

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
2 442 463 NOK	4 770 039 NOK	48.8%	90.3%

The 'MBM Plural' algorithm yields the best results, substituting 903/1000 demand elements (90.3%). Using 'Combined' as the optimization metric, a total score of 2 442 463 NOK is achieved. For comparison, a score of 4 770 039 NOK would have been obtained by employing exclusively new materials. This results in a total saving of 48.8%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 1.99% of the total score. Open the CSV-file "ASUS Study Case 4_substitutions.csv" to examine the substitutions.

Constants used in calculations

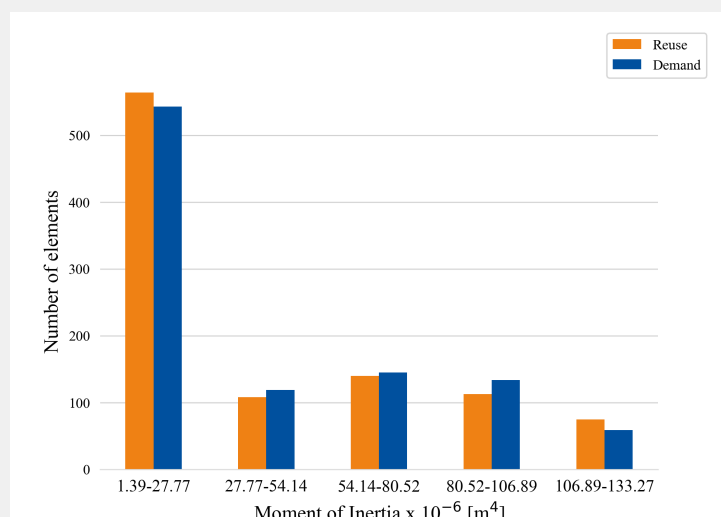
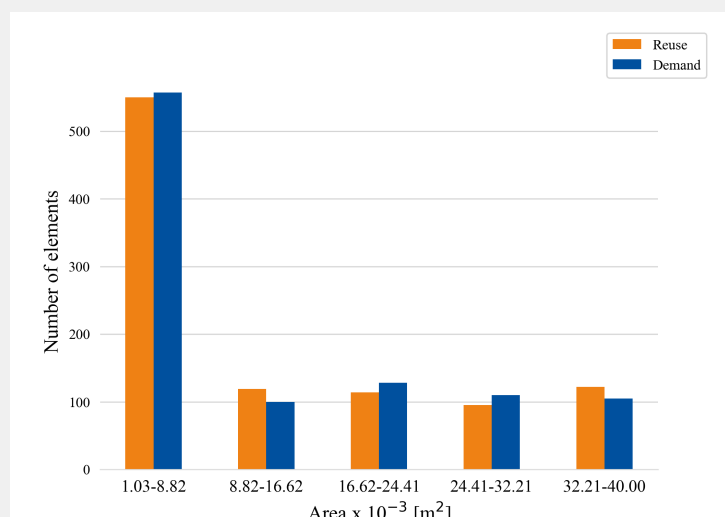
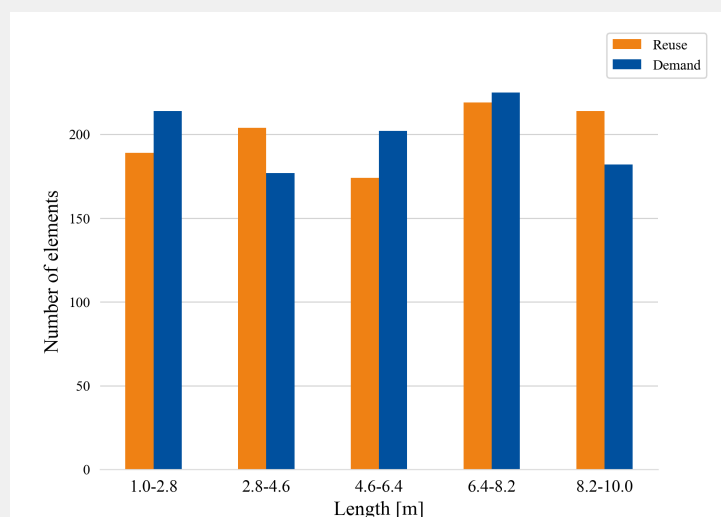
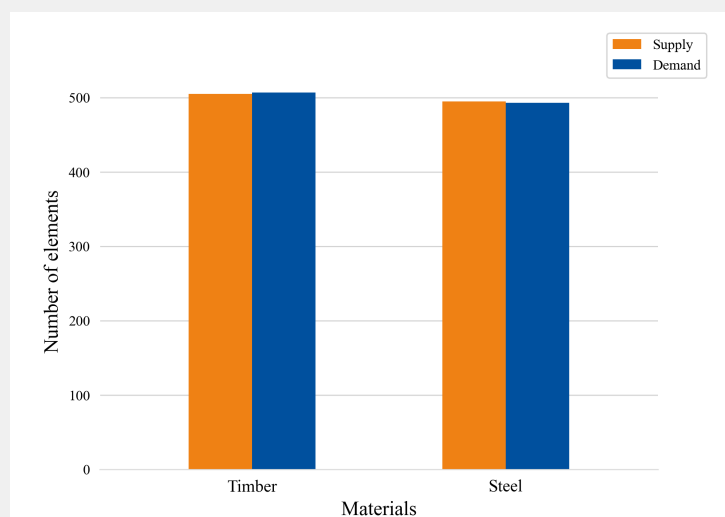
Constant	Value	Unit
Density timber	491.0	kg/m ³
Density steel	7850.0	kg/m ³
GWP new timber	28.9	kgCO ₂ eq
GWP reused timber	2.25	kgCO ₂ eq
GWP new steel	9263.0	kgCO ₂ eq
GWP reused steel	278.0	kgCO ₂ eq
Valuation of GWP	7.0	NOK/kgCO ₂ eq
Price new timber	3400.0	NOK/m ³

Price reused timber	1700.0	NOK/m ³
Price new steel	67.0	NOK/kg
Price reused steel	33.5	NOK/kg
GWP transportation	89.6	g/tonne/km
Price of transportation	4.0	NOK/tonne/km

Information about datasets

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

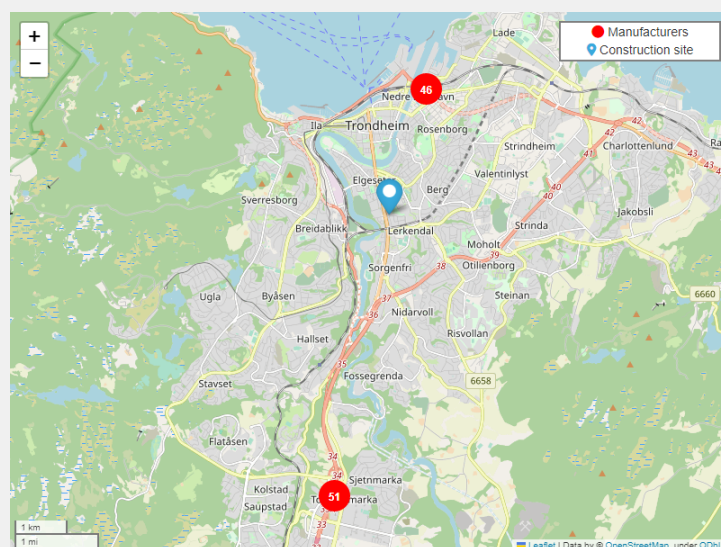
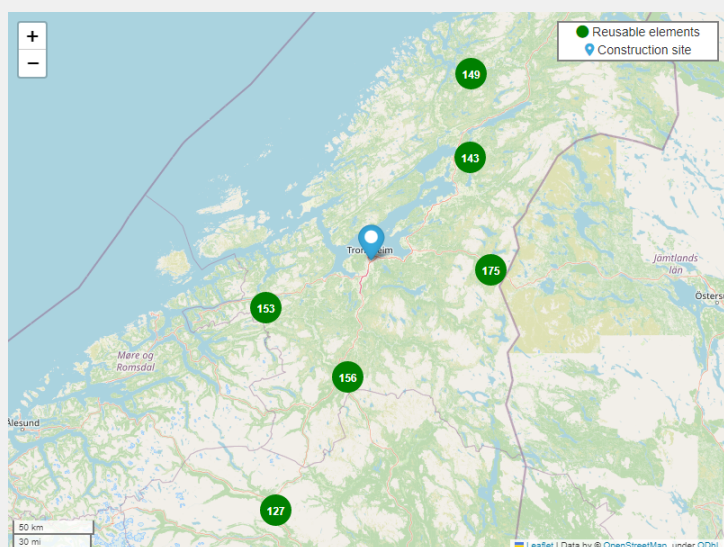
The files contains 1000 reuse elements and 1000 demand elements. The graphs below depicts some of the properties of the elements, including length, area, moment of inertia and the material distribution.



Impact of transportation

Transportation score	Percentage of total score	Transportation all new
48 605 NOK	1.99%	1 928 NOK

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 48 605 NOK. This accounts for 1.99% of the total score of 2 442 463 NOK. For comparison, the transportation impact for exclusively using new materials would have been 1 928 NOK. 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
MBM Plural	2 442 463 NOK	90.3%	80.097s
Greedy Algorithm Plural	2 445 273 NOK	90.5%	69.301s
Greedy Algorithm	2 488 956 NOK	88.6%	36.396s

The design tool is runned with 3 algorithms, namely: MBM Plural, Greedy Algorithm Plural, and Greedy Algorithm. The MBM Plural yields the lowest score, as shown in the table. The substitutions by this algorithm are completed in 80.097 seconds.