Designer Embodied Carbon (EC) Calculation - Civil & Electrical

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

Project Name:	Kendal BSP 33kV Switchgear Replacement \ Reinforcement Project
Project Scope:	Replace existing 33kV switchgear with Siemens NX+ Switchgear. Re-use existing 33kV Switchroom. Install raised steelwork plaform for switchgear. Temporary equipment that will be re-used on other projects not included in calculations.

Project Embodied Carbon Breakdown and Totals t(Co2e):	
Total A1-5w	90.66
A5a	1.76
Total A1-5 t(CO2e)	**92.42**

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

Calculation Date:	18/09/2024
Project Code:	50018327
Project Completed in Financial Year:	FY24
Estimated Cost of Civil Build(£): (To Estimate A5a)	£252,000

Structural timber: in Tonnes, (To Calculate Sequstration Value)	0
Sequestration Value t(CO2e):	0

Design Values														Notes/ Comments
Embodied Carbon t(CO2e)					ECF kg(CO2e/kg)			Embodied Carbon t(CO2e)				Total EC t(CO2e)		
Stage of works	Material	Units values to input in conversion to tonnes cell	Value to Convert to Tonnes	Quantity(t)	A1-3	A4	A5w	A1-3	A4	A5w	A1-5w	A1-5w		
Foundation Excavation & Backfill	**Soil assumed 5% cement content.** 1m3 = 1.9 tonnes of clay soil. Ref:	**input value in m3** (in 'conversion to tonnes' cell)	7.8	18.1116	0.061	0.005	0.004452	1.1048	0.0906	0.0806	1.275998443	Foundation Excavation & Backfill	1.275998443	
Foundation	**Asphalt, 8% (Bitumen) binder content** (by mass) weighted @ 2322kg / m3	**input value in m3** (in 'conversion to tonnes' cell)	23.1	53.6382	0.086	0.005	0.005777	4.6129	0.2682	0.3099	5.190944081	Foundation	5.190944081	
	PVC Pipes (Waste water) weight @ 0.72kg / m	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.23	0.005	0.172409	0	0	0	0		0	
	Concrete Kerb 26.74 linear meters per m3	**input value in m3** (in 'conversion to tonnes' cell)	0.2	0.2	0.1880	0.005	0.00211	0.0376	0.001	0.0004	0.039022		0.039022	
	Limestone Aggregate, 2650kg/m3	**input value in m3** (in 'conversion to tonnes' cell)	13	34.45	0.0050	0.005	0.001484	0.1723	0.1723	0.0511	0.3956238		0.3956238	
Reinforced Concrete	**Ready mix concrete 32/40**. 2350kg / m3	**input value in m3** (in 'conversion to tonnes' cell)	20	47	0.1320	0.005	0.008215	6.204	0.235	0.3861	6.825105	Reinforced Concrete	6.825105	
	Rebar (New) weighted @ H10 = 0.62kg / m	**input value in meters** (in 'conversion to tonnes' cell)	0.75	0.75	2.7700	0.032	0.14946	2.0775	0.024	0.1121	2.213595		2.213595	
	Rebar (New) weighted @ H12 = 0.89kg / m	**input value in meters** (in 'conversion to tonnes' cell)	0.15	0.3	2.7700	0.032	0.14946	0.831	0.0096	0.0448	0.885438		0.885438	
	Rebar (New) weighted @ H20 = 2.47kg / m	**input value in meters** (in 'conversion to tonnes' cell)	0	0	2.7700	0.032	0.14946	0	0	0	0		0	
Steelwork	**Stainless Steel Windposts Grade 304** weighted @ 37.5kg / m	**input value in meters** (in 'conversion to tonnes' cell)	0	0	6.1500	0.032	0.062	0	0	0	0	Steelwork	0	
	Steel General (New) weighted @ 7900kg / m3 (contractor weights for materials on steel is a must)	**input value in kg** (in 'conversion to tonnes' cell)	3200	3.2	2.8900	0.032	0.0294	9.248	0.1024	0.0941	9.44448		9.44448	
	Mild Steel Fencing weighted @ 25kg per linear meter	**input value in meters** (in 'conversion to tonnes' cell)	0	0	1.5300	0.005	0.01553	0	0	0	0		0	
Superstructure	**Clay Brick** (2000kg / m3)	**input value in kg** (in 'conversion to tonnes' cell)	500	0.5	0.2400	0.005	0.06575	0.12	0.0025	0.0329	0.155375	Superstructure	0.155375	
	Louvres RSH5700 edition / weighted @ 25kg/m2 (Assumed alluminium frame)	**input value in kg** (in 'conversion to tonnes' cell)	0	0	12.7900	0.032	0.1284	0	0	0	0		0	
	Mineral wool insulation, Rockwool RW3, weighted at 60kg/m3	**input value in kg** (in 'conversion to tonnes' cell)	108	0.108	1.2800	0.005	0.069059	0.1382	0.0005	0.0075	0.146238372		0.146238372	
	Autoclaved Aerated Concrete Block 600kg / m3	**input value in kg** (in 'conversion to tonnes' cell)	0	0	0.3750	0.005	0.0995	0	0	0	0		0	
Roof	**Timber truss** weight @ 3kg / m	**input value in kg** (in 'conversion to tonnes' cell)	0	0	0.4200	0.005	0.12847	0	0	0	0	Roof	0	
	Concrete roof tiles weighted @ 3kg / m2	**input value in kg** (in 'conversion to tonnes' cell)	0	0	0.1000	0.005	0.00123	0	0	0	0		0	
	Concrete Roof Columns weighted @ 355kg / m	**input value in meters** (in 'conversion to tonnes' cell)	0	0	0.1880	0.005	0.00211	0	0	0	0		0	
	PVC Pipes (weight @ 0.72kg / m)	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.2300	0.005	0.172409	0	0	0	0		0	
Cable Excavation & Backfill	**Soil assumed 5% cement content.** 1m3 = 1.9 tonnes of clay soil. Ref: (https://coolconversion.com/volume-mass-construction/~1~cubic-meter~of~clay-soil~to~tonne)	**input value in m3** (in 'conversion to tonnes' cell)	277.2	52.668	0.0610	0.005	0.004452	3.2127	0.2633	0.2345	3.710565936	Excavation & Backfill	3.710565936	'assumed removal of 10% excavated material and backfill'
Cables	**Cable Ducts PVC-3 Phases** - ave weight 3.3kg / m	**input value in meters** (in 'conversion to tonnes' cell)	462	1.5246	3.2300	0.005	0.172409	4.9245	0.0076	0.2629	5.194935761	Cables	5.194935761	Until manufacturers ECF values are available the ECF value for New Copper is used for Power Cables. Multicore cables are assummed to be 80% copper, 20% PVC by weight.
	Single Core Cable 33kV - 3 Phases : ave weight @ 15.6kg/m	**input value in meters** (in 'conversion to tonnes' cell)	462	7.2072	3.8100	0.16	0.03988	27.459	1.1532	0.2874	28.90000714		28.90000714	
	Single Core Cable 6.6 / 11kV - 3 Phases : av weight @ xxkg/m	**input value in meters** (in 'conversion to tonnes' cell)	0	0	3.8100	0.032	0.0386	0	0	0	0		0	
	Muilticore Cable : av weight @ 1.5kg/m	**input value in meters** (in 'conversion to tonnes' cell)	860	1.29	3.7000	0.032	0.0375	4.773	0.0413	0.0484	4.862655		4.862655	
Transformers	**Transformer 33kV**	**input value in Tonnes** (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0	Transformers	0	
	Transformer 132kV	**input value in Tonnes** (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0		0	
	Transformer EAT	**input value in Tonnes** (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0		0	
Switchgear	**33kV Switchgear:** ave weight 730kg	**input value in Tonnes** (in 'conversion to tonnes' cell)	14	4.83	3.5429	0.5173	0.0408	17.112	2.4984	0.197	19.80750249	Switchgear	19.80750249	33kV Switchgear based on manufacturer's information for similar switchgear
	Protection Panels: ave weight 260kg	**input value in Tonnes** (in 'conversion to tonnes' cell)	2	0.52	3.0300	0.032	0.0308	1.5756	0.0166	0.016	1.608256		1.608256	
		input value in Tonnes (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0		0	
		input value in Tonnes (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0		0	
		input value in Tonnes (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0		0	
		input value in Tonnes (in 'conversion to tonnes' cell)	0	0		0.16	0.00178	0	0	0	0		0	

Calculation Notes:	
Weight of structural Timber (Excluding temp works):	tonnes
Weight of Temporary Timber (formworks, Assumed reuse):	tonnes
Foundation -Trench Excavations	At Length[**2.5**] m x Width[**2.1**] m x Depth[**1.5**] m = [**7.8**] m3
Cables - Trench Excavtions	At Length[**462**] m x Width[**0.4**] m x Depth[**1.5**] m = [**277.2**] m3
Power Cable circuit lengths	462m circuit length in total. Does not include GT cabling which was part of GT project.

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 and what they indicate.

Low		Medium		High
0	12.5	25	37.5	50

The **notes table** to the left can be used to help **breakdown** and **review calculations**. The **structural timber** values in **tonnes** can be used to **calculate** the **sequestration value**, this is used to calculate the **amount** of **carbon storage throughout the builds life cycle** **Example: 20 tonnes of structural timer x -1.64 kg(CO2e) = -32.8t(CO2e).** For more information see notes calculation A1-5 on the tab below.

Reference note:	**Calculations & Embodied Carbon factors for materials used in the tableare sourced from the Brisa (ICE) & IstructE**
Ref for material Emobdied 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)

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**

Project Photographs / Drawings