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PREFAB

architecture

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Efficiency *through* precast concrete, steel and glass

The number of designers and builders adopting prefabrication to achieve better quality and efficient construction is increasing considerably over the years. Manufactured in factories under strict quality control, prefabricated components such as precast concrete, steel staircases and glass facades are being used in projects for their consistent and higher quality. This issue of PREFAB Architecture features three such buildings that have used prefabricated components extensively.

The new Community Library in Bishan stands out in the town centre with its colourful Pods, which look like books being pulled out of bookshelves. Due to its tight urban site, the design incorporated elements for ease of construction to minimise its impact on its surrounding. The post-tensioning concrete structure maximised the floor area and kept internal columns to a minimum. The project capitalised on the use of skylights, trellises and coloured glass both inside and outside to filter the incoming natural daylight in a myriad of shades and colours. The buildability of the building was achieved through careful planning, effective use of materials and strategic use of steel, glass and metal at appropriate locations to achieve its overall architectural objective of a civic building.

The newly completed 32-storey Leonie Studio is located at the prestigious Leonie Hill area.

Originally designed as a conventional in-situ RC frame structure, the contractor, Kimly Construction Pte Ltd realised the repetitive building design provided an opportunity to go precast. To cut down on wet trades, non-concrete components like glass railing, metal staircases and aluminium louvers were used. The final finished building shows that prefabrication enables the builder to deliver speedy, quality and cost-efficient building works to meet the demands of quality and value in this modern era. The Best Buildable Design Awards in the Residential Category was conferred on Leonie Studio this year for its construction efficiency.

IKEA Tampines marked the first full concept IKEA store, and the largest home furnishing store in Singapore last November. Keeping its architecture simple and clean, the IKEA store is housed in a big blue-and-yellow box with a modular dimension of 16 m x 8 m column space. Adopting a mixed structural system of precast and steel components with sandwiched panel facades, the overall construction period for this store took only 12 months. It won a Best Buildable Design Award this year under the Industrial Category. Its family-friendly features also earned IKEA Tampines the only Gold Award at this year's Universal Design Awards for the Built Environment.

By Phua Hui Chun

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A Beacon On Leonie Hill

By KC Chan, Kimly Construction Pte Ltd

Project Details:

Client: Leonie Land Pte Ltd
Architect: RSP Architects Planners & Engineers Pte Ltd
C&S Engineer: Chan Chee Wah Consultants
M&E Engineer: United Project Consultants Pte Ltd
Project Manager: Leonie Land Pte Ltd
Quantity Surveyor: WT Partnership
Landscape Designer: Tierra Design (S) Pte Ltd
Interior Designer: KK Consultants & Designers Pte Ltd
Main Contractor: Kimly Construction Pte Ltd
Precaster: Kimly Construction Pte Ltd

Standardisation through prefabrication allows close quality checking on the ground and leads to a level of flatness in walls and straightness of lines



Perched atop Leonie Hill, overlooking lush greenery is Leonie Studio, a 32-storey tower block with 97 units with a sky garden on the 24th floor that decorates the facade. Located amidst established condominiums such as Leonie Garden, Hilton Tower, Leonie Tower has a 2-level basement carpark. The rest of the communal facilities are located on the ground level in a total site area of 2849.8 sq m.

Re-Design

The project was originally designed as a conventional in-situ RC frame structure. However, when the contract was awarded to Kimly Construction Pte Ltd, the uniformity of the layout provided them with an opportunity to use their standardised in-house system formwork to speed up the construction.

The site was surrounded by buildings and bounded by Leonie Hill Road. With a 2-level basement carpark that occupied virtually the whole site, the construction would be very restricted in terms of space and manoeuvrability. It required very careful planning and precise sequencing of all activities. Conscious of the need to keep noise levels down to a minimum and to maintain a clean and tidy site by virtue of the site's proximity to the upmarket residential neighbourhood, Kimly Construction looked at the options available for construction. The repetitive building design in terms of the unit layouts and elevated features provided an opportunity to use extensive precast construction.

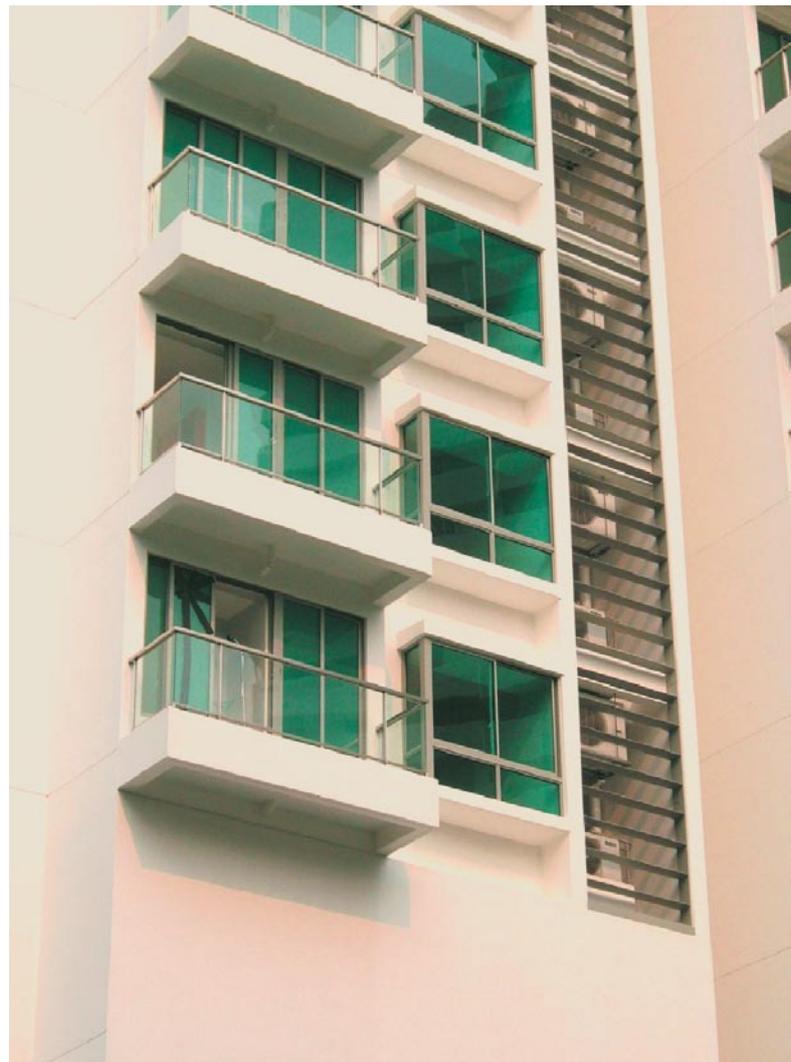
Kimly therefore proposed to the client and consultants a re-design of the building's structure using precast elements such as prefabricated concrete planks (half), beams, balconies, staircases, and air-conditioner ledges.

Standardisation Through Prefabrication

With a narrow access road and a site that was extremely tight for space with virtually no room for storage, a just-in-time approach in conjunction with extensive prefabrication had to be adopted for construction to minimise obstruction and noise to the neighbouring residences.

The whole project was re-designed with a combination of RC elements and PC components. The vertical RC elements were constructed using Kimly's standardised in-house system formwork and all the horizontal members were converted to PC planks designed with minimum pour strip. Beams in the living room were eliminated as they were incorporated into the PC walls.

All the PC components were produced in-house at Kimly's own precast yard at Jalan Boon Lay and transported to the site for immediate hoisting.



The use of a standardised aluminium louvred screen increased the buildable aspect of the project through its repetitiveness and the omission of wet trades





Windows And Doors

As there were only four main layout types of units, all the windows and doors could be standardised to a high degree, thus reducing the installation time and labour for these components and considerably increasing productivity on site.

Glass Railing

Laminated tempered glass railing with stainless steel framing were used extensively in balconies and planter boxes, significantly reducing wet trades.

Aluminium Louvered A/C Screen

The use of a standardised aluminium louvered screen, while adding to the aesthetics of the building, increased the buildable aspect of the project through its repetitiveness and the omission of wet trades.

Metal Staircase

The use of steel for the external staircase allowed for off-site assembly of its components and better control of its finish and overall quality.



Laminated tempered glass railing with stainless steel framing were extensively used in balconies and planter boxes



The use of steel for the external staircase allowed for the off-site assembly of its components and a better control of its finish and overall quality



Overall Quality

Standardisation through prefabrication allowed close quality checking on the ground and led to a level of evenness on the walls and perfectly straight lines that could not have been attained using conventional methods of construction.

M&E Features

The use of a combination of mechanical jet fans placed at strategic locations and short duct lengths at the two-level basement avoided the extensive use of conventional horizontal ducts at the ceiling area. This increased the ceiling area, which in turn increased the headroom for the carpark area, lowering construction cost and time.

Such an approach also enhanced the aesthetics as it reduced the clutter that is usually found at the ceiling of most basement carparks.

Multi-Tiered Hanging Cage

With such a tight site, using external scaffolding was not feasible. So Kimly used its in-house multi-tiered hanging cage for its entire external architectural works to free the ground level for access. Using this method meant that ground congestion was eased enabling work on the external façade to progress swiftly as several activities could be performed simultaneously.

Conclusion

This project is evidence that the practice of standardisation and the use of prefabricated components do not necessarily result in a dull and mundane form of architecture. Modern high-rise buildings with their architectural language of curtain walls, glass frontages,

bay windows, balconies and flower troughs have a repetitive vernacular which lends itself very appropriately to standardisation and prefabrication.

In fact, prefabrication is equally suitable and adaptable for all forms of architecture – from the modern clean-line look to post-modern retro-styles and their repetitive motifs. Prefabrication enables the contractors to deliver in a speedy, high-quality and cost-efficient manner to meet the ever-increasing demands of quality and value in this modern era.



An in-house multi-tiered hanging cage was used for all the external architectural works to free the ground level for access.



Ductless Basement Carpark Ventilation System.

Bishan Library

- thinking out of the box

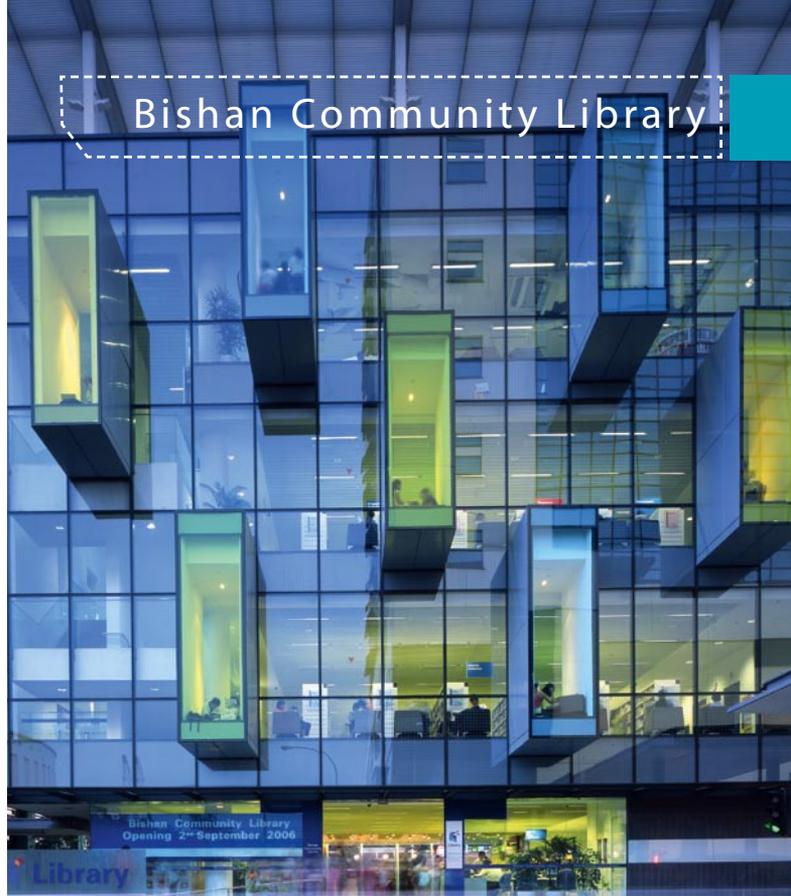
By Look Boon Gee, Principal Partner, LOOK Architects

Project Details:

Client: National Library Board, Singapore
Architect: LOOK Architects
Main Contractor: Sunhuan Construction Pte Ltd
Civil & Structural Engineer: Meinhardt (S) Pte Ltd
Mechanical & Electrical Engineer: Meinhardt (S) Pte Ltd
Quantity Surveyor: BEC Consultants
Landscape / Interior / Graphic Consultants: LOOK Architects
Site Area: 4,200 sqm
Project Cost: Approx. S\$10 million

Photographs by Mr Tim Nolan and Mr Patrick Bingham Hall

The colourful pods
create powerful
composition, playful
and thought-
provoking at the
same time



Bishan Community Library

The new library is located at the fulcrum of the town centre, a strong landmark that addresses the main road junction

Colourful reading pods project over the main streets, capturing the imagination of the passers-by beneath the pods externalise and the library programme, setting up a direct dialogue with the neighbourhood

The architects who designed this project felt the strong and consistent push to think out of the box – to rethink the concept of a library and its role to the community. There was a need for the new Bishan Community Library to reach out and engage the interest of the people. Located at one of the typical satellite town centres in Singapore, the design tries to inject a sense of fun into the monotony of heartland living to invigorate and inspire the pursuit of knowledge.

Design Concept

Bishan Library's design concept is a metaphor of a tree house to create an environment for learning via a journey of discovery and play. The use of skylights, trellises and coloured glass both inside and outside filter the incoming natural daylight in a myriad of shades and colours. This creates a conducive and comfortable dappled light quality in the library interior, simulating the filtered light through the foliage of trees. The children's library is tucked in the basement for practical segregation of noises as well as to provide a private realm for the imagination of the young minds to run free in a subterranean cavern themed design with colourful wall reliefs that extend to become furniture.

The 'Pods' that are cantilevered off the building's main façade over the busy streets below and the building atrium afford more private spaces. They serve as hotspots for hobby groups or act as intimate spaces for the exchange of ideas or quiet reflection by individual users. The unique building façade creates a building that piques the curiosity of the community.



Patrons of the library can retreat into "private" spaces provided by the pods

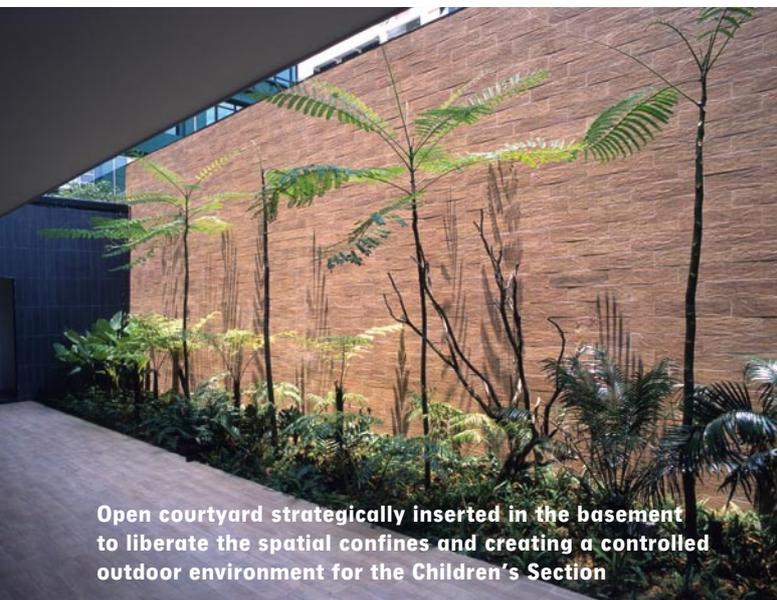
Bishan Community Library

The services are all concentrated in a solid core on the western elevation that shields the building from the harsh evening sun. A tall atrium space links the different floors together allowing spatial and visual interactions between different user groups. A generous ramp in the atrium draws people from the street into the heart of the building while also helping to discharge crowds effectively after events. The atrium acts as the fulcrum of the building providing a sense of arrival for visitors and giving the library a sense of space.



The furniture and interior finishes have been carefully designed and coordinated to complement the architecture

The Architect's studies showed that the conflicting requirements of view, fire unprotected opening, solar control and daylight were best met by having an efficient building with an



Open courtyard strategically inserted in the basement to liberate the spatial confines and creating a controlled outdoor environment for the Children's Section

Building Strategies

The idea of constructing a stand-alone community library on the vacant land next to Bishan MRT was mooted some years ago. The project was eventually commissioned by the National Library Board in 2003 and opened in September 2006. The facilities at the library include a programming zone, children, adult and teenage section, audio-visual, offices for the staff, sorting room, quiet reading room and front reception.

From the start, the design incorporated elements for ease of construction on a tight urban site including minimising its impact on its surroundings. The building is oriented to benefit maximum exposure to the urban streetscape which has unobstructed views of the Bishan Town Centre.



Coloured pods are hung delightfully within the triple volume atrium space, washed with natural daylight filtering through the skylight above



The pods cantilevered off the building façade are likened to books “pull-out” off a shelf, a creative reading of the architecture, aptly capturing its essence

atrium with a skylight that filtered daylight into most of the library floors and the main circulation zone. Scaled models were erected to understand the effect of the external sun louvres on the roof trellis and horizontal ceiling screen.

The library is carefully zoned to have the services zone on the west and column free space for the book collection. The windows to the east wall are recessed openings to meet fire safety requirement and to let in daylight.

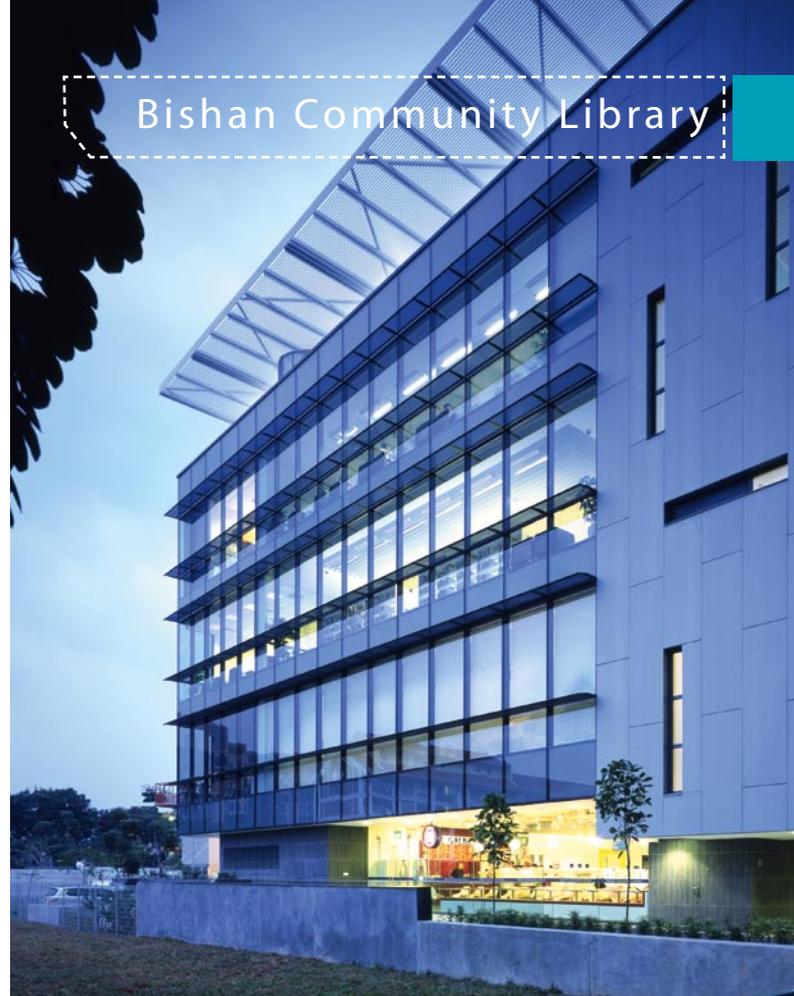
As the 1,400 sq m site is strategically located adjacent to the CPF Building, site planning was challenging and there was limited access due to space constraints. The solution was to design a compact and efficient building with a main entrance facing Bishan Place. The glazed facade provided visual linkage from the main entrance to the housing estate behind the building and the transparency was achieved by using clear glazing.



The client required the building, which has a GFA of 4,237 sq m to operate efficiently and economically, and to keep with the existing character of the town centre of Bishan.

Structural Design

The insitu concrete structure comprising four typical floors over a basement were designed to maximise the floor area and enhance ease of operations. Internal columns were kept to a minimum by using post-tensioning floor slabs to maximise floor area and to provide additional flexibility to the space planning of the library.



Bishan Community Library

A more unassuming and calm façade fronting the residential flats

The adoption of post-tensioning for all the typical floors was highly successful from both the structural and architectural points of view. With this strategy, it was possible to restrict the number of supports to only four plus a lift / staircase core.

The project team used glass with painted plastered board walls for the internal finishes. The ceilings were exposed to reduce the sprinkler provision and ease of maintenance while the lighting system and a/c outlets were integrated with the aluminium screen ceiling.

The library was designed using materials like steel and aluminium for the roof trellis, which provide visual screening of the M&E services from surrounding buildings and solar shading for the roof and skylights over the 3-storey atrium circulation space.

The most prominent architectural feature is the external/ internal pods which signify books being pull out of the book shelf. All of the pods are clad with subtle coloured glazing to simulate the colour of nature, ie. blue + yellow = green.

Conclusion

The buildability of the building was achieved through careful planning, effective use of materials and strategic use of steel, glass and metal at appropriate locations to achieve its overall architectural objective of a civic building. The building was well received by the public and received an award in 2006 from the Cityscape & the Architectural Review under the 'Community (Built)' category.

Big Blue and Yellow IKEA stands out in Tampines

*By Ong Teik Jeong, Director/ Architect,
TJ Ong Architect*



Project Details:

Client: IKANO Pte Ltd
Concept Architect: TJ Ong Architect
Architect: DSA Architects
Civil & Structural Engineer: PEC Consultant
Structural Steel Engineer: KTP Consultants Pte Ltd
M&E Concept Engineer: DC Consulting Engineers
M&E Engineer: GIMS & Associates
Project Manager: IKANO Pte Ltd
Main Contractor: Poh Lian Construction Pte Ltd
Quantity Surveyor: WT Partnership / JUB PADU
Precaster: Sunway Concrete Products (S) Pte Ltd
Landscape Designer: Idawaty Tanudin
Interior Designer: IKEA Built-Up Team

Ikea Tampines

Housed in a big blue-and-yellow box, the newly built IKEA Tampines store is a distinctive trademark of the IKEA brand. While the store was built to leverage on its hallmark European ambience, much care has been taken to understand and address local customers' needs. From brightly lit car parks and friendly trolleys, to children play areas and affordable cafes - the IKEA store has the customer's best interests at heart.

IKEA architecture is characterised by being functional, innovative and with a careful eye on cost. The IKEA architecture is an integral part of every IKEA Store design. The entire IKEA building is 'wrapped' in the IKEA trademark of blue and yellow.

IKEA stores are characterised by architecture based on the Swedish functionalistic tradition. The building is visually clear, focused and stripped to the essential. The materials and finishes are kept simple and raw. Unpainted concrete, hot dipped galvanised on structures and metal cladding are meant for low maintenance while exposing the material and method of construction.

Prefabrication

The method of construction was very clear from the beginning, which was to adopt off-site prefabrication and install on site, which is similar to European techniques. At the same time, IKEA's design specification had to be followed and adapted to local requirements and availability. Most of the major design work, especially the superstructure, had to be resolved together with the M&E design to allow the commencement of the precasting work in order to

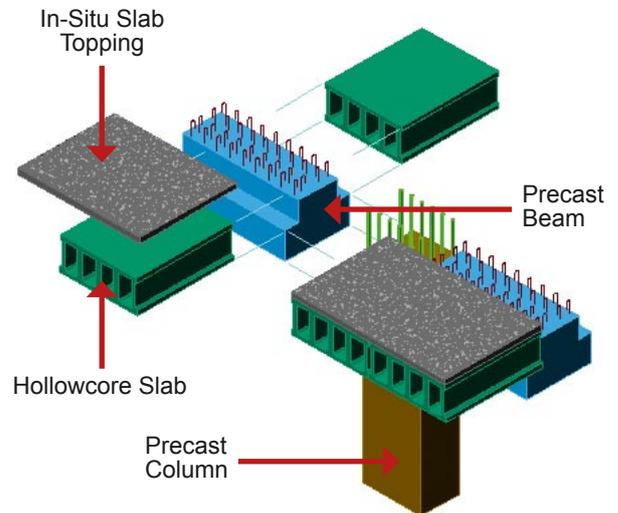
Free standing pylon sign tower



Simple yet strong geometrical building form

meet the deadline on site. During construction, problems such as alignment between precast structures and steel were quickly resolved. Adjustments were quickly made for other works to commence.

The construction of all IKEA Stores is based on a modular system of a 2-storey store of 16 m by 8 m column space. All structural components, from columns, beams and slabs of the 2 level carpark to the store's first floor were installed using precast concrete. Based on loading requirements, the hollow-core slab thickness varied from 450 mm to 550 mm spanning a 16.0 m length with 100 mm topping of wire-mesh reinforcement concrete. Special floor hardeners were used on the concrete surface to obtain a smooth and shining surface with a controlled flatness tolerance of ± 4 mm over 2.0 m length. This was to give the impression of lighter, brighter floor, which is also tougher.



'Superflat' powerfloat system on concrete topping





Clean and simple elevations



Extensive use of precast structural components



Precast and prefabricated steel column/girder system

Hollow square sections were used to support the roof where the AHUs were located. The span varies from 24 m to 32 m. A portal frame-like structure was designed to optimise on the height and to allow for Mechanical & Electrical (M&E) fittings to penetrate. A perpendicular secondary c-channel of 6 m length was introduced to support the roofing material and the suspended grid ceiling. The trusses were installed to achieve an accurate 3 degree slope through roof drainage.

Other steel structures that were used include the external escape staircases and the 40 m sign tower. Most finishes of the steel were hot dipped galvanised.

The roof construction consisted of sandwiched elements with impermeable PVC membrane material, 100 mm thick rockwool, aluminium foil and a layer of metal decking on the underside.



Structural steel frames at 16m centres



Steel components at top most storey

Modular dimension metal/aluminium cladding and glass curtain wall was introduced





Prefabricated steel staircase and handrail for external emergency escape staircase

A syphonic rainwater discharge system was used due to the low pitch roof and the flexibility to minimise and locate the downpipes at suitable positions.

The external wall construction is also a sandwiched element, fastened to horizontal steel channels onto steel columns or concrete columns. The sandwich elements were constructed with a special rolled profile 0.6 mm thick high tensile metal sheeting, coloured according to IKEA's trademark blue with an insulation of 50 mm thick mineral wool, aluminium foil and covered internally with a 0.35 mm corrugated galvanised metal sheet.

Conclusion

The overall construction period for this store took 12 months including earthworks, piling, building and interior fit-out. The precast and prefabricated steel system used for the building components enabled the owner to complete the project on time for the scheduled opening despite the short construction period.

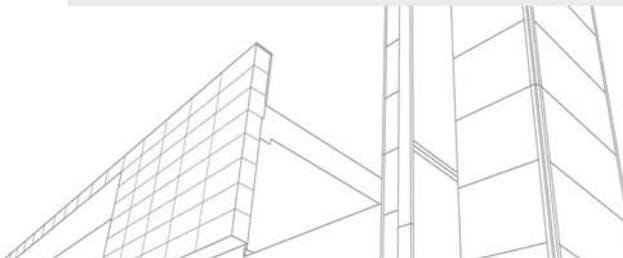


panelsystems



Rokcore is a high quality non combustible structural rock wool cored composite panel. Rokcore is manufactured using premium Paroc technology and is available in a wide range of coloured zinc coated steel facings.

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<ul style="list-style-type: none"> Rokcore has excellent thermal and fire properties 	<ul style="list-style-type: none"> Rokcore is long lasting with excellent strength, durability and overall finish
<ul style="list-style-type: none"> Rokcore is made from structural rock wool core 	<ul style="list-style-type: none"> Reducing framing / support - Lower total costs
<ul style="list-style-type: none"> Rokcore can span up to 12m in a single span 	<ul style="list-style-type: none"> Rokcore is quick and easy to install
<ul style="list-style-type: none"> Rokcore is lightweight 	<ul style="list-style-type: none"> Rokcore provides energy efficient and fire rated solutions



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