Sydney Domestic Airport Carpark

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Domestic Terminal Carpark

SYDNEY AIRPORT

Sydney Airport is undergoing some major changes as part of the New Southern Railway Project due to be completed in 2000. The project will link the city with the existing East Hills and Illawarra railway line and link up with new train stations at the domestic and international airport terminals. There will also be new underground stations at Alexandria and Mascot.

Constructing a train station at the domestic terminal required demolition of one third of the existing carpark. A new carpark was first built to replace the car spaces lost in the demolition. Subsequent stages can be built at a later time to fit into the rail system construction program and to minimise disruption to airport customer parking.

Stage 1 of this replacement carpark comprises 4 suspended and a ground floor level, to replace the car spaces lost from demolition and to provide additional spaces, a total of approximately 1370 spaces. Three levels are now completed and operating, and the 4th level is about to be built.

Subsequent construction of additional carpark levels can be undertaken as required to meet growing parking demand with structural capacity available for up to 8 suspended levels. This would provide a total of up to 2450 car spaces over the current building footprint and many more if the footprint was extended to the full available site.

Completion of these subsequent levels can be undertaken after construction of a rail tunnel beneath its foundations to link with the train station.

Tunnel construction in the soft ground conditions encountered at the domestic terminal may cause a small amount of settlement of the carpark structure. This may require Stage 1 of the carpark to be jacked back to its original position and allowance has been made for this. Building just 4 levels of the carpark in Stage 1 and using a lightweight flexible structural steel framing system, meets the requirements of minimum structure loads onto the substrata during tunnel construction, and enables rejacking of the structure if required.

The rail tunnel will be approximately 10m in diameter and its crown will be approximately 11m below ground level. This is also well below the water table in the area, which is close to ground level.

Bedrock is at approximately 20m and it would not have been possible to pile down to this level for the carpark in the tunnel region. The foundation system adopted was then:

- Vibro compaction of the upper 2 to 4m of loose sands to create a denser sand zone.
- Installation of piled foundations through the compacted zone and into the natural dense sands below. Piles were able to be limited to 4m in length.
- The piling system specified was a screw pile system to maximise skin friction as well as end bearing. With this total system and relatively close spaced columns above, the structure load on the tunnel during construction is minimised and spread into substrata as much as possible.

Carpark demand and ground conditions combined with the influence of the tunnel and train station construction set some unusual and interesting structural challenges to which structural steel provided the solution:

1 Fast construction was required to provide replacement carparking as quickly as possible, so that demolition of the existing carpark

could then commence and subsequently station construction.

2 A steel structure provided minimum mass, important in the transmission of loads to the tunnel during construction in particular, and reducing forces in earthquake conditions, both important considerations with the poor soil conditions. Minimum mass will also be a critical factor if the jacking process is required after the tunnel is completed.

3 Steel's flexibility and ductility are important qualities to minimise the effects of any differential movement during tunnelling and re-alignment during the jacking process. This can be done by bolting brackets against the columns and jacking between the brackets and pilecaps. Extra-long holding down bolts were specified to allow for movement during jacking.

The new carpark is connected to the original carpark to allow traffic flow between the two, although each has their own entries and exits. Decks are split level with long ramps at each end for access from Ground to Level 1, and from then on patrons can use a 'fast up' and 'fast down' ramp system. It is a fully open-deck carpark and fire protection of the steel structure is not required.

Apart from the minimum loads transmitted to the rail tunnel by ground conditions, the structural design aimed to minimise point loading above the tunnel. To simulate distributed loading, columns and pile groups were closer than normal and generally spaced at every second car space, 5.5m, along the length of the building.

Overall dimensions of the new carpark structure are 103.5m long and 65.5m wide. Width consists of 4 portals and a cantilever extension at each end of the portals. The two inner portals are 16.25m between the columns and the outside portals are 12.15m between the columns. Cantilever extensions are 4.35m long. This layout ensures that columns are generally at the corners of parking bays causing minimum interference with parking vehicles.

The carpark structure is made up of steel columns and beams with a 140mm cast insitu concrete slab acting compositely with the steel beams. There are no beams in the transverse direction to the primary beams in the portals and so lateral bracing was achieved by utilising the diaphragm action of the floor slab and tubular bracing members. In the frame directions, lateral loads are resisted by portal frame action of the steel frames. Minimum structural interference with the carpark layout was achieved by positioning the columns at the grid spacing noted above and in accordance with the requirements of A82890.1 SAA Parking Code. Bracing members were aligned with the ends of parking bays.

All the main beam to column connections are bolted moment end plate connections. To achieve an economical and more elegant solution the 364 x 300mm I columns were fabricated from plate with thickness and welding specified so that stiffener plates at the connection locations were not necessary. The beams are 692 x 250mm welded beams in grade 350 steel for the 16.250m spans and 610UB101 grade 300 for the 12.15m spans. Cantilevers were cut from 610UB101 grade 300 sections to provide a tapered beam, which created a slender appearance to the slab edge from the carpark's exterior. The cantilevers project over an existing easement for possible ultimate road widening and were designed with bolted connections to enable subsequent removal if the easement should be required in the future.

The facade system has continued the steel theme utilising a diagonal pattern of tubular members in modular frames. Each panel is bolted to vertical tubular posts at structural grid lines to create a light and open impression. Vehicle impact posts and rails are constructed on the slab just inside the facade.

A minimum grade across the decks necessary for overall drainage, was simply achieved by inclining the beams. This has the advantage of allowing the concrete slab to be placed with constant thickness, at a minimum grade.

The project, with its challenging design requirements, was able to capitalise on the advantages of steel: low mass; high strength; speed of construction; and flexibility - ease of modification.

Painting required blast clean to Class 2.5 and a three coat paint system comprising Inorganic Zinc Primer, High Build Epoxy and High Gloss Catalysed Acrylic. The system was chosen to provide high quality protection close to a marine environment and also exposure to aviation pollution. It allowed a wide range of colour selection for the top coat with high quality fully compatible lower coats.

Project Participants

Client:	New Southern Railway Project Consortium Transfield Bouygues Joint Venture
Builder:	Transfield Bouygues Joint Venture
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Architect:	Malone Campbell-Allen
Fabricator:	Transfield Constructions Pty Ltd
Owner/Operator:	Federal Airports Corporation