NTNU

May 12, 2023

Results from Element Matching

Project name: Campussamling Hesthagen

Construction site located at: 63.4154, 10.3995

Summary of results

Total score	Score without reuse	Savings	Substitutions
1 170 kgCO2eq	14 313 kgCO2eq	91.83%	94.0%

The 'Greedy Algorithm Plural' algorithm yields the best results, substituting 94/100 demand elements (94.0%). Using 'GWP' as the optimization metric, a total score of 1 170 kgCO2eq is achieved. For comparison, a score of 14 313 kgCO2eq would have been obtained by employing exclusively new materials. This results in a total saving of 91.83%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 12.27% of the total score. Open the CSV-file "Campussamling Hesthagen Study Case 2_substitutions.csv" to examine the substitutions.

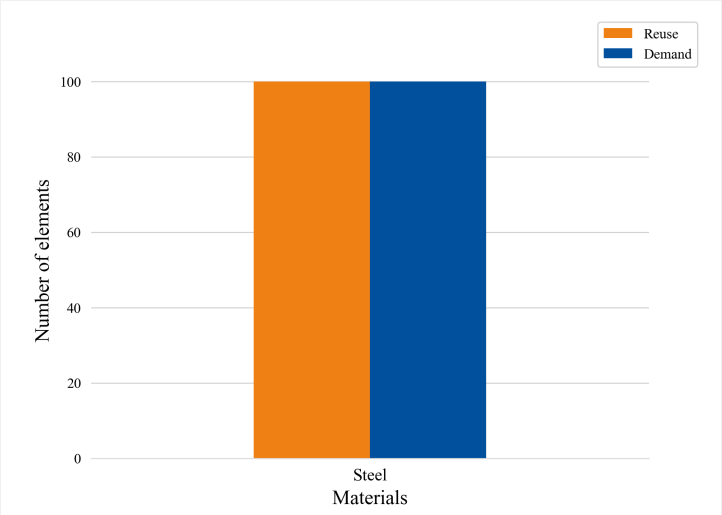
Constants used in calculations

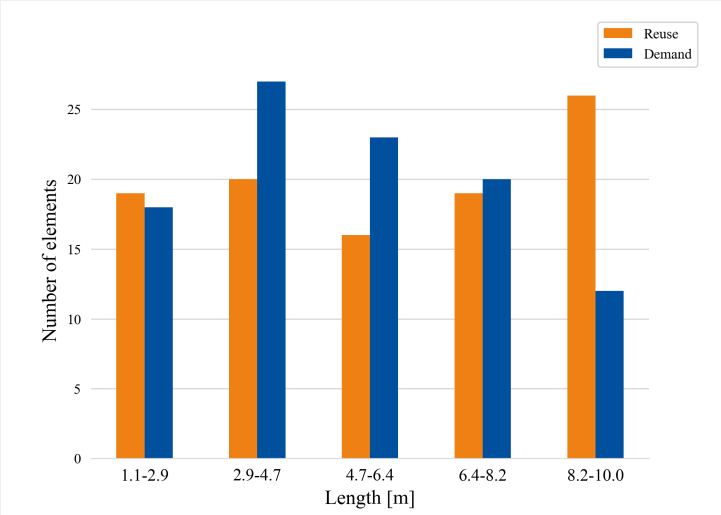
Constant	Value	Unit
Density timber	491.0	kg/m^3
Density steel	7850.0	kg/m^3
GWP new timber	28.9	kgCO2eq
GWP reused timber	2.25	kgCO2eq
GWP new steel	9263.0	kgCO2eq
GWP reused steel	278.0	kgCO2eq
GWP transportation	89.6	g/tonne/km

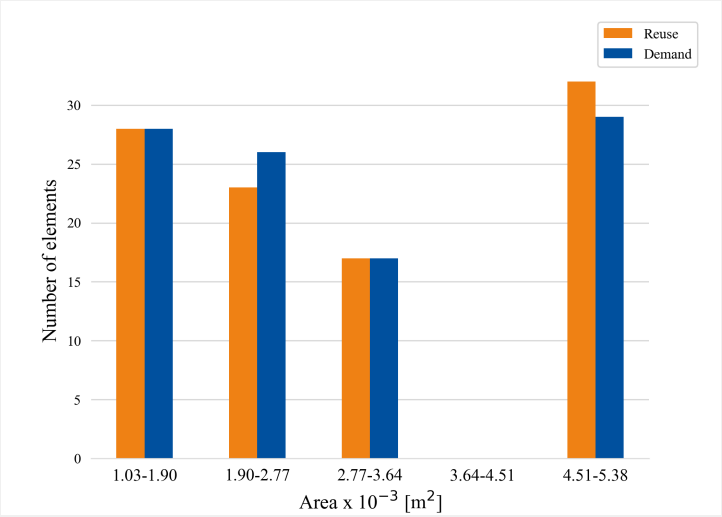
Information about datasets

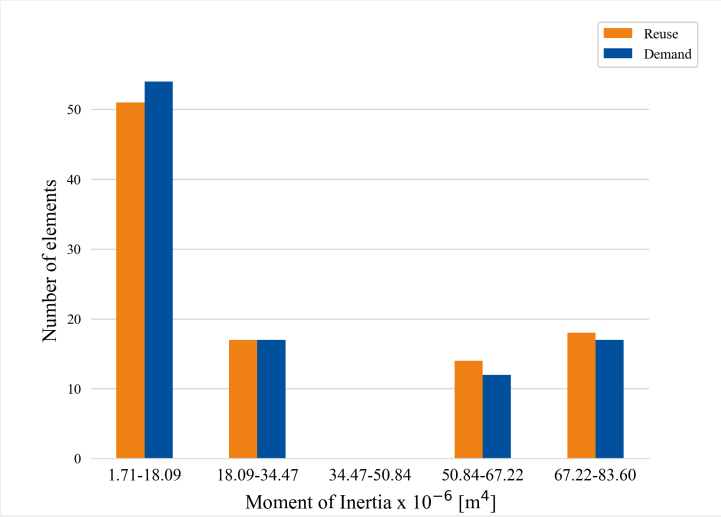
Elements	Filename	Number of elements
Reused	master_thesis_study_case_supply_new_locs.csv	100
Demand	master_thesis_study_case_demand_new_locs.csv	100

The files contains 100 reuse elements and 100 demand elements. The graphs below depicts some of the properties of the elements, including length, area, moment of inertia and the material distribution.





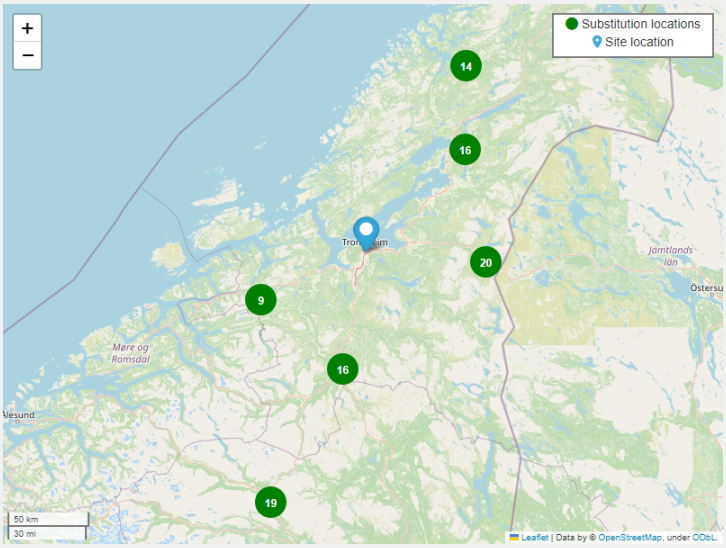


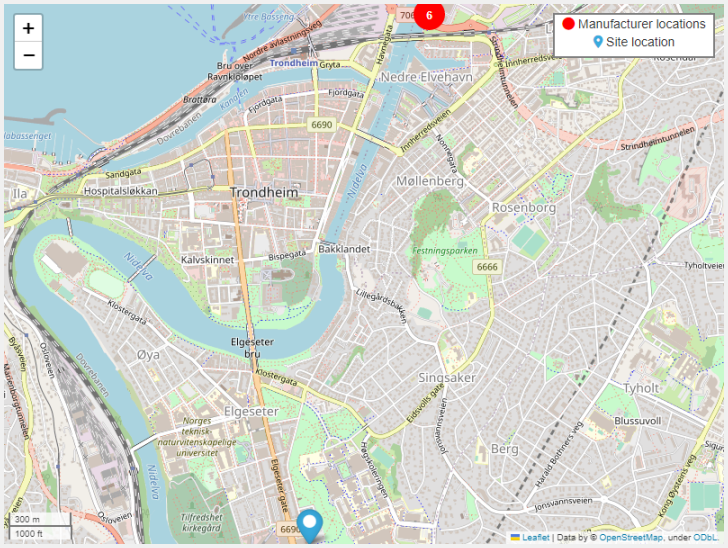


Impact of transportation

Transportation score	Percentage of total score	Transportation all new
144 kgCO2eq	12.27%	4 kgCO2eq

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 144 kgCO2eq. This accounts for 12.27% of the total score of 1 170 kgCO2eq. For comparison, the transportation impact for exclusively using new materials would have been 4 kgCO2eq. Two maps are included to show the location of the suggested substitutions of reused elements and the manufacturer locations where new elements can be obtained. The numbers on the maps indicate the number of elements present at each location.





Performance of algorithms

Name	Total score	Substitutions	Time
Greedy Algorithm Plural	1 170 kgCO2eq	94.0%	0.345s
MBM Plural	1 343 kgCO2eq	94.0%	0.132s
Greedy Algorithm	1 941 kgCO2eq	85.0%	0.112s

The design tool is runned with 3 algorithms, namely: Greedy Algorithm Plural, MBM Plural, and Greedy Algorithm. The Greedy Algorithm Plural yields the lowest score, as shown in the table. The substitutions by this algorithm are completed in 0.345 seconds.