NTNU

May 04, 2023

Results from Element Matching

Project name: Bod nidarosdomen

Construction site located at: 63.4269, 10.3969

Summary of results

Total score	Score without reuse	Savings	Substitutions
673.52 kg CO2 equivalents	3085.3 kg CO2 equivalents	78.17%	81.58%

The 'Maximum Bipartite Matching' algorithm yields the best results, substituting 31/38 demand elements (81.58%). Using 'GWP' as the optimization metric, a total score of 673.52 kg CO2 equivalents is achieved. For comparison, a score of 3085.3 kg CO2 equivalents would have been obtained by employing exclusively new materials. This results in a total saving of 78.17%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 31.8% of the total score. Open the CSV-file "Bod_nidarosdomen_substitutions.csv" to examine the substitutions.

Constants used in calculations

Constant	Value	Unit
Density timber	491.0	kg/m^3
Density steel	7850	kg/m^3
GWP new timber	28.9	kg C02 equivalents
GWP reused timber	2.25	kg C02 equivalents
GWP new steel	800.0	kg C02 equivalents
GWP reused steel	4.0	kg C02 equivalents
GWP transportation	96.0	kg/m^3 per tonne

Information about datasets

Elements	Filename	Number of elements
Reused	SUPPLY_DATAFRAME_SVERRE.xlsx	109
Demand	DEMAND_DATAFRAME_SVERRE.xlsx	38

Impact of transportation

Transportation score	Percentage of total score	Transportation all new
214.19 kg CO2 equivalents	31.8%	971.14 kg CO2 equivalents

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 214.19 kg CO2 equivalents. This accounts for 31.8% of the total score of 673.52 kg CO2 equivalents. For comparison, the transportation impact for exclusively using new materials would have been 971.14 kg CO2 equivalents.

Performance of algorithms

Name	Total score	Substitutions	Time
Maximum Bipartite Matching	673.52 kg CO2 equivalents	81.58%	0.021s
Greedy Algorithm Plural	673.52 kg CO2 equivalents	81.58%	0.057s

The design tool is runned with 2 algorithms, namely: Maximum Bipartite Matching, and Greedy Algorithm Plural. The Maximum Bipartite Matching yields the lowest score, as shown in the table. The substitutions by this algorithm are completed in 0.021 seconds.