Case Study: New South Glasgow Hospitals

Minimising construction waste through project design

Key facts
- Applying WRAP’s Designing out Waste principles to the project design identified 21 areas of potential waste reduction during the design phase.
- Use of the WRAP waste forecasting tools has assisted Brookfield Multiplex in identifying and quantifying waste reduction opportunities and associated cost savings.
- The project implemented an innovative on-site sorting system in order to target a landfill diversion rate of 90%.

The construction of New South Glasgow Hospitals (NSGH) is one of the NHS’s flagship projects. The principal contractor, Brookfield Multiplex, has used tools developed by the Waste and Resources Action Programme (WRAP) to identify potential waste reduction opportunities throughout the design stage of the project.

Background
The NSGH project in Glasgow is a £575 million capital project and the largest NHS construction project in Scotland. The project involves the construction of a new children’s and acute hospital with supporting laboratory facilities that will provide patients in the west of Scotland with outstanding healthcare facilities.

Artist impression of New South Glasgow Hospitals over central park
Opportunities for off-site and modular construction were explored in every aspect of the design to provide a number of operational advantages including waste reduction. We have since worked closely with our design team and suppliers to establish which options are practicable to implement.

Jim Murray
Design Manager
Brookfield Multiplex

Greater Glasgow and Clyde NHS Board specified high standards of environmental and sustainability performance including a BREEAM ‘Excellent’ rating. This requirement introduced stringent targets for minimising waste generation, which was further supported by Brookfield Multiplex’s corporate target to divert 83% of waste from landfill. In order to achieve these targets Brookfield Multiplex approached Zero Waste Scotland for guidance and assistance with the use of the WRAP Designing out Waste Tool and Net Waste Tool. Zero Waste Scotland is the trading name of WRAP in Scotland.

Designing out Waste
The Designing out Waste Tool has been developed for use by design teams in the pre-design phase of a project. The tool applies a structured approach to the outline project design to identify specific waste minimisation actions that can be implemented throughout the design and construction phase. The identification of waste minimisation actions is achieved in a workshop involving professionals from different design disciplines with each identifying opportunities within their respective elements of the project.

The approach focuses on five principles for waste reduction:

- design for re-use and recovery;
- design for off-site construction;
- design for materials optimisation;
- design for waste-efficient procurement; and
- design for deconstruction and flexibility.

A Designing out Waste workshop held at the project outset by Brookfield Multiplex initially focused on two of the five design principles, as the ability to identify actions in each area is influenced by factors such as the project programme and interface with other design considerations.

Opportunities to design for re-use and recovery and for off-site construction on the NSGH project were apparent at the very start of the project whereas other areas, such as design for materials optimisation, required a degree of design work to be undertaken before waste reduction opportunities could be identified. Embedding the five principles as design considerations supported by the iterative use of the tools throughout the design phase ensured that opportunities arising throughout the project were identified and capitalised upon.

Design for off-site construction
This design principle explores the options for prefabrication and off-site manufacturing in preparation for on-site assembly. The NSGH design team had a major focus on off-site construction with the principle applied across numerous aspects of the design at an early stage.

The approach taken by Brookfield Multiplex is reflected in the number of prefabricated components present in the final design including a link bridge connecting buildings and elements associated with the hospital helipad. Widespread use of prefabricated ‘plug and play’ mechanical and electrical services risers and cable trays are other areas where off-site manufacturing has been maximised, contributing towards an overall reduction in waste.
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The adoption of the unitised structural cladding design has brought many benefits to the project including a reduction in waste, and accelerated the fit-out programme by sealing the building earlier than planned.

Alan Keeley
Construction Director
Brookfield Multiplex

The extent of off-site fabrication present within the project design is reflected in the outputs from the initial Designing out Waste workshop. The examples present in the final design and construction highlight where the forecasting tools can add value throughout the design stage and decision-making process.

One of the most visible building components to be manufactured off-site is the glass curtain walling present on the main tower of the hospital. The unitised structural cladding system specified by Brookfield Multiplex will arrive prepared for installation, eliminating the need for contractors to work with materials and therefore removing the potential for waste generation. One of the implementation challenges faced by project architect Nightingale Associates in specifying prefabricated panels was designing to the standard cladding panel sizes, which required adjustments to be made to the setting out of the cladding panels. Another potential waste reduction opportunity identified during the design stage was the off-site fabrication of a number of concrete structures within the building. This included columns, stairways and floor slab end beams – building components which might otherwise have been cast on-site, potentially increasing on-site waste generation.

The main materials optimisation opportunity identified on the design of NSGH was to standardise internal wall dimensions to reduce the number of off-cuts required on dry-lined plasterboard walls. The design team initially considered a standardised room dimension, although the client’s need for flexibility, a common challenge to implementing this principle, constrained the opportunity.

To overcome this challenge Brookfield Multiplex’s design team worked with the NHS Trust to develop a list of required room types against which standard designs could be produced.

Design for materials optimisation
This principle promotes the efficient use of construction materials through a design, focusing on material and resource efficiency. Promoting efficiencies through standardisation of components and considering the materials specified in the design can substantially reduce the level of waste generated throughout the construction phase of a project.

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To overcome this challenge Brookfield Multiplex’s design team worked with the NHS Trust to develop a list of required room types against which standard designs could be produced.
Retaining an element of standardisation enabled Nightingale Associates to introduce standard dimensions that could be replicated throughout the building. In doing so, Brookfield Multiplex was able to design standard dimensions such as sill heights for internal glazing sections, reducing the need for cutting during installation. Identifying specific waste reduction opportunities contributed to a potential reduction in the waste plasterboard arisings in comparison with standard industry practice, which may have required a greater degree of on-site material working.

Another area where materials optimisation was promoted was through the setting out of materials within the detailed design. This included the setting out of plasterboard planks in corridor ceilings in a way that eliminated the need for cutting. The layout of flooring tiles in the building atrium involved the specification of different sized tiles within the design to reduce both the overordering of material and the need for cutting during installation.

**Net Waste: calculating the benefits**

The Net Waste Tool was used following the Designing out Waste process to quantify the potential waste saving from the identified waste minimisation actions. Specific opportunities identified during the Designing out Waste process were input to enable the impact to be determined against a baseline of standard industry practice.

The outputs suggested that actions identified by Brookfield Multiplex could achieve a 6,500-tonne waste saving compared with an industry baseline depending upon the extent of actions implemented in the final project design.

The outputs from the Net Waste Tool were also used to develop a best practice site waste management plan for the project. In addition to generating a forecast of waste volumes, the tool also provided a record of design actions along with an indication of savings that could be achieved upon implementation. The recording and quantification of these decisions taken throughout the project provide Brookfield Multiplex with a basis for project review along with evidencing waste prevention within the project.

The Net Waste Tool was also used to estimate the impact of the innovative on-site waste sorting system introduced to the project. This involved Brookfield Multiplex appointing Edinburgh-based Recycling and Data Services Limited to segregate construction waste into individual material streams on-site for direct delivery to material reprocessors. Modelling this approach using the Net Waste Tool identified a diversion rate of over 90% – significantly higher than the 75% good practice rate suggested by the tool.

Key statistics generated by the Net Waste tool were instrumental in proceeding with both the Designing out Waste actions and the on-site sorting system. Some of the headline savings estimated by the Net Waste Tool included:

- A 6,500-tonne reduction in construction waste generated throughout the project if all identified actions were to be implemented.
- An identified potential cost saving in the avoided cost of wasted materials when compared with standard industry practice.
- A landfill diversion rate of over 90%.

The use of the Net Waste Tool also assisted Brookfield Multiplex in identifying its progress against the 10% recycled content target established for the project.
Brookfield Multiplex proposes to use the tool on completion of the project to compare target and actual performance and has recently undertaken a project review.

This review has been supported by a supply chain partnership event facilitated by Zero Waste Scotland. The event sought to identify specific waste reduction opportunities around the Designing out Waste principles that can be implemented in partnership with Brookfield Multiplex’s supplier and contractors. Suppliers attending the event were asked to identify specific waste reduction actions around which each supplier would be required to implement two actions in their work on the project. The output of this event continues to promote waste minimisation as a design consideration throughout the remainder of the NSGH project.