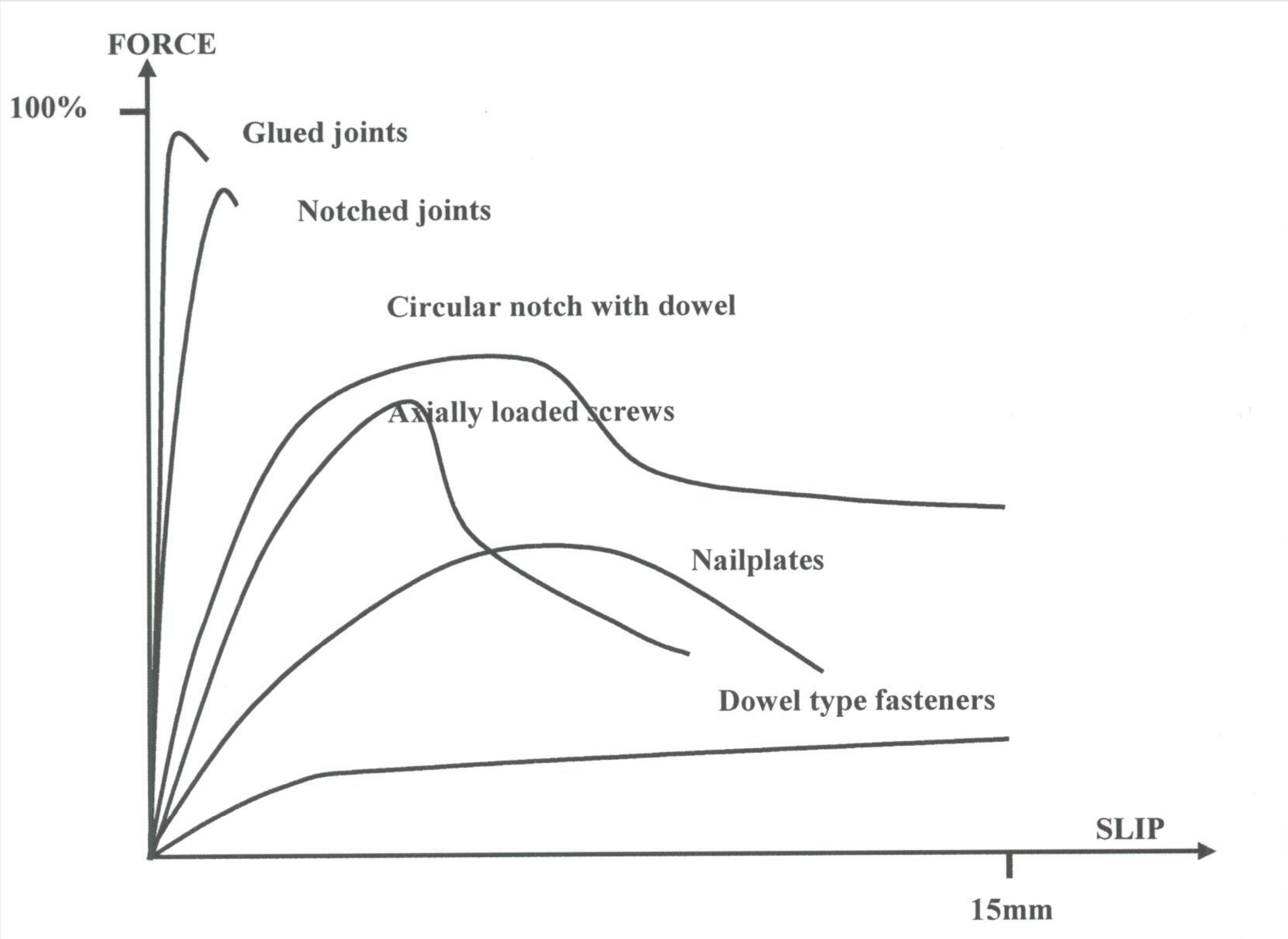
- a new concrete layer is not directly interacting with the timber beams

- application of common building nails, not special mechanical fasteners, not approved (without CE mark)

-wet process of concreting may lead to the decay of timber structures and to a considerable shortage of durability

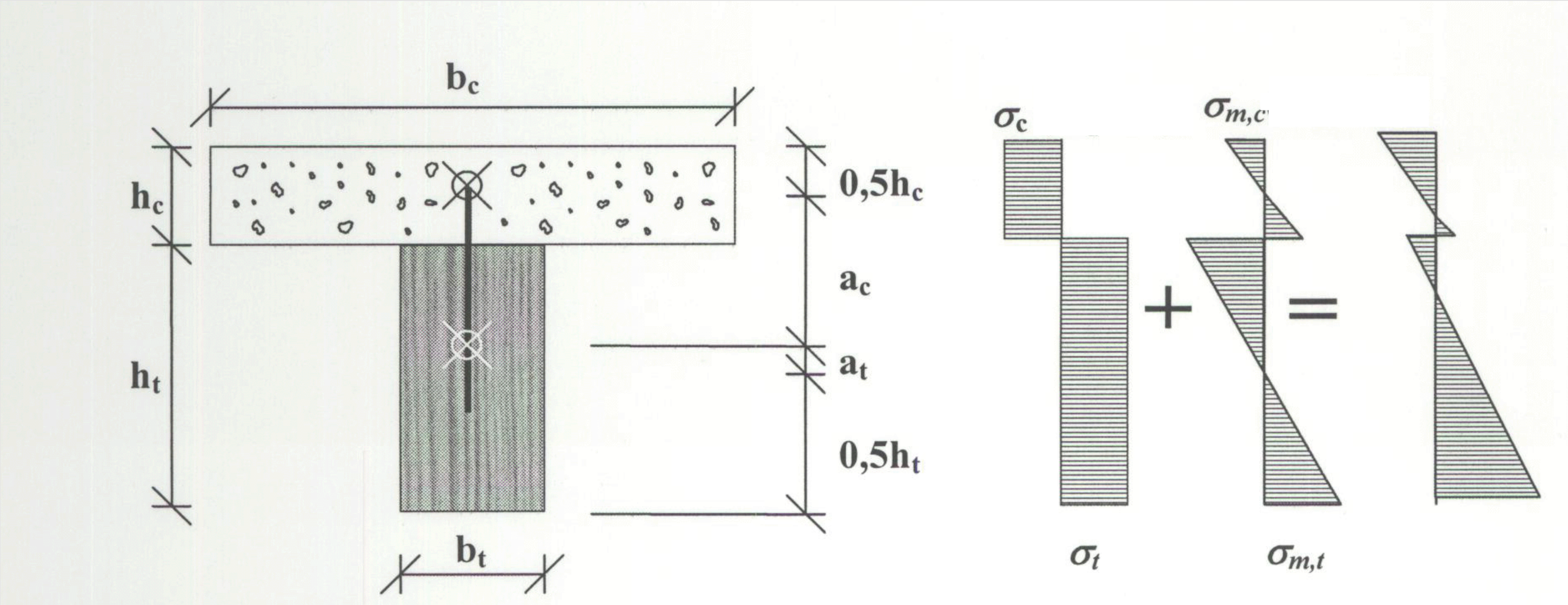
-missing methodological procedure for the reliability verification and execution of composite timber-concrete floors

Load-slip behaviour of fasteners



The behaviour of different types of fasteners is based on a load-slip relationship from the fastener tests. It is shown that the dowel type fasteners allow large slip between timber and concrete and their application is not effective.

Models for timber-concrete composite structures



Analysis of stresses in composite timber-concrete floor

Probability of failure and robustness for timber-concrete composite structures

$$R = \sum_{i=1}^{N_H} p(H_i) \sum_{j}^{N_D} \sum_{k=1}^{N_S} p(D_j \mid H_i) p(S_k \mid D_j) C(S_k)$$

Hazards H_i include overloading, gas explosion, fire, excessive humidity, biological agents, corrosion, incorrect or oversimplified structural modelling, errors related to the material properties, poor detailing or quality of execution

The index of robustness I_{Rob} may be applied for the assessment of a composite concrete-timber floor robustness as proposed by JCSS which is comparing the risks associated with direct and indirect consequences given as

$$I_{Rob} = R_{Dir}/(R_{dir} + R_{ind})$$

Model uncertainty ξ

The real behaviour of the composite action of concrete - shear fasteners - timber under various loading conditions may differ from the recommended analytical models.

For the assessment of difference between experiments and analytical models, the model uncertainty ξ specified as a ratio between the experimental test results and analytical models may be considered as

$$\xi = \sigma_{exp} / \sigma_t$$

Robustness of analytical models

The probability P of exceeding the specific design value $v_d(x_d)$ (e.g. design stress, design deflection), which was determined according to the recommendations of standard design procedure, may be analysed :

$$P = \mathrm{P}\{(v_d(\boldsymbol{x}_d) - \xi_v v(\boldsymbol{X})) < 0\}$$

x_d is the vector of design values of basic variables

X is the vector of random basic variables

ξ_v is the model uncertainty

Concluding remarks

- Presented example indicates that the rehabilitation of existing timber floors should be based on clear methodological procedures, detailing and application of efficient shear fasteners.

- When the gas installation is present in building, the redesign of existing structures should also take into account potential accidental gas explosion as required in EN 1991-1-7.

- The index of robustness may be used for the verification of a composite behavior of a timber-concrete floors.

- The aptness of analytical models and degree of accuracy in modelling of structural behaviour has direct impact on required reliability and robustness of considered structures.