This case study was written at the time when OneSteel was part of BHP. In that context, in some instances within this case study, reference may be made to BHP.

Speed and Safety for Emergency Services

The new $4.9M Department of Emergency Services combined Workshop, Office and Warehouse complex at Kedron Park in Brisbane employed the latest composite steel and concrete floor design techniques, as well as a performance-based fire engineering approach.

FIRE SAFE

Above: Cutting edge design has delivered the goods for the Department of Emergency Services.

Completed in November 1999, the 75m by 36m building comprises:

- a 1200 square metre warehouse storage facility, 11 metres in height
- workshops for technicians to prepare equipment and to fit-out ambulances and fire trucks
- storage area adjacent to the workshops to hold equipment for vehicle fit-out purposes
- central administration offices servicing both the workshops and the warehouse areas, and a large conference area for 200 people.

Architectural Expression Exploits the Advantages of Steel with a Fine and Elegantly Expressed Structure

According to Mark Jones of Mark Jones Architects, all the various steel elements were selected after detailed research into alternatives.

"Material selections were made on the basis of economy, availability and keeping the client's maintenance costs to a minimum," he said. "Time and cost advantages confirmed the choice of a structural steel frame in preference to concrete construction."

The various functional elements of the building are expressed in architecturally distinctive treatments. The warehouse is a simple but striking large blue shed, whilst the office portion of the building expresses its occupancy through fenestration and sun shading. An industrial quality has been used for the workshop annex area. The vertical circulation zone at the entry of the building is expressed in strong vertical elements of solid colour and glass. The suspended floors are composite BONDEK II slabs, to take advantage of the fast speed of construction.

Latest Steel Composite Technology, with Speed and Accuracy

Engineer Geoff Martin of Geoff Martin & Associates designed a structural steel frame system for the entire multi-faceted complex. The single storey logistics warehouse component is a braced steel portal; the single storey workshops annexe and the central three storey office component are both braced steel frames, whilst the office suspended floors are of composite steel and concrete construction.

Geoff was impressed with the technical support and composite design aids provided by BHP. Use of COMPBEAM™ software, which incorporates partial shear theory for composite beams, enabled quick and cost-effective design of the steel beams.

The composite floor is designed for a Live Load of 3 kPa on a 6.3m x 6m grid. Floor beams are composite and are all 300PLUS sections. Primary beams are typically 310UB40, and span 6.3m at 6m centres. Secondary beams are typically 250UB31, and span 6.3m at 2.8m centres. A 135mm thick in-situ concrete slab is supported on 1.00mm BONDEK II.

The builder for the project was A.W. Edwards Pty Ltd. Site Manager, Scott Baldwin, said steel was the right decision for this job.

"It provided fast erection and fitted together very well on site," he said.

Scott said a key construction issue during pouring of composite floors is to ensure that any primary beam is fully loaded before the wet concrete slab supported by the beam is screeded to final level. Scott and consulting engineer Geoff Martin devised a concrete pouring sequence that ensured concrete was poured to both the floor bays that were supported by the primary beam, before continuing on to other bays. This allowed the beam to deflect under the mass of wet concrete, so that the supported slab could be confidently screeded to final level. A high level of accuracy of the finished floor level was thereby obtained, and enabled fast construction of the overall floor.

Performance-based Fire Engineering Design Addresses the Issues that Really Matter

The aim of the fire safety design in this project was to prevent the occurrence of a

significant fire, thereby enabling people to evacuate safely and minimising potential property damage. The client was particularly concerned with avoiding loss of stored goods, considering the emergency nature of many of the materials.

The complex includes areas with differing uses. The central zone comprises a three level office building located between, and attached to, a single storey annexe/workshop and a single storey warehouse. The central section consists of an office/electronics workshop on Level 1, offices on Level 2, and offices and conference rooms on Level 3.

The warehouse includes a high bay storage area and a dispatch and store area. The high bay storage area contains a 6m high racking zone containing a variety of materials including bandages, boots and forms, all packed in cardboard cartons. No flammable liquids are stored in the warehouse.

The Building Code of Australia (BCA) deemed-to-satisfy requirements suggest different types of construction for the various areas of the building (Table 1).

Fire and mechanical engineering consultants to the project, MultiTech Solutions Pty Ltd, undertook a Level 2 fire engineering analysis of the building in accordance with the Fire Code Reform Centre's "Fire Engineering Guidelines". The intent of the analysis was to comply with BCA performance requirements CP1, CP2, CP4, CP9, DP4, EP1.4 and EP2.2.

According to MultiTech Solution's Director, David Auld, the key issues identified were:

- Provision of early warning of fire to occupants, especially those in third floor offices and conference rooms. This is a particular concern if a fire starts in a ground floor workshop, at a time when the workshop is unoccupied.
- Fire spread from the warehouse to the office/conference room levels.
- Protection of property generally, and stored goods in particular (especially electronic components), from smoke damage.

The major outcomes of the fire engineering analysis were:

- Incorporate a sprinkler system throughout the building. In the warehouse, provide 68ºC sprinklers with deflectors within the racking and 141ºC quick response sprinklers at roof level. Provide cut-off sprinklers to drench the wall between the warehouse and the three storey construction.
- Smoke exhaust from Level 3 offices/conference rooms, the warehouse and the annexe, including detection in supply and return air ductwork associated with the air conditioning system. Provide a skeleton smoke detection system to Level 3 office and conference rooms, and the warehouse.
- Occupant intervention – provide portable extinguishers complying with AS2444, especially in the annexe and warehouse.

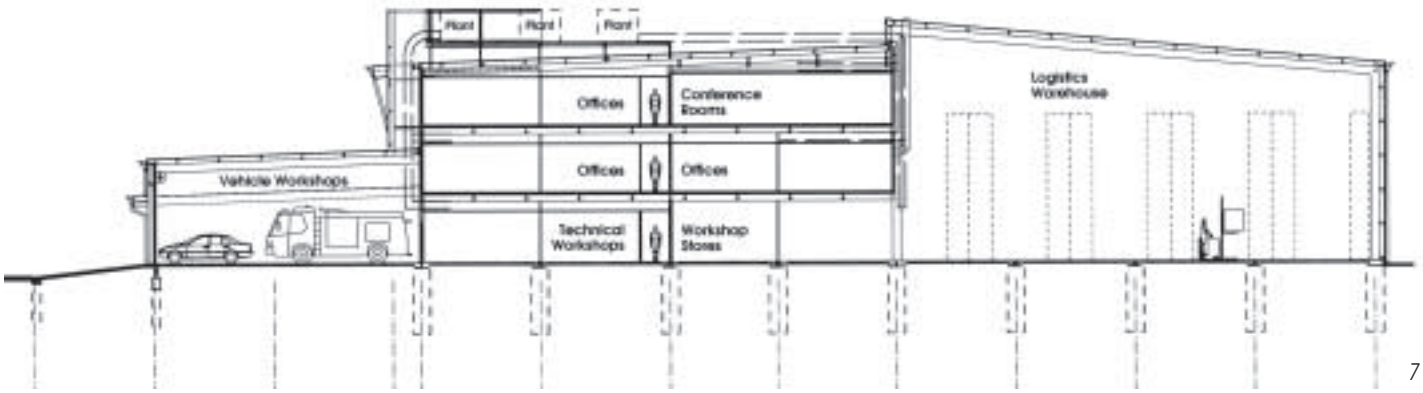
The design of the complex utilises strong steel expression.

Table 1

Occupancy Type	Classification	No. of Storeys	Type of Const'n	Construction Requirements
Offices	5	3	B	• Columns generally, FRL 240/-/- • Internal columns above top floor, FRL -/-/- • Floors, FRL 90/90/90 (concession)
Conference rooms[1]	9b	3	A	• Internal columns above top floor, FRL -/-/- • Floors, FRL 90/90/90 (concession)
Warehouse	7	1	B	• Internal columns, FRL 240/-/- • External columns, FRL 240/180/90
Annexe	8	1	B	• Internal columns, FRL 240/-/- • External columns, FRL 240/180/90

Note 1: conference rooms occupy approximately half of Level 3 of the central section.

Above: Construction of unprotected steel frame in July, 1999.
Below: Cross section of the Emergency Services complex.



• On-going management by the Department of Emergency Services - maintain fire safety systems in accordance with relevant Australian Standards. Manage occasions of sprinkler system isolation so that isolation period is minimised. Reconnect the system overnight when refurbishment activity is not being undertaken.
• Structural steel frame and composite floor – unprotected steel columns and floor beams are adequate in a sprinklered fire. Adopt FRL 60/-/- for floor.
• Occupant avoidance – with the above measures in place, the available safe egress time (ASET) is significantly higher than the required safe egress time (RSET)

The decision to sprinkler the building has dual benefits in that it improves life safety and minimises potential property damage. The fire safety engineering analysis incorporated, in part, the recommendations of "Design of Sports Stand Buildings for Fire Safety" and the FCRC's "Fire Safety in Shopping Centres – Project 6" publications.

Steel Fabrication and Erection

Milfab Pty Ltd fabricated and erected the 120 tonnes of steel for the project, including steel to external walkways, sunhoods etc. Shear studs were installed on site and erection was carried out using a 30 tonne hydraulic crane. The steel frame is protected with a zinc-rich primer and all exposed steelwork is hot dipped galvanised.

Project Participants

Client:	Queensland Department of Emergency Services
Architect:	Mark Jones Architects
Structural Engineer:	Geoff Martin & Associates
Mechanical & Fire Engineer:	Multitech Solutions Pty Ltd
Hydraulic Consultant:	Mike Norris & Partners
Electrical Engineer:	Barry Webb & Associates
Interiors:	Paul Jones
Project Manager:	Lloyd Goves
Builder:	A.W. Edwards Pty Ltd
Quantity Surveyor:	Lowry Hart Partnership
Steel Fabricator:	Milfab Pty Ltd
Stud Welding:	Stud Welding Pty Ltd
Deck Laying:	Viking Constructions
Shop Detailer:	Tregar Engineering