

Introductory Course on Modular MEP Design and Prefabrication

FORTIS CONSTRUCTION

4/25/2023



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CONSTRUCTION INC.

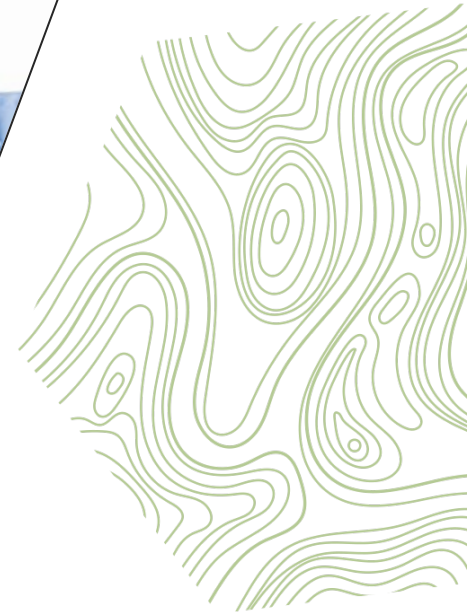
Lecturer's Profile

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Mr. Stephen Michael Adams BEng (Mech)

With over 19 years of working experience in Singapore, Macau, Hong Kong, the Middle East and the UK, Stephen has worked on a variety of Industrial, Commercial, Utility, Process and Rail Projects for leading E&M / Main Contractors . This included a Market leading Data Centre in Singapore where 70% of the MEP services were prefabricated off-site, after setting up a manufacturing facility to support the project. Most recently he is working on a Hyperscale Data Centre for Fortis Construction that is using DfMA for large scale construction.

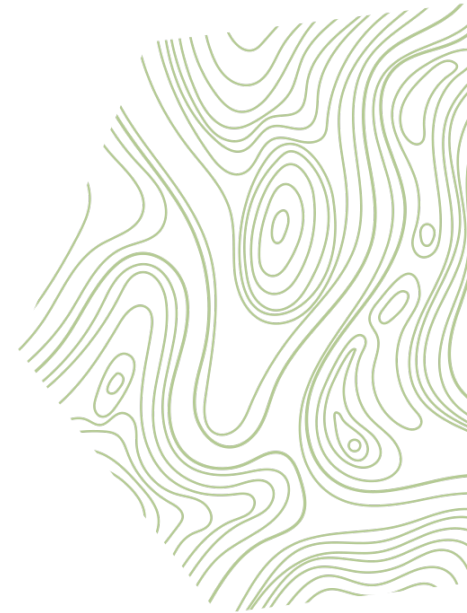


Modular MEP Prefabrication

Content

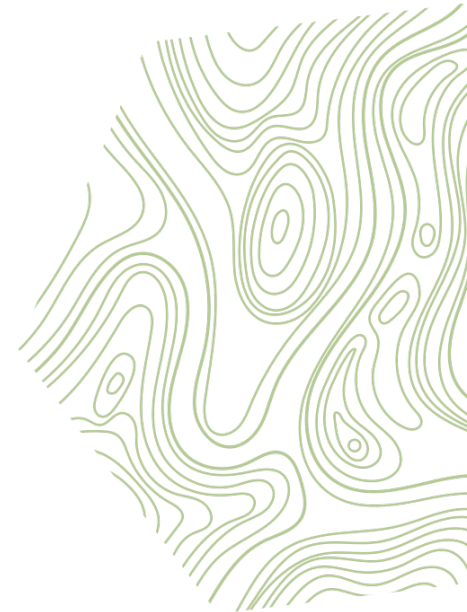
Session 1

- Introduction & Background
- Prefab Modular Design
- Types of Connections
- Factory Start-Up
- Equipment and Techniques
- Assembly of Module frames
- Production & Coordination



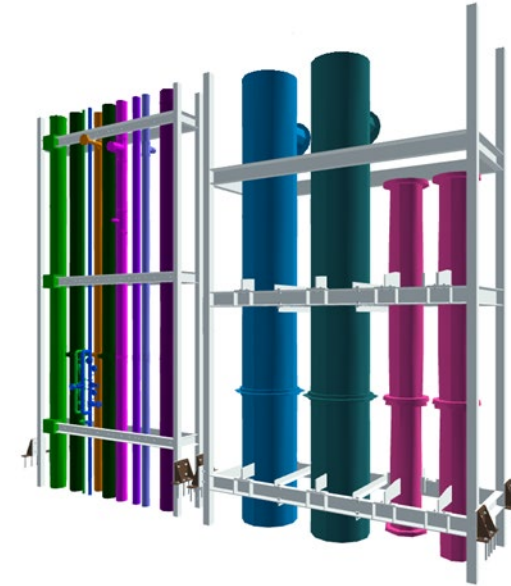
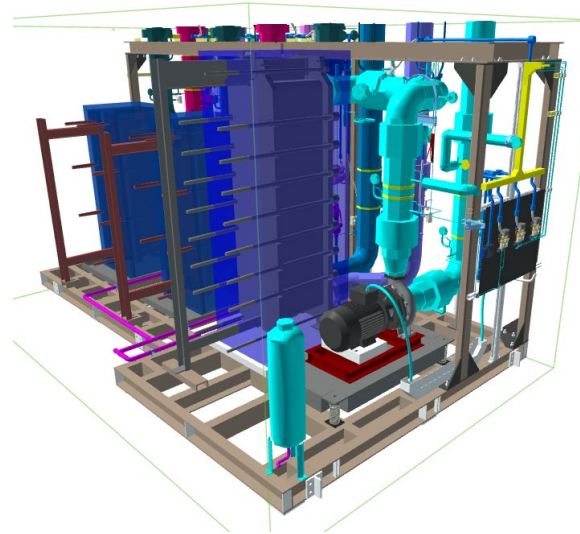
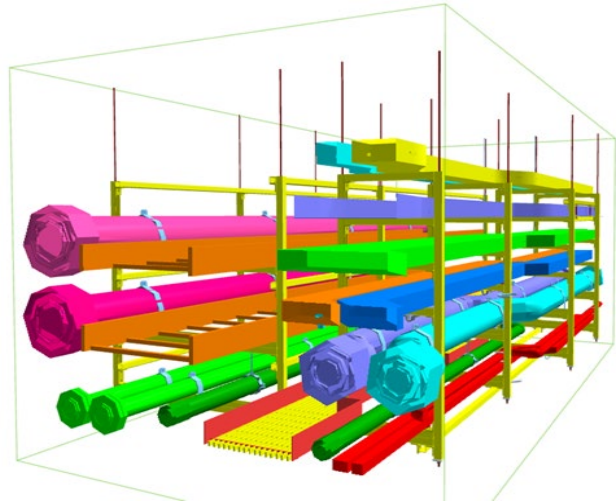
Content

- Logistics, Deliveries & Planning
- Safety considerations in lifting, handling and delivery
- Methods of Installation and productivity metrics.
- Integration of Prefab MEP with other trades.
- Summary
- Q&A



Introductions

Prefabricated MEP Modules

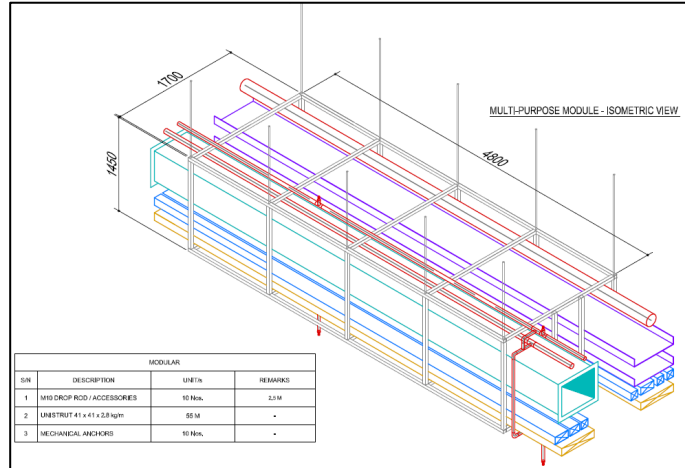


What are Prefabricated Mechanical, Electrical, and Plumbing (MEP) systems?

A Modular system consisting of an assembly of MEP components and equipment that are integrated into an off-site assembly and then installed on site.

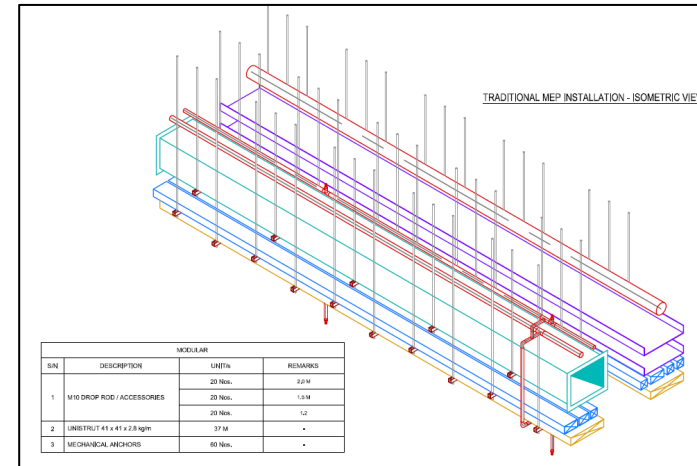
Prefabricated MEP Modules

MEP MODULAR



- Fabricated in a control Environment
- Mitigates Rework
- Quality
- Health & Safety
- Sustainability

TRADITIONAL INSTALLATION



- Reduced Labour on Site
- Saving in site time.
- Multi-tasking labour
- More productivity

PRODUCT VS PROJECT

Measure Outcomes

Ongoing

Focus on Value

An actual thing

Adaptive



Measure Output

Has a finish

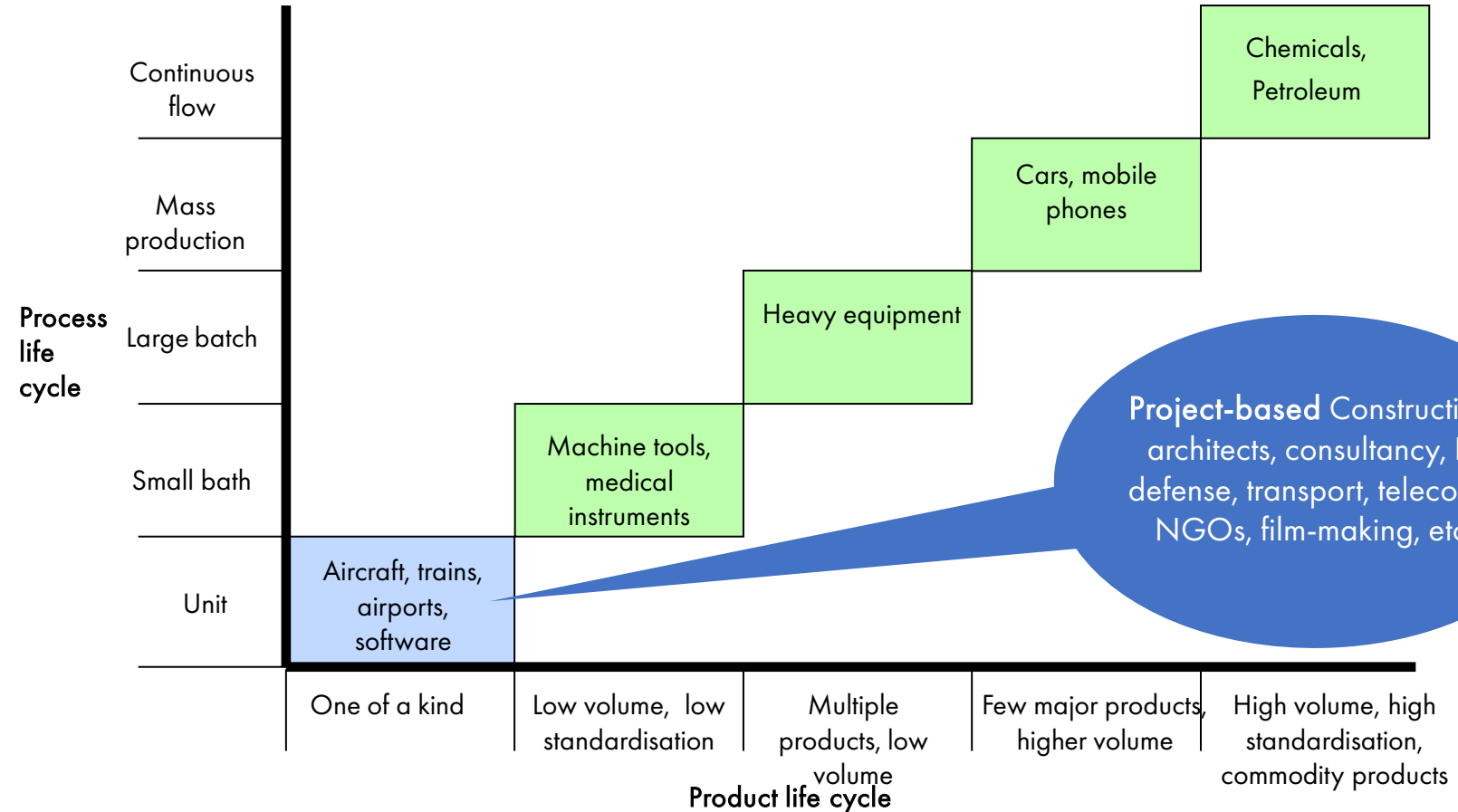
Scope, time & Budget

Task Management

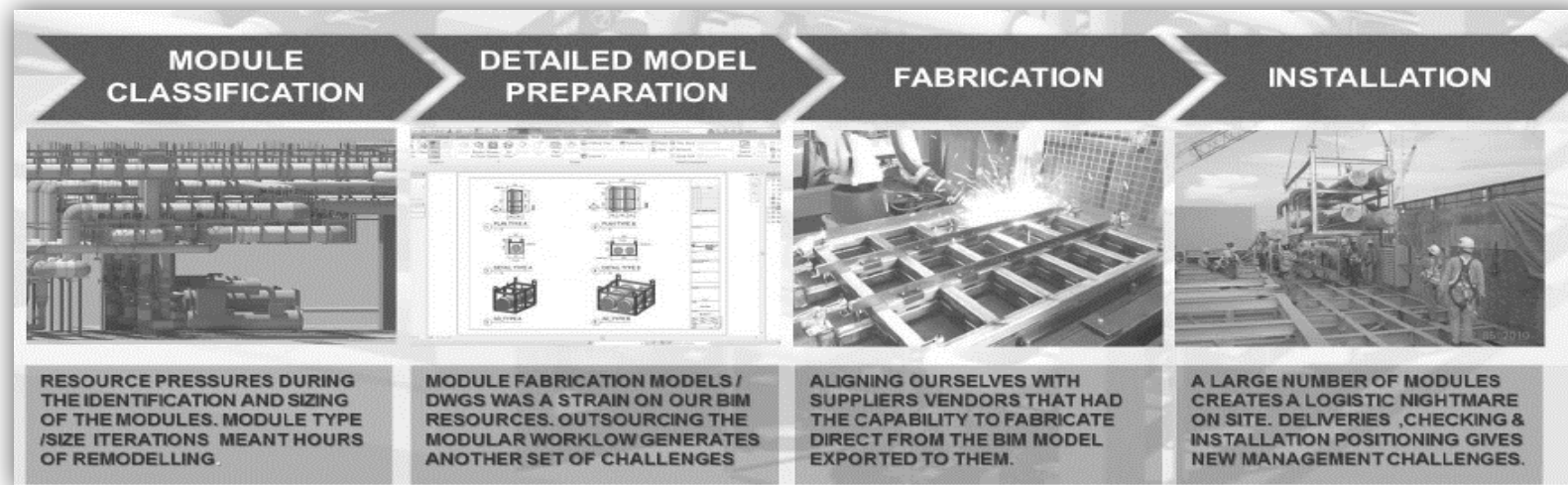
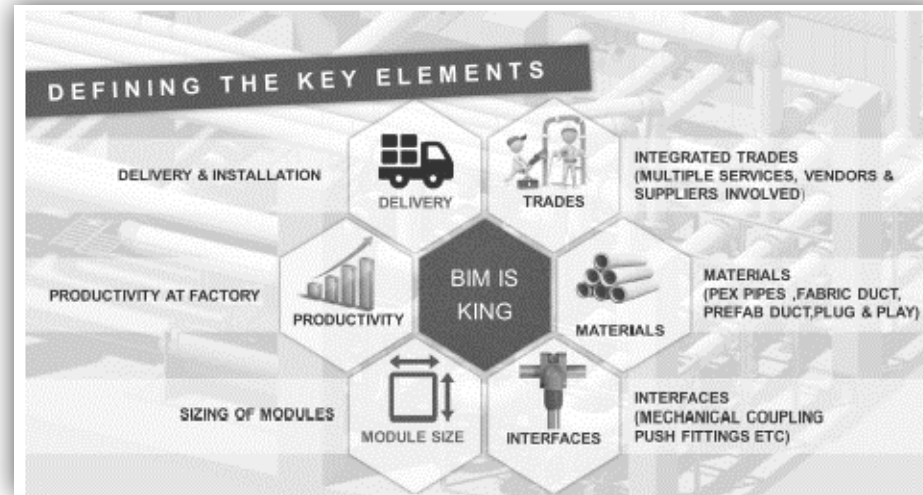
Predictive

Product vs Project

The process and product life cycle have a linear relationship and although construction projects are continuously being undertaken each one flow each one is unique.



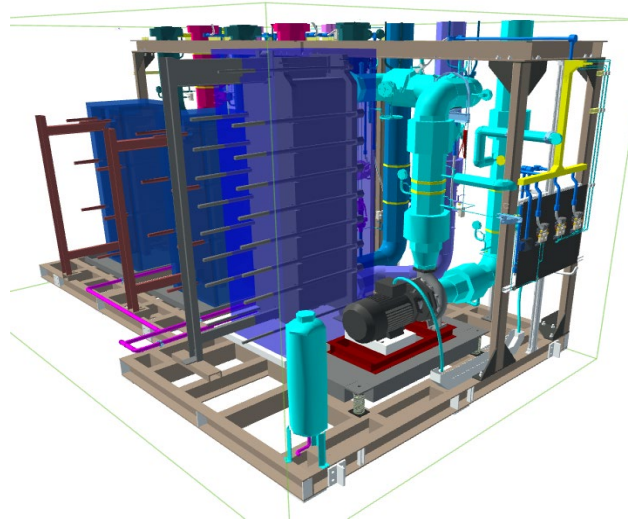
Defining the Key Elements



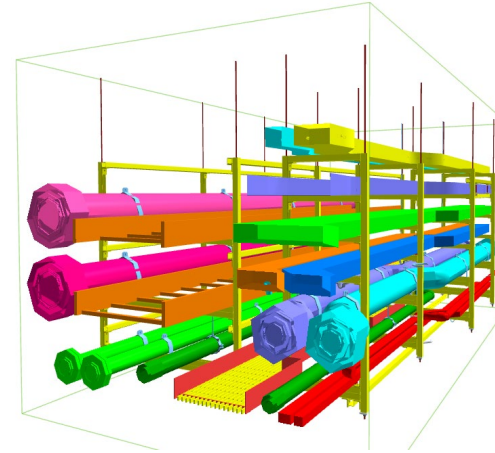
Prefab Modular Design

Design Stage

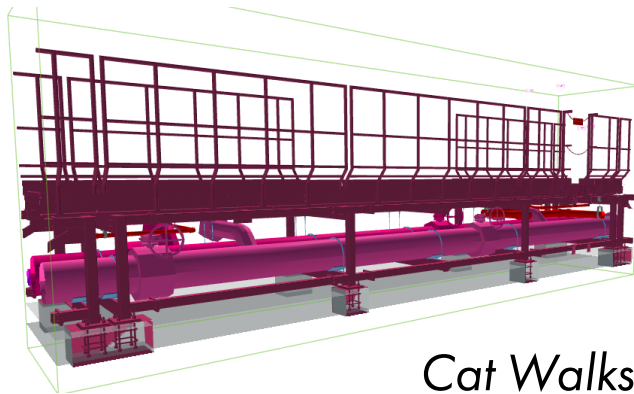
Equipment Skid



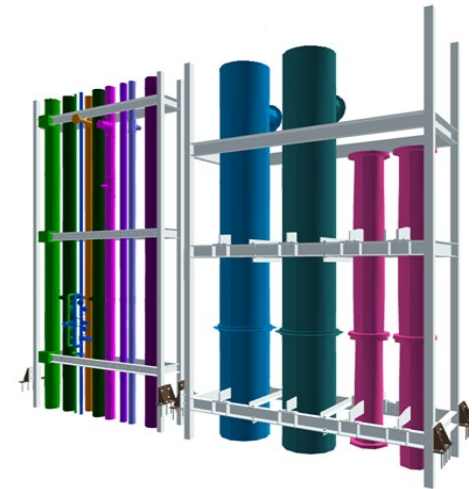
Corridors



Cat Walks

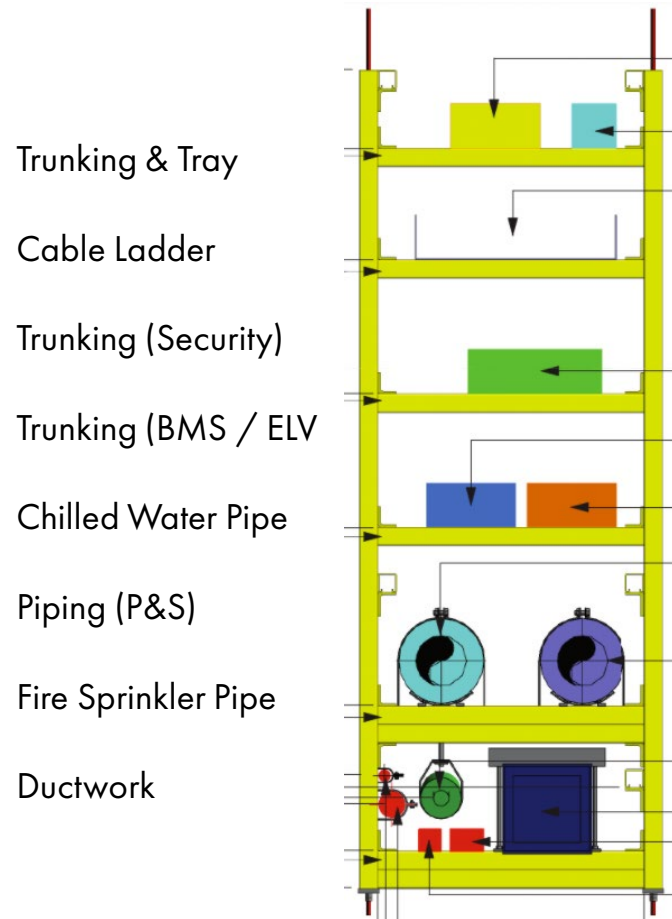


Risers



Identifying the Scope of Works

A typical Modular Assembly with several services combined onto the same support frame system.



Service	Responsible Party
Trunking / Tray / Ladder	Elec Subcontractor
Trunking (Sec / BMS / ELV)	Elec / ELV Subcontractor
Piping (P&S)	P&S Subcontractor
Chilled Water piping	ACMV Subcontractor
Ductwork	ACMV Subcontractor
Sprinkler Pipework	Fire Subcontractor
Trunking (FA & PA)	Fire Subcontractor

Design Stage

General Arrangement Shop Drawings

IFC

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ISSUED FOR CONSTRUCTION

NO.	DESCRIPTION	QUANTITY	UNIT
1	CONCRETE	100	m ³
2	STEEL	500	kg
3	GLASS	200	m ²
4	PAINT	100	kg
5	INSULATION	50	m ³
6	MECHANICAL	10	kg
7	ELECTRICAL	5	kg
8	PLUMBING	5	kg
9	MECHANICAL	5	kg
10	ELECTRICAL	5	kg
11	PLUMBING	5	kg
12	MECHANICAL	5	kg
13	ELECTRICAL	5	kg
14	PLUMBING	5	kg
15	MECHANICAL	5	kg

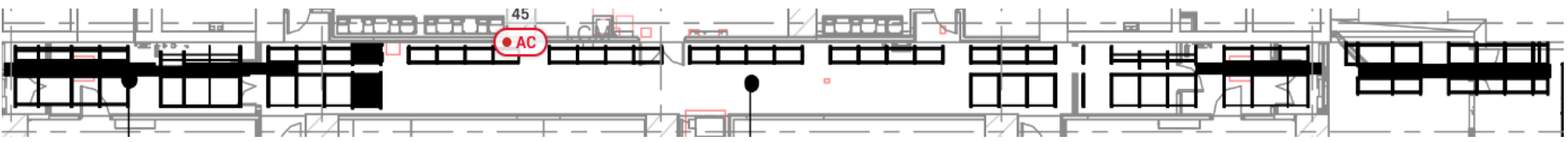
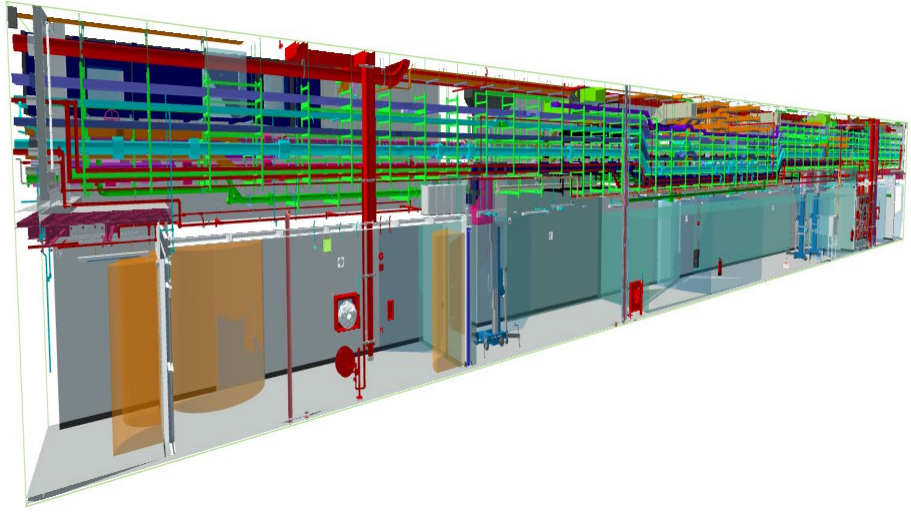
LEGAL DRAFT

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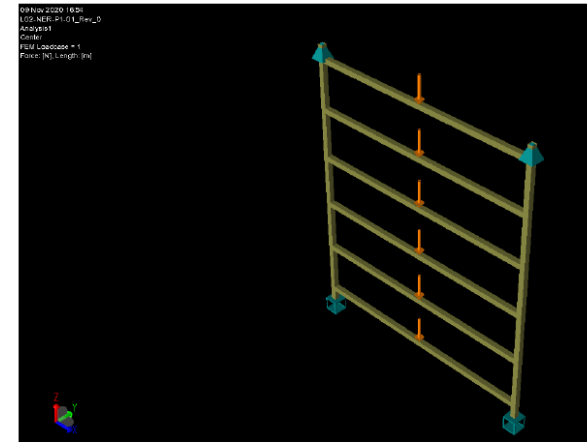
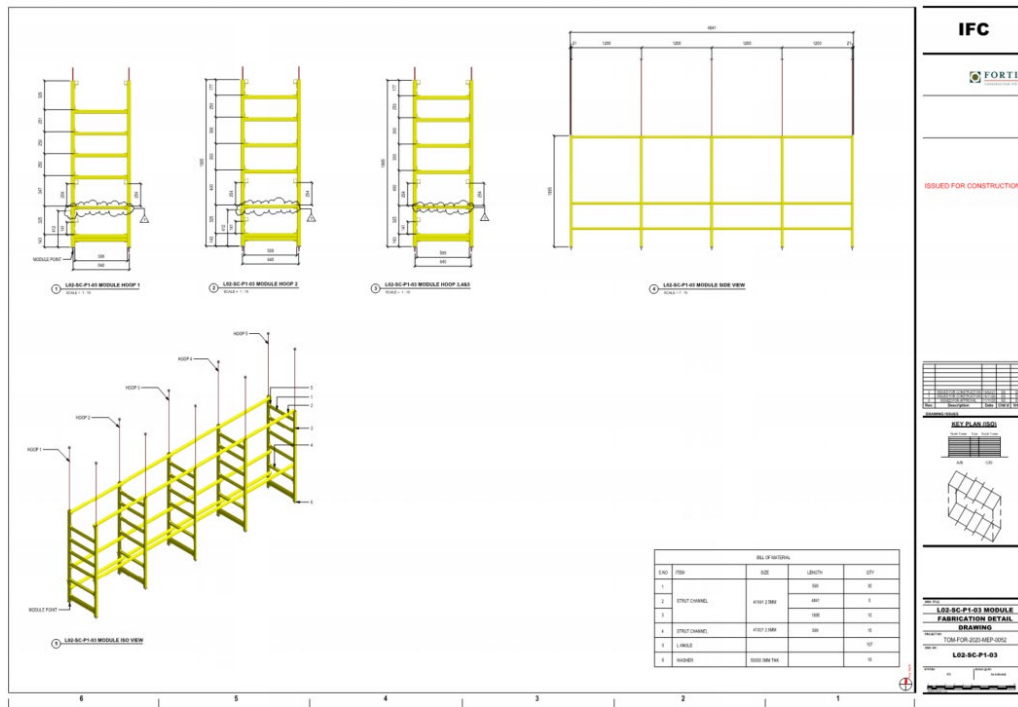
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Design Stage

Structural Arrangements



Frame No	LO2-NER-P1-01
Material Data	
Tier Channel Type (Strut Channel)	41 X 41 X 2.5 mm / Min Yield Strength 250 MPa
Column Channel Type (Strut Channel)	41 X 41 X 2.5 mm / Min Yield Strength 250 MPa
Bracket Size - 90° Fitting	50 X 50 X 6 mm / Min Yield Strength 250 MPa
Bolts and Nuts	M12 / Grade 8.8 / Min Bolt Torque 65Nm
Hoop and Tier Data	
Max Allowable Tier Load (kg)	≤ 150
Max Allowable Hoop Load (kg)	≤ 960
Hoop Height (meters)	≤ 2.0
Hoop Width (meters)	≤ 1.7
No of Tiers	6



Demarcations & Responsibilities

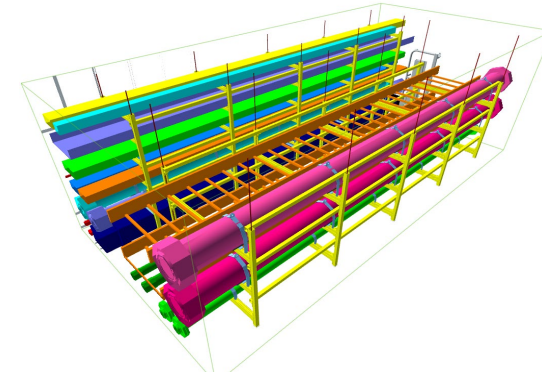
Consideration for other Trades

Party	Impact
Main Contractor	<ul style="list-style-type: none">- Crane Usage- Logistics for storing- Loading Platforms- Sequence of Riser.- Builders works openings- Cast-in Anchors
Architectural Work	<ul style="list-style-type: none">- Builders Work Opening- Sequencing wall construction- Sequencing finishing works
Facade	<ul style="list-style-type: none">- Openings for installation and Maintenance- Connection and support details.

Design Stage – Modular Types

Multi-Service Modules

- A single frame service module that include a range of MEP services e.g. domestic water, ACMV, CHW/CDW pipe, fire protection system, drainage as well as electrical services comprising of basket, tray and/or ladder.
- Ideal arrangements for Common Corridors or typical floors where a number of services are condensed into tight areas and eliminates extensive hanger rods and individual service supports.
- These Modules can be fully connected in the factory including pipe pressure tests before being dispatched to site.
- The Modules can be developed to install Final fix items such as Lights, Cameras, Motion detectors, etc....



Engineering



Fabrication

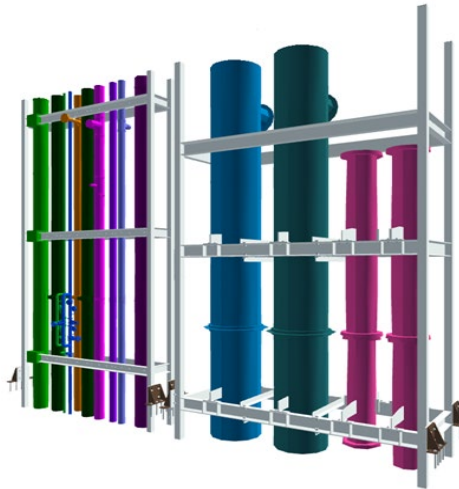


Installation

Design Stage – Modular Types

Riser Modules

- Riser modules designed and manufactured to any size or form and can house the full range of mechanical and electrical building services.
- Ideal arrangements for Common Risers through high rise developments and can be designed to include:
 - Flooring and kick plates can be included if required.
 - As part of the structural design, lifting and slinging points will be identified and installed to ease off-loading and final positioning.
 - Fire stopping barriers can also be incorporated to ease site complexity.



Engineering



Fabrication

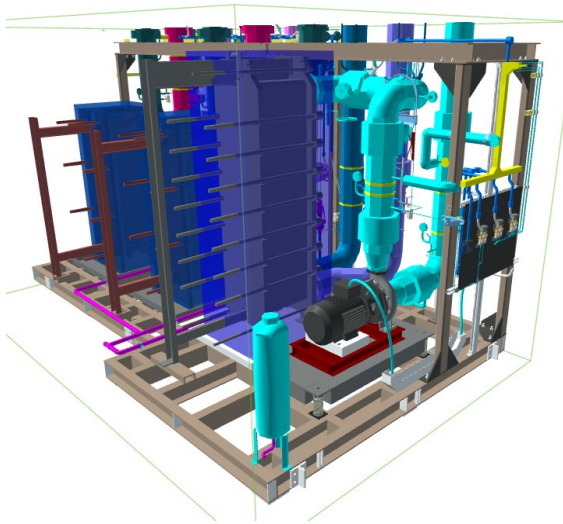


Installation

Design Stage – Modular Types

Plant Room Modules

- These modules are a fully loaded plantroom in sections which are then delivered to site and assembled with mechanical fittings. Eliminates the risks from welding on-site and improves the overall quality of the final installation.
- A packaged plantroom can be manufactured far in advance of the lay down area being completed. They can incorporate all types of plant, from Clarifiers to Pumps and from LV panels to CHP plant.
- These modules can also include all necessary pipework, ductwork, containment, isolator and inverters required, with only final pipe connections wiring and commissioning once they have been fixed into position on site.



Engineering



Fabrication

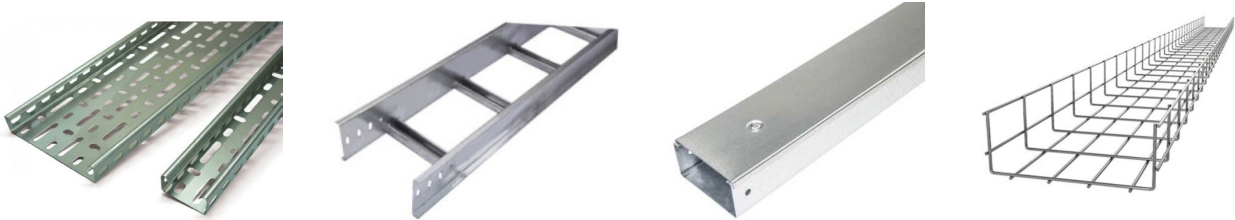


Installation

3.0 Types of Connection Methods

Types of Connections Methods

Containment



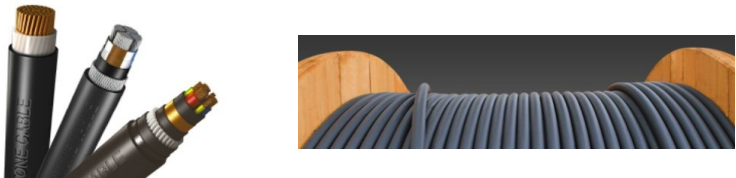
Pipes



Ductwork



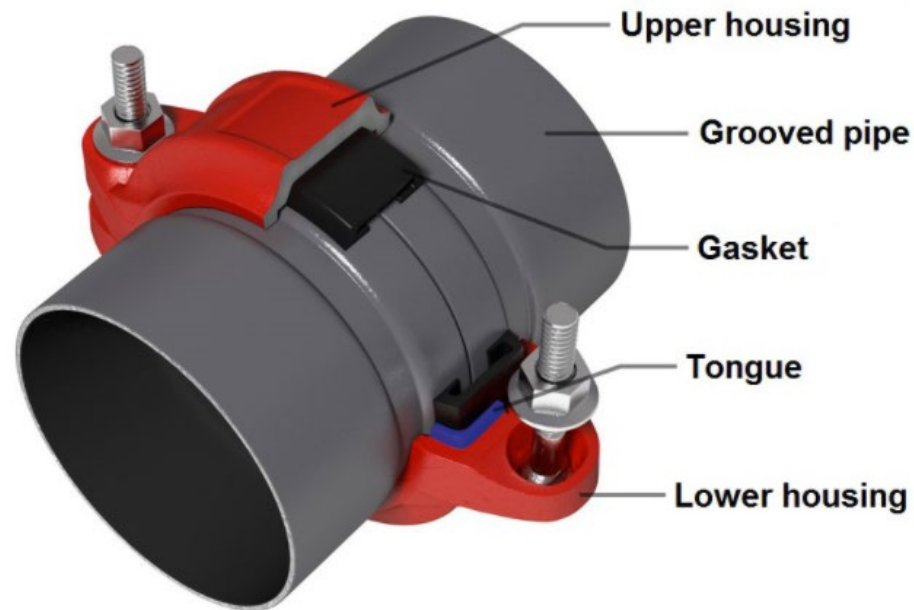
Cables



Types of Connections Methods

Mechanical Couplings

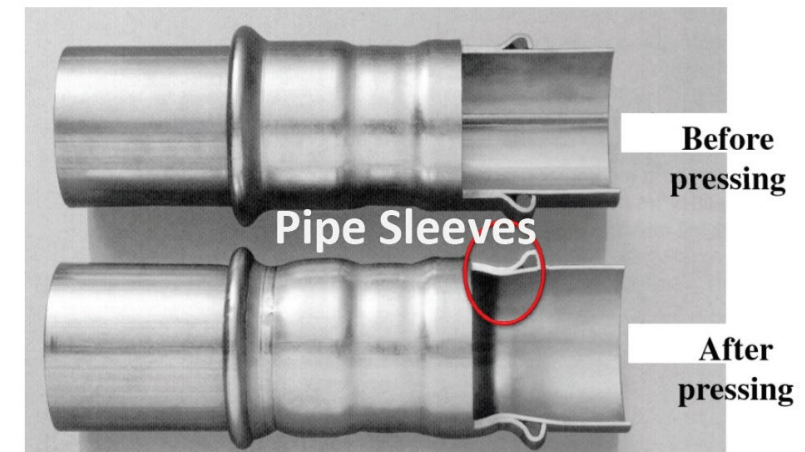
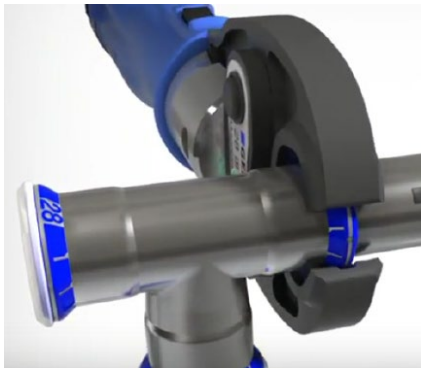
- Mechanical Grooved Coupling are designed for a wide type of applications and can be easily connected with the use of a gasket, housing and nuts / bolts.
- Used for, Chilled water and condenser water pipe, domestic water pipe, fire sprinkler, etc...



Types of Connections Methods

Pipe Crimping

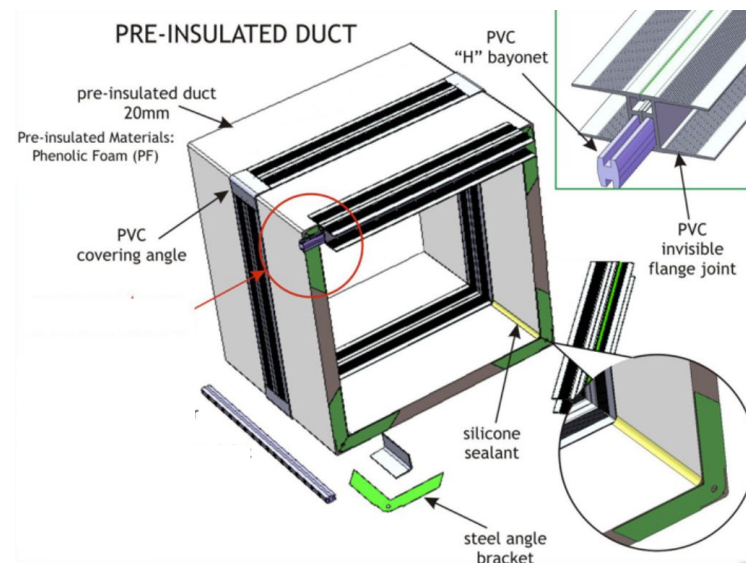
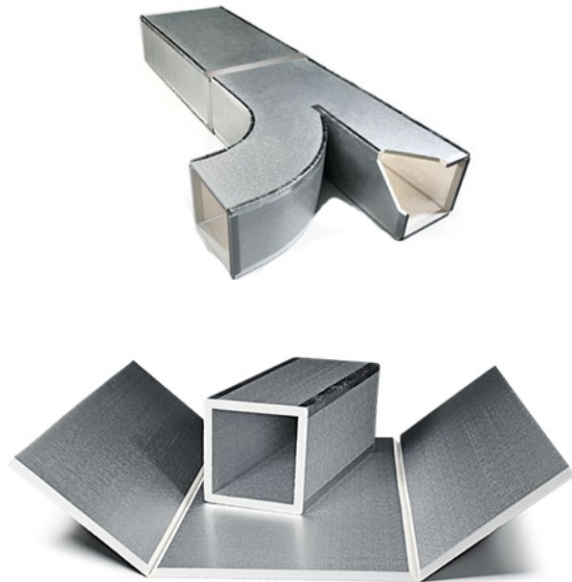
- Mechanical Grooved Coupling are designed for a wide type of applications and can be easily connected with the use of a gasket, housing and nuts / bolts.
- Used for, domestic water pipe, fire sprinkler, etc...
- Typical for Stainless Steel and Cooper Pipework



Types of Connections Methods

Pre-Insulated Ductwork

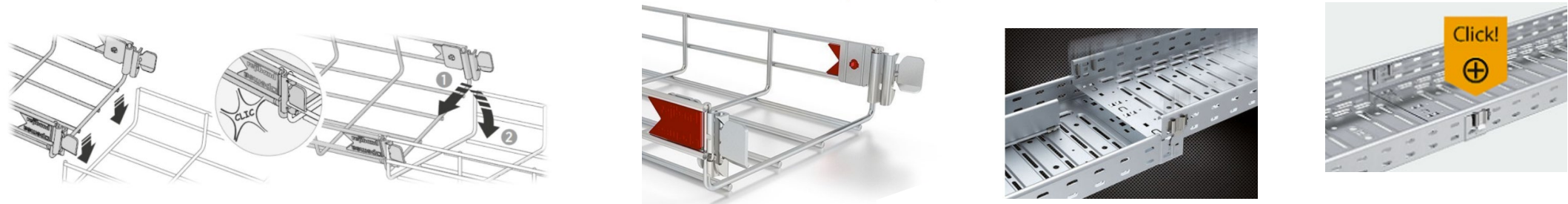
- Pre-insulated ductwork is a rectangular or similar profile ACMV ductwork system that can be installed in a single fix.
- Using this system, it removes some of the problems associated with galvanized sheet steel lagged with mineral fibre.
- Lightweight and reduces the loading onto the MEP Module supports.



Types of Connections Methods

Cable Containment

Quick fastening Systems of connecting a variety of cable containment systems can be adopted.



Cable Connections

Modular Wiring techniques can be applied for pre-fabricated PLUG & PLAY installation from Distribution Boards to Final Outlets.



Types of Connections Methods

Mechanical Connection



Welded Connection



4.0 Factory Start Up

Factory Set-up and the Key Elements

- Location
- Raw Material
- Storage
- Equipment
- Lifting & Logistics

Factory Set-up and the Key Elements

- Work Areas
- Quality Checking
- Testing
- Safety
- Finished Goods

Factory Set-up and the Key Elements

It comprises of the following areas as shown in Figure below (these are the areas the module has to move through in the production area)

1. Cutting area (With automatic cutting machines)
2. Frame assembly
3. Pipework service manufacture area
4. Pre-assembly Coating and Finishing area
5. Module assembly lines (for various types)
6. Final Finish area

5.0 Assembly of MEP Modules

Manufacturing

Multi Purpose Corridor Modules



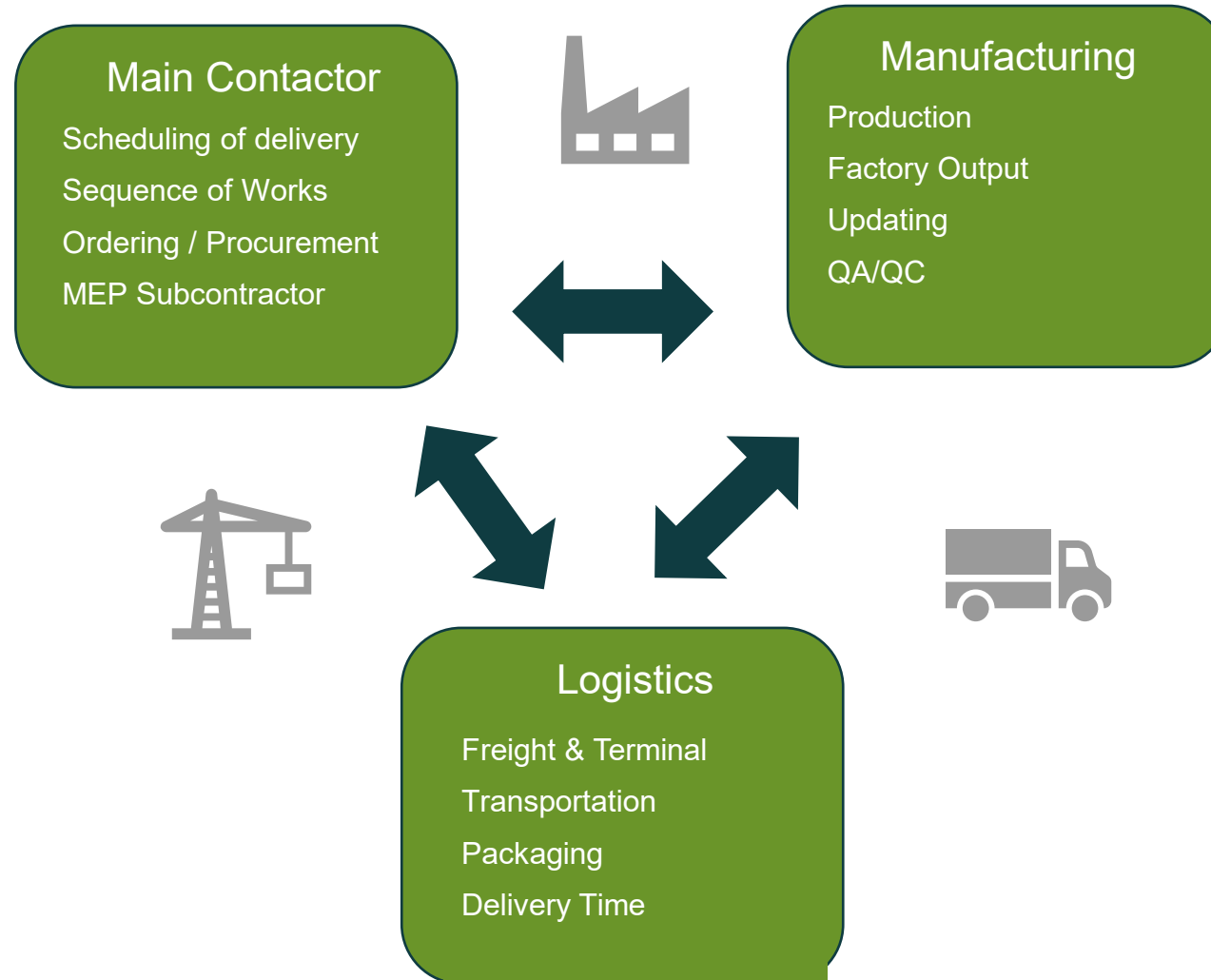
Modular frames fabrication completed



Modular M&E services installation

6.0 Logistics, Deliveries and Planning

Logistics, Deliveries and Planning



Logistics, Deliveries and Planning

Planning the deliveries to consider the following:

- Logistical Pre-arrangements Plan before Production
- Protective Packaging after production.
- Customs Clearance & Freight Management.
- Road Survey & Traffic Management
- Consequence of Delivery
- Streamlined Installation and Crane Hoisting at site

“Just-in-time Deliveries”



7.0 Safety

Safety

Traditional MEP work involves multiple trades that need to be installed one by one

- Scaffolding is needed for each trade, resulting in increase in RISKS of FALLING FROM HEIGHT.
- This RISK is multiplied as numerous trades have to work at height to install their respective MEP fixings
- Reduces Hot Work
- Reduced Plant Equipment



8.0 Installation

Installation

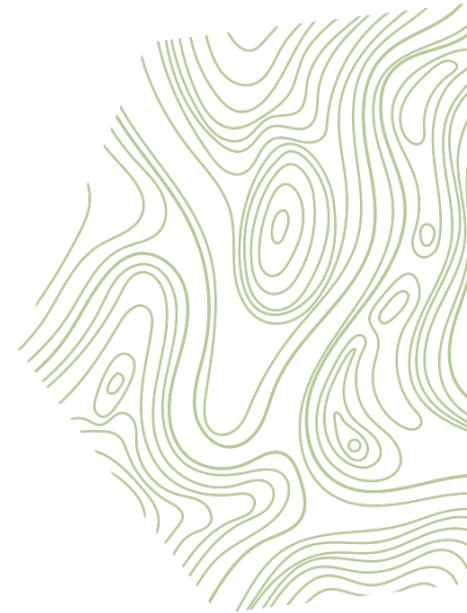
The basic steps for installation of the modules

1. Delivery to Site
2. Offload the modules from the Transportation.
3. Storage (avoid where possible....)
4. Maneuver the modules to the work front.
5. Lift or position Modules into place and support.
6. Connect the MEP Services between the modules
7. Continue installation until all modules are connected

But how do we support or hang the modules.....?

Installation – Key Take Away

- Setting out and spending time on the engineering to ensure the hangers and fixing details are correct.
- Sequence the works correctly and maintain communication with the factory. Things change, they need to be managed.
- Manage the Deliveries and Programme. Space is a premium and you cannot afford to congest the site.
- Plan the connection details and congested areas.



Quality Control & Quality Assurance

- ✓ All MEP Modules inspected and tested
- ✓ Inspection and Test Plans (ITP's) executed with hold points before delivery.
- ✓ All Welding NDT and test reports provided
- ✓ All Modules are shrink wrapped with assigned QR code and modular asset number



Q & A