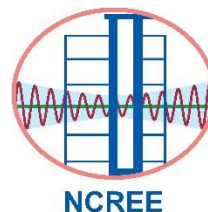




QuakeCoRE
NZ Centre for Earthquake Resilience



Blind Prediction Competition 2019

The organizers thank all the participants of the QuakeCoRE Blind Prediction Competition 2019. We received final submissions from 14 teams (12 for Category-1 and 2 for Category-2), from 8 different countries and regions.

We are pleased to announce two winners among those participants and each winning team shall receive up to NZD 3000 in travel funding*. This document summarizes the overall results and judging criteria. We shall provide the link for more detailed results once the test data is published online.

Winning Teams

Gianrocco Mucedero, Antonio Silva, Daniele Perrone, Ricardo Monteiro

from IUSS Pavia, Italy

(participated in **Category-1**, Assigned Team #: 2)

Ricardo Bustamante, Rodolfo Alvarez, and Jose I. Restrepo

from Department of Structural Engineering, University of California, San Diego, USA

(participated in **Category-2**, Assigned Team #: 6)

The two winning teams had the best overall predictions among the 14 participants and also within the categories under which they submitted their entries.

*Travel Funding: For an international winner, the travel funding must be used to attend the 2020 QuakeCoRE Annual Meeting. All travel funding will be done based on reimbursement and can only be used to support travel which meets QuakeCoRE's travel policy.

Judgement

Scoring method

1. 'Error' was calculated for each of the 8 parameters (1a through 2b) for each of the 11 inputs.

$$Error = \left| \frac{R_{exp} - R_{predicted}}{R_{exp}} \right|$$

2. Each team obtained a score ($= 1 - \text{Error}$) for each parameter in each input.
No points were assigned when Error was larger than $\pm 50\%$ or an answer was not provided.
3. Teams with the top two highest scores were selected as winners.

Note: Each team was assigned a random 'team number' (from 1 to 14) to maintain anonymity during the scoring process. Teams 1 and 6 participated in Category-2 and the rest participated in Category-1. The assigned team numbers are also used in later sections of this document.

Deliverables

Table 1 Deliverables

S/N	Deliverable	Units	Score
0	Fundamental Period (before each input)	s	-
1a	Maximum displacement of Frame-1* (relative to the table) in X-direction at first storey	mm	1 – Error
1b	Diaphragm rotation at first storey corresponding to 1a	rad	1 - Error
1c	Maximum displacement (relative to the table) in Y-direction at first storey	mm	1 – Error
	Select if maximum displacement was in Frame A or B (Please type A or B)	-	-
1d	Maximum displacement (relative to the table) in X-direction at the roof	mm	1 – Error
1e	Diaphragm rotation at roof corresponding to 1d	rad	1 – Error
1f	Maximum displacement (relative to the table) in Y-direction at roof level	mm	1 – Error
2a	Maximum absolute acceleration in X-direction at geometric centre of first storey	g	1 – Error
2b	Maximum absolute acceleration in X-direction at geometric centre of roof	g	1 – Error
3a	Displacement history of Frame-1 (in X-direction) at first storey and roof**	mm vs. time (s)	
3b	Diaphragm rotation history (in X-Y plane) at first storey and roof**	rad. vs. time (s)	
3c	Acceleration history (in X-direction) at first storey and roof**	g. vs. time (s)	
4	Copy of analysis model to be submitted via email/ or drive link	-	

**Only required in Category-1 and to be used for detailed analyses of predictions.

Test results

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Summary of test results

Test results for parameters 1a) through 2b)

Table 2: Test results for 1a) to 2b)

S/N (Units)	Series-1A				Series-1B				Series-2		
	10%	20%	60%	60%-2	10%	20%	40%	60%	10%	20%	40%
1a (mm)	12.6	29.5	164.5	226.7	74.2	110.2	196.2	429.4	9.9	22.7	59.5
1b (rad)	0.0015	0.0037	0.0224	0.0309	0.0083	0.0121	0.0210	0.0424	0.0003	0.0003	0.0002
1c (mm)	3.6	8.6	42.1	62.9	18.1	24.8	40.2	90.6	1.5	1.3	17.0
	'B'	'B'	'B'	'B'	'A'	'A'	'A'	'B'	'B'	'B'	'B'
1d (mm)	19.0	41.6	184.7	251.3	83.4	124.7	215.8	456.9	15.8	34.9	83.5
1e (rad)	0.0017	0.0041	0.0234	0.0317	0.0086	0.0127	0.0220	0.0434	0.0003	0.0005	0.0001
1f (mm)	4.8	9.8	45.6	72.3	20.0	31.6	46.7	107.3	3.4	2.2	16.2
2a (g)	0.07	0.14	0.29	0.32	0.10	0.16	0.25	0.31	0.10	0.20	0.37
2b (g)	0.09	0.20	0.42	0.45	0.12	0.18	0.28	0.36	0.13	0.25	0.48



a) Series-1A



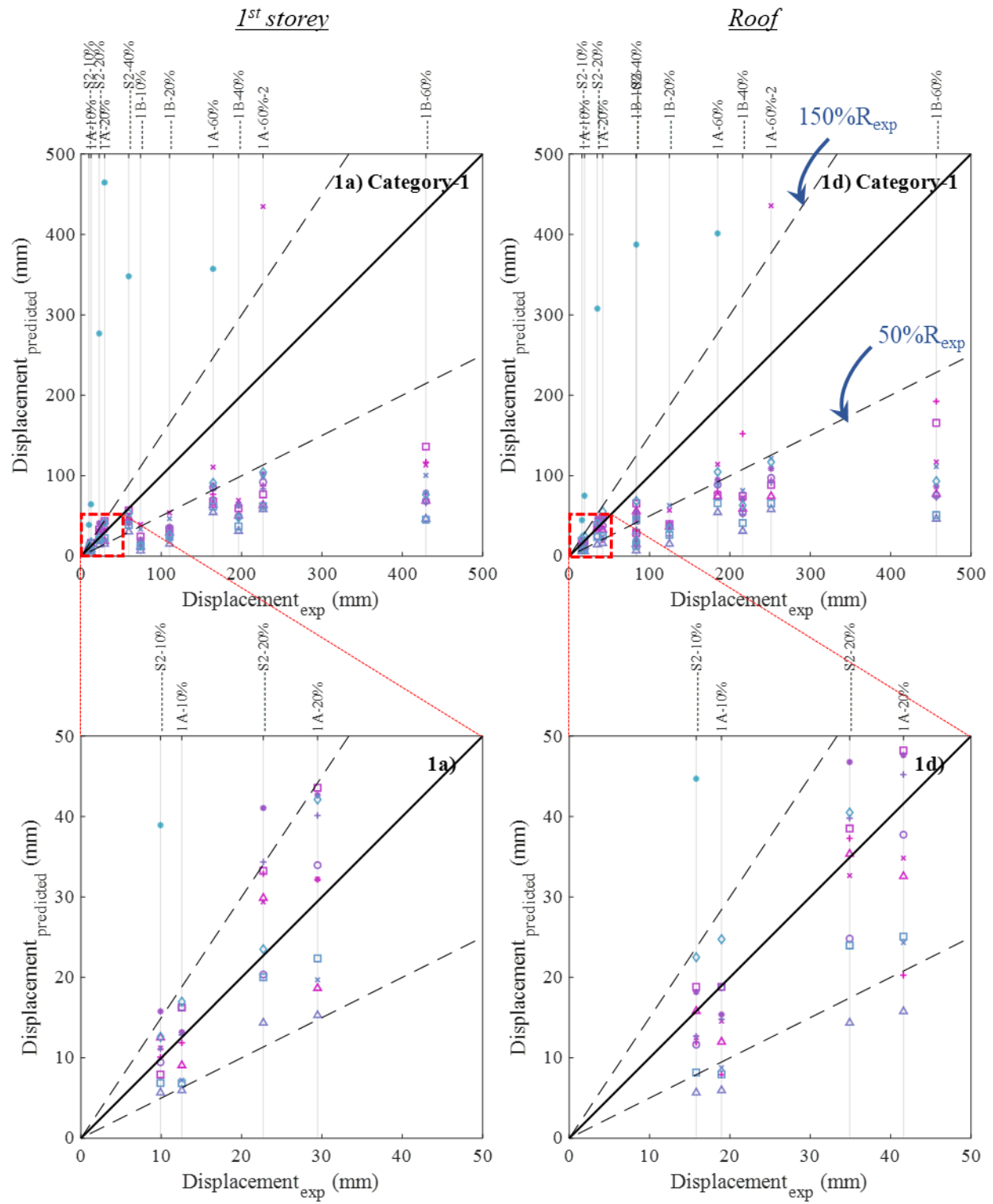
b) Series-1B



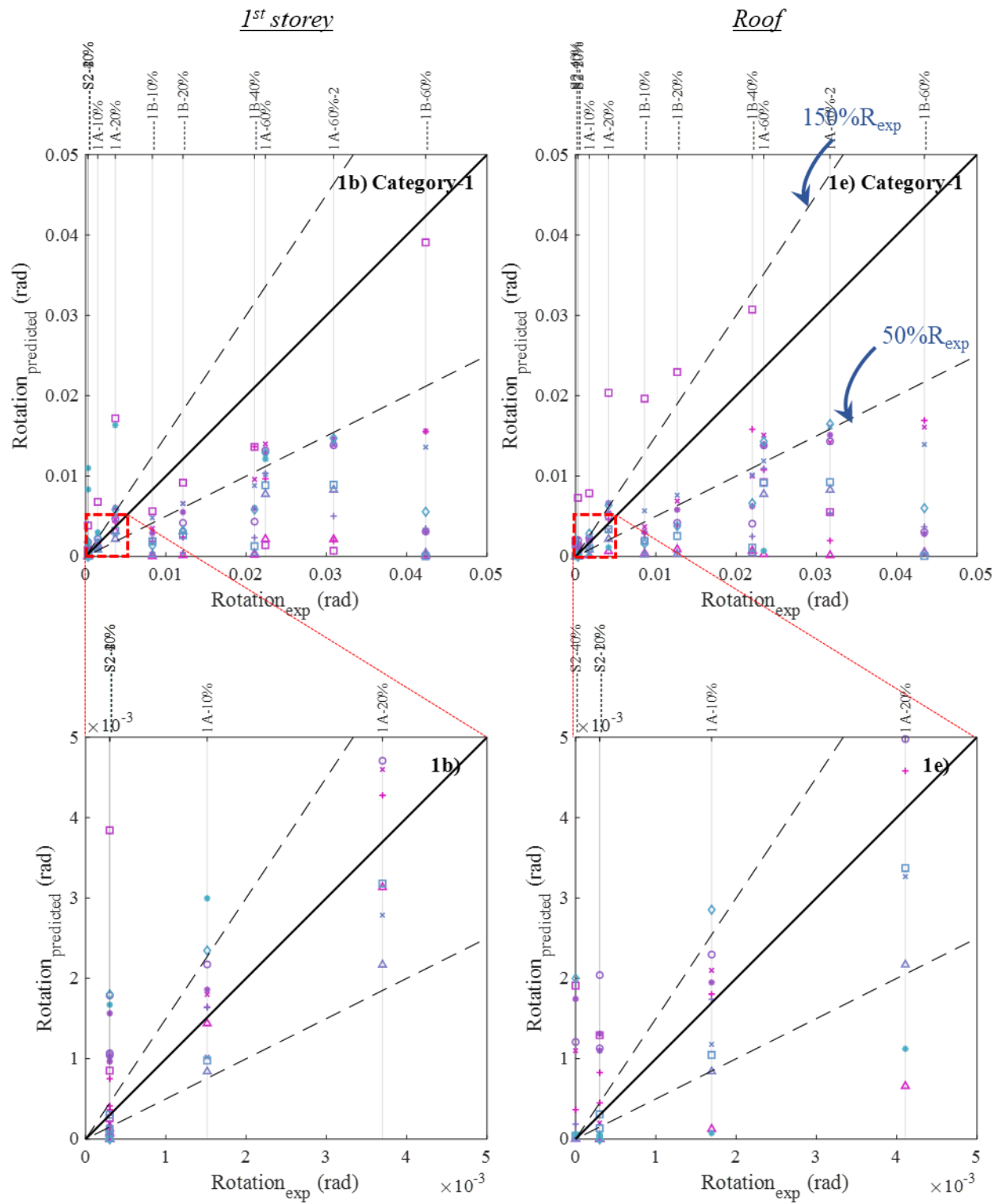
c) Series-2 (after S2-60%)

Figure 1 Photos of the specimens after each test series, (a) Series-1A, (b) Series-1B, and (c) Series-2

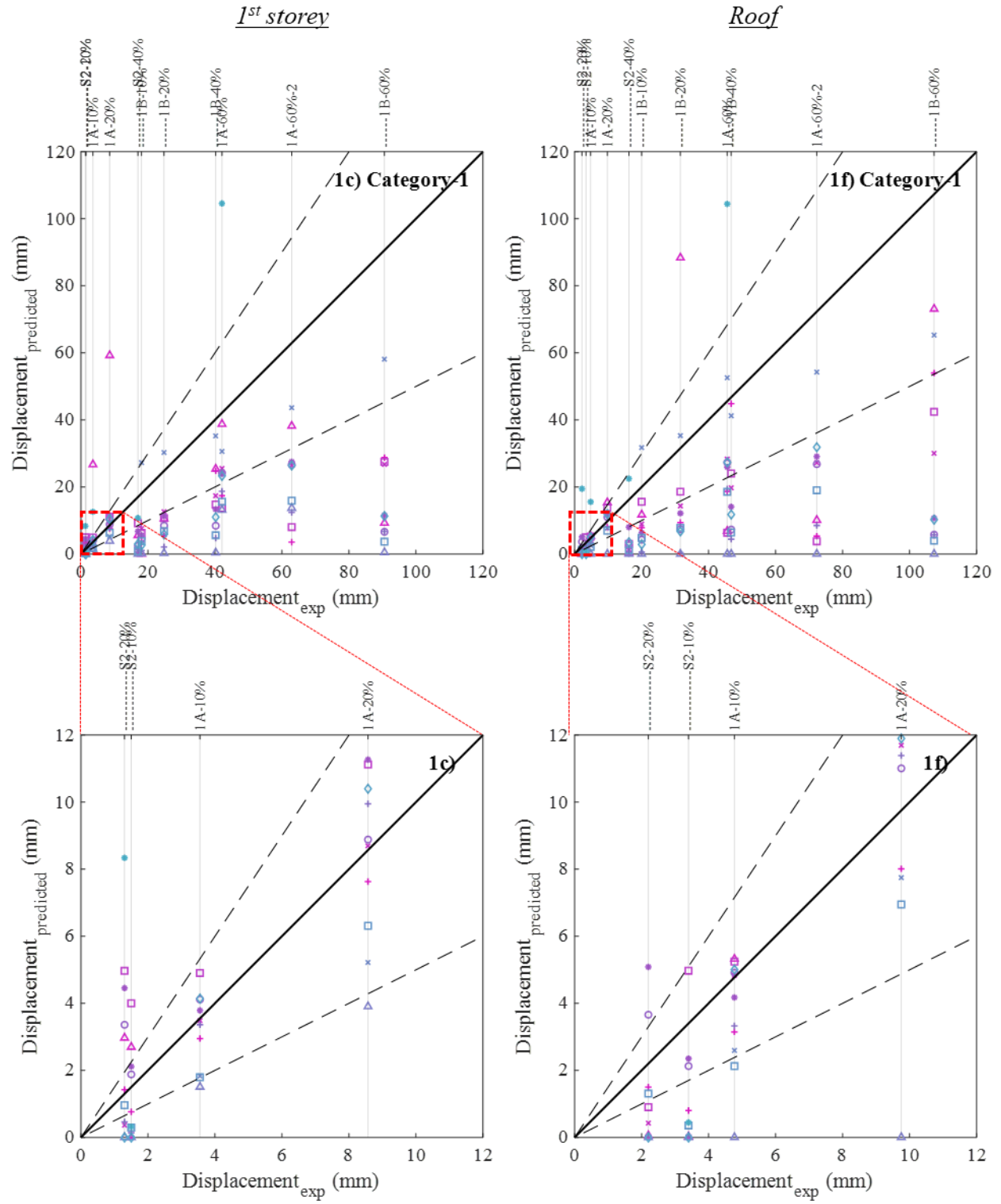
Displacement in X-Direction



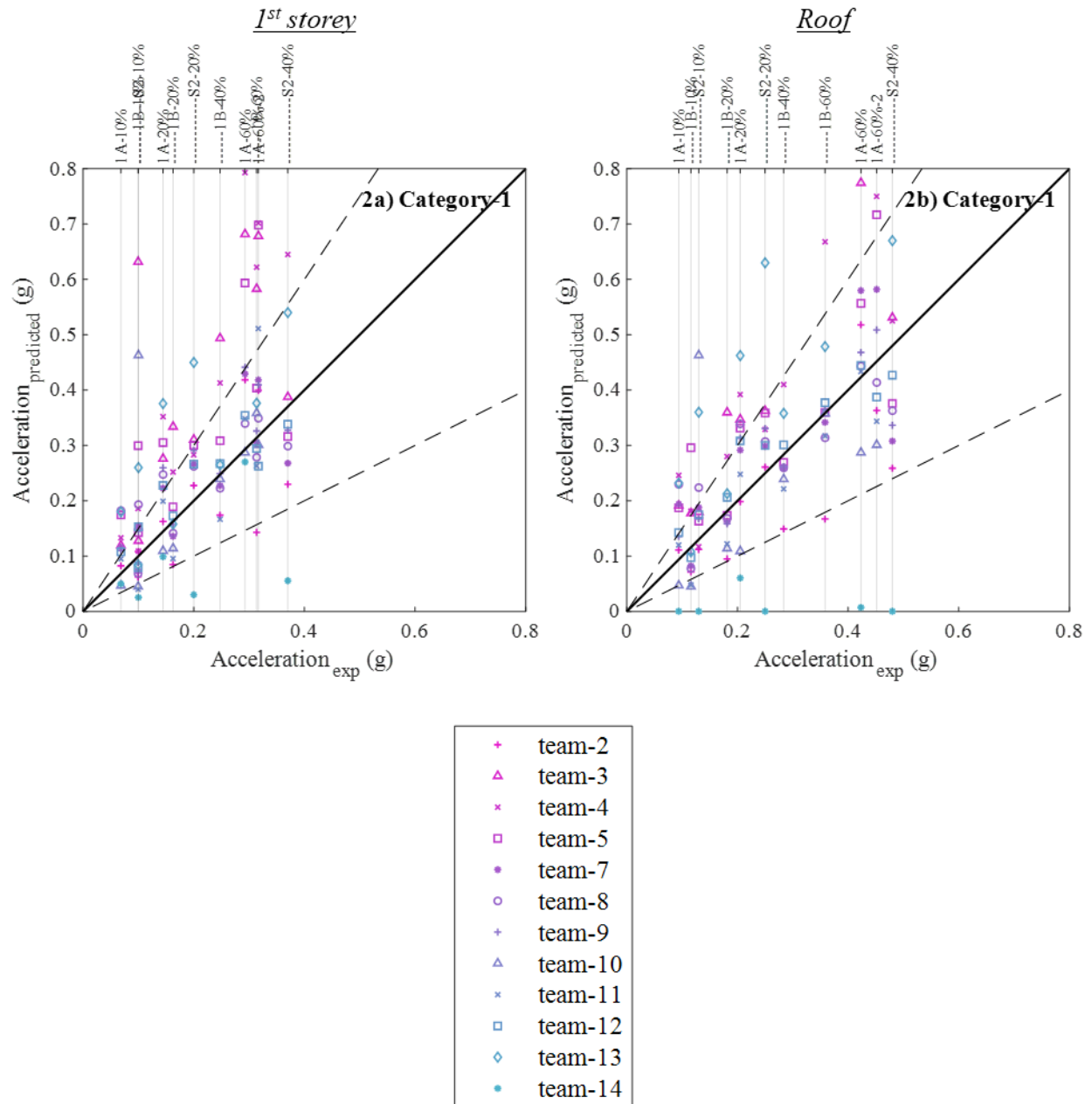
Diaphragm Rotation

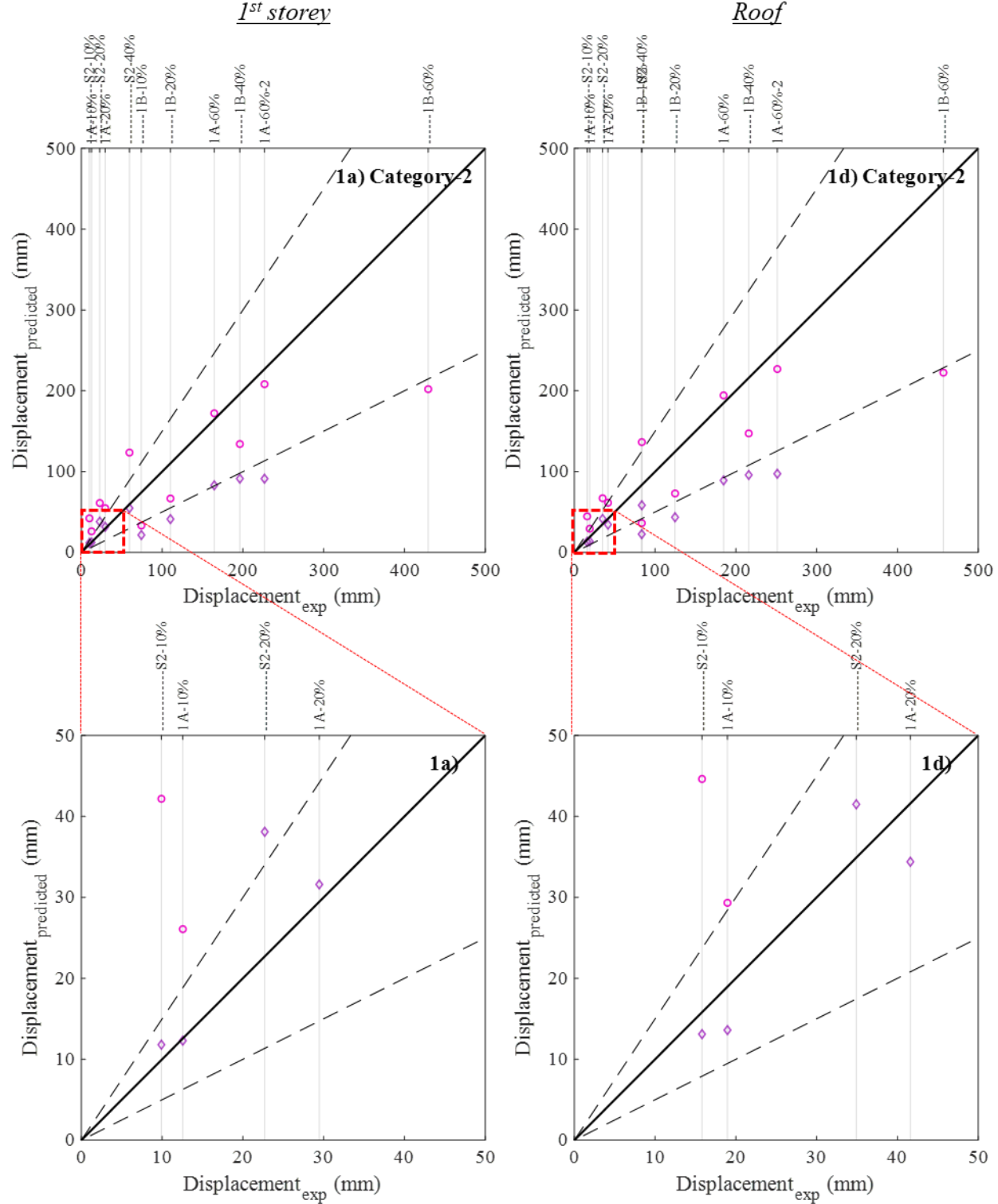


Displacement in Y-Direction

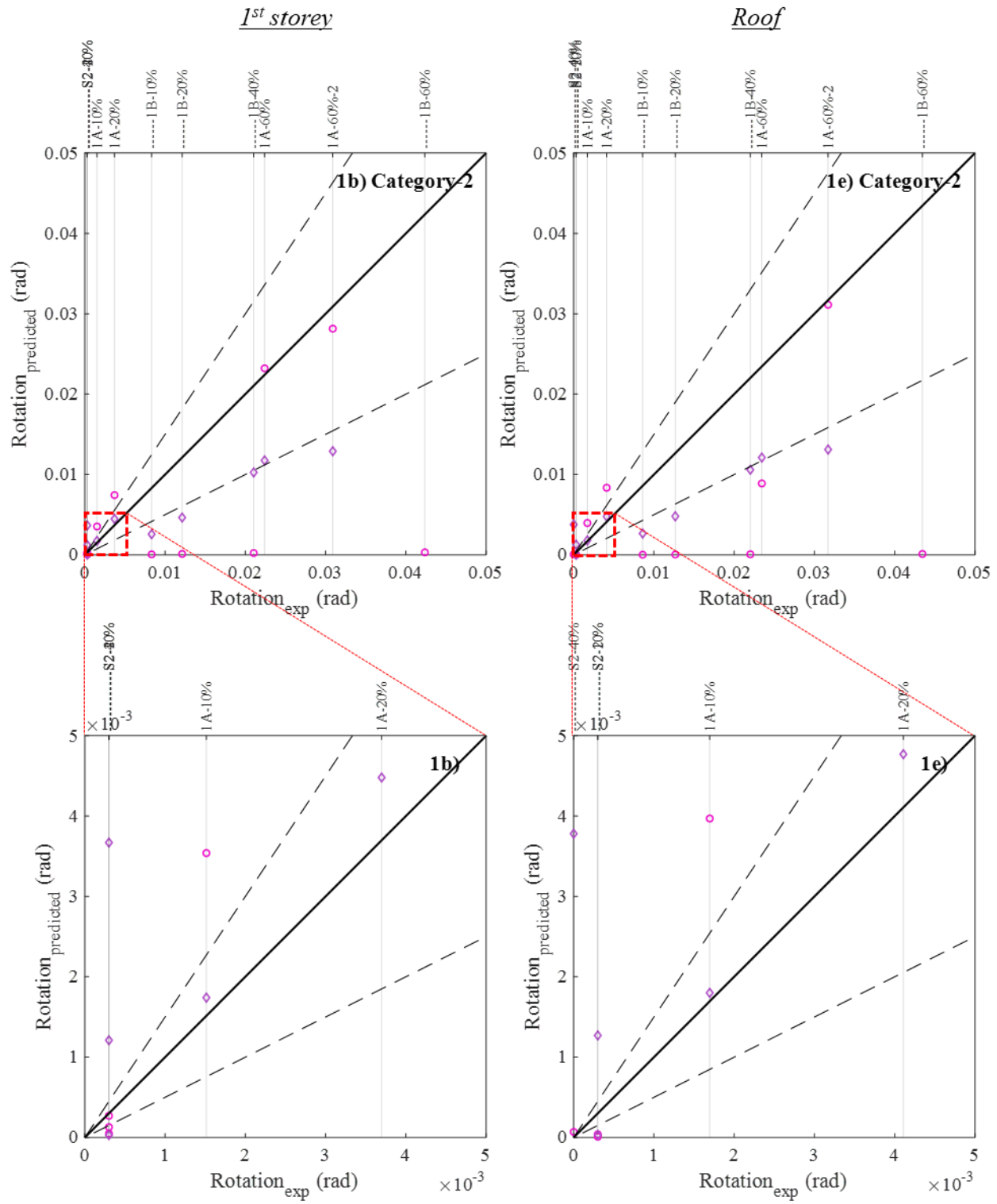


Acceleration in X-direction at geometric centre

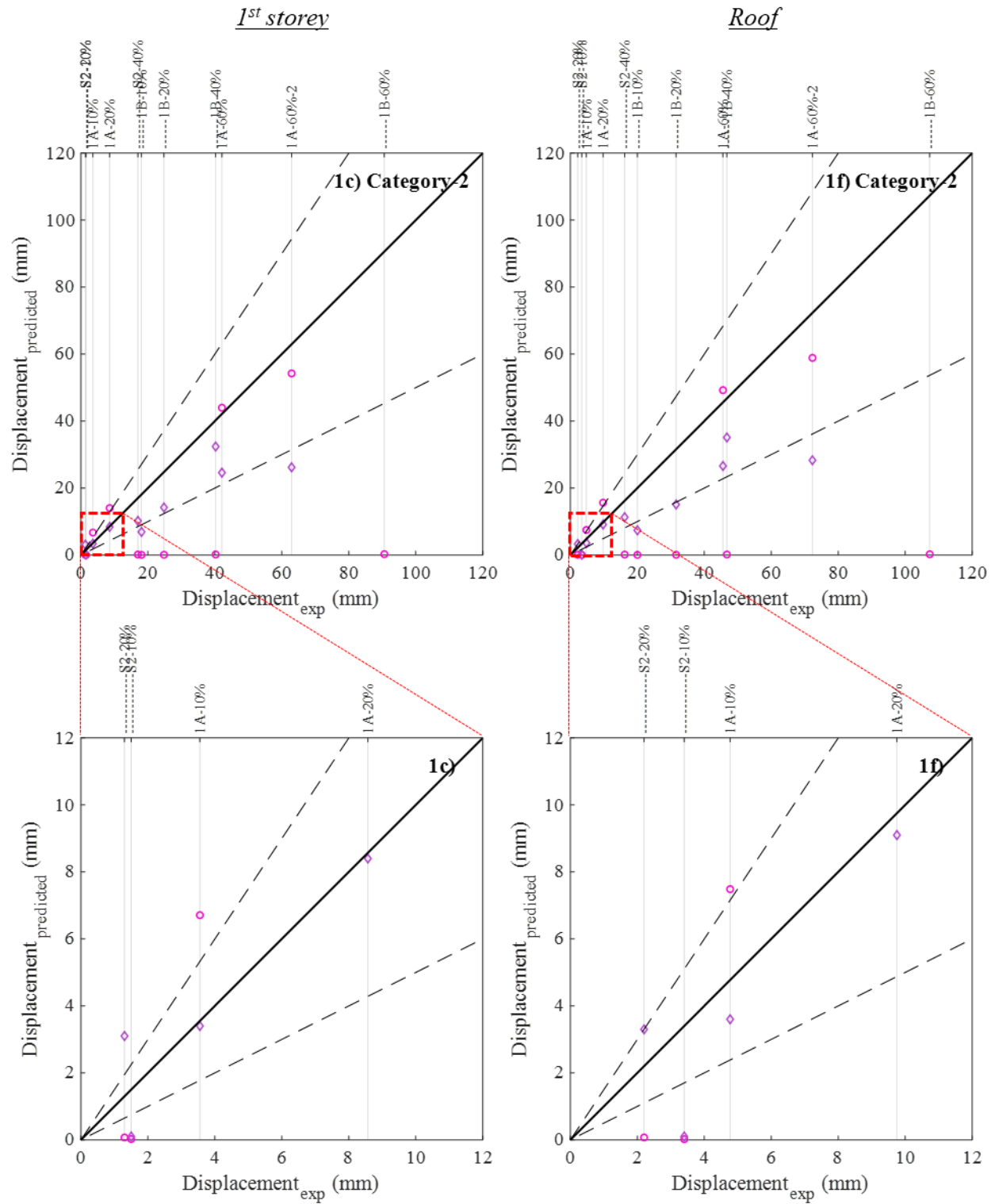




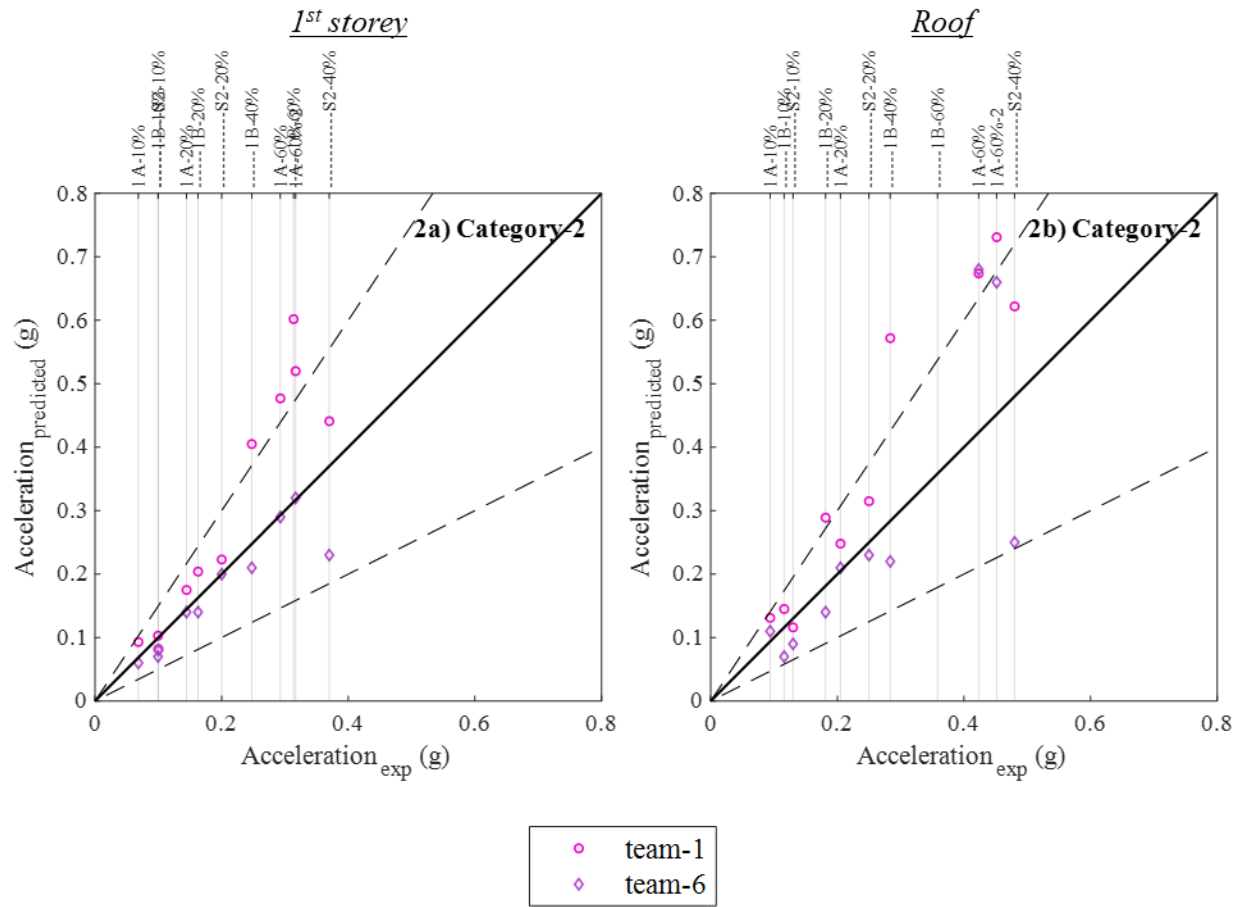
Diaphragm Rotation



Displacement in Y-Direction



Acceleration in X-direction at geometric centre



Measurement method

0) Period of the structure (before each input)

Predominant period of tested structures was identified using the ‘Frequency Domain Decomposition’ method. White noise tests were conducted before each earthquake input and the recorded acceleration data (for all stories) from the white noise tests were filtered and used to determine period. The location of the 3D accelerometers is shown in **Figure 3**

Table 3 Table Period of the structure (FDD) before each input ground motion

Series-1A				Series-1B				Series-S2			
10%	20%	60%	60%-2	10%	20%	40%	60%	10%	20%	40%	60%
0.89	0.90	0.93	1.28	1.36	1.33	1.39	1.36	0.93	0.90	1.00	1.12

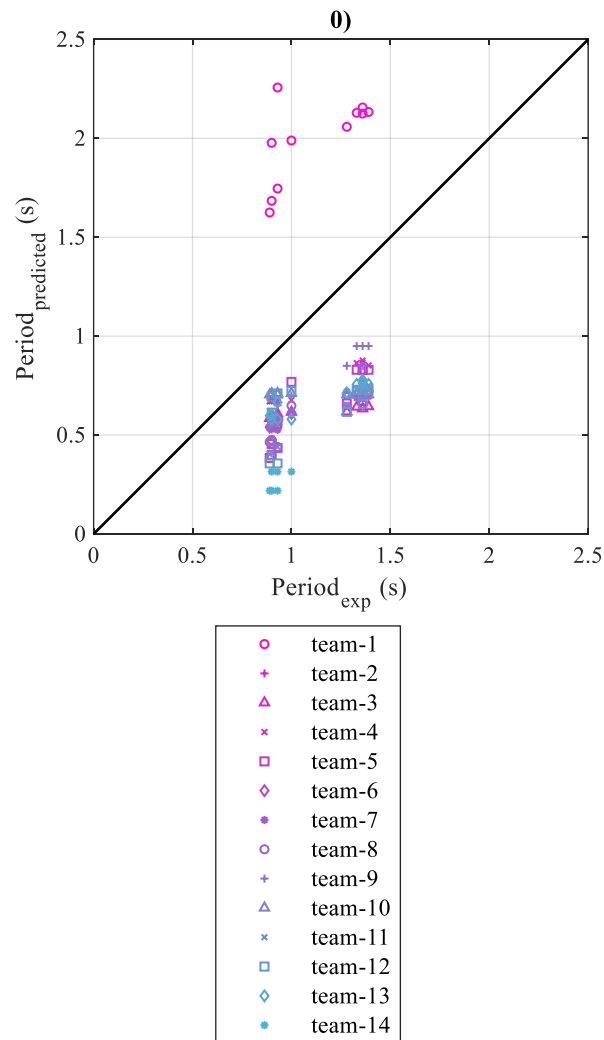


Figure 2 Predicted period vs. period obtained from white noise tests

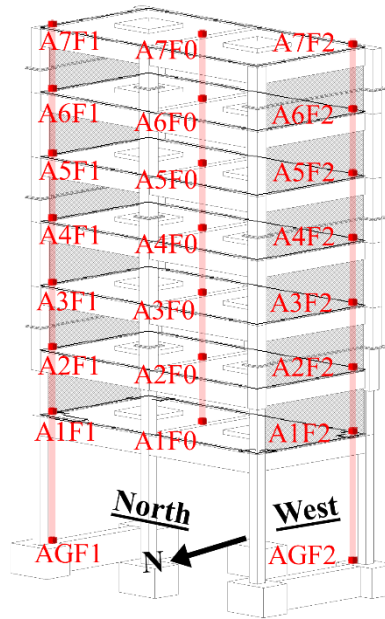


Figure 3 Location of accelerometers

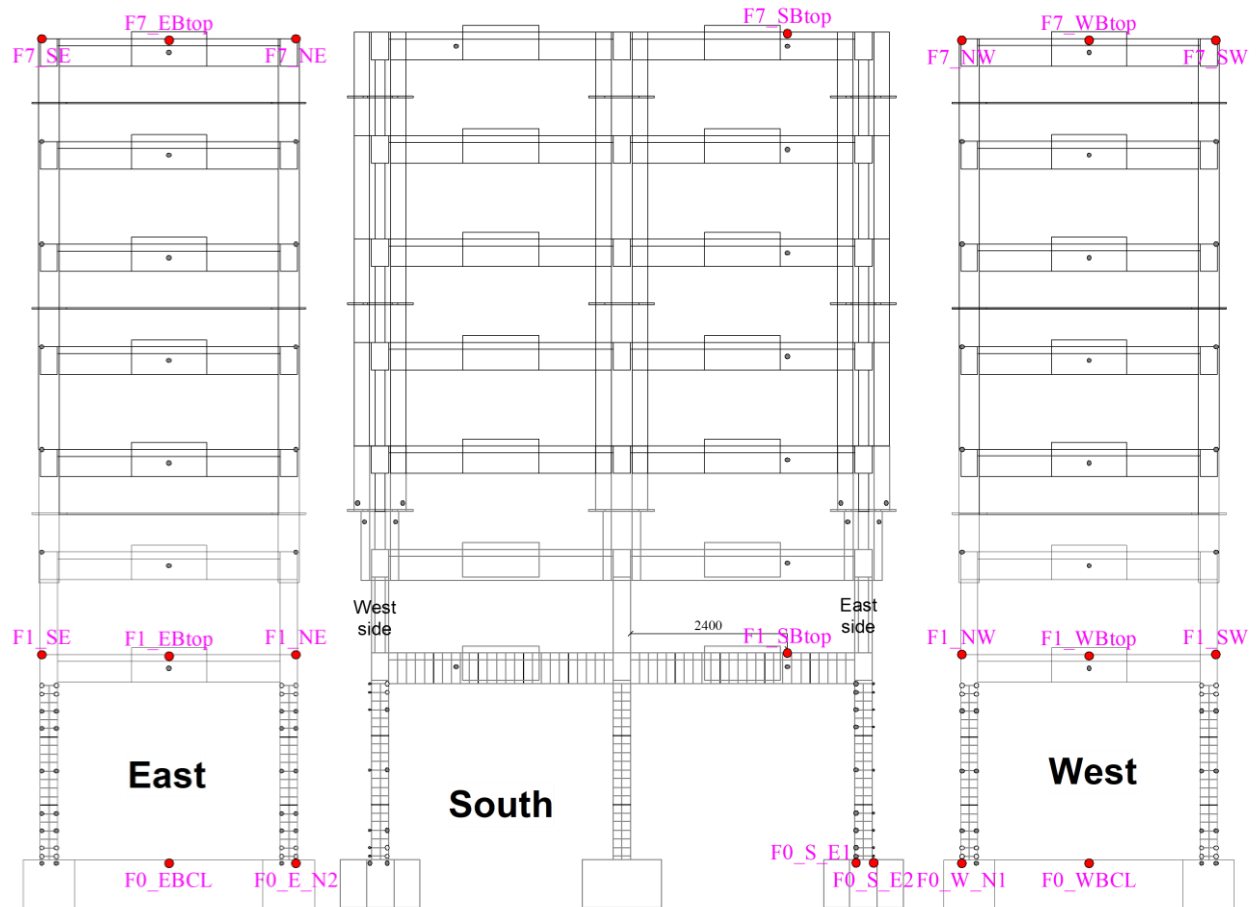


Figure 4 Location of MOCAP markers

1a) Maximum displacement of Frame-1* (relative to the table) in X-direction at first storey

Absolute maximum of displacement of “F1_EBtop” relative to “F0_EBCL” in X-direction

1b) Diaphragm rotation at first storey corresponding to 1a

Diaphragm rotation of the first storey corresponding time step to 1a). The Diaphragm rotation of the first floor at $t = t$ was defined by the equation below:

$$\frac{X.F1_EBtop(t) - X.F1_WBtop(t)}{|Y0.F1_EBtop - Y0.F1_WBtop|}$$

X. ... (t): displacement in X-direction at time = t

Y0.: Coordinate Y of the marker at the beginning of the test

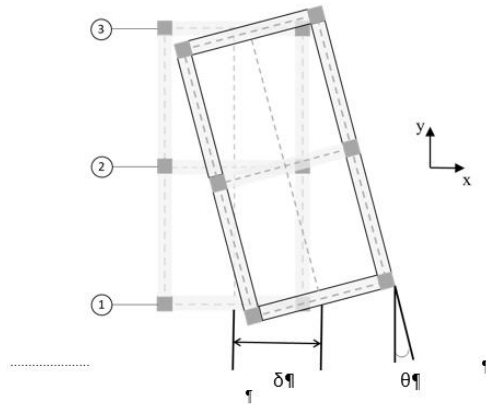


Figure-2: Displacement and Rotation

(From 5_Rules and Deliverables.docx)

1c) Maximum displacement (relative to the table) in Y-direction at first storey

Absolute maximum displacement in Y-direction defined as below:

South frame (Frame-A): $Y.F1_SBtop - ave(Y.F0_S_E1, Y.F0_S_E2)$

North frame (Frame-B): average of $Y.F1_NW - Y.F0_W_N1$ and $Y.F1_NE - Y.F0_E_N2$

1d) Maximum displacement (relative to the table) in X-direction at the roof

Absolute maximum displacement of “F7_EBtop” relative to “F0_EBCL” in X-direction.

1e) Diaphragm rotation at roof corresponding to 1d

Diaphragm rotation of the roof corresponding time step to 1a). The Diaphragm rotation of the first floor at $t = t$ was defined by the equation below:

$$\frac{X.F7_EBtop(t) - X.F7_WBtop(t)}{|Y0.F7_EBtop - Y0.F7_WBtop|}$$

1f) Maximum displacement (relative to the table) in Y-direction at roof level

Absolute maximum displacement in Y-direction defined as below:

South frame (Frame-A): $Y.F7_SBtop - ave(Y.F0_S_E1, Y.F0S_E2)$

North frame (Frame-B): average of $Y.F7_NW - Y.F0_W_N1$ and $Y.F7_NE - Y.F0_E_N2$

2a) Maximum absolute acceleration in X-direction at geometric centre of first storey

Absolute maximum of filtered acceleration history in X-direction; recorded by the accelerometer “A1F0”.

2b) Maximum absolute acceleration in X-direction at geometric centre of roof

Absolute maximum of filtered acceleration history in X-direction; recorded by the accelerometer “A7F0”

3a) Displacement history of Frame-1 (in X-direction) at first storey and roof

Same as 1a) and 1d) for the first storey and roof, respectively.

3b) Diaphragm rotation history (in X-Y plane) at first storey and roof

Same as 1b) and 1e) for the first storey and roof, respectively.

3c) Acceleration history (in X-direction) at first storey and roof

Same as 2a) and 2b) for the first storey and roof, respectively.