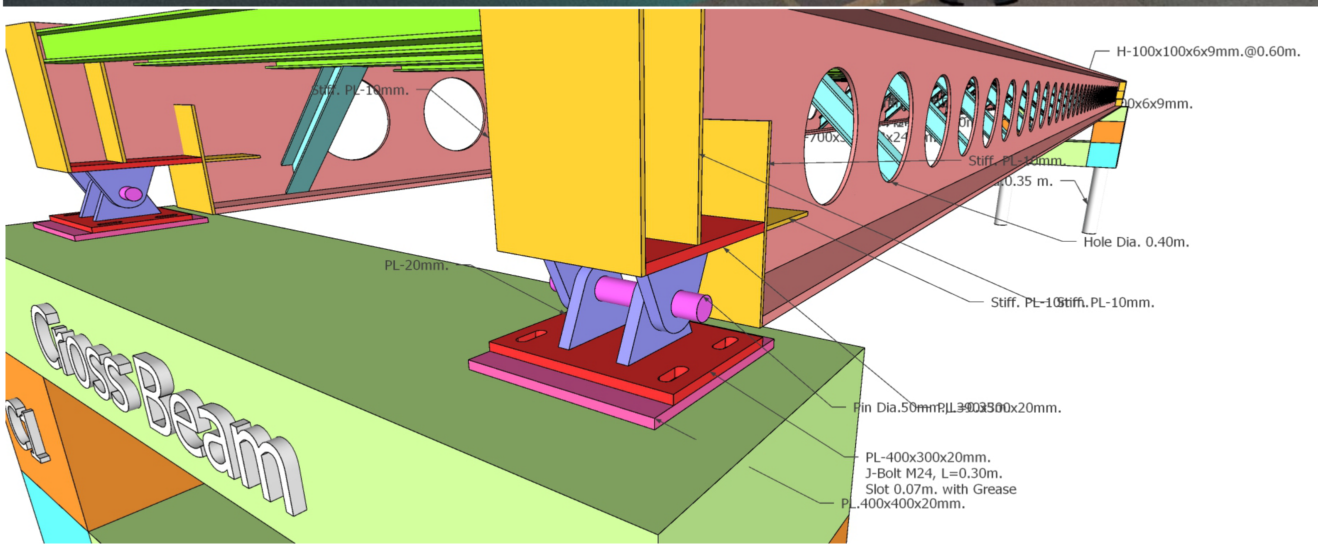
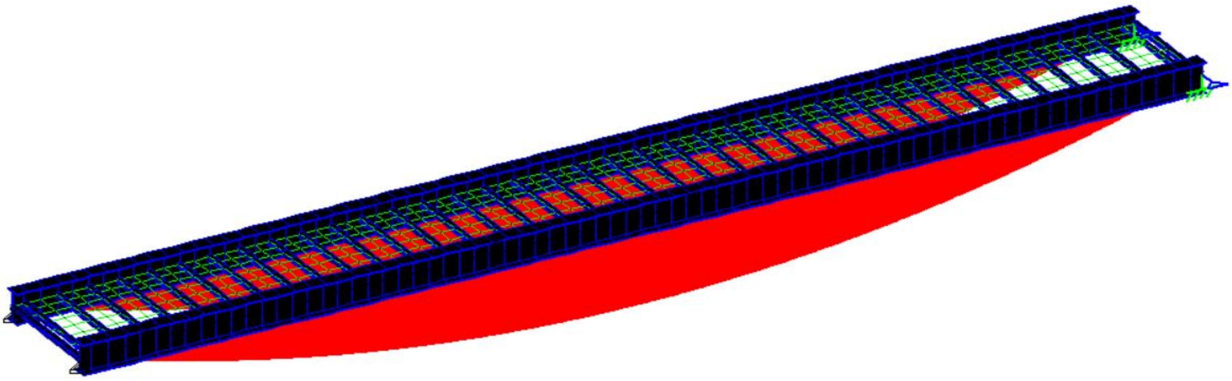
รายการคำนวณสะพานคนข้าม





Design Criteria

1. Loading

1.1 Dead Load

- Unit weight of steel = 7,850 kg/m^3
- Unit weight of concrete = 2,400 kg/m^3

1.2 Live Load

LL. = 400 kg/m^2

2. Material Structural

2.1 Cast-in-Place concrete

Purpose cylinder compressive strength at the age of 28 day, 280 ksc cement shall be Portland Cement, type I.

2.2 Structural Steel

Steel shapes, plates and bars	ASTM A36
Anchor shall be conformed to	ASTM A36
Bolts high strength bolts	ASTM A490

2.3 Welding Low-Hydrogen electrodes with E70 KSI

3. Material Property

fc' =	280	ksc	n =	9	
fy =	2,400	Ksc (Round Bar:SR 24)	k =	0.302	
fy =	4,000	Ksc (Deformed Bar:SD 40)	j =	0.899	
fy =	1,700	Ksc (Steel Structure ASTM A36)	R =	8.808	ksc
fc =	64.875	ksc			

Covering Footing and Column = 5 cm

Covering Socket = 5 cm

Covering Other = 2.50 cm

4. Design Standard

All structure design base on E.I.T. STANDARD (ว.ส.ท.) , ACI 318 standard and AASHTO for live load on side walk.

5. Other

<u>ตารางที่ 1</u> น้ำหนักบรรทุกคงที่ของวัสดุชนิดต่าง ๆ

น้ำหนักบรรทุกคงที่ของวัสดุ	หน่วยน้ำหนักโดยประมาณ
1. คอนกรีตเสริมเหล็ก	2300- 2400 กก./ลบ.ม.
2. เหล็ก	7700 – 7900 กก./ลบ.ม.
3. ไม้	460 – 490 กก./ลบ.ม.
4. กระจก	2900 – 3000 กก./ลบ.ม.
5. น้ำ	1000 กก./ลบ.ม.
6. ผนังอิฐบล็อกรวมฉาบหนา 10 ซม.	120 – 150 กก./ตร.ม.
7. ผนังอิฐมอญรวมฉาบหนา 10 ซม.	180 – 200 กก./ตร.ม.
8. ผนังอิฐบล็อกมวลเบารวมฉาบหนา 10 ซม.	90 – 100 กก./ตร.ม.
9. ผนังเบา เช่น ไม้อัด, ยิปซั่ม รวมโครงคร่าว	20 – 40 กก./ตร.ม.
10. หลังคากระเบื้องลอนคู่, ลอนเล็ก รวมแป	12 – 15 กก./ตร.ม.
11. หลังคากระเบื้องโมเนีย, ดินเผาเคลือบ รวมระแนง	50 – 70 กก./ตร.ม.
12. โครงสร้างหลังคา	20 – 50 กก./ตร.ม.
13. ฝ้าเพดาน รวมโครงคร่าว	15 – 20 กก./ตร.ม.
14. พื้นไม้รวมตง	30 – 50 กก./ตร.ม.
15. พื้นสำเร็จรูปรวมคอนกรีตทับหน้า รวมหนา 10 ซม.	240 – 260 กก./ตร.ม.
16. กระเบื้องปูพื้นรวมปูนทราย หนา 5 ซม.	120 – 150 กก./ตร.ม.

3.3.5 Where the abrasion of concrete is not expected, the traffic may bear directly on the concrete slab. If considered desirable, ¼ inch or more may be added to the slab for a wearing surface.

3.3.6 The following weights are to be used in computing the dead load:

	#/cu.ft.
Steel or cast steel	490
Cast iron	450
Aluminum alloys	175
Timber (treated or untreated)	50
Concrete, plain or reinforced	150
Compacted sand, earth, gravel, or ballast	120
Loose sand, earth, and gravel	100
Macadam or gravel, rolled	140
Cinder filling	60
Pavement, other than wood block	150
Railway rails, guardrails, and fastenings (per linear foot of track)	200
Stone masonry	170
Asphalt plank, 1 in. thick	9 lb. sq. ft.

3.4 LIVE LOAD

The live load shall consist of the weight of the applied moving load of vehicles, cars, and pedestrians.

3.5 OVERLOAD PROVISIONS

3.5.1 For all loadings less than H 20, provision shall be made for an infrequent heavy load by applying Loading Combination IA (see Article 3.22), with the live load assumed to be H or HS truck and to occupy a single lane without concurrent loading in any other lane. The overload shall apply to all parts of the structure affected, except the roadway deck, or roadway deck plates and stiffening ribs in the case of orthotropic bridge superstructures.

3.5.2 Structures may be analyzed for an overload that is selected by the operating agency in accordance with Loading Combination Group IB in Article 3.22.

3.6 TRAFFIC LANES

3.6.1 The lane loading or standard truck shall be assumed to occupy a width of 10 feet.

3.6.2 These loads shall be placed in 12-foot wide design traffic lanes, spaced across the entire bridge roadway width measured between curbs.

3.6.3 Fractional parts of design lanes shall not be used, but roadway widths from 20 to 24 feet shall have two design lanes each equal to one-half the roadway width.

3.6.4 The traffic lanes shall be placed in such numbers and positions on the roadway, and the loads shall be placed in such positions within their individual traffic lanes, so as to produce the maximum stress in the member under consideration.

3.7 HIGHWAY LOADS

3.7.1 Standard Truck and Lane Loads*

3.7.1.1 The highway live loadings on the roadways of bridges or incidental structures shall consist of standard trucks or lane loads that are equivalent to truck trains. Two systems of loading are provided, the H loadings and the HS loadings—the HS loadings being heavier than the corresponding H loadings.

3.7.1.2 Each lane load shall consist of a uniform load per linear foot of traffic lane combined with a single concentrated load (or two concentrated loads in the case of continuous spans—see Article 3.11.3), so placed on the span as to produce maximum stress. The concentrated load and uniform load shall be considered as uniformly distributed over a 10-foot width on a line normal to the center line of the lane.

3.7.1.3 For the computation of moments and shears, different concentrated loads shall be used as indicated in Figure 3.7.6B. The lighter concentrated loads shall be used when the stresses are primarily bending stresses, and the heavier concentrated loads shall be used when the stresses are primarily shearing stresses.

*Note: The system of lane loads defined here (and illustrated in Figure 3.7.6.B) was developed in order to give a simpler method of calculating moments and shears than that based on wheel loads of the truck.

Appendix B shows the truck train loadings of the 1935 Specifications of AASHO and the corresponding lane loadings.

In 1944, the HS series of trucks was developed. These approximate the effect of the corresponding 1935 truck preceded and followed by a train of trucks weighing three-fourths as much as the basic truck.

3.7.2 Classes of Loading

There are four standard classes of highway loading: H 20, H 15, HS 20, and HS 15. Loading H 15 is 75% of Loading H 20. Loading HS 15 is 75% of Loading HS 20. If loadings other than those designated are desired, they shall be obtained by proportionately changing the weights shown for both the standard truck and the corresponding lane loads.

3.7.3 Designation of Loadings

The policy of affixing the year to loadings to identify them was instituted with the publication of the 1944 Edition in the following manner:

H 15 Loading, 1944 Edition shall be designated	H 15-44
H 20 Loading, 1944 Edition shall be designated	H 20-44
H 15-S 12 Loading, 1944 Edition shall be designated	HS 15-44
H 20-S 16 Loading, 1944 Edition shall be designated	HS 20-44

The affix shall remain unchanged until such time as the loading specification is revised. The same policy for identification shall be applied, for future reference, to loadings previously adopted by AASHTO.

3.7.4 Minimum Loading

Bridges supporting Interstate highways or other highways which carry, or which may carry, heavy truck traffic, shall be designed for HS 20-44 Loading or an Alternate Military Loading of two axles four feet apart with each axle weighing 24,000 pounds, whichever produces the greatest stress.

3.7.5 H Loading

The H loadings consist of a two-axle truck or the corresponding lane loading as illustrated in Figures 3.7.6A and 3.7.6B. The H loadings are designated H followed by a number indicating the gross weight in tons of the standard truck.

3.7.6 HS Loading

The HS loadings consist of a tractor truck with semitrailer or the corresponding lane load as illustrated in Figures 3.7.7A and 3.7.6B. The HS loadings are designated by the letters HS followed by a number indicating the gross weight in tons of the tractor truck. The variable axle spacing has been introduced in order that the spacing of axles may approximate more closely the tractor trailers now in use. The variable spacing also provides a more satisfactory loading for continuous spans, in that heavy axle loads may be so placed on adjoining spans as to produce maximum negative moments.

3.8 IMPACT

3.8.1 Application

Highway Live Loads shall be increased for those structural elements in Group A, below, to allow for dynamic, vibratory and impact effects. Impact allowances shall not be applied to items in Group B. It is intended that impact be included as part of the loads transferred from superstructure to substructure, but shall not be included in loads transferred to footings nor to those parts of piles or columns that are below ground.

3.8.1.1 Group A—Impact shall be included.

(1) Superstructure, including legs of rigid frames.
(2) Piers, (with or without bearings regardless of type) excluding footings and those portions below the ground line.
(3) The portions above the ground line of concrete or steel piles that support the superstructure.

3.8.1.2 Group B—Impact shall not be included.

(1) Abutments, retaining walls, piles except as specified in Article 3.8.1.1 (3).
(2) Foundation pressures and footings.
(3) Timber structures.
(4) Sidewalk loads.
(5) Culverts and structures having 3 feet or more cover.

3.8.2 Impact Formula

3.8.2.1 The amount of the impact allowance or increment is expressed as a fraction of the live load stress, and shall be determined by the formula:

$$I = \frac{50}{L + 125} \qquad (3\text{-}1)$$

in which,

I = impact fraction (maximum 30 percent);

3.13 ELECTRIC RAILWAY LOADS

If highway bridges carry electric railway traffic, the railway loads shall be determined from the class of traffic which the bridge may be expected to carry. The possibility that the bridge may be required to carry railroad freight cars shall be given consideration.

3.14 SIDEWALK, CURB, AND RAILING LOADING

3.14.1 Sidewalk Loading

3.14.1.1 Sidewalk floors, stringers, and their immediate supports shall be designed for a live load of 85 pounds per square foot of sidewalk area. Girders, trusses, arches, and other members shall be designed for the following sidewalk live loads:

Spans 0 to 25 feet in length . . . . 85 lb./ft.^{2}
Spans 26 to 100 feet in length . . . . 60 lb./ft.^{2}
Spans over 100 feet in length according to the formula

$$P = \left(30 + \frac{3,000}{L}\right)\left(\frac{55 - W}{50}\right) \qquad (3\text{-}3)$$

in which

P = live load per square foot, max. 60-lb. per sq. ft.
L = loaded length of sidewalk in feet.
W = width of sidewalk in feet.

3.14.1.2 In calculating stresses in structures that support cantilevered sidewalks, the sidewalk shall be fully loaded on only one side of the structure if this condition produces maximum stress.

3.14.1.3 Bridges for pedestrian and/or bicycle traffic shall be designed for a live load of 85 PSF.

3.14.1.4 Where bicycle or pedestrian bridges are expected to be used by maintenance vehicles, special design consideration should be made for these loads.

3.14.2 Curb Loading

3.14.2.1 Curbs shall be designed to resist a lateral force of not less than 500 pounds per linear foot of curb, applied at the top of the curb, or at an elevation 10 inches above the floor if the curb is higher than 10 inches.

3.14.2.2 Where sidewalk, curb, and traffic rail form an integral system, the traffic railing loading shall be applied and stresses in curbs computed accordingly.

3.14.3 Railing Loading

For Railing Loads, see Article 2.7.1.3.

3.15 WIND LOADS

The wind load shall consist of moving uniformly distributed loads applied to the exposed area of the structure. The exposed area shall be the sum of the areas of all members, including floor system and railing, as seen in elevation at 90 degrees to the longitudinal axis of the structure. The forces and loads given herein are for a base wind velocity of 100 miles per hour. For Group II and Group V loadings, but not for Group III and Group VI loadings, they may be reduced or increased in the ratio of the square of the design wind velocity to the square of the base wind velocity provided that the maximum probable wind velocity can be ascertained with reasonable accuracy, or provided that there are permanent features of the terrain which make such changes safe and advisable. If a change in the design wind velocity is made, the design wind velocity shall be shown on the plans.

3.15.1 Superstructure Design

3.15.1.1 Group II and Group V Loadings

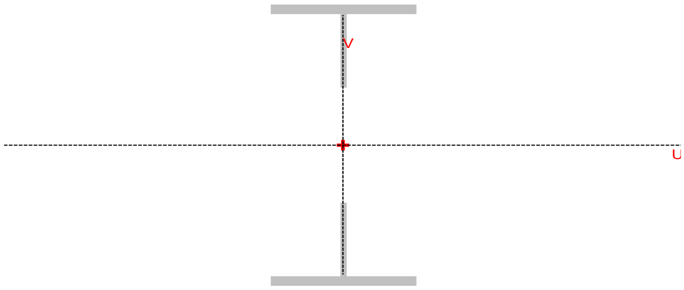
3.15.1.1.1 A wind load of the following intensity shall be applied horizontally at right angles to the longitudinal axis of the structure:

For trusses and arches ....75 pounds per square foot
For girders and beams ....50 pounds per square foot

3.15.1.1.2 The total force shall not be less than 300 pounds per linear foot in the plane of the windward chord and 150 pounds per linear foot in the plane of the leeward chord on truss spans, and not less than 300 pounds per linear foot on girder spans.

3.15.1.2 Group III and Group VI Loadings

Group III and Group VI loadings shall comprise the loads used for Group II and Group V loadings reduced by 70% and a load of 100 pounds per linear foot applied at right angles to the longitudinal axis of the structure and 6 feet above the deck as a wind load on a moving live load.



Section element	Rotation angle	Mirror	Material	E (kg/cm^2)
Sheet 300 x 24			Steel	2089704.383
Sheet 300 x 24			Steel	2089704.383
Sheet 176 x 13	90.0		Steel	2089704.383
Sheet 176 x 13	90.0		Steel	2089704.383

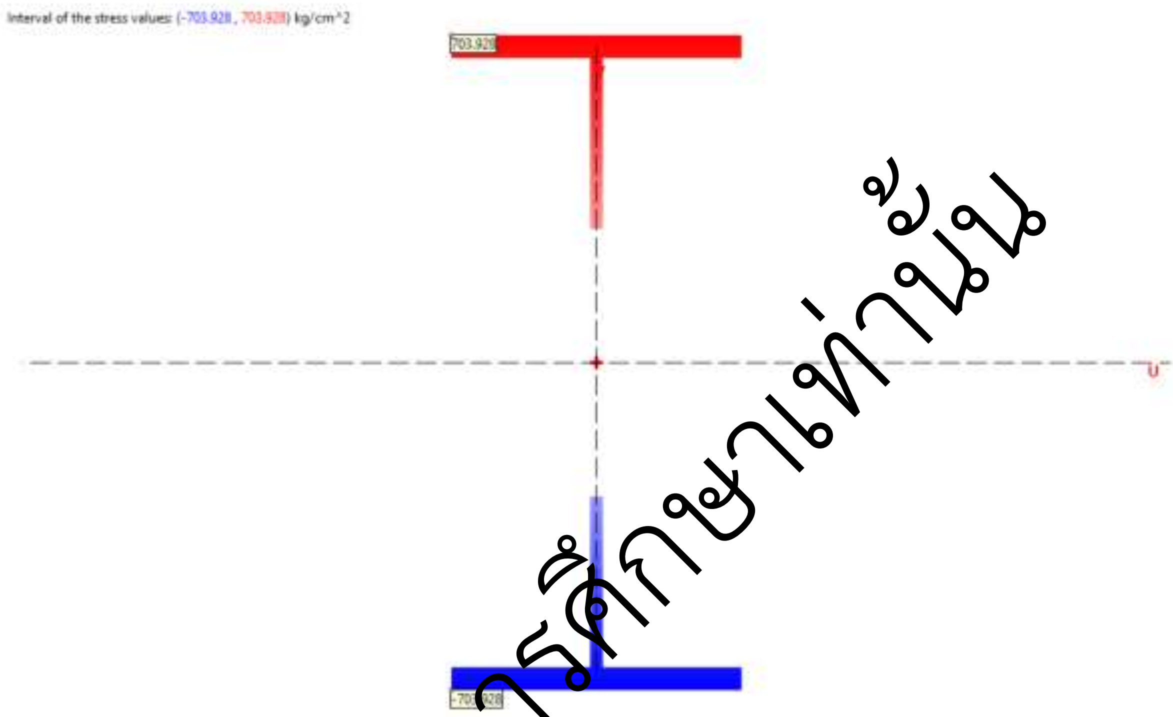
The overall dimensions of the section are 300 x 676 mm

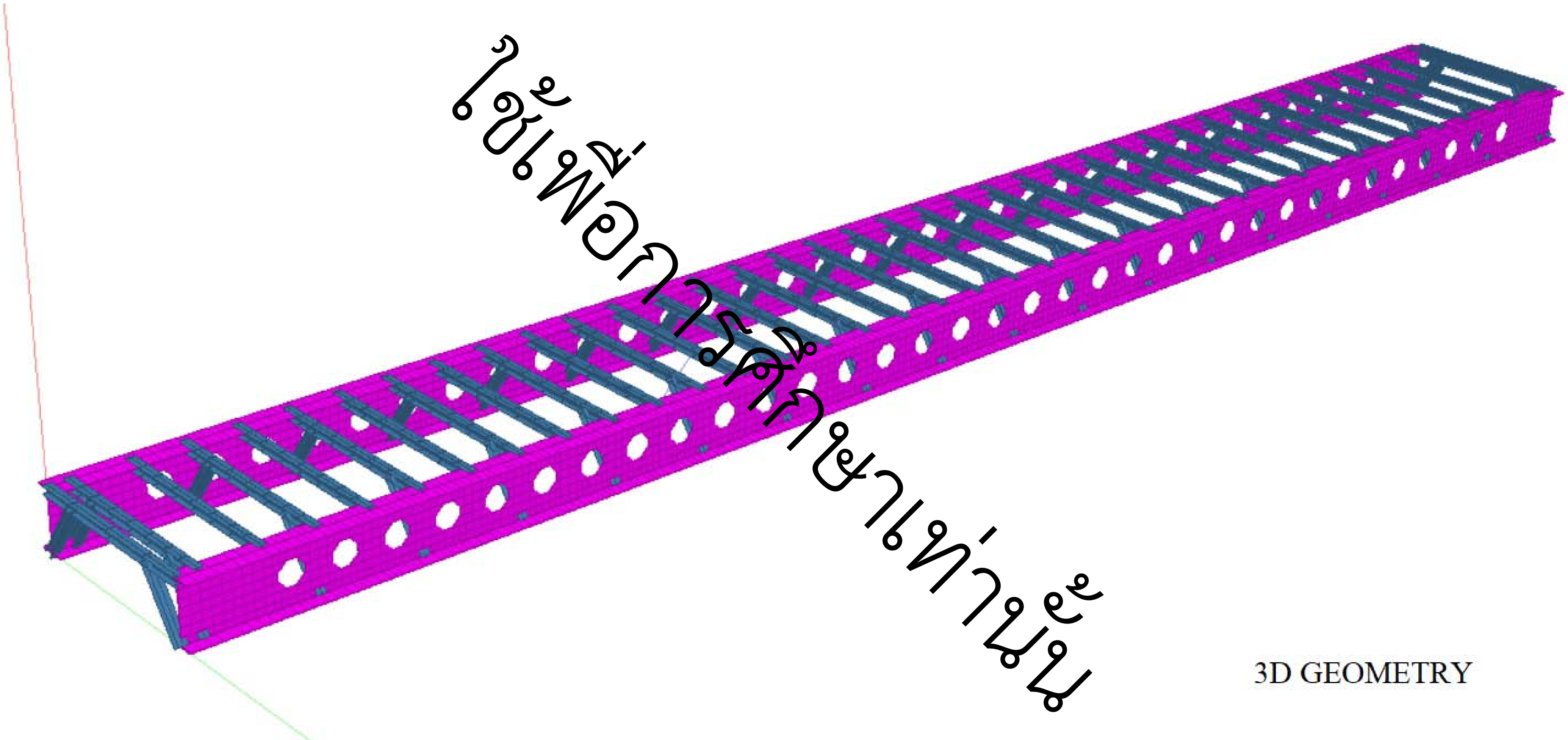
Basic geometry of the section

	Parameter	Value	
A	Cross sectional area	189.76	cm^2
α	Angle between Y-Z and U-V axes	0.0	deg
I_y	Moment of inertia about axis parallel to Y passing through centroid	177660.16	cm^4
I_z	Moment of inertia about axis parallel to Z passing through centroid	10806.44	cm^4
I_t	Torsional moment of inertia (St. Venant)	283.87	cm^4
i_y	Radius of gyration about axis parallel to Y passing through centroid	30.6	cm
i_z	Radius of gyration about axis parallel to Z passing through centroid	7.55	cm
W_{u+}	Elastic modulus about U-axis (+ve extreme)	5256.22	cm^3
W_{u-}	Elastic modulus about U-axis (-ve extreme)	5256.22	cm^3
W_{v+}	Elastic modulus about V-axis (+ve extreme)	720.43	cm^3
W_{v-}	Elastic modulus about V-axis (-ve extreme)	720.43	cm^3
$W_{pl,u}$	Plastic modulus about axis parallel to U-axis	5727.76	cm^3
$W_{pl,v}$	Plastic modulus about axis parallel to V-axis	1094.87	cm^3
I_u	Moment of inertia about U-axis	177660.16	cm^4
I_v	Moment of inertia about V-axis	10806.44	cm^4
i_u	Radius of gyration about U-axis	30.6	cm
i_v	Radius of gyration about V-axis	7.55	cm
a_{u+}	Centroid to edge of compression zone along +ve U-axis	3.8	cm
a_{u-}	Centroid to edge of compression zone along -ve U-axis	3.8	cm
a_{v+}	Centroid to edge of compression zone along +ve V-axis	27.7	cm
a_{v-}	Centroid to edge of compression zone along -ve V-axis	27.7	cm
y_M	Distance to centroid along Y-axis	15.0	cm
z_M	Distance to centroid along Z-axis	33.8	cm
y_P	Distance to equal area axis along Y-axis	15.0	cm

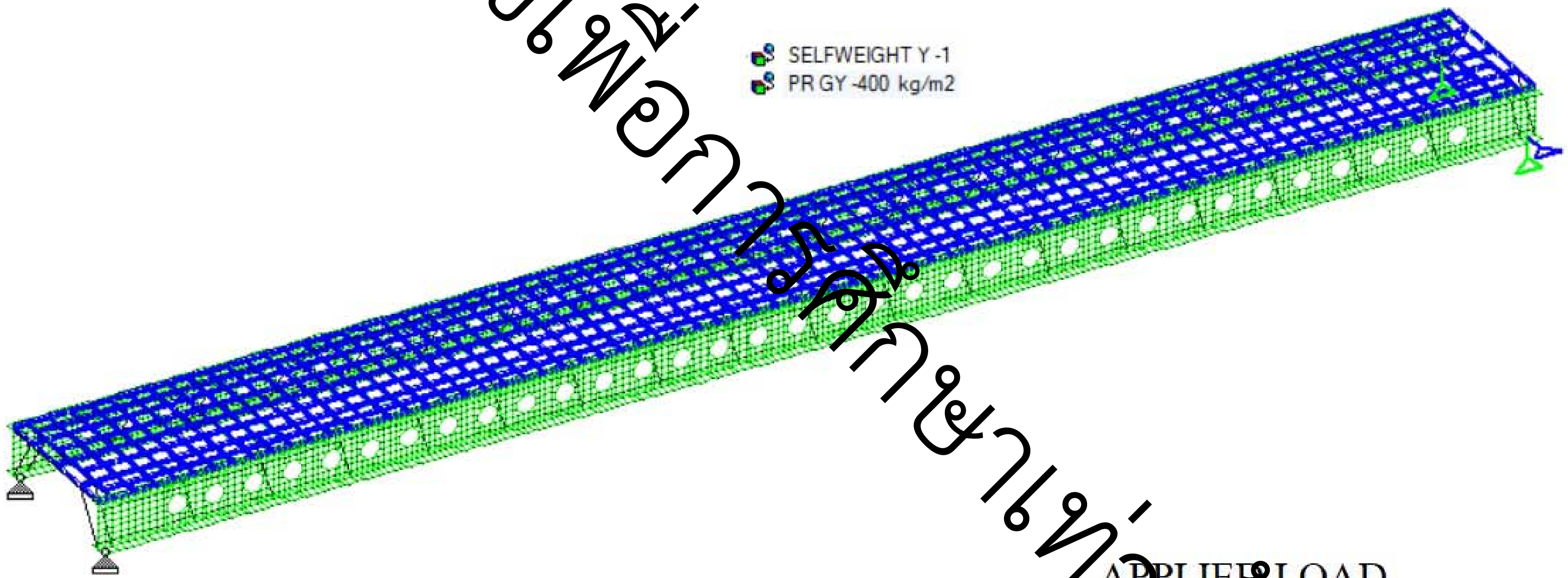
z_P	Distance to equal area axis along Z-axis	33.8	cm
I_{yz}	Moment of inertia Iyz in the user coordinates	-6.01853e-028	^{4}
u_P	Distance to equal area axis along U-axis	0.0	cm
v_P	Distance to equal area axis along V-axis	0.0	cm

File: D:\Thai Daichi Co.,Ltd\งานแว่น\สะพานคนข้าม\Section\Section700x300.sec

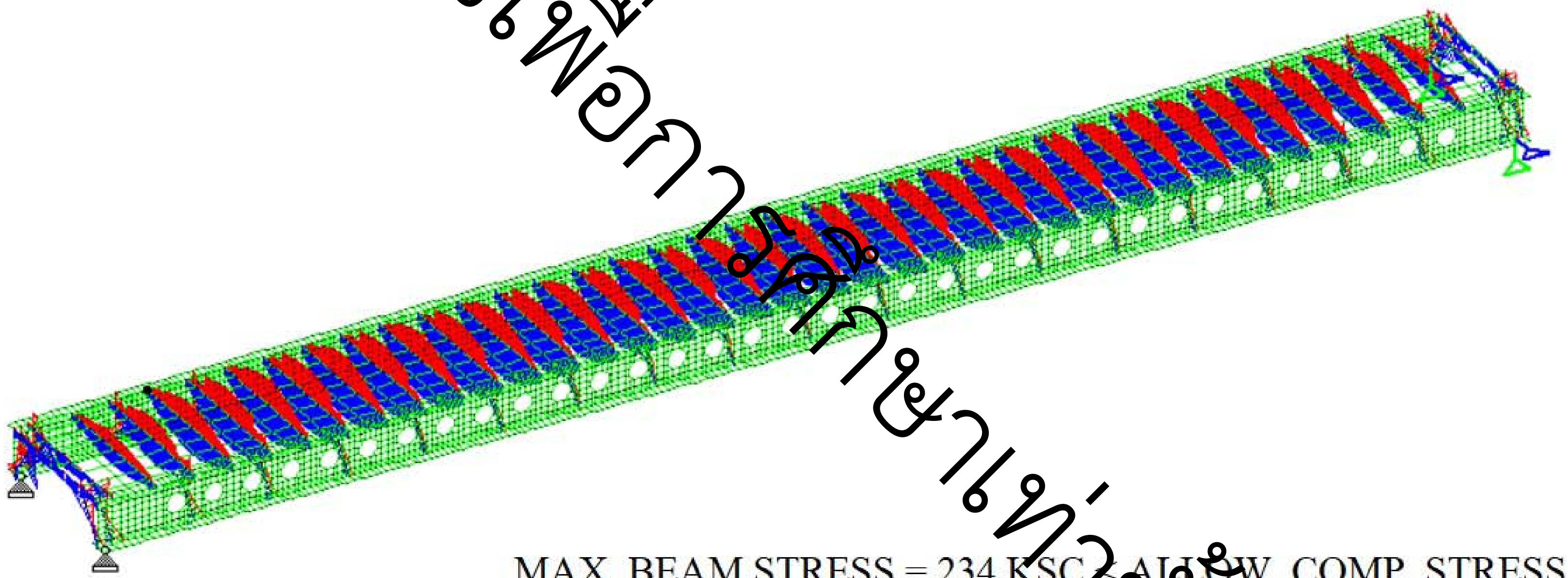




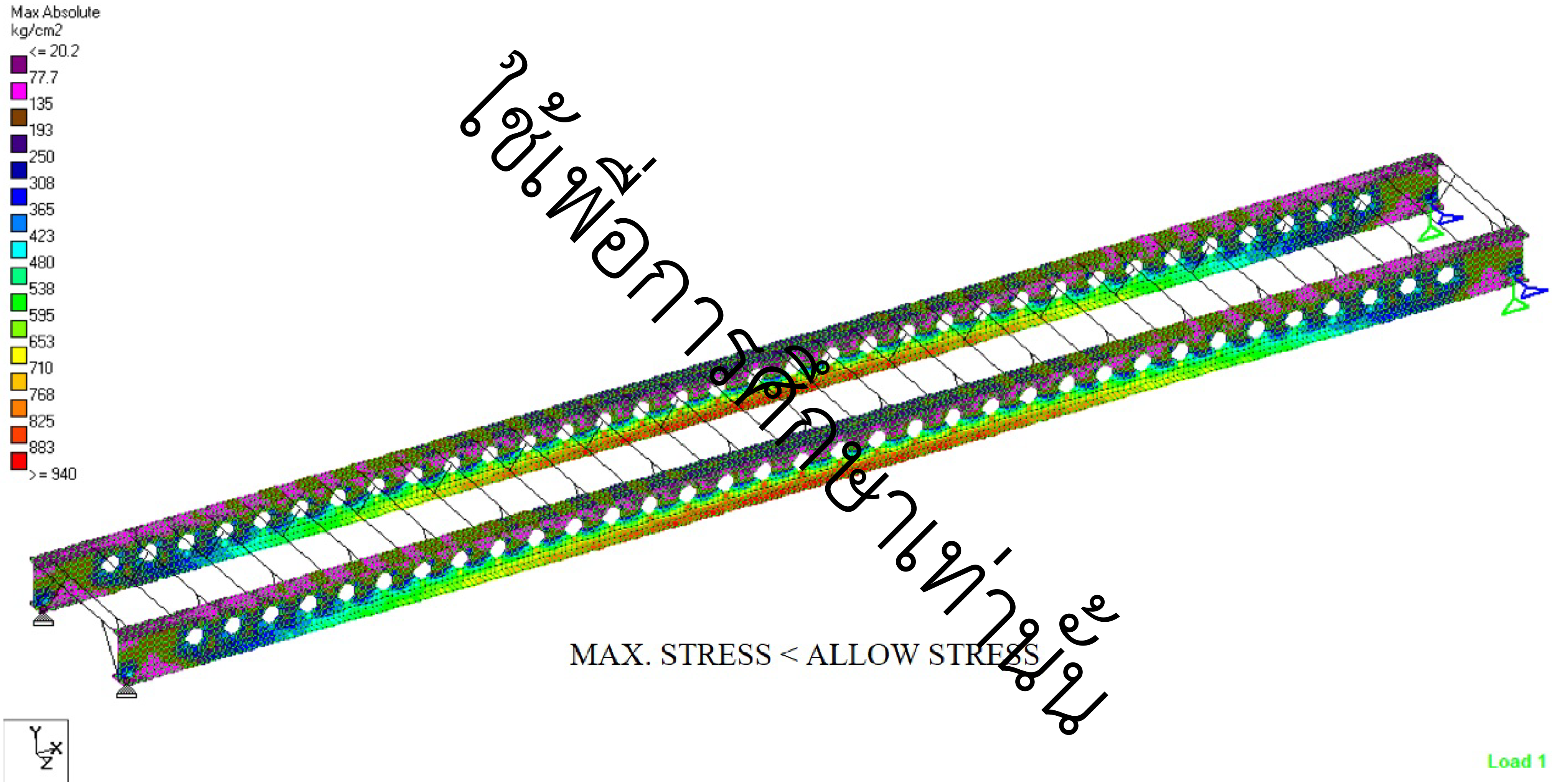
3D GEOMETRY

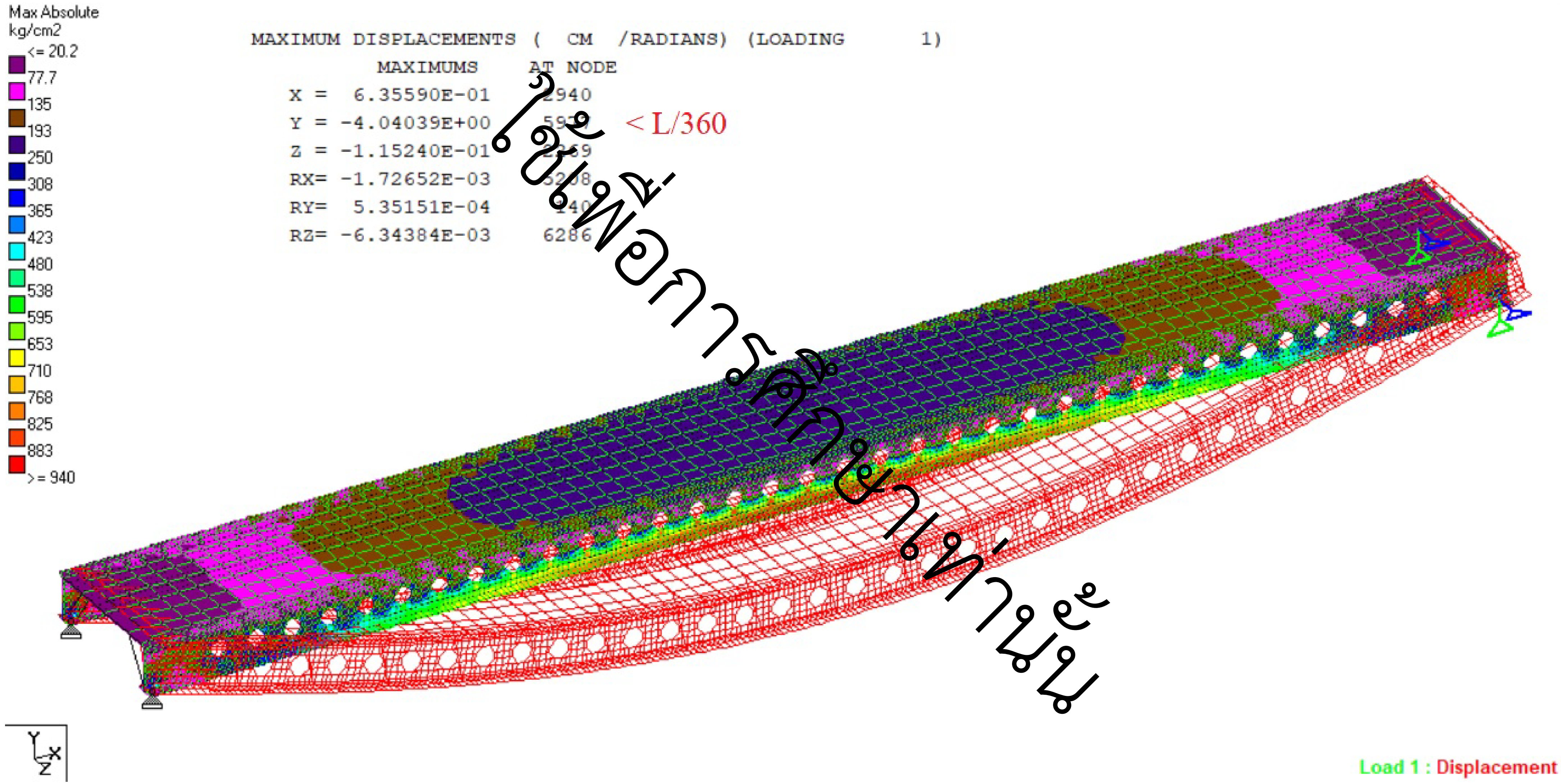


APPLIED LOAD

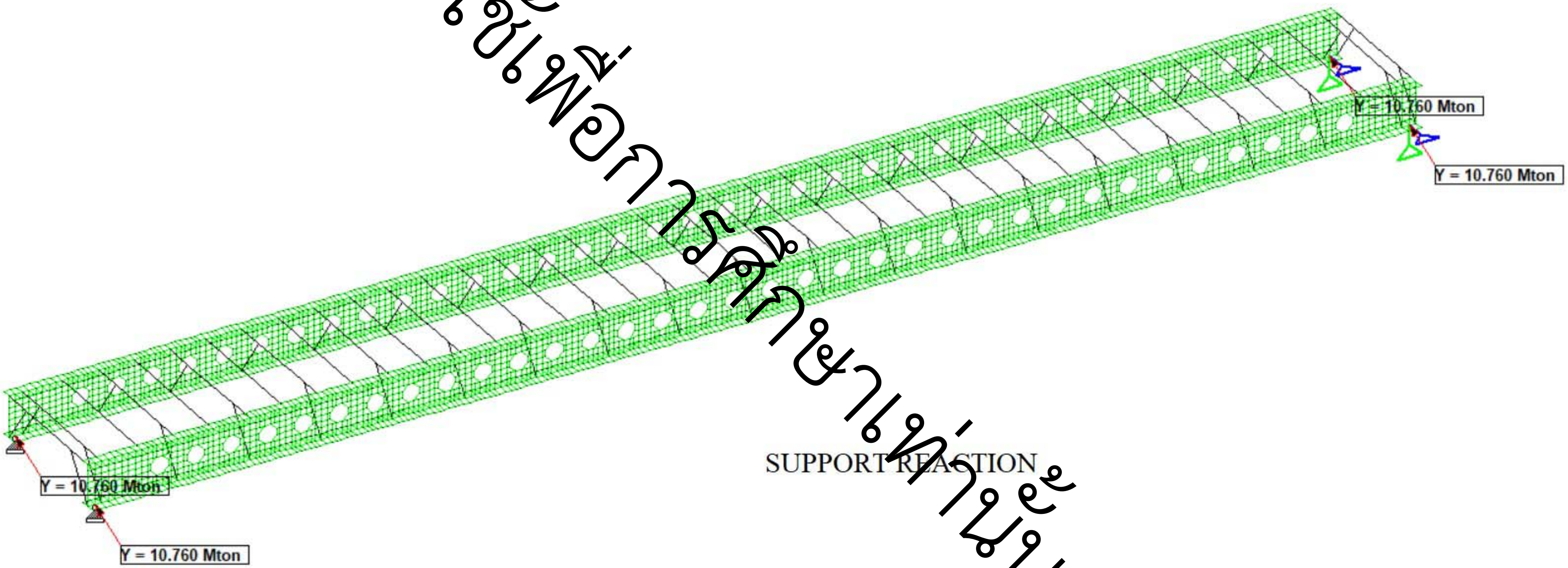


MAX. BEAM STRESS = 234 KSC < ALLOW. COMP. STRESS

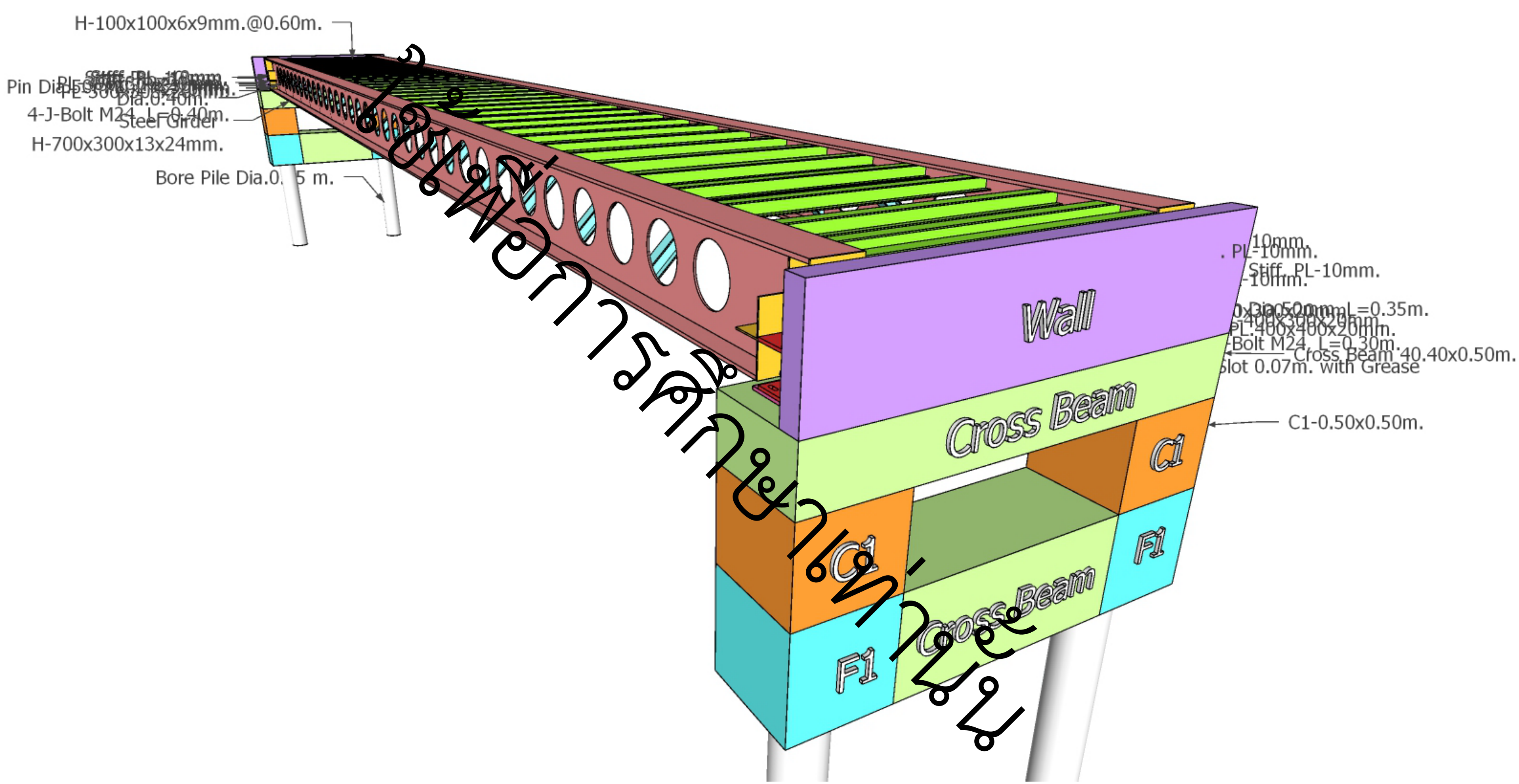

Max Absolute
kg/cm2
<= 20.2
77.7
135
193
250
308
365
423
480
538
595
653
710
768
825
883
>= 940
MAX. STRESS < ALLOW STRESS
Load 1



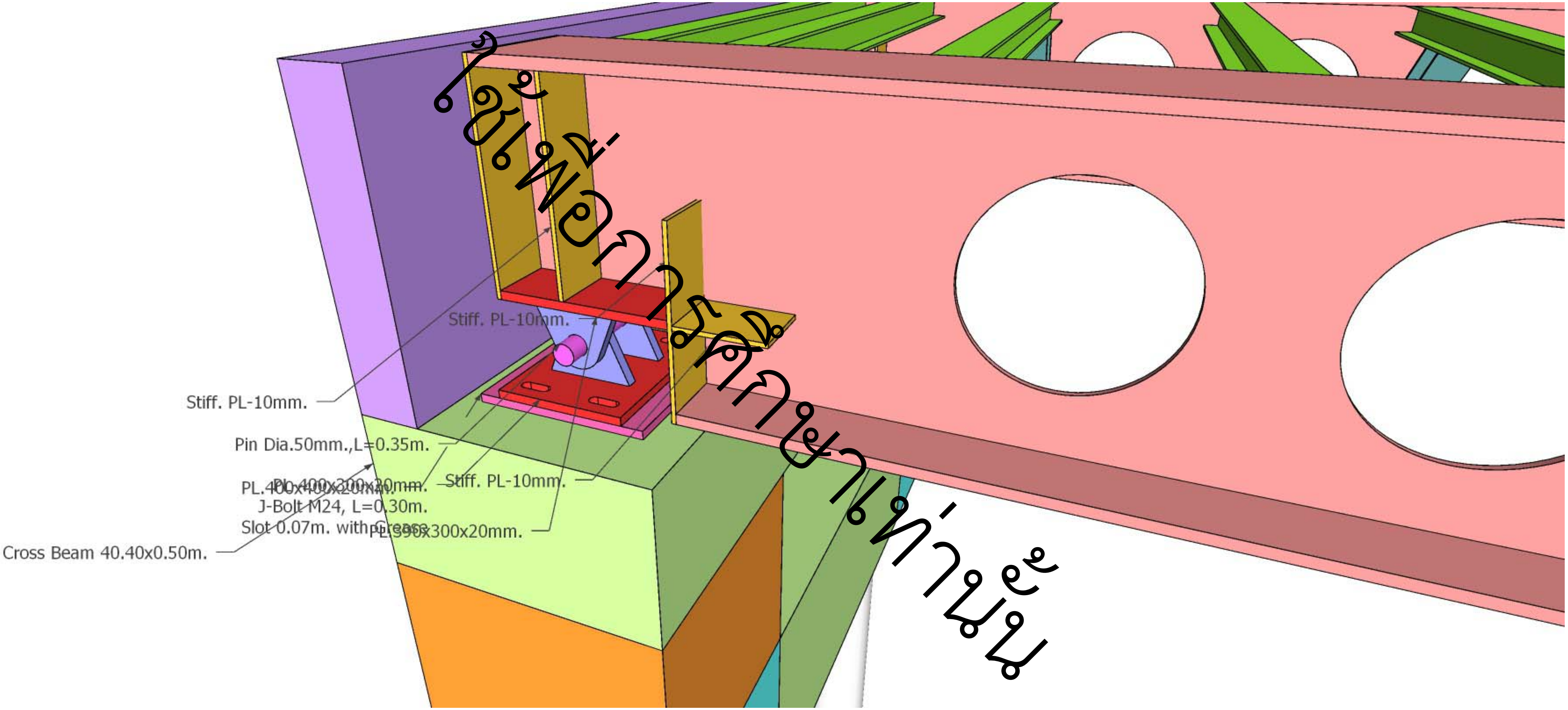
Max Absolute
kg/cm2
<= 20.2
77.7
135
193
250
308
365
423
480
538
595
653
710
768
825
883
>= 940
MAXIMUM DISPLACEMENTS (CM /RADIANS) (LOADING 1)
MAXIMUMS AT NODE
X = 6.35590E-01 2940
Y = -4.04039E+00
Z = -1.15240E-01
RX= -1.72652E-03
RY= 5.35151E-04
RZ= -6.34384E-03 6286
< L/360
Load 1 : Displacement

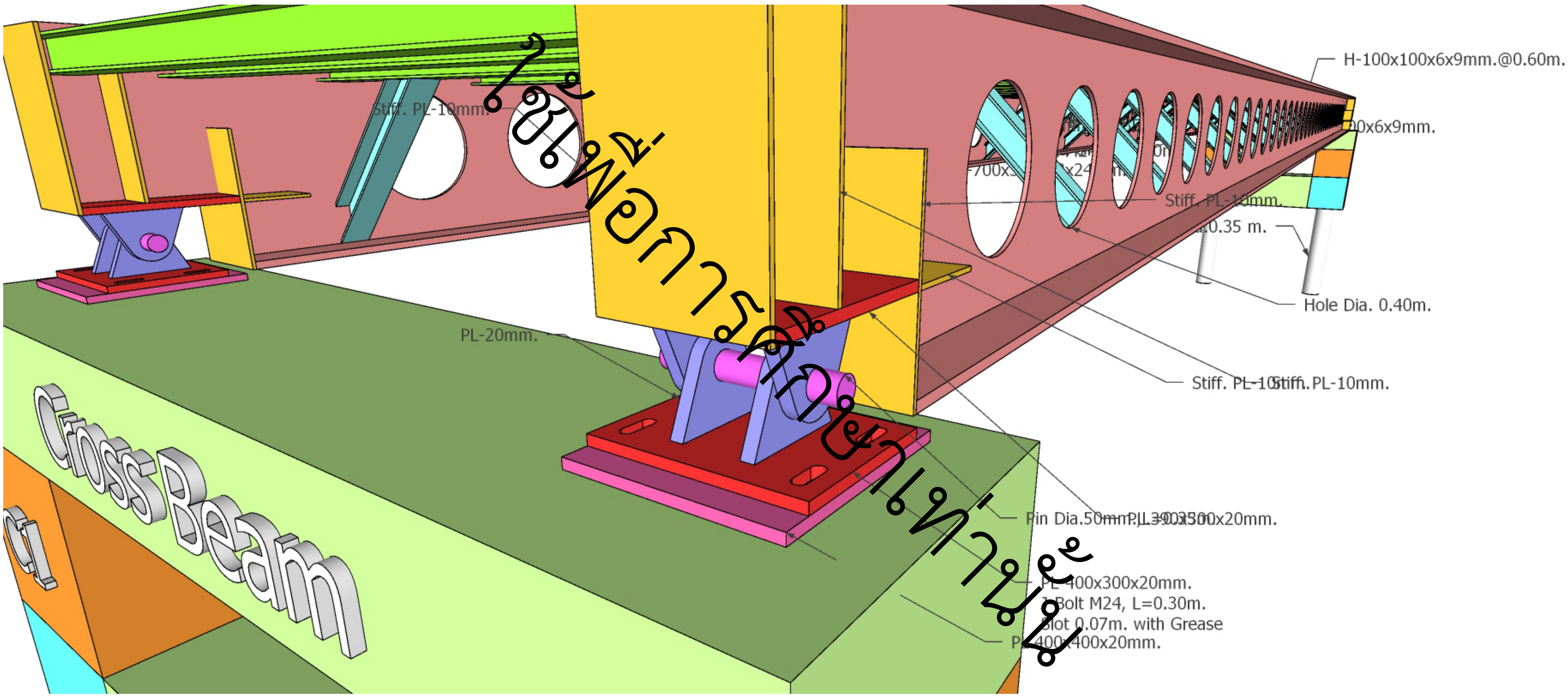


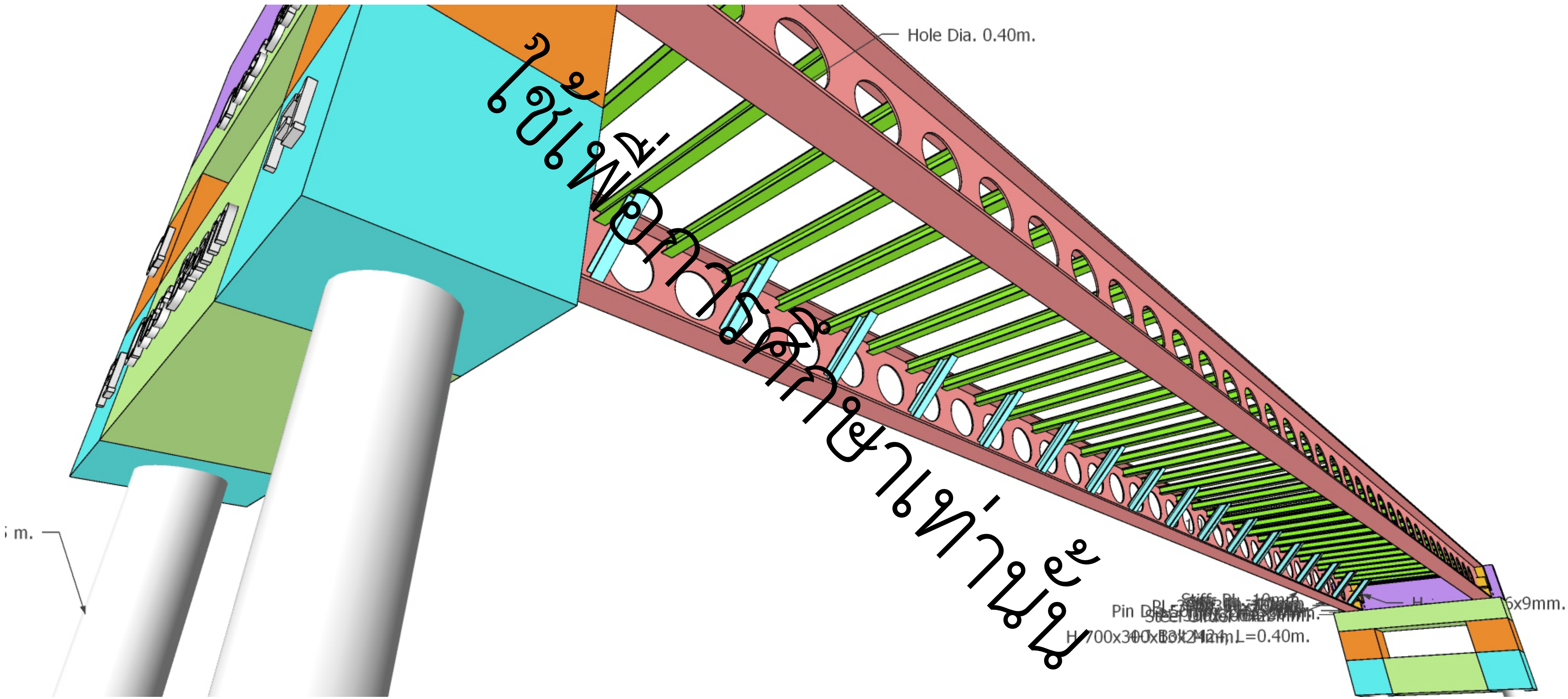
SUPPORT REACTION

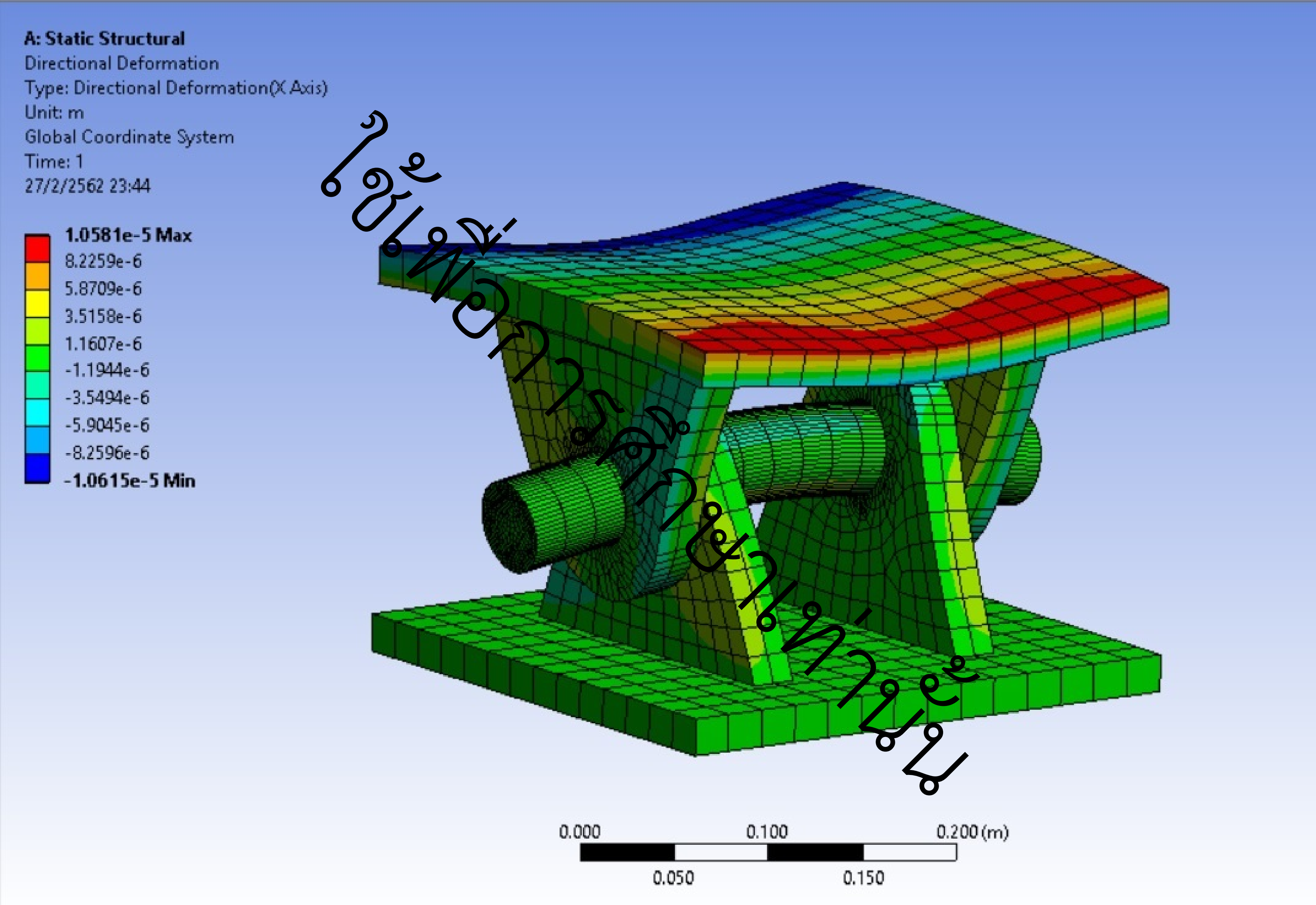


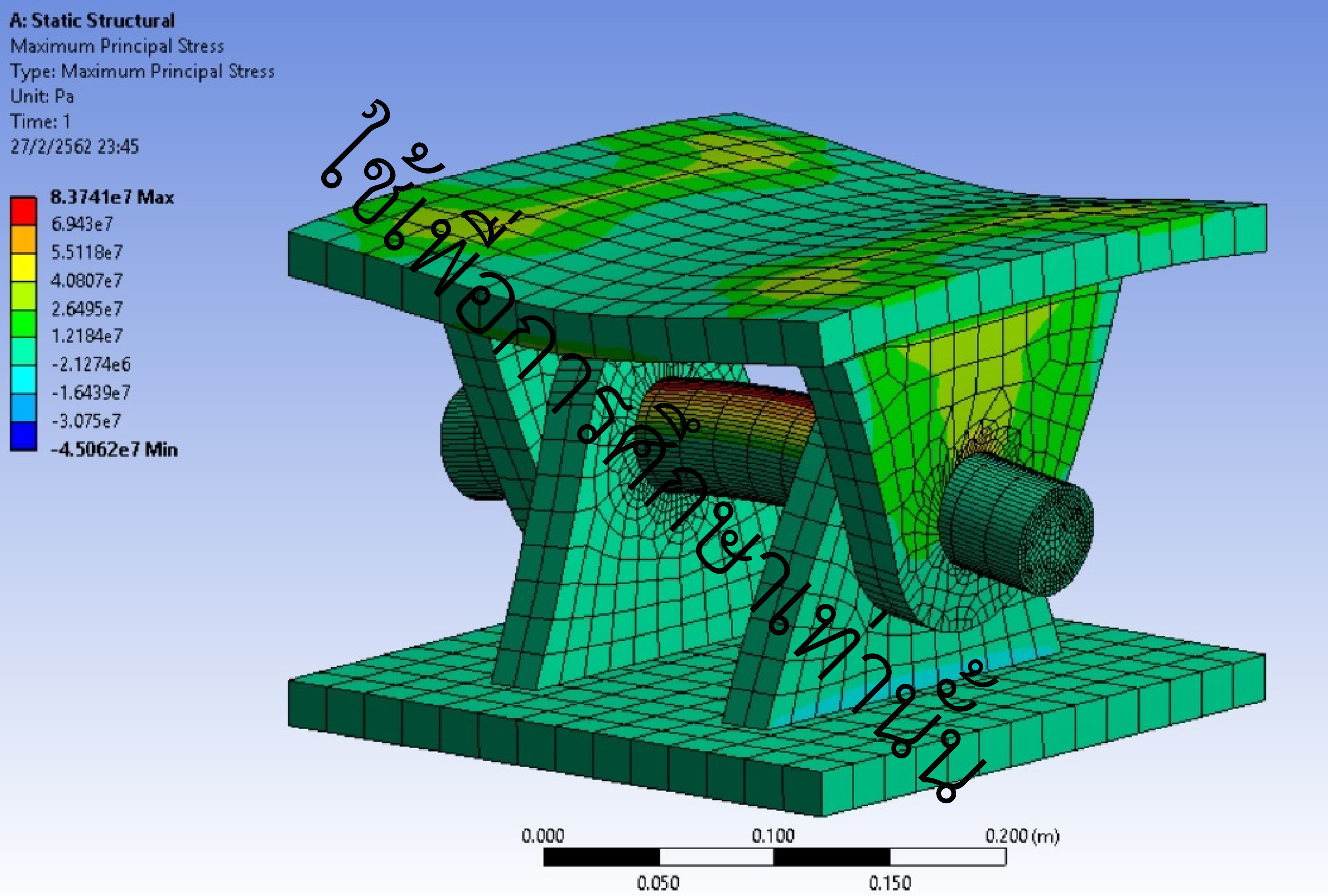
H-100x100x6x9mm.@0.60m.
4-J-Bolt M24 L=0.40m.
Steel Girder
H-700x300x13x24mm.
Bore Pile Dia.0. 5 m.
Wall
Cross Beam
C1
F1
Cross Beam
C1
F1
Stiff. PL-10mm.
Cross Beam 40.40x0.50m.
C1-0.50x0.50m.


Stiff. PL-10mm.
Stiff. PL-10mm.
Stiff. PL-10mm.
Pin Dia.50mm.,L=0.35m.
PL.400x400x20mm.
J-Bolt M24, L=0.30m.
Cross Beam 40.40x0.50m.


H-100x100x6x9mm.@0.60m.
Stiff. PL-10mm.
Hole Dia. 0.40m.
Stiff. PL-10mm.
PL-20mm.
PL-400x300x20mm.
Bolt M24, L=0.30m.
Slot 0.07m. with Grease
PL-400x400x20mm.
Cross Beam


Hole Dia. 0.40m.
Pin D
H 700x300x13x24mm.
L=0.40m.
6x9mm.


A: Static Structural
Directional Deformation
Type: Directional Deformation(X Axis)
Unit: m
Global Coordinate System
Time: 1
27/2/2562 23:44
1.0581e-5 Max
8.2259e-6
5.8709e-6
3.5158e-6
1.1607e-6
-1.1944e-6
-3.5494e-6
-5.9045e-6
-8.2596e-6
-1.0615e-5 Min
0.000
0.050
0.100
0.150
0.200 (m)


A: Static Structural
Maximum Principal Stress
Type: Maximum Principal Stress
Unit: Pa
Time: 1
27/2/2562 23:45
8.3741e7 Max
6.943e7
5.5118e7
4.0807e7
2.6495e7
1.2184e7
-2.1274e6
-1.6439e7
-3.075e7
-4.5062e7 Min
0.000
0.100
0.200 (m)
0.050
0.150

Steel Girder

WF Beam H-700x300x13x24 mm

b = 300 mm, d = 700 mm

tw = 13 mm, tf = 24 mm

w = 185.00 kg/m

A = 189.76 cm^2

Ix = 177,660.00 cm^4

rx = 30.60 cm

Sx = 5,727.00 cm^3

L = 22.00 m

Fy = 2,400 ksc

Mmax = 59,734 kg-m

Allowable bending moment, Fb = 0.6 x 2400 = 1440 ksc

Sx = 59734 / 1440

= 4148.19 < 5727 **OK**

Check shear force

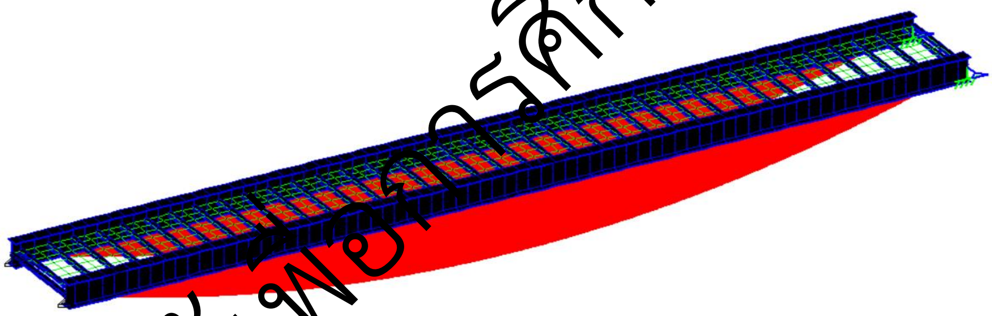
Shear Max = 10,375 kg

fv = 10375/ [((70)-2x(2.4))x1.3]

= 122 ksc

Allowable shear force, Fv = 0.4 x 2400

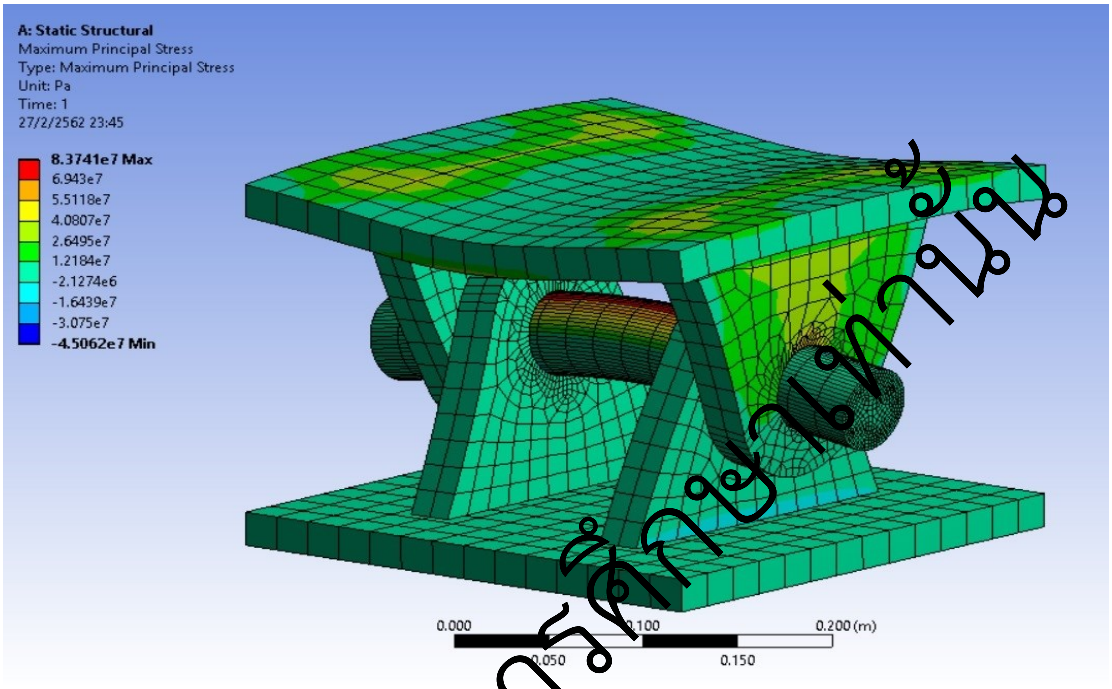
= 960 ksc **> fv OK**



BENDING MOMENT DIAGRAM

Pin for Anchor Block

Maximum Shear, Vmax =	11,000	kg	
Vmax / 2 =	5,500	kg	
Allowable shear stress,Ft =	960	ksc	
Pin size	50	mm	
A =	19.63	cm^2	
Check capacity shear force =	960x19.63		
=	**18,845**	kg	**> 5500 OK**



Steel Cross Beam

WF Beam H-100x100x13x24 mm

b = 100 mm, d = 100 mm

tw = 13 mm, tf = 24 mm

w = 17.20 kg/m

A = 21.90 cm^2

Ix = 383.00 cm^4

rx = 4.18 cm

Sx = 76.50 cm^3

L = 2.00 m

Fy = 2,400 ksc

Mmax = 181 kg-m

Allowable bending moment, Fb = 0.6 x 2400 = 1440 ksc

Sx = 181 / 1440

= 12.57 < 76.5 **OK**

Check shear force

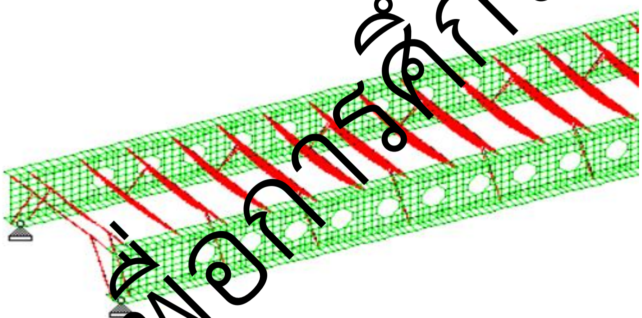
Shear Max = 190 kg

fv = 190/ [((10)-2x(2.4))x1.3]

= 28 ksc

Allowable shear force, Fv = 0.4 x 2400

= 960 ksc **> fv OK**



BENDING MOMENT DIAGRAM

Cross Beam1 กว้าง 0.70 m, ลึก 0.40 m, d = 37.00 cm

น้ำหนักคาน = 0.7x0.4 x2,400 = 672 kg/m

โมเมนต์ต้านทานของคอนกรีต (Mc) = 12.646x0.7x(37^2) = 12,119 kg-m

โมเมนต์ดัดสูงสุดจาก BMD ได้ Mmax = 3,000 kg-m **< Mc ใช้ได้**

As = (3000x100)/(1700x0.895x37)

= 5.33 cm^2

พิจารณาใช้เหล็ก DB- 16 mm จำนวน 6 เส้น

As = 12.06 cm^2

ใช้เหล็ก 6 - DB 16 As = 12.06 cm^2 **> As ใช้ได้**

As-min = (14/4000)x0.7x37

= 9.07 cm^2

พิจารณาใช้เหล็ก DB- 16 mm จำนวน 12 เส้น (จำนวนเหล็กรวมทั้งหน้าตัด)

As = 24.13 cm^2

ใช้เหล็ก 12 - DB 16 As = 24.13 cm^2 **> As-min ใช้ได้**

ความต้านทานแรงเฉือน (Vc) = 0.29xSQRT(240)0.7x37

= 11,636 kg

จากรูป SFD ได้ Vmax = 2,337 kg **< Vc ใช้ได้**

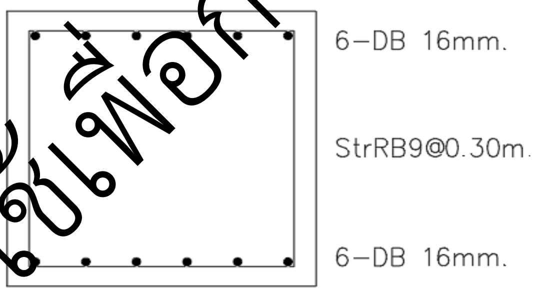
เลือกใช้เหล็กปลอกขนาด RB- 9 mm, ใช้เหล็กปลอก = 1 ชุด

พื้นที่รับแรงเฉือนของเหล็กเสริม = 1.27 cm^2

S = (1.27x1200x37) / (2337-11636)

= -6.1 Cm ใช้ 30 Cm

เลือกใช้เหล็กปลอก 1 RB-9 mm @ 30 cm



Cross Beam2 กว้าง 0.70 m, ลึก 0.70 m, d = 67.00 cm

น้ำหนักคาน = 0.7x0.7 x2,400 = 1,176 kg/m

โมเมนต์ต้านทานของคอนกรีต (Mc) = 12.646x0.7x(67^2) = 39,738 kg-m

โมเมนต์ดัดสูงสุดจาก BMD ได้ Mmax = 3,000 kg-m **< Mc ใช้ได้**

As = (3000x100)/(1700x0.895x67)

= 2.94 cm^2

พิจารณาใช้เหล็ก DB- 16 mm จำนวน 6 เส้น

As = 12.06 cm^2

ใช้เหล็ก 6 - DB 16 As = 12.06 cm^2 **> As ใช้ได้**

As-min = (14/4000)x0.7x67

= 16.42 cm^2

พิจารณาใช้เหล็ก DB- 16 mm จำนวน 12 เส้น (จำนวนเหล็กรวมทั้งหน้าตัด)

As = 24.13 cm^2

ใช้เหล็ก 12 - DB 16 As = 24.13 cm^2 **> As-min ใช้ได้**

ความต้านทานแรงเฉือน (Vc) = 0.29xSQRT(240)0.7x67

= 21,071 kg

จากรูป SFD ได้ Vmax = 2,337 kg **< Vc ใช้ได้**

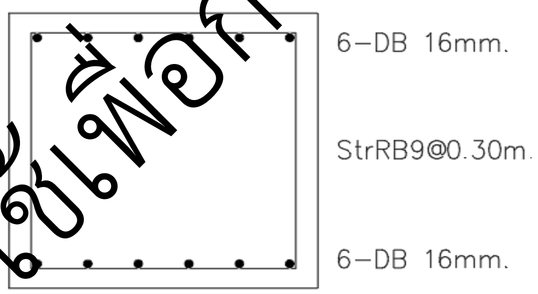
เลือกใช้เหล็กปลอกขนาด RB- 9 mm, ใช้เหล็กปลอก = 1 ชุด

พื้นที่รับแรงเฉือนของเหล็กเสริม = 1.27 cm^2

S = (1.27x1200x67) / (2337-21071)

= -5.5 Cm ใช้ 30 Cm

เลือกใช้เหล็กปลอก 1 RB-9 mm @ 30 cm



Minimum Reinforcement for Wall-DB (Horizontal bar)

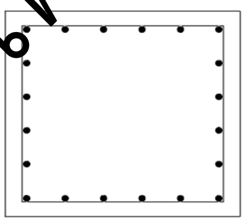
Wide =	1.00	m		thk. =	0.15	m
Area , A =	15x100	cm				
=	1,500.00	cm^2				
As-min =	1500x0.0025	cm		(ว.ส.ท.7400, SD40)		
=	3.75	cm^2				
Try DB-	12	mm	@	3.32	bars	
Spacing	30.16	cm				
Used	30.00	cm				
As =	3.77	cm^2				

Minimum Reinforcement for Wall-DB (Vertical bar)

Wide =	1.00	m		thk. =	0.15	m
Area , A =	15x100	cm				
=	1,500.00	cm^2				
As-min =	1500x0.0015	cm	(ว.ส.ท.7400, SD40)			
=	2.25	cm^2				
Try DB-	12	mm	@	1.99	bars	
Spacing	50.27	cm				
Used	30.00	cm				
As =	3.77	cm^2				

ออกแบบเสา : C1

ความสูงของเสา =	1.00	m			
พิจารณาเลือกหน้าตัดเสา =	0.70	x	0.70	m	
พื้นที่หน้าตัดเสา Ag =	10000 x 0.7 x 0.7	=	4900	cm^2	
น้ำหนักถ่ายลงเสา =	11,000	kg			
น้ำหนักเสา =	2,400x0.7x0.7x1				
=	1,176	kg			
น้ำหนักทั้งหมด (Total Load) =	11000 + 1176				
=	12,176	kg			
พิจารณาใช้เหล็ก DB	16.00	mm	As =	2.01	cm^2
ใช้จำนวนเหล็ก =	24.00	เส้น			
As =	48.24	cm^2			
รับน้ำหนักโดยคอนกรีต =	0.85x (0.25x240x4900 + 1600x2.01)				
=	252,634	kg			
รับน้ำหนักโดยเหล็กเสริม =	0.85x1600x48.24				
=	65,606	kg			
รวมรับน้ำหนักทั้งหมด (P) =	252633.6+65606				
=	318,240	kg	> Total Load ใช้ได้		
ตรวจสอบ พท.เหล็ก =	0.01x70x70 < 48.24 < 0.08x70x70				
=	49 < 48.24 < 392				
พิจารณาใช้เหล็กปลอก RB	9	mm			
เหล็กปลอก 16 เท่าของเหล็กยืน =	25.60	cm			
เหล็กปลอก 48 เท่าของเหล็กปลอก =	43.20	cm			
ความกว้างด้านแคบสุดของเสา =	70.00	cm			
พิจารณาใช้เหล็กปลอก RB	9	mm	@	25.00	m



0.70

24 DB-16 mm

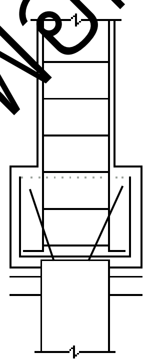
St - RB-9 mm @ 25 cm

0.70

ออกแบบฐานรากเข็ม : F1

รวมน้ำหนักทั้งหมดที่ลงฐานราก =	11,000	kg				
น้ำหนักฐานรากคิดเป็นร้อยละ =	10.00					
น้ำหนักฐานราก =	11000x0.1					
=	1,100	kg				
รวมน้ำหนักทั้งหมด (Total Load) =	11000+1100	=	12,100	kg		
ใช้เสาเข็ม	เส้นผ่าศูนย์กลาง =	0.35	m			
	น้ำหนักปลอดภัย =	30	ton/pile			
ใช้เสาเข็มจำนวน =	12.1 / 30	=	1	pile		
เสาเข็มจะรับน้ำหนักต้นละ =	12.1 / 1	=	12.10	ton		
ความกว้างของฐานราก =	0.35 x 2 เท่า	=	0.70	m, เลือกใช้	0.70	m
ความยาวของฐานราก =	0.35 x 2 เท่า	=	0.70	m, เลือกใช้	0.70	m
ระยะห่างระหว่างเสาเข็ม =	0.35 x 2 เท่า	=	0.70	m		
ตอม่อมีขนาด กว้าง =	0.40	m ยาว =	0.40	m		
M =	12.1x((0.7-0.4)/2)	=	1.82	ton-m		
d =	SQRT(1815/(15.466x0.7))	=	12.95	cm		
เลือกฐานรากหนา =	0.70	m, d =	0.65	m		
พิจารณาใช้เหล็ก DB -	16	mm, As =	2.01	cm^2		
ใช้จำนวนเหล็ก =	6	เส้น As =	12.06	cm^2		
ใช้เหล็กเสริมล่าง =	**6 DB - 16 mm**	@ =	0.10	m		
เหล็กเสริมกันร้าว =	0.0025x70x70	=	12.25	cm^2		
เลือกใช้เหล็กเหล็กเสริมกันร้าว =	**6 DB - 16 mm**	As =	14.07	cm^2	**> 12.25 cm^2 ใช้ได้**	

เหล็กรัดรอบ 1-RB 9 mm
ใช้เหล็กเสริมล่าง 6 DB - 16 mm
ใช้เหล็กกันร้าว 6 DB - 16 mm
ใช้เสาเข็ม 0.35 m จำนวน 1 ต้น
น้ำหนักปลอดภัย = 30 ตัน/ต้น



0.7 m

0.70

0.70