DEEP FOUNDATIONS INSTITUTE

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CASE STUDY - ENERGY CALCULATIONS FOR PILES

There are many embodied carbon dioxide and embodied energy calculators available. The main difference between them is the data that is used, i.e. the embodied CO2 or embodied energy value for each material, and the type of building or sector or construction method that the calculator has been specifically designed for. Calculation procedures are straightforward, but the time is important when the calculation is carried out in design development and as construction products are finalised. The primary purpose of these tools is to compare solutions and products so that an informed decision can be made in terms of cost, programme and sustainability.

Embodied energy is generally preferred over embodied carbon dioxide because it considers both the impacts of the building fabric plus those with the operation of the building. However, for foundations there is not normally any ongoing operational requirements so either would generally be appropriate when comparing different foundation solutions. However, a direct comparison of different materials or products is not encouraged. Instead elements providing the same function should be compared; for example do not compare concrete and steel but compare say a concrete pile to a steel pile noting that their geometry will certainly be different.

Piling contractor Stent has produced a carbon dioxide assessment tool, specifically designed for their piling products in the UK market called Green Siesta. The tool assumes average CO2 values for concrete and steel based upon typical values for the UK. However, when the concrete mix or steel supplier is certain, as is the case for their precast concrete driven piles which are manufactured in-house, then specific CO2 values can be used in the assessment. Undertaking site specific calculations, not generic ones, is recommended due to the unique combination of ground conditions and building loads present on a site. It is not obvious when one pile solution will be better or worse in terms of CO2 impact than another pile solution, and sometimes the results are surprising. The table below gives some examples.

Project	Conforming CO2 (tonnes)	Alternative CO2 (tonnes)	CO2 Saved (tonnes)
Project in London	1,422 CFA	1,269 CFA	153
Project in Reading, Berkshire	260 CFA	145 Precast	115
Project in Bracknell, Berkshire	949 CFA	CFA 306 Precast 389	254
Project in London	CFA 9,369 LDP 392	CFA 3,110 Precast 5,025 LDP 392	1,234
Project in Reading, Berkshire	CFA 191 LDP 176	Precast 149	Not chosen by client

Stent CFA Carbon Assessment

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Ashwood Way, Basingstoke. RG23 8BG
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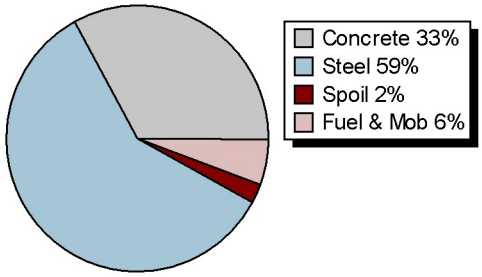
Estimate:	21801/1/1 - CFA
Project:	Westgate Shooping Centre, Oxford
Tender:	Secant Wall Hard Firm
Prepared:	15/02/2008

Summary

Approximate tonnes of carbon dioxide embedded and emitted:

Concrete	1,152.79 te	(includes transport)
Steel	2,070.96 te	(includes transport)
Spoil	81.88 te	(transport only)
Fuel & Mob.	194.74 te	
Total CO_2	3,500.37 te	



Breakdown

Concrete

Concrete Mix	Strength/Class	Replacement	CO_2 Kg/m3	Volume	Transport CO_2	Total CO_2
Male	C28/35 DC-2	70% GGBFS	128.47 kg	6,244.73 m3	7,825.21 kg	810.11 te
Female	C8/10 DC-1	90% GGBFS	54.02 kg	3,854.09 m3	4,829.53 kg	213.03 te
Guide wall	C20/25 DC-1	30% GGBFS	180.71 kg	712.53 m3	892.86 kg	129.65 te

Transport carbon is based on the batching plant being approximately 4 miles from site with an average load of 5.5 m3 per wagon.
Round trips are assumed by a rigid HGV and 100% urban driving.

Steel

Reinforcement	Embedded CO_2	No.cages	Transport CO_2	Total CO_2
1,200.52 te	2064.9 te	737	6.06 te	2,070.96 te

Embedded carbon is based on a UK market average for steel bar and rod of 1,720 CO_2 kg/te
Transport carbon is based on cage fabrication being approximately 50 miles from site with an average load of 20 cages per wagon.
Round trips are assumed by an articulated HGV with 40% urban, 40% rural and 20% motorway driving.
Carbon emissions from the fabrication of the cages are not included.

Spoil

Total Spoil	Av.m3 per wagon	Av.haulage distance	Total CO_2
9,029.34 m3	9.5 m3	50 miles	81.88 te

Round trips are assumed by a rigid HGV with 50% rual and 50% urban driving.

Fuel

Estimated diesel use: 74,045 litres Direct CO2 emission = 194.74 te

Based on DEFRA data which currently excludes emissions from the manufacture of the fuel itself.

Mobilisation

No.articulated HGV's: 0 No.rigid HGV's: 0

Approx.mob.distance: 150 miles Transport CO_2= 0 te

Round trips are assumed by an articulated HGV with 40% urban, 40% rural and 20% motorway driving.

Calculations are based on figures provided
for Stent by Nifes Consulting Group
www.nifes.co.uk