Incorporating C&S Designs to Enable Sustainable FM

Civil & Structural Design as the foundation of long-term **Facility Management** — how design decisions made today shape operational performance for decades to come.

CONFERENCE PRESENTATION FM STRATEGY C&S DESIGN

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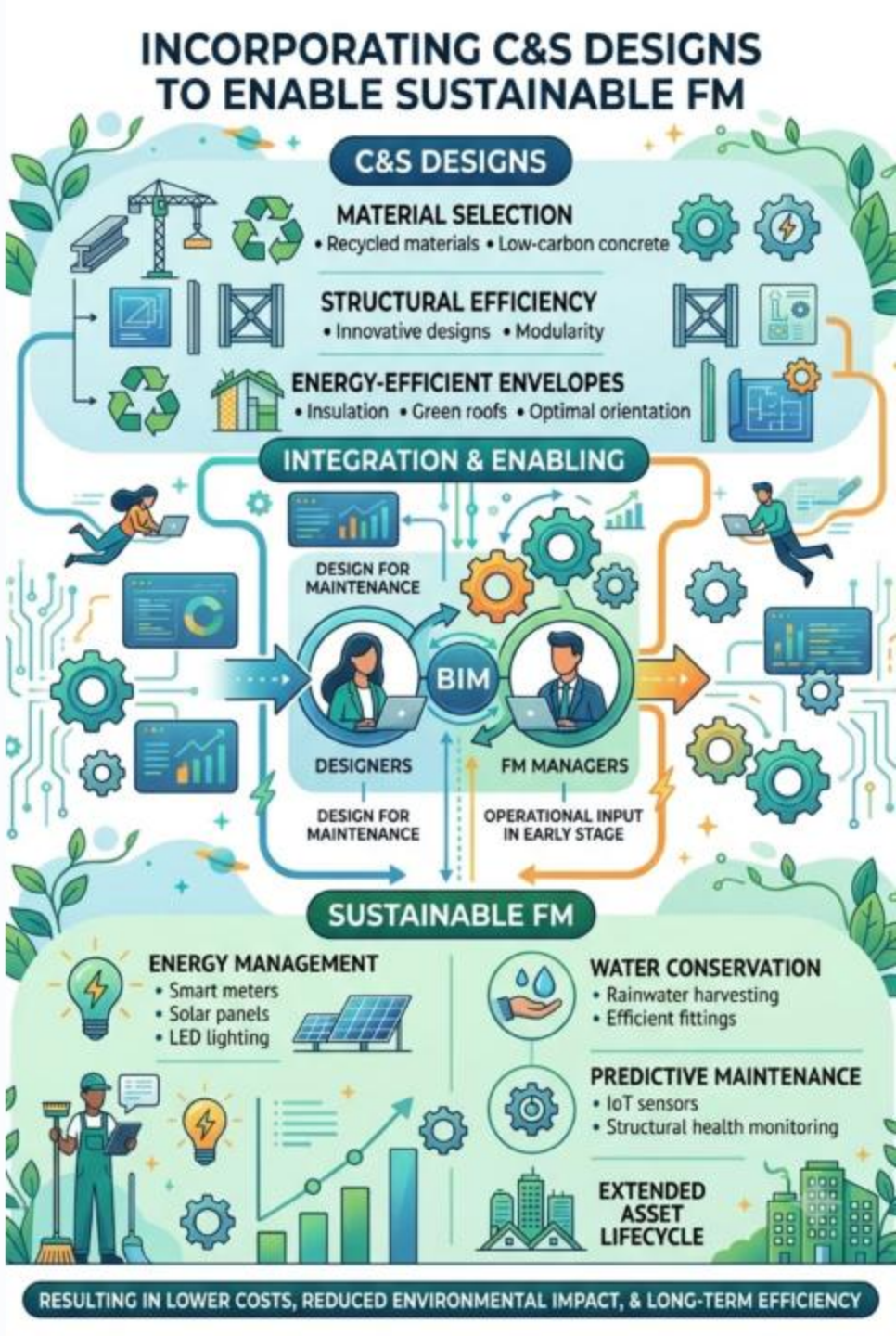

A Building's True Test Begins After Opening Day

> "A design decision made today can become a maintenance problem for the next 30 years."

Sustainable FM begins before occupation — it begins when the building is planned, designed, detailed, and constructed.

Definitions and the FM-Friendly Design Process

Key Definitions

Civil & Structural (C&S) design forms the physical backbone of any building and site. It encompasses substructure and super structure design, Road and Drainage, Water Reticulation, Sewerage and Earthwork.

Facility Management is the discipline of overseeing, maintaining, and operating a physical building and its systems once construction is complete, ensuring the space is safe, efficient, and functional for its occupants throughout its lifecycle.

FM-Friendly Design Process

Briefing Stage

Define FM needs and operational requirements from the outset.

Concept & Detailed Design

Check access, durability, safety, openings, hatches, and material specifications.

Tender & Construction

Embed FM requirements in drawings, specifications, and BIM deliverables; verify what is actually built.

Handover & Operation

Deliver asset register, manuals, warranties, and as-built BIM records; collect feedback for future projects.

The best time to solve FM problems is during design, when changes are still low-cost and low-disruption.

Why Sustainable FM Need to Starts During Design

Sustainability extends far beyond green technology. It encompasses designing buildings that are **durable, maintainable, safe, and cost -effective** to operate over their full lifespan. IFMA defines FM as supporting the functionality, comfort, safety, sustainability, and efficiency of buildings and surrounding infrastructure.

The Scale of the Problem

UNEP and GlobalABC reported that buildings and construction account for approximately **37% of global** CO_2 emissions and nearly **50% of global material extraction** — making design decisions a genuine sustainability lever.

What is Design Decisions Affect

- Energy and water consumption over the building's life
- Maintenance frequency and associated disruption
- Replacement cost and material waste
- Safety of maintenance workers on site
- Building downtime during repair works
- Long-term carbon footprint and was

Note :

UNEP stands for the **United Nations Environment Programme**.

GlobalABC stands for the **Global Alliance for Buildings and Construction**.

C&S Design Decisions and Long-Term Operation

C&S design is not only about structural strength and code compliance. Every decision made at the drawing board has a direct consequence for future operation, maintenance cost, and operational safety.

C&S Design Decision	FM Impact
Structural layout	Affects routing of services, access zones, and capacity for future modifications.
Slab and wall openings	Prevents unsafe hacking, coring, and unplanned structural changes post-completion.
Roof design	Affects waterproofing, drainage, inspection frequency, and safe maintenance access.
Drainage design	Reduces flooding, ponding, blockage, and water damage to the structure.
Pavement and road layout	Affects access for maintenance vehicles and emergency response teams.
Utility trenches	Affects ease of inspection, repair, replacement, and future service expansion.
Material selection	Affects corrosion, cracking, cleaning, repair frequency, and overall service life.

FM Interaction Across Project Stages

FM must engage with the project team throughout the entire lifecycle — not only at handover. **BS 8536 2022 : Design, manufacture and construction for operability** .

Code of practice promotes early FM operator involvement, a focus on asset performance in use, structured aftercare after handover, and high-quality information and data delivery.

Design Stage

Review access, maintainability, safety, drainage, material selection, and spare capacity. Produce FM requirements register and maintainability review comments.

Construction Stage

Check actual openings, hatches, trenches, manholes, drainage falls, materials, and site changes. Produce verified construction records and updated drawings.

Post-Construction Stage

Review defects, monitor performance, update asset data, plan preventive maintenance, and capture lessons learned into an asset register.

The FM team should act as the "future operator's voice" throughout design and construction — not just at the end.

Main FM-Friendly Design Principles

A sustainable facility must be easy to maintain, safe to operate, and flexible enough to accommodate future needs. The aim is not to overdesign — it is to design *intelligently*, so that operation is safer, simpler, and less wasteful over the full building life.

Durability

Last longer with fewer defects, reducing material waste and replacement frequency across the building life.

Maintainability

Components can be inspected, cleaned, repaired, and replaced with minimal disruption to occupants and operations.

Accessibility

FM teams can safely reach equipment, chambers, roofs, drains, and structural elements without improvisation or risk.

Safety

Maintenance work can be carried out without unnecessary hazard to workers or occupants throughout the building's operational life.

Adaptability

The building can support future changes, technology upgrades, and evolving user requirements without major structural intervention.

Common FM Problems Caused by Poor Design Coordination

The construction success is not proven at handover — it should be proven in use. Soft Landings keeps operation in mind from day one to close the gap between design intent and real performance.

Blocked Access

- No safe access to M&E Equipment/plant, drainage points, or roof areas.
- Inspection hatches too small or located in unsafe positions.

Unplanned Penetrations

Cable trays or pipes passing through structural elements without planned openings, forcing dangerous post-construction hacking and coring.

Poor Drainage Design

- Inadequate roof falls causing ponding and leakage.
- Utility trenches without proper drainage or removable covers.
- Manholes buried under landscaping or parking.

Inadequate Records, Upgrading Consideration & Material

As-built drawings not matching actual construction. No spare sleeves, ducts, or capacity for future upgrades. Materials selected without considering corrosion or cleaning.

BUILDING LIFE CYCLE COMPARISON:
INTEGRATED FM vs. NO EARLY FM INVOLVEMENT

WITH EARLY FM
(Facility Management)

1. DESIGN STAGE
(Concept & Planning)
- FM consultation
- Operability
- Maintainability planned

2. CONSTRUCTION
- Construction Quality
- Handover Preparation
- Future maintenance access

3. OPERATIONS & OCCUPANCY
(Years 1-30+)
- Lower Operational Costs
- High Occupant Satisfaction
- Optimized Systems

4. RENOVATION & RETROFIT
- Planned Improvements
- Efficient Upgrades

5. DECOMMISSIONING
- Sustainable End-of-Life
- Asset Disposition

✓		✗
Collaborative		Reactive
Lower OPEX	vs	Higher OPEX
Efficient		Disruption
Proactive		Inefficient

✓		✗
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WITHOUT EARLY FM

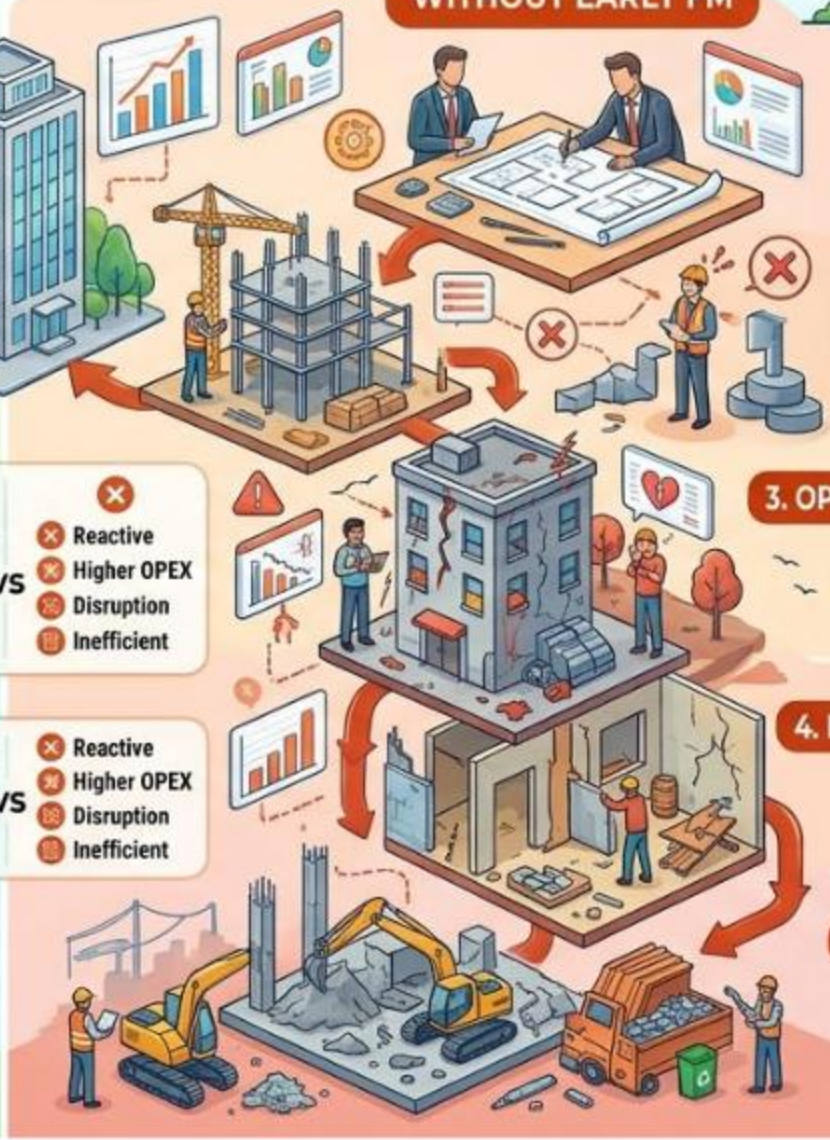
1. DESIGN STAGE
- Aesthetics & Function focus only

2. CONSTRUCTION
- Reactive Changes
- Delayed Handover
- Design flaws discovered

3. OPERATIONS & OCCUPANCY
- High Operating Costs
- Frequent Failures
- Reactive Maintenance
- Low Satisfaction

4. RENOVATION & RETROFIT
- Difficult Retrofits
- High Costs
- Operational Challenges

5. DECOMMISSIONING
- Higher Demolition Costs
- Poor Asset Planning



Overview : Malaysia Scenario

In Malaysia, C&S coordination is especially critical — buildings face heavy rainfall, high humidity, intensive public usage, and long-term client expectations for performance and value for money.

1

Without FM Interaction

Critical infrastructure — cable risers, drainage chambers, roof gutters, trench covers, waterproofing details, and as-built records — is designed and delivered without any consideration for how it will be maintained.

Result:

Repeated hacking works, persistent leakage, longer shutdowns, higher complaint rates, and elevated long-term maintenance cost.

2

With FM Interaction

FM is integrated from the earliest design stages, ensuring all access points, structural provisions, material selections, and digital records are confirmed and delivered in full before and at handover.

Result:

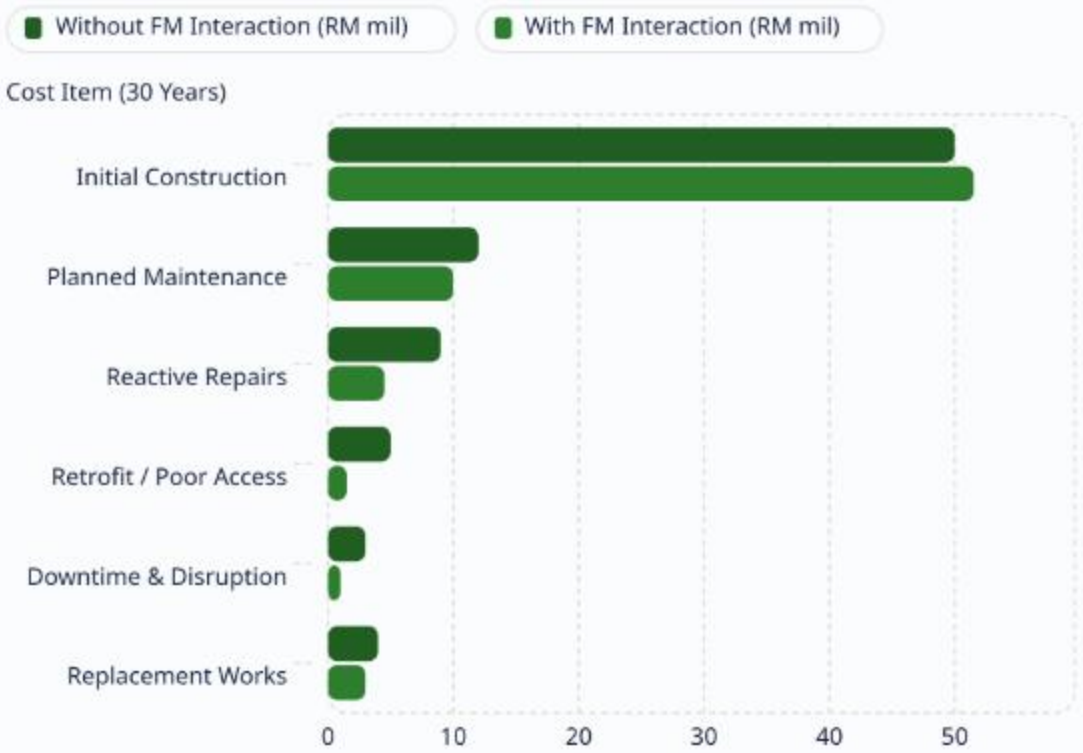
Reduced defects, lower reactive maintenance spend, and a building that performs as designed from day one.

In Malaysia, PWD FMM 2016 (Public Works Department Facilities Management and Maintenance 2016) standardises FM procurement and implementation for public facilities, while CIDB supports FM quality through accredited and competent facility management personnel — providing a policy framework to support early FM integration.

Syed Shabahar, S. N. S., Mohd Isa, H., Lop, N. S., & Ismail, H. (2026). *The challenges of facilities management and maintenance contract document implementation for office buildings in Malaysia. Planning Malaysia,*

Design for Life-Cycle Cost, Not Only Construction Cost

The lowest construction cost does not always produce the lowest total cost. **ISO 15686-5** provides requirements and guidance for life-cycle cost analysis of buildings and constructed assets — measuring true cost from acquisition through operation to disposal.



The Cost Logic

For a facility with an initial cost of **RM50 million** , early FM interaction reduces the 30-year total from **RM83 million to RM71.5 million** — saving over **RM11 million** .
Spending a little more upfront on better access, durable materials, and coordinated openings means fewer emergency repairs, less retrofit work, and less operational downtime.

THE IMPORTANCE OF FACILITY MANAGEMENT IN THE LIFE CYCLE COSTING CALCULATION by Munteanu & Mehedintu, 2016

Structural Design Considerations for Future Maintenance

A strong structure is not enough — it must also be practical for long -term inspection and maintenance . Structural design must account for how the building will be serviced, repaired, and adapted across its full operational life.

Pre-Construction: Penetrations and Openings Coordination

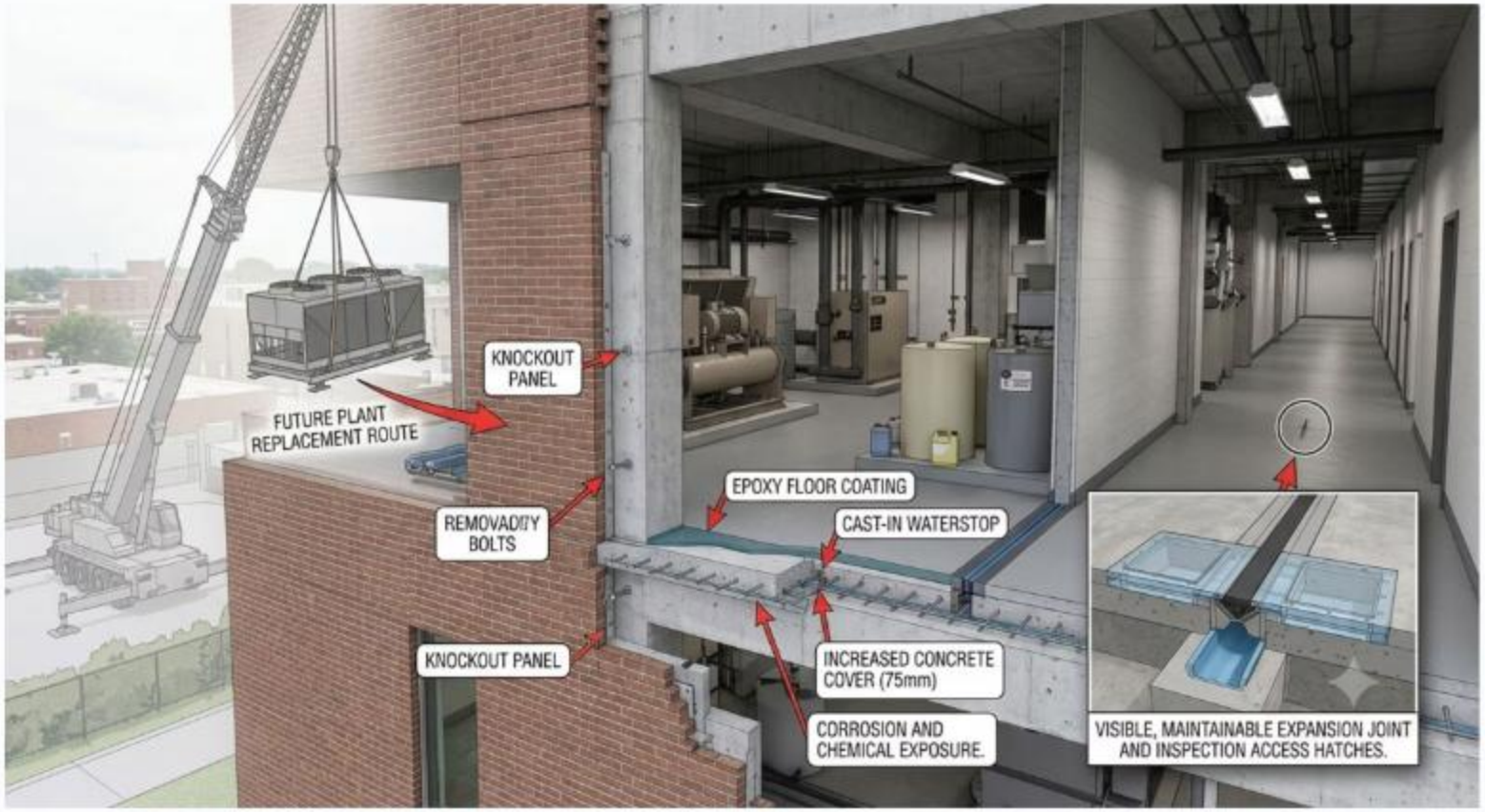
- **Plan** the arrangement of slab, beam, and wall openings before construction.
- **Coordinate** sleeves and penetrations to avoid post-completion coring.

Operation: Safe Access and Heavy Equipment Servicing

- **Plan** the arrangement of slab, **Design** roof areas for safe access to plant and systems.
- **Allow** maintenance loads on roof slabs and walkways.
- **Provide** fixing and lifting points for equipment servicing.

Lifecycle: Future Replacement and Environmental Durability

- **Plan** future plant replacement routes into the structure.
- **Provide** protection structure from corrosion, leakage, and chemical exposure.
- **Keep** expansion joints **visible**, accessible, and maintainable.



Civil Infrastructure Considerations

Civil infrastructure often generates the most persistent FM problems when Drainage, Road , Earthwork- SLOPE,and Sewerage are not planned with operation in mind — particularly in tropical climates with heavy rainfall and high humidity.

Drainage

Provide correct falls and accessible drainage points. Avoid hidden drains. Position inspection chambers at practical locations. Design for heavy rainfall and maintenance cleaning in line with Malaysia's MSMA guidance.

Road Work

Design for maintenance vehicle loads and emergency access. Avoid ponding through correct gradients. Ensure manhole covers are accessible and clearly identified — never blocked by permanent structures.

Slope

Provide surface and subsoil drainage. Allow clear inspection of cracks, movement, erosion, and weep holes. Consider long-term slope stability and vegetation management.

Sewerage

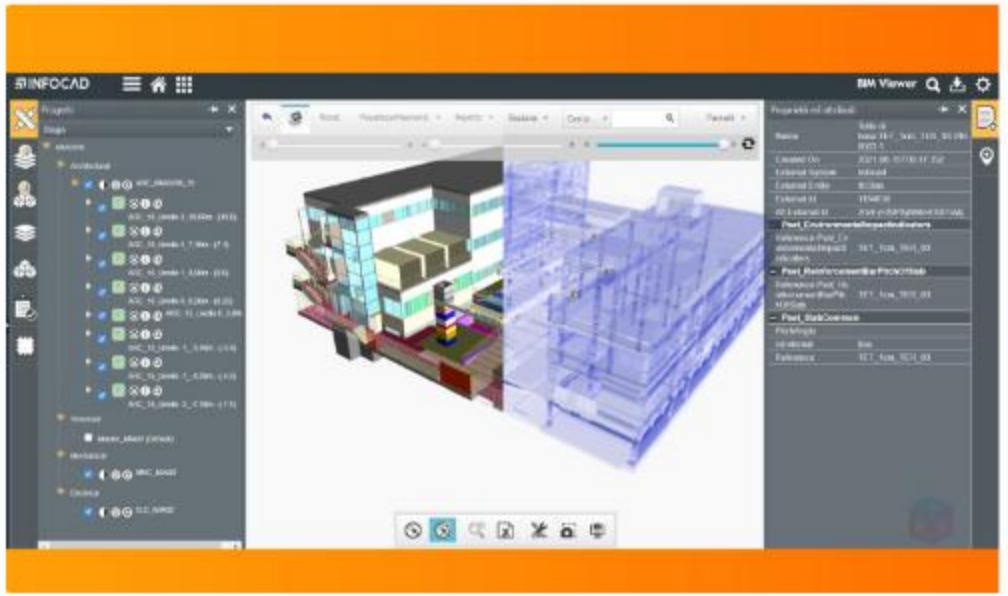
Design sewerage systems to manage effluent effectively while ensuring the long-term durability and maintainability of the network.

In Malaysia's climate, drainage performance, waterproofing integrity, and corrosion resistance are especially critical for sustainable FM outcomes.

BIM, As-Built Records, Asset Tagging & Digital Handover

A sustainable building requires reliable, structured information — not only physical construction. BIM should actively support operation throughout the asset lifecycle, not merely serve as a design presentation tool. ISO 19650 establishes the international standard for managing information over the whole lifecycle of a built asset using BIM.

FM Handover Information Must Include :-



Research confirms that clear owner and asset information requirements are critical —but many projects still fail when FM information requirements are not defined early in the process.

Practical Design Checklist for FM-Friendly Buildings

Element	What to Check	Why It Matters
Cable openings / sleeves	Size, location, spare capacity, fire stopping, waterproofing.	Prevents costly coring and hacking later.
Inspection hatches	Right size, safe location, easy access without damaging finishes.	Allows inspection and repair without structural damage.
Utility trenches	Removable covers, internal drainage, spare ducts, safe depth.	Makes future repairs and upgrades practical.
Manholes / chambers	Accessible, correct cover weight, clearly labelled.	Saves time when utilities need urgent repair.
Roof drainage	Correct falls, overflow provision, access walkway, edge protection.	Reduces leakage, ponding, and water damage.
Waterproofing details	Upstands, joints, penetrations, and protection layer in good order.	Prevents repeated and costly water ingress.
Material selection	Durable, corrosion-resistant, locally available, easy to clean.	Lowers repair frequency and replacement cost.
As-built records	Drawings, photos, asset tags, and BIM model updated at handover.	Helps FM teams locate, maintain, and replace assets efficiently.

Key Takeaways

> "A sustainable building is not only green on paper. It is a building that can be safely operated, maintained, repaired, and adapted throughout its life."

1 C&S Design Decisions Affect the Whole Building Life

Foundations, slabs, openings, drainage, pavements, slopes, and utility trenches all directly influence FM performance and operational cost.

2 FM Must Be Involved in Early Stage

Late involvement causes avoidable retrofit works, reactive repairs, and operational disruption that could have been designed out at minimal cost.

3 Access Is Sustainability

If something cannot be safely accessed, it cannot be maintained properly — leading to premature failure, waste, and higher carbon impact.

4 Life-Cycle Cost Trumps Lowest Construction Cost

Good design may cost slightly more upfront, but consistently reduces long-term maintenance cost, downtime, and operational disruption.

5 Digital Handover Is Part of Sustainable FM

BIM, asset tagging, and accurate as-built records are essential tools for FM teams to manage, maintain, and adapt assets effectively throughout the building life.

Suggested References

The following standards, guidance documents, and research publications underpin the principles discussed in this presentation.

1 **IFMA — What is Facility Management?**
FM definition and role in supporting functionality, comfort, safety, sustainability, and efficiency of the built environment.

2 **UNEP & GlobalABC — Global Status Report 2025–2026**
Building sector CO_2 emissions (~37% of global total) and material extraction (~50% of global use).

3 **ISO 15686-5:2017 — Life-Cycle Costing**
Requirements and guidance for life-cycle cost analysis of buildings and constructed assets.

4 **ISO 19650 — BIM Information Management**
Managing information over the whole lifecycle of a built asset using Building Information Modelling.

5 **BS 8536:2022 — Design for Operability**
Early operator involvement, aftercare, information quality, and performance in use across the building lifecycle.

6 **DID Malaysia — MSMA**
Urban Stormwater Management Manual for Malaysia — planning and design guidance for stormwater management in tropical conditions.

Additional references: ISO 55000:2024 (Asset Management); Tsay et al. 2022 (BIM for FM); PWD FMM 2016 (Malaysia); CIDB Malaysia Certified Facility Management Manager accreditation.