



S-DP6

# OFFSITE CONSTRUCTION

**TARGET AUDIENCE & DESCRIPTION:** This information is aimed at everyone in the construction supply chain, manufacturers, architects, contractors, housing associations, local authorities, health care trusts. It is intended to help with the decisions to be made when considering Offsite or MMC technologies for a project, and allow the reader to understand and make best use of the technical and practical benefits in doing so.

## 1. WHAT IS OFFSITE?

“All those elements of construction that involve the pre-assembly of a number of construction components, which would otherwise be traditionally incorporated in the works as separate components”

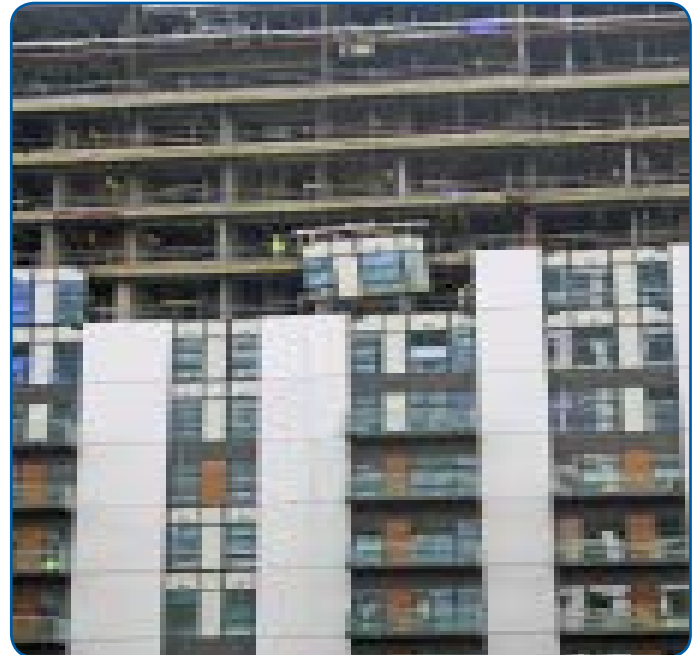
There are a number of abbreviations around the subject of Offsite:-

- OSC Offsite Construction
- OSM Offsite Manufacturing
- OSF Offsite Fabrication
- MMC Modern Methods of Construction

Offsite is a conveyor belt of systems, with new ones being added all the time, which become accepted as “traditional” as they are used more regularly. Examples of this would be roof trusses, door sets and fully finished windows.

## 2. SYSTEMS FALL INTO THE FOLLOWING CATEGORIES:

- **Volumetric Modular Construction**  
These are Volumetric modular units, which are transported to site as large building elements and then attached to an existing building linked together to form complete buildings.
- **Bathroom and Kitchen Pods**  
Fully finished rooms manufactured using concrete, steel and plasterboard, fibre-glass or a combination of these.
- **Light Steel Frame (LSF)**  
Structural panels assembled from cold-formed galvanised steel sections.
- **Timber Frame**  
Structural timber panels made up of timber studs and beams, stiffened on one side with oriented strand-board or plasterboard, which form the inner leaf of the cavity wall.
- **Structurally Insulated Panels (SIPS)**  
Structural sandwich panels comprising a core of insulation with plywood, strand-board or cement-bonded particleboard skins, bonded to form structural, load-bearing panels.
- **Insulated Concrete Formwork (ICF)**  
Hollow insulating elements similar to large Lego bricks, which act as permanent formwork and insulation. Concrete is then poured into the polystyrene framework.



- **Pre-cast Concrete**  
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.
- **Pre-engineered Mechanical & Electrical Services**  
Mechanical ducting or pipe-work systems combined with electrical service distribution. Preassembled plant rooms, integrated ductwork or pipe-work/ cables in a support tray.
- **Unitised (finished) Walling Systems**  
Diverse range of factory manufactured elements of external walling where the some or all of the assembly has been completed in a factory.
- **Pre-assembled Roofing Systems**  
Elements of the roof can be made in the factory and delivered to site to enable rapid installation of the roof structure complete with weather membrane and insulation.
- **Components**  
General term used loosely for individual items which are assembled together with other components where the finished assembly is defined as a whole.

**3. ADVANTAGES**

- Reduced construction time meaning early rental or sales income for the client.
- Higher Quality Finish. Working in a clean dry factory controlled environment is far more conducive to the production of quality than a traditional site. There will also be reduced damage from handling and storage on site
- Centralised control. Buying from one source reduces time and effort.
- Health & Safety. Safer than working on a construction site due to fewer people on site, reduction in working at height. Health & safety is also easier to control in a factory environment. (Manufacturing sector is six times safer than construction (HASPREST Research project, Loughborough university, 2004)
- Sustainability. Factory manufacture is inherently less wasteful than traditional forms of construction, and is thus inherently more sustainable, but specifically:
  - Factory material waste is typically less than 1.5% compared with 10+% on a traditional construction site and the recycling of waste is far more reliably controlled in a factory environment than it is on site.
  - Factory operatives are some 300% more efficient than the same activity carried out on site (government research)
  - A study on a 2008 modular housing project revealed that there were 90% fewer vehicle deliveries than would be expected on a comparable traditional build.
  - Government statistics show that the average distance a factory operative travels to work is 2 miles mostly using public transport. National average distance to work overall is 8.5 miles and this doesn't take into account travelling to site as a specific.
  - less packaging
- Less risk, the weather and potential avoidance of cost increases.
- Less construction disruption. Work on site is safer, quieter and cleaner. Potentially up to 90% fewer vehicle movements on site which is important in residential areas, hospitals or schools.
- Less demand on resources. On site for a shorter period and purchasing and invoicing are simpler.
- Potentially less design time. Modular buildings require fewer design resources, saving lead-in time and cutting costs for the contractor.
- Permanent Skilled Workforce.

**4. DISADVANTAGES**

Disadvantages of offsite, particularly if applied incorrectly or executed inappropriately include the following:

- Early decision making is required about the build method and the exact specification requirements.
- Greater level of coordination at the procurement stage is required to ensure that the offsite packages interface correctly with each other and with the traditional elements of build.
- When offsite does go wrong the consequences can be greater than with traditional construction which, over the years, has developed a million and one work arounds.
- Cost issues can be a red herring. Initial elemental costs may be more expensive but one has to take account of all the benefits Offsite offers and not just the cost of the materials. Other cost benefits include, cost certainty and reduced risk, reduced abortive work and defects, reduced prelims and site overheads, better quality resulting in reduced maintenance and reduced construction time which can result in cost benefit from earlier occupation.

**5. EXAMPLES OF OFFSITE APPLICATION**

Innovate Offsite, a guide to Offsite and how it is being made to work today, is available to download from <http://www.mtech-consult.com/magflip/Free%20Version/Default.html>. A hard copy is available by contacting Mtech direct.

A further collection of good examples of offsite construction across a range of market sectors may be found at [http://www.buildoffsite.org/pdf/Cameos\\_MAIN\\_DOC.pdf](http://www.buildoffsite.org/pdf/Cameos_MAIN_DOC.pdf)

**6. REGULATORY SIGNIFICANCE**

There are no regulatory requirements specific to offsite construction. The Buildoffsite Registration Scheme operated by the Lloyd's Register Group is a process based assessment scheme designed to benchmark offsite construction organisations against best practice in terms of competency, methodology and safety.

The scheme serves as the vehicle for the standardisation of best practice across the offsite industry. Information can be found at <http://www.buildoffsite.org/register.htm>

**6. WHERE CAN I FIND OUT MORE?**

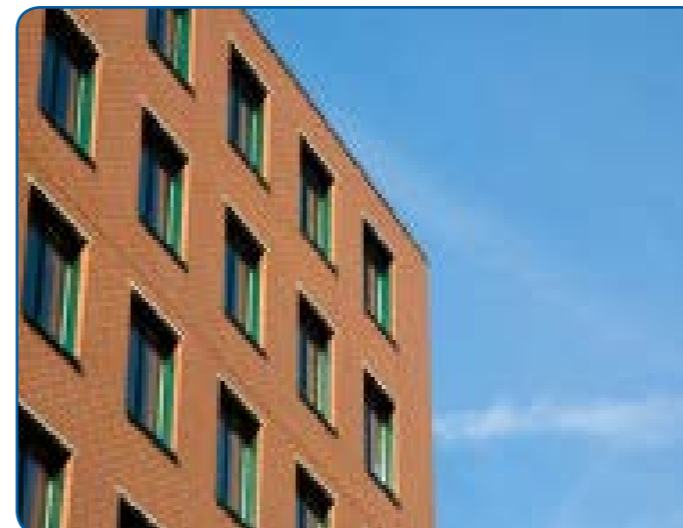
In 2005, Scottish Enterprise Glasgow commissioned work to provide basic information to allow Scottish manufacturers to assess their potential and consider business strategies for entering the UK construction industry with innovative construction solutions. The work was undertaken by the Mtech Group (see below), and led to the following reports:

1. Offsite Construction Market Investigation, August 2005
2. The Strategic Development of the Scottish Off-site Construction Industry, August 2005
3. OSC Manufacturer Data, August 2005
4. OSC Manufacturer Pie Chart, August 2005
5. OSC Manufacturer Summary, August 2005

Buildoffsite is an industry-wide campaigning organisation that promotes greater uptake of offsite techniques by UK construction. It is an alliance of clients, developers, designers, contractors, manufacturers, suppliers, government, advisors and researchers. Further information can be found at <http://www.buildoffsite.org>

A number of useful publications are available for free download from the Buildoffsite website. These include a glossary of commonly used terms for a wide range of offsite operations, viz [http://www.buildoffsite.org/pdf/BuildoffsiteglossaryV1.3revised\\_july06.pdf](http://www.buildoffsite.org/pdf/BuildoffsiteglossaryV1.3revised_july06.pdf)

ManuBuild is a large, European scale, industry-led collaborative research project on industrialised construction. The ManuBuild vision is of a future where customers will be able to purchase high quality, manufactured buildings having a high degree of design flexibility and at low cost compared to today.



For the first time, inspirational unconstrained building design will be combined with highly efficient industrialised production. ManuBuild targets a radical breakthrough from the current "craft and resource-based construction" to "Open Building Manufacturing", combining ultra-efficient (ambient) manufacturing in factories and on sites with an open system for products and components offering diversity of supply in the market. Information on ManuBuild may be found at <http://www.manubuild.net/>.

Buildoffsite and specialist consultancies such as Mtech provide a range of awareness and training events concerned with offsite construction, see <http://www.buildoffsite.org/events.htm> and <http://www.mtech-consult.com/events/> for details.

The ManuBuild network is developing ideas for a range of training programmes see <http://www.manubuild.net/>

The Scottish Construction Centre is planning a series of industry workshops to explore the strength of interest in a programme of work to help companies understand how they may gain from increased adoption of offsite construction techniques.

For further information, please contact the centre at

**enquiries@scocon.org / Tel: 0845 863 0026**

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## GENERAL OFFSITE CONSTRUCTION

No.	TITLE/DESCRIPTION	LINK/Reference
1	Egan, J (1998) Rethinking Construction: the report of the construction task force, The Office of the Deputy Prime Minister.	<a href="http://www.constructingexcellence.org.uk/resources/publications/deault.jsp">http://www.constructingexcellence.org.uk/resources/publications/deault.jsp</a>
2	National Audit Office (2001) Modernising Construction	<a href="http://www.constructingexcellence.org.uk/resourcecentre/publications">http://www.constructingexcellence.org.uk/resourcecentre/publications</a>
3	Off-site Construction Magazine, Formerly Prefabricated Building Systems Magazine, published by Commercial Publications Ltd.	<a href="http://www.oscmagazine.com/MediaPck.htm">http://www.oscmagazine.com/MediaPck.htm</a>

## HOUSING

No.	TITLE/DESCRIPTION	LINK/Reference
1	Parliamentary Office of Science and Technology (2003) Modern Methods of House Building, No. 209, December.	URL: <a href="http://www.parliament.uk/documents/upload/postpn209.pdf">http://www.parliament.uk/documents/upload/postpn209.pdf</a>
2	Venables, T., Barlow, J. & Gann, D. (2004) Manufacturing Excellence: UK capacity in offsite manufacturing, The Housing Forum, Innovation Studies Centre, Imperial College London.	<a href="http://www.constructingexcellence.org.uk/sectors/housingforum/publications.jsp">http://www.constructingexcellence.org.uk/sectors/housingforum/publications.jsp</a>

## LIGHT STEEL FRAME

No.	TITLE/DESCRIPTION	LINK/reference
1	Lawson, R.M., Grubb, P.J., Prewer, J. & Trebilcock, P.J. (1999) Modular Construction using Light Steel Framing: an architect's guide, Steel Construction Institute,	Publication P272, ISBN 1 85942 096 6.
2	Steel Construction Institute, Case Studies on Modular Steel Framing,	Publication P271, ISBN 1 85942 095 8.
3	Steel Construction Institute, Case studies on light steel framing Publication	

## VOLUMETRIC MODULAR

No.	TITLE/DESCRIPTION	LINK/Reference
1	Neale, R., Price, A. & Sher, W. (1993) Prefabricated modules in construction, Chartered Institute of Building (CIOB),	ISBN 1 85350 061 9.
2	The Housing Forum (2001), Modular construction for process efficiency and product quality, The Construction Best Practice Programme.	<a href="http://www.constructingexcellence.org.uk/sectors/housingforum">http://www.constructingexcellence.org.uk/sectors/housingforum</a>

## PRE-ASSEMBLY AND STANDARDISATION

No.	TITLE/DESCRIPTION	LINK/Reference
1	CIRIA (1999) Standardisation and pre-assembly – adding value to construction projects, Construction Industry Research and Information Association,	CIRIA Report No. 176, London.
2	Gibb, A.G.F. (2001) Standardisation and customisation in construction: a review of recent and current industry and research initiatives on standardisation and customisation in construction, CRISP Consultancy Commission – 00/20, May.	<a href="http://www.ncrisp.org.uk">http://www.ncrisp.org.uk</a>
3	Gibb, A.G.F. (2001) Pre-assembly in construction: a review of recent and current industry and research initiatives on pre-assembly in construction, CRISP Consultancy Commission – 00/19, May.	<a href="http://www.ncrisp.org.uk">http://www.ncrisp.org.uk</a>

## MECHANICAL &amp; ELECTRICAL SERVICES

No.	TITLE/DESCRIPTION	LINK/Reference
1	Wilson, D.G., Smith, M.H. & Deal J. (1998) Prefabrication & Pre-assembly: applying the techniques to building engineering services, BSRIA,	ISBN 0860225054

## ACADEMIC JOURNAL PAPERS

No.	TITLE/DESCRIPTION	LINK/Reference
1	Gann, D. (1996) Construction as a manufacturing process? Similarities and differences between industrialized housing and car production in Japan, Construction Management & Economics, Volume 14 (5), 437-450.	
2	Gibb, A.G.F. (2001) Standardization and pre-assembly-distinguishing myth from reality using case study research, Construction Management & Economics, Volume 19 (3), 307-315.	
3	Pasquire, C L & Gibb, A.G.F. (2002) Considerations for assessing the benefits of standardisation and pre-assembly in construction, Journal of Financial Management of Property and Construction, Vol. 7 (3),	ISSN 1366-4387.

## BOOKS TO PURCHASE:

No.	TITLE/DESCRIPTION	LINK/Reference
1	Goffin, K. & Rick Mitchell (2005) Innovation Management: strategy and implementation using the pentathlon framework, Palgrave MacMillan.	ISBN: 1-4039-1260-2
2	Hvam, L., Mortensen, N.H. & Riis, J. (2008) Product Customization, Springer. (Want to know how to standardise and mass-customise, tell your clients all about this when they are planning their social housing, private dwelling designs or apartment types - when the market picks up again!)	ISBN: 978-3-540-71449-1
3	Ortiz, C.A. (2006) Kaizen Assembly - Designing, Constructing and Managing a Lean Assembly Line, Taylor & Francis. (How all sites/factories should be run - essential reading on how to practically implement Kaizen)	ISBN: 0-8493-7187-2
4	Myers, D (2008) Construction Economics - a new approach, 2nd Edition, Taylor & Francis. (If you want to know about the economics of OSC, then read Chpt 9 p154 'Offsite Construction Methods')	ISBN:0-415-46229-0

## FURTHER INTERNET LINKS

No.	TITLE/DESCRIPTION	LINK/Reference
1	Mtech Consult Ltd	<a href="http://www.mtech-consult.com">http://www.mtech-consult.com</a>
2	Building Research Establishment	<a href="http://www.bre.co.uk/">http://www.bre.co.uk/</a>
3	Building Services Research and Information Association	<a href="http://www.bsria.co.uk/">http://www.bsria.co.uk/</a>
4	Constructing Excellence	<a href="http://www.constructingexcellence.org.uk/">http://www.constructingexcellence.org.uk/</a>
5	Construction Industry Research and Information Association	<a href="http://www.ciria.org.uk/">http://www.ciria.org.uk/</a>
6	Construction Research and Innovation Strategy Panel	<a href="http://www.ncrisp.org.uk/">http://www.ncrisp.org.uk/</a>
7	IMMPREST	<a href="http://www.lboro.ac.uk/research/immiprest/">http://www.lboro.ac.uk/research/immiprest/</a>
8	The Modular and Portable Building Association (formerly the National Prefabricated Building Association)	<a href="http://www.mpba.biz/">http://www.mpba.biz/</a>
9	PrOSP a – Promoting Off-site Production Applications	<a href="http://www.prospa.org/">http://www.prospa.org/</a>