APPENDIX A

FOOTNOTES TO EMERGY EVALUATION TABLES

OF SELECTED BUILDING MATERIALS

Table A.1. Footnotes to Table 6.1: Emergy evaluation of marble tiles (without services).

1	Marble		
	Input	0.084 m^3	From Nicoletti *et al.* (2002), p. 289, figure 3
	(input m^3) x (2750 kg/m^3)	231.000 kg	Density of granite from Zhang (2005), p. 40, table 3.8
	Gram equivalent	2.31 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.45 E+09 seJ/g	Same as metamorphic rocks from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.44 E+09 seJ/g	
2	Water (industry)		
	Input	66.4 l	From Nicoletti *et al.* (2002), p. 289, figure 3
	(input l)*(0,001 m^3)	0.0664 m^3	
	Water density	1000 kg/m^3	
	(input m^3) x (water density m^3)	66.4 kg	
	Gram equivalent	6.64 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
3	Electricity		
	Input	12.42 kWh	From Nicoletti *et al.* (2002), p.290, table 6
	(input kWh) x (3,6 MJ)	44.712 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	4.47 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
4	Thermal energy (mostly oil fuels)		
	Input	9.10 MJ	From Nicoletti *et al.* (2002), p. 290, table 6
	Joule equivalent	9.10 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11E+05 seJ/J	

Table A.2. Footnotes to Table 6.2: Emergy evaluation of granite tiles (without services).

	Granite		
	Input	0.084 m^3	Adapted from Nicoletti *et al.* (2002), p. 289, figure 3
	(input m^3) x (2667 kg/m^3)	224.028 kg	Mean density of granite from Zhang (2005), p. 40, table 3.8
	Gram equivalent	2.24 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	5.00 E+08 seJ/g	From Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.40 E+08 seJ/g	
2	Water (industry)		
	Input	66.4 l	Adapted from Nicoletti *et al.* (2002), p. 289, figure 3
	(input l)*(0,001 m^3)	0.0664 m^3	
	Water density	1000 kg/m^3	
	(input m^3) x (water density m^3)	66.4 kg	
	Gram equivalent	6.64 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
3	Electricity		
	Input	12.42 kWh	Adapted from Nicoletti *et al.* (2002), p.290, table 6
	(input kWh) x (3,6 MJ)	44.712 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	4.47 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
4	Thermal energy (mostly oil fuels)		
	Input	9.10 MJ	Adapted from Nicoletti *et al.* (2002), p. 290, table 6
	Joule equivalent	9.10 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12E+05 seJ/J	

Table A.3. Footnotes to Table 6.3: Emergy evaluation of ceramic tiles (without services).

1	Clay		
	Input	8.8 kg	From Nicoletti *et al.* (2002), p. 287, table 2
	Gram equivalent	8.80 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.36 E+09 seJ/g	
2	Feldspars		
	Input	4.89 kg	From Nicoletti *et al.* (2002), p. 287, table 2
	Gram equivalent	4.89 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	5.00 E+08 seJ/g	Assumed same as granitic rocks, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.40 E+08 seJ/g	
3	Limestone		
	Input	2.93 kg	From Nicoletti *et al.* (2002), p. 287, table 2
	Gram equivalent	2.93 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
4	Siliceous sand		
	Input	2.81 kg	From Nicoletti *et al.* (2002), p. 287, table 2
	Gram equivalent	2.81 E+03 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
5	Frit (glazing)		
	Input	1.13 kg	From Nicoletti *et al.* (2002), p. 287, table 2 and table 4
	Gram equivalent	1.13 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	

Table A.3. Continued.

6	Water (industry)		
	Input	0.024 m^3	From Nicoletti *et al.* (2002), p. 287, table 2
	Water density	1000 kg/m^3	
	(input m^3) x (water density kg/m^3)	24.0 kg	
	Gram equivalent	2.40 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
7	Electricity		
	Input	5.63 kWh	From Nicoletti *et al.* (2002), p. 288, table 5
	(input kWh) x (3,6 MJ)	20.268 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	2.03 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
8	Oil fuels		
	Input	2.24 MJ	From Nicoletti *et al.* (2002), p. 288, table 5
	Joule equivalent	2.24 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
9	Natural gas		
	Input	51.97 MJ	From Nicoletti *et al.* (2002), p. 288, table 5
	Joule equivalent	5.20 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.06 E+04 seJ/J	
10	Methane		
	Input	52.92 MJ	From Nicoletti *et al.* (2002), p. 288, table 5
	Joule equivalent	5.29 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	Assumed same as natural gas, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.06+04 seJ/J	

Table A.4. Footnotes to Table 6.4: Emergy evaluation of stucco (without services).

1	Gypsum		
	Input	1228.00 kg	From Fisher (2008), p. 29, table 6.3
	Gram equivalent	1.23 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Brown & McClanahan (1996), p. 114, table 1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
2	Electricity		
	Input	32.70 kWh	From Fisher (2008), p. 29, table 6.3
	(input kWh) x (3,6 MJ)	117.72 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	1.18 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
3	Natural gas		
	Input	21.10	From Fisher (2008), p. 29, table 6.3
	(input kWh) x (3,6 MJ)	8.71 E+02 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	8.71 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.06 E+04 seJ/J	
4	LPG		
	Input	26.90 kWh	From Fisher (2008), p. 29, table 6.3
	(input kWh) x (3,6 MJ)	96.84 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	9.68 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.5. Footnotes to Table 6.5: Emergy evaluation of facing paper (without services).

1	Virgin paper		
	Input	19.80 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	1.98 E+04 g	
	HHV brown paper	1.79 E+04 J/g	From Goel (2008), p. A4-1
	Joule equivalent (input x HHV)	3.55 E+08 J	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.61 E+05 seJ/J	From Pulselli *et al.* (2007), p. 6, table 2
2	Recycled paper		
	Input	1030,00 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	1.98 E+04 g	
	HHV brown paper	1.79 E+04 J/g	From Goel (2008), p. A4-1
	Joule equivalent (input x HHV)	1.85 E+10 J	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.61 E+05 seJ/J	Assumed same as paper from Pulselli *et al.* (2007), p. 6, table 2
3	Starch		
	Input	6.80 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	6.80 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as glue and adhesives, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
4	Biocide		
	Input	9.00 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	9.00 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
5	Dyes		
	Input	0.30 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	3.00 E+01 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	

Table A.5. Continued.

6	ASA sizing		
	Input	2.30 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	2.30 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
7	Retention polymer		
	Input	0.70 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	7.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
8	Antifoaming agent		
	Input	0.30 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	3.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
9	Aluminum oxide		
	Input	4.80 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	4.80 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
10	Water (mains and river)		
	Input	7105 l	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	7.11 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.23 E+05 seJ/g	From Buenfil (2001), p. 223, table D-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	5.43 E+06 seJ/g	

Table A.5. Continued.

11	Electricity		
	Input	541.80 kWh	From Fisher (2008), p. 28, table 6.2
	(input kWh) x (3,6 MJ)	1950.48 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	1.95 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
12	Oil fuels		
	Input	0.50 l	From Fisher (2008), p. 28, table 6.2
	MJ equivalent (input l) x (38.7 MJ/l)	2.07 E+01 MJ	
	Joule equivalent	2.07 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
13	Natural gas		
	Input	54.40 m^3	From Fisher (2008), p. 28, table 6.2
	MJ equivalent (input m^3 x 41.3 MJ/m^3)	2.25 E+03 MJ	
	Joule equivalent	2.25 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.06+04 seJ/J	

Table A.6. Footnotes to Table 6.6: Emergy evaluation of plasterboard panel (without services).

1	Stucco		
	Input	859.00 kg	From Fisher (2008), p. 29, Table 7.4
	Gram equivalent	8.59 E+05 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.18 E+09 seJ/g	From this study, Table 6.4
2	Facing paper		
	Input	47.00 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	4.70 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.57 E+09 seJ/g	From this study, Table 6.5
3	Corn starch		
	Input	4.00 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	4.00 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as glue and adhesives, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
4	Potassium sulphate		
	Input	0.70 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	7.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.10 E+09 seJ/g	Assumed same as potassium fertilizer, from Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.85 E+09 seJ/g	
5	Fluidiser		
	Input	0.60 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	0.60 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	

Table A.6. - Continued.

6	Detergent (soap)		
	Input	0.10 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	1.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
7	Edge glue		
	Input	0.20 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	2.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as glue and adhesives, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
8	Waste paper		
	Input	1.70 kg	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	1.70 E+03 g	
	HHV brown paper	1.79 E+04 J/g	From Goel (2008), p. A4-1
	Joule equivalent (input x HHV)	3.05 E+07 J	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.61 E+05 seJ/J	Assumed same as paper from Pulselli *et al.* (2007), p. 6, table 2
9	Copper sulphate		
	Input	0.20 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	2.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
10	Lignin sulphonate		
	Input	1.70 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	1.70 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	

Table A.6. Continued.

11	Ink		
	Input	0.01 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	1.00 E+01 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.85 E+09 seJ/g	Assumed same as paint, from Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.11 E+09 seJ/g	
12	Nealit (finely ground gypsum)		
	Input	5.20 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	5.20 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as gypsum, from Brown & McClanahan (1996), p. 114, table 1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
13	Dextrose		
	Input	0.90 kg	From Fisher (2008), p. 29, table 6.4
	Gram equivalent	9.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
14	Water (mains)		
	Input	7526.00 l	From Fisher (2008), p. 28, table 6.2
	Gram equivalent	5.26 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al.* (2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
15	Electricity		
	Input	25 kWh	From Fisher (2008), p. 29, table 6.4
	(input kWh) x (3,6 MJ)	90.00 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	9.00 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	

Table A.6. Continued.

16	Natural gas		
	Input	49.00 m^3	From Fisher (2008), p. 29, table 6.4
	MJ equivalent (input m^3 x 41.3 MJ/m^3)	2.02 E+03 MJ	From this study
	Joule equivalent	2.02 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.07+04 seJ/J	

Table A.7. Footnotes to Table 6.7: Emergy evaluation of finished plasterboard panel (without services).

1	Plasterboard		
	Input	10.20 kg	From Iberplaco (2004)
	Gram equivalent	1.02 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.43 E+09 seJ/g	From this study, Table 6.6
2	Gypsum		
	Input	0.33 kg	From Iberplaco (2004)
	Gram equivalent	3.30 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Brown & McClanahan (1996), p. 114, table 1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Water (potable)		
	Input	0.165 kg	From Iberplaco (2004)
	Gram equivalent	1.65 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	

Table A.8. Footnotes to Table 6.8: Emergy evaluation of Portland cement (average system production without services).

1	Limestone		
	Input	1165 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	1.17 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
2	Cement rock		
	Input	207 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	2.07 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as limestone, from Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Shale		
	Input	52 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	5.20 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
4	Clay		
	Input	60 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	6.00 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.36 E+09 seJ/g	
5	Bottom ash		
	Input	10 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	1.00 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	8.30 E+08 seJ/g	Assumed same as fly ash, from Wang *et al.* (2006) p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.39 E+09 seJ/g	

Table A.8. Continued.

6	Foundry sand		
	Input	4 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	4.00 E+03 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	Assumed same as sand, from Campbell *et al.* (2005), p. B-2, table B1.1
7	Sand		
	Input	40 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	4.00 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
8	Iron ore		
	Input	14 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	1.40 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.22 E+09 seJ/g	From Buranakarn (1998), p. 142, table A-2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.05 E+09 seJ/g	
9	Blast furnace slag		
	Input	20 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	2.00 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.61 E+09 seJ/g	From Buranakarn (1998), p. 142, table A-2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+10 seJ/g	
10	Slate		
	Input	1 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	1.00 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.45 E+09 seJ/g	Assumed same as metamorphic rocks, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.44 E+09 seJ/g	
11	Other raw materials		Mainly minerals: bauxite, dolomite, lime, quartz, pozzolan, and silica
	Input	26 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	2.60 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as general minerals, from Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	

Table A.8. Continued.

12	Gypsum		
	Input	49 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	4.90 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Brown & McClanahan (1996), p. 114, table 1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
13	Water (process)		
	Input	88 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Gram equivalent	8.80 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
14	Water (non process)		
	Input	752 kg	From Marceau *et al.* (2006) p. 13, table 9a
	Grams equivalent	7.52 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
15	Electricity		
	Input	144 kWh	From Marceau *et al.* (2006) p. 18, table 14a
	(input kWh) x (3,6 MJ)	5.18 E+02 MJ	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	5.18 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	

Table A.8. Continued.

16	Coal		
	Input	107 kg	From Marceau *et al.* (2006) p. 18, table 14a
	Input gram equivalent	107000 g	
	HHV	21.352 E+06 Btu/short ton	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 short ton x 907200 g)	2.48 E+04 J/g	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-10, table B.12
	(input g) x (HHV J/g)	2.66 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.40 E+04 seJ/J	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.72 E+04 seJ/J	
17	Gasoline		
	Input	0.133 l	From Marceau *et al.* (2006) p. 18, table 14a
	HHV	125000 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.48 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/l)	4.63 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
18	Liquefied petroleum gas		
	Input	0.0143 l	From Marceau *et al.* (2006) p. 18, table 14a
	HHV	91300 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	2.54 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	3.64 E+05 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	7.00 E+04 seJ/J	From Buranakarn (1998), p. 139, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.18 E+05 seJ/J	

Table A.8. Continued.

19	Middle distillates		
	Input	1.066 l	From Marceau *et al.* (2006) p. 18, table 14a
	HHV	138700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.87 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	4.12 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Assumed same as fuel oils, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
20	Natural gas		
	Input	5.569 m^3	From Marceau *et al.* (2006) p. 18, table 14a
	HHV	1109 Btu/ft^3	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 ft^3 x 0,0283 m^3)	4.13 E+07 J/m^3	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-7, table B.8
	(input m^3) x (HHV J/m^3)	2.30 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.06 E+04 seJ/J	
21	Petroleum coke		
	Input	3800.0 kcal	From Marceau *et al.* (2006) p. 18, table 14a
	Bulk density	880 kg/m^3	
	Or 1 m^3 = 1000 l	0.88 kg/l	
	Input litre equivalent	25.34 l	
	HHV	143400 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	4.00 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	1.01 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	5.40 E+04 seJ/J	Caruso *et al.* (2001), p. 270, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	9.07 E+04 seJ/J	

Table A.8. Continued.

22	Residual oil		
	Input	0.0442 l	From Marceau *et al.* (2006) p. 18, table 14a
	HHV	149700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	4.17 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	1.84 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Assumed as fuel oils, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.9. Footnotes to Table 6.9: Emergy evaluation of concrete C20/25 (without services).

1	Sand		
	Input	0.391 m^3	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	Mass	1602 kg/m^3	
	Kilogram equivalent	626.38 kg	
	Gram equivalent	6.26 E+05 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
2	Gravel		
	Input	0.676 m^3	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	Mass	1522 kg/m^3	
	Kilogram equivalent	1028.87 kg	
	Gram equivalent	1.03 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.36 E+09 seJ/g	
3	Aggregates		
	Input	0.391 m^3	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	Mass	1682 kg/m^3	
	Kilogram equivalent	657.66 kg	
	Gram equivalent	6.58 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.36 E+09 seJ/g	
4	Portland cement		
	Input	300 kg	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	Gram equivalent	3.00 E+05 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.53 E+09 seJ/g	From this study, Table 6.8

Table A.9. Continued.

5	Water (potable)		
	Input	0.316 m^3	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	Water density	1000 kg/m^3	
	(Input m^3) x (water density kg/m^3)	316 kg	
	Gram equivalent	3.16 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	
6	Diesel		
	Input	0.975 l	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	HHV	138700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.87 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	3.77 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.10. Footnotes to Table 6.10: Emergy evaluation of mortar (without services).

1	Sand		
	Input	1.064 m^3	From Manso *et al.* (1997), p. 1217, table IC-2691
	Mass	1602 kg/m^3	
	Kilogram equivalent	1704.53 kg	
	Gram equivalent	1.70 E+06 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
2	Portland cement		
	Input	298 kg	From Manso *et al.* (1997), p. 1217, table IC-2691
	Gram equivalent	2.98 E+05 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.53 E+09 seJ/g	From this study, Table 6.8
3	Water (potable)		
	Input	0.316 m^3	From Manso *et al.* (1997), p. 1217, table IC-2691
	Water density	1000 kg/m^3	
	(Input m^3) x (water density kg/m^3)	316 kg	
	Gram equivalent	3.16 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	
4	Diesel		
	Input	0.975 l	From Manso *et al.* (1997), p. 1217, table IC-2691
	HHV	138700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.87 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	3.77 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.11. Footnotes to Table 6.11: Emergy evaluation of rendering mortar (without services).

1	Sand		
	Input	0.015 m^3	From Manso *et al.* (1997), p. 1224, table IC-2709
	Mass	1602 kg/m^3	
	Kilogram equivalent	24.03 kg	
	Gram equivalent	2.40 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
2	Lime		
	Input	4.2 kg	From Manso *et al.* (1997), p. 1224, table IC-2709
	Gram equivalent	4.20 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Portland cement		
	Input	4.2 kg	From Manso *et al.* (1997), p. 1224, table IC-2709
	Gram equivalent	4.20 E+03 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.53 E+09 seJ/g	From this study, Table 6.8
4	Water (potable)		
	Input	0.007 m^3	From Manso *et al.* (1997), p. 1224, table IC-2709
	Water density	1000 kg/m^3	
	(Input m^3) x (water density kg/m^3)	7 kg	
	Grams equivalent	7.00 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	

Table A.11. Continued.

5	Diesel		
	Input	0.975 l	From Manso *et al.* (1997), p. 1224, table IC-2709
	HHV	138700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.87 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	3.77 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.12. Footnotes to Table 6.12: Emergy evaluation of finished plaster (without services).

1	Lime		
	Input	1.75 kg	From Manso *et al.* (1997), p. 1224, table IC-2709
	Gram equivalent	1.75 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
2	Gypsum		
	Input	0.90 kg	From Manso *et al.* (1997), p. 1224, table IC-2709
	Gram equivalent	9.00 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Brown & McClanahan (1996), p. 114, table 1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Water (potable)		
	Input	0.006 m^3	From Manso *et al.* (1997), p. 1212, table IC-2682 3
	Water density	1000 kg/m^3	
	(Input m^3) x (water density kg/m^3)	6.00 kg	
	Gram equivalent	600 E+035 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	

Table A.13. Footnotes to Table 6.13: Emergy evaluation of finished painting (without services).

1	Paint (finishing)		
	Input	0.2 l	From Manso *et al.* (1997), p. 722, table IC-1568
	Mass	1.360 kg/l	From Robbialac (2008)
	Kilogram equivalent	0.274 kg	
	Gram equivalent	2.74 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.85 E+09 seJ/g	Assumed same as paint, from Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.11 E+09 seJ/g	
2	Paint (primary)		
	Input	0.06 l	From Manso *et al.* (1997), p. 722, table IC-1568
	Mass	1.02 kg/l	From Robbialac (2008)
	Kilogram equivalent	0.0612 kg	
	Gram equivalent	6.12 E+01 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.85 E+09 seJ/g	Assumed same as paint, from Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.11 E+09 seJ/g	
3	Water (potable)		
	Input	0.001 m^3	From Manso *et al.* (1997), p. 865, table IC-1568
	Kg equivalent	1.00 E+00 kg	
	Gram equivalent	1.00 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	

Table A.14. Footnotes to Table 6.14: Emergy evaluation of OSB panel (without services).

1	Harvested logs (wood)		
	Input	46.827 ft^3/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	1 ft^3 equivalent	0.028317 m^3	
	(inpt ft^3) x (m^3 equivalent)	1.325 m^3/kft^2	
	(input m^3/kft^3) / 1000	0.001325 m^3/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input m^3/ft^2) / (m^2 equivalent)	0.01427 m^3/m^2	
	Wood medium density	600.00 kg/m^2	
	(input m^3/m^2) x (wood density)	8.56 kg/m^2	
	Gram equivalent	8.56 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.04 E+08 seJ/g	From Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.79 E+08 seJ/g	
2	Bark		
	Input	4.2118 ft^3/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	1 ft^3 equivalent	0.028317 m^3	
	(inpt ft^3) x (m^3 equivalent)	0.119 m^3/kft^2	
	(input m^3/kft^3) / 1000	0.0001193 m^3/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input m^3/ft^2) / (m^2 equivalent)	0.0013 m^3/m^2	
	Wood medium density	240.00 kg/m^2	
	(input m^3/m^2) x (wood density)	0.31 kg/m^2	
	Gram equivalent	3.08 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.04 E+08 seJ/g	Assumed same as wood logs, from Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.79 E+08 seJ/g	

Table A.14. Continued.

3	Phenol formaldehyde resin		
	Input	18.1989 kg/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input kg/kft^2)/1000	0.0181989 g/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input kg/ft^2) / (m^2 equivalent)	0.1959 kg/m^2	
	Gram equivalent	1.96 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
4	MDIA resin		
	Input	3.5024 kg/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input kg/kft^2)/1000	0.0035024 g/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input kg/ft^2) / (m^2 equivalent)	0.0377 kg/m^2	
	Gram equivalent	3.77 E+01 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
5	Slack wax (paraffin)		
	Input	8.2839 kg/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input kg/kft^2)/1000	0.0082839 g/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input kg/ft^2) / (m^2 equivalent)	0.0892 kg/m^2	
	Gram equivalent	8.92 E+01 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	

Table A.14. Continued.

6	Water		
	Input	1464.7926 l/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input l/kft^3)/1000	1.4648 l/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input l/ft^2) / (m^2 equivalent)	15.7669 l/m^2	
	Water density	1 kg/l	
	(input l/m^2) x (water density kg/l)	15.7669 kg/m^2	
	Gram equivalent	1.58 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
7	Electricity		
	Input	210.38 kWh/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input kWh/kft^3)/1000	0.21038 kWh/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input kWh/ft^2) / (m^2 equivalent)	2.2645 kWh/m^2	
	(input kWh/m^2) x (3,6 MJ/kWh)	8.15 MJ/m^2	Energy unit conversion from Davis & Diegel (2007), p. B-6, table B.6
	Joule equivalent	8.15 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
8	Natural gas		
	Input	35.9629 m^3/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input m^3/kft^3)/1000	0.03596 kWh/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input m^3/ft^2) / (m^2 equivalent)	0.3871 m^3/m^2	
	HHV	1109 Btu/ft^3	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 ft^3 x 0,0283 m^3)	4.13 E+07 J/m^3	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-7, table B.8
	(input m^3) x (HHV J/m^3)	1.60 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	

Table A.14. Continued.

9	Diesel fuel		
	Input	5.1712 l/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input l/kft^3)/1000	0.00517 l/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input l/ft^2) / (m^2 equivalent)	0.05566 l/m^2	
	HHV	138700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.87 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/l)	2.15 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
10	Middle distillates		
	Input	1.5524 l/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input l/kft^3)/1000	0.00155 l/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input l/ft^2) / (m^2 equivalent)	0.0167 l/m^2	
	HHV	138700 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.87 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/g)	6.46 E+05 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Assumed same as fuel oils, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.14. Continued.

11	Liquefied petroleum gas		
	Input	2.5314 l/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input l/kft^3)/1000	0.00253 l/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input l/ft^2) / (m^2 equivalent)	0.0272 l/m^2	
	HHV	91300 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	2.54 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6
	(input l) x (HHV J/g)	6.93 E+05 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	7.00 E+04 seJ/J	From Buranakarn (1998), p. 139, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.18 E+05 seJ/J	
12	Gasoline		
	Input	0.4314 l/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input l/kft^3)/1000	0.0004314 l/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input l/ft^2) / (m^2 equivalent)	0.00445 l/m^2	
	HHV	125000 Btu/gal	From Davis & Diegel (2007), p. B-4, table B.4
	(HHV Btu x 1055 J) / (1 gal x 3,785 l)	3.48 E+07 J/l	Energy unit conversion from Davis & Diegel (2007), p. B6, table B-6, and p. B-8, table B.10
	(input l) x (HHV J/l)	1.55 E+05 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.14. Continued.

13	Biomass (assumed as bark residues)		
	Input	358.8275 kg/kft^2	From U. S. Life Cycle Inventory Database (http://www.nrel.gov/lci/)
	(input kg/kft^3)/1000	0.3588 kg/ft^2	
	1 ft^2 equivalent	0.0929 m^2	
	(input kg/ft^2) / (m^2 equivalent)	3.8623 kg/m^2	
	HHV	20.42 MJ/kg	From Goel (2006), p. A4-2
	(input kg/m^2) x (HHV J/kg)	78.86 MJ	
	Joule equivalent	7.89 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.49 E+04 seJ/J	Assumed same as wood biomass (Odum, 1996, p. 194, table 10.4)
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	5.86 E+05 seJ/J	

Table A.15. Footnotes to Table 6.15: Emergy evaluation of Thermoformed EPS (without services).

1	Air		
	Input	86.00 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al.* (2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
2	Bauxite		
	Input	1.20 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	8.55 E+08 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.44 E+09 seJ/g	
3	Bentonite		
	Input	0.18 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
4	Calcium sulphate		
	Input	0.018 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
5	Clay		
	Input	3.80 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.00E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.36E+09 seJ/g	
5	Clay		
	Input	3.80 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.00E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.36E+09 seJ/g	

Table A.15. Continued.

6	Dolomite		
	Input	0.014 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as limestone, from Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
7	Ferromanganese		
	Input	0.001 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
8	Fluorspar		
	Input	0.013 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
9	Gravel		
	Input	0.004 g	From Boustead (1999)
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
10	Iron		
	Input	1.20 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.65 E+09 seJ/g	From Bjorklund *et al.* (2001), p. 299, table 1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	4.45 E+09 seJ/g	
11	Lead		
	Input	0.004 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Wang *et al.* (2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	

Table A.15. Continued.

12	Limestone		
	Input	3.10 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
13	Nitrogen		
	Input	32.00 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.19 E+09 seJ/g	From Odum (1996), p. 68, table 4.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.04 E+09 seJ/g	
14	Olivine		
	Input	0.011 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as minerals, from Odum (1996), p. 44, table 3.3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
15	Oxygen		
	Input	0.07 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	5.16 E+07 seJ/g	From Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.67 E+07 seJ/g	
16	Phosphate		
	Input	0.001 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.90 E+09 seJ/g	From Odum (1996), p. 124, table 7.7
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.55 E+09 seJ/g	
17	Potassium chloride		
	Input	0.003 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.10 E+09 seJ/g	From Odum (1996), p. 310
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.85 E+09 seJ/g	

Table A.15. Continued.

18	Sand		
	Input	0.13 g	From Boustead (1999)
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.24 E+09 seJ/g	From Campbell *et al.* (2005), p. B-2, table B1.1
19	Shale		
	Input	0.049 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
20	Sodium chloride		
	Input	21.00 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
21	Sulphur (bonded)		
	Input	0.049 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
22	Sulphur (elemental)		
	Input	0.13 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.80 E+08 seJ/g	Assumed same as chemicals, from Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	6.38 E+08 seJ/g	
23	Water (industry)		
	Input	194000.00 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al* .(2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	

Table A.15. Continued.

24	Water (potable)		
	Input	8600.00 g	From Boustead (1999)
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.74 E+07 seJ/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.96 E+07 seJ/g	
25	Electricity		
	Input	15.70 MJ	From Boustead (1999)
	Joule equivalent	1.57 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
26	Oil fuels		
	Input	36.95 MJ	From Boustead (1999)
	Joule equivalent	3.69 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
27	Other fuels (mostly natural gas)		
	Input	50.51 MJ	From Boustead (1999)
	Joule equivalent	5.05 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	Assumed as natural gas, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.06 E+05 seJ/J	

Table A.16. Footnotes to Table 6.16: Emergy evaluation of Alumina (without services).

1	Bauxite		
	Input	1928.00 kg	From IAI (2000)
	Gram equivalent	1.93 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	8.55 E+08 seJ/g	From Odum. (1996), p.187, table 10.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.44 E+09 seJ/g	
2	Caustic soda		
	Input	75.00 kg	From IAI (2000)
	Gram equivalent	7.50 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as general minerals from Odum *et al.* (2000), p. 10, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Lime		
	Input	48.00 kg	From IAI (2000)
	Gram equivalent	4.80 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	From Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
4	Water (industry)		
	Input	3.32 m^3	From IAI (2000)
	Density	1000 kg/m^3	
	Kg equivalent	3320.00 kg	
	Gram equivalent	3.32 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al.* (2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	

Table A.16. Continued.

5	Sea water		
	Input	3.37 m^3	From IAI (2000)
	Average density of sea water	1027 kg/m^3	
	(input m^3) x (avg. density sea water kg/m^3)	3460.99 kg	
	Gram equivalent	3.46 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.08 E+05 seJ/g	Assumed same as global water streams, from Buenfil (2001), p. 23, table D-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.81 E+05 seJ/g	
6	Electricity		
	Input	1013.83 MJ	From IAI (2000)
	Joule equivalent	1.01 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
7	Fuel oil		
	Input	5855.62 MJ	From IAI (2000)
	Joule equivalent	5.86 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
8	Natural gas		
	Input	5943.12 MJ	From IAI (2000)
	Joule equivalent	5.94 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.08+04 seJ/J	
9	Diesel		
	Input	60.17 MJ	From IAI (2000)
	Joule equivalent	6.02 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Bastianoni *et al.* (2001), p. 368,table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.16. Continued.

10	Coal		
	Input	2811.08 MJ	From IAI (2000)
	Joule equivalent	2.81 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.40 E+04 seJ/J	Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	7.93 E+04 seJ/J	

Table A.17. Footnotes to Table 6.17: Emergy evaluation of Anode Carbon (without services).

1	Coke		
	Input	852.00 kg	From IAI (2000)
	Gram equivalent	8.25 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	2.05 E+09 seJ/g	From Brandt-Williams (1999), p. 236, table F.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.44 E+09 seJ/g	
2	Pitch		
	Input	235.00 kg	From IAI (2000)
	Gram equivalent	2.35 E+05 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as coal, from Odum (1996), p. 310, table C.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Water (industry)		
	Input	1.13 m^3	From IAI (2000)
	Density	1000 kg/m^3	
	Kg equivalent	1130.00 kg	
	Gram equivalent	1.13 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al.* (2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
4	Electricity		
	Input	1126.15 MJ	From IAI (2000)
	Joule equivalent	1.13 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
5	Fuel oil		
	Input	699.06 MJ	From IAI (2000)
	Joule equivalent	6.99 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.17. Continued.

6	Natural gas		
	Input	1903.24 MJ	From IAI (2000)
	Joule equivalent	1.90 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.09+04 seJ/J	
7	Diesel		
	Input	182.95 MJ	From IAI (2000)
	Joule equivalent	1.82 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.18. Footnotes to Table 6.18: Emergy evaluation of Aluminium primary metal (without services).

1	Alumina		
	Input	1928.00 kg	From IAI (2000)
	Gram equivalent	1.93 E+06 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	4.62 E+09 seJ/g	From this study, table 6.16
2	Anode carbon		
	Input	443.00 kg	From IAI (2000)
	Gram equivalent	4.43 E+05 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	3.92 E+09 seJ/g	From this study, table 6.15
3	Water (industry)		
	Input	2.95 m^3	From IAI (2000)
	Density	1000 kg/m^3	
	Kg equivalent	2950.00 kg	
	Gram equivalent	2.95 E+06 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.64 E+05 seJ/g	From Wang *et al.* (2006), p. 64, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.12 E+06 seJ/g	
4	Sea water		
	Input	20.80 m^3	From IAI (2000)
	Average density of sea water	1027 kg/m^3	
	(input m^3) x (avg. density sea water kg/m^3)	21,361.60 kg	
	Gram equivalent	2.14 E+07 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.08 E+05 seJ/g	Assumed same as global water streams, from Buenfil (2001), p. 23, table D-1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.81 E+05 seJ/g	

Table A.18. Continued.

5	Electricity		
	Input	116,762.57 MJ	From IAI (2000)
	Joule equivalent	1.17 E+11 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
7	Fuel oil		
	Input	699.06 MJ	From IAI (2000)
	Joule equivalent	6.99 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
8	Natural gas		
	Input	1903.24 MJ	From IAI (2000)
	Joule equivalent	1.90 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.10+04 seJ/J	
9	Diesel		
	Input	154.59 MJ	From IAI (2000)
	Joule equivalent	1.55 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.19. Footnotes to Table 6.19: Emergy evaluation of Aluminium primary ingot (without services).

1	Primary aluminium		
	Input	1000.00 kg	From IAI (2000)
	Gram equivalent	1.00 E+06 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	4.50 E+10 seJ/g	From this study Table 6.18
2	Alloying additives		
	Input	17.00 kg	From IAI (2000)
	Gram equivalent	1.70 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.00 E+09 seJ/g	Assumed same as general minerals from Odum *et al.* (2000), p. 10, table 3
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.68 E+09 seJ/g	
3	Electricity		
	Input	1545.01 MJ	From IAI (2000)
	Joule equivalent	1.55 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
4	Fuel oil		
	Input	859.56 MJ	From IAI (2000)
	Joule equivalent	8.60 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
5	Natural gas		
	Input	2373.97 MJ	From IAI (2000)
	Joule equivalent	2.37 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.11+04 seJ/J	

Table A.19. Continued.

6	Diesel		
	Input	8.00 MJ	From IAI (2000)
	Joule equivalent	8.00 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
7	Gasoline		
	Input	3.21 MJ	From IAI (2000)
	Joule equivalent	3.21 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
8	Propane		
	Input	22.98 MJ	From IAI (2000)
	Joule equivalent	2.30 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	Assumed same as natural gas, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.12+04 seJ/J	

Table A.20. Footnotes to Table 6.20: Emergy evaluation of Aluminium extruded profiles (without services).

1	Primary aluminium ingot		
	Input	1444.00 kg	From IAI (2000)
	Gram equivalent	1.44 E+06 g	
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	4.58 E+10 seJ/g	From this study Table 6.19
2	Electricity		
	Input	8000.92 MJ	From IAI (2000)
	Joule equivalent	8.00 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
3	Fuel oil		
	Input	205.77 MJ	From IAI (2000)
	Joule equivalent	2.06 E+08 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
4	Natural gas		
	Input	2682.09 MJ	From IAI (2000)
	Joule equivalent	2.68 E+09 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.13+04 seJ/J	
5	Diesel		
	Input	6.31 MJ	From IAI (2000)
	Joule equivalent	6.31 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Bastianoni *et al.* (2001), p. 368, table 2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	

Table A.20. Continued.

6	Gasoline		
	Input	0.62 MJ	From IAI (2000)
	Joule equivalent	6.20 E+05 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	From Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
7	Propane		
	Input	41.92 MJ	From IAI (2000)
	Joule equivalent	4.19 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	4.80 E+04 seJ/J	Assumed same as natural gas, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	8.14+04 seJ/J	

Table A.21. Footnotes to Table 6.21: Emergy evaluation of solid wood flooring (without services).

1	Wood lumber		
	Input	7.40 kg	From Jonsson *et al.* (1997), p. 252, table 4
	Gram equivalent	7.40 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	8.33 E+08 seJ/g	From Buranakarn (1998), p. 143, table A-2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.40 E+09 seJ/g	
2	Electricity		
	Input	8.37 MJ	From Jonsson *et al.* (1997), p. 252, table 4
	Joule equivalent	8.37 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	1.74 E+05 seJ/J	From Odum (1996), p. 305, table C.1
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	2.92 E+05 seJ/J	
3	Fossil fuels		
	Input	5.39 MJ	From Jonsson *et al.* (1997), p. 252, table 4
	Joule equivalent	5.39 E+06 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	6.60 E+04 seJ/J	Assumed same as fuel oils, from Odum (1996), p. 308, table C.2
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	1.11 E+05 seJ/J	
4	Renewable fuels (wood biomass)		
	Input	35.40 MJ	From Jonsson *et al.* (1997), p. 252, table 4
	Joule equivalent	3.54 E+07 J	
	Emergy per unit input (baseline 9.44 E+24 seJ/y)	3.94 E+04 seJ/J	From Odum (1996), p. 194, table 10.4
	Emergy per unit input (baseline 15.83 E+24 seJ/y)	5.86+04 seJ/J	

APPENDIX B

DENSITY OF SELECTED BUILDING MATERIALS

Table B.1. Density of selected building materials.

Material	Mass	Unit	Reference sources
Aluminium (hinged frame)	2.300	kg/m	Source: Technal
Aluminium (sliding frame)	2.600	kg/m	Source: Technal
Asphalt sheet (4 mm thickness)	4.000	kg/m^2	Danosa (1999)
Ceramic hollow brick (110 mm thickness)	4.000 695.000	kg/unit kg/m^3	Preceram (2008)
Ceramic hollow brick (150 mm thickness)	5.300 662.000	kg/unit kg/m^3	Preceram (2008)
Ceramic hollow brick (200 mm thickness)	8.000 626.000	kg/unit kg/m^3	Preceram (2008)
Ceramic tiles (6 mm thickness)	13.000	kg/m^2	Average from Cinca (2004)
Concrete	2400.000	kg/m^3	Mehta & Monteiro (2006)
Granite (Stone)	2667.000	kg/m^3	Average density from Zhang (2005)
Granite (Tiles 1.8 mm thickness)	48.006	kg/m^2	From this study using average density for Granite stone
Granite (Tiles 3 mm thickness)	80.010	kg/m^2	From this study using average density for Granite stone
Glass (float)	2500.000	kg/m^3	Krause (2005)
Glass (6 mm thickness)	15.000	kg/m^2	From this study using average density for glass
Glass (8 mm thickness)	20.000	kg/m^2	From this study using average density for glass
Gravel	1500.000	kg/m^3	Mehta & Monteiro (2006)
Gypsum cardboard (13 mm thickness)	10.200	kg/m^2	Iberplaco (2004)
Gypsum cardboard (Waterproof 13 mm thickness)	11.000	kg/m^2	Iberplaco (2004)
Marble (Stone)	2750.000	kg/m^2	Zhang (2005)
Marble (Tiles 20 mm thickness)	55.000	kg/m^2	From this study using average density for Marble stone
Mortar	1950.000	Kg/m^3	Ciarga (2008)
Mortar (rendering)	1750.000	Kg/m^3	Ciarga (2008)
Oriented Strand Board (OSB) panel	550.000	kg/m^3	Porteous & Kermani (2007)
OSB panel (0.95 mm thickness)	5.225	kg/m^2	From this study using density for OSB
OSB panel (19 mm thickness)	10.450	kg/m^2	From this study using density for OSB
OSB panel (25 mm thickness)	16.250	kg/m^2	From this study using average density for OSB

Table B.1. - Continued.

Material	Mass	Unit	Reference
Paint for plaster (finishing)	1.360 0.548	kg/l kg/m^2	Robbialac (2008)
Paint for plaster (primary)	1.020 0.120	kg/l kg/m^2	Robbialac (2008)
Paint for steel	1.210 0.900	kg/l kg/m^2	Robbialac (2008b)
Plaster	1000.000	Kg/m^3	Ciarga (2008)
Plywood	450.000	kg/m^3	Porteous & Kermani (2007)
Plywood (15 mm thickness)	6.900	kg/m^2	From this study using density for Plywood
Polystyrene (EPS)	20.000	Kg/m^3	Robbialac (2008c)
Polystyrene (XPS - flooring)	25.000	Kg/m^3	Dow (1994)
Polystyrene (XPS - roofing)	35.000	Kg/m^3	Dow (1994)
Steel (Round bar 6 mm thickness)	0.222	Kg/m	JSC (2004)
Steel (Round bar 10 mm thickness)	0.617	Kg/m	JSC (2004)
Steel (Round bar 12 mm thickness)	0.888	Kg/m	JSC (2004)
Steel (Round bar 16 mm thickness)	1.578	Kg/m	JSC (2004)
Steel (Galvanized rail R48)	0.457	Kg/m	Iberplaco (2004)
Steel (Galvanized rail M46)	0.444	Kg/m	Iberplaco (2004)
Steel (HEB 200 section)	61,300.00	Kg/m	Farinha & Reis (1993)
Steel (IPN 140 section)	14,400.00	Kg/m	Farinha & Reis (1993)
Steel (Stainless plate 1 mm thickness)	7.900	kg/m^2	JSC (2004)
Steel (Galvanized plate 1 mm thickness)	7.850	kg/m^2	JSC (2004)
Steel (Galvanized corrugated plate 0.75 mm thickness)	7.060	kg/m^2	Haironville (2007)
Varnish	1.060 0.420	kg/l kg/m^2	Robbialac (2008a)
Wood (Ipe)	920.000	kg/m^3	USDA (1999)
Wood (Pine)	600.000	kg/m^3	Average density from Carvalho (1997)
Wood (Oak)	760.000	kg/m^3	USDA (1999)
Wood floor (Oak 30 mm thickness)	22.800	Kg/m^2	From this study using density for Oak
Wood plastic composites (Geodeck Traditional)	19.640	kg/m^2	Converted from Klyosov (2007)
Zinc (Sheet 1 mm thickness)	7.200	kg/m^2	Rheinzink (1988)

APPENDIX C

LIST OF TRANSFORMITIES AND SPECIFIC EMERGY USED IN THIS STUDY

Table C.1. List of Specific Emergy values for selected materials.

Item	Specific Emergy (sej/g)		Reference sources
	Baseline 9.44 E+24 sej/year	Baseline 5.83 E+24 sej/year	
Bauxite	8.55 E+09	1.44 E+09	Odum (1996). P. 187
Blast furnace slag (wo/s)	6.61 E+09	1.11 E+10	Buranakarn (1998). P. 142, table A-2
Cement rock	1.00 E+09	1.68 E+09	Assumed same as limestone
Clay	2.00 E+09	3.36 E+09	Odum (1996), p. 310, table C.4
Coal	1.00 E+09	1.68 E+09	Odum (1996), p. 310, table C.4
Coke	2.05 E+09	3.44 E+09	Brandt-Williams (1999), p. 236, table F.4
Feldspars	5.00 E+08	8.40 E+08	Assumed same as granitic rocks
Foundry sand		2.24 E+09	Assume same as sand
Frit (glazing)	1.00 E+09	1.68 E+09	
Granite	5.00 E+08	8.40 E+08	Odum (1996), p. 44, table 3.3
Gravel		2.24 E+09	Campbell *et al.* (2005), p. B-2, table B1.1
Gypsum	1.00 E+09	1.68 E+09	Brown & McClanahan (1996), p. 114, table 1
Iron ore (wo/s)	1.22 E+09	2.05 E+09	Buranakarn (1998), p. 142, table A-2
Lime	1.00 E+09	1,68 E+09	Odum (1996), p. 310, table C.4
Limestone	1.00 E+09	1,68 E+09	Odum (1996), p. 310, table C.4
Metamorphic rocks	1.45 E+09	2.44 E+09	Odum (1996), p. 44, table 3.3
Minerals (general)	1.00 E+09	1,68 E+09	Odum (1996), p. 44, table 3.3
Pitch	1.00 E+09	1.68 E+09	Assumed same as coal
Sand		2.24 E+09	Campbell *et al.* (2005), p. B-2, table B1.1
Shale	1.00 E+09	1,68 E+09	Odum (1996, p. 310, table C.4
Siliceous sand		2.24 E+09	Campbell *et al.* (2005), p. B-2, table B1.1
Slate	1.45 E+09	2.44 E+09	Assumed same as metamorphic rocks
Water (industry)	6.64 E+05	1.12 E+06	Wang *et al.* (2006), p. 64, table 2
Water (rivers and streams)	3.23 E+05	5.43 E+05	Buenfil (2001), p. 223, table D-1
Water (potable)	4.74 E+06	7.96 E+07	Castellini *et al.* (2006), p. 346, table 3
Zinc	6.80 E+10	1.14 E+11	Brown *et al.* (1992) table A1.

Table C.2. List of Specific Emergy values for selected products.

Item	Specific Emergy (sej/g)		Reference sources
	Baseline 9.44 E+24 sej/year	Baseline 5.83 E+24 sej/year	
Aggregates	2.00 E+09	3.36 E+09	Odum (1996), p. 310, table C.4
Alumina (wo/s)		4.62 E+09	From this study (table 6.16)
Aluminium primary metal (wo/s)		4.50 E+10	From this study (table 6.18)
Aluminium primary ingot (wo/s)		4.58 E+10	From this study (table 6.19)
Aluminium extruded profiles (wo/s)		6.85 E+10	From this study (table 6.20)
Anode carbon (wo/s)		3.91 E+09	From this study (table 6.17)
Asphalt	4.74 E+08	7.69 E+08	Bjorklund *et al.* (2001), p. 299, table 1
Asphalt sheet	4.74 E+08	7.69 E+08	Assumed same as asphalt
Bark	4.04 E+08	6.79 E+08	Assumed same as harvested logs
Bottom ash	8.30 E+08	1.39 E+09	Assumed same as fly ash
Ceramic brick	2.52 E+09	4.23 E+09	Bjorklund *et al.* (2001), p. 299, table 1
Ceramic hollow brick	2.52 E+09	4.23 E+09	Assumed as ceramic brick
Ceramic tiles (wo/s)		3.32 E+09	From this study (table 6.3)
Chemicals (general)	3.80 E+08	6.38 E+08	Buranakarn (1998), p. 140, table A-1
Concrete C20/25 (wo/s)		3.40 E+09	From this study (table 6.9)
Fiberglass	3.00 E+09	5.04 E+09	Ulgiati & Brown (2002), p. 341, table 1
Flat glass	4.74 E+09	7.96 E+09	Buranakarn (1998), p. 140, table A-1
Fly ash	8.30 E+08	1.39 E+09	Wang *et al.* (2006), p. 64, table 2
Foaming agent	3.80 E+08	6.38 E+08	Assumed same as chemicals
Glue (wo/s)	3.80 E+08	6.38 E+08	Buranakarn (1998), p. 140, table A-1
Granite tiles (wo/s)		4.21 E+09	From this study (table 6.2)
Marble tiles		1.21 E+10	From this study (table 6.1)
MDIA Resin	3.80 E+08	6.38 E+08	Assumed same as chemicals
Modified starch		6.38 E+08	Assumed same as glue
Mortar (wo/s)		2.51 E+09	From this study (table 6.10)
Mortar (rendering) (wo/s)		2.30 E+09	From this study (table 6.11)
OSB Panel (wo/s)		1.92 E+09	From this study (table 6.14)
Paint	1.85 E+09	3.11 E+09	Brown & Ulgiati (2002), p. 327, table 2
Paint (finished)		3.35 E+09	From this study (table 6.13)
Paper (J)		3.61 E+05	Pulselli *et al.* (2006), p. 6, table 2
Phenol formaldehyde resin	3.80 E+08	6.38 E+08	Assumed same as chemicals

Table C.2. Continued.

Item	Specific Emergy (sej/g)		Reference sources
	Baseline 9.44 E+24 sej/year	Baseline 5.83 E+24 sej/year	
Pig iron (wo/s)	1.99 E+09	3.34 E+09	Buranakarn (1998), p. 142, table A-2
Plaster (wo/s)		1.64 E+09	From this study (table 6.12)
Plasterboard (wo/s)		2.43 E+09	From this study (table 6.6)
Plasterboard (stucco) (wo/s)		2.18 E+09	From this study (table 6.4)
Plasterboard (facing paper) (wo/s)		7.57 E+09	From this study (table 6.5)
Plasterboard (finished) (wo/s)		2.41 E+09	From this study (table 6.7)
Plastics (wo/s)	5.76 E+09	9.68 E+09	Buranakarn (1998), p. 143, table A-2
Plywood (wo/s)	1.63 E+09	2.74 E+09	Buranakarn (1998), p. 140, table A-1
Rock wool	1.84 E+09	3.09 E+09	Bjorklund et al. (2001), p. 299, table 1
Portland cement (wo/s)		3.53 E+09	From this study (table 6.8)
Slack wax	3.80 E+08	6.38 E+08	Assumed same as chemicals
Steel (Primary wo/s)	3.69 E+09	6.20 E+09	Bargigli & Ulgiati (2003), p. 152, table 4
Steel (Secondary wo/s)	6.04 E+08	1.01 E+09	Bargigli & Ulgiati (2003), p. 152, table 4
Steel (Mix wo/s)	3.16 E+09	5.31 E+09	Bargigli & Ulgiati (2003), p. 152, table 4
Thermoformed Polystyrene (EPS) (wo/s)		1.39 E+10	From this study (table 6.15)
Thermoformed Polystyrene (XPS) (wo/s)		1.39 E+10	Assumed same as thermoformed XPS
Varnish		3.11 E+09	Assumed same as paint
Wood logs (harvested)	4.04 E+08	6.79 E+08	Bastianoni *et al.* (2001), p. 368,table 2
Wood lumbers (wo/s)	8.33 E+08	1.40 E+09	Buranakarn (1998), p. 143, table A-2
Wood plastic composites (wo/s)	5.61 E+09	9.42 E+09	Buranakarn (1998), p. 143, table A-2
Wood solid flooring (wo/s)		2.09 E+09	From this study (table 6.21)

Table C.3. List of Solar Transformities for selected energy and fuels.

Item	Solar Transformity (sej/J)		Reference sources
	Baseline 9.44 E+24 sej/year	Baseline 5.83 E+24 sej/year	
Biomass	3.49 E+04	5.68 E+04	Assumed same as wood biomass
Coal	4.40 E+04	6.72 E+04	Odum (1996), p. 310, table C.4
Diesel	6.60 E+04	1.11 E+05	Bastianoni *et al.* (2001), p. 368, table 2
Distillate fuel oil		1.11 E+05	Assumed same as oil fuels
Electricity	1.74 E+05	2.92 E+05	Odum (1996), P. 305, table C.1
Gasoline	6.60 E+04	1.11 E+05	Odum (1996), p. 308, table C.2
Liquefied petroleum gas	7.00 E+04	1.18 E+05	Buranakarn (1998), p. 139, table A-1
Methane		8.06 E+04	Assumed same as natural gas
Middle distillates	6.60 E+04	1.11 E+05	Assumed same as oil fuels
Natural gas	4.80 E+04	8.06 E+04	Odum (1996), p. 308, table C.2
Oil fuels	6.60 E+04	1.11 E+05	Odum (1996), p. 308, table C.2
Petroleum coke	5.40 E+04	9.07 E+04	Caruso *et al.* (2001), p. 270, table 2
Residual oil	6.60 E+04	1.11 E+05	Assumed same as fuel oils
Thermal energy	6.60 E+04	1.11 E+05	Odum (1996), p. 308, table C.2
Wood biomass	3.49 E+04	5.68 E+04	Odum (1996), p. 194, table 10.4

APPENDIX D

FOOTNOTES TO TABLES OF EMERGY EVALUATION OF WALS W1, W2, AND W3

Table D.1. Footnotes to Table 7.6: Emergy analysis of wall W1 (without services).

Footnotes:

1	Ceramic hollow brick (110 mm)		
	Input	16 units	From Manso et al. (2005), p. 207, table IC-462
	Weight of ceramic bricks	4 kg/unit	From Preceram (2008)
	(input units)*(4 kg/unit0,001 m^3)	64.00 kg	
	Gram equivalent	6.40 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	2.52 E+09 sej/g	From Bjorklund *et al.* (2001), p. 299, table 1
	Emergy per unit input (baseline 15.83 E+24 sej/y)	4.23 E+09 sej/g	
2	Mortar (masonry)		
	Input	0.016 m^3	From Manso et al. (2005), p. 207, table IC-462
	Density	1950.00 kg/m^3	Ciarga (2008)
	(input m^3) x (density kg/m^3)	31.20 kg	
	Gram equivalent	3.12 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 sej/y)	2.51 E+09 sej/g	From this study, table 8.10
3	Rendering mortar		
	Input	0.040 m^3	From Manso et al. (2005), p. 207, table IC-462
	Density	1750.00 kg/m^3	Ciarga (2008)
	(input m^3) x (density kg/m^3)	70.00 kg	
	Gram equivalent	7.00 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 sej/y)	2.30 E+09 sej/g	From this study, table 8.11
4	Finishing plaster		
	Input	0.010 m^3	From Manso et al. (2005), p. 207, table IC-462
	Density	1000.00 kg/m^3	Ciarga (2008)
	(input m^3) x (density kg/m^3)	10.00 kg	
	Gram equivalent	1.00 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 sej/y)	1.64 E+09 sej/g	From this study, table 8.12

Table D.1. – Continued.

5	Paint (finishing)		
	Input	0.40 l	From Manso *et al.* (2005), p. 722, table IC-1568
	Density	1.37 kg/l	Robbialac (2008)
	Mass (input x kg/m^3)	0.548 kg	
	Gram equivalent	5.48 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.85 E+09 sej/g	From Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.11 E+09 sej/g	
8	Paint (primary)		
	Input	0.12 l	From Manso *et al.* (2005), p. 722, table IC-1568
	Density	1.02 kg/l	Robbialac (2008)
	Mass (input x kg/m^3)	0.12 kg	
	Gram equivalent	1.22 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.85 E+09 sej/g	From Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.11 E+09 sej/g	
9	Water (potable) for paint		
	Input	0.002 m^3	From Manso *et al.* (2005), p. 722, table IC-1568
	Mass (input x 1000 kg/m^3)	2 kg	
	Gram equivalent	2 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	4.74 E+07 sej/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 sej/y)	7.96 E+07 sej/g	

Table D.2. Footnotes to Table 7.14: Emergy analysis of wall W2 (without services).

Footnotes:

1	Galvanized steel rail R48		
	Input	0.90 m	From Iberplaco (2004)
	Density	0,457 kg/m	From Iberplaco (2004)
	Mass (input x kg/m)	0.411 kg	
	Gram equivalent	4.11 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	3.16 E+09 sej/g	From Bargigli & Ulgiati (2003), p. 152, table 4
	Emergy per unit input (baseline 15.83 E+24 sej/y)	5.31 E+09 sej/g	
2	Galvanized steel rail M46		
	Input	3.00 m	From Iberplaco (2004)
	Density	0,444 kg/m	From Iberplaco (2004)
	Mass (input x kg/m)	1.332 kg	
	Gram equivalent	1.33 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	3.16 E+09 sej/g	From Bargigli & Ulgiati (2003), p. 152, table 4
	Emergy per unit input (baseline 15.83 E+24 sej/y)	5.31 E+09 sej/g	
3	Rockwool		
	Input	0.042 m^3	From this study
	Density	40 kg/m^3	
	Mass (input x kg/m^3)	1.680 kg	
	Gram equivalent	1.68 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.84 E+09 sej/g	From Bjorklund *et al.* (2001), p. 269, table 1
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.09 E+09 sej/g	
4	Plasterboard		
	Input	2 m^2	From this study
	Density	9.45 kg/m^2	
	Mass (input x kg/m^2)	18.90 kg	
	Gram equivalent	1.89 E+04 g	
	Emergy per unit input (baseline 15.83 E+24 sej/y)	2.43 E+09 sej/g	From this study, table 8.6

Table D.2. – Continued.

5	Gypsum		
	Input	0.66 kg	From Iberplaco (2004)
	Gram equivalent	6.60 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.00 E+09 sej/g	From Brown & McClanahan (1996), p. 114, table 1
	Emergy per unit input (baseline 15.83 E+24 sej/y)	1.68 E+09 sej/g	
6	Water (potable) for gypsum		
	Input	0.33 kg	From Iberplaco (2004)
	Gram equivalent	3.30 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	4.74 E+07 sej/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 sej/y)	7.96 E+07 sej/g	
7	Paint (finishing)		
	Input	0.40 l	From Manso *et al.* (2005), p. 722, table IC-1568
	Density	1.37 kg/l	Robbialac (2008)
	Mass (input x kg/m^3)	0.548 kg	
	Gram equivalent	5.48 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.85 E+09 sej/g	From Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.11 E+09 sej/g	
8	Paint (primary)		
	Input	0.12 l	From Manso *et al.* (2005), p. 722, table IC-1568
	Density	1.02 kg/l	Robbialac (2008)
	Mass (input x kg/m^3)	0.12 kg	
	Gram equivalent	1.22 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.85 E+09 sej/g	From Brown & Ulgiati (2002), p. 327, table 2
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.11 E+09 sej/g	

Table D.2. – Continued.

9	Water (potable) for paint		
	Input	0.002 m^3	From Manso *et al.* (2005), p. 722, table IC-1568
	Mass (input x 1000 kg/m^3)	2 kg	
	Gram equivalent	2 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	4.74 E+07 sej/g	From Castellini *et al.* (2006), p. 346, table 3
	Emergy per unit input (baseline 15.83 E+24 sej/y)	7.96 E+07 sej/g	

Table D.3. Footnotes to Table 7.22: Emergy analysis of wall W3 (without services).

Footnotes:

1	Wood frame (pine)		
	Input	0.290 m^3	From this study
	Density	600.000 kg/m^3	Average density from Carvalho (1997)
	Mass (input x kg/m^3)	17.660 kg	
	Gram equivalent	1.77 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	8.33 E+08 sej/g	From Buranakarn (1998), p. 143, table A-2
	Emergy per unit input (baseline 15.83 E+24 sej/y)	1.40 E+09 sej/g	
2	Rockwool		
	Input	0.072 m^3	From this study
	Density	40 kg/m^3	
	Mass (input x kg/m^3)	2.89 kg	
	Gram equivalent	2.89 E+03 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.84 E+09 sej/g	From Bjorklund *et al.* (2001), p. 299, table 1
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.09E+09 sej/g	
3	Plywood (15 mm thickness)		
	Input	2.00 m^2	From this study
	Density	6.9 kg/m^2	From Porteous & Kermani (2007)
	Mass (input x kg/m^2)	13.80 kg	
	Gram equivalent	1.38 E+04 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.63 E+09 sej/g	From Buranakarn (1998), p. 140, table A-1
	Emergy per unit input (baseline 15.83 E+24 sej/y)	2.74 E+09 sej/g	
4	Varnish		
	Input	0.4 l	From this study
	Density	1.06 kg/l	Robbialac (2008a)
	Mass (input x kg/l)	0.420 kg	
	Gram equivalent	4.24 E+02 g	
	Emergy per unit input (baseline 9.44 E+24 sej/y)	1.85 E+09 sej/g	Assumed same as paint (Brown & Ulgiati, 2002, p. 326, table 2)
	Emergy per unit input (baseline 15.83 E+24 sej/y)	3.11 E+09 sej/g	

APPENDIX E

ALTERNATIVES TO RECOVERY SCENARIOS FOR WALLS W2 AND W3

E.1 *Alternative recovery scenarios for Wall W2*

E.1.1 *Alternative to end-of-life scenarios: ELS 2*

Table E.1. ELS 2: analysis of end-of-life scenarios of materials for 1 m^2 of wall W2.

Note	Item	End-of-life scenarios for materials mass		
		Reuse (g)	Recycle (g)	No recovery (g)
M01	Galvanized steel frame	0	1691	52
M02	Mineral wool	1562	0	118
M03	Plasterboard	9477	10,530	1053
M04	Paint	0	0	670

Table E.2. ELS 2: Emergy evaluation of best options for materials that will be substituted by recovered materials of Wall W2 (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M01	Galvanized steel frame				
MS01	Pig iron	g	1,69 E+03	3.34 E+09	5.65 E+12
M02	Mineral wool				
MS02	Mineral wool	g	1.56 E+03	3.09 E+09	4.83 E+12
M03	Plasterboard				
MS03.1	Plasterboard	g	9.47 E+03	2.43 E+09	2.30 E+13
MS03.2	Gypsum	g	2.00 E+04	1.68 E+09	1.77 E+13
M04	Paint				
	Not substitute		0		0

See Appendix C for references on Unit Solar Emergy sources.

Table E.3. ELS 2: application of Equations 1 and 2 to materials composing Wall W2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M01	Galvanized steel frame	9.26 E+12	1	9.26 E+12
M02	Mineral wool	5.19 E+12	1	5.19 E+12
M03	Plasterboard	5.07 E+13	1	5.07 E+13
M04	Paint	2.24 E+12	4	8.98 E+12
Equation 2: Total of Emergy of materials for Wall W2 during Lifespan(seJ)				7.41 E+13

Table E.4. ELS 2: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials of Wall W2.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Equation 3 (seJ)
M01	Galvanized steel frame	MS01	Pig iron	5.65 E+12	1	5.65 E+12
M02	Mineral wool	MS02	Mineral wool	4.83 E+12	1	4.83 E+12
M03	Plasterboard	MS03.1	Plasterboard	2.30 E+13	1	2.30 E+13
M03	Plasterboard	MS03.2	Gypsum	1.77 E+13	1	1.77 E+13
M04	Paint	MS04	None	0	4	0
Equation 4: Recovery Effectiveness of wall W2 (seJ)						5.12 E+13

Table E.5. ELS 2: application of Equation 5 to Wall W2.

Recovery Effectiveness of W2 (seJ)	Emergy of W2 (seJ)	DE
5.12 E+13	7.41 E+13	0.69

E.1.2 *Alternative to end-of-life scenarios: ELS 3*

Table E.6. ELS 3: analysis of end-of-life scenarios of materials for 1 m^2 of wall W2.

Note	Item	End-of-life scenarios for materials mass		
		Reuse (g)	Recycle (g)	No recovery (g)
M-01	Galvanized steel frame	0	1691	52
M-02	Mineral wool	1562	0	118
M-03	Plasterboard	0	0	21,060
M-04	Paint	0	0	670

Table E.7. ELS 3: Emergy evaluation of best options for materials that will be substituted by recovered materials of Wall W2 (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M-01	Galvanized steel frame				
MS-01	Pig iron	g	1,69 E+03	3,34 E+09	5.65 E+12
M-02	Mineral wool				
MS-02	Mineral wool	g	1.56 E+03	3.09 E+09	4.83 E+12
M-03	Plasterboard				
MS-03	Not substitute		0		0
M-04	Paint				
	Not substitute		0		0

See Appendix C for references on Unit Solar Emergy sources.

Table E.8. ELS 3: application of Equations 1 and 2 to materials composing Wall W2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M-01	Galvanized steel frame	9.26 E+12	1	9.26 E+12
M-02	Mineral wool	5.19 E+12	1	5.19 E+12
M-03	Plasterboard	5.70 E+13	1	5.70 E+13
M-04	Paint	2.24 E+12	4	8.98 E+12
Equation 2: Total of Emergy of materials for Wall W2 during Lifespan(seJ)				7.41 E+13

Table E.9. ELS 3: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials of Wall W2.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Equation 3 (seJ)
M01	Galvanized steel frame	MS01	Pig iron)	5.65 E+12	1	5.65 E+12
M02	Mineral wool	MS02	Mineral wool	4.83 E+12	1	4.83 E+12
M03	Plasterboard	MS03	None	0	1	0
M04	Paint	MS04	None	0	4	0
Equation 4: Recovery Effectiveness of wall W2 (seJ)						1.05 E+13

Table E.10. ELS 3: application of Equation 5 to Wall W2.

Recovery Effectiveness of W2 (ser)	Emergy of W2 (seJ)	DE
1.05 E+13	7.41 E+13	0.14

E.1.3 *Alternative to end-of-life scenarios: ELS 4*

Table E.11. ELS 4: analysis of end-of-life scenarios of materials for 1 m² of wall W2.

Note	Item	End-of-life scenarios for materials mass		
		Reuse (g)	Recycle (g)	No recovery (g)
M-01	Galvanized steel frame	0	1691	52
M-02	Mineral wool	0	1562	118
M-03	Plasterboard	0	0	21,060
M-04	Paint	0	0	670

Table E.12. ELS 4: Emergy evaluation of best options for materials that will be substituted by recovered materials of Wall W2 (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M-01	Galvanized steel frame				
MS-01	Pig iron	g	1,69 E+03	3.34 E+09	5.65 E+12
M-02	Mineral wool				
MS-02	Rock	g	1.56 E+03	1.68 E+09	2.62 E+12
M-03	Plasterboard				
MS-03	Gypsum	g	0		0
M-04	Paint				
	Not substitute		0		0

See Appendix C for references on Unit Solar Emergy sources.

Table E.13. ELS 4: application of Equations 1 and 2 to materials composing Wall W2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M-01	Galvanized steel frame	9.26 E+12	1	9.26 E+12
M-02	Mineral wool	5.19 E+12	1	5.19 E+12
M-03	Plasterboard	5.07 E+13	1	5.07 E+13
M-04	Paint	2.24 E+12	4	8.98 E+12
Equation 2: Total of Emergy of materials for Wall W2 during Lifespan(seJ)				7.41 E+13

Table E.14. ELS 4: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials of Wall W2.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Equation 3 (seJ)
M01	Galvanized steel frame	MS01	Pig iron	5.65 E+12	1	5.65 E+12
M02	Mineral wool	MS02	Mineral wool	2.62 E+12	1	2.62 E+12
M03	Plasterboard	MS03	Gypsum	0	1	0
M04	Paint	MS04	None	0	4	0
Equation 4: Recovery Effectiveness of wall W2 (seJ)						8.27 E+12

Table E.15. ELS 4: application of Equation 5 to Wall W2.

Recovery Effectiveness of W2 (seJ)	Emergy of W2 (seJ)	DE
8.27 E+12	7.41 E+13	0.11

E.2 *Alternative recovery scenarios for Wall C*

E.2.1 *Alternative to end-of-life scenarios: ELS 2*

Table E.16. ELS 2: analysis of end-of-life scenarios of 1 m^2 of wall W3.

Note	Item	End-of-life scenarios for materials mass		
		Reuse (g)	Recycle (g)	No recovery (g)
M-01	Wood frame (pine)	0	16,422	1236
M-02	Mineral wool	2687	0	202
M-03	Plywood (15 mm thickness)	0	12,834	966
M-04	Varnish	0	0	424

Table E.17. ELS 2: Emergy evaluation of best options for materials that will be substituted by recovered materials of Wall W3 (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M-01	Wood frame (pine)				
MS-01	Wood logs	g	1,64 E+04	6.79 E+08	1.12 E+13
M-02	Mineral wool				
MS-02	Mineral wool	g	2.68 E+03	3.09 E+09	8.30 E+12
M-03	Plywood				
MS-03	Energy recovery	J	1.93 E+08	1.85 E+04	3.56 E+12
M-04	Varnish				
	Not substitute		0		0

Table E.18. ELS 2: application of Equations 1 and 2 to materials composing Wall W3.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M-01	Wood frame (pine)	2.47 E+13	1	2.47 E+13
M-02	Mineral wool	8.93 E+12	1	8.93 E+12
M-03	Plywood	3.78 E+13	4	1.51 E+14
M-04	Varnish	1.32 E+12	4	5.27 E+12
Equation 2: Total of Emergy of materials for Wall W3 during Lifespan(seJ)				1.90 E+14

Table E.19. ELS 2: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials of Wall W3.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Equation 3 (seJ)
M01	Wood frame (pine)	MS01	Wood logs	1.12 E+13	1	1.12 E+13
M02	Mineral wool	MS02	Mineral wool	8.30 E+12	1	8.30 E+12
M03	Plywood	MS03	Combustion	3.56 E+12	4	1.42 E+13
M04	Varnish	MS04	None	0	4	0
Equation 4: Recovery Effectiveness of wall W3 (seJ)						3.37 E+13

Table E.20. ELS 2: application of Equation 5 to Wall W3.

Recovery Effectiveness of W3 (seJ)	Emergy of W3 (seJ)	DE
3.37 E+13	1.90 E+14	0.18

E.2.2 *Alternative to end-of-life scenarios: ELS 3*

Table E.21. ELS 3: analysis of end-of-life scenarios of 1 m^2 of wall W3.

Note	Item	End-of-life scenarios for materials mass		
		Reuse (g)	Recycle (g)	No recovery (g)
M-01	Wood frame (pine)	0	16,422	1236
M-02	Mineral wool	2687	0	202
M-03	Plywood (15 mm thickness)	0	12,834	966
M-04	Varnish	0	0	424

Table E.22. ELS 3: Emergy evaluation of best options for materials that will be substituted by recovered materials of Wall W3 (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M-01	Wood frame (pine)				
MS-01	Energy recovery	J	2,46 E+08	1.58 E+04	4.56 E+12
M-02	Mineral wool				
MS-02	Mineral wool	g	2.60 E+03	3.09 E+09	8.30 E+12
M-03	Plywood				
MS-03	Energy recovery	J	1.93 E+08	1.58 E+04	3.56 E+12
M-04	Varnish				
	Not substitute		0		0

See Appendix C for references on Unit Solar Emergy sources.

Table E.23. ELS 3: application of Equations 1and 2 to materials composing Wall W3.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M-01	Wood frame (pine)	2.47 E+13	1	2.47 E+13
M-02	Mineral wool	8.93 E+12	1	8.93 E+12
M-03	Plywood	3.78 E+13	4	1.51 E+14
M-04	Varnish	1.32 E+12	4	5.27 E+11
Equation 2: Total of Emergy of materials for Wall W3 during Lifespan(seJ)				1.90 E+14

Table E.24. ELS 3: Application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials of Wall W3.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Equation 3 (seJ)
M01	Wood frame (pine)	MS01	Combustion	4.56 E+12	1	4.56 E+12
M02	Mineral wool	MS02	Mineral wool	8.30 E+12	1	8.30 E+12
M03	Plywood	MS03	Combustion	3.56 E+12	4	1.42 E+13
M04	Varnish	MS04	None	0	4	0
Equation 4: Recovery Effectiveness of wall W3 (seJ)						2.71 E+13

Table E.25. ELS 3: Application of Equation 5 to Wall W3.

Recovery Effectiveness of W3 (seJ)	Emergy of W3 (seJ)	DE
2.71 E+13	1.90 E+14	0.14

E.2.3 *Alternative to end-of-life scenarios: ELS 4*

Table E.26. ELS 4: Analysis of end-of-life scenarios of 1 m^2 of wall W3.

Note	Item	End-of-life scenarios for materials mass		
		Reuse (g)	Recycle (g)	No recovery (g)
M-01	Wood frame (pine)	0	16,422	1236
M-02	Mineral wool	0	2687	202
M-03	Plywood (15 mm thickness)	0	0	13800
M-04	Varnish	0	0	424

Table E.27. ELS 4: Emergy evaluation of best options for materials that will be substituted by recovered materials of Wall W3 (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M-01	Wood frame (pine)				
MS-01	Energy recovery	J	2.46 E+08	1.85 E+04	4.56 E+12
M-02	Mineral wool				
MS-02	Minerals (rock)	G	2.69 E+03	1.68 E+09	4.51 E+12
M-03	Plywood				
	Not substitute		0		0
M-04	Varnish				
	Not substitute		0		0

See Appendix C for references on Unit Solar Emergy sources.

Table E.28. ELS 4: Application of Equations 1 and 2 to materials composing Wall W3.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M-01	Wood frame (pine)	2.47 E+13	1	2.47 E+13
M-02	Mineral wool	8.93 E+12	1	8.93 E+12
M-03	Plywood	3.78 E+13	4	1.51 E+14
M-04	Varnish	1.32 E+12	4	5.27 E+12
Equation 2: Total of Emergy of materials for Wall W3 during lifespan(seJ)				1.90 E+14

Table E.29. ELS 4: Application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials of Wall W3.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Equation 3 (seJ)
M01	Wood frame (pine)	MS01	Combustion	4.56 E+12	1	4.56 E+12
M02	Mineral wool	MS02	Minerals (rock)	4.51 E+12	1	4.51 E+12
M03	Plywood	MS03	None	0	4	0
M04	Varnish	MS04	None	0	4	0
Equation 4: Recovery Effectiveness of wall W3 (seJ)						9.07 E+12

Table E.30. ELS 4: Application of Equation 5 to Wall C.

Recovery Effectiveness of W3 (seJ)	Emergy of W3 (seJ)	DE
9.07 E+12	1.90 E+14	0.05

APPENDIX F

CHARACTERISATION OF BUILDING B1

F.1 *Building B1: drawings*

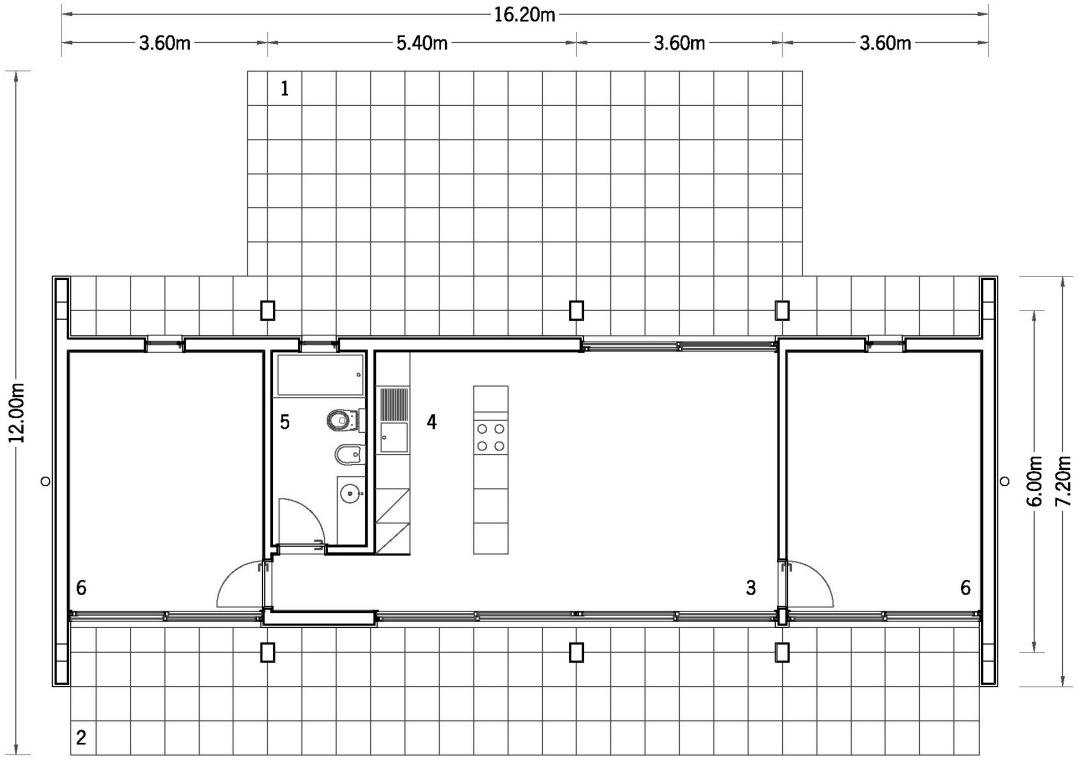

Figure F.1. Building B1: plan
(1) Terrace, 2) Balcony, 3) Living room, 4) Kitchen, 5) Bathroom, 6) Bedroom.

Figure F.2. Building B1: 3D South view.

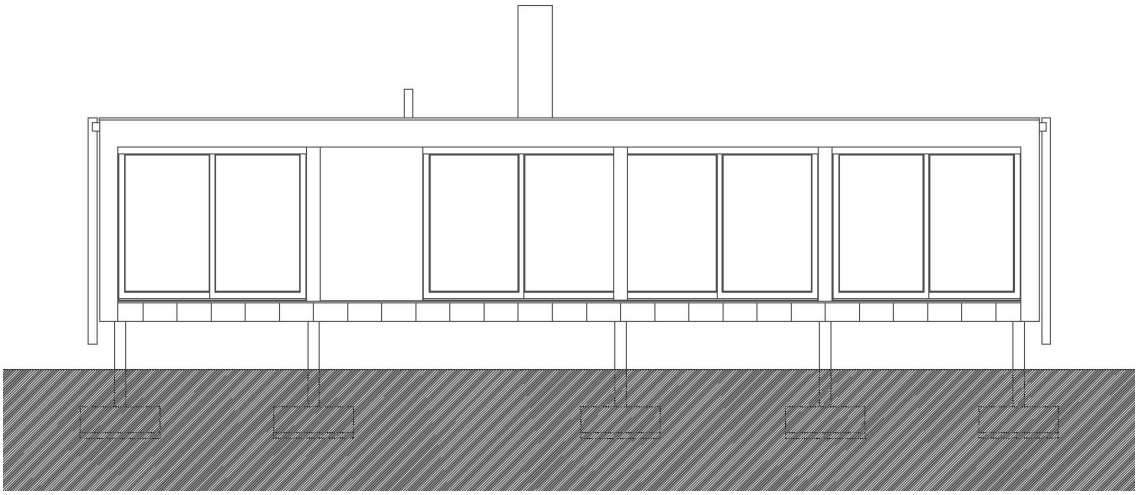

Figure F.3. Building B1: South elevation.

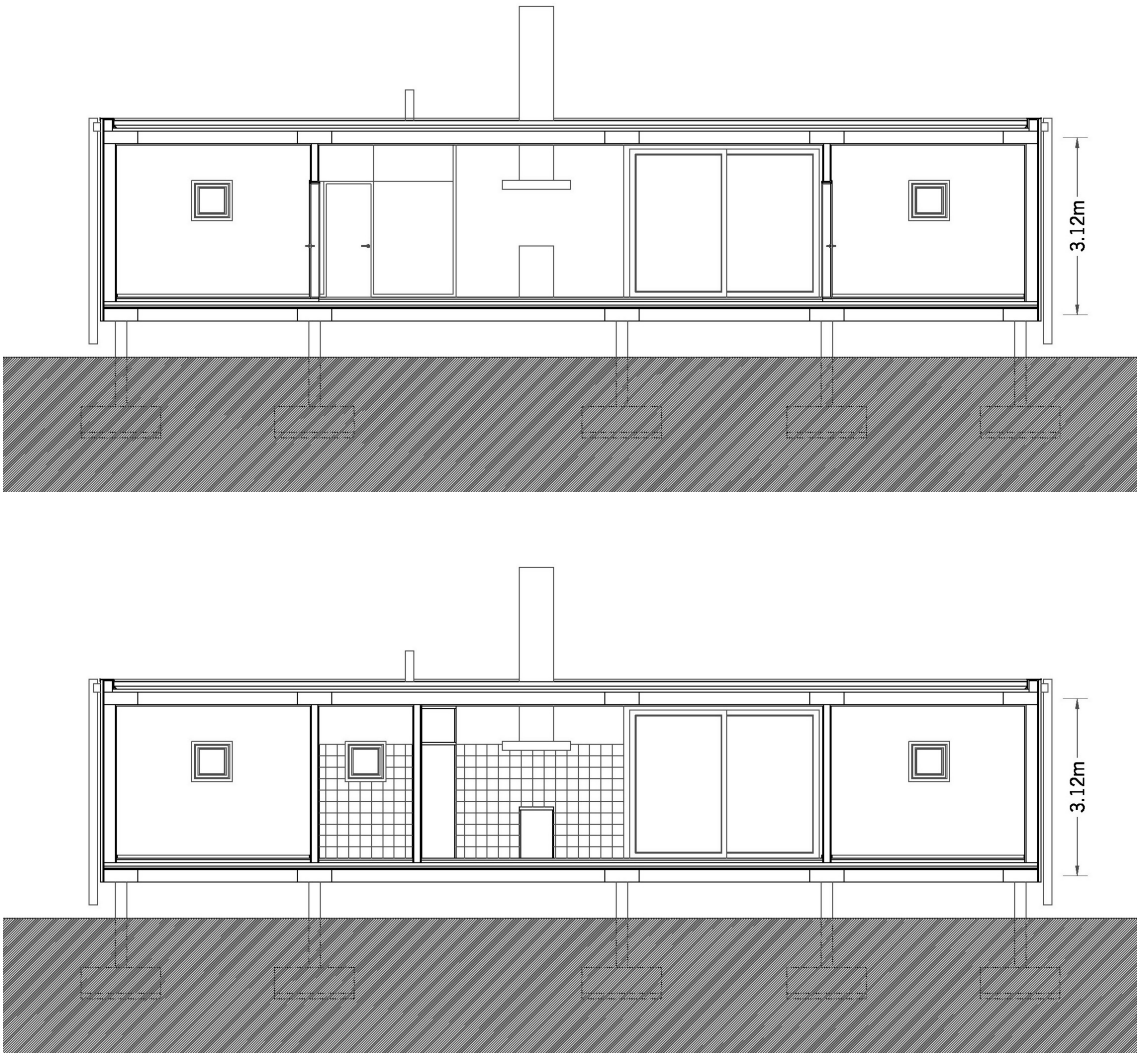

Figure F.4. Building B1: longitudinal sections.

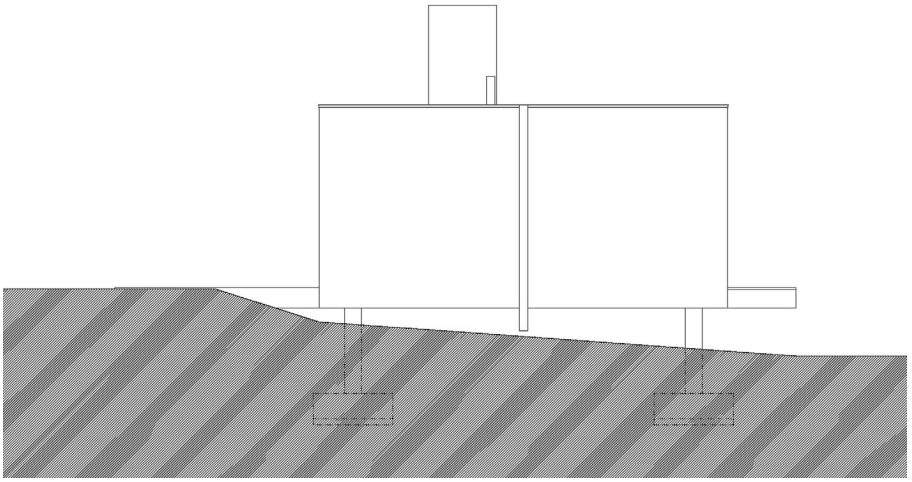

Figure F.5. Building B1: West elevation.

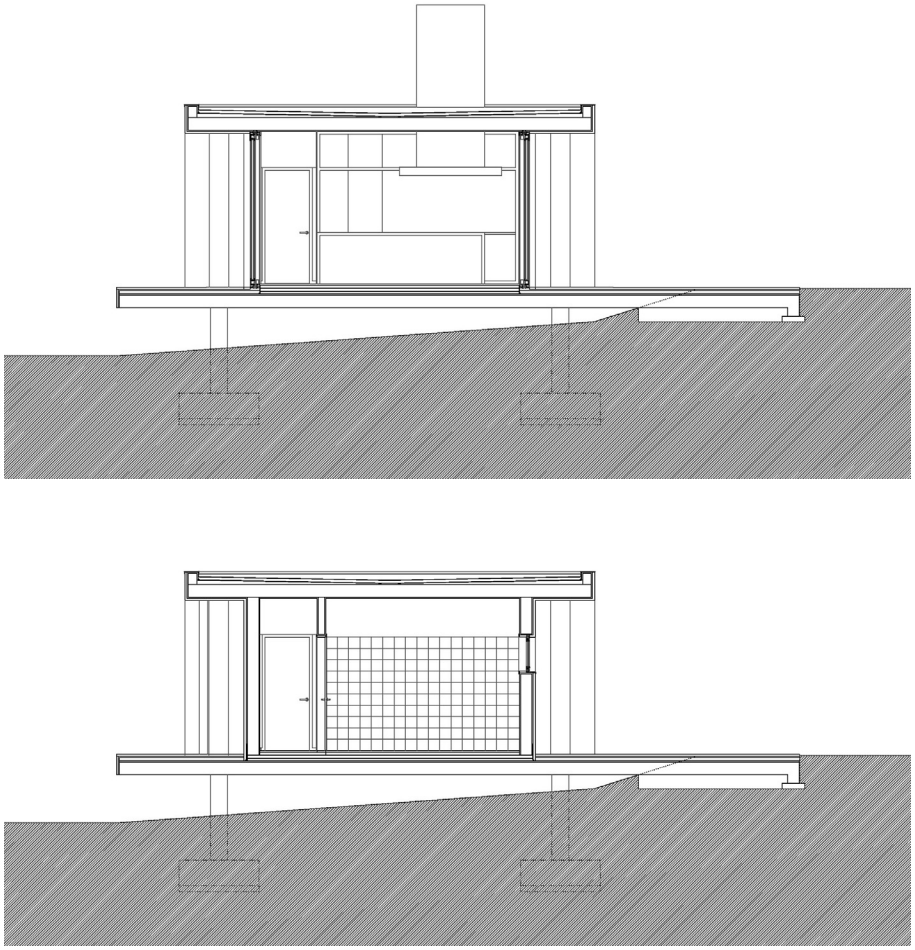

Figure F.6. Building B1: cross sections.

F.2 *Building B1: mass inventory*

Table F.1. Building B1: mass inventory of materials.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S01: FOUNDATIONS						
S01-E01 Square base						
M01 Structural concrete						
M01.1	Concrete	10.78	m^3	2400.00	kg/m^3	2.59 E+07
M01.2	Steel (round bar 12 mm thickness)	450.00	m	0.888	kg/m	4.00 E+05
S01-E02 Columns						
M02 Structural concrete						
M02.1	Concrete	900.00	m^3	2400.00	kg/m^3	2.16 E+06
M02.2	Steel (total)					3.19 E+05
M02.2a	Steel (round bar 16 mm thickness)	140.00	m	1.578	kg/m	2.21 E+05
M02.2b	Steel (round bar 12 mm thickness)	62.00	m	0.888	kg/m	5.51 E+04
M02.2c	Steel (round bar 6 mm thickness)	196.00	m	0.222	kg/m	4.35 E+04
S02: STRUCTURAL FRAME						
S02-E01 Columns						
M03 Structural concrete						
M03.1	Concrete	1.74	m^3	2400.00	kg/m^3	4.18 E+06
M03.2	Steel (total)					9.22 E+05
M03.2a	Steel (round bar 16 mm thickness)	168.00	m	1.578	kg/m	2.65 E+05
M03.2b	Steel (round bar 12 mm thickness)	666.49	m	0.888	kg/m	5.92 E+05
M03.2c	Steel (round bar 6 mm thickness)	294.00	m	0.222	kg/m	6.53 E+04
S02-E02 Beams ground floor						
M04 Structural concrete						
M04.1	Concrete	6.88	m^3	2400.00	kg/m^3	1.65 E+07
M04.2	Steel (total)					9.17 E+05
M04.2a	Steel (round bar 12 mm thickness)	666.49	m	0.888	kg/m	5.92 E+05
M04.2b	Steel (round bar 6 mm thickness)	294.00	m	0.222	kg/m	3.25 E+05
S02-E03 Beams roof						
M05 Structural concrete						
M05.1	Concrete	4.67	m^3	2400.00	kg/m^3	1.12 E+07
M05.2	Steel (total)					5.84 E+05
M05.2a	Steel (round bar 12 mm thickness)	453.20	m	0.888	kg/m	4.02 E+05
M05.2b	Steel (round bar 6 mm thickness)	819.00	m	0.222	kg/m	1.82 E+06

References for materials density are given in Appendix B

Table F.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S02-E04 Slab ground floor						
M06 Structural concrete						
M06.1	Concrete	30.57	m^3	2400.00	kg/m^3	7.34 E+07
M06.2	Steel (total)					3.34 E+06
M06.2a	Steel (round bar 12 mm thickness)	1002.26	m	0.888	kg/m	8.90 E+05
M06.2b	Steel (round bar 10 mm thickness)	3965.78	m	0.617	kg/m	2.45 E+06
M07 Mortar		3.40	m^3	1950.00	kg/m^3	6.64 E+06
S02-E05 Slab roof						
M08 Structural concrete						
M08.1	Concrete	21.52	m^3	2400.00	kg/m^3	5.17 E+07
M08.2	Steel (total)					2.33 E+06
M08.2a	Steel (round bar 12 mm thickness)	687.46	m	0.888	kg/m	6.10 E+05
M08.2b	Steel (round bar 10 mm thickness)	2789.49	m	0.617	kg/m	1.72 E+06
M09 Mortar		6.83	m^3	1950.00	kg/m^3	1.33 E+07
S03: FAÇADES AND ROOFS						
S03-E01 External walls						
M10 Ceramic hollow brick masonry (200 mm thickness)						
M10.1	Ceramic hollow brick (200 mm thickness)	1135.00	un	8.00	kg/un	9.08 E+06
M10.2	Mortar (masonry)	3.55	m^3	1950.00	kg/m^3	6.92 E+06
M11 Mortar (rendering)		2.65	m^3	1950.00	kg/m^3	5.69 E+06
M12 Thermal insulation (Thermoformed EPS out insulation)		4.77	m^3	20.00	kg/m^3	3.55 E+04
M13 Paint		124,11	m^3	0.668	kg/m^2	8.28 E+04
S03-E02 Doors						
M14 Door F01 (sliding door)						
M14.1	Aluminium	35.60	m	2.30	kg/m	8.19 E+04
M14.2	Double flat glass (6-8-6 thickness)	31,36	m^2	15.00	Kg/m^2	4.70E+05
M14.3	Wood (Oak)	0.018	m^3	760.00	kg/m^3	1.40 E+04
M14.4	Varnish	1.30	m^2	0.420	Kg/m^2	5.47 E+02
M15 Door F02 (sliding door)						
M15.1	Aluminium	8.94	m	2.30	kg/m	2.06 E+04
M15.2	Double flat glass (6-8-6 thickness)	15,28	m^2	15.00	Kg/m^2	2.29 E+05
M15.3	Wood (Oak)	0.013	m^3	760.00	kg/m^3	9.91 E+03
M15.4	Varnish	0.83	m^2	0.420	Kg/m^2	3.51 E+02

References for materials density are given in Appendix B

Table F.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
M16 Door F03 (sliding door)						
M16.1	Aluminium	17.84	m	2.30	kg/m	4.10 E+04
M16.2	Double flat glass (6-8-6 thickness)	30,18	m^2	15.00	Kg/m^2	4.52 E+05
M16.3	Wood (Oak)	0.020	m^3	760.00	kg/m^3	1.48 E+04
M16.4	Varnish	1.25	m^2	0.420	Kg/m^2	5.28 E+02
S03-E03 Windows						
M17 Window F05 (hinged window)						
M17.1	Aluminium	7.56	m	2.60	kg/m	1.97 E+04
M17.2	Double flat glass (6-8-6 thickness)	11,52	m^2	15.00	Kg/m^2	1.72 E+05
M17.3	Wood (Oak)	0.036	m^3	760.00	kg/m^3	2.73 E+04
M17.4	Varnish	1.63	m^2	0.420	Kg/m^2	6.85 E+02
S03-E04 Roof						
M18 Asphalt sheet		122,86	m^3	4.00	Kg/m^2	4.91 E+05
M19 Thermal insulation (Thermoformed XPS)		4.33	m^3	35.00	kg/m^3	1.51 E+05
M20 Gravel		8.65	m^3	1500.00	kg/m^3	1.29 E+07
M21 Zinc sheet (1 mm thickness)		18.59	m^2	7.20	kg/m^3	1.33 E+05
S04: FLOORS						
S04-E01 External floor						
M22 Granite floor						
M22.1	Granite tiles (30 mm thickness)	101.07	m^2	80.01	kg/m^3	8.08 E+06
M22.2	Mortar	2.35	m^3	1950.00	kg/m^3	3.96 E+06
S04-E02 Interior floor						
M23 Asphalt sheet		348.71	m^3	4.00	Kg/m^2	1.28 E+06
M24 Thermal insulation (Thermoformed XPS)		2.985	m^3	25.00	kg/m^3	7.46 E+04
M25 Mortar		4.47	m^3	1750.00	kg/m^3	8.73 E+06
M26 Wood frame (Pine)		0.347	m^3	600.00	kg/m^3	2.64 E+05
M27 Wood floor (Oak 30 mm thickness)		64.95	m^3	22.80	kg/m^3	1.48 E+06
M28 Varnish (wood floor)		64.95	m^3	0.420	Kg/m^2	2.73 E+04
M29 Marble floor						
M29.1	Marble tiles (20 mm thickness)	5.61	m^2	55.00	kg/m^3	3.08 E+05
M29.2	Mortar	0.28	m^3	1950.00	kg/m^3	5.47 E+05

References for materials density are given in Appendix B

Table F.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S05: INTERIOR PARTITION						
S05-E01 Interior walls						
M30 Ceramic hollow brick masonry (110 mm thickness)						
M30-1	Ceramic hollow brick (110 mm thickness)	584.00	un	4.00	kg/un	2.33 E+06
M30-2	Mortar (masonry)	0.64	m^3	1950.00	kg/m^3	1.24 E+06
M31 Mortar (rendering)		2.65	m^3	1750.00	kg/m^3	4.65 E+06
M32 Plaster		0.245	m^3	1000.00	kg/m^3	2.44 E+05
M33 Paint		89,39	m^3	0.668	kg/m^2	5.97 E+04
M34 Plywood finishing (15 mm thickness)		5.30	m^3	6.90	kg/m^3	3.66 E+04
M35 Varnish (plywood)		5.30	m^3	0.420	Kg/m^2	2.23 E+03
M36 Wood foot panel (Oak)		0.025	m^3	760.00	kg/m^3	1.87 E+04
M37 Varnish (wood foot panel)		2.13	m^3	0.420	Kg/m^2	8.49 E+02
M38 Ceramic tiles		39,41	m^3	13.00	Kg/m^2	5.12 E+05
S05-E02 Doors						
M39 Door F04 (hinged door)						
M39.1	Wood frame (oak)	0.087	m^3	760.00	kg/m^3	6.63 E+04
M39.2	Prefabricated wood door	3.00	un	14.00	kg/un	4.20 E+04
M39.3	Varnish	14.37	m^3	0.420	kg/m^2	6.04 E+03
S06: CEILINGS						
S06-E01 External ceilings						
M40 Mortar (rendering)		0.654	m^3	1750.00	kg/m^3	1.14 E+06
M41 Thermal insulation (Thermoformed XPS)		1.30	m^3	35.00	kg/m^3	4.55 E+04
M42 Paint		32.54	m^3	0.668	kg/m^2	2.17 E+04
S06-E02 Interior ceilings						
M43 Mortar (rendering)		1.14	m^3	1750.00	kg/m^3	2.47 E+06
M44 Plaster		0.35	m^3	1000.00	kg/m^3	3.52 E+02
M45 Paint		70,56	m^3	0.668	kg/m^2	4.69 E+04
TOTAL MASS (g)						**2.88 E+08**

References for materials density are given in Appendix B

F.3 *Building B1: analysis of building configuration*

Table F.2. Building B1: analysis of building configuration.

Note	Item	SL (yr)	Rep	Mass (g)	Connections
S01: FOUNDATIONS					
S01-E01 Square base					
M01	Structural concrete				~~M02~~
M01.1	Concrete	50	1	2.59 E+07	~~M01.2~~
M01.2	Steel (round bar 12 mm thickness)	50	1	4.00 E+05	~~M01.1~~
S01-E02 Columns					
M02	Structural concrete				~~M01~~ ~~M04~~
M02.1	Concrete	50	1	2.16 E+06	~~M02.2~~
M02.2	Steel (total)	50	1	3.19 E+05	~~M02.1~~
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M03	Structural concrete				~~M04~~ ~~M5~~
M03.1	Concrete	50	1	4.18 E+06	~~M03.2~~
M03.2	Steel (total)	50	1	9.22 E+05	~~M03.1~~
S02-E02 Beams ground floor					
M04	Structural concrete				~~M02~~ ~~M03~~ ~~M06~~
M04.1	Concrete	50	1	1.65 E+07	~~M04.2~~
M04.2	Steel (total)	50	1	9.17 E+05	~~M04.1~~
S02-E03 Beams roof					
M05	Structural concrete				~~M03~~ ~~M08~~ ~~M08~~
M05.1	Concrete	50	1	1.12 E+07	~~M05.2~~
M05.2	Steel (total)	50	1	5.84 E+05	~~M05.1~~
S02-E04 Slab ground floor					
M06	Structural concrete				~~M04~~ ~~M07~~ ~~M10~~
M06.1	Concrete	50	1	7.34 E+07	~~M06.2~~
M06.2	Steel (total)	50	1	3.34 E+06	~~M06.1~~
M07	Mortar	50	1	6.64 E+06	~~M06~~ ~~M22~~ ~~M23~~ ~~M30~~

(*) Service life equals Lifespan of building element where forecast service life of materials is longer.

Where:

~~M,~~ is for closed connections

M, Is for open connection

Table F.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S02-E05 Slab roof									
M08 Structural concrete					M05	M09	M10	M40	M43
M08.1	Concrete	50	1	5.17 E+07	M08.2				
M08.2	Steel (total)	50	1	2.33 E+06	M08.1				
M09 Mortar		50	1	1.33 E+07	M08	M18			
S03: FAÇADES AND ROOFS									
S03-E01 External walls									
M10 Ceramic hollow brick masonry (200 mm thickness)					M06	M08	M11	M31	
M10.1	Ceramic hollow brick (200 mm thickness)	50	1	9.08 E+06	M10.2				
M10.2	Mortar (masonry)	50	1	6.92 E+06	M10.1				
M-11 Mortar (rendering)		50	1	5.69 E+06	M10	M12			
M12 Thermal insulation (Thermoformed EPS - Cladding outinsulation)		50	1	3.55 E+04	M11	M13			
M13 Paint		5	10	8.28E+04	M12				
S03-E02 Doors									
M14 Door F01 (sliding door)					M10	M11	M12	M31	M32
M14.1	Aluminium	30	2	8.19 E+04	M14.2	M14.3			
M14.2	Double flat glass (6-8-6 thickness)	30	2	4.70E+05	M14.1				
M14.3	Wood (Oak)	30	2	1.40 E+04	M14.1	M14.4			
M14.4	Varnish	15	4	5.47 E+02	M14.3				
M15 Door F02 (sliding door)					M10	M11	M12	M31	M32
M15.1	Aluminium	30	2	2.06 E+04	M15.2	M14.3			
M15.2	Double flat glass (6-8-6 thickness)	30	2	2.29 E+05	M15.1				
M15.3	Wood (Oak)	30	2	9.91 E+03	M15.1	M15.4			
M15.4	Varnish	15	4	3.51 E+02	M15.3				
M16 Door F03 (sliding door)					M10	M11	M12	M31	M32
M16.1	Aluminium	30	2	4.10 E+04	M16.2	M16.3			
M16.2	Double flat glass (6-8-6 thickness)	30	2	4.52 E+05	M16.1				
M16.3	Wood (Oak)	30	2	1.48 E+04	M16.1	M16.4			
M16.4	Varnish	15	4	5.28 E+02	M16.3				

(*) Service life equals Lifespan of building element where forecast service life of materials is longer.

Table F.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S03-E03 Windows									
M17 Window F05 (hinged window)					M10	M11	M12	M31	M32
M17.1	Aluminium	30	2	1.97 E+04	M17.2	M17.3			
M17.2	Double flat glass (6-8-6 thickness)	30	2	1.72 E+05	M17.1				
M17.3	Wood (Oak)	30	2	2.73 E+04	M17.1	M17.4			
M17.4	Varnish	15	4	6.85 E+02	M17.3				
S03-E04 Roof									
M18 Asphalt sheet		50	1	4.91 E+05	M09	M19			
M19 Thermal insulation (Thermoformed XPS)		50	1	1.51 E+05	M18	M20			
M20 Gravel		50	1	1.29 E+07	M-19				
M21 Zinc sheet (1 mm thickness)		50	1	1.33 E+05	M10	M11	M12	M18	
S04: FLOORS									
S04-E01 External floor									
M22 Granite floor					M07				
M22.1	Granite tiles (30 mm thickness	50	1	8.08 E+06	M22.2				
M22.2	Mortar	50	1	3.96 E+06	M22.1				
S04-E01 Interior floor									
M23 Asphalt sheet		50	1	1.28 E+06	M07	M24			
M24 Thermal insulation (Thermoformed XPS)		50	1	7.46 E+04	M23	M25			
M25 Mortar		50	1	8.73 E+06	M24	M26	M29		
M26 Wood frame (Pine)		30	2	2.64 E+05	M25	M27			
M27 Wood floor (Oak 30 mm thickness)		30	2	1.48 E+06	M26	M28			
M28 Varnish (wood floor)		15	4	2.73 E+04	M27				
M29 Marble floor					M25				
M29.1	Marble tiles (20 mm thickness)	50	1	3.08 E+05	M29.2				
M29.2	Mortar	50	1	5.47 E+05	M29.1				

(*) Service life equals Lifespan of building element where forecast service life of materials is longer.

Table F.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S05: INTERIOR PARTITION									
S05-E01 Interior walls									
M30	Ceramic hollow brick masonry (110 mm thickness)				M07	M08	M31		
M30.1	Ceramic hollow brick (110 mm thickness)	50	1	2.33 E+06	M30.2				
M30.2	Mortar (masonry)	50	1	1.24 E+06	M30.1				
M31	Mortar (rendering)	50	1	4.65 E+06	M30	M32	M34	M36	M37
M32	Plaster	50	1	2.44 E+05	M31	M33			
M33	Paint	15	4	5.97 E+04	M32				
M34	Plywood finishing (15 mm thickness)	15	4	3.66 E+04	M31	M35			
M35	Varnish (plywood)	15	4	2.23 E+03	M34				
M36	Wood foot panel (Oak)	30	2	1.87 E+04	M31	M37			
M37	Varnish (wood foot panel)	15	4	8.49 E+02	M36				
M38	Ceramic tiles	30	2	5.12 E+05	M31				
S05-E02 Doors									
M39	Door F04 (hinged door)				M30	M31			
M39.1	Wood frame (oak)	30	2	6.63 E+04	M39.2	M39.3			
M39.2	Prefabricated wood door	30	2	4.20 E+04	M39.1	M39.3			
M39.3	Varnish	15	4	6.04 E+03	M39.1	M39.2			
S06: CEILINGS									
S06-E01 External ceilings									
M40	Mortar (rendering)	50	1	1.14 E+06	M08	M41			
M41	Thermal insulation (Thermoformed XPS)	50	1	4.55 E+04	M40	M42			
M42	Paint	5	10	2.17 E+04	M41				
S06-E01 Interior ceilings									
M43	Mortar (rendering)	30	1	2.47 E+06	M08	M44			
M44	Plaster	30	1	3.52 E+02	M43	M45			
M45	Paint	15	4	4.69 E+04	M44				

(*) Service life equals Lifespan of building element where forecast service life of materials is longer.

F.4 *Building B1: analysis of end-of-life scenarios of materials*

Table F.3. Building B1: analysis of end-of-life scenarios of materials.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S01: FOUNDATIONS					
S01-E01 Square base					
M01 Structural concrete					
M01.1	Concrete	2.59 E+07	0	2.41 E+07	1.81 E+06
M01.2	Steel (round bar)	4.00 E+05	0	3.72 E+05	2.80 E+04
S01-E02 Columns					
M02 Structural concrete					
M02.1	Concrete	2.16 E+06	0	2.01 E+06	1.51 E+05
M02.2	Steel (round bar)	3.19 E+05	0	2.97 E+05	2.23 E+04
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M03 Structural concrete					
M03.1	Concrete	4.18 E+06	0	3.88 E+06	2.92 E+05
M03.2	Steel (round bar)	9.22 E+05	0	8.58 E+05	6.46 E+04
S02-E02 Beams ground floor					
M04 Structural concrete					
M04.1	Concrete	1.65 E+07	0	1.54 E+07	1.16 E+06
M04.2	Steel (round bar)	9.17 E+05	0	8.53 E+05	6.42 E+04
S02-E03 Beams roof					
M05 Structural concrete					
M05.1	Concrete	1.12 E+07	0	1.04 E+07	7.86 E+05
M05.2	Steel (round bar)	5.84 E+05	0	5.43 E+05	4.09 E+04
S02-E04 Slab ground floor					
M06 Structural concrete					
M06.1	Concrete	7.34 E+07	0	6.82 E+07	5.14 E+06
M06.2	Steel (round bar)	3.34 E+06	0	3.10 E+06	2.34 E+05
M07 Mortar		6.64 E+06	0	5.98 E+06	6.64 E+05
S02-E05 Slab roof					
M08 Structural concrete					
M08.1	Concrete	5.17 E+07	0	4.80 E+07	3.62 E+06
M08.2	Steel (round bar)	2.33 E+06		2.17 E+06	1.63 E+05
M09 Mortar		1.33 E+07		1.20 E+06	1.63 E+05

Table F.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M10 Ceramic hollow brick masonry (200 mm thickness)					
M10.1	Ceramic hollow brick (200 mm thickness)	9.08 E+06	0	8.17 E+06	9.08 E+05
M10.2	Mortar (masonry)	6.92 E+06	0	6.23 E+06	6.92 E+05
M11 Mortar (rendering)		5.69 E+06	0	5.12 E+06	5.69 E+05
M12 Thermal insulation (Thermo-formed EPS)		3.55 E+04	0	0	3.55 E+04
M13 Paint		8.28 E+04	0	0	8.28 E+04
S03-E02 Doors					
M14 Door F01 (sliding door)					
M14.1	Aluminium	8.19 E+04	0	7.78 E+04	4.10 E+03
M14.2	Double flat glass (6-8-6 thickness)	4.70E+05	4.37 E+05	0	3.29 E+04
M14.3	Wood (Oak)	1.40 E+04	0	1.20 E+04	9.80 E+02
M14.4	Varnish	5.47 E+02	0	0	5.47 E+02
M15 Door F02 (sliding door)					
M15.1	Aluminium	2.06 E+04	0	1.96 E+04	1.03 E+03
M15.2	Double flat glass (6-8-6 thickness)	2.29 E+05	2.13 E+05	0	1.60 E+04
M15.3	Wood (Oak)	9.91 E+03	0	9.22 E+03	6.94 E+02
M15.4	Varnish	3.51 E+02	0	0	3.51 E+02
M16 Door F03 (sliding door)					
M16.1	Aluminium	4.10 E+04	0	3.90 E+04	2.05 E+03
M16.2	Double flat glass (6-8-6 thickness)	4.52 E+05	4.20 E+05	0	3.16 E+04
M16.3	Wood (Oak)	1.48 E+04	0	1.38 E+04	1.04 E+03
M16.4	Varnish	5.28 E+02	0	0	5.28 E+02
S03-E03 Windows					
M17 Window F05 (hinged window)					
M17.1	Aluminium	1.97 E+04	0	1.87 E+04	9.85 E+02
M17.2	Double flat glass (6-8-6 thickness)	1.72 E+05	1.60 E+05	0	1.20 E+04
M17.3	Wood (Oak)	2.73 E+04	0	2.54 E+04	1.91 E+03
M17.4	Varnish	6.85 E+02	0	0	6.85 E+02

Table F.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S03-E04 Roof					
M18	Asphalt sheet	4.91 E+05	0	0	4.91 E+05
M19	Thermal insulation (Thermo-formed XPS)	1.51 E+05	0	0	1.51 E+05
M20	Gravel	1.29 E+07	1.16 E+07	0	1.29 E+06
M21	Zinc sheet (1 mm thickness)	1.33 E+05	0	1.26 E+05	6.65 E+03
S04: FLOORS					
S04-E01 External floor					
M22	Granite floor				
M22.1	Granite tiles (30 mm thick-ness	8.08 E+06	0	7.27 E+06	8.08 E+05
M22.2	Mortar	3.96 E+06	0	3.56 E+06	3.96 E+05
S04-E02 Interior floor					
M23	Asphalt sheet	1.28 E+06	0	0	1.28 E+06
M24	Thermal insulation (Thermo-formed XPS)	7.46 E+04	0	0	7.46 E+04
M25	Mortar	8.73 E+06	0	7.86 E+06	8.73 E+05
M26	Wood frame (Pine)	2.64 E+05	0	2.46 E+05	1.85 E+04
M27	Wood floor (Oak 30 mm thickness)	1.48 E+06	0	1.38 E+06	1.04 E+05
M28	Varnish (wood floor)	2.73 E+04	0	0	2.73 E+04
M29	Marble floor				
M29.1	Marble tiles (20 mm thick-ness)	3.08 E+05	0	2.77 E+05	3.08 E+04
M29.2	Mortar	5.47 E+05	0	4.92 E+05	5.47 E+04
S05: INTERIOR PARTITION					
S05-E01 Interior walls					
M30	Ceramic hollow brick masonry (110 mm thickness)				
M30.1	Ceramic hollow brick (110 mm thickness)	2.33 E+06	0	2.10 E+06	2.33 E+05
M30.2	Mortar (masonry)	1.24 E+06	0	1.12 E+05	1.24 E+04
M31	Mortar (rendering)	4.65 E+06	0	4.19 E+06	4.65 E+05
M32	Plaster	2.44 E+05	0	2.20 E+05	2.44 E+04
M33	Paint	5.97 E+04	0	0	5.97 E+04
M34	Plywood finishing (15 mm thick-ness)	3.66 E+04	0	3.40 E+04	2.56 E+03
M35	Varnish (plywood)	2.23 E+03	0	0	2.23 E+03

Table F.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
M36	Wood foot panel (Oak)	1.87 E+04	0	1.74 E+04	1.31 E+03
M37	Varnish (wood foot panel)	8.49 E+02	0	0	8.49 E+02
M38	Ceramic tiles	5.12 E+05	0	4.61 E+05	5.12 E+04
S05-E02 Doors					
M39	Door F04 (hinged door)				
M39.1	Wood frame (oak)	6.63 E+04	0	6.17 E+04	4.64 E+03
M39.2	Prefabricated wood door	4.20 E+04	0	3.91 E+04	2.94 E+03
M39.3	Varnish	6.04 E+03	0	0	6.04 E+03
S06: CEILINGS					
S06-E01 External ceilings					
M40	Mortar (rendering)	1.14 E+06	0	1.03 E+06	1.14 E+05
M41	Thermal insulation (Thermo-formed XPS)	4.55 E+04	0	0	4.55 E+04
M42	Paint	2.17 E+04	0	0	2.17 E+04
S06-E02 Interior ceilings					
M43	Mortar (rendering)	2.47 E+06	0	2.22 E+06	2.47 E+05
M44	Plaster	3.52 E+02	0	3.17 E+02	3.52 E+01
M45	Paint	4.69 E+04	0	0	4.69 E+04

APPENDIX G

CHARACTERISATION OF BUILDING B2

G.1 *Building B2: drawings*

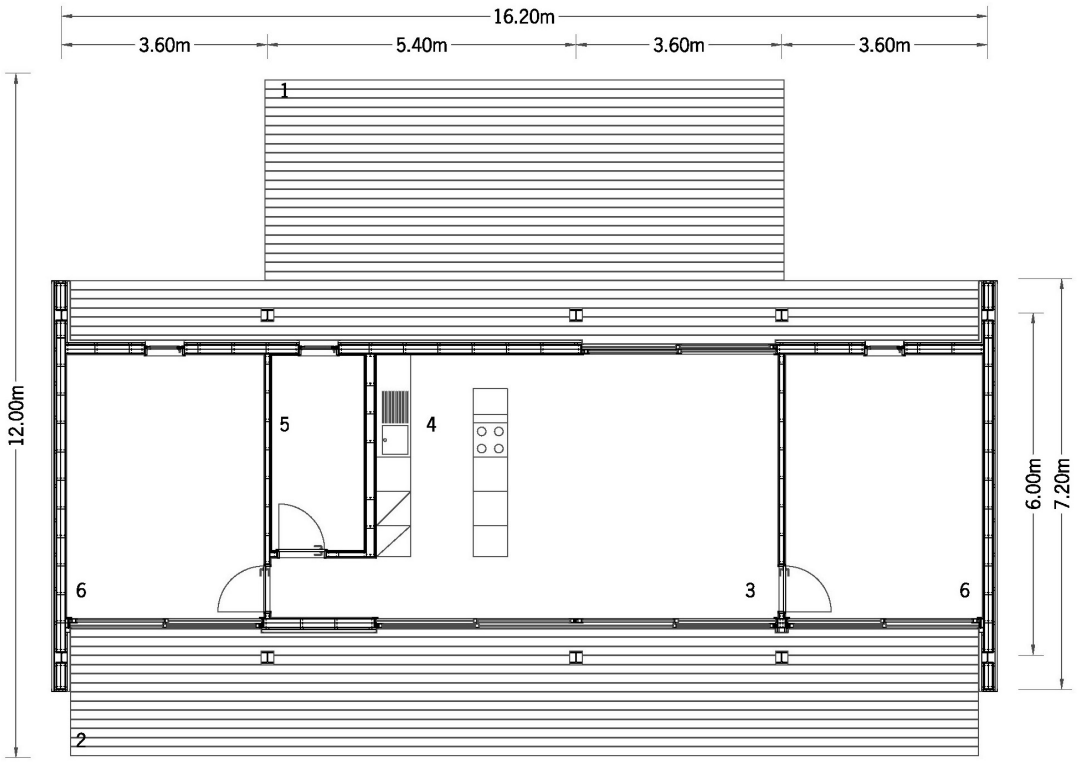

Figure G.1. Building B2: plan
1) Terrace, 2) Balcony, 3) Living room, 4) Kitchen, 5) Bathroom, 6) Bedroom.

Figure G.2. Building B2: 3D South view.

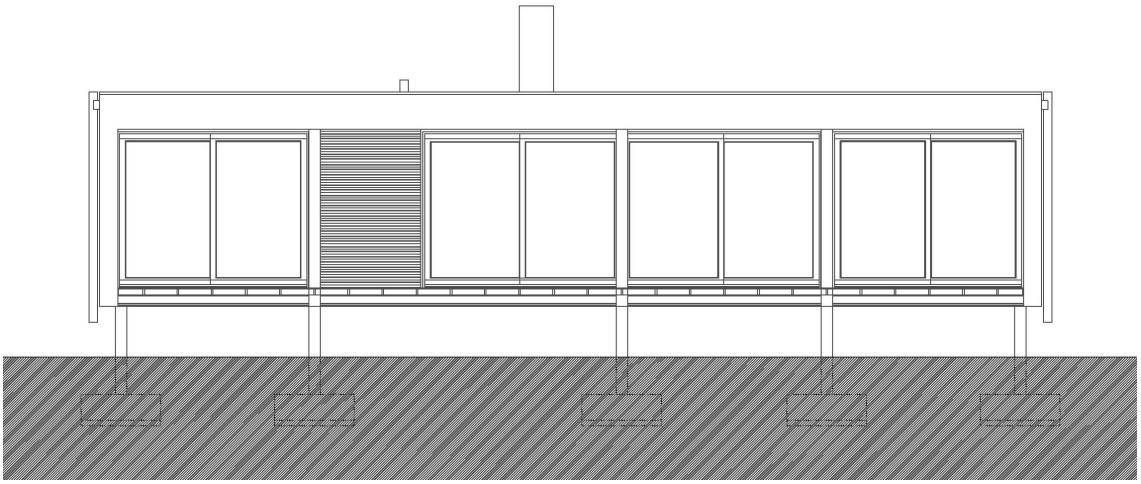

Figure G.3. Building B2: South elevation.

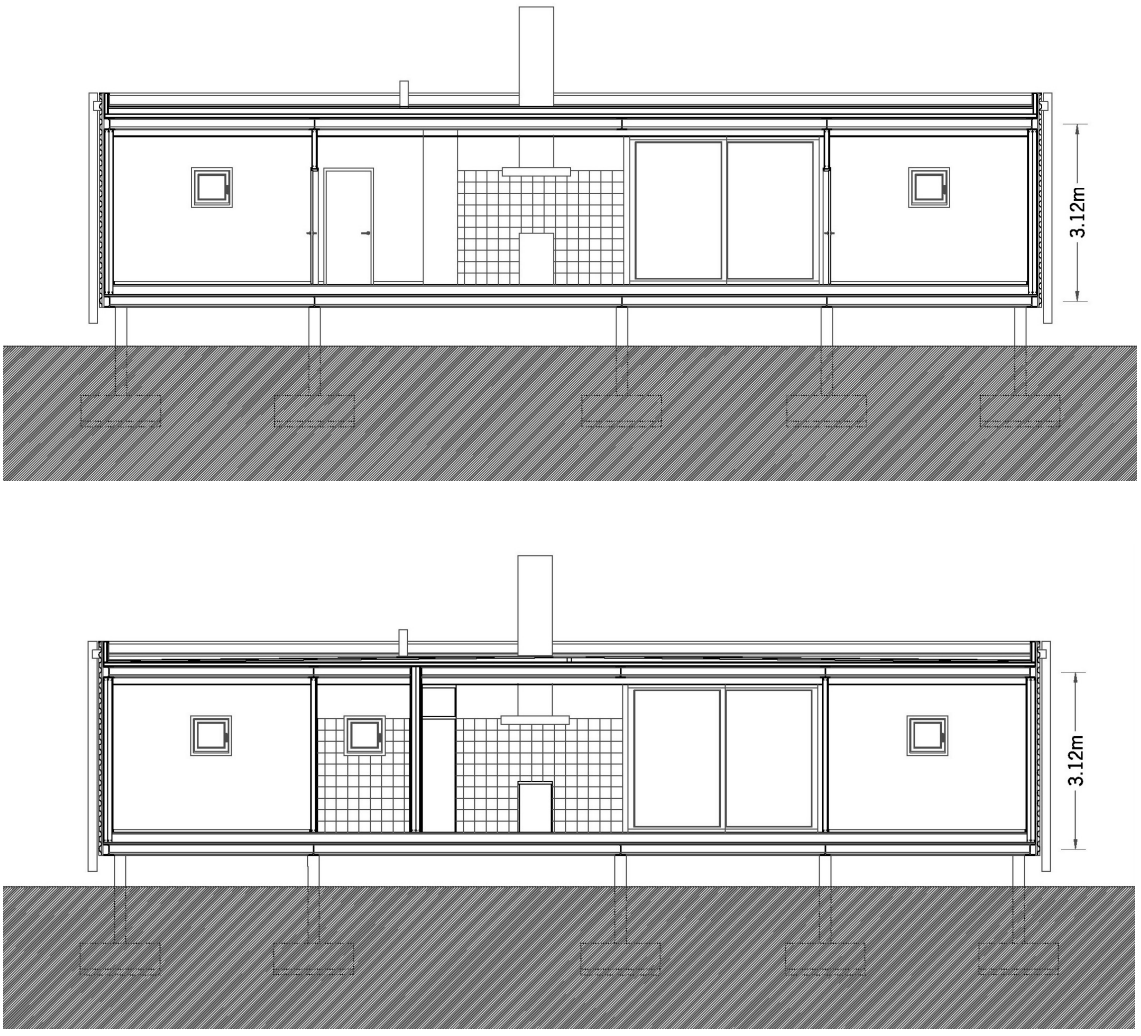

Figure G.4. Building B2: longitudinal sections.

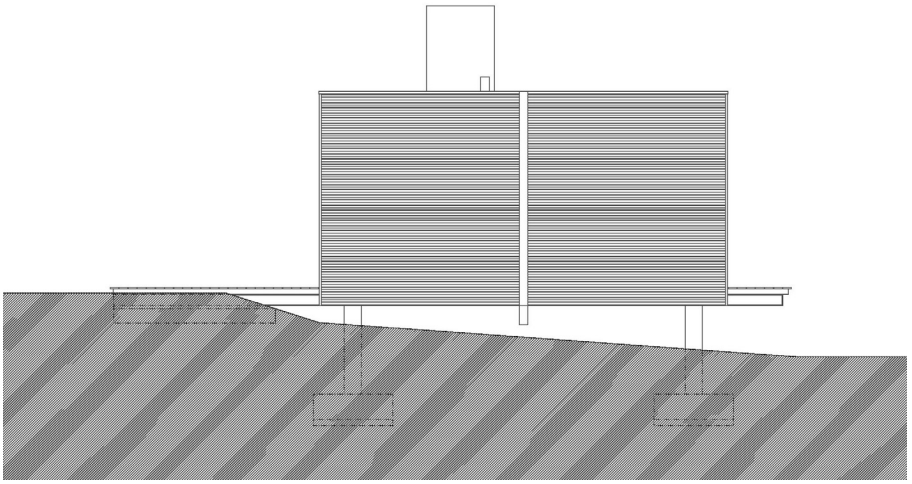

Figure G.5. Building B2: West elevation.

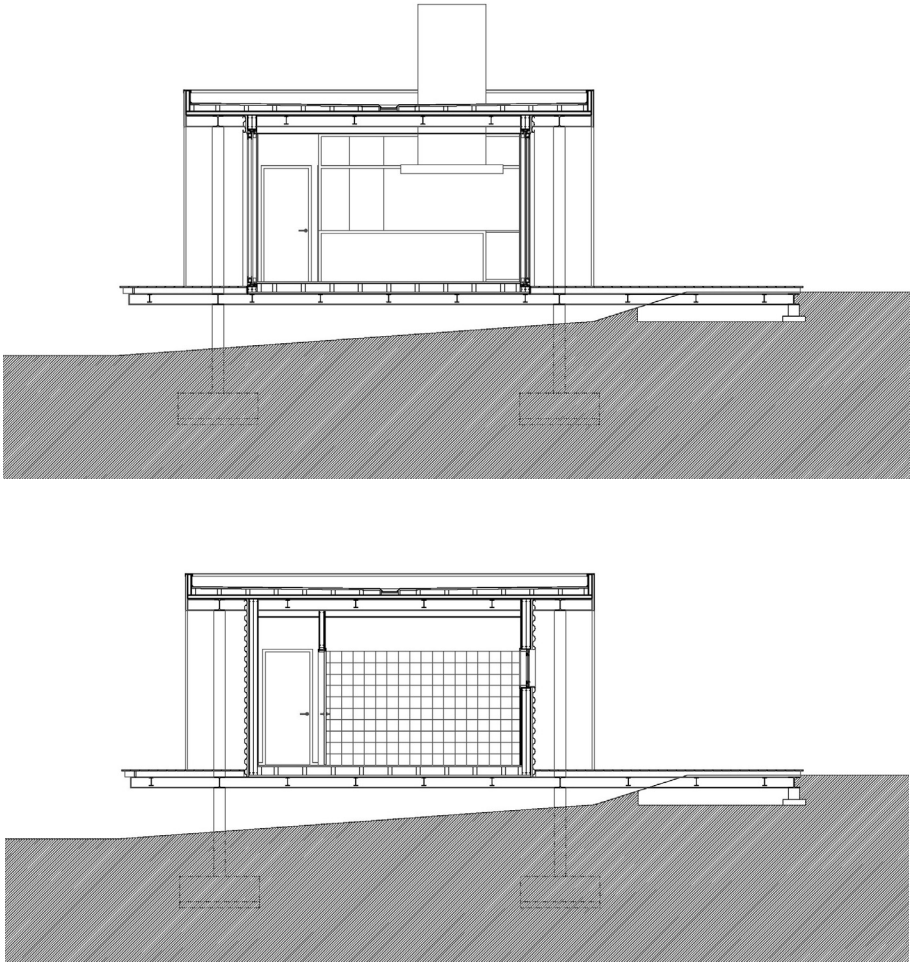

Figure G.6. Building B2: cross sections.

G.2 *Building B2: mass inventory*

Table G.1. Building B2: mass inventory of materials.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S01: FOUNDATIONS						
S01-E01 Square base						
M01 Structural concrete						
M01.1	Concrete	10.78	m^3	2400.00	kg/m^3	2.59 E+07
M01.2	Steel (round bar 12 mm thickness)	450.00	m	0.888	kg/m	4.00 E+05
S01-E02 Columns						
M02 Galvanized steel (HEB 200 section)		15.50	m	61300.00	kg/m	9.50 E+05
M03 Paint		14.82	m^2	0.90	kg/m^2	1.60 E+04
S02: STRUCTURAL FRAME						
S02-E01 Columns						
M04 Galvanized steel (HEB 200 section)		29.20	m	61300.00	kg/m	1.79 E+06
M05 Paint		33.58	m^2	0.90	kg/m^2	3.02 E+04
S02-E02 Beams ground floor						
M06 Galvanized steel (HEB 200 section)		91.68	m	61300.00	kg/m	5.62 E+06
M07 Paint (HEB 200)		105.43	m^2	0.90	kg/m^2	9.49 E+04
M08 Galvanized steel (IPN 140 section)		108.00	m	14400.00	kg/m	1.56 E+06
M09 Paint (IPN 140)		59.40	m^2	0.90	kg/m^2	5.35 E+04
S02-E03 Beams roof						
M10 Galvanized steel (HEB 200 section)		68.50	m	61300.00	kg/m	4.20 E+06
M11 Paint (HEB 200)		78.77	m^2	0.90	kg/m^2	7.09 E+04
M12 Galvanized steel (IPN 140 section)		81.00	m	14400.00	kg/m	1.17 E+06
M13 Paint (IPN 140)		44.55	m^2	0.90	kg/m^2	4.01 E+04
S02-E04 Slab ground floor						
M14 OSB panel (25 mm thickness)		81,01	m^2	16.25	kg/m^2	1.32 E+06
S02-E05 Slab roof						
M15 Structural thermal insulation panel						
M15.1	OSB panel (19 mm thickness)	230.25	m^2	10.45	Kg/m^2	2.41 E+06
M15.2	Thermoformed XPS	6.62	m^2	35.00	Kg/m^3	2.32 E+05
M16 Wood frame (Pine)		1.52	m^3	600.00	Kg/m^3	9.07 E+05
M17 OSB panel (25 mm thickness)		117.58	m^2	16.25	kg/m^2	1.91 E+06

References for materials density are given in Appendix B

Table G.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S03: FAÇADES AND ROOFS						
S03-E01 External walls						
M18 Galvanized steel frame						
M18.1	Galvanized steel rail R48	261,40	m	0.457	kg/m	1.19 E+05
M18.2	Galvanized steel rail M48	402,46	m	0.444	kg/m	1.79 E+05
M19 OSB panel (19 mm thickness)		33.86	m^3	10.45	kg/m^3	3.54 E+05
M20 Varnish (external face OSB panel)		97.51	m^2	0.420	kg/m^2	4.10 E+04
M21 Mineral wool (medium density)		5.94	m^3	70.00	kg/m^3	4.16 E+05
M22 Plasterboard		111.83	m^3	10.53	kg/m^2	1.18 E+06
M23 Paint		111,47	m^3	0.670	kg/m^2	7.45 E+04
M24 Wood stripe (Pine – 40 x 40 mm section)		0.46	m^3	600.00	kg/m^3	2.78 E+05
M25 Galvanized steel plate (1 mm thickness)		4.96	m^2	7.85	kg/m^2	3.89 E+04
M26 Corrugated galvanized steel plate (0.75 mm thickness)		60.73	m^2	7.06	kg/m^2	4.29 E+05
S03-E02 Doors						
M27 Door F01 (sliding door)						
M27.1	Aluminium	35.60	m	2.30	kg/m	8.19 E+04
M27.2	Double flat glass (6-8-6 thickness)	31,36	m^2	15.00	kg/m^2	4.70E+05
M27.3	Wood (Oak)	0.018	m^3	760.00	kg/m^3	1.40 E+04
M27.4	Varnish	1.30	m^2	0.420	kg/m^2	5.47 E+02
M28 Door F02 (sliding door)						
M28.1	Aluminium	8.94	m	2.30	kg/m	2.06 E+04
M28.2	Double flat glass (6-8-6 thickness)	15,28	m^2	15.00	kg/m^2	2.29E+05
M28.3	Wood (Oak)	0.013	m^3	760.00	kg/m^3	9.91 E+03
M28.4	Varnish	0.83	m^2	0.420	kg/m^2	3.51 E+02
M29 Door F03 (sliding door)						
M29.1	Aluminium	17.84	m	2.30	kg/m	4.10 E+04
M29.2	Double flat glass (6-8-6 thickness)	30,18	m^2	15.00	kg/m^2	4.52E+05
M29.3	Wood (Oak)	0.020	m^3	760.00	kg/m^3	1.48 E+04
M29.4	Varnish	1.25	m^2	0.420	kg/m^2	5.28 E+02
S03-E03 Windows						
M30 Window F05 (hinged window)						
M30.1	Aluminium	7.56	m	2.60	kg/m	1.97 E+04
M30.2	Double flat glass (6-8-6 thickness)	11,52	m^2	15.00	kg/m^2	1.72E+05
M30.3	Wood (Oak)	0.036	m^3	760.00	kg/m^3	2.73 E+04
M30.4	Varnish	1.63	m^2	0.420	kg/m^2	6.85 E+02

References for materials density are given in Appendix B

Table G.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S03-E04 Roof						
M31 PVC roofing sheet		264,18	m^3	4.00	kg/m^2	1.06 E+06
M32 Stainless steel plate (1 mm thickness)		11.40	m^2	7.90	kg/m^3	9.01 E+04
S04: FLOORS						
S04-E01 External floor						
M33 Wood plastic composite deck (30 mm thickness)		80.08	m^2	19.64	kg/m^2	1.57 E+06
S04-E02 Interior floor						
M34 Mineral wool (medium density)		10.57	m^3	70.00	kg/m^3	7.40 E+05
M35 Wood frame (Pine)		1.85	m^3	600.00	kg/m^3	1.12 E+06
M36 Wood floor (Oak 30 mm thickness)		64.95	m^3	22.80	kg/m^3	1.48 E+06
M37 Varnish		74.97	m^3	0.420	kg/m^2	3.15 E+04
S05: INTERIOR PARTITION						
S05-E01 Interior walls						
M38 Galvanized steel frame						
M38.1	Galvanized steel rail R48	36,33	m	0.457	kg/m	1.66 E+04
M38.2	Galvanized steel rail M46	113,56	m	0.444	kg/m	5.04 E+04
M39 Mineral wool (medium density)		1.55	m^3	70.00	kg/m^3	1.09 E+05
M40 Plasterboard		142,84	m^3	10.53	kg/m^2	1.50 E+06
M41 Paint		62.17	m^3	0.670	kg/m^2	4.16 E+04
M42 Wood foot panel (Oak)		0.018	m^3	760.00	kg/m^3	1.39 E+04
M43 Varnish (wood foot panel)		1.50	m^2	0.420	Kg/m^2	2.26 E+03
M44 Ceramic tiles		36,47	m^3	13.00	kg/m^2	4.74 E+05
S05-E02 Doors						
M45 Door F04 (hinged door)						
M45.1	Wood frame (oak)	0.087	m^3	760.00	kg/m^3	6.63 E+04
M45.2	Prefabricated wood door	3.00	un	14.00	kg/un	4.20 E+04
M45.3	Varnish	14.37	m^3	0.420	Kg/m^2	6.04 E+03

References for materials density are given in Appendix B

Table G.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S06: CEILINGS						
S06-E01 External ceilings						
M46	Wood stripe (Pine – 40 x 40 mm section)	0.09	m^3	600.00	kg/m^3	5.64 E+04
M46	Galvanized steel plate (1 mm thickness)	23.13	m^2	7.85	kg/m^2	1.82 E+05
S06-E02 Interior ceilings						
M48	Galvanized steel rail F530	217.25	m	457	kg/m	9.93 E+04
M49	Plasterboard (waterproof)	72.41	m^2	11.33	kg/m^2	8.20 E+05
M50	Paint (primary)	72.41	m^3	0.670	kg/m^2	4.48 E+04
TOTAL MASS (g)						**6.29 E+07**

References for materials density are given in Appendix B

G.3 *Building B2: analysis of building configuration*

Table G.2. Building B2: analysis of building configuration.

Note	Item	SL (yr)	Rep	Mass (g)	Connections			
S01: FOUNDATIONS								
S01-E01 Square base								
M01	Structural concrete				M02			
M01.1	Concrete	50	1	2.59 E+07	M01.2			
M01.2	Steel (round bar 12 mm thickness)	50	1	4.00 E+05	M01.1			
S01-E02 Columns								
M02	Galvanized steel (HEB 200 section)	50	1	9.50 E+05	M01	M03	M06	
M03	Paint	15	4	1.60 E+04	M02			
S02: STRUCTURAL FRAME								
S02-E01 Columns								
M04	Galvanized steel (HEB 200 section)	50	1	1.79 E+06	M05	M06	M10	
M05	Paint	15	4	3.02 E+04	M04			
S02-E02 Beams ground floor								
M06	Galvanized steel (HEB 200 section)	50	1	5.62 E+06	M02	M04	M07	M08
M07	Paint	15	4	9.49 E+04	M06			
M08	Galvanized steel (IPN 140 section)	50	1	1.56 E+06	M06	M09		
M09	Paint (IPN 140)	15	4	5.35 E+04	M08			
S02-E03 Beams roof								
M10	Galvanized steel (HEB 200 section)	50	1	4.20 E+06	M04	M11	M12	
M11	Paint	15	4	7.09 E+04	M010			
M12	Galvanized steel (IPN 140 section)	50	1	1.17 E+06	M10	M13		
M13	Paint (IPN 140)	15	4	4.01 E+04	M12			

(*) Service life equals lifespan for materials which forecast service life is longer than lifespan

Where:

M/ is for closed connections

M, Is for open connection

Table G.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections			
S02-E04 Slab ground floor								
M14	OSB panel (25 mm thickness)	50	1	1.32 E+06	M06	M08	M34	M35
S02-E05 Slab roof								
M15	Structural thermal insulation panel				M10	M12	M16	
M15.1	OSB panel (19 mm thickness)	50	1	2.41 E+06	M15.2			
M15.2	Thermoformed XPS	50	1	2.32 E+05	M15.1			
M16	Wood frame (Pine)	50	1	9.07 E+05	M15	M17		
M17	OSB panel (25 mm thickness)	50	1	1.91 E+06	M16	M31		
S03: FAÇADES AND ROOFS								
S03-E01 External walls								
M-18	Galvanized steel frame	50	1	2.98 E+05	M14	M19	M22	
M19	OSB panel (19 mm thickness)	50	1	3.54 E+05	M18	M20	M21	M24
M20	Varnish (external face OSB panel)	50	1	4.10 E+04	M19			
M21	Mineral wool (medium density)	50	1	4.16 E+05	M18	M19	M22	
M22	Plasterboard	50	1	1.18 E+06	M18	M21	M23	
M23	Paint	15	4	7.45 E+04	M22			
M24	Wood stripe (Pine – 40 x 40 mm section)	50	1	2.78 E+05	M19	M25	M26	
M25	Galvanized steel plate (1 mm thickness)	50	1	3.89 E+04	M24	M26		
M26	Corrugated galvanized steel plate (0.75 mm thickness)	50	1	4.29 E+05	M24	M25		
S03-E02 Doors								
M27	Door F01 (sliding door)				M18	M25	M40	
M27.1	Aluminium	50	1	8.19 E+04	M27.2	M27.3		
M27.2	Double flat glass (6-8-6 thickness)	50	1	4.70E+05	M27.1			
M27.3	Wood (Oak)	30	2	1.40 E+04	M27.1	M27.4		
M27.4	Varnish	15	4	5.47 E+02	M27.3			

(*) Service life equals lifespan for materials which forecast service life is longer than lifespan

Table G.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections		
M28 Door F02 (sliding door)					M18	M25	M40
M28.1	Aluminium	50	1	2.06 E+04	M28.2	M28.3	
M28.2	Double flat glass (6-8-6 thickness)	50	1	2.29 E+05	M28.1		
M28.3	Wood (Oak)	30	2	9.91 E+03	M28.1	M28.4	
M28.4	Varnish	15	4	3.51 E+02	M28.3		
M29 Door F03 (sliding door)					M18	M25	M40
M29.1	Aluminium	50	1	4.10 E+04	M29.2	9M27.3	
M29.2	Double flat glass (6-8-6 thickness)	50	1	4.52 E+05	M29.1		
M29.3	Wood (Oak)	30	2	1.48 E+04	M29.1	M29.4	
M29.4	Varnish	15	4	5.28 E+02	M29.3		
S03-E03 Windows							
M30 Window F05 (hinged window)					M18	M25	M40
M30.1	Aluminium	50	1	1.97 E+04	M30.2	M30.3	
M30.2	Double flat glass (6-8-6 thickness)	50	1	1.72E+05	M30.1		
M30.3	Wood (Oak)	30	2	2.73 E+04	M30.1	M30.4	
M30.4	Varnish	15	4	6.85 E+02	M30.3		
S03-E04 Roof							
M31 PVC roofing sheet		20	3	1.06 E+06	M-02		
M32 Stainless steel plate (1 mm thickness)		50	1	9.01 E+04	M-02		
S04: FLOORS							
S04-E01 External floor							
M33 Wood plastic composite deck (30 mm thickness)		50	1	1.57 E+06	M17	M32	
S04-E02 Interior floor							
M34 Mineral wool (medium density)		50	1	7.40 E+05	M14	M35	M36
M35 Wood frame (Pine)		30	2	1.12 E+06	M14	M34	M36
M36 Wood floor (Oak 30 mm thickness)		30	2	1.48 E+06	M34	M35	M37
M37 Varnish		15	4	3.15 E+04	M36		

(*) Service life equals lifespan for materials which forecast service life is longer than lifespan

Table G.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S05: INTERIOR PARTITION									
S05-E01 Interior walls									
M38	Galvanized steel frame	50	1	6.70 E+04	M18	M36	M39	M40	
39	Mineral wool (medium density)	50	1	1.09 E+05	M18	M38	M40		
M40	Plasterboard	50	1	1.50 E+06	M22	M36	M38	M39	M41
M41	Paint	15	4	4.16 E+04	M40				
M42	Wood foot panel (Oak)	30	2	1.39 E+04	M22	M40	M43		
M43	Varnish (wood foot panel)	15	4	2.26 E+03	M42				
M44	Ceramic tiles	30	2	4.74 E+05	M40				
S05-E02 Doors									
M45	Door F04 (hinged door)				M39	M40			
M45.1	Wood frame (oak)	30	2	6.63 E+04	M39.2	M39.3			
M45.2	Prefabricated wood door	30	2	4.20 E+04	M39.1	M39.3			
M45.3	Varnish	15	4	6.04 E+03	M39.1	M39.2			
S06: CEILINGS									
S06-E01 External ceilings									
M46	Wood stripe (Pine – 40 x 40 mm section)	50	1	5.64 E+04	M15	M47			
M47	Galvanized steel plate (1 mm thickness)	50	1	1.82 E+05	M25	M26	M46		
S06-E01 Interior ceilings									
M48	Galvanized steel rail F530	50	1	9.93 E+04	M15	M49			
M49	Plasterboard (waterproof)	50	1	8.20 E+05	MM48	M40	M50		
M450	Paint	15	4	4.48 E+04	M49				

(*) Service life equals lifespan for materials which forecast service life is longer than lifespan

G.4 *Building B2: analysis of end-of-life scenarios of materials*

Table G.3. Building B2: analysis of end-of-life scenarios of materials.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S01: FOUNDATIONS					
S01-E01 Square base					
M01	Structural concrete				
M01.1	Concrete	2.59 E+07	0	2.41 E+07	1.81 E+06
M01.2	Steel (round bar)	4.00 E+05	0	3.72 E+05	2.80 E+04
S01-E02 Columns					
M02	Galvanized steel (HEB 200 section)	9.50 E+05	9.22 E+05	0	2.85 E+04
M03	Paint	1.60 E+04	0	0	1.60 E+04
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M04	Galvanized steel (HEB 200 section)	1.79 E+06	1.74 E+06	0	5.37 E+04
M05	Paint	3.02 E+04	0	0	3.02 E+04
S02-E02 Beams ground floor					
M06	Galvanized steel (HEB 200 section)	5.62 E+06	5.45 E+06	0	1.69 E+05
M07	Paint (HEB 200)	9.49 E+04	0	0	9.49 E+04
M08	Galvanized steel (IPN 140 section)	1.56 E+06	1.51 E+06	0	4.68 E+04
M09	Paint (IPN 140)	5.35 E+04	0	0	5.35 E+04
S02-E03 Beams roof					
M10	Galvanized steel (HEB 200 section)	4.20 E+06	4.07 E+06	0	1.26 E+05
M11	Paint (HEB 200)	7.09 E+04	0	0	7.09 E+06
M12	Galvanized steel (IPN 140 section)	1.17 E+06	1.13 E+06	0	3.51 E+04
M13	Paint (IPN 140)	4.01 E+04	0	0	4.01 E+04
S02-E04 Slab ground floor					
M14	OSB panel (25 mm thickness)	1.32 E+06	0	1.84 E+10	9.24 E+04
S02-E05 Slab roof					
M15	Structural thermal insulation panel				
M15.1	OSB panel (19 mm thickness)	2.41 E+06	0	0	2.41 E+06
M15.2	Thermoformed XPS	2.32 E+05	0	0	2.23 E+05

Table G.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
M16	Wood frame (Pine)	9.07 E+05	0	8.44 E+05	6.35 E+04
M17	OSB panel (25 mm thickness)	1.91 E+06	0	2.66 E+10	1.34 E+05
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M18	Galvanized steel frame	2.98 E+05	0	2.89 E+05	8.94 E+03
M19	OSB panel (19 mm thickness)	3.54 E+05	0	4.94 E+09	2.48 E+04
M20	Varnish (external face OSB panel)	4.10 E+04	0	0	4.10 E+04
M21	Mineral wool (medium density)	4.16 E+05	3.87 E+05	0	2.91 E+04
M22	Plasterboard	1.18 E+06	0	1.12 E+06	5.90 E+04
M23	Paint	7.45 E+04	0	0	7.45 E+04
M24	Wood stripe (Pine – 40 x 40 mm section)	2.78 E+05	0	2.59 E+05	1.95 E+04
M25	Galvanized steel plate (1 mm thickness)	3.89 E+04	0	3.77 E+05	1.17 E+03
M26	Corrugated galvanized steel plate (0.75 mm thickness)	4.29 E+05	o	4.16 E+05	1.29 E+04
S03-E02 Doors					
M27	Door F01 (sliding door)				
M27.1	Aluminium	8.19 E+04	0	7.78 E+04	4.10 E+03
M27.2	Double flat glass (6-8-6 thickness)	4.70E+05	4.37 E+05	0	3.29 E+04
M27.3	Wood (Oak)	1.40 E+04	0	1.30 E+04	9.80 E+02
M27.4	Varnish	5.47 E+02	0	0	5.47 E+02
M28	Door F02 (sliding door)				
M28.1	Aluminium	2.06 E+04	0	1.71 E+04	8.98 E+02
M28.2	Double flat glass (6-8-6 thickness)	2.29 E+05	2.14 E+05	0	1.61 E+04
M28.3	Wood (Oak)	9.91 E+03	0	6.60 E+03	4.97 E+02
M28.4	Varnish	3.51 E+02	0	0	1.80 E+02
M29	Door F03 (sliding door)				
M29.1	Aluminium	4.10 E+04	0	3.14 E+04	1.65 E+03
M29.2	Double flat glass (6-8-6 thickness)	4.52 E+05	4.25 E+05	0	3.20 E+04
M29.3	Wood (Oak)	1.48 E+04	0	9.90 E+03	7.46 E+02
M29.4	Varnish	5.28 E+02	0	0	2.28 E+02

Table G.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
M16	Wood frame (Pine)	9.07 E+05	0	8.44 E+05	6.35 E+04
M17	OSB panel (25 mm thickness)	1.91 E+06	0	2.66 E+10	1.34 E+05
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M18	Galvanized steel frame	2.98 E+05	0	2.89 E+05	8.94 E+03
M19	OSB panel (19 mm thickness)	3.54 E+05	0	4.94 E+09	2.48 E+04
M20	Varnish (external face OSB panel)	4.10 E+04	0	0	4.10 E+04
M21	Mineral wool (medium density)	4.16 E+05	3.87 E+05	0	2.91 E+04
M22	Plasterboard	1.18 E+06	0	1.12 E+06	5.90 E+04
M23	Paint	7.45 E+04	0	0	7.45 E+04
M24	Wood stripe (Pine – 40 x 40 mm section)	2.78 E+05	0	2.59 E+05	1.95 E+04
M25	Galvanized steel plate (1 mm thickness)	3.89 E+04	0	3.77 E+05	1.17 E+03
M26	Corrugated galvanized steel plate (0.75 mm thickness)	4.29 E+05	o	4.16 E+05	1.29 E+04
S03-E02 Doors					
M27	Door F01 (sliding door)				
M27.1	Aluminium	8.19 E+04	0	7.78 E+04	4.10 E+03
M27.2	Double flat glass (6-8-6 thickness)	4.70E+05	4.37 E+05	0	3.29 E+04
M27.3	Wood (Oak)	1.40 E+04	0	1.30 E+04	9.80 E+02
M27.4	Varnish	5.47 E+02	0	0	5.47 E+02
M28	Door F02 (sliding door)				
M28.1	Aluminium	2.06 E+04	0	1.71 E+04	8.98 E+02
M28.2	Double flat glass (6-8-6 thickness)	2.29 E+05	2.14 E+05	0	1.61 E+04
M28.3	Wood (Oak)	9.91 E+03	0	6.60 E+03	4.97 E+02
M28.4	Varnish	3.51 E+02	0	0	1.80 E+02
M29	Door F03 (sliding door)				
M29.1	Aluminium	4.10 E+04	0	3.14 E+04	1.65 E+03
M29.2	Double flat glass (6-8-6 thickness)	4.52 E+05	4.25 E+05	0	3.20 E+04
M29.3	Wood (Oak)	1.48 E+04	0	9.90 E+03	7.46 E+02
M29.4	Varnish	5.28 E+02	0	0	2.28 E+02

Table G.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S03-E03 Windows					
M-30 Window F05 (hinged window)					
M30.1	Aluminium	1.97 E+04	0	8.38 E+03	4.41 E+02
M30.2	Double flat glass (6-8-6 thickness)	1.72 E+05	1.86 E+04	0	1.40 E+03
M30.3	Wood (Oak)	2.73 E+04	0	2.38 E+04	1.79 E+03
M30.4	Varnish	6.85 E+02	0	0	3.40 E+02
S03-E04 Roof					
M31 PVC roofing sheet		1.06 E+06		0	1.06 E+06
M32 Stainless steel plate (1 mm thickness)		9.01 E+04	0	8.38 E+04	6.31 E+03
S04: FLOORS					
S04-E01 External floor					
M33 Wood plastic composite deck (30 mm thickness)		1.57 E+06	1.46 E+06	0	1.10 E+05
S04-E02 Interior floor					
M34 Mineral wool (medium density)		7.40 E+05	6.88 E+05	0	5.18 E+04
M35 Wood frame (Pine)		1.12 E+06	0	1.04 E+06	7.84 E+04
M36 Wood floor (Oak 30 mm thickness)		1.48 E+06	0	1.38 E+06	1.04 E+05
M-37 Varnish		3.15 E+04	0	0	3.15 E+04
S05: INTERIOR PARTITION					
S05-E01 Interior walls					
M38 Galvanized steel frame		6.70 E+04	0	6.50 E+04	2.01 E+03
M39 Mineral wool (medium density)		1.09 E+05	1.01 E+05	0	7.63 E+03
M40 Plasterboard		1.50 E+06	0	1.43 E+05	2.25 E+05
M41 Paint		4.16 E+04	0	0	4.16 E+04
M42 Wood foot panel (Oak)		1.39 E+04	0	1.29 E+04	9.73 E+02
M43 Varnish (wood foot panel)		2.26 E+03	0	0	2.26 E+03
M44 Ceramic tiles		4.74 E+05	0	4.27 E+05	4.74 E+04
S05-E02 Doors					
M45 Door F04 (hinged door)					
M45.1	Wood frame (oak)	6.63 E+04	0	6.17 E+04	4.64 E+03
M45.2	Prefabricated wood door	4.20 E+04	0	3.91 E+04	2.94 E+03
M45.3	Varnish	6.04 E+03	0	0	6.04 E+03

Table G.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S06: CEILINGS					
S06-E01 External ceilings					
M46	Wood stripe (Pine – 40 x 40 mm section)	5.64 E+04	0	5.25 E+04	3.95 E+03
M47	Galvanized steel plate (1 mm thickness)	1.82 E+05	0	1.77 E+05	5.46 E+03
S06-E02 Interior ceilings					
M48	Galvanized steel rail F530	9.93 E+04	0	5.25 E+04	2.98 E+03
M49	Plasterboard (waterproof)	8.20 E+05	0	1.77 E+05	4.10 E+04
M50	Paint	4.48 E+04		0	4.48 E+04

APPENDIX H

CHARACTERISATION OF BUILDING B3

H.1 *Buidling B3: drawings*

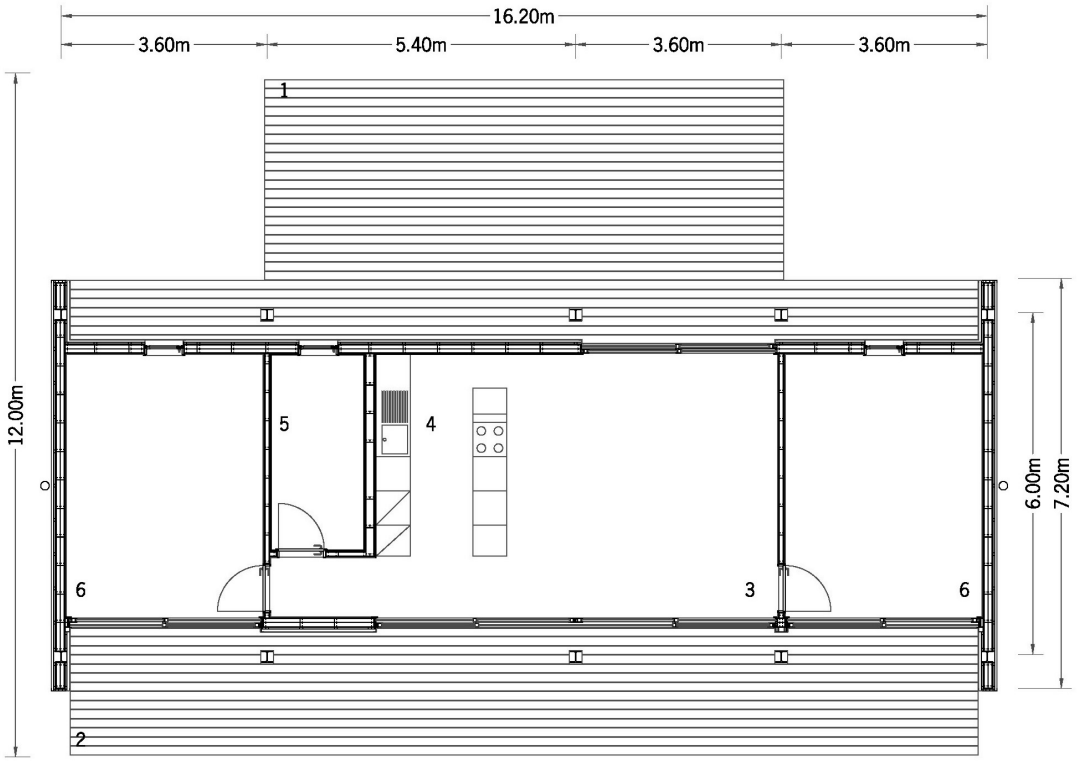

Figure H.1. Building B3: plan
1) Terrace, 2) Balcony, 3) Living room, 4) Kitchen, 5) Bathroom, 6) Bedroom.

Figure H.2. Building B3: 3D South view.

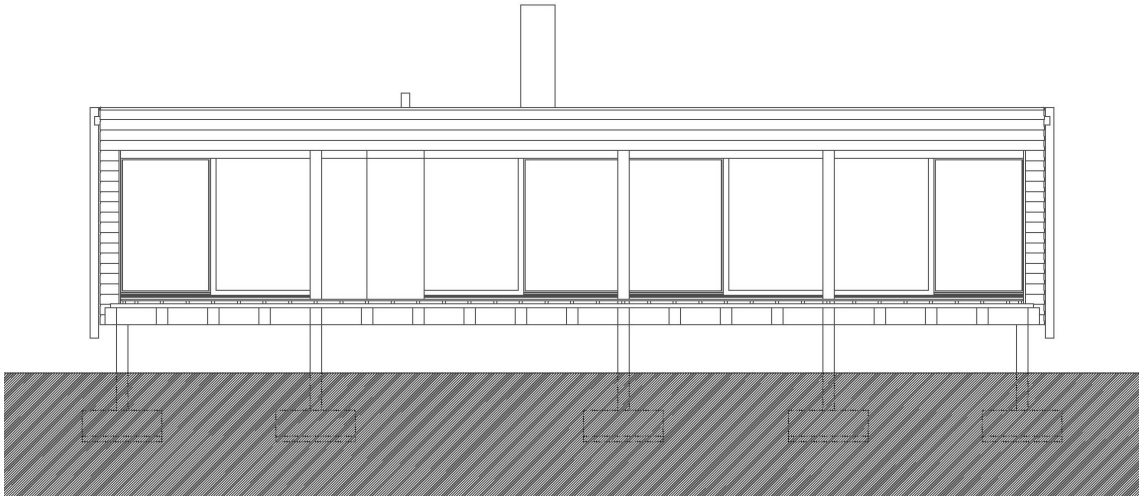

Figure H.3. Building B3: South elevation.

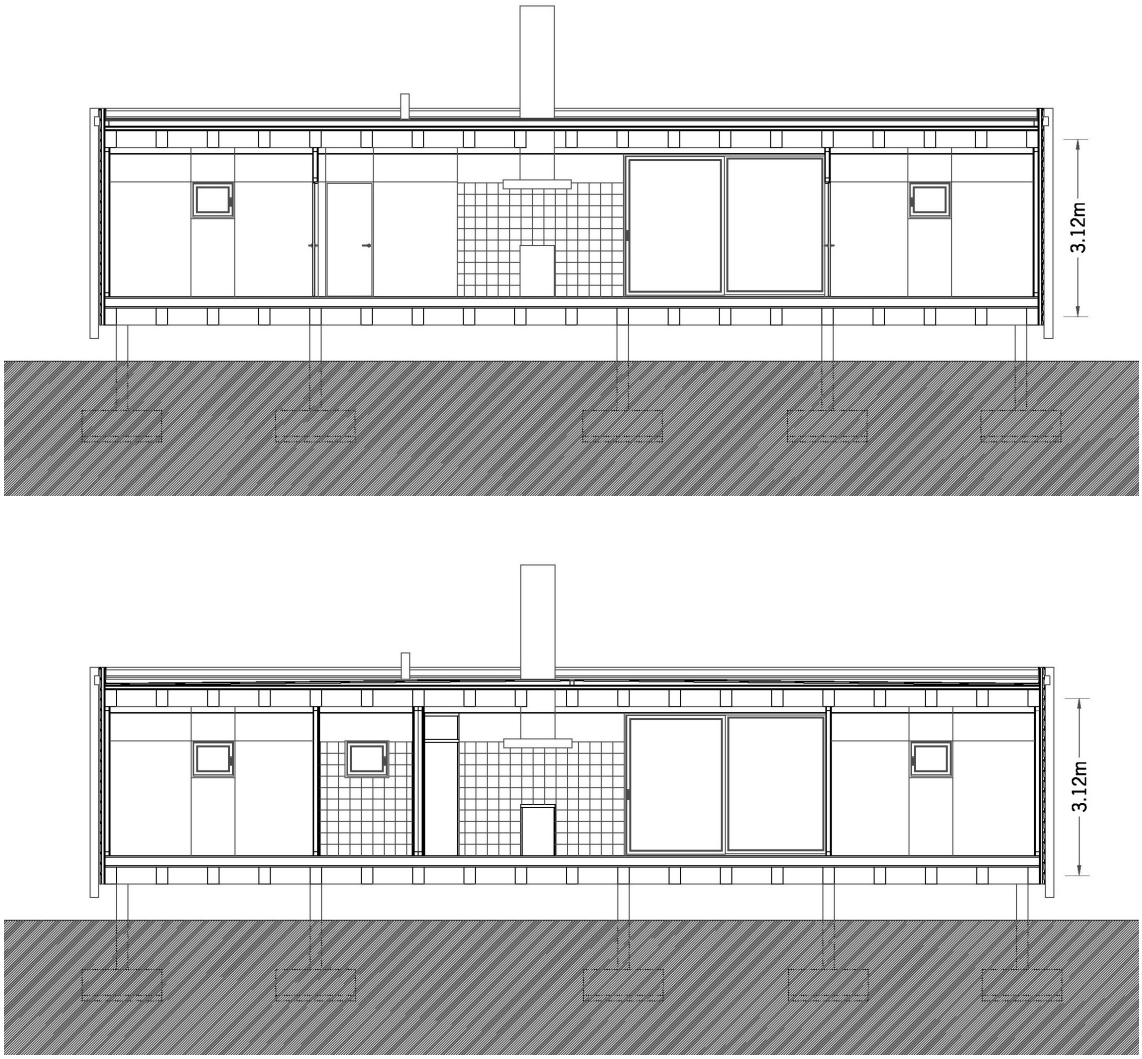

Figure H.4. Building B3: longitudinal sections.

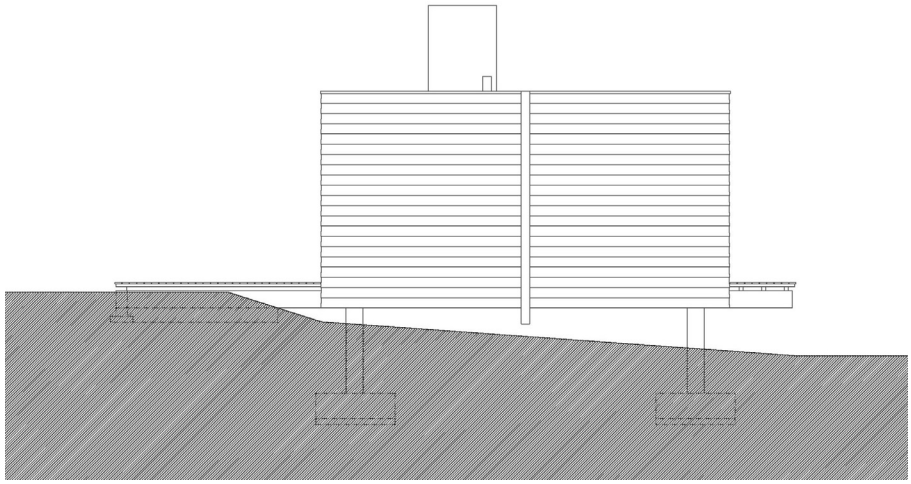

Figure H.5. Building B3: West elevation.

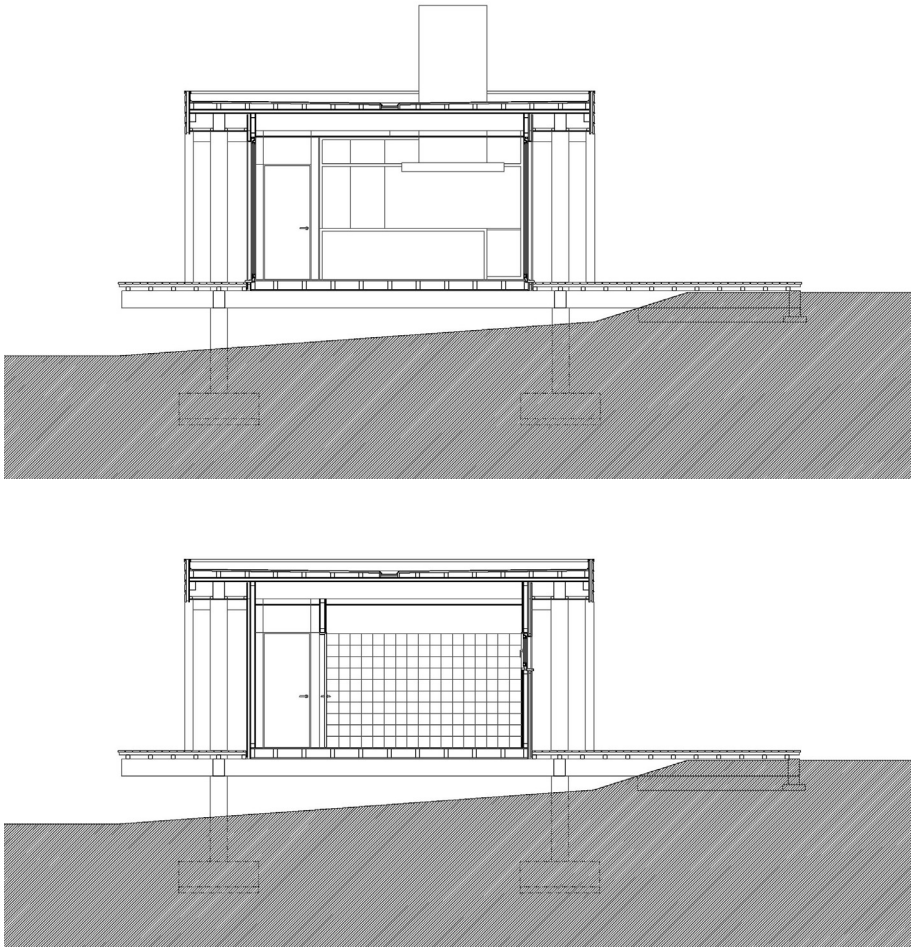

Figure H.6. Building B3: cross sections.

H.2 *Building B3: mass inventory*

Table H.1. Building B3: mass inventory of materials.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S01: FOUNDATIONS						
S01-E01 Square base						
M01 Structural concrete						
M01.1	Concrete	10.78	m^3	2400.00	kg/m^3	2.59 E+07
M01.2	Steel (round bar 12 mm thickness)	450.00	m	0.888	kg/m	4.00 E+05
S01-E02 Columns						
M02 Wood structure (Oak)		0.90	m^3	760.00	kg/m^3	6.84 E+05
M03 Varnish		15.00	m^2	0.420	Kg/m^2	6.30 E+03
S02: STRUCTURAL FRAME						
S02-E01 Columns						
M04 Wood structure (Oak)		2.05	m^3	760.00	kg/m^3	1.56 E+06
M05 Varnish		34.20	m^2	0.420	Kg/m^2	1.44 E+04
S02-E02 Beams ground floor						
M06 Wood structure (oak)		14.37	m^3	760.00	kg/m^3	1.09 E+07
M07 Varnish		239.63	m^2	0.420	Kg/m^2	1.01 E+05
S02-E03 Beams roof						
M08 Wood structure (oak)		12.32	m^3	760.00	kg/m^3	9.37 E+06
M09 Varnish		166.18	m^2	0.420	Kg/m^2	6.98 E+04
S02-E04 Slab ground floor						
M10 Wood structure (Oak)						
M10.1	Wood (150 x 100 mm section)	2.95	m^3	760.00	kg/m^3	2.24 E+06
M10.2	Wood (70 x 70 mm section)	14.37	m^3	760.00	kg/m^3	8.58 E+05
M10.3	Wood (50 x 55 mm section)	14.37	m^3	760.00	kg/m^3	3.82 E+05
M11 OSB panel (25 mm thickness)		79.86	m^3	16.25	kg/m^2	1.30 E+06
S02-E05 Slab roof						
M12 Wood structure (Oak)						
M12.1	Wood (150 x 100 mm section)	0.49	m^3	760.00	kg/m^3	3.74 E+05
M12.2	Wood (100 x 70 mm section)	1.60	m^3	760.00	kg/m^3	1.22 E+06
M13 Structural thermal insulation panel						
M13.1	OSB panel (19 mm thickness)	230.25	m^2	10.45	Kg/m^2	2.41 E+06
M13.2	Thermoformed XPS	5.76	m^2	35.00	Kg/m^3	2.01 E+05

References for materials density are given in Appendix B

Table H.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S03: FAÇADES AND ROOFS						
S03-E01 External walls						
M14	Wood frame (Pine – 70 x 70 mm section)	0.70	m^3	600.00	kg/m^3	6.30 E+05
M15	OSB panel (19 mm thickness)	158.34	m^3	10.45	kg/m^3	1.65 E+06
M16	Varnish (external face OSB panel)	135.01	m^2	0.420	Kg/m^2	5.67 E+04
M17	Mineral wool (medium density)	3.82	m^3	70.00	kg/m^3	2.68 E+05
M18	Wood stripe (Pine – 40 x 40 mm section)	0.22	m^3	600.00	kg/m^3	1.33 E+05
M19	Wood board (Oak)	2.67	m^3	760.00	kg/m^3	2.03 E+06
M20	Varnish (external face wood board)	89.22	m^2	0.420	Kg/m^2	3.75 E+04
M21	Wood stripe (Pine - 40 x 40 mm section)	0.21	m^3	600.00	kg/m^3	1.30E+05
M22	Plywood (external face) (15 mm thickness)	82.28	m^3	6.90	kg/m^3	5.68 E+05
M23	Varnish (external face plywood)	82.28	m^2	0.420	Kg/m^2	3.46 E+04
S03-E02 Doors						
M24	Door F01 (sliding door)					
M24.1	Wood (Oak)	0.16	m^3	760.00	kg/m^3	1.25 E+05
M24.2	Double flat glass (6-8-6 thickness)	31,53	m^2	15.00	kg/m^2	4.73E+05
M24.3	Varnish	16.94	m^2	0.420	Kg/m^2	7.12 E+03
M25	Door F02 (sliding door)					
M25.1	Wood (Oak)	0.08	m^3	760.00	kg/m^3	6.33 E+04
M25.2	Double flat glass (6-8-6 thickness)	15,58	m^2	15.00	Kg/m^2	2.34E+05
M25.3	Varnish	8.83	m^2	0.420	Kg/m^2	3.71 E+03
M26	Door F03 (sliding door)					
M26.1	Wood (Oak)	0.16	m^3	760.00	kg/m^3	1.21 E+05
M26.2	Double flat glass (6-8-6 thickness)	30,51	m^2	15.00	Kg/m^2	4.58 E+05
M26.3	Varnish	16.67	m^2	0.420	Kg/m^2	7.00 E+03
S03-E03 Windows						
M27	Window F05 (hinged window)					
M27.1	Wood (Oak)	0.06	m^3	760.00	kg/m^3	4.26 E+04
M27.2	Double flat glass (6-8-6 thickness)	1,53	m^2	15.00	Kg/m^2	2.31 E+05
M27.3	Varnish	4.12	m^2	0.420	Kg/m^2	1.73 E+03
S03-E04 Roof						
M28	PVC roofing sheet	122,86	m^3	4.00	kg/m^2	4.91 E+05
M29	Zinc sheet (1 mm thickness)	18.59	m^2	7.20	kg/m^3	1.33 E+05

References for materials density are given in Appendix B

Table H.1. - Continued.

Note	Item	Data (units)	Unit	Density (units)	Unit	Mass (g)
S04: FLOORS						
S04-E01 External floor						
M30	Wood (Ipe- 27 mm thickness)	85.15	m^2	920.00	kg/m^3	1.16 E+06
S04-E02 Interior floor						
M31	Mineral wool (medium density)	3.82	m^3	70.00	kg/m^3	2.68 E+05
M32	Wood floor (Oak 30 mm thickness)	79.86	m^3	22.80	kg/m^3	1.82 E+06
M33	Varnish	79.86	m^3	0.420	kg/m^2	3.35 E+04
S05: INTERIOR PARTITION						
S05-E01 Interior walls						
M34	Wood frame (Pine – 70 x 70 mm section)	0.70	m^3	600.00	kg/m^3	4.19 E+05
M35	Mineral wool (medium density)	4.158	m^3	70.00	kg/m^3	2.91 E+05
M36	Plywood finishing (15 mm thickness)	179.70	m^3	6.90	kg/m^3	1.73 E+06
M37	Varnish (plywood)	139.63	m^2	0.420	kg/m^2	5.86 E+04
M38	Plasterboard (waterproof)	44.11	m^2	11.00	kg/m^2	4.85 E+04
M39	Paint	6,37	m^3	0.670	kg/m^2	4.26 E+03
M40	Ceramic tiles	34,60	m^3	13.00	kg/m^2	4.50 E+05
S05-E02 Doors						
M41	Door F04 (hinged door)					
M41.1	Wood frame (oak)	0.02	m^3	760.00	kg/m^3	1.39 E+04
M41.2	Prefabricated wood door	3.00	un	14.00	kg/un	4.20 E+04
M41.3	Varnish	14.48	m^3	0.420	kg/m^2	6.08 E+03
S06: CEILINGS						
S06-E01 External ceilings						
M42	Wood stripe (Pine – 50 x 40 mm section)	0.26	m^3	600.00	kg/m^3	1.55 E+05
M43	Plywood finishing (15 mm thickness)	31.54	m^3	6.90	kg/m^3	2.18 E+05
M44	Varnish	31.54	m^3	0.420	kg/m^2	1.32 E+04
S06-E02 Interior ceilings						
M45	Galvanized steel rail F530	225.02	m^3	457.00	kg/m^3	1.03 E+05
M46	Plasterboard (waterproof)	75.00	m^2	11.33	kg/m^2	8.25 E+05
M47	Paint	75.00	m^3	0.670	kg/m^2	5.01 E+04
TOTAL MASS (g)						**7.34 E+07**

References for materials density are given in Appendix B

H.3 *Building B3: analysis of building configuration*

Table H.2. Building B3: analysis of building configuration.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S01: FOUNDATIONS									
S01-E01 Square base									
M01	Structural concrete				M02				
M01.1	Concrete	50	1	2.59 E+07	~~M01.2~~				
M01.2	Steel (round bar 12 mm thickness)	50	1	4.00 E+05	~~M02,.1~~				
S01-E02 Columns									
M02	Wood structure (Oak)	50	1	6.84 E+05	M01	~~M03~~			
M03	Varnish	3	17	6.30 E+03	~~M02~~				
S02: STRUCTURAL FRAME									
S02-E01 Columns									
M04	Wood structure (Oak)	50	1	1.56 E+06	~~M05~~	M06			
M05	Varnish	3	17	1.44 E+04	~~M04~~				
S02-E02 Beams ground floor									
M06	Wood structure (Oak)	50	1	1.09 E+07	M02	~~M07~~	M09	M10	M11
M07	Varnish	3	17	1.01 E+05	~~M06~~				
S02-E03 Beams roof									
M08	Wood structure (Oak)	50	1	9.37 E+06	M04	~~M09~~	M12	M13	
M09	Varnish	3	17	6.98 E+04	~~M08~~				
S02-E04 Slab ground floor									
M10	Wood structure (Oak)	50	1	3.48 E+06	M06	M11	M31		
M11	OSB panel (25 mm thickness)	50	1	1.30 E+06	M06	M10	M31		
S02-E05 Slab roof									
M12	Wood structure (Oak)	50	1	1.60 E+06	M08	M13			
M13	Structural thermal insulation panel				M08	M12	~~M28~~		
M13.1	OSB panel (19 mm thickness)	50	1	2.41 E+06	~~M13.2~~				
M13.2	Thermoformed XPS	50	1	2.01 E+05	~~M13.1~~				

(*)Service life equals Lifespan of building element where forecast service life of materials is longer.

Where:

~~M,~~ is for closed connections

M, Is for open connection

Table H.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S03: FAÇADES AND ROOFS									
S03-E01 External walls									
M-14 Wood frame (Pine – 70 x 70 mm section)		50	1	6.30 E+05	M11	M13	M15	M17	M22
M15 OSB panel (19 mm thickness)		50	1	1.65 E+06	M14	M16	M18		
M16 Varnish (external face OSB panel)		50	1	5.67 E+04	M15				
M17 Mineral wool (medium density)		50	1	2.68 E+05	M14	M15			
M18 Wood stripe (Pine – 40 x 40 mm section)		40	2	1.33 E+05	M15	M19			
M19 Wood board (Oak)		40	2	2.03 E+06	M18	M20			
M20 Varnish (external face wood board)		3	17	3.75 E+04	M19				
M21 Wood stripe (Pine - 40 x 40 mm section)		15	4	1.30E+05	M14	M17	M22		
M22 Plywood (external face) (15 mm thickness)		15	4	5.68 E+05	M17	M21	M23		
M23 Varnish (external face plywood)		3	17	3.46 E+04	M22				
S03-E02 Doors									
M24 Door F01 (sliding door)					M14	M19	M22		
M24.1	Wood (Oak)	35	2	1.25 E+05	M24.2	M24.3			
M24.2	Double flat glass (6-8-6 thickness)	35	2	4.73E+05	M24.1				
M24.3	Varnish	3	17	7.12 E+03	M24.1				
M25 Door F02 (sliding door)					M14	M19	M22		
M25.1	Wood (Oak)	35	2	6.33 E+04	M24.2	M24.3			
M25.2	Double flat glass (6-8-6 thickness)	35	2	2.34E+05	M24.1				
M25.3	Varnish	3	17	3.71 E+03	M24.1				
M26 Door F03 (sliding door)					M14	M19	M22		
M26.1	Wood (Oak)	35	2	1.21 E+05	M24.2	M24.3			
M26.2	Double flat glass (6-8-6 thickness)	35	2	4.58 E+05	M24.1				
M26.3	Varnish	3	17	7.00 E+03	M24.1				

(*)Service life equals Lifespan of building element where forecast service life of materials is longer.

Table H.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections				
S03-E03 Windows									
M-27 Window F05 (hinged window)					M14	M19	M22		
M27.1	Wood (Oak)	35	2	4.26 E+04	M24.2	~~M24.3~~			
M27.2	Double flat glass (6-8-6 thickness)	35	2	2.31 E+05	M24.1				
M27.3	Varnish	3	17	1.73 E+03	~~M24.1~~				
S03-E04 Roof									
M28 PVC roofing sheet		20	3	4.91 E+05	~~M13~~				
M29 Zinc sheet (1 mm thickness)		50	1	1.33 E+05	M14	M19	M28		
S04: FLOORS									
S04-E01 External floor									
M30 Wood (Ipe- 27 mm thickness)		30	2	1.16 E+06	M06				
S04-E01 Interior floor									
M31 Mineral wool (medium density)		50	1	2.68 E+05	M10	M11	M32		
M32 Wood floor (Oak 30 mm thickness)		30	2	1.82 E+06	M11	M31	~~M33~~		
M33 Varnish		15	4	3.35 E+04	~~M32~~				
S05: INTERIOR PARTITION									
S05-E01 Interior walls									
M34 Wood frame (Pine – 70 x 70 mm section)		50	1	4.19 E+05	M11	M13	M35	M36	M38
M35 Mineral wool (medium density)		50	1	2.91 E+05	M34	M36	M37		
M36 Plywood finishing (15 mm thickness)		15	4	1.73 E+06	M34	M35	~~M37~~		
M37 Varnish (plywood)		15	4	5.86 E+04	~~M36~~				
M38 Plasterboard (waterproof)		50	1	4.85 E+05	M35	~~M39~~	~~M40~~		
M39 Paint		15	4	4.26 E+03	~~M38~~				
M40 Ceramic tiles		30	2	4.50 E+05	~~M38~~				

(*)Service life equals Lifespan of building element where forecast service life of materials is longer.

Table H.2. - Continued.

Note	Item	SL (yr)	Rep	Mass (g)	Connections		
S05-E02 Doors							
M41 Door F04 (hinged door)					M34	M36	M38
M41.1	Wood frame (oak)	30	2	1.39 E+04	M41.2	M41.3	
M41.2	Prefabricated wood door	30	2	4.20 E+04	M41.1	M41.3	
M41.3	Varnish	15	4	6.08 E+03	M41.2	M41.2	
S06: CEILINGS							
S06-E01 External ceilings							
M42 Wood stripe (Pine – 50 x 40 mm section)		15	4	1.55 E+05	M13	M43	
M43 Plywood finishing (15 mm thickness)		15	4	2.18 E+05	M42	M44	
M44 Varnish		3	17	1.32 E+04	M43		
S06-E01 Interior ceilings							
M45 Galvanized steel rail F530		50	1	1.03 E+05	M13	M46	
M46 Plasterboard (waterproof)		50	1	8.25 E+05	M45	M47	
M47 Paint		15	4	5.01 E+04	M46		

(*)Service life equals Lifespan of building element where forecast service life of materials is longer.

H.4 *Building B3: analysis of end-of-life scenarios of materials*

Table H.3. Building B3: analysis of end-of-life scenarios of materials.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S01: FOUNDATIONS					
S01-E01 Square base					
M01 Structural concrete					
M01.1	Concrete	2.59 E+07		2.33 E+07	2.95 E+06
M01.2	Steel (round bar)	4.00 E+05		3.80 E+05	2.00 E+04
S01-E02 Columns					
M-02 Wood structure (Oak)		6.84 E+05	6.36 E+05	0	4.79 E+04
M03 Varnish		6.30 E+03	0	0	6.30 E+03
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M-04 Wood structure (Oak)		1.56 E+06	1.45 E+06	0	1.09 E+05
M05 Varnish		1.44 E+04	0	0	1.44 E+04
S02-E02 Beams ground floor					
M-06 Wood structure (Oak)		1.09 E+07	1.01 E+07	0	7.63 E+05
M07 Varnish		1.01 E+05	0	0	1.01 E+05
S02-E03 Beams roof					
M-08 Wood structure (Oak)		9.37 E+06	8.71 E+06	0	6.56 E+05
M09 Varnish		6.98 E+04	0	0	6.98 E+04
S02-E04 Slab ground floor					
M10 Wood structure (Oak)		3.48 E+06	3.24 E+06	0	2.44 E+05
M11 OSB panel (25 mm thickness)		1.30 E+06	0	1.21 E+06	9.10 E+04
S02-E05 Slab roof					
M12 Wood structure (Oak)		1.60 E+06	1.49 E+06	0	1.12 E+05
M13 Structural thermal insulation panel					
M13.1	OSB panel (19 mm thickness)	2.41 E+06	0	2.41 E+06	289
M13.2	Thermoformed XPS	2.01 E+05	0	2.01 E+05	
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M-14 Wood frame (Pine – 70 x 70 mm section)		6.30 E+05	0	5.86 E+05	4.41 E+04
M15 OSB panel (19 mm thickness)		1.65 E+06	0	1.53 E+06	1.16 E+05
M16 Varnish (external face OSB panel)		5.67 E+04	0	0	5.67 E+04

Table H.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
M17	Mineral wool (medium density)	2.68 E+05	2.49 E+05	0	1.88 E+04
M18	Wood stripe (Pine – 40 x 40 mm section)	1.33 E+05	0	1.23 E+05	9.28 E+03
M19	Wood board (Oak)	2.03 E+06	0	1.89 E+06	1.42 E+05
M20	Varnish (external face wood board)	3.75 E+04	0	0	3.75 E+04
M21	Wood stripe (Pine - 40 x 40 mm section)	1.30E+05	0	1.21 E+05	9.11 E+03
M22	Plywood (external face) (15 mm thickness)	5.68 E+05	0	5.28 E+05	3.98 E+04
M23	Varnish (external face plywood)	3.46 E+04	0	0	3.46 E+04
S03-E02 Doors					
M-24	Door F01 (sliding door)				
M24.1	Wood (Oak)	1.25 E+05	0	1.16 E+05	8.75 E+03
M24.2	Double flat glass (6-8-6 thickness)	4.73E+05	4.40 E+05	0	3.31 E+04
M24.3	Varnish	7.12 E+03	0	0	3.47 E+03
M-25	Door F02 (sliding door)				
M25.1	Wood (Oak)	6.33 E+04	0	5.89 E+04	4.43 E+03
M25.2	Double flat glass (6-8-6 thickness)	2.34E+05	2.18 E+05	0	1.64 E+04
M25.3	Varnish	3.71 E+03	0	0	3.47 E+03
M-26	Door F03 (sliding door)				
M26.1	Wood (Oak)	1.21 E+05	0	1.13 E+05	8.47 E+03
M26.2	Double flat glass (6-8-6 thickness)	4.58 E+05	2.18 E+05	0	3.21 E+03
M26.3	Varnish	7.00 E+03	0	0	3.47 E+03
S03-E03 Windows					
M-27	Window F05 (hinged window)				
M27.1	Wood (Oak)	4.26 E+04	0	3.96 E+04	2.98 E+03
M27.2	Double flat glass (6-8-6 thickness)	2.31 E+05	2.15 E+04	0	1.62 E+03
M27.3	Varnish	1.73 E+03	0	0	3.47 E+03
S03-E04 Roof					
M-28	PVC roofing sheet	4.91 E+05	0	0	4.91 E+05
M-29	Zinc sheet (1 mm thickness)	1.33 E+05	0	1.26 E+05	6.65 E+03

Table H.3. - Continued.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S04: FLOORS					
S04-E01 External floor					
M-30 Wood (Ipe- 27 mm thickness)		1.16 E+06	0	1.08 E+06	8.12 E+04
S04-E02 Interior floor					
M-31 Mineral wool (medium density)		2.68 E+05	2.49 E+05	0	1.88 E+04
M-32 Wood floor (Oak 30 mm thickness)		1.82 E+06	0	1.69 E+06	1.27 E+05
M-33 Varnish		3.35 E+04	0	0	3.35 E+04
S05: INTERIOR PARTITION					
S05-E01 Interior walls					
M-34 Wood frame (Pine – 70 x 70 mm section)		4.19 E+05	0	3.89 E+05	2.93 E+04
M35 Mineral wool (medium density)		2.91 E+05	2.71 E+05	0	2.04 E+04
M-36 Plywood finishing (15 mm thickness)		1.73 E+06	0	1.61 E+06	1.21 E+05
M-37 Varnish (plywood)		5.86 E+04	0	0	5.68 E+04
M-38 Plasterboard (waterproof)		4.85 E+05	0	4.61 E+04	2.43 E+04
M-39 Paint		4.26 E+03	0	0	4.26 E+03
M-40 Ceramic tiles		4.50 E+05	0	4.05 E+05	3.15 E+04
S05-E02 Doors					
M-41 Door F04 (hinged door)					
M41.1	Wood frame (oak)	1.39 E+04	0	1.29 E+04	9.73 E+02
M41.2	Prefabricated wood door	4.20 E+04	0	3.91 E04	2.94 E+03
M41.3	Varnish	6.08 E+03	0	0	6.08 E+03
S06: CEILINGS					
S06-E01 External ceilings					
M42 Wood stripe (Pine – 50 x 40 mm section)		1.55 E+05	0	1.45 E+05	1.09 E+04
M43 Plywood finishing (15 mm thickness)		2.18 E+05	0	2.03 E+05	1.53 E+04
M44 Varnish		1.32 E+04	0	0	1.32 E+04
S06-E02 Interior ceilings					
M45 Galvanized steel rail F530		1.03 E+05	0	9.99 E+04	3.09 E+03
M46 Plasterboard (waterproof)		8.25 E+05	0	8.00 E+05	4.25 E+04
M47 Paint		5.01 E+04	0	0	5.01 E+04

APPENDIX I

EMERGY ANALYSIS OF MATERIALS FLOWS FOR BUILDINGS B1, B2, AND B3

I.1 *Building B1: Emergy analysis of material flows*

Table I.1. Building B1: Emergy analysis of material flows (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S01: FOUNDATIONS					
S01-E01 Square base					
M01 Structural concrete					
M01.1	Concrete	g	2.59 E+07	3.40 E+09	8.80 E+16
M01.2	Steel	g	4.00 E+05	5.31 E+09	2.12 E+15
S01-E02 Columns					
M02 Structural concrete					
M02.1	Concrete	g	2.16 E+06	3.40 E+09	7.34 E+15
M02.2	Steel	g	3.19 E+05	5.31 E+09	1.69 E+15
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M03 Structural concrete					
M03.1	Concrete	g	4.18 E+06	3.40 E+09	1.42 E+16
M03.2	Steel	g	9.22 E+05	5.31 E+09	4.90 E+15
S02-E02 Beams ground floor					
M04 Structural concrete					
M04.1	Concrete	g	1.65 E+07	3.40 E+09	5.62 E+16
M04.2	Steel	g	9.17 E+05	5.31 E+09	4.87 E+15
S02-E03 Beams roof					
M05 Structural concrete					
M05.1	Concrete	g	1.12 E+07	3.40 E+09	3.82 E+16
M05.2	Steel	g	5.84 E+05	5.31 E+09	3.10 E+15
S02-E04 Slab ground floor					
M06 Structural concrete					
M06.1	Concrete	g	7.34 E+07	3.40 E+09	2.49 E+17
M06.2	Steel	g	3.34 E+06	5.31 E+09	1.77 E+16
M07 Mortar		g	6.64 E+06	2.51 E+09	1.67 +16
S02-E05 Slab roof					
M08 Structural concrete					
M08.1	Concrete	g	5.17 E+07	3.40 E+09	1.76 E+17
M08.2	Steel	g	2.33 E+06	5.31 E+09	1.24 E+16
M09 Mortar		g	1.33 E+07	2.51 E+09	3.34 E+16

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.1. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M10 Ceramic hollow brick masonry (200 mm thickness)					
M10.1	Ceramic hollow brick (200 mm thickness)	g	9.08 E+06	4.23 E+09	3.84 E+16
M10.2	Mortar (masonry)	g	6.92 E+06	2.51 E+09	1.74 E+16
M11 Mortar (rendering)		g	1.33 E+07	2.30 E+09	1.31 E+16
M12 Thermal insulation (Thermoformed EPS)		g	3.55 E+04	1.39 E+10	4.93 E+14
M13 Paint		g	8.28 E+04	3.35 E+09	2.77 E+14
S03-E02 Doors					
M14 Door F01 (sliding door)					
M14.1	Aluminium	g	8.19 E+04	6.85 E+10	4.69 E+15
M14.2	Double flat glass (6-8-6 thickness)	g	4.70E+05	7.69 E+09	3.61 E+15
M14.3	Wood (Oak)	g	1.40 E+04	1.40 E+09	1.96 E+13
M14.4	Varnish	g	5.47 E+02	3.11 E+09	1.70 E+12
M15 Door F02 (sliding door)					
M15.1	Aluminium	g	2.06 E+04	6.85 E+10	1.25 E+15
M15.2	Double flat glass (6-8-6 thickness)	g	2.29 E+05	7.69 E+09	1.76 E+15
M15.3	Wood (Oak)	g	9.91 E+03	1.40 E+09	1.39 E+13
M15.4	Varnish	g	3.51 E+02	3.11 E+09	1.09 E+12
M16 Door F03 (sliding door)					
M16.1	Aluminium	g	4.10 E+04	6.85 E+10	2.48 E+15
M16.2	Double flat glass (6-8-6 thickness)	g	4.52 E+05	7.69 E+09	3.48 E+15
M16.3	Wood (Oak)	g	1.48 E+04	1.40 E+09	2.07 E+13
M16.4	Varnish	g	5.28 E+02	3.11 E+09	1.64 E+12
S03-E03 Windows					
M17 Window F05 (hinged window)					
M17.1	Aluminium	g	1.97 E+04	6.85 E+10	1.19 E+15
M17.2	Double flat glass (6-8-6 thickness)	g	1.72E+05	7.69 E+09	1.32 E+15
M17.3	Wood (Oak)	g	2.73 E+04	1.40 E+09	3.82 E+13
M17.4	Varnish	g	6.85 E+02	3.11 E+09	2.13 E+12
S03-E04 Roof					
M18 Asphalt sheet		g	4.91 E+05	7.96 E+08	3.91 E+14
M19 Thermal insulation (Thermoformed XPS)		g	1.51 E+05	1.39 E+10	2.10 E+15
M20 Gravel		g	1.29 E+07	2.24 E+09	3.82 E+16
M21 Zinc sheet (1 mm thickness)		g	1.33 E+05	1.14 E+11	1.52 E+16

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.1. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S04: FLOORS					
S04-E01 External floor					
M22 Granite floor					
M22.1	Granite tiles (30 mm thickness	g	8.08 E+06	4.11 E+09	3.32 E+16
M22.2	Mortar	g	3.96 E+06	2.51 E+09	9.94 E+15
S04-E02 Interior floor					
M23 Asphalt sheet		g	1.28 E+06	7.96 E+08	1.02 E+15
M24 Thermal insulation (Thermoformed XPS)		g	7.46 E+04	1.39 E+10	1.04 E+15
M25 Mortar		g	8.73 E+06	2.51 E+09	2.19 E+16
M26 Wood frame (Pine)		g	2.64 E+05	1.40 E+09	3.70 E+14
M27 Wood floor (Oak 30 mm thickness)		g	1.48 E+06	2.09 E+09	3.09 E+15
M28 Varnish (wood floor)		g	2.73 E+04	3.11 E+09	8.49 E+13
M29 Marble floor					
M29.1	Marble tiles (20 mm thickness)	g	3.08 E+05	1.21 E+10	3.73 E+15
M29.2	Mortar	g	5.47 E+05	2.51 E+09	1.37 E+15
S05: INTERIOR PARTITION					
S05-E01 Interior walls					
M30 Ceramic hollow brick masonry (110 mm thickness)					
M30.1	Ceramic hollow brick (110 mm thickness)	g	2.33 E+06	4.23 E+09	9.68 E+15
M30.2	Mortar (masonry)	g	1.24 E+06	2.51 E+09	3.36 E+15
M31 Mortar (rendering)		g	4.65 E+06	2.30 E+09	1.07 E+16
M32 Plaster		g	2.44 E+05	1.64 E+09	4.00 E+14
M33 Paint		g	5.97 E+04	3.35 E+09	2.00 E+14
M34 Plywood finishing (15 mm thickness)		g	3.66 E+04	2.74 E+09	1.00 E+14
M35 Varnish (plywood)		g	2.23 E+03	3.11 E+09	6.94 E+12
M36 Wood foot panel (Oak)		g	1.87 E+04	1.40 E+09	2.62 E+13
M37 Varnish (wood foot panel)		g	8.49 E+02	3.11 E+09	2.64 E+12
M38 Ceramic tiles		g	5.12 E+05	3.32 E+09	1.70 E+15
S05-E02 Doors					
M39 Door F04 (hinged door)					
M39.1	Wood frame (oak)	g	6.63 E+04	1.40 E+09	9.28 E+13
M39.2	Prefabricated wood door	g	4.20 E+04	1.40 E+09	5.88 E+13
M39.3	Varnish	g	6.04 E+03	3.11 E+09	1.88 E+13

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.1. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S06: CEILINGS					
S06-E01 External ceilings					
M40	Mortar (rendering)	g	1.14 E+06	2.30 E+09	2.62 E+15
M41	Thermal insulation (Thermoformed XPS)	g	4.55 E+04	1.39 E+10	6.32 E+14
M42	Paint	g	2.17 E+04	3.35 E+09	7.27 E+13
S06-E02 Interior ceilings					
M43	Mortar (rendering)	g	2.74 E+06	2.30 E+09	5.68 E+15
M44	Plaster	g	3.52 E+02	1.64 E+09	5.77 E+11
M45	Paint	g	4.69 E+04	3.35 E+09	1.57 E+14
Total EMERGY initial input					**9.73 E+17**

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

I.2 *Building B2: Emergy analysis of material flows*

Table I.2. Building B2: Emergy analysis of material flows (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S01: FOUNDATIONS					
S01-E01 Square base					
M01	Structural concrete				
M01.1	Concrete	g	2.59 E+07	3.40 E+09	8.80 E+16
M01.2	Steel	g	4.00 E+05	5.31 E+09	2.12 E+15
S01-E02 Columns					
M02	Galvanized steel (HEB 200 section)	g	9.50 E+05	5.31 E+09	5.04 E+15
M03	Paint	g	1.60 E+04	3.11 E+09	4.98 E+13
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M04	Galvanized steel (HEB 200 section)	g	1.79 E+06	5.31 E+09	9.50 E+15
M05	Paint	g	3.02 E+04	3.11 E+09	9.39 E+13
S02-E02 Beams ground floor					
M06	Galvanized steel (HEB 200 section)	g	5.62 E+06	5.31 E+09	2.98 E+16
M07	Paint (HEB 200)	g	9.49 E+04	3.11 E+09	2.95 E+14
M08	Galvanized steel (IPN 140 section)	g	1.56 E+06	5.31 E+09	8.28 E+15
M09	Paint (IPN 140)	g	5.35 E+04	3.11 E+09	1.66 E+14
S02-E03 Beams roof					
M10	Galvanized steel (HEB 200 section)	g	4.20 E+06	5.31 E+09	2.23 E+16
M11	Paint (HEB 200)	g	7.09 E+04	3.11 E+09	2.20 E+14
M12	Galvanized steel (IPN 140 section)	g	1.17 E+06	5.31 E+09	6.21 E+15
M13	Paint (IPN 140)	g	4.01 E+04	3.11 E+09	1.25 E+14
S02-E04 Slab ground floor					
M14	OSB panel (25 mm thickness)	g	1.32 E+06	1.92 E+09	2.53 E+15
S02-E05 Slab roof					
M15	Structural thermal insulation panel				
M15.1	OSB panel (19 mm thickness)	g	2.41 E+06	1.92 E+09	4.63 E+13
M15.2	Thermoformed XPS	g	2.32 E+05	1.39 E+10	3.22 E+15
M16	Wood frame (Pine)	g	9.07 E+05	1.40 E+09	1.27 E+15
M17	OSB panel (25 mm thickness)	g	1.91 E+06	1.92 E+09	3.67 E+15

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.2. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M18	Galvanized steel frame	g	2.98 E+05	5.31 E+09	1.58 E+15
M19	OSB panel (19 mm thickness)	g	3.54 E+05	1.92 E+09	6.80 E+14
M20	Varnish (external face OSB panel)	g	4.10 E+04	3.11 E+09	1.28 E+14
M21	Mineral wool (medium density)	g	4.16 E+05	3.09 E+09	1.29 E+15
M22	Plasterboard	g	1.18 E+06	2.41 E+09	2.84 E+15
M23	Paint	g	7.45 E+04	3.35 E+09	2.50 E+14
M24	Wood stripe (Pine – 40 x 40 mm section)	g	2.78 E+05	1.40 E+09	3.89 E+14
M25	Galvanized steel plate (1 mm thickness)	g	3.89 E+04	5.31 E+09	2.07 E+14
M26	Corrugated galvanized steel plate (0.75 mm thickness)	g	4.29 E+05	5.31 E+09	2.28 E+15
S03-E02 Doors					
M27	Door F01 (sliding door)				
M27.1	Aluminium	g	8.19 E+04	6.85 E+10	4.96 E+15
M27.2	Double flat glass (6-8-6 thickness)	g	4.70E+05	7.69 E+09	3.61 E+15
M27.3	Wood (Oak)	g	1.40 E+04	1.40 E+09	1.96 E+13
M27.4	Varnish	g	5.47 E+02	3.11 E+09	1.70 E+12
M28	Door F02 (sliding door)				
M28.1	Aluminium	g	2.06 E+04	6.85 E+10	1.25 E+15
M28.2	Double flat glass (6-8-6 thickness)	g	2.29 E+05	7.69 E+09	1.76 E+15
M28.3	Wood (Oak)	g	9.91 E+03	1.40 E+09	1.39 E+13
M28.4	Varnish	g	3.51 E+02	3.11 E+09	1.09 E+12
M29	Door F03 (sliding door)				
M29.1	Aluminium	g	4.10 E+04	6.85 E+10	2.48 E+15
M29.2	Double flat glass (6-8-6 thickness)	g	4.52 E+05	7.69 E+09	3.48 E+15
M29.3	Wood (Oak)	g	1.48 E+04	1.40 E+09	2.07 E+13
M29.4	Varnish	g	5.28 E+02	3.11 E+09	1.64 E+12
S03-E03 Windows					
M30	Window F05 (hinged window)				
M30.1	Aluminium	g	1.97 E+04	6.85 E+10	1.19 E+15
M30.2	Double flat glass (6-8-6 thickness)	g	1.72E+05	7.69 E+09	1.32 E+15
M30.3	Wood (Oak)	g	2.73 E+04	1.40 E+09	3.82 E+13
M30.4	Varnish	g	6.85 E+02	3.11 E+09	2.13 E+12

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.2. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S03-E04 Roof					
M31	PVC roofing sheet	g	1.06 E+06	9.68 E+08	1.03 E+16
M32	Stainless steel plate (1 mm thickness)	g	9.01 E+04	5.31 E+09	4.78 E+14
S04: FLOORS					
S04-E01 External floor					
M33	Wood plastic composite deck (30 mm thickness)	g	1.57 E+06	9.42 E+09	1.48 E+16
S04-E02 Interior floor					
M34	Mineral wool (medium density)	g	7.40 E+05	3.09 E+09	2.29 E+15
M35	Wood frame (Pine)	g	1.12 E+06	1.40 E+09	1.57 E+15
M36	Wood floor (Oak 30 mm thickness)	g	1.48 E+06	2.09 E+09	3.09 E+15
M37	Varnish	g	3.15 E+04	3.11 E+09	9.80 E+13
S05: INTERIOR PARTITION					
S05-E01 Interior walls					
M38	Galvanized steel frame	g	6.70 E+04	5.31 E+09	3.56 E+14
M39	Mineral wool (medium density)	g	1.09 E+05	3.09 E+09	3.37 E+14
M40	Plasterboard	g	1.50 E+06	2.41 E+09	3.62 E+15
M41	Paint	g	4.16 E+04	3.35 E+09	1.39 E+14
M42	Wood foot panel (Oak)	g	1.39 E+04	1.40 E+09	1.95 E+13
M43	Varnish (wood foot panel)	g	2.26 E+03	3.11 E+09	7.03 E+12
M44	Ceramic tiles	g	4.74 E+05	3.32 E+09	1.57 E+15
S05-E02 Doors					
M45	Door F04 (hinged door)				
M45.1	Wood frame (oak)	g	6.63 E+04	1.40 E+09	9.28 E+13
M45.2	Prefabricated wood door	g	4.20 E+04	1.40 E+09	5.88 E+13
M45.3	Varnish	g	6.04 E+03	3.11 E+09	1.88 E+13
S06: CEILINGS					
S06-E01 External ceilings					
M46	Wood stripe (Pine – 40 x 40 mm section)	g	5.64 E+04	1.40 E+09	7.90 E+13
M47	Galvanized steel plate (1 mm thickness)	g	1.82 E+05	5.31 E+09	9.66 E+14
S06-E02 Interior ceilings					
M48	Galvanized steel rail F530	g	9.93 E+04	5.31 E+09	5.27 E+14
M49	Plasterboard (waterproof)	g	8.20 E+05	2.41 E+09	1.98 E+15
M50	Paint	g	4.84 E+04	3.35 E+09	1.62 E+14
Total EMERGY initial input					**2.60 E+17**

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

I.3 *Building B3: Emergy analysis of material flows*

Table I.3. Building B3: Emergy analysis of material flows (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S01: FOUNDATIONS					
S01-E01 Square base					
M01	Structural concrete				
M01.1	Concrete	g	2.59 E+07	3.40 E+09	8.80 E+16
M01.2	Steel	g	4.00 E+05	5.31 E+09	2.12 E+15
S01-E02 Columns					
M02	Wood structure (Oak)	g	6.84 E+05	1.40 E+09	9.58 E+14
M03	Varnish	g	6.30 E+03	3.11 E+09	1.96 E+13
S02: STRUCTURAL FRAME					
S02-E01 Columns					
M04	Wood structure (Oak)	g	1.56 E+06	1.40 E+09	2.18 E+15
M05	Varnish	g	1.44 E+04	3.11 E+09	4.48 E+13
S02-E02 Beams ground floor					
M06	Wood structure (Oak)	g	1.09 E+07	1.40 E+09	1.53 E+16
M07	Varnish	g	1.01 E+05	3.11 E+09	3.14 E+14
S02-E03 Beams roof					
M08	Wood structure (Oak)	g	9.37 E+06	1.40 E+09	1.31 E+16
M09	Varnish	g	6.98 E+04	3.11 E+09	2.17 E+14
S02-E04 Slab ground floor					
M10	Wood structure (Oak)	g	3.48 E+06	1.40 E+09	4.87 E+15
M11	OSB panel (25 mm thickness)	g	1.30 E+06	1.92 E+09	2.50 E+15
S02-E05 Slab roof					
M12	Wood structure (Oak)	g	1.60 E+06	1.40 E+09	2.24 E+15
M13	Structural thermal insulation panel				
M13.1	OSB panel (19 mm thickness)	g	2.41 E+06	1.92 E+09	4.63 E+15
M13.2	Thermoformed XPS	g	2.01 E+05	1.39 E+10	2.79 E+15

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.3. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S03: FAÇADES AND ROOFS					
S03-E01 External walls					
M14	Wood frame (Pine – 70 x 70 mm section)	g	6.30 E+05	1.40 E+09	8.82 E+14
M15	OSB panel (19 mm thickness)	g	1.65 E+06	1.92 E+09	3.17 E+15
M16	Varnish (external face OSB panel)	g	5.67 E+04	3.11 E+09	1.76 E+14
M17	Mineral wool (medium density)	g	2.68 E+05	3.09 E+09	8.28 E+14
M18	Wood stripe (Pine – 40 x 40 mm section)	g	1.33 E+05	1.40 E+09	1.86 E+14
M19	Wood board (Oak)	g	2.03 E+06	1.40 E+09	2.84 E+15
M20	Varnish (external face wood board)		3.75 E+04	3.11 E+09	1.17 E+14
M21	Wood stripe (Pine - 40 x 40 mm section)	g	1.30E+05	1.40 E+09	1.82 E+14
M22	Plywood (external face) (15 mm thickness)	g	5.68 E+05	2.74 E+09	1.56 E+15
M23	Varnish (external face plywood)	g	3.46 E+04	3.11 E+09	1.08 E+14
S03-E02 Doors					
M24	Door F01 (sliding door)				
M24.1	Wood (Oak)	g	1.25 E+05	1.40 E+09	1.75 E+14
M24.2	Double flat glass (6-8-6 thickness)	g	4.73 E+05	7.69 E+09	3.64 E+15
M24.3	Varnish	g	7.12 E+03	3.11 E+09	2.21 E+13
M25	Door F02 (sliding door)				
M25.1	Wood (Oak)	g	6.33 E+04	1.40 E+09	8.86 E+13
M25.2	Double flat glass (6-8-6 thickness)	g	2.34 E+05	7.69 E+09	1.80 E+15
M25.3	Varnish	g	3.71 E+03	3.11 E+09	1.15 E+13
M26	Door F03 (sliding door)				
M26.1	Wood (Oak)	g	1.21 E+05	1.40 E+09	1.69 E+14
M26.2	Double flat glass (6-8-6 thickness)	g	4.58 E+05	7.69 E+09	3.52 E+15
M26.3	Varnish	g	7.00 E+03	3.11 E+09	2.18 E+13
S03-E03 Windows					
M27	Window F05 (hinged window)				
M27.1	Wood (Oak)	g	4.26 E+04	1.40 E+09	5.96 E+13
M27.2	Double flat glass (6-8-6 thickness)	g	2.31 E+04	7.69 E+09	1.78 E+14
M27.3	Varnish	g	1.73 E+03	3.11 E+09	5.38 E+12
S03-E04 Roof					
M28	PVC roofing sheet	g	4.91 E+05	9.68 E+09	4.75 E+15
M29	Zinc sheet (1 mm thickness)	g	1.33 E+05	1.14 E+11	1.52 E+16

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

Table I.3. – Continued.

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S04: FLOORS					
S04-E01 External floor					
M30	Wood (Ipe- 27 mm thickness)	g	1.16 E+06	1.40 E+09	1.62 E+15
S04-E02 Interior floor					
M31	Mineral wool (medium density)	g	2.68 E+05	3.09 E+09	8.28 E+14
M32	Wood floor (Oak 30 mm thickness)	g	1.82 E+06	2.09 E+09	3.80 E+15
M33	Varnish	g	3.35 E+04	3.11 E+09	1.04 E+14
S05: INTERIOR PARTITION					
S05-E01 Interior walls					
M34	Wood frame (Pine – 70 x 70 mm section)	g	4.19 E+05	1.40 E+09	5.86 E+14
M35	Mineral wool (medium density)	g	2.91 E+05	3.09 E+09	8.99 E+14
M36	Plywood finishing (15 mm thickness)	g	1.73 E+06	2.74 E+09	4.74 E+15
M37	Varnish (plywood)	g	5.86 E+04	3.11 E+09	1.82 E+14
M38	Plasterboard (waterproof)	g	4.85 E+04	2.41 E+09	1.17 E+14
M39	Paint	g	4.26 E+03	3.35 E+09	1.43 E+13
M40	Ceramic tiles	g	4.50 E+05	3.32 E+09	1.49 E+15
S05-E02 Doors					
M41	Door F04 (hinged door)				
M41.1	Wood frame (oak)	g	1.39 E+04	1.40 E+09	1.95 E+13
M41.2	Prefabricated wood door	g	4.20 E+04	1.40 E+09	5.88 E+13
M41.3	Varnish	g	6.08 E+03	3.11 E+09	1.89 E+13
S06: CEILINGS					
S06-E01 External ceilings					
M42	Wood stripe (Pine – 50 x 40 mm section)	g	1.55 E+05	1.40 E+09	2.18 E+14
M43	Plywood finishing (15 mm thickness)	g	2.18 E+05	2.74 E+09	5.97 E+14
M44	Varnish	g	1.32 E+04	3.11 E+09	4.11 E+13
S06-E02 Interiorl ceilings					
M45	Galvanized steel rail F530	g	1.03 E+05	5.31 E+09	5.47 E+14
M46	Plasterboard (waterproof)	g	8.50 E+05	2.41 E+09	2.05 E+15
M47	Paint	g	5.01 E+04	3.35 E+09	1.68 E+14
Total EMERGY initial input					**1.97 E+17**

See Appendix C for references on Unit Solar Emergy sources and Appendix F for mass input.

APPENDIX J

EMERGY EVALUATION OF BEST OPTIONS FOR MATERIALS THAT WILL BE REPLACED BY RECOVERED MATERIALS OF BUILDINGS B1, B2, AND B3

J.1 *Building B1: Emergy evaluation of best options for materials that will be substituted by recovered materials*

Table J.1. Building B1: Emergy evaluation of best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M01 Structural concrete							
M01.1	Concrete	MS01.1	Granite	g	2.41 E+07	8.40 E+08	2.02 E+16
M01.2	Steel	MS01.2	Pig iron	g	3.72 E+05	3.34 E+09	1.24 E+15
M02 Structural concrete							
M02.1	Concrete	MS02.1	Granite	g	2.01 E+06	8.40 E+08	1.69 E+15
M02.2	Steel	MS02.2	Pig iron	g	2.97 E+05	3.34 E+09	9.91 E+14
M03 Structural concrete							
M03.1	Concrete	MS03.1	Granite	g	3.88 E+06	8.40 E+08	3.26 E+15
M03.2	Steel	MS03.2	Pig iron	g	8.58 E+05	3.34 E+09	2.68 E+15
M04 Structural concrete							
M04.1	Concrete	MS04.1	Granite	g	1.54 E+07	8.40 E+08	1.29 E+16
M04.2	Steel	MS04.2	Pig iron	g	8.53 E+05	3.34 E+09	2.85 E+15
M05 Structural concrete							
M05.1	Concrete	MS05.1	Granite	g	1.04 E+07	8.40 E+08	8.77 E+15
M05.2	Steel	MS05.2	Pig iron	g	5.43 E+05	3.34 E+09	1.81 E+15
M06 Structural concrete							
M06.1	Concrete	MS06.1	Granite	g	6.82 E+07	8.40 E+08	5.73 E+16
M06.2	Steel	MS06.2	Pig iron	g	3.10 E+06	3.34 E+09	1.04 E+16
M07 Mortar		MS07 A Granite		g	5.98 E+06	1.68 E+09	5.02 E+15
M08 Structural concrete							
M08.1	Concrete	MS08.1	Granite	g	4.80 E+07	8.40 E+08	4.04 E+16
M08.2	Steel	MS08.2	Pig iron	g	2.17 E+06	3.34 E+09	7.24 E+15
M09 Mortar		MS09 Granite		g	1.20 E+07	8.40 E+08	1.01 E+16
M10 Ceramic hollow brick masonry (200 mm thickness)							
M10.1	Ceramic hollow brick	MS10.1	Granite	g	8.17 E+06	8.40 E+08	6.85 E+15
M10.2	Mortarl	MS10.2	Granite	g	6.23 E+06	8.40 E+08	5.23 E+15
M11 Mortar (rendering)		MS11 Granite		g	5.12 E+06	8.40 E+08	4.30 E+15
M12 Thermal insulation (Thermoformed EPS out insulation)		MS12 None		g	0	0	0
M13 Paint		MS13 None		g	0	0	0

Table J.1. – Continued.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M14 Door F01 (sliding door)							
M14.1	Aluminium	MS14.1	Aluminium (primary ingot)	g	7.78 E+04	4.50 E+10	3.50 E+15
M14.2	Double flat glass (6-8-6 thickness)	MS14.2	Flat glass	g	4.37 E+05	7.69 E+09	3.36 E+15
M14.3	Wood (Oak)	MS14.3	Wood logs	g	1.30 E+04	6.79 E+08	8.84 E+12
M14.4	Varnish	MS14.4	None	g	0	0	0
M15 Door F02 (sliding door)							
M15.1	Aluminium	MS15.1	Aluminium (primary ingot)	g	1.96 E+04	4.50 E+10	8.81 E+14
M15.2	Double flat glass (6-8-6 thickness)	MS15.2	Flat glass	g	2.13 E+05	7.69 E+09	1.64 E+15
M15.3	Wood (Oak)	MS15.3	Wood logs	g	9.22 E+03	6.79 E+08	6.26 E+12
M15.4	Varnish	MS15.4	None	g	0	0	0
M16 Door F03 (sliding door)							
M16.1	Aluminium	MS16.1	Aluminium (primary ingot)	g	3.90 E+04	4.50 E+10	1.75 E+15
M16.2	Double flat glass (6-8-6 thickness)	MS16.2	Flat glass	g	4.20 E+05	7.69 E+09	3.23 E+15
M16.3	Wood (Oak)	MS16.3	Wood logs	g	1.38 E+04	6.79 E+08	9.35 E+12
M16.4	Varnish	MS16.4	None	g	0	0	0
M17 Window F05 (hinged window)							
M17.1	Aluminium	MS17.1	Aluminium (primary ingot)	g	1.87 E+04	4.50 E+10	8.42 E+14
M17.2	Double flat glass (6-8-6 thickness)	MS17.2	Flat glass	g	1.60 E+05	7.69 E+09	1.23 E+15
M17.3	Wood (Oak)	MS17.3	Wood logs	g	2.54 E+04	6.79 E+08	1.72 E+13
M17.4	Varnish	MS17.4	None	g	0	0	0
M18 Asphalt sheet		MS18 None		g	0	0	0
M19 Thermal insulation (Thermoformed XPS)		MS19 None		g	0	0	0
M20 Gravel		MS20 Gravel		g	1.16 E+07	2,24 E+09	2.60 E+16
M21 Zinc sheet (1 mm thickness)		MS21 Zinc		g	1.26 E+05	1.14 E+11	1.44 E+16
M22 Granite floor							
M22.1	Granite tiles (30 mm thickness	MS23.1	Granite	g	7.27 E+06	8.40 E+08	6.11 E+15
M22.2	Mortar	MS23.2	Granite	g	3.56 E+06	8.40 E+08	2.99 E+15
M23 Asphalt sheet		MS23 None		g	0	0	0

Table J.1. – Continued.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M24	Thermal insulation	MS24	None	g	0	0	0
M25	Mortar	MS25	Granite	g	7.86 E+06	8.40 E+08	6.60 E+15
M26	Wood frame (Pine)	MS26	Wood logs	g	2.46 E+05	6.79 E+08	5.56 E+12
M27	Wood floor (Oak 30 mm thickness)	MS27	Wood logs	g	1.38 E+06	6.79 E+08	3.12 E+13
M28	Varnish (wood floor)	MS28	None	g	0	0	0
M29	Marble floor						
M29.1	Marble tiles (20 mm thickness)	MS29.1	Granite	g	2.77 E+05	8.40 E+08	2.33 E+14
M29.2	Mortar	MS29.2	Granite	g	4.92 E+05	8.40 E+08	4.14 E+14
M30	Ceramic hollow brick masonry (110 mm thickness)						
M30.1	Ceramic hollow brick	MS30.1	Granite	g	2.10 E+06	8.40 E+08	1.76 E+15
M30.2	Mortar	MS30.2	Granite	g	1.12 E+05	8.40 E+08	9.73 E+13
M31	Mortar (rendering)	MS31	Granite	g	4.19 E+06	8.40 E+08	3.52 E+15
M32	Plaster	MS32	Granite	g	2.20 E+05	8.40 E+08	1.84 E+14
M33	Paint	MS33	None	g	0	0	0
M34	Plywood finishing (15 mm thickness)	MS34	Combustion	J	5.11 E+08	1.85 E+04	9.45 E+12
M35	Varnish (plywood)	MS35	None	g	0	0	0
M36	Wood foot panel (Oak)	MS36	Wood logs	g	1.74 E+04	6.79 E+08	1.18 E+13
M37	Varnish (wood foot panel)	MS37	None	g	0	0	0
M38	Ceramic tiles	MS38	Granite	g	4.61 E+05	8.40 E+08	3.87 E+14
M39	Door F04 (hinged door)						
M39.1	Wood frame (oak)	MS39.1	Wood logs	g	6.17 E+04	6.79 E+08	4.19 E+13
M39.2	Prefabricated wood door	MS39.2	Wood logs	g	3.91 E+04	6.79 E+08	2.65 E+13
M39.3	Varnish	MS39.3	None	g	0	0	0
M40	Mortar (rendering)	MS40	Granite	g	1.03 E+06	8.40 E+08	8.62 E+14
M41	Thermal insulation (Thermoformed EPS out insulation)	MS41	None	g	0	0	0
M42	Paint	MS42	None	g	0	0	0
M43	Mortar (rendering)	MS43	Granite	g	2.22 E+06	8.40 E+08	1.87 E+15
M44	Plaster	MS44	Granite	g	3.17 E+02	8.40 E+08	2.66 E+11
M45	Paint	MS45	None	g	0	0	0

See Appendix C for references on Unit Solar Emergy sources.

J.2 *Building B2: Emergy evaluation of best options for materials that will be substituted by recovered materials*

Table J.2. Building B2: Emergy evaluation of best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M01 Structural concrete							
M01.1	Concrete	MS01.1	Granite	g	2.41 E+07	8.40 E+08	2.02 E+16
M01.2	Steel	MS01.2	Pig iron	g	3.72 E+05	3.34 E+09	1.24 E+15
M02 Galvanized steel (HEB 200 section)		MS02 Steel profiles		g	9.22 E+05	5.31 E+09	4.89 E+15
M03 Paint		MS03 None		g	0	0	0
M04 Galvanized steel (HEB 200 section)		MS04 Steel profiles		g	1.74 E+06	5.31 E+09	9.22 E+15
M05 Paint		MS05 None		g	0	0	0
M06 Galvanized steel (HEB 200 section)		MS06 Steel profiles		g	5.45 E+06	5.31 E+09	2.89 E+16
M07 Paint		MS07 None		g	0	0	0
M08 Galvanized steel (IPN 140 section)		MS08 Steel profiles		g	1.51 E+06	5.31 E+09	8.04 E+15
M09 Paint (IPN 140)		MS09 None		g	0	0	0
M10 Galvanized steel (HEB 200 section)		MS10 Steel profiles		g	4.07 E+06	5.31 E+09	2.16 E+16
M11 Paint		MS11 None		g	0	0	0
M12 Galvanized steel (IPN 140 section)		MS12 Steel profiles		g	1.13 E+06	5.31 E+09	6.03 E+15
M13 Paint		MS13 None		g	0	0	0
M14 OSB panel (25 mm thickness)		MS14 Combustion		J	8.44 E+05	1.85 E+04	3.41 E+14
M15 Structural thermal insulation panel							
M15.1	OSB panel (19 mm thickness)	MS15.1	None	g	0	0	0
M15.2	Thermoformed XPS	MS15.2	None	g	0	0	0
M16 Wood frame (Pine)		MS16 Wood logs		g	8.44 E+05	6.79 E+08	5.73 E+14
M17 OSB panel (25 mm thickness)		MS17 Combustion		J	2.66 E+10	1.85 E+04	4.93 E+14
M18 Galvanized steel frame		MS18 Pig iron		g	2.89 E+05	3.34 E+09	9.65 E+14
M19 OSB panel (19 mm thickness)		MS19 Combustion		J	4.94 E+09	1.85 E+04	9.14 E+13
M20 Varnish		MS20 None		g	0	0	0

Table J.2. – Continued.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M21 Mineral wool (medium density)		MS21 Mineral wool		g	3.87 E+05	3.09 E+09	1.20 E+15
M22 Plasterboard		MS22 Gypsum		g	1.12 E+06	1.68 E+09	1.88 E+15
M23 Paint		MS23 None		g	0	0	0
M24 Wood stripe (Pine – 40 x 40 mm section)		MS24 Wood logs		g	2.59 E+05	6.79 E+08	1.76 E+14
M25 Galvanized steel plate (1 mm thickness)		MS25 Pig iron		g	3.77 E+05	3.34 E+09	1.26 E+14
M26 Corrugated galvanized steel plate (0.75 mm thickness)		MS26 Pig iron		g	4.16 E+05	3.34 E+09	1.39 E+15
M27 Door F01 (sliding door)							
M27.1	Aluminium	MS27.1	Aluminium (primary ingot)	g	7.78 E+04	4.50 E+10	3.50 E+15
M27.2	Double flat glass (6-8-6 thickness)	MS27.2	Granite	g	4.37 E+05	7.69 E+09	3.36 E+15
M27.3	Wood (Oak)	MS27.3	Wood logs	g	1.30 E+04	6.79 E+08	8.84 E+12
M27.4	Varnish	MS27.4	None	g	0	0	0
M28 Door F02 (sliding door)							
M28.1	Aluminium	MS27.1	Aluminium (primary ingot)	g	1.71 E+04	4.50 E+10	7.67 E+14
M28.2	Double flat glass (6-8-6 thickness)	MS27.2	Granite	g	2.14 E+05	7.69 E+09	1.64 E+15
M28.3	Wood (Oak)	MS27.3	Wood logs	g	6.60 E+03	6.79 E+08	4.48 E+12
M28.4	Varnish	MS27.4	None	g	0	0	0
M29 Door F03 (sliding door)							
M29.1	Aluminium	MS29.1	Aluminium (primary ingot)	g	3.14 E+04	4.50 E+10	1.41 E+15
M29.2	Double flat glass (6-8-6 thickness)	MS29.2	Granite	g	4.25 E+05	7.69 E+09	3.27 E+15
M29.3	Wood (Oak)	MS29.3	Wood logs	g	9.90 E+03	6.79 E+08	6.73 E+12
M29.4	Varnish	MS29.4	None	g	0	0	0
M30 Window F05 (hinged window)							
M30.1	Aluminium	MS30.1	Aluminium (primary ingot)	g	8.38 E+03	4.50 E+10	3.77 E+14
M30.2	Double flat glass (6-8-6 thickness)	MS30.2	Granite	g	1.86 E+04	7.69 E+09	1.43 E+14
M30.3	Wood (Oak)	MS30.3	Wood logs	g	2.38 E+04	6.79 E+08	1.61 E+13
M30.4	Varnish	MS30.4	None	g	0	0	0
M31 PVC Roofing sheet		MS31 None		g	0	0	0

Table J.2. – Continued.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M32 Stainless steel plate (1 mm thickness)		MS32 Pig iron		g	8.38 E+04	3.34 E+09	2.80 E+14
M33 Wood plastic composite deck (30 mm thickness)		MS33 Plastic lumber		g	1.46 E+06	9.24 E+09	1.38 E+16
M34 Mineral wool (medium density)		MS34 Mineral wool		g	6.88 E+05	3.09 E+09	2.13 E+15
M35 Wood frame (Pine)		MS35 Wood logs		g	1.04 E+06	6.79 E+08	7.07 E+15
M36 Wood floor (Oak 30 mm thickness)		MS36 Wood logs		g	1.38 E+06	6.79 E+08	9.35 E+14
M37 Varnish		MS37 None		g	0	0	0
M38 Galvanized steel frame		MS38 Pig iron		g	6.50 E+04	3.34 E+09	2.17 E+14
M39 Mineral wool (medium density)		MS39 Mineral wool		g	1.01 E+05	3.09 E+09	3.13 E+14
M40 Plasterboard		MS40 Gypsum		g	1.43 E+05	1.68 E+09	2.39 E+15
M41 Paint		MS41 None		g	0	0	0
M42 Wood foot panel (Oak)		MS42 Wood logs		g	1.29 E+04	6.79 E+08	8.78 E+12
M43 Varnish		MS43 None		g	0	0	0
M44 Ceramic tiles		MS44 Granite		g	4.27 E+05	8.40 E+08	3.58 E+14
M45 Door F04 (hinged door)							
M45.1	Wood frame (oak)	MS45.1	Wood logs	g	6.17 E+04	6.79 E+08	4.19 E+13
M45.2	Prefabricated wood door	MS45.2	Wood logs	g	3.91 E+04	6.79 E+08	2.65 E+13
M45.3	Varnish	MS45.3	None	g	0	0	0
M46 Wood stripe (Pine – 40 x 40 mm section)		MS46 Wood logs		g	5.25 E+04	6.79 E+08	3.56 E+13
M47 Galvanized steel plate (1 mm thickness)		MS47 Pig iron		g	1.77 E+05	3.34 E+09	5.90 E+14
M48 Galvanized steel rail F530		MS48 Pig iron		g	5.25 E+04	3.34 E+09	3.22 E+14
M49 Plasterboard (waterproof)		MS49 Gypsum		g	1.77 E+05	1.68 E+09	1.31 E+15
M50 Paint		MS50 None		g	0	0	0

See Appendix C for references on Unit Solar Emergy sources.

J.3 *Building B3: Emergy evaluation of best options for materials that will be substituted by recovered materials*

Table J.3. Building B3: Emergy evaluation of best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M01 Structural concrete							
M01.1	Concrete	MS01.1	Granite	g	2.33 E+07	8.40 E+08	1.96 E+16
M01.2	Steel	MS01.2	Pig iron	g	3.80 E+05	3.34 E+09	1.27 E+15
M02 Wood structure (Oak)		MS02 Wood structure		g	6.36 E+05	1.40 E+09	8.91 E+14
M03 Varnish		MS03 None		g	0	0	0
M04 Wood structure (Oak)		MS04 Wood structure		g	1.45 E+06	1.40 E+09	2.03 E+15
M05 Varnish		MS05 None		g	0	0	0
M06 Wood structure (Oak)		MS06 Wood structure		g	1.01 E+07	1.40 E+09	1.42 E+16
M07 Varnish		MS07 None		g	0	0	0
M08 Wood structure (Oak)		MS08 Wood structure		g	8.71 E+06	1.40 E+09	1.22 E+16
M09 Varnish		MS09 None		g	0	0	0
M10 Wood structure (Oak)		MS10 Wood structure		g	3.24 E+06	1.40 E+09	4.53 E+15
M11 OSB panel (25 mm thickness)		MS11 Combustion		J	1.81 E+10	1.85 E+04	3.35 E+14
M12 Wood structure (Oak)		MS12 Wood structure		g	1.49 E+06	1.40 E+09	2.08 E+15
M13 Structural thermal insulation panel							
M13.1	OSB panel (19 mm thickness)	MS13.1	None	g	0	0	0
M13.2	Thermoformed XPS	MS13.2	None	g	0	0	0
M14 Wood frame (Pine – 70 x 70 mm section)		MS14 Wood logs		g	5.86 E+05	6.79 E+08	3.98 E+14
M15 OSB panel (19 mm thickness)		MS15 Combustion		J	2.30 E+10	1.85 E+04	4.26 E+14
M16 Varnish		MS16 None		g	0	0	0
M17 Mineral wool (medium density)		MS17 Mineral wool		g	2.49 E+05	3.09 E+09	7.70 E+14
M18 Wood stripe (Pine – 40 x 40 mm section)		MS18 Wood logs		g	1.23 E+05	6.79 E+08	8.37 E+13
M19 Wood board (Oak)		MS19 Wood logs		g	1.89 E+06	6.79 E+08	1.28 E+13
M20 Varnish		MS20 None		g	0	0	0
M21 Wood stripe (Pine - 40 x 40 mm section)		MS21 Combustion		J	1.82 E+09	1.85 E+04	3.36 E+13
M22 Plywood (external face) (15 mm thickness)		MS22 Combustion		J	7.92 E+09	1.85 E+04	1.47 E+04

Table J.3. – Continued.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M23 Varnish		MS23 None		g	0	0	0
M24 Door F01 (sliding door)							
M24.1	Wood (Oak)	MS24.1	Wood logs	g	1,16 E+05	6.79 E+08	7.89 E+13
M24.2	Double flat glass (6-8-6 thickness)	MS24.2	Flat glass	g	4.40 E+05	7.69 E+09	3.38 E+15
M24.3	Varnish	MS24.3	None	g	0	0	0
M25 Door F02 (sliding door)							
M25.1	Wood (Oak)	MS25.1	Wood logs	g	5.89 E+04	6.79 E+08	4.00 E+13
M25.2	Double flat glass (6-8-6 thickness)	MS25.2	Flat glass	g	2.18 E+05	7.69 E+09	1.67 E+15
M25.3	Varnish	MS25.3	None	g	0	0	0
M26 Door F03 (sliding door)							
M26.1	Wood (Oak)	MS26.1	Wood logs	g	1.13 E+04	6.79 E+08	7.64 E+13
M26.2	Double flat glass (6-8-6 thickness)	MS26.2	Flat glass	g	4.26 E+04	7.69 E+09	3.28 E+15
M26.3	Varnish	MS26.3	None	g	0	0	0
M27 Window F05 (hinged window)							
M27.1	Wood (Oak)	MS27.1	Wood logs	g	3.96 E+04	6.79 E+08	2.69 E+13
M27.2	Double flat glass (6-8-6 thickness)	MS27.2	Flat glass	g	2.15 E+04	7.69 E+09	1.65 E+14
M27.3	Varnish	MS27.3	None	g	0	0	0
M28 PVC roofing sheet		MS28 None		g	0	0	0
M29 Zinc sheet (1 mm thickness)		MS29 Zinc		g	1.26 E+05	1.14 E+11	1.44 E+16
M30 Wood (Ipe- 27 mm thickness)		MS30 Wood logs		g	1.08 E+06	6.79 E+08	7.33 E+14
M31 Mineral wool (medium density)		MS31 Mineral wool		g	2.49 E+05	3.09 E+09	7.70 E+14
M32 Wood floor (Oak 30 mm thickness)		MS32 Wood logs		g	1.69 E+06	6.79 E+08	1.15 E+15
M33 Varnish		MS33 None		g	0	0	0
M34 Wood frame (Pine – 70 x 70 mm section)		MS34 Wood logs		g	3.89 E+05	6.79 E+08	2.64 E+14
M35 Mineral wool (medium density)		MS35 Mineral wool		g	2.71 E+05	3.09 E+09	8.37 E+14
M36 Plywood finishing (15 mm thickness)		MS36 Combustion		J	2.41 E+10	1.85 E+04	4.46 E+14
M37 Varnish		MS37 None		g	0	0	0
M38 Plasterboard (waterproof)		MS38 Gypsum		g	4.61 E+04	1.68 E+09	7.74 E+13

Table J.3. – Continued.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
M39	Paint	MS39	None	g	0	0	0
M40	Ceramic tiles	MS40	Granite	g	4.05 E+05	8.40 E+08	3.40 E+14
M41	Door F04 (hinged door)						
M41.1	Wood frame (oak)	MS41.1	Wood logs	g	1.29 E+04	6.79 E+08	8.78 E+12
M41.2	Prefabricated wood door	MS41.2	Wood logs	g	3.91 E+04	6.79 E+08	2.65 E+13
M41.3	Varnish	MS41.3	None	g	0	0	0
M42	Wood stripe (Pine – 50 x 40 mm section)	MS42	Combustion	J	2.17 E+09	1.85 E+04	4.01 E+13
M43	Plywood finishing (15 mm thickness)	MS43	Combustion	J	3.04 E+09	1.85 E+04	5.63 E+13
M44	Varnish	MS44	None	g	0	0	0
M45	Galvanized steel rail F530	MS45	Pig iron	g	9.99 E+04	3.34 E+09	3.34 E+14
M46	Plasterboard (water-proof)	MS46	Gypsum	g	8.08 E+05	1.68 E+09	1.36 E+15
M47	Paint	MS47	None	g	0	0	0

See Appendix C for references on Unit Solar Emergy sources.

APPENDIX K

DE CALCULATIONS FOR BUILDINGS B1, B2, AND B3

K.1 *Building B1: evaluation of Deconstruction Effectiveness*

Table K.1. Building B1: application of Equations 1 and 2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M01 Structural concrete				
M01.1	Concrete	8.80 E+16	1	8.80 E+16
M01.2	Steel (total)	2.12 E+15	1	2.12 E+15
				9.01 E+16
M02 Structural concrete				
M02.1	Concrete	7.34 E+15	1	7.34 E+15
M02.2	Steel (total)	1.69 E+15	1	1.69 E+15
				9.04 E+15
M03 Structural concrete				
M03.1	Concrete	1.42 E+16	1	1.42 E+16
M03.2	Steel (total)	4.90 E+15	1	4.90 E+15
				1.91 E+16
M04 Structural concrete				
M04.1	Concrete	5.62 E+16	1	5.62 E+16
M04.2	Steel (total)	4.87 E+15	1	4.87 E+15
				6.11 E+16
M05 Structural concrete				
M05.1	Concrete	3.82 E+16	1	3.82 E+16
M05.2	Steel (total)	3.10 E+15	1	3.10 E+15
				4.13 E+16
M06 Structural concrete				
M06.1	Concrete	2.49 E+17	1	2.49 E+17
M06.2	Steel (total)	1.77 E+16	1	1.77 E+16
				2.67 E+17
M07 Mortar		1.67 E+16	1	1.67 E+16
M08 Structural concrete				
M08.1	Concrete	1.76 E+17	1	1.76 E+17
M08.2	Steel (total)	1.24 E+16	1	1.24 E+16
				1.88 E+17
M09 Mortar		3.34 E+16	1	3.34 E+16
M10 Ceramic hollow brick masonry (200 mm thickness)				
M10.1	Ceramic hollow brick (200 mm thickness)	3.84 E+16	1	3.84 E+16
M10.2	Mortar (masonry)	1.74 E+16	1	1.74 E+16
				5.58 E+16

Table K.1. – Continued.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M11	Mortar (rendering)	1.31 E+16	1	1.31 E+16
M12	Thermal insulation (Thermoformed EPS)	4.93 E+14	1	4.93 E+14
M13	Paint	2.77 E+14	10	2.77 E+15
M14	Door F01 (sliding door)			
M14.1	Aluminium	4.96 E+15	2	9.93 E+15
M14.2	Double flat glass (6-8-6 thickness)	3.61 E+15	2	7.23 E+15
M14.3	Wood (Oak)	1.96 E+13	2	3.92 E+13
M14.4	Varnish	1.70 E+12	4	6.80 E+12
				1.72 E+16
M15	Door F02 (sliding door)			
M15.1	Aluminium	1.25 E+15	2	2.50 E+15
M15.2	Double flat glass (6-8-6 thickness)	1.76 E+15	2	3.52 E+15
M15.3	Wood (Oak)	1.39 E+13	2	2.77 E+13
M15.4	Varnish	1.09 E+12	4	4.37 E+12
				6.05 E+15
M16	Door F03 (sliding door)			
M16.1	Aluminium	2.48 E+15	2	4.97 E+15
M16.2	Double flat glass (6-8-6 thickness)	3.48 E+15	2	6.95 E+15
M16.3	Wood (Oak)	2.70 E+13	2	4.14 E+13
M16.4	Varnish	1.64 E+12	4	6.57 E+12
				1.20 E+16
M17	Window F05 (hinged window)			
M17.1	Aluminium	1.19 E+15	2	2.39 E+15
M17.2	Double flat glass (6-8-6 thickness)	1.32 E+15	2	2.65 E+15
M17.3	Wood (Oak)	3.82 E+13	2	7.64 E+13
M17.4	Varnish	2.13 E+12	4	8.52 E+12
				5.03 E+15
M18	Asphalt sheet	3.91 E+14	1	3.91 E+14
M19	Thermal insulation (Thermoformed XPS)	2.10 E+15	1	2.10 E+15
M20	Gravel	3.82 E+16	1	3.82 E+16
M21	Zinc sheet (1 mm thickness)	1.52 E+16	1	1.52 E+16
M22	Granite floor			
M22.1	Granite tiles (30 mm thickness	3.32 E+16	1	3.32 E+16
M22.2	Mortar	9.94 E+15	1	9.94 E+15
				4.31 E+16

Table K.1. – Continued.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M23	Asphalt sheet	1.02 E+15	1	1.02 E+15
M24	Thermal insulation (Thermoformed XPS)	1.04 E+15	1	1.04 E+15
M25	Mortar	2.19 E+16	1	2.19 E+16
M26	Wood frame (Pine)	3.70 E+14	2	7.39 E+14
M27	Wood floor (Oak 30 mm thickness)	3.09 E+15	2	6.19 E+15
M28	Varnish (wood floor)	8.49 E+13	4	3.40 E+14
M29	Marble floor			
M29.1	Marble tiles (20 mm thickness)	3.73 E+15	1	3.73 E+15
M29.2	Mortar	1.37 E+15	1	1.37 E+15
				5.10 E+15
M30	Ceramic hollow brick masonry (110 mm thickness)			
M30.1	Ceramic hollow brick (110 mm thickness)	9.68 E+15	1	9.68 E+15
M30.2	Mortar (masonry)	3.11E+15	1	3.11E+15
				1.30 E+16
M31	Mortar (rendering)	1.07 E+16	1	1.07 E+16
M32	Plaster	4.00 E+14	1	4.00 E+14
M33	Paint	2.00 E+14	4	8.00 E+14
M34	Plywood finishing (15 mm thickness)	1.00 E+14	4	4.01 E+14
M35	Varnish (plywood)	6.94 E+12	4	2.77 E+13
M36	Wood foot panel (Oak)	2.62 E+13	2	5.24 E+13
M37	Varnish (wood foot panel)	2.64 E+12	4	1.06 E+13
M38	Ceramic tiles	1.70 E+15	2	3.40 E+15
M39	Door F04 (hinged door)			
M39.1	Wood frame (oak)	9.28 E+13	2	1.68 E+14
M39.2	Prefabricated wood door	5.88 E+13	2	1.18 E+14
M39.3	Varnish	1.88 E+13	4	7.51 E+13
				3.78 E+14
M40	Mortar (rendering)	2.62 E+15	1	2.62 E+15
M41	Thermal insulation (Thermoformed XPS)	6.32 E+14	1	6.32 E+14
M42	Paint	7.27 E+13	10	7.27 E+14
M43	Mortar (rendering)	5.68 E+15	1	5.68 E+15
M44	Plaster	5.77 E+11	1	5.77 E+11
M45	Paint	1.57 E+14	4	6.28 E+143
Equation 2: Total of Emergy of materials for building B1 during Lifespan (seJ)				1.00 E+18

Table K.2. Building B1: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M01 Structural concrete						
M01.1	Concrete	MS02.1	Granite	2.02 E+16	1	2.02 E+16
M01.2.	Aggregates	MS02.2	Pig iron	1.24 E+15	1	1.24 E+15
						2.15 E+16
M02 Structural concrete						
M02.1	Concrete	MS01.1	Granite	1.69 E+15	1	1.69 E+15
M02.2.	Steel	MS01.2	Pig iron	9.91 E+14	1	9.91 E+14
						2.68 E+15
M03 Structural concrete						
M03.1	Concrete	MS03.1	Granite	3.26 E+15	1	3.26 E+15
M03.2.	Steel	MS03.2	Pig iron	2.86 E+15	1	2.86 E+15
						6.13 E+15
M04 Structural concrete						
M04.1	Concrete	MS04.1	Granite	1.29 E+16	1	1.29 E+16
M04.2.	Steel	MS04.2	Pig iron	2.85 E+15	1	2.85 E+15
						1.58 E+16
M05 Structural concrete						
M05.1	Concrete	MS05.1	Granite	8.77 E+15	1	8.77 E+15
M05.2.	Steel	MS05.2	Pig iron	1.81 E+15	1	1.81 E+15
						1.06 E+16
M06 Structural concrete						
M06.1	Concrete	MS06.1	Granite	5.73 E+16	1	5.73 E+16
M06.2.	Steel	MS06.2	Pig iron	1.04E+16	1	1.04E+16
						6.77 E+16
M07 Mortar		MS07	Granite	5.02 E+15	1	5.02 E+15
M08 Structural concrete						
M08.1	Concrete	MS08.1	Granite	4.04 E+16	1	4.04 E+16
M08.2.	Steel	MS08.2	Pig iron	7.24 E+15	1	7.24 E+15
						4.76 E+16
M09 Mortar		MS09	Granite	1.01 E+16	1	1.01 E+16
M10 Ceramic hollow brick masonry (200 mm thickness)						
M10.1	Ceramic hollow brick	MS10.1	Granite	6.85 E+15	1	6.85 E+15
M10.2.	Mortar (masonry)	MS10.2	Granite	5.23 E+15	1	5.23 E+15
						1.21 E+16
M11 Mortar (rendering)		MS11	Granite	4.30 E+15	1	4.30 E+15

Table K.2. – Continued.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M12 Thermal insulation (Thermoformed EPS)		MS12 None		0	1	0
M13 Paint		MS13 None		0	10	0
M14 Door F01 (sliding door)						
M14.1	Aluminium	MS14.1	Aluminium (primary ingot)	3.50 E+15	2	7.00 E+15
M14.2	Double flat glass (6-8-6 thickness)	MS14.2	Flat glass	3.36 E+15	2	6.72 E+15
M14.3	Wood (Oak)	MS14.3	Wood logs	8.84 E+12	2	1.77 E+13
M14.4	Varnish	MS14.4	None	0	4	0
						1.37 E+16
M15 Door F02 (sliding door)						
M15.1	Aluminium	MS15.1	Aluminium (primary ingot)	8.18 E+14	2	1.76 E+15
M15.2	Double flat glass (6-8-6 thickness)	MS15.2	Flat glass	1.64 E+15	2	3.28 E+15
M15.3	Wood (Oak)	MS15.3	Wood logs	6.26 E+12	2	1.25 E+13
M15.4	Varnish	MS15.4	None	0	4	0
						5.05 E+15
M16 Door F03 (sliding door)						
M16.1	Aluminium	MS16.1	Aluminium (primary ingot)	1.75 E+15	2	3.51 E+15
M16.2	Double flat glass (6-8-6 thickness)	MS16.2	Flat glass	3.23 E+15	2	6.47 E+15
M16.3	Wood (Oak)	MS16.3	Wood logs	9.35 E+12	2	1.87 E+13
M16.4	Varnish	MS16.4	None	0	4	0
						9.99 E+15
M17 Window F05 (hinged window)						
M17.1	Aluminium	MS17.1	Aluminium (primary ingot)	8.42 E+14	2	1.68 E+15
M17.2	Double flat glass (6-8-6 thickness)	MS17.2	Flat glass	1.23 E+15	2	2.46 E+15
M17.3	Wood (Oak)	MS17.3	Wood logs	1.72 E+13	2	3.45 E+13
M17.4	Varnish	MS17.4	None	0	4	0
						4.18 E+15
M18 Asphalt sheet		MS18 None		0	1	0
M19 Thermal insulation (Thermoformed XPS)		MS19 None		0	1	0
M20 Gravel		MS20 Gravel		2.60 E+16	1	2.60 E+16

Table K.2. – Continued.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M21 Zinc sheet (1 mm thickness)		MS21 Zinc		1.44 E+16	1	1.44 E+16
M22 Granite floor						
M22.1	Granite tiles (30 mm thickness	MS22.1	Granite	6.11 E+15	1	6.11 E+15
M22.2	Mortar	MS22.2	Granite	2.99 E+15	1	2.99 E+15
						9.10 E+15
M23 Asphalt sheet		MS23 None		0	1	0
M24 Thermal insulation (Thermoformed XPS)		MS24 None		0	1	0
M25 Mortar		MS25 Granite		6.60 E+15	1	6.60 E+15
M26 Wood frame (Pine)		MS26 Wood logs		5.56 E+12	2	3.33 E+14
M27 Wood floor (Oak 30 mm thickness)		MS27 Wood logs		3.12 E+13	2	1.87 E+15
M28 Varnish (wood floor)		MS28 None		0	4	0
M29 Marble floor						
M29.1	Marble tiles (20 mm thickness)	MS29.1	Granite	2.33 E+14	1	2.33 E+14
M29.2	Mortar	MS29.2	Granite	4.14 E+14	1	4.14 E+14
						6.46 E+14
M30 Ceramic hollow brick masonry (110 mm thickness)						
M30.1	Ceramic hollow brick	MS30.1	Granite	1.76 E+15	1	1.76 E+15
M30.2.	Mortar (masonry)	MS30.2	Granite	9.73 E+13	1	9.73 E+13
						1.68 E+15
M31 Mortar (rendering)		MS31 Granite		3.52 E+15	1	3.52 E+15
M32 Plaster		MS32 Granite		1.84 E+14	1	1.84 E+14
M33 Paint		MS33 None		0	4	0
M34 Plywood finishing (15 mm thickness)		MS34 Combustion		9.45 E+12	4	3.78 E+13
M35 Varnish (plywood)		MS35 None		0	4	0
M36 Wood foot panel (Oak)		MS36 Wood logs		1.18 E+13	2	2.36 E+13
M37 Varnish (wood foot panel)		MS37 None		0	4	0
M38 Ceramic tiles		MS38 Granite		3.87 E+14	2	7.74 E+14

Table K.2. – Continued.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M39 Door F04 (hinged door)						
M39.1	Wood frame (oak)	MS39.1	Wood logs	4.19 E+13	2	8.37 E+13
M39.2	Prefabricated wood door	MS39.3	Wood logs	2.65 E+13	2	5.30 E+13
M39.3	Varnish	MS39.4	None	0	4	0
						1.37 E+14
M40 Mortar (rendering)		MS40 Granite		8.62 E+14	1	8.62 E+14
M41 Thermal insulation (Thermoformed XPS)		MS41 None		0	1	0
M42 Paint		MS42 None		0		0
M43 Mortar (rendering)		MS43 Granite		1.87 E+15	1	1.87 E+15
M44 Plaster		MS44 Granite		2.66 E+11	1	2.66 E+11
M45 Paint		MS45 None		0	4	0
Equation 4: Revecovery Effectiveness of building B1 (seJ)						3.05 E+17

Table K.3. Building B1: application of Equation 5.

Recovery Effectiveness of B1 (seJ)	Emergy B1 (seJ)	DE
3.05 E+17	1.00 E+18	0.303

K.2 *Building B2: evaluation of Deconstruction Effectiveness*

Table K.4. Building B2: application of Equations 1 and 2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M01	Structural concrete			
M01.1	Concrete	8.80 E+16	1	8.80 E+16
M01.2	Steel (round bar 12 mm thickness)	2.12 E+15	1	2.12 E+15
				9.01 E+16
M02	Galvanized steel (HEB 200 section)	5.04 E+15	1	5.04 E+15
M03	Paint	4.98 E+13	4	1.99 E+14
M04	Galvanized steel (HEB 200 section)	9.50 E+15	1	9.50 E+15
M05	Paint	9.39 E+13	4	3.76 E+14
M06	Galvanized steel (HEB 200 section)	2.98 E+16	1	2.98 E+16
M07	Paint	2.95 E+14	4	1.18 E+15
M08	Galvanized steel (IPN 140 section)	8.28 E+15	1	8.28 E+15
M09	Paint (IPN 140)	1.66 E+14	4	6.66 E+14
M10	Galvanized steel (HEB 200 section)	2.23 E+16	1	2.23 E+16
M11	Paint	2.20 E+14	4	8.82 E+14
M12	Galvanized steel (IPN 140 section)	6.21 E+15	1	6.21 E+15
M13	Paint (IPN 140)	1.25 E+14	4	4.99 E+14
M14	OSB panel (25 mm thickness)	2.53 E+15	1	2.53 E+15
M15	Structural thermal insulation panel			
M15.1	OSB panel (19 mm thickness)	4.63 E+13	1	4.63 E+13
M15.2	Thermoformed XPS	3.22 E+15	1	3.22 E+15
				7.85 E+15
M16	Wood frame (Pine)	1.27 E+15	1	1.27 E+15
M17	OSB panel (25 mm thickness)	3.67 E+15	1	3.67 E+15
M18	Galvanized steel frame	1.58 E+15	1	1.58 E+15
M19	OSB panel (19 mm thickness)	6.80 E+14	1	6.80 E+14
M20	Varnish (external face OSB panel)	1.28 E+14	1	1.28 E+14
M21	Mineral wool (medium density)	1.29 E+15	1	1.29 E+15
M22	Plasterboard	2.84 E+15	1	2.84 E+15
M23	Paint	2.50 E+14	4	9.98 E+14
M24	Wood stripe (Pine – 40 x 40 mm section)	3.89 E+14	1	3.89 E+14
M25	Galvanized steel plate (1 mm thickness)	2.07 E+14	1	2.07 E+14
M26	Corrugated galvanized steel plate (0.75 mm thickness)	2.28 E+15	1	2.28 E+15

Table K.4. – Continued.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M27 Door F01 (sliding door)				
M27.1	Aluminium	4.96 E+15	1	4.96 E+15
M27.2	Double flat glass (6-8-6 thickness)	3.61 E+15	1	3.61 E+15
M27.3	Wood (Oak)	1.96 E+13	2	3.92 E+13
M27.4	Varnish	1.70 E+12	4	6.80 E+12
				8.62 E+15
M28 Door F02 (sliding door)				
M28.1	Aluminium	1.25 E+15	1	1.25 E+15
M28.2	Double flat glass (6-8-6 thickness)	1.76 E+15	1	1.76 E+15
M28.3	Wood (Oak)	1.39 E+13	2	2.77 E+13
M28.4	Varnish	1.09 E+12	4	4.37 E+12
				6.01 E+16
M29 Door F03 (sliding door)				
M29.1	Aluminium	2.48 E+15	1	2.48 E+15
M29.2	Double flat glass (6-8-6 thickness)	3.48 E+15	1	3.48 E+15
M29.3	Wood (Oak)	2.70 E+13	2	4.14 E+13
M29.4	Varnish	1.64 E+12	4	6.57 E+12
				6.01 E+15
M30 Window F05 (hinged window)				
M30.1	Aluminium	1.19 E+15	1	1.19 E+15
M30.2	Double flat glass (6-8-6 thickness)	1.32 E+15	1	1.32 E+15
M30.3	Wood (Oak)	3.82 E+13	2	7.64 E+13
M30.4	Varnish	2.13 E+12	4	8.52 E+12
				2.52 E+15
M31 PVC roofing sheet		1.03 E+16	3	3.08 E+16
M32 Stainless steel plate (1 mm thickness)		4.78 E+14	1	4.78 E+14
M33 Wood plastic composite deck (30 mm thickness)		1.48 E+16	1	1.48 E+16
M34 Mineral wool (medium density)		2.29 E+15	1	2.29 E+15
M35 Wood frame (Pine)		1.57 E+15	2	3.14 E+15
M36 Wood floor (Oak 30 mm thickness)		3.09 E+15	2	6.19 E+15
M37 Varnish		9.80 E+13	4	3.92 E+14
M38 Galvanized steel frame		3.56 E+14	1	3.56 E+14
M39 Mineral wool (medium density)		3.37 E+14	1	3.37 E+14
M40 Plasterboard		3.62 E+15	1	3.62 E+15
M41 Paint		1.39 E+14	4	5.57 E+14
M42 Wood foot panel (Oak)		1.95 E+13	2	3.89 E+13

Table K.4. – Continued.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M43	Varnish (wood foot panel)	7.03 E+12	4	2.81 E+13
M44	Ceramic tiles	1.57 E+15	2	3.15 E+15
M45	Door F04 (hinged door)			
M45.1	Wood frame (oak)	9.28 E+13	2	1.68 E+14
M45.2	Prefabricated wood door	5.88 E+13	2	1.18 E+14
M45.3	Varnish	1.88 E+13	4	7.51 E+13
				3.78 E+14
M46	Wood stripe (Pine – 40 x 40 mm section)	7.90 E+13	1	7.90 E+13
M47	Galvanized steel plate (1 mm thickness)	9.66 E+14	1	9.66 E+14
M48	Galvanized steel rail F530	5.27 E+14	1	5.27 E+14
M49	Plasterboard (waterproof)	1.98 E+15	1	1.98 E+15
M50	Paint	1.62 E+14	4	6.48 E+14
Equation 2: Total of Emergy of materials for building B2 during Lifespan (seJ)				2.92 E+17

Table K.5. Building B2: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M01 Structural concrete						
M01.1	Concrete	MS02.1	Aggregates	2.02 E+16	1	2.02 E+16
M01.2.	Aggregates	MS02.2	Pig iron	1.24 E+15	1	1.24 E+15
						2.15 E+16
M02 Galvanized steel (HEB 200 section)		MS02	Steel profiles	4.89 E+15	1	4.89 E+15
M03 Paint		MS03	None	0	4	0
M04 Galvanized steel (HEB 200 section)		MS04	Steel profiles	9.22 E+15	1	9.22 E+15
M05 Paint		MS05	None	0	4	0
M06 Galvanized steel (HEB 200 section)		MS06	Steel profiles	2.89 E+16	1	2.89 E+16
M07 Paint		MS07	None	0	4	0
M08 Galvanized steel (IPN 140 section)		MS08	Steel profiles	8.04 E+15	1	8.04 E+15
M09 Paint		MS09	None	0	4	0
M10 Galvanized steel (HEB 200 section)		MS10	Steel profiles	2.16 E+16	1	2.16 E+16
M11 Paint		MS11	None	0	4	0
M12 Galvanized steel (IPN 140 section)		MS12	Steel profiles	6.03 E+15	1	6.03 E+15
M13 Paint		MS13	None	0	4	0
M14 OSB panel (25 mm thickness)		MS14	Combustion	3.41 E+14	1	3.41 E+14
M15 Structural thermal insulation panel						
M15.1	OSB panel (19 mm thickness)	MS15.1	None	0	1	0
M15.2	Thermoformed XPS	MS15.2	None	0	1	0
						0
M16 Wood frame (Pine)		MS16	Wood logs	5.73 E+14	1	5.73 E+14
M17 OSB panel (25 mm thickness)		MS17	Combustion	4.93 E+14	1	4.93 E+14
M18 Galvanized steel frame		MS18	Pig iron	9.56 E+14	1	9.56 E+14
M19 OSB panel (19 mm thickness)		MS19	Combustion	9.14 E+13	1	9.14 E+13
M20 Varnish (external face OSB panel)		MS20	None	0	1	0
M21 Mineral wool (medium density)		MS21	Mineral wool	1.20 E+15	1	1.20 E+15
M22 Plasterboard		MS22	Gypsum	1.88 E+15	1	1.88 E+15

Table K.5. – Continued.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M23 Paint		MS23 None		0	4	0
M24 Wood stripe (Pine – 40 x 40 mm section)		MS24 Wood logs		1.76 E+14	1	1.76 E+14
M25 Galvanized steel plate (1 mm thickness)		MS25 Pig iron		1.26 E+14	1	1.26 E+14
M26 Corrugated galvanized steel plate (0.75 mm thickness)		MS26 Pig iron		1.39 E+15	1	1.39 E+15
M27 Door F01 (sliding door)						
M27.1	Aluminium	MS27.1	Aluminium (primary ingot)	3.50 E+15	1	3.50 E+15
M27.2	Double flat glass (6-8-6 thickness)	MS27.2	Flat glass	3.36 E+15	1	3.36 E+15
M27.3	Wood (Oak)	MS27.3	Wood logs	8.84 E+12	2	1.77 E+13
M27.4	Varnish	MS27.4	None	0	4	0
						6.88 E+15
M28 Door F02 (sliding door)						
M28.1	Aluminium	MS28.1	Aluminium (primary ingot)	7.67 E+14	1	7.67 E+14
M28.2	Double flat glass (6-8-6 thickness)	MS28.2	Flat glass	1.64 E+15	1	1.64 E+15
M28.3	Wood (Oak)	MS28.3	Wood logs	4.48 E+12	2	8.97 E+12
M28.4	Varnish	MS28.4	None	0	4	0
						2.42 E+15
M29 Door F03 (sliding door)						
M29.1	Aluminium	MS29.1	Aluminium (primary ingot)	1.41 E+15	1	1.41 E+15
M29.2	Double flat glass (6-8-6 thickness)	MS29.2	Flat glass	3.27 E+15	1	3.27 E+15
M29.3	Wood (Oak)	MS29.3	Wood logs	6.73 E+12	2	1.35 E+13
M29.4	Varnish	MS29.4	None	0	4	0
						4.70 E+15
M30 Window F05 (hinged window)						
M30.1	Aluminium	MS30.1	Aluminium (primary ingot)	3.77 E+14	1	3.77 E+14
M30.2	Double flat glass (6-8-6 thickness)	MS30.2	Flat glass	1.43 E+14	1	1.43 E+14
M30.3	Wood (Oak)	MS30.3	Wood logs	1.61 E+13	2	3.23 E+13
M30.4	Varnish	MS30.4	None	0	4	0
						5.52 E+14
M31 Asphalt sheet		MS31 None		0	3	0

Table K.5. – Continued.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M32	Stainless steel plate (1 mm thickness)	MS32	Pig iron	2.80 E+14	1	2.80 E+14
M33	Wood plastic composite deck (30 mm thickness)	MS33	Plastic lumber	1.38 E+16	1	1.38 E+16
M34	Mineral wool (medium density)	MS34	Mineral wool	2.13 E+15	1	2.13 E+15
M35	Wood frame (Pine)	MS35	Wood logs	7.07 E+15	2	1.41 E+15
M36	Wood floor (Oak 30 mm thickness)	MS36	Wood logs	9.35 E+14	2	1.87 E+15
M37	Varnish	MS37	None	0	4	0
M38	Galvanized steel frame	MS38	Pig iron	2.17 E+14	1	2.17 E+14
M39	Mineral wool (medium density)	MS39	Mineral wool	3.13 E+14	1	3.13 E+14
M40	Plasterboard	MS40	Gypsum	2.39 E+15	1	2.39 E+15
M41	Paint	MS41	None	0	4	0
M42	Wood foot panel (Oak)	MS42	Wood logs	8.78 E+12	2	1.76 E+13
M43	Varnish (wood floor)	MS43	None	0	4	0
M44	Ceramic tiles	MS44	Granite	3.58 E+14	1	7.17 E+14
M45	Door F04 (hinged door)					
M45.1	Wood frame (oak)	MS45.1	Wood logs	4.19 E+13	2	8.37 E+13
M45.2	Prefabricated wood door	MS45.2	Wood logs	2.65 E+13	2	5.30 E+13
M45.3	Varnish	MS45.3	None	0	4	0
						1.37 E+14
M46	Wood stripe (Pine – 40 x 40 mm section)	MS46 A	Wood logs	3.56 E+13	1	3.56 E+13
M47	Galvanized steel plate (1 mm thickness)	MS47	Pig iron	5.90 E+14	1	3.62 E+14
M48	Galvanized steel rail F530	MS48	Pig iron	3.34 E+14	1	1.97 E+14
M49	Plasterboard	MS49	Gypsum	1.31 E+15	1	1.31 E+15
M50	Paint	MS50	None	0	4	0
Equation 4: Recovery Effectiveness of building B2 (seJ)						1.47 E+17

Table K.6. Building B2: application of Equation 5.

Recovery Effectiveness of B2 (seJ)	Emergy of B2 (seJ)	DE
1.47 E+17	2.92 E+17	0.506

K.3 *Building B3: evaluation of Deconstruction Effectiveness*

Table K.7. Building B3: application of Equations 1 and 2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M01 Structural concrete				
M01.1	Concrete	8.80 E+16	1	8.80 E+16
M01.2	Steel (round bar 12 mm thickness)	2.12 E+15	1	2.12 E+15
				9.01 E+16
M02 Wood structure (Oak)		9.58 E+14	1	9.58 E+14
M03 Varnish		1.96 E+13	17	3.33 E+14
M-04 Wood structure (Oak)		2.18 E+15	1	2.18 E+15
M05 Varnish		4.48 E+13	17	7.61 E+14
M-06 Wood structure (Oak)		1.53 E+16	1	1.53 E+16
M07 Varnish		3.14 E+14	17	5.34 E+15
M-08 Wood structure (Oak)		1.31 E+16	1	1.31 E+16
M09 Varnish		2.17 E+14	17	3.69 E+15
M10 Wood structure (Oak)		4.87 E+15	1	4.87 E+15
M11 OSB panel (25 mm thickness)		2.50 E+15	1	2.50 E+15
M12 Wood structure (Oak)		2.24 E+15	1	2.24 E+15
M13 Structural thermal insulation panel				
M13.1	OSB panel (19 mm thickness)	4.63 E+15	1	4.63 E+15
M13.2	Thermoformed XPS	2.79 E+15	1	2.79 E+15
				7.42 E+15
M14 Wood frame (Pine – 70 x 70 mm section)		8.82 E+14	1	8.82 E+14
M15 OSB panel (19 mm thickness)		3.17 E+15	1	3.17 E+15
M16 Varnish (external face OSB panel)		1.76 E+14	1	1.76 E+14
M17 Mineral wool (medium density)		8.28 E+14	1	8.28 E+14
M18 Wood stripe (Pine – 40 x 40 mm section)		1.86 E+14	2	3.71 E+14
M19 Wood board (Oak)		2.84 E+15	2	5.68 E+15
M20 Varnish (external face wood board)		1.17 E+14	17	1.98 E+15
M21 Wood stripe (Pine - 40 x 40 mm section)		1.82 E+14	4	7.29 E+14
M22 Plywood (external face) (15 mm thickness)		1.56 E+15	4	6.23 E+15
M23 Varnish (external face plywood)		1.08 E+14	17	1.83 E+15
M24 Door F01 (sliding door)				
M24.1	Wood (Oak)	1.75 E+14	2	3.50 E+14
M24.2	Double flat glass (6-8-6 thickness)	3.64 E+15	2	7.27 E+15
M24.3	Varnish	2.21 E+13	17	3.76 E+14
				8.00 E+15

Table K.7. – Continued.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M25 Door F02 (sliding door)				
M25.1	Wood (Oak)	8.86 E+13	2	1.77 E+14
M25.2	Double flat glass (6-8-6 thickness)	1.80 E+15	2	3.60 E+15
M25.3	Varnish	1.15 E+13	17	1.96 E+14
				3.97 E+15
M26 Door F03 (sliding door)				
M26.1	Wood (Oak)	1.69 E+14	2	3.39 E+14
M26.2	Double flat glass (6-8-6 thickness)	3.52 E+15	2	7.04 E+15
M26.3	Varnish	2.18 E+13	17	3.70 E+14
				7.75 E+14
M27 Window F05 (hinged window)				
M27.1	Wood (Oak)	5.96 E+13	2	1.19 E+14
M27.2	Double flat glass (6-8-6 thickness)	1.78 E+14	2	3.55 E+14
M27.3	Varnish	5.38 E+12	17	9.15 E+13
				5.66 E+14
M28 PVC roofing sheet		4.75 E+15	3	2.38 E+14
M29 Zinc sheet (1 mm thickness)		1.52 E+16	1	1.52 E+16
M30 Wood (Ipe- 27 mm thickness)		1.62 E+15	2	3.25 E+15
M31 Mineral wool (medium density)		8.28 E+14	1	8.28 E+14
M32 Wood floor (Oak 30 mm thickness)		3.80 E+15	2	7.61 E+15
M33 Varnish		1.04 E+14	4	4.17 E+14
M34 Wood frame (Pine – 70 x 70 mm section)		5.86 E+14	1	5.86 E+14
M35 Mineral wool (medium density)		8.99 E+14	1	8.99 E+14
M36 Plywood finishing (15 mm thickness)		4.74 E+15	4	1.90 E+16
M37 Varnish (plywood)		1.82 E+14	4	7.29 E+14
M38 Plasterboard (waterproof)		1.17 E+14	1	1.17 E+14
M39 Paint		1.43 E+13	4	5.07 E+13
M40 Ceramic tiles		1.49 E+15	2	2.99 E+15
M41 Door F04 (hinged door)				
M41.1	Wood frame (oak)	1.95 E+13	2	3.89 E+13
M41.2	Prefabricated wood door	5.88 E+13	2	1.18 E+14
M41.3	Varnish	1.89 E+13	4	7.56 E+13
				2.32 E+14

Table K.7. – Continued.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ)
M42	Wood stripe (Pine – 50 x 40 mm section)	2.18 E+14	4	8.70 E+14
M43	Plywood finishing (15 mm thickness)	5.97 E+14	4	2.39 E+15
M44	Varnish	4.11 E+13	17	6.98 E+14
M45	Galvanized steel rail F530	5.47 E+14	1	5.47 E+14
M46	Plasterboard (waterproof)	2.05 E+15	1	2.05 E+15
M47	Paint	1.68 E+14	4	6.71 E+14
Equation 2: Total of Emergy of materials for building B3 during Lifespan (seJ)				2.64 E+17

Table K.8. Building B3: application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials.

Note	Mi	Note	SMi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M01 Structural concrete						
M01.1	Concrete	MS01.1	Granite	1.96 E+16	1	1.96 E+16
M01.2.	Aggregates	MS01.2	Pig iron	1.27 E+15	1	1.27 E+15
						2.08 E+16
M-02 Wood structure (Oak)		MS02	Wood structure	8.91 E+14	1	8.91 E+14
M03 Varnish		MS03	None	0	17	0
M-04 Wood structure (Oak)		MS04	Wood structure	2.03 E+15	1	2.03 E+15
M05 Varnish		MS05	None	0	17	0
M-06 Wood structure (Oak)		MS06	Wood structure	1.42 E+16	1	1.42 E+16
M07 Varnish		MS07	None	0	17	0
M-08 Wood structure (Oak)		MS08	Wood structure	1.22 E+16	1	1.22 E+16
M07 Varnish		MS09	None	0	17	0
M10 Wood structure (Oak)		MS10	Wood structure	4.53 E+15	1	4.53 E+15
M11 OSB panel (25 mm thickness)		MS11	Combustion	3.35 E+14	1	3.35 E+14
M12 Wood structure (Oak)		MS12	Wood structure	2.08 E+15	1	2.08 E+15
M13 Structural thermal insulation panel						
M13.1	OSB panel (19 mm thickness)	MS13.1	None	0	1	0
M13.2	Thermoformed XPS	MS13.2	None	0	1	0
						0
M14 Wood frame (Pine – 70 x 70 mm section)		MS15	Wood logs	3.98 E+14	1	3.98 E+14
M15 OSB panel (19 mm thickness)		MS15	Combustion	4.26 E+14	1	4.26 E+14
M16 Varnish		MS16	None	0	1	0
M17 Mineral wool (medium density)		MS17	Mineral wool	7.70 E+14	1	7.70 E+14
M18 Wood stripe (Pine – 40 x 40 mm section)		MS18	Wood logs	8.37 E+13	2	1.67 E+14
M19 Wood board (Oak)		MS19	Wood logs	1.28 E+15	2	2.56 E+15
M20 Varnish		MS20	None	0	1	0
M21 Wood stripe (Pine - 40 x 40 mm section)		MS21	Combustion	3.36 E+13	4	1.43 E+14
M22 Plywood (external face) (15 mm thickness)		MS22	Combustion	1.47 E+14	4	5.86 E+14
M23Varnish		MS23	None	0	17	0

Table K.8. – Continued.

Note	Mi	Note	SMi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M24 Door F01 (sliding door)						
M24.1	Wood (Oak)	MS24.1	Wood logs	7.89 E+13	2	1.58 E+14
M24.2	Double flat glass (6-8-6 thickness)	MS24.2	Flat glass	3.38 E+15	2	6.77 E+15
M24.3	Varnish	MS24.3	None	0	17	0
						6.92 E+15
M25 Door F02 (sliding door)						
M25.1	Wood (Oak)	MS25.1	Wood logs	4.00 E+13	2	7.99 E+13
M25.2	Double flat glass (6-8-6 thickness)	MS25.2	Flat glass	1.67 E+15	2	3.35 E+15
M25.3	Varnish	MS25.3	None	0	17	0
						3.43 E+15
M26 Door F03 (sliding door)						
M26.1	Wood (Oak)	MS26.1	Wood logs	7.64 E+13	2	1.53 E+14
M26.2	Double flat glass (6-8-6 thickness)	MS26.2	Flat glass	3.28 E+15	2	6.55 E+15
M26.3	Varnish	MS26.3	None	0	17	0
						6.70 E+15
M27 Window F05 (hinged window)						
M27.1	Wood (Oak)	MS27.1	Wood logs	2.69 E+13	2	5.38 E+13
M27.2	Double flat glass (6-8-6 thickness)	MS27.2	Flat glass	1.65 E+14	2	3.30 E+14
M27.3	Varnish	MS27.3	None	0	17	0
						3.84 E+14
M28 PVC roofing sheet		MS28	None	0	3	0
M29 Zinc sheet (1 mm thickness)		MS29	Zinc	1.44 E+16	1	1.44 E+16
M30 Wood (Ipe- 27 mm thickness)		MS30	Wood logs	7.33 E+14	2	1.47 E+15
M31 Mineral wool (medium density)		MS31	Mineral wool	7.70 E+14	1	7.70 E+14
M32 Wood floor (Oak 30 mm thickness)		MS32 A	Wood logs	1.15 E+15	2	2.30 E+15
M33 Varnish		MS33	None	0	4	0
M34 Wood frame (Pine – 70 x 70 mm section)		MS34	Wood logs	2.64 E+14	1	2.64 E+14
M35 Mineral wool (medium density)		MS35	Mineral wool	8.37 E+14	1	8.37 E+14
M36 Plywood finishing (15 mm thickness)		MS36	Combustion	4.46 E+14	4	1.79 E+15

Table K.8. – Continued.

Note	Mi	Note	SMi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
M37	Varnish (wood floor)	MS37	None	0	4	0
M38	Plasterboard	MS38	Gypsum	7.74 E+13	1	7.74 E+13
M39	Paint	MS39	None	0	4	0
M40	Ceramic tiles	MS40	Granite	3.40 E+14	2	6.80 E+14
M41	Door F04 (hinged door)					
M41.1	Wood frame (oak)	MS41.1	Wood logs	8.78 E+12	2	1.76 E+13
M41.2	Prefabricated wood door	MS41.2	Wood logs	2.65 E+13	2	5.30 E+13
M41.3	Varnish	MS41.3	None	0	4	0
						7.60 E+13
M42	Wood stripe (Pine – 50 x 40 mm section)	MS42	Combustion	4.01 E+13	4	1.60 E+14
M43	Plywood finishing (15 mm thickness)	MS43	Combustion	5.63 E+13	4	2.25 E+14
M44	Varnish (wood floor)	MS44	None	0	17	0
M45	Galvanized steel rail F530	MS45	Pig iron	3.34 E+14	1	3.34 E+14
M46	Plasterboard	MS46	Gypsum	1.36 E+15	1	1.36 E+15
M47	Paint	MS47	None	0	4	0
Equation 4: Recovery Effectiveness of building B3 (seJ)						1.04 E+17

Table K.9. Building B3: application of Equation 5.

Recovery Effectiveness of B3 (seJ)	Emergy of B3 (seJ)	DE
1.04 E+17	2.64 E+17	0.395

APPENDIX L

ALTERNATIVES TO INTERNAL WALLS FOR BUILDINGS B1 AND B3

L.1 *Alternative to internal walls for building B1*

Table L.1. Building B1 (alternative to internal walls): analysis of end-of-life scenarios.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S05: INTERNAL PARTITION					
S05-E01 Internal walls					
Changed materials					
M30.1	Ceramic hollow brick (110 mm thickness)	2.33 E+06	0	2.10 E+06	2.33 E+05
M30.2	Mortar (masonry)	1.24 E+06	0	1.12 E+05	1.24 E+04
M31	Mortar (rendering)	4.65 E+06	0	4.19 E+06	4.65 E+05
M32	Plaster	2.44 E+05	0	2.20 E+05	2.44 E+04
M33	Paint	5.97 E+04	0	0	5.97 E+04
Alternatives to M30 to M33					
Galvanized steel frame		6.70 E+04	0	6.50 E+04	2.01 E+03
Mineral wool (medium density)		1.09 E+05	1.01 E+05	0	7.63 E+03
Plasterboard		1.50 E+06	0	1.43 E+05	2.25 E+05
Paint		4.16 E+04	0	0	4.16 E+04

Table L.2. Building B1 (alternative to internal walls): Emergy analysis (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S05: INTERNAL PARTITION					
S05-E01 Internal walls					
Changed materials					
M30 Ceramic hollow brick masonry (110 mm thickness)					
M30.1	Ceramic hollow brick (110 mm thickness)	g	2.33 E+06	4.23 E+09	9.68 E+15
M30.2	Mortar (masonry)	g	1.24 E+06	2.51 E+09	3.36 E+15
M31 Mortar (rendering)		g	4.65 E+06	2.30 E+09	1.07 E+16
M32 Plaster		g	2.44 E+05	1.64 E+09	4.00 E+14
M33 Paint		g	5.97 E+04	3.35 E+09	2.00 E+14
Alternatives to M30 to M33					
Galvanized steel frame		g	6.70 E+04	5.31 E+09	3.56 E+14
Mineral wool (medium density)		g	1.09 E+05	3.09 E+09	3.37 E+14
Plasterboard		g	1.50 E+06	2.41 E+09	3.62 E+15
Paint		g	4.16 E+04	3.35 E+09	1.39 E+14
Total EMERGY initial input					**9.54 E+17**

See Appendix C for references on Unit Solar Emergy sources.

Table L.3. Building B1 (alternative to internal walls): Emergy evaluation of best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
Changed materials							
M30 Ceramic hollow brick masonry (110 mm thickness)							
M30.1	Ceramic hollow brick	MS30.1	Granite	g	2.10 E+06	8.40 E+08	1.76 E+15
M30.2	Mortar	MS30.2	Granite	g	1.12 E+05	8.40 E+08	9.73 E+13
M31 Mortar (rendering)		MS31 Granite		g	4.19 E+06	8.40 E+08	3.52 E+15
M32 Plaster		MS32 Granite		g	2.20 E+05	8.40 E+08	1.84 E+14
M33 Paint		MS33 None		g	0	0	0
Alternatives to M30 to M33							
Galvanized steel frame		Pig iron		g	6.50 E+04	3.34 E+09	2.17 E+14
Mineral wool (medium density)		Mineral wool		g	1.01 E+05	3.09 E+09	3.13 E+14
Plasterboard		Gypsum		g	1.43 E+05	1.68 E+09	2.39 E+15
Paint		None		g	0	0	0

L.1.1 *Building B1 (alternative to internal walls): evaluation of Deconstruction Effectiveness*

Table L.4. Building B1: (alternative to internal walls): application of Equations 1 and 2.

Note	Item	Emergy (sej)	Replacements	Equation 1 (seJ)
Changed materials				
M30 Ceramic hollow brick masonry (110 mm thickness)				
M30.1	Ceramic hollow brick (110 mm thickness)	9.68 E+15	1	9.68 E+15
M30.2	Mortar (masonry)	3.11E+15	1	3.11E+15
				1.30 E+16
M31 Mortar (rendering)		1.07 E+16	1	1.07 E+16
M32 Plaster		4.00 E+14	1	4.00 E+14
M33 Paint		2.00 E+14	4	8.00 E+14
Alternatives to M30 to M33				
Galvanized steel frame		3.56 E+14	1	3.56 E+14
Mineral wool (medium density)		3.37 E+14	1	3.37 E+14
Plasterboard		3.62 E+15	1	3.62 E+15
Paint		1.39 E+14	4	5.57 E+14
Equation 2: Total of Emergy of materials for building B1 during lifespan (seJ)				9.79 E+17

Table L.5. Building B1 (alternative to internal walls): application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
Changed materials						
M30 Ceramic hollow brick masonry (110 mm thickness)						
M30.1	Ceramic hollow brick	MS30.1	Granite	1.76 E+15	1	1.76 E+15
M30.2.	Mortar (masonry)	MS30.2	Granite	9.73 E+13	1	9.73 E+13
						1.86 E+15
M31 Mortar (rendering)		MS31 Granite		3.52 E+15	1	3.52 E+15
M32 Plaster		MS32 Granite		1.84 E+14	1	1.84 E+14
M33 Paint		MS33 None		0	4	0
Alternatives to M30 to M33						
Galvanized steel frame		Pig iron		2.17 E+14	1	2.17 E+14
Mineral wool (medium density)		Mineral wool		3.13 E+14	1	3.13 E+14
Plasterboard		Gypsum		2.39 E+15	1	2.39 E+15
Paint		None		0	4	0
Equation 4: Recovery Effectiveness of building B1 (seJ)						3.02 E+17

Table L.6. Building B1 (alternative to internal walls): application of Equation 5.

Recovery Effectiveness of B1 (seJ)	Emergy of B1 (seJ)	DE
3.02 E+17	9.79 E+17	**0.307**

L.2 *Alternative to internal walls for building B3*

Table L.7. Building B3 (alternative to internal walls): analysis of end-of-life scenarios of materials.

Note	Item	Mass (g)	End-of-life scenarios for materials mass		
			Reuse (g)	Recycle (g)	No recovery (g)
S05: INTERNAL PARTITION					
S05-E01 Internal walls					
Changed materials					
M-34	Wood frame (Pine – 70 x 70 mm section)	4.19 E+05	0	3.89 E+05	2.93 E+04
M35	Mineral wool (medium density)	2.91 E+05	2.71 E+05	0	2.04 E+04
M-36	Plywood finishing (15 mm thickness)	1.73 E+06	0	1.61 E+06	1.21 E+05
M-37	Varnish (plywood)	5.86 E+04	0	0	5.68 E+04
M-38	Plasterboard (waterproof)	4.85 E+05	0	4.61 E+04	2.43 E+04
M-39	Paint	4.26 E+03	0	0	4.26 E+03
Alternatives to M34 to M39					
	Galvanized steel frame	6.70 E+04	0	6.50 E+04	2.01 E+03
	Mineral wool (medium density)	1.09 E+05	1.01 E+05	0	7.63 E+03
	Plasterboard	1.50 E+06	0	1.43 E+05	2.25 E+05
	Paint	4.16 E+04	0	0	4.16 E+04
	Wood foot panel (Oak)	1.39 E+04	0	1.29 E+04	9.73 E+02
	Varnish (wood foot panel)	2.26 E+03	0	0	2.26 E+03

Table L.8. Building B3 (alternative to internal walls): Emergy analysis (without services).

Note	Item	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
S05: INTERNAL PARTITION					
S05-E01 Internal walls					
	Changed materials				
	M30 Ceramic hollow brick masonry (110 mm thickness)				
	M34 Wood frame (Pine – 70 x 70 mm section)	g	4.19 E+05	1.40 E+09	5.86 E+14
	M35 Mineral wool (medium density)	g	2.91 E+05	3.09 E+09	8.99 E+14
	M36 Plywood finishing (15 mm thickness)	g	1.73 E+06	2.74 E+09	4.74 E+15
	M37 Varnish (plywood)	g	5.86 E+04	3.11 E+09	1.82 E+14
	M38 Plasterboard (waterproof)	g	4.85 E+04	2.41 E+09	1.17 E+14
	M39 Paint	g	4.26 E+03	3.35 E+09	1.43 E+13
	Alternatives to M34 to M39				
	Galvanized steel frame	g	6.70 E+04	5.31 E+09	3.56 E+14
	Mineral wool (medium density)	g	1.09 E+05	3.09 E+09	3.37 E+14
	Plasterboard	g	1.50 E+06	2.41 E+09	3.62 E+15
	Paint	g	4.16 E+04	3.35 E+09	1.39 E+14
	Wood foot panel (Oak)	g	1.39 E+04	1.40 E+09	1.95 E+13
	Varnish (wood foot panel)	g	2.26 E+03	3.11 E+09	7.03 E+12
Total EMERGY initial input					**2.48 E+17**

See Appendix C for references on Unit Solar Emergy sources.

Table L.9. Building B3 (alternative to internal walls): Emergy evaluation of best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Unit	Data (units)	Unit Solar EMERGY (seJ/unit)	Solar EMERGY (seJ)
Changed materials							
M34 Wood frame (Pine – 70 x 70 mm section)		MS34 Wood logs		g	3.89 E+05	6.79 E+08	2.64 E+14
M35 Mineral wool (medium density)		MS35 Mineral wool		g	2.71 E+05	3.09 E+09	8.37 E+14
M36 Plywood finishing (15 mm thickness)		MS36 Combustion		J	2.41 E+10	1.85 E+04	4.46 E+14
M37 Varnish		MS37 None		g	0	0	0
M38 Plasterboard (water-proof)		MS38 Gypsum		g	4.61 E+04	1.68 E+09	7.74 E+13
M39 Paint		MS39 None		g	0	0	0
Alternatives to M34 to M39							
Galvanized steel frame		Pig iron		g	6.50 E+04	3.34 E+09	2.17 E+14
Mineral wool (medium density)		Mineral wool		g	1.01 E+05	3.09 E+09	3.13 E+14
Plasterboard		Gypsum		g	1.43 E+05	1.68 E+09	2.39 E+15
Paint		None		g	0	0	0
Wood foot panel (Oak)		Wood logs		g	1.29 E+04	6.79 E+08	8.78 E+12
Varnish (wood foot panel)		None		g	0	0	0

L.2.1 *Building B3 (alternative to internal walls): evaluation of Deconstruction Effectiveness*

Table L.10. Building B3 (alternative to internal walls): application of Equations 1 and 2.

Note	Item	Emergy (seJ)	Replacements	Equation 1 (seJ/yr)
Changed materials				
M34	Wood frame (Pine – 70 x 70 mm section)	5.86 E+14	1	5.86 E+14
M35	Mineral wool (medium density)	8.99 E+14	1	8.99 E+14
M36	Plywood finishing (15 mm thickness)	4.74 E+15	4	1.90 E+16
M37	Varnish (plywood)	1.82 E+14	4	7.29 E+14
M38	Plasterboard (waterproof)	1.17 E+14	1	1.17 E+14
M39	Paint	1.43 E+13	4	5.70 E+13
Alternatives to M34 to M39				
	Galvanized steel frame	3.56 E+14	1	3.56 E+14
	Mineral wool (medium density)	3.37 E+14	1	3.37 E+14
	Plasterboard	3.62 E+15	1	3.62 E+15
	Paint	1.39 E+14	4	5.57 E+14
	Wood foot panel (Oak)	1.95 E+13	2	3.89 E+13
	Varnish (wood foot panel)	7.03 E+12	4	2.81 E+13
	Equation 2: Total of Emergy of materials for building B3 during lifespan (seJ)			2.64 E+17

Table L.11. Building B3 (alternative to internal walls): application of Equations 3 and 4 to best options for materials that will be substituted by recovered materials.

Note	Mi	Note	MSi	Emergy of MSi (seJ)	Replacements	Emergy Equation 3 (seJ)
Changed materials						
M34	Wood frame (Pine – 70 x 70 mm section)	MS34	Wood logs	2.64 E+14	1	2.64 E+14
M35	Mineral wool (medium density)	MS35	Mineral wool	8.37 E+14	1	8.37 E+14
M36	Plywood finishing (15 mm thickness)	MS36	Combustion	4.46 E+14	4	1.79 E+15
M37	Varnish (wood floor)	MS37	None	0	4	0
M38	Plasterboard	MS38	Gypsum	7.74 E+13	1	7.74 E+13
M39	Paint	MS39	None	0	4	0
Alternatives to M34 to M39						
	Galvanized steel frame		Pig iron	2.17 E+14	1	2.17 E+14
	Mineral wool (medium density)		Mineral wool	3.13 E+14	1	3.13 E+14
	Plasterboard		Gypsum	2.39 E+15	1	2.39 E+15
	Paint		None	0	4	0
	Wood foot panel (Oak)		Wood logs	8.78 E+12	2	1.76 E+13
	Varnish (wood foot panel)		None	0	4	0
Equation 4: Recovery effectiveness of Building B3 (seJ)						1.04 E+17

Table L.12. Building B3 (alternative to internal walls): application of Equation 5.

Recovery Effectiveness of B3 (seJ/yr)	Emergy of B3 (seJ)	DE
1.04 E+17	2.48 E+17	**0.421**