Short description of activities related to the field of **COST Action E 24**
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Main topics relevant to COST Action E24	Examples of activities	Number of scientists
Timber structures in seismic regions	Evaluation of seismic Action Reduction Factor for timber structures using reliability analysis	2
Timber-concrete composite structures	Service and Ultimate state behaviour: modelling coupled with reliability analysis	2
Old timber structures	Analysis and Evaluation of historical timber construction	3

Timber Structures in seismic regions (in co-operation with British Columbia University, Canada).

Application of structural reliability to earthquake engineering is done linking a non-linear dynamic timber-structures analysis program (DRAIN) with a reliability evaluation software, using a first order, response surfaces method (RELAN). In case of a shear wall, the dynamic response and reliability of this wall will be affected by the masses carried or, what is the same, the contributory area. For a given wall capacity, the force reduction factor R will control, through the Code provisions, the allowable masses. Thus studying the reliability of the wall under different contributory areas is the same as studying the variation in reliability with the factor R adopted in the code. Rather than fixing this factor on the basis of ductility considerations (as commonly done, for example, when using "equal displacement demand" assumptions) it definitively can be fixed through a calibration to a target reliability for the intended limit state.

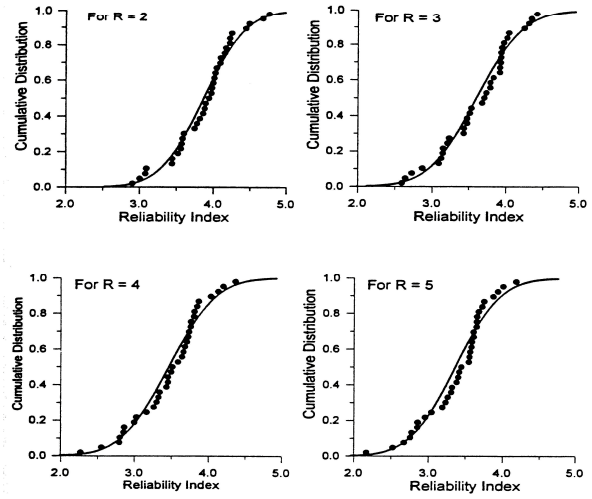

Figure 5. Distributions of reliability index β for different R.

Table 1. Relationship R vs. NBCC compliance probability.

Force Reduction Factor R	Probability with which NBCC reliability is met over a 30 year-life
2.0	0.975
3.0	0.902
4.0	0.854
5.0	0.800

Reference: A. CECCOTTI, R. FOSCHI: "Reliability assessment of wood shear walls under earthquake excitation". In *Computational Stochastic Mechanics*, P. Spanos ed., Balkema, 1999.

Timber-concrete composite structures (in co-operation with Florence University).
Reliability analysis of timber-concrete mechanically jointed composite sections is made by coupling a finite element non linear analysis programme (serviceability and ultimate state) set up at the University of Florence and Venice with a first order, response surface reliability analysis programme (RELAN). The objective is to calibrate proper material partial safety coefficients aimed to target β values for mechanically jointed beams, accounting for materials and actions variability.

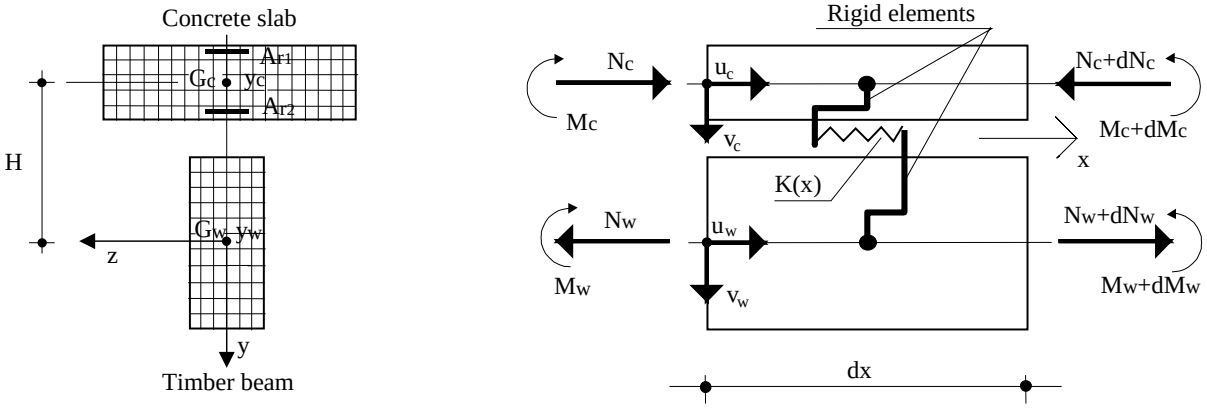

Fig. 1 The used finite element

Reference: M. FRAGIACOMO: "Long-term behaviour of timber-concrete composite beams". In *Proc. of the 3rd Phd symposium in civil engineering*, Vienna, 2000.

Old timber structures (in co-operation with Florence University).
The use of modern calculation codes (conceived for not-yet existing structures), adopting characteristic strength profiles and standard grading rules, for safety analysis of old timber structures can lead to unnecessary reinforcements, often with a detriment of the cultural authenticity of the construction. This issue is particularly dramatic in Italy where historically important buildings are everywhere as floors and roofs in masonry buildings, mainly.
Situation: basically a timber element is classified into strength grades according to some *grade determining defects*. It is not possible, however, to know a priori where in situ that element will be located, how it will be loaded, and where the most stressed section will be (*critical section*).
Therefore grading of timber elements should be done *ad hoc* on the spot where the critical section is actually located. More: even that *ad hoc* grading, refers to 5% lower fractile strength characteristic values, that means there is still a high chance that the element will be more resistant than that value.
Non-destructive testing methods coupled with analytical tools, could help to guess an *actual* strength value and the introduction of reduced safety coefficients could be proposed.
Moreover, load standards are changed over the years increasing snow loads, for example, where an old structure does exist from centuries with no interest in human discussions. Finally more sophisticated structural schemes, closer to reality, should be used.
Action taken, so far: destructive and non-destructive tests are systematically performed on timber elements in situ and/or discarded from building sites, analytical tools are used and evaluated on real buildings application.
References:
A. CECCOTTI: "Evaluation and Analysis of the Old Timber Structures", in *Proc. of Italy-Japan Conference*, Florence, 2000.
A. CECCOTTI, M. TOGNI: "NDT on ancient timber beams: assessment of strength/stiffness properties combining visual and instrumental methods". In *Proc. of international symposium on non-destructive testing of wood*. Ed. Presses Polytechniques et Universitaires Romandes, Lausanne,1996.