

December Newsletter – T2 Mega Roof (Head House)

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Planning:

The Mega-roof, associated with world's largest airport terminals, is a structure that shelters thousands of passengers and staff. Due to the tremendous passenger movement and various operations, terminals are planned over a large area. Space being the ever-ending concern in our city, a plan for a high-rise airport terminal was required. Such a concept does not exist and thus it was necessary to make a mark in the world. The detailed plan formulated for the Mega-roof, entails keeping the roof at a distance from the external facade. This allows the roof to provide shelter from external elements, as well as allowing natural daylight to permeate through. The form, the feel and the overall aesthetics of the structure keeps in line with our vision of being the pride of Mumbai.

Design and Engineering:

Departure area:

The Mega-roof encloses the entry, check-in and security check region. Passengers shall have the comfort of space provided by the 15m high soffit. To provide a bright and spacious feel, the design allows diffused daylight and artificial light to illuminate the terminal. This is made

possible through various circular glass lenses that are crafted into the sculpted ceiling and column capitals.

Arrival area:

Arriving passengers shall be ushered in through the lower levels. They shall have a view of the roof through various cut-outs that grace the entire area. These cut-outs are large open spaces that surround each supporting column. Diffused daylight will pilfer through the cut-outs to gently light up the areas.

Columns:

To provide the passengers with an obstruction-free visual expanse, the architects placed the columns at intervals on a 34m x 64m grid. The spacing at large intervals means that each column carries a load of about 2000 tonnes. The entire structure was designed to allow light into the terminal through the cut-outs. This meant having each column connected only at the first and ground level.

Engineers designed each column of high-grade steel plates in a cruciform shape, which dealt with the large wind/ earthquake induced bending moment and sway. The load and free length issues involved encasing each column in high-grade concrete of 2.3m diameter, starting from the foundation till the top. Deep trusses were incorporated into the design to handle the load and maintain a sag-free roof.

Pods:

30 diamond-shaped pods enhance the design of the Mega-roof. They are incorporated into the structure, with the sole purpose of providing support to the columns and the roof covering. Each pod comprises of 4200-4500 steel elements, weighing 250 tonnes. They are pre-fabricated, and condensed to nearly 150 components before delivery. Assembly of each pod required over 10,000 bolts and 80 men.

Overall structure:

The Mega-roof can be likened to 30 Mushrooms placed at intervals, covered by one fabric. The roof covering and the false ceiling converge at the periphery to form a seamless curve, known as the bull-nose. The largest outer projection beyond the column is 36m.

Construction challenges:

A vast brown-field operation led to large logistical obstacles. A major issue faced was that of erecting the steel roof.

An innovative construction method was the only solution. This required creating a temporary launching station outside the construction area. The link to the site was a temporary highway-like truss structure, at a height of 125 feet above ground. With a predicted travel distance of 350m, the truss highway consists of around 811 steel elements. 10 such segments have been used to transport the pods.

Post assembly at the launching station, the structure is transported by a bogey on the truss highway to its final location. This basically entails the shifting of a 12,000 sq. ft., 50 feet tall structure on a bogey of 1200 sq. ft.

Operations and Maintenance:

The roof was designed to facilitate maintenance and not cause any disruption to airport activities below. The vast span of the roof and the minimal use of columns, simplifies passenger operations in the terminal. A large space, known as the Attic, has been reserved between the ceiling and the roof covering. This attic houses various building utilities that are a necessary support to the functions below. These include fire fighting, ventilation, security and lighting services. These utilities can be easily accessed by maintenance personnel, without causing any disturbance to the passengers below. Simply put, light bulbs can be replaced without the passengers being aware of the activity.

Interesting aspects about the Mega-roof:

The one thing that catches the eye on nearing the terminal is the Mega-roof. Its sheer size and detailing captivates the viewers, leaving them with a sense of incredulity.

Few facts:

- It covers an approximate area of 50,000 sq. m., which is equivalent to 10 football fields.
 - It has an approximate perimeter of 1.2 km.
 - The height above the last level is 15m
 - The whole roof is built with 18,000 m of structural steel, which is enough to build 2 Eiffel towers.
 - The entire structure is supported on 30 columns, which can be viewed in entirety only from a distance of 200m.
 - Cranes with 500 MT capacities were deployed to erect the steel structures.
 - 272 skylights complement the intricate lightweight membrane that makes up the roofing.
 - One of Asia's longest cable-supported glass facades encompasses the Mega-roof.
 - The steelwork required 1 million bolts, supported by large lengths of welding.
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