

## Response and Damage of High-Rise Buildings in the Nishi-Shinjuku Area, Tokyo, Japan, during the 2011 Tohoku Earthquake

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We reported seismic response, damage and emergency response of high-rise buildings in the Shinjuku Station area in Tokyo, Japan, for the 2011 Great East Japan Earthquake, using strong motion data, numerical simulations and questionnaire/hearing surveys. The Shinjuku Campus of Kogakuin University of 29-stories showed that the maximum amplitudes of the strong motions during the mainshock are 1 m/s/s, 0.2 m/s, and 0.1 m for accelerations, velocities, and displacements, respectively, at the ground level. And those of the 29th floors are amplified to 3 m/s/s, 0.7 m/s, and 0.37 m, respectively. The JMA intensity also amplified from 4 at 1st floor to 6- at 29th floor. Even though there was no structural damage, nonstructural elements suffered damage at the middle to higher floor: falls of ceiling boards, and deformation of partition walls. An emergency elevator had been stopped for more than 3 weeks, because of twisted cables and broken parts. The questionnaire/hearing surveys from 16 buildings in the Shinjuku area showed that their seismic response and damage patterns are similar to those of Kogakuin University. Even though there was no severe building damage, emergency managers felt difficulty to make an appropriate announcement whether people should stay or evacuate from the building to obtain the damage information immediately after the earthquake. This suggests the effectiveness of RSM (Real-Time Seismic Monitoring system) after an earthquake.

**Keywords:** 2011 Great East Japan earthquake, Long-Period Strong Ground Motion, High-Rise Building, Numerical Analysis, Non Structural Elements, Emergency Response

Table 1 Max. amplitudes of of the Kogakuin and STEC buildings during 2011 East Japan earthquake

(a) Kogakuin University Building							(b) STEC Office Building							
Floor	EW	NS1	NS2	UD	8	1	Floor	EW	NS1	NS2	UD	8	1	B6F
Relative Displacement to 1F (cm)	33.7	29.0	25.9	16.9	-	0.0	29.7	23.5	15.3	7.0	0.0	-	-	-
Absolute Displacement (cm)	30.6	26.1	25.1	-	-	3.7	34.4	28.9	20.5	8.9	-	-	-	-
Acceleration (cm/s/s)	291.6	151.4	153.4	232.4	198.2	87.5	248.9	125.8	246.0	190.0	-	-	-	-
JMA Intensity	5.9	5.2	5.1	-	-	4.6	5.9	4.9	5.5	5.9	4.6	-	-	-

Note: NS1=West Side, NS2=East Side  
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 The JMA intensities of the shaded cells are calculated using the two horizontal components

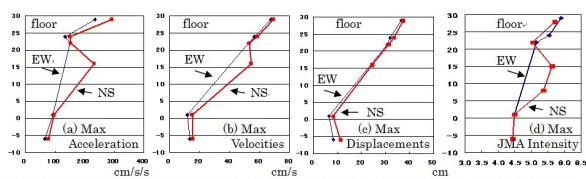


Fig.1 Maximum Accelerations, Velocities, Displacements, and the JMA Intensities of Kogakuin Univ.