



Element Fender MV1600X2000 Anchorage Bolt Bond Strength Performance Analysis Report

Abstract : This report analyzes the strength of element fender crash plates using hydrostatic structural analysis. It is assumed that the load (3250kN) in the bottom region of the fender is applied to the fender to check its structural and anchorage bolt strength.

1. Modeling

The 3D model of the element fender is shown in Figure 1. Detailed dimension refer to attached drawing.

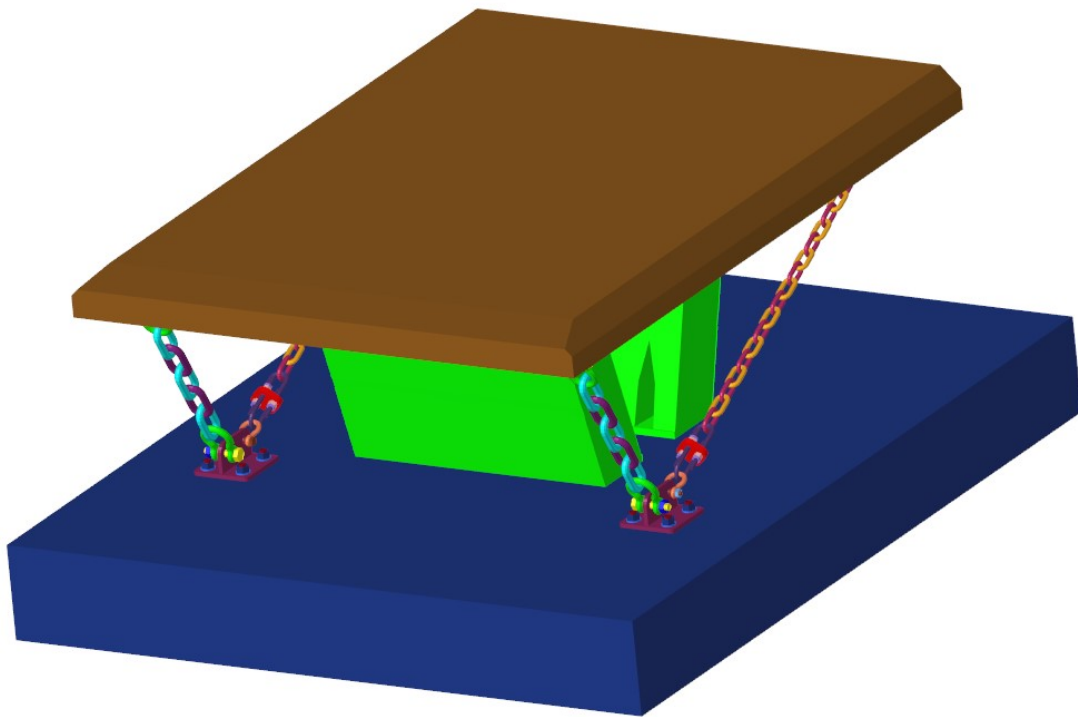


Figure 1

2. Properties of Material

The material of the element fender and the properties is shown as Table 1.

Table 1 Material properties

Item	Material	Density (kg/m)	Young's modulus(MPa)	Poisson' s Ratio	Tensile Yield Strength(MPa)	Tensile Ultimate Strength(MPa)
Element Fender	Rubber	920	HS84	0.495	—	>16
Front Panel	Q355B	7800	210000	0.3	355	> 490
Chain Bracket	Q355B	7800	210000	0.3	355	> 490
Tension Chain	CM690	7850	210000	0.3	410	690
Weight Chain	CM690	7850	210000	0.3	410	690
Anchor Bolt	Grade 8.8	7850	210000	0.3	640	800
Concrete	C16	2400	32500	0.3	—	16
Glue	HIT-RE500	1200	2000	0.3	—	15.8

3. Analysis Information

Analysis type	Static Analysis
Mesh type	Solid
Solver	LS-Dyna
Unit system	Millimetre s T N

4. Load and Boundary Condition

For the design of element fender load cases have been investigated: A load of 3250 kN is applied at the bottom of the front frame, and the concrete is set up with fixed restraints. Details are shown in Figure 2 .

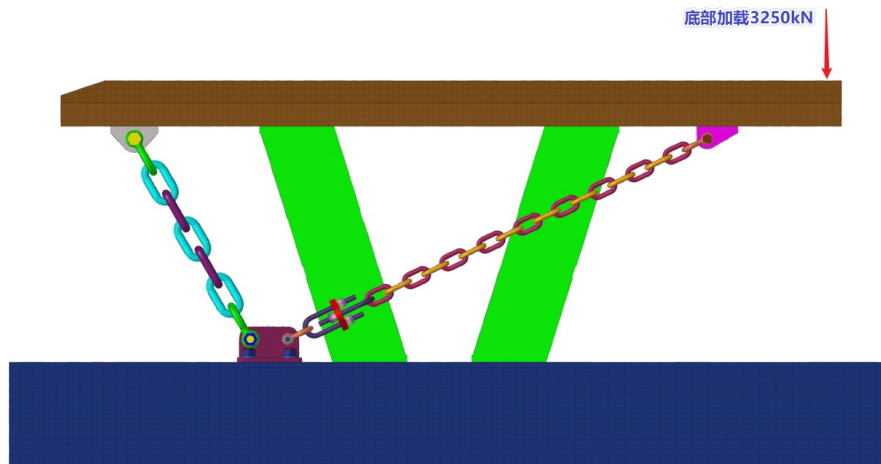


Figure 2

5. Mesh

The maximum element size of the element fender is 40 mm. Nodes number is 476728 and elements number is 555238. Meshing modeling is shown in Figure 3.

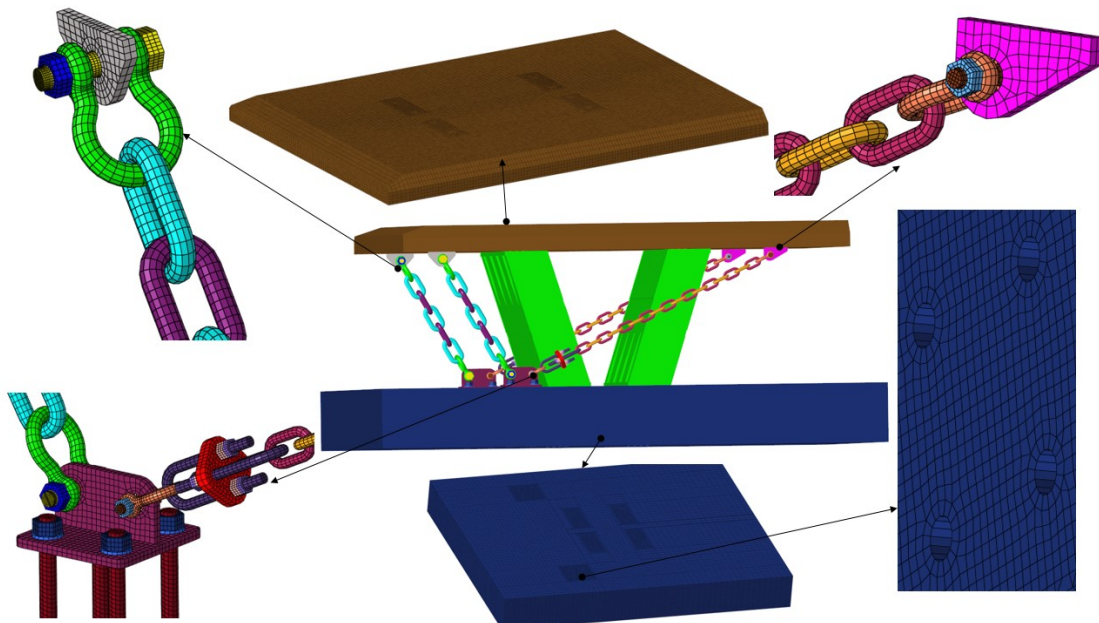


Figure 3

6. FEA Result

In order to check the stress of the anchor bolts and the concrete,

the anchor bolts are numbered according to Figure 4, the specifications of the anchor bolts numbered 1-8 are M56×670mm, the specifications of the anchor bolts numbered 9-16 are M56×690mm.

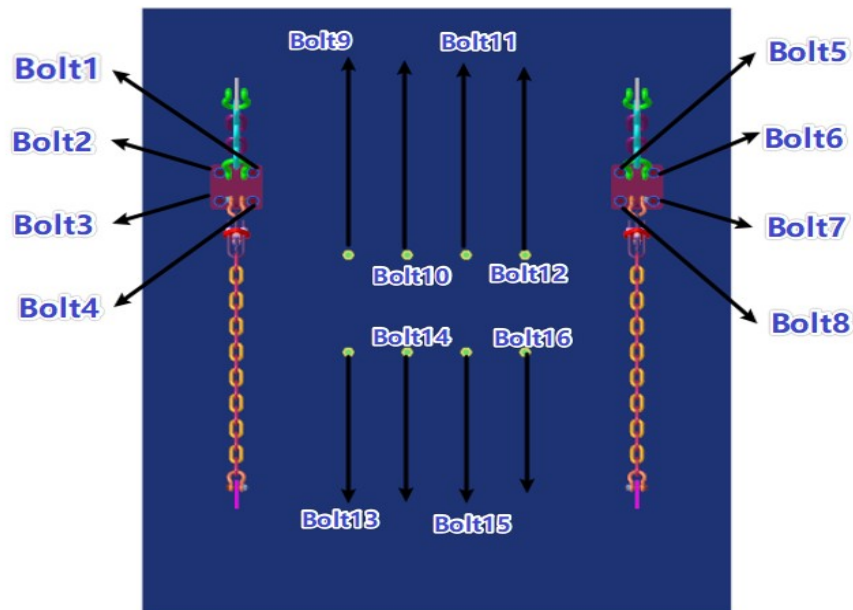
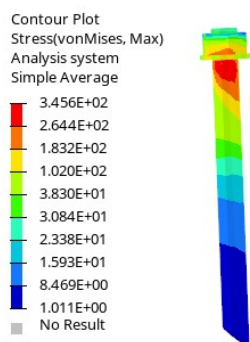
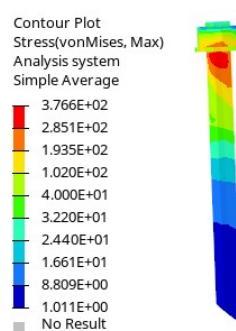


Figure 4

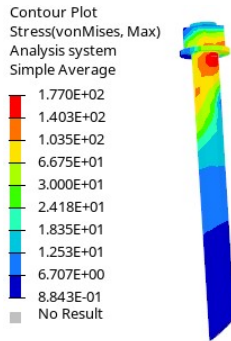
CASE 1 Stress Result of the anchor bolt M56×670mm (Bolt1-Bolt8)



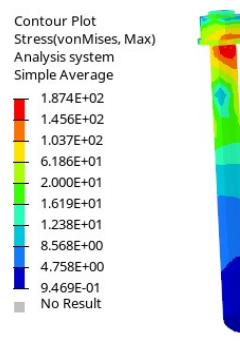
Stress Contour 345MPa



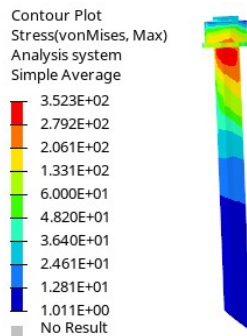
Stress Contour 376 MPa



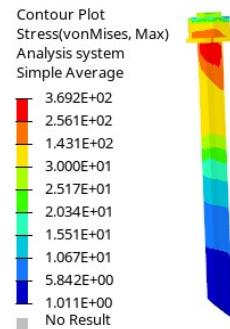
Stress Contour 177 MPa



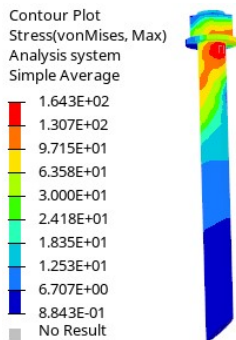
Stress Contour 187 MPa



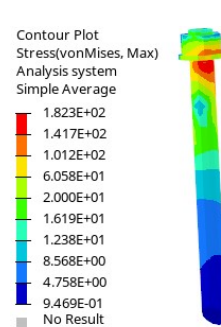
Stress Contour 352 MPa



Stress Contour 369 MPa

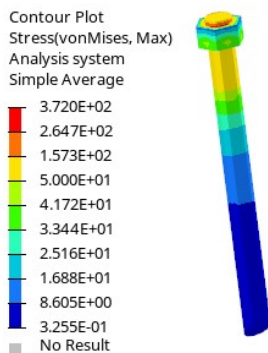


Stress Contour 164 MPa

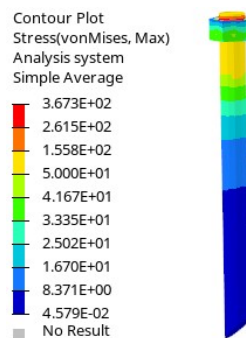


Stress Contour 182 MPa

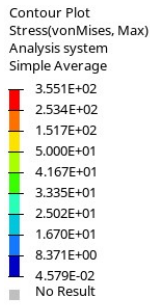
CASE 1 Stress Result of the anchor bolt M56×690mm (Bolt9-Bolt16)



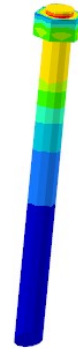
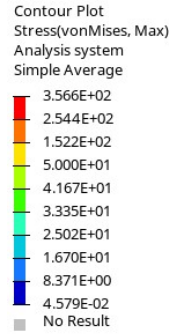
Stress Contour 372MPa



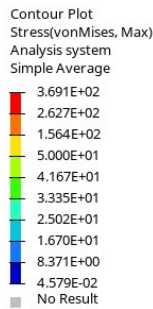
Stress Contour 367 MPa



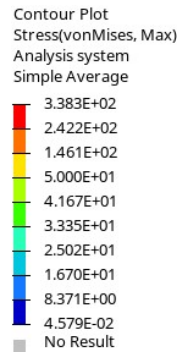
Stress Contour 355 MPa



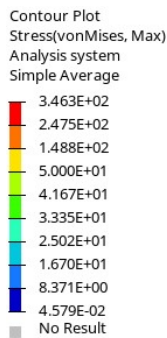
Stress Contour 356 MPa



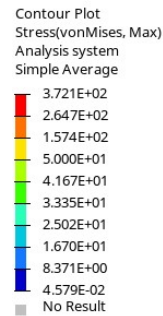
Stress Contour 369 MPa



Stress Contour 338 MPa

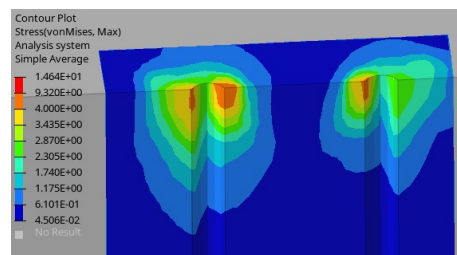
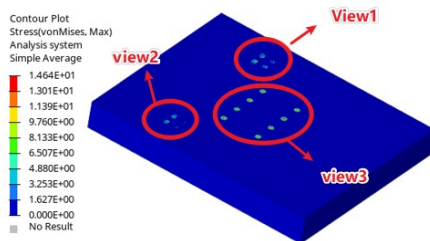


Stress Contour 346 MPa



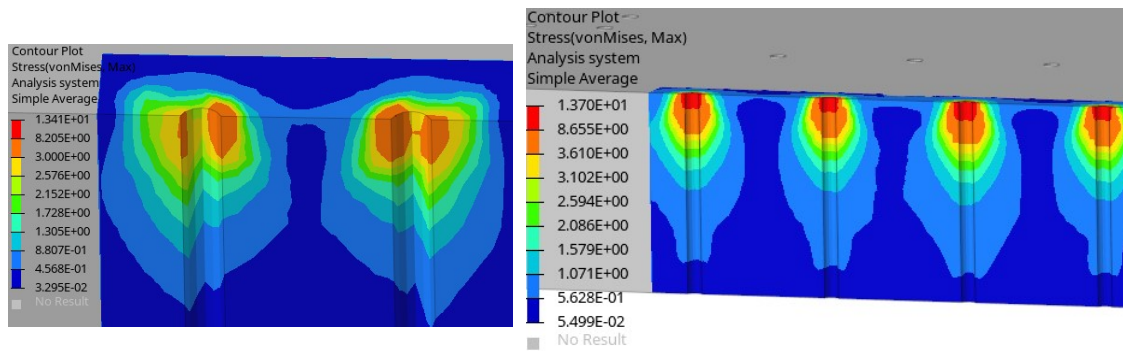
Stress Contour 372 MPa

CASE 1 Stress Result of the concrete



Concrete Stress Contour 14.64 MPa

Detail View1 Contour



Detail View2 Contour

Detail View3 Contour

FEA Result are as follows:

Item	Bolt Dimension (mm)	Stress (MPa)	Safety factor	Yield Stress (MPa)	Conclusion
Bolt1	M56×670mm	345	1.86	640	OK
Bolt2	M56×670mm	376	1.70	640	OK
Bolt3	M56×670mm	177	3.62	640	OK
Bolt4	M56×670mm	187	3.42	640	OK
Bolt5	M56×670mm	352	1.82	640	OK
Bolt6	M56×670mm	369	1.73	640	OK
Bolt7	M56×670mm	164	3.90	640	OK
Bolt8	M56×670mm	182	3.52	640	OK
Bolt9	M56×690mm	372	1.72	640	OK
Bolt10	M56×690mm	367	1.74	640	OK
Bolt11	M56×690mm	355	1.80	640	OK
Bolt12	M56×690mm	356	1.80	640	OK
Bolt13	M56×690mm	369	1.73	640	OK
Bolt14	M56×690mm	338	1.89	640	OK
Bolt15	M56×690mm	346	1.85	640	OK

Bolt16	M56×690mm	372	1.72	640	OK
Item	Bolt Dimension (mm)	Stress (MPa)	Safety factor	Tensile stress (MPa)	Conclusion
Concrete1	M56×670mm	14.6	1.37	20	OK
Concrete2	M56×670mm	14.6	1.37	20	OK
Concrete3	M56×690mm	13.2	1.52	20	OK

7. Summary of the Results

- Case 1, in the simulation of working conditions, load 3250kN at the bottom area of the front frame of the element fender MV1600X2000 system, for anchor bolt 1-8 (M56 × 670mm), the maximum stress is 376MPa and corresponding part is bolt 2, the safety coefficient is 1.70. Less than the yield stress of the material 640 MPa, Satisfy design requirements.
- Case 1, in the simulation of working conditions, load 3250kN at the bottom area of the front frame of the element fender MV1600X2000 system, for anchor bolt 9-16 (M56 × 690mm), the maximum stress is 372MPa and corresponding part is bolt 9 and bolt 16, the safety coefficient is 1.72. Less than the yield stress of the material 640 MPa, Satisfy design requirements.
- The concrete stress of the anchor bolt M56X670mm is 14.6MPa, The concrete stress of the anchor bolt M56X690mm 13.2MPa, Less than Tensile stress 20MPa. Satisfy design requirements.