Final Project: Group name list

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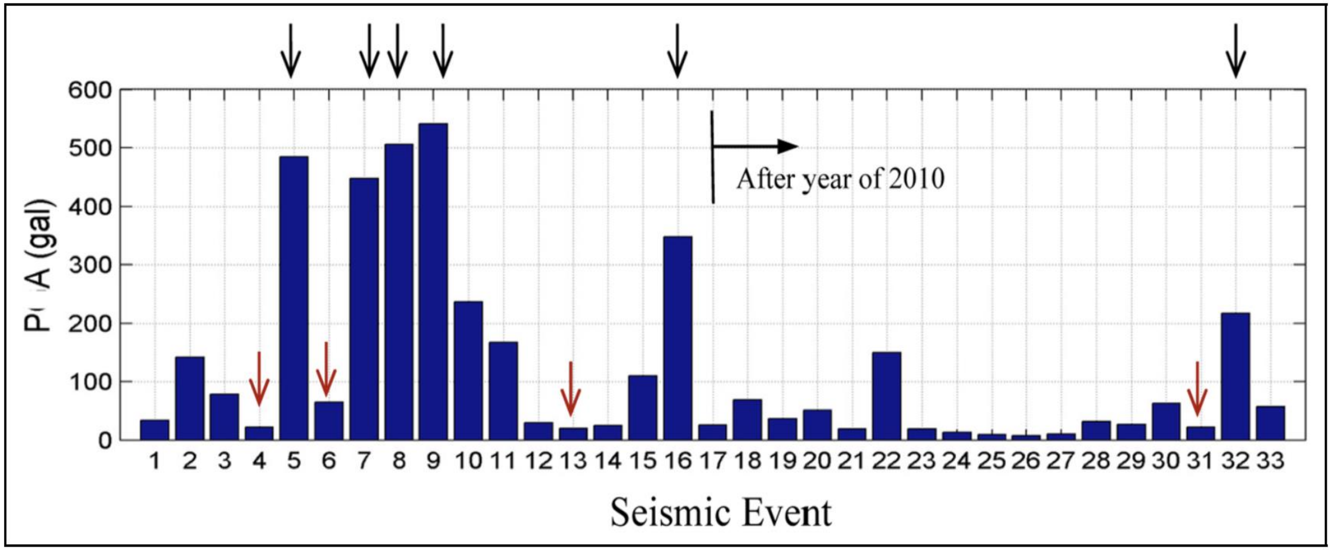
Each group presents ~15 min. (including 3. min discussion)
Upload presenting material to desktop before presentation (using file name “Group#”).
Put names of contributors in the first page of presenting material.

Final project presentation: Dec. 12, 2023

During the past 15 years several seismic events had been recorded by this earthquake monitoring system of this building, as shown in the following figure.

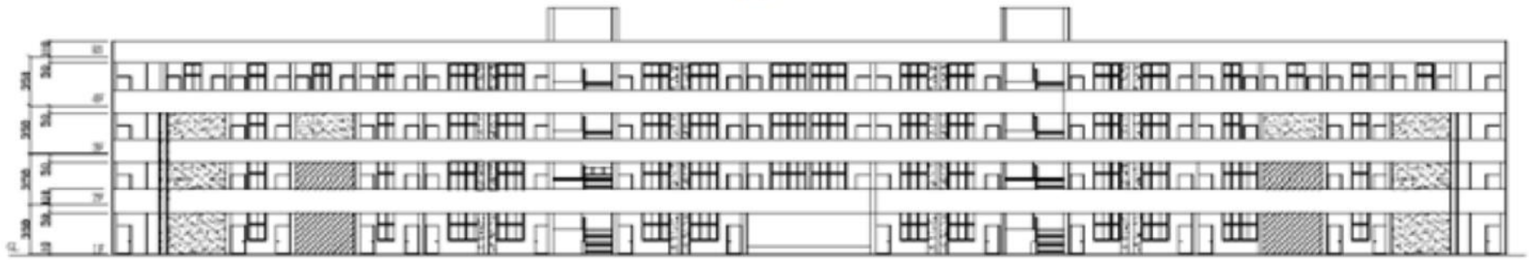
Among them: **Event-5** is the Chi-Chi earthquake (1999-9-21, M=7.3).
Significant acceleration response of the building was recorded.



Problem description:

Consider the seismic response data of a school building (Ming-Li Elementary School, Hwa-Liang). The instrumentation layout in this building is shown in this presentation (see figures next page).

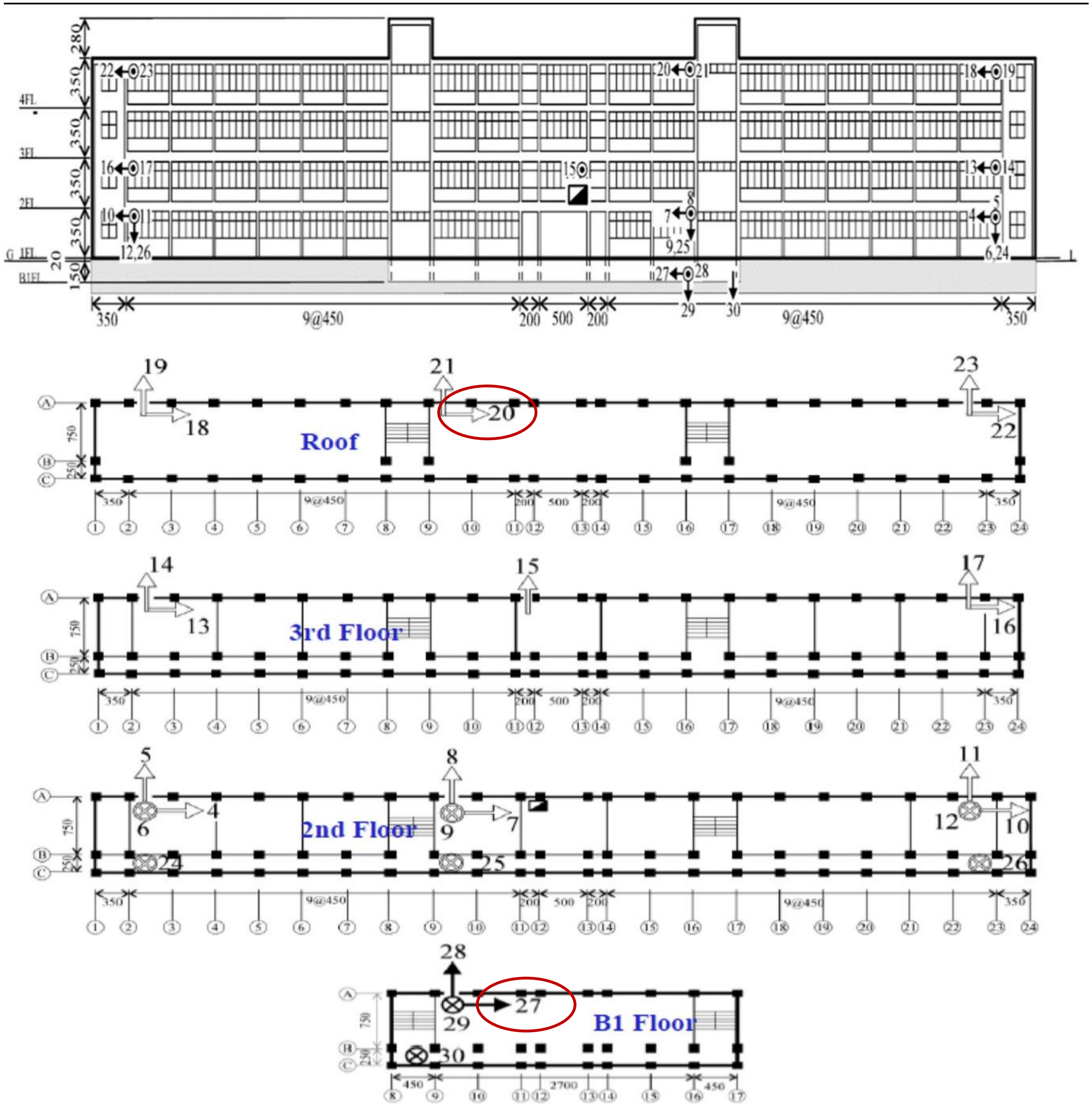
(a)



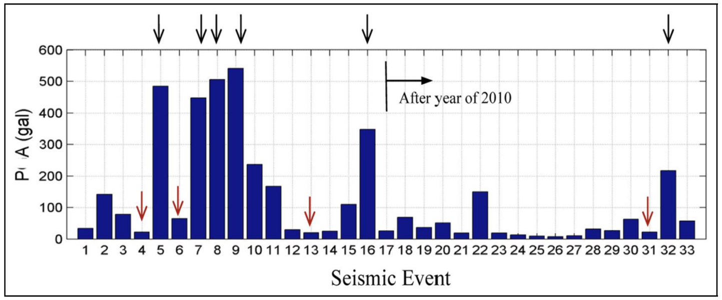
(Front view)

(b)

(Back view)

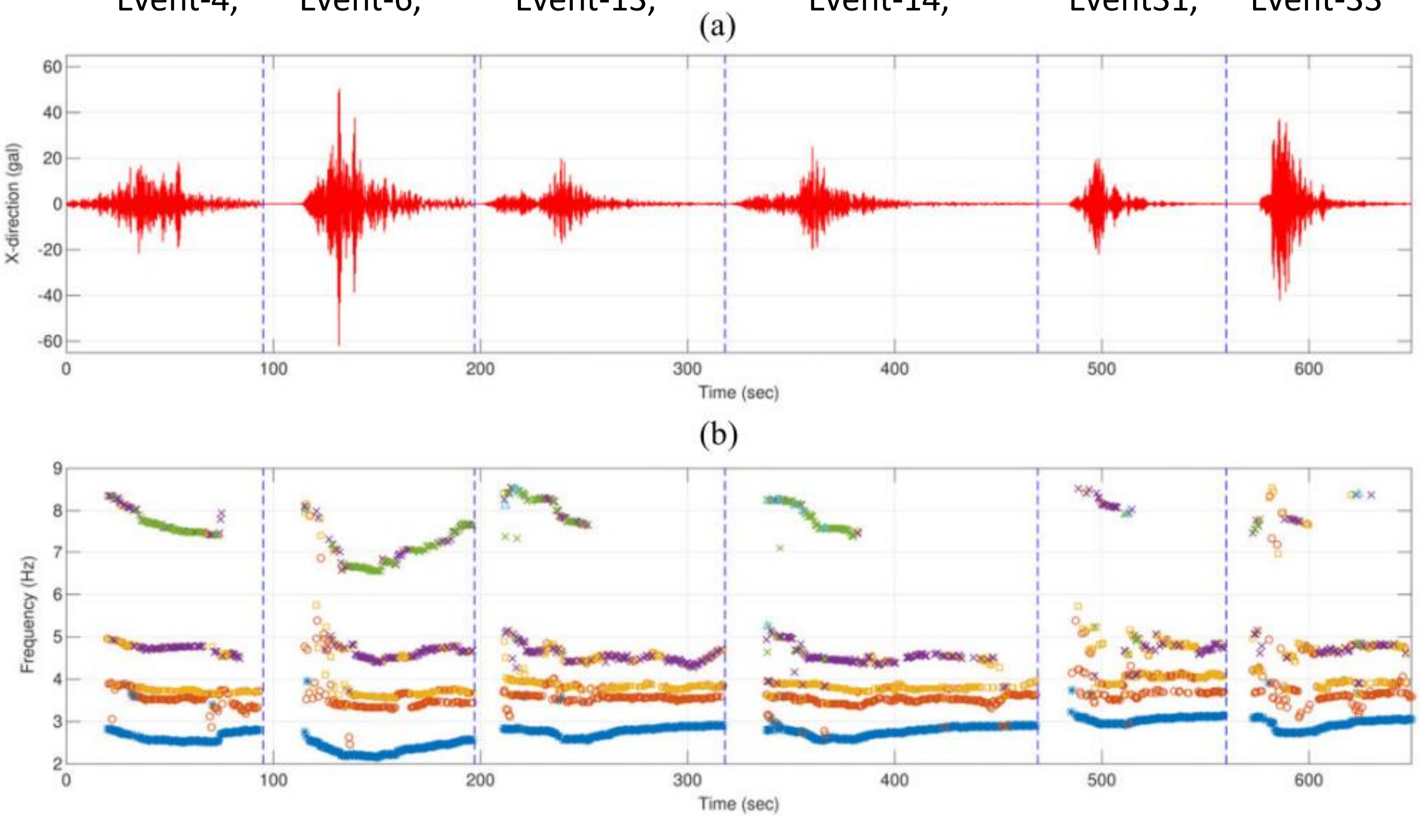


Roof
3rd Floor
2nd Floor
B1 Floor



1. 1994/05/24-L (M:6.6, H:4.45km)
2. 1994/06/05-L (M:6.5, H:5.3km)
3. 1995/06/25-L (M:6.5, H:39.88km)
4. 1996/09/05-L (M:7.07 , H:14.76km)
5. 1999/09/20-H (M:7.3, H:8km)
6. 1999/09/20-L (M:6.59, H:8.57km)
7. 1999/09/22-L (M:6.8, H:15.59km)
8. 1999/09/25-L (M:6.8, H:12.06km)
9. 1999/11/01-L (M:6.9, H:31.33km)
10. 2000/06/10-H (M:6.7, H:16.21km)
11. 2004/10/15-L (M:7.1, H:91.03km)
12. 2004/11/08-L (M:6.58, H:10km)
13. 2006/12/26-T (M:6.96, H:44.11km)
14. 2006/12/26-T (M:6.99, H:50.22km)
15. 2007/09/06-T (M:6.63, H:54.01km)
16. 2009/12/19-T (M:6.92, H:43.78km)
17. 2010/01/04-T (M:5.46, H:46.05km)
18. 2010/01/19-T (M:5.61, H:41.01km)
19. 2010/02/12-T (M:5.23, H:18.39km)
20. 2010/03/04-T (M:6.42, H:22.64km)
21. 2010/04/11-T (M:5.4, H:30.3km)
22. 2010/06/15-T (M:5.53, H:16.73km)
23. 2010/07/08-T (M:5.25, H:19.27km)
24. 2010/07/09-T (M:5.77, H:113.62km)
25. 2010/07/17-T (M:5.22, H:39.97km)
26. 2010/07/18-T (M:5.2, H:24.33km)
27. 2010/07/25-T (M:5.65, H:19.6km)
28. 2010/08/21-T (M:5.32, H:40.15km)
29. 2010/09/20-T (M:5.08, H:36.23km)
30. 2010/09/28-T (M:5.02, H:9.01km)
31. 2010/10/02-T (M:5.09, H:19.38km)
32. 2010/11/21-T (M:6.14, H:46.87km)
33. 2010/12/06-T (M:5.16, H:24.84km)

Event-4, Event-6, Event-13, Event-14, Event31, Event-33



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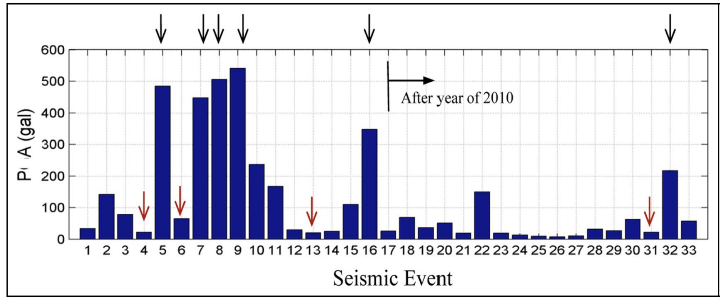
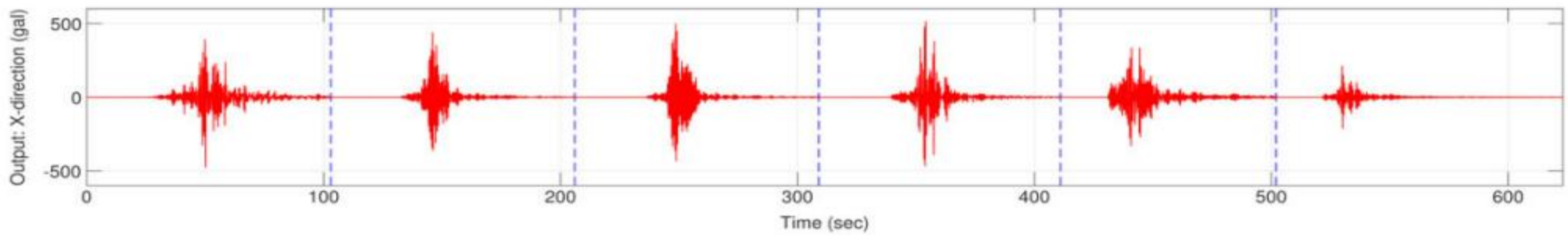


Event-5, Event-7, Event-8, Event-9, Event-16, Event-32

(a)



(b)

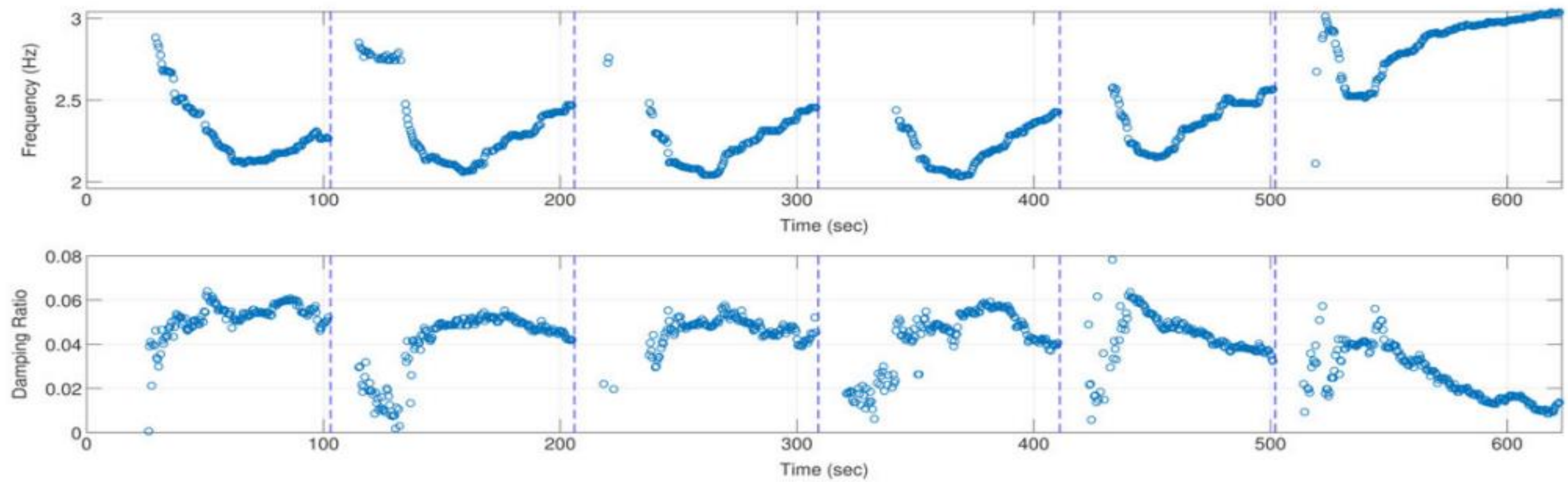


Figure 9. (a) Plot of the acceleration response data of sensing node 20 from six selected large seismic event, (b) Comparison of the identified time-varying fundamental frequency and damping ratio of the six large seismic events during its service life using recursive subspace identification.

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Tracking modal parameters from building seismic response data using recursive subspace identification algorithm

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SUMMARY

Tracking modal parameters and estimating the current structural state of a building from seismic response measurements, particularly during strong earthquake excitations, can provide useful information for building safety assessment and the adaptive control of a structure. Therefore, online or recursive identification techniques need to be developed and implemented for building seismic response monitoring. This paper develops and examines different methods to track modal parameters from building seismic response data. The methods include recursive data-driven subspace identification (RSI-DATA) using Givens rotation algorithm, and RSI-DATA using Bona fide algorithm. The question on how well the results of RSI-DATA reflect the real condition is investigated and verified with a bilinear SDOF simulation study. Time-varying modal parameters of a four-story reinforced concrete school building are identified based on a series of earthquake excitations, including several seismic events, large and small. Discussions on the different methods' ability to track the time-varying modal parameters are presented. The variation of the identified building modal frequencies and damping ratios from a series of event-by-event seismic responses, particularly before and after retrofitting of the building is also discussed.

Data was provided in Excel file

	編號	軸向	位置描述
A	CH01	X	自由場
B	CH02	Y	自由場
C	CH03	Z	自由場
D	CH04	X	2F樓地板下、幼稚班教室
E	CH05	Y	2F樓地板下、幼稚班教室
F	CH06	Z	2F樓地板下、幼稚班教室
G	CH07	X	1F樓地板上、川堂
H	CH08	Y	1F樓地板上、川堂
I	CH09	Z	1F樓地板上、川堂
J	CH10	X	2F樓地板下、右側教室
K	CH11	Y	2F樓地板下、右側教室
L	CH12	Z	2F樓地板下、右側教室
M	CH13	X	3F樓地板下、左側教室
N	CH14	Y	3F樓地板下、左側教室
O	CH15	Y	3F樓地板下、校長室
P	CH16	X	3F樓地板下、合作社
Q	CH17	Y	3F樓地板下、合作社
R	CH18	X	RF樓地板下、左側教室
S	CH19	Y	RF樓地板下、左側教室
T	CH20	X	RF樓地板下、自然教室
U	CH21	Y	RF樓地板下、自然教室
V	CH22	X	RF樓地板下、右側教室
W	CH23	Y	RF樓地板下、右側教室
X	CH24	Z	2F樓地板下、左側走廊
Y	CH25	Z	2F樓地板下、川堂走廊
Z	CH26	Z	2F樓地板下、右側走廊
AA	CH27	X	地下室樓地板上
AB	CH28	Y	地下室樓地板上
AC	CH29	Z	地下室樓地板上
AD	CH30	Z	地下室樓地板上

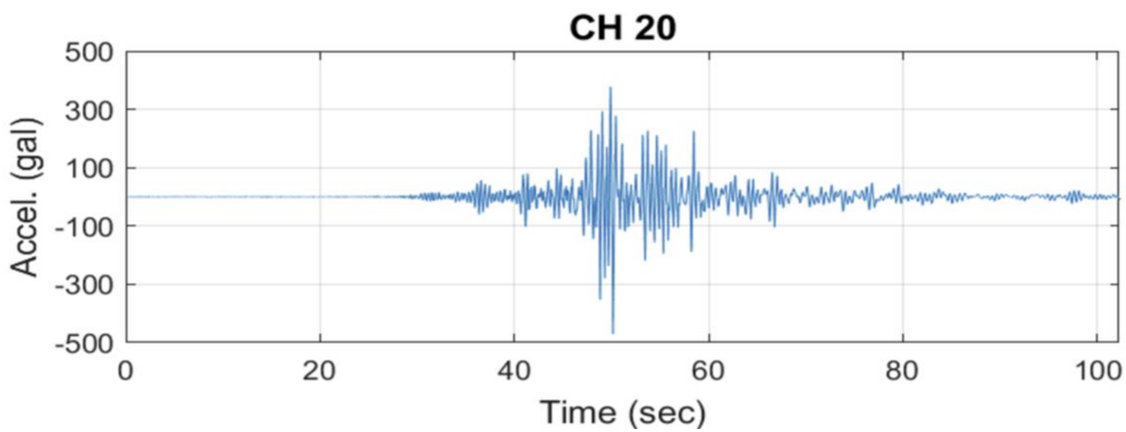
A, B, C, ... Indicated and column index
In the data excel file.

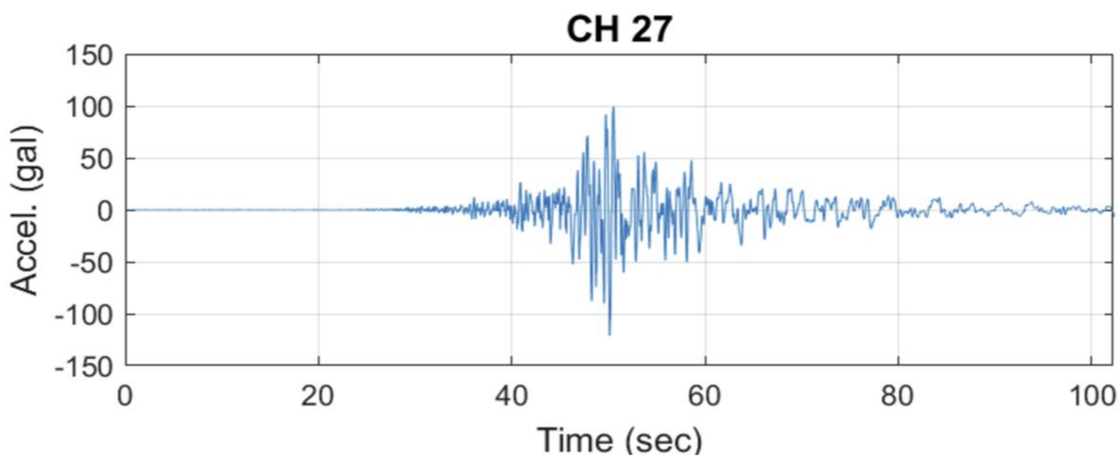
Following the row on the left-hand table:
A → CH01, B → CH02, ...

The sampling rate of the data is 200 Hz.

Before the analysis you may plot the data in advance, and duration of the data you are going to analyze.

1999-9-21 event





For analysis define the duration starting from 20 sec to the end record.

Based on the response data of the building from seismic event (1999-9-21),

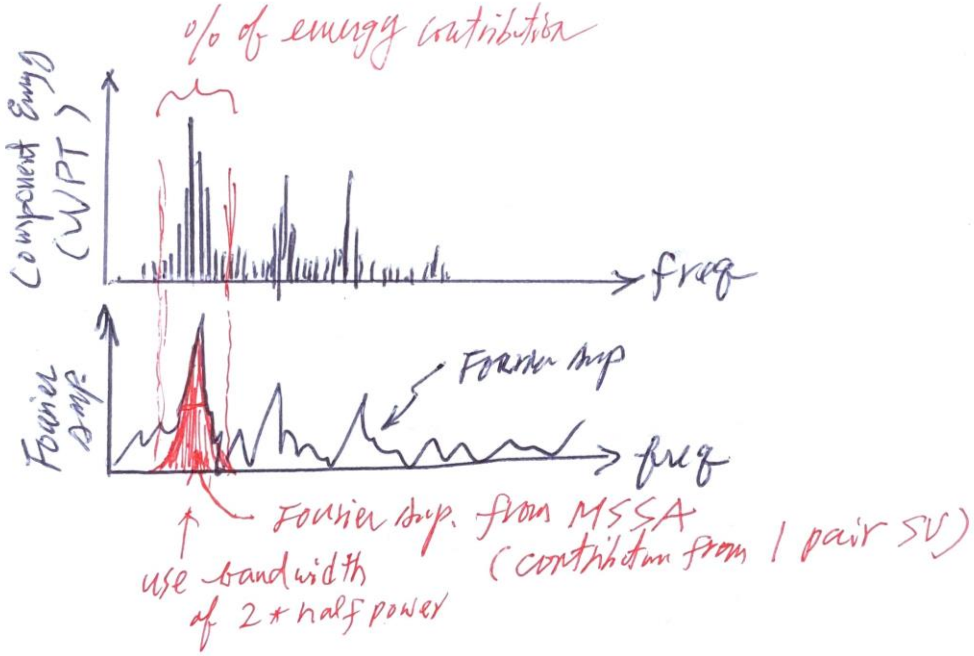
Consider the following measurement for your analysis:

Group-1(odd #) : Longitudinal direction
Input: Ch27, Output: Ch7, (Ch13+Ch16)/2, and Ch20

Group-2(even #): Transverse direction
Input: Ch28, Output: Ch8, Ch.15 and Ch 21

The following analyses need to be presented:

1. Spectrogram of each floor (and Marginal spectrum)
2. Estimate FRF of each floor (using offline SIMO-ARX model), modal frequencies, damping ratios and mode shapes of the building,
3. Check the wavelet coherence between the basement and the roof responses,
4. Using RARX model to estimate the time-varying modal parameters of the building (consider basement motion as input and roof response as output, SISO).
   Plot time-varying modal frequencies, check the mode shapes rom three discrete times: early stage, at time when most significant PA appears, near the end of the response
5. Using the relative acceleration data (between basement and roof), estimate the relative displacement (from 1999-9-21 event data).
6. Apply WPT to plot the distribution of component energy (from roof response data) and then apply MSSA on the response data and discuss the modal contribution of the fundamental mode of the system (from Fourier amplitude spectrum).
   Estimate the first mode modal contribution from this event data.



Final project presentation:

1. Each group will present 15 min. with 5 min. discussions.
2. Using power point file for presentation. (file needs to upload desktop before presentation)
3. Each presenting file needs to identify the names of contributors.