

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
8528.93 kgCO ₂ eq	74 340 kgCO ₂ eq	88.53%	90.3%

The 'Maximum Bipartite Matching Plural' algorithm yields the best results, substituting 903/1000 demand elements (90.3%). Using 'GWP' as the optimization metric, a total score of 8528.93 kgCO₂eq is achieved. For comparison, a score of 74339.73 kgCO₂eq would have been obtained by employing exclusively new materials. This results in a total saving of 88.53%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 5.48% of the total score. Open the CSV-file "Study Case 2_substitutions.csv" to examine the substitutions.

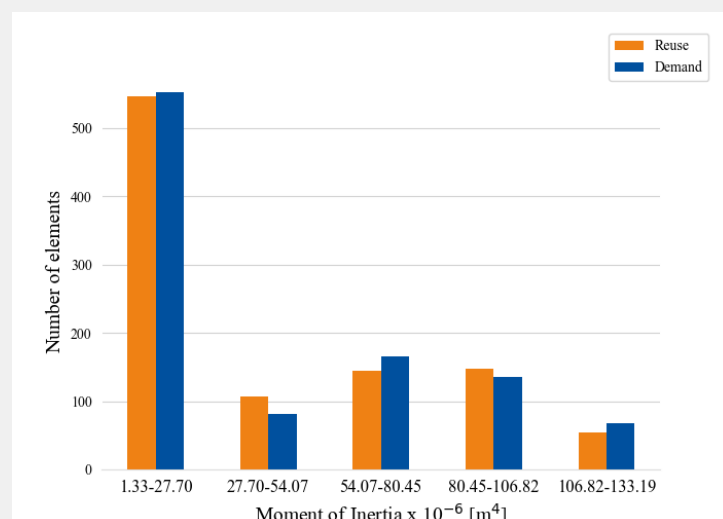
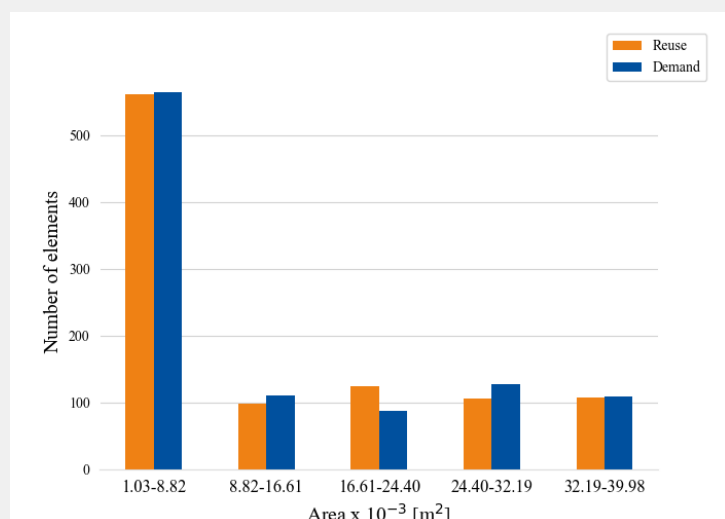
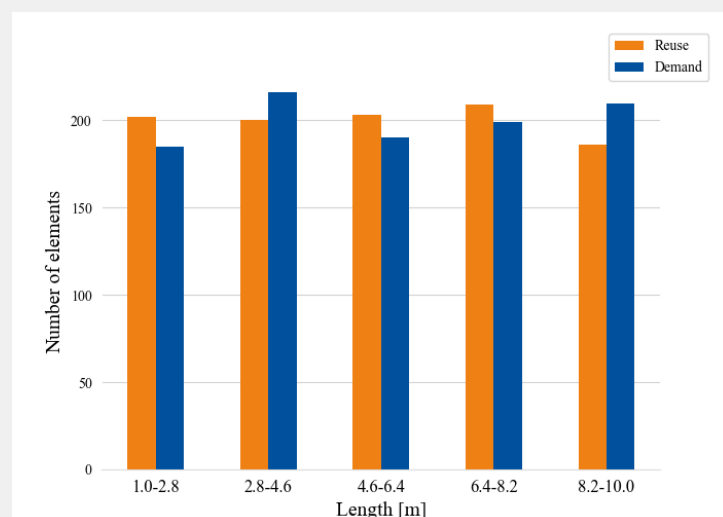
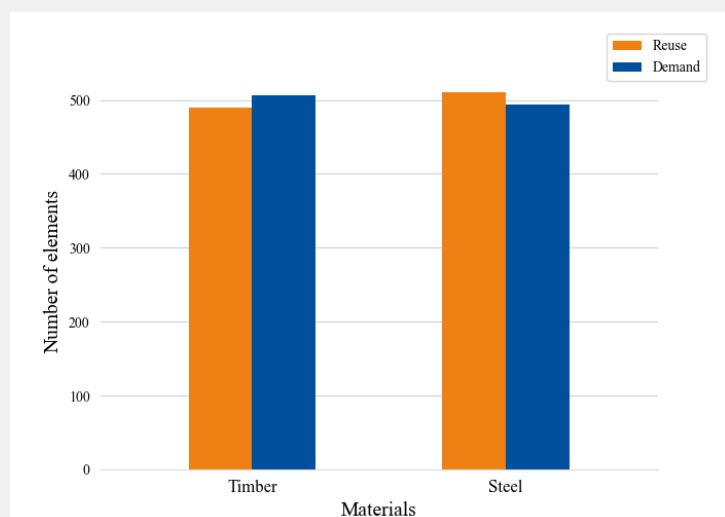
Constants used in calculations

Constant	Value	Unit
Density timber	491.0	kg/m ³
Density steel	7850.0	kg/m ³
GWP new timber	28.9	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	kg/m ³ per tonne

Information about datasets

Elements	Filename	Number of elements
Reused	master_thesis_study_case_supply.csv	1000
Demand	master_thesis_study_case_demand.csv	1000

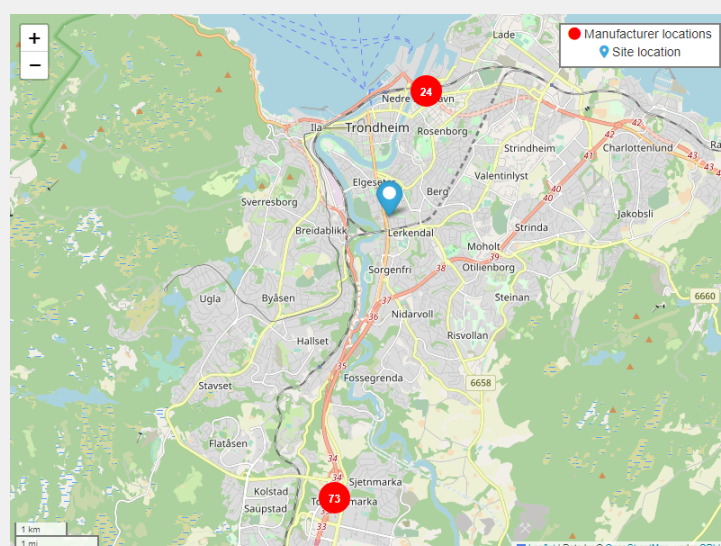
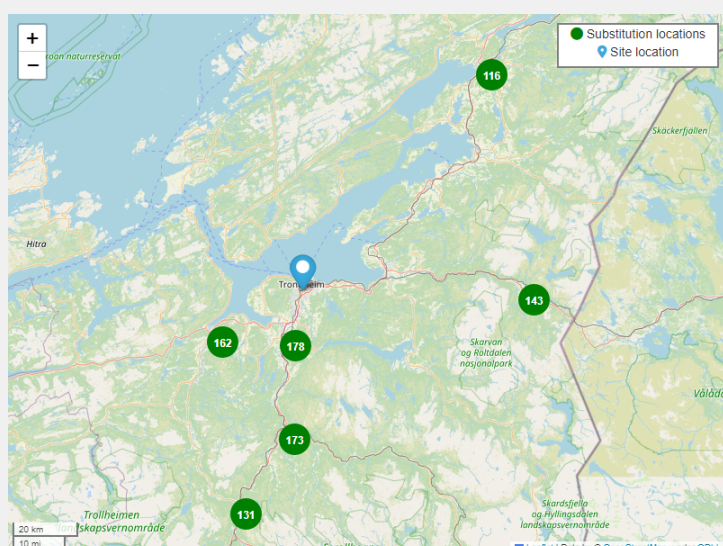
The files contains 1000 reuse elements and 1000 demand elements. The graphs below depicts some of the properties of the elements, including length, area, moment of inertia and the material distribution.



Impact of transportation

Transportation score	Percentage of total score	Transportation all new
467.47 kgCO ₂ eq	5.48%	37.88 kgCO ₂ eq

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 467.47 kgCO₂eq. This accounts for 5.48% of the total score of 8528.93 kgCO₂eq. For comparison, the transportation impact for exclusively using new materials would have been 37.88 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
Maximum Bipartite Matching Plural	8528.93 kgCO ₂ eq	90.3%	92.918s
Greedy Algorithm Plural	9106.17 kgCO ₂ eq	88.9%	62.704s
Greedy Algorithm	9113.64 kgCO ₂ eq	88.8%	21.541s

The design tool is runned with 3 algorithms, namely: Maximum Bipartite Matching Plural, Greedy Algorithm Plural, and Greedy Algorithm. The Maximum Bipartite Matching Plural yields the lowest

score, as shown in the table. The substitutions by this algorithm are completed in 92.918 seconds.