



*International Institute of
Seismology and
Earthquake Engineering*



Strong Motion Records at Hachinohe City Hall

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Contents

- Strong Motion Instrumentation at Hachinohe City Hall
 - Main bldg. 2 sensors
 - Annex bldg. 6 sensors
- Record from an earthquake of July 24, 2008
 - $PGA: 0.78G$ 、 $I_{JMA}: 5.8$



Target Building

■ Main Building

- 6 floors + 1 basement floor, SRC, completed in 1980
- Slightly damaged by the 1994 Far Off Sanriku Eq.

■ Annex Building

- 10 floors + 1 basement floor, SRC, base-isolation, completed in 1998



Location



(Yahoo! map)





*International Institute of
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**BUILDING
RESEARCH
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Exterior



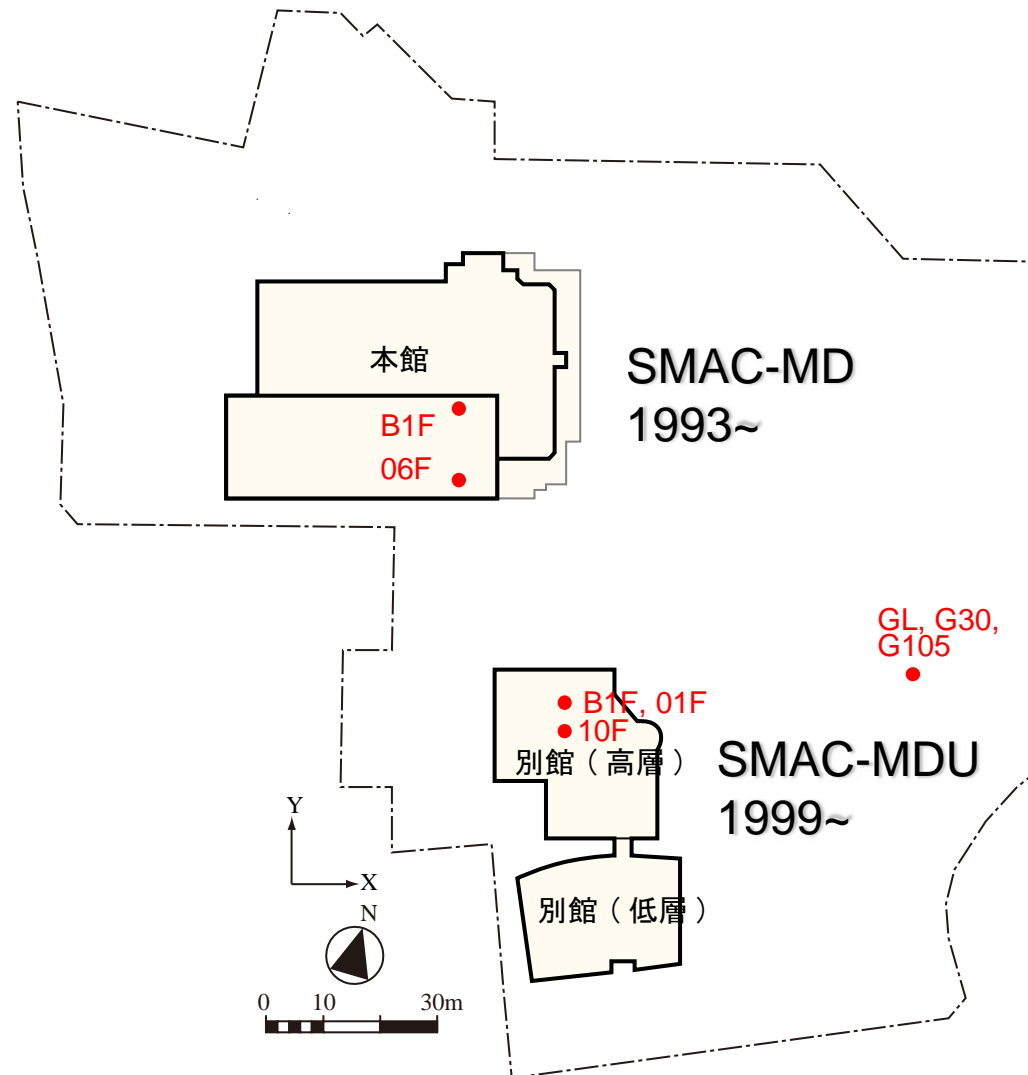
Annex bldg.



Main bldg.



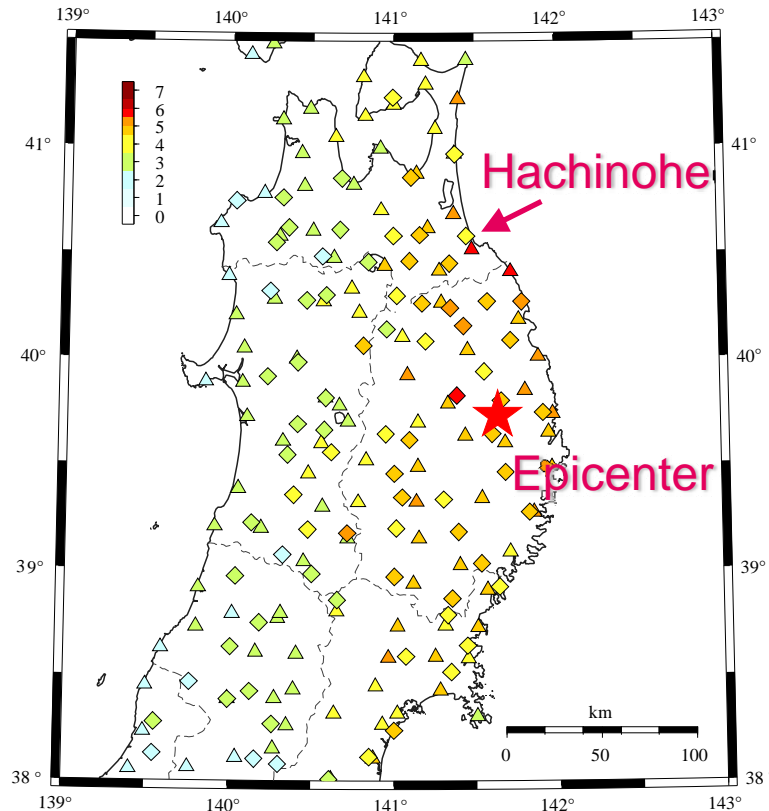
Sensor Configuration





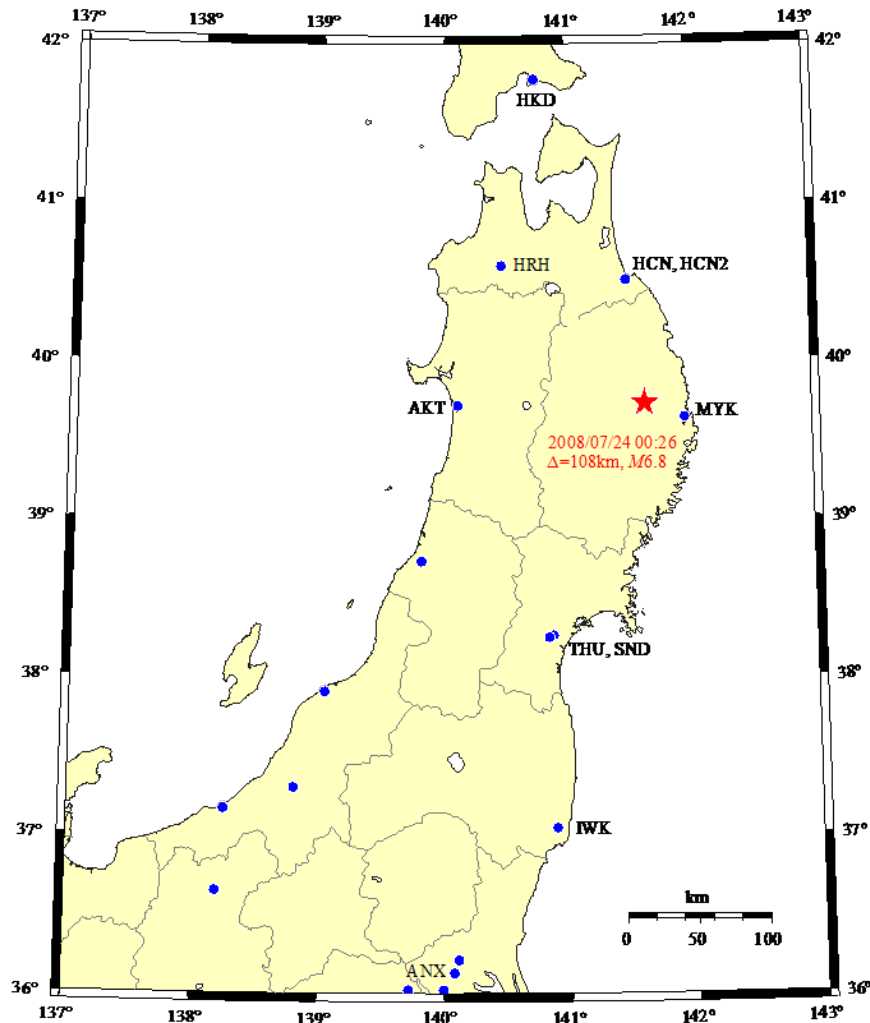
N Coast Iwate Pref. Eq.

- July 24, 2008 at 00:26
- $M_{JMA}=6.8$
- $h=108$ km
- $\Delta=87$ km





BRI Stations



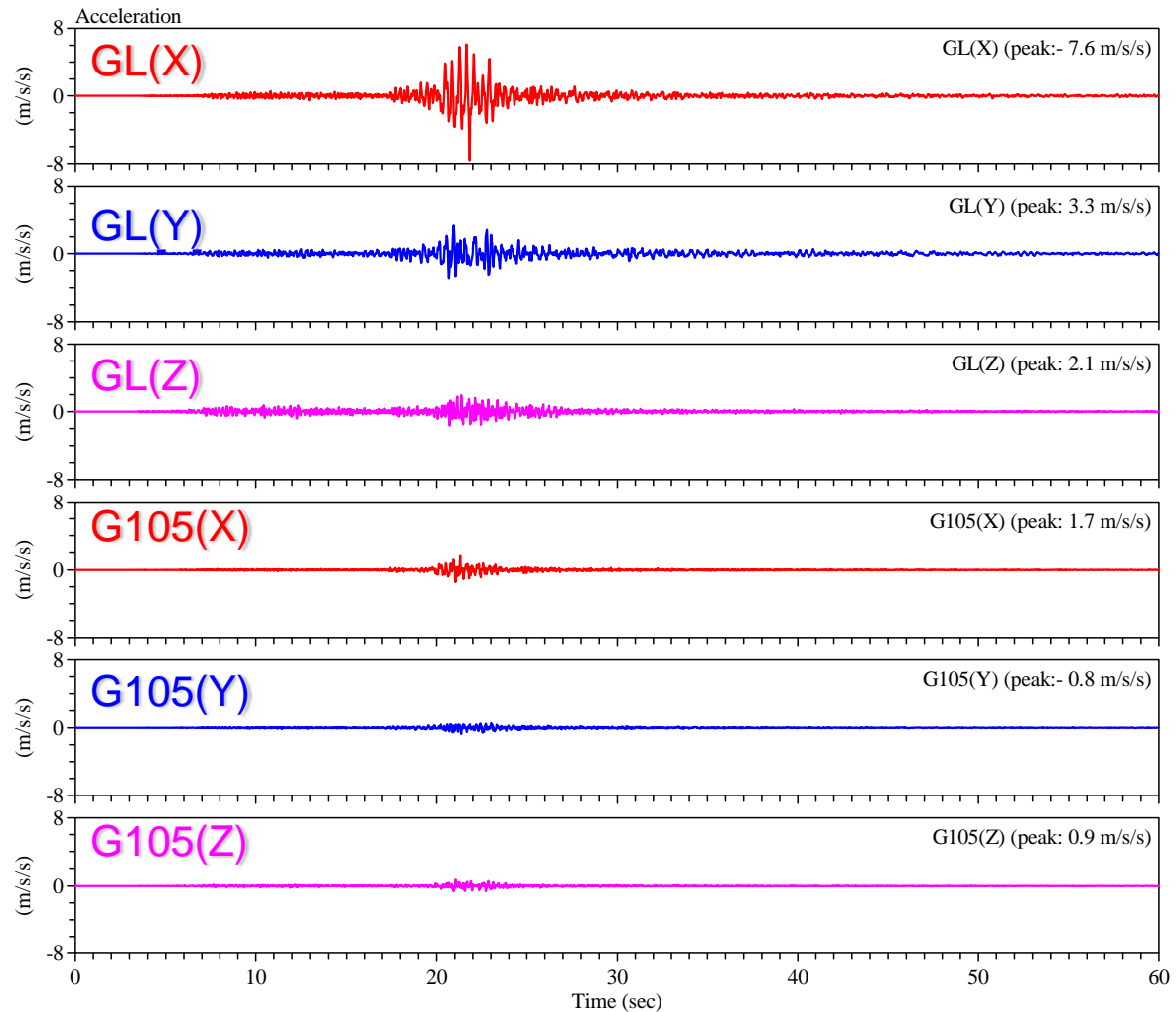


Peak Accelerations

Bldg.	Loc.	I_{JMA}	Peak Acc. (m/s^2)		
			X	Y	Z
Main	06F	6.4	9.83*	5.85	3.56
	B1F	4.9	1.98	1.59	1.27
Annex	10F	5.3	2.02	1.39	5.70
	01F	4.8	1.67	1.37	1.37
	B1F	5.0	2.28	2.07	2.34
	GL	5.8	7.63	3.32	2.12
	G30	4.3	1.38	1.53	0.84
	G105	4.1	1.67	0.79	0.85



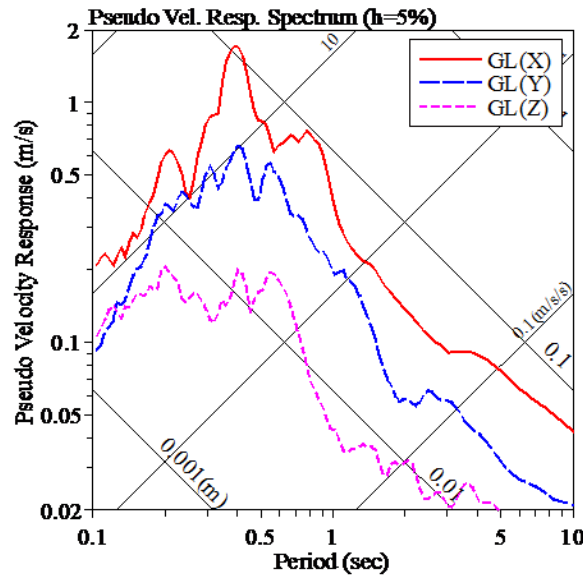
Ground Motions



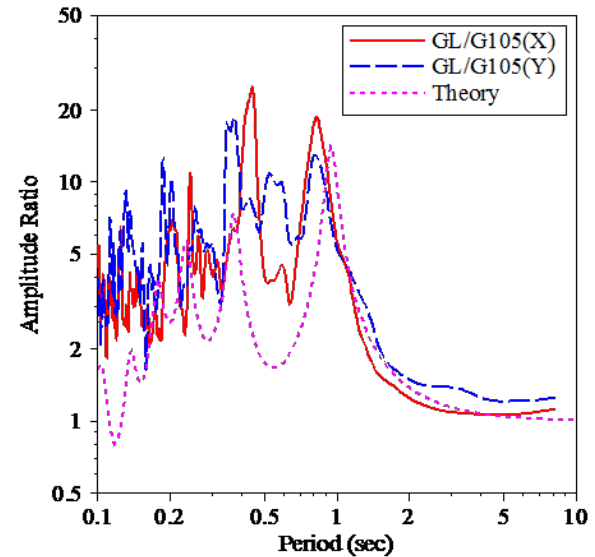
Ground (GL, upper) and bedrock(G105, lower)



Ground Motion Characteristics



pSv on the ground ($h=5\%$)



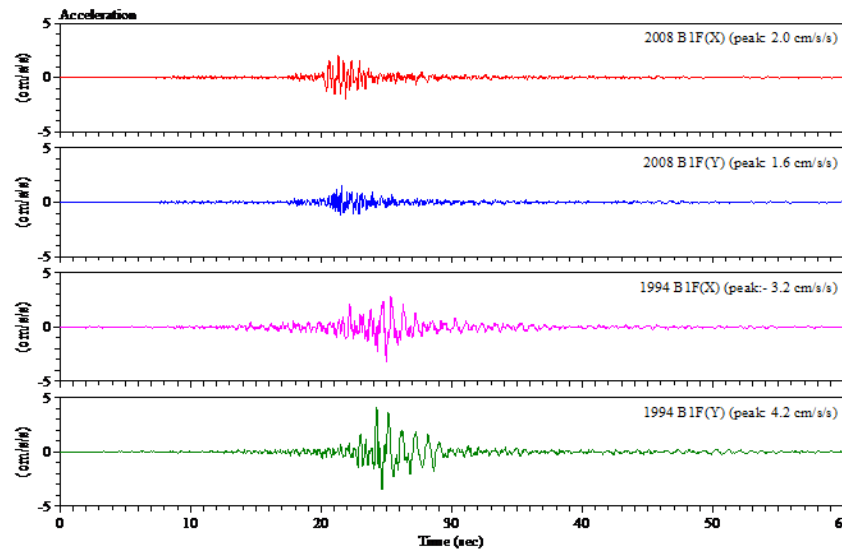
Fourier spectrum ratio
(GL/G105, horizontal)



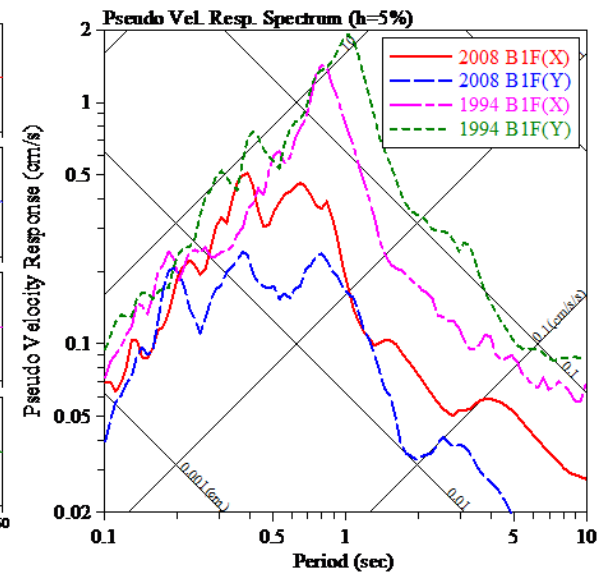
Comparison b/w 1994 and 2008

■ Record at Main bldg. B1F

- I_{JMA} were 4.9 (2008) and 5.8 (1994)



Acceleration records (upper 2008 and lower 1994)

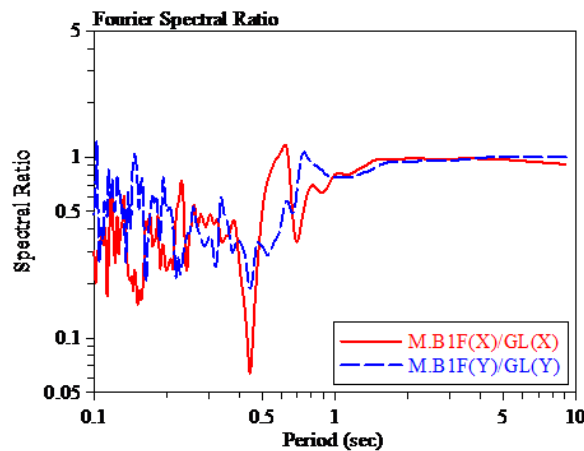


Pseudo velocity response spectrum (pSv)

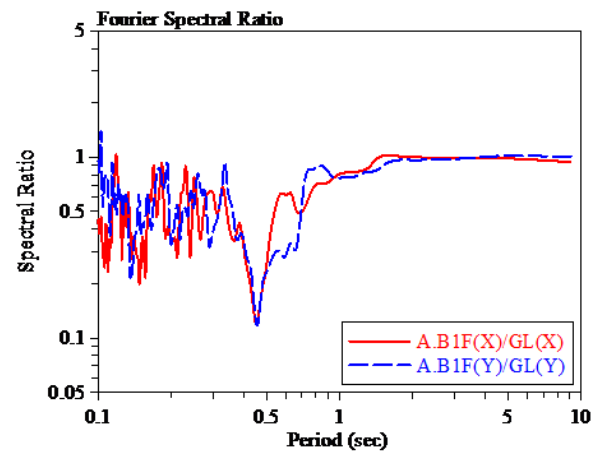


Input Motion to Buildings

Location	I_{JMA}	Peak Acc. (m/s^2)		
		X	Y	Z
GL	5.8	7.63	3.32	2.12
Main bldg. B1F	4.9	1.98	1.59	1.27
Annex bldg. B1F	5.0	2.28	2.07	2.34



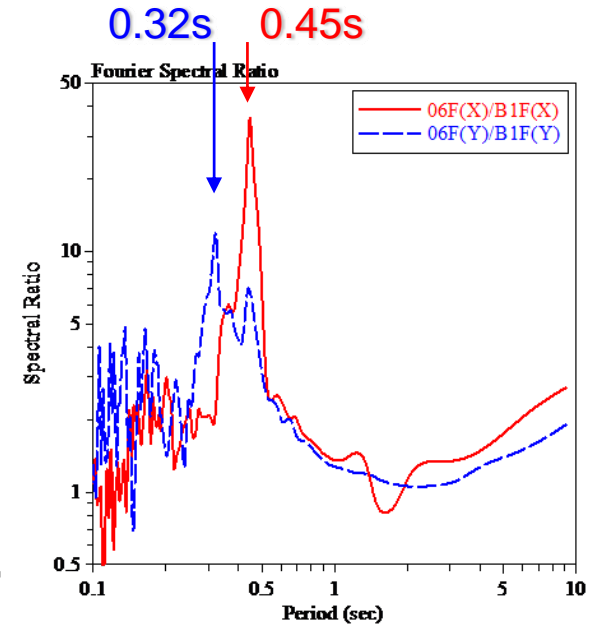
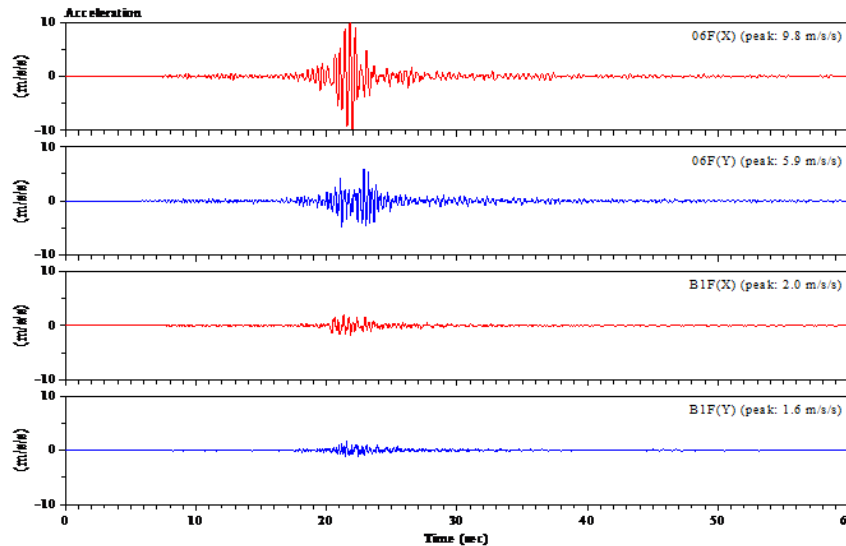
Fourier spectrum ratio (Main, B1F/GL)



Fourier spectrum ratio (Annex, B1F/GL)

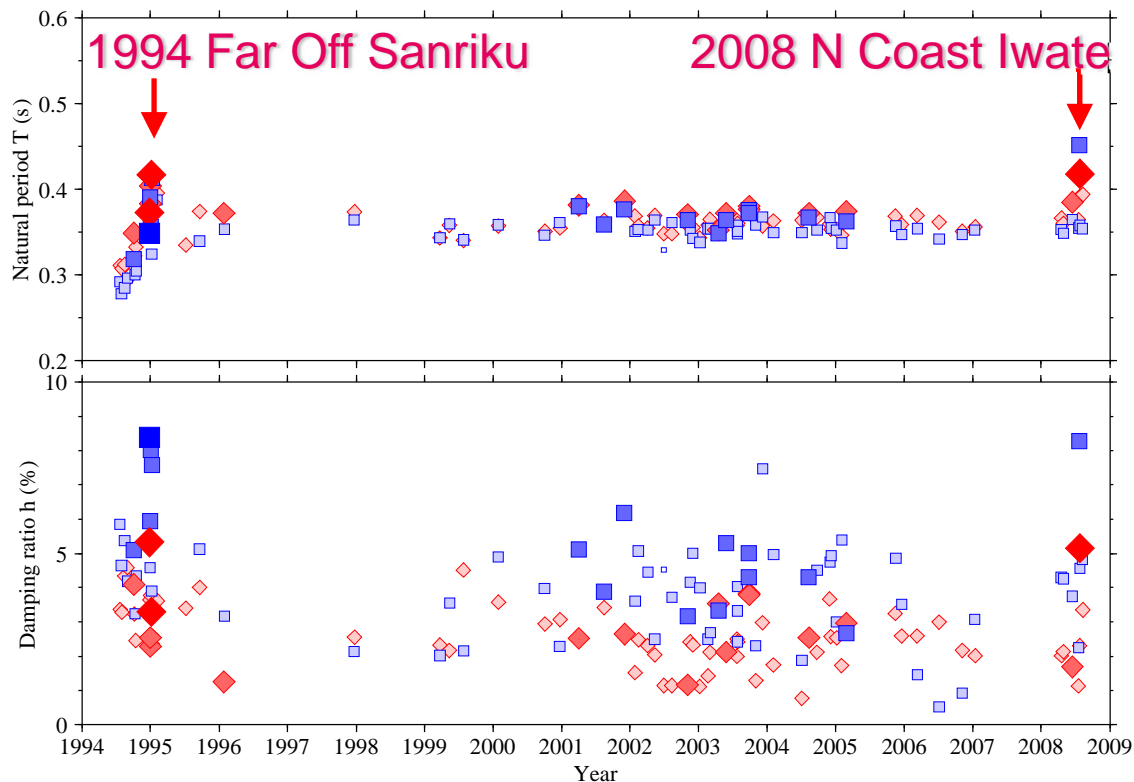


Response of Main Bldg.





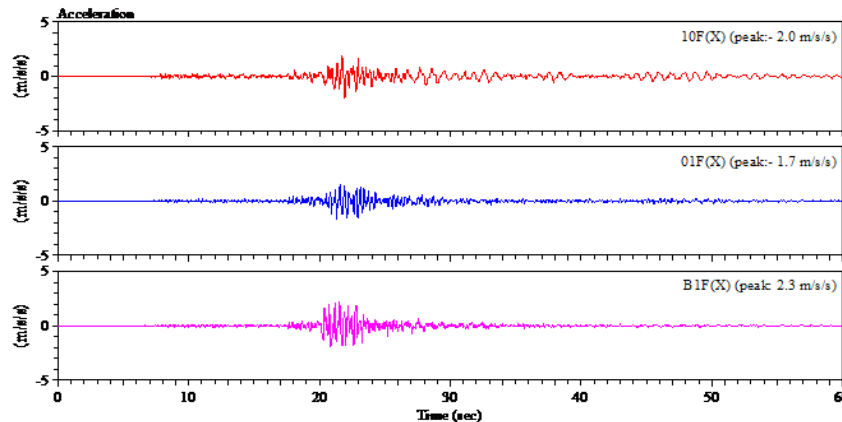
Transition of natural periods



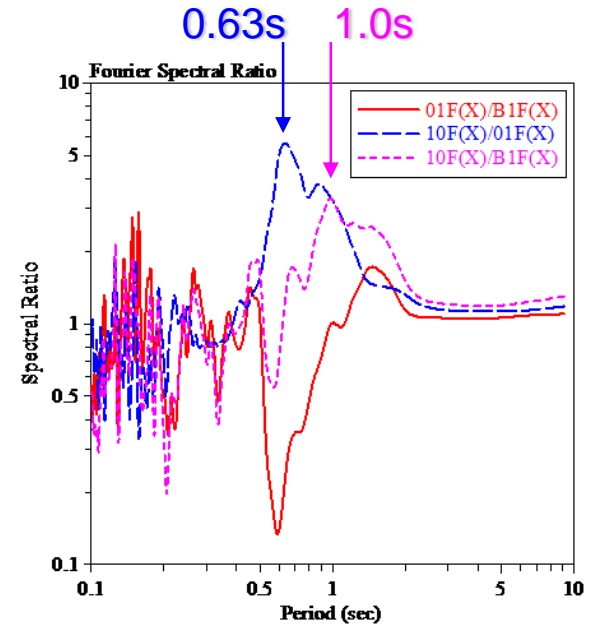
Identified natural periods and damping ratios from 1994 to 2008



Response Annex Bldg. (X)



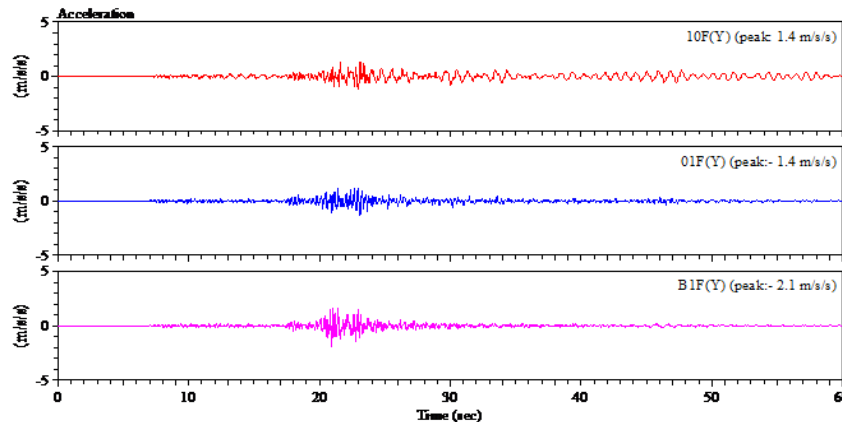
Acceleration records at 10F (upper), 01F (middle) and B1F (lower) in Annex bldg. (X-direction)



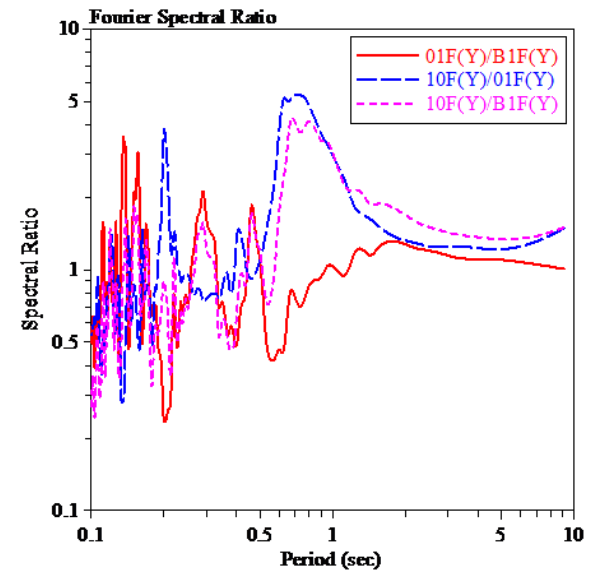
Fourier spectrum ratios (01F/B1F, 10F/01F, 10F/B1F, X-direction)



Response Annex Bldg. (Y)



Acceleration records at 10F (upper),
01F (middle) and B1F (lower) in
Annex bldg. (Y-direction)



Fourier spectrum ratios
(01F/B1F, 10F/01F,
10F/B1F, Y-direction)



Conclusions

- Strong motion characteristics of the N Coast Iwate Pref. Eq.
 - Predominant short period components
 - Amplification in the period range from 0.4 sec. to 0.9 sec. caused by surface geology
 - Amplitudes in X (EW) is larger than in Y (NS)



Conclusions

■ Main Building

- Response in X exceeded 1G
- Natural period 0.45 sec.
- Torsional behavior in Y
- Clear transition of natural periods



Conclusions

- Annex (base-isolated) Building
 - Small amplification in acceleration
 - Base-isolation was effective in X (1.0 sec.)
 - Lower input level compared with design criteria (PGV at B1F 15 cm/s)