

ASSESSMENT OF NONLINEAR DYNAMIC RESPONSE OF DIAGRID STRUCTURES EXPOSED TO VARIATION OF INCIDENCE ANGLE OF PULSE TYPE GROUND MOTIONS

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In recent years, diagrid structures have received increasing attention for aesthetically pleasing and structurally efficient system. As is common in these structures, the diagrid frames form the perimeter of the building (Adeli & Asadi, 2017; Sadeghi & Rofoi, 2018). In this research, three 20-story diagrid structures which have different façade pattern were selected and designed. Three skeletal configurations with diagonal angle of approximately 56°, 64°, 76° respect to horizontal axis have been considered. Furthermore, another bundled tube structure with the same sizes and skeletal configuration was also designed as the basic model for analytical comparison purposes subjected to near-field earthquakes. The façade pattern of the studied models with various criterion angles are shown in Figure 1. All of these four studied models are loaded and designed according to the Iranian seismic code 2800 and the Iranian national building code (issues 6 and 10).

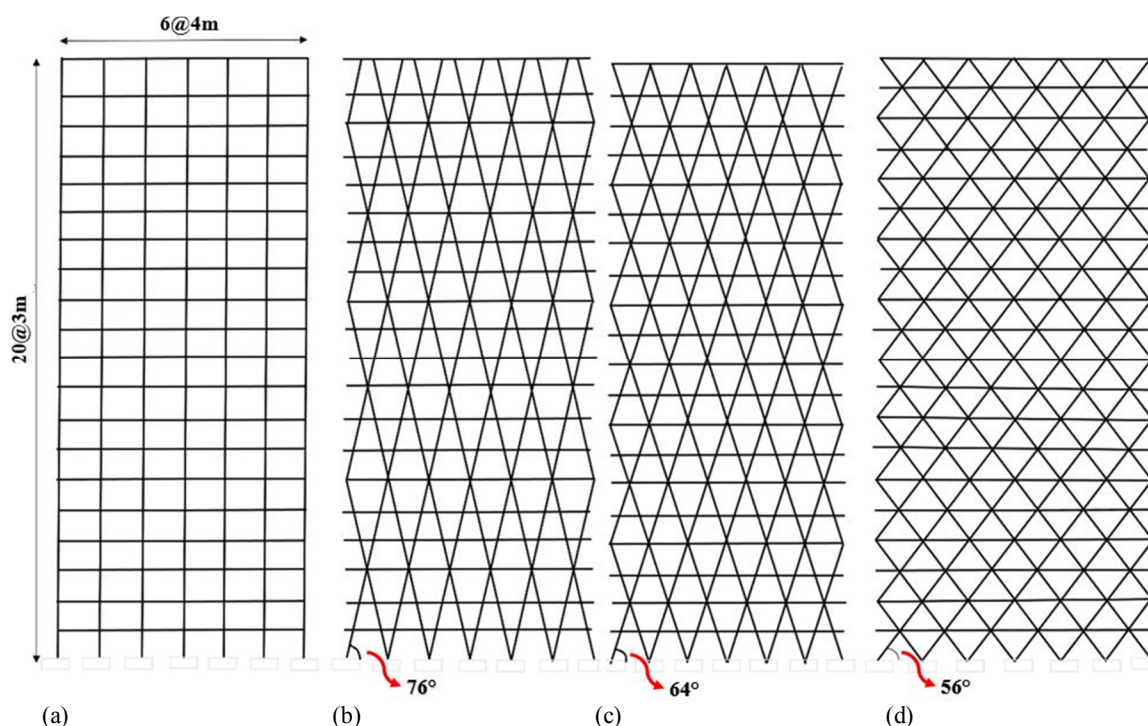


Figure 1. The façade pattern of the 20-story studied structures with various criterion angles; (a) the bundled tube & panel angle 90°, (b) the diagrid & diagonal angle 76°, (c) the diagrid & diagonal angle 64°, (d) the diagrid & diagonal angle 56°.

In almost all structural design codes, the direction of ground motion incidence is usually considered the same as main skeletal axis. The purposed simultaneous effect is also considered by superposition of 100% of earthquake lateral forces imposed in the direction of a unique main axis which interacts with 30% of the aforementioned forces that applied in the direction of the other transverse main axis. Meanwhile in reality, there are many possible incident angles that would lead to non-uniform increases of dynamic response parameters (Hernandez & Lopez, 2002). In this paper, a set of values from 0 to 45 degrees with an increment of 15° has been applied for definition of incident angles related to earthquake excitations (Figure 2).

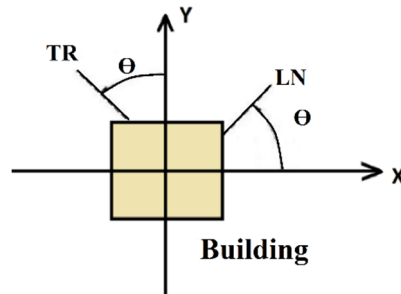


Figure 2. Definition of an incidence angle θ for an input seismic motion includes LN & TR components as well as structural main axes X & Y.

It should be noted that several nonlinear dynamic time-history analyses must be carried out to detect the critical orientation which would reach to maximum seismic demands subjected to different earthquake records (Kim & Lee, 2010). Figure 3 shows the variations of maximum story drift related to the studied structures (Figure 1) which have been obtained via conducting nonlinear dynamic time history analyses. These results were generated subjected to the Bam record 2003 in Iran. It is indicated that the maximum values of story drift caused by Bam record is significantly smaller than the allowable limit which is recommended by the Iranian seismic code 2800, i.e. 0.02. Findings reveal that as the angle of diagonal beam-columns increases, the maximum story drifts will relatively be greater. Moreover, the largest drift parameter is obtained at 0° incidence angle for all the three diagrid models. It is noticeable that to assess the seismic performance of diagrid structures subjected to severe earthquakes, the full nonlinear geometric-material behavior is necessary to be studied. The viewpoints regarded to the skeletal damage index, dynamic instability and progressive collapse can be of the comprehensive subjects.

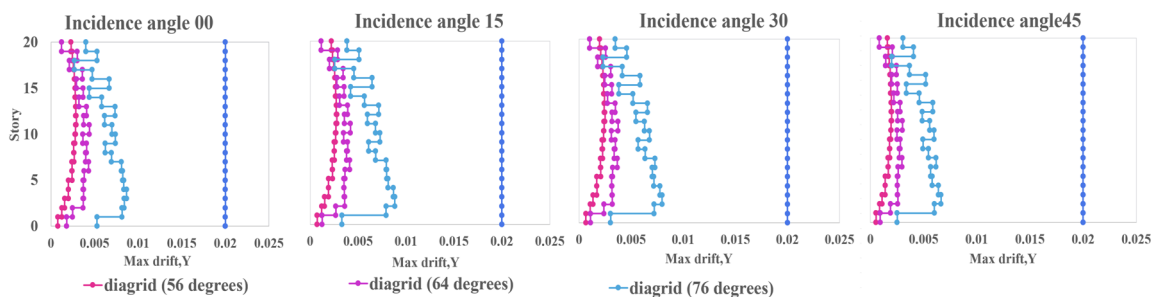


Figure 3. The envelopes of maximum story drift in Y direction subjected to the Bam record 2003.

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