Application of 1000N Class Ultra-high Strength Steel to the Building

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Summary

This paper presents the outline of the building to which 1000N class ultra-high strength steel has applied for the first time in the world. In addition, experiments and FEM analyses on 1000N class welded H-section columns assumed to be under the condition that horizontal force and axial force due to earthquakes are exerted are reported.

Keywords: ultra-high strength steel; centralized vibration control structure; welded H-section column; high axial load; local buckling.

1. Application of 1000N Class Steel to the Building

The building was constructed in the City of Amagasaki in Hyogo Prefecture in 2011, as an office for performing the research and development of steel materials. The building uses 1000N class steel for the first time. For the building, planning is employed in such a manner that the ground floor (entrance floor) is clearly separated both esthetically and structurally from the other floors (office floors) above there. In the ground floor, 1000N class welded H-section columns are used, and the piece number of columns is intentionally lessened compared to that in the second floor or above. The building has important three features in planning as in the following. The first feature lies in that a large space of 133m x 23 m is configured as the workspace (Figure 2). The second feature lies in that the first floor intensive vibration control structural system is employed (Figure 3). The third feature lie in that a novel office system is employed (Figure 4). For the building, planning is employed in such a manner that the ground floor (entrance floor) is clearly separated both esthetically and structurally from the other floors (office floors) above there. In the ground floor, 1000N class welded H-section columns are used, and the piece number of columns is intentionally lessened compared to that in the second floor or above. The ground floor is designed in such a manner that the rigidity of story becomes more flexible compared to that of the second floor or above. Bracings for vibration control with low yield point steel SLY225 are intensively arranged in the ground floor with this flexible and large displacement within the elastic limit, which is called as a soft first-story.

2. Experiments and Analyses

Rahmen frames with bracings for vibration control may have the case where high axial force is exerted on columns in the event of an earthquake. Experiments and analyses are assumed to be under the condition that horizontal force and axial force due to earthquakes are exerted on columns. The results of the experiments and analyses are as follows:

Irrespective of axial force, full plastic bending yield strength was achieved and stabilized historical behaviour against cyclic load was presented.

The thickness of web contributes to the stability after local buckling. Thickening the thickness of web allows us to alleviate the decline in yield strength after buckling and thus prevent axial crushing.

Figure 1: Appearance of the building

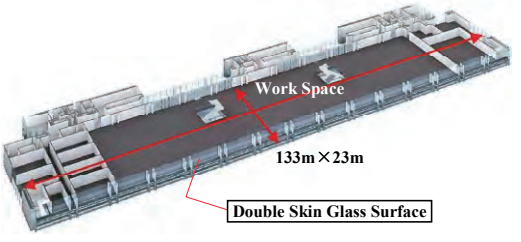


Figure 2: Bird's-eye view of the typical floor

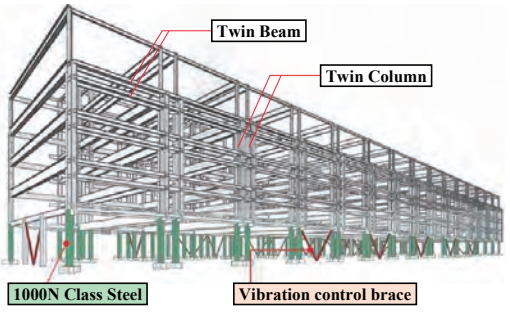
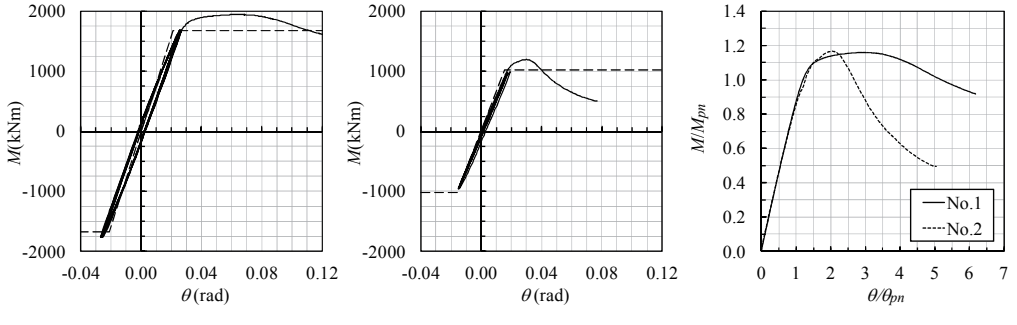


Figure 3: Structural perspective view

Figure 4: Imaging view of workspace



(a)No.1;WF-300x300x12x19(n=0) (b)No.2;WF-300x300x12x19(n=0.47) (c)Skeleton curves

Figure 5: Result of tests