Brookfield Place, Perth

Australian Construction Achievement Awards

Technical Paper

Abstract

The site of Brookfield Place is one of the most famous and historical sites in the Perth CBD, having been Perth's infamous "hole in the ground" for 20 years following the partial completion by a previous owner in the early 90s. The vacant lot and untenanted heritage buildings sat as eyesores on the Perth landscape prior to Brookfield Multiplex committing to transform the space with the view of creating a vibrant inner city destination.

Brookfield Place is one of Australia's most significant commercial and retail developments; occupying the commercial heart of the CBD, it provides a new civic space for the people of Perth. Brookfield Place offers an exciting addition to the Perth city skyline, providing a unique example of how a cutting edge contemporary design can mesh with its historical predecessors, these being the Heritage buildings which front the precinct. Blending the best of the old and the new, Brookfield Place has demonstrated our ability to deliver upon key commercial building criteria by:

- Encompassing significant sustainability benefits;
- Working collaboratively with our client and tenants to deliver best for project solutions;
- Providing new civic space for the City of Perth;
- Giving a new lease of life to dilapidated heritage buildings and meeting current and future client requirements.

Introduction

The Brookfield Place Development project consisted of:

1. Design and construction of a 45-storey office tower with a net lettable area of 74,854m^2;
2. The refurbishment of five heritage buildings (net lettable commercial area 4,064m^2; net lettable retail area 7,126m^2). These included Newspaper House, Print Hall, WA Trustees, Royal Insurance and Perth Technical College;
3. New childcare centre, gym, and a 10 tenancy cafe court;
4. 4 levels of basement, tenant end of trip cycling facilities, Tenant Roof Terrace and Storage

The following plans and elevations summarise the expanse of the precinct and the overall scope of works:

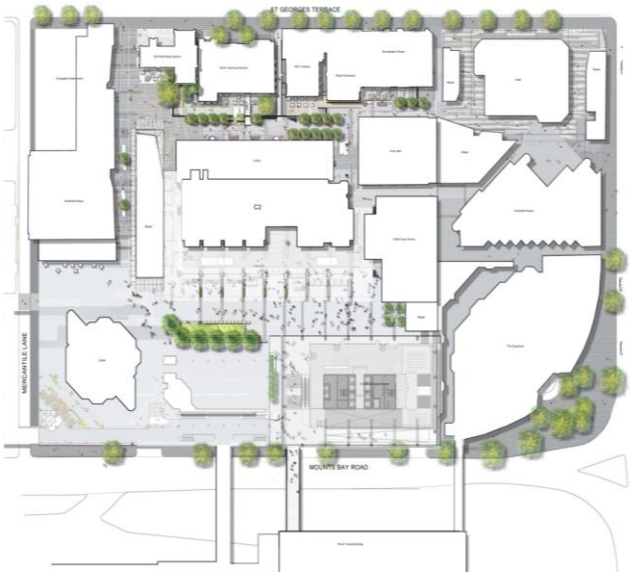

Figure 1 – Brookfield Place precinct master plan

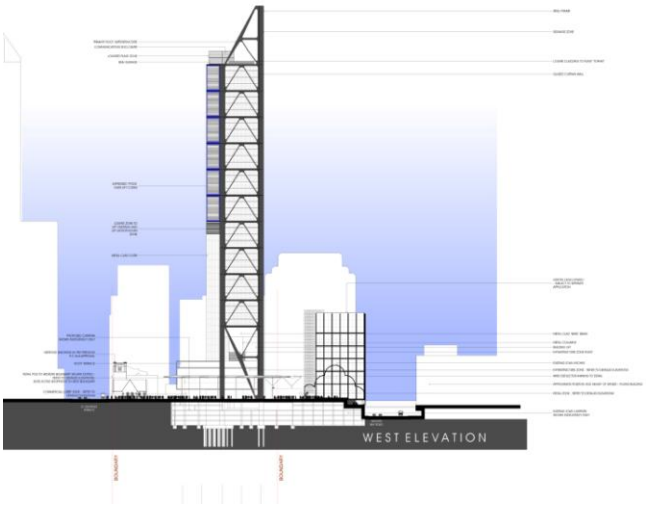

Figure 1 - Section through west elevation

The core contractual arrangements between the various parties included:

- *Design and Construct (D&C) Contract* - Brookfield Place was primarily delivered under a Design and Construct (D&C) Contract which was negotiated in June 2008 between Brookfield as the Principal and Brookfield Multiplex as the Contractor.

- *Tenant Agreement for Lease (AFL) with BHP Billiton* - Brookfield Multiplex was also required to develop the Tenant AFL with BHP Billiton on behalf of the building owner, Brookfield.
- *Barrick Gold Design & Construct Fit-out Contract* - Brookfield Multiplex was engaged by tenant, Barrick Gold, for the design and construction of their 5,000m^2 fit-out.

Outcomes

Safety

The Key Result Areas for Occupational Health and Safety (OH&S) were to ensure;

- No lost time incidents occurred;
- Growing a strong safety culture;
- Eliminate Risks through Brookfield Multiplex's 'Safety in Design' program; and
- Identifying and prioritising critical risks in project planning.

Brookfield Multiplex maintains accreditation under AS 4801 - Occupational health and safety management systems, as well as accreditation with the Office of the Federal Safety Commissioner complying with The Building and Construction Industry Improvement Regulations 2005. Furthermore, Brookfield Multiplex applies the AS/NZS 31000:2009 Risk management principals and guidelines.

A strong safety culture was established from the top down with the emphasis placed on safety going well beyond our contractual obligation. While safety in design played a critical part in managing risk in a theoretical manner, Brookfield Multiplex also took a proactive 'hands on' approach throughout the course of construction which ensured all Brookfield Multiplex staff, subcontractors, consultants and visitors understood the critical importance of safety and thus making it a priority. To achieve this goal:

- A comprehensive subcontractor management process was implemented to ensure compliance with Brookfield Multiplex's accreditations, relevant OH&S legislation and applicable codes and standards;
- Employing Brookfield Multiplex's 'Safety By Design' philosophy to focus on critical risks and emphasise the planning process;
- Over 4,800 personnel were site inducted;
- Brookfield Multiplex's Safety Management Plan was reviewed at regular intervals in line with changing construction environment.

This approach proved to be extremely successful as throughout the course of project no major incident occurred which resulted in serious injury or harm.

In addition, the project received the MBA's *Federal Safety Commissioner's Award for Outstanding Safety Solution* for the innovative ''Mega-Deck'' used to provide safe and efficient access to the external K-frame during erection.

There was no record of any incidents, injuries or near misses involving the ‘‘Mega-Deck’’ or by the work conducted by the teams during installation while working on the ‘Mega-Deck’. Additionally, the ‘‘Mega-Deck’’ system created safe access and egress for personnel required to work on the K-Frame without fear of losing material or tools. The way the system was designed also ensured that no personnel were exposed to awkward body postures that significantly contribute to musculoskeletal sprains and strains. This significantly reduced the potential for health and safety related lost time caused by manual handling involved with the task.

Such a revolutionary system has not been seen or used in Western Australia before and has ensured compliance with the principles of ‘OH&S in Design’ to ensure personnel have not been exposed to unnecessary risk.

Time

The Key Result Areas for Time were to ensure:

- Target finish date of 29th August 2012, later altered to Practical Completion date of 17th May 2012;
- Complete a fully functional building and surrounding precinct prior to existing BHPB leases expiring;
- Mitigate lost time as a result of GFC related finding delays.

The feasibility of the Brookfield Place Development was, from the outset, dictated by time. Negotiations with the anchor tenant for the tower component of the project, BHP Billiton, were based upon the abilty of Brookfield Multiplex to design and simultaneously deliver a 74,854m^2 premium grade commercial tower, as well as the associated 10,000m^2 heritage restorations and plaza precinct, in order to meet with the expiration of existing leases that BHP Billiton had in numerous buildings throughout Perth CBD. BHP Billiton mandated that the entire precinct be completed in one single milestone to allow for their entire workforce to simultaneously move into a completed, fully functional precinct, without needing to extend any of their existing lease agreements.

Having such tight time frames in place, it was necessary for Brookfield Multiplex to execute an Agreement For Lease (AFL) with BHP Billiton based on high level performance specifications and development approval drawings only, before proceeding to a fast-tracked design development and the tenant approval process. Concurrently, early trade packages were procured and let to enable ground works to commence prior to the design of the building superstructure being fully resolved. This process of fast-tracking design and construct continued throughout the duration of the project, with design delivery staying just ahead of site execution.

Due to the tight construction time frames, many examples of time saving construction methodologies were initiated to allow for the project to be completed on time. At every

planning meeting the primary topic of discussion was to determine the logistics for progressing with the next activity, questioning how long the activity would take and whether there was a quicker way.

Completion of the roof top 'capitol' structure was achieved in line with contract programme, despite lost time due to inclement weather (predominately winds) averaging 40% throughout the 4 month erection period. For time critical sections of the podium structure outside of the tower footprint, a 'jump start' methodology was employed that took the structure directly from Basement Level 4, to the Podium level. This created overhead protection for the building of level B3-B1, allowing key overhead works at the top of the tower to continue unabated. For the final 4 months of programme the project was operating on a 3 shift basis, 24 hours a day, 6.5 days a week with a peak workforce of 600 employed on the project, with up to 150 of these workers undertaking the night shift (10pm-6am).

To facilitate the earliest possible occupation for BHP Billiton, Brookfield Multiplex was able to hand over specific sections of the Works to BHP Billiton prior to PC. This enabled them to carry out business critical works required to be completed prior to occupation. In many instances, Brookfield Multiplex not only facilitated access for BHP Billiton contractors, but worked alongside them so that all parties were able to achieve the optimum outcomes in regards to time.

All of these factors contributed to Brookfield Multiplex achieving Practical Completion on the 17th May 2012, a full 104 days early of contractual date of Practical Completion, set for the 29th August 2012.

Cost

The project was delivered within 94% of the contract amount with the final project costings per the following:

Overall, Brookfield Multiplex achieved significant cost savings throughout the project whilst being able to maintain the integrity of the product delivered. Cost savings were predominantly centred on streamlining construction through the implementation of smarter, faster and more efficient solutions rather than reducing the overall quality of the product.

Quality

The Key Result Areas for Quality were to:

- Maximize client satisfaction;
- Deliver a high quality product within set budget and timeframe;
- Mitigate defects where evident and rectify as soon as practicable.

To ensure maximum client satisfaction, Brookfield Multiplex's goal was to achieve Practical Completion with a minimum number of defects, and ultimately have zero impact on the tenant's operations post-handover. To this end it was our responsibility to manage our team, including architects and engineering consultants, to deliver a product which has reset the benchmark for commercial developments in Perth.

Through a collaborative approach, the acceptance of building design, configuration, materials, colours, furniture, fittings and equipment, was managed through an extensive approvals system where 1,000+ samples moved through the approvals process. Brookfield Multiplex ensured client satisfaction through providing full scale prototypes; these included a façade prototype which was assembled in China, lift and work station prototypes which were assembled in Switzerland, and meeting room prototypes which were assembled in Australia.

A quality product was then delivered by carefully selecting highly skilled tradespeople and the management of quality workmanship by our site management team. The project's approach to quality involved the implementation of Brookfield's ISO9001 certified Quality Management Plan with the approach to quality being set out in the Project Management Plan. All members of the project team were responsible for the implementation of the Quality Management Plan while this same Quality Management Plan flowed throughout the project and was passed onto the subcontractors where it had a direct correlation to their payments and liabilities through the construction commissioning and defects period.

At completion of construction the project team undertook a detailed defects inspection for each package and area of work. Areas were tested and a cutting edge cloud-based defect management system called PenMatrix was deployed to record and issue internal defects to relevant subcontractors. The PenMatrix system allowed our staff to complete a standard defects form using a digital pen which captures, stores and saves the information as snapshots. This information was then converted to PDF format and integrated into the PenMatrix database and workflow system, which was then exported to subcontractors for immediate action. This process streamlined the defect rectification process and allowed us to identify, issue and action over 7,000 defects prior to them being picked up by the client's or tenants' consultants.

The supply of final documentation for Brookfield Place was extensive, with over 5,861 design drawings and 15,406 shop drawings completed for the project; while 600 As Constructed drawings and over 75 Operation and Maintenance Manuals were completed. This information was captured using a cloud-based Operations and Maintenance (O&M) system called WebFM which collated the documentation to create a digital handover manual.

Environment

The Key Result Areas for Environmental were to:

- Recycle more than 80% waste;
- Ensuring we had no impact on the Swan River and surrounding areas;
- Remediating the disused heritage buildings.

As a high profile, inner city site, it was critical that best practice environmental management was implemented from the onset and closely managed through to project completion. This was achieved through the implementation of Brookfield Multiplex's Environmental Management System (EMS) which involved a full environmental site audit, environmental risk analysis, a register of controls and targets, and allocation of responsibilities. The EMP was implemented by OHS&E coordinators, site managers, supervisors and engineers. Every subcontractor was required to submit their own EMS prior to commencement on site, and these were reviewed, monitored and coordinated by the EMS coordinators.

The key achievements from the successful implementation of our EMS were:

- Achieving a waste recycling rate of over 80%, in excess of the initial 60% Greenstar target;
- Developing and agreeing with stakeholders a detailed ground water treatment plan to allow discharge of dewatering offtake into the Swan River – implemented with zero incidents;
- Remediating the disused heritage buildings to remove harmful substances such as asbestos and lead-based paints – all five heritage buildings received a consultant signoff confirming 100% remediated.

All of the above were achieved with nil incident and impact on the environment and Perth city users.

Heritage

The Key Result Areas for Heritage were to:

- Integrate heritage into overall project scope;
- Ensure all finishes were restored to their original glory using original finishes, both internally and externally;
- Create unique heritage commercial and retail areas.

Heritage was a substantial component of Brookfield Place, where five heritage listed buildings that had sat dormant and disused on St Georges Terrace for over 30 years were incorporated into the project design and subsequently transformed from what were

previously dilapidated, un-tenantable 'eyesores', into what is now a unique heritage commercial and retail area offering food, fashion and commercial space in some of the Perth's most sympathetically restored historical buildings.

Each of the buildings have been restored to their original glory, with Newspaper House and Perth Technical College awarded the biennial '*City of Perth Heritage Award'* in recognition of the outstanding transformation and reuse of the original buildings.

When Brookfield Multiplex took over the site, the buildings were in very poor state with considerable damage to both the internal and external fabric with extensive water damage and graffiti-spray throughout including wainscott, wrought iron balustrading and marble; as well as the exterior facade.

With the help and advice of the Heritage Architects, Palassis, Brookfield Multiplex demolished later additions and meticulously restored original finishes. Any timber works including wainscott, dado and picture railing plus timber skirting were cleaned and thoroughly refurbished including the application of a traditional oil finish. Brookfield Multiplex managed to clean the graffiti off the porous marble and only replace very few pieces which were missing or existing marble was beyond repair. Existing windows were refurbished and painted in the heritage colour previously used. Jarrah parquetry and the meticulous refurbishment of the existing high ceilings with their plaster cornices and columns reveal were carried out.

The sandstone and granite exterior was carefully cleaned and re-pointed after a long process of discussions and trials involving the Heritage Architect to finding the best method with the least physical intervention. Copper facade was restored over months of timely and carful removal of graffiti and debris.

A specific services strategy was developed to guide the installation of any new services required so that services are tidy and uncluttered. Where future access was difficult, Brookfield Multiplex included additional service points for the future tenants.

Sustainability

The Key Result Areas for Sustainability were to:

- Achieve 5-star Green star rating for base build and fit-out;
- Achieve 5 star NABERS rating;
- Maximizing indoor environmental quality for the end user.

The commercial tower has been awarded a 5-star Greenstar (Design V2) base build rating, and BHP Billiton's interior fit-out is being assessed for a 5-star Greenstar rating against Office Interiors V1.1 tool. The commercial tower is also on target to achieve a 5-

star NABERS rating for both base building and fit-out services, exceeding the 4.5 star contractual requirements.

The rating, which represents ‘Australian Excellence’ in environmentally sustainable design, recognises a number of the building’s features, including energy-efficient heating, ventilation and air-conditioning systems, high-performance glazing and lighting, and the use of a ‘grey water’ system to improve water usage.

Brookfield Multiplex and the design team identified 3 areas to target in order to deliver an end product that was not only functional but just as importantly, sustainable. These targets included water management, performance of the indoor environment and energy management.

The building was designed to minimise water consumption and a key initiative in doing so was to introduce Greywater recycling systems. These systems were designed to recycle up to 10,000 litres of water per day. Waterless urinals were fitted throughout the commercial tower, while a rainwater harvesting system has been incorporated into design in which rainwater is directed into the Greywater system.

The Indoor environment has been designed to maintain a low temperature via a low volume variable air distribution system with partition control which creates numerous zones per floor. Carbon Dioxide monitoring facilities have been installed, designed to maximize indoor environmental quality.

To minimise energy consumption the building has been designed with a double glazed façade while zoned lighting with two lighting control panels per floor have been installed while motion sensors can be found throughout. Other initiatives includeT4 light fixtures, LED lighting, while variable speed drives on all mechanical pumps and air handling units have been incorporated into design.

COMPLEXITY, DIFFICULTY AND OPTIMISATION OF THE CONSTRUCTION TASK

Logistics, Interfaces & Constraints

The project contained a high level of challenges and constraints within both the design and delivery stages of works. These key challenges and constraints included the following:

Land locked CBD site

The site presented itself with no direct access to adjoining roads. Vehicle access obtained via constructing a heavy vehicle access ramp over the adjoining property (lot 201, a future development site). This led to a situation where trucks were entering site and driving on the basement slab to be unloaded by one of the three tower cranes. Although this circulation route was satisfactory to build the tower, with its smaller footprint, it meant that the construction of the basements and the Northern Infrastructure element had to be delayed to allow the trucks to pass

In addition to the construction of a heavy vehicle access ramp, a number of other strategies were implemented to resolve the logistical difficulty of obtaining access for various supply types to the central location of the site:

- *Crane selection* - A specially imported Potain MR615 heavy lift crane was used as a part of this strategy, allowing a lifting capacity of 8 tons at a 60m radius. This allowed for hoisting materials from a designated loading zone on St Georges Terrace, over the top of the heritage buildings and into site.
- *Recovery holes and top down construction* - to facilitate continued construction activities while maintaining truck access to cranes, the B3 slab was poured out of sequence (delayed). This combined with the use of recovery holes to allow crane hooks to lift materials directly off trucks located on B4, while the remaining basement and infrastructure slabs were progressed.

Interfacing with Neighbouring Car park

Brookfield Place sits on a shared precinct with two other sites, one of those being Westralia Square (two high rise buildings with a live, five level car park), with the other being the vacant site. Brookfield Place basement connects in with Westralia Square's existing basements. Some of the two sites services are shared, such as mechanical ventilations systems and power supplies crossing site boundaries.

This basement integration posed significant logistical and design complexities which included the following:

- Ensuring no disruption to the ongoing operations of adjacent buildings. A temporary mechanical extraction system was installed and operated during the construction phase.
- Management of a high volume of vehicle and pedestrian traffic within the precinct. New HV switch rooms were added into the neighbour's carpark including relocation of their switchroom as part of the Brookfield Place constructions. The carpark operation was maintained during these processes. This included redirecting traffic flows, altering carpark layouts and the like.
- Design and delivery of the project to ensure compliance with neighbours' requirements.

This shared basement meant that our neighbour, Insurance Commission of Western Australia (ICWA), had an interest in our project and its delivery. Accordingly, ICWA was involved in the design of the project basement and its associated services. They were active participants in the delivery as well, Brookfield Multiplex included IWCA in all relevant project delivery decisions via regular meetings and the provision of detailed project planning documentation for ICWA's review prior to commencement of works.

Breadth in Scope

Brookfield Place was significantly more than just a typical office tower delivery project. The project created a "precinct" which involved the construction of a commercial tower, provision for fit-out of the tower to the end-users' requirements, restoration and conversion of heritage buildings, childcare, gym, cafe court and five level integrated car park basement. Collectively these elements were designed and delivered in a way that enabled them to be completed, commissioned, defected and handed over simultaneously and to the high satisfaction of all stakeholders involved.

This breadth of scope required the development and implementation of a thorough management structure with different design, construction, commissioning, defects and stakeholder management processes for each of the elements outlined above.

End User Requirements

The project was delivered for the pre-committed anchor tenant, BHP Billiton. This tenant had an extensive list of requirements within the building to satisfy their business requirements. As a result of the end-user requirements, Brookfield Multiplex upgraded many of the building services over what would be considered typical for an office tower. These include:

- Provision of 24 hour replenishment storage water for cooling towers (storage of 280,000 litres onsite);
- 24 hour diesel storage to power generators (72,000 litres);

- Full capacity fire and hydrant system (258,000 litres of water stored);
- High speed (8m per second) destination controlled lifts integrated with building security (access) system;
- Fully programmable lighting control system (Dynalite control system);
- 100% reserve power supply from diesel generators.

Unique risks to the Project

Installation of the K-Frame

Early in the project, the site management team identified risks involved with the erection of the external steel framework on the east and west sides of the building. The principle concern was providing working access to the steel frame to assemble each of the elements.

As outlined in section 1, the external steel framework was approximately 2 metres from the edge of the floor slab and outside of the protection of the self climbing perimeter screen system. As working access would need to be provided many times on both the east and west ends of the building, alternatives were identified such as assembling the K-Frame on the ground and lifting into place and using EWPs to access the work etc.

Figure 3 - K-Frame Steelwork Installation

After considering the options and consulting with the subcontractor group, Form 700, it was decided that the best method of access would be via a cantilevered platform. The Form 700 engineering team designed and built the award-winning *'Mega-Deck''* in Victoria using a full size mock-up of the K-Frame and, following successful trials, it was shipped to WA. Brookfield Multiplex staff were involved at each stage of the process and worked closely with Form 700 to develop this solution.

The idea of building the 'Mega-Deck' was conceived in the initial design where it was originally considered that we would use a cantilever scaffold to access the K-Frame. The time frame for the construction of the scaffold to access the K-Frame was expected to take approximately one week for the erection of the scaffold, works to be completed on the K-Frame and the stripping process. Limitations of the scaffold system would include the need to complete a detailed overhead works program for the work areas below that would include exclusion zones and spotters. Personnel working on the cantilever scaffold would be exposed to unnecessary risk of working on the edge of the building. As such, it was decided the manpower, labour costs and risk associated with a

cantilevered scaffold was not acceptable with the implementation of the 'Mega-Deck' solving each of these issues.

The expected time for the installation and commissioning of the *'Mega-Deck'* was expected to take roughly twenty minutes, significantly reducing time and the risks associated with working at heights. The use of the 'Mega-Deck' allows other tasks to be conducted below the work, eliminating the need to establish exclusion zones. This significantly increased productivity as it allowed ground level works to proceed concurrently.

Core and Associated Glass Elevators

As part of the client requirement for open floor plates, the lift core was designed to be at the north side of the building, rather than the typical centrally-located core. This presented an opportunity for the designers to install glass sided passenger lifts, with corresponding glazed curtain wall forming the building envelope. This created a unique risk of safely installing structural steel and curtain wall panels within a shaft. The site team resolved this issue by installing a crash deck over the work area. This deck protected workers in the shaft from falling objects originating from the concrete works which were continuing on the core. Below the crash deck a cantilevered scaffold was set up, allowing approximately 4 floors at a time to be scaffold within the lift shafts. Structural steel was installed and painted, windows were then installed. The crash deck and associated scaffold under were progressively relocated up the building as the concrete works advanced.

Simultaneous construction on multiple work faces

As described above, the project was delivered across multiple work faces with a breadth of scope unlike any previously undertaken in Perth. This included the commercial tower, heritage buildings, childcare, gym, cafe court and five level integrated car park basements. Resulting from the high number of different elements, the project management team were required to develop and implement processes and procedures to overcome the complex mix of challenges that were encountered.

The risk was addressed via the establishment of small project sub-teams, with their own individual areas of responsibility. Coordination of the sub-teams was the responsibility of the overall project leadership team. To assist in programme coordination all sub-teams programmed their relative areas and a full time on-site planner consolidated these programmes into a master to identify areas of potential conflict.

With so many sub-projects occurring on a tight CBD site, the coordination of day-to-day activities presented significant challenges. The team overcame these challenges by establishing exclusion zones and instituting a daily coordination meeting. This meeting was attended by Brookfield Multiplex supervisors and representatives from all subcontractors. At this meeting exclusion zones were allocated for the next day's

works. The outcomes of these meetings were recorded and issued to all project staff, including subcontractors, by the end of the day.

Capitol Installation – Steel work

One of the most significant challenges was the erection of the 550t+ steel framed Capitol. The Capitol commences at the L47 roof slab, approximately 240m above the surrounding ground level, and rises another 34 metres. This component of the project presented risks in design, logistics, safety, programme and future maintenance, all of which were overcome via a thorough, 14 month pre-planning period where the Capitol structure was designed in collaboration with our consultants, suppliers and riggers, as well as going through a multi-stage peer review process prior to works commencing on site.

Figure 4 - Installation of Capital Steel

In order to install the steelwork on this Capitol, the site cranes were relocated. The 615 Potain crane plus an additional Flavalle 500 crane were installed on the roof to enable the lifting of the steel members (some weighing in excess of 35t).

Cladding of Capitol

The design required that the Capitol steelwork had to be finished with aluminum cladding to match the K-frame and external columns. The site team identified that locating and installing cladding in this location would present significant risks. To minimize the risks the project team elected to pre-clad the steelwork on the ground thus leaving minimal in-situ cladding required for connection. Columns were delivered to site and then clad. Using the recovery holes left in the basement slabs, columns were then lifted to the roof and installed in position.

Figure 5 - Installation of pre-clad Capitol column

Existing diaphragm wall, over 20 years old.

This water retention system had, over time, deteriorated and when combined with a basement below ground water level produced substantial ingress of contaminated ground water. A decision was made to collect and treat the water instead of patching the diaphragm wall. An onsite treatment plant was installed to remove pollutants from the ground water penetrating the diaphragm wall, and discharge to sewer system as regulated by Water Corporation (the relevant authority).

LEADERSHIP AND MANAGEMENT OF THE PROJECT DELIVERY

Project Team Relationships

Brookfield Place was delivered under a Design and Construct model with Brookfield Multiplex assuming the role as Head Contractor and Development Manager. From the outset Brookfield Multiplex deployed its integrated property business model to the leasing, development management, design and construction of the precinct to ensure that what was delivered maximised value and made the most out of the opportunity that was available.

One of the first tasks was to build a team of appropriate size and skill the meet the demands of the project. Logically the team rapidly expanded as the project gained momentum where, at peak, the Brookfield Multiplex Project Team comprised 65 persons. Experienced commercial high-rise staff were utilised from across the Brookfield Multiplex Australasian business from which an integrated project team consisting of members of our ownership, development, construction and facilities management businesses was built around. The team was co-located on site and worked together in a way that was instrumental in the undoubted overall success of the project on all levels.

An early decision was made to integrate Client and Contractor on site; the benefits of this collaboration are demonstrated in the final product. The project was delivered under the philosophy of “one team, one goal’ which translated into BHP Billiton being more than just a tenant, and Brookfield more than just a client. Rather the Project team ensured there was a collaborative approach to design, delivery and hand over which ensured we delivered the best possible product to suit the end-users’ requirements.

Contribution to the Design Process

Our Design and Construct obligation also included the management of the design process which included the management of over 14 design consultancies.

Brookfield Multiplex’s design management team ensured the relationship between each of the consultants was maintained by introducing a weekly design coordination meeting which were held on site where any pressing issues were discussed, noted and shared amongst the project via the communication platform, Aconex.

Having such tight time frames in place, it was necessary for Brookfield Multiplex to fast-track design development and the tenant approval process. Concurrently early trade packages were procured and let to enable ground works to commence prior to the design of the building superstructure being fully resolved. This process of fast-tracking design and construct continued throughout the duration of the project, with design delivery staying just ahead of site execution.

The working relationship established between the designers and users gave a great mutual understanding of the performance requirements and solutions required to deliver a product to the requirements of the end-users. The open lines of communication, sharing of information and working in a transparent sense throughout the design process ensured both parties had a thorough understanding of requirements and thus, a higher degree of ownership over the process.

Planning and Control of Design and Construction Operations

Brookfield Multiplex's design involvement started early in negotiations with BHP Billiton, working collaboratively with the anchor tenant to ensure the final design met BHP Billiton's specific business requirements while delivering a world class precinct. The fundamental driver of the project was time, and most critical to this process was the development and negotiation of the broad performance based design criteria contained in BHP Billiton's lease and conversion into detailed construction documentation. As a result, the detailed documentation was able to be delivered within the required timeframes and without major disputes with BHP Billiton.

The five heritage buildings fronting St Georges Terrace also presented various design challenges. Brookfield Multiplex worked closely with the *City of Perth* and the *Heritage Council of Western Australia* to ensure a successful outcome was delivered not only to the client but also to the *City of Perth* and general public of Western Australia. BM successfully refurbished and integrated the existing heritage buildings into the new Brookfield Place plaza. Key design initiatives included a sunken plaza opening up the existing heritage basements, once below ground with no natural light, to the new plaza creating a sun drenched alfresco space.

From project inception BM identified the integration of the podium with the neighbouring buildings to be fundamental to the overall success of Brookfield Place. BM worked closely with the client and consultant team to develop a coordinated strategy for the integration of Brookfield Place with surrounding developments. BM coordinated the detailed design and managed the physical works on site, turning the project vision into reality.

The site management was responsible for construction operations and ensured programme requirements were maintained by coordinating works so as all trades maintained continuity in work while keeping close eye on quality and safety at all times. In the early stages of planning the project management team developed plans to manage elements of critical importance, these included programming, site logistics, construction methodology and site accommodation each of which are explained in further detail below.

Logistics planning

The planning of project logistics was a key factor in the overall success with the project management team engaging themselves at the early stages of design in order to manage, and tailored design to suit construction methodology and logistics requirements. Strategies for cranes, access, lay down areas and site accommodation were identified early in the design stage.

A number of strategies were implemented to resolve the logistical difficulty of obtaining access for various supply types to the central location of the site. Key strategies included:

- Access – One major feature was the construction of a ramp over the adjoining property (lot 201), a future potential development site, to provide vehicle access to the site. This led to a situation where trucks were entering site and driving on the basement slab to be unloaded by one of the three tower cranes.
- Crane selection – A specially imported Potain MR615 heavy lift crane was used to mitigate logistical issues associated with being a land locked site. Utilizing the Potain MR6915 facilitated a lifting capacity of 8 tons at a 60m radius. This allowed for hoisting of some of the required material into site from a loading zone on St Georges Terrace.
- Recovery holes and top down construction - To facilitate continued construction activities while maintaining truck access to cranes, the B3 slab was poured out of sequence (delayed). This combined with the use of recovery holes to allow crane hooks to lift materials directly off trucks located on B4. While the remaining basement and infrastructure slabs were progressed.

OH&S Planning and Implementation

As with all our projects, in order to manage OH&S on site we tailored Brookfield Multiplex's in house management system which became a hierarchical system where documents and systems meet and support the requirements of those at higher levels; there were 6 levels in the structure. Level 1 was the strategic objectives and policies, level 2 was the management standards, level 3 the operational procedures, level 4 the project management plans, level 5 the management action plans and risk workshops and level 6 the forms, safe work practices and supporting documentation.

Throughout the project, responsibility was delegated throughout the different levels of management; at a project level the Project Manager was responsible for ensuring the OH&S management system was implemented whilst ensuring Site Managers and Supervisors fulfilled their OH&S responsibilities and employed the systems provided. This included, but was not limited to, participating in risk workshops, enforcing safety health and environmental policies, completing regular site inspections, ensuring safe work practices are followed, attending and contributing to safety meetings, reviewing safe work methodology and ensuring all persons working on site are appropriately inducted.

Brookfield Multiplex fostered and promoted the development of a mature safety culture driven by senior management actions. The senior managers lead by role and keeping in line with the strategies four key themes, these include the following;

1. Being safer by design and planning;
2. Focusing priority on critical risks;
3. Demonstrating practices not just paperwork;
4. Growing a strong safety culture;
    - A disciplined culture
    - A reporting culture
    - A learning culture
    - A culture where people know that conveying bad news will enhance not limit careers.

Brookfield Multiplex provided a significant level of OH&S training for all staff, both in general and also such that it aligns specifically to the role of the individual. Training included the following:

- Industry inductions (White Card) for all staff and construction workers;
- First aid course for graduates, supervisors and construction workers;
- Certificate IV in OH&S for site managers and project managers;
- Emergency Warden Training and Precast Installation Courses for coordinators and supervisors;
- OH&S training and other tickets for construction workers such as Scaffold, Working at Heights, Traffic Management, Manual Handling, WEP, Hazardous Substances and others.

Industrial Relations

Brookfield Multiplex employed a similar ‘built-in’ approach to Industrial Relations, ensuring there was an open and continuous dialogue with all stakeholders. This leadership approach was highly successful, with only a single day lost to site industrial action across the whole 46-month project.

The project also required trades to work extended hours in order to meet the complexities of the project and maintain tight programme requirements. This put Industrial Relations agreements under severe pressure, but through careful management and following strict in house procedures we were able to run split shifts

ensuing the site was open for up to 24hrs per day, 7 days per week, whilst eliminating any potential industrial relations risks resulting thereof.

Project and senior site managers were given the responsibility to manage Industrial Relations on a day to day basis. This ensured there was direct communication throughout the workforce and any potential issues could be mitigated before becoming real issues.

We have received positive feedback in a number of instances and have been given praise from all key stakeholders with regards to the performance and management of industrial relations on the project of which all would attest their appreciation of the performance of the project team.

The Project Leadership Team

David Ockenden – Regional Director (overall project delivery, client and tenant management);Tony Hodder – Regional Director (construction delivery); David Eden – Construction Manager / Commercial Manager; Tim O'Neil – Project Manager; Jovan Bacovic – Senior Site Manager; Nick McInerney – Design Manager; Lane Bauer – Contracts Manager