

# Prompt Report of Experiment for Low Cost Base Isolation with Slide Bearing

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## Note

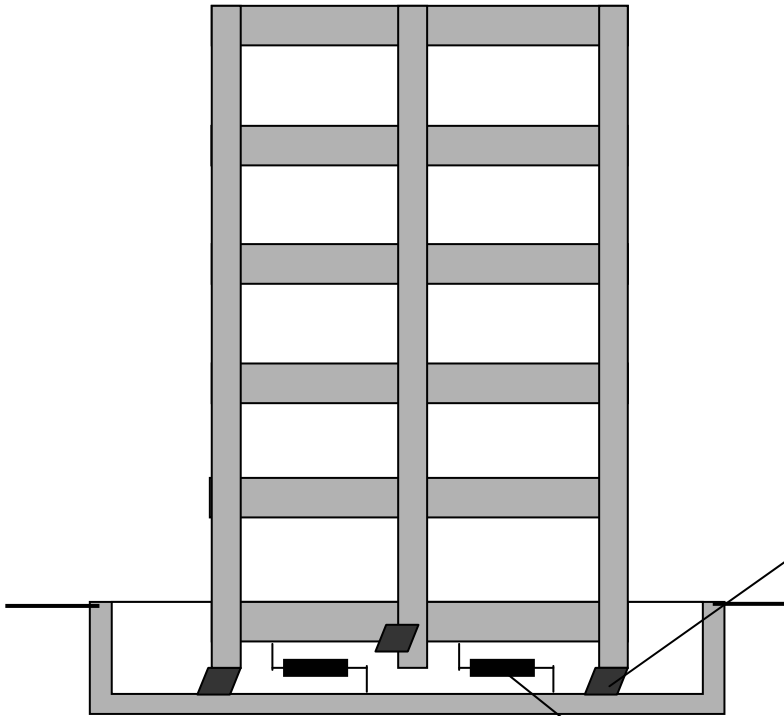
The following experiments were executed by Osaka University, Building Research Institute (BRI), JFE Steel Co., Takenaka Co., Daiwa House Industry Co. , and Konoike Construction Co.

# Basic Concept of ‘Only putting on’ base isolation

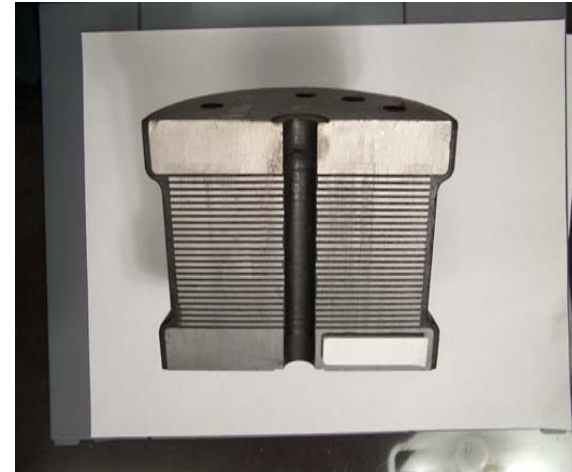
The research based on this concept were started at Tachibana Lab. in Architectural Engineering Division of Osaka University since 2000.

This concept was introduced at the International Workshop on Simple and Affordable Seismic Isolation (February 8, 2007 Tokyo)

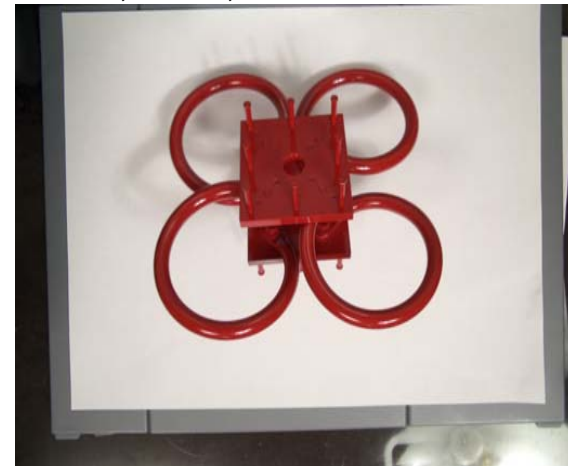
# Typical Base-Isolator System



Aim:  
Avoiding the resonance with the earthquake by prolonging the vibration cycle



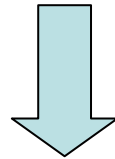
Laminated rubber Bearing  
CLB, LRB, etc



DAMPER  
Elast-Plastic Damper  
Visco-Elastic Damper etc.

# Problems of base isolator systems

- 1) It's expensive.
- 2) The resonance arises if long cycle periods are included in earthquake.

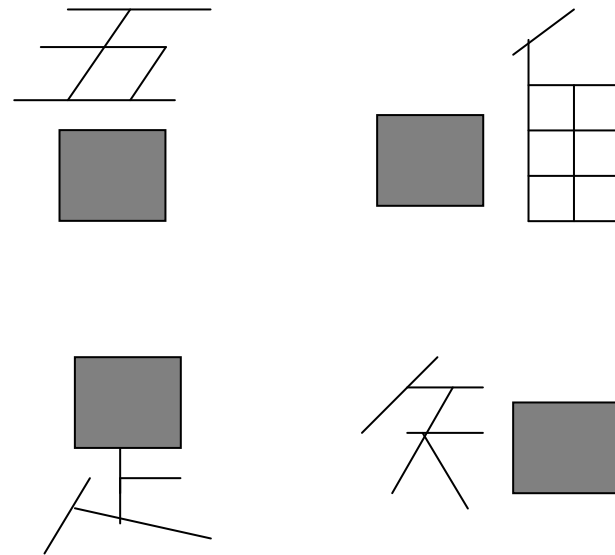
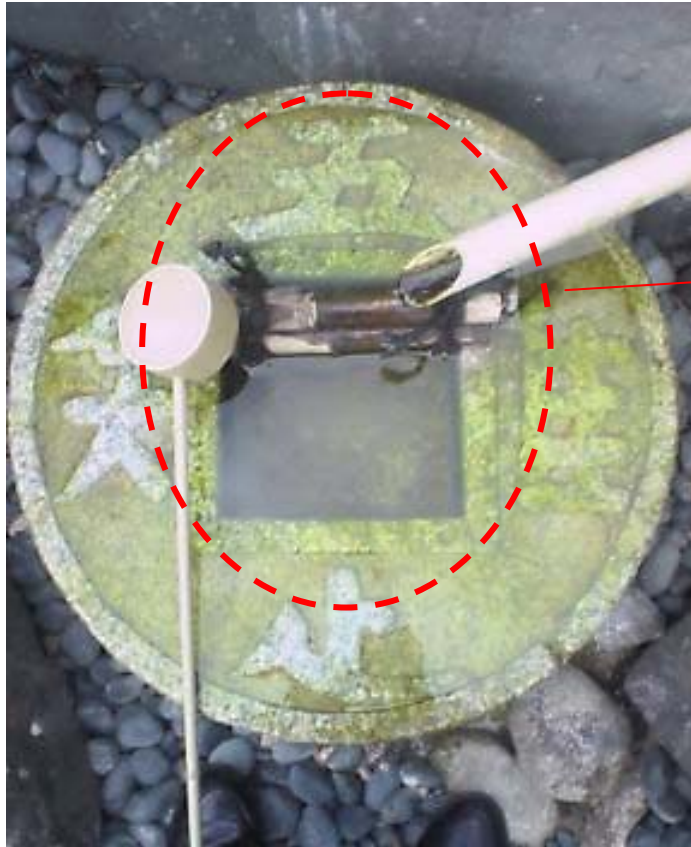


**Let's change of our mind.**

## Then how to change of our mind?

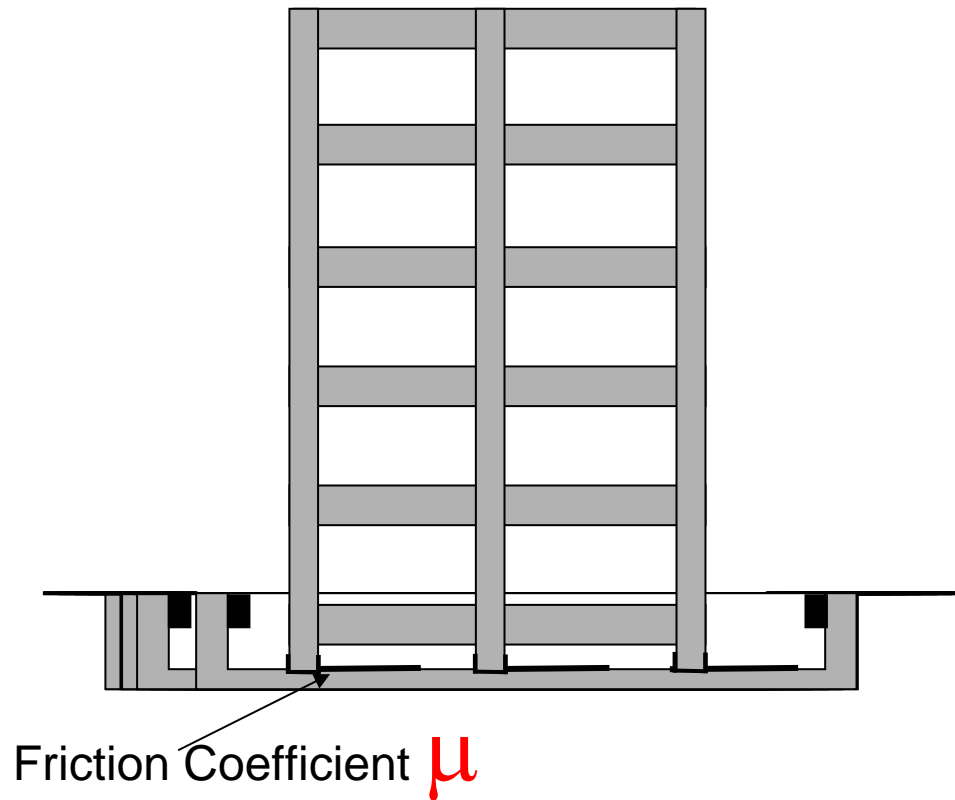
- 1) We should be satisfied if the acceleration of the building can be decreased to the about 50%.
- 2) We should allow the remaining gap of the building after the earthquake.

# We should not devour



Washing water at ZEN temple


# It's very simple idea






## Necessary condition of $\mu$

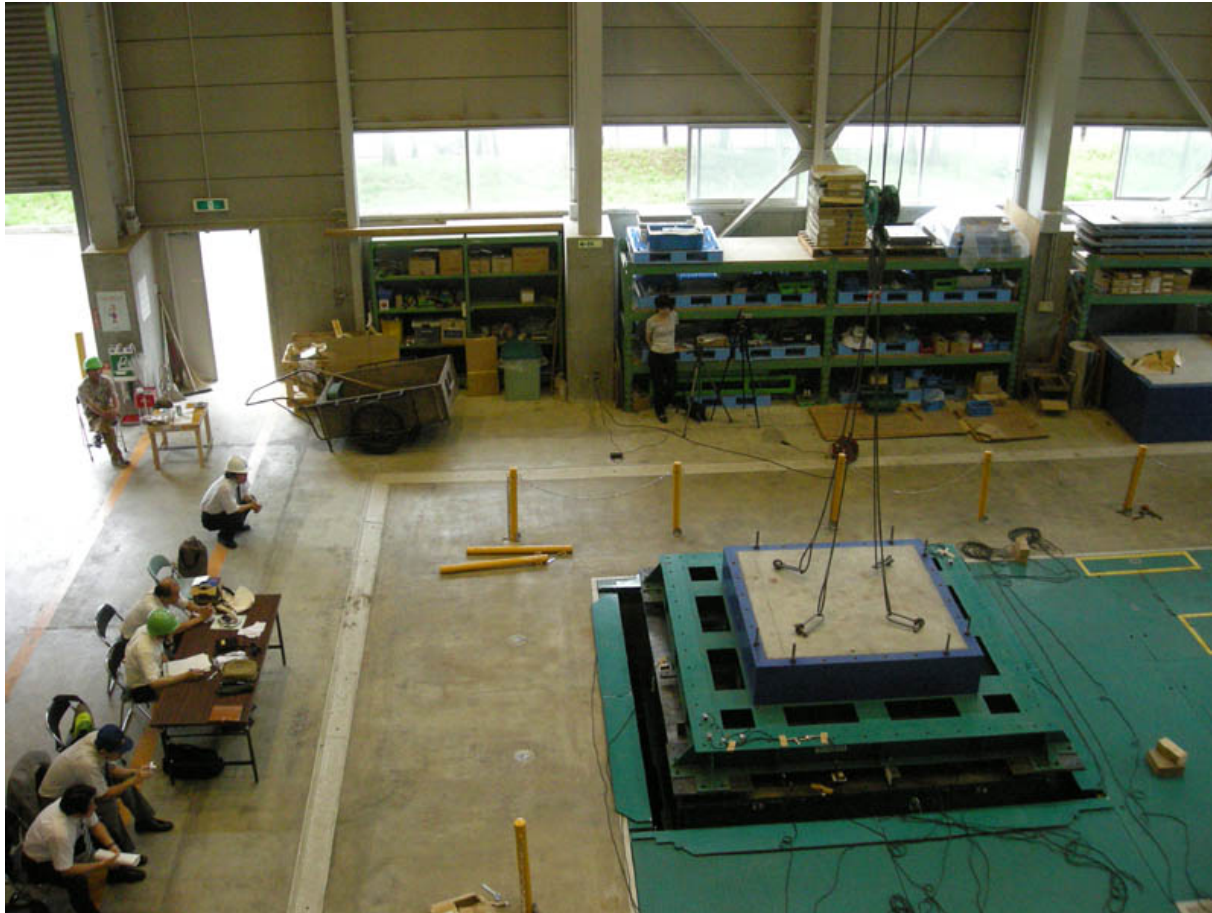
- a) Do not slide due to wind force or small earthquakes
- b) Must slide by big earthquake  
(Max acceleration  $> 200 \text{ cm/sec}^2$ )



$\mu \doteq 0.2$  

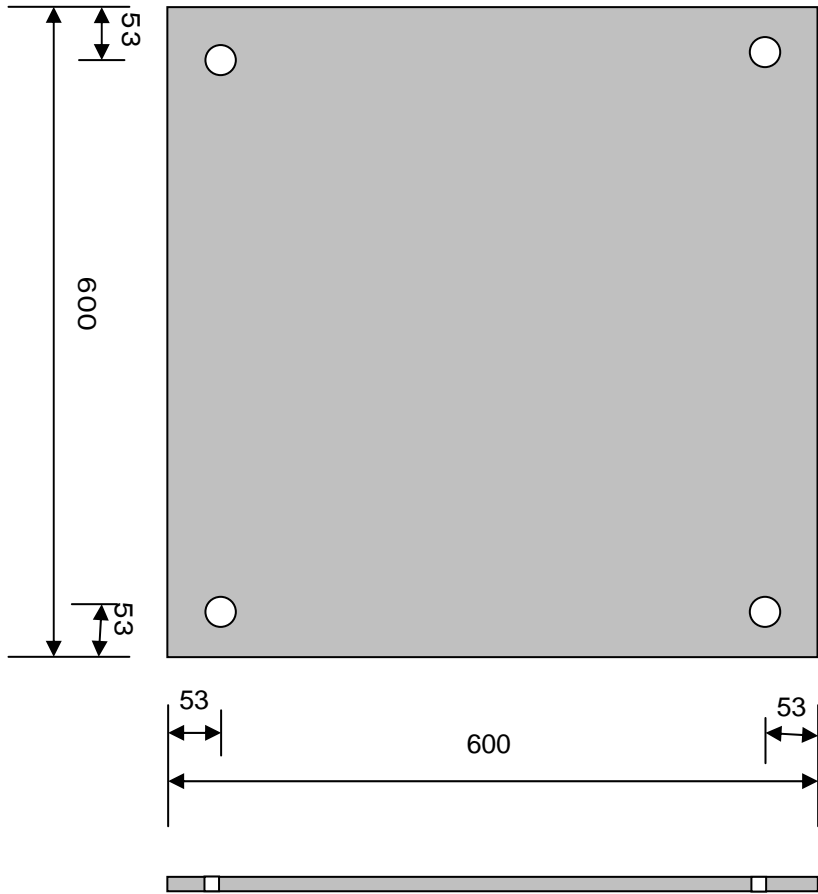
Stainless Steel  
or  
Steel with Coating

# Experiment (July 3-4, 2007)

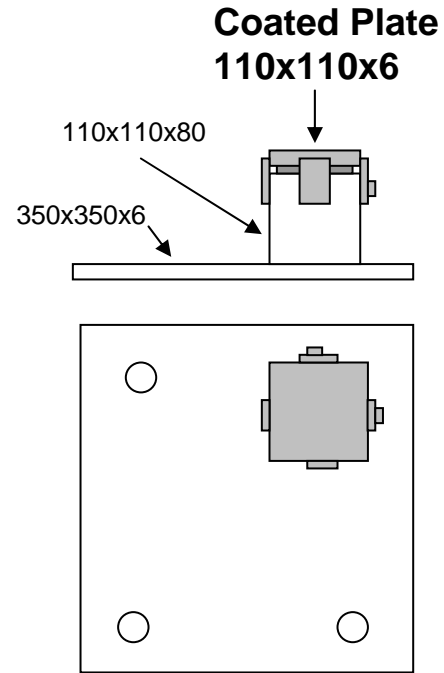


at Konoike Construction Co.

# Upper Plate



# Support Block and Coated Plate



# Upper Plate



# Support block and Coated Plate



# ‘Only putting on’



# Plate Combinations

Case	Upper Plate			Lower Plate		
	Material	Surface-treatment	Coating	Material	Surface-treatment	Coating
1	SUS304	Non	Non	SUS304	Phosphoric-acid- cleaning	M1014
2	SS400	Phosphoric-acid- cleaning	M1014	SUS304	Phosphoric-acid- cleaning	M1014
3	SS400	Phosphoric-acid- cleaning	M1014	SS400	Phosphating	M1014
4	SS400	Phosphoric-acid- cleaning	M1014	SS400	Tufftride+ phosphating	M1014
5	SS400	Phosphoric-acid- cleaning	M1014	SUS304	Phosphoric-acid- cleaning	F1433
6	SS400	Phosphoric-acid- cleaning	M1014	SS400	Phosphating	F1433
7	SS400	Phosphoric-acid- cleaning	M1014	SS400	Tufftride+ phosphating	F1433

Shaking Table:  
3000x3000mm  
Total Weight: 4.9 tonf

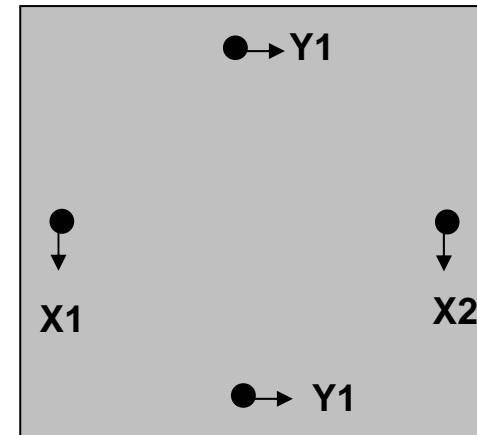


M: molybdenum  
F: fluorine

M1014, F1433, Phosphating and Tufftride are trade name or in-house terms used in Nihon Parkerrizing Co.

# 3-dimensional dynamic loading

JMA-KOBE NS (X)  
JMA-KOBE EW(Y)  
JMA-KOBE Z



## Procedure of loading

By changing the maximum acceleration of JMA-KOBE NS, dynamic loads are given as follows. The other components (JMA-KOBE EW, JMA-KOBE UD) are determined proportionally.

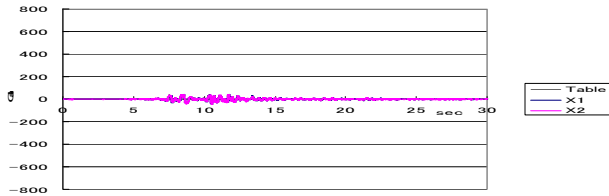
START  $\Rightarrow$  50 cm/s<sup>2</sup>  $\Rightarrow$  100 cm/s<sup>2</sup>  $\Rightarrow$  200 cm/s<sup>2</sup>  $\Rightarrow$  300 cm/s<sup>2</sup>  $\Rightarrow$  400 cm/s<sup>2</sup>  
 $\Rightarrow$  500 cm/s<sup>2</sup>  $\Rightarrow$  600 cm/s<sup>2</sup>  $\Rightarrow$  800 cm/s<sup>2</sup>  $\Rightarrow$  END

These maximum values are setted values. Recorded values are different about 5%.

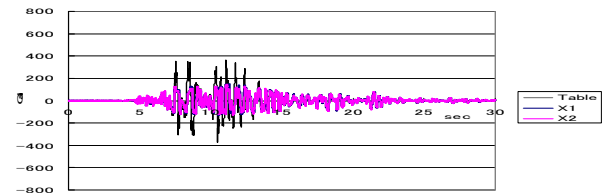


# Comparison (for Case-7)

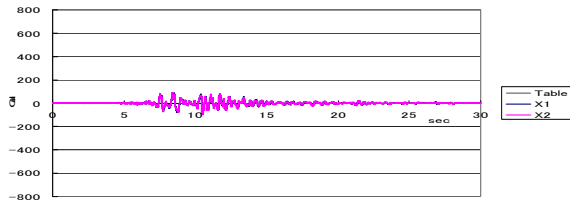
50 cm/s<sup>2</sup>



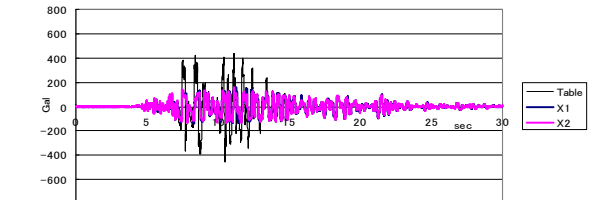
400 cm/s<sup>2</sup>



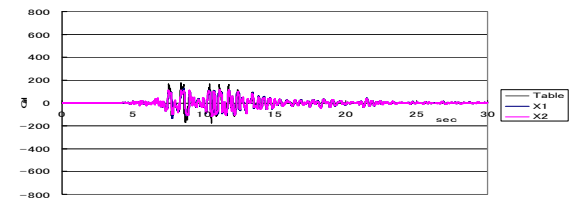
100 cm/s<sup>2</sup>



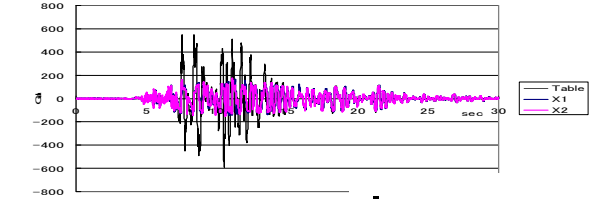
500 cm/s<sup>2</sup>



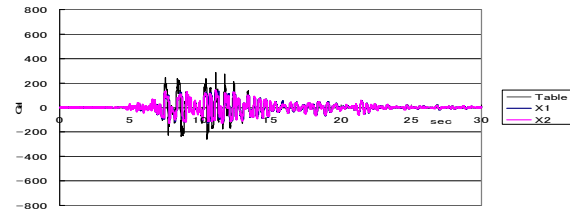
200 cm/s<sup>2</sup>



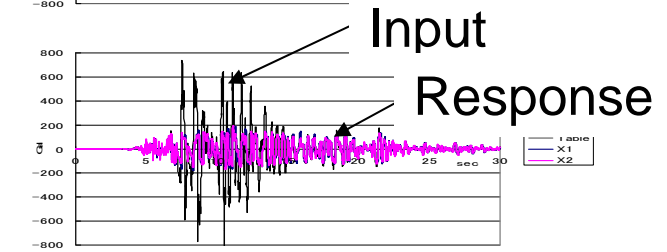
600 cm/s<sup>2</sup>



300 cm/s<sup>2</sup>

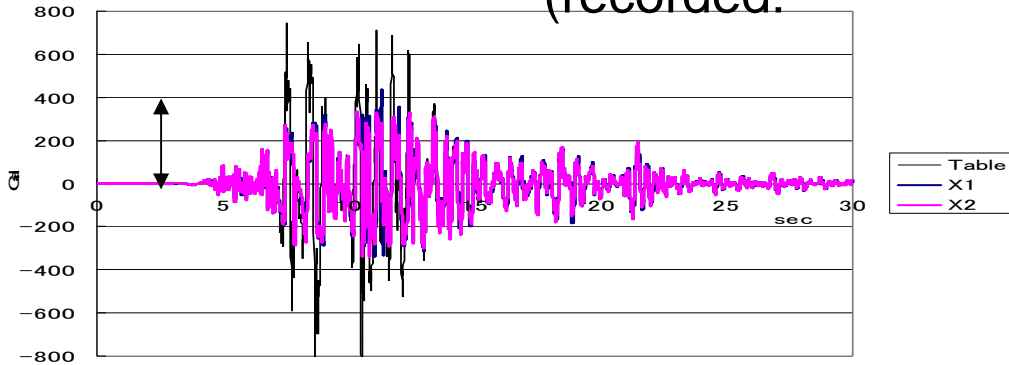


800 cm/s<sup>2</sup>

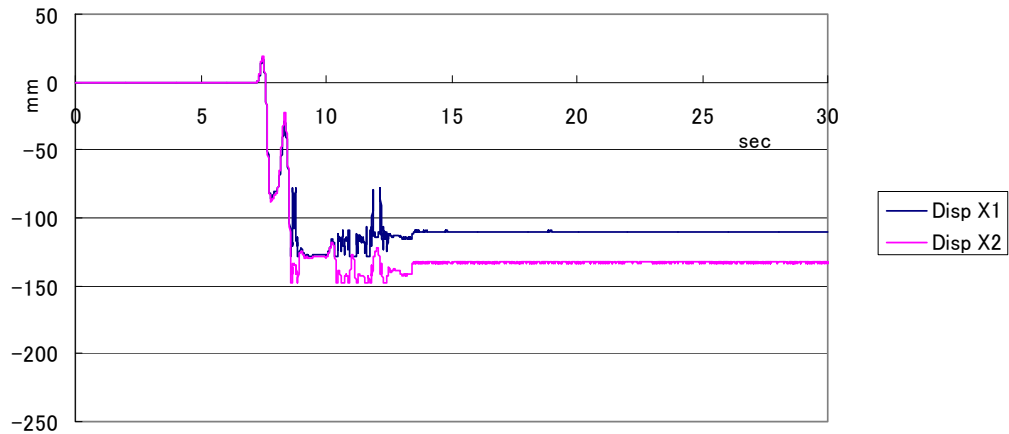


# CASE-1 SUS+SUS

JMA-KOBE NS 800 cm/s<sup>2</sup>  
(recorded:



Acceleration  $\ddot{X}$  (cm/s<sup>2</sup>)



Relative Displacement X (mm)

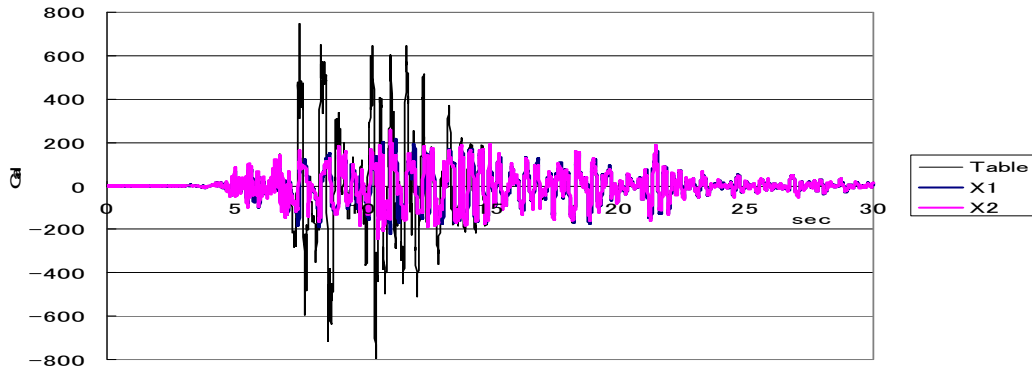


SUS304 with M1014

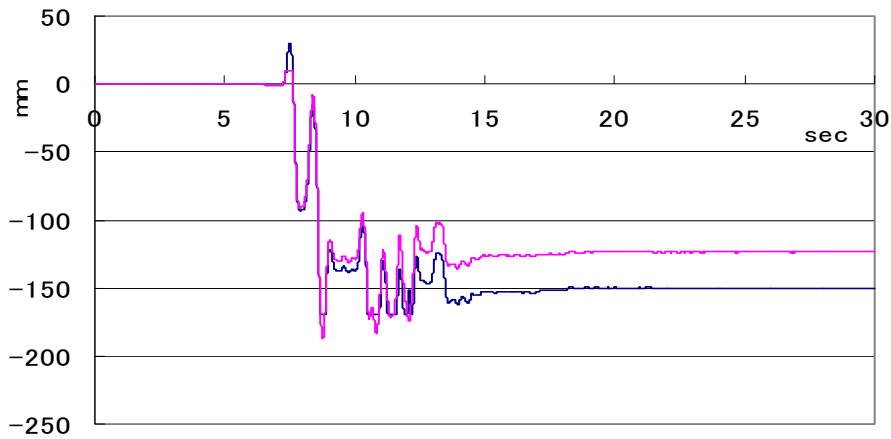
Coatings are peeled off

# CASE-2 SS+SUS

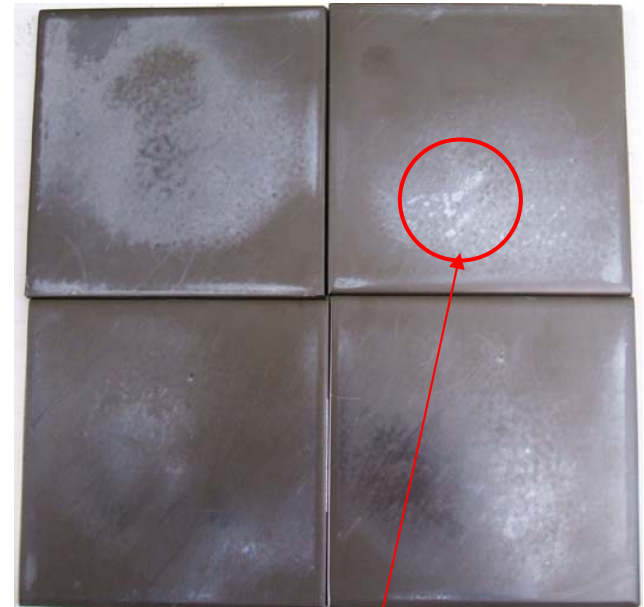
(JMA-KOBE NS 800 cm/s<sup>2</sup>)



Acceleration  $\ddot{X}$  (cm/s<sup>2</sup>)



Relative Displacement  $X$  (mm)

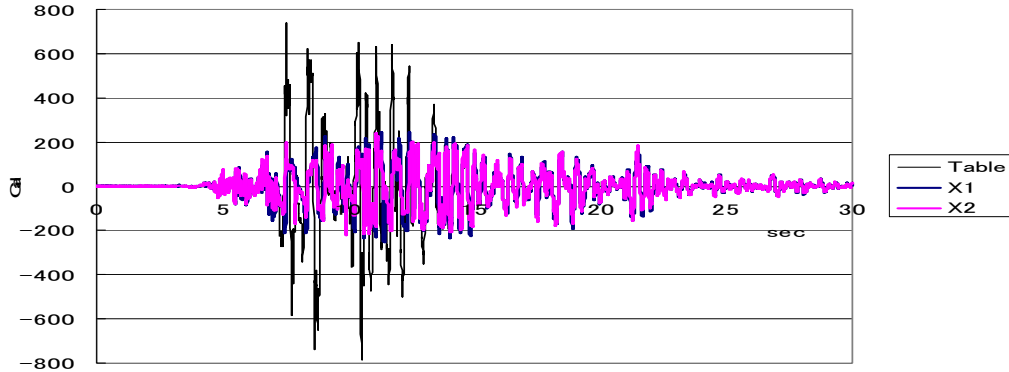


SUS304 with M1014

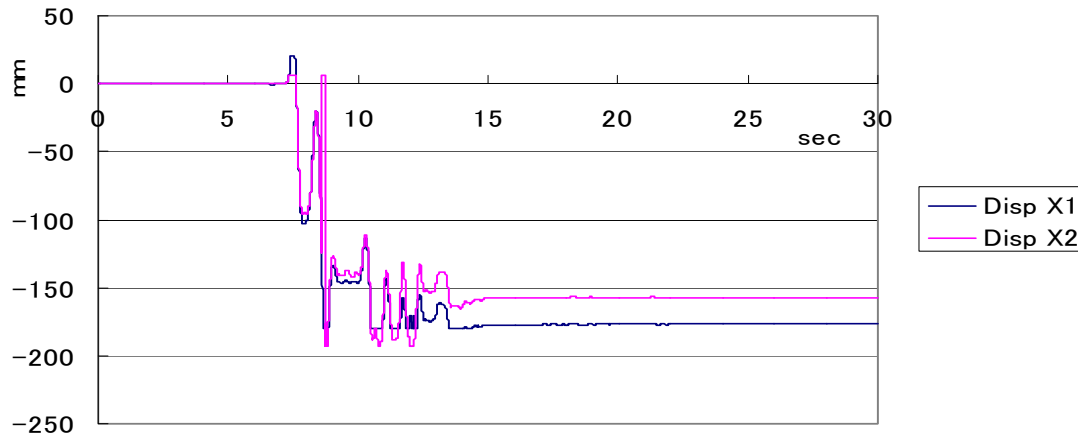
Coating is peeled off.

# CASE-3 SS+SS

(JMA-KOBE NS 800 cm/s<sup>2</sup>)



Acceleration  $\ddot{X}$  (cm/s<sup>2</sup>)



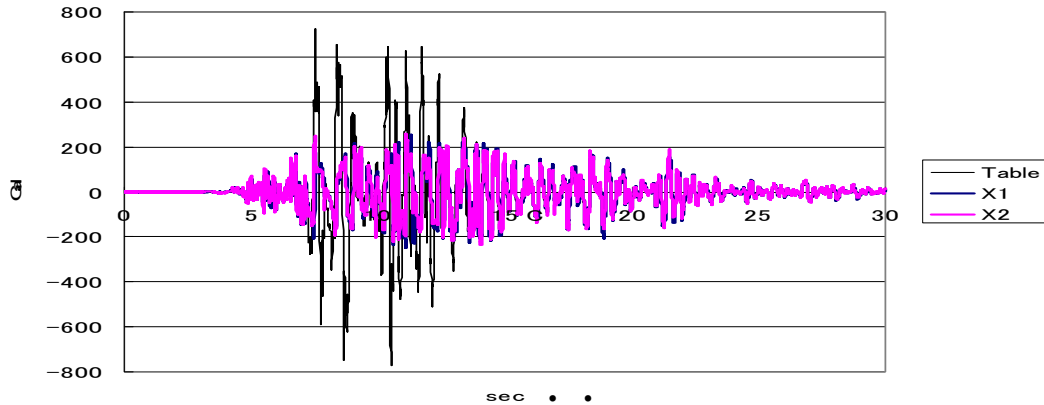
Relative Displacement X (mm)



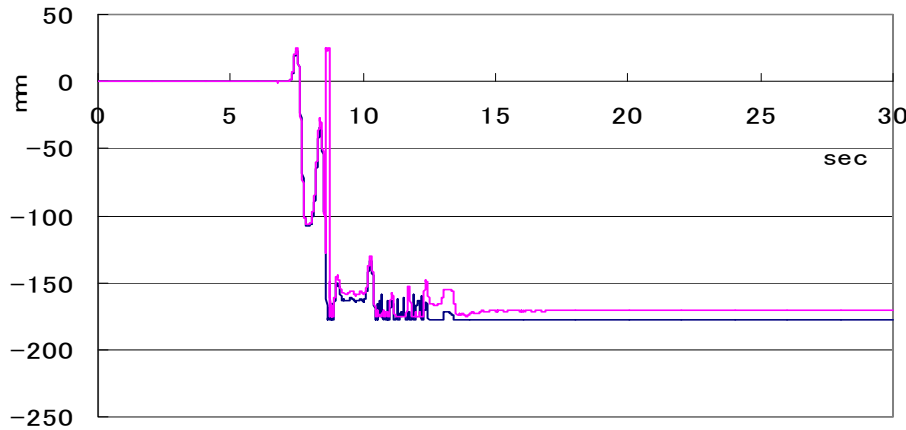
SS304 with M1014

# CASE-4 SS+SS

(JMA-KOBE NS 800 cm/s<sup>2</sup>)



Acceleration X (cm/s<sup>2</sup>)



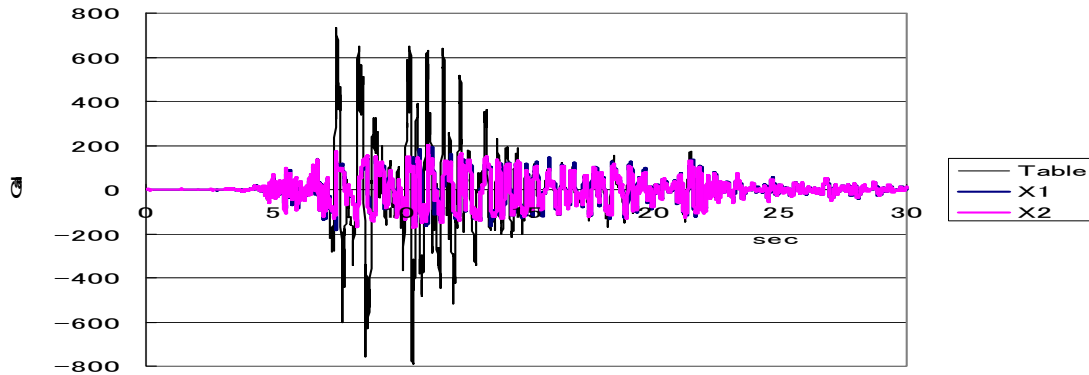
Relative Displacement X (mm)



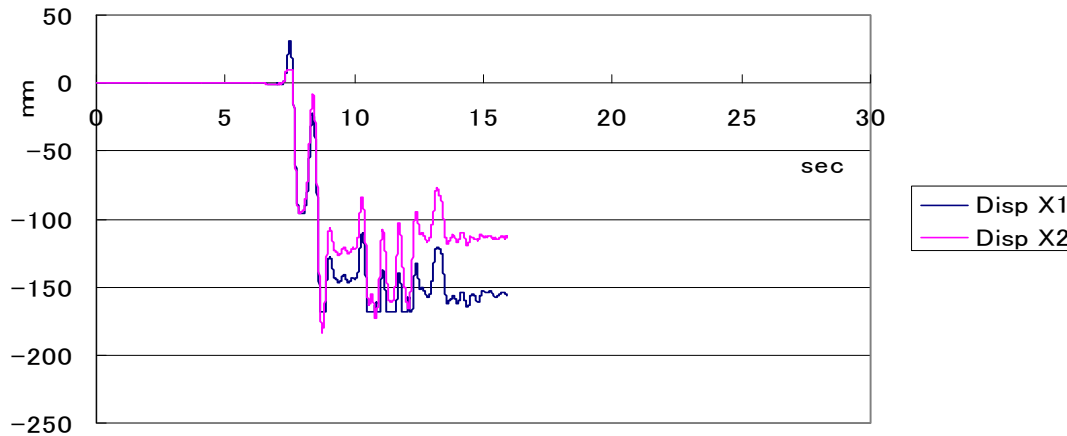
SS304 with M1014(TAFFT)

# CASE-5 SS+SUS

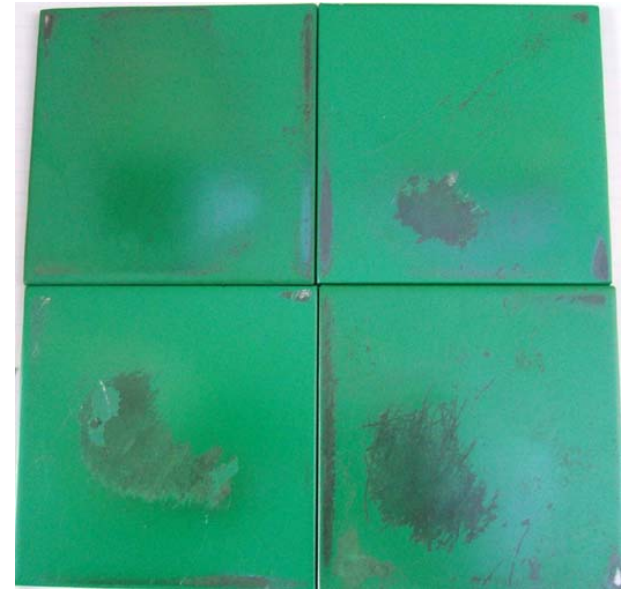
(JMA-KOBE NS 800 cm/s<sup>2</sup>)



Acceleration  $\ddot{X}$  (cm/s<sup>2</sup>)



Relative Displacement X (mm)



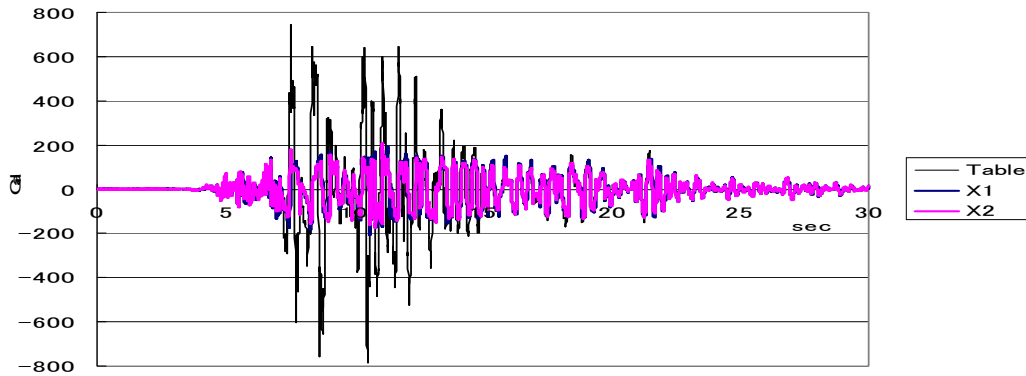
SUS304 with F1433

Low cost base isolation

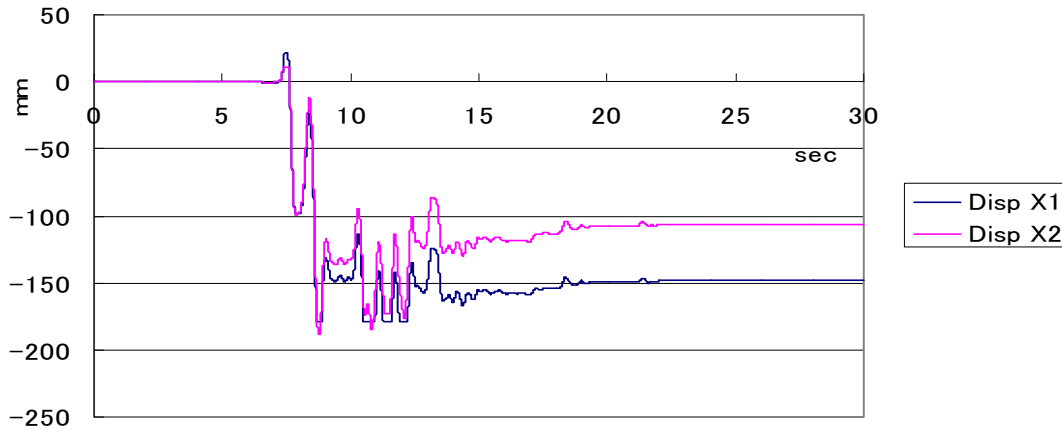
2007/7/18

# CASE-6 SS+SS

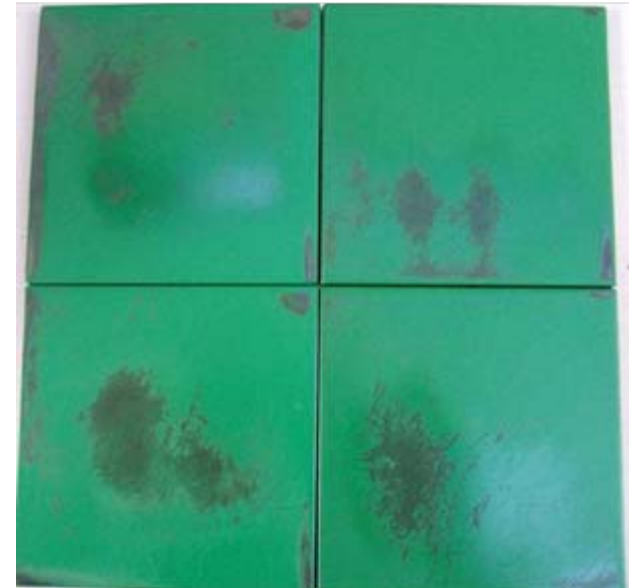
(JMA-KOBE NS 800 cm/s<sup>2</sup>)



Acceleration  $\ddot{X}$  (cm/s<sup>2</sup>)



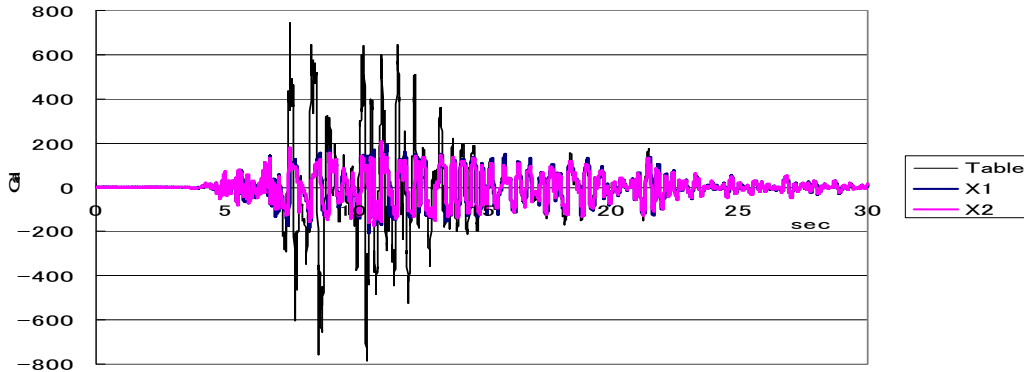
Relative Displacement X (mm)



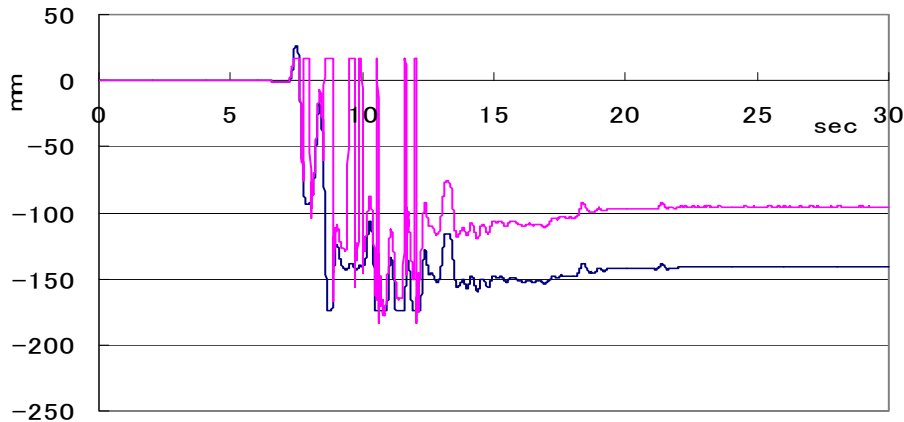
SS400 with F1433

# CASE-7 SS+SS

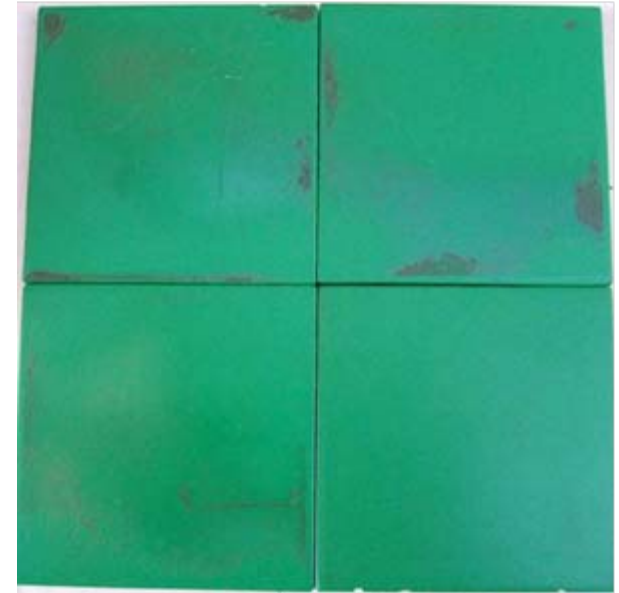
(JMA-KOBE NS 800 cm/s<sup>2</sup>)



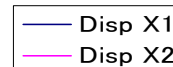
Acceleration  $\ddot{X}$  (cm/s<sup>2</sup>)



Relative Displacement X (mm)

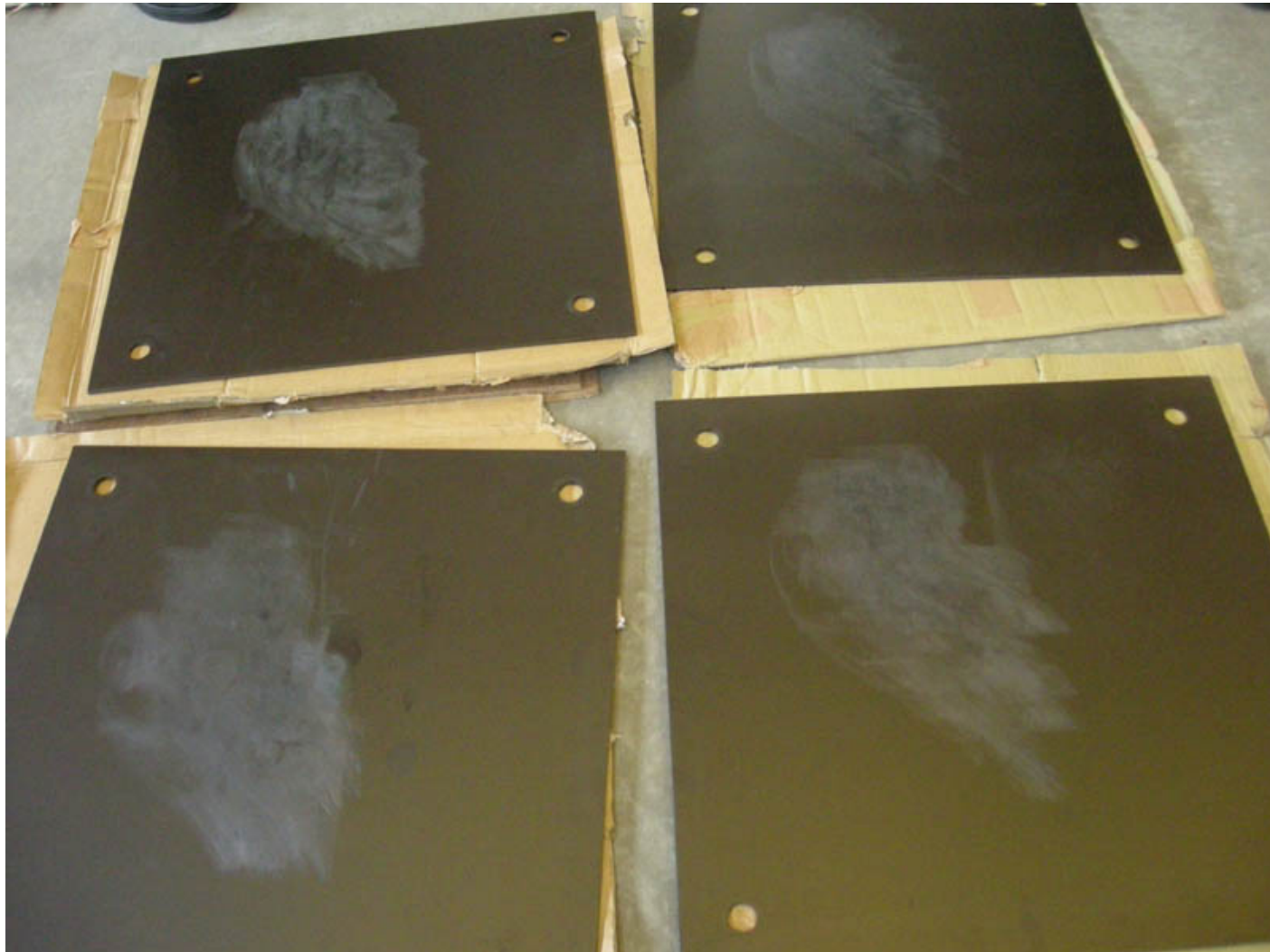


SS400 with F1433(TAFFT)





# Rubbed Mark of Upper Plate



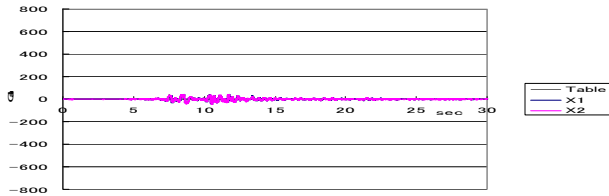
# Remarks

For the case of JMA-KOBE NS 800 cm/s<sup>2</sup>

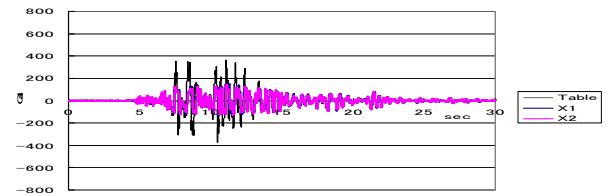
- 1) The maximum acceleration response is about 200 cm/sec<sup>2</sup> (except CASE-1).
- 2) The maximum relative displacement is about 20cm.

# Comparison (for Case-7)

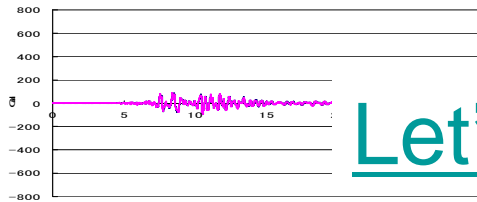
50 cm/s<sup>2</sup>



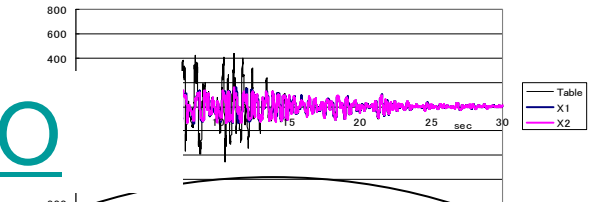
400 cm/s<sup>2</sup>



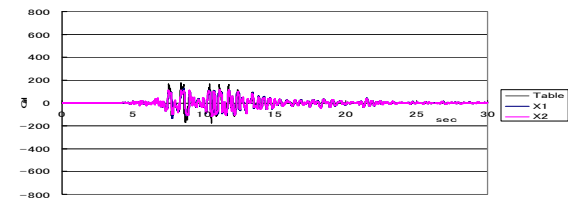
100 cm/s<sup>2</sup>



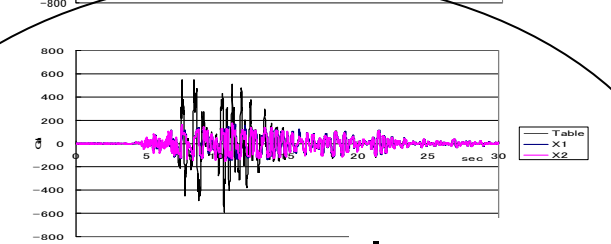
Let's see VIDEO



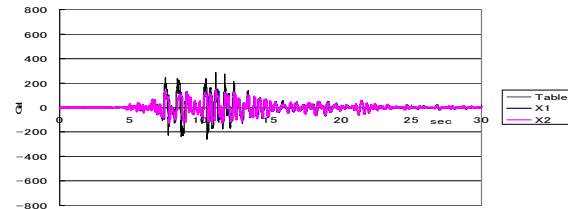
200 cm/s<sup>2</sup>



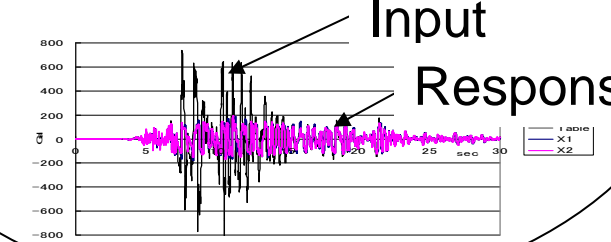
600 cm/s<sup>2</sup>



300 cm/s<sup>2</sup>



800 cm/s<sup>2</sup>



# Acknowledgement

This prompt report is due to following cooperators.

*Mr.Narafu (BRI),, Mr.Yamaguchi (BRI), Dr.Yokoyama (Konoike Construction Co.), Dr.Ikawa (Konoike Construction Co.), Mr.Ito (Konoike Construction Co.), Mr.Inosako (JFE Steel Co.), Dr.Yamamoto (Takenaka Co.),, Dr.Yoneda (Takenaka Co.), Dr.Furumi (Daiwa House Ind.Co.), Miss.Abe (Daiwa House Ind.Co.), Mr.Mizushima (Osaka Univ.) and Mr.Iizuka (Nihon Parkerizing Co.)*

*Thank you for your tension*