

Is offsite sustainable?

Offsite manufacture, sometimes called prefabrication, modular or industrialised building, is an approach to constructing the built environment that has been at the leading edge of innovation for a number of years. Put simply, offsite is manufacturing and assembling whole buildings or substantial parts of buildings prior to installation into their final location. The work almost always takes place in a factory environment. The offsite spectrum includes non-volumetric units such as panels and building services modules; volumetric units such as toilet or kitchen ‘pods’; and whole building solutions, often known as ‘modular buildings’. Offsite is a strategy that affects the whole project rather than just the application of ad-hoc products or technologies. Government-prompted reports have extolled its virtues, manufacturers have publicised its benefits, developers have worried about its cost and architects have debated its worth. Notwithstanding, offsite is here to stay as a valuable part of the built environment.

But, is offsite sustainable? The vision of many of the early exponents fits the sustainable culture very well: Buckminster Fuller’s goal in the middle of the last century was to ‘touch the earth lightly’ and his Dymaxion Dwelling Machine – or Wichita House¹ was his realisation of this ambition. However, like many such experiments, the Wichita house was ultimately destined to become a museum exhibit. Kieran Timberlake’s Loblolly House² sees the minimum impact of the construction process through offsite as part of its sustainable credentials, along with the widespread use of recycled and local materials, such as locally quarried stones and sustainably harvested wood windows.

So, are today’s offsite solutions sustainable? Yes, they are, or, at least, they should be!

Offsite is sustainable because factories can control energy and emissions more easily than construction sites. A number of offsite manufacturers are also looking at alternative, renewable methods of producing power for their manufacturing and assembly plants. Construction sites have made significant strides forward in recent years in reducing waste and recycling, driven, in part, by the increased taxes on landfill. But factories are still much better able to reduce waste and recycle un-used materials than sites. The WRAP report³, Waste Reduction Potential of Offsite Manufactured Pods, compared GRP and light steel framed toilet pods to insitu constructed toilets. WRAP found that “in overall terms, the production of composite pods produces less 1% of wasted material, most of which is either recycled or re-used, which is a

¹ www.designmuseum.org/design/r-buckminster-fuller

² www.treehugger.com

³ WAS 003.003 – Offsite Construction Case Studies

significant saving when considering waste arising from site activities. Moreover, once delivered to site, the pods are directly installed into their final position and do not require any extra work, hence, generating no waste on the construction site.” From a social perspective, manufacturing and assembly facilities can be located in areas where there is currently high unemployment, thus providing viable work for suitable operatives. Many of the manufacturers use multi-skilled workers and often draw these from non-construction backgrounds such as other manufacturing sectors. However, it should be noted that an increase in offsite solutions in a country such as the UK will lead to an overall reduction in the number of people employed due to increased automation in the factory environment.

Whilst life cycle performance depends heavily on good quality design it is clear that, in the more easily controlled factory environment, elements are much more likely to be produced in accordance with the specification and design intent. For instance, the airtightness of buildings produced in a factory is much better than those built on site. Consultant Martin Goss of MTech states that “with volumetric modular or a well designed closed panel system it is entirely feasible to achieve $1\text{m}^3/\text{m}^2/\text{hr}$ @ 50 Pascal (Building Regulations currently require a maximum of 10), whereas even well built traditional building will struggle to beat 5”. He goes on to argue that “airtight construction is nominally free for factory built construction - good details, close tolerances at joints, and removing reliance on mastic as the primary seal overcomes longevity concerns”. Reducing unplanned air leakage is an essential part of reducing energy loss as well as reducing draughts; however, some form of mechanical ventilation may be required to provide control of stale air. Notwithstanding, to date, few data exist regarding the through life performance of offsite solutions and this is an area where more studies are required.

Some have claimed that maintenance is more problematic with offsite produced units, arguing that work done in the factory affords much better access, which is then not possible after installation. But this is, once again, an issue of careful design where access for maintenance must be a key consideration. Furthermore, a study of maintenance of bathrooms in student accommodation at Loughborough University⁴ showed that both offsite GRP and precast concrete bathrooms cost considerably less to maintain than the insitu constructed options. Offsite solutions require less on-site work than traditional techniques, resulting in less local disruption through dust and noise and fewer health and safety risks for workers. In particular, offsite can eliminate the need to work at height which is the main cause of construction fatalities

⁴ Pan, W. and Gibb, A.G.F. (2009) Maintenance performance evaluation of offsite and insitu bathrooms Construction Innovation Journal – Special Issue on Offsite Manufacturing, 9(1). pp. 7-21, ISSN-1471-4175 10.1108/14714170910931525

and major accidents. However, the changing risk, such as increased craneage, must still be managed.

Transportation is another 'old chestnut' that is often given as an excuse not to use offsite solutions. However, like cost, offsite transport is transparent and there is no evidence that the environmental impact is greater than all the 'white vans' attending post traditional construction sites. Furthermore, most insitu projects don't currently consider the carbon miles of all the materials being transported to the local builder's merchant from where they buy their materials. Many offsite manufacturers are considering local assembly facilities and some are using flat-pack alternatives to volumetric modules to avoid 'transporting air'.

So, is offsite sustainable? Most certainly yes!

Alistair Gibb

Professor of Construction Engineering Management

Department of Civil and Building Engineering

Loughborough University

a.g.gibb@lboro.ac.uk