

PLAN HISTORY

DATE	REV.	DESCRIPTION	DWN.	CHKD.	MGR.
2022-08-12	A	SUBMITTED TO THE CLASS FOR REFERENCE	S.A.BAE	H.J.NAM	K.H.LEE

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		HULL NO. 50KPC11 (S1940) TYPE 48,600 DWT CLASS IMO TYPE2 CHEMICAL / PRODUCT OIL TANKER			
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1. Introduction

1.1 General

Direct calculation method was adopted for the determination and verification of the scantlings of main supporting members of Hull Nos. S1940(48,600 DWT CLASS IMO TYPE2 CHEMICAL/ PRODUCT OIL TANKER) in accordance with the “Common Structural Rules for Bulk Carriers and Oil Tankers (01 Jan 2021)”, hereinafter “CSR”.

The main objective of the F.E analysis is to confirm the structural adequacy of the longitudinal hull girder structural members, primary supporting structural members and transverse bulkheads of the tanks in the midship cargo region.

The F.E. Modeling was performed utilizing a well known finite element software, “KR SeaTrust-HullScan (STC, Version 2.0439)”.

The generation of CSR loads and boundary conditions were performed by utilizing “KR SeaTrust-HullScan (STC, Version 2.0439)”.

“MSC Nastran V2013.1” was used for the solving the F.E.model including the loads and boundary conditions.

“Yield Strength” for each element were evaluated by checking the stress plots utilizing “KR SeaTrust-HullScan (STC, Version 2.0439)”.

“Buckling Strength” for each plate panels were calculated and the buckling utilisation factors were graphically presented by “KR SeaTrust-HullScan (STC, Version 2.0439)”

The global coordinate system is as shown in **Table 1.1**

COORDINATE	DIRECTION
X	Ship's Length
Y	Ship's Breadth
Z	Ship's Depth

Table 1.1 – Global coordinate system

The unit for load and dimension is “N” and “mm”, respectively.



1.2 Vessel Description

1.2.1 Principal Dimension

Length O.A	Appx. 182.90 M
Length B.P	173.90 M
Length Scant.	172.31 M
Breadth Mld.	32.20 M
Depth Mld.	19.10 M
Draught Design	11.00 M
Draught Scant.	13.35 M

1.2.2 Structural Layout

The structural layout is shown in the followings

- 1) “Rev.A of Midship Section & Typ. BHD Const. (DWG. No.B1001000)”
- 2) “Rev.A of Construction Profile & Deck Plans (DWG. No.B1002000)”
- 3) “Rev.A of Shell Expansion (DWG. No.B1003000)”

1.2.3 Extent of the Analysis Model

Due to the asymmetrical nature of the structure about centerline, it was necessary to idealize full breadth of the ship and, also taking into account the symmetrical nature of the cargo tanks in longitudinal direction, three cargo tanks were idealized for all loading conditions, where the middle part of the model were used to examine the adequacy of hull structure.

The extent of the analysis model is shown in Fig.1.1

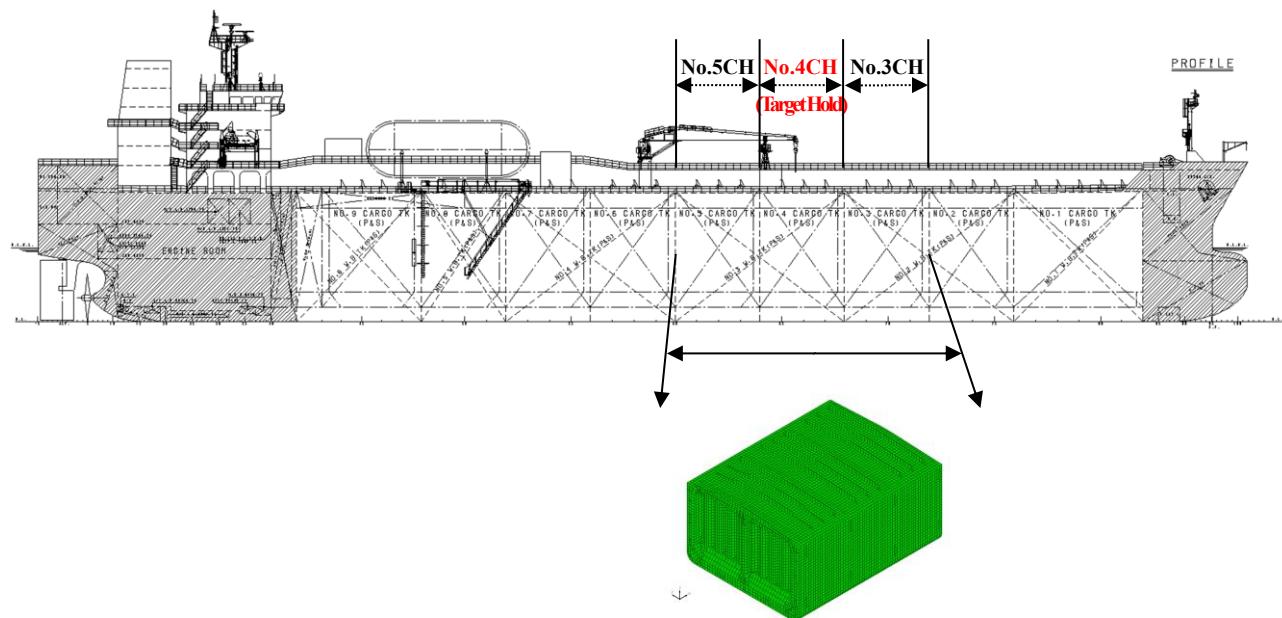


Fig.1.1 – Extent of F.E. Model for No.4 cargo tank analysis



1.2.4 Element Properties

The finite element model and properties are shown in **Appendix.1 – Fig.A1.01 ~ A1.20**

The finite element model have been modelled with thicknesses calculated by deducting half the corrosion addition, i.e. $-0.5tc$, from the gross thickness of all structural elements.

The local buckling capacity of plates and stiffeners has been calculated by deducting the full corrosion addition, i.e. $-1.0 tc$, from the gross thickness.

The total corrosion addition, tc , in mm, for both sides of the structural member is obtained by the formula: $tc = Roundup0.5 (tc1 + tc2 + tres(=0.5))$

For an internal member within a given compartment, the total corrosion addition, tc is obtained from the formula: $tc = Roundup0.5 (2tc1) + tres(=0.5)$, where $tc1$ is the value specified in **Table 1.2** for one side exposure to that compartment.

Roundup0.5 (t) means that t is rounded to the upper half millimetre.

The corrosion addition for each of the two sides of a structural member, $tc1$ or $tc2$, is specified in **Table 1.2** shown below.

Compartment type	Structural member	t_{c1} or t_{c2}		
		Oil tankers	BC-A or BC-B ships with $L \geq 150$ m	Other BC ships
Ballast water tank, bilge tank, drain storage tank, chain locker (1)	Face plate of PSM	Within 3m below top of tank (4)	2.0	
		Elsewhere	1.5	
	(6)	Within 3m below top of tank (4)	1.7	
		Elsewhere	1.2	
	Cargo oil tank	Within 3m below top of tank (4)	1.7	N/A
		Elsewhere	1.4	
Dry bulk cargo hold (5)	Transverse bulkhead	Inner-bottom plating/bottom of tank	2.1	
		Other members	Within 3m below top of tank (4)	
			1.7	
	Upper part (6)	Elsewhere	1.0	
		Upper part (6)	2.4	1.0
		Lower stool: sloping plate, vertical plate and top plate (7)	5.2	2.6
	Other parts	Other parts	3.0	1.5
		Sloped plating of hopper tank, inner bottom plating	3.7	2.4
		Upper part (6)	N/A	
		Webs and flanges of the upper end brackets of side frames of single side bulk carriers	1.8	1.0
Exposed to atmosphere	Other members	Webs and flanges of lower brackets of side frames of single side bulk carriers	2.2	1.2
		Other parts	2.0	1.2
Exposed to seawater	Weather deck plating		1.7	
	Other members		1.0	
Fuel and lube oil tank	Shell plating between the minimum design ballast draught waterline and the scantling draught waterline		1.5	
	Shell plating elsewhere		1.0	
Fresh water tank			0.7	
Void spaces (8)	Spaces not normally accessed, e.g. access only via bolted manhole openings, pipe tunnels, inner surface of stool space not common with a dry bulk cargo hold or ballast cargo hold, etc.		0.7	
	Dry spaces		Internals of machinery spaces, pump room, store rooms, steering gear space, etc.	0.5

Table 1.2 – Corrosion addition, $tc1$ or $tc2$



2. Loading and Boundary Conditions

2.1 Hull Girder Loads

Permissible Bending moment and Shear force are described as shown Table 2.1 and 2.2

FR. No	SEAGOING		HARBOUR	
	Hogging	Sagging	Hogging	Sagging
11	80000	-40600	80000	-50800
27	350000	-143100	350000	-178900
40	598500	-319800	598500	-399800
41	709700	-413900	745900	-459700
42	739200	-438800	800400	-480900
43	882300	-560000	1065800	-563500
46	1213600	-740000	1679800	-754600
47+1963	1398100	-773700	2021700	-861100
48	1398100	-773700	2021700	-861100
50	1398100	-773700	2021700	-861100
52	1398100	-773700	2021700	-861100
54	1398100	-773700	2021700	-861100
56	1398100	-773700	2021700	-861100
58	1398100	-773700	2021700	-861100
60	1398100	-773700	2021700	-861100
62	1398100	-773700	2021700	-861100
64	1398100	-773700	2021700	-861100
66	1398100	-773700	2021700	-861100
68	1398100	-773700	2021700	-861100
69+687	1398100	-773700	2021700	-861100
70	1287100	-715000	1841600	-805600
72	1023800	-575500	1414100	-673900
74	743400	-427000	959000	-533800
76	480000	-314900	531500	-393600
79	286900	-153500	286900	-191800
82	100000	-63600	107300	-79500
86	60000	-44400	75000	-55500

Table 2.1 –Permissible hull girder still water bending moments(kN-m)



FR. No	SEAGOING		HARBOUR	
	Positive	Negative	Positive	Negative
11	17000	-900	17000	-1000
27	22300	-18600	22300	-22300
40	26500	-32900	33000	-33000
41	33700	-37000	35600	-37000
42	33100	-38100	35900	-38100
43	30000	-31500	37200	-31500
46	22800	-15900	39800	-16200
48	27100	-25900	41000	-29100
50	17200	-15900	35000	-16200
52	22200	-22200	29700	-24900
54	20900	-30000	21600	-30000
56	25700	-32200	29700	-32200
58	17200	-22300	21600	-22300
60	22200	-30900	29700	-30900
62	17200	-22300	21600	-22300
64	22200	-30900	29700	-30900
66	17200	-22300	21600	-34200
68	22200	-30900	29700	-42800
70	17200	-30900	21600	-44000
72	22200	-30000	29700	-45100
74	17200	-28500	21600	-46400
76	26400	-26400	29700	-47500
79	17100	-20000	17100	-20000
82	8000	-11000	8000	-11000
86	3900	-7300	3900	-7300

Table 2.2 –Permissible hull girder still water shear forces(kN)



2.2 Loading Conditions

All loading conditions are described as shown **Table 2.3** and **2.4** according to the “CSR” and applied loading condions are described as shown **Table 2.5**

No.	Loading pattern	Still water loads			Dynamic load cases		
		Draught	C_{BM-LC} : % of perm. SWBM	C_{SF-LC} : % of perm. SWSF	Midship cargo region		
Seagoing conditions							
B1		0.9 T_{sc}	100% (sagging)	100%	HSM-1 HSA-1	BSP-1P/S	N/A
			100% (hogging)	100%	HSM-2 FSM-2	BSR-1P BSP-1P	OST-2P
B2		0.9 T_{sc}	100% (sagging)	100%	HSM-1 HSA-1	BSP-1P/S	N/A
			100% (hogging)	100%	HSM-2 FSM-2	BSR-1S BSP-1S	OST-2S
B3		0.9 T_{sc}	100% (hogging)	100% ⁽³⁾ Max SFLC	HSM-2 FSM-2	N/A	N/A
				100% ⁽⁴⁾ Max SFLC	HSM-2 FSM-2	N/A	N/A
			100%	N/A	BSP-1P/S	N/A	N/A
			0%	100% ⁽⁵⁾ Max SFLC	HSM-1 FSM-1	N/A	N/A
B4		0.6 T_{sc}	100% (sagging)	75%	HSM-1	BSP-1P	OSA-2P/S
B5		0.6 T_{sc}	100% (sagging)	75%	HSM-1	BSP-1S	OSA-2P/S
B6		0.6 T_{sc}	100% (sagging)	100% ⁽³⁾ Max SFLC	HSM-1	N/A	N/A
				100% ⁽⁴⁾ Max SFLC	HSM-1	N/A	N/A
			100%	N/A	BSP-1P/S	N/A	N/A
			0%	100% ⁽⁵⁾ Max SFLC	HSM-2	N/A	N/A

Table 2.3 – Sea-going loading conditions for cargo tank structural strength assessment

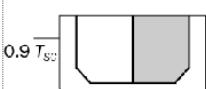
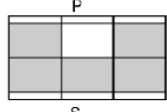
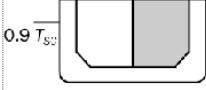
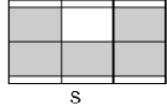
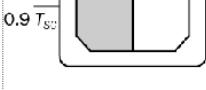
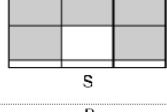
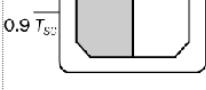
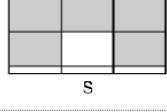
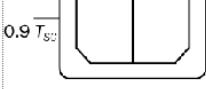
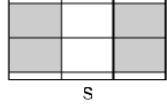
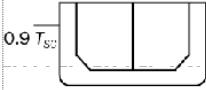
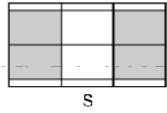
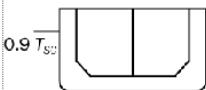
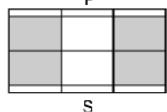
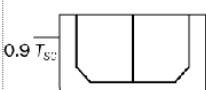
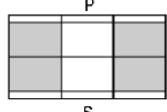
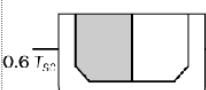
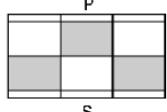
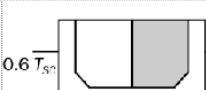
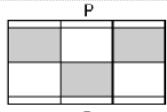
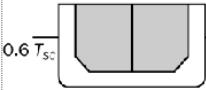
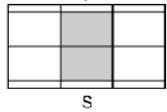
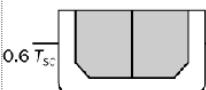
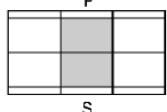


Harbour and testing conditions						
B8		0.33 T_{sc}	100% (sagging)	100% ⁽¹⁾ Max SFLC	N/A	
				100% ⁽²⁾ Max SFLC	N/A	
B9		0.33 T_{sc}	100% (sagging)	75%	N/A	
B10		0.33 T_{sc}	100% (sagging)	75%	N/A	
B11		T_{sc}	100% (hogging)	100% ⁽¹⁾ Max SFLC	N/A	
				100% ⁽²⁾ Max SFLC	N/A	
<p>⁽¹⁾ The shear force is to be adjusted to target value at aft bulkhead of the mid-hold. ⁽²⁾ The shear force is to be adjusted to target value at forward bulkhead of the mid-hold. ⁽³⁾ For the mid-hold where $x_{b-aft} \leq 0.5L$ and $x_{b-fwd} \geq 0.5L$, the shear force is to be adjusted to target value at aft bulkhead of the mid-hold. ⁽⁴⁾ For the mid-hold where $x_{b-aft} \leq 0.5L$ and $x_{b-fwd} \geq 0.5L$, the shear force is to be adjusted to target value at forward bulkhead of the mid-hold. ⁽⁵⁾ This load combination is to be considered only For the mid-hold where $x_{b-aft} > 0.5L$ or $x_{b-fwd} < 0.5L$.</p>						

Table 2.4 – Harbour & Tank testing loading conditions for cargo tank structural strength assessment



48,600 DWT CLASS IMO TYPE2 CHEMICAL/PRODUCT OIL TANKER
Midship Cargo Tank Structural Strength Analysis for No.4 Cargo Hold

STANDARD LOADING CONDITION FOR DIRECT STRENGTH ANALYSIS								
Applicable to Tankers with one centreline oil-tight bulkhead Midship cargo hold region								
No	Description	Loading Pattern		Draught	GM	Kr	SWBM	SWSF
<input checked="" type="checkbox"/> 1	B01_1			12.015	3.864	11.270	-1.000	1.000
<input checked="" type="checkbox"/> 2	B01_2			12.015	3.864	11.270	1.000	1.000
<input checked="" type="checkbox"/> 3	B02_1			12.015	3.864	11.270	-1.000	1.000
<input checked="" type="checkbox"/> 4	B02_2			12.015	3.864	11.270	1.000	1.000
<input checked="" type="checkbox"/> 5	B03_1			12.015	3.864	11.270	1.000	1.000
<input checked="" type="checkbox"/> 6	B03_2			12.015	3.864	11.270	1.000	1.000
<input checked="" type="checkbox"/> 7	B03_3			12.015	3.864	11.270	1.000	1.000
<input checked="" type="checkbox"/> 8	B03_4			12.015	3.864	11.270	0.000	1.000
<input checked="" type="checkbox"/> 9	B04			8.010	7.728	12.880	-1.000	0.750
<input checked="" type="checkbox"/> 10	B05			8.010	7.728	12.880	-1.000	0.750
<input checked="" type="checkbox"/> 11	B06_1			8.010	7.728	12.880	-1.000	1.000
<input checked="" type="checkbox"/> 12	B06_2			8.010	7.728	12.880	-1.000	1.000



48,600 DWT CLASS IMO TYPE2 CHEMICAL/PRODUCT OIL TANKER
Midship Cargo Tank Structural Strength Analysis for No.4 Cargo Hold

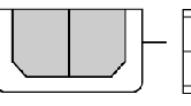
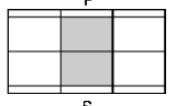
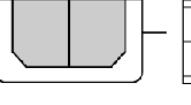
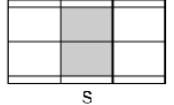
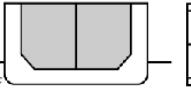
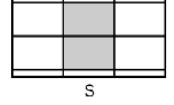
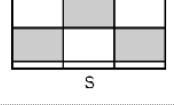
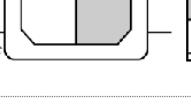
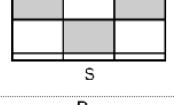
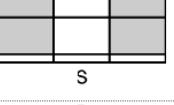
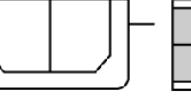
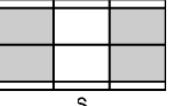
<input checked="" type="checkbox"/> 13	B06_3	0.6 \overline{T}_{SC}			8.010	7.728	12.880	-1.000	1.000	BSP_1P BSP_1S	None
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<input checked="" type="checkbox"/> 16	B08_1	0.33 \overline{T}_{SC}			4.406	7.728	12.880	-1.000	1.000	Static	Max SFLC(Aft)
<input checked="" type="checkbox"/> 17	B08_2	0.33 \overline{T}_{SC}			4.406	7.728	12.880	-1.000	1.000	Static	Max SFLC(Fwd)
<input checked="" type="checkbox"/> 18	B09	0.33 \overline{T}_{SC}			4.406	7.728	12.880	-1.000	0.750	Static	None
<input checked="" type="checkbox"/> 19	B10	0.33 \overline{T}_{SC}			4.406	7.728	12.880	-1.000	0.750	Static	None
<input checked="" type="checkbox"/> 20	B11_1	\overline{T}_{SC}			13.350	3.864	11.270	1.000	1.000	Static	Max SFLC(Aft)
<input checked="" type="checkbox"/> 21	B11_2	\overline{T}_{SC}			13.350	3.864	11.270	1.000	1.000	Static	Max SFLC(Fwd)

Table 2.5 –Applied loading conditions for No.4 cargo tank structural strength assessment

2.3 Boundary Conditions

The boundary conditions consist of the rigid links at model ends, point constraints and end-beams. The rigid links connect the nodes on the longitudinal members at the model ends to an independent point at neutral axis in centreline. The boundary conditions to be applied at the ends of the cargo hold FE model are given in **Table 2.6**

Location	Translation			Rotation		
	δ_x	δ_y	δ_z	θ_x	θ_y	θ_z
Aft End						
Independent point	-	Fix	Fix	M_{T-end}	-	-
Cross section	-	Rigid link	Rigid link	Rigid link	-	-
End beam, see [2.5.4]						
Fore End						
Independent point	-	Fix	Fix	Fix	-	-
Intersection of centreline and inner bottom	Fix	-	-	-	-	-
Cross section	-	Rigid link	Rigid link	Rigid link	-	-
End beam, see [2.5.4]						

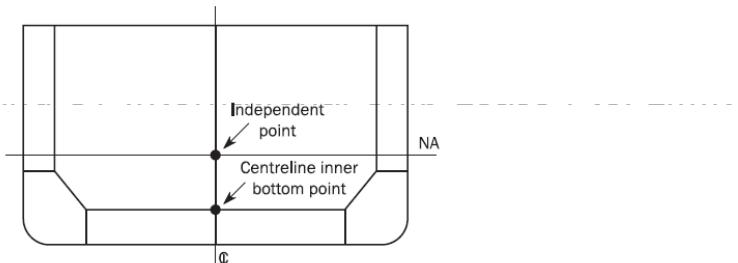


Table 2.6 – Boundary constraints at model ends

End constraint beams are to be modelled at the both end sections of the model along all longitudinally continuous structural members.

The properties of beams are calculated at fore and after sections separately and all beams at each end section have identical properties as follows:

- Net moment of inertia: $I_{yy-n50} = I_{zz-n50} = I_{xx-n50}$ (J) = 1/25 of the vertical hull girder moment of inertia of fore/aft end cross sections based on the net FE model.
- Net cross sectional area: A_{y-n50} and A_{z-n50} = 1/80 of the fore/aft end cross sectional areas based on the net FE model.

where:

I_{yy-n50} : Moment of inertia about local beam Y axial, in m^4 .

I_{zz-n50} : Moment of inertia about local beam Z axial, in m^4 .

I_{xx-n50} (J) : Torsional inertia, in m^4 .

A_{y-n50} : Shear area in local beam Y direction, in m^2 .

A_{z-n50} : Shear area in local beam Z direction, in m^2 .



3. Results of the F.E. Analysis

3.1 Deformed Shape

The deformed shapes are shown in [Appendix.2 - Fig.A2.01 ~ A2.45](#)

Deformed shapes are based on the Rev.A of F.E. model and will not be updated . Although the magnitude of the deformation may be slightly changed due to the modification of the F.E. model and properties, the typical deformed shapes for each load cases will not be changed.

3.2 Yield Strength and Buckling Strength Assessment

The von-Mises plots and buckling strength assessments for each structures are shown on

[Appendix.3 - Fig.A3.01 ~ A3.22](#)



4. Acceptance Criteria

4.1. Yield Strength Criteria

The scantlings of the transverse and longitudinal structural members were finally determined by the general application of the following yielding criteria (**Table.4.1**) to the results of the cargo tank structural strength analysis.

Yield Criteria ; $\lambda_y \leq \lambda_{perm}$ (λ_{perm} =Coarse mesh permissible yield utilisation factors)						
Structure component	load combination S+D (Seagoing Conditions)			load combination S (Harbour Conditions)		
	$\lambda_{perm} = 1.00$			$\lambda_{perm} = 0.80$		
	$\lambda_{perm} = 0.90$ (Corr.Bhd with L.Stool)			$\lambda_{perm} = 0.72$ (Corr.Bhd with L.Stool)		
	Permissible von-Mises or axial stress, N/mm ²			Permissible von-Mises or axial stress, N/mm ²		
	Mild steel	HT32 steel	HT36 steel	Mild steel	HT32 steel	HT36 steel
Plating of all longitudinal hull girder structural members, primary supporting structural members and bulkheads.						
Face plate of primary supporting members modelled using shell or rod elements.	235.00	301.28	326.39	188.00	241.03	261.11
Dummy rod of corrugated bulkhead.						
Corrugation of vertically corrugated bulkheads with lower stool.	211.50	271.15	293.75	169.20	216.92	235.00

Table.4.1 – Permissible stresses for each structure categories



4.2. Buckling Strength Criteria

The buckling performance of each member is considered acceptable if it satisfies the following criterion:

$$\eta_{act} \leq \eta_{allow}$$

Where:

η_{allow} : allowable buckling utilisation factor

η_{act} : actual buckling utilisation factor based on the applied design loads

unit : N/mm²

Maximum Permissible Utilisation Factor Against Buckling		
Structural component	Buckling utilisation factor	
Plate and stiffened panel	Seagoing(S+D)	$\eta_{allow} = 1.0$
	Harbour(S)	$\eta_{allow} = 0.8$
Corrugated bulkheads with lower stool	Seagoing(S+D)	$\eta_{allow} = 0.9$
	Harbour(S)	$\eta_{allow} = 0.72$

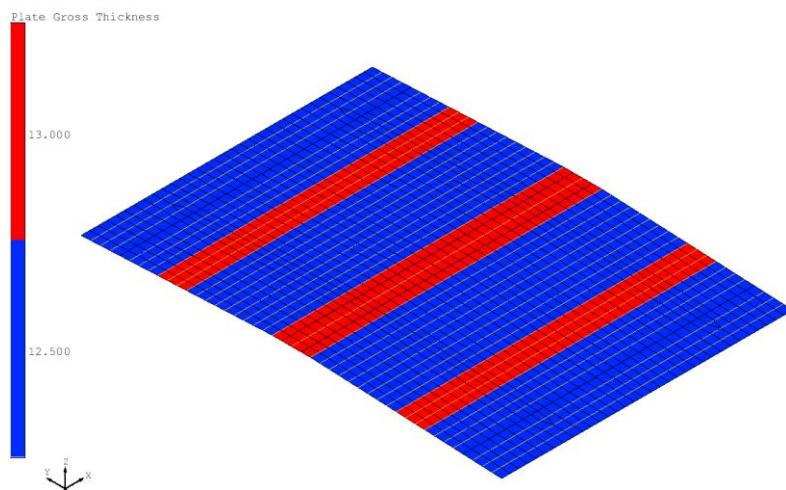
Table 4.2 – Maximum permissible utilisation factor against buckling

5. Conclusion

According to the structural analysis results, the structure design and/or the scantlings of these vessels were found to be in complying with the CSR requirements with regard to yield and buckling strength criteria.

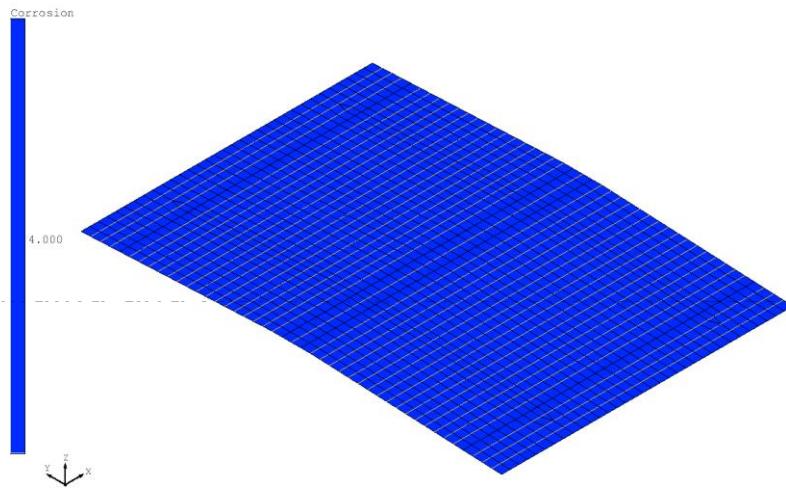


Appendix.1- F.E. Models and Properties



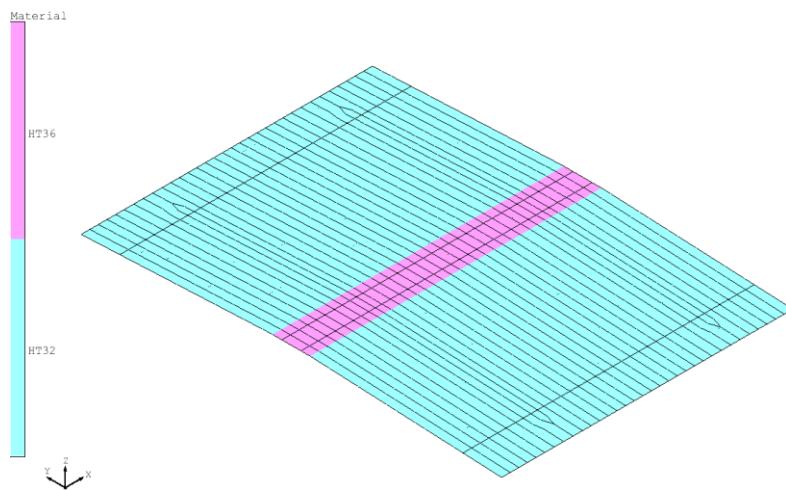
Fringe : Gross Thickness ,01_UPPER DECK

Fig.A1.01.a-F.E. Model and properties of UPPER DECK(Gross thickness)



Fringe : Corrosion ,01_UPPER DECK

Fig.A1.01.b-F.E. Model and properties of UPPER DECK(Corrosion)



Fringe : Material ,01_UPPER DECK

Fig.A1.01.c-F.E. Model and properties of UPPER DECK(Material)

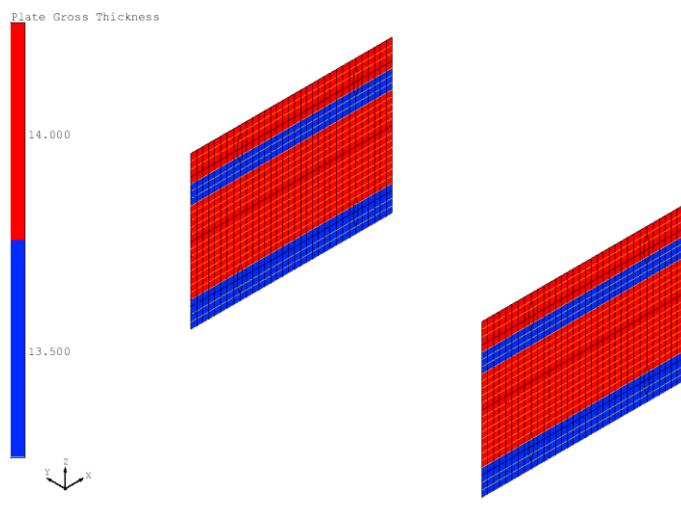


Fig.A1.02.a-F.E. Model and properties of SIDE SHELL(Gross thickness)

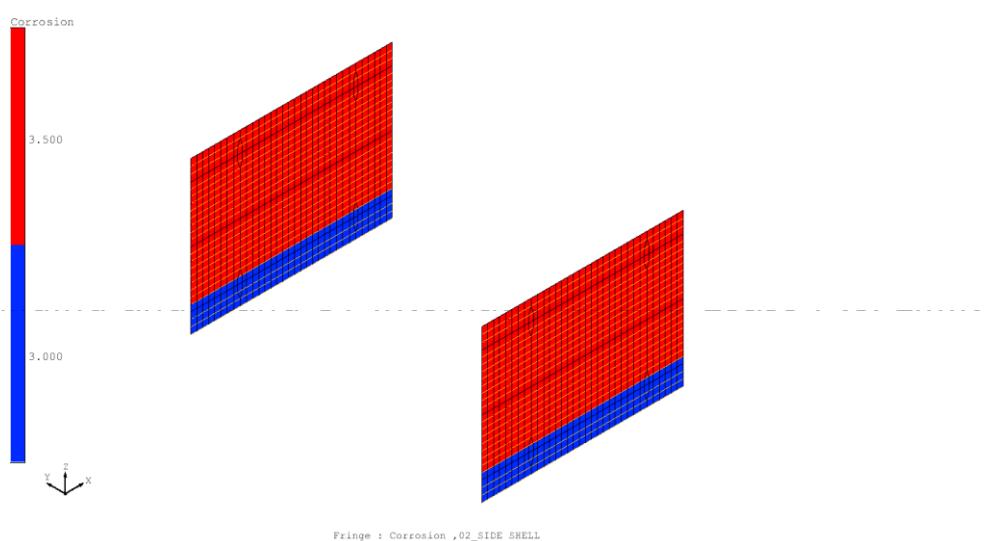


Fig.A1.02.b-F.E. Model and properties of SIDE SHELL(Corrosion)

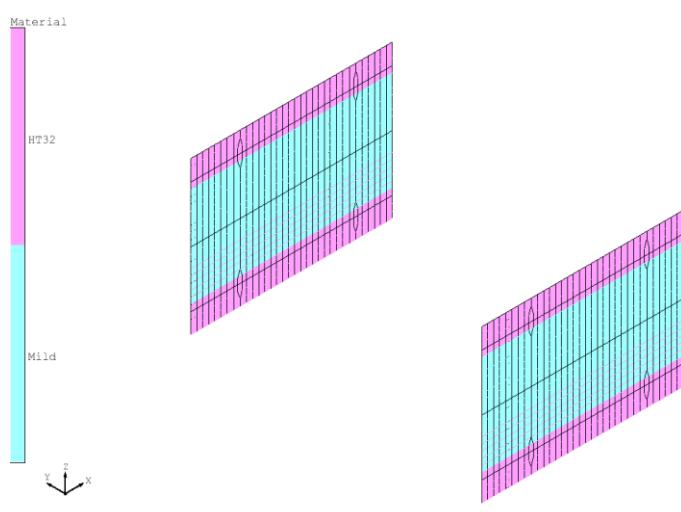


Fig.A1.02.c-F.E. Model and properties of SIDE SHELL(Material)

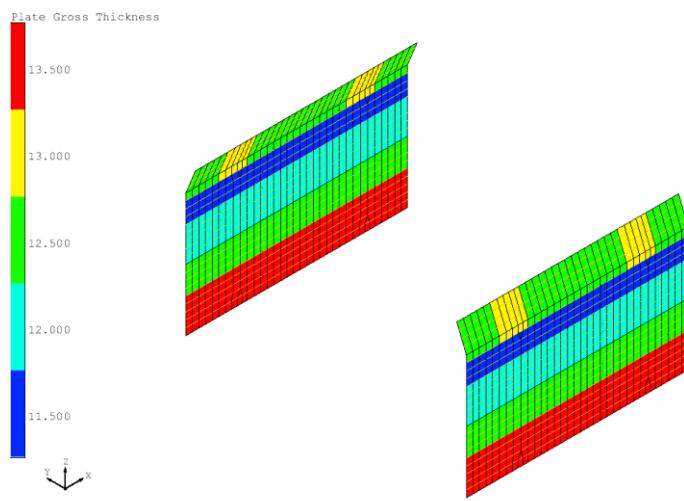


Fig.A1.03.a-F.E. Model and properties of INNER HULL(Gross thickness)

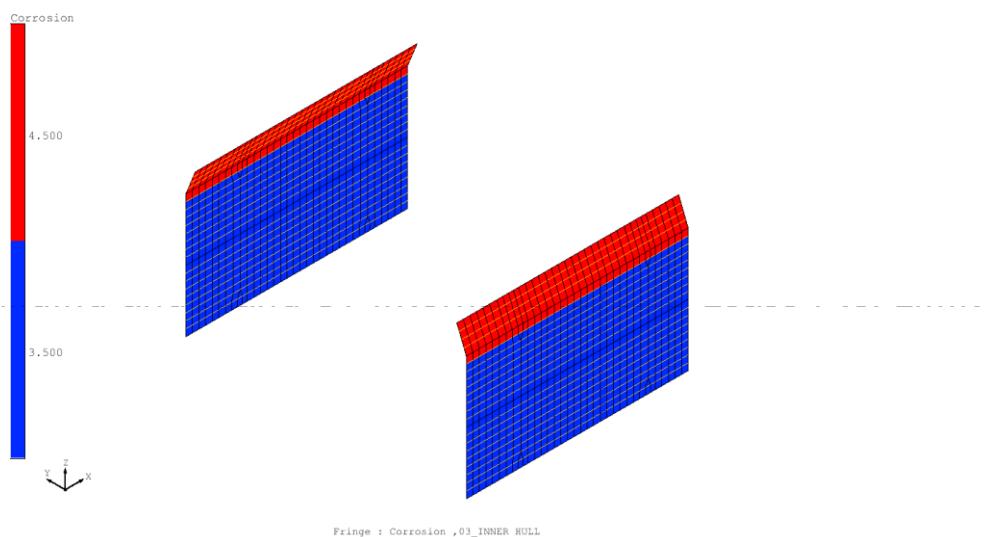


Fig.A1.03.b-F.E. Model and properties of INNER HULL(Corrosion)

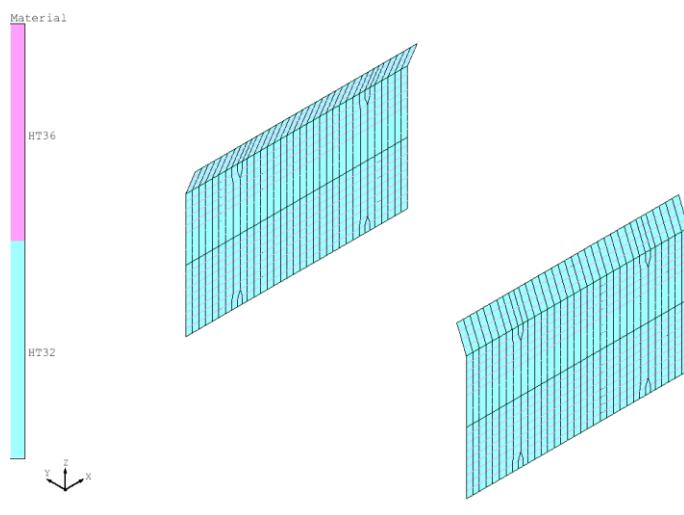


Fig.A1.03.c-F.E. Model and properties of INNER HULL(Material)

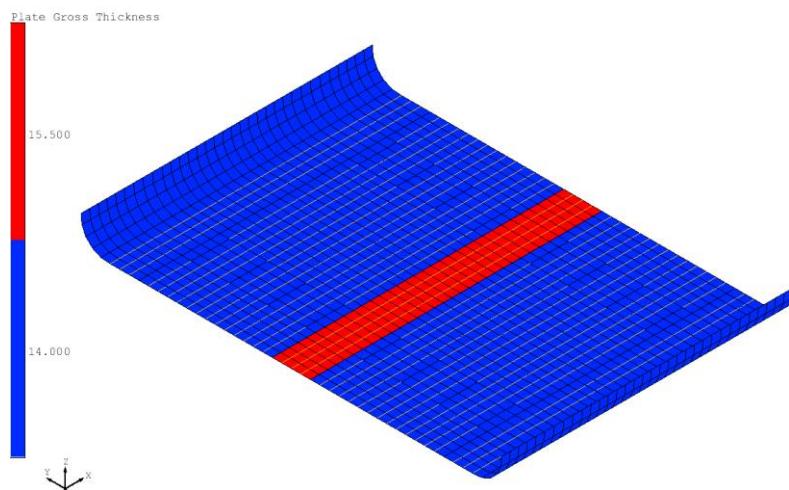


Fig.A1.04.a-F.E. Model and properties of BOTTOM SHELL(Gross thickness)

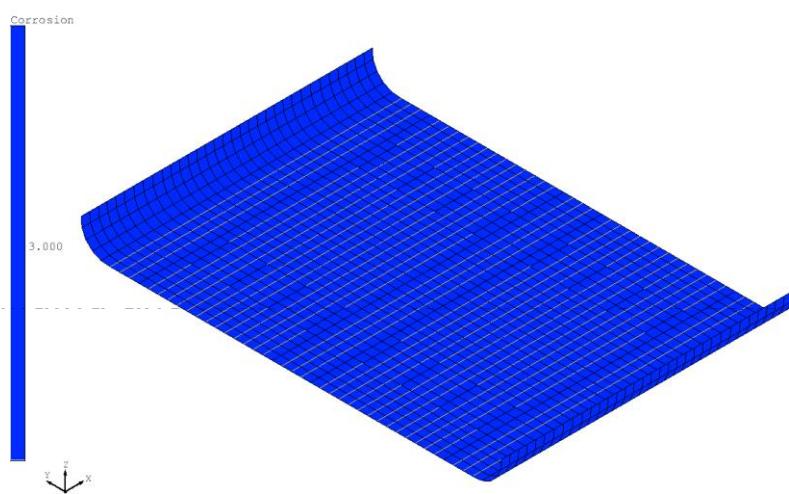


Fig.A1.04.b-F.E. Model and properties of BOTTOM SHELL(Corrosion)

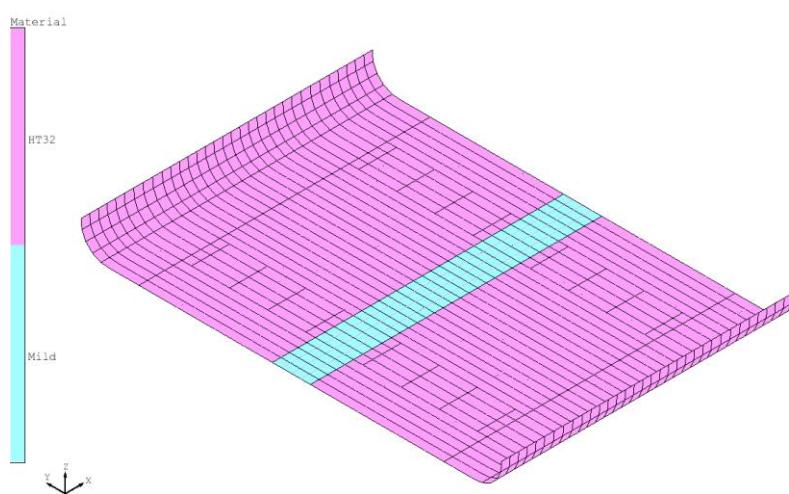
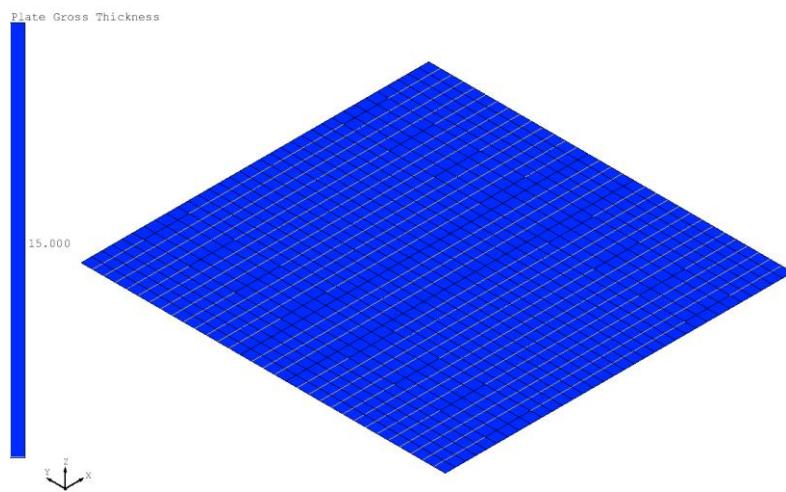
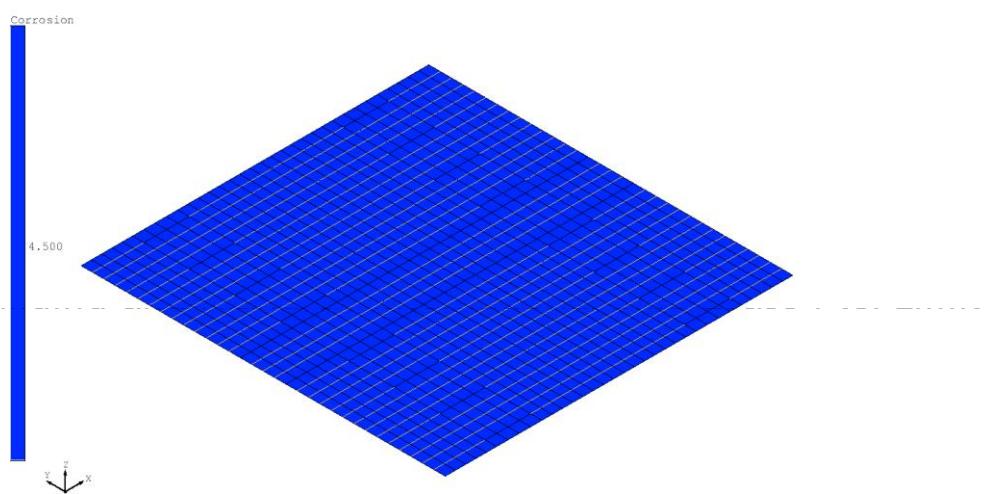


Fig.A1.04.c-F.E. Model and properties of BOTTOM SHELL(Material)



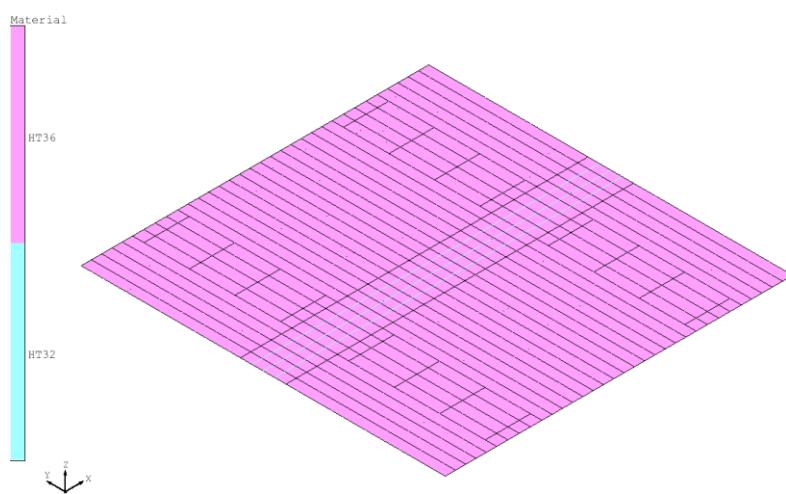
Fringe : Gross Thickness ,05_INNER BOTTOM

Fig.A1.05.a-F.E. Model and properties of INNER BOTTOM(Gross thickness)



Fringe : Corrosion ,05_INNER BOTTOM

Fig.A1.05.b-F.E. Model and properties of INNER BOTTOM(Corrosion)



Fringe : Material ,05_INNER BOTTOM

Fig.A1.05.c-F.E. Model and properties of INNER BOTTOM(Material)

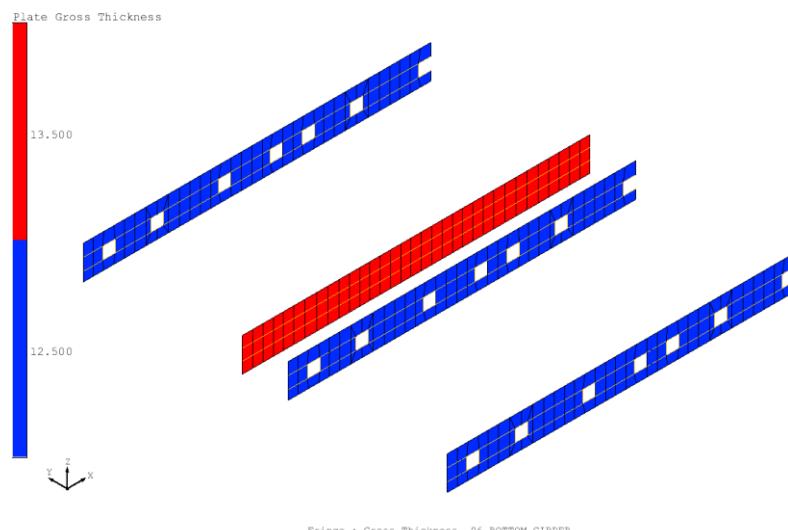


Fig.A1.06.a-F.E. Model and properties of DOUBLE BOTTOM GIRDER(Gross thickness)

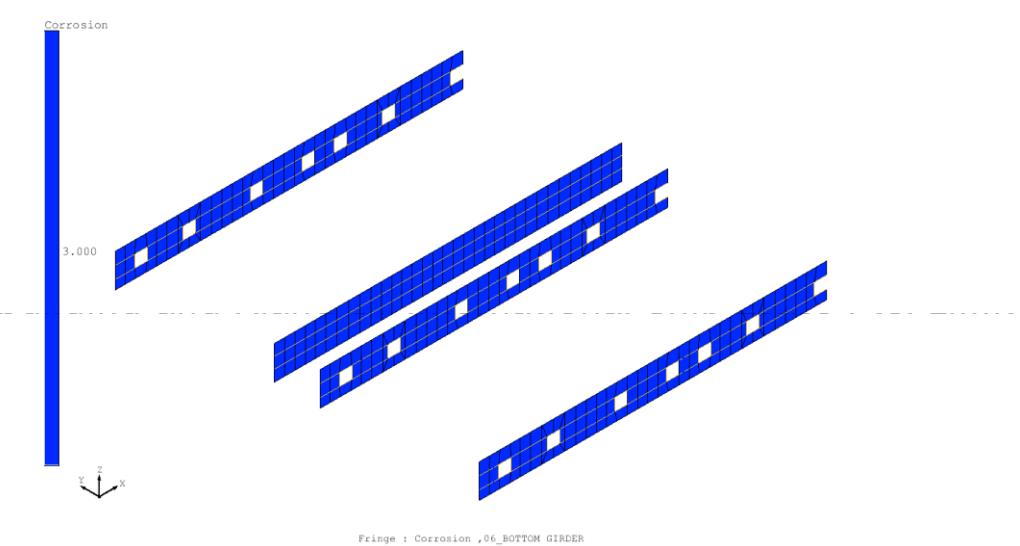


Fig.A1.06.b-F.E. Model and properties of DOUBLE BOTTOM GIRDER(Corrosion)

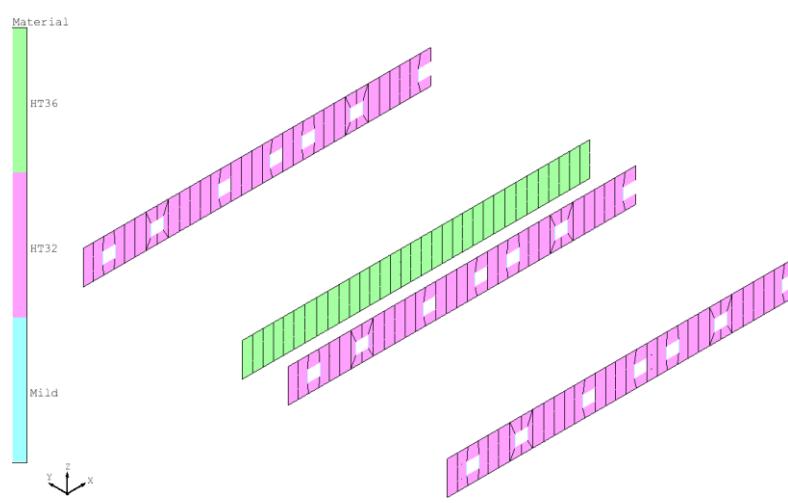


Fig.A1.06.c-F.E. Model and properties of DOUBLE BOTTOM GIRDER(Material)

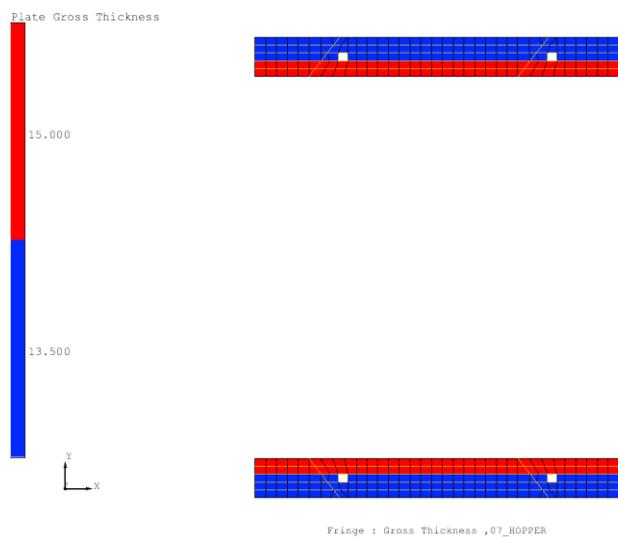


Fig.A1.07.a-F.E. Model and properties of HOPPER PLATE(Gross thickness)

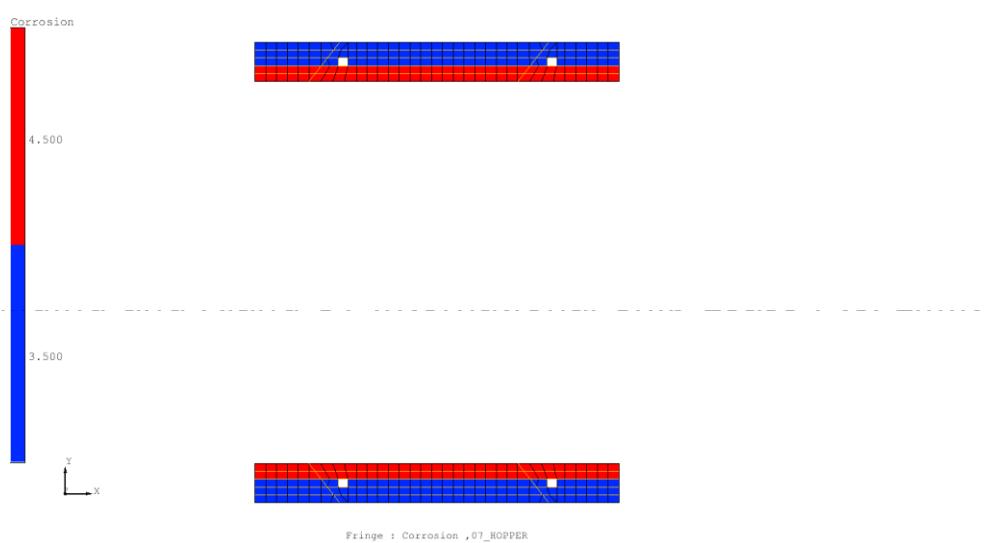


Fig.A1.07.b-F.E. Model and properties of HOPPER PLATE(Corrosion)

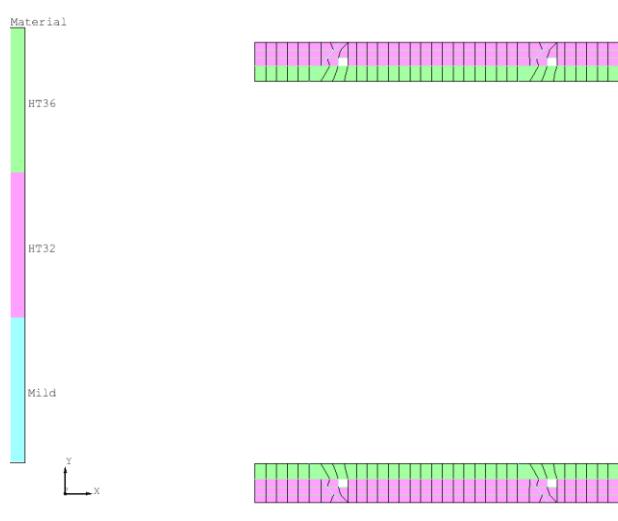


Fig.A1.07.c-F.E. Model and properties of HOPPER PLATE(Material)

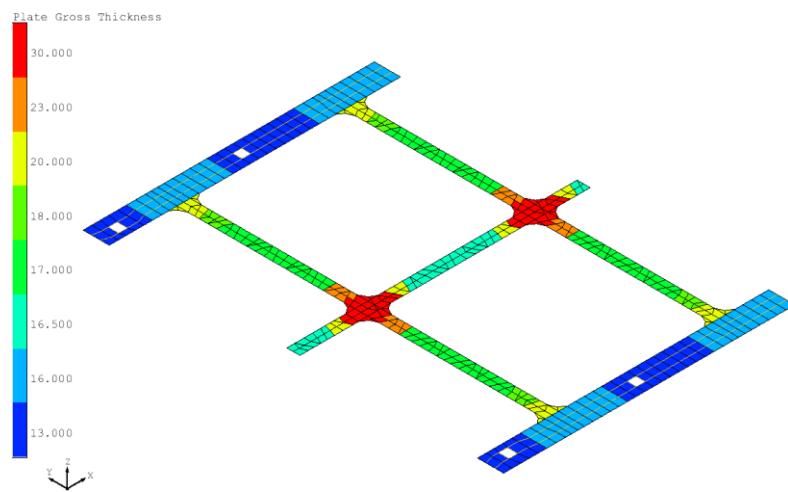


Fig.A1.08.a-F.E. Model and properties of NO.1 STRINGER(Gross thickness)

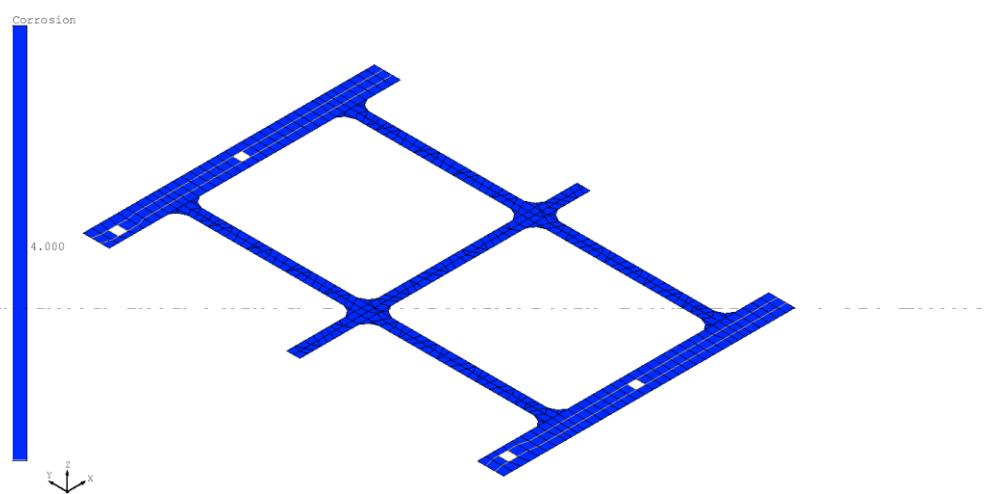


Fig.A1.08.b-F.E. Model and properties of NO.1 STRINGER(Corrosion)

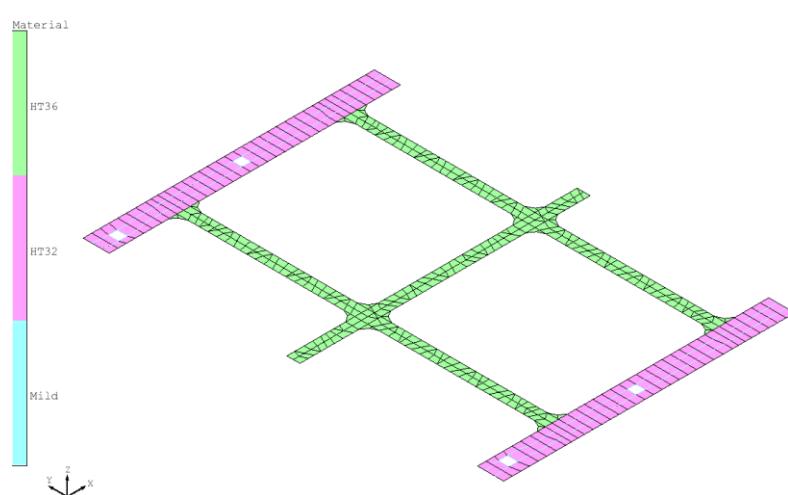


Fig.A1.08.c-F.E. Model and properties of NO.1 STRINGER(Material)

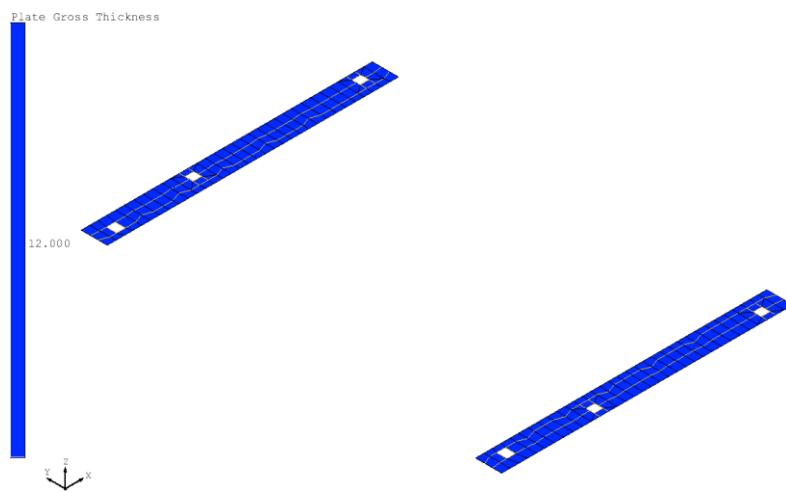


Fig.A1.09.a-F.E. Model and properties of NO.2 STRINGER(Gross thickness)

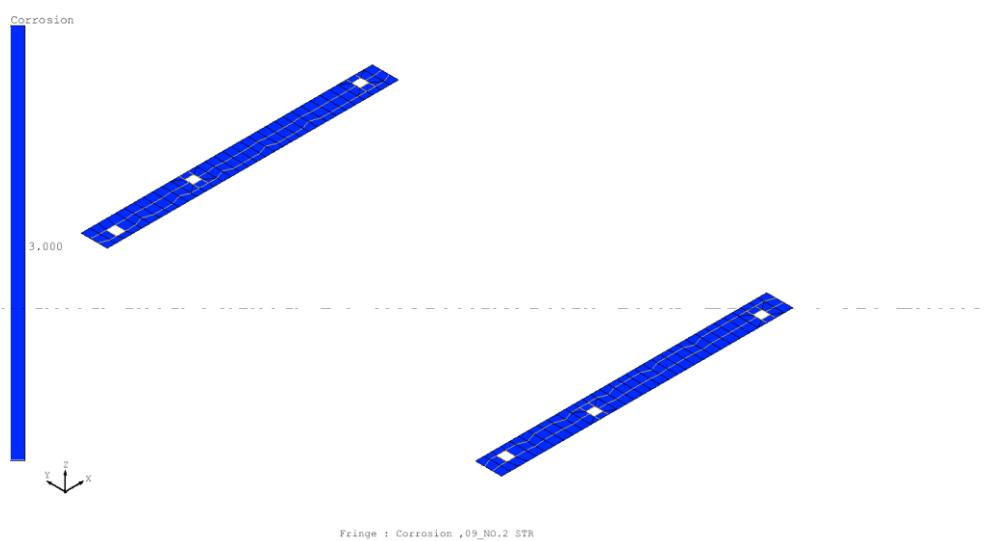


Fig.A1.09.b-F.E. Model and properties of NO.2 STRINGER(Corrosion)

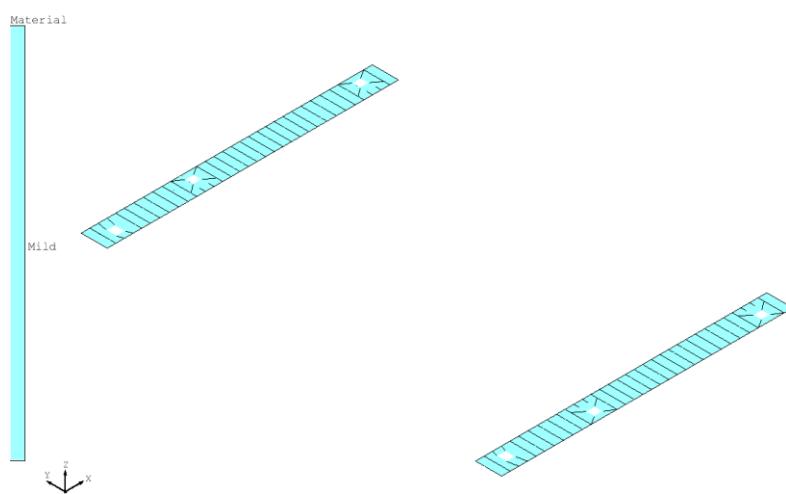


Fig.A1.09.c-F.E. Model and properties of NO.2 STRINGER(Material)

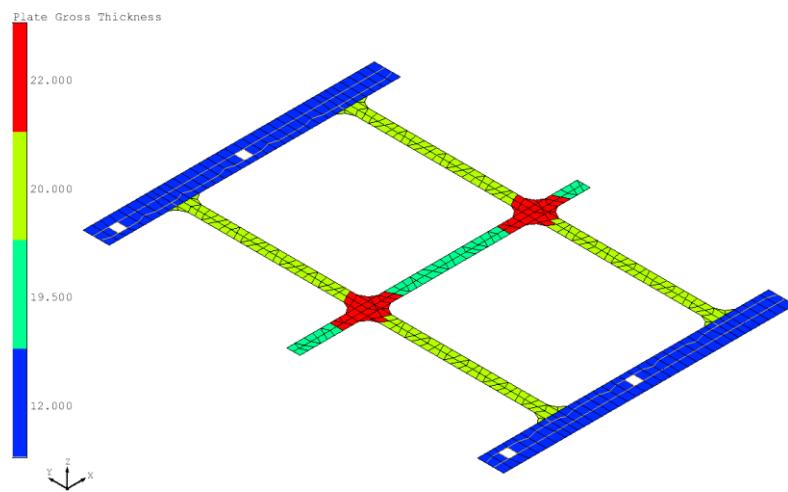


Fig.A1.10.a-F.E. Model and properties of NO.3 STRINGER(Gross thickness)

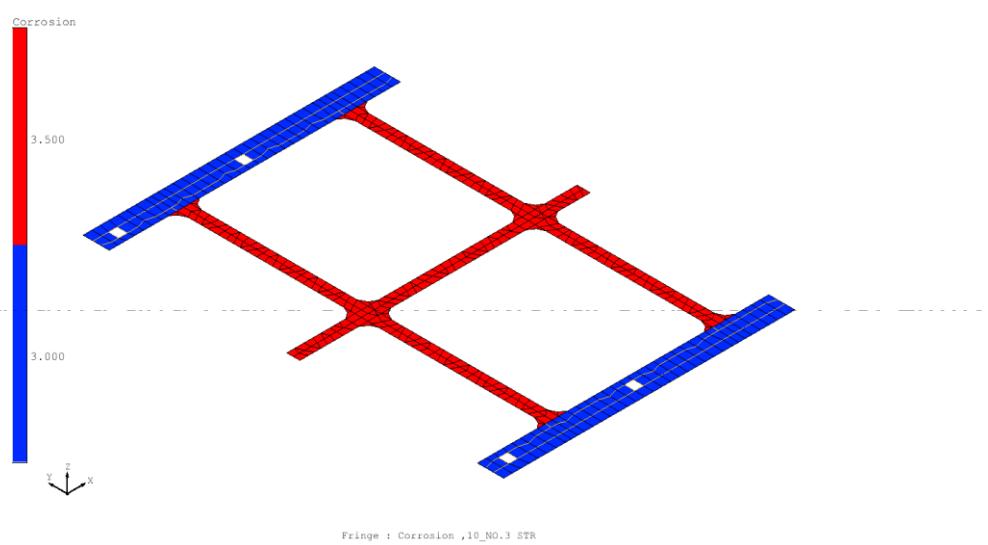


Fig.A1.10.b-F.E. Model and properties of NO.3 STRINGER(Corrosion)

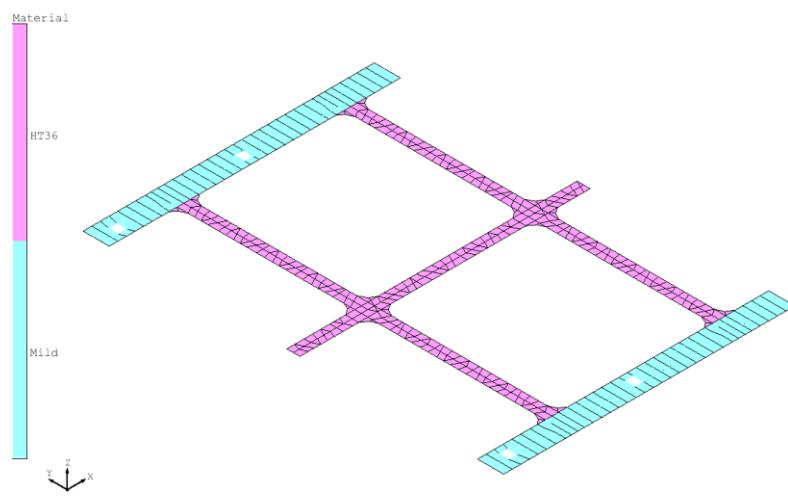


Fig.A1.10.c-F.E. Model and properties of NO.3 STRINGER(Material)

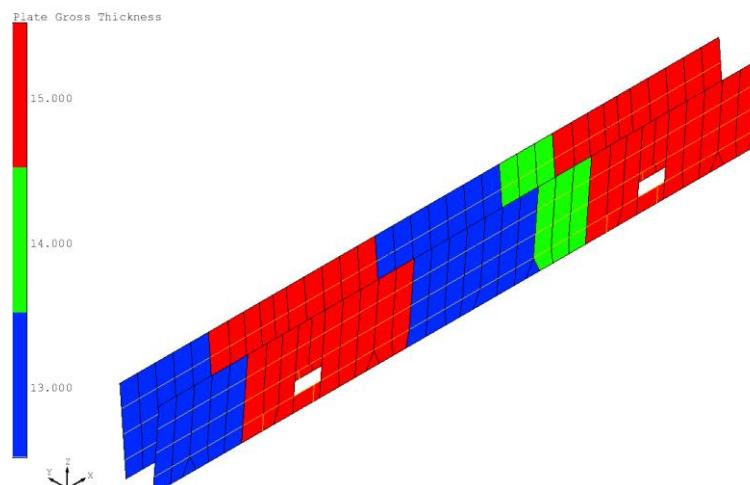


Fig.A1.11.a-F.E. Model and properties of LONG'L UPPER STOOL(Gross thickness)

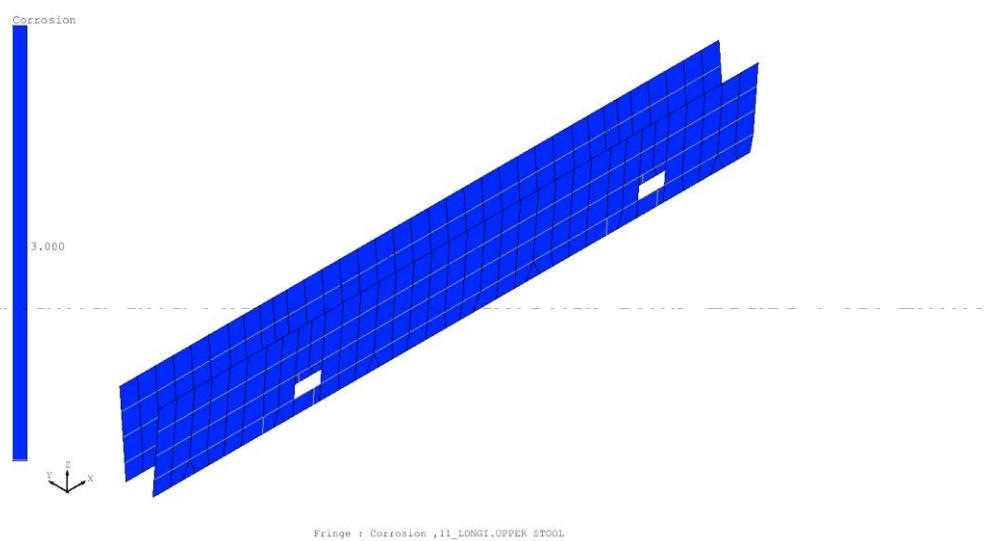


Fig.A1.11.b-F.E. Model and properties of LONG'L UPPER STOOL(Corrosion)

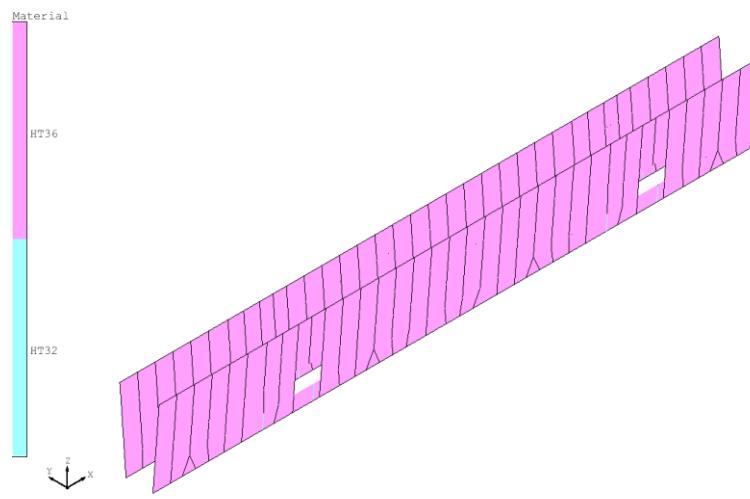


Fig.A1.11.c-F.E. Model and properties of LONG'L UPPER STOOL(Material)

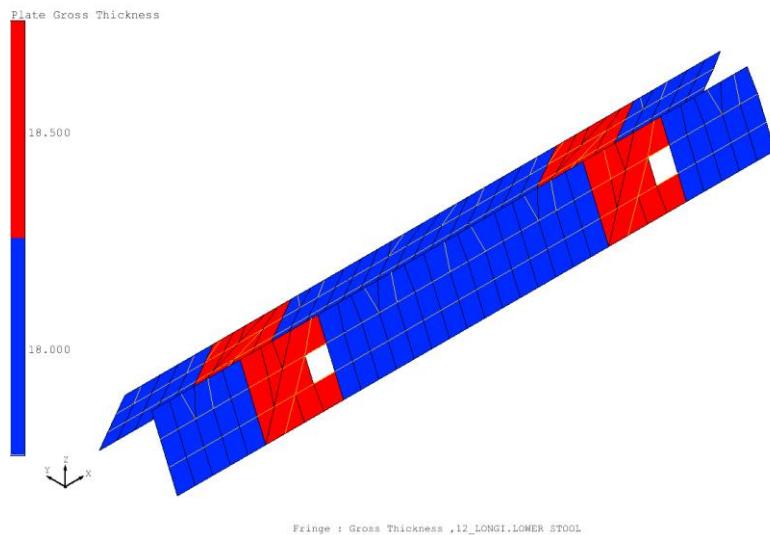


Fig.A1.12.a-F.E. Model and properties of LONG'L LOWER STOOL(Gross thickness)

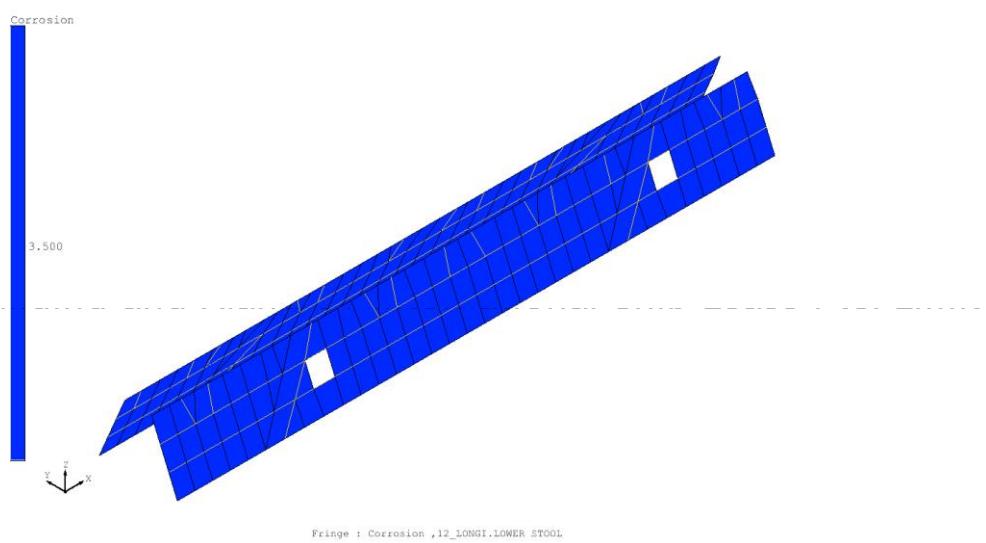


Fig.A1.12.b-F.E. Model and properties of LONG'L LOWER STOOL(Corrosion)

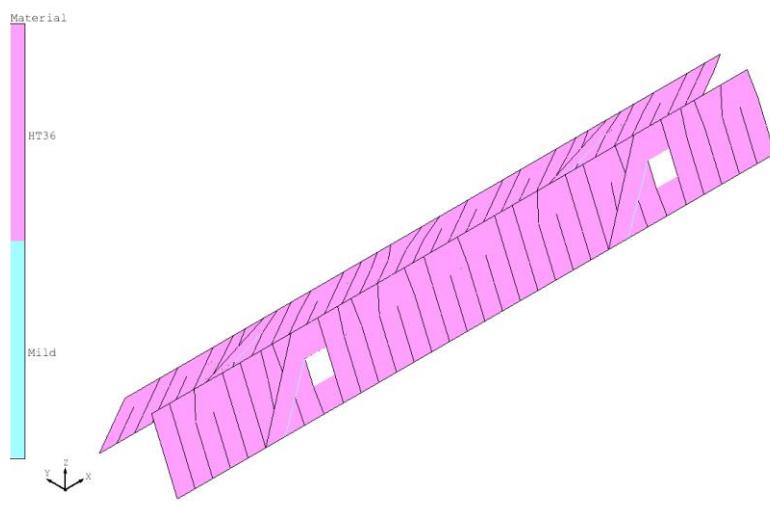


Fig.A1.12.c-F.E. Model and properties of LONG'L LOWER STOOL(Material)

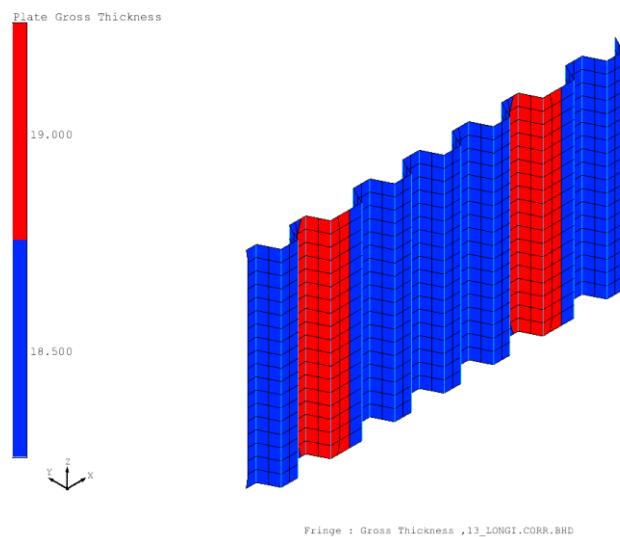


Fig.A1.13.a-F.E. Model and properties of LONG'L CORR. BHD(Gross thickness)

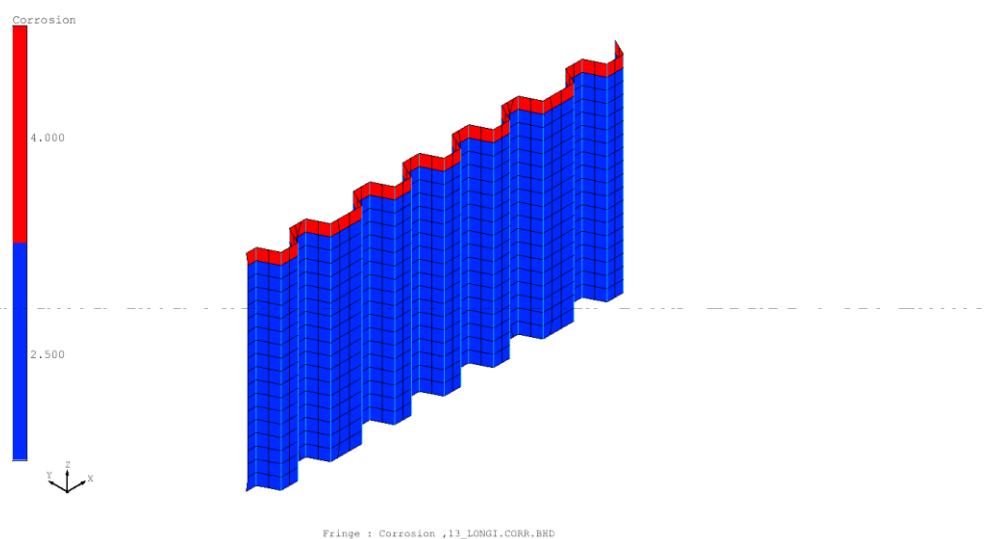


Fig.A1.13.b-F.E. Model and properties of LONG'L CORR. BHD(Corrosion)

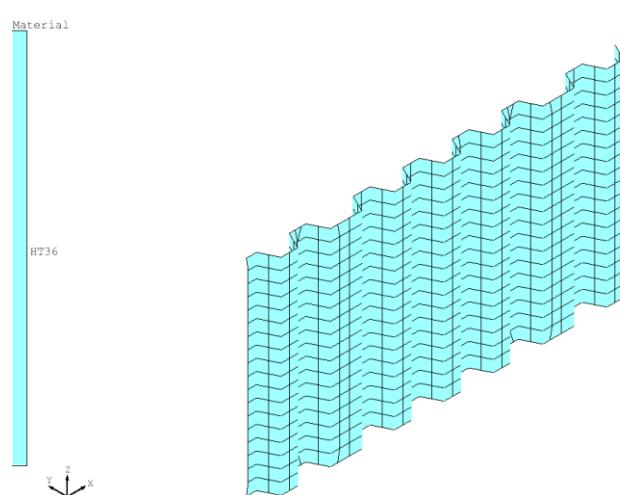
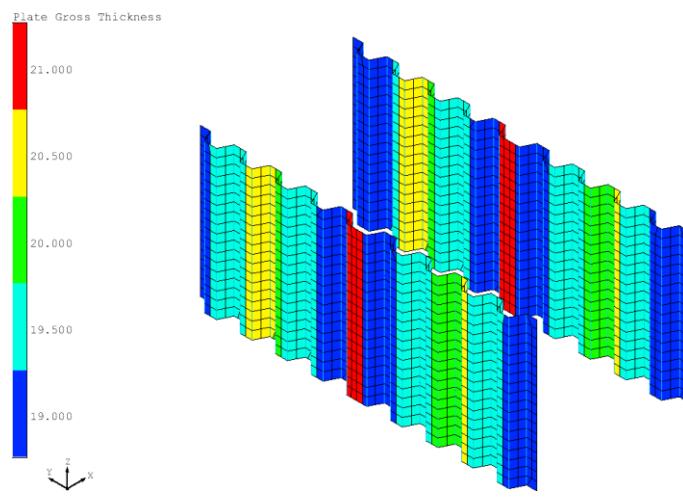
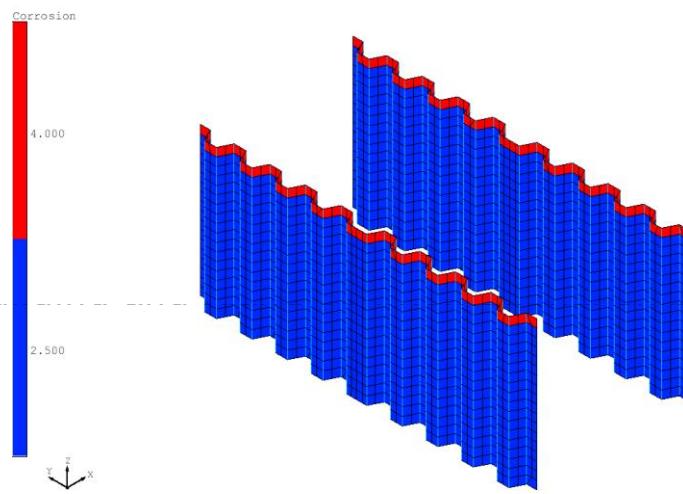


Fig.A1.13.c-F.E. Model and properties of LONG'L CORR. BHD(Material)



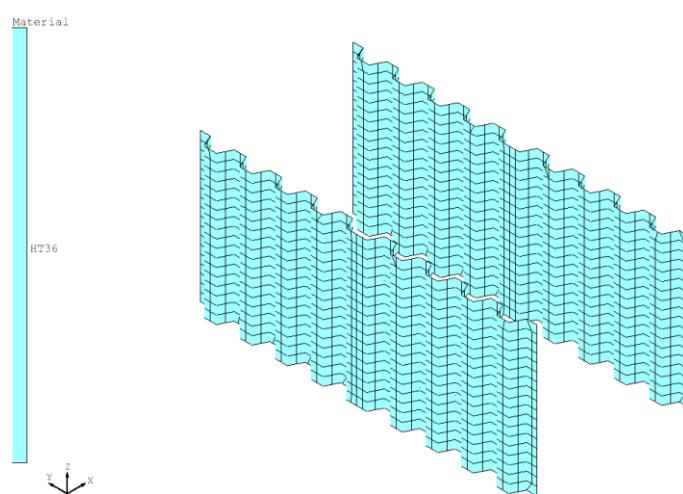
Fringe : Gross Thickness ,14_TRANS.CORR.BHD

Fig.A1.14.a-F.E. Model and properties of TRANS. CORR. BHD(Gross thickness)



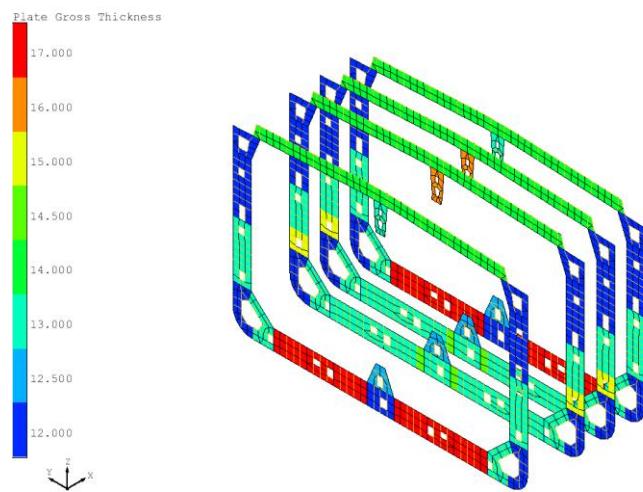
Fringe : Corrosion ,14_TRANS.CORR.BHD

Fig.A1.14.b-F.E. Model and properties of TRANS. CORR. BHD(Corrosion)



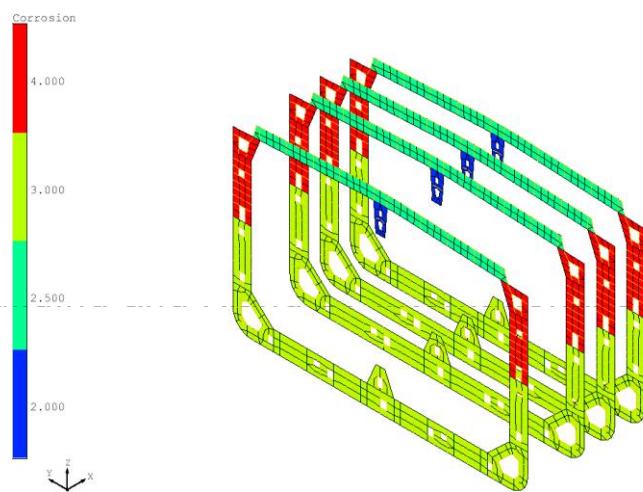
Fringe : Material ,14_TRANS.CORR.BHD

Fig.A1.14.c-F.E. Model and properties of TRANS. CORR. BHD(Material)



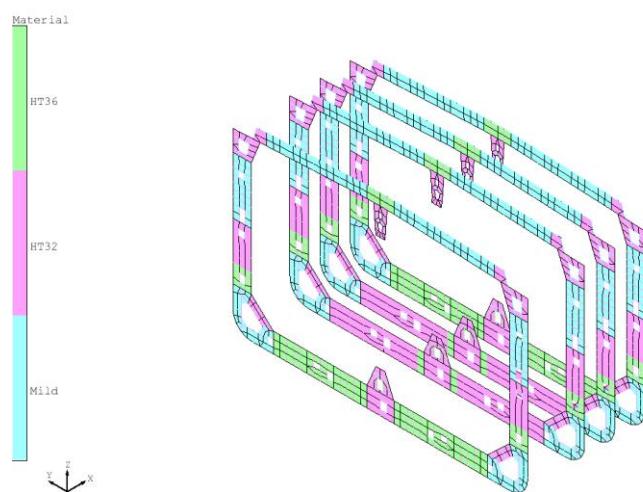
Fringe : Gross Thickness ,15_TYP.WEB

Fig.A1.15.a-F.E. Model and properties of TYP. WEB FRAME(Gross thickness)



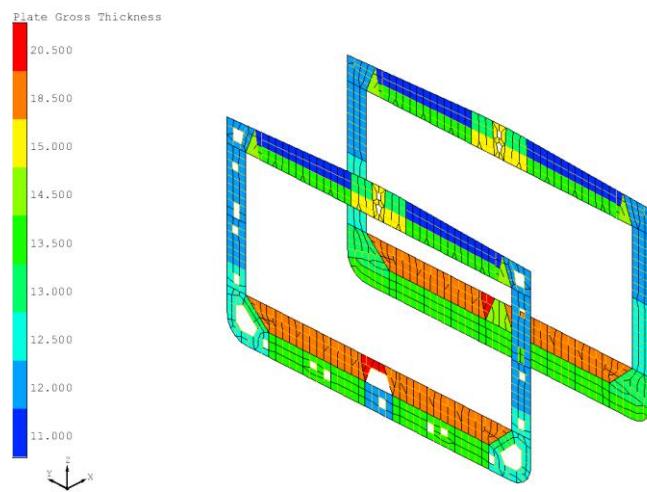
Fringe : Corrosion ,15_TYP.WEB

Fig.A1.15.b-F.E. Model and properties of TYP. WEB FRAME(Corrosion)



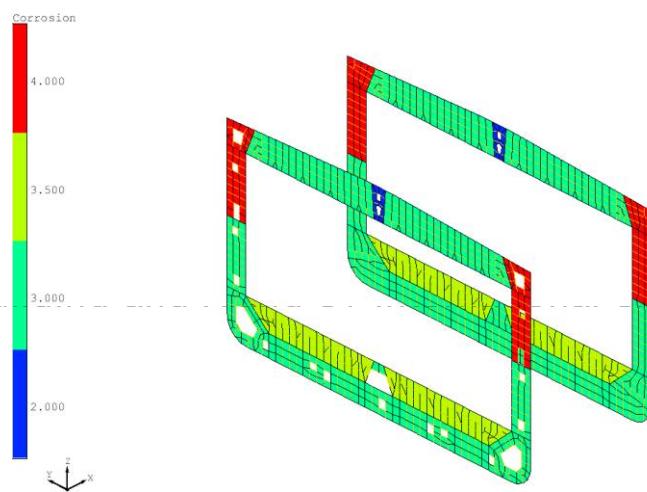
Fringe : Material ,15_TYP.WEB

Fig.A1.15.c-F.E. Model and properties of TYP. WEB FRAME(Material)



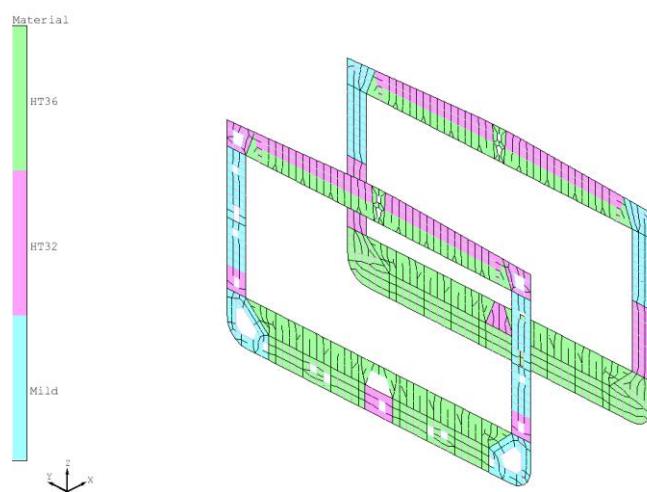
Fringe : Gross Thickness ,16_TRANS.BHD

Fig.A1.16.a-F.E. Model and properties of TRANS. BULKHEAD(Gross thickness)



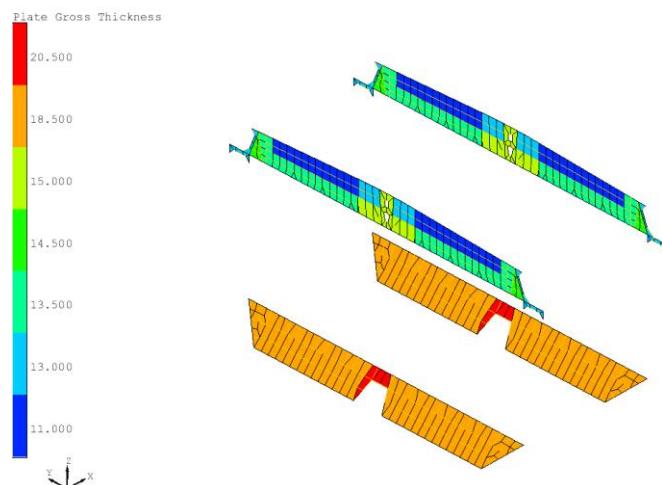
Fringe : Corrosion ,16_TRANS.BHD

Fig.A1.16.b-F.E. Model and properties of TRANS. BULKHEAD(Corrosion)



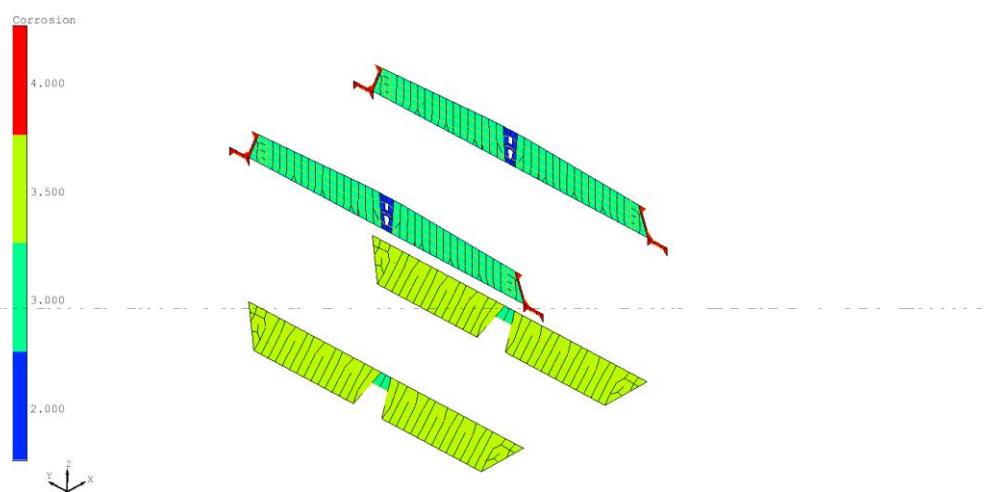
Fringe : Material ,16_TRANS.BHD

Fig.A1.16.c-F.E. Model and properties of TRANS. BULKHEAD(Material)



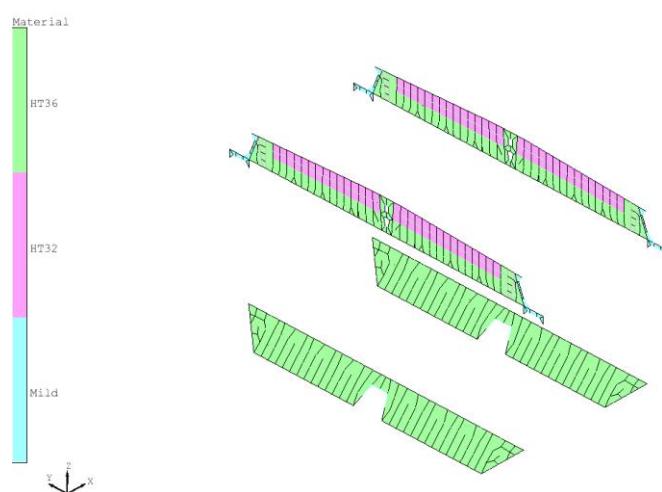
Fringe : Gross Thickness ,17_TRANS.BHD-1000

Fig.A1.17.a-F.E. Model and properties of TRANS. BHD-1000SEC.(Gross thickness)



Fringe : Corrosion ,17_TRANS.BHD-1000

Fig.A1.17.b-F.E. Model and properties of TRANS. BHD-1000SEC.(Corrosion)



Fringe : Material ,17_TRANS.BHD-1000

Fig.A1.17.c-F.E. Model and properties of TRANS. BHD-1000SEC.(Material)

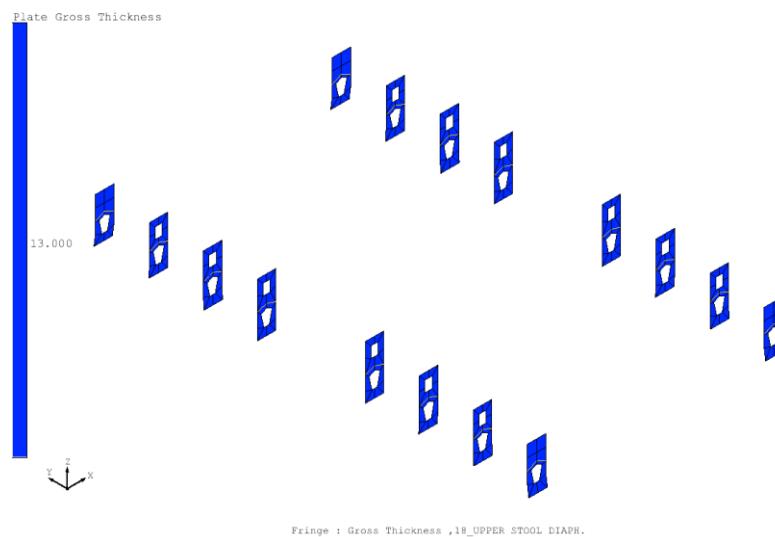


Fig.A1.18.a-F.E. Model and properties of UPPER STOOL DIAPH.(Gross thickness)

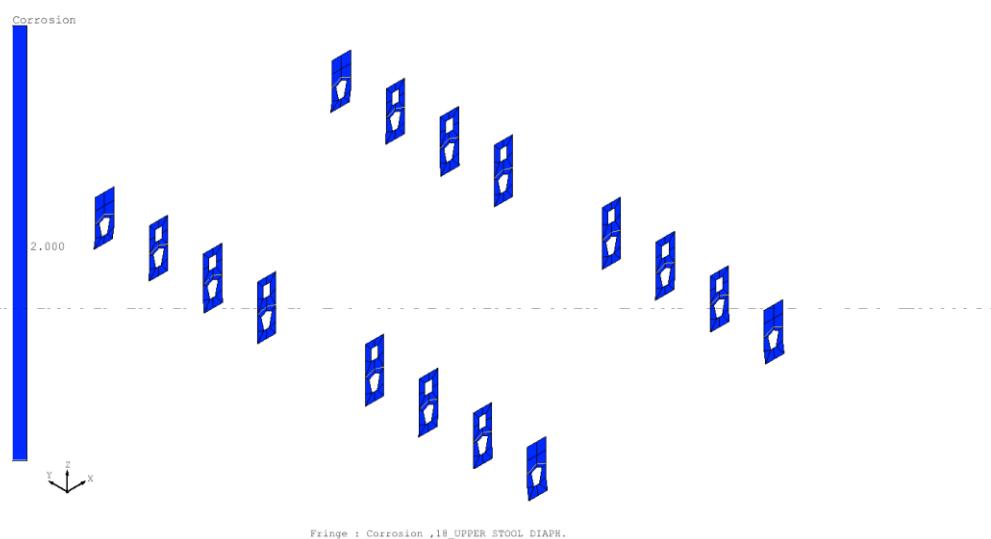


Fig.A1.18.b-F.E. Model and properties of UPPER STOOL DIAPH.(Corrosion)

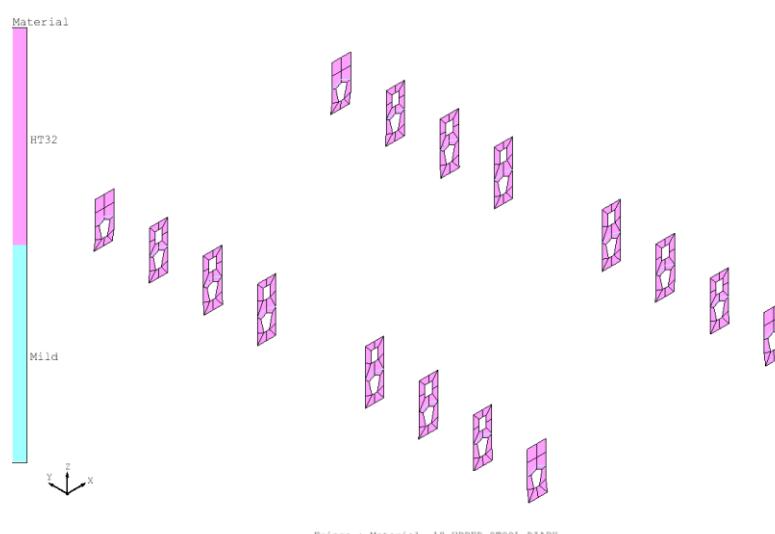


Fig.A1.18.c-F.E. Model and properties of UPPER STOOL DIAPH.(Material)

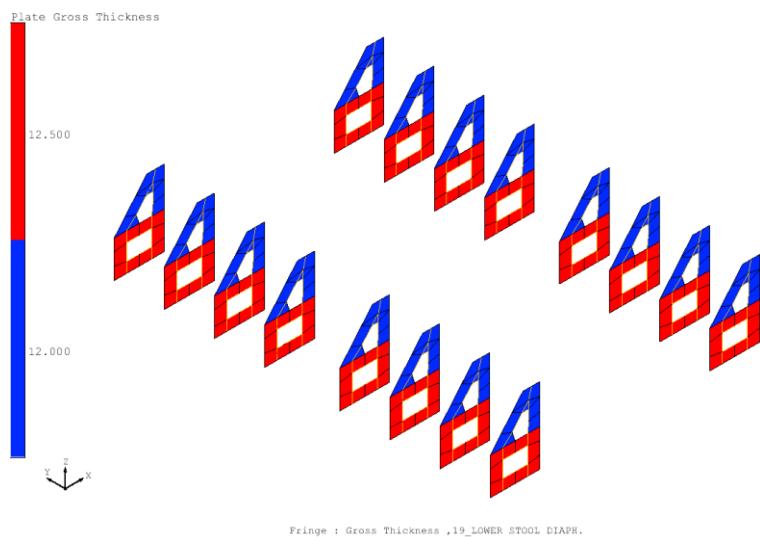


Fig.A1.19.a-F.E. Model and properties of LOWER STOOL DIAPH.(Gross thickness)

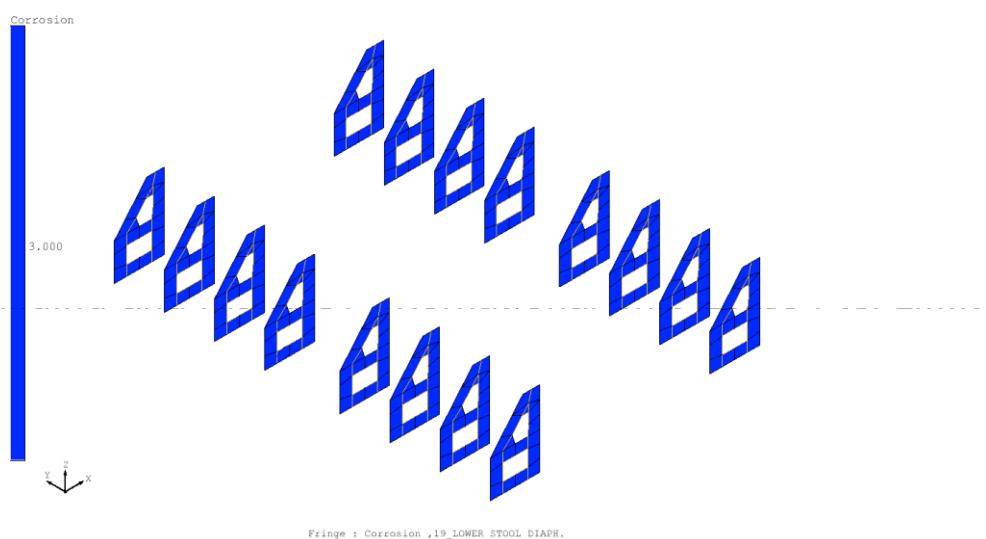


Fig.A1.19.b-F.E. Model and properties of LOWER STOOL DIAPH.(Corrosion)

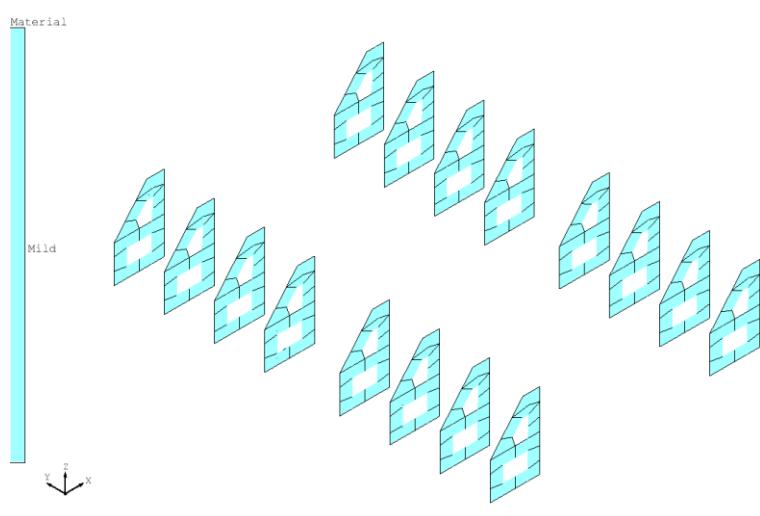


Fig.A1.19.c-F.E. Model and properties of LOWER STOOL DIAPH.(Material)

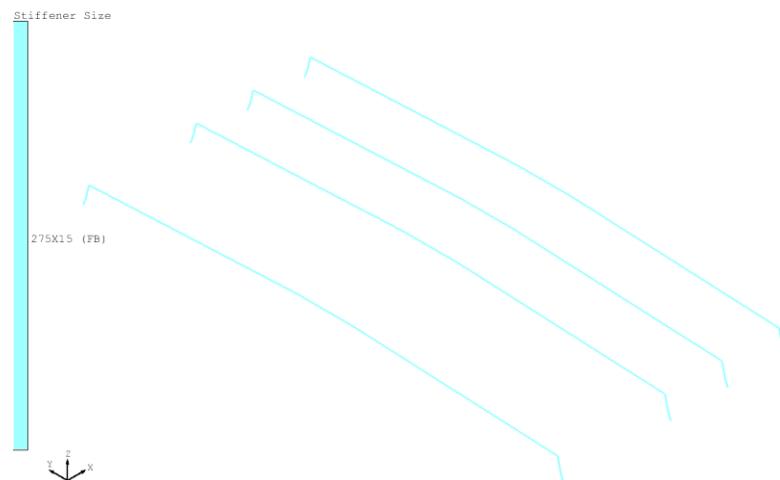


Fig.A1.20.a-F.E. Model and properties of DECK TRANSVERSE BEAM(Gross thickness)

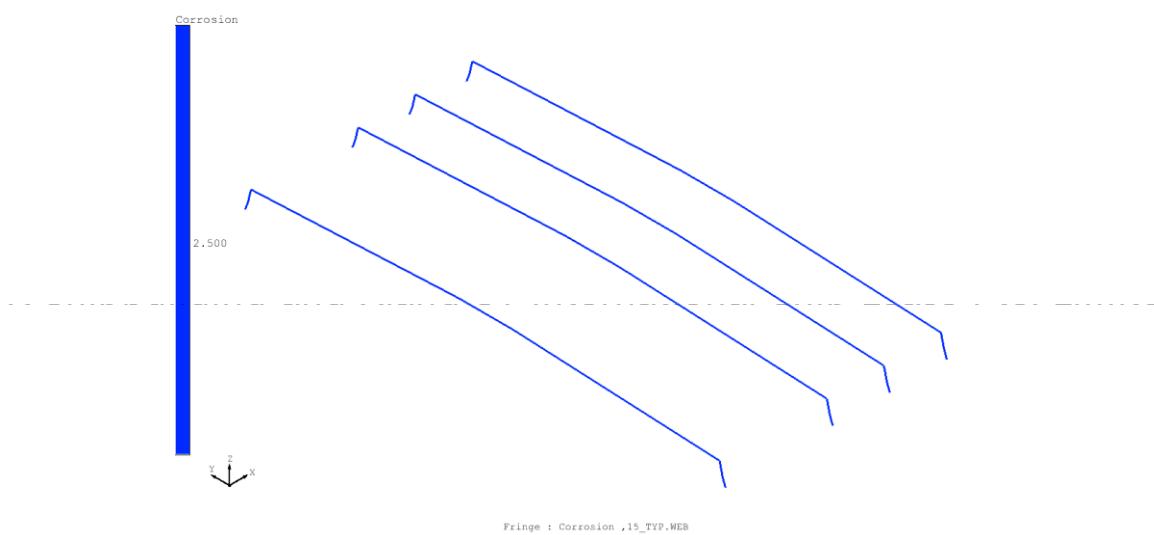


Fig.A1.20.b-F.E. Model and properties of DECK TRANSVERSE BEAM(Corrosion)

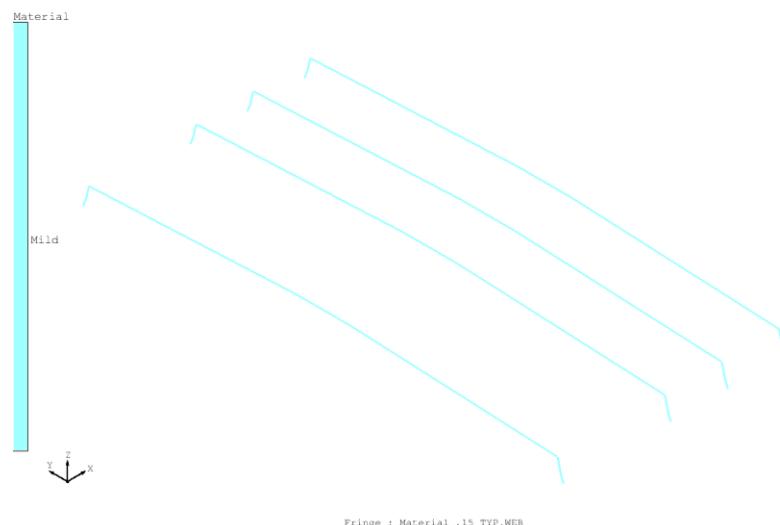
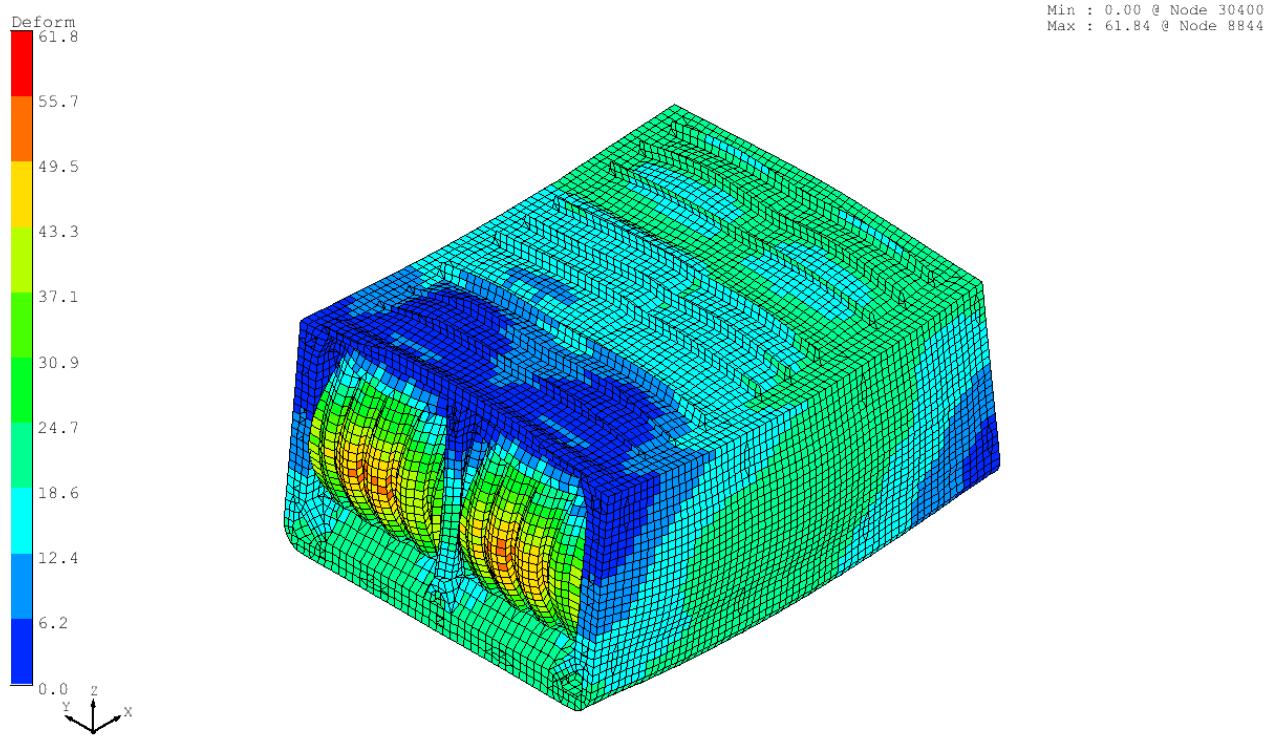


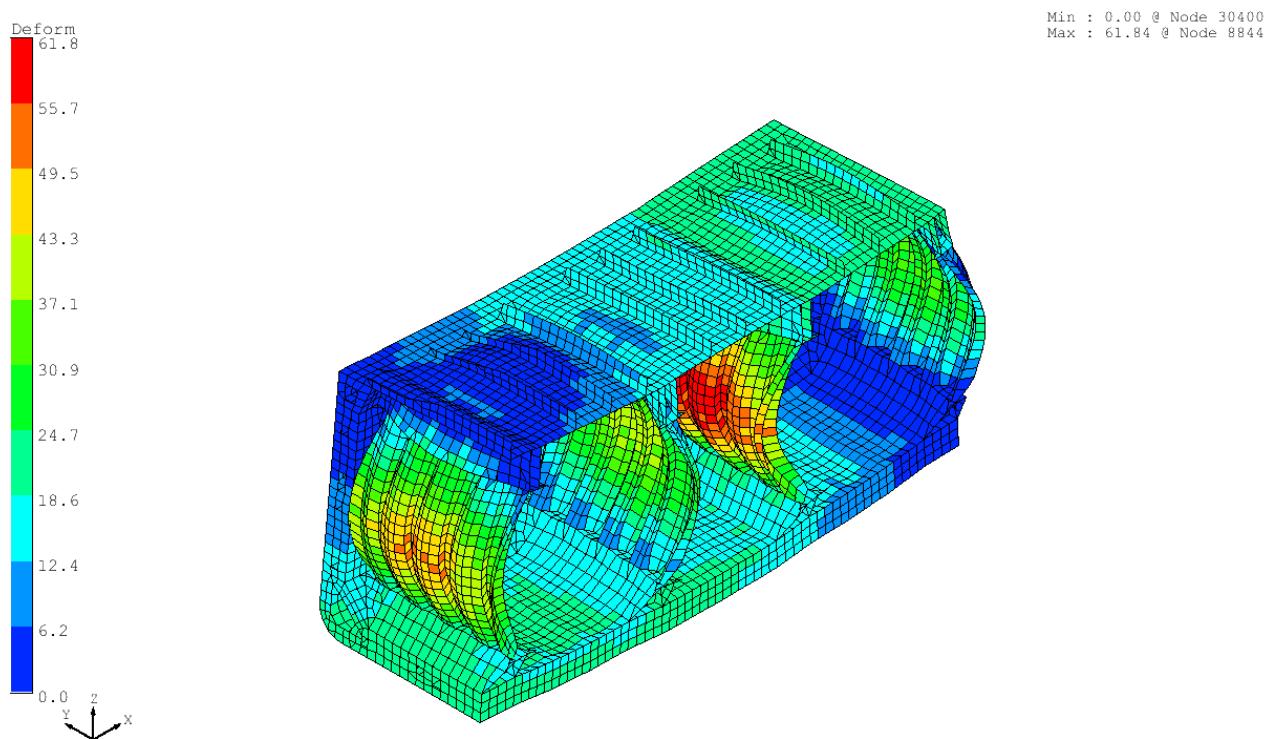
Fig.A1.20.c-F.E. Model and properties of DECK TRANSVERSE BEAM(Material)



Appendix.2- Deformed Shape



Fringe : Element Deform ,Default, 001_B01_1_HSM_1



Fringe : Element Deform ,Default, 001_B01_1_HSM_1

Fig.A2.01 – Deformed shape, LC001_B01-1_HSM_1

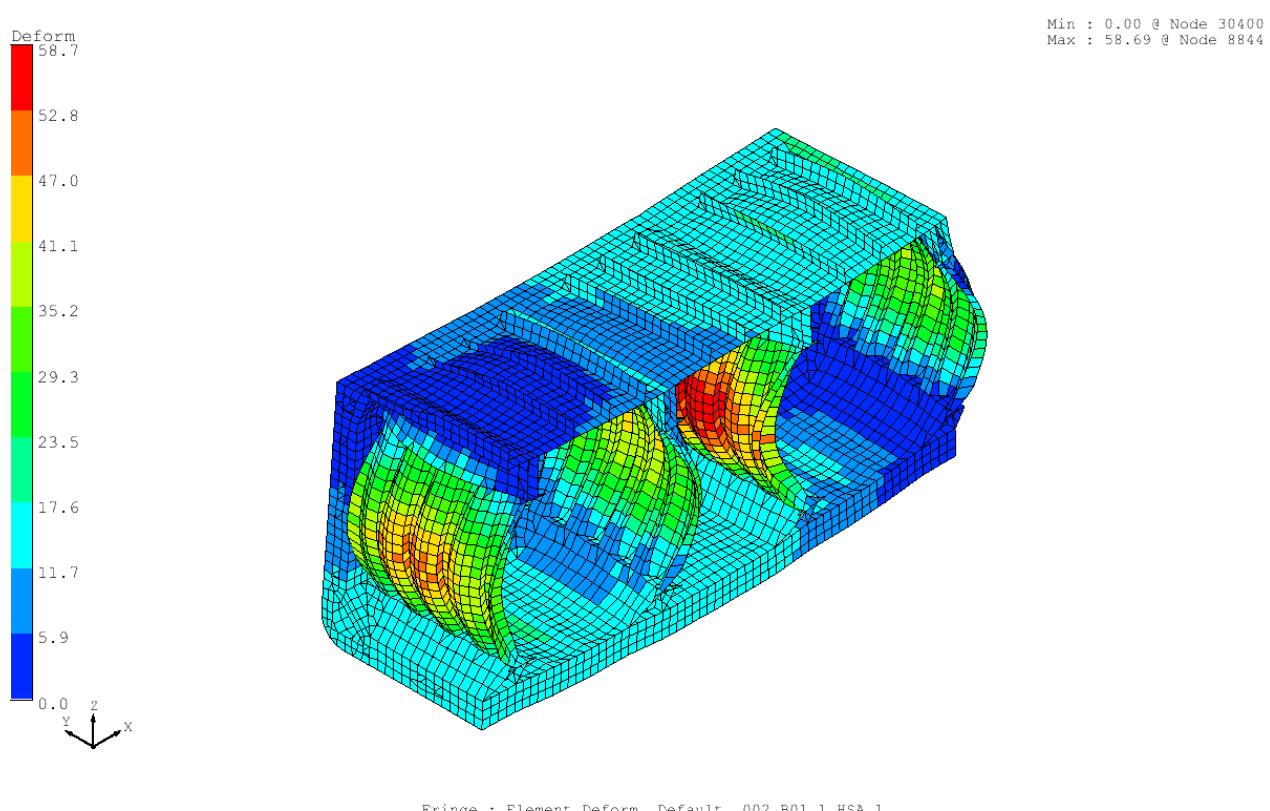
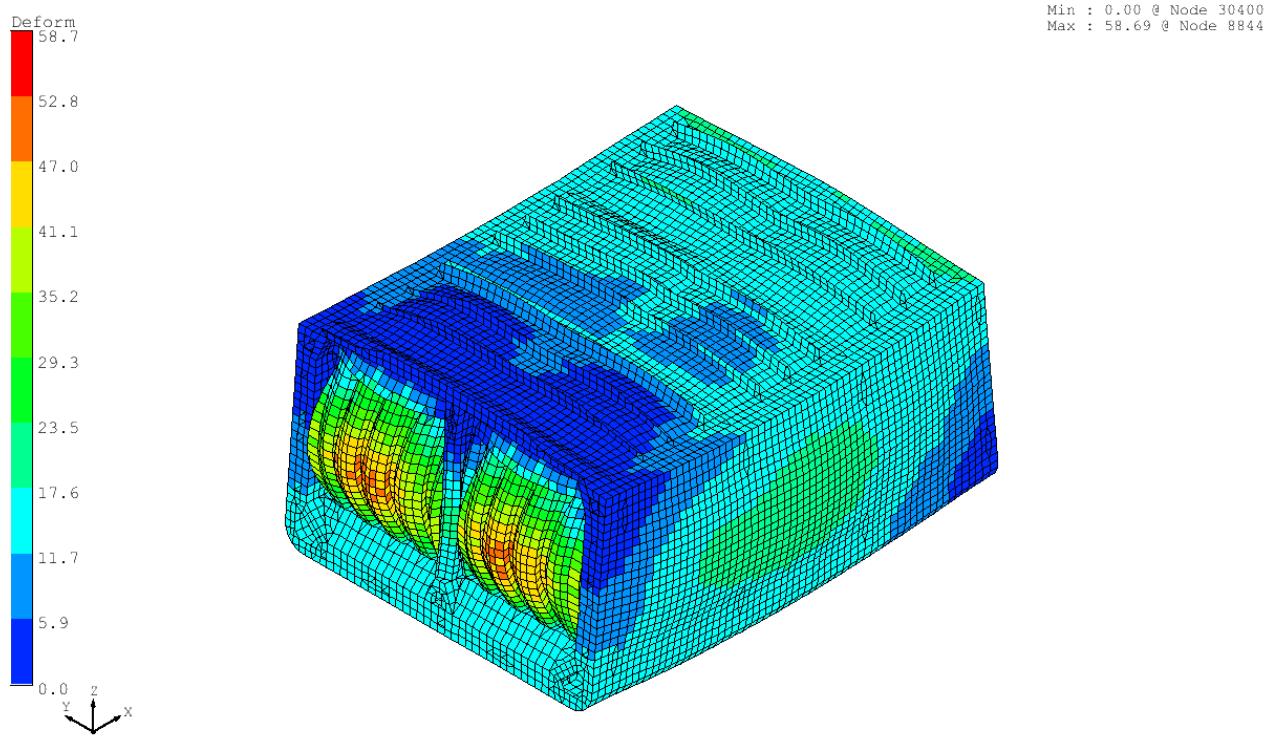


Fig.A2.02 – Deformed shape, LC002_B01-1_HSA_1

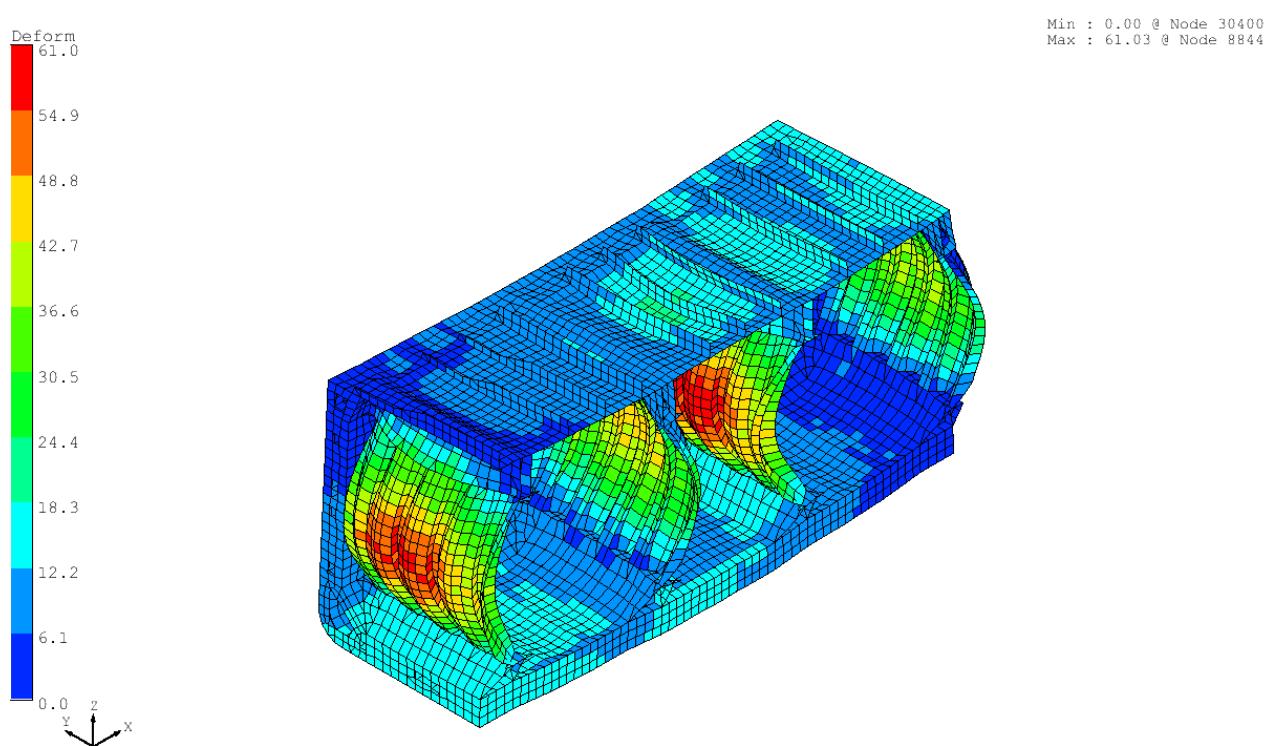
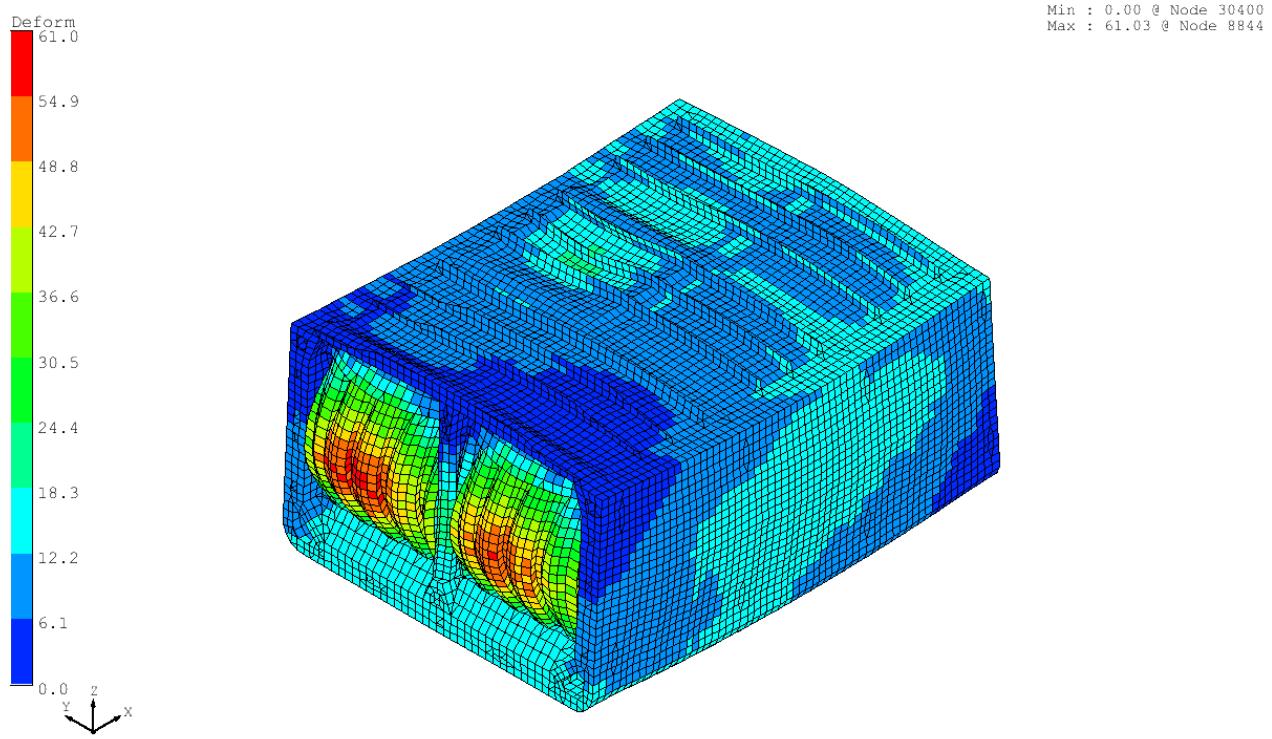
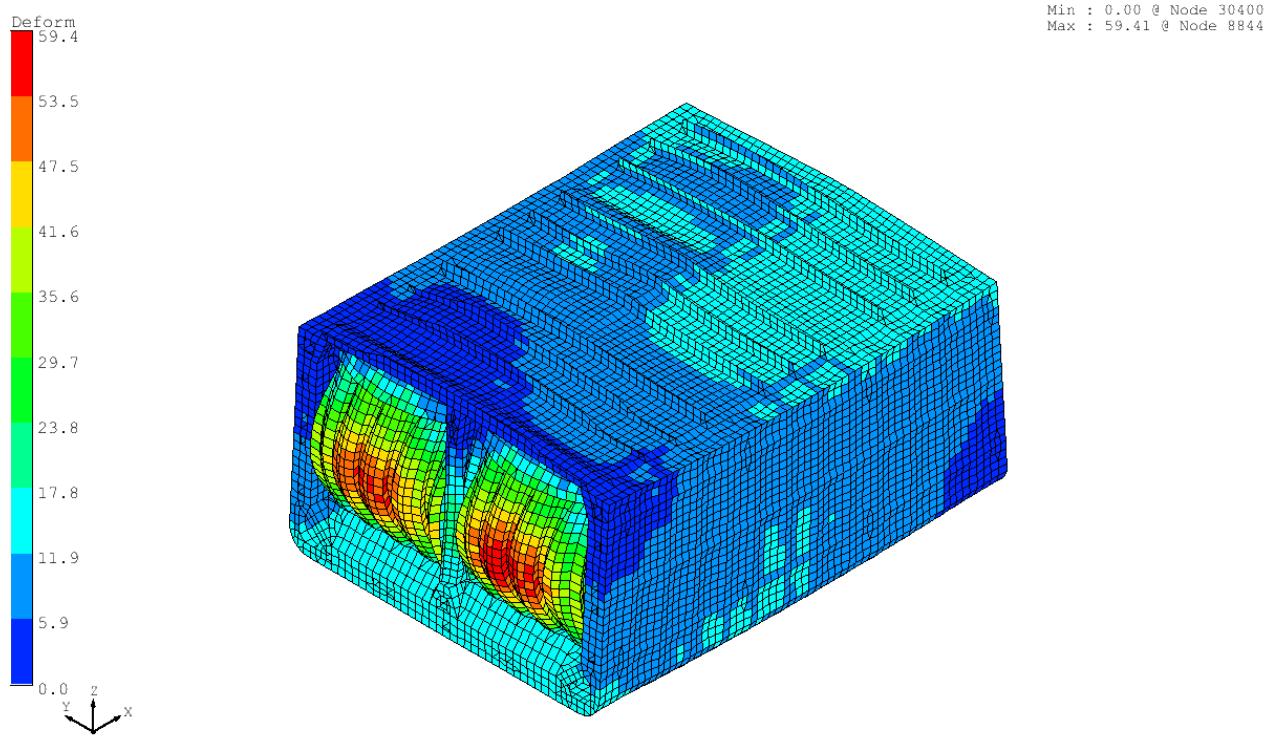
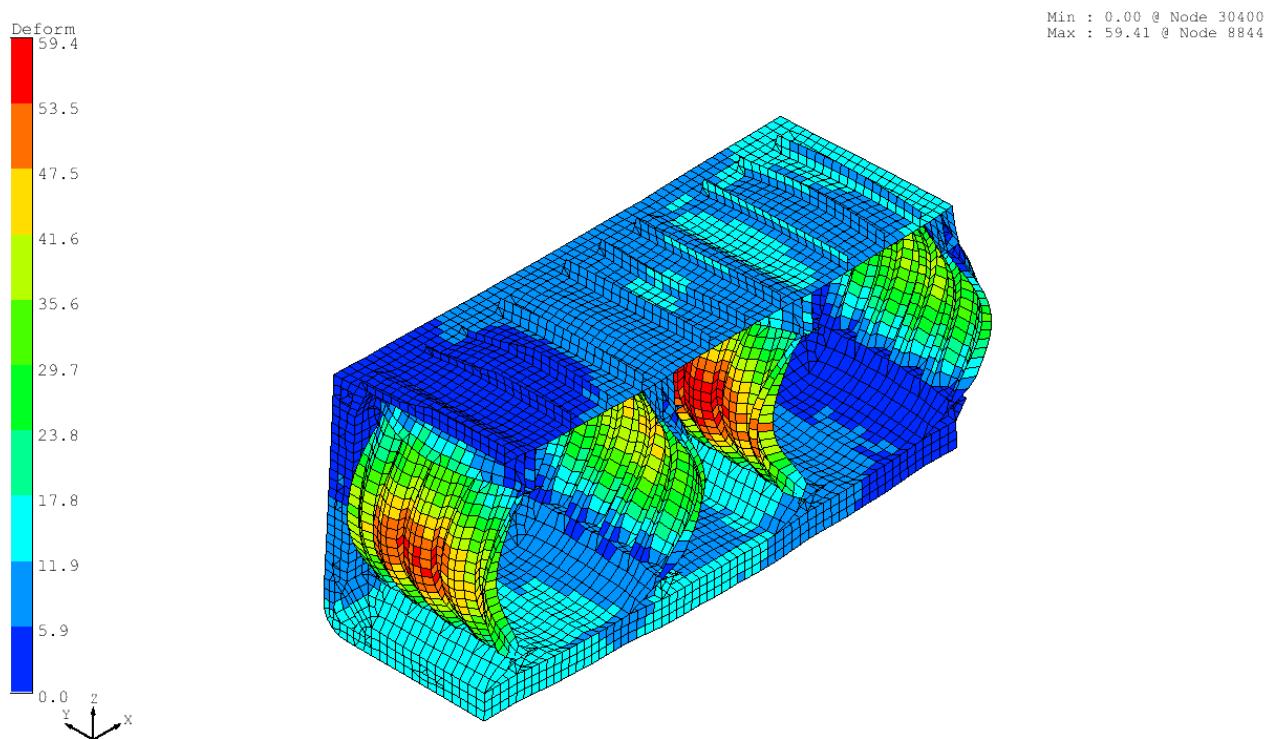


Fig.A2.03 – Deformed shape, LC003_B01-1_BSP_1P



Fringe : Element Deform ,Default, 004_B01_1_BSP_1S



Fringe : Element Deform ,Default, 004_B01_1_BSP_1S

Fig.A2.04 – Deformed shape, LC004_B01-1_BSP_1S

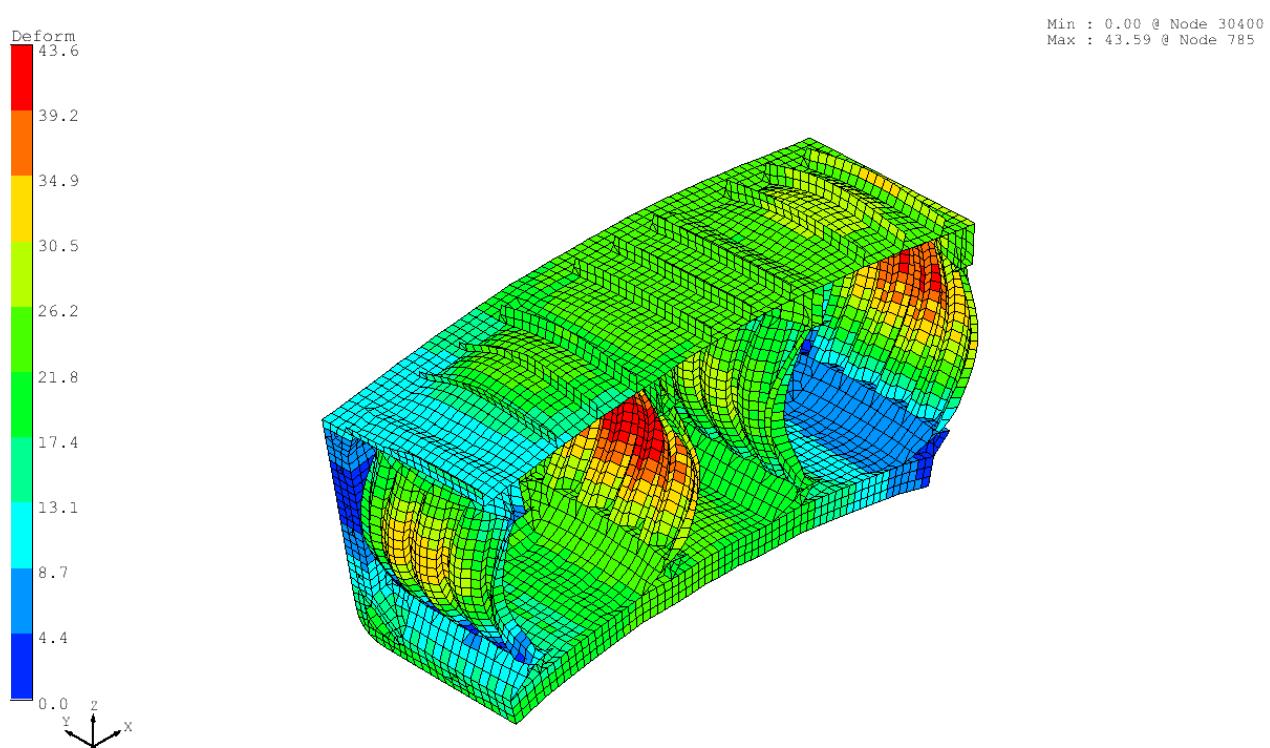
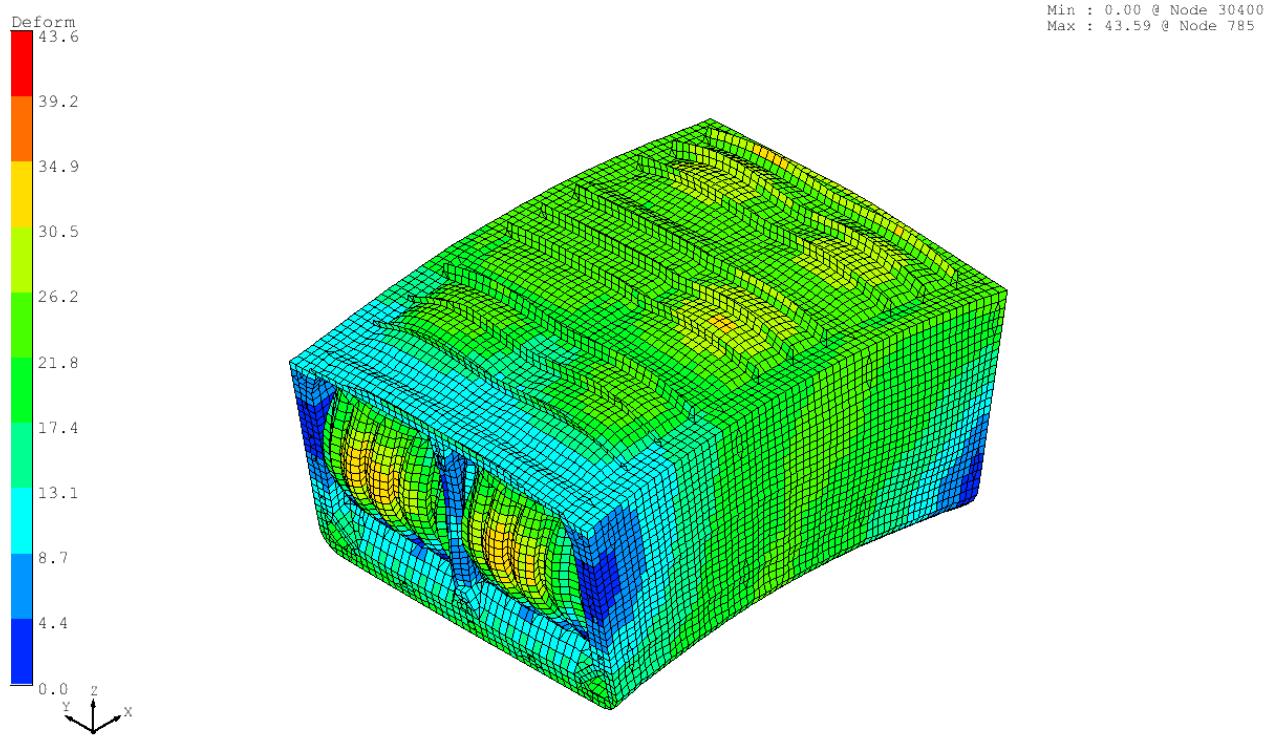
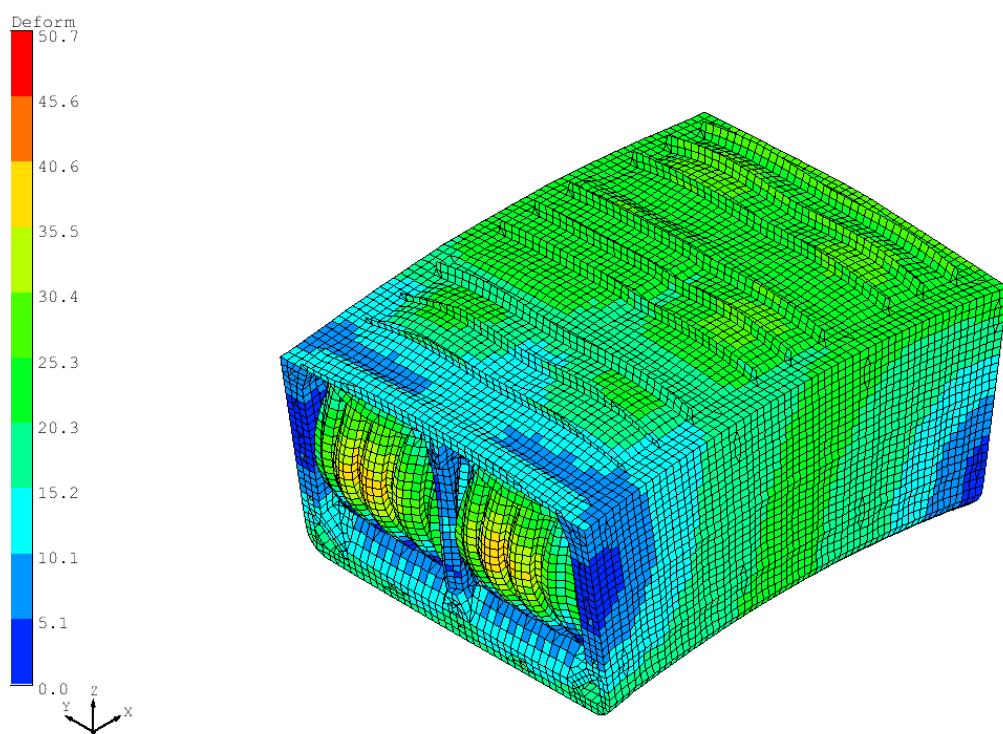
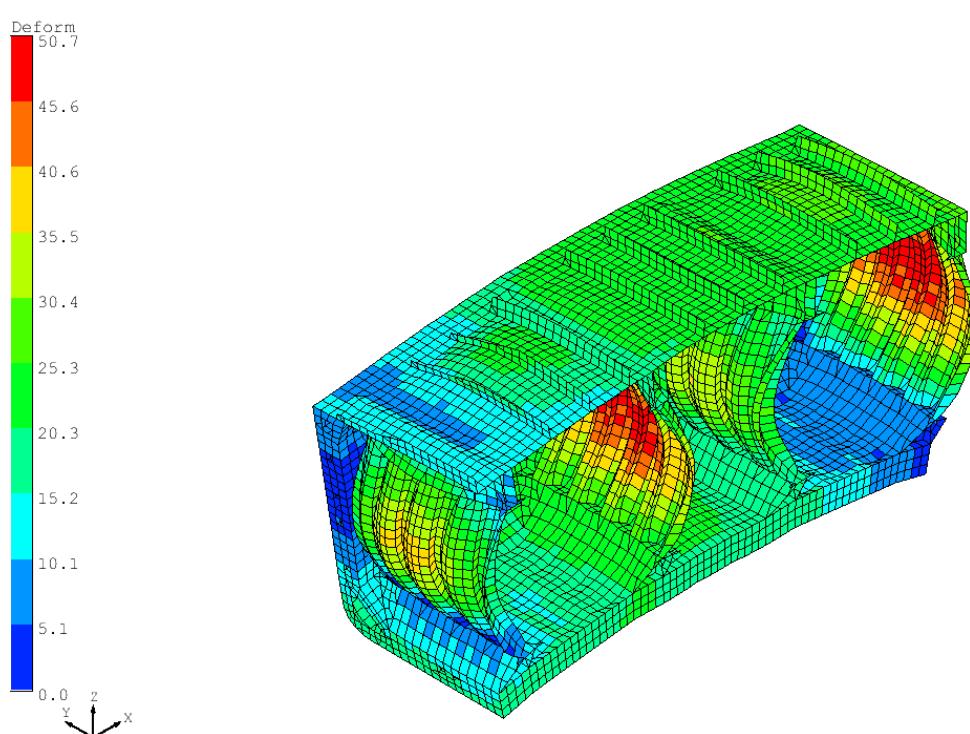


Fig.A2.05 – Deformed shape, LC005_B01-2_HSM_2

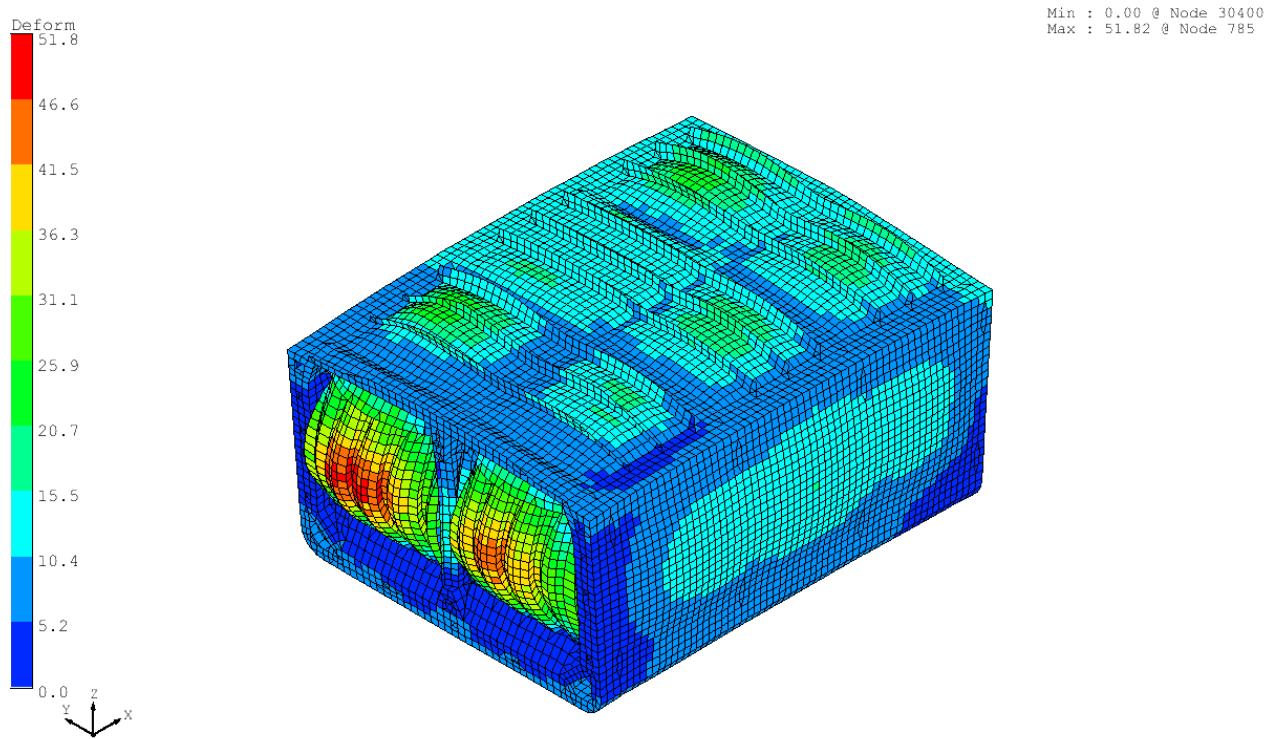


Fringe : Element Deform ,Default, 006_B01_2_FSM_2

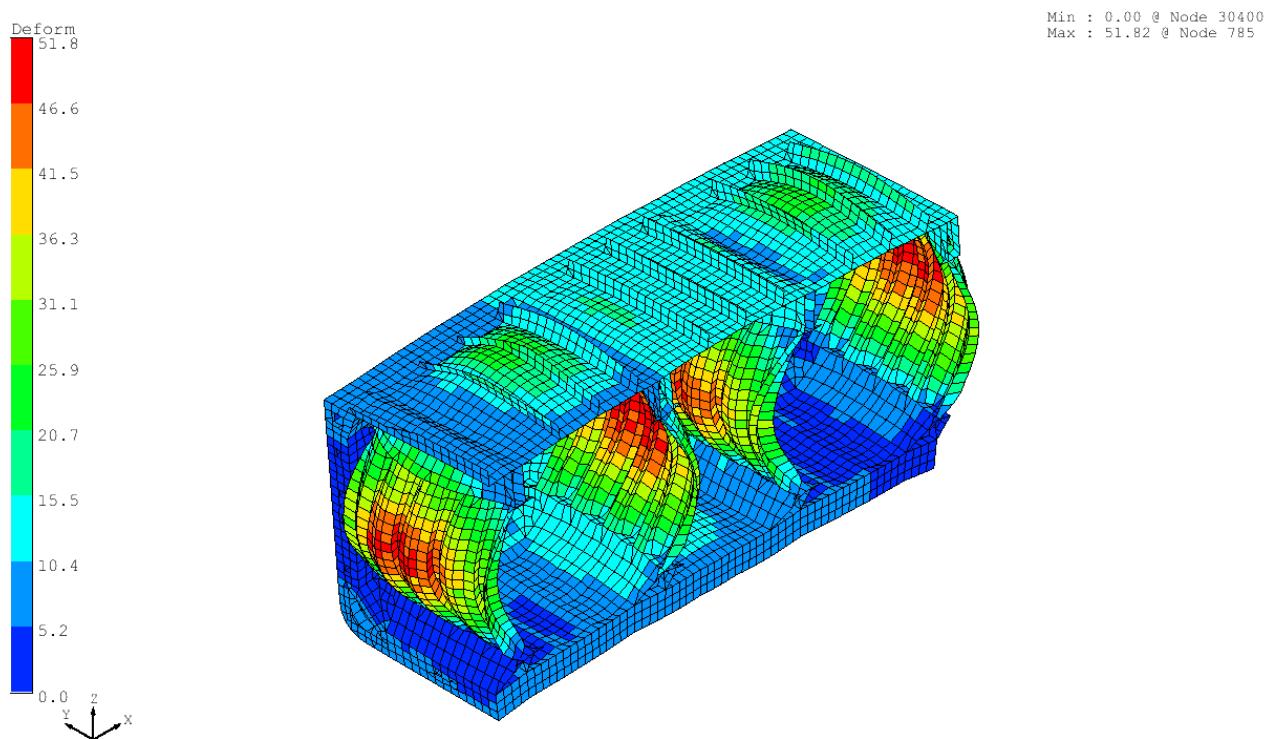


Fringe : Element Deform ,Default, 006_B01_2_FSM_2

Fig.A2.06 – Deformed shape, LC006_B01-2_FSM_2



Fringe : Element Deform ,Default, 007_B01_2_BSR_1P



Fringe : Element Deform ,Default, 007_B01_2_BSR_1P

Fig.A2.07 – Deformed shape, LC007_B01-2_BSR_1P

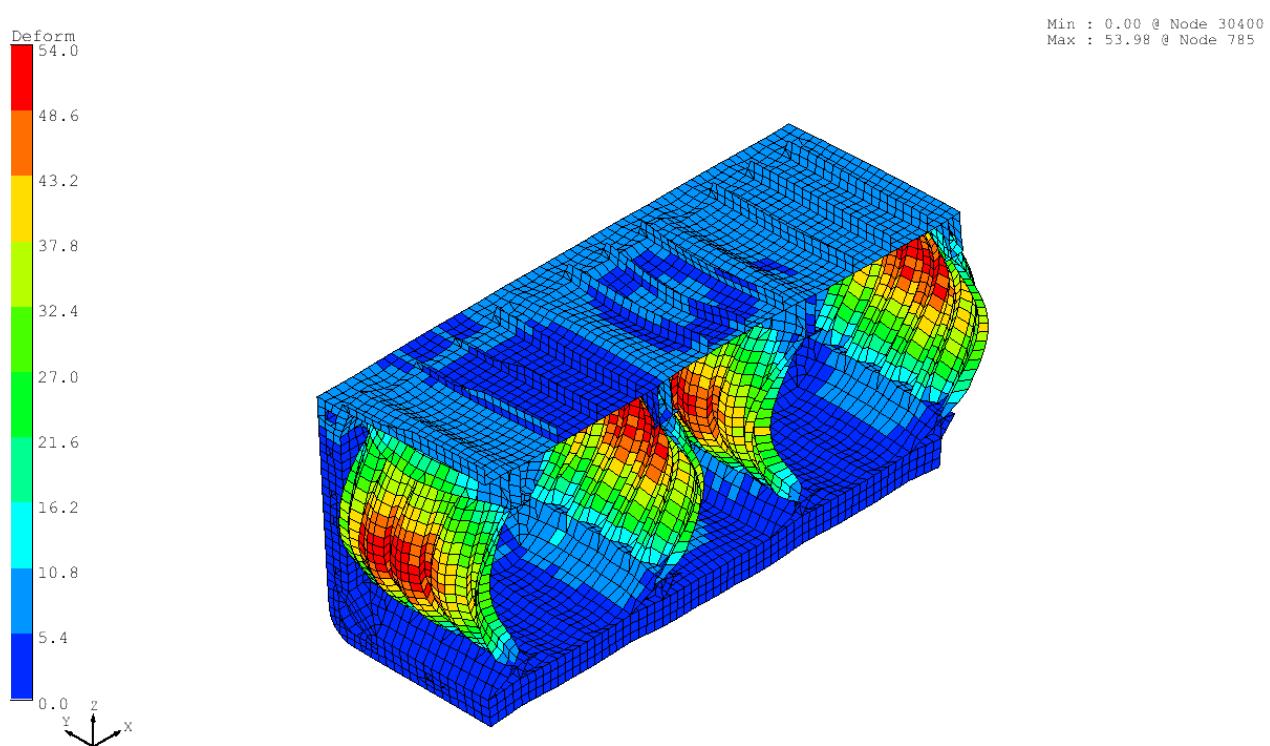
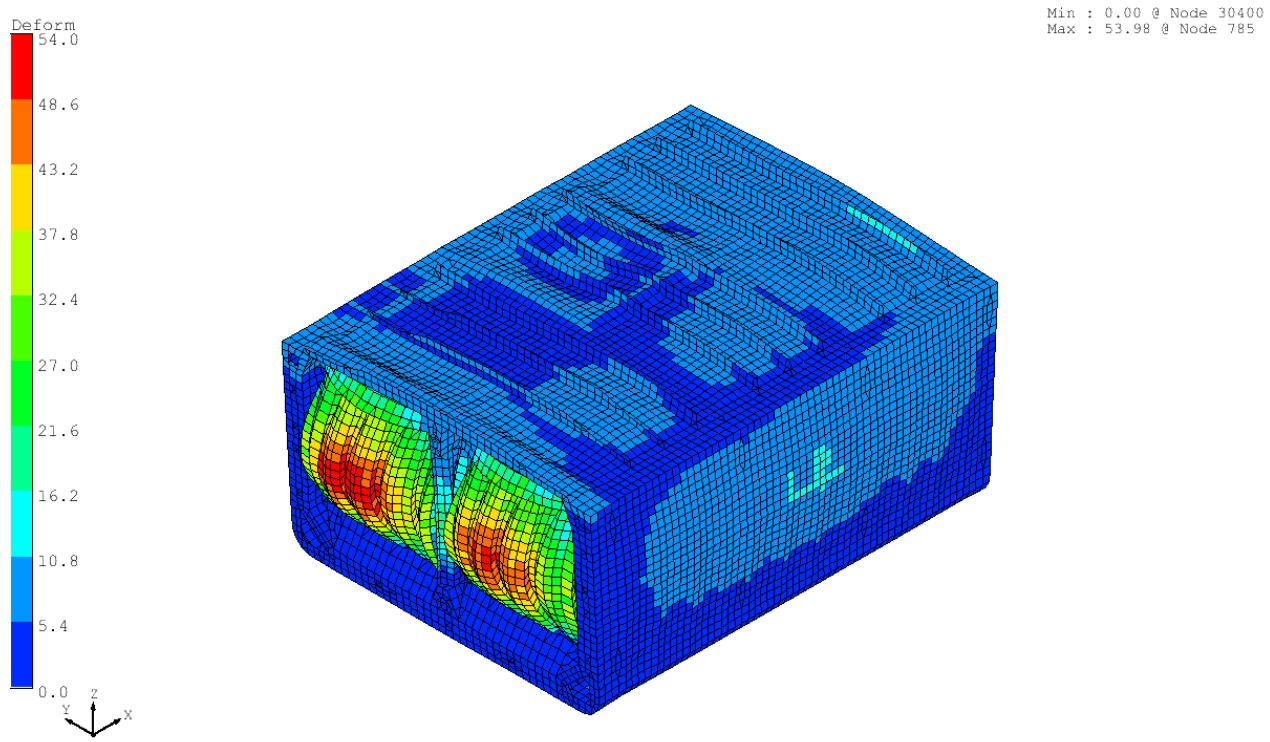
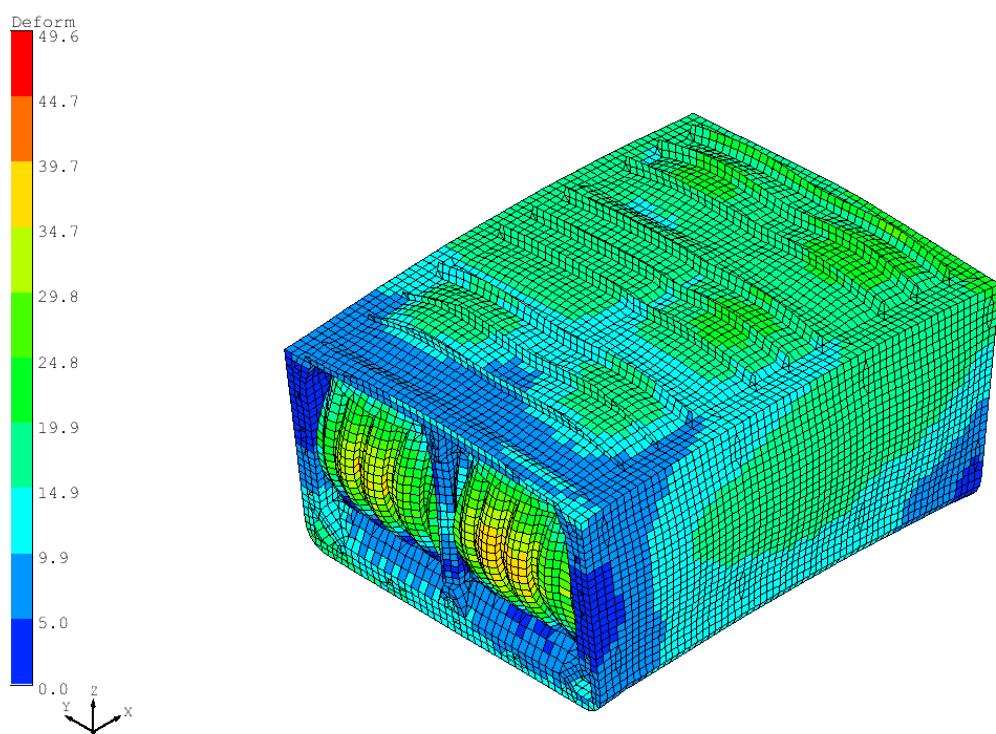
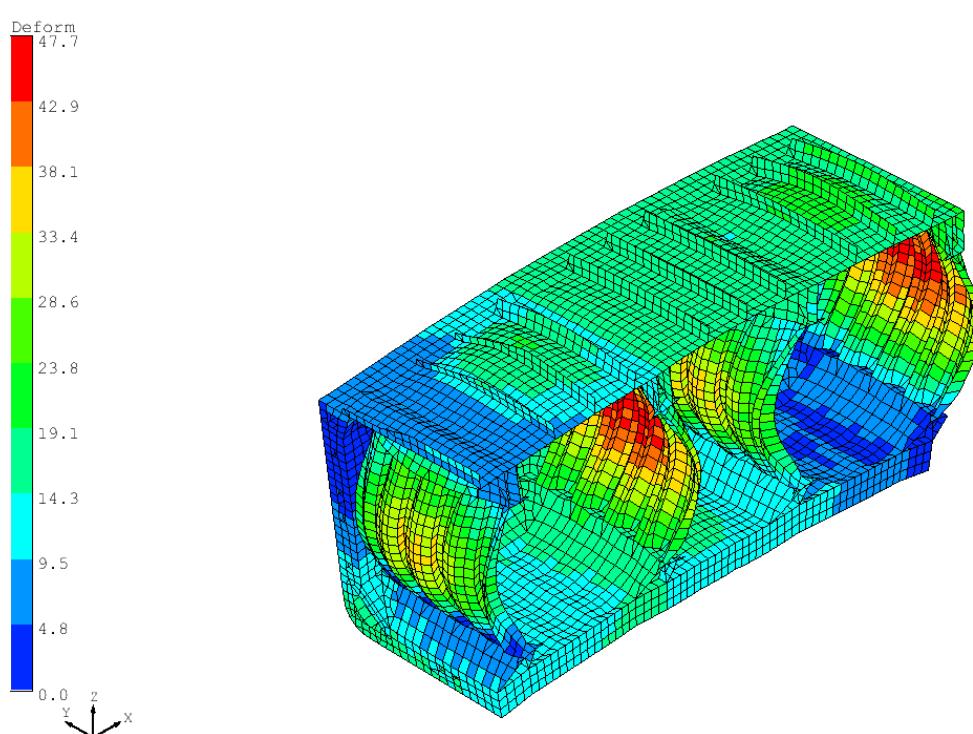


Fig.A2.08 – Deformed shape, LC008_B01-2_BSP_1P



Fringe : Element Deform ,Default, 009_B01_2_OST_2P



Fringe : Element Deform ,Default, 009_B01_2_OST_2P

Fig.A2.09 – Deformed shape, LC009_B01_2_OST_2P

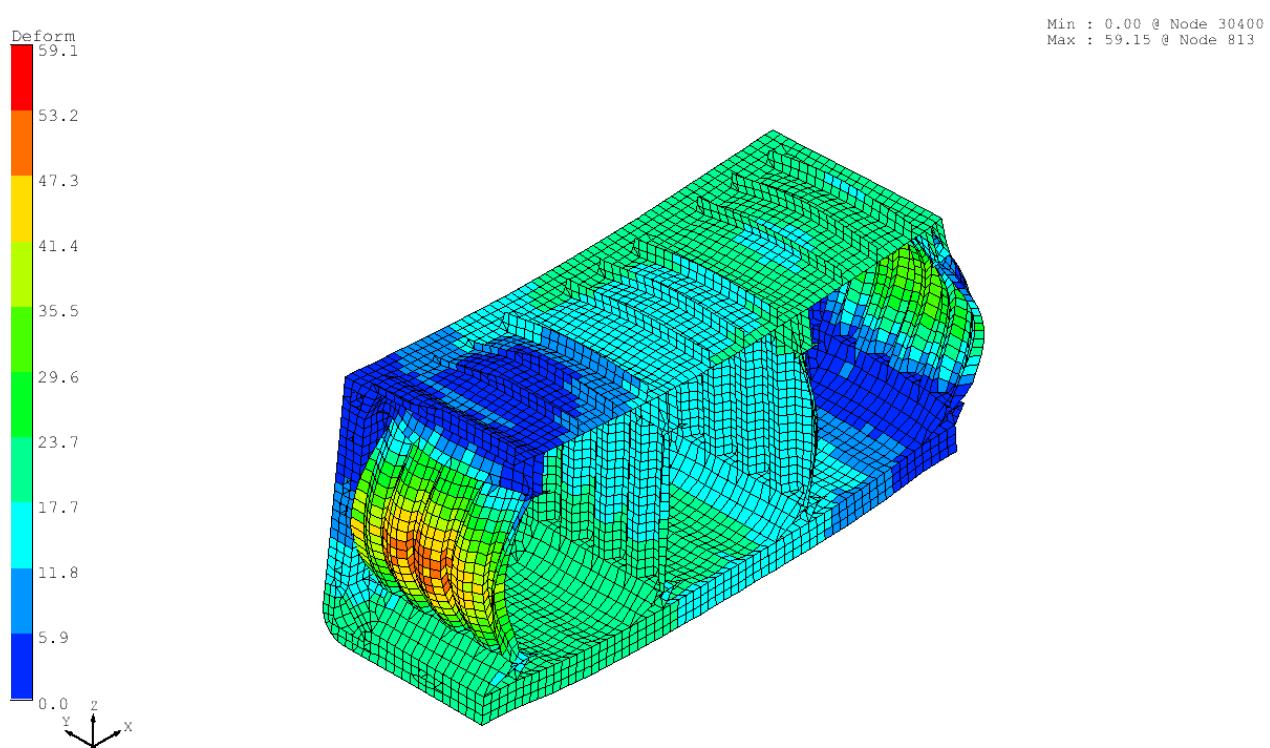
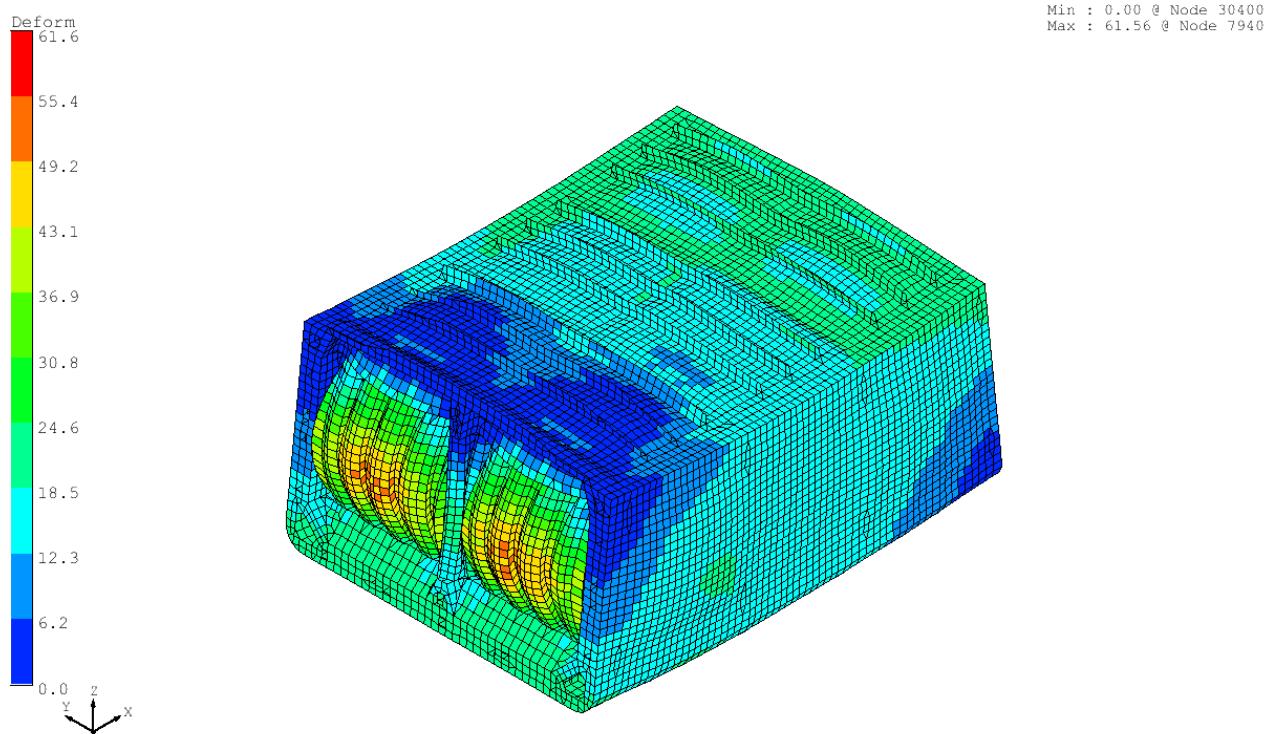


Fig.A2.10– Deformed shape, LC010_B02-1_HSM_1

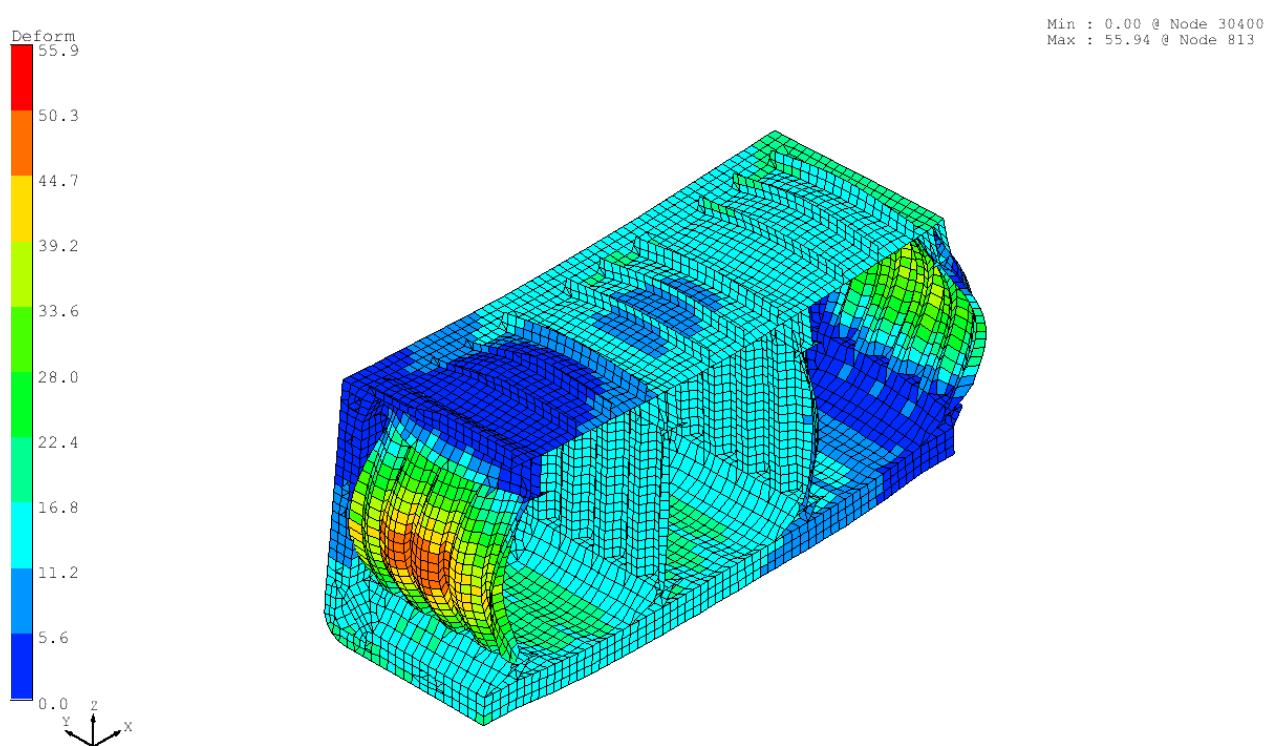
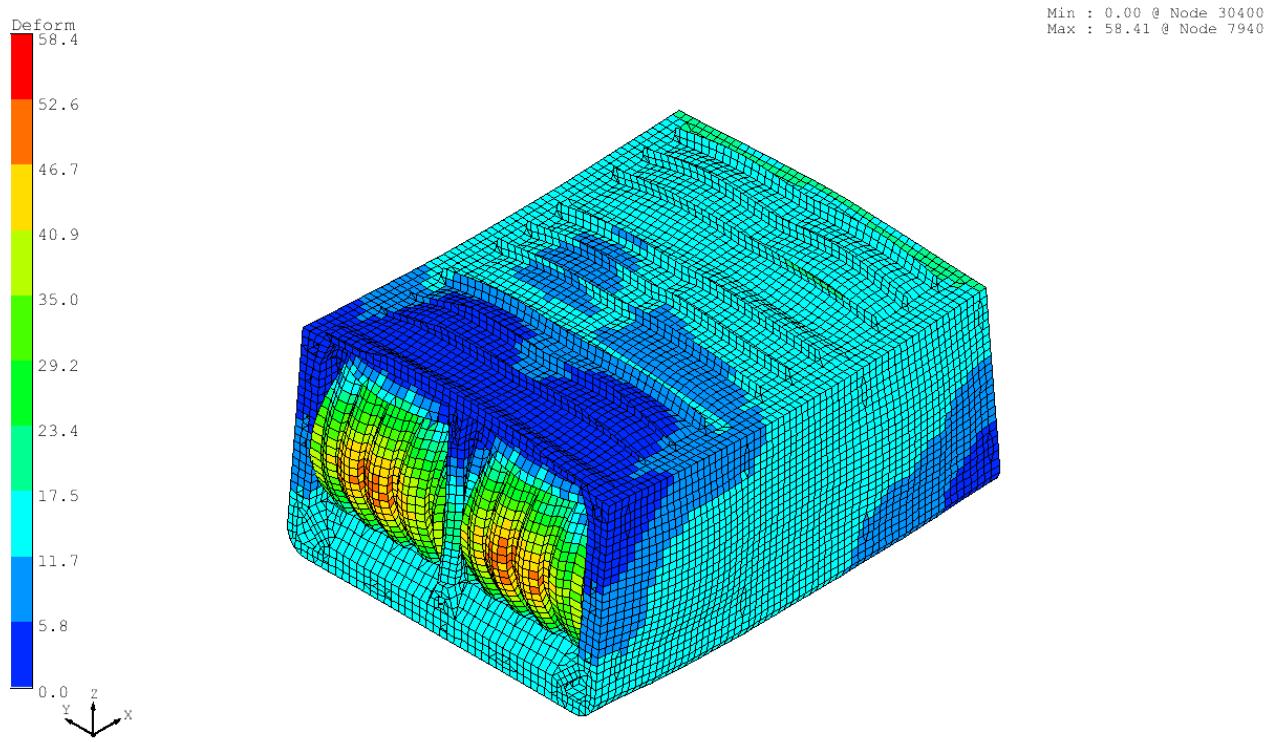
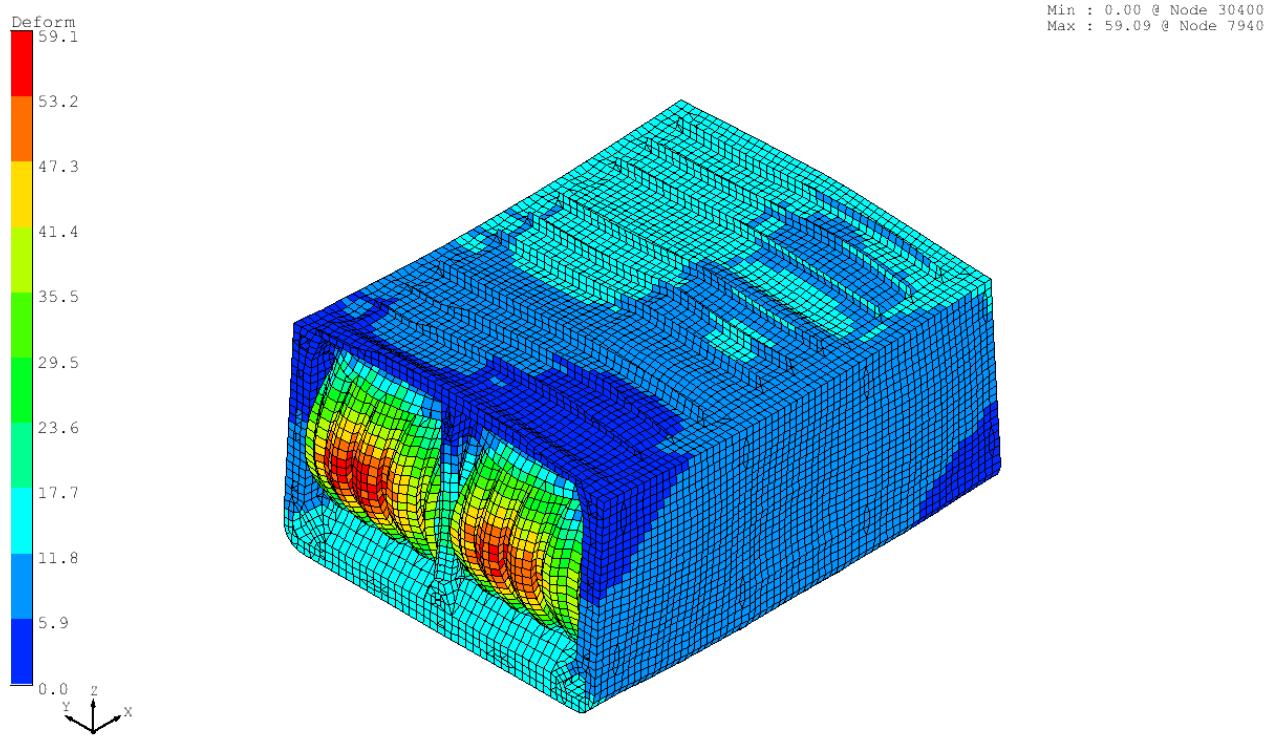
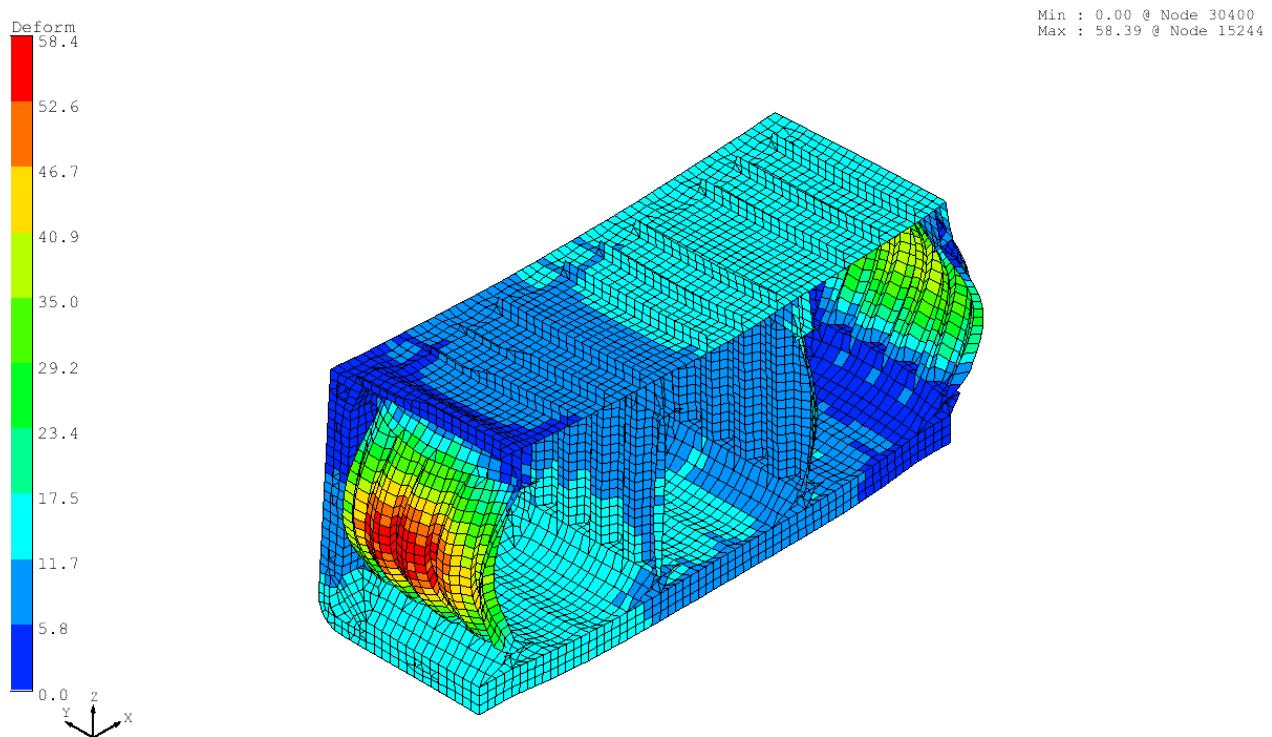


Fig.A2.11– Deformed shape, LC011_B02-1_HSA_1

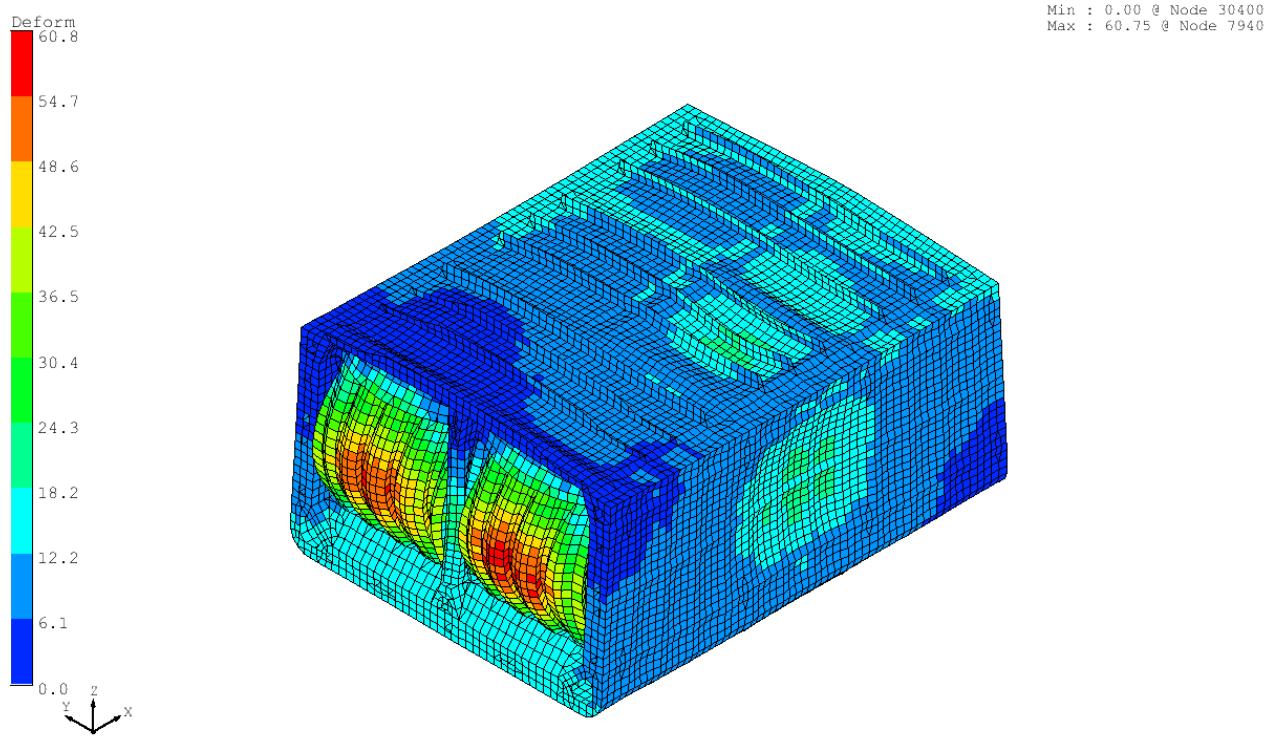


Fringe : Element Deform ,Default, 012_B02_1_BSP_1P

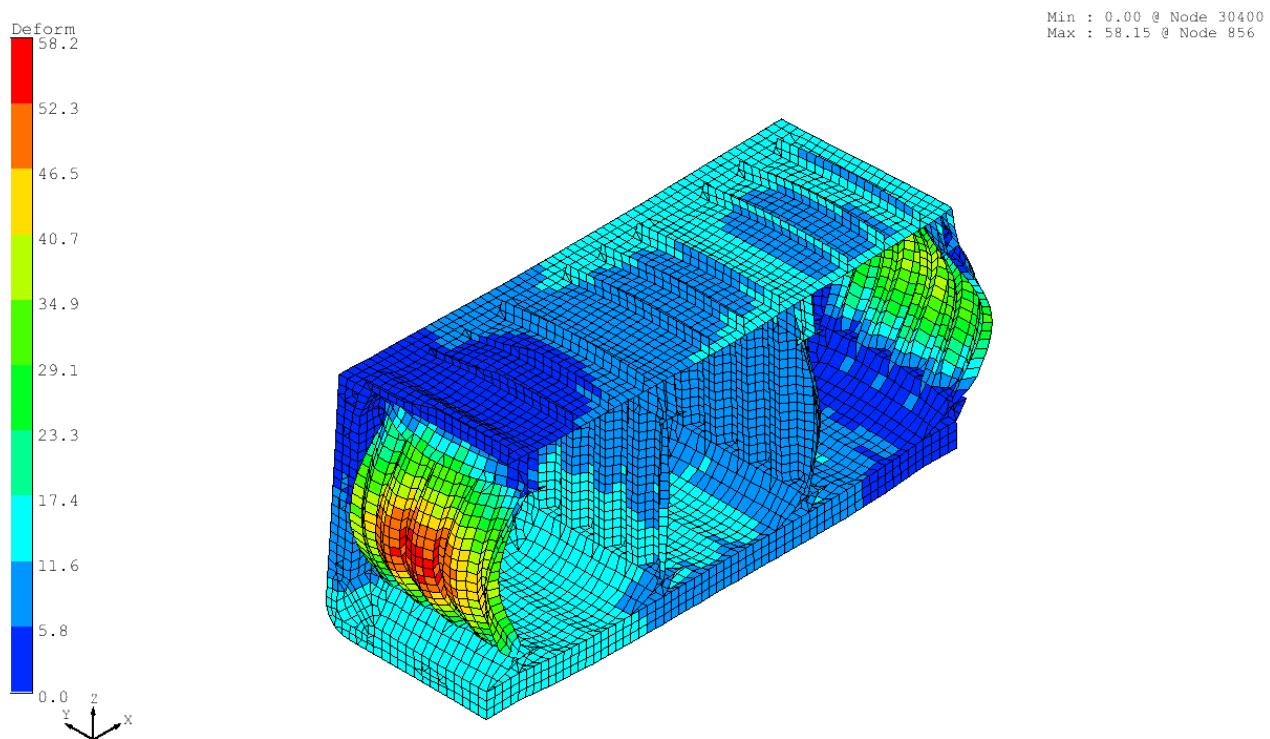


Fringe : Element Deform ,Default, 012_B02_1_BSP_1P

Fig.A2.12 – Deformed shape, LC012_B02-1_BSP_1P



Fringe : Element Deform ,Default, 013_B02_1_BSP_1S



Fringe : Element Deform ,Default, 013_B02_1_BSP_1S

Fig.A2.13 – Deformed shape, LC013_B02-1_BSP_1S

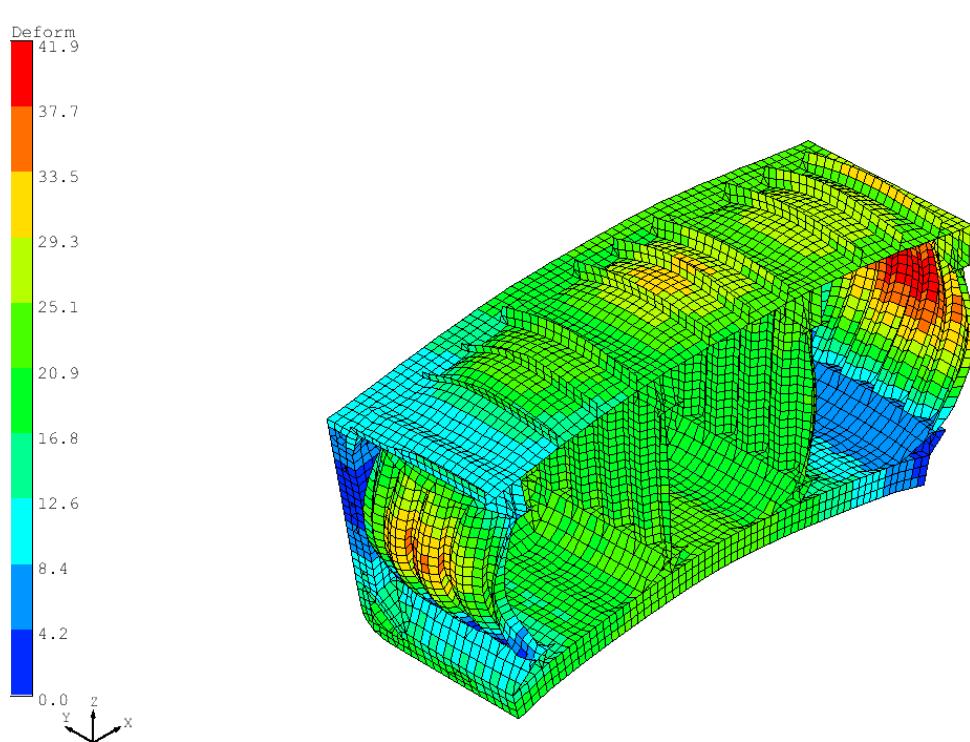
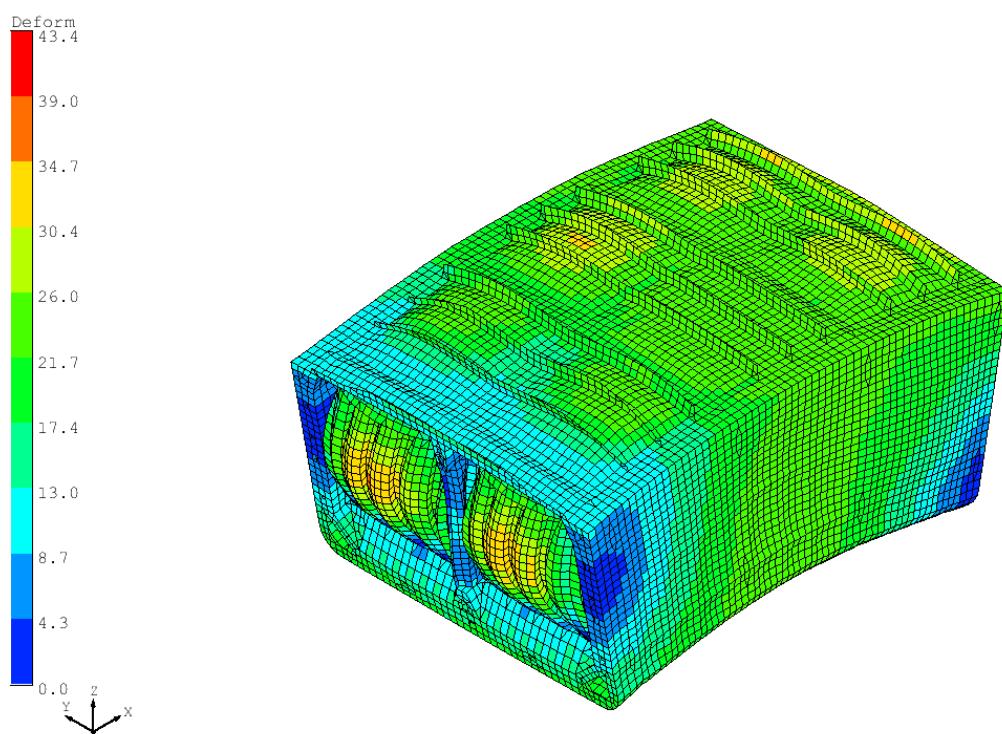
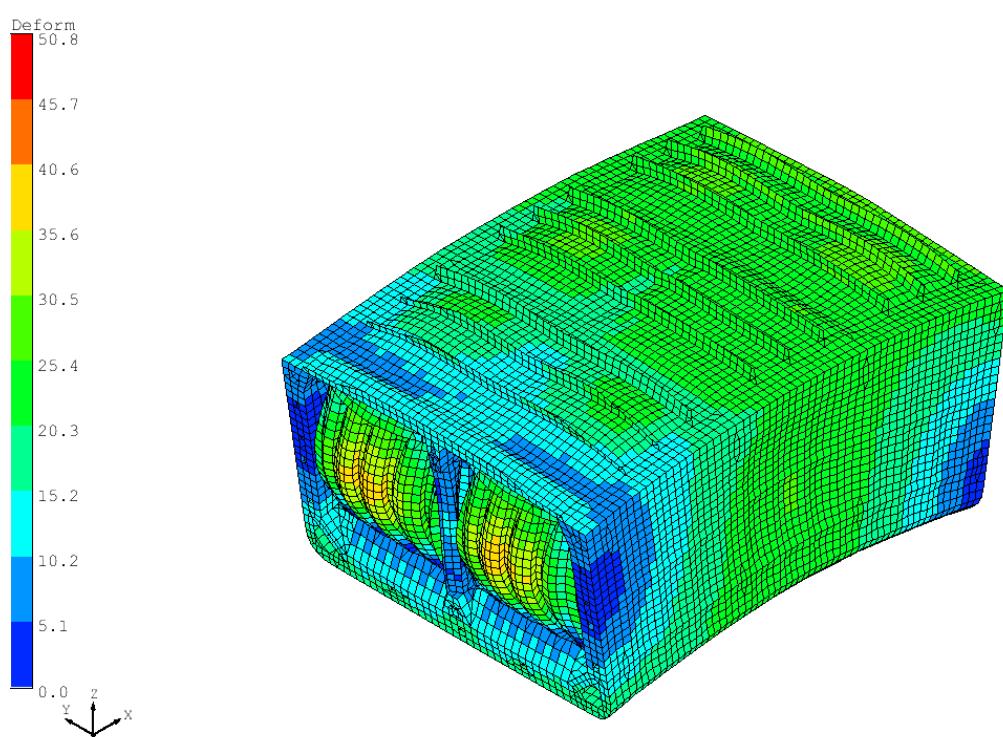
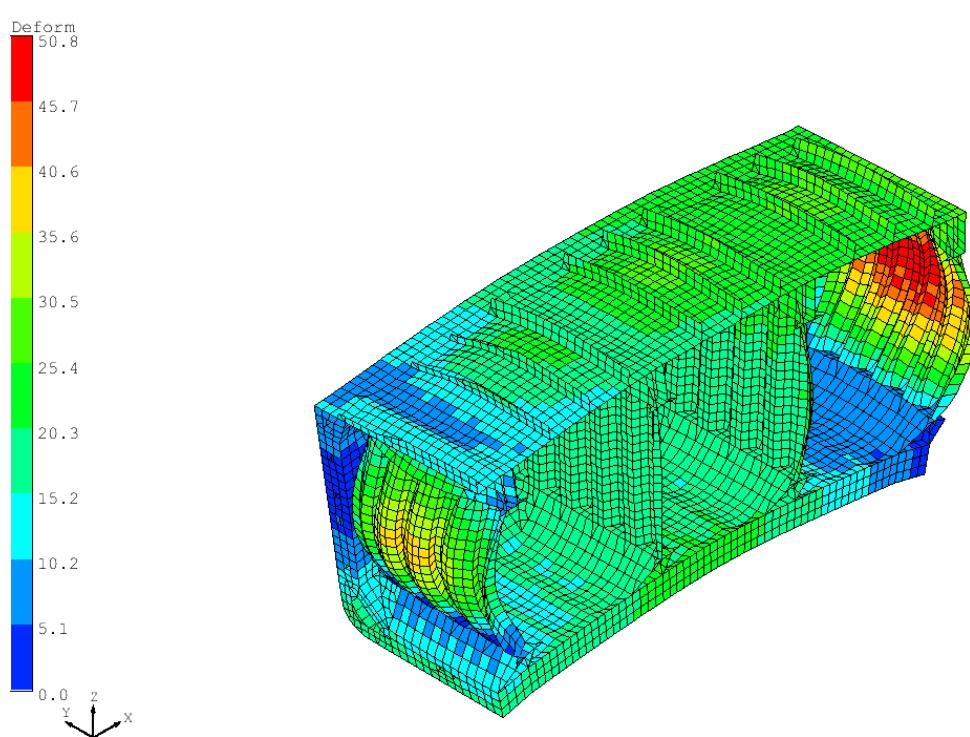


Fig.A2.14 – Deformed shape, LC014_B02-2_HSM_2

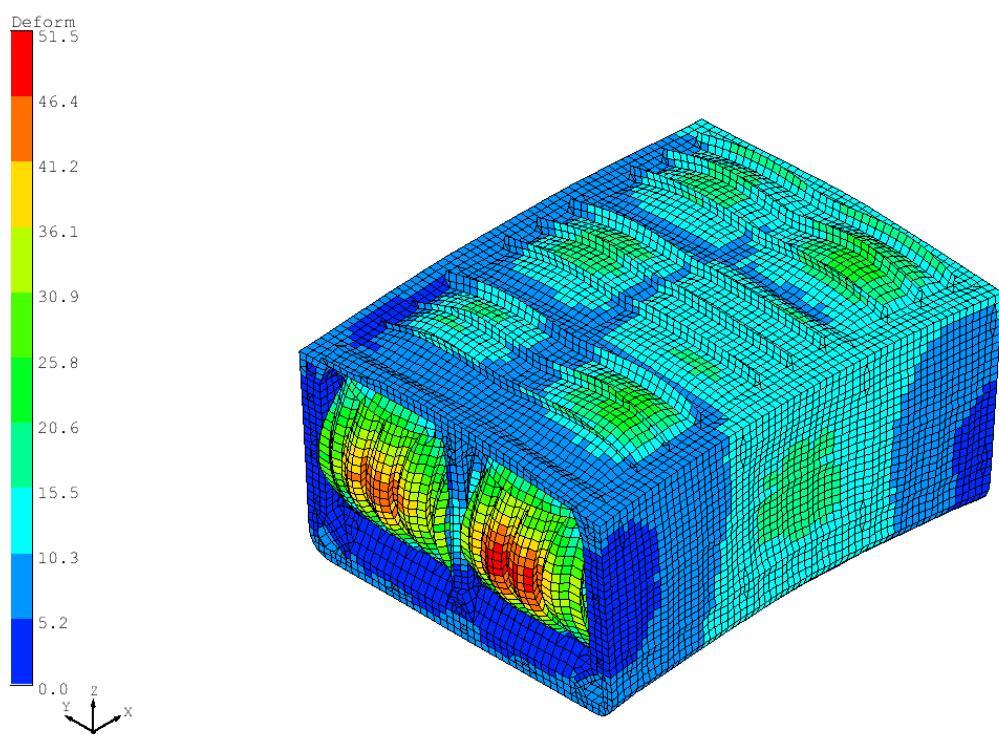


Fringe : Element Deform ,Default, 015_B02_2_FSM_2

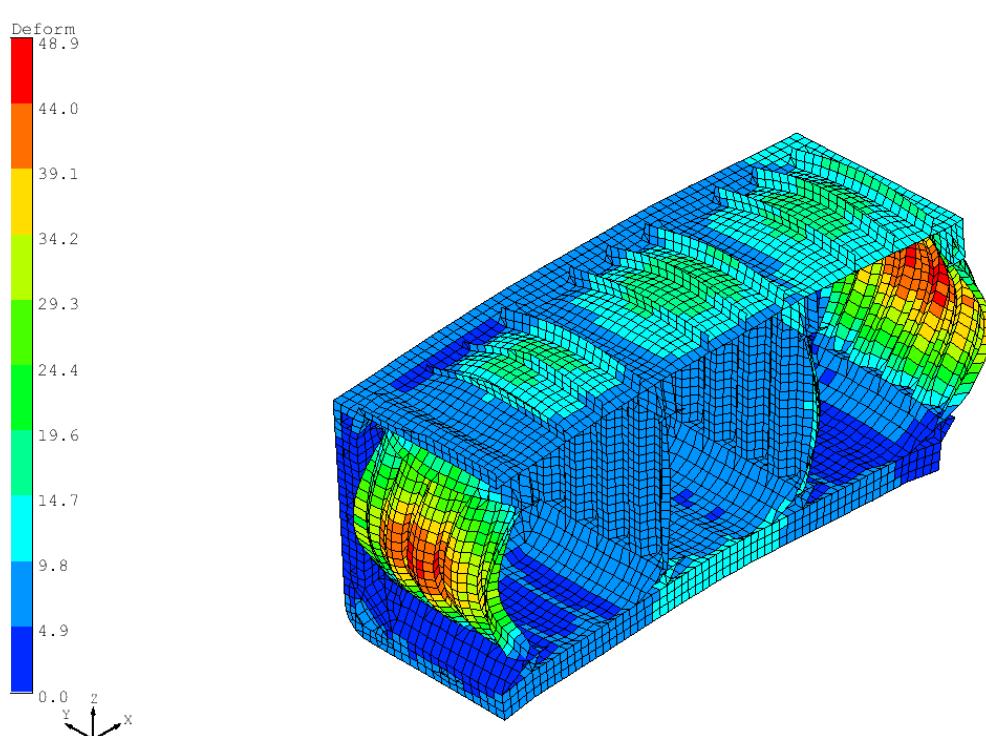


Fringe : Element Deform ,Default, 015_B02_2_FSM_2

Fig.A2.15 – Deformed shape, LC015_B02-2_FSM_2



Min : 0.00 @ Node 30400
Max : 51.54 @ Node 26063



Min : 0.00 @ Node 30400
Max : 48.89 @ Node 25028

Fringes : Element Deform ,Default, 016_B02_2_BSR_1S

Fig.A2.16 – Deformed shape, LC016_B02-2_BSR_1S

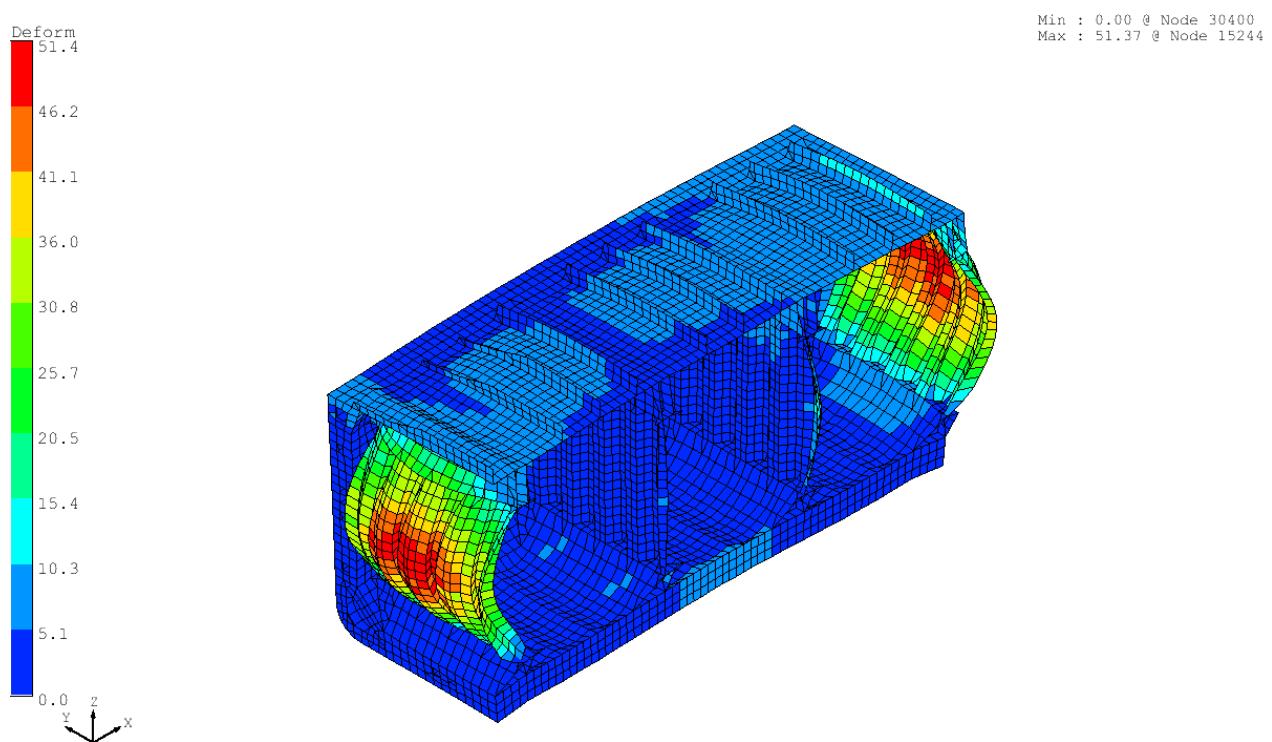
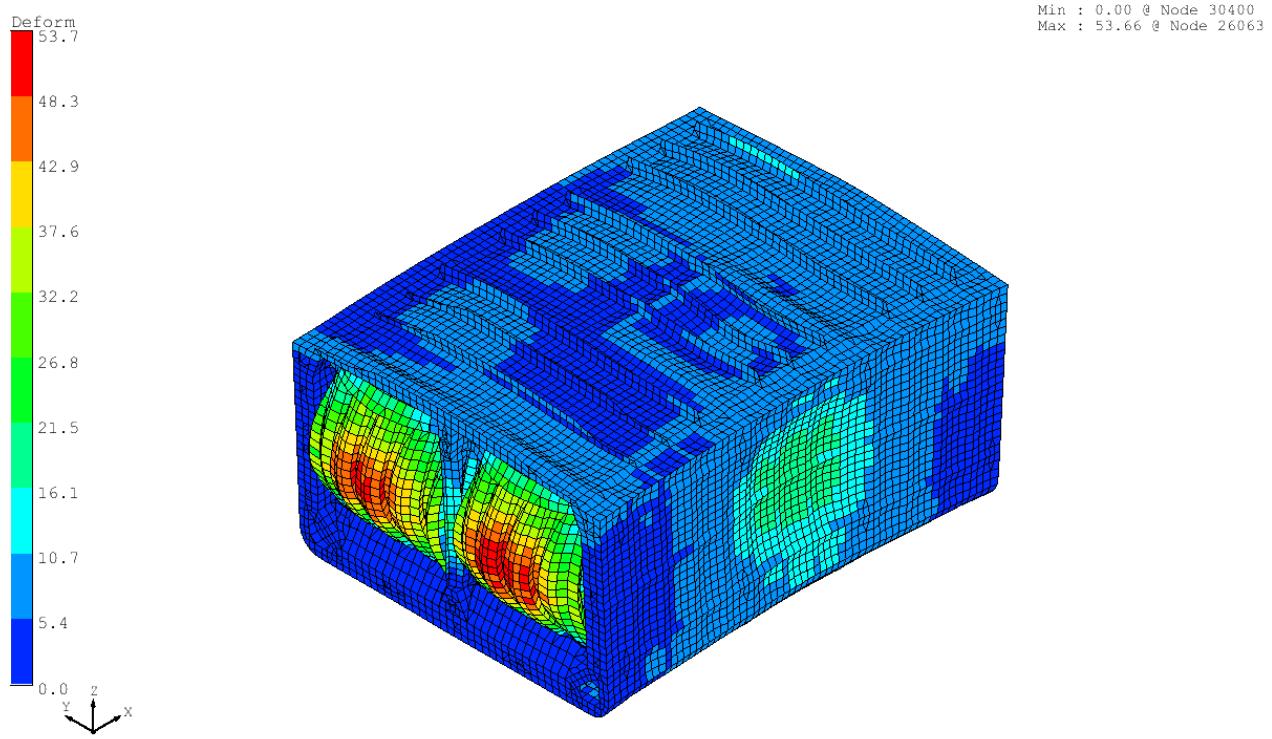
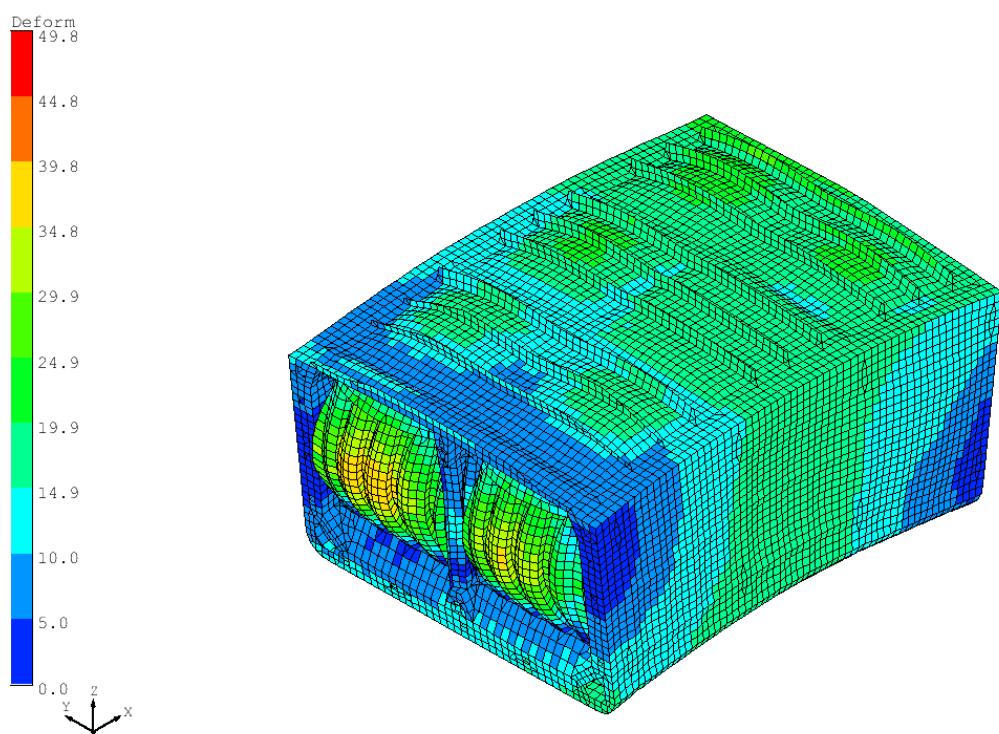
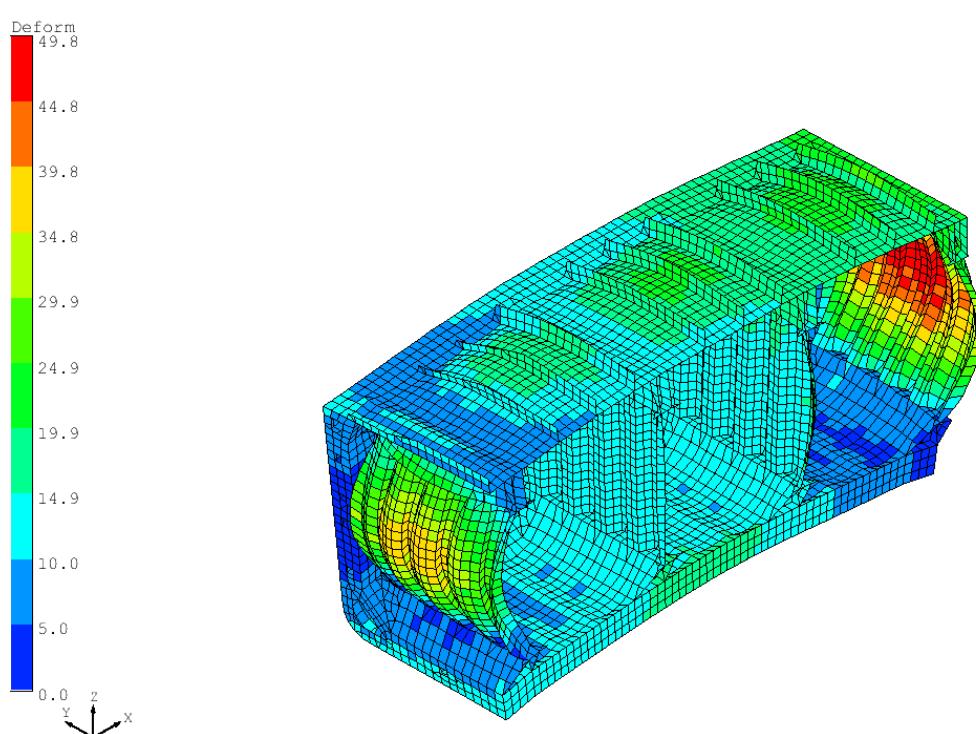


Fig.A2.17 – Deformed shape, LC017_B02-2_BSP_1S

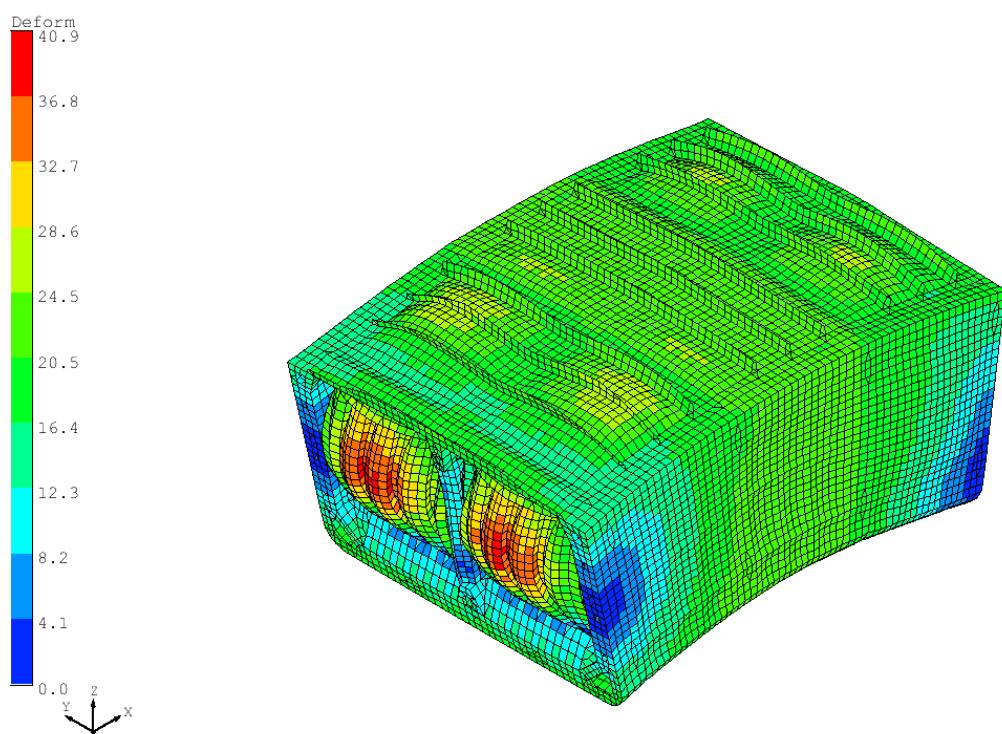


Fringe : Element Deform ,Default, 018_B02_2_OST_2S

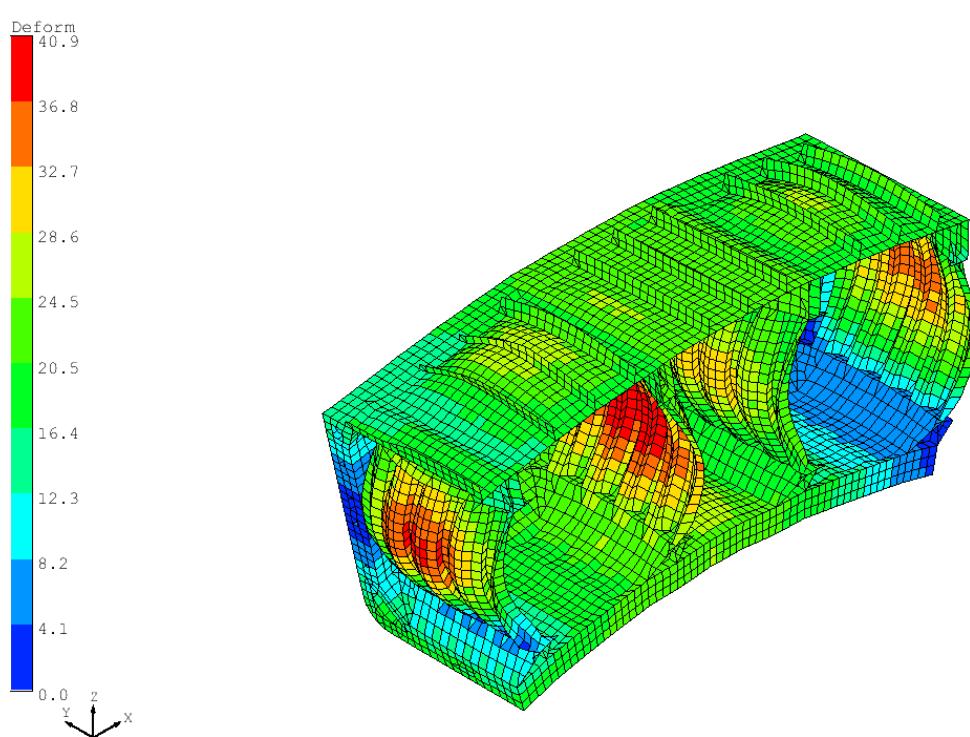


Fringe : Element Deform ,Default, 018_B02_2_OST_2S

Fig.A2.18 – Deformed shape, LC018_B02_2_OST_2S

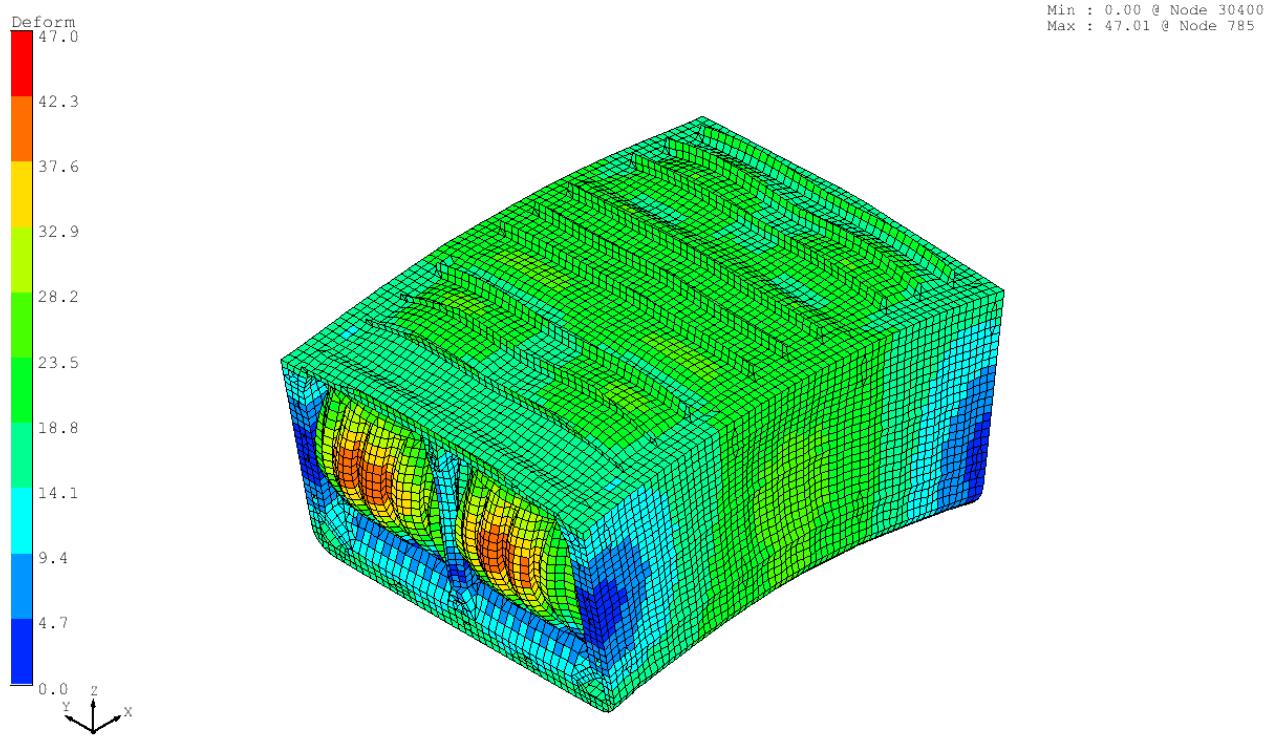


Fringe : Element Deform ,Default, 019_B03_1_HSM_2

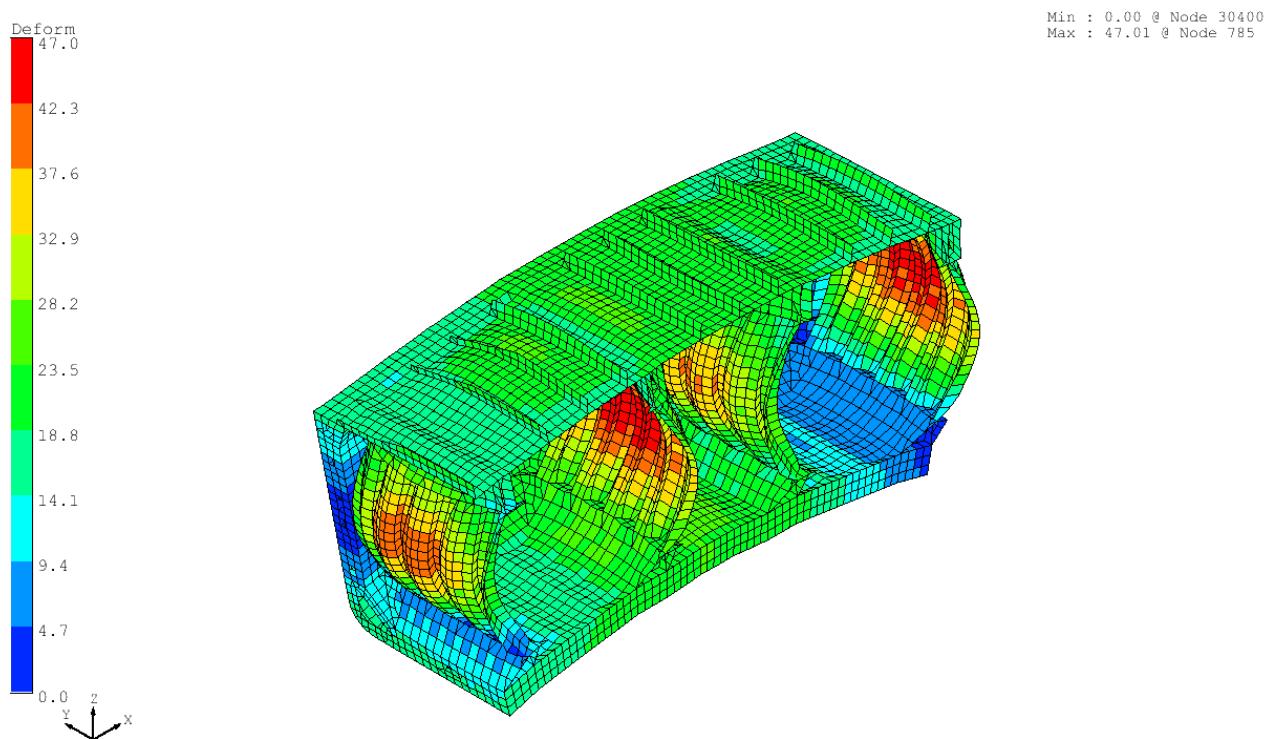


Fringe : Element Deform ,Default, 019_B03_1_HSM_2

Fig.A2.19 – Deformed shape, LC019_B03-1_HSM_2

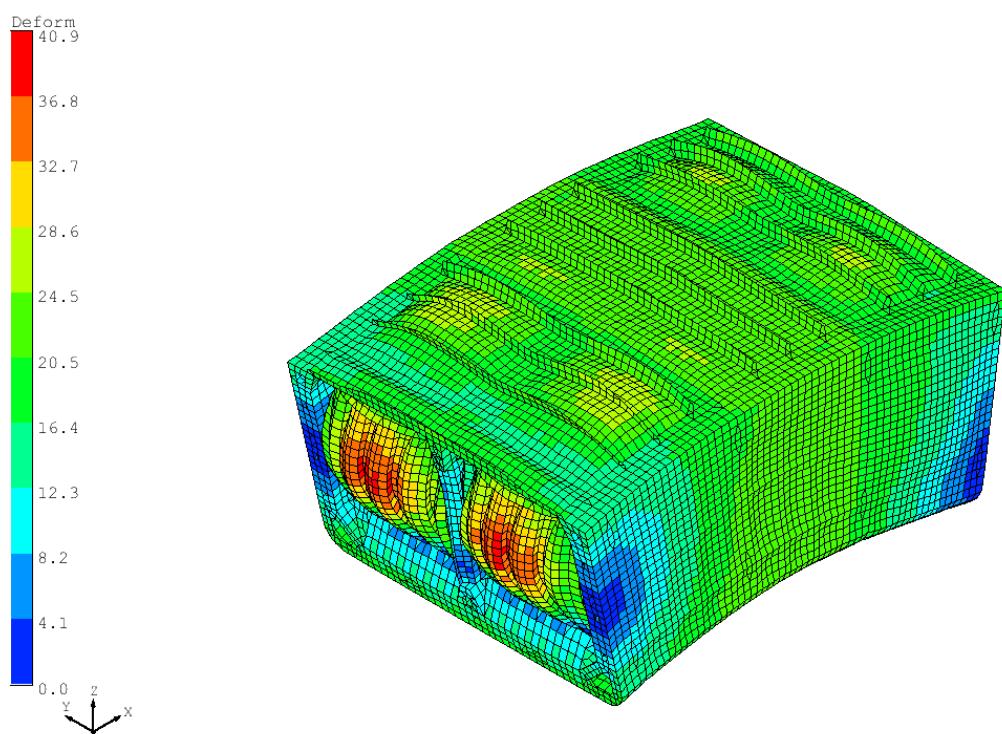


Fringe : Element Deform ,Default, 020_B03_1_FSM_2

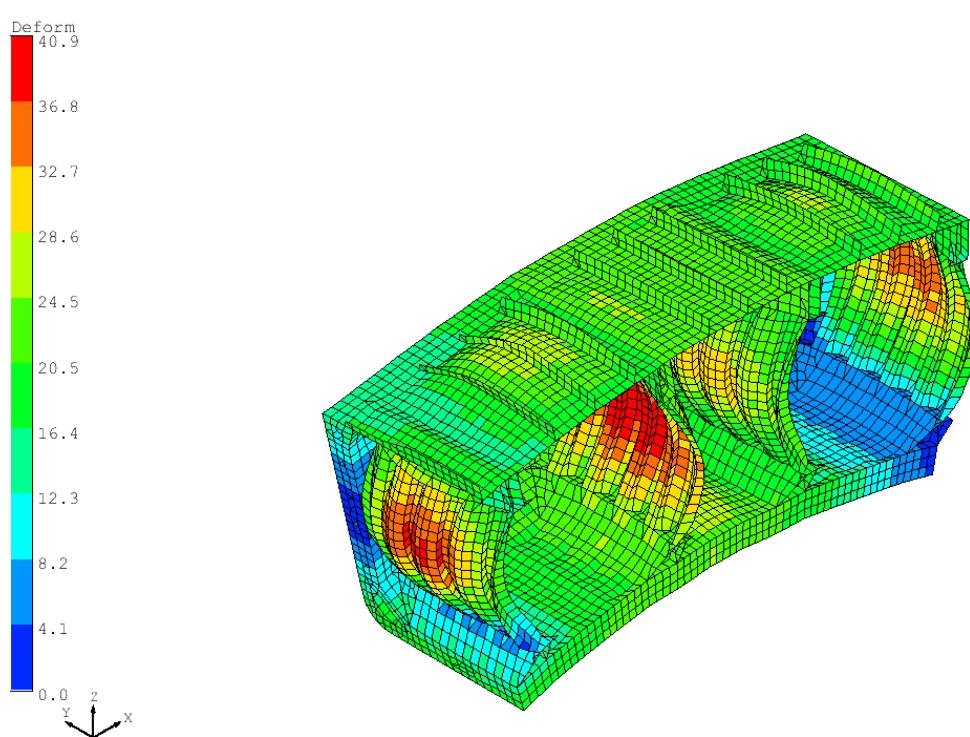


Fringe : Element Deform ,Default, 020_B03_1_FSM_2

Fig.A2.20 – Deformed shape, LC020_B03-1_FSM_2

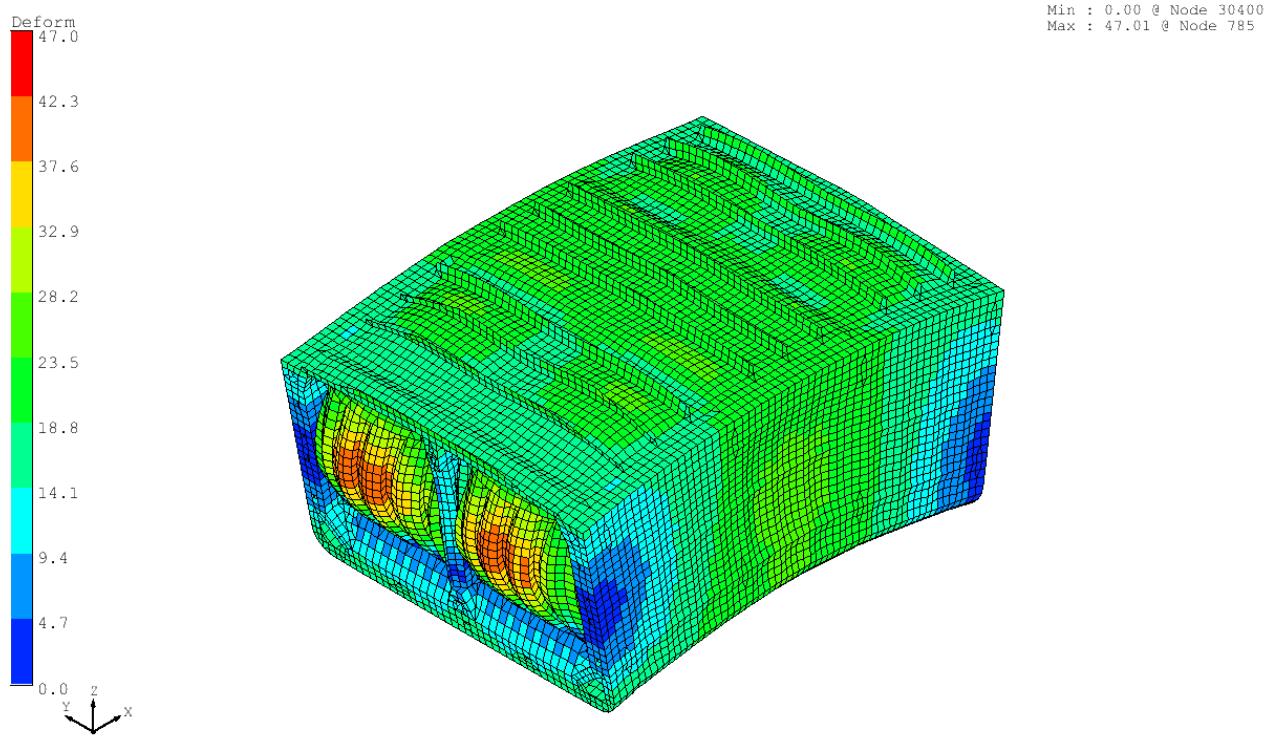


Fringe : Element Deform ,Default, 021_B03_2_HSM_2

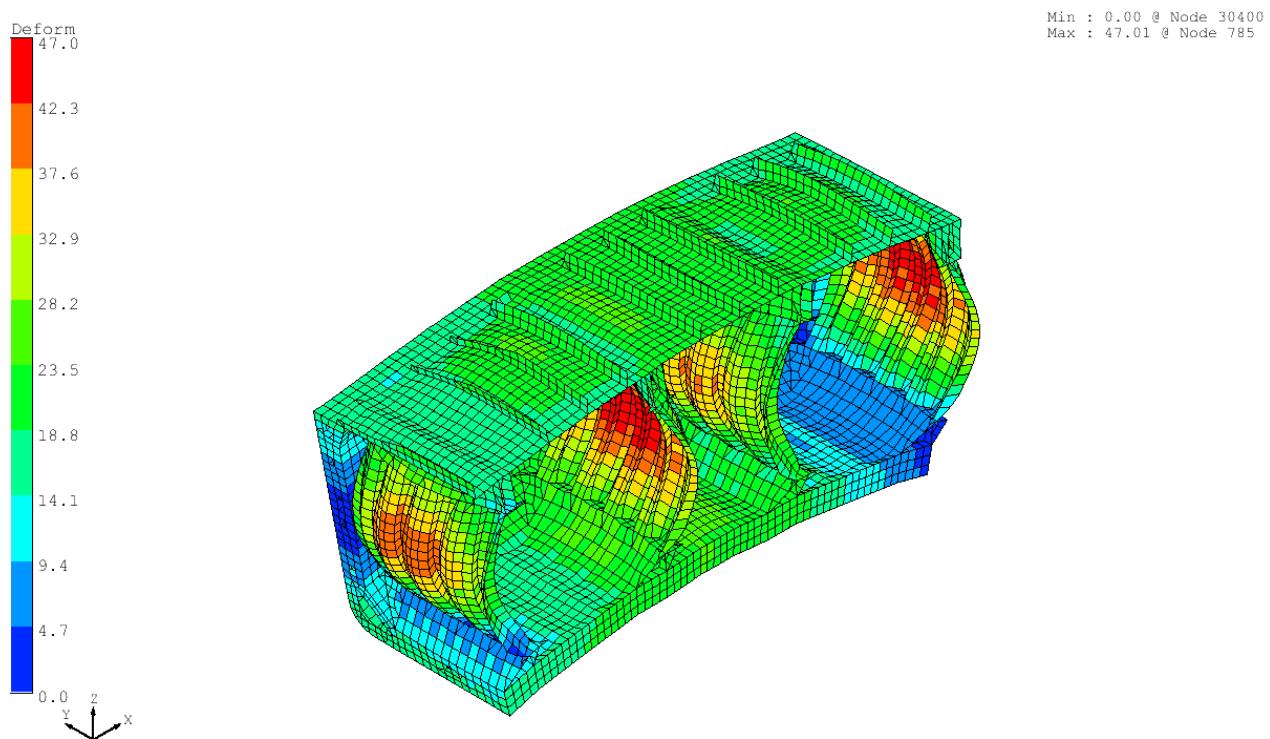


Fringe : Element Deform ,Default, 021_B03_2_HSM_2

Fig.A2.21 – Deformed shape, LC021_B03-2_HSM_2



Fringe : Element Deform ,Default, 022_B03_2_FSM_2



Fringe : Element Deform ,Default, 022_B03_2_FSM_2

Fig.A2.22 – Deformed shape, LC022_B03-2_FSM_2

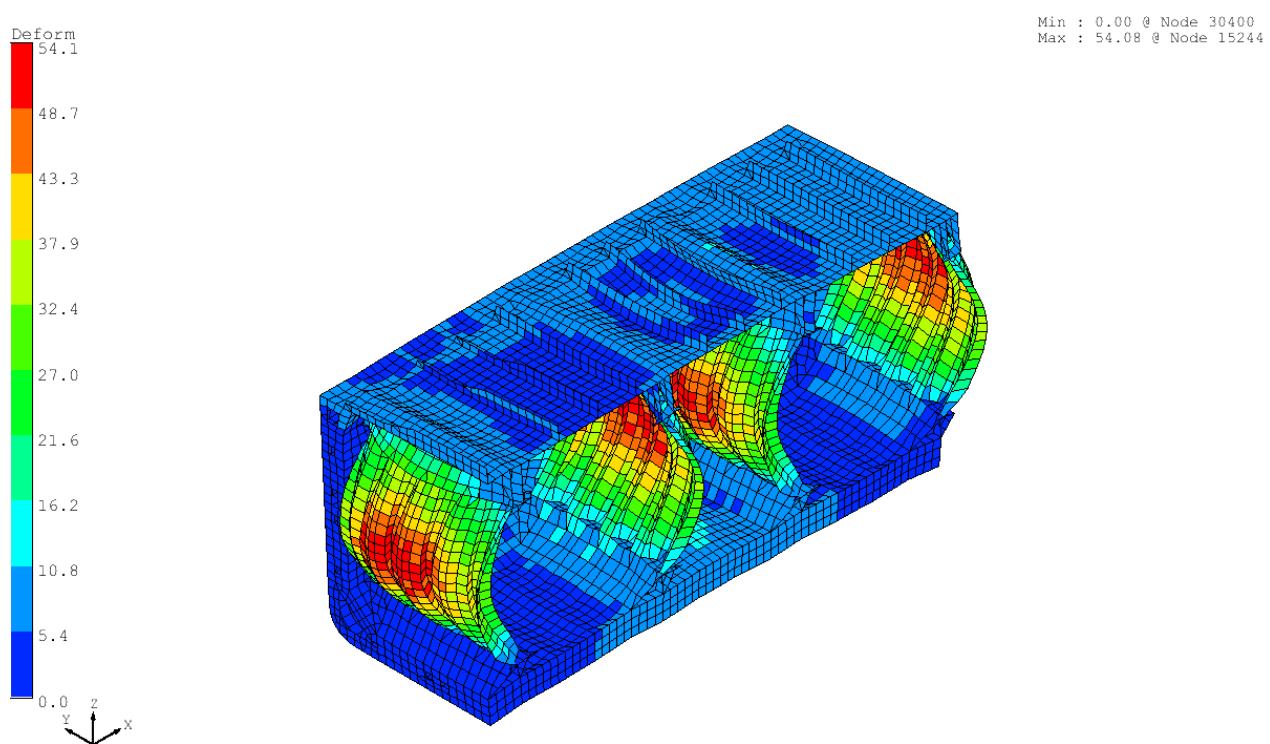
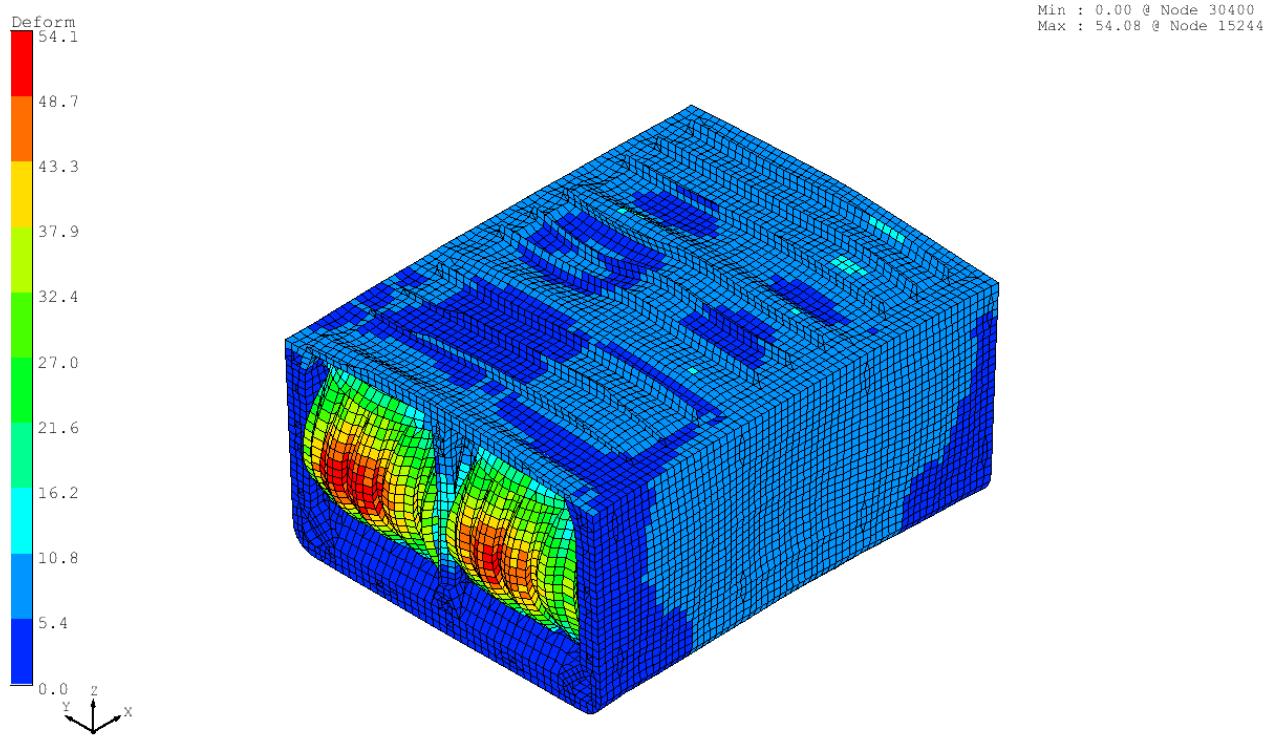
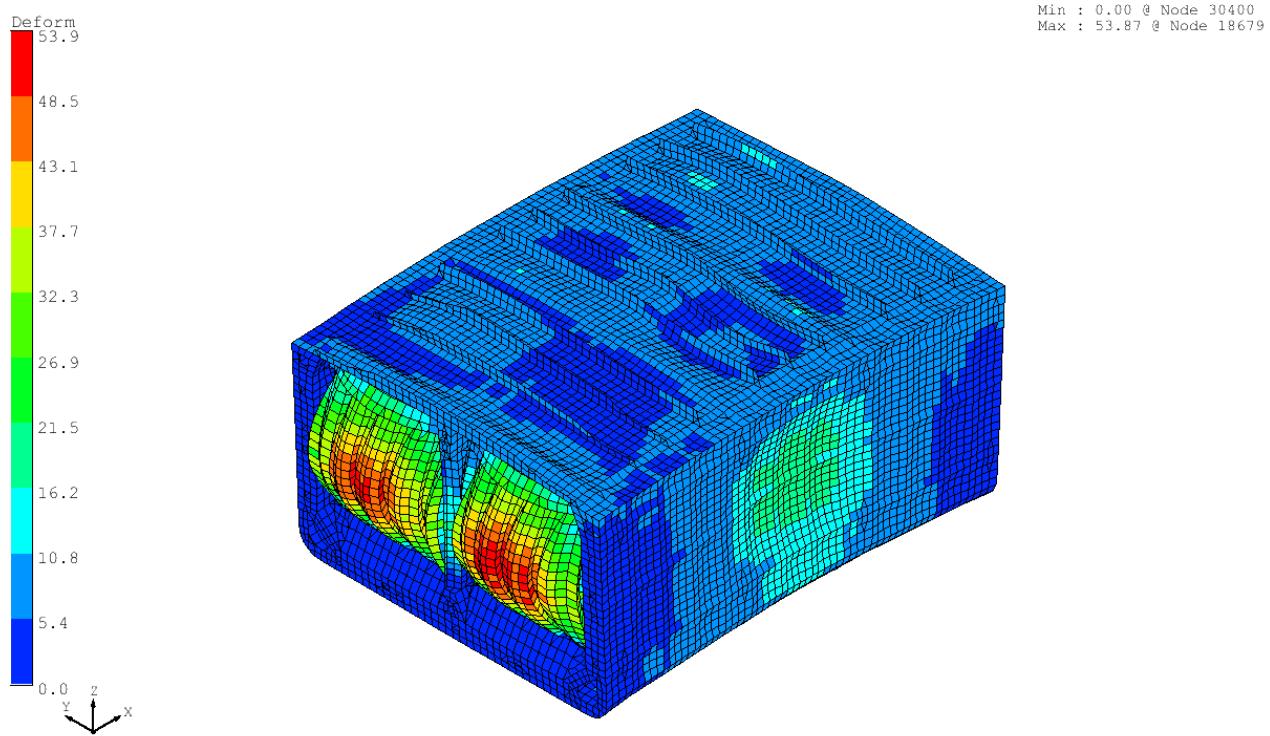
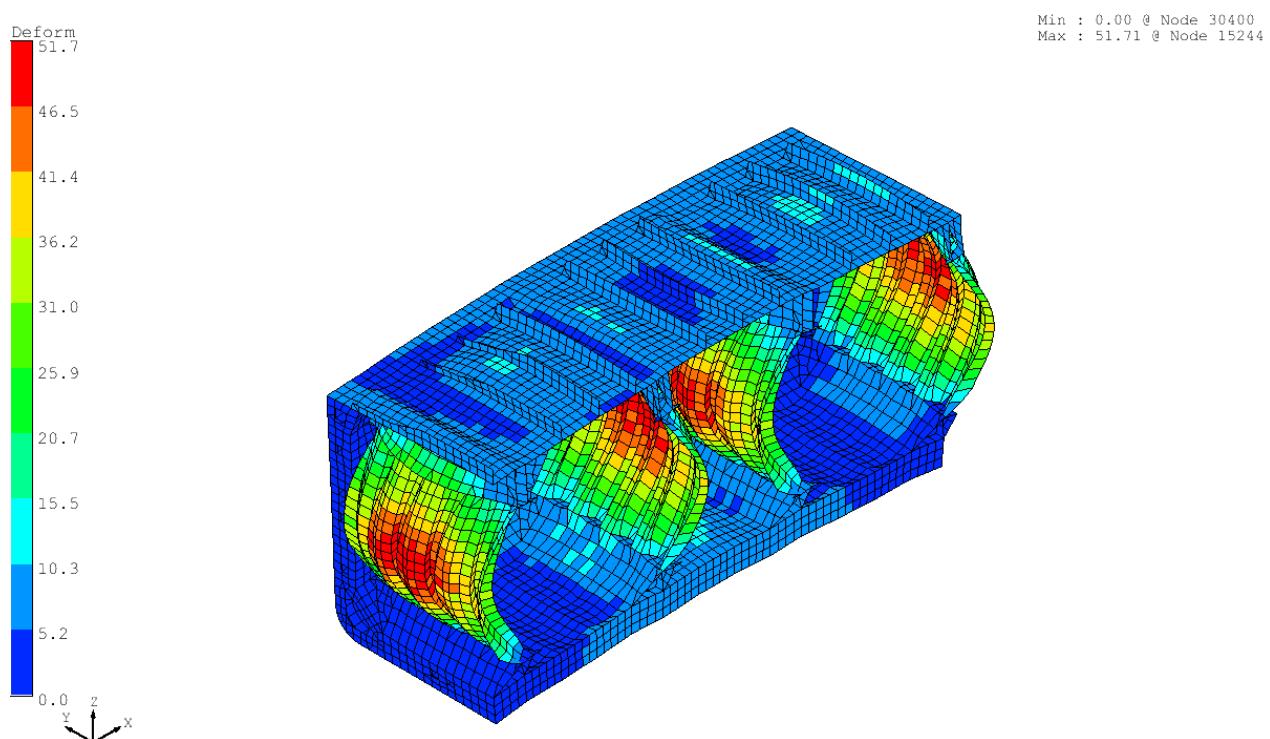


Fig.A2.23 – Deformed shape, LC023_B03-3_BSP_1P



Min : 0.00 @ Node 30400
Max : 53.87 @ Node 18679



Min : 0.00 @ Node 30400
Max : 51.71 @ Node 15244

Fringe : Element Deform ,Default, 024_B03_3_BSP_1S

Fig.A2.24 – Deformed shape, LC024_B03-3_BSP_1S

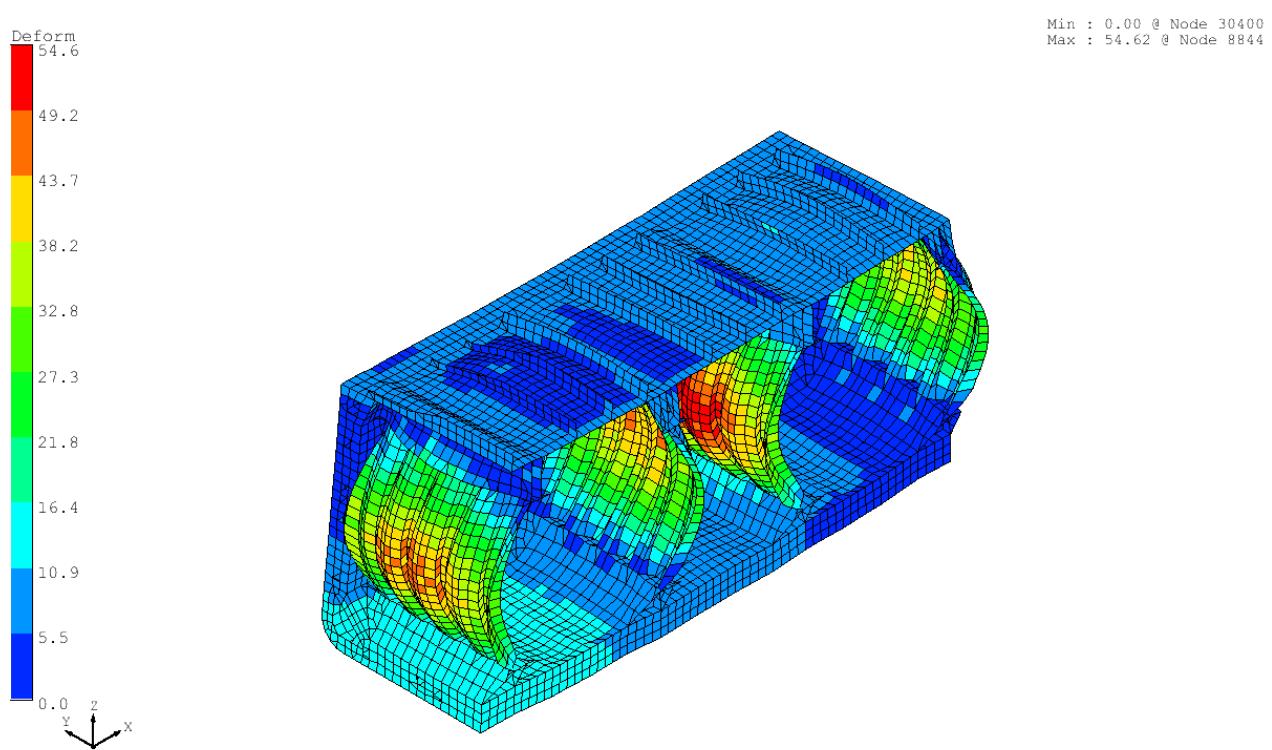
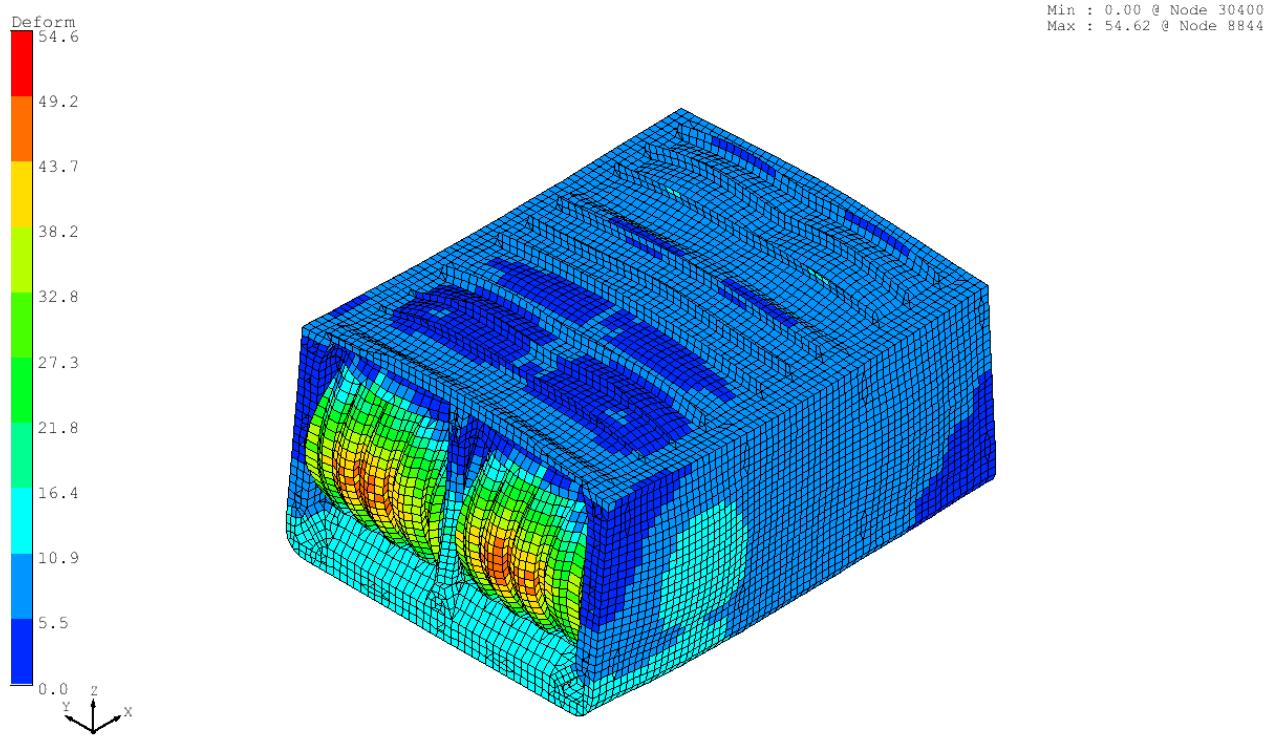


Fig.A2.25 – Deformed shape, LC025_B03-4_HSM_1

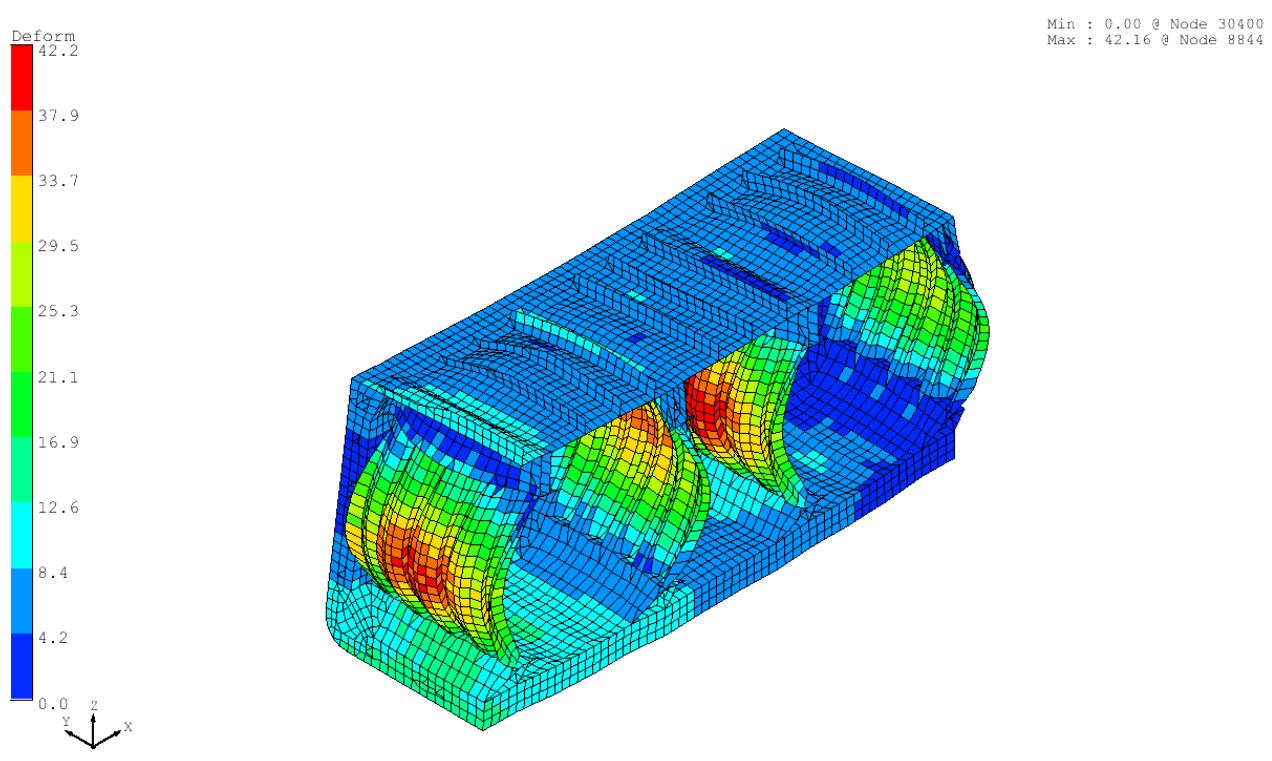
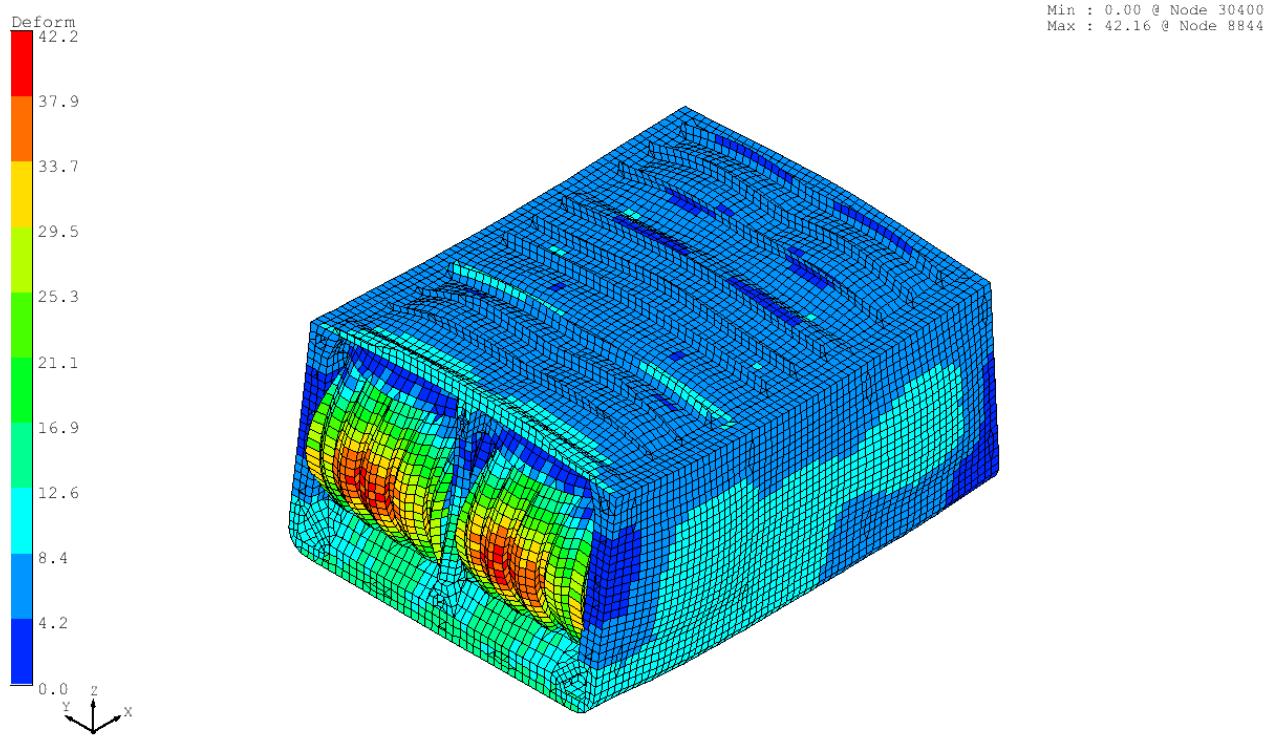


Fig.A2.26 – Deformed shape, LC026_B03-4_FSM_1

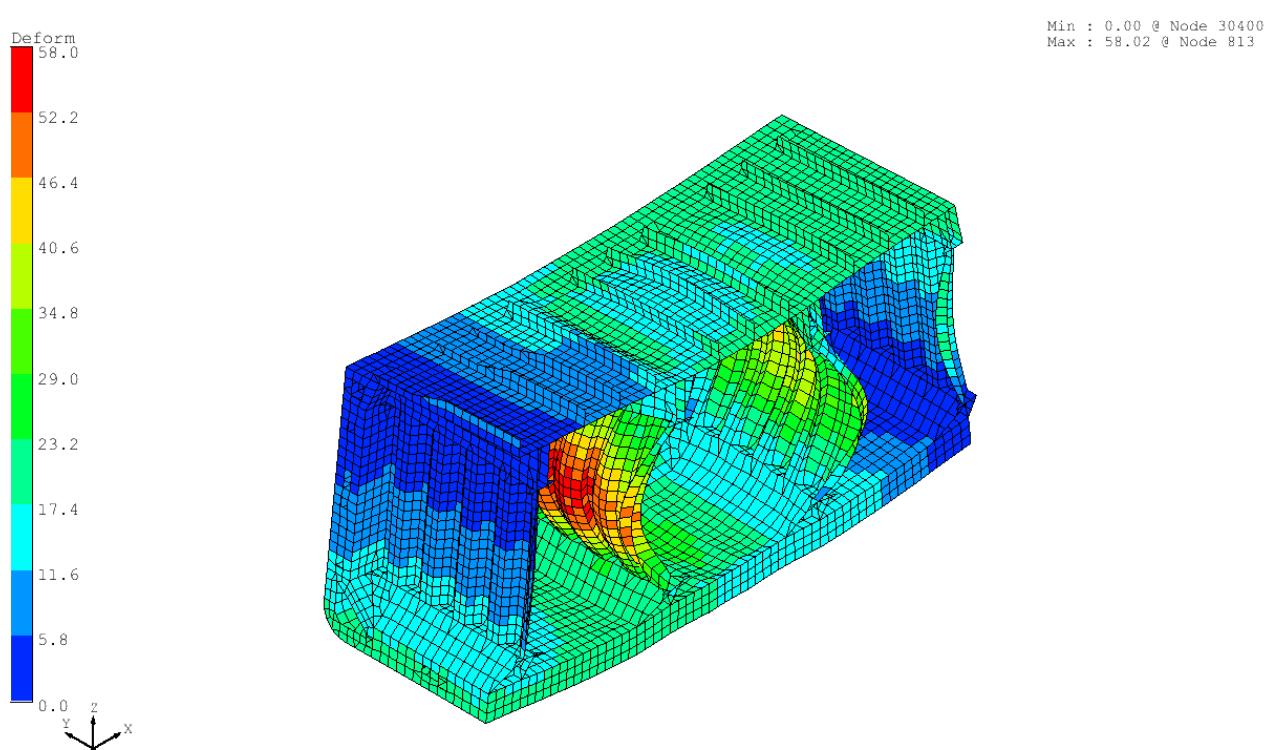
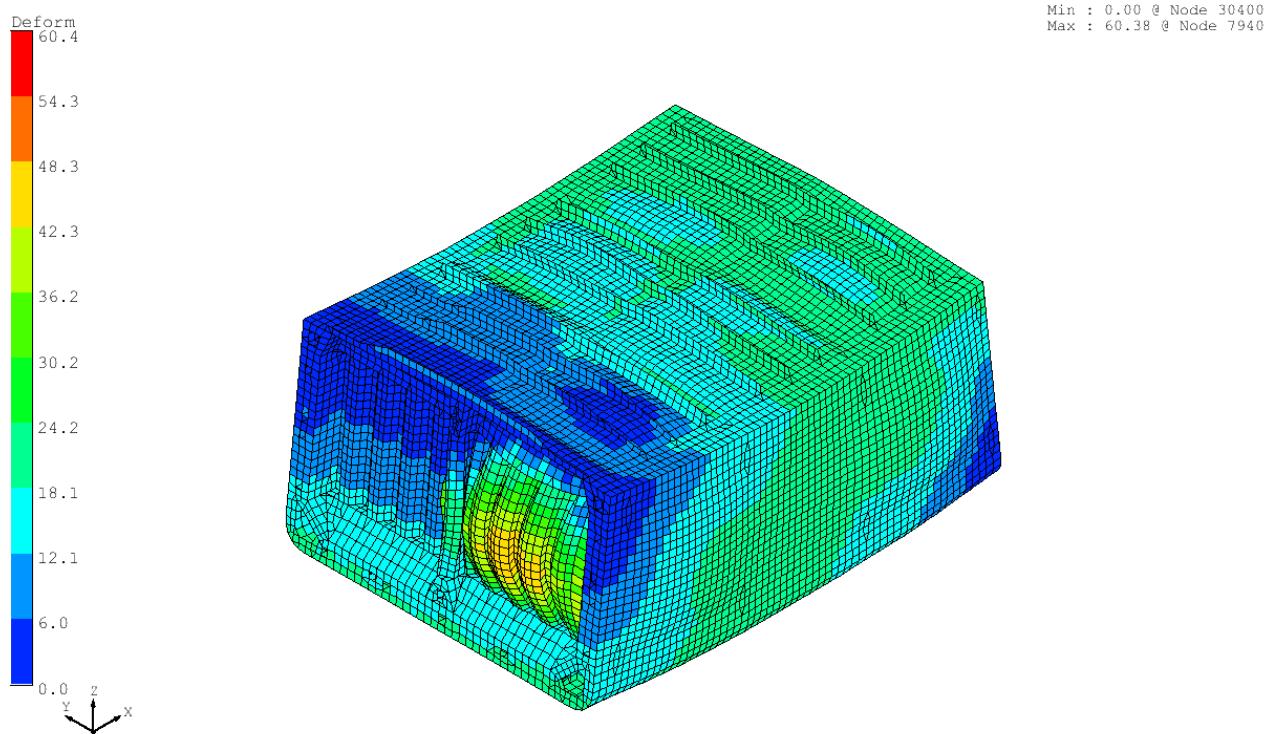
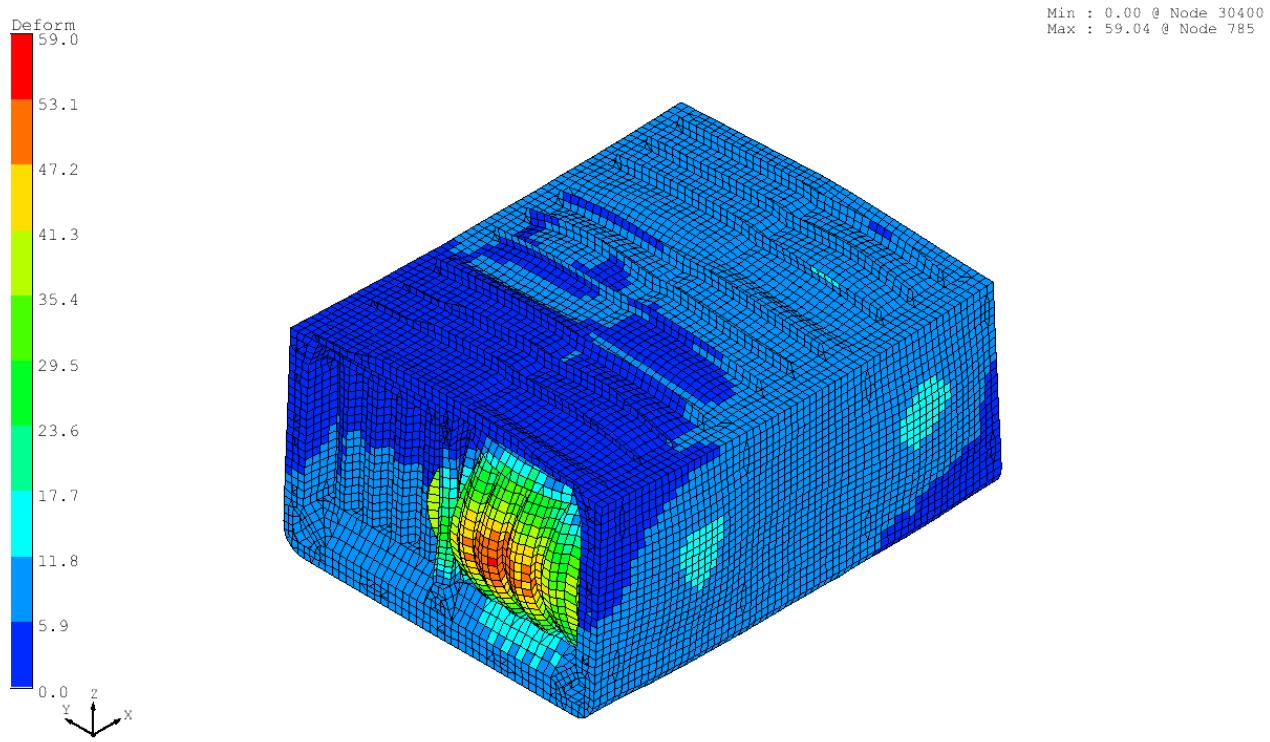
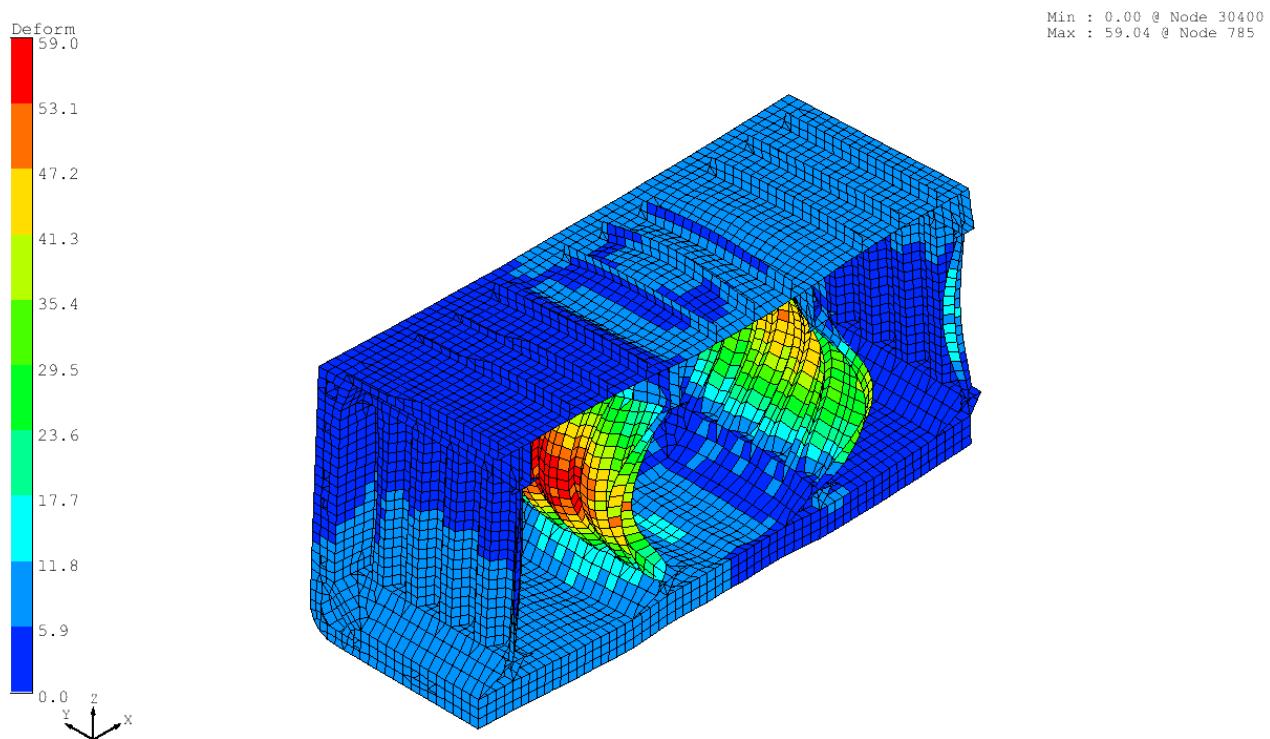


Fig.A2.27 – Deformed shape, LC027_B04_HSM_1



Fringe : Element Deform ,Default, 028_B04_BSP_1P



Fringe : Element Deform ,Default, 028_B04_BSP_1P

Fig.A2.28 – Deformed shape, LC028_B04_BSP_1P

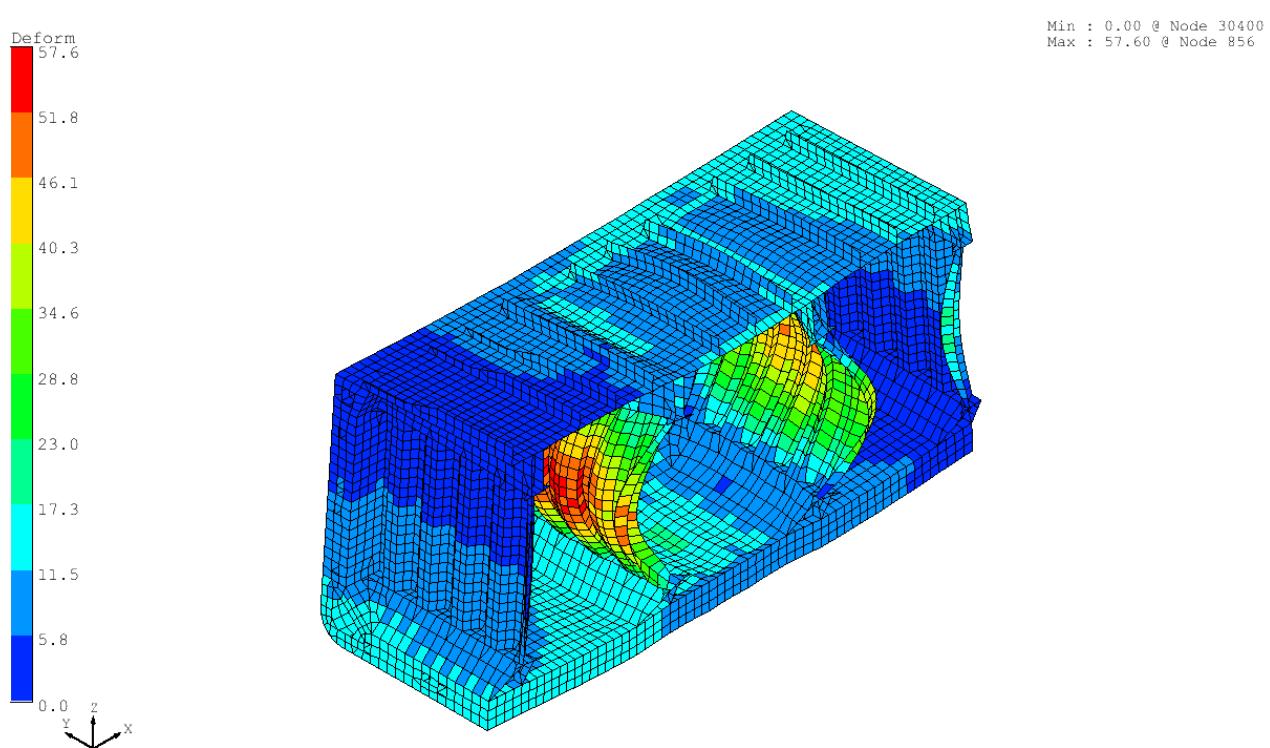
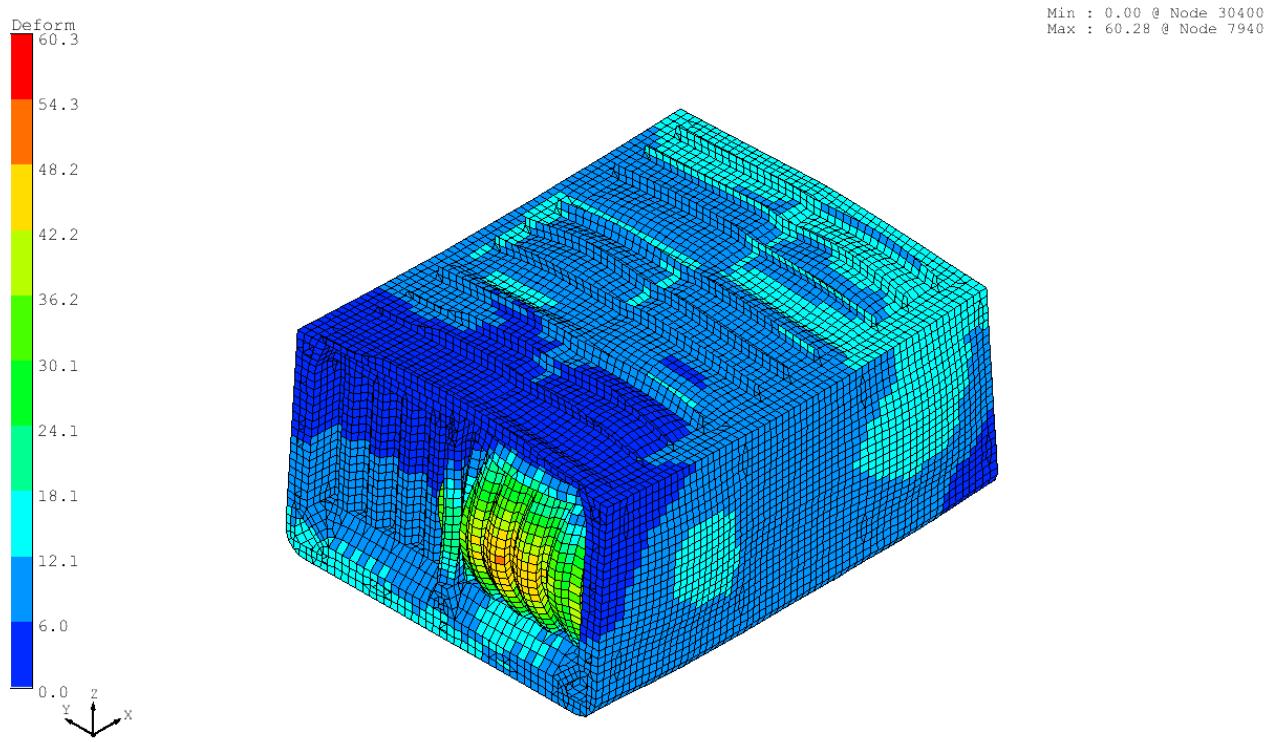


Fig.A2.29 – Deformed shape, LC029_B04_OSA_2P

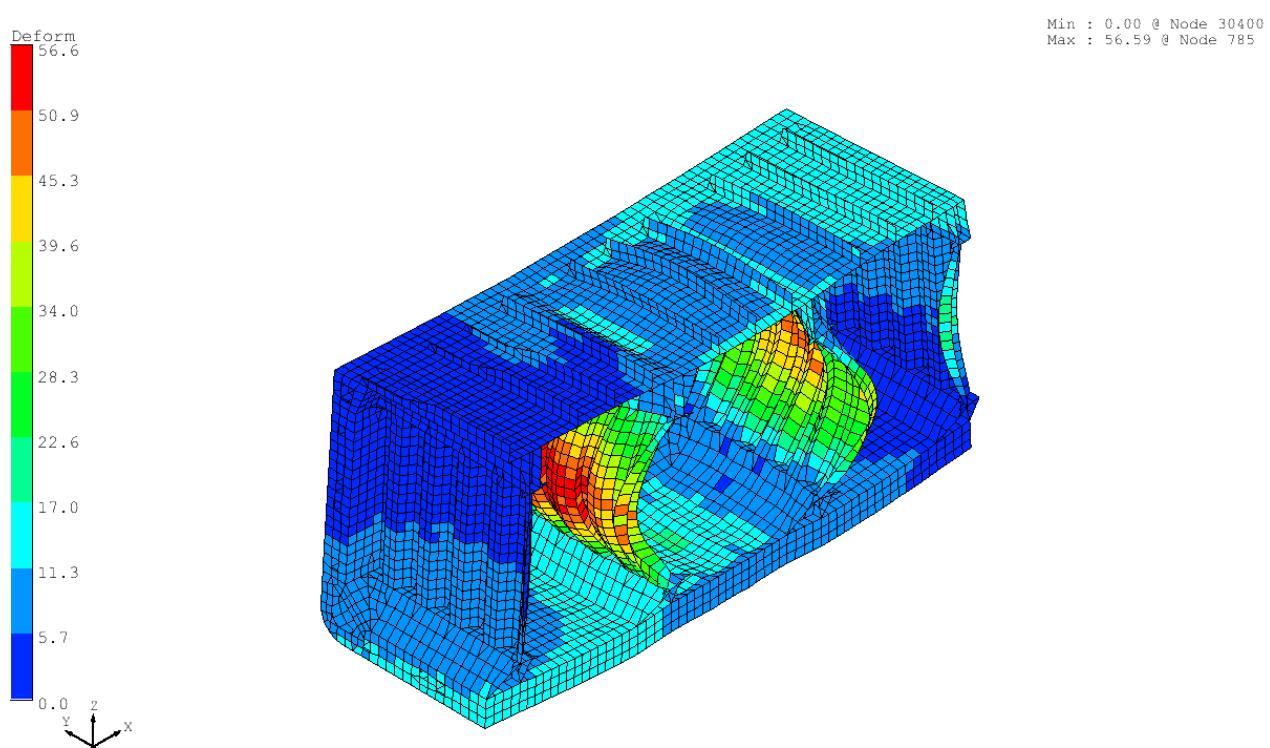
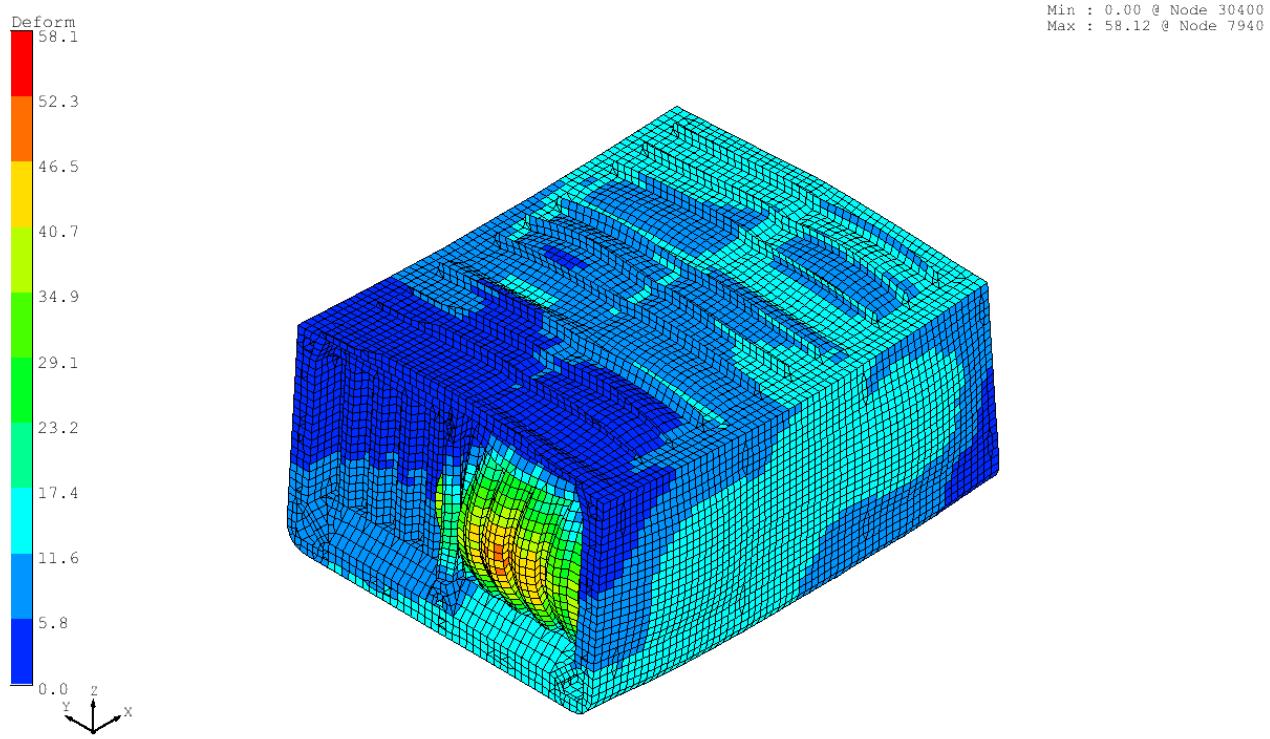
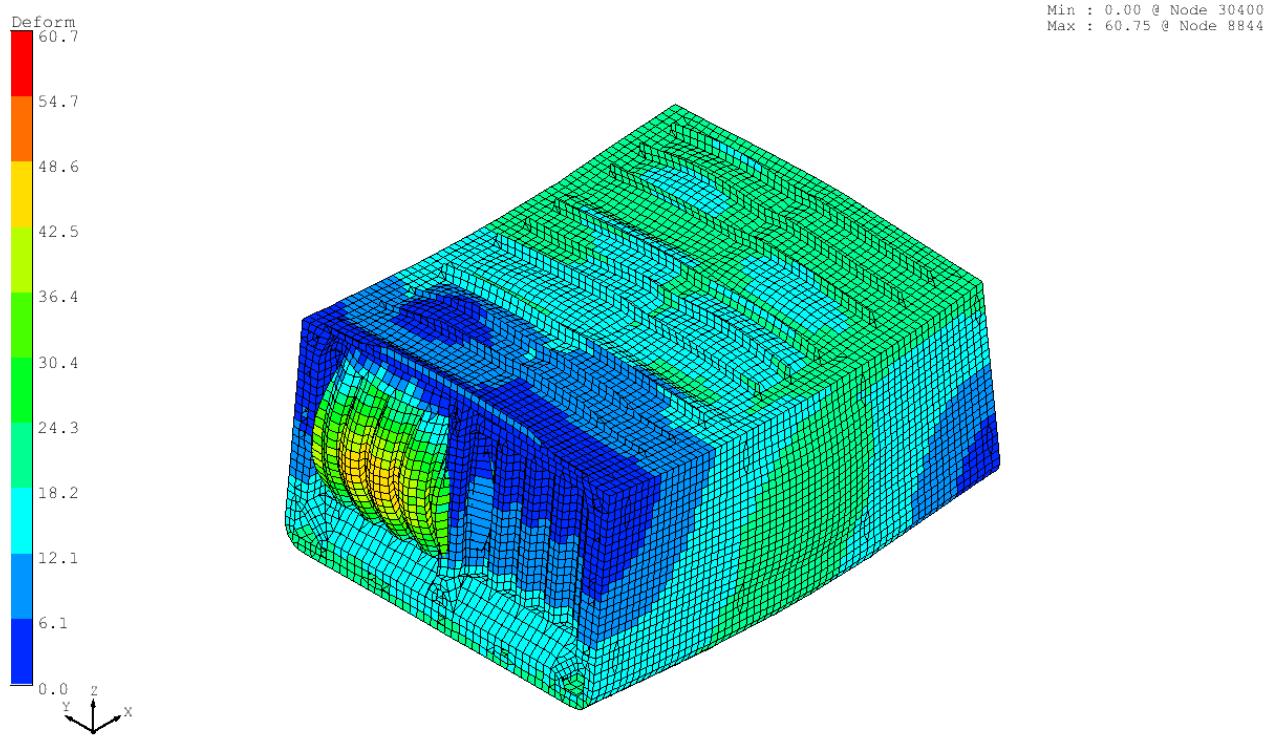
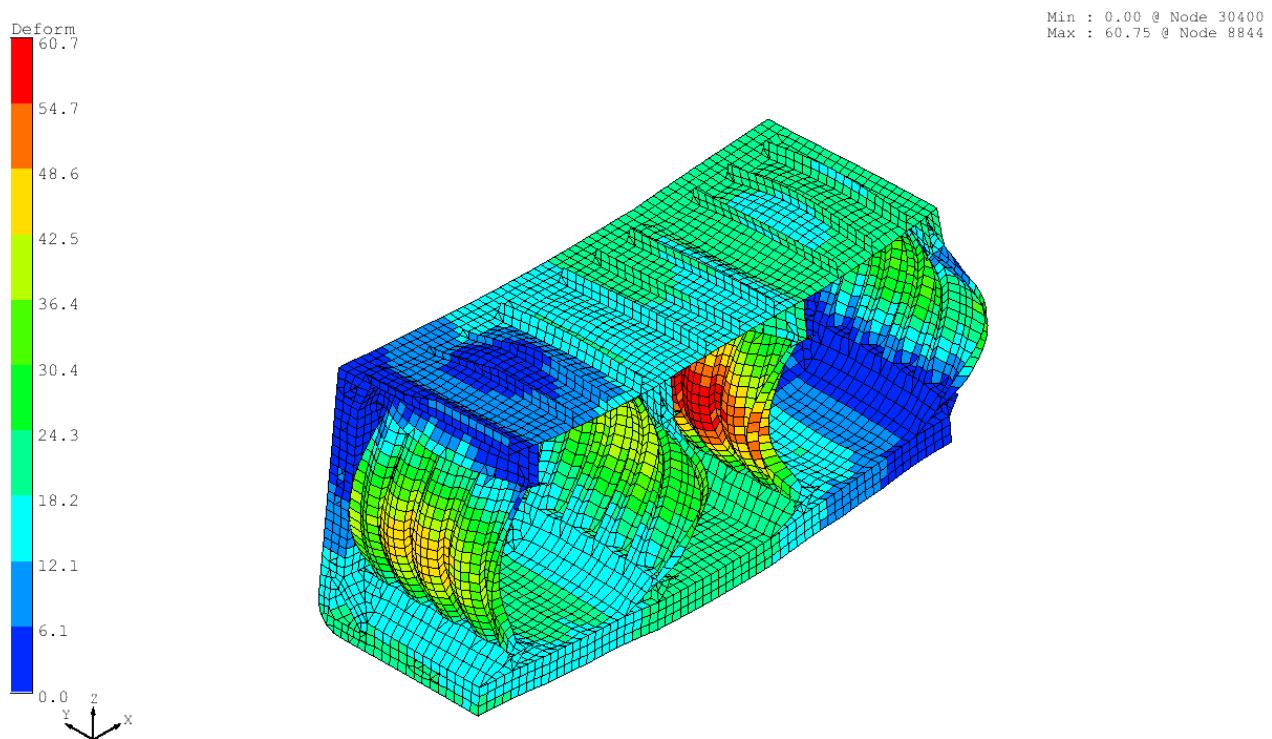


Fig.A2.30 – Deformed shape, LC030_B04_OSA_2S

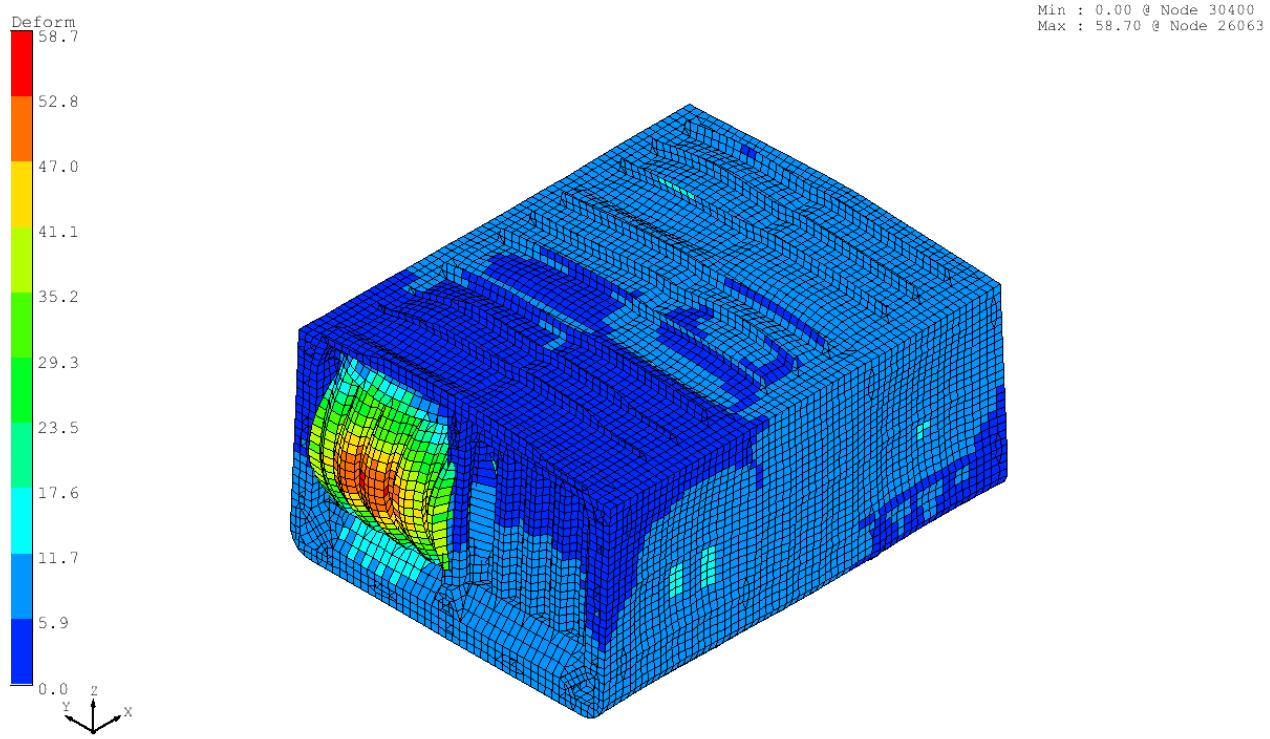


Fringe : Element Deform ,Default, 031_B05_HSM_1

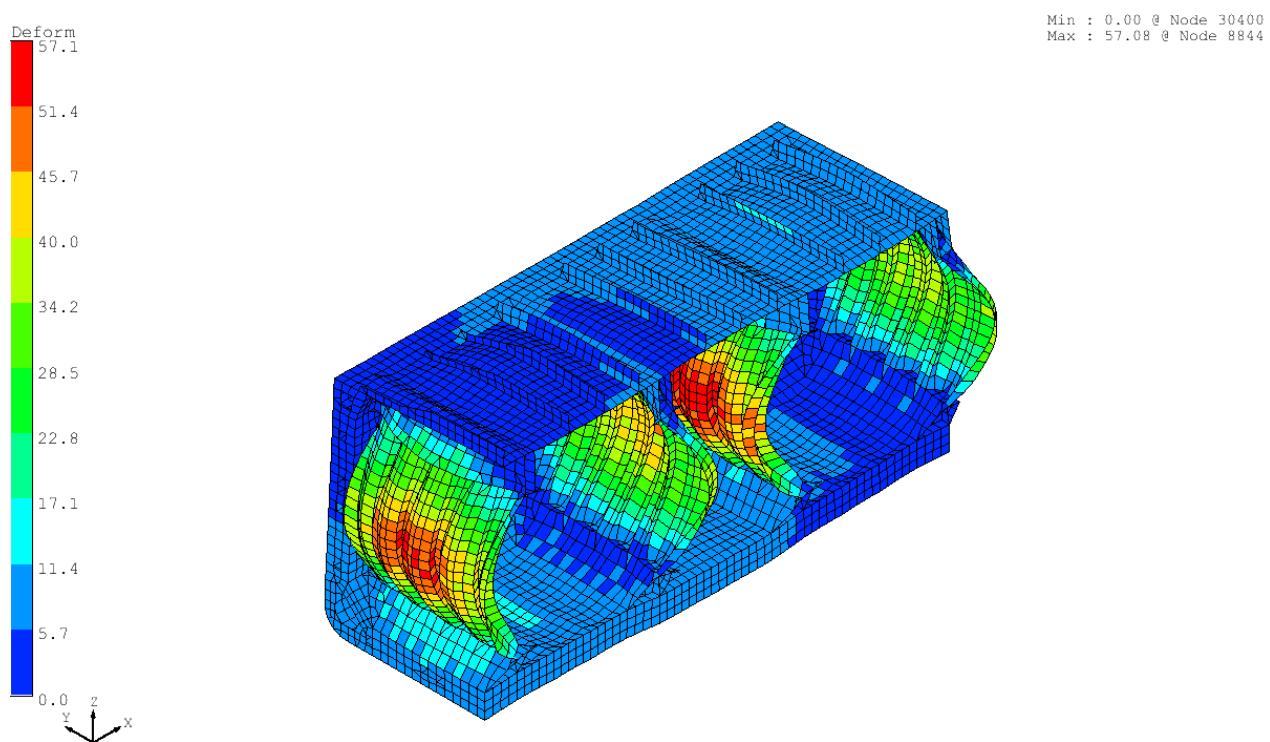


Fringe : Element Deform ,Default, 031_B05_HSM_1

Fig.A2.31 – Deformed shape, LC031_B05_HSM_1



Fringe : Element Deform ,Default, 032_B05_BSP_1S



Fringe : Element Deform ,Default, 032_B05_BSP_1S

Fig.A2.32 – Deformed shape, LC032_B05_BSP_1S

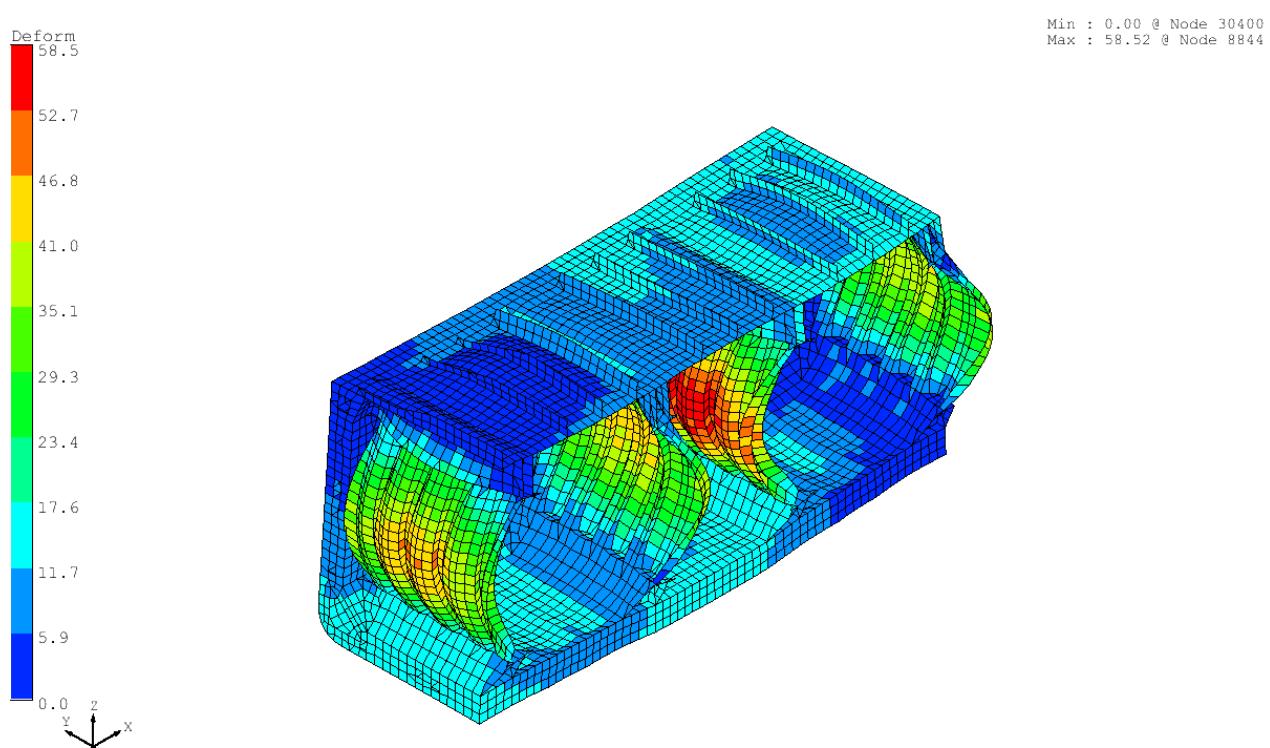
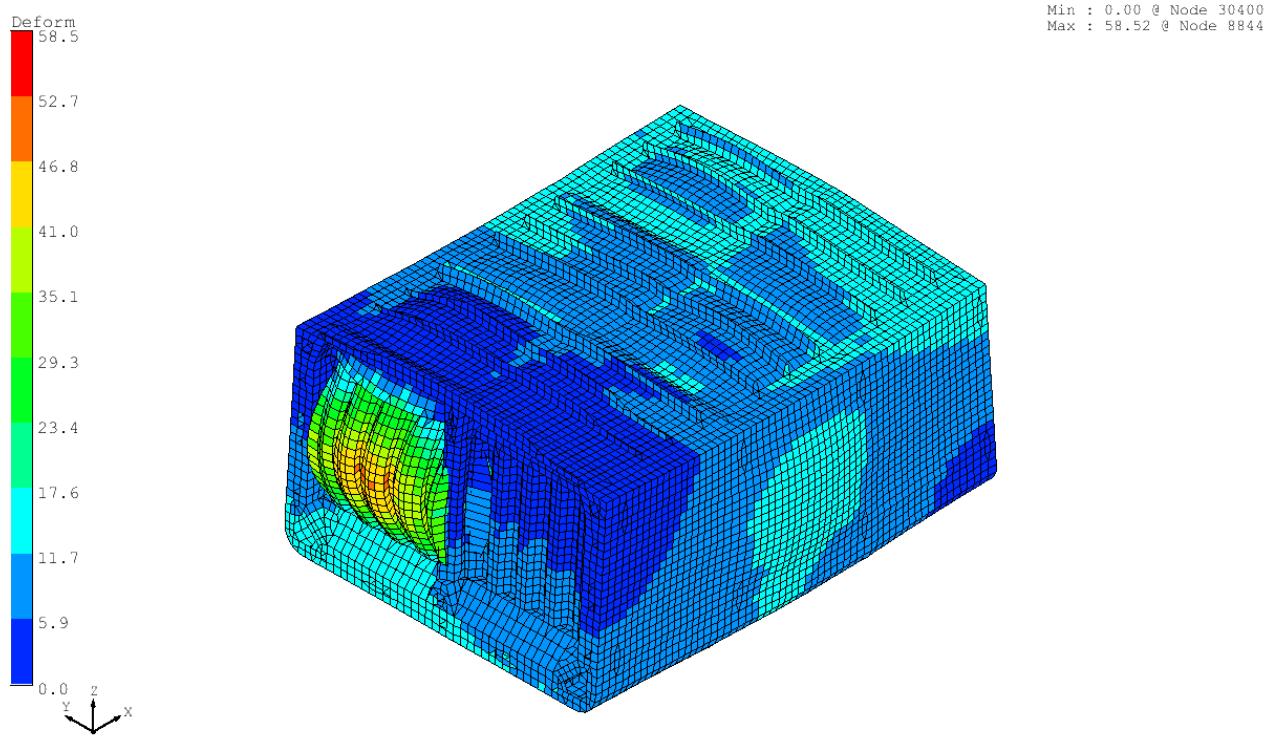
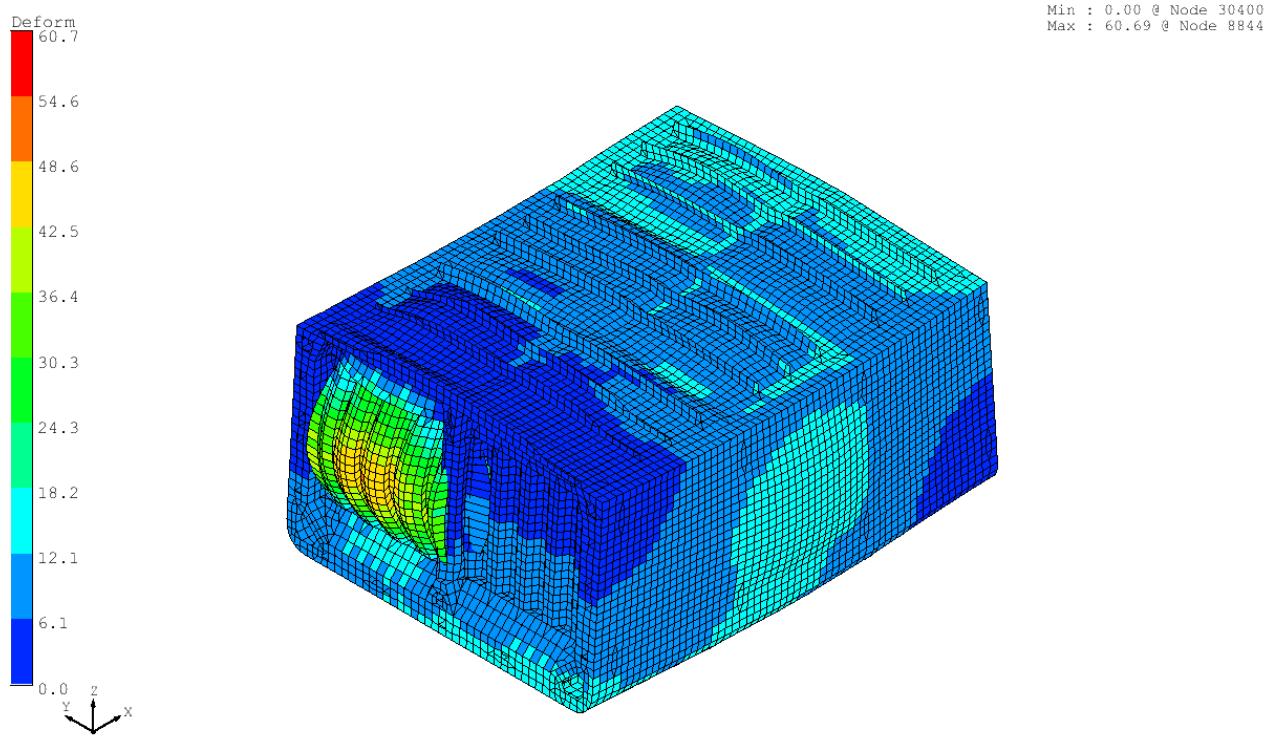
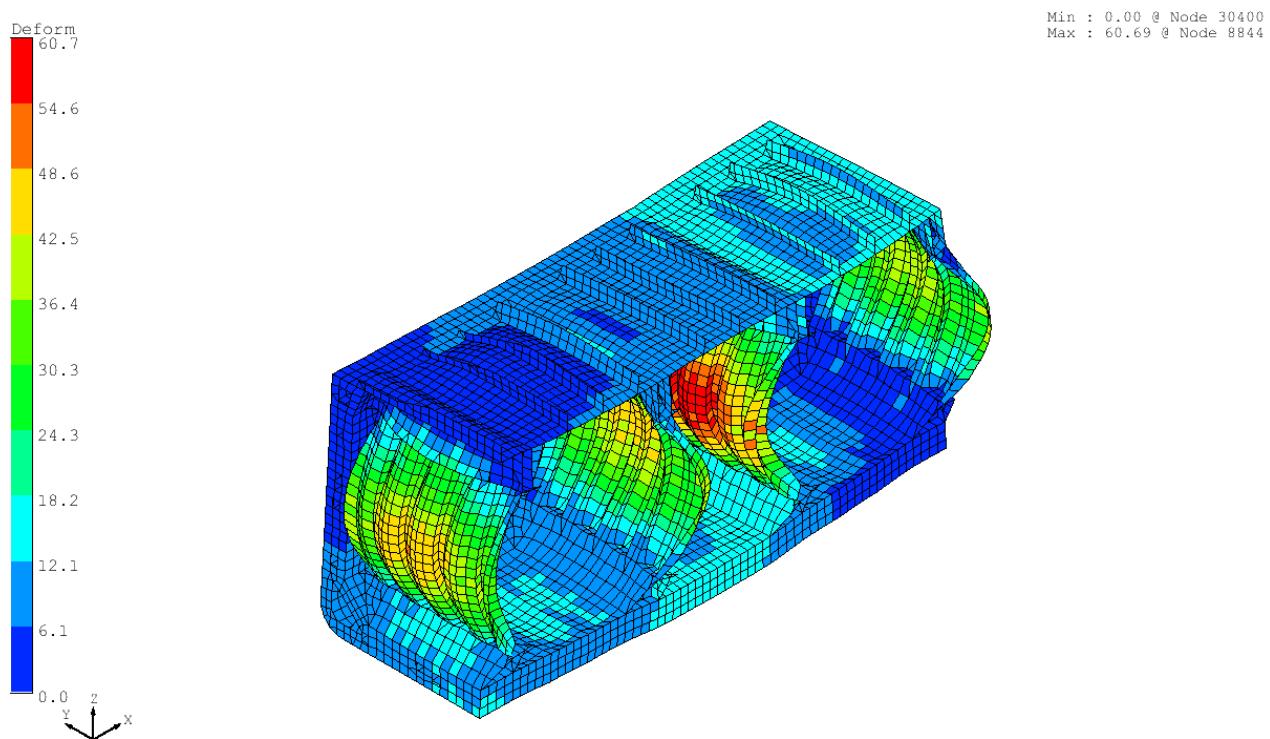


Fig.A2.33 – Deformed shape, LC033_B05_OSA_2P



Fringe : Element Deform ,Default, 034_B05_OSA_2S



Fringe : Element Deform ,Default, 034_B05_OSA_2S

Fig.A2.34 – Deformed shape, LC034_B05_OSA_2S

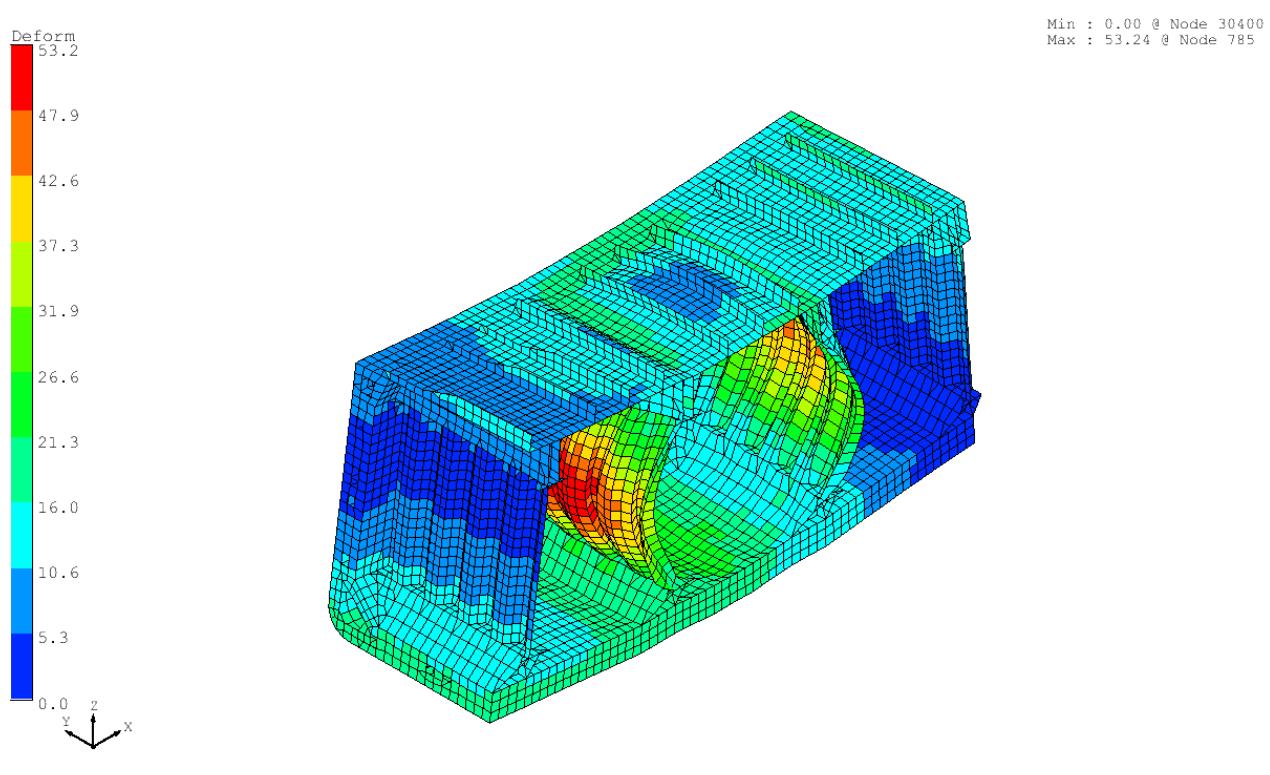
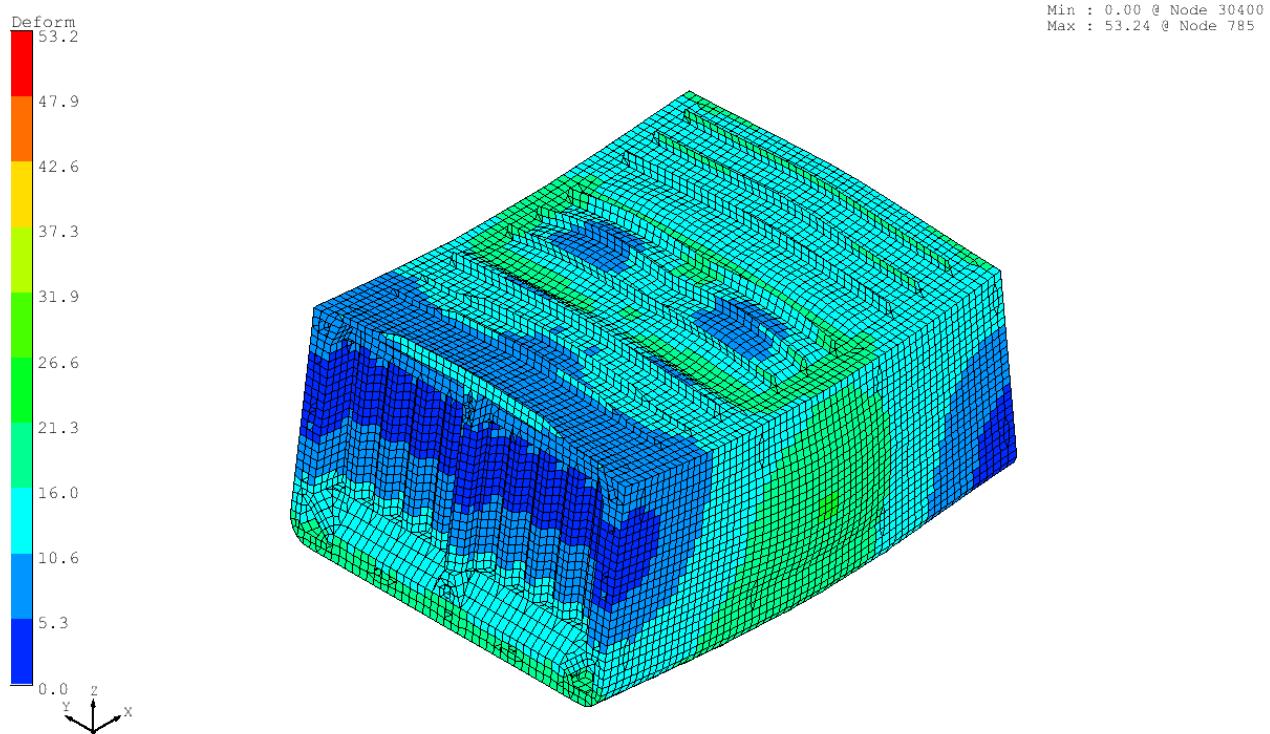


Fig.A2.35 – Deformed shape, LC035_B06-1_HSM_1

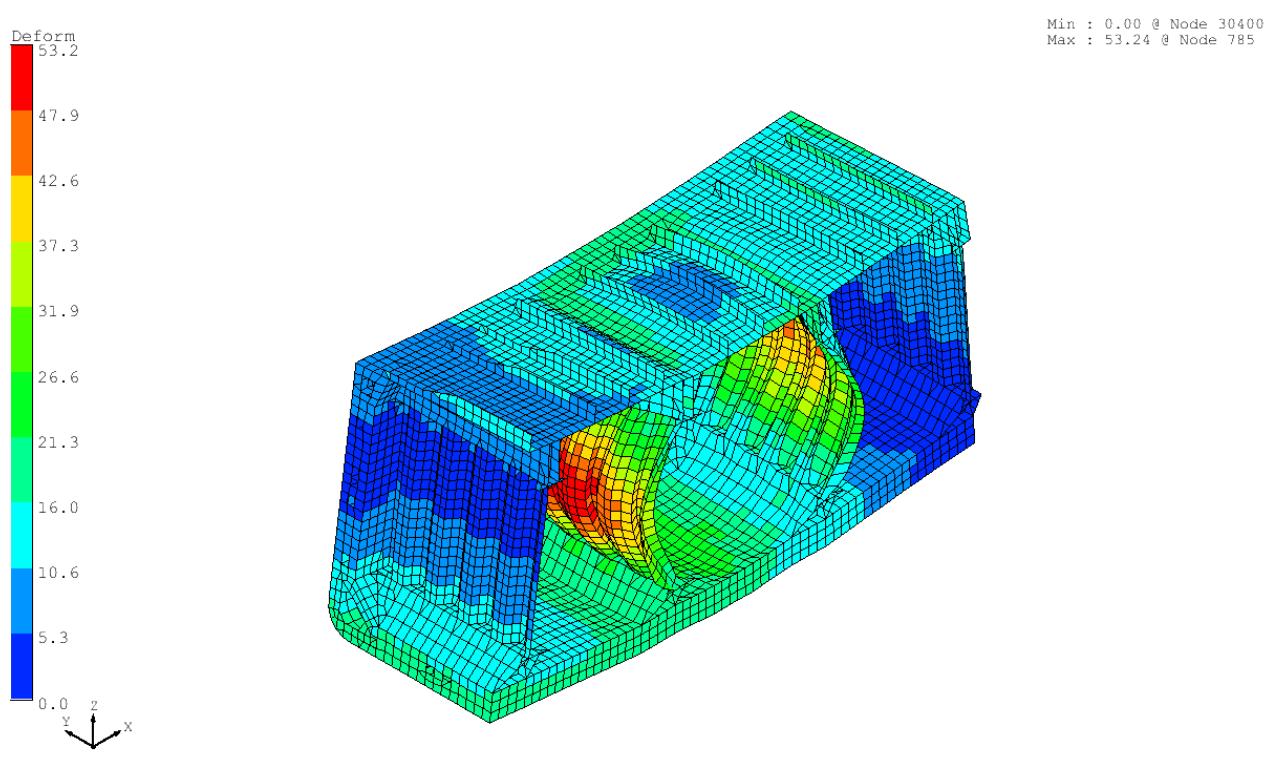
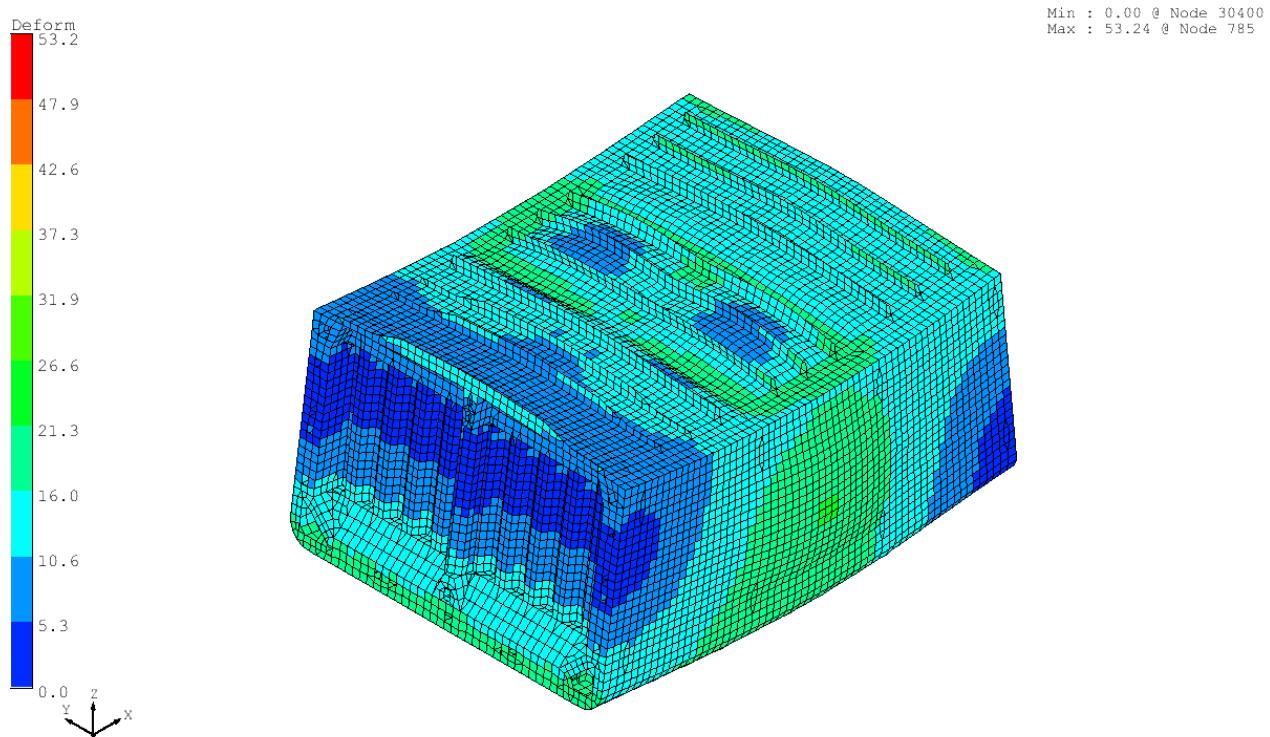


Fig.A2.36 – Deformed shape, LC036_B06-2_HSM_1

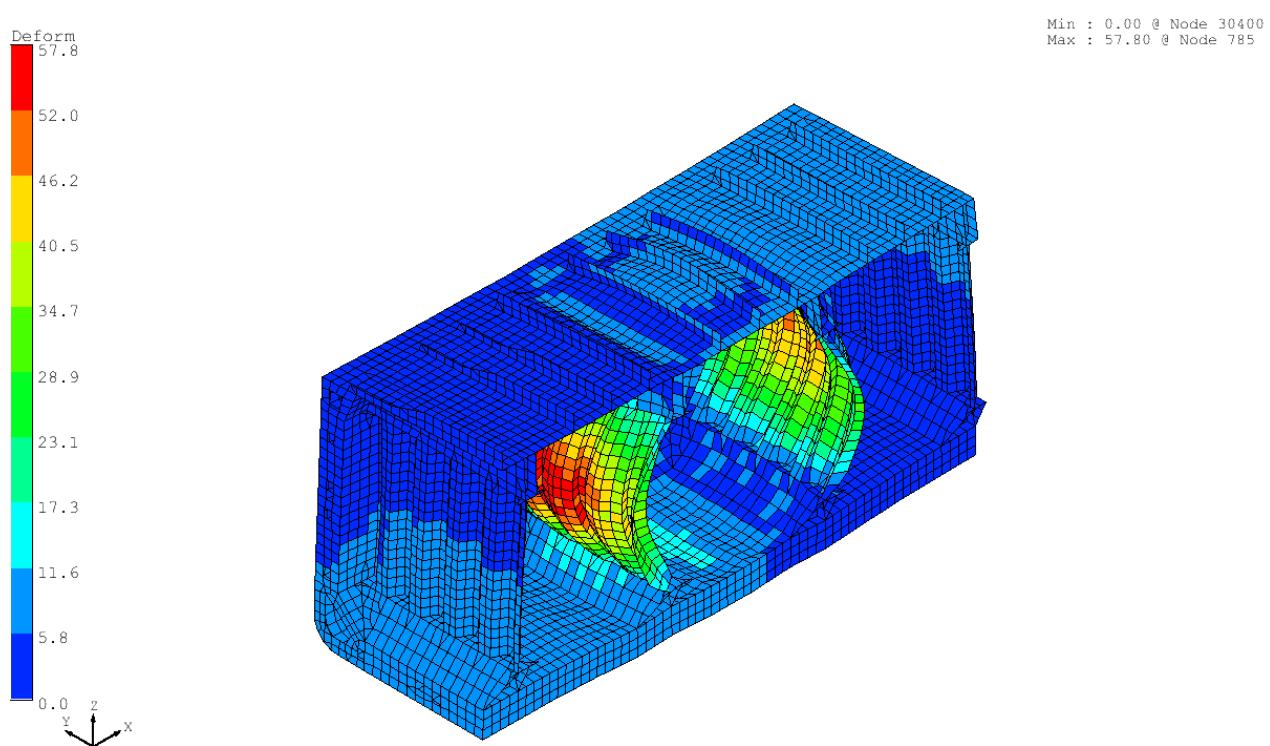
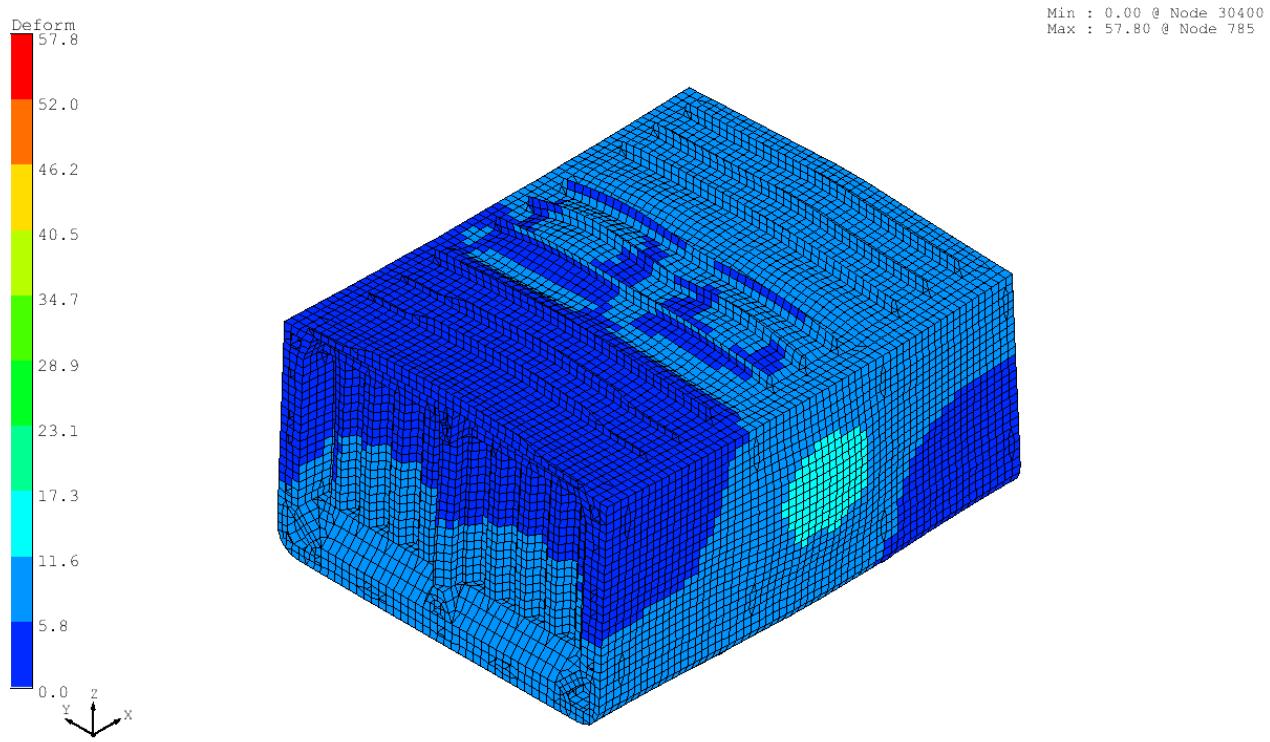


Fig.A2.37 – Deformed shape, LC037_B06-3_BSP_1P

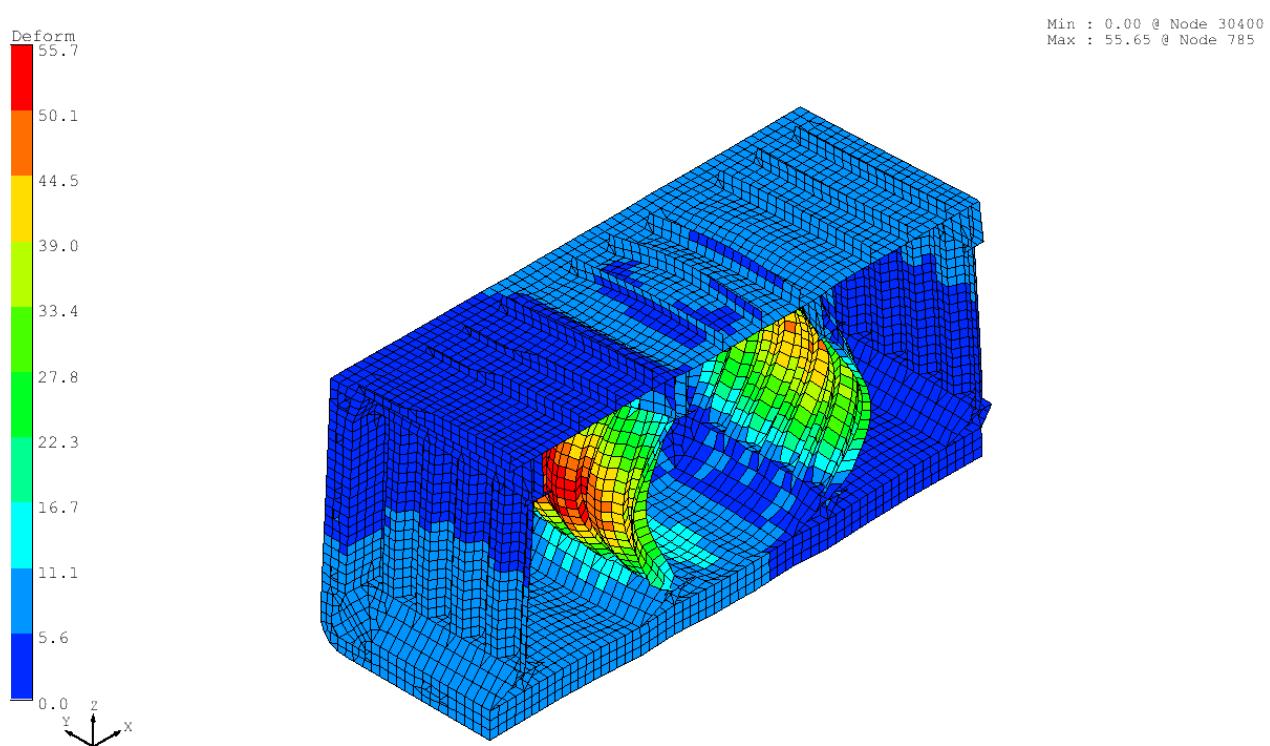
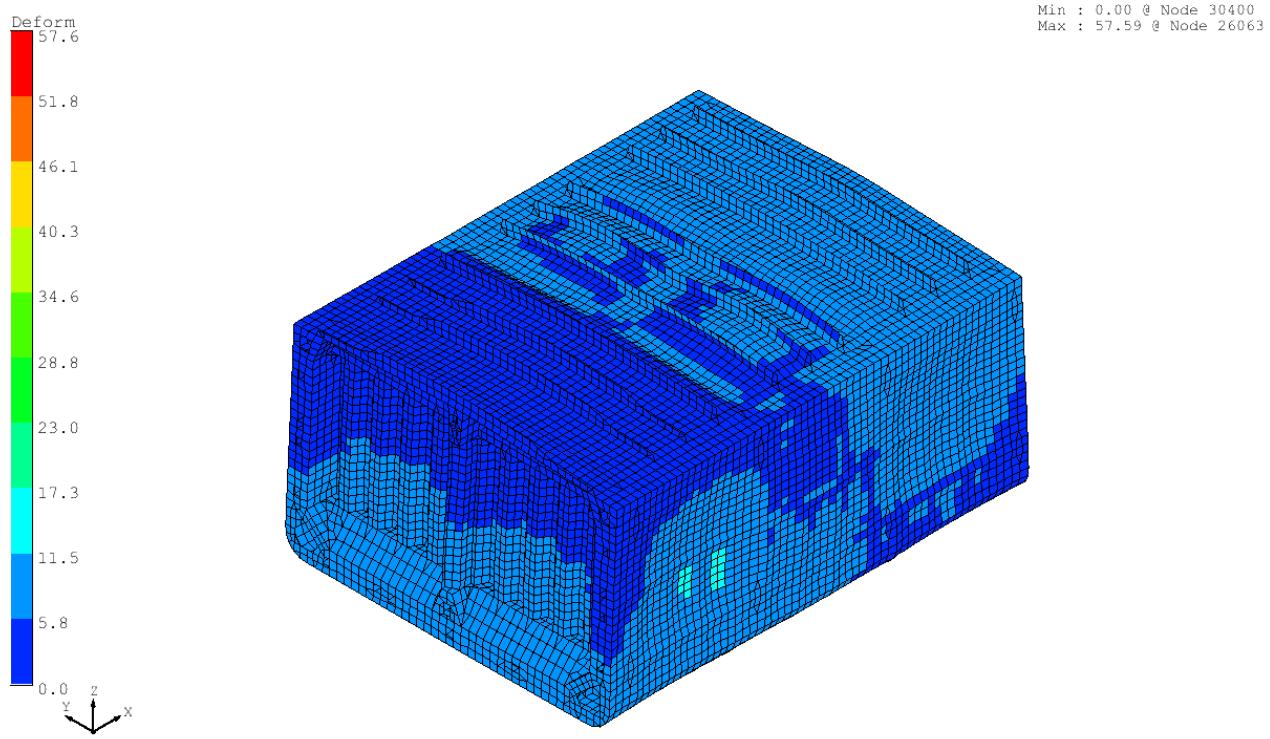
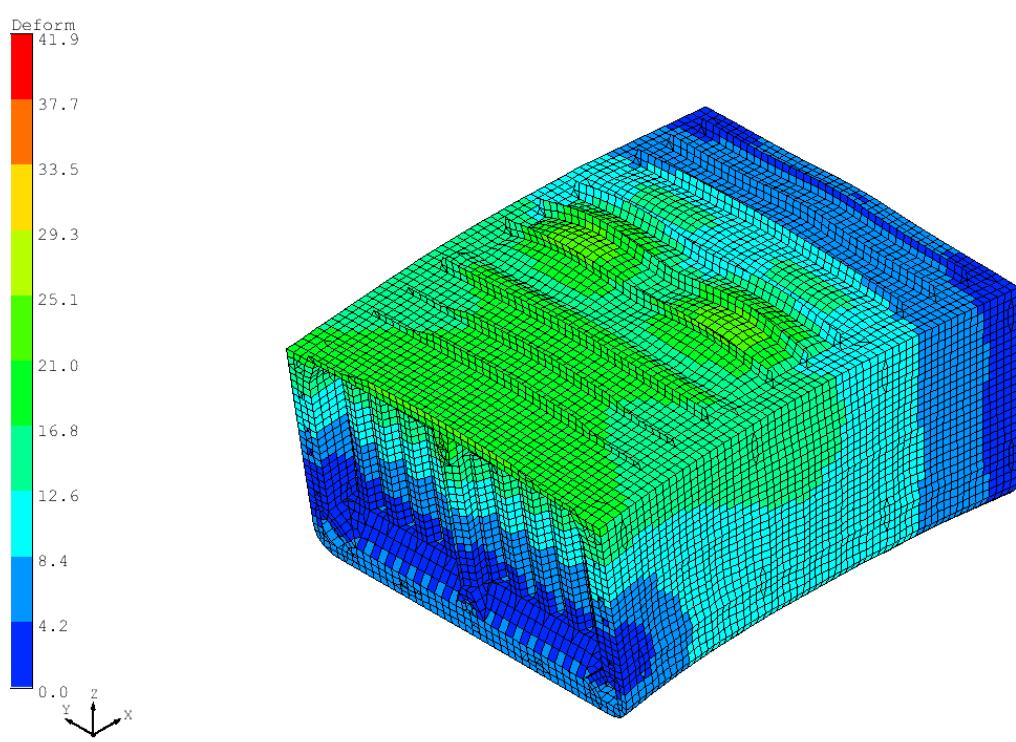
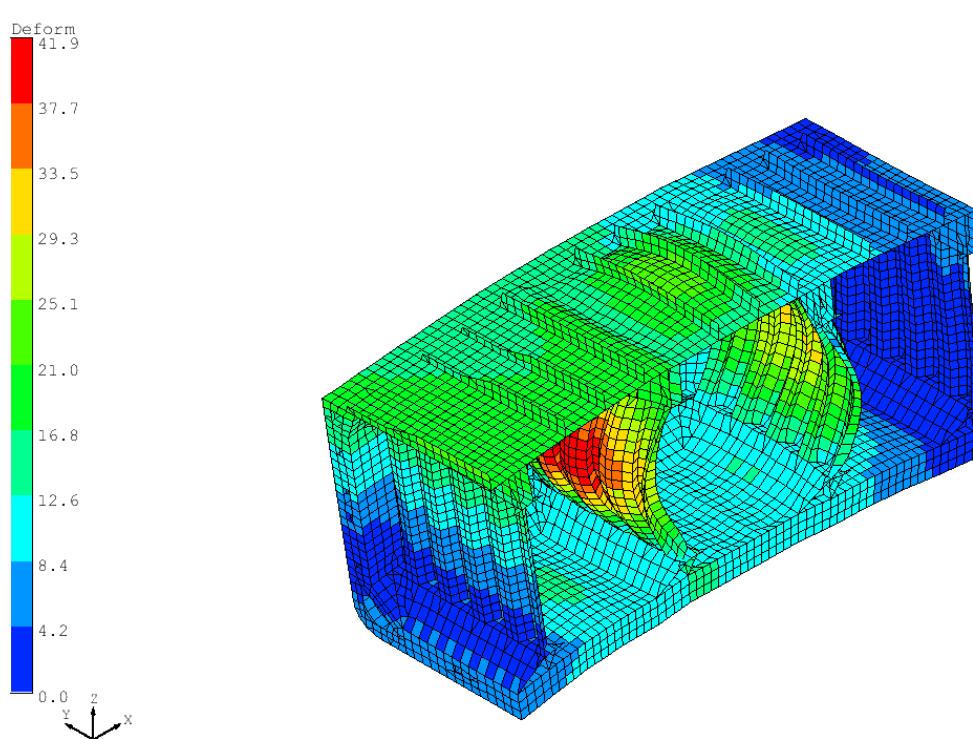


Fig.A2.38 – Deformed shape, LC038_B06-3_BSP_1S



Fringe : Element Deform ,Default, 039_B06_4_HSM_2



Fringe : Element Deform ,Default, 039_B06_4_HSM_2

Fig.A2.39 – Deformed shape, LC039_B06-4_HSM_2

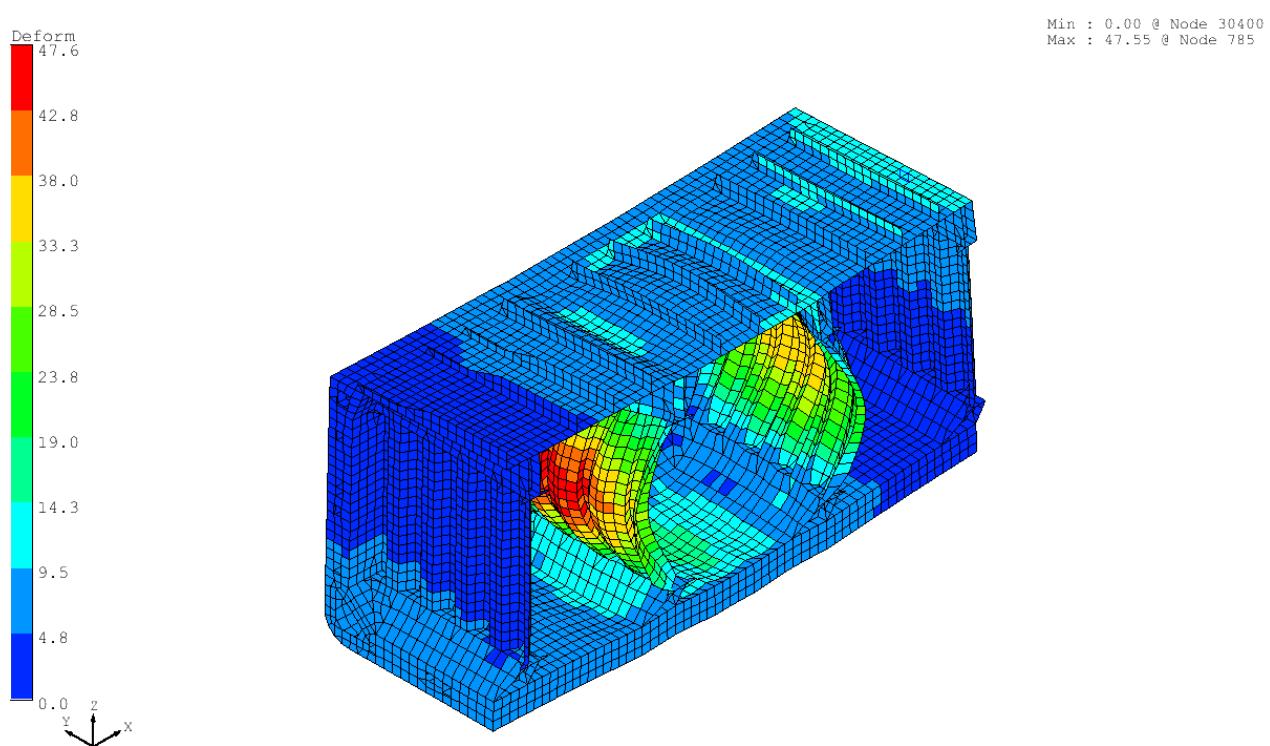
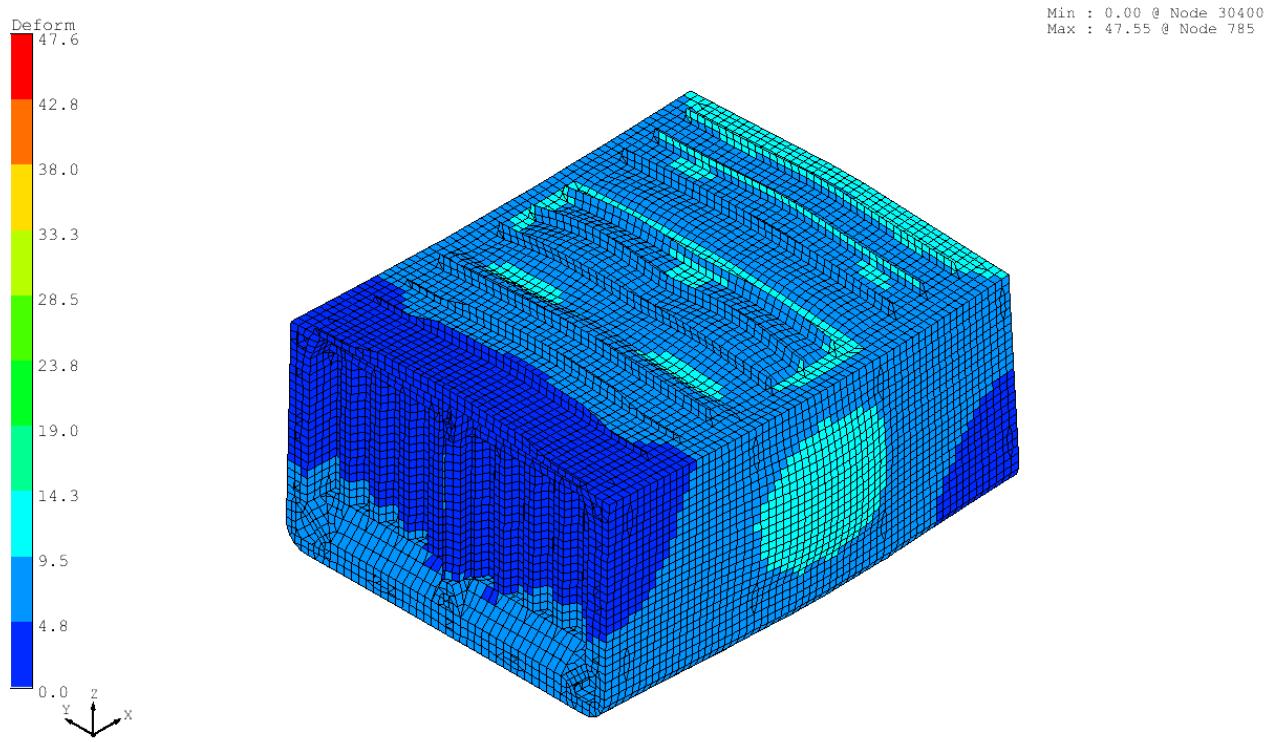
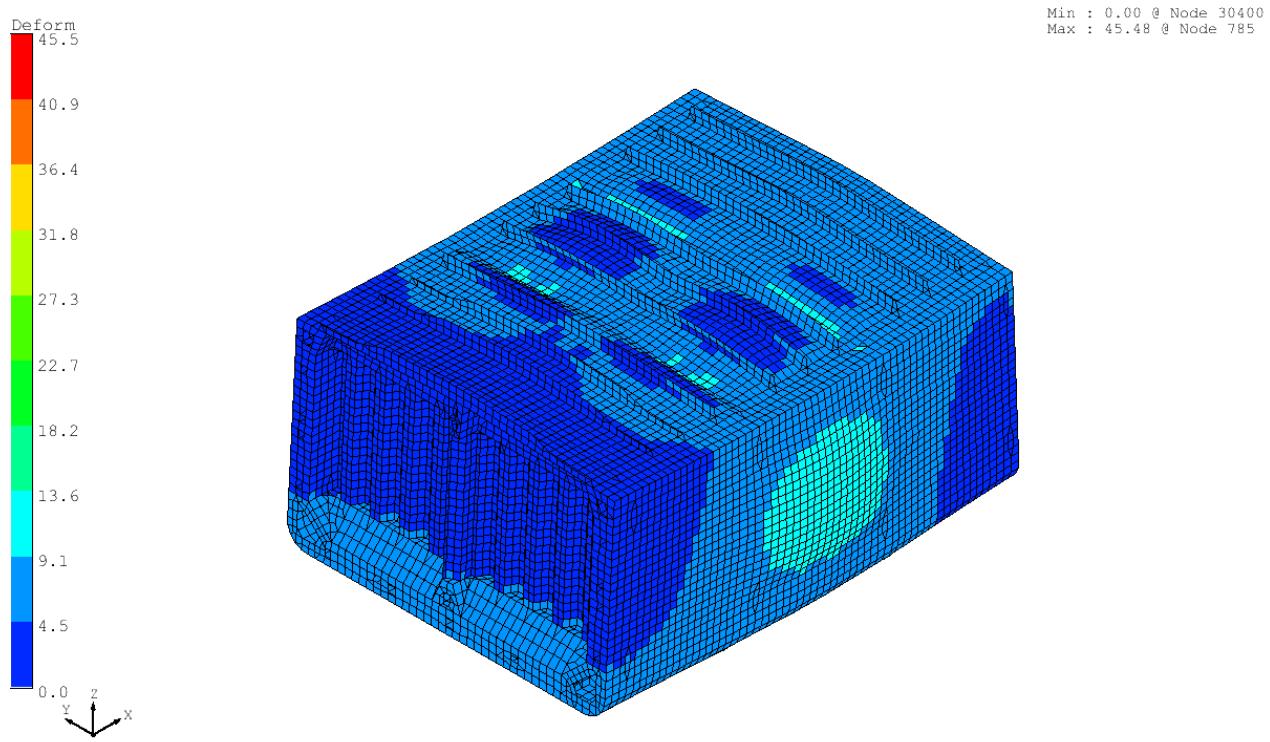
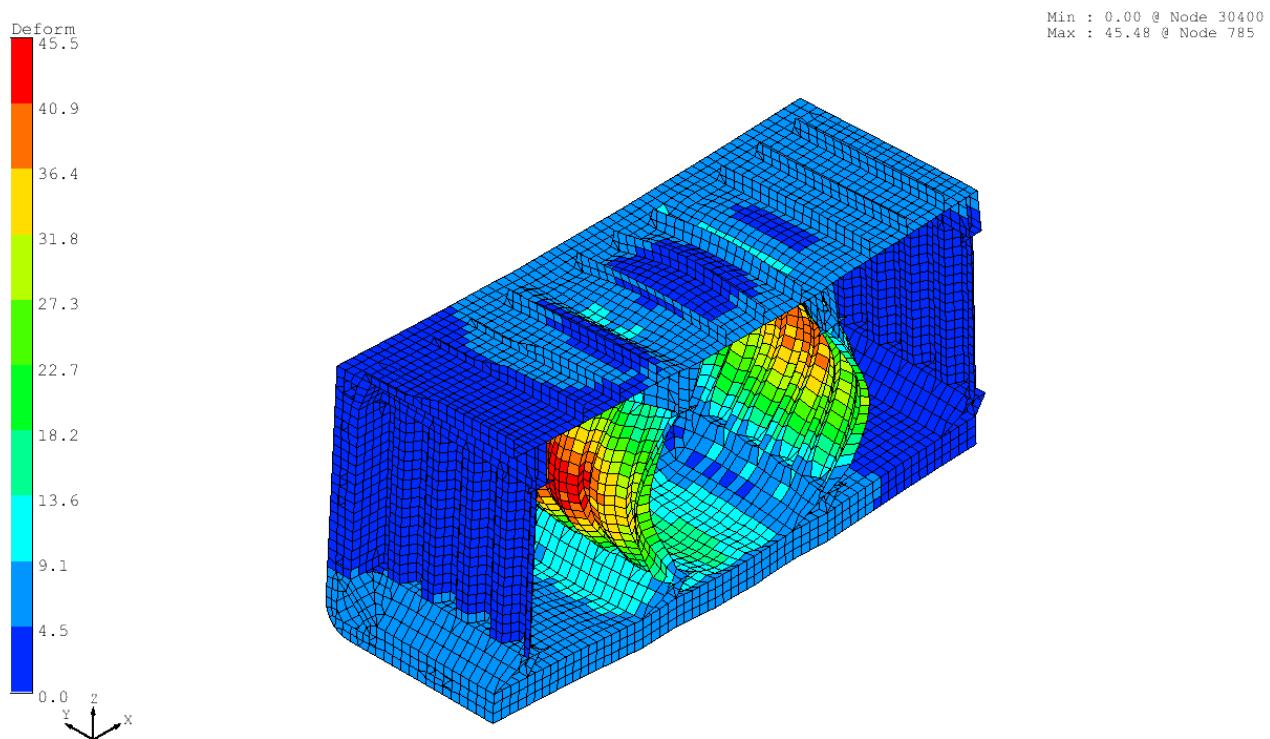


Fig.A2.40 – Deformed shape, LC040_B08-1 HARBOUR



Fringe : Element Deform ,Default, 041_B08_2HARBOUR



Fringe : Element Deform ,Default, 041_B08_2HARBOUR

Fig.A2.41 – Deformed shape, LC041_B08-2 HARBOUR

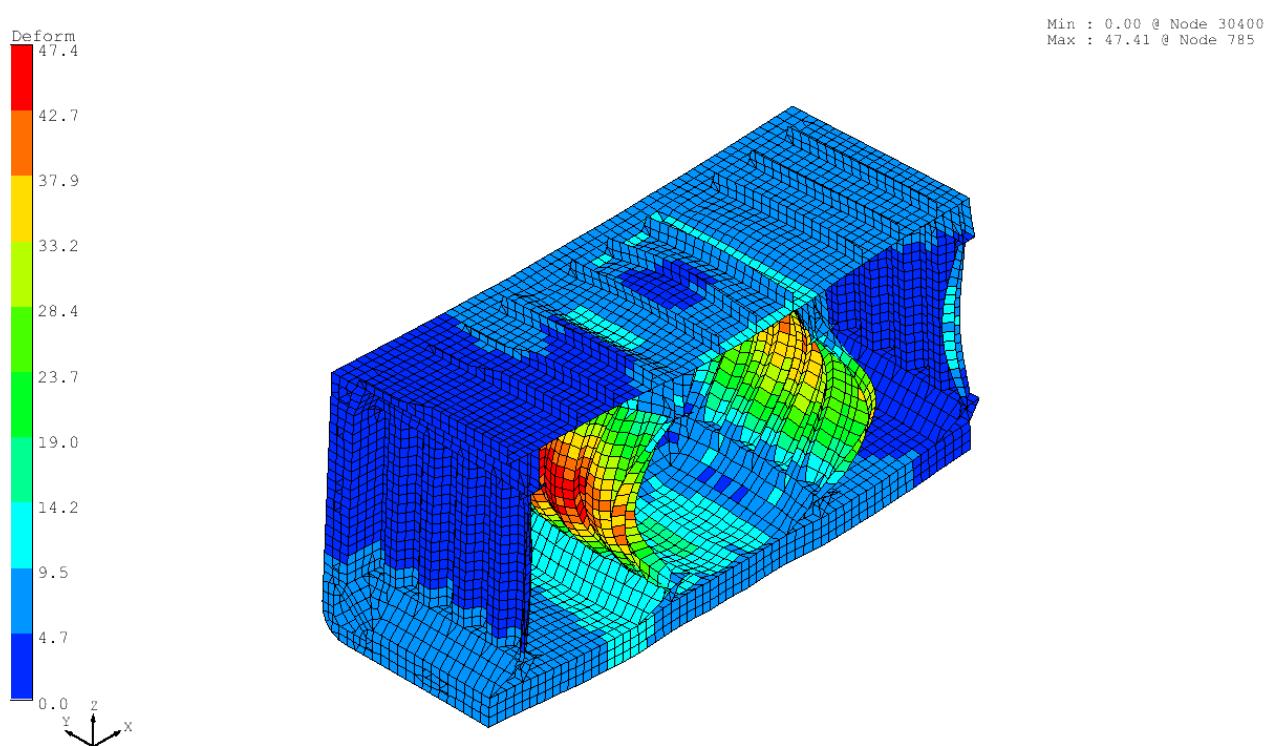
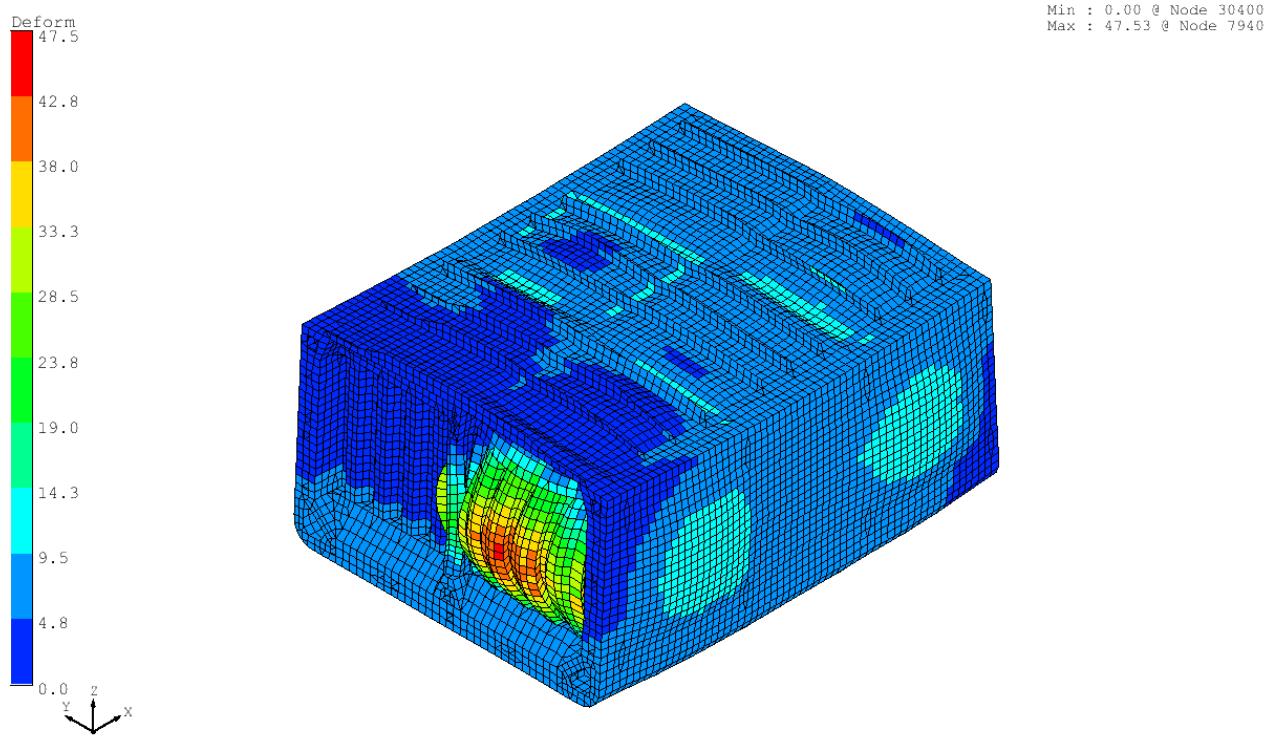
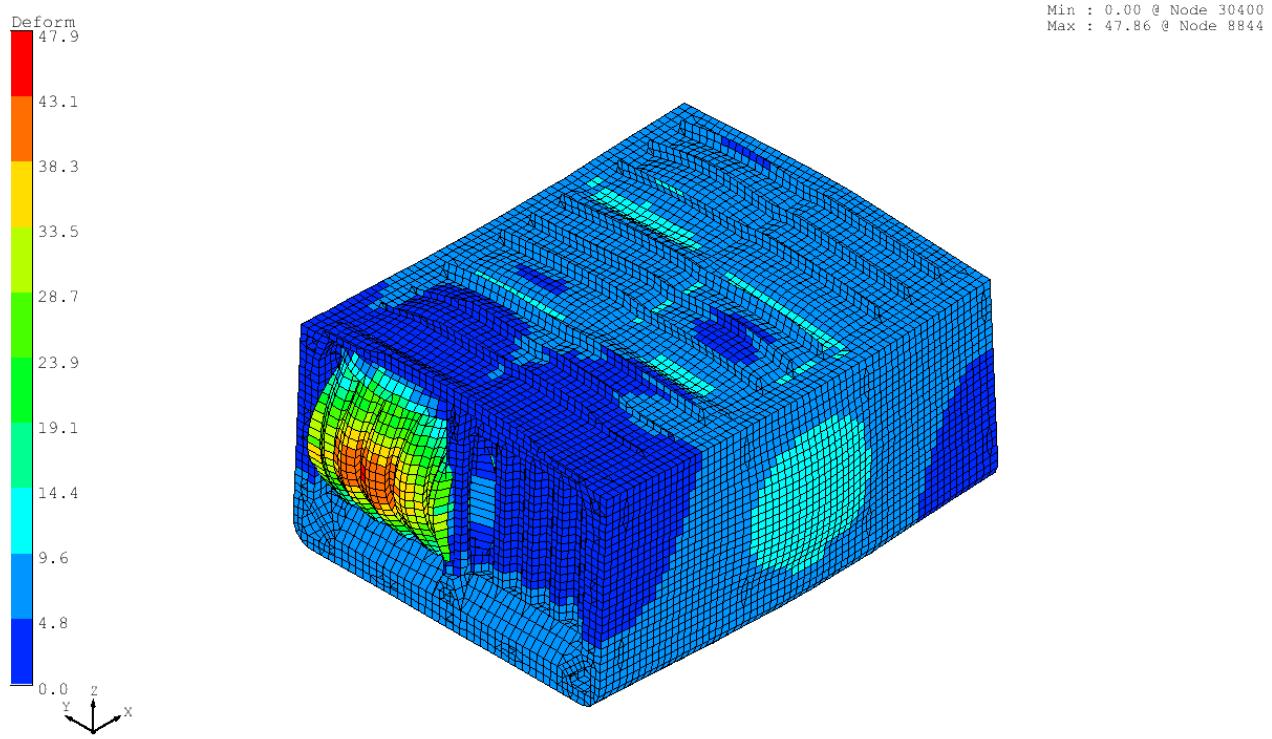
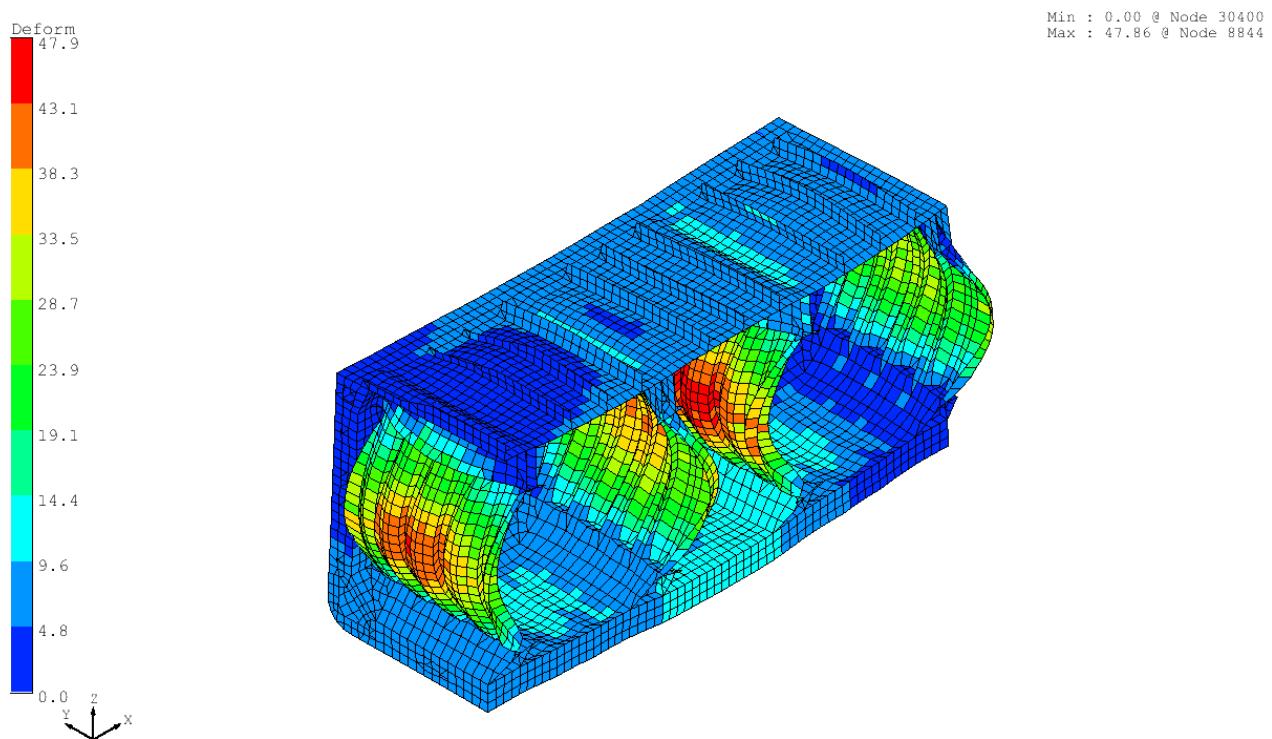


Fig.A2.42 – Deformed shape, LC042_B09_HARBOUR

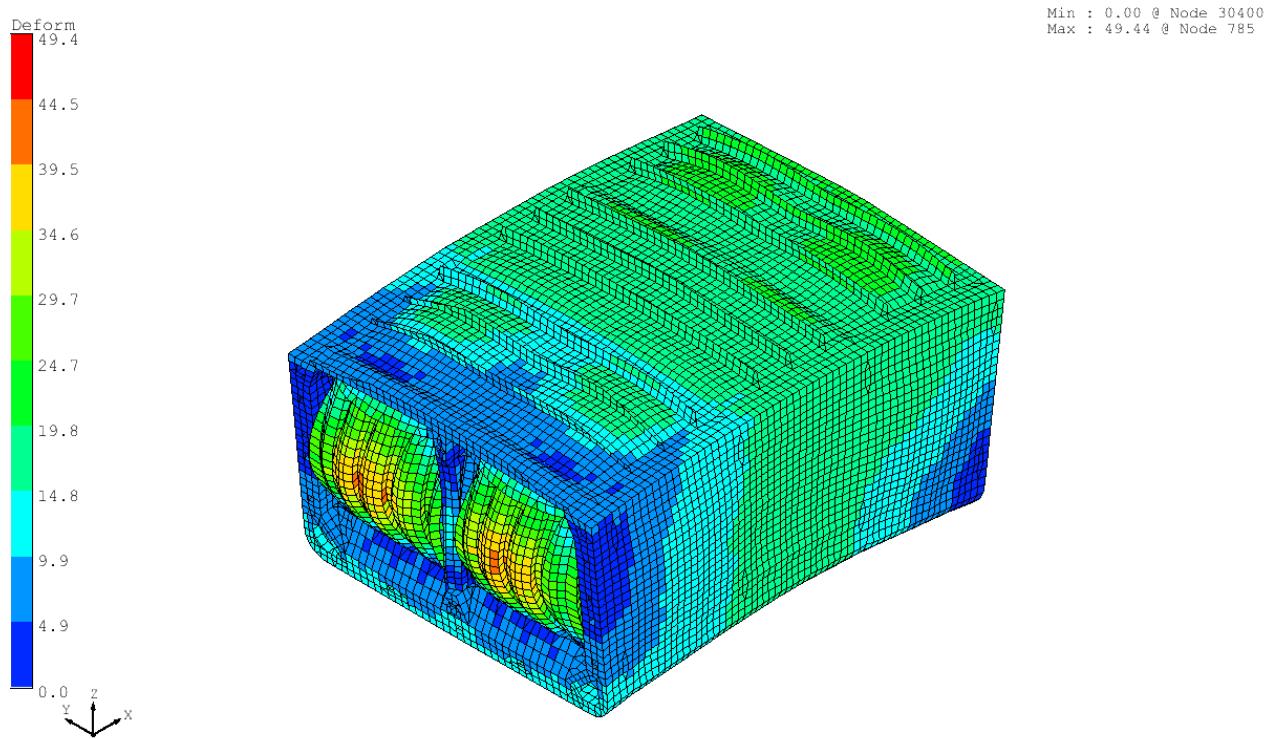


Fringe : Element Deform ,Default, 043_B10HARBOUR

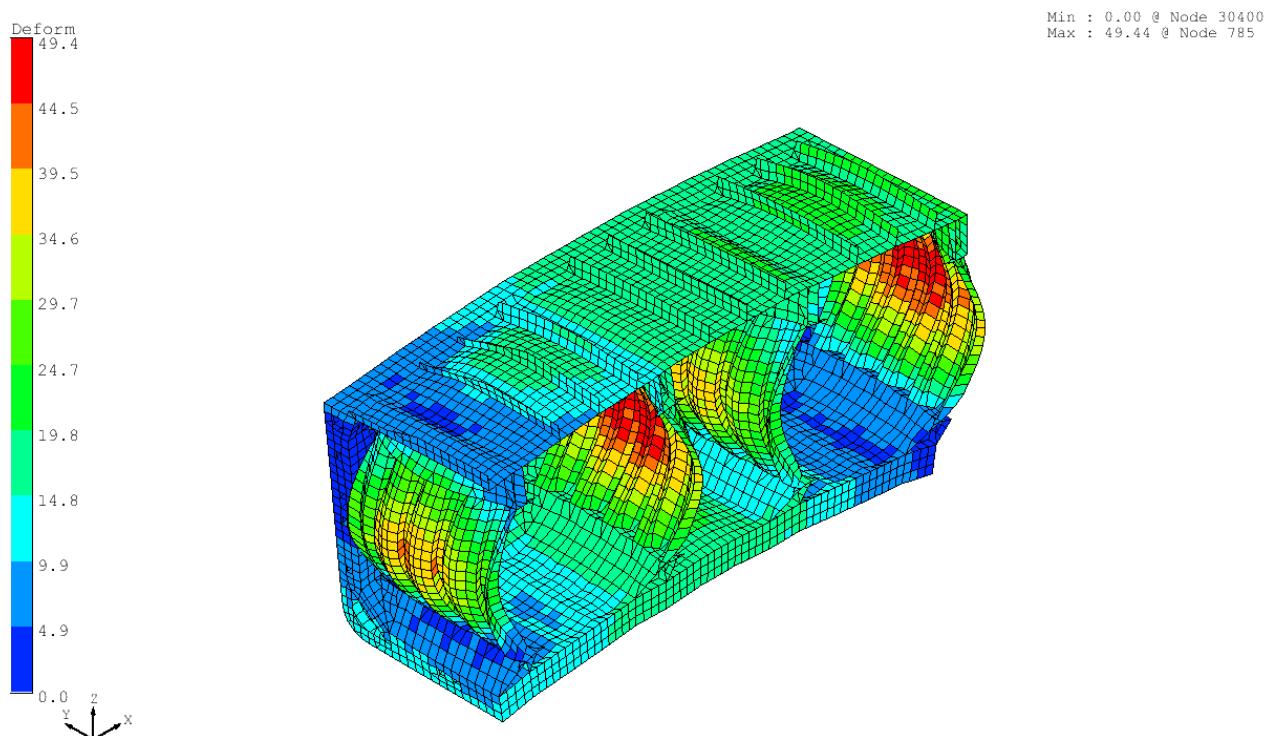


Fringe : Element Deform ,Default, 043_B10HARBOUR

Fig.A2.43 – Deformed shape, LC043_B10_HARBOUR

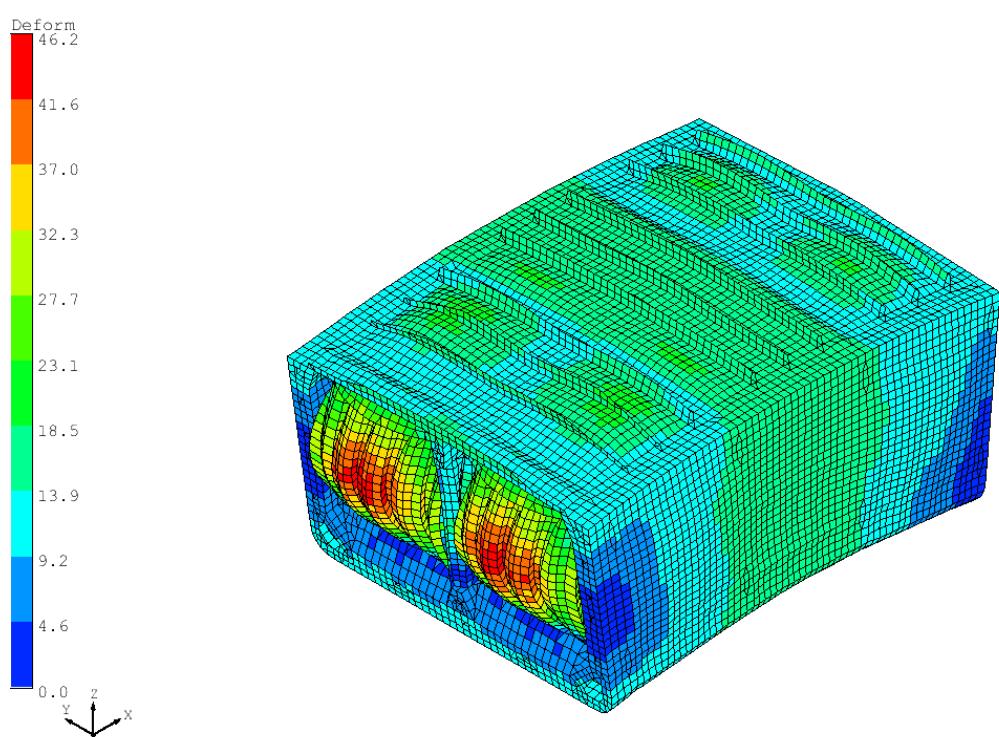


Fringe : Element Deform ,Default, 044_B11_1HARBOUR

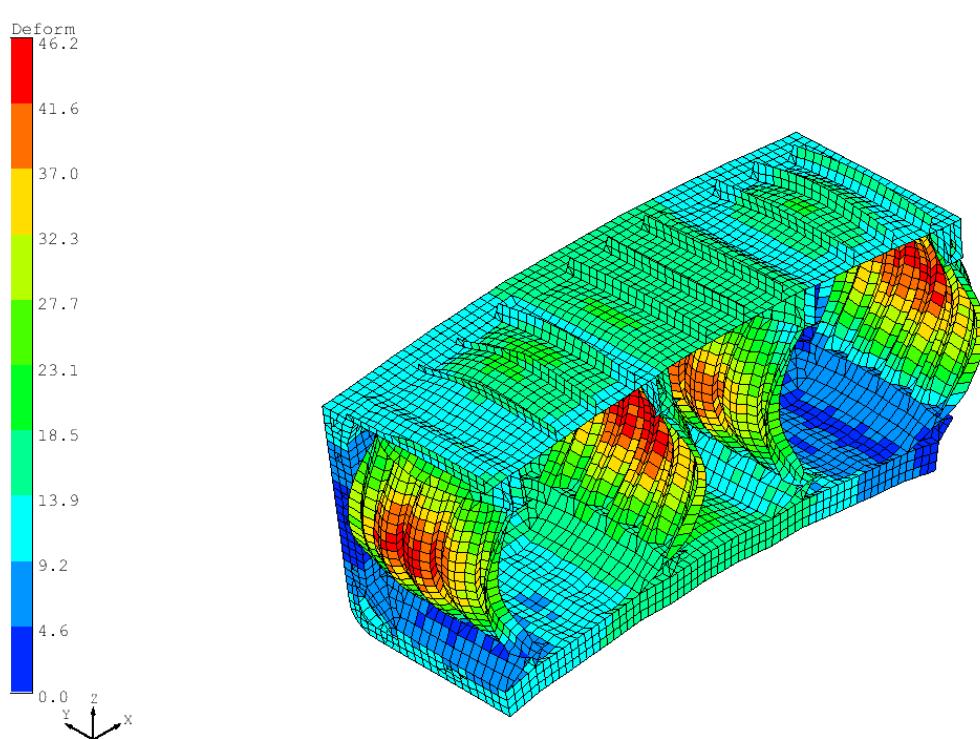


Fringe : Element Deform ,Default, 044_B11_1HARBOUR

Fig.A2.44 – Deformed shape, LC044_B11-1_HARBOUR



Fringe : Element Deform ,Default, 045_B11_2HARBOUR



Fringe : Element Deform ,Default, 045_B11_2HARBOUR

Fig.A2.45 – Deformed shape, LC045_B11-2 HARBOUR



Appendix.3- Result of Assessment

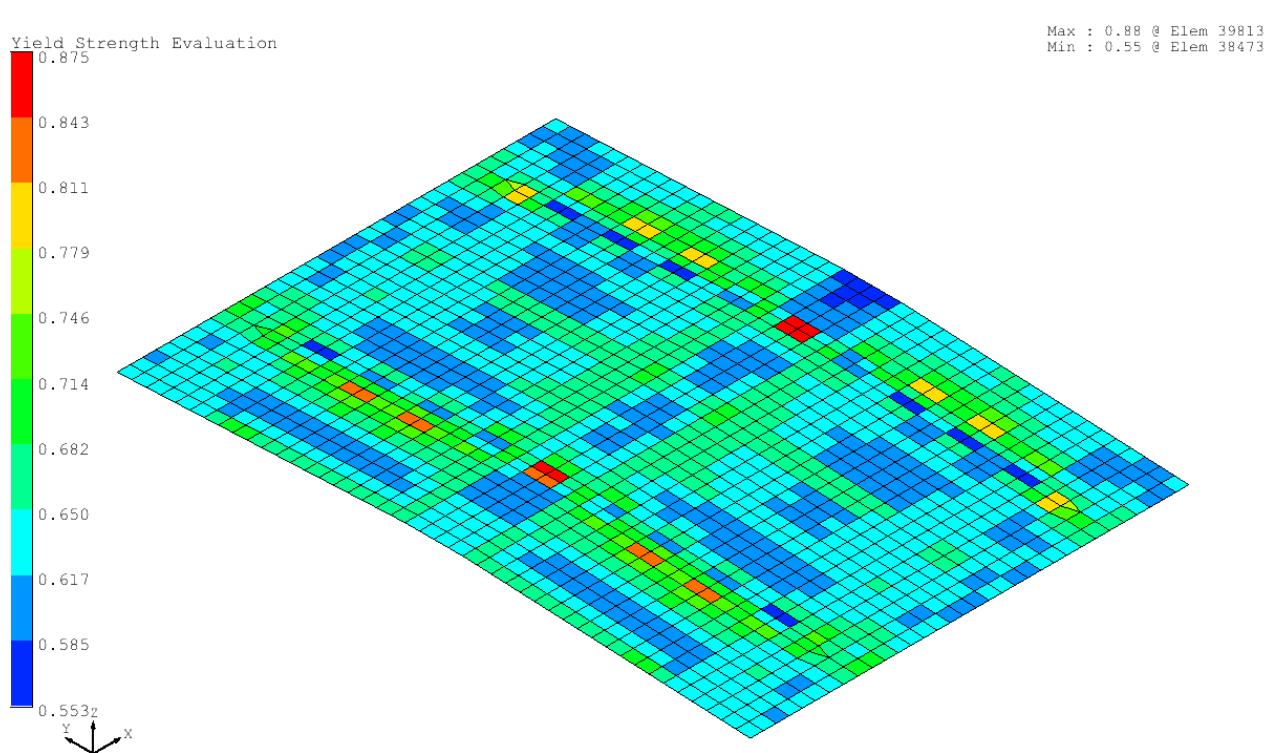
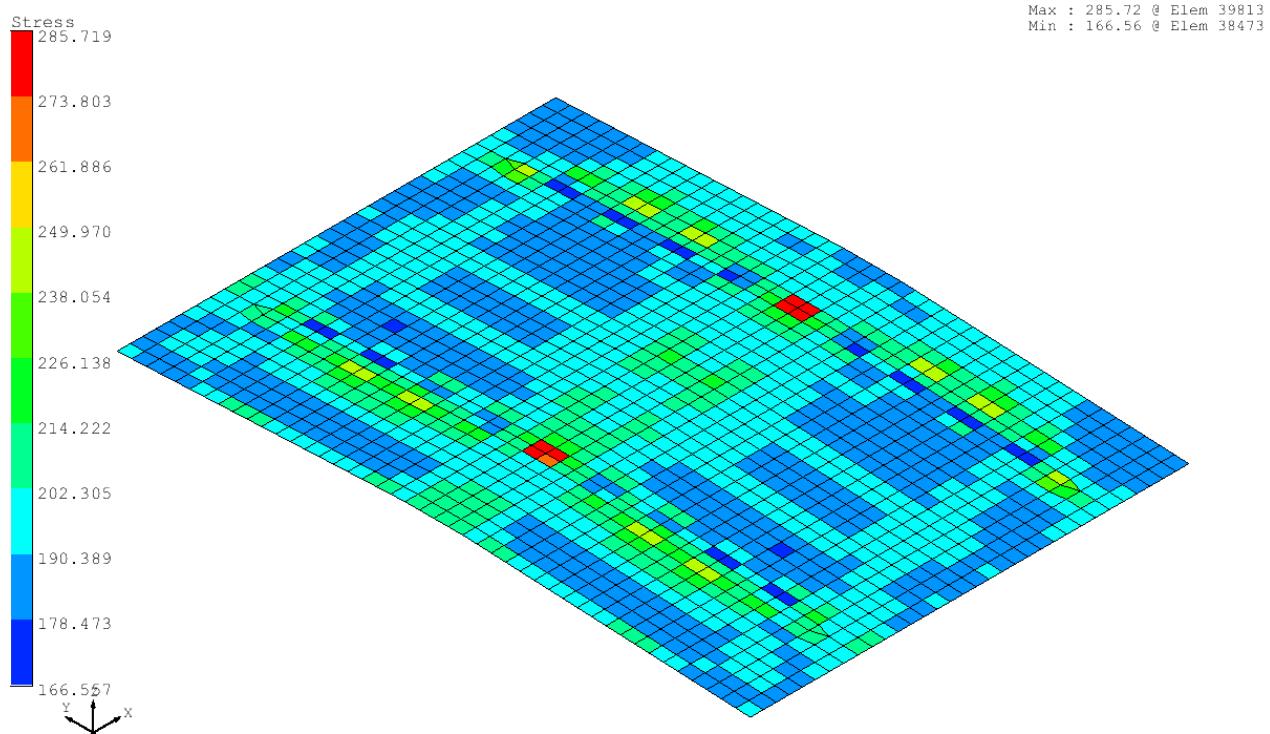


Fig.A3.01.a-F.E. Result of UPPER DECK (Yielding, Sea-going Max.)

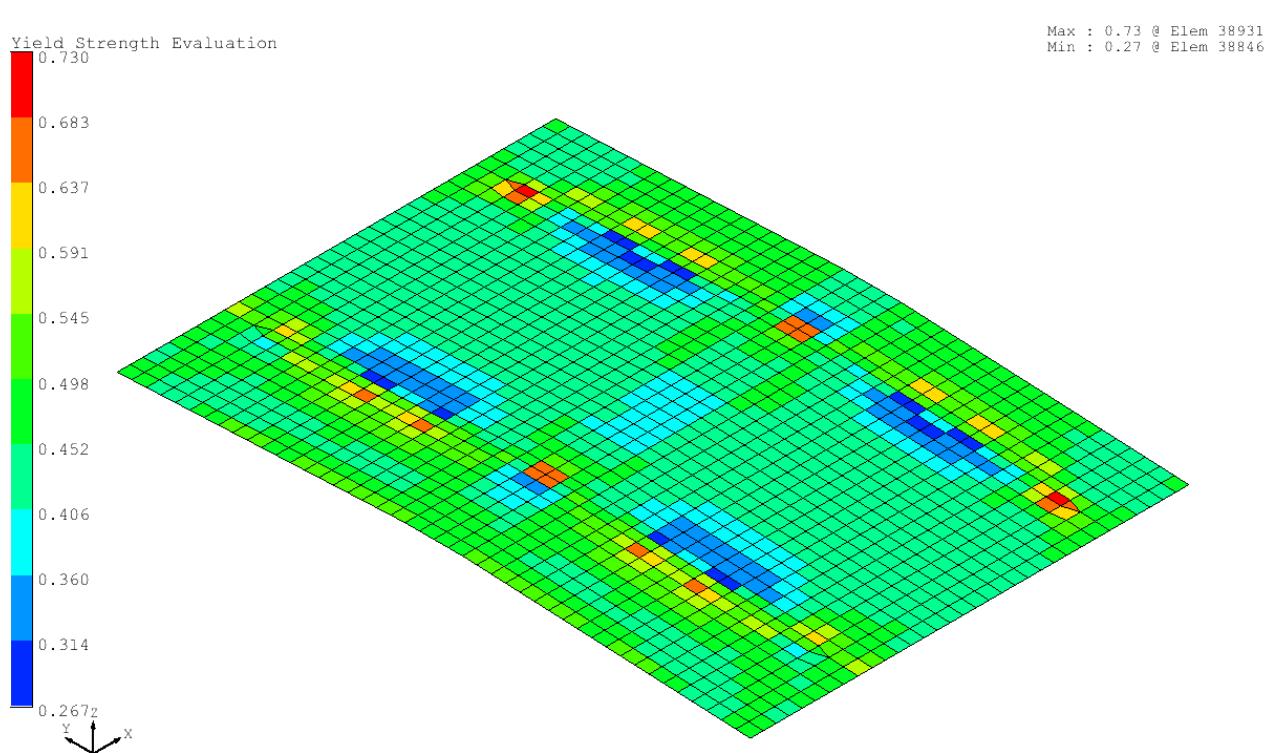
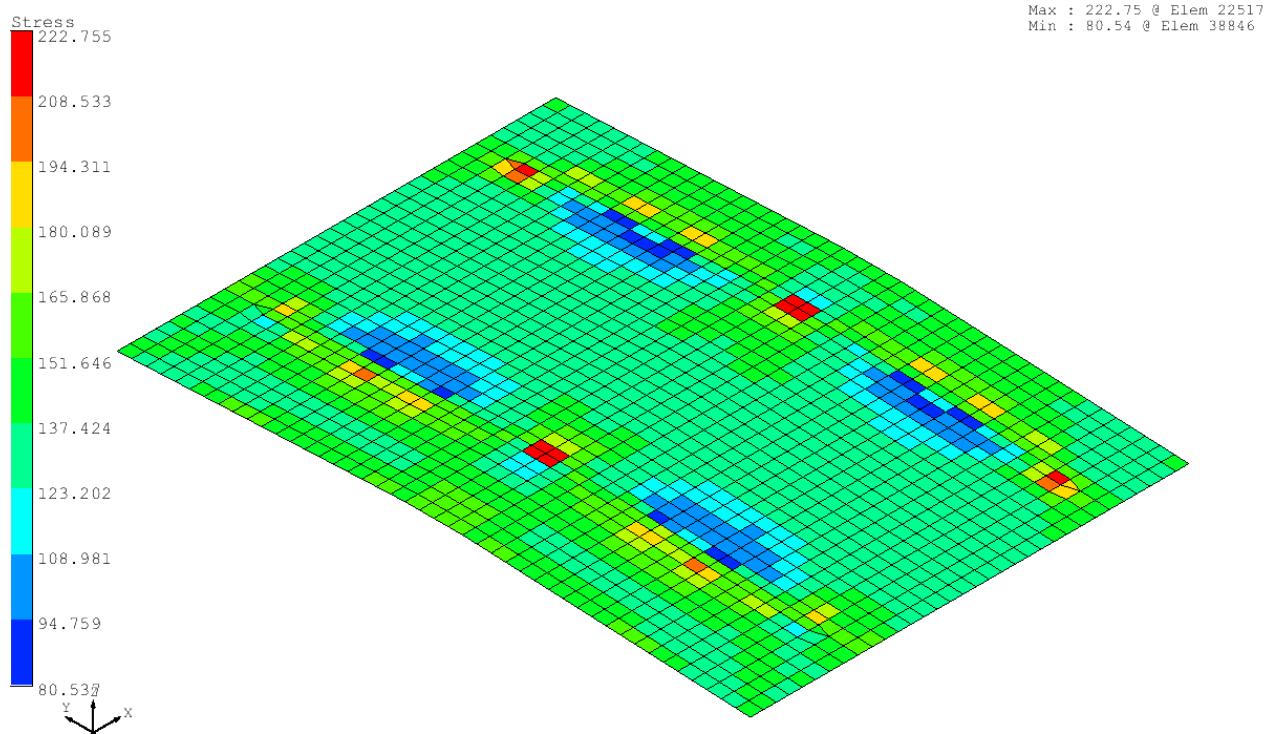
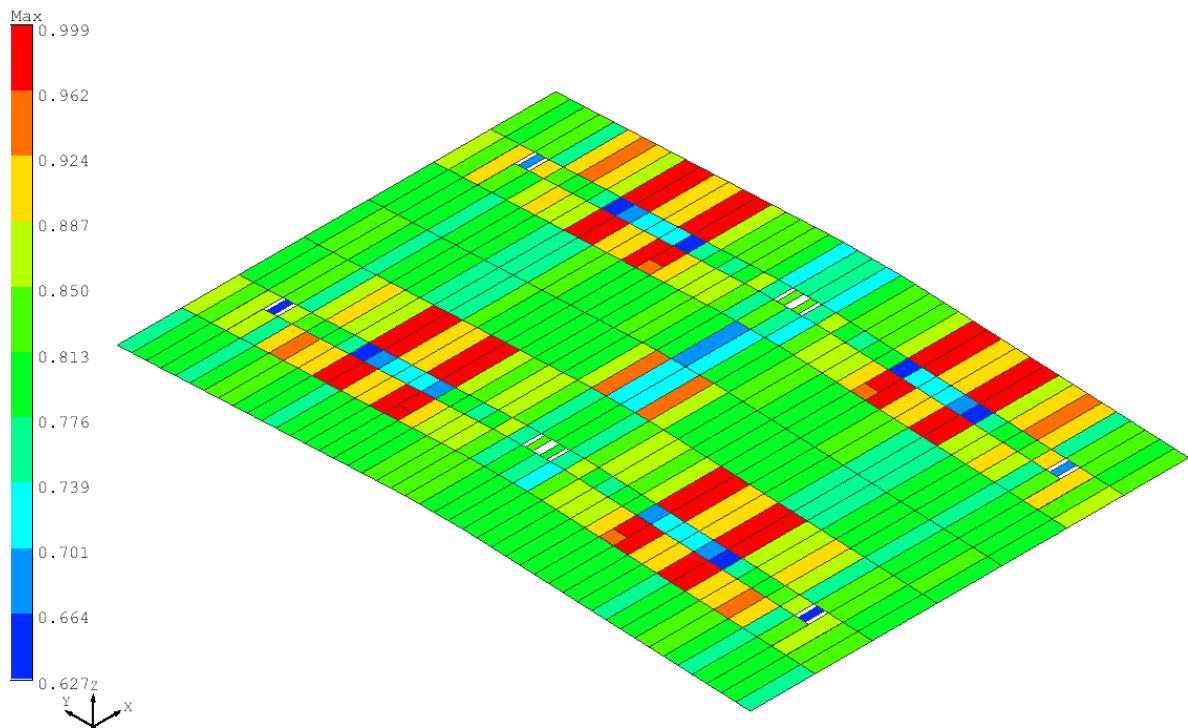
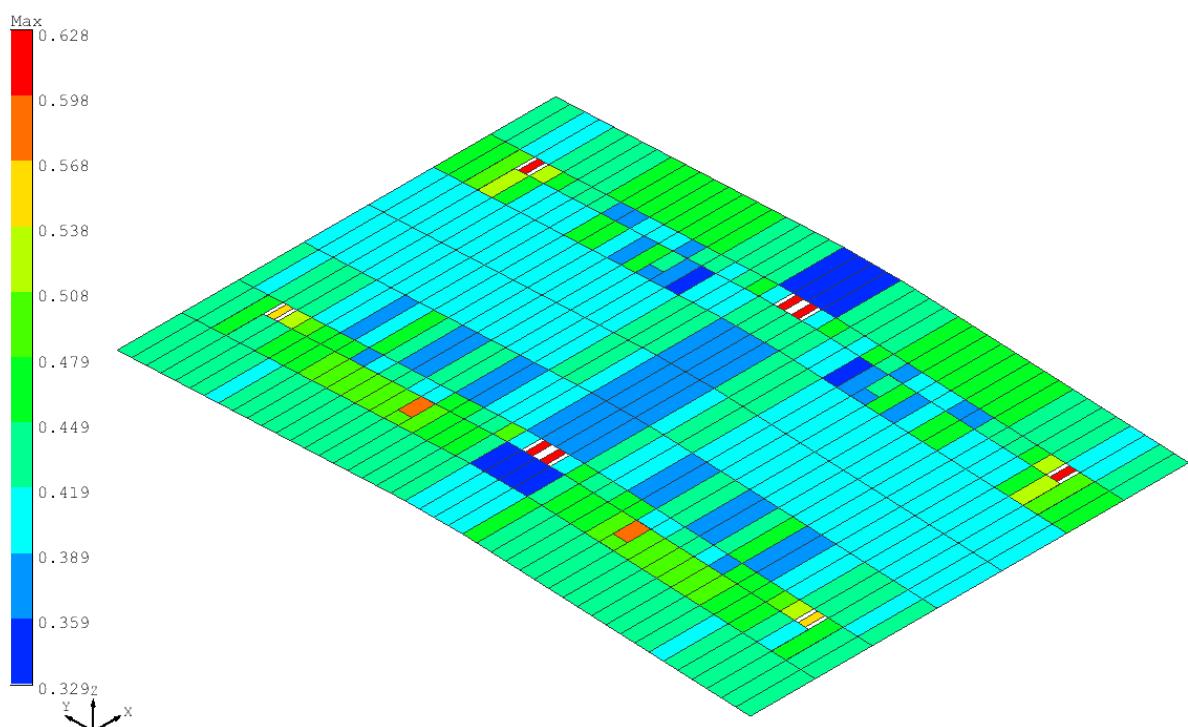


Fig.A3.01.b-F.E. Result of UPPER DECK (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:1.00, Min:0.63

Fig.A3.01.c-F.E. Result of UPPER DECK (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.63, Min:0.33

Fig.A3.01.d-F.E. Result of UPPER DECK (Buckling, Worst Case S)

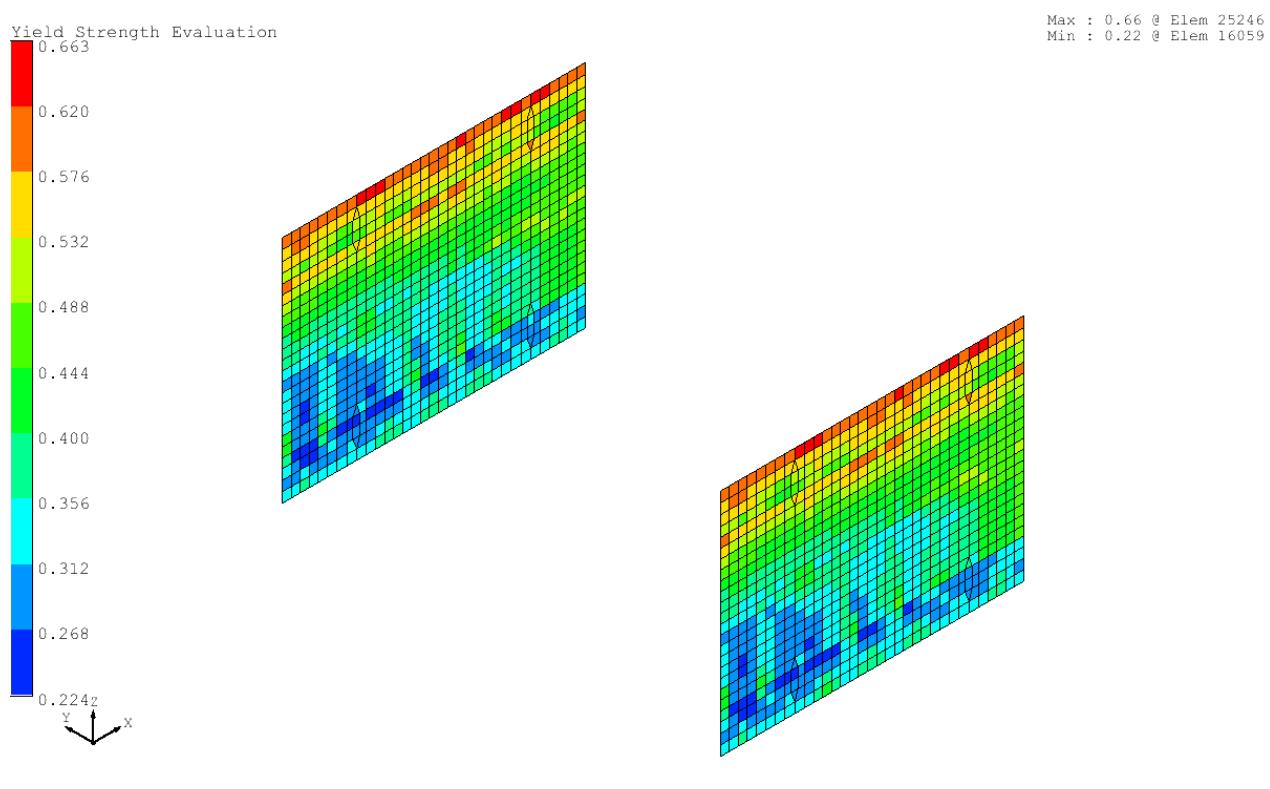
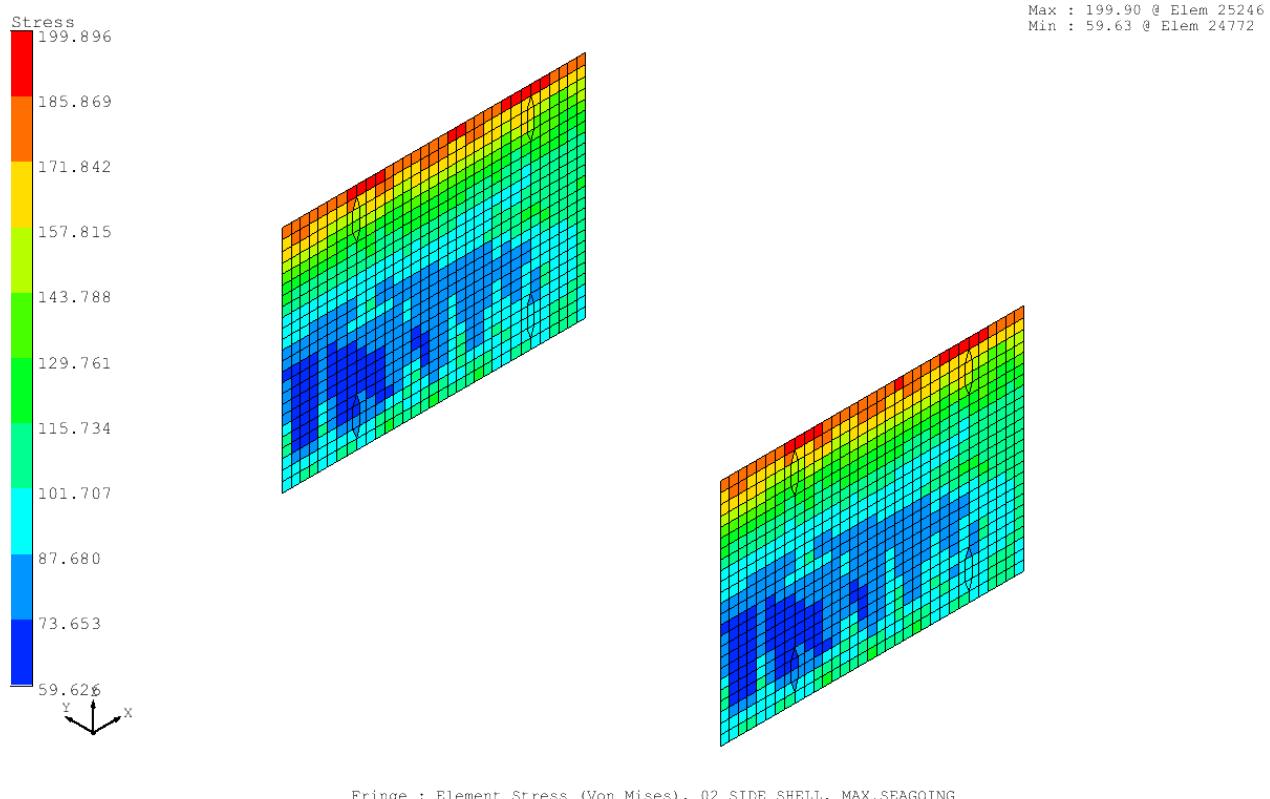


Fig.A3.02.a-F.E. Result of SIDE SHELL (Yielding, Sea-going Max.)

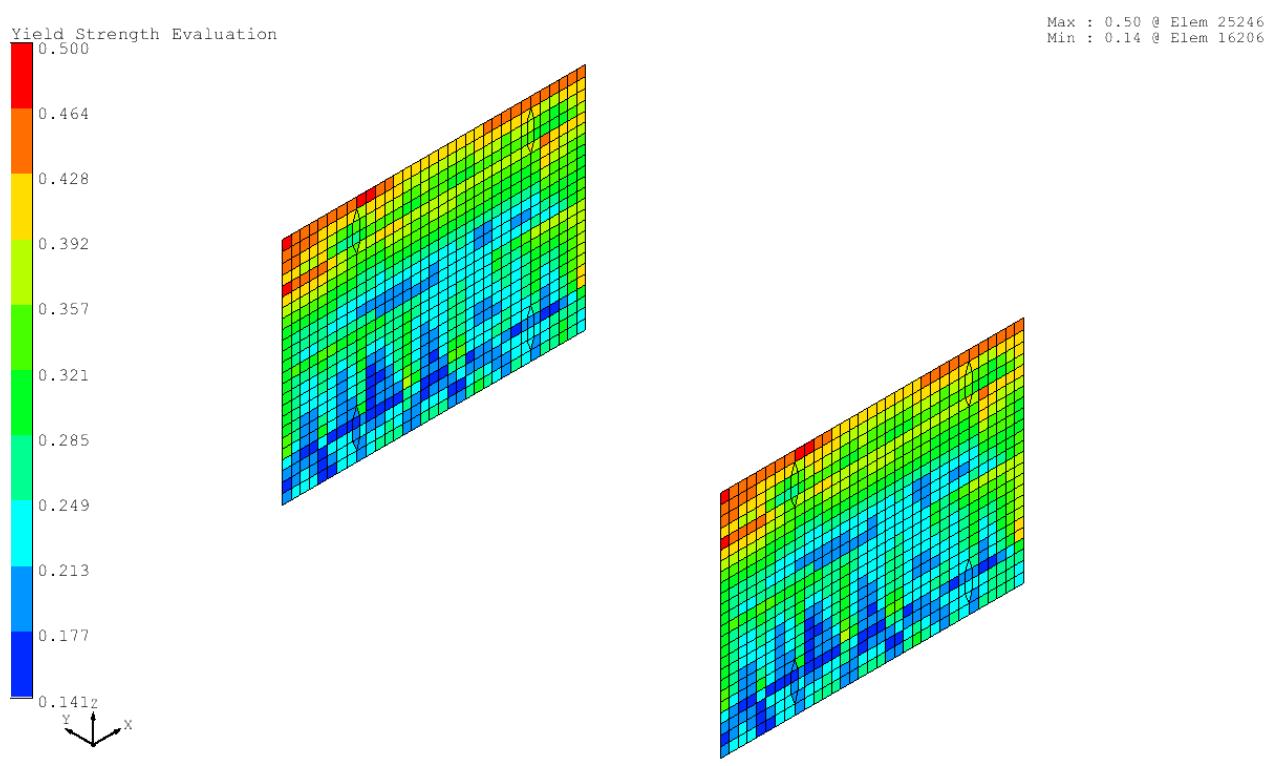
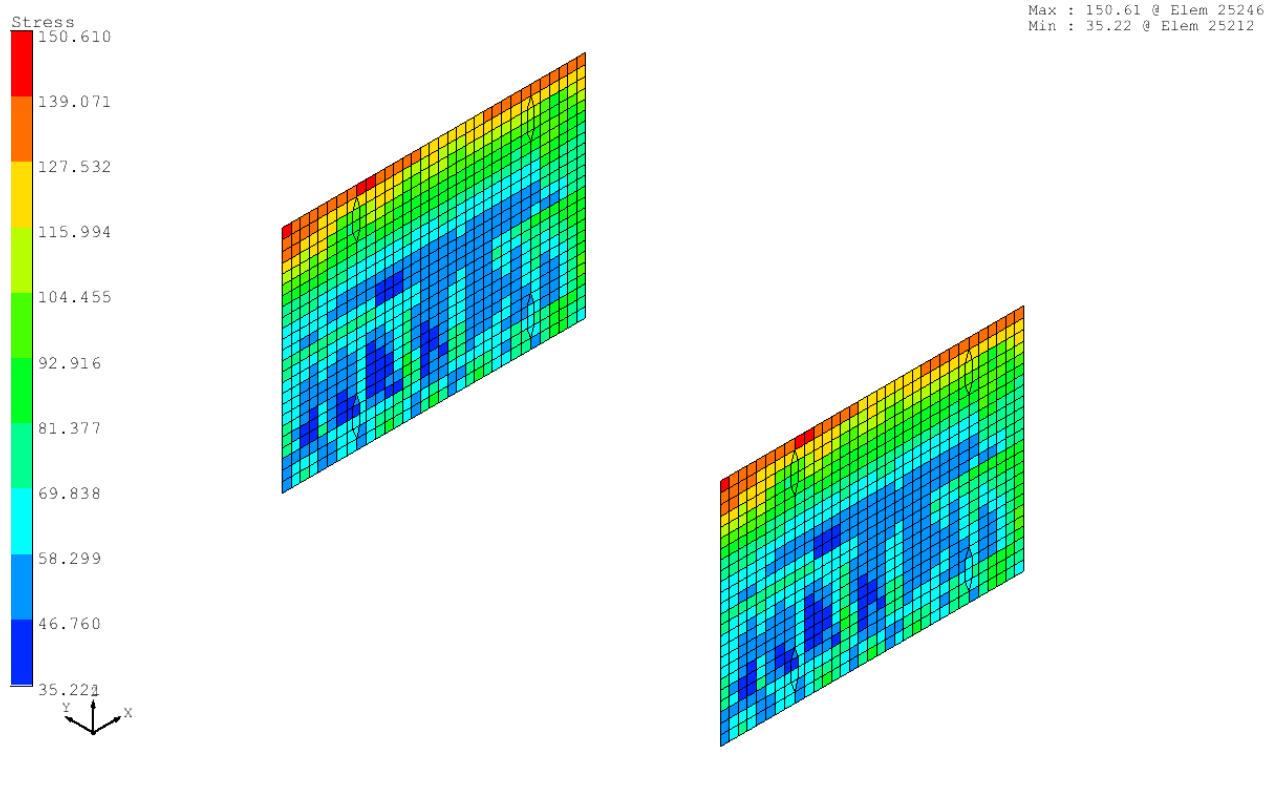
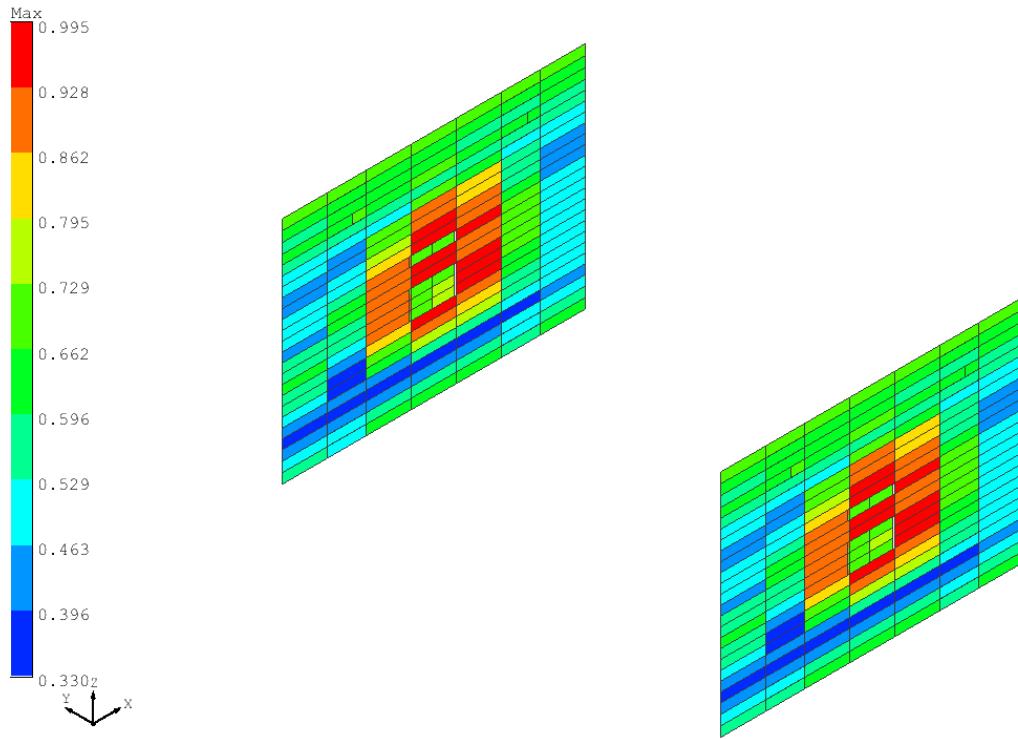
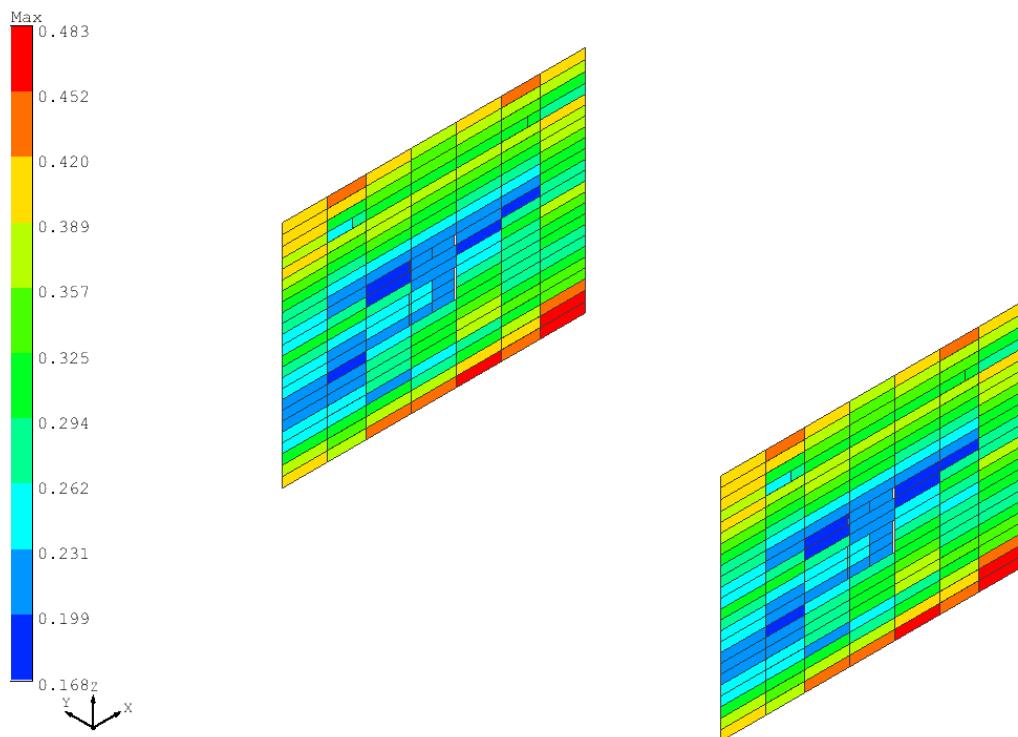


Fig.A3.02.b-F.E. Result of SIDE SHELL (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.99, Min:0.33

Fig.A3.02.c-F.E. Result of SIDE SHELL (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.48, Min:0.17

Fig.A3.02.d-F.E. Result of SIDE SHELL (Buckling, Worst Case S)

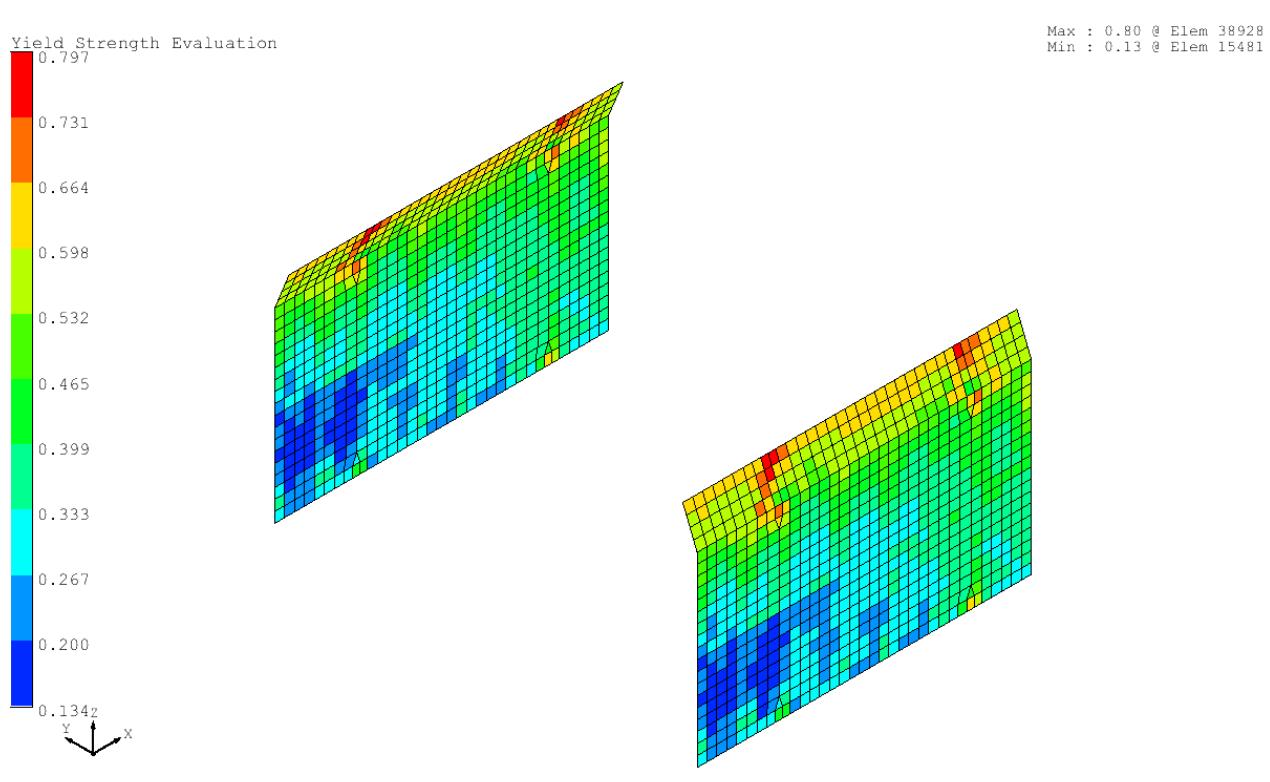
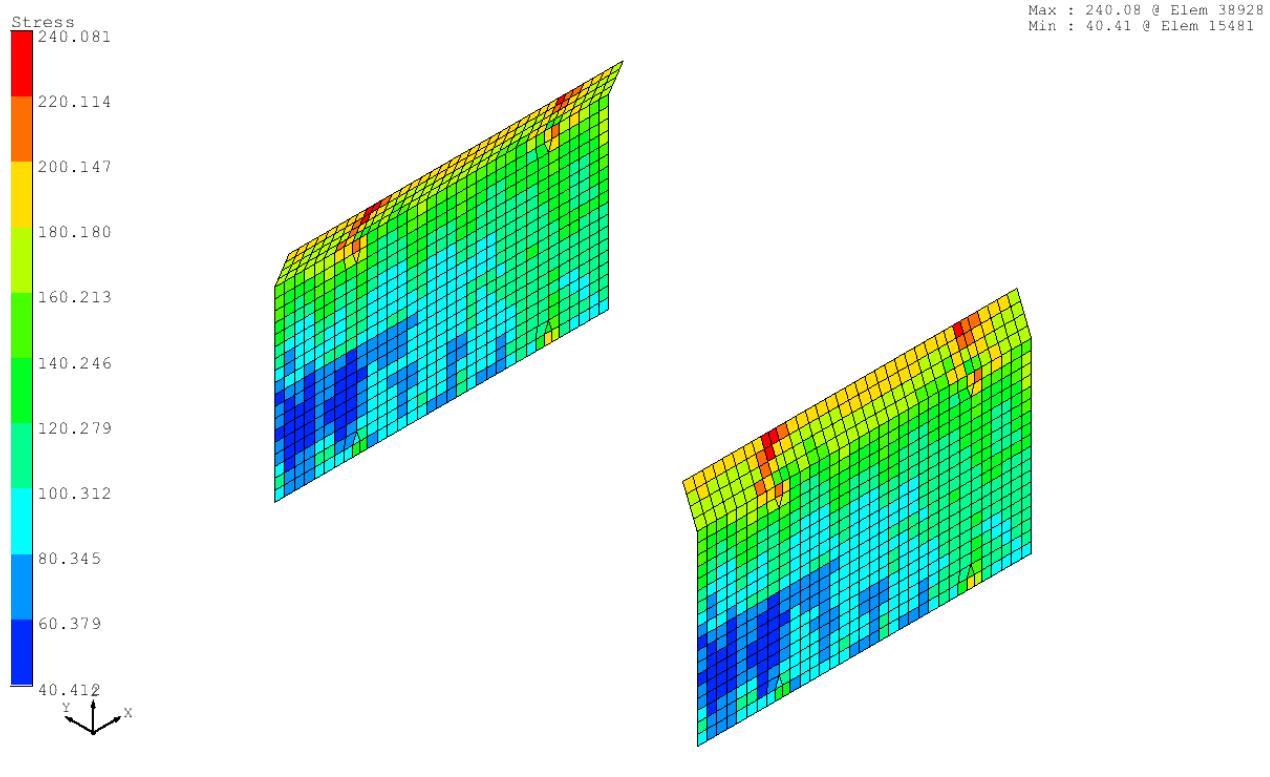


Fig.A3.03.a-F.E. Result of INNER HULL (Yielding, Sea-going Max.)

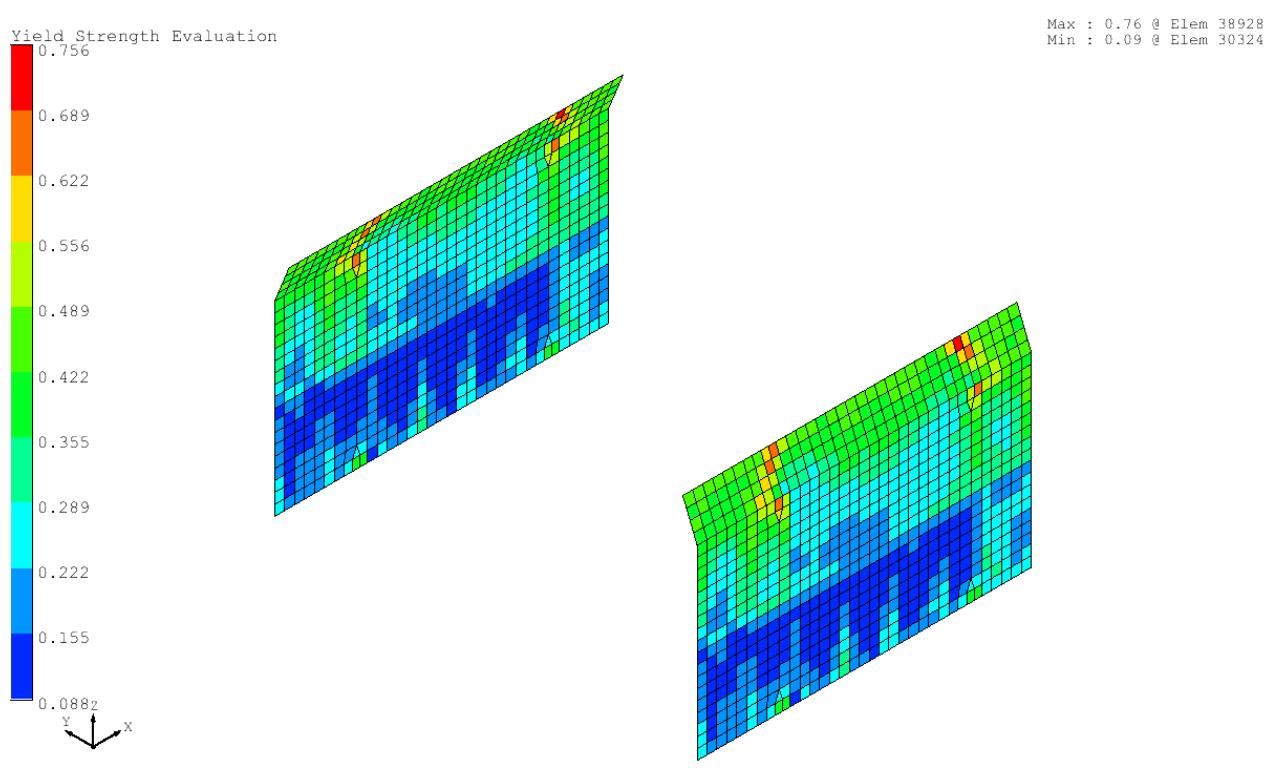
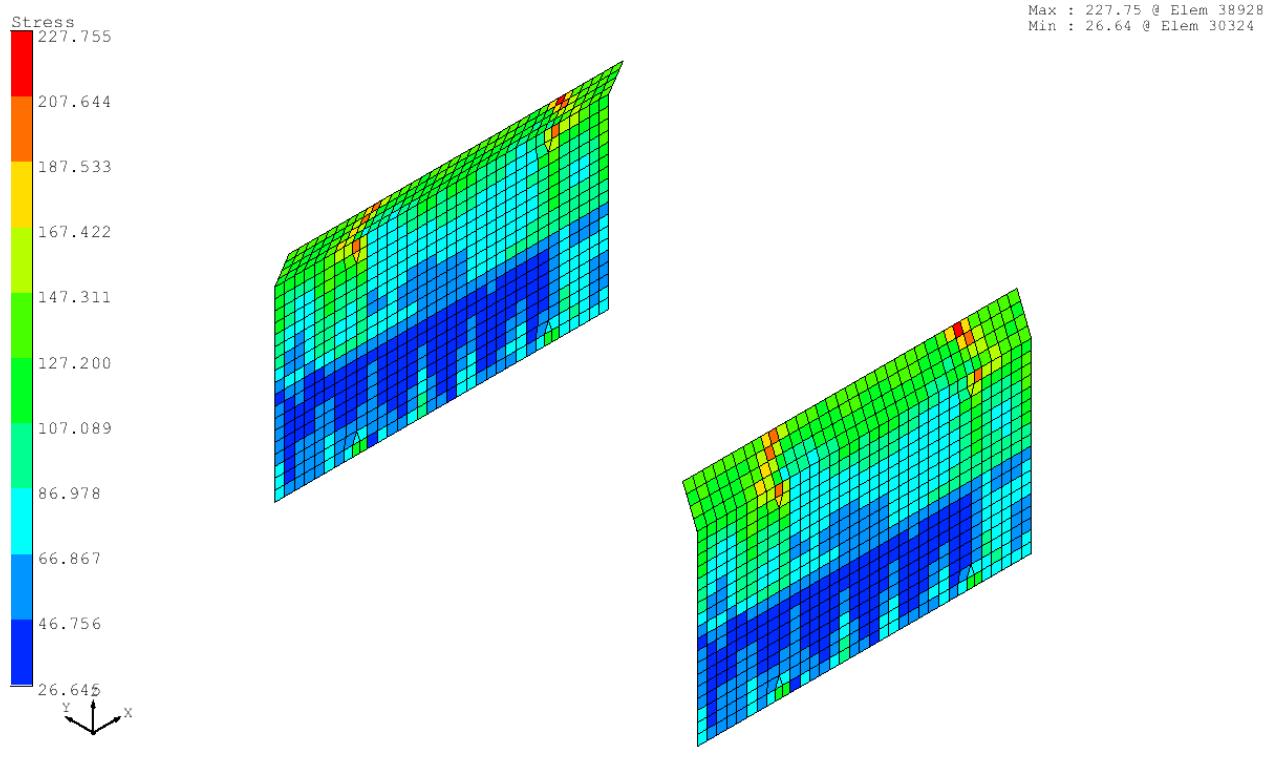
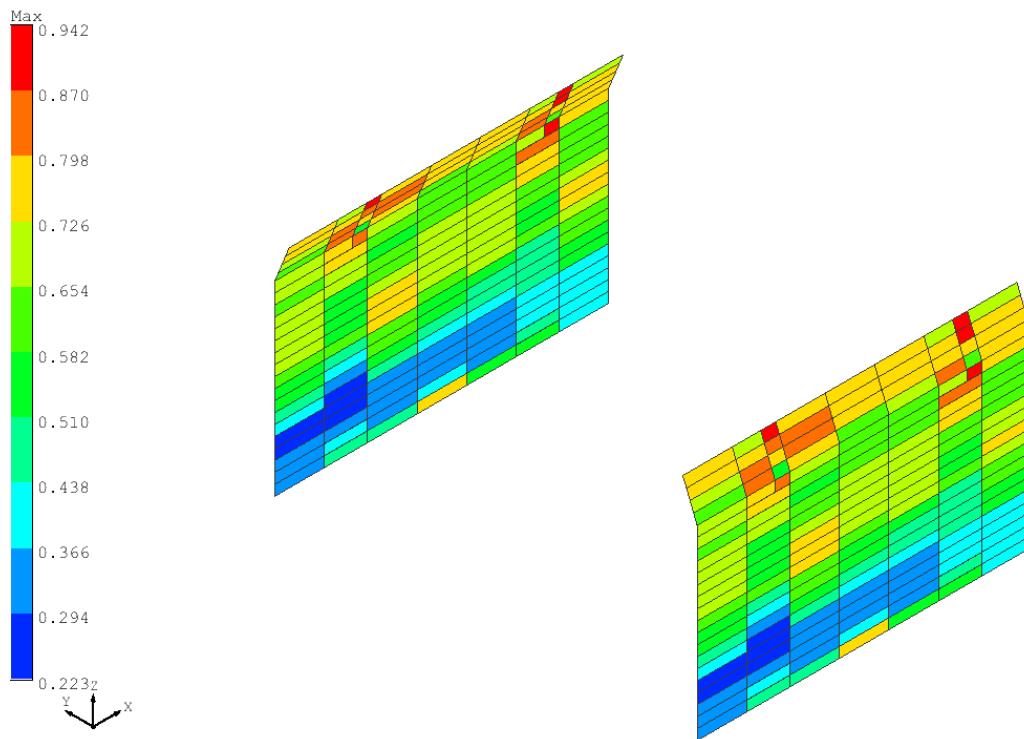
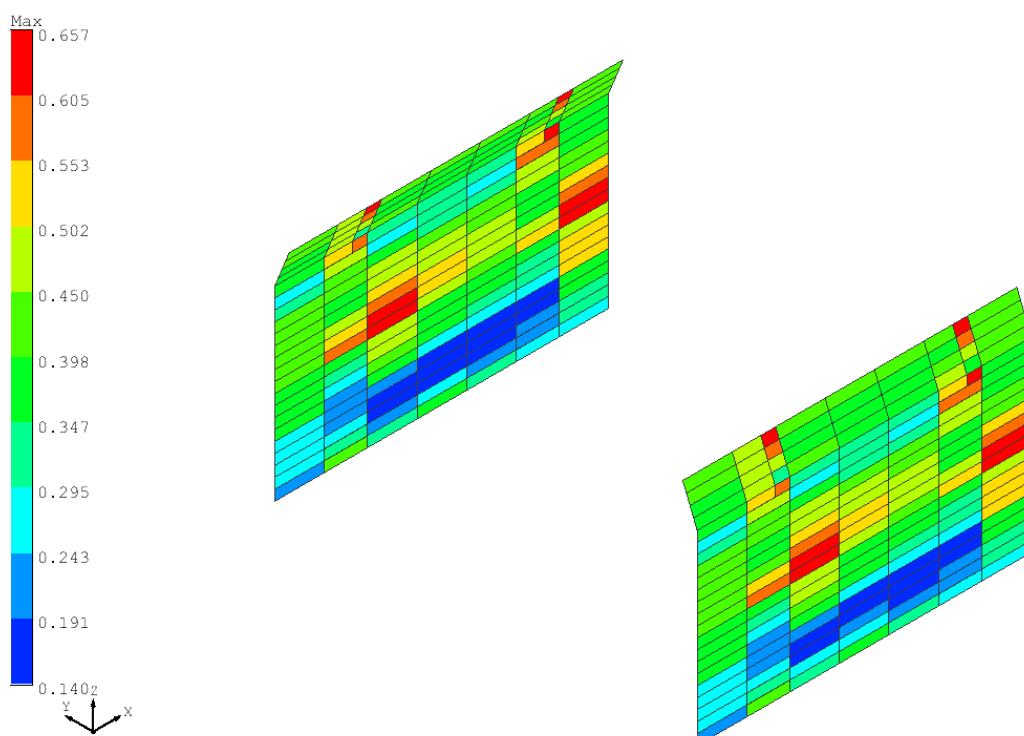


Fig.A3.03.b-F.E. Result of INNER HULL (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.94, Min:0.22

Fig.A3.03.c-F.E. Result of INNER HULL (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.66, Min:0.14

Fig.A3.03.d-F.E. Result of INNER HULL (Buckling, Worst Case S)

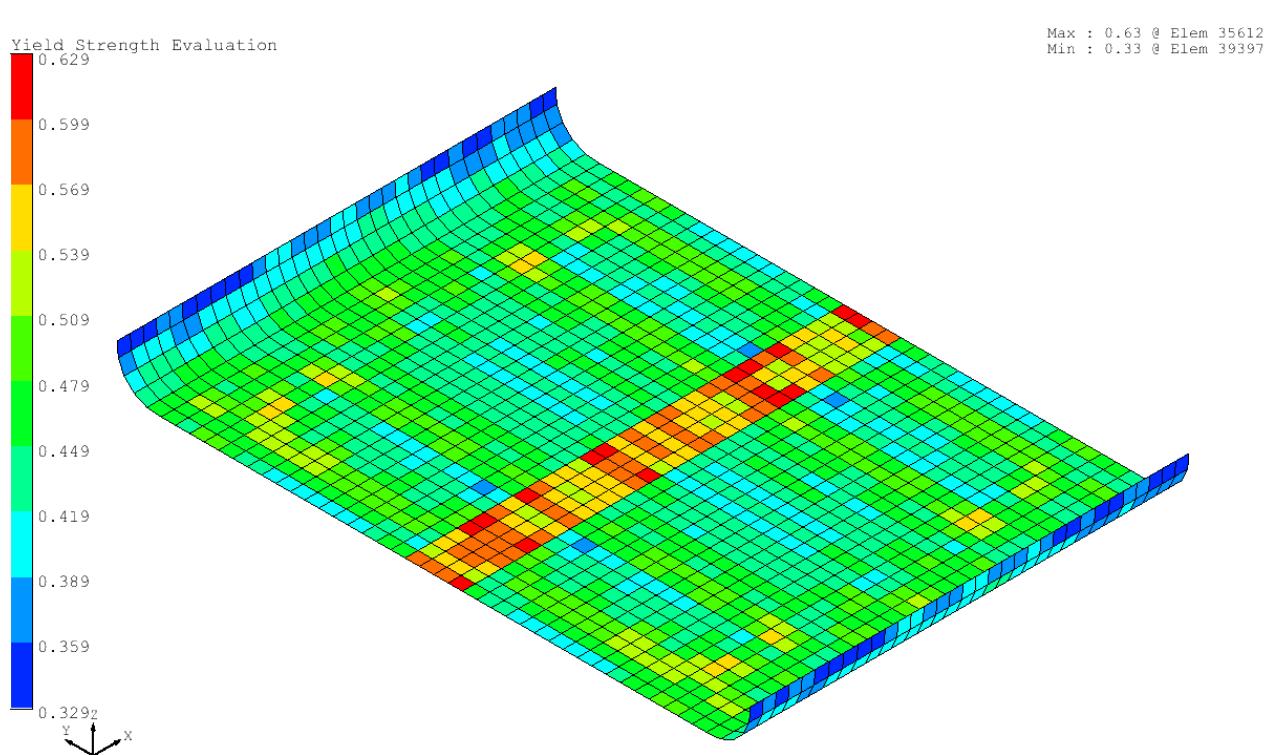
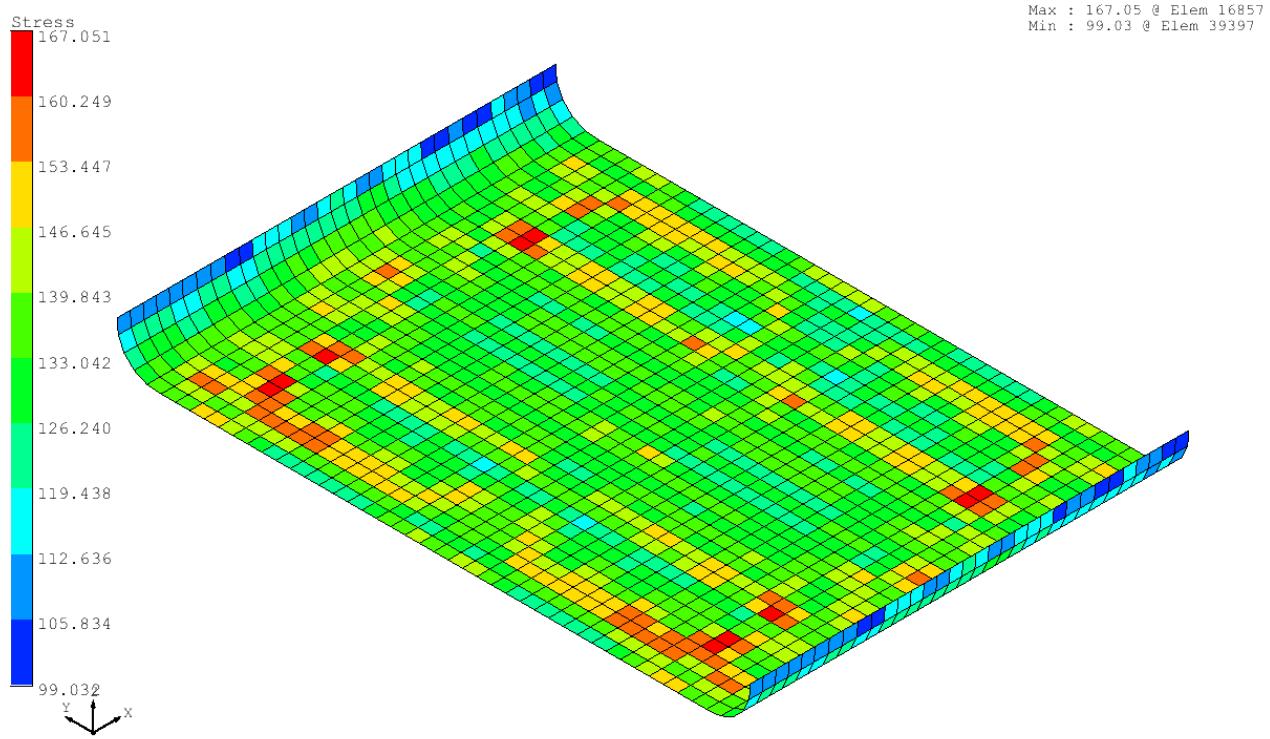


Fig.A3.04.a-F.E. Result of BOTTOM SHELL (Yielding, Sea-going Max.)

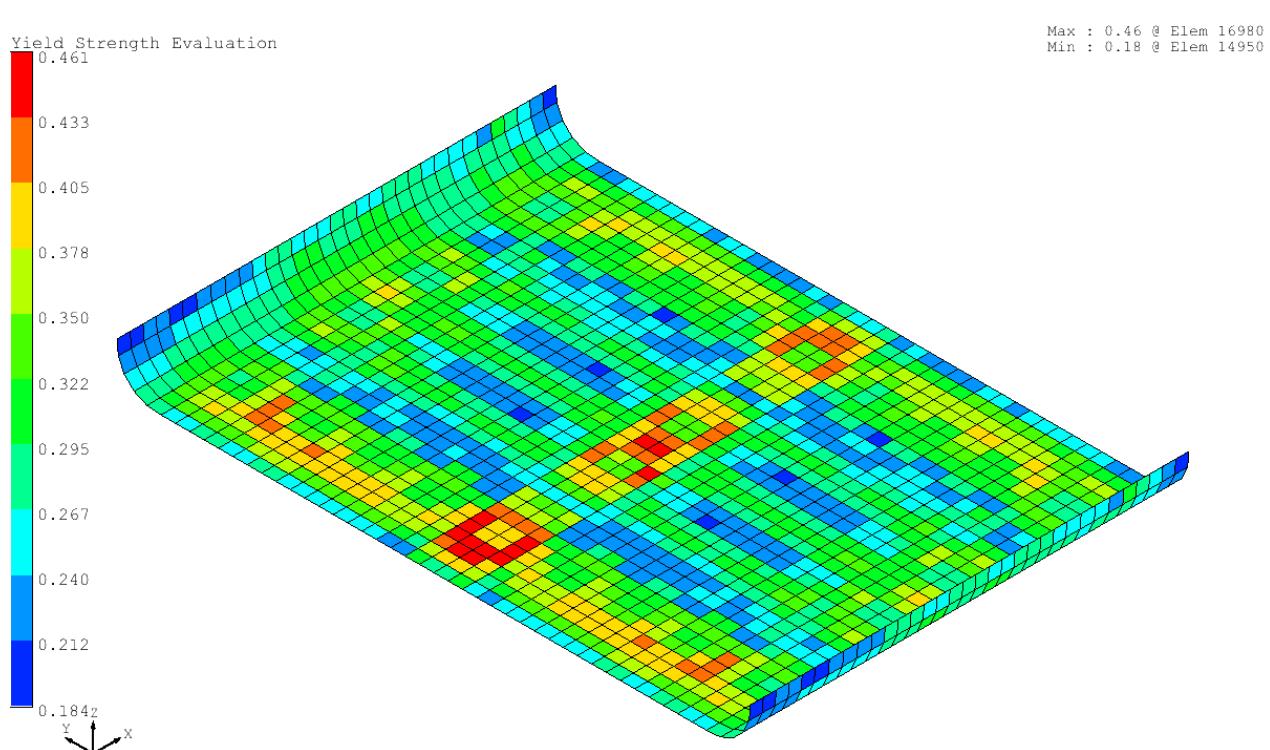
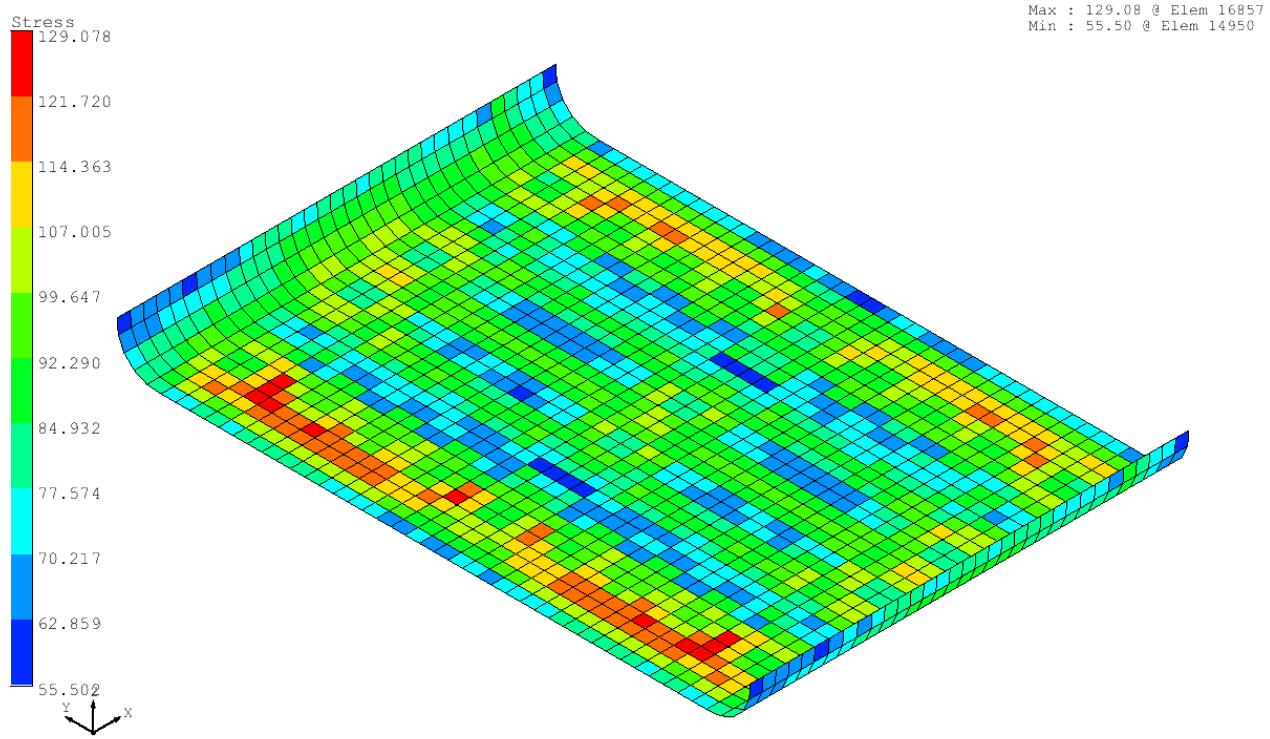


Fig.A3.04.b-F.E. Result of BOTTOM SHELL (Yielding, Harbour Max.)

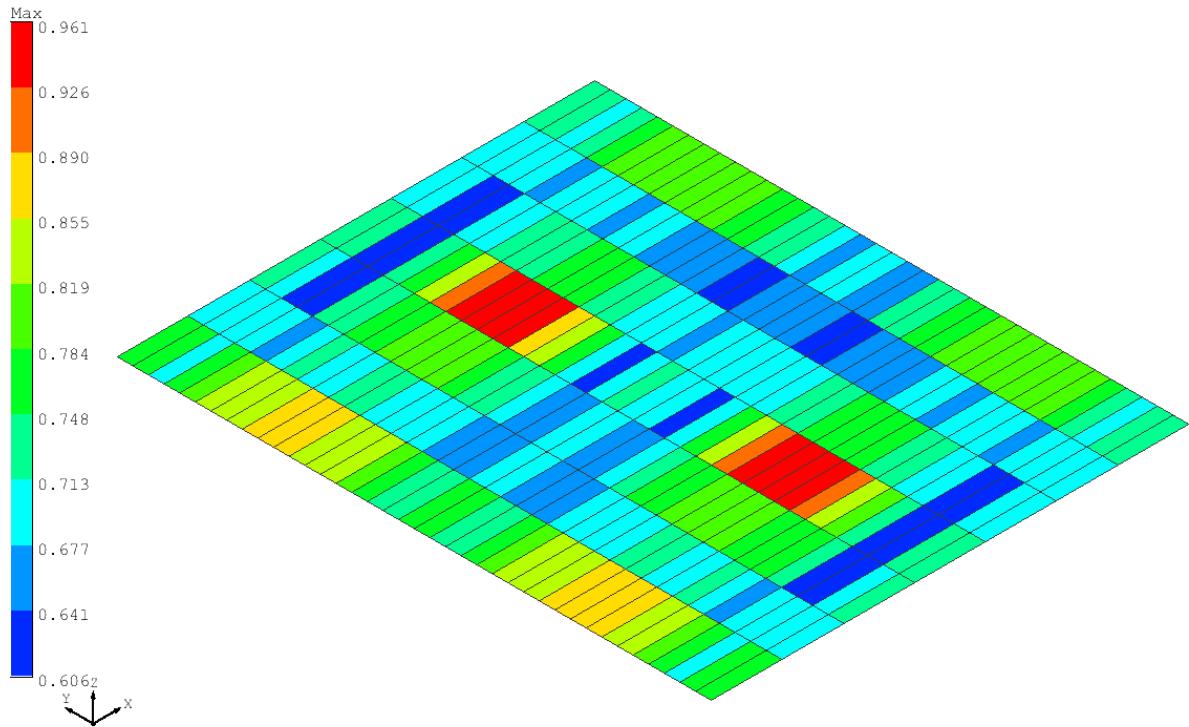
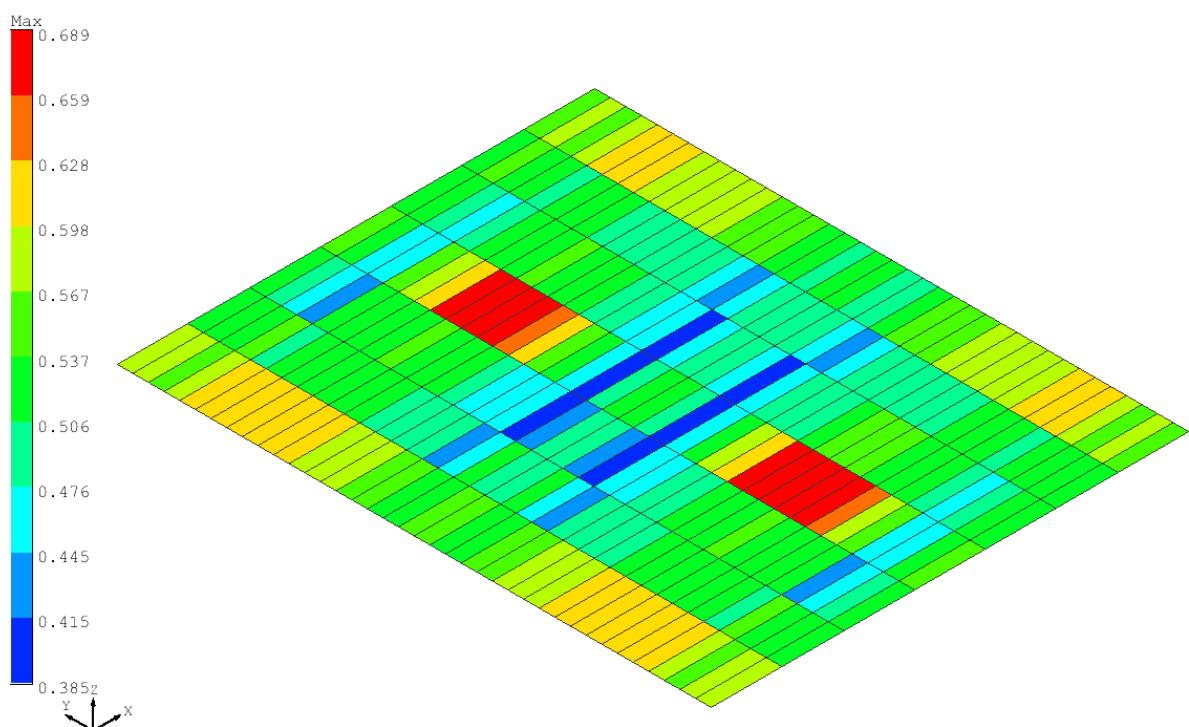


Fig.A3.04.c-F.E. Result of BOTTOM SHELL (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.69, Min:0.38

Fig.A3.04.d-F.E. Result of BOTTOM SHELL (Buckling, Worst Case S)

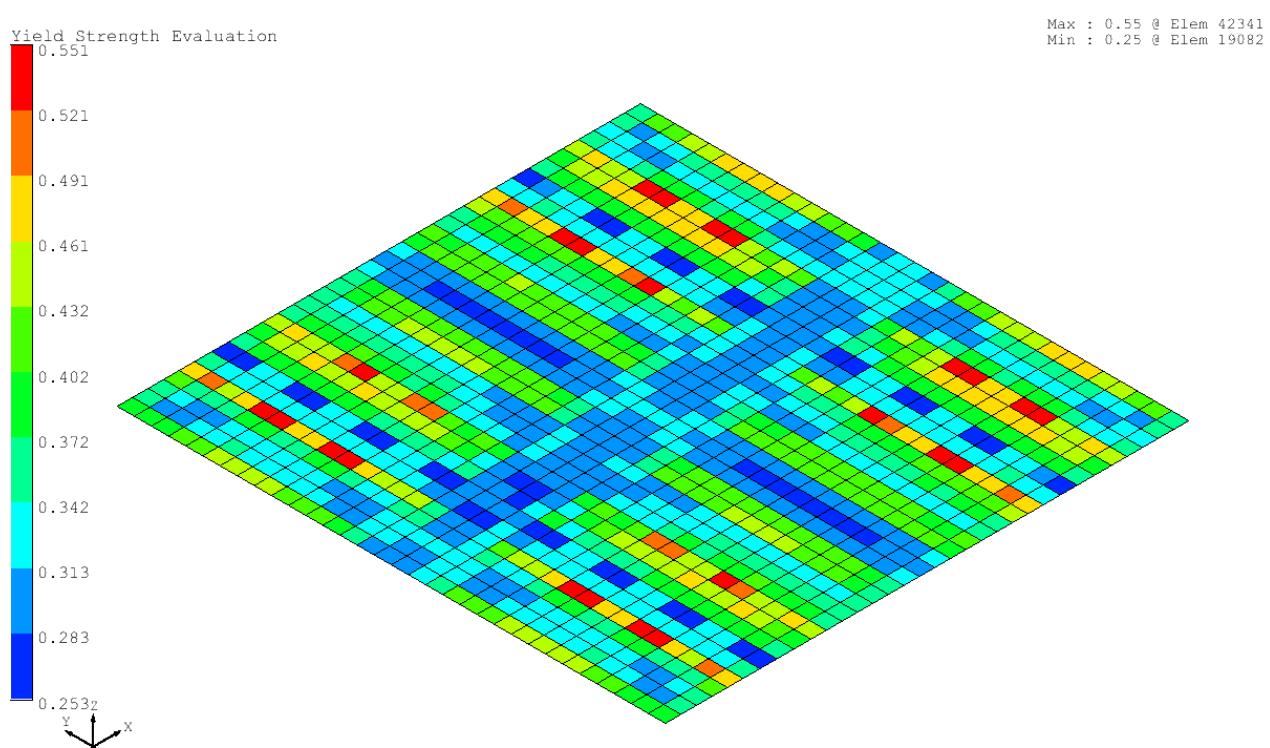
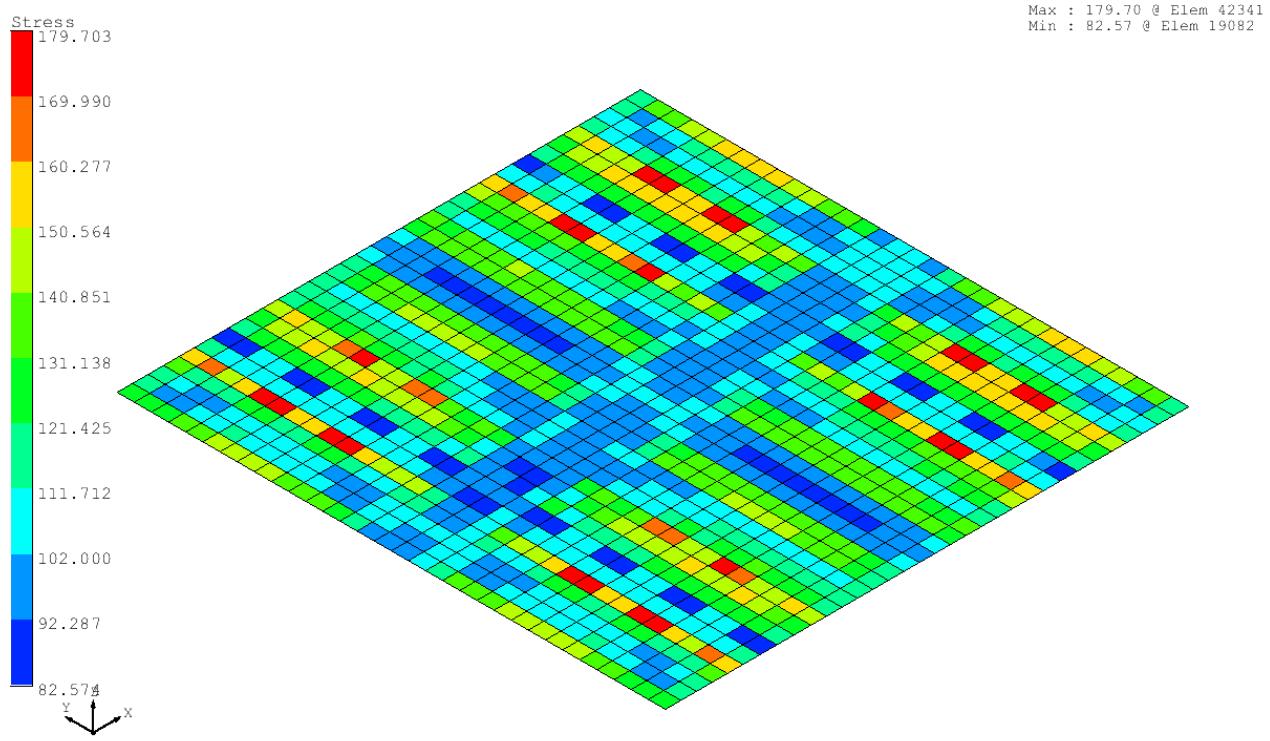


Fig.A3.05.a-F.E. Result of INNER BOTTOM (Yielding, Sea-going Max.)

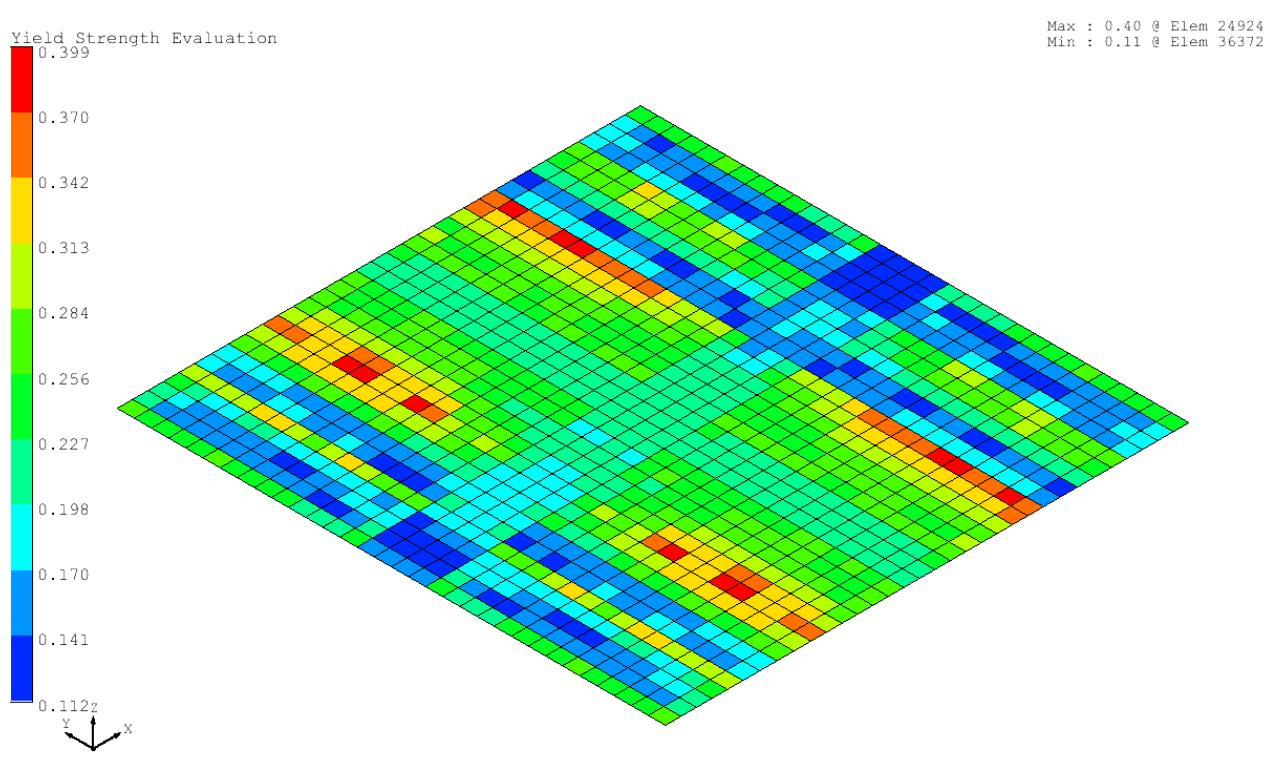
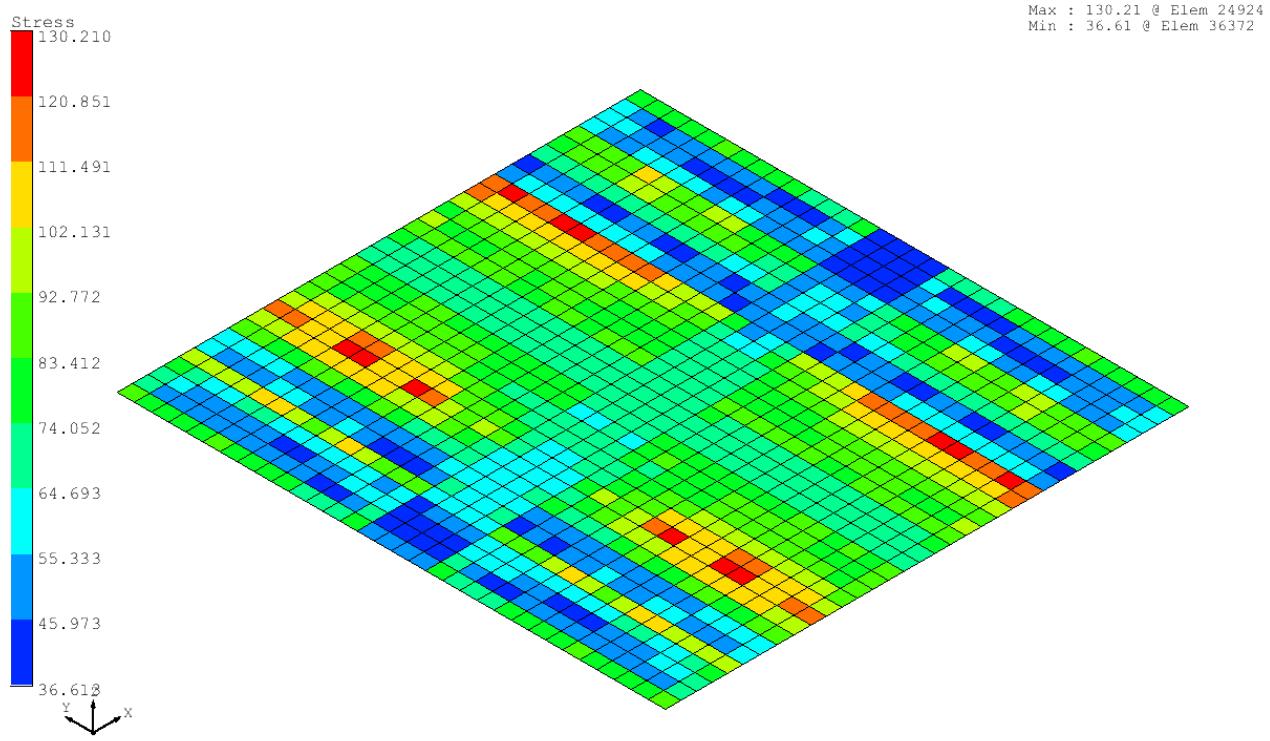
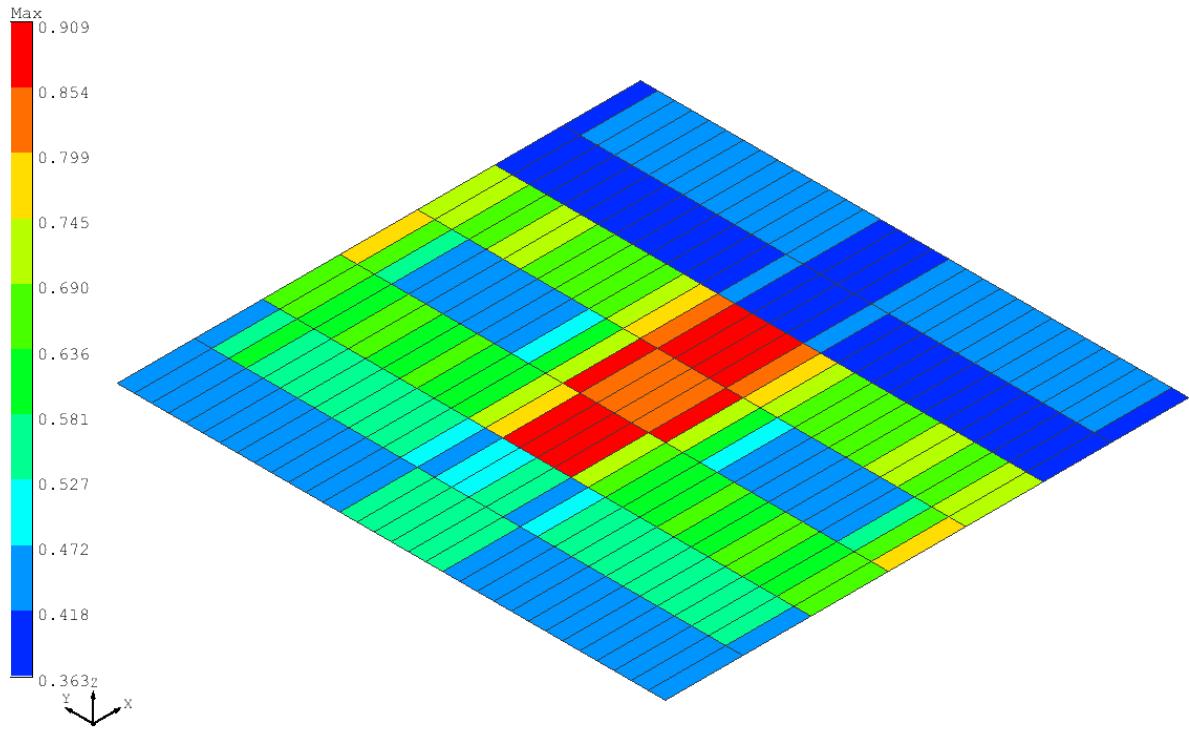
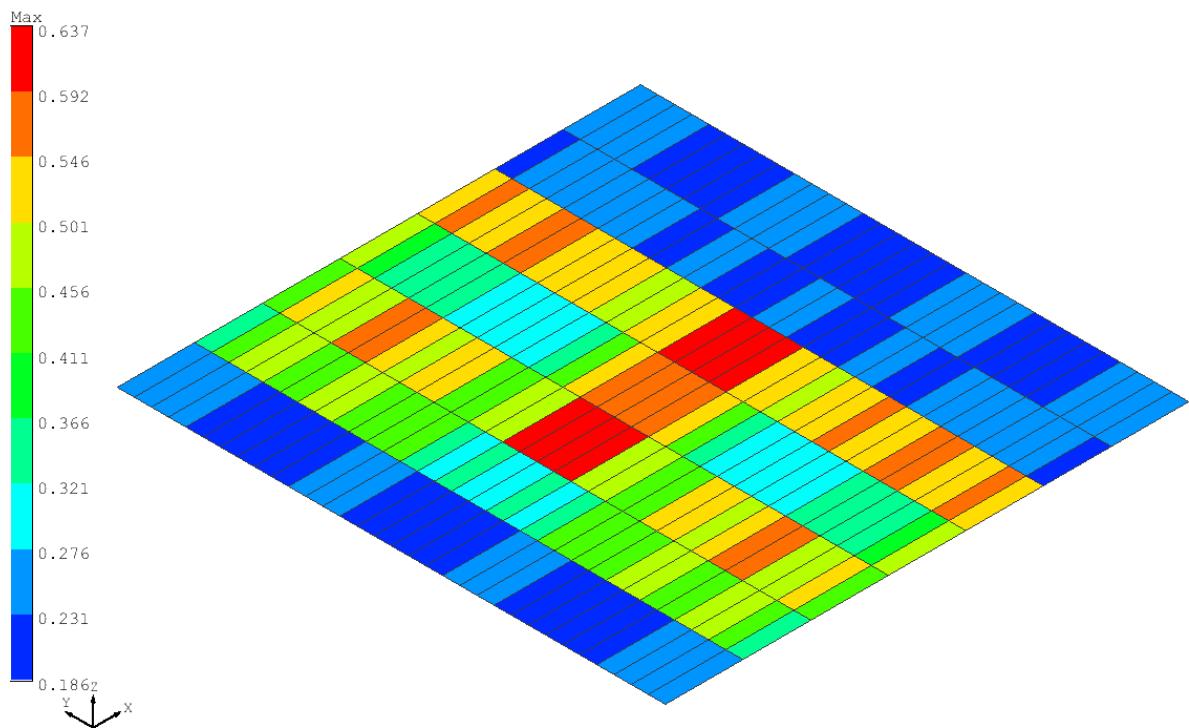


Fig.A3.05.b-F.E. Result of INNER BOTTOM (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.91, Min:0.36

Fig.A3.05.c-F.E. Result of INNER BOTTOM (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.64, Min:0.19

Fig.A3.05.d-F.E. Result of INNER BOTTOM (Buckling, Worst Case S)

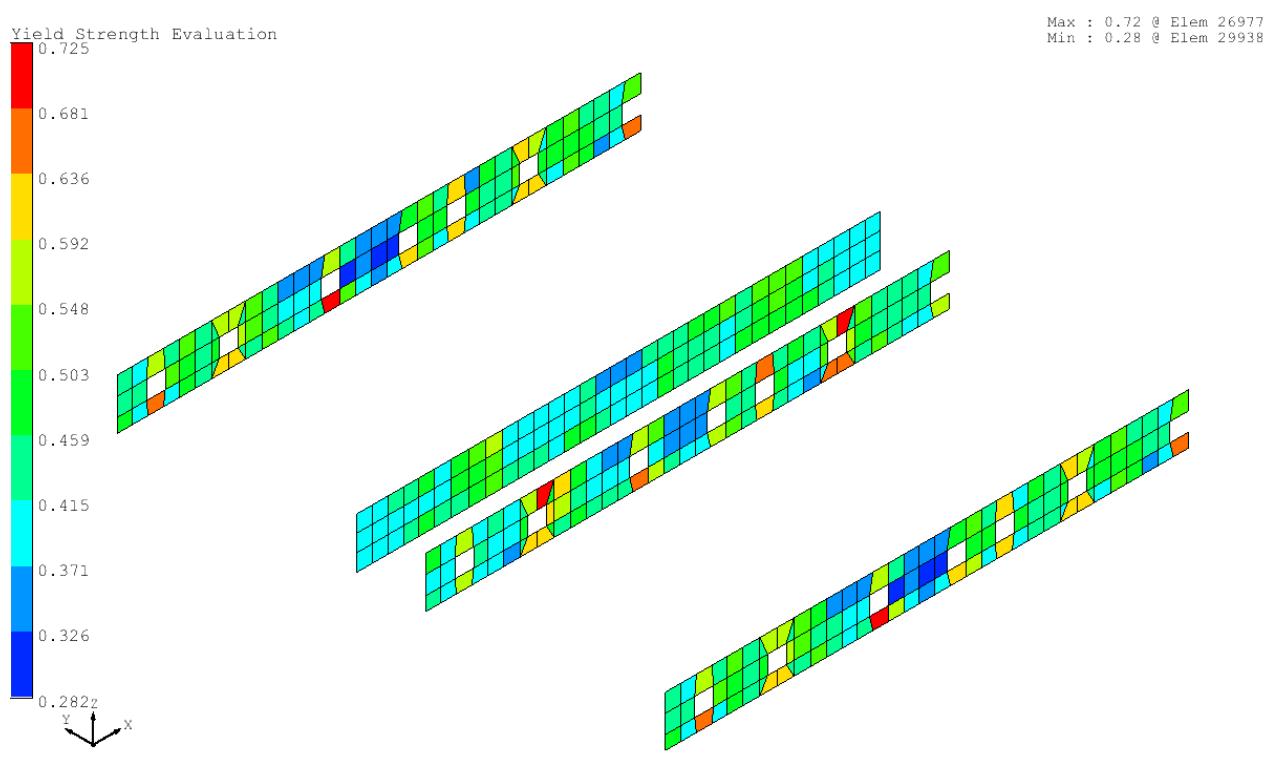
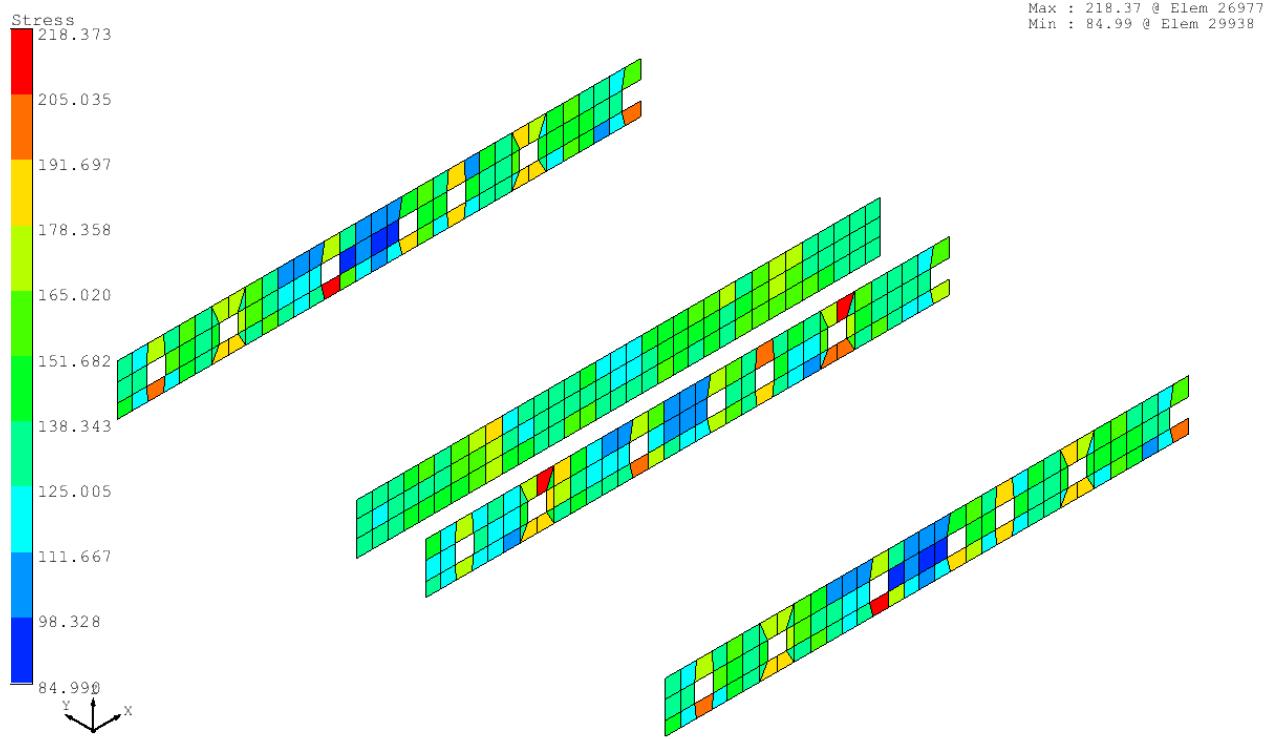


Fig.A3.06.a-F.E. Result of DOUBLE BOTTOM GIRDER (Yielding, Sea-going Max.)

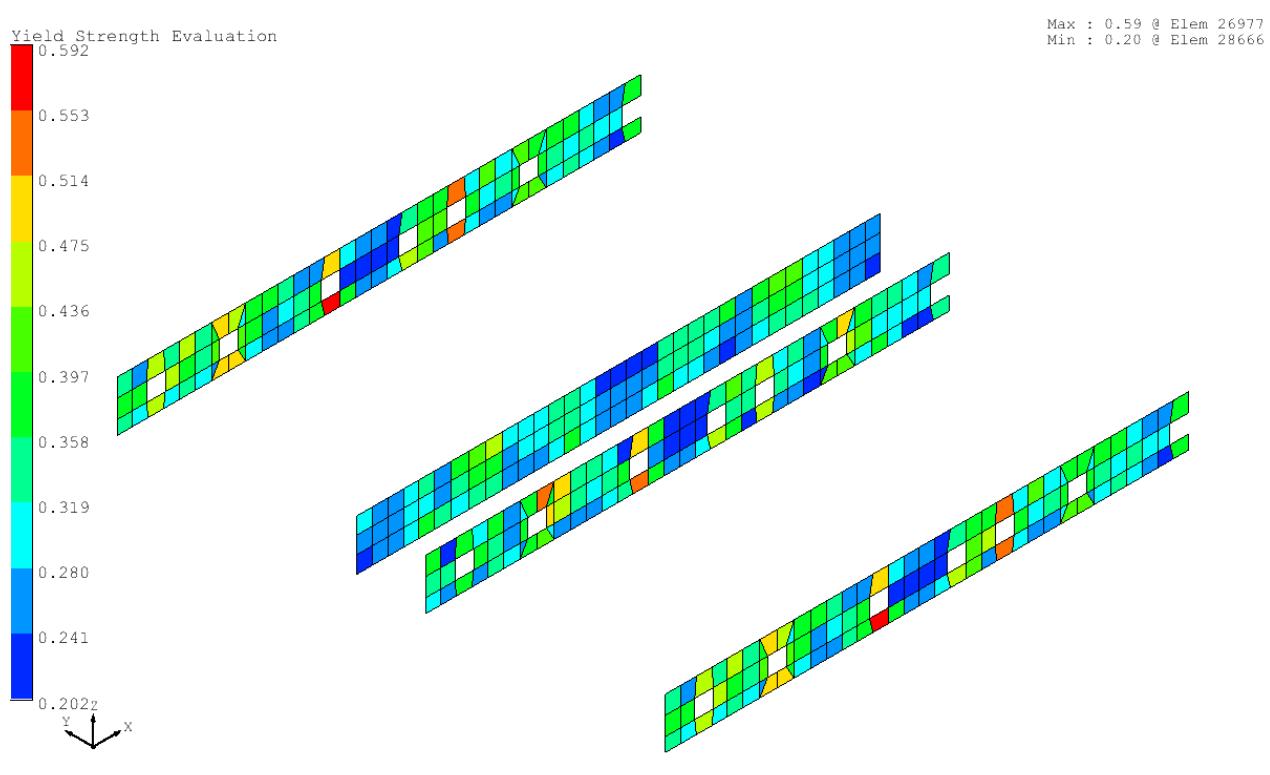
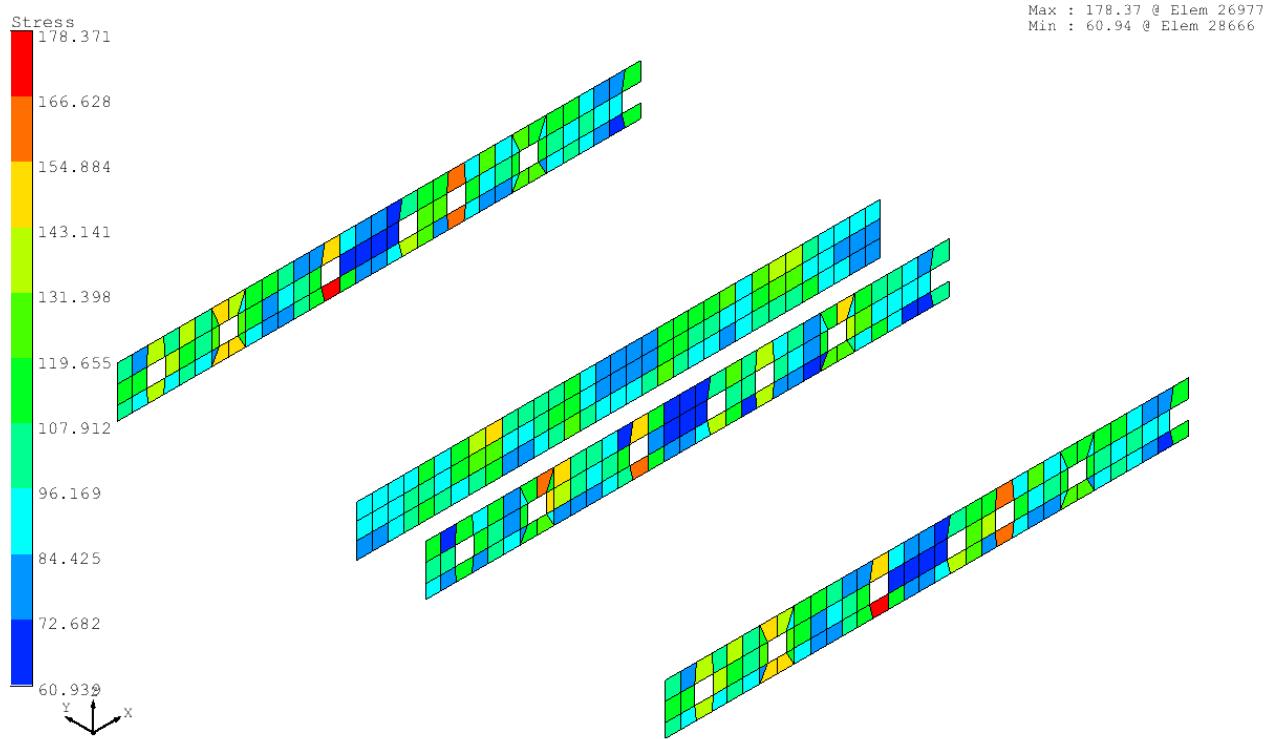
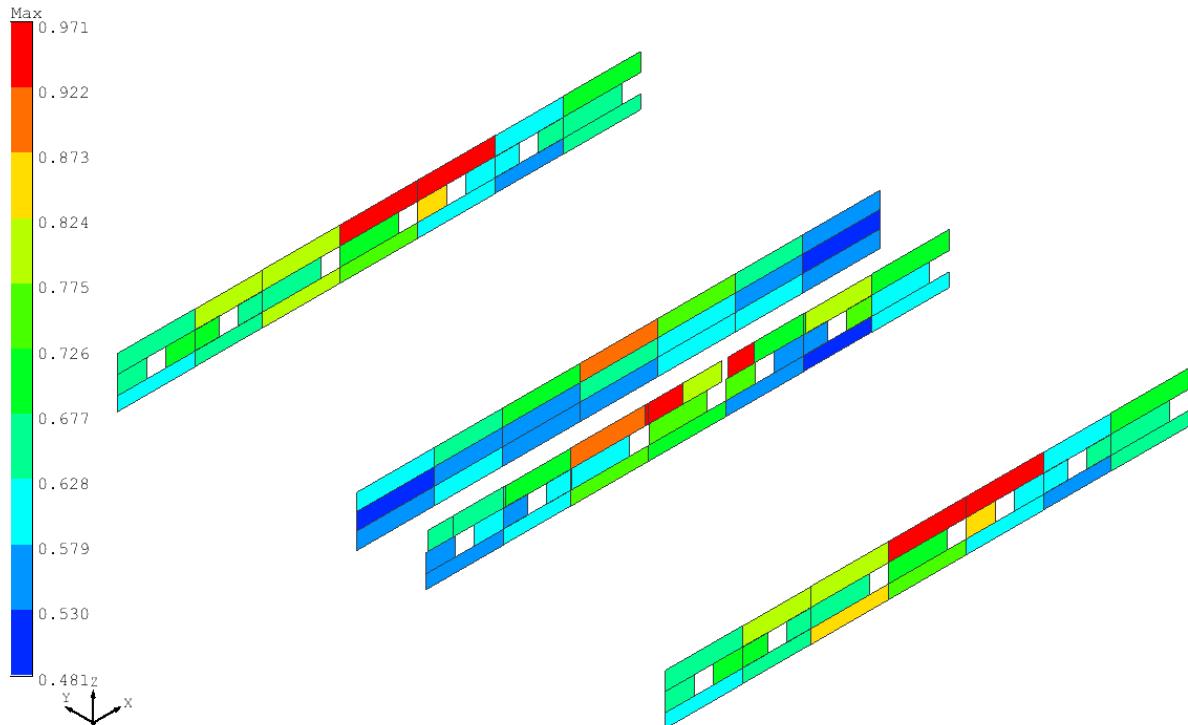
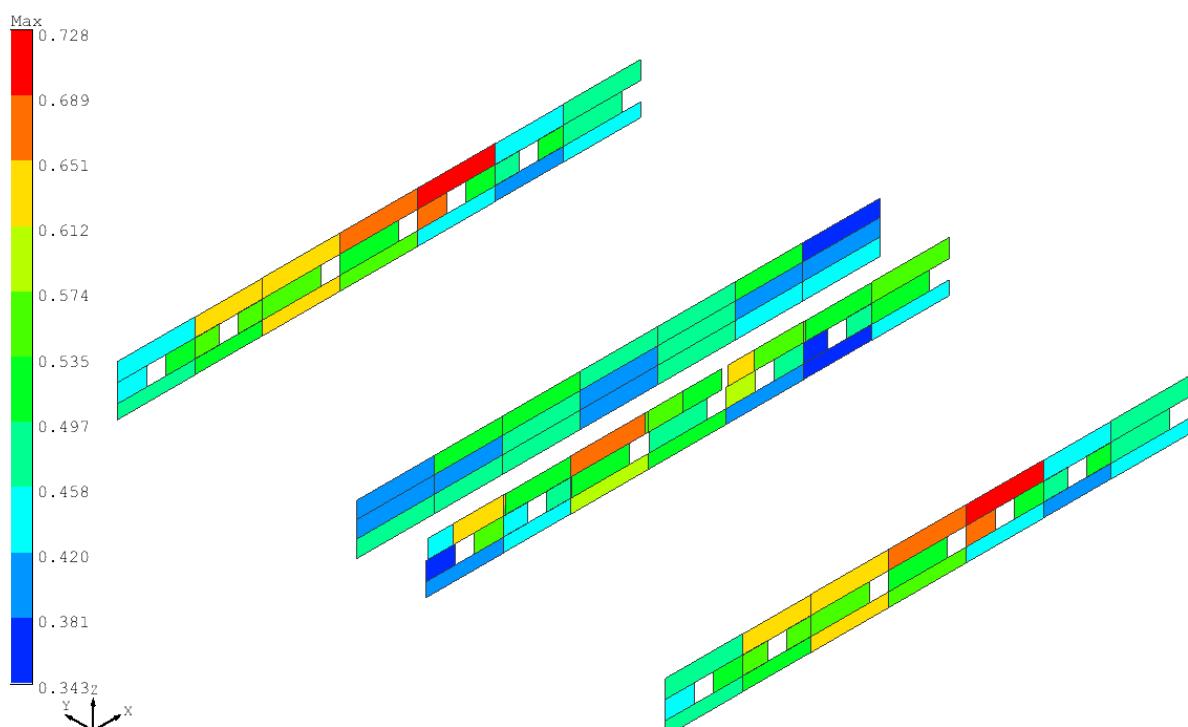


Fig.A3.06.b-F.E. Result of DOUBLE BOTTOM GIRDER (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.97, Min:0.48

Fig.A3.06.c-F.E. Result of DOUBLE BOTTOM GIRDER (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.73, Min:0.34

Fig.A3.06.d-F.E. Result of DOUBLE BOTTOM GIRDER (Buckling, Worst Case S)

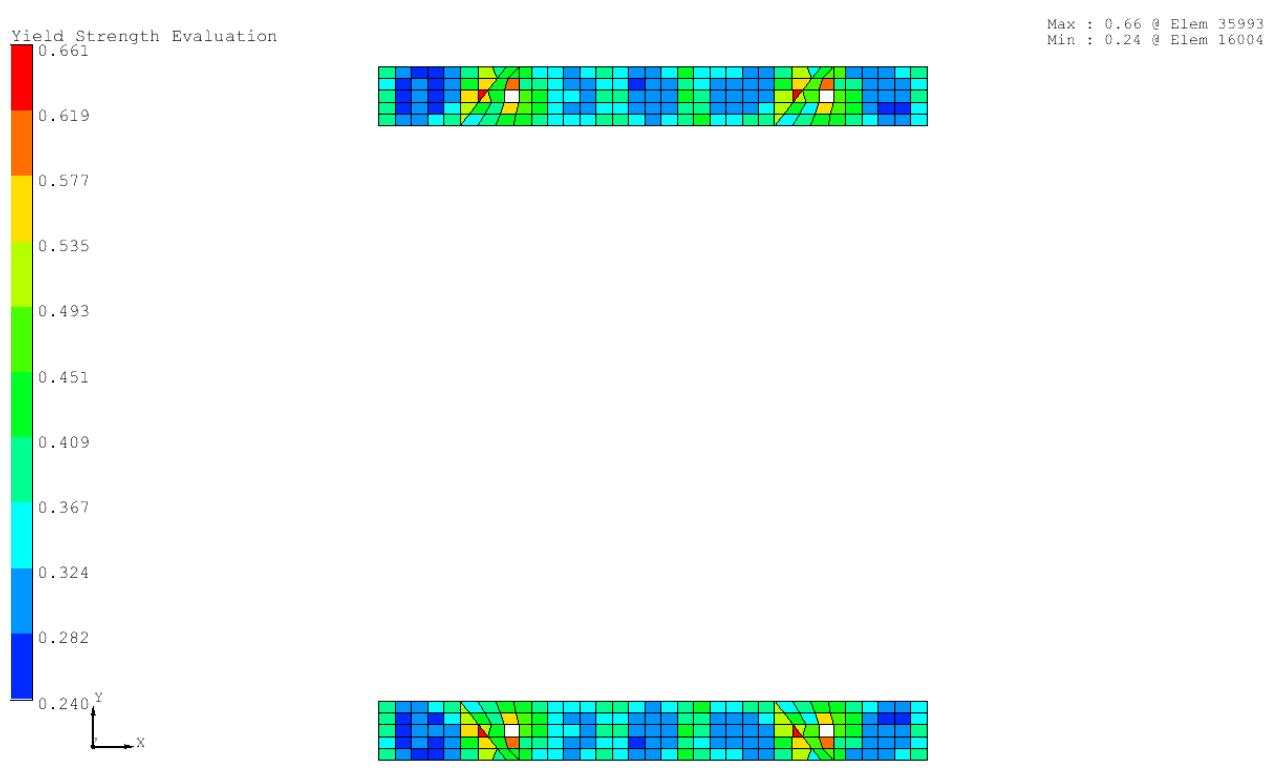
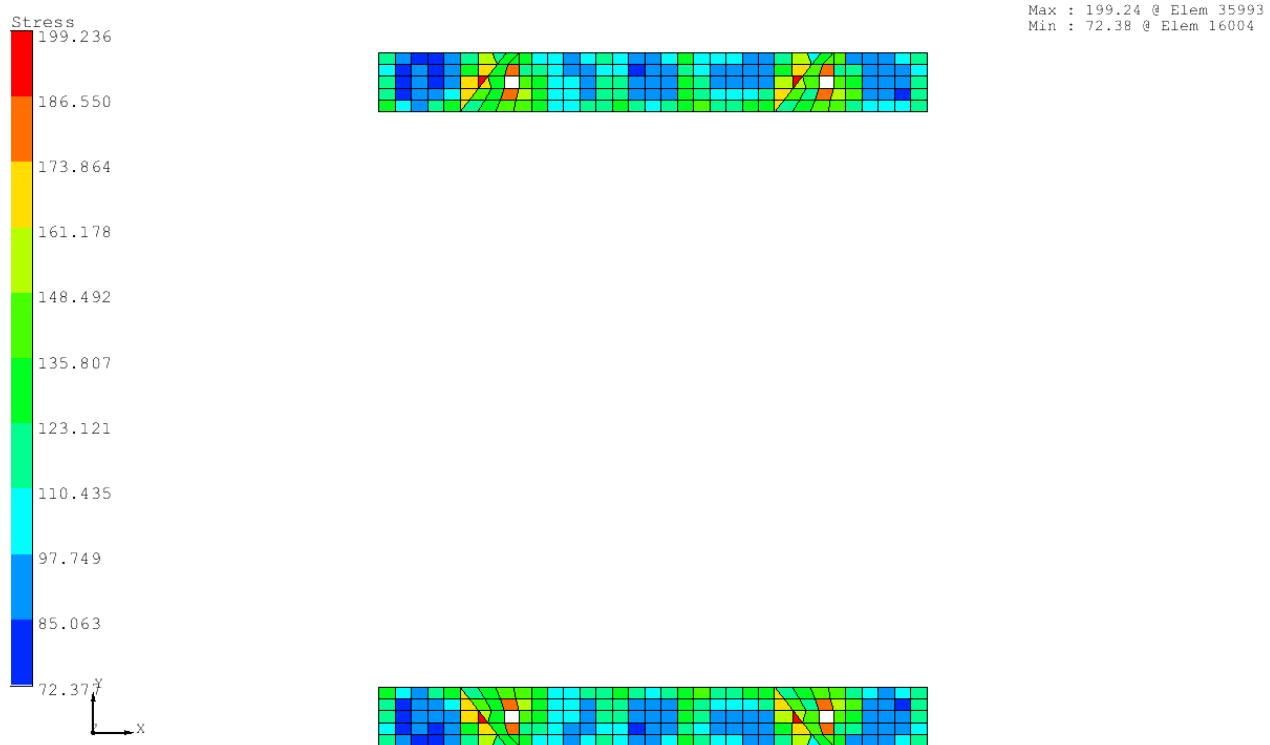


Fig.A3.07.a-F.E. Result of HOPPER PLATE (Yielding, Sea-going Max.)

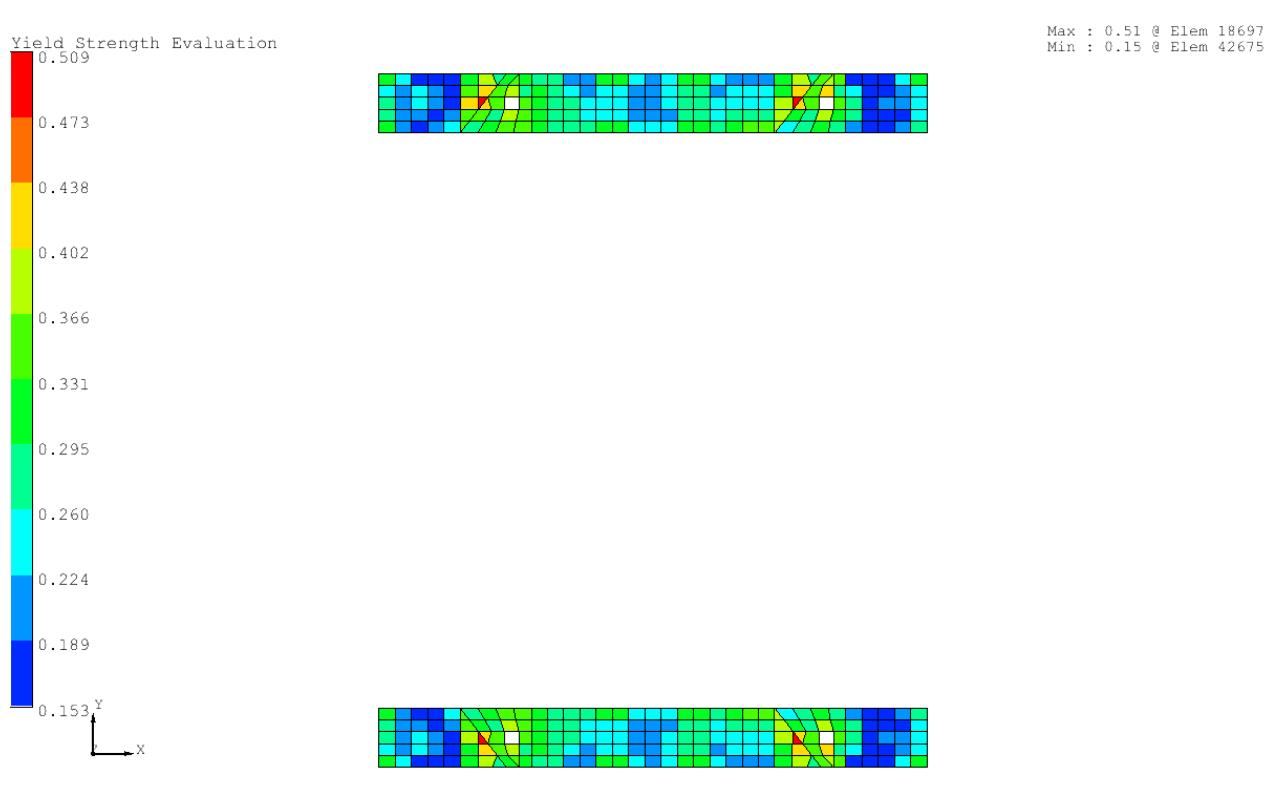
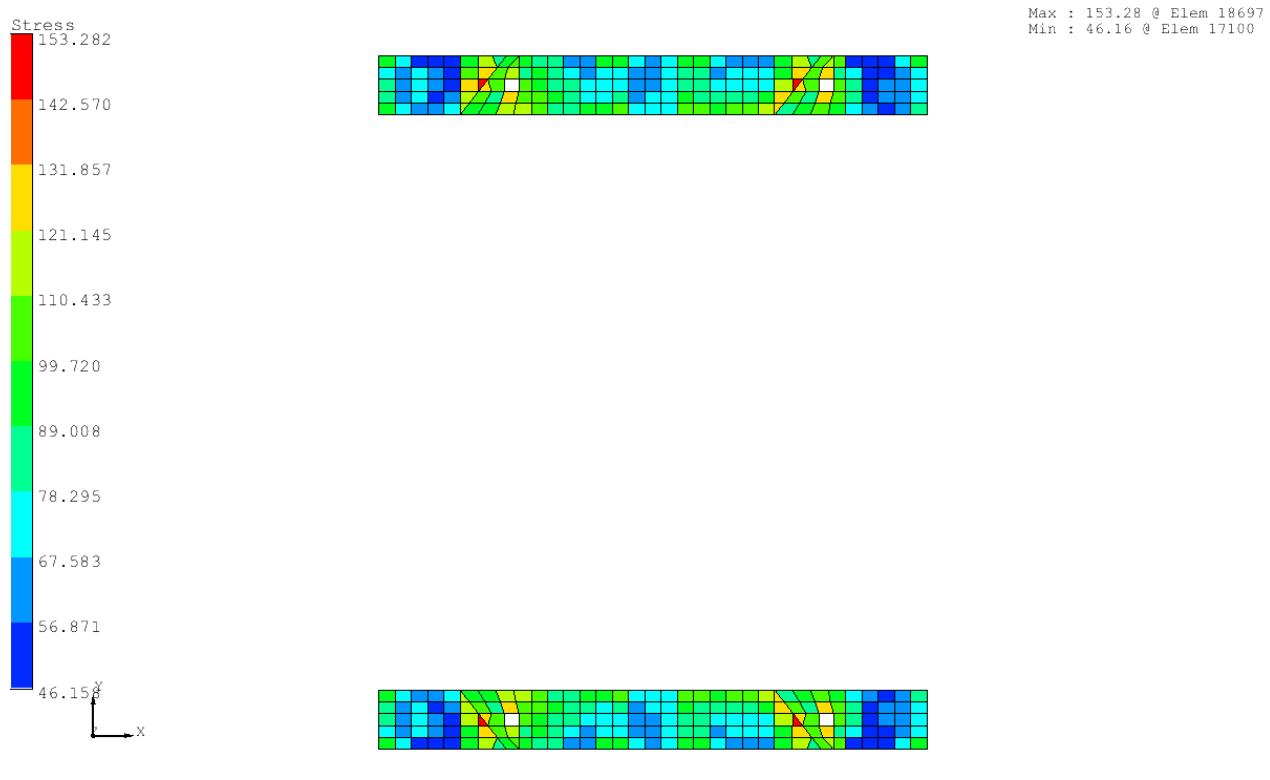
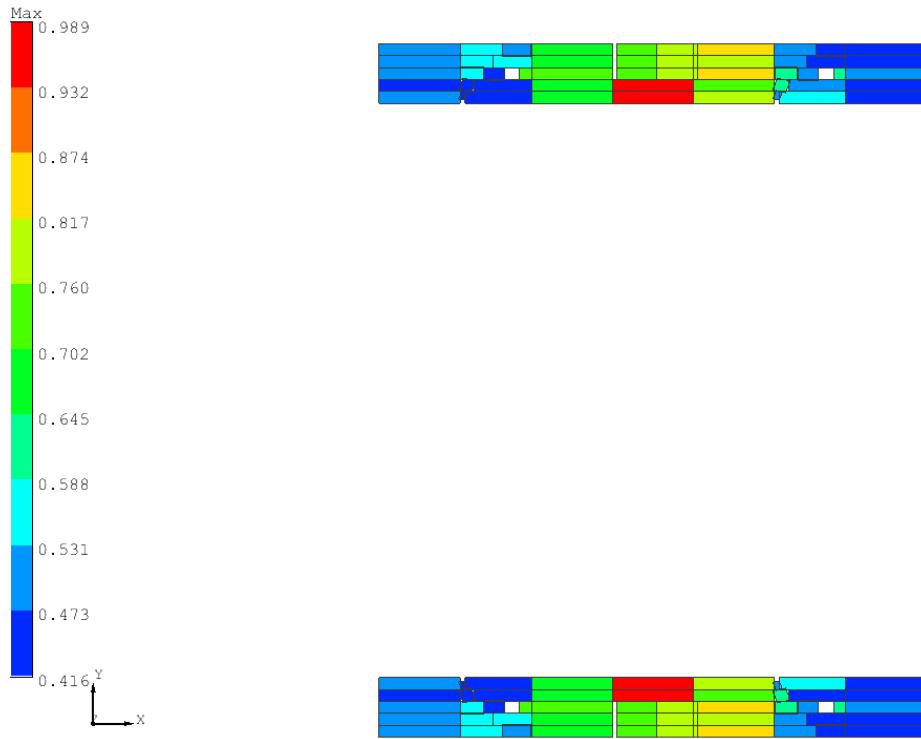
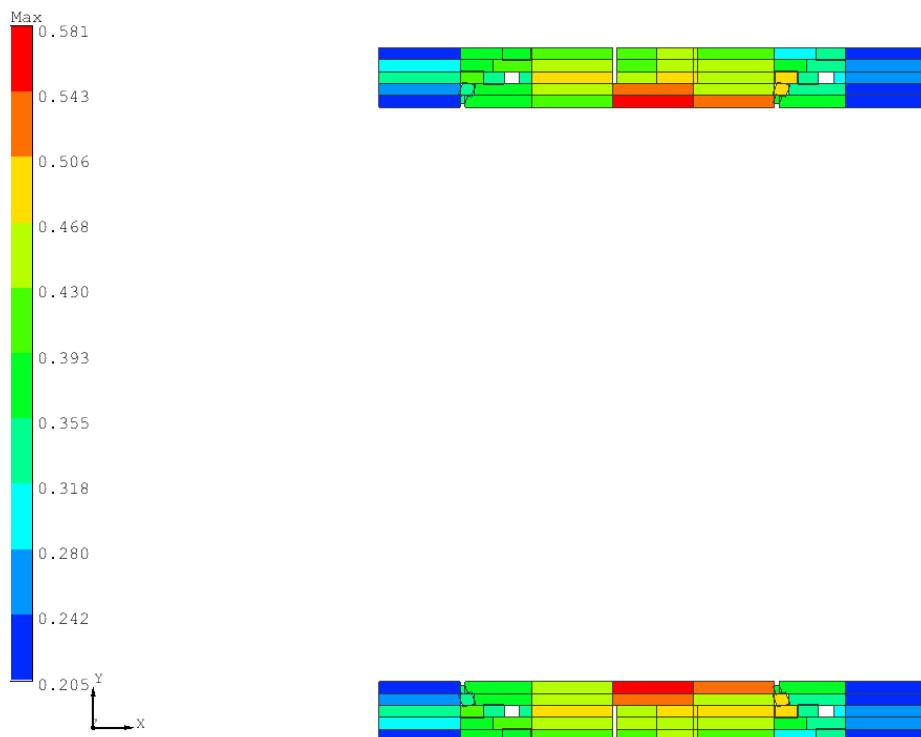


Fig.A3.07.b-F.E. Result of HOPPER PLATE (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.99, Min:0.42

Fig.A3.07.c-F.E. Result of HOPPER PLATE (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.58, Min:0.20

Fig.A3.07.d-F.E. Result of HOPPER PLATE (Buckling, Worst Case S)

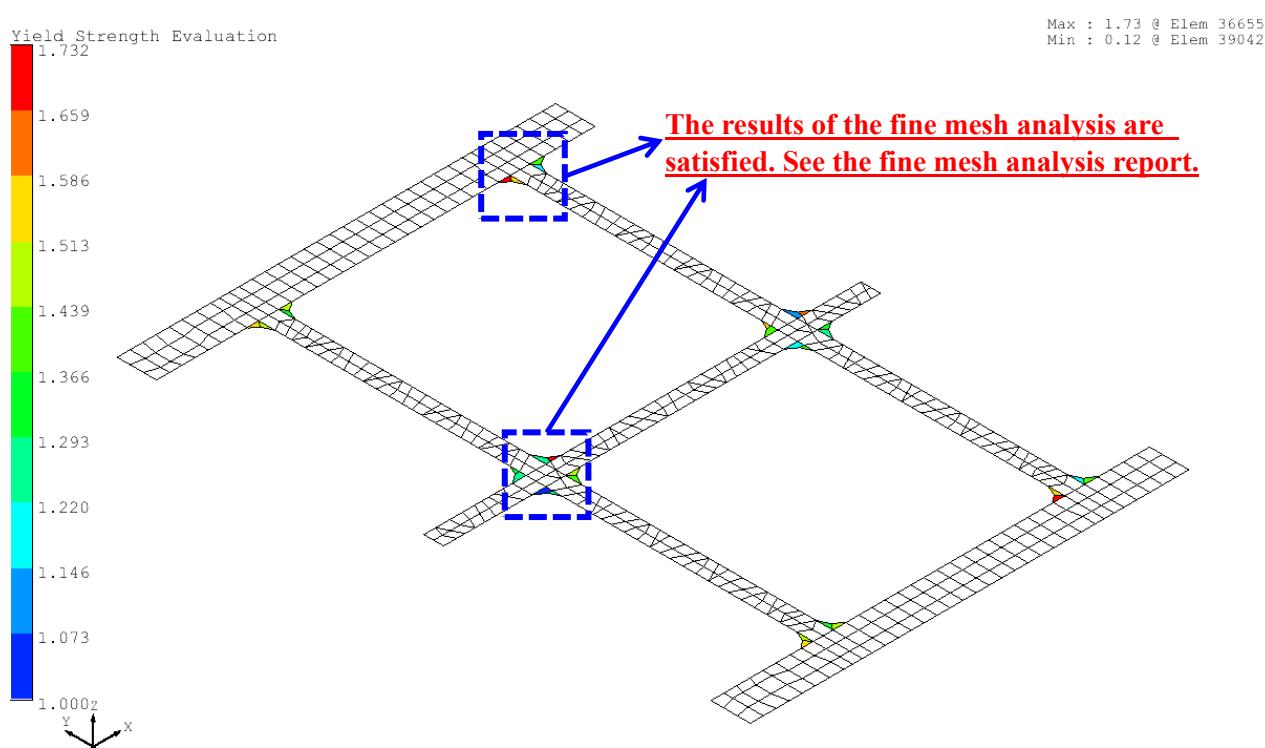
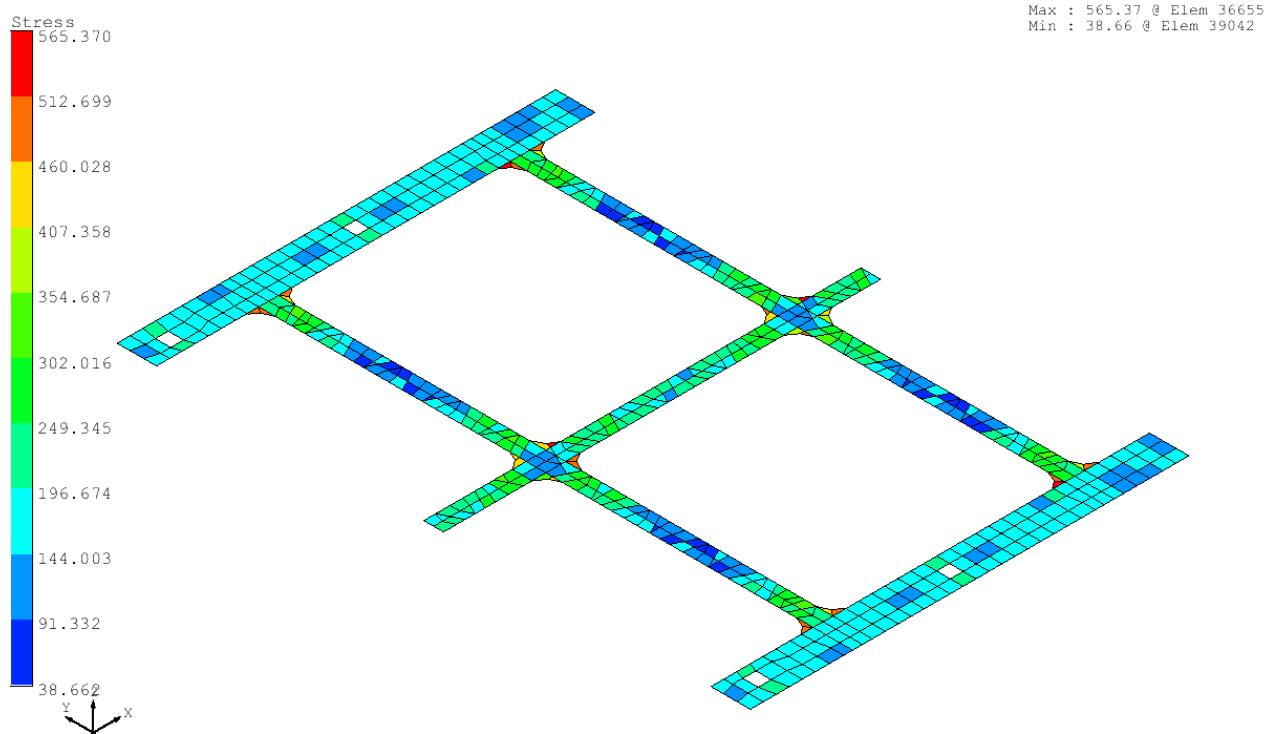


Fig.A3.08.a-F.E. Result of NO.1 STRINGER (Yielding, Sea-going Max.)

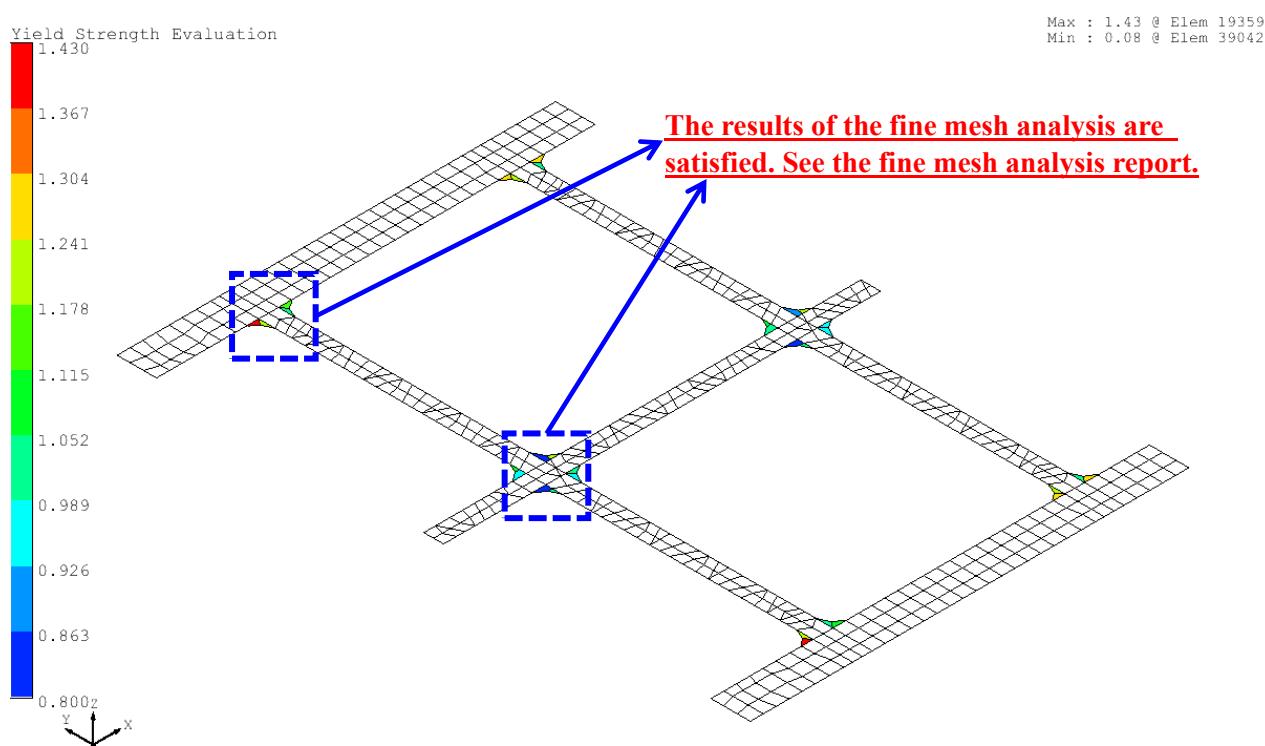
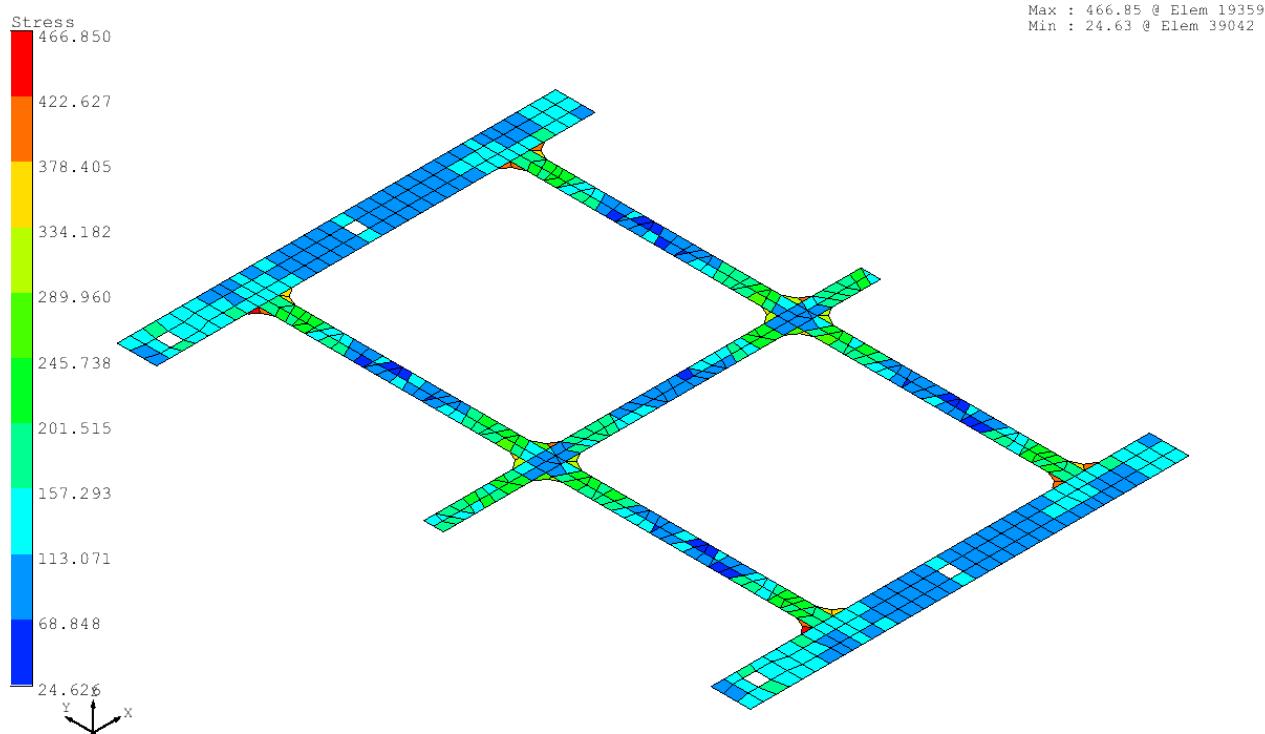
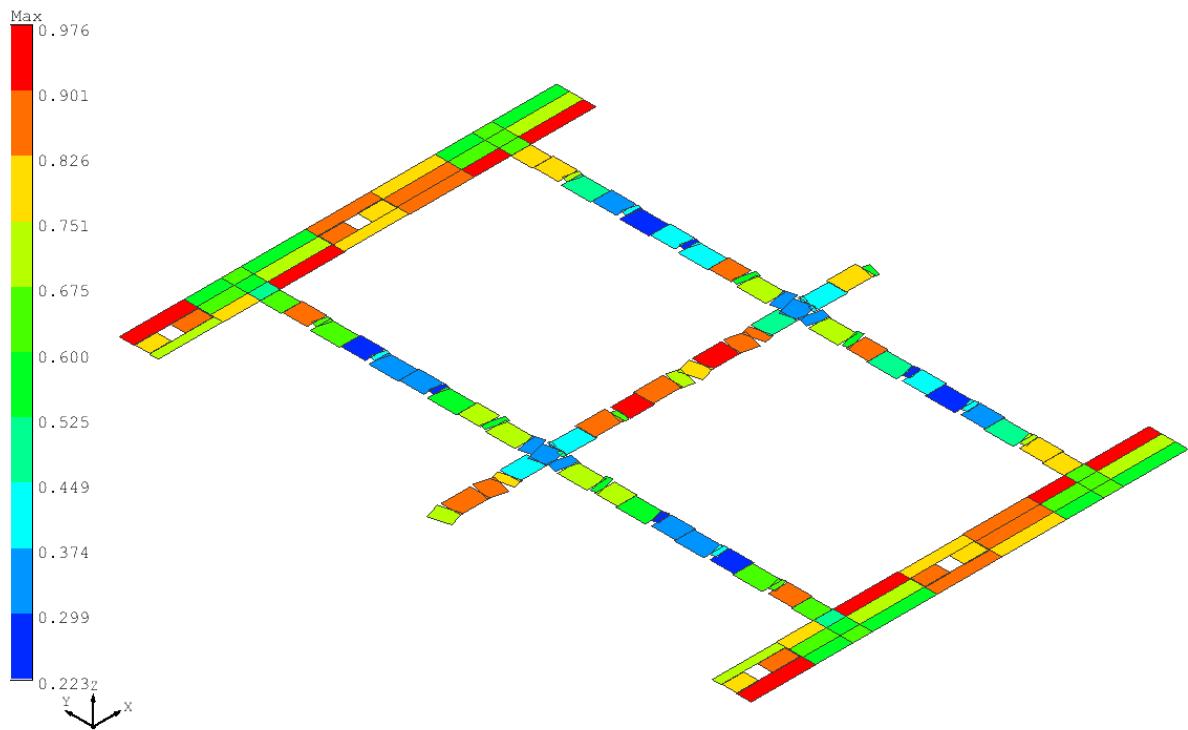
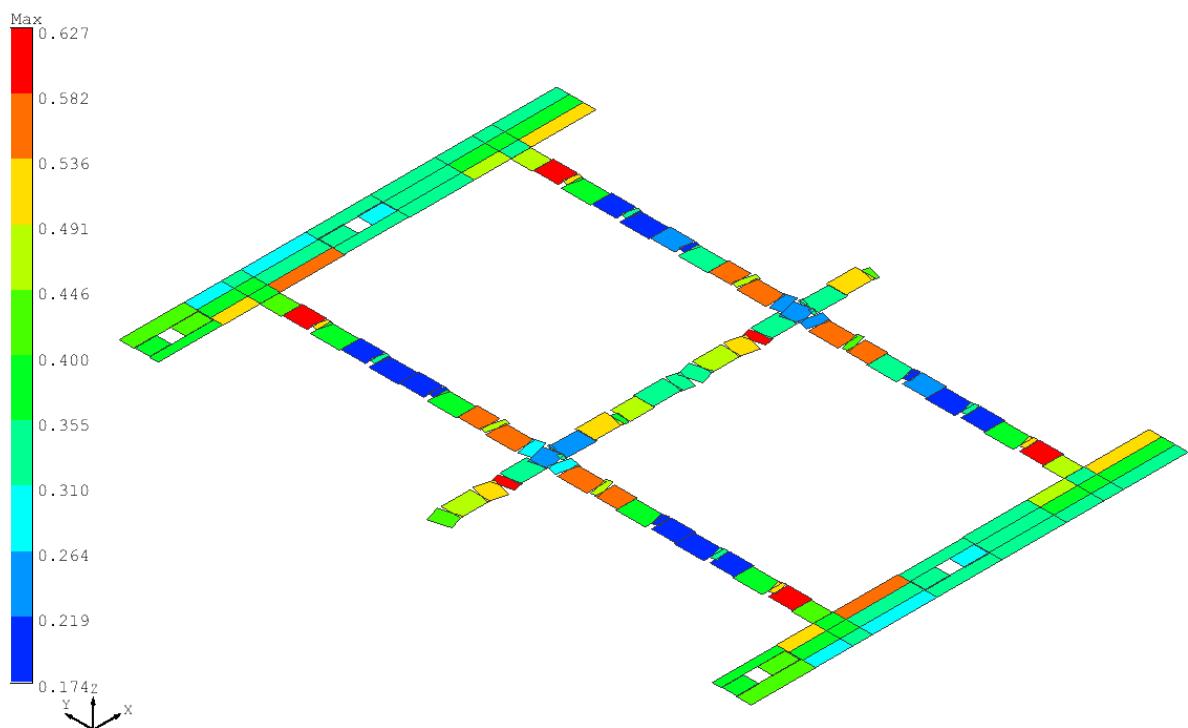


Fig.A3.08.b-F.E. Result of NO.1 STRINGER (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.98, Min:0.22

Fig.A3.08.c-F.E. Result of NO.1 STRINGER (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.63, Min:0.17

Fig.A3.08.d-F.E. Result of NO.1 STRINGER (Buckling, Worst Case S)

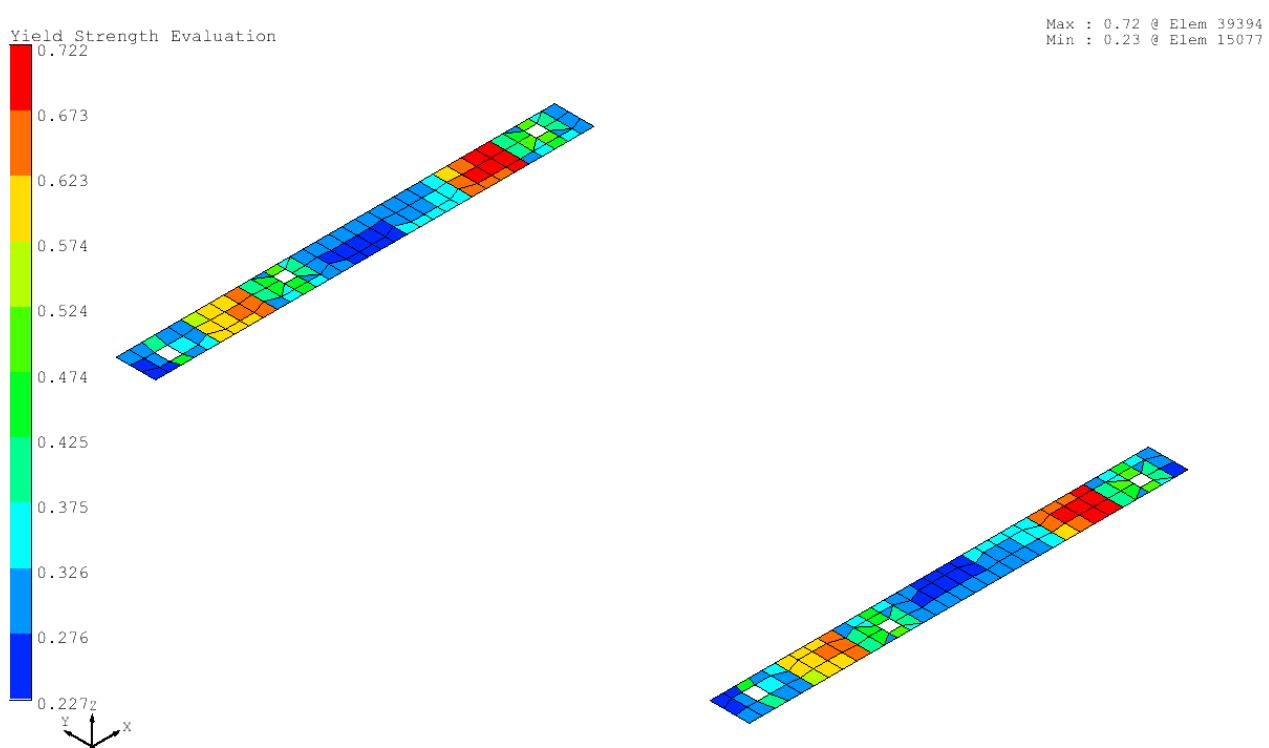
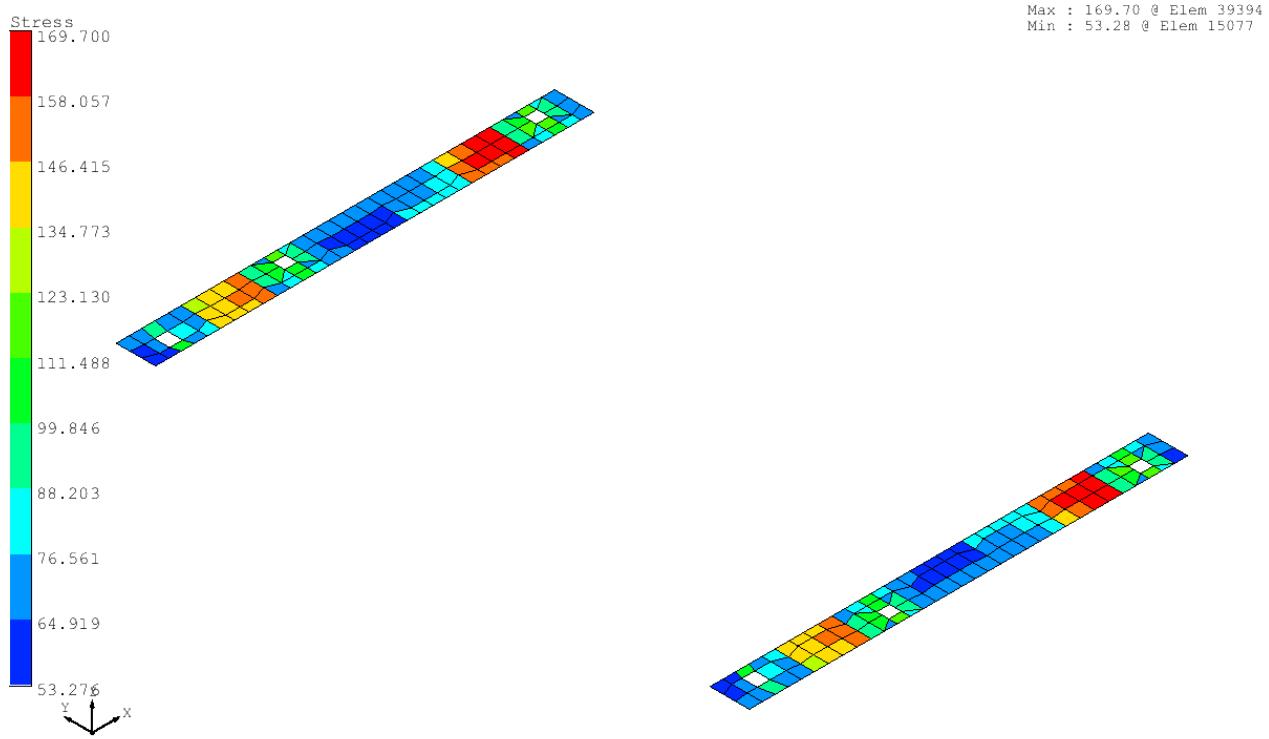


Fig.A3.09.a-F.E. Result of NO.2 STRINGER (Yielding, Sea-going Max.)

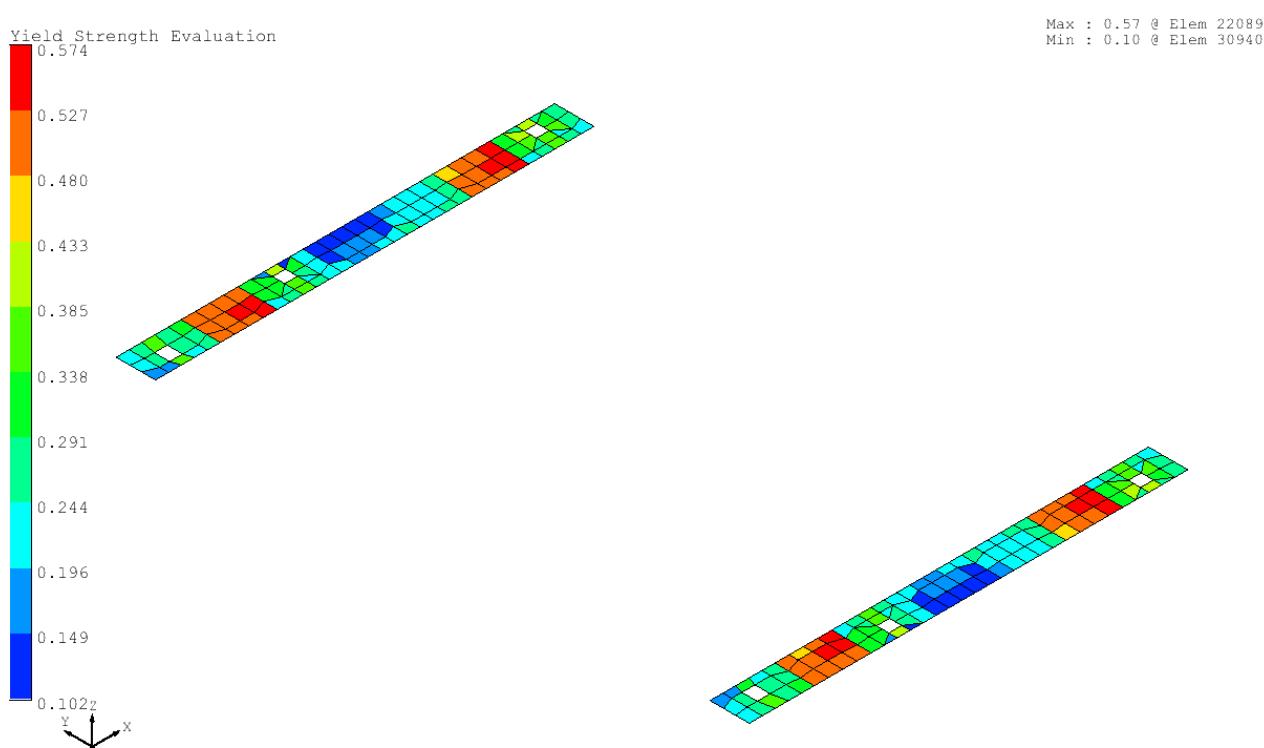
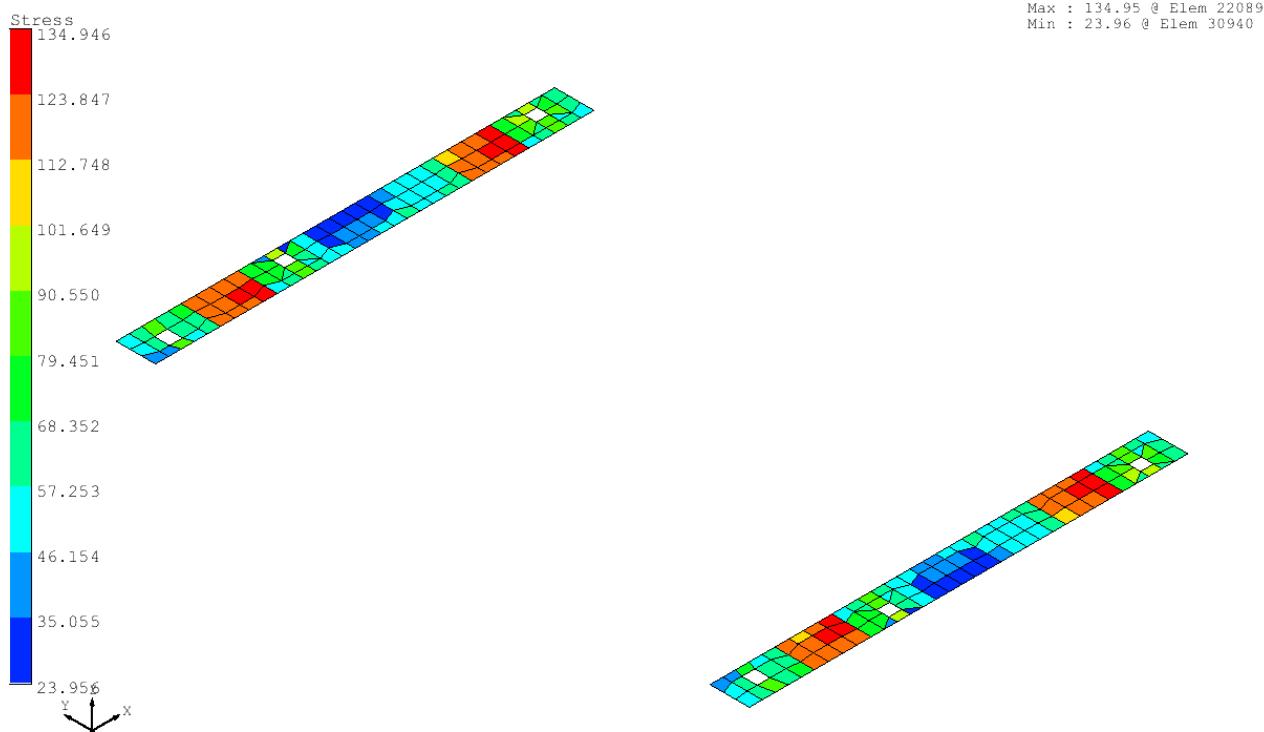
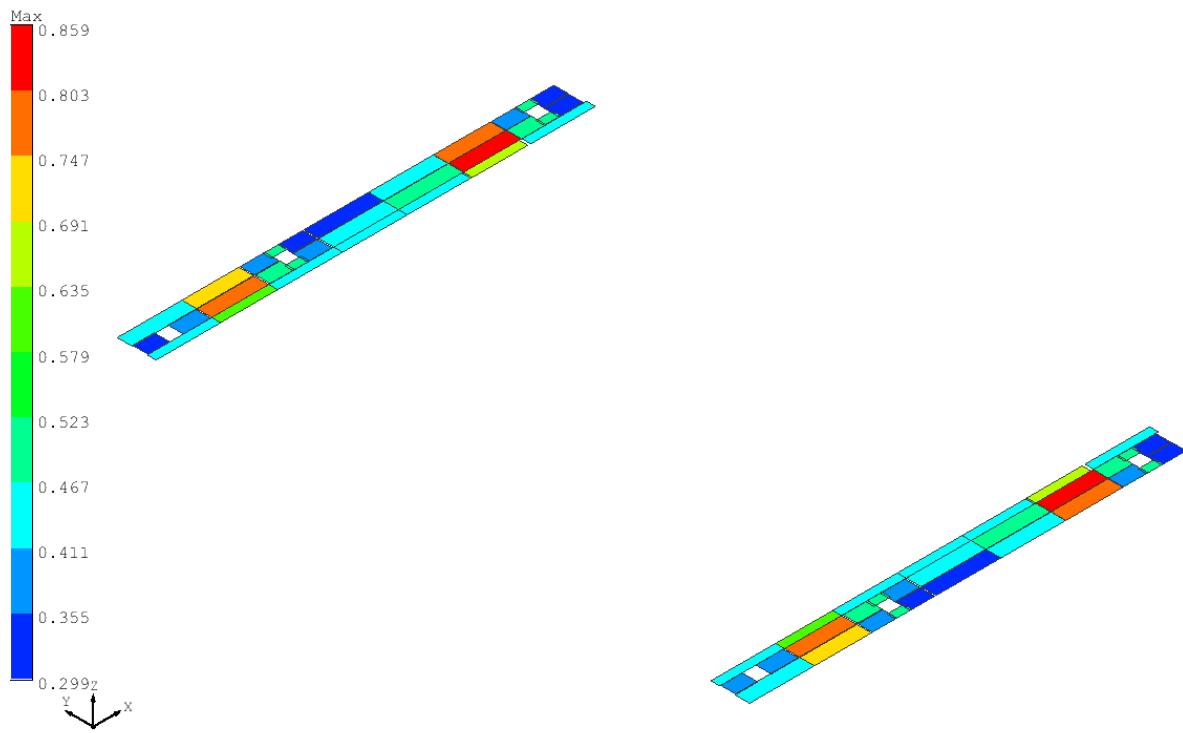
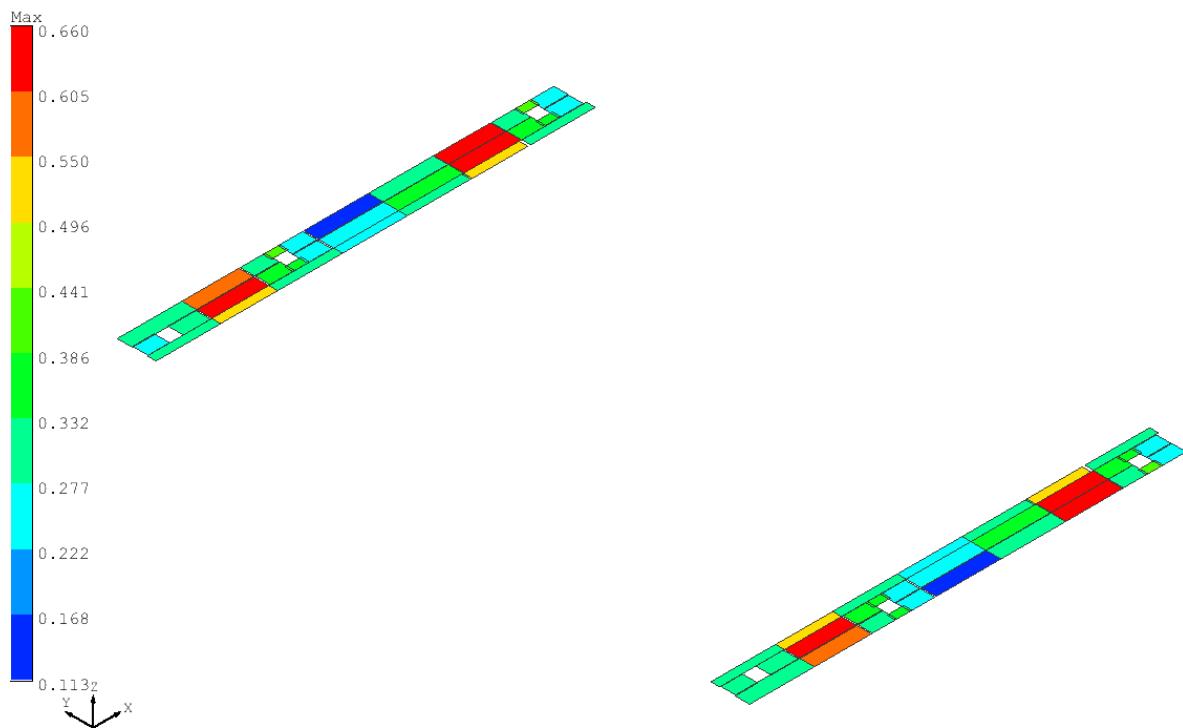


Fig.A3.09.b-F.E. Result of NO.2 STRINGER (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.86, Min:0.30

Fig.A3.09.c-F.E. Result of NO.2 STRINGER (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.66, Min:0.11

Fig.A3.09.d-F.E. Result of NO.2 STRINGER (Buckling, Worst Case S)

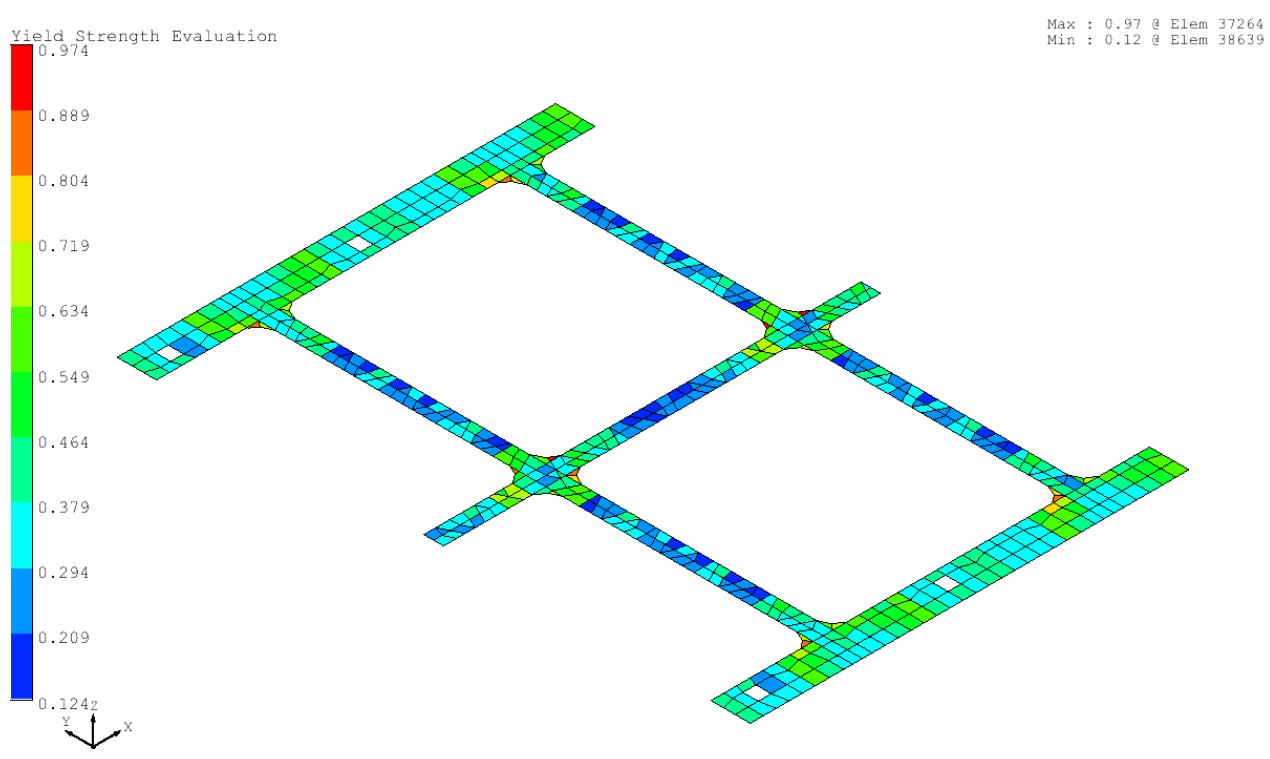
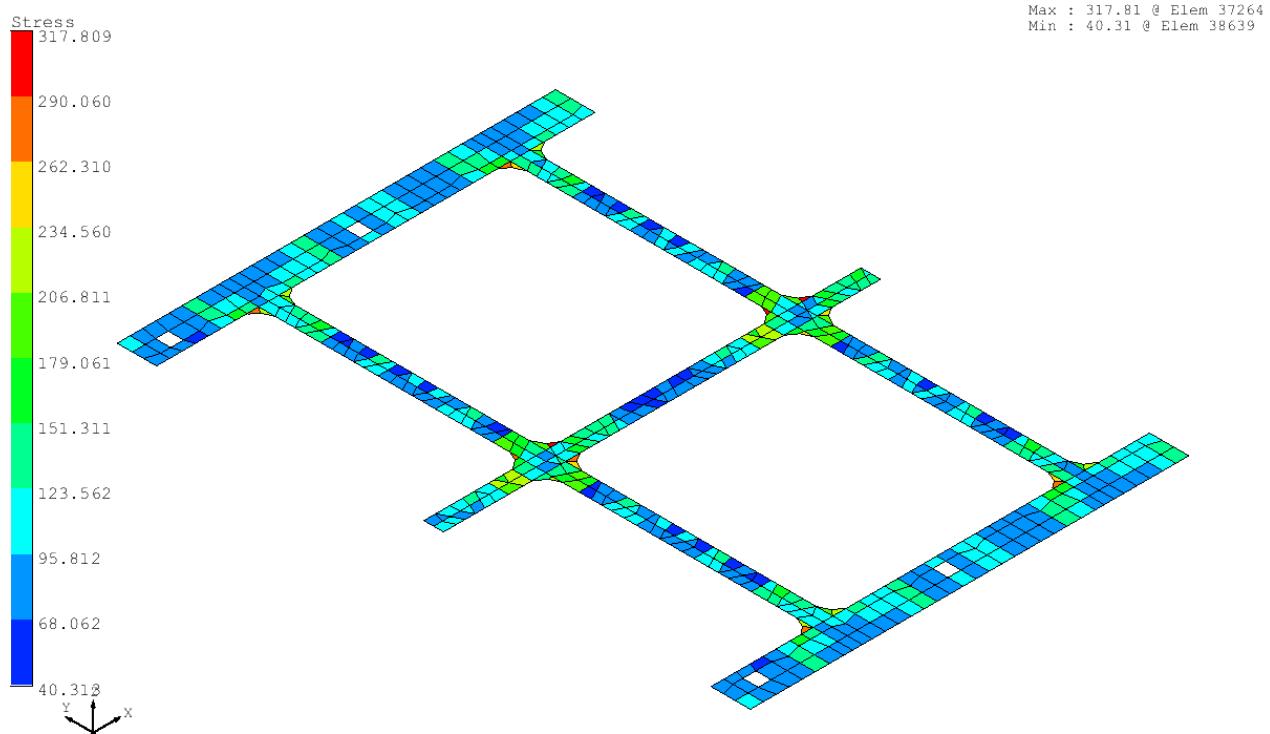


Fig.A3.10.a-F.E. Result of NO.3 STRINGER (Yielding, Sea-going Max.)

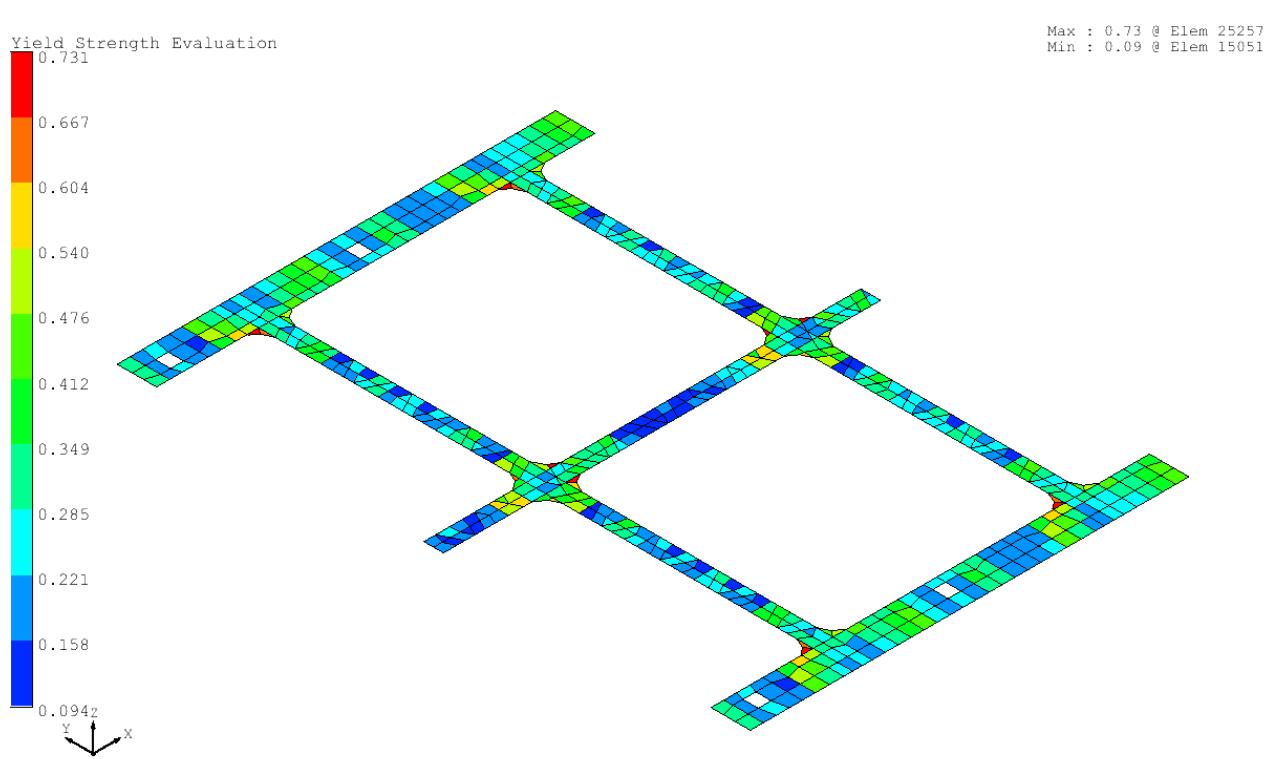
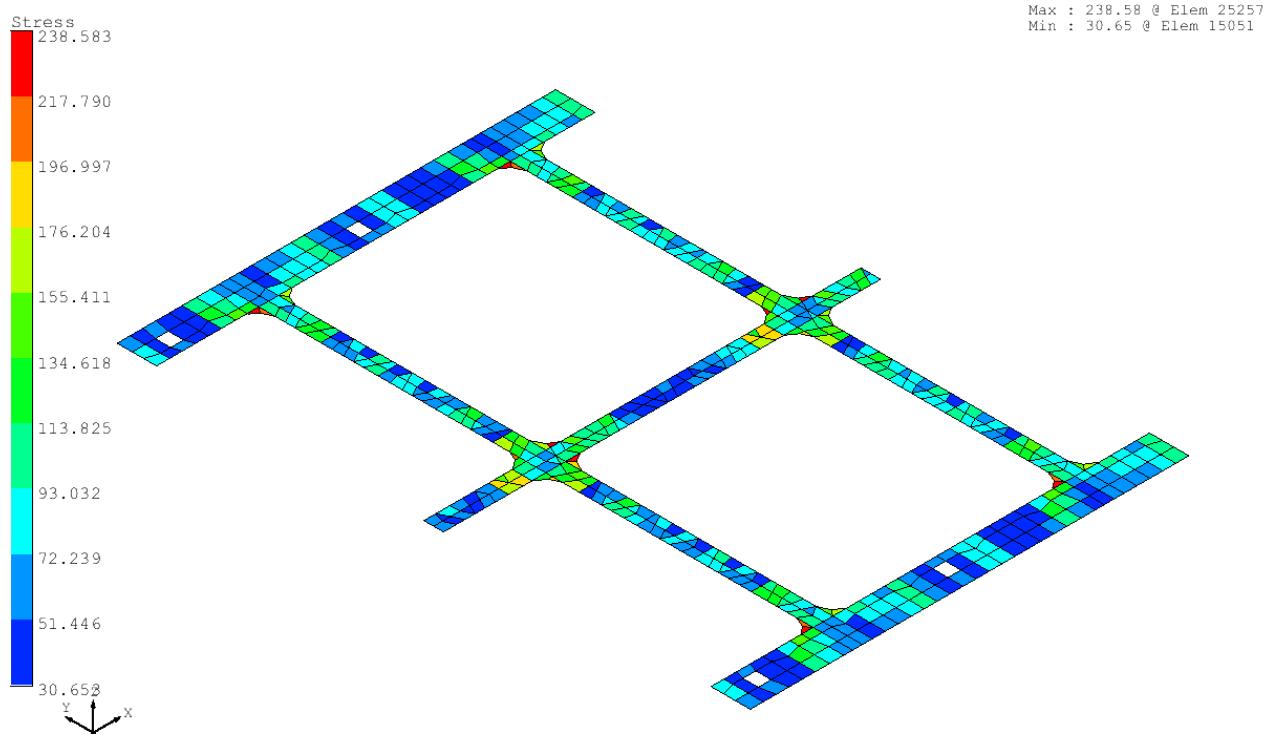
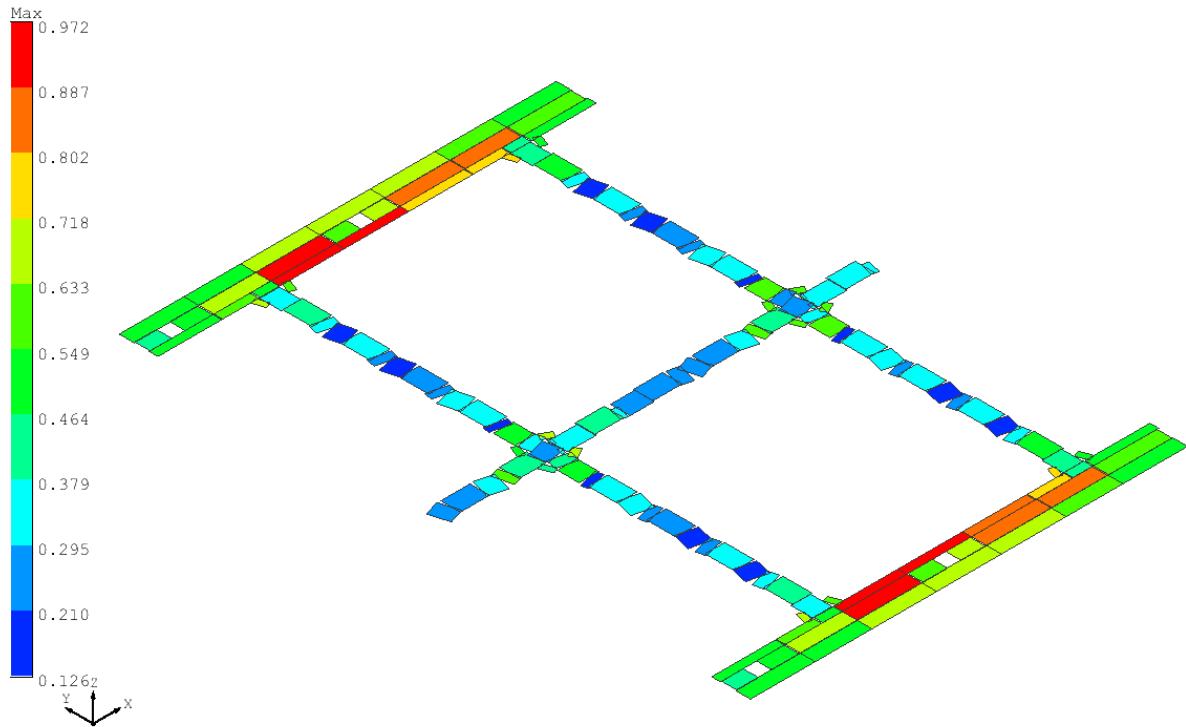
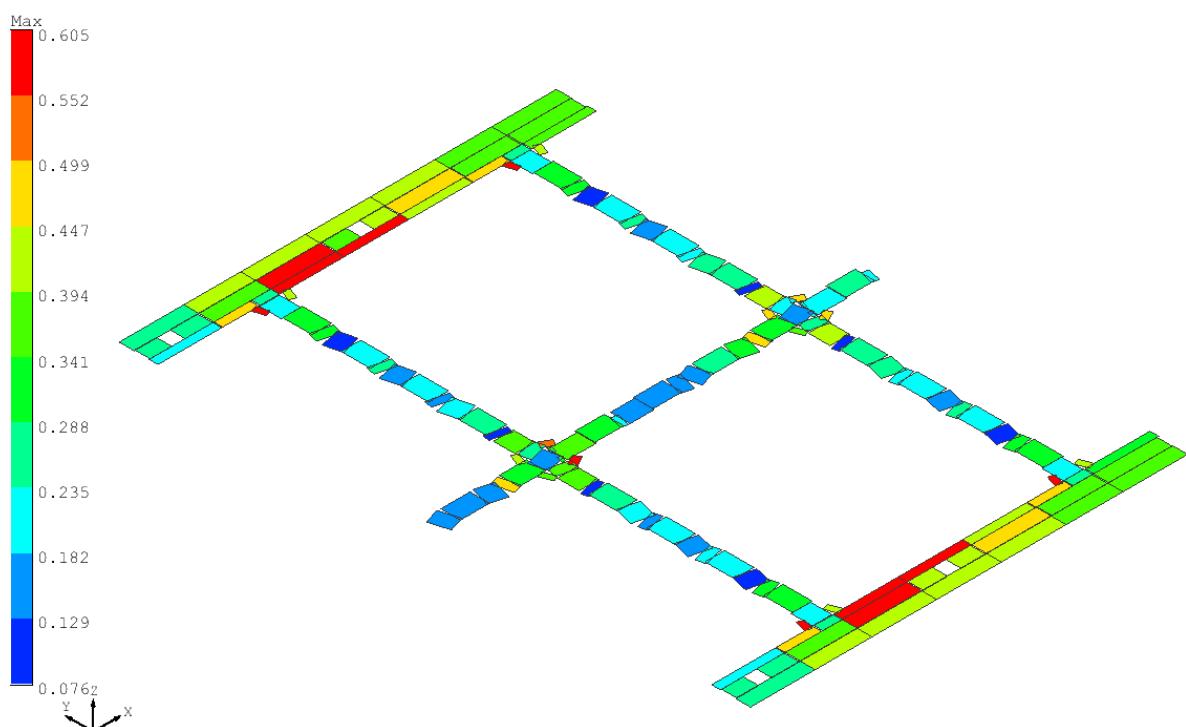


Fig.A3.10.b-F.E. Result of NO.3 STRINGER (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.97, Min:0.13

Fig.A3.10.c-F.E. Result of NO.3 STRINGER (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.61, Min:0.08

Fig.A3.10.d-F.E. Result of NO.3 STRINGER (Buckling, Worst Case S)

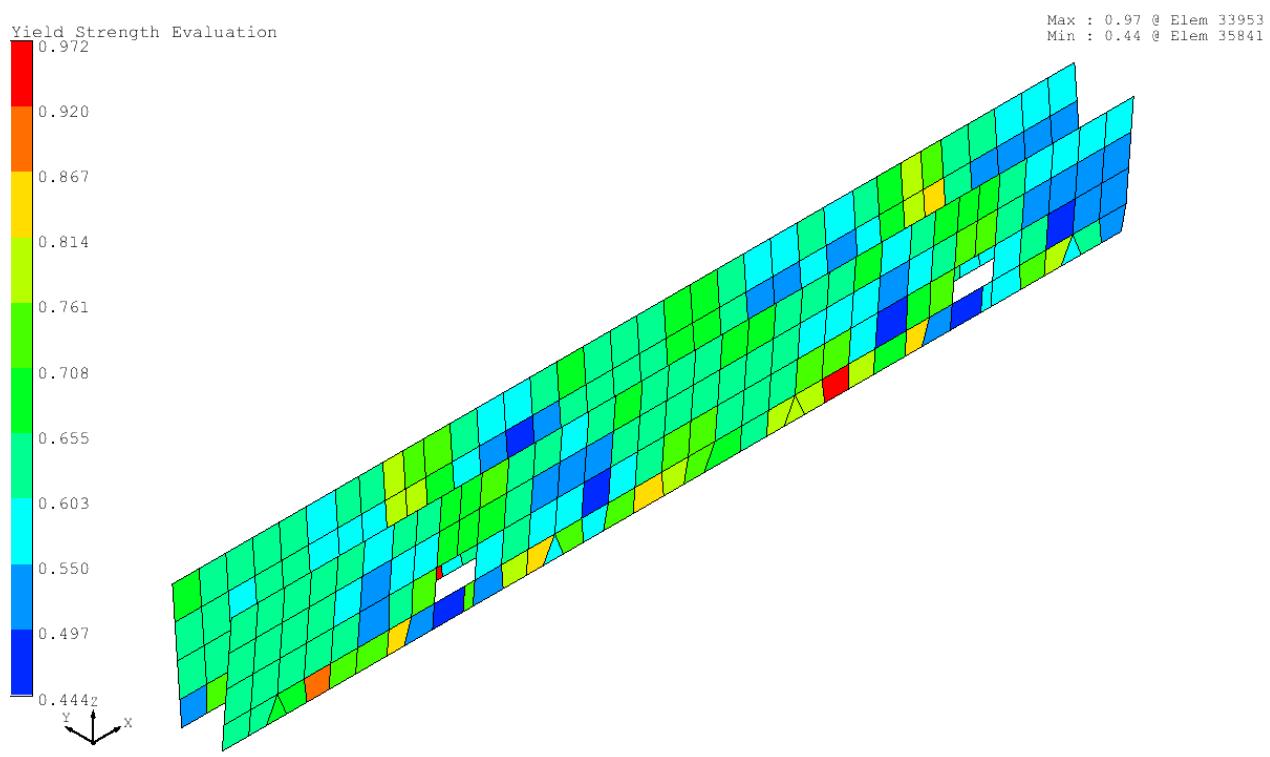
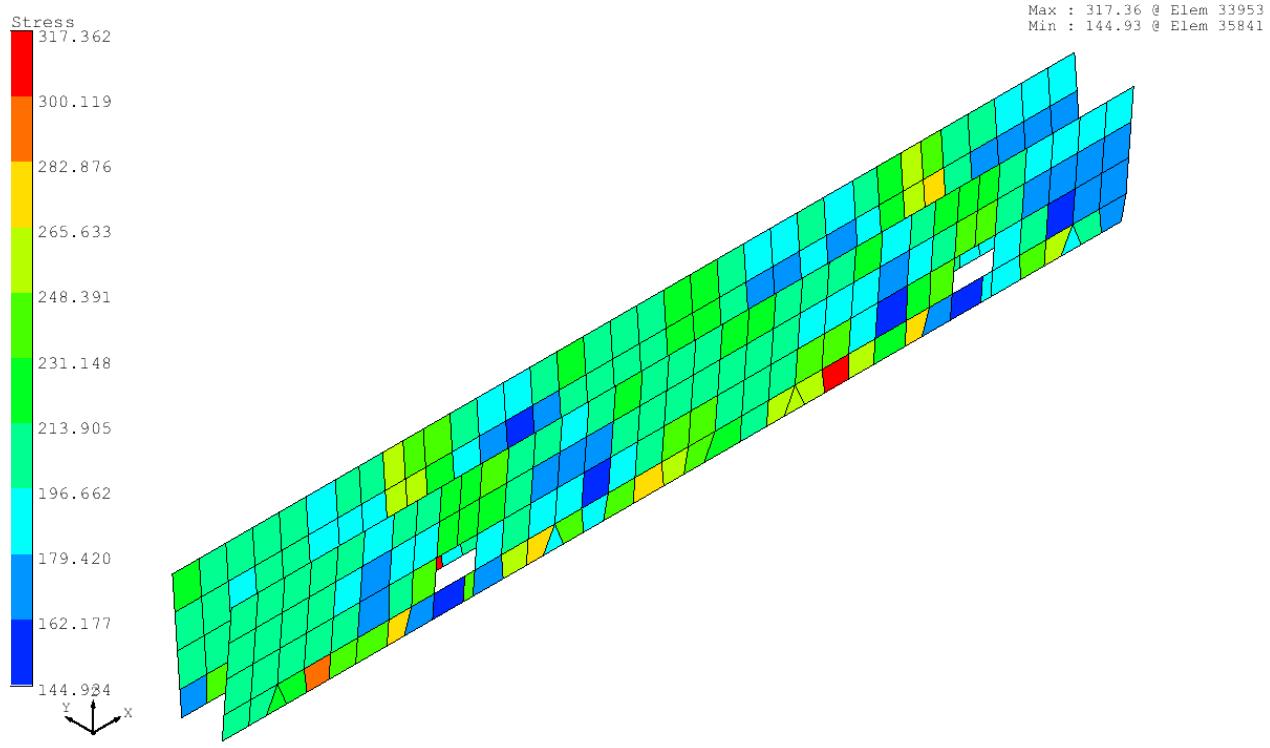


Fig.A3.11.a-F.E. Result of LONG'L UPPER STOOL (Yielding, Sea-going Max.)

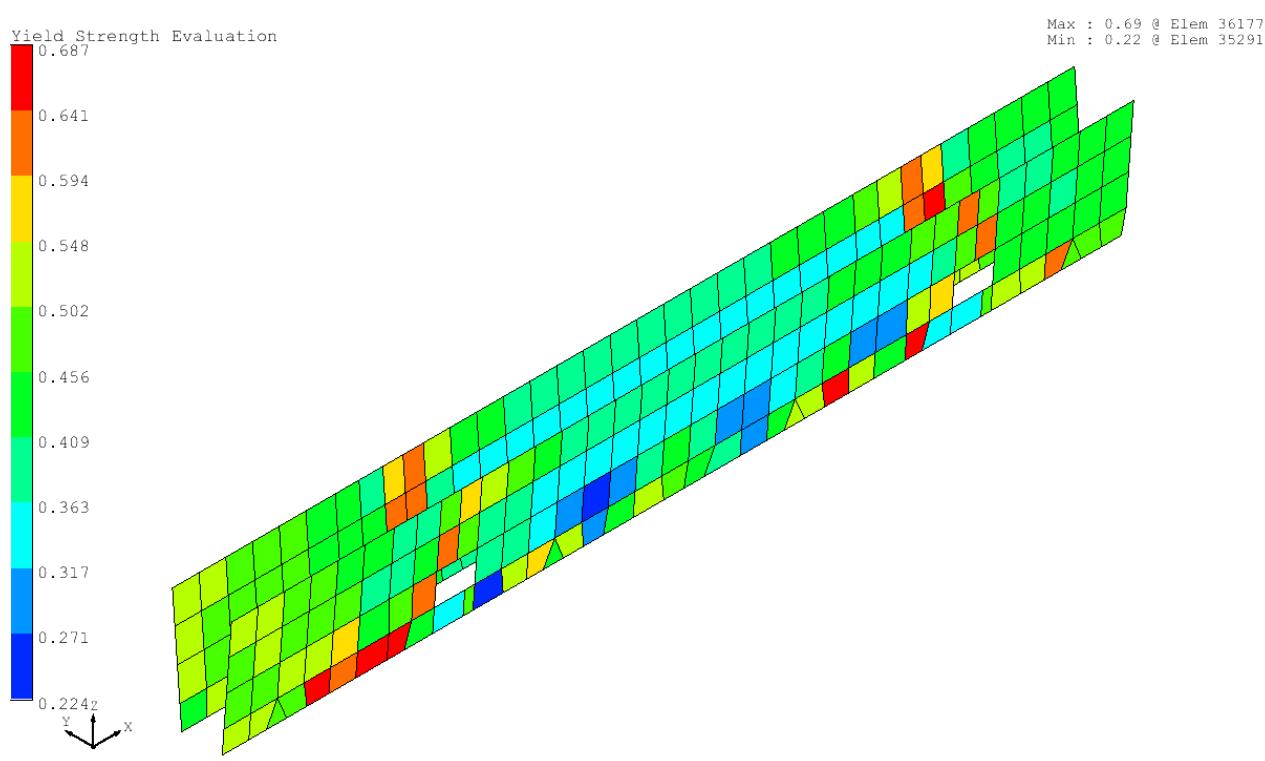
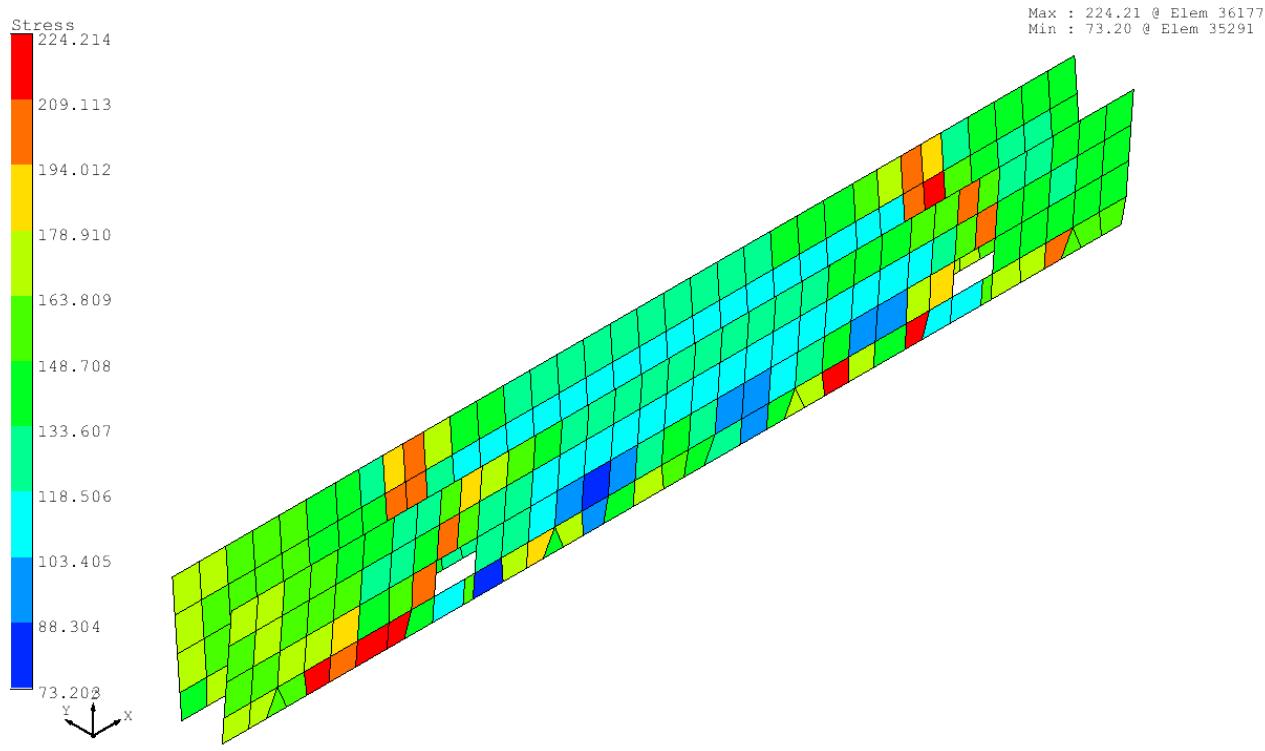
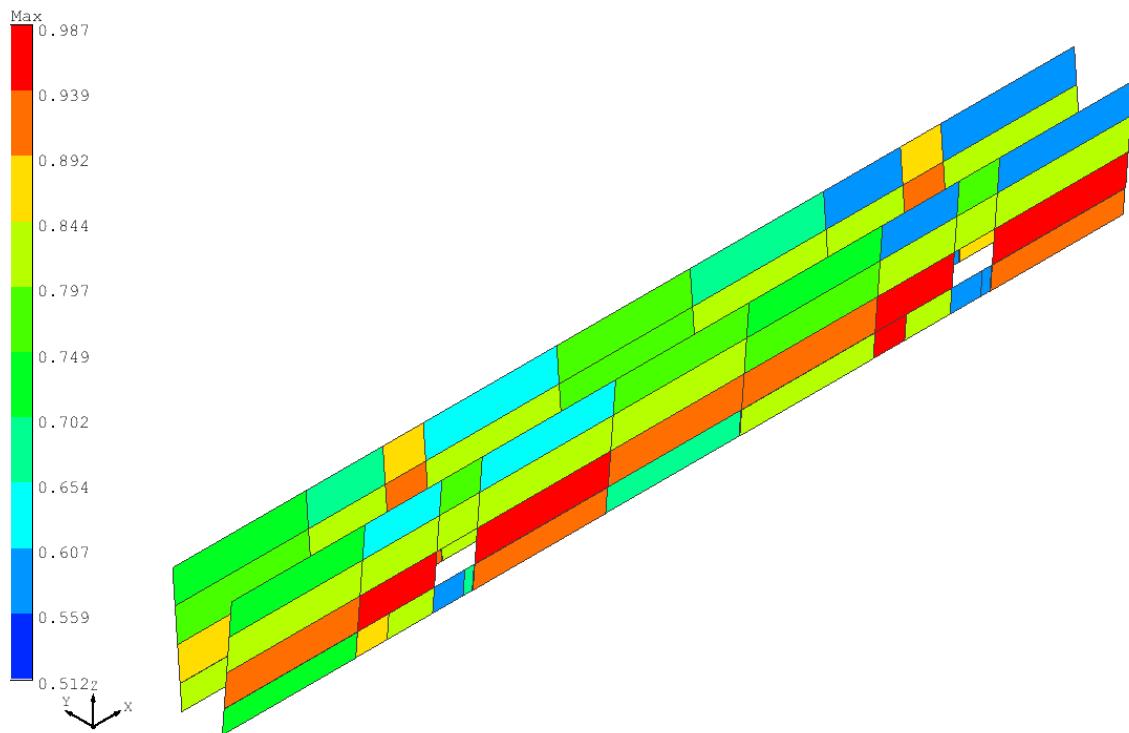
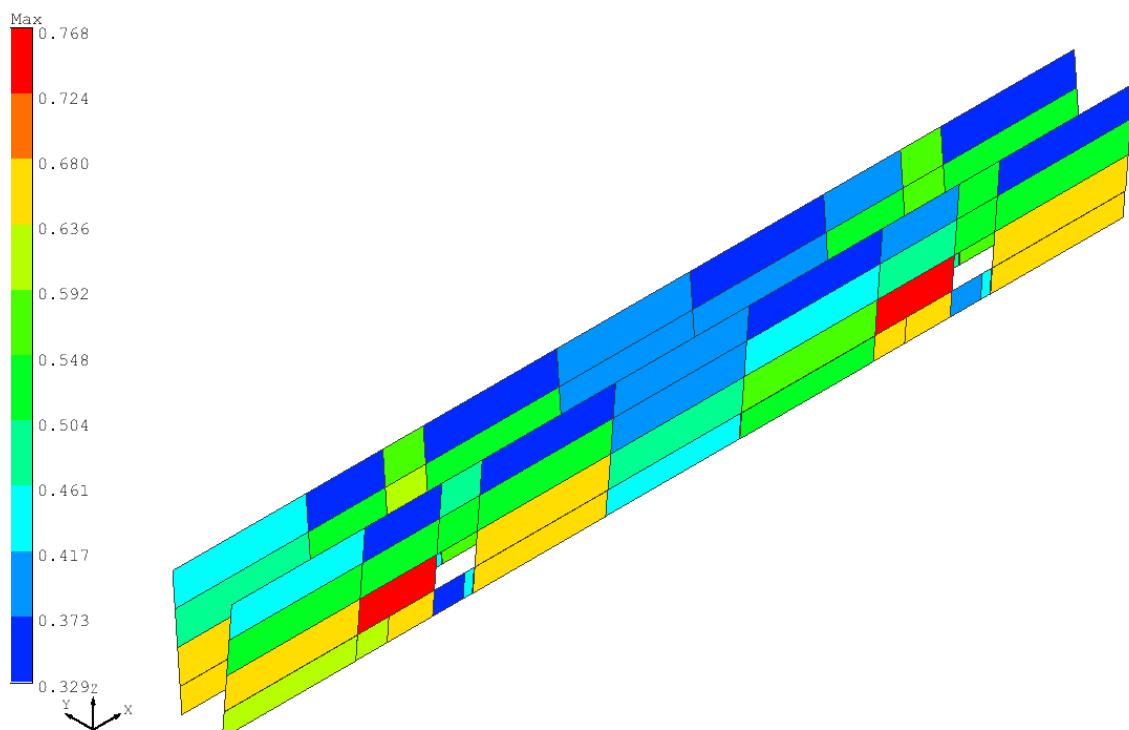


Fig.A3.11.b-F.E. Result of LONG'L UPPER STOOL (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.99, Min:0.51

Fig.A3.11.c-F.E. Result of LONG'L UPPER STOOL (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.77, Min:0.33

Fig.A3.11.d-F.E. Result of LONG'L UPPER STOOL (Buckling, Worst Case S)

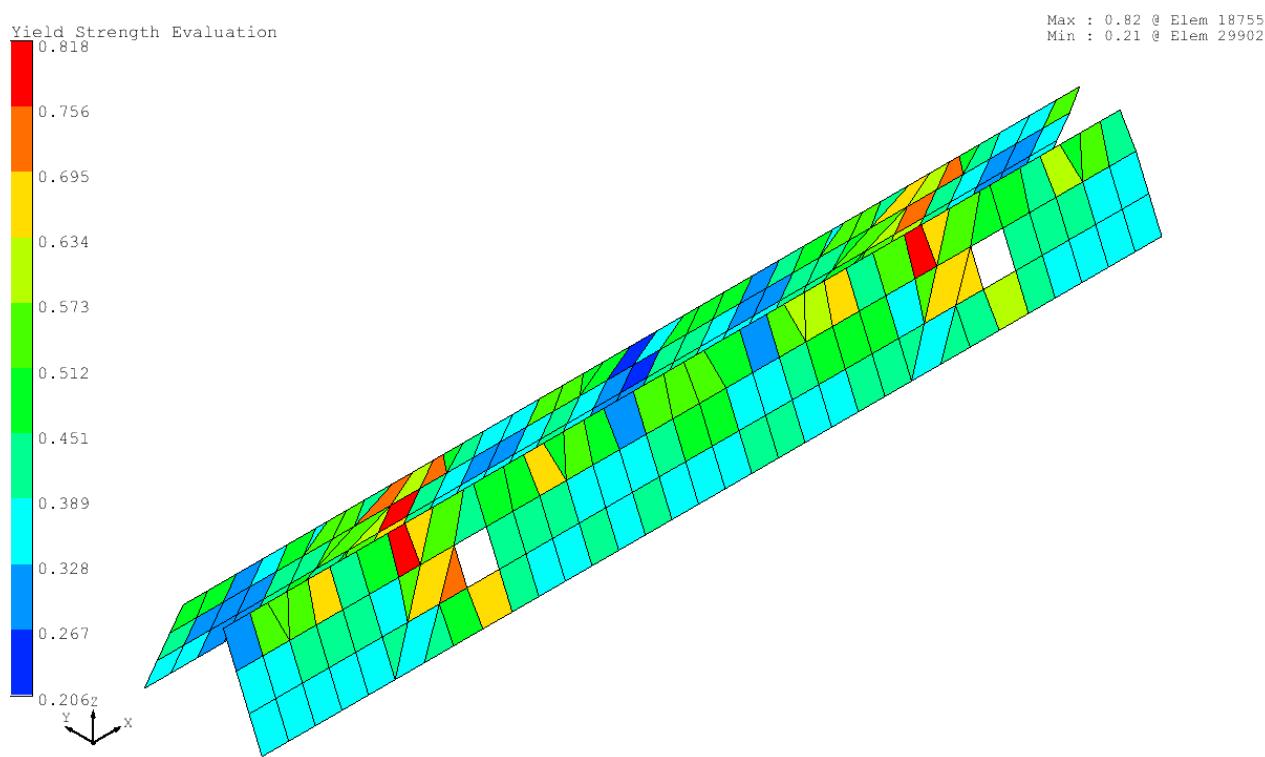
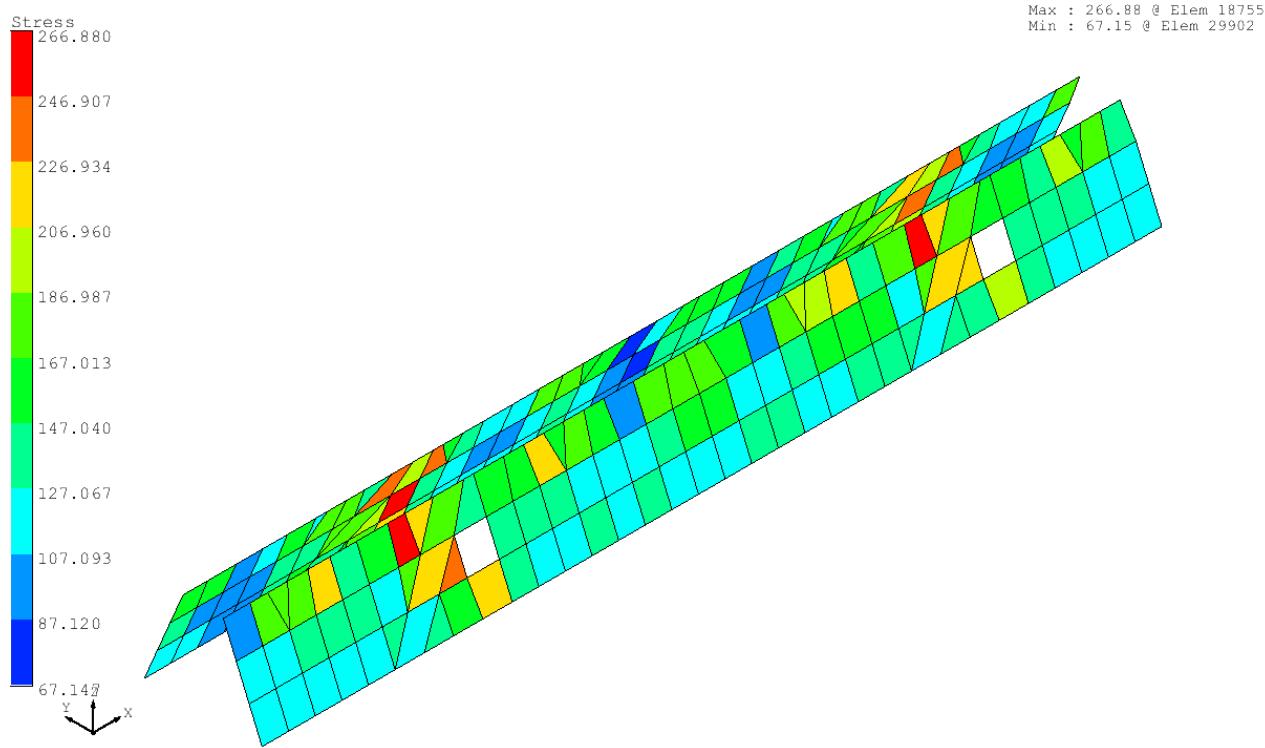


Fig.A3.12.a-F.E. Result of LONG'L LOWER STOOL (Yielding, Sea-going Max.)

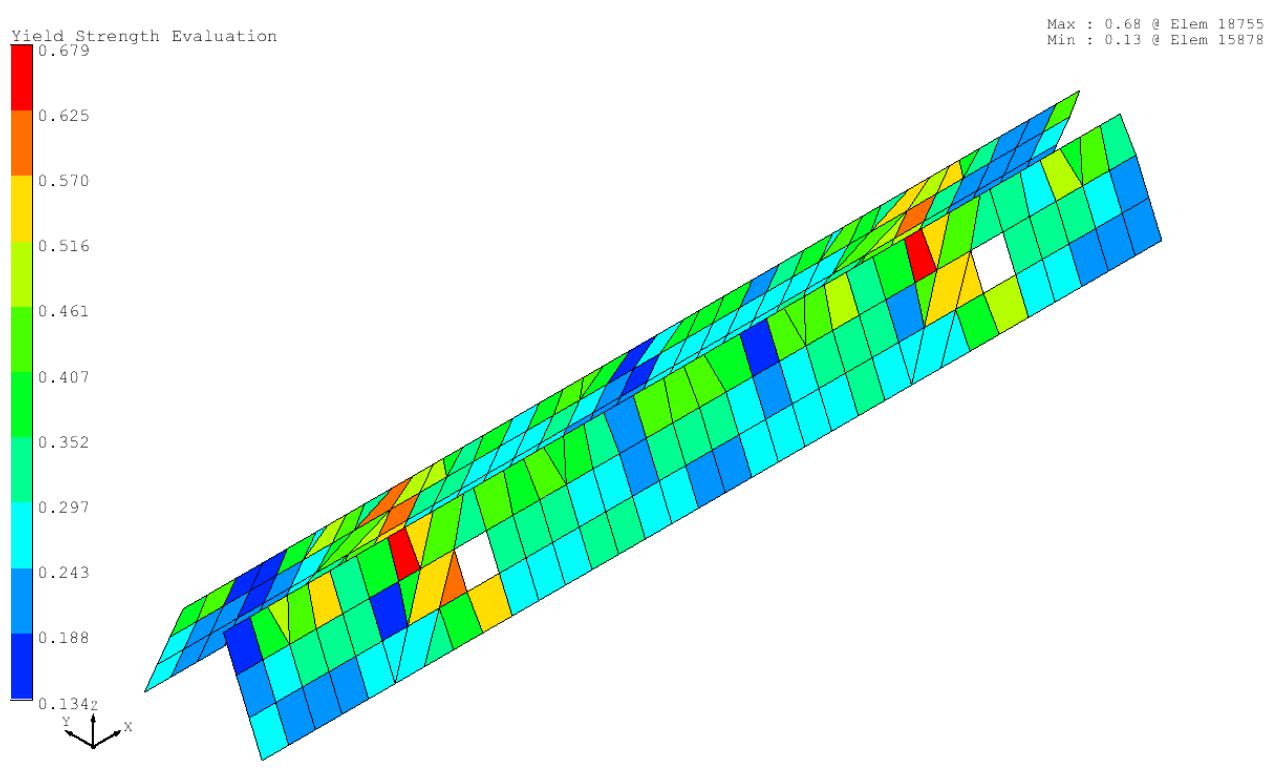
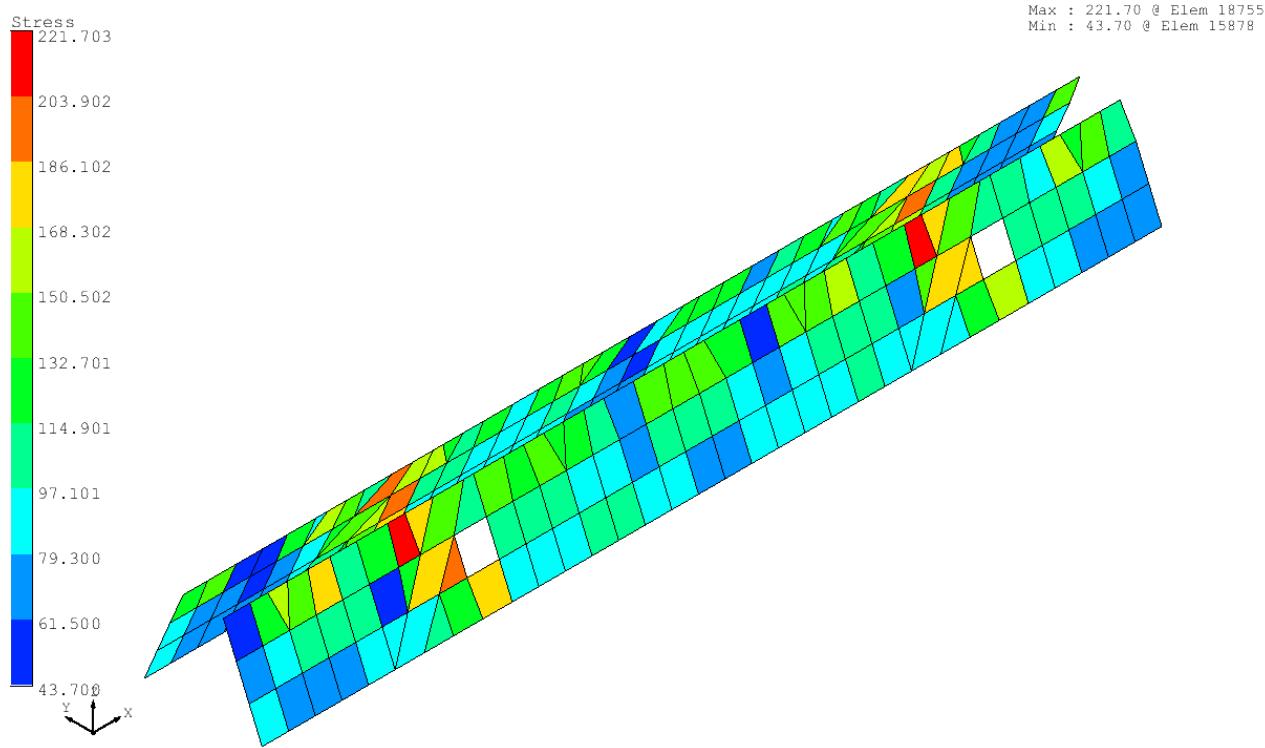
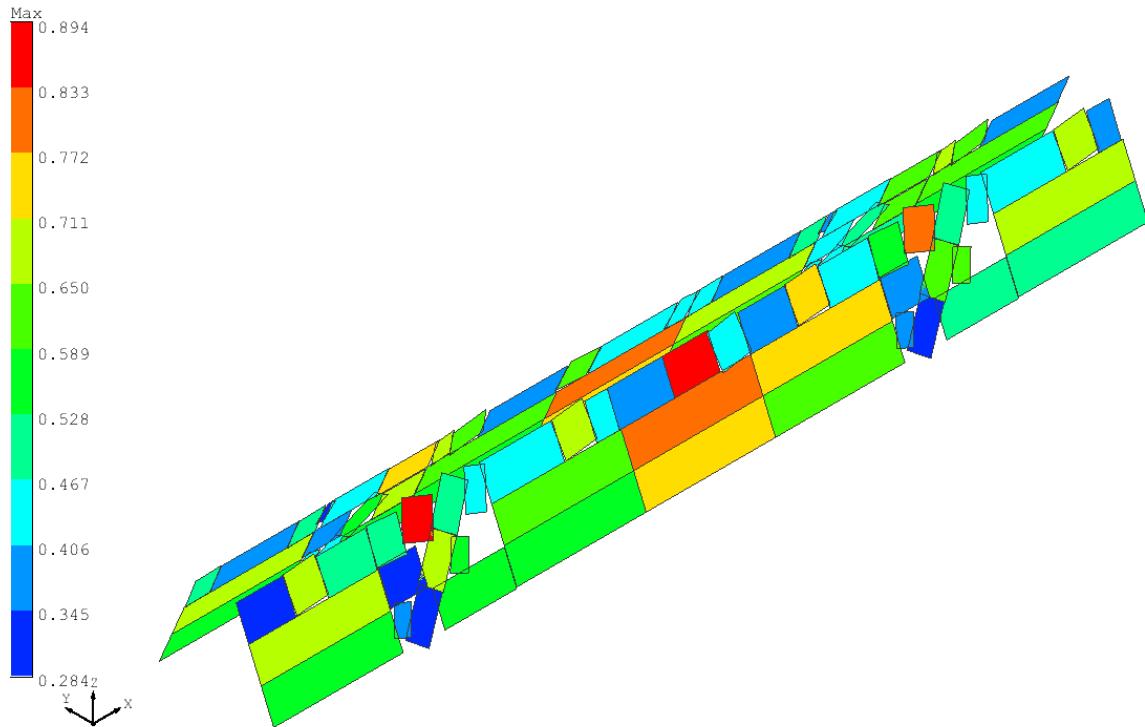
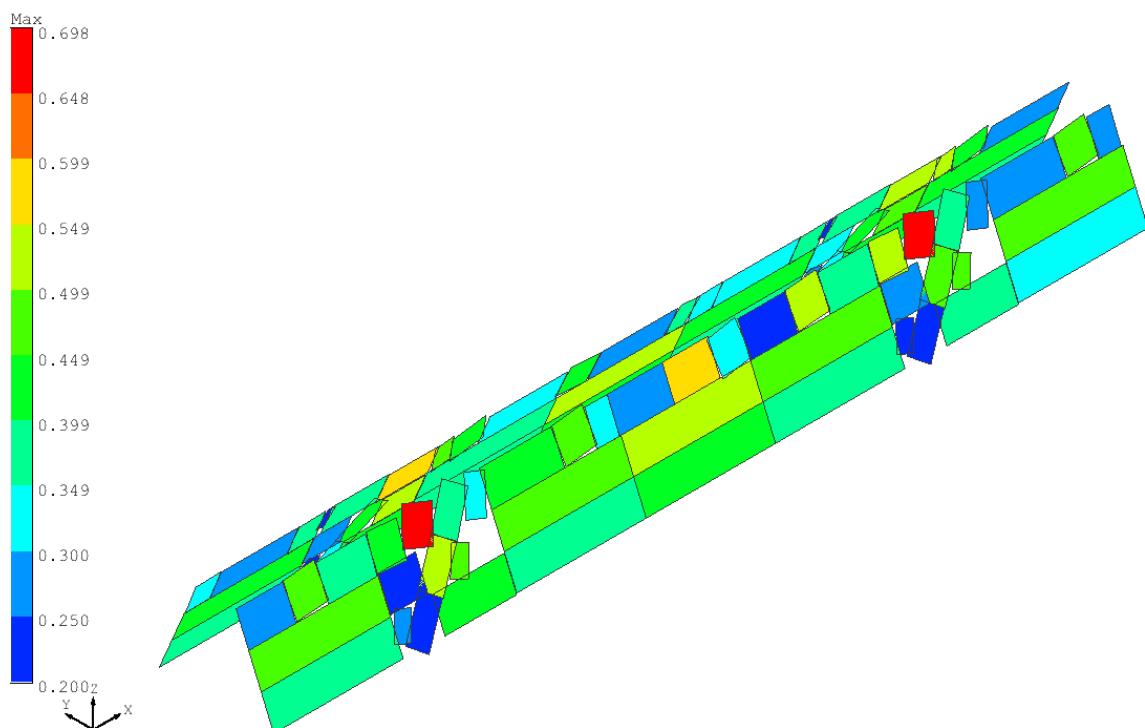


Fig.A3.12.b-F.E. Result of LONG'L LOWER STOOL (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.89, Min:0.28

Fig.A3.12.c-F.E. Result of LONG'L LOWER STOOL (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.70, Min:0.20

Fig.A3.12.d-F.E. Result of LONG'L LOWER STOOL (Buckling, Worst Case S)

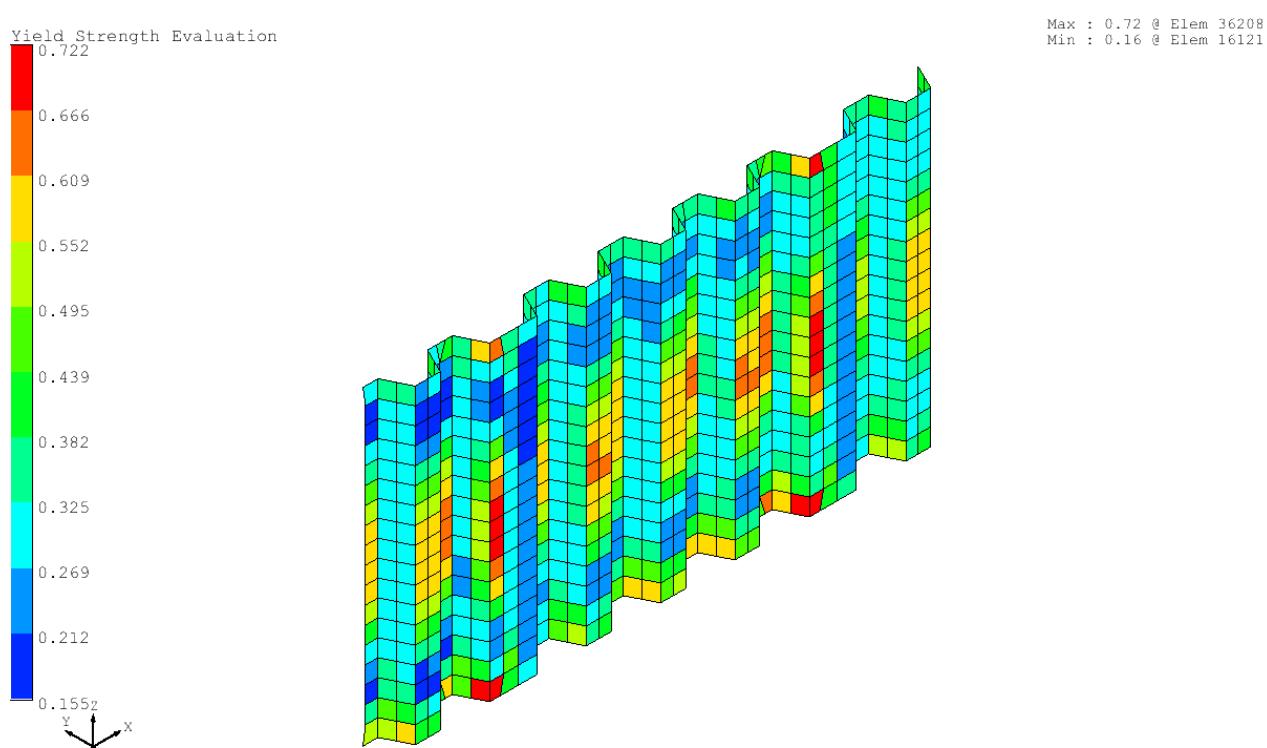
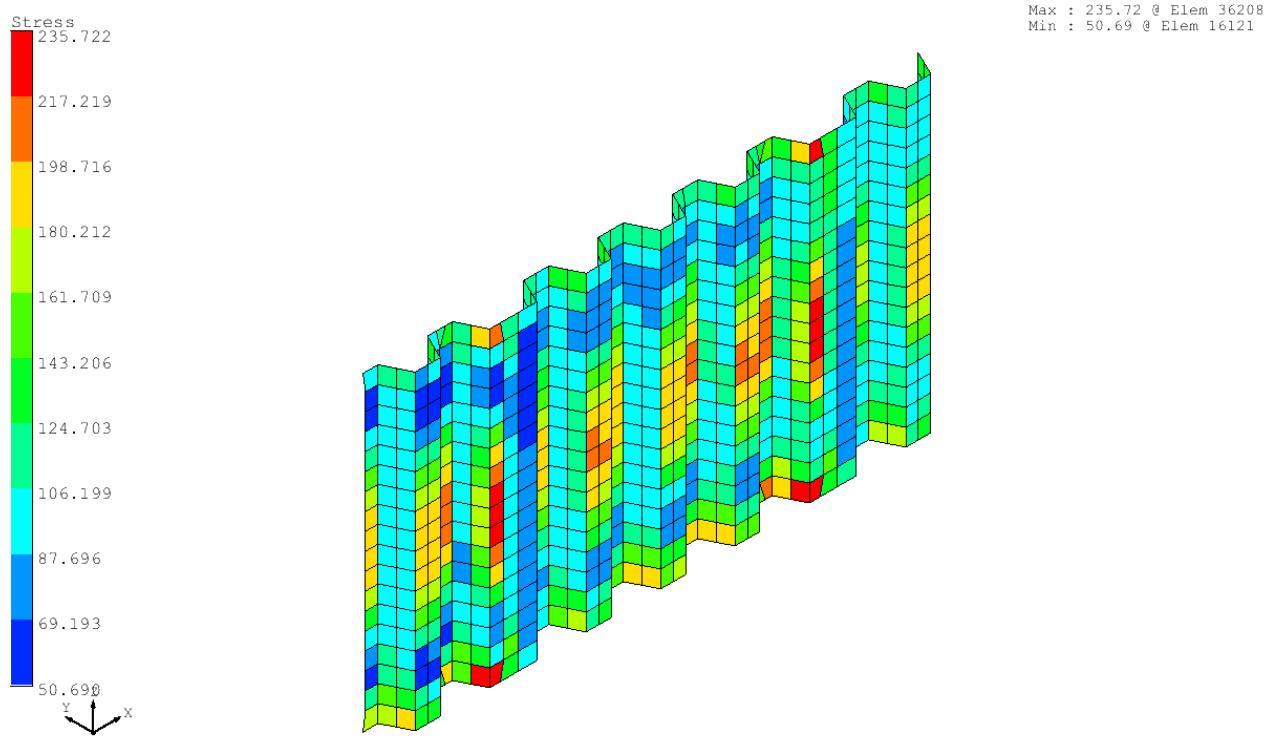


Fig.A3.13.a-F.E. Result of LONG'L CORR. BHD (Yielding, Sea-going Max.)

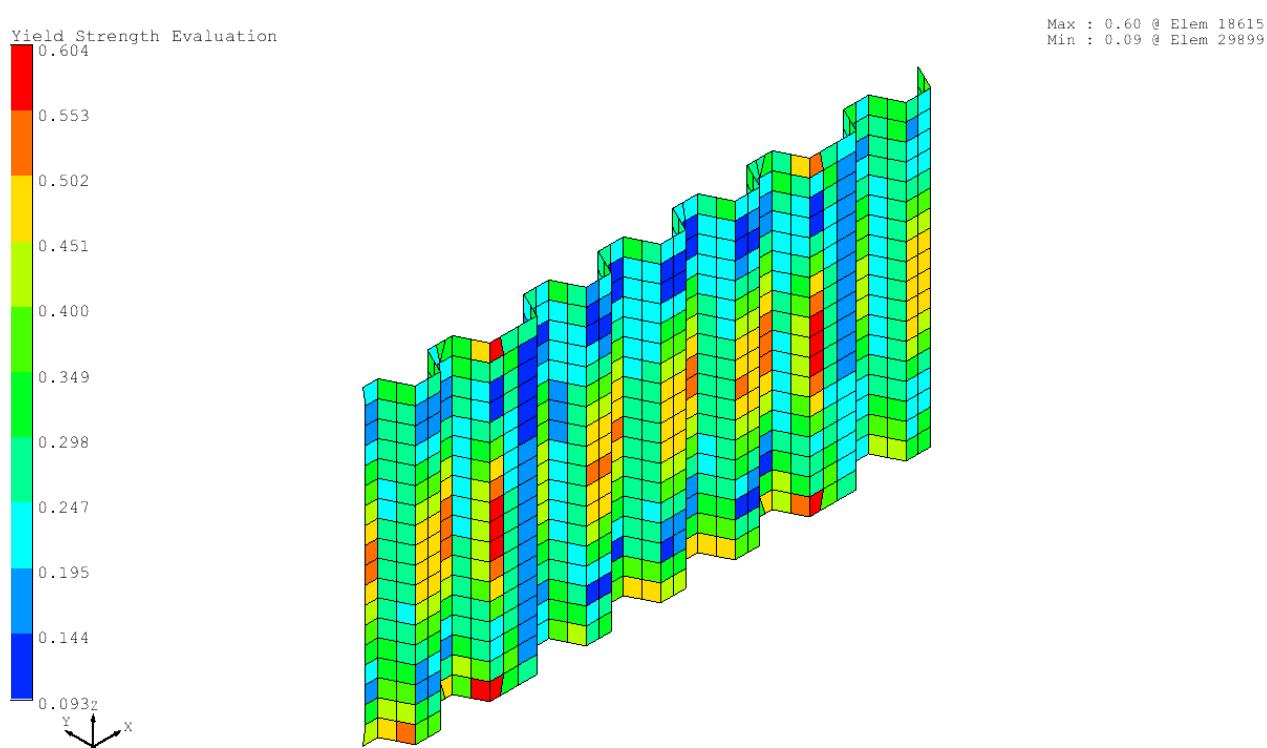
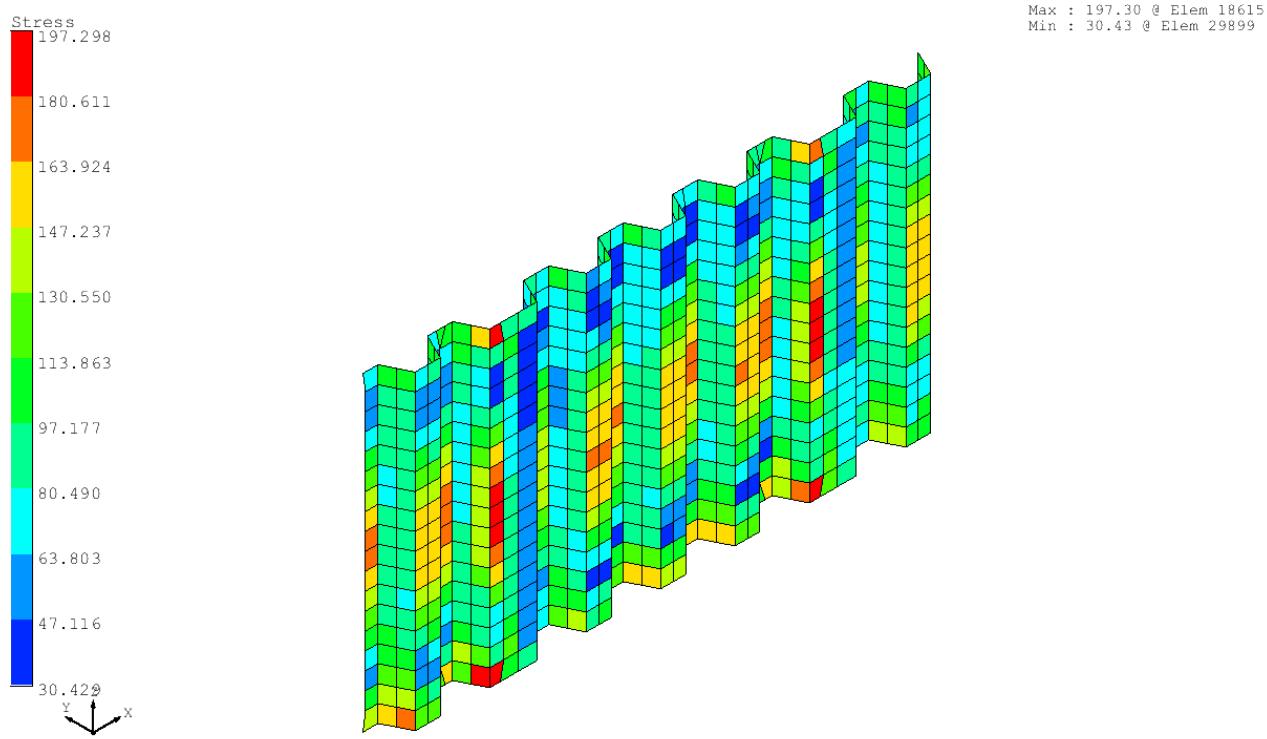
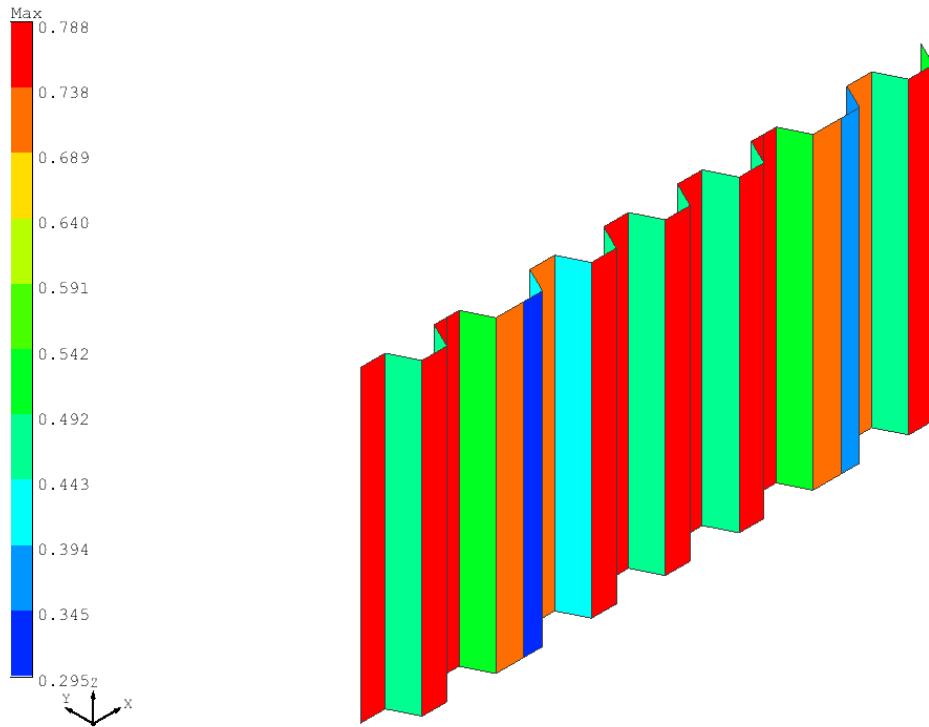
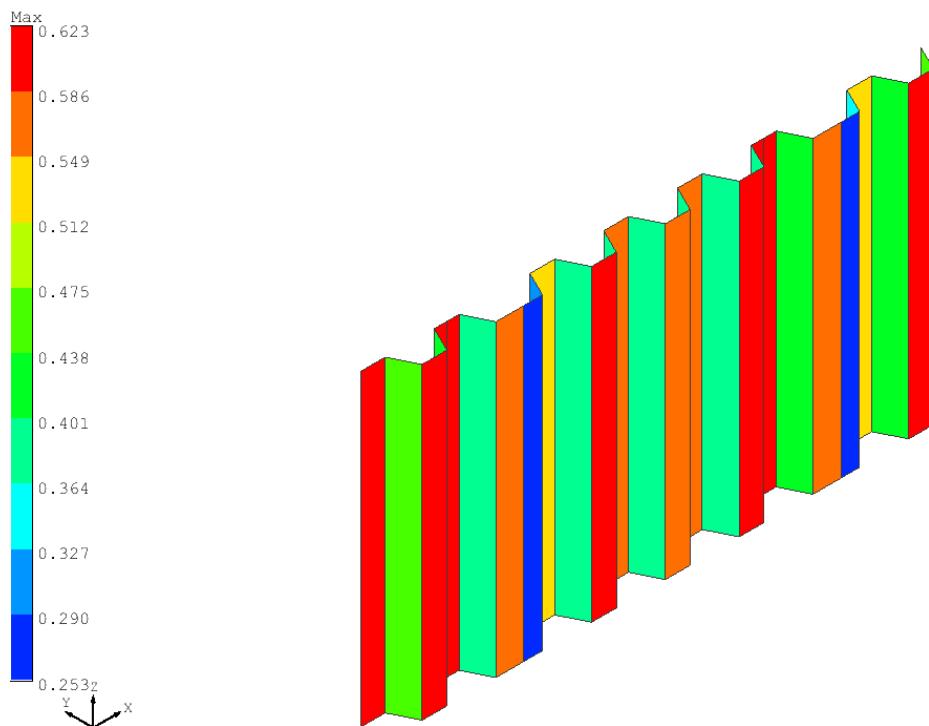


Fig.A3.13.b-F.E. Result of LONG'L CORR. BHD (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.79, Min:0.30

Fig.A3.13.c-F.E. Result of LONG'L CORR. BHD (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.62, Min:0.25

Fig.A3.13.d-F.E. Result of LONG'L CORR. BHD (Buckling, Worst Case S)

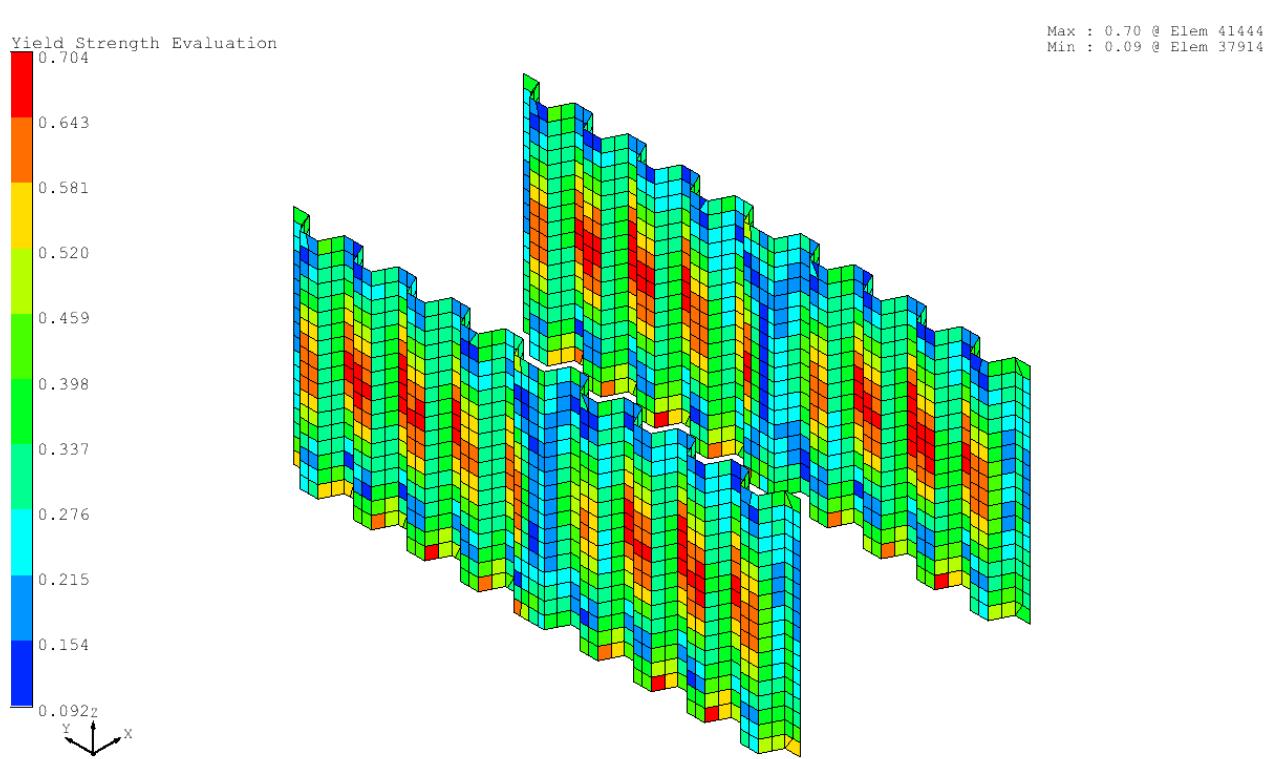
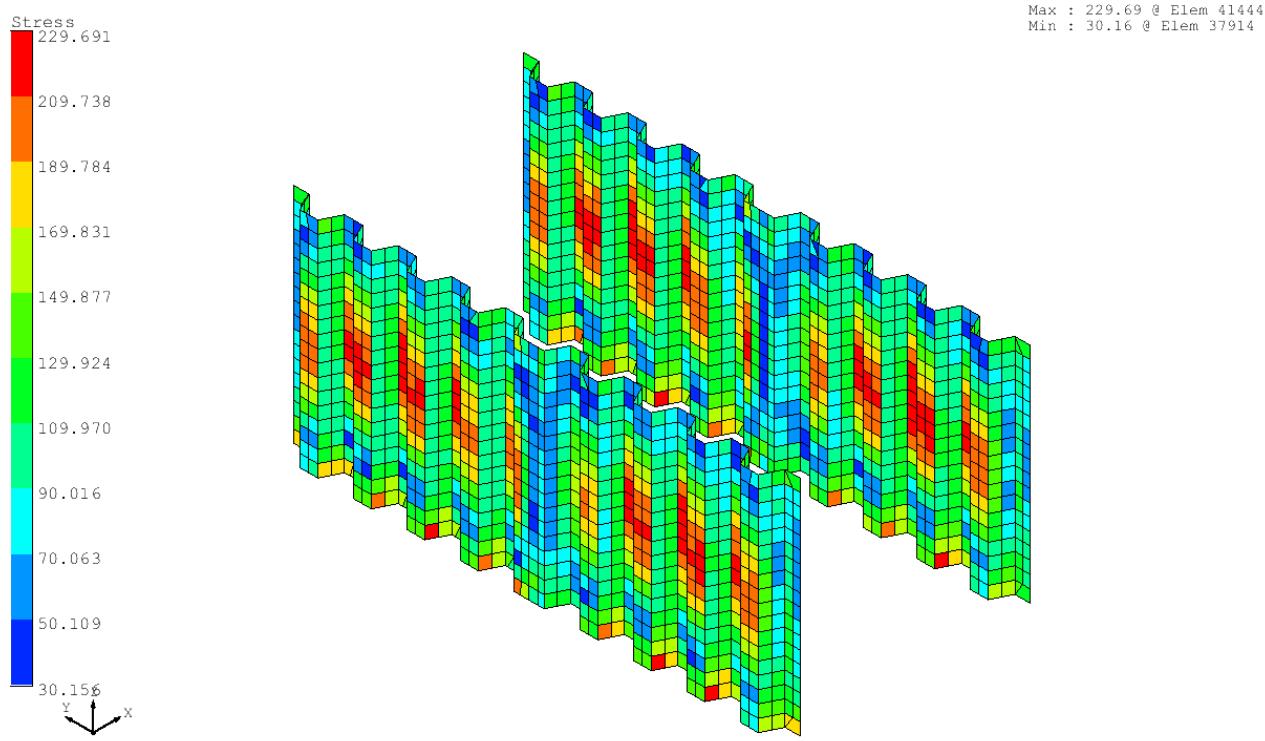


Fig.A3.14.a-F.E. Result of TRANS. CORR. BHD (Yielding, Sea-going Max.)

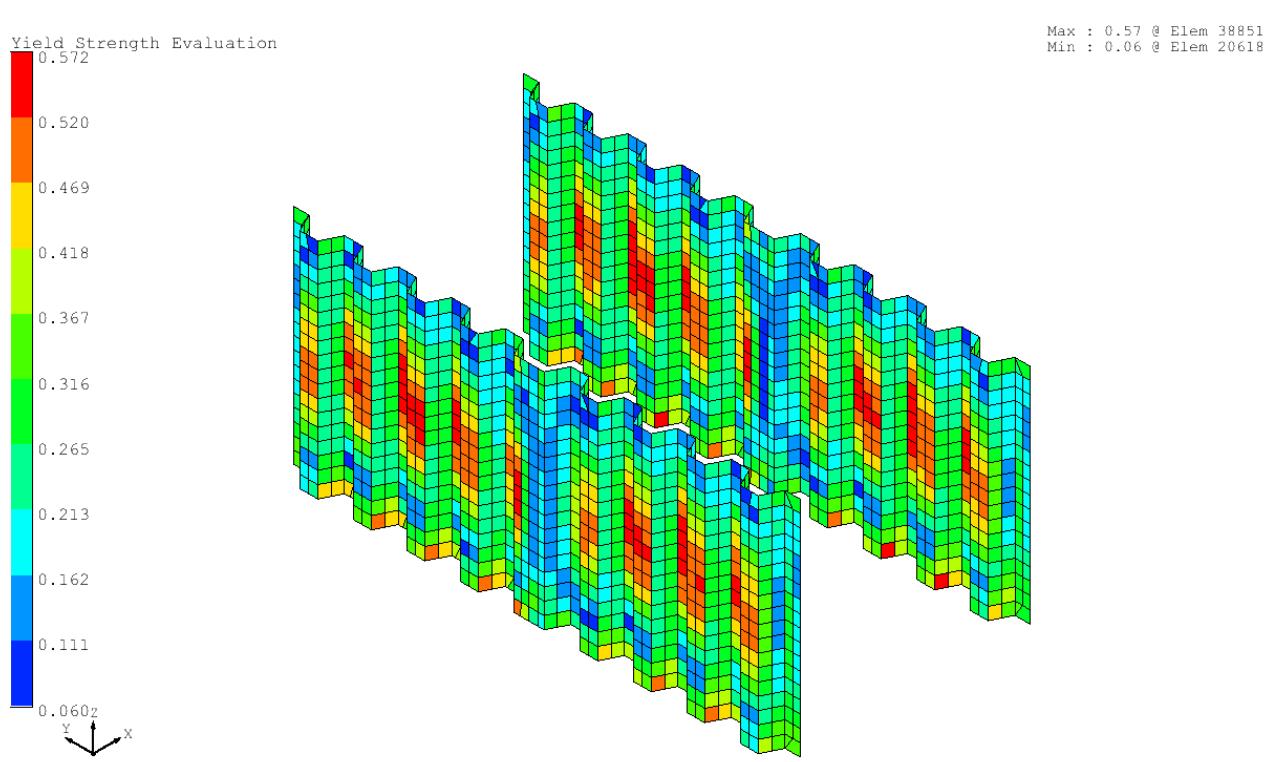
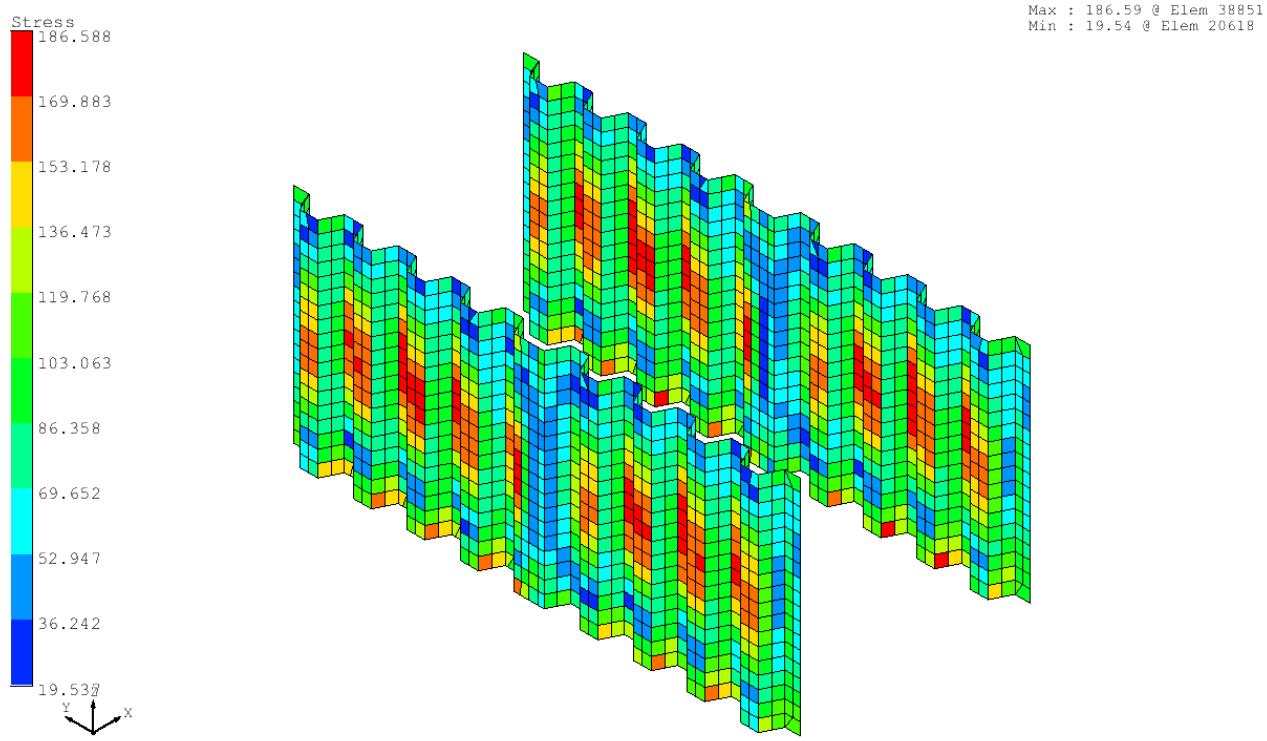
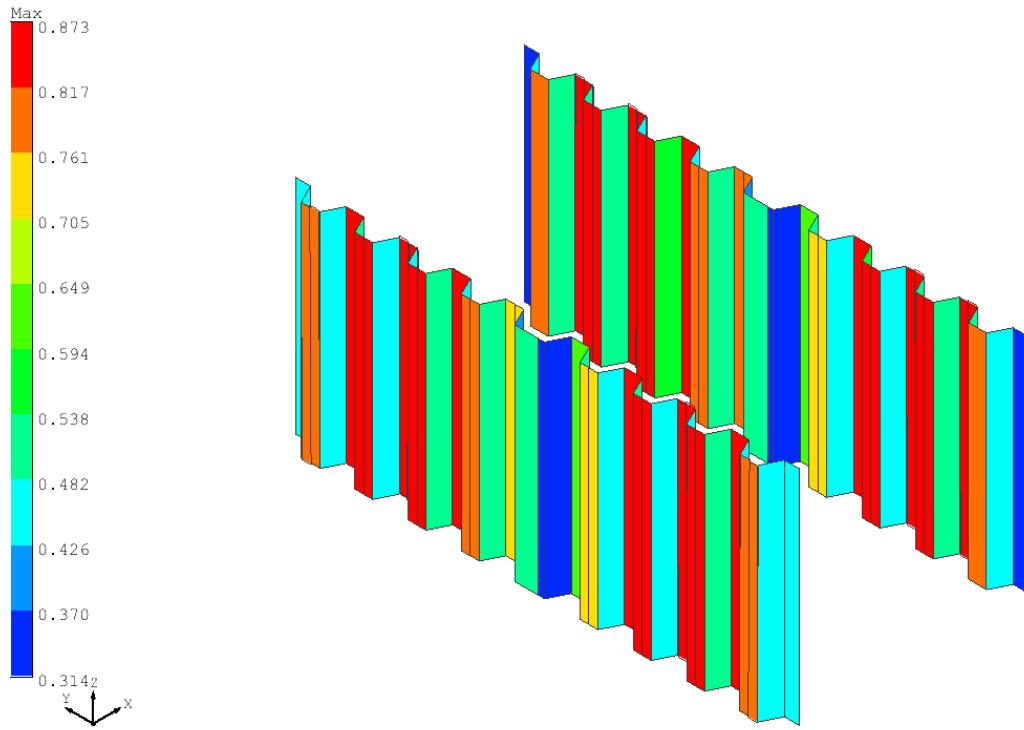
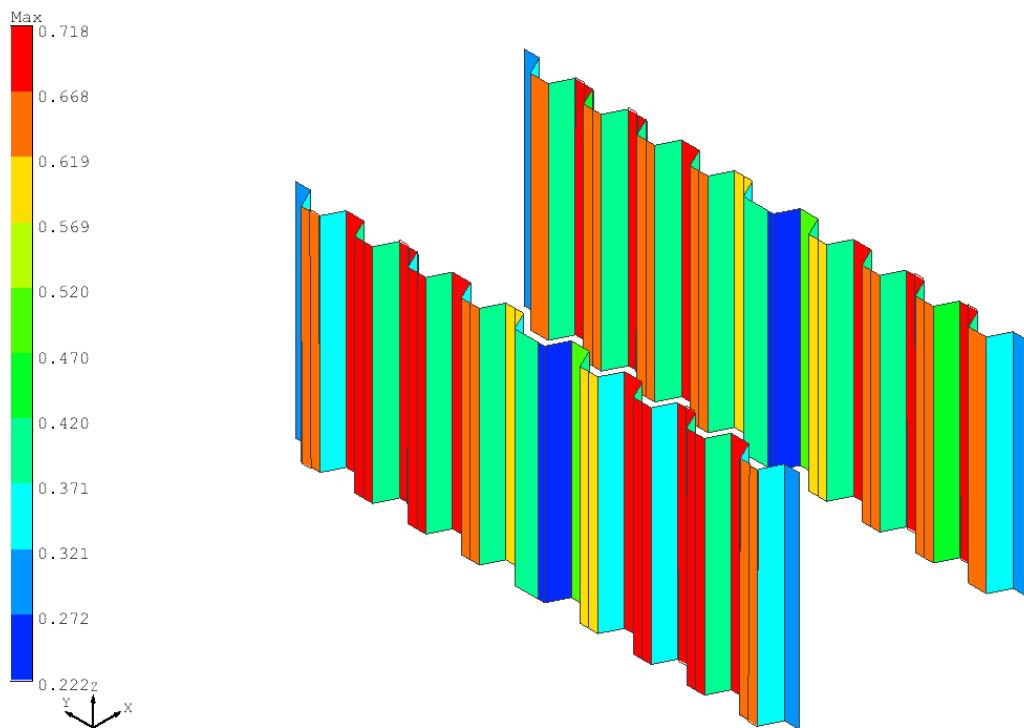


Fig.A3.14.b-F.E. Result of TRANS. CORR. BHD (Yielding, Harbour Max.)



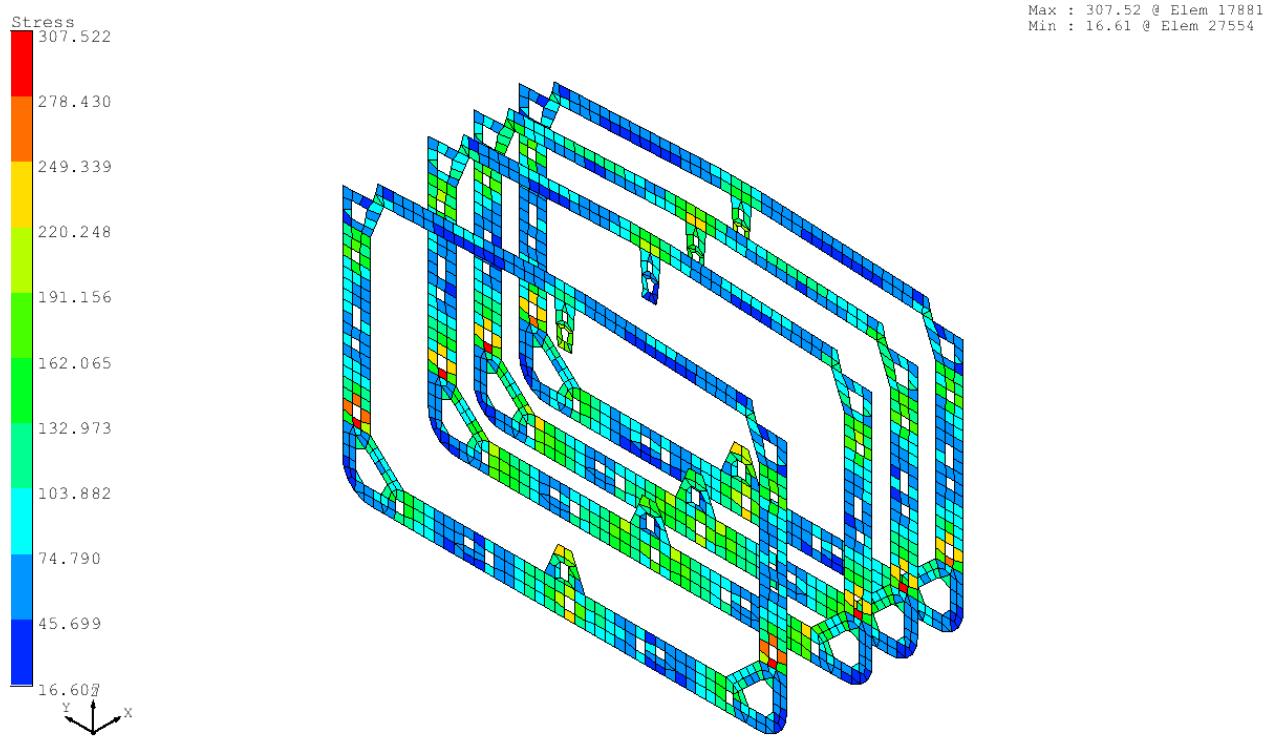
Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.87, Min:0.31

Fig.A3.14.c-F.E. Result of TRANS. CORR. BHD (Buckling, Worst Case S+D)

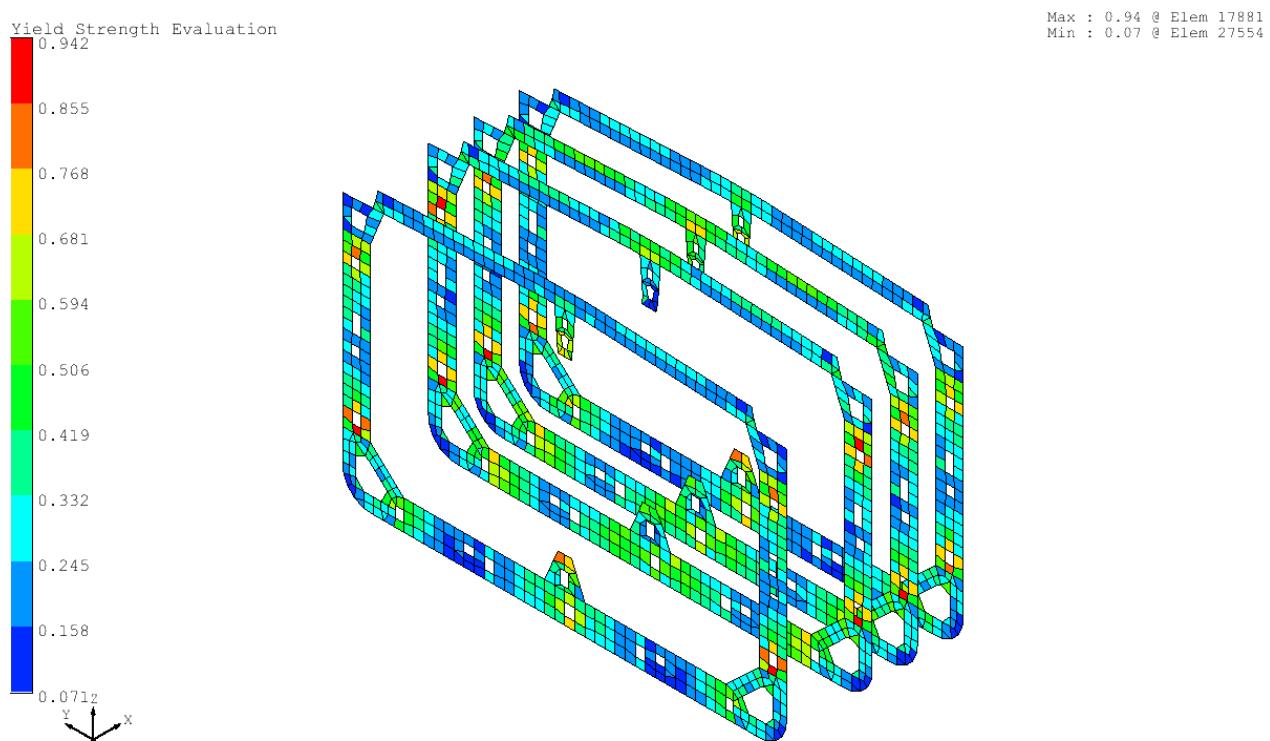


Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.72, Min:0.22

Fig.A3.14.d-F.E. Result of TRANS. CORR. BHD (Buckling, Worst Case S)



Fringe : Element Stress (Von Mises), 15_TYP.WEB, MAX.SEAGOING



Fringe : Yield Strength Evaluation ,15_TYP.WEB, MAX.SEAGOING

Fig.A3.15.a-F.E. Result of TYP. WEB FRAME (Yielding, Sea-going Max.)

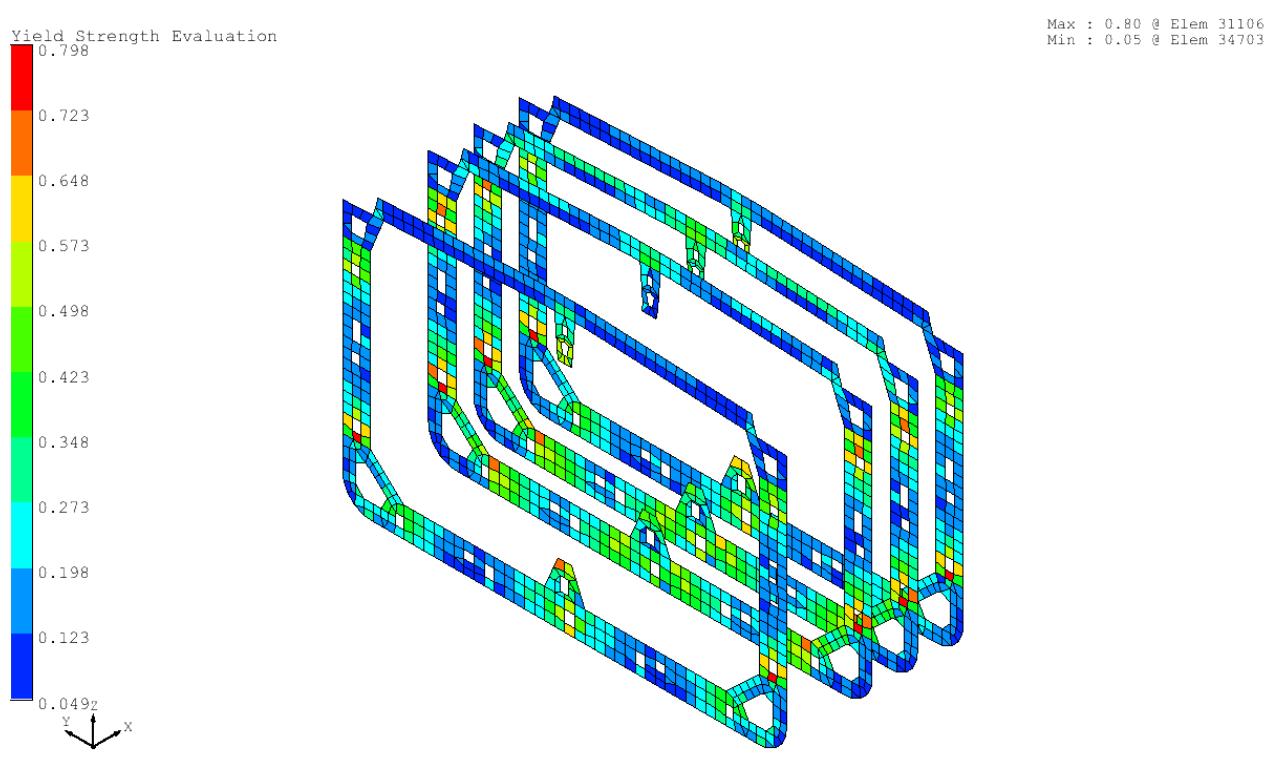
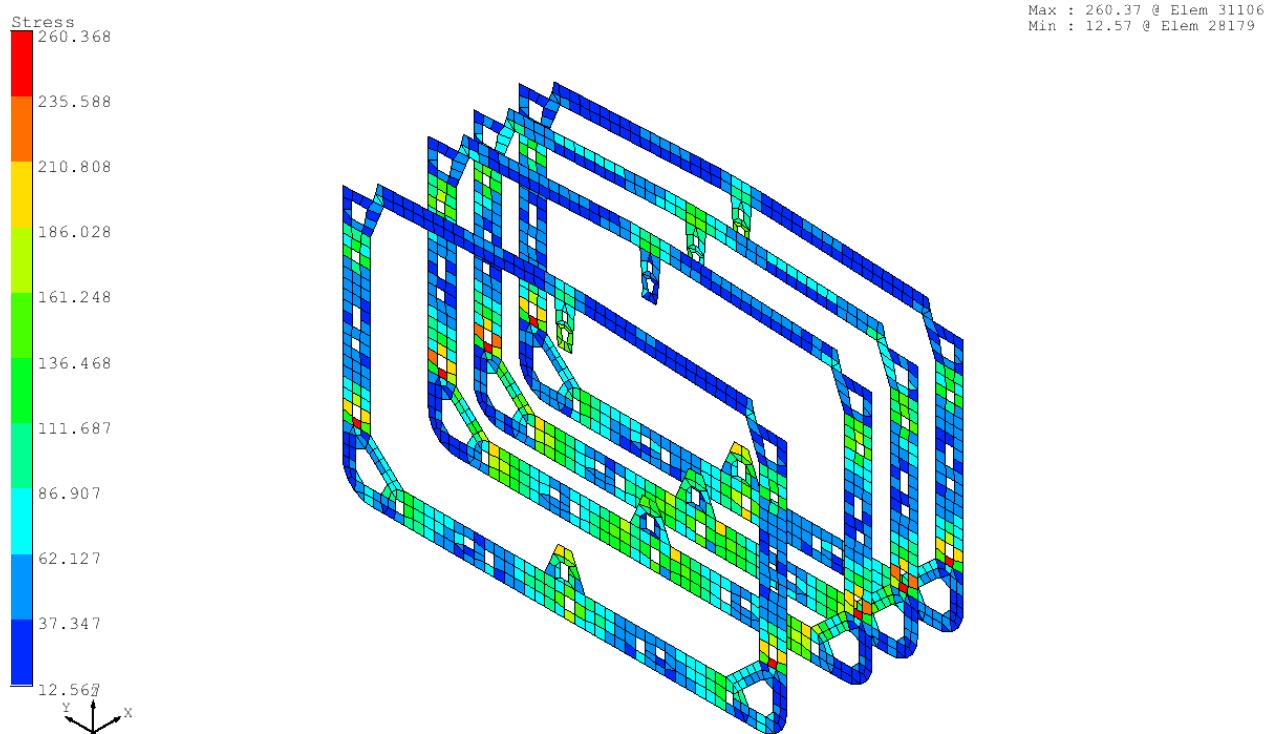
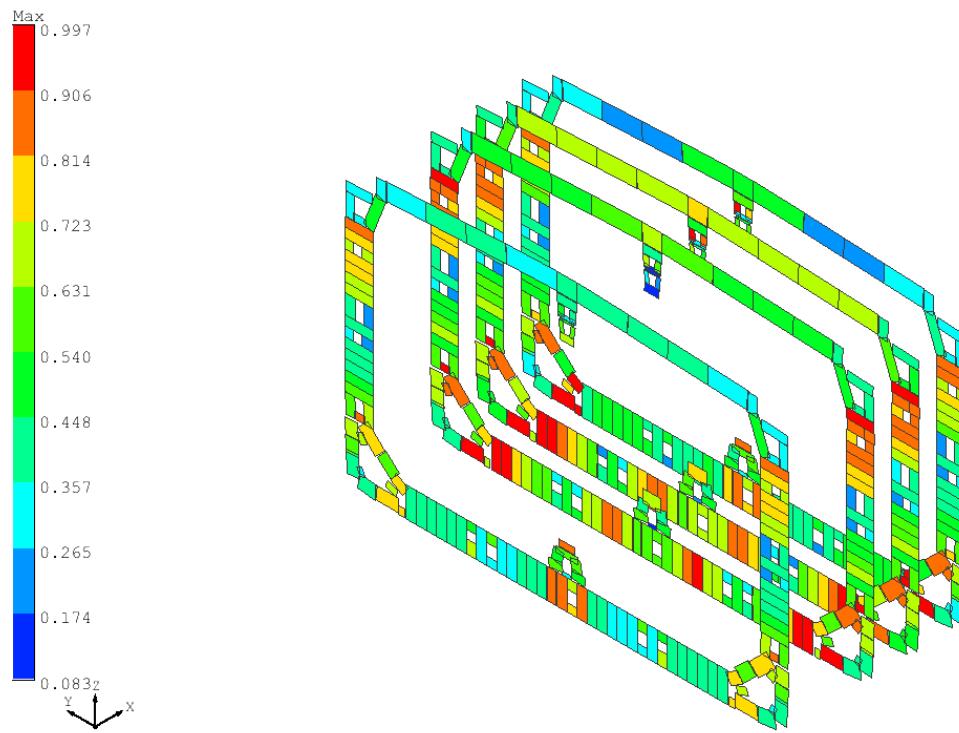
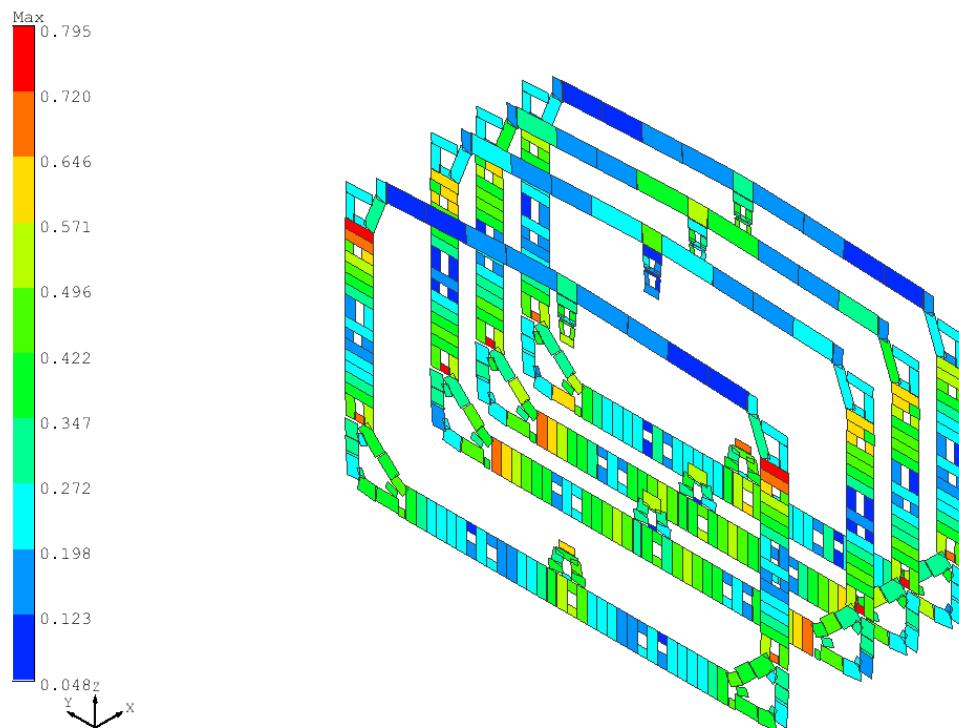


Fig.A3.15.b-F.E. Result of TYP. WEB FRAME (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:1.00, Min:0.08

Fig.A3.15.c-F.E. Result of TYP. WEB FRAME (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.80, Min:0.05

Fig.A3.15.d-F.E. Result of TYP. WEB FRAME (Buckling, Worst Case S)

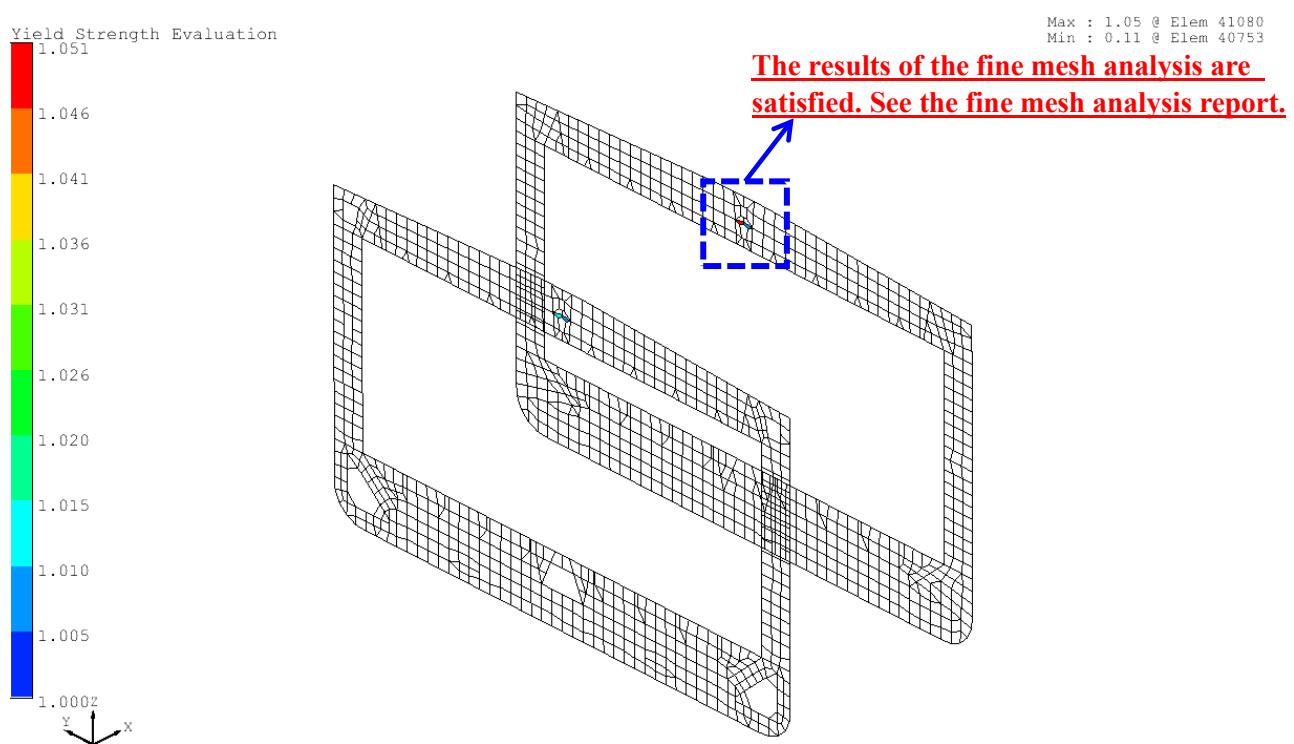
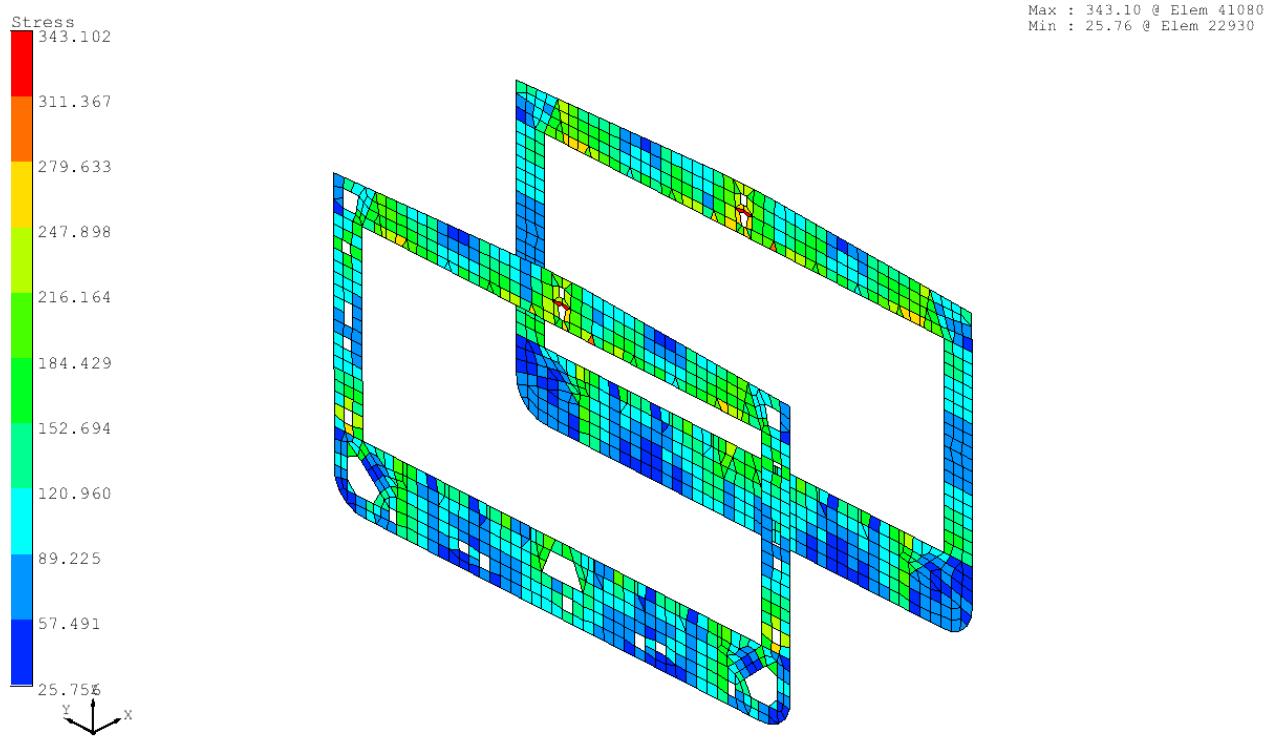
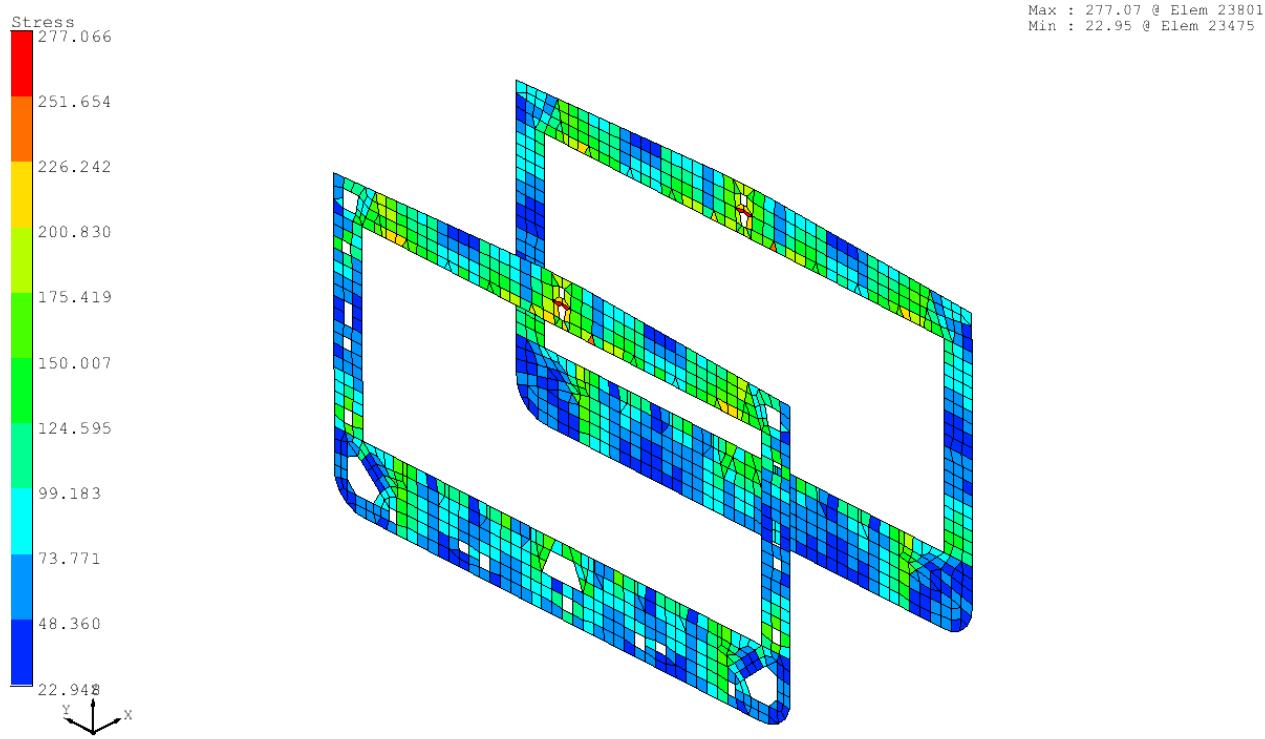
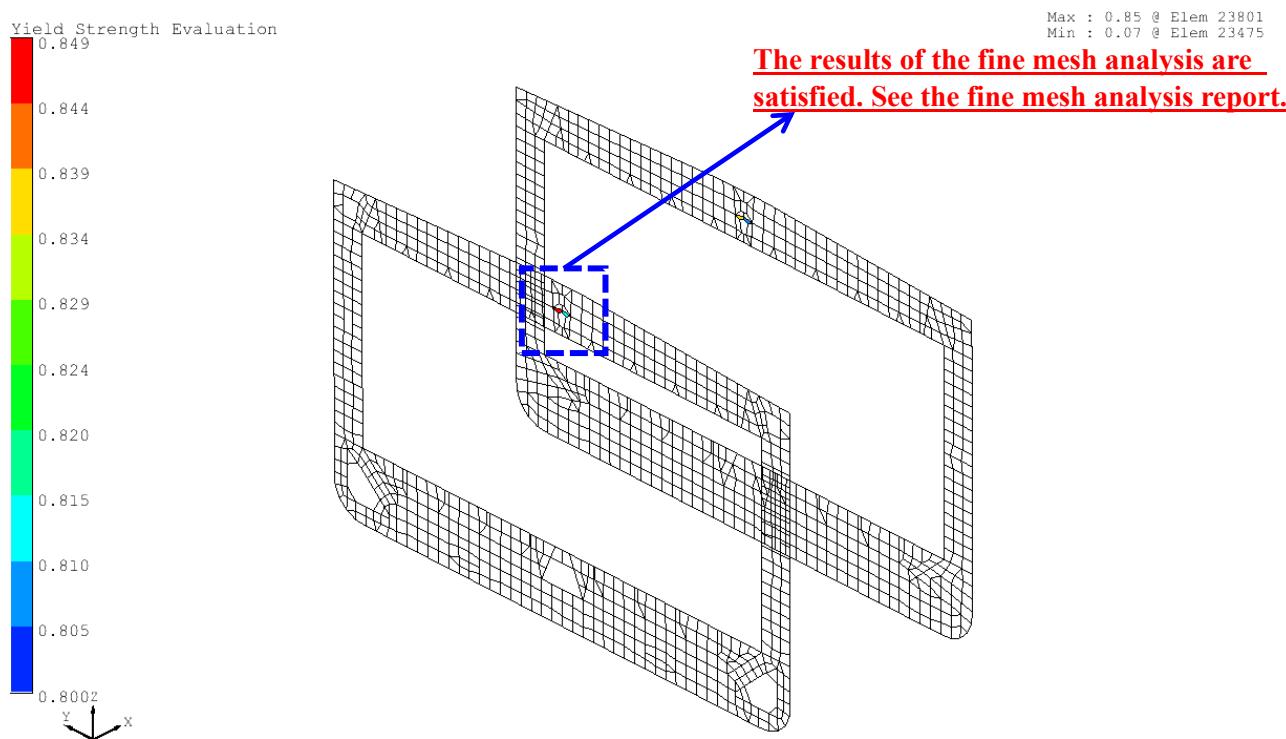


Fig.A3.16.a-F.E. Result of TRANS. BULKHEAD (Yielding, Sea-going Max.)

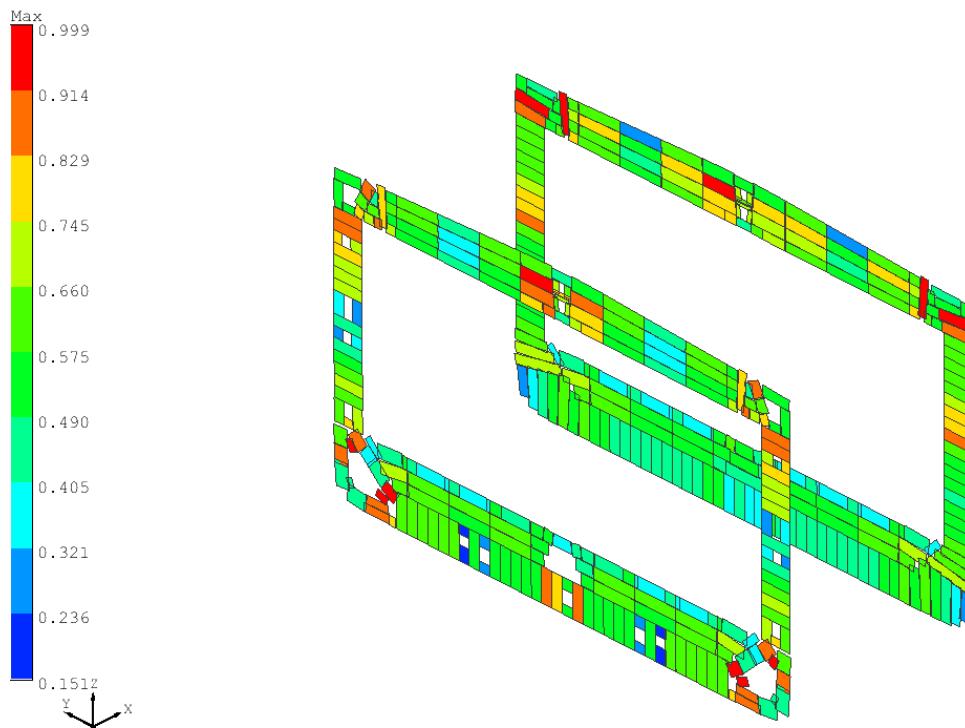


Fringe : Element Stress (Von Mises), 16_TRANS.BHD, MAX.HARBOUR



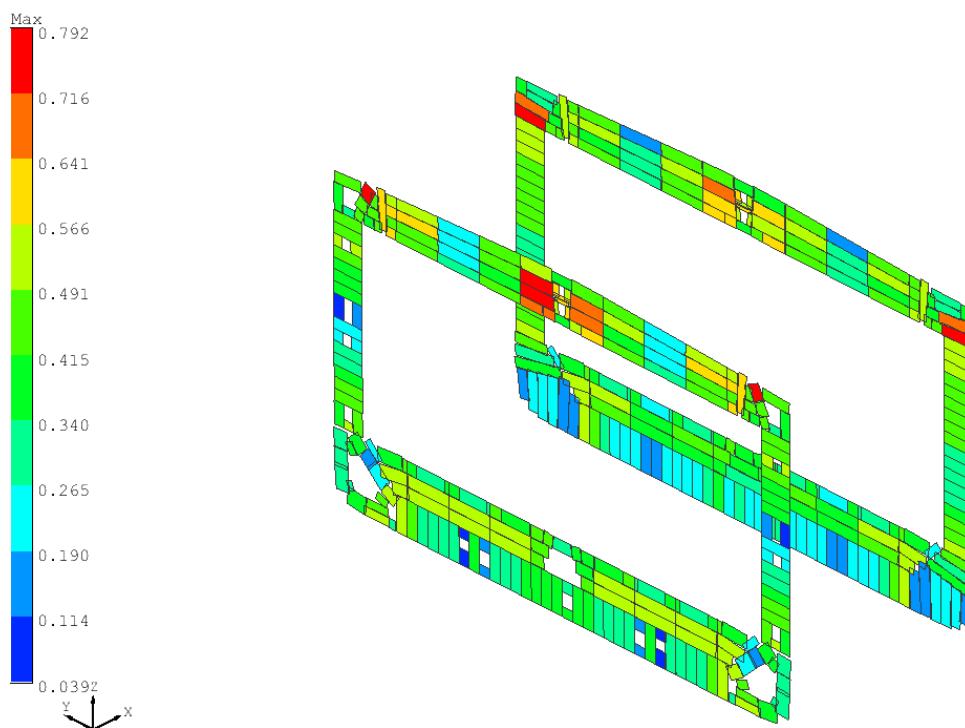
Fringe : Yield Strength Evaluation ,16_TRANS.BHD, MAX.HARBOUR

Fig.A3.16.b-F.E. Result of TRANS. BULKHEAD (Yielding, Harbour Max.)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:1.00, Min:0.15

Fig.A3.16.c-F.E. Result of TRANS. BULKHEAD (Buckling, Worst Case S+D)



Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.79, Min:0.04

Fig.A3.16.d-F.E. Result of TRANS. BULKHEAD (Buckling, Worst Case S)

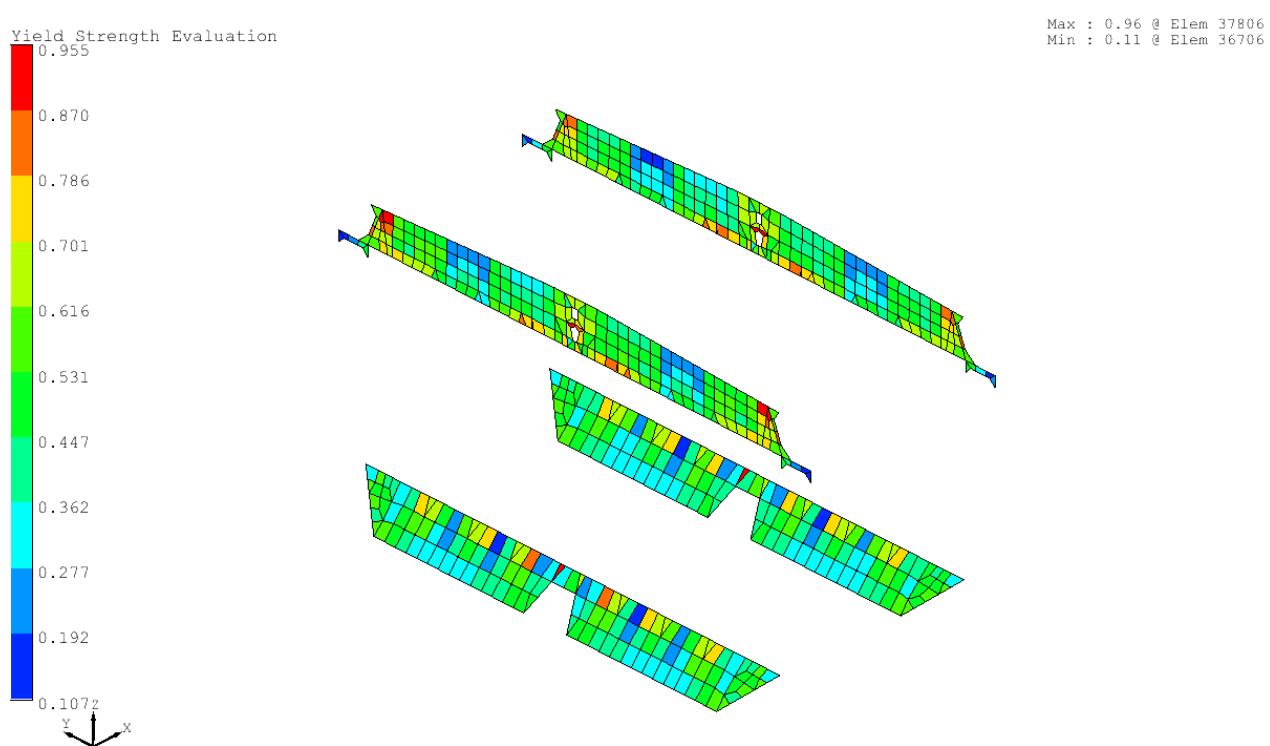
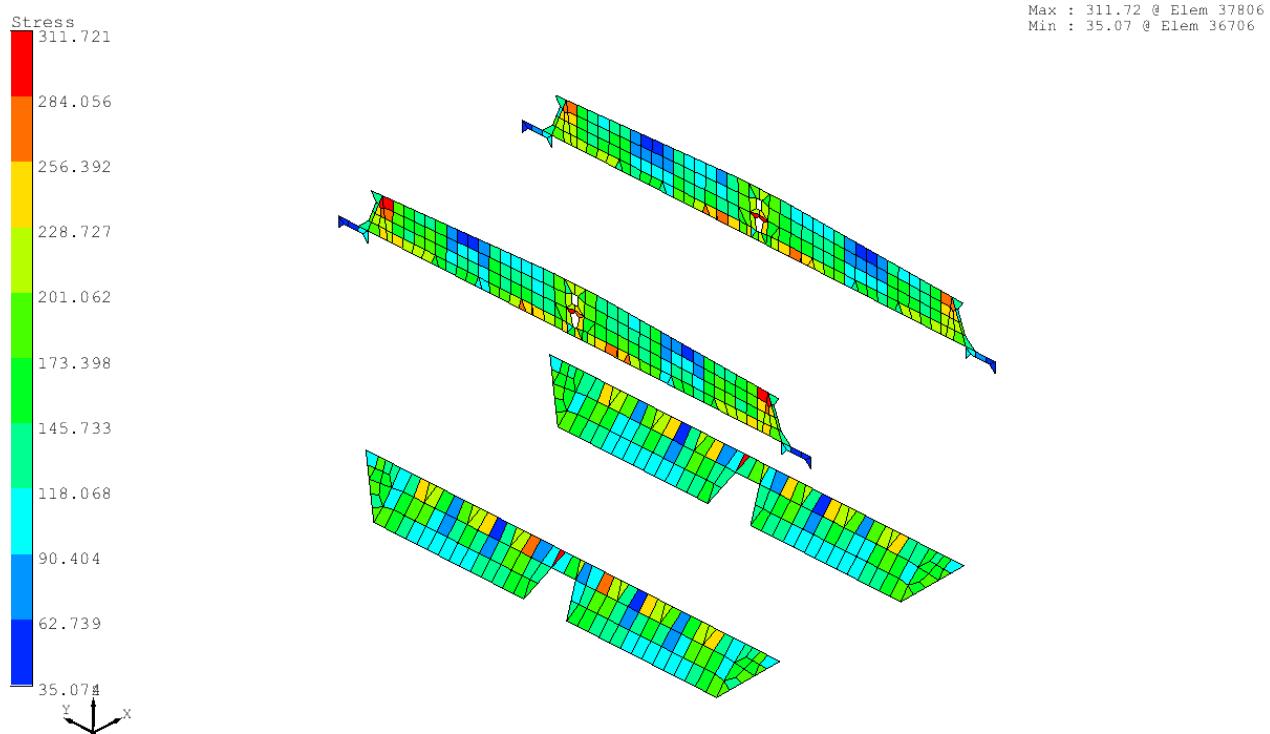


Fig.A3.17.a-F.E. Result of TRANS. BHD-1000SEC. (Yielding, Sea-going Max.)

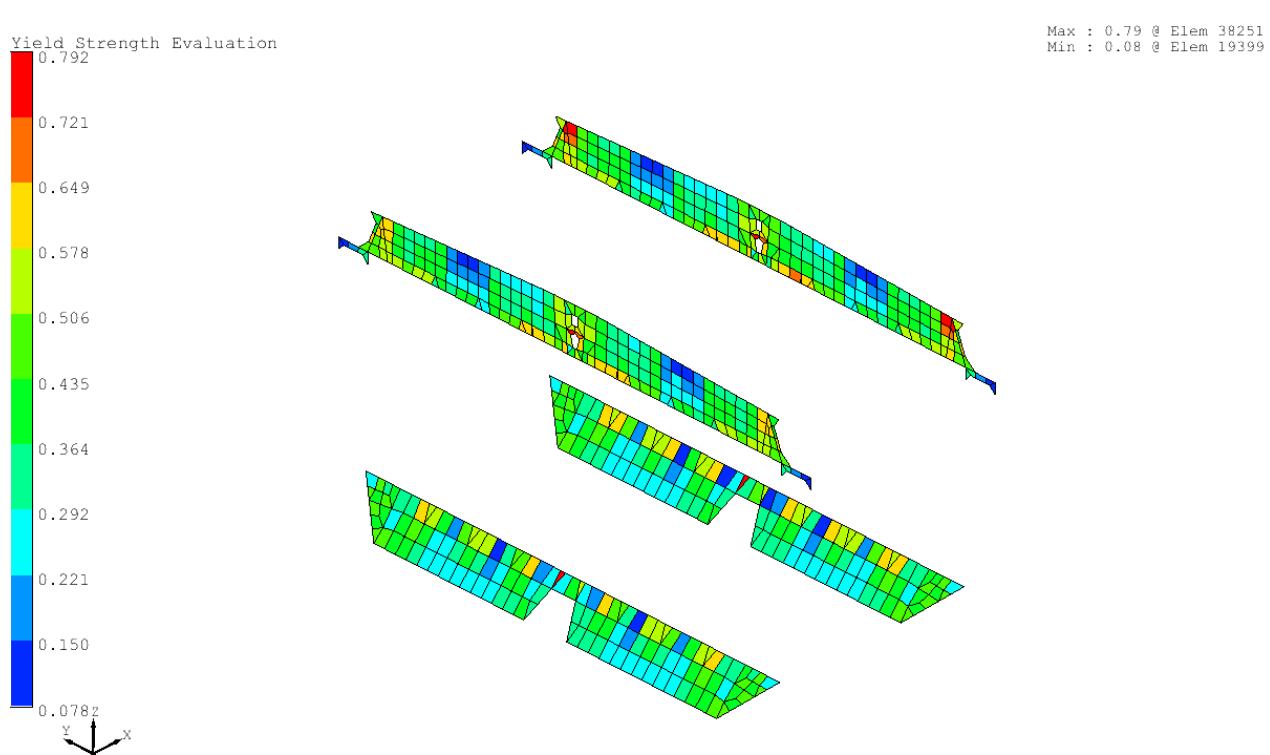
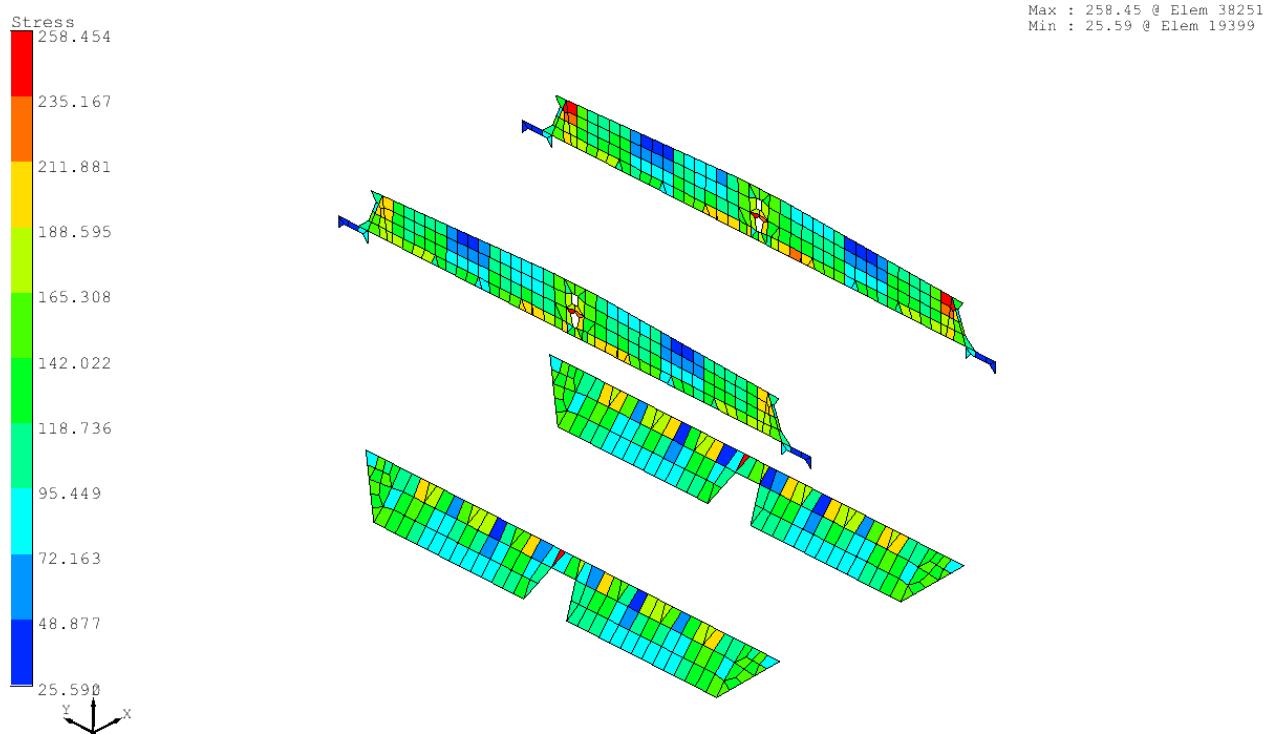
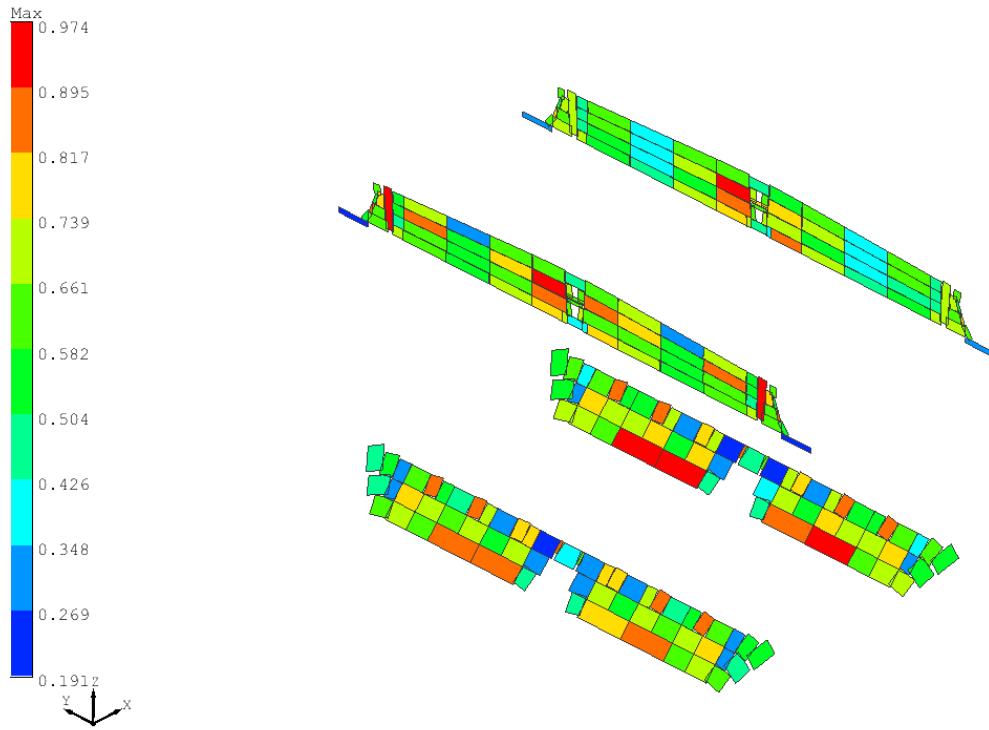
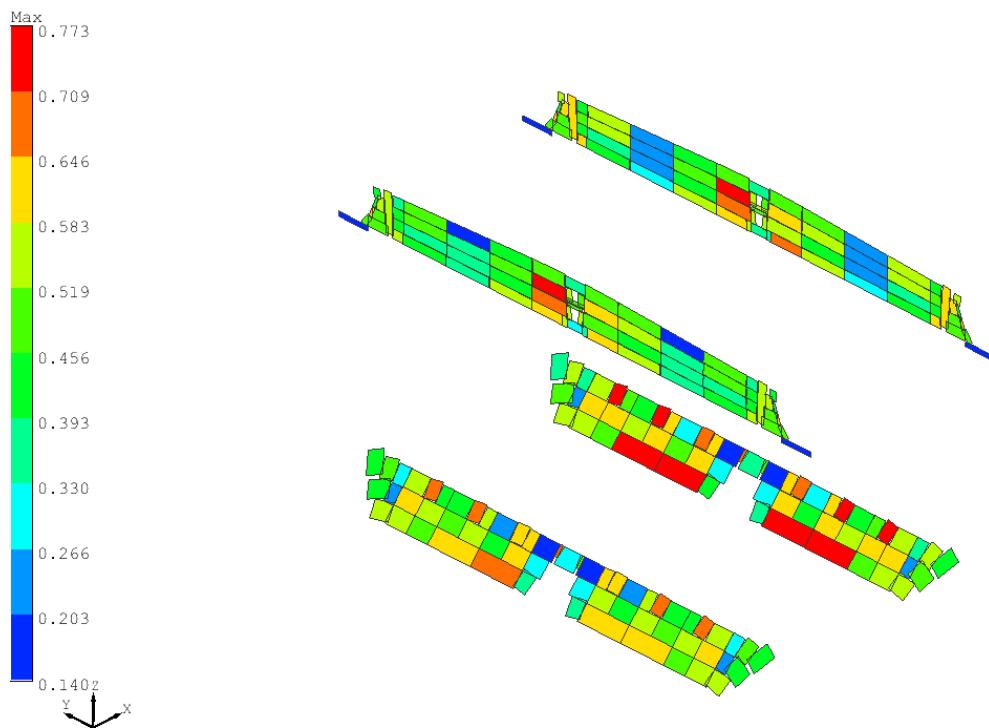


Fig.A3.17.b-F.E. Result of TRANS. BHD-1000SEC. (Yielding, Harbour Max.)



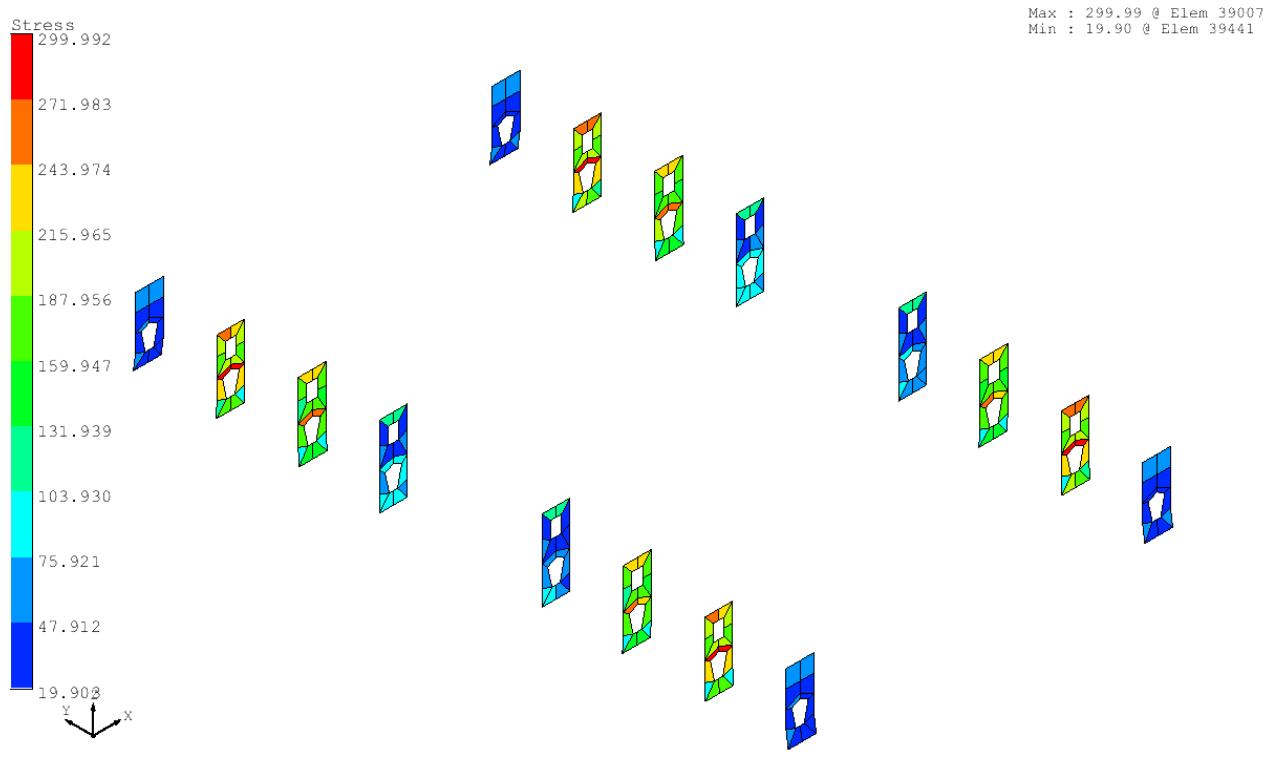
Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.97, Min:0.19

Fig.A3.17.c-F.E. Result of TRANS. BHD-1000SEC. (Buckling, Worst Case S+D)

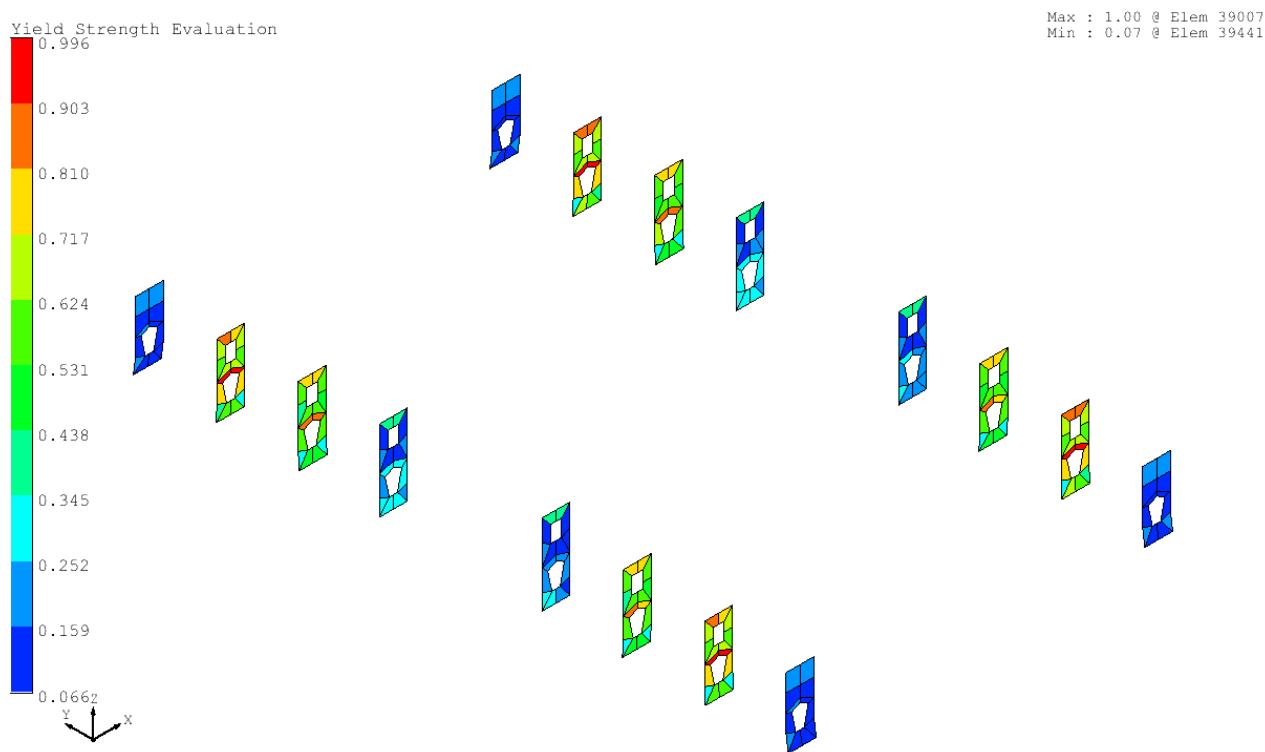


Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.77, Min:0.14

Fig.A3.17.d-F.E. Result of TRANS. BHD-1000SEC. (Buckling, Worst Case S)



Fringe : Element Stress (Von Mises), 18_UPPER STOOL DIAPH., MAX.SEAGOING



Fringe : Yield Strength Evaluation ,18_UPPER STOOL DIAPH., MAX.SEAGOING

Fig.A3.18.a-F.E. Result of UPPER STOOL DIAPH. (Yielding, Sea-going Max.)

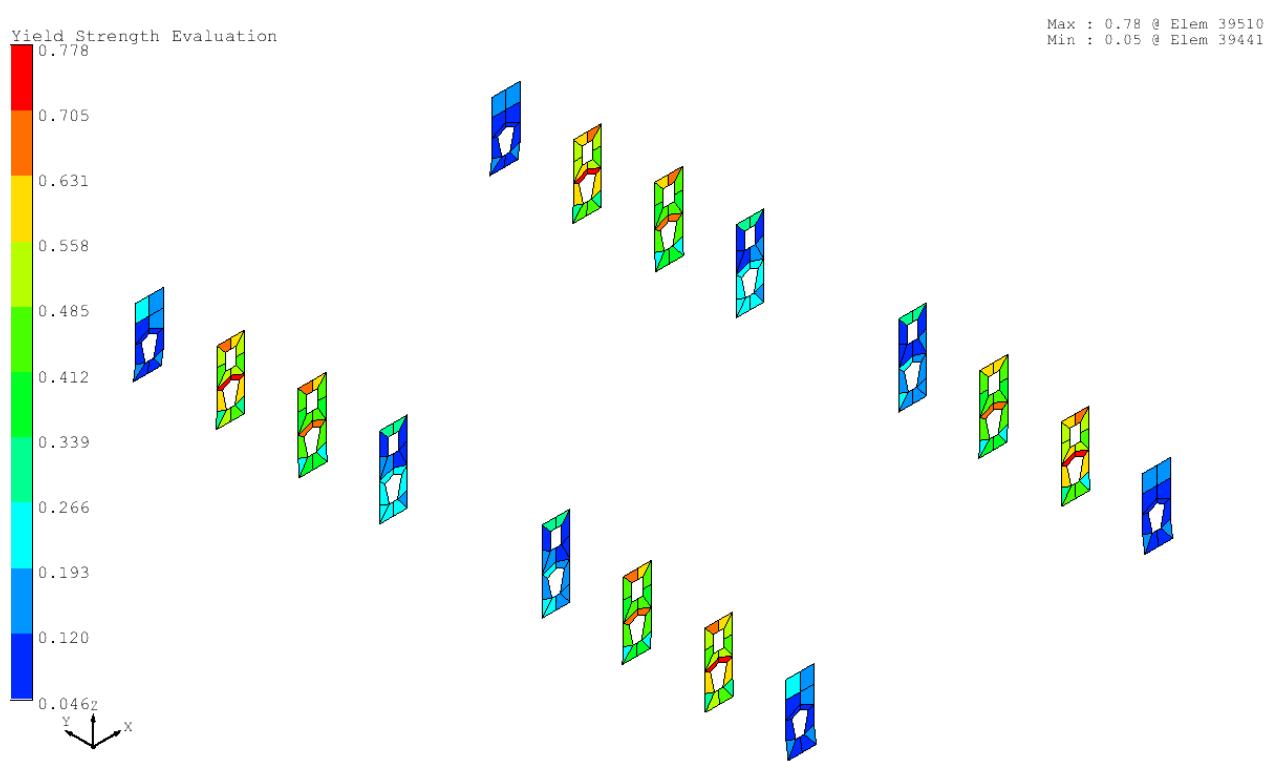
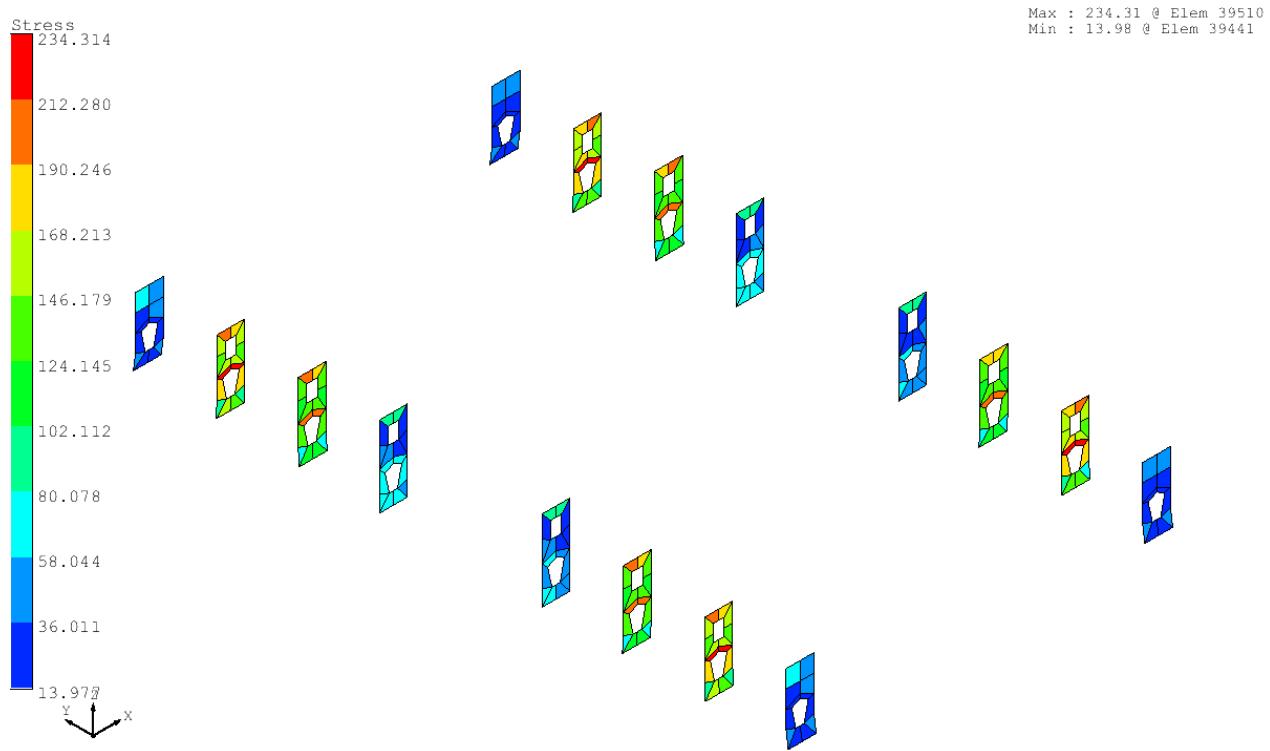


Fig.A3.18.b-F.E. Result of UPPER STOOL DIAPH. (Yielding, Harbour Max.)

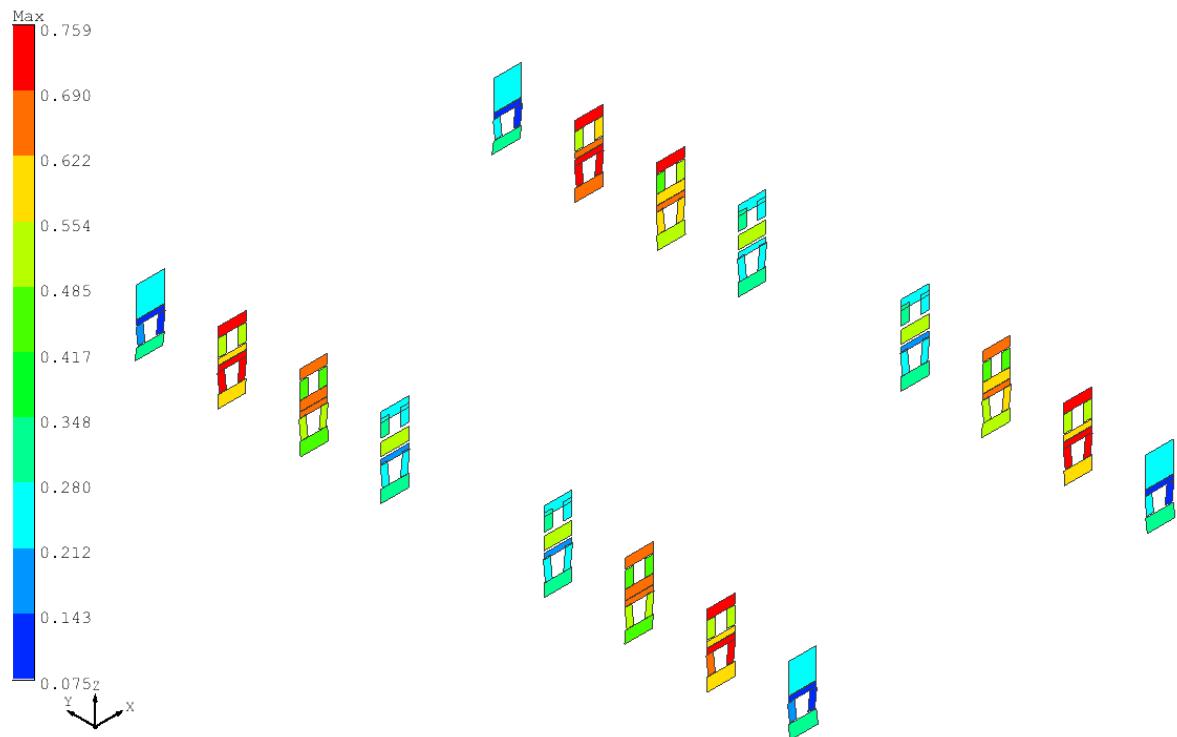


Fig.A3.18.c-F.E. Result of UPPER STOOL DIAPH. (Buckling, Worst Case S+D)

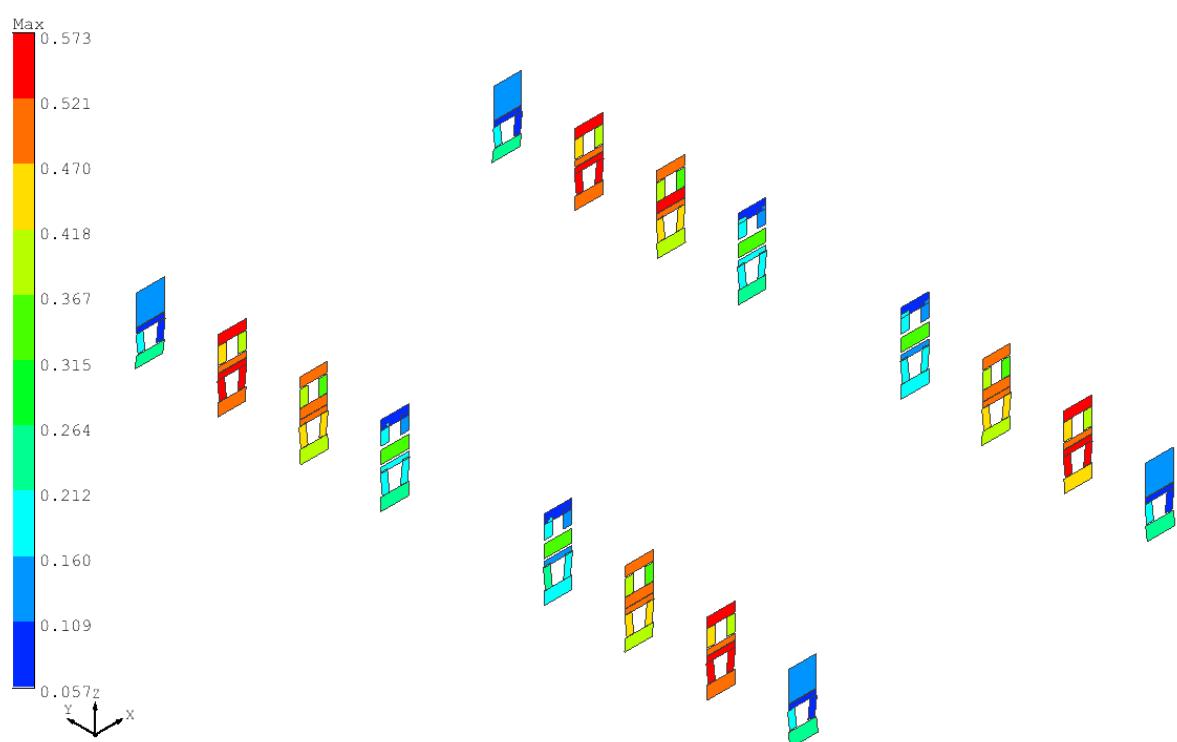


Fig.A3.18.d-F.E. Result of UPPER STOOL DIAPH. (Buckling, Worst Case S)

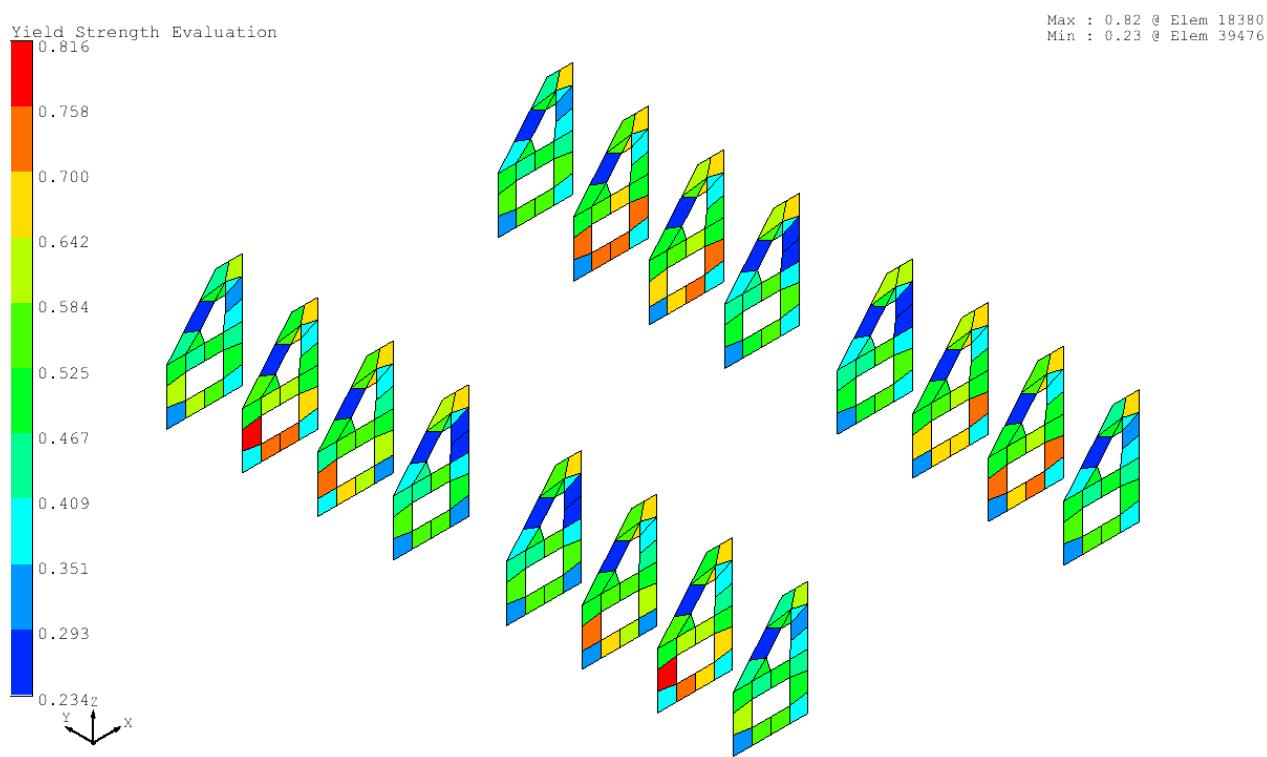
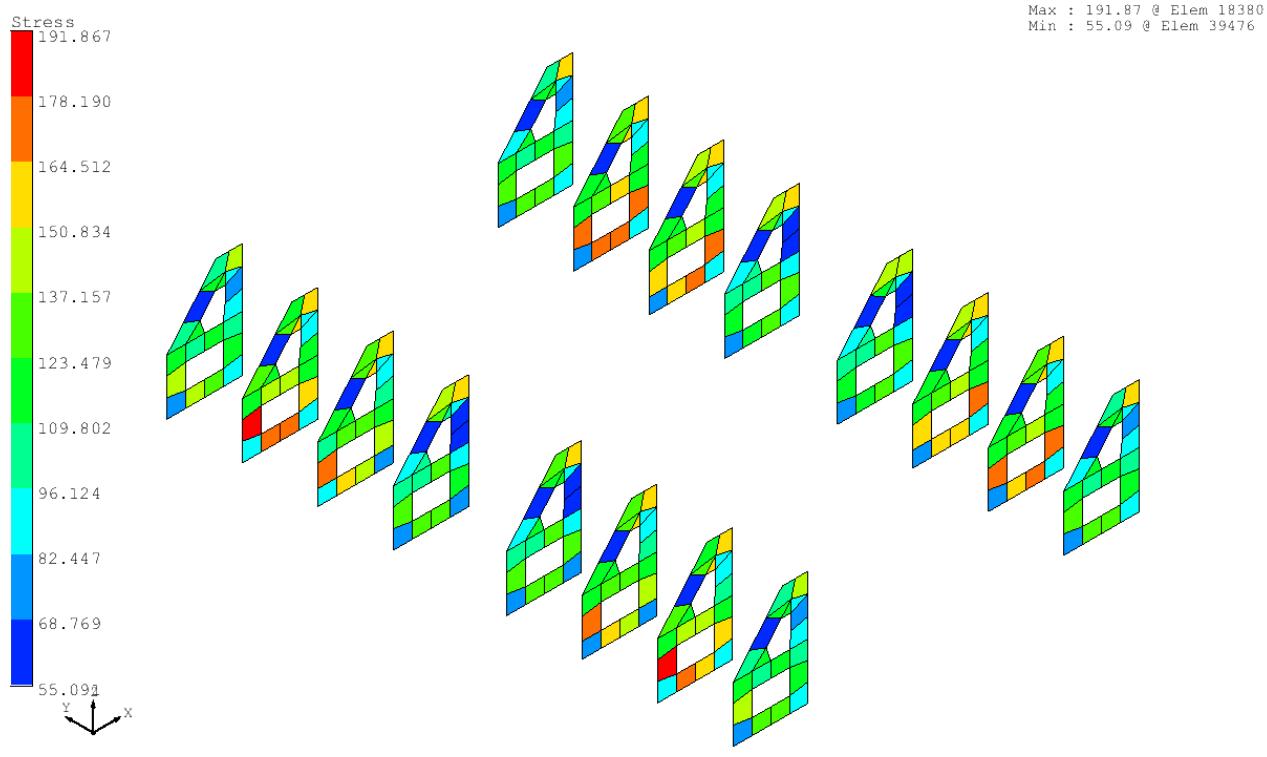
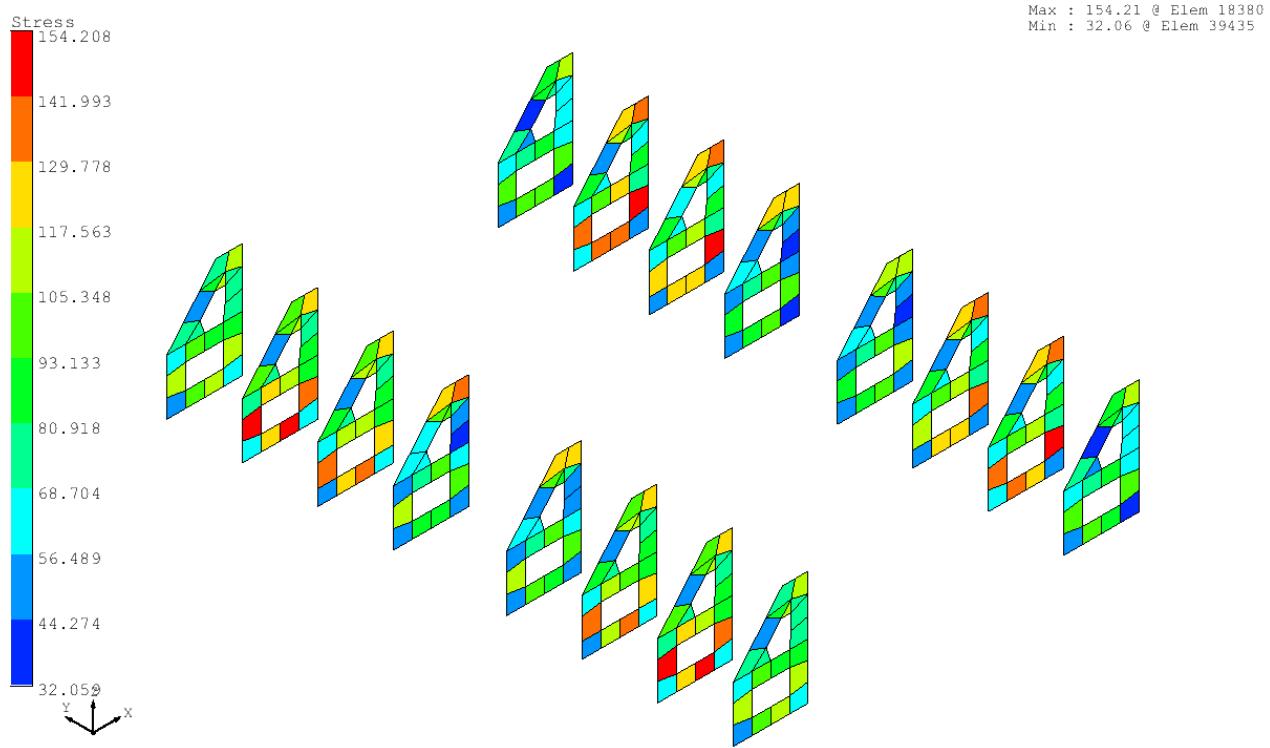
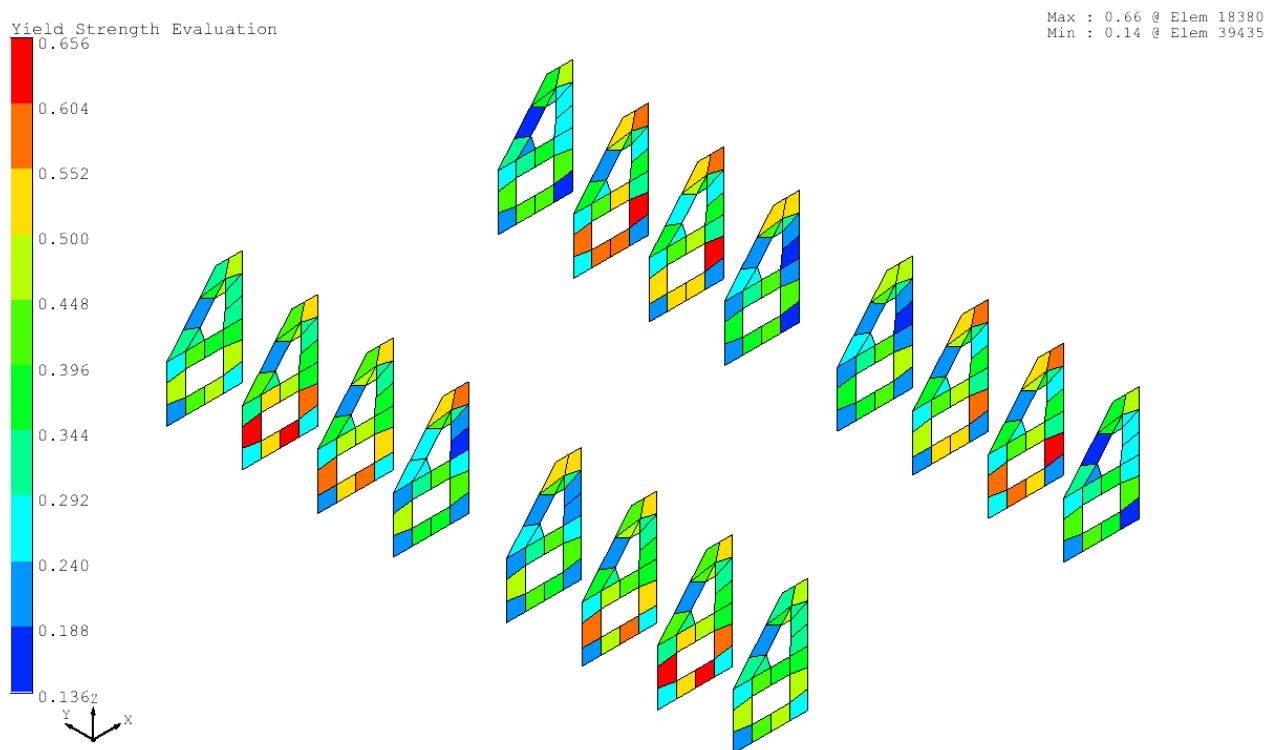


Fig.A3.19.a-F.E. Result of LOWER STOOL DIAPH. (Yielding, Sea-going Max.)

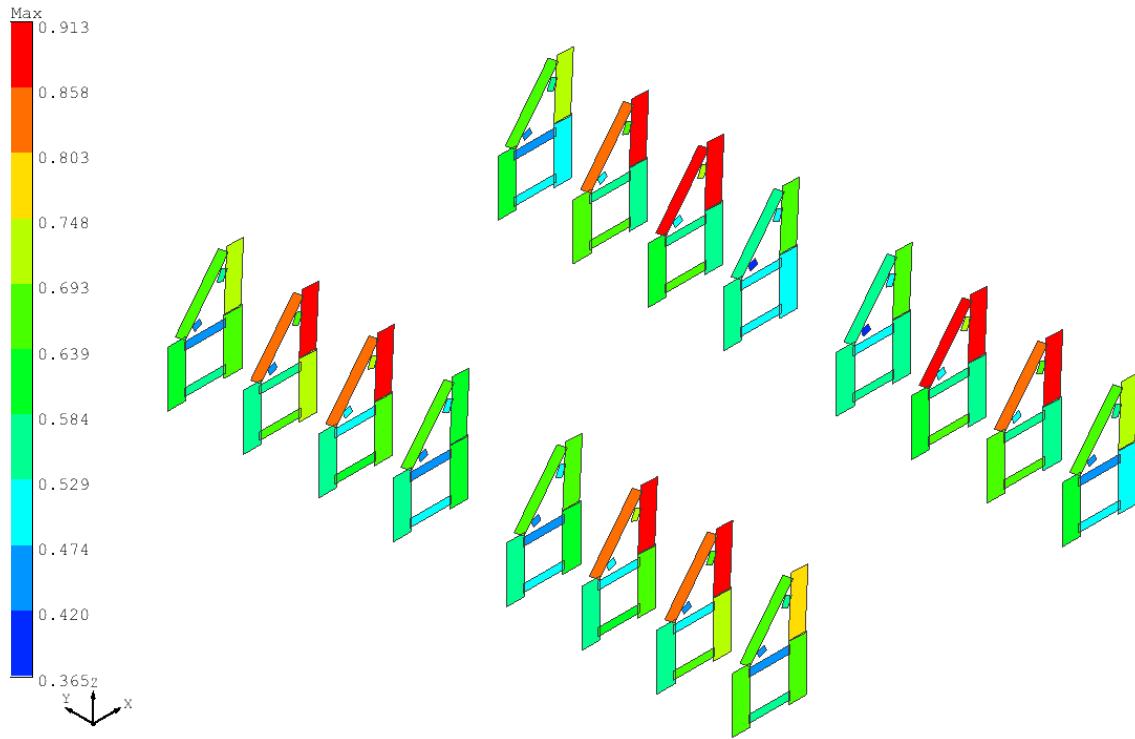


Fringe : Element Stress (Von Mises), 19_LOWER STOOL DIAPH., MAX.HARBOUR



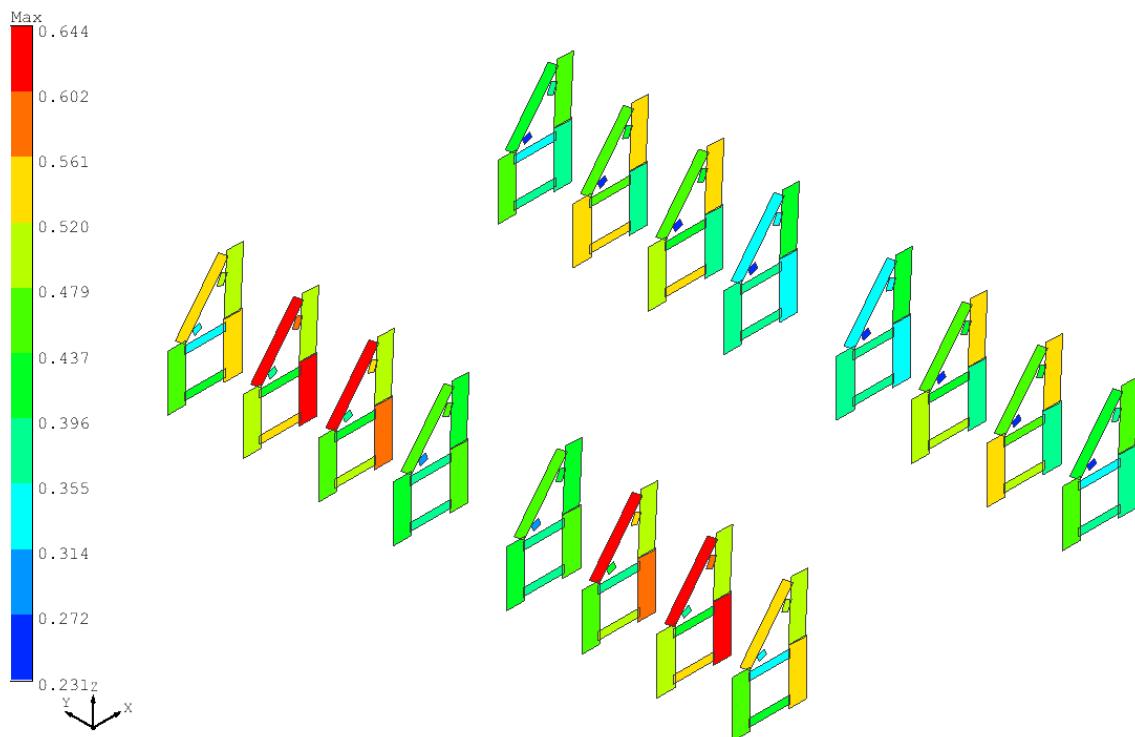
Fringe : Yield Strength Evaluation ,19_LOWER STOOL DIAPH., MAX.HARBOUR

Fig.A3.19.b-F.E. Result of LOWER STOOL DIAPH. (Yielding, Harbour Max.)



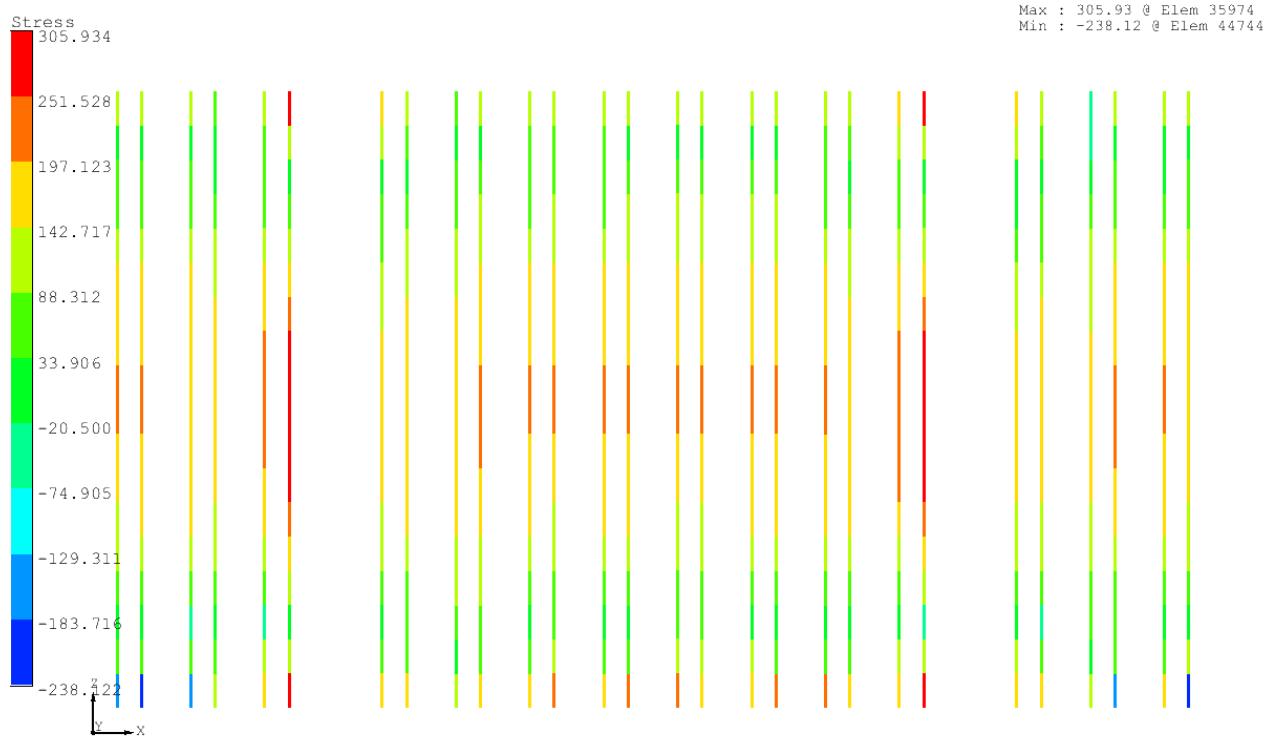
Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S+D), Max:0.91, Min:0.36

Fig.A3.19.c-F.E. Result of LOWER STOOL DIAPH. (Buckling, Worst Case S+D)

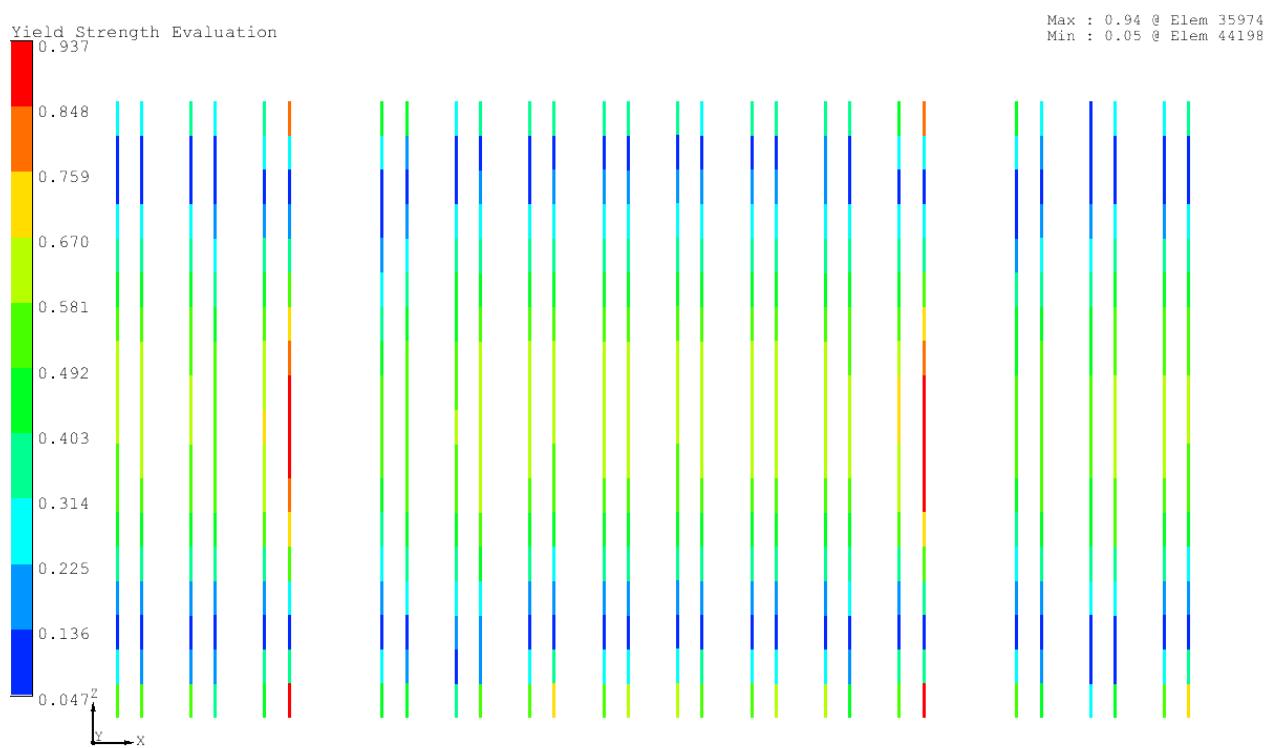


Buckling(HCSR and After 2020 KR Rules, 1 July, 2021), Max, Worst Case (S), Max:0.64, Min:0.23

Fig.A3.19.d-F.E. Result of LOWER STOOL DIAPH. (Buckling, Worst Case S)



Fringe : Element Stress (Axial), 13_LONGI.CORR.BHD, MAX.SEAGOING



Fringe : Yield Strength Evaluation , 13_LONGI.CORR.BHD, MAX.SEAGOING

Fig.A3.20.a-F.E. Result of LONG'L CORR. BHD BEAM (Yielding, Sea-going Max.)

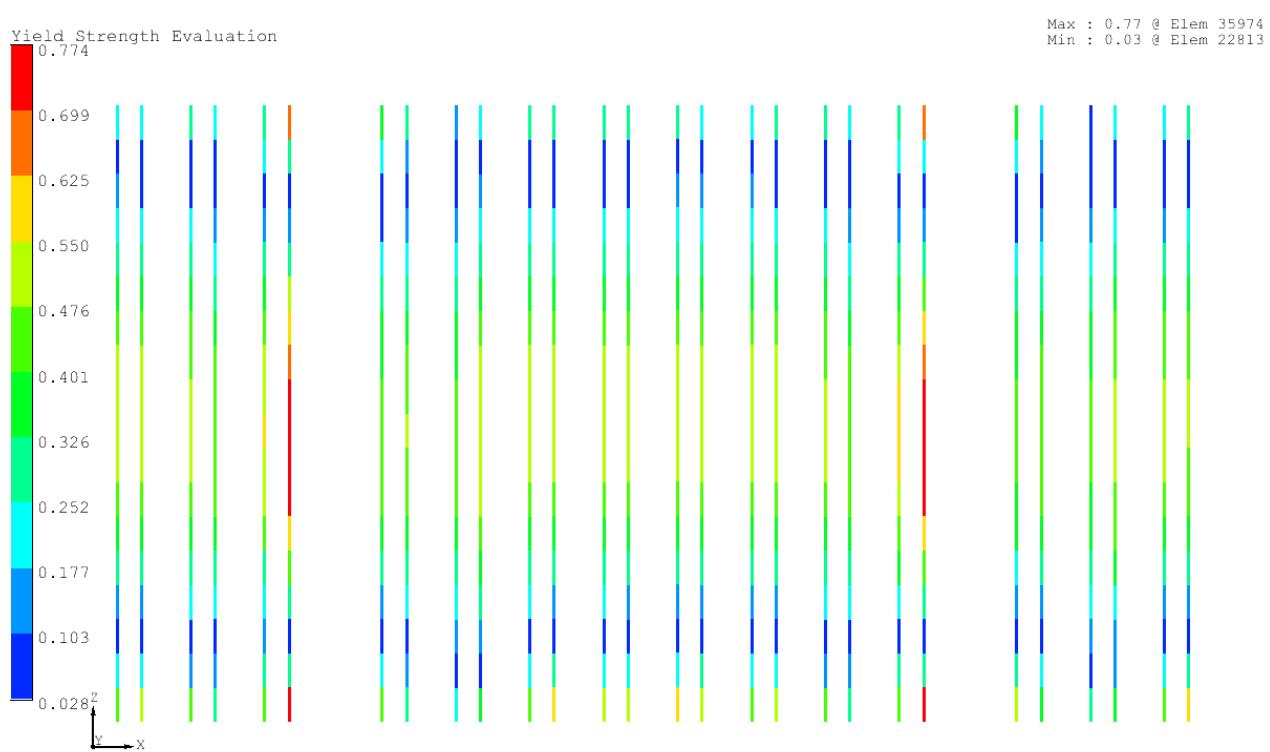
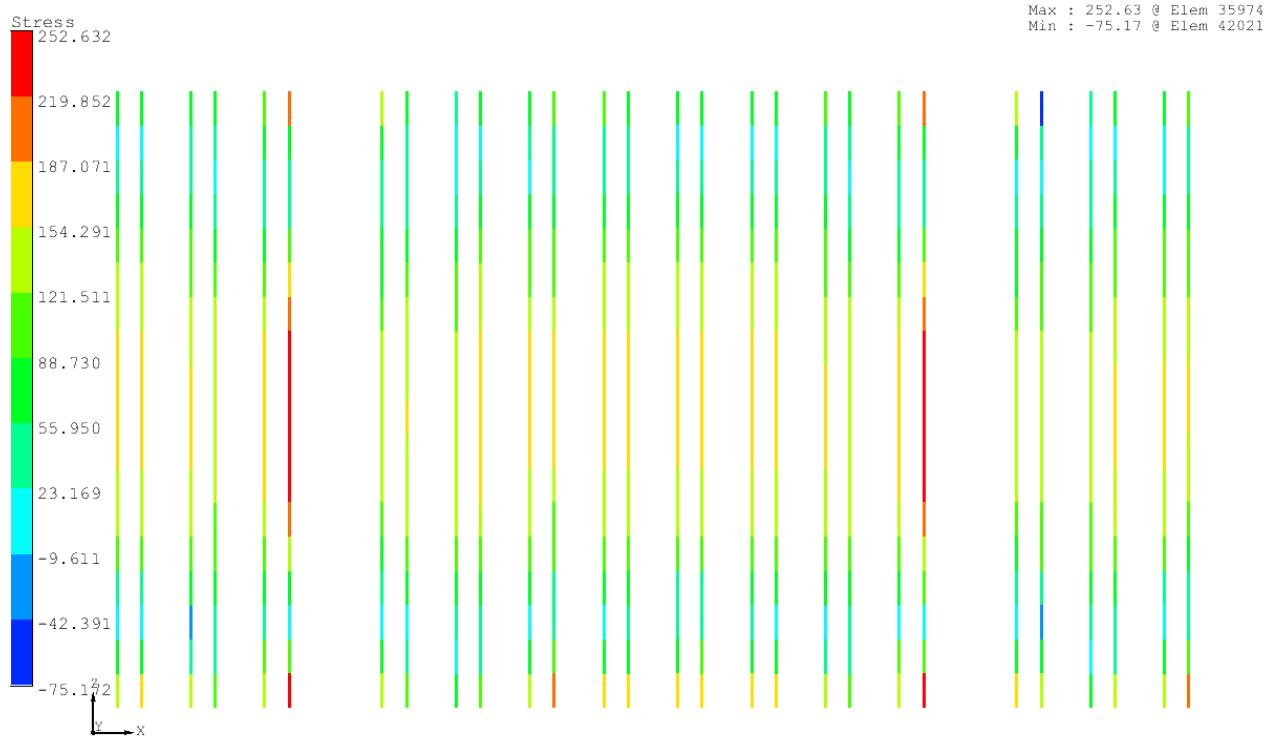


Fig.A3.20.b-F.E. Result of LONG'L CORR. BHD BEAM (Yielding, Harbour Max.)

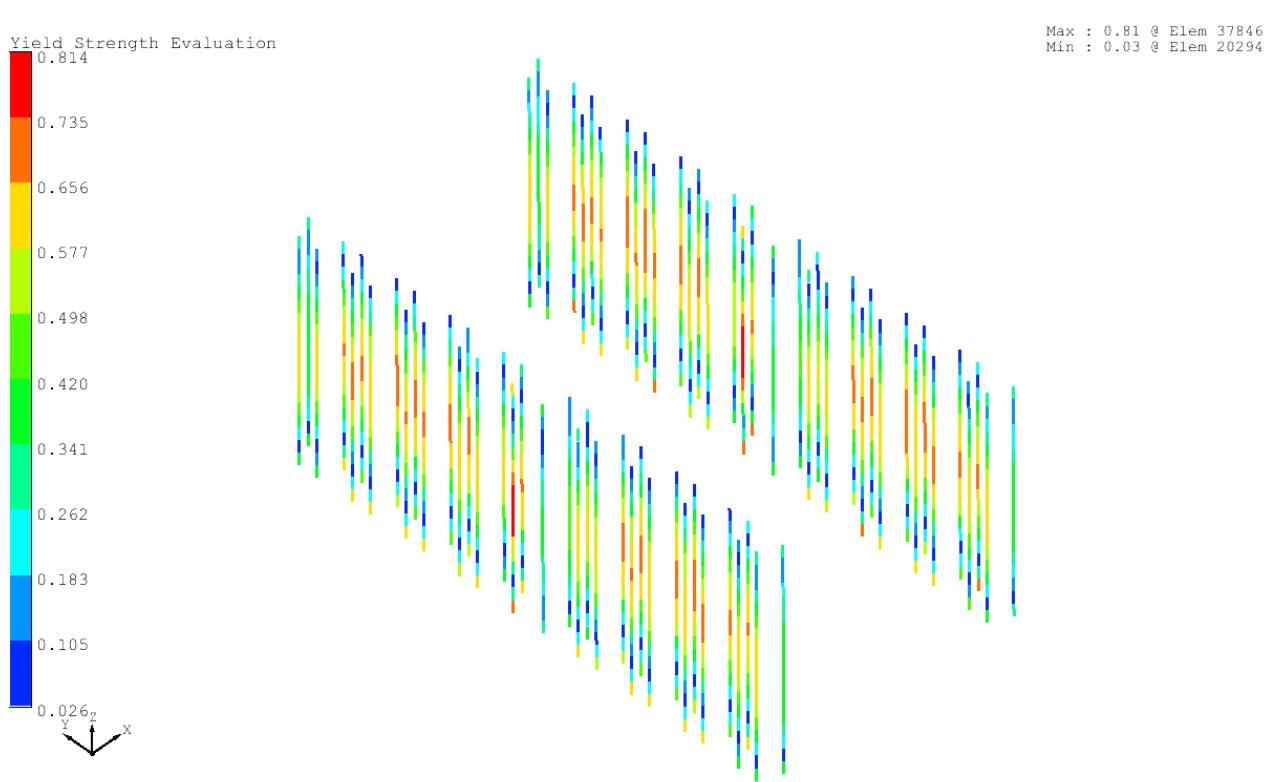
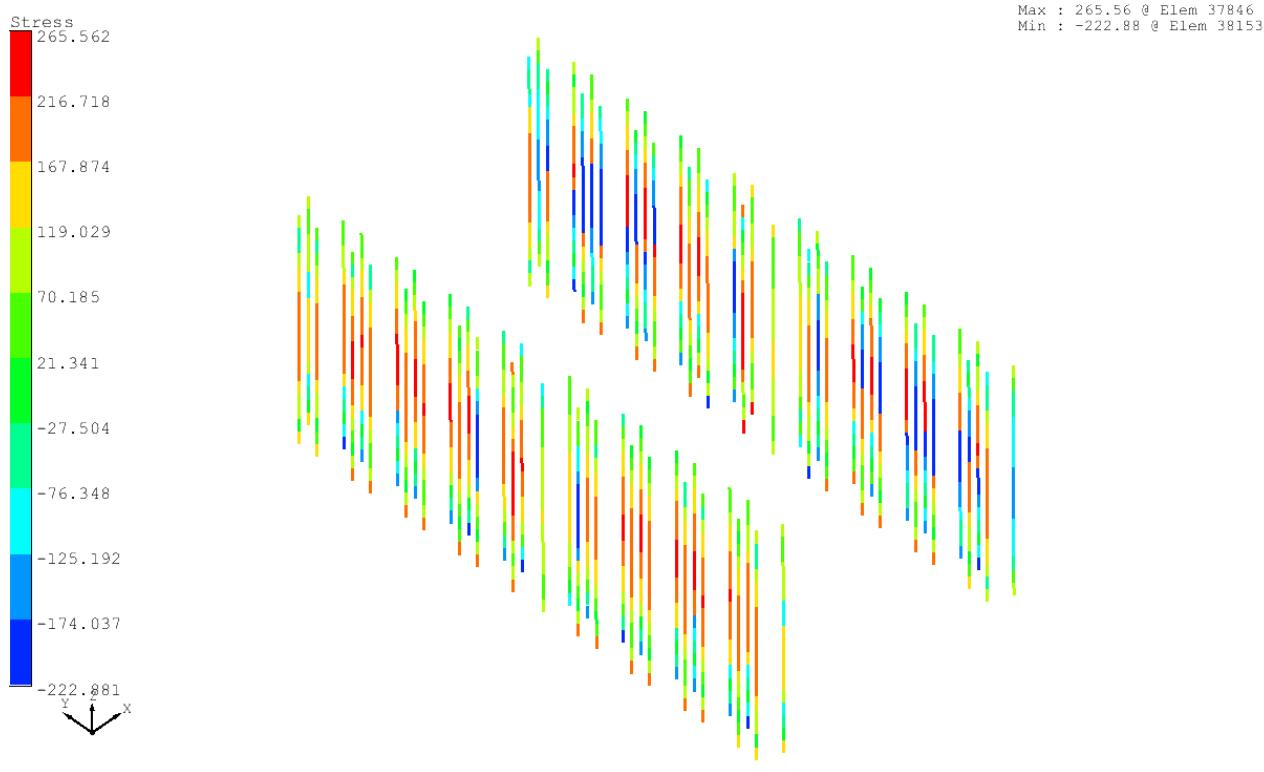


Fig.A3.21.a-F.E. Result of TRANS. CORR. BHD BEAM (Yielding, Sea-going Max.)

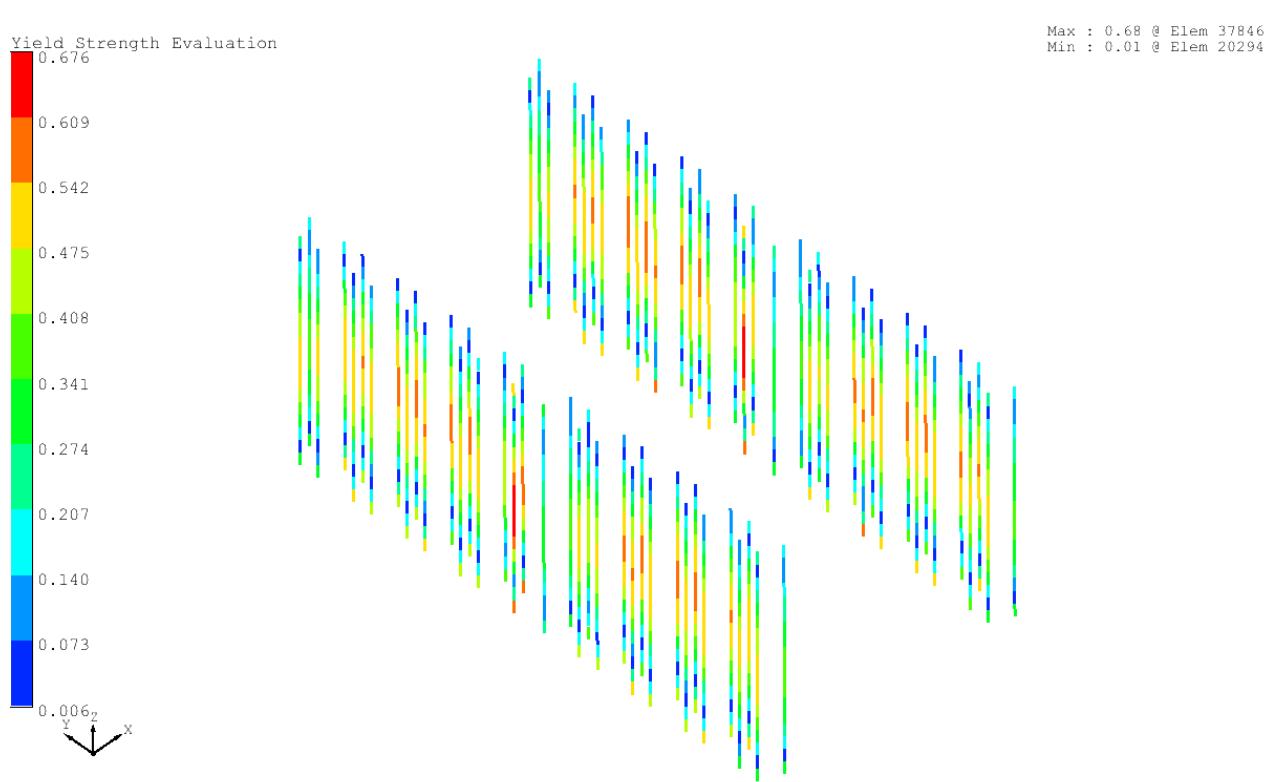
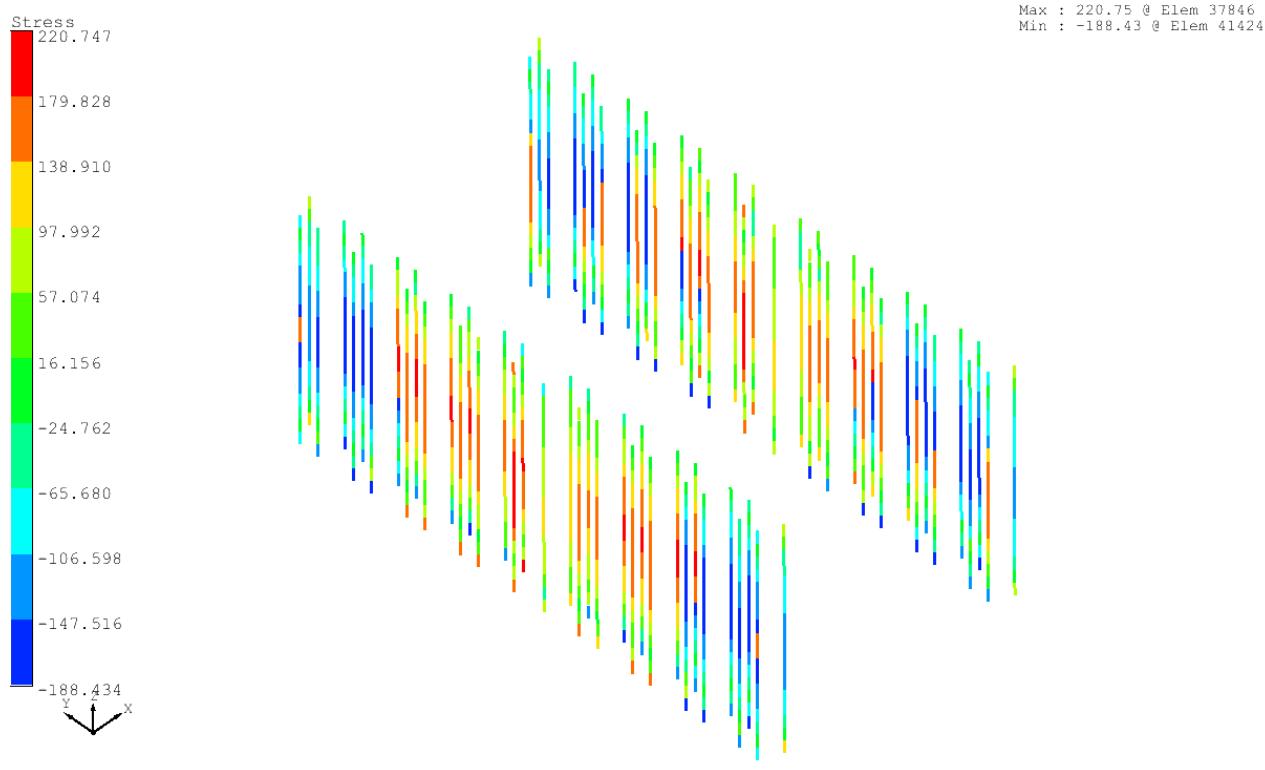


Fig.A3.21.b-F.E. Result of TRANS. CORR. BHD BEAM (Yielding, Harbour Max.)

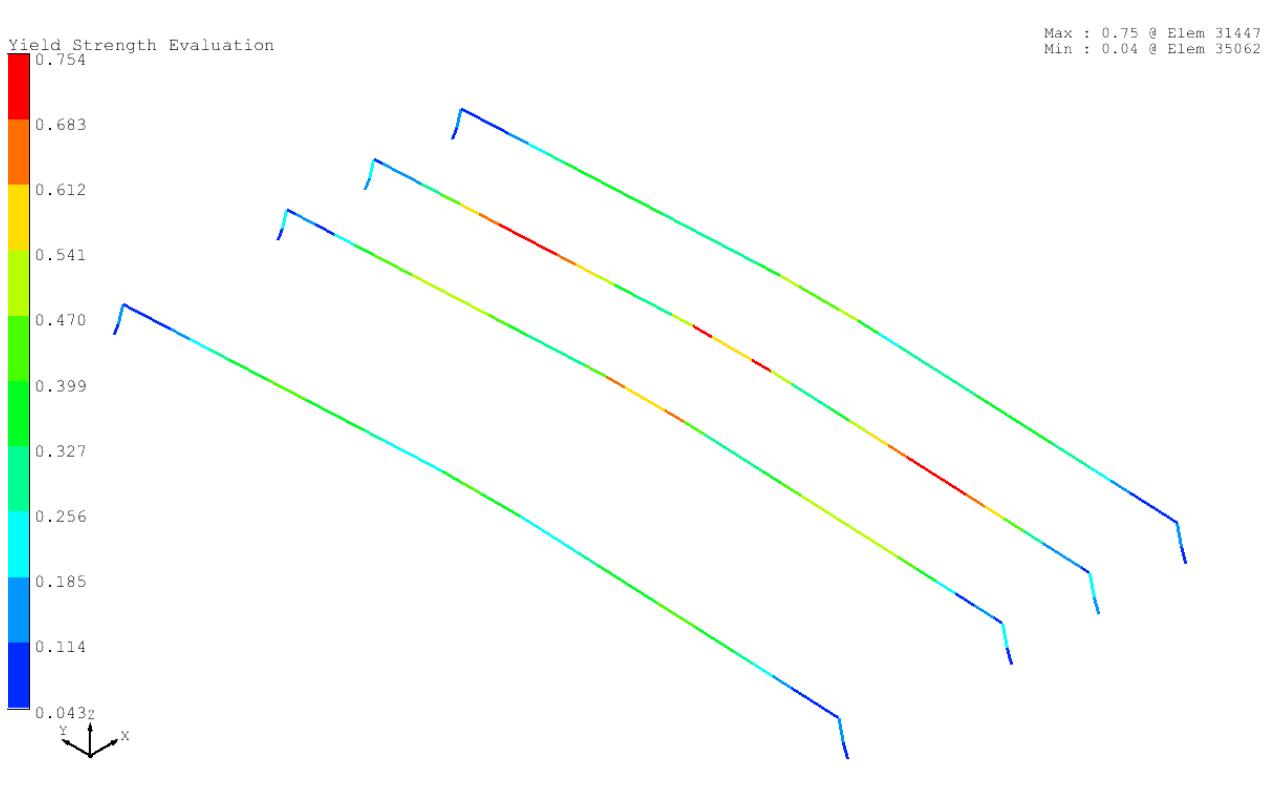
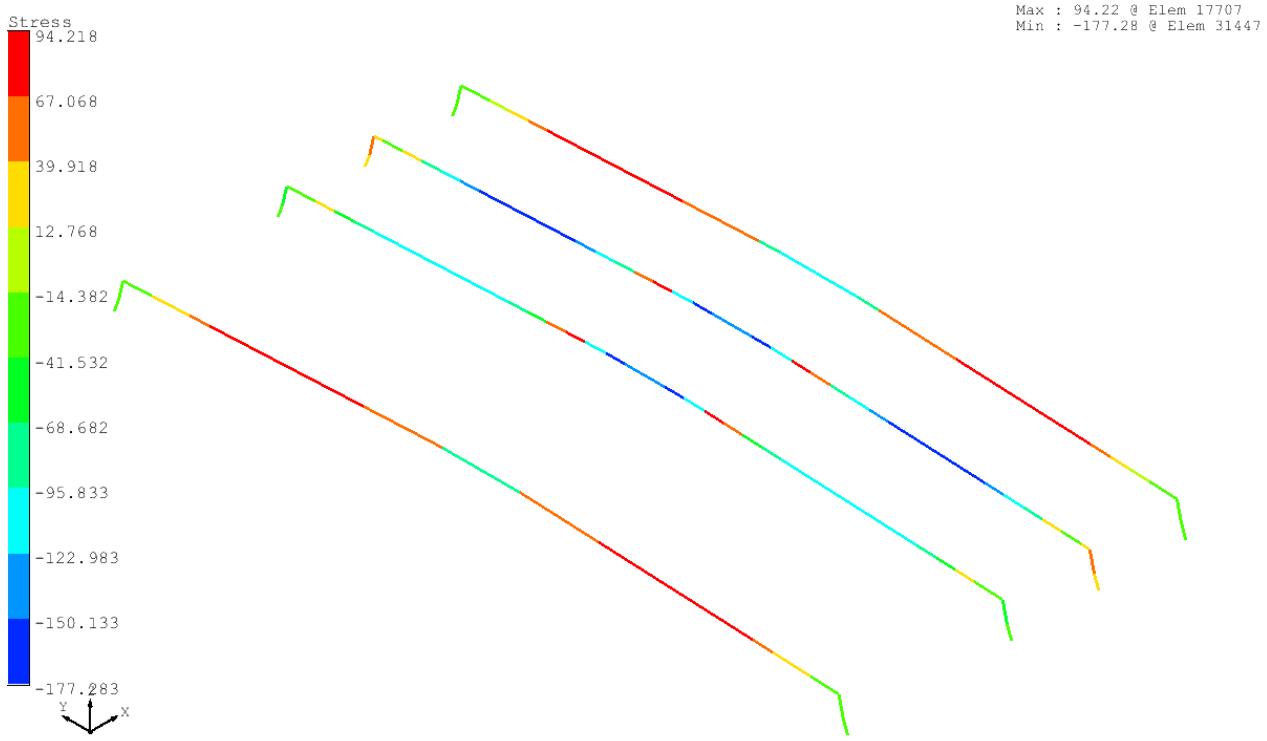


Fig.A3.22.a-F.E. Result of DECK TRANSVERSE BEAM (Yielding, Sea-going Max.)

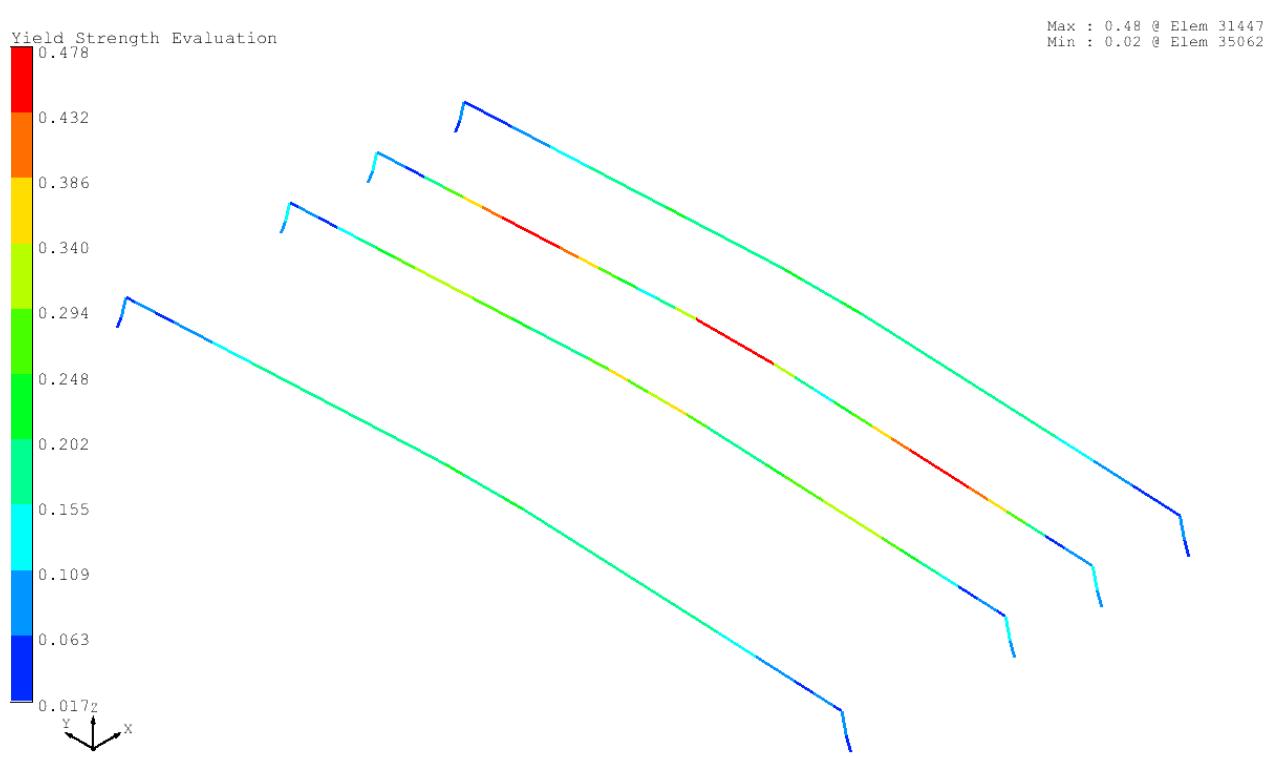
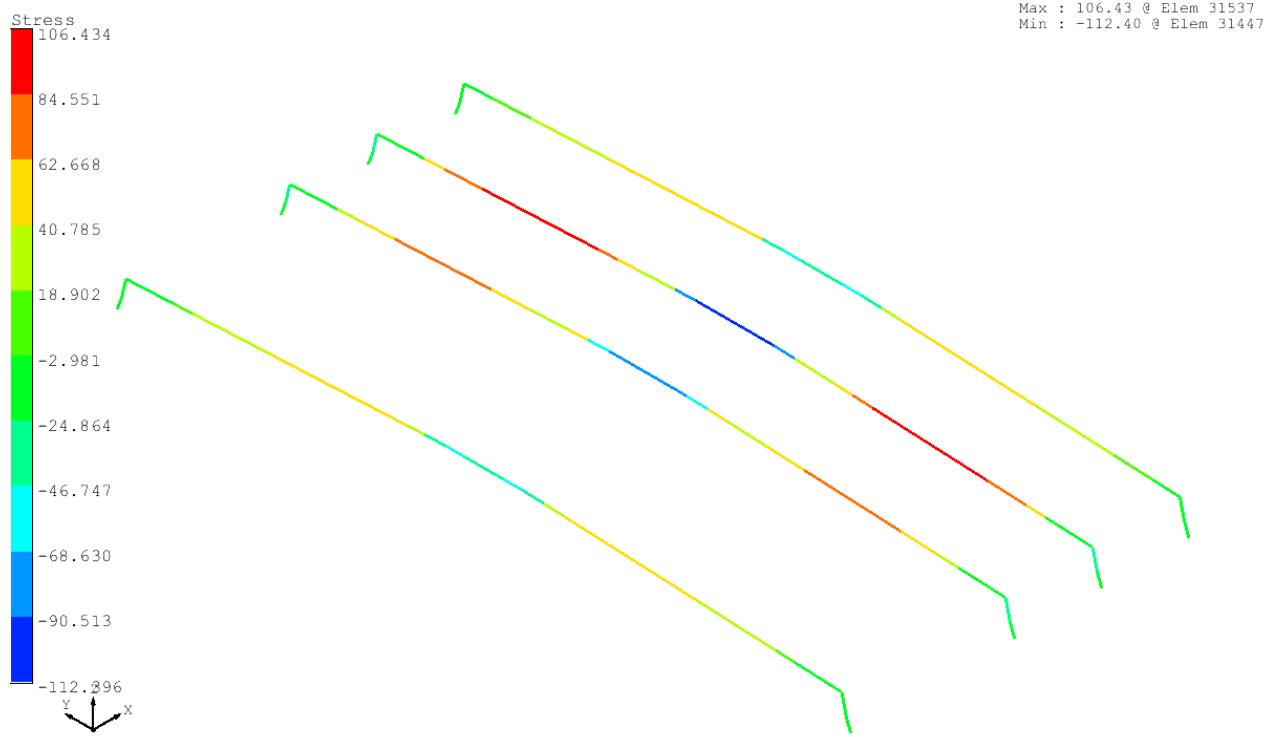


Fig.A3.22.b-F.E. Result DECK TRANSVERSE BEAM (Yielding, Harbour Max.)