

# Seismic design and pseudo-dynamic tests of blind-bolted CFT frames with buckling-restrained braces

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## **Captions for Figures**

Fig. 1 Plan view of prototype building and scale model specimen (unit: mm)

Fig. 2 Dimension of specimens (unit: mm).

Fig. 3 Details of concrete slab (unit: mm)

Fig. 4 Details of composite joints (unit: mm)

Fig. 5 Blind bolts with extension (unit: mm)

Fig. 6 Details of BRBs and gusset plates (unit: mm)

Fig. 7 Design stages of direct displacement-based design method (DDBD)

Fig. 8 Design acceleration spectrum

Fig. 9 Design displacement spectrum

Fig. 10 Gusset plate in tension

Fig. 11 Gusset plate in compression

Fig. 12 Experimental diagram

Fig. 13 Experimental setup photograph

Fig. 14 Scaled ground acceleration time history record in PDTs

Fig. 15 Story displacement response of specimen BBFD1

Fig. 16 Story displacement response of specimen BBCF2

Fig. 17 Failure modes of specimen BBFD1

Fig. 18 Failure modes of specimen BBCF2

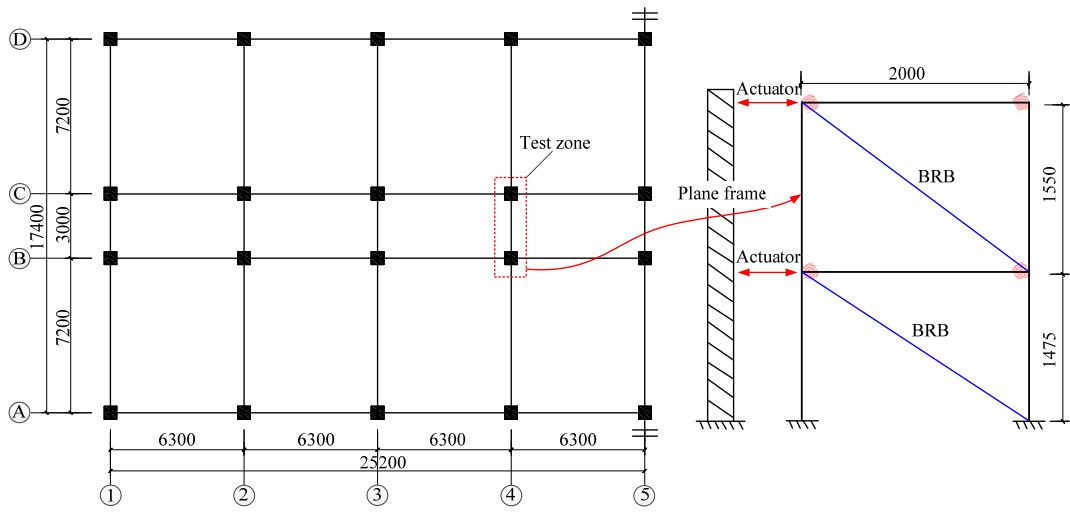
Fig. 19 Story shear versus story drift relationships of specimen BBFD1

Fig. 20 Story shear versus story drift relationships of specimen BBCF2

Fig. 21 Skeleton curves of inter-story shear versus drift

Fig. 22 Stiffness degradation

Fig. 23 Energy dissipation time history curves



(a) Prototype building

(b) Scale model

Fig. 1 Plan view of prototype building and scale model specimen (unit: mm)

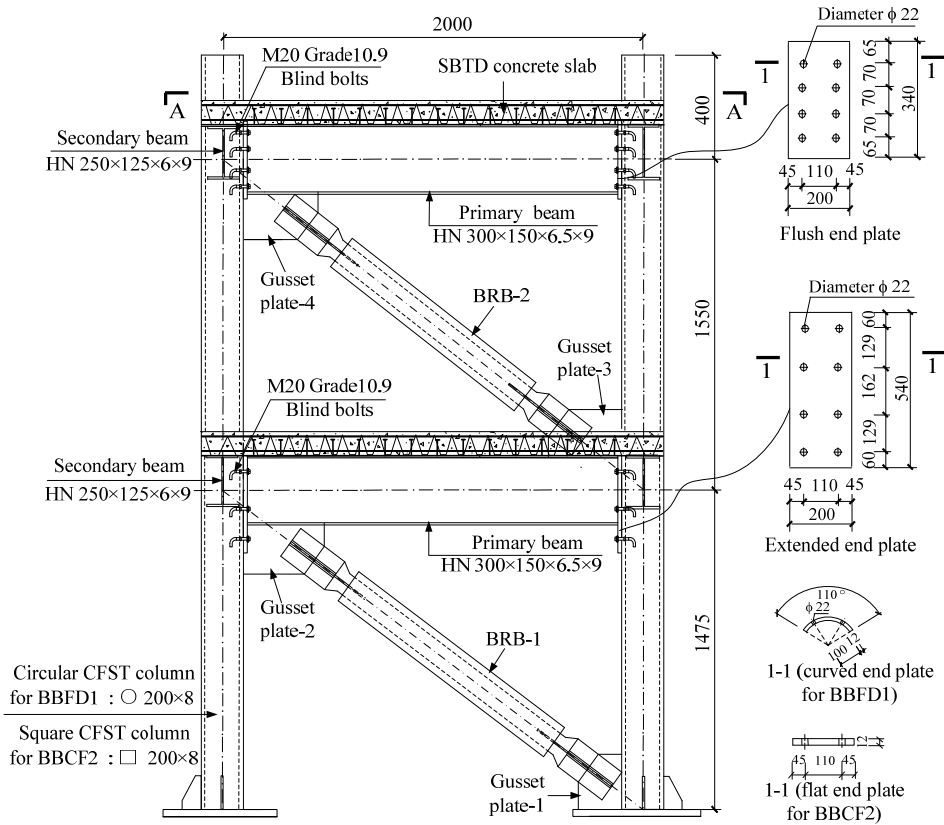


Fig. 2 Dimension of specimens (unit: mm)

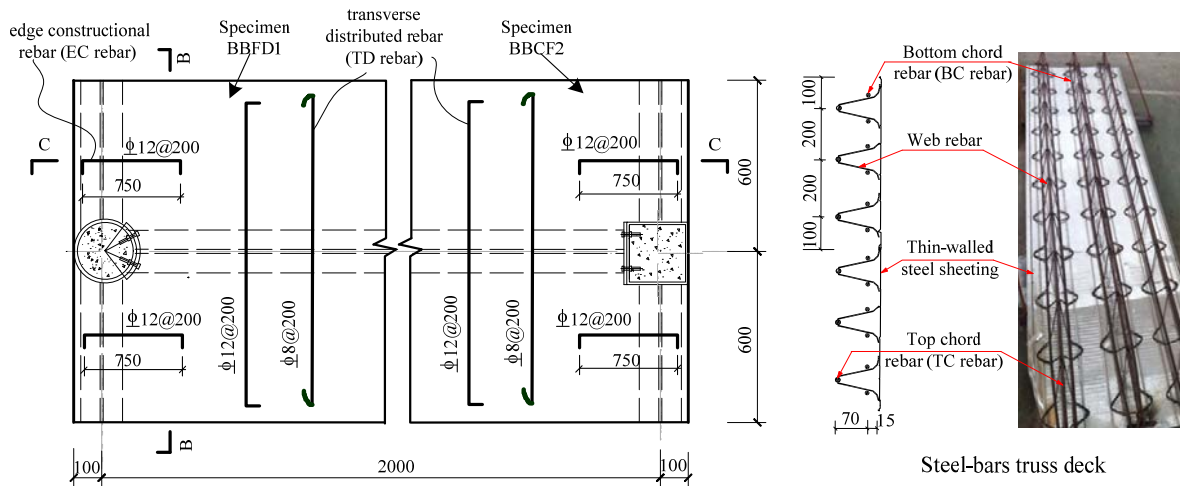


Fig. 3 Details of concrete slab (unit: mm)

Note: The symbol “ $\Phi$ ” represents the yield strength of the reinforcing bar is of grade 335 N/mm<sup>2</sup>.

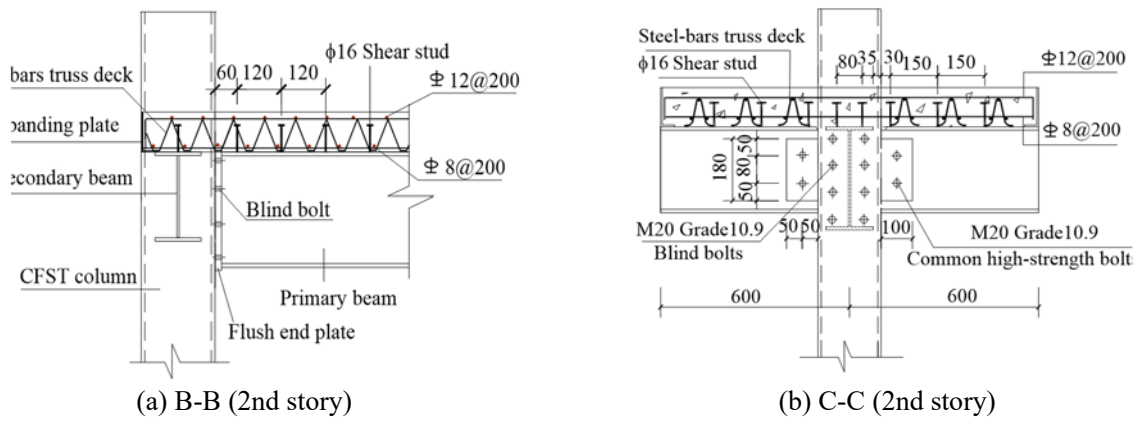


Fig. 4 Details of composite joints (unit: mm)

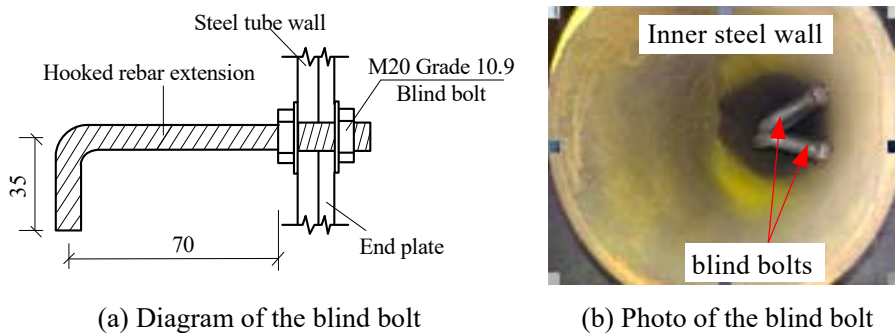
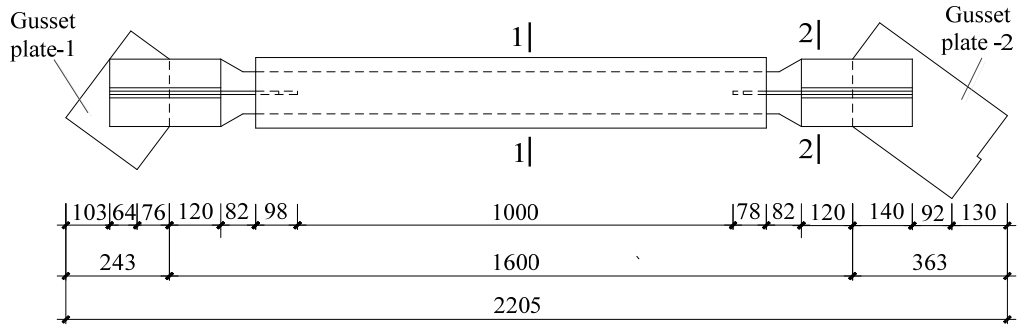
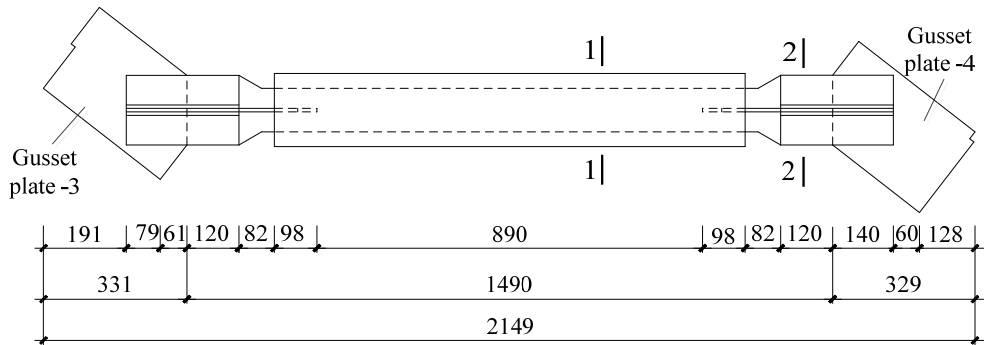


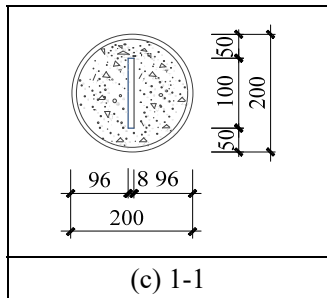
Fig. 5 Blind bolts with extension (unit: mm)



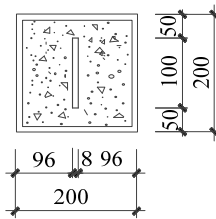
(a) BRB-1 with gusset plates



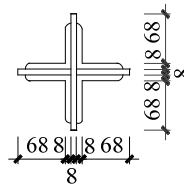
(b) BRB-2 with gusset plates



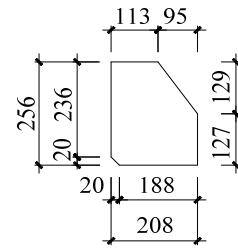
(c) 1-1



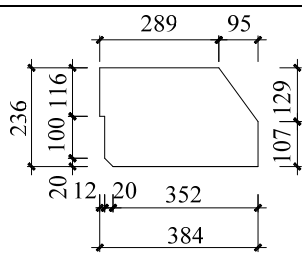
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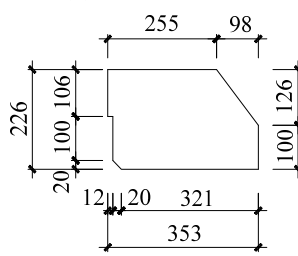
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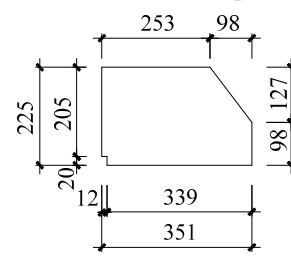
(f) Gusset plate-1



(g) Gusset plate-2

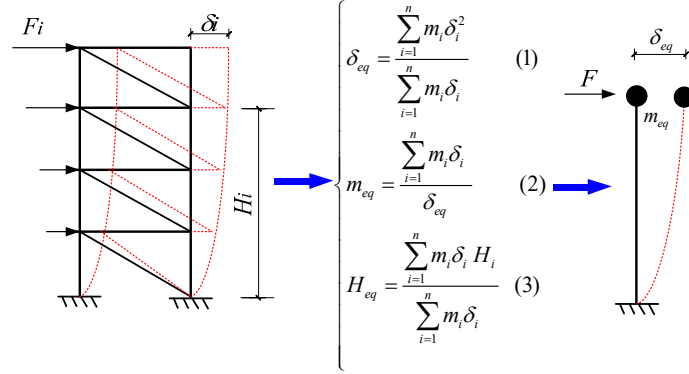


(h) Gusset plate-3

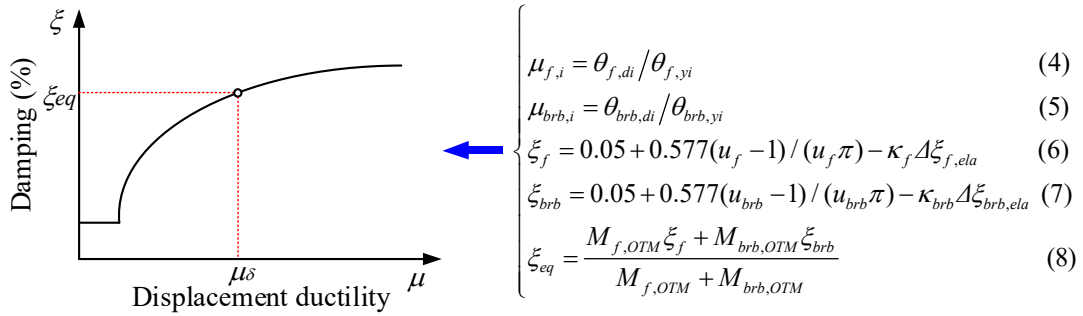


(i) Gusset plate-4

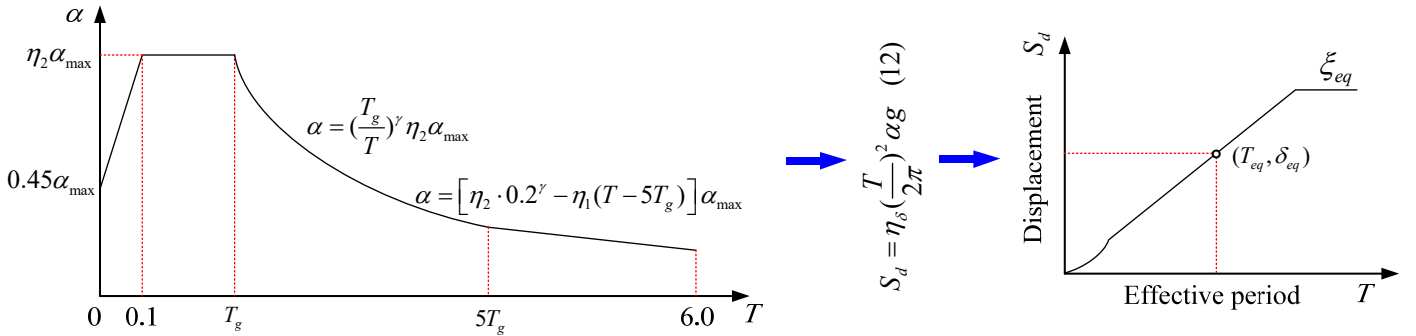
Fig. 6 Details of BRBs and gusset plates (unit: mm)



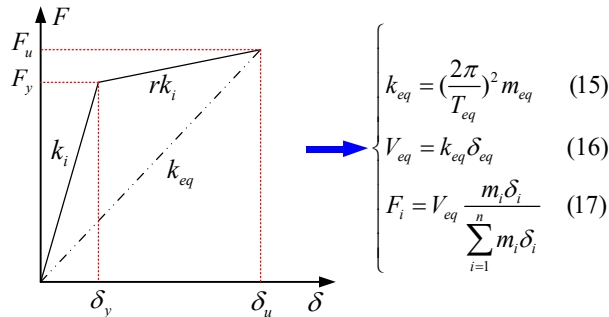
(a) Equivalent SDOF system



(b) Equivalent viscous damping versus ductility



(c) Effective period from reduced displacement spectrum



(d) Effective stiffness and base shear

Fig. 7 Design stages of direct displacement-based design method (DDBD)

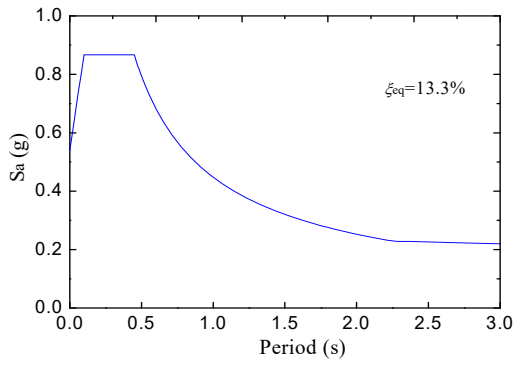


Fig. 8 Design acceleration spectrum

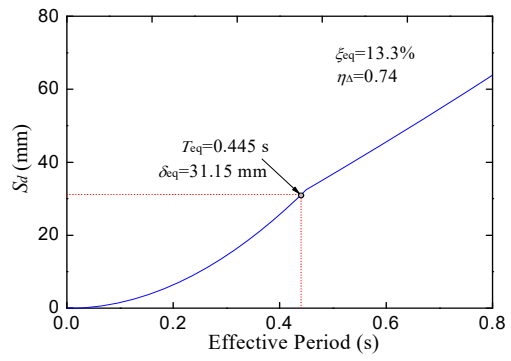


Fig. 9 Design displacement spectrum

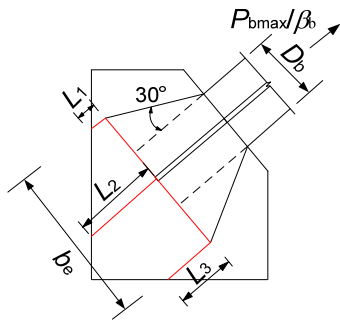


Fig.10 Gusset plate in tension

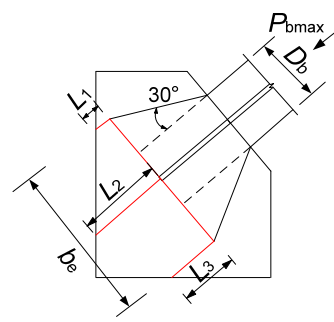


Fig. 11 Gusset plate in compression

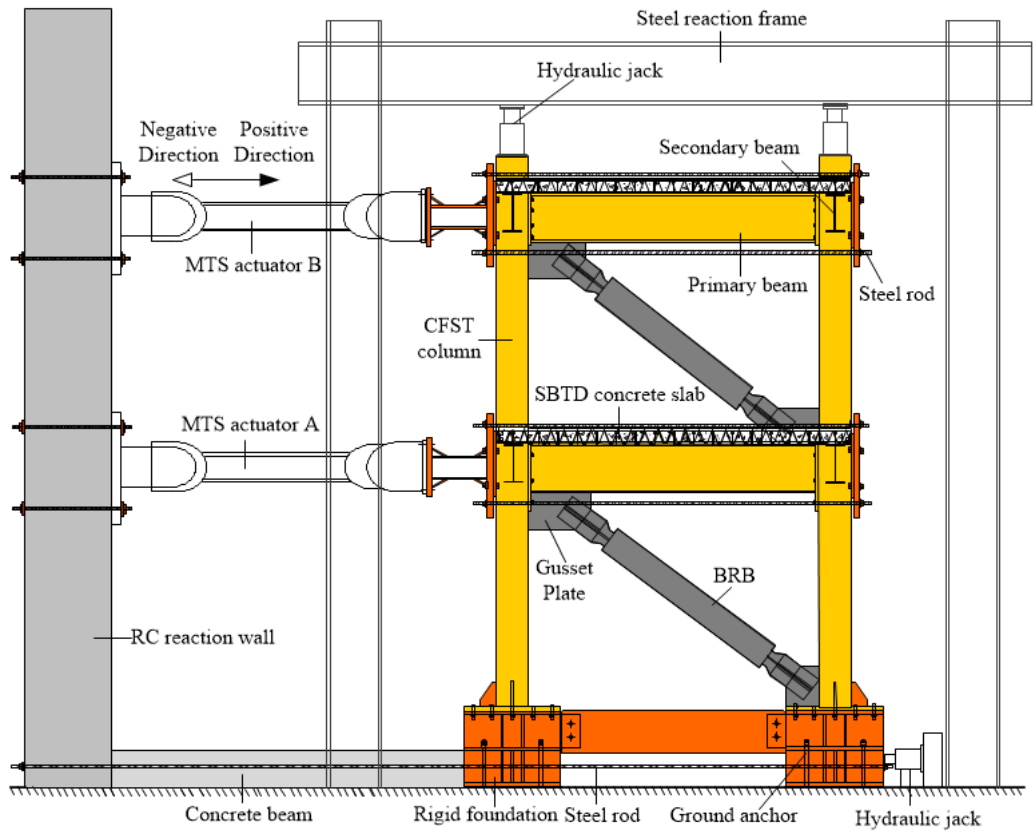


Fig. 12 Experimental diagram



Fig. 13 Experimental setup photograph

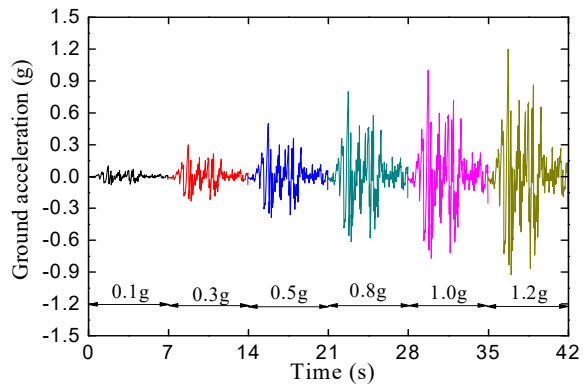
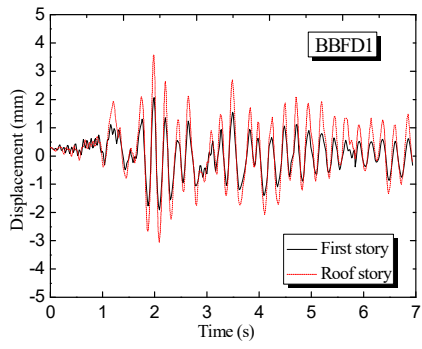
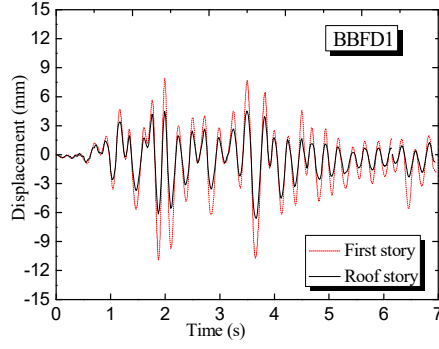


Fig. 14 Scaled ground acceleration time history record in PDTs

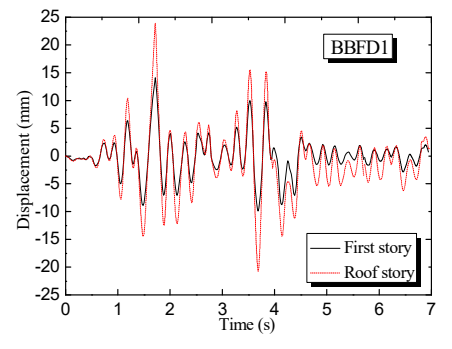




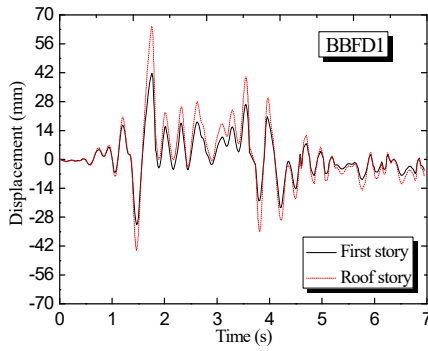
(a) Test No.1



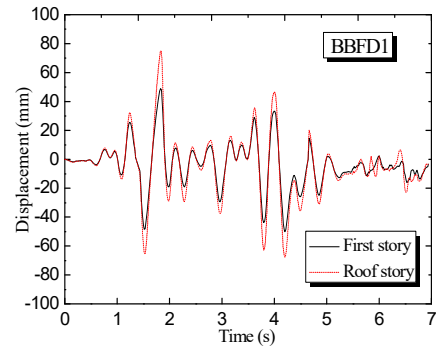
(b) Test No.2



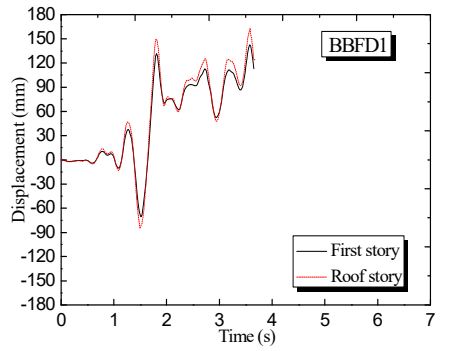
(c) Test No.3



(d) Test No.4

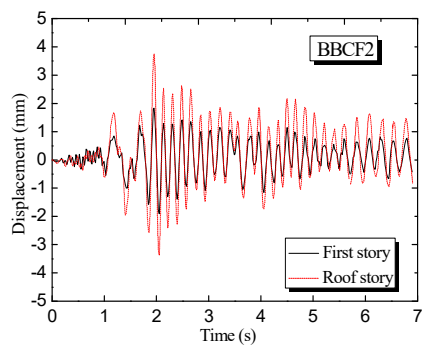


(e) Test No.5

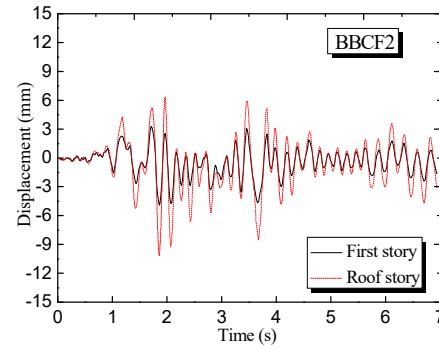


(f) Test No.6

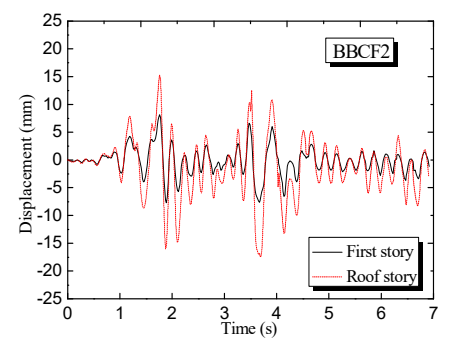
Fig. 15 Story displacement response of specimen BBFD1



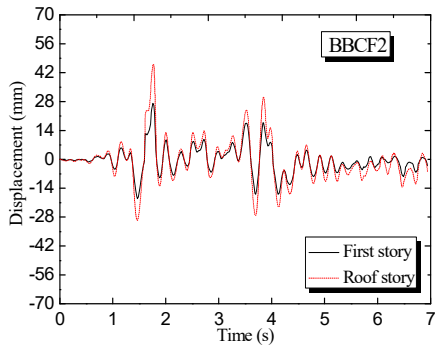
(a) Test No.1



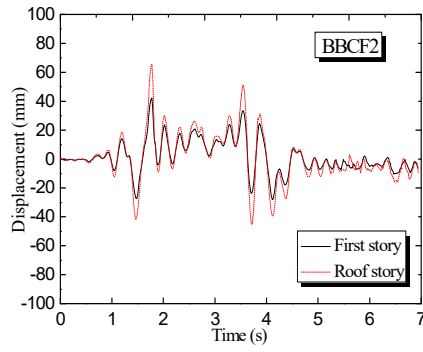
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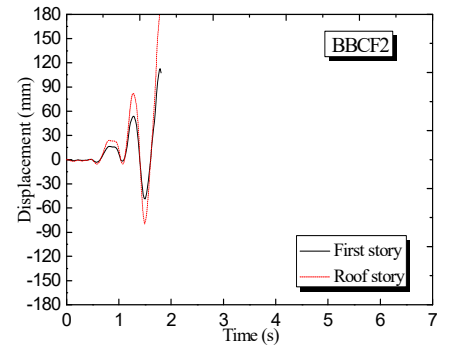
(c) Test No.3



(d) Test No.4



(e) Test No.5



(f) Test No.6

Fig. 16 Story displacement response of specimen BBCF2



(a) Out-of-plane deformation of BRB in the 1st story



(b) Slab cracks near right column in the 1st story



(c) Bending of extended end plate



(d) Fracture near the top of stiffeners

Fig. 17 Failure modes of specimen BBFD1



(a) Out-of-plane deformation of BRB in the 2nd story



(b) Slab cracks near right column in the 1st story



(c) Slab cracks near right column in the 2nd story



(d) Bending of extended end plate



(e) Buckled beam bottom flange and gusset plate in the 1st story



(f) Fracture near the top of gusset plate

Fig. 18 Failure modes of specimen BBCF2

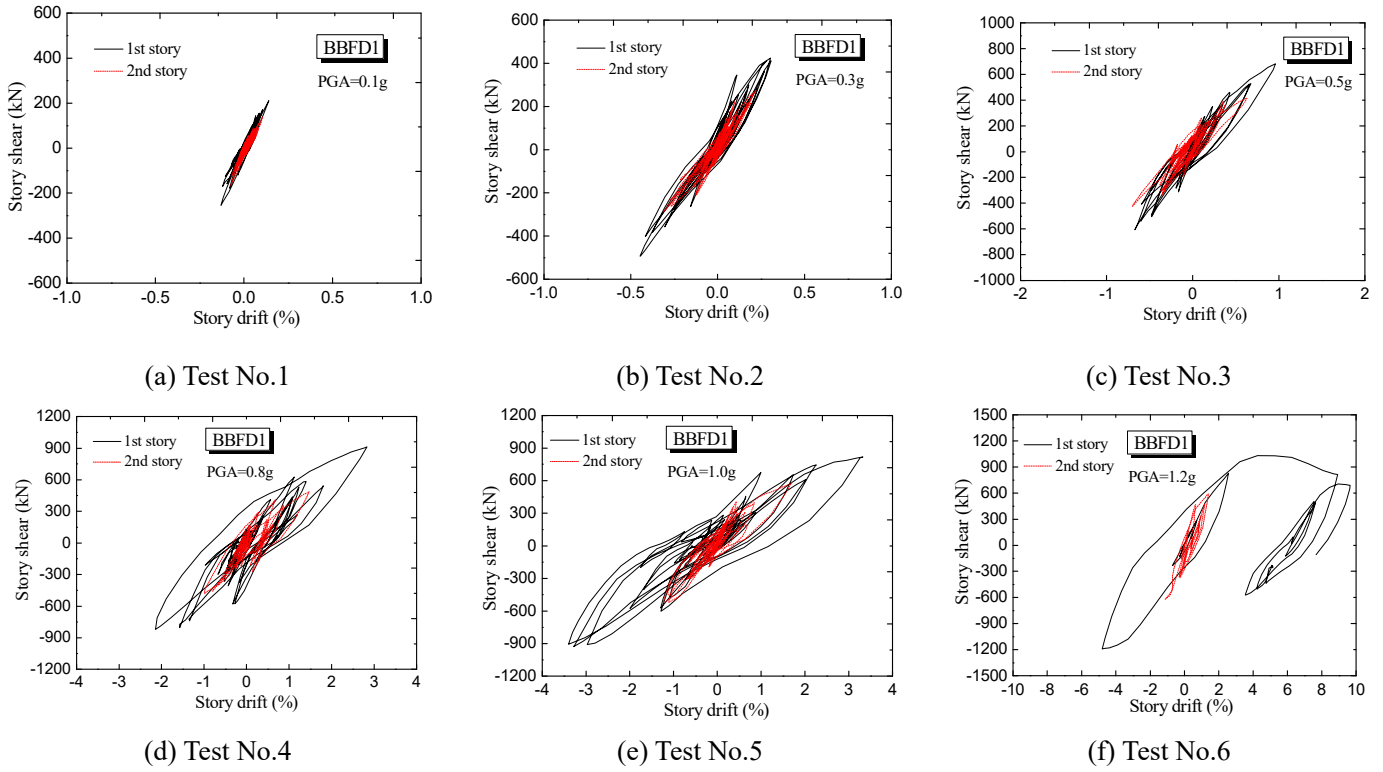


Fig. 19 Story shear versus story drift relationships of specimen BBFD1

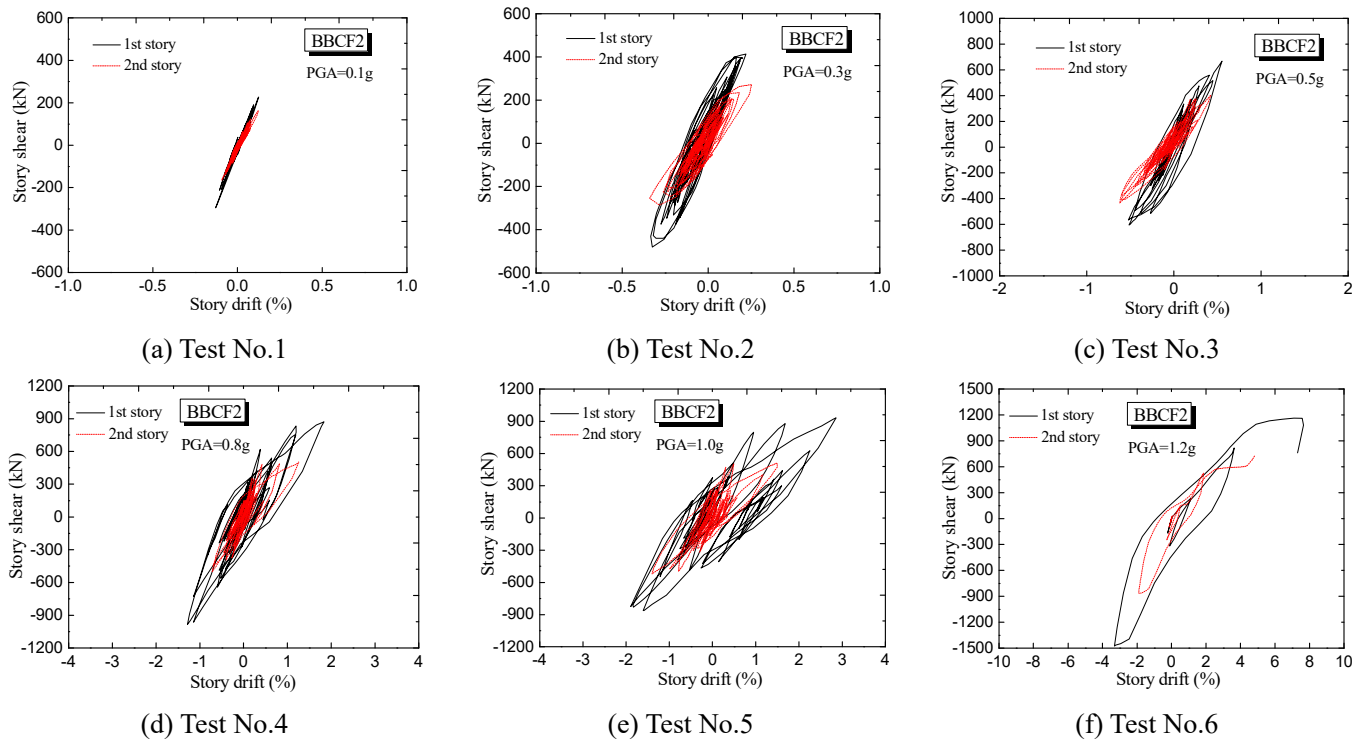
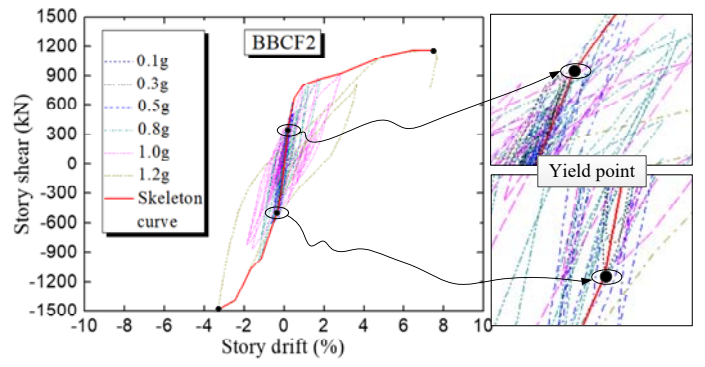
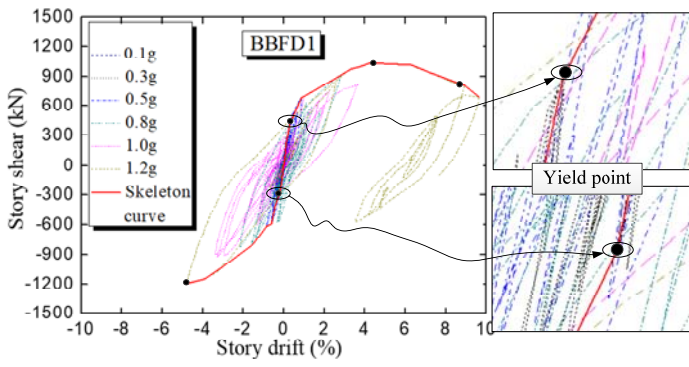
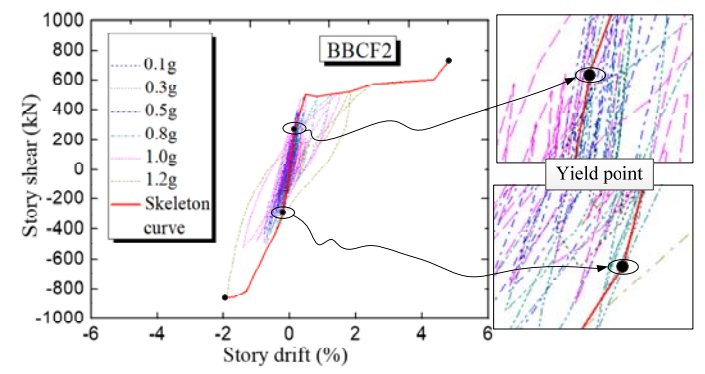
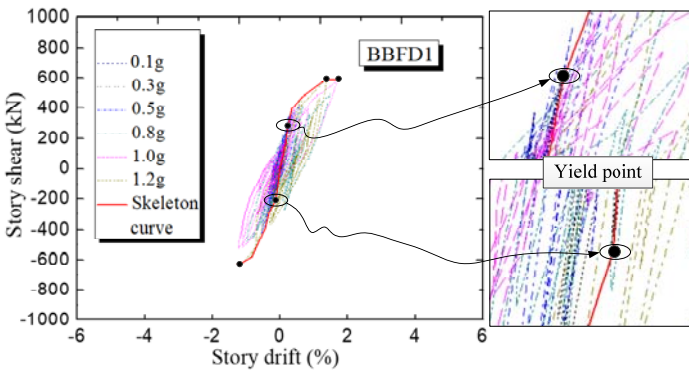


Fig. 20 Story shear versus story drift relationships of specimen BBCF2

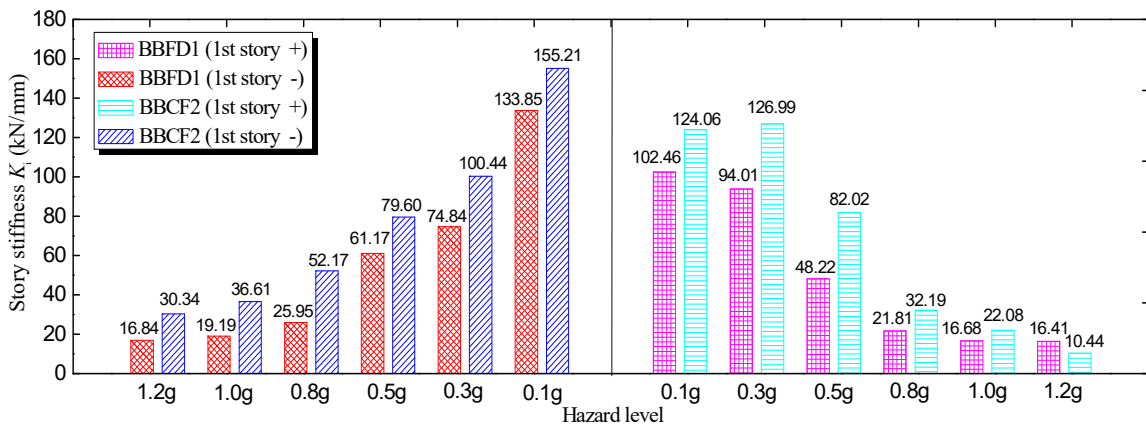


(a) Skeleton curves of 1st story

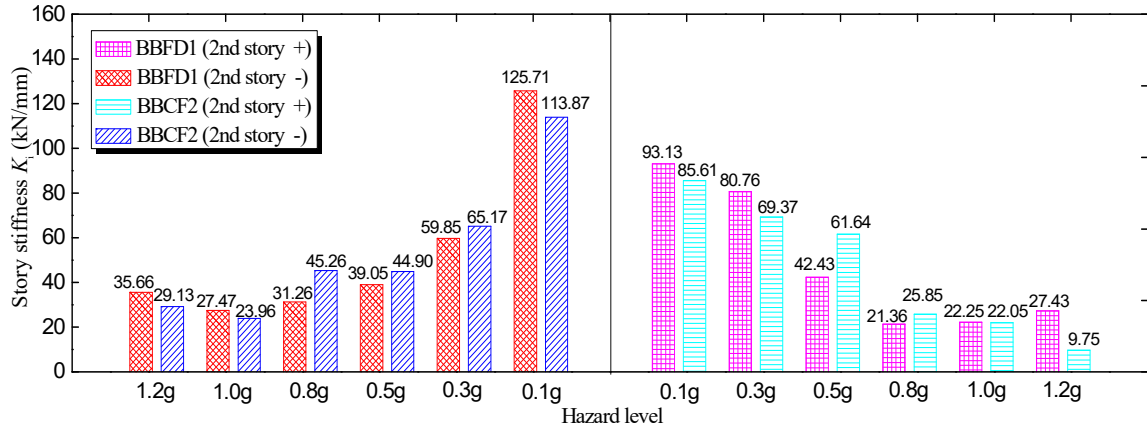


(b) Skeleton curves of 2nd story

Fig. 21 Skeleton curves of inter-story shear force versus drift

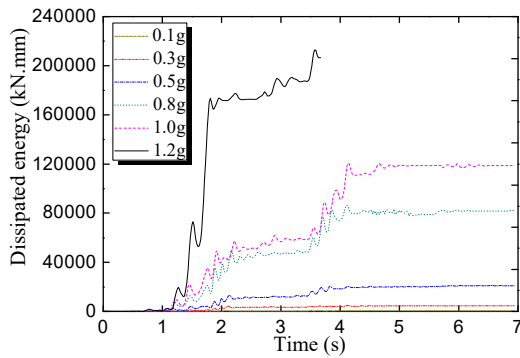


(a) Stiffness degradation of 1st story

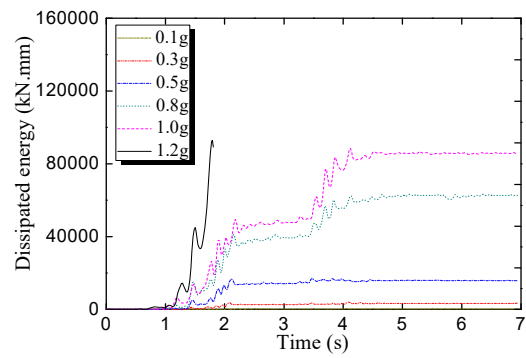


(a) Stiffness degradation of 2nd story

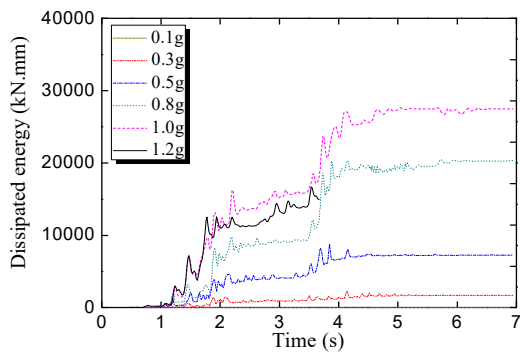
Fig. 22 Stiffness degradation



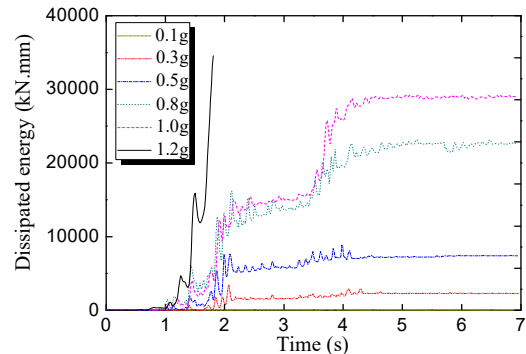
(a) 1st story for specimen BBFD1



(b) 1st story for specimen BBCF2



(a) 2nd story for specimen BBFD1



(b) 2nd story for specimen BBCF2

Fig. 23 Energy dissipation time history curves