TRUST PLATFORM: THE FIRST BUILDING-SPECIFIC SEISMIC RISK ASSESSMENT TOOL FOR IRAN

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Over the past years, different building-specific seismic risk assessment tools have been developed. These tools are intended to estimate damage costs and functionality downtime of buildings, which are beyond the life safety requirements of current codes. Although all these programs can be used to measure the performance of different structures, they highly depend on regional economics and construction procedures. In addition, downtime loss estimations are significantly a function of operational efficiency of local contractors and developers (Kahandawa et al., 2018). Therefore, a building-specific seismic risk assessment tool for a certain geographic region is inevitable.

A building-specific seismic risk assessment platform, called TRUST, is developed for the first time for the country of Iran. This program evaluates the associated risk of structures based on the required repair cost and time for restoring buildings to their pre-earthquake condition. This paper demonstrates the methodology used for the development of TRUST platform, which is essentially based on the existing performance assessment calculation tool (PACT) (FEMA-P58, 2012). In this software, the risk measures of buildings are calculated by a number of realizations utilizing Monte Carlo simulation to map various sources of uncertainties. The reparability of buildings is examined through the comparison between the simulated demands against collapse and residual drift capacity of buildings. If a building is considered repairable for a certain realization, then the attributes of damage such as repair cost, repair time, casualties and unsafe placarding are calculated (FEMA-P58, 2012). The vulnerability of components is assessed by capacity fragility functions which define the probability of building components that will be damaged under considered earthquakes (Porter et al., 2007). Then, the consequence functions that demonstrate the repair cost and the time of all structural and nonstructural elements are used. Consequence functions of PACT are based on the socio-economic situation of the USA. TRUST uses similar functions developed for the country of Iran.

In order to examine the accuracy of calculation engine programed in TRUST, the results of software are verified by PACT software using the same US consequence functions and capacity curves. To do so, a linear model of a three-story SMRF (Special Moment Resisting Frame) office building is chosen from the database of PACT. This building is analyzed for eight intensity levels with the minimum and maximum annual frequency of exceedance of 0.00027 and 0.024, respectively. The dispersions of demand values are then set to zero in order to compare the results between two software more deterministically. Such a comparison between PACT and TRUST results shows that the repair cost and time of the buildings are estimated with fractional differences. It should be noted that the differences between the outcomes of two software are expected due to the inherent uncertainties exist in capacity curves and consequence functions. The results of repair cost and time of PACT and TRUST are shown in Table 1.

Table 1. Repair cost and repair time of TRUST and PACT for eight intensities based on zero dispersion.

	TRUST		**PACT**		**TRUST and PACT Comparison**	
Intensity Levels	Cost ($)	Time (days)	Cost ($)	Time (days)	Cost (%)	Time (%)
1	291,000	5.8	294,933	5.9	1.3	1.0
2	548,000	10.7	556,744	10.9	1.6	1.8
3	1,117,000	16.6	1,133,482	15.3	1.5	8.9
4	1,677,000	23.4	1,690,000	25.0	0.8	6.4
5	2,193,000	30.6	2,190,821	31.7	0.1	3.4
6	2,633,000	36.4	2,633,742	36.0	0.0	1.1
7	3,102,000	43.6	3,060,839	45.6	1.3	4.4
8	3,585,000	50.1	3,480,555	49.5	3.0	1.2

Finally, in order to inspect the overall precision of TRUST software for the country of Iran, the actual repair cost of few damaged buildings from recent 2017 Kermanshah earthquake (Iran-Iraq border) is used (Alavi et al., 2017). Damage cost estimations by TRUST using linear and nonlinear analyses of buildings show high consistency with the actual component and system-level damage costs.

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