NTNU

May 21, 2023

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
8 333 kgCO2eq	73 037 kgCO2eq	88.59%	90.1%

The best results was obtained by the following algorithm: Greedy Algorithm Plural. This algorithm sucessfully substituted 901/1000 demand elements (90.1%). Using 'GWP' as the optimization metric, a total score of 8 333 kgCO2eq was achieved. For comparison, a score of 73 037 kgCO2eq would have been obtained by employing exclusively new materials. This resulted in a total saving of 88.59%. 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 not accounted for. Open the CSV-file "ASUS_Study_Case_1_substitutions.xlsx" to examine the substitutions.

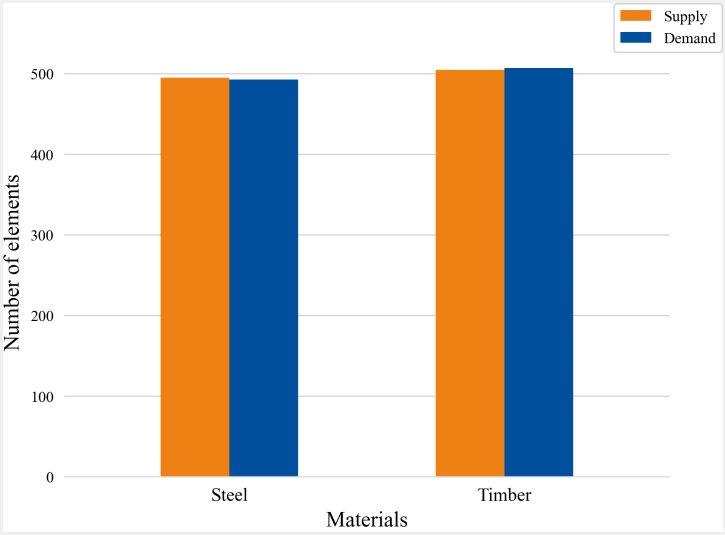
Constants used in calculations

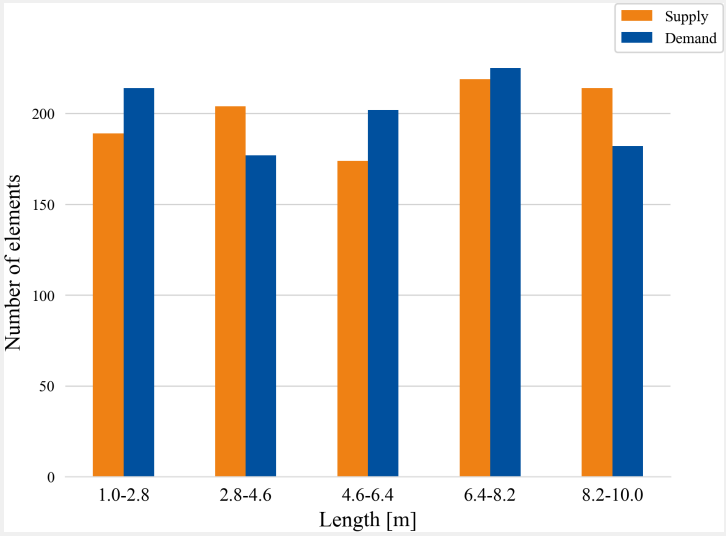
Constant	Value	Unit
Density timber	491.0	kg/m^3
Density steel	7850.0	kg/m^3
GWP new timber	28.9	kgCO2eq
GWP reused timber	2.25	kgCO2eq
GWP new steel	9263.0	kgCO2eq
GWP reused steel	278.0	kgCO2eq

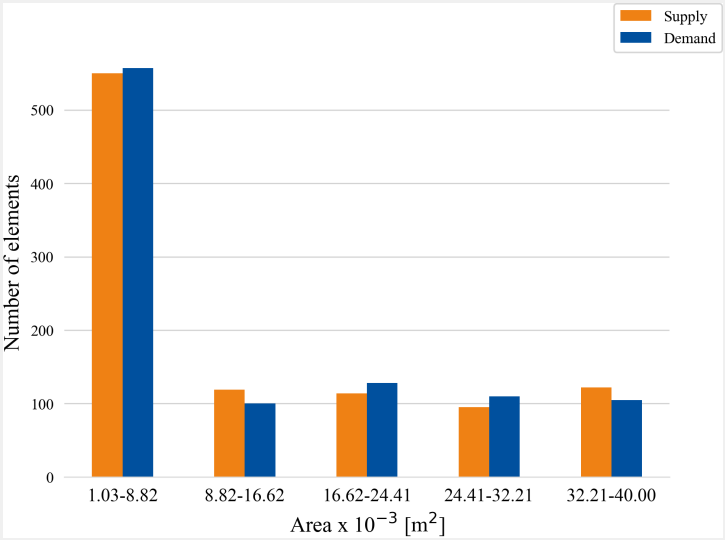
Information about datasets

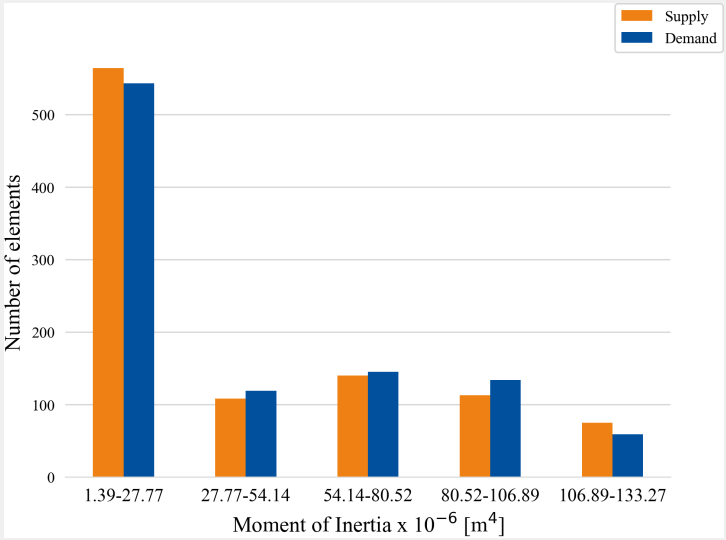
Elements	Filename	Number of elements
Reused	master_thesis_supply.xlsx	1000
Demand	master_thesis_demand.xlsx	1000

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.









Performance of algorithms

Name	Total score	Substitutions	Time
MBM Plural 8465.02 27.676 Greedy Algorithm	Greedy Algorithm 9320.1	90.1%	8 332 .75s utions Sub_
MBM Plural 8465.02 27.676 Greedy Algorithm	Greedy Algorithm 9320.1	90.6%	8 465 .02s utions Sub_
MBM Plural 8465.02 27.676 Greedy Algorithm	Greedy Algorithm 9320.1	89.0%	932 0.1s utions Sub_

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 25.247 seconds.