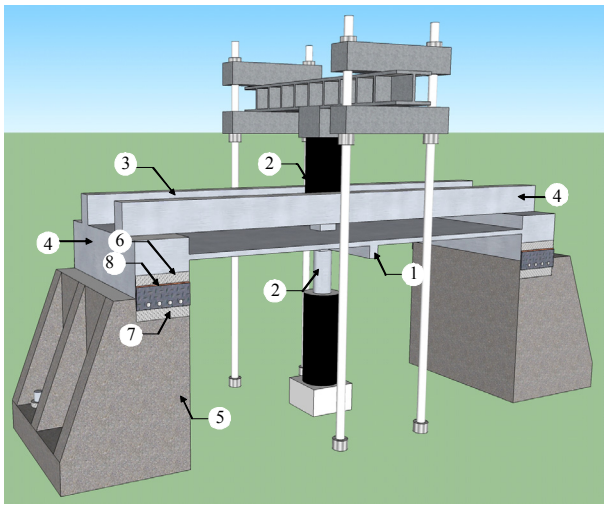
2013 Progressive Collapse Test Competition

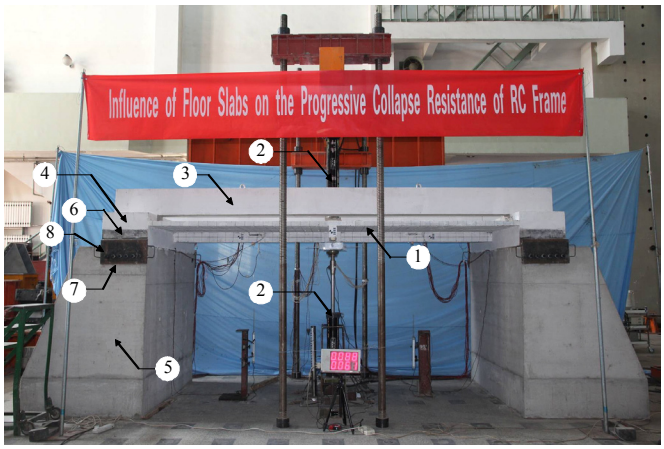
Collapse Prevention Committee, Architectural Society of China
and Tsinghua University

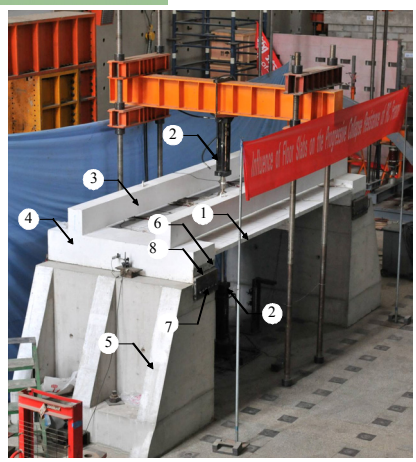
Brief introduction of the test specimen

The primary objective of this competition is to predict the peak load resistance of a continuous reinforced concrete (RC) beam. The goal of the experiment is to investigate the influence of the floor slabs on the progressive collapse resistance of an RC (reinforced concrete) frame.

The test setup of the specimen is shown in Figure 1. It is a two-span continuous beam with concrete slabs on each side. The beam and the slab are fixed at both ends in the longitudinal direction. The vertical load is applied to the middle column to simulate the removal of the middle column.







(1) Test specimen; (2) Hydraulic jack; (3) Strong beams; (4) Boundary blocks; (5) Supporting blocks; (6) Steel plate embedded in the specimen; (7) Steel plate embedded in the supporting block; (8) Connection of steel plate;

Figure 1 Test setup

The key characteristics of this test are as follows:

(1) The vertical load is applied by using two hydraulic jacks (Figure 2). The upper hydraulic jack applies a constant load to the top of the column while the lower hydraulic jack unloads step-by-step to simulate the pseudo-static removal of the supporting column.

(2) A strongly fixed boundary condition is applied to both ends of the specimen. The boundary blocks are connected by two strong beams to control the horizontal displacement. They are also welded to the supporting blocks to prevent the rotation. During the tests, no displacement or rotation is measured at the supports.

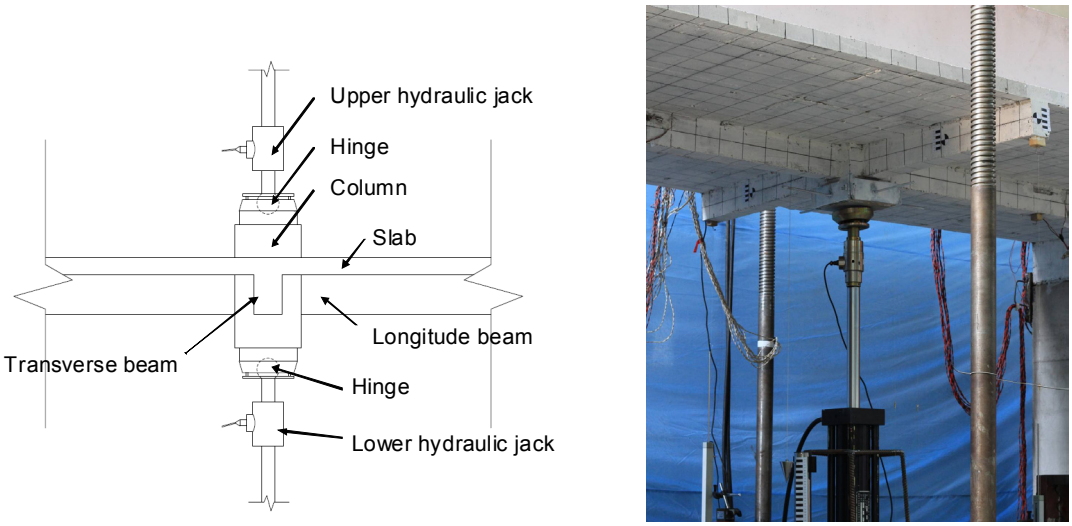


Figure 2 Details of the loaded point

The sectional dimensions and reinforcement details of the specimen are shown in Figure 3. Beam reinforcement details are shown in Section 1-1 and Section 2-2. Reinforcement on the top of the slab is ϕ6@190mm, which is cut 550 mm away from the edge of the beams or the boundary blocks (Section 3-3 and Section 5-5). Reinforcement at the bottom of the slab is ϕ6@190mm and spans through the entire slab (Section 3-3, Section 4-4 and Section 5-5).

The material (steel and concrete) test results of the specimen are shown in Table 2 and Figure 4.

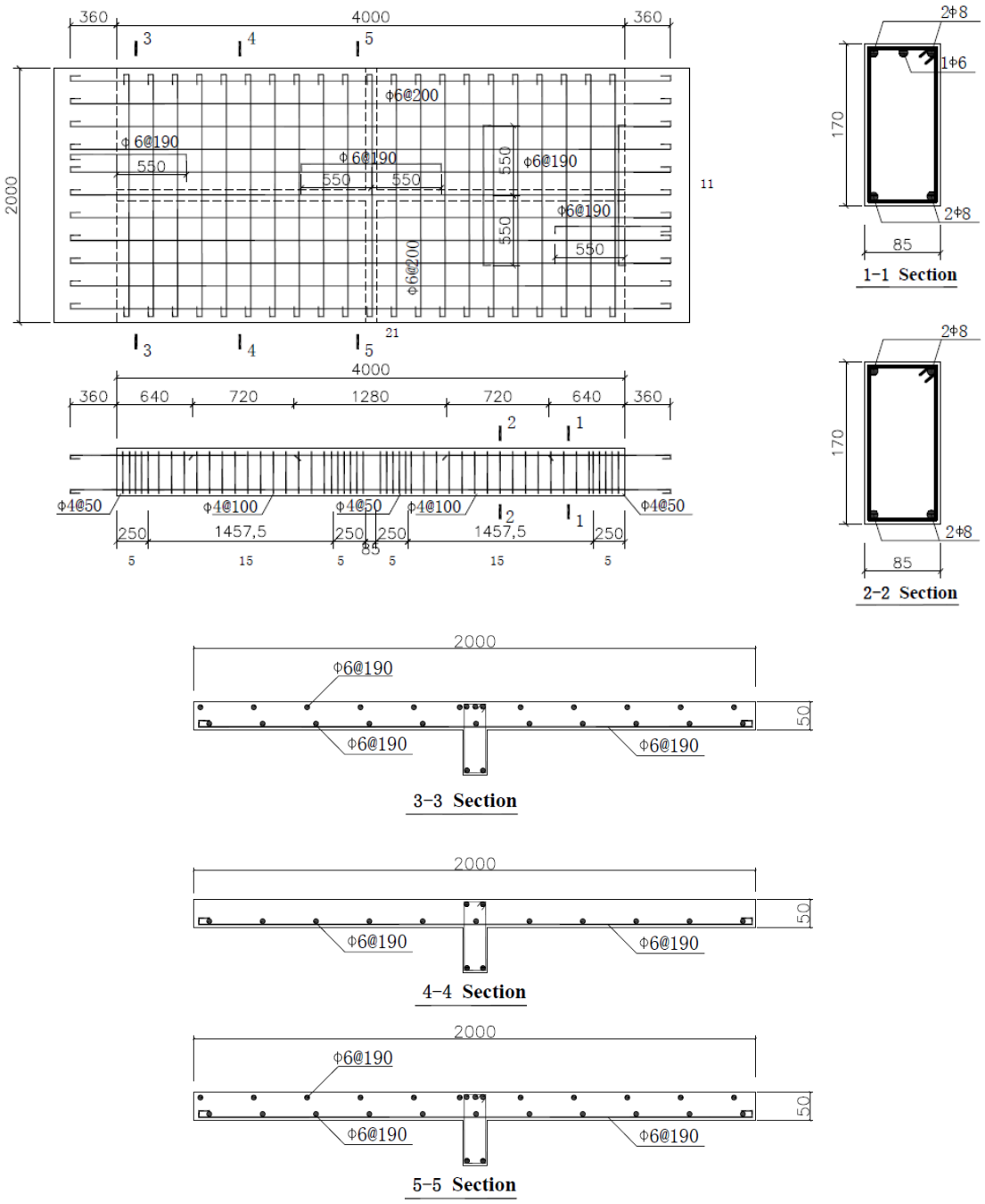
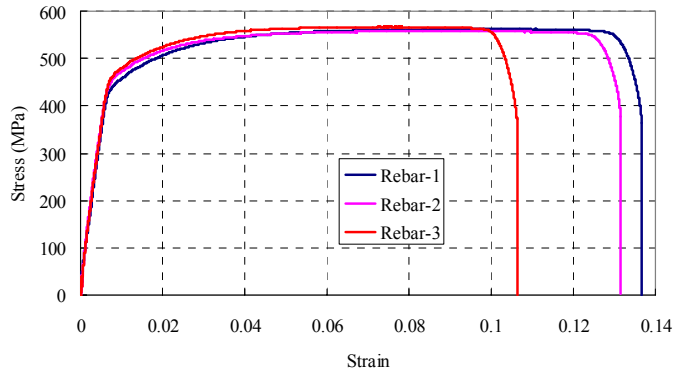


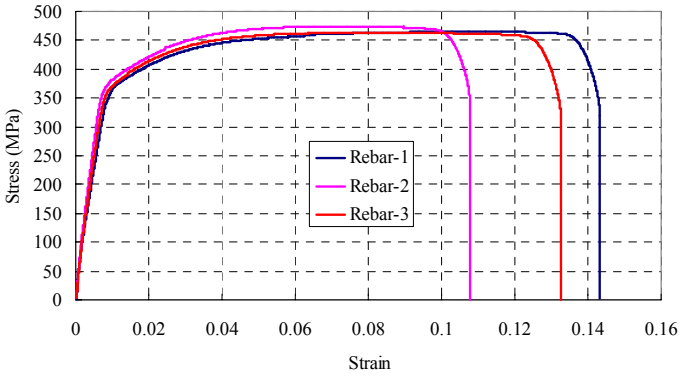
Figure 3 Reinforcement in the specimen

Table 2 Concrete Cube strength (150 x 150 x 150 mm)

Peak load (kN)	Peak strength (MPa)	Average strength (MPa)
940	41.78	
1020	45.33	42.25
892	39.64	



(a) Stress-strain curve of ϕ6 steel bar



(b) Stress-strain curve of ϕ8 steel bar

Figure 4 Stress-strain relation of steel reinforcement

Competition rules

From the experiment, the shape of the measured reaction force versus displacement of the beam-column joint (in the middle of the specimen) is shown in Figure 4. Participants should predict the value of the reaction force at Peak 1 (i.e., peak strength of the beam mechanism) and Peak 2 (i.e., peak strength of catenary mechanism).

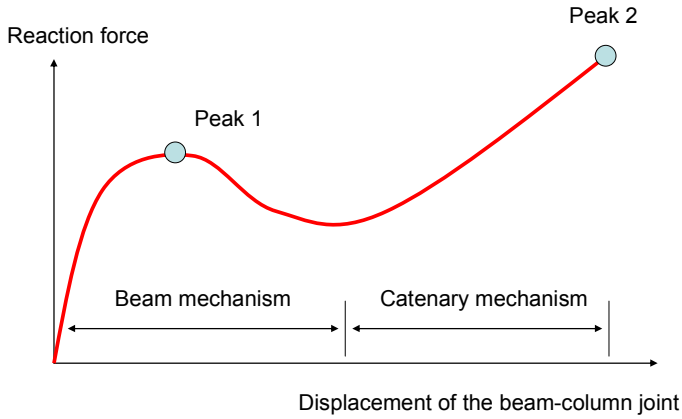


Figure 4 Shape of the reaction force versus displacement of the beam-column joint response

Please send **THE PREDICTED RESULTS TOGETHER WITH A DETAILED INTRODUCTION ON HOW THE FORCES ARE CALCULATED** to luxz@tsinghua.edu.cn before **SEP. 10th, 2013**. The winner will be picked based on two criteria: **(1) THE RATIONALITY OF THE PREDICTION METHOD AND, (2) THE PREDICTION ACCURACY.**

Any further questions can also be sent to luxz@tsinghua.edu.cn.