

CH6, Sec3, 3.2.4 – Checking criteria

Rule Change:

In addition each compressive stress σ_x and σ_y and the shear stress τ are to comply with the following formulae:

$$\left(\frac{\sigma_x \cdot S}{K_x \cdot R_{eH}} \right)^{e1} \leq 1.0$$

$$\left(\frac{\sigma_y \cdot S}{K_y \cdot R_{eH}} \right)^{e2} \leq 1.0$$

$$\left(\frac{|\tau| \cdot S \cdot \sqrt{3}}{K_\tau \cdot R_{eH}} \right)^{e3} \leq 1.0$$

GL-Answer: In General we consider only the rule defined load cases and loading conditions for the dimensioning of the structure, which are called design-load cases. In case of buckling checks we have to accept, that in reality also load cases exist, they give other load and therefore stress combinations as defined in the design-load-cases. Of course it is guaranteed, that the design-load cases cover the cases with respect of the calculation of the most critical stress-components. In case of buckling we have to consider all possible stress combinations. This is somewhat different and because of that we require, that the buckling strength of the plate has to be high enough to withstand each compressive stress acting alone. This means, that possible stabilizing effects of pressure stresses are neglected.

This can be illustrated with the following figures.

In Figure 1 the interaction curve is shown including the Poisson effect. As can be seen there are stress combinations allowable for which the σ_y -component can be greater, than in the case for σ_y is acting alone on the plate. Because of the problem mentioned above, the interaction curve as the base for the rule requirements is limited to stress combinations as shown in figure 2. Please note that this figure is given in Appendix 1 of the Buckling-TB-document. Please refer to “Buckling Strength Assessment of Plates in the IACS Common Structural rules for Bulk Carriers – Sample Applications” , Figure 2.

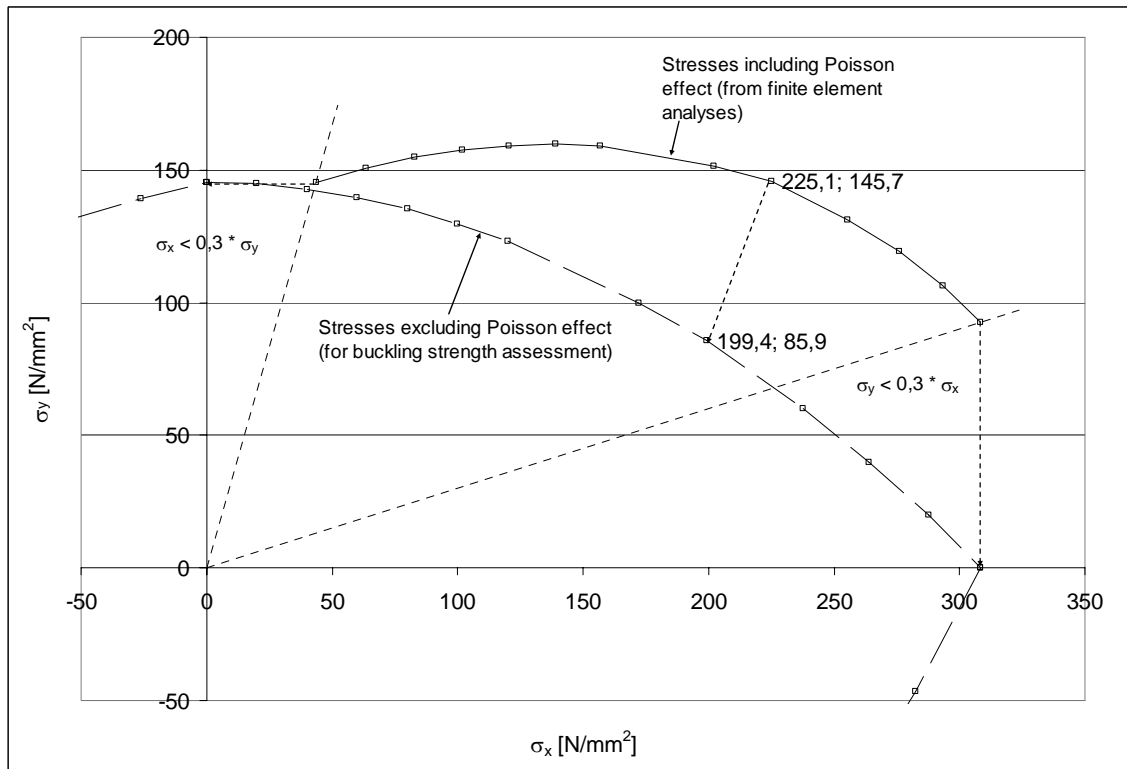


Figure 1: interaction **without** the requirement that the plate has to be stiff enough to withstand each compressive stress alone

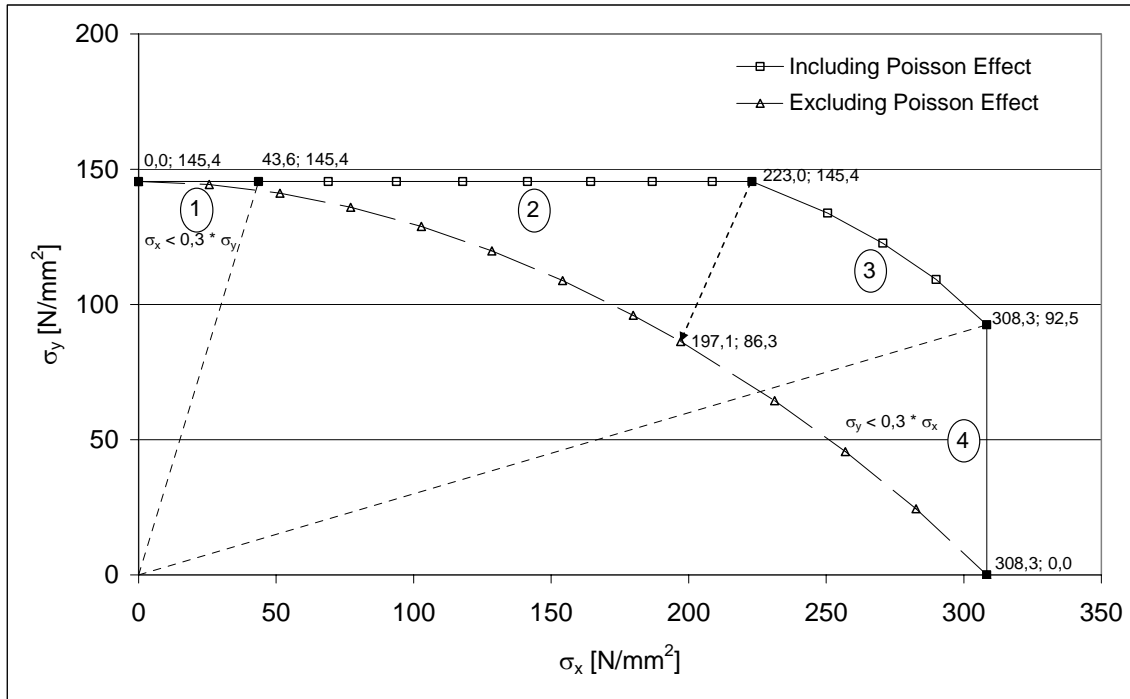


Figure 2: interaction **with** the requirement that the plate has to be stiff enough to withstand each compressive stress alone

200	200	0	0.10	1.00	1.00	235	154	154	0.00
200	150	0	0.10	1.00	1.00	235	170	99	0.00
200	100	0	0.10	1.00	1.00	235	187	44	0.00
200	50	0	0.10	1.00	1.00	235	200	0	1.00
200	0	0	0.10	1.00	1.00	235	200	0	1.00
200	-50	0	0.10	1.00	1.00	235	200	-50	1.00
200	-100	0	0.10	1.00	1.00	235	200	-100	1.00
200	-150	0	0.10	1.00	1.00	235	200	-150	1.00
200	-200	0	0.10	1.00	1.00	235	200	-200	1.00
200	200	0	1.00	0.70	1.00	235	154	154	0.17
200	150	0	1.00	0.70	1.00	235	170	99	0.17
200	100	0	1.00	0.70	1.00	235	187	44	0.17
200	50	0	1.00	0.70	1.00	235	200	0	1.00
200	0	0	1.00	0.70	1.00	235	200	0	1.00
200	-50	0	1.00	0.70	1.00	235	200	-50	1.00
200	-100	0	1.00	0.70	1.00	235	200	-100	1.00
200	-150	0	1.00	0.70	1.00	235	200	-150	1.00
200	-200	0	1.00	0.70	1.00	235	200	-200	1.00
200	200	0	1.00	0.40	1.00	235	154	154	0.01
200	150	0	1.00	0.40	1.00	235	170	99	0.01
200	100	0	1.00	0.40	1.00	235	187	44	0.01
200	50	0	1.00	0.40	1.00	235	200	0	1.00
200	0	0	1.00	0.40	1.00	235	200	0	1.00
200	-50	0	1.00	0.40	1.00	235	200	-50	1.00
200	-100	0	1.00	0.40	1.00	235	200	-100	1.00
200	-150	0	1.00	0.40	1.00	235	200	-150	1.00
200	-200	0	1.00	0.40	1.00	235	200	-200	1.00
200	200	0	1.00	0.10	1.00	235	154	154	0.00
200	150	0	1.00	0.10	1.00	235	170	99	0.00
200	100	0	1.00	0.10	1.00	235	187	44	0.00
200	50	0	1.00	0.10	1.00	235	200	0	1.00
200	0	0	1.00	0.10	1.00	235	200	0	1.00
200	-50	0	1.00	0.10	1.00	235	200	-50	1.00
200	-100	0	1.00	0.10	1.00	235	200	-100	1.00
200	-150	0	1.00	0.10	1.00	235	200	-150	1.00
200	-200	0	1.00	0.10	1.00	235	200	-200	1.00
99	99	0	0.50	1.00	1.00	235	76	76	0.03

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d Values			Results of Interaction Formula (IF)				
Factors			Single Terms with converted stresses			Proper usage of IF	
e ₁	e ₂	e ₃	1st Term IF	2nd Term IF	IF	1st Term IF	2nd Term IF
2.00	2.00	2.00	0.43	0.43	0.72	0.72	0.72
2.00	2.00	2.00	0.53	0.18	0.59	0.72	0.41
2.00	2.00	2.00	0.63	0.03	0.54	0.72	0.18
2.00	2.00	2.00	0.72	0.00	0.59	0.72	0.05
2.00	2.00	2.00	0.72	0.00	0.72	0.72	0.00
2.00	2.00	2.00	0.72	0.05	0.95	0.72	0.05
2.00	2.00	2.00	0.72	0.18	1.27	0.72	0.18
2.00	2.00	2.00	0.72	0.41	1.67	0.72	0.41
2.00	2.00	2.00	0.72	0.72	2.17	0.72	0.72
1.24	2.00	1.70	0.92	0.43	1.88	1.27	0.72
1.24	2.00	1.70	1.04	0.18	1.59	1.27	0.41
1.24	2.00	1.70	1.17	0.03	1.39	1.27	0.18
1.24	2.00	1.70	1.27	0.00	1.14	1.27	0.05
1.24	2.00	1.70	1.27	0.00	1.27	1.27	0.00
1.24	2.00	1.70	1.27	0.05	1.50	1.27	0.05
1.24	2.00	1.70	1.27	0.18	1.82	1.27	0.18
1.24	2.00	1.70	1.27	0.41	2.22	1.27	0.41
1.24	2.00	1.70	1.27	0.72	2.72	1.27	0.72
1.03	2.00	1.40	1.66	0.43	2.89	2.17	0.72
1.03	2.00	1.40	1.84	0.18	2.57	2.17	0.41
1.03	2.00	1.40	2.02	0.03	2.35	2.17	0.18
1.03	2.00	1.40	2.17	0.00	2.03	2.17	0.05
1.03	2.00	1.40	2.17	0.00	2.17	2.17	0.00
1.03	2.00	1.40	2.17	0.05	2.40	2.17	0.05
1.03	2.00	1.40	2.17	0.18	2.71	2.17	0.18
1.03	2.00	1.40	2.17	0.41	3.12	2.17	0.41
1.03	2.00	1.40	2.17	0.72	3.62	2.17	0.72

1.00	2.00	1.10	6.55	0.43	9.24	8.51	0.72
1.00	2.00	1.10	7.25	0.18	8.92	8.51	0.41
1.00	2.00	1.10	7.95	0.03	8.69	8.51	0.18
1.00	2.00	1.10	8.51	0.00	8.38	8.51	0.05
1.00	2.00	1.10	8.51	0.00	8.51	8.51	0.00
1.00	2.00	1.10	8.51	0.05	8.74	8.51	0.05
1.00	2.00	1.10	8.51	0.18	9.06	8.51	0.18
1.00	2.00	1.10	8.51	0.41	9.46	8.51	0.41
1.00	2.00	1.10	8.51	0.72	9.96	8.51	0.72
2.00	1.24	1.70	0.43	0.92	1.88	0.72	1.27
2.00	1.24	1.70	0.53	0.53	1.52	0.72	0.89
2.00	1.24	1.70	0.63	0.19	1.20	0.72	0.54
2.00	1.24	1.70	0.72	0.00	0.77	0.72	0.23
2.00	1.24	1.70	0.72	0.00	0.72	0.72	0.00
2.00	1.24	1.70	0.72	0.23	1.13	0.72	0.23
2.00	1.24	1.70	0.72	0.54	1.63	0.72	0.54
2.00	1.24	1.70	0.72	0.89	2.16	0.72	0.89
2.00	1.24	1.70	0.72	1.27	2.72	0.72	1.27
2.00	1.03	1.40	0.43	1.66	2.89	0.72	2.17
2.00	1.03	1.40	0.53	1.05	2.33	0.72	1.61
2.00	1.03	1.40	0.63	0.46	1.79	0.72	1.07
2.00	1.03	1.40	0.72	0.00	1.07	0.72	0.52
2.00	1.03	1.40	0.72	0.00	0.72	0.72	0.00
2.00	1.03	1.40	0.72	0.52	1.43	0.72	0.52
2.00	1.03	1.40	0.72	1.07	2.15	0.72	1.07
2.00	1.03	1.40	0.72	1.61	2.88	0.72	1.61
2.00	1.03	1.40	0.72	2.17	3.62	0.72	2.17
2.00	1.00	1.10	0.43	6.55	9.24	0.72	8.51
2.00	1.00	1.10	0.53	4.21	7.11	0.72	6.38
2.00	1.00	1.10	0.63	1.87	4.98	0.72	4.26
2.00	1.00	1.10	0.72	0.00	2.67	0.72	2.13
2.00	1.00	1.10	0.72	0.00	0.72	0.72	0.00
2.00	1.00	1.10	0.72	2.13	3.03	0.72	2.13
2.00	1.00	1.10	0.72	4.26	5.34	0.72	4.26
2.00	1.00	1.10	0.72	6.38	7.65	0.72	6.38
2.00	1.00	1.10	0.72	8.51	9.96	0.72	8.51
1.06	2.00	1.50	0.63	0.11	1.01	0.83	0.18

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