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
8 529 kgCO2eq	74 340 kgCO2eq	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 8 529 kgCO2eq is achieved. For comparison, a score of 74 340 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 "Campussamling Hesthagen 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

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.
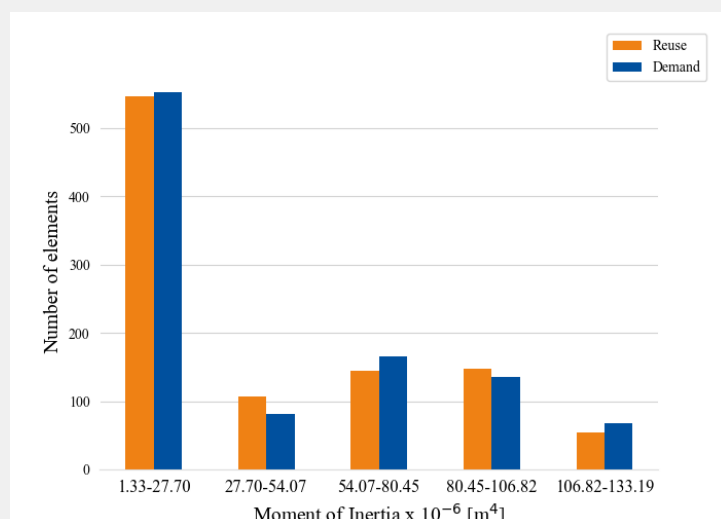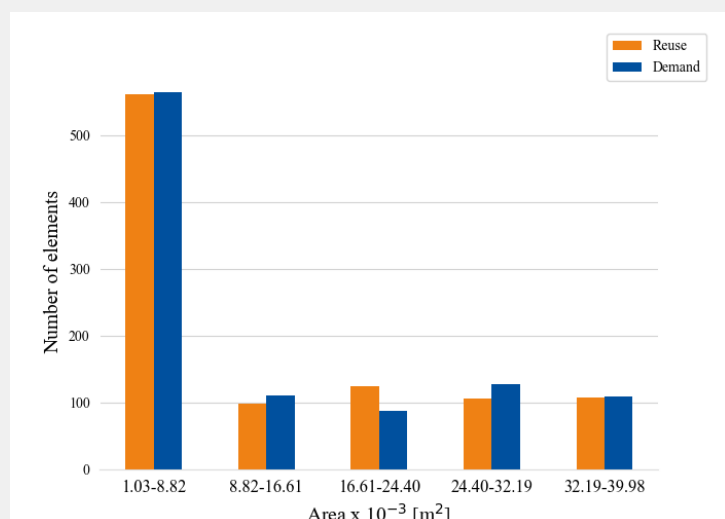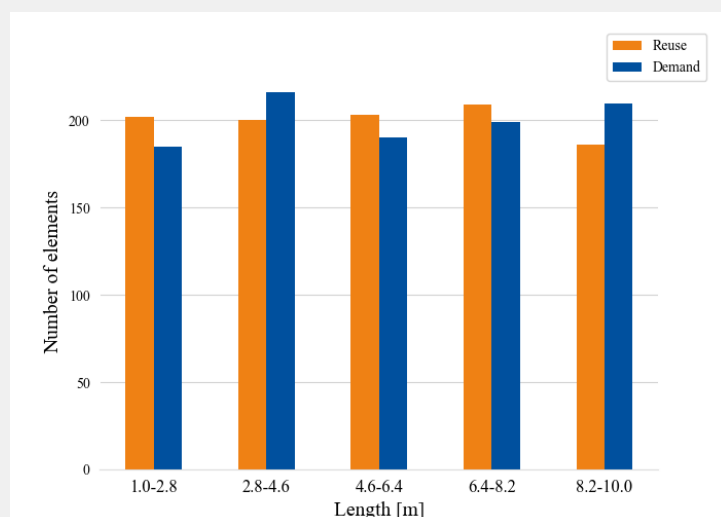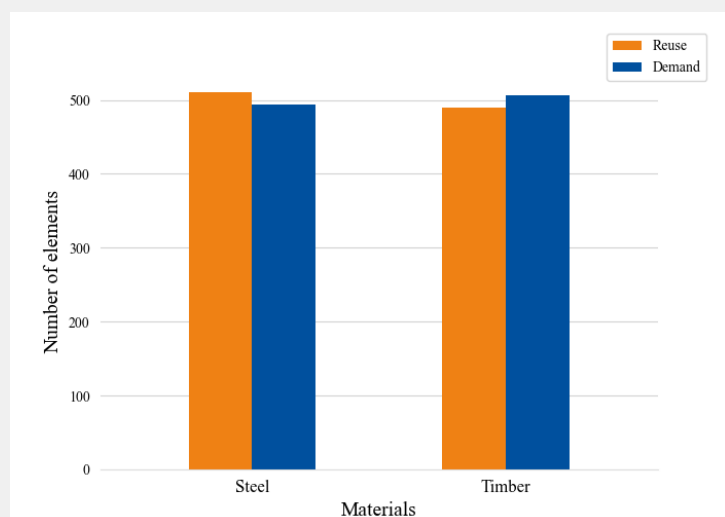
Impact of transportation

Transportation score	Percentage of total score	Transportation all new
467 kgCO2eq	5.48%	38 kgCO2eq

All calculations in this report take impacts of transportation of the materials to the construction site into consideration. Transportation itself is responsible for 467 kgCO2eq. This accounts for 5.48% of the total score of 8 529 kgCO2eq. For comparison, the transportation impact for exclusively using new materials would have been 38 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.
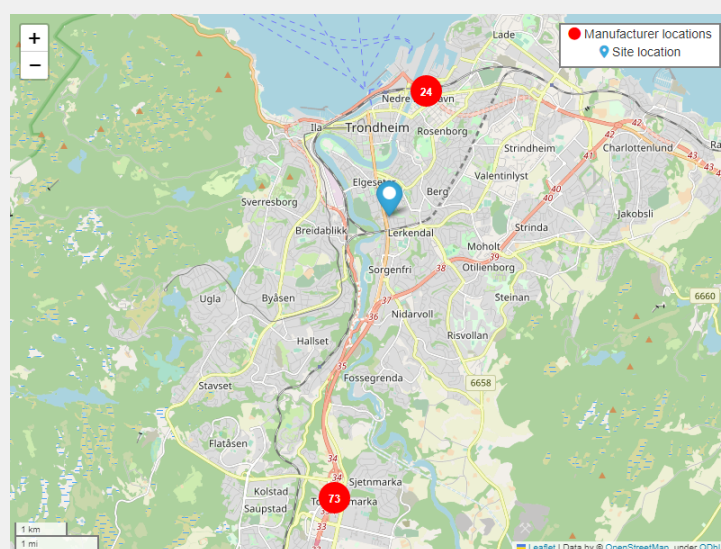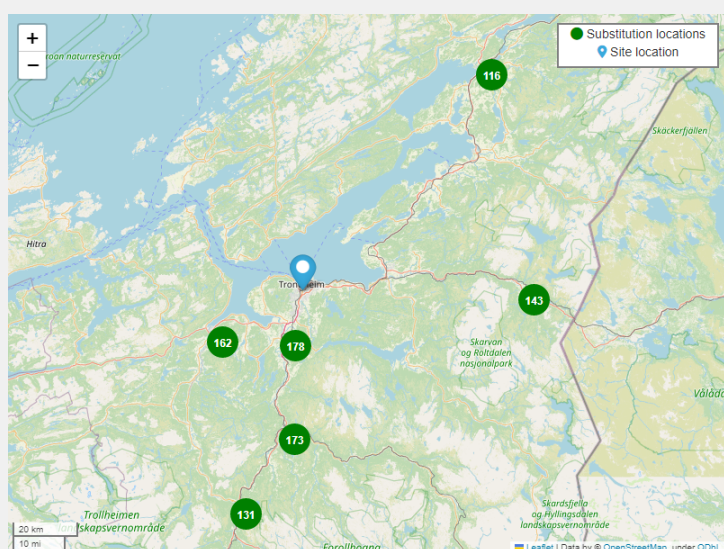
Performance of algorithms

Name	Total score	Substitutions	Time
Maximum Bipartite Matching Plural	8 529 kgCO2eq	90.3%	49.332s
Greedy Algorithm Plural	9 106 kgCO2eq	88.9%	28.768s
Greedy Algorithm	9 114 kgCO2eq	88.8%	16.719s

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 49.332 seconds.