Preliminary Consequence Assessment on Harmonized CSR from Chinese Shipbuilding Industry

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(CANSI)

中国船舶工业行业协会

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- Assessment ships
- Assessment scope
- Assessment tools
- Preliminary results presentation
- Conclusions

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Background

- To provide a comprehensive consequence assessment result to the Chinese shipbuilding industry
- Members from CANSI
- Support by CCS
- CSRH External Release 1 July 2012

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CA Ships

	L_{BP}	B	D	T_S	DWT
VLCC	320	60	30.5	22.5	320K
Suezmax	264	48	24	17.5	160K
Aframax	234	42	21.6	15.45	110K
Panamax	220	32.26	21.2	14.7	76K
MR	176	32.2	18.6	12.4	48K
Capesize1	294	50	24.9	18.4	206K
Capesize2	285	46	24.8	18.1	180K
Baby Cape	254	43	20.3	14.5	118K
Post Panamax	221	36.8	19.9	14.2	87K
Panamax	225.1	32.26	20.2	14.45	82K
Handymax1	185	32.26	18	12.8	57K
Handymax2	172	30	14.7	10.1	35K

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CA Scope

Midship region of cargo

- 0.4L amidships for tankers
- Empty hold & loaded hold in 0.4L amidships for bulk carriers

- Hull girder bending strength
- Minimum thickness
- Slenderness or proportional ratio
- Hull local scantling
- Prescriptive buckling
- Simplified Fatigue
- FE yielding
- FE buckling

CA Tools

CCS software system for CSRH

- SDP
- DSA

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Prescriptive result presentation

- Rule reference: External Release 1 July 2012
- Plating: Difference in thickness, [mm]
  - Shown as CSRH-CSR, for Rule to Rule comparison
  - Shown as CSRH-As_built, for real increase or decrease
- Stiffeners: Difference on modulus, shown as percentage calculated as
  - (CSRH-CSR)/CSR, for Rule to Rule comparison, [%]
  - (CSRH-As_built)/As_built, for real increase or decrease, [%]

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Prescriptive result presentation

Local Min T	➔ +/-
Local Pres.	➔ +/-
Local Bilge	➔ +/-
Local GRAB	➔ +/-
Local Steel coils	➔ +/-
HG Buckling	➔ CSRH η>1.0
Pres. Buckling	➔ CSRH η>1.0
Fatigue	➔ CSRH T_F<25

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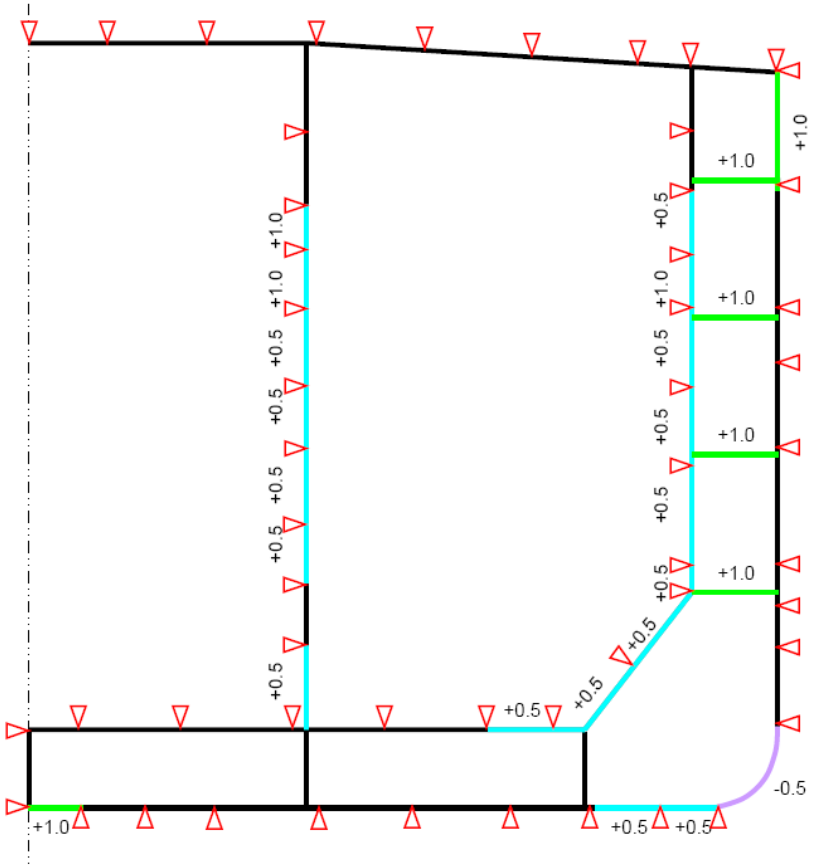
Prescriptive result - OT
320K VLCC, Plating

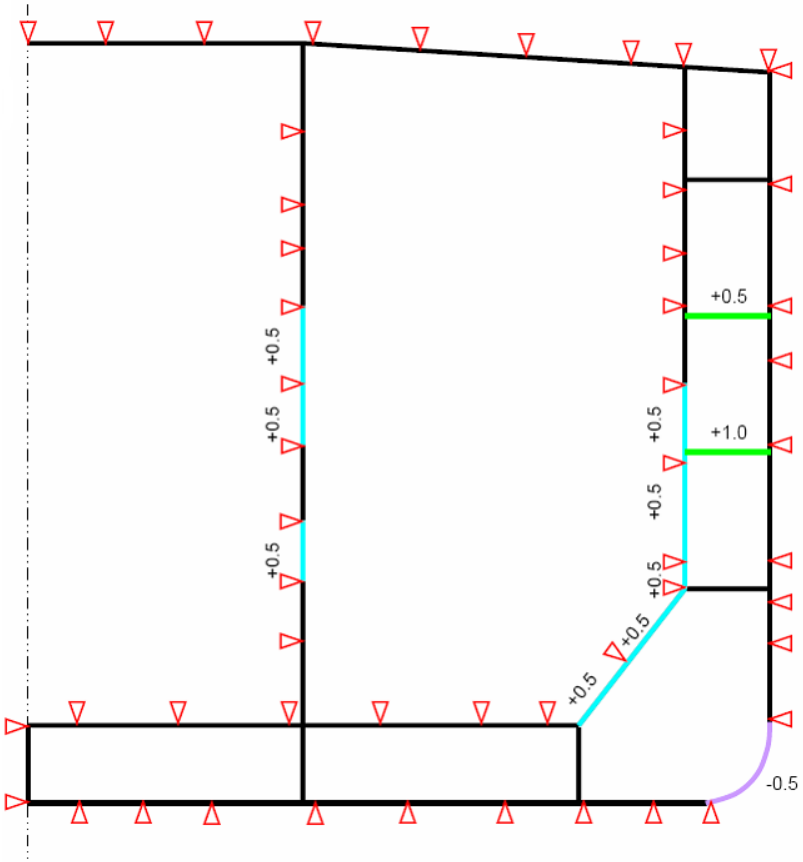
CSRH to CSR

[mm]



CSRH to As-built

[mm]



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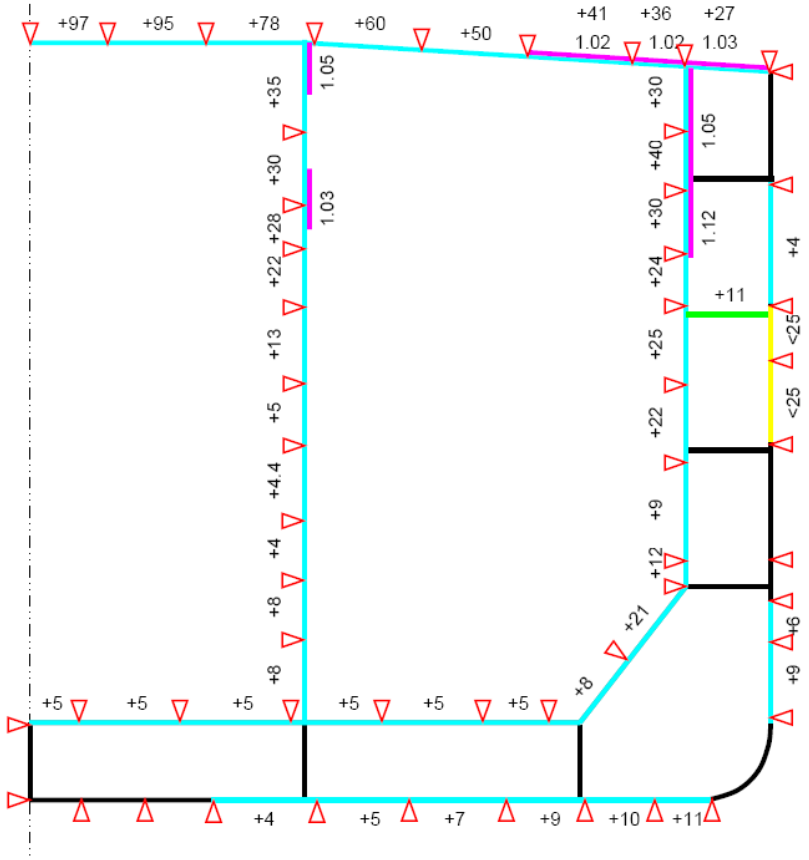
Prescriptive result - OT
320K VLCC, Stiffener

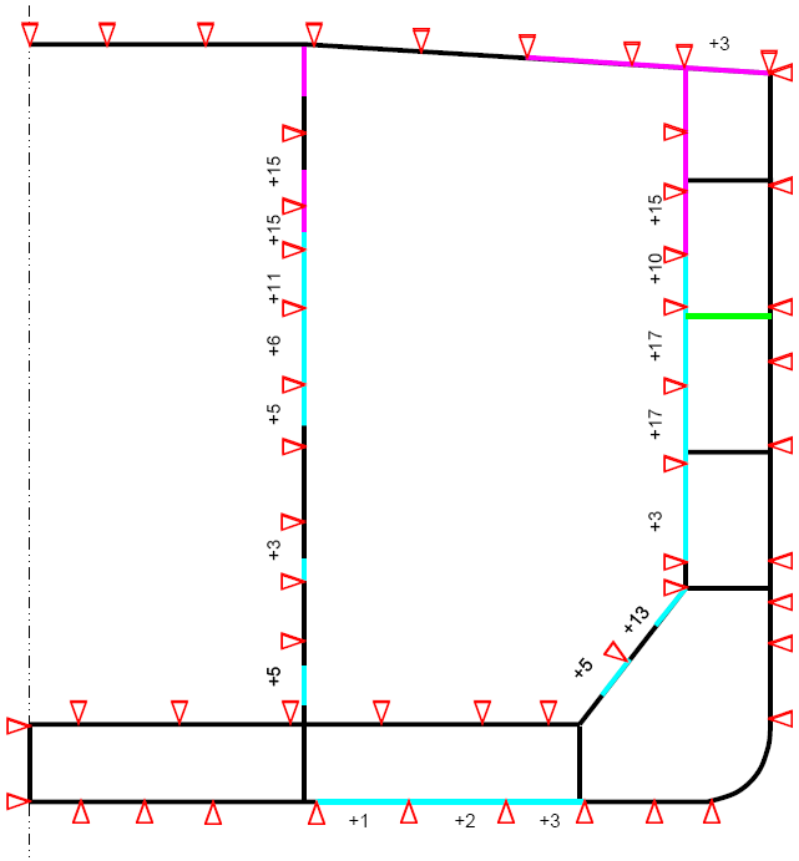
CSRH to CSR

[%]



CSRH to As-built

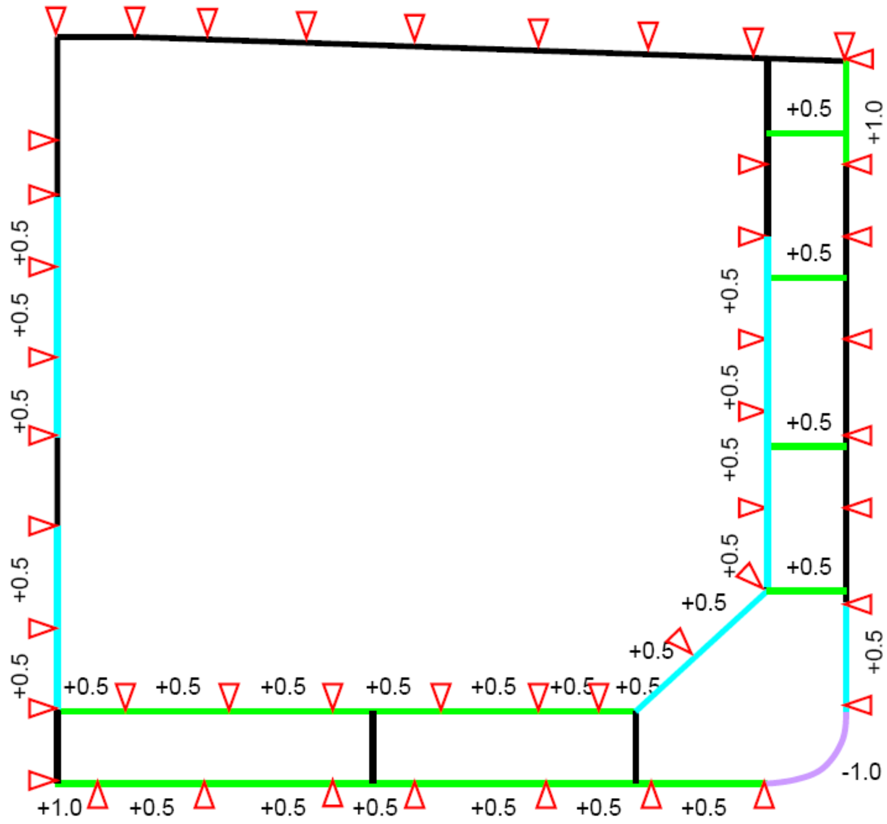
[%]



Prescriptive result - OT
160K Suezmax, Plating

CSRH to CSR

[mm]



CSRH to As-built

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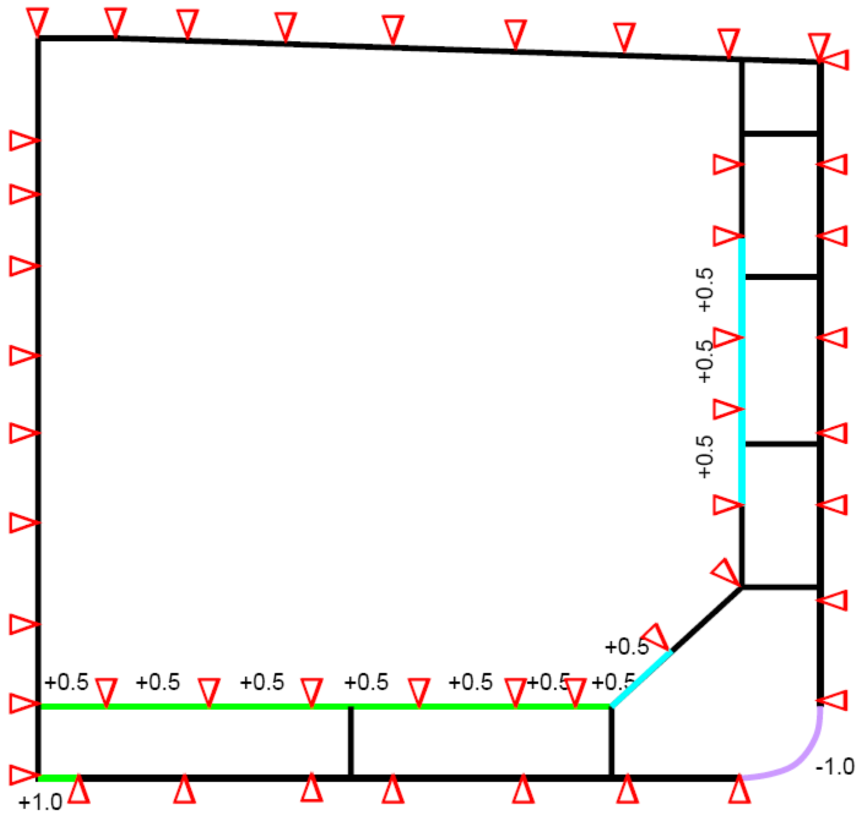

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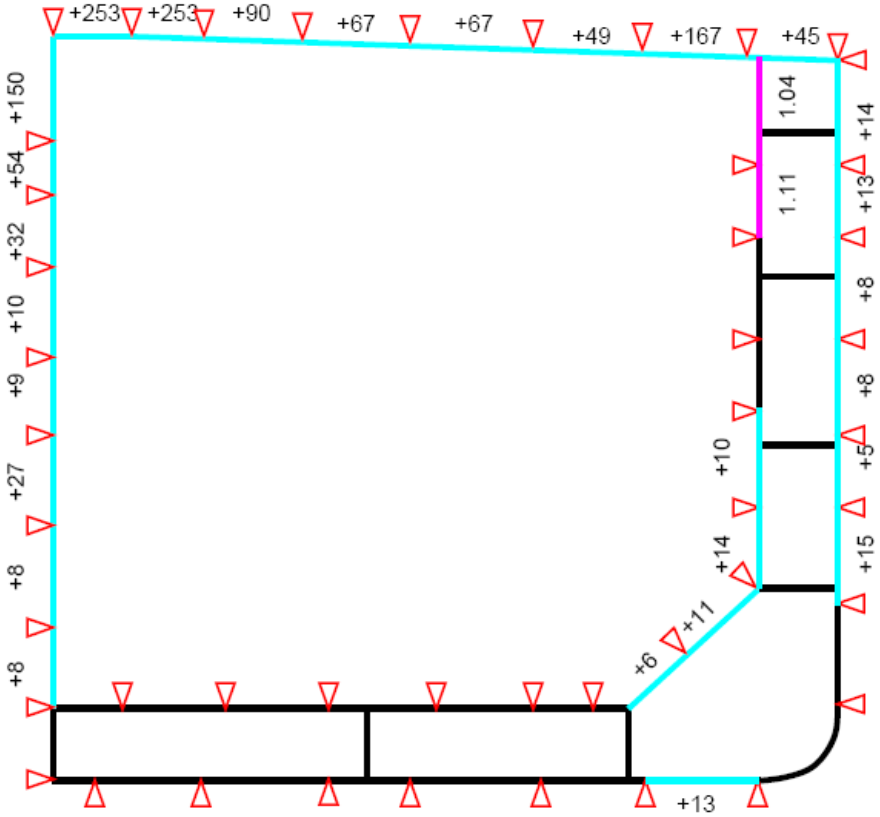
Prescriptive result - OT
160K Suezmax, Stiffener

CSRH to CSR

[%]



CSRH to As-built

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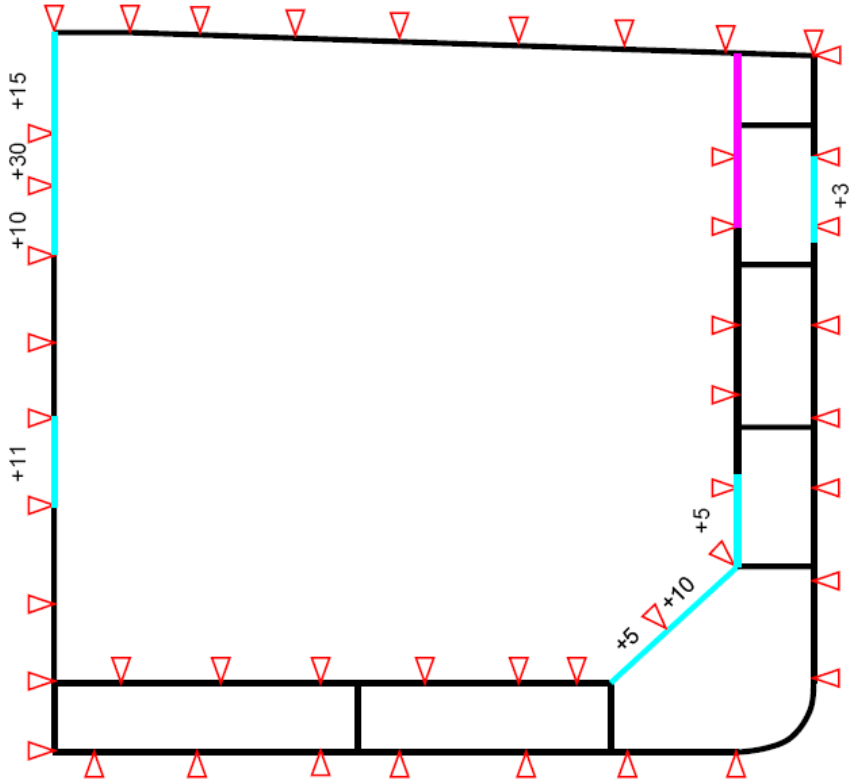

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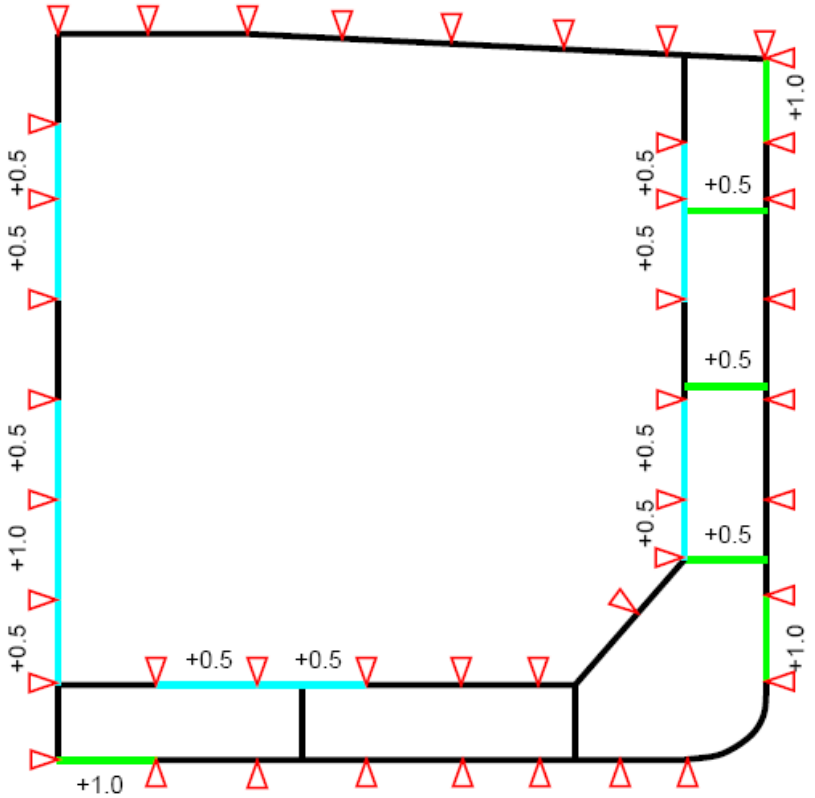
Prescriptive result - OT
110K Aframax, Plating

CSRH to CSR

[mm]



CSRH to As-built

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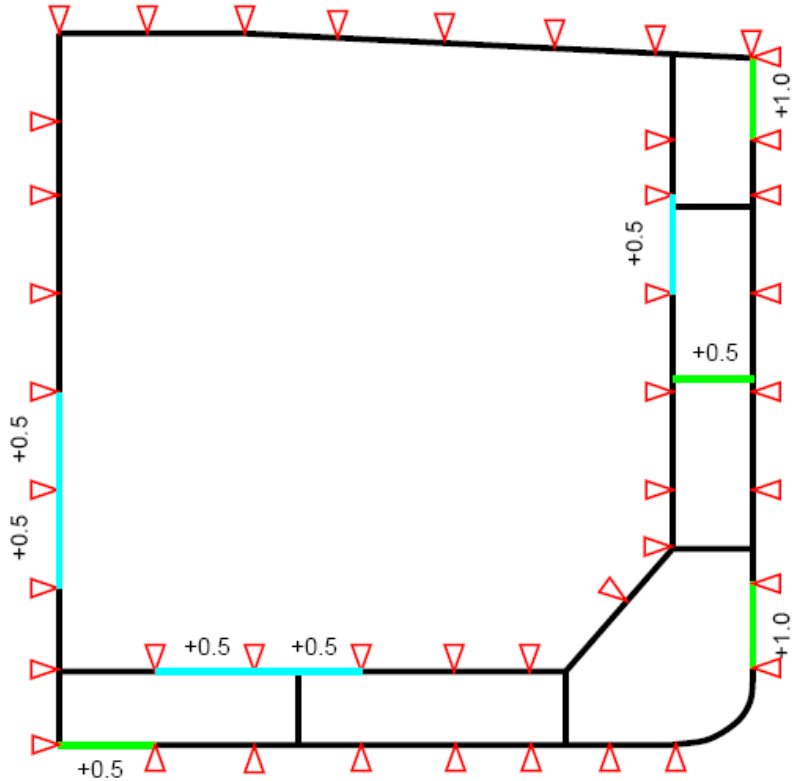

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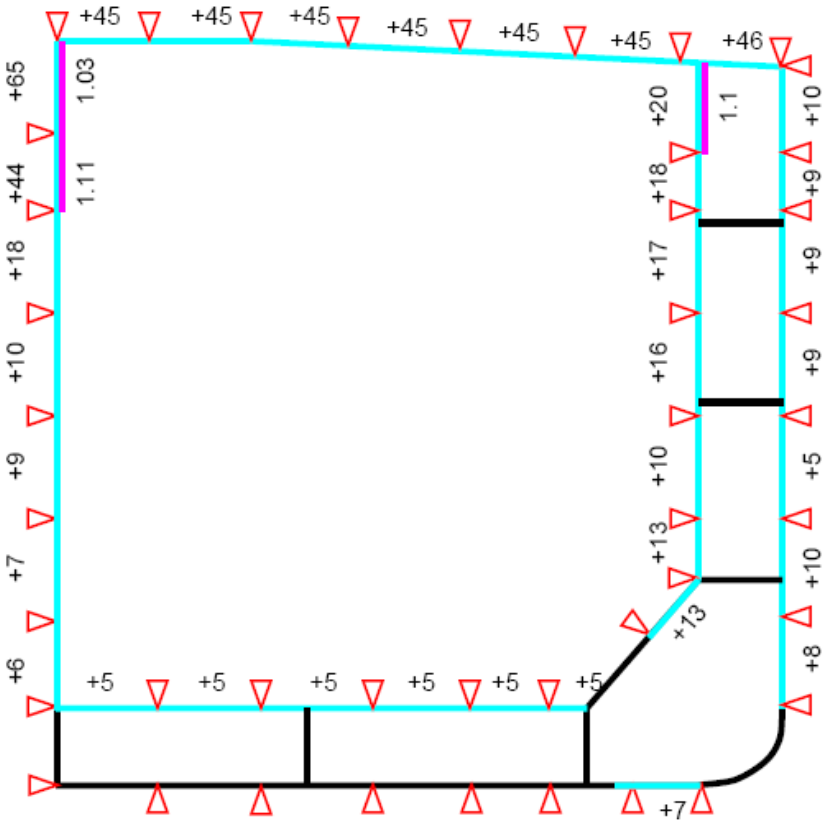
Prescriptive result - OT
110K Aframax, Stiffener

CSRH to CSR

[%]



CSRH to As-built

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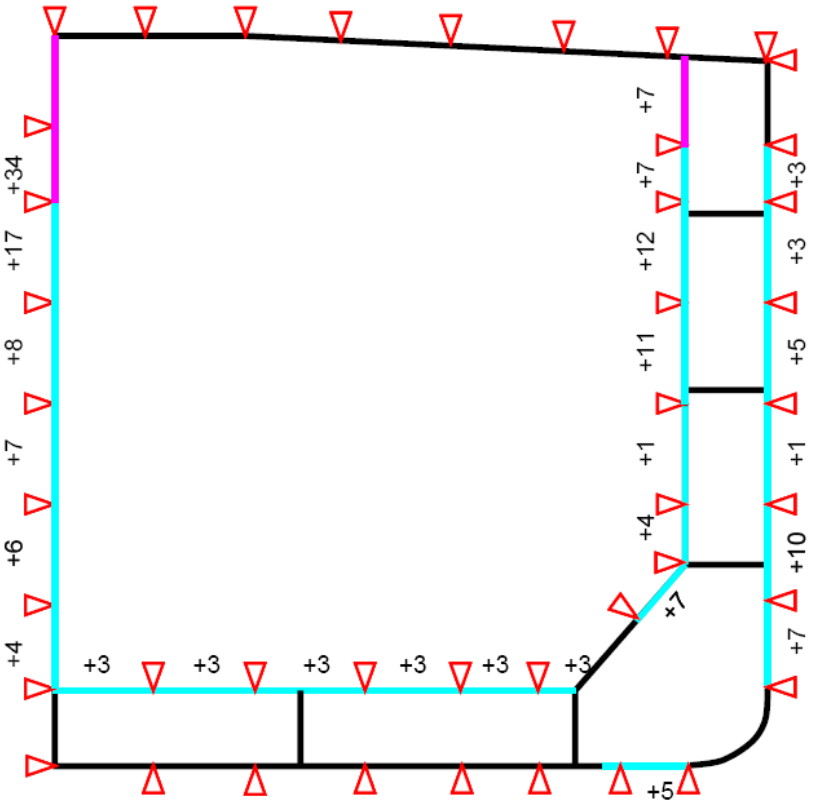

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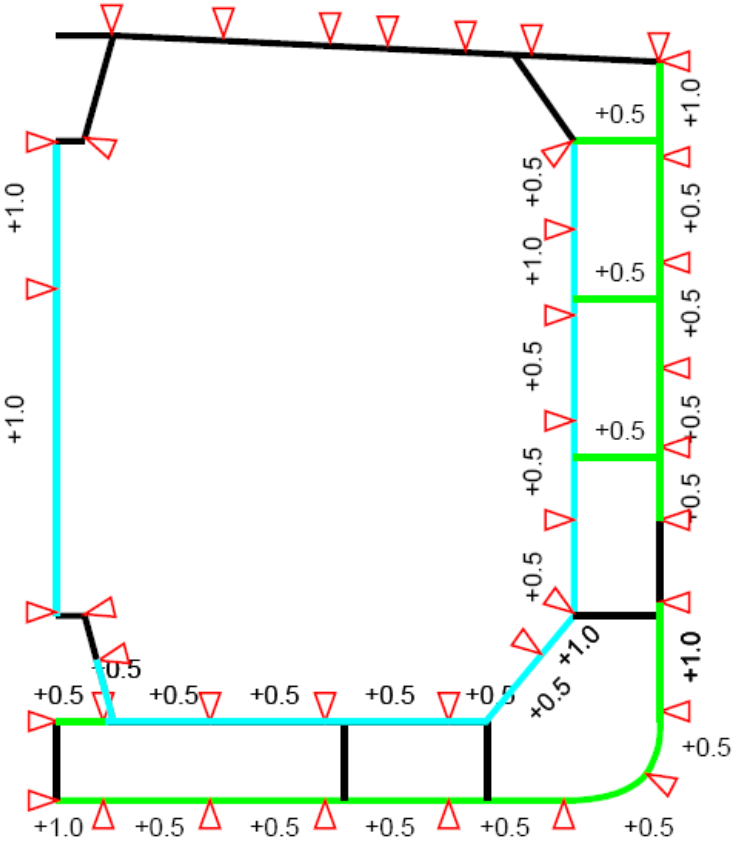
Prescriptive result - OT
76K Panamax, Plating

CSRH to CSR

[mm]



CSRH to As-built

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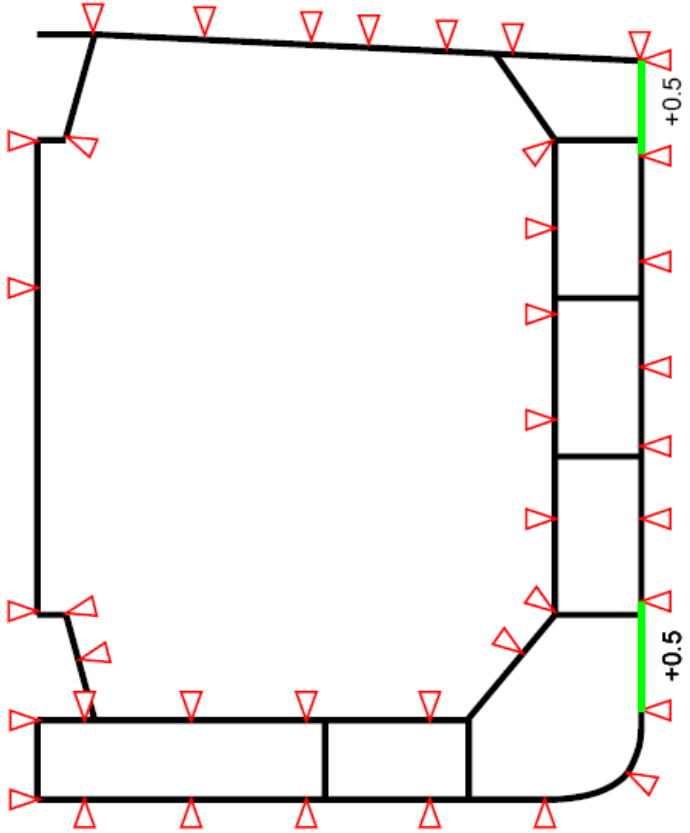

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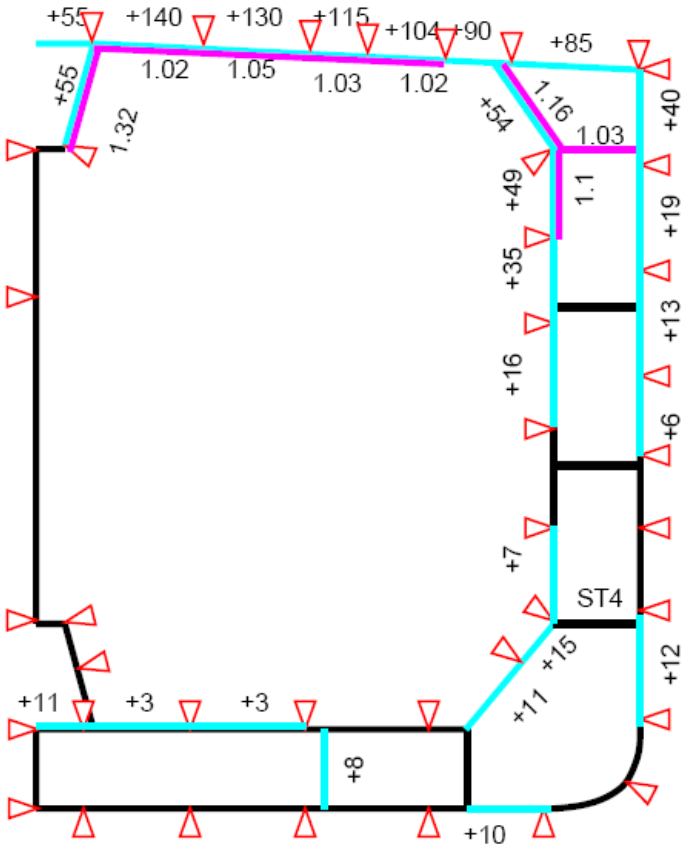
Prescriptive result - OT
76K Panamax, Stiffener

CSRH to CSR

[%]



CSRH to As-built

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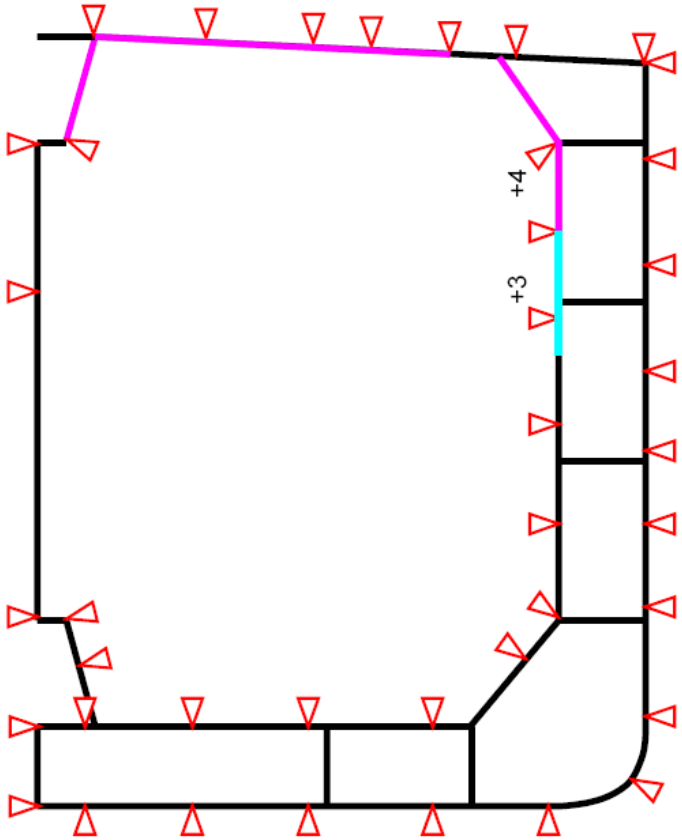

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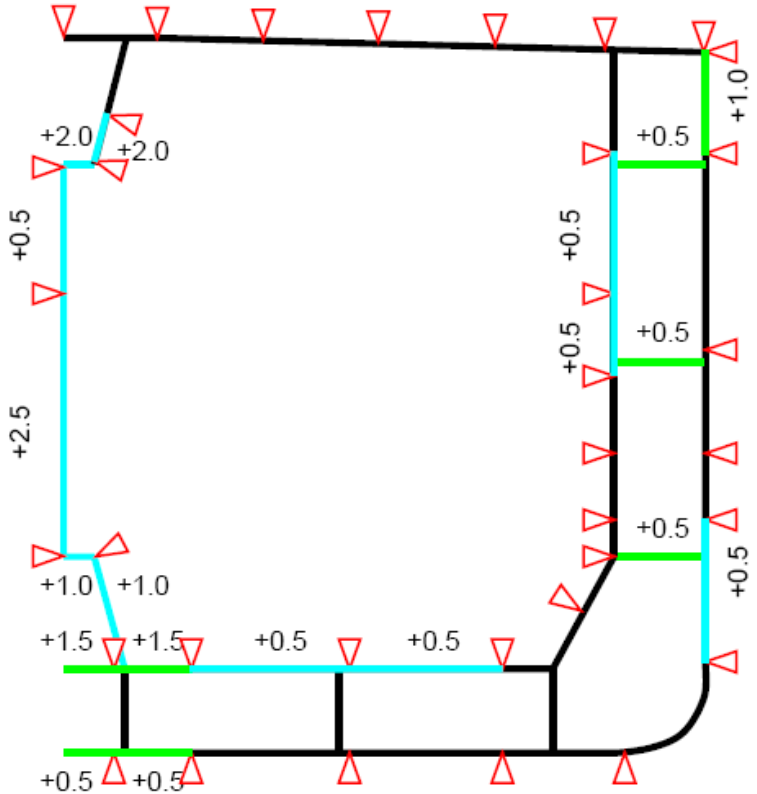
Prescriptive result - OT
48K Handymax, Plating

CSRH to CSR

[mm]



CSRH to As-built

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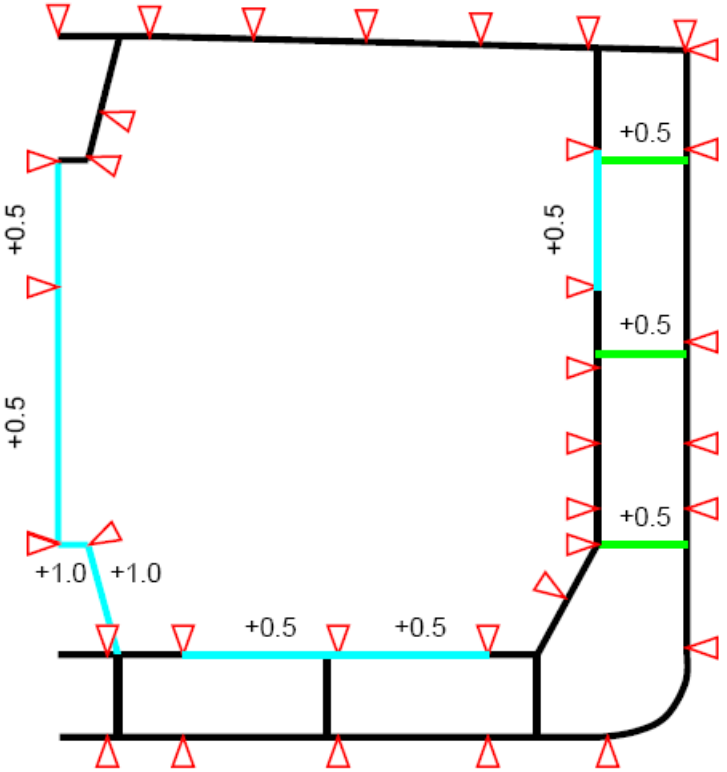

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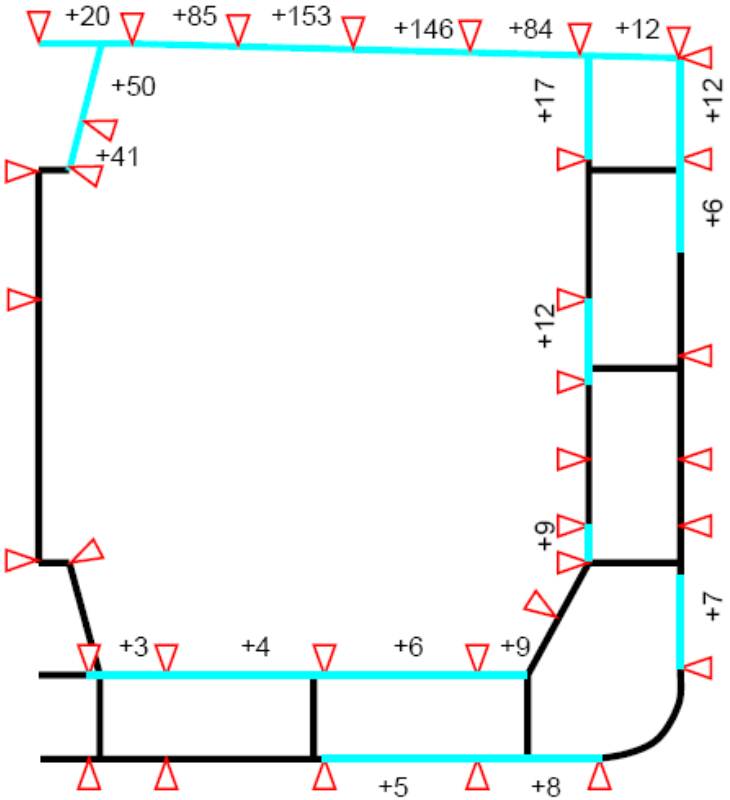
Prescriptive result - OT
48K Handymax, Stiffener

CSRH to CSR

[%]



CSRH to As-built

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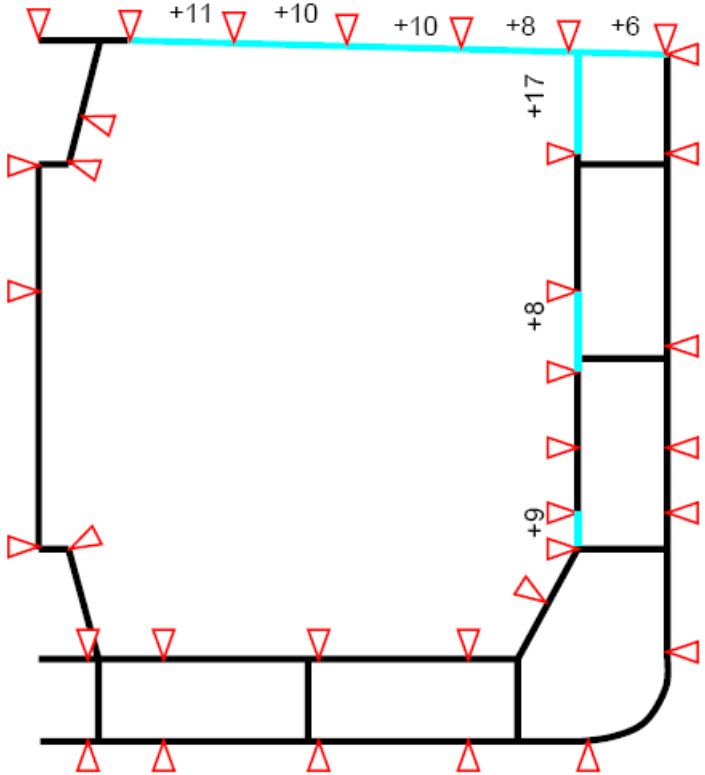

Preliminary Conclusion (1/2)
OT-Prescriptive Requirement

- For all tankers, scantling of keel plating, sheer strake & horizontal girder in wing ballast tank, increase due to minimum thickness requirement.
- For some tankers (Suezmax), scantling of inner bottom and side shell, increase due to minimum thickness requirement.
- Scantling of the tank boundaries will increase about 0.5~1.0mm due to the increased local pressure (e.g. P_{valve} considered in Dynamic condition).

Preliminary Conclusion (2/2)
OT-Prescriptive Requirement

- Requirement for the stiffener modulus increase a lot. However, the offered scantling should increase a little.
- Scantling of the stiffeners on tank boundaries increase, due to the increased local pressure (e.g. P_{valve} considered in Dynamic condition).
- The buckling utilization factor of stiffeners on deck and within 0.1D below deck at side increase, due to hull girder buckling requirement.

Preliminary FEA results

- No change to the scantlings of the CSR ships
- FEA is for the following members
  - Longitudinal structural members
  - PSM in the midship region
  - Members for transverse bulkhead
- Yielding: FE results are plotted showing the yielding utilization factor beyond 0.7.
- Buckling: FE results are plotted showing the buckling utilization factor beyond 0.7.

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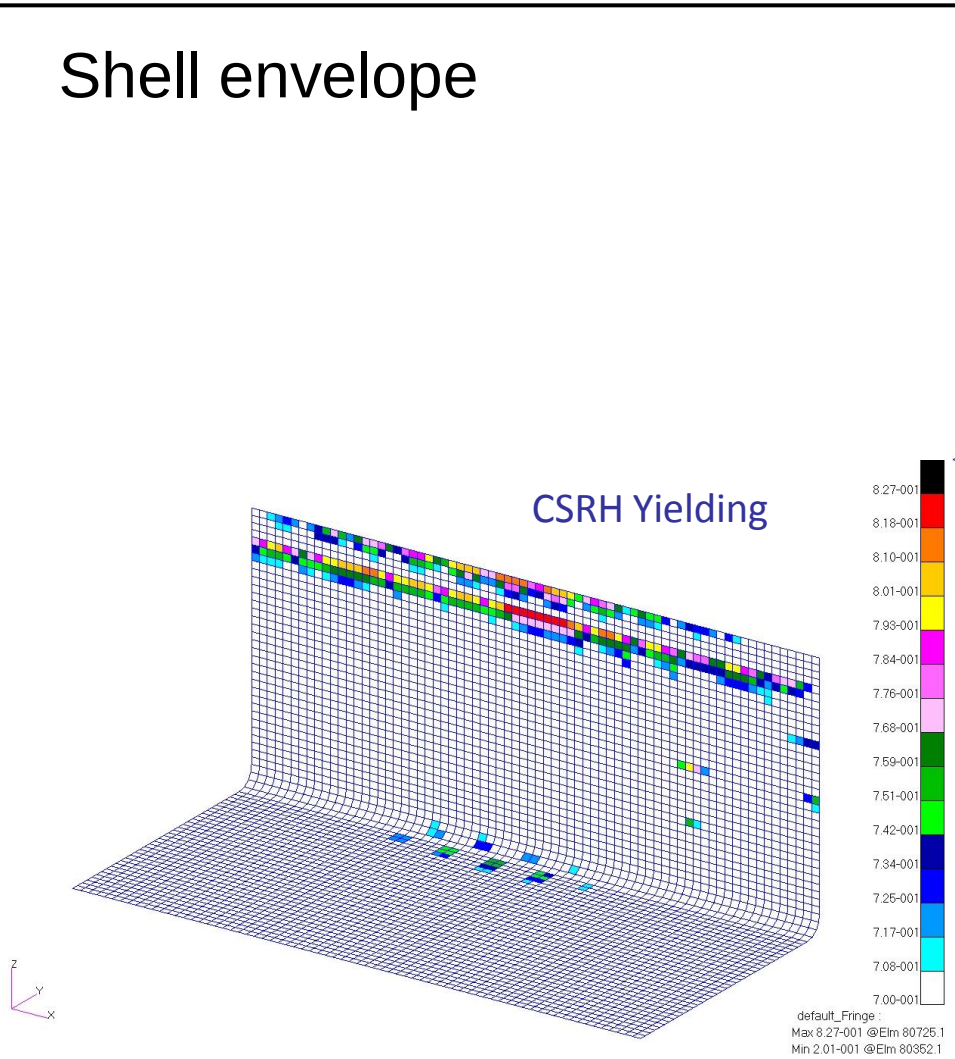
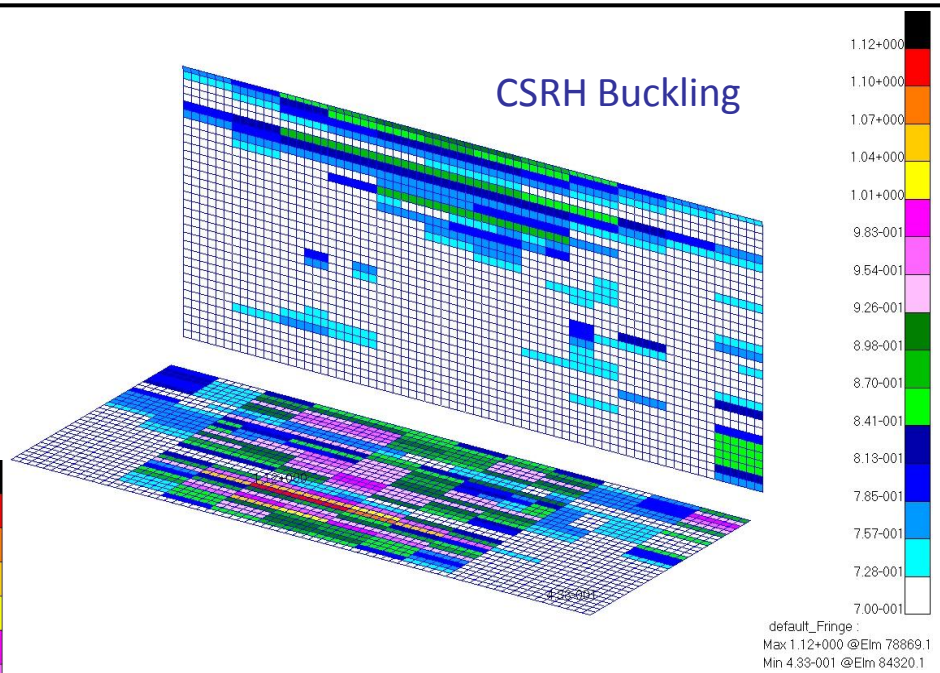
FE results: OT-320K VLCC (1/5)

Shell envelope





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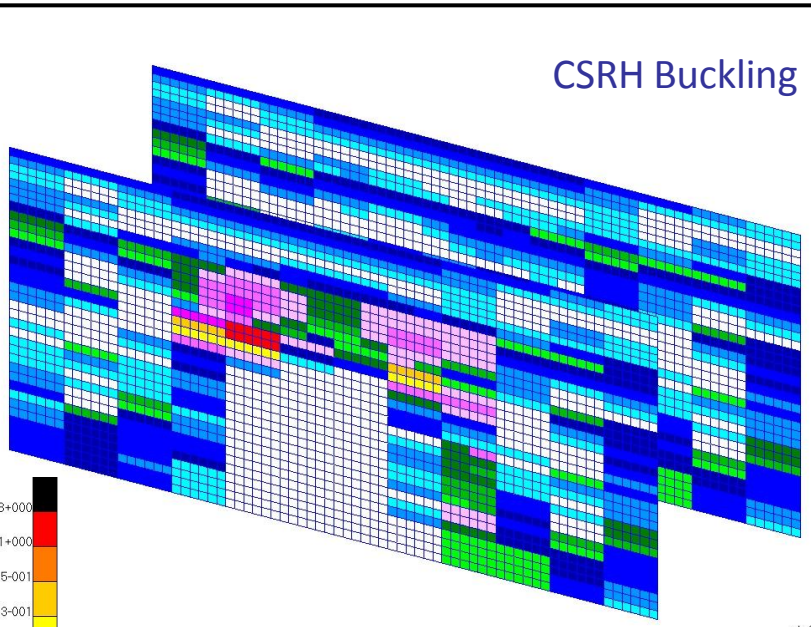
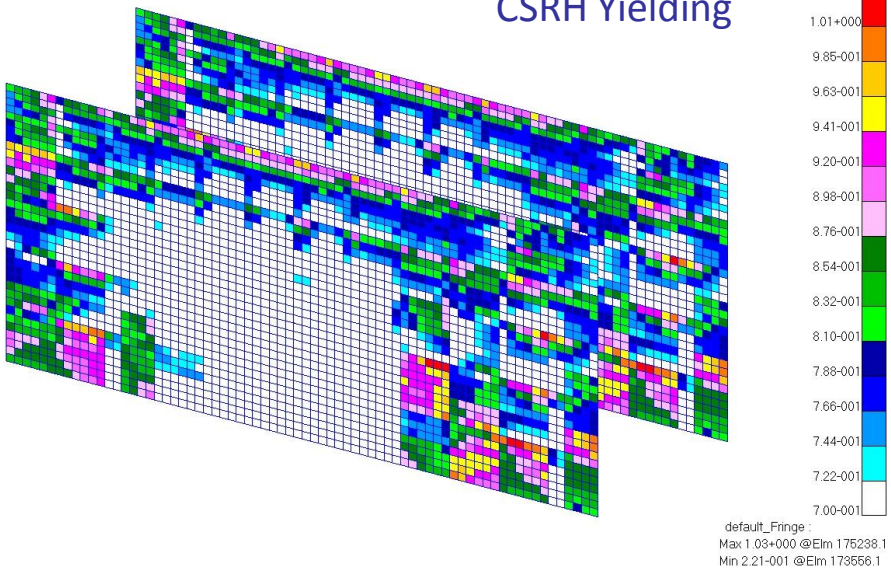
FE results: OT-320K VLCC (2/5)

Longitudinal bulkhead

CSRH Buckling

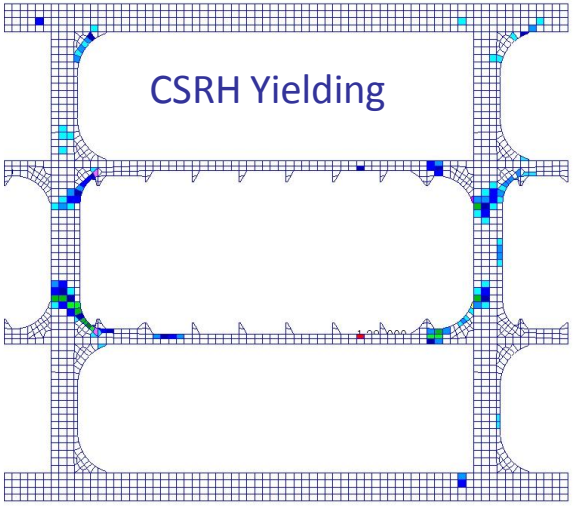


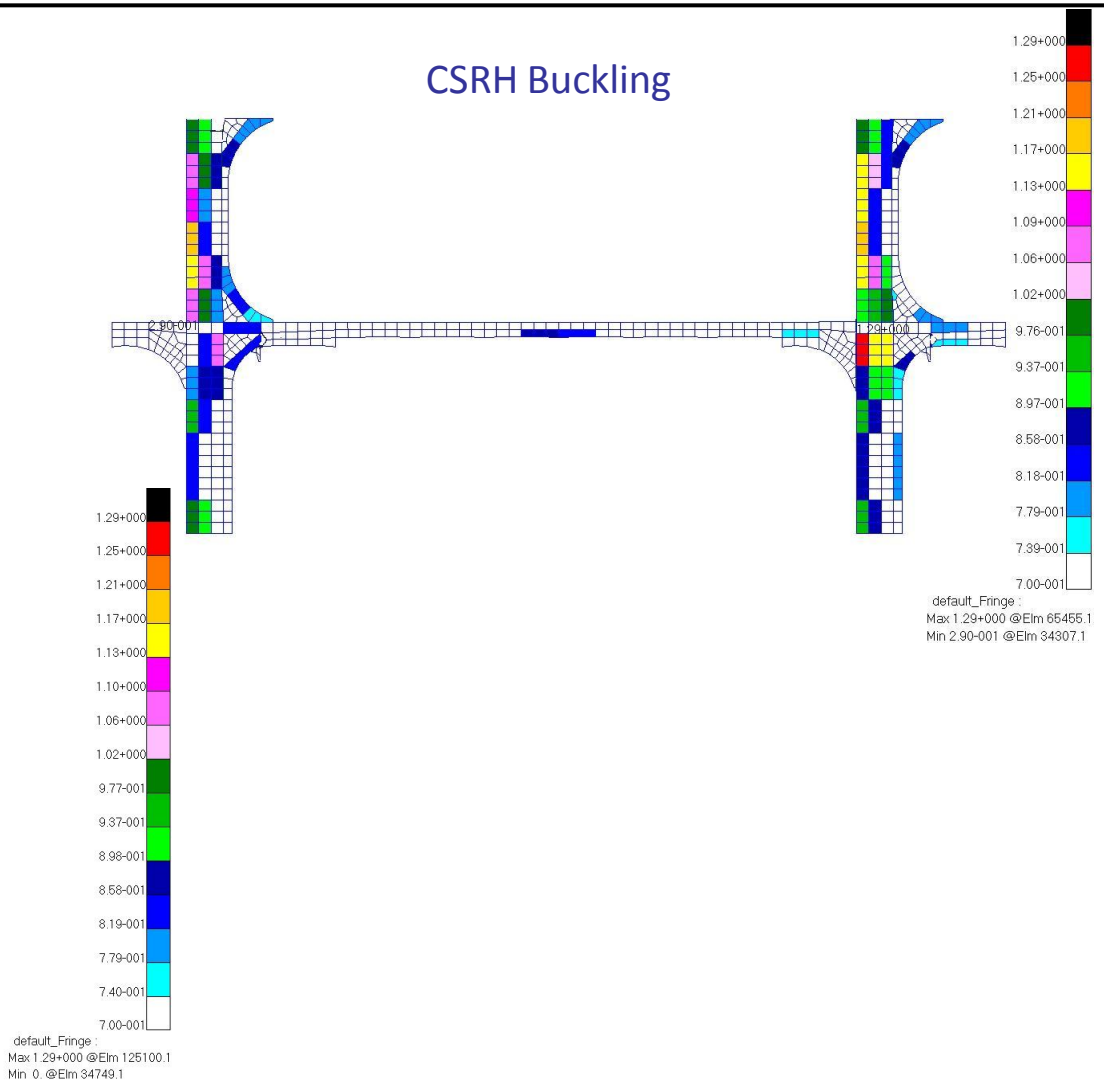
CSRH Yielding



FE results: OT-320K VLCC (3/5)

NO.2 Stringer

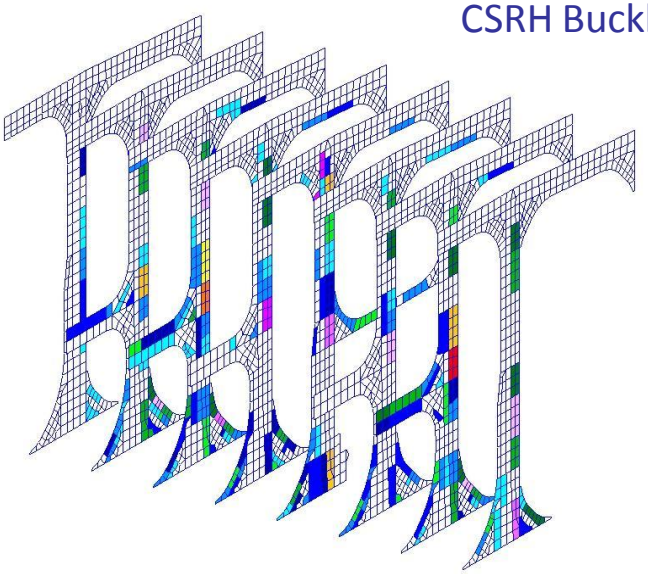


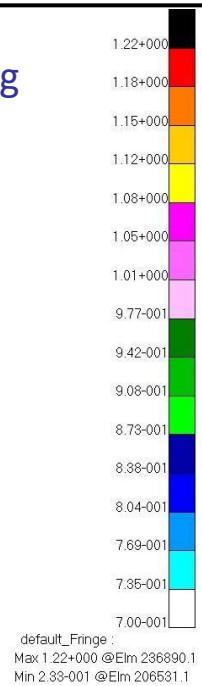


FE results: OT-320K VLCC (4/5)

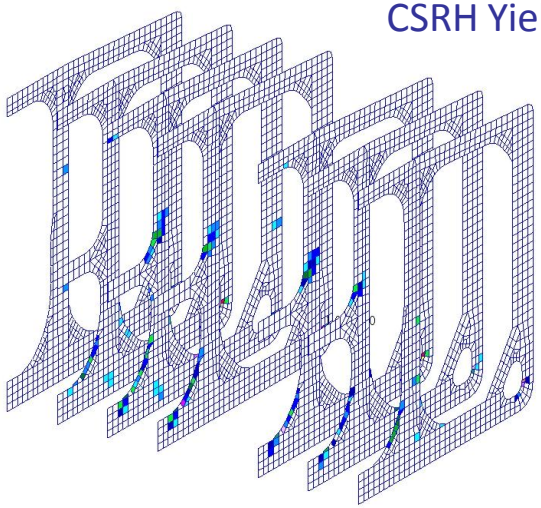
Typical web frame

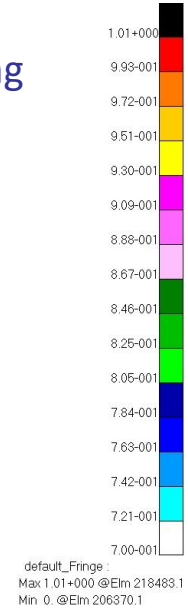
CSRH Buckling





CSRH Yielding





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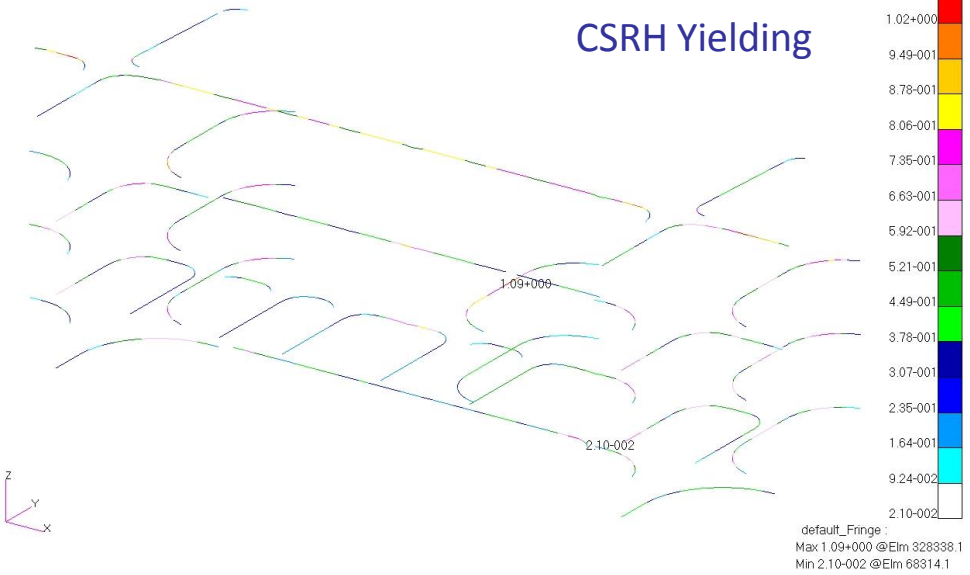
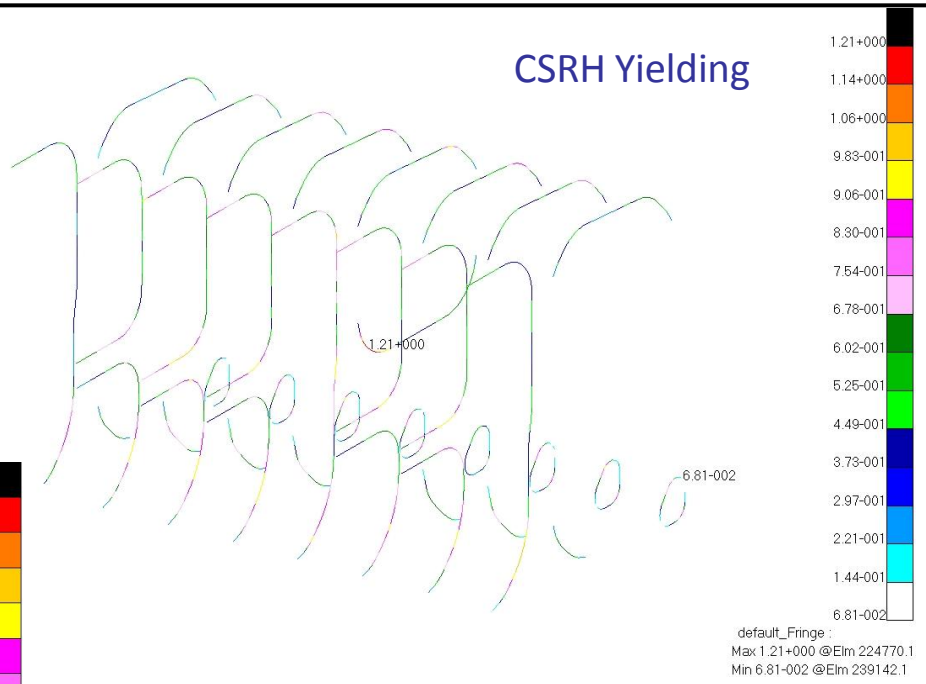
FE results: OT-320K VLCC (5/5)

Face plate of PSM

CSRH Yielding



CSRH Yielding



Preliminary Conclusion
VLCC-FE Assessment

- For FE buckling, the utilization factor of very local area not meet the requirement of CSRH.

- For FE yielding, the main members which stress beyond CSRH criteria: face plates of PSM
  - Increased internal pressure of tanks
  - Permissible stresses of higher tensile steel

- In general, the offered scantlings of VLCC comply with CSRH

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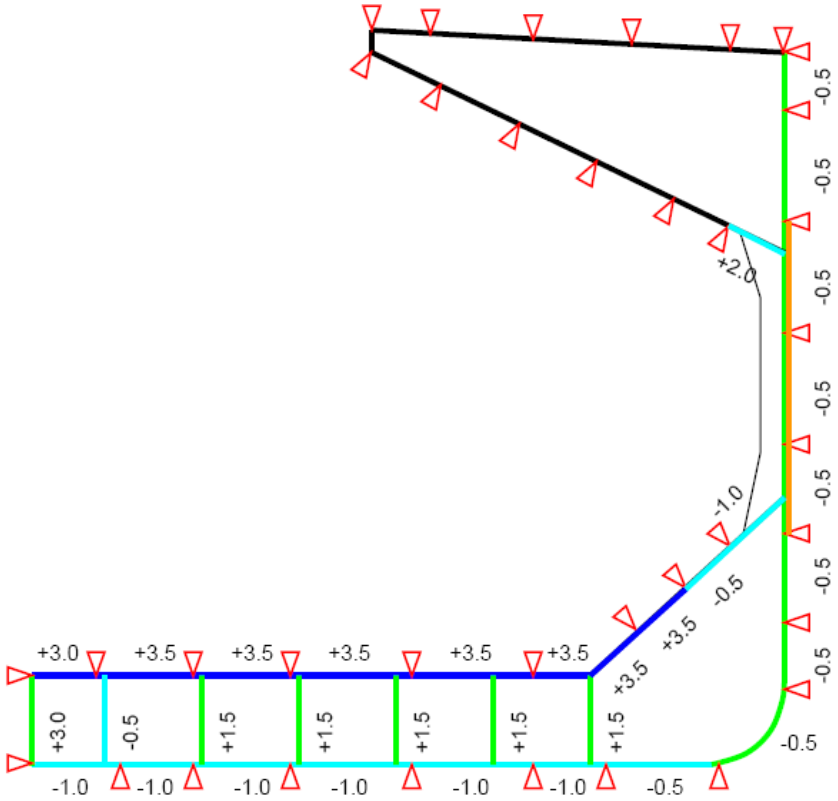
Prescriptive result
BC-206K Capesize, Plating (1/2)

Empty hold

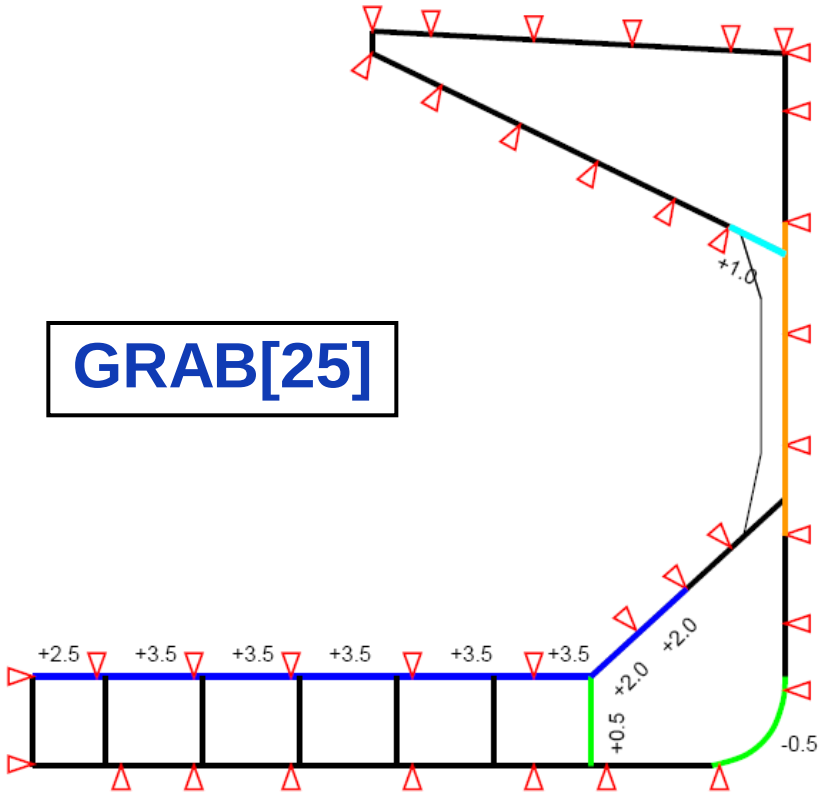
CSRH to CSR

[mm]



CSRH to As-built

[mm]



GRAB[25]

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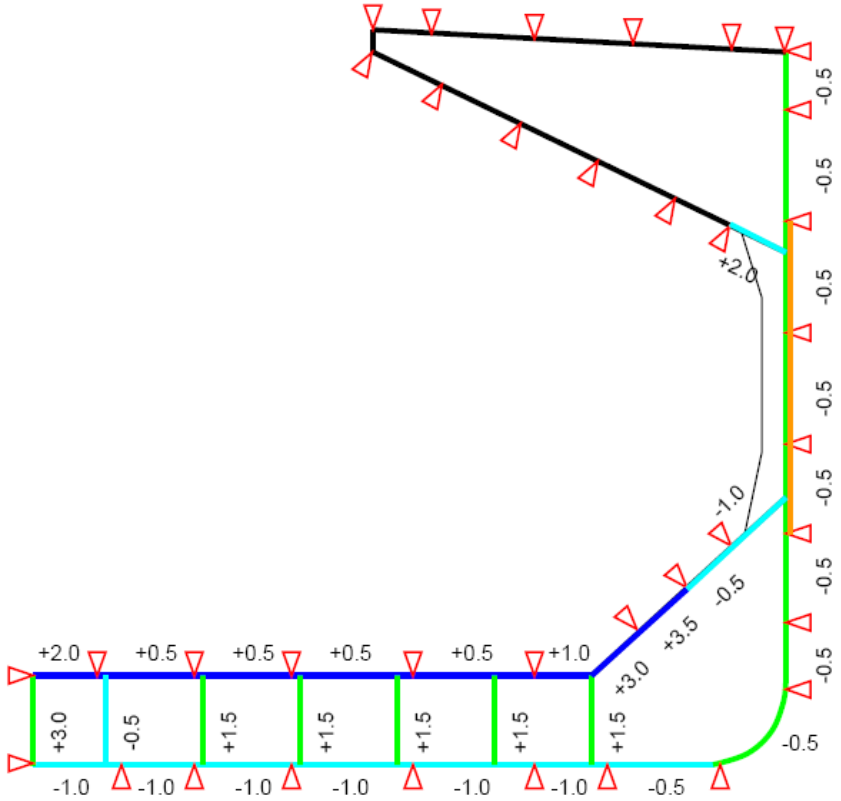
Prescriptive result
BC-206K Capesize, Plating (2/2)

CSRH to CSR

[mm]

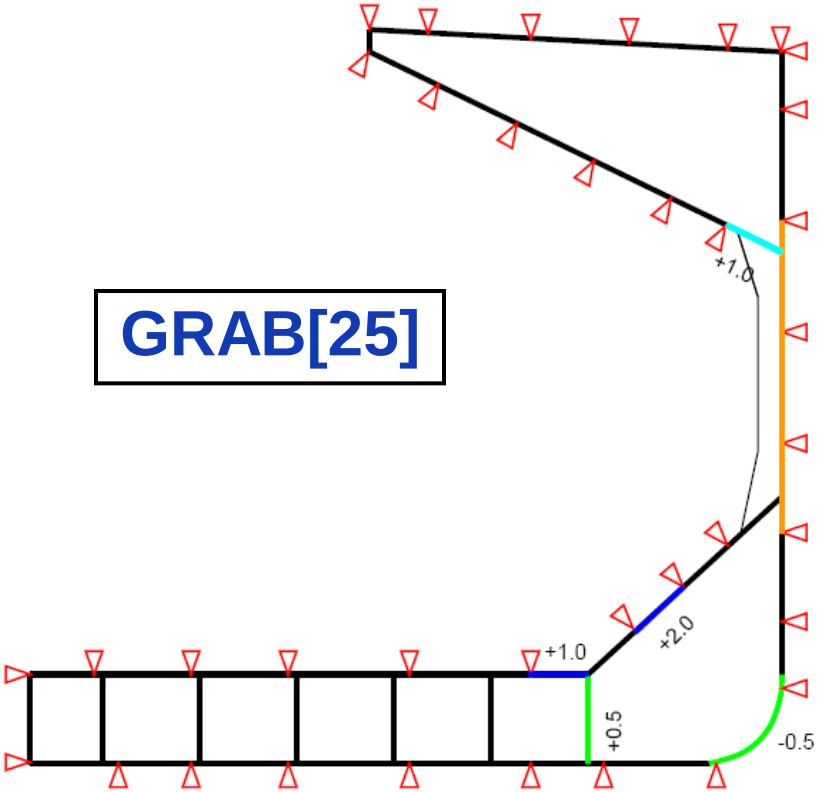
Loaded hold



CSRH to As-built

[mm]

GRAB[25]



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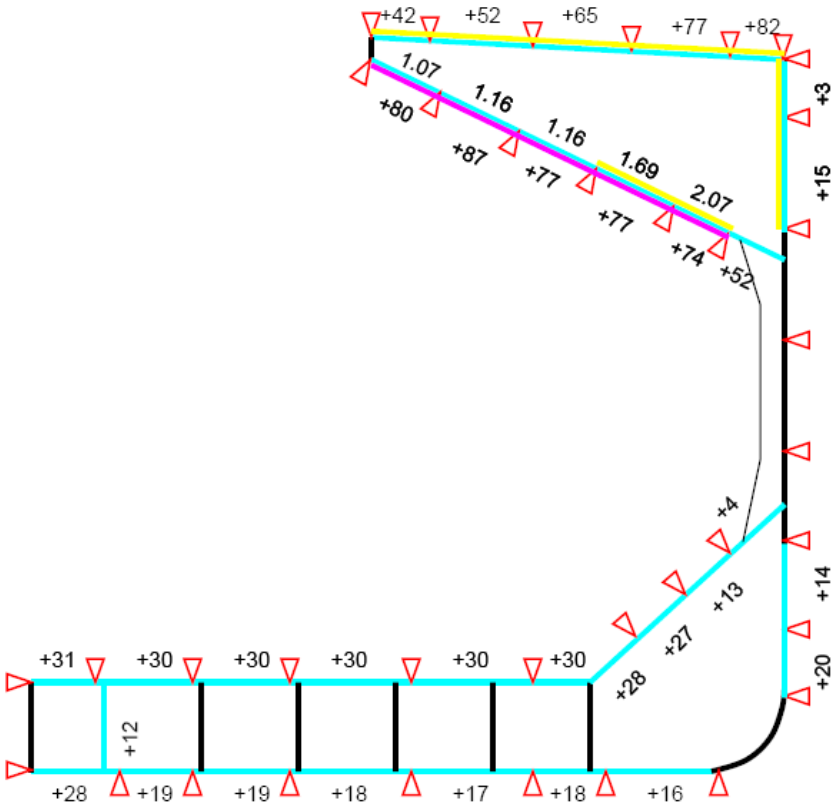
Prescriptive result
BC-206K Capesize, Stiffeners (1/2)

Empty hold

CSRH to CSR

[%]



CSRH to As-built

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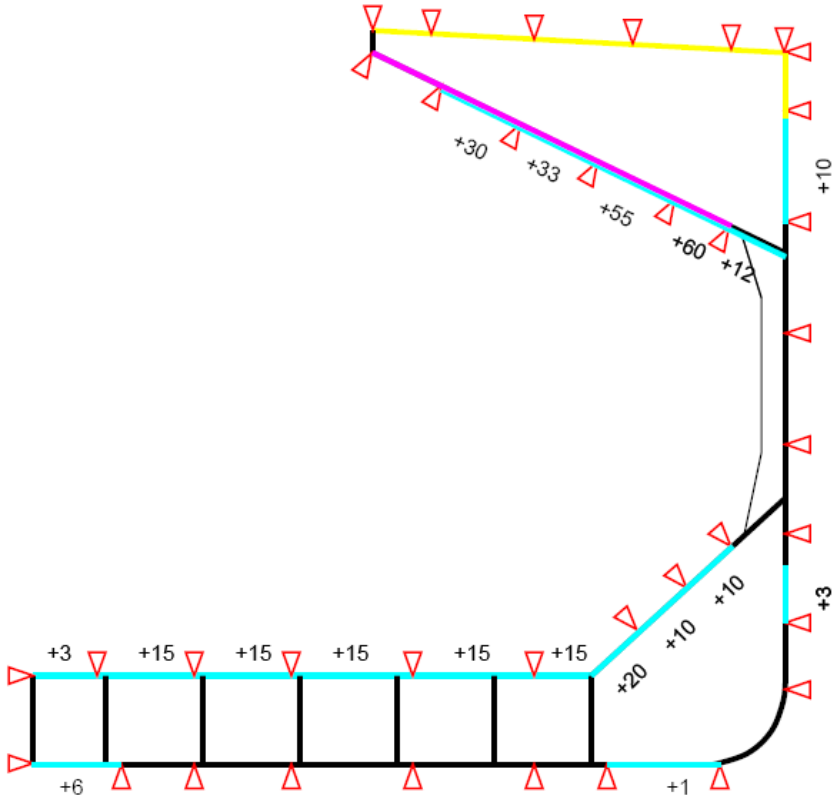
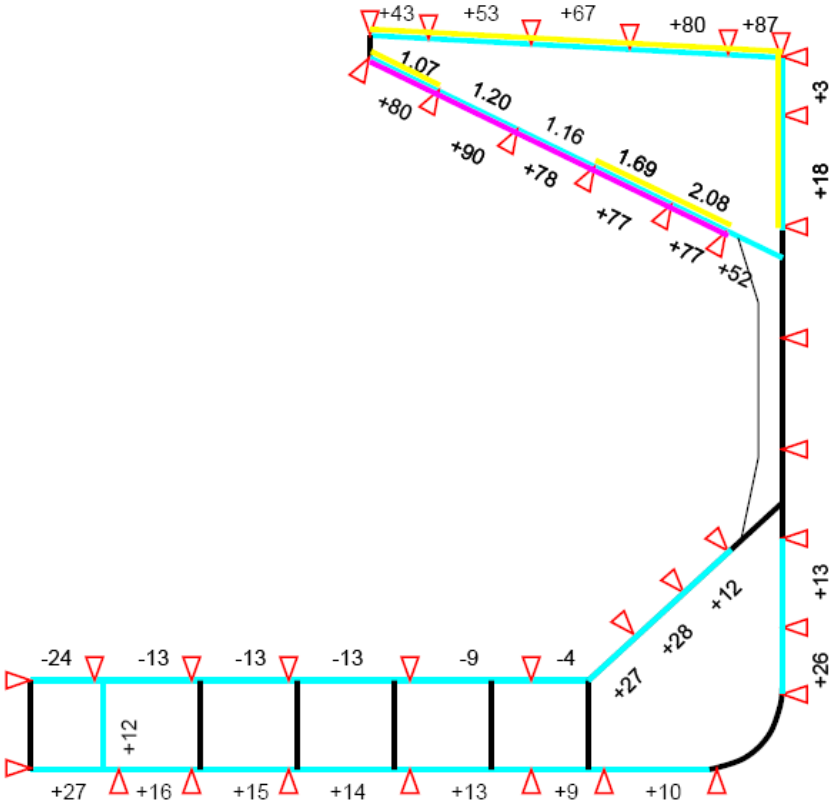


Prescriptive result
BC-206K Capesize, Stiffeners (2/2)

Loaded hold

CSRH to CSR

[%]



CSRH to As-built

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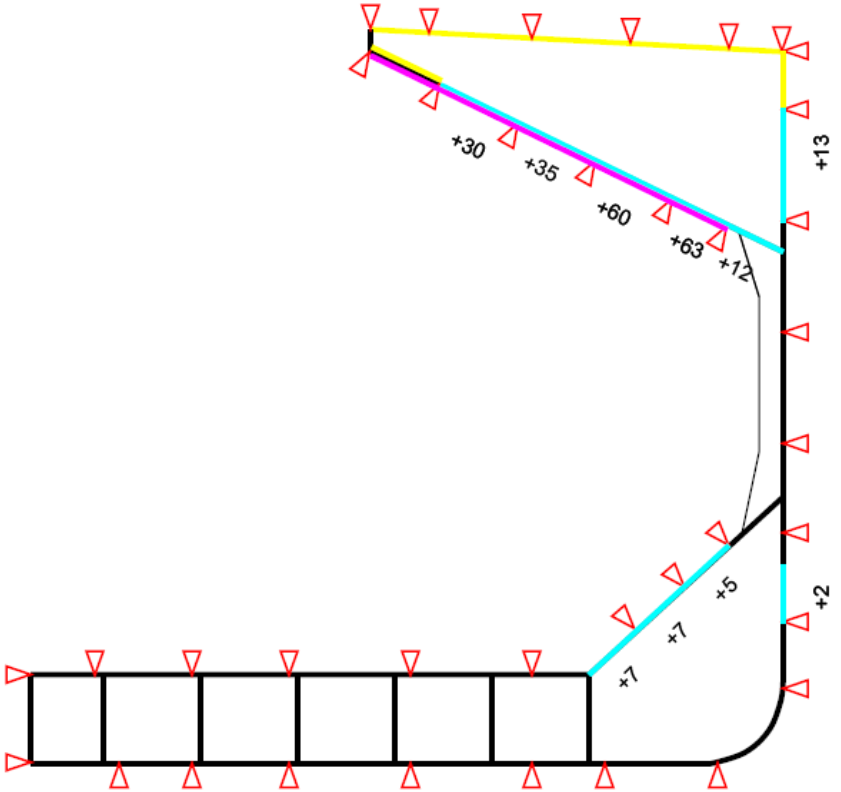

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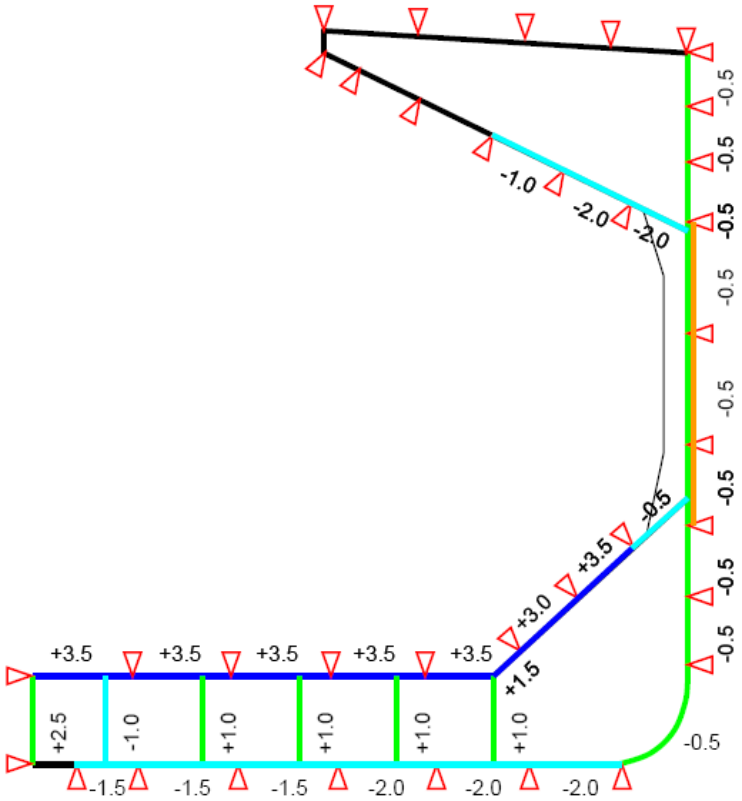
Prescriptive result
BC-118K Baby Cape, Plating (1/2)

Empty hold

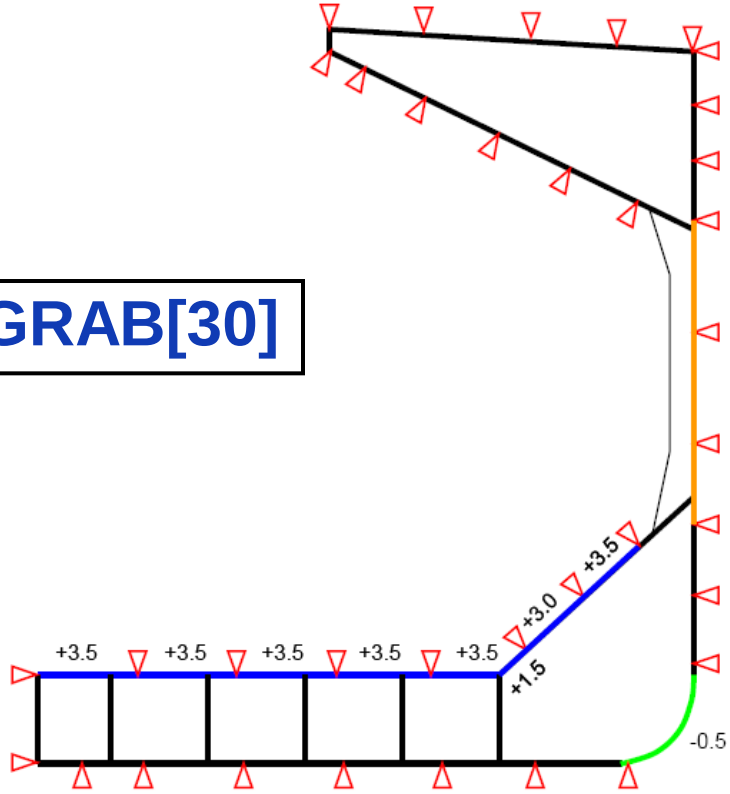
CSRH to CSR

[mm]



CSRH to As-built

[mm]

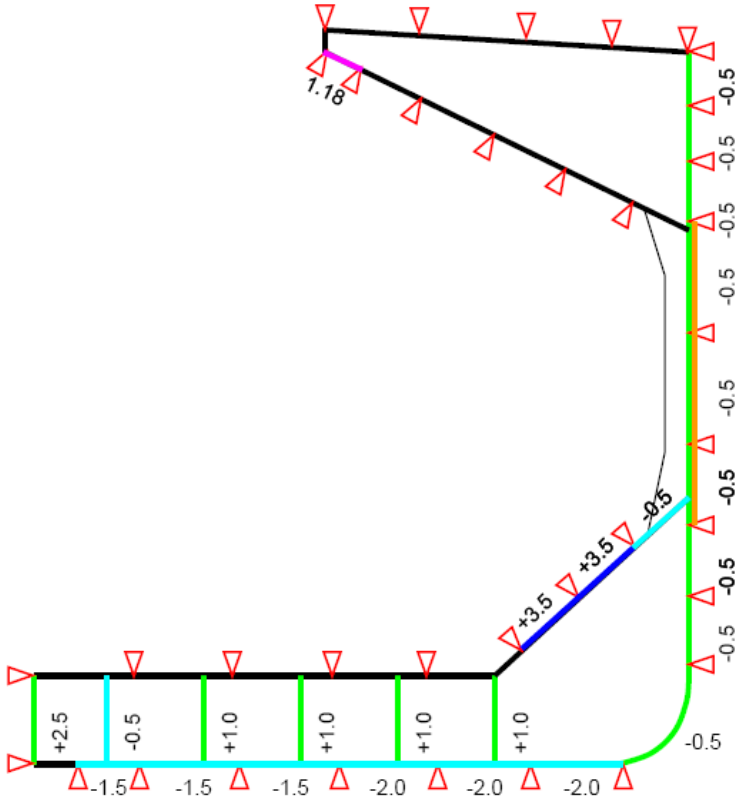


GRAB[30]

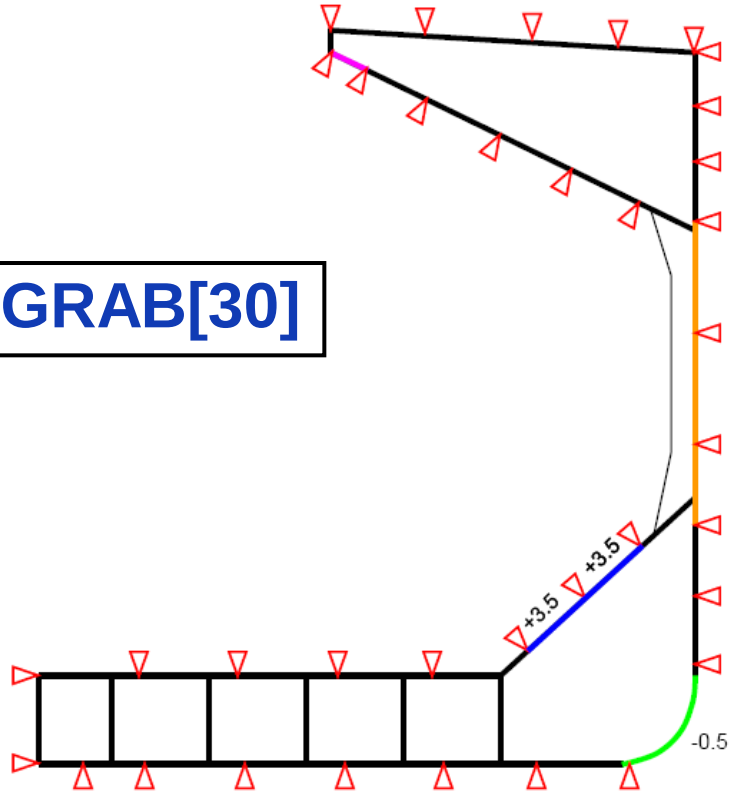
Prescriptive result
BC-118K Baby Cape, Plating (2/2)

Loaded hold

CSRH to CSR
[mm]



CSRH to As-built
[mm]



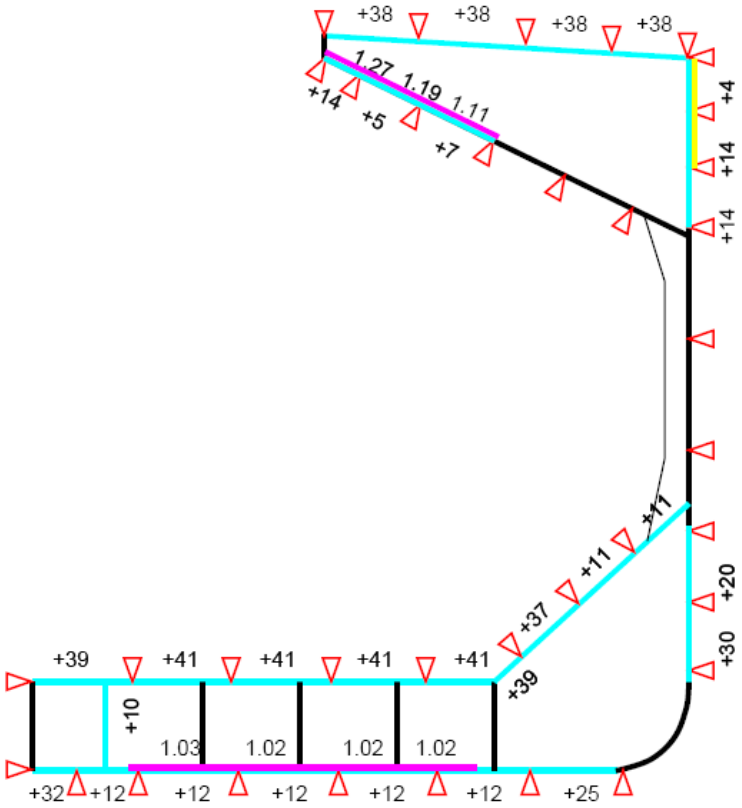
GRAB[30]

Prescriptive result
BC-118K Baby Cape, Stiffeners (1/2)

Empty hold

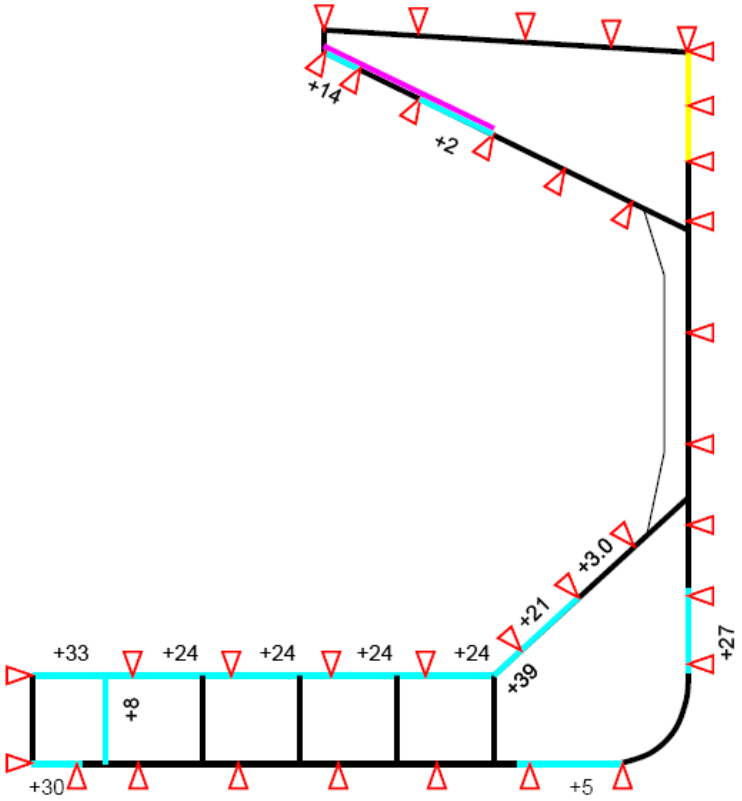
CSRH to CSR

[%]



CSRH to As-built

[%]



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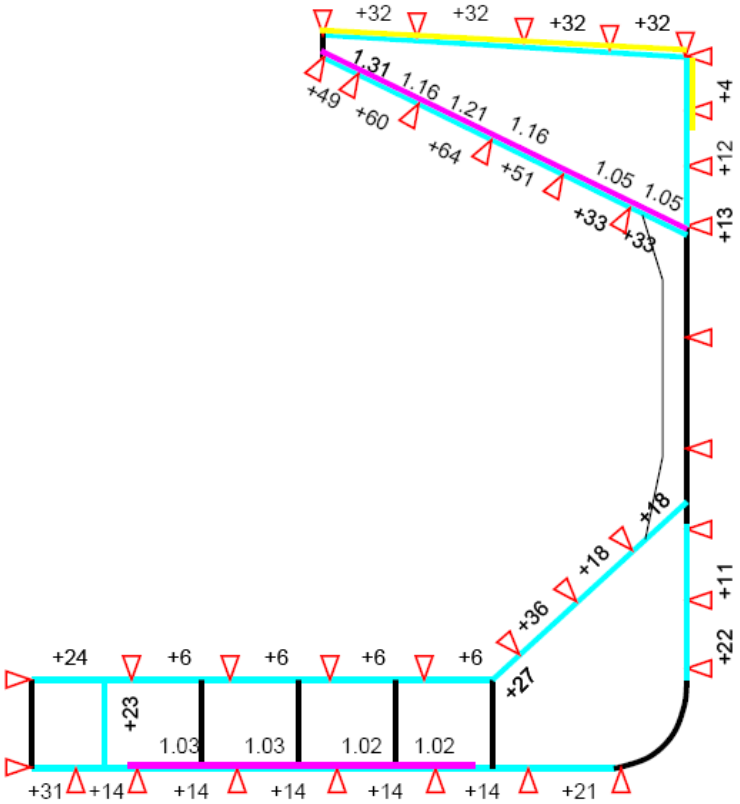
Prescriptive result
BC-118K Baby Cape, Stiffeners (2/2)

Loaded hold

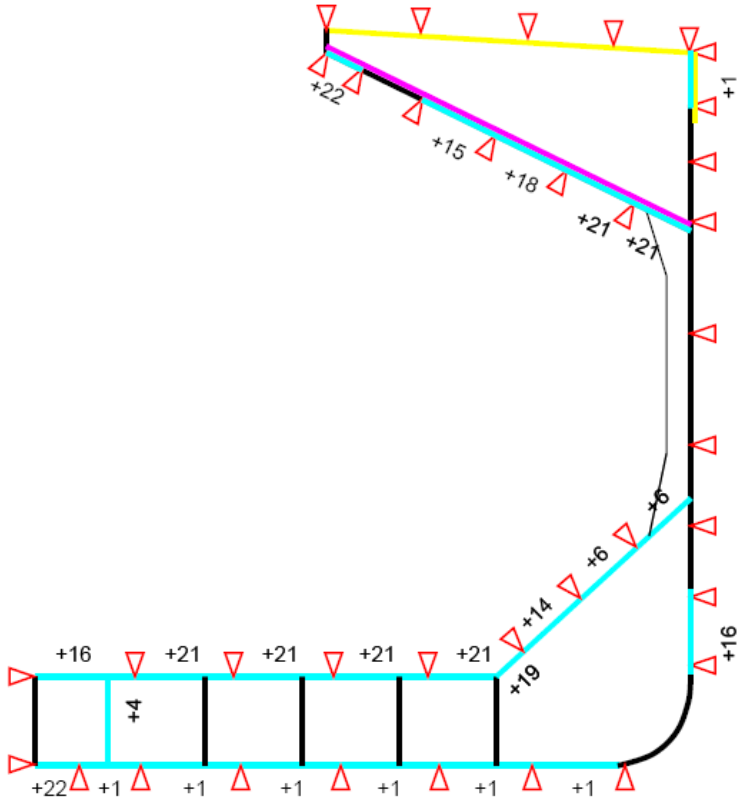
CSRH to CSR

[%]



CSRH to As-built

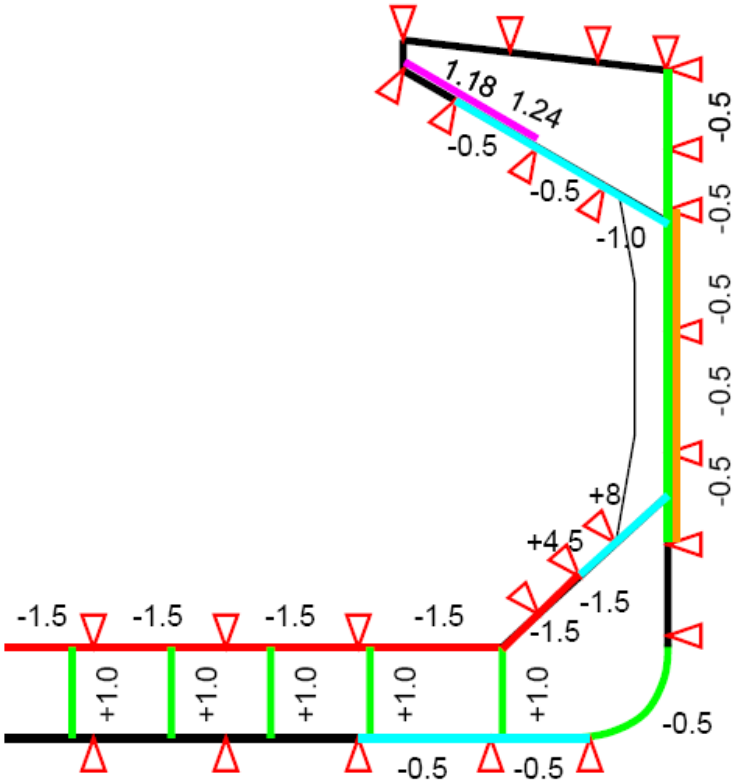
[%]



Prescriptive result
BC-57K Handymax, Plating (1/2)

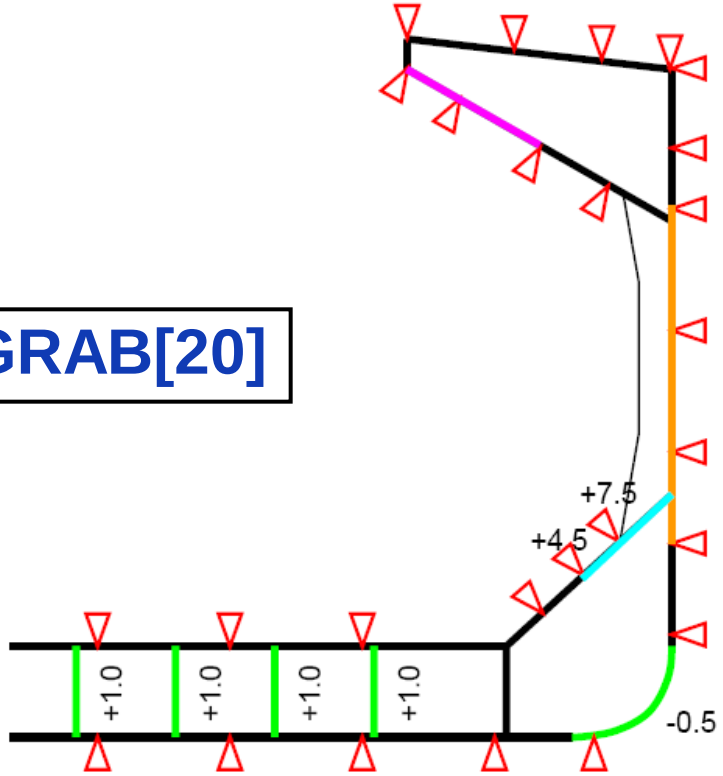
Empty hold

CSRH to CSR
[mm]



CSRH to As-built
[mm]

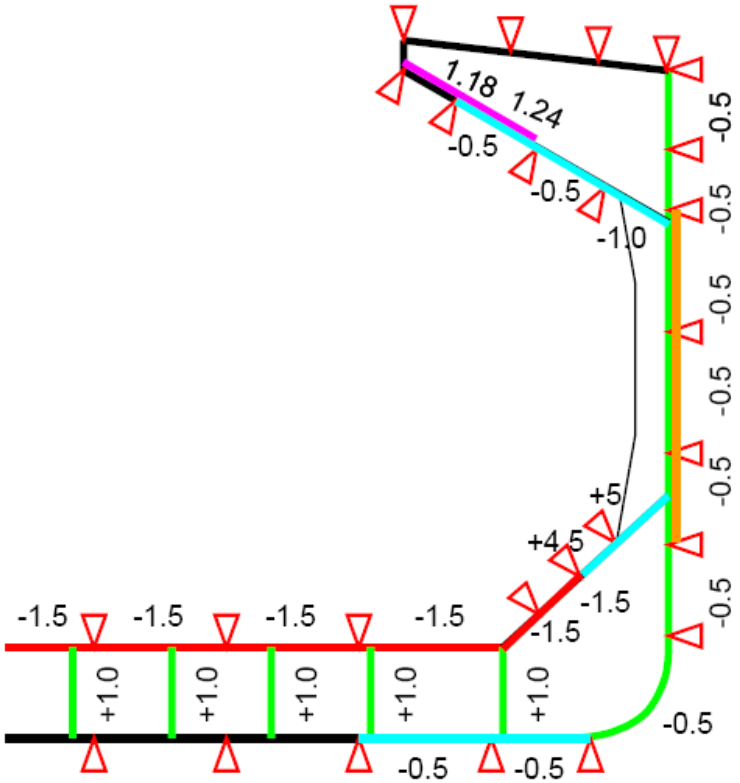
GRAB[20]



Prescriptive result
BC-57K Handymax, Plating (2/2)

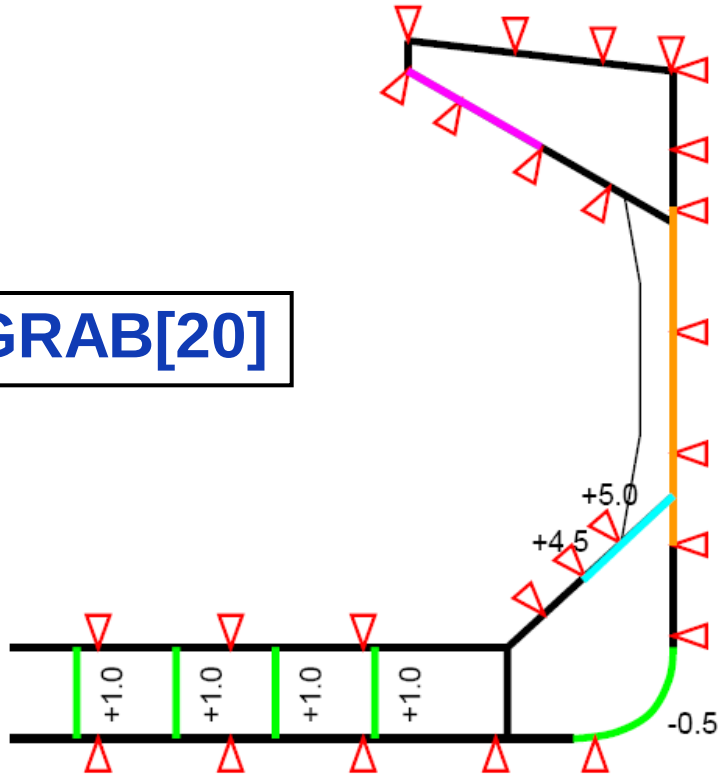
Loaded hold

CSRH to CSR
[mm]



CSRH to As-built
[mm]

GRAB[20]



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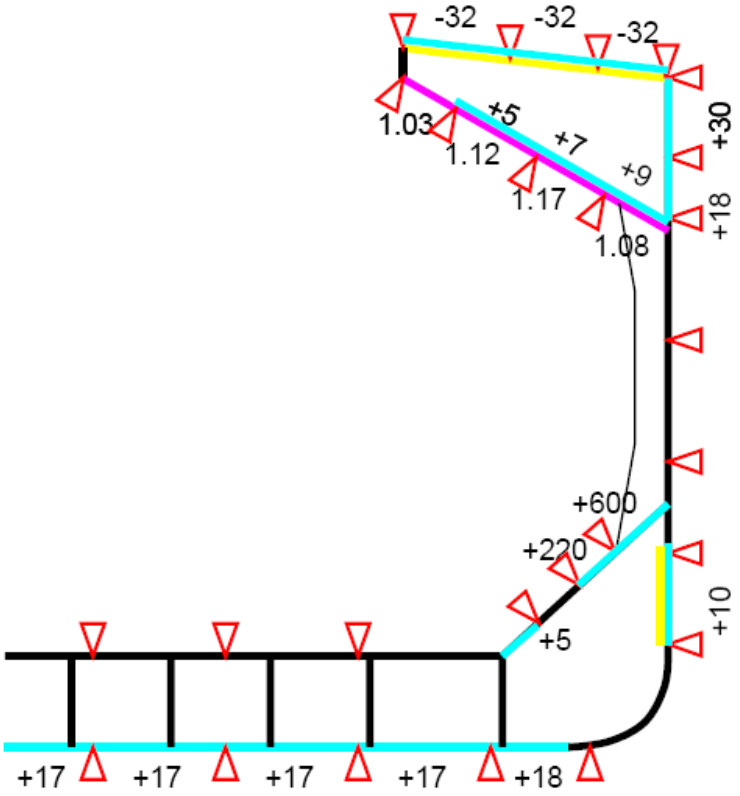
Prescriptive result
BC-57K Handymax, Stiffeners (1/2)

Empty hold

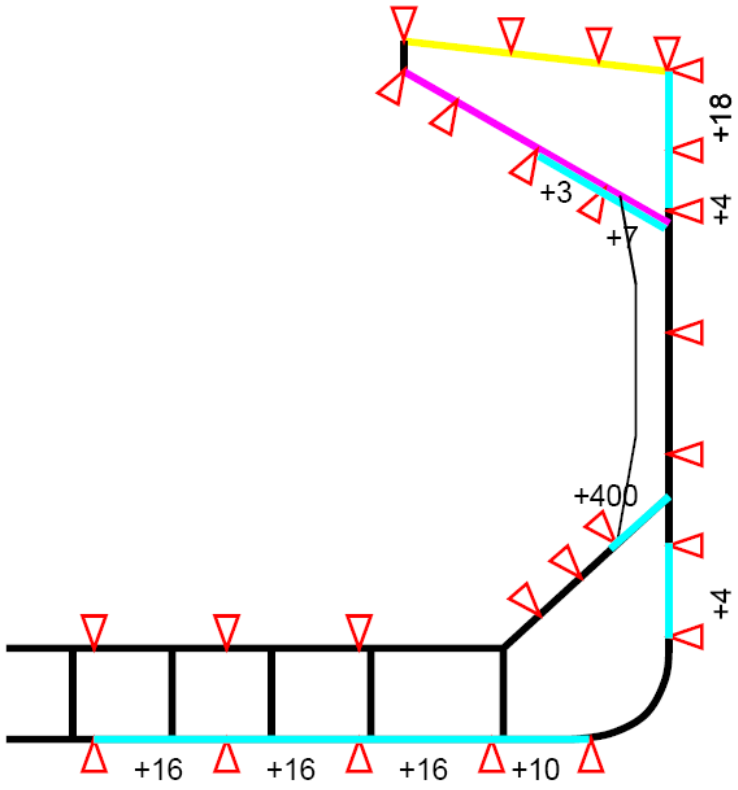
CSRH to CSR

[%]



CSRH to As-built

[%]



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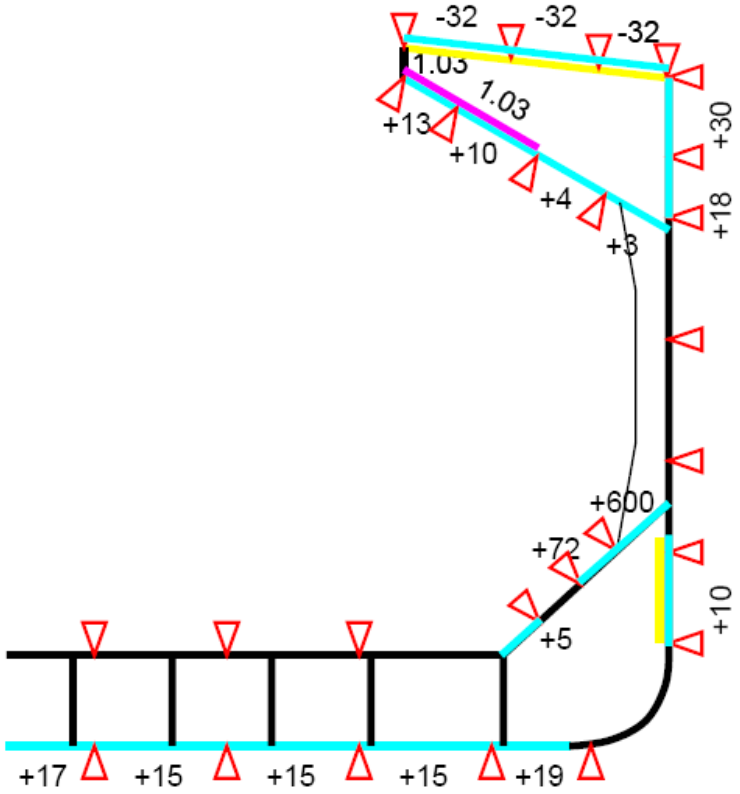
Prescriptive result
BC-57K Handymax, Stiffeners (2/2)

Loaded hold

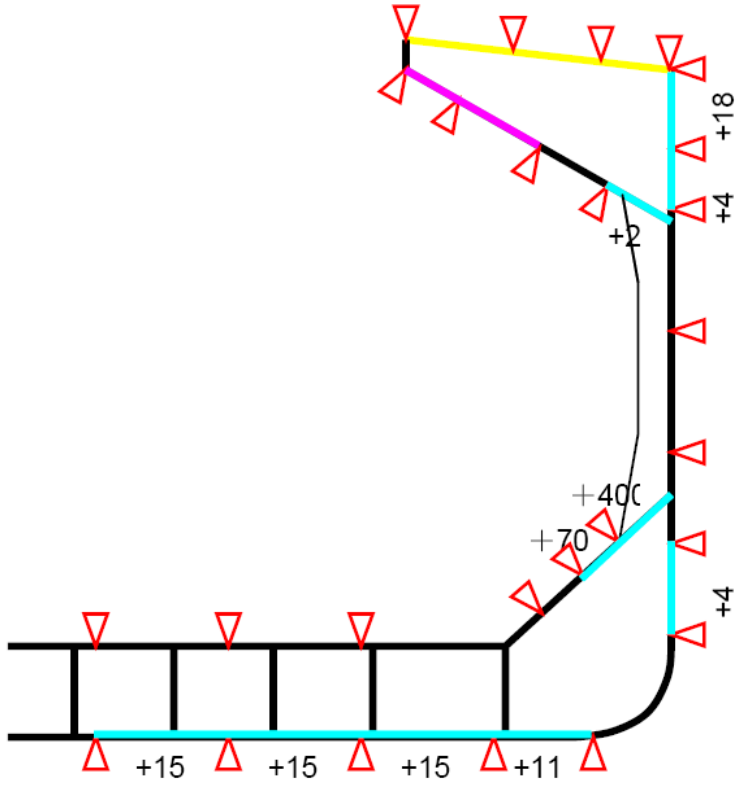
CSRH to CSR

[%]



CSRH to As-built

[%]



Preliminary Conclusion (1/2)
BC-Prescriptive Requirement

- Double bottom girder, due to minimum thickness requirement:
  - Centre girder, 1.5~3.0mm
  - Other girder, 1.0mm

  However, maybe little impact on the real scantling.
- Side shell in the quay contact region decrease 0.5mm. Serious buckling occurs for the single side shell.
- Grab[40]: > 70,000 dwt, the thickness of inner bottom, hopper & the lower stool side plate of T.BHD increase remarkably. (up to 4.5mm)

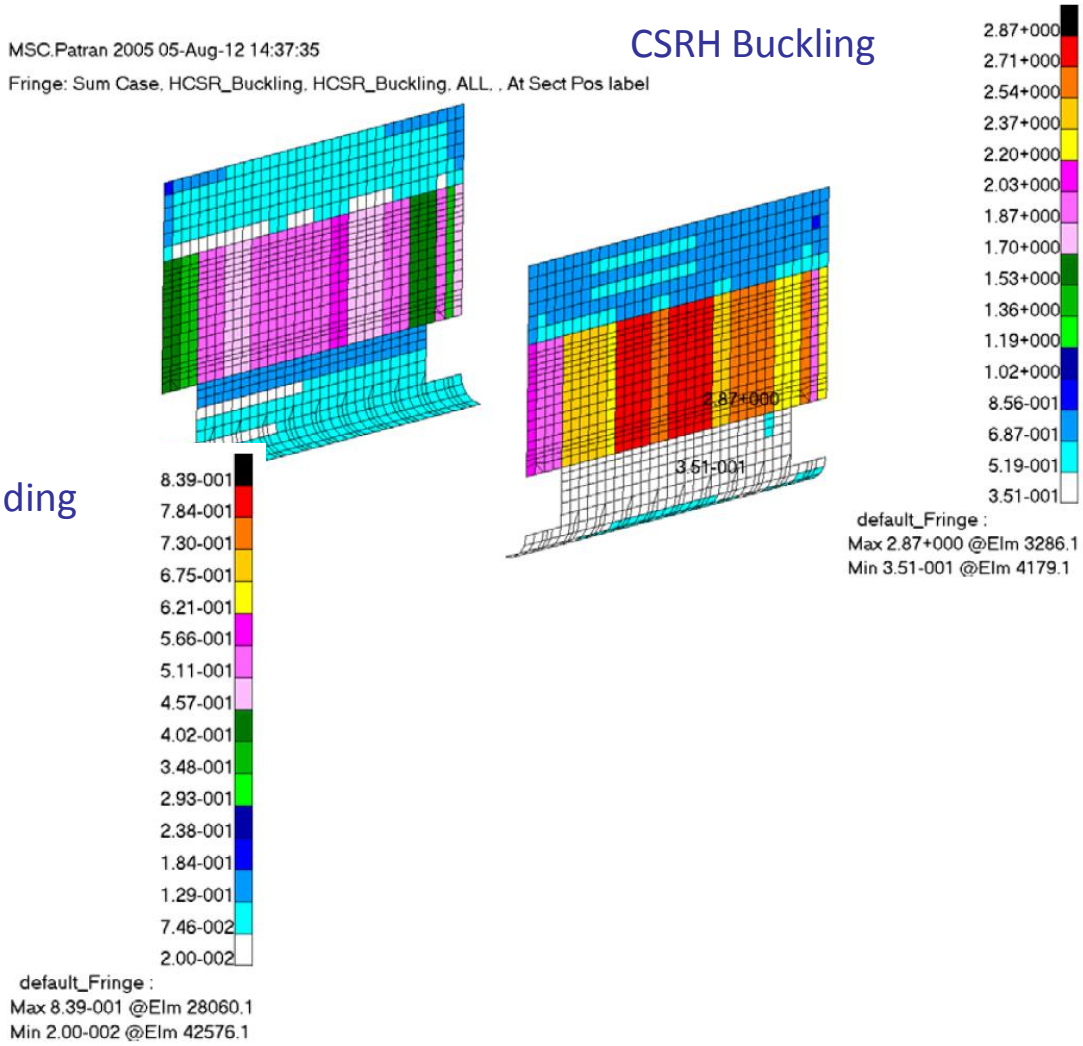
Preliminary Conclusion (2/2)
BC-Prescriptive Requirement

- Requirement for the longitudinal modulus increase a lot.
- Fatigue of the longitudinals on the deck and within 0.1D below deck at side, dose not meet the requirement of CSRH generally.
- Buckling of topside tank sloping plating longitudinals: requirement of CSRH is more rigorous than that of CSR.

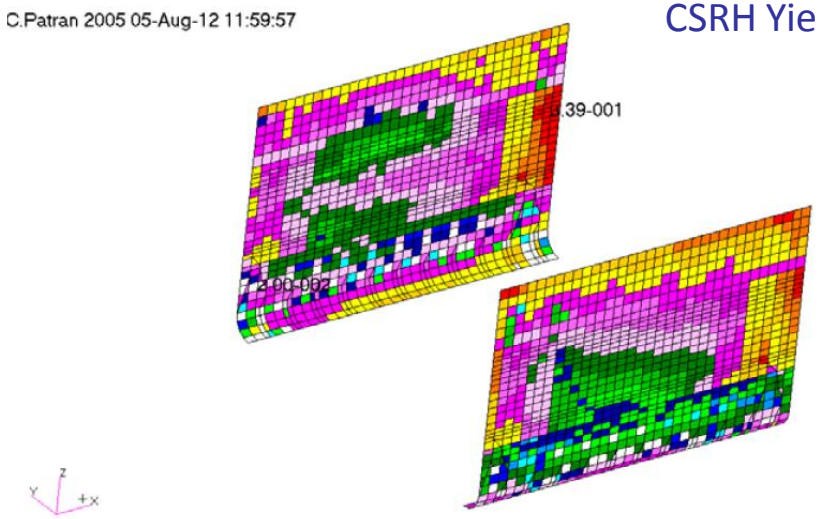
FE results: BC-82K Panamax (1/4)

Side shell (Ballast hold)

CSRH Buckling



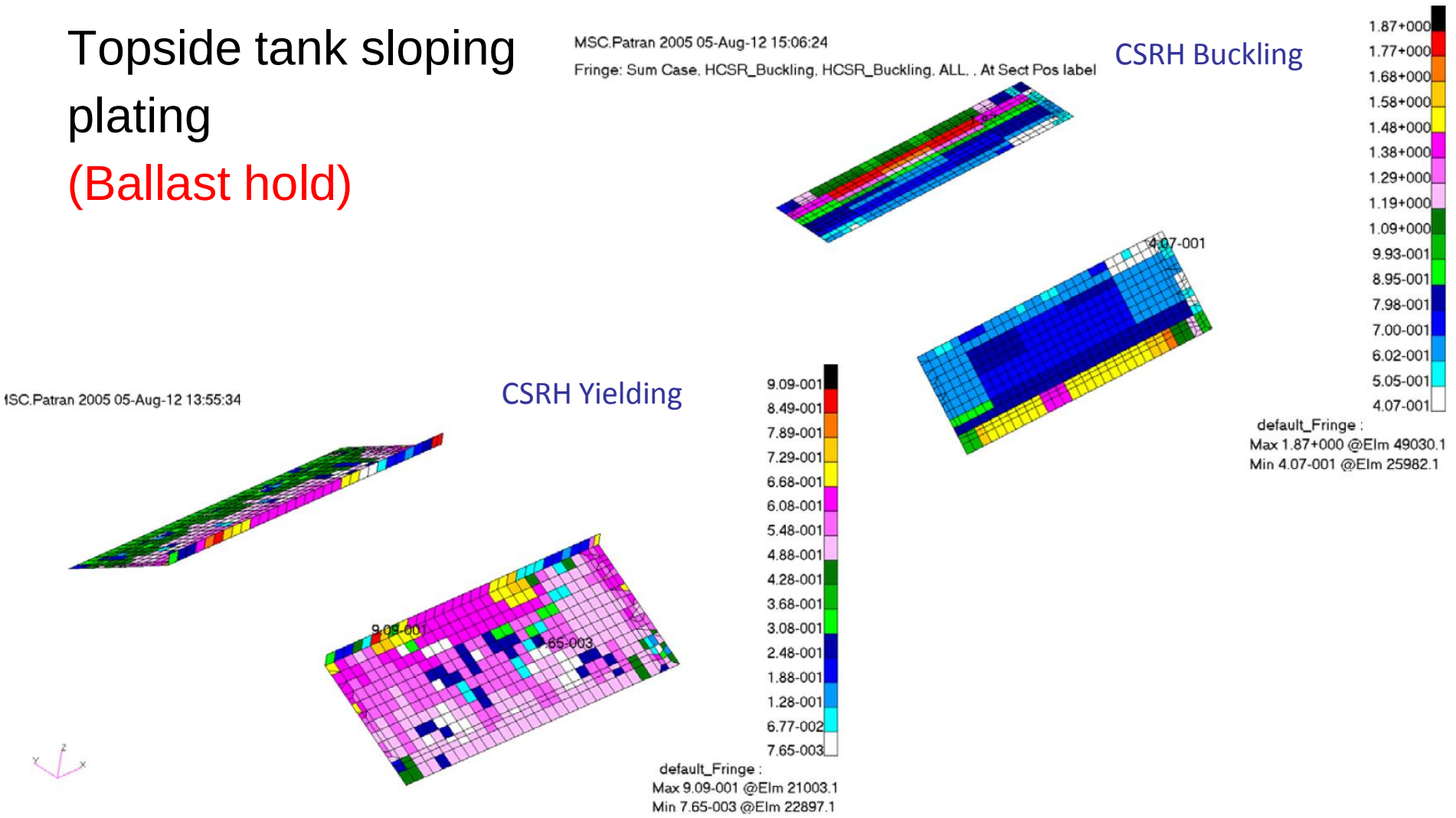
CSRH Yielding



FE results: BC-82K Panamax (2/4)

Topside tank sloping plating

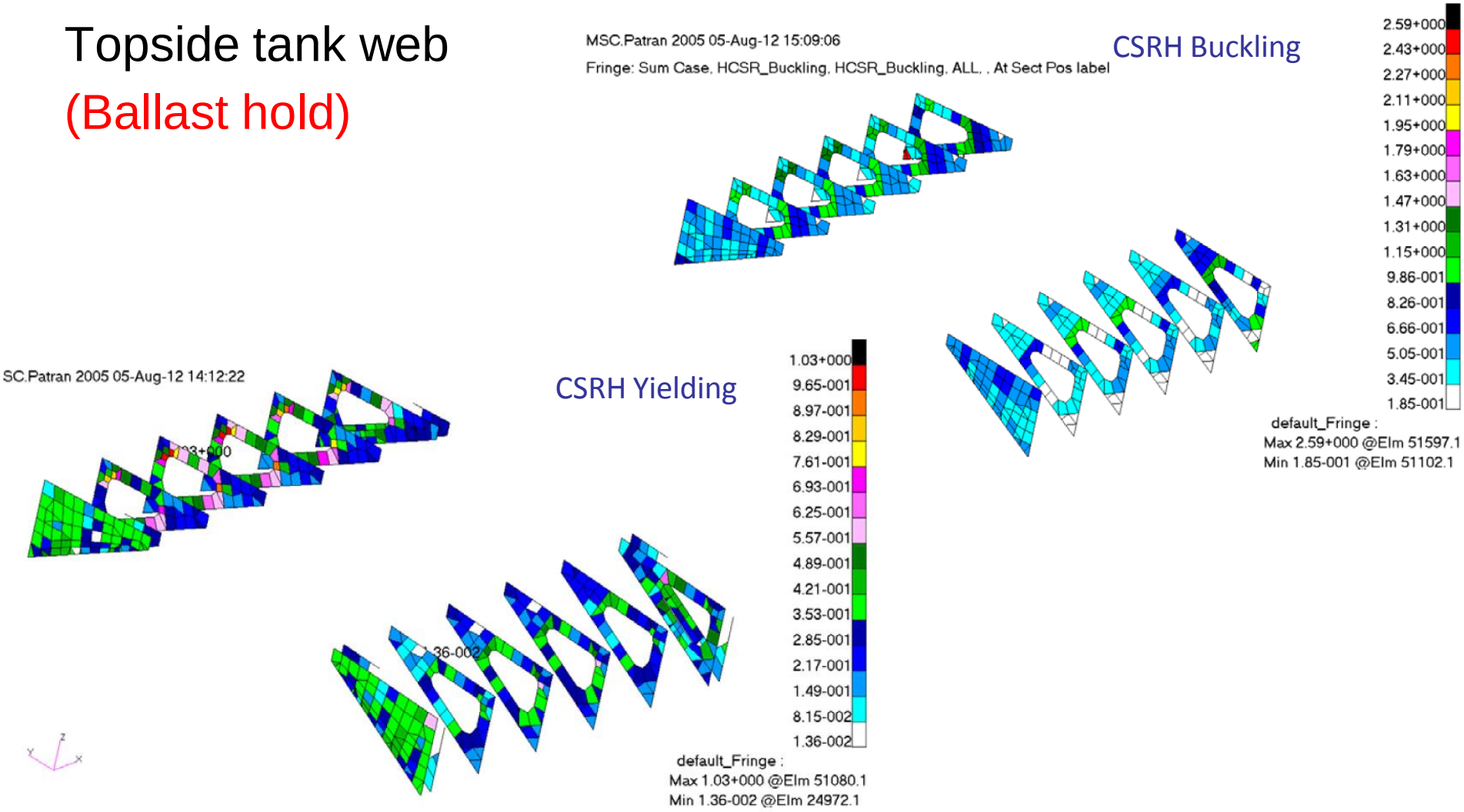
(Ballast hold)



FE results: BC-82K Panamax (3/4)

Topside tank web

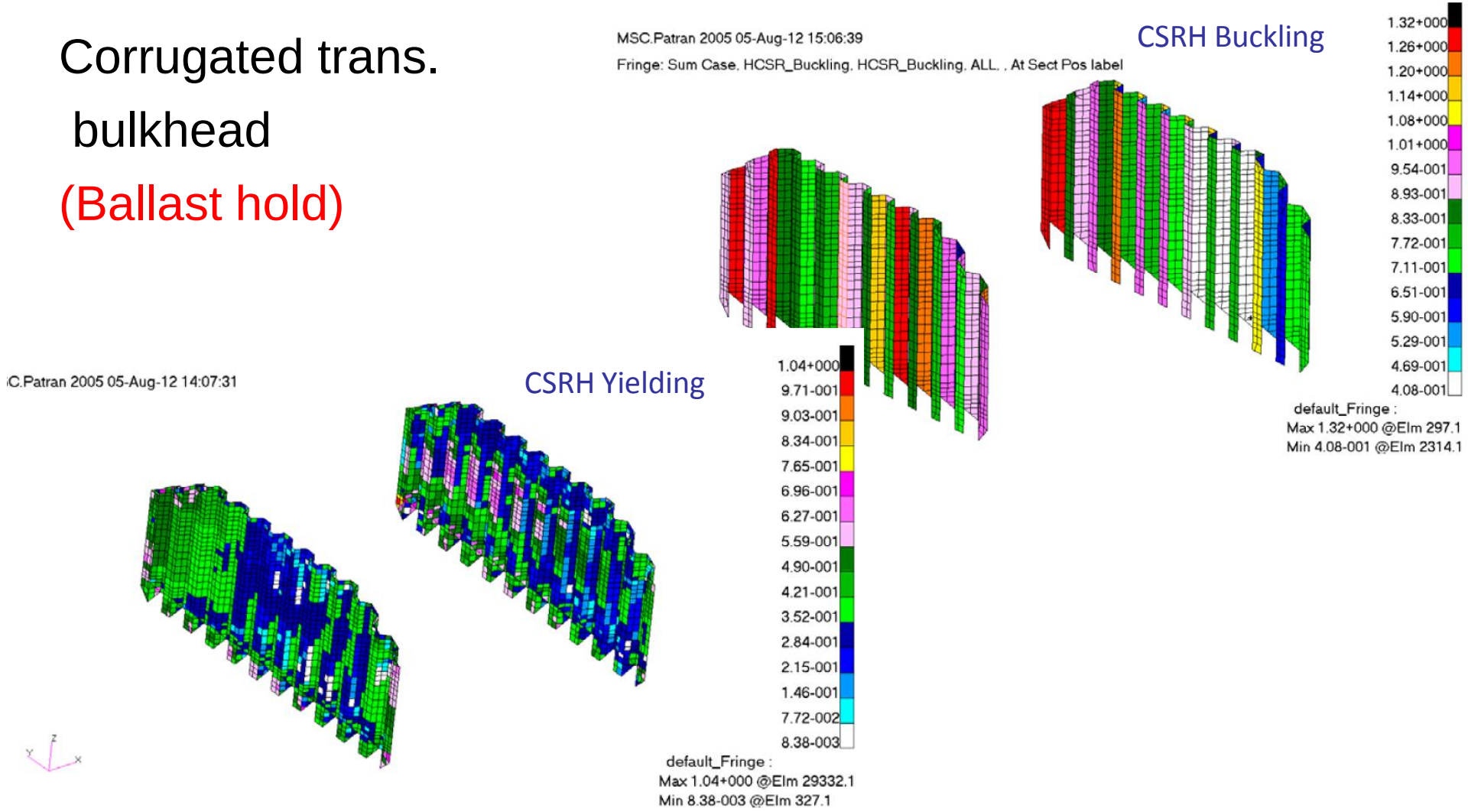
(Ballast hold)



FE results: BC-82K Panamax (4/4)

Corrugated trans. bulkhead

(Ballast hold)



Preliminary Conclusion
82K Panamax-FE Assessment

- FE buckling of CSRH makes a great impact on BC.
  - Single side shell
  - Topside tank web
  - Topside tank sloping plating
  - Corrugated trans. bhd
- FE yielding of CSRH makes a little impact on BC.
- The FE model of CSR-BC to be modified according to the modeling requirement of CSRH, such as deleting the openings and so on.

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Weight increase estimation

- Weight increase estimation for Oil tankers is as follows:

[Unit : ton]

	VLCC	Suezmax	Aframax	Panamax	Handymax
Weight Increase （Preliminary）	**+71 (1.2%)**	**+22 (0.8%)**	**+31 (1.9%)**	**+15 (1.0%)**	**+15 (1.6%)**

Note: Only one cargo tank in amidship, including one W.T. Trans. BHD

- Weight increase estimation for Bulk carriers does not carried out due to a lot of items “in progress”.

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Conclusions (1/2)

- By our preliminary CA, it is found that:
  - Increase of scantlings due to prescriptive requirement is higher than that due to FE yielding.
  - The impact of CSRH on Bulk Carriers is greater than that on Oil Tankers.
- Some findings during IACS CA or industry review are to be paid more attention, especially for Bulk Carriers:
  - Buckling issues, e.g. for single side shell
  - Fatigue issues, e.g. for longitudinal end connections in the region of upper deck and 0.1D below
  - GRAB [40] too strict, GRAB [25] acceptable
  - Impact of Harbour condition on local scantlings

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Conclusions (2/2)

- For the next, we Chinese industry will investigate the mentioned findings and pay more attention to the CA for outside midship, but the followings should be guaranteed:
  - 13 “in progress” items to be finished, especially for fatigue and direct strength analysis
  - Provision of sufficient software tool, especially for FE analysis for cargo areas outside 0.4L region, hot spot fatigue evaluation, fatigue screening assessment
  - Enough period for external review (the current schedule is found to be insufficient, especially the 2nd external review!)

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