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"BEHAVIOR OF PRECAST STRUCTURAL WALLS POST-TENSIONED BY UNBONDED TENDONS IN SHAKING TABLE TESTS ON ACTUAL-SIZE 4-STORY PRESTRESSED CONCRETE BUILDING"

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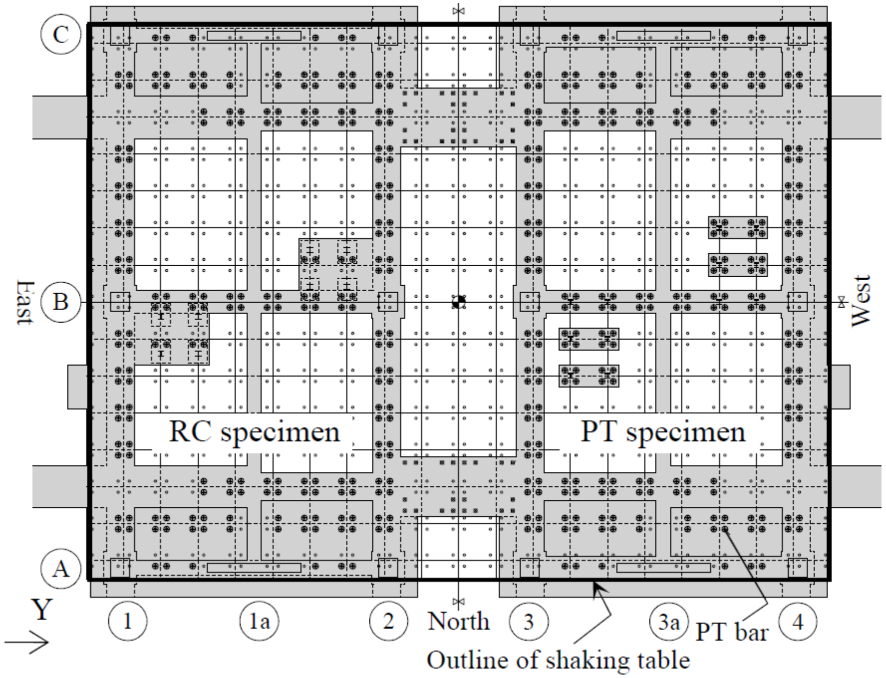
1.- INTRODUCTION

2010 E-Defense Shaking Table test on actual-size 4-Story RC and PT Concrete Building



3-directional input motion.

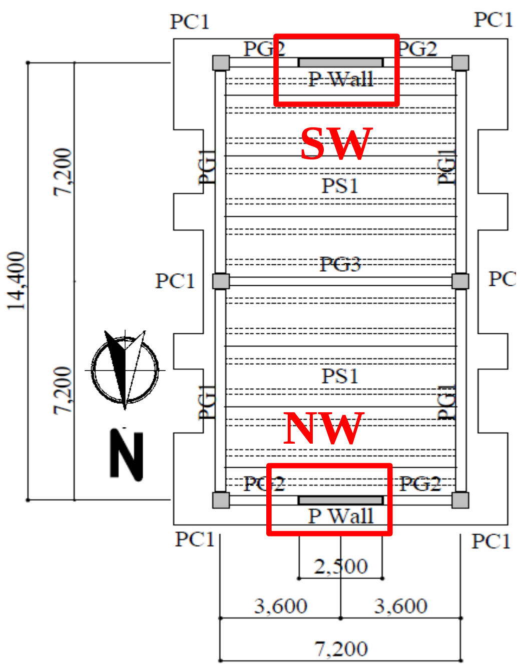
Loading sequence:

1) JMA-Kobe: 10, 25, 50 and 100%

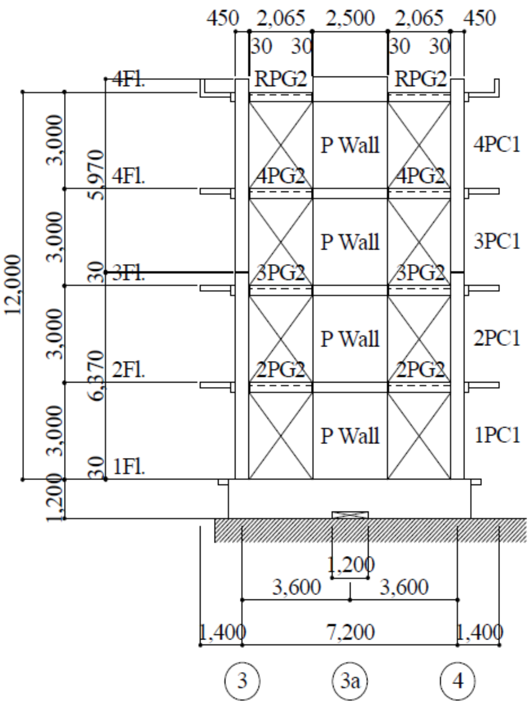
2) JR-Takatori: 40 and 60%

2.- DESCRIPTION OF PRECAST WALLS

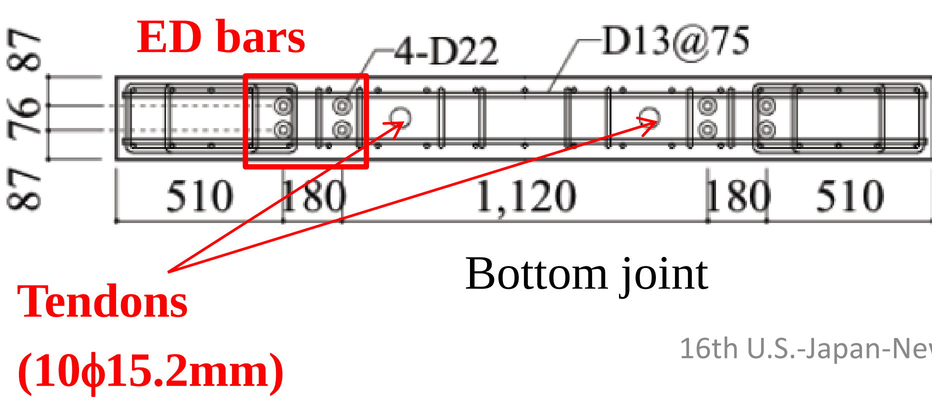
Unbonded Post-Tensioned Precast Walls



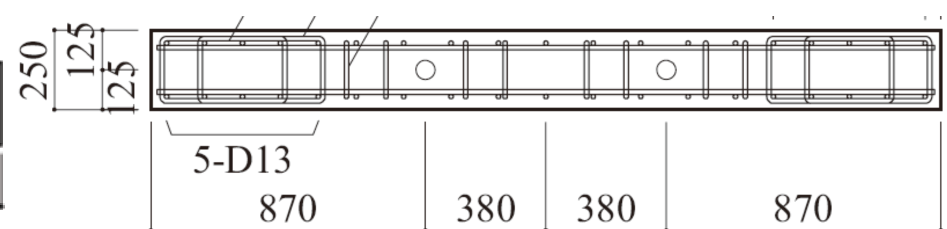
Plan view



Elevation of wall



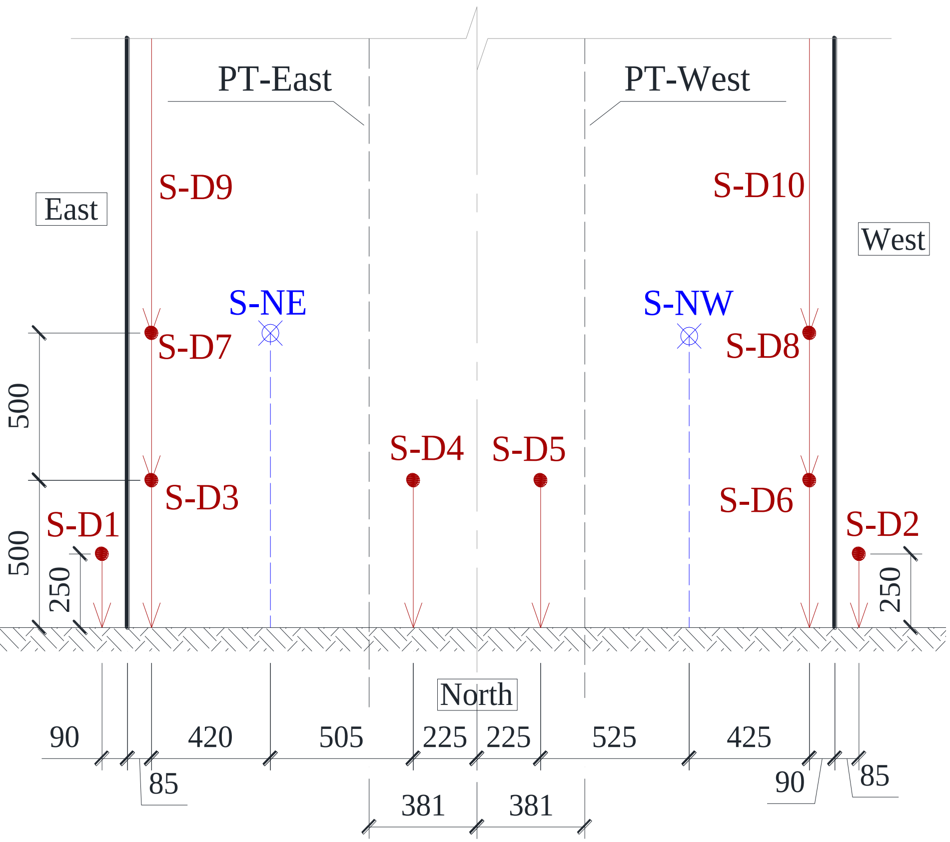
Bottom joint



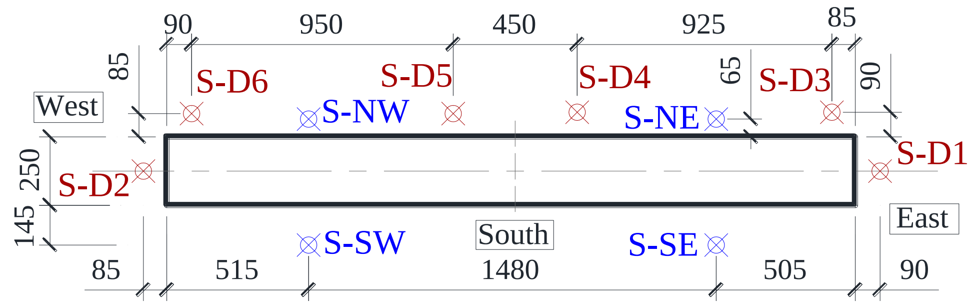
Upper joint

2.- DESCRIPTION OF PRECAST WALLS

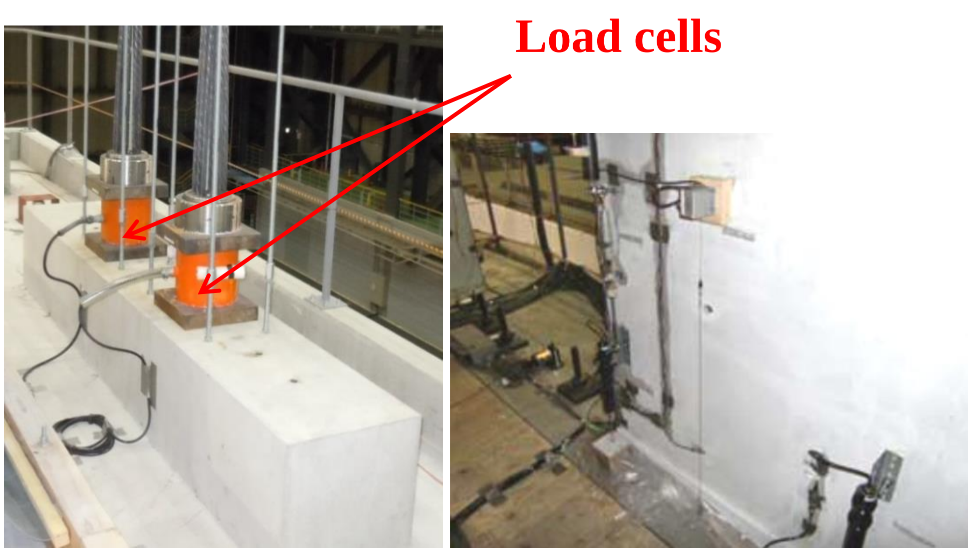
INSTRUMENTATION IN WALLS



Transducer location at first floor

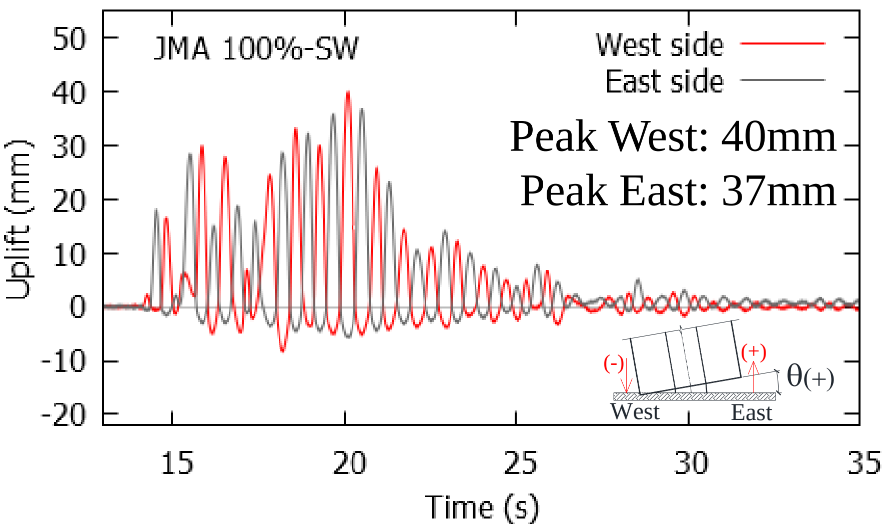


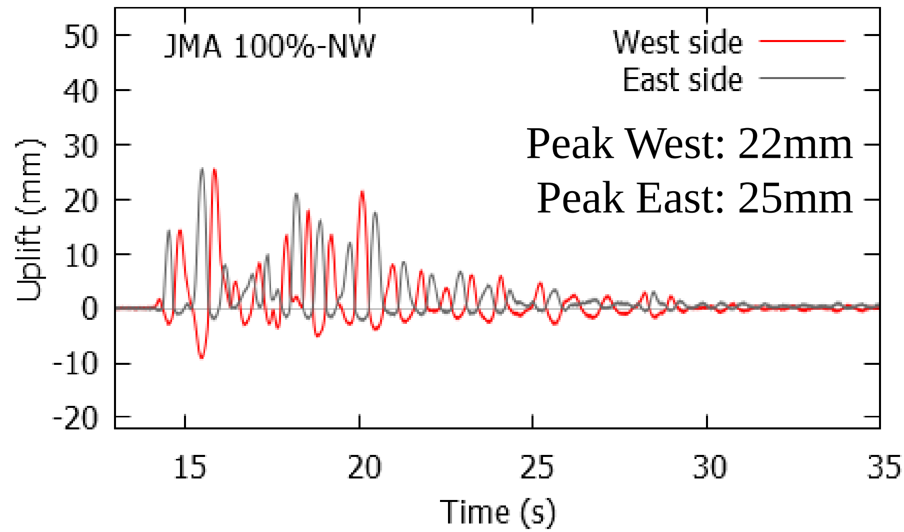
Location of transducers at base joint



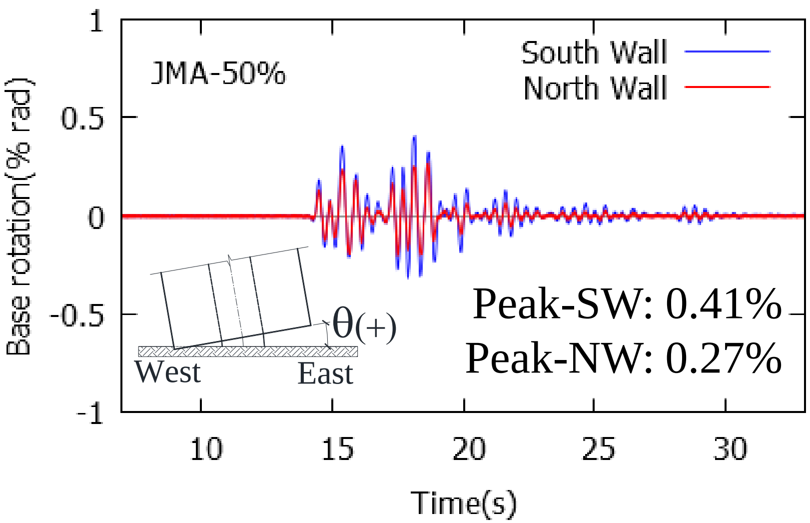
3.- PERFORMANCE OF WALL SYSTEM

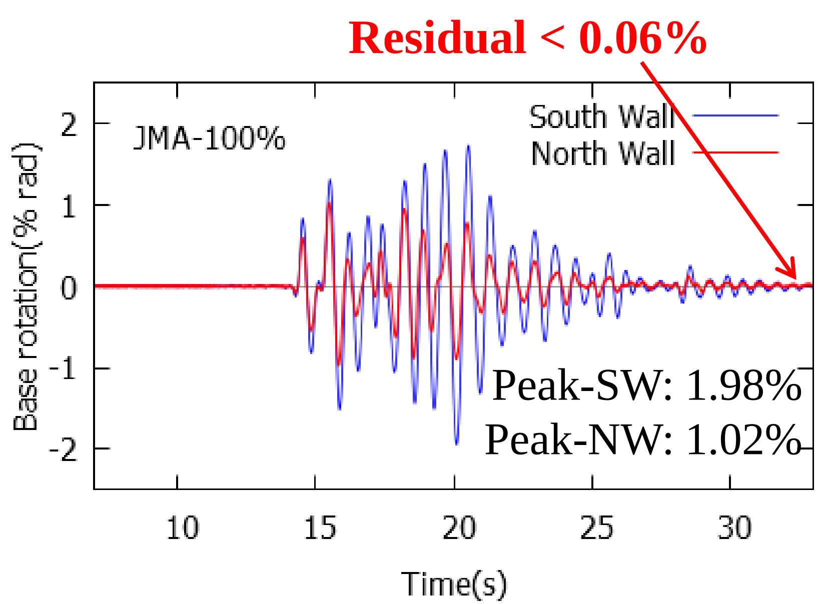
Uplift at the sides of base joint





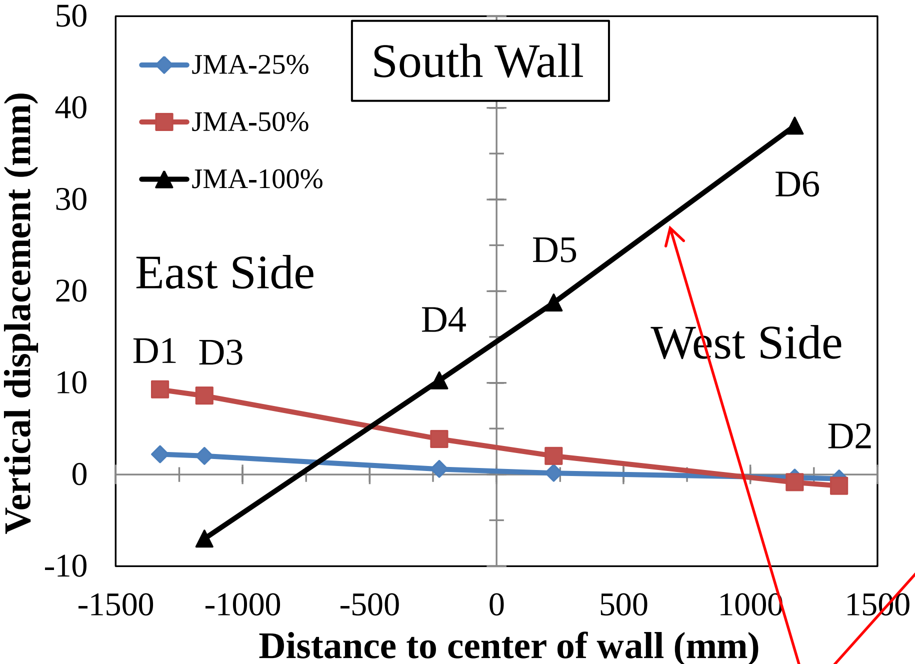
Base rotation angles

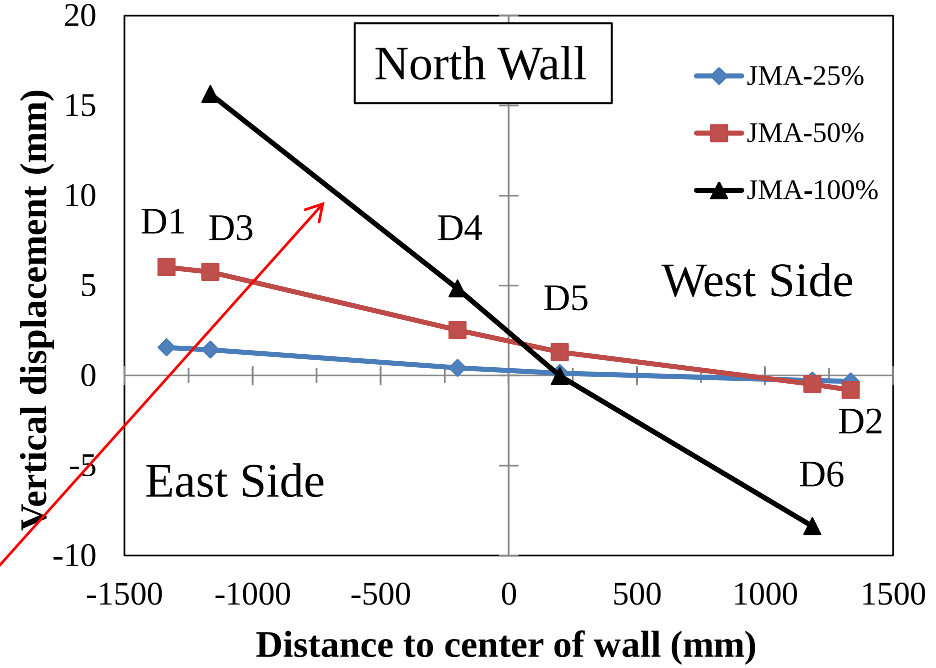




3.- PERFORMANCE OF WALL SYSTEM

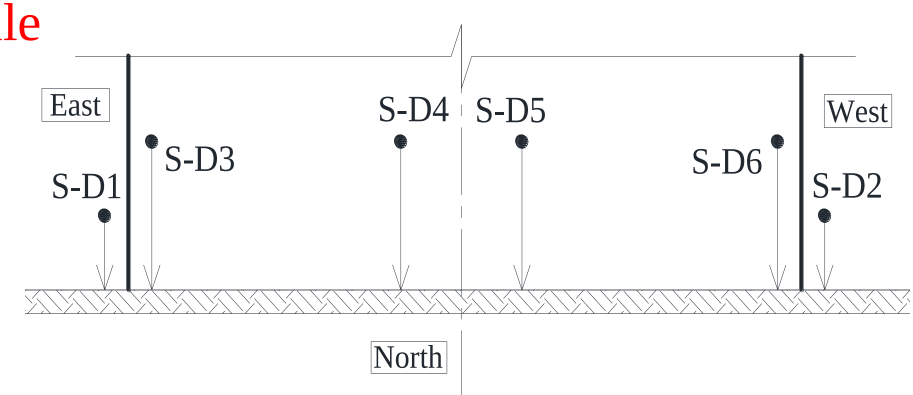
Vertical displacement profile of base joint during peak opening





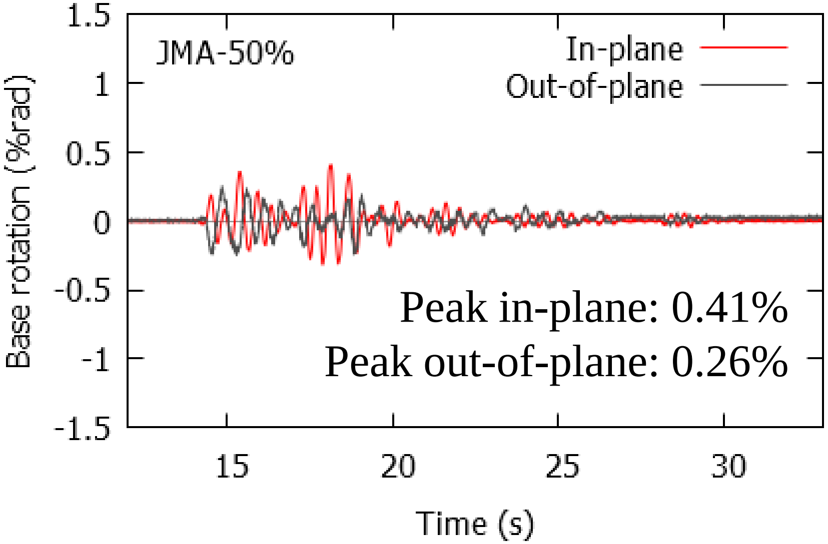
Almost linear profile

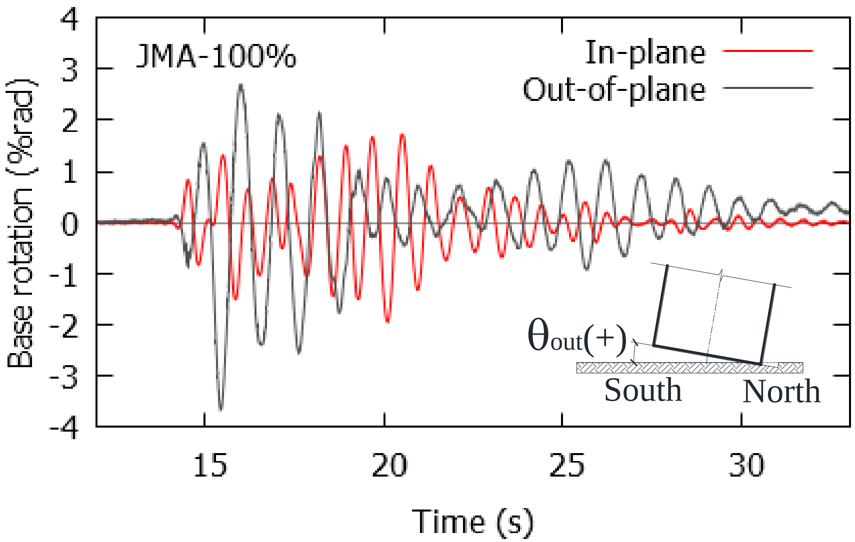
ACI ITG-5.2 assumes a plane section for large gap openings.



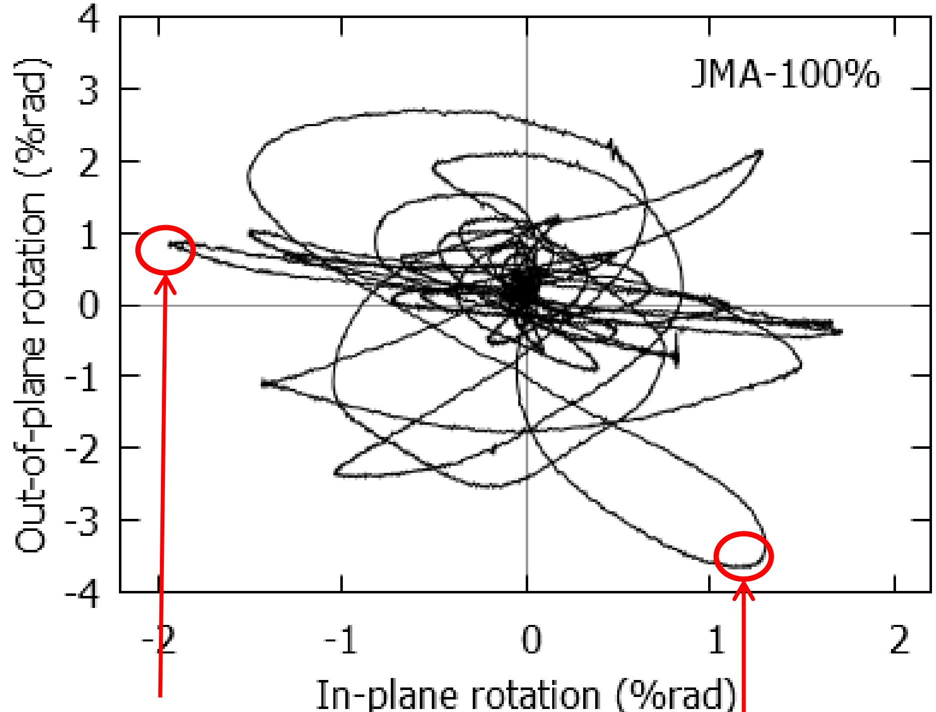
3.- PERFORMANCE OF WALL SYSTEM

Out-of-plane Base rotation angle in South Wall





Bi-directional motion



Peak θ : 1.9%

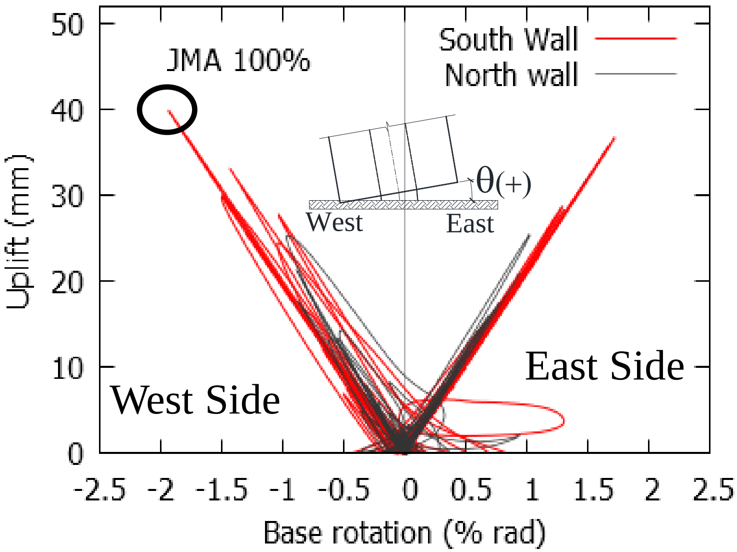
Peak θ_{out}: 0.9%

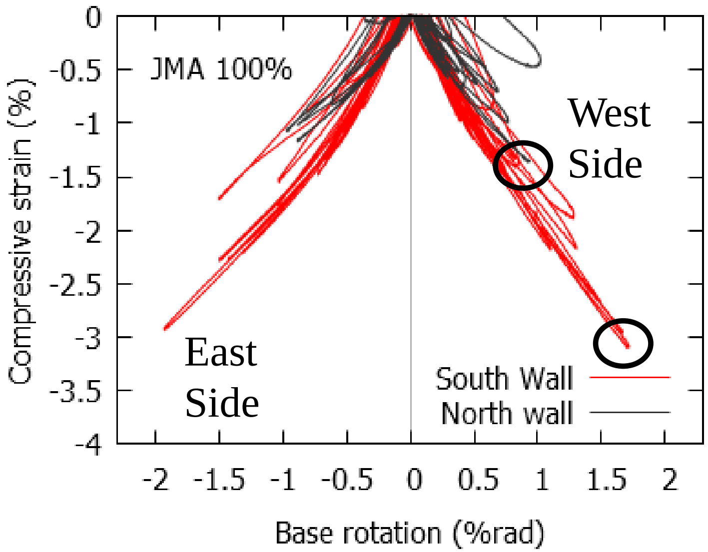
Peak θ_{out}: 3.7%

Peak θ : 1.2%

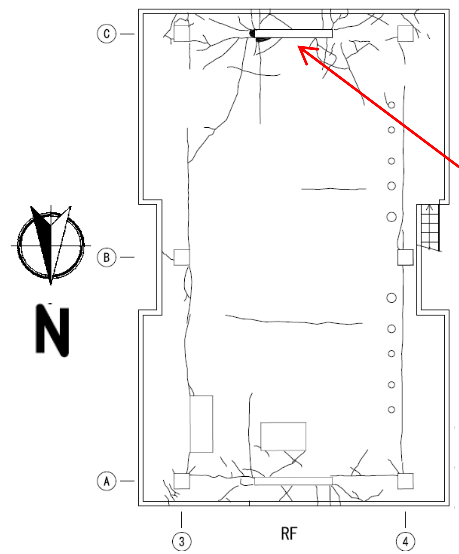
3.- PERFORMANCE OF WALL SYSTEM

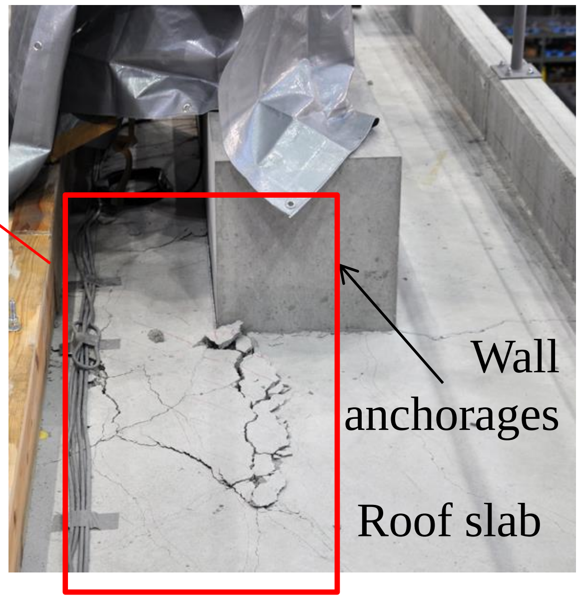
Effects of in-plane base rotations





Cracks in roof slab





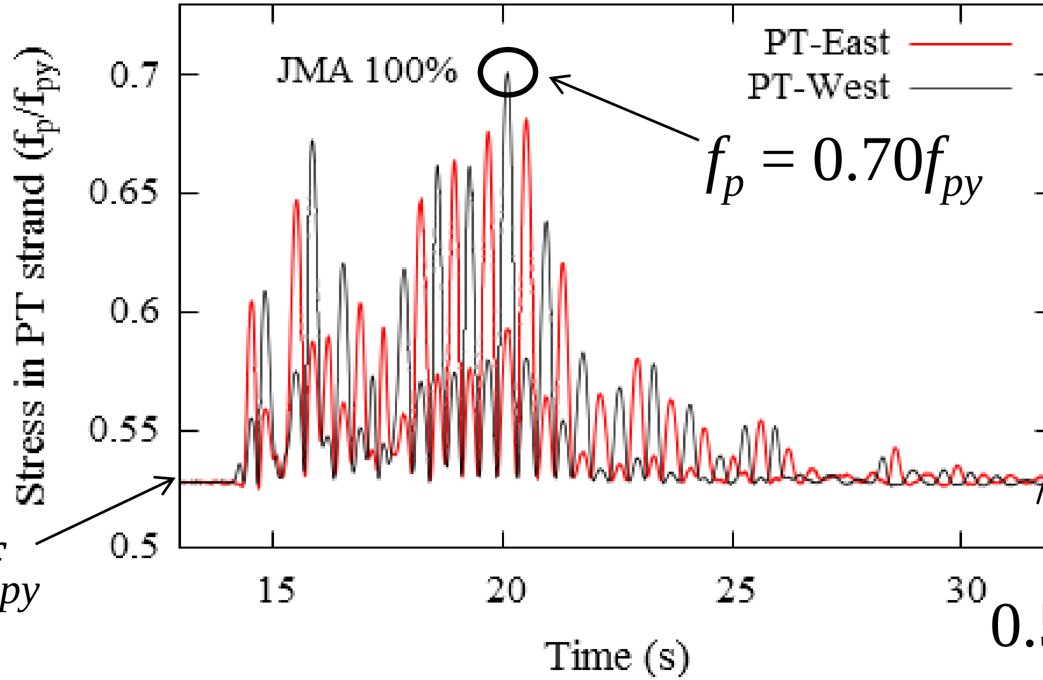
Condition at toes

3.- PERFORMANCE OF WALL SYSTEM

Stresses in tendons of South Wall

Strand properties:
f_{py} = 1821MPa
f_{pu} = 2004MPa

Nominal properties:
f_{py_n} = 1601MPa
f_{pu_n} = 1882MPa



$f_p = 0.70f_{py}$

$f_{po} = 0.53f_{py}$

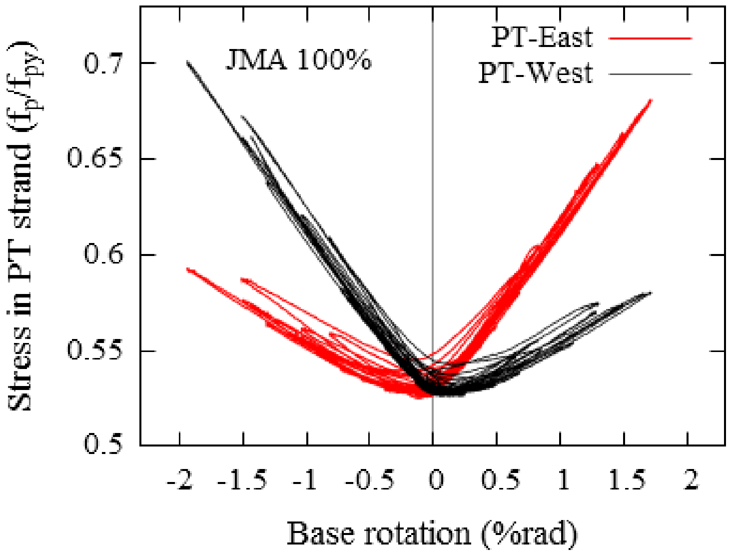
$0.53f_{py}$

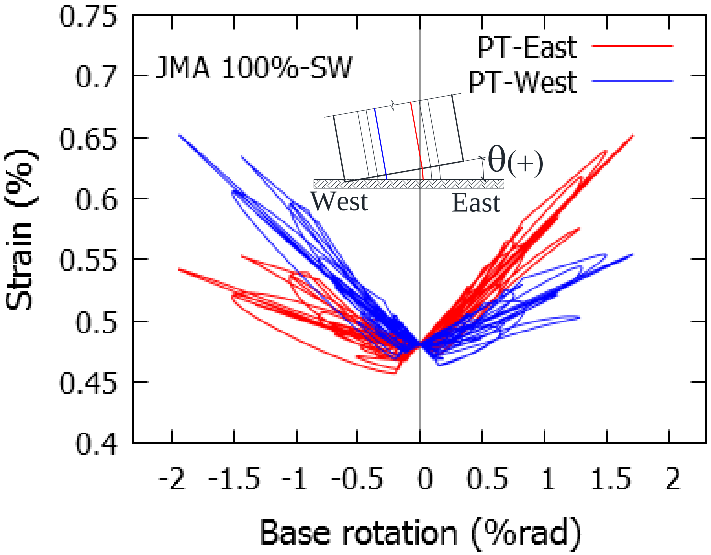
Cyclic loading effects on strand-anchorage systems – Test requirements

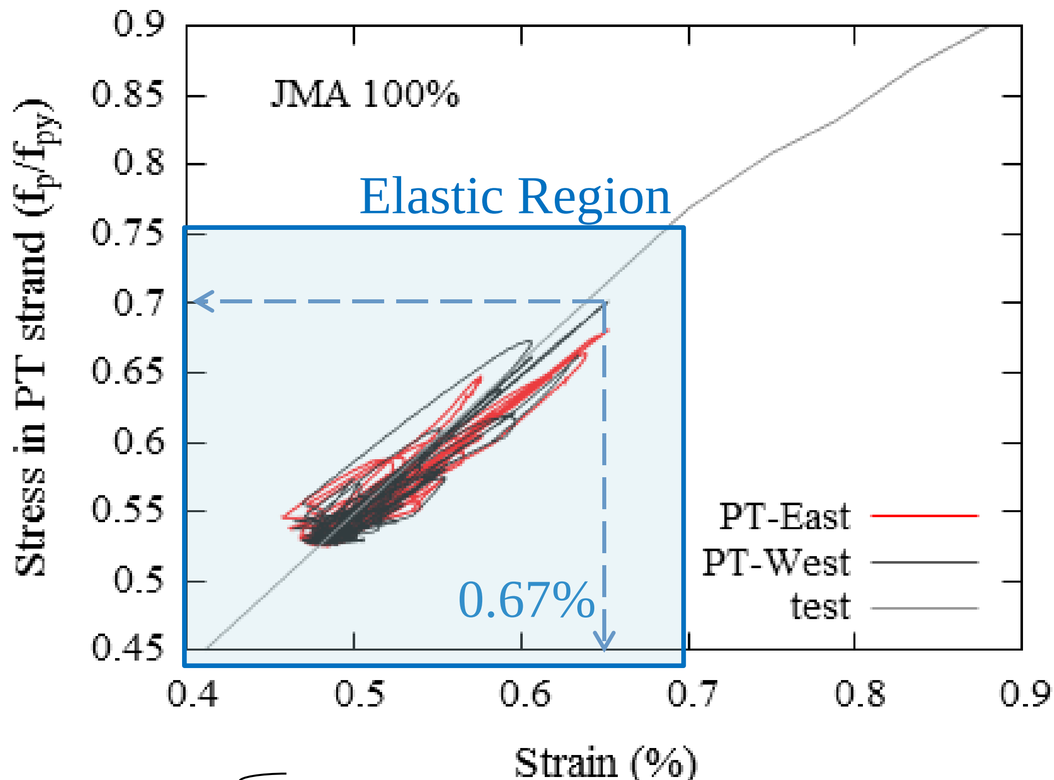
	NZS3101	ICC-ES	AIJ	Test results
Stress f_{pu_n} (f_{pu})	0.50 – 0.80	0.40 – 0.80	0.50 – 0.90	0.50 (0.48) – 0.67 (0.64)
# Cycles	50	50	200	26
Frequency (Hz)	-	1 – 3	-	2.11

3.- PERFORMANCE OF WALL SYSTEM

Performance of tendons in South Wall







Self-centering Capacity

$f_p \leq f_{py\_n}$ (ACI ITG-5.2)

$\varepsilon_p \leq 1\%$ (Walsh & Kurama 2010)

CONCLUDING REMARKS

- The walls supported large drift without serious damage.
- South wall sustained larger deformations (2 times larger) than north wall.
- Steel fibers controlled the concrete spalling at the north wall.
- Significant out-of-plane base rotation angle (3.7% in the SW).
- Damage was observed in the slabs due to the rocking motion of walls.
- Stresses in the PT strands of the south wall remained in the elastic range (max stress 0.7fpy).
- Test results revealed some issues:
  - Out-of-plane rocking motion
  - Damage in slabs and other components
  - Influence of fiber content in concrete panels.

THANK YOU VERY MUCH

ACKNOWLEDGMENTS:
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