ANALYSIS OF THE PIPING SUPPORTING STRUCTURE IN A BOILER PLANT

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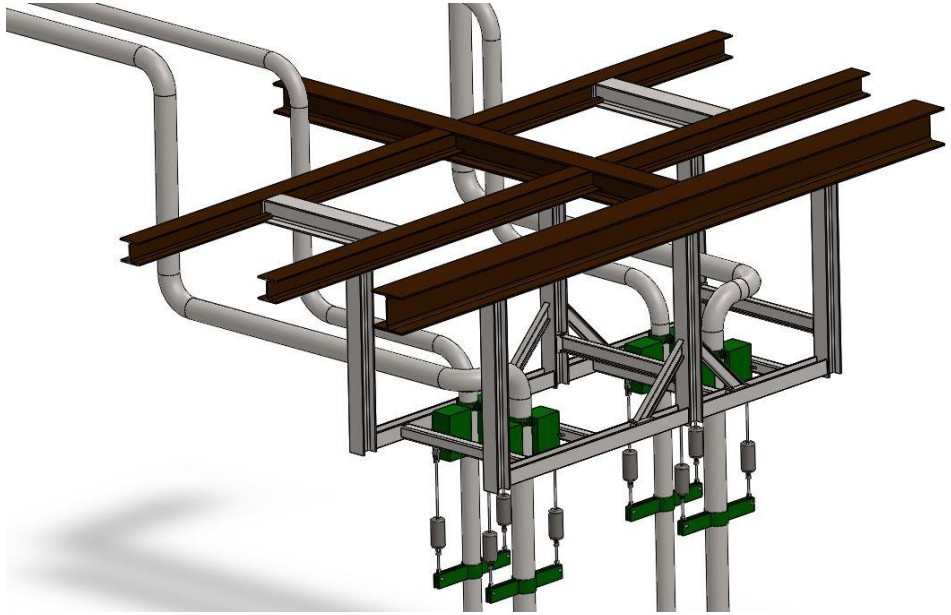
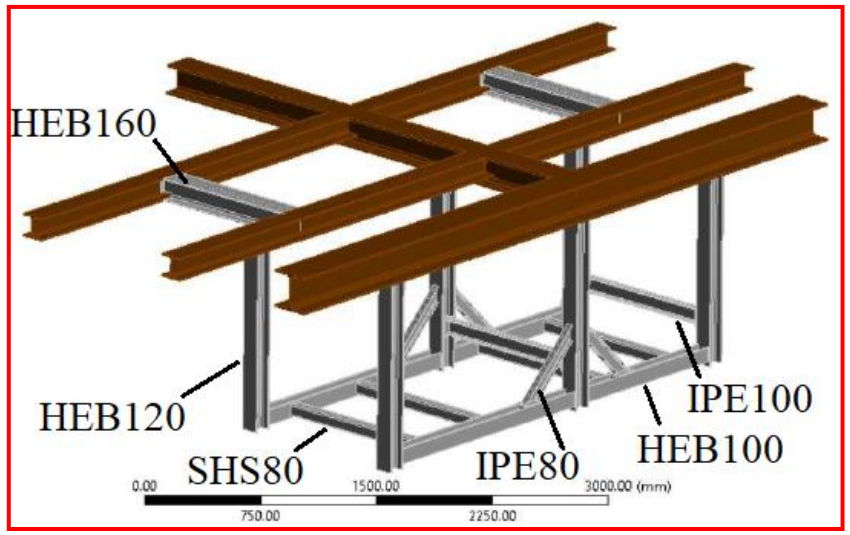
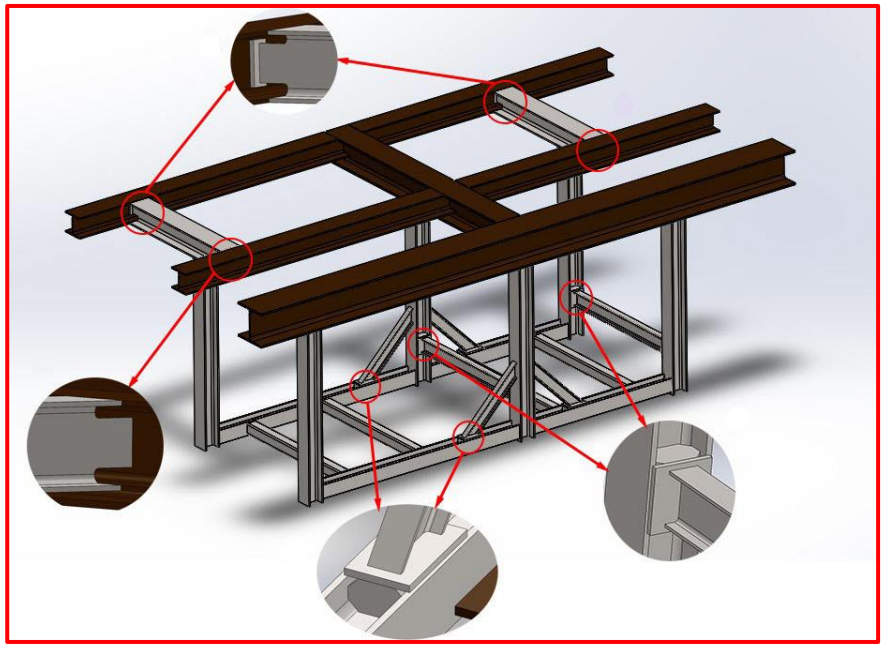


SCOPE OF WORK

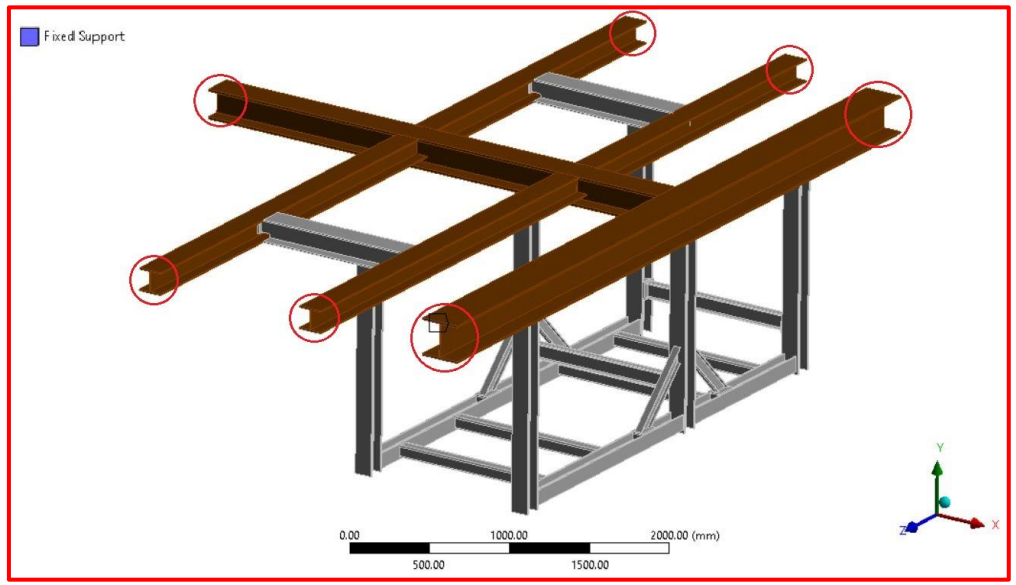
- This investigation aims to show the possibilities of using different finite element types and to see what kind of possible impact those elements will have on similar structures.
- The analysis focuses on the stress and displacement examined on a structure that supports the piping system for the boiler feedwater supply within a thermal power plant.

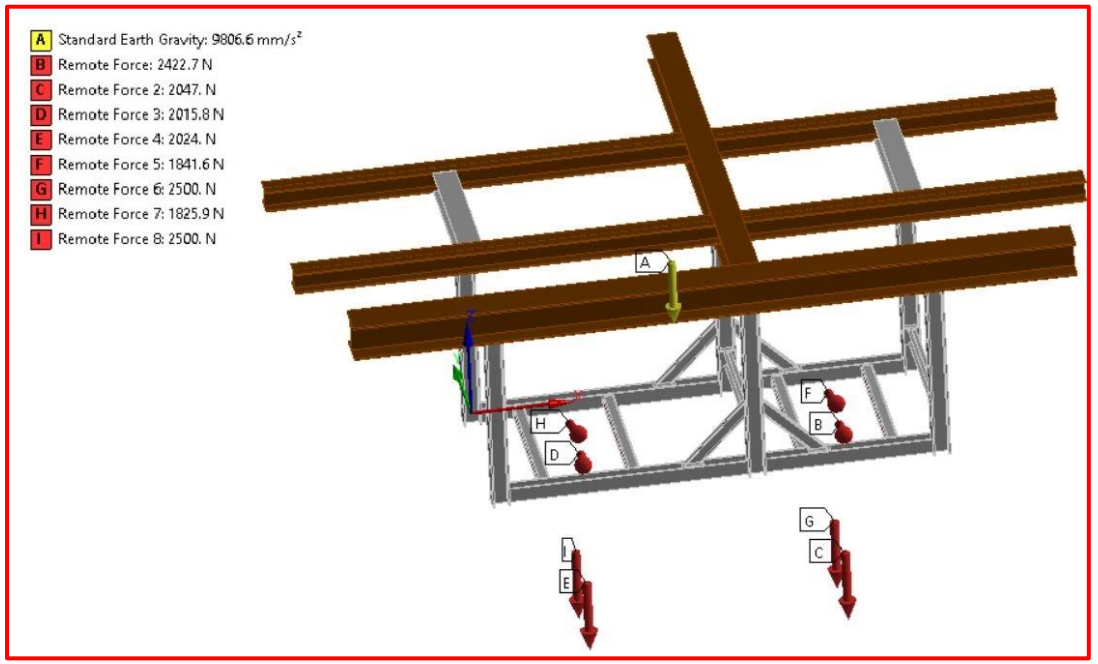




BOUNDARY CONDITIONS

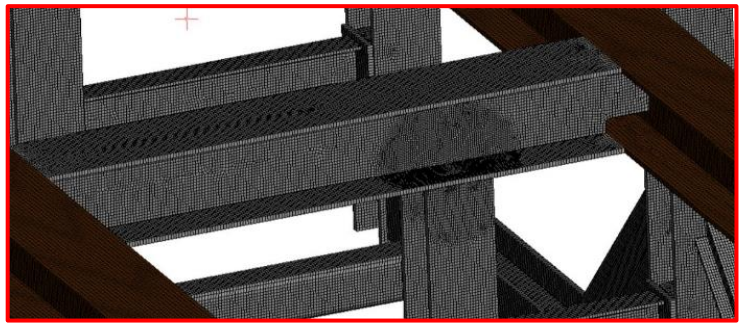
- Fixed support is set as a boundary condition, and the contact between each profile is defined as "Bonded“.
- The support loads have been obtained from pipe stress analysis. In pipe stress analysis the supports from the observed structure are set as boundary conditions, and the pressure and temperature of the pipeline are set as loads.



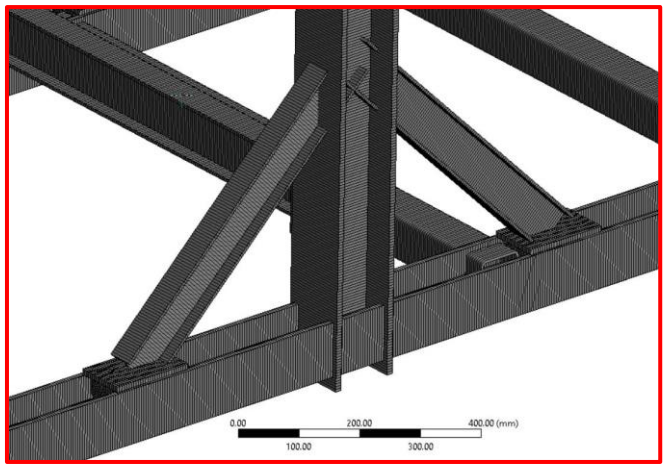


DISCRETISATION

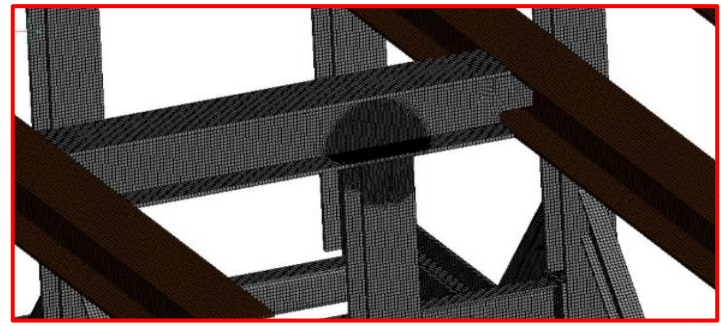
- For analysis and comparison of results, beam (Beam188 and 189), three–dimensional solid (Solid185, 186, 187), shell (Shell181 and 281), and solid-shell elements (Solsh190) were used.



Shell



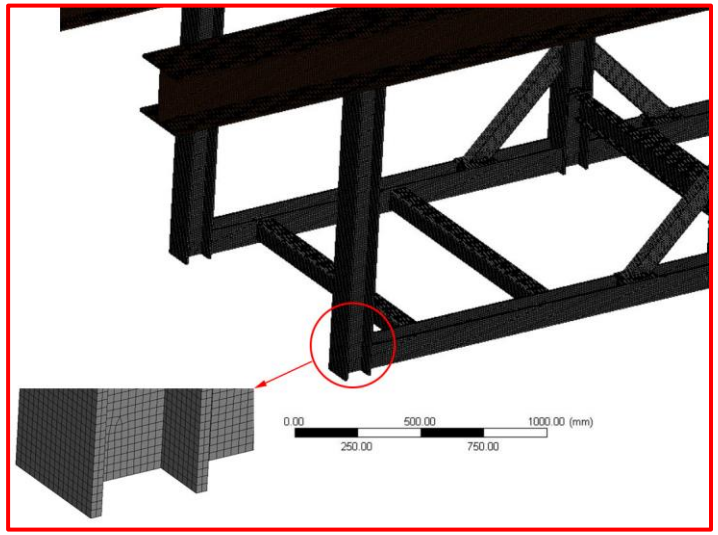
Beam



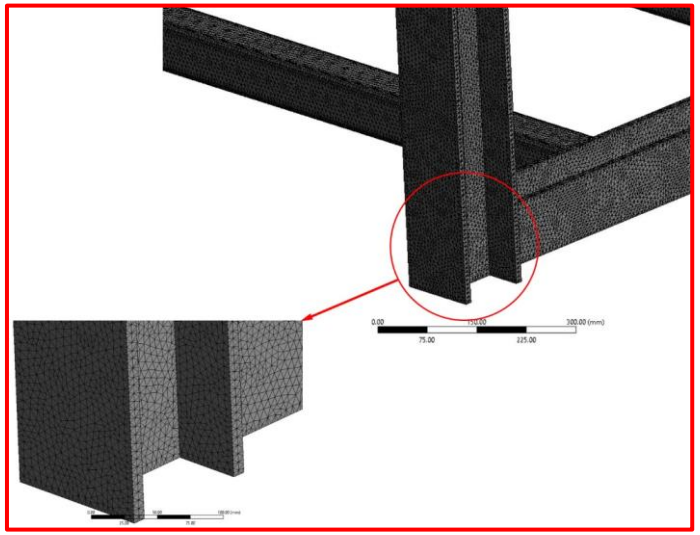
Solid-Shell

DISCRETISATION

- For analysis and comparison of results, beam (Beam188 and 189), three–dimensional solid (Solid185, 186, 187), shell (Shell181 and 281), and solid-shell elements (Solsh190) were used.



Solid - Hexahedral

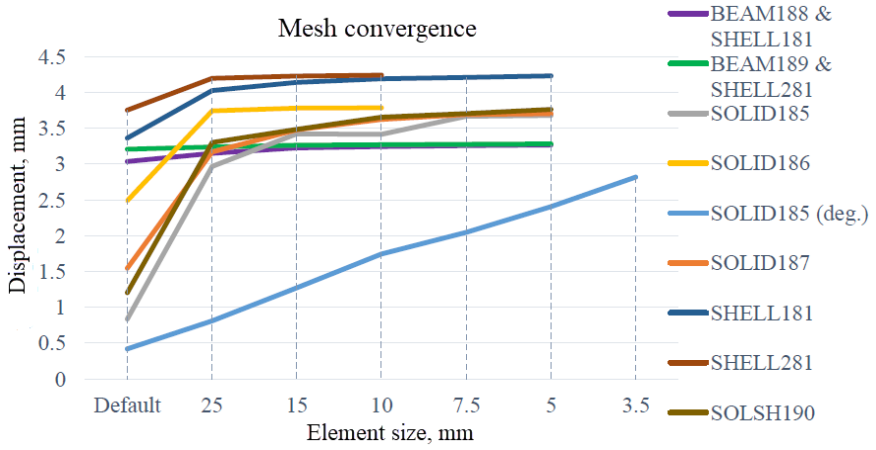


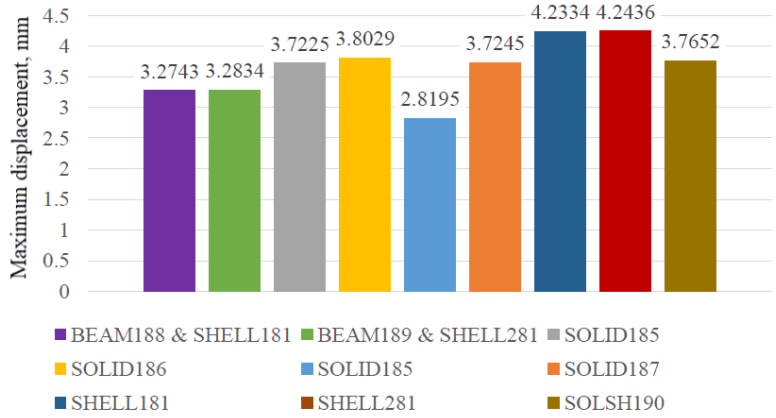
Solid - Tetrahedral

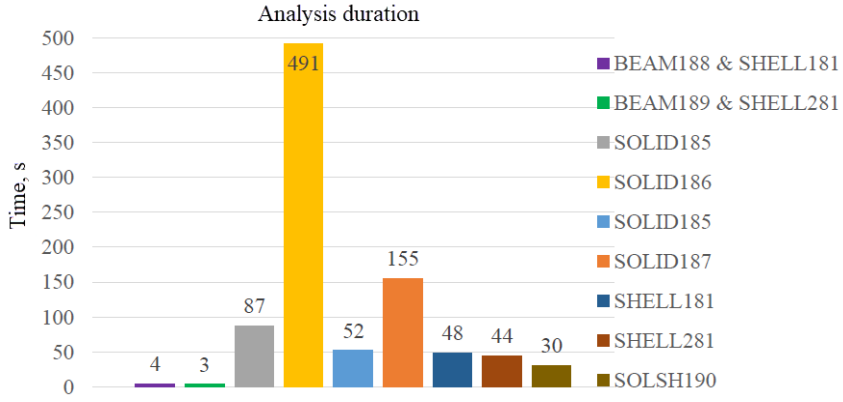
Element type	Number of nodes	Number of elements	Elapsed time (s)	CPU time (s)
BEAM188	7533	4221	3	2.453
BEAM189	13097	4221	4	3.109
SOLID185	192078	104468	87	40.32
SOLID186	670563	103232	491	67.20
SOLID187	469182	211108	155	57.28
SHELL181	89647	87291	48	20.35
SHELL281	265034	87303	44	40.08
SOLSH190	214793	86095	30.234	30

COMPARISON OF FINITE ELEMENTS RESULTS

- The obtained results include displacement convergence diagrams for each type of finite element used, along with the corresponding time required to obtain solutions for each element.







CONCLUSION

- The displacement solutions do not deviate significantly from each other, but some elements show more flexible behavior, while others have stiffer behavior.
- The stiffest behavior was observed from Beam188 combined with Shell181 finite element and Beam189 combined with Shell281 finite element.
- Most flexible behaviors were observed from Shell181 and Shell281 finite elements.
- It's concluded that the use of Solid185 degenerated finite element in similar calculations is not recommended.
- The application of Solsh190 (solid-shell) finite elements in the analysis of similar steel structures shows promise and offers potential benefits. This is evident in the analysis's duration, convergence, and the obtained solutions.
- Connecting Solsh190 to other elements doesn’t requires additional effort.
- The flaw Solsh190 elements have is that they require geometry preparation to make meshing possible, which sometimes can be a very time-consuming task.