Living Lab

Transport Infrastructure Efficiency Strategy

TIES LIVING LAB PROGRAMME

Off-site construction for modular equipment rooms (IP3)

October 2022

INTRODUCTION

There is a growing need for rapid replacement and improvement of the aged signalling environments of UK rail networks, including an imminent need for new signalling and communications equipment rooms (SERs and CERs, respectively). The number of these units could run into the thousands, across the highways and rail networks. If modern methods of construction (MMC) can be used it would be possible to save 40–50% on the cost of each equipment room, amounting to tens of millions of pounds saved from the public purse.

This information paper reports on a project on MMC equipment rooms, which was one of the four "live" demonstrator projects under the Transport Infrastructure Efficiency Strategy (TIES) Living Lab collaboration. The aim was to explore the suitability of off-site construction of SERs, to explore whether the technique could be rolled out widely across the rail transport network, and to gauge the level of savings that could be achieved.

Transport for London (TfL) already had a commitment to install a new signalling system through its Piccadilly line upgrade programme and, as one of the TIES Partner organisations, developed a plan to procure a demonstrator SER unit. The objective was to demonstrate how MMC can not only drive efficiency in terms of manufacturing, delivery timescales and cost, but also minimise disruption within the SER locations via off-site manufacturing.

BACKGROUND

The government's Construction 2025 industrial strategy (published in 2013) encouraged the wider construction industry to aspire to achieve a 33% reduction in both the initial cost of construction and the whole life cost of assets, and a 50% reduction in the overall time from inception to completion for new build and refurbished assets by 2025. This was followed, in December 2017, by the Transforming Infrastructure Performance (TIP) plan to increase the effectiveness of investment in economic infrastructure such as transport and energy networks. The TIP aims to tackle the systemic issues that limit the performance of UK infrastructure, particularly through investing in MMC to improve the operational performance and productivity of the sector. Further, the *National Infrastructure Strategy* (published in December 2020) sets out plans to transform UK infrastructure in order to "level up" the country and achieve net zero emissions by 2050.

SERs and CERs are found throughout the rail transport network (as well as in other industrial settings) and, to date, have been delivered using conventional brick-and-block build techniques and to non-standard specifications.

Upgrading a network that was designed and built many decades ago means that providing SERs in certain parts of the London Underground is problematic because of the difficult locations and severe space constraints, and the consequential need to have a bespoke approach for installing each SER.

There is also a perception that SER installation is expensive for what they are: each SER is essentially a shipping container-sized box (typically of steel) for safe and secure housing of the signalling equipment.

Several potential benefits of MMC for SERs have been identified. For example:

- Assembling the SER structures in a factory will provide a more controllable environment, so increasing certainty in quality of delivery.
- A factory environment is also much safer – and quicker – than on-site construction, so results in shorter, more reliable project timescales.
- MMC makes it possible to demonstrate the ability to expand the volume of the structure without affecting the operational equipment housed inside.
- It is possible to pre-install, test and assure the performance of the electronics in a factory environment, further reducing on-site work.
- It will have a positive socioeconomic impact, because the SERs and CERs can be built anywhere in the country, bringing employment and other economic benefits to areas beyond London and the south-east.

CHALLENGES

In addition to the expected challenges of moving to a new way of delivering SERs and CERs using MMC, there were project-specific challenges to overcome, not least achieving buy-in from the TIES Partners, especially for the need to adopt harmonised standards across the Partners, and to coordinate workloads and plan the rollout of the demonstrator.

Although each equipment room is essentially a "steel box" with equipment inside, the bespoke characteristics of each location mean that the greatest potential for efficiencies lies in off-site construction and the possibilities for economies of scale, which can also make installation quicker and more cost-effective.

This approach therefore required the services of a specialist contractor that had a track-record of delivering similar turnkey equipment rooms for different industry sectors.

TfL decided to work with Mavin, which has already supplied its Powercube containerised modular datacentres and other building types to the NHS and the Ministry of Defence.

SPECIFYING THE TEST SER

Ultimately the rollout of the SERs and other equipment rooms across the TIES Partners will require additional work to ensure that industry-wide specifications can be agreed. But for the purposes of this initial project

TfL decided to go ahead with the build on the basis of design details provided by Mavin Powercube, which created the design using its own standard assurances. Post construction and installation, TfL will test and verify the building using its own standards. This will enable TfL to produce an itinerary catalogue for an SER modular build, which will then also be used to question and challenge the current London Underground standards.

The aims were:

- To construct, deliver and install the unit within a 10–18 week window (including site preparation)
- For the design to be easy to modify in future to suit other locations
- For the unit to be easily scalable and redeployable.

The specification developed by Mavin Powercube features secure equipment zones separated by a "welfare" zone where maintenance staff can meet, eat and drink, and dry out or clean up between jobs.

The test building

The proposed modular building is 15,000 mm long and 3,800 mm wide externally. Internally it comprises the SER and an electrical switch room (ESR) with a drying room/staging area between them.

Although the general specification was provided by Mavin Powercube, the building incorporates London Underground requirements where possible.

Mavin constructed the SER modular building off-site at a manufacturing facility in Wales, fulfilling the objective of spreading employment opportunities beyond the south-east of Britain.

In terms of carbon emissions and energy saving features, the SER will adopt a BioSolar roof solution in compliance with the S1052 standard (Gravity Drainage Systems). The blue/green roof section will comprise substrate, drainage layers and attenuation cells, protective layers and a polymeric waterproofing membrane.

The module will be installed at the TfL test centre (the Tunnelling and Underground Construction Academy) and used for testing new switching technologies before they can be included on the approved products list.

Once in situ, further testing of the unit will be conducted, including: tests of the solar panel output; verification against the London Underground design standards; and checks and tests of the durability of the blue/green roof and its maintenance requirements.

LESSONS LEARNED

- As this is an innovation project with TfL using a new company that is classed as a small to medium-sized enterprise (SME), it was challenging for TfL and Mavin Powercube to work within typical London Underground design requirements, which has resulted in a lengthy design process.
- TfL agreed to stretch its boundaries with regard to traditional design and assurance processes and relied on Mavin Powercube's own assurances. TfL will conduct checks and obtain assurances outside of the TIES project and evaluate the benefits and possible performance gaps of the SER unit.

LEAVING A LEGACY

Reducing the up-front design and manufacturing costs by adopting MMC is only part of the equation. There are numerous other savings and efficiency gains from:

- The ongoing operation of a more efficient environment
- Reduced maintenance and upkeep
- Increased use of renewable energy per SER/CER etc.
- Significantly lower on-site civil disruption when deploying
- Substantial improvements in line-side health and safety
- The ability to redeploy the units.

Currently, the first unit is in manufacturing and this process has been seamless.

Next steps, which will be outside of the TIES Living Lab project, include:

- Collection of the solar panel performance data
- Full evaluation of costs, once TfL has complete verification of the SER modular build.

Due to the constraints placed on the specification in order to meet project delivery, the SER unit has been constructed without a full compliance/design process to the London Underground standards and assurances, so the current SER unit may not be suitable to place in an operational underground environment. However, TfL will do these checks and assurances post construction. As this is an innovation project its aim is to stretch traditional boundaries and be able to explore other means of modern construction.

Although TIES Partner HS2 Ltd did not identify any relevant standards applicable to SERs, it acknowledged that the technology could have the potential to be rolled out to the design of its SERs. Network Rail and other transport industry businesses could also utilise this SER modular build.

This work was coordinated by Transport for London and delivered by experts from Mavin Powercube and the TIES Living Lab under the project on Modern Methods of Construction (MMC) Equipment Rooms, overseen by the Cost and Performance Benchmarking Steering Group.

Living Lab

Transport Infrastructure Efficiency Strategy

The TIES Living Lab is a transformative collaboration of 25 partners together with Government, i3P and the Construction Innovation Hub that use data, technology and Modern Methods of Construction within live transport infrastructure projects to deliver significant value-adding benefits across the transport infrastructure sector. The programme is funded via a grant from Innovate UK through the Transforming Construction programme, plus contributions from the Department for Transport, HS2, Transport for London, Network Rail and National Highways.

The four strategic outcomes of the collaboration are to:

1. Improve the way Transport Infrastructure projects are set up to maximise value
2. Achieve better assurance of project and programme value and what assets should cost (benchmarking)
3. Accelerate the wider adoption of MMC
4. Establish the TIES Living Lab as a catalyst for long term cultural change across sectors by making a compelling case for long term HM Treasury funding to scale this facility.

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