

ABU DHABI NATIONAL EXHIBITION CENTRE**Constantine Migiakis**

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1.ABSTRACT

The Extension of the National Exhibition Centre of Abu Dhabi was a project with high engineering and architectural demands and the challenge was to meet the client's strict deadline to complete the project in 12 months. Totally, 5500t of steel and 210000m³ cast in-situ concrete were used. Steel structure of the roof and concourse was erected in a period of approximately 5 months. Glass and Cladding specialist subcontractors provided solutions for fast erection, installation as well as structural and architectural detailing. Proper co-ordination between different subcontractor shop drawings was continuously required particularly of the interface between different materials. Mechanical and electrical works required detailed review for the provisions to be taken on the structural steel works (Trusses) and the openings in R.C. walls.



Fig 1: Overall view of the project

2. INTRODUCTION

Abu Dhabi recently announced the expansion of its National Exhibition Centre, a project that will see the venue double in size to become middle east's largest purpose - built exhibition centre with inter connected exhibition floor space more than 50,000m². The building structure is a combination of R.C. Concrete, Pre-Stressed Concrete, Structural Steel, Glazing and Aluminum Cladding in order to meet the high demands of architectural design.

3. PROJECT DESCRIPTION

The project consists of the Exhibition centre building, two Car Park buildings and a Hotel. The Exhibition centre building covers an area of 65000 m². It consists of the main exhibition hall area, the multipurpose hall (convention and conference centre), the galleries for accommodating the mechanical equipment storages as well as offices, and the concourse area which is located between the entrances and the exhibition halls. The building is a combination of Structural Steel and R.C. Concrete.

The galleries which are located on the perimeter of the building are R.C structure with prestressed - precast slabs as flooring. Column and beam are cast in-situ. The type of prefabricated slab used as the typical flooring is hollow core slabs (HCS) spanning up to 12m, with panel width of 1.2 m. Typical depth for those slabs varies between 200mm-400mm and the weight is 5,7kN/m² for the 400mm slab. The slabs are supported on the beam nib on each side. A structural screed with thickness 75mm is provided on the top of the slabs to provide connection and diaphragm action on the floors. Openings can be provided on the HCS to account for mechanical and electrical equipment to pass through the floors.

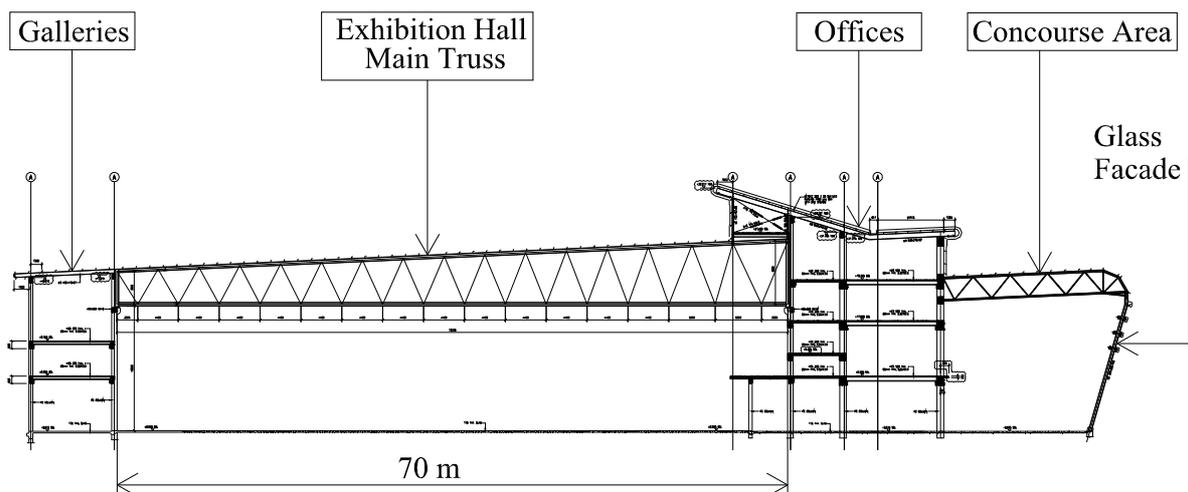


Fig 2: Typical Elevation of the Exhibition Hall Building

The main exhibition hall roof consists of steel trusses, spanning approximately 70m. The trusses are supported on concrete corbels, and have a spacing of 6m. Each truss has a total depth of 7.5m and weights 34 t. On the lateral direction the trusses are connected with vertical and horizontal tie-members and bracings at the support points and at the roof level. On the support points two anchor bolts are provided giving a hinge connection on one side and a sliding connection on the other side. The total pre-camber of the truss is 50mm and was fabricated in 3 pieces of approximately 23m length, transferred and assembled on site. In order to transfer each piece, special permission was required from the transportation authority since the truck occupied 2 lanes of traffic (The truss segment was laying horizontally on the truck).

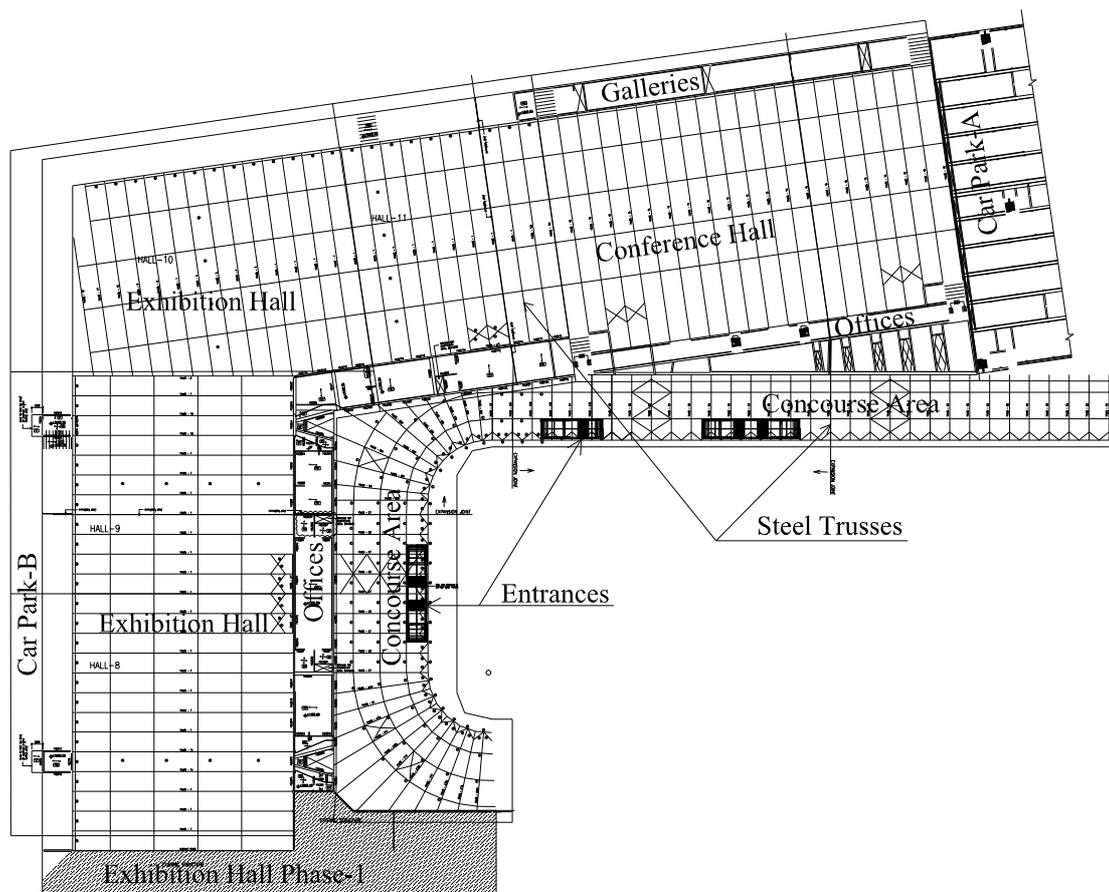


Fig.3: Plan layout of the Exhibition Centre

As soon as the truss was assembled on its full length on site, it has erected with the use at 2 cranes 100 t capacity, lifting in parallel (tandem lifting). One truss per day could be erected, achieving a completion of erection of 70 trusses within 3 months. The exhibition Halls connects to the Car Park building through steel-composite bridges. Heavy-type steel trusses have been used, and the erection was achieved with temporary steel fixing towers at the support of the segments.



Fig 4: Exhibition Hall – Erection of steel trusses with 2 cranes 100t

The steel roof is extended over the galleries with the use of rafter beams, supported on the top of the concrete columns.

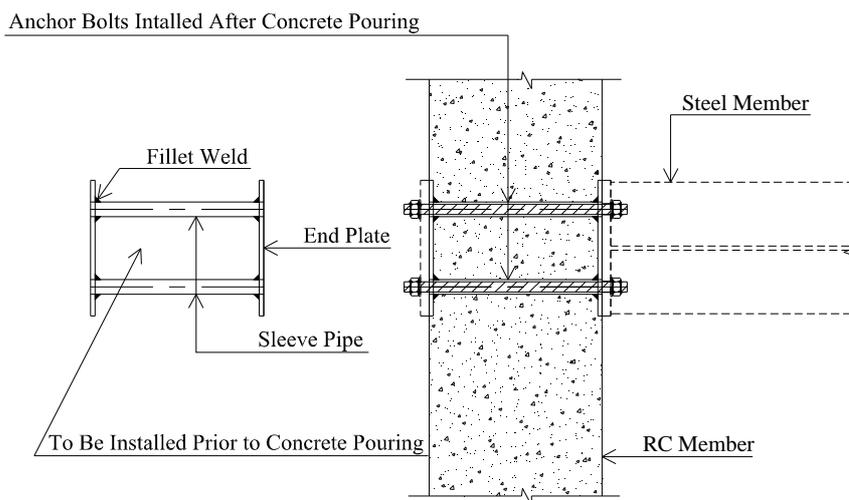


Fig 5: Sleeve system for the fixing of steel members to RC members

The concourse area is a complete steel structure with trusses at spacing 6m and span length of approximately 30m. Those trusses are supported on the concrete beams of the exhibition hall at one side. An inclined steel column is provided on the external side of the truss resting on a continuous concrete pedestal. On those members, the external glazing and vertical cladding will be supported. The vertical trusses are connected with horizontal trusses at three different levels on the façade in order to account for different sizes of glazing units. Geometry of the trusses is complicated at the curved areas of the building. The entrances of the building are steel structures curving at the ends. Special screen areas for advertisements are also provided on the facades, where heavier loads have to be accommodated.



Fig 6: Concourse area – Steel trusses and horizontal lattice trusses at curved parts

Furthermore, mechanical equipment and false ceiling support system had to be accommodated to the trusses. In general, erection of 3 trusses per day could be achieved in the concourse area.

4. STRUCTURAL DESIGN

The loads considered in the design are those according to British standards. A basic wind speed of 25m/sec is adopted, resulting to a wind uplift pressure on the roof of 1.45 kN/m^2 . At the corners and edges, higher values are considered. Earthquake load is not taken into account, according to UAE National Seismic Code, for buildings with height less than 30m. For the roof, the cladding uniform dead load was assumed 0.2 kN/m^2 , the mechanical loads 0.7 kN/m^2 , false ceiling loads 0.2 kN/m^2 and live load 0.6 kN/m^2 . Three concentrated loads acting on the truss of 50kN were assumed for the suspension of large labels, etc. A temperature variation of $\pm 30\text{C}$ was also considered as well as movable wall loads of 1.2 kN/m applied on the full length of the bottom chord of the truss. The cladding profiles were verified as cold formed sheeting members and finite elements analysis was performed for the verification of glazing units.

5. CLADDING

The cladding system of the roof and the facades is of aluminum “standing seam” type comprising the internal liner sheeting, the intermediate insulation layer and the kalzip external panels.

The liner sheet is the inner layer of the cladding. It is 0,7mm thick trapezoidal aluminum sheeting with a total depth of 40mm, fixed to the Z purlins with screws. After the installation of the liner sheet a layer of polyethylene vapor barrier is placed, followed by the fixing of the hat sections. Those are continuous omega-shaped G.I profiles 1,5mm thick where the clips are connected in order to provide fixity to the insulation and the external layer of the Kalzip panel. The omega profiles are fixed to the liner sheet with the use of aluminum bulb tile rivets.

Following, the clips sections (L-angles) are fixed on the hat sections with the use of self tapping screws. The insulation material (typically rockwool) is then placed having a thickness of 150 mm and must fulfill strict requirements in heat, sound and moisture prevention, according to client specifications. Finally the Kalzip panels, rolled formed on site are installed.

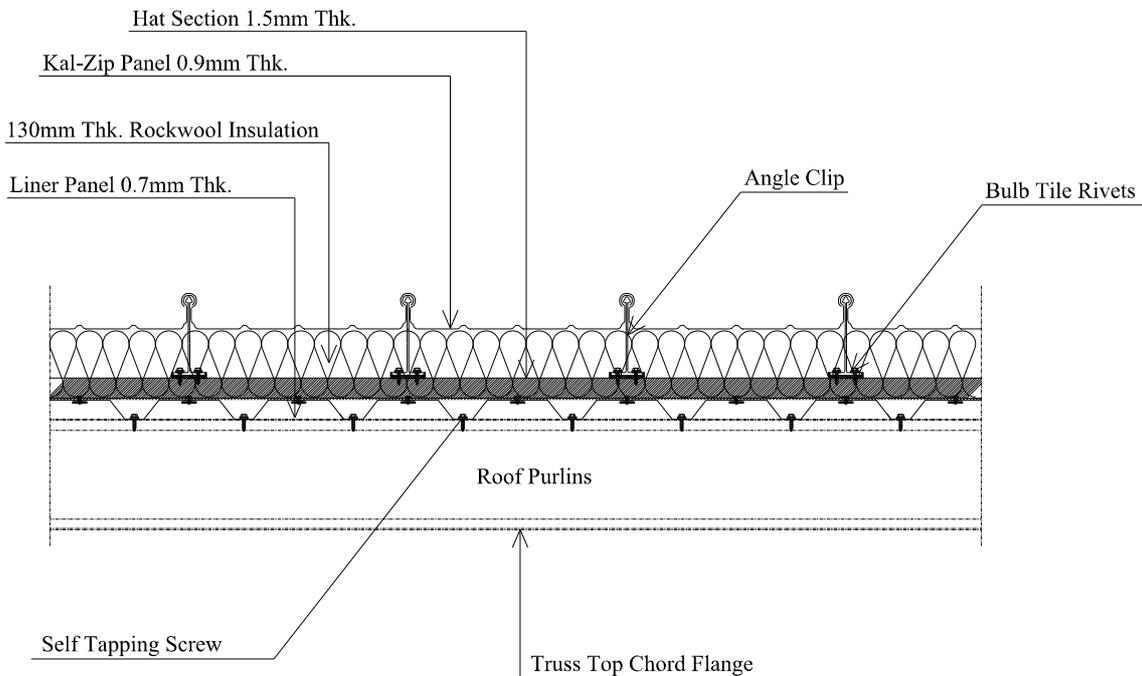


Fig 7: Cladding roof system details

The liner sheet has been painted black on the internal surface and the Kalzip panel which is visible externally is grey color in order to satisfy architectural requirements. Special detailing is provided on the expansion joint locations to accommodate deformation of $\pm 20\text{mm}$ and at the interfaces between glass and cladding.

6. GLAZING

External structural glazing is placed on the facade of the concourse area. The glass plate is stiffened with in use of fin plates perpendicular to its plane at spacing of 1.5m. The fin plate length is 9m and is anchored on the concrete pedestal. On the top is fixed laterally to the steel horizontal trusses. Between the horizontal trusses, parts of glazing strips are placed. Glazing is also used for the skylight openings on the roof, the lift structure and walkway platforms as part of the slab. Architecturally the glazing fits with the steel structure in many forms. Aluminum brackets are provided for the fixing of the glass panels to the fin panels and also for the fixing in the steel structure. The tolerances considered in the steel structure for the alignment of the glass are $\pm 20\text{mm}$ and the allowable deformations on the expansion joints of the building $\pm 25\text{mm}$. Special methodologies has been used for the erection of the glass panels, considering the parallel works on the roof cladding and floor finishes.

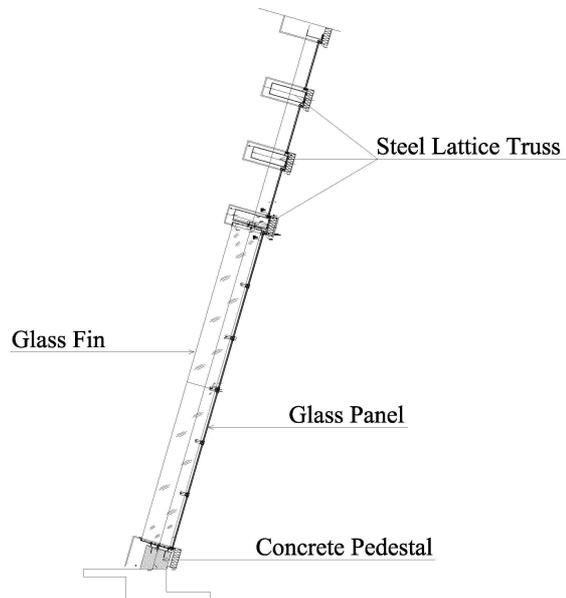


Fig 8: Concourse area - Glazing façade elevation

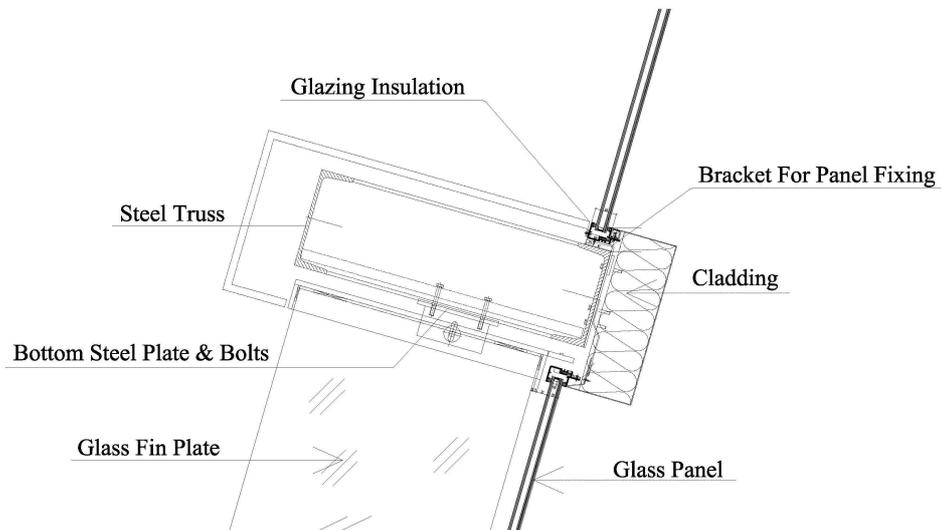


Fig 9: Glass fin connection detail to steel truss



Fig.10: Installation of glass fin plates above entrances

Allowable deflection for the glass panels is 10mm and allowable stress 33MPa. For the fin plate, allowable deformation is 15mm and 15MPa allowable stress.



Fig.11: Concourse area, glass fins-false ceiling and marble finished works

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ΠΕΡΙΛΗΨΗ

Το έργο αφορά την επέκταση του Νέου Εκθεσιακού Κέντρου του Αμπού Ντάμπι, στα Ηνωμένα Αραβικά Εμιράτα. Αποτελείται από το κτίριο των εκθεσιακών χώρων με το κέντρο πολλαπλών χρήσεων (Συνεδριακό κέντρο) συνολικής έκτασης 65000μ², δύο πολυόροφα κτίρια στάθμευσης έκτασης 210000μ² και ξενοδοχείο 19 ορόφων έκτασης 60000μ², συνολικού προϋπολογισμού 240000000 Ευρώ. Το εκθεσιακό κέντρο είναι κατασκευή από Ω.Σ περιμετρικά του κτιρίου που χρησιμοποιείται κυρίως για μηχανολογικό εξοπλισμό και χώρους γραφείων, ενώ η οροφή και οι αίθουσες υποδοχής του κοινού είναι μεταλλικές. Οι πρόσοψη του κτιρίου αποτελείται από ενισχυμένα ναλοπετάσματα και επικαλύψεις απο αλουμίνιο. Το συνολικό βάρος μεταλλικής κατασκευής είναι 5500 t. Οι ιδιαίτερες αρχιτεκτονικές απαιτήσεις του έργου, ο συνδυασμός διαφορετικών υλικών στις συνδέσεις και η διαμόρφωση ειδικών λεπτομερειών στις όψεις αποτέλεσαν προκλήσεις για την κατασκευή σε συνδυασμό με τον σύντομο χρόνο παράδοσης του έργου που ήταν 12 μήνες.