The Long Span Structure Using a Skelsion Structure (Haneda Airport International Terminal Station)

Katsuhrio Ootake
Senior Engineer
Taisei Corporation
Tokyo, Japan
ootake@kiku.taisei.co.jp

Katsuhrio Ootake, born 1968, received his engineering degree from the Univ. of Hosei.

Yoshihisa Sato
Manager
Taisei Corporation
Tokyo, Japan
satoyosi@arch.taisei.co.jp

Yoshihisa Satot, born 1958, received his engineering degree from the Univ. of Tohoku.

Osamu Hosozawa
Deputy General Manager
Taisei Corporation
Tokyo, Japan
hosozawa@arch.taisei.co.jp

Osamu Hosozawa, born 1951, received his engineering degree from the Univ. of Yokohama National.

Summary

The skelsion with tension strings (hereafter referred to Skelsion) structure is the combination system of Beam String Structure (hereafter referred to BSS) with brace. This structure system is tension structure. The structure system is materialized by initial tension load. This paper is an introduction of the structure system and construction technique for initial tension load.

The skelsion is a structure system made by slender element using BSS and the tie rods. BSS have been used to resist vertical load. The tie rods were installed in three dimensions to connect each BSS to prevent blowing up by wind load and to resist horizontal seismic load. The tie rods function combination for at both span and girder directions.

The length of span is 31.4m, and girder direction is 2.75m X 12 units. This structure system is rigid frame structure by H-beams, BSS with combination posts and cables, and the tie rods installed in three dimensions. The solid ball joint is installed at the crossing point of five tie rods.

These slender elements are showed above platform area and combined with high transparency glass exterior wall. The large span structure with light impression is realized.

Keywords: Beam String Structure; Skelsion Structure; Initial tension load; Cable Structure; Construction; Tie rod

1. Overview of structure

A skelsion structure is a hybrid structure that combines a beam string structure, which offers excellent vertical load processing capacity, with tie rods that offer great tensile strength and considerable toughness. The tie rod members function to prevent the structure from being blown upward during strong winds and also to resist horizontal force in the event of an earthquake. The three dimensional tie rod members creates a structural system made up of slender structural members that are actively incorporated into the visible design of the highly transparent glass facade. The result is a large span structure that has a very light appearance.

The frame is made up of 12 units measuring 2.75 m in the ridge direction and 31.4 m in the longitudinal direction. The structural system used for the building comprises a portal type rigid frame made of H-beams, a beam string structure composed of struts and cables, and tie rods placed vertically so as to resist external force in the rigid frame direction and the ridge direction. In the string beam structure, two parallel cables are installed for each beam.

Ball joints are placed at the intersections of five tie rods. Horizontal braces are placed on the grid made up of large girders and beams to ensure the rigidity of the horizontal plane of the roof. As the structural members themselves constitute finishing members, the structural plan combines the advantages of a tension structure in order to create a structure made up of slender members.

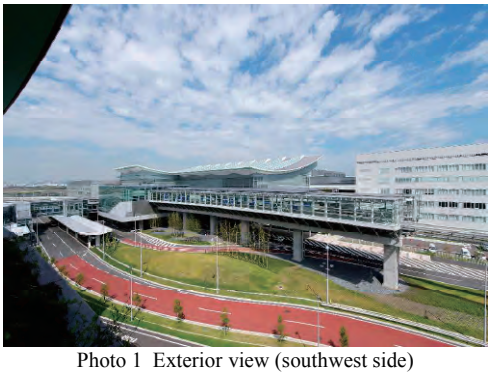

Photo 1 Exterior view (southwest side)

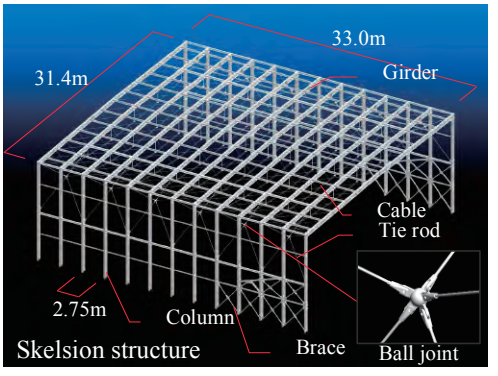

Fig. 1 Frame structure

2. Conclusions

As a result of the construction of this skelsion structure, the following were confirmed.

· For the introduction of initial tension to the beam string structure, the cables were temporarily prestressed at the factory with long-term temporary axial force, and the design coordinate was marked on the cable. This established a system for introducing tension force from one side.

· A construction system was established in which four of the five tie rods placed vertically at five different angles were managed using member length, and tension was introduced to only the remaining tie rod to simultaneously introduce tension to all five tie rods.

The establishment of these construction systems ensured construction quality, shortened the work period and reduced costs.

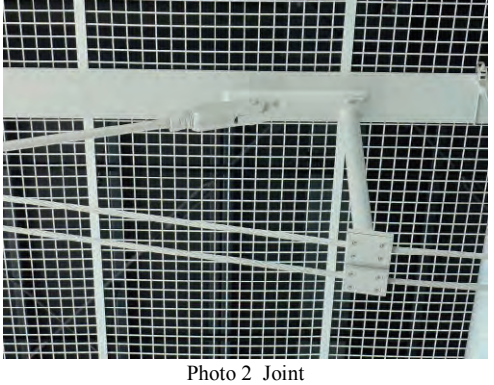

Photo 2 Joint

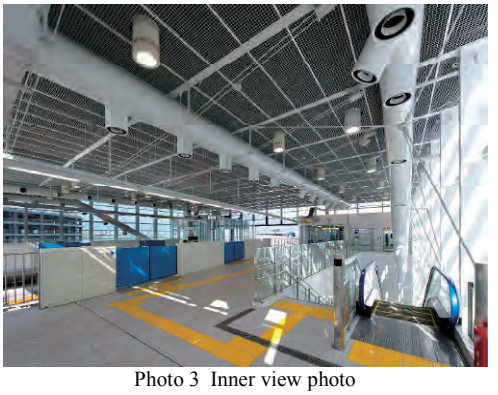

Photo 3 Inner view photo

Photo 4 Tie rods

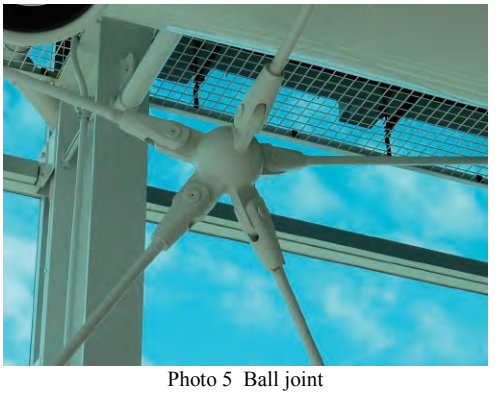

Photo 5 Ball joint