Cover Story

Fact File

Client
Airports Authority of India

Architect
Airports Authority of India
(Architect Wing)

Structural Consultant
Mahimtura Consultants Pvt Ltd

Joint Architect
C & S Architects

Steel Fabricator
Pratibha Pipes & Structural Ltd

Steel Supplier
Tata Structura

Steel Tonnage
3500 MT approx

New Terminal Building (Phase II) Amritsar Airport

world class architecture with ultra modern facilities

Amritsar Airport registered a passenger growth of 64.6 per cent during April–December 2009 which made Amritsar Airport the fastest growing airport in India. A new integrated terminal building was inaugurated on 25 February 2009, with an area of approximately 40,175 square metres compared to 12,770 previously. This new terminal is a blend of modern and Indian designs, constructed of glass and steel, but with Indian arches and colours. The new terminal building is equipped with a central air conditioning system, an inline X-ray baggage inspection system integrated with the baggage conveyor system, escalators, public address system, Flight Information Display System (FIDS), CCTV for surveillance, check-in counters with Common Use Terminal Equipment (CUTE), car parking, etc.

Structural Design

The city of Amritsar has always remained a religious and tourist centre in Punjab, and was in need of a fully operational international airport in recent years. The airport is located 11 km towards the north-west from Amritsar city. The city is surrounded by industrial belt and has a great potential of import/export cargo in particular in context of woolen, hosiery, sports goods, agriculture products, and engineering and pharma goods. Thus, the new terminal building (Phase II) at Sri Guru Ram Dass Jee International Airport was thought, conceived, planned, constructed and was made operational in 2009. The basic aim was to give the airport a new look with more passenger facilities with most advanced and increased security features.

The expansion of the existing airport building covered new arrival and departure. The area of terminal building is increased to approx 30, 000 sq mtrs. Because of the proposed expansion, both the efficiency and capacity of the airport in terms of passenger handling has increased.

Structural Consultants & Architect

The structural consultancy assignment was awarded to Mahimtura Consultants. The project was based on and developed on a design - build concept. The architect for this fabulous parabolic profiled structure is C & S Architects, an in-house architect from the contracting firm. The New Integrated Terminal Building is an example of world class architecture with ultra modern facilities for international and domestic passengers.

General Features

- From aesthetic point of view Amritsar airport has a blend of modern and Indian designs, finished in steel and glass on the face, with arches and colours.
- The structure of the airport comprises of main building and the structural steel roof structure. The roof has a curved profile to offering an aesthetic look, which is supported by flare arm spaced 15 - 20 m. at the center.
- The roofing is in structural steel and has RCC slabs at intermediate level. The airport layout has 8 no large grids in length and 3 in width. The column grid is approx 35m x 35m.

Structural Design Features

The new domestic airport has following structural design related features:

- Soil bearing capacity (SBC) 9 T/sq mtr
- Concrete grade - M 40
- Reinforcement grade - Fe 415
- Structural steel grade – yst 310 N/mm2
- Composite columns using 16 mm steel plate, carrying heavy load to the tune of 900 T spaced @ 30 m c/c
- 60 mm MS plate with 60 mm dia bolts was used for safe transfer of column load to the foundation
- Height of the structure varies from a min of 32.9 m (108 ft) to a max of 51.56 m (169 ft)
- Our structural design was vetted and approved by VJTI
- The entire exposed structural steel work was protected with fire proof treatment

Major Challenges Faced

It was not an altogether newly planned airport I the outskirts of a metropolitan city. The existing airport building remained operational and the new building was taken up. Secondly, the SBC was low and the soil was very weak. Thus heavy foundation system was designed to cater to heavy column loads.

The flare arm for the truss designed out of structural steel in a bending profile was a complicated activity in view of its design and actual connection at site. Other challenge was to facilitate connection of RCC elements of the slab / beam with the structural steel columns by providing insert/bearing plates at exact location and in desired profile.

While the construction was on, the airport was functioning as normal. The airport was not shut down for even a single day. The heavy space frame members were held in position using higher capacity cranes. The connections were

done taking into consideration all safety precautions and without any compromise on quality standards.

Structural Design Uniqueness

The spans are massive approx 35 m X 35 m and more than 25,000 structural steel members were used to design / construct the roofing. Due to the irregular shape end cutting on the pipe, it was a challenge for the designer as well as the contractor to erect the members in position and do the assembly / connection.

For a spacious and airy feel, a maximum space of 40 x 40 meters was kept between columns alongside 60 x 60 meters for the central grids. Taking into account the functional capacity of the existing terminal, as well as overall economic constraints, the largest span covering the roofing system had been conceived as open-web, three dimensional and multidirectional. Such structural shape reduced wind pressure, wind-induced vortex and eddies to the minimum, as well as resisted aerodynamic behaviour without additional introduction of lateral bracing systems.

The total quantity of structural steel consumed for the said airport is approx. 3500 MT.

Structural Steel

- Basic structural steel truss is designed and fabricated out of MS pipes and square hollow sections.
- Various pipe dia. (NB) used in the design are as follows:
- For flare arm - 600 mm dia using 16 mm plates.
- For bottom chord - 300 mm dia using 6 mm plate
- For truss members -250 mm dia (8 mm plate), 200 mm (8 mm plate), 20 mm (6 mm plate) and 150 mm (6 mm plate)
- For Purlins (Square hollows sections) - 145 X 82 X 4.8 mm

Tata Structura Usage

Tata Structura segments used in the construction are like extensive hollow pipes in both, rectangular and circular shapes, thereby facilitating maximum benefits of two-directional moments of inertia and torsional stiffness. They are also kept small in size for ease in construction and fabrication. Maximum span glazing curtain walls were used with bowstring truss configuration to have a clear view from both inside and outside the terminal building. ■

Hiten Mahimtura
Director, Mahimtura Consultants Pvt Ltd

“It was a real challenge to construct Amritsar International Airport while existing airport was in operation. The construction continued inspite of difficulties due to existence of services, stringent climatic conditions, existing structures in front to be kept intact etc. Erection of trusses was another challenge, because it was in a dia-grid manner, and these trusses were temporarily supported by crane / trestles till the connecting members were placed in position. Finally, the supporting system beneath was released when connections of trusses and secondary members was completed. The arches in structural steel spanning across the airport was approximately 25 M and this could be achieved by a good design, site staff and excellent contracting team.”