



*International Institute of
Seismology and
Earthquake Engineering*



The 2007 Niigata-ken Chuetsu-oki Earthquake

T. Kashima
IISEE/BRI



Event

- Origin time: 2007/07/16 10:13
- JMA Magnitude: 6.8
- Focal depth: 17 km
- Epicenter: Offshore Chuetsu, Niigata Pref.



Damage

■ Casualties

- 11 killed
- 186 severely injured
- 1,804 slightly injured

■ Houses

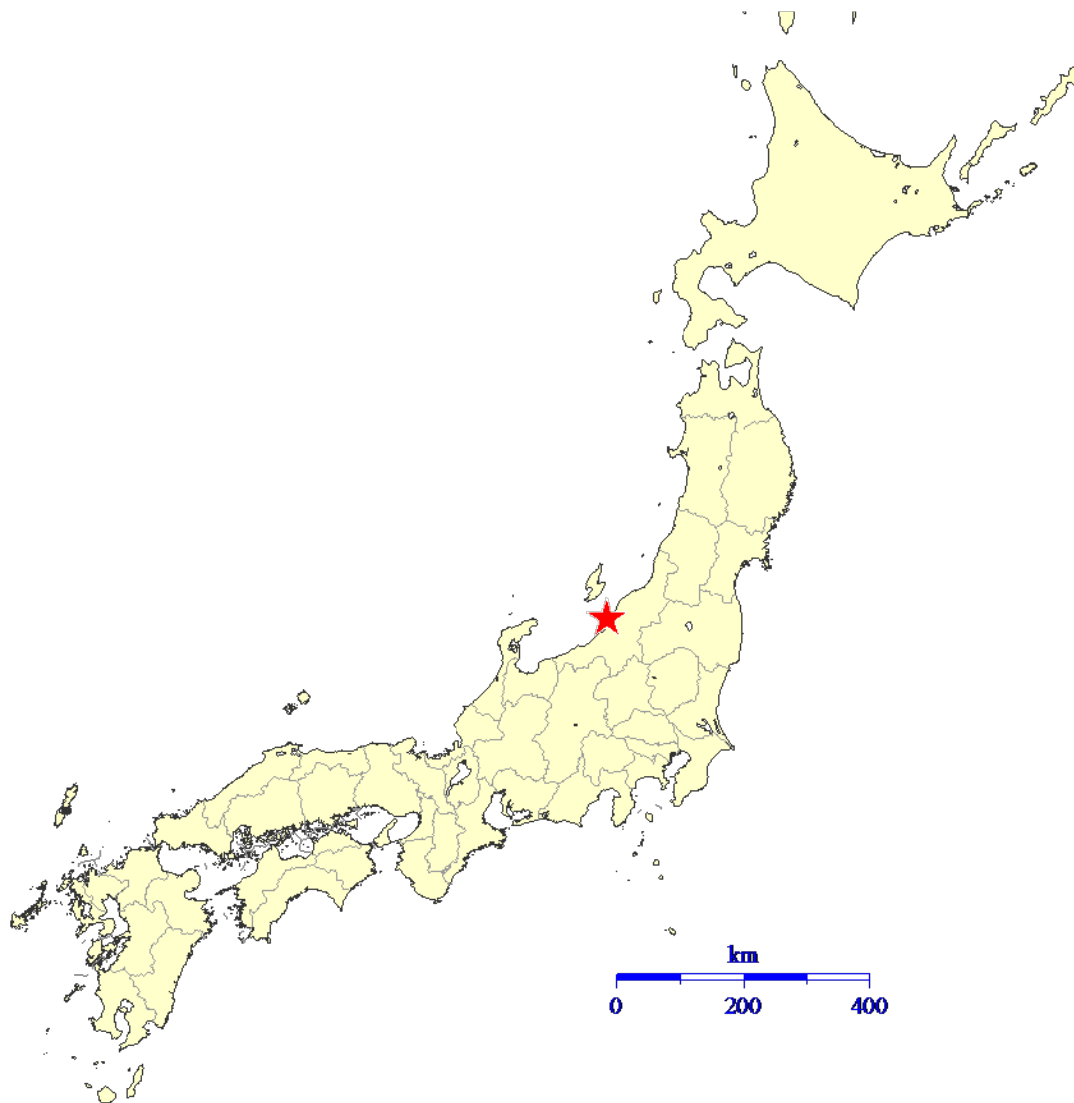
- 1,086 collapsed
- 3,790 partially destroyed
- 34,469 damaged



BUILDING RESEARCH INSTITUTE
*International Institute of
Seismology and
Earthquake Engineering*

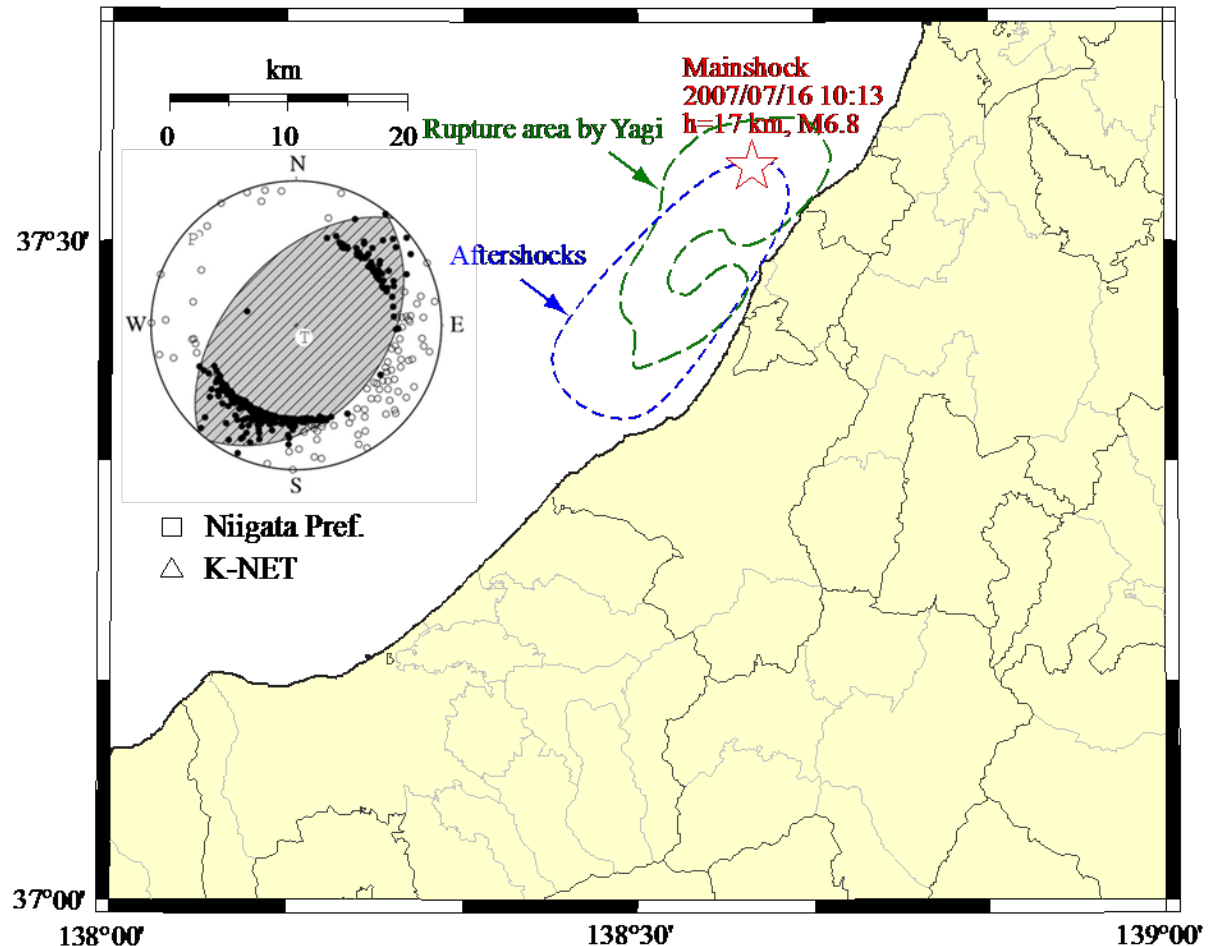


Location



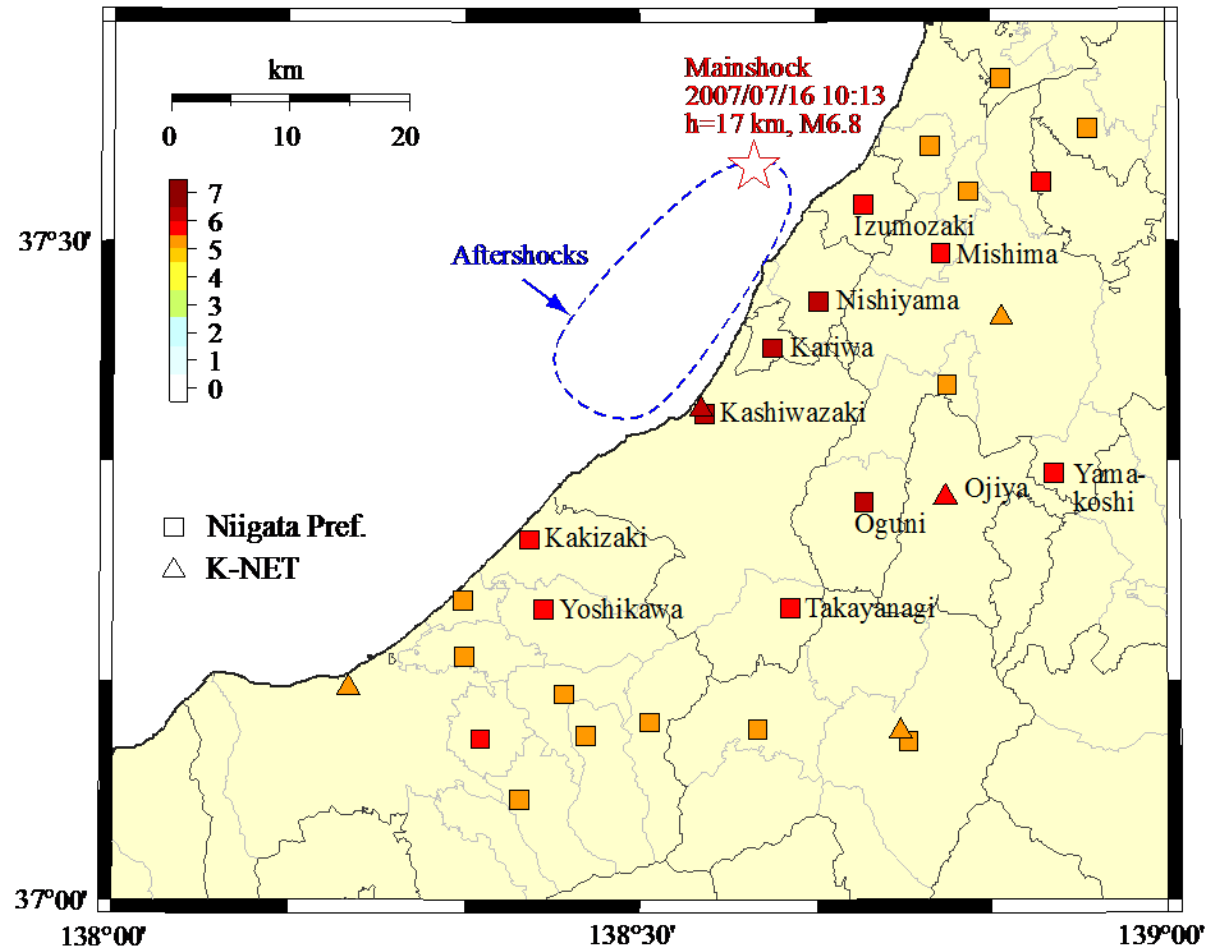


Epicenter and rupture area





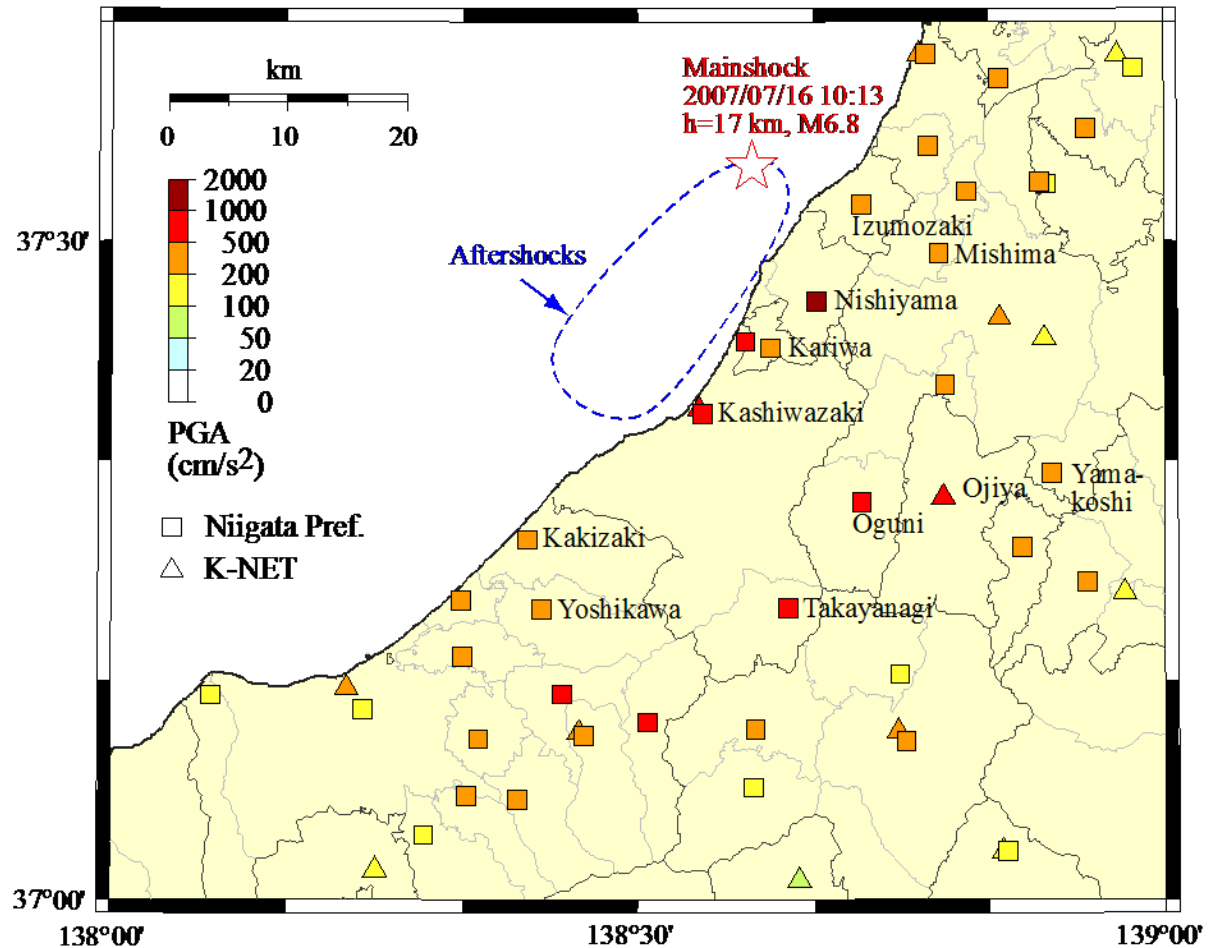
JMA seismic intensities





PGAs

BUILDING RESEARCH INSTITUTE
International Institute of
Seismology and
Earthquake Engineering

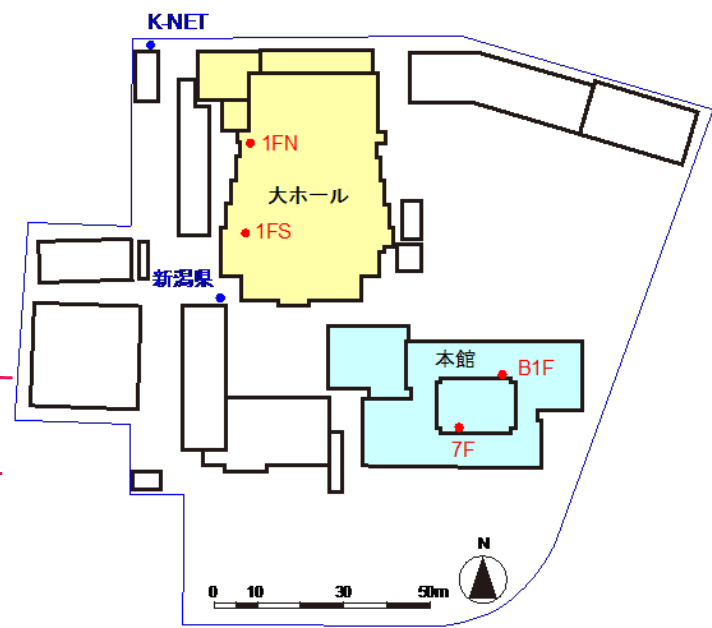




BUILDING RESEARCH INSTITUTE
International Institute of Seismology and Earthquake Engineering



Kashiwazaki City Hall

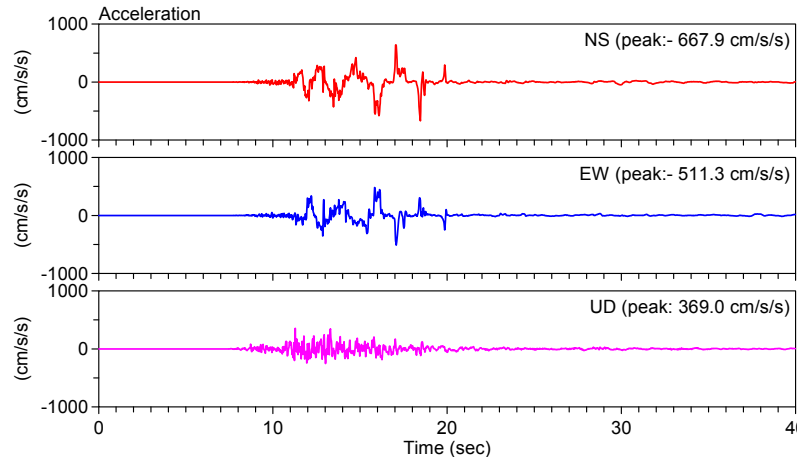




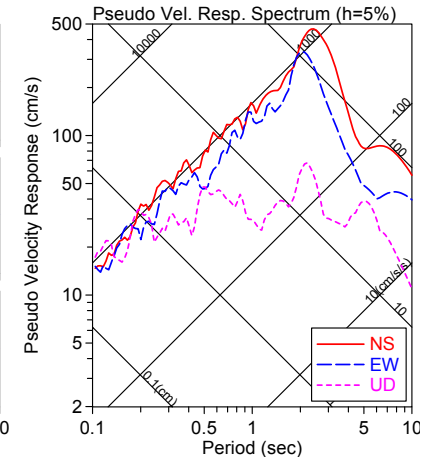
International Institute of
 Seismology and
 Earthquake Engineering
 BUILDING RESEARCH
 INSTITUTE



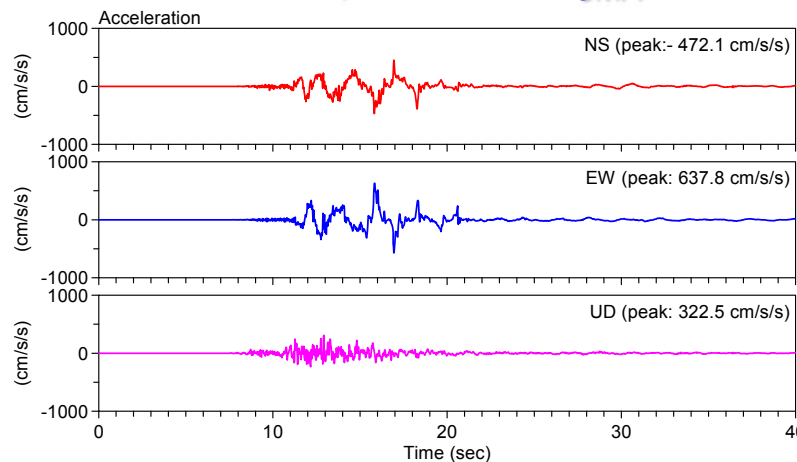
Kashiwazaki City Hall



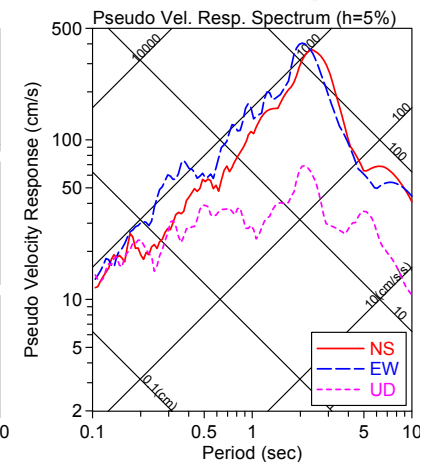
Record Time: 2007/07/16 10:13:20, Site: NIG018: K-NET Kashiwazaki



K-NET NIG018 ($\Delta=21$ km, $I_{JMA}=6.4$, $PGA=668$ cm/s²)



Record Time: 2007/07/16 10:13:20, Site: 65025: Niigata Kashiwazaki

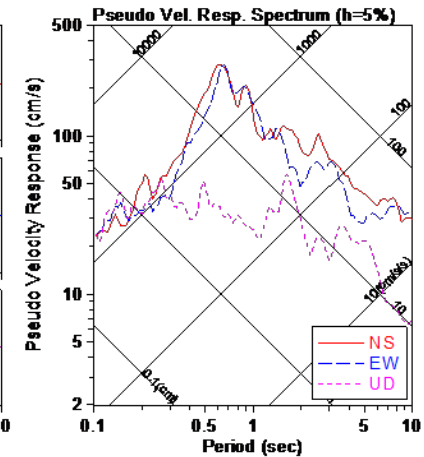
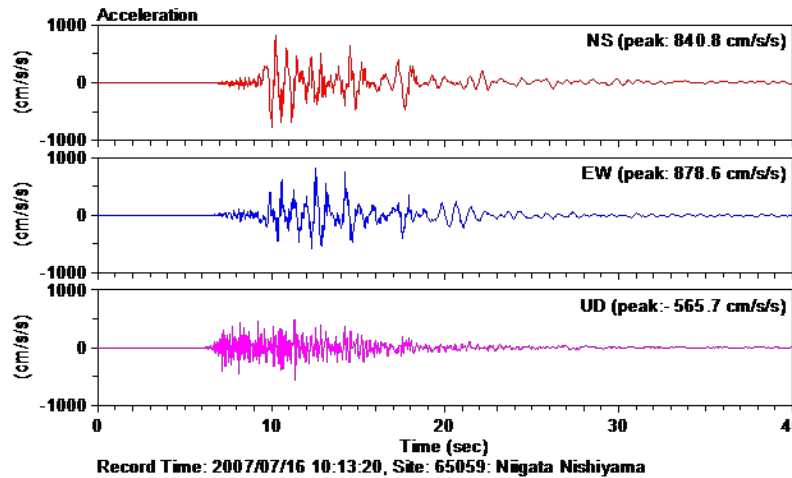


Niigata Kashiwazaki ($\Delta=21$ km, $I_{JMA}=6.3$, $PGA=638$ cm/s²)



Nishiyama Office

International Institute of
 Seismology and
 Earthquake Engineering
 BUILDING RESEARCH
 INSTITUTE



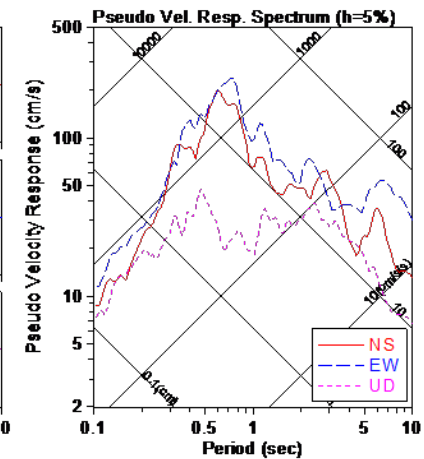
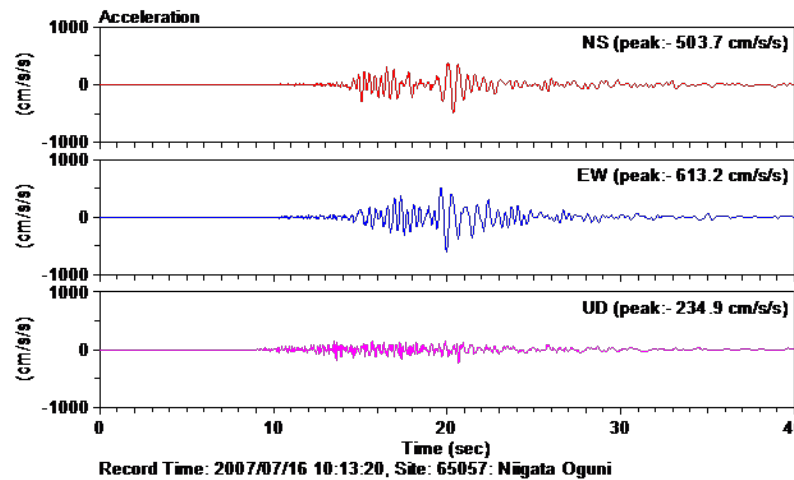
Niigata Nishiyama ($\Delta=13$ km, $I_{JMA}=6.2$, $PGA=879$ cm/s²)



Oguni Office, Nagaoka City

International Institute of
Seismology and
Earthquake Engineering

BUILDING
RESEARCH
INSTITUTE



Niigata Oguni ($\Delta=30$ km, $I_{JMA}=6.1$, $PGA=613$ cm/s²)

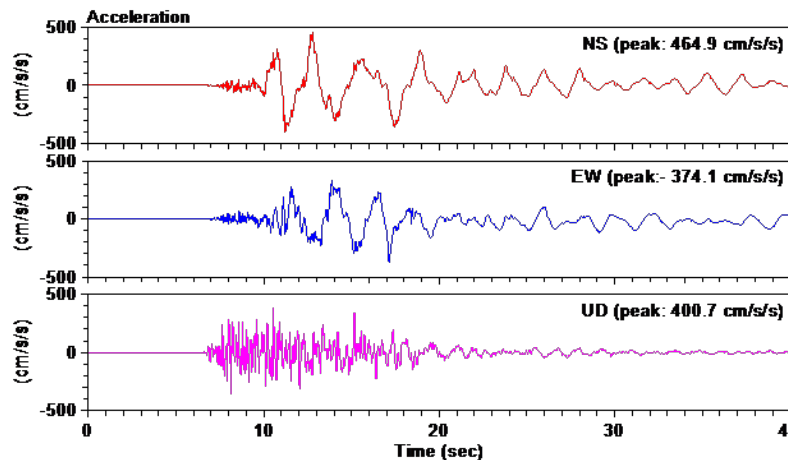


*International Institute of
Seismology and
Earthquake Engineering*

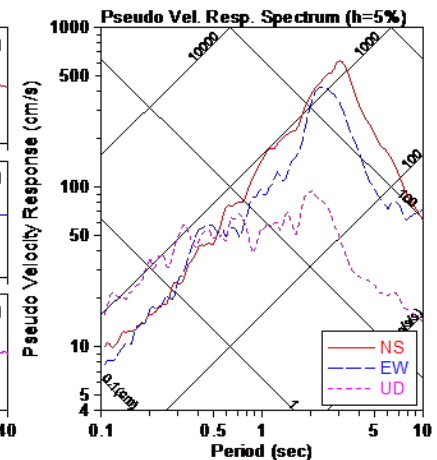
**BUILDING
RESEARCH
INSTITUTE**



Kariwa Town Office



Record Time: 2007/07/16 10:13:20, Site: 65058: Niigata Kariwa



Niigata Kariwa ($\Delta=15$ km, $I_{JMA}=6.0$, $PGA=465$ cm/s²)



Damages

**BUILDING
RESEARCH
INSTITUTE**

*International Institute of
Seismology and
Earthquake Engineering*





**BUILDING
RESEARCH
INSTITUTE**

*International Institute of
Seismology and
Earthquake Engineering*

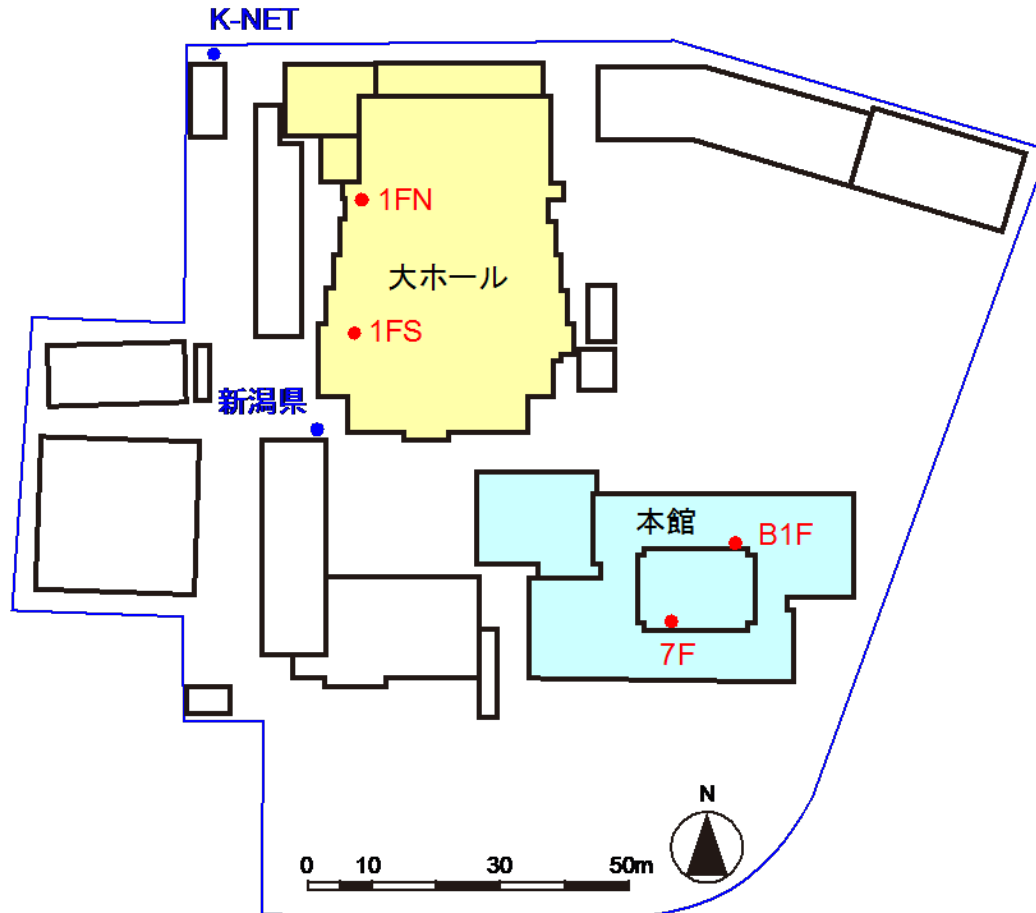


Damages





Aftershock observation at Kashiwazaki City Office





BUILDING RESEARCH INSTITUTE
*International Institute of
Seismology and
Earthquake Engineering*



Kashiwazaki City Main Bldg.





BUILDING RESEARCH INSTITUTE
*International Institute of
Seismology and
Earthquake Engineering*



Kashiwazaki Civic Hall





BUILDING RESEARCH INSTITUTE
*International Institute of
Seismology and
Earthquake Engineering*



Damage #1



Connecting passage



West storage



BUILDING RESEARCH INSTITUTE
*International Institute of
Seismology and
Earthquake Engineering*



Damage #2



Inside of storage

Stage



Strong motion from aftershock

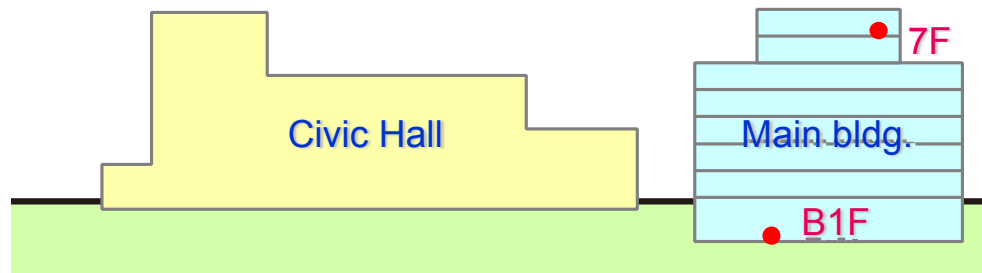
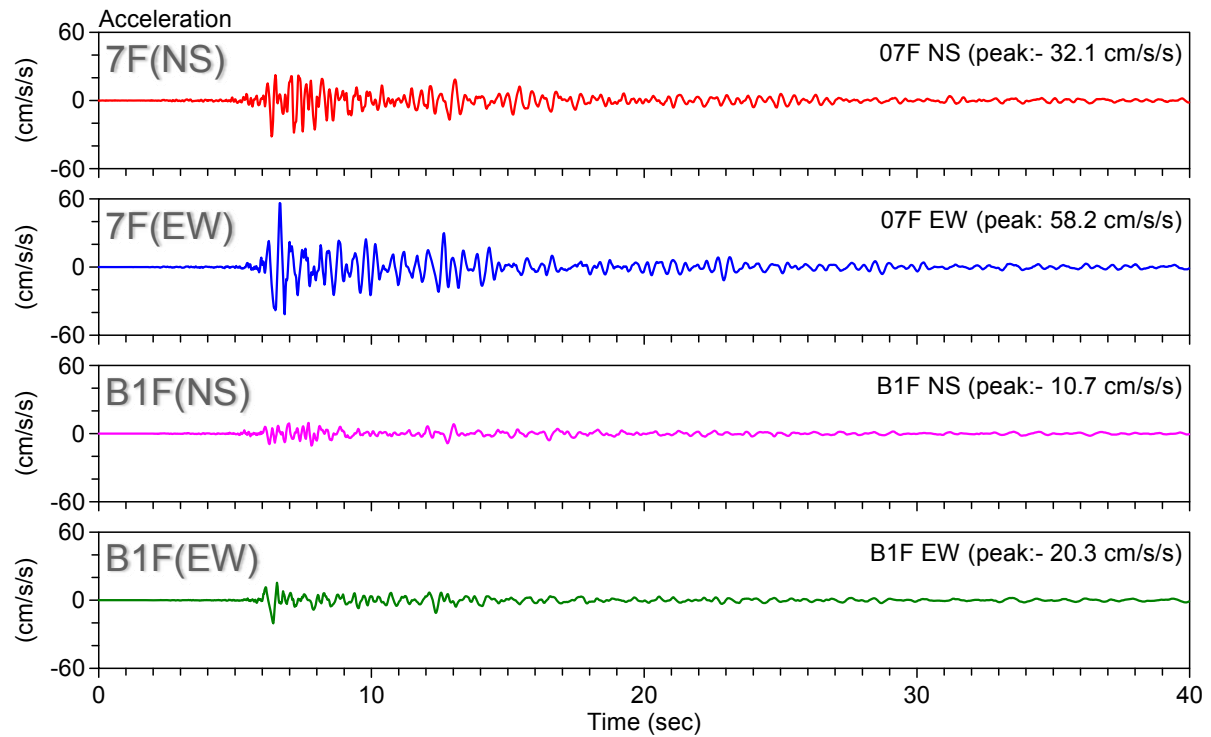
- 2007/7/25 6:52 $h=24\text{km}$, $M4.8$, $\Delta=23\text{km}$

Code	Site	Loc.	I_{JMA}	A_{max}
KSW	Main bldg.	B1F	2.7	21.1
		07F	3.6	58.7
KSW2	Civic hall	1FN	3.0	32.6
		1FS	3.0	32.8
NIG018	K-NET	GL	3.2	43.8

I_{JMA} : JMA intensity, A_{max} : PGA (cm/s^2)

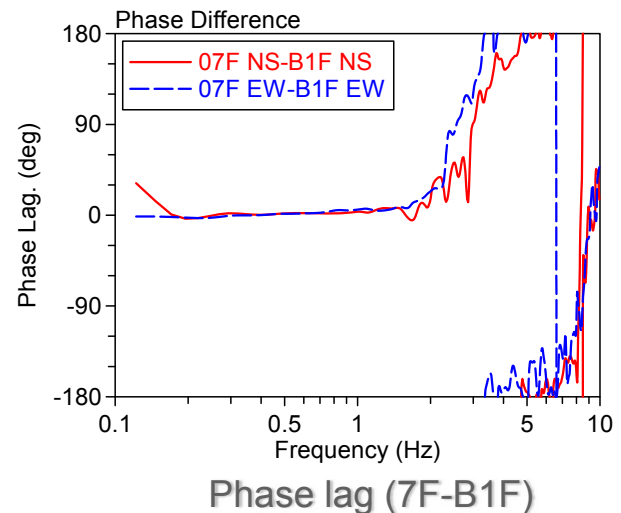
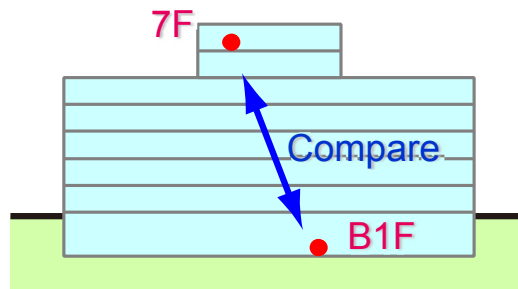
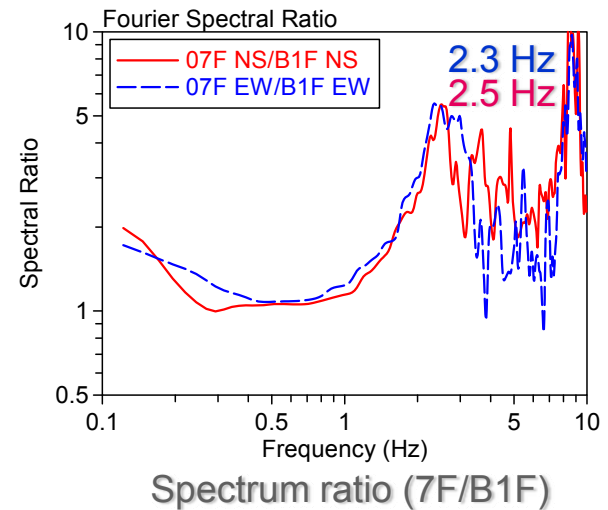
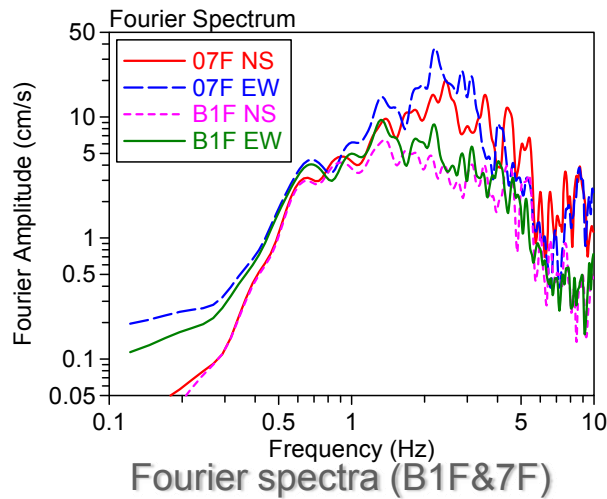


Acceleration at main bldg.





Fourier spectrum ratio (7F/B1F)





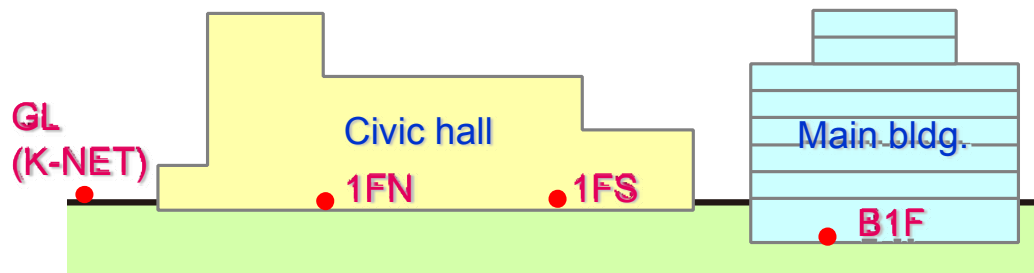
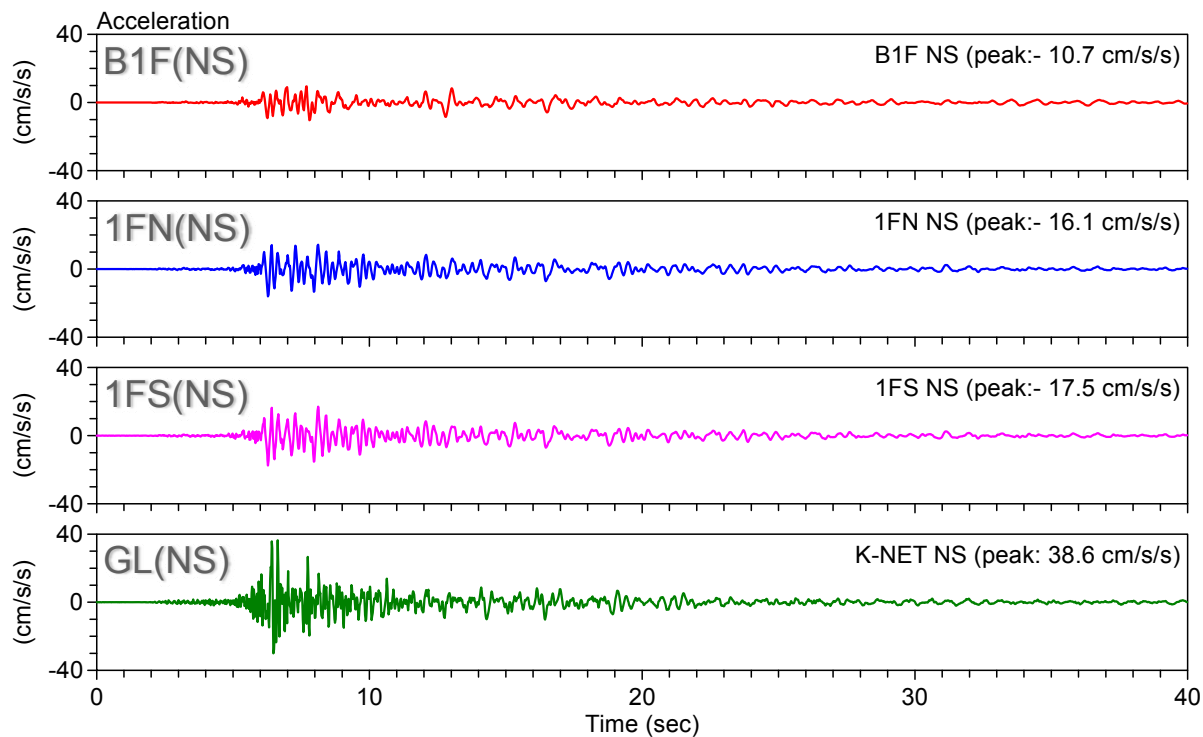
Peak Acc. in each direction

- 2007/7/25 6:52 $h=24\text{km}$, $M4.8$, $\Delta=23\text{km}$

Site	Loc.	Peak Acc. (cm/s^2)		
		NS	EW	UD
KSW: Main bldg.	B1F (B1F/GL)	10.7 (0.28)	20.3 (0.54)	15.4 (0.63)
KSW2: Civic hall	1FN (1FN/GL)	16.1 (0.42)	32.2 (0.86)	24.4 (0.82)
	1FS (1FS/GL)	17.5 (0.45)	31.7 (0.85)	20.6 (0.84)
K-NET	GL	38.6	37.3	24.4

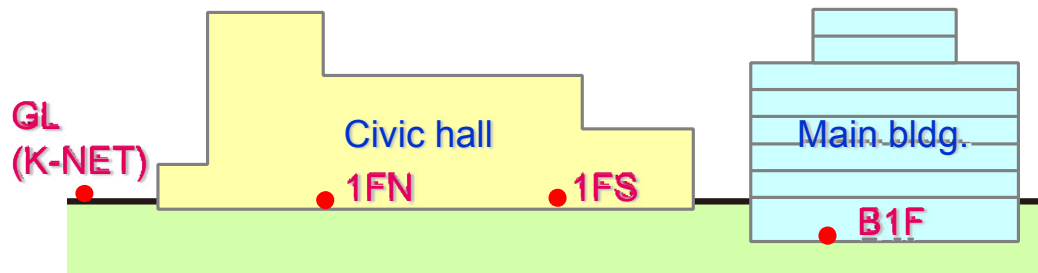
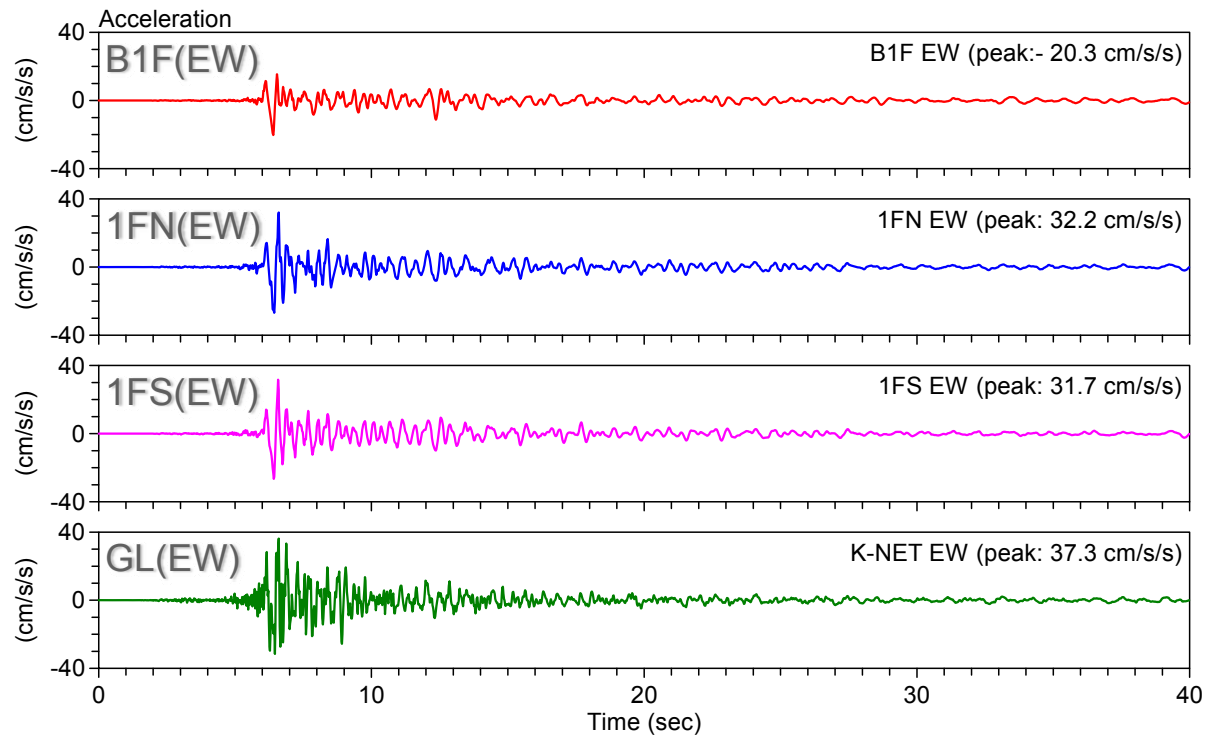


Acceleration at B1F, 1F, GL (K-NET) in NS direction



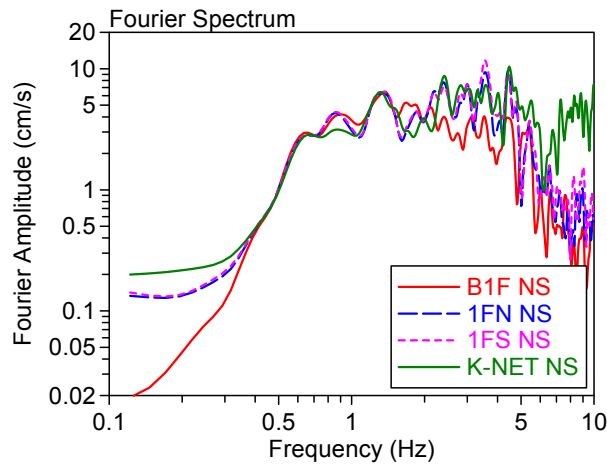


Acceleration at B1F, 1F, GL (K-NET) in EW direction

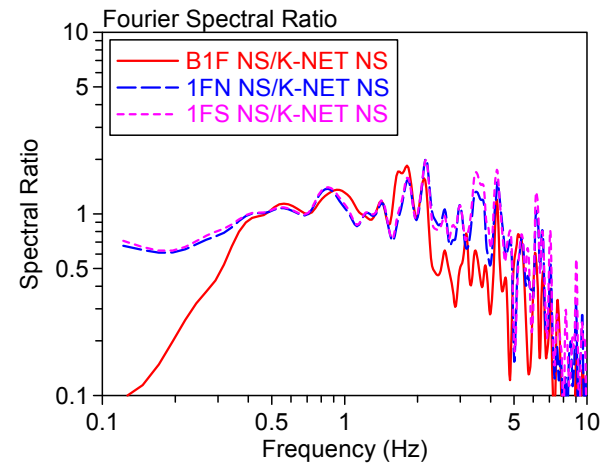




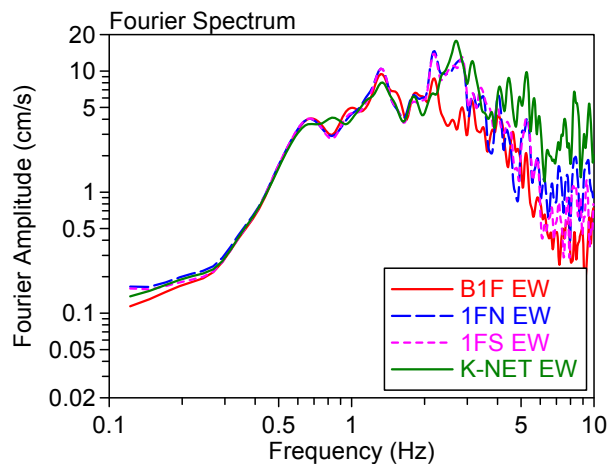
Fourier spectra at B1F, 1F, GL(K-NET) and ratios to GL



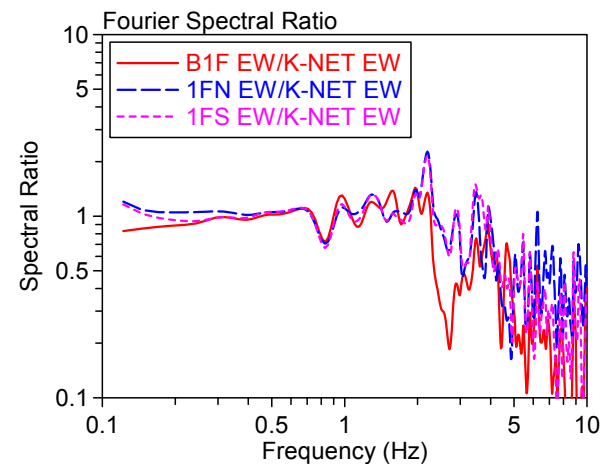
Fourier spectra (NS)



Spectrum ratio to GL (NS)



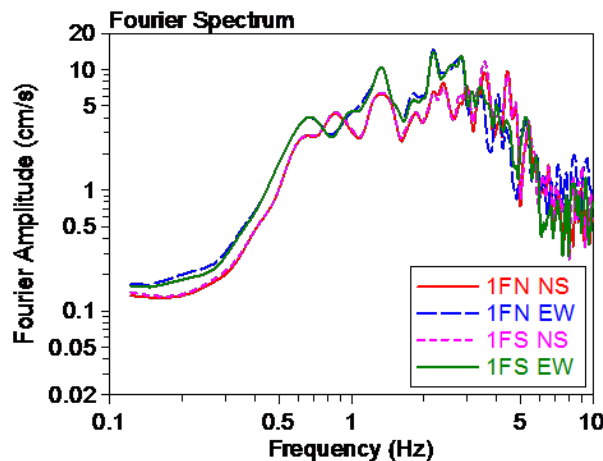
Fourier spectra (EW)



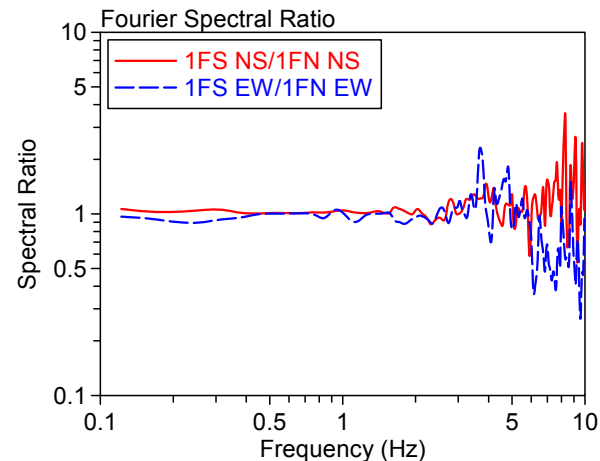
Spectrum ratio to GL (EW)



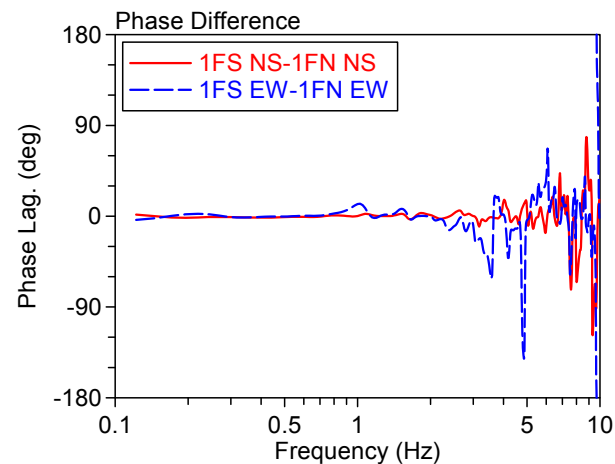
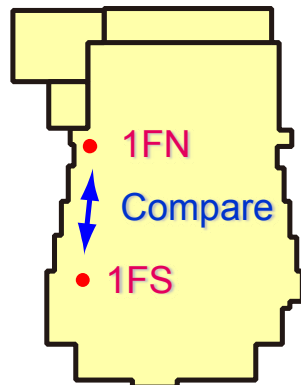
Fourier spectra at 1FN, 1FS and spectrum ratio (1FS/1FN)



Fourier spectra (1FN&1FS)



Spectrum ratio (1FS/1FN)

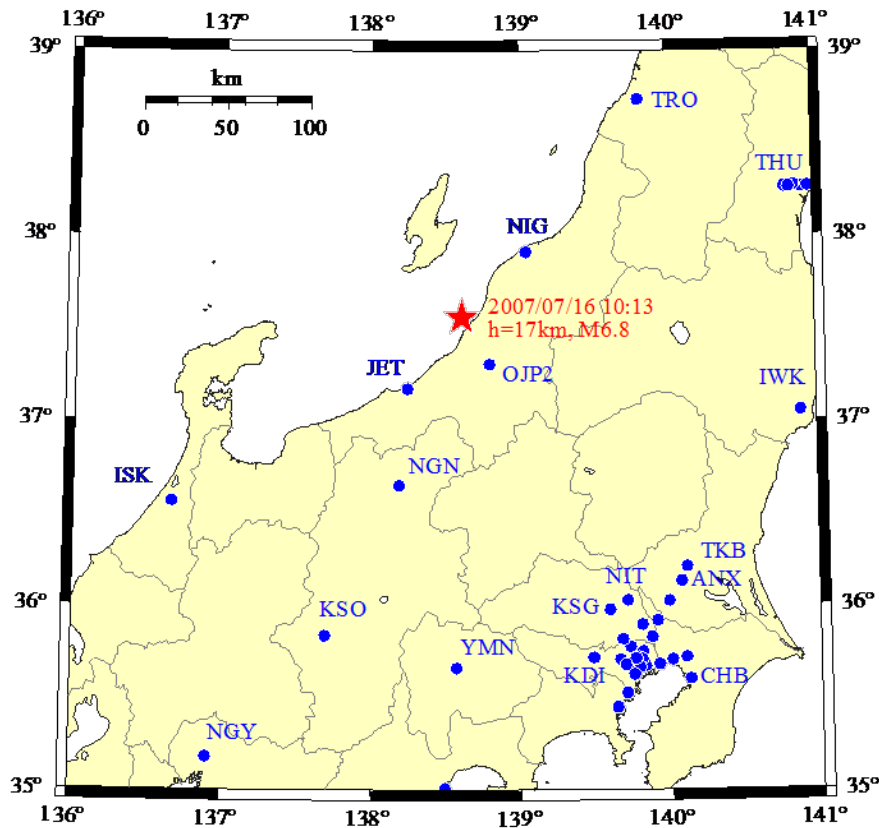


Phase lag (1FS-1FN)



Records from BRI network

- 37 stations have been triggered

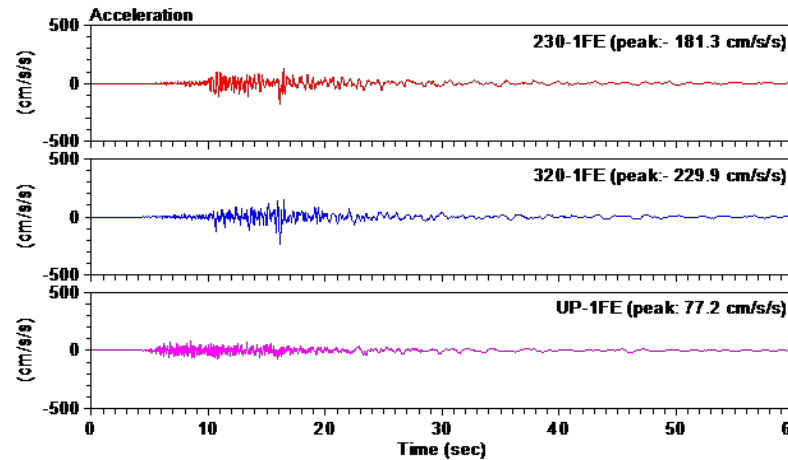




BUILDING RESEARCH INSTITUTE
 International Institute of Seismology and Earthquake Engineering

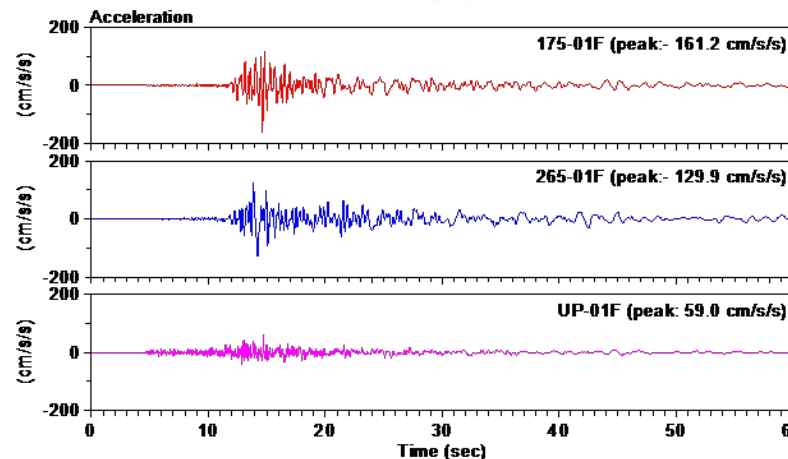
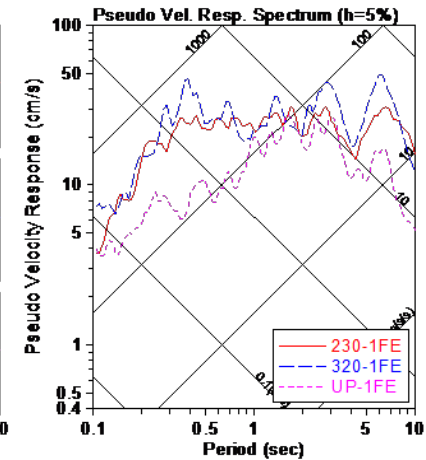


Records from BRI network



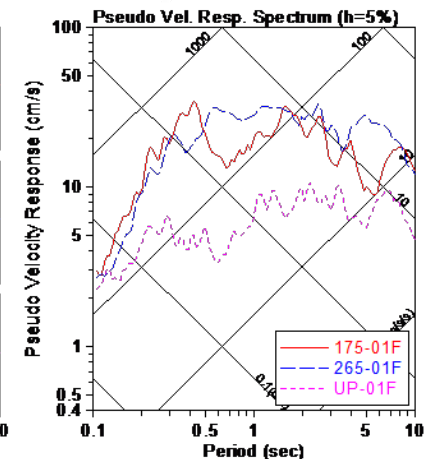
Record Time: 2007/07/16 10:13:25, Site: OJP2: Ojiya Primary School, Seismic Intensity: 4.7

Ojiya 1F ($\Delta=33$ km, $I_{JMA}=4.7$, $PGA=230$ cm/s²)



Record Time: 2007/07/16 10:13, Site: JET: Joetsu Social Education Office, Seismic Intensity: 4.8

Joetsu 1F ($\Delta=54$ km, $I_{JMA}=4.8$, $PGA=161$ cm/s²)





BUILDING RESEARCH INSTITUTE
*International Institute of
Seismology and
Earthquake Engineering*



Central Gov. Office #2

- Steel structure
- 21F+B4F
- Seismic damper
- Office building





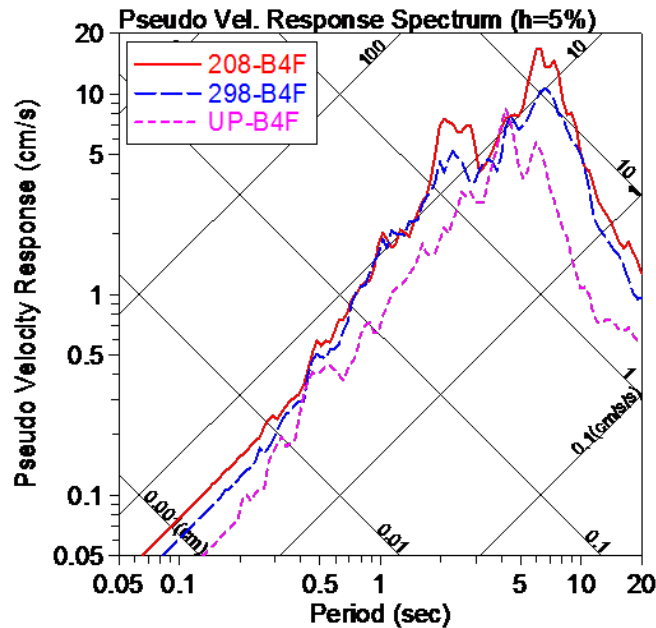
Kosha Tower Tsukuda

- RC structure
- 37F+B1F
- Apartment

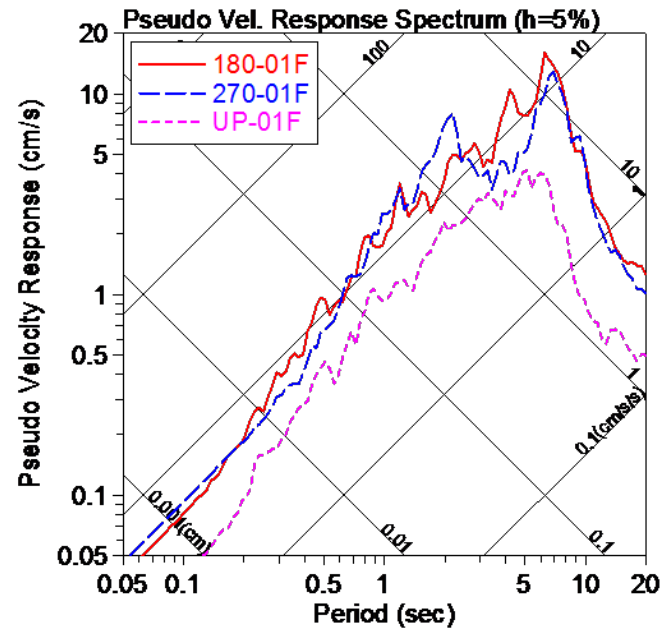




pSv at basement



Central Gov. Office #2



Kosha Tower Tsukuda

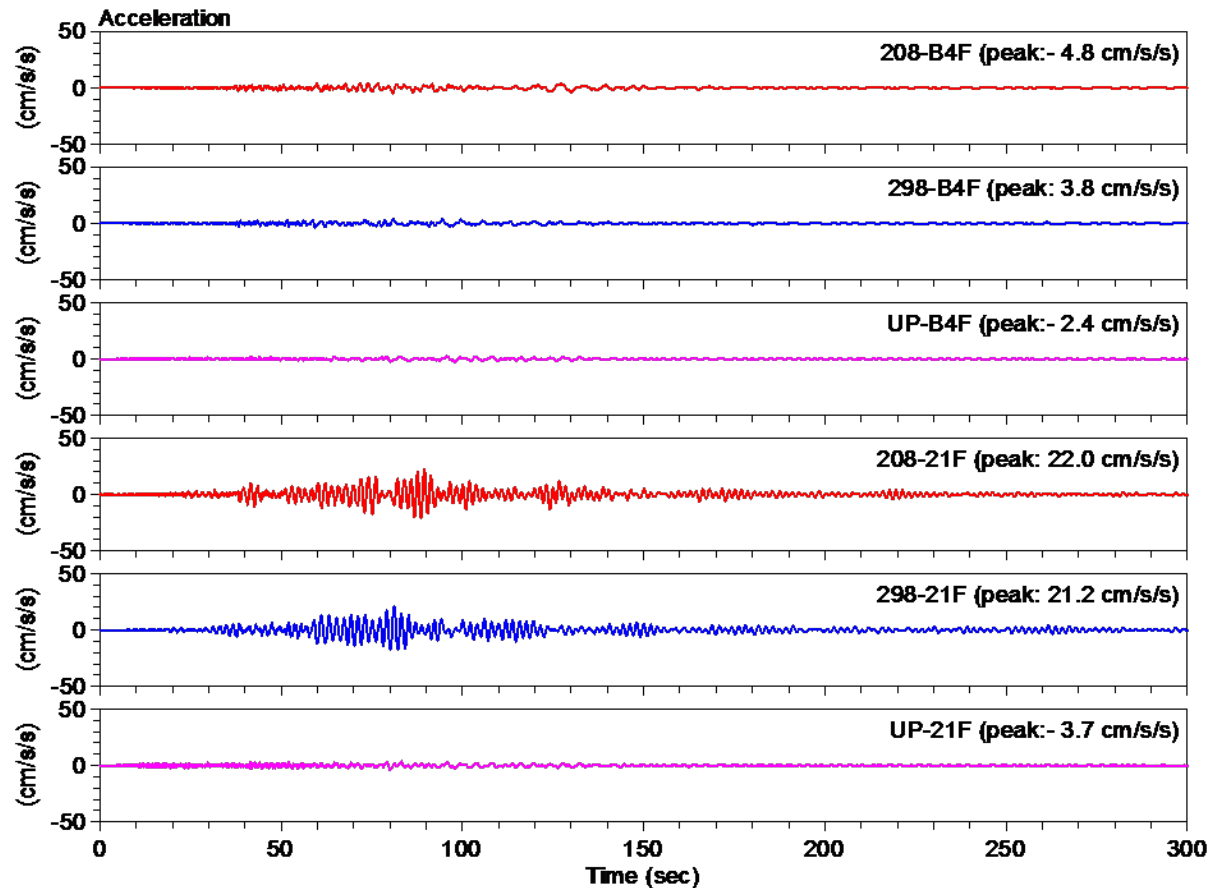


*International Institute of
Seismology and
Earthquake Engineering*

**BUILDING
RESEARCH
INSTITUTE**



Acc. at Central Gov. Office #2



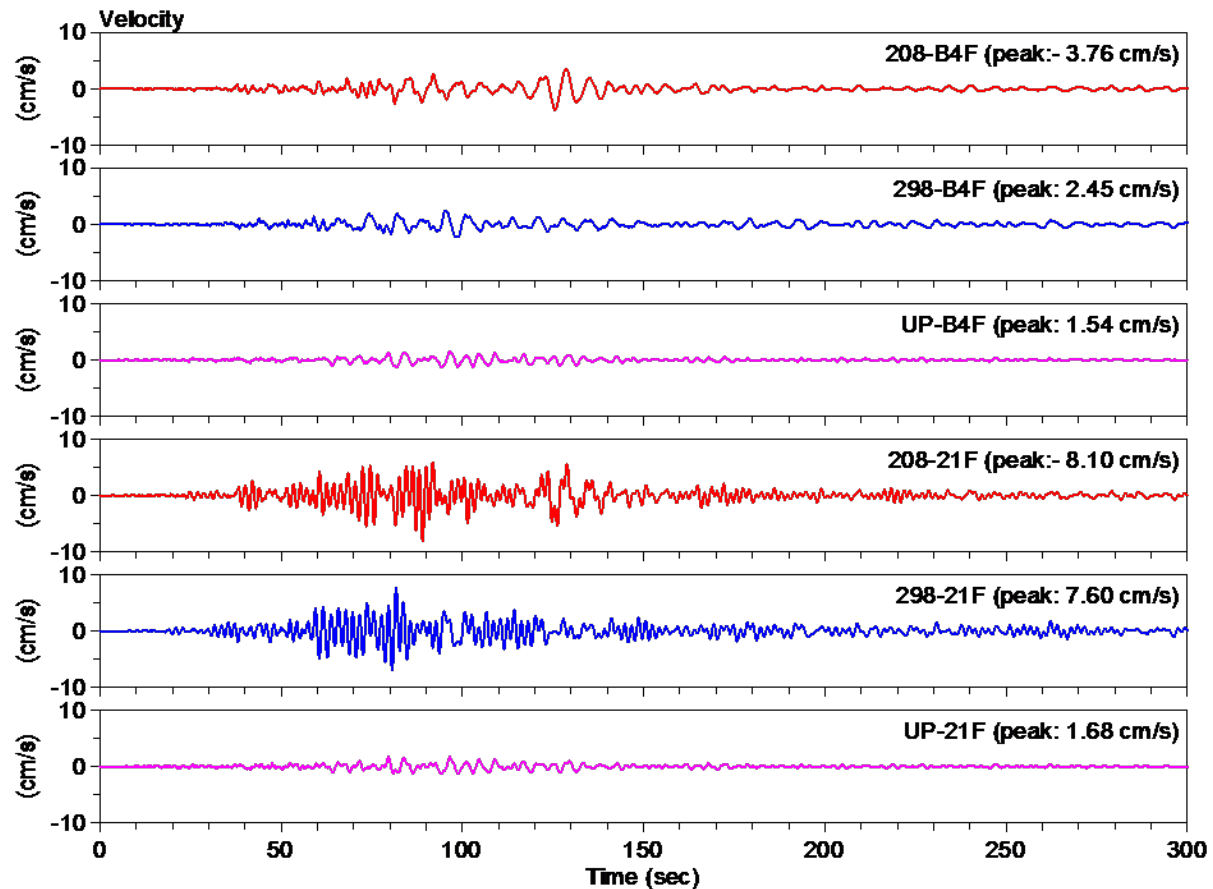


*International Institute of
Seismology and
Earthquake Engineering*

**BUILDING
RESEARCH
INSTITUTE**



Vel. at Central Gov. Office #2



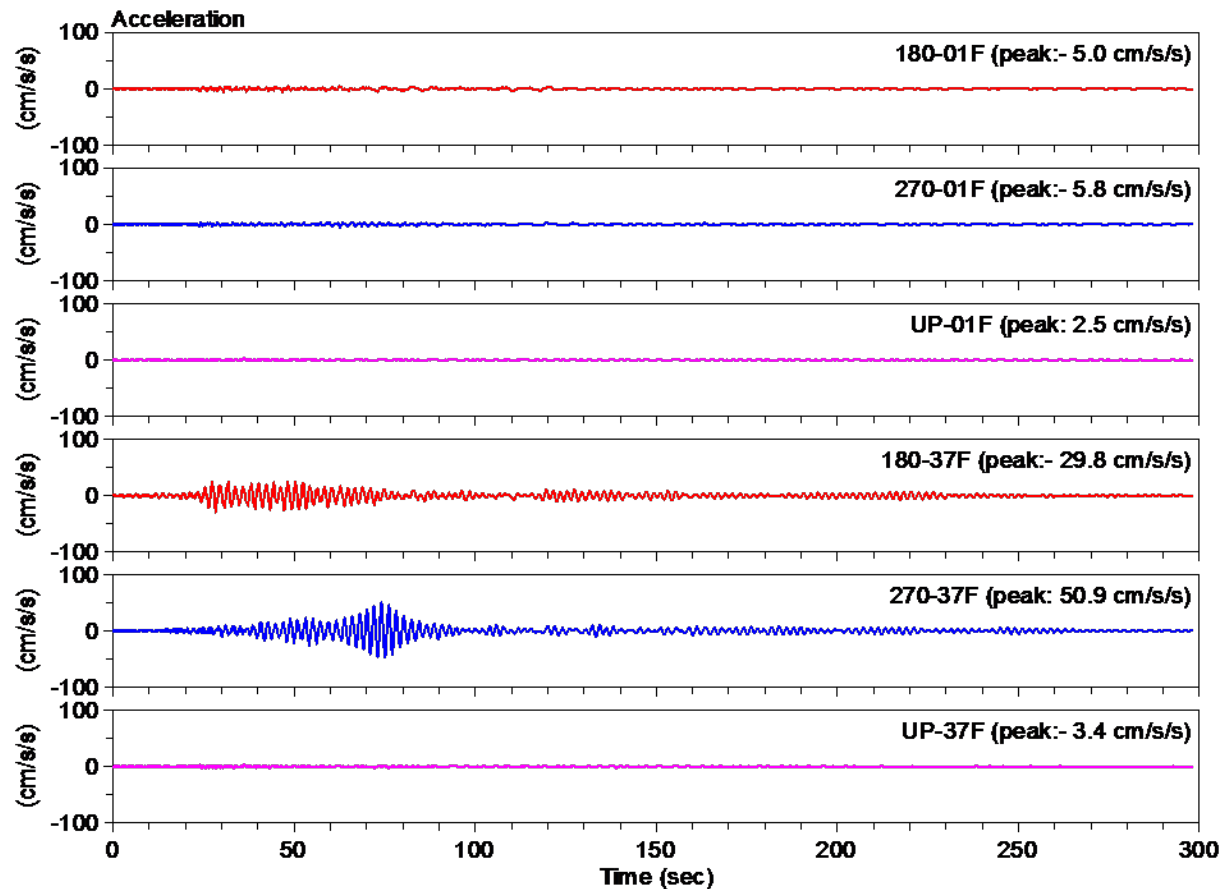


*International Institute of
Seismology and
Earthquake Engineering*

**BUILDING
RESEARCH
INSTITUTE**



Acc. at Kosha Tsukuda Tower





*International Institute of
Seismology and
Earthquake Engineering*

**BUILDING
RESEARCH
INSTITUTE**



Vel. at Kosha Tsukuda Tower

