

## Design and Construction of Wheel-shaped String Beam Roof with U-turn on the Bottom Chord Cables

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### Abstract

Wheel-shaped string beam structural system is adopted for the roof of Shakujii Gymnasium arena.

Wheel-shaped roof has 35 meter diameter and sits on 36 meter by 36 meter square shape podium made of reinforced concrete structure. At four corner of podium, there are triangle shaped roof openings generated by gap of square and wheel shape. Those openings are used as natural ventilation and natural light intake.

Top chord of wheel-shaped roof is composed of single layered outer rings, double layered inner ring and radially arranging steel beams, which divide both inner and outer rings into 20 even arch.

Cables connecting outer ring and bottom of inner ring are functioned as bottom chord of string beam. One cable starts one of divided node of outer ring toward inner ring, then makes u-turn over through cable guide arranged on bottom of inner ring and finally reaches adjacent node of outer ring. Following this geometry, 20 V-shaped cables create innovative cable arrangement of wheel-shaped string beam roof.

Additionally, using simple and reliable detail for cable end, proposed cable arrangement reduces construction cost.

The main report introduces detail of cable connection, roof construction steps and measuring result of cable tension/deformation in addition to outline of roof structural system.

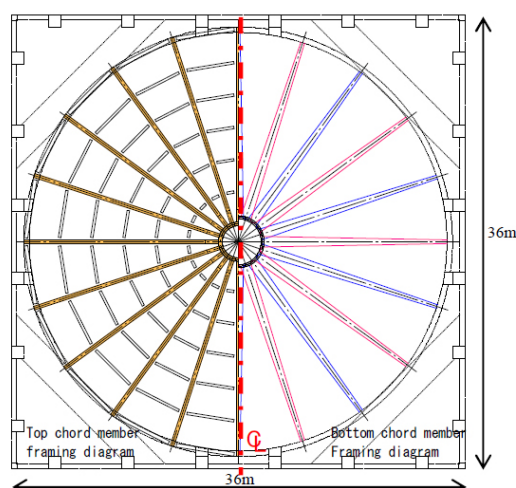


Fig. 1 Arena roof framing diagram

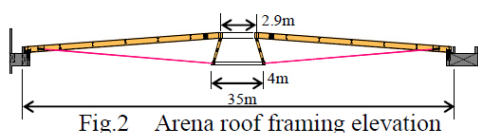


Fig. 2 Arena roof framing elevation

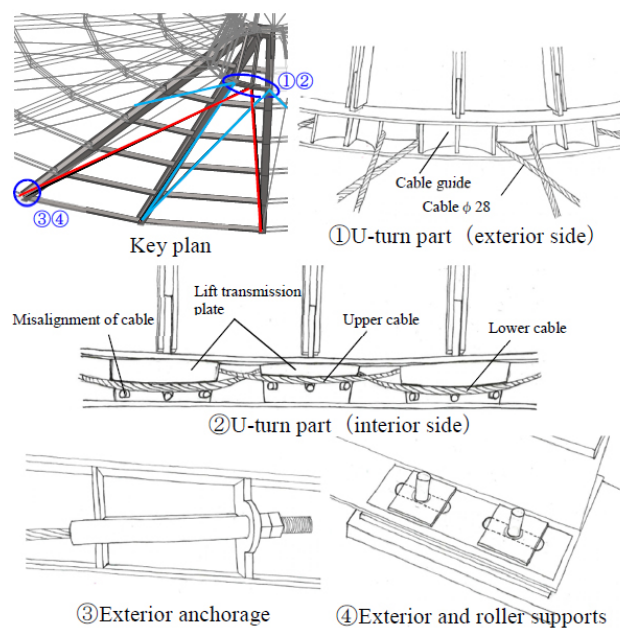


Fig. 3 Detail of the cable anchorages