

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 kgCO ₂ eq	73 074 kgCO ₂ eq	87.57%	90.7%

The best results was obtained by the following algorithm: Greedy Algorithm Plural. This algorithm successfully substituted 907/1000 demand elements (90.7%). Using 'GWP' as the optimization metric, a total score of 9 083 kgCO₂eq was achieved. For comparison, a score of 73 074 kgCO₂eq would have been obtained by employing exclusively new materials. This resulted in a total saving of 87.57%. The amount of kgCO₂eq is equivalent to 708 flights for one person between Oslo and Trondheim. Note that impacts of transporting the materials to the construction site was accounted for and contributed to 10.44% of the total score. Open the CSV-file "ASUS_Study_Case_2_substitutions.xlsx" to examine the substitutions.

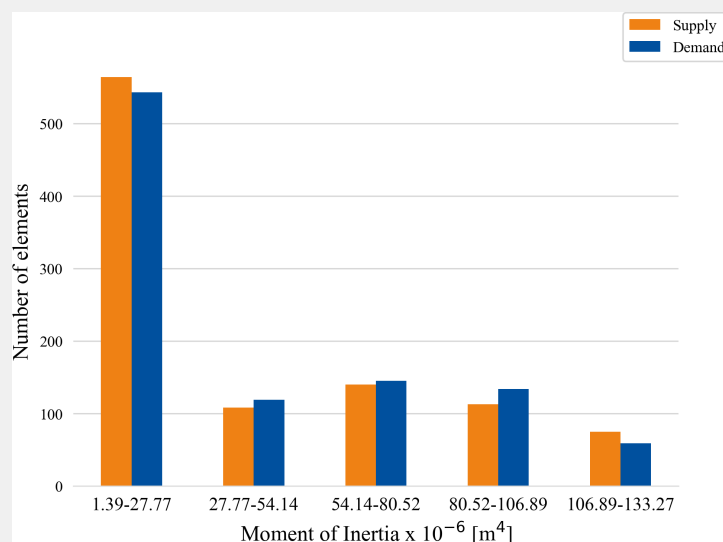
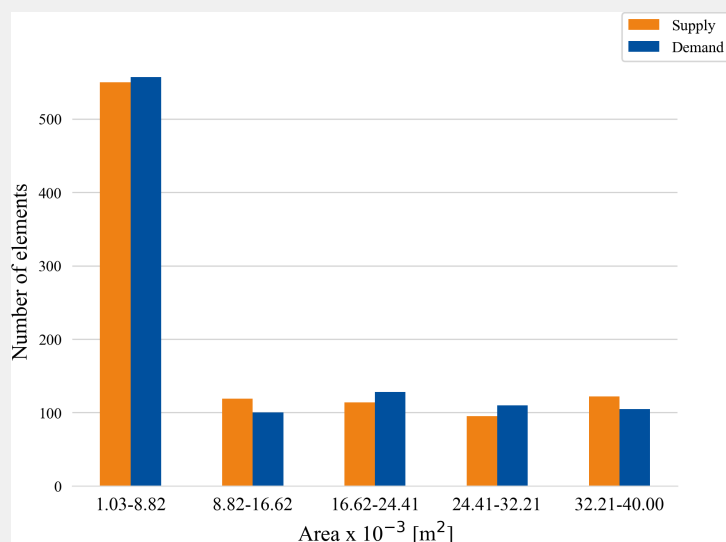
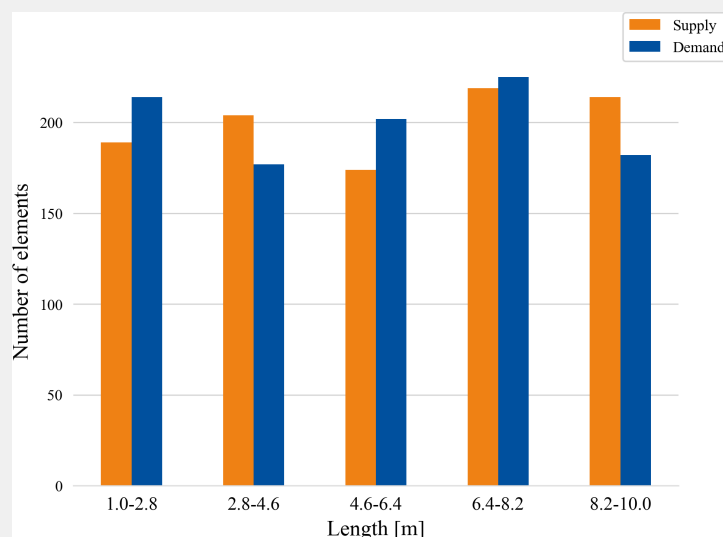
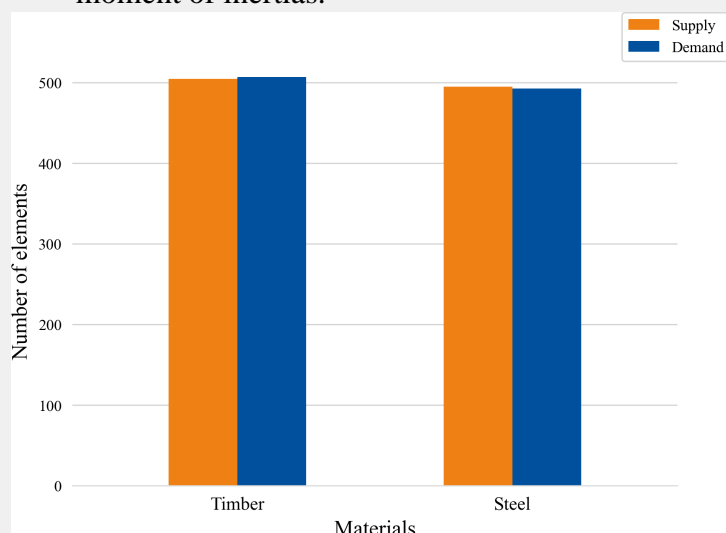
Constants used in calculations

Constant	Value	Unit
Density timber	491.0	kg/m ³
Density steel	7850.0	kg/m ³
GWP new timber	28.9	kgCO ₂ eq
GWP reused timber	2.25	kgCO ₂ eq
GWP new steel	9263.0	kgCO ₂ eq
GWP reused steel	278.0	kgCO ₂ eq
GWP transportation	89.6	g/tonne/km

Information about datasets

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

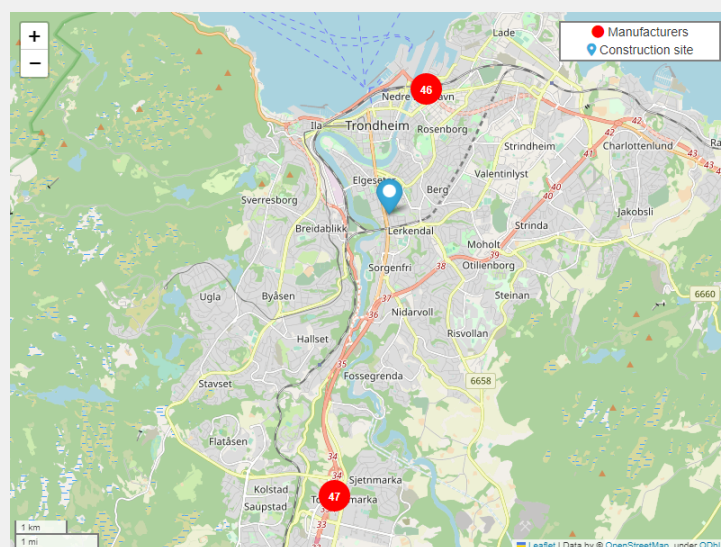
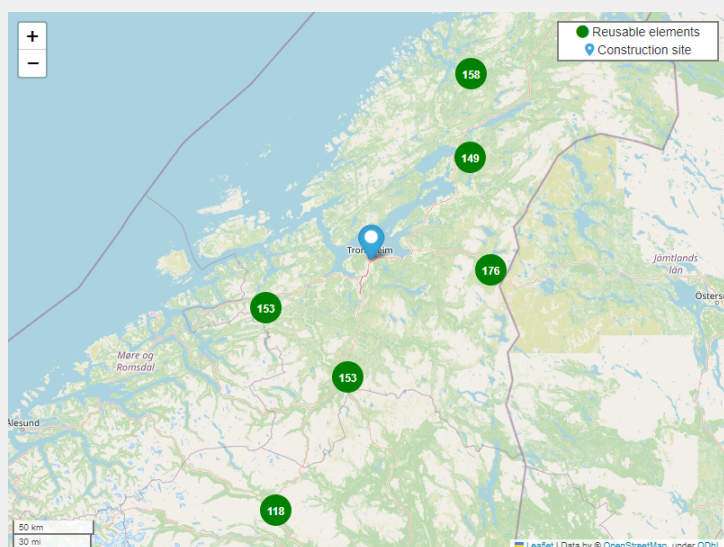
The files used contains 1000 reuse elements and 1000 demand elements. The graphs below depicts the distribution of some of the properties of the elements, including the materials, lengths, areas, and moment of inertias.



Impact of transportation

Utilizing reusable elements	Percentage of total score	Only manufactured elements
948 kgCO ₂ eq	10.44%	37 kgCO ₂ eq

All calculations in this report accounted for the effects of material transportation to the construction site. Transportation itself was 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

Algorithm name	Total score	Substitutions	Time
Greedy Algorithm Plural	9 083 kgCO ₂ eq	90.7%	62 .32s
MBM Plural	9 225 kgCO ₂ eq	90.7%	128 .87s
Greedy Algorithm	10 284 kgCO ₂ eq	89.0%	33 .58s

The design tool was executed with 3 algorithms, namely: Greedy Algorithm Plural, MBM Plural, and Greedy Algorithm. The Greedy Algorithm Plural yielded the lowest score, as shown in the table. The substitutions by this algorithm was completed in 62.323 seconds.