

5 MINIMISING AND MANAGING BUILDING WASTE AT THE DESIGN STAGE

5.1 Waste Arising from Design

Design decisions and approaches can significantly affect waste minimisation during construction as well as the reuse and recycling of construction materials. The causes for waste on building site are not limited to action on the site but also are due to material and component selection for structure, services and finishes at the design stage. The causes of waste that can be attributed to design include (PolyU, 1993):

- Dimensional dis-coordination, i.e. the dimensions in buildings do not correspond with the size of the supplied materials thus resulting in excessive off-cuts.
- Variations in design at the construction stage, which lead to additional wastage in the form of demolition of faulty design work.
- Discrepancies in drawings and specifications produce unwanted work and increase construction waste.
- Reliance on traditional in-situ construction methods with bamboo scaffolding and timber formwork, which generate a lot of waste as compared to tubular scaffolding and system forms.
- Over design results in waste. Larger volumes of materials are required for construction than should be the case, and greater volumes will need to be removed at the end of the project's life.
- Specifications failing to match the quality of the building required.
- Resistance to adopt alternative materials e.g. environmentally friendly materials.
- Ignoring buildability, the designer has no time to complete the detailed design for buildability and the contractor builds the components on his

own. If the designer is not satisfied with the contractor's works, abortive work becomes building waste.



Figure 5.1 Discrepancies in structural and building services drawings led to hacking off of concrete

5.2 Design Considerations

The influence of a designer on the reduction of construction waste can be exerted in several ways. In matching the design to the actual needs, resources (materials) can be minimised.

In the design of buildings, the specifications and assembly of materials should be consistent with their use and/or recycling after demolition. Design presents perhaps the most significant opportunity to delay and minimise the arrival of materials as waste.

5.2.1 Standardisation

The use of a more standardised design can reduce waste generation. Material wastage can be reduced by a greater attention to detailing and dimensional coordination. Standard and modular flat designs are can be more widely used with many benefits. This method has been widely used by the Housing Department for many years and has led to significant cost and quality benefits.

5.2.2 Designing for flexibility

Flexibility of design must also be explored to ensure those opportunities for future adaptation of buildings when the usage of the building changes, e.g. conversion of bigger flats to smaller flats, and vice versa. This will save the building from being demolished for re-construction.

Designing for flexibility is important if it prolongs a structure's life. The most wasteful approach is to demolish a structure before it has reached the end of its useful life simply because it does not meet changing design loading needs.

5.2.3 Designing for long life

Product longevity can be engineered through designing a durable product and /or a product that can be easily and cheaply maintained. Some means of encouraging/promoting waste minimisation at the design stage are recommended below (CIRIA Specification Publication 122):

- a) Industry should team up with materials producers and suppliers in search of processes for avoiding or reducing waste.
- b) Multi-functional materials should be used wherever possible, serving for example to provide heat and sound insulation at the same time, whilst remaining economical.
- c) Materials should be durable i.e. resilient to operational conditions/corrosion so as to have a longer life.
- d) Comprehensive repair and refurbishment schemes should be actively encouraged in preference to wholesale demolition and reconstruction.

5.2.4 Prefabrication

Designing to accommodate materials on the market in standard product sizes should minimise cut off wastage on construction sites. Factory controlled processes are more reliable, and can use more sophisticated techniques and fittings, all of which can reduce the net amount of material employed. (CIRIA

Special Publication 122). The concrete facades, staircases, floor slabs, timber doorsets, bathroom and kitchen fittings can be prefabricated off-site under factory condition. Precast pavings are widely used by developers in general landscaping and come in different sizes, colour and type and can be laid in different patterns. In addition to being reusable, they are generally considered to be more aesthetically pleasing than concrete footways.

5.2.5 Materials and techniques

Materials and techniques to replace traditional labour intensive site trades such as proprietary sprayed plasters, and dry panel partitions, produce less waste compared to conventional mortar. Housing Department and some large developers in Hong Kong have experience in using these techniques.

5.2.6 Flat finishes and fittings

“Basic shell” should be considered as one option available to purchasers where only essential fittings to comply with the statutory requirements are provided, to allow the owners to choose and carry out their own decorations. Clear identification of users’ requirements to avoid abortive fitting-out by residents after occupancy is important in large scale housing developments.

5.2.7 Refuse room at typical floor

It is worthwhile to make provisions for storage and processing of recyclables at typical floors of the building: design a refuse room with provisions of recycling bins.

5.2.8 Contract documentation, Specifications and Standards

The contract documentation, specifications and standards of construction work should be reviewed with regards to facilitating waste minimisation and in general should be more explicit on waste management matters such as storage, sorting and disposal.

5.2.9 Design for future reuse and adaptability

Currently, the construction industry of buildings relies heavily on the use of

composite materials such as reinforced concrete, rendered masonry, coated steel/timber and so on. The eventual separation of these materials is rarely considered in design. Products need to be designed so as to be durable and easy to separate from other components/materials. This may not always be easy since designing for flexibility and reuse is not always necessarily consistent with using minimum materials. Indispensable combinations of materials, aging and contamination, as well as paintwork, can change the composition and the properties of the materials. These must therefore be reconditioned and checked very carefully before being used again to make sure that they offer the level of quality required (CIRIA Special Publication 122).

5.2.10 Design for recycling

It may be necessary to specify even in the design phase whether the parts or products concerned may be recycled without technical or economic problems, or whether recycling requires a reasonable or major effort. When designing a product for recycling, “recycling friendly” or “environment friendly” materials should be used so as to avoid residues at the end of product life (CIRIA Special Publication 122).

5.2.11 Minimising waste from design variation

At the design stage, consider the variations that may be required as a result of changes in site conditions, and try to make the design and the construction process flexible enough to accommodate changes without wastage, i.e. plan for potential variations.

When appropriate, consider arranging design-and-build contracts for the benefits of packaging elements of the works that could be susceptible to variation. This will focus attention on decisions being made at appropriate times in construction programme. (CIRIA Special Publication 134).

5.3 Designer’s Checklist

The designer has a significant role to play all the way from inception to detail design when it comes to environmental issues, including the amount of waste that might arise from the project. An early decision surrounds the choice of site,

which may lead to the question of demolition waste, and possibly of contaminated materials being present. The design team will need to ask the client the appropriate questions, e.g.:

- How much of the existing construction works can be retained for the new use?
- Can any of the components within the existing construction works be re-used in the new building or elsewhere?
- To what extent can the new construction works, or any of its components or elements, be fabricated off-site in controlled conditions and is the client interested in considering options that may have a lesser impact on the environment?
- Could the client's proposal be realised on an alternative site, giving the same results but with lower environmental impacts and levels of waste arising?
- Is the client prepared to recommend to design team the need to look further into the future and "design for deconstruction," for example, in specifying composite products that do not require adhesives so as to enable easier separation and consequently render both material available for recycling in a cleaner state?

(Source: Task Group 3: Construction and Demolition Waste Management, May 2000)

The following is some recommendations in Design:

- ✧ Existing landscaping and contours should be used to avoid over excavation.
- ✧ Minimise waste by designing standard ceiling heights and building dimensions. Simplify building geometry.
- ✧ Avoid waste from structural over-design (use optimum-value

engineering/advance framing).

- ✧ Durable materials should be specified for the construction and finishes.
- ✧ Use building products made from recycled materials when possible.
- ✧ Use salvaged building materials when possible.
- ✧ Specify reusable or recyclable materials for hoarding, scaffolding and formwork.
- ✧ Adopt innovative technology like prefabrication and precast units when possible. It is the key to minimise waste from wet trade.
- ✧ Communication between the designer and contractor is important so that each realizes how the design decisions will affect on site operations and waste generation.