

점검시설 진입계단 구조검토서

2015. 11.

(주) 건 교 산 업

§1. 검토목적

교량 상부에서 교량점검시설을 연결하는 계단으로 작업자가 교량 상부에서 교량점검시설로 진입시 안전성을 확보하기 위함.

§2. 설계조건

1. 구조형식 : 캔틸레버식 교측보도용 난간 및 점검용 계단
2. 설계방법 : 허용응력 설계법
3. 설계하중
 - 1) 고정하중 : 사용부재 단위중량적용
 - 2) 활하중

구 분	설 계 조 건	비 고
바닥판(보도)	▪ 보도 등에 작용시키는 설계활하중은 $3.5 \times 10^{-3} MPa$ 로 한다.	▪ 도로교 설계기준 (한국도로교통협회) - P. 7
난 간	▪ 난간의 설계하중은 수직하중 600N/m, 수평하중 400N/m를 난간상단에 작용시키는 것으로 한다.	▪ 도로설계요령 (한국도로공사) - P. 349
출입사다리	▪ 사다리에 작용하는 설계활하중은 집중하중으로 고정하중 1kN/인이 2.1m간격으로 걸려있는 것으로 한다.	▪ 도로설계실무편람 (한국도로공사) - P. 770

4. 사용재료

1) 알루미늄합금(AL-PANEL)

(1) 재 질 : AC7A - F

(2) 물리상수

- 인장강도(f_u) = 230MPa
- 단위중량(γ) = 2800kg/m³
- 탄성계수(E_s) = 10,000ksi
= 70,000MPa

(3) 허용응력도

- 축방향 인장응력(f_{ta}) = 45MPa
- 축방향 압축응력(f_{ca}) = 45MPa
- 휨 응 력(f_a) = 45MPa
- 전단응력(v_a) = 25MPa
- 지압응력(f_{ba}) = 70MPa

2) 알루미늄합금(Main post, Angle, Channel, Pipe)

(1) 재 질 : A6063S - T5

(2) 물리상수

- 인장강도(f_u) = 230MPa
- 단위중량(γ) = 2800kg/m³
- 탄성계수(E_s) = 10,000ksi
= 70,000MPa

(3) 허용응력도

- 축방향 인장응력(f_{ta}) = 60MPa
- 축방향 압축응력(f_{ca}) = 60MPa
- 휨 응 력(f_a) = 60MPa
- 전단응력(v_a) = 35MPa
- 지압응력(f_{ba}) = 100MPa

3) Stainless Steel (Sub Bracket, Angle)

(1) 재 질 : STS304

(2) 물리상수

- 인장강도(f_u) = 520MPa
- 단위중량(γ) = 7850kg/m³

(3) 허용응력도

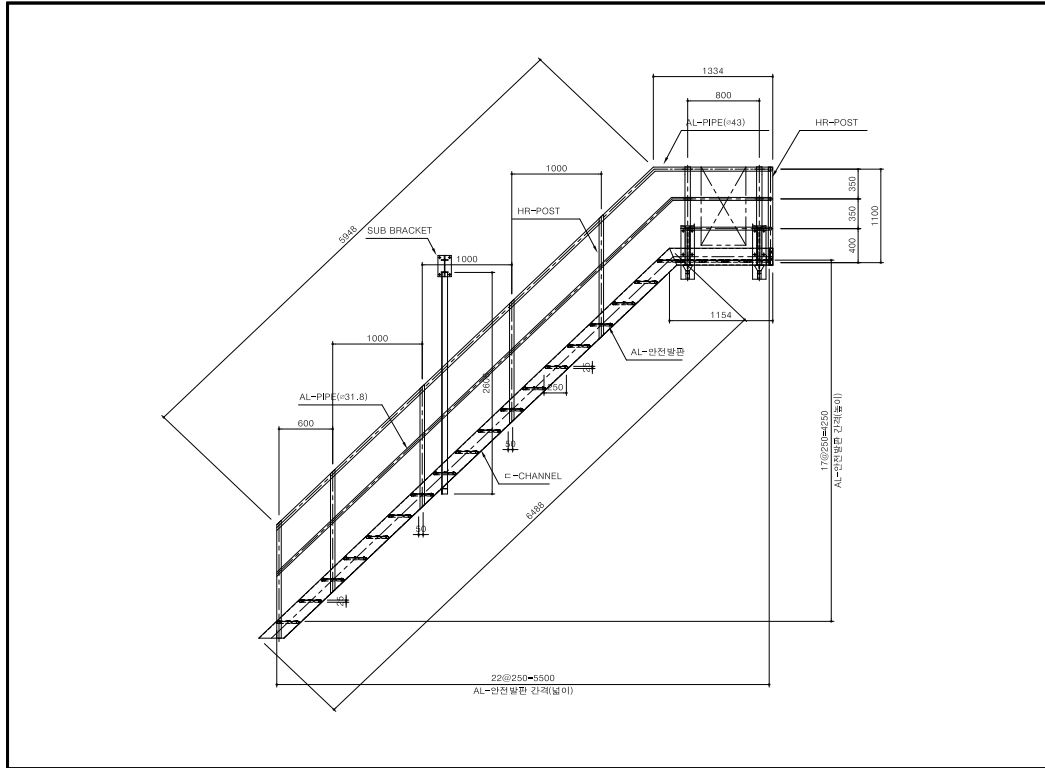
- 축방향 인장응력(f_{ta}) = 210MPa
- 축방향 압축응력(f_{ca}) = 210MPa
- 휨 응 력(f_a) = 210MPa
- 전단응력(v_a) = 120MPa

5. 참고문헌

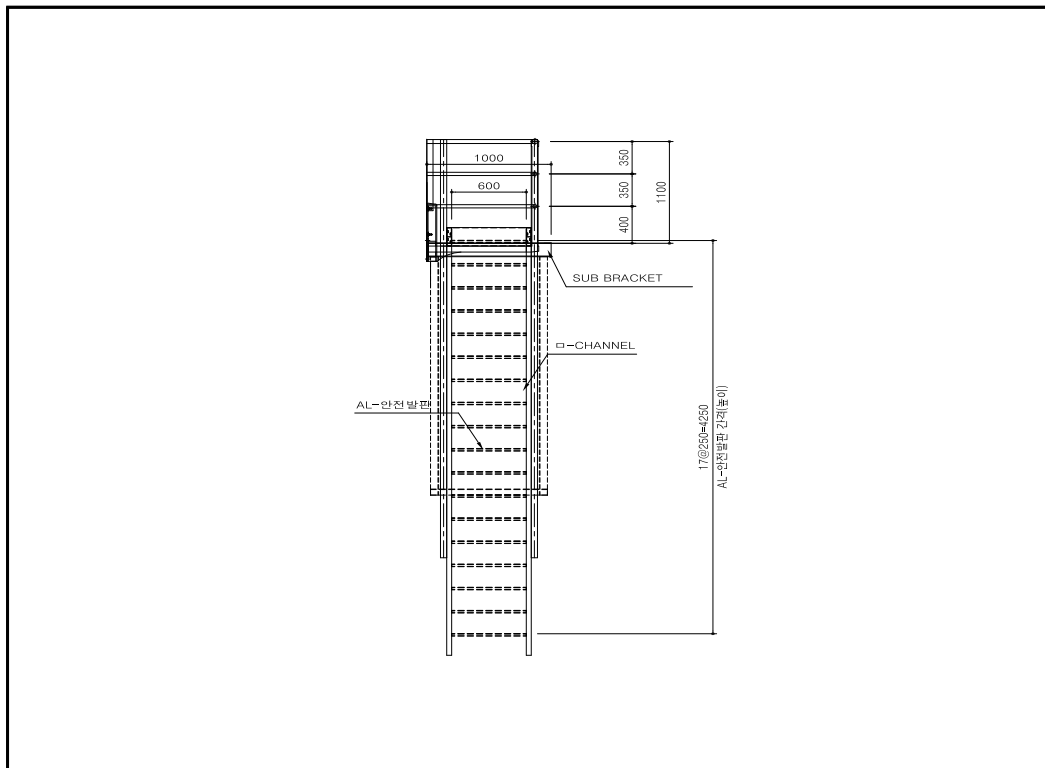
- 1) 도로교설계기준 (한국도로교통협회)
- 2) 도로설계요령 (한국도로공사)
- 3) 도로설계 실무편람 (한국도로공사)
- 4) 교량점검시설 개선검토 참고자료 (한국도로공사)
- 5) 기타 관련도서

§3. 설계단면

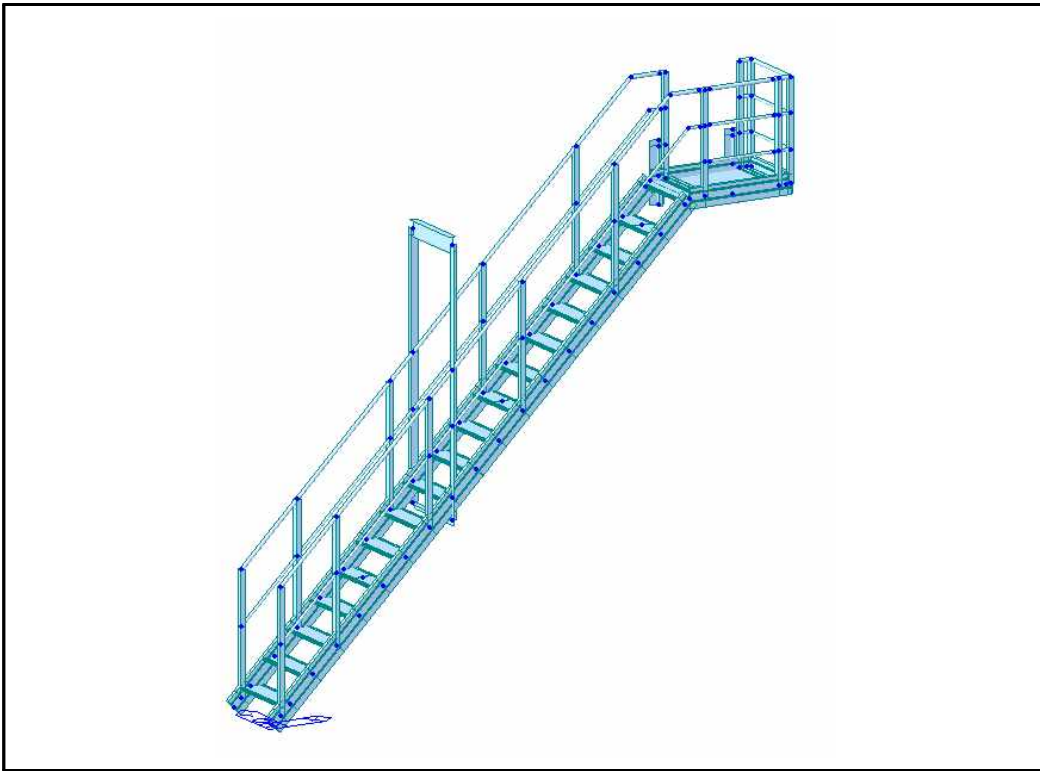
1. 설치 측면도



2. 설치 정면도

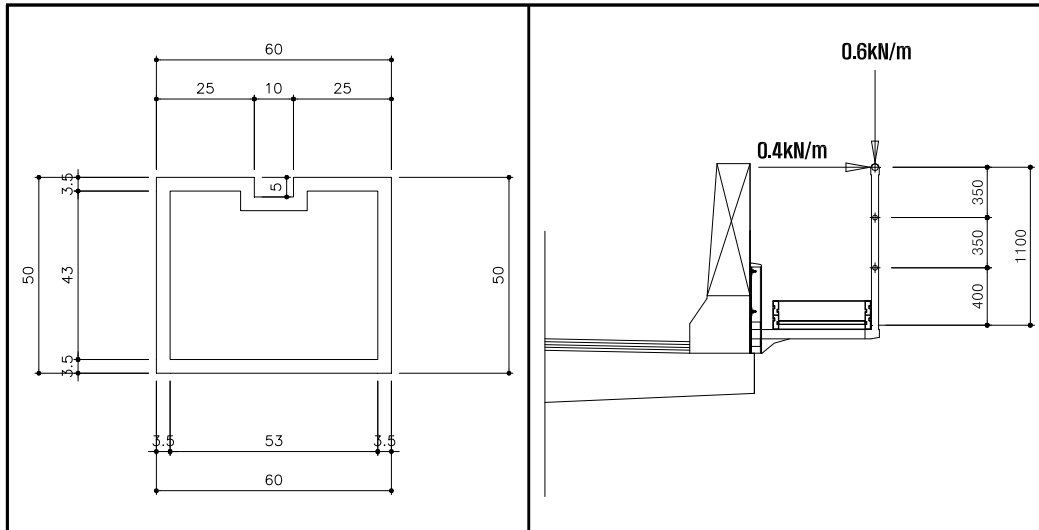


3. 모델링



§4. 부재검토

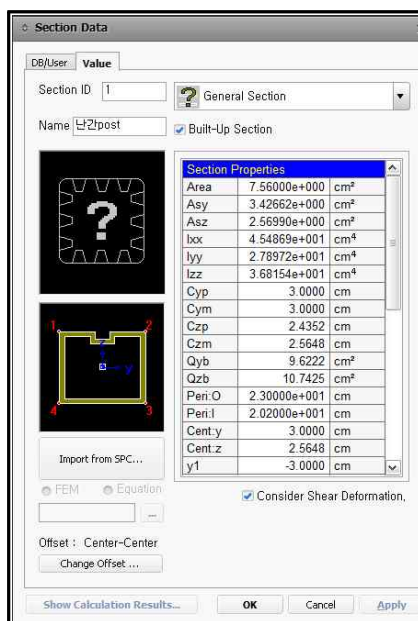
1. 난 간



1) 설계단면력

- $N_A = 600\text{N/m} \times 1.000\text{m} = 600\text{N}$
- $V_A = 400\text{N/m} \times 1.000\text{m} = 400\text{N}$
- $M_A = 400\text{N/m} \times 1.000\text{m} \times 1.100\text{m}$
 $= 440.00\text{N} \cdot \text{m}$
 $= 44000\text{N} \cdot \text{cm}$

2) 단면제원



- $A_s = 7.560\text{cm}^2$
- $A_{\text{web}} = 5.0 \times 0.35 \times 2 = 3.5\text{cm}^2$
- $I_y = 27.897\text{cm}^4$
- $Z_{yu} = I_y / Y_u$
 $= 27.897 / 2.4352 = 11.455\text{cm}^3$
- $Z_{yL} = I_y / Y_L$
 $= 27.897 / 2.5648 = 10.876\text{cm}^3$

3) 응력검토

· 전단응력검토

$$\begin{aligned} - v &= V_A / A_{WEB} \\ &= 400.000 / 3.500 \\ &= 114.285\text{N/cm}^2 = 1.142\text{MPa} < v_a = 35\text{MPa} \quad \therefore \text{O.K} \end{aligned}$$

· 휨응력검토

$$\begin{aligned} - f_b &= N_A / A_S \pm M_A / Z_y \\ &= 600.000 / 7.560 \pm 44000 / 10.876 \\ &= 79.365 \pm 4045.605 \\ - f_c &= 3966.235\text{N/cm}^2 = 39.662\text{MPa} < f_{ca} = 60\text{MPa} \quad \therefore \text{O.K} \\ - f_t &= 4124.970\text{N/cm}^2 = 41.249\text{MPa} < f_{ca} = 60\text{MPa} \quad \therefore \text{O.K} \end{aligned}$$

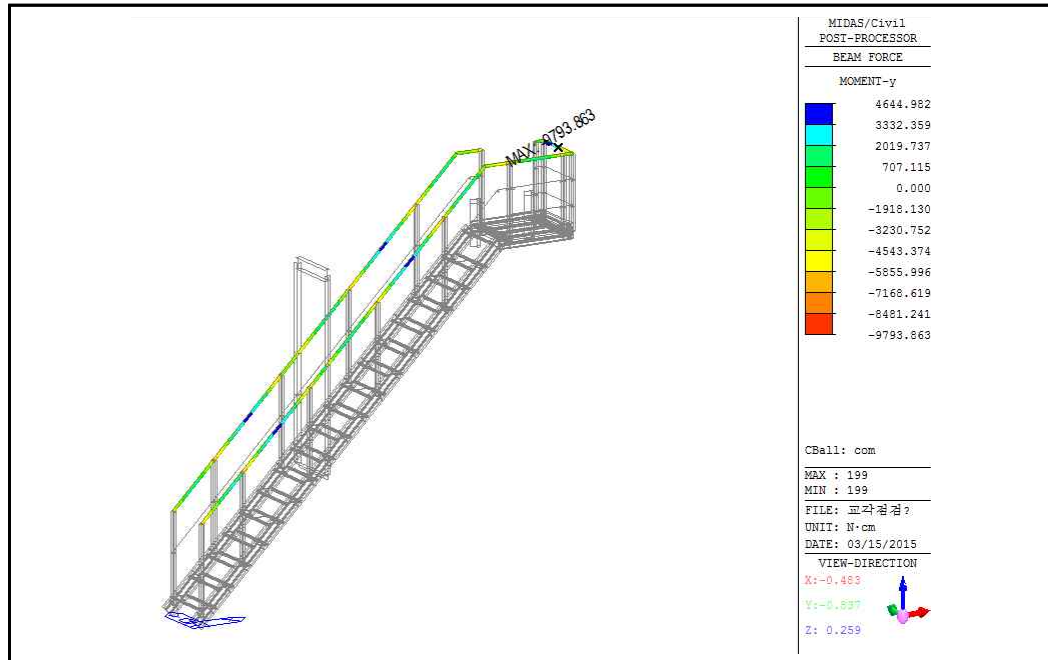
· 합성응력검토

$$\begin{aligned} \left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 &\leq 1.2 \\ \left(\frac{41.249}{60} \right)^2 + \left(\frac{1.142}{35} \right)^2 &\leq 1.2 \\ = 0.473 &\leq 1.2 \quad \therefore \text{O.K} \end{aligned}$$

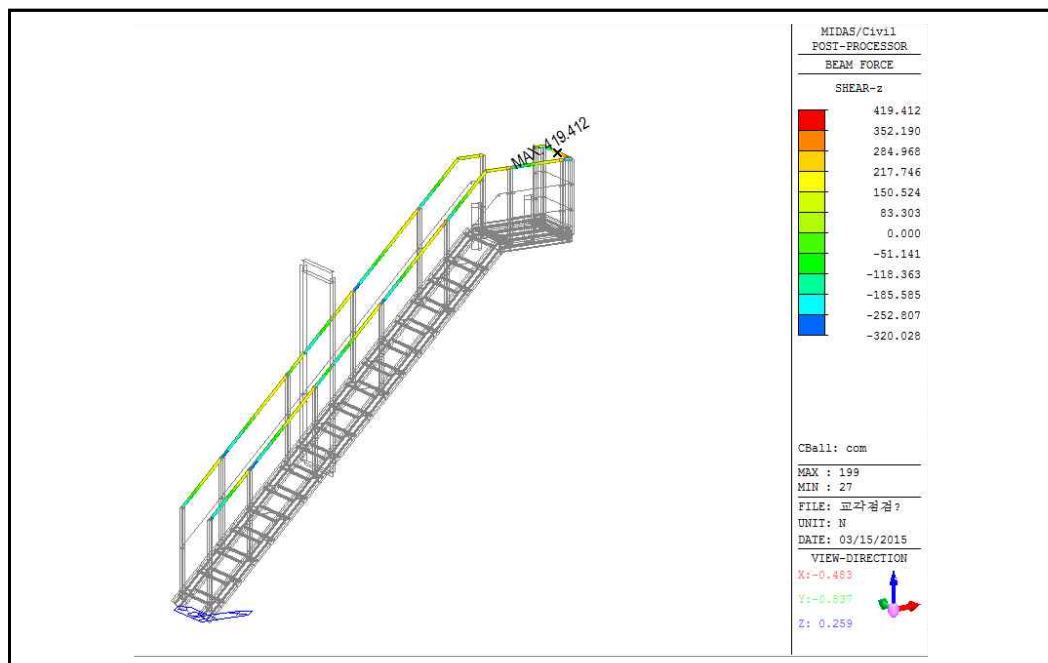
2. 난간 PIPE (φ43 x 2.5t)

1) 설계단면력산정

◎모멘트도



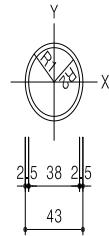
◎전단력도



$$\therefore V_A = 419.412\text{N}$$

$$\therefore M_A = 9793.863\text{N} \cdot \text{cm}$$

2) 단면제원



$$- R_1 = 2.150\text{cm}$$

$$- R_2 = 1.900\text{cm}$$

$$- A_S = \pi/4 \times (4.300^2 - 3.800^2) \\ = 3.181\text{cm}^2$$

$$- I_x = I_y = \pi/64 \times (4.300^4 - 3.800^4) \\ = 6.547\text{cm}^4$$

$$- Z_x = Z_y = I_x / y \\ = 6.547 / 2.150 = 3.045\text{cm}^3$$

3) 응력검토

· 전단응력 검토

$$- v = \frac{4V_A}{3A_S} \times \frac{R_2^2 + R_2R_1 + R_1^2}{R_2^2 + R_1^2} \\ = \frac{4 \times 419.412}{3 \times 3.181} \times \frac{4.30^2 + 4.30 \times 3.80 + 3.80^2}{4.30^2 + 3.80^2} \\ = 175.798 \times 1.496 = 262.993\text{N/cm}^2 = 2.629\text{MPa} < v_a = 35\text{MPa} \quad \therefore \text{O.K}$$

· 휨응력검토

$$- f_b = M_A / Z \\ = 9793.863 / 3.045 \\ = 3216.375\text{N/cm}^2 = 32.163\text{MPa} < f_{ba} = 60\text{MPa} \quad \therefore \text{O.K}$$

· 합성응력검토

$$\left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 \leq 1.2 \\ \left(\frac{32.163}{60} \right)^2 + \left(\frac{2.629}{35} \right)^2 \leq 1.2 \\ = 0.292 \leq 1.2 \quad \therefore \text{O.K}$$

3. 난간 PIPE ($\phi 31.8 \times 2.5t$)

1) 설계단면력산정

◎모멘트도



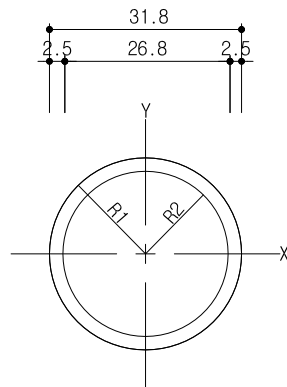
◎전단력도



$$\therefore V_A = 245.277N$$

$$\therefore M_A = 4830.233N \cdot cm$$

2) 단면제원



$$- R_1 = 1.590\text{cm}$$

$$- R_2 = 1.340\text{cm}$$

$$- A_S = \pi/4 \times (3.180^2 - 2.680^2) \\ = 2.301\text{cm}^2$$

$$- I_x = I_y = \pi/64 \times (3.180^4 - 2.680^4) \\ = 2.487\text{cm}^4$$

$$- Z_x = Z_y = I_x / y \\ = 2.487 / 1.590 = 1.564\text{cm}^3$$

3) 응력검토

· 전단응력 검토

$$- v = \frac{4V_A}{3A_S} \times \frac{R_2^2 + R_2R_1 + R_1^2}{R_2^2 + R_1^2}$$

$$= \frac{4 \times 245.277}{3 \times 2.301} \times \frac{3.18^2 + 3.18 \times 2.68 + 2.68^2}{3.180^2 + 2.680^2}$$

$$= 142.127 \times 1.492 = 212.053\text{N/cm}^2 = 2.120\text{MPa} < v_a = 35\text{MPa} \quad \therefore \text{O.K}$$

· 휨응력검토

$$- f_b = M_A / Z$$

$$= 4830.233 / 1.564$$

$$= 3088.384\text{N/cm}^2 = 30.884\text{MPa} < f_{ba} = 60\text{MPa} \quad \therefore \text{O.K}$$

· 합성응력검토

$$\left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 \leq 1.2$$

$$\left(\frac{30.884}{60} \right)^2 + \left(\frac{1.492}{35} \right)^2 \leq 1.2$$

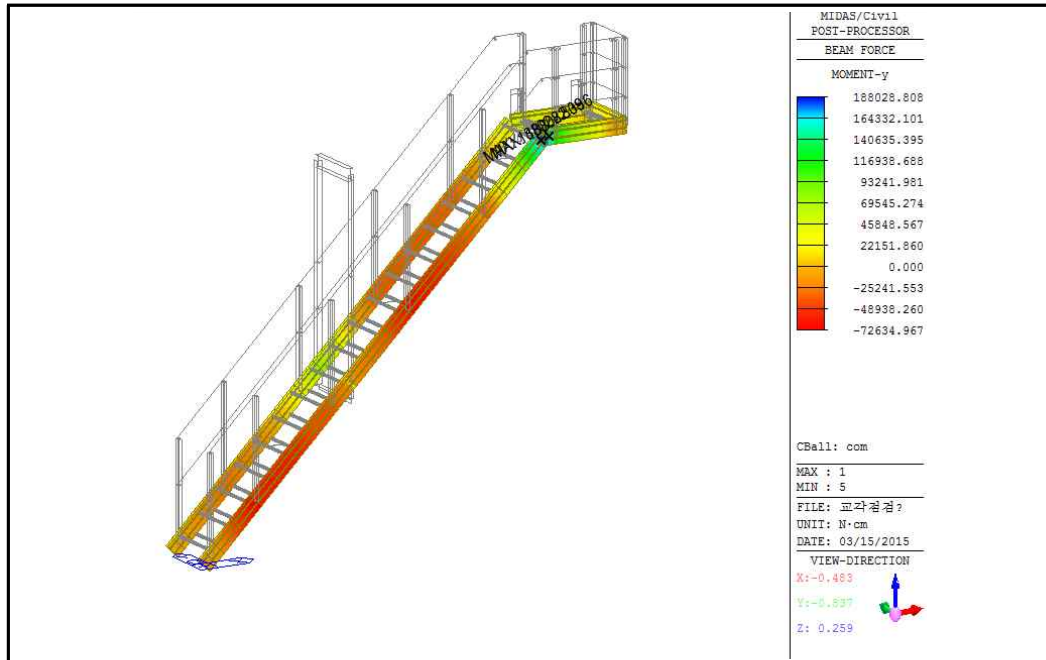
$$= 0.266 \leq 1.2$$

$\therefore \text{O.K}$

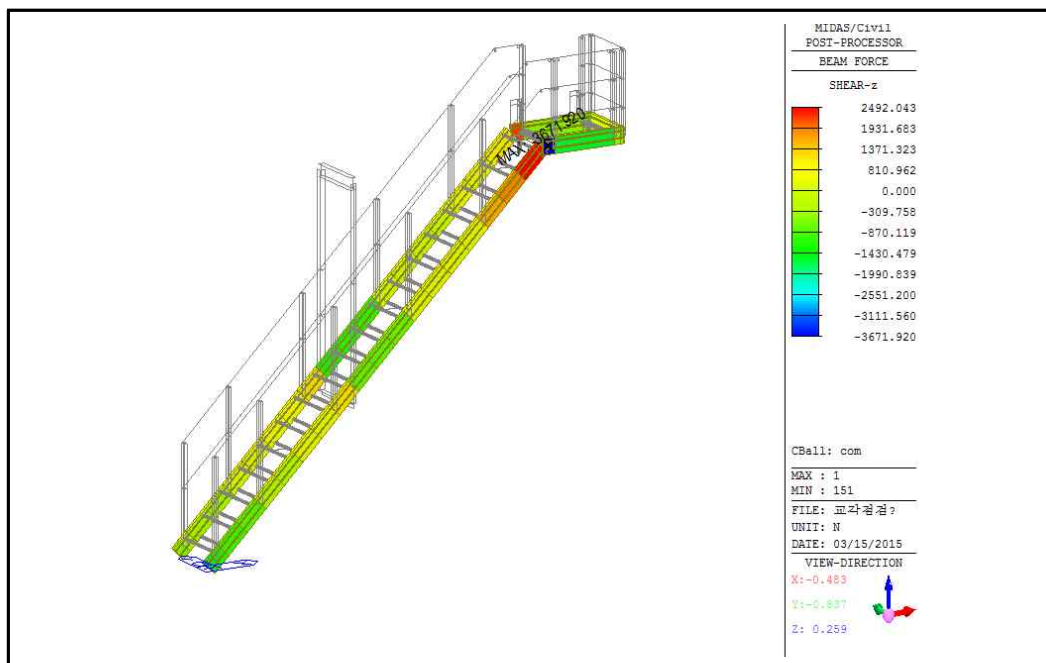
4. 바닥 CHANNEL

1) 설계 단면력산정

◎모멘트도



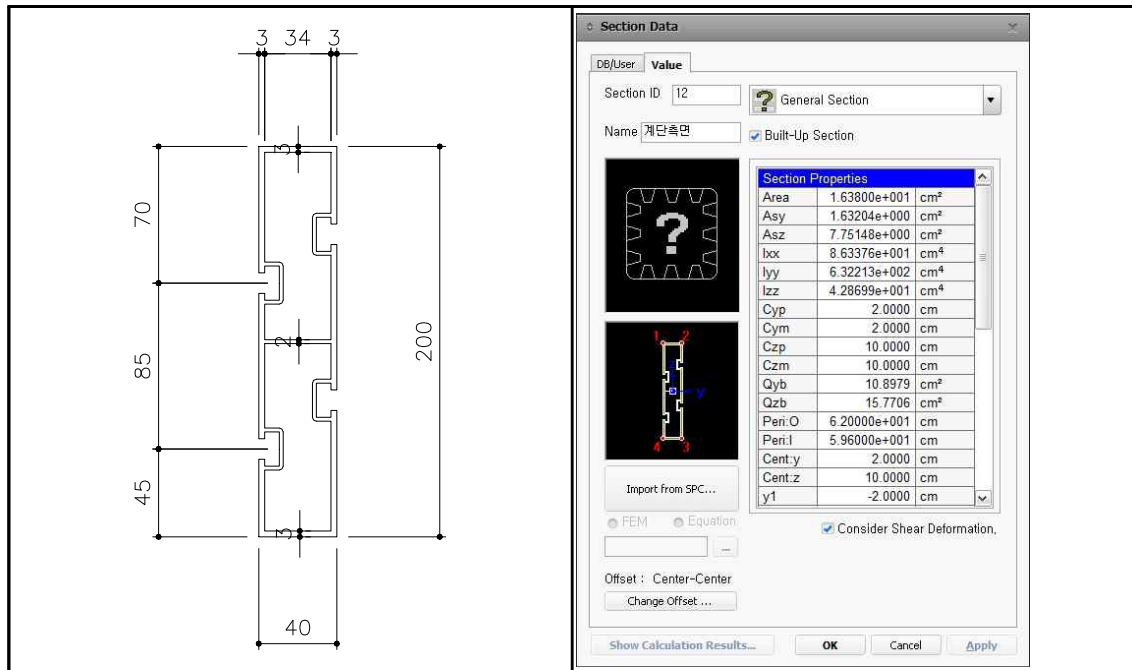
◎전단력도



$$\therefore V_A = 3671.920\text{N}$$

$$\therefore M_A = 188028.808\text{N} \cdot \text{cm}$$

2) 단면제원



3) 응력검토

· 전단응력검토

$$\begin{aligned}
 -v &= V_A / A_{WEB} \\
 &= 3671.920 / (20 \times 0.3) \\
 &= 611.986 \text{ N/cm}^2 = 6.119 \text{ MPa} < v_a = 35 \text{ MPa} \quad \therefore \text{O.K}
 \end{aligned}$$

· 휨응력검토

$$\begin{aligned}
 -f_b &= M_A / Z_{X(U)} \\
 &= 188028.808 / (632.213 / 10.000) \\
 &= 2974.137 \text{ N/cm}^2 = 29.741 \text{ MPa} < f_{ba} = 60 \text{ MPa} \quad \therefore \text{O.K}
 \end{aligned}$$

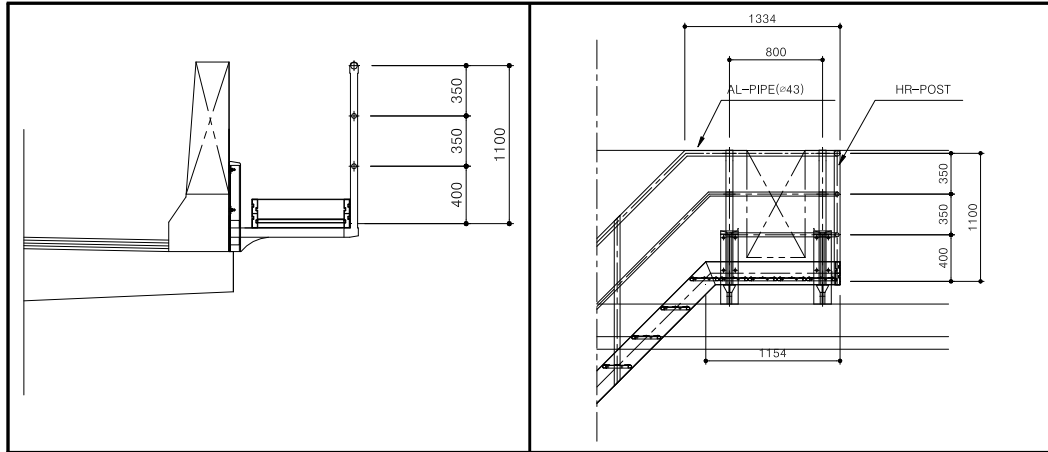
· 합성응력검토

$$\begin{aligned}
 \left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 &\leq 1.2 \\
 \left(\frac{29.741}{60} \right)^2 + \left(\frac{6.119}{35} \right)^2 &\leq 1.2 \\
 &= 0.276 \leq 1.2 \quad \therefore \text{O.K}
 \end{aligned}$$

5. 바닥판 및 보강브라켓

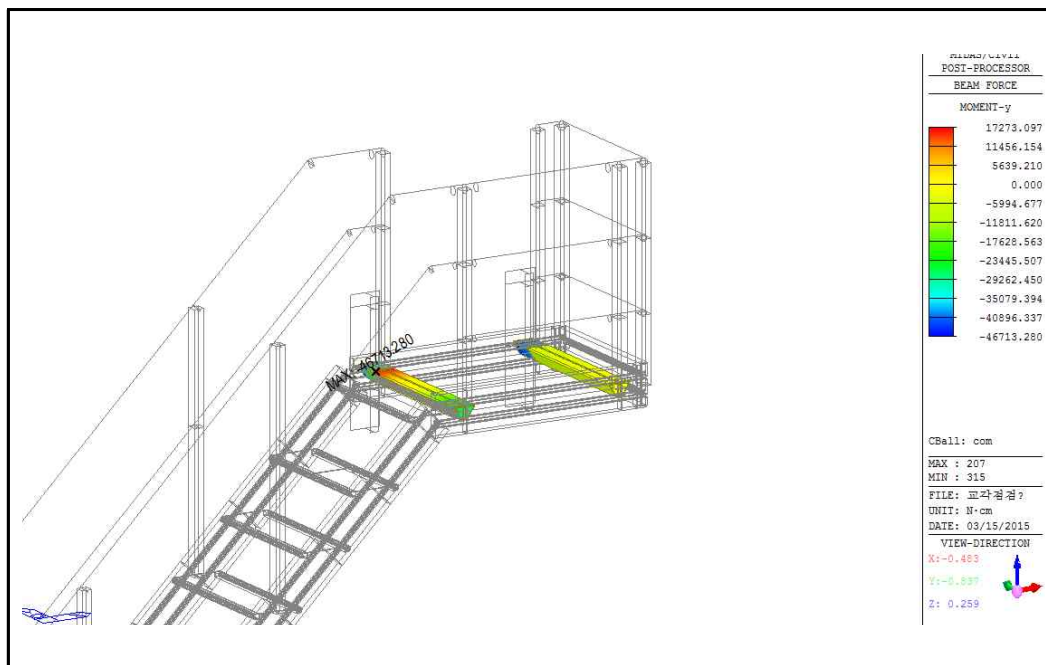
5.1 설계단면력산정

1) 설치일반도

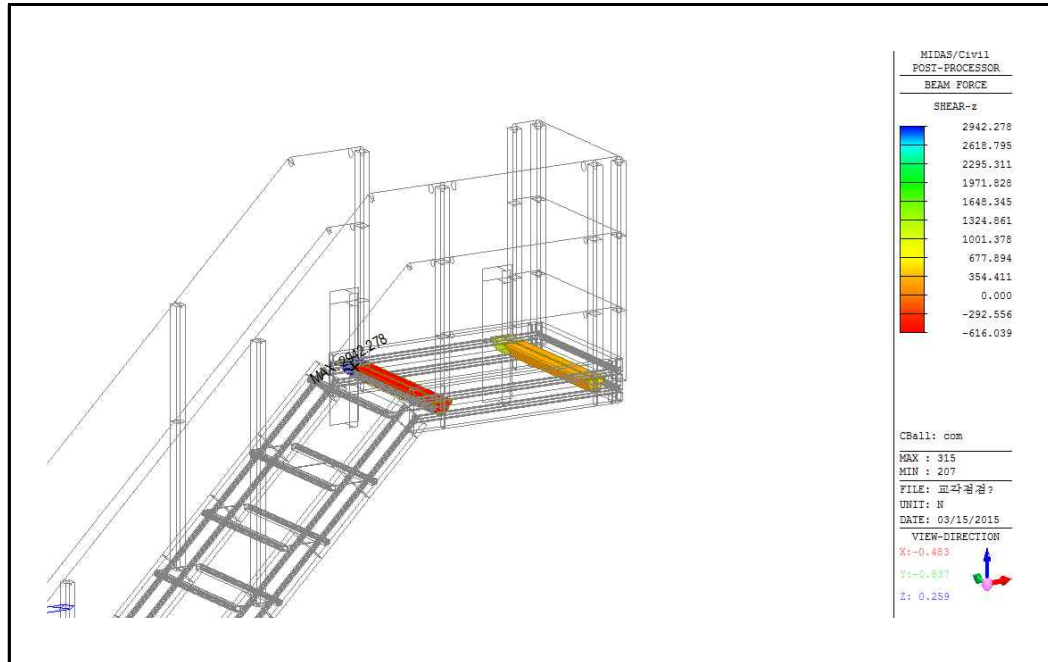


2) 설계단면력산정

◎모멘트도



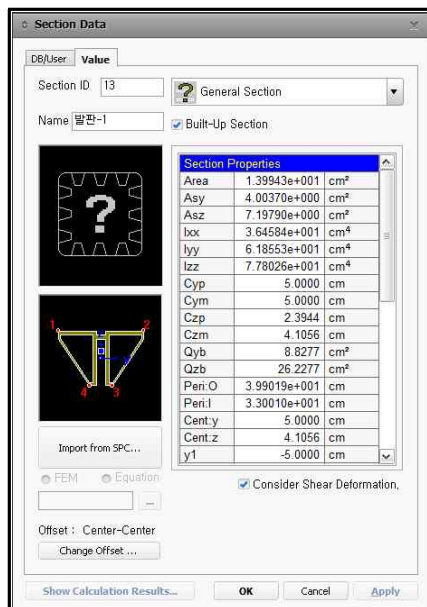
○전단력도



$$\therefore V_A = 2942.278 \text{ N}$$

$$\therefore M_A = 46713.280 \text{ N} \cdot \text{cm}$$

3) 단면제원



$$- A_s = 13.994 \text{ cm}^2$$

$$- A_{\text{web}} = 6.500 \times 1.00 = 6.50 \text{ cm}^2$$

$$- I_y = 61.855 \text{ cm}^4$$

$$- Z_{yu} = I_y / Y_u$$

$$= 61.855 / 2.3944 = 25.833 \text{ cm}^3$$

$$- Z_{yL} = I_y / Y_L$$

$$= 61.855 / 4.1056 = 15.066 \text{ cm}^3$$

4) 응력검토

· 전단응력검토

$$\begin{aligned}
 - v &= V_A / A_{WEB} \\
 &= 2942.278 / 6.500 \\
 &= 452.658 \text{ N/cm}^2 = 4.526 \text{ MPa} < v_a = 35 \text{ MPa} \quad \therefore \text{O.K}
 \end{aligned}$$

· 휨응력검토

$$\begin{aligned}
 - f_b &= M_A / Z_{X(U)} \\
 &= 46713.280 / 15.066 \\
 &= 3100.576 \text{ N/cm}^2 = 31.005 \text{ MPa} < f_{ba} = 60 \text{ MPa} \quad \therefore \text{O.K}
 \end{aligned}$$

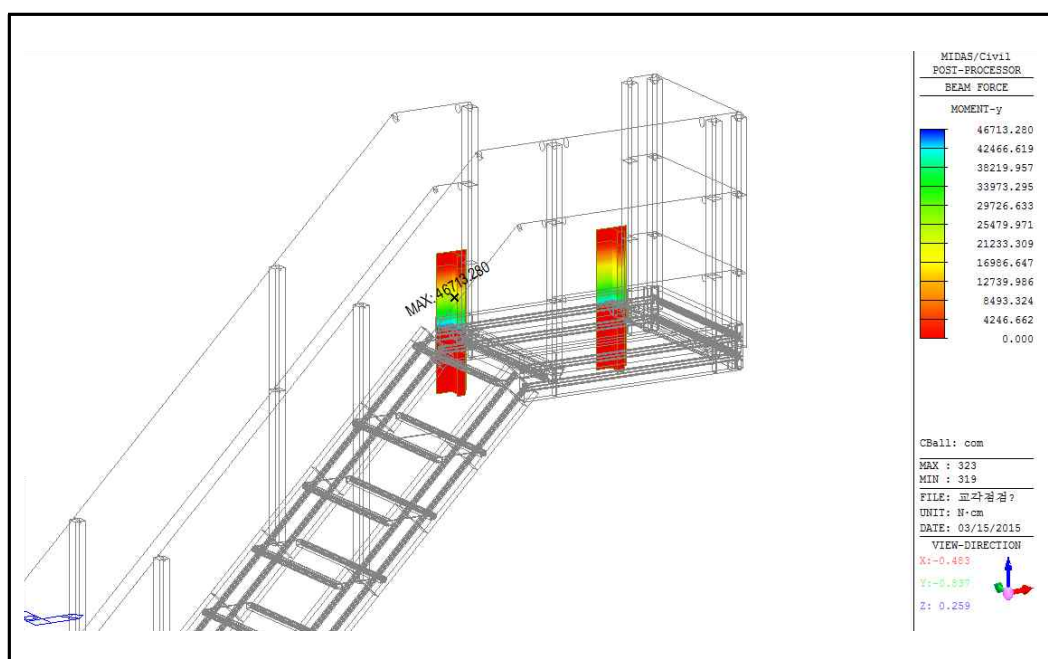
· 합성응력검토

$$\begin{aligned}
 \left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 &\leq 1.2 \\
 \left(\frac{31.005}{60} \right)^2 + \left(\frac{4.526}{35} \right)^2 &\leq 1.2 \\
 &= 0.283 \leq 1.2 \quad \therefore \text{O.K}
 \end{aligned}$$

5.2 정착브라켓

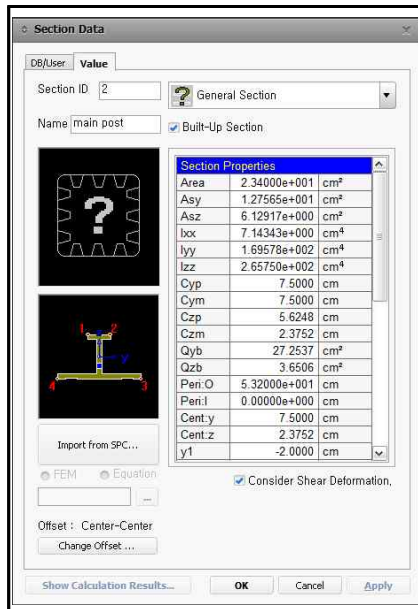
1) 단면력

◎모멘트도



$$\cdot M_{\max} = 46713.280 \text{ N} \cdot \text{cm}$$

2) 단면제원



$$- A_s = 23.400 \text{ cm}^2$$

$$- A_{\text{web}} = 1.0 \times 6.00 = 6.000 \text{ cm}^2$$

$$- I_y \doteq 169.578 \text{ cm}^4$$

$$- Z_{yu} = I_y / Y_u$$

$$= 169.578 / 5.6248 = 30.148 \text{ cm}^3$$

$$- Z_{yL} = I_y / Y_L$$

$$= 169.578 / 2.3752 = 71.395 \text{ cm}^3$$

3) 응력검토

· 휨응력검토

$$- f_b = M_A / Z_{x(U)}$$

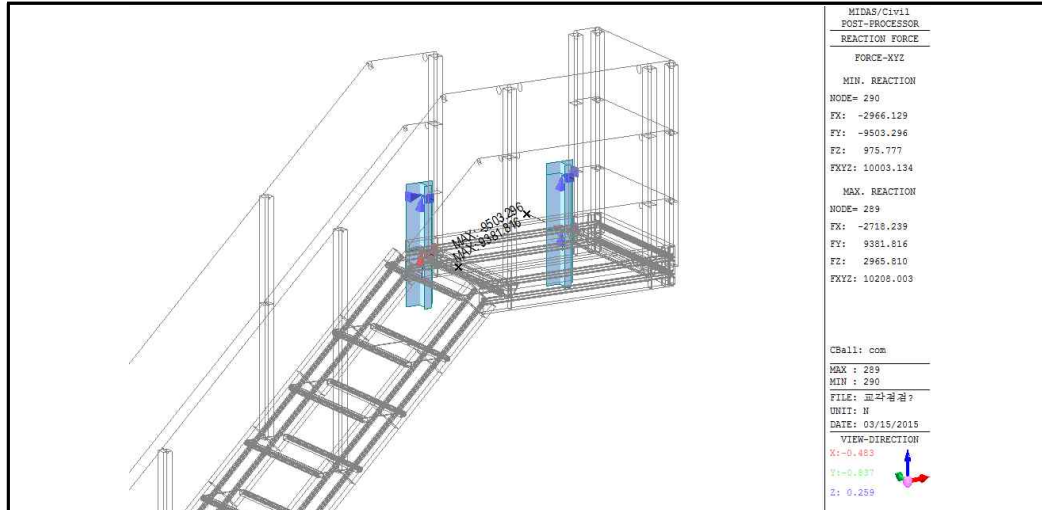
$$= 46713.280 / 30.148$$

$$= 1549.465 \text{ N/cm}^2 = 15.494 \text{ MPa} < f_{ba} = 60 \text{ MPa} \quad \therefore \text{O.K}$$

5.3 Anchor Bar

1) 앵커의 작용하중

◎반력도



$$\therefore N_{ua} = 1.7 \times 9503.296 \text{ N} / 2ea = 8077.801 \text{ N} \text{ (앵커1개에 작용하는 인장력)}$$

$$\therefore V_{ua} = 1.7 \times 2966.129 \text{ N} / 2ea = 2521.209 \text{ N} \text{ (앵커1개에 작용하는 전단력)}$$

2) 앵커의 재료평가 - 탄소강 제작된 것으로 앵커품질에 대한 부록참조

$$\therefore f_{uta} = 795 \text{ MPa} - \text{설계기준 인장강도 (KSB 0241방법적용, 시험성적서 참조)}$$

$$\therefore f_{ya} = 616 \text{ MPa} - \text{설계기준 항복강도 (KSB 0241방법적용, 시험성적서 참조)}$$

콘크리트용 앵커 설계기준은 단면적 감소 30% 이상, 연신율 14% 이상을 연성강재요소의 요건으로 정의하고 있고 주어진 앵커재료는 연성강재이다.

3) 인장하중 하에서 강재강도

$$\phi N_{sa} \geq N_{ua}$$

$$N_{sa} = nA_{se} f_{uta}$$

$$\phi nA_{se} f_{uta} \geq N_{ua} = 8077.801 \text{ N}$$

연성강재요소의 인장파괴에 지배되는 경우 강도감소계수 $\phi=0.75$ 이고 단일앵커이므로 $n = 1$ 이다.

$$\phi N_{sa} = 0.75 \times 1 \times 84.4 \times 795 = 50323.500 \text{ N} > 8077.801 \text{ N} \therefore \text{O.K}$$

강재의 직경 12mm 앵커의 강재강도는 인장하중에 적합함

4) 최소연단거리 - 콘크리트 구조설계기준(2007) 5.4절

∴ 철근의 최소피복두께 이상 : 100 mm 이상

∴ ACI 355.2 에 의한 제품시험에서 최소 모서리 거리 : 65 mm 이상

∴ 최대 골재크기의 2배이상 : $2 \times 25 = 50$ mm 이상

$$c_{a,min} = 150mm \text{ 적용} \quad \therefore \text{O.K}$$

5) 인장하중 하에서 콘크리트 파괴강도

$$\phi N_{cb} \geq N_{ua}$$

∴ “앵커가 범주2 (즉, 중간설치 민감도와 중간신뢰도), 콘크리트조개짐을 제어하기위한 별도의 보조철근이 없는 것으로 가정” 이때 강도감소계수 $\phi=0.55$ 로 적용

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$$

$$N_b = k_c \sqrt{f_{ck}} h_{ef}^{1.5}$$

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} k_c \sqrt{f_{ck}} h_{ef}^{1.5} \geq N_{ua} = 8077.801 \text{ N}$$

$$k_c = k_{cr} = 7$$

$$\psi_{ed,N} = 0.7 + 0.3 \frac{c_{a,min}}{1.5h_{ef}}, c_{a,min} < 1.5h_{ef} \text{ 이므로}$$

$$\psi_{ed,N} = 0.7 + 0.3 \frac{150}{1.5(80)} = 1.075$$

$$\psi_{c,N} = 1.0 \text{ 사용하중하에서 콘크리트 균열이 발생하는 경우 } (f_t > f_{tr})$$

$$\psi_{cp,N} = 1.0 \text{ 사용하중하에서 콘크리트 균열이 발생하는 경우 } (f_t > f_{tr})$$

$$A_{Nco} = 9h_{ef}^2 = 9 \times (80)^2 = 57600 \text{ mm}^2$$

$$A_{Nc} = (c_{a1} + 1.5h_{ef}) (2 \times 1.5h_{ef}) = (150 + 1.5 \times 80)(2 \times 1.5 \times 80) = 64800 \text{ mm}^2$$

$$\frac{A_{Nc}}{A_{Nco}} = \frac{64800}{57600} = 1.125$$

$$\therefore N_{cb} = 1.075 \times 1.125 \times 1.0 \times 1.0 \times 7 \times \sqrt{27} \times (80)^{1.5} = 31475.735 \text{ N}$$

$$\therefore \phi N_{cb} = 0.55 \times 31475.735 = 17311.654 \text{ N} > 8077.801 \text{ N} \quad \therefore \text{O.K}$$

6) 앵커뿔힘강도

$$\phi N_{pn} > N_{ua}$$

$$N_{pn} = \psi_{c,p} N_p$$

∴ “앵커가 범주2 (즉, 중간설치 민감도와 중간신뢰도), 콘크리트조개짐을 제어하기위한 별도의 보조철근이 없는 것으로 가정” 이때 강도감소계수 $\phi=0.55$ 로 적용

또한 $N_p = N_{p,cr} = 13.930\text{kN}$ 로 한다.(콘크리트 구조기준해설(2012)- 부록 II.26 참조

“II.26 - 콘크리트용 앵커 설계법 및 예제집 P 141 참조) 매입깊이가 80mm 로 매입깊이가 65mm 와 90mm의 중간값으로 적용함

$$\psi_{c,p} = 1$$

$\phi N_{pn} =$ 사용하중하에서 콘크리트 균열이 발생하는 경우 ($f_t > f_t$)

$$\phi N_{pn} = 0.55 \times 13930 = 7661.500 \text{ N} > 8077.801 \text{ N}$$

6) 인장하중 하에서 모든 파괴 형태 확인

인장에 대한 파괴 형태별 설계강도 요약

구 분	계산결과	비고
앵커강재 파괴	50323.500 N	
콘크리트 파괴	17311.654 N	
앵 커 뿔 힘	7661.500 N	지배강도

7) 전단하중 하에서 강재강도

$$\phi V_{sa} \geq V_{ua}$$

$$V_{sa} = n \times 0.6 \times A_{se} f_{uta}$$

$$\phi n \times 0.6 \times A_{se} f_{uta} \geq V_{ua} = 2521.209 \text{ N}$$

연성강재요소의 강도에 지배되는 경우 강도감소계수 $\phi=0.65$ 이고 단일앵커이므로 $n = 1$ 이다.

$$\phi V_{sa} = 0.65 \times 0.6 \times 84.4 \times 795 = 26168.220 \text{ N} > 2521.209 \text{ N} \quad \therefore \text{O.K}$$

강재의 직경 12mm 앵커의 강재강도는 전단하중에 적합함

8) 전단하중 하에서 콘크리트 파괴강도

$$\phi V_{cb} \geq V_{ua}$$

∴ “전단하중에 대하여 콘크리트파괴가 지배적인 경우 강도감소계수 $\phi=0.70$ 로 적용
(조건 B 보조철근이 없는 것으로 가정)

$$V_{cb} = \frac{A_{Vc}}{A_{Vco}} \psi_{ed, V} \psi_{c, V} V_b$$

$$V_b = 0.6 \left[\frac{l_e}{d_0} \right]^{0.2} \sqrt{d_0} \sqrt{f_{ck}} (c_{a1})^{1.5} \geq V_{ua}$$

$$\phi V_{cb} = \phi \frac{A_{Vc}}{A_{Vco}} \psi_{ed, V} \psi_{c, V} 0.6 \left[\frac{l_e}{d_0} \right]^{0.2} \sqrt{d_0} \sqrt{f_{ck}} (c_{a1})^{1.5} \geq V_{ua} = 2521.209 \text{ N}$$

$$\frac{A_{Vc}}{A_{Vco}} = 1 \text{ 그리고 } c_{a1} = 150\text{mm (연단거리)}$$

c_{a2} 는 c_{a1} 에 수직인 방향으로 앵커중심으로부터 콘크리트 가장자리까지 거리

$c_{a2} = 625\text{mm}$ 이므로 거리가 $1.5 h_{ef} = 1.5 \times 80 = 120\text{mm}$ 이상이다.

$\psi_{ed, V} = 1.0$ $c_{a2} > 1.5c_{a1}$ 인 경우

$\psi_{c, V} = 1.0$ 사용하중하에서 콘크리트 균열이 발생하는 경우 ($f_t > f_t$)

$$d_0 = 12\text{mm}$$

$$l_e = h_{ef} = 80 \text{ mm 그러나 } l_e \leq 8d_0 ; 8d_0 = 8 \times 12 = 96\text{mm}$$

$$l_e = 80 \text{ mm 적용}$$

$$\phi V_{cb} = 0.7 \times 1.0 \times 1.0 \times 1.0 \times 0.6 \times \left(\frac{80}{12} \right)^{0.2} \times \sqrt{12} \times \sqrt{27} \times (150)^{1.5} = 20297.401 \text{ N}$$

$$\therefore \phi V_{cb} \geq V_{ua} = 20297.401 \text{ N} > 2521.209 \text{ N} \quad \therefore \text{O.K}$$

9) 콘크리트 프라이아웃강도

$$\phi V_{CP} > V_{ua}$$

$$V_{cp} = k_{cp} N_{cb}$$

∴ “전단하중에 대하여 콘크리트파괴가 지배적인 경우 강도감소계수 $\phi=0.70$ 로 적용
(조건 B 보조철근이 없는 것으로 가정)

또한 $k_{cp} = 2.0$, $h_{ef} = 80\text{mm} > 65\text{mm}$ 인 경우 $N_{cb} = 31475.735 \text{ N}$ (인장하중검토참조)

$$\Phi V_{cp} = 0.7 \times 2.0 \times 31475.735 = 44066.029 \text{ N} > 2521.209 \text{ N}$$

10) 전단 하중 하에서 모든 파괴 형태 확인

인장에 대한 파괴 형태별 설계강도 요약

구 분	계산결과	비고
앵커강재 파괴	26168.220 N	
콘크리트 파괴	20297.401 N	지배강도
콘크리트 프라이아웃	44066.029 N	

11) 인장 - 전단 상관 작용 검토

- $V_{ua} \leq 0.2 \Phi V_n$ 인 경우 앵커는 인장강도로 지배

- $N_{ua} \leq 0.2 \Phi N_n$ 인 경우 앵커는 전단강도로 지배

$V_{ua} \leq 0.2 \Phi V_n$ 인 경우, 전체 인장강도를 사용할 수 있음 : $\Phi N_n \geq N_{ua}$

$$0.2 \Phi V_n = 0.2 \times 20297.401 \text{ N} = 4059.480 \text{ N} > 2521.209 \text{ N} \quad \therefore \text{조건에 만족}$$

$N_{ua} \leq 0.2 \Phi N_n$ 인 경우, 전체 전단강도를 사용할 수 있음 : $\Phi V_n \geq V_{ua}$

$$0.2 \Phi N_n = 0.2 \times 7661.500 \text{ N} = 1532.300 \text{ N} < 8077.801 \text{ N} \quad \therefore \text{조건에 미흡}$$

$V_{ua} \leq 0.2 \Phi V_n$ 이고 $N_{ua} \geq 0.2 \Phi N_n$ 이므로 인장과 전단 상관 작용을 검토 하여야 한다.

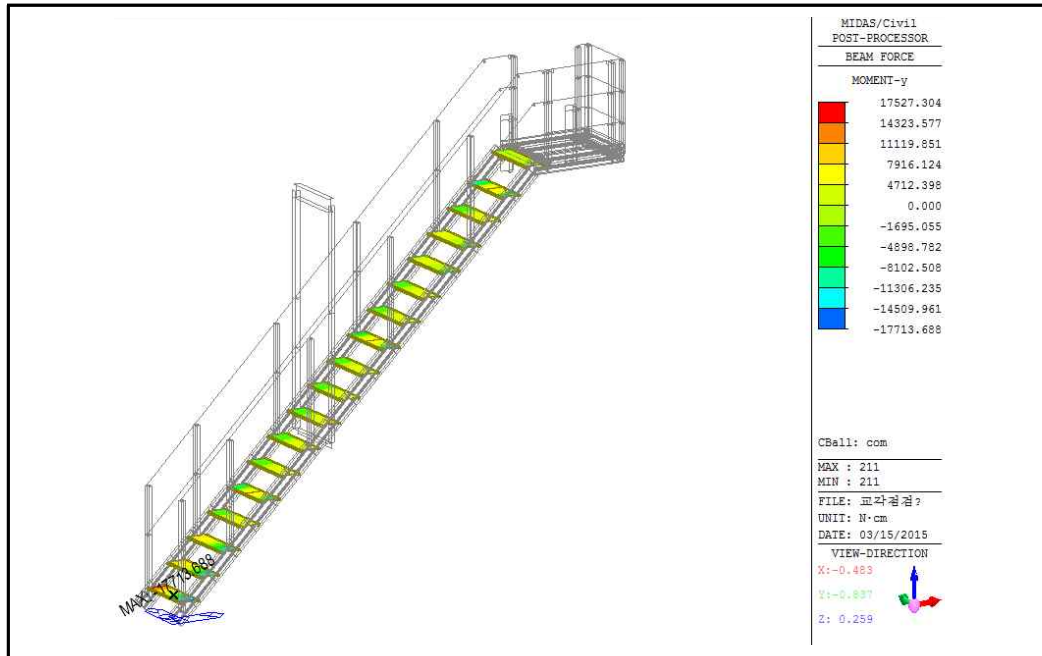
$$\frac{N_{ua}}{\Phi N_n} + \frac{V_{ua}}{\Phi V_n} \leq 1.2$$

$$\frac{8077.801}{7661.500} + \frac{2521.209}{20297.401} = 1.178 \leq 1.2 \quad \therefore \text{O.K}$$

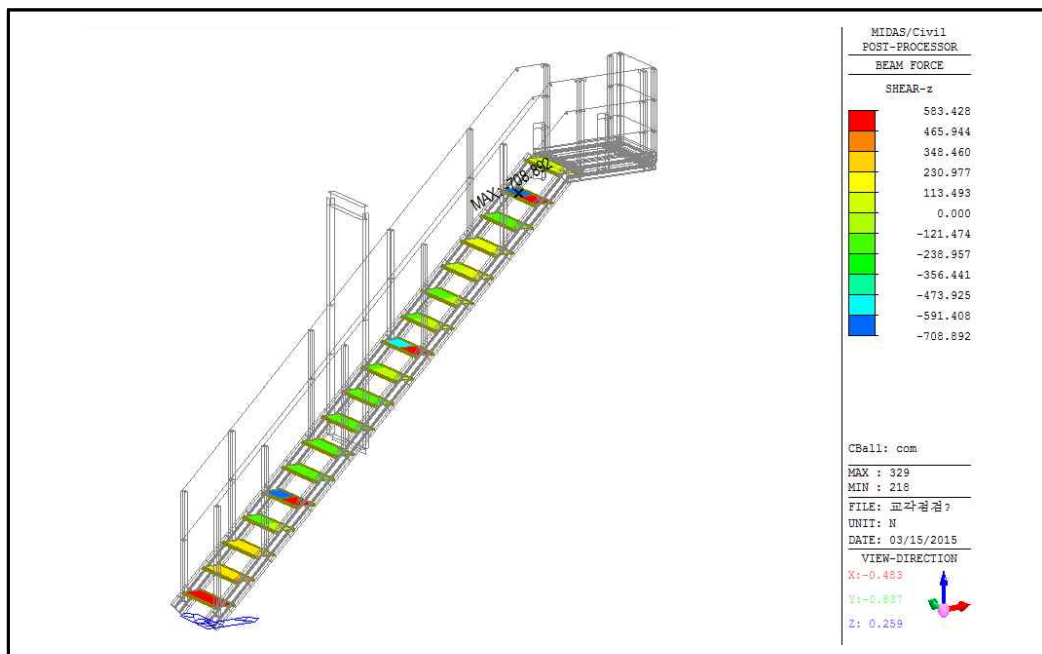
6. 발판 검토

1) 설계단면력산정

◎모멘트도



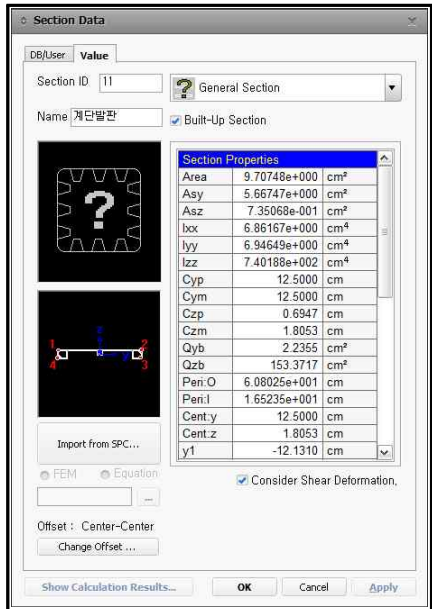
◎전단력도



$$\therefore V_A = 708.892\text{N}$$

$$\therefore M_A = 17713.688\text{N} \cdot \text{cm}$$

2) 단면제원



Property	Value	Unit
Area	9.70748e+000	cm²
Asy	5.66747e+000	cm²
Asz	7.35068e+001	cm²
box	6.86167e+000	cm⁴
byy	6.94649e+000	cm⁴
lzz	7.40188e+002	cm⁴
Cyp	12.5000	cm
Cym	12.5000	cm
Czp	0.6947	cm
Czm	1.8053	cm
Qyb	2.2355	cm²
Qzb	153.3717	cm²
Peri:O	6.08025e+001	cm
Peri:I	1.65235e+001	cm
Cent:y	12.5000	cm
Cent:z	1.8053	cm
y1	-12.1310	cm

- $A_s = 9.707\text{cm}^2$
- $I_z = 740.188\text{cm}^4$
- $Z_{yu} = I_z / Y_u$
 $= 740.188 / 12.500 = 59.215\text{cm}^3$

3) 응력검토

· 휨응력 검토

$$f = \frac{M}{I} y = \frac{17713.688}{740.188} \times 12.500$$

$$= 299.141\text{N/cm}^2 = 2.991\text{MPa} < f_{ba} = 60\text{MPa} \quad \therefore \text{O.K}$$

· 전단응력 검토

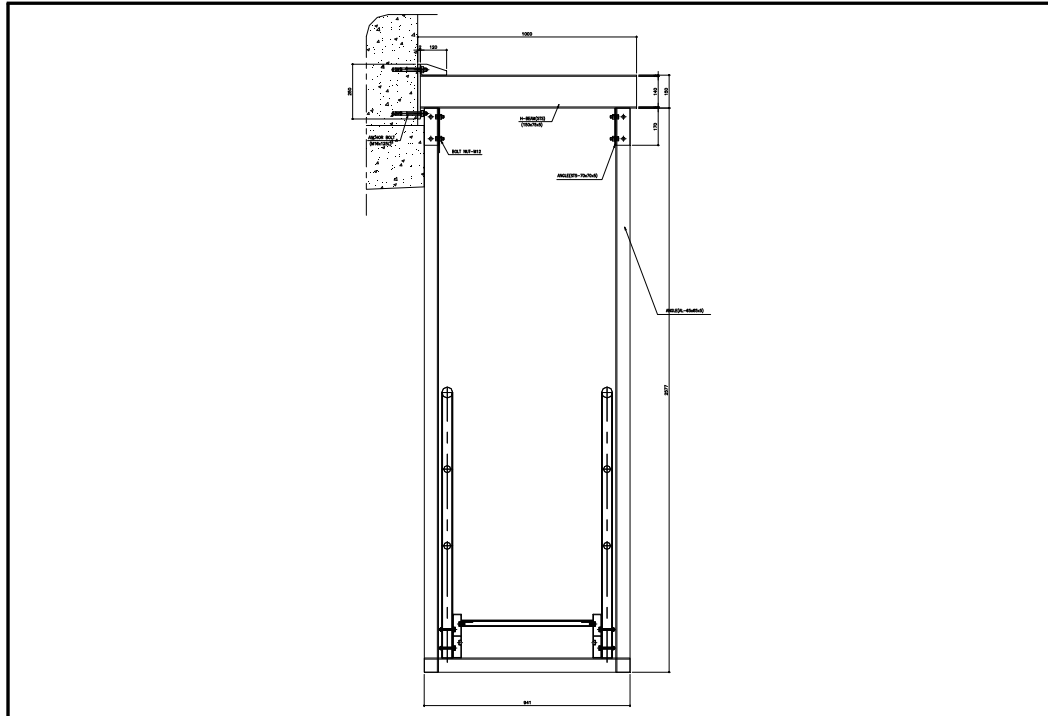
$$f = \frac{S}{A} = \frac{708.892}{9.707}$$

$$= 73.028\text{N/cm}^2 = 0.730\text{MPa} < f_{ba} = 35\text{MPa} \quad \therefore \text{O.K}$$

7. STS ANGLE 및 SUB BRACKET

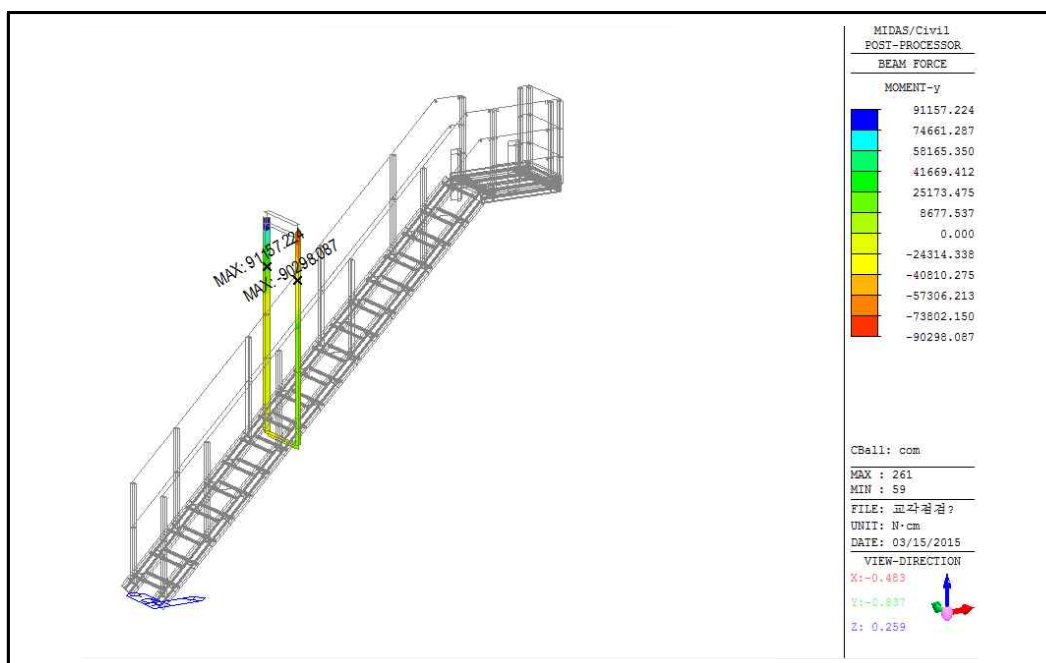
7.1 STS ANGLE 설계단면력산정

1) 설치일반도

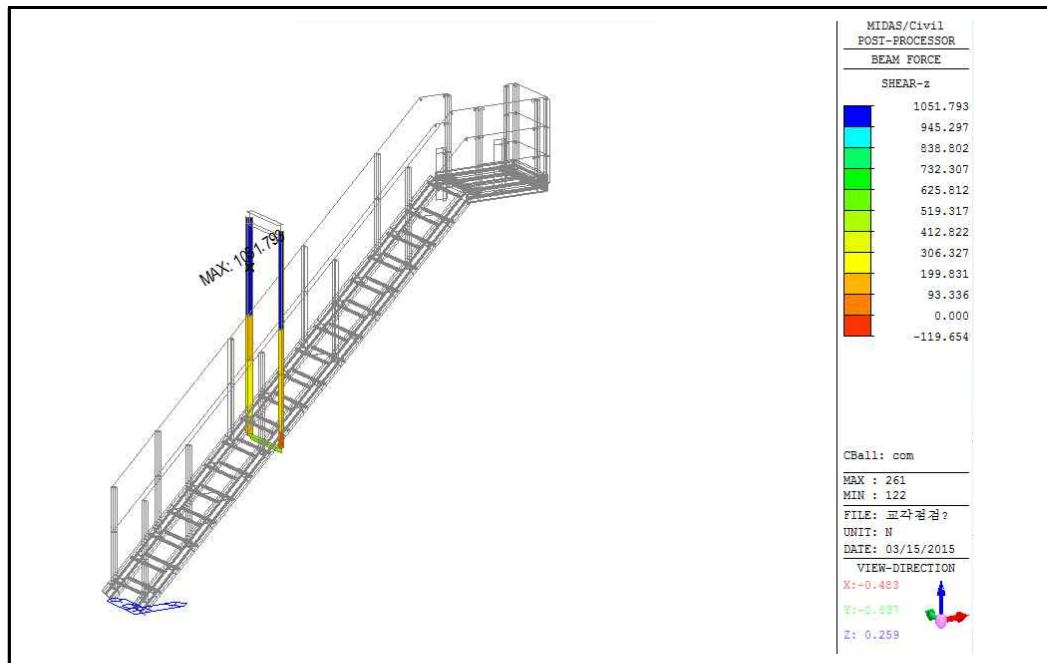


2) 설계단면력산정

◎모멘트도



◎ 전단력도



$$\therefore V_A = 1051.793 \text{ N}$$

$$\therefore M_A = 91157.224 \text{ N} \cdot \text{cm}$$

3) 단면제 원

Section Data

DB/User

Section ID: 6

Name: al-angle

User DB KS

Sect. Name: []

Built-Up Section: ☒

Get Data from Single Angle

DB Name: KS

Sect. Name: []

H: 6.5 cm

B: 6.5 cm

tw: 0.5 cm

tf: 0.5 cm

Consider Shear Deformation: ☒

Offset: Center-Top

Change Offset ...

Show Calculation Results... OK Cancel Apply

Section Properties

	Value	Unit
Area	6.250000e+000	cm ²
Asy	2.708333e+000	cm ²
Asz	2.708333e+000	cm ²
Ixx	5.208333e-001	cm ⁴
Iyy	2.554521e+001	cm ⁴
Izz	2.554521e+001	cm ⁴
Cyp	4.690000e+000	cm
Cym	1.810000e+000	cm
Czp	1.810000e+000	cm
Czm	4.690000e+000	cm
Qyb	1.099805e+001	cm ²
Qzb	1.099805e+001	cm ²
Peri:0	2.600000e+001	cm
Peri:l	0.000000e+000	cm
Center:y	1.810000e+000	cm
Center:z	4.690000e+000	cm
y1	-1.810000e+000	cm
z1	1.810000e+000	cm
y2	4.690000e+000	cm
z2	1.810000e+000	cm
y3	-1.310000e+000	cm
z3	-4.690000e+000	cm
y4	-1.810000e+000	cm
z4	-4.690000e+000	cm

Close

4) 응력검토

· 전단응력검토

$$\begin{aligned}
 - v &= V_A / A_{WEB} \\
 &= 1051.793 / (6.50 \times 0.50) \\
 &= 323.628/\text{cm}^2 = 3.236\text{MPa} < v_a = 120\text{MPa} \quad \therefore \text{O.K}
 \end{aligned}$$

· 휨응력검토

$$\begin{aligned}
 - f_b &= M_A / Z_{X(U)} \\
 &= 91157.224 / (25.545/4.690) \\
 &= 16738.381\text{N}/\text{cm}^2 = 167.383\text{MPa} < f_{ba} = 210\text{MPa} \quad \therefore \text{O.K}
 \end{aligned}$$

· 합성응력검토

$$\begin{aligned}
 \left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 &\leq 1.2 \\
 \left(\frac{167.383}{210} \right)^2 + \left(\frac{3.236}{120} \right)^2 &\leq 1.2 \\
 = 0.636 &\leq 1.2 \quad \therefore \text{O.K}
 \end{aligned}$$

7.2 SUB BRACKET 연결재

1) 단면력

◎모멘트도



◎전단력도



$$\therefore V_A = 2543.765\text{N}$$

$$\therefore M_A = 96474.766\text{N} \cdot \text{cm}$$

3) 단면제원

Section Data

DB/User

Section ID: 8

Name: SUB-브라켓

Section: H-Section

DB Name: KS

Sect. Name:

☒ Built-Up Section

Get Data from Single Angle

DB Name: KS

Sect. Name:

H	15	cm
B1	7.5	cm
tw	0.5	cm
tf1	0.5	cm
B2	7.5	cm
tf2	0.7	cm
r1	0	cm
r2	0	cm

☒ Consider Shear Deformation.

Offset: Center-Center

Change Offset ...

Show Calculation Results... OK Cancel Apply

Section Properties

	Value	Unit
Area	1.590000e+001	cm ²
Asy	7.500000e+000	cm ²
Asz	7.500000e+000	cm ²
Ixx	1.770000e+000	cm ⁴
Iyy	5.694981e+002	cm ⁴
Izz	4.233125e+001	cm ⁴
Cyp	3.750000e+000	cm
Cym	3.750000e+000	cm
Czp	8.107547e+000	cm
Czm	6.892453e+000	cm
Qyb	8.786899e+001	cm ²
Qzb	7.031250e+000	cm ²
Peri:O	5.760000e+001	cm
Peri:I	0.000000e+000	cm
Center:y	3.750000e+000	cm
Center:z	6.892453e+000	cm
y1	-3.750000e+000	cm
z1	8.107547e+000	cm
y2	3.750000e+000	cm
z2	8.107547e+000	cm
y3	3.750000e+000	cm
z3	-6.892453e+000	cm
y4	-3.750000e+000	cm
z4	-6.892453e+000	cm

Close

4) 응력검토

· 전단응력검토

$$\begin{aligned} - v &= V_A / A_{WEB} \\ &= 2543.765 / 7.500 \\ &= 339.168 \text{N/cm}^2 = 3.391 \text{MPa} < v_a = 120 \text{MPa} \quad \therefore \text{O.K} \end{aligned}$$

· 휨응력검토

$$\begin{aligned} - f_b &= M_A / Z_{X(U)} \\ &= 96474.766 / 70.247 \\ &= 1373.364 \text{N/cm}^2 = 13.733 \text{MPa} < f_{ba} = 210 \text{MPa} \quad \therefore \text{O.K} \end{aligned}$$

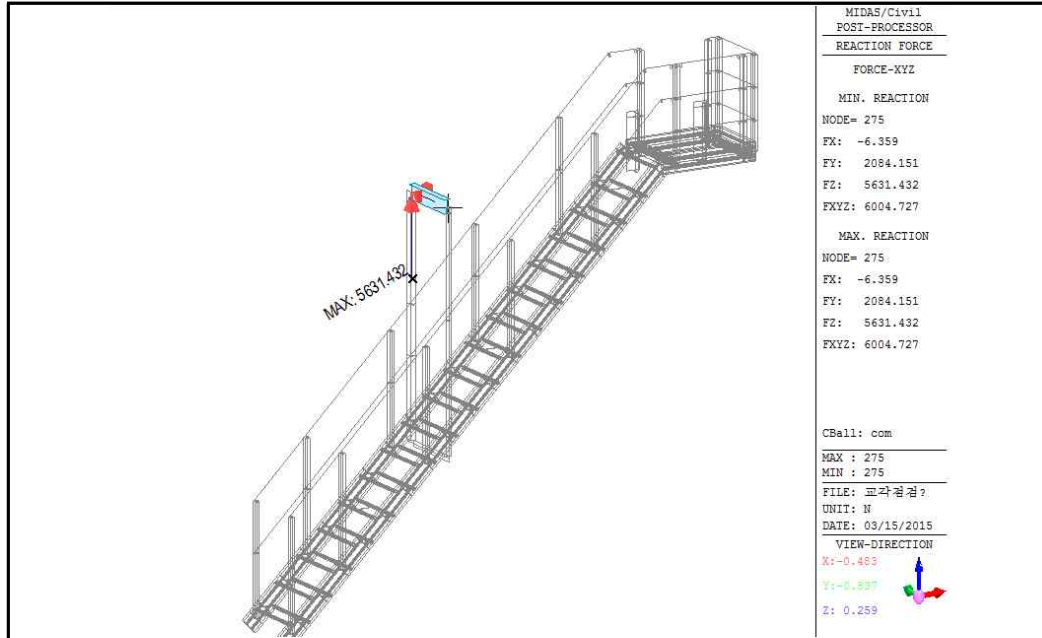
· 합성응력검토

$$\begin{aligned} \left(\frac{f_b}{f_{ba}} \right)^2 + \left(\frac{v}{v_a} \right)^2 &\leq 1.2 \\ \left(\frac{13.733}{210} \right)^2 + \left(\frac{3.391}{120} \right)^2 &\leq 1.2 \\ &= 0.005 \leq 1.2 \quad \therefore \text{O.K} \end{aligned}$$

7.3 Anchor Bar

1) 앵커의 작용하중

◎반력도



$$\therefore N_{ua} = 1.7 \times 5631.431 \text{ N} / 2ea = 4786.716 \text{ N} \text{ (앵커1개에 작용하는 인장력)}$$

$$\therefore V_{ua} = 1.7 \times 2084.151 \text{ N} / 2ea = 1771.528 \text{ N} \text{ (앵커1개에 작용하는 전단력)}$$

2) 앵커의 재료평가 - 탄소강 제작된 것으로 앵커품질에 대한 부록참조

$$\therefore f_{uta} = 795 \text{ MPa} - \text{설계기준 인장강도 (KSB 0241방법적용, 시험성적서 참조)}$$

$$\therefore f_{ya} = 616 \text{ MPa} - \text{설계기준 항복강도 (KSB 0241방법적용, 시험성적서 참조)}$$

콘크리트용 앵커 설계기준은 단면적 감소 30% 이상, 연신율 14% 이상을 연성강재요소의 요건으로 정의하고 있고 주어진 앵커재료는 연성강재이다.

3) 인장하중 하에서 강재강도

$$\phi N_{sa} \geq N_{ua}$$

$$N_{sa} = n A_{se} f_{uta}$$

$$\phi n A_{se} f_{uta} \geq N_{ua} = 4786.716 \text{ N}$$

연성강재요소의 인장파괴에 지배되는 경우 강도감소계수 $\phi=0.75$ 이고 단일앵커이므로 $n = 1$ 이다.

$$\phi N_{sa} = 0.75 \times 1 \times 84.4 \times 795 = 50323.500 \text{ N} > 4786.716 \text{ N} \quad \therefore \text{O.K}$$

강재의 직경 12mm 앵커의 강재강도는 인장하중에 적합함

4) 최소연단거리 - 콘크리트 구조설계기준(2007) 5.4절

∴ 철근의 최소피복두께 이상 : 100 mm 이상

∴ ACI 355.2 에 의한 제품시험에서 최소 모서리 거리 : 65 mm 이상

∴ 최대 골재크기의 2배이상 : $2 \times 25 = 50$ mm 이상

$$c_{a,min} = 150mm \text{ 적용} \quad \therefore \text{O.K}$$

5) 인장하중 하에서 콘크리트 파괴강도

$$\phi N_{cb} \geq N_{ua}$$

∴ “앵커가 범주2 (즉, 중간설치 민감도와 중간신뢰도), 콘크리트조개짐을 제어하기위한 별도의 보조철근이 없는 것으로 가정” 이때 강도감소계수 $\phi=0.55$ 로 적용

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$$

$$N_b = k_c \sqrt{f_{ck}} h_{ef}^{1.5}$$

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} k_c \sqrt{f_{ck}} h_{ef}^{1.5} \geq N_{ua} = 4786.716 \text{ N}$$

$$k_c = k_{cr} = 7$$

$$\psi_{ed,N} = 0.7 + 0.3 \frac{c_{a,min}}{1.5h_{ef}}, c_{a,min} < 1.5h_{ef} \text{ 이므로}$$

$$\psi_{ed,N} = 0.7 + 0.3 \frac{150}{1.5(80)} = 1.075$$

$$\psi_{c,N} = 1.0 \text{ 사용하중하에서 콘크리트 균열이 발생하는 경우 } (f_t > f_t)$$

$$\psi_{cp,N} = 1.0 \text{ 사용하중하에서 콘크리트 균열이 발생하는 경우 } (f_t > f_t)$$

$$A_{Nco} = 9h_{ef}^2 = 9 \times (80)^2 = 57600 \text{ mm}^2$$

$$A_{Nc} = (c_{a1} + 1.5h_{ef}) (2 \times 1.5h_{ef}) = (150 + 1.5 \times 80)(2 \times 1.5 \times 80) = 64800 \text{ mm}^2$$

$$\frac{A_{Nc}}{A_{Nco}} = \frac{64800}{57600} = 1.125$$

$$\therefore N_{cb} = 1.075 \times 1.125 \times 1.0 \times 1.0 \times 7 \times \sqrt{24} \times (80)^{1.5} = 29675.608 \text{ N}$$

$$\therefore \phi N_{cb} = 0.55 \times 29675.608 = 16321.584 \text{ N} > 4786.716 \text{ N} \quad \therefore \text{O.K}$$

6) 앵커뿔힘강도

$$\phi N_{pn} > N_{ua}$$

$$N_{pn} = \psi_{c,p} N_p$$

∴ “앵커가 범주2 (즉, 중간설치 민감도와 중간신뢰도), 콘크리트조개짐을 제어하기위한 별도의 보조철근이 없는 것으로 가정” 이때 강도감소계수 $\phi=0.55$ 로 적용

또한 $N_p = N_{p,cr} = 13.930\text{kN}$ 로 한다.(콘크리트 구조기준해설(2012)- 부록 II.26 참조

“II.26 - 콘크리트용 앵커 설계법 및 예제집 P 141 참조) 매입깊이가 80mm 로 매입깊이가 65mm 와 90mm의 중간값으로 적용함

$$\psi_{c,p} = 1$$

$\phi N_{pn} =$ 사용하중하에서 콘크리트 균열이 발생하는 경우 ($f_t > f_t$)

$$\phi N_{pn} = 0.55 \times 13930 = 7661.500 \text{ N} > 4786.716 \text{ N}$$

6) 인장하중 하에서 모든 파괴 형태 확인

인장에 대한 파괴 형태별 설계강도 요약

구 분	계산결과	비고
앵커강재 파괴	50323.500 N	
콘크리트 파괴	16321.584 N	
앵 커 뿔 힘	7661.500 N	지배강도

7) 전단하중 하에서 강재강도

$$\phi V_{sa} \geq V_{ua}$$

$$V_{sa} = n \times 0.6 \times A_{se} f_{uta}$$

$$\phi n \times 0.6 \times A_{se} f_{uta} \geq V_{ua} = 1771.528 \text{ N}$$

연성강재요소의 강도에 지배되는 경우 강도감소계수 $\phi=0.65$ 이고 단일앵커이므로 $n = 1$ 이다.

$$\phi V_{sa} = 0.65 \times 0.6 \times 84.4 \times 795 = 26168.220 \text{ N} > 1771.528 \text{ N} \quad \therefore \text{O.K}$$

강재의 직경 12mm 앵커의 강재강도는 전단하중에 적합함

8) 전단하중 하에서 콘크리트 파괴강도

$$\phi V_{cb} \geq V_{ua}$$

∴ “전단하중에 대하여 콘크리트파괴가 지배적인 경우 강도감소계수 $\phi=0.70$ 로 적용
(조건 B 보조철근이 없는 것으로 가정)

$$V_{cb} = \frac{A_{Vc}}{A_{Vco}} \psi_{ed, V} \psi_{c, V} V_b$$

$$V_b = 0.6 \left[\frac{l_e}{d_0} \right]^{0.2} \sqrt{d_0} \sqrt{f_{ck}} (c_{a1})^{1.5} \geq V_{ua}$$

$$\phi V_{cb} = \phi \frac{A_{Vc}}{A_{Vco}} \psi_{ed, V} \psi_{c, V} 0.6 \left[\frac{l_e}{d_0} \right]^{0.2} \sqrt{d_0} \sqrt{f_{ck}} (c_{a1})^{1.5} \geq V_{ua} = 1771.528 \text{ N}$$

$$\frac{A_{Vc}}{A_{Vco}} = 1 \text{ 그리고 } c_{a1} = 150\text{mm (연단거리)}$$

c_{a2} 는 c_{a1} 에 수직인 방향으로 앵커중심으로부터 콘크리트 가장자리까지 거리

$c_{a2} = 625\text{mm}$ 이므로 거리가 $1.5 h_{ef} = 1.5 \times 80 = 120\text{mm}$ 이상이다.

$\psi_{ed, V} = 1.0$ $c_{a2} > 1.5c_{a1}$ 인 경우

$\psi_{c, V} = 1.0$ 사용하중하에서 콘크리트 균열이 발생하는 경우 ($f_t > f_t$)

$$d_0 = 12\text{mm}$$

$$l_e = h_{ef} = 80 \text{ mm 그러나 } l_e \leq 8d_0 ; 8d_0 = 8 \times 12 = 96\text{mm}$$

$$l_e = 80 \text{ mm 적용}$$

$$\phi V_{cb} = 0.7 \times 1.0 \times 1.0 \times 1.0 \times 0.6 \times \left(\frac{80}{12} \right)^{0.2} \times \sqrt{12} \times \sqrt{24} \times (150)^{1.5} = 19136.573 \text{ N}$$

$$\therefore \phi V_{cb} \geq V_{ua} = 19136.573 \text{ N} > 1771.528 \text{ N} \quad \therefore \text{O.K}$$

9) 콘크리트 프라이아웃강도

$$\phi V_{CP} > V_{ua}$$

$$V_{cp} = k_{cp} N_{cb}$$

∴ “전단하중에 대하여 콘크리트파괴가 지배적인 경우 강도감소계수 $\phi=0.70$ 로 적용
(조건 B 보조철근이 없는 것으로 가정)

또한 $k_{cp} = 2.0$, $h_{ef} = 80\text{mm} > 65\text{mm}$ 인 경우 $N_{cb} = 29675.608 \text{ N}$ (인장하중검토참조)

$$\Phi V_{cp} = 0.7 \times 2.0 \times 29675.608 = 41545.851 \text{ N} > 1771.528 \text{ N}$$

10) 전단 하중 하에서 모든 파괴 형태 확인

인장에 대한 파괴 형태별 설계강도 요약

구 분	계산결과	비고
앵커강재 파괴	26168.220 N	
콘크리트 파괴	19136.573 N	지배강도
콘크리트 프라이아웃	41545.851 N	

11) 인장 - 전단 상관 작용 검토

- $V_{ua} \leq 0.2 \Phi V_n$ 인 경우 앵커는 인장강도로 지배
- $N_{ua} \leq 0.2 \Phi N_n$ 인 경우 앵커는 전단강도로 지배

$V_{ua} \leq 0.2 \Phi V_n$ 인 경우, 전체 인장강도를 사용할 수 있음 : $\Phi N_n \geq N_{ua}$

$$0.2 \Phi V_n = 0.2 \times 19136.573 \text{ N} = 3827.314 \text{ N} > 1771.528 \text{ N} \quad \therefore \text{조건에 만족}$$

$N_{ua} \leq 0.2 \Phi N_n$ 인 경우, 전체 전단강도를 사용할 수 있음 : $\Phi V_n \geq V_{ua}$

$$0.2 \Phi N_n = 0.2 \times 7661.500 \text{ N} = 1532.300 \text{ N} < 4786.716 \text{ N} \quad \therefore \text{조건에 미흡}$$

$V_{ua} \leq 0.2 \Phi V_n$ 이고 $N_{ua} \geq 0.2 \Phi N_n$ 이므로 인장과 전단 상관 작용을 검토 하여야 한다.

$$\frac{N_{ua}}{\Phi N_n} + \frac{V_{ua}}{\Phi V_n} \leq 1.2$$

$$\frac{4786.716}{7661.500} + \frac{1771.528}{19136.573} = 0.717 \leq 1.2 \quad \therefore \text{O.K}$$

§5. 결 론

상기 검토내용과 같이 교량측면 계단참 및 계단의 각 부재별 응력 및 작용하중은 허용치를 초과하지 않으며 소요안전도를 충분히 확보하고 있고 응력도 허용값 이내로 충분히 안전한 것으로 판단된다.

검토자 : 토목구조기술사 김 달 성



§6. 부 록

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: MIDAS/Civil Text(MCT) File.
: Date : 2015/3/15
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*VERSION
8.1.5
*UNIT : Unit System
: FORCE, LENGTH, HEAT, TEMPER
N, CM, KCAL, C
*PROJINFO : Project Information

*STRUCTYPE : Structure Type
: iSTYP, iMASS, iSMAS, bMASSOFFSET, bSELFWEIGHT, GRAV, TEMPER, bALIGNBEAM, bALIGNSLAB, bROTGRIGID
0, 1, 1, NO, NO, 980.6, 0, NO, NO, NO
*REBAR-MATL-CODE : Rebar Material Code
: CONC_CODE, CONC_MDB, SRC_CODE, SRC_MDB
KS01-Civil(RC), SD300, KS01-Civil(RC), SD300
*NODE : Nodes
: iNO, X, Y, Z
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144, 469.982093502075, 0, 516.774878952102
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299, 118.524878950248, 36.5, 118.524878950244

*ELEMENT ; Elements
; IEL, TYPE, IMAT, IPRO, IN1, IN2, ANGLE, ISUB, EXVAL, IOPT(EXVAL2) ; Frame Element
; IEL, TYPE, IMAT, IPRO, IN1, IN2, ANGLE, ISUB, EXVAL, EXVAL2, bLMT ; Comp/Tens Truss
; IEL, TYPE, IMAT, IPRO, IN1, IN2, IN3, IN4, ISUB, IVID ; Planar Element
; IEL, TYPE, IMAT, IPRO, IN1, IN2, IN3, IN4, IN5, IN6, IN7, IN8 ; Solid Element
; IEL, TYPE, IMAT, IPRO, IN1, IN2, REF, RPX, RPY, RPZ, ISUB, EXVAL ; Frame(Ref. Point)

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2, BEAM, 1, 12, 130, 131, 180
3, BEAM, 1, 12, 132, 133, 180
4, BEAM, 1, 12, 134, 135, 180
5, BEAM, 1, 12, 136, 137, 180
6, BEAM, 1, 12, 138, 2, 180
10, BEAM, 1, 2, 144, 143, 0
12, BEAM, 1, 2, 147, 146, 0
13, BEAM, 1, 1, 148, 149, 0
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32, BEAM, 1, 3, 169, 170, 180
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38, BEAM, 1, 3, 134, 172, 180
39, BEAM, 1, 3, 136, 173, 180
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46, BEAM, 1, 3, 178, 177, 180
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106, BEAM, 1, 12, 201, 199, 180
107, BEAM, 1, 12, 199, 130, 180
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113, BEAM, 1, 12, 194, 132, 180
117, BEAM, 1, 12, 133, 191, 180
118, BEAM, 1, 12, 191, 209, 180
119, BEAM, 1, 12, 209, 134, 180
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141, BEAM, 1, 1, 163, 162, 0
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164, BEAM, 1, 11, 229, 134, 0
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167, BEAM, 1, 11, 232, 137, 0
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197, BEAM, 1, 2, 168, 262, 0

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210.	BEAM	2,	8,	181,	275,	0
211.	BEAM	1,	11,	276,	183,	0
212.	BEAM	1,	11,	277,	186,	0
213.	BEAM	1,	11,	278,	299,	0
214.	BEAM	1,	11,	279,	191,	0
215.	BEAM	1,	11,	280,	194,	0
216.	BEAM	1,	11,	281,	196,	0
217.	BEAM	1,	11,	282,	199,	0
218.	BEAM	1,	11,	283,	297,	0
219.	BEAM	1,	11,	284,	209,	0
220.	BEAM	2,	6,	212,	285,	0
224.	BEAM	1,	12,	223,	224,	180
225.	BEAM	1,	12,	225,	226,	180
226.	BEAM	1,	12,	227,	228,	180
227.	BEAM	1,	12,	229,	230,	180
228.	BEAM	1,	12,	231,	232,	180
229.	BEAM	1,	12,	233,	222,	180
232.	BEAM	1,	2,	242,	241,	0
233.	BEAM	1,	1,	243,	244,	0
236.	BEAM	1,	3,	225,	253,	180
237.	BEAM	1,	2,	253,	242,	0
238.	BEAM	1,	1,	254,	243,	0
239.	BEAM	1,	1,	255,	254,	0
240.	BEAM	1,	1,	256,	255,	0
241.	BEAM	1,	1,	258,	257,	0
242.	BEAM	1,	1,	259,	258,	0
244.	BEAM	1,	3,	261,	262,	180
245.	BEAM	1,	3,	262,	263,	180
246.	BEAM	1,	3,	263,	264,	180
249.	BEAM	1,	3,	227,	265,	180
250.	BEAM	1,	3,	229,	266,	180
251.	BEAM	1,	3,	231,	267,	180
252.	BEAM	1,	2,	268,	262,	0
254.	BEAM	1,	3,	240,	245,	180
255.	BEAM	1,	3,	272,	271,	180
256.	BEAM	1,	3,	237,	248,	180
257.	BEAM	1,	3,	273,	268,	180
258.	BEAM	1,	12,	261,	252,	180
259.	BEAM	1,	3,	233,	274,	180
260.	BEAM	1,	3,	274,	259,	180
261.	BEAM	2,	6,	275,	256,	90
262.	BEAM	1,	12,	224,	283,	180
263.	BEAM	1,	12,	283,	282,	180
264.	BEAM	1,	12,	282,	225,	180
265.	BEAM	1,	12,	226,	281,	180
266.	BEAM	1,	12,	281,	280,	180
267.	BEAM	1,	12,	280,	227,	180
268.	BEAM	1,	12,	228,	279,	180
269.	BEAM	1,	12,	279,	284,	180
270.	BEAM	1,	12,	284,	229,	180
271.	BEAM	2,	6,	284,	285,	90
272.	BEAM	1,	12,	230,	278,	180
273.	BEAM	1,	12,	278,	277,	180
274.	BEAM	1,	12,	277,	231,	180
275.	BEAM	1,	12,	232,	276,	180
276.	BEAM	1,	12,	276,	233,	180
277.	BEAM	1,	3,	268,	237,	180
278.	BEAM	1,	3,	271,	240,	180
279.	BEAM	1,	12,	252,	273,	180
280.	BEAM	1,	3,	253,	254,	180
281.	BEAM	1,	2,	265,	253,	0
282.	BEAM	1,	1,	257,	256,	0
283.	BEAM	2,	6,	256,	286,	90
284.	BEAM	1,	3,	265,	255,	180
285.	BEAM	1,	2,	286,	265,	0
286.	BEAM	1,	3,	266,	257,	180
287.	BEAM	1,	2,	267,	266,	0
288.	BEAM	1,	3,	267,	258,	180
289.	BEAM	1,	2,	274,	267,	0
291.	BEAM	1,	12,	272,	223,	180
293.	BEAM	1,	12,	273,	272,	180
294.	BEAM	2,	6,	286,	284,	90
295.	BEAM	1,	2,	266,	286,	0
296.	BEAM	1,	1,	244,	245,	0
299.	BEAM	1,	1,	248,	264,	0
300.	BEAM	1,	2,	241,	240,	0
303.	BEAM	1,	1,	149,	150,	0
304.	BEAM	1,	1,	150,	151,	0
305.	BEAM	1,	2,	237,	263,	0
306.	BEAM	1,	2,	143,	142,	0
307.	BEAM	1,	2,	142,	169,	0
308.	BEAM	1,	2,	175,	174,	0
310.	BEAM	1,	2,	177,	176,	0
311.	BEAM	1,	2,	146,	145,	0
312.	BEAM	1,	2,	145,	144,	0
313.	BEAM	1,	1,	152,	153,	0
314.	BEAM	1,	1,	153,	170,	0
315.	BEAM	1,	13,	272,	289,	0
316.	BEAM	1,	13,	273,	290,	0
319.	BEAM	1,	10,	291,	289,	90
320.	BEAM	1,	10,	292,	290,	90
321.	BEAM	1,	10,	295,	293,	90
322.	BEAM	1,	10,	296,	294,	90
323.	BEAM	1,	10,	289,	295,	90
324.	BEAM	1,	10,	290,	296,	90
325.	PLATE	1,	1,	273,	272,	179, 1
326.	PLATE	1,	1,	261,	252,	158, 1
327.	PLATE	1,	1,	252,	273,	179, 1
328.	PLATE	1,	1,	272,	223,	128, 1
329.	BEAM	1,	11,	297,	201,	0
330.	BEAM	1,	11,	298,	132,	0
331.	BEAM	1,	11,	299,	188,	0

*GROUP : Group
; NAME, NODE_LIST, ELEM_LIST, PLANE_TYPE
= -channel, , , 0
HR-POST , , , 0
AL-PIPE(φ43.2), , , 0
AL-PIPE(φ31.8), , , 0
STS-ANGLE , , , 0
브라켓하부 , , , 0
브라켓-POST, , , 0
발판 , , , 0

```

AL-ANGLE . . . 0
하단발판 . . . 0
0 . . . 1to6 10 12 13 16 22to28 30to32 37to40 42 45 46 51 52 56to59 \
105to107 111to113 117to119 122to125 129 130 134 136 138to148 151 \
154to156, 0
04-RM . . . 0
DIM . . . 0
box-L2 . . . 0
*MATERIAL : Material
: IMAT, TYPE, MNAME, SPHEAT, HEATCO, PLAST, TUNIT, bMASS, DAMPRATIO, [DATA1] : STEEL, CONC, USER
: IMAT, TYPE, MNAME, SPHEAT, HEATCO, PLAST, TUNIT, bMASS, DAMPRATIO, [DATA2], [DATA2] : SRC
: [DATA1] : 1, DB, NAME, CODE
: [DATA1] : 2, ELAST, POISN, THERMAL, DEN, MASS
: [DATA1] : 3, Ex, Ey, Ez, Tx, Ty, Tz, Sxy, Sxz, Syz, Pxy, Pxz, Pyz, DEN, MASS : Orthotropic
: [DATA2] : 1, DB, NAME, CODE or 2, ELAST, POISN, THERMAL, DEN, MASS
1, USER, A6063S-T5, 0, 0, 0, C, YES, 0, 2, 7.0000e+006, 0.3, 1.2000e-005, 0.02256, 2.3e-005
2, USER, STS, 0, 0, 0, C, YES, 0, 2, 1.9700e+007, 0.3, 1.2000e-005, 0.0793, 8.08e-005
*MATL-COLOR
: IMAT, W_R, W_G, W_B, HF_R, HF_G, HF_B, HE_R, HE_G, HE_B, bBLEND, FACT
1, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
2, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
*SECT-PSCVALUE : PSC Value, General Section, Composite PC, Composite General
: SECT=ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, bBU, bEQ : 1st line
: [STIFF1] : 2nd line
: [STIFF2] : 3rd line
: [STIFF3] : 4th line
: T1, T2, BT, HT : 5th line(PSC)
: bSHEARCHK, [SCHK], [WT] : 6th line(PSC)
: SW, GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc : 7th line(COMPOSITE-PC)
: OPOLY=X1, Y1, X2, Y2, ..., Xn, Yn : Outer Polygon(PLANE)
: IPOLY=X1, Y1, X2, Y2, ..., Xn, Yn : Inner Polygon(PLANE)
...
: IPOLY=X1, Y1, X2, Y2, ..., Xn, Yn : Inner Polygon(PLANE)
: VERTEX=X1, Y1, X2, Y2, ..., Xn, Yn : Vertex(General-LINE)
: LINE=V11, VJ1, dTHIK1, iALIGN1 : Line(General-LINE)
...
: LINE=V1n, VJn, dTHIKn, iALIGNn : Line(General-LINE)
: LOOP=COUNT1, LIX11, LIX12, ..., LIXn : Line(General-LINE)
...
: LOOP=COUNTn, LIXn1, LIXn2, ..., LIXnn : Line(General-LINE)
: SECT=ISEC, TYPE, SNAME, [OFFSET2], bSD, SHAPE, iyVAR, izVAR, bEQ : 1st line - TAPERED
: [STIFF1-I] : 2nd line
: [STIFF2-I] : 3rd line
: [STIFF3-I] : 4th line
: [STIFF1-J] : 5th line
: [STIFF2-J] : 6th line
: [STIFF3-J] : 7th line
: T1-I, T2-I, BT-I, HT-I, T1-J, T2-J, BT-J, HT-J : 8th line(PSC)
: bSHEARCHK, [SCHK-I], [WT-I], [SCHK-J], [WT-J] : 9th line(PSC)
: OPOLY=bl, X1, Y1, X2, Y2, ..., Xn, Yn : Outer Polygon(PLANE)
: IPOLY=bl, X1, Y1, X2, Y2, ..., Xn, Yn : Inner Polygon(PLANE)
...
: IPOLY=bl, X1, Y1, X2, Y2, ..., Xn, Yn : Inner Polygon(PLANE)
: VERTEX=bl, X1, Y1, X2, Y2, ..., Xn, Yn : Vertex(General-LINE)
: LINE=bl, V11, VJ1, dTHIK1, iALIGN1 : Line(General-LINE)
...
: LINE=bl, V1n, VJn, dTHIKn, iALIGNn : Line(General-LINE)
: LOOP=bl, COUNT1, LIX11, LIX12, ..., LIXn : Line(General-LINE)
...
: LOOP=bl, COUNTn, LIXn1, LIXn2, ..., LIXnn : Line(General-LINE)
: SECT=ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, bBU, bEQ, BPRT : 1st line - COMPOSITE-GEN
: [PART1] : 2nd line
: [PART2] : 3rd line
...
: SECT=ISEC, TYPE, SNAME, [OFFSET2], bSD, SHAPE, iyVAR, izVAR, bEQ, PARTNUM : 1st line - COMPOSITE-GEN(TAPERED)
: [PART1-I] : 2nd line
: [PART2-I] : next lines
...
: [PART1-J] : next lines
: [PART2-J] : next lines
...
: [OFFSET] : OFFSET, iCENT, iREF, iHORZ, HUSER, iVERT, VUSER
: [OFFSET2] : OFFSET, iCENT, iREF, iHORZ, HUSER1, HUSERJ, iVERT, VUSER1, VUSERJ
: [STIFF1] : AREA, ASy, ASz, lxx, lyy, lzz
: [STIFF2] : Cyp, Cym, Czp, Czm, Qyb, Qzb, PERLOUT, PERLIN, Cy, Cz
: [STIFF3] : Y1, Y2, Y3, Y4, Z1, Z2, Z3, Z4
: [SCHK] : Z1, Z3, bAUTO_QY1, QY1, bAUTO_QY2, QY2, bAUTO_QY3, QY3
: [WT] : TOR, bAUTO_SHR1, SHR1, bAUTO_SHR2, SHR2, bAUTO_SHR3, SHR3
: [PART] : PART=part_num
: [STIFF1]
: [STIFF2]
: [STIFF3]
: [STIFF1] : [STIFF1] of Part Sum.
: [STIFF2] : [STIFF2] of Part Sum.
: [STIFF3] : [STIFF3] of Part Sum.
: OPOLY=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn : Outer Polygon(PLANE)
: IPOLY=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn : Inner Polygon(PLANE)
...
: IPOLY=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn : Inner Polygon(PLANE)
: VERTEX=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn : Vertex(General-LINE)
: LINE=(bl-Tapered), V11, VJ1, dTHIK1, iALIGN1 : Line(General-LINE)
...
: LINE=(bl-Tapered), V1n, VJn, dTHIKn, iALIGNn : Line(General-LINE)
: LOOP=(bl-Tapered), COUNT1, LIX11, LIX12, ..., LIXn : Line(General-LINE)
...
: LOOP=(bl-Tapered), COUNTn, LIXn1, LIXn2, ..., LIXnn : Line(General-LINE)
: SECT= 11, VALUE, 계단발판, CC, 0, 0, 0, 0, 0, YES, GEN, YES, YES
9.70748, 5.66747, 0.735068, 6.86167, 6.94649, 740.188
12.5, 12.5, 0.694681, 1.80532, 2.23552, 153.372, 60.8025, 16.5235, 12.5, 1.80532
-12.131, 12.3503, 12.131, -12.3503, 0.470451, 0.584944, -1.58109, -1.69557
OPOLY=-12.5, -0.320219, -12.5, -1.33881, -12.4902, -1.43747, -12.4611, -1.53226
-12.4138, -1.61943, -12.3503, -1.69557, -12.1936, -1.67422
-12.1932, -1.52745, -12.27, -1.35449, -12, -1.06881
-11.73, -1.33881, -11.7783, -1.49297, -11.6152, -1.80532
-9.50001, -1.80532, -9.50001, 0.244681, -9.30001, 0.444681
9.29999, 0.444681, 9.49999, 0.244681, 9.49999, -1.80532
11.4851, -1.80532, 11.5784, -1.70189, 11.6887, -1.78736
11.8276, -1.75012, 11.8804, -1.621, 12.0132, -1.66361
12.131, -1.58109, 12.1364, -1.44171, 12.2758, -1.43633
12.3583, -1.31849, 12.3157, -1.18567, 12.4448, -1.13295
12.482, -0.993989, 12.3966, -0.883759, 12.5, -0.790419
12.5, 0.228181, 12.4902, 0.326844, 12.4611, 0.421627
12.4138, 0.508803, 12.3503, 0.584944, 12.1936, 0.563591
12.1932, 0.416811, 12.27, 0.243851, 12, -0.0418191
11.73, 0.228181, 11.7783, 0.382331, 11.6152, 0.694681
-11.4851, 0.694681, -11.5784, 0.591261, -11.6887, 0.676721

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-11.8276, 0.639491, -11.8804, 0.510361, -12.0132, 0.552971
-12.131, 0.470451, -12.1364, 0.331081, -12.2758, 0.325701
-12.3583, 0.207851, -12.3157, 0.0750409, -12.4448, 0.0223109
-12.482, -0.116649, -12.3966, -0.226879
IPOLY=-12.25, -0.305319, -12.2386, -0.175083, -12.2048, -0.048804
-12.1495, 0.0696809, -12.0745, 0.176772, -11.9821, 0.269214
-11.875, 0.3442, -11.7565, 0.39945, -11.6302, 0.433287
-11.5, 0.444681, -9.85001, 0.444681, -9.75001, 0.344681
-9.75001, -1.55532, -11.4114, -1.55532, -11.5095, -1.4359
-11.6567, -0.975279, -12.125, -0.854689, -12.25, -0.757859
IPOLY=-9.74999, 0.344681, 9.84999, 0.444681, 11.4114, 0.444681, 11.5095, 0.325261
11.6567, -0.135349, 12.125, -0.255949, 12.25, -0.352769
12.25, -0.805319, 12.2386, -0.935555, 12.2048, -1.06183
12.1495, -1.18032, 12.0745, -1.28741, 11.9821, -1.37985
11.875, -1.45484, 11.7565, -1.51009, 11.6302, -1.54392
11.5, -1.55532, 9.74999, -1.55532
SECT= 12, VALUE , 계단측면 , CC, 0, 0, 0, 0, 0, YES, GEN, YES, YES
16.38, 1.63204, 7.75148, 86.3376, 632.213, 42.8699
2, 2, 10, 10, 10.8979, 15.7706, 62, 59.6, 2, 10
-2, 2, 2, -2, 10, 10, -10, -10
OPOLY=-2, 10, -2, 3.525, -1.7, 3.525, -1.7, 3.875, -0.95, 3.875, -0.95, 2.125
-1.7, 2.125, -1.7, 2.475, -2, 2.475, -2, -4.975, -1.7, -4.975
-1.7, -4.625, -0.95, -4.625, -0.95, -6.375, -1.7, -6.375
-1.7, -6.025, -2, -6.025, -2, -10, 2, -10, 2, -3.525, 1.7, -3.525
1.7, -3.875, 0.95, -3.875, 0.95, -2.125, 1.7, -2.125, 1.7, -2.475
2, -2.475, 2, 4.975, 1.7, 4.975, 1.7, 4.625, 0.95, 4.625
0.95, 6.375, 1.7, 6.375, 1.7, 6.025, 2, 6.025, 2, 10
IPOLY=-1.7, -0.1, 1.7, -0.1, 1.7, -1.925, 0.75, -1.925, 0.75, -4.075, 1.7, -4.075
1.7, -9.7, -1.7, -9.7, -1.7, -6.575, -0.75, -6.575, -0.75, -4.425
-1.7, -4.425
IPOLY=-1.7, 9.7, 1.7, 9.7, 1.7, 6.575, 0.75, 6.575, 0.75, 4.425, 1.7, 4.425, 1.7, 0.1
-1.7, 0.1, -1.7, 1.925, -0.75, 1.925, -0.75, 4.075, -1.7, 4.075
SECT= 13, VALUE , 발판-1 , CC, 0, 0, 0, 0, 0, YES, GEN, YES, YES
13.9943, 4.0037, 7.1979, 36.4584, 61.8553, 77.8026
5, 5, 2.39444, 4.10556, 8.82775, 26.2277, 39.9019, 33.001, 5, 4.10556
-5, 5, 1.35, -1.35, 2.39444, 2.39444, -4.10556, -4.10556
OPOLY=-5, 2.39444, -5, 1.39444, -1.35, -4.10556, -0.5, -4.10556, -0.5, 1.39444
0.5, 1.39444, 0.5, -4.10556, 1.35, -4.10556, 5, 1.39444
5, 2.39444, 0.5, 2.39444, 0.5, 1.89444, -0.5, 1.89444
-0.5, 2.39444
IPOLY=-4.8, 1.89444, -1, 1.89444, -1, -3.76552, -1.33563, -3.76552, -4.8, 1.45477
IPOLY=1, 1.89444, 4.8, 1.89444, 4.8, 1.45477, 1.33563, -3.76552, 1, -3.76552
SECT= 14, VALUE , 발판지지 , CC, 0, 0, 0, 0, 0, YES, GEN, YES, YES
29.4943, 6.85781, 18.5621, 81.7551, 669.244, 79.0943
5, 5, 5.73445, 10.7656, 23.5753, 0.940709, 48.9019, 33.001, 5, 10.7656
-5, 5, 0.5, -0.5, 5.73445, 5.73445, -10.7656, -10.7656
OPOLY=-5, 5.73445, -5, 4.73445, -1.35, -0.765555, -0.5, -0.765555, -0.5, -10.7656
0.5, -10.7656, 0.5, -0.765555, 1.35, -0.765555, 5, 4.73445
5, 5.73445, 0.5, 5.73445, 0.5, 5.23445, -0.5, 5.23445
-0.5, 5.73445
IPOLY=-4.8, 5.23445, -1, 5.23445, -1, -0.425515, -1.33563, -0.425515, -4.8, 4.79478
IPOLY=1, 5.23445, 4.8, 5.23445, 4.8, 4.79478, 1.33563, -0.425515, 1, -0.425515
*SECTION : Section
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, [DATA1], [DATA2] : 1st line - DB/USER
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, BLT, D1, ..., D8, iCEL : 1st line - VALUE
: AREA, ASy, ASz, lxx, lyy, lzz : 2nd line
: CyP, CyM, CzP, CzM, QyB, QzB, PERI_OUT, PERI_LIN, Cy, Cz : 3rd line
: Y1, Y2, Y3, Y4, Z1, Z2, Z3, Z4, Zyy, Zzz : 4th line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, ELAST, DEN, POIS, POIC, SF : 1st line - SRC
: D1, D2, [SRC] : 2nd line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, 1, DB, NAME1, NAME2, D1, D2 : 1st line - COMBINED
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, 2, D11, D12, D13, D14, D15, D21, D22, D23, D24 : 2nd line
: ISEC, TYPE, SNAME, [OFFSET2], bSD, SHAPE, lyVAR, izVAR, STYPE : 1st line - TAPERED
: DB, NAME1, NAME2 : 2nd line(STYPE=DB)
: [DIM1], [DIM2] : 2nd line(STYPE=USER)
: D11, D12, D13, D14, D15, D16, D17, D18 : 2nd line(STYPE=VALUE)
: AREA1, ASy1, ASz1, lxx1, lyy1, lzz1 : 3rd line(STYPE=VALUE)
: CyP1, CyM1, CzP1, CzM1, QyB1, QzB1, PERI_OUT1, PERI_LIN1, Cy1, Cz1 : 4th line(STYPE=VALUE)
: Y11, Y12, Y13, Y14, Z11, Z12, Z13, Z14, Zyy1, Zyy2 : 5th line(STYPE=VALUE)
: D21, D22, D23, D24, D25, D26, D27, D28 : 6th line(STYPE=VALUE)
: AREA2, ASy2, ASz2, lxx2, lyy2, lzz2 : 7th line(STYPE=VALUE)
: CyP2, CyM2, CzP2, CzM2, QyB2, QzB2, PERI_OUT2, PERI_LIN2, Cy2, Cz2 : 8th line(STYPE=VALUE)
: Y21, Y22, Y23, Y24, Z21, Z22, Z23, Z24, Zyy2, Zzz2 : 9th line(STYPE=VALUE)
: OPT1, OPT2, [JOINT] : 2nd line(STYPE=PSC)
: ELAST, DEN, POIS, POIC : 2nd line(STYPE=PSC-CMPW)
: bSHEARCHK, [SCHK-I], [SCHK-J], [WT-I], [WT-J], Wl, WJ, bSYM, bSIDEHOLE : 3rd line(STYPE=PSC)
: bSHEARCHK, bSYM, bHUNCH, [CMPWEB-I], [CMPWEB-J] : 3rd line(STYPE=PSC-CMPW)
: bUSERDEFMESH SIZE, MESH SIZE, bUSERINPSTIFF, [STIFF-I], [STIFF-J] : 4th line(STYPE=PSC)
: [SIZE-A]-I : 5th line(STYPE=PSC)
: [SIZE-B]-I : 6th line(STYPE=PSC)
: [SIZE-C]-I : 7th line(STYPE=PSC)
: [SIZE-D]-I : 8th line(STYPE=PSC)
: [SIZE-A]-J : 9th line(STYPE=PSC)
: [SIZE-B]-J : 10th line(STYPE=PSC)
: [SIZE-C]-J : 11th line(STYPE=PSC)
: [SIZE-D]-J : 12th line(STYPE=PSC)
: GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc, bMULTI, EsEc-L, EsEc-S : 2nd line(STYPE=CMP-B/I)
: SW_i, Hw_i, tw_i, B_i, Bf1_i, tf1_i, B2_i, Bf2_i, tf2_i : 3rd line(STYPE=CMP-B/I)
: SW_j, Hw_j, tw_j, B_j, Bf1_j, tf1_j, B2_j, Bf2_j, tf2_j : 4th line(STYPE=CMP-B/I)
: N1, N2, Hr, Hr2, tr1, tr2 : 5th line(STYPE=CMP-B)
: GN, CTC, Bc, Tc, Hh, EgdEsb, DgdDsb, Pgd, Psb, bSYM, SW_i, SW_j : 2nd line(STYPE=CMP-CI/CT)
: OPT1, OPT2, [JOINT] : 3rd line(STYPE=CMP-CI/CT)
: [SIZE-A]-I : 4th line(STYPE=CMP-CI/CT)
: [SIZE-B]-I : 5th line(STYPE=CMP-CI/CT)
: [SIZE-C]-I : 6th line(STYPE=CMP-CI/CT)
: [SIZE-D]-I : 7th line(STYPE=CMP-CI/CT)
: [SIZE-A]-J : 8th line(STYPE=CMP-CI/CT)
: [SIZE-B]-J : 9th line(STYPE=CMP-CI/CT)
: [SIZE-C]-J : 10th line(STYPE=CMP-CI/CT)
: [SIZE-D]-J : 11th line(STYPE=CMP-CI/CT)
: ISEC, TYPE, SNAME, [OFFSET], bSD, STYPE1, STYPE2 : 1st line - CONSTRUCT
: SHAPE, ...(same with other type data from shape) : Before (STYPE1)
: SHAPE, ...(same with other type data from shape) : After (STYPE2)
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - COMPOSITE-SB
: Hw, tw, B, Bf1, tf1, B2, Bf2, tf2 : 2nd line
: N1, N2, Hr, Hr2, tr1, tr2 : 3rd line
: SW, GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc, bMulti, Elong, Esh : 4th line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - COMPOSITE-SI
: Hw, tw, B, tf1, B2, tf2 : 2nd line
: SW, GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc, bMulti, Elong, Esh : 3rd line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - COMPOSITE-CI/CT
: OPT1, OPT2, [JOINT] : 2nd line
: [SIZE-A] : 3rd line
: [SIZE-B] : 4th line
: [SIZE-C] : 5th line
: [SIZE-D] : 6th line

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: SW, GN, CTC, Bc, Tc, Hh, EgdEsb, DgdDsb, Pgd, Psb : 7th line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - PSC
: OPT1, OPT2, [JOINT] : 2nd line
: bSHEARCHK, [SCHK], [WT], WIDTH, bSYM, bSIDEHOLE : 3rd line
: bUSERDEFMESH SIZE, MESH SIZE, bUSERINPSTIFF, [STIFF] : 4th line
: [SIZE-A] : 5th line
: [SIZE-B] : 6th line
: [SIZE-C] : 7th line
: [SIZE-D] : 8th line
: [DATA1] : 1, DB, NAME or 2, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10
: [DATA2] : CCSHAPE or ICEL or iN1, iN2
: [SRC] : 1, DB, NAME1, NAME2 or 2, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, iN1, iN2
: [DIM1], [DIM2] : D1, D2, D3, D4, D5, D6, D7, D8
: [OFFSET] : OFFSET, iCENT, iREF, iHORZ, HUSER, iVERT, VUSER
: [OFFSET2] : OFFSET, iCENT, iREF, iHORZ, HUSER, iVERT, VUSER, VUSERJ
: [JOINT] : 8(1CELL, 2CELL), 13(3CELL), 9(PSCM), 8(PSCH), 9(PSCT), 2(PSCB), 0(nCELL), 2(nCEL2)
: [SIZE-A] : 6(1CELL, 2CELL), 10(3CELL), 10(PSCM), 6(PSCH), 8(PSCT), 10(PSCB), 5(nCELL), 11(nCEL2)
: [SIZE-B] : 6(1CELL, 2CELL), 12(3CELL), 6(PSCM), 6(PSCH), 8(PSCT), 6(PSCB), 8(nCELL), 18(nCEL2)
: [SIZE-C] : 10(1CELL, 2CELL), 13(3CELL), 9(PSCM), 10(PSCH), 7(PSCT), 8(PSCB), 0(nCELL), 11(nCEL2)
: [SIZE-D] : 8(1CELL, 2CELL), 13(3CELL), 6(PSCM), 7(PSCH), 8(PSCT), 5(PSCB), 0(nCELL), 18(nCEL2)
: [STIFF] : AREA, ASy, ASz, lxx, lyy, lzz
: [SCHK] : bAUTO_Z1, Z1, bAUTO_Z3, Z3
: [WT] : bAUTO_TOR, TOR, bAUTO_SHR1, SHR1, bAUTO_SHR2, SHR2, bAUTO_SHR3, SHR3
: [CMPWEB] : EFD, LRF, A, B, H, T
: 1, DBUSER, 상단PIPE, CC, 0, 0, 0, 0, 0, 0, YES, P, 2, 4.3, 0.25, 0, 0, 0, 0, 0, 0, 0
: 2, DBUSER, 하단PIPE, CC, 0, 0, 0, 0, 0, 0, YES, P, 2, 3.18, 0.25, 0, 0, 0, 0, 0, 0, 0
: 3, DBUSER, HR-POST, CC, 0, 0, 0, 0, 0, 0, YES, B, 2, 5, 5, 0.35, 0.35, 0, 0, 0, 0, 0, 0
: 4, DBUSER, C-CHANNEL, CC, 0, 0, 0, 0, 0, 0, YES, C, 2, 20, 3.5, 0.5, 0.5, 3.5, 0.5, 0, 0, 0, 0
: 5, DBUSER, sts-angle, CC, 0, 0, 0, 0, 0, 0, YES, L, 2, 5, 5, 0.5, 0.5, 0, 0, 0, 0, 0
: 6, DBUSER, al-angle, CT, 0, 0, 0, 0, 0, 0, YES, L, 2, 6.5, 6.5, 0.5, 0.5, 0, 0, 0, 0, 0
: 7, DBUSER, 구발판, CC, 0, 0, 0, 0, 0, 0, YES, CC, 2, 25, 2.5, 0.25, 0.75, 3, 0, 0, 0, 0, 0
: 8, DBUSER, SUB-브라켓, CC, 0, 0, 0, 0, 0, 0, YES, H, 2, 15, 7.5, 0.5, 0.5, 7.5, 0.7, 0, 0, 0, 0
: 9, DBUSER, 브라켓-하부, CT, 0, 0, 0, 0, 0, 0, YES, H, 2, 8, 15, 0.8, 1, 4, 0.8, 0, 0, 0, 0
: 10, DBUSER, 브라켓-POST, CC, 0, 0, 0, 0, 0, 0, YES, H, 2, 8, 15, 1, 1, 4, 0.8, 0, 0, 0, 0
*SECT-COLOR
: ISEC, W_R, W_G, W_B, HF_R, HF_G, HF_B, HE_R, HE_G, HE_B, bBLEND, FACT
: 1, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 2, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 3, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 4, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 5, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 6, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 7, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 8, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 9, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 10, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 11, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 12, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 13, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
: 14, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
*DGN-SECT
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, [DATA1], [DATA2] : 1st line - DB/USER
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, BLT, D1, ..., D8, ICEL : 1st line - VALUE
: AREA, ASy, ASz, lxx, lyy, lzz : 2nd line
: CyP, CyM, CzP, CzM, QyB, QzB, PERI_OUT, PERI_LIN, Cy, Cz : 3rd line
: Y1, Y2, Y3, Y4, Z1, Z2, Z3, Z4, Zyy, Zzz : 4th line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, ELAST, DEN, POIS, POIC, SF : 1st line - SRC
: D1, D2, [SRC] : 2nd line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, 1, DB, NAME1, NAME2, D1, D2 : 1st line - COMBINED
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, 2, D11, D12, D13, D14, D15, D21, D22, D23, D24
: ISEC, TYPE, SNAME, [OFFSET2], bSD, SHAPE, iyVAR, izVAR, STYPE : 1st line - TAPERED
: DB, NAME1, NAME2 : 2nd line(STYPE=DB)
: [DIM1], [DIM2] : 2nd line(STYPE=USER)
: D11, D12, D13, D14, D15, D16, D17, D18 : 2nd line(STYPE=VALUE)
: AREA1, ASy1, ASz1, lxx1, lyy1, lzz1 : 3rd line(STYPE=VALUE)
: CyP1, CyM1, CzP1, CzM1, QyB1, QzB1, PERI_OUT1, PERI_LIN1, Cy1, Cz1 : 4th line(STYPE=VALUE)
: Y11, Y12, Y13, Y14, Z11, Z12, Z13, Z14, Zyy1, Zyy2 : 5th line(STYPE=VALUE)
: D21, D22, D23, D24, D25, D26, D27, D28 : 6th line(STYPE=VALUE)
: AREA2, ASy2, ASz2, lxx2, lyy2, lzz2 : 7th line(STYPE=VALUE)
: CyP2, CyM2, CzP2, CzM2, QyB2, QzB2, PERI_OUT2, PERI_LIN2, Cy2, Cz2 : 8th line(STYPE=VALUE)
: Y21, Y22, Y23, Y24, Z21, Z22, Z23, Z24, Zyy2, Zzz2 : 9th line(STYPE=VALUE)
: OPT1, OPT2, [JOINT] : 2nd line(STYPE=PSC)
: ELAST, DEN, POIS, POIC : 2nd line(STYPE=PSC-CMPW)
: bSHEARCHK, [SCHK-I], [SCHK-J], [WT-I], [WT-J], Wl, WJ, bSYM, bSIDEHOLE : 3rd line(STYPE=PSC)
: bSHEARCHK, bSYM, bHUNCH, [CMPWEB-I], [CMPWEB-J] : 3rd line(STYPE=PSC-CMPW)
: bUSERDEFMESH SIZE, MESH SIZE, bUSERINPSTIFF, [STIFF-I], [STIFF-J] : 4th line(STYPE=PSC)
: [SIZE-A-I] : 5th line(STYPE=PSC)
: [SIZE-B-I] : 6th line(STYPE=PSC)
: [SIZE-C-I] : 7th line(STYPE=PSC)
: [SIZE-D-I] : 8th line(STYPE=PSC)
: [SIZE-A-J] : 9th line(STYPE=PSC)
: [SIZE-B-J] : 10th line(STYPE=PSC)
: [SIZE-C-J] : 11th line(STYPE=PSC)
: [SIZE-D-J] : 12th line(STYPE=PSC)
: GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc, bMULTI, EsEc-L, EsEc-S : 2nd line(STYPE=CMP-B/I)
: SW_i, Hw_i, tw_i, B_i, Bf1_i, tf1_i, Bf2_i, tf2_i : 3rd line(STYPE=CMP-B/I)
: SW_j, Hw_j, tw_j, B_j, Bf1_j, tf1_j, Bf2_j, tf2_j : 4th line(STYPE=CMP-B/I)
: N1, N2, Hr, Hr2, tr1, tr2 : 5th line(STYPE=CMP-B)
: GN, CTC, Bc, Tc, Hh, EgdEsb, DgdDsb, Pgd, Psb, bSYM, SW_i, SW_j : 2nd line(STYPE=CMP-CI/CT)
: OPT1, OPT2, [JOINT] : 3rd line(STYPE=CMP-CI/CT)
: [SIZE-A-I] : 4th line(STYPE=CMP-CI/CT)
: [SIZE-B-I] : 5th line(STYPE=CMP-CI/CT)
: [SIZE-C-I] : 6th line(STYPE=CMP-CI/CT)
: [SIZE-D-I] : 7th line(STYPE=CMP-CI/CT)
: [SIZE-A-J] : 8th line(STYPE=CMP-CI/CT)
: [SIZE-B-J] : 9th line(STYPE=CMP-CI/CT)
: [SIZE-C-J] : 10th line(STYPE=CMP-CI/CT)
: [SIZE-D-J] : 11th line(STYPE=CMP-CI/CT)
: ISEC, TYPE, SNAME, [OFFSET], bSD, STYPE1, STYPE2 : 1st line - CONSTRUCT
: SHAPE, ...(same with other type data from shape) : Before (STYPE1)
: SHAPE, ...(same with other type data from shape) : After (STYPE2)
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - COMPOSITE-SB
: Hw, tw, B, Bf1, tf1, Bf2, tf2 : 2nd line
: N1, N2, Hr, Hr2, tr1, tr2 : 3rd line
: SW, GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc, bMulti, Elong, Esh : 4th line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - COMPOSITE-SI
: Hw, tw, B, tf1, Bf2, tf2 : 2nd line
: SW, GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc, bMulti, Elong, Esh : 3rd line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - COMPOSITE-CI/CT
: OPT1, OPT2, [JOINT] : 2nd line
: [SIZE-A] : 3rd line
: [SIZE-B] : 4th line
: [SIZE-C] : 5th line
: [SIZE-D] : 6th line
: SW, GN, CTC, Bc, Tc, Hh, EgdEsb, DgdDsb, Pgd, Psb : 7th line
: ISEC, TYPE, SNAME, [OFFSET], bSD, SHAPE : 1st line - PSC

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:      OPT1, OPT2, [JOINT] ; 2nd line
:      bSHEARCHK, [SCHK], [WT], WIDTH, bSYM, bSIDEHOLE ; 3rd line
:      bUSERDEFMESH SIZE, MESH SIZE, bUSERINPSTIFF, [STIFF] ; 4th line
:      [SIZE-A] ; 5th line
:      [SIZE-B] ; 6th line
:      [SIZE-C] ; 7th line
:      [SIZE-D] ; 8th line
: [DATA1] : 1, DB, NAME or 2, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10
: [DATA2] : CCSHAPE or ICEL or IN1, IN2
: [SRC] : 1, DB, NAME1, NAME2 or 2, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, IN1, IN2
: [DIM1], [DIM2] : D1, D2, D3, D4, D5, D6, D7, D8
: [OFFSET] : OFFSET, ICENT, IREF, IHORZ, HUSER, IVERT, VUSER
: [OFFSET2] : OFFSET, ICENT, IREF, IHORZ, HUSERI, HUSERJ, IVERT, VUSERI, VUSERJ
: [JOINT] : 8(1CELL, 2CELL), 13(3CELL), 9(PSCM), 8(PSCH), 9(PSCT), 2(PSCB), 0(nCELL), 2(nCEL2)
: [SIZE-A] : 6(1CELL, 2CELL), 10(3CELL), 10(PSCM), 6(PSCH), 8(PSCT), 10(PSCB), 5(nCELL), 11(nCEL2)
: [SIZE-B] : 6(1CELL, 2CELL), 12(3CELL), 6(PSCM), 6(PSCH), 8(PSCT), 6(PSCB), 8(nCELL), 18(nCEL2)
: [SIZE-C] : 10(1CELL, 2CELL), 13(3CELL), 9(PSCM), 10(PSCH), 7(PSCT), 8(PSCB), 0(nCELL), 11(nCEL2)
: [SIZE-D] : 8(1CELL, 2CELL), 13(3CELL), 6(PSCM), 7(PSCH), 8(PSCT), 5(PSCB), 0(nCELL), 18(nCEL2)
: [STIFF] : AREA, ASy, ASz, lxx, lyy, lzz
: [SCHK] : bAUTO_Z1, Z1, bAUTO_Z3, Z3
: [WT] : bAUTO_TOR, TOR, bAUTO_SHR1, SHR1, bAUTO_SHR2, SHR2, bAUTO_SHR3, SHR3
: [CMPWEB] : EFD, LRF, A, B, H, T
: 1, DBUSER, 상단PIPE, CC, 0, 0, 0, 0, 0, 0, YES, P, 2, 4.3, 0.25, 0, 0, 0, 0, 0, 0, 0
: 2, DBUSER, 하단PIPE, CC, 0, 0, 0, 0, 0, 0, YES, P, 2, 3.18, 0.25, 0, 0, 0, 0, 0, 0, 0
: 3, DBUSER, HR-POST, CC, 0, 0, 0, 0, 0, 0, YES, B, 2, 5, 5, 0.35, 0.35, 0, 0, 0, 0, 0, 0
: 4, DBUSER, C-CHANNEL, CC, 0, 0, 0, 0, 0, 0, YES, C, 2, 20, 3.5, 0.5, 0.5, 3.5, 0.5, 0, 0, 0, 0
: 5, DBUSER, sts-angle, CC, 0, 0, 0, 0, 0, 0, YES, L, 2, 5, 5, 0.5, 0.5, 0, 0, 0, 0, 0
: 6, DBUSER, al-angle, CT, 0, 0, 0, 0, 0, 0, YES, L, 2, 6.5, 6.5, 0.5, 0.5, 0, 0, 0, 0, 0
: 7, DBUSER, 구발판, CC, 0, 0, 0, 0, 0, 0, YES, CC, 2, 25, 2.5, 0.25, 0.75, 3, 0, 0, 0, 0, 0
: 8, DBUSER, SUB-브라켓, CC, 0, 0, 0, 0, 0, 0, YES, H, 2, 15, 7.5, 0.5, 0.5, 7.5, 0.7, 0, 0, 0, 0
: 9, DBUSER, 브라켓-하부, CT, 0, 0, 0, 0, 0, 0, YES, H, 2, 8, 15, 0.8, 1, 4, 0.8, 0, 0, 0, 0
: 10, DBUSER, 브라켓-POST, CC, 0, 0, 0, 0, 0, 0, YES, H, 2, 8, 15, 1, 1, 4, 0.8, 0, 0, 0, 0
* DGN-SECT-PSCVALUE : Design Section of PSC Value
: SECT=SEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, bBU, bEQ ; 1st line
: [STIFF1] ; 2nd line
: [STIFF2] ; 3rd line
: [STIFF3] ; 4th line
: T1, T2, BT, HT ; 5th line(PSC)
: bSHEARCHK, [SCHK], [WT] ; 6th line(PSC)
: SW, GN, CTC, Bc, Tc, Hh, EsEc, DsDc, Ps, Pc ; 7th line(COMPOSITE-PC)
: OPOLY=X1, Y1, X2, Y2, ..., Xn, Yn ; Outer Polygon(PLANE)
: IPOLY=X1, Y1, X2, Y2, ..., Xn, Yn ; Inner Polygon(PLANE)
: IPOLY=X1, Y1, X2, Y2, ..., Xn, Yn ; Inner Polygon(PLANE)
: VERTEX=X1, Y1, X2, Y2, ..., Xn, Yn ; Vertex(General-LINE)
: LINE=V11, VJ1, dTHIK1, iALIGN1 ; Line(General-LINE)
: ...
: LINE=V1n, VJn, dTHIKn, iALIGNn ; Line(General-LINE)
: LOOP=COUNT1, LIX11, LIX12, ..., LIXn ; Line(General-LINE)
: ...
: LOOP=COUNTn, LIXn1, LIXn2, ..., LIXnn ; Line(General-LINE)
: SECT=SEC, TYPE, SNAME, [OFFSET2], bSD, SHAPE, iyVAR, izVAR, bEQ ; 1st line - TAPERED
: [STIFF1-I] ; 2nd line
: [STIFF2-I] ; 3rd line
: [STIFF3-I] ; 4th line
: [STIFF1-J] ; 5th line
: [STIFF2-J] ; 6th line
: [STIFF3-J] ; 7th line
: T1-I, T2-I, BT-I, HT-I, T1-J, T2-J, BT-J, HT-J ; 8th line(PSC)
: bSHEARCHK, [SCHK-I], [WT-I], [SCHK-J], [WT-J] ; 9th line(PSC)
: OPOLY=bl, X1, Y1, X2, Y2, ..., Xn, Yn ; Outer Polygon(PLANE)
: IPOLY=bl, X1, Y1, X2, Y2, ..., Xn, Yn ; Inner Polygon(PLANE)
: IPOLY=bl, X1, Y1, X2, Y2, ..., Xn, Yn ; Inner Polygon(PLANE)
: VERTEX=bl, X1, Y1, X2, Y2, ..., Xn, Yn ; Vertex(General-LINE)
: LINE=bl, V11, VJ1, dTHIK1, iALIGN1 ; Line(General-LINE)
: ...
: LINE=bl, V1n, VJn, dTHIKn, iALIGNn ; Line(General-LINE)
: LOOP=bl, COUNT1, LIX11, LIX12, ..., LIXn ; Line(General-LINE)
: ...
: LOOP=bl, COUNTn, LIXn1, LIXn2, ..., LIXnn ; Line(General-LINE)
: SECT=SEC, TYPE, SNAME, [OFFSET], bSD, SHAPE, bBU, bEQ, BPRT ; 1st line - COMPOSITE-GEN
: [PART1] ; 2nd line
: [PART2] ; 3rd line
: ...
: SECT=SEC, TYPE, SNAME, [OFFSET2], bSD, SHAPE, iyVAR, izVAR, bEQ, PARTNUM ; 1st line - COMPOSITE-GEN(TAPERED)
: [PART1-I] ; 2nd line
: [PART2-I] ; next lines
: ...
: [PART1-J] ; next lines
: [PART2-J] ; next lines
: ...
: [OFFSET] : OFFSET, ICENT, IREF, IHORZ, HUSER, IVERT, VUSER
: [OFFSET2] : OFFSET, ICENT, IREF, IHORZ, HUSERI, HUSERJ, IVERT, VUSERI, VUSERJ
: [STIFF1] : AREA, ASy, ASz, lxx, lyy, lzz
: [STIFF2] : Cyp, Cym, Czp, Czm, Qyb, Qzb, PERI_OUT, PERI_IN, Cy, Cz
: [STIFF3] : Y1, Y2, Y3, Y4, Z1, Z2, Z3, Z4
: [SCHK] : Z1, Z3, bAUTO_QY1, QY1, bAUTO_QY2, QY2, bAUTO_QY3, QY3
: [WT] : TOR, bAUTO_SHR1, SHR1, bAUTO_SHR2, SHR2, bAUTO_SHR3, SHR3
: [PART] : PART=part_num
: : [STIFF1]
: : [STIFF2]
: : [STIFF3]
: : [STIFF1] ; [STIFF1] of Part Sum.
: : [STIFF2] ; [STIFF2] of Part Sum.
: : [STIFF3] ; [STIFF3] of Part Sum.
: : OPOLY=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn ; Outer Polygon(PLANE)
: : IPOLY=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn ; Inner Polygon(PLANE)
: : ...
: : IPOLY=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn ; Inner Polygon(PLANE)
: : VERTEX=(bl-Tapered), X1, Y1, X2, Y2, ..., Xn, Yn ; Vertex(General-LINE)
: : LINE=(bl-Tapered), V11, VJ1, dTHIK1, iALIGN1 ; Line(General-LINE)
: : ...
: : LINE=(bl-Tapered), V1n, VJn, dTHIKn, iALIGNn ; Line(General-LINE)
: : LOOP=(bl-Tapered), COUNT1, LIX11, LIX12, ..., LIXn ; Line(General-LINE)
: : ...
: : LOOP=(bl-Tapered), COUNTn, LIXn1, LIXn2, ..., LIXnn ; Line(General-LINE)
: SECT= 11, VALUE, 계단발판, CC, 0, 0, 0, 0, 0, 0, YES, GEN, YES, YES
: 9.70748, 5.66747, 0.735068, 6.86167, 6.94649, 740.188
: 12.5, 12.5, 0.694681, 1.80532, 2.23552, 153.372, 60.8025, 16.5235, 12.5, 1.80532
: -12.131, 12.3503, 12.131, -12.3503, 0.470451, 0.584944, -1.58109, -1.69557
: OPOLY=-12.5, -0.320219, -12.5, -1.33881, -12.4902, -1.43747, -12.4611, -1.53226
: -12.4138, -1.61943, -12.3503, -1.69557, -12.1936, -1.67422
: -12.1932, -1.52745, -12.27, -1.35449, -12, -1.06881
: -11.73, -1.33881, -11.7783, -1.49297, -11.6152, -1.80532
: -9.50001, -1.80532, -9.50001, 0.244681, -9.30001, 0.444681

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9.29999, 0.444681, 9.49999, 0.244681, 9.49999, -1.80532
11.4851, -1.80532, 11.5784, -1.70189, 11.6887, -1.78736
11.8276, -1.75012, 11.8804, -1.621, 12.0132, -1.66361
12.131, -1.58109, 12.1364, -1.44171, 12.2758, -1.43633
12.3583, -1.31849, 12.3157, -1.18567, 12.4448, -1.13295
12.482, -0.993989, 12.3966, -0.883759, 12.5, -0.790419
12.5, 0.228181, 12.4902, 0.326844, 12.4611, 0.421627
12.4138, 0.508803, 12.3503, 0.584944, 12.1936, 0.563591
12.1932, 0.416811, 12.27, 0.243851, 12, -0.0418191
11.73, 0.228181, 11.7783, 0.382331, 11.6152, 0.694681
-11.4851, 0.694681, -11.5784, 0.591261, -11.6887, 0.676721
-11.8276, 0.639491, -11.8804, 0.510361, -12.0132, 0.552971
-12.131, 0.470451, -12.1364, 0.331081, -12.2758, 0.325701
-12.3583, 0.207851, -12.3157, 0.0750409, -12.4448, 0.0223109
-12.482, -0.116649, -12.3966, -0.226879
IPOLY=-12.25, -0.305319, -12.2386, -0.175083, -12.2048, -0.048804
-12.1495, 0.0696809, -12.0745, 0.176772, -11.9821, 0.269214
-11.875, 0.3442, -11.7565, 0.39945, -11.6302, 0.433287
-11.5, 0.444681, -9.85001, 0.444681, -9.75001, 0.344681
-9.75001, -1.55532, -11.4114, -1.55532, -11.5095, -1.4359
-11.6567, -0.975279, -12.125, -0.854689, -12.25, -0.757859
IPOLY=9.74999, 0.344681, 9.84999, 0.444681, 11.4114, 0.444681, 11.5095, 0.325261
11.6567, -0.135349, 12.125, -0.255949, 12.25, -0.352769
12.25, -0.805319, 12.2386, -0.935555, 12.2048, -1.06183
12.1495, -1.18032, 12.0745, -1.28741, 11.9821, -1.37985
11.875, -1.45484, 11.7565, -1.51009, 11.6302, -1.54392
11.5, -1.55532, 9.74999, -1.55532
SECT= 12, VALUE , 계단측면 , CC, 0, 0, 0, 0, 0, YES, GEN, YES, YES
16.38, 1.63204, 7.75148, 86.3376, 632.213, 42.8699
2, 2, 10, 10, 10.8979, 15.7706, 62, 59.6, 2, 10
-2, 2, 2, -2, 10, 10, -10, -10
OPOLY=-2, 10, -2, 3.525, -1.7, 3.525, -1.7, 3.875, -0.95, 3.875, -0.95, 2.125
-1.7, 2.125, -1.7, 2.475, -2, 2.475, -2, -4.975, -1.7, -4.975
-1.7, -4.625, -0.95, -4.625, -0.95, -6.375, -1.7, -6.375
-1.7, -6.025, -2, -6.025, -2, -10, 2, -10, 2, -3.525, 1.7, -3.525
1.7, -3.875, 0.95, -3.875, 0.95, -2.125, 1.7, -2.125, 1.7, -2.475
2, -2.475, 2, 4.975, 1.7, 4.975, 1.7, 4.625, 0.95, 4.625
0.95, 6.375, 1.7, 6.375, 1.7, 6.025, 2, 6.025, 2, 10
IPOLY=-1.7, -0.1, 1.7, -0.1, 1.7, -1.925, 0.75, -1.925, 0.75, -4.075, 1.7, -4.075
1.7, -9.7, -1.7, -9.7, -1.7, -6.575, -0.75, -6.575, -0.75, -4.425
-1.7, -4.425
IPOLY=-1.7, 9.7, 1.7, 9.7, 1.7, 6.575, 0.75, 6.575, 0.75, 4.425, 1.7, 4.425, 1.7, 0.1
-1.7, 0.1, -1.7, 1.925, -0.75, 1.925, -0.75, 4.075, -1.7, 4.075
SECT= 13, VALUE , 발판-1 , CC, 0, 0, 0, 0, 0, 0, YES, GEN, YES, YES
13.9943, 4.0037, 7.1979, 36.4584, 61.8553, 77.8026
5, 5, 2.39444, 4.10556, 8.82775, 26.2277, 39.9019, 33.001, 5, 4.10556
-5, 5, 1.35, -1.35, 2.39444, 2.39444, -4.10556, -4.10556
OPOLY=-5, 2.39444, -5, 1.39444, -1.35, -4.10556, -0.5, -4.10556, -0.5, 1.39444
0.5, 1.39444, 0.5, -4.10556, 1.35, -4.10556, 5, 1.39444
5, 2.39444, 0.5, 2.39444, 0.5, 1.89444, -0.5, 1.89444
-0.5, 2.39444
IPOLY=-4.8, 1.89444, -1, 1.89444, -1, -3.76552, -1.33563, -3.76552, -4.8, 1.45477
IPOLY=-1, 1.89444, 4.8, 1.89444, 4.8, 1.45477, 1.33563, -3.76552, 1, -3.76552
SECT= 14, VALUE , 발판지지 , CC, 0, 0, 0, 0, 0, 0, YES, GEN, YES, YES
29.4943, 6.85781, 18.5621, 81.7551, 669.244, 79.0943
5, 5, 5.73445, 10.7656, 23.5753, 0.940709, 48.9019, 33.001, 5, 10.7656
-5, 5, 0.5, -0.5, 5.73445, 5.73445, -10.7656, -10.7656
OPOLY=-5, 5.73445, -5, 4.73445, -1.35, -0.765555, -0.5, -0.765555, -0.5, -10.7656
0.5, -10.7656, 0.5, -0.765555, 1.35, -0.765555, 5, 4.73445
5, 5.73445, 0.5, 5.73445, 0.5, 5.23445, -0.5, 5.23445
-0.5, 5.73445
IPOLY=-4.8, 5.23445, -1, 5.23445, -1, -0.425515, -1.33563, -0.425515, -4.8, 4.79478
IPOLY=-1, 5.23445, 4.8, 5.23445, 4.8, 4.79478, 1.33563, -0.425515, 1, -0.425515
*THICKNESS ; Thickness
; ITHK, TYPE, bSAME, THIK-IN, THIK-OUT, bOFFSET, OFFTYPE, VALUE ; TYPE=VALUE
; ITHK, TYPE, SUBTYPE, RPOS, WEIGHT ; TYPE=STIFFENED, SUBTYPE=VALUE
; SHAPE, THIK-IN, THIK-OUT, HU, HL ; for yz section
; SHAPE, THIK-IN, THIK-OUT, HU, HL ; for xz section
; ITHK, TYPE, SUBTYPE, RPOS, PLATETHIK ; TYPE=STIFFENED, SUBTYPE=USER
; bRIB {, SHAPE, DIST, SIZE1, SIZE2, ..., SIZE6} ; for yz section
; bRIB {, SHAPE, DIST, SIZE2, SIZE2, ..., SIZE6} ; for xz section
; ITHK, TYPE, SUBTYPE, RPOS, PLATETHIK, DBNAME ; TYPE=STIFFENED, SUBTYPE=DB
; bRIB {, SHAPE, DIST, SNAME} ; for yz section
; bRIB {, SHAPE, DIST, SNAME} ; for xz section
1, VALUE, YES, 0.25, 0, NO, 0, 0
*THIK-COLOR
; ITHK, W_R, W_G, W_B, HF_R, HF_G, HF_B, HE_R, HE_G, HE_B, bBLEND, FACT
1, 255, 0, 0, 0, 255, 0, 0, 0, 255, NO, 0.5
*STLDCASE ; Static Load Cases
; LCNAME, LCTYPE, DESC
자중, USER
수직하중, USER
수평하중, USER
작업하중, USER
*CONSTRAINT ; Supports
; NODE_LIST, CONST(Dx,Dy,Dz,Rx,Ry,Rz), GROUP
275 289 290 295 296, 111000,
2 222, 111001,
*USE-STLD, 자중
; *SELFWEIGHT, X, Y, Z, GROUP
; *SELFWEIGHT, 0, 0, -1,
; End of data for load case [자중] -----
*USE-STLD, 수직하중
*BEAMLOAD ; Element Beam Loads
; ELEM_LIST, CMD, TYPE, DIR, bPROJ, [ECCEN], [VALUE], GROUP
; ELEM_LIST, CMD, TYPE, TYPE, DIR, VX, VY, VZ, bPROJ, [ECCEN], [VALUE], GROUP
; [VALUE] ; D1, P1, D2, P2, D3, P3, D4, P4
; [ECCEN] ; bECCEN, ECCDIR, I-END, J-END, bJ-END
; [ADDITIONAL] ; bADDITIONAL, ADDITIONAL I-END, ADDITIONAL J-END, bADDITIONAL J-END
13, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
16, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
24, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
25, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
26, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
27, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
28, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
141, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
199, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
233, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
238, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
239, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
240, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
241, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
242, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
282, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO
296, BEAM, UNILOAD, GZ, NO, NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, NO, 0, 0, NO

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299, BEAM , UNILoad, GZ, NO , NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, , NO, 0, 0, NO
303, BEAM , UNILoad, GZ, NO , NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, , NO, 0, 0, NO
304, BEAM , UNILoad, GZ, NO , NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, , NO, 0, 0, NO
313, BEAM , UNILoad, GZ, NO , NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, , NO, 0, 0, NO
314, BEAM , UNILoad, GZ, NO , NO, aDir[1], , , 0, -6, 1, -6, 0, 0, 0, 0, , NO, 0, 0, NO
; End of data for load case [수직하중]
*USE-STLD, 수평하중
*BEAMLOAD : Element Beam Loads
; ELEM_LIST, CMD, TYPE, DIR, bPROJ, [ECCEN], [VALUE], GROUP
; ELEM_LIST, CMD, TYPE, TYPE, DIR, VX, VY, VZ, bPROJ, [ECCEN], [VALUE], GROUP
; [VALUE] : D1, P1, D2, P2, D3, P3, D4, P4
; [ECCEN] : bECCEN, ECCDIR, I-END, J-END, bJ-END
; [ADDITIONAL] : bADDITIONAL, ADDITIONAL_I-END, ADDITIONAL_J-END, bADDITIONAL_J-END
13, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
16, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
24, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
25, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
26, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
27, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
28, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
141, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
199, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
233, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
238, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
239, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
240, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
241, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
242, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
282, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
296, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
299, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
303, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
304, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
313, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
314, BEAM , UNILoad, GY, NO , NO, aDir[1], , , 0, -4, 1, -4, 0, 0, 0, 0, , NO, 0, 0, NO
; End of data for load case [수평하중]
*USE-STLD, 작업하중
*CONLOAD : Nodal Loads
; NODE_LIST, FX, FY, FZ, MX, MY, MZ, GROUP
297, 0, 0, -1000, 0, 0, 0,
298, 0, 0, -1000, 0, 0, 0,
299, 0, 0, -1000, 0, 0, 0,
*PRESSURE : Pressure Loads
; ELEM_LIST, CMD, ETYP, LTYP, DIR, VX, VY, VZ, bPROJ, PU, P1, P2, P3, P4, GROUP ; ETYP=PLATE, LTYP=FACE
; ELEM_LIST, CMD, ETYP, LTYP, iEDGE, DIR, VX, VY, VZ, PU, P1, P2, GROUP ; ETYP=PLATE, LTYP=EDGE
; ELEM_LIST, CMD, ETYP, iEDGE, DIR, VX, VY, VZ, PU, P1, P2, GROUP ; ETYP=PLANE
; ELEM_LIST, CMD, ETYP, iFACE, DIR, VX, VY, VZ, bPROJ, PU, P1, P2, P3, P4, GROUP ; ETYP=SOLID
; [PLATE] : plate, plane stress, [PLANE] : axisymmetric, plane strain
325, PRES , PLATE, FACE, LZ, 0, 0, 0, NO, -0.35, 0, 0, 0, 0,
326, PRES , PLATE, FACE, LZ, 0, 0, 0, NO, -0.35, 0, 0, 0, 0,
327, PRES , PLATE, FACE, LZ, 0, 0, 0, NO, -0.35, 0, 0, 0, 0,
328, PRES , PLATE, FACE, LZ, 0, 0, 0, NO, -0.35, 0, 0, 0, 0,
; End of data for load case [작업하중]
*LOADCOMB : Combinations
; NAME=NAME, KIND, ACTIVE, bES, iTYPE, DESC, iSERV-TYPE, nLCOMTYPE ; line 1
; ANAL1, LCNAME1, FACT1, ... ; from line 2
NAME=com1, GEN, ACTIVE, 0, 0, , 0, 0
ST, 자중, 1, ST, 수직하중, 1
NAME=com2, GEN, ACTIVE, 0, 0, , 0, 0
ST, 자중, 1, ST, 수직하중, 1, ST, 작업하중, 1
NAME=com3, GEN, ACTIVE, 0, 0, , 0, 0
ST, 자중, 1, ST, 수직하중, 1, ST, 작업하중, 1, ST, 수평하중, 1
NAME=com, GEN, ACTIVE, 0, 1, , 0, 0
CB, com1, 1, CB, com2, 1, CB, com3, 1
*LC-COLOR : Diagram Color for Load Case
; ANAL, LCNAME, iR1(ALL), iG1(ALL), iB1(ALL), iR2(MIN), iG2(MIN), iB2(MIN), iR3(MAX), iG2(MAX), iB2(MAX)
ST, 자중, 192, 192, 0, 0, 192, 192, 0, 192, 128
ST, 수직하중, 0, 128, 255, 0, 192, 128, 0, 128, 192
ST, 수평하중, 212, 160, 255, 255, 255, 255, 210, 210, 210
ST, 작업하중, 0, 128, 192, 0, 192, 192, 0, 128, 128
CB, com1, 146, 0, 255, 146, 0, 255, 0, 128, 128
CB, com2, 0, 128, 57, 255, 87, 128, 192, 0, 128
CB, com3, 148, 87, 255, 255, 87, 128, 93, 255, 87
CB, com, 192, 0, 128, 148, 87, 255, 192, 72, 0
*SECTION MANAGER-GROUP & PART : Section Manager - Group & Part
; SECT = NO, bSAMEJ ; line 1
; GRPDISIZE, GRPDJSIZE, PARTISIZE, PARTJSIZE ; line 2
; ;
; LOOP UTIL (GRPDISIZE, GRPDJSIZE) ;
; GROUPID, GROUPNAME, GROUPTYPE ; line n
; ;
; LOOP UTIL (PARTISIZE, PARTJSIZE) ;
; PARTTYPE, GROUPID, PARTNAME, PARTSHAPE, bSTIFFENER ; line n
; LINESIZE, LINEINDEX[i]..... ; line n
; ;
SECT=11, YES
0, 0, 0, 0
SECT=12, YES
0, 0, 0, 0
SECT=13, YES
0, 0, 0, 0
SECT=14, YES
0, 0, 0, 0
*SECTION MANAGER-STIFFENER : Section Manager - Stiffener
; SECT = NO, bSAMEJ ; line 1
; STFNISIZE, STFNJSIZE ; line 2
; ;
; LOOP UTIL (STFNISIZE, STFNJSIZE) ;
; TYPE, Z, STANDREF, POSLINE, STANDREFL, NUM, CTC ; line n
; STIFFTYPE, dSIZE(0 ~ 20) ; line n
; LINESIZE, LINEINDEX[i]..... ; line n
; ;
SECT=11, YES
0, 0
SECT=12, YES
0, 0
SECT=13, YES
0, 0
SECT=14, YES
0, 0
*ENDDATA

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