BCO

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MAKING THE FUTURE WORKPLACE

Materials and methods towards a circular economy

HYBRIDITY

For a given typology the traditional choice between 'steel or concrete' is being replaced by an approach of combining different materials into hybrid systems.

A product of the digital revolution is our ability to focus on the discipline of materials science more than ever before, and how materials can be modified to suit particular engineering needs is becoming a popular industry trend. The opportunities are vast, spanning from nanotechnology to the traditional physical connecting of two base materials. This concept is, of course, nothing new; the combination of steel and concrete has meant reinforced concrete has been a stable building material for hundreds of years. However, embracing hybridity aims to utilise the optimum properties of different materials, combining them to achieve holistic efficiency and thus environmental logic.

BIM

Building information modelling (BIM) can have a significant role to play, not only through the three-dimensional coordination of the key design disciplines, but also, more importantly, by using the detailed physical and functional characteristics of a building described through a BIM model, and integrating these with environmental modelling approaches to achieve a holistic design and assessment.

low cost/high value: One size does not fit all, but a generous shell should provide the best opportunity for the greatest market share.

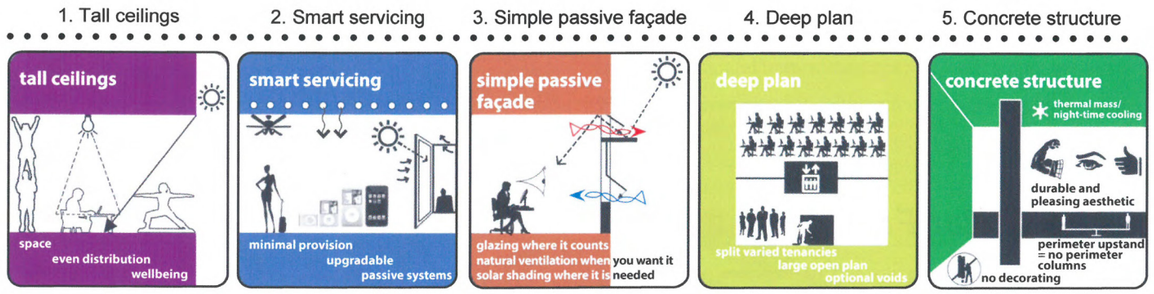

Figure 16
The future principles of the White Collar Factory
Source: AHMM

GREEN CONCRETE

The process of making cement creates high levels of embodied energy, hence there is a need for a more sustainable version of concrete. There has been much research in this area in recent years, with two manufactures making great leaps: Cemfree, which was developed by the DB Group, and Novacem, a carbon-negative concrete, developed as a result of research at Imperial College, London. Cemfree is a genuine, realistic alternative to conventional concrete, allowing savings of up to 88% embodied CO_2.

Keltbray has recently partnered with Cemfree, and was the first in the UK to install permanent works piles using Cemfree. While the demand for Cemfree is slowly gaining traction, costs still need to become equivalent to concrete for its use to become mainstream. The largest obstacle to overcome, however, will be related to insurance, as currently Cemfree simply has no proven track record or a history of consistent material testing.

Further research at MIT in Massachusetts, USA, is focusing on the current manufacturing process, and it suggests that the traditional heating process when combining limestone, sand and clay should be replaced by an electrolysis technique. Rather than heating the ground-up limestone, the new process uses an electrolyser, where electrodes split water molecules into oxygen and hydrogen. This process creates an acid at one electrode and a base at the other. The limestone is dissolved in the acid, and calcium hydroxide is created at the other end as solid flakes. These flakes of lime can then be harvested to produce cement. The researchers have demonstrated the technique in the laboratory, and have shown that it works on a small scale. The research team says the process could be scaled up quite easily, but it is still just one part of the larger process of making cement. More work needs to be done before the technique can be implemented in the real world, but it is a promising step. ■

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TIMBER HYBRIDS

Engineered timber is a useful case study of structural hybridity, as, while the environmental imperative of using timber is evident, designing to an 'all timber' specification can present challenges. Thus designers explore the use of other materials in order to enhance the holistic ability of a particular system. Steelwork has been used for many years in timber design to deal with stress concentrations at connections and provide additional stiffness to bending elements, but it can also improve ductility and the linear-elastic behaviour of a system. Combining timber with concrete is also gaining popularity in terms of improving the dynamic performance of the system and improving column grids. ■

Figure 17
Timber combined with 1960s concrete: Cambridge Heath by Waugh Thistleton Architects
Source: Jim Stephenson

Figure 18
Timber fire protection to steelwork: GC Osaka by Shigeru Ban Architects
Source: Hiroyuki Hirai

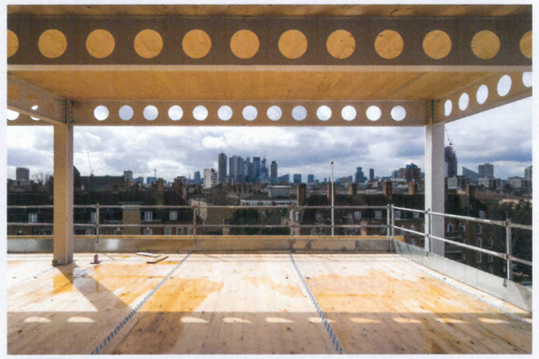

Figure 19
Timber and steel composite floors: Orsman Road by Waugh Thistleton Architects
Source: Tim Crocker

Figure 20
Softwood and hardwood working together to achieve mechanical free connections: Tamedia by Shigeru Ban Architects
Source: Didier Boy de la Tour

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