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THE EFFECT OF USING ADDITIONAL ISOLATED UPPER FLOOR ON THE PERFORMANCE POINT OF R.C. FRAME STRUCTURES IN ARMENIA

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Widely distributed 111 series 10 story R.C. frame buildings are constructed during former Soviet Union in Armenia and Nagorno-Karabakh province. In current research we illustrate the concept of seismic upgrading of above-mentioned buildings, using an Additional Isolated Upper Floor (AIUF). For this purpose, a three dimensional of 111-c R.C. frame building is modeled and analyzed according to Armenian SNIP II-6.02 code, based on three soil categories of Rock (Vs>800m/s), Dense Soil (500<Vs<800m/s) and Loose Soil (150<Vs<500m/s) respectively for spectral acceleration level of S_a=0.40g. Later, the AIUF which behaves as a Tuned Mass Damper is added to the model and after tuning for the frequency and damping ratios, Modal Pushover Analysis is carried out on both preliminary and secondary structural models. Finally, by the means of FEMA356 guideline, Capacity Spectrum and Performance Point characteristics due to related soil categories are computed for each model, using Armenian SNIP II-6.02 pseudo-acceleration spectrums.

Previous experience of earthquakes illustrates that many types of structures behave nonlinearly during a severe earthquake. So a huge amount of input energy is mainly dissipated through the form of damping and hysteresis. The Tuned Mass Damper (TMD) being a passive aseismic control system, reduces both the lateral displacement and base shear forces caused by the earthquakes. In the case of AIUF, the TMD is constructed by the use of HDRB isolators and if truly tuned, structures equipped with AIUF could behave linearly during a severe earthquake. Once the mentioned earthquake is applied, the vibrational movement of the TMD is activated in a phase not matching the main vibration phase of the main structure, as could be observed in Figure 1, causing the inertial force of the AIUF to act as a TMD on the top of the structure and dissipate the induced energy. Armenian 111-c series residential R.C. building is composed of three bays of 6 m on each direction, containing a basement on -3.0m level as shown in Figure 2. On the x-direction, the building is partially braced, demonstrating a very weak stiffness. Steel Chevron (Λ) bracing is added for preventing the torsional displacement of the building, as it is shown in Figure 2-a. Later the AIUF is added to the preliminary model, weighting about 3~5% of the total weight of the structure, resulting secondary model as Figure 2-b.

The project is on upgrading the seismic resistance of 10 storey R.C. frame buildings by means of additional isolated upper floor (AIUF). The isolated upper floor allows not only upgrading the earthquake resistance of a building, but also enlarging its useful space as well. The most distinctive feature of the new earthquake resistance upgrading method, however, is that there is no need to re-settle the occupants of the building during construction. After completing the Modal Pushover Analyses, it could be observed that using and amplifies the deformed state of the performance point while reducing the related base shear force in case of dense and loose soils. For rock the results are just the opposite as could be observed in Table 1. For all soil categories, the P.P. base shear force remains constant. According to capacity spectrums in Figure 3, the seimic behaviour is mainy linear when using Additional Isolated Upper Floor, which is the main goal of using asesimic control systems.

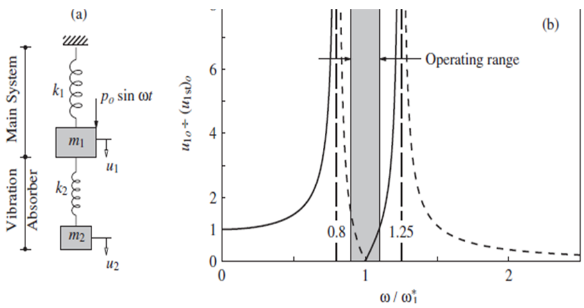

Figure 1. Response amplitude versus existing frequency.

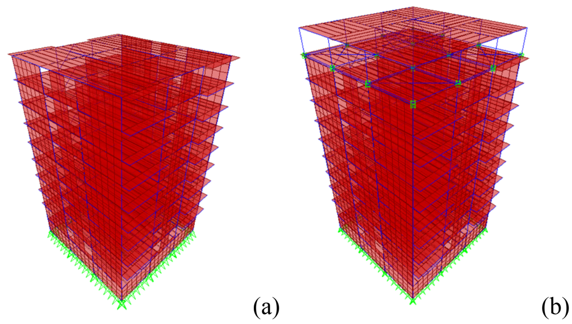

Figure 2. Numerical Models (a) without AIUF (b) with AIUF.

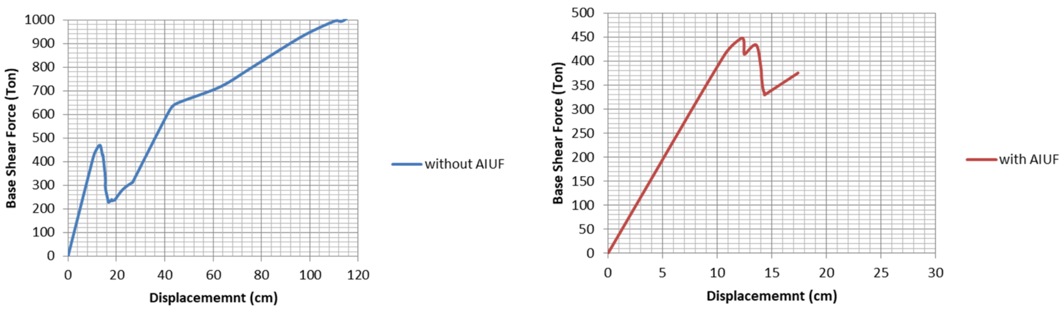

Figure 3. Capacity Spectrum of numerical models.

Table 1. Performance Point character results according to FEMA356 guideline.

Soil Type	P.P.	without AIUF	with AIUF
Rock	V* D*	305.0 25.5	375.5 23.9
Dense Soil	V D	494.5 35.8	375.5 41.2
Loose Soil	V D	660.8 48.6	375.5 56.4

* V= base shear force (Ton) and D= displacement (cm)

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