Seismic Behavior Analysis of Electrical Cabinets due to Rocking in Shaking Table Test

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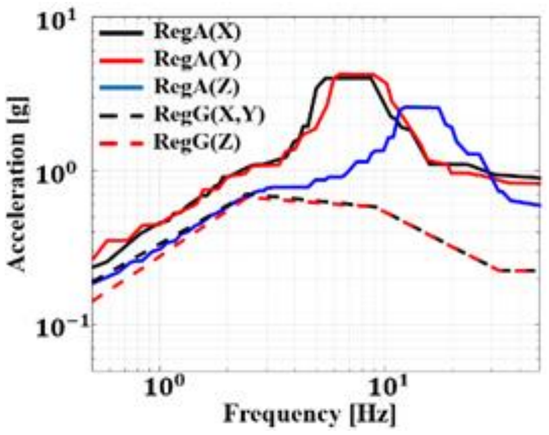
Abstract

Generally, the seismic performance evaluation of electrical cabinets is conducted through the shaking table test or finite element analysis. Seismic performance evaluation through finite element analysis generally assumes that the electrical cabinet is firmly secured to the floor or foundation. Depending on the electrical cabinet fixing method, however, such boundary condition assumption in finite element analysis may not be valid as the bolted electrical cabinet bottom may experience rocking or uplifting. Therefore, this study conducted a shaking table test to analyze the effects of such rocking or uplifting on the dynamic behavior of electrical cabinets.

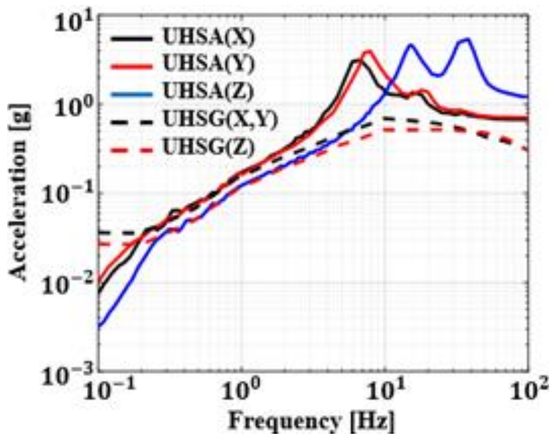
Keywords : *Electrical cabinet, Rocking, Shaking table test, Dynamic behavior*

Shaking Table Test

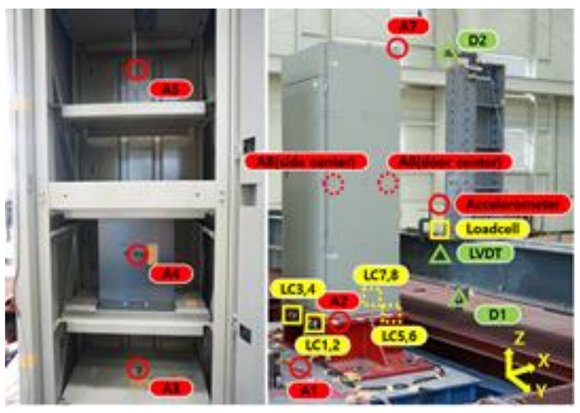
Regulatory Guide 1.60 spectrum



Uniform hazard spectrum (Uljin site)



Sensor installation location



Ring-type load cells installed in anchor bolts

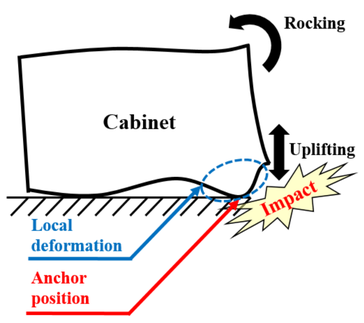
Shaking table test procedure

No.	Test Name	Dir.	Remarks
1	Pre-resonance search test	X	Sinusoidal sweep 2 Otc. /min., 1 Hz ~ 50 Hz, 0.07g
2		Y	
3		Z	
4	Time history test	RegG	Multi-frequency Seismic Simulation Tests, Triaxial Testing, Time duration 30s, Strong motion time duration 20s
5		RegA	
6		UHSG	
7		UHSA	
8	Post-resonance search test	X	Sinusoidal sweep 2 Otc. /min., 1 Hz ~ 50 Hz, 0.07g
9		Y	
10		Z	

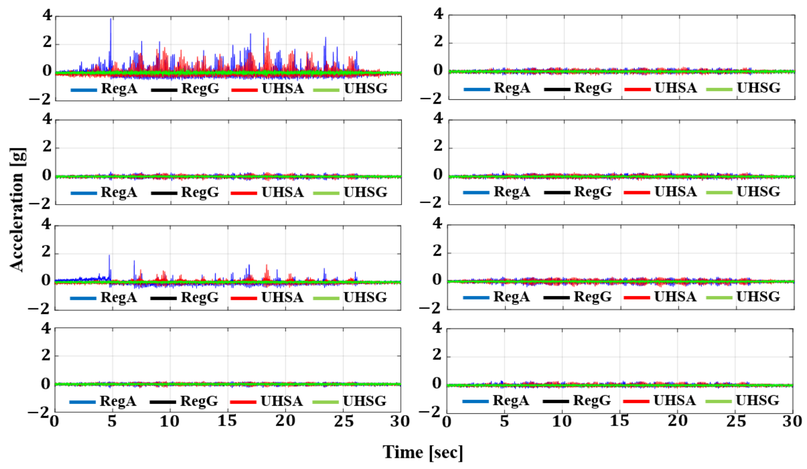
Results of resonance search test

Locaion	Resonant frequency (Hz)					
	Pre			Post		
	X	Y	Z	X	Y	Z
Inside 1st story (A3)	16.0	21.8	22.3	16.3	21.8	22.3
Inside 2nd story Panel center (A4)	26.3	16.0	22.3	26.3	22.0	22.3
Inside 3rd story Panel center (A5)	30.3	16.8	17.0	30.3	17.0	17.0
Door center (A6)	16.0	16.3	16.0	16.0	16.5	16.0
Top (A7)	22.3	N/A	N/A	21.8	N/A	N/A
Side panel center (A8)	22.5	16.0	16.0	21.5	16.0	16.0

Rocking and uplifting

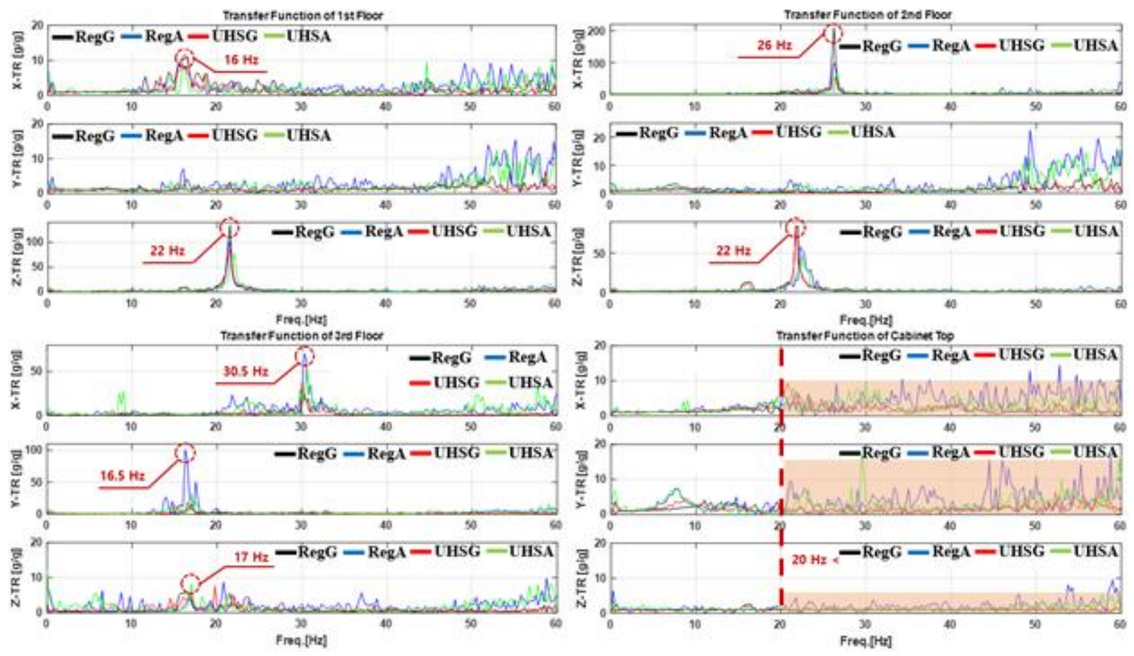


Acceleration response measured at top



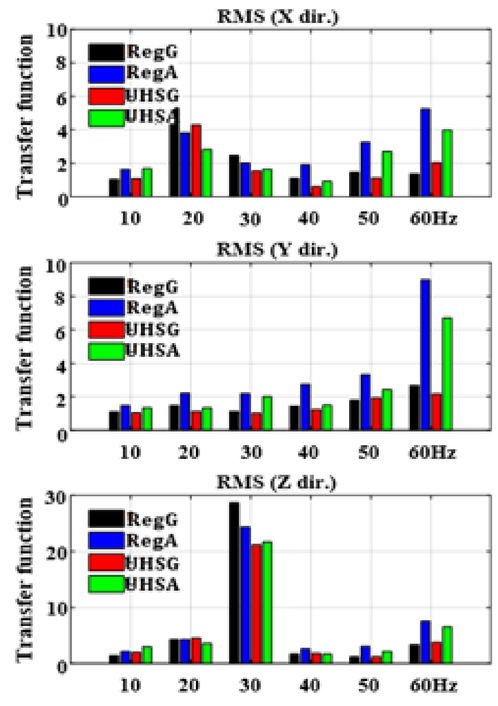
Analysis of Electrical Cabinet Response due to Rocking

Transfer function of acceleration response

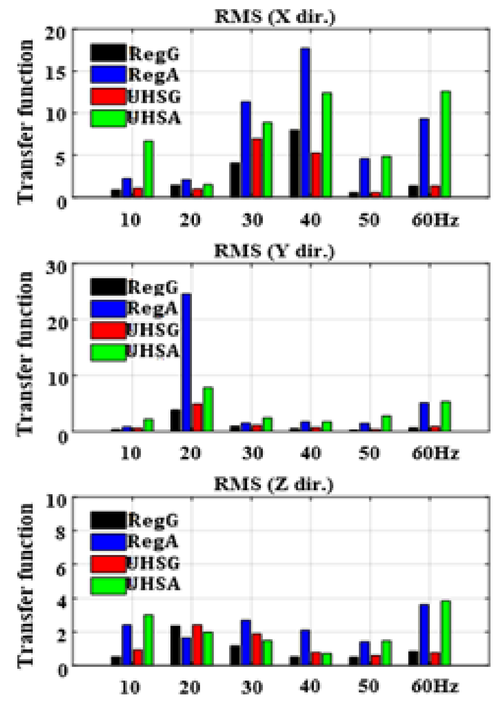


RMS value (0.5 – 60 Hz) of transfer function calculated based on 10 Hz division unit

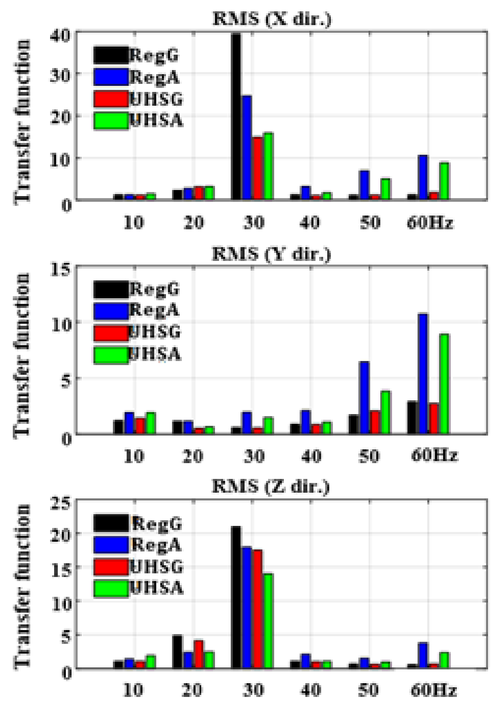
The first floor



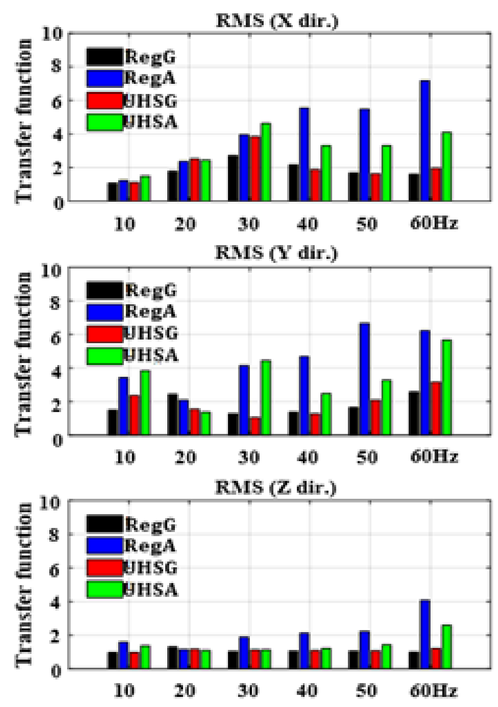
The second floor



The third floor



Cabinet top



Conclusions

It is estimated that shocks caused by rocking are transmitted to the top via the electrical-cabinet frame. RegA, where rocking occurred, was found to be great in all directions compared to UHSA, where the maximum acceleration value, measured at the top of the electrical cabinet, was the highest. The shocks caused by the electrical-cabinet rocking were found to have significantly increased the transfer function value in the 20 Hz or higher frequency range at the top of the electrical cabinet. The transfer function of the third floor inside the electrical cabinet was confirmed to have greatly increased due to the impact of rocking. The response of the first and second floors of the electrical cabinet, however, was not greatly affected. Thus, it is estimated that the impact of shocks accompanied by rocking or uplifting was concentrated on the top of the electrical cabinet.