# Modern Methods of Construction

## Off-site module construction: quality controls

**This Risk Insight aims to assist clients and construction teams with key areas of quality controls regarding Modern Methods of Construction (MMC) off-site modules. This includes considerations throughout the project life cycle, from design conception through to installation and defect management.**

## Key project stages for consideration:

> Design
> Manufacture
> Storage (off-site)
> Lifting activities (off-site)
> Transportation
> Arrival on site and lifting activities to position on site
> Installation and defect management.

Taking these stages into consideration, the following information can support contractors or the principal contractor who is considering utilising off-site modular construction on construction projects. It is imperative that all parties involved in the activity clearly understand the risks posed at each stage to prevent delays and costly in-situ rectification works.

The below table summarises the stages and considerations:

| Design and initial concept | |
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| Supply chain | Ensure due diligence is undertaken regarding supply chain capability, including availability of materials, competency and availability of labour (from manufacture to transportation, and installation on site). |
| Design | Refine the design following lessons learnt, and defect analysis prior to mass build of orders. Minimise design changes following this stage where possible and all changes to be formally recorded and informed to all parties including suppliers, manufacturers, principal contractor / contractors and installers. |
| Suitability of materials | Consider all materials in regard to suitability for the environment they are to be located/stored.<br>All materials and all components used should be resilient to stress/movement during transportation and lifting activities, including pipework and jointing systems.<br>Sprinkler system pipework with fire stopping should be checked for compatibility and the potential for reaction with the barrier chemicals. |
| Lifting and movement | Lifting eyes to be suitable (position, type and safe working loads) for the lifting requirements as per risk assessment and prevent any 'crushing' during lifts.<br>All standing weights and point loads are to be documented and the design for the lifting measures to be fit for purpose. |
| Pressure testing | Pressure testing (commissioning and operational) to be suitable for the pipework selection and as per manufacturer's guidelines.<br>If Pressure Reducing Valves (PRVs) are to be used, ensure operational prior to commissioning and installed as per manufacturer's guidelines. |
| Accessibility | In the event of a potential leak from defective pipework, the areas containing the joints should be easily accessible without resulting in significant damage (and remedial work) to the modules.<br>Access panels should be thoroughly considered during design for accessibility to key equipment and points of failure (i.e. pipework joints) and ensure functional design as opposed to aesthetical design. |

| Manufacturing | |
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| Competency | Prior to manufacturing, ensure the off-site manufacturer's competencies and accreditations have been checked and formally recorded. Insurance coverage checks are to be formally recorded. |
| Pressure testing | Pressure testing to be undertaken as per manufacturer's guidelines and in accordance with the principal contractor's water management plan. This should be documented, and a copy provided to all parties involved. |
| Quality inspections | Robust quality control procedures including formalised quality inspections and photographs should be undertaken prior to covering the pipework etc with plasterboard.<br><br>Quality inspections should be undertaken by the principal contractor and the site team should have training to understand off-site construction and the additional risks presented.<br><br>It is highly recommended additional quality inspections are undertaken by independent third-party auditing companies to accredited standards i.e. ISO 9001.<br><br>All records to be retained and readily accessible to support responsibility in the event of a loss. |

| Storage (off-site) | |
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| Temporary weather protection measures | All temporary flexible protective covering materials must be third-party approved (LPS 1207) and fire rated.<br><br>Moisture controls including prevention of weather/water ingress and internal monitoring of the modules must be considered.<br><br>The protections should ensure the modules can 'breathe', to assist with mould prevention from internal 'sweating'.<br><br>Frequent monitoring to be undertaken to ensure moisture levels are at satisfactory levels. |
| Location, duration and environment | The area/s in which the completed modules are to be stored must be suitable to prevent damage from perils.<br><br>Raising the modules, a minimum of 150mm above floor level, can assist with reducing the likelihood of damage from groundwater.<br><br>Manufacturing to installation should be timely to reduce the likelihood of extended storage periods.<br><br>Ensure the environment in which the modules are to be stored does not negatively impact on the build, i.e. storage in coastal areas can be vulnerable to damage from the salt in the air. Ensure all temporary weather protection is suitable for the environment.<br><br>Consider the potential impacts on the modules from extended off-site storage, due to potential delays on site and ensure frequent inspections are undertaken both externally and internally. |

| Lifting activities (off-site) | |
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| Competency | Prior to any lifting activities, the principal contractor is to ensure competencies and accreditations have been checked and formally recorded including appointed person / lift and crane supervisor / slinger and signaller.<br><br>Insurance coverage checks are to be formally recorded. |
| Risk assessment | Risk assessment to ensure the correct lifting methods are to be implemented including suitability of the plant/machinery. |
| Correct lifting techniques | All plant/machinery to be suitable for lifting activities as per risk assessment and lifting plans.<br><br>All lifting eyes and lifting aids designed on the modules to be utilised correctly. All lifting equipment in accordance with LOLER.<br><br>Reduce unnecessary lifting/movement activities off site as far as possible. Over-movement and over-lifting can significantly increase the likelihood of joint and component failure. |

| Transportation | |
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| Secure loading | Suitable securing of the load and review of the transportation routes / inclement weather prior to collection of the load. |
| Site preparation | Principal contractor and contractors involved are to ensure the site is suitable for the vehicle to enter site to the designated location. The access to site and ground conditions should be inspected to ensure suitability and to minimise movement.<br><br>Suitable and dry lay-down area, which has been designed to take the point loads required. Areas to be segregated from work areas to reduce inadvertent damage during storage. |
| Temporary weather protection measures | Temporary weather protection measures to be reviewed prior to transit.<br><br>Consider the protection layers during movement and transport, ensure quality audits have been completed regarding the protection layers as these may need to be exposed for lifting and resealed prior to transit. |

| Arrival on site and lifting activities to position on site | |
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| Quality inspections | Robust quality control procedures including formalised quality inspections by the site team and photographs taken prior to acceptance of the module/s upon arrival to site. |
| Competency | Prior to any lifting activities, principal contractor to review competencies and accreditations of the contractors undertaking the lifting activities.<br>Dedicated lifting team to be in place including clear roles and responsibilities. |
| Risk assessment | Risk assessment and lift plan to be in place to ensure the correct lifting methods are to be implemented including suitability of the plant/machinery. |
| Correct lifting techniques | All lifting eyes and lifting aids designed on the modules to be utilised correctly.<br>All lifting equipment in accordance with LOLER. |

| Installation and defect management | |
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| Quality inspections | Robust quality control procedures including formalised quality inspections by the site team and photographs taken following removal of temporary protections on the modules. |
| Early defect analysis | Where possible, a sample module or a select number of modules to be installed are thoroughly inspected including pressure checks, prior to manufacturing/ lifting of the remainder of the modules therefore reducing the likelihood of series defect losses and also improving quality control by early identification of potential defects. Early identification of defects can assist with early design changes to minimise defects. |
| Competency | M&E companies to be vetted and ensure they have experience with off-site modular units. Competence checks on supply chain including operatives and management. |
| Water management plan | All subcontractors to work in accordance with the CIREG-compliant site water management plan developed by the principal contractor. |
| Defects and repairs – competency and warranties | Consider who will undertake repairs and their competencies as off-site manufacturing companies may not have experience with in-situ construction site works and new skills sets may be required.<br>Before allowing M&E companies on site to undertake repairs, warranties and contractual agreements must be checked as altering/exposing a module may void the warranties. |

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