8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

MULTISCALE APPROACH FOR THE MODELLING OF TIMBER STRUCTURES UNDER ERTHQUAKE LOADING

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Key Words: *Timber structures, Tests, Modelling, Earthquake loading*

ABSTRACT

Properly designed light framed buildings consisting of wood-based shear walls perform generally well during earthquake. However, some configurations like buldings with large openings or irregular plan layout can have a poor performance against severe earthquake. Therefore it is important to study these configurations and possible winknesses to assess the security of old buildings or to design the new buildings. But it is expensive to test full scale strucutres on a shake table, so it is essential to develop numerical tools capable to simulate the non linear behaviour until failure of such structures.

In this paper, we present a multi scale approach for the modelling of wood framed structures, with or without sheathing pannels :

- We start with the modeling of the connexions where most of the non lineaities occurs. It can be the nailed connexions between the pannels and the beams (sheathing pannels) or it can be the beam-column doweled joints. An hysteretic model has been developped to take into account the monotonic or cyclic degradations [1]. Cyclic tests on single connexion are used to identify the model parameters. Theses tests are not too expensive since they are not dynamic and made on a small elementary strucures.

- Then we compute the in plane shear response of elementary pannels (shear walls or floors) with a detailed simulation where each connexion is modelled. The response of the panel (corner displacements and forces) is used as a “numerical experiment” to identify the parameters of a panel model. Since the shape of the curves are very similar, we use the same hysteretic model as the one for the connexions, only the parameters are differents. At this step, we avoid expensive tests on full scale pannels (and a lot of configurations with different openings and stiffnesses can be rapidly simulated).

- The final step is to simulate the global 3D response of the building made of

different frames (with several beam-column connexions) and different sheathing pannels or floors. The global simulation is fast because of the fwe degree of freedom. A lot of runs can be done to evaluate the vulnerability under different seismic signals and different earthquake directions.

The validation of the first and second steps of the method has already been done [2,3]. In this paper we present a validation of the final 3D dynamic simulation step. A two storey framed structure with different floors (one is weaknened to break the symetry and to have 3D global torsional effects, Figure 1) has been tested under pseudodynamic loading. We present the tests and the non linear dynamic simulation. On Figure 1 one can see the comparison of displacements at the first floor. In the test, the maximum difference between center and right is about 10 cm (because of the weakening). The maximum difference between test and simulation is about 3 cm. So we can say that the main tendencies of the test are reproduced in the simulation with a good approximation.

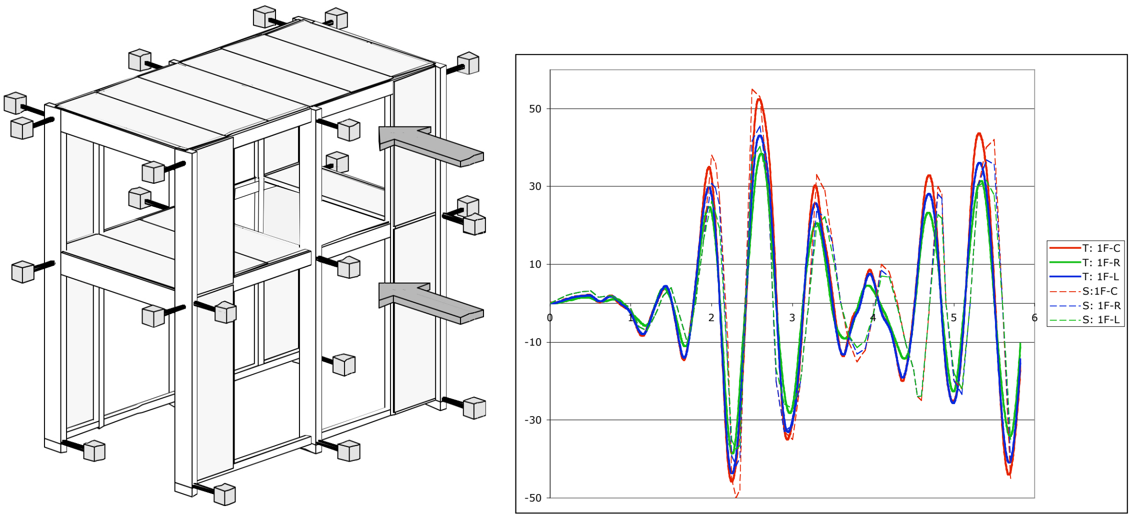

Figure 1 : Sketch of the tested specimen (pseudo-dynamic) and displacements at the 1first level (Left, Right & Center, Test and Simulation)

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