A1 Raw materials supply
A2 Transport raw materials
A3 Manufacturing
A4 Transport
A5 Site works
B1 In use
B2 Maintenance
B3 Repair
B4 Replacement
B5 Refurbishment
B6 Energy use
B7 Water use
C1 Deconstruction
C2 Transport
C3 Waste processing
C4 Disposal
D Reuse

Project SmartForm
Reducing Emissions Onsite

The aim of Project SmartForm is to improve the efficiency of formwork management through the creation of an Artificial Intelligence (AI) enhanced, Internet of Things (IoT) enabled, digital management system. Optimising formwork placement, management and reuse. Our goal is to reduce carbon emissions, save construction time and reduce the cost of every cubic metre of poured concrete.

Making formwork more efficient

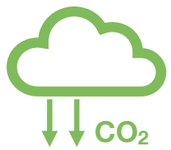
Concrete cores are increasingly used in tall buildings. Since the collapse of the World Trade Center Towers in 2001, robust concrete cores have increasingly been recognised as critical to maximising structural integrity. They are superior to steel framed cores when resisting fire, blasts and impacts.[1]

Tall buildings require a high degree of repetition in the formwork to mould floor after floor of the poured concrete structure.[1] However, this is a labour intensive process, consuming large quantities of plywood and generating high levels of material wastage in the form of offcuts and discarded components.[2] A potential solution to these issues is SmartForm, which helps reduce the labour requirements and environmental impacts involved in the formwork process.

Project SmartForm

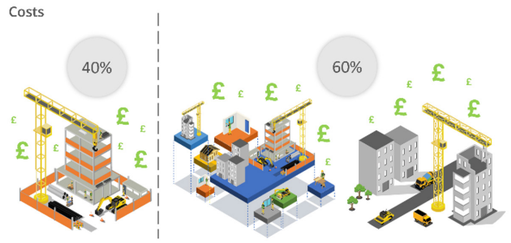
Led by our sister company, BIM Academy, SmartForm applies an IoT approach to introduce bidirectional data flows, combining BIM data with sensor inputs and site progression mapping. This dynamic formwork management system has been found to reduce carbon emissions by 20 percent and concrete construction time by 40 percent.

Formwork costs up to £58 per cubic metre. However, SmartForm enables a 25 percent overall reduction in the time and cost, offering the UK construction industry savings of up to £15 for every cubic metre of poured concrete.



20%
reduction in carbon emissions

Formwork accounts for 40 percent of building costs for a concrete structure, rising to as much as 60 percent for civil engineering structures.[3]



Formwork costs are high because a formwork section requires multiple steps:

1 Stockpiling / preparing materials
2 Assembling / erecting formwork panels
3 Concrete pouring
4 Stripping
5 Visual inspection
6 Cleaning
7 Dismantling
8 Reusing

This complexity is exacerbated by variables such as concrete cure time, the quality of delivered materials, weather conditions and knock on effects from construction changes.

Prefabricated modular systems help maximise reuse capability, but their high cost and reduced flexibility means plywood remains the most popular formwork choice. Plywood is low cost but only lasts for 12 to 14 uses before it is disassembled and recycled, which is a labour intensive and environmentally damaging process. Labour costs alone account for up to 50 percent of formwork expenses.[4] With large sites split into multiple construction fronts and sets of identical formwork, site engineers lack a realtime full site overview to optimise both labour and materials.

50% of expenses
Labour costs equate to up to half of formwork expenses

Delivering clean growth

To meet the government's Clean Growth Strategy commitment to build low cost and low carbon homes, construction processes must be improved to reduce the time, environmental effects and costs.[5] Our approach creates a digital twin of the formwork process to optimise efficiency, reduce cost and increase productivity.[6]

For the efficient management of formwork onsite and offsite, we are using embedded sensors. We are researching and developing an embedded sensor for monitoring temperature and hydration during curing that stays within the structure for its life — passively monitoring material performance over time.

A community of innovative practice

This project also supports ongoing collaborations aiming to reduce carbon emissions in concrete production. An example is our ongoing research partnership with Sphera, developing patentable technologies to transform waste plastic into plastic aggregates for use in construction materials. This partially replaces sand in traditional building materials like concrete.

Trialling the use of the plastic aggregate has already proven to be successful in reducing the concrete curing time, with the latest collaboration using the Smartform sensors and management system to monitor material performance.

The project has gained extensive support from organisations within the construction industry. Skanska has supported from conception with continued support throughout the feasibility study. Tekla is also assisting in the formwork design, as we look at design software interoperability with SmartForm.

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