Glossary of Terms 2018

Offsite residential construction

Acknowledgements

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The editors acknowledge the input of many construction experts, practitioners, and the Buildoffsite Direction Group in the development of this glossary. The details of contributors are available from Buildoffsite: **info@buildoffsite.com**

Other contributors

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Introduction to offsite and Modern Methods of Construction (MMC)

Offsite is a term used to describe the spectrum of applications where buildings, structures or parts are manufactured and assembled remote from the building site prior to installation in their final position. In other words, moving operations that are traditionally completed onsite to a manufacturing environment. The offsite spectrum is extensive and, currently, the sector is diverse and fragmented.

Various reports have been produced for the different sub-sectors, in particular residential. These reports all use their own terminology, which is often mutually exclusive. This glossary provides an authoritative cross-sectoral perspective.

To maximise the benefits from offsite it is essential to adopt a manufacturing rather than a construction philosophy and process. Ad hoc application of offsite technologies will only bring limited benefits.

A useful generic categorisation (Gibb, 1999) considers the spectrum in terms of the following:

1 ***Component subassembly***

- relatively small scale items that are invariably assembled offsite, eg light fittings, windows, door furniture.

2 ***Non-volumetric pre-assembly***

- a large category covering items where the designer has chosen to assemble in a factory before installation
- units do not enclose usable space
- applications may be skeletal, planar or complex, eg panel systems, cladding panels, above ceiling service modules.

3 ***Volumetric pre-assembly***

- units that enclose usable space and are then installed within or onto a building or structure
- typically fully finished internally, eg toilet/bathroom pods, plant rooms.

4 ***Complete buildings***

- units that enclose usable space and actually form part of the completed building or structure (units may or may not incorporate modular co-ordinated dimensions)
- typically fully factory finished internally (and possibly also externally), eg edge of town hotel or restaurant facilities, multi-residence housing.

This spectrum is useful in identifying the increasing impact of the chosen solution on the project process.

It is important to recognise that offsite applications should be considered for each project. It is simplistic to assume that Level 4 will always be the best solution for all projects, although it clearly offers the greatest extent of offsite.

Currently the offsite sector is both disparate and diverse. Some technologies are mature (eg structural steelwork or pre-cast concrete) and some technologies are only suitable for certain application sectors, eg SIPs panels are designed for low to medium rise residential applications.

Also, a particular project may benefit from several different offsite applications for example structural frame, cladding units, multi-service modules and volumetric toilet pods. The important issue in this case is the design and management of the interfaces between systems.

Offsite is applicable across all construction sectors and both terminology and categorisation vary between sectors.

Introduction to the offsite and MMC glossary

This glossary describes commonly used terms for various offsite operations to aid understanding of those who wish to use offsite applications. These have been listed in alphabetical order along with a brief description. Where a number of terms relate to a generic item they have been grouped together (eg pods). Some terms relate to offsite as a whole and some to particular applications with different materials, technologies or market sectors.

It should be noted that these terms are frequently used outside of their precise definition. So it is important to understand how these terms are used in relation to particular products, systems or approaches.

Sources for glossary terms and acknowledgements are listed at the end of this document.

A

Advanced Panel Timber Frame

See *Frames*.

Aesthetics

Offsite has historically been accused of producing poor aesthetic design. However, there are many examples that negate this accusation. It is not an impediment to design excellence.

Delight from an aesthetic and performance perspective is a matter of design quality. Using an offsite process facilitates making an excellent design into an excellent end-product.

Air Handling Unit (pre-wired) (AHU)

Packaged air handling unit fully tested, pre-wired packaged unit complete with integral refrigeration components and controls.

B

Bathroom Pod

See *Pod*.

Beam and Block Floor

Extruded or wetcast prestressed beams between 150 mm and 225 mm deep, spaced to suit the applied loading and spans, together with blocks of various types. These may be purpose-made blocks with rebates to suit the shape of the beams (‘tray blocks’) or may be standard concrete masonry blocks which have been tested and certified for use in floors. Also commonly used are specially shaped extruded or expanded polystyrene blocks, which provide a high degree of insulation for ground floors.

Beam and Column Frame

See *Frame*.

Buildoffsite Property Assurance Scheme (BOPAS)

BOPAS incorporates assurance and insurance as a means of mitigating many of the perceived risks to which the lending community and other key stakeholders in the residential market are exposed, in relation to offsite construction systems and techniques. The scheme incorporates

an assessment against best practice of manufacturing and construction systems, construction system integrity and durability. It is supported by a national database of residential properties assured under the scheme, and can be readily accessed by valuers to support informed and accurate valuations.

Brick Slips

Commonly used on offsite manufactured external walls to replicate the appearance of conventional brickwork, or on existing homes when upgrading thermal performance. Brick slips are generally 20 mm thick compared with a 100 mm standard brick. The slips are fixed with glue to the metal or plastic frame of an external wall panel.

Building Information Modelling (BIM)

BIM is used to generate and manage data throughout the entire life cycle of the building, from inception, design, through construction to demolition and recycling. Models are created that contain not only the building geometry, but are data-rich in terms of relations, physical attributes, time, costs and quantities. The result is a collaborative tool that can be used by the whole project team, clients and end users. Benefits include a significant reduction in risk through improved co-ordination, control and flow of information, improved accuracy of cost and programme planning, increased productivity, efficiency and predictability because of managing teams and data centrally and reduced rework on site.

Building Module

Self-contained volumetric element of building, typically room-sized, that has its own superstructure and is manufactured offsite. It is attached to or placed inside the main building structure and is typically used to house plant and services, washrooms and for similar relatively complex purposes. An alternative term for ‘pod’, but sometimes used to describe units that make up the whole building.

See *Box Construction, Modular Construction, Modular Volumetric Systems, Pod, Portable Buildings, Portable Accommodation, Prefabricated Buildings and Volumetric Building Modules.*

Buildoffsite

An alliance of clients, developers, contractors, manufacturers, suppliers, government, advisors and researchers forming an industry-wide campaigning organisation that promotes and helps enable the greater use of offsite techniques by UK construction.

Buildoffsite Registration Scheme

This scheme is operated by Lloyds Register EMEA and is a risk-based assessment scheme that focuses on process and has been developed specifically for offsite-manufactured systems. The accreditation demonstrates the application of best practice in the manufacture and construction of offsite systems and provides the assurance of predictability of system performance.

Building Services Offsite Applications

The use of offsite for building services is currently an under-used application.

See *Air Handling Unit, Cable Containment, Ceiling Void Module, Chiller Beam Assembly, Combined and Single Service Horizontal Rack, Condensing Unit, Dressed Product, Heating Pod, Heavy-Duty Services Module, Integrated Plumbing System IPS, Light and Air Diffuser, Modular Wiring, Multi-Purpose Riser, Plant Room Module, Pod, Skids, Valve Assembly, Wiring Loom.*

Building System

Any pre-engineered method of building that has a pre-defined scope and configuration limits. Building systems can be volumetric, panel, stick build or hybrid. See *System*.

C

Cable Containment (pre-assembled)

A cable system incorporating pre-assembled bracketry. Brackets supplied complete with pre-assembled spring nuts and bolts. Systems vary and can include:

- both bolted and welded forms
- trapezes and other non-standard bracketry
- fixing rails, cantilever arms and various accessories.

Case Studies

Buildoffsite maintains a database of case studies that demonstrate a wide range of real world illustrations of the use of offsite construction solutions to deliver project and business objectives. These are also available from several other sources including the Construction Leadership Council (CLC). The case studies cover a wide range of project applications in the building and civil engineering sectors. In addition *Buildoffsite* and CLC are compiling a set of case studies provided by individual member organisations describing the practical benefits that have been delivered. In each example the project is assessed against a template that includes cost, time, quality, health and safety, and sustainability. Where possible the case studies also provide quantified benefits from using offsite solutions.

Case studies are available at: **https://www.buildoffsite.com/outputs/publications**

Ceiling Void Modules

See *Combined and Single Service Horizontal Rack.*

Chimney (prefabricated)

The factory production of chimneys (mainly for individual residential units). *In situ* chimneys are a particular problem for consistency of performance and quality, for example in terms of insulation.

Closed Panel Systems

See *System* or *Panel.*

Combined Pod

Follows a typical bathroom pod technique, but combines a factory-finished bathroom with a pre-serviced kitchen, airing cupboard/hot water cylinder or boiler plant with building monitoring systems (BMS) etc.

See *Pods*.

Combined and Single Service Horizontal Rack (or Ceiling Void Module)

Integrated ductwork with pipe work and cable management support trays into a multi-services module mounted in the ceiling or under the floor. Usually constructed as an open frame structure, which reduces the overall weight of each section.

Horizontal distribution has been in use for many years, but more recently mechanical ducting or pipework systems/modules are usually combined with electrical service distribution. Often ‘supply and fit’, these systems are fully manufactured offsite in factory conditions. While the pipework or ducting can be tested in the factory the system once connected must be system-tested and commissioned onsite. Modules should be constructed to give ease of access in the long-term.

Examples have shown that two operatives can install over 90 m of pipework and over 45 m of cabling support in one day.

Component

A term used loosely for items that are manufactured offsite and then assembled together with other components. If this is completed offsite then the product is defined as a whole. If this is carried out onsite then it falls into Category 1 (see **page 3**) Careful design of components and their interfaces is crucial for effective manufacture and assembly.

Composite Construction

A generic term covering a wide variety of construction techniques, particularly where two different materials are used in combination to fulfil a specific function. For example, composite floor slabs can comprise *in situ* concrete with profiled metal decking, which acts as structural reinforcement. These slabs are supported on hot-rolled steel beams. Often, the beams are composite themselves, using shear connectors (normally welded headed studs) to achieve structural interaction with the slab. This form of construction is extremely structurally efficient with good spanning capability. Composite construction can also use pre-cast concrete slabs with a composite structural screed.

See *Hybrid Construction*.

Concrete Tunnel Form

This is an onsite construction method using *in situ* concrete poured into two half-tunnels to form the walls and ceiling of a room producing a monolithic structure. When this process is repeated, generally on a 24hr cycle, residential units can be created with great rapidity. This is a fast-track method of construction that is suitable for repetitive cellular projects.

Condensing Unit (pre-assembled)

The part of a refrigerating mechanism that pumps vaporised refrigerant from the evaporator, compresses it, liquifies it in the condenser and returns it to the refrigerant control.

Pre-assembled condensing units have components factory mounted to ensure minimum onsite installation. Units leave the factory with lines pre-charged ready to install with quick connect fittings. Control panels are factory pre-wired with a single connection point.

Configuration

Interrelated functional and physical characteristics of a product defined in product configuration information.

Configuration Item

An entity within a configuration.

Configuration Management

Co-ordinated activities to direct and control a configuration (see ISO 10007:2003).

Cross Wall Construction

Multi-storey structure where the walls are designed as the means of primary support. Longitudinal stability is achieved by external wall panels and/or diaphragm action involving the floors and roof, connected back to lift cores or staircases, which may also be formed by pre-cast wall panels or shaft units.

D

Domestic Energy Centre

Modular unit to satisfy the complete hot and cold water and electrical requirements for an apartment, gas or electrical heating.

Dressed Product (pre-assembled)

A generic term applying to factory pre-assembled products (usually building services) that would otherwise be assembled onsite. For example a hand basin fitted with taps and waste.

Design for Manufacture and Assembly (DFMA)

In the construction industry, DFMA involves improving quality through the application of efficiency.

Finding the most efficient way of delivering a project reduces the resources required (whether this is measured in cost, time, carbon, waste or labour) while increasing positive aspects such as health and safety, quality, certainty. A DFMA solution can be achieved to a higher quality at lower cost and in less time.

DFMA takes many forms, but the common factor is the application of factory (or factory-like) conditions to construction projects.

A DFMA solution starts by understanding the end product and draws upon the range of suppliers and systems available. Varying degrees of 'granularity' can be added according to the project requirements. Volumetric solutions create as much of the finished product as possible in the factory, with on-site labour minimised. 'Flat pack' or panelised create a kit of parts that can be quickly assembled on site. Often prefabricated sub-assemblies are deployed along with more traditional build elements.

For some situations, traditional build elements may be used, but the site is effectively turned into a factory. Pre-packed 'fit out kits' are delivered to the work face with everything needed for the work. Waste is virtually eliminated, along with the most common causes of delay on site, ie lack of materials, follow-on trades and reworking.

DFMA also allows for buildings to be deconstructed more safely, with components or even entire buildings able to be reconfigured or redeployed elsewhere. This is the ultimate form of sustainable construction.

See *Circular Construction*.

E

Element

Part of a building or structure that could be considered for standardisation and offsite production such as foundations, structural frame, envelope, services, internals and modular units.

Elemental Cost Evaluation

Also called 'analysis as it is typically used in construction via standard methods of measurement, but it may overlook many of the benefits available from offsite.

Envelope

The external walls and roof that form the perimeter or enclosure of a building. Roofing includes flat or pitched roofs. The extent of offsite manufacture will vary between systems:

- stick system – components all assembled onsite
- unitised – components pre-assembled offsite into storey height, ~1 m wide panels
- panelised – components pre-assembled offsite into storey height, bay-width panels.

F

Factory Engineered Concrete (FEC)

Applies to pre-cast concrete elements of a structure. This includes wall and floor elements, ceilings, staircases, columns and beams. Also, FEC elements can include building service containment routes, window and door openings and possibly thermal insulation.

Fast Build Concrete Retaining Wall

Freestanding units of pre-cast reinforced concrete, designed to provide efficient and versatile bulk storage and temporary or permanent earth retaining.

Field Factory

A factory facility set up near to the construction site, usually to reduce the need for long distance transportation of pre-assembled products. Particularly relevant for large scale, often civil engineering or infrastructure projects such as airports or bridges.

Flying Factory

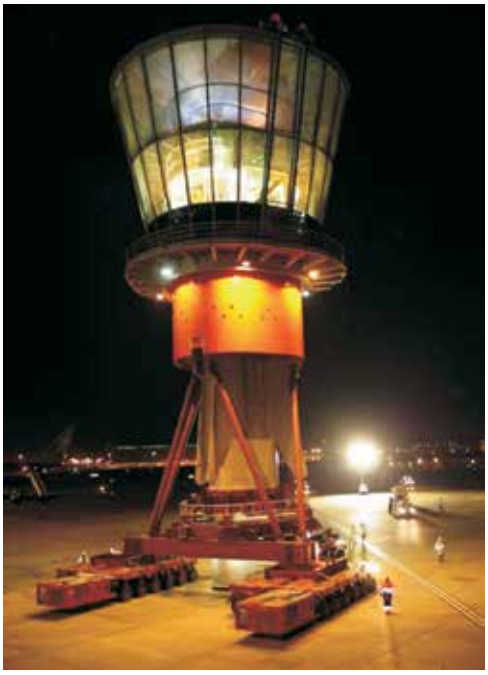
As *Field Factory*, but generally for a short duration.

Failure Modes and Effect Analysis (FMEA)

A design tool used in product development and sometimes in offsite. Similar to project risk management but applied to products.

Flat Pack

Prefabricated elements or systems that are transported to site as 2D elements, rather than in 3D volumetric form. These can be used where volumetric options are not feasible.



Floor Cassette

A factory-manufactured panel comprising a series of floor joists joined together with trimmers or end-joists to form a load-bearing element of floor construction. Generally used for residential or low to medium-rise buildings and usually steel or timber.

Flat Slab

While not part of the offsite spectrum, flat slabs are included in The Concrete Centre's (2018) definition of modern methods of construction (MMC). Flat slabs are built quicker than traditional methods due to modern formwork being simplified and minimised and a combination of early striking and flying formwork systems. Use of prefabricated services can be maximised because of the uninterrupted service zones beneath the floor slab and there are no restrictions on the positioning of horizontal services and partitions.

Foundation (Fast Track)

Pre-cast concrete systems can be used to construct foundations rapidly. The elements are usually to a bespoke design and cast in a factory environment.

These systems improve productivity, especially in adverse weather conditions, and reduce the amount of excavation required – particularly advantageous when dealing with contaminated ground.

Offsite foundation techniques also include steel mini piles and helical screw piles.

Frame and Framing Systems

The term ‘frame’ typically refers to the structure of a building and may be constructed from many different materials. Also, the term may be used to describe the supporting structure for a pod or other volumetric unit.

This section includes descriptions for several terms related to frames and framing.

Light Gauge Steel Frame (LGSF)/Light Steel Frame (LSF)

Structural panels assembled from cold formed galvanised steel sections. They are normally factory assembled but field factories can be used. Light steel framing is typically used for the primary structure of housing and low to medium rise buildings of two to four storeys. For taller buildings it can be complemented by the use of hot-rolled members at key locations.

Open (Cell) Panel Timber Frame

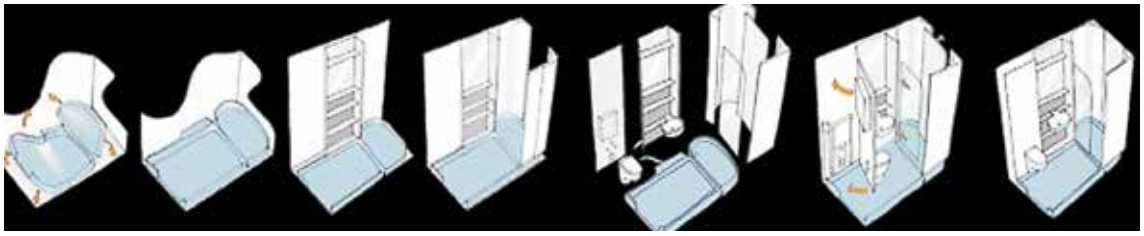
Structural timber panels forming the inner load-bearing leaf of the cavity wall which are manufactured in factory conditions, brought to the site and fixed together to form a rigid load-bearing superstructure. These consist of timber studs and beams, stiffened on one side with wood-based panels, such as oriented strand board, or plasterboard. The lining of the second side of the building component, and the application of insulation and other features, usually happens onsite. Open cell timber frame is currently the conventional form of timber frame in the UK and is often referred to as *Timber Frame*.

Advanced Panel Timber Frame

This generic term covers the latest developments in conventional panelised timber frame. Advanced panel timber frame is a factory-manufactured timber-stud constructed frame with sheathing in the conventional timber frame manner. Manufacturers fit rigid insulation between the studs and prefinished windows and external doors in the panel before dispatch to site.

Frame Mounted

Term used to describe units mounted on a frame or other supporting structure, used either for transportation, final support or both.



Pre-cast Concrete Frame

Structural frame using pre-cast concrete columns and beams, and/or panels. These may be factory finished internally or externally and may remain exposed in the final building. The extent of onsite work may vary significantly between projects. Members may be single columns or beams with factory-made connections, or the members may be pre-assembled into larger sections, either offsite or at low level adjacent to the works. Pre-cast concrete may be used together with *in situ* concrete or structural steel as part of a hybrid frame.

Steel Frame Building Systems

Building systems that use steel as the primary structural material. In domestic scale construction they are generally formed from light steel framing.

For larger buildings hot rolled sections are used in pre-engineered buildings. Typically, such frames need site-applied finishes although fire protection may be applied in the factory and in certain circumstances exposed columns may appear in the final building. Elements may be single columns or beams with factory-made connections, or the members may be pre-assembled into larger sections, either offsite or at low level near to the works. Structural steel may be used together with *in situ* or pre-cast concrete as part of a hybrid frame.

G

Glued Masonry Panels

A technique comprising panels of lightweight concrete blocks with glued joints fabricated offsite and crane lifted into position onsite.

H

Health and Safety

It is recognised that levels of safety in a factory environment are higher than they are on a traditional construction site. In a factory potential hazards are more readily identified and procedures and equipment introduced to avoid the risk of accidents in the first place. Materials can be delivered to a designated place near the point of manufacture on a just

in time basis whereas on a traditional construction site it is still common place for materials to be stored on site and then having to be repeatedly moved to suit progress. Having a fixed point of work as in a factory will inevitably ensure safer practices.

The use of offsite components and assemblies on site requires prior consideration of all relevant factors including assessing and eliminating the risk of accidents. The simple fact that the use of offsite methods usually means that fewer but more specialist workers will be present on site will also tend to reduce the likelihood of accidents.

A significant number of serious accidents arise from falls from height. Early regard to DFMA using offsite construction solutions can serve to minimise and even eliminate the need for scaffolding.

Heating Pod

A 'mini-plant room', typically fully commissioned and 'ready to go', with modular boiler plant. The smaller units can be wall mounted, whereas the larger units are rig or floor mounted.

See *Pod*.

Heavy Duty Services Module

Volumetric services pre-assembly for vertical risers or horizontal distribution. They may contain pipework, ductwork and electrical elements.

Hollowcore Floor

Prestressed, pre-cast concrete slab units that derive their name from the voids or cores which run through the units. The cores can function as service ducts and significantly reduce the self-weight of the slabs, maximising structural efficiency. Units are generally available in standard 1200 mm widths and in depths from 110 mm to 400 mm.

Hot Rolled Steel

Used in the form of beams, channels, angles and plate, the elements are fabricated in the factory with attachments and connections for ease of site erection. Also, offsite processes provide facilities for services and add fire protection.

Hybrid

A term describing something that is a combination of more than one discrete system or material. This term, in the context of offsite should not be confused with its use to describe the combination of structural steel and concrete in the frame of a building or structure.

Hybrid Building System

A combination of volumetric and panelised systems where the high value areas (kitchen and bathroom) are typically formed from volumetric units (sometimes referred to as *pods*) and the rest of the structure formed from some form of framing system (also known as *semi-volumetric*).

Hybrid Concrete Construction (HCC)

HCC combines pre-cast and cast *in situ* construction.

I

Industrialised Building

A lesser used term for offsite in the UK, but more common internationally.

Insulated Concrete Formwork (ICF)

An onsite innovation, ICF is a building system made from inter-locking hollow polystyrene elements that act as permanent formwork as well as permanent insulation. *In situ* concrete is then poured into the polystyrene formwork.

See *Permanent Insulated Concrete Formwork (PIF)*.

Integrated Plumbing System (IPS)

Wash hand basins, WCs assembled offsite into 'units' with a range of backboards, showers, baths, taps etc. Most units are designed to be removed and replaced with new units once they have reached the end of their serviceable life.

Integrated Supply Chain

See *Supply Chain Integration*.

Interc Lean

This term is used in many ways, but it is mainly concerned with the identification of value from a customer's perspective (and only providing that), eliminating waste in all forms and creating an efficient flow of work based upon the next customer in the chain.

The application of Lean is accepted in most manufacturing industries. The results are evident in the step-change in product value and the improvements in product quality.

Lift Shaft (prefabricated)

Containment for lifts and sometimes also bracing for structural frames. They are manufactured offsite, and often in pre-cast concrete or steel.

Light Gauge Steel Frame (LGSF)

Light Steel Frame (LSF)

See *Frame*.

Luminaires (pre-assembled)

Multi-service luminaires' incorporating lighting, smoke detectors, sprinkler heads, PIR detectors, loud speakers and acoustic dampers.

M

Mass Customisation

The benefits of mass production are creatively combined with systems that offer greater

choice for the individual customer, improved control of the total construction process, and flexibility of assembly options. These are standard processes delivering flexible products.

Mass Production

The production of a large number of identical or very similar components to realise the benefits of economies of scale. This term was used commonly in the 1950s and 1960s, but is rarely used now with respect to offsite.

Modern Methods of Construction (MMC), Residential Use Categories

OSM – Volumetric

Volumetric construction involves the production of 3D units in controlled factory conditions before being transported to site. Volumetric units can be brought to site in a variety of forms ranging from a basic structure to one with all internal and external finishes and services installed, ready for assembly. A family-sized dwelling might typically be manufactured in four volumetric units plus roof units.

OSM – Panellised

Flat panel units are produced in a factory and assembled on-site to produce a 3D structure. The most common approach is to use open panels, or frames, which consist of a skeletal structure only, with services, insulation, external cladding and internal finishing occurring on-site. More complex panels (often known as closed panels) involve more factory-based fabrication and may include lining materials and insulation. These may also include services, windows, doors, internal wall finishes and external claddings. This category embraces newer panellised approaches such as structural insulated panels (SIPs), storey height aircrete panels, crosswall panellised construction and cross laminated timber (CLT) panels.

OSM – Hybrid

This method combines both panellised and volumetric approaches (often known as semi-volumetric). Typically, volumetric units (sometimes called pods) are used for the highly serviced and more repeatable areas such as kitchens and bathrooms, with the remainder of the dwelling or building constructed using panels. The hybrid approach is sometimes used to provide added flexibility on complex sites and those requiring additional communal areas. As with both volumetric and panellised approaches the degree of factory-based fabrication is variable.

See *OSM – Panellised.*

OSM – Sub-Assemblies and Components

This category is intended to encompass approaches that are not classified as systemic OSM, but use several factory fabricated innovative sub-assemblies or components in an otherwise traditionally-built structural fabric. Typically, schemes incorporating the use of small volumetric units such as pre-assembled bathrooms (often known as pods, see *Hybrid*), floor or roof cassettes, spandrel panels, pre-cast concrete foundation assemblies, pre-formed wiring looms,

mechanical engineering composites, pre-assembled facades etc would fall into this category. Cavity masonry constructed schemes using manufactured units, such as windows, door-sets, roof trusses etc that might otherwise be part of the fabrication process in the other OSM categories – should not be included as sub-assemblies or components in this category.

Non-OSM MMC

This category is intended to encompass schemes using innovative home building techniques and structural systems that fall outside the OSM categories. The presence of innovation is an important feature that might be apparent through an innovative non-OSM building system, through a building technique familiar in other sectors but new to house building, or in traditional components being combined in innovative ways. Typically, insulated concrete formwork (ICF), thin joint blocks and other innovative masonry or concrete approaches would fall within this category.

Modular Construction

Modular System

Modular Volumetric System

Modularisation

Module

These terms would imply a level of modular co-ordination. However, more commonly, they refer to volumetric building modules where the units form the structure of the building as well as enclosing useable space. The terms are also sometimes used to describe room modules, which do not incorporate their own superstructure. They are particularly popular for hotels and student residences due to the economies of scale available from many similar sized modules and the particular benefit of reduced site construction time.

See *Modular Co-ordination*.

Modular Co-ordination

The discipline of designing buildings and structures using a specific module (for example 100 mm) where all the elements and components are described as multiples of the module. To ensure fit and co-ordination.

Modular (Electrical) Wiring

A pre-assembled electrical cabling system, using pre-terminated electrical cables usually made up into looms or wiring harnesses to provide the electrical distribution system for all mains small power, lighting and appliances.

See *Wiring Looms*.

Multi-Purpose Riser

Multiple service vertical distribution module, constructed from primed or galvanised mild steel and incorporating appropriate building services that may be lagged (insulated). These modules can be connected offsite, but are often transported in 7.5 m lengths to avoid transportation problems. Modules can carry combined mechanical and electrical services but most manufacturers specialise in one or the other. The majority of the electrical risers are manufactured using a mesh or ladder system to allow easy distribution at floor levels in various directions. These systems are often bespoke in design and while the base structure may offer a level of standardisation the dimensions and carrying capacity will vary between projects.

N

Non-Volumetric Pre-assembly

Items that are pre-assembled, but 'non-volumetric' in that they do not enclose usable space.

O

Offsite Construction (OSC)

Offsite Manufacturing (OSM)

Offsite Production (OSP)

Largely interchangeable terms referring to the part of the construction process that is carried out away from the building site. This can be in a factory or sometimes in specially created temporary production facilities close to the construction site (or field factories). Common alternative spellings for offsite are off-site or off site.

Offsite Process

Offsite is a process rather than just a collection of technological solutions. The approach requires a change from a traditional building process towards a manufacturing one. This has implications for all parties involved.

Open (Cell) Panel Timber Frame

See *Frame*.

Open Panel System

See *System*.

P

Packaged Plant

Used to describe one or more items of mechanical and/or electrical plant that are combined (packaged) in the factory to form a transportable unit.

See *Plant Room Module (pre-assembled)*.

Panel

Describes a planar unit, typically manufactured offsite, which may have a structural as well as an enclosure function. Related terms are listed as follows.

Panel Building System

Comprising walls, floors and roofs in the form of flat pre-engineered panels that are erected onsite to form the box-like elements of the structure that then require various levels of finishing. This term applies to all different material types.

See *System*.

Pre-cast Flat Panel System

Floor and wall units are produced offsite in a factory and erected onsite, ideal for all repetitive cellular projects. Panels can include services, windows, doors and finishes. Building envelope panels with factory fitted insulation and decorative cladding can also be used as load-bearing elements.

See *System*.

Structurally Insulated Panels (SIPs)

This form of construction is used in panel building systems, typically in the residential sector. Structural sandwich panels often comprise a core of foam with plywood, oriented strand board (OSB) or cement-bonded particleboard skins, bonded together to form a one-piece structural, load-bearing panel. The cores of SIPs can be made from a number of materials, including moulded expanded polystyrene (EPS), extruded polystyrene (XPS), and urethane foam. Can be engineered and assembled to provide a structure that needs no frame or skeleton to support it.

Panelised

For social housing this is a Homes England MMC category where flat panel units are produced in a factory and assembled on site to produce a 3D structure. The most common approach is to use open panels, or frames, which consist of a skeletal structure only with services, insulation, external cladding and internal finishing occurring on site. More complex panels (or closed panels) involve factory-based fabrication and may include lining materials and insulation. These may also include services, windows, doors, internal wall finishes and external claddings. The term is also used more generally outside social housing.

See *Envelope*.

Permanent Insulated Concrete Formwork (PIF)

See *Insulated Concrete Formwork (ICF).*

Plant Room Module (pre-assembled)

Packaged or skid-mounted pre-assembled plant rooms prefinished in the factory, ready for direct connection to mains services onsite. Can include complete plant room areas including air handling units (AHUs), fans, chillers, boilers, pumps and pressurisation units, together with elements of the building envelope.

Pod

Prefabricated volumetric pod, fully factory finished internally complete with building services. Probably not completed externally, except for roof-mounted plant rooms which may include external cladding.

Types of pod include bathrooms, shower rooms, plant rooms, kitchens.

Pod framing or structure may be light steel frame (LSF) or rolled hollow section (RHS) steel, timber frame, pre-cast concrete or GRP (mainly for smaller pods).

Floors are typically suspended timber or concrete, tiled or finished as appropriate.

Ceilings and wall covering are typically plasterboard, except for glass-reinforced polyester (GRP)/pre-cast concrete where that is the pod build material, tiled or finished as appropriate.

Occasionally pods may be delivered as a flat-pack assemblies.

Portable Buildings and Portable Accommodation

These are volumetric prefabricated buildings that are designed so that they can be moved and relocated. They are frequently semi-permanent and have a relatively short life span of 20 to 30 years. Many are rented out.

Pre-assembly

The manufacture and assembly of a complex unit comprising several components before the unit is installed onsite. Offsite is a commonly-used term for construction of this type.

Pre-engineered

Standardisation of product allows the development of pre-engineering, which is a term occasionally used in offsite manufacturing circles. Often it means no more than the production of the drawings before the product is made by adapting or modifying drawings from a previous application of the system. The correct use of the term is where a product is fully engineered and can be described in a technical manual or catalogue, where it is fully detailed and programmed for manufacture, where it is fully costed and the price is available, and then it is pre-engineered.

For example, the manufacture of room modules begins with a 3D computer aided design (CAD) model, which details each component and ascribes a unique part number. This detailed model provides the bill of materials for each module and is then converted into computer aided manufacture (CAM) files. CAM files contain all of the data for the module, broken down into the subassemblies of walls, floor cassettes, ceiling cassettes etc. These files also contain all the machine codes that control the various stations on the automated assembly line. It is this link between the product and production equipment that provides the repeatable dimensional accuracy of a manufactured product when compared with other, more traditional methods of construction.

The term is used to distinguish between bespoke, prototype building (traditional) and factory manufacture, which by its very nature requires pre-design and proving before being incorporated into the works onsite.

Prefabrication and Prefabricated Building

This is a general term for the manufacture of entire buildings or parts of buildings offsite before their assembly onsite. Prefabricated buildings include both portable buildings and the various types of permanent building systems. Offsite is a commonly-used term for permanent buildings procured in this manner.

Pre-manufactured value

Smart construction places great emphasis on work carried out away from the site, known as pre-manufactured value. This results in a major improvement in the efficiency of the construction process, predictability of performance and outcomes, increased speed and greater certainty of project timetable and of project completion.

Process for Offsite Manufacture

See *Offsite Process*.

Pump Module (skid mounted)

Supplies pressurised water for heating and chilled water solutions.

R

R&D Tax Credits

Research and development (R&D) relief is a UK corporation tax relief that may reduce an organisation's tax bill (HRMC, 2007). The purpose is to incentivise UK businesses to invest in R&D in order to improve their products and services and to boost their competitiveness.

The UK Government is anxious that companies undertaking eligible R&D activities are taking maximum advantage of tax credit opportunities.

This is a specialist area of tax law and it can be helpful for companies to be able to call on specialist advice to ensure that they are claiming the maximum possible relief.

Risers (pre-assembled)

Pre-assembled electrical and/or mechanical vertical distribution modules designed either to be self-standing structures or fixed to walls. See *Multi-Purpose Riser.*

Roof Cassettes

A factory-manufactured panel similar to floor cassettes. For pitched roofs in residential applications they will usually be timber or steel-based SIPs spanning from eaves to ridge. They are supplied insulated and require no additional truss style support making them ideal for providing extra roof space in housing applications. They are also used in commercial situations.

S

Sandwich Cladding Panel

Cladding unit incorporating internal and external finishes and integral insulation. Pre-cast concrete and steel systems are typical.

Serviced Building Modules (prefabricated)

See *Building Module*.

Serviced Room Pods (prefabricated)

See *Pod*.

Serviced Vertical Riser (prefabricated)

See *Multi-Purpose Riser*.

Skeletal Frame

Generic term describing frame systems, typically supplied without insulation or finished panels.

Skids

Transportable frames for carrying standardised pre-assembled products, mainly building services, for example pump skids, boiler skids etc. This term is sometimes used for skid-mounted boiler etc.

S&P

Standardisation and pre-assembly.

Smart

Through a collection of techniques, processes and collaborative partnerships Smart construction is building design construction and operation that makes full use of digital technologies and industrialised manufacturing (offsite) techniques to improve productivity, minimise whole-life cost, improve sustainability and maximise user benefits.

Often referred to as MMC or expressed as pre-manufactured value it includes data management, new materials and new building techniques.

Standardisation

The extensive use of components, methods or processes in which there is regularity, repetition and a background of successful practice. This may include standard building products, standard forms of contract, standard details, design or specifications and standard processes, procedures or techniques. Also, it can mean generic, national, client, supplier or project standardisation.

Staircases (pre-assembled)

Stairs and stair and landing units fabricated offsite and typically pre-cast concrete or steel. Significant benefits from early access as well as no propping. Also, may be fully finished architectural staircases.

Steel Frame Building System

See *System* and *Frame*.

Steel Panelised System

See *Panel*.

Stick Build Systems

See *System*.

Structurally Insulated Panels (SIPs)

See *Panels*.

Subassemblies

Major building elements that are manufactured offsite, but do not form the primary structure of the building, for example cassette panels.

Supply Chain Integration (SCI)

SCI involves sub-sectors working co-operatively so that the collective effort will most effectively deliver the clients' requirements and avoid unnecessary work.

SCI is about adding value to the design and construction processes and improving time, cost, quality, safety and cost in use.

The role of SCI is becoming more important and needs a broad range of skills, and is likely to be characterised in terms of breadth of knowledge rather than reliance on depth. The use of software and interface protocols is becoming more common and is likely to become established practice in response to the use of Building Information Modelling (BIM).

It is critical for the project integrator to ensure the entire supply chain (including professionals) communicate as a single entity and understand the need to collectively manage and ensure cohesion at the interfaces between different functions.

Sustainability

Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. Sustainable construction needs to perform not against a single, financial bottom line but against this triple bottom line.

The use of offsite construction solutions has the potential to contribute to enhanced sustainability in the delivery of construction projects through enabling improvements in cost, time, quality, health and safety and the reduction in waste and carbon use in all its forms.

System

Applied to offsite, a system is any pre-engineered method of building that has a predefined scope and configuration limits. Building systems can use many different materials, or combinations of materials and can be volumetric, panel, stick build or hybrid.

System Building

Internationally this is typically used to describe open or closed building systems that invariably incorporate a significant amount of standardisation, either in components and/or dimensions. The term may also be used in a broader context.

See *System* and *Building System*.

Open Panel System

The construction of the structural frame for the building using panels assembled in the factory. Open panel systems of various materials are delivered to the site purely as a structural element with services, insulation, cladding and internal finishes installed *in situ*.

Closed Panel System

Similar to Open Panel Systems in that the structural elements of the building are delivered to the site in flat panels. However closed panel systems typically include more factory based fabrication such as lining materials and insulation and may even include cladding, internal finishes, services, doors and windows.

Steel Frame Building System

Stick-build systems that use steel as the primary structural material. It is common to hear the term light steel frame (LSF) which, in this context, refers to thin-gauge steel sections supplied as components or panelised elements.

Stick Build System

These consist of pre-engineered frame elements in steel, composites, and timber or pre-cast concrete that are typically bolted together onsite to erect a skeletal structure that is then enclosed and finished onsite.

T

Thin Joint Masonry

While not part of the offsite spectrum it is included in Homes England definition of MMC. It allows the depth of the mortar to be reduced from 10 mm to 3 mm or less, resulting in faster laying and improved productivity, particularly on long runs of walling. Construction speed can be further increased by around 13 per cent using large-format concrete blocks, which have a face size equivalent to two traditional concrete blocks. The mortar cures rapidly, achieving full bond strength within one to two hours, eliminating the problem of 'floating' and enabling more courses to be laid per day.

Thin Joint Masonry (pre-assembled)

The use of thin joint 'glued' blockwork pre-assembled offsite into panels that are then delivered to site and installed by crane in one operation. Panels may be single skin or cavity construction complete with insulation.

Tilt-up

Large pre-cast concrete wall panels cast horizontally onsite, usually face down on a previously completed floor slab immediately next to their final position. Once cured, panels are then tilted upright into position. Opportunities include cold stores, controlled environments, food, drug and clean rooms, firewalls, schools, prisons, warehouses and offices.

Timber Frame

See *Frame*.

Timber Frame Building Systems

See *Frame*.

Trussed Rafters

Typically used for pitched roofs on residential developments, trussed rafters, fabricated offsite from small section members have been in use for many years. Materials include timber and light-gauge steel plates.

V

Valve Assemblies (pre-assembled)

Valve assemblies prefabricated to individual specification, which reduce onsite installation time, site storage requirements and purchase orders.

Volumetric Building Modules and Systems

Volumetric Modular Construction

Volumetric Unit

These terms are usually used ro describe:

- volumetric units that enclose useable space, but are installed inside or on top of a building (ie pods)
- volumetric units that enclose useable space and are joined together onsite to form the whole building without the need for any extra support structure.

Units may be manufactured from many different materials including, steel, concrete and timber, with smaller pod units also available in GRP. Units are invariably fully finished internally in the factory with external finishes, often brickwork, applied onsite or sometimes also externally factory-finished.

W

Warranty Providers

Lenders and mortgage providers for new built houses or major home extensions commonly seek security against early failures in construction through a warranty provision or latent defect insurance.

There are a variety of warranty providers on the market offering varying levels of warranty duration and scope of cover.

Whole Wall Panels and Partitions

Traditionally the construction of internal walling systems has been an onsite construction process involving the adaptation and use of standard sized components to create walls of any size.

This is a flexible approach and is particularly suited to the needs of the refurbishment sector. However, the installation process can be time consuming, and may involve a considerable amount of manual handling.

Wiring Loom

A pre-assembled collection of cables and connectors

See *Modular Wiring*.

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