ATHOS
This group of eight storey high offices in Paris was built at a cost of 27 million Euros (around $A48 million). The superstructure has steel beams with a span of eleven metres. Interior footbridge cross the atrium suspended by tension cables fixed to the interior façade to create an extremely light and slender structure.

STRUCTURAL STEEL – THE MATERIAL OF CHOICE

INNOVATIVE STRUCTURAL ENGINEER PETER TERRELL VISITED AUSTRALIA AND TELLS OF THE STEEL REVOLUTION IN THE FRENCH CAPITAL.

Long clear spans and faster construction times of up to 20% – key drivers in the increased use of structural steel in Paris.

Paris based English engineer, Peter Terrell, visited Australia in October under the auspices of OneSteel and BlueScope Steel and spoke of his influence in converting what was, until recently, a concrete building environment to steel.

Much of historic Paris is, relatively speaking, not so old. The city was rebuilt following the 1848 revolution by Napoleon III. In a process of "constructive destruction" the city was rebuilt to replace the narrow rabbit warren of streets with ancient overhanging dwellings, dating back centuries. Baron Georges Eugene Haussman laid out the boulevards lined by elegant, uniform façades identified and loved today as Parisian.

It is these buildings that are being rebuilt. Innards are gutted, structures redesigned to accommodate modern functions and interiors remodelled with stunning sweeps of clear span space, made possible by steel.

Paris had, until recently, a strong concrete culture. Post World War II, steel was in short supply so most buildings were concrete-framed as concrete technologies developed to feed the worldwide post-war building boom.

Like most good stories the leap in structural steel construction in Paris began with a single project. Terrell International demonstrated the commercial benefits of large open plan spaces to a single owner/developer. Once one steel framed building, with large column free spaces, was snatched up at premium rates within 48 hours of hitting the rental market, steel began to make an impact.

Peter Terrell is the Principal of Terrell International and a member of the Council of the Steel Construction Institute in the UK and of the Consultative and Development Committee of the Centre Technique Industriel de la Construction Métallique. In 2001 he was awarded the Association pour le la promotion de l'enseignement de la construction en acier (A.P.K.) prize for his contribution to promoting steelwork design and construction in France.

Steel is now the material of choice for an increasing number of buildings in Paris, taking advantage of faster construction times and clear span space that steel offers.

Peter Terrell demonstrated in his projects what could be achieved when an innovative engineer presents solutions to the developer and tailors the solution to meet the need of his client.

In the late eighties Peter Terrell established Terrell International as a structural engineering consultancy in Paris and challenged the monopoly of concrete on building structures.

From a position where almost no projects were constructed in steel 10 years ago, steel is now the material of choice on around 32% of buildings and that is growing. Peter estimates that between 50-60 per cent of larger projects (20-30,000 square metres) where the spans are 18 metres or above are now done in steel.

In a series of briefings with Australian construction executives, including engineers, detailers and fabricators, Peter Terrell shared his expertise, experience and insights into steel construction.

Much of the work Terrell International does in Paris is in the reconstruction of buildings from the mid 19th century where, for historic considerations, it is necessary to retain the building's façade. Peter Terrell said that, from experience in Paris, the only way to achieve existing floor-to-floor levels in buildings with long spans and retained façades was in steel.

The regulatory environment for these projects is strict with almost no obstruction allowed on the streets of Paris. This often necessitates complex façade propping, adding to overall production costs.

Many of Terrell International's commercial reconstructions were executed with clear spans of 17 to 20 metres achieving unprecedented column free space. These buildings rent within very short time frames and attract premium rentals in a highly competitive market.

It appeared that it is the variations to the way steel is used overseas that has given it its exceptional market growth.

STEEL'S ADVANTAGE

One of the major advantages of a steel solution is in construction time. Delivery of a steel project can be up to 20 per cent faster than an alternative solution.

As Peter Terrell discussed his work several issues emerged from his Australian audiences. One of the major issues was, naturally enough, the cost of a structural steel solution.

COST VERSUS VALUE

Cost is an important issue for clients in both France and Australia with the cost of a steel structure anywhere between 2-4 per cent of alternative material.

When asked about why an increase of 2 per cent on a steel structure was such a cost issue Peter Terrell said that, "to a developer every saving was worth having. The balance for a developer is quality against cost".

"If they produce quality they either have a better guaranteed market for their product so they can consolidate their position, or if the market turns down the building is more likely to rent and at an increased rental value. So if they perceive that benefit they will accept the structural cost increase."

Peter Terrell says that Paris cost estimates indicate that projects where the spans are over 12 to 14 metres are cost competitive in structural steel. Australian audiences agreed that this is the case in local construction but with different cost variables, such as the cost of formwork. Other issues raised were resonance or vibration, redundancy and fire safety.

DYNAMIC RESPONSE

Peter Terrell said that with the type of cellular beam structures - the floors with large openings in the web of the beams - vibration and fire engineering were the main concerns.

Peter said that he prefers the term "dynamic response" to "vibration" because "vibration means that you have already set (the floor) into some form of

Don McDonald, Chief Executive, Australian Steel Institute and Peter Terrell (right). The seminars in Sydney and Melbourne were organised by the ASI, and jointly sponsored by OneSteel & BlueScope Steel (previously BHP Steel).

Increasingly, the use of long, clear-span prefabricated steel beams and metal decking form the major part of the structural package

resonance". Dynamic response depends upon the input to a system. When you are talking about a building it depends on the use to which that building will be put. Offices have a completely different input to a gymnasium or a dance hall.

"When I talk about input I'm talking about the event or force that creates a dynamic response in the supporting structure. For offices it's now generally accepted that the defining input that is liable to illicit a dynamic response in the floor is one person walking or at most two people walking in step."

"Because we are dealing with relatively light structures the relationship between the mass of a human being and the mass of the floor is more readily affected by this dynamic input than a heavier system. So the design and dynamic response of these floors has to be very carefully looked at. It's a common misconception that long span floors give the most problems in this respect. In fact, the longer spanning floors have greater mass and are therefore more difficult to excite."

Once a building was fitted out the carpets, office furnishings and equipment and other non-structural components added sufficient damping that floor vibration largely became a non-issue.

FIRE ENGINEERING

Fire engineering issues differ in France, where 28 metres, the height of a fireman's ladder, is classified as low rise and above 28 metres high rise. The fire resistance level (FRL) for the first is 60 minutes while for the latter it is 120 minutes. No sprinklers are required in France and no dispensation is available if they are installed.

Peter Terrell said that where a fire protection spray is used it is better not to paint the steel to achieve more reliable adhesion. If it is not fire sprayed then the regulations in the UK allow internal steel to be left bare, but not so in France, where painting is required. In Australia, which is reported to be a world leader in fire engineering, no passive spray is becoming acceptable because of the increasing use of sprinklers and fire engineering.

REDUNDANCY

When the question of redundancy was raised Peter Terrell said that the steel structures were designed with multi-load paths so that a single failure in a member couldn't lead to the collapse of a structure. He added that since the WTC collapse, redundancy in design needs to be ensured and occupant exit routes hardened. He said that cellular and solid beams would perform better than the WTC trusses in fire.

COLLABORATIVE APPROACH

Peter Terrell emphasised that client needs have to be a prime focus. When this is at the heart of the project developers, clients, designers, engineers and fabricators can work together to provide a high quality commercially attractive solution.

Increasingly, the use of long, clear-span prefabricated steel beams and metal decking form the major part of the structural package.

The key points that emerged from these technical briefings were:

- the best approach to design was to take a holistic approach where the structural engineers meet with the client and mechanical and service engineers early in a project's planning
- the best advantage for steel is where the grids and the layouts are suitable for steel and
- beams don't need to be painted in air-conditioned offices.