Australian company building on successful entry into Asia

Installation of pre-fabricated louvres from purpose-built travelling platform which traverses along the super truss.

Alfasi Steel Constructions has recently completed a major structural steel undertaking for the roof of the main terminal building for the New Bangkok International Airport.

The company has been awarded a second contract on the project, a sophisticated tension structure for the 40,000 square metre façade.

Buoyed by these successful projects, Alfasi has now also opened an office in Hong Kong.

Avri Alfasi, Chief Executive Officer said that: "We have proven we can operate successfully and profitably in an overseas environment, and on one of the largest projects completed by our company. We are very bullish about prospects in the region so the obvious next step was to build on the reputation and experience gained in Bangkok."

In September 2002, Alfasi was part of a consortium of Australian companies including Chadwick Technology (cladding and gutters) and Thai SCO (glazing), that secured the design and construct contract for the roof of the main terminal building.

The terminal building, featuring large open span areas was perfectly suited to steel construction. The roof, with seven main bays covering approximately 120,000 square metres, consists of:

- steel super trusses, supported on primary columns, span 210 metres at 81 metre centres
- steel secondary trusses at nine metre centres span between the super trusses
- 9 x 72 metre long pitched roofs (skylights)
- 4.5 x 9 metre long louvres form a shading system over the skylights.

Alfasi's scope of work as originally designed involved:

- 8,300 tonnes of structural steel, which increased to 9,500 tonnes with the extra works
- 848 skylight modules of various configurations
- 1304 louvres and
- 344 supporting trusses.

The super and secondary trusses formed part of a separate contract completed by other contractors.

Erection methodology

Critical to the success of this project was conversion of the conforming design from a traditional framed approach to a modular system. Nine metre skylight modules, complete with glass and cladding for lifting into position on the main terminal building roof, were fabricated in Alfasi's site factory.

The consortium of Alfasi Steel Constructions, Chadwick Technology and Thai SCO secured the D & C contract for the roof of New Bangkok International Airport.

Design and construction bid

Alfasi's bid was based on an alternative design and a modular solution to the roof skylight and louvre construction which enabled many activities, previously on the critical path, to be undertaken off-site. Importantly, the consortia bid also provided the client with a single point of responsibility for all roof-related matters.

The alternative design proposed by Alfasi:

- resulted in a five percent reduction in steel from the conforming design
- optimised off-site works
- standardised detailing
- minimised the erection program
- minimised crane demand.

The preliminary concept design was completed by Alfasi's engineering staff in Thailand to enable constant interaction with the project architect, liaison with the main contractor and co-ordination within the consortium. However, detailed structural design and shop detailing was then completed in Australia by Baigents, with whom Alfasi had previously worked.

The erection methodology concept

The original concept proposal by the main contractor had removed much of the roof erection from the program's critical path by allowing seven levels of concrete construction within the main terminal building to proceed whilst the roof steelwork was fabricated and erected. The concept required progressive erection of roof sections on either side of the building and launching of them horizontally over the top of the concrete structure below. Work commenced with the western most bay working progressively on each bay to the east.

Additional scope relating to erection methodology

Alfasi's original scope of work was for the preparation of the methodology of the skylight and louvre erection. Showing the confidence in the skill of the Australian contractor, the scope was extended to the development and confirmation of the concept methodology for the entire roof erection, encompassing the assembly of the secondary trusses and the horizontal launching process, as described above (excluding the super trusses).

The erection methodology concept	Alfasi's detailed methodology as adopted
1. Erect a pair of super trusses forming each bay, and assemble a pair of secondary trusses (by others).	Utilised a pair of needle beams, attached to top of the secondary truss at each end, extended over launching beams located on top and parallel to the super trusses to facilitate truss launching.
2. Erect a row of skylight modules, gutters and flashings on the two secondary trusses creating a 9 x 72 metre long section.	Used a purpose-built travelling work platform (complete with jacks and winches) supported on the launching rails. The work platform traversed along the super truss, working from one end.
3. Launch this section nine metres towards the centre of the building.	A 20 tonne travelling crane supported on the launching rails lifted each skylight module from the travelling work platform either into final position or into a purpose built travelling frame (skate).
4. Repeat two and three, and launch the now 18 metre section a further nine metres.	
5. Repeat process from each side to create 2 x 63 metre roof sections nine metres apart at the centre of building.	On completion of launching process, a row of skylights was lifted in to close the centre gap using the purpose built skate.

Partially complete, the installation of the skylight and louvre modules progresses above the super truss steelwork.

Basic data

Total Tonnage of Steel: 9,500 tonnes
Typical Skylight Module Weight: 3.6 tonnes
Typical Louvre Weight: 6.0 tonnes
Erection Period: 9 months
Peak workforce: 150 including supervision

This process removed a significant number of constraints and dependencies between the various tasks.

Alfasi also took on the responsibility for long and short term programming, chairing the critical co-ordination meetings between the super truss / secondary truss erector, the jacking company, the mechanical and electrical installation contractor, the main contractor and roof team, as well as detailed crane studies for all cranes required for the various lifts.

In preparation for erection

With a structure and method of this nature, the detailing associated with the launching process needed to consider the structural displacements of the various supporting elements.

The responses of the super trusses, wing tip structures, secondary trusses and skylight modules were assessed by Alfasi to ensure adequate clearances during erection and launching. These displacements included vertical displacements, racking distortion of the roof section during launching and warping of the super trusses, due to unequal loading during launching of the roof on one side only.

On-site assembly – site factory

A 10,000 square metre assembly factory was established on the site, enabling site assembly, cladding and glazing installation of the modules of skylights or louvres in a production line approach.

The establishment of the on-site facility including the purpose built assembly jigs and paint booth was overseen by Alfasi's Peter Jones. Jones, who stayed in Thailand until the completion of work through the on-site factory, said that: "It was critical to create a production line process, to meet the required site demand for the various modules, as well as maintain the quality of the product. After an initial start up and training period, we found the local workers were constantly delivering a high standard of workmanship."

Upon completion of the design and shop detailing, the fabrication of the steel elements was subcontracted to local nominated subcontractors. Most elements were too large

to be transported to site, so were split into sub-assemblies and fabricated in the off-site fabrication yards under Alfasi's management and quality assurance (QA) inspections. These were delivered to site according to the erection needs and monitored by an in-house tracking system.

These sub-assemblies were welded to form the final steel module before inspection and application of final paint, prior to aluminium glazing bar/glass installation. Typically four panels of laminated glass (by Thai SCO) were installed in these sub-assembly areas, followed by the installation of the aluminium ceiling, insulation and roof cladding system (by Chadwick).

All of this activity utilised purpose built trailers, frames and trolleys for ease of movement, storage and control of damage.

Tender production rates, set at four modules per day (skylight) and three modules per day (louvres) were exceeded throughout the duration of the assembly.

Final erection

As sub-assembly was progressing, the erection methodology was successfully implemented to complete the roof steelwork and louvre system. The methodology sequence was:

1. Skylight modules and completed louvres were called up in the required order from storage areas.

2. Quick release lifting beams were connected to the sides of each module and locating brackets were used to accurately position modules.

3. In-situ splicing was minimised through pre-fabrication in longest lengths possible.

4. After the main contractor requested acceleration due to delays by others, typical erection rates of 12 modules per day were achieved.

5. Utilising the same rails as the 20 tonne travelling crane (i.e. the original launching beams), skylight modules were moved along the structure to the appropriate launching position. This process was repeated until all modules had been installed.

6. The closure bay (centre gap between secondary truss roof sections) skylights were installed using a purpose designed and built skate-type platform and a winching system.

7. Attention to the detail in the preparation, planning and off-site processes ensured a smooth process during the on-site erection.

The New Bangkok International Airport will open in 2006. This complex project, with all its program challenges, has been completed with the expertise of Alfasi and their consortium partners. The new airport will handle up to 40,000,000 passengers per annum and aims to ensure Bangkok remains a major air transport hub in Asia.

Project team

Main Contractor: ITO Joint Venture (Principally Takenaka Japan)

Project Architect: Murphy Jahn / TAMS / Act (USA)

Project Structural Engineers: Werner Sobek Ingeniere (Germany)

Steelwork Contractor: ALFASI Steel Constructions

D&C Engineers and Steel Detailers: Baigents (Melbourne, Australia)

Gable end skylights were pre-assembled, complete with glazing, cladding and water proof membrane, ready for erection.