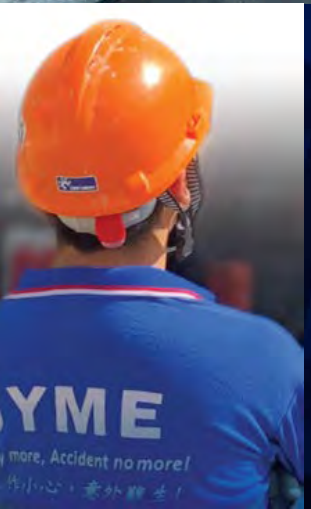



# BYME Bouygues Group
# DfMA / MiC solutions

# COMPANY OVERVIEW

## Local Hong Kong company supported by an international group

BOUYGUES

Energy – Transport

ALSTOM

(Ownership: 29.3%)

| Telecoms | Television | Construction | Roads | Property |
|---|---|---|---|---|
| Bouygues Telecom | TF1 | BOUYGUES CONSTRUCTION | COLAS | Bouygues Immobilier |

BOUYGUES BATIMENT INTERNATIONAL

BOUYGUES TRAVAUX PUBLICS

BOUYGUES CONSTRUCTION CONCESSIONS

香港寶嘉 Dragages HongKong

A member of the Bouygues Construction group

VSL

DTP TERRASSEMENT

Specialist Civil Works division

BOUYGUES ENERGIES & SERVICES

嘉福機電工程有限公司 BYME Engineering (HK) Ltd.

BYME MACAU 嘉福工程(澳門)有限公司

# COMPANY OVERVIEW

- Head Offices in **Hong Kong and Macau since 1990**

## Full Packaged MEP Contractor with full major public work licenses

- Mechanical Ventilation and Air-Conditioning (MVAC) [ Public Work, AC Installation Group II ]
- Electrical Service [ Public Work, Electrical Installation Group III & Public Work, Industrial Type Electrical Installation ]
- Fire Service [ Public Work, Fire Service Installation Group II ]
- Plumbing & Drainage [ Public Work, Plumbing Installation Group II ]
- Building Management Systems (BMS) and Extra Low Voltage (ELV) Services

## Architectural, Builder's Work & Finishing (ABWF)

- Registered General Building Contractor (RGBC) of HK Building Department [GBC 16/2015]

# BYME DfMA / MiC OVERVIEW

- BYME strives everyday not only to maintain, but to also excel at DfMA / MiC installations on each project. Our engineers are constantly progressing through innovative ideas in order to push the boundaries of accelerating work flow and increasing safety on site.
- We have already completed various projects which have incorporated DfMA (Design for Manufacturing & Assembly) into the work flow process and plan to repeat and improve upon these processes in future projects to come.
- We are also in the process of incorporating new innovative DfMA solutions into upcoming projects.

# MERITS of DfMA / MiC

## Experience / Knowledge gained from DfMA /MiC installations with various clients and consultants

| DfMA modules | Gain in terms of productivity | Gain in terms of quality | Gain in terms of saftety | Gains in terms of Inspection and Testing |
|---|---|---|---|---|
| **Chiller plant modules** | - Less welding on site<br>- Main works to be complete in a controlled environment<br>- Storage space is minimized on site | - More precise welding can be done in factory | - Less hot works (welding) on site<br>- Main works to be complete in a safe environment | - Pumps and Chillers can be tested separately off site |
| **Major BS horizontal modules** | - Site works on site is reduced to the strict minimum<br>- No more multiple trade presence in congested areas | - Avoidance of inter trade clash in services location | - Less hot works (welding) on site<br>- Less work at height<br>- Less work in congested area | - Material inspection can be done off site, saving on productivity |
| **Major BS vertical modules** | - Site works on site is reduced to the strict minimum<br>- No more multiple trade presence in congested areas | - Avoidance of inter trade clash in services location | - Less hot works (welding) on site<br>- Less work at height<br>- Less work in congested area | - Material inspection can be done off site, saving on productivity |
| **Packaged pump room** | - Site works on site is reduced to the strict minimum | - More precise welding can be done in factory | - Less hot works (welding) on site | - Pump testing can be performed off site |
| **Integrated AHU units** | - Site works on site is reduced to the strict minimum | - Accurate construction in a factory environment | - Less electrical works and test on site | - AHU pretest can be done off site |

嘉福機電工程有限公司
BYME Engineering (HK) Ltd.

# DfMA / MiC – Project References

# ASIA WORLD EXPO
## World Class Exhibition Venue

# ASIA WORLD EXPO
## MiC – Early years 2003


**Preinstalled Ducts and Lighting on Roof Frame prior to Lifting**

Pre-installation of major backbone equipment and materials prior to full lifting of the entire roof led to an improvement in programme and early delivery of the entire project to the client by 3 months

# Infrastructure - Liantang - Heung Yuen Wai Boundary Control Formation


E&M Works for 2 sections of dual-tube two-lane Tunnels (Cheung Shan Tunnel (CST) & Lung Shan Tunnel (LST)), 56 nos. of Cross Passage areas & Building Services Systems for 6 auxiliary Buildings.

**E&M System:**

- 49 Cross Passages in LST, with LV switchgear, ventilation systems and other building services systems
- 7 Cross Passages in CST, with LV switchgear, ventilation systems and other building services systems
- E&M Systems for 5 Vent Buildings and Administration Building with Electrical Services System, Environmental Control System, Central Monitoring & Control System (Include Software Development), Tunnel Ventilation System, Fire Services System, Plumbing & Drainage System, ELV Systems (CCTV & Access Control).

# Infrastructure - Liantang - Heung Yuen Wai Boundary Control Formation



## Modular Tunnel lighting installation

In order to increase the productivity, enhance the site condition and eliminate potential incident risk, **maximizing the use of "Design For Manufacturing and Assembly (DfMA)".** An innovative tunnel Pre-Fabrication Installation method was adopted for Lighting Fitting installation in the Liantang Tunnel Project.

This innovation adopted by BYME on Liantang tunnel project has already received **two awards on the OSHC & CIC Construction** Safety Day campaign 2018 dated 6 Jul 18 and 17th OSH Award 2018 dated 5 Sept 2018 respectively. This installation method increases productivity by 3.5x and rapidly increases installation speed by workers.

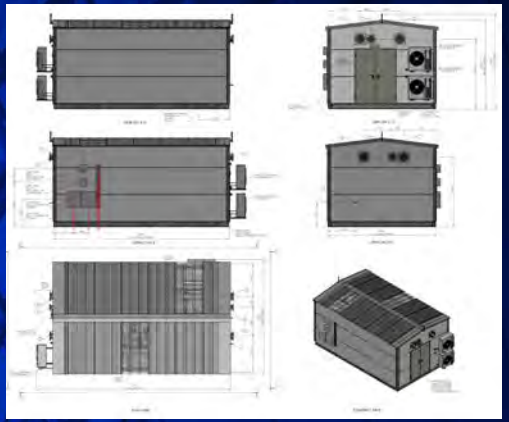
# HKG10 DATA CENTRE – Tseung Kwan O

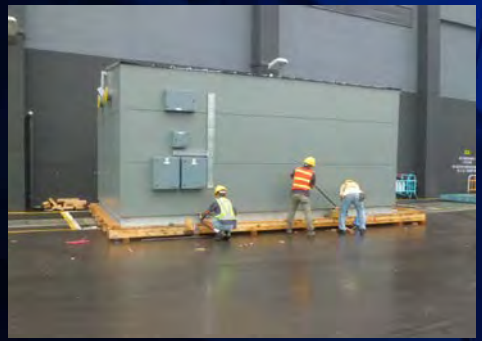
## Phase II & III Mission Critical Retail Colocation 10MW IT Load Data Centre

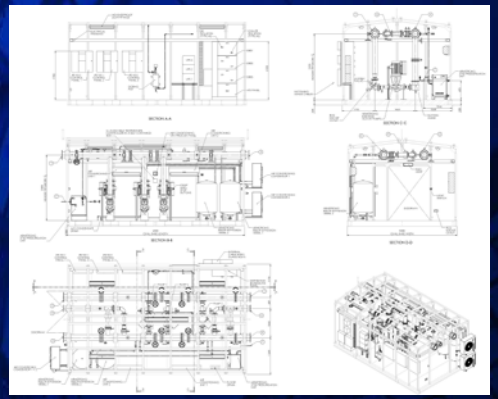
# HKG10 DATA CENTRE – Tseung Kwan O

## Full Pre-fabricated Chilled Water Pump Room

- Pump Room construction in UK
- Pump Control Hardware from Canada
- Pump room was hoisted to roof on to new steel roof gantry with 500T mobile crane;
- The pump room was fixed to the roof structure by bolts & nuts;
- This modular construction resolved the programme, housekeeping difficulties.



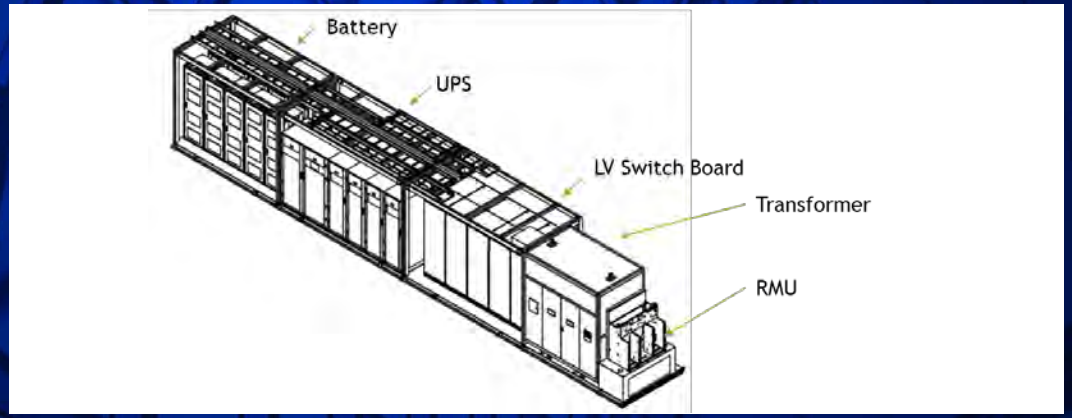


# HKG1 - DATA CENTRE - Tsing Yi

## Full Retrofit and A&A for Existing Industrial Building into a Full 20MW Hyperscale Data Centre

# HKG1 - DATA CENTRE - Tsing Yi

## DfMA – Mission Critical Power Transfer Units (HV Transformer/LVSB/UPS/Batt/RMU)

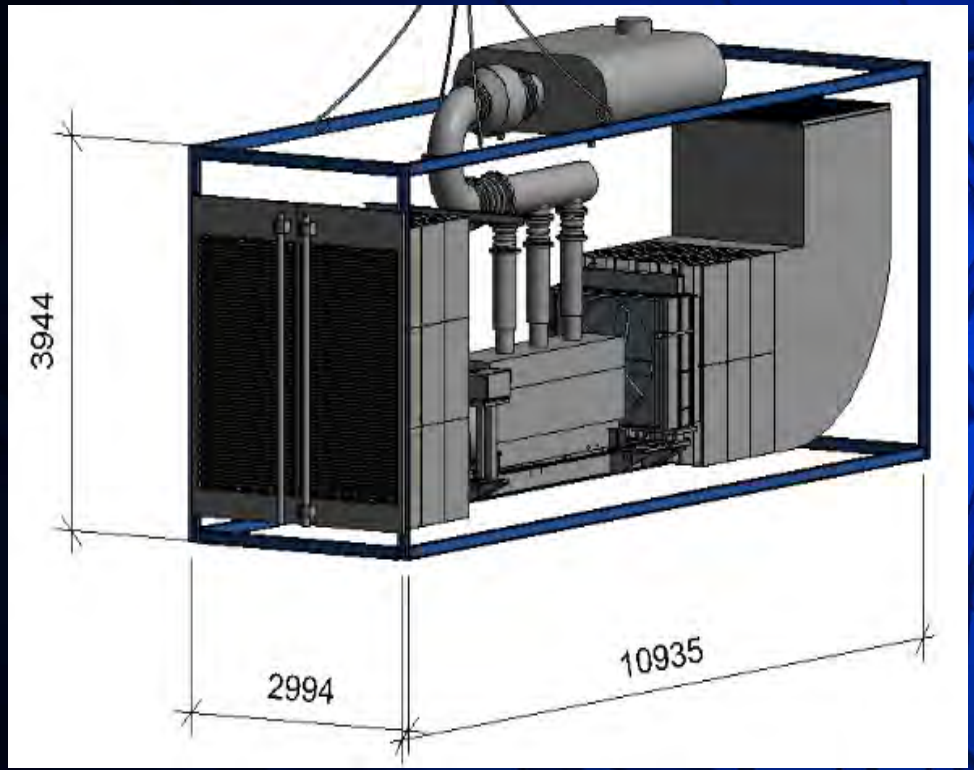



**PTU installation for electrical plantroom**

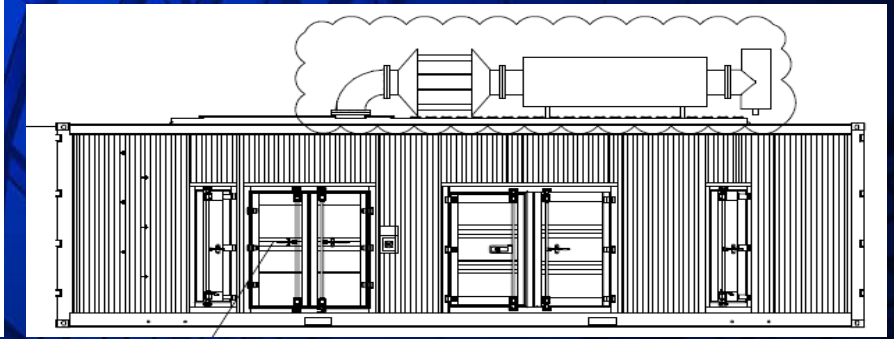
In order to tackle the special limitation for the plantroom we propose to integrate in a single MiC Module, transformer, Switch board, UPS and battery. This approach is used in by our company in Data Center Project for ease of installation and maintenance. This approach also save on cable quantities

# HKG1 - DATA CENTRE - Tsing Yi

## DfMA – Rooftop Mission Critical Generators







**ENCLOSED GENSET rooftop DfMA installation**

With the lack of space in the industrial building, the fully assembled GENSET units were placed within water tight containers on the rooftop. This was a space saving solution which found an alternative location for the MEP equipment.

# TRADE AND INDUSTRY TOWER KAI TAK

## Fast Track Government Building

**Trade and Industry Tower**

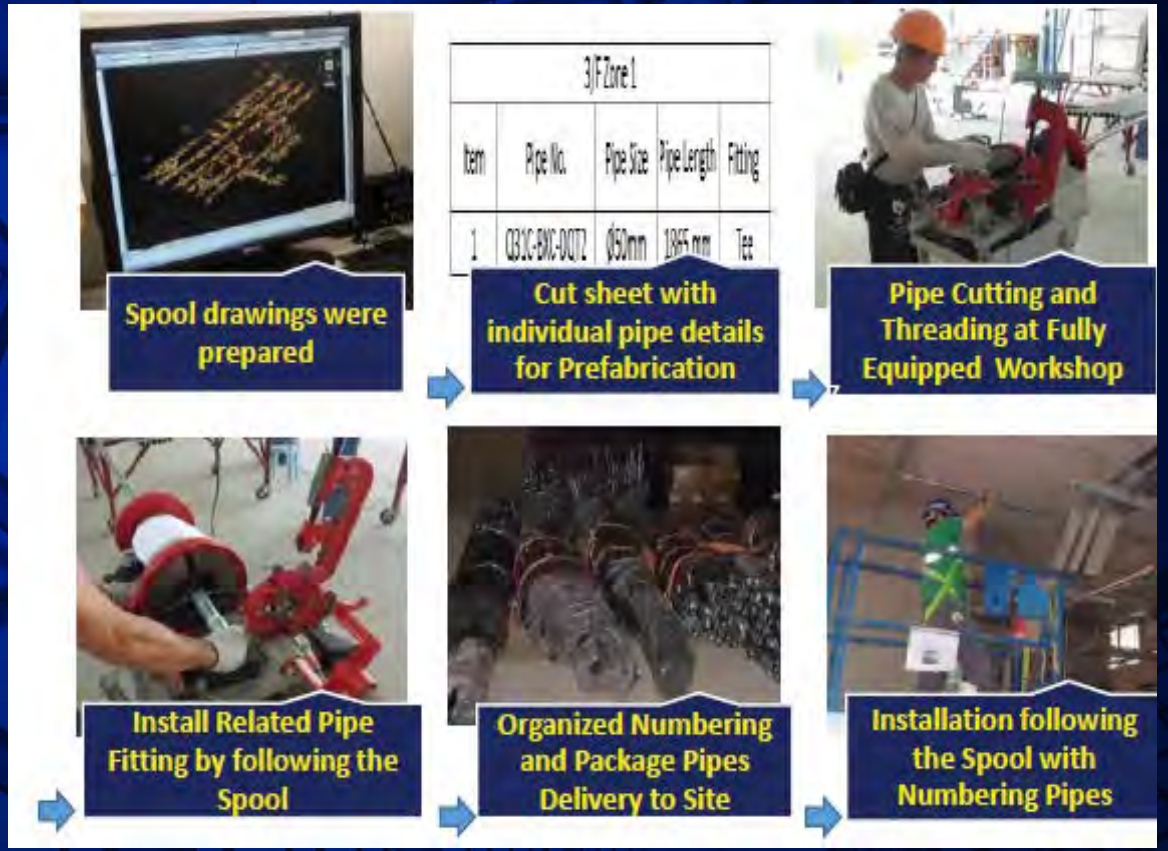
Period: 2012 – 2014
Contract Value: HK$ 237M
Systems: Electrical, Extra Low Voltage, Plumbing & Drainage

# TRADE AND INDUSTRY TOWER KAI TAK

## DfMA - Fire Services System

Prefabrication Method

- Preparation for DfMA including CAD and BIM
- Cut sheets prepared according to working construction drawings from BIM model
- Materials delivered to dedicated off site pre-fab yard
- Pipeworks fabricated in a factory-like controlled environment with full QC in place. DOL and JIT strategies utilized to maximize productivity and minimize wastage.
- 30% Production Rate increase
- 60% Material Waste decrease
- Highly Improved Quality & logistic Control



# HONG KONG JOCKEY CLUB – FLOODLIGHT REPLACEMENT PROJECT

# HONG KONG JOCKEY CLUB – FLOODLIGHT REPLACEMENT PROJECT


**Pillar Boxes**

The pillar Box structural Member fabrication, cover up process, coating process and pre-assembly were done in the prefabrication factory. The pre-assembled pillar boxes were then transported to site and installed directly into its final position for the electrical services of the newly replaced Hong Kong Jockey Club Flood Lights.

# HONG KONG ZHUHAI MACAU BRIDGE

**Date: 2013-2017**

Spanning over 50 km, Hong Kong-Zhuhai-Macau Bridge is set to be the key improvement to the socio-economic aspects of the region.
BYME's scope of works in this very challenging project include the supply and installation of HV distribution system from Scenic Hill Tunnel Ventilation Building to provide electrical distribution supply for all the equipment at bridge. In addition, the scope of works also include the supply and installation of road lighting system, general lighting at carriageway and deck void area, and pile cap/navigation channel lighting to aid boat operators. Complementing the operation and maintenance processes, SCADA system is provided to allow monitoring of major equipment such as HV system and power meters located at different parts of the systems. Finally, complete main earth & clean earth systems for electrical distribution supply and ELV system are provided to ensure the highest level of safety in the operation of the systems.

# HONG KONG ZHUHAI MACAU BRIDGE

## Electrical & Lighting Installation

**Pllar boxes**

The bridge is 50km long and was designed with LV cables for supply of road lighting. After implementing design reviews and optimization planning, HV systems were implemented due to severe voltage drops incurred by long LV cable spans. HV Pillar boxes on the Zhuhai Macau bridge were assembled offsite in modules for ease of installation. Once installed on site, only final fixes were required significantly reducing installation time on the bridge itself.

嘉福機電工程有限公司
BYME Engineering (HK) Ltd.

# DfMA / MiC- International Projects

# VENETIAN PARCEL 3 PODIUM - Macau

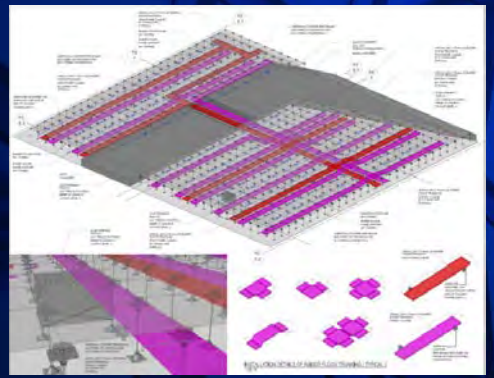
**BYME Engineering (Macau) Ltd.**

BYME, through its subsidiary of BYME Engineering (Macau) Ltd., was tasked to supply and install the Electrical System at The podium which consists of Basement 2, Basement 1, Lower Ground, and Level 1 to Level 6. The Podium scope of works encapsulate various areas including carpark, retail shops, gaming area, back of house and front offices, Food & Beverage outlets, mechanical plantrooms, electrical switch rooms, and electrical distribution rooms.

# VENETIAN PARCEL 3 PODIUM - Macau
## Electrical Installation

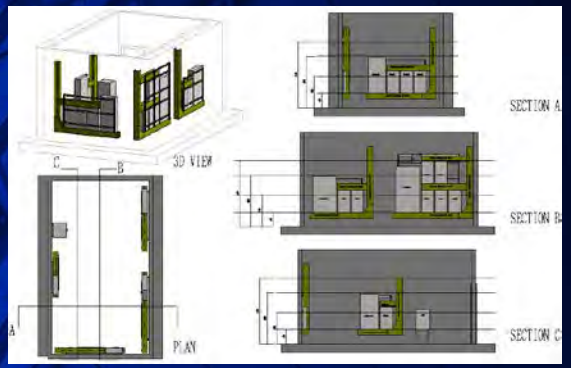
### Underfloor cable containments at Main Casino

- All junction & crossing point installed in modules off site;
- All branches were fabricated off site with a prepared cut sheet;
- All junction/ crossing modules & branches were delivered to site for installation;
- Modular off site construction improved site progress, improves quality, minimises potential accidents & reduces wastage.

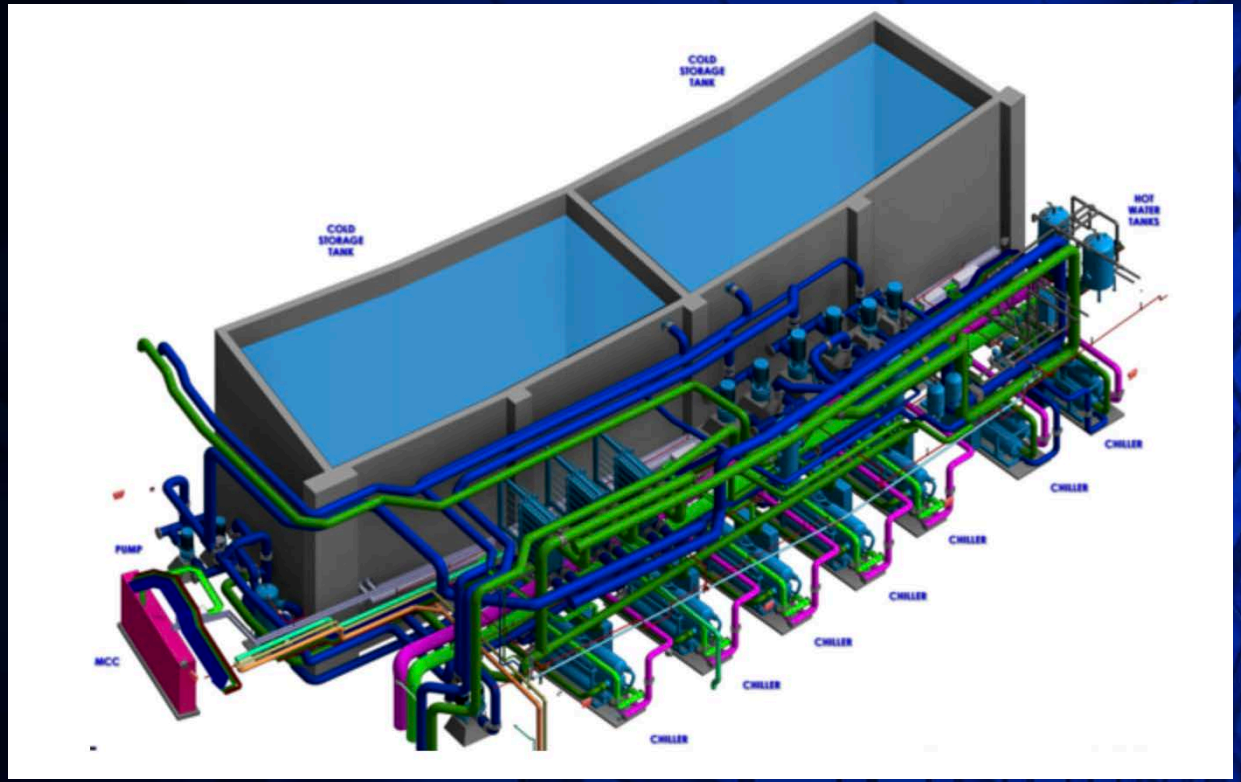



### Electrical Installation at Meter Room

- The distribution boards, switchgears & cable containments was installed in module off site.
- Each module was design in 2.5m x 2m high for easy delivery & access.
- This modular construction improves work quality, accelerates site progress and improves site safety.




# SINGAPORE SPORTS HUB




## Prefabricated components to create the plant room

A Prefabrication workshop was created to prepare the prefabricated piping modules for the chiller and thermal storage plant rooms

# SINGAPORE SPORTS HUB
## Prefabrication Pump Fittings

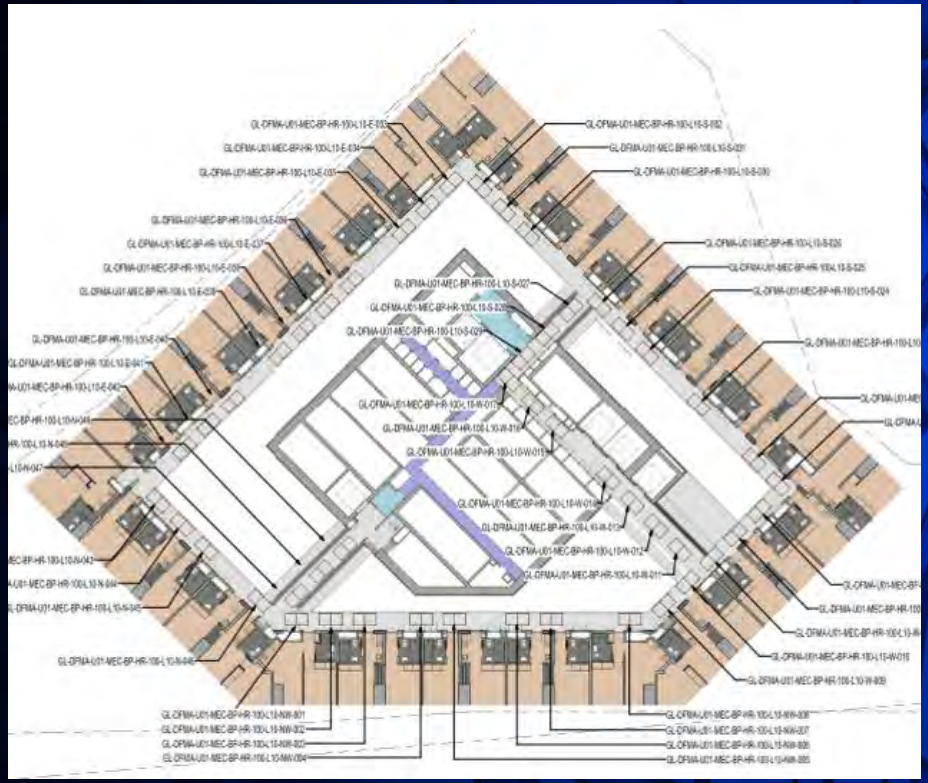


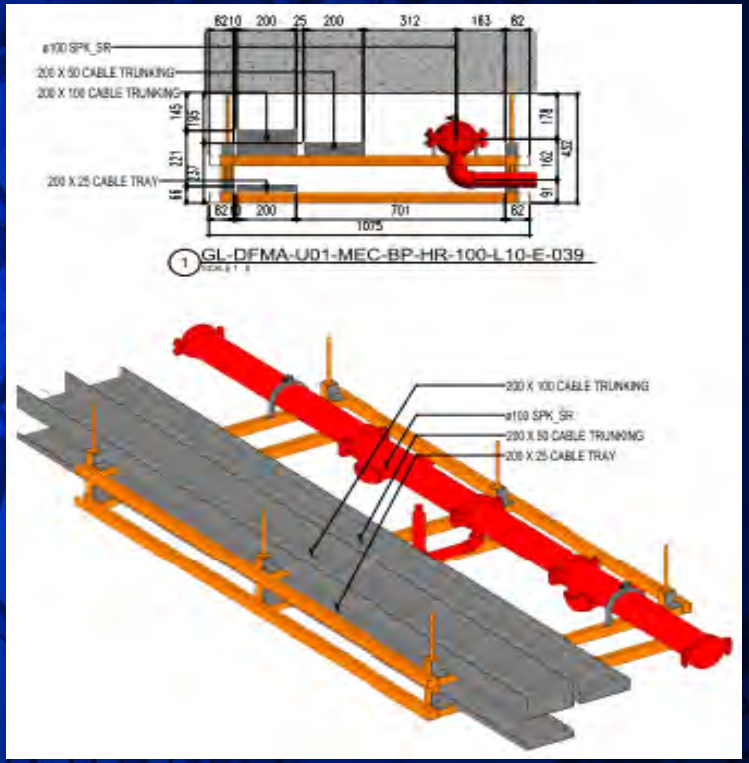
### Prefabricated Packaged Pump Set Modules and Pipework

By using BIM, the overall pump plant can be simulated with detailed pump positions and pipework routing at detailed design stage. With the detailed design and the prefabrication technologies, the **Pump sets can be Prefabricated and Tested Offsite with Significantly Higher Production Rate under Safer Working Environment.**

# SINGAPORE – PROJECT G

## DfMA – Corridor MEP Modules





# SINGAPORE – PROJECT G

## DfMA – Corridor MEP Modules

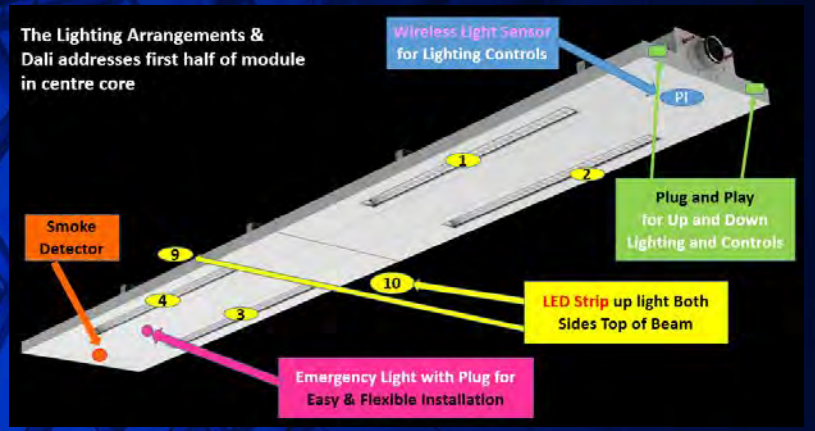
| Activity (per module) | | Traditional method | Prefab MEP |
|---|---|---|---|
| **1. Manoeuvring modules/ materials from the delivery point to the installation/ storage location** | Number of workers | 8 | 4 |
| | Time spent per worker | 1.5 hour | 1 hour |
| | Man hours | 12 | 4 |
| **2. Positioning and installation of anchor rods** | Number of workers | 8 | 4 |
| | Time spent per worker | 2.5 hour | 1 hour |
| | Man hours | 20 | 4 |
| **3. Installation of one module** | Number of workers | 8 | 4 |
| | Time spent per worker | 4 hours | 2 hours |
| | Man hours | 32 | 8 |
| | Total man hours | 64 | 16 |
| | **Manpower saving** | | **75%** |
| | **Productivity improvement** | | **300%** |

# CAMBRIDGE ASSESSMENT - UK

## MEP Ceiling modules

For Office Buildings, an **Innovative MEP Ceiling Module Concept** integrating lighting, ventilation grilles etc. can be proposed as we have successfully delivered this concept in previous Office Building Projects.

- ✓ No false ceiling and shallow modules
  - ➔ **Low floor to ceiling height + Good day light**
- ✓ MEP modules used to house lighting, Fire alarm, also used as acoustic panels
  - ➔ Increase Productivity & Effectiveness
  - ➔ Combined MEP **Minimize Copper Losses**
  - ➔ Optimized Lighting System allows **15-25% Energy Saving**
- ✓ **Globally very cost effective** since smaller vent ducts, lower façade cost (building height can be reduced)
- ✓ Integrate E&M Systems with Intelligent BMS for **Energy Efficient Operation**




# BROOMFIELD HOSPITAL – Chelmsford Essex - UK

**Date: 2007**

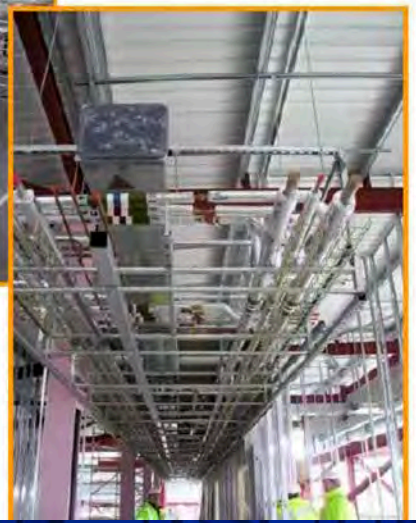
Many Prefabrication solutions were adopted on this project which brought the following benefits:

1. Reduction in site labour
2. Improvement in quality control
3. Improvement of site coordination/interfaces
4. Potential Programme reduction (Broomfield benchmarked for future projects)
5. Cost Savings

# BROOMFIELD HOSPITAL – Chelmsford Essex - UK

**FACTORY ASSEMBLY**

**RISER MODULE INSTALLED**

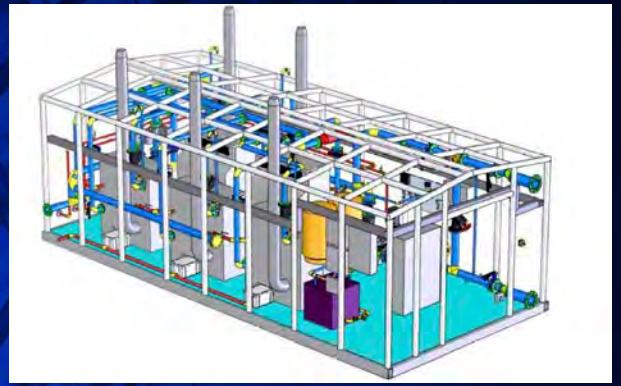


*Delivered to site on racks suitable for hoisting straight into the final location.*

**Corridor service modules**

Corridor service modules were used for around 75% of the corridor areas. The modules contained LTHW, CHW, HWS & CWS pipework, brackets for medical gases and all cable containment systems. Some ductwork was incorporated onto the modules but this was limited due to the ceiling void height and the trust requirements for 25% spare area of the void for future expansion. If the trust requirements for this item could be removed, more ductwork can be incorporated into the modules and significant program savings could be realized in future projects. 19 prefabricated Mechanical Service Risers were also used for this projects and measured between 6-12m in height.

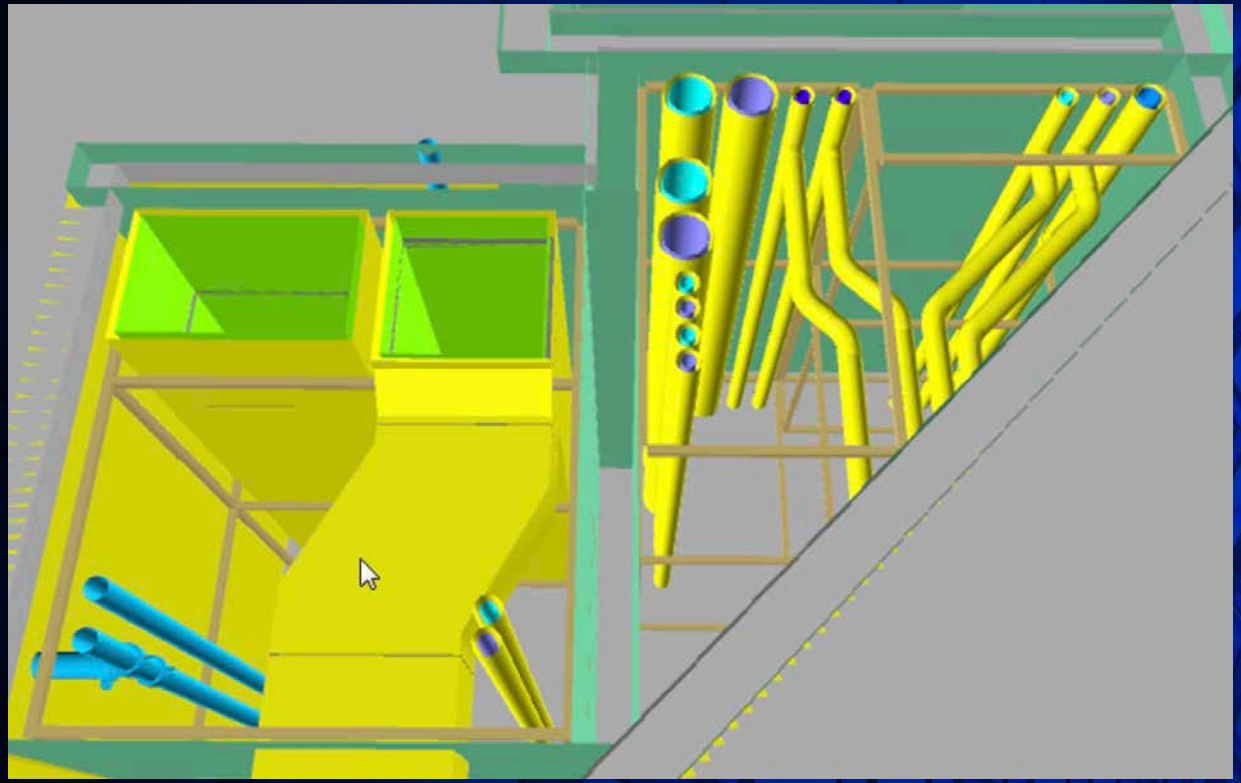
# BROOMFIELD HOSPITAL – Chelmsford Essex - UK

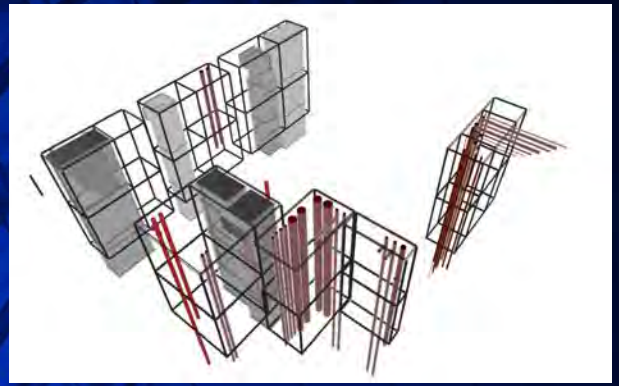


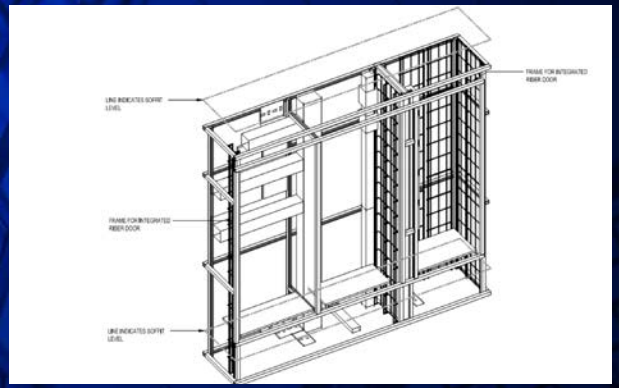
**Prefabricated Plantrooms**

The Intention on Broomfield was to prefabricate the main boilerhouse. This plantroom includes all pipework, boilers, pumps, insulation, wiring, controls and lighting. A fully prefabricated plantroom of this size takes 2-3 weeks to install on site. If prefabricated plantrooms are considered at concept stage of a project, it is feasible to include electrical and AHU rooms to DfMA plantroom solutions.

# Hospital Project - UK



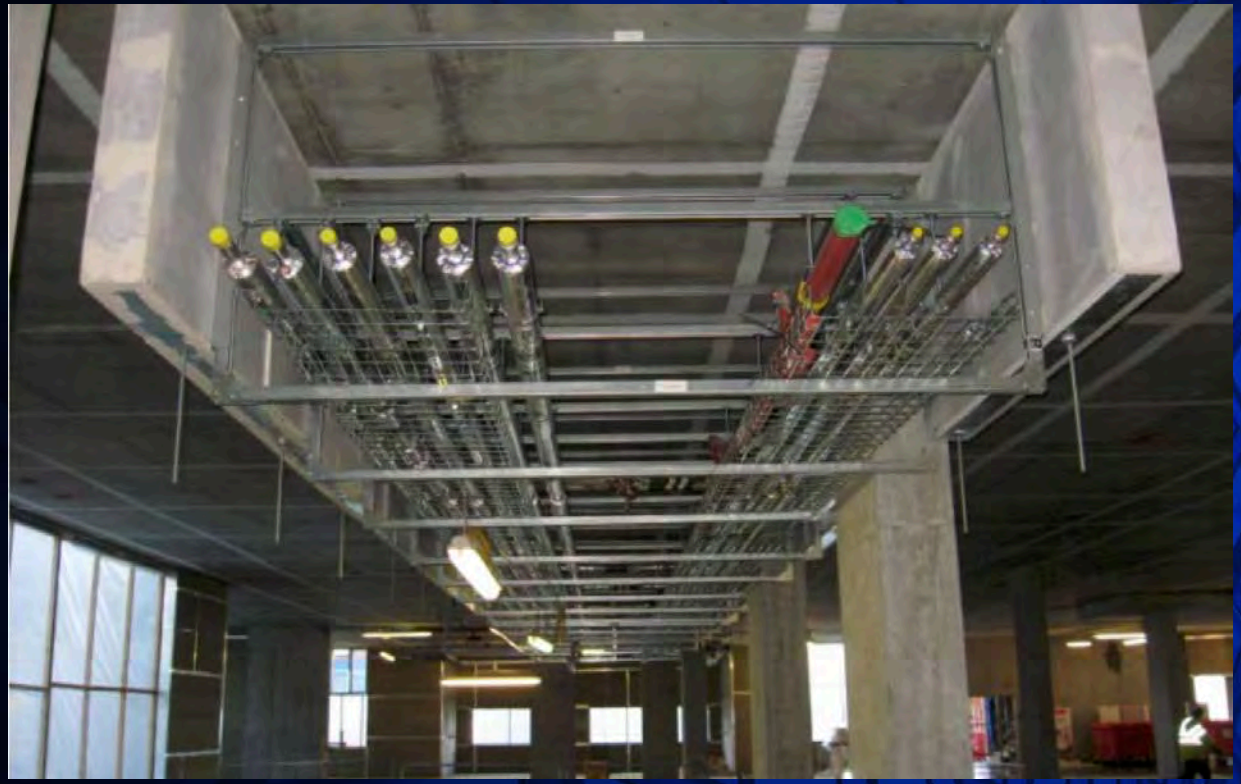


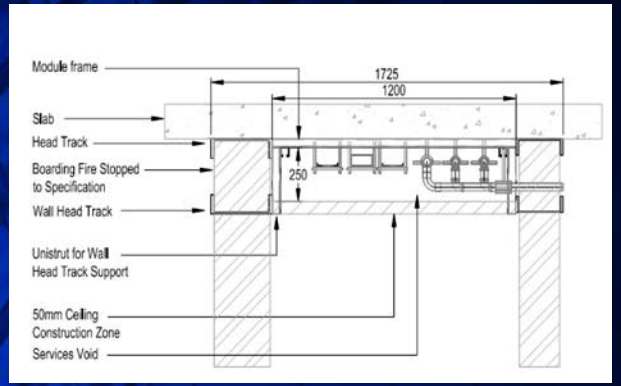


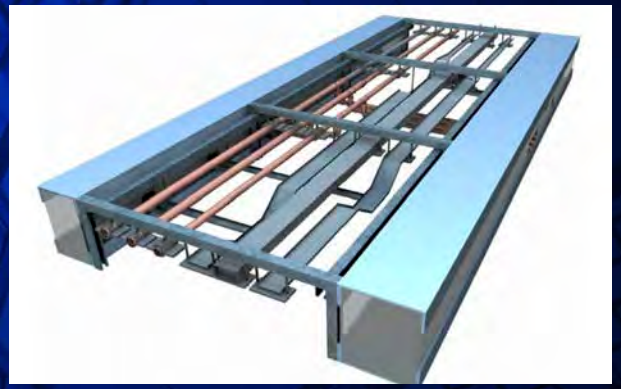
**Prefabricated Riser modules**

Risers and corridor modules were used on Hospital project completed with flooring decks and kick plates in order to create a safe opening on the riser the moment it is installed. This removes the need for hole protection, scaffold access and subsequent modifications to the scaffold throughout a traditional riser installation.

# Hospital Project - UK





**Prefabricated Corridor modules**

# Hospital Project - UK

**Prefabricated Plant Skids**

Modularised Plant Skids are used for the complex installation around major plant items within the main plant areas identified as, the level 6 external plant areas and the B2 Plant room.

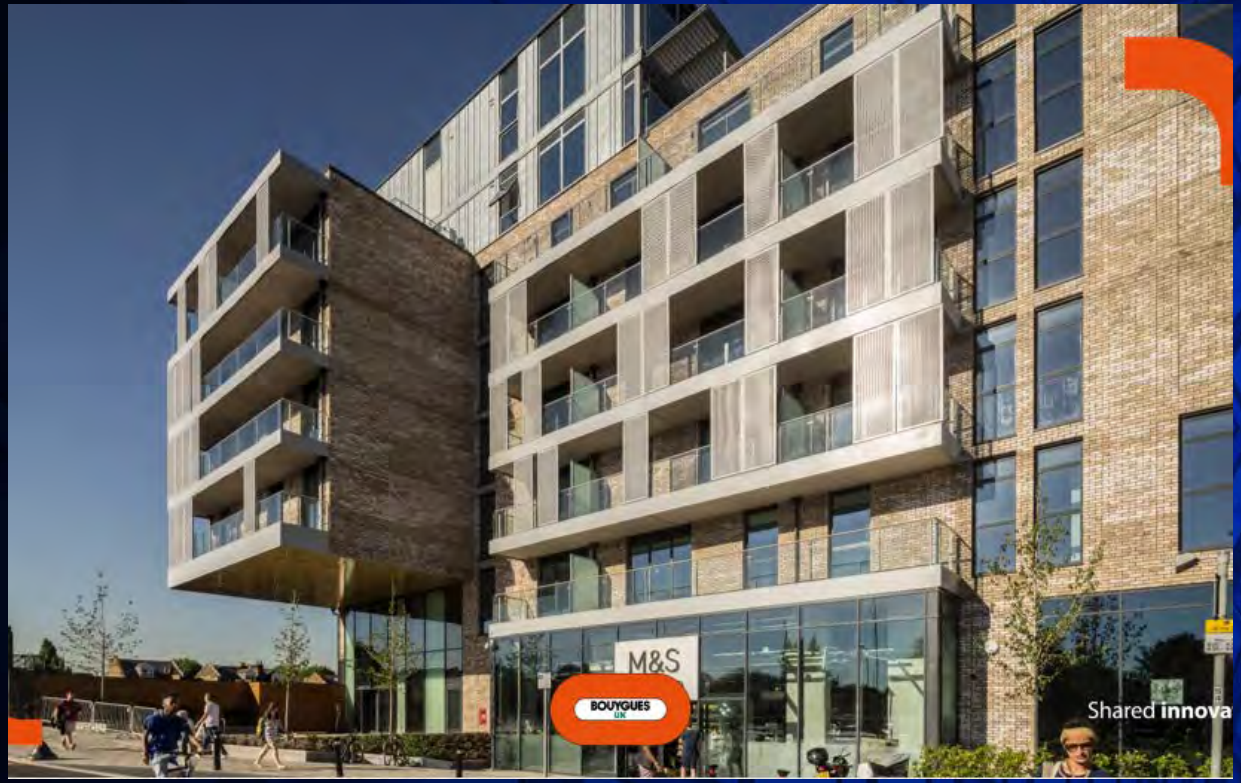
This includes all pumps and plate heat exchangers delivered as pre-fabricated skids, including the following:

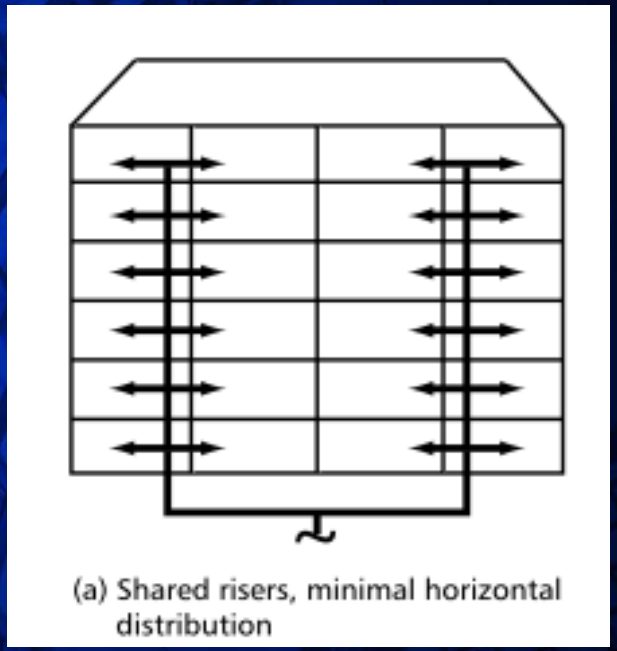
- Isolation Valves, strainers, flexible connections, test point & gauges
- Fully tested & insulated pipework
- BMS controls ready to 'plug & play'
- Power cabling from local isolator to equipment
- Inertia bases and anti-vibration mounts
- Labeling and identification

The Modularized plant skids for the banks of pumps located in B2 of this project come pre-Insulated, pre-wired and ready for 'plug & play'

# Housing Projects M&E - UK

## Residential Activity solutions



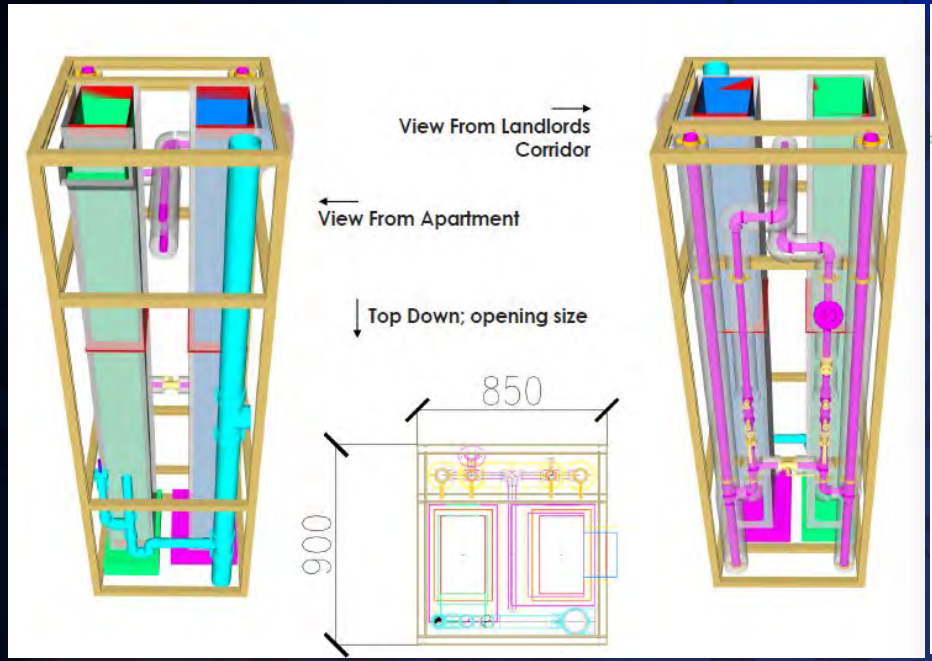



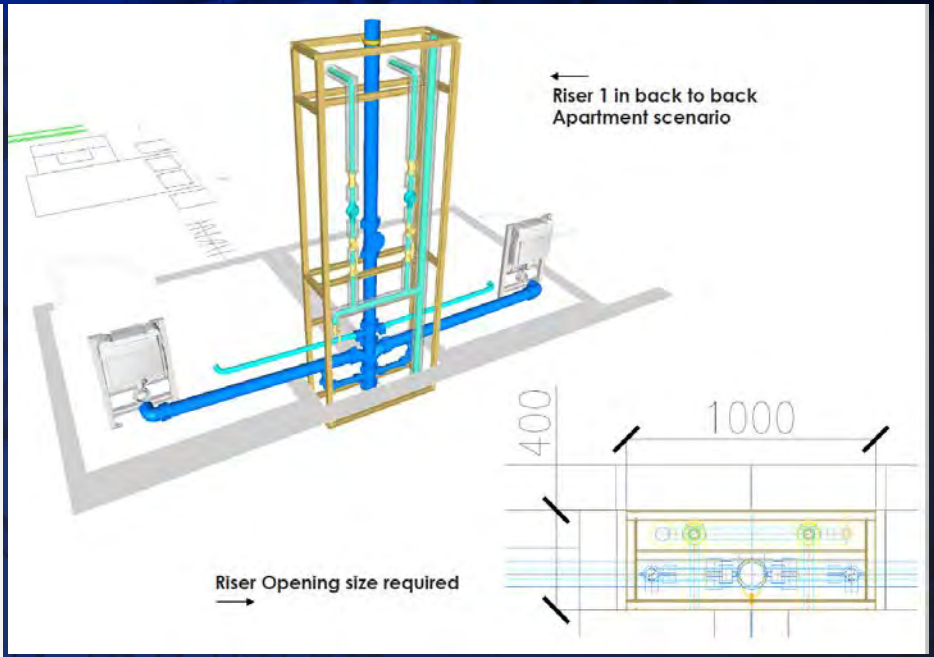

**Vertical Distribution Solutions (Cold water, LTHW water, Electrical Risers)**

Individual vertical distribution:
Best option to limit Coordination in the corridor and Overheating in the corridor.
Improves Standardisation of services for each typical unit, Height of the building and Prefabricated options.

# Housing Projects M&E - UK

## Typical Modular Risers

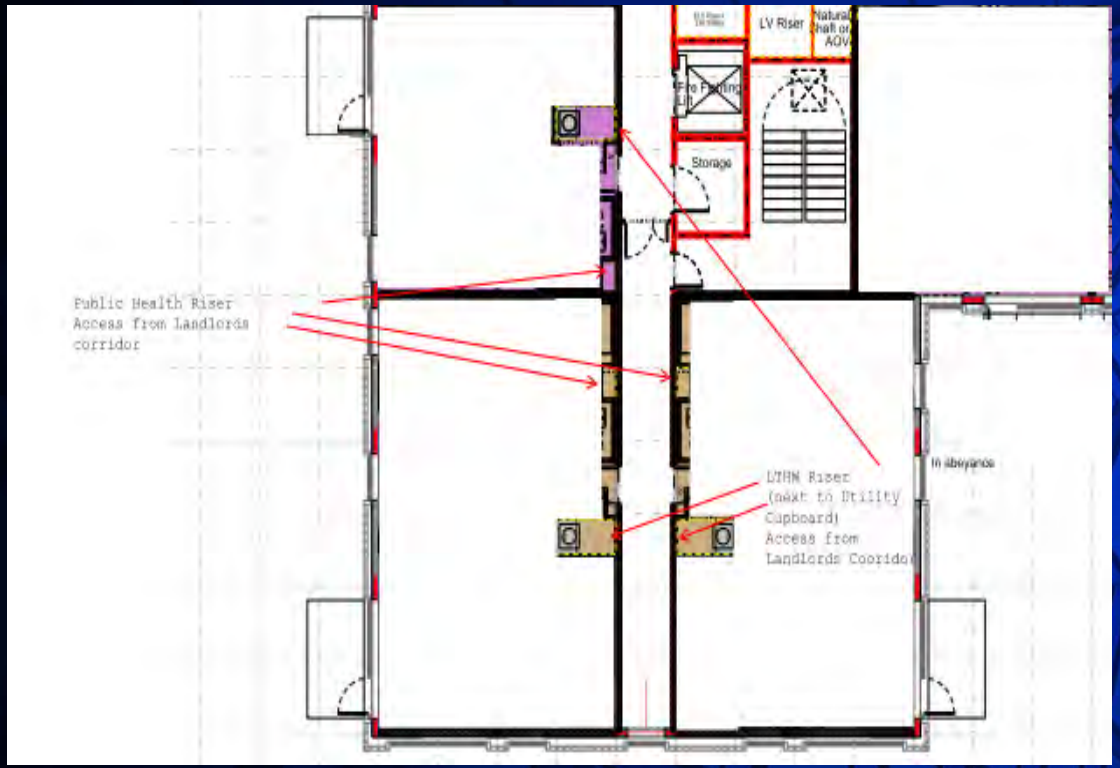


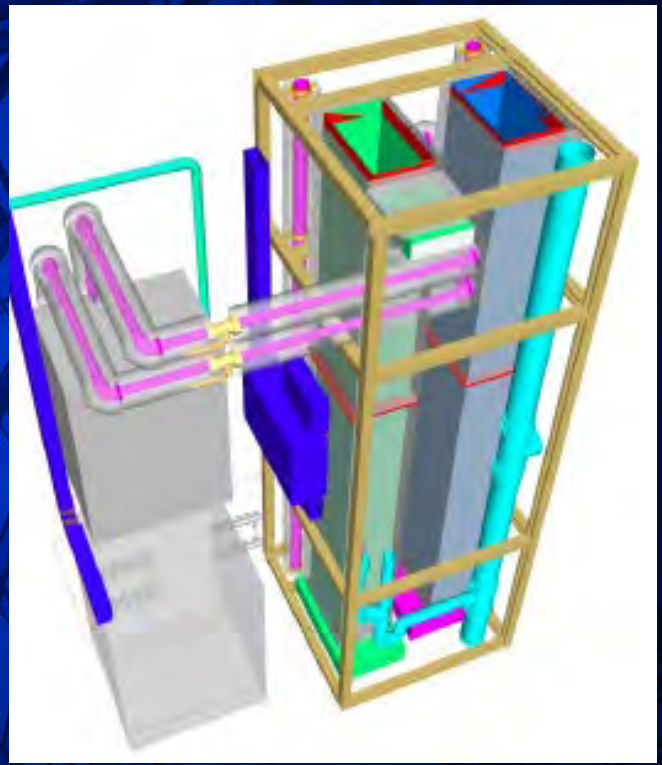




Typical Riser Used in the construction of this housing project in the UK. As seen, risers were used throughout the building for ventilation, water and electrical purposes. In the process of industrialisation, the main objective is to standardise our product in order to reduce the design cost, optimise production cost and introduce self delivery/off site solutions.

# Housing Projects M&E - UK

## Typical standard Utility Cupboard

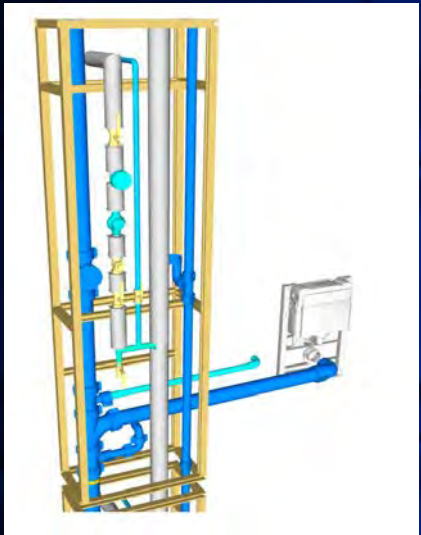


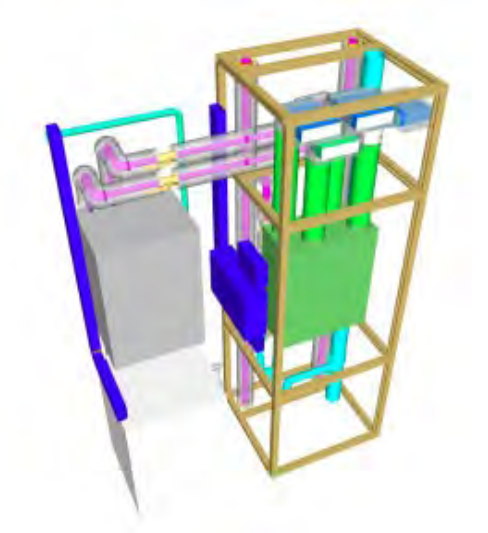



**Utility Cupboard**

- Isolating valves & flushing bypass is accessible from the communal corridor.
- Heat meters are located within the HIU (in the flat utility cupboard) and can be located on this riser if required by the client / ESCO.

# Housing Projects M&E - UK
## Riser Utilities





### Public health Risers

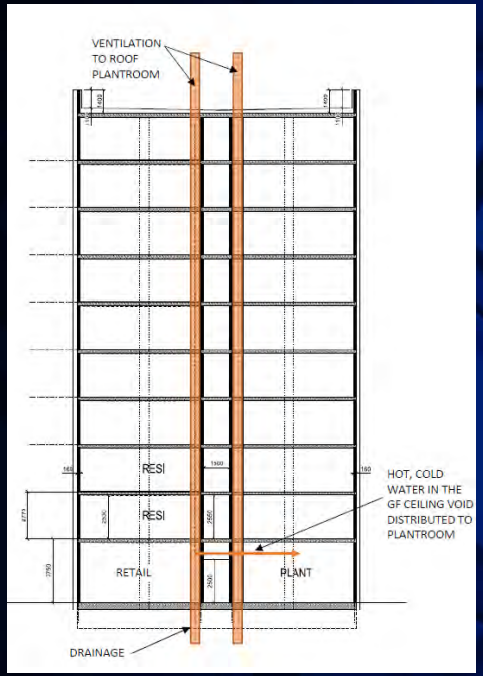
- Cold Water will be distributed vertically (same strategy as LTHW) in a separate Riser located behind bathrooms.
- Drainage stacks will be located on the same riser & within the Utility cupboard.
- Space has been allowed in the riser for an optional connection of the residential sprinkler services network.
- The tenant meter assembly will be accessible from the communal corridor for ease of maintenance and billing meter reading.
- Drainage stacks located within the Public Health Riser will be accessible.

### Electrical Risers

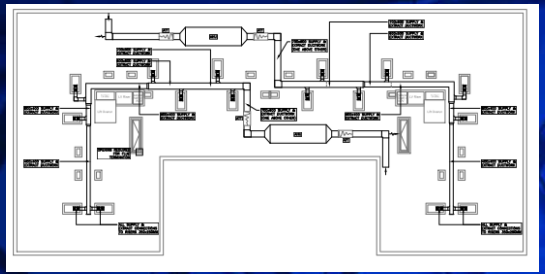
- All electrical services will be distributed through the LV & ELV Riser available for each core.
- Electrical meters will be located in the LV Risers. If required by the client, these could be installed within the Utility cupboard in the flat.
- Consumer unit will be located within the Utility Cupboard of each flat.
- 2 incoming data fibre can be provided per flat, terminating in the Utility Cupboard with 2 Master Sockets (RJ45); data can be distributed throughout each room of the flat.

# Housing Projects M&E - UK
## Ventilation Risers

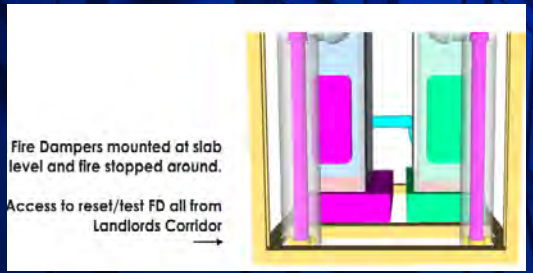
### Centralized Ventilation Risers




•AHU with Thermal Wheel is located on the roof for each core.

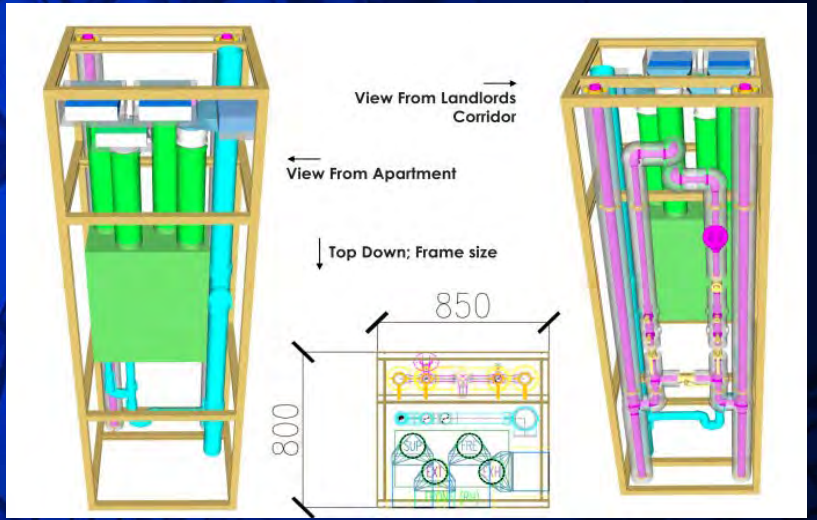


•Maintenance of the ventilation units will be completed at the roof level only; access to the flats is not required to check the filters conditions.
•Fresh air intake is located on the higher level to eliminate pollution issues
•Fire Dampers will be accessible from the communal corridor




### Individual Ventilation Risers

- An individual MVHR will be provided within the Utility Cupboard of each flat.
- Individual MVHR will be accessible from the Utility Cupboard of each flat.



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# DfMA / MiC – Upcoming Projects

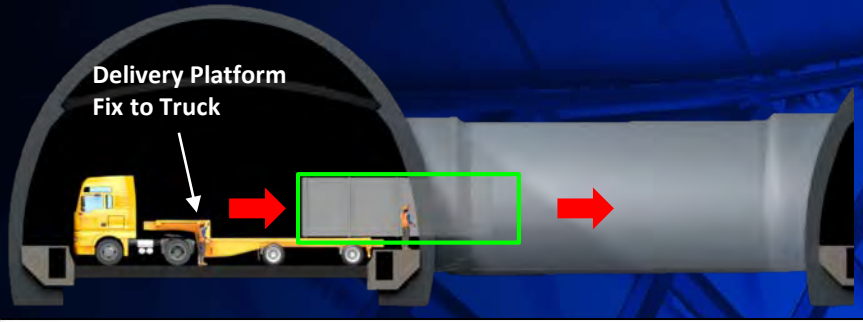
# T2 TRUNK ROAD TUNNEL PROJECT

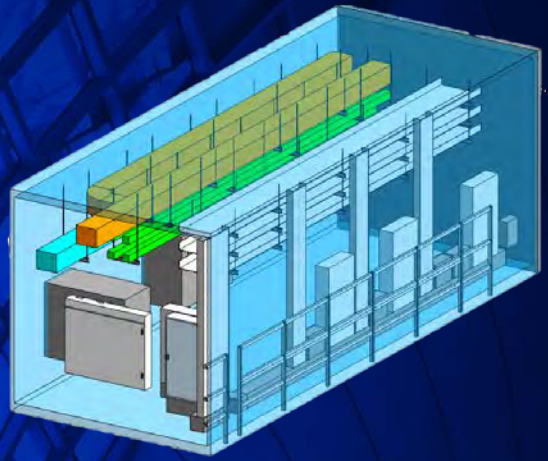

**Date of commencement: Nov 2019**

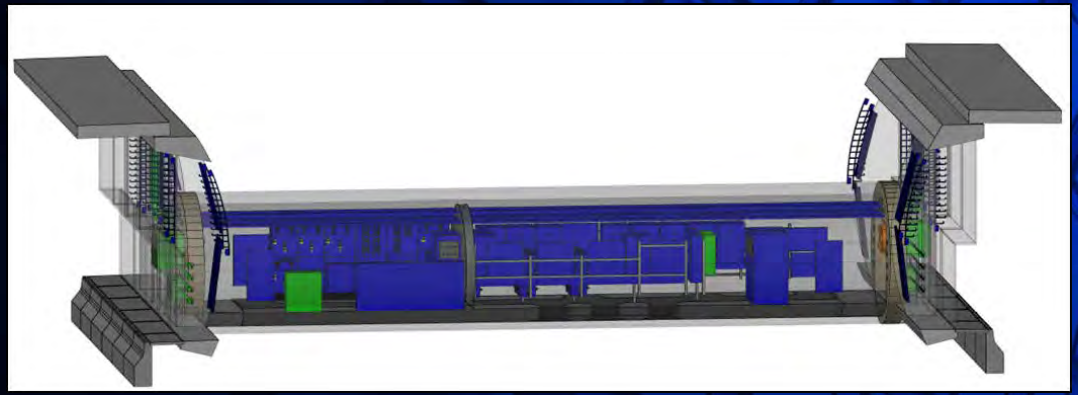
This project is sub-sea tunnel infrastructure including 1 tunnel and 2 ventilations building. The tunnel is constructed between CHA KWO LING and Kowloon Bay.
Total length is around 3.4km from Western Tunnel Portal to East Ventilation Building.
There are total 33nos. of Cross Passages (CP) inside tunnel, 7nos. of E&M CPs for E&M system installation.
Building Services will be installed in East Ventilation Building and West Ventilation Building including the Air Purification System is inside WVB for handling tunnel air quality.
Tunnel Ventilation system are used for Fire Safety Smoke Control and air quality. Tunnel ventilation fan will be controlled and monitored through the CMCS and AQMS at both West Ventilation Building and East Ventilation Building.

# T2 TRUNK ROAD TUNNEL PROJECT

## Infrastructure





**Pre-Constructed Cross Passages for Tunnel E&M systems**

Cross passages are traditionally bored, lined and fitted with E&M systems which is costly and timely to complete. This innovation is being studied to incorporate MiC methodologies for **the T2 cross passages** which will be pre-constructed into 2 sections off site (FSI and Non-FSI). These sections are to include all builder's work finishes and E&M equipment installations.

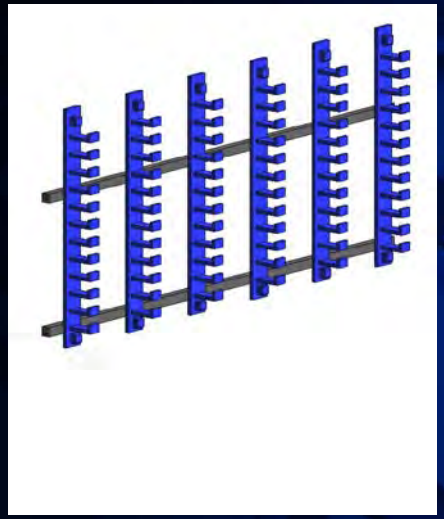
**Delivery of Prefabricated MiC (Module 1) with 6m length** completed with all builder's work finishes and E&M equipment installation will be **from Westbound**

**Expectations**

- **Production rate increase 30%**
- **Waste reduction 80%**

# T2 TRUNK ROAD TUNNEL PROJECT

## Step 1



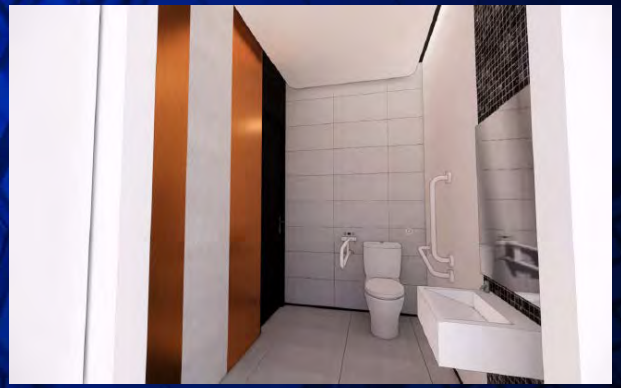
## Step 2


## Step 3

**Pre-fabricated/Pre-assembled Tunnel Cable Brackets**

Taking the combined cladding & E&M brackets a step further, a new innovative method is necessary to increase work flow. **Prefabricated Bracket modules** of 6 brackets each are installed requiring less drilling and speeding up the installation process. These modules will be comprised of **6 E&M brackets and 6 cladding brackets** for a continuous installation design. Installation of modules involves attaching E&M brackets to wall, cable pulling followed by mounting of cladding bracket module.

# HONG KONG AIRPORT AUTHORITY
## Building Project

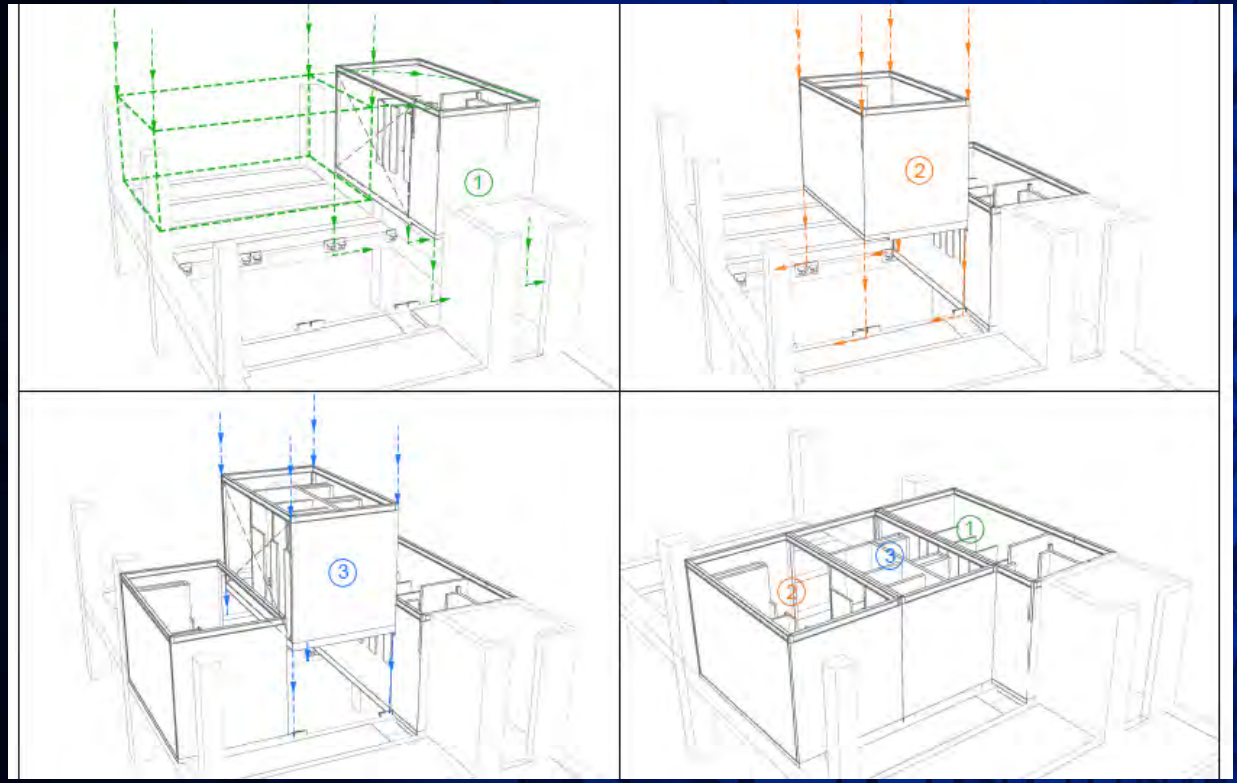


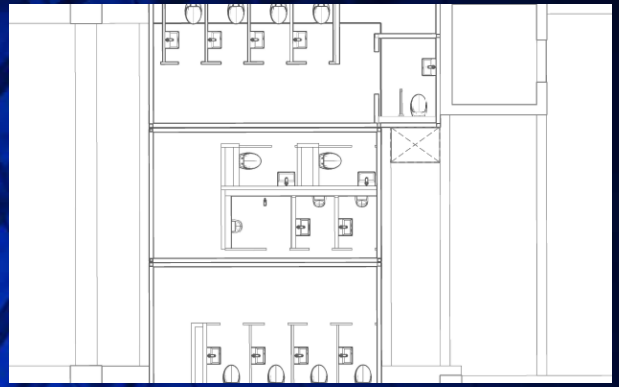
**Prefabricated Toilet**

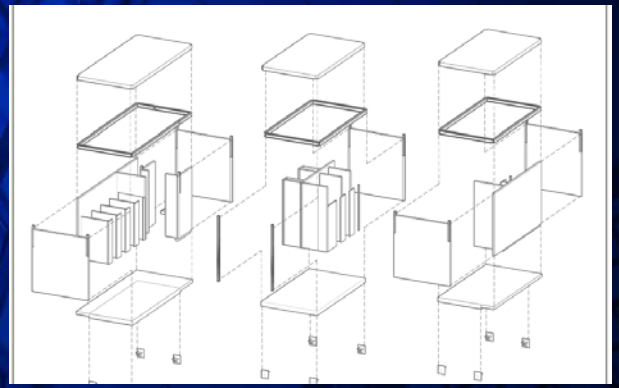
MiC Toilet Planning was implemented by DHK (Dragage HK) and their sub-contractor. For the MEP installation works, false ceiling inside the toilet is part of the MiC installation. Tax issues.

# HONG KONG AIRPORT AUTHORITY

## Prefabricated toilets





**Prefabricated Pods**

In order to install the prefabricated toilets, the plan to produce pods was devised for easy functionality. These pods pre-assembled off-site in a warehouse are transported to site and placed in their respective locations.

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# MiC/DfMA – Other Prefabrication Innovations

# DATA CENTRE INNOVATION

**Modular Data Centre**

Modular Data Centres are constructed by integrating IT racks, In-Row cooling and modular based UPS in a single aisle containment.

Additional facilities such as Data Centre Interface Management (DCIM) can be added to facilitate operation.

This innovation would reduce spatial requirement, optimize power usage by increasing IT power density, limit risks of hot spots, reduce cooling demand and consumption, ease construction and T&C, and facilitates maintenance.

# BYES DATA CENTRE

## Modular Data Centers

| Module Type | Size | Count |
|---|---|---|
| 2 Tier H/L Distribution Module | 3600 x 1000 x 500mm | 1 |
| AHU Valve Set Module | 3000 x 800 x 1800mm | 1 |
| Post Support Module | 12000 x 1000 x 3500mm | 11 |
| Post Support Module | 6000 x 1000 x 3500mm | 12 |
| Walk In Riser Module | 12000 x 3000 x 2000mm | 4 |
| Slim Riser Module | 12000 x 3000 x 550mm | 1 |
| Slim Riser Module | 12000 x 2500 x 550mm | 11 |
| Single Tier H/L Distribtuon Module | 3600 x 1600 x 500mm | 12 |
| Single Tier H/L Distribtuon Module | 6000 x 1600 x 500mm | 16 |
| Spine Riser Module | 12000 x 500 x 500mm | 8 |
| UPS / LV Module | 12000 x 3375 x 800mm | 16 |
| Plant Room Module | 5000 x 3000 x 3000 | 1 |
| CRAH Unit Modules | 4750 x 1900 x 800mm | 32 |
| CRAH Unit Modules | 5250 x 1900 x 800mm | 32 |
| Easy Load H/L Modules | 6000 x 800 x 1000mm | 186 |
| Roof Plant Bases | 12000 x 3500 x 500mm | 8 |
| L/L Unistrut Frames (cables) | 6000 x 800 x 1000mm | 90 |

The DGP Approach to improve our performance in delivering Industrial buildings & Data Centers:
Benchmarking good practice existing within our group and also competitors (included in R&D programme): Plant Skids – Plant Shelter – Pipework assemblies/ spools – Utility cabinets – Multi service Modules – IPS: Integrated Plumbing System - Bathroom Pod – Risers ….
Select best techniques applicable for Data Centers
Implementation stage for new projects: systematic review of modules opportunities at early commercial stage (DfMA)