NTNU

May 15, 2023

Results from Element Matching

Project name: ASUS

Construction site located at: 63.4154, 10.3995

Summary of results

Total score	Score without reuse	Savings	Substitutions
9 083 kgCO2eq	73 074 kgCO2eq	87.57%	90.7%

The 'Greedy Algorithm Plural' algorithm yields the best results, substituting 907/1000 demand elements (90.7%). Using 'GWP' as the optimization metric, a total score of 9 083 kgCO2eq is achieved. For comparison, a score of 73 074 kgCO2eq would have been obtained by employing exclusively new materials. This results in a total saving of 87.57%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 10.44% of the total score. Open the CSV-file "ASUS 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

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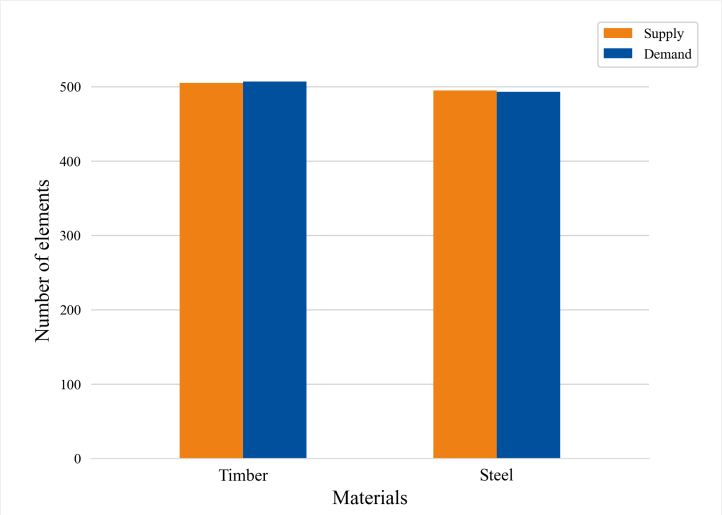
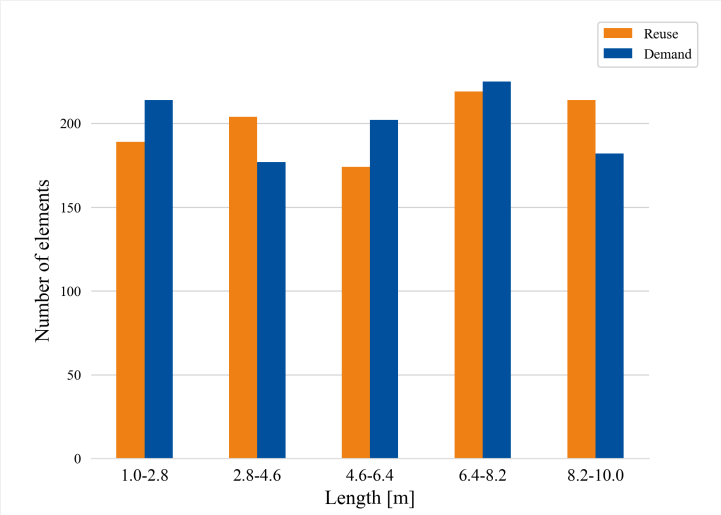
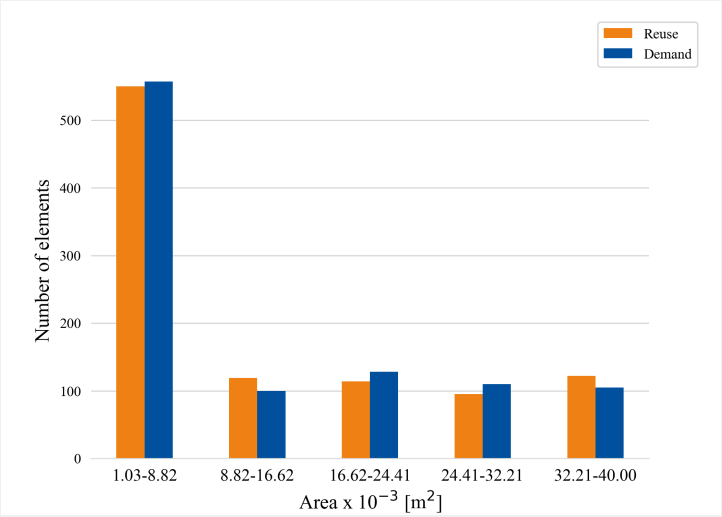
Information about datasets

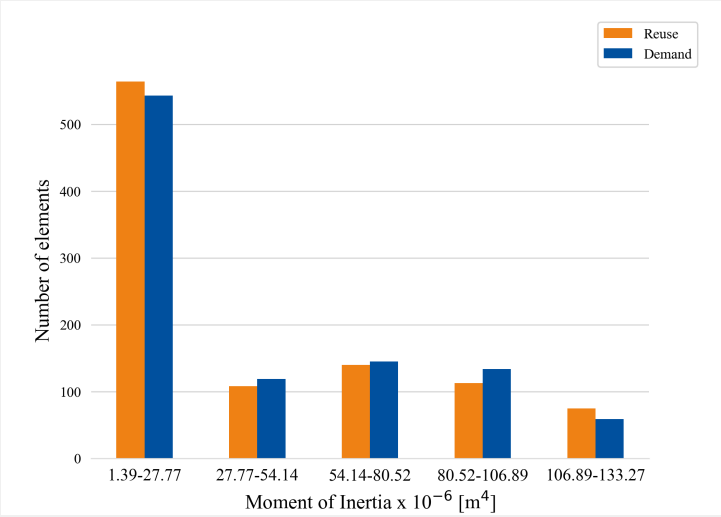
Elements	Filename	Number of elements
Reused	master_thesis_supply.xlsx	1000
Demand	master_thesis_demand.xlsx	1000

The files contains 1000 reuse elements and 1000 demand elements. The graphs below depicts some of the properties of the elements, including length, area, moment of inertia and the material distribution.





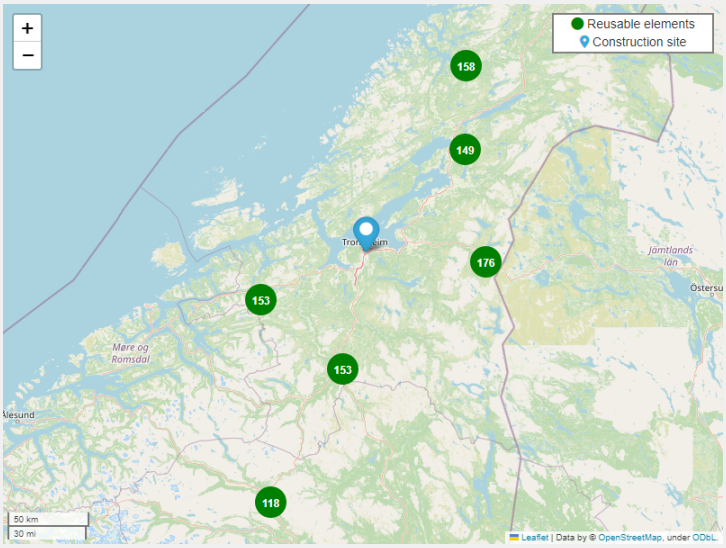


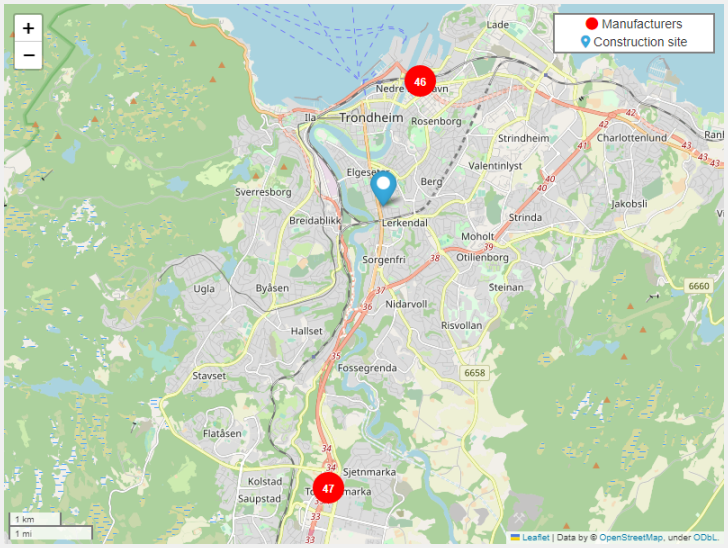


Impact of transportation

Transportation score	Percentage of total score	Transportation all new
948 kgCO2eq	10.44%	37 kgCO2eq

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 948 kgCO2eq. This accounts for 10.44% of the total score of 9 083 kgCO2eq. For comparison, the transportation impact for exclusively using new materials would have been 37 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	9 083 kgCO2eq	90.7%	71.013s
MBM Plural	9 225 kgCO2eq	90.7%	126.502s
Greedy Algorithm	10 284 kgCO2eq	89.0%	34.511s

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 71.013 seconds.