Test Design 2 Analysis

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Link to this SSA

`https://www.overleaf.com/read/rzdhxtnzqkhg#deb2ae`

Goals

To go through the Test Results for all groups designated with design 2 and note the findings.

Summary

From the test results, the minimum load this design could carry was found to be : 100N and the maximum load was found to be: 2kN. It can be concluded that this design is particularly weak, it tends to buckle easily at the font jib or fails due to tension at node 8.

Recommendations

It is recommended that a design be able to withstand buckling loads safely to prevent failure. This can be implemented by shortening members prone to buckling, ie; members (4.9, 6.9, 5.9, 2.4, 3.5). It is also recommended to consider distribution of tensile stresses to prevent dense concentration of tension in certain members of the structure.

Future Use

The conclusions made from the analysis can be included in the final report. These conclusions can be displayed as parameters accounted for during the selection of the 3D design in the final report.

1 Elaboration

1.1 Predesign 2

This is Design 2, as given to the groups for building:

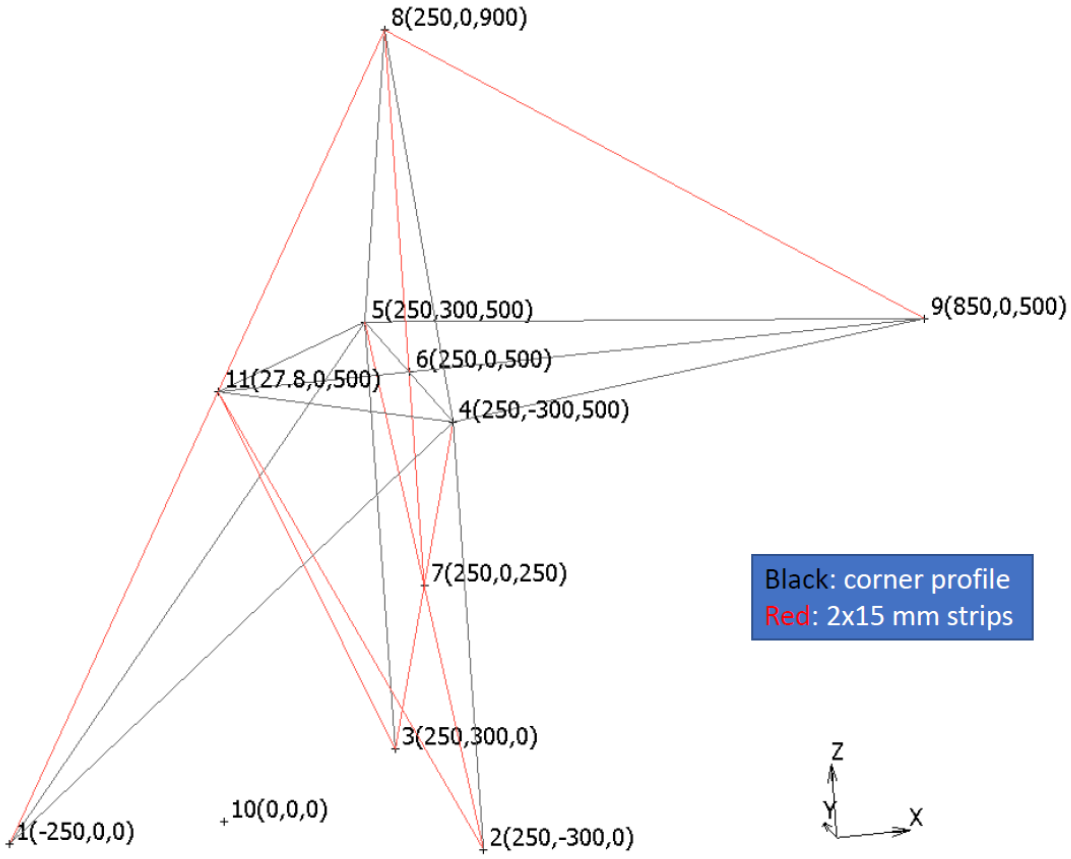

Figure 1: Design 2

1.2 Analyzing Group By Group Videos

Below are observations made after watching videos of each group that built design 2:

Group No.	Particularities/Additions /Optimizations	Cause of Failure	Maximal Load Carried (in Newtons)
2	Did not attach member 1.4, 1.5, 5.8 and 4.8	Buckling of members 2.4, 3.5, 7.8	100
5	Attached loading plate axially along on the x-y axis	Bolt failure at connection in node 9	500
8	Connections are strong (Double bolting and use of the plates is appropriate), loading plate is bent and is oriented along the y-z axis	Buckling and twisting of members 4.9, 6.9, 5.9 and deformation of plate at node 8	1000
11	Loading plate is oriented along the x-z axis, connections are strong (Double bolting and use of plates is optimized at joints)	Member 11.8 broke at node 8	1400
14	Strong connections at side, no additions	Weak joint at node 8 causing disconnection	500
17	Absence of plates at joints 8 and 9, loading plate is along x-y axis, strong joints(Double and multiple bolting where neccesary, use of plates in nodes 4,5 and 11)	Buckling of members 2.4,3.5, 4.9, 5.9 and 6.9	1000
20	Strong joints(use of plates at ever node, double bolting), loading plate oriented along x-z axis	buckling of member 6.8 and disconnection of 4.8 at node 8	1600
23	Weak joint at node 8, loading plate oriented along x-z axis	bolt failure at node 8	1000
26	Weak Joints, scarce to no use of plates	Buckling of front jib and member 6.8, bolt failure at node 8	1800
29	Weak connections at node 8, tilt/depression of structure in x direction before loading	Harsh buckling of front jib and disconnection of member 11.8 at node 8	750
32	Connections hidden with paper tape, loading plate along x-z direction	Buckling of front jib	2000
32	Connections hidden with paper tape, loading plate along x-z direction	Buckling of front jib	2000
44	Slight upward tilt in jib, load-plate oriented along y-z axis, absence of joint-plate at node 11, strong joints(Double bolting wherever necessary)	Buckling of front jib	1200
47	Load-plate oriented along x-y axis, absence of joint-plates except at node 11,	Buckling of front jib and disconnection of member 8.9 at node 8	1400

Table 1: Group-by-Group analysis for some groups

Note:

- Axes are with respect to the definition in the predesign document.
- Test results for groups 35, 38 and 41 were unavailable.
- At the time of writing this SSA, test results were only available for the groups mentioned in the table

The above table is an indicator for the common areas of failure of this design. After watching the footage of all the groups, conclusions can be made about this design.

1.3 Conclusions/ Observations

- If connections are secure, the design fails due to buckling
- If connection at node 8 is not reinforced/bolted properly, the design fails at node 8
- If members are shortened and all joints are properly secured by bolts, the design will still fail at high loads (>1.8kN)
- Due to poor tensile force distribution and long members, this design is not desirable for the goal load of 3kN