

혜안건축사사무소

구조검토 의견서

문서번호 : 코아 20-P-0219

2020 . 03. 06

수 신 :

참 조 :

건 명 : 버스 쉼터

제 목 : 버스 쉼터 지붕에 하중 증가로 인한 구조검토 건

1. 귀사의 일익 번창을 기원합니다.
2. 귀사에서 문의하신 “버스 쉼터”에서 지붕의 하중 증가로 인한 구조검토에 대한 의견은 다음과 같습니다.

다 음

버스 쉼터 지붕에 흠하중의 증가로 구조물을 검토하였습니다. 쉼터 지붕에 추가되는 하중은 식물 1개의 모듈당 5kg으로 52개(260kg), 인조형식재 1개의 모듈당 1kg으로 12개(12kg), 고정용 프레임 38kg이 지붕에 설치되고, 이 하중에 눈/비 등의 하중을 반영하여 이것을 m²당 하중으로 치환하면 약 48kg/m²이 됩니다. 버스 쉼터 검토결과, 부재 RF1의 외력에 대한 내력의 응력비는 0.5, C1(H-125x125x6.5x9)의 외력에 대한 내력의 응력비는 0.44로 조사되어, 눈/비 등의 외부환경을 고려한 흠하중에 대해서 안전한 것으로 검토되었습니다. 따라서 버스 쉼터 지붕에 흠하중을 추가하여도 구조안전에 문제가 없을 것으로 판단됩니다.

혜안건축사사무소 건축사 김 명 섭 (인)



1. 일반사항

1.1 사업명

버스 쉼터

1.2 건물 개요

구분	개요
위 치	서울시
용 도	버스쉼터
규 모	-

1.3 구조 형식

구분	형식
구조형식	철골조
기초형식	-

1.4 구조 재료

- 콘크리트 : $f_{ck}=21$ MPa
- 철근 : $f_y=400$ MPa(SD400)
- 철골 : $f_y=275$ MPa(SS275)

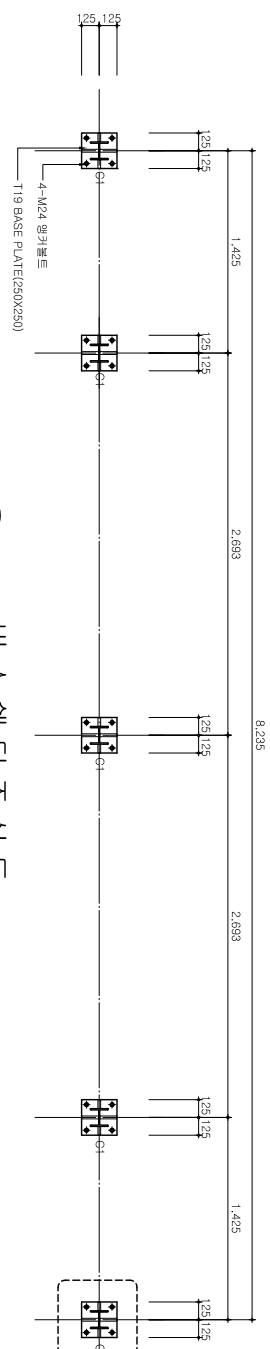
1.5 구조 설계 기준

- 건축물 내진설계기준 및 해설 2019(KDS41 17 00 : 대한건축학회 2019)
- 건축구조기준 및 해설 (KBC2016, 대한건축학회, 2016)
- 콘크리트구조기준 해설 (KCI2012, 한국콘크리트학회, 2012)

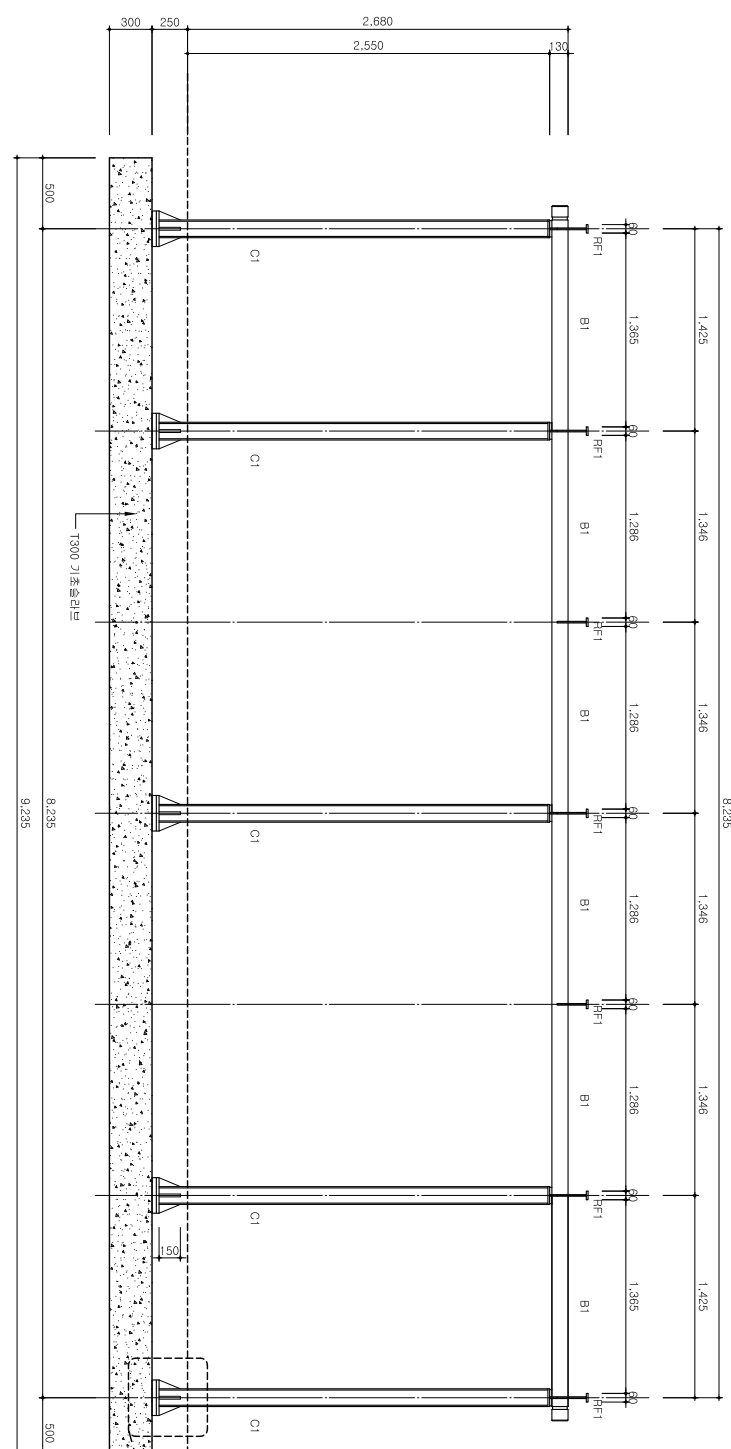
1.6 구조 해석

- MIDAS GENw에 의한 3차원 구조 해석 · MIDAS SDSw에 의한 기초 구조 해석
- MIDAS SET ART 의한 부재설계 · BEST PRO에 의한 부재설계

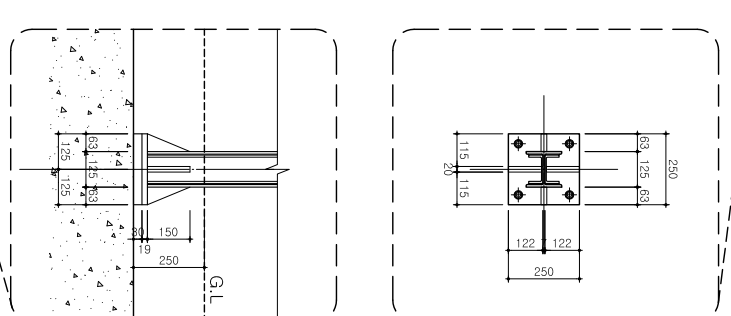
2. 구조평면도 및 부재일람표



1 버스셀터주심도
SCALE=1/40(A3)



2 버스셀터콘구조도(정면)
SCALE=1/40(A3)



NOTE

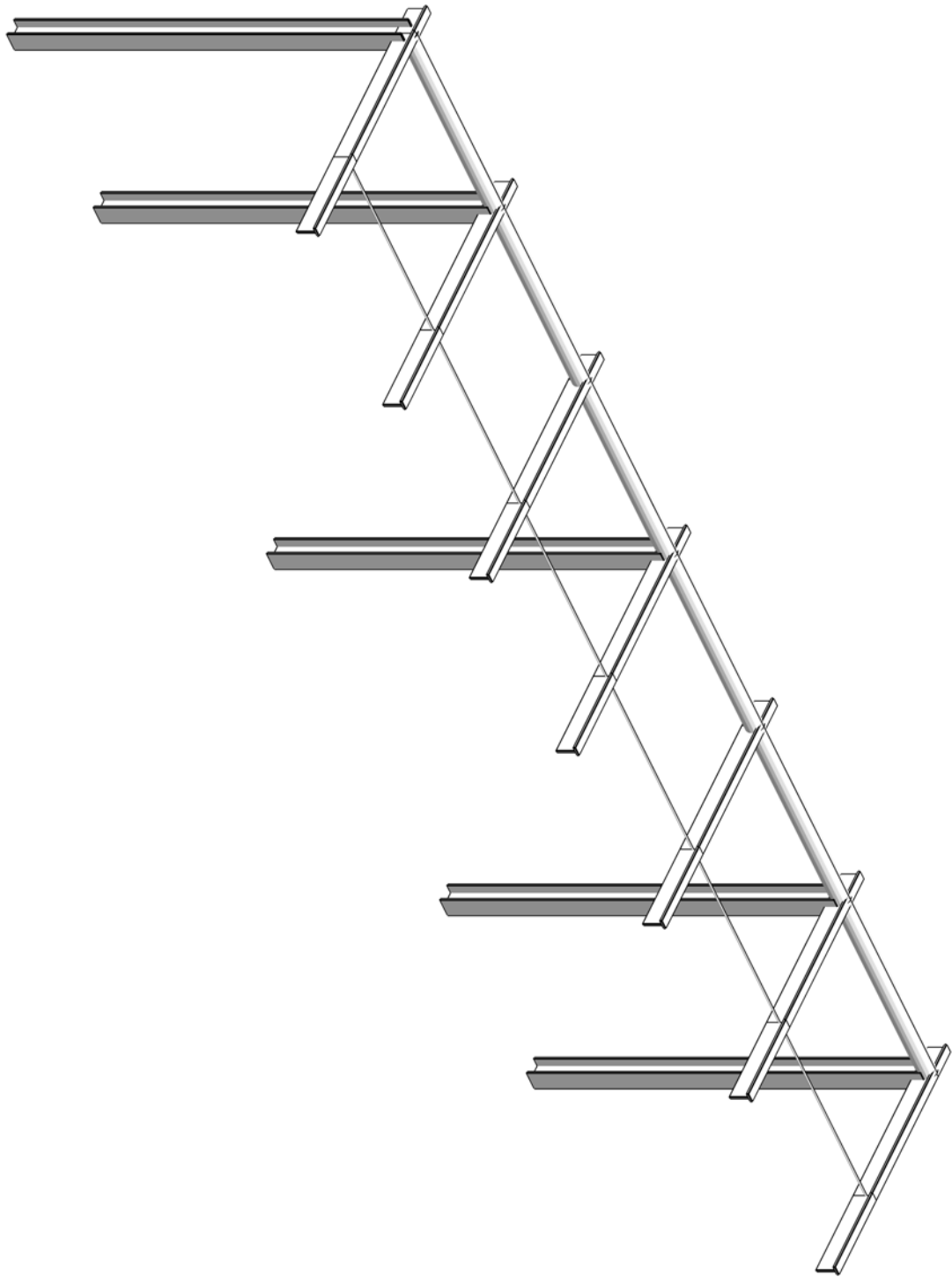
*MEMBERLIST

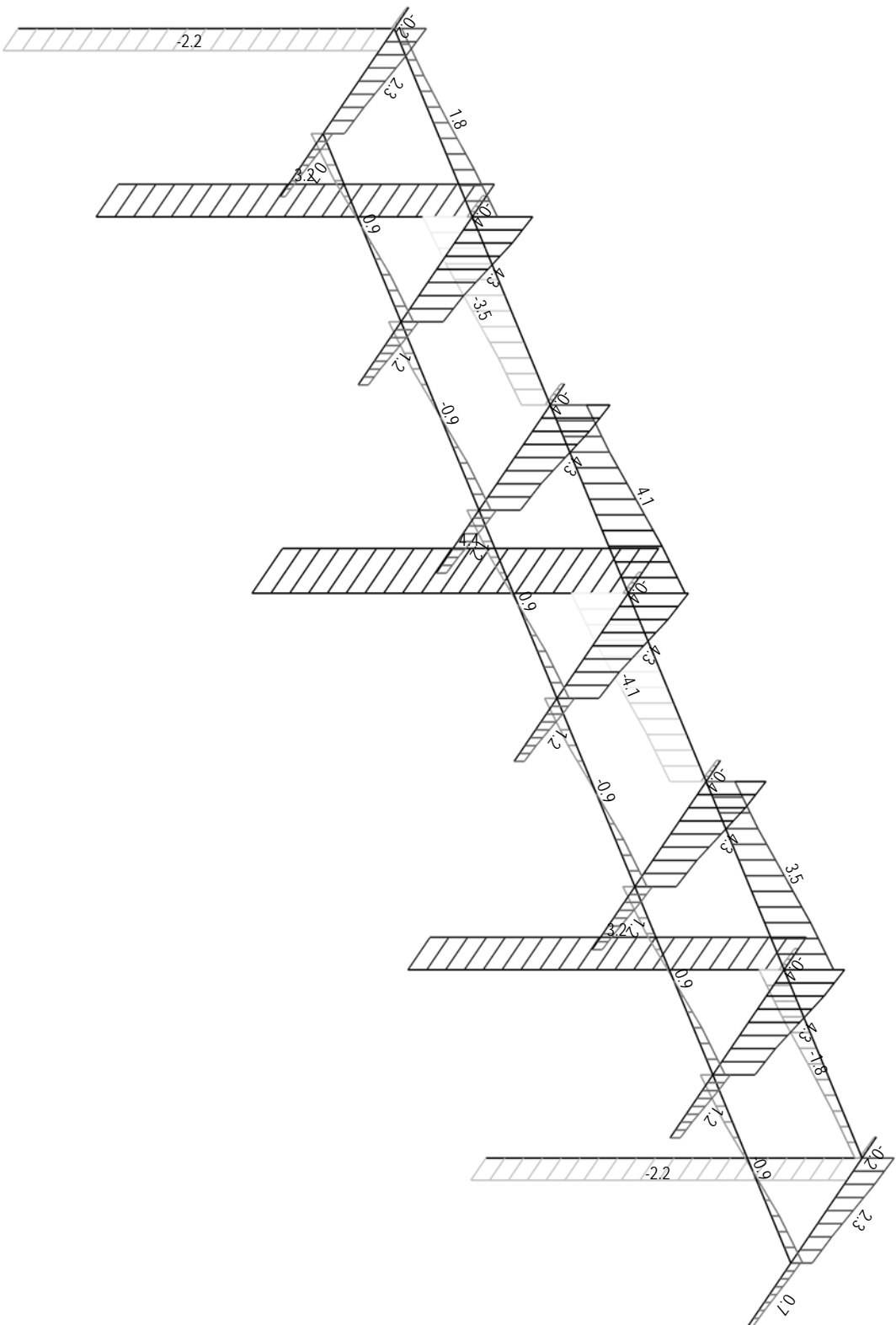
1. C1: H-125X125X6.5X9

2. B1: Ø114.3X4.5T

3. RF1: T12 STEEL PL. (135X70)

3. 응력 해석 및 부재설계





BEAM DIAGRAM

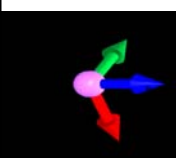
SHEAR-z
4.39695e+000
3.62844e+000
2.85992e+000
2.09141e+000
1.32289e+000
5.54380e-001
0.00000e+000
-9.82649e-001
-1.75116e+000
-2.51968e+000
-3.28819e+000
-4.05671e+000

CBALL: STL ENV_STR

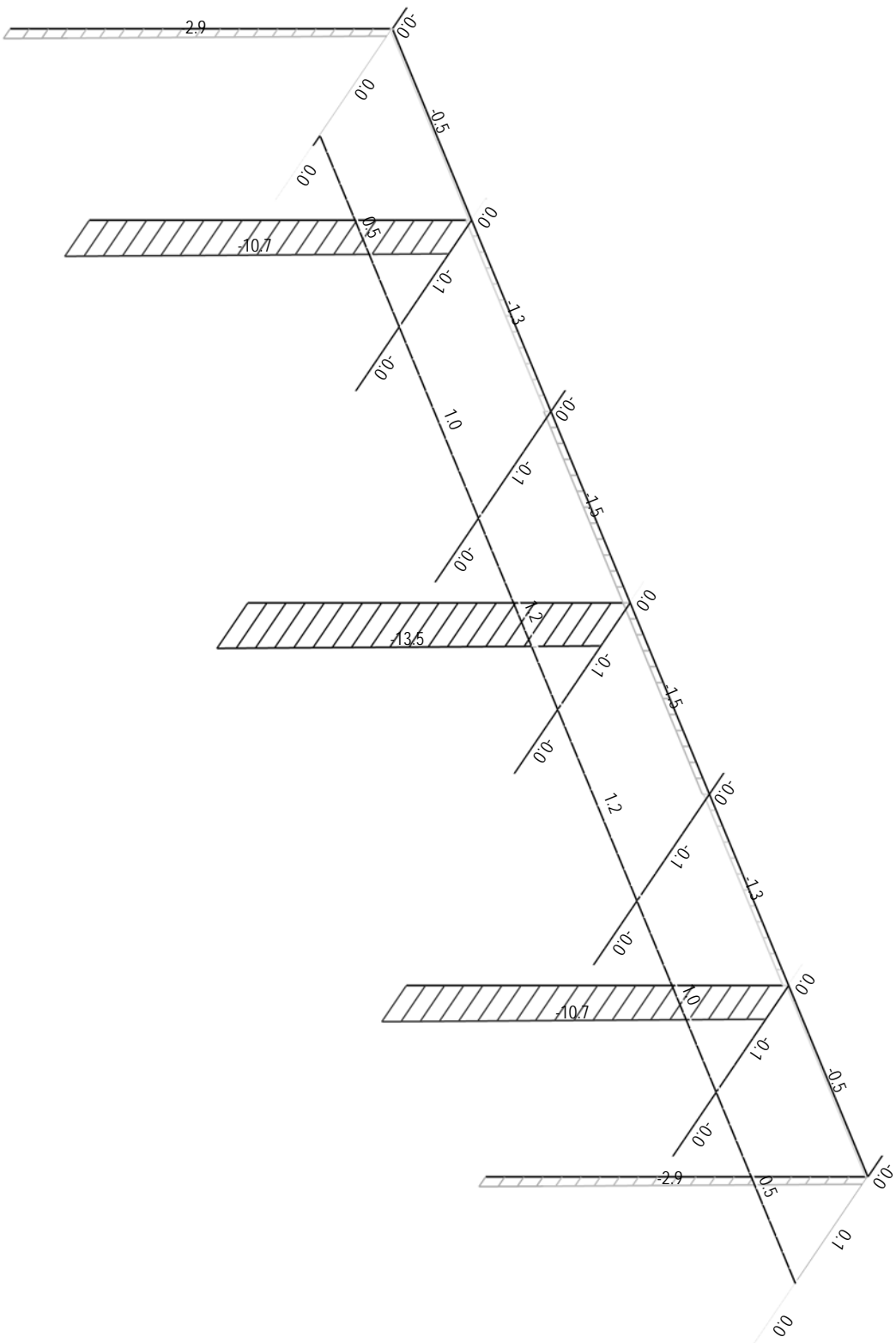
MAX : 4
MIN : 25

FILE:
UNIT: KN
DATE: 02/18/2020

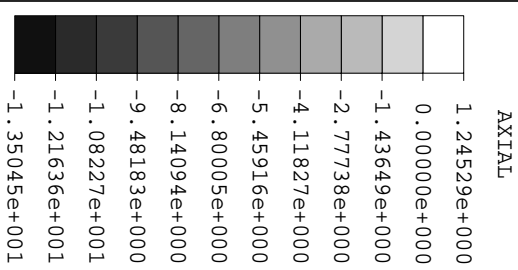
VIEW-DIRECTION
X: -0.522
Y: -0.668
Z: 0.530



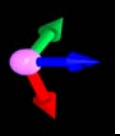
-CBall : STL ENV_STR




midas Gen
POST-PROCESSOR
BEAM DIAGRAM



CBALL: STL_ENV_STR
MAX : 32
MIN : 4
FILE:
UNIT: KN
DATE: 02/18/2020
VIEW-DIRECTION
X: -0.522
Y: -0.668
Z: 0.530

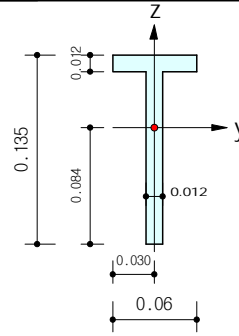


Certified by :

	Company		Project Title	
	Author		File Name	E:\...\내 작업\모델\승차대.mgb

1. Design Information

Design Code KSSC-LSD16
 Unit System kN, m
 Member No 36
 Material SS275 (No:1)
 (Fy = 275000, Es = 210000000)
 Section Name RF1 : 135x12 (No:3)
 (Rolled : RF1 : 135x12).
 Member Length : 1.00000



2. Member Forces

Axial Force Fxx = -0.0015 (LCB: 8, POS:J)
 Bending Moments My = -3.1637, Mz = -0.4559
 End Moments Myi = -0.4401, Myj = -3.1637 (for Lb)
 Myi = -0.4401, Myj = -3.1637 (for Ly)
 Mzi = 0.01041, Mzj = -0.4559 (for Lz)
 Shear Forces Fyy = 0.46635 (LCB: 8, POS:1/2)
 Fzz = 4.30773 (LCB: 4, POS:J)

Depth	0.13500	Web Thick	0.01200
Top F Width	0.06000	Top F Thick	0.01200
Area	0.00220	Asz	0.00162
Qyb	0.00350	Qzb	0.00045
Iyy	0.00000	Izz	0.00000
Ybar	0.03000	Zbar	0.08363
Syy	0.00005	Szz	0.00001
ry	0.04307	rz	0.01032


3. Design Parameters

Unbraced Lengths Ly = 1.00000, Lz = 1.00000, Lb = 1.00000
 Effective Length Factors Ky = 1.00, Kz = 1.00
 Moment Factor / Bending Coefficient
 Cmy = 1.00, Cmz = 1.00, Cb = 1.00

4. Checking Results

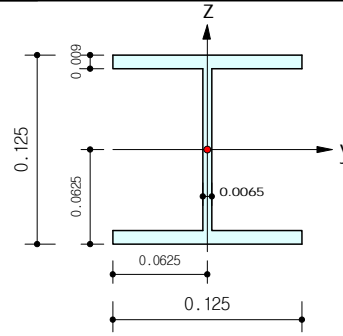
Slenderness Ratio
 KL/r = 96.9 < 200.0 (Memb:36, LCB: 8)..... 0.K
 Axial Strength
 Pu/phiPn = 0.002/295.178 = 0.000 < 1.000 0.K
 Bending Strength
 Muy/phiMny = 3.1637/12.0580 = 0.262 < 1.000 0.K
 Muz/phiMnz = 0.45594/1.92812 = 0.236 < 1.000 0.K
 Combined Strength (Compression+Bending)
 Pu/phiPn = 0.00 < 0.20
 Rmax = Pu/(2*phiPn) + [Muy/phiMny + Muz/phiMnz] = 0.499 < 1.000 0.K
 Shear Strength
 Vuy/phiVny = 0.004 < 1.000 0.K
 Vuz/phiVnz = 0.018 < 1.000 0.K

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	Author		File Name	E:\...\내 작업\모델\승차대.mgb

1. Design Information

Design Code KSSC-LSD16
 Unit System kN, m
 Member No 4
 Material SS275 (No:1)
 (Fy = 275000, Es = 210000000)
 Section Name C1 : H 125x125x6.5/9 (No:1)
 (Rolled : H 125x125x6.5/9).
 Member Length : 2.60000



2. Member Forces

Axial Force Fxx = -10.351 (LCB: 8, POS:1)
 Bending Moments My = -15.102, Mz = 0.00000
 End Moments Myi = -15.102, Myj = -5.2440 (for Lb)
 Myi = -15.102, Myj = -5.2440 (for Ly)
 Mzi = 0.00000, Mzj = 0.00000 (for Lz)
 Shear Forces Fyy = 0.20345 (LCB: 22, POS:1/2)
 Fzz = 4.39695 (LCB: 6, POS:1/2)

Depth	0.12500	Web Thick	0.00650
Top F Width	0.12500	Top F Thick	0.00900
Bot.F Width	0.12500	Bot.F Thick	0.00900
Area	0.00303	Asz	0.00081
Qyb	0.01147	Qzb	0.00195
Iyy	0.00001	Izz	0.00000
Ybar	0.06250	Zbar	0.06250
Syy	0.00014	Szz	0.00005
ry	0.05290	rz	0.03110


3. Design Parameters

Unbraced Lengths Ly = 2.60000, Lz = 2.60000, Lb = 2.60000
 Effective Length Factors Ky = 1.00, Kz = 1.00
 Moment Factor / Bending Coefficient
 Cmy = 0.85, Cmz = 0.85, Cb = 1.00

4. Checking Results

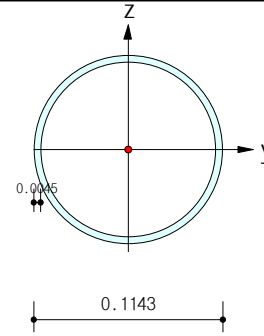
Slenderness Ratio
 $KL/r = 83.6 < 200.0$ (Memb:4, LCB: 8)..... 0.K
 Axial Strength
 $Pu/\phi Pn = 10.351/508.856 = 0.020 < 1.000$ 0.K
 Bending Strength
 $Muy/\phi Mn_y = 15.1016/35.4004 = 0.427 < 1.000$ 0.K
 $Muz/\phi Mn_z = 0.0000/17.7953 = 0.000 < 1.000$ 0.K
 Combined Strength (Compression+Bending)
 $Pu/\phi Pn = 0.02 < 0.20$
 $Rmax = Pu/(2*\phi Pn) + [Muy/\phi Mn_y + Muz/\phi Mn_z] = 0.437 < 1.000$ 0.K
 Shear Strength
 $Vuy/\phi Vn_y = 0.001 < 1.000$ 0.K
 $Vuz/\phi Vn_z = 0.033 < 1.000$ 0.K

Certified by :

	Company		Project Title	
	Author		File Name	E:\...\내 작업\모델\승차대.mgb

1. Design Information

Design Code KSSC-LSD16
 Unit System kN, m
 Member No 24
 Material SS275 (No:1)
 (Fy = 275000, Es = 210000000)
 Section Name B1 : P 114.3x4.5 (No:2)
 (Rolled : P 114.3x4.5).
 Member Length : 1.40000



2. Member Forces

Axial Force Fxx = -1.1238 (LCB: 4, POS:J)
 Bending Moments My = -2.5835, Mz = 0.52972
 End Moments Myi = 2.06334, Myj = -2.5823 (for Lb)
 Myi = 2.06334, Myj = -2.5823 (for Ly)
 Mzi = 0.24627, Mzj = 0.52948 (for Lz)
 Shear Forces Fyy = -0.3858 (LCB: 8, POS:1/2)
 Fzz = 4.05671 (LCB: 4, POS:J)

Outer Dia.	0.11430	Wall Thick	0.00450
Area	0.00155	Asz	0.00078
Qyb	0.00302	Qzb	0.00302
Iyy	0.00000	Izz	0.00000
Ybar	0.05715	Zbar	0.05715
Syy	0.00004	Szz	0.00004
ry	0.03890	rz	0.03890

3. Design Parameters

Unbraced Lengths Ly = 1.40000, Lz = 1.40000, Lb = 1.40000
 Effective Length Factors Ky = 1.00, Kz = 1.00
 Moment Factor / Bending Coefficient
 Cmy = 1.00, Cmz = 1.00, Cb = 1.00

4. Checking Results

Slenderness Ratio
 $KL/r = 36.0 < 200.0$ (Memb:24, LCB: 4)..... 0.K
 Axial Strength
 $Pu/\phi Pn = 1.124/357.460 = 0.003 < 1.000$ 0.K
 Bending Strength
 $Muy/\phi Mny = 2.5835/13.4349 = 0.192 < 1.000$ 0.K
 $Muz/\phi Mnz = 0.5297/13.4349 = 0.039 < 1.000$ 0.K
 Combined Strength (Compression+Bending)
 $Pu/\phi Pn = 0.00 < 0.20$
 $Rmax = Pu/(2*\phi Pn) + \text{SQRT}[(Muy/\phi Mny)^2 + (Muz/\phi Mnz)^2] = 0.198 < 1.000$ 0.K
 Shear Strength
 $Vuy/\phi Vny = 0.003 < 1.000$ 0.K
 $Vuz/\phi Vnz = 0.035 < 1.000$ 0.K



Design Conditions

(1). Design Code and Materials

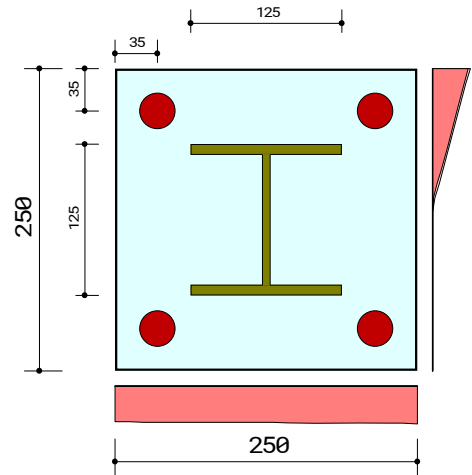
- Design Code : KBC17-Steel(LSD)
- Concrete : $f_{ck} = 21 \text{ N/mm}^2$
- Plate : SS275 ($F_y = 265 \text{ N/mm}^2$)
- Anchor Bolt : KS:4.6 ($F_{u,anc} = 400 \text{ N/mm}^2$)

(2). Section Dimension

- Column Size : H-125x125x6.5x9
- Base Plate Size : $B_x \times B_y \times t_b = 250 \times 250 \times 19 \text{ mm}$
- Anchor Bolt : 4 - $\phi 30$
- Bolt Location : $d_x = 35, d_y = 35 \text{ mm}$

(3). Force and Moment

- $P_u = 13.50 \text{ kN}$
- $M_{ux} = 15.10, M_{uy} = 0.30 \text{ kN}\cdot\text{m}$
- $V_{ux} = 0.20, V_{uy} = 4.40 \text{ kN}$



Check Base Plate : Bearing Stress

- X_c : Neutral Axis = 116.27 mm
- $f_{u,max} = \epsilon \times E_c = 6.63 \text{ N/mm}^2$
- $\phi F_n = \phi \times 0.85 \times f_{ck} \sqrt{A_2/A_1} = 19.64 \text{ N/mm}^2$
- $f_{u,max}/\phi F_n = 0.338 < 1.0 \text{ ---> O.K.}$

Check Anchor Bolt : Tensile Strength

- $T_{u,max} = 40.11 \text{ kN}$
- $F_{nt} = 0.75 \times F_{u,anc} = 300.00 \text{ N/mm}^2$
- $\phi T_n = \phi \times F_{nt} \times A_{anc} = 159.04 \text{ kN}$
- $T_{u,max}/\phi T_n = 0.252 < 1.0 \text{ ---> O.K.}$

Check Anchor Bolt : Shear Strength

- $V_{uxy} = \sqrt{V_{ux}^2 + V_{uy}^2} = 4.40 \text{ kN}$
- $T_{sum} = \sum T_{anc} = 78.84 \text{ kN}$
- $\phi V_n = \phi \times 0.55 \times (P_u + T_{sum}) = 27.93 \text{ kN} > V_{uxy} \text{ ----> O.K.}$

Design Anchor Bolt : Development Length

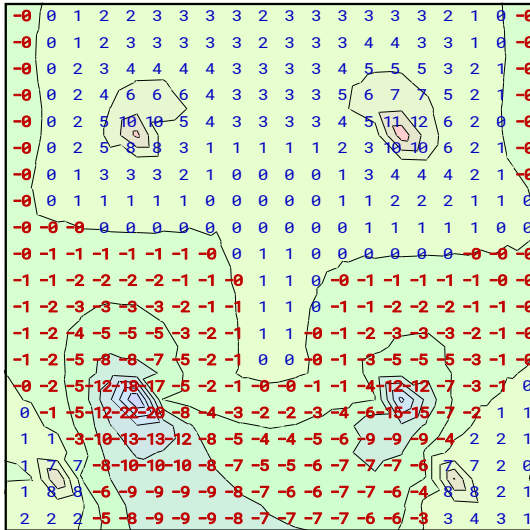
- $T_u = \phi \times F_{nt} \times A_{anc} = 159.04 \text{ kN}$
- $L_h = (T_u/2) / (0.70 f_{ck} d) = 180.32 \text{ mm}$
- $L_{Req'd} = L_h + 12d = 540.32 \text{ mm (Hooked Bar)}$



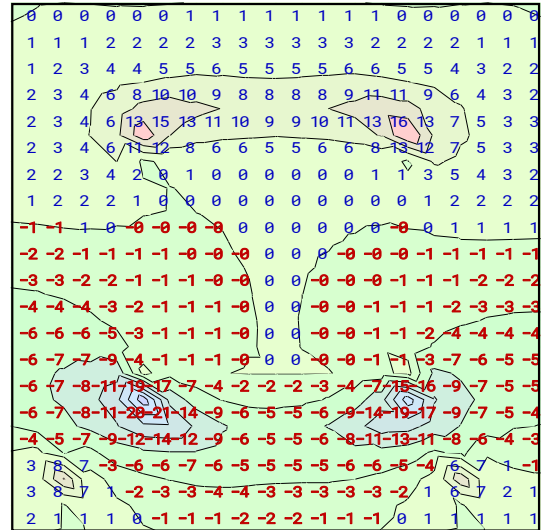
Force & Moment Diagram

(Unit : kN·mm/mm)

▶ Base PL. X-X Moment, Rib PL. Moment



▶ Base PL. Y-Y Moment, Rib PL. Shear



Check Base Plate : Moment Strength

- . $M_{u,max} = \text{Max}[M_{ux}, M_{uy}] = 13.00 \text{ kN}\cdot\text{mm}/\text{mm}$
- . $Z_{bp} = t_b^2/4 = 90 \text{ mm}^3/\text{mm}$
- . $\phi M_n = \phi \times F_y \times Z_{bp} = 21.52 \text{ kN}\cdot\text{mm}/\text{mm}$
- . $M_{u,max}/\phi M_n = 0.604 < 1.0 \text{ ---> O.K.}$