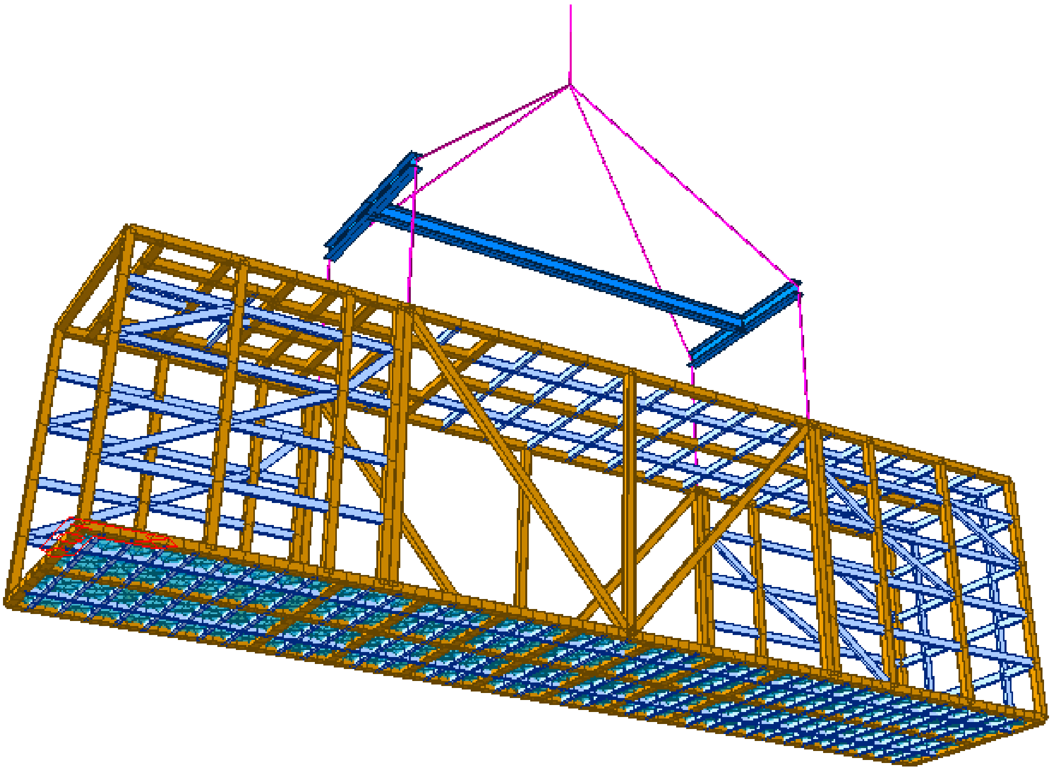
STRUCTURAL ANALYSIS

OF CONTAINER FRAME



STRUCTURE ENGINEER : MR. CHAY SANGSAWAI PROF.8611

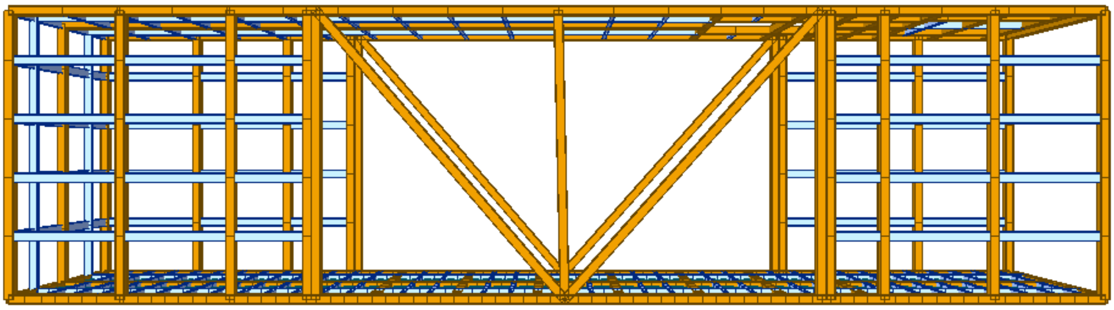
1. Analysis Result Summary

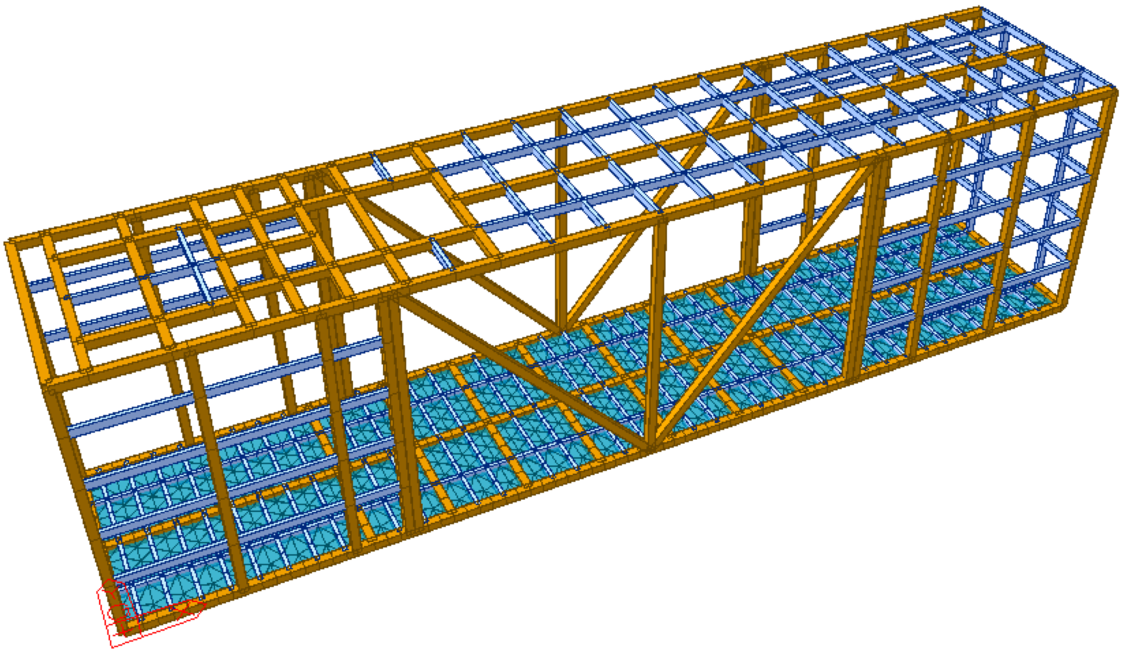
ANALYSIS RESULTS SUMMARY

1. Normal Condition With Proposed Load

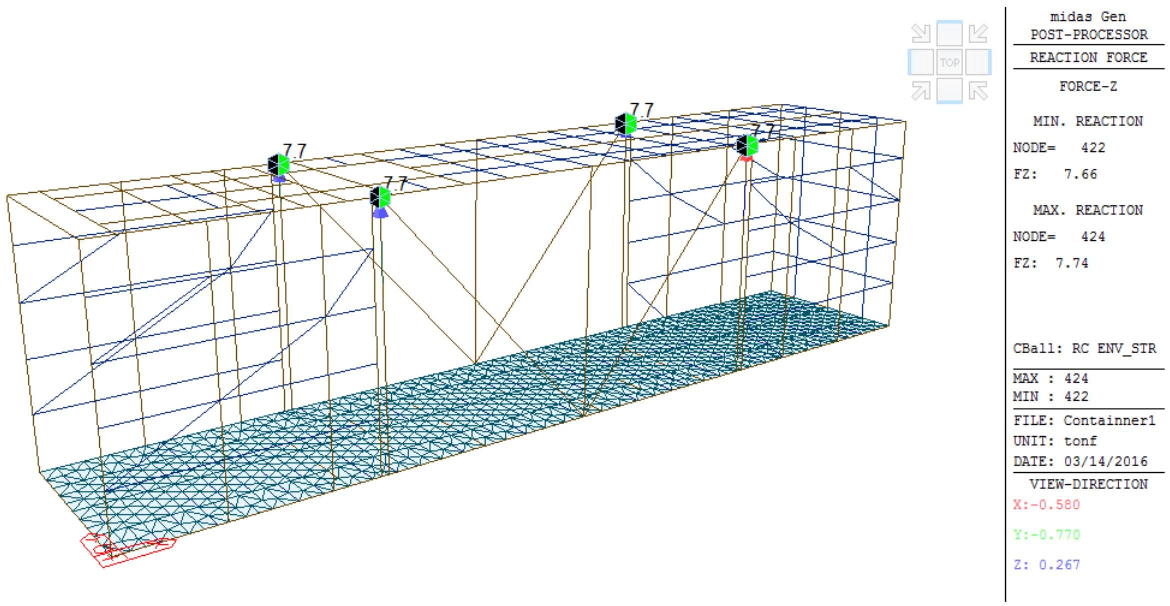
Description	Result		Design Limit	Remark
Vertical Member	0.186	<	1	Ok!
Horizontal Member	0.242	<	1	Ok!
Diagonal Member	0.077	<	1	Ok!

2. Add Bracing Structure Before Lifting Container

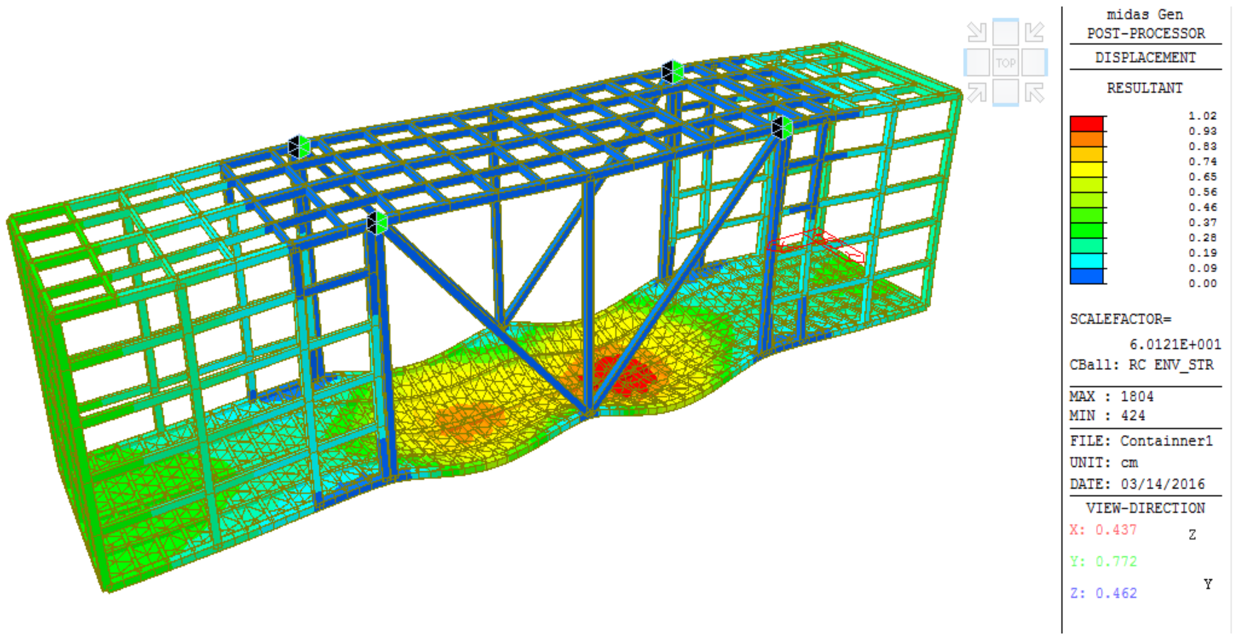




3. Tension at lifting support 7.70 tons per point



4. Displacement max 1.02 cm (CASE 1)



5. Recommended for Container Lift Up

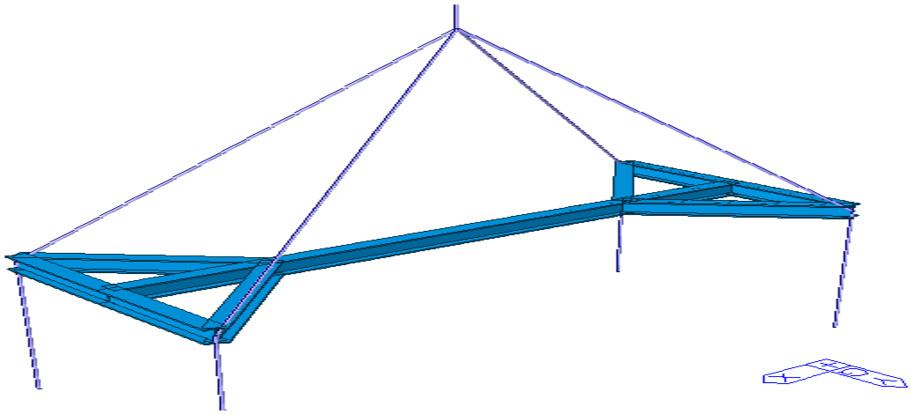
Load max for design Temporary lifting = 8,000 x 4 = 32,000 kg

1. Add Temporary structure Diagonal member and Vertical member see picture

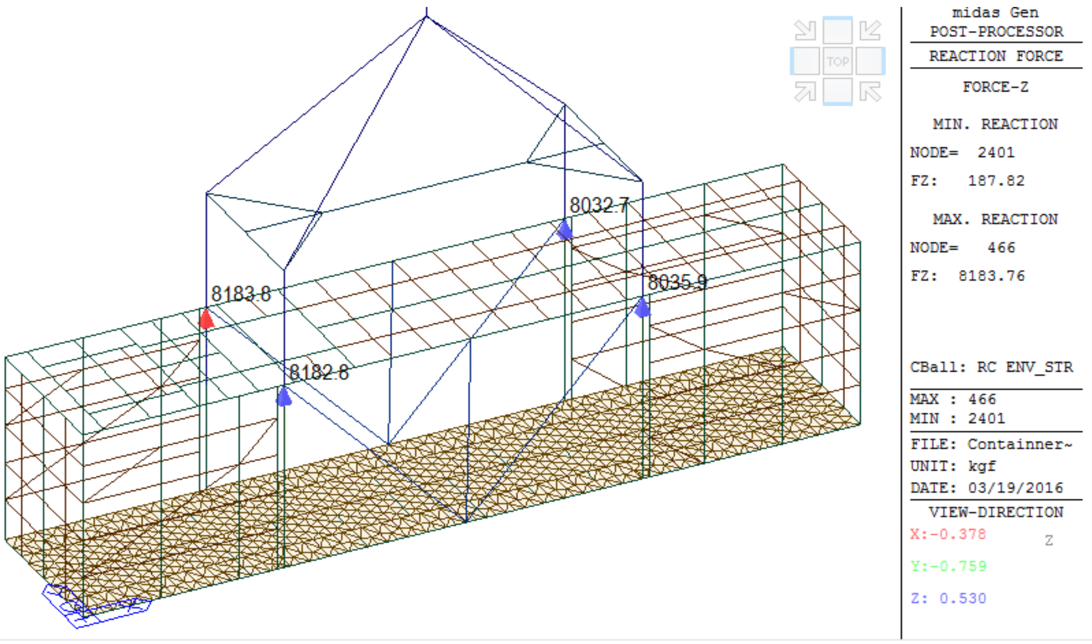
C-chanel 150 x 75 x 6.5 /10 mm

2. At joint Plate 9 mm with 2-Bolt M20

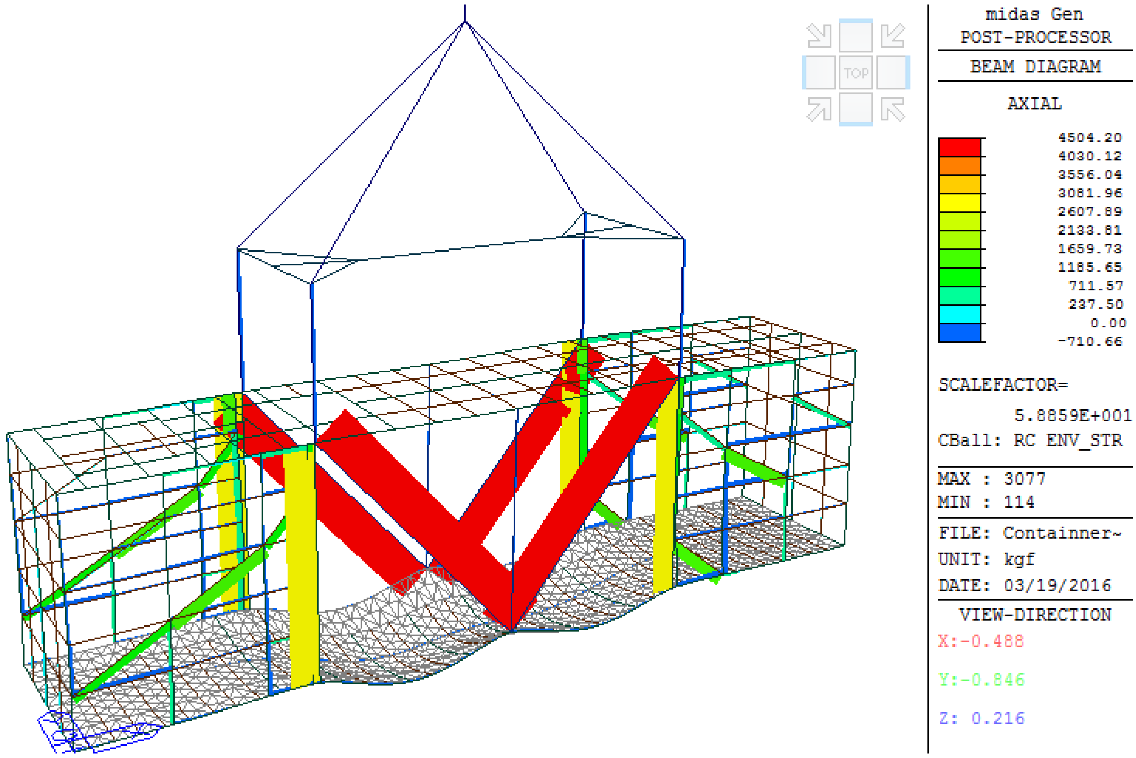
3. Temporary Structure for Lifting Structure I - 200 x 150 x 9 x16 mm

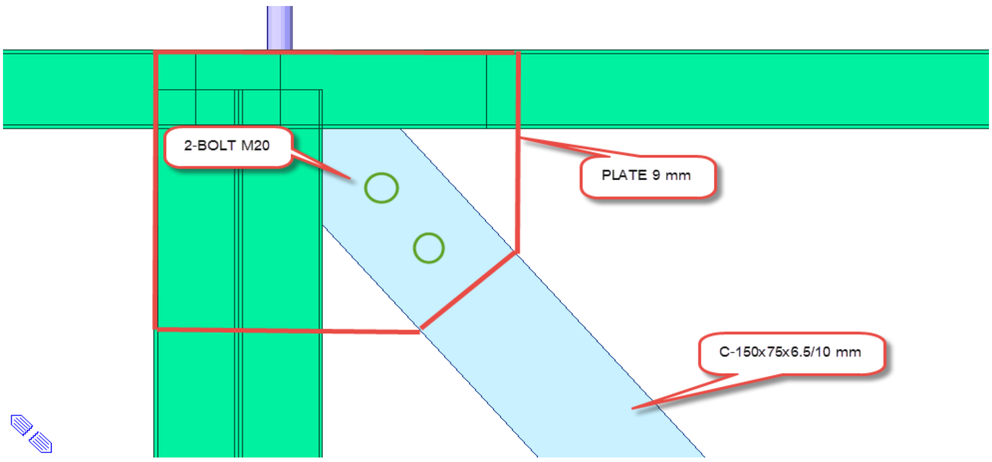


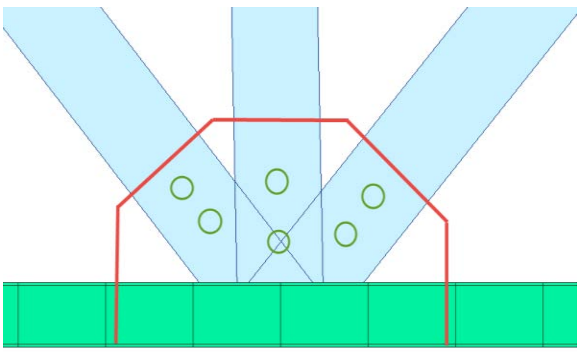
4. Load max for design Temporary lifting = 8,184 x 4 = 32,736 kg

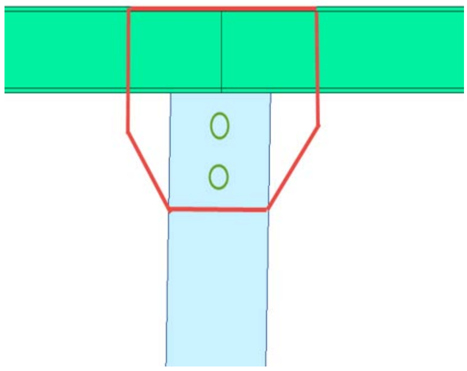


5 . JOINT DETAIL


midas Gen
POST-PROCESSOR
BEAM DIAGRAM
AXIAL
4504.20
4030.12
3556.04
3081.96
2607.89
2133.81
1659.73
1185.65
711.57
237.50
0.00
-710.66
SCALEFACTOR=
5.8859E+001
CBall: RC ENV_STR
MAX : 3077
MIN : 114
FILE: Containner~
UNIT: kgf
DATE: 03/19/2016
VIEW-DIRECTION
X:-0.488
Y:-0.846
Z: 0.216


2-BOLT M20
PLATE 9 mm
C-150x75x6.5/10 mm





2. Calculation & Analysis Criteria

STRUCTURAL ANALYSIS
Container

I. APPLICATION STANDARD AND SPECIFICATION

All materials, fabrication, and testing shall conform to the following standards or equivalents:

1. Member stress : AISC360-05/IBC2006 "Specification for Structural Steel Buildings"
2. Live load roof and wind load : PPIUG 1983
5. Material to be used : ASTM Standard or equivalent
6. Fabrication method : AISC Standard or equivalent

II. MATERIAL

Standard material used in structural analysis and design, given in the following table :

No	Material	Standard	Specification
1	Steel Pipes	JIS G3444/STK400/SCH 80	fy=240 MPa
2	Steel Shape & Plates	ASTM A36 / JIS G3101	fy=245 MPa
3	Bolts	HTB	Grade 8.8
4	Anchor Bolts	ASTM A307	fy=245 MPa
5	Welds	AWS D1.1 E60XX	fy=345 MPa
6	Hot-dip Galvanized	ASTM A123	*70 micron thickness*
7	Concrete	ACI 318M-89	f'c=18.314 Mpa

III. LOADING

The following is the proposed loading used in structural analysis :

A. Dead Load (DL)

Vertical load due to the weight of all permanent structural members such as leg, bracing, horizontal members, etc

The dead load of the structure is automatically generated by the software.

B. Equipment Load

1. Gas Engine = 11000 kg
2. GGCP = 200 kg
3. LVMDP = 400 kg
4. Intake Ventilation = 600 kg
5. Radiator = 1500 kg
6. Silencer & support = 800 kg
7. Dischage Ventilation = 500 kg

C. Wind Load (WL)

Load caused by wind applied to the structure.

According to PPIUG 1983, minimum design wind load is:

- 25 kg/m2 if distance to seashore >5 km
- 40 kg/m2 if distance to seashore <5 km

E. Load Combination

Load combination shall be investigated when calculating the maximum member stresses and structure reaction are listed in detailed analysis report.

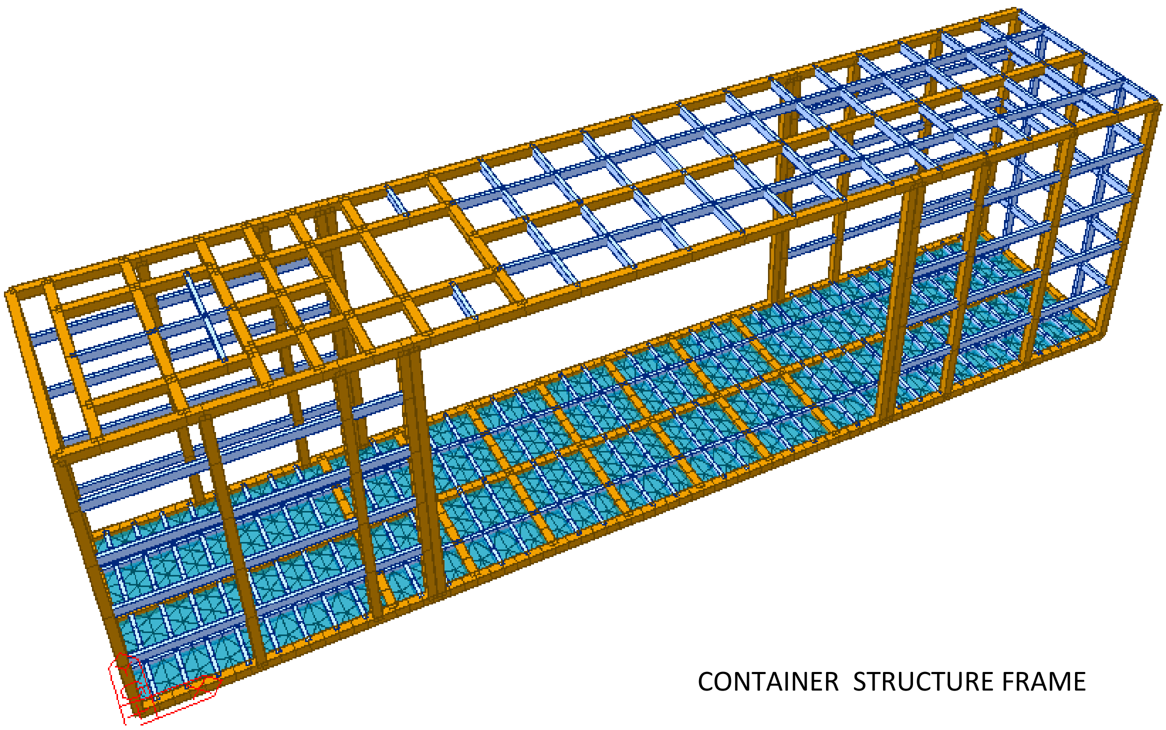
IV. Handling Condition

The following is the handling Condition analyzed in structural analysis:

1. Normal condition with all floor element of the container has direct contact with the ground
   All equipment loads are included in this condition.

V. STRUCTURAL ANALYSIS

For container analysis, the structural analysis has been carried out using Midas Gen is a set of programs, which assist engineer in the analysis and checking of general structure. With assistance of this program, engineer will be able to analyze the capacity of the structure by modelling the structural system of the structure.



CONTAINER STRUCTURE FRAME

3. Structural Analysis

```
+==============================================================+
|  MIDAS(Modeling, Integrated Design & Analysis Software)     |
|  midas Gen - Load Combinations                               |
|                                              (c)SINCE 1989   |
+==============================================================+
|  MIDAS Information Technology Co.,Ltd.          (MIDAS IT)   |
|  Gen 2015                                                    |
+==============================================================+

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DESIGN TYPE : Steel Design
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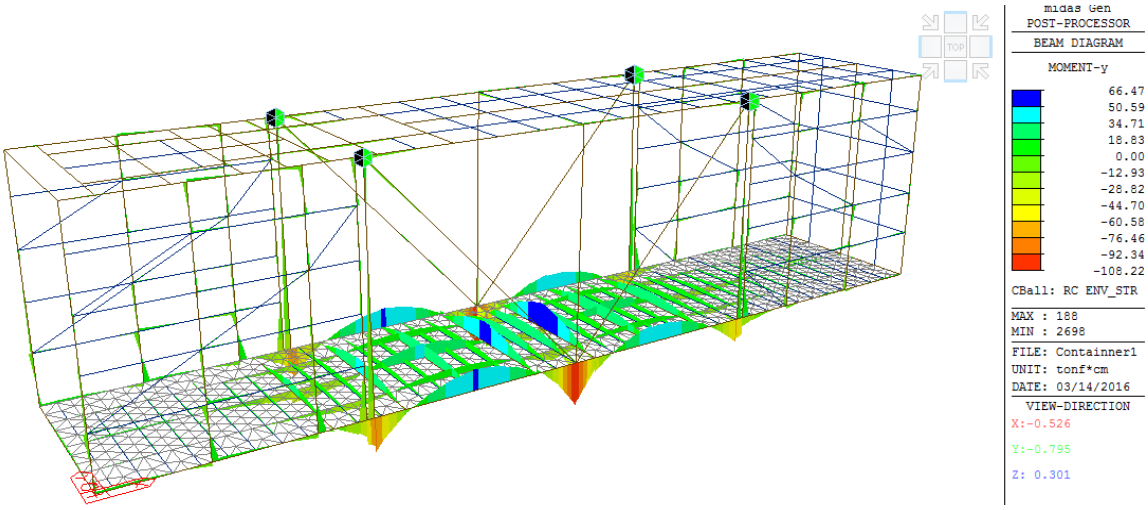
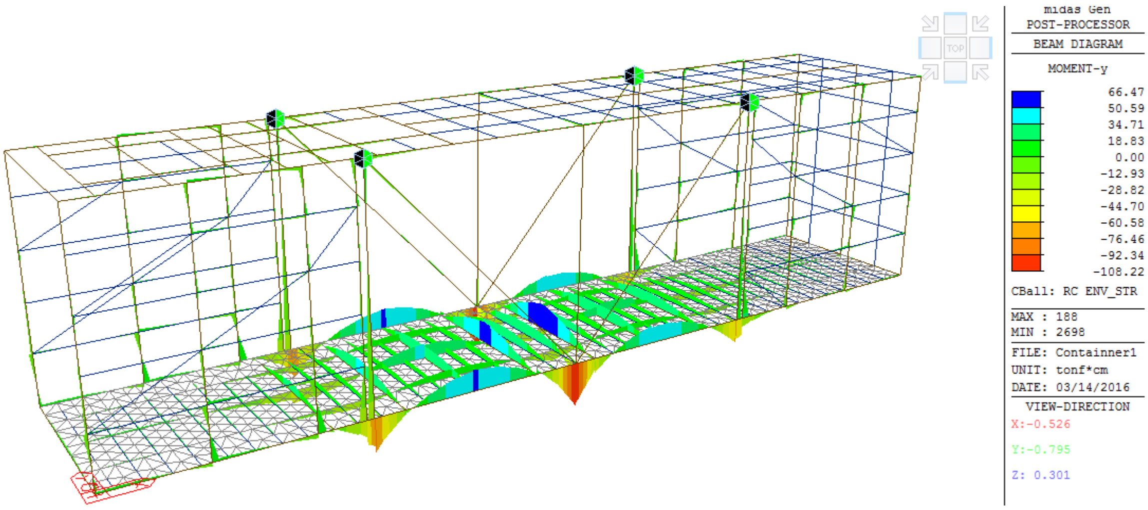
LIST OF LOAD COMBINATIONS
==============================================================================================
NUM   NAME          ACTIVE            TYPE
               LOADCASE(FACTOR) +             LOADCASE(FACTOR) +               LOADCASE(FACTOR)

==============================================================================================

1     sLCB1         Strength/Stress   Add
                    Self( 1.400)
----------------------------------------------------------------------------------------------

2     sLCB2         Strength/Stress   Add
                    Self( 1.200) +                  LL( 1.600)
----------------------------------------------------------------------------------------------
```





1. Design Information

Design Code : AISC-LRFD2K

Unit System : tonf, cm

Member No : 101

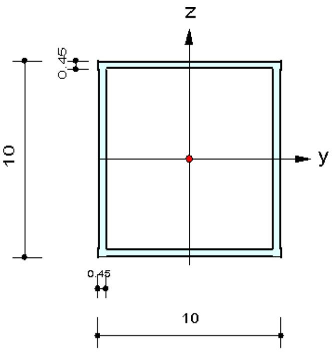
Material : SS400 (No:1)

(Fy = 2.40000, Es = 2100.00)

Section Name : TB-100x100x4.5 (No:1)

(Rolled : B 100x100x4.5).

Member Length : 30.5000



2. Member Forces

Axial Force Fxx = -0.0132 (LCB: 2, POS:J)

Bending Moments My = -101.24, Mz = 0.32351

End Moments Myi = -67.320, Myj = -101.24 (for Lb)

Myi = -33.832, Myj = -101.24 (for Ly)

Mzi = -0.0502, Mzj = 0.32351 (for Lz)

Shear Forces Fyy = -0.0245 (LCB: 2, POS:1/2)

Fzz = 2.22515 (LCB: 2, POS:J)

Depth	10.0000	Web Thick	0.45000
Flg Width	10.0000	Top F Thick	0.45000
Web Center	9.55000	Bot.F Thick	0.45000
Area	16.6700	Asz	9.00000
Qyb	34.2263	Qzb	34.2263
Iyy	249.000	Izz	249.000
Ybar	5.00000	Zbar	5.00000
Syy	49.9000	Szz	49.9000
ry	3.87000	rz	3.87000

3. Design Parameters

Unbraced Lengths Ly = 30.5000, Lz = 15.2500, Lb = 15.2500

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 = 82.7 < 200.0 (Memb:3076, LCB: 2)................................ O.K

Axial Strength

Pu/phiPn = 0.0132/33.9046 = 0.000 < 1.000 .... O.K

Bending Strength

Muy/phiMny = 101.236/133.072 = 0.761 < 1.000 .... O.K

Muz/phiMnz = 0.324/133.072 = 0.002 < 1.000 .... O.K

Combined Strength (Compression+Bending)

Pu/phiPn = 0.00 < 0.20

Rmax = Pu/(2*phiPn) + [Muy/phiMny + Muz/phiMnz] = 0.763 < 1.000 .... O.K

Shear Strength

Vuy/phiVny = 0.002 < 1.000 .... O.K

Vuz/phiVnz = 0.205 < 1.000 .... O.K

1. Design Information

Design Code : AISC-LRFD2K

Unit System : kgf, m

Member No : 21

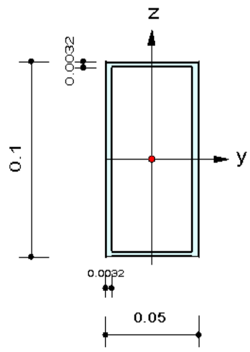
Material : SS400 (No:1)

(Fy = 24000000, Es = 21000000000)

Section Name : B 100x50x3.2 (No:2)

(Rolled : B 100x50x3.2).

Member Length : 0.51800



2. Member Forces

Axial Force Fxx = 96.2537 (LCB: 2, POS:I)

Bending Moments My = -393.67, Mz = 0.57696

End Moments Myi = -393.67, Myj = -70.904 (for Lb)

Myi = -393.67, Myj = 217.942 (for Ly)

Mzi = 0.57696, Mzj = -0.4820 (for Lz)

Shear Forces Fyy = 4.08875 (LCB: 2, POS:I)

Fzz = -1247.3 (LCB: 2, POS:I)

Depth	0.10000	Web Thick	0.00320
Flg Width	0.05000	Top F Thick	0.00320
Web Center	0.04680	Bot.F Thick	0.00320
Area	0.00089	Asz	0.00064
Qyb	0.00231	Qzb	0.00141
Iyy	0.00000	Izz	0.00000
Ybar	0.02500	Zbar	0.05000
Syy	0.00002	Szz	0.00002
ry	0.03550	rz	0.02060

3. Design Parameters

Unbraced Lengths Ly = 0.51800, Lz = 0.25900, Lb = 0.25900

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 = 59.7 < 200.0 (Memb:657, LCB: 2).................................. O.K

Axial Strength

Pu/phiPn = 96.3/19282.3 = 0.005 < 1.000 .... O.K

Bending Strength

Muy/phiMny = 393.674/637.319 = 0.618 < 1.000 .... O.K

Muz/phiMnz = 0.577/389.179 = 0.001 < 1.000 .... O.K

Combined Strength

Combined Stress

Pu/phiPn = 0.00 < 0.20

Rmax = Pu/(2*phiPn) + [Muy/phiMny + Muz/phiMnz] = 0.622 < 1.000 .... O.K

Shear Strength

Vuy/phiVny = 0.001 < 1.000 .... O.K

Vuz/phiVnz = 0.162 < 1.000 .... O.K

1. Design Information

Design Code : AISC-LRFD2K

Unit System : kgf, m

Member No : 3115

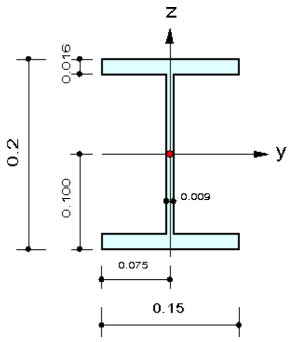
Material : SS400 (No:1)

(Fy = 24000000, Es = 21000000000)

Section Name : I-200x150x9x16 (No:4)

(Rolled : I-200x150x9x16).

Member Length : 5.60000



2. Member Forces

Axial Force Fxx = -7.8643 (LCB: 1, POS:1/2)

Bending Moments My = 283.582, Mz = 0.00000

End Moments Myi = 7.40073, Myj = 6.93468 (for Lb)

Myi = 7.40073, Myj = 6.93468 (for Ly)

Mzi = 0.00000, Mzj = 0.00000 (for Lz)

Shear Forces Fyy = 0.00000 (LCB: 1, POS:I)

Fzz = 197.516 (LCB: 1, POS:J)

Depth	0.20000	Web Thick	0.00900
Top F Width	0.15000	Top F Thick	0.01600
Bot.F Width	0.15000	Bot.F Thick	0.01600
Area	0.00642	Asz	0.00180
Qyb	0.02806	Qzb	0.00281
Iyy	0.00004	Izz	0.00001
Ybar	0.07500	Zbar	0.10000
Syy	0.00045	Szz	0.00010
ry	0.08340	rz	0.03430

3. Design Parameters

Unbraced Lengths Ly = 5.60000, Lz = 5.60000, Lb = 5.60000

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 = 163.3 < 200.0 (Memb:3115, LCB: 1)................................. O.K

Axial Strength

Pu/phiPn = 7.9/37189.0 = 0.000 < 1.000 .... O.K

Bending Strength

Muy/phiMny = 283.58/9055.75 = 0.031 < 1.000 .... O.K

Muz/phiMnz = 0.00/2168.64 = 0.000 < 1.000 .... O.K

Combined Strength (Compression+Bending)

Pu/phiPn = 0.00 < 0.20

Rmax = Pu/(2*phiPn) + [Muy/phiMny + Muz/phiMnz] = 0.031 < 1.000 .... O.K

Shear Strength

Vuy/phiVny = 0.000 < 1.000 .... O.K

Vuz/phiVnz = 0.008 < 1.000 .... O.K

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 midas Gen - Steel Code Checking   [ AISC-LRFD2K ]                              Gen 2015
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      *. PROJECT     :
      *. MEMBER NO   =     101,  ELEMENT TYPE = Beam
      *. LOADCOMB NO =       2,  MATERIAL NO  =      1,  SECTION NO =      1
      *. UNIT SYSTEM : tonf, cm

      *. SECTION PROPERTIES : Designation = TB-100x100x4.5, B 100x100x4.5
         Shape     = B - Section. (Rolled)
         Depth     =     10.000,  Flg Width    =     10.000,  Web Center  =      9.550
         Web Thick =      0.419,  Top F Thick =      0.419,  Bot.F Thick =      0.419

         Area = 1.66700e+001,  Asy  = 9.00000e+000,  Asz  = 9.00000e+000
         Ybar = 5.00000e+000,  Zbar = 5.00000e+000,  Qyb  = 3.42263e+001,  Qzb  = 3.42263e+001
         Syy  = 4.99000e+001,  Szz  = 4.99000e+001,  Zyy  = 6.16073e+001,  Zzz  = 6.16073e+001
         Iyy  = 2.49000e+002,  Izz  = 2.49000e+002,  Iyz  = 0.00000e+000
         ry   = 3.87000e+000,  rz   = 3.87000e+000
         J    = 3.91943e+002,  Cwp  = 1.00000e+028

      *. DESIGN PARAMETERS FOR STRENGTH EVALUATION :
         Ly   = 3.05000e+001,  Lz   = 1.52500e+001,  Lu   = 1.52500e+001
         Ky   = 1.00000e+000,  Kz   = 1.00000e+000

      *. MATERIAL PROPERTIES :
         Fy   = 2.40000e+000,  Es   = 2.10000e+003,  MATERIAL NAME  = SS400


=====================================================================================
   [[[*]]]   COMPUTE MOMENT MAGNIFICATION FACTORS AND MAGNIFIED MOMENTS.
=====================================================================================

      ( ). Factored force/moments caused by unit load case.
           *.Load combination ID =   2
           ------------------------------------------------------------------------------
            Load Case              Pu          Myi          Myj          Mzi          Mzj
           ------------------------------------------------------------------------------
            DL                  -0.05        -2.15        -6.33         0.01         0.07
            LL                   0.03       -31.68       -94.90        -0.06         0.26
            DL+LL               -0.01       -33.83      -101.24        -0.05         0.32
            WL or EL             0.00         0.00         0.00         0.00         0.00
           ------------------------------------------------------------------------------
            DL+LL+WL(EL)        -0.01       -33.83      -101.24        -0.05         0.32
           ------------------------------------------------------------------------------
           *.Member end moments caused by gravity load(DL+LL).
             My1G =        33.83,   My2G =       101.24
             Mz1G =         0.05,   Mz2G =         0.32

      ( ). Compute equivalent moment factor (Cmy, Cmz).
           -. Cmy  =  1.000 (User defined or default value)
           -. Cmz  =  1.000 (User defined or default value)
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      ( ). Compute moment magnification factors(B1y,B1z).
           -. Pu      =  Pu(DL+LL) + Pu(WL(EL))    =       0.01 tonf.
           -. About major(Local-y) axis.
              SLENy  =  Ky*Ly/ry                   =       7.88
              Lambda =  (SLENy/pi)*SQRT(Fy/Es)     =     0.0848
              Pey    =  (Area*Fy)/Lambda^2         =    5562.59 tonf.
              B1y    =  Cmy / (1-Pu/Pey)           =       1.00
           -. About minor(Local-z) axis.
              SLENz  =  Kz*Lz/rz                   =       3.94
              Lambda =  (SLENz/pi)*SQRT(Fy/Es)     =     0.0424
              Pez    =  (Area*Fy)/Lambda^2         =   22250.35 tonf.
              B1z    =  Cmz / (1-Pu/Pez)           =       1.00

      ( ). Magnification factors for sidesway moments(B2y,B2z).
           -. B2y   =  1.00 (Default value)
           -. B2z   =  1.00 (Default value)

      ( ). Given factored axial forces and moments at <J>.
           ---------------------------------------------------------------
            Load Case           Pu                  My                  Mz
           ---------------------------------------------------------------
            DL                -0.05               -6.33                0.07
            LL                 0.03              -94.90                0.26
            DL+LL             -0.01             -101.24                0.32
            WL or EL           0.00                0.00                0.00
           ---------------------------------------------------------------
            DL+LL+WL(EL)      -0.01             -101.24                0.32
           ---------------------------------------------------------------

      ( ). Compute magnified moments.
           -. Muy   =  B1y*My(DL+LL) + B2y*My(WL(EL)) =     -101.24 tonf-cm.
           -. Muz   =  B1z*Mz(DL+LL) + B2z*Mz(WL(EL)) =        0.32 tonf-cm.

      ( ). Factored max. shear forces.
           -. Vuy   =        -0.02 tonf.
           -. Vuz   =         2.23 tonf.

======================================================================================
   [[[*]]]   CHECK AXIAL STRENGTH.
======================================================================================

      ( ). Check slenderness ratio of axial compression member (Kl/r).
           [ AISC-LRFD2K Specification for HSS 2.3 ]
           -. Kl/r   =     7.9  <   200.0  ---> O.K.

      --------------------------------------------------------
      [*]  Calculate Q about y-axis (Rectangular HSS).
      --------------------------------------------------------
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 midas Gen - Steel Code Checking    [ AISC-LRFD2K ]                          Gen 2015
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      ( ). Check width-thickness ratio of flange of box (BTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_r = 1.40*SQRT[Es/Fy] =    41.41
           -. Dflg = B - 3*tw =     8.74 cm.
           -. DTRf = Dflg/tf  =    20.89  <  Lambda_r  --->  NON-SLENDER SECTION !

      ( ). Check width-thickness ratio of web of box (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_r = 1.40*SQRT[Es/Fy] =    41.41
           -. Dweb = H - 3*tf =     8.74 cm.
           -. DTRw = Dweb/tw  =    20.89  <  Lambda_r  --->  NON-SLENDER SECTION !

      ( ). Calculate reduction factor of Rectangular HSS (Q).
           [ AISC-LRFD2K Specification for HSS 4.2 (4.2-6) ]
           -. Q1 =    1.000  (about y-axis).

      ---------------------------------------------------------
      [*]  Calculate Q about z-axis (Rectangular HSS).
      ---------------------------------------------------------

      ( ). Check width-thickness ratio of flange of box (BTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_r = 1.40*SQRT[Es/Fy] =    41.41
           -. Dflg = H - 3*tf =     8.74 cm.
           -. DTRf = Dflg/tw  =    20.89  <  Lambda_r  --->  NON-SLENDER SECTION !

      ( ). Check width-thickness ratio of web of box (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_r = 1.40*SQRT[Es/Fy] =    41.41
           -. Dweb = B - 3*tw =     8.74 cm.
           -. DTRw = Dweb/tf  =    20.89  <  Lambda_r  --->  NON-SLENDER SECTION !

      ( ). Calculate reduction factor of Rectangular HSS (Q).
           [ AISC-LRFD2K Specification for HSS 4.2 (4.2-6) ]
           -. Q2 =    1.000  (about z-axis).

      ( ). Define reduction factor of Rectangular HSS (Q).
           -. Q =  MIN[ Q1, Q2 ]  =   1.000

      ( ). Calculate column slenderness parameter (Lambda_c).
           [ AISC-LRFD2K Specification for HSS 4.2 (4.2-4) ]
                              (Kl/r)          Fy
           -. Lambda_c   =   -------- * SQRT[----]  =  0.085
                                pi            Es

      ( ). Calculate critical stress (Fcr).
           [ AISC-LRFD2K Specification for HSS 4.2 (4.2-2) ]
           -. Lambda_c   =  0.085  <  1.5
           -. Odr   =  Lambda_c^2  =  0.007
           -. Fcr   =  (0.658^Odr)*Fy  =      2.3928 tonf/cm^2.
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      ( ). Calculate axial compressive strength (phiPn).
           [ AISC-LRFD2K Specification for HSS 4.2 (4.2-1) ]
           -. Fcr    =       2.3928 tonf/cm^2.
           -. Resistance factor for compression   :  phi = 0.85
           -. phiPn  =  phi*Area*Fcr  =         33.90 tonf.

      ( ). Check ratio of axial strength (Pu/phiPn).
                Pu                   0.01
           -. -------  =  ---------------  =3.886e-004  <  1.000  ---> O.K.
               phiPn               33.90

======================================================================================
   [[[*]]]   CHECK FLEXURAL STRENGTH ABOUT MAJOR AXIS.
======================================================================================

      ( ). Compute plastic bending moment (Mp).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mp = Fy*Zyy =        147.86 tonf-cm.

      ( ). Compute limiting buckling moment (Mr).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mr = Fy*Syy =        119.76 tonf-cm.

      --------------------------------------------------------------------------
      [*]   Check Web Local Buckling (WLB).
      --------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for WLB.
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
                                                  [       2.75*Pu ]
           -. Lambda_p(Lp) = 3.76 * SQRT[Es/Fy] [ 1.0 - ------- ] =   111.11
                                                  [        phiPy  ]
                                                  [       0.74*Pu ]
           -. Lambda_r(Lr) = 5.70 * SQRT[Es/Fy] [ 1.0 - ------- ] =   168.56
                                                  [        phiPy  ]

      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   20.89  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn2).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn2  =  Mp  =        147.86 tonf-cm.

      --------------------------------------------------------------------------
      [*]   Check Flange Local Buckling (FLB).
      --------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for FLB.
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_p(Lp)  =  1.12*SQRT[Es/Fy]  =   33.13
           -. Lambda_r(Lr)  =  1.40*SQRT[Es/Fy]  =   41.41
```

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--------------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking    [ AISC-LRFD2K ]                              Gen 2015
============================================================================================


      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   20.89  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn1).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn1  =  Mp  =        147.86 tonf-cm.

      ( ). Compute flexural strength about major axis (phiMny).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mny  =  MIN[ Mn1, Mn2 ]  =       147.86 tonf-cm.
           -. Resistance factor for flexure  :  phi = 0.90
           -. phiMny  =  phi*Mny  =       133.07 tonf-cm.

      ( ). Check ratio of flexural strength (Muy/phiMny).
                Muy              101.24
           -. --------  =  ---------------  =  0.761  <  1.000  --->  O.K.
               phiMny            133.07

======================================================================================
   [[[*]]]   CHECK FLEXURAL STRENGTH ABOUT MINOR AXIS.
======================================================================================

      ( ). Compute plastic bending moment (Mp).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mp = Fy*Zzz =        147.86 tonf-cm.

      ( ). Compute limiting buckling moment (Mr).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mr = Fy*Szz =        119.76 tonf-cm.

      --------------------------------------------------------------------------
      [*]   Check Web Local Buckling (WLB).
      --------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for WLB.
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
                                                [        2.75*Pu ]
           -. Lambda_p(Lp) = 3.76 * SQRT[Es/Fy] [ 1.0 - ------- ] =   111.11
                                                [         phiPy  ]
                                                [        0.74*Pu ]
           -. Lambda_r(Lr) = 5.70 * SQRT[Es/Fy] [ 1.0 - ------- ] =   168.56
                                                [         phiPy  ]

      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   20.89  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn2).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn2  =  Mp  =        147.86 tonf-cm.
```

```
---------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking   [ AISC-LRFD2K ]                          Gen 2015
=======================================================================================


      ------------------------------------------------------------------------
      [*]   Check Flange Local Buckling (FLB).
      ------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for FLB.
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_p(Lp)  =  1.12*SQRT[Es/Fy]  =   33.13
           -. Lambda_r(Lr)  =  1.40*SQRT[Es/Fy]  =   41.41

      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   20.89  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn1).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn1  =  Mp  =        147.86 tonf-cm.

      ( ). Compute flexural strength about minor axis (phiMnz).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mnz  =  MIN[ Mn1, Mn2 ]  =        147.86 tonf-cm.
           -. Resistance factor for flexure  :  phi = 0.90
           -. phiMnz  =  phi*Mnz  =        133.07 tonf-cm.

      ( ). Check ratio of flexural strength (Muz/phiMnz).
                Muz                   0.32
           -. --------  =  ---------------  =  0.002  <  1.000  --->  O.K.
               phiMnz               133.07

=====================================================================================
   [[[*]]]   CHECK INTERACTION OF COMBINED STRENGTH.
=====================================================================================

      ( ). Check interaction ratio of combined strength.
           [ AISC-LRFD2K Specification for HSS 7.1 ]
           -. Pu/phiPn  <  0.20  --->  Formula(7.1-2)
                            Pu       [    Muy        Muz    ]
           -. ComRat  =  --------- + [ -------- + -------- ]
                          2*phiPn    [  phiMny     phiMnz   ]
                      =1.943e-004 + [  0.761  +  0.002 ]
                      =  0.763  <  1.000  --->  O.K.

=====================================================================================
   [[[*]]]   CHECK SHEAR STRENGTH.
=====================================================================================

      ( ). Calculate critical stress (Fn).
           [ AISC-LRFD2K Specification for HSS 5.2 (5.2-5) ]
           -. Lambda_r = 2.45*SQRT[Es/Fy] =    72.47
           -. DTR = h/tw =  20.895 < Lambda_r
           -. Fn  = 0.6*Fy =       1.4400 tonf/cm^2.
```

```
-----------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking   [ AISC-LRFD2K ]                            Gen 2015
=========================================================================================


      ( ). Calculate shear strength in local-y direction (phiVny).
           [ AISC-LRFD2K specification for HSS 5.2 ]
           -. Resistance factor for shear   :  phi = 0.90
           -. Aw =           8.37 cm^2.
           -. Vn = Fn*Aw =          12.05 tonf.
           -. phiVny = phi*Vn =          10.85 tonf.

      ( ). Check ratio of shear strength (Vu/phiVn).
           ( LCB =    2, POS =    J )
           -. Applied shear force : Vuy =          0.02 tonf.
                 Vuy                  0.02
           -. --------  =  ---------------  =  0.002  <  1.000  --->  O.K.
               phiVny               10.85

      ( ). Calculate critical stress (Fn).
           [ AISC-LRFD2K Specification for HSS 5.2 (5.2-5) ]
           -. Lambda_r = 2.45*SQRT[Es/Fy] =    72.47
           -. DTR = h/tw =  20.895 < Lambda_r
           -. Fn  = 0.6*Fy =       1.4400 tonf/cm^2.

      ( ). Calculate shear strength in local-z direction (phiVnz).
           [ AISC-LRFD2K specification for HSS 5.2 ]
           -. Resistance factor for shear   :  phi = 0.90
           -. Aw =           8.37 cm^2.
           -. Vn = Fn*Aw =          12.05 tonf.
           -. phiVnz = phi*Vn =          10.85 tonf.

      ( ). Check ratio of shear strength (Vu/phiVn).
           ( LCB =    2, POS =    J )
           -. Applied shear force : Vuz =          2.23 tonf.
                 Vuz                  2.23
           -. --------  =  ---------------  =  0.205  <  1.000  --->  O.K.
               phiVnz               10.85
```

```
-----------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking   [ AISC-LRFD2K ]                           Gen 2015
=========================================================================================


      *. PROJECT     :
      *. MEMBER NO   =      21,  ELEMENT TYPE = Beam
      *. LOADCOMB NO =       2,  MATERIAL NO  =     1,  SECTION NO =     2
      *. UNIT SYSTEM : tonf, cm

      *. SECTION PROPERTIES : Designation = B 100x50x3.2
         Shape     = B - Section. (Rolled)
         Depth     =     10.000,  Flg Width   =      5.000,  Web Center  =      4.680
         Web Thick =      0.298,  Top F Thick =      0.298,  Bot.F Thick =      0.298

         Area = 8.92700e+000,  Asy  = 3.20000e+000,  Asz  = 6.40000e+000
         Ybar = 2.50000e+000,  Zbar = 5.00000e+000,  Qyb  = 2.30512e+001,  Qzb  = 1.40762e+001
         Syy  = 2.25000e+001,  Szz  = 1.52000e+001,  Zyy  = 2.95055e+001,  Zzz  = 1.80175e+001
         Iyy  = 1.12000e+002,  Izz  = 3.80000e+001,  Iyz  = 0.00000e+000
         ry   = 3.55000e+000,  rz   = 2.06000e+000
         J    = 9.14677e+001,  Cwp  = 1.00000e+028

      *. DESIGN PARAMETERS FOR STRENGTH EVALUATION :
         Ly   = 5.18000e+001,  Lz   = 2.59000e+001,  Lu   = 2.59000e+001
         Ky   = 1.00000e+000,  Kz   = 1.00000e+000

      *. MATERIAL PROPERTIES :
         Fy   = 2.40000e+000,  Es   = 2.10000e+003,  MATERIAL NAME  = SS400


=====================================================================================
   [[[*]]]   COMPUTE MOMENT MAGNIFICATION FACTORS AND MAGNIFIED MOMENTS.
=====================================================================================

      ( ). Compute moment magnification factors(B1y,B1z).
           -. If tension or bending member.
           -. Assumed   B1y  =  1.00
           -. Assumed   B1z  =  1.00

      ( ). Magnification factors for sidesway moments(B2y,B2z).
           -. B2y    =  1.00  (Default value)
           -. B2z    =  1.00  (Default value)

      ( ). Given factored axial forces and moments at <I>.
           ----------------------------------------------------------------
            Load Case              Pu                  My                 Mz
           ----------------------------------------------------------------
            DL                   0.02               -2.54               0.02
            LL                   0.08              -36.82               0.04
            DL+LL                0.10              -39.36               0.06
            WL or EL             0.00                0.00               0.00
           ----------------------------------------------------------------
            DL+LL+WL(EL)         0.10              -39.36               0.06
           ----------------------------------------------------------------
```

```
--------------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking   [ AISC-LRFD2K ]                              Gen 2015
============================================================================================


      ( ). Compute magnified moments.
           -. Muy   =  B1y*My(DL+LL) + B2y*My(WL(EL)) =      -39.36 tonf-cm.
           -. Muz   =  B1z*Mz(DL+LL) + B2z*Mz(WL(EL)) =        0.06 tonf-cm.

      ( ). Factored max. shear forces.
           -. Vuy   =   4.08e-003 tonf.
           -. Vuz   =       -1.25 tonf.

========================================================================================
   [[[*]]]   CHECK AXIAL STRENGTH.
========================================================================================

      ( ). Check slenderness ratio of axial tension member (l/r).
           [ AISC-LRFD2K Specification for HSS 2.3 ]
           -. l/r  =    14.6  <   300.0  ---> O.K.

      ( ). Calculate axial tensile strength (phiPn).
           [ AISC-LRFD2K Specification for HSS 3.1 (3.1-1) ]
           -. Resistance factor for tension  :  phi = 0.90
           -. phiPn  =  phi*Area*Fy  =         19.28 tonf.

      ( ). Check ratio of axial strength (Pu/phiPn).
                Pu                   0.10
           -. -------  =  ---------------  =  0.005  <  1.000  ---> O.K.
               phiPn                19.28

========================================================================================
   [[[*]]]   CHECK FLEXURAL STRENGTH ABOUT MAJOR AXIS.
========================================================================================

      ( ). Compute plastic bending moment (Mp).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mp = Fy*Zyy =         70.81 tonf-cm.

      ( ). Compute limiting buckling moment (Mr).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mr = Fy*Syy =         54.00 tonf-cm.

      --------------------------------------------------------------------------
      [*]   Check Web Local Buckling (WLB).
      --------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for WLB.
           [ AISC-LRFD2K Specification for HSS 2.2, Table 2.2-1 ]
           -. Pu  >  0.  --->  Webs in flexural tension.
           -. Lambda_p(Lp)  =  3.76*SQRT[Es/Fy]       =  111.22
           -. Lambda_r(Lr)  =  5.70*SQRT[Es/Fy]       =  168.61
```

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------------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking    [ AISC-LRFD2K ]                           Gen 2015
==========================================================================================


      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   30.60  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn2).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn2  =  Mp  =         70.81 tonf-cm.

      ---------------------------------------------------------------------------
      [*]   Check Flange Local Buckling (FLB).
      ---------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for FLB.
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_p(Lp)  =  1.12*SQRT[Es/Fy]  =   33.13
           -. Lambda_r(Lr)  =  1.40*SQRT[Es/Fy]  =   41.41

      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   13.80  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn1).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn1  =  Mp  =         70.81 tonf-cm.

      ( ). Compute flexural strength about major axis (phiMny).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mny  =  MIN[ Mn1, Mn2 ]  =         70.81 tonf-cm.
           -. Resistance factor for flexure  :  phi = 0.90
           -. phiMny  =  phi*Mny  =         63.73 tonf-cm.

      ( ). Check ratio of flexural strength (Muy/phiMny).
                Muy                    39.36
           -. --------  =  ---------------  =  0.618  <  1.000  --->  O.K.
               phiMny                  63.73

=========================================================================================
   [[[*]]]   CHECK FLEXURAL STRENGTH ABOUT MINOR AXIS.
=========================================================================================

      ( ). Compute plastic bending moment (Mp).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mp = Fy*Zzz =         43.24 tonf-cm.

      ( ). Compute limiting buckling moment (Mr).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mr = Fy*Szz =         36.48 tonf-cm.

      ---------------------------------------------------------------------------
      [*]   Check Web Local Buckling (WLB).
      ---------------------------------------------------------------------------
```

```
-------------------------------------------------------------------------------------------
 midas Gen - Steel Code Checking   [ AISC-LRFD2K ]                              Gen 2015
===========================================================================================

      ( ). Calculate limiting width-thickness ratios for WLB.
           [ AISC-LRFD2K Specification for HSS 2.2, Table 2.2-1 ]
           -. Pu  >  0.  --->  Webs in flexural tension.
           -. Lambda_p(Lp)  =  3.76*SQRT[Es/Fy]        =  111.22
           -. Lambda_r(Lr)  =  5.70*SQRT[Es/Fy]        =  168.61

      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   13.80  <  Lambda_p  --->  COMPACT.

      ( ). Compute nominal flexural strength (Mn2).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn2  =  Mp  =          43.24 tonf-cm.

      ----------------------------------------------------------------------------
      [*]   Check Flange Local Buckling (FLB).
      ----------------------------------------------------------------------------

      ( ). Calculate limiting width-thickness ratios for FLB.
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. Lambda_p(Lp)  =  1.12*SQRT[Es/Fy]  =   33.13
           -. Lambda_r(Lr)  =  1.40*SQRT[Es/Fy]  =   41.41

      ( ). Check width-thickness ratio of web (DTR).
           [ AISC-LRFD2K Specification for HSS 2.2 Table 2.2-1 ]
           -. DTR  =  h/t  =   30.60  <  Lambda_p  --->  COMPACT.

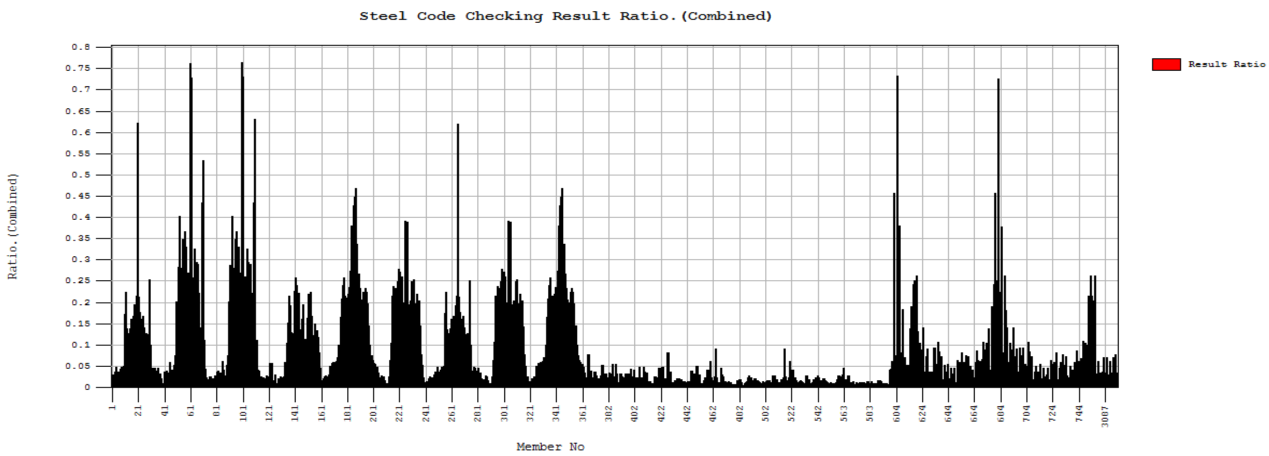
      ( ). Compute nominal flexural strength (Mn1).
           [ AISC-LRFD2K Specification for HSS 5.1 (5.1-4) ]
           -. Mn1  =  Mp  =          43.24 tonf-cm.

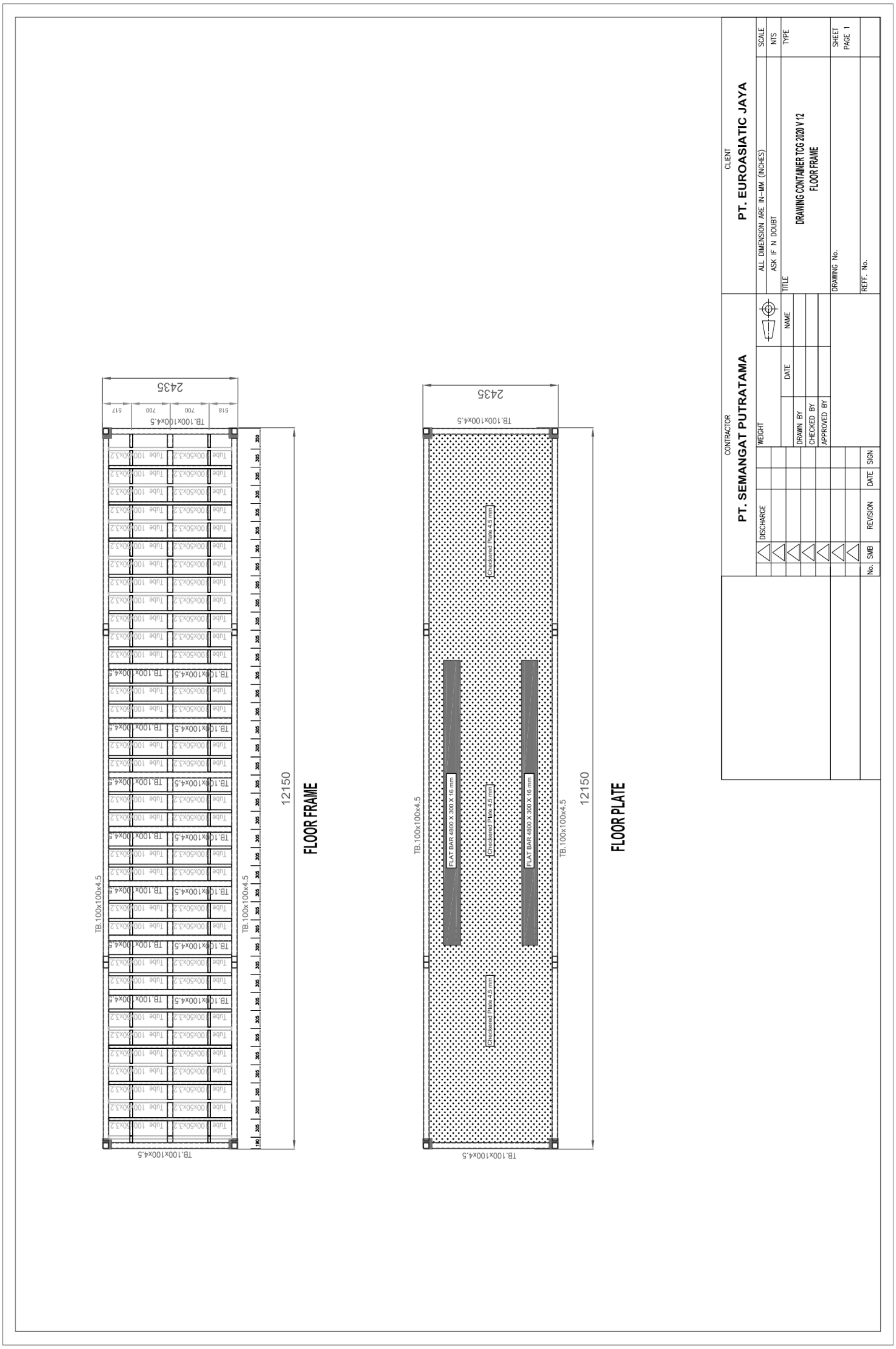
      ( ). Compute flexural strength about minor axis (phiMnz).
           [ AISC-LRFD2K Specification for HSS 5.1 ]
           -. Mnz  =  MIN[ Mn1, Mn2 ]  =          43.24 tonf-cm.
           -. Resistance factor for flexure  :  phi = 0.90
           -. phiMnz  =  phi*Mnz  =          38.92 tonf-cm.

      ( ). Check ratio of flexural strength (Muz/phiMnz).
                Muz                0.06
           -. --------  =  ---------------  =  0.001  <  1.000  --->  O.K.
               phiMnz              38.92

======================================================================================
   [[[*]]]  CHECK INTERACTION OF COMBINED STRENGTH.
======================================================================================

      ( ). Check interaction ratio of combined strength.
           [ AISC-LRFD2K Specification for HSS 7.1 ]
           -. Pu/phiPn  <  0.20  --->  Formula(7.1-2)
```





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FLOOR PLATE
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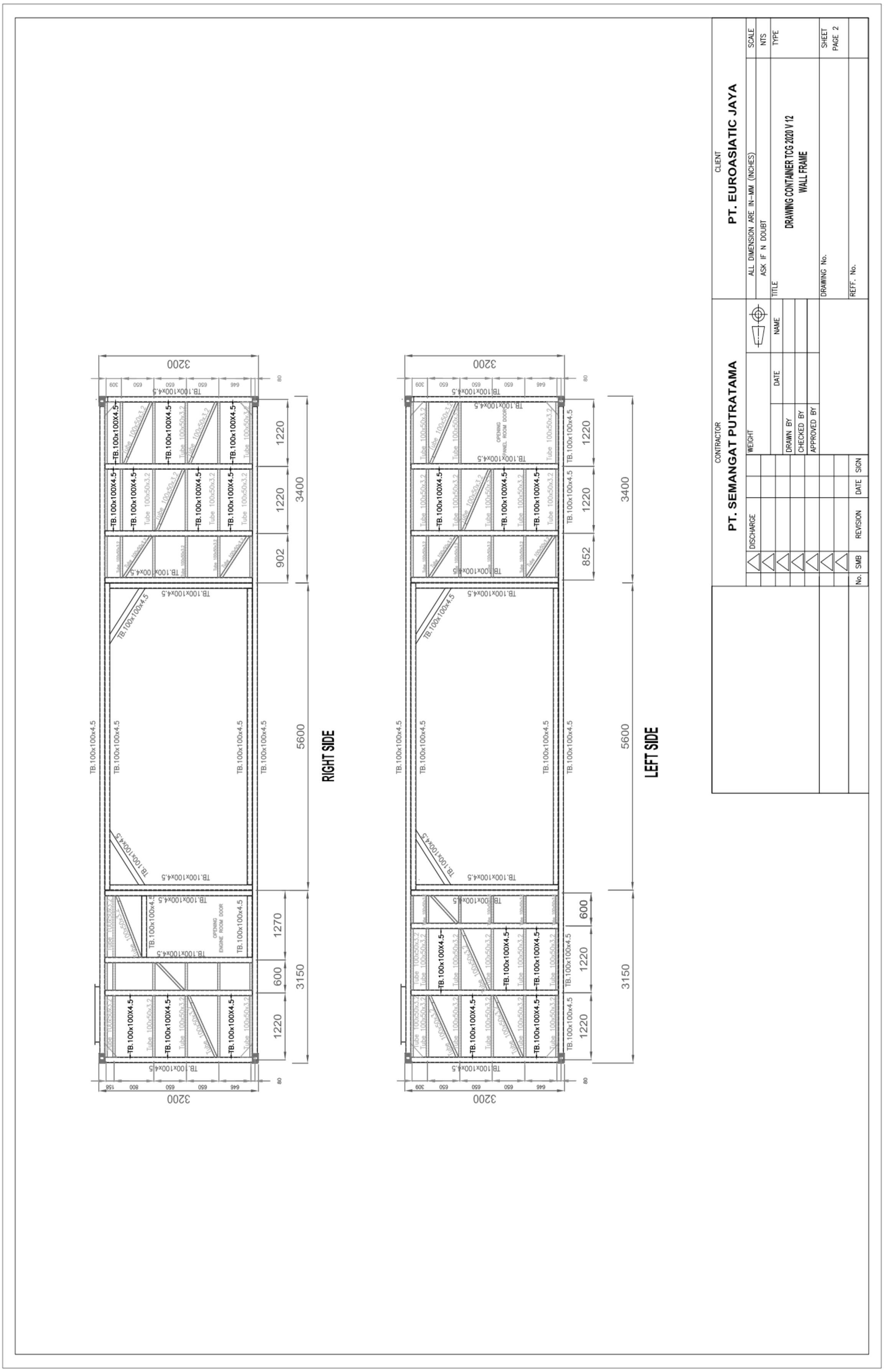
PT. SEMANGAT PUTRATAMA
DRAWING CONTAINER TCG 2020 V 12
FLOOR FRAME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DRAWING CONTAINER TCG 2020 V 12
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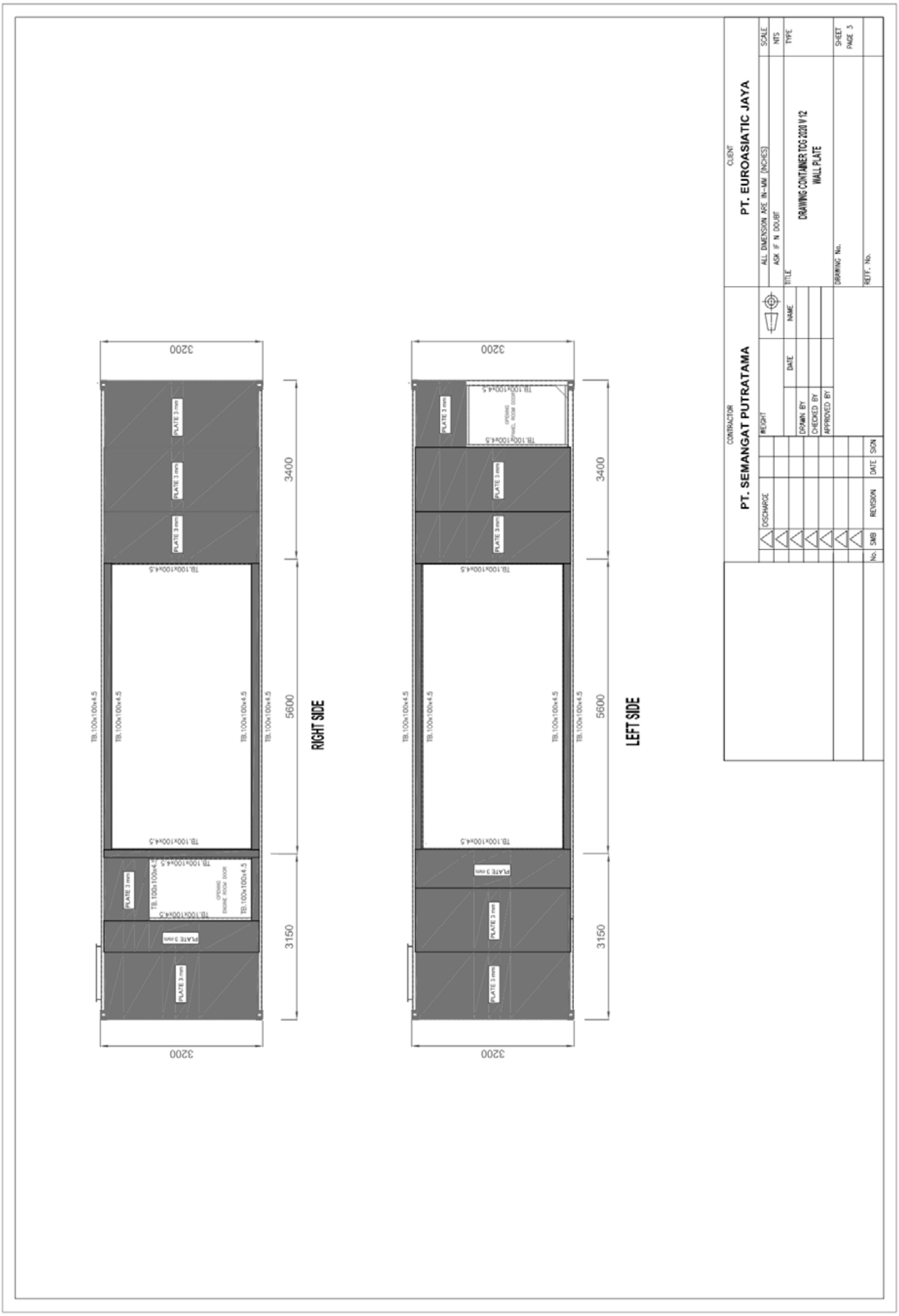
RIGHT SIDE
LEFT SIDE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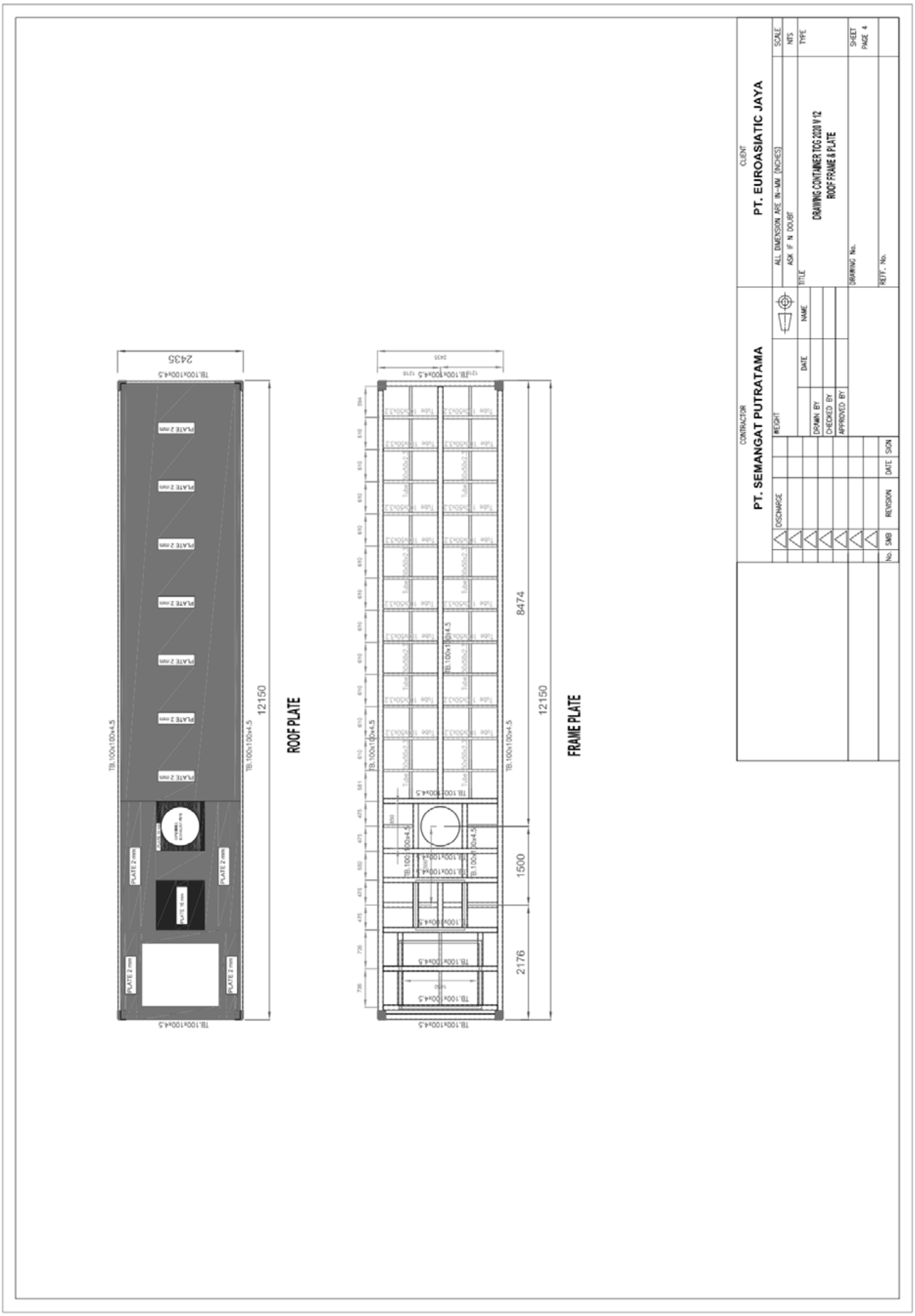
PT. SEMANGAT PUTRATAMA
WALL PLATE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FRAME PLATE
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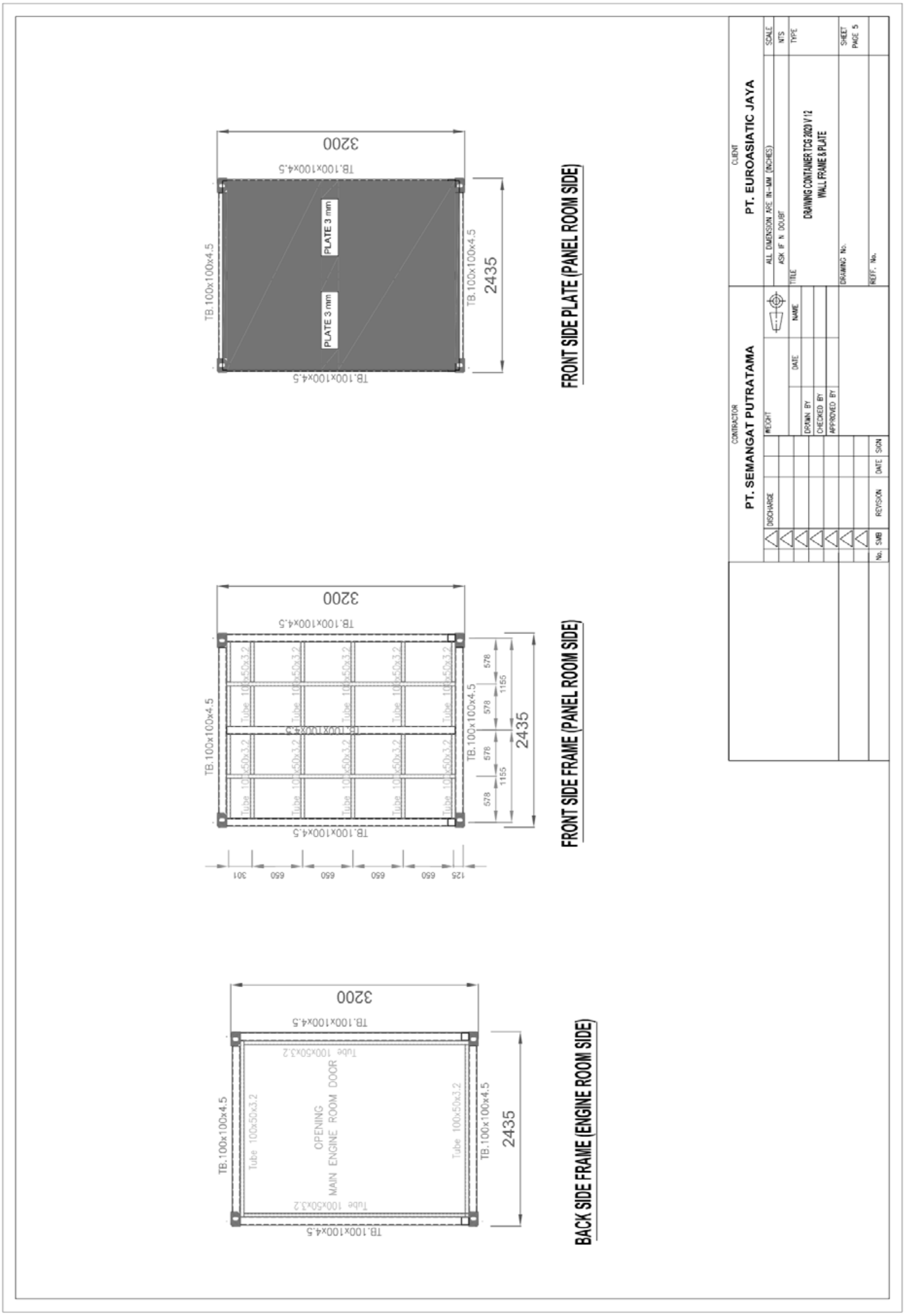
DRAWING CONTAINER TCG 2020 V 12
ROOF FRAME & PLATE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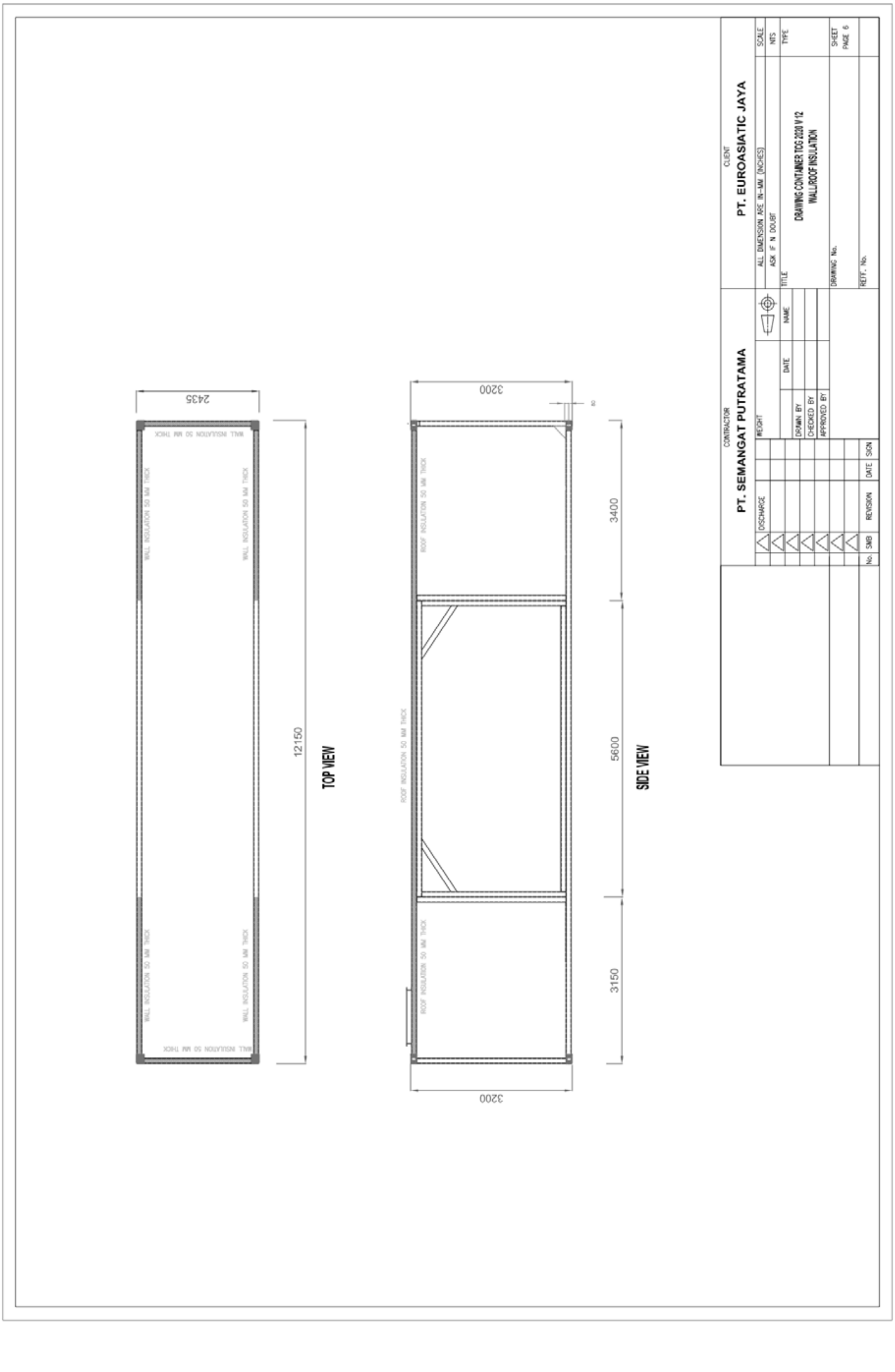
Tube 100x50x3.2
3200
2435
OPENING
MAIN ENGINE ROOM DOOR
PT. EUROASIATIC JAYA
PT. SEMANGAT PUTRATAMA
WALL FRAME & PLATE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DRAWING CONTAINER TCG 2020 V 12
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SHEET
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DRAWING No.
REFF. No.
DISCHARGE
WEIGHT
DATE
NAME
DRAWN BY
CHECKED BY
APPROVED BY
No.
SMB
REVISION
DATE
SIGN
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SIDE VIEW
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3400
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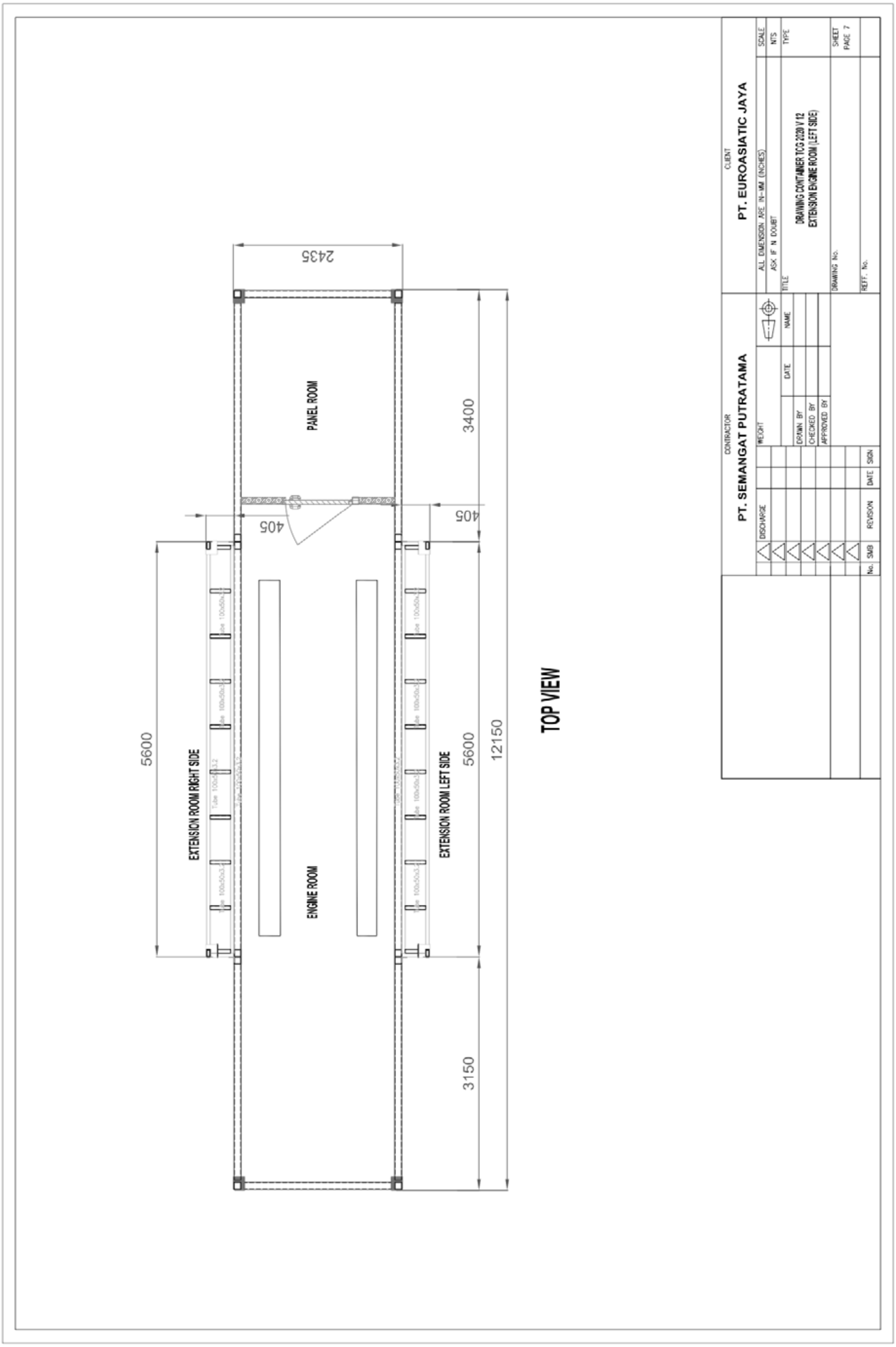
WALL INSULATION 50 MM THICK
ROOF INSULATION 50 MM THICK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ENGINE ROOM
EXTENSION ROOM RIGHT SIDE
EXTENSION ROOM LEFT SIDE
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3400
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405
5600
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12150
3150
CONTRACTOR
PT. SEMANGAT PUTRATAMA
CLIENT
PT. EUROASIATIC JAYA
ALL DIMENSION ARE IN-MM (INCHES)
ASK IF N DOUBT
SCALE
NTS
TYPE
TITLE
DRAWING CONTAINER TCG 2020 V 12
EXTENSION ENGINE ROOM (LEFT SIDE)
DRAWING No.
REFF. No.
SHEET
PAGE 7
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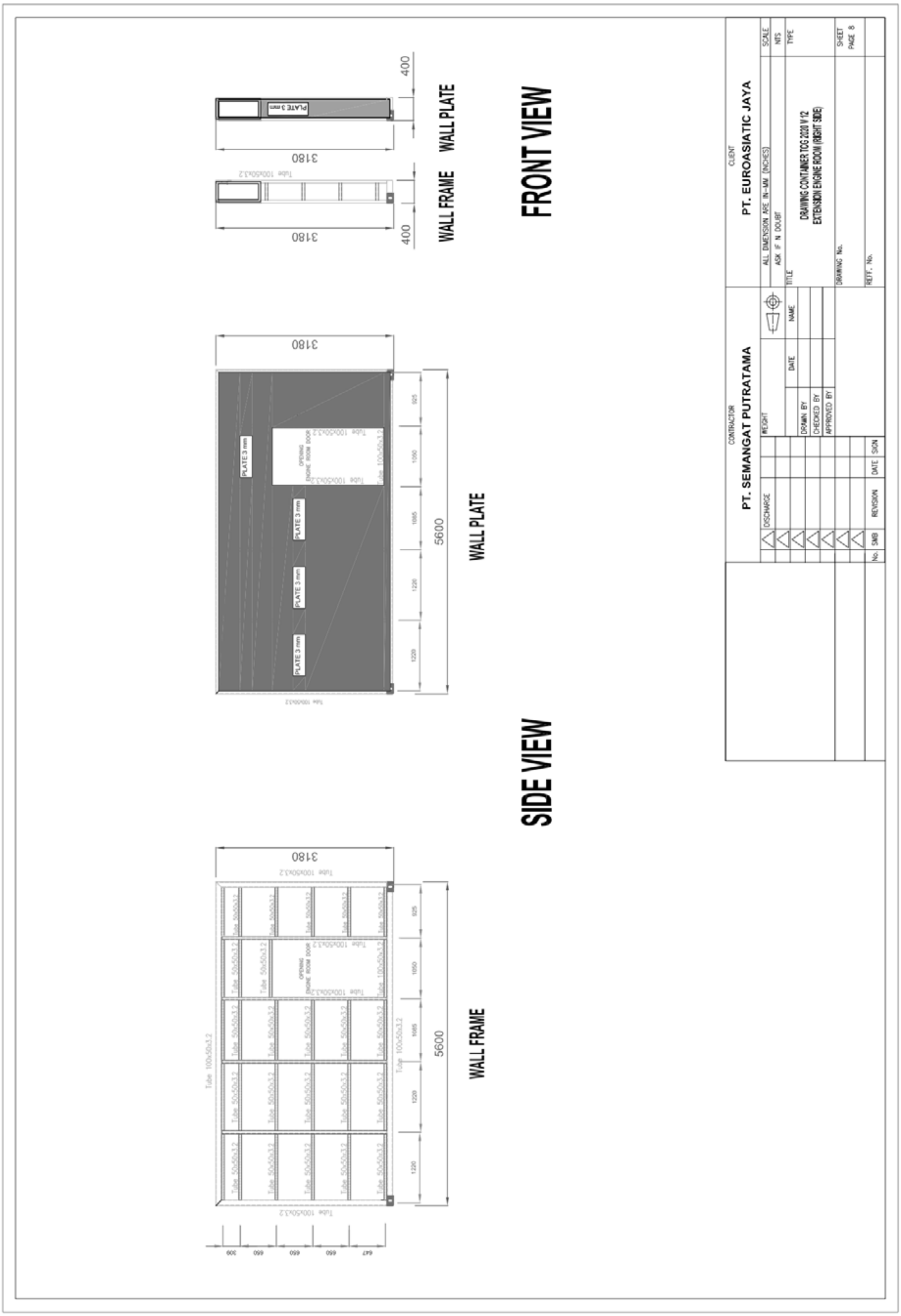
WEIGHT
DATE
NAME
DRAWN BY
CHECKED BY
APPROVED BY
No.
SMB
REVISION
DATE
SIGN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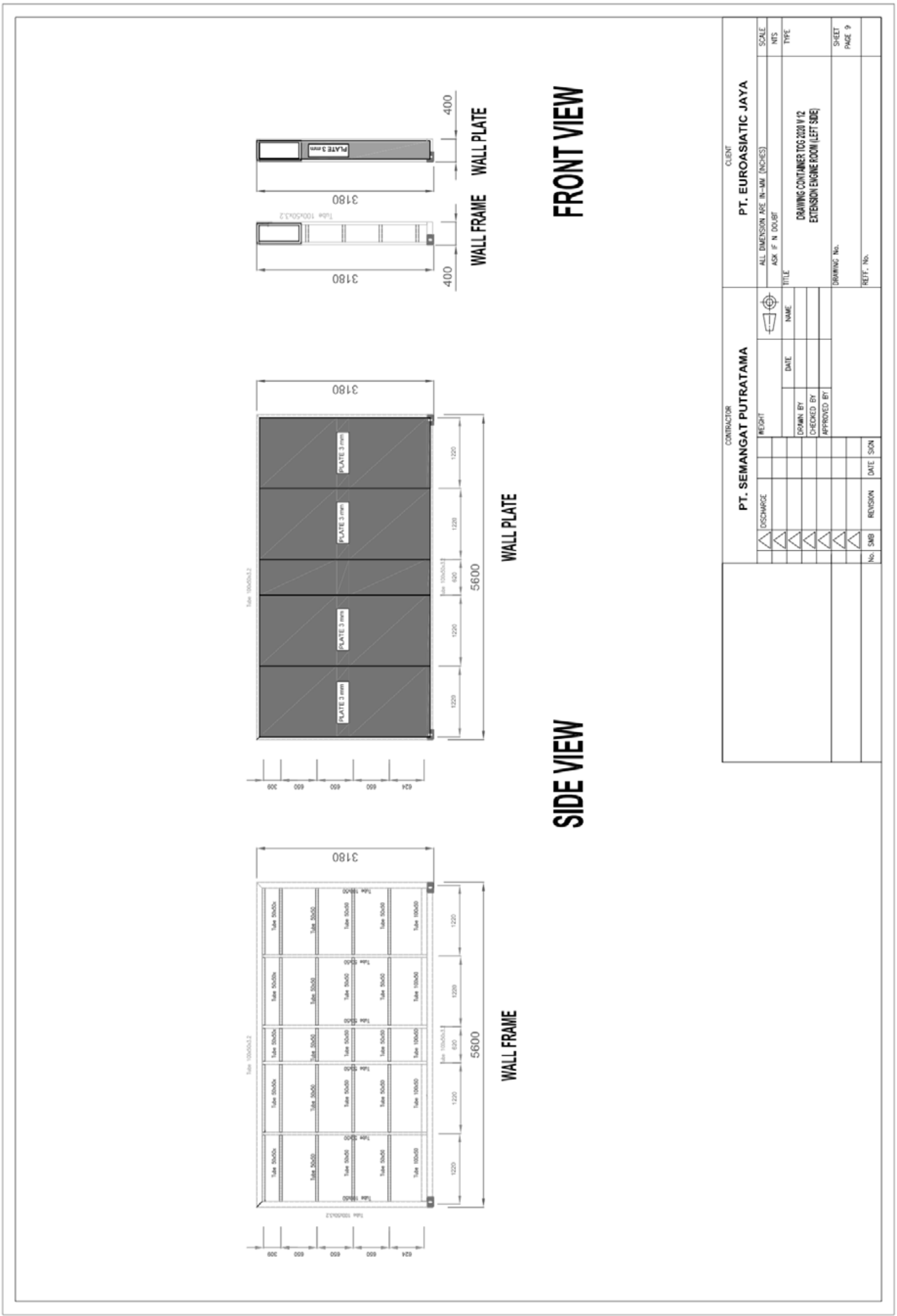
WALL PLATE
WALL FRAME
SIDE VIEW
WALL PLATE
WALL FRAME
3180
400
5600
PT. EUROASIATIC JAYA
PT. SEMANGAT PUTRATAMA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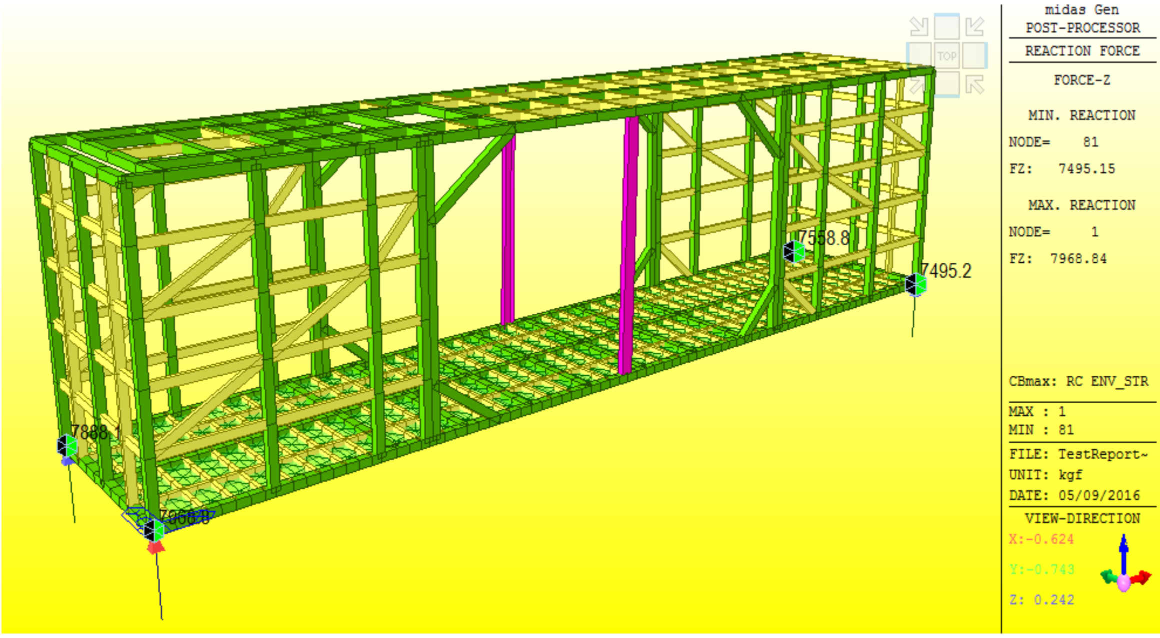
WALL FRAME
WALL PLATE
3180
400
PLATE 3 mm
SIDE VIEW
WALL PLATE
WALL FRAME
5600
1220
620
CLIENT
PT. EUROASIATIC JAYA
CONTRACTOR
PT. SEMANGAT PUTRATAMA
ALL DIMENSION ARE IN--MM (INCHES)
ASK IF IN DOUBT
SCALE
NTS
TYPE
TITLE
DRAWING CONTAINER TCG 2020 V 12
EXTENSION ENGINE ROOM (LEFT SIDE)
DRAWING No.
REFF. No.
SHEET
PAGE 9
DRAWN BY
CHECKED BY
APPROVED BY
DATE
NAME
DISCHARGE
WEIGHT
REVISION
DATE
SIGN

TEST AND RESULT

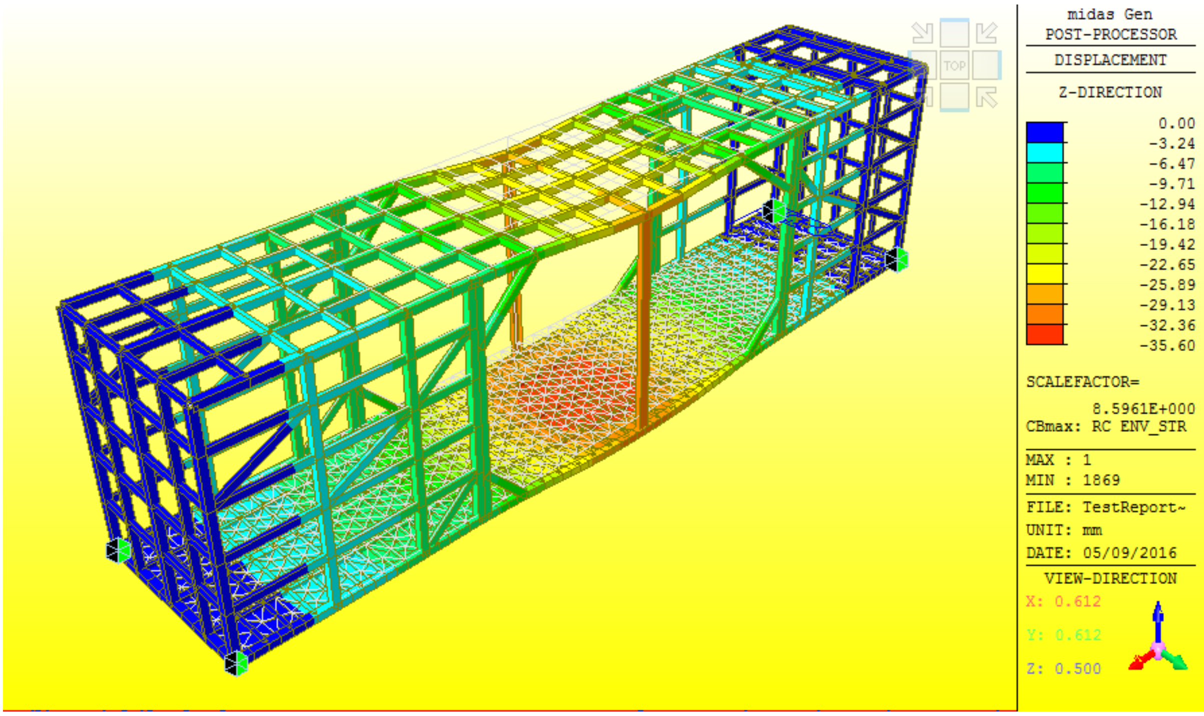
เนื่องจากสภาพหน้างานมีบางจุดที่ไม่สามารถที่จำทำการประกอบชิ้นส่วนค้ำยันให้ได้ตามรายการคำนวณ จึงได้ทำการออกแบบตรวจสอบเพิ่มเติม ดังรูป

<u>การทดสอบก่อนทำการยกจริง ให้ทำตามขั้นตอนดังนี้</u>

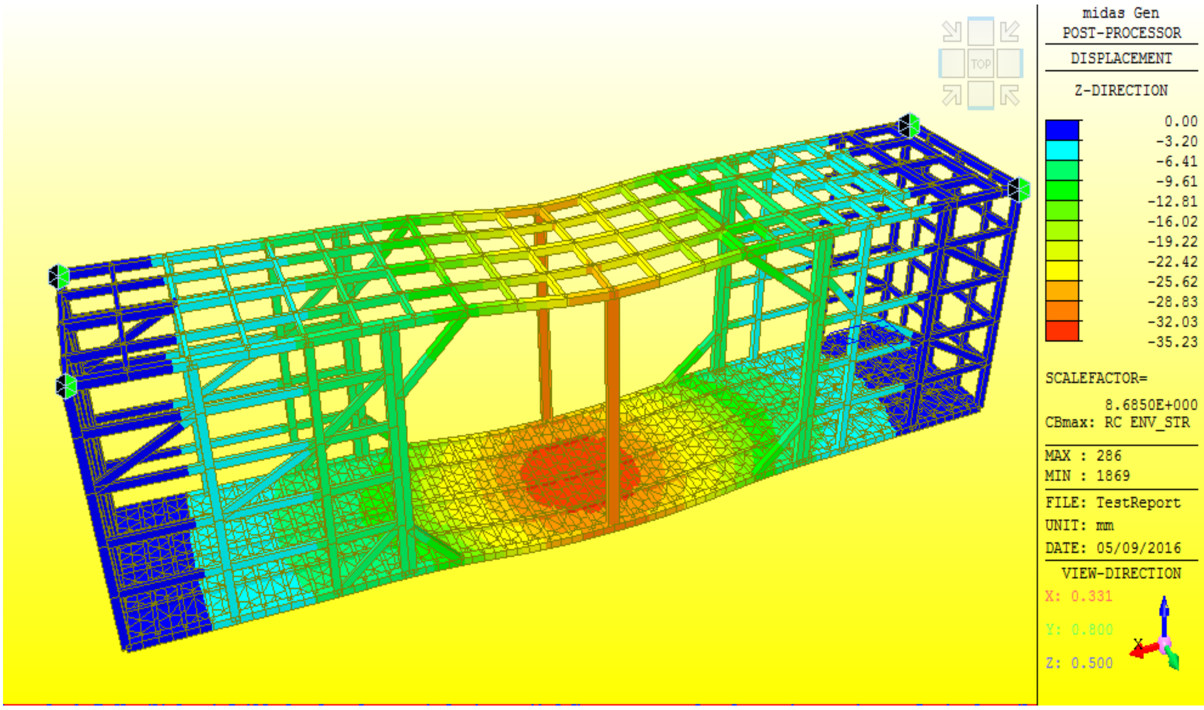
1. ประกอบเชื่อมยึดค้ำยันทั้ง 4 มุม และตำแหน่งกลางตู้แนวดิ่ง ตามแบบ
2. ตรวจสอบความเรียบร้อย และวัดค่าระดับทุกจุดตามตำแหน่งขา support ทั้งหมด
3. ให้ทำการ up lift ระบบโครงตู้ทั้งหมดโดยใช้แม่แรงไฮดรอลิคทั้งสี่มุม
4. ทำการปลดขา support ด้านล่างตู้ออกทั้งหมด คงเหลือเฉพาะสี่มุม
5. วัดค่าการทรุดตัวของชุดตู้ที่ตำแหน่งเดิม



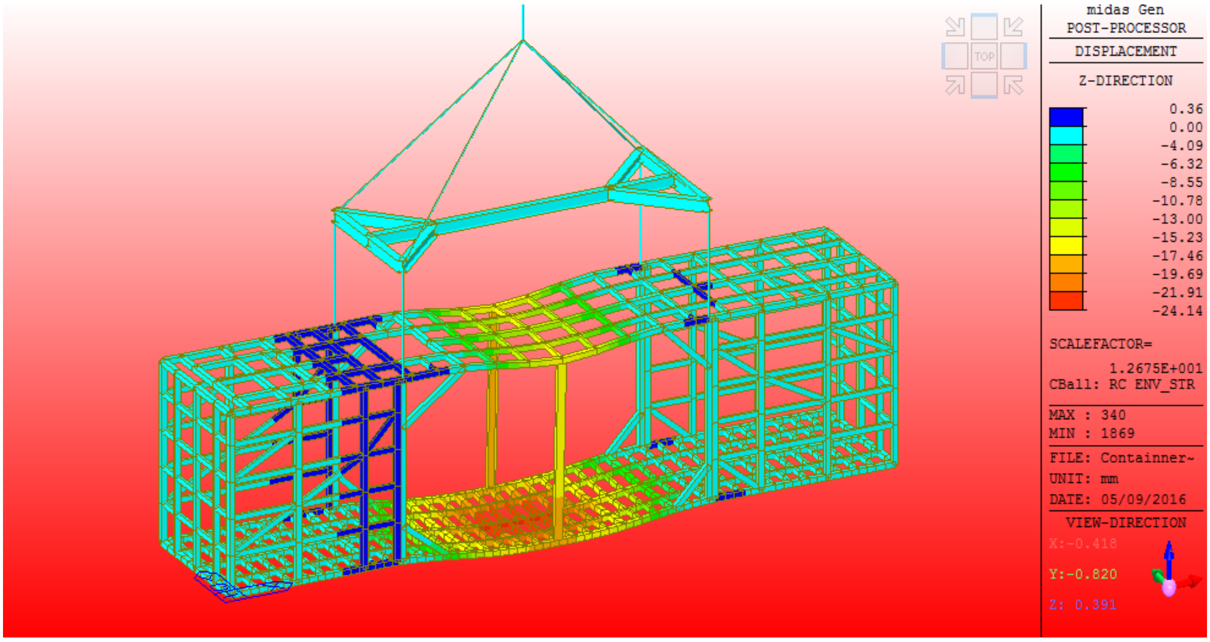
REACTION AT SUPPORT 7,968.84 kg



จากการวิเคราะห์ ได้ค่า DISPLACEMENT -35.60 mm มากกว่าค่าที่ได้จากการทดสอบ -2.50 mm ----------------> OK



ข้อแนะนำ ให้ใช้เครนในการยก 2 ตัว เนื่องจากน้ำหนักของเครื่องจักรไม่อยู่ในจุกกึ่งกลางตู้ และ จุดศูยน์ถ่วงของเครื่องจักร จะค่อนไปอีกฝั่ง ต้องทำการ Balance Load ให้เหมาะสมก่อนทำการยก



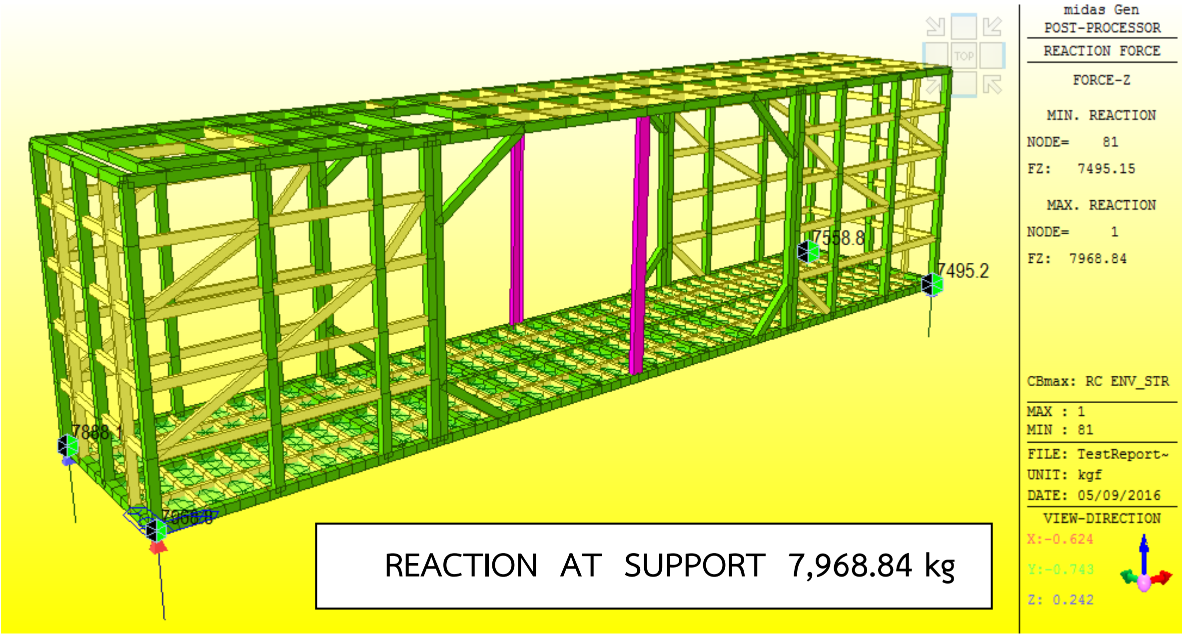
กรณีจุดยกอยู่ที่ตำแหน่งเดิม จากผลการวิเคราะห์โดยเอาชิ้นส่วนค้ำยันเดิมออกเนื่องจากกีดขวางกับงานระบบ ค่า DISPLACEMENT -24.14 mm.

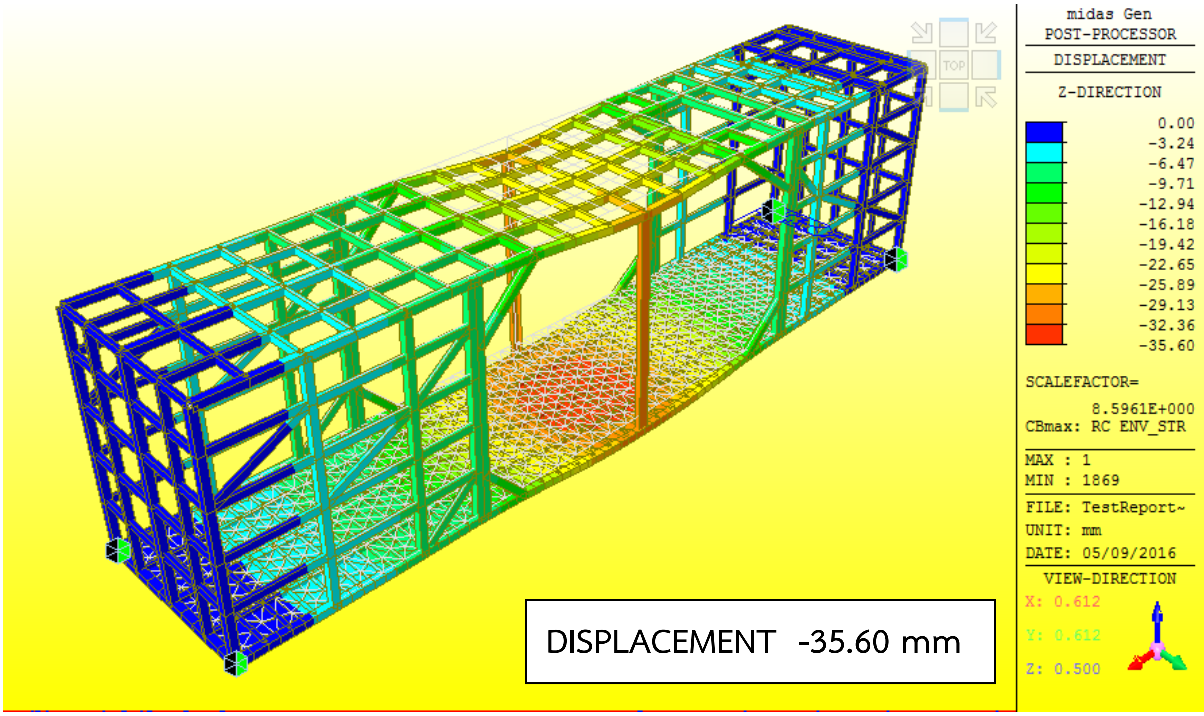
STRUCTURAL ANALYSIS

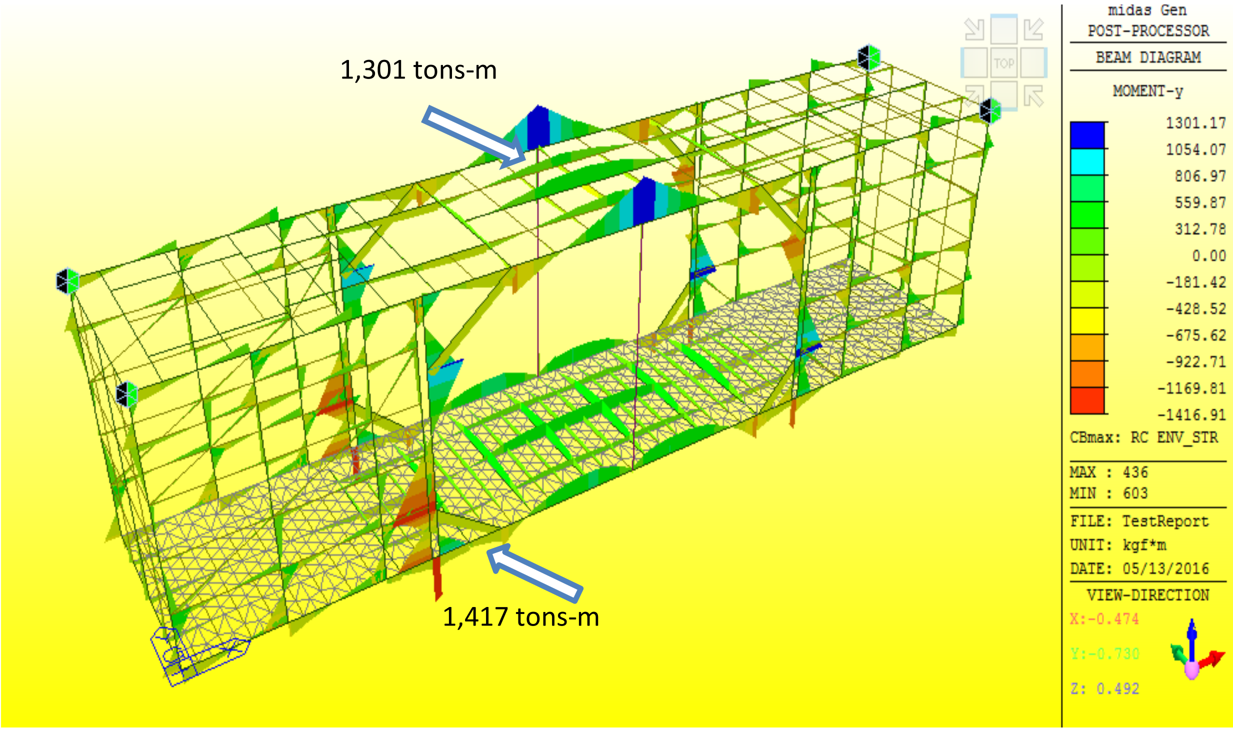
OF CONTAINER FRAME (PART 2)

DISPLACEMENT TEST AND RESULT

STRUCTURE ANALYSIS FOR TESTING

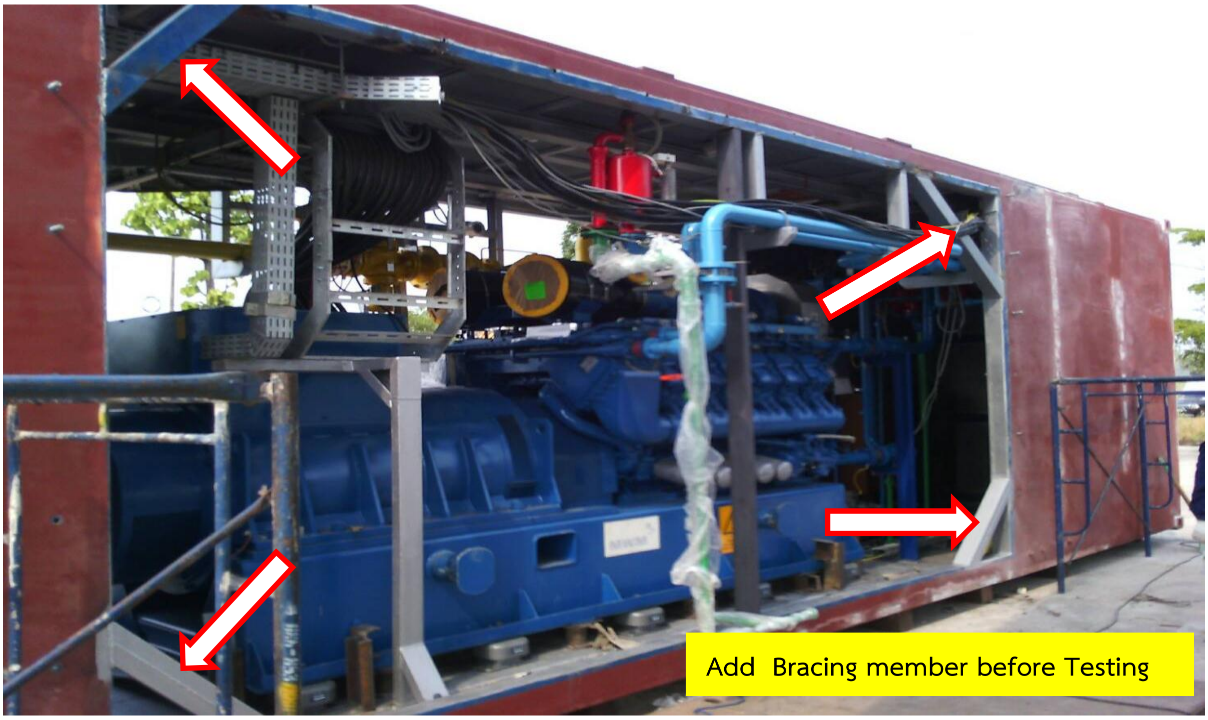






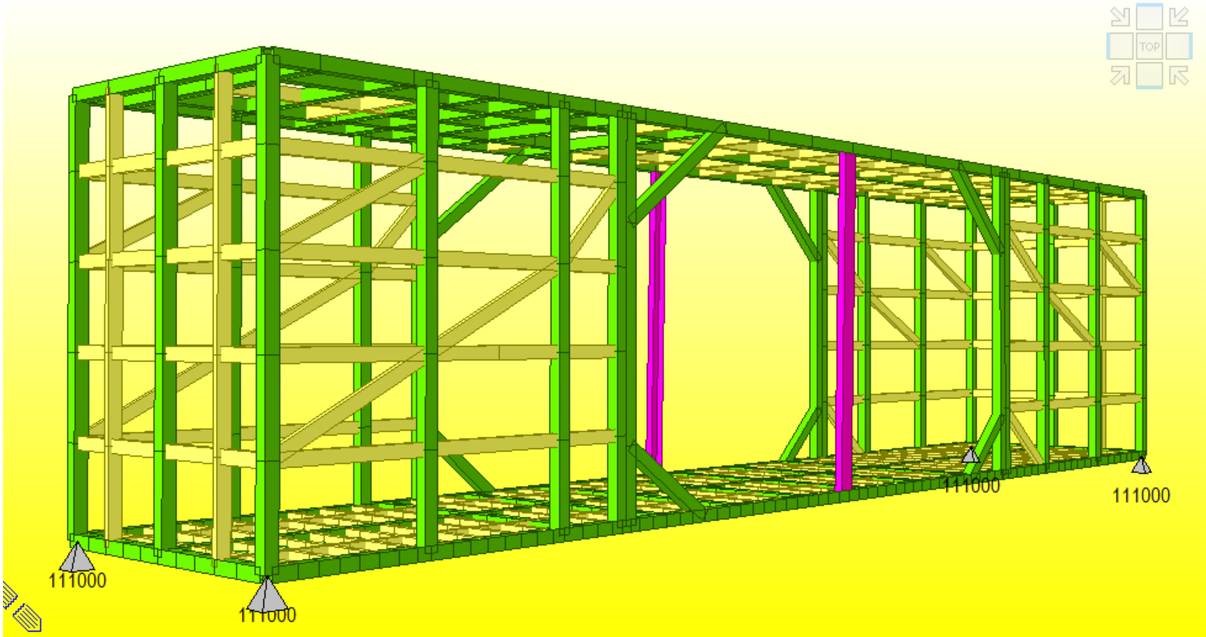
Analysis for Container Lift Up ; moment at middle member 1,301 tons-m and Vertical member 1,417 tons-m

Add Bracing Structure Before Testing Container

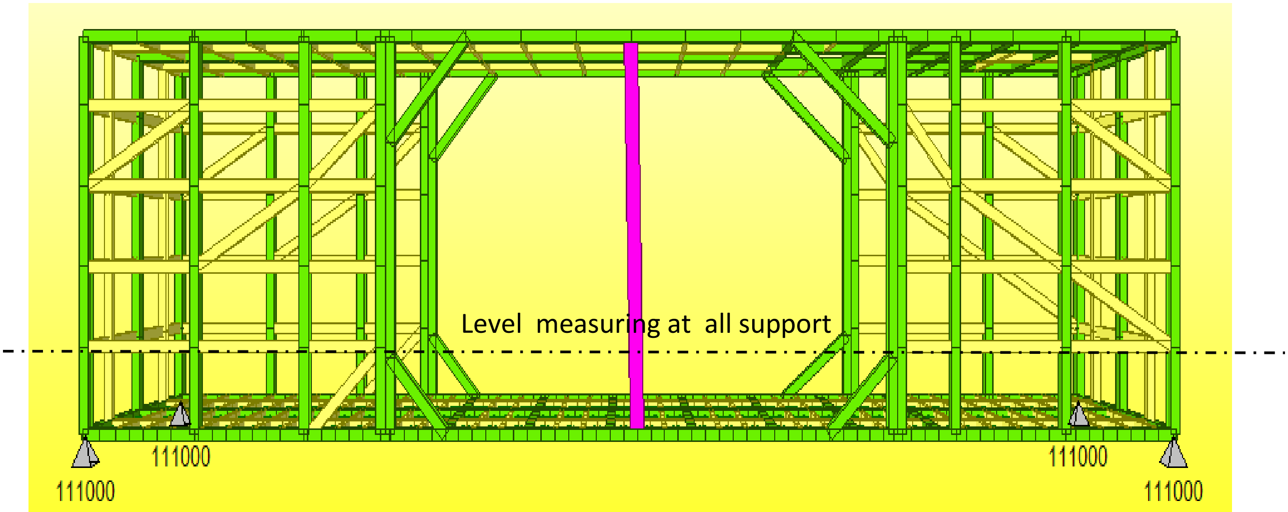


Method of Displacement Test

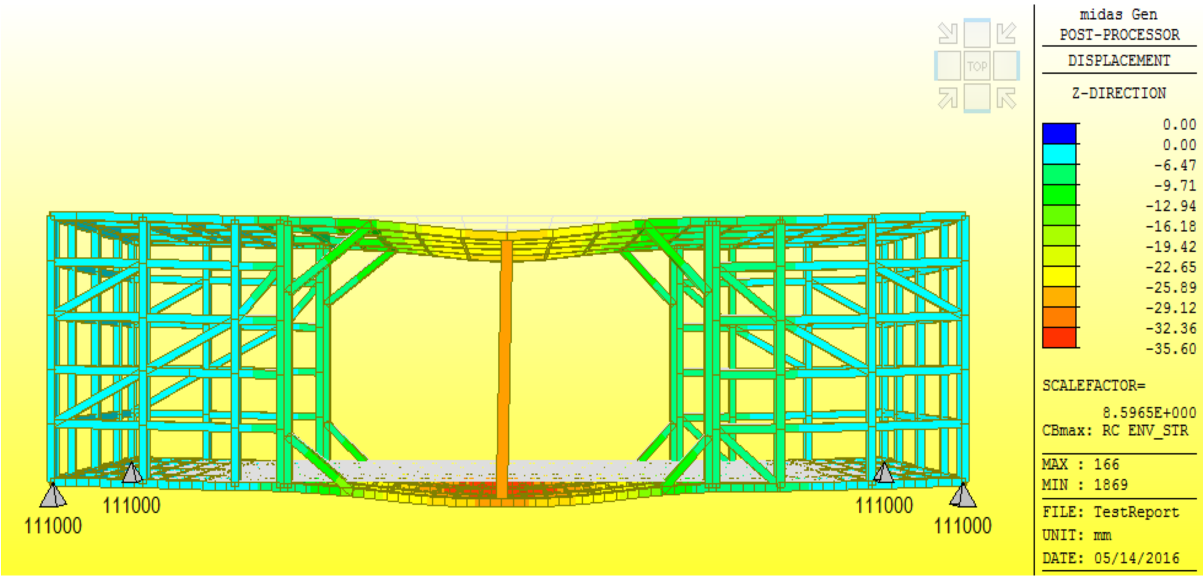
- Install Bracing member at Corner and Vertical member at center



- Recheck and Level measuring all support before Jackking container
- All four support ; Jig and Hydraulic lifting device



- Remove all support and install four corner support Level measuring at point
- Final Level measuring at middle container and all support



<u>DISPLACEMENT TEST RESULT</u>

Final Level measuring at middle container

Displacement = 2.50 mm

Less than Displacement form Analysis   35.60 mm ----------> OK

WORKING PHOTOS

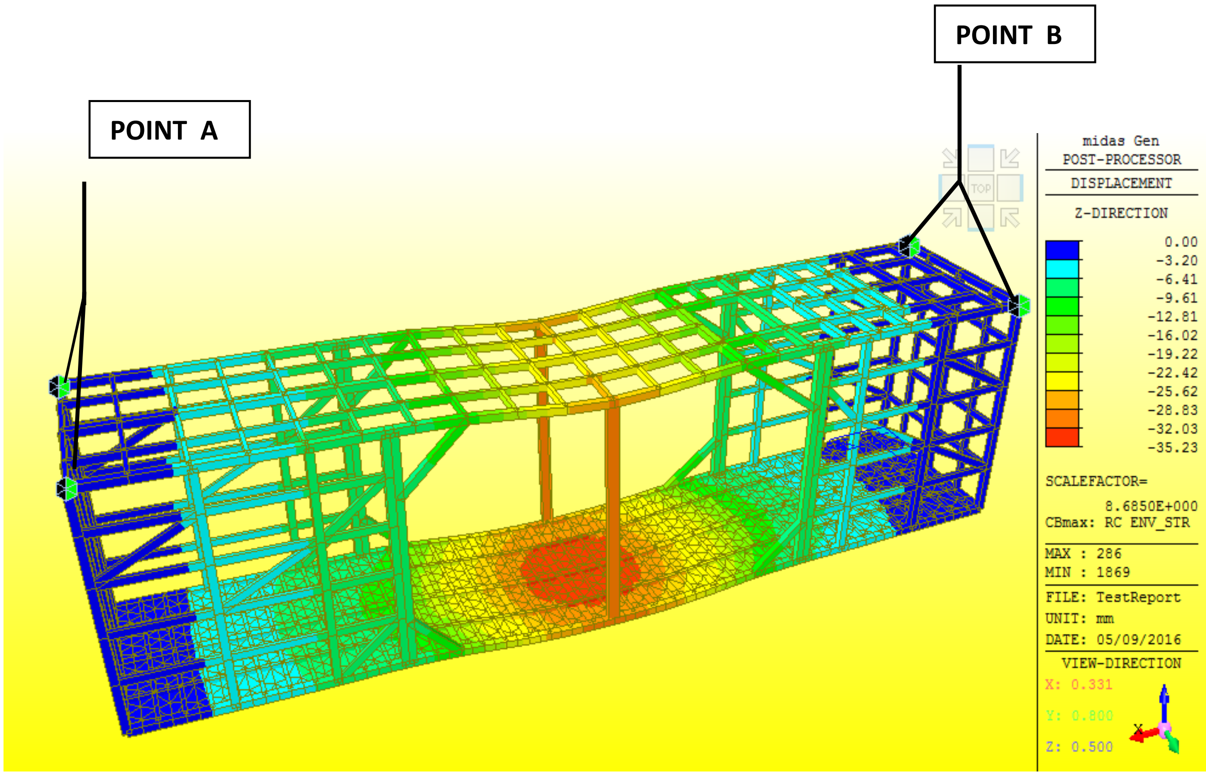
Structure deflect measuring by Level measuring device

Structure deflect measuring by Level measuring device

Jig and Hydraulic Lifting device

Recommended for Container Lift Up

1. Load max for design Temporary lifting = 8,000 x 4 = 32,000 kg
2. Add Temporary structure Diagonal member and Vertical member see picture
3. C-chanel 150 x 75 x 6.5 /10 mm at corner
4. At joint Plate 9 mm with 2-Bolt M20
5. Use two Crane kato at left and right container and balance load before Container Lift Up



Tension at lifting support 8 x 2 = 16 tons per point