Hunters Lane Household Waste & Recycling Centre, Rugby

[17]

When refurbishing car park retaining walls at the Hunters Lane Household Waste & Recycling Centre, a pre-cast concrete face panel Geosystem with steel strip reinforcement was used in place of a sheet pile wall.

Hunters Land HWRC Case Study: Key Facts

- By using a Geosystem in place of more traditional sheet piling techniques, the risks to nearby structures from associated ground vibrations were minimised.
- By using the concrete panel wall system, which combines granular fill and a geo-component in the form of galvanised steel straps attached to the concrete face panels, substantial cost and CO_2 savings were also be realised.

Project Details

The retaining walls within the car park at Warwickshire County Council's Hunters Lane Household Waste & Recycling Centre (HWRC) were refurbished by contractor Weldon Plant using a concrete face panel and steel strip system designed by the Reinforced Earth Company (RECO). This Geosystem was chosen in place of the more traditional sheet pile wall originally proposed.

A total of 2,396 tonnes of granular fill were imported to site to construct the retaining walls. The fill was reinforced with zinc galvanised steel strips, and the face was formed from square, pre-cast concrete panels connected to the steel strips. The main advantage of using this method of construction instead of sheet piling was the reduction in risk to the nearby structures from ground vibrations. Additionally, removing the need for steel sheet piles (which bring with them substantial embodied CO_2 from the steel-making process) meant that substantial CO_2 savings could be realised, as well as cost savings.

Traditional design (for comparison)

The sheet piling method would have involved the import of an estimated 112 tonnes of steel sheet piles to provide the main structural elements for the refurbished walls (see Figure 1).

It is not known who would have supplied the piles, so it has been assumed that they would have been delivered from around 50 miles from site (based on the distance to major sheet piling suppliers). The sheet piles themselves would have had an estimated embodied CO_2 content of 315.50 tonnes, with an additional 0.90 tonnes being released during their transport to site. The purchase and delivery of the sheet piles to site would have cost approximately £138,690[1]. It is assumed that no fill would have been required for the works due to the nature of sheet pile installation techniques.

The brick cladding, wall footing and concrete parapet for the sheet pile wall would have been constructed using 244 tonnes of concrete. CEMEX have a local depot in Rugby and it is likely that the material would have been sourced from there. This amount of concrete would have had an embodied CO_2 content of 41.24 tonnes, with an additional 0.03 tonnes of CO_2 being produced through the delivery of the material. The delivered cost of the concrete would have been around £18,550. The parapet would also have included reinforcement bars, contributing further CO_2 embodied within the steel. However, it is unclear how much reinforcement would have been specified, and so an assessment for this has not been included within the calculations.

The wall was to have been completed with a brick cladding, which it has been assumed would have been sourced from a local merchant. The cladding would have had an estimated embodied CO_2 content of 35.74 tonnes with an additional 0.01 tonnes of CO_2 released during transport. The cost of the brick cladding and the delivery to site would have been around £2,495.

These figures are summarised in Table 1 (after Figures 1 and 2).

[1] *This figure is based upon an indicative rate of £150/m^2 obtained from a piling contractor and is considered to be a conservative estimate.*

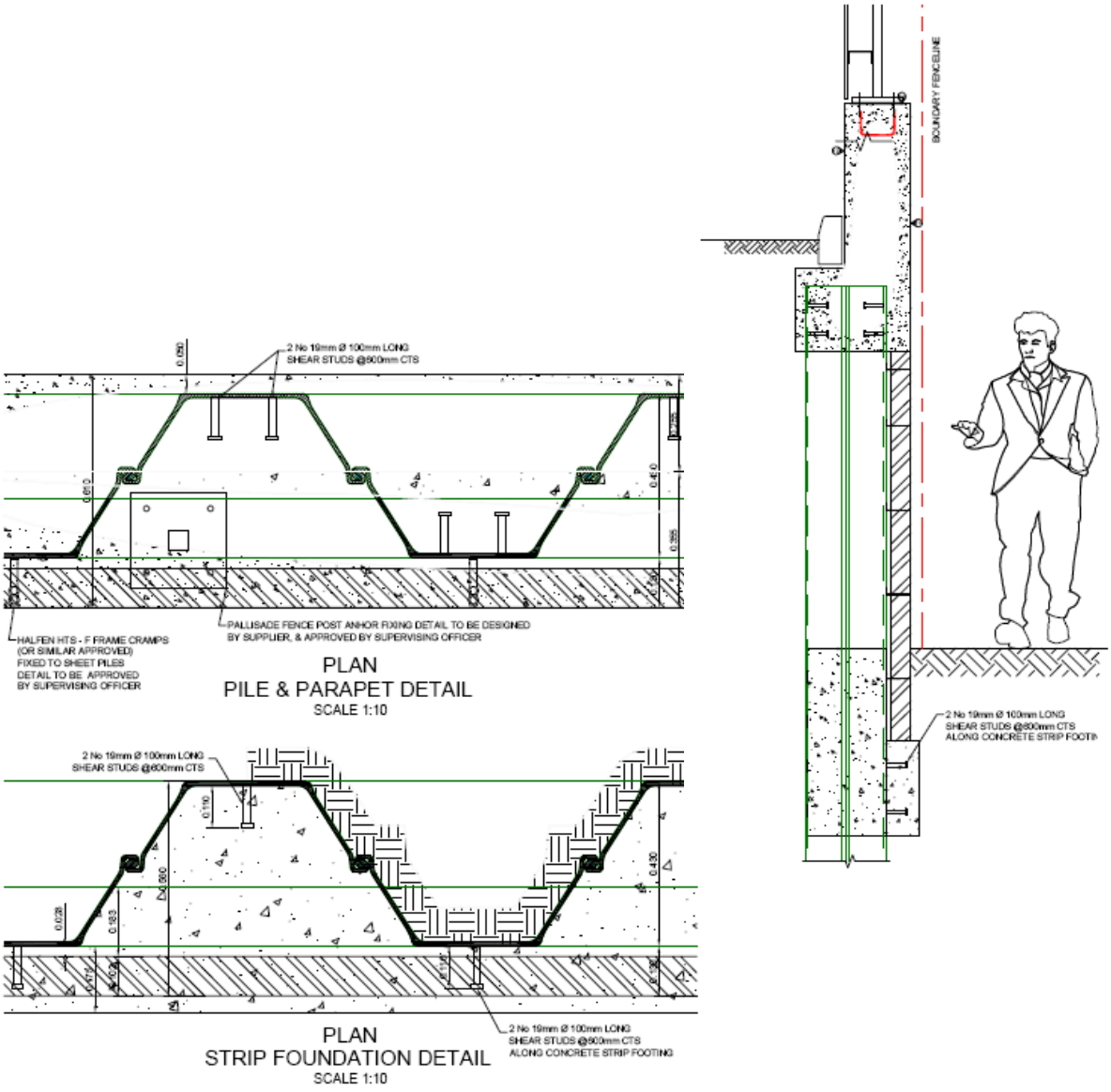

Figure 1: *Example of original proposed sheet piled wall with brick cladding design*

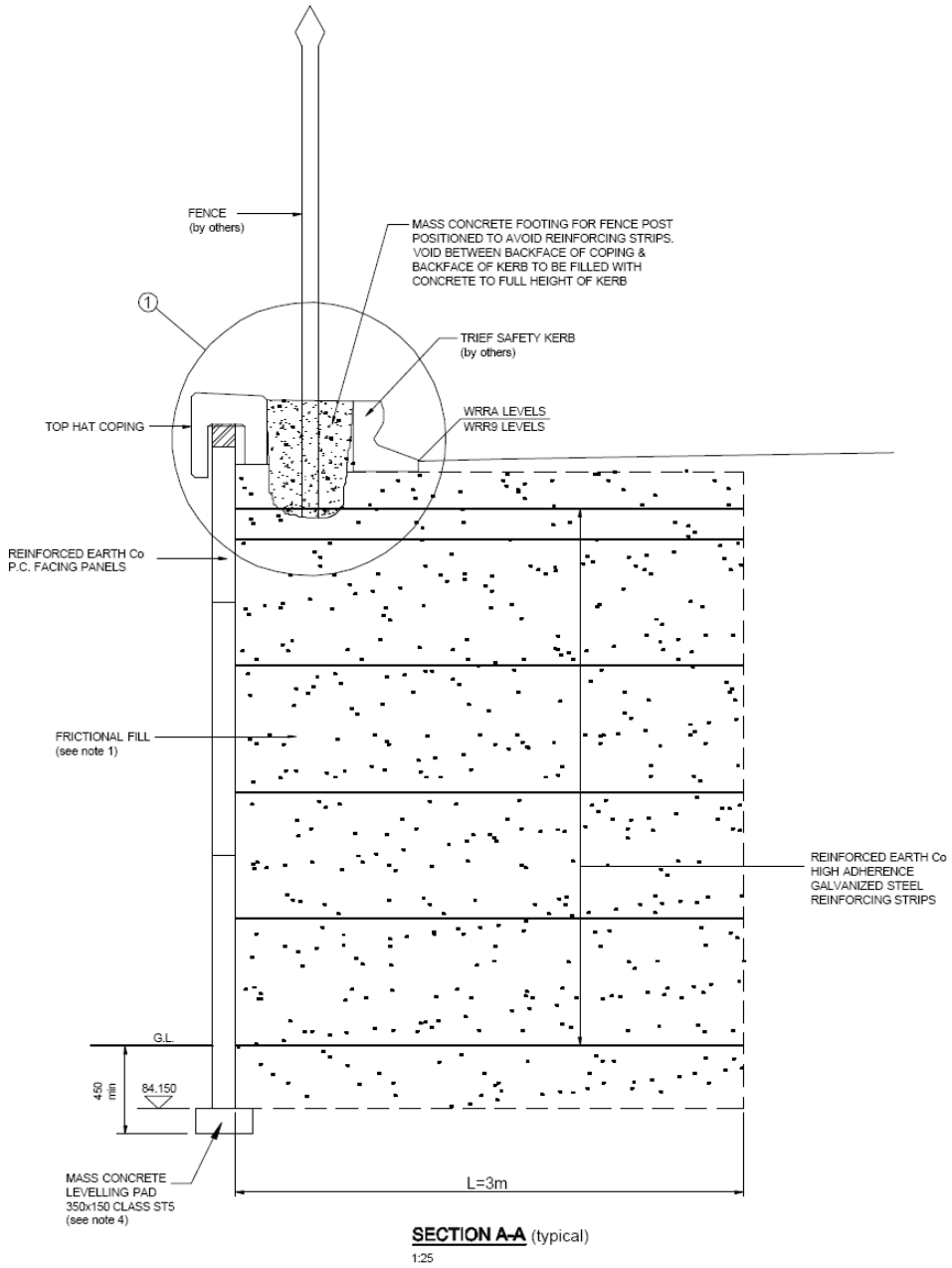

Figure 2: *Example of Concrete Panel Wall with steel strips reinforcement used at Hunters Lane*

Table 1: *Costs and tonnages of material required for originally proposed* ***sheet piles***

Material	Amount of[2] Material (Tonnes)	Total $C0_2$[3] (Tonnes)	Total Cost[1] (£)
Sheet Piles	112	316.40	138,690
Parapet and Footing Concrete	244	41.27	18,550
Brick Cladding	68	35.75	2,495
Total	**424**	**393.42**	**159,735**

Geosystems design

Using the preferred Geosystems solution to refurbish the car park retaining walls meant that it was necessary to import 2,396 tonnes of high specification granular fill material to site. This was sourced locally, from a supplier approximately 15 miles from site. This material has been assessed as having an embodied CO_2 content of approximately 11.98 tonnes, with an additional 5.38 tonnes of CO_2 being released during transportation of the material to site. The delivered cost of the granular fill was £24,200.

RECO zinc-galvanised steel reinforcement strips were used to stabilise the concrete face panels, being embedded within the fill to provide support for the retaining structure. An estimated 4.60 tonnes of the strips were delivered to site with an embodied CO_2 content of 12.72 tonnes (90% of it from the steel and the rest from the zinc) and an additional 0.41 tonnes of CO_2 attributed to their delivery.

Approximately 49 tonnes of concrete were required for the pre-cast concrete parapet. This had an embodied CO_2 content of 8.27 tonnes with an additional 1.22 tonnes of CO_2 being produced during transportation to site. The supply of the Geosystems geo-

[2] *Provided by the contractor who carried out the site works*
[3] *Values for CO_2 include embodied and that produced by haulage*

components and their delivery to site was at a cost of £51,000 (including pre-cast parapet).

To complete the Geosystems retaining structure, some 136.5 tonnes of concrete were required, bringing with them an embodied CO_2 content of 20.59 tonnes (with an additional 0.01 tonnes produced during transportation from the nearby CEMEX depot in Rugby). The concrete supply and transportation to site was at a total cost of approximately £4,320.

The above figures are summarised in Table 2.

Table 2: C*osts and tonnages of material required for Geosystem method of* ***refurbishment***

Material	Amount of Material (Tonnes)	Total $C0_2$ (Tonnes)	Total Cost (£)
Granular Fill	2,396	17.36	24,200
Reinforcing strip	4.6	13.13	51,000
Concrete Materials	186	31.97	4,320
Total	**2,586.5**	**62.73**	**79,520**

Comparison of the two designs

Construction plant and equipment

Little information is available regarding the construction process and site plant that would have been required for the originally proposed sheet piling method. For the purposes of comparison it has been estimated that the supporting plant would have been similar in cost and CO_2 emissions to that required for the Geosystems solution.

The CO_2 emissions and financial costs arising from the use of site-based plant and equipment have therefore not been included in this case study.

Environmental and financial costs

Figure 3 illustrates the different approaches required to deliver the two alternative designs, and assigns the calculated values for embodied CO_2 to each stage. Figure 4 does the same thing for the financial costs. The figures are taken from Tables 1 and 2, and further underlying data and calculations are provided in Tables 3 and 4 (which follow Figures 3 and 4).

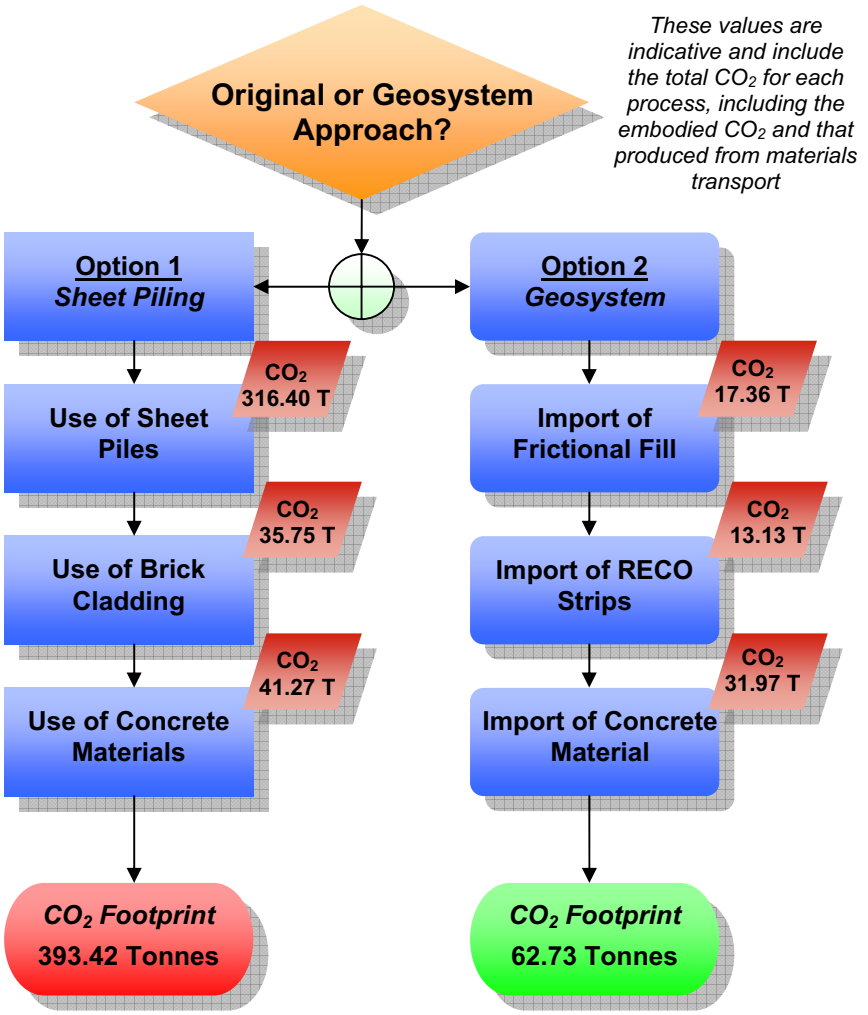

Figure 3: *Flowchart comparing the alternative options for construction of the retaining walls and their associated carbon footprints*

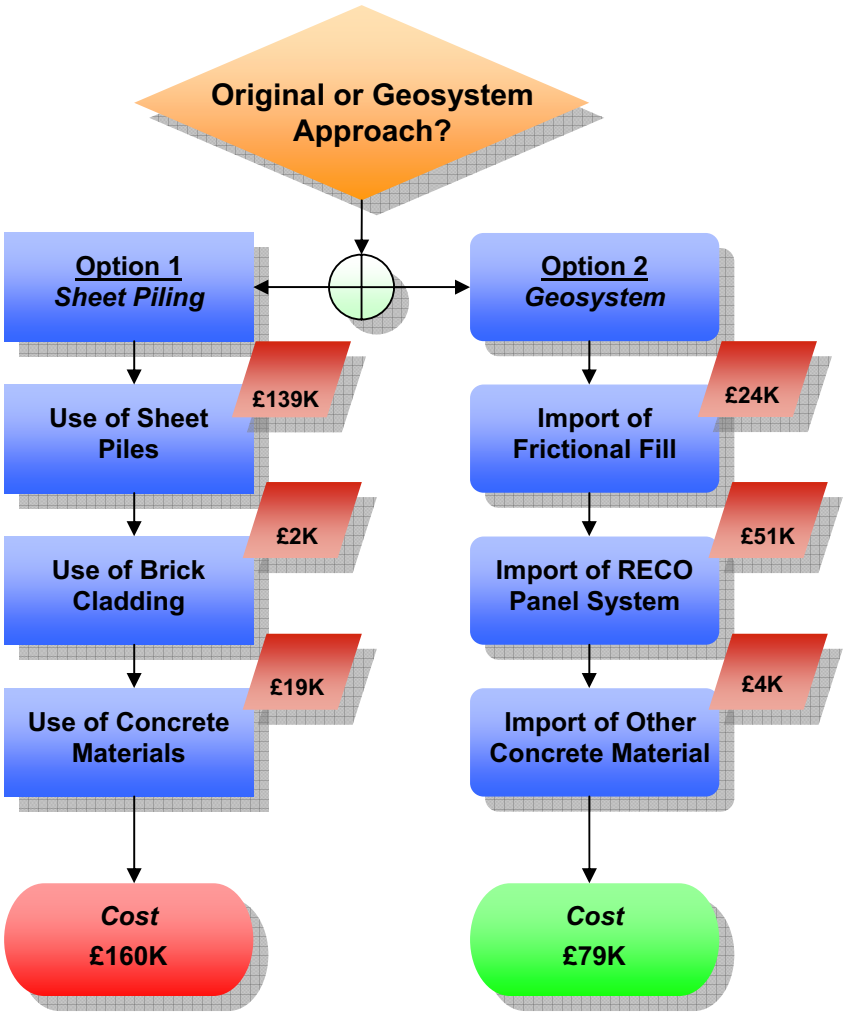

Figure 4: *Flowchart comparing the alternative options for construction of the retaining walls and their associated financial costs*

It should be noted that these values are indicative and some parameters were not included, as outlined in the text above. However, the result of this is considered to produce conservative estimates for the savings of both CO_2 and costs.

Basis for carbon and cost calculations

Table 3 provides the basis for the embodied CO_2 calculations used in this Case Study. This excludes any consideration of CO_2 emissions from transport to site.

Table 3: *Calculations used to determine the embodied CO_2 of materials*

Product	***Material (and % by weight)***	***Mass (tonnes)***	***Embodied Carbon Value*** (Ref 3) ***in tonnes of CO_2 per tonne of material***		***Embodied Carbon (tonnes)***
RECO strips	Steel (99)	4.6	Steel sheet (Virgin)	2.51	11.55
	Zinc (1)		Zinc (Virgin)	3.86	
Sheet piles	Steel	11.19	Galvanised steel sheet (Virgin)	2.82	315.50
Brick cladding	Facing bricks	68.73	Facing bricks	0.52	35.74
Footing and parapet	Concrete	244.03	Concrete RC40	0.169	41.24
Top hat parapet	Concrete	185.52	Concrete C40	0.169	31.35
Granular fill	Aggregate	2,395	Aggregate	0.005	11.98

Table 4 provides the cost factors used in this Case Study.

Table 4: *Material Costs for both methods and the Sources for Costs*

Material	***Unit price***	***Source of price***
Sheet piles (delivered)	£150 / m²	Contractor
Ready mix concrete (delivered)	£76 / tonne	Contractor
Granular fill	£10.10 / tonne	Contractor
RECO wall system	£30,000 for 334 m²	Contractor / Manufacturer
RECO coping	£21,000 for 117 m	Contractor / Manufacturer
Facing bricks	£79.89 / m²	SPONS

Conclusions

At Hunters Lane HWRC, using a Geosystem in place of a more traditional sheet pile method of construction, the following conclusions can be drawn.

- Through using a Geosystem in place of a sheet pile wall, a reduction in the CO_2 footprint of over 80% was possible for the materials and their import to site.
- The majority of this saving arose from using materials with a lower embodied CO_2 content than the steel sheet piles.
- Using the Geosystem approach meant that a financial saving of around 50% was also possible for the component materials and their delivery to site (i.e. not including the cost of construction).

Carbon Footprint

- The carbon footprint for the sheet pile option would have equated to approximately 393 Tonnes of CO_2. This is equivalent to flying from London to Edinburgh and back 35 times(Ref 1). In order to offset that amount of CO_2, it would be necessary to plant around 560 Ash trees.

- The selection of a Geosystem solution for the Hunters Lane HWRC retaining wall refurbishment meant that there was a carbon saving of approximately 80%. This is equivalent to a carbon offset of approximately 450 ash trees (Ref 2).

(Ref 1) *Defra (2007) Department for Transport and AEA Energy & Environment. Guidelines to Defra's GHG conversion factors for company reporting*

(Ref 2) *Carbon Neutral (2009) Plant a Tree for Me, Carbon Offset Tree Planting in Lancashire www.carbonneutralfuel.co.uk, Webmaster: Hubmaker*

(Ref 3) *University of Bath & Carbon Trust, Inventory of Carbon & Energy Version 1.6a*

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