The People's Project

Engineered Safety Case Study

TPP_ESI_033 – MIPS

Brief:

During the early design and construction planning phases, the general admittance concourse toilet areas were identified as congested multi trade service zones requiring architectural finishes. A product based installation required investigation as a solution to help reduce the associated risks with multiple trades in these areas. Whilst reducing construction based activities, to seek efficiencies and programme improvements based on our standard DfMA approach.

Headline Requirements:

- Engineered Safety
- Multiple WC Banks
- Architectural Finish – IPS Panelling
- Environmental / corrosivity resistance
- Usage / footfall – longevity and durability
- Code compliance – Eurocode / crowd loads etc
- Standardisation
- Fully serviced / insulated
- Logistically viable / handling
- Positive lift points

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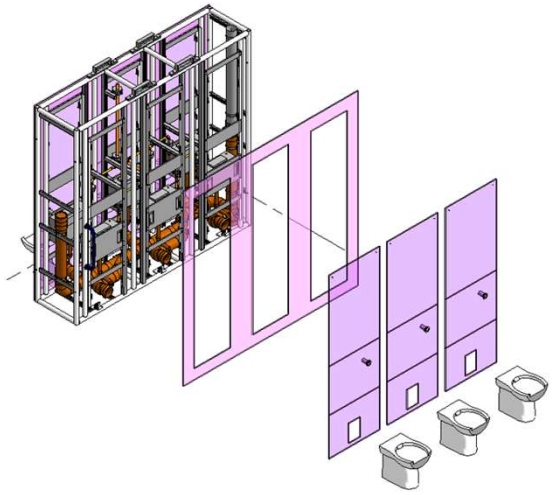
Action Taken:

Research was undertaken to review what products were currently available within the marketplace or supply chain and their suitability. Or, if new standard solutions and DfMA products required in house development.

Research found that there are limited products within the market which provide a wholistic solution of multiple WC's, IPS finishes and are fully serviced (including SVP and Cold water floats). The plan and vision was for a solution which could be installed as complete volumetric building blocks.

Products within the market place & supply chain.

The required solution.



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Product Development / Standardisation:

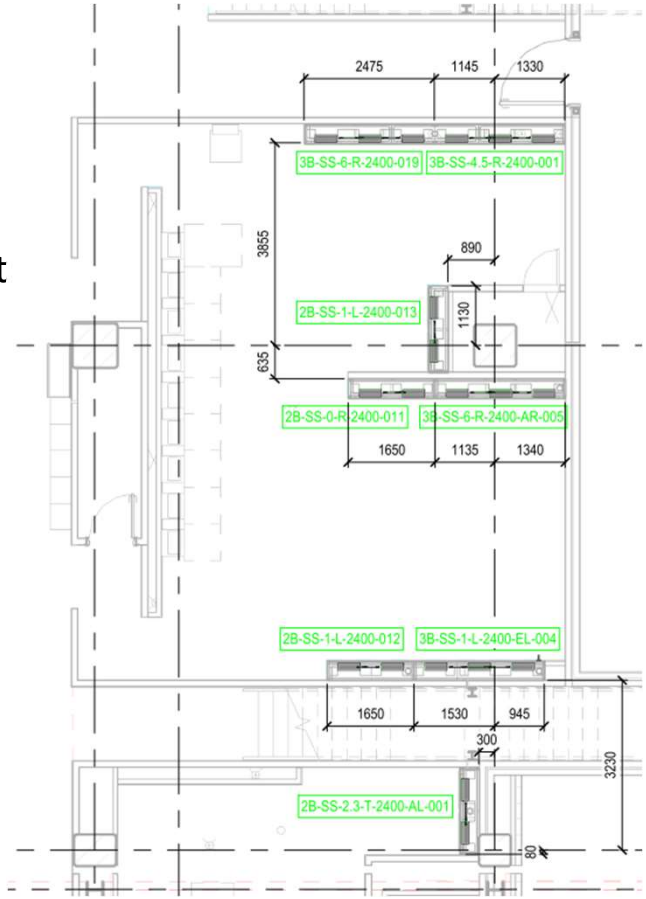
Investigation was carried out to find the optimum WC configurations i.e. 2 bay and 3 bay modules, which could be positioned side by side to create larger banks of WC's as required.
During the investigations it was decided that single WC's were a low priority to target in terms of overall benefit.

Working in collaboration with Pattern Architects and the construction team;
IPS sizes / heights, void depths, WC centres, wall and cubicle setting out details were co-ordinated and designed around standardised configurations as a product set based approach.

This product set become known as MIPS (modular integrated plumbing system).

Standard Configurations Developed:

MIPs Type	2110mm High	2400mm High
2 Bay WC Single Sided	✓	✓
3 Bay WC Single Sided	✓	✓
2 Bay WC Back to Back		✓
3 Bay WC Back to Back		✓



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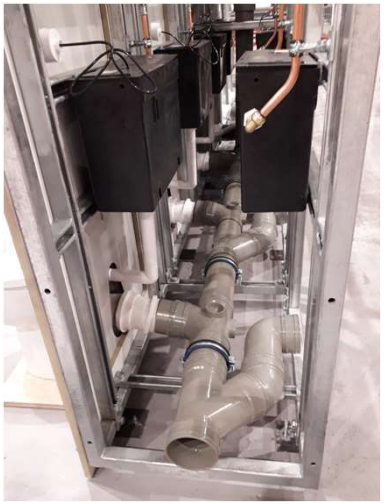
Protype / First of Type

The MIPS went through a series of research, design collaboration, planning activities, product development and prototyping. Leading towards the production of "First of Type" units which captured the final design and lessons learnt prior to main manufacture of circa 260No. MIPS.

Prototype → First of Type



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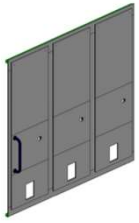
Key Engineered Safety Developments at CHtM

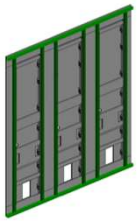
The main Engineered Safety Developments which were embedded into the final solution included:

- A Track System was installed at CHtM so that the MIPS are safely secured to prevent toppling of the units during assembly. The fixing points at the base of the MIPS frames designed to connect the MIPS to the slab on site were utilised, this prevented the requirement of additional holes or fixing details required solely for manufacturing purposes.

Site fixing brackets utilised to fix to CHtM Track System

- Standardised IPS Systems delivered to CHtM as pre assembled and pre-cut / drilled components. This minimised the requirement of cutting & drilling materials at CHtM, reducing dust from composite panel materials. This also assisted with assembly efficiencies on the CHtM production line reducing activities within the factory.





Pre made rail system complete with clips

Pre-cut Services apertures

Infill / backing panels pre-cut

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Key Engineered Safety Developments – Logistics / Handling

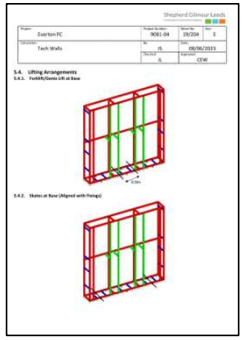
Engineered Safety Developments which were embedded into the structural design and final solution included:

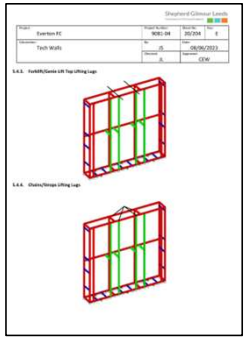
Positive Lift Points

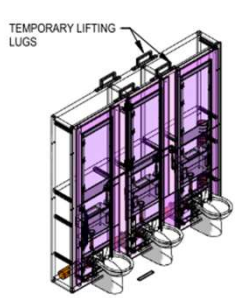
M12 Positive Connection Points fabricated within top of each MIPS frame.

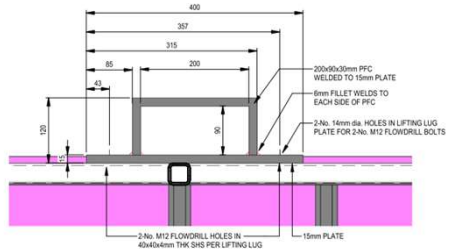
MIPS Structural analysis and design permits the use of 4No. RUD M12 VLBG Lifting Eyes.

This allows lifting / manoeuvring within CHtM via Gantry Cranes. And on site via Crane.









2 Temporary Lifting Lug - Section 1 : 5

1 3 Bay Single Assembly Exploded View - Lifting Lugs

The same M12 Positive Connection Points fabricated within the top of each MIPS frame can be used to fix Temporary Lifting Lugs, these are designed to enable manoeuvring and final positioning using plant and equipment with Fork attachments.

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NOTE: A Top lift method was required to prevent damage to the underside of the IPS panels and to prevent fork entrapment once the MIPS are lowered to the ground.

Genie type lifting equipment was required due to the minimal headroom above the MIPS on site at Everton. Especially under the seating / raker structures.

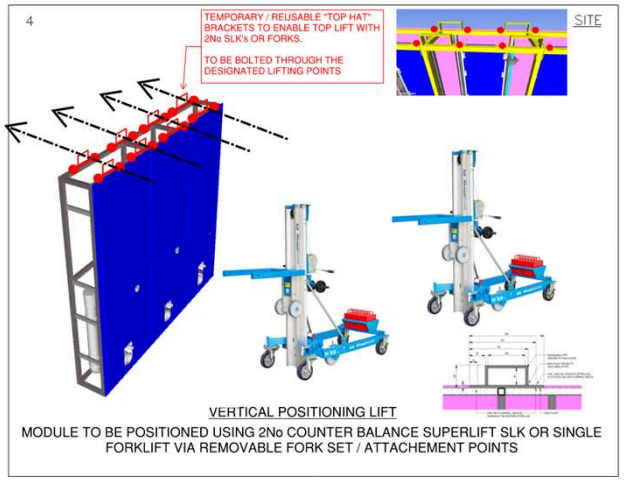
Key Engineered Safety Developments – Logistics / Handling

Lifting / Final Positioning Trials with Select

Crane attached to MIPS during trial as safety precaution.

The weight of a 3 Bay SS MIPS is within/load capacity of 1No. Counter Balance Genie SLK10. A trial was undertaken at CHT to understand the effectiveness of this.

During the trial it was found that the load wanted to lean forward with the flex of the Genie mast due to the off-balance created by the weight off the IPS Panels in relation to the lightweight services.



The lifting trial was stopped at CHtM as it was decided that although the load was within capacity, the equipment and load was leaning too far forward. This provided an unstable load scenario and also introduced the possible risk of the load slipping from the forks within the lifting lugs.

Working with Selects input, a revised methodology was agreed utilising 2No. Genie SLK10's. The MIPS frame design was updated prior to main manufacturing to include more positive lift points so that 8No. Lifting Lugs could be used for the 2No. Genies's side by side.

2No.Genie's During Site Installation with limited headroom.

Lifting Trials → Findings / Reassess → On Site Installation

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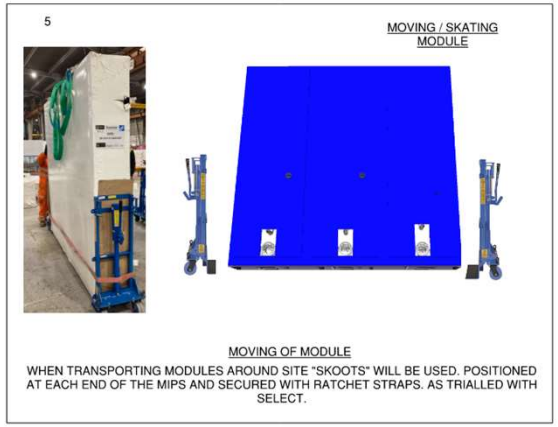
Key Engineered Safety Developments – Logistics / Handling

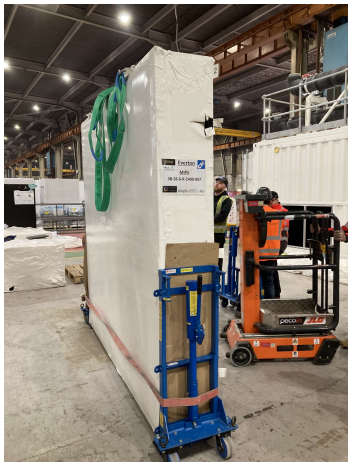
A method was required to distribute the MIPS from the loading areas to point of installation:

Skating Trials with Select

Bespoke fabricated wheelsets, bolted to the MIPS base fixing angles were originally envisaged as the skating method for site distribution. Upon trialling this the solution worked and provided stability when skating, although the process to attached the skates could have been improved from an efficiency and time perspective.



From the trial the time to connect the skates needed improving. The load had to be lowered onto stakes, which also had to be independently restrained and held upright to align bolt holes. Select proposed to trial "Skoots" equipment as an alternative to help make the process more efficient and to prevent the requirement of fabricating multiple bespoke wheelsets.



The "Skoots" trial was successful at CHtM, the method of connecting these were more efficient than the original wheel sets, bolted connections were no longer required. The equipment itself also has some built in height adjustability which can help overcoming obstacles or changes of height on site. The centre of gravity of the load and head height was also lowered. This solution also negated the requirement to fabricate multiple wheelsets.

Skating Trials at CHtM → Findings / Reassess → Final Method / On Site Installation

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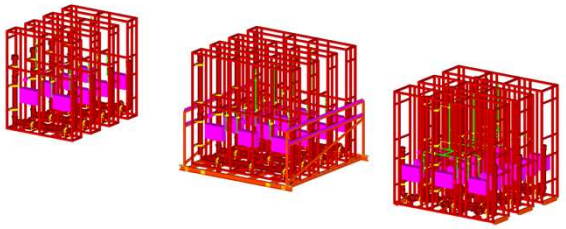
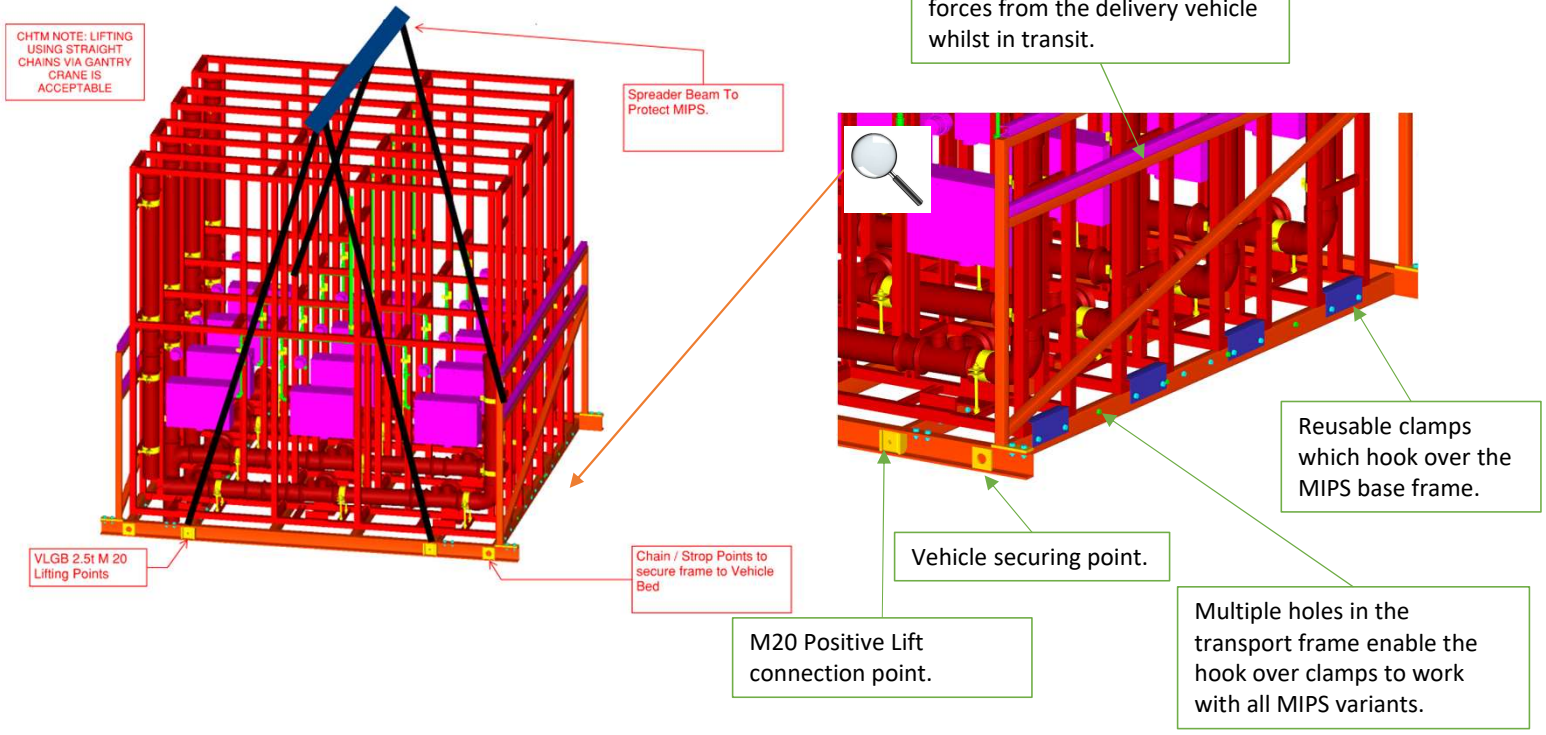


Key Engineered Safety Developments – Logistics / Handling

A Method was required to safely secure the MIPS to the bed of delivery vehicles and also when fully loaded with MIPS so that they could be safely loaded and offloaded using positive lift attachment points. A transport frame was designed which could accommodate multiple MIPS variants:



NOTE: The lifting frames can be lifted via crane fully loaded with up to 4No. MIPS

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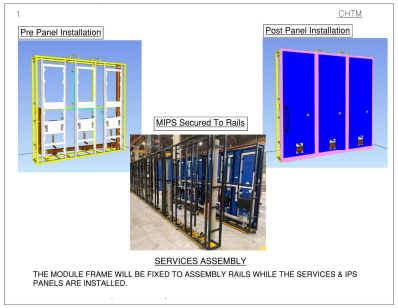
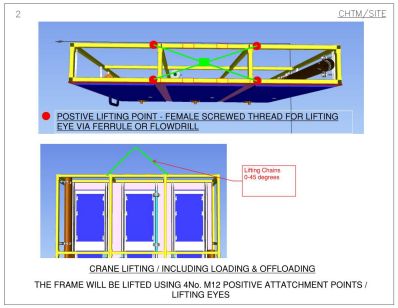
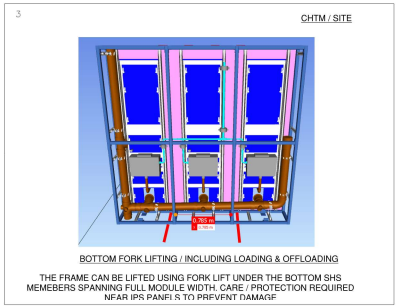
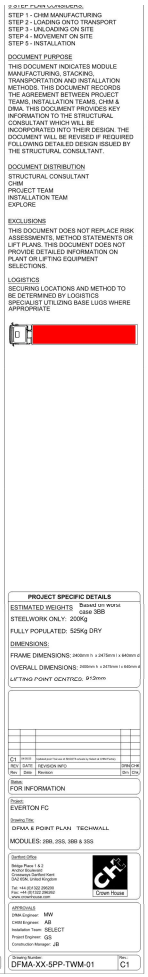
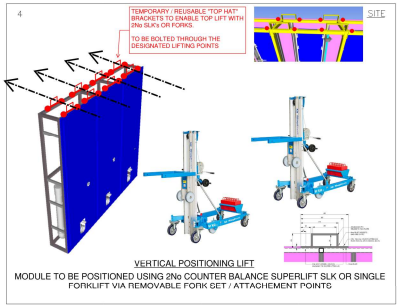
Key Engineered Safety – Final Construction Issue 5 Step Plan

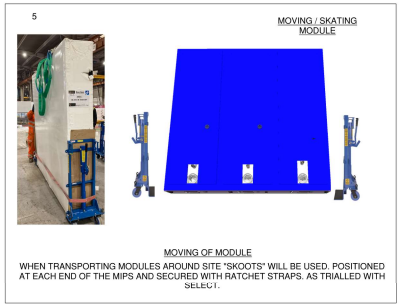


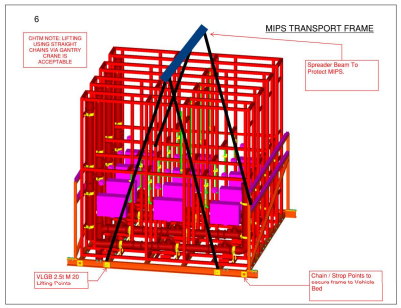


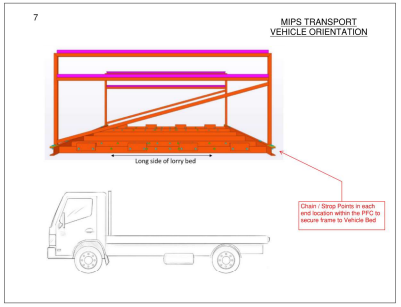












RESIDUAL RISK REGISTER		
RISK	CONTROL MEASURE	RESPONSIBLE PARTY
Toppling of MIPS during Skating on site with the Skoots.	Skoots to be used in accordance with Select Safe System of Work. Environmental wind / ground condition to be evaluated. MIPS not to be left unattended on Skoots.	Select / Project Logistics Team.
Toppling of MIPS if stored on site prior to fixing to floor brackets.	MIPS to be stored / secured on MIPS Transport frame. In the transition period in-between site skating and install, the MIPS are not to be left free standing and must me temporarily secured.	Select / Project Logistics Team.
Damage to finished IPS surfaces and flush controls.	Temporary protection / packaging to remain on the Modules during the skating and installation period.	Select / Project Logistics Team.
Risk associated with lifting equipment and cranage.	Lifting to be carried out using designated lift points and positive litt points when using cranes. In accordance with Select Safe System of Work.	Select / Project Logistics Team.

Key contacts

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