3D Monolithic Precast

Construction Technology Solution

PRECAST SYSTEM & TECHNOLOGY

3D

monolithic

load bearing

zero wastage

blast proof

conduits and wiring

50+ years Structural Guarantee

5k – 100 k sq. ft. in 24 hours

embedded insulated wall

power finished floor

1st & 2nd fix MEP conduits

high seismic load

no scaffolding

no joints

modular

5 panel in one

95% less gas emission

ongoing maintenance reduced by 95%

3D Volumetric Casting

Computerized Mold System

on site casting

fair finish, inside/out

no timber

no plastering

no propping

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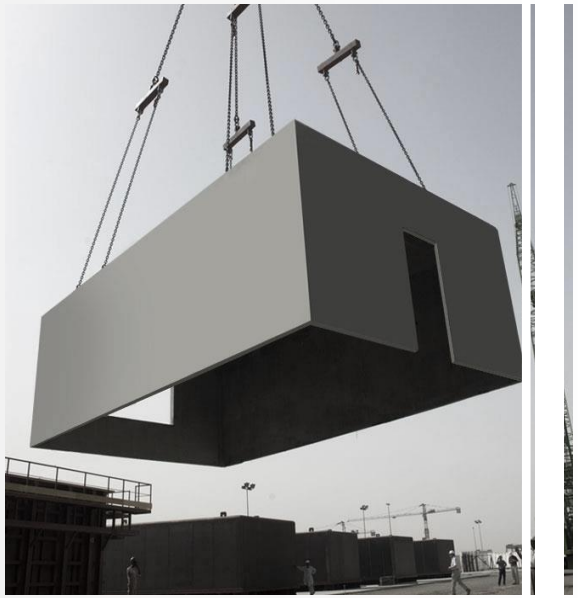
THE TECHNOLOGY SOLUTION



Salmon Leap Associates India Pvt. Ltd. has signed a Joint Venture with EMOLJAC Investments Pty Ltd., Australia. EMOLJAC brings in the patented technology for residential, commercial, institutional, educational, healthcare and other construction related sectors.

The company that will undertake this activity in India and the sub-continent region is hoMMission India Pvt. Ltd.

hoMMission would provide comprehensive 3D modular concrete structure building systems that will revolutionize the way construction is currently undertaken in country.

This technology is implemented in various countries including Australia, UAE and Beirut and will be implemented throughout the GCC countries, MENA and North African countries.

The 3Dimenional pre-cast modular building system reduces overall construction time, cost, labour and gives superior acoustic, thermal and fire rating properties.

The technology system that produces the module is fully automated and hydraulically driven which monitors the mould to maintain the production process within the fine tolerances (±3mm) that ensure accurate repetitious casting on a daily basis.

The unique technology application is summarized below

- ✓ The modules unlike traditional flat pre-cast panels, uses a process of producing five panels in a single pour, or a three- dimensional shape creating a pre-designed shaped room.
- ✓ The moulds are customizable during the modules' design process. All openings - doors and windows, access points—piping and conduit and insulation are designed into the mould. Building all the features into the mould's design reduces project turnaround time and costs.
- ✓ This method is replicated and the modules are fitted together—side-by-side or atop of each other. This allows the roof of the first module to become the floor of the second module as they are vertically stacked, similar to Lego blocks or bricks.
- ✓ The ability to fit the modules together reduces construction time.

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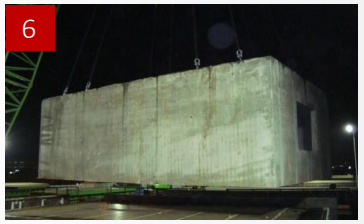
THE CONSTRUCTION TECHNOLOGY

Enabling Paradigm Shift

1. Reinforcing & insulation
2. High – tech steel computerized mould system
3. Reinforcement lifted & placed
4. First and Second fix MEP positioned
5. Concrete - *super plasticized, low -shrinkage 40 Mpa concrete*
6. Lift at strength of 14.20 Mpa
7. Cure & commence fit out
8. Transport to erection position
9. Lift modular unit into place & assemble
10. Finish



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ADVANTAGES

upto **80%** FASTER
than traditional construction methods

upto **50%** STRONGER
each unit 1 piece

upto **90%** WASTE FREE
totally relocatable recyclable

upto **50%** CHEAPER
material and labour cost

On-site manufacturing
eliminates transportation & multiple handling

Stronger, one piece, stackable
3D monolithic concrete construction

Improved
thermal & acoustic performance

Reduced
operating & ongoing maintenance costs

Note:
Depending on 1. Design 2. Time Frame 3. Project Size

THE TECHNOLOGY ADVANTAGE

Unlike the conventional and traditional 1D and 2D Precast methods, this technology is the new unique truly 3D, monolithic, Modular solution that can be poured complete with window and door frames, electrical and plumbing conduits already inlaid.

The major advantages the technology offers over its competitors are

- ✓ Rapid construction on-site
- ✓ Quality & accuracy (+/- 2mm – 5 mm)
- ✓ Long term strength and durability
- ✓ Fire, water, cyclone, earthquake, termite, marine and corrosion proof
- ✓ Fire rating / sprinkler concessions
- ✓ All weather production facility
- ✓ Reduces scaffold and formwork
- ✓ No propping, caulking, brackets
- ✓ Clean and neat construction site
- ✓ Windows, doors and other modular furniture can be ordered straight from the drawings due the accuracy.
- ✓ The external and internal walls painting can be done without the need to plaster or render
- ✓ The doors, windows along with their frames can be fitting at the time of casting the modules.
- ✓ Value engineering can add cost and time savings of up to 20% on the overall construction.
- ✓ Transportable factory – the moulds can be transported

The above advantages enables savings of 10 – 15% on the average cost per project and can build 20 – 30% faster per project with Quality Control built in.

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TECHNOLOGY DETAILS

The building system is a sophisticated modular precast building method providing a concrete structure finish which is accurate and with a high quality which dramatically reduces overall construction time and provides superior acoustic, thermal and fire rating properties.

Underpinning the construction method is the unique smart moulds employed to produce each module. Each mould is an intricate piece of machinery, manufactured to Project design and specifications and is fully customizable, except for its fixed internal dimensions.

This means every time a new unit is made, the mould can be customized to meet the architectural requirements. Furthermore the doors, windows and any provision for services (electrical, plumbing, etc.) can be cast into the outer concrete walls. Each mould is fully automated and hydraulically driven with fine tolerances (+/- 2mm – 5 mm) to allow accurate, repetitious casting on a daily basis.

Durable concrete, reinforced with steel, super-plasticized with a low shrinkage rate is poured into a pre-made three dimensional mould and when set forms the block containing the main components of the structure – the walls and ceilings or walls and floor. These monolithic 3D modules can then be simply arranged and stacked as rooms to produce a self-supporting building structure up to 10 storeys high.

The system is ideal for repetitious building projects such as apartments; high end, as well as medium to low end villas, motels / hotels, labour camps, housing units, age-care villas, student accommodation, site offices, industrial building and schools – all built to the highest environmental specifications.

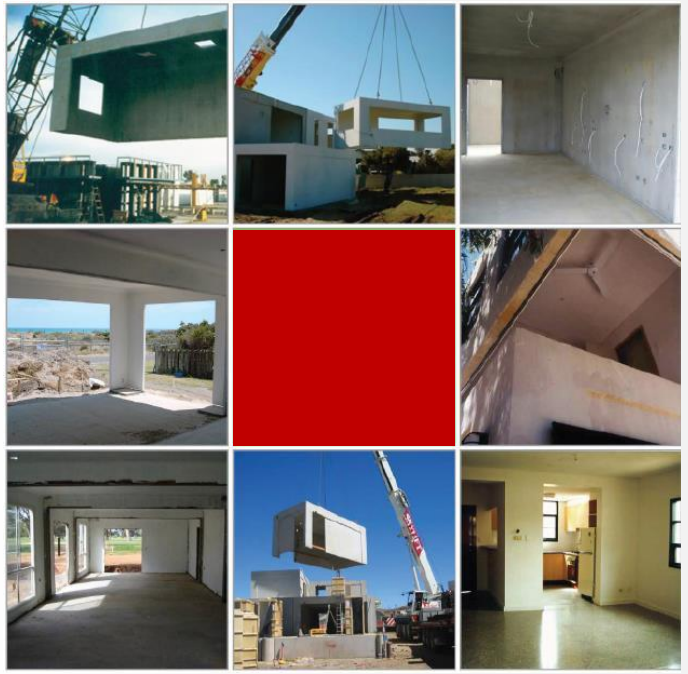
The salient features of the building technology is detailed out in the following sections

SPEED

The technology delivers construction times up to 80% faster than traditional superstructure systems and is ideal for large and repetitious projects where onsite manufacturing delivers optimum benefits.

STRENGTH

The inherent load bearing strength of each module means that multi-level constructions of up to 10 storeys can be economically and more safely achieved than using tilt slab or traditional practices. The system provides a highly flexible precast building that is strong, durable, fire, termite, cyclone, water and weather proof.



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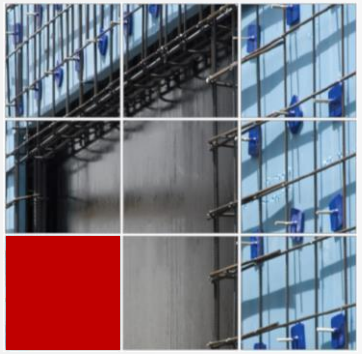
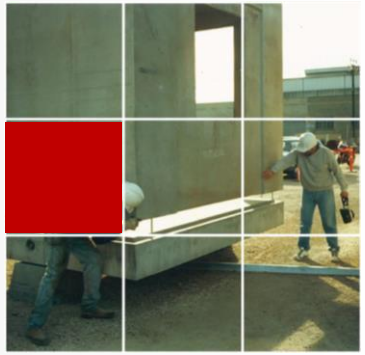


Thermal Insulation

Surface Finish

Wastage Free



Precise Engineering

DURABILITY

The structure has a longevity of 50+ years with low Maintenance and operating costs. Precast concrete is more durable than other materials; it is fire-proof, termite proof and water-proof. The superior finish achieved with controlled manufacturing processes means that the concrete may be left in its natural state and not finished, painted or covered at all, if so required.

SAFETY

The self-supporting system provides a safer work environment than traditional tilt slab construction methods requiring no propping, brackets or expensive scaffolding.

DESIGN FLEXIBILITY

The technology provides architects and developers with endless design options with wall openings and windows, doors and stairwells that can be pre-moulded into each module. The modules are assembled on the site according to the plans and the rest of the structure is added - roofing, veranda, façade decoration, flooring, plumbing and finishing touches such as light fittings, final painting, tiles, carpet etc.

Modules can be arranged to create design structures including multi-level.

ONSITE PRODUCTION

Daily controlled production, fully committed to each individual project with a customized plant per project.

PRODUCTION EFFICIENCY

The factory is an all-weather production facility and provides faster construction time regardless of weather conditions.

Onsite factory controlled fit-outs such as windows, doors, joinery, insulation and even painting can be pre-installed prior to installation to reduce onsite labour and construction costs.

RE-LOCATABLE

Both the manufacturing plants and the individual modules can be re-located to another location.

The mobile factories can be set up on site to save on transport and gas emission, to secure a better production rate, a faster delivery rate, a better pricing outcome.

SURFACE FINISHES

With a Class 1 finish, the off-form quality of wall and ceiling means that plasterwork is eliminated.

The surfaces are so well finished that it is ready to receive paint.

The flooring also does not require screeding and the tiles can be fitted directly using adhesive.

THERMAL & ACOUSTIC

The thermal and acoustic qualities of the modules are tremendous, with insulation being embedded within each concrete sandwich.

High external finishes further enhance efficiencies.

WASTAGE FREE

Virtually wastage free, the system utilizes lean manufacturing processes incorporating precise control of mix formulations, materials and labour input.

Tight controls of quantities of materials and precise mix proportions mean the optimum use of materials. The modules are manufactured repeatedly in the same moulds meaning little or no wastage of materials.

PRECISE ENGINEERING

The System delivers a highly accurate output within 2mm – 5mm of exact specifications.

Internal dimensions being with a tolerance of 1-3 mm, enables pre-ordering of all joinery work which results in savings throughout the construction management process.

ENVIRONMENTAL BENEFITS

Unlike traditional building methods that utilise precious raw materials that are highly wasteful, highly labour intensive and costly, this Precast System is a unique - highly flexible 3 dimensional modular precast building system that utilizes lean manufacturing processes to produce an eco- efficient, energy efficient, acoustically efficient, structurally efficient more durable low maintenance building solution.

Precast concrete is environmentally friendly in a variety of ways. The ingredients of concrete (water, aggregate and cement) are abundant in supply and take a lesser toll in their extraction than other construction materials.

As a nearly inert material, concrete is an ideal medium for recycling waste or industrial bi- products. Many materials that would end up in a landfill can be used instead to make concrete; blast furnace slag, recycled polystyrene and fly ash are among materials that can be included in the recipe for concrete and further enhance its appeal.

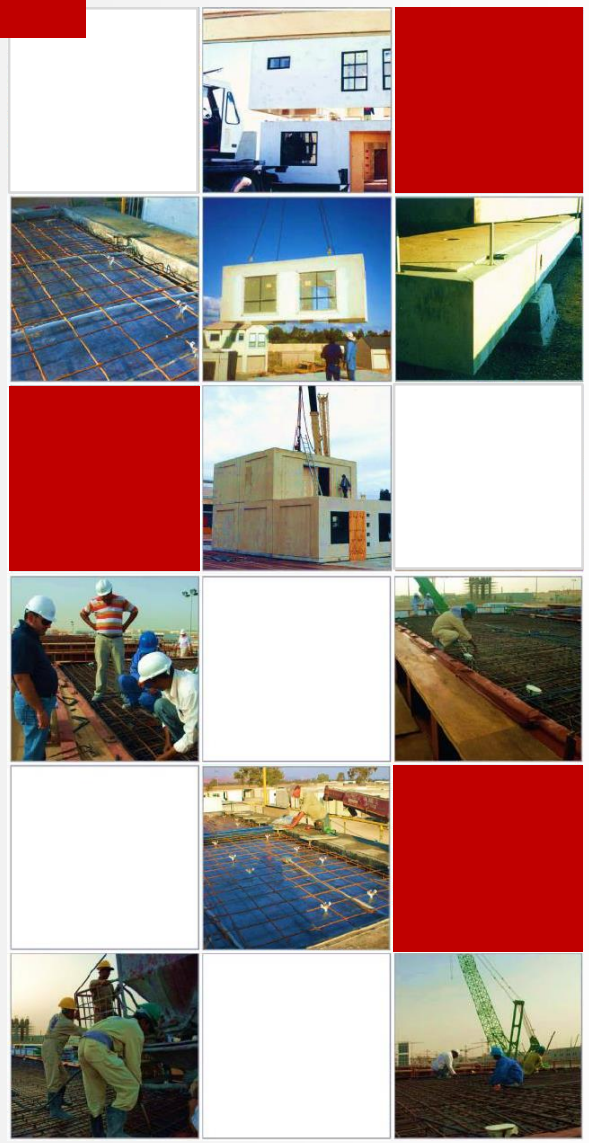
ENERGY EFFICIENT

Another environment plus for concrete is energy efficiency.

From manufacture to transport to construction, is modest in its energy needs and generous in its payback. Additionally, once in place concrete offers significantly higher energy savings over the lifetime of a building. In homes and buildings concrete thermal mass, bolstered by insulating materials, affords high R-factors and moderates temperature swings by storing and releasing energy when needed for heating and cooling and the light reflective nature of concrete makes it very easy to illuminate.

RECYCLING

Further commendable characteristics of concrete are waste minimization and long life. Whether cast- in-place or precast, concrete is used on as needed basis. Leftovers are easily reused or recycled and concrete is a durable material that actually gains strength over time, conserving resources by reducing maintenance and the need for reconstruction.



TECHNICAL DETAILS

CONCRETE

The concrete used in the production of the modules is 40 MPa, low shrinkage, super-plasticized mix with steel reinforcement.

Class 1 & 2 finish is achieved on all internal and external surfaces which is suitable for direct finish application.

TRANSPORTATION & INSTALLATION

Centre of Gravity: The manufactured units are very stable rectangular structures with a centre of gravity just over half way up their height. This is affected by the number and configuration of openings for doors and windows.

Each unit during the shop drawing phase has its own specific centre of gravity calculated and located on the shop drawing so that the lifting points can be positioned to ensure that the modules lift level from the mould are easy to install.

Lifting: the cast in lifting points are usually from a proprietary precast lifting supplier. The modules are lifted from 4 points located depending on the COG calculated. The lifting chains are 60 degrees or more from horizontal and in some instances a lifting spreader is used.

Transport: in the event the units are not cast on site, large steel transport frames are used across a traditional truck tray to transport the units around the manufacture site to their installation position or to another site (up to several hundred kilometers away).

Chains are generally used to secure the loads either over the top or to specifically designed anchor points cast into the underside of the units. This transport method generally has to be decided prior to manufacture so that the relevant cast in points are catered for.

LOAD TESTING

Load testing has been undertaken in a factory environment under supervision by Kinhill Engineers (South Australia) of a 5 storey building. Finite elements analysis has been performed by Conwell Wagner Engineers (South Australia).

PENETRATIONS / OPENINGS

These can also be cast into each individual module (preferred) or cut out later should extensions to the building be desired. The corner columns and the perimeter top beam are the structural elements and should not be compromised, although some exceptions are possible. The walls on all sides can have block outs / penetrations wherever required. The roof slab can also be moulded for stair openings, skylights, service ducts, lifts etc.

PRODUCTION CAPACITY

Each mould can produce one module per day.

Production can commence approximately one week after the shop drawing of the individual is approved. A detailed production program is produced for every job to ensure critical path and onsite production programs are met.

ACOUSTIC PROPERTIES

Mass is the greatest influence on the response of wall to sound. The heavier a wall/partition, the greater the sound insulating it can provide to the increase of energy required to set in motion.

Acoustic separation by a physical gap is the most effective means to stop acoustic vibrations as they do not have a medium by which to transmit the frequency.

For the reason above the “double skin” concrete wall becomes one of the most effective acoustic insulation systems.

Acoustic requirements for different classes of building vary considerably and are often a governing design requirement in modern buildings today. An acoustic consultant can be engaged to give project specific advice as to the requirements, especially in a multi-

occupancy building, however, the double skin concrete system satisfies most building class requirements.

As a guide the following values are expected for a single or double skin wall element.

- 90mm precast concrete wall 45 R_W
- 2*90 walls with 20mm gap 55 R_W

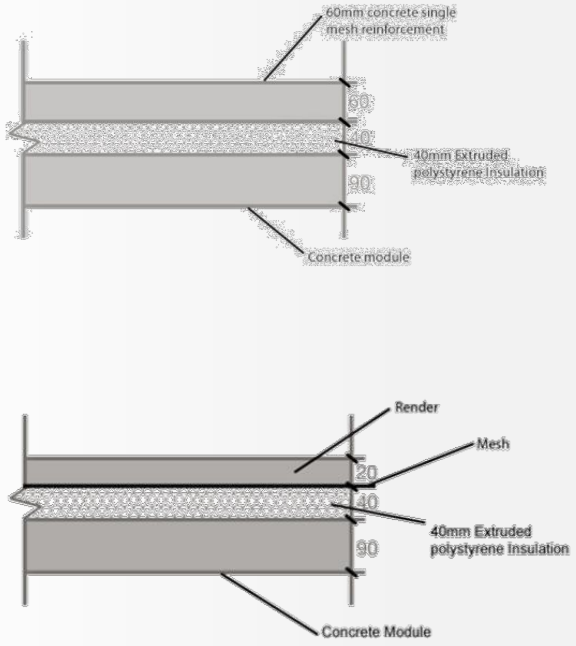
THERMAL PROPERTIES

Thermal insulation in building design has become important, due to heating and cooling energy costs over the life of a building.

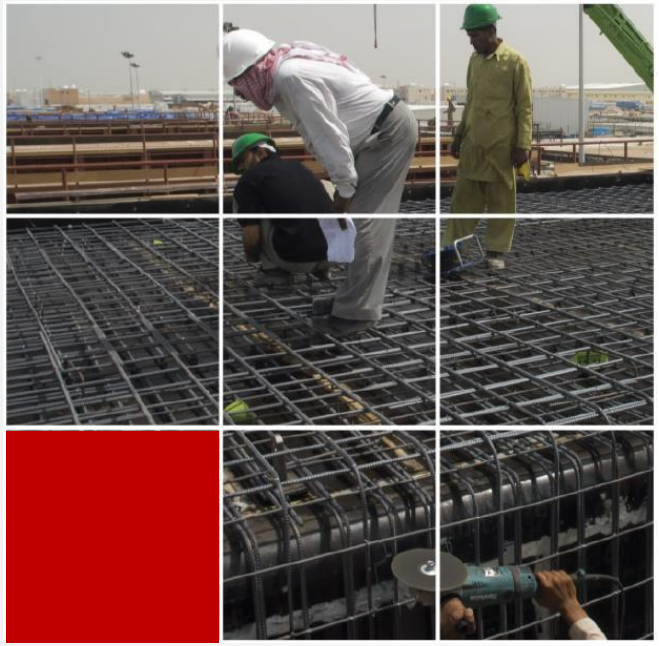
One of the most important properties in determining insulating characteristics of a building product is the thermal mass. Concrete has great thermal mass but poor insulating ability. One of the most effective principles then is to insulate the thermal mass from the extremes of the environment and keeping its temperature ambient.

The System is well suited to several methods of applied, or cast in situ insulation such as foam and render, or sandwich panel construction, which help insulate the concrete against temperature variations while keeping the internal thermal mass ambient.

Sandwich panel construction used extensively in the Middle East, Europe and North America and involves casting an inner structural layer of concrete, a central core of foam insulators, and an outer layer of concrete simultaneously in one operations. The cores are held



Thermal Properties



together by a thermoplastic resin and shear connector that bridges the 3 layers.

This is not the most cost effective solution but the most permanent solution. It is quite heavy and requires a high level of factory supervision to achieve.

The mould must be designed and modified specifically to allow the system to be poured; so the exact extent of the insulation requirements must be known prior to manufacture.

Post Fixed Form and Renders the most versatile system as is done independently of the modular manufacture process and can be placed on any wall, returns required can be done in the factory or on site.

The insulation value can also be varied quite simply by increasing the thickness of the foam layer at minimal extra cost.

This process is recommended for villa construction.

STUCTURAL DESIGN

The Modular product has been developed since 1987 by engaging some of the most sophisticated Finite Element method analysis techniques by some of the world's largest and most respected engineering firms such as Connell Wagner and GHD.

Basically, the module acts as a 3 dimensional frame where the horizontal roof element ties all the walls together and stiffens the unit. Although penetrations, doors, windows etc. can be placed practically anywhere, there is a beam on all sides and the corner columns that should not be compromised if possible, especially for multistory construction.

A general guide is that the columns should not be reduced to within 600 mm from the corners and the perimeter beam should be a minimum 500 mm deep. Individual structural certification is required if these conditions are compromised.

FIRE RATING

The fire rating of a particular building is a direct function of the design and will need to be calculated on an individual basis. However, the controlled cover to reinforcement, double skin concrete wall and highly vibrated concrete of the technology gives the maximum possible fire rating (up to 4 hours) between rooms) for particular wall thickness.

Causes of Low fire Rating	hoMMission Advantage
✓ Smoke propagation kills more people in high density fires than the actual fire or structure collapse itself.	✓ Fully integrated walls and roof gives complete and contained 3 hour+ fire and smoke containment per room
✓ The fire and the smoke spread is generally through the breakdown of the columns and beams which supports the building.	✓ There are no brackets, bolts, exposed steel fittings that will yield
✓ The collapse mechanism in majority of fires in precast structures is the yielding of the steel brackets and support structures which hold the walls and the roof together.	✓ The egress distance is small as there are exits at the end of each corridor
	✓ Coupled with other aids like smoke compartmentalization doors it can obtain a 3+ fire rating without a need for the fully reticulated system.

RESEARCH AND DEVELOPMENT

The company is committed to a continual R&D program to ensure adherence to the ever changing building code requirements and different types of applications.

The company has embarked on an ambitious approach to increase thermal, acoustic and fire rating properties while maintaining the existing benefits of modular system.

Current Research & Development includes

- ✓ Lightweight Concrete
- ✓ Colored Concrete
- ✓ Polished Floors
- ✓ Sandblasted Finishes
- ✓ Carbon Credit Trading

CONSTRUCTION SYSTEM COMPARISON

Factors	hoMMission	Block Work	2D Precast
BUILD CONCEPT	✓ A single trade and subcontract package ✓ Cast complete rooms in one piece and install with a single lift ✓ Sub-terrain structures	✓ Requires separate structures of beams, columns and floor system ✓ Wall in-fills need more jointing detail ✓ Must use separate floor system for multi-level	✓ Flat elements cast on flat table and installed individually and require numerous joints, brackets and grouting
FACTORY PRODUCTION	✓ Monolithic cast of wall and ceiling which is equivalent to 5 and 14 flat panels ✓ No brackets, props or vertical joints required ✓ Customizable for penetrations and openings ✓ Repetitious production of a module	✓ More on-site trades, reinforcement, brick or block laying and rendering ✓ Onsite labour intensive ✓ Concrete pump and untidy	✓ Larger factory area for equivalent production and many more vertical joints
INSULATION	✓ Closed joints reducing locations for air transfer ✓ Internal foam layer sandwich panel (200-210 mm) ✓ External UV Reflective coating (up to 100%), available in 45 colours	N/A	✓ Must be cast in foam, walls have a perimeter border not containing insulation ✓ Many vertical joints ✓ Cast in foam layer does not extend to full area of panel
WASTAGE	✓ Walls and roof act together structurally minimizing the volume of concrete, steel and reinforcing bars leading to less wastage	✓ Excessive site wastage, clean-up, disposal, cutting of bricks and blocks, pallets, mortar, sand piles, hoses and water	✓ Minimum 2 layers of reinforcing for insulated walls ✓ Requires extra 12m of vertical jointing per room

CONSTRUCTION SYSTEM COMPARISON

Factors	hoMMission	Block Work	2D Precast
FINISHES	✓ Internal and external paint can be applied as part of the production process	✓ Only achieved by site application, increased labour cost and interior accuracy ✓ Coloured bricks available but generally need to apply another finish or lining	✓ Factory painting not possible due to multiple joints ✓ Colour variation as panels are poured separately ✓ More visible joints
LABOUR	✓ Hydraulic mould requires 8 men to operate up to 80 m2 per 12 hours ✓ Installation requires 3 people	✓ Labour intensive ✓ Requires more site amenities, supervision, temporary services and scaffolding	✓ Each panel requires 2 man-days (~ 10 man-days for 5 panels)
INSTALLATION	✓ A single lift ✓ No propping or levelling ✓ Minimal site fittings, brackets and dowels ✓ Solid working platform immediately available for subsequent levels ✓ Erect 4-5 levels in one day ✓ Greater accuracy, monolithic construction reduces bracket and joint costs	✓ Slow ✓ Labour intensive ✓ Greater overhead costs	✓ Multiple small lifts causes delays, 2 levels per day max ✓ 5 crane movements to install one panel ✓ Individual propping and levelling ✓ Less accuracy with accumulating errors ✓ No immediate working platform until all jointing is completed
TRANSPORT & LIFTING	✓ 1 crane to extract and place for yard and site	✓ Extensive scaffolding, materials hoist and safety provisions	✓ Need approximately 8 cranes on site

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CONSTRUCTION SYSTEM COMPARISON

Factors	hoMMission	Block Work	2D Precast
SERVICES	✓ Windows and door frames, electrical and plumbing conduits built into mould ✓ Can cast holes in roof slabs for vertical plumbing service running from top to bottom of building	✓ Most be progressively manually built in or chased in later	✓ Impractical to factory install windows ✓ Corner electrical joining impossible ✓ Plumbing service holes more difficult
HYDRONIC COOLING / HEATING	✓ Pipes can be cast into floor for efficient cooling / heating	✓ Not possible	✓ Difficult / impossible to do with hollow core planks
SAFETY	✓ Modern lifting techniques ✓ Safe working platforms ✓ Limited access to external surface required	✓ Excessive site labour with potentially high injury risk ✓ Loose power leads, hoses and scaffolding creates safety risks	✓ Installation requires temporary phase (propping) with added safety requirement.

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