Parliament Library Building Domes

The Parliament Library building in New Delhi, India, was completed in 2002. Given the significance of the building, the developers (Central Public Works Department) were keen to use the best materials possible, with the latest technologies. It was also imperative for the building to blend in with the surrounding environment. The result is a four-storey building, two floors of which are above ground. The main architectural feature is the twelve individual domes which make up the roof, each comprising different dimensions, designs and materials. The domes are both the highest and most recognisable elements of the building. Two of the domes are made from glass and stainless steel.

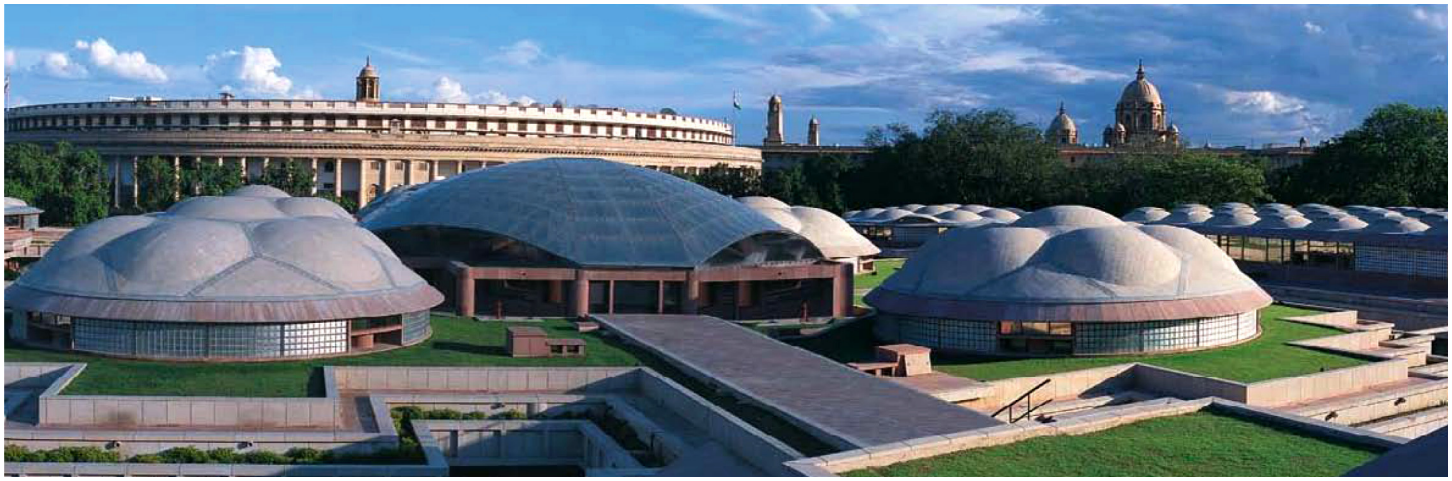

Figure 1: General view of the domes of the New Delhi Parliament Library

Material Selection

The library is adjacent to the Indian Parliament building, which was built in the 1920's as a key element of the colonial plan for the city of New Delhi. As shown in Figure 1, the building was designed to create a unique and architecturally-pleasing landscape. It was imperative that the design for the new library was sensitive to the surroundings and political context as well as displaying contemporary and up-to-date features. Furthermore, the brief stipulated that the new structures should not dominate the main building. For these reasons, stainless steel provided an appropriate solution for many of the material requirements.

Stainless steel is very visible throughout the complex, both internally and externally, and is used for two of the domes. It was first included in the design of this building when the engineers identified it as a suitable material for the cramps which hold the external sand stone in place, owing to its excellent corrosion resistance. After consultations with the Nickel Institute and ISSDA (Indian Stainless Steel Development Association), grade 1.4307 (S30403) was selected.

Figure 2: View of cast stainless steel joint with reflective glass

In total, there are around 350 tonnes of austenitic grade 1.4307 (S30403) used in the development for many diverse applications such as the domes structural members, cramps, handrails, library stacks, fitting sand furnishings etc. Stainless steel was chosen for its durability and low maintenance as well for aesthetic considerations.

The central focal dome spans 25 m with a rise of 4.2 m and comprises stainless steel tubular members, grade 1.4307, welded to cast nodes. Insulated glass panes are used between the members to allow natural light into the central part of the building. A natural gloss finish was specified. For the VIP dome, grade 1.4307 stainless steel tubes were also employed to create a roof with a diameter of 16 m and pitch of 2.5 m. In addition to the domes, stainless steel cramps, also in grade 1.4307, hold the external sandstone in place.

Figure 3: View of the stainless steel and glass central focal dome

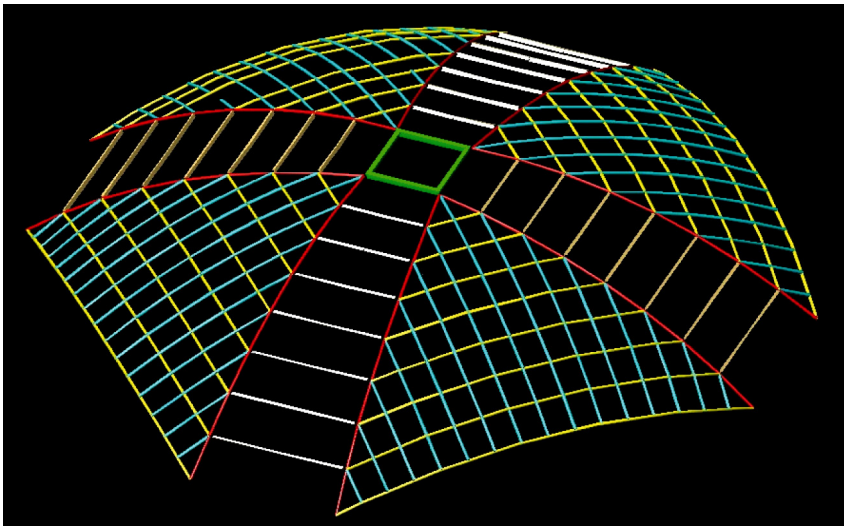

Figure 4: Image of the computer model of the dome

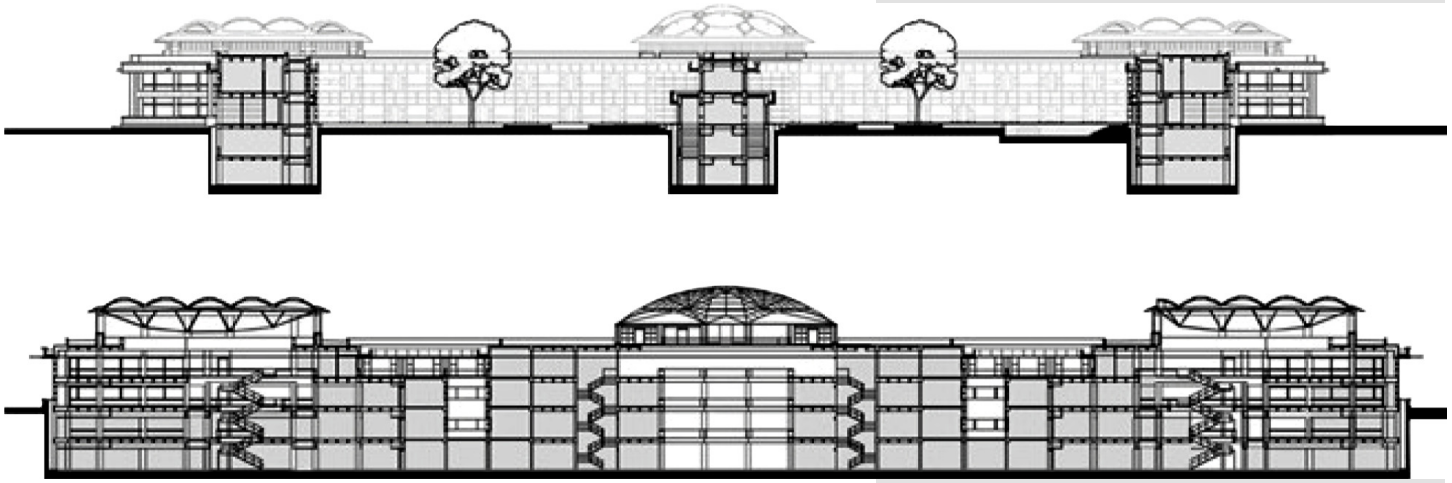

Figure 5: Section views of Parliament Library schematic

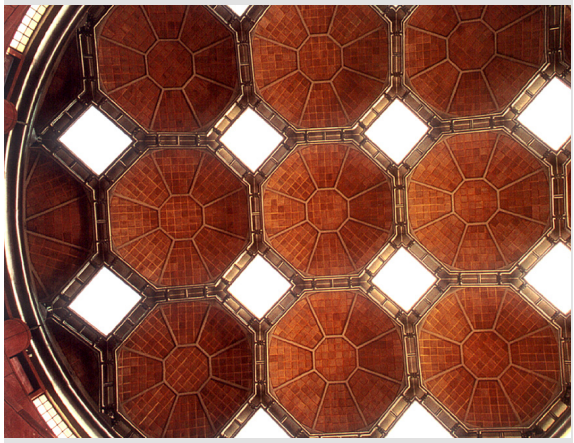

Figure 6: Internal view of the VIP dome

Figure 7: Support system for the VIP dome

Design

Located on a 10 acre site, the library is nearly 55,000 m^2 in area and can accommodate three million books on the two basement floors. Site conditions and trees prohibited the north-western corner of the site from being developed, leaving the square incomplete. Otherwise the plan, with its courtyards and axes, is similar to historic precedents. Of the four storeys in the building, only two are above ground level. The height of the building is restricted to the podium level of the Parliament House as it is important not to obstruct the view both to and from the government headquarters.

The Parliament Library building is designed for a service life of 125 years. The plan of the building is inspired by pre-colonial Indian architecture such as the magnificent Taj Mahal, with its square base and symmetrical composition. The basic structure for the building is a reinforced concrete frame with columns generally spaced at 10 m intervals. The intermediate floors are of coffered concrete slab construction while the roof is mainly either steel-and-concrete domes or stainless steel and glass. The novel design and construction of the domes was the first of its kind in India.

The central focal dome comprises a lattice of stainless steel tubular members and cables converging at key tension cast nodes. There are four doubly-curved triangular ‘petals’ inter-supported through four ladder purlins which are joined at the top by a rectangular compression element (see Figure 3). Each petal is a grid of stainless steel tubes with an outer diameter of 101.6 mm and 10 mm in thickness. The overall stability is ensured through a network of tension rods. All joints in the framework were cast in foundries and connected to the tubes by a combination of high strength preloaded (slip resistant) bolts and welding. Consequently, the joints appear simple and elegant, even where 12 members meet. The entire structure is clad with insulated glass elements which allow natural light into the central part of the building.

The second dome containing stainless steel, known as the VIP dome, has a diameter of 16 m and a height of 2.5 m. It contains stainless steel tubes shaped into a combination of 9 octagons and 12 squares (refer to Figure 6). To fit these shapes onto a truly spherical surface, the octagons were slightly distorted. The octagons are covered with a fibre reinforced concrete shell which is clad with sandstone and granite, held by stainless steel cramps. The squares are clad with glass panels. The entire structure is supported on a ring beam through articulated pin joints at 16 locations to allow rotation of these joints. The ring beam is further supported on 8 circular columns.

Figure 8: Erection of the focal dome

Fabrication and Erection

Geometric precision was achieved for the various elements of the dome, including the cast joints, the curved tubular sections and the fixings, through careful workmanship. The stainless steel sections were rolled in Mumbai before being sent to Chennai for bending and were then assembled, welded and polished on site.

Figure 9: Steel members assembled on site during construction

Information for this case study was kindly provided by Raj Rewel Associates

References and Bibliography

[1] Parliament Library, New Delhi. *Architecture Week*, October 2003

Procurement Details

Client:	Lok Sabha Secretariat, Government of India
Architect:	Raj Rewal Associates, New Delhi
Structural Engineer:	Central Public Works Department, Government of India
Contractor:	Larsen & Toubro Ltd., ECC Construction Division

Online Information Centre for Stainless Steel in Construction:
www.stainlessconstruction.com

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