

Steel Plan Multi Technical Manual



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Revisions

Revision	Date	Description	Author	Approved
1.0	27/02/18	First Issue	JAC	PAA

OVERVIEW

BUILDING COMPOSITION

Floor: 178mm deep channel section, floor joists at 600mm centres and galvanised steel transit skids

External Walls: Clad with 0.5mm Plastisol coated steel, 70mm insulation core with Fireline vinyl faced plasterboard

Roof: Interlocked Plastisol coated steel sheets, with a 1° slope into the purpose made guttering and square section uPVC down pipes

Ceiling: Composite steel faced panels with 70mm polymer insulation, overlaid with 15mm Fireline plasterboard. An extra layer of insulation is placed above the ceiling panel to create a cold roof design

Opening Windows: White uPVC, double glazed, top hung fully opening windows complete with ventilators

External Doors: Insulation core bonded to plastisol faced steel complete with locking mechanisms and door furniture



This product sheet relates to the Elliott Steelplan Multi (ELM) Building System.

The ELM building comprises of a suspended floor mounted on a galvanised steel base frame, external square section steel columns, welded to the base frame at each corner, supporting the longitudinal steel lattice beams which carry the ceiling and roof decking. This method of construction ensures a clear internal span over the whole floor area of the module.

The steel monopitch roof provides positive shedding of rainwater and the composite steel faced ceiling panels give a flat ceiling throughout the building.

Hot dipped galvanised steel products are used throughout the building and extensive use of durable Plastisol coated steel for external finishes ensure minimal maintenance for the duration of its design life of 25 years.

Key Factors

Behaviour in relation to fire – the modular units are based on a standard design, and form the basis for compliance with statutory requirements with respect to Part B 1 (Fire Safety) of the Building Regulations. Checks shall be undertaken to ensure full compliance based on project and site specific parameters. The buildings are not intended for use in schemes with a floor height in excess of 18m

Strength and stability – the building system has adequate strength and stability and has been assessed in accordance with British Standards in one, two and three storey configurations (see Section 0).

Thermal insulation – roofs, walls, floors are insulated to meet the requirements of Approved Document L2A of the Building Regulations (see Section 7).

Weather tightness and damp-proofing – the steel suspended floor and columns raise the finished floor level of the building clear off the ground giving the system an inherent resistance to ground moisture (see Section 10).

Durability – the building system has a design life of 25 years. The standard 'lacquer coated' steel finish has a predicted service life of up to 20 years to first repaint (see Section 11.1)

Technical Specification

1. Description

1.1 General

The ELM Building System comprises factory engineered, volumetric modules assembled by Elliott.

The modules have a suspended floor mounted on a galvanised steel base frame, external square section steel columns, welded to the base frame at each corner, supporting the longitudinal steel lattice beams which carry the ceiling and roof decking. This method of construction ensures a clear internal span over the whole floor area of the module.

The steel monopitch roof provides positive shedding of rainwater and the composite steel faced ceiling panels give a flat ceiling throughout the building.

Hot dipped galvanised steel products are used throughout the building and extensive use of durable Plastisol coated steel for external finishes ensure minimal maintenance for the duration of its design life of 25 years.

The overall modules dimensions are:

- Length (ext.) = 12.366m
- Width (ext.) = 3.112m
- Height (ext.) = 3.303m

1.2 Ground Floor

The base frame is constructed in 178mm deep channel section, cold rolled from 3mm hot dip galvanised steel to BS EN 10143: 1993. Floor joists formed from hot dip galvanised steel are mechanically fixed into the base frame at 600mm centres to give a uniform floor loading 3kN/m².

Insulation is provided by 160mm polymer slab material positioned between the floor joists.

An 18mm plywood floor to CE EN 13986 is fitted throughout, secured to the base frame by self-drilling steel screws.

The U value of the floor is 0.22 W/m² K (based on perimeter to area ratio of 0.314).

1.3 External Walls

The wall construction has been engineered to provide one-hour fire resistance from in to out and both internal and external surfaces have a reaction to fire rating of Class "O" rated as defined in Approved Document B of the Building Regulations.

Wall panels are of a sandwich type panel construction and are based upon a 1200mm wide module. The external cladding is nominally 0.5mm Plastisol coated hot dip galvanised steel and an inner lining of 12.7mm Fireline, vinyl faced glass reinforced gypsum board provides a robust and washable surface. The linings are polyurethane pressure bonded to a 70mm thick insulation core to form a rigid wall construction. Galvanised steel channel sections are incorporated as required within the wall panel to provide strengthened fixing points as necessary.

Recessed panel-to-panel joints are secured with zinc coated steel screws that fasten directly into galvanised steel tongues. Matching Plastisol coated steel cover strips are fixed over the panel joints to give a flush external finish and to ensure long-term weather integrity.

The U value of the external wall construction is 0.35W/m²K.

1.4 Roof

The roof is made of interlocking Plastisol coated steel sheets, running in one continuous length from ridge to eaves, with a 1° slope to ensure positive water shedding into the purpose made guttering and square section uPVC down pipes. The deck is supported on transverse galvanised steel channel purlins, secured to the lattice beams at nominally 1.2m spacing.

1.5 Ceiling

The ceiling consists of composite steel faced panels with 70mm polymer insulation between, with an interior finish of 15mm Megadeco with white vinyl face. This construction provides a reaction to fire rating of "Class O" as defined in Approved Document B of the Building Regulations.

An extra layer of insulation is placed above the ceiling panel to create a cold roof design with a U-value of 0.23 W/m²K.

1.6 Windows

The units come with 900mm(w) x 1100mm(h) fully openable top opening vent windows as standard. Double glazed unit, incorporating 4mm clear float glass externally and 4mm K glass internally with a 16/20mm air gap, fitted within a white PVCu frame.

Opening lights are top-hung and close onto draught and weather gaskets. Internally the window reveals are finished with matching white PVCu trim. Ventilators are fitted in the top rail of the fully opening window sash, maintaining a pleasant condensation-free internal environment. Obscure glass is fitted to toilet vents.

NOTE: It is the responsibility of the client to ensure the landscaping around the building meets the requirements of the Building Regulations Approved Document Part M, with regard to opening of windows.

1.7 External Doors

External doors are faced on both sides with Plastisol sheet steel, structurally bonded to a 42mm insulation core. They incorporate an integral double seal to achieve a high level of weather and draught resistance. Doors are fitted with high security cylinder Eurolock and stainless steel lever furniture, with escape fittings if required, and are hung in a welded steel doorframe with a powder-coated finish. Heavy-duty stainless steel hinges to BSEN 1670 1998 are fitted as standard on all external doors.

Where indicated, a 600mm x 920mm and a 600mm x 400mm vision panel glazed with laminated glass, mounted in a powder coated steel frame are incorporated.

Where indicated, a 200mm x 1250mm vision panel glazed with laminated glass, mounted in a powder coated steel frame is incorporated.

1.8 Internal Partitions

Partitions are timber framed construction consisting of the following makeup depending on location (refer to drawing)

32dB Rated Walls: 89 x 38mm softwood framing with studwork at 600mm centres, faced both sides with 2 layers of 12.5mm GTEC Megadeco vinyl faced plasterboard

1hr Rated Walls: 89 x 38mm softwood framing with studwork at 600mm centres, faced both sides with 2 layers of 15mm GTEC Megadeco vinyl faced plasterboard

37dB Rated Walls: 89 x 38mm softwood framing with studwork at 600mm centres, faced both sides with 1 layer of 15mm GTEC vinyl faced plasterboard

45dB Rated Walls: 89 x 38mm softwood framing with studwork at 600mm centres, faced both sides with 2 layers of 12.5mm GTEC vinyl faced plasterboard (staggered joints). Cavity to be filled with acoustic insulation.

Additional fixings/noggins are included in partitions for fixtures and fittings where required.

1.9 Flooring

Barrier matting will be 12mm Heckmondwike Hippo, colour Slate

Vinyl floor finish will be with 2mm slip resistant Polysafe Strata, colour Bedrock 4170.

Carpet will be 500x500mm Birch Hi-Tec nylon tiles, colour Slate 712

1.10 Internal Doors

Doors are 44mm thick hollow core with Egger Oak melamine faced chipboard finish and fitted with 3No. hinges fixed to a softwood door frame. Doors are fitted with an 88mm heavy duty cylinder mortice lock/thumb turn and satin stainless steel level handles on round sprung screw on roses.

Doors which require vision panels are installed with a 185mm x 1500mm Pilkington Pyroshield panel. Refer to drawing for locations.

Toilet doors are 44mm thick hollow core with Egger Oak melamine faced chipboard finish and fitted with 3No. hinges fixed to a softwood door frame. Doors are fitted with an 88mm heavy duty bathroom lock, SSS Disabled Snib turn and indicator and satin stainless steel level handles on round sprung screw on roses.

1.11 Fire Stopping

In order to maintain the fire performance of the building, all penetrations through the compartment walls must be fire stopped using one of the following methods

- **Plastics pipes greater than 40mm**
All plastic pipes over 40mm to be provided with a proprietary sealing system. Use an intumescent fire sleeve sealed on internal sides with intumescent sealant. (standard weather sealant may be used externally)
- **Pipes and Cables less than 40mm**
Penetrations less than 40mm to be sealed with intumescent sealant on internal side. (standard weather sealant may be used externally)

1.12 Fixtures and Fittings

Toilet cubicles are to be manufactured from partition panels and FSC Compliant pale grey Melamine Faced Chipboard (MFC) Thickness 18mm. Cubicles are provided with an indicator lock, hat/coat hook and single toilet roll holder. Standard internal cubicle dimensions are 1600mm x 700mm, an ambulant cubicle being 1600mm x 800mm.

1.13 Variation to Specification

ELM modules are primarily utilised as a lease product and form part of Elliott's rental fleet. All specification items are offered to provide an indication of quality and are subject to change to an equal product without notice.

Performance in relation to statutory legislation will not be compromised by changes to the specification.

2. Manufacture

The building system is manufactured in a factory controlled environment by Elliott. The steel-framed components of the system are fabricated using conventional metalworking techniques and assembled by Elliott Cannock Operations.

The management system of Elliott Cannock Operations has been assessed and registered as meeting the requirements of BS EN 9001:2008 by DAS Certification (Certificate No DAS60199427/0/Q).

3. Delivery and Site Handling

All units are supplied with relevant lifting eyes and installation lugs, bolts and fixings for assembly and an external bay joint capping.

The modules are transported on a flat-bed lorry or trailer of sufficient size.

The open sides of the modules are weatherproofed prior to transit.

The modules are unloaded by crane and are normally positioned on the day of delivery, thus site storage is not required.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the ELM Product.

4. Design Considerations

4.1 Use

The ELM is a steel portal frame modular system building. The modules can form either a single-storey, two-storey or three-storey structure.

5. Strength and Stability

5.1 Loadings

- Floor imposed load on floor joists and floor chassis end members: 3kN/m^2
- Roof Imposed Load supported on purlins and roof end members : 0.75kN/m^2

5.2 Codes

All Eurocodes are used in conjunction with the respective UK National Annex.

- BS 648: 1964 – Schedule of Weights of Building Materials
- BS 5268: Part 2 1996 – Structural Use of Timber: Permissible Stress Design. Materials and Workmanship
- BS 5268: Part 6.2 2001, Part 6 – Code of Practice for Timber Frame Walls. Section 6.2: Buildings Other than Dwelling not Exceeding Four Storeys
- BS 5950: Part 1, 2000 – Structural Use of Steelwork in Building: Design in Simple and Continuous Construction: Hot Rolled Sections
- BS 5950: Part 5, 1998 – Structural Use of Steelwork in Building: Code of Practice for Design of Cold Formed Thin Gauge Sections
- BS 6399: Part 1, 1996 – Loadings for Buildings: Dead and Imposed Loads
- BS 6399: Part 2, 1997 – Loadings for Buildings: Wind Loads
- BS 6399: Part 3, 1988 – Loading for Buildings: Imposed Roof Loads

5.3 Stability

Steel frames provide stability in transverse direction. Longitudinal with stability provided by racking resistance of walls.

Modules are bolted together horizontally at floor and roof level to provide effective horizontal ties and provide resistance to disproportionate collapse.

6. Behaviour in Relation to Fire

6.1 Fire Safety Plan

The majority of fires can be prevented by designing out risks, taking simple precautions and by adopting safe working practices. Installation of Elliott's ELM Modular Building System can support the implementation of a robust and well defined site fire safety plan.

Legislation requires a suitable and sufficient fire risk assessment to be carried out by a responsible person (the employer or persons in control). The Regulatory Reform (Fire Safety) Order 2005 (FSO) in England and Wales and the Fire (Scotland) Act 2005 (FSA) places responsibility for compliance on the 'responsible person'.

Whilst ELM has been designed to meet the requirement of Approved Document B of the Building Regulations. The modular units are based on a standard design, and form the basis for compliance with statutory requirements with respect to Part B 1 (Fire Safety) of the Building Regulations. Checks shall be undertaken by Elliott design engineers to ensure full compliance based on project and site specific parameters. The buildings are not intended for use in schemes with a floor height in excess of 18m.

As the manufacturer of the modular building system, Elliott have no control of the premises in use and it is therefore the responsibility of the user to ensure adequate Fire Risk Assessments are completed and routinely updated and any additional measures implemented.

6.2 External Wall Construction

1 hour fire rated walls are constructed of 12.7mm vinyl faced Lafarge Firecheck Plasterboard fixed to 70mm thick Styrofoam LBX which is subsequently fixed to an outer cladding of 0.5mm thick plastisol coated steel (drawing SM-00-0014A). To protect the external steel rectangular hollow sections, the insulation is stopped and two layer of Firecheck board are fixed to angles, with the resulting cavity filled with glasswool.

The building does not have a storey that exceeds 18m in height. The insulation is not required to be of limited combustibility. The external wall surfaces are in accordance with Diagram 40 of Approved Document B for surface spread of flame classification (see 6.5 below).

No cavities are provided in the standard wall details (Figure SM-00-0014) but cavity barriers would be required in any external wall cavities provided if overcladding is provided as part of any external modification.

Note: Such cavities are required to be designed in accordance with Section 9 of the Approved Document.

The external wall surfaces achieve a Class 0 surfaces spread of flame classification

6.3 Internal Ceiling Construction

1 hour internal ceilings also protect the structural steelwork (lattice beams) supporting the floor. The ceilings comprise of 15mm Lafarge Firecheck vinyl faced plasterboard fixed to a ceiling panel core of 70mm Styrofoam LBX, an outer panel of 0.5mm thick polyester coated steel. The ceiling construction is not contiguous stopping at the ceiling angles beneath the lattice beams.

As per drawing SM-00-0014A, fire protection of the lattice beams are provided by a layer of 12.5mm thick Lafarge Firecheck mechanically fixed to a 15mm layer of Firecheck plasterboard with the resulting cavity between the plasterboard and the lattice beams filled with glasswool.

All wall and ceiling linings will provide a Class O surface spread of flame finish

6.4 Floor Construction

The floor comprises of an 18mm thick plywood decking supported by floor joists (drawing SM-00-0062B).

6.5 External Columns

While the steel lattice beams will be protected by the ceiling assembly, it is not proposed to provide fire resistance to the external columns. Fire protection is provide internally via 1 hour fire rated walls.

A third party review was undertake by Professor Yong Wang of the University of Manchester on the 30th of October 2017. (Copy available on request)

When the middle column, which may be located between two windows is assessed, for both a deflected (wind) and non-deflected (no wind) condition, the temperatures of the steel fail to reach the 550°C commonly accepted failure temperature, with temperatures of 450°C and 415°C respectively.

An additional assessment by Professor Wang, also notes the minimum distance of 100mm from steelwork to window, in the event that a variation is sought.

On this basis, it is considered that the external columns do not require the provision of additional fire protection, provided it is not located closer than 100mm from the window.

6.6 Instructions in Use

In order that the ELM Modular Building System continues to perform as designed and installed, the following points must be noted and actioned as necessary:

- The building must remain in the same condition in which it was handed over to the client by Elliott's approved installation team
- No alterations or modifications must be made to the building without express written permission from Elliott
- Any permitted alterations must be carried out by Elliott or their appointed agent at the user's expense
- Walls and ceiling panels must not be penetrated in any way by the user, doing so may compromise the fire performance of the building
- It is strongly recommended regular inspections are conducted of the building for damage or any unauthorised alterations
- Any necessary repairs and maintenance arising from damage or unauthorised alterations must be carried out by Elliott or their appointed agents
- It is strongly recommended any portable appliances used within the building are regularly tested
- Electrical installations should be routinely inspected, intervals will be clearly defined on the electrical commissioning certificate
- Do not cover the heating appliances or place materials or garments on or under it or obstruct the air circulation.
- The ELM Modular Building system must not be used for sleeping accommodation without express written permission from Elliott

7. Thermal insulation

For the purpose of calculations, the element U values, may be taken from Table 2. Values have been calculated in accordance with using the combined method (BS EN ISO 6946: 2007) and BS EN ISO 13370:2007 (for floors).

Table 2 Element U Values

System Element	U Value ($\text{Wm}^{-2}\text{K}^{-1}$)
Wall	0.35
Floor	0.22 ⁽¹⁾
Roof	0.23

(1) For a perimeter area ratio of 0.314

The wall, floor and roof panels can limit excessive heat loss and contribute to reducing carbon emissions.

Clause 2.23 of Approved Document L2A allows special considerations apply to certain non-exempt buildings including modular and portable buildings.

All modular buildings other than those exempt are required to issue a compliant carbon calculation. The calculation must be specific to the building unless the building is being hired for a period less than two years and is < 1000m².

If a modular/portable building is being used for hire purposes then a generic calculation may be issued to building control to demonstrate compliance.

A unique calculation can be issued to demonstrate compliance for a hired building as an alternative to a generic at the discretion of the supplier.

Where calculations are carried out there are special considerations available for selection by the energy assessor to account for the inclusion of sub-assemblies in the construction manufactured before 6th April 2014

Due to the unique construction properties of a modular or portable building special considerations are made within the calculation software to enable/allow the use of electric heating as this is the only practical heating method within the construction.

In addition for a modular building where more than 70% of its external envelope is to be created from sub-assemblies manufactured prior to 6th April 2014 it is not required to comply with the full requirement of criteria two reduction factors.

8. Condensation

8.1 General

The system is not suitable for use where the internal relative humidity is expected to exceed 70% for any significant length of time, since condensation may occur. The ideal level of indoor humidity is between 40-60% relative humidity (%rH), a figure endorsed by HEVAC, CIBSE, BSRIA and BRE. Assuming normal internal conditions of temperature and humidity, and appropriate ventilation is provided (see Section 0), it is considered that the amount and duration of any condensation will not significantly affect the structural or thermal properties of the building.

If the floor is penetrated by services, e.g. soil pipes, the joints between the services and the floor deck and floor insulation must be adequately sealed to prevent the ingress of water and water vapour.

Equipment producing large quantities of water vapour, for example flueless heaters, must not be used.

Adequate underfloor ventilation is provided to ensure that any condensation on the steelwork or insulation is effectively dispersed (see Section 0).

8.2 Interstitial Condensation

Providing wall and roof panels are sealed correctly and in accordance with this specification, the system will adequately limit the risk of interstitial condensation. The system has been designed following condensation risk analysis using the methods set out in BS EN ISO 13788:2012.

9. Ventilation

Ventilation shall be designed to meet the specific project parameters and in all cases meet the minimum requires stipulated in Approved Document F of the Building Regulations.

9.1 Adjustable Ventilation

The design of the windows should allow for adequate ventilation and is an important factor in reducing the incidence of surface condensation. The windows should be designed so that the amount of openable window ventilation is a minimum of 5% of the floor area otherwise the provision of mechanical ventilation must be considered.

9.2 Fixed Ventilation

Standard windows are fitted with trickle vents providing 4000mm² free area.

9.3 Sub Floor Ventilation

The void beneath the ground floor must have at least 1500mm² of open ventilation area per metre run of external wall or 500mm²/m² of floor area, whichever gives the greater.

10. Weather Tightness and Damp-Proofing

10.1 Ground Floor

The steel columns raise the building clear of the ground, giving it an inherent resistance to ground moisture.

We would recommend consideration be given to treatment of the ground beneath the building. On long term lease projects we would recommend clearing any turf and other vegetation matter at least to a depth sufficient to prevent later growth.

Any proposals should be agreed with the Building Control inspector.

10.2 Roof and External Walls

The roof and external wall surfaces provide adequate weather resistance.

10.3 Windows and Doors

The perimeter joints between windows and doors and the wall panels have are sealed and have been assessed and tested by Elliott to ensure that water penetration will not occur at these positions.

11. Services

11.1 General

The following sub clauses within this section are intended to illustrate briefly, the various methods and standards of installation that are generally adopted for Electrical and associated installations. All installation works are carried out by fully qualified electricians. The operatives are competent and experienced in the installations and building systems.

11.2 Codes and Standards

The installations have been designed generally in accordance with and conform to the following Codes of Practice and British Standards and current amendments where relevant:

BS 7671:2008 IEE Wiring Regulations 17th Edition Amendment 3 2015. Requirements for Electrical Installations.

BS 5266: Pt.1: 2016 Code of Practice for Emergency Lighting of Premises other than Cinemas and Certain Other Specified Premises Used for Entertainment

BS 5839: Part 1: 2013 (selected parts) Fire Detection and Alarm Systems for Buildings (where fitted)

CIBSE: Code for Interior Lighting

11.3 Electrical Supplies

The following sub clauses within this section are intended to illustrate briefly, the various methods and standards of installation that are generally adopted for Electrical and associated installations. All installation works will be carried out by NICEIC or ECA registered and approved installers. The operatives are competent and experienced in the installations and building systems.

11.4 Distribution

The distribution system has been designed zonally, to suit the overall building operational requirements and to minimise sub-circuit cable sizes, whilst complying with the requirements of BS 7671. The system configuration is dependent on the number of modules within the development and the electrical installation characteristics of the installation.

The distribution equipment complies with all the latest Euro norms and British standards and will be complete with a main incoming switch disconnector. All final circuits will have protection using RCBO's or miniature circuit breakers depending on the installation method.

11.5 Installation Methods

The wiring system shall consist of low smoke zero halogen cables twin and earth cables with copper conductors. The cables will be routed within the roof void and dropped through the wall or ceiling panels directly to the appliance being supplied. Where sub-circuits are inter-linked between modules, the inter-connection will be carried out using a wiring loom, utilising male and female shrouded plugs and sockets or fixed junction boxes.

11.6 Lighting Installations

The lighting installation will be designed in accordance with the CIBSE Code for Interior Lighting. The luminaires, lamps and sizes will normally detail within the luminaire legend on the drawing or the building schedule. The wiring system for the lighting installation will be routed within the roof void with the sub-circuit cables entering the luminaires through the rear cable entry. Cables passing through ceiling panels will be mechanically protected where required.

The luminaires will be installed complete with all controllers and lamp colour temperatures as required in the CIBSE guide. Lighting control will be achieved with local control switches, the types to be as detailed on drawings or building schedule. Optional controls and sensors can be accommodated within the design.

11.7 Emergency Lighting Installation

The emergency lighting system shall be designed in accordance with BS 5266: Part 1. The wiring installation to emergency lighting has been carried out as detailed for the general lighting installation. The wiring sub-circuits utilised will be the same as the general lighting to the area; the sub-circuits to the emergency lighting will be dedicated circuits to the installation. Test switches are provided within each area to allow the simulation of electrical supply failure and to periodically test performance of luminaires. The switches are identified as Emergency Lighting Test. The completed system has been tested in accordance with BS 5266: Part 1 and system data will be provided to be for inclusion in the operational and maintenance documentation.

11.8 Small Power Installations

The small power installations are to be carried out as detailed in installation methods. The circuit configuration and circuit protection will comply with BS7671 and will be detailed in circuit schedules once the manufacturing process has commenced.

11.9 Heating Installation and Controls

The heating installation will be carried out as detailed in installation methods. Local isolation will be provided adjacent to each heating appliance cable entry, final connections to be carried out using flexible cable. The heating appliances will be controlled by internal thermostats or remote space thermostats as detailed, frost protection will be installed in wet areas to avoid freezing problems.

11.10 Water Heating

The water heating installation is as detailed in installation methods. The sub-circuits are wired in radials, all cable drops to be contained in surface fixed white PVC trunking. Local isolation is provided adjacent to each water heating appliance cable entry. The final connections to the appliance will be carried out using flexible cables. They are securely fixed to the structure with suitable fixing screws.

11.11 Mechanical Ventilation Installation

Mechanical ventilation is installed within Toilets, Showers, Kitchens and general ablution areas. Ventilation fans within the zone 1 splash area of showers or bathrooms are low voltage type with the control transformer outside the zone. Toilet area ventilation fans are fitted with overrun timers triggered by the lighting PIR device.

Apertures are cut within the wall panels to suit the respective ventilation fans, all penetrations are sealed following the measures set out in Section 1.111.11. The fans are to be secured to walls as manufacturers recommendations. The external grilles are sealed to wall panels with suitable silicon sealant.

The wiring installation to the ventilation fans is as detailed in installation methods. Local isolation is via a specific fan isolator adjacent to the fan and the final connection carried out in white flexible cable. The sub-circuit installation is contained within surface fixed white PVC trunking.

11.12 Earthing, Bonding & Testing and Commissioning

The completed installation will be provided with Earthing and Bonding arrangements in accordance with BS 7671.

The completed installation will be inspected and tested before dispatch, to verify the requirements for full compliance with BS 7671 have been met. On completion of verification a full NICEIC certification document will be produced detailing the extent of the installation. All certification documents will be completed and signed by authorized competent person or persons.

The installation will be fully commissioned and functionally tested and the quality systems documentation completed and provided. Detailed documentation will be provided for the operation and maintenance for all systems.

11.13 Fire Detection and Alarm System

The fire detection and alarm system will generally be designed and comply with the applicable parts of BS 5839-1: 2013. The installation to the devices will be carried out using FP200 gold cable or an approved equal, routed within the roof void, with the drops contained within surface fixed white PVC trunking. The cables will be terminated at control panels and devices with seals, glands and shrouds. Control panel and devices will be of the types detailed on drawings. On completion the system will be tested and commissioned in accordance with BS 5839-1: 2013 and certification documentation and logbook provided.

11.14 Air Conditioning

The units have been selected based on heat load calculations to meet the requirements of comfort conditions within the required space with an air change rate of 1.5 times per hour in office areas.

Air conditioning units installed at high level on an internal wall with the condensing unit being fixed outside the building located on a concrete base.

The installation would comprise all interconnecting refrigerant pipe work, all gravity drain condensate pipe work, all associated pipe work bracketing and interconnecting control wiring.

The installation of the refrigerant pipe work would be carried out in refrigerant quality copper tube being insulated with Class 'O' insulation. Pipe work would run outside the building clipped to the external wall and on completion would be pressure tested to 1.5 times maximum working pressure, then evacuated and charged with ozone friendly R410A refrigerant.

Condensate pipe work would be run in rigid plastic to the nearest drainage point at ground level adjacent to the condensing unit.

As the 230 volt power requirement for the indoor units is derived from the outdoor condensing units we have included for all interconnecting power and control wiring. The power wiring to the outdoor unit will be from local mains isolator mounted within 1 metre of the outdoor unit location.

Wiring between the outdoor and indoor units will be run in flexible multi-core cable clipped with refrigerant pipe work. The installation would be carried out in accordance with the IEE regulations latest edition.

For air conditioning systems to maintain their optimum performance they need to be regularly inspected and maintained to the manufacturer's instructions. Good practice is for an inspection and cleaning procedure to be carried out and recorded every 6 months.

11.15 Plumbing

The plumbing installation consists of plastic feed pipes of suitable diameter, with push fit fittings as appropriate. The supply pipe is fitted with a stopcock, pressure reducing valve, drain off valve and a double check valve with a pipe tail terminating outside the building, ready for connection to the mains by others. All fittings shall be WRAS approved

Waste pipes and traps are in PVC and are carried to one or more outlets through the wall, ready to be connected to onsite drainage by others. All penetrations through the walls are sealed with intumescent sealant (refer to Section 1.11). Air admittance values are fitted where necessary. It is assumed that the surrounding drains are openly vented.

All pipe work is surface mounted and left exposed and unpainted.

12. Maintenance

The building should be maintained in accordance with the Operation and Maintenance manual, which will be issued on handover.

13. Durability

The main structural framework of the system is assessed as capable of achieving a design life of 25 years. The standard 'lacquer coated' steel finish has a predicted service life of up to 20 years to first repaint

Foot traffic over the roof should be restricted to the purpose of maintenance and suitable precautions taken to avoid the risk of damaging the 'lacquer coated' steel coating. Appropriate risk assessments and safe working arrangements must be developed and implemented for any operations involving work at height.

14. Re-use and Recyclability

The system's steel components can be readily recycled. In addition, buildings can be dismantled, removed from their location, refurbished and re-sited.

Installation

15. General

The ELM Building System must be erected with due regard to any boundary conditions and site specific fire risk assessments (see Section 6).

Erection is carried out by the Elliott or their appointed agents who have received product specific training and follow approved techniques and processes. No unauthorised alterations must be carried out without express permission of Elliott.

All necessary health and safety procedures must be observed and strictly adhered to.

16. Site Preparation

16.1 Site Investigation

A full review of the prevailing site conditions in respect to site preparation and resistance to contaminate shall be carried out by the main contractor responsible for foundation design and installation in order to satisfy the requirements of Approved Document C of the Building Regulations.

A site investigation should be carried out by an appropriately qualified and experienced individual to determine the maximum bearing pressure of the substrate and selecting a suitable foundation design.

16.2 Substructure Design

Elliott will provide a site specific load cell to illustrate the required foundation centres and imposed loadings. Unless specifically itemised within Elliott's offer the Client is responsible for all site investigations, site preparation and sub structure design

The size and type of foundation will depend on the bearing capacity of the ground and the conditions prevailing on site. It is important that the building foundations are capable of withstanding the full loads of the building, including all imposed loading and wind loading. This will generally involve the placement of concrete foundations, and competent professional advice should be sought that adequate provisions are made.

16.3 Drainage

In preparing the site for erection of the building, adequate drainage must be provided, to prevent water collecting beneath or against the building structure. For example, flower beds should not be positioned so that loose soil can become banked against the building perimeter.

Rainwater is discharged via downpipes and positions are shown on the drawing.

16.4 Setting-Out Tolerance

The minimum depth from the top of foundation pad / support pier to ground is to be no less than 150mm.

Overall variation in finished levels to be less than $\pm 3\text{mm}$

Tolerances on foundation positions to be $\pm 10\text{mm}$ from datum.

17. Installation Procedure

The modules are placed by crane by Elliott on prepared foundations using purpose-designed lifting points incorporated in the steel frame. Access to the site is required for the crane and this requirement will be agreed with the client.

A suitably rated mobile crane is set up on site and under the direction of an Approved Person the modules are lifted onto the prepared foundation pads using the same omni-direction lift eyes. Where appropriate the modules are shimmed with steel packers to provide a level floor.

A specific pre-defined building erection sequence is used to ensure correct location of each building module within the building. The ground floor module must be carefully positioned and secured with fixings where specified.

Modules are bolted together at the four steel column points. Connection details (e.g. fixings, sealing strips, wall ties, external walls, cavity barriers/fire stops) are completed ensuring that all horizontal and vertical joints are correct and free from damage.

Once the modules are installed roof weatherproofing at junction between modules, internal lining and trim finishes, and external finishes over joints are completed on site.

18. Demolition and Removal

Relocation of the modular building shall be performed in the reverse of the installation procedure described above. Prior to lifting of the modules the lifting eyes and structural elements must be inspected by a competent person to ensure condition and suitability for lifting. Specialist contractors with relevant experience in relocation of modular buildings must be employed.

The building **shall not** be removed, altered or demolished without written authority from Elliott.

19. Construction (Design and Management) Regulations 2015

Projects undertaken in the UK are subject to the requirements of the Construction (Design and Management) Regulations 2015 (CDM 2015), the objective of which is to ensure that health and safety issues are properly considered during a project's design and development so that the risk of harm to those who have to construct, use and maintain the building is reduced

As a designer, in accordance with regulation 9 of the CDM regulations, Elliott have taken into account the general principals of prevention in the preparation of this specification and where reasonably practicable, have eliminated, minimised and/or controlled foreseeable hazards associated with the design.

Where elimination hasn't been reasonably practicable, Elliott is required to provide 'pre-construction' information in respect of any significant and/or unusual project-specific hazards that remain.

19.1 Principal Designer

The principal designer manages health and safety in the pre-construction phase of a project. The role extends to the construction phase through the principal designer's duties to liaise with the principal contractor and ongoing design work.

The client is obliged to appoint a principal designer on projects where there is more than one contractor. If the client fails to appoint a principal designer formally, the client itself will become the principal designer.

19.2 Designer

A designer is an organisation or individual whose business involves preparing or modifying designs for construction projects, or arranging for, or instructing, others to do this. Designs include drawings, design details, specifications, bills of quantity and design calculations.

Elliott will undertake the role of Designer unless otherwise instructed in writing and will provide design information to the principal designer for inclusion in the pre-construction information and the health and safety file.

19.3 Principal Contractor

The principal contractor manages the construction phase of a project. This involves liaising with the client and principal designer throughout the project, including during the pre-construction phase.

Unless formally appointed Elliott shall adopt the role of Contractor.

19.4 Contractor

A contractor is anyone who directly employs or engages construction workers or manages construction work. Contractors include sub-contractors, any individual self-employed worker or business that carries out, manages or controls construction work.

Elliott will undertake the role of Contractor unless otherwise instructed in writing. Elliott will plan and manage their works in strict accordance with the requirements of the Client appointed Principal Contractor.