

Results from Element Matching

Project name: Campus development NTNU

Construction site located at: 63.4154, 10.3995

Summary of results

Total score	Score without reuse	Savings	Substitutions
4585074.48 kr	4 612 423 kr	0.59%	42.3%

The 'Greedy Algorithm Plural' algorithm yields the best results, substituting 423/1000 demand elements (42.3%). Using 'Combined' as the optimization metric, a total score of 4585074.48 kr is achieved. For comparison, a score of 4612423.16 kr would have been obtained by employing exclusively new materials. This results in a total saving of 0.59%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 0.28% of the total score. Open the CSV-file "Campus_development_NTNU_substitutions.csv" to examine the substitutions.

Constants used in calculations

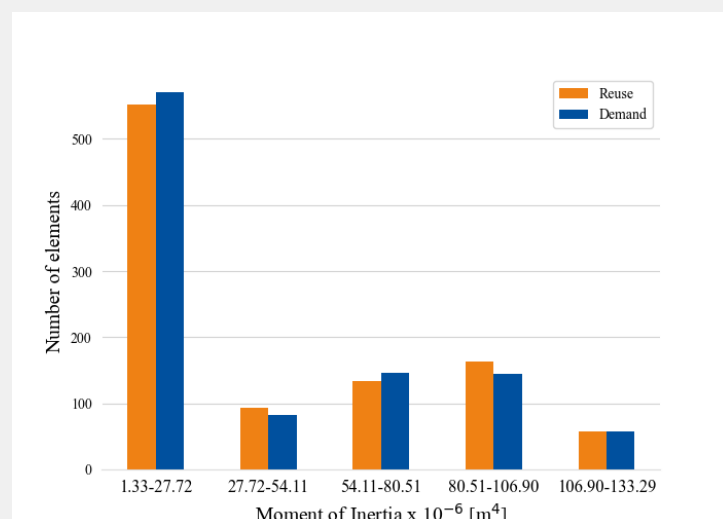
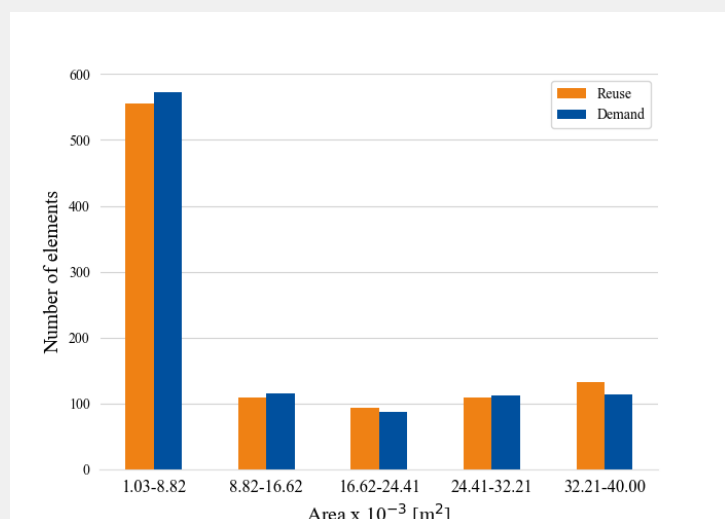
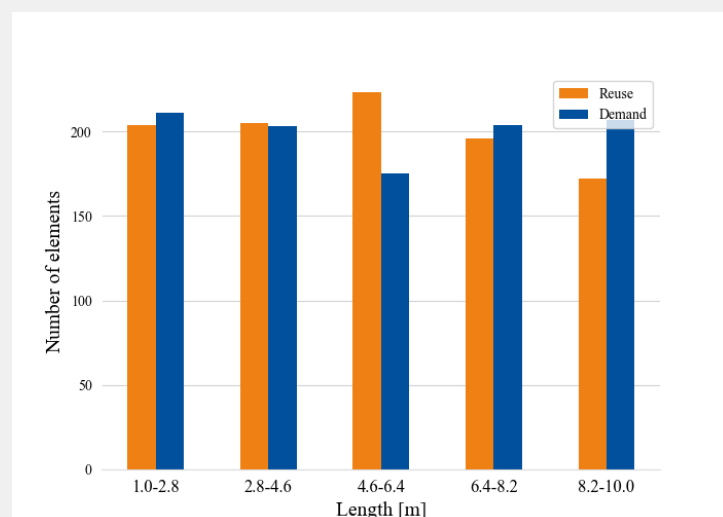
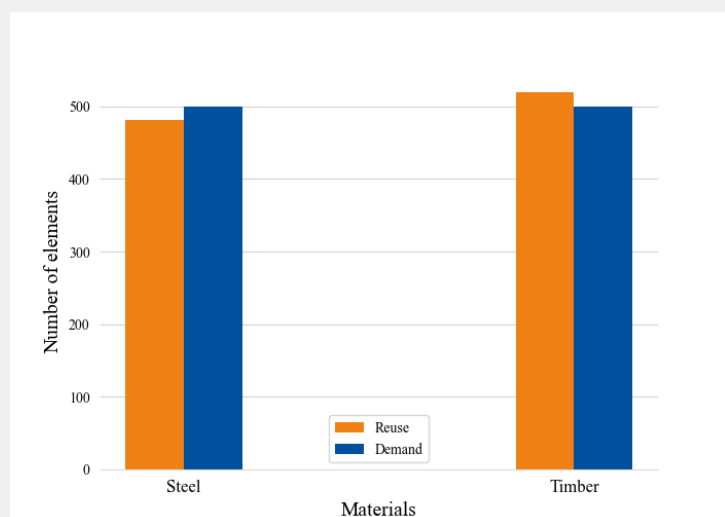
Constant	Value	Unit
Density timber	491.0	kg/m ³
Density steel	7850.0	kg/m ³
GWP new timber	28.9	kg CO2 equivalents
GWP reused timber	2.25	kg CO2 equivalents
GWP new steel	9263.0	kg CO2 equivalents
GWP reused steel	278.0	kg CO2 equivalents
Valuation of GWP	0.7	kr/kg CO2 equivalents
Price new timber	3400.0	kr/m ³

Price reused timber	3400.0	kr/m ³
Price new steel	67.0	kr/m ³
Price reused steel	67.0	kr/m ³
GWP transportation	89.6	kg/m ³ per tonne
Price of transportation	4.0	kr/km/tonne

Information about datasets

Elements	Filename	Number of elements
Reused	study_case_supply_1000.xlsx	1000
Demand	study_case_demand_1000.xlsx	1000

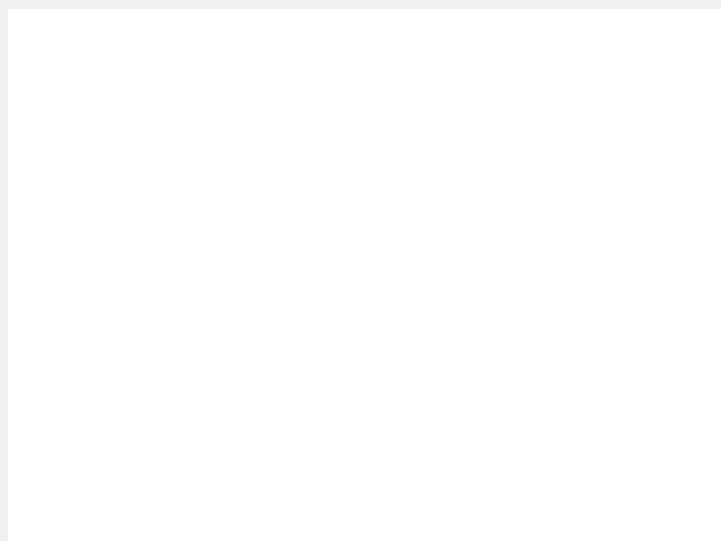
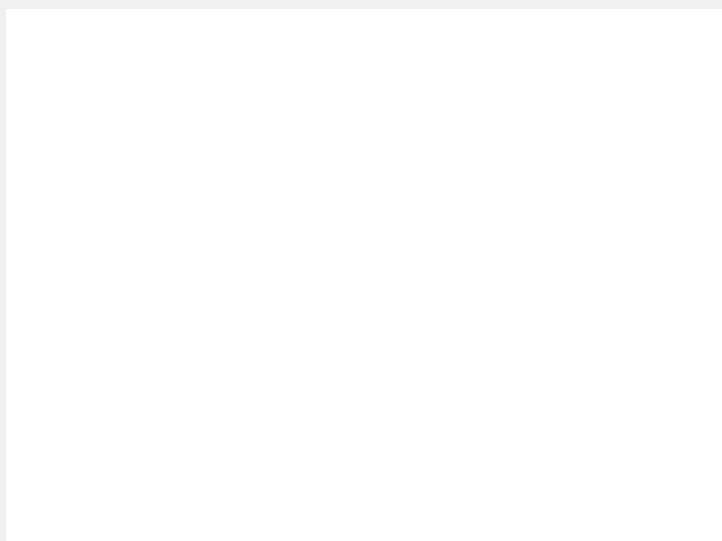
The files contains 1000 reuse elements and 1000 demand elements. The graphs below depicts some of the properties of the elements, including length, area, moment of inertia and the material distribution.



Impact of transportation

Transportation score	Percentage of total score	Transportation all new
12812.14 kr	0.28%	1734.5 kr

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 12812.14 kr. This accounts for 0.28% of the total score of 4585074.48 kr. For comparison, the transportation impact for exclusively using new materials would have been 1734.5 kr. 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	4585074.48 kr	42.3%	10.757s
Maximum Bipartite Matching	4585171.21 kr	42.0%	2.215s

The design tool is runned with 2 algorithms, namely: Greedy Algorithm Plural, and Maximum Bipartite Matching. The Greedy Algorithm Plural yields the lowest score, as shown in the table. The substitutions by this algorithm are completed in 10.757 seconds.