

Case study: Waste minimisation through off site construction

Volumetric construction reduces waste from barracks

NATO Headquarters, Northwood, Middlesex



Partly constructed modules at the factory

Key facts

- 48% less waste with volumetric compared with traditional construction.
- 5.2m³ less waste generated per 100m² of construction.
- Applicable to other types of repetitive accommodation (hotels, student residences, etc.).

Off site construction has a range of benefits compared with traditional build including the potential to greatly reduce on site waste. This case study highlights the potential savings through the use of volumetric modules in the construction of multi-occupancy buildings.

Project details

The redevelopment of the Northwood site by Carillion Construction included a new accommodation block with 166 en-suite single bedrooms and communal areas over five floors. Caledonian Building Systems won a £6 million contract to design, supply and install the modular superstructure including external cladding of the concrete block and the roofing works.

The benefits of off site construction

Use of modular construction shortens working time on site, demands less site storage of materials and makes completion dates more reliable. For this major project, Carillion wanted to reduce the number of work packages and establish greater programme certainty for critical items such as the living accommodation.

Building the modules in a controlled factory environment makes it easier to minimise and segregate waste as it is produced. Fewer raw materials need to be handled, cut and fitted on site – thus reducing waste and waste management costs.

Volumetric construction can also reduce the number and variety of skilled trades required on site.

Construction method

The production process at Caledonian brings the different trades to each module in turn. The cycle starts with assembly of the welded steel frame. The floor is insulated with glasswool and boarded with orientated strand board (OSB). Installation of the ceiling and internal steel studding is followed by the first mechanical and electrical (M&E) fix and internal plasterboarding. External joinery, insulation, plasterboard, OSB sheathing and breather membrane are applied before the second fix internal joinery and M&E. The final stage is to tape and joint the plasterboard, decorate and carry out other finishing. The completed module is wrapped in plastic and stored outside pending delivery to site.

On site the modules are craned into position and fitted with bespoke roofing and cladding. M&E connections are made, corridors and stairwells are boarded, and final decoration performed.

Waste savings

Waste volumes from both the Caledonian factory and the Northwood site were added together and compared with those from similar multi-occupancy projects using traditional on site construction.

Use of volumetric construction reduced waste by 5.2m³ per 100m² of construction (i.e. 48%) compared with site-based construction. This performance indicator highlights reductions in metal, insulation, plaster/cement, timber, plastics, electrical, furniture and canteen/office/ad hoc waste. There is more packaging waste but factory segregation makes recycling easier. No bricks were used on the Northwood project and the concrete waste came mainly from the external blockwork cladding.

Caledonian segregates wood, plasterboard, metals, packaging materials, inert materials and green waste for reuse or recycling. To minimise contamination, only trained staff are allowed to put material in the skips. The large reduction in the canteen/office/ad hoc waste category is probably because around 75% of the project (by value) is completed in a controlled factory environment with more efficient use of labour and tighter management of materials. The controlled working conditions are also the main reason for the reduction in electrical, insulation, furniture, timber and metal waste.

Other benefits

Use of volumetric construction meant fewer workers on site, less need to remove waste and fewer general deliveries at a high security military establishment. The need for less construction work on site also improved health and safety.

Comparison of waste volumes†		
Waste stream*	Waste generated (m ³ per 100m ² of floor area constructed)	
	Traditional	Volumetric
Ceramics/bricks	0.41	0.00
Inert	0.00	0.00
Electrical equipment	0.38	0.09
Liquids and oils	0.00	0.00
Plastics	0.62	0.06
Packaging	1.40	1.48
Canteen/office/ad hoc	1.65	0.06
Metals	1.22	0.16
Insulation	0.77	0.22
Concrete**	0.02	1.15
Hazardous	0.01	0.06
Timber	1.24	0.76
Plaster/cement	2.66	1.47
Furniture	0.28	0.00
Total	10.66	5.51
† Excludes inert waste from groundworks. * Categories are from BRE's SMARTWaste system. ** Blocks, mortar, etc.		

A more detailed case study is available from our website at www.wrap.org.uk/construction

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