# Results from Element Matching

**Project name:**   MAC

**Construction site located at:**   63.4154, 10.3995

## Summary of results

| Total score | Score without reuse | Savings | Substitutions |
|---|---|---|---|
| 2 246 616 NOK | 4 770 039 NOK | 52.9% | 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 2 246 616 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 52.9%. Note that impacts of transporting the materials to the construction site is accounted for and contributes to 2.16% of the total score. Open the CSV-file "MAC 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 | kgCO2eq |
| GWP reused timber | 2.25 | kgCO2eq |
| GWP new steel | 9263.0 | kgCO2eq |
| GWP reused steel | 278.0 | kgCO2eq |
| Valuation of GWP | 7.0 | NOK/kgCO2eq |
| 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 | 30.0 | 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.
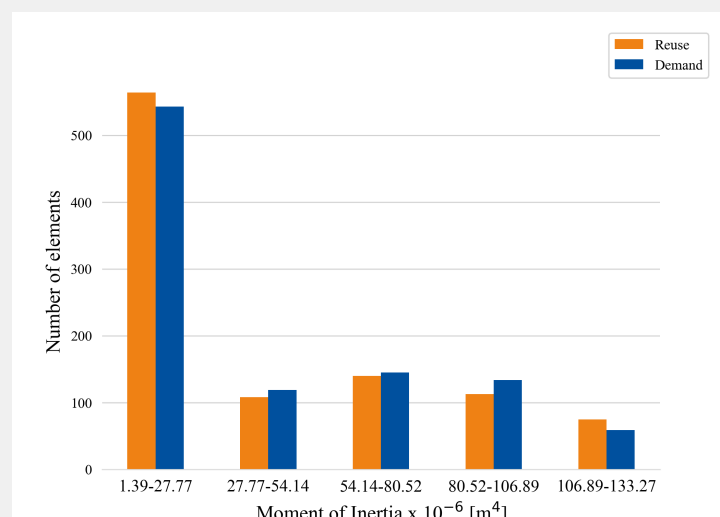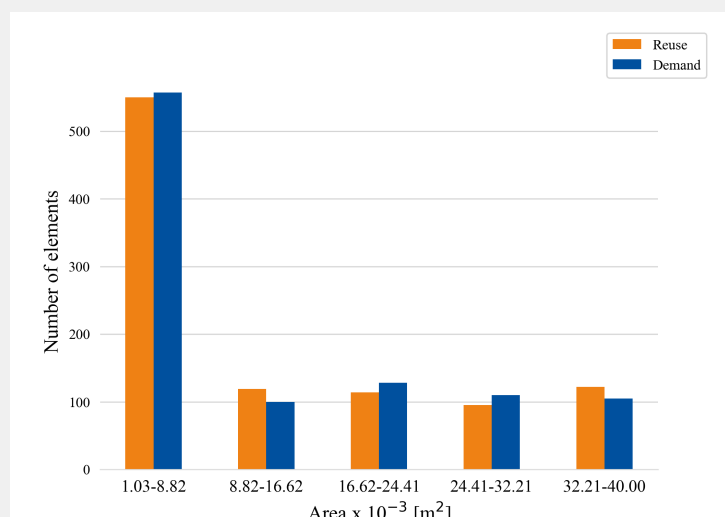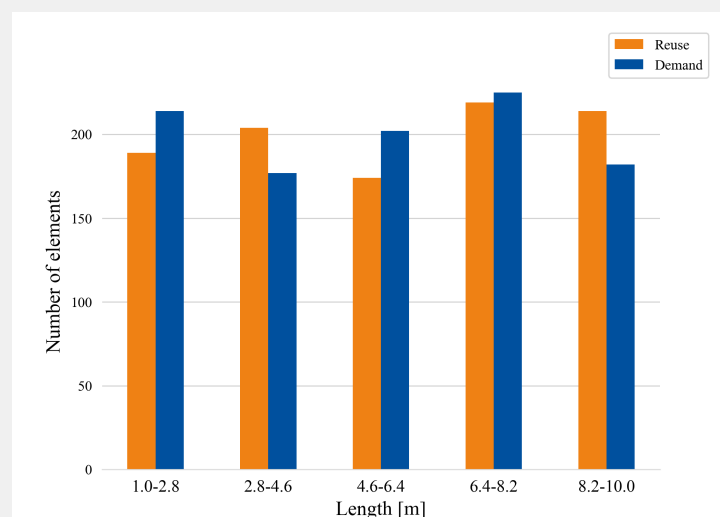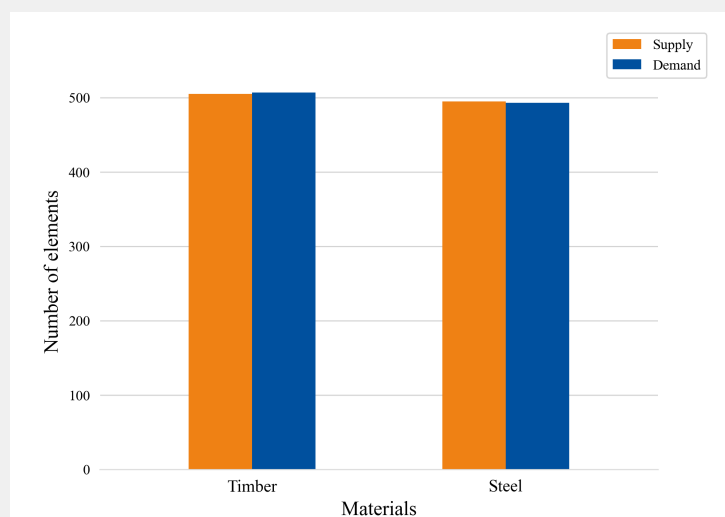
# Impact of transportation

| Transportation score | Percentage of total score | Transportation all new |
|---|---|---|
| 48 639 NOK | 2.16% | 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 48 639 NOK. This accounts for 2.16% of the total score of 2 246 616 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.
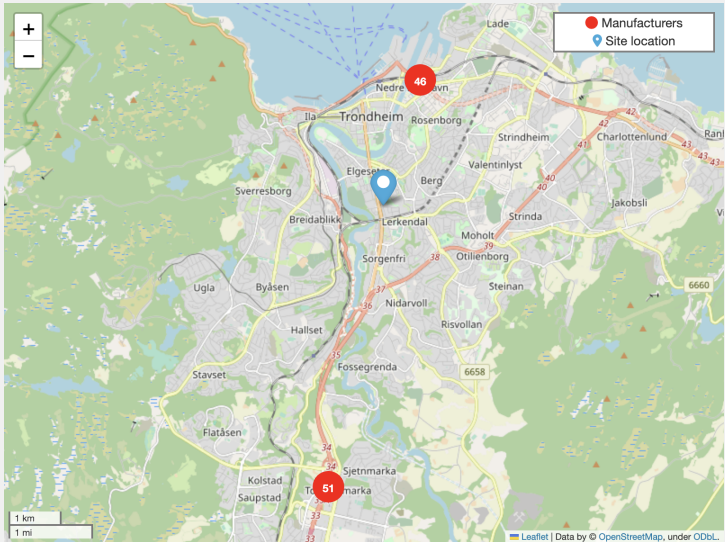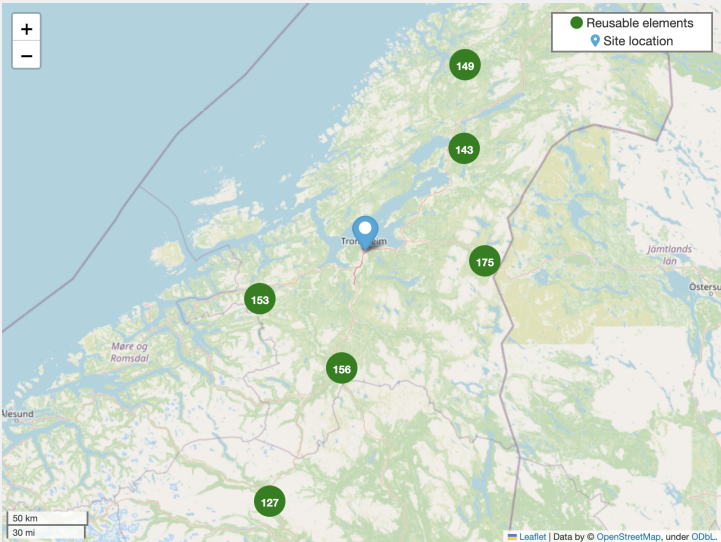
## Performance of algorithms

| Name | Total score | Substitutions | Time |
|---|---|---|---|
| MBM Plural | 2 246 616 NOK | 90.3% | 15.916s |
| Greedy Algorithm Plural | 2 248 197 NOK | 90.5% | 11.327s |
| Greedy Algorithm | 2 295 591 NOK | 88.6% | 6.909s |

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 15.916 seconds.