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COMPARISON OF SEISMIC RESPONSES OF STEEL MOMENT FRAMES WITH AND WITHOUT ROCKING CORE

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Implementing "Low Damage Buildings" that almost eliminates the residual drift and concentrates structural damage on predetermined members considered as one of the state-of-the-art approaches for improving seismic performance in these systems. Hence, the main building is totally elastic, and inelastic behavior and energy absorption only occur in predicted elements. As a matter of fact, rocking core system is one of the most important low damage systems, which consists of a steel moment frame with grade beam–restrained column supports, a rigid rocking core, replaceable link beams and post-tensioned tendons (Grigorian et al., 2019, 2017; Wang et al., 2018; Kafaeikivi et al., 2016). The configuration is presented in Figure 1.

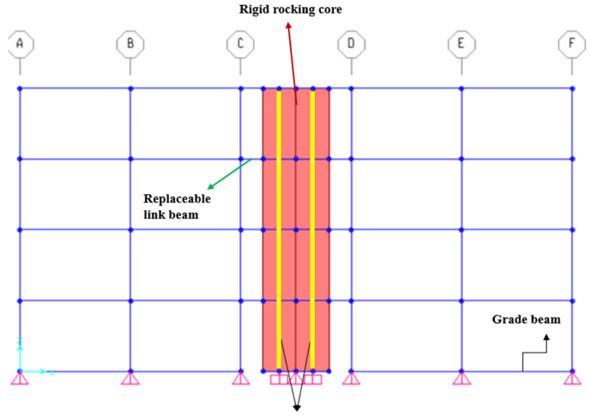

Figure 1. Steel moment frame with rocking core (Akbari, 2019).

The purpose of this study is to compare the seismic responses of moment-resisting frames with and without rocking core. Therefore, three different steel frames in heights of 4, 8, and 12 stories and 5-meter spans were designed using common building codes, and the rocking core was added to the frames. The designed frames were subjected to nonlinear static analysis and incremental dynamic analysis with eight records of far- and near-field earthquakes represented in Table 1.

All in all, the results demonstrated that adding a rocking core to the moment frame escalates the energy absorption and dissipation in the steel moment frames and since it can enhance the performance level of the structure consequently. According to pushover analysis, it is observed that base shear value of 4, 8, and 12 story frames with rocking core is obtained about 1.15, 1.20, and 1.25 times the corresponding value for the traditional structures, respectively. Also, the stiffness of rocking systems reduced by 25, 20, and 15 percent, compared to common moment frames. In both static and dynamic analysis, it is noted that by using rocking core systems, the inter-story drifts are more uniformly distributed, compared with those in conventional moment frame systems. Adding a rocking core to the moment frame prevents forming a soft-story failure in advance. Eventually, uniform displacement distribution of the inter-story drift not only results in a uniform distribution of bending moment in the members but also leads to a reduction in the total weight of the structure and the future costs.

IDA curves of 4-story buildings are shown in Figure 2.

Table 1. The set of eight ground motions used.

Near-field earthquakes								
No.	**RSN**	**Event Name**	**Station Name**	**Magnitude**	**R_{rup} (km)**	**PGA_X [g]**	**PGA_Z [g]**	**PGV [cm/s]**
1	779	Loma Prieta	LGPC	6.93	3.88	0.57	0.90	96.10
2	1111	Kobe	Nishi-Akashi	6.9	7.08	0.48	0.39	46.82
3	1507	Chi-Chi	TCU071	7.62	5.8	0.53	0.42	52.30
4	1633	Manjil	Abbar	7.37	12.55	0.51	0.54	42.46
Far-field earthquakes								
5	70	San Fernando	Lake Hughes #1	6.61	27.4	0.15	0.11	18.16
6	288	Irpinia	Brienza	6.9	22.56	0.22	0.20	13.10
7	359	Coalinga	Parkfield - Vineyard Cany 1E	6.36	26.38	0.18	0.08	17.95
8	830	Cape Mendocino	Shelter Cove Airport	7.01	28.78	0.23	0.05	6.92

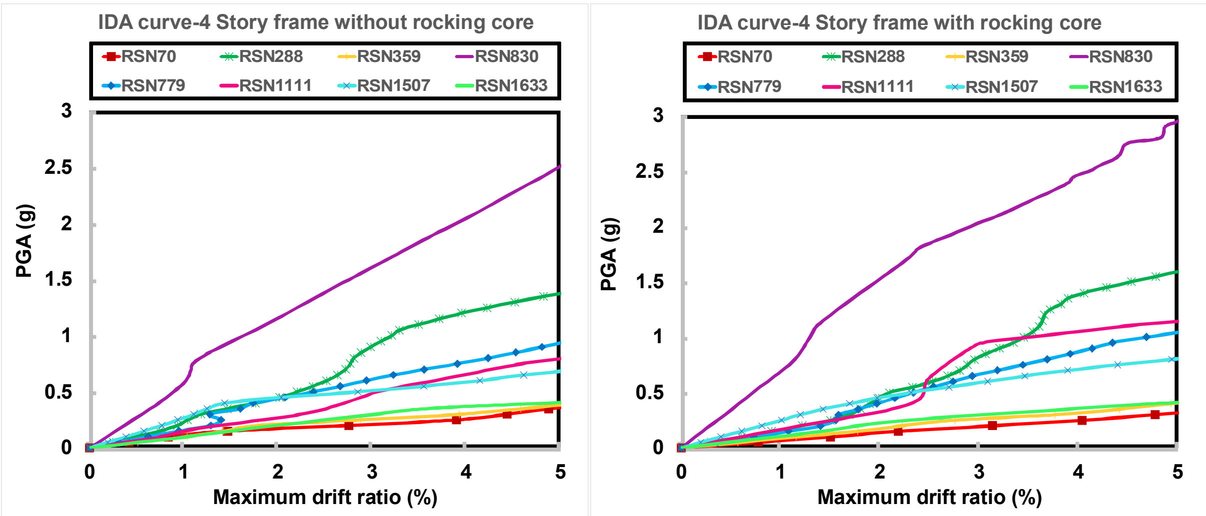

Figure 2. (a) IDA curves of 4 story moment frame (b) IDA curves of 4 story frame with rocking core.

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