THE HONG KONG INSTITUTION OF ENGINEERS
香港工程師學會

Best Practices for Multi-trade Integrated Mechanical, Electrical and Plumbing (MiMEP)

The Hong Kong Institution of Engineers
Excellence and Standardisation Taskforce

HKIE Excellence and Standardization Taskforce – MiMEP Sub-Group
High Level Recommendations for MiMEP Adoption

1. **Introduction (MiMEP)**
   MiMEP refers to the integration of multi-trade building services components, into a single volumetric assembly of prefabricated modules, manufactured off-site in a workshop, then transported to the site for connection of modules to complete various trades of building services installations to minimize on-site work.

2. **Recommendations at Project Inception Stage**
   It is recommended for project team to engage the MiMEP stakeholder and the relevant stakeholders at project inception stage for overall planning of MiMEP design.

   a) *Early Involvement of MiMEP Stakeholder*
      - **Design Integration**: The engagement of MiMEP stakeholder at the project inception stage is crucial to achieve optimal results. Their early input ensures architectural, structural, and MEP designs are well coordinated before fabrication begins, enabling seamless integration of MiMEP considerations into the overall project strategy. This initiative-taking approach addresses technical, logistical, and operational aspects from the outset, preventing disharmonized sequences of works and on-site clashes that are common in traditional construction, while minimizing potential conflicts and abortive works at later stages.
      - **Technical Expertise**: MiMEP stakeholder's early involvement ensures that technical specifications are appropriately developed and integrated into the overall project documentation. This includes providing guidance on types of MiMEP module, fabrication process, logistic practicability, testing requirements, maintenance and compliance with relevant standards and regulations, ensuring that the project is both technically sound and aligned with industry's best practices.
      - **Risk Assessment & Mitigation:** By participating early, MiMEP stakeholder can identify potential risks such as manufacturing capacity constraints, supply chain vulnerabilities, transportation challenges, logistic and site limitations. These insights enable the project team to develop alternative solutions to resolve the challenges, thereby safeguarding project delivery and performance.

   b) *Early Involvement of Stakeholders*
      - **Project Team Formation**: It is recommended to establish an integrated project team comprising diverse stakeholders to bring different perspectives at the earliest stage. This collaborative approach can facilitate effective communication, shared decision-making, and collective problem-solving, while fostering innovative solutions. Regular coordination meetings should

be conducted to ensure alignment of objectives and design intent, review progress, and address emerging issues promptly, thereby strengthening project efficiency and cohesion.

- **Stakeholder Responsibilities & Roles**: Clear definition of roles and responsibilities for each stakeholder is essential to avoid confusion and ensure accountability. Early clarity strengthens ownership, streamline workflows, and supports effective project governance.

c) *Operation & Spatial Requirement*

- **Future Operation Requirements**: Consideration should be given to potential changes in operation, technology upgrades, and expansion possibilities. This ensures that the MiMEP system can remain adaptable to evolving operation needs without requiring major modifications of MiMEP modules.
- **Space Utilization**: Efficient space utilization is achieved through careful planning of module dimensions and layers, service routing, and coordination with architectural/structural elements.
- **Future Maintenance**: Future maintenance requirements should be incorporated into the initial planning to ensure long-term operability. Provisions should include lifting facilities, access panels, and spare parts management. Clear maintenance pathways and modular replacement strategies should be established to reduce downtime and improve asset management. Smart monitoring systems (e.g., IoT sensors) should be integrated to enable predictive maintenance and reduce unexpected failures.
- **Regulatory Compliance & Risk Management**: All applicable regulations and compliance requirements should be identified and addressed early in the planning process. Continuous liaison with government authorities is also essential to secure necessary approvals for structural calculations and non-standard designs. Risk management should also cover supply chain resilience, installation safety, and contingency planning for unforeseen site conditions.

3. Recommendations at Detailed Project Design Stage

a) *Design for Standardization in Repetitive Space Layout*

- Design standardization process should be carried forward from the early project inception stage through to the final design and Design for Manufacture and Assembly (DfMA) module production stage. MiMEP modules should be optimized and standardized in terms of types, dimensions, weights, and layers to address future proof operation requirements, logistics and transportation constraints, and long-term maintenance concerns, thereby enhancing operational and spatial efficiencies.

- Standardized MiMEP modules can streamline inventory management and factory production processes. They can also facilitate quality control by enabling repetitive fabrication processes and consistent inspection protocols.
- Standardized dimensions/weights/layers of MiMEP modules enable simplification of transportation planning, reduction of logistical complexities, and enable rapid on-site assembly.
- Module maximization should be pursued wherever possible, with MiMEP modules designed to their fullest extent to minimize on-site work. Where site or logistical constraints necessitate division into smaller sectional modules, final sizing should be verified through BIM modeling to ensure feasibility and compatibility.
- For projects involving Repair, Maintenance, Alteration, and Addition (RMAA) works, digital survey of existing conditions should be conducted with point cloud data integrated into BIM models to support delivery route planning, spatial coordination, and clash detection with existing structures.

b) *Design for Safety (Structural)*

- Safety consideration should be embedded into structural design of MiMEP modules. Structural requirements, including system module weight and dynamic loading, should be provided to the structural engineer to ensure slabs and modules sub-frames accordingly.
- Structural provisions for lifting and handling should be comprehensively addressed in the module design. This includes lifting lugs, rigging points, and other features designed to accommodate stress during transportation and installation, with appropriate safety factors applied.
- Where modules are installed in fire-rated spaces or contain fire-rated components, fire-resistant materials and construction methods should be incorporated. Fire-rated ducts passing through modules require that the entire module sub-frame and associated support should be fire-rated accordingly.
- Additional requirements for RMAA Projects: For existing buildings, structural assessments should be reviewed to verify slab capacity, lifting routes, and integration with existing fire-rated assemblies.

c) *Design for Maintenance (Assessable Route)*

- The project team shall consider future maintenance route of MiMEP modules to be assessable via lifting facilities to facilitate efficient access for maintenance personnel, ensuring safe transport of modules and associated tools.

- Lifting facilities must be incorporated into the design to enable removal and replacement of modules. This includes lifting points, access for lifting equipment, and clear pathways for module removal.
- Additional requirements for RMAA Projects: Maintenance planning should incorporate digital survey data to identify existing obstructions and develop BIM-based simulations of modules removal and replacement routes, ensuring feasibility in constrained environments, computability with current layouts and minimizing disruption during alternation.

d) *Design for Flexibility (Modification, Bolts & Nuts, Oval Holes, Detachable Sub-Frame)*

- Flexibility in MiMEP module design is essential to accommodate future modifications and interior space changes, ensuring adaptability to evolving operation needs and enhancing stakeholders' satisfaction through versatile layouts.
- The design should proactively anticipate potential upgrades and modifications by incorporating additional space margins and flexible connection points, thereby minimizing the need for major system modifications.
- A steel framework with an oval hole design is recommended to support flexible on-site adjustments installation. This feature allows minor adjustments during assembly, simplifies alignment, enhances structural stability, and reduces the likelihood of errors.
- The use of bolt-nut detachable sub-frames should be considered, enabling stakeholders to remove sub-frames to suit operation or maintenance. This approach not only improves interior aesthetics, or operation needs but also provides customization options while reducing unnecessary structural elements for maintenance purposes.
- All modules shall be designed using a Plug-n-Play approach to ensure seamless on-site integration, minimizing rework and disruption. Standardized connection points, factory pre-tested components, and precise alignment features will enable rapid installation while guaranteeing full compatibility with existing infrastructure and future system requirements.

4. Recommendations for the Use of Digital and Innovation Technologies

a) Building Information Modeling (BIM)

- BIM serves as the foundation for MiMEP implementation, providing a comprehensive digital framework for design, coordination, and lifecycle management.
- The strategic application of BIM throughout the project lifecycle delivers significant benefits in terms of coordination efficiency, design quality, and operational effectiveness.
- BIM models should be updated continuously throughout construction with asset information accurately input to establish an as-built BIM Model. This model should comply with relevant BIM-Asset Management Standards, using open BIM-compliant formats to ensure seamless interoperability. Asset data in the form of COBie format, system topology, O&M documents, as-built drawings, photos should be available with asset tags and zone tags in the form of RFID and QR codes to support long-term asset management.

b) Open BIM Platform

- The adoption of Open BIM platforms enhances interoperability and collaboration among project stakeholders using different software platforms.
- This approach promotes open standards and facilitates effective information exchange throughout the project lifecycle, ensuring that asset data remains accessible and usable across different systems.

c) BIM Cave

- The BIM Cave represents an advanced visualization and collaboration environment that enhances design understanding and decision-making capabilities through immersive technology. It allows stakeholders to experience the spatial and operational aspects of MiMEP modules in a simulated environment, improving design validation and stakeholder buy-in.

d) Synchronous Lifting Platform

- Synchronous lifting platforms optimize workflow by enabling controlled and coordinated lifting operations. This technology enhances productivity by reducing installation time and minimizing manual handling requirements.
- The use of synchronous lifting platforms significantly improves safety during installation operations by providing stable and controlled lifting capabilities, reducing risks associated with manual lifting and handling of heavy modules.

e) *"T-shaped" Hanger Design on Fire Services Pipe Support*
- The "T-shaped" hanger design provides an innovative solution for in-situ individual fire services pipe support that complies with independent pipe support requirements under regulations. This design enables compliance with regulatory requirements while simplifying installation processes and improving efficiency.

f) *3D Print Model*
- 3D printing technology provides valuable capabilities for visualization, testing, and quality assurance throughout the MiMEP implementation process.

g) *OpenSpace (BIM 360) Site Walk Inspection*
- OpenSpace technology, integrated with BIM 360 platforms, provides advanced capabilities for site inspection and progress monitoring through AI-enhanced 360-degree site photography.
- This improves transparency, supports remote collaboration, and enhances project documentation accuracy.

h) *QR Code*
- QR codes enable transparent tracking of modules and provide easy access to comprehensive module information, which can enhance transparency and efficiency throughout the MiMEP lifecycle.

i) *Remote Real Time Video Inspection*
- Remote inspection capabilities provide flexibility and efficiency in quality assurance processes, particularly for fabrication processes conducted in off-site locations.

j) *Robotic Technologies*
- Advanced robotic technologies offer opportunities for enhancing automation, efficiency, and quality control in both factory and site environments.

k) *Point Cloud Scanning*
- For MiMEP modules requiring tight site tolerance, point cloud scanning should be conducted in relevant site areas to reconfirm module design before leaving the factory.
- This technology enables precise verification of site conditions and allows adjustments to be made in the factory environment when necessary.

5. Recommendations on Project Procurement Stage

a) Pre-qualification

- The project team is suggested to conduct Pre-qualification exercise to assess the qualified MiMEP contractors and confirm their ability to complete the project successfully.
- The project team shall conduct a pre-qualification to:
  Step 1: Identify potential MiMEP contractors with proven MiMEP experience. Assess their ability to address customs, taxation and logistics planning, module design capability, installation methodology, safety considerations.
  Step 2: Understand MiMEP contractors' module manufacturing arrangements, including factory capacity, quality assurance processes, and compliance with standards.

b) Procurement Strategy

- Procurement study should be conducted to evaluate different MEP tender package options to optimize costs, efficiency, and integration of trades, while ensuring alignment with project timelines and quality standards.
- Bundled procurement packages should be considered for multi-trade modules to reduce fragmentation and improve coordination.

c) Tender Requirements and Specifications

- Tender documents should clearly define module interfacing requirements and the responsibility of each MEP service trade. This ensures tenderers fully understand their scope, extents, and responsibilities of MiMEP installation, reducing ambiguity and disputes.
- Tender documents should clearly define the payment arrangement, particularly for off-site manufacturing.

d) MiMEP Coordinator

- The project team shall consider appointing a MiMEP coordinator on site.
- This role is responsible for MiMEP module design coordination, production, transportation, and installation sequencing, ensuring smooth integration across trades.

6. Recommendations for Quality Assurance

- A comprehensive Quality Assurance (QA) and Quality Control (QC) Plan to be adopted both in the MiMEP factory and on-site to assure consistent quality of each module.

- The project team shall witness and verify Factory Acceptance Test (FAT) and conduct off-site Testing and Commissioning (T&C) such as hydraulic test for pipeworks, magnetic particle test for weld joints and etc. Any failing modules shall be rectified before delivery to site.
- MiMEP stakeholders shall produce mock-up for inspection and approval by the project team before mass production, ensuring design intent and quality benchmarks are met.
- Digital QA tools such as QR code systems should be used to track compliance and streamline reporting.

7. Recommendations for Logistics, Vertical Transportation

a) Logistic Planning

- The project team shall consider module dimensions, weights, delivery route, travel time from factory to site, and compliance with traffic regulations.
- BIM-based logistics simulations are recommended to optimize delivery sequencing and avoid congestion.

b) Vertical Transportation Planning

- Number of modules to be vertically transported, and the responsibility of the main contractor should be identified clearly in the tender document so that the main contractor can fully understand their scopes of vertical transportation of MiMEP modules.
- Lift capacity and tower crane scheduling should be coordinate early to avoid bottlenecks.

c) Module-Specific Planning

- Logistic arrangements should be tailored to module type and dimensions, optimizing stacking and vehicle loading for maximum efficiency and safety.
- Digital route planning using BIM and point-cloud is recommended for RMAA projects to ensure computability with existing site constraints.

8. Recommendations for Site Installation

a) Just-In-Time Delivery

- Modules should be delivered according to the construction sequence to avoid congestion.
- BIM simulations of on-site delivery routes are recommended to identify access route issues and optimize sequencing.

b) *Worker Training and Coordination*

- On-site installation must be performed by workers who are familiar with the modules and trained by MiMEP stakeholders.
- Close coordination between main contractors and MiMEP stakeholder is essential for smooth and safe installation.
- Safety training with lifting should be mandatory for workers managing MiMEP modules.

c) *Site-Specific Handling Methods*

- If tower crane is considered to use for on-site installation, the project team should reserve specific hours per day for lifting and estimate the average lift and install time to plan daily module installation capacity.
- Monorail, I-beam, and winch systems are recommended for high-rise delivery on-site.
- Muck holes should be used for transporting modules to basement or ground floor levels.
- Digital lifting simulations should be conducted to validate crane paths, lifting angles and safety margins before execution.