Concrete in off-site volumetric construction

With Britain in the grip of the longest recession anyone can remember there is broad agreement that one way forward is to build our way out of it. More building will fuel a stagnant economy and provide much needed homes, schools, hospitals and other public buildings. But while Government incentives may invigorate some building sectors, many argue that they do not address the root problem of construction, which is high cost. So it seems that not only do we need more building, we also need more economical building. Ole Henriksen of Buildpod International reports.

One proven way to achieve this is using off-site construction of large building components to reduce costs, improve quality and speed up the building process. However, most 'volumetric' building methods use steel or wood as the main material, raising a number of issues with high material costs, structural integrity and long-term maintenance.

This situation inspired a Danish architect to invent a building method that combines the benefits of off-site construction with the desirable properties of concrete, which remains the preferred building material for many clients for its strength and durability. After more than five years of development, this building system has been patented and is now approaching implementation with a test build underway and client projects in the pipeline.

A new way to build with concrete

The basic components of the system, which is called bPod (short for build-pod), are concrete panels not unlike traditional precast panels and indeed these panels can be manufactured on many existing production lines.

The main difference from traditional panel construction is that the relatively lightweight panels are assembled to room-sized units up to around 5m wide by 12m long depending on local transport considerations. Partition walls can divide a pod into separate rooms or pods can combine to form larger rooms.

Still in the factory, the bPods are fitted with insulation panels and completely decorated and finished internally with everything from floorboards to the kitchen sink. This takes place at factory floor level and in controlled production conditions, like any other modern production process. It is therefore independent of weather and free from the risks and costs of delivering and installing materials and components at height. Quality and productivity benefits from this kind of production are well documented.

The finished bPods are then transported to the building site where a crane is used to stack them next to and on top of each other to create the finished building. External facing elements are added, complete with doors, windows and more insulation.

Above: A short wall with openings for a door and window is positioned. Doors and windows will normally be installed in the façade elements which will be added to the assembled bPods on-site.

Above left: The first long wall is positioned on the floor slab. Ribs enhance rigidity and some ribs also serve as permanent shuttering for the load-bearing structure, which will be cast in-situ following on-site erection. The pods themselves are not load bearing and the wall panels are therefore relatively thin.

Below: A long wall with openings for an internal door and an interconnection to a second bPod is positioned. Internal doors will be fitted during the completion process, which takes place off-site.

A short wall with an opening for a narrow, horizontal window is positioned in a bedroom bPod. The window will in most cases be installed in the façade elements, which will be added to the assembled bPods on-site.

Fitting the ceiling slab onto the assembled walls completes the assembly of the bPod. Steel inserts are used to weld the ceiling to the walls and internal completion and decoration follows before transport to the building site.

The completed bPod will not be lifted by its ceiling but by chains connected to the floor slab. The assembly of these test pods takes place outdoors while a production line is being prepared. Production bPods will be assembled and finished indoors.

At this point comes the main difference from traditional element construction. The bPods, and the panels they consist of, are not load bearing. Instead, channels formed between insulation panels are filled with reinforced concrete, one storey at a time, to form the load-bearing columns and beams that are unique to the system and allow bPod buildings to be built higher than most other off-site building techniques.

As each level of pods is added, adjustable fittings ensure exact levelling and maintenance of tolerances throughout the building, and guide brackets are used for accurate and safe assembly of the pods. Lifts, staircases and installation cores for water, drainage, power, ventilation and communications are built into the bPods as needed.

So no more first and second fixes on the building site. All that's required after erection are finishing touches and interconnection of services.

In another departure from traditional construction, the inventor sold the patent to a British company, which is now marketing the technology internationally. Buildpod International is not a construction company but a technology provider who licenses its patented building process to contractors, developers, building associations and other clients worldwide. This makes the system available to the existing construction industry at a relatively modest level of investment.

Intelligent use of concrete saves energy

The energy budget of a building is complex and long-term. There is the energy that goes into construction, including manufacture and transport of all parts and materials. Then there is all the energy spent in using the building during its entire lifetime and finally the energy needed for the eventual disposal of the building.

Although concrete is heavy on energy in construction, the bPod process uses less concrete than traditional construction. In addition, Buildpod International argues that during its lifetime concrete, when used intelligently, more than makes up for its initial energy use. With the ability to last longer, the energy spent in constructing concrete buildings will be less per year of its lifetime than building materials that last a shorter time. Finally, concrete is highly recyclable when the building comes to the end of its life, replacing virgin material in new buildings or other construction.

But the largest part of a building's energy budget is spent over many years of use, in particular on heating, cooling and lighting. This is where the bPod technology makes the difference between traditional construction and modern, intelligent use of concrete.

Uniquely in multi-storey construction, bPod buildings can be made to meet any required energy standard because their cavity wall can accommodate any required amount of insulation. In addition, a variety of insulation materials can be used, such as recycled paper for low environmental impact or ultra-insulators such as aerogel for thinner Passive House walls.

Test build in progress

In collaboration with its Danish franchisee, Buildpod International is currently constructing a proof-of-concept building, which will also serve to test and fine-tune aspects of the technology.

Panels for the first three bPods have been cast on a traditional production line and the test pods assembled outdoors while an indoor assembly line is being prepared. After interior fitting and decoration, these pods will be assembled into the first bPod building, which will be ready later this year. ●