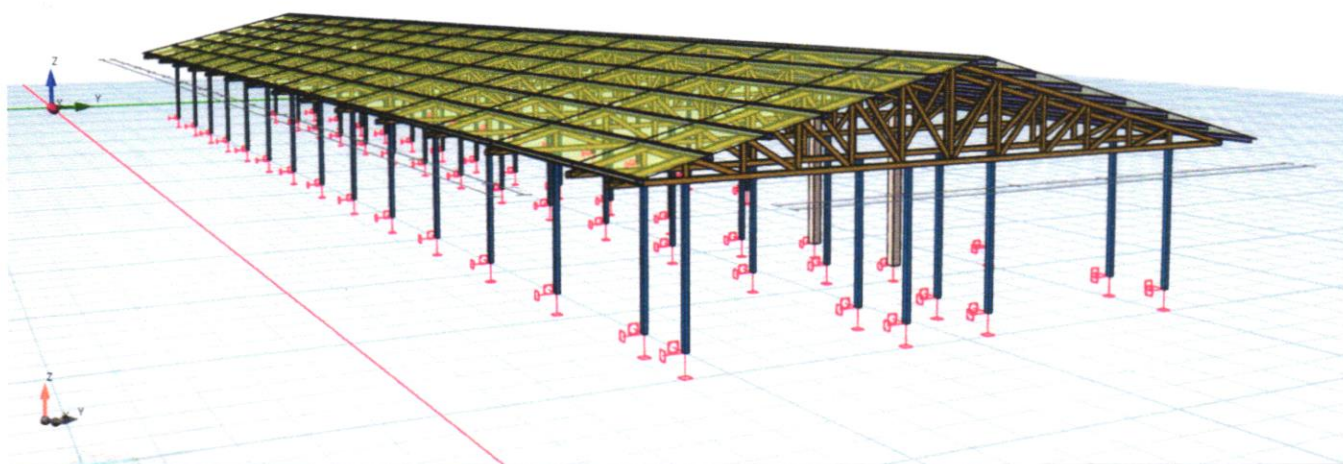


รายการคำนวณโครงสร้าง

หลังคาคลุมตลาดฟ้า

โครงการ ออกแบบงานปรับปรุงอาคารชีววิทยา 1 ภาควิชาชีววิทยา

คณะวิทยาศาสตร์ มหาวิทยาลัยเชียงใหม่



สถานที่ก่อสร้าง

239 ถนน ห้วยแก้ว ตำบลสุเทพ อำเภอเมืองเชียงใหม่ จังหวัด เชียงใหม่ 50200

จัดทำโดย



114/66 M.2 P.K.VILL A.SANSAI ,CHIANG MAI 50210 THAILAND,083-3230909

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 - ข้อมูลวัสดุ
- 3.น้ำหนักบรรทุกที่ใช้ในการออกแบบระบบโครงสร้าง
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- 7.Roof Structure Design
8. Column Design

1. ข้อมูลระบบโครงสร้าง

1.1 ประเภทของอาคาร : อาคารโครงสร้างคอนกรีตเสริมเหล็ก : ข้อ 4 ระบบโครงสร้างแบบผสมที่มีโครงต้านแรงดัดที่มีความเหนียวที่สามารถต้านทานแรงด้านข้างไม่น้อยกว่าร้อยละ 25 ของแรงกระทำกับอาคารทั้งหมด Dual Systems With Special Moment-Resisting Frames : ร่วมกับกำแพงรับแรงเฉือนที่มีการให้รายละเอียดพิเศษ (Special Reinforced Concrete Shear Wall)

เสา : คอนกรีตเสริมเหล็ก

คาน : คอนกรีตเสริมเหล็ก

พื้น : Slab , Precasted Slab , Slab on Ground

ฐานราก : คอนกรีตเสริมเหล็ก เสาเข็มตอก

2.2 ethod ที่ใช้ในการออกแบบ : คอนกรีตเสริมเหล็กวิธีกำลัง (Strength Design Method) SDM
: LRFD

CODE DESIGN : Concrete Design Code
ACI 318-19
United States
Building code Requirements for Structural Concrete (2019)

Steel Design Code
AISC 360-10 (LRFD)
United States
Specification for Structural Steel Buildings (LRFD)

Loading Code
DPT 1311-50
Thailand
Loading Standard For Building Design in Thailand

2.มาตรฐานที่ใช้ในการออกแบบ

พระราชบัญญัติควบคุมอาคาร 2522

กฎกระทรวง กำหนดการรับน้ำหนัก ความต้านทาน ความคงทนของอาคาร และพื้นดินที่รองรับอาคารในการต้านทานแรงสั่นสะเทือนของแผ่นดินไหว พ.ศ.2564

กฎกระทรวง กำหนดฐานรากของอาคารและพื้นดินที่รองรับอาคาร พ.ศ.2566

กฎกระทรวง กำหนดการออกแบบโครงสร้างอาคารและคุณสมบัติของวัสดุที่ใช้ในโครงสร้างอาคาร พ.ศ.2566

ประกาศกระทรวงมหาดไทย เรื่องการออกแบบและคำนวณโครงสร้างอาคารเพื่อต้านทานแรงสั่นสะเทือนของแผ่นดินไหว

มยพ.1311-50 มาตรฐานการคำนวณแรงลมและการตอบสนองของอาคาร

มยพ.1301/1302-61 มาตรฐานการออกแบบอาคารต้านทานการสั่นสะเทือนของแผ่นดินไหว

คู่มือการปฏิบัติประกอบมาตรฐานการออกแบบอาคารต้านทานการสั่นสะเทือนของแผ่นดินไหว กรมโยธาธิการและผังเมือง

Building Code Requirement for Structure Concrete (ACI318-14)

2.1.ข้อมูลวัสดุ

คอนกรีตกำลังอัดรูปทรงกระบอกที่ 28 วัน f_c 280 ksc สำหรับเสา คาน ผนังรับแรง

เหล็กเสริมหลัก (ข้ออ้อย) เกรด SD40 มีค่า f_y ไม่น้อยกว่า 4,000 ksc

เหล็กเสริมรอง (เหล็กกลม) เกรด SR24 มีค่า f_y ไม่น้อยกว่า 2,400 ksc

เหล็กgrupพรรณ SS400 มาตรฐาน มอก.

ข้อมูลวัสดุ Material

General

Material Name	: SS 400 (TIS)
Material Color	: 132, 194, 41

Mechanical Properties

Modulus of Elasticity	: 2040000.00 kg/cm ²
Shear Modulus	: 766917.00 kg/cm ²
Poisson's Ratio	: 0.33
Thermal Expansion Coeff.	: 0.00001200 (1/°C)
Unit Weight	: 7850.000 kg/m ³

Design Parameters

Minimum Yield Strength	: 2400.00 kg/cm ²
Tensile Strength	: 4550.00 kg/cm ²
Bearing Strength	: 0.00 kg/cm ²
Material Coeff	: 1.00
Standard (Norm)	: TIS 1227-2558(2015)

เหล็กgrupพรรณ SS 400 TIS

3.รายการน้ำหนักบรรทุก

น้ำหนักบรรทุกคงที่ (Dead Load) DL

- น้ำหนักคอนกรีตเสริมเหล็ก 2,400 กก./ลบ.ม.
- น้ำหนักเหล็กเสริม 7,850 กก./ลบ.ม.
- น้ำหนักเหล็กกรุผนัง 7,850 กก./ลบ.ม.
- น้ำหนักดิน 1,800 กก./ลบ.ม.

น้ำหนักบรรทุกจรชั้นต่ำ (Live Load) LL. กฎกระทรวงปี 2566

- | | |
|----------------------------------|---------------|
| -พื้นกันสาดหรือพื้นหลังคาคอนกรีต | 30 กก./ตร.ม. |
| -พื้นที่ห้องพักอาศัย | 200 กก./ตร.ม. |
| -บันไดและทางเดิน | 300 กก./ตร.ม. |
| -แผงโซลาร์เซลล์ | 20 กก./ตร.ม. |

น้ำหนักบรรทุกเพิ่ม (Super Dead Load) SDL.

- | | |
|---|---------------|
| -ปูนทรายปรับระดับปูกระเบื้องเซรามิค 5 ซม. | 150 กก./ตร.ม. |
| -ผนังก่ออิฐมวลเบาหนา 10 ซม.รวมฉาบ 2 ด้าน | 100 กก./ตร.ม. |
| -ผนังก่ออิฐมวลเบาหนา 20 ซม.รวมฉาบ 2 ด้าน | 220 กก./ตร.ม. |
| -ฝ้าเพดานและงานระบบใต้หลังคา | 20 กก./ตร.ม. |
| -วัสดุฝังหลังคา | 5 กก./ตร.ม. |

-ค่าคูณลดกำลัง

ตามมาตรฐาน ACI 318-14 กำหนดให้ใช้ค่าคูณลดกำลัง

Load Factor

Dead Load : 1.40

Live Load : 1.70

Strength Reduction Factor

Moment : 0.90

Axial Tension Controlled	: 0.90
Shear and Torsion	: 0.75
Compression ,Spirally Reinforced	: 0.75
Bearing on Concrete	: 0.65
Bending on Concrete	: 0.65

-Load Case and Load Combination

ข้อ ๖ การออกแบบและคำนวณส่วนต่าง ๆ ของอาคารตามวิธีหน่วยแรงที่ยอมให้ ให้ใช้
ค่าหน่วยแรงสูงสุดที่คำนวณจากชุดตัวคือน้ำหนักบรรทุก แล้วแต่กรณี ดังต่อไปนี้

(๑) ส่วนของอาคารที่คิดเฉพาะน้ำหนักบรรทุกคงที่และน้ำหนักบรรทุกจร

$$\text{นง.} = \text{นค.} + \text{นจ.}$$

(๒) ส่วนของอาคารที่คิดแรงลม

$$\text{นง.} = \text{นค.} + 0.75 (\text{นจ.} + \text{รล.})$$

$$\text{นง.} = 0.6 \text{ นค.} + \text{รล.}$$

(๓) ส่วนของอาคารที่คิดแรงสั่นสะเทือนของแผ่นดินไหว

$$\text{นง.} = \text{นค.} + 0.7 \text{ รผ.}$$

$$\text{นง.} = \text{นค.} + 0.5125 \text{ รผ.} + 0.75 \text{ นจ.}$$

$$\text{นง.} = 0.6 \text{ นค.} + 0.7 \text{ รผ.}$$

(๔) ส่วนของอาคารที่คิดแรงดันดิน แรงดันน้ำ แรงดันจากของเหลว และผลของอุณหภูมิ
การหดตัว การคืบ และการทรุดตัว

$$\text{นง.} = \text{นค.} + \text{นจ.} + \text{รด.} + \text{รข.} + \text{รท.}$$

เมื่อ นง. = น้ำหนักบรรทุกใช้งาน

นค. = น้ำหนักบรรทุกคงที่

นจ. = น้ำหนักบรรทุกจร รวมด้วยแรงกระแทก

รล. = แรงลม

รผ. = แรงสั่นสะเทือนของแผ่นดินไหว

รด. = แรงดันดินหรือแรงดันน้ำด้านข้าง

Load Combinations

No	การรวมกัน	D	Dc	L	Lc	Lp1	Lp2	Ez	Ex+	Ex-	Ey+	Ey-	Nx
1	D *F	1.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	D+L(1)	1.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	D+L	1.40	.00	1.70	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	D+L1	1.20	.00	1.70	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	D+Lp1	1.40	.00	.00	.00	1.70	.00	.00	.00	.00	.00	.00	.00
6	D+Lp2	1.40	.00	.00	.00	.00	1.70	.00	.00	.00	.00	.00	.00
7	D+Lp12	1.20	.00	.00	.00	1.70	.00	.00	.00	.00	.00	.00	.00
8	D+Lp22	1.20	.00	.00	.00	.00	1.70	.00	.00	.00	.00	.00	.00
9	Dc+Lc+Ez+Ex+	.00	1.20	.00	1.00	.00	.00	1.00	1.00	.00	.00	0.30	.00
10	Dc+Lc+Ez-Ex+	.00	1.20	.00	1.00	.00	.00	1.00	- 1.00	.00	.00	- 0.30	.00
11	Dc+Lc+Ez+Ex-	.00	1.20	.00	1.00	.00	.00	1.00	.00	1.00	0.30	.00	.00

12	Dc+Lc+Ez-Ex-	.00	1.20	.00	1.00	.00	.00	1.00	.00	- 1.00	- 0.30	.00	.00
13	Dc+Lc+Ez+Ey+	.00	1.20	.00	1.00	.00	.00	1.00	.00	0.30	1.00	.00	.00
14	Dc+Lc+Ez-Ey+	.00	1.20	.00	1.00	.00	.00	1.00	.00	- 0.30	- 1.00	.00	.00
15	Dc+Lc+Ez+Ey-	.00	1.20	.00	1.00	.00	.00	1.00	0.30	.00	.00	1.00	.00
16	Dc+Lc+Ez-Ey-	.00	1.20	.00	1.00	.00	.00	1.00	- 0.30	.00	.00	- 1.00	.00
17	Dc+Ez+Ex+	.00	0.90	.00	.00	.00	.00	- 1.00	1.00	.00	.00	0.30	.00
18	Dc+Ez-Ex+	.00	0.90	.00	.00	.00	.00	- 1.00	- 1.00	.00	.00	- 0.30	.00
19	Dc+Ez+Ex-	.00	0.90	.00	.00	.00	.00	- 1.00	.00	1.00	0.30	.00	.00
20	Dc+Ez-Ex-	.00	0.90	.00	.00	.00	.00	- 1.00	.00	- 1.00	- 0.30	.00	.00
21	Dc+Ez+Ey+	.00	0.90	.00	.00	.00	.00	- 1.00	.00	0.30	1.00	.00	.00
22	Dc+Ez-Ey+	.00	0.90	.00	.00	.00	.00	- 1.00	.00	- 0.30	- 1.00	.00	.00
23	Dc+Ez+Ey-	.00	0.90	.00	.00	.00	.00	- 1.00	0.30	.00	.00	1.00	.00
24	Dc+Ez-Ey-	.00	0.90	.00	.00	.00	.00	- 1.00	- 0.30	.00	.00	- 1.00	.00
25	G+Q+WCase1x+Nx	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	1.00
26	G+Q-WCase1x-Nx	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	- 1.00
27	G+Q+WCase1y+Ny	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	G+Q-WCase1y-Ny	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	G+WCase1x+Nx	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
30	G-WCase1x-Nx	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
31	G+WCase1y+Ny	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
32	G-WCase1y-Ny	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
33	G+Q+WCase1x+Nx	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	1.00
34	G+Q-WCase1x-Nx	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	- 1.00
35	G+Q+WCase1y+Ny	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	G+Q-WCase1y-Ny	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	G+Q+WCase2x+Nx	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	1.00
38	G+Q-WCase2x-Nx	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	- 1.00
39	G+Q+WCase2y+Ny	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	G+Q-WCase2y-Ny	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	G+WCase2x+Nx	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	G-WCase2x-Nx	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	G+WCase2y+Ny	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	G-WCase2y-Ny	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	G+Q+WCase2x+Nx	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	1.00
46	G+Q-WCase2x-Nx	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	- 1.00
47	G+Q+WCase2y+Ny	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	G+Q-WCase2y-Ny	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	G+Q+WCase3	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	G+Q-WCase3	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
51	G+Q+WCase3-	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

52	G+Q-WCase3-	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
53	G+WCase3	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
54	G-WCase3	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
55	G+WCase3-	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
56	G-WCase3-	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
57	G+Q+WCase3	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
58	G+Q-WCase3	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
59	G+Q+WCase3-	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
60	G+Q-WCase3-	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
61	G+Q+WCase4	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
62	G+Q-WCase4	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
63	G+Q+WCase4-	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
64	G+Q-WCase4-	1.20	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
65	G+WCase4	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
66	G-WCase4	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
67	G+WCase4-	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
68	G-WCase4-	0.90	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
69	G+Q+WCase4	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
70	G+Q-WCase4	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
71	G+Q+WCase4-	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	G+Q-WCase4-	1.20	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00	.00

4.Win Load

การวิเคราะห์แรงลม ใช้มาตรฐานการคำนวณแรงลมและการตอบสนองของลมอ้างอิงตาม มยผ. 1311-50 โดยการคำนวณค่าแรงลมสถิติเทียบเท่าโดยวิธีการอย่างง่าย (Simple Procedure) ใช้สำหรับ

1.ระบบโครงสร้างหลักต้านแรงลม ของอาคารเดี่ยวและอาคารสูงปานกลาง ที่มีความสูงไม่เกิน 80 ม. และมีความสูงไม่เกิน 3 เท่าของความกว้าง ประสิทธิภาพที่น้อยที่สุด ยกเว้นอาคารที่สั้นไหว่งง่าย ได้แก่อาคารที่มีน้ำหนักเบา และมีความถี่ธรรมชาติต่ำ และมีความสัมพันธ์ความหน่วงของอาคารต่ำ

2. ผนังภายนอก (cladding) ของอาคารที่มีรูปทรงไม่ซับซ้อน ทุกประเภท

ขอขยาย การใช้มาตรฐาน

- กำหนดวิธีการคำนวณค่าของแรงลม และผลกระทบในรูปแบบต่างๆ ของลมที่มีต่ออาคาร เพื่อใช้ในการออกแบบระบบโครงสร้างหลักของอาคารองค์อาคาร และส่วนประกอบอื่นๆ ของอาคาร เช่น ผนังภายนอกตัวอาคาร หลังคา เป็นต้น

- เป็นข้อกำหนดในขั้นต่ำสุดที่จำเป็นต่อการออกแบบอาคาร เพื่อให้อาคารมีความปลอดภัย และเพื่อจำกัดผลกระทบในรูปแบบต่างๆ ของลมที่มีต่ออาคารให้อยู่ในระดับที่ยอมรับได้ตาม เกณฑ์มาตรฐานสากล

- นำไปใช้ในการออกแบบอาคารทั่วไป ตั้งแต่อาคารเดี่ยวจนถึงอาคารสูงที่มีรูปทรงปกติ แต่ มาตรฐานนี้ไม่ครอบคลุมถึงการออกแบบอาคารที่มีลักษณะพิเศษ หรือโครงสร้างอื่นๆ ที่อาจ มีการตอบสนองต่อแรงลมรุนแรงกว่าปกติ เช่น ปล่องไฟที่มีความสูงชะลูด สะพานช่วงยาว ฯลฯ

- ไม่ได้ครอบคลุมสภาพภูมิประเทศที่มีลักษณะพิเศษ ที่อาจทำให้เกิด แรงลมที่สูงกว่าปกติ เช่น ช่องลม ผลของอาคารข้างเคียง ฯลฯ

ข้อมูลการออกแบบ

พื้นที่ก่อสร้างอยู่ที่ ถนน ห้วยแก้ว ตำบลสุเทพ อำเภอเมืองเชียงใหม่ จังหวัด เชียงใหม่

$I_w(\text{ค่าประจําความสําคัญของแรงลม}) = 1.00$

กำหนดประเภทของอาคารความสําคัญ = **ปกติ (Normal)** (Impotance Type)

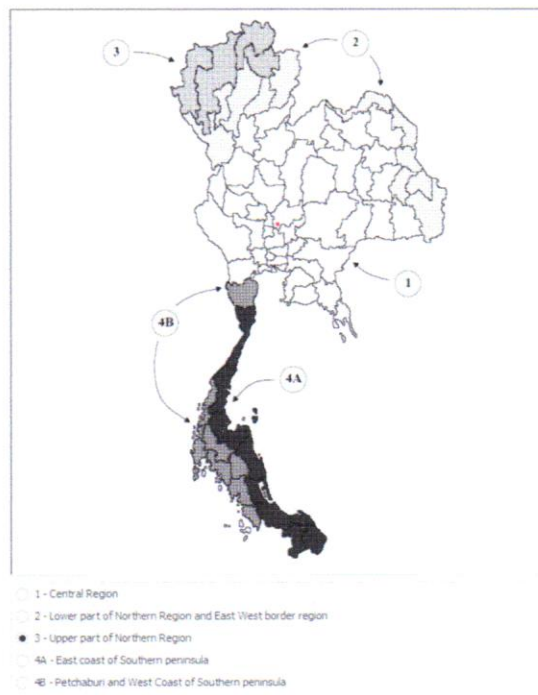
สภาพภูมิประเทศ = **แบบ A พื้นที่โล่ง** (Exposure Category)

กลุ่มความเร็วลมอ้างอิงตาม มยผ = **กลุ่มที่ 1 V = 25 m/s** (Zone Index)

$\rho(\text{ความหนาแน่นของมวลอากาศ}) = 1.25 \text{ kg(mass)/m}^3$

$C_g(\text{ค่าประกอบเนื่องจากการกระโชกของลมภายนอกอาคาร}) = 2.0$

$C_{gi}(\text{ค่าประกอบเนื่องจากการกระโชกของลมภายในอาคาร}) = 2.0$



กลุ่มความเร็วลมอ้างอิงตาม มยผ = กลุ่มที่ 1 $V = 25 \text{ m/s}$ (Zone Index)

$$V3/V3600 = 1,500$$

ดังนั้น

แรงลมอ้างอิงในมาตรฐานนี้ 25 m/s

จะเทียบเท่าความเร็วลมอ้างอิงในมาตรฐาน ASCE7-05 $= 25 \times 1.52 = 38 \text{ m/s}$

Wind Load Calculator : Prota Structure 2022 (6.0.392)

Basic Wind Properties	Structure Properties
Basic Wind Speed (m/s) : 33.5	Building Category : Reinforced Concrete
Primary Wind Angle (°) : 0.0	
Terrain and Surroundings	Exposure Type
Exposure Category : Exposure A	
Zone Index : Zone Index 3	☒ Exposure A ☐ Exposure B ☐ Exposure C
Importance Type : Normal	OK Cancel

Wind Load Summary Report Inputs

Wind Code : DPT 1311-50 (Thailand)

Basic Wind Speed (m/s) : 33.5 m/s

Primary Wind Angle (°) : 0 °

Wind direction step angle (CCW from horizontal X-axis) : 90 °

Wind direction step angle (CCW from horizontal X-axis) : 90 °

Exposure Type : Exposure A

Zone Index : Zone Index 3

Importance Type : Normal

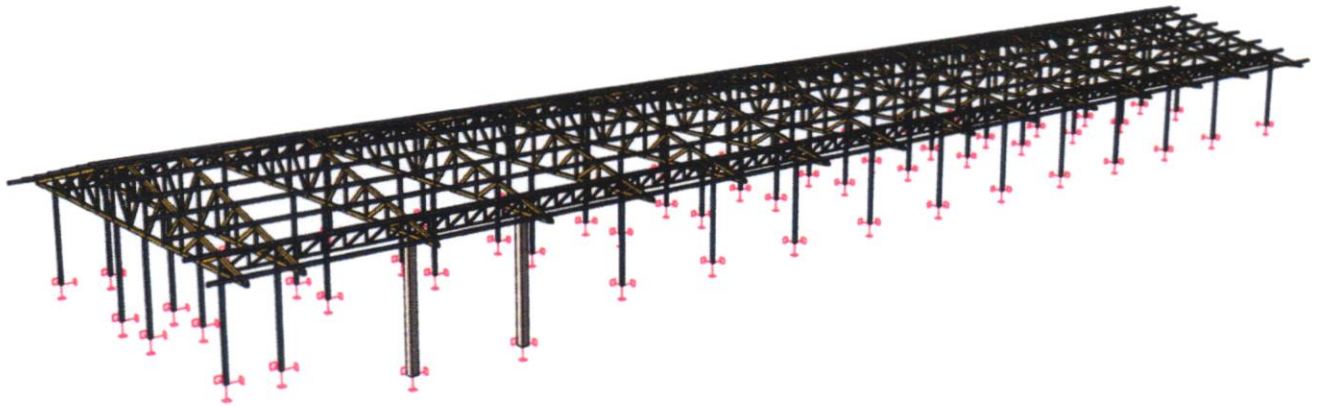
Building Type : Reinforced Concrete Structure

Storey	Mass (kg)	X-g (m)	Y-g (m)
☐ St: 1 (+3.00m)	7742.292	36.938393	10.863773

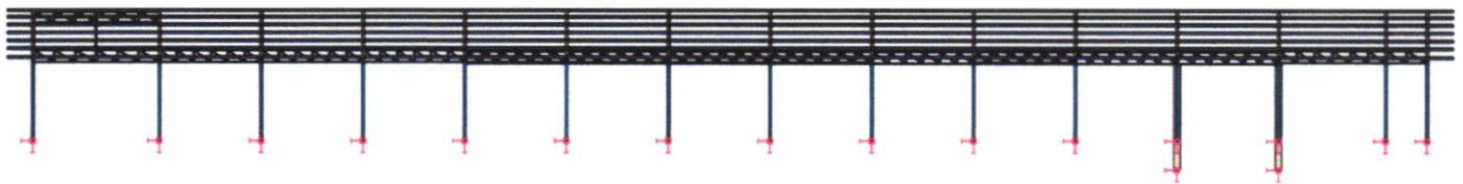
	Fx (kg)	Fy (kg)	Mz (kg.m)	X (m)	Y (m)
Ex+	151.374	-1.011	0	36.938393	11.443773
Ex-	151.374	-1.011	0	36.938393	10.283773
Ey+	1.011	90.986	0	39.610893	10.863773
Ey-	1.011	90.986	0	34.265893	10.863773
Wx	0	0	0	0	0
Wmx	0	0	0	0	0
Wy	0	0	0	0	0
Wmy	0	0	0	0	0

6.การจำลองโครงสร้างองค์อาคาร

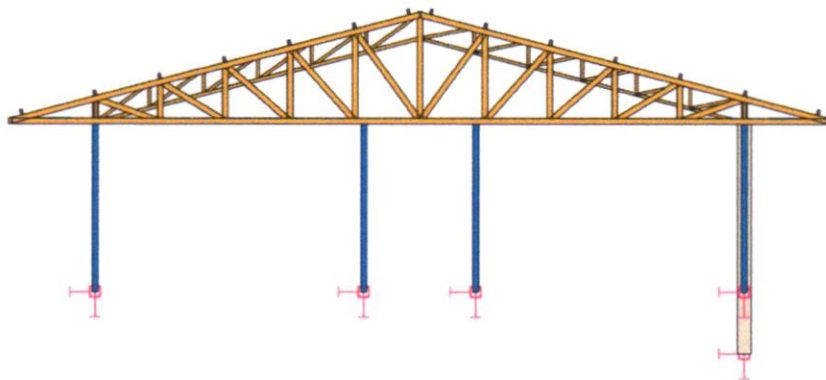
ลักษณะการจำลองอาคาร



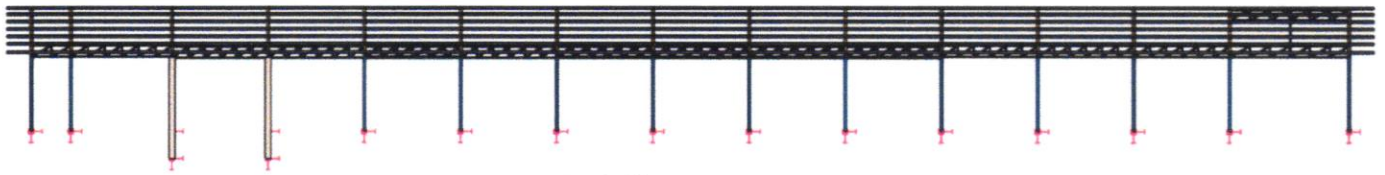
Perspective



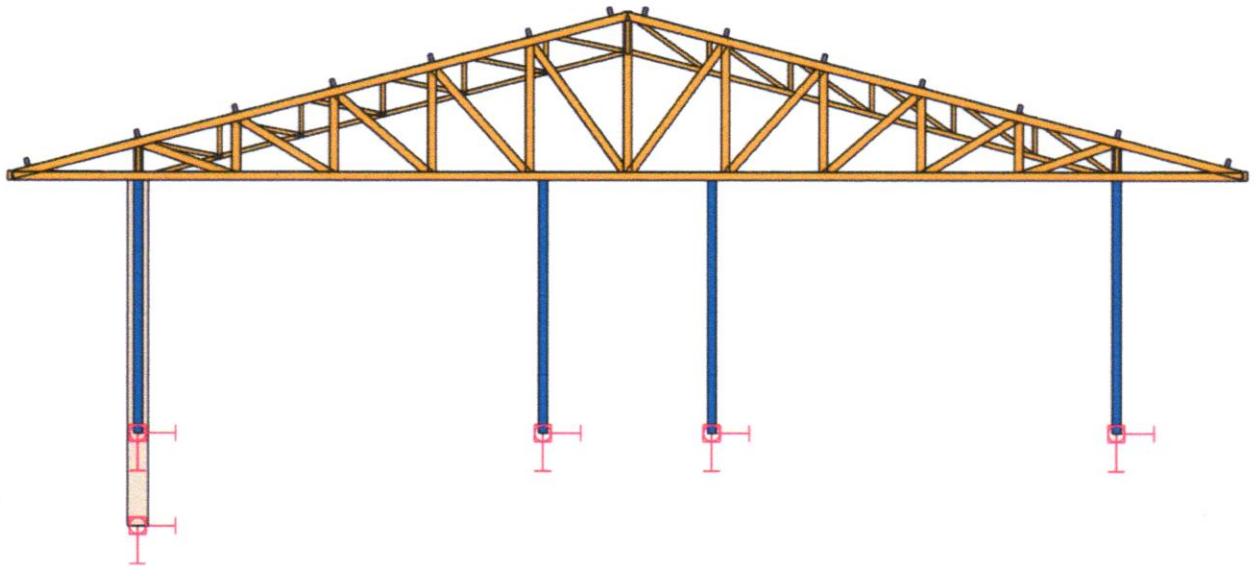
Font Elevation



Right Elevation



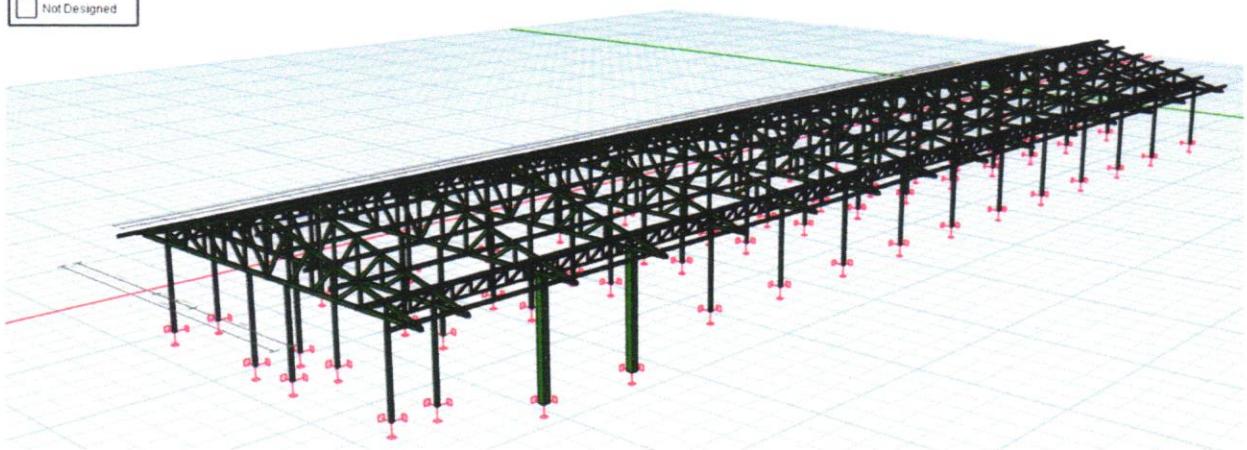
Back Elevation



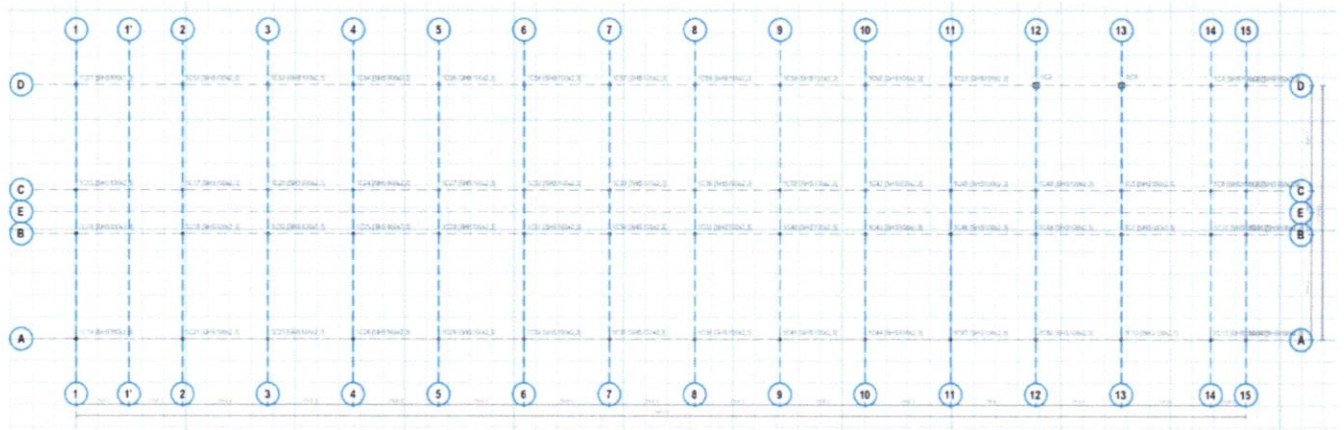
Left Elevation

Design Status

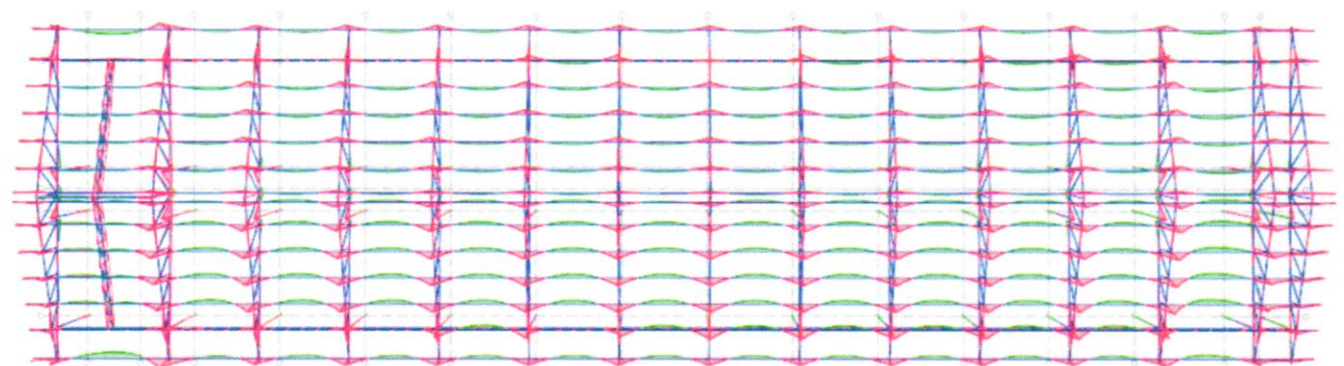
Fail
Warning
Expired Analysis
OK
Do not design
Not Designed



design status check

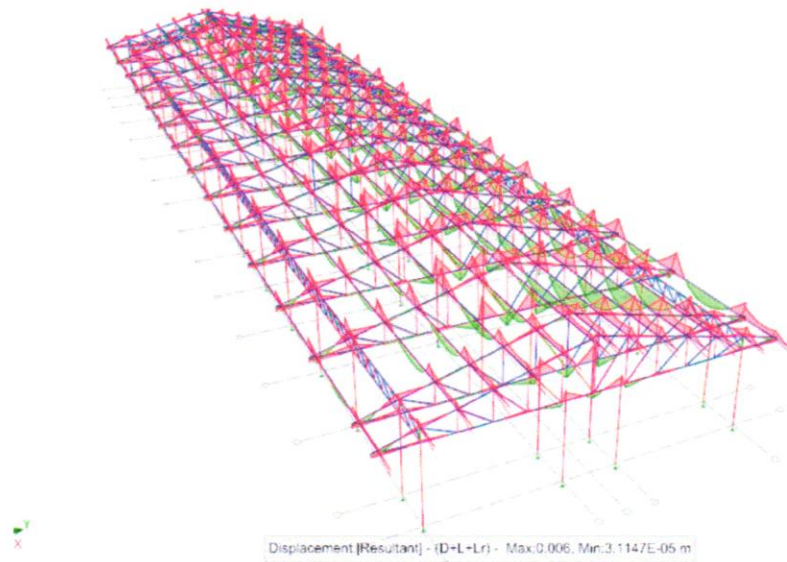


Column Plan

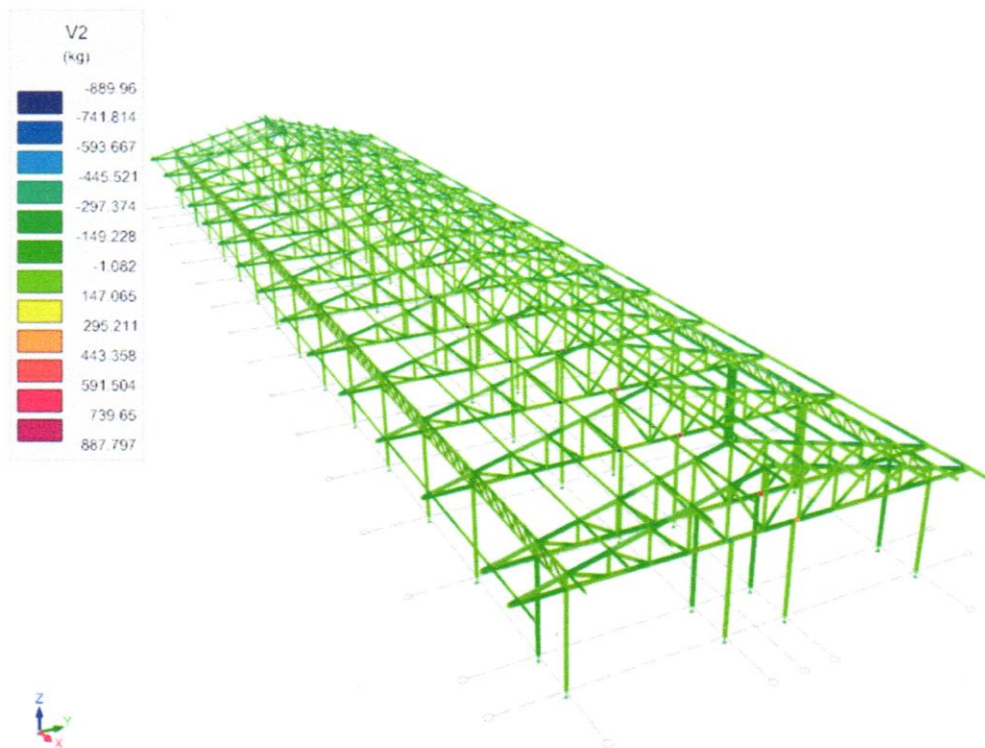


Displacement [Resultant] - (D+L+Lr) - Max:0.006, Min:3.1147E-05 m

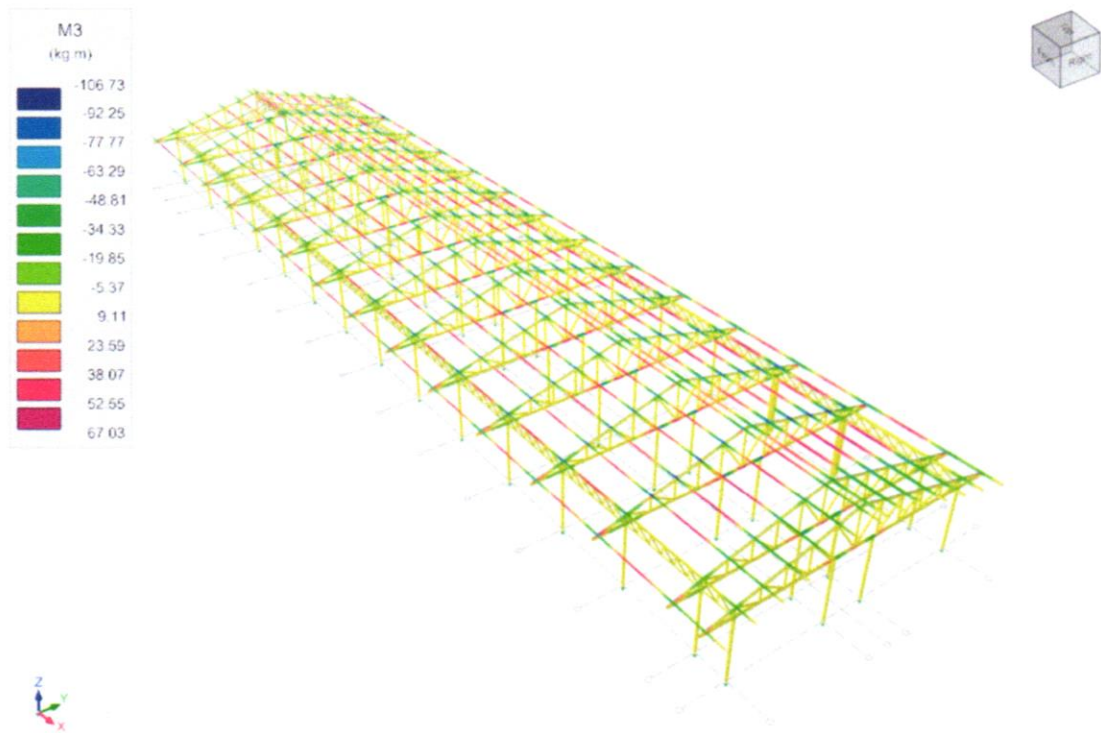
Shear Diagram Top Roof st FL



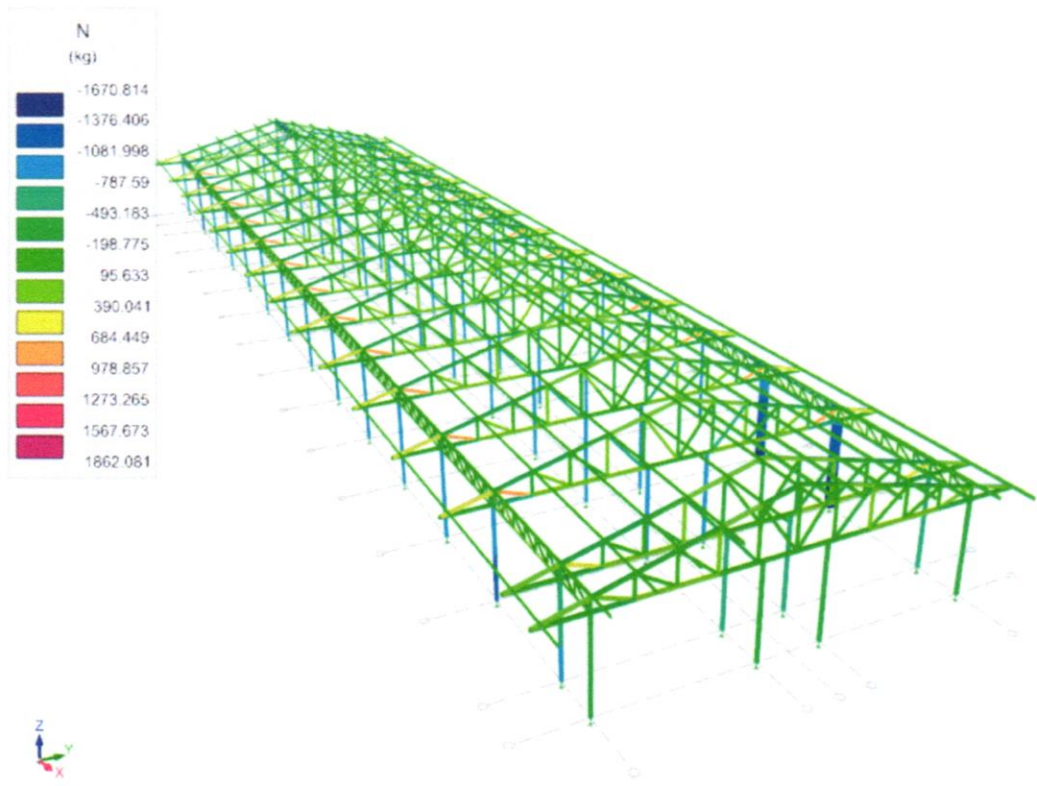
Bending Moment Diagram Top Roof th FL



Shear Diagram Building

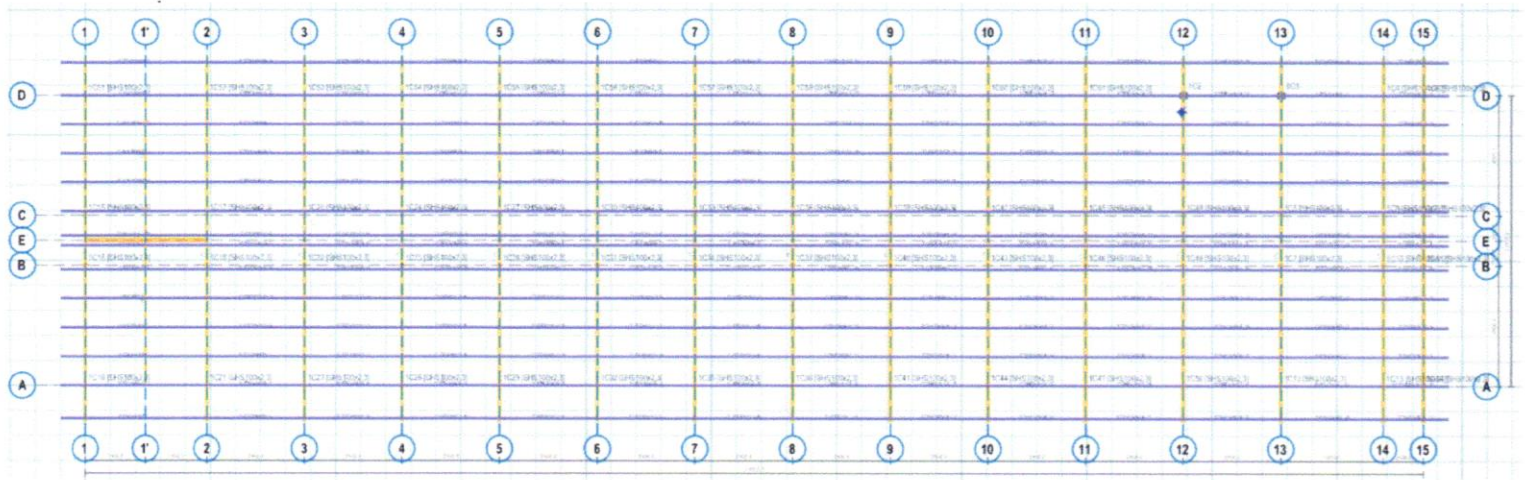


Bending Moment Diagram Building



Axial Load

7. Roof Structure(ออกแบบโครงสร้างหลังคา)



7.1 การออกแบบแปเหล็ก

Steel Purlin 1P1

	Member	Section / Material	kL/r	Deflection	U. Ratio	Status	Governing Check
Purlin	P1	CWL100x50x20x2,8 / SS 400 (TIS)	236 < 300 ✓	12.7 < 24.3 (L/200) ✓	0.563 < 1.000	Pass ✓	Combined
	P2	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	1.4 < 24.3 (L/200) ✓	0.602 < 1.000	Pass ✓	Combined
	P3	CWL100x50x20x2,8 / SS 400 (TIS)	236 < 300 ✓	3.4 < 24.3 (L/200) ✓	0.346 < 1.000	Pass ✓	Combined
	P4	CWL100x50x20x2,8 / SS 400 (TIS)	236 < 300 ✓	4.6 < 24.3 (L/200) ✓	0.384 < 1.000	Pass ✓	Combined
	P5	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	5.1 < 24.3 (L/200) ✓	0.391 < 1.000	Pass ✓	Combined
	P6	CWL100x50x20x2,8 / SS 400 (TIS)	236 < 300 ✓	4.5 < 24.3 (L/200) ✓	0.346 < 1.000	Pass ✓	Combined
	P7	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	3.5 < 24.3 (L/200) ✓	0.245 < 1.000	Pass ✓	Combined
	P8	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	12.7 < 24.3 (L/200) ✓	0.535 < 1.000	Pass ✓	Combined
	P9	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	1.2 < 24.3 (L/200) ✓	0.578 < 1.000	Pass ✓	Combined
	P10	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	3.3 < 24.3 (L/200) ✓	0.327 < 1.000	Pass ✓	Combined
	P11	CWL100x50x20x2,8 / SS 400 (TIS)	236 < 300 ✓	4.5 < 24.3 (L/200) ✓	0.366 < 1.000	Pass ✓	Combined

P12	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	5.0 < 24.3 (L/200) ✓	0.373 < 1.000	Pass ✓	Combined
P13	CWL100x50x20x2,8 / SS 400 (TIS)	236 < 300 ✓	4.4 < 24.3 (L/200) ✓	0.328 < 1.000	Pass ✓	Combined
P14	CWL100x50x20x2,8 / SS 400 (TIS)	236 ≥ 200!	3.6 < 24.3 (L/200) ✓	0.215 < 1.000	Pass ✓	Combined
P15	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	1.5 < 19.5 (L/200) ✓	0.422 < 1.000	Pass ✓	Combined
P16	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	0.0 < 19.5 (L/200) ✓	0.089 < 1.000	Pass ✓	Combined
P17	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.9 < 19.5 (L/200) ✓	0.466 < 1.000	Pass ✓	Combined
P18	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.9 < 19.5 (L/200) ✓	0.390 < 1.000	Pass ✓	Bending (Major)
P19	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.8 < 19.5 (L/200) ✓	0.462 < 1.000	Pass ✓	Combined
P20	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.432 < 1.000	Pass ✓	Combined
P21	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.9 < 19.5 (L/200) ✓	0.220 < 1.000	Pass ✓	Combined
P22	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	1.5 < 19.5 (L/200) ✓	0.435 < 1.000	Pass ✓	Combined
P23	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	0.0 < 19.5 (L/200) ✓	0.084 < 1.000	Pass ✓	Combined
P24	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	4.0 < 19.5 (L/200) ✓	0.447 < 1.000	Pass ✓	Combined
P25	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.9 < 19.5 (L/200) ✓	0.390 < 1.000	Pass ✓	Bending (Major)
P26	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.8 < 19.5 (L/200) ✓	0.443 < 1.000	Pass ✓	Combined
P27	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.4 < 19.5 (L/200) ✓	0.413 < 1.000	Pass ✓	Combined
P28	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.0 < 19.5 (L/200) ✓	0.227 < 1.000	Pass ✓	Combined
P29	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.9 < 19.5 (L/200) ✓	0.341 < 1.000	Pass ✓	Combined
P30	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.057 < 1.000	Pass ✓	Axial Compression
P31	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.451 < 1.000	Pass ✓	Combined

P32	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.452 < 1.000	Pass ✓	Combined
P33	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.385 < 1.000	Pass ✓	Bending (Major)
P34	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.4 < 19.5 (L/200) ✓	0.419 < 1.000	Pass ✓	Combined
P35	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.8 < 19.5 (L/200) ✓	0.325 < 1.000	Pass ✓	Combined
P36	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.9 < 19.5 (L/200) ✓	0.329 < 1.000	Pass ✓	Combined
P37	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.054 < 1.000	Pass ✓	Axial Compression
P38	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.460 < 1.000	Pass ✓	Combined
P39	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.460 < 1.000	Pass ✓	Combined
P40	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.5 < 19.5 (L/200) ✓	0.386 < 1.000	Pass ✓	Bending (Major)
P41	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.4 < 19.5 (L/200) ✓	0.351 < 1.000	Pass ✓	Bending (Major)
P42	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.2 < 19.5 (L/200) ✓	0.238 < 1.000	Pass ✓	Combined
P43	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.5 < 19.5 (L/200) ✓	0.347 < 1.000	Pass ✓	Combined
P44	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.203 < 1.000	Pass ✓	Combined
P45	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.465 < 1.000	Pass ✓	Combined
P46	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.458 < 1.000	Pass ✓	Combined
P47	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.456 < 1.000	Pass ✓	Combined
P48	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.418 < 1.000	Pass ✓	Combined
P49	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.4 < 19.5 (L/200) ✓	0.311 < 1.000	Pass ✓	Combined
P50	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.6 < 19.5 (L/200) ✓	0.340 < 1.000	Pass ✓	Combined
P51	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.049 < 1.000	Pass ✓	Axial Compression

P52	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined
P53	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.453 < 1.000	Pass ✓	Combined
P54	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.6 < 19.5 (L/200) ✓	0.382 < 1.000	Pass ✓	Bending (Major)
P55	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.420 < 1.000	Pass ✓	Combined
P56	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.8 < 19.5 (L/200) ✓	0.245 < 1.000	Pass ✓	Combined
P57	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.9 < 19.5 (L/200) ✓	0.330 < 1.000	Pass ✓	Combined
P58	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	4.6 < 19.5 (L/200) ✓	0.462 < 1.000	Pass ✓	Combined
P59	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.8 < 19.5 (L/200) ✓	0.447 < 1.000	Pass ✓	Combined
P60	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.452 < 1.000	Pass ✓	Combined
P61	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.382 < 1.000	Pass ✓	Bending (Major)
P62	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.421 < 1.000	Pass ✓	Combined
P63	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.4 < 19.5 (L/200) ✓	0.318 < 1.000	Pass ✓	Combined
P64	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.6 < 19.5 (L/200) ✓	0.333 < 1.000	Pass ✓	Combined
P65	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.198 < 1.000	Pass ✓	Combined
P66	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.451 < 1.000	Pass ✓	Combined
P67	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined
P68	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.383 < 1.000	Pass ✓	Bending (Major)
P69	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.418 < 1.000	Pass ✓	Combined
P70	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.8 < 19.5 (L/200) ✓	0.238 < 1.000	Pass ✓	Combined
P71	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.4 < 19.5 (L/200) ✓	0.342 < 1.000	Pass ✓	Combined

P72	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.1 < 19.5 (L/200) ✓	0.199 < 1.000	Pass ✓	Combined
P73	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.4 < 19.5 (L/200) ✓	0.459 < 1.000	Pass ✓	Combined
P74	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.455 < 1.000	Pass ✓	Combined
P75	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.382 < 1.000	Pass ✓	Bending (Major)
P76	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.4 < 19.5 (L/200) ✓	0.410 < 1.000	Pass ✓	Combined
P77	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.8 < 19.5 (L/200) ✓	0.311 < 1.000	Pass ✓	Combined
P78	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.9 < 19.5 (L/200) ✓	0.331 < 1.000	Pass ✓	Combined
P79	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	4.6 < 19.5 (L/200) ✓	0.460 < 1.000	Pass ✓	Combined
P80	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.8 < 19.5 (L/200) ✓	0.449 < 1.000	Pass ✓	Combined
P81	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.7 < 19.5 (L/200) ✓	0.452 < 1.000	Pass ✓	Combined
P82	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.6 < 19.5 (L/200) ✓	0.453 < 1.000	Pass ✓	Combined
P83	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.4 < 19.5 (L/200) ✓	0.419 < 1.000	Pass ✓	Combined
P84	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.2 < 19.5 (L/200) ✓	0.247 < 1.000	Pass ✓	Combined
P85	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.8 < 19.5 (L/200) ✓	0.340 < 1.000	Pass ✓	Combined
P86	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	4.3 < 19.5 (L/200) ✓	0.496 < 1.000	Pass ✓	Combined
P87	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.7 < 19.5 (L/200) ✓	0.457 < 1.000	Pass ✓	Combined
P88	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.455 < 1.000	Pass ✓	Combined
P89	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.456 < 1.000	Pass ✓	Combined
P90	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.1 < 19.5 (L/200) ✓	0.427 < 1.000	Pass ✓	Combined
P91	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.9 < 19.5 (L/200) ✓	0.221 < 1.000	Pass ✓	Combined

P92	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.6 < 19.5 (L/200) ✓	0.347 < 1.000	Pass ✓	Combined
P93	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.204 < 1.000	Pass ✓	Combined
P94	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.465 < 1.000	Pass ✓	Combined
P95	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.458 < 1.000	Pass ✓	Combined
P96	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.457 < 1.000	Pass ✓	Combined
P97	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.2 < 19.5 (L/200) ✓	0.425 < 1.000	Pass ✓	Combined
P98	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.1 < 19.5 (L/200) ✓	0.216 < 1.000	Pass ✓	Combined
P99	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.6 < 19.5 (L/200) ✓	0.336 < 1.000	Pass ✓	Combined
P100	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.7 < 19.5 (L/200) ✓	0.480 < 1.000	Pass ✓	Combined
P101	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.5 < 19.5 (L/200) ✓	0.453 < 1.000	Pass ✓	Combined
P102	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined
P103	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.382 < 1.000	Pass ✓	Bending (Major)
P104	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.4 < 19.5 (L/200) ✓	0.420 < 1.000	Pass ✓	Combined
P105	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.9 < 19.5 (L/200) ✓	0.324 < 1.000	Pass ✓	Combined
P106	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.6 < 19.5 (L/200) ✓	0.334 < 1.000	Pass ✓	Combined
P107	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.198 < 1.000	Pass ✓	Combined
P108	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.449 < 1.000	Pass ✓	Combined
P109	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.452 < 1.000	Pass ✓	Combined
P110	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.6 < 19.5 (L/200) ✓	0.383 < 1.000	Pass ✓	Bending (Major)
P111	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.4 < 19.5 (L/200) ✓	0.412 < 1.000	Pass ✓	Combined

P112	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.2 < 19.5 (L/200) ✓	0.238 < 1.000	Pass ✓	Combined
P113	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.7 < 19.5 (L/200) ✓	0.338 < 1.000	Pass ✓	Combined
P114	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.8 < 19.5 (L/200) ✓	0.482 < 1.000	Pass ✓	Combined
P115	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.6 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined
P116	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined
P117	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.453 < 1.000	Pass ✓	Combined
P118	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.417 < 1.000	Pass ✓	Combined
P119	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.4 < 19.5 (L/200) ✓	0.310 < 1.000	Pass ✓	Combined
P120	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.9 < 19.5 (L/200) ✓	0.333 < 1.000	Pass ✓	Combined
P121	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	4.6 < 19.5 (L/200) ✓	0.462 < 1.000	Pass ✓	Combined
P122	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.8 < 19.5 (L/200) ✓	0.450 < 1.000	Pass ✓	Combined
P123	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.7 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined
P124	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.382 < 1.000	Pass ✓	Bending (Major)
P125	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.421 < 1.000	Pass ✓	Combined
P126	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.8 < 19.5 (L/200) ✓	0.246 < 1.000	Pass ✓	Combined
P127	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.7 < 19.5 (L/200) ✓	0.338 < 1.000	Pass ✓	Combined
P128	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.8 < 19.5 (L/200) ✓	0.482 < 1.000	Pass ✓	Combined
P129	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.6 < 19.5 (L/200) ✓	0.383 < 1.000	Pass ✓	Bending (Major)
P130	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.6 < 19.5 (L/200) ✓	0.457 < 1.000	Pass ✓	Combined
P131	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.457 < 1.000	Pass ✓	Combined

P132	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.421 < 1.000	Pass ✓	Combined
P133	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.4 < 19.5 (L/200) ✓	0.315 < 1.000	Pass ✓	Combined
P134	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.5 < 19.5 (L/200) ✓	0.341 < 1.000	Pass ✓	Combined
P135	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	0.2 < 19.5 (L/200) ✓	0.210 < 1.000	Pass ✓	Combined
P136	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.4 < 19.5 (L/200) ✓	0.459 < 1.000	Pass ✓	Combined
P137	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.5 < 19.5 (L/200) ✓	0.455 < 1.000	Pass ✓	Combined
P138	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.5 < 19.5 (L/200) ✓	0.385 < 1.000	Pass ✓	Bending (Major)
P139	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.3 < 19.5 (L/200) ✓	0.418 < 1.000	Pass ✓	Combined
P140	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.9 < 19.5 (L/200) ✓	0.238 < 1.000	Pass ✓	Combined
P141	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.7 < 19.5 (L/200) ✓	0.334 < 1.000	Pass ✓	Combined
P142	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.8 < 19.5 (L/200) ✓	0.484 < 1.000	Pass ✓	Combined
P143	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.7 < 19.5 (L/200) ✓	0.448 < 1.000	Pass ✓	Combined
P144	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.7 < 19.5 (L/200) ✓	0.443 < 1.000	Pass ✓	Combined
P145	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.7 < 19.5 (L/200) ✓	0.385 < 1.000	Pass ✓	Bending (Major)
P146	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.5 < 19.5 (L/200) ✓	0.407 < 1.000	Pass ✓	Combined
P147	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.6 < 19.5 (L/200) ✓	0.303 < 1.000	Pass ✓	Combined
P148	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.8 < 19.5 (L/200) ✓	0.327 < 1.000	Pass ✓	Combined
P149	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	4.2 < 19.5 (L/200) ✓	0.480 < 1.000	Pass ✓	Combined
P150	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.8 < 19.5 (L/200) ✓	0.445 < 1.000	Pass ✓	Combined
P151	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.8 < 19.5 (L/200) ✓	0.454 < 1.000	Pass ✓	Combined

P152	CWL100x50x20x2,8 / SS 400 (TIS)	0 < 0 ✓	3.8 < 19.5 (L/200) ✓	0.385 < 1.000	Pass ✓	Bending (Major)
P153	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	3.5 < 19.5 (L/200) ✓	0.421 < 1.000	Pass ✓	Combined
P154	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.0 < 19.5 (L/200) ✓	0.243 < 1.000	Pass ✓	Combined
P155	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.5 < 19.5 (L/200) ✓	0.357 < 1.000	Pass ✓	Combined
P156	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	4.1 < 19.5 (L/200) ✓	0.477 < 1.000	Pass ✓	Combined
P157	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.2 < 19.5 (L/200) ✓	0.485 < 1.000	Pass ✓	Combined
P158	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.0 < 19.5 (L/200) ✓	0.500 < 1.000	Pass ✓	Combined
P159	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.0 < 19.5 (L/200) ✓	0.503 < 1.000	Pass ✓	Combined
P160	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.7 < 19.5 (L/200) ✓	0.463 < 1.000	Pass ✓	Combined
P161	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.0 < 19.5 (L/200) ✓	0.350 < 1.000	Pass ✓	Combined
P162	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.4 < 19.5 (L/200) ✓	0.343 < 1.000	Pass ✓	Combined
P163	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	4.0 < 19.5 (L/200) ✓	0.507 < 1.000	Pass ✓	Combined
P164	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.2 < 19.5 (L/200) ✓	0.467 < 1.000	Pass ✓	Combined
P165	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	3.0 < 19.5 (L/200) ✓	0.481 < 1.000	Pass ✓	Combined
P166	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 300 ✓	2.9 < 19.5 (L/200) ✓	0.484 < 1.000	Pass ✓	Combined
P167	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	2.7 < 19.5 (L/200) ✓	0.445 < 1.000	Pass ✓	Combined
P168	CWL100x50x20x2,8 / SS 400 (TIS)	190 < 200 ✓	1.4 < 19.5 (L/200) ✓	0.266 < 1.000	Pass ✓	Combined
P169	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 300 ✓	4.4 < 20.5 (L/200) ✓	0.382 < 1.000	Pass ✓	Combined
P170	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	0.3 < 20.5 (L/200) ✓	0.174 < 1.000	Pass ✓	Combined
P171	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 300 ✓	6.0 < 20.5 (L/200) ✓	0.511 < 1.000	Pass ✓	Combined

P172	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	6.4 < 20.5 (L/200) ✓	0.504 < 1.000	Pass ✓	Combined
P173	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	6.4 < 20.5 (L/200) ✓	0.502 < 1.000	Pass ✓	Combined
P174	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 300 ✓	5.9 < 20.5 (L/200) ✓	0.462 < 1.000	Pass ✓	Combined
P175	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	4.5 < 20.5 (L/200) ✓	0.348 < 1.000	Pass ✓	Combined
P176	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 300 ✓	4.5 < 20.5 (L/200) ✓	0.452 < 1.000	Pass ✓	Combined
P177	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	0.3 < 20.5 (L/200) ✓	0.208 < 1.000	Pass ✓	Combined
P178	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 300 ✓	6.0 < 20.5 (L/200) ✓	0.602 < 1.000	Pass ✓	Combined
P179	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	6.4 < 20.5 (L/200) ✓	0.595 < 1.000	Pass ✓	Combined
P180	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	6.4 < 20.5 (L/200) ✓	0.593 < 1.000	Pass ✓	Combined
P181	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 300 ✓	5.9 < 20.5 (L/200) ✓	0.545 < 1.000	Pass ✓	Combined
P182	CWL100x50x20x2,8 / SS 400 (TIS)	200 < 200 ✓	3.7 < 20.5 (L/200) ✓	0.317 < 1.000	Pass ✓	Combined
P183	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.2 < 8.0 (L/200) ✓	0.185 < 1.000	Pass ✓	Combined
P184	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.0 < 8.0 (L/200) ✓	0.182 < 1.000	Pass ✓	Combined
P185	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.7 < 8.0 (L/200) ✓	0.256 < 1.000	Pass ✓	Combined
P186	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.9 < 8.0 (L/200) ✓	0.290 < 1.000	Pass ✓	Combined
P187	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.9 < 8.0 (L/200) ✓	0.295 < 1.000	Pass ✓	Combined
P188	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.7 < 8.0 (L/200) ✓	0.273 < 1.000	Pass ✓	Combined
P189	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.4 < 8.0 (L/200) ✓	0.208 < 1.000	Pass ✓	Combined
P190	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 200 ✓	1.2 < 8.0 (L/200) ✓	0.207 < 1.000	Pass ✓	Combined
P191	CWL100x50x20x2,8 / SS 400 (TIS)	78 < 300 ✓	1.0 < 8.0 (L/200) ✓	0.177 < 1.000	Pass ✓	Combined

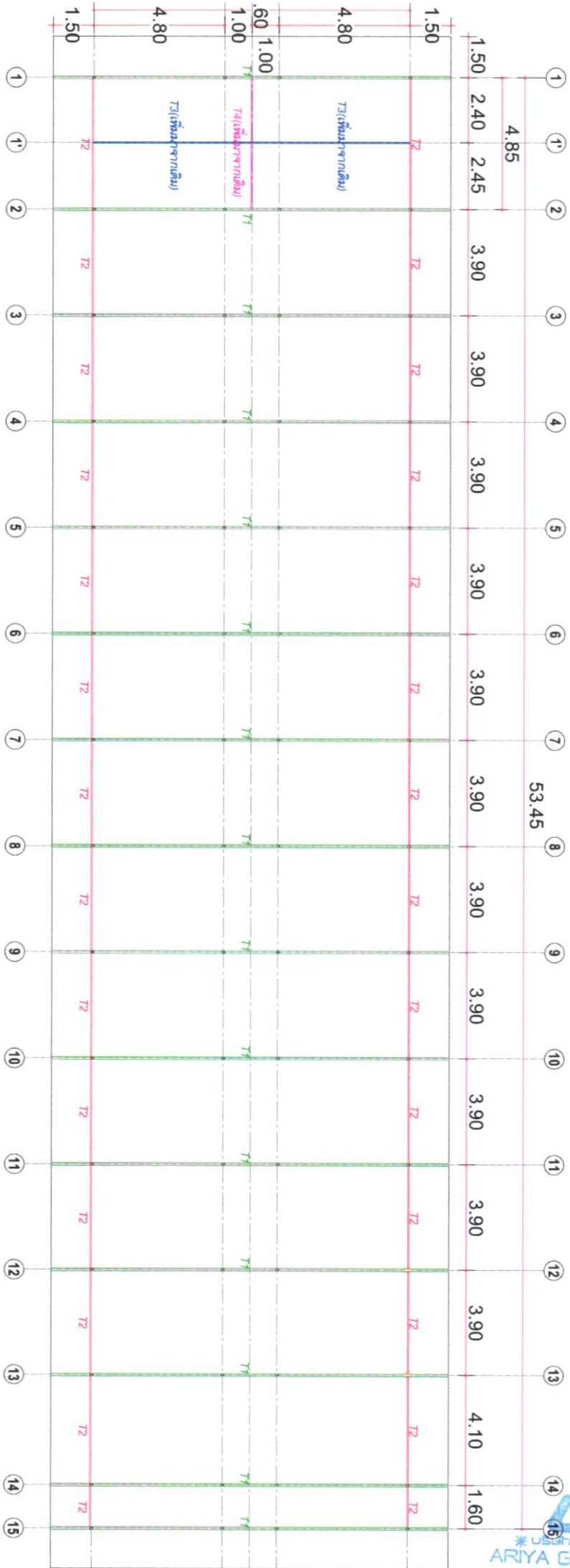
Purlin 1P1 - P2

Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 4850.0$ mm	$L_y = 4850.0$ mm	$L_b = 4850.0$ mm
Slenderness Ratio:	$203 \geq 200!$				

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.565 < 1.00 ✓	D+L+Lr	1301.372	2302.439 (FB)	2302.43 9	∞


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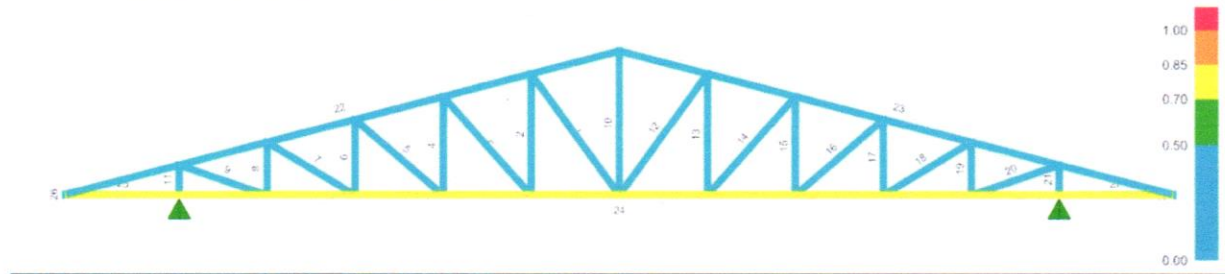
Shear		U. Ratio	Cmb.	V_r	V_c
Major (y-y)		0.026 < 1.00 ✓	D+L+Lr	180.021	6952.781
Minor (z-z)		0.014 < 1.00 ✓	D+L+Lr	-46.557	3323.981
Torsion		U. Ratio	Cmb.	T_r	T_c
		0.014 < 1.00 ✓	D+L+Lr	-4.73	331.87
Deflection		δ_v (mm)		δ_v Limit (mm)	
Deflection Span		4850.0 mm			
Category		Purlin/Girt			
D+L		1.4		< 24.3 (L/200) ✓	



แปลโครงสร้างหลังคา

SCALE 1 : 200

7.2 การออกแบบโครงหลังคาเหล็ก (grid line 1) T1



Steel Truss 1T1

	Member	Section / Material	kL/r	Deflection	U. Ratio	Status	Governing Check
Top Chord	TC22	2CWL100x50x20x2.8 / SS 400 (TIS)	191 < 200 ✓	0.5 < 48.3 (L/240) ✓	0.174 < 1.000	Pass ✓	Combined
	TC23	2CWL100x50x20x2.8 / SS 400 (TIS)	191 < 200 ✓	0.5 < 48.3 (L/240) ✓	0.178 < 1.000	Pass ✓	Combined
Bottom Chord	BC24	2CWL100x50x20x2.8 / SS 400 (TIS)	205 ≥ 200!	0.6 < 48.3 (L/240) ✓	0.791 < 1.000	Pass ✓	Combined
Diagonal	D1	CWL100x50x20x2.8 / SS 400 (TIS)	109 < 300 ✓	-	0.047 < 1.000	Pass ✓	Axial Tension
	D3	CWL100x50x20x2.8 / SS 400 (TIS)	87 < 200 ✓	-	0.086 < 1.000	Pass ✓	Axial Compression
	D5	CWL100x50x20x2.8 / SS 400 (TIS)	77 < 200 ✓	-	0.033 < 1.000	Pass ✓	Axial Compression
	D7	CWL100x50x20x2.8 / SS 400 (TIS)	68 < 300 ✓	-	0.024 < 1.000	Pass ✓	Axial Tension
	D9	CWL100x50x20x2.8 / SS 400 (TIS)	61 < 300 ✓	-	0.117 < 1.000	Pass ✓	Axial Tension
	D12	CWL100x50x20x2.8 / SS 400 (TIS)	99 < 300 ✓	-	0.045 < 1.000	Pass ✓	Axial Tension
	D14	CWL100x50x20x2.8 / SS 400 (TIS)	87 < 200 ✓	-	0.085 < 1.000	Pass ✓	Axial Compression
	D16	CWL100x50x20x2.8 / SS 400 (TIS)	77 < 200 ✓	-	0.033 < 1.000	Pass ✓	Axial Compression
	D18	CWL100x50x20x2.8 / SS 400 (TIS)	68 < 300 ✓	-	0.024 < 1.000	Pass ✓	Axial Tension
	D20	CWL100x50x20x2.8 / SS 400 (TIS)	61 < 300 ✓	-	0.117 < 1.000	Pass ✓	Axial Tension
	D25	CWL100x50x20x2.8 / SS 400 (TIS)	72 < 200 ✓	-	0.088 < 1.000	Pass ✓	Axial Compression

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Combined Forces	U. Ratio	Cmb.	$P_r/2P_t + M_{rx}/M_{ox} + M_{ry}/M_{oy}$			
	0.178 < 1.00 ✓	D+L+Lr				
		P_r	P_t			
Axial Tension	0.064-1039.851	16179.120 (TR)				
		M_r	M_c			
Bending Major (y-y)	0.107	-50.61	471.95 (FLB)			
Bending Minor (z-z)	0.039	-18.30	471.95 (FLB)			
Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.143 < 1.00 ✓	D+L+Lr	559.021	3898.988 (FB)	3898.98 8	∞
Axial Tension	U. Ratio	Cmb.	P_r	P_t		
	0.064 < 1.00 ✓	D+L+Lr	-1041.016	16179.120		
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	0.057 < 1.00 ✓	D+L+Lr	-328.278	5755.925		
Minor (z-z)	0.060 < 1.00 ✓	D+L+Lr	342.685	5755.925		
Torsion	U. Ratio	Cmb.	T_r	T_c		
	0.124 < 1.00 ✓	D+L+Lr	-70.25	568.44		
Deflection		δ_v (mm)	δ_v Limit (mm)			
Deflection Span	11600.0 mm					
Category	Roof Beam					
D		0.2	< 32.2 (L/360) ✓			
D+L		0.5	< 48.3 (L/240) ✓			
Bottom Chord BC24						
Section:	2CWL100x50x20x2.8 / SS 400 (TIS)					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1160.0$ mm	$L_y = 14600.0$ mm	$L_b = 14600.0$ mm	
Slenderness Ratio:	207 ≥ 200!					

Combined Forces	U. Ratio 0.791 < 1.00 ✓	Cmb. D+L+Lr	$P_r/P_c + (8/9)(M_{rx}/M_{cx} + M_{ry}/M_{cy})$			
Axial Compression	0.745	P_r 980.575	P_c 1316.833 (FB)			
Bending Major (y-y)	0.043	M_r -39.66	M_c 914.85 (WLB)			
Bending Minor (z-z)	0.009	-8.54	914.85 (WLB)			
Axial Compression	U. Ratio 0.745 < 1.00 ✓	Cmb. D+L+Lr	P_r 980.575	P_c 1316.833 (FB)	P_{nFB} 1316.83 3	P_{nTTFB} ∞
Axial Tension	U. Ratio 0.026 < 1.00 ✓	Cmb. D+L+Lr	P_r -554.544	P_t 20952.000		
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	0.216 < 1.00 ✓	D+L+Lr	-1604.878	7426.080		
Minor (z-z)	0.002 < 1.00 ✓	D+L+Lr	11.189	7426.080		
Torsion	U. Ratio 0.016 < 1.00 ✓	Cmb. D+L+Lr	T_r 11.34	T_c 730.29		
Deflection		δ_v (mm)	δ_v Limit (mm)			
Deflection Span	11600.0 mm					
Category	Roof Beam					
D		0.3	< 32.2 (L/360) ✓			
D+L		0.6	< 48.3 (L/240) ✓			
Diagonal D1						
Section:	CWL100x50x20x2.8 (SS 400 (TIS))					
Section Class:	Compact					
Units:	(kg, kg.m)					

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 2058.1$ $L_y = 2058.1$ $L_b = 2058.1$
mm mm mm

Slenderness Ratio: $109 < 300 \checkmark$

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	$0.047 < 1.00 \checkmark$	D+L+Lr	-547.136	11692.622
Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.001 < 1.00 \checkmark$	Dc+Lc+Ez- Ey-	3.853	5283.533
Minor (z-z)	$0.000 < 1.00 \checkmark$	G-WCase4-	0.000	3628.800

Diagonal D3

Section: RHS100x50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 1818.1$ mm $L_y = 1818.1$ mm $L_b = 1818.1$ mm

Slenderness Ratio: $87 < 200 \checkmark$

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.086 < 1.00 \checkmark$	D+L+Lr	844.504	9864.388 (FB)	9864.38 8	∞
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	$0.001 < 1.00 \checkmark$	Dc+Lc+Ez- Ey-	3.967	5755.925		
Minor (z-z)	$0.000 < 1.00 \checkmark$	D+L+Lr	0.000	2775.125		

Diagonal D5

Section: CWL100x50x20x2.8 / SS 400 (TIS)

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 1598.6$ mm $L_y = 1598.6$ mm $L_b = 1598.6$ mm

Slenderness Ratio: $77 < 200 \checkmark$

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.033 < 1.00 ✓	D+L+Lr	360.312	10756.396 (FB)	10756.39 6	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.000	2775.125

Diagonal D7

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1409.1$ mm	$L_y = 1409.1$ mm	$L_b = 1409.1$ mm
Slenderness Ratio:	68 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.024 < 1.00 ✓	D+L+Lr	-290.819	12039.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.000	2775.125

Diagonal D9

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1263.2$ mm	$L_y = 1263.2$ mm	$L_b = 1263.2$ mm
Slenderness Ratio:	61 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.117 < 1.00 ✓	D+L+Lr	-1409.592	12039.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.000	2775.125

Diagonal D12

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 2058.1$ mm	$L_y = 2058.1$ mm	$L_b = 2058.1$ mm
Slenderness Ratio:	99 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.045 < 1.00 ✓	D+L+Lr	-541.454	12039.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.000	2775.125

Diagonal D14

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1818.1$ mm	$L_y = 1818.1$ mm	$L_b = 1818.1$ mm
Slenderness Ratio:	87 < 200 ✓				

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.085 < 1.00 ✓	D+L+Lr	842.408	9864.388 (FB)	9864.38 8	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	0.000 < 1.00 ✓	G-WCase4-	0.000	2775.125

Diagonal D16

Section: RHS100x50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 1598.6$ mm $L_y = 1598.6$ mm $L_b = 1598.6$ mmSlenderness Ratio: $77 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.033 < 1.00$ ✓	D+L+Lr	360.251	10756.396 (FB)	10756.39 6	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.001 < 1.00$ ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	$0.000 < 1.00$ ✓	D+L+Lr	0.000	2775.125

Diagonal D18

Section: CWL100x50x20x2.8 / SS 400 (TIS)

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 1409.1$ mm $L_y = 1409.1$ mm $L_b = 1409.1$ mmSlenderness Ratio: $68 < 300$ ✓

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	$0.024 < 1.00$ ✓	D+L+Lr	-293.052	12039.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.001 < 1.00$ ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	$0.000 < 1.00$ ✓	D+L+Lr	0.000	2775.125

Diagonal D20

Section: CWL100x50x20x2.8 / SS 400 (TIS)

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 1263.2$ mm $L_y = 1263.2$ mm $L_b = 1263.2$ mmSlenderness Ratio: $61 < 300$ ✓

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	3.967	5755.925
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.000	2775.125

Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1504.2$ mm	$L_y = 1504.2$ mm	$L_b = 1504.2$ mm
Slenderness Ratio:	$72 < 200 \checkmark$				

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez-Ey-	-5.130	5755.925
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez+Ey +	0.000	2775.125

Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1504.2$ mm	$L_y = 1504.2$ mm	$L_b = 1504.2$ mm
Slenderness Ratio:	$72 < 200 \checkmark$				

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Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	-5.130	5755.925
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex-	0.000	2775.125

Vertical V2

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1700.0$ mm	$L_y = 1700.0$ mm	$L_b = 1700.0$ mm
Slenderness Ratio:	82 < 200 ✓				

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.097 < 1.00 ✓	D+L+Lr	1005.876	10349.127 (FB)	10349.12 7	∞

Vertical V4

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1400.0$ mm	$L_y = 1400.0$ mm	$L_b = 1400.0$ mm
Slenderness Ratio:	67 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.030 < 1.00 ✓	D+L+Lr	-355.975	12039.120

Vertical V6

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1100.0$ mm	$L_y = 1100.0$ mm	$L_b = 1100.0$ mm
Slenderness Ratio:	53 < 200 ✓				

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.012 < 1.00 ✓	D+L+Lr	153.821	12563.774 (FB)	12563.77 4	∞
Vertical V8						
Section:	CWL100x50x20x2.8 / SS 400 (TIS)					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 800.0 \text{ mm}$ $L_y = 800.0 \text{ mm}$ $L_b = 800.0 \text{ mm}$			
Slenderness Ratio:	38 < 200 ✓					

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.044 < 1.00 ✓	D+L+Lr	592.084	13418.178 (FB)	13418.17 8	∞

Vertical V10						
Section:	CWL100x50x20x2.8 / SS 400 (TIS)					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 2000.0 mm	L _y = 2000.0 mm	L _b = 2000.0 mm	
Slenderness Ratio:	96 < 200 ✓					

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.156 < 1.00 ✓	D+L+Lr	1422.363	9104.597 (FB)	9104.59 7	∞

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.007 < 1.00 ✓	D+L+Lr	-39.030	5755.925
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	-0.219	2775.125
Vertical V11				
Section:	CWL100x50x20x2.8 / SS 400 (TIS)			
Section Class:	Compact			
Units:	(kg, kg.m)			
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 500.0 mm L _y = 500.0 mm L _b = 500.0 mm	
Slenderness Ratio:	24 < 200 ✓			

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.080 < 1.00 ✓	D+L+Lr	1128.368	14036.014 (FB)	14036.01 4	∞

Vertical V13

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 1700.0 mm	L _y = 1700.0 mm	L _b = 1700.0 mm
Slenderness Ratio:	82 < 200 ✓				

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.098 < 1.00 ✓	D+L+Lr	1015.586	10349.127 (FB)	10349.12 7	∞

Vertical V15

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1400.0$ mm	$L_y = 1400.0$ mm	$L_b = 1400.0$ mm
Slenderness Ratio:	67 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.030 < 1.00 ✓	D+L+Lr	-356.838	12039.120

Vertical V17

Section:	CWL100x50x20x2.8 / SS 400 (TIS)				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 1100.0$ mm	$L_y = 1100.0$ mm	$L_b = 1100.0$ mm
Slenderness Ratio:	53 < 200 ✓				

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.012 < 1.00 ✓	D+L+Lr	155.251	12563.774 (FB)	12563.77 4	∞
Vertical V19						
Section:	CWL100x50x20x2.8 / SS 400 (TIS)					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 800.0 mm L _y = 800.0 mm L _b = 800.0 mm			
Slenderness Ratio:	38 < 200 ✓					

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.044 < 1.00 ✓	D+L+Lr	593.738	13418.178 (FB)	13418.17 8	∞
Vertical V21						
Section:	CWL100x50x20x2.8 / SS 400 (TIS)					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 500.0 mm L _y = 500.0 mm L _b = 500.0 mm			
Slenderness Ratio:	24 < 200 ✓					

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.080 < 1.00 ✓	D+L+Lr	1120.734	14036.014 (FB)	14036.01 4	∞
Vertical V26						
Section:	CWL100x50x20x2.8 / SS 400 (TIS)					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 112.1 mm L _y = 112.1 mm L _b = 112.1 mm			
Slenderness Ratio:	5 < 200 ✓					

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.001 < 1.00 ✓	D+L+Lr	18.346	14426.016 (FB)	14426.01 6	∞

Vertical V28

Section: CWL100x50x20x2.8 / SS 400 (TIS)

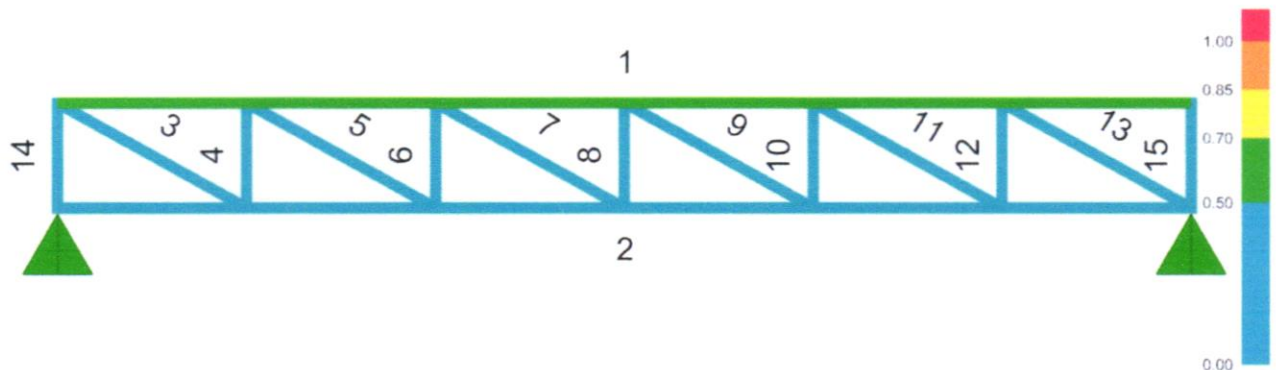
Section Class: **Compact**

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 112.1 \text{ mm}$ $L_y = 112.1 \text{ mm}$ $L_b = 112.1 \text{ mm}$ Slenderness Ratio: **$5 < 200$ ✓**

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.001 < 1.00$ ✓	D+L+Lr	18.213	14426.016 (FB)	14426.01 6	∞

7.3 การออกแบบโครงหลังคาเหล็ก T2



Steel Truss T4

	Member	Section / Material	kL/r	Deflection	U. Ratio	Status	Governing Check
Top Chord	TC1	SHS50x1,7 / SS 400 (TIS)	251 ≥ 200!	1.5 < 20.2 (L/240) ✓	0.657 < 1.000	Pass ✓	Combined
Bottom Chord	BC2	SHS50x1,7 / SS 400 (TIS)	251 ≥ 200!	1.5 < 20.2 (L/240) ✓	0.338 < 1.000	Pass ✓	Combined
Diagonal	D3	SHS50x2,3 / SS 400 (TIS)	50 < 300 ✓	-	0.124 < 1.000	Pass ✓	Axial Tension
	D5	SHS50x2,3 / SS 400 (TIS)	50 < 300 ✓	-	0.094 < 1.000	Pass ✓	Axial Tension
	D7	SHS50x2,3 / SS 400 (TIS)	50 < 300 ✓	-	0.120 < 1.000	Pass ✓	Shear (Major)
	D9	SHS50x2,3 / SS 400 (TIS)	50 < 200 ✓	-	0.106 < 1.000	Pass ✓	Axial Compression
	D11	SHS50x2,3 / SS 400 (TIS)	50 < 200 ✓	-	0.148 < 1.000	Pass ✓	Axial Compression
	D13	SHS50x2,3 / SS 400 (TIS)	50 < 200 ✓	-	0.174 < 1.000	Pass ✓	Axial Compression
Vertical	V4	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.057 < 1.000	Pass ✓	Axial Compression
	V6	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.041 < 1.000	Pass ✓	Axial Compression
	V8	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.022 < 1.000	Pass ✓	Axial Tension
	V10	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.060 < 1.000	Pass ✓	Axial Tension
	V12	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.082 < 1.000	Pass ✓	Axial Tension

Top Chord TC1					
Section:	SHS50x1,7 (SS 400 (TIS))				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 808.0 \text{ mm}$	$L_y = 4850.0 \text{ mm}$	$L_b = 4850.0 \text{ mm}$
Slenderness Ratio:	$251 \geq 200!$				

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.636 < 1.00 ✓	D+L+Lr	528.570	830.986 (FB)	830.986	∞

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.041 < 1.00 ✓	D+L+Lr	86.451	2090.837
Minor (z-z)	0.004 < 1.00 ✓	D+L+Lr	7.880	2090.837


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Deflection		δ_v (mm)	δ_v Limit (mm)
Deflection Span	4850.0 mm		
Category	Roof Beam		
D		0.6	< 13.5 (L/360) ✓
D+L		1.5	< 20.2 (L/240) ✓
Bottom Chord BC2			
Section:	SHS50x1,7 (SS 400 (TIS))		
Section Class:	Compact		
Units:	(kg, kg.m)		
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 808.0 \text{ mm}$ $L_y = 4850.0 \text{ mm}$ $L_b = 4850.0 \text{ mm}$
Slenderness Ratio:	251 ≥ 200!		
Combined Forces	U. Ratio	Cmb.	$P_r/P_t + (8/9)(M_{ox}/M_{ox} + M_{ry}/M_{cy})$
	0.338 < 1.00 ✓	D+L+Lr	
		P_r	P_t
Axial Tension	0.296-1750.331	5911.920 (TR)	
		M_r	M_c
Bending Major (y-y)	0.037	4.80	128.55 (WLB)
Bending Minor (z-z)	0.010	-1.32	128.55 (WLB)
Axial Compression	U. Ratio	Cmb.	P_r P_c P_{nFB} P_{nTTFB}
	0.069 < 1.00 ✓	D+L+Lr	57.141 830.986 (FB) 830.986 ∞
Axial Tension	U. Ratio	Cmb.	P_r P_t
	0.296 < 1.00 ✓	D+L+Lr	-1750.331 5911.920
Shear	U. Ratio	Cmb.	V_r V_c
Major (y-y)	0.013 < 1.00 ✓	D+L+Lr	28.033 2090.837
Minor (z-z)	0.002 < 1.00 ✓	D+L+Lr	-4.633 2090.837
Torsion	U. Ratio	Cmb.	T_r T_c
	0.054 < 1.00 ✓	D+L+Lr	5.50 102.55

Deflection		δ_v (mm)	δ_v Limit (mm)
Deflection Span	4850.0 mm		
Category	Roof Beam		
D		0.6	< 13.5 (L/360) ✓
D+L		1.5	< 20.2 (L/240) ✓

Diagonal D3

Section:	SHS50x2,3 (SS 400 (TIS))				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 950.2$ mm	$L_y = 950.2$ mm	$L_b = 950.2$ mm
Slenderness Ratio:	50 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.124 < 1.00 ✓	D+L+Lr	-976.710	7899.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	1.813	2775.125
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex+	0.000	2775.125

Diagonal D5

Section:	SHS50x2,3 (SS 400 (TIS))				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 950.2$ mm	$L_y = 950.2$ mm	$L_b = 950.2$ mm
Slenderness Ratio:	50 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.094 < 1.00 ✓	D+L+Lr	-742.846	7899.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	1.813	2775.125
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.000	2775.125

Diagonal D7

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 950.2 \text{ mm}$ $L_y = 950.2 \text{ mm}$ $L_b = 950.2 \text{ mm}$
 Slenderness Ratio: $50 < 300 \checkmark$

Axial Tension		U. Ratio	Cmb.	P_r	P_t
		$0.048 < 1.00 \checkmark$	D+L+Lr	-382.222	7899.120
Shear		U. Ratio	Cmb.	V_r	V_c
Major (y-y)		$0.120 < 1.00 \checkmark$	D+L+Lr	334.224	2775.125
Minor (z-z)		$0.000 < 1.00 \checkmark$	Dc+Lc+Ez+Ex	0.422	2775.125

Diagonal D9

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 950.2 \text{ mm}$ $L_y = 950.2 \text{ mm}$ $L_b = 950.2 \text{ mm}$
 Slenderness Ratio: $50 < 200 \checkmark$

Axial Compression		U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
		$0.106 < 1.00 \checkmark$	D+L+Lr	888.558	8365.521 (FB)	8365.521	∞
						1	
Shear		U. Ratio	Cmb.	V_r	V_c		
Major (y-y)		$0.001 < 1.00 \checkmark$	Dc+Lc+Ez-Ey	1.813	2775.125		
Minor (z-z)		$0.000 < 1.00 \checkmark$	D+L+Lr	0.000	2775.125		

Diagonal D11

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 950.2 \text{ mm}$ $L_y = 950.2 \text{ mm}$ $L_b = 950.2 \text{ mm}$
 Slenderness Ratio: $50 < 200 \checkmark$

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.148 < 1.00 ✓	D+L+Lr	1239.060	8365.521 (FB)	8365.52 1	∞
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez-Ey-	1.813	2775.125		
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez+Ey +	0.000	2775.125		

Diagonal D13

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 951.9$ mm $L_y = 951.9$ mm $L_b = 951.9$ mm
 Slenderness Ratio: 50 < 200 ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.174 < 1.00 ✓	D+L+Lr	1454.680	8361.776 (FB)	8361.77 6	∞
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	1.818	2775.125		
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex+	0.000	2775.125		

Vertical V4

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: 26 < 200 ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.057 < 1.00 ✓	D+L+Lr	525.713	9156.587 (FB)	9156.58 7	∞

Vertical V6

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0 \text{ mm}$ $L_y = 500.0 \text{ mm}$ $L_b = 500.0 \text{ mm}$

Slenderness Ratio: $26 < 200 \checkmark$

Axial Compression	U. Ratio	Cmb.	P _r	P _c	P _{nFB}	P _{nTTFB}
	0.041 < 1.00 ✓	D+L+Lr	376.917	9156.587 (FB)	9156.58 7	∞

Vertical V8

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm

Slenderness Ratio: $26 < 300 \checkmark$

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.022 < 1.00 ✓	D+L+Lr	-174.055	7899.120

Vertical V10

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm

Slenderness Ratio: $26 < 300 \checkmark$

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.060 < 1.00 ✓	D+L+Lr	-477.579	7899.120

Vertical V12

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0 \text{ mm}$ $L_y = 500.0 \text{ mm}$ $L_b = 500.0 \text{ mm}$

Slenderness Ratio: $26 < 300 \checkmark$

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.082 < 1.00 ✓	D+L+Lr	-644.089	7899.120

Vertical V14

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.080 < 1.00$ ✓	D+L+Lr	735.337	9156.587 (FB)	9156.58 7	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.003 < 1.00$ ✓	D+L+Lr	9.297	2775.125
Minor (z-z)	$0.002 < 1.00$ ✓	D+L+Lr	5.320	2775.125

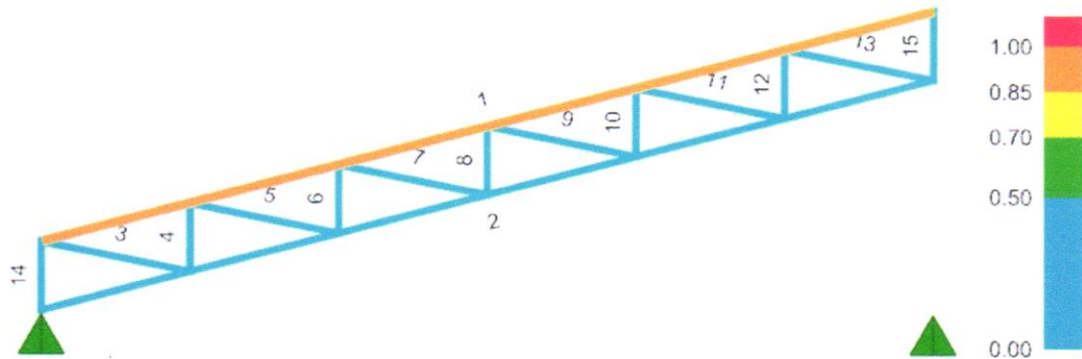
Vertical V15

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.065 < 1.00$ ✓	D+L+Lr	591.816	9156.587 (FB)	9156.58 7	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.000 < 1.00$ ✓	Dc+Lc+Ez- Ex-	-1.067	2775.125
Minor (z-z)	$0.003 < 1.00$ ✓	D+L+Lr	8.770	2775.125

7.4 การออกแบบโครงหลังคาเหล็ก (grid line 1') T3



Steel Truss T3

	Member	Section / Material	kL/r	Deflection	U. Ratio	Status	Governing Check
Top Chord	TC1	SHS60x4 / SS 400 (TIS)	271 ≥ 200!	2.0 < 24.2 (L/240) ✓	0.902 < 1.000	Pass ✓	Combined
Bottom Chord	BC2	SHS50x2 / SS 400 (TIS)	313 ≥ 200!	1.9 < 24.2 (L/240) ✓	0.243 < 1.000	Pass ✓	Combined
Diagonal	D3	SHS50x2,3 / SS 400 (TIS)	53 < 300 ✓	-	0.135 < 1.000	Pass ✓	Axial Tension
	D5	SHS50x2,3 / SS 400 (TIS)	53 < 300 ✓	-	0.068 < 1.000	Pass ✓	Axial Tension
	D7	SHS50x2,3 / SS 400 (TIS)	53 < 200 ✓	-	0.002 < 1.000	Pass ✓	Axial Compression
	D9	SHS50x2,3 / SS 400 (TIS)	53 < 200 ✓	-	0.063 < 1.000	Pass ✓	Axial Compression
	D11	SHS50x2,3 / SS 400 (TIS)	53 < 200 ✓	-	0.125 < 1.000	Pass ✓	Axial Compression
	D13	SHS50x2,3 / SS 400 (TIS)	53 < 200 ✓	-	0.181 < 1.000	Pass ✓	Axial Compression
Vertical	V4	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.058 < 1.000	Pass ✓	Axial Compression
	V6	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.029 < 1.000	Pass ✓	Axial Compression
	V8	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.002 < 1.000	Pass ✓	Axial Tension

V10	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.035 < 1.000	Pass ✓	Axial Tension
V12	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.065 < 1.000	Pass ✓	Axial Tension
V14	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.035 < 1.000	Pass ✓	Shear (Major)
V15	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.034 < 1.000	Pass ✓	Axial Compression

Top Chord TC1

Section: SHS60x4 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 998.0$ mm $L_y = 5990.8$ mm $L_b = 5990.8$ mm

Slenderness Ratio: 271 ≥ 200!

Combined Forces	U. Ratio	Cmb.	$P_r/P_c + (8/9)(M_{rx}/M_{cx} + M_{ry}/M_{cy})$			
	0.902 < 1.00 ✓	D+L+Lr				
		P_r	P_c			
Axial Compression	0.808	1564.122	1934.996 (FB)			
		M_r	M_c			
Bending Major (y-y)	0.105	42.92	407.12 (WLB)			
Bending Minor (z-z)	0.000	0.02	407.12 (WLB)			
Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.858 < 1.00 ✓	D+L+Lr	1661.183	1934.996 (FB)	1934.99 6	∞
Axial Tension	U. Ratio	Cmb.	P_r	P_t		
	0.099 < 1.00 ✓	D+L+Lr	-1594.661	16128.000		

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.045 < 1.00 ✓	D+L+Lr	-249.302	5598.720
Minor (z-z)	0.020 < 1.00 ✓	D+L+Lr	111.892	5598.720

Torsion	U. Ratio	Cmb.	T_r	T_c
	0.015 < 1.00 ✓	D+L+Lr	-4.74	321.94

Deflection		δ_v (mm)	δ_v Limit (mm)
Deflection Span	5800.0 mm		
Category	Roof Beam		
D		0.9	< 16.1 (L/360) ✓
D+L		2.0	< 24.2 (L/240) ✓

Bottom Chord BC2

Section: SHS50x2 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 998.0$ mm $L_y = 5990.8$ mm $L_b = 5990.8$ mm
 Slenderness Ratio: 313 ≥ 200!

Combined Forces	U. Ratio	Cmb.	$P_r/P_t + (8/9)(M_{rx}/M_{cx} + M_{ry}/M_{cy})$			
	0.243 < 1.00 ✓	D+L+Lr				
			P_r	P_t		
Axial Tension	0.228-1577.976	6912.000 (TR)				
			M_r	M_c		
Bending Major (y-y)	0.016	2.32		149.39 (WLB)		
Bending Minor (z-z)	0.001	0.17		149.39 (WLB)		

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.036 < 1.00 ✓	D+L+Lr	22.742	624.778 (FB)	624.778	∞

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.228 < 1.00 ✓	D+L+Lr	-1577.976	6912.000

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.005 < 1.00 ✓	D+L+Lr	12.887	2436.480
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	0.239	2436.480

Torsion	U. Ratio	Cmb.	T _r	T _c
	0.007 < 1.00 ✓	D+L+Lr	-0.83	119.04

Deflection		δ _v (mm)	δ _v Limit (mm)
Deflection Span	5800.0 mm		
Category	Roof Beam		
D		0.9	< 16.1 (L/360) ✓
D+L		1.9	< 24.2 (L/240) ✓

Diagonal D3

Section:	SHS50x2,3 (SS 400 (TIS))				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 998.1 mm	L _y = 998.1 mm	L _b = 998.1 mm
Slenderness Ratio:	53 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.135 < 1.00 ✓	D+L+Lr	-1063.217	7899.120

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez-Ey-	2.168	2775.125
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez+Ey	0.000	2775.125

Diagonal D5

Section:	SHS50x2,3 (SS 400 (TIS))				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 998.1 mm	L _y = 998.1 mm	L _b = 998.1 mm
Slenderness Ratio:	53 < 300 ✓				

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.068 < 1.00 ✓	D+L+Lr	-536.508	7899.120

Diagonal D11

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 998.1$ mm $L_y = 998.1$ mm $L_b = 998.1$ mmSlenderness Ratio: $53 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.125 < 1.00$ ✓	D+L+Lr	1036.218	8258.244 (FB)	8258.244	∞
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	$0.001 < 1.00$ ✓	Dc+Lc+Ez- Ey-	2.168	2775.125		
Minor (z-z)	$0.000 < 1.00$ ✓	G+Q- WCase4-+Lr	0.000	2775.125		

Diagonal D13

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 1000.5$ mm $L_y = 1000.5$ mm $L_b = 1000.5$ mmSlenderness Ratio: $53 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.181 < 1.00$ ✓	D+L+Lr	1497.374	8252.598 (FB)	8252.59 8	∞
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	$0.001 < 1.00$ ✓	Dc+Lc+Ez- Ey-	-2.174	2775.125		
Minor (z-z)	$0.000 < 1.00$ ✓	Dc+Lc+Ez- Ex+	0.000	2775.125		

Vertical V4

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mmSlenderness Ratio: $26 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.058 < 1.00 ✓	D+L+Lr	532.308	9156.587 (FB)	9156.58 7	∞

Vertical V6

Section:	SHS50x2,3 (SS 400 (TIS))					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 500.0 \text{ mm}$	$L_y = 500.0 \text{ mm}$	$L_b = 500.0 \text{ mm}$	
Slenderness Ratio:	26 < 200 ✓					

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.029 < 1.00 ✓	D+L+Lr	262.065	9156.587 (FB)	9156.58 7	∞

Vertical V8

Section:	SHS50x2,3 (SS 400 (TIS))					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 500.0 \text{ mm}$	$L_y = 500.0 \text{ mm}$	$L_b = 500.0 \text{ mm}$	
Slenderness Ratio:	26 < 300 ✓					

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.002 < 1.00 ✓	D+L+Lr	-12.960	7899.120

Vertical V10

Section:	SHS50x2,3 (SS 400 (TIS))					
Section Class:	Compact					
Units:	(kg, kg.m)					
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 500.0 \text{ mm}$	$L_y = 500.0 \text{ mm}$	$L_b = 500.0 \text{ mm}$	
Slenderness Ratio:	26 < 300 ✓					

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.035 < 1.00 ✓	D+L+Lr	-272.679	7899.120

Vertical V12

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 300$ ✓

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	$0.065 < 1.00$ ✓	D+L+Lr	-513.632	7899.120

Vertical V14

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.016 < 1.00$ ✓	D+L+Lr	149.105	9156.587 (FB)	9156.587	∞

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	$0.005 < 1.00$ ✓	D+L+Lr	-42.737	7899.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.035 < 1.00$ ✓	D+L+Lr	-95.847	2775.125
Minor (z-z)	$0.009 < 1.00$ ✓	D+L+Lr	-23.683	2775.125

Vertical V15

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 200$ ✓

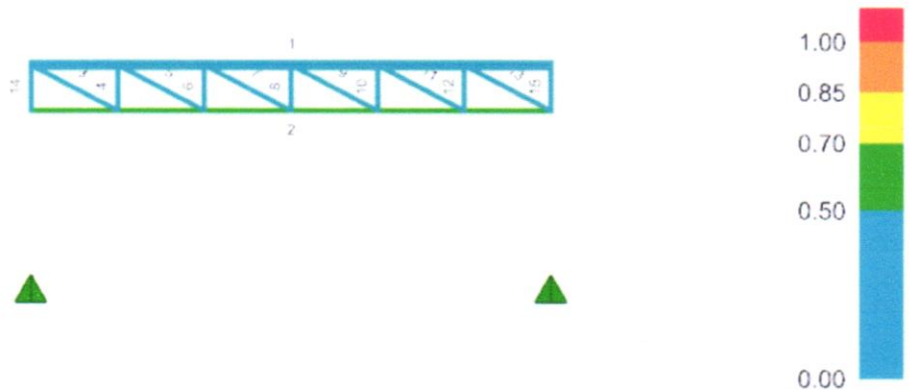
Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
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0.034 < 1.00 ✓	D+L+Lr	315.580	9156.587 (FB)	9156.58 7	∞
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Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.003 < 1.00 ✓	D+L+Lr	-27.037	7899.120

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.011 < 1.00 ✓	D+L+Lr	-29.698	2775.125
Minor (z-z)	0.009 < 1.00 ✓	D+L+Lr	24.316	2775.125

7.5 การออกแบบโครงหลังคาเหล็ก T4



Steel Truss T2

	Member	Section / Material	kL/r	Deflection	U. Ratio	Status	Governing Check
Top Chord	TC1	SHS50x3,2 / SS 400 (TIS)	125 < 200 ✓	2.9 < 20.2 (L/240) ✓	0.400 < 1.000	Pass ✓	Combined
Bottom Chord	BC2	SHS50x2,3 / SS 400 (TIS)	255 ≥ 200!	2.9 < 20.2 (L/240) ✓	0.627 < 1.000	Pass ✓	Combined
Diagonal	D3	SHS50x2,3 / SS 400 (TIS)	50 < 300 ✓	-	0.243 < 1.000	Pass ✓	Axial Tension
	D5	SHS50x2,3 / SS 400 (TIS)	50 < 300 ✓	-	0.238 < 1.000	Pass ✓	Axial Tension
	D7	SHS50x2,3 / SS 400 (TIS)	50 < 300 ✓	-	0.200 < 1.000	Pass ✓	Shear (Major)
	D9	SHS50x2,3 / SS 400 (TIS)	50 < 200 ✓	-	0.200 < 1.000	Pass ✓	Axial Compression
	D11	SHS50x2,3 / SS 400 (TIS)	50 < 200 ✓	-	0.230 < 1.000	Pass ✓	Axial Compression
	D13	SHS50x2,3 / SS 400 (TIS)	50 < 200 ✓	-	0.206 < 1.000	Pass ✓	Axial Compression
Vertical	V4	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.112 < 1.000	Pass ✓	Axial Compression
	V6	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.105 < 1.000	Pass ✓	Axial Compression
	V8	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.018 < 1.000	Pass ✓	Axial Compression
	V10	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.114 < 1.000	Pass ✓	Axial Tension

V12	SHS50x2,3 / SS 400 (TIS)	26 < 300 ✓	-	0.127 < 1.000	Pass ✓	Axial Tension
V14	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.060 < 1.000	Pass ✓	Axial Compression
V15	SHS50x2,3 / SS 400 (TIS)	26 < 200 ✓	-	0.032 < 1.000	Pass ✓	Axial Compression

Top Chord TC1

Section: SHS50x3,2 / SS 400 (TIS)

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 808.0$ mm $L_y = 4850.0$ mm $L_b = 4850.0$ mm

Slenderness Ratio: 125 < 200 ✓

Combined Forces	U. Ratio	Cmb.	$P_r/P_c + (3/9)(M_{rx}/M_{cx} + M_{ry}/M_{cy})$			
	0.400 < 1.00 ✓	D+L+Lr P_r	P_c			
Axial Compression	0.326	4009.613	12288.199 (FB)			
		M_r	M_c			
Bending Major (y-y)	0.080	78.14	971.86 (WLB)			
Bending Minor (z-z)	0.003	-2.98	971.86 (WLB)			

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.326 < 1.00 ✓	D+L+Lr	4009.613	12288.199 (FB)	12288.19 9	∞

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.023 < 1.00 ✓	D+L+Lr	-510.958	22302.720

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.145 < 1.00 ✓	D+L+Lr	1142.556	7896.269
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex+	-2.198	7896.269

Torsion	U. Ratio	Cmb.	T_r	T_c
	0.000 < 1.00 ✓	D+L+Lr	-0.30	775.56

Deflection		δ_v (mm)	δ_v Limit (mm)
Deflection Span	4850.0 mm		
Category	Roof Beam		
D		1.2	< 13.5 (L/360) ✓
D+L		2.9	< 20.2 (L/240) ✓

Bottom Chord BC2

Section:	SHS50x2,3 (SS 400 (TIS))				
Section Class:	Compact				
Units:	(kg, kg.m)				
Effective Length:	$K_x = 1.000$	$K_y = 1.000$	$L_x = 808.0$ mm	$L_y = 4850.0$ mm	$L_b = 4850.0$ mm
Slenderness Ratio:	255 ≥ 200!				

Combined Forces	U. Ratio	Cmb.	$P_r/P_t + (8/9)(M_{rx}/M_{cx} + M_{ry}/M_{cy})$		
	0.627 < 1.00 ✓	D+L+Lr			
		P_r	P_t		
Axial Tension	0.565	4465.431	7899.120 (TR)		
		M_r	M_c		
Bending Major (y-y)	0.068	11.54	169.69 (WLB)		
Bending Minor (z-z)	0.001	-0.20	169.69 (WLB)		

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.028 < 1.00 ✓	D+L+Lr	30.004	1068.796 (FB)	1068.796	∞

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.565 < 1.00 ✓	D+L+Lr	-4465.431	7899.120

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.007 < 1.00 ✓	D+L+Lr	-20.490	2775.125



Minor (z-z)	0.006 < 1.00 ✓	D+L+Lr	16.122	2775.125
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Torsion	U. Ratio	Cmb.	T _r	T _c
	0.051 < 1.00 ✓	D+L+Lr	-6.86	135.03

Deflection	δ _v (mm)		δ _v Limit (mm)	
Deflection Span	4850.0 mm			
Category	Roof Beam			
D	1.2	< 13.5 (L/360) ✓		
D+L	2.9	< 20.2 (L/240) ✓		
Diagonal D3				
Section:	SHS50x2,3 (SS 400 (TIS))			
Section Class:	Compact			
Units:	(kg, kg.m)			
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 950.2 mm	L _y = 950.2 mm L _b = 950.2 mm
Slenderness Ratio:	50 < 300 ✓			

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.243 < 1.00 ✓	D+L+Lr	-1920.518	7899.120

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	1.813	2775.125
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex+	0.000	2775.125
Diagonal D5				
Section:	SHS50x2,3 (SS 400 (TIS))			
Section Class:	Compact			
Units:	(kg, kg.m)			
Effective Length:	K _x = 1.000	K _y = 1.000	L _x = 950.2 mm	L _y = 950.2 mm L _b = 950.2 mm
Slenderness Ratio:	50 < 300 ✓			

Axial Tension	U. Ratio	Cmb.	P _r	P _t
	0.238 < 1.00 ✓	D+L+Lr	-1876.481	7899.120

Shear	U. Ratio	Cmb.	V _r	V _c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	1.813	2775.125
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex+	0.000	2775.125

Diagonal D7

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 950.2 \text{ mm}$ $L_y = 950.2 \text{ mm}$ $L_b = 950.2 \text{ mm}$
 Slenderness Ratio: $50 < 300 \checkmark$

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	$0.198 < 1.00 \checkmark$	D+L+Lr	-1567.195	7899.120
Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	$0.200 < 1.00 \checkmark$	D+L+Lr	554.991	2775.125
Minor (z-z)	$0.006 < 1.00 \checkmark$	D+L+Lr	-16.536	2775.125

Diagonal D9

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 950.2 \text{ mm}$ $L_y = 950.2 \text{ mm}$ $L_b = 950.2 \text{ mm}$
 Slenderness Ratio: $50 < 200 \checkmark$

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.200 < 1.00 \checkmark$	D+L+Lr	1674.643	8365.521 (FB)	8365.52 1	∞
Shear	U. Ratio	Cmb.	V_r	V_c		
Major (y-y)	$0.001 < 1.00 \checkmark$	Dc+Lc+Ez- Ey-	1.813	2775.125		
Minor (z-z)	$0.000 < 1.00 \checkmark$	Dc+Lc+Ez- Ey-	0.000	2775.125		

Diagonal D11

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 950.2 \text{ mm}$ $L_y = 950.2 \text{ mm}$ $L_b = 950.2 \text{ mm}$
 Slenderness Ratio: $50 < 200 \checkmark$

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.230 < 1.00 ✓	D+L+Lr	1924.295	8365.521 (FB)	8365.52 1	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez-Ey-	1.813	2775.125
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez+Ex +	0.000	2775.125

Diagonal D13

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 951.9$ mm $L_y = 951.9$ mm $L_b = 951.9$ mm

Slenderness Ratio: 50 < 200 ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.206 < 1.00 ✓	D+L+Lr	1719.088	8361.776 (FB)	8361.77 6	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.001 < 1.00 ✓	Dc+Lc+Ez- Ey-	1.818	2775.125
Minor (z-z)	0.000 < 1.00 ✓	Dc+Lc+Ez- Ex+	0.000	2775.125

Vertical V4

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm

Slenderness Ratio: 26 < 200 ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.112 < 1.00 ✓	D+L+Lr	1027.875	9156.587 (FB)	9156.58 7	∞

Vertical V6

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.105 < 1.00$ ✓	D+L+Lr	963.434	9156.587 (FB)	9156.58 7	∞

Vertical V8

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 200$ ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	$0.018 < 1.00$ ✓	D+L+Lr	166.935	9156.587 (FB)	9156.58 7	∞

Vertical V10

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 300$ ✓

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	$0.114 < 1.00$ ✓	D+L+Lr	-900.004	7899.120

Vertical V12

Section: SHS50x2,3 (SS 400 (TIS))
 Section Class: Compact
 Units: (kg, kg.m)
 Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm
 Slenderness Ratio: $26 < 300$ ✓

Axial Tension	U. Ratio	Cmb.	P_r	P_t
	0.127 < 1.00 ✓	D+L+Lr	-999.596	7899.120

Vertical V14

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm

Slenderness Ratio: 26 < 200 ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.060 < 1.00 ✓	D+L+Lr	551.649	9156.587 (FB)	9156.58 7	∞

Shear	U. Ratio	Cmb.	V_r	V_c
Major (y-y)	0.011 < 1.00 ✓	D+L+Lr	29.412	2775.125
Minor (z-z)	0.000 < 1.00 ✓	D+L+Lr	1.238	2775.125

Vertical V15

Section: SHS50x2,3 (SS 400 (TIS))

Section Class: Compact

Units: (kg, kg.m)

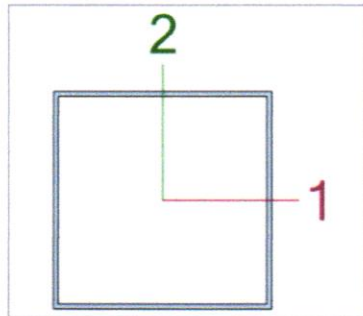
Effective Length: $K_x = 1.000$ $K_y = 1.000$ $L_x = 500.0$ mm $L_y = 500.0$ mm $L_b = 500.0$ mm

Slenderness Ratio: 26 < 200 ✓

Axial Compression	U. Ratio	Cmb.	P_r	P_c	P_{nFB}	P_{nTTFB}
	0.032 < 1.00 ✓	D+L+Lr	290.228	9156.587 (FB)	9156.58 7	∞



8. Column Design (การออกแบบเสาเหล็ก)



Section	SHS100x2,3
Section Width	100 mm
Section Height	100 mm
Wall Thickness	2 mm
Section Area	0.0009 m ²
Shear Area 1	0.0005 m ²
Shear Area 2	0.0005 m ²
Torsional Constant	0.000002 m ⁴
Moment of Inertia 11	0.000001 m ⁴
Moment of Inertia 22	0.000001 m ⁴
Radius of Gyration 11	39 mm
Radius of Gyration 22	39 mm
Elastic Section Modulus 11	2.790E-05 m ³
Elastic Section Modulus 22	2.790E-05 m ³
Plastic Section Modulus 11	3.294E-05 m ³
Plastic Section Modulus 22	3.294E-05 m ³

General Parameters

Design Code:	AISC 360-10 (LRFD)
Effective Length:	K _x = 1.00 K _y = 1.00 L _x = 3000.0 mm L _y = 3000.0 mm
	C _b = 1.00 L _b = 3000.0 mm L _p = 0.0 mm L _r = 0.0 mm

Section Classification

Section Class: **Non Compact**

► [Calculation Details](#)

Check for Combined Forces

Utilization Ratio:	0.152 < 1.00 ✓ (D+L+L _r)
Slenderness Ratio (kL/r):	76 < 200.00 ✓

► [Calculation Details](#)

Axial Compression Check

Utilization Ratio:	0.158 < 1.00 ✓ (D+L+L _r)
Slenderness Ratio (kL/r):	76 < 200.00 ✓

► [Calculation Details](#)

Shear Check

U. Ratio(Major):	0.003 < 1.00 ✓ (D+L+L _r)
U. Ratio(Minor):	0.001 < 1.00 ✓ (Dc+Lc+Ez+Ex+)

► [Calculation Details](#)

Torsion Check

Utilization Ratio:	0.000 < 1.00 ✓ (Dc+Lc+Ez+Ex+)
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► [Calculation Details](#)

การออกแบบเสาเหล็ก

Steel Column 1C20

Section:	SHS100x2,3 (SS 400 (TIS))
Section Class:	Non Compact
Units:	(kg, kg.m)
Effective Length:	K _x = 1.000 K _y = 1.000 L _x = 3000.0 mm L _y = 3000.0 mm L _b = 3000.0 mm
Slenderness Ratio:	76 < 200 ✓

Combined Forces		U. Ratio	Cmb.			
		0.152 < 1.00 ✓	D+L+L _r	<i>P_r/2P_c + M_{rx}/M_{cx} + M_{ry}/M_{cy}</i>		
			P _r	P _c		
Axial Compression		0.157	2186.408	13933.106 (FB)		
			M _r	M _c		
Bending Major (y-y)		0.074	-34.69	471.95 (FLB)		
Bending Minor (z-z)		0.000	0.00	471.95 (FLB)		
Axial Compression		U. Ratio	Cmb.	P _r	P _c	P _{nFB}
		0.158 < 1.00 ✓	D+L+L _r	2207.576	13933.106 (FB)	13933.106
						∞
Shear		U. Ratio	Cmb.	V _r	V _c	
Major (y-y)		0.003 < 1.00 ✓	D+L+L _r	-17.410	5755.925	
Minor (z-z)		0.001 < 1.00 ✓	Dc+Lc+Ez+Ex+	4.043	5755.925	
Torsion		U. Ratio	Cmb.	T _r	T _c	
		0.000 < 1.00 ✓	Dc+Lc+Ez+Ex+	-0.12	568.44	



เอกสารฉบับนี้ ใช้สำหรับ ออกแบบโครงการงานปรับปรุงอาคารชีววิทยา 1
ภาควิชาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยเชียงใหม่ เท่านั้น



ร.อ. น. น. น.

สำเนาถูกต้อง



เอกสารฉบับนี้ ใช้สำหรับออกแบบโครงการงานปรับปรุง
อาคารชีววิทยา 1 ภาควิชาชีววิทยา คณะวิทยาศาสตร์
มหาวิทยาลัยเชียงใหม่ เท่านั้น

สำเนาถูกต้อง

รศ.ดร. น.ค.

