

Off-Site Manufacturing – Environmental Benefits

Introduction

Off-site manufacturing (OSM) techniques have been successfully used on the construction of a new Humanities Building at the University of Manchester. This short paper summarises the environmental benefits that have been achieved by using precast concrete wall panels that are manufactured off-site and arrive on-site ready for installation complete with glazed windows, insulation and tiling on the exterior.

Panel Construction

Each panel comprises a precast concrete panel, which is lined with Kingspan insulation, fitted with a double glazed window unit, and is tiled on the exterior with terracotta coloured ceramic tiles. The panels were assembled off-site by 'Marble Mosaics' of Western-Super-Mare, with glazing provided by Solaglass. Tiles are fixed to the panel using a standard building adhesive for bonding ceramics to concrete.

Two styles of panels were used; 62No. small panel (6 x 4m) for the West and East elevations of the building and 20No. large panels (7.5 x 4m) for the North and South elevations. Small panels have a mass of 11.5 tonnes and large panels 13.5 tonnes.

Panels are cast with corbels and anchor bolt holes which allow them to sit on the edge of the concrete floor slab on each floor and to be secured to the concrete columns.

Each small panel contains 222No. tiles, and each large panel 302No. tiles. Therefore, total tiles used on the contract are 19,804No.

Panel Delivery & Installation

Panels were delivered to site on a flat-bed lorry with specially designed stillage to support each panel, with two panels on each load. A total of 41 deliveries were made to the site during the duration of the contract. Figure 1, below, shows a panel on the lorry prior to unloading.

Figure 1 - Panel on lorry prior to installation



Panels are installed using a crane, cherry picker and four fitters with an average of four panels being fitted each shift. Panels are lifted into place, with the corbels resting on the floor slab and are then fixed using anchor bolts. The small gap between the panel and the floorslab is then closed using Kingspan to provide insulation and adequate fireproofing (Fig 2)

Figure 2 - Kingspan Insulation used to close gap between floorslab and wall.



Environmental Benefits

No panels were received on site with damage, with only one single tile needing replacement following fitting. Significant waste savings were made as follows:

Assumed Wastage		
Description	Savings - Materials	Savings (£)
10% wastage on tiles from damages on site, poor cutting and sub-standard fitting. Assume each tile costs £1.00	~2000No. tiles	£2000
No packaging from tiles or glazing requiring disposal as general waste at site	Assume 4No. 8CuYd skips @ 120 each	£480
No waste packaging from adhesives / mastics requiring disposal as hazardous waste at site	Assume ½ a 8CuYd skip @ 300 each	£150
No wastage on damaged glazing units	Assume 5% wastage / damage. Skip savings and cost of materials	~£1000
		UU£3630

Other environmental benefits include a reduction in traffic movements, and little on-site construction noise associated with fixing the panels reducing potential nuisance issues.

Other Benefits

OSM provided benefits from a health and safety perspective as no scaffolding required, less trades were on site at any one time and there is a reduction in the number of individual operations being conducted, all factors contributing to lower risk.

Significant quality benefits also achieved as each panel is finished prior to arriving on site and it is considerably easier to tile a panel in a horizontal position inside a manufacturing shed than once in-situ on site. All panels met project QA requirements. OSM also reduced the construction programme with all panels being installed in approximately 20 days (80 man days). This effectively weatherproofs the building allowing internal trades to commence works sooner than would be possible using a traditional construction approach.

Difficulties Encountered

No difficulties were encountered but it is vital to ensure efficient scheduling to maximise effectiveness of OSM. Scheduling on this project enabled areas to be prepared and cleared prior to installation with panels being craned from delivery vehicle and placed in position in one movement with no on-site storage required. Other trades had to be well co-ordinated to ensure they are not working in the vicinity of where panels are being installed.

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