ZGF

PORTLAND STATE UNIVERSITY :: SCHOOL OF ARCHITECTURE

Embodied Carbon of Wall Assemblies

Tally

12" Cast In Place Concrete	5728
4" Spray Foam	1690.9
Exterior Grade Plywood	114.8
3 5/8" Metal Stud	248.8
5/8" Gypsum	148.5

7961

EC3

12" Cast In Place Concrete	6561.2
4" Spray Foam	1534.3
Exterior Grade Plywood	350
3 5/8" Metal Stud	113.1
5/8" Gypsum	153.9

8712.5

Mass Wall - Cast In Place

Tally

Stone	3912.3
3" Mineral Wool	697.5
WRB	201
Exterior Grade Plywood	114.8
2" x 6" Wood Stud with MW Fill	283.5
5/8" Gypsum	148.5

5357.9

EC3

Stone	1280
3" Mineral Wool	220.1
WRB	61.1
Exterior Grade Plywood	350
2" x 6" Wood Stud	194
3" Mineral Wool	132.7
5/8" Gypsum	153.9

2391.8

Dual Insualtion - Stone Veneer

Tally

Brick	2154.2
3" Mineral Wool	697.5
WRB	201
Exterior Grade Plywood	114.8
2" x 6" Wood Stud with MW Fill	283.5
5/8" Gypsum	148.5

3599.5

EC3

Brick	2670
3" Mineral Wool	220.1
WRB	61.1
Exterior Grade Plywood	350
2" x 6" Wood Stud	194
3" Mineral Wool	132.7
5/8" Gypsum	153.9

3781.8

Dual Insualtion - Brick Veneer

Tally

6" Precast Concrete	2179.5
WRB	201
3 5/8" Metal Stud with MW Fill	249.7
5/8" Gypsum	151.5

2781.7

EC3

6" Precast Concrete	2179.5
WRB	61.1
Mineral Wool	81
3 5/8" Metal Stud	252
5/8" Gypsum	161

2734.6

Mass Wall - Precast Concrete

Tally

Metal Panel	1158.1
3" Mineral Wool	697.5
WRB	201
Exterior Grade Plywood	114.8
2" x 6" Wood Stud with MW Fill	283.5
5/8" Gypsum	148.5

2603.4

EC3

Metal Panel	2660.3
3" Mineral Wool	220.1
WRB	61.1
Exterior Grade Plywood	350
2" x 6" Wood Stud	194
3" Mineral Wool	132.7
5/8" Gypsum	153.9

3772.1

Dual Insulation - Metal Shingle

Tally — Average GWP A1 - A3

EC3 — GWP A1 - A3

kgCO2e

Assemblies

Tally

3/4" Wood	490.8
3" Mineral Wool	697.5
WRB	201
Exterior Grade Plywood	114.8
2" x 6" Wood Stud with MW Fill	283.5
5/8" Gypsum	148.5

1936.1

EC3

3/4" Wood	158.3
3" Mineral Wool	220.1
WRB	61.1
Exterior Grade Plywood	350
2" x 6" Wood Stud	194
3" Mineral Wool	132.7
5/8" Gypsum	153.9

1270.1

Dual Insulation - Wood Cladding

Tally

Terra Cotta	366.3
3" Mineral Wool	697.5
WRB	201
Exterior Grade Plywood	114.8
2" x 6" Wood Stud with MW Fill	283.5
5/8" Gypsum	148.5

1811.6

Dual Insualtion - Terra Cotta

Tally

Double Pane Glazing	555.7
Spandrel Panel	907.3
Aluminum	1676.3

3139.3

EC3

Double Pane Glazing	598.2
Flat Glass	277.5
Fiberglass Insulation	136.8
Metal Panel	295.6
Aluminum	1932.2

3240.3

Curtain Wall - Double Pane 50% Glazing

Tally

Triple Pane	803.2
Spandrel Panel	907.3
Aluminum	1676.3

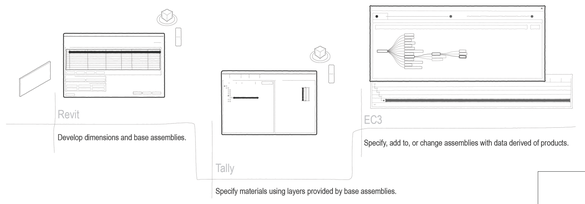
3139.3

EC3

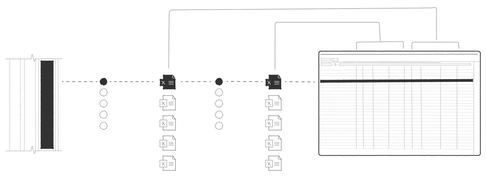
Triple Pane Glazing	907.9
Flat Glass	277.5
Fiberglass Insulation	136.8
Metal Panel	295.6
Aluminum	1932.2

3240.3

Curtain Wall - Triple Pane` 50% Glazing



Work Flow



Abstract

Climate change is asking designers to think about the impact of their design choices, the amount of carbon that is not only being released during operations, but the embodied carbon of materials as well. Embodied carbon refers to the amount of carbon to resource, manufacture, and assemble the item.

Our work focuses around wall assemblies and the embodied carbon of each component. Working with ZGF to make a variable and in depth tool to work with embodied carbon of different materials. This tool will inform their decisions and reduce their carbon impact on the environment in the future.

Methodology

Utilizing Revit we built out the wall assemblies. Making them readily available for Tally, a LCA tool, in which we defined each component from given materials in Tally. Then we pulled the wall assemblies to EC3 where we could compare between Tally and EC3. We assumed a life cycle assessment of only E1-3 in both programs in order to make the results comparable on the same level. This data was taken to Excel to be formatted into a tool in the future.

Results

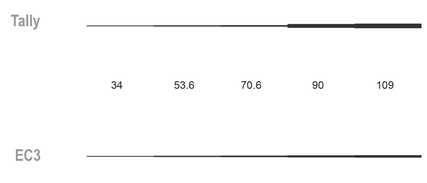
While results differ some between programs, the cladding can make a significant impact to the overall Global Warming Potential (GWP). As expected metal studs have a much higher carbon cost than wood studs. Cast in place concrete has the highest overall GWP within a wall assembly, with the metal in studs and curtain wall mullions having the highest impact per unit. The insulation GWP seems significant as well, with all the options of different insulation solutions, there is potential for reduction in this area. As we use these programs more, the difference between the values seems to lessen. The results appear comparable to one another, when the data is available. Further research should be done into the accuracy of the averages in the future, in particular with relation to location and feasibility of use of those products.

Metal Stud — GWP A1 - A3 — kgCO2e

3 5/8"	4"	6"	8"	10"	12"
249.71	667.21	858.54	1044.97	1304.98	1496.31

Wood Stud — GWP A1 - A3 — kgCO2e

2" x 4"	2" x 6"	2" x 8"	2" x 10"	2" x 12"
32.15	50.52	66.62	84.99	103.36



Cladding