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Structural Applications of Mega Masts

Sudarshan Krishnan, Ph.D

Associate Professor of Structures
University of Illinois at Urbana-Champaign
117 Temple Buell Hall, 611 Taft Drive, Champaign IL 61820, USA
e-mail: skrishnn@illinois.edu, web page: <http://www.illinois.edu>

ABSTRACT

Large cable-stayed masts have been used in iconic stadia structures. Their structural merits lie in the reduced core size and high compression strength derived from the use of prestressed stays attached to tiers of cross-arms [1]. Two stadia projects are presented herein, namely, the Algarve stadium in Portugal designed by HOK Sport and the competition project for the Saitama Arena proposed by Richard Rogers Partnership in collaboration with Matsuda Hirata. Both structural schemes are similar in that the roof is suspended above the seating to allow for uninterrupted spans and views for the spectators. Four majestic steel stayed masts support the roof structure.

The Algarve stadium structure has steel trussed-arches connecting the base of the stayed columns along the long directions. Two additional tubular arches reduce the overhang of the roof framing. The PVC fabric membrane roof is suspended from cable trusses and supported by the arch system below. Each roof is supported by two mega stayed columns that rise 72 m high and help to anchor the high-tension forces from the 210 m long catenary cables holding the fabric membrane. The stayed masts are anchored by means of four 32 mm diameter cables. The column core dimensions and weight are optimized by a system of three-tier cross-arms that provide lateral restraint to the 660 mm diameter core tube [2].

The Saitama Arena structure has four mega stayed masts with one tier of cross-arms, 90 m tall, elliptical in cross-section and with a maximum girth of 4 m. The columns support a 3 m deep perimeter beams. The perimeter beams support the orthogonal grid of steel trusses. The overhanging wings are supported by a series of trusses cantilevered from the perimeter beams and tied to the steel struts. The entire structure is stabilized by a network of prestressed cables in order to ensure an alternate load path even if one of the mega masts were to fail [3].

Keywords: stayed masts, prestress, buckling, tension, membrane, case-studies, stadium, Algarve, Saitama.

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