OWNER	PURCHASER	MECHANICAL CALCULATION BOOK FOR	VENDOR	DESIGNER
NIGC	OTC OTEC	EA-TEST	TASHA	SEC Sabz Engineering Company شرکت مهندسی سبز

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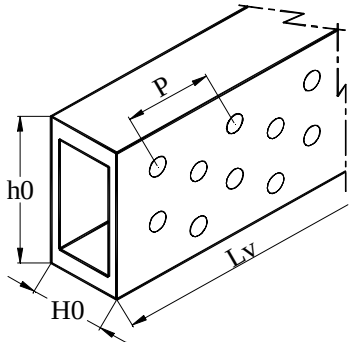
HEADER DESIGN UNDER EXTERNAL PRESSURE



REFERENCE
ASME SEC. VIII DIV. 1 APP. 13(2000)

P (External design pressure; bar)	1	ν (Poisson's ratio)	0.3
T (Design temp.°C)	160	L_V (Lenght of vessel; mm)	3,800
Header material	SA-516 Gr.70	t_1 (Top & bottom plate thk.; mm)	12
Type of material	C.S.	t_2 (Tube & plug sheet thk.; mm)	15
S_A (Allowable stress; bar)	137.9	t_5 (End plate thk.; mm)	9
p (Pitch; mm)	66.68	H (Inside length of short side; mm)	110
d_o (Tube outside diameter; mm)	25.4	h (Inside length of long side; mm)	350
S_Y (Yield strenght; bar)	2,322	H_0 (Outside length of short side; mm)	146
E* (Effective Modules of elestisity; bar)	1,234,816	h_0 (Outside length of long side; mm)	380
R_1 (Least radius of gyration; mm) =Sqrt(I_e/A)	59.31	C.A. (Corrosion Allowance; mm)	3
e_m (Membrane Ligament Eff.)	0.53	E_2 (Modules of elestisity; bar)	1,929,400

Stability Equation : $(2S_{mA}/S_{crA}) + (2S_{mB}/S_{crB}) <= 1.0$

$S_{crA} = S'_{crA}$ if $S'_{crA} <= S_Y/2$; $S_{crA} = S''_{crA}$ if $S'_{crA} > S_Y/2$

$S_{crB} = S'_{crB}$ if $S'_{crB} <= S_Y/2$; $S_{crB} = S''_{crB}$ if $S'_{crB} > S_Y/2$

Short Side Plate :

$S_{mA} = (P_e hH)/2*(t_1H+t_2*e_m h)$	4.69	L_V/H	34.55	K_A (From Fig. 13-14(a))	5.50
$S_{mB} = (P_e h/2*t_1)$	14.58	H/L_v	0.03	K_B (From Fig. 13-14(a))	1.00

$S'cr_A = [\pi^2E^*/(12(1-\nu^2))]*(t_1/H)^2*K_A$ = 73,050 ; $S''cr_A = S_Y - (S_Y^2/4\,S'_{crA})$ = 2,304

$S'cr_B = [\pi^2E^*/(12(1-\nu^2))]*(t_1/L_V)^2*K_B$ LV=H ===> 13,282 ; $S''cr_B = S_Y - (S_Y^2/4\,S'_{crB})$ = 2,221

Scr_A = 2,304 ; Scr_B = 2,221 ; $(2S_{mA}/S_{crA}) + (2S_{mB}/S_{crB})$ = 0.02

(Short side plate stability checking is O.K.)

Long Side Plate :

$S_{mA} = (P_e hH)/2*(t_1H+t_2*e_m h)$	4.69	L_V/h	10.86	K_A (From Fig. 13-14(a))	5.50
$S_{mB} = (P_e H/2*t_2*e_m)$	6.92	h/L_v	0.09	K_B (From Fig. 13-14(a))	1.00

$S'cr_A = [\pi^2E^*/(12(1-\nu^2))]*(t_2/H)^2*K_A$ = 11,274 ; $S''cr_A = S_Y - (S_Y^2/4\,S'_{crA})$ = 2,202

$S'cr_B = [\pi^2E^*/(12(1-\nu^2))]*(t_2/L_V)^2*K_B$ LV=h ===> 2,050 ; $S''cr_B = S_Y - (S_Y^2/4\,S'_{crB})$ = 1,664

Scr_A = 2,202 ; Scr_B = 1,664 ; $(2S_{mA}/S_{crA}) + (2S_{mB}/S_{crB})$ = 0.01

(Long side plate stability checking is O.K.)

End plates :

$S_{mA} = (P_e HL_V)/2*(t_2*e_m L_V+t_5H)$	6.70	h/H	3.18	K_A (From Fig. 13-14(a))	5.55
$S_{mB} = P_e hL_V/2*(t_1L_V+t_5h)$	13.64	H/h	0.31	K_B (From Fig. 13-14(a))	13.77

$S'cr_A = [\pi^2E^*/(12(1-\nu^2))]*(t_2/H)^2*K_A$ = 41,453 ; $S''cr_A = S_Y - (S_Y^2/4\,S'_{crA})$ = 2,289

$S'cr_B = [\pi^2E^*/(12(1-\nu^2))]*(t_5/h)^2*K_B$ = 10,164 ; $S''cr_B = S_Y - (S_Y^2/4\,S'_{crB})$ = 2,189

Scr_A = 2,289 ; Scr_B = 2,189 ; $(2S_{mA}/S_{crA}) + (2S_{mB}/S_{crB})$ = 0.02

(End plate stability checking is O.K.)

Column Stability Equation: $(S_a/F_a) + S_b/(1- S_a / F'_e)S_A <= 1.0$

$S_a = P_e h_0 H_0/(2*(t_1H_0 + t_2*e_m*h_0))$ = 5.81

$Cc = Sqrt(2*\pi^2E^*/S_Y)$ = 102.46

$F_a = [1-((2L_V / R_1)^2 / (2C_C^2))]S_Y / [(5/3+3(2L_V / R_1)/8C_C-(2L_V / R_1)^3 / 8C_C^3]$ IF $2L_V/R_1$ <= 267.52

$Fa = 12\pi^2E^* / 23(2L_V / R_1)^2$ IF $2L_V/R_1 > Cc$ 387.24

$2L_V/R_1$ = 128.14 ⇒ F_a = 387.24

$C_1 = H_0 / 2$ = 73.00 ; y = 0.00 ; $S_b = MC_1/I_e$ = 0.00

$M = P_e\, h_0\, H_0\, y$ = 0.00

$F'e = 12\,\pi^2E^*/(23*(2L_V / R_1)^2)$ = 123

$I_e = h_0 H_0^3/12 - h_i H_i^3/12$ = 59,730,140

A = Cross section area (mm^2) = 16,980

$(S_a/F_a) + S_b/(1- S_a / F'_e)S_A$ = 0.0150

(Column stability checking is O.K.)