

The Geeky Stuff

*Accurate Calculation of Embodied
Carbon and Energy*

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eCO² & eEnergy

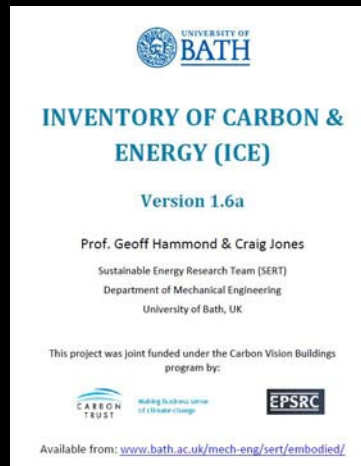


Test Building - Revit

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Data from University of Bath

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eCO² & eEnergy

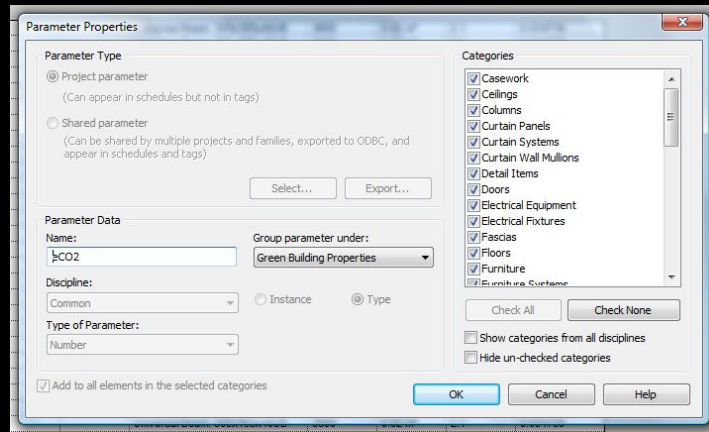
Material Profile: Concrete						
Embodied Energy (EE) Database Statistics - MJ/kg						
Material	No. Records	Average EE	Standard Deviation	Minimum EE	Maximum EE	Comments on the Database Statistics
Concrete, General	100	0.85	0.08	0.50	1.20	None
Concrete, Structural	80	0.85	0.08	0.50	1.20	
Concrete, Precast	10	0.85	0.08	0.50	1.20	
Concrete, Non-structural	10	0.85	0.08	0.50	1.20	
Concrete, Slab	10	0.85	0.08	0.50	1.20	
Selected Embodied Energy & Carbon Values and Associated Data						
Boundaries	Cradle to Gate	Data Range		(± 30%)		Specific Comments
Material	Embodied Energy - MJ/kg	Embodied Carbon - kg CO2/kg				
General Concrete	0.85	0.130		Detection of a specific concrete type will give greater accuracy, please see comments.		
1:1.2 Cement Sand Aggregate	1.20	0.200		(High strength)		
1:1.5:3	1.11	0.190		(used in floor slabs, columns & load bearing structures)		
1:2:4	0.80	0.100		(Typical in construction of buildings under 3 storeys)		
1:2.5:5	0.84	0.100				
1:3:6	0.77	0.090		(non-structural mass concrete)		
1:4:8	0.69	0.080				
REINFORCED CONCRETE (ICE CMR Model Values)						
For reinforcement add to selected coefficient for each 20kg steel reinforcement	0.26	0.018		For each 20 kg steel per m2 concrete		
EXAMPLE: Reinforced RCC (see below with 100kg steel)	2.12 (1.86 + 0.26 * 4)	0.341 (0.103 + 0.238 * 4)				
CONCRETE BLOCKS (ICE CMR Model Values)						
Block - 8 MPa Compressive Strength	0	0.001				
Block - 10 MPa	0.67	0.014				
Block - 12 MPa	0.71	0.000		Extrapolated from the concrete block mix proportions with a small allowance added for concrete block saving.		
Block - 15 MPa	0.81	0.000				
Unreinforced Aerated Blocks	0.80	0.08 to 0.10		See ICE CMR model results.		

Typical Data

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eCO²

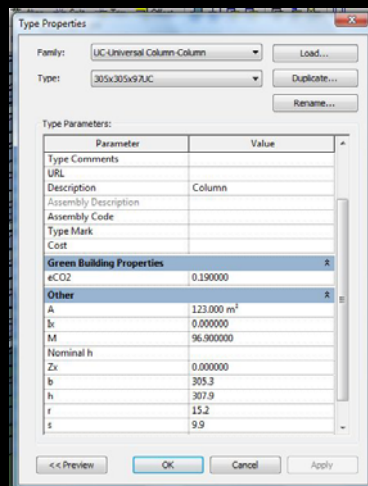


Create Parameter

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eCO²



Add Value to Parameter for Element

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[illegible]

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The screenshot shows the 'Schedule Properties' dialog box in Revit. The 'Fields' tab is active. In the 'Available fields' list, 'Analyze As' is selected. A 'Calculated Value' dialog box is open over the main dialog. In this sub-dialog, the 'Name' is 'Calculated eCO2', the 'Discipline' is 'Common', the 'Type' is 'Number', and the 'Formula' is 'Volume / 1 m³ * eCO2'. The 'Formula' field is highlighted with a blue selection box.

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eCO²

Structural Column Schedule						
Count	Description	Family and Type	Length	Volume	eCO2/m³	Calculated eCO2
1	Column	UC-Universal Column-Column: 305x305x9TUC	23891	0.29 m³	0.19	0.055137
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Column eCO² in Schedule

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and Framing eCO² in Schedule

eCO²

Floor Schedule						
Area	Count	Description	eCO2/m3	Family and Type	Level	Volume
716 m²	1		3.6	Floor: Beam and Block 225mm Susp Ground	Level 0	229.13 m³
716 m²	1		3.6	Floor: Beam and Block 225mm Susp Ground	Level 1	229.13 m³
716 m²	1		3.6	Floor: Beam and Block 225mm Susp Ground	Level 2	229.13 m³
716 m²	1		3.6	Floor: Beam and Block 225mm Susp Ground	Level 3	229.13 m³
716 m²	1		3.6	Floor: Beam and Block 225mm Susp Ground	Level 4	229.13 m³
397 m²	1		3.6	Floor: Beam and Block 225mm Susp Ground	Level 5	127.18 m³

...and Slab eCO² in Schedule

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Analysis of Output

Summary Sheet

	eCO2	eEnergy	eWaste
Columns	3.47 kg CO2	7654.00 kJ	
Slabs	4582.11 kg CO2	45654.00 kJ	
Framing	22.94 kg CO2	654.00 kJ	
Facade Panels	394.00 kg CO2	6544.00 kJ	
Doors	218.54 kg CO2	397.00 kJ	
Floor Finishes	294.33 kg CO2	8765.00 kJ	
Wall Finishes	32.77 kg CO2	873.00 kJ	
Ductwork	308.45 kg CO2	8765.00 kJ	
Pipework	1084.34 kg CO2	3457.00 kJ	
Light Fittings	633.70 kg CO2	765.00 kJ	
Containment etc.	295.00 kg CO2	234.00 kJ	
Total eCO2	7869.65 kg CO2	83762.00 kJ	

Totals:	By Area	By Volume
eCO2	1.79 kg CO2/m2	0.48 kg CO2/m3
eEnergy	19.08 kJ/m2	5.14 kJ/m3

Room Schedule

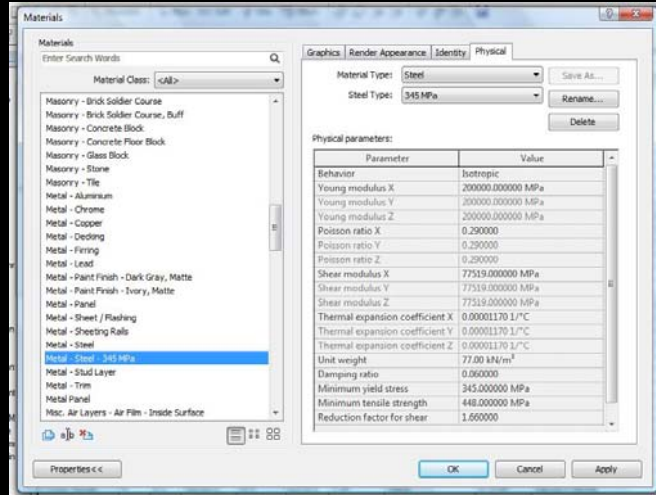
Level	Area	Count	Number	Perimeter	Unbounded Height	Volume
Level 0	716.00	1	2	109216	4000	2787.49
Level 1	716.00	1	3	109216	4000	2636.27
Level 2	716.00	1	4	109216	4000	2636.27
Level 3	716.00	1	5	109216	4000	2636.27
Level 4	562.00	1	6	95097	4000	2067.09
Level 5	561.00	1	7	138219	4000	2058.78
Level 6	403.00	1	8	80606	4000	1463.21
Totals	4390.00					16285.38

In Excel, data from Revit model

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Analysis of Output



Revit Materials Database

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Analysis of Output



Access Relational Database

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Analysis of Output

F1		eCO2				
A	B	C		D	E	F
1	Id	Keynote	Name	Description	Cost	eCO2
2	23		Default			
3	24		Default Wall			
4	25		Default Roof			
5	26 L40		Glass			
6	27		Phase - Demo			
7	28		Phase - Exist			
8	29		Phase - Temporary			
9	414 F10		Masonry - Brick		0	
10	415 F10		Masonry - Concrete Block			
11	416 K10		Metal - Stud Layer			
12	417 K11		Wood - Sheathing - plywood			
13	418		Misc. Air Layers - Air Space			
14	419		Air Barrier - Air Infiltration Barrier			
15	420 P11		Insulation / Thermal Barriers - Rigid insulation			
16	421		Vapour / Moisture Barriers - Vapour Retarder			
17	422		Vapour / Moisture Barriers - Damp-proofing			
18	423 K10		Plasterboard	Interior finish		
19	424		Insulation / Thermal Barriers - Cavity Fill			
20	519		Site - Earth			
21	520 Q30		Site - Grass			
22	521 Q22		Site - Tarmacadam			
23	522		Site - Sand			
24	523 E10/132		Concrete - Cast In Situ			
25	524 F11		Masonry - Glass Block			
26	525 F		Masonry - Stone			
27	526 F		Masonry - Tile			

Exported Materials Database

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Analysis of Output

A1		f6		ElementId	
A	B	C	D	E	
ElementId	MaterialId	Area	Volume		
183331	532	42.81631	0.294945		
183332	532	42.81631	0.294945		
183333	532	42.81631	0.294945		
183334	532	42.81631	0.294945		
183335	532	42.81631	0.294945		
183336	532	42.81631	0.294945		
183337	532	42.81631	0.294945		
183338	532	42.81631	0.294945		
183339	532	42.81631	0.294945		
183340	532	42.81631	0.294945		
183341	532	42.81631	0.294945		
183342	532	42.81631	0.294945		
183343	532	42.81631	0.294945		
183344	532	42.81631	0.294945		
183345	532	42.81631	0.294945		
183346	532	42.81631	0.294945		
183347	532	42.81631	0.294945		
183348	532	42.81631	0.294945		
183349	532	42.81631	0.294945		
183350	532	42.81631	0.294945		
183351	532	42.81631	0.294945		
183352	532	42.81631	0.294945		
183353	532	42.81631	0.294945		
183354	532	42.81631	0.294945		
183355	532	42.81631	0.294945		
183356	532	42.81631	0.294945		

Exported Material Quantities

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Automating the Values

☒	Material	eCO2/kg	eEnergy/kg	eWaste/kg
☐ 1	Structural Steel	0.1900	200.0000	0.1
☐ 2	Concrete Generic	2.0000	400.0000	0.2
☐ 3	Concrete Cast in-situ	3.2000	600.0000	0.4
☐ 4	Concrete Cast in-situ Lightweight	2.2000	500.0000	0.4
☐ 5	Concrete Glass Reinforced	2.8000	1,000.0000	1
☐ 6	Concrete Precast	1.6000	350.0000	0.1
☐ 7	Concrete Screed	2.0000	300.0000	0.2
☐ 8				
☐ 9				

Access Database to drive Material parameters