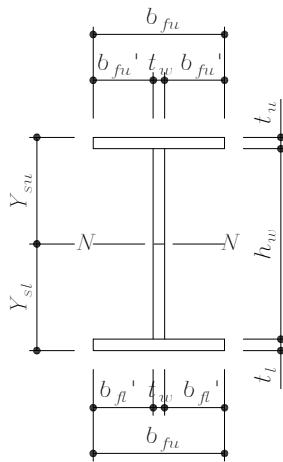


8. 가로보 설계

8.1 가로보의 설계

[1CR01]



▪ 단면제원

(단위:mm)

사용강재	b_{fu}	b_{fu}'	b_{fl}	b_{fl}'	h_w	t_{fu}	t_{fw}	t_{fl}
SM400B	300.0	144.0	300.0	144.0	1,700.0	12.0	12.0	12.0

가로보간격(전) : $B_f = 0.0$ mm 가로보지간 : $L = 2,800.0$ mm

가로보간격(후) : $B_r = 3,350.0$ mm

▪ 부재 검토 (도.설.해 3.8.4.1)

(단위:mm)

복부판 두께 검토			상판 두께 검토			하판 두께 검토		
필요	사용	판정	필요	사용	판정	필요	사용	판정
$h_w / 150 = 11.3$	12	0.K	$b_{fu}' / 16 = 9.0$	12	0.K	$b_{fl}' / 16 = 9.0$	12	0.K

▪ 하중 관련

강재 (kN/m ³)	강재 할증	차륜하중(kN)			탱크하중		트레일러		
		P_r (kN/m)	P_f (kN/m)	L_1 (mm)	P_{tk} (kN/m)	L_2 (mm)	P_1 (kN/m)	P_2 (kN/m)	P_3 (kN/m)
78.50	1.3139	96.00	24.00	4,200.0	0.000	0.0	0.000	0.000	0.000

▪ 도심 산정

구분	규격	A_s (mm ²)	Y (mm)	$A_s \cdot Y$ (mm ³)	$A_s \cdot Y^2$ (mm ⁴)	I_{xo} (mm ⁴)
UPPER FL.	1 - 300.0 × 12.0	3,600.0	856.0	3.082E+06	2.638E+09	4.320E+04
WEB	1 - 1,700.0 × 12.0	20,400.0	-	-	-	4.913E+09
LOWER FL.	1 - 300.0 × 12.0	3,600.0	-856.0	-3.082E+06	2.638E+09	4.320E+04
합계		27,600.0	-	0.000E+00	5.276E+09	4.913E+09

$$I_x' = \sum A_s \cdot Y^2 + \sum I_{xo} = 5,275,699,200.0 + 4,913,086,400.0 = 1.019E+10 \text{ mm}^4$$

$$\delta_y = \sum A_s \cdot Y / \sum A_s = 0.0 / 27,600.0 = 0.000 \text{ mm}$$

$$I_{33} = I_x' - \sum A_s \times \delta_y^2 = 10,188,785,600.0 - 27,600.0 \times 0.0^2 = 1.019E+10 \text{ mm}^4$$

$$y_{su} = h_w / 2 + t_{fu} - \delta_y = 1,700.0/2 + 12.00 - 0.0 = 862.000 \text{ mm}$$

$$y_{sl} = h_w / 2 + t_{fl} + \delta_y = 1,700.0/2 + 12.00 - 0.0 = 862.000 \text{ mm}$$

1) 관용해석

(1) 작용 하중 산정

① 고정 하중

슬래브 : $W_c = 0.240 \times 25.000 = 6.000 \text{ kN/m}$

포장 : $W_a = 0.050 \times 23.500 = 1.175 \text{ kN/m}$

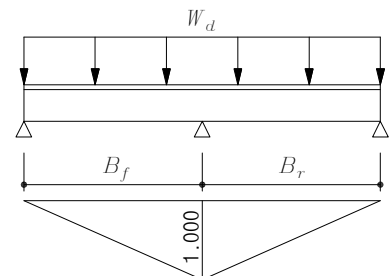
$\Sigma = 7.175 \text{ kN/m}$

강재 자중 : $W_s = 0.028 \times 78.500 = 2.167 \text{ kN/m}$

강재 할증 : $W_{ds} = 2.167 \times 1.3139 = 2.847 \text{ kN/m}$

영향선 면적 : $(0.000 + 3.350) \times 1.00/2 = 1.675 \text{ m}^2$

고정 하중 : $W_d = 7.175 \times 1.675 + 2.847 \times 1.000 = 14.865 \text{ kN/m}$



② 활 하 중

⇒ 차륜하중 (DB-24) 재하시

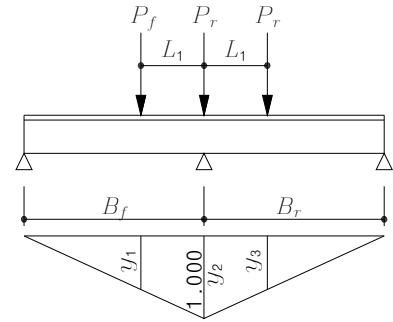
활하중 작용 거리 및 영향선 종거

$x_1 =$	0.0 mm	$\Rightarrow$	$y_1 =$	0.000	
$x_4 =$	0.0 mm	$\Rightarrow$	$y_4 =$	0.000	
$x_2 =$	0.0 mm	$\Rightarrow$	$y_2 =$	1.000	
$x_5 =$	0.0 mm	$\Rightarrow$	$y_5 =$	0.000	
$x_3 =$	0.0 mm	$\Rightarrow$	$y_3 =$	0.000	
				$\Sigma y =$	1.000

$$\therefore P_{sl} = 24.000 \times 0.000 + 96.000 \times (1.000 + 0.000) = 96.000 \text{ kN}$$

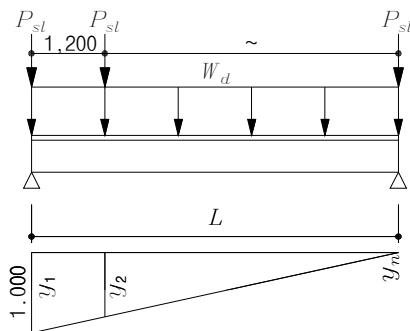
충격 계수

$$i = 15 / (40 + 3.350) = 0.346 > 0.300 \therefore i = 0.300$$



(2) 전단력 산정

⇒ 차륜하중 (DB-24) 재하시



▪ 최대 재하가능한 윤하중 수 $n = 2$

▪ 가로보 지간장 : $A = 2.800 \times 1.000 / 2 = 1.400 \text{ m}^2$

▪ 고정하중에 의한 전단력

$$V_d = W_d \times A = 14.865 \times 1.400 = 20.811 \text{ kN}$$

▪ 가로보 끝단에서 윤하중까지의 거리 및 종거

$x_1 =$	0.0 mm	$\Rightarrow$	$y_1 =$	1.000
$x_2 =$	1,200.0 mm	$\Rightarrow$	$y_2 =$	0.571
$x_3 =$	- mm	$\Rightarrow$	$y_3 =$	-
$x_4 =$	- mm	$\Rightarrow$	$y_4 =$	-
$x_5 =$	- mm	$\Rightarrow$	$y_5 =$	-
				$\Sigma y =$ 1.571

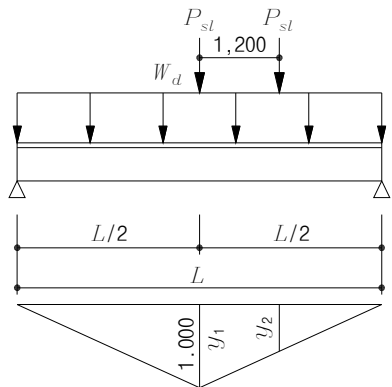
▪ 활하중에 의한 전단력(충격계수 포함)

$$V_{l+i} = P_{sl} \times (1+i) \times \sum y = 96.000 \times (1 + 0.300) \times 1.571 = 196.114 \text{ kN}$$

$$\therefore V_t = V_d + V_{l+i} = 20.811 + 196.114 = 216.925 \text{ kN}$$

(3) 모멘트 산정

⇒ 차륜하중 (DB-24) 재하시



▪ 최대 재하가능한 윤하중 수 $n = 2$

▪ 영향선 면적 : $A = 2.800 \times 1.000 / 2 = 1.400 \text{ m}^2$

▪ 고정하중에 의한 모멘트

$$M_d = W_d \times A \times L / 4 = 14.865 \times 1.400 \times 2.800 / 4 = 14.568 \text{ kN} \cdot \text{m}$$

▪ 가로보 중앙에서 윤하중까지의 거리 및 종거

$x_1 =$	0.0 mm	$\Rightarrow$	$y_1 =$	1.000	
$x_2 =$	1,200.0 mm	$\Rightarrow$	$y_2 =$	0.143	
$x_3 =$	- mm	$\Rightarrow$	$y_3 =$	-	
				$\Sigma y =$	1.143

▪ 활하중에 의한 모멘트(충격계수 포함)

$$M_{l+i} = P_{sl} \times (1+i) \times \sum y \times L / 4 = 96.000 \times (1 + 0.300) \times 1.143 \times 2.800 / 4 = 99.840 \text{ kN} \cdot \text{m}$$

$$\therefore M_t = M_d + M_{l+i} = 14.568 + 99.840 = 114.408 \text{ kN} \cdot \text{m}$$

2) 격자해석

[3D Frame 해석결과]

구분	단위	합성전 고정하중		합성후 고정하중	활하중	지점침하	합계
		강재자중	슬래브 자중				
모멘트	kN·m	9.103	59.186	-22.345	926.569	1.043	973.556
전단력	kN	6.253	29.906	19.564	545.402	0.768	601.893

Frame 해석결과 : $V_{max} = 601.893 \text{ kN}$, $M_{max} = 973.556 \text{ kN·m}$ (OutPut 참조)- 부재번호 119

3) 결과 비교

관용해석에서 나온 부재력과 Frame 해석에서 나온 부재력 중 불리한 값을 설계에 적용함.

계산적용부재력 : $V_{max} = 601.893 \text{ kN}$, $M_{max} = 973.556 \text{ kN·m}$

4) 단면 검토

- 자유돌출판의 압축부 국부좌굴에 대한 허용응력 (도.설 해 3.4.2.2 표3.4.4)

- 상부 플랜지

$$b_{fu} / 12.9 = 11.2 \text{ mm} \leq t_{fu} = 12.0 \text{ mm}$$

$$\Rightarrow \textcircled{1} f_{ca} = 140.0 \text{ MPa}$$

- 하부 플랜지

$$b_{fl} / 12.9 = 11.2 \text{ mm} \leq t_{fl} = 12.0 \text{ mm}$$

$$\Rightarrow \textcircled{1} f_{ca} = 140.0 \text{ MPa}$$

- 허용 휨 압축응력 (도.설 해 3.3.2.1 표3.3.4)

- 상부 플랜지

A_w : 복부판의 총단면적 (mm^2)	$\Rightarrow$	20,400.0 mm^2	$A_w/A_c = 5.667 > 2.0$
A_c : 압축플랜지 총단면적 (mm^2)	$\Rightarrow$	3,600.0 mm^2	
L : 압축플랜지의 고정점간 거리 (mm)	$\Rightarrow$	2,800.0 mm	
b_{fu} : 압축플랜지 폭 (mm)	$\Rightarrow$	300.0 mm	
$K = \sqrt{3 + (A_w/2A_c)}$	$\Rightarrow$	2.415	

$$5.0 < L / b_{fu} = 2,800.0 / 300.0 = 9.3 \leq 25.0$$

$$\Rightarrow \textcircled{2} f_{ca} = 260.0 - 6.60 (L/b_{fu} - 5.0) = 260.0 - 6.60 \times (2,800.0/300.0 - 5.0) = 231.4 \text{ MPa}$$

$$9.3/K = 3.9 < L / b_{fu} = 2,800.0 / 300.0 = 9.3 \leq 30.0$$

$$\Rightarrow \textcircled{2} f_{ca} = 140.0 - 1.24 (K \cdot L/b_{fu} - 9.3) = 140.0 - 1.24 \times (2.415 \times 2,800.0/300.0 - 9.3) = 123.6 \text{ MPa}$$

- 하부 플랜지

A_w : 복부판의 총단면적 (mm^2)	$\Rightarrow$	20,400.0 mm^2	$A_w/A_c = 5.667 > 2.0$
A_c : 압축플랜지 총단면적 (mm^2)	$\Rightarrow$	3,600.0 mm^2	
L : 압축플랜지의 고정점간 거리 (mm)	$\Rightarrow$	2,800.0 mm	
b_{fl} : 압축플랜지 폭 (mm)	$\Rightarrow$	300.0 mm	
$K = \sqrt{3 + (A_w/2A_c)}$	$\Rightarrow$	2.415	

$$5.0 < L / b_{fl} = 2,800.0 / 300.0 = 9.3 \leq 25.0$$

$$\Rightarrow \textcircled{2} f_{ca} = 260.0 - 6.60 (L/b_{fl} - 5.0) = 260.0 - 6.60 \times (2,800.0/300.0 - 5.0) = 231.4 \text{ MPa}$$

$$9.3/K = 3.9 < L / b_{fl} = 2,800.0 / 300.0 = 9.3 \leq 30.0$$

$$\Rightarrow \textcircled{2} f_{ca} = 140.0 - 1.24 (K \cdot L/b_{fl} - 9.3) = 140.0 - 1.24 \times (2.415 \times 2,800.0/300.0 - 9.3) = 123.6 \text{ MPa}$$

∴ ②에 허용응력 값이 ①에 허용응력 값보다 작은 경우에는 허용 휨 압축응력에 대한 허용응력을 사용한다.

$$f_{ca} = 123.6 \text{ MPa} , f_{ta} = 140.0 \text{ MPa} \quad (\text{상부 플랜지}) \quad (\text{도.설 해 3.3.2.1 표3.3.1})$$

$$u_a = 80.0 \text{ MPa} \quad (\text{도.설 해 3.3.2.1 표3.3.5})$$

∴ ②에 허용응력 값이 ①에 허용응력 값보다 작은 경우에는 허용 휨 압축응력에 대한 허용응력을 사용한다.

$$f_{ca} = 123.6 \text{ MPa} , f_{ta} = 140.0 \text{ MPa} \quad (\text{하부 플랜지}) \quad (\text{도.설 해 3.3.2.1 표3.3.1})$$

$$u_a = 80.0 \text{ MPa} \quad (\text{도.설 해 3.3.2.1 표3.3.5})$$

▪ 응 력 검 토

$$u = V_u / A_w = 601,892.9 / (1,700.0 \times 12.0)$$

$$u = 29.505 \text{ MPa} \leq u_a = 80.0 \text{ MPa} \quad \dots\dots \text{O.K !!}$$

$$f_u = M_u \cdot y_{su} / I_{33} = 973,556,345.0 \times 862.0 / 10,188,785,600.0$$

$$f_u = 82.366 \text{ MPa} \leq f_{ca} = 123.6 \text{ MPa} \quad (\text{상부 플랜지 압축인 경우}) \quad \dots\dots \text{O.K !!}$$

$$f_u = 82.366 \text{ MPa} \leq f_{ta} = 140.0 \text{ MPa} \quad (\text{상부 플랜지 인장인 경우}) \quad \dots\dots \text{O.K !!}$$

$$f_l = M_u \cdot y_{sl} / I_{33} = 973,556,345.0 \times 862.0 / 10,188,785,600.0$$

$$f_l = 82.366 \text{ MPa} \leq f_{ta} = 140.0 \text{ MPa} \quad (\text{하부 플랜지 인장인 경우}) \quad \dots\dots \text{O.K !!}$$

$$f_l = 82.366 \text{ MPa} \leq f_{ca} = 123.6 \text{ MPa} \quad (\text{하부 플랜지 압축인 경우}) \quad \dots\dots \text{O.K !!}$$

▪ 합성응력 검토

$$\left(\frac{f}{f_a} \right)^2 + \left(\frac{v}{v_a} \right)^2 \leq 1.2 \quad \dots\dots \text{O.K !!}$$

[상부 플랜지 인장, 하부 플랜지 압축]

$$\left(\frac{82.366}{123.580} \right)^2 + \left(\frac{29.505}{80.000} \right)^2 = 0.444 + 0.136 = 0.580 \leq 1.2 \quad \dots\dots \text{O.K !!}$$

[상부 플랜지 압축, 하부 플랜지 인장]

$$\left(\frac{82.366}{123.580} \right)^2 + \left(\frac{29.505}{80.000} \right)^2 = 0.444 + 0.136 = 0.580 \leq 1.2 \quad \dots\dots \text{O.K !!}$$

[수직보강재를 생략할 수 있는 플랜지 순간격의 최대치]

(도.설 해 3.8.5.1 표3.8.5)

$$71 t_w = 852.0 \text{ mm} < h_w = 1,700.0 \text{ mm} \quad \text{수직보강재 필요}$$

5) 수직 보강재의 설계 (SM400B 사용)

수평 보강재 사용 단수 : $n = 0$

복부판의 연섬유 압축응력 : $f = 82.366 \text{ MPa}$

복부판의 전단응력 : $u = 29.505 \text{ MPa}$

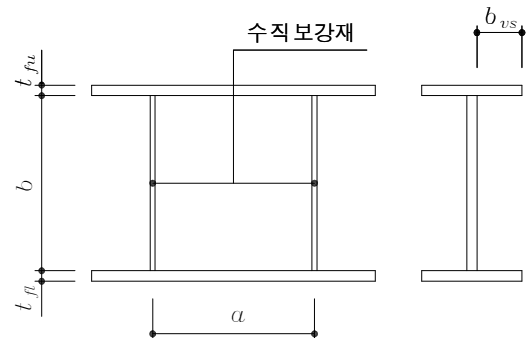
사용 수직 보강재의 폭 : $b_{vs} = 150.0 \text{ mm}$

사용 수직 보강재의 두께 : $t_{vs} = 16.0 \text{ mm}$

사용 수직 보강재의 간격 : $a = 1,000.0 \text{ mm}$

상·하 양 플랜지의 순간격 : $b = 1,700.0 \text{ mm}$

복부판의 두께 : $t = 12.0 \text{ mm}$



- 수직보강재 간격 검토

$$a / b = 1,000.0 / 1,700.0 = 0.588 \leq 1.500 \quad \dots\dots \text{O.K !!}$$

- 수평 보강재를 사용하지 않을 경우

$$a / b \leq 1.00 \quad \text{이므로} \Rightarrow 0.245 \leq 1 \quad \dots\dots \text{O.K !!}$$

- 수직 보강재의 강도검토

(도.설.해 3.8.5.2)

· 필요 강도

$$I_{(req)} = b \cdot t^3 \cdot r / 10.92 = 1,700.0 \times 12.0^3 \times 23.120 / 10.92 = 6.220\text{E}+06 \text{ mm}^4$$

· 수직 보강재의 소요강비

$$r = 8.0[b/a]^2 = 8.0 \times (1,700.0 / 1,000.0)^2 = 23.120$$

· 사용 강도

$$I_{(use)} = \frac{1}{3} \times 16.0 \times 150.0^3 \times 2ea = 3.600\text{E}+07 \text{ mm}^4$$

$$I_{(use)} = 3.600\text{E}+07 \text{ mm}^4 \geq I_{(req)} = 6.220\text{E}+06 \text{ mm}^4 \quad \dots\dots \text{O.K !!}$$

- 수직보강재 최소 폭 및 두께 검토

(도.설.해 3.8.5.2)

$$b_{vs(req)} = 1,700.0 / 30 + 50\text{mm} = 106.667 \text{ mm} \leq b_{vs(use)} = 150.000 \text{ mm} \quad \dots\dots \text{O.K !!}$$

$$t_{vs(req)} = 150.0 / 13 = 11.538 \text{ mm} \leq t_{vs(use)} = 16.000 \text{ mm} \quad \dots\dots \text{O.K !!}$$

■ 공통 입력 사항

사용강재	단 위 중 량 (kN/m ³)			강재 할증	차륜하중 (kN)		차륜하중제원 (mm)	
	콘크리트	포장	강재		P_r	P_f	L_1	B_1
SM400B	25.00	23.50	78.50	1.31390	96.00	24.00	4,200	1,800

■ 단면 제원

(단위: mm)

구 분	b_{fu}	b_{fu}'	b_{fl}	b_{fl}'	h_w	t_{fu}	t_w	t_{fl}	I_{33}	y_{su}	y_{sl}
1CR01	300.0	144.0	300.0	144.0	1,700.0	12.0	12.0	12.0	1.019E+10	862.0	862.0
1CR02	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR03	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR04	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR05	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR06	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR07	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR08	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR09	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR10	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR11	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR12	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR13	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR14	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR15	300.0	143.0	300.0	143.0	1,900.0	12.0	14.0	12.0	1.458E+10	962.0	962.0
1CR16	300.0	143.0	300.0	143.0	2,000.0	12.0	14.0	12.0	1.662E+10	1,012.0	1,012.0
1CR17	300.0	144.0	300.0	144.0	2,100.0	12.0	14.0	12.0	1.883E+10	1,062.0	1,062.0
1CR18	400.0	144.0	400.0	144.0	2,200.0	12.0	16.0	12.0	2.594E+10	1,112.0	1,112.0
1CR19	300.0	144.0	300.0	144.0	2,100.0	12.0	14.0	12.0	1.883E+10	1,062.0	1,062.0
1CR20	300.0	143.0	300.0	143.0	1,900.0	12.0	14.0	12.0	1.458E+10	962.0	962.0
1CR21	300.0	144.0	300.0	144.0	1,700.0	12.0	12.0	12.0	1.019E+10	862.0	862.0
1CR22	300.0	144.0	300.0	144.0	1,600.0	12.0	12.0	12.0	8.773E+09	812.0	812.0
1CR23	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR24	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR25	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR26	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR27	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR28	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR29	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR30	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR31	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR32	300.0	144.0	300.0	144.0	1,500.0	12.0	12.0	12.0	7.490E+09	762.0	762.0
1CR33	300.0	144.0	300.0	144.0	1,600.0	12.0	12.0	12.0	8.773E+09	812.0	812.0
1CR34	300.0	143.0	300.0	143.0	1,900.0	12.0	14.0	12.0	1.458E+10	962.0	962.0
1CR35	400.0	192.0	400.0	192.0	2,400.0	12.0	16.0	12.0	3.239E+10	1,212.0	1,212.0
1CR36	400.0	144.0	400.0	144.0	2,900.0	12.0	20.0	12.0	6.100E+10	1,462.0	1,462.0
1CR37	400.0	144.0	400.0	144.0	2,900.0	12.0	22.0	12.0	6.506E+10	1,462.0	1,462.0
1CR38	400.0	144.0	400.0	144.0	2,900.0	12.0	20.0	12.0	6.100E+10	1,462.0	1,462.0
1CR39	400.0	191.0	400.0	191.0	2,600.0	12.0	18.0	12.0	4.274E+10	1,312.0	1,312.0
1CR40	400.0	192.0	400.0	192.0	2,200.0	12.0	16.0	12.0	2.594E+10	1,112.0	1,112.0
1CR41	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR42	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR43	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR44	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR45	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR46	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR47	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR48	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR49	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR50	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR51	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR52	300.0	144.0	300.0	144.0	1,800.0	12.0	12.0	12.0	1.174E+10	912.0	912.0
1CR53	400.0	192.0	400.0	192.0	2,400.0	12.0	16.0	12.0	3.239E+10	1,212.0	1,212.0
1CR54	400.0	144.0	400.0	144.0	2,400.0	12.0	16.0	12.0	3.239E+10	1,212.0	1,212.0

■ 기타 제원

(단위:mm)

구 분	바닥판두께 t_s	포장두께 t_p	가로보 간격		가로보지간 L	비 고
			B_f	B_r		
1CR01	240.0	50.0	0.0	3,350.0	2,800.0	
1CR02	240.0	50.0	3,350.0	4,000.0	2,800.0	
1CR03	240.0	50.0	4,000.0	4,000.0	2,800.0	
1CR04	240.0	50.0	4,000.0	5,000.0	2,800.0	
1CR05	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR06	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR07	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR08	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR09	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR10	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR11	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR12	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR13	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR14	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR15	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR16	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR17	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR18	240.0	50.0	5,000.0	4,000.0	2,800.0	
1CR19	240.0	50.0	4,000.0	5,000.0	2,800.0	
1CR20	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR21	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR22	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR23	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR24	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR25	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR26	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR27	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR28	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR29	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR30	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR31	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR32	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR33	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR34	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR35	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR36	240.0	50.0	5,000.0	4,000.0	2,800.0	
1CR37	240.0	50.0	4,000.0	5,000.0	2,800.0	
1CR38	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR39	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR40	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR41	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR42	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR43	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR44	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR45	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR46	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR47	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR48	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR49	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR50	240.0	50.0	5,000.0	5,000.0	2,800.0	
1CR51	240.0	50.0	5,000.0	4,000.0	2,800.0	
1CR52	240.0	50.0	4,000.0	4,000.0	2,800.0	
1CR53	240.0	50.0	4,000.0	3,270.0	2,800.0	
1CR54	240.0	50.0	3,270.0	0.0	2,800.0	

▪ 부재 검토 (단위:mm)

(단위: mm)

구 분	복부판 두께 검토			상판 두께 검토			하판 두께 검토		
	필 요	사용	판정	필 요	사용	판정	필 요	사용	판정
1CR01	$h_w/150 = 11.3$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR02	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR03	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR04	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR05	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR06	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR07	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR08	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR09	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR10	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR11	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR12	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR13	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR14	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR15	$h_w/150 = 12.7$	14.0	O.K	$b_{fu}'/16 = 8.9$	12.0	O.K	$b_{fl}'/16 = 8.9$	12.0	O.K
1CR16	$h_w/150 = 13.3$	14.0	O.K	$b_{fu}'/16 = 8.9$	12.0	O.K	$b_{fl}'/16 = 8.9$	12.0	O.K
1CR17	$h_w/150 = 14.0$	14.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR18	$h_w/150 = 14.7$	16.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR19	$h_w/150 = 14.0$	14.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR20	$h_w/150 = 12.7$	14.0	O.K	$b_{fu}'/16 = 8.9$	12.0	O.K	$b_{fl}'/16 = 8.9$	12.0	O.K
1CR21	$h_w/150 = 11.3$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR22	$h_w/150 = 10.7$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR23	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR24	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR25	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR26	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR27	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR28	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR29	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR30	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR31	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR32	$h_w/150 = 10.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR33	$h_w/150 = 10.7$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR34	$h_w/150 = 12.7$	14.0	O.K	$b_{fu}'/16 = 8.9$	12.0	O.K	$b_{fl}'/16 = 8.9$	12.0	O.K
1CR35	$h_w/150 = 16.0$	16.0	O.K	$b_{fu}'/16 = 12.0$	12.0	O.K	$b_{fl}'/16 = 12.0$	12.0	O.K
1CR36	$h_w/150 = 19.3$	20.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR37	$h_w/150 = 19.3$	22.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR38	$h_w/150 = 19.3$	20.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR39	$h_w/150 = 17.3$	18.0	O.K	$b_{fu}'/16 = 11.9$	12.0	O.K	$b_{fl}'/16 = 11.9$	12.0	O.K
1CR40	$h_w/150 = 14.7$	16.0	O.K	$b_{fu}'/16 = 12.0$	12.0	O.K	$b_{fl}'/16 = 12.0$	12.0	O.K
1CR41	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR42	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR43	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR44	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR45	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR46	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR47	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR48	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR49	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR50	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR51	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR52	$h_w/150 = 12.0$	12.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K
1CR53	$h_w/150 = 16.0$	16.0	O.K	$b_{fu}'/16 = 12.0$	12.0	O.K	$b_{fl}'/16 = 12.0$	12.0	O.K
1CR54	$h_w/150 = 16.0$	16.0	O.K	$b_{fu}'/16 = 9.0$	12.0	O.K	$b_{fl}'/16 = 9.0$	12.0	O.K

- 작용 하중 산정

구 분	활하중 작용거리					활하중 작용점 영향선 종거					비 고
	x_1	x_4	x_2	x_5	x_3	y_1	y_4	y_2	y_5	y_3	
1CR01	0.0	0.0	0.0	0.0	0.0	0.000	0.000	1.000	0.000	0.000	
1CR02	0.0	0.0	0.0	0.0	0.0	0.000	0.000	1.000	0.000	0.000	
1CR03	0.0	0.0	0.0	0.0	0.0	0.000	0.000	1.000	0.000	0.000	
1CR04	0.0	0.0	0.0	0.0	800.0	0.000	0.000	1.000	0.000	0.160	
1CR05	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR06	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR07	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR08	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR09	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR10	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR11	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR12	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR13	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR14	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR15	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR16	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR17	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR18	800.0	0.0	0.0	0.0	0.0	0.160	0.000	1.000	0.000	0.000	
1CR19	0.0	0.0	0.0	0.0	800.0	0.000	0.000	1.000	0.000	0.160	
1CR20	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR21	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR22	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR23	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR24	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR25	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR26	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR27	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR28	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR29	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR30	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR31	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR32	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR33	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR34	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR35	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR36	800.0	0.0	0.0	0.0	0.0	0.160	0.000	1.000	0.000	0.000	
1CR37	0.0	0.0	0.0	0.0	800.0	0.000	0.000	1.000	0.000	0.160	
1CR38	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR39	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR40	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR41	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR42	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR43	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR44	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR45	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR46	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR47	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR48	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR49	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR50	800.0	0.0	0.0	0.0	800.0	0.160	0.000	1.000	0.000	0.160	
1CR51	800.0	0.0	0.0	0.0	0.0	0.160	0.000	1.000	0.000	0.000	
1CR52	0.0	0.0	0.0	0.0	0.0	0.000	0.000	1.000	0.000	0.000	
1CR53	0.0	0.0	0.0	0.0	0.0	0.000	0.000	1.000	0.000	0.000	
1CR54	0.0	0.0	0.0	0.0	0.0	0.000	0.000	1.000	0.000	0.000	

구 분	고 정 하 중 (kN/m)					활 하 중 (kN)			
	슬래브	포 장	강재자중	영향선면적	W_d	P_f'	P_r'	충격계수	P_{sl}
1CR01	6.000	1.175	2.847	1.675	14.865	24.000	96.000	0.300	96.000
1CR02	6.000	1.175	2.970	3.675	29.339	24.000	96.000	0.300	96.000
1CR03	6.000	1.175	2.970	4.000	31.670	24.000	96.000	0.300	96.000
1CR04	6.000	1.175	2.970	4.500	35.258	24.000	96.000	0.300	111.360
1CR05	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR06	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR07	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR08	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR09	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR10	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR11	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR12	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR13	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR14	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR15	6.000	1.175	3.486	5.000	39.361	24.000	96.000	0.300	115.200
1CR16	6.000	1.175	3.631	5.000	39.506	24.000	96.000	0.300	115.200
1CR17	6.000	1.175	3.775	5.000	39.650	24.000	96.000	0.300	115.200
1CR18	6.000	1.175	4.621	4.500	36.908	24.000	96.000	0.300	99.840
1CR19	6.000	1.175	3.775	4.500	36.062	24.000	96.000	0.300	111.360
1CR20	6.000	1.175	3.486	5.000	39.361	24.000	96.000	0.300	115.200
1CR21	6.000	1.175	2.847	5.000	38.722	24.000	96.000	0.300	115.200
1CR22	6.000	1.175	2.723	5.000	38.598	24.000	96.000	0.300	115.200
1CR23	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR24	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR25	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR26	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR27	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR28	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR29	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR30	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR31	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR32	6.000	1.175	2.599	5.000	38.474	24.000	96.000	0.300	115.200
1CR33	6.000	1.175	2.723	5.000	38.598	24.000	96.000	0.300	115.200
1CR34	6.000	1.175	3.486	5.000	39.361	24.000	96.000	0.300	115.200
1CR35	6.000	1.175	4.951	5.000	40.826	24.000	96.000	0.300	115.200
1CR36	6.000	1.175	6.972	4.500	39.260	24.000	96.000	0.300	99.840
1CR37	6.000	1.175	7.571	4.500	39.858	24.000	96.000	0.300	111.360
1CR38	6.000	1.175	6.972	5.000	42.847	24.000	96.000	0.300	115.200
1CR39	6.000	1.175	5.817	5.000	41.692	24.000	96.000	0.300	115.200
1CR40	6.000	1.175	4.621	5.000	40.496	24.000	96.000	0.300	115.200
1CR41	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR42	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR43	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR44	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR45	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR46	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR47	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR48	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR49	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR50	6.000	1.175	2.970	5.000	38.845	24.000	96.000	0.300	115.200
1CR51	6.000	1.175	2.970	4.500	35.258	24.000	96.000	0.300	99.840
1CR52	6.000	1.175	2.970	4.000	31.670	24.000	96.000	0.300	96.000
1CR53	6.000	1.175	4.951	3.635	31.032	24.000	96.000	0.300	96.000
1CR54	6.000	1.175	4.951	1.635	16.682	24.000	96.000	0.300	96.000

■ 관용해석에 의한 전단력 산정

(단위:kN)

구 분	가로보 끝단에서 윤하중까지의 거리					활하중 작용점 영향선 종거					비 고
	x_1	x_2	x_3	x_4	x_5	y_1	y_2	y_3	y_4	y_5	
1CR01	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR02	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR03	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR04	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR05	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR06	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR07	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR08	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR09	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR10	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR11	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR12	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR13	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR14	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR15	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR16	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR17	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR18	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR19	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR20	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR21	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR22	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR23	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR24	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR25	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR26	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR27	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR28	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR29	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR30	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR31	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR32	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR33	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR34	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR35	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR36	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR37	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR38	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR39	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR40	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR41	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR42	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR43	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR44	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR45	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR46	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR47	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR48	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR49	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR50	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR51	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR52	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR53	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	
1CR54	0.0	1,200.0	-	-	-	1.000	0.571	-	-	-	

구 분	윤하중하중수 n	영향선면적 A	종거합 Σy	고정하중 V_d	활하중 V_{l+i}	V_t	비 고
1CR01	2.0	1.400	1.571	20.811	196.114	216.925	
1CR02	2.0	1.400	1.571	41.074	196.114	237.188	
1CR03	2.0	1.400	1.571	44.339	196.114	240.453	
1CR04	2.0	1.400	1.571	49.361	227.493	276.854	
1CR05	2.0	1.400	1.571	54.384	235.337	289.721	
1CR06	2.0	1.400	1.571	54.384	235.337	289.721	
1CR07	2.0	1.400	1.571	54.384	235.337	289.721	
1CR08	2.0	1.400	1.571	54.384	235.337	289.721	
1CR09	2.0	1.400	1.571	54.384	235.337	289.721	
1CR10	2.0	1.400	1.571	54.384	235.337	289.721	
1CR11	2.0	1.400	1.571	54.384	235.337	289.721	
1CR12	2.0	1.400	1.571	54.384	235.337	289.721	
1CR13	2.0	1.400	1.571	54.384	235.337	289.721	
1CR14	2.0	1.400	1.571	54.384	235.337	289.721	
1CR15	2.0	1.400	1.571	55.106	235.337	290.443	
1CR16	2.0	1.400	1.571	55.308	235.337	290.645	
1CR17	2.0	1.400	1.571	55.510	235.337	290.847	
1CR18	2.0	1.400	1.571	51.672	203.959	255.630	
1CR19	2.0	1.400	1.571	50.487	227.493	277.980	
1CR20	2.0	1.400	1.571	55.106	235.337	290.443	
1CR21	2.0	1.400	1.571	54.210	235.337	289.548	
1CR22	2.0	1.400	1.571	54.037	235.337	289.374	
1CR23	2.0	1.400	1.571	53.864	235.337	289.201	
1CR24	2.0	1.400	1.571	53.864	235.337	289.201	
1CR25	2.0	1.400	1.571	53.864	235.337	289.201	
1CR26	2.0	1.400	1.571	53.864	235.337	289.201	
1CR27	2.0	1.400	1.571	53.864	235.337	289.201	
1CR28	2.0	1.400	1.571	53.864	235.337	289.201	
1CR29	2.0	1.400	1.571	53.864	235.337	289.201	
1CR30	2.0	1.400	1.571	53.864	235.337	289.201	
1CR31	2.0	1.400	1.571	53.864	235.337	289.201	
1CR32	2.0	1.400	1.571	53.864	235.337	289.201	
1CR33	2.0	1.400	1.571	54.037	235.337	289.374	
1CR34	2.0	1.400	1.571	55.106	235.337	290.443	
1CR35	2.0	1.400	1.571	57.156	235.337	292.493	
1CR36	2.0	1.400	1.571	54.964	203.959	258.923	
1CR37	2.0	1.400	1.571	55.801	227.493	283.294	
1CR38	2.0	1.400	1.571	59.986	235.337	295.323	
1CR39	2.0	1.400	1.571	58.369	235.337	293.706	
1CR40	2.0	1.400	1.571	56.694	235.337	292.031	
1CR41	2.0	1.400	1.571	54.384	235.337	289.721	
1CR42	2.0	1.400	1.571	54.384	235.337	289.721	
1CR43	2.0	1.400	1.571	54.384	235.337	289.721	
1CR44	2.0	1.400	1.571	54.384	235.337	289.721	
1CR45	2.0	1.400	1.571	54.384	235.337	289.721	
1CR46	2.0	1.400	1.571	54.384	235.337	289.721	
1CR47	2.0	1.400	1.571	54.384	235.337	289.721	
1CR48	2.0	1.400	1.571	54.384	235.337	289.721	
1CR49	2.0	1.400	1.571	54.384	235.337	289.721	
1CR50	2.0	1.400	1.571	54.384	235.337	289.721	
1CR51	2.0	1.400	1.571	49.361	203.959	253.320	
1CR52	2.0	1.400	1.571	44.339	196.114	240.453	
1CR53	2.0	1.400	1.571	43.445	196.114	239.559	
1CR54	2.0	1.400	1.571	23.355	196.114	219.469	

■ 관용해석에 의한 모멘트 산정

(단위:kN·m)

구 분	가로보 끝단에서 윤하중까지의 거리					활하중 작용점 영향선 종거					비 고
	x_1	x_2	x_3	x_4	x_5	y_1	y_2	y_3	y_4	y_5	
1CR01	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR02	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR03	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR04	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR05	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR06	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR07	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR08	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR09	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR10	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR11	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR12	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR13	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR14	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR15	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR16	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR17	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR18	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR19	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR20	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR21	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR22	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR23	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR24	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR25	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR26	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR27	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR28	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR29	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR30	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR31	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR32	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR33	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR34	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR35	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR36	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR37	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR38	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR39	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR40	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR41	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR42	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR43	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR44	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR45	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR46	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR47	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR48	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR49	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR50	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR51	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR52	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR53	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	
1CR54	0.0	1,200.0	-	-	-	1.000	0.143	-	-	-	

구 분	n	영향선면적 A	종거합 $\sum y$	고정하중 M_d	활하중 M_{l+i}	M_t	비 고
1CR01	2.0	1.400	1.143	14.568	99.840	114.408	
1CR02	2.0	1.400	1.143	28.752	99.840	128.592	
1CR03	2.0	1.400	1.143	31.037	99.840	130.877	
1CR04	2.0	1.400	1.143	34.553	115.814	150.367	
1CR05	2.0	1.400	1.143	38.069	119.808	157.877	
1CR06	2.0	1.400	1.143	38.069	119.808	157.877	
1CR07	2.0	1.400	1.143	38.069	119.808	157.877	
1CR08	2.0	1.400	1.143	38.069	119.808	157.877	
1CR09	2.0	1.400	1.143	38.069	119.808	157.877	
1CR10	2.0	1.400	1.143	38.069	119.808	157.877	
1CR11	2.0	1.400	1.143	38.069	119.808	157.877	
1CR12	2.0	1.400	1.143	38.069	119.808	157.877	
1CR13	2.0	1.400	1.143	38.069	119.808	157.877	
1CR14	2.0	1.400	1.143	38.069	119.808	157.877	
1CR15	2.0	1.400	1.143	38.574	119.808	158.382	
1CR16	2.0	1.400	1.143	38.715	119.808	158.523	
1CR17	2.0	1.400	1.143	38.857	119.808	158.665	
1CR18	2.0	1.400	1.143	36.170	103.834	140.004	
1CR19	2.0	1.400	1.143	35.341	115.814	151.156	
1CR20	2.0	1.400	1.143	38.574	119.808	158.382	
1CR21	2.0	1.400	1.143	37.947	119.808	157.755	
1CR22	2.0	1.400	1.143	37.826	119.808	157.634	
1CR23	2.0	1.400	1.143	37.705	119.808	157.513	
1CR24	2.0	1.400	1.143	37.705	119.808	157.513	
1CR25	2.0	1.400	1.143	37.705	119.808	157.513	
1CR26	2.0	1.400	1.143	37.705	119.808	157.513	
1CR27	2.0	1.400	1.143	37.705	119.808	157.513	
1CR28	2.0	1.400	1.143	37.705	119.808	157.513	
1CR29	2.0	1.400	1.143	37.705	119.808	157.513	
1CR30	2.0	1.400	1.143	37.705	119.808	157.513	
1CR31	2.0	1.400	1.143	37.705	119.808	157.513	
1CR32	2.0	1.400	1.143	37.705	119.808	157.513	
1CR33	2.0	1.400	1.143	37.826	119.808	157.634	
1CR34	2.0	1.400	1.143	38.574	119.808	158.382	
1CR35	2.0	1.400	1.143	40.009	119.808	159.817	
1CR36	2.0	1.400	1.143	38.475	103.834	142.308	
1CR37	2.0	1.400	1.143	39.061	115.814	154.875	
1CR38	2.0	1.400	1.143	41.990	119.808	161.798	
1CR39	2.0	1.400	1.143	40.858	119.808	160.666	
1CR40	2.0	1.400	1.143	39.686	119.808	159.494	
1CR41	2.0	1.400	1.143	38.069	119.808	157.877	
1CR42	2.0	1.400	1.143	38.069	119.808	157.877	
1CR43	2.0	1.400	1.143	38.069	119.808	157.877	
1CR44	2.0	1.400	1.143	38.069	119.808	157.877	
1CR45	2.0	1.400	1.143	38.069	119.808	157.877	
1CR46	2.0	1.400	1.143	38.069	119.808	157.877	
1CR47	2.0	1.400	1.143	38.069	119.808	157.877	
1CR48	2.0	1.400	1.143	38.069	119.808	157.877	
1CR49	2.0	1.400	1.143	38.069	119.808	157.877	
1CR50	2.0	1.400	1.143	38.069	119.808	157.877	
1CR51	2.0	1.400	1.143	34.553	103.834	138.386	
1CR52	2.0	1.400	1.143	31.037	99.840	130.877	
1CR53	2.0	1.400	1.143	30.411	99.840	130.251	
1CR54	2.0	1.400	1.143	16.348	99.840	116.188	

2) 격 자 해 석

▪ 격자해석에 의한 전단력 해석결과

(단위:kN)

구 분	단위	합성전 고정하중		합성후 고정하중	활하중	지점침하	V_t	부재 번호
		강재자중	슬래브 자중					
1CR01	kN	6.253	29.906	19.564	545.402	0.768	601.893	107
1CR02	kN	4.467	4.203	4.852	142.438	0.183	156.144	108
1CR03	kN	-4.188	-0.401	0.489	-83.825	-0.035	87.959	109
1CR04	kN	-4.191	-0.447	-0.102	-107.214	-0.015	111.969	110
1CR05	kN	-4.137	0.193	-0.327	-118.649	-0.024	122.944	111
1CR06	kN	-4.165	-0.264	-0.262	-114.458	-0.023	119.171	112
1CR07	kN	-4.237	-1.360	-0.630	-114.066	-0.040	120.333	113
1CR08	kN	-4.241	-1.375	-0.658	-113.942	-0.052	120.269	114
1CR09	kN	-4.118	0.759	-0.080	-113.127	-0.045	116.612	115
1CR10	kN	4.290	2.448	0.579	112.436	0.014	119.766	116
1CR11	kN	4.412	4.176	1.383	109.925	0.033	119.929	117
1CR12	kN	4.424	3.981	1.812	108.710	0.105	119.032	118
1CR13	kN	4.437	2.684	1.498	108.302	0.216	117.137	119
1CR14	kN	-4.001	-2.468	-0.361	-105.733	-0.250	112.812	120
1CR15	kN	-6.170	-22.178	-9.525	-127.332	-0.544	165.748	121
1CR16	kN	-7.618	-53.030	-35.275	-124.085	-1.858	221.867	122
1CR17	kN	-10.812	-134.858	-72.523	-309.370	-4.127	531.690	123
1CR18	kN	-17.769	-241.228	-121.387	-888.897	-7.097	1,276.378	124
1CR19	kN	-10.564	-105.362	-71.209	-352.015	-4.478	543.628	125
1CR20	kN	-7.000	-61.390	-38.670	-173.510	-2.672	283.242	126
1CR21	kN	-4.080	-37.777	-12.464	-92.102	-0.817	147.241	127
1CR22	kN	-4.647	-11.802	-4.177	-101.147	-0.289	122.063	128
1CR23	kN	-3.866	-0.585	-0.821	-104.704	-0.184	110.161	129
1CR24	kN	3.690	2.977	0.539	112.412	0.131	119.750	130
1CR25	kN	3.765	3.100	1.033	114.354	0.086	122.337	131
1CR26	kN	3.764	2.294	0.374	115.141	0.038	121.611	132
1CR27	kN	3.760	1.970	0.033	115.571	0.019	121.353	133
1CR28	kN	3.768	2.192	0.070	115.681	0.015	121.725	134
1CR29	kN	3.763	2.310	0.380	115.238	0.013	121.704	135
1CR30	kN	3.777	3.746	1.129	114.783	0.080	123.515	136
1CR31	kN	3.682	3.422	0.589	112.249	0.137	120.080	137
1CR32	kN	-3.899	-0.009	-0.454	-102.588	-0.196	107.145	138
1CR33	kN	-4.846	-11.310	-2.887	-103.603	-0.345	122.991	139
1CR34	kN	-4.633	-38.150	-7.926	-101.741	-0.962	153.411	140
1CR35	kN	-7.352	-45.576	-21.943	-140.467	-2.909	218.247	141
1CR36	kN	-12.195	-41.294	-45.820	-308.497	-5.992	413.798	142
1CR37	kN	-16.935	-145.054	-74.647	-1,003.804	-9.435	1,249.874	143
1CR38	kN	-11.421	-58.817	-50.960	-327.488	-6.236	454.922	144
1CR39	kN	-12.990	-108.819	-35.490	-127.237	-1.523	286.060	145
1CR40	kN	-12.095	-102.008	-15.764	-137.191	-0.309	267.367	146
1CR41	kN	5.861	27.693	0.872	97.877	0.769	133.072	147
1CR42	kN	5.205	17.005	1.924	109.153	0.516	133.803	148
1CR43	kN	4.897	11.642	5.429	113.607	0.511	136.087	149
1CR44	kN	4.638	6.994	3.312	112.891	0.275	128.109	150
1CR45	kN	4.419	3.533	0.338	112.640	0.047	120.976	151
1CR46	kN	4.529	5.496	0.490	112.094	0.027	122.636	152
1CR47	kN	4.526	5.492	0.257	112.071	0.002	122.347	153
1CR48	kN	4.534	5.740	0.039	112.531	0.013	122.858	154
1CR49	kN	4.618	6.960	0.195	112.524	0.006	124.304	155
1CR50	kN	4.515	5.053	-1.078	113.369	0.043	121.902	156
1CR51	kN	-4.368	-4.576	0.983	-100.628	-0.012	108.602	157
1CR52	kN	-4.628	-8.956	1.470	-80.290	-0.031	92.436	158
1CR53	kN	7.782	13.644	11.363	102.772	0.208	135.768	159
1CR54	kN	12.423	121.809	93.176	680.379	1.881	909.667	160

■ 격자해석에 의한 모멘트 해석결과

(단위: kN·m)

구 분	단위	합성전 고정하중		합성후 고정하중	활하중	지점침하	M_t	부재 번호
		강재자중	슬래브 자중					
1CR01	kN·m	9.103	59.186	-22.345	926.569	1.043	973.556	107
1CR02	kN·m	7.086	26.169	-55.834	332.374	0.234	310.030	108
1CR03	kN·m	6.421	20.029	-67.797	-142.444	-0.048	183.839	109
1CR04	kN·m	6.462	22.113	-73.887	-146.836	-0.022	192.170	110
1CR05	kN·m	6.355	22.425	-78.848	-149.846	-0.041	199.956	111
1CR06	kN·m	6.343	22.490	-82.705	-143.115	-0.034	197.022	112
1CR07	kN·m	6.236	20.913	-84.862	-143.925	-0.059	201.697	113
1CR08	kN·m	6.240	21.176	-85.753	-144.440	-0.074	202.852	114
1CR09	kN·m	6.372	23.724	-85.420	-144.450	-0.068	199.842	115
1CR10	kN·m	6.544	26.908	-84.327	-146.163	-0.037	197.075	116
1CR11	kN·m	5.917	17.187	-86.631	-129.643	-0.057	193.226	117
1CR12	kN·m	5.904	18.193	-85.612	-133.847	-0.145	195.507	118
1CR13	kN·m	5.822	20.072	-82.374	-146.551	-0.283	203.313	119
1CR14	kN·m	5.840	26.285	-75.278	-163.171	-0.572	206.896	120
1CR15	kN·m	5.160	-8.608	-98.872	-204.325	-0.844	307.488	121
1CR16	kN·m	3.883	-52.071	-140.434	-303.351	-2.790	494.762	122
1CR17	kN·m	-1.085	-169.898	-191.597	-661.142	-6.092	1,029.815	123
1CR18	kN·m	-4.747	-316.760	-298.577	-1,809.700	-10.586	2,440.370	124
1CR19	kN·m	0.855	-128.903	-197.326	-755.931	-6.664	1,087.970	125
1CR20	kN·m	6.720	-60.037	-164.885	-379.299	-3.976	601.478	126
1CR21	kN·m	5.131	-25.679	-91.610	-164.622	-1.201	277.979	127
1CR22	kN·m	2.976	8.556	-70.934	-130.470	-0.414	190.286	128
1CR23	kN·m	4.818	24.772	-74.269	-134.471	-0.246	179.395	129
1CR24	kN·m	5.476	28.605	-77.673	-148.101	-0.072	191.765	130
1CR25	kN·m	5.624	27.229	-80.460	-153.576	-0.041	201.225	131
1CR26	kN·m	5.625	25.204	-83.258	-158.598	-0.029	211.056	132
1CR27	kN·m	5.624	24.543	-84.392	-161.361	-0.042	215.628	133
1CR28	kN·m	5.629	24.739	-83.942	-161.616	-0.051	215.241	134
1CR29	kN·m	5.619	25.277	-81.923	-159.650	-0.040	210.716	135
1CR30	kN·m	5.621	28.245	-77.719	-155.143	-0.048	199.044	136
1CR31	kN·m	5.375	29.003	-73.021	-150.792	-0.063	189.498	137
1CR32	kN·m	4.499	24.591	-66.157	-136.187	-0.250	173.505	138
1CR33	kN·m	3.053	10.388	-65.880	-135.416	-0.472	188.327	139
1CR34	kN·m	6.277	-25.316	-84.954	-130.777	-1.386	236.155	140
1CR35	kN·m	10.512	-35.848	-132.652	-236.457	-4.276	398.721	141
1CR36	kN·m	13.584	-28.420	-178.402	-713.627	-9.038	915.902	142
1CR37	kN·m	12.001	-169.572	-223.783	-2,245.799	-14.247	2,641.399	143
1CR38	kN·m	15.829	-43.058	-185.962	-737.808	-9.352	960.350	144
1CR39	kN·m	6.003	-116.204	-148.623	-256.359	-2.343	517.525	145
1CR40	kN·m	1.719	-111.418	-109.000	-173.093	-0.461	392.254	146
1CR41	kN·m	3.143	-14.129	-59.093	-120.080	-1.083	191.243	147
1CR42	kN·m	4.495	0.550	-73.189	-126.591	-0.800	195.535	148
1CR43	kN·m	4.936	4.912	-86.322	-128.805	-0.841	206.121	149
1CR44	kN·m	5.193	7.974	-88.251	-127.610	-0.535	203.229	150
1CR45	kN·m	6.133	19.695	-85.668	-149.700	-0.093	209.634	151
1CR46	kN·m	6.236	20.754	-86.497	-147.768	-0.112	207.388	152
1CR47	kN·m	6.182	19.526	-86.582	-147.062	-0.136	208.072	153
1CR48	kN·m	5.151	4.264	-85.239	-130.309	-0.108	206.241	154
1CR49	kN·m	5.017	2.652	-81.942	-133.060	-0.085	207.418	155
1CR50	kN·m	5.228	7.546	-73.259	-141.186	-0.066	201.737	156
1CR51	kN·m	5.934	21.749	-64.239	-136.410	-0.057	173.022	157
1CR52	kN·m	5.850	28.125	-49.987	164.072	0.093	148.152	158
1CR53	kN·m	14.019	61.026	-55.468	426.470	0.722	446.769	159
1CR54	kN·m	22.441	261.521	105.740	1,465.618	3.474	1,858.795	160

■ 자유돌출판의 압축부 국부좌굴에 대한 허용응력

[illegible]

▪ 허용 휨 압축응력

구 분	상 부 플 랜 지					비 고
	A_w	A_c	A_w/A_c	K	f_{ca}	
1CR01	20,400.0	3,600.0	5.667	2.415	9.3/K < L/bfu ≤ 30.0 = 123.580 MPa	
1CR02	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR03	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR04	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR05	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR06	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR07	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR08	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR09	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR10	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR11	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR12	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR13	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR14	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR15	26,600.0	3,600.0	7.389	2.587	9.3/K < L/bfu ≤ 30.0 = 121.588 MPa	
1CR16	28,000.0	3,600.0	7.778	2.625	9.3/K < L/bfu ≤ 30.0 = 121.156 MPa	
1CR17	29,400.0	3,600.0	8.167	2.661	9.3/K < L/bfu ≤ 30.0 = 120.730 MPa	
1CR18	35,200.0	4,800.0	7.333	2.582	9.3/K < L/bfu ≤ 30.0 = 129.120 MPa	
1CR19	29,400.0	3,600.0	8.167	2.661	9.3/K < L/bfu ≤ 30.0 = 120.730 MPa	
1CR20	26,600.0	3,600.0	7.389	2.587	9.3/K < L/bfu ≤ 30.0 = 121.588 MPa	
1CR21	20,400.0	3,600.0	5.667	2.415	9.3/K < L/bfu ≤ 30.0 = 123.580 MPa	
1CR22	19,200.0	3,600.0	5.333	2.380	9.3/K < L/bfu ≤ 30.0 = 123.982 MPa	
1CR23	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR24	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR25	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR26	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR27	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR28	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR29	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR30	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR31	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR32	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfu ≤ 30.0 = 124.390 MPa	
1CR33	19,200.0	3,600.0	5.333	2.380	9.3/K < L/bfu ≤ 30.0 = 123.982 MPa	
1CR34	26,600.0	3,600.0	7.389	2.587	9.3/K < L/bfu ≤ 30.0 = 121.588 MPa	
1CR35	38,400.0	4,800.0	8.000	2.646	9.3/K < L/bfu ≤ 30.0 = 128.567 MPa	
1CR36	58,000.0	4,800.0	12.083	3.007	9.3/K < L/bfu ≤ 30.0 = 125.432 MPa	
1CR37	63,800.0	4,800.0	13.292	3.106	9.3/K < L/bfu ≤ 30.0 = 124.574 MPa	
1CR38	58,000.0	4,800.0	12.083	3.007	9.3/K < L/bfu ≤ 30.0 = 125.432 MPa	
1CR39	46,800.0	4,800.0	9.750	2.806	9.3/K < L/bfu ≤ 30.0 = 127.174 MPa	
1CR40	35,200.0	4,800.0	7.333	2.582	9.3/K < L/bfu ≤ 30.0 = 129.120 MPa	
1CR41	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR42	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR43	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR44	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR45	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR46	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR47	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR48	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR49	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR50	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR51	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR52	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfu ≤ 30.0 = 123.183 MPa	
1CR53	38,400.0	4,800.0	8.000	2.646	9.3/K < L/bfu ≤ 30.0 = 128.567 MPa	
1CR54	38,400.0	4,800.0	8.000	2.646	9.3/K < L/bfu ≤ 30.0 = 128.567 MPa	

구 분	하 부 플 랜 지					비 고
	A_w	A_c	A_w/A_c	K	f_{ca}	
1CR01	20,400.0	3,600.0	5.667	2.415	9.3/K < L/bfl ≤ 30.0 = 123.580 MPa	
1CR02	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR03	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR04	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR05	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR06	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR07	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR08	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR09	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR10	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR11	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR12	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR13	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR14	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR15	26,600.0	3,600.0	7.389	2.587	9.3/K < L/bfl ≤ 30.0 = 121.588 MPa	
1CR16	28,000.0	3,600.0	7.778	2.625	9.3/K < L/bfl ≤ 30.0 = 121.156 MPa	
1CR17	29,400.0	3,600.0	8.167	2.661	9.3/K < L/bfl ≤ 30.0 = 120.730 MPa	
1CR18	35,200.0	4,800.0	7.333	2.582	9.3/K < L/bfl ≤ 30.0 = 129.120 MPa	
1CR19	29,400.0	3,600.0	8.167	2.661	9.3/K < L/bfl ≤ 30.0 = 120.730 MPa	
1CR20	26,600.0	3,600.0	7.389	2.587	9.3/K < L/bfl ≤ 30.0 = 121.588 MPa	
1CR21	20,400.0	3,600.0	5.667	2.415	9.3/K < L/bfl ≤ 30.0 = 123.580 MPa	
1CR22	19,200.0	3,600.0	5.333	2.380	9.3/K < L/bfl ≤ 30.0 = 123.982 MPa	
1CR23	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR24	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR25	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR26	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR27	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR28	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR29	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR30	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR31	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR32	18,000.0	3,600.0	5.000	2.345	9.3/K < L/bfl ≤ 30.0 = 124.390 MPa	
1CR33	19,200.0	3,600.0	5.333	2.380	9.3/K < L/bfl ≤ 30.0 = 123.982 MPa	
1CR34	26,600.0	3,600.0	7.389	2.587	9.3/K < L/bfl ≤ 30.0 = 121.588 MPa	
1CR35	38,400.0	4,800.0	8.000	2.646	9.3/K < L/bfl ≤ 30.0 = 128.567 MPa	
1CR36	58,000.0	4,800.0	12.083	3.007	9.3/K < L/bfl ≤ 30.0 = 125.432 MPa	
1CR37	63,800.0	4,800.0	13.292	3.106	9.3/K < L/bfl ≤ 30.0 = 124.574 MPa	
1CR38	58,000.0	4,800.0	12.083	3.007	9.3/K < L/bfl ≤ 30.0 = 125.432 MPa	
1CR39	46,800.0	4,800.0	9.750	2.806	9.3/K < L/bfl ≤ 30.0 = 127.174 MPa	
1CR40	35,200.0	4,800.0	7.333	2.582	9.3/K < L/bfl ≤ 30.0 = 129.120 MPa	
1CR41	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR42	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR43	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR44	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR45	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR46	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR47	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR48	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR49	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR50	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR51	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR52	21,600.0	3,600.0	6.000	2.449	9.3/K < L/bfl ≤ 30.0 = 123.183 MPa	
1CR53	38,400.0	4,800.0	8.000	2.646	9.3/K < L/bfl ≤ 30.0 = 128.567 MPa	
1CR54	38,400.0	4,800.0	8.000	2.646	9.3/K < L/bfl ≤ 30.0 = 128.567 MPa	

▪ 계산 적용 부재력 및 허용응력

구 분	V_{umax} (kN)	M_{umax} (kN·m)	상부 플랜지 (MPa)			하부 플랜지 (MPa)			비 고
			f_{ca}	f_{ta}	σ_a	f_{ca}	f_{ta}	σ_a	
1CR01	601.89	973.56	123.58	140.00	80.00	123.58	140.00	80.00	
1CR02	237.19	310.03	123.18	140.00	80.00	123.18	140.00	80.00	
1CR03	240.45	183.84	123.18	140.00	80.00	123.18	140.00	80.00	
1CR04	276.85	192.17	123.18	140.00	80.00	123.18	140.00	80.00	
1CR05	289.72	199.96	123.18	140.00	80.00	123.18	140.00	80.00	
1CR06	289.72	197.02	123.18	140.00	80.00	123.18	140.00	80.00	
1CR07	289.72	201.70	123.18	140.00	80.00	123.18	140.00	80.00	
1CR08	289.72	202.85	123.18	140.00	80.00	123.18	140.00	80.00	
1CR09	289.72	199.84	123.18	140.00	80.00	123.18	140.00	80.00	
1CR10	289.72	197.07	123.18	140.00	80.00	123.18	140.00	80.00	
1CR11	289.72	193.23	123.18	140.00	80.00	123.18	140.00	80.00	
1CR12	289.72	195.51	123.18	140.00	80.00	123.18	140.00	80.00	
1CR13	289.72	203.31	123.18	140.00	80.00	123.18	140.00	80.00	
1CR14	289.72	206.90	123.18	140.00	80.00	123.18	140.00	80.00	
1CR15	290.44	307.49	121.59	140.00	80.00	121.59	140.00	80.00	
1CR16	290.64	494.76	121.16	140.00	80.00	121.16	140.00	80.00	
1CR17	531.69	1,029.82	120.73	140.00	80.00	120.73	140.00	80.00	
1CR18	1,276.38	2,440.37	129.12	140.00	80.00	129.12	140.00	80.00	
1CR19	543.63	1,087.97	120.73	140.00	80.00	120.73	140.00	80.00	
1CR20	290.44	601.48	121.59	140.00	80.00	121.59	140.00	80.00	
1CR21	289.55	277.98	123.58	140.00	80.00	123.58	140.00	80.00	
1CR22	289.37	190.29	123.98	140.00	80.00	123.98	140.00	80.00	
1CR23	289.20	179.40	124.39	140.00	80.00	124.39	140.00	80.00	
1CR24	289.20	191.76	124.39	140.00	80.00	124.39	140.00	80.00	
1CR25	289.20	201.22	124.39	140.00	80.00	124.39	140.00	80.00	
1CR26	289.20	211.06	124.39	140.00	80.00	124.39	140.00	80.00	
1CR27	289.20	215.63	124.39	140.00	80.00	124.39	140.00	80.00	
1CR28	289.20	215.24	124.39	140.00	80.00	124.39	140.00	80.00	
1CR29	289.20	210.72	124.39	140.00	80.00	124.39	140.00	80.00	
1CR30	289.20	199.04	124.39	140.00	80.00	124.39	140.00	80.00	
1CR31	289.20	189.50	124.39	140.00	80.00	124.39	140.00	80.00	
1CR32	289.20	173.50	124.39	140.00	80.00	124.39	140.00	80.00	
1CR33	289.37	188.33	123.98	140.00	80.00	123.98	140.00	80.00	
1CR34	290.44	236.16	121.59	140.00	80.00	121.59	140.00	80.00	
1CR35	292.49	398.72	93.75	140.00	80.00	93.75	140.00	80.00	
1CR36	413.80	915.90	125.43	140.00	80.00	125.43	140.00	80.00	
1CR37	1,249.87	2,641.40	124.57	140.00	80.00	124.57	140.00	80.00	
1CR38	454.92	960.35	125.43	140.00	80.00	125.43	140.00	80.00	
1CR39	293.71	517.53	94.73	140.00	80.00	94.73	140.00	80.00	
1CR40	292.03	392.25	93.75	140.00	80.00	93.75	140.00	80.00	
1CR41	289.72	191.24	123.18	140.00	80.00	123.18	140.00	80.00	
1CR42	289.72	195.54	123.18	140.00	80.00	123.18	140.00	80.00	
1CR43	289.72	206.12	123.18	140.00	80.00	123.18	140.00	80.00	
1CR44	289.72	203.23	123.18	140.00	80.00	123.18	140.00	80.00	
1CR45	289.72	209.63	123.18	140.00	80.00	123.18	140.00	80.00	
1CR46	289.72	207.39	123.18	140.00	80.00	123.18	140.00	80.00	
1CR47	289.72	208.07	123.18	140.00	80.00	123.18	140.00	80.00	
1CR48	289.72	206.24	123.18	140.00	80.00	123.18	140.00	80.00	
1CR49	289.72	207.42	123.18	140.00	80.00	123.18	140.00	80.00	
1CR50	289.72	201.74	123.18	140.00	80.00	123.18	140.00	80.00	
1CR51	253.32	173.02	123.18	140.00	80.00	123.18	140.00	80.00	
1CR52	240.45	148.15	123.18	140.00	80.00	123.18	140.00	80.00	
1CR53	239.56	446.77	93.75	140.00	80.00	93.75	140.00	80.00	
1CR54	909.67	1,858.80	128.57	140.00	80.00	128.57	140.00	80.00	

· 응 력 검 토

구 분	전단응력 (MPa)			상부 플랜지 (MPa)				하부 플랜지 (MPa)			
	U	U_a	판정	f_u	f_{ca}	f_{ta}	판정	f_l	f_{ca}	f_{ta}	판정
1CR01	29.50	80.00	0.K	82.37	123.58	140.00	0.K	82.37	123.58	140.00	0.K
1CR02	10.98	80.00	0.K	24.08	123.18	140.00	0.K	24.08	123.18	140.00	0.K
1CR03	11.13	80.00	0.K	14.28	123.18	140.00	0.K	14.28	123.18	140.00	0.K
1CR04	12.82	80.00	0.K	14.93	123.18	140.00	0.K	14.93	123.18	140.00	0.K
1CR05	13.41	80.00	0.K	15.53	123.18	140.00	0.K	15.53	123.18	140.00	0.K
1CR06	13.41	80.00	0.K	15.30	123.18	140.00	0.K	15.30	123.18	140.00	0.K
1CR07	13.41	80.00	0.K	15.67	123.18	140.00	0.K	15.67	123.18	140.00	0.K
1CR08	13.41	80.00	0.K	15.76	123.18	140.00	0.K	15.76	123.18	140.00	0.K
1CR09	13.41	80.00	0.K	15.52	123.18	140.00	0.K	15.52	123.18	140.00	0.K
1CR10	13.41	80.00	0.K	15.31	123.18	140.00	0.K	15.31	123.18	140.00	0.K
1CR11	13.41	80.00	0.K	15.01	123.18	140.00	0.K	15.01	123.18	140.00	0.K
1CR12	13.41	80.00	0.K	15.18	123.18	140.00	0.K	15.18	123.18	140.00	0.K
1CR13	13.41	80.00	0.K	15.79	123.18	140.00	0.K	15.79	123.18	140.00	0.K
1CR14	13.41	80.00	0.K	16.07	123.18	140.00	0.K	16.07	123.18	140.00	0.K
1CR15	10.92	80.00	0.K	20.28	121.59	140.00	0.K	20.28	121.59	140.00	0.K
1CR16	10.38	80.00	0.K	30.13	121.16	140.00	0.K	30.13	121.16	140.00	0.K
1CR17	18.08	80.00	0.K	58.07	120.73	140.00	0.K	58.07	120.73	140.00	0.K
1CR18	36.26	80.00	0.K	104.61	129.12	140.00	0.K	104.61	129.12	140.00	0.K
1CR19	18.49	80.00	0.K	61.35	120.73	140.00	0.K	61.35	120.73	140.00	0.K
1CR20	10.92	80.00	0.K	39.68	121.59	140.00	0.K	39.68	121.59	140.00	0.K
1CR21	14.19	80.00	0.K	23.52	123.58	140.00	0.K	23.52	123.58	140.00	0.K
1CR22	15.07	80.00	0.K	17.61	123.98	140.00	0.K	17.61	123.98	140.00	0.K
1CR23	16.07	80.00	0.K	18.25	124.39	140.00	0.K	18.25	124.39	140.00	0.K
1CR24	16.07	80.00	0.K	19.51	124.39	140.00	0.K	19.51	124.39	140.00	0.K
1CR25	16.07	80.00	0.K	20.47	124.39	140.00	0.K	20.47	124.39	140.00	0.K
1CR26	16.07	80.00	0.K	21.47	124.39	140.00	0.K	21.47	124.39	140.00	0.K
1CR27	16.07	80.00	0.K	21.94	124.39	140.00	0.K	21.94	124.39	140.00	0.K
1CR28	16.07	80.00	0.K	21.90	124.39	140.00	0.K	21.90	124.39	140.00	0.K
1CR29	16.07	80.00	0.K	21.44	124.39	140.00	0.K	21.44	124.39	140.00	0.K
1CR30	16.07	80.00	0.K	20.25	124.39	140.00	0.K	20.25	124.39	140.00	0.K
1CR31	16.07	80.00	0.K	19.28	124.39	140.00	0.K	19.28	124.39	140.00	0.K
1CR32	16.07	80.00	0.K	17.65	124.39	140.00	0.K	17.65	124.39	140.00	0.K
1CR33	15.07	80.00	0.K	17.43	123.98	140.00	0.K	17.43	123.98	140.00	0.K
1CR34	10.92	80.00	0.K	15.58	121.59	140.00	0.K	15.58	121.59	140.00	0.K
1CR35	7.62	80.00	0.K	14.92	93.75	140.00	0.K	14.92	93.75	140.00	0.K
1CR36	7.13	80.00	0.K	21.95	125.43	140.00	0.K	21.95	125.43	140.00	0.K
1CR37	19.59	80.00	0.K	59.35	124.57	140.00	0.K	59.35	124.57	140.00	0.K
1CR38	7.84	80.00	0.K	23.02	125.43	140.00	0.K	23.02	125.43	140.00	0.K
1CR39	6.28	80.00	0.K	15.89	94.73	140.00	0.K	15.89	94.73	140.00	0.K
1CR40	8.30	80.00	0.K	16.81	93.75	140.00	0.K	16.81	93.75	140.00	0.K
1CR41	13.41	80.00	0.K	14.85	123.18	140.00	0.K	14.85	123.18	140.00	0.K
1CR42	13.41	80.00	0.K	15.19	123.18	140.00	0.K	15.19	123.18	140.00	0.K
1CR43	13.41	80.00	0.K	16.01	123.18	140.00	0.K	16.01	123.18	140.00	0.K
1CR44	13.41	80.00	0.K	15.78	123.18	140.00	0.K	15.78	123.18	140.00	0.K
1CR45	13.41	80.00	0.K	16.28	123.18	140.00	0.K	16.28	123.18	140.00	0.K
1CR46	13.41	80.00	0.K	16.11	123.18	140.00	0.K	16.11	123.18	140.00	0.K
1CR47	13.41	80.00	0.K	16.16	123.18	140.00	0.K	16.16	123.18	140.00	0.K
1CR48	13.41	80.00	0.K	16.02	123.18	140.00	0.K	16.02	123.18	140.00	0.K
1CR49	13.41	80.00	0.K	16.11	123.18	140.00	0.K	16.11	123.18	140.00	0.K
1CR50	13.41	80.00	0.K	15.67	123.18	140.00	0.K	15.67	123.18	140.00	0.K
1CR51	11.73	80.00	0.K	13.44	123.18	140.00	0.K	13.44	123.18	140.00	0.K
1CR52	11.13	80.00	0.K	11.51	123.18	140.00	0.K	11.51	123.18	140.00	0.K
1CR53	6.24	80.00	0.K	16.72	93.75	140.00	0.K	16.72	93.75	140.00	0.K
1CR54	23.69	80.00	0.K	69.54	128.57	140.00	0.K	69.54	128.57	140.00	0.K

▪ 합성 응력 검토

구 분	상부 플랜지 인장 하부 플랜지 압축인 경우					상부 플랜지 압축 하부 플랜지 인장인 경우				
	인장	전단	합성응력	허용	판별	인장	전단	합성응력	허용	판별
1CR01	0.444	0.136	0.580	1.2	0.K	0.444	0.136	0.580	1.2	0.K
1CR02	0.038	0.019	0.057	1.2	0.K	0.038	0.019	0.057	1.2	0.K
1CR03	0.013	0.019	0.033	1.2	0.K	0.013	0.019	0.033	1.2	0.K
1CR04	0.015	0.026	0.040	1.2	0.K	0.015	0.026	0.040	1.2	0.K
1CR05	0.016	0.028	0.044	1.2	0.K	0.016	0.028	0.044	1.2	0.K
1CR06	0.015	0.028	0.044	1.2	0.K	0.015	0.028	0.044	1.2	0.K
1CR07	0.016	0.028	0.044	1.2	0.K	0.016	0.028	0.044	1.2	0.K
1CR08	0.016	0.028	0.044	1.2	0.K	0.016	0.028	0.044	1.2	0.K
1CR09	0.016	0.028	0.044	1.2	0.K	0.016	0.028	0.044	1.2	0.K
1CR10	0.015	0.028	0.044	1.2	0.K	0.015	0.028	0.044	1.2	0.K
1CR11	0.015	0.028	0.043	1.2	0.K	0.015	0.028	0.043	1.2	0.K
1CR12	0.015	0.028	0.043	1.2	0.K	0.015	0.028	0.043	1.2	0.K
1CR13	0.016	0.028	0.045	1.2	0.K	0.016	0.028	0.045	1.2	0.K
1CR14	0.017	0.028	0.045	1.2	0.K	0.017	0.028	0.045	1.2	0.K
1CR15	0.028	0.019	0.046	1.2	0.K	0.028	0.019	0.046	1.2	0.K
1CR16	0.062	0.017	0.079	1.2	0.K	0.062	0.017	0.079	1.2	0.K
1CR17	0.231	0.051	0.282	1.2	0.K	0.231	0.051	0.282	1.2	0.K
1CR18	0.656	0.205	0.862	1.2	0.K	0.656	0.205	0.862	1.2	0.K
1CR19	0.258	0.053	0.312	1.2	0.K	0.258	0.053	0.312	1.2	0.K
1CR20	0.106	0.019	0.125	1.2	0.K	0.106	0.019	0.125	1.2	0.K
1CR21	0.036	0.031	0.068	1.2	0.K	0.036	0.031	0.068	1.2	0.K
1CR22	0.020	0.035	0.056	1.2	0.K	0.020	0.035	0.056	1.2	0.K
1CR23	0.022	0.040	0.062	1.2	0.K	0.022	0.040	0.062	1.2	0.K
1CR24	0.025	0.040	0.065	1.2	0.K	0.025	0.040	0.065	1.2	0.K
1CR25	0.027	0.040	0.067	1.2	0.K	0.027	0.040	0.067	1.2	0.K
1CR26	0.030	0.040	0.070	1.2	0.K	0.030	0.040	0.070	1.2	0.K
1CR27	0.031	0.040	0.071	1.2	0.K	0.031	0.040	0.071	1.2	0.K
1CR28	0.031	0.040	0.071	1.2	0.K	0.031	0.040	0.071	1.2	0.K
1CR29	0.030	0.040	0.070	1.2	0.K	0.030	0.040	0.070	1.2	0.K
1CR30	0.027	0.040	0.067	1.2	0.K	0.027	0.040	0.067	1.2	0.K
1CR31	0.024	0.040	0.064	1.2	0.K	0.024	0.040	0.064	1.2	0.K
1CR32	0.020	0.040	0.060	1.2	0.K	0.020	0.040	0.060	1.2	0.K
1CR33	0.020	0.035	0.055	1.2	0.K	0.020	0.035	0.055	1.2	0.K
1CR34	0.016	0.019	0.035	1.2	0.K	0.016	0.019	0.035	1.2	0.K
1CR35	0.025	0.009	0.034	1.2	0.K	0.025	0.009	0.034	1.2	0.K
1CR36	0.031	0.008	0.039	1.2	0.K	0.031	0.008	0.039	1.2	0.K
1CR37	0.227	0.060	0.287	1.2	0.K	0.227	0.060	0.287	1.2	0.K
1CR38	0.034	0.010	0.043	1.2	0.K	0.034	0.010	0.043	1.2	0.K
1CR39	0.028	0.006	0.034	1.2	0.K	0.028	0.006	0.034	1.2	0.K
1CR40	0.032	0.011	0.043	1.2	0.K	0.032	0.011	0.043	1.2	0.K
1CR41	0.015	0.028	0.043	1.2	0.K	0.015	0.028	0.043	1.2	0.K
1CR42	0.015	0.028	0.043	1.2	0.K	0.015	0.028	0.043	1.2	0.K
1CR43	0.017	0.028	0.045	1.2	0.K	0.017	0.028	0.045	1.2	0.K
1CR44	0.016	0.028	0.045	1.2	0.K	0.016	0.028	0.045	1.2	0.K
1CR45	0.017	0.028	0.046	1.2	0.K	0.017	0.028	0.046	1.2	0.K
1CR46	0.017	0.028	0.045	1.2	0.K	0.017	0.028	0.045	1.2	0.K
1CR47	0.017	0.028	0.045	1.2	0.K	0.017	0.028	0.045	1.2	0.K
1CR48	0.017	0.028	0.045	1.2	0.K	0.017	0.028	0.045	1.2	0.K
1CR49	0.017	0.028	0.045	1.2	0.K	0.017	0.028	0.045	1.2	0.K
1CR50	0.016	0.028	0.044	1.2	0.K	0.016	0.028	0.044	1.2	0.K
1CR51	0.012	0.021	0.033	1.2	0.K	0.012	0.021	0.033	1.2	0.K
1CR52	0.009	0.019	0.028	1.2	0.K	0.009	0.019	0.028	1.2	0.K
1CR53	0.032	0.006	0.038	1.2	0.K	0.032	0.006	0.038	1.2	0.K
1CR54	0.293	0.088	0.380	1.2	0.K	0.293	0.088	0.380	1.2	0.K

4) 수직 보강재의 설계 (SM400B 사용)

▪ 수직 보강재 설치 검토 및 단면 제원

구 분	설치 검토 (mm)			n	f (MPa)	σ (MPa)	b_{vs} (mm)	t_{vs} (mm)	a (mm)	b (mm)	t (mm)
	순간격	허용값	판 정								
1CR01	1,700	852.0	필 요	0	82.366	29.505	130.0	10.0	1,400.0	1,700.0	12.0
1CR02	1,800	852.0	필 요	0	24.080	10.981	130.0	10.0	1,400.0	1,800.0	12.0
1CR03	1,800	852.0	필 요	0	14.279	11.132	130.0	10.0	1,400.0	1,800.0	12.0
1CR04	1,800	852.0	필 요	0	14.926	12.817	130.0	10.0	1,400.0	1,800.0	12.0
1CR05	1,800	852.0	필 요	0	15.530	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR06	1,800	852.0	필 요	0	15.303	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR07	1,800	852.0	필 요	0	15.666	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR08	1,800	852.0	필 요	0	15.755	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR09	1,800	852.0	필 요	0	15.522	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR10	1,800	852.0	필 요	0	15.307	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR11	1,800	852.0	필 요	0	15.008	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR12	1,800	852.0	필 요	0	15.185	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR13	1,800	852.0	필 요	0	15.791	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR14	1,800	852.0	필 요	0	16.069	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR15	1,900	994.0	필 요	0	20.285	10.919	130.0	10.0	1,400.0	1,900.0	14.0
1CR16	2,000	994.0	필 요	0	30.126	10.380	130.0	14.0	1,400.0	2,000.0	14.0
1CR17	2,100	994.0	필 요	0	58.070	18.085	130.0	14.0	1,400.0	2,100.0	14.0
1CR18	2,200	1,136.0	필 요	0	104.612	36.261	180.0	14.0	1,400.0	2,200.0	16.0
1CR19	2,100	994.0	필 요	0	61.349	18.491	130.0	14.0	1,400.0	2,100.0	14.0
1CR20	1,900	994.0	필 요	0	39.679	10.919	130.0	10.0	1,400.0	1,900.0	14.0
1CR21	1,700	852.0	필 요	0	23.518	14.194	130.0	10.0	1,400.0	1,700.0	12.0
1CR22	1,600	852.0	필 요	0	17.611	15.072	130.0	10.0	1,400.0	1,600.0	12.0
1CR23	1,500	852.0	필 요	0	18.251	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR24	1,500	852.0	필 요	0	19.509	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR25	1,500	852.0	필 요	0	20.471	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR26	1,500	852.0	필 요	0	21.471	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR27	1,500	852.0	필 요	0	21.937	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR28	1,500	852.0	필 요	0	21.897	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR29	1,500	852.0	필 요	0	21.437	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR30	1,500	852.0	필 요	0	20.249	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR31	1,500	852.0	필 요	0	19.278	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR32	1,500	852.0	필 요	0	17.651	16.067	130.0	10.0	1,400.0	1,500.0	12.0
1CR33	1,600	852.0	필 요	0	17.430	15.072	130.0	10.0	1,400.0	1,600.0	12.0
1CR34	1,900	994.0	필 요	0	15.579	10.919	130.0	10.0	1,400.0	1,900.0	14.0
1CR35	2,400	1,136.0	필 요	0	14.918	7.617	180.0	14.0	1,400.0	2,400.0	16.0
1CR36	2,900	1,420.0	필 요	0	21.952	7.134	190.0	20.0	1,400.0	2,900.0	20.0
1CR37	2,900	1,562.0	필 요	0	59.352	19.591	210.0	22.0	1,400.0	2,900.0	22.0
1CR38	2,900	1,420.0	필 요	0	23.017	7.843	190.0	20.0	1,400.0	2,900.0	20.0
1CR39	2,600	1,278.0	필 요	0	15.887	6.276	190.0	20.0	1,400.0	2,600.0	18.0
1CR40	2,200	1,136.0	필 요	0	16.815	8.296	180.0	14.0	1,400.0	2,200.0	16.0
1CR41	1,800	852.0	필 요	0	14.854	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR42	1,800	852.0	필 요	0	15.187	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR43	1,800	852.0	필 요	0	16.009	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR44	1,800	852.0	필 요	0	15.785	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR45	1,800	852.0	필 요	0	16.282	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR46	1,800	852.0	필 요	0	16.108	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR47	1,800	852.0	필 요	0	16.161	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR48	1,800	852.0	필 요	0	16.019	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR49	1,800	852.0	필 요	0	16.110	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR50	1,800	852.0	필 요	0	15.669	13.413	130.0	10.0	1,400.0	1,800.0	12.0
1CR51	1,800	852.0	필 요	0	13.439	11.728	130.0	10.0	1,400.0	1,800.0	12.0
1CR52	1,800	852.0	필 요	0	11.507	11.132	130.0	10.0	1,400.0	1,800.0	12.0
1CR53	2,400	1,136.0	필 요	0	16.715	6.239	180.0	14.0	1,400.0	2,400.0	16.0
1CR54	2,400	1,136.0	필 요	0	69.544	23.689	180.0	14.0	1,400.0	2,400.0	16.0

▪ 수직보강재 간격 검토

구 분	간격 검토						수직보강재 강도검토 (mm ⁴)			비 고
	a/b	허용값	판정	$n = 0$	허용값	판정	$I_{(req)}$	$I_{(use)}$	판정	
1CR01	0.824	1.500	0.K	0.325	1.000	0.K	3.173E+06	7.323E+06	0.K	
1CR02	0.778	3.000	0.K	0.040	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR03	0.778	3.000	0.K	0.027	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR04	0.778	3.000	0.K	0.034	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR05	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR06	0.778	3.000	0.K	0.036	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR07	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR08	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR09	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR10	0.778	3.000	0.K	0.036	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR11	0.778	3.000	0.K	0.036	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR12	0.778	3.000	0.K	0.036	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR13	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR14	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR15	0.737	3.000	0.K	0.021	1.000	0.K	7.035E+06	7.323E+06	0.K	
1CR16	0.700	3.000	0.K	0.039	1.000	0.K	8.205E+06	1.025E+07	0.K	
1CR17	0.667	3.000	0.K	0.163	1.000	0.K	9.498E+06	1.025E+07	0.K	
1CR18	0.636	1.500	0.K	0.381	1.000	0.K	1.630E+07	2.722E+07	0.K	
1CR19	0.667	3.000	0.K	0.179	1.000	0.K	9.498E+06	1.025E+07	0.K	
1CR20	0.737	3.000	0.K	0.051	1.000	0.K	7.035E+06	7.323E+06	0.K	
1CR21	0.824	3.000	0.K	0.044	1.000	0.K	3.173E+06	7.323E+06	0.K	
1CR22	0.875	3.000	0.K	0.035	1.000	0.K	2.646E+06	7.323E+06	0.K	
1CR23	0.933	3.000	0.K	0.034	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR24	0.933	3.000	0.K	0.035	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR25	0.933	3.000	0.K	0.035	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR26	0.933	3.000	0.K	0.036	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR27	0.933	3.000	0.K	0.036	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR28	0.933	3.000	0.K	0.036	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR29	0.933	3.000	0.K	0.036	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR30	0.933	3.000	0.K	0.035	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR31	0.933	3.000	0.K	0.034	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR32	0.933	3.000	0.K	0.033	1.000	0.K	2.180E+06	7.323E+06	0.K	
1CR33	0.875	3.000	0.K	0.035	1.000	0.K	2.646E+06	7.323E+06	0.K	
1CR34	0.737	3.000	0.K	0.017	1.000	0.K	7.035E+06	7.323E+06	0.K	
1CR35	0.583	3.000	0.K	0.013	1.000	0.K	2.116E+07	2.722E+07	0.K	
1CR36	0.483	3.000	0.K	0.018	1.000	0.K	7.293E+07	9.145E+07	0.K	양면
1CR37	0.483	1.500	0.K	0.090	1.000	0.K	9.707E+07	1.358E+08	0.K	양면
1CR38	0.483	3.000	0.K	0.020	1.000	0.K	7.293E+07	9.145E+07	0.K	양면
1CR39	0.538	3.000	0.K	0.010	1.000	0.K	3.831E+07	4.573E+07	0.K	
1CR40	0.636	3.000	0.K	0.012	1.000	0.K	1.630E+07	2.722E+07	0.K	
1CR41	0.778	3.000	0.K	0.036	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR42	0.778	3.000	0.K	0.036	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR43	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR44	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR45	0.778	3.000	0.K	0.038	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR46	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR47	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR48	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR49	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR50	0.778	3.000	0.K	0.037	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR51	0.778	3.000	0.K	0.028	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR52	0.778	3.000	0.K	0.024	1.000	0.K	3.767E+06	7.323E+06	0.K	
1CR53	0.583	3.000	0.K	0.014	1.000	0.K	2.116E+07	2.722E+07	0.K	
1CR54	0.583	1.500	0.K	0.226	1.000	0.K	2.116E+07	2.722E+07	0.K	

▪ 수직보강재 최소 폭 및 두께 검토

(단위:mm)

구 분	최소 폭 검토			최소 폭 검토			비 고
	$b_{vs(req)}$	$b_{vs(usc)}$	판정	$t_{vs(req)}$	$t_{vs(usc)}$	판정	
1CR01	106.667	130.000	0.K	10.000	10.000	0.K	
1CR02	110.000	130.000	0.K	10.000	10.000	0.K	
1CR03	110.000	130.000	0.K	10.000	10.000	0.K	
1CR04	110.000	130.000	0.K	10.000	10.000	0.K	
1CR05	110.000	130.000	0.K	10.000	10.000	0.K	
1CR06	110.000	130.000	0.K	10.000	10.000	0.K	
1CR07	110.000	130.000	0.K	10.000	10.000	0.K	
1CR08	110.000	130.000	0.K	10.000	10.000	0.K	
1CR09	110.000	130.000	0.K	10.000	10.000	0.K	
1CR10	110.000	130.000	0.K	10.000	10.000	0.K	
1CR11	110.000	130.000	0.K	10.000	10.000	0.K	
1CR12	110.000	130.000	0.K	10.000	10.000	0.K	
1CR13	110.000	130.000	0.K	10.000	10.000	0.K	
1CR14	110.000	130.000	0.K	10.000	10.000	0.K	
1CR15	113.333	130.000	0.K	10.000	10.000	0.K	
1CR16	116.667	130.000	0.K	10.000	14.000	0.K	
1CR17	120.000	130.000	0.K	10.000	14.000	0.K	
1CR18	123.333	180.000	0.K	13.846	14.000	0.K	
1CR19	120.000	130.000	0.K	10.000	14.000	0.K	
1CR20	113.333	130.000	0.K	10.000	10.000	0.K	
1CR21	106.667	130.000	0.K	10.000	10.000	0.K	
1CR22	103.333	130.000	0.K	10.000	10.000	0.K	
1CR23	100.000	130.000	0.K	10.000	10.000	0.K	
1CR24	100.000	130.000	0.K	10.000	10.000	0.K	
1CR25	100.000	130.000	0.K	10.000	10.000	0.K	
1CR26	100.000	130.000	0.K	10.000	10.000	0.K	
1CR27	100.000	130.000	0.K	10.000	10.000	0.K	
1CR28	100.000	130.000	0.K	10.000	10.000	0.K	
1CR29	100.000	130.000	0.K	10.000	10.000	0.K	
1CR30	100.000	130.000	0.K	10.000	10.000	0.K	
1CR31	100.000	130.000	0.K	10.000	10.000	0.K	
1CR32	100.000	130.000	0.K	10.000	10.000	0.K	
1CR33	103.333	130.000	0.K	10.000	10.000	0.K	
1CR34	113.333	130.000	0.K	10.000	10.000	0.K	
1CR35	130.000	180.000	0.K	13.846	14.000	0.K	
1CR36	146.667	190.000	0.K	14.615	20.000	0.K	
1CR37	146.667	210.000	0.K	16.154	22.000	0.K	
1CR38	146.667	190.000	0.K	14.615	20.000	0.K	
1CR39	136.667	190.000	0.K	14.615	20.000	0.K	
1CR40	123.333	180.000	0.K	13.846	14.000	0.K	
1CR41	110.000	130.000	0.K	10.000	10.000	0.K	
1CR42	110.000	130.000	0.K	10.000	10.000	0.K	
1CR43	110.000	130.000	0.K	10.000	10.000	0.K	
1CR44	110.000	130.000	0.K	10.000	10.000	0.K	
1CR45	110.000	130.000	0.K	10.000	10.000	0.K	
1CR46	110.000	130.000	0.K	10.000	10.000	0.K	
1CR47	110.000	130.000	0.K	10.000	10.000	0.K	
1CR48	110.000	130.000	0.K	10.000	10.000	0.K	
1CR49	110.000	130.000	0.K	10.000	10.000	0.K	
1CR50	110.000	130.000	0.K	10.000	10.000	0.K	
1CR51	110.000	130.000	0.K	10.000	10.000	0.K	
1CR52	110.000	130.000	0.K	10.000	10.000	0.K	
1CR53	130.000	180.000	0.K	13.846	14.000	0.K	
1CR54	130.000	180.000	0.K	13.846	14.000	0.K	

8.2 가로보의 연결

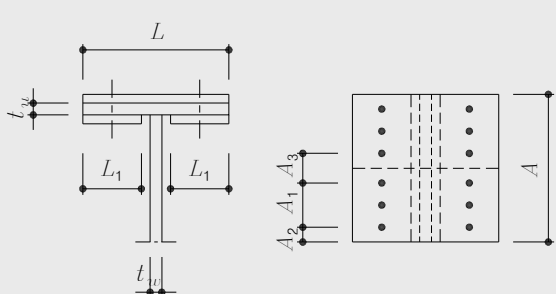
[1CR01]

(강종 : SM400B)

(가로보 계산 참조)

모멘트 $M(kN)$	전단력 $V(kN)$	상부FL.응력 $f_u(MPa)$		하부FL.응력 $f_l(MPa)$		허용휨인장응력 $f_{sa}(MPa)$	단면2차모멘트 $I(mm^4)$
		인장	압축	압축	인장		
973.56	601.89	82.366	82.366	82.366	82.366	140.00	1.019E+10

사용BOLT : H.T.B (M22 F 10T) $\rho_{sa} = 48,000 \times 2 \text{면} = 96,000 \text{ N}$ (도.설.해3.3.2.3)



$t_u = 12.0 \text{ mm}$
 $t_w = 12.0 \text{ mm}$
 $L = 300.0 \text{ mm}$
 $L_1 = 124.0 \text{ mm}$
 $A = 505.0 \text{ mm}$
 $A_1 = 2 @ 85 \text{ mm}$
 $= 170.0 \text{ mm}$
 $A_2 = 40.0 \text{ mm}$
 $A_3 = 85.0 \text{ mm}$

1) 상부 플랜지 이음 (압축부) (도.설 해 3.4.2.2 표3.4.4)

- 주요 부재의 연결은 적어도 모재의 전 강도의 75% 이상의 강도를 갖도록 설계하여야 한다. 다만, 전단력에 대해서는 작용응력을 사용하여 설계해도 좋다. (도.설.해 3.5.1.1, 3.5.3.2)

$$f_s = 82.4 \text{ MPa}$$

$$f_{s(min)} = 0.75 \times 140.0 = 105.0 \text{ MPa} \quad \therefore \text{이음부의 설계응력 } (f_u) \quad f_s' = 105.0 \text{ MPa 적용}$$

① 필요 BOLT수의 결정

$$n_{req} = A_s \times f_s' / \rho_{sa} = 3,600.0 \times 105.0 / 96,000.0 = 3.9ea \Rightarrow n_t = 6.0ea \dots\dots 0.K !!$$

② 이음판의 결정

- 필요 단면적 산정

$$A_{req} = A_s \times f_s' / f_{sa} = 3,600.0 = 3,600.0 \text{ mm}^2$$

- 사용 이음판 전단면적

$$A_{use} = 1 \text{ PL} - 300.0 \times 14.0 \times 505.0 = 4,200.0$$

$$2 \text{ PL} - 124.0 \times 14.0 \times 505.0 = 3,472.0$$

$$\Sigma = 7,672.0 \text{ mm}^2 \geq A_{req} \dots\dots 0.K !!$$

- 이음판의 응력

$$f_s = A_s \times f_s' / A_{use} = 3,600.0 \times 105.0 / 7,672.0 = 49.3 \text{ MPa} \leq f_{sa} \dots\dots 0.K !!$$

③ BOLT의 응력검토

- 축방향력 또는 전단력을 받는 판을 연결하는 경우의 BOLT 응력검토

$$\rho_p = P / n_t = 3,600.0 \times 105.0 / 6.0 = 63,000.0 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

- 휨에 의한 전단력을 받는 판을 수평방향으로 연결하는 BOLT의 응력검토

Q : 합성전 및 합성후의 부재 총단면의 중립축에 대한 전단력을 계산하는 접합선

외측의 단면1차 모멘트

$$Q = 300.0 \times 12.0 \times (862.0 - 6.0) = 3.082E+06 \text{ mm}^3$$

$$I = 1.019E+10 \text{ mm}^4 \quad [\text{총단면의 중립축에 대한 단면2차 모멘트}]$$

$$p = \text{플랜지 전폭} / \text{횡방향 BOLT수} = 300.0 / 2.0ea = 150.0 \text{ mm} \quad [\text{볼트의 피치}]$$

$$n = 3.0ea \quad [\text{접합선의 직각방향의 볼트의 수}]$$

$$\rho_h = V \cdot Q / I \times p / n$$

$$= 601.893^3 \times 3,081,600.0 / 10,188,785,600.0 \times 150.0 / 3.0 = 9,102.1 \text{ N/ea}$$

- 축방향력, 휨모멘트 및 전단력이 함께 작용하는 판을 연결할 경우의 BOLT 식

$$\rho = \sqrt{(\rho_p^2 + \rho_h^2)} = \sqrt{3.969E+09 + 8.285E+07} = 63,654.1 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

2) 상부 플랜지 이음 (인장부) (도.설 해 3.4.2.2 표3.4.4)

- 주요 부재의 연결은 적어도 모재의 전 강도의 75% 이상의 강도를 갖도록 설계하여야 한다. 다만, 전단력에 대해서는 작용응력을 사용하여 설계해도 좋다. (도.설.해 3.5.1.1, 3.5.3.2)

$$f_s = 82.4 \text{ MPa}$$

$$f_{s(min)} = 0.75 \times 140.0 = 105.0 \text{ MPa} \quad \therefore \text{이음부의 설계응력 } (f_u) \quad f_s' = 105.0 \text{ MPa 적용}$$

① 필요 BOLT수의 결정

$$n_{req} = A_s \times f_s' / \rho_{sa} = 3,600.0 \times 105.0 / 96,000.0 = 3.9ea \Rightarrow n_t = 6.0ea \dots\dots 0.K !!$$

② 이음판의 결정

- 필요 단면적 산정

$$A_{req} = A_s \times f_s' / f_{sa} = 3,600.0 = 3,600.0 \text{ mm}^2$$

- 사용 이음판 전단면적

$$\begin{aligned} A_{use} &= 1 \text{ PL} - 300.0 \times 14.0 \times 505.0 = 4,200.0 \\ &2 \text{ PL} - 124.0 \times 14.0 \times 505.0 = 3,472.0 \\ \hline \Sigma &= 7,672.0 \text{ mm}^2 \end{aligned}$$

- 이음판의 순단면적 (인장부의 순단면적은 BOLT 지름 공제)

$$A_n = 7,672.0 - 25.0 \times 14.0 \times 2.0 \text{열} \times 2.0ea = 6,272.0 \text{ mm}^2 \geq A_{req} \dots\dots 0.K !!$$

- 이음판의 응력

$$f_s = A_s \times f_s' / A_n = 3,600.0 \times 105.0 / 6,272.0 = 60.3 \text{ MPa} \leq f_{sa} \dots\dots 0.K !!$$

③ BOLT의 응력검토

- 축방향력 또는 전단력을 받는 판을 연결하는 경우의 BOLT 응력검토

$$\rho_p = P / n_t = 3,600.0 \times 105.0 / 6.0 = 63,000.0 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

- 힘에 의한 전단력을 받는 판을 수평방향으로 연결하는 BOLT의 응력검토

Q : 합성전 및 합성후의 부재 총단면의 중립축에 대한 전단력을 계산하는 접합선 외측의 단면1차 모멘트

$$Q = 300.0 \times 12.0 \times (862.0 - 6.0) = 3.082E+06 \text{ mm}^3$$

$$I = 1.019E+10 \text{ mm}^4 \quad [\text{총단면의 중립축에 대한 단면2차 모멘트}]$$

$$p = \text{플랜지 전폭} / \text{횡방향 BOLT수} = 300.0 / 2.0ea = 150.0 \text{ mm} \quad [\text{볼트의 피치}]$$

$$n = 3.0ea \quad [\text{접합선의 직각방향의 볼트의 수}]$$

$$\begin{aligned} \rho_h &= V \cdot Q / I \times p / n \\ &= 601.893^3 \times 3,081,600.0 / 10,188,785,600.0 \times 150.0 / 3.0 = 9,102.1 \text{ N/ea} \end{aligned}$$

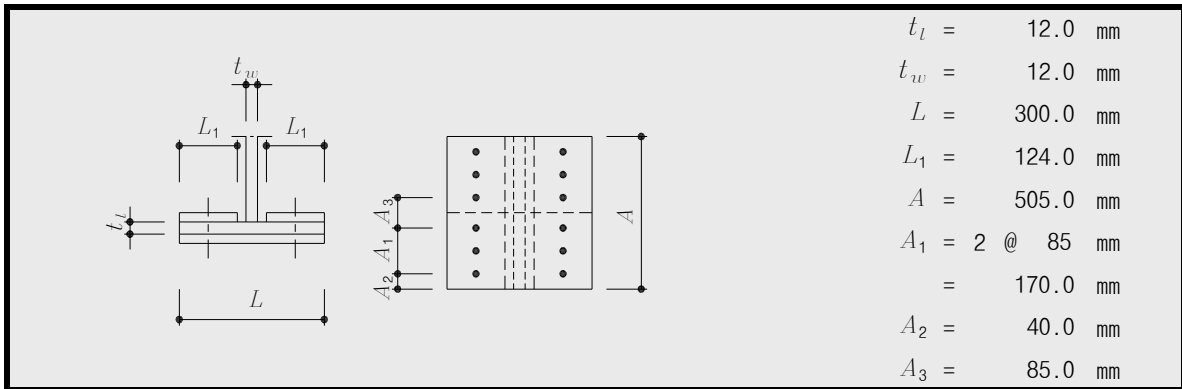
- 축방향력, 휨모멘트 및 전단력이 함께 작용하는 판을 연결할 경우의 BOLT 식

$$\rho = \sqrt{(\rho_p^2 + \rho_h^2)} = \sqrt{3.969E+09 + 8.285E+07} = 63,654.1 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

④ 모재의 응력검토

$$A_{sn} = 12.0 \times (300.0 - 25.0 \times 2.0) = 3,000.0 \text{ mm}^2$$

$$f_u = A_s \times f_s' / A_{sn} = 3,600.0 \times 105.0 / 3,000.0 = 126.0 \text{ MPa} \leq f_{sa} \dots\dots 0.K !!$$



3) 하부 플랜지 이음 (압축부) (도.설 해 3.4.2.2 표3.4.4)

- 주요 부재의 연결은 적어도 모재의 전 강도의 75% 이상의 강도를 갖도록 설계하여야 한다. 다만, 전단력에 대해서는 작용응력을 사용하여 설계해도 좋다. (도.설.해 3.5.1.1, 3.5.3.2)

$$f_s = 82.4 \text{ MPa}$$

$$f_{s(min)} = 0.75 \times 140.0 = 105.0 \text{ MPa} \quad \therefore \text{이음부의 설계응력 } (f_l) \quad f_s' = 105.0 \text{ MPa 적용}$$

① 필요 BOLT수의 결정

$$n_{req} = A_s \times f_s' / \rho_{sa} = 3,600.0 \times 105.0 / 96,000.0 = 3.9ea \Rightarrow n_t = 6.0ea \dots\dots 0.K !!$$

② 이음판의 결정

- 필요 단면적 산정

$$A_{req} = A_s \times f_s' / f_{sa} = 3,600.0 = 3,600.0 \text{ mm}^2$$

- 사용 이음판 전단면적

$$A_{use} = 1 \text{ PL} - 300.0 \times 14.0 \times 505.0 = 4,200.0$$

$$2 \text{ PL} - 124.0 \times 14.0 \times 505.0 = 3,472.0$$

$$\Sigma = 7,672.0 \text{ mm}^2 \geq A_{req} \dots\dots 0.K !!$$

- 이음판의 응력

$$f_s = A_s \times f_s' / A_{use} = 3,600.0 \times 105.0 / 7,672.0 = 49.3 \text{ MPa} \leq f_{sa} \dots\dots 0.K !!$$

③ BOLT의 응력검토

- 축방향력 또는 전단력을 받는 판을 연결하는 경우의 BOLT 응력검토

$$\rho_p = P / n_t = 3,600.0 \times 105.0 / 6.0 = 63,000.0 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

- 힘에 의한 전단력을 받는 판을 수평방향으로 연결하는 BOLT의 응력검토

Q : 합성전 및 합성후의 부재 총단면의 중립축에 대한 전단력을 계산하는 접합선

외측의 단면1차 모멘트

$$Q = 300.0 \times 12.0 \times (862.0 - 6.0) = 3.082E+06 \text{ mm}^3$$

$$I = 1.019E+10 \text{ mm}^4 \quad [\text{총단면의 중립축에 대한 단면2차 모멘트}]$$

$$p = \text{플랜지 전폭} / \text{횡방향 BOLT수} = 300.0 / 2.0ea = 150.0 \text{ mm} \quad [\text{볼트의 피치}]$$

$$n = 3.0ea \quad [\text{접합선의 직각방향의 볼트의 수}]$$

$$\rho_h = V \cdot Q / I \times p / n$$

$$= 601.893^3 \times 3,081,600.0 / 10,188,785,600.0 \times 150.0 / 3.0 = 9,102.1 \text{ N/ea}$$

- 축방향력, 휨모멘트 및 전단력이 함께 작용하는 판을 연결할 경우의 BOLT 식

$$\rho = \sqrt{(\rho_p^2 + \rho_h^2)} = \sqrt{3.969E+09 + 8.285E+07} = 63,654.1 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

4) 하부 플랜지 이음 (인장부)

(도.설 해 3.4.2.2 표3.4.4)

- 주요 부재의 연결은 적어도 모재의 전 강도의 75% 이상의 강도를 갖도록 설계하여야 한다. 다만, 전단력에 대해서는 작용응력을 사용하여 설계해도 좋다. (도.설.해 3.5.1.1, 3.5.3.2)

$$f_s = 82.4 \text{ MPa}$$

$$f_{s(min)} = 0.75 \times 140.0 = 105.0 \text{ MPa} \quad \therefore \text{이음부의 설계응력 } (f_l) \quad f_s' = 105.0 \text{ MPa 적용}$$

① 필요 BOLT수의 결정

$$n_{req} = A_s \times f_s' / \rho_{sa} = 3,600.0 \times 105.0 / 96,000.0 = 3.9ea \Rightarrow n_t = 6.0ea \dots\dots 0.K !!$$

② 이음판의 결정

- 필요 단면적 산정

$$A_{req} = A_s \times f_s' / f_{sa} = 3,600.0 = 3,600.0 \text{ mm}^2$$

- 사용 이음판 전단면적

$$A_{use} = 1 \text{ PL} - 300.0 \times 14.0 \times 505.0 = 4,200.0$$

$$2 \text{ PL} - 124.0 \times 14.0 \times 505.0 = 3,472.0$$

$$\Sigma = 7,672.0 \text{ mm}^2$$

- 이음판의 순단면적 (인장부의 순단면적은 BOLT 지름 공제)

$$A_n = 7,672.0 - 25.0 \times 14.0 \times 2.0 \text{열} \times 2.0ea = 6,272.0 \text{ mm}^2 \geq A_{req} \dots\dots 0.K !!$$

- 이음판의 응력

$$f_s = A_s \times f_s' / A_n = 3,600.0 \times 105.0 / 6,272.0 = 60.3 \text{ MPa} \leq f_{sa} \dots\dots 0.K !!$$

③ BOLT의 응력검토

- 축방향력 또는 전단력을 받는 판을 연결하는 경우의 BOLT 응력검토

$$\rho_p = P / n_t = 3,600.0 \times 105.0 / 6.0 = 63,000.0 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

- 휨에 의한 전단력을 받는 판을 수평방향으로 연결하는 BOLT의 응력검토

Q : 합성전 및 합성후의 부재 총단면의 중립축에 대한 전단력을 계산하는 접합선

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$$Q = 300.0 \times 12.0 \times (862.0 - 6.0) = 3.082E+06 \text{ mm}^3$$

$$I = 1.019E+10 \text{ mm}^4 \quad [\text{총단면의 중립축에 대한 단면2차 모멘트}]$$

$$p = \text{플랜지 전폭} / \text{횡방향 BOLT수} = 300.0 / 2.0ea = 150.0 \text{ mm} \quad [\text{볼트의 피치}]$$

$$n = 3.0ea \quad [\text{접합선의 직각방향의 볼트의 수}]$$

$$\rho_h = V \cdot Q / I \times p / n$$

$$= 601.893^3 \times 3,081,600.0 / 10,188,785,600.0 \times 150.0 / 3.0 = 9,102.1 \text{ N/ea}$$

- 축방향력, 휨모멘트 및 전단력이 함께 작용하는 판을 연결할 경우의 BOLT 식

$$\rho = \sqrt{(\rho_p^2 + \rho_h^2)} = \sqrt{3.969E+09 + 8.285E+07} = 63,654.1 \text{ N/ea} \leq \rho_{sa} \dots\dots 0.K !!$$

④ 모재의 응력검토

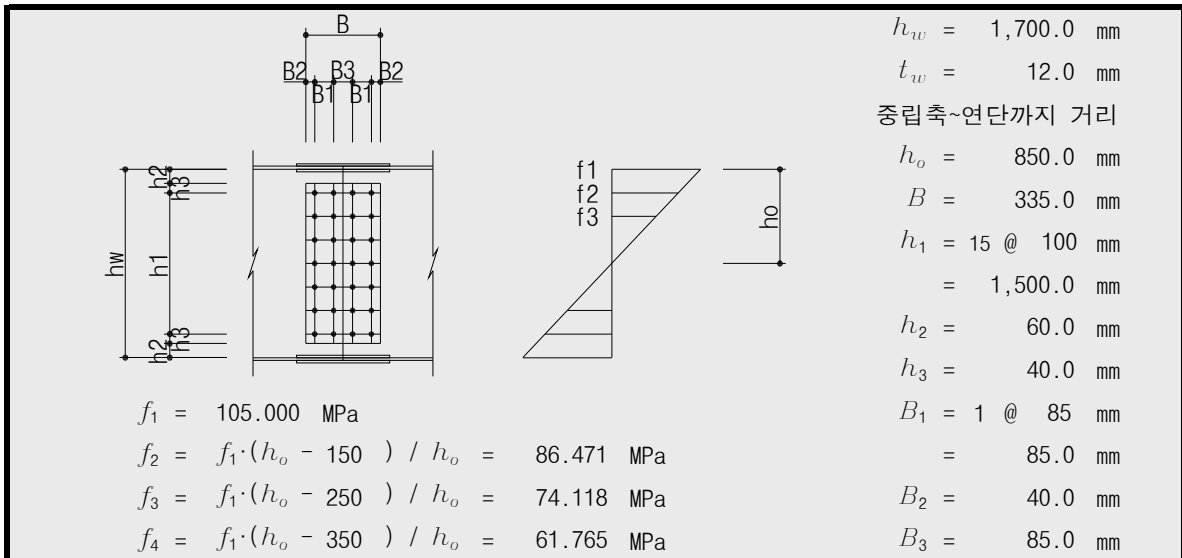
$$A_{sn} = 12.0 \times (300.0 - 25.0 \times 2.0) = 3,000.0 \text{ mm}^2$$

$$f_u = A_s \times f_s' / A_{sn} = 3,600.0 \times 105.0 / 3,000.0 = 126.0 \text{ MPa} \leq f_{sa} \dots\dots 0.K !!$$

5) WEB 연결부의 계산

① BOLT의 응력계산

- 휨에 의한 BOLT의 응력



제1열 $\rho_p = (105.00 + 86.471) / 2 \times 150.0 \times 12.0 / 2 = 8.62\text{E}+04 \text{ N/ea} \leq \rho_{sa} \dots\dots \text{O.K !!}$

- 전단력에 의한 볼트의 응력

$\rho_s = 601.893 / 32.0\text{ea} = 1.88\text{E}+04 \text{ N/ea} \leq \rho_{sa} \dots\dots \text{O.K !!}$

- 합성 응력의 검토

$\rho = \sqrt{(\rho_p^2 + \rho_h^2)} = \sqrt{7.424\text{E}+09 + 3.538\text{E}+08} = 8.82\text{E}+04 \text{ N/ea} \leq \rho_{sa} \dots\dots \text{O.K !!}$

② 이음판의 응력계산

- 복부판의 단면2차 모멘트

$I_w = 12.0 \times 1,700.0^3 / 12 = 4.91\text{E}+09 \text{ mm}^4$

- 가로보 중립축에서 이음판 상연까지의 거리

$y_{su} = 1,700.0 / 2 - 60.0 = 790.0 \text{ mm}$

- 가로보 이음판의 단면2차모멘트

규격	$A_s(\text{mm}^2)$	$Y(\text{mm})$	$A_s \cdot Y(\text{mm}^3)$	$A_s \cdot Y^2(\text{mm}^4)$	$I_{xo}(\text{mm}^4)$
2 - 1,580.0 × 10.0	31,600.0	0.0	0.000E+00	0.000E+00	6.574E+09
합계	31,600.0	0.0	0.000E+00	0.000E+00	6.574E+09

$I_s = I_{xo} + AY^2 = 6,573,853,333.3 + 0.0 = 6.57\text{E}+09 \text{ mm}^4$

- 가로보 복부판이 담당하는 휨모멘트

$M_w = M \cdot I_w / I = 973.556 \times 0.004913 / 0.010189 = 469.446 \text{ kN} \cdot \text{m}$

- 가로보 이음판의 응력검토

$f_w = M_w \cdot y_{su} / I_s = 469.446 \times 790.0 / 6,573,853,333.3 = 56.415 \text{ MPa} \leq f_{sa} \dots\dots \text{O.K !!}$

- 공통 입력 사항 (강종 및 사용 BOLT 제원)

사용강재	볼트 제원	볼트 허용 응력 (N)
SM400B	H.T.B M22 F 10T	96,000.0

▪ 작용 단면력 및 응력

구 분	모멘트 $M(\text{kN})$	전단력 $V(\text{kN})$	상부FL.응력 $f_u(\text{MPa})$		하부FL.응력 $f_l(\text{MPa})$		$f_{sa}(\text{MPa})$	$I(\text{mm}^4)$
			인장	압축	압축	인장		
1CR01	973.56	601.89	82.366	82.366	82.366	82.366	140.00	1.019E+10
1CR02	310.03	156.14	24.080	24.080	24.080	24.080	140.00	1.174E+10
1CR03	183.84	87.96	14.279	14.279	14.279	14.279	140.00	1.174E+10
1CR04	192.17	111.97	14.926	14.926	14.926	14.926	140.00	1.174E+10
1CR05	199.96	122.94	15.530	15.530	15.530	15.530	140.00	1.174E+10
1CR06	197.02	119.17	15.303	15.303	15.303	15.303	140.00	1.174E+10
1CR07	201.70	120.33	15.666	15.666	15.666	15.666	140.00	1.174E+10
1CR08	202.85	120.27	15.755	15.755	15.755	15.755	140.00	1.174E+10
1CR09	199.84	116.61	15.522	15.522	15.522	15.522	140.00	1.174E+10
1CR10	197.07	119.77	15.307	15.307	15.307	15.307	140.00	1.174E+10
1CR11	193.23	119.93	15.008	15.008	15.008	15.008	140.00	1.174E+10
1CR12	195.51	119.03	15.185	15.185	15.185	15.185	140.00	1.174E+10
1CR13	203.31	117.14	15.791	15.791	15.791	15.791	140.00	1.174E+10
1CR14	206.90	112.81	16.069	16.069	16.069	16.069	140.00	1.174E+10
1CR15	307.49	165.75	20.285	20.285	20.285	20.285	140.00	1.458E+10
1CR16	494.76	221.87	30.126	30.126	30.126	30.126	140.00	1.662E+10
1CR17	1,029.82	531.69	58.070	58.070	58.070	58.070	140.00	1.883E+10
1CR18	2,440.37	1,276.38	104.612	104.612	104.612	104.612	140.00	2.594E+10
1CR19	1,087.97	543.63	61.349	61.349	61.349	61.349	140.00	1.883E+10
1CR20	601.48	283.24	39.679	39.679	39.679	39.679	140.00	1.458E+10
1CR21	277.98	147.24	23.518	23.518	23.518	23.518	140.00	1.019E+10
1CR22	190.29	122.06	17.611	17.611	17.611	17.611	140.00	8.773E+09
1CR23	179.40	110.16	18.251	18.251	18.251	18.251	140.00	7.490E+09
1CR24	191.76	119.75	19.509	19.509	19.509	19.509	140.00	7.490E+09
1CR25	201.22	122.34	20.471	20.471	20.471	20.471	140.00	7.490E+09
1CR26	211.06	121.61	21.471	21.471	21.471	21.471	140.00	7.490E+09
1CR27	215.63	121.35	21.937	21.937	21.937	21.937	140.00	7.490E+09
1CR28	215.24	121.73	21.897	21.897	21.897	21.897	140.00	7.490E+09
1CR29	210.72	121.70	21.437	21.437	21.437	21.437	140.00	7.490E+09
1CR30	199.04	123.52	20.249	20.249	20.249	20.249	140.00	7.490E+09
1CR31	189.50	120.08	19.278	19.278	19.278	19.278	140.00	7.490E+09
1CR32	173.50	107.14	17.651	17.651	17.651	17.651	140.00	7.490E+09
1CR33	188.33	122.99	17.430	17.430	17.430	17.430	140.00	8.773E+09
1CR34	236.16	153.41	15.579	15.579	15.579	15.579	140.00	1.458E+10
1CR35	398.72	218.25	14.918	14.918	14.918	14.918	140.00	3.239E+10
1CR36	915.90	413.80	21.952	21.952	21.952	21.952	140.00	6.100E+10
1CR37	2,641.40	1,249.87	59.352	59.352	59.352	59.352	140.00	6.506E+10
1CR38	960.35	454.92	23.017	23.017	23.017	23.017	140.00	6.100E+10
1CR39	517.53	286.06	15.887	15.887	15.887	15.887	140.00	4.274E+10
1CR40	392.25	267.37	16.815	16.815	16.815	16.815	140.00	2.594E+10
1CR41	191.24	133.07	14.854	14.854	14.854	14.854	140.00	1.174E+10
1CR42	195.54	133.80	15.187	15.187	15.187	15.187	140.00	1.174E+10
1CR43	206.12	136.09	16.009	16.009	16.009	16.009	140.00	1.174E+10
1CR44	203.23	128.11	15.785	15.785	15.785	15.785	140.00	1.174E+10
1CR45	209.63	120.98	16.282	16.282	16.282	16.282	140.00	1.174E+10
1CR46	207.39	122.64	16.108	16.108	16.108	16.108	140.00	1.174E+10
1CR47	208.07	122.35	16.161	16.161	16.161	16.161	140.00	1.174E+10
1CR48	206.24	122.86	16.019	16.019	16.019	16.019	140.00	1.174E+10
1CR49	207.42	124.30	16.110	16.110	16.110	16.110	140.00	1.174E+10
1CR50	201.74	121.90	15.669	15.669	15.669	15.669	140.00	1.174E+10
1CR51	173.02	108.60	13.439	13.439	13.439	13.439	140.00	1.174E+10
1CR52	148.15	92.44	11.507	11.507	11.507	11.507	140.00	1.174E+10
1CR53	446.77	135.77	16.715	16.715	16.715	16.715	140.00	3.239E+10
1CR54	1,858.80	909.67	69.544	69.544	69.544	69.544	140.00	3.239E+10

1) 상부 플랜지 이음 검토

■ 상부 플랜지 이음 제원

(단위 : mm)

[illegible]

(1) 상부 플랜지 (압축부)

구 분	이음부의 설계응력 (MPa)			이음판 응력검토 (MPa)					비 고
	f_s	$f_{s(min)}$	f_s'	A_{req}	A_{use}	f_{sa}	f_s	판정	
1CR01	82.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR02	24.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR03	14.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR04	14.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR05	15.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR06	15.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR07	15.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR08	15.8	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR09	15.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR10	15.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR11	15.0	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR12	15.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR13	15.8	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR14	16.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR15	20.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR16	30.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR17	58.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR18	104.6	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR19	61.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR20	39.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR21	23.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR22	17.6	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR23	18.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR24	19.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR25	20.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR26	21.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR27	21.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR28	21.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR29	21.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR30	20.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR31	19.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR32	17.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR33	17.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR34	15.6	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR35	14.9	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR36	22.0	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR37	59.4	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR38	23.0	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR39	15.9	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR40	16.8	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR41	14.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR42	15.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR43	16.0	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR44	15.8	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR45	16.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR46	16.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR47	16.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR48	16.0	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR49	16.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR50	15.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR51	13.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR52	11.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR53	16.7	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR54	69.5	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	

구 분	BOLT 응력검토 (N/ea)										
	Q	p	n	n_{req}	n_t	판정	ρ_{sa}	ρ_p	ρ_h	ρ	판정
1CR01	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	9,102.1	63,654.1	0.K
1CR02	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,168.6	63,037.3	0.K
1CR03	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,221.6	63,011.8	0.K
1CR04	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,555.1	63,019.2	0.K
1CR05	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,707.5	63,023.1	0.K
1CR06	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,655.1	63,021.7	0.K
1CR07	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,671.2	63,022.2	0.K
1CR08	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,670.4	63,022.1	0.K
1CR09	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,619.6	63,020.8	0.K
1CR10	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,663.4	63,022.0	0.K
1CR11	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,665.6	63,022.0	0.K
1CR12	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,653.2	63,021.7	0.K
1CR13	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,626.9	63,021.0	0.K
1CR14	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,566.8	63,019.5	0.K
1CR15	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,955.9	63,030.4	0.K
1CR16	3.622E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,417.3	63,046.4	0.K
1CR17	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,366.1	63,228.1	0.K
1CR18	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,001.0	84,000.0	17,414.3	85,786.1	0.K
1CR19	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,002.0	63,000.0	5,486.6	63,238.5	0.K
1CR20	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,003.0	63,000.0	3,342.4	63,088.6	0.K
1CR21	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,004.0	63,000.0	2,226.6	63,039.3	0.K
1CR22	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,005.0	63,000.0	2,018.5	63,032.3	0.K
1CR23	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,006.0	63,000.0	2,001.4	63,031.8	0.K
1CR24	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,007.0	63,000.0	2,175.6	63,037.6	0.K
1CR25	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,008.0	63,000.0	2,222.6	63,039.2	0.K
1CR26	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,009.0	63,000.0	2,209.4	63,038.7	0.K
1CR27	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,010.0	63,000.0	2,204.7	63,038.6	0.K
1CR28	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,011.0	63,000.0	2,211.5	63,038.8	0.K
1CR29	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,012.0	63,000.0	2,211.1	63,038.8	0.K
1CR30	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,013.0	63,000.0	2,244.0	63,040.0	0.K
1CR31	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,014.0	63,000.0	2,181.6	63,037.8	0.K
1CR32	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,015.0	63,000.0	1,946.6	63,030.1	0.K
1CR33	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,016.0	63,000.0	2,033.8	63,032.8	0.K
1CR34	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,017.0	63,000.0	1,810.3	63,026.0	0.K
1CR35	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,018.0	84,000.0	2,600.0	84,040.2	0.K
1CR36	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,019.0	84,000.0	3,160.6	84,059.4	0.K
1CR37	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,020.0	84,000.0	8,950.2	84,475.5	0.K
1CR38	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,021.0	84,000.0	3,474.7	84,071.8	0.K
1CR39	6.269E+06	200.0	3.0	5.3	6.0	0.K	96,022.0	84,000.0	2,797.3	84,046.6	0.K
1CR40	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,023.0	84,000.0	3,647.8	84,079.2	0.K
1CR41	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,024.0	63,000.0	1,848.2	63,027.1	0.K
1CR42	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,025.0	63,000.0	1,858.3	63,027.4	0.K
1CR43	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,026.0	63,000.0	1,890.0	63,028.3	0.K
1CR44	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,027.0	63,000.0	1,779.2	63,025.1	0.K
1CR45	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,028.0	63,000.0	1,680.2	63,022.4	0.K
1CR46	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,029.0	63,000.0	1,703.2	63,023.0	0.K
1CR47	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,030.0	63,000.0	1,699.2	63,022.9	0.K
1CR48	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,031.0	63,000.0	1,706.3	63,023.1	0.K
1CR49	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,032.0	63,000.0	1,726.4	63,023.6	0.K
1CR50	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,033.0	63,000.0	1,693.0	63,022.7	0.K
1CR51	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,034.0	63,000.0	1,508.3	63,018.1	0.K
1CR52	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,035.0	63,000.0	1,283.8	63,013.1	0.K
1CR53	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,036.0	84,000.0	1,617.4	84,015.6	0.K
1CR54	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,037.0	84,000.0	10,836.9	84,696.2	0.K

(2) 상부 플랜지 (인장부)

구 분	이음부 설계응력 (MPa)			이음판 응력검토 (MPa)							
	f_s	$f_{s(min)}$	f_s'	A_{sn}	A_{req}	A_{use}	판정	f_{sa}	f_s	f_u	판정
1CR01	82.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR02	24.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR03	14.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR04	14.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR05	15.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR06	15.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR07	15.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR08	15.8	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR09	15.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR10	15.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR11	15.0	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR12	15.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR13	15.8	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR14	16.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR15	20.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR16	30.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR17	58.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR18	104.6	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR19	61.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR20	39.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR21	23.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR22	17.6	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR23	18.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR24	19.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR25	20.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR26	21.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR27	21.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR28	21.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR29	21.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR30	20.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR31	19.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR32	17.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR33	17.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR34	15.6	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR35	14.9	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR36	22.0	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR37	59.4	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR38	23.0	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR39	15.9	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR40	16.8	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR41	14.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR42	15.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR43	16.0	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR44	15.8	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR45	16.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR46	16.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR47	16.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR48	16.0	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR49	16.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR50	15.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR51	13.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR52	11.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR53	16.7	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR54	69.5	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K

구 분	BOLT 응력검토 (N/ea)										
	Q	p	n	n_{req}	n_t	판정	ρ_{sa}	ρ_p	ρ_h	ρ	판정
1CR01	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	9,102.1	63,654.1	0.K
1CR02	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,168.6	63,037.3	0.K
1CR03	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,221.6	63,011.8	0.K
1CR04	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,555.1	63,019.2	0.K
1CR05	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,707.5	63,023.1	0.K
1CR06	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,655.1	63,021.7	0.K
1CR07	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,671.2	63,022.2	0.K
1CR08	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,670.4	63,022.1	0.K
1CR09	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,619.6	63,020.8	0.K
1CR10	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,663.4	63,022.0	0.K
1CR11	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,665.6	63,022.0	0.K
1CR12	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,653.2	63,021.7	0.K
1CR13	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,626.9	63,021.0	0.K
1CR14	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,566.8	63,019.5	0.K
1CR15	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,955.9	63,030.4	0.K
1CR16	3.622E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,417.3	63,046.4	0.K
1CR17	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,366.1	63,228.1	0.K
1CR18	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	17,414.3	85,786.1	0.K
1CR19	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,486.6	63,238.5	0.K
1CR20	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	3,342.4	63,088.6	0.K
1CR21	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,226.6	63,039.3	0.K
1CR22	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,018.5	63,032.3	0.K
1CR23	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,001.4	63,031.8	0.K
1CR24	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,175.6	63,037.6	0.K
1CR25	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,222.6	63,039.2	0.K
1CR26	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,209.4	63,038.7	0.K
1CR27	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,204.7	63,038.6	0.K
1CR28	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,211.5	63,038.8	0.K
1CR29	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,211.1	63,038.8	0.K
1CR30	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,244.0	63,040.0	0.K
1CR31	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,181.6	63,037.8	0.K
1CR32	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,946.6	63,030.1	0.K
1CR33	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,033.8	63,032.8	0.K
1CR34	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,810.3	63,026.0	0.K
1CR35	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	2,600.0	84,040.2	0.K
1CR36	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,160.6	84,059.4	0.K
1CR37	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	8,950.2	84,475.5	0.K
1CR38	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,474.7	84,071.8	0.K
1CR39	6.269E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	2,797.3	84,046.6	0.K
1CR40	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,647.8	84,079.2	0.K
1CR41	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,848.2	63,027.1	0.K
1CR42	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,858.3	63,027.4	0.K
1CR43	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,890.0	63,028.3	0.K
1CR44	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,779.2	63,025.1	0.K
1CR45	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,680.2	63,022.4	0.K
1CR46	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,703.2	63,023.0	0.K
1CR47	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,699.2	63,022.9	0.K
1CR48	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,706.3	63,023.1	0.K
1CR49	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,726.4	63,023.6	0.K
1CR50	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,693.0	63,022.7	0.K
1CR51	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,508.3	63,018.1	0.K
1CR52	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,283.8	63,013.1	0.K
1CR53	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	1,617.4	84,015.6	0.K
1CR54	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	10,836.9	84,696.2	0.K

- 하부 플랜지 이음 제원

[illegible][illegible]

(1) 하부 플랜지 (압축부)

구 분	이음부의 설계응력 (MPa)			이음판 응력검토 (MPa)					비 고
	f_s	$f_{s(min)}$	f_s'	A_{req}	A_{use}	f_{sa}	f_s	판정	
1CR01	82.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR02	24.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR03	14.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR04	14.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR05	15.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR06	15.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR07	15.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR08	15.8	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR09	15.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR10	15.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR11	15.0	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR12	15.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR13	15.8	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR14	16.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR15	20.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR16	30.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR17	58.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR18	104.6	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR19	61.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR20	39.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR21	23.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR22	17.6	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR23	18.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR24	19.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR25	20.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR26	21.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR27	21.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR28	21.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR29	21.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR30	20.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR31	19.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR32	17.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR33	17.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR34	15.6	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR35	14.9	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR36	22.0	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR37	59.4	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR38	23.0	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR39	15.9	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR40	16.8	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR41	14.9	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR42	15.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR43	16.0	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR44	15.8	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR45	16.3	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR46	16.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR47	16.2	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR48	16.0	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR49	16.1	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR50	15.7	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR51	13.4	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR52	11.5	105.0	105.0	3,600.0	4,800.0	140.0	78.8	0.K	
1CR53	16.7	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	
1CR54	69.5	105.0	105.0	4,800.0	5,800.0	140.0	86.9	0.K	

구 분	BOLT 응력검토 (N/ea)										
	Q	p	n	n_{req}	n_t	판정	ρ_{sa}	ρ_p	ρ_h	ρ	판정
1CR01	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	9,102.1	63,654.1	0.K
1CR02	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,168.6	63,037.3	0.K
1CR03	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,221.6	63,011.8	0.K
1CR04	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,555.1	63,019.2	0.K
1CR05	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,707.5	63,023.1	0.K
1CR06	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,655.1	63,021.7	0.K
1CR07	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,671.2	63,022.2	0.K
1CR08	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,670.4	63,022.1	0.K
1CR09	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,619.6	63,020.8	0.K
1CR10	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,663.4	63,022.0	0.K
1CR11	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,665.6	63,022.0	0.K
1CR12	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,653.2	63,021.7	0.K
1CR13	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,626.9	63,021.0	0.K
1CR14	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,566.8	63,019.5	0.K
1CR15	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,955.9	63,030.4	0.K
1CR16	3.622E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,417.3	63,046.4	0.K
1CR17	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,366.1	63,228.1	0.K
1CR18	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	17,414.3	85,786.1	0.K
1CR19	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,486.6	63,238.5	0.K
1CR20	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	3,342.4	63,088.6	0.K
1CR21	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,226.6	63,039.3	0.K
1CR22	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,018.5	63,032.3	0.K
1CR23	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,001.4	63,031.8	0.K
1CR24	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,175.6	63,037.6	0.K
1CR25	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,222.6	63,039.2	0.K
1CR26	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,209.4	63,038.7	0.K
1CR27	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,204.7	63,038.6	0.K
1CR28	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,211.5	63,038.8	0.K
1CR29	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,211.1	63,038.8	0.K
1CR30	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,244.0	63,040.0	0.K
1CR31	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,181.6	63,037.8	0.K
1CR32	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,946.6	63,030.1	0.K
1CR33	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,033.8	63,032.8	0.K
1CR34	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,810.3	63,026.0	0.K
1CR35	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	2,600.0	84,040.2	0.K
1CR36	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,160.6	84,059.4	0.K
1CR37	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	8,950.2	84,475.5	0.K
1CR38	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,474.7	84,071.8	0.K
1CR39	6.269E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	2,797.3	84,046.6	0.K
1CR40	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,647.8	84,079.2	0.K
1CR41	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,848.2	63,027.1	0.K
1CR42	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,858.3	63,027.4	0.K
1CR43	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,890.0	63,028.3	0.K
1CR44	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,779.2	63,025.1	0.K
1CR45	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,680.2	63,022.4	0.K
1CR46	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,703.2	63,023.0	0.K
1CR47	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,699.2	63,022.9	0.K
1CR48	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,706.3	63,023.1	0.K
1CR49	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,726.4	63,023.6	0.K
1CR50	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,693.0	63,022.7	0.K
1CR51	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,508.3	63,018.1	0.K
1CR52	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,283.8	63,013.1	0.K
1CR53	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	1,617.4	84,015.6	0.K
1CR54	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	10,836.9	84,696.2	0.K

(2) 하부 플랜지 (인장부)

구 분	이음부 설계응력 (MPa)			이음판 응력검토 (MPa)							
	f_s	$f_{s(min)}$	f_s'	A_{sn}	A_{req}	A_{use}	판정	f_{sa}	f_s	f_l	판정
1CR01	82.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR02	24.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR03	14.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR04	14.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR05	15.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR06	15.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR07	15.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR08	15.8	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR09	15.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR10	15.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR11	15.0	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR12	15.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR13	15.8	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR14	16.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR15	20.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR16	30.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR17	58.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR18	104.6	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR19	61.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR20	39.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR21	23.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR22	17.6	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR23	18.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR24	19.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR25	20.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR26	21.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR27	21.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR28	21.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR29	21.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR30	20.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR31	19.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR32	17.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR33	17.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR34	15.6	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR35	14.9	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR36	22.0	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR37	59.4	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR38	23.0	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR39	15.9	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR40	16.8	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR41	14.9	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR42	15.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR43	16.0	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR44	15.8	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR45	16.3	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR46	16.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR47	16.2	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR48	16.0	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR49	16.1	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR50	15.7	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR51	13.4	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR52	11.5	105.0	105.0	3,800.0	3,600.0	4,800.0	0.K	140.0	78.8	99.5	0.K
1CR53	16.7	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K
1CR54	69.5	105.0	105.0	4,800.0	4,800.0	5,800.0	0.K	140.0	86.9	105.0	0.K

구 분	BOLT 응력검토 (N/ea)										
	Q	p	n	n_{req}	n_t	판정	ρ_{sa}	ρ_p	ρ_h	ρ	판정
1CR01	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	9,102.1	63,654.1	0.K
1CR02	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,168.6	63,037.3	0.K
1CR03	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,221.6	63,011.8	0.K
1CR04	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,555.1	63,019.2	0.K
1CR05	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,707.5	63,023.1	0.K
1CR06	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,655.1	63,021.7	0.K
1CR07	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,671.2	63,022.2	0.K
1CR08	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,670.4	63,022.1	0.K
1CR09	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,619.6	63,020.8	0.K
1CR10	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,663.4	63,022.0	0.K
1CR11	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,665.6	63,022.0	0.K
1CR12	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,653.2	63,021.7	0.K
1CR13	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,626.9	63,021.0	0.K
1CR14	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,566.8	63,019.5	0.K
1CR15	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,955.9	63,030.4	0.K
1CR16	3.622E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,417.3	63,046.4	0.K
1CR17	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,366.1	63,228.1	0.K
1CR18	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	17,414.3	85,786.1	0.K
1CR19	3.802E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	5,486.6	63,238.5	0.K
1CR20	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	3,342.4	63,088.6	0.K
1CR21	3.082E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,226.6	63,039.3	0.K
1CR22	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,018.5	63,032.3	0.K
1CR23	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,001.4	63,031.8	0.K
1CR24	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,175.6	63,037.6	0.K
1CR25	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,222.6	63,039.2	0.K
1CR26	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,209.4	63,038.7	0.K
1CR27	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,204.7	63,038.6	0.K
1CR28	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,211.5	63,038.8	0.K
1CR29	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,211.1	63,038.8	0.K
1CR30	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,244.0	63,040.0	0.K
1CR31	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,181.6	63,037.8	0.K
1CR32	2.722E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,946.6	63,030.1	0.K
1CR33	2.902E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	2,033.8	63,032.8	0.K
1CR34	3.442E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,810.3	63,026.0	0.K
1CR35	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	2,600.0	84,040.2	0.K
1CR36	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,160.6	84,059.4	0.K
1CR37	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	8,950.2	84,475.5	0.K
1CR38	6.989E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,474.7	84,071.8	0.K
1CR39	6.269E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	2,797.3	84,046.6	0.K
1CR40	5.309E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	3,647.8	84,079.2	0.K
1CR41	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,848.2	63,027.1	0.K
1CR42	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,858.3	63,027.4	0.K
1CR43	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,890.0	63,028.3	0.K
1CR44	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,779.2	63,025.1	0.K
1CR45	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,680.2	63,022.4	0.K
1CR46	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,703.2	63,023.0	0.K
1CR47	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,699.2	63,022.9	0.K
1CR48	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,706.3	63,023.1	0.K
1CR49	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,726.4	63,023.6	0.K
1CR50	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,693.0	63,022.7	0.K
1CR51	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,508.3	63,018.1	0.K
1CR52	3.262E+06	150.0	3.0	3.9	6.0	0.K	96,000.0	63,000.0	1,283.8	63,013.1	0.K
1CR53	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	1,617.4	84,015.6	0.K
1CR54	5.789E+06	200.0	3.0	5.3	6.0	0.K	96,000.0	84,000.0	10,836.9	84,696.2	0.K

3) WEB 연결부 검토

▪ WEB 이음 제원

구 분	h_w (mm)	t_w (mm)	t_{ws} (mm)	h_o (mm)	I_w (mm ⁴)	y_s (mm)	I_s (mm ⁴)	f_{sa} (MPa)	f_w (MPa)	판정
1CR01	1,700.0	12.0	10.0	850.0	4.91E+09	790.0	6.57E+09	140.0	56.4	O.K
1CR02	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	16.4	O.K
1CR03	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	9.7	O.K
1CR04	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.1	O.K
1CR05	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.6	O.K
1CR06	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.4	O.K
1CR07	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.6	O.K
1CR08	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.7	O.K
1CR09	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.6	O.K
1CR10	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.4	O.K
1CR11	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.2	O.K
1CR12	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.3	O.K
1CR13	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.7	O.K
1CR14	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.9	O.K
1CR15	1,900.0	14.0	10.0	950.0	8.00E+09	890.0	9.40E+09	140.0	16.0	O.K
1CR16	2,000.0	14.0	10.0	1,000.0	9.33E+09	940.0	1.11E+10	140.0	23.6	O.K
1CR17	2,100.0	14.0	10.0	1,050.0	1.08E+10	990.0	1.29E+10	140.0	45.2	O.K
1CR18	2,200.0	16.0	10.0	1,100.0	1.42E+10	1,040.0	1.50E+10	140.0	92.6	O.K
1CR19	2,100.0	14.0	10.0	1,050.0	1.08E+10	990.0	1.29E+10	140.0	47.8	O.K
1CR20	1,900.0	14.0	10.0	950.0	8.00E+09	890.0	9.40E+09	140.0	31.3	O.K
1CR21	1,700.0	12.0	10.0	850.0	4.91E+09	790.0	6.57E+09	140.0	16.1	O.K
1CR22	1,600.0	12.0	10.0	800.0	4.10E+09	740.0	5.40E+09	140.0	12.2	O.K
1CR23	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	12.7	O.K
1CR24	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	13.6	O.K
1CR25	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	14.3	O.K
1CR26	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	15.0	O.K
1CR27	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	15.3	O.K
1CR28	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	15.3	O.K
1CR29	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	15.0	O.K
1CR30	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	14.1	O.K
1CR31	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	13.5	O.K
1CR32	1,500.0	12.0	10.0	750.0	3.38E+09	690.0	4.38E+09	140.0	12.3	O.K
1CR33	1,600.0	12.0	10.0	800.0	4.10E+09	740.0	5.40E+09	140.0	12.0	O.K
1CR34	1,900.0	14.0	10.0	950.0	8.00E+09	890.0	9.40E+09	140.0	12.3	O.K
1CR35	2,400.0	16.0	10.0	1,200.0	1.84E+10	1,140.0	1.98E+10	140.0	13.1	O.K
1CR36	2,900.0	20.0	10.0	1,450.0	4.06E+10	1,390.0	3.58E+10	140.0	23.7	O.K
1CR37	2,900.0	22.0	10.0	1,450.0	4.47E+10	1,390.0	3.58E+10	140.0	70.5	O.K
1CR38	2,900.0	20.0	10.0	1,450.0	4.06E+10	1,390.0	3.58E+10	140.0	24.8	O.K
1CR39	2,600.0	18.0	10.0	1,300.0	2.64E+10	1,240.0	2.54E+10	140.0	15.6	O.K
1CR40	2,200.0	16.0	10.0	1,100.0	1.42E+10	1,040.0	1.50E+10	140.0	14.9	O.K
1CR41	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.1	O.K
1CR42	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.3	O.K
1CR43	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.9	O.K
1CR44	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.7	O.K
1CR45	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	11.1	O.K
1CR46	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.9	O.K
1CR47	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	11.0	O.K
1CR48	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.9	O.K
1CR49	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	11.0	O.K
1CR50	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	10.7	O.K
1CR51	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	9.1	O.K
1CR52	1,800.0	12.0	10.0	900.0	5.83E+09	840.0	7.90E+09	140.0	7.8	O.K
1CR53	2,400.0	16.0	10.0	1,200.0	1.84E+10	1,140.0	1.98E+10	140.0	14.7	O.K
1CR54	2,400.0	16.0	10.0	1,200.0	1.84E+10	1,140.0	1.98E+10	140.0	61.0	O.K

구 분	h_1 (mm)	h_2 (mm)	h_3 (mm)	B_1 (mm)	B_2 (mm)	B_3 (mm)	비 고
1CR01	15 @ 100 = 1,500.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR02	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR03	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR04	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR05	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR06	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR07	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR08	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR09	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR10	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR11	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR12	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR13	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR14	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR15	17 @ 100 = 1,700.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR16	18 @ 100 = 1,800.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR17	19 @ 100 = 1,900.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR18	20 @ 100 = 2,000.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR19	19 @ 100 = 1,900.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR20	17 @ 100 = 1,700.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR21	15 @ 100 = 1,500.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR22	14 @ 100 = 1,400.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR23	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR24	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR25	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR26	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR27	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR28	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR29	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR30	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR31	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR32	13 @ 100 = 1,300.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR33	14 @ 100 = 1,400.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR34	17 @ 100 = 1,700.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR35	22 @ 100 = 2,200.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR36	27 @ 100 = 2,700.0	60.0	40.0	3 @ 80 = 240.0	40.0	85.0	
1CR37	27 @ 100 = 2,700.0	60.0	40.0	3 @ 80 = 240.0	40.0	85.0	
1CR38	27 @ 100 = 2,700.0	60.0	40.0	3 @ 80 = 240.0	40.0	85.0	
1CR39	24 @ 100 = 2,400.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR40	20 @ 100 = 2,000.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR41	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR42	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR43	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR44	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR45	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR46	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR47	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR48	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR49	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR50	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR51	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR52	16 @ 100 = 1,600.0	60.0	40.0	1 @ 80 = 80.0	40.0	85.0	
1CR53	22 @ 100 = 2,200.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	
1CR54	22 @ 100 = 2,200.0	60.0	40.0	2 @ 80 = 160.0	40.0	85.0	

구 분	f_1 (MPa)	f_2 (MPa)	f_3 (MPa)	f_4 (MPa)	ρ_{sa} (N/ea)	제1열 ρ_p (N/ea)	ρ_s (N/ea)	ρ (N/ea)	판정
1CR01	105.0	86.5	74.1	61.8	9.60E+04	8.62E+04	1.88E+04	8.82E+04	0.K
1CR02	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	4.59E+03	8.67E+04	0.K
1CR03	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	2.59E+03	8.67E+04	0.K
1CR04	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.29E+03	8.67E+04	0.K
1CR05	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.62E+03	8.67E+04	0.K
1CR06	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.51E+03	8.67E+04	0.K
1CR07	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.54E+03	8.67E+04	0.K
1CR08	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.54E+03	8.67E+04	0.K
1CR09	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.43E+03	8.67E+04	0.K
1CR10	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.52E+03	8.67E+04	0.K
1CR11	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.53E+03	8.67E+04	0.K
1CR12	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.50E+03	8.67E+04	0.K
1CR13	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.45E+03	8.67E+04	0.K
1CR14	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.32E+03	8.67E+04	0.K
1CR15	105.0	88.4	77.4	66.3	9.60E+04	6.77E+04	3.07E+03	6.78E+04	0.K
1CR16	105.0	89.3	78.8	68.3	9.60E+04	6.80E+04	3.89E+03	6.81E+04	0.K
1CR17	105.0	90.0	80.0	70.0	9.60E+04	6.83E+04	8.86E+03	6.88E+04	0.K
1CR18	105.0	90.7	81.1	71.6	9.60E+04	7.83E+04	2.03E+04	8.09E+04	0.K
1CR19	105.0	90.0	80.0	70.0	9.60E+04	6.83E+04	9.06E+03	6.88E+04	0.K
1CR20	105.0	88.4	77.4	66.3	9.60E+04	6.77E+04	5.25E+03	6.79E+04	0.K
1CR21	105.0	86.5	74.1	61.8	9.60E+04	8.62E+04	4.60E+03	8.63E+04	0.K
1CR22	105.0	85.3	72.2	59.1	9.60E+04	8.56E+04	4.07E+03	8.57E+04	0.K
1CR23	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	3.93E+03	8.51E+04	0.K
1CR24	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.28E+03	8.52E+04	0.K
1CR25	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.37E+03	8.52E+04	0.K
1CR26	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.34E+03	8.52E+04	0.K
1CR27	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.33E+03	8.52E+04	0.K
1CR28	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.35E+03	8.52E+04	0.K
1CR29	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.35E+03	8.52E+04	0.K
1CR30	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.41E+03	8.52E+04	0.K
1CR31	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	4.29E+03	8.52E+04	0.K
1CR32	105.0	84.0	70.0	56.0	9.60E+04	8.51E+04	3.83E+03	8.51E+04	0.K
1CR33	105.0	85.3	72.2	59.1	9.60E+04	8.56E+04	4.10E+03	8.57E+04	0.K
1CR34	105.0	88.4	77.4	66.3	9.60E+04	6.77E+04	2.84E+03	6.78E+04	0.K
1CR35	105.0	91.9	83.1	74.4	9.60E+04	7.88E+04	3.16E+03	7.88E+04	0.K
1CR36	105.0	94.1	86.9	79.7	9.60E+04	7.47E+04	3.69E+03	7.48E+04	0.K
1CR37	105.0	94.1	86.9	79.7	9.60E+04	8.21E+04	1.12E+04	8.29E+04	0.K
1CR38	105.0	94.1	86.9	79.7	9.60E+04	7.47E+04	4.06E+03	7.48E+04	0.K
1CR39	105.0	92.9	84.8	76.7	9.60E+04	8.90E+04	3.81E+03	8.91E+04	0.K
1CR40	105.0	90.7	81.1	71.6	9.60E+04	7.83E+04	4.24E+03	7.84E+04	0.K
1CR41	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.91E+03	8.67E+04	0.K
1CR42	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.94E+03	8.67E+04	0.K
1CR43	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	4.00E+03	8.67E+04	0.K
1CR44	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.77E+03	8.67E+04	0.K
1CR45	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.56E+03	8.67E+04	0.K
1CR46	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.61E+03	8.67E+04	0.K
1CR47	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.60E+03	8.67E+04	0.K
1CR48	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.61E+03	8.67E+04	0.K
1CR49	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.66E+03	8.67E+04	0.K
1CR50	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.59E+03	8.67E+04	0.K
1CR51	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	3.19E+03	8.67E+04	0.K
1CR52	105.0	87.5	75.8	64.2	9.60E+04	8.66E+04	2.72E+03	8.67E+04	0.K
1CR53	105.0	91.9	83.1	74.4	9.60E+04	7.88E+04	1.97E+03	7.88E+04	0.K
1CR54	105.0	91.9	83.1	74.4	9.60E+04	7.88E+04	1.32E+04	7.98E+04	0.K