The analysis of a precast sheer wall building

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Abstract. In this paper a 33 story precast shear wall structure is analyzed. In order to study the safety of the tall parapet wall the parapet wall is established in the model. Structure analysis software YJK-EP is taken for the elastic-plastic analysis of this precast sheer wall structure, specifically, the whole anti-seismic performance under rare earthquake is analyzed, three seismic waves, one artificial wave and two natural waves, are loaded according to code[1], and their reaction under earthquake in the direction of X and Y are calculated. The result of the analysis shows that the inter layer displacement angel under rare earthquake is much smaller than the norm limits (1/100)[2], which indicates that the structure can meet the requirement of the code in terms of overall anti-seismic performance. Damage image of the shear wall shows that the parapet damage is minor and the parapet is in elastic stage.

Introduction

In recent years, with the rapid development of computer technology, software and the finite element technology, nonlinear analysis methods of structures have got breakthrough progress[3]. Many scholars have carried out the elastic-plastic analysis of many complex structures[4-6]. This paper a precast sheer wall building is analyzed by YJK. The selected prefabricated building, 33 floors in total, 2.9m high for each floor and 3.7m high for basement, is whole prefabricated above cast-in-place ground except the basement. In order to study the whole anti-seismic performance of the structure and the anti-seismic performance impact of the height of strengthened floor onto the 33 floors building under big earthquake, the elastic-plastic response of the structure is analyzed. According to the code, three waves, one artificial wave and two natural waves, are selected and studied for the seismic response in main direction X and Y separately, the responses of the 33 floors building structure under the three waves of earthquake are studied and compared.

The structure model

The elastic-plastic analysis is taken for the 33 floors building, which is of 95.7m height of main body structure, YJK elastic-plastic calculation model (YJK-EP for short) is chosen as Fig.1..
Considering of the complex elastic-plastic analysis theory and practical reinforcement of the structure, the elastic-plastic model can be simplified properly in order to get steady and reliable result. Also, to make sure that YJK elastic-plastic analysis is unanimous with the designed model and YJK-EP model, the three models should be compared in terms of their overall computing. The result of the overall computing and the first three cycles comparison of the models are shown as table 1, from which the overall index fits well, however, because of the difference among each unit and impact of reinforcement, the calculation result maybe not identical.

Table 1 Comparison of the calculation models

		YJK	YJK-EP
mass(t)		19006	18817
period（s）	T1	3.52	3.33
	T2	2.98	2.72
	T3	2.05	1.92

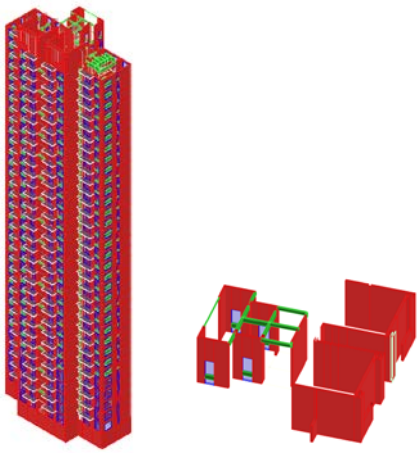
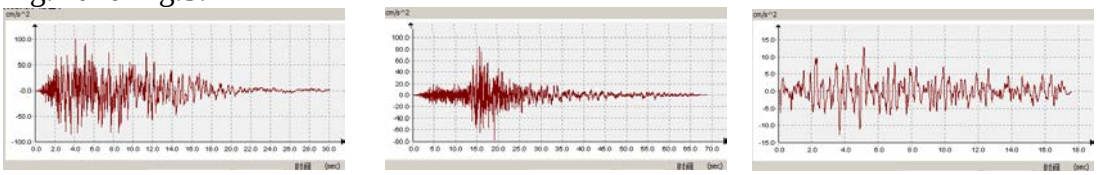


Fig.1 YJK model of 33 floors structure

Earthquake waves

During the nonlinear time-history analysis, three earthquake waves are selected by YJK, one artificial wave and two natural waves, the main direction oscillogram and response spectrum are seen in Fig.2 and Fig.3.



ArtWave-RH3TG035 Chi-Chi, Taiwan-05_NO_2982 Manjil, Iran_NO_1639

Fig.2 Earthquake wave

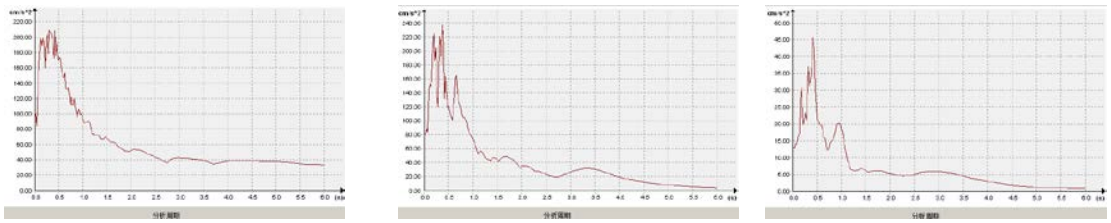


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Fig.3 Spectrum of the earthquake wave

Table 2 comparison between earthquake wave base shear force and mode decomposition response spectrum base shear force

	Shear force X direction (KN)	Shear force Y direction (KN)
Spectrum	16356	16444
ArtWave	12797	13386
N.Palm	12145	13816
Manjil	15442	14536
Average	13462	13913

From table 3, the minimum base sheer of X direction by earthquake waves time-history analysis is 12145kN, greater than the 65% of the response spectrum base sheer 16356KN, the average of the base sheer from the three earthquake waves time-history analysis is 13462kN, which is greater than the 80% of response spectrum. The results of base sheer in Y direction also satisfy the above two condition. The selected earthquake waves for time-history analysis meet the requirement of the code

for seismic design of building[1]. Based on the feature of plane and façade of the structure, earthquake waves are input in orthogonal direction in plane and vertically, and the peek acceleration ratio in primary and secondary direction is 1:0.85:0.65,for which V direction and Y direction are calculated as primary direction, the peek acceleration in primary direction is taken as 220gal.

Calculation results

Under the load of three waves, the maximum inter story drift angle of the structure by YJK-EP are compared as Table 3-4.

Table 3 displacement angle of X direction

Floor	RH3TG	Chi-Chi	Manjil	Average
1	1/1271	1/1267	1/1379	1/1304
2	1/740	1/651	1/708	1/698
3	1/558	1/495	1/556	1/535
4	1/499	1/435	1/473	1/467
5	1/468	1/420	1/443	1/443
6	1/444	1/409	1/407	1/419
7	1/432	1/397	1/403	1/410
8	1/437	1/384	1/388	1/402
9	1/419	1/376	1/374	1/388
10	1/409	1/372	1/352	1/376
11	1/395	1/368	1/343	1/367
12	1/389	1/362	1/333	1/360
13	1/381	1/358	1/315	1/349
14	1/365	1/353	1/320	1/345
15	1/358	1/359	1/302	1/338
16	1/351	1/354	1/294	1/331
17	1/351	1/358	1/286	1/329
18	1/352	1/364	1/282	1/328
19	1/353	1/369	1/280	1/329
20	1/352	1/370	1/286	1/332
21	1/355	1/365	1/274	1/326
22	1/361	1/374	1/272	1/329
23	1/372	1/383	1/271	1/334
24	1/380	1/396	1/270	1/339
25	1/392	1/392	1/274	1/343
26	1/394	1/405	1/288	1/354
27	1/410	1/417	1/287	1/361
28	1/424	1/437	1/287	1/369
29	1/435	1/448	1/296	1/379
30	1/457	1/465	1/317	1/401
31	1/478	1/487	1/322	1/414
32	1/464	1/516	1/326	1/419
33	1/329	1/572	1/229	1/328
34	1/829	1/1328	1/434	1/704

Table 4 displacement angle of Y direction

Floor	RH3TG	Chi-Chi	Manjil	Average
1	1/1318	1/2833	1/2174	1/1908
2	1/621	1/1497	1/966	1/906
3	1/457	1/1099	1/720	1/668
4	1/372	1/929	1/577	1/546
5	1/328	1/839	1/513	1/484
6	1/293	1/767	1/452	1/433
7	1/266	1/714	1/411	1/395
8	1/243	1/664	1/380	1/363
9	1/227	1/625	1/353	1/340
10	1/218	1/596	1/327	1/322
11	1/208	1/570	1/309	1/306
12	1/197	1/548	1/289	1/290
13	1/192	1/532	1/279	1/281
14	1/184	1/517	1/269	1/271
15	1/182	1/509	1/260	1/265
16	1/178	1/501	1/255	1/260
17	1/178	1/500	1/248	1/257
18	1/175	1/495	1/243	1/253
19	1/175	1/495	1/239	1/252
20	1/169	1/490	1/229	1/243
21	1/173	1/487	1/231	1/246
22	1/175	1/482	1/227	1/246
23	1/177	1/476	1/222	1/244
24	1/177	1/468	1/221	1/244
25	1/181	1/465	1/223	1/247
26	1/177	1/461	1/228	1/246
27	1/182	1/461	1/230	1/250
28	1/185	1/468	1/230	1/252
29	1/189	1/469	1/228	1/254
30	1/183	1/471	1/235	1/253
31	1/191	1/477	1/241	1/261
32	1/193	1/483	1/241	1/263
33	1/198	1/491	1/233	1/264
34	1/550	1/1340	1/644	1/729

The maximum layer displacement angle by RH3TG in Y direction is the greatest, the structure damage picture under RH3TG is shown as Fig.5, from which the structure damage is focus on the structure coupling beam, the sheer wall is little damaged, of which the damage is mainly focus on lower part, and decreasing as the floor rises.

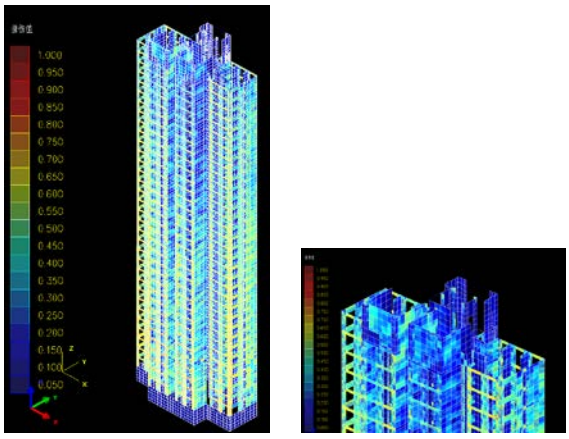

Fig.5 Structure damage

Conclusions

The maximum inter layer displacement angel by elastic-plastic analysis is much smaller than the code limits (1/100) [2], which indicates that the structure meet the requirement of the code in terms of overall anti-seismic performance. The structure damage picture shows that the structure damage is focus on the structure coupling beam, the overall of the sheer wall is little damaged, with damage mainly focus on lower part, and decreasing as the floor rises. Damage image of the parapet shows that the parapet damage is minor and the parapet is in elastic stage under rare earthquake.

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