Designer Embodied Carbon (EC) Calculation - Civil & Electrical

Build Table Most Contributing Materials 1%>. Embodied Carbon A1-5

Project Name:	**Woodley - Romiley Cable Fluid Filled Cable Replacement**
Project Scope:	**33kV Single Circuit 400mm2 Cu XLPE. Route Length 2255m.**

Project Embodied Carbon Breakdown and Totals t(Co2e):	
Total A1-5w	269.58
A5a	3.15
Total A1-5 t(CO2e)	**272.74**

Note: Total A1-5w t(CO2e): Type 1&2 + Type 3&4 = Ans

Note: Total A1-5t(CO2e): Total A1-5w + A5a = Ans

Calculation Date:	**18/09/2024**
Project Code:	**50011825**
Project Completed in Financial Year:	**FY24**
Estimated Cost of Civil Build(£): (To Estimate A5a)	£450,639.00

Roadway	From	To				UNMADE GROUND IMPORTED MAT: (m)	Road Type 1&2 Imported Material (m)	Road Type 3&4 Imported Material (m)	Total
GROUNDS OF WOODLEY SUSTATION	CONNECTION POINT ONTO CABLE BOX	JOHN STREET				40			40
JOHN STREET	GROUNDS OF WOODLEY SUBSTATION	STOCKPORT ROAD STREET						25	25
STOCKPORT ROAD EAST	JOHN STREET	REDHOUSE LANE					83		83
REDHOUSE LANE	STOCKPORT ROAD EAST	HIGHER BENTS LANE						646	646
HIGHER BENTS LANE	REHOUSE LANE	QUEEN'S ROAD					287		287
QUEENS ROAD	HIGHER BENTS LANE	PRINCES ROAD						47	47
PRINCES ROAD	QUEENS LANE	BANK ROAD						128	128
BANK ROAD	PRINCES ROAD	RUSKIN GROVE						152	152
RISKIN GROVE	BANK ROAD	KINGS ROAD						150	150
KINGS ROAD	RUSKIN GROVE	BERRYCROFT LANE						34	34
BERRYCROFT LANE	KINGS ROAD	SCHOOL BROW					56		56
SCHOOL BROW	BERRYCROFT LANE	STOCKPORT ROAD					325		325
STOCKPORT ROAD EAST	SCHOOL BROW	GREEN LANE					200		200
GREEN LANE	STOCKPORT ROAD	GROUNDS OF ROMILEY SUSTATION						32	32
GROUNDS OF ROMILEY SUBSTATION	GREEN LANE	CONNECTION POINT ONTO CABLE BOXES						50	50
									0
				Total		40	951	1,264	2,255
		Desktop Contigency		0%		0	0	0	0
						40	951	1,264	2,255

Road & Cable Calculations Table

		Cable Type & Excavation	Cable/Duct Number	Units values to input in conversion to tonnes cell	Conversion to tonnes	Quantity (t)	ECF kg(CO2e/kg) A1-3	ECF kg(CO2e/kg) A4	ECF kg(CO2e/kg) A5w	Embodied Carbon t(CO2e) A1-3	Embodied Carbon t(CO2e) A4	Embodied Carbon t(CO2e) A5w	Embodied Carbon t(CO2e) A1-5w	Total EC t(CO2e)	Total EC t(CO2e) A1-5w	Notes / Comments
Type 1&2	Low & High Voltage	Asphalt, 8% (Bitumen) binder content (by mass) weight @ 2322kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	38	88.236	0.086	0.005	0.006	7.588296	0.44118	0.50074	8.539215372	**Binder/ Suface Course layer (Tarmac)**	8.539215372	
		Ready mix concrete 32/40. 2350kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	68.47	160.9045	0.132	0.005	0.008	21.239394	0.8045225	1.32183	23.36574697	**Base layer (Concrete)**	23.36574697	
		Ready Mix Expanding Foam Concrete weight @ 4.5kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.188	0.005	0.011	0	0	0	0			
		Engineering MOT		**input value in m3** (in 'conversion to tonnes' cell)	79.88	119.82	0.005	0.005	0.001	0.5991	0.5991	0.17781	1.37601288			
		Aggregate, 1500kg/m3 Note: aggregate density will change per m3 based on type and mm to dust of material.		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.005	0.005	0.001	0	0	0	0	**Sub - base layer (Aggregate / MOT / DTP)**	2.77246728	Depth of soil to be calculated @ 50% imported and 50% backfill
		Sand, 1600kg/m3		**input value in m3** (in 'conversion to tonnes' cell)	76	121.6	0.005	0.005	0.001	0.608	0.608	0.18045	1.3964544			
		Waste material content. 1m3 = 1.43 tonnes.		**input value in m3** (in 'conversion to tonnes' cell)	304.32	435.1776		0.005	0.001	0	2.175888	0.53048	2.706369494	**Excavations & Backfill layer**	3.650239562	
		Soil assumed 5% cement content. 1m3 = 1.9 tonnes of clay soil.		**input value in m3** (in 'conversion to tonnes' cell)	79.88	151.772		0.005	0.001	0	0.75886	0.18501	0.943870068			
		Cable Ducts PVC weight @ 200mm dia 4.44kg / m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172	0	0	0	0	**Cable Ducts**	17.69283494	
		Cable Ducts PVC weight @ 150mm dia 3.3kg / m	1	**input value in meters** (in 'conversion to tonnes' cell)	951	3.1383	3.23	0.005	0.172	10.136709	0.0156915	0.54107	10.69347166			
		Cable Ducts PVC weight @ 100mm dia 2.16kg / m	1	**input value in meters** (in 'conversion to tonnes' cell)	951	2.05416	3.23	0.005	0.172	6.6343368	0.0102708	0.35416	6.999363271			
		Cable 33kV (New) : weight @ 5.22kg/m	3	**input value in meters** (in 'conversion to tonnes' cell)	951	14.89266	3.81	0.16	0.04	56.7410346	2.3828256	0.59392	59.71777948	**Cables**	59.71777948	Until manufacturers ECF values are available the ECF value for New Copper is used for Power Cables.
		Cable 6.6 / 11kV (New) : weight @ 1.7kg/m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.81	0.032	0.039	0	0	0	0			
														A1-5w t(CO2e)	115.7382836	

Road & Cable Calculations Table

		Cable Type & Excavation	Cable/Duct Number	Units values to input in conversion to tonnes cell	Conversion to tonnes	Quantity (t)	ECF kg(CO2e/kg) A1-3	ECF kg(CO2e/kg) A4	ECF kg(CO2e/kg) A5w	Embodied Carbon t(CO2e) A1-3	Embodied Carbon t(CO2e) A4	Embodied Carbon t(CO2e) A5w	Embodied Carbon t(CO2e) A1-5w	Total EC t(CO2e)	Total EC t(CO2e) A1-5w	Notes / Comments
Type 3 & 4	Low & High Voltage	Asphalt, 8% (Bitumen) binder content (by mass) weight @ 2322kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	50.56	117.40032	0.086	0.005	0.006	10.0964275	0.5870016	0.67822	11.36165077	**Binder/ Suface Course layer (Tarmac)**	11.36165077	
		Ready mix concrete 32/40. 2350kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	91	213.85	0.132	0.005	0.008	28.2282	1.06925	1.75678	31.05422775	**Base layer (Concrete)**	31.05422775	
		Ready Mix Expanding Foam Concrete weight @ 4.5kg / m3		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.188	0.005	0.011	0	0	0	0			
		Engineering MOT		**input value in m3** (in 'conversion to tonnes' cell)	106.18	159.27	0.005	0.005	0.001	0.79635	0.79635	0.23636	1.82905668			
		Aggregate, 1500kg/m3 Note: aggregate density will change per m3 based on type and mm to dust of material.		**input value in m3** (in 'conversion to tonnes' cell)	0	0	0.005	0.005	0.001	0	0	0	0	**Sub - base layer (Aggregate / MOT / DTP)**	3.68670852	Depth of soil to be calculated @ 50% imported and 50% backfill
		Sand, 1600kg/m3		**input value in m3** (in 'conversion to tonnes' cell)	101.1	161.76	0.005	0.005	0.001	0.8088	0.8088	0.24005	1.85765184			
		Waste material content. 1m3 = 1.43 tonnes.		**input value in m3** (in 'conversion to tonnes' cell)	404.48	578.4064		0.005	0.001	0	2.892032	0.70608	3.597109402	**Excavations & Backfill layer**	4.8517429	
		Soil assumed 5% cement content. 1m3 = 1.9 tonnes of clay soil.		**input value in m3** (in 'conversion to tonnes' cell)	106.18	201.742		0.005	0.001	0	1.00871	0.24592	1.254633498			
		Cable Ducts PVC weight @ 200mm dia 4.44kg / m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172	0	0	0	0	**Cable Ducts**	23.51602877	
		Cable Ducts PVC weight @ 150mm dia 3.3kg / m	1	**input value in meters** (in 'conversion to tonnes' cell)	1264	4.1712	3.23	0.005	0.172	13.472976	0.020856	0.71915	14.21298442			
		Cable Ducts PVC weight @ 100mm dia 2.16kg / m	1	**input value in meters** (in 'conversion to tonnes' cell)	1264	2.73024	3.23	0.005	0.172	8.8186752	0.0136512	0.47072	9.303044348			
		Cable 33kV (New) : weight @ 5.22kg/m	3	**input value in meters** (in 'conversion to tonnes' cell)	1264	19.79424	3.81	0.16	0.04	75.4160544	3.1670784	0.78928	79.37252709	**Cables**	79.37252709	Until manufacturers ECF values are available the ECF value for New Copper is used for Power Cables.
		Cable 6.6 / 11kV (New) : weight @ 1.7kg/m	0	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.81	0.032	0.039	0	0	0	0			
														A1-5w t(CO2e)	153.8428858	

Important note:	**All materials calculated in above sheet, includes only imported materials**

Key:

A1-3	Caculation are based on **Embodied Carbon Factors (ECF)** to **Extract & Manufacture** the material Calculated as: **Tonnes x ECF kg(CO2e/kg) = Embodied Carbon t(CO2e). Sourced IstructE**
A4	Calculation based on **kg of CO2e produced** by Distance travelled in **km**, ECF based on: **Tonnes x ECF kg(CO2e/kg) = Embodied Carbon t(CO2e).** Distances referenced from **IStructE: Locally sourced within 50km = 0.005kg(CO2e) / Nationally Sourced within 320km = 0.32kg(COe) / European sourced within 1500km = 0.16kg(CO2e): Sourced IstructE**
A5w	Calculation based on the **Waste Factor (WF) of Materials.** So **brick** has a **waste factor of 20%, Steel 1%** etc. : Material **WF**x(**Material ECF** x **Distance Travelled** x **Distance travelled forwaste material taken to lanfill (C2)** x **C02 used for processing disposal (C3-4)** = **A5w** / Example, assumed waste of concrete is : **0.053 x (A1-3 x x A4 x C2 x C3-4) = A5w : Sourced IStructE**
5a	Typical assumed **costat stage A1-5 of build is 50% so: 700kg(CO2e) per £100,000** so: **0.7 x (cost of build ÷ 100,000) = Ans t(CO2e): Soruced IstructE**

Note:

Please fill in all relavent **cells highlighted** in **GREY** -
Profile Depths for Type 1&2:
Tarmac top layer = **100mm**
Concrete layer = **180mm**
MOT = **210mm**
Backfill = **210mm**
Sand layer = **200mm** (+/-300mm)
Material Waste = **Estimate 80% of total Excavated material**
Profile Depths for Type 3&4:
Tarmac top layer = **100mm**
Concrete layer = **50mm**
MOT = **275mm**
Backfill = **275mm**
Sand layer = **200mm** (+/- 300mm)
Material Waste = **Estimate 80% of total Excavated material**

Calculating for Cable & Ducts note:

When **adding** in **cable lengths** in meters, the calculation **must** include **cable numbers** for the table to **calulate** the **embodied carbon factor**

Key: **Designer to fill in all cells highlighted in light grey**

The 'Embodied Carbon t(CO2e)' cells are using a traffic light system to indicate, low- high contributing materials. Below this cell in an example of how the colour format works for each material and what they indicate.

Low		Medium		High
0	12.5	25	37.5	50

Ref for material Embodied Carbon Factors:	**A BSRIA guide: Hammond.G etal., 'Embodied Carbon', The inventory of Cabon and Energy., (ICE).**
	Embodied Carbon - The Inventory of Carbon and Energy (ICE) (greenbuildingencyclopaedia.uk)
Ref for calculating Embodied Carbon A1-5& Cell colour formatting:	**The Institution of Structural Engineers 'How to calculate embodied carbon'.**
	A brief guide to calculating embodied carbon (istructe.org)

Project Photographs / Drawings