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VERIFYING THE CHOICE OF A NUMERICAL MODEL OF A BUILDING BY IN SITU INVESTIGATION AFTER REALIZATION

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The choice of the structural system, the spatial position of the supporting elements as well as their section are defined in the state of project. The numerical model of a structural reinforced concrete building is based on some assumptions. Mechanical characteristics values of the materials used for the model represent theoretical data recommended by the regulations specific to each country. In the case of seismic design, the dynamic parameters of the structure are fundamental, taking into account or not soil-structure interactions phenomena. Validation of the numerical model in the dynamic domain is based on the deformability capacity in relation with the inter-floor displacements to be respected. Therefore, the dynamic characteristics period, mode shape and damping are the essential elements of a civil engineering structure to judge of its seismic behavior. In practice, often all the assumptions are not respected, the value of the concrete strength taken into account in the model is not always achieved during the execution phase. It becomes dangerous when the situation leads to a critical state of the work, which is sometimes difficult to make a diagnostic. A recent building located on the periphery of Algiers the capital of Algeria, is taken as an example to illustrate a proposal for experimental verification of a theoretical model. The selected building is located in the Algiers department. The site is classified as zone of strong seismicity (Zone III). The building is designed and realized according to the assumptions required by the Algerian seismic code RPA99/2003. The building includes a ground floor, nine floors and an inaccessible terrace. Structural system consists only of reinforced concrete walls. The spatial distribution of wall elements is done symmetrically in both directions. It can be seen in Figure 1 that the number of walls in transverse direction is significantly greater than the longitudinal direction. The theoretical values considered are 25MPa for the strength of the concrete f_{cj} at 28 days and an elastic modulus corresponds to the long term load 32100.00 MPa (E_{ij} = 3700 (f_{cj})1/3). The reinforcement steels is (HA) type FeE500.

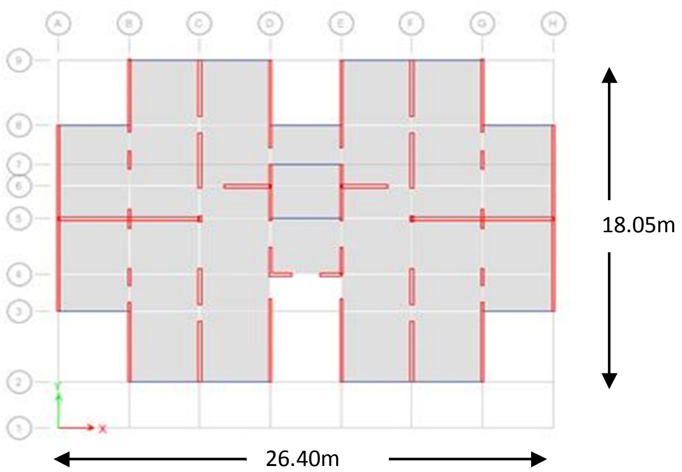

Figure 1. Horizontal cross section of building.

The number of vibration modes to be considered for designing the structure of a building must correspond at least to 90% of its mass. For the studied building, the first two modes of vibration are sufficient to satisfy the consideration (Table 1). The first structure vibration mode is a translation in the longitudinal direction (x-x). It corresponds to a period of 0,322368 sec and 75,7003% of the building's mass. The second vibration mode is a rotation around the Z axis, with a period of 0,298166 sec that corresponds to 69,1553% of the building's mass.

Table 1. Numerical dynamics characteristics model.

Mode	Period (sec)	UX (%)	UY (%)	UZ (%)	∑UX	∑ UY	∑ UZ
1	0,322368	75,7003	0,0001	0,3925	75,7003	0,0001	0,3925
2	0,293603	0,4551	0	69,1553	76,1554	0,0001	69,5478

The non-destructive investigation technique called ambient vibration noise technique is used to identify the dynamic characteristics of the building without non-structural elements. In the case of the building studied, the experimental period value is 0.397 sec (2.52 Hz) for the longitudinal direction and 0,389 sec (2.57 Hz) for the transverse direction. The small difference between the longitudinal and transversal value of the building's numerical period means that the building structure has equivalent stiffness in both directions. The same remark is also observed on experimental values.

However, a significant difference is observed between the numerical and the experimental values yhat are higher than the first ones. It can be concluded that the structure of the building constructed is more flexible than that of the building calculated supposing theoretical assumptions.

Also, the level of embedding supposed to the 1st level is really located at the lower level at ground floor and the experimental and numerical mode shape forms are regular.

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(N.B: DTR-BC = Regulatory Technical Document - Concrete Design).