



# **SPECIFICATIONS FOR PREFABRICATED COLD FORMED STEEL ROOF TRUSSES**



**SPECIFICATIONS FOR PREFABRICATED COLD FORMED STEEL ROOF TRUSSES****TABLE OF CONTENT****PAGE**

<b>1.</b>	<b>DEFINITIONS .....</b>	<b>1</b>
1.1.	System Provider (S.P.)	
1.2.	Superintending Officer (S.O.)	
1.3.	Contractor	
1.4.	Fabricator	
1.5.	Installer	
1.6.	Professional Engineer with Practising Certificate (P.E.P.C.)	
1.7.	Construction Drawing	
1.8.	Fabrication Drawing	
1.9.	As-built Drawing	
1.10.	Prefabricated Roof Trusses	
1.11.	Accredited Laboratory	
<b>2.</b>	<b>GENERAL REQUIREMENT .....</b>	<b>2</b>
2.1.	Specification Outline	
2.2.	General Truss Limitation	
2.3.	Fabricator	
2.4.	Installer	
2.5.	S.O.'s Approval	
2.6.	Analysis, Design Report and Drawings Submission	
2.7.	Standards	
2.8.	Duties of P.E.P.C.	
2.9.	Fire Resistance & Protection	
<b>3.</b>	<b>QUALITY ASSURANCE AND CONTROL .....</b>	<b>5</b>
3.1.	Quality Assurance Program	
3.2.	Test Result Submission	
<b>4.</b>	<b>DESIGN, FABRICATION, SUPPLY AND INSTALLATION WARRANTY .....</b>	<b>5</b>
<b>5.</b>	<b>DESIGN REQUIREMENT .....</b>	<b>6</b>
5.1.	Design Data	
5.2.	Design Standards	
5.3.	Eccentricity	
5.4.	Additional Design Consideration	
<b>6.</b>	<b>DETAILING AND DRAWINGS .....</b>	<b>8</b>
6.1.	Layout Drawings	
6.2.	Design Detail Drawings	
6.3.	Bracing	
6.4.	Connection	

6.5.	Roof Battens	
6.6.	Bottom Chord Restraints	
6.7.	Tie-Down and Hanger	
6.8.	Wall Plate	
7.	MATERIAL AND TESTING .....	13
7.1.	General	
7.2.	Base Steel Requirement	
7.3.	Fastener Requirement	
7.4.	Anchor Requirement	
7.5.	Wall Plate Requirement	
7.6.	Material Testing Requirements	
8.	MANUFACTURING.....	16
8.1.	Manufacturing Capability	
8.2.	Production Quality Control	
9.	TRUSS FABRICATIONS .....	17
9.1.	Factory Fabrication	
9.2.	On Site Fabrication	
9.3.	Site Measurement	
9.4.	Camber	
9.5.	Identification of Completed Trusses	
9.6.	Splicing	
9.7.	Drilling	
10.	TRUSS HANDLING AND INSTALLATION .....	19
10.1.	Handling	
10.2.	Installation	
10.3.	Installation Tolerances	
10.4.	Bolted Connection	
10.5.	Anchoring of Trusses to Supporting Structure	
10.6.	Roof Frame Bracing	
10.7.	Member Stiffener	
10.8.	Installation of Roof Covering	
11.	ALTERATION TO TRUSSES .....	29

**LIST OF FIGURE**

<b>FIGURE 2.1: DIMENSIONS OF TYPICAL CROSS SECTION.....</b>	<b>3</b>
<b>FIGURE 6.1: ISOMETRIC VIEW OF BRACING LAYOUT .....</b>	<b>8</b>
<b>FIGURE 6.2: ROOF BATTEN DETAIL .....</b>	<b>9</b>
<b>FIGURE 6.3: CEILING BATTENS DETAILS .....</b>	<b>10</b>
<b>FIGURE 6.4: STRAP FIXING DETAIL (PLAN VIEW).....</b>	<b>10</b>
<b>FIGURE 6.5: STRAP FIXING DETAIL (SECTION VIEW) .....</b>	<b>10</b>
<b>FIGURE 6.6: HOLDING DOWN CONNECTION FOR STEEL WALL PLATE .....</b>	<b>11</b>
<b>FIGURE 6.7: SECTION VIEW FOR BRACKET AND ANCHOR BOLT .....</b>	<b>11</b>
<b>FIGURE 6.8: CONNECTION DETAIL FOR STEEL WALL PLATE .....</b>	<b>12</b>
<b>FIGURE 9.1: CHAMBER.....</b>	<b>18</b>
<b>FIGURE 10.1: STORAGE OF TRUSSES AT SITE (TRUSSED RAFTER STACKED HORIZONTALLY) .....</b>	<b>19</b>
<b>FIGURE 10.2: STORAGE OF TRUSSES AT SITE (TRUSSED RAFTER STACKED VERTICALLY BEFORE COVERING) .....</b>	<b>20</b>
<b>FIGURE 10.3: TOLERANCE ON VERTICALITY (LOCAL) .....</b>	<b>20</b>
<b>FIGURE 10.4: TOLERANCE ON VERTICALITY (GLOBAL) .....</b>	<b>21</b>
<b>FIGURE 10.5: TOLERANCE ON STRAIGHTNESS .....</b>	<b>21</b>
<b>FIGURE 10.6: TOLERANCE ON POSITION .....</b>	<b>22</b>
<b>FIGURE 10.7: TOLERANCE ON SQUARENESS .....</b>	<b>22</b>
<b>FIGURE 10.8: BATTEN CONTINUOUS IN AREAS UNBOUND BY BRACING .....</b>	<b>23</b>
<b>FIGURE 10.9: BATTEN CONTINUOUS IN AREAS UNBOUND BY BRACING .....</b>	<b>23</b>
<b>FIGURE 10.10: FIXING DETAIL OF UNDER-PURLIN BRACING .....</b>	<b>25</b>
<b>FIGURE 10.11: TYPICAL SPLICED DETAIL OF STEEL BRACE .....</b>	<b>25</b>
<b>FIGURE 10.12: SUGGESTED ROOF BRACING LAYOUT .....</b>	<b>25</b>
<b>FIGURE 10.13: SUGGESTED ROOF BRACING LAYOUT (TENSION) TRUSSES UP TO 10 M SPAN .....</b>	<b>26</b>
<b>FIGURE 10.14: SUGGESTED ROOF BRACING LAYOUT (TENSION) TRUSSES SPANS 10 M TO 12 M.....</b>	<b>26</b>
<b>FIGURE 10.15: TYPICAL MAIN AND CAPPING TRUSS .....</b>	<b>27</b>
<b>FIGURE 10.16: SUGGESTED WEB TIES AND FIXING DETAILS.....</b>	<b>27</b>
<b>FIGURE 10.17: C-LIPPED SECTION STIFFENER DETAIL WITH SCREW AT SPLICED LOCATION .....</b>	<b>28</b>

**LIST OF TABLE**

<b>TABLE 7.1: MINIMUM COATING MASS OF BASE STEEL .....</b>	<b>13</b>
<b>TABLE 10.1: MINIMUM BASIC WORKING LOAD FOR STEEL BRACE.....</b>	<b>24</b>
<b>TABLE APPENDIX 5.1: MINIMUM MECHANICAL AND ELECTRICAL, M&amp;E TYPICAL LOAD ON BOTTOM CHORD OF TRUSS(S) .....</b>	<b>36</b>

**LIST OF APPENDIX**

<b>APPENDIX 1: APPLICATION FORM.....</b>	<b>30</b>
<b>APPENDIX 2: MATERIAL TESTING REQUIREMENTS.....</b>	<b>31</b>
<b>APPENDIX 3: CHECKLIST ON THE CONTRACTOR SUBMISSION.....</b>	<b>32</b>
<b>APPENDIX 4: GUIDELINES ON THE CONTENTS OF WARRANTY CERTIFICATE.....</b>	<b>35</b>
<b>APPENDIX 5: TYPICAL LOADING FOR M&amp;E.....</b>	<b>36</b>
<b>APPENDIX 6: REQUIREMENT OF ROOF TRUSS SUBMISSION.....</b>	<b>38</b>

**LIST OF DIAGRAM**

<b>DIAGRAM 5.1: .....</b>	<b>37</b>
<b>REFERENCES.....</b>	<b>40</b>



## 1. DEFINITIONS

### 1.1. System Provider (S.P.)

A manufacturer and a supplier of a proprietary roof truss system, approved by Jabatan Kerja Raya (JKR) which employs quality assurance procedures in the supply of material, design with detailing and trusses component manufacturing. The S.P. shall be responsible to fabricate, deliver and install the cold formed steel roof trusses system. The S.P. shall guarantee the due performance of the entire roofing system.

### 1.2. Superintending Officer (S.O.)

An appointed government officer or his representative under the main contract of works, and of which who implement the duties defined for the work under the contract. Where applicable, it also represents the Project Director or his representative.

### 1.3. Contractor

Means the Contractor defined under the main contract of works, and of which who undertake the obligations for the work under the contract.

### 1.4. Fabricator

A licensed company appointed by an approved S.P., who assembles the structural component including the truss-to-truss, bracing, tie-down, erection, lifting instructions, in addition to install the roof truss system in a manner approved by the S.P..

### 1.5. Installer

A competent personnel with Construction Industry Development Board (CIDB) accreditation, appointed by the S.P. or fabricator to assemble, erect and install the S.P.'s proprietary roofing truss system.

### 1.6. Professional Engineer with Practising Certificate (P.E.P.C.)

A Professional Engineer with Practicing Certificate, appointed by the S.P. and has a valid registration with the Board of Engineers Malaysia (BEM) and permitted to practice in the civil and structural engineering field.

### 1.7. Construction Drawing

Drawings endorsed by P.E.P.C. representing the design principle and parameter contain information to produce fabrication drawings and comply to Clause 6.0 of this specification.

### 1.8. Fabrication Drawing

Drawing or set of drawings produced by the fabricator and verified by P.E.P.C. to shows more details than the construction drawings but shall not alter the design principle and technical specification stipulated in the construction drawings.

### 1.9. As-built Drawing

Drawing or set of drawings submitted by the S.P. to the Contractor showing the dimensions, geometry and location of all elements of the work completed under a contract. It shall reflects all changes made to the construction drawings during the construction process but which solely due to the construction and/or installation limitation or constraint. All drawings shall be endorsed by P.E.P.C..

### 1.10. Prefabricated Roof Trusses

Roof truss fabricated in a controlled environment, either at site or off-site and subsequently transported, positioned, and assembled into construction works.

### 1.11. Accredited Laboratory

Laboratory approved under National Laboratory Accreditation Scheme (*Skim Akreditasi Makmal Malaysia* (SAMM)), Department of Standards Malaysia (*Standards Malaysia*).

## 2. GENERAL REQUIREMENT

The S.P. shall comply with all relevant laws and regulations in connection to design, materials, labours and conducts. The S.P. shall also take all measures to ensure safety and practicality of fabrication and installation of roof trusses.

### 2.1. Specification Outline

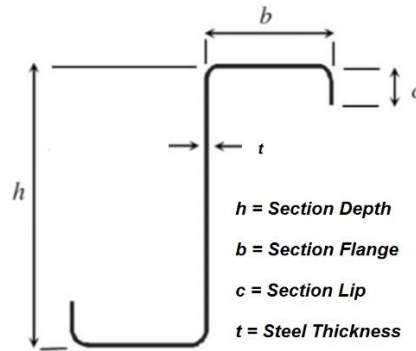
This specification outlines the requirements for the analysis, design, detailing, drawing, manufacture, material, handling and erection of the roof members and their associated ancillary fixing products and methods, to ensure that all items act together as an integral structure, which is structurally stable under all the specified combinations of loading conditions.

### 2.2. General Truss Limitation

This specification is intended to apply to prefabricated cold formed steel roof trusses within the following general limitations:

- (i) Maximum truss span or unsupported truss length 12.00 metres with permitted deviation of  $\pm 0.05$  metres unless otherwise instructed by the S.O.. The design shall comply with requirements in **Appendix 6** of this specification;
- (ii) Maximum truss spacing of 1.20 metres with permitted deviation of  $\pm 0.025$  metres;
- (iii) The minimum basic wind speed shall be 35.0 m/s;
- (iv) Minimum base steel thickness,  $t$  (Figure 2.1) for main truss member shall be;
  - a) 1.0 mm for unsymmetrical section or open cross section; or
  - b) 0.6 mm for symmetrical machine-manufactured box or closed cross section.
- (v) Minimum base steel thickness,  $t$  (Figure 2.1) for other truss element shall be;
  - a) 0.5 mm for batten or purlin;
  - b) 1.2 mm for wall plate; and
  - c) 1.0 mm for bracing.
- (vi) Minimum section depth,  $h$  (Figure 2.1) shall be 75.0 mm in the direction of local major axis of truss member section;
- (vii) Minimum section flange,  $b$  (Figure 2.1) shall be 35.0 mm in the direction of local minor axis of truss member section;
- (viii) Minimum section lip,  $c$  (Figure 2.1) shall be 7.0 mm in the direction of local major axis of truss member section;
- (ix) Minimum size of section for batten or purlin shall be proposed and endorsed by P.E.P.C. according to the design; and
- (x) Connector shall only be of hexagon head/wafer-head self-drilling screw or bolt. Welding is not allowed as fastener.





**Figure 2.1: Dimensions of Typical Cross Section**

*Note: This figure is for illustration only. The section is not limited to this type of cross section.*

### 2.3. Fabricator

All trusses may be assembled and installed either by the S.P. or a licensed company appointed by the S.P. and registered with CIDB under Class B02 IBS: *Sistem Kerangka Keluli*. A copy of CIDB registration certificate shall be submitted to the S.O. for verification.

### 2.4. Installer

All fabrication and installation works shall be executed and supervised by skilled construction workers, accredited and certified by CIDB. The S.O. may verify the identification and qualification of the installer prior to the installation.

### 2.5. S.O.'s Approval

Prior to manufacture of the proposed roof truss system for the S.O.'s approval, Contractor shall provide two (2) copies of truss analysis and design reports, construction drawings and quality assurance program by an approved S.P.. The particulars of the S.P., fabricator, installers and P.E.P.C., including valid licences and other certificates shall be as published in J-Truss System Online. Otherwise, the Contractor shall submit the application form in **Appendix 1** to the S.O. for his approval. S.O. may use **Appendix 3** as a checklist on the completeness of the Contractor's submission.

All analysis, design reports and construction drawings shall be duly signed by the S.P. and endorsed by P.E.P.C.. The S.O. shall reserve the right to reject any of the proposal. The Contractor shall obtain a written approval from the S.O. prior to commencement of roof truss system supply, fabrication and installation works.

### 2.6. Analysis, Design Report and Drawings Submission

The S.P. shall propose a roof truss system which is safe, functional and conforming to design standard. Submission of proposal shall include truss analysis, design report, and construction drawings. The truss analysis and design shall indicate all design parameters including but not limited to loads, load combinations, connections criteria, bracings and tie-downs of the truss. Design output of the truss members, battens, connections, tie-downs and wall plates, anchors, bracings, truss accessories, splicings and stiffeners whereby related to the analysis shall be included in the design report.

All details in the construction drawings shall be sufficient as such to enable checking against the analysis and design report, by specifying and providing not limited to; the truss layout and configuration, steel grades, section properties of members, length of members in each truss configuration, properties of truss accessories, specification of corrosion protection, specification of fastener and anchor, tie-down and anchoring details and all type of connection details including the connection of all attachments to the trusses.

Technical specifications or mill certificates for base steel, fastener and anchor of which the design refers to shall also be included in the submission. Verification test certificate from

an approved accredited laboratory on the technical parameter specified in the technical specifications or mill certificates shall be submitted upon request by the S.O..

## **2.7. Standards**

Where Malaysian Standards (M.S.) and Malaysia National Annex (N.A.), are available for the respective Eurocodes (E.C.), Australian Standards (A.S.) or ISO Standards (I.S.O.), the M.S. and the N.A. shall be adopted as the principal standards for material, testing, transportation, erection and installation of the truss system. Standards for design shall comply with Clause 5.2 of this specification.

If the N.A. are unavailable for the respective E.C., British Standards National Annex (B.S.N.A.) may be adopted where appropriate. All normative or indispensable standards to the adopted standards shall be read together with the adopted standard.

The value, symbols, description or performance from the standards cited by clauses, tables or appendices in this specification shall be deemed to include the value, symbols, description or performance to such standard as amended, revised, supplemented, varied or replaced from time to time by the publisher.

## **2.8. Duties of P.E.P.C.**

The P.E.P.C. shall sign-off and endorse every process of the truss system delivery that includes:

- (i) Roof truss analysis and design;
- (ii) Construction drawings;
- (iii) Fabrication drawings;
- (iv) Design changes document in every stage of works;
- (v) Roof truss installation completion document, prior to issuance of Certificate of Practical Completion (CPC) by the S.O.;
- (vi) As Built Drawings; and
- (vii) Defect report prior to issuance of Certificate of Making Good Defect (CMGD) by the S.O..

## **2.9. Fire Resistance and Protection**

Where required by the law, fire resistance of truss members shall be designed in accordance with EN 1993-1-2:2005. Attachment to roof trusses e.g., the ceiling or roof covering, shall preferably a non-combustible type and classified as no flame spread when tested in accordance with relevant parts of BS 467 series.

### 3. QUALITY ASSURANCE AND CONTROL

#### 3.1. Quality Assurance Program

The Contractor shall submit to the S.O. a program on quality assurance on the roof truss material, production and manufacturing, fabrication, handling, storage, transportation and installation. The program shall indicate the nature, frequency and the schedule of all conformance and verification tests to be carried out by the Contractor. The S.P. shall well-informed on the quality of truss materials delivered to the site. Where the site sampling for testing is required by the S.P., as part of the quality assurance of the roof truss system, the Contractor shall make provisions allowing for this test to be carried out.

#### 3.2. Test Result Submission

The Contractor shall be fully responsible to carry out any conformance and verification tests and notify the S.O. on dates of actual tests. The S.O. may exercise his sole discretion as to whether to witness such tests or otherwise. The tests results shall be jointly endorsed by the S.P. and submitted to the S.O. for his retention.

### 4. DESIGN, FABRICATION, SUPPLY AND INSTALLATION WARRANTY

- 4.1. All roof truss components shall be manufactured only by approved S.P. producing quality assured products and services to the approval of the S.O..
- 4.2. Prior to the fabrication of the roof truss system, the Contractor shall submit to the S.O. two (2) copies of construction drawings, endorsed by P.E.P.C. and other document for S.O.'s approval as required in Clause 2.5 of this specification. S.O. may use **Appendix 6** to assess the completeness of the Contractor's submission.
- 4.3. Where possible, a copy of the S.P.'s current ISO 9001 accreditation certificate issued by a Malaysian approved and accredited body shall also be submitted.
- 4.4. Immediately after the completion of the installation of the roof truss system and prior to the issuance of the CPC, the Contractor shall submit the following documents to the S.O. for information and record:
  - (i) System Provider's Warranty against any defects or damages which may arise during a period of ten (10) years from the Date of Practical Completion of Works due to any defect, fault or insufficiency in design, materials or workmanship or against any other failure which an experienced Contractor may reasonably contemplate but shall not include normal replacement and maintenance. The warranty certificate shall have contents not limited to guidelines as stated in **Appendix 4**;
  - (ii) Certification that the steel sections and fasteners conform to the relevant standards and are protected against corrosion, together with proof that such certification has been verified by tests carried out by accredited laboratory, for the current year or the previous year;
  - (iii) Certification that the correct steel grades were used in the fabrication of the trusses and roof structure by including a copy of the mill test certificate and data sheets for the steel used in the truss system; and
  - (iv) Four (4) sets of as-built drawings of the roof truss system signed by the S.P. and endorsed by P.E.P.C..
- 4.5. Prior to the issuance of CMGD, the S.P. shall inspect and ensure that all the bolted connections have been checked for tensioning, corrosion protection and any inadequacies rectified. All relevant inspection and defect report shall be duly endorsed by P.E.P.C..

## 5. DESIGN REQUIREMENT

### 5.1. Design Data

#### 5.1.1. Load Item

All loads shall be clearly itemised as below:

##### (i) Permanent Action

Permanent action shall be in accordance with requirement in MS EN 1991-1-1: 2010. However, ceiling load shall not be less than 0.25 kN/m<sup>2</sup>. Unless otherwise confirmed with loads data acquired by the S.P. and the Contractor, the load for mechanical and electrical (M&E) services shall not be less than the value stated in **Appendix 5**.

##### (ii) Variable Action

##### a) Imposed Load

Imposed load shall be in accordance with requirement in MS EN 1991-1-1: 2010. Notwithstanding to the value specified in the standard, the minimum value of imposed loads,  $q_k$  on roofs that not accessible except for normal maintenance and repair, shall be  $q_k = 0.25 \text{ kN/m}^2$ , distributed uniformly over the whole area of the supported roofs or  $Q_k = 0.9 \text{ kN}$  concentrated load applied on trusses as to produce maximum stresses in the affected members.

##### b) Wind Load

The requirement of wind load shall be as per MS 1553: 2002, with the minimum basic wind speed as per Clause 2.2 in this specification or the value in MS 1553: 2002 whichever higher.

Load combinations shall be clearly identified as in MS EN 1990: 2010 and itemised to enable design checking to be carried out upon the most adverse conditions or the effect (e.g. effect of uplift) under consideration.

#### 5.1.2. Building Services Load

The Contractor and S.P. shall collectively be responsible to ascertain the final M&E loads requirements before submitting construction drawings. The data on the actual weight, location and route of these services shall be incorporated in the analysis and design of the trusses. Load from M&E services shall be acting on the bottom chord of trusses.

Any other source of superimpose point load such as stage lighting shall be investigated and incorporated into the analysis. Load from water tank shall not be allowed. Potential source of vibration shall be investigated to prevent the vibration of the truss systems to its natural frequencies.

### 5.2. Design Standards

The design of steel truss members, bracings, connections, wall plate and truss accessories shall be in accordance with either of the following standards as the main standard:

##### (i) AS/NZS 4600:2018

##### (ii) MS EN 1993-1-3: 2019

The above standards shall deem to include other standards that supplement or read together with the standards.

### 5.3. **Eccentricity**

The centroidal axes of connected members should meet at a point, otherwise the effect of eccentricity of connection should be considered in the design of the members and their connections.

### 5.4. **Additional Design Consideration**

Roof trusses shall be designed to the following requirements:

#### 5.4.1. **Ceiling**

Where the roof trusses designed do not suit sizes of the ceiling panels arrangement, the designer shall include in his design any additional bearers, tie-beam, ceiling joists and other members that are required to facilitate the ceiling panels.

#### 5.4.2. **Architectural Features**

The S.P. shall consider in his design, suitability of cold formed steel roof trusses with architectural features requirements such as exposed roof trusses, roof overhang, shape and height of trusses cold formed steel roof trusses. Cantilever roof truss, roof truss overhang and purlins overhang shall be properly checked and design against the structural serviceability requirement.

#### 5.4.3. **Roof Coverings**

The S.P. shall consider in his design, type of roof coverings system that being used for the roof. In the case of roof shingles installation, the S.P.'s design shall facilitate the fixings of the shingles.

#### 5.4.4. **M&E Services**

All M&E services shall be installed using strap fixed on bottom chord member and shall be shown in the drawing. Installation on purlins is not allowed. Drilling and cutting is strictly not allowed on all truss members. Rod to support ducting shall be designed to be installed on stronger axis to avoid twisting of trusses member.

M&E services installed with any ducting bracket shall be protected with rubber pad to reduce effect of vibration.

#### 5.4.5. **Water Tank**

Water tank shall not be placed on roof trusses and shall be supported independently. The S.P. shall liaise and coordinate with the Contractor on the location of water tank and supporting beams during preliminary design works to allow provisions for truss openings in the truss section drawings.

#### 5.4.6. **Non-Load Bearing Wall**

All load from roof trusses and bracing systems are not allowed to be transferred to non-load bearing wall.

#### 5.4.7. **Multiple Trusses**

Where multiple trusses (i.e. 2 or more trusses acting together) is specified to support heavy loads such as M&E services or where a truss is required to support a large roof area due to its location as a girder truss, then all the elements of each multiple trusses shall act together to support the common load. Multiple trusses elements shall be screwed or bolted together in the specified manner prior to installation or loading.

## 6. DETAILING AND DRAWINGS

Construction drawing shall consist of:

### 6.1. Layout Drawings

Layout drawings shall indicate the plan view of all trusses together with ties, bracing, under purlins, truss or member label and the loading as per designed.

### 6.2. Design Detail Drawings

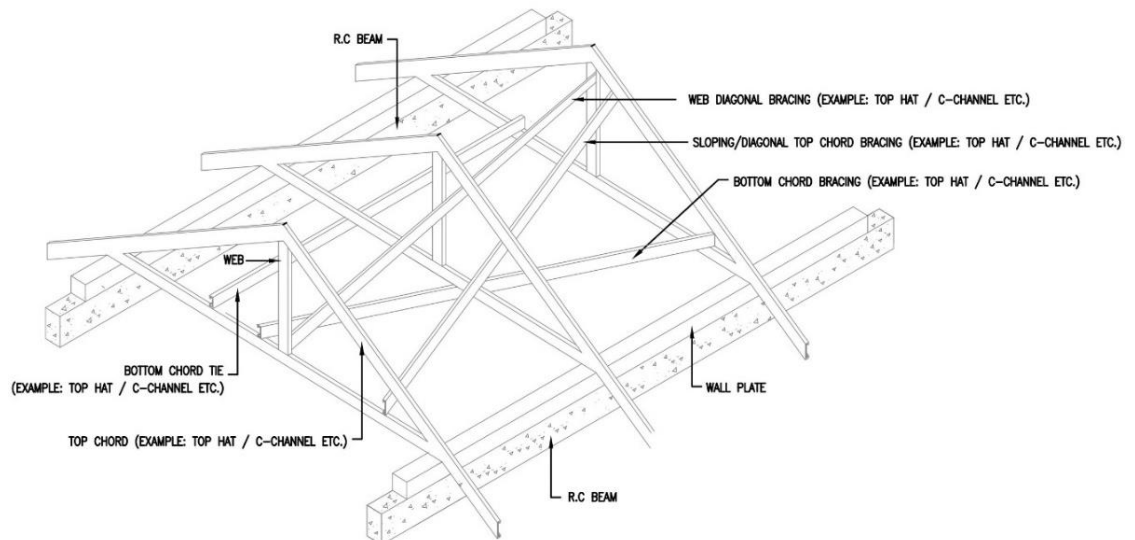
The design detail drawings shall clearly indicate the following:

- (i) Shape of truss and member profile;
- (ii) Member section properties;
- (iii) Span, height, spacing, pitch, overhang and camber;
- (iv) Permanent and variable action;
- (v) Magnitude and direction of forces transferred to the supporting structure;
- (vi) Truss bracing details;
- (vii) Under purlin details;
- (viii) Connection details;
- (ix) Wall plate details;
- (x) Hanger connection details;
- (xi) Splicing details; and
- (xii) Box-up member details (if any).

Each truss shall be clearly drawn on a separate drawing that clearly specify all member sizes, grades, lengths, angles, connector sizes, orientations and positions of roof trusses.

### 6.3. Bracing

Bracing layout and details drawing shall be provided for the entire roof structure. Type of bracing and connection details at apex, top plate splice and standard connection details shall be specified in the drawing. Where bracings are provided at different planes on the roof system, such bracing details shall be clearly shown in the drawings. Refer to Figure 6.1 for typical isometric view of bracing layout.



**Figure 6.1: Isometric View of bracing Layout**

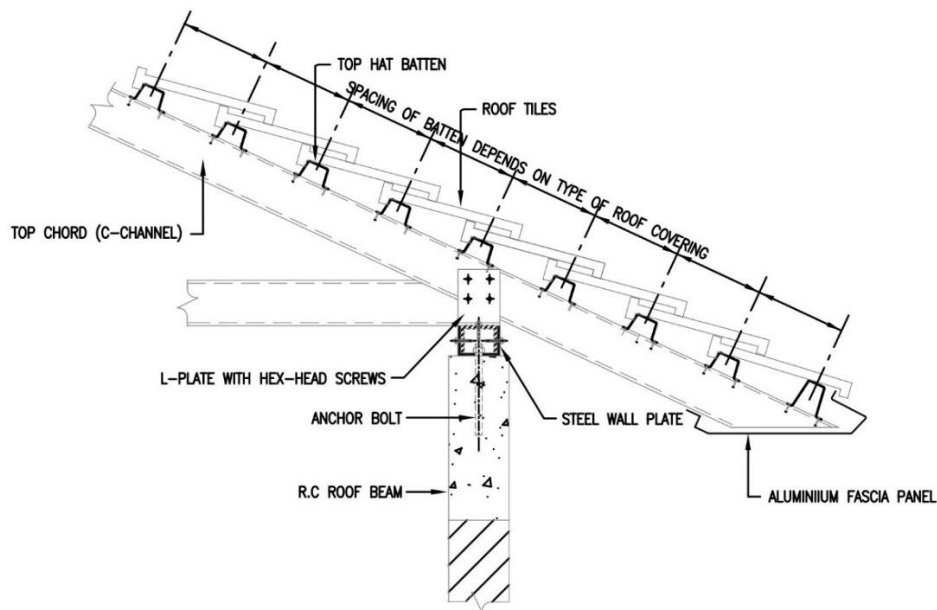
*Note: This figure is for illustration only.*

#### 6.4. Connection

The connection method and fixing type of each member to member or truss to truss connection shall be clearly detailed to enable checking, installation and inspection. Each truss to truss connection shall be shown in isolation and in combination with the total roof structure. Roof truss member shall be connected with minimum of three (3) nos. of fasteners.

#### 6.5. Roof Battens

Roof battens layout drawing shall be provided to indicate arrangement and roof position of batten. Roof battens or top chord restraints shall be indicated in shape, size and thickness. The spacing of the battens on the top chord or rafter shall be indicated and they shall be fastened with minimum two (2) nos. of hexagon head/wafer-head self-drilling screw. Refer to Figure 6.2 for suggested roof batten detail.

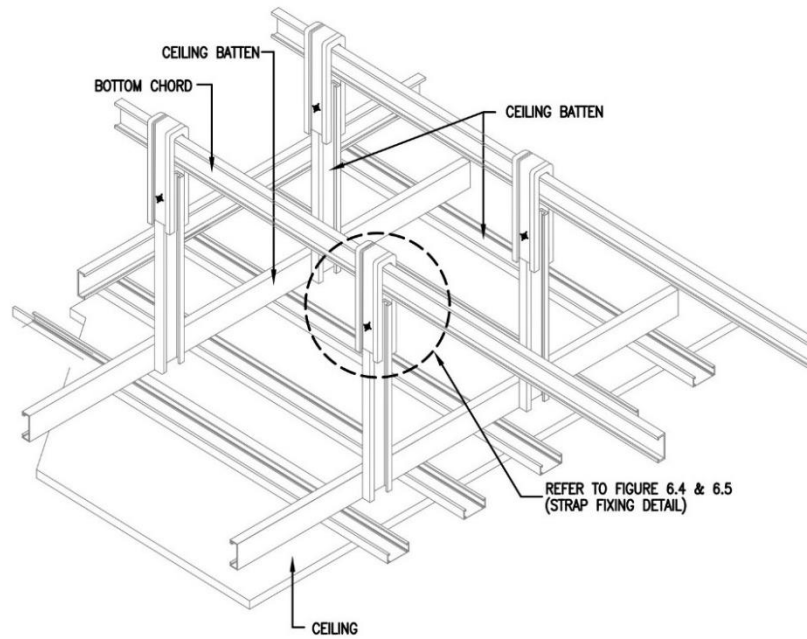


**Figure 6.2: Roof Batten Detail**

*Note: This figure is for illustration only.*

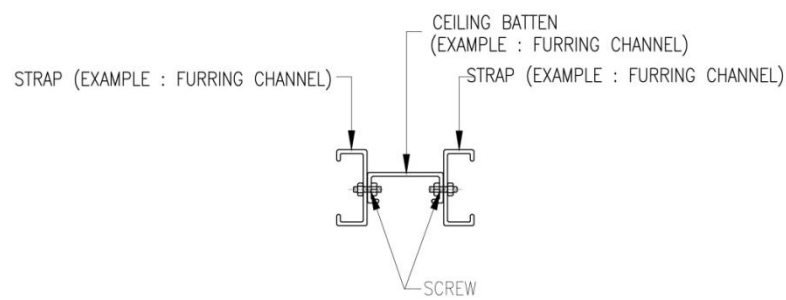
#### 6.6. Bottom Chord Restraints

Bottom chord restraints, wherever applicable, shall be indicated in shape, size and thickness. The spacing of the battens on the bottom chord or ceiling joist shall be indicated and they shall be fixed with minimum two (2) nos. of hexagon head/wafer-head self-drilling screw. Refer to Figure 6.3, Figure 6.4 and Figure 6.5 for suggested ceiling batten detail.



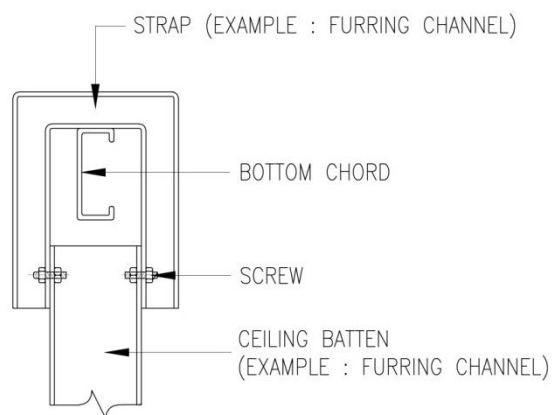
**Figure 6.3: Ceiling Battens Details**

*Note: This figure is for illustration only.*



**Figure 6.4: Strap Fixing Detail (Plan View)**

*Note: This figure is for illustration only.*



**Figure 6.5: Strap Fixing Detail (Section View)**

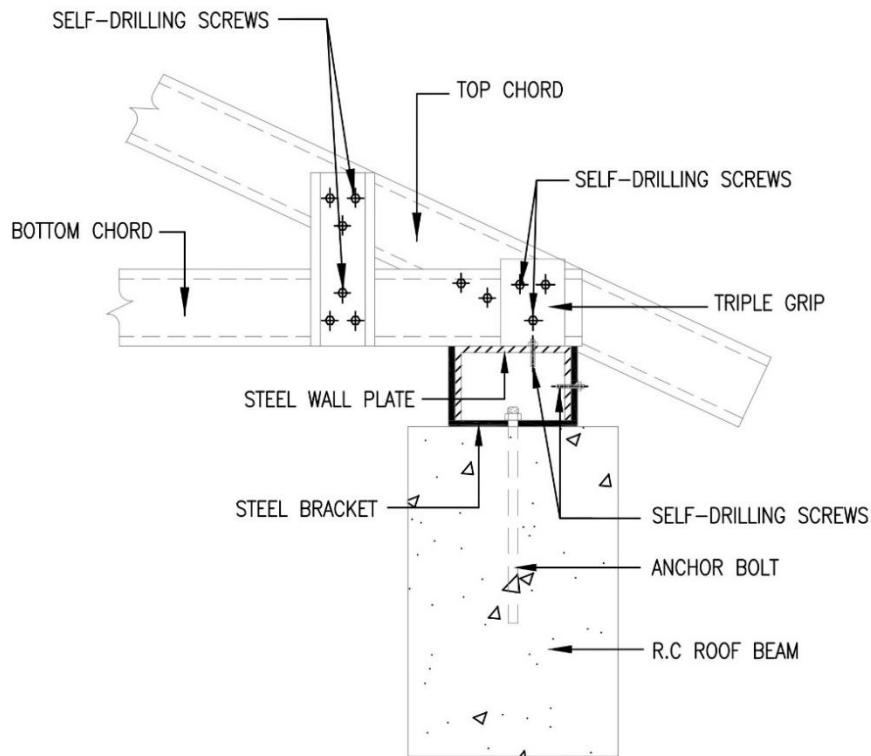
*Note: This figure is for illustration only.*



### 6.7. Tie-Down and Hanger

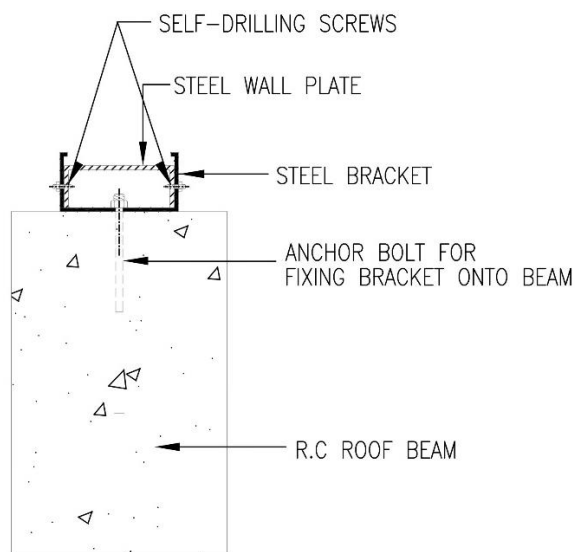
Tie-down of truss or rafter and ceiling joist shall be indicated with appropriate metal fixing type and its numbers together with the number and placement of fasteners. The fasteners or anchor bolt diameter, length and coatings, if any shall also be specified.

All trusses unless specified otherwise, shall be adequately anchored with proprietary types of fixings such as triple grips or multi grips, to the supporting structure to resist uplift and horizontal loads. Suggested tie down as shown in Figure 6.6 and Figure 6.7.



**Figure 6.6:** Holding Down Connection for Steel Wall Plate

*Note: This figure is for illustration only.*



**Figure 6.7:** Section View for Bracket and Anchor Bolt

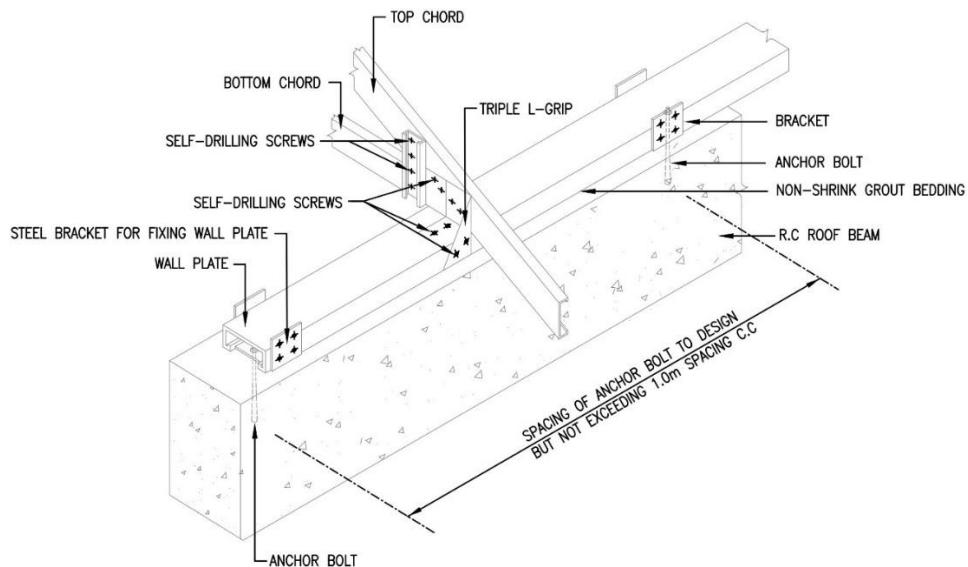
*Note: This figure is for illustration only.*

## 6.8. Wall Plate

All roof trusses supported on top of concrete beam shall be adequately anchored with fixing such as triple grips or multi grips to wall plate. Wall plate shall be designed to resist vertical and horizontal forces, able to provide bearing and distribute the load to the supporting beam. The wall plate shall be anchored to the supporting beam by means of anchor bolts.

### 6.8.1. Steel Wall Plate

Thickness of bearing wall plate shall be based on design, but the minimum base steel thickness shall not be less than 1.2 mm. Width of the bearing wall plate shall not be less than 75 mm for span not exceeding 10 m. For unsupported truss span between 10.0 m to 12.0 m, the minimum width of the bearing wall plate shall be 100 mm. The spacing of anchor bolts shall be in accordance with design but not exceeding 1.0 m spacing centre to centre. Refer to Figure 6.8 for suggested connection detail for steel wall plate.



**Figure 6.8:** Connection Detail for Steel Wall Plate

*Note: This figure is for illustration only.*

## 7. MATERIAL AND TESTING

### 7.1. General

Roof truss materials, namely base steels, fasteners and anchors, shall have *Perakuan Pematuhan Standard* (PPS) certificate under CIDB Act 520 (Fourth Schedule). The PPS shall have test certificate attachment for the strength, thickness, coating and chemical composition required in this specification.

The registered S.P.'s test reports for truss system are also available in J-Truss System Online for reference. The validity of test report shall be three (3) years from the date of test result.

### 7.2. Base Steel Requirement

#### 7.2.1. Base Steel Specification

Steel grade use for the roof truss system shall conform to structural-quality steel in MS 1196:2020 or MS 2660: 2020:

- i. For steel thickness of less than or equal to 1.20 mm, the steel grade shall be of grade designation 550 with the minimum lower yield strength of 550MPa;
- ii. For steel thickness of greater than 1.20 mm, the steel grade shall be of grade designation 450 with the minimum lower yield strength of 450MPa;
- iii. All steel braces shall have minimum base steel thickness of 1.00 mm and minimum lower yield stress of 250 MPa.

#### 7.2.2. Coating Specification

The coating mass limits of base steel shall be in accordance with MS 1196:2020 or MS 2660: 2020. The minimum coating mass shall be as shown in Table 7.1

**Table 7.1:** Minimum coating mass of base steel

Base steel thickness	Minimum coating mass for each corrosivity category <sup>(a)</sup>		
	C1 and C2	C3	C4
less than or equal to 1.20mm	Z200 or AZ150	Z450 or AZ150	Z600 <sup>(b)</sup> or AZ200
greater than 1.20mm	Z275 or AZ150	Z450 or AZ150	Z600 <sup>(b)</sup> or AZ200
<b>Note:</b> <sup>(a)</sup> Refer to ISO 9223 on description of typical environment corrosivity category C2 (low corrosivity), C3 (medium corrosivity) and C4(high corrosivity). Onshore zone of coastal areas without spray of salt water shall be considered as outdoor marine environment and shall be classified as atmospheric environments with corrosivity category C3 and C4. Typically, the backshore areas, starting after 400 meters measured landward from the shoreline to coastline, may be considered as atmospheric environments with corrosivity category C4 (high corrosivity). Corrosivity category C3 (medium corrosivity) area is within 400 meters measured landward from the coastline. Coating for corrosivity category C5 (Very high) and CX (extreme) are outside the scope of this specification. <sup>(b)</sup> Coating for structural-quality steel whereby not covered by MS2660:2020, reference may be made to AS 1397.			

The S.P. shall predetermined the suitability its truss systems constructed in environment with corrosivity category C3 and C4 prior to the submission to the S.O. for approval.

### 7.3. Fastener Requirement

#### 7.3.1. Fastener Specification

All requirements for fasteners shall comply with AS 3566.1-2002 for self-drilling screw shall be of a gauge and length recommended by the S.P.. The usage of rubber washer shall not be allowed on a permanent basis.

For self-drilling screw, coarse thread fasteners (up to 16 threads per inch) shall be used for fastening steel up to 2.4 mm. Fine thread fasteners (more than 16 threads per inch) shall be used for fastening thicker steel sections where the thickness between 2.4 mm - 3.2 mm. The full form threads shall extend close to the head.

The minimum surface hardness and maximum core hardness of self-drilling screw for fixing to steel shall comply to AS 3566.1-2002.

The S.P. shall submit technical specification from the fastener manufacturer confirming the dimension compliance, strength and coating properties of fastener to standard specified in this specification.

#### 7.3.2. Coating

All fasteners: self-drilling screw, bolt, etc, used in roof truss construction shall be coated by hot-dip galvanizing, sherardizing or other suitable treatment against corrosion and shall comply corrosion resistances to Table 2, AS 3566.2-2002.

The truss system constructed in area with the respective atmospheric environments classification and corrosivity categories in accordance with ~~to~~ ISO 9223 shall comply with the following minimum corrosion resistance class:

- (i) Class 2 corrosion resistance for atmospheric environments with corrosivity category C2 (low corrosivity) and C1 (very low corrosivity);
- (ii) Class 3 corrosion resistance for atmospheric environments with corrosivity category C3 (medium corrosivity); and
- (iii) Class 4 corrosion resistance for atmospheric environments with corrosivity category C4 (high corrosivity).

Onshore zone of coastal areas without spray of salt water shall be considered as outdoor marine environment and shall be classified as atmospheric environments with corrosivity category C3 and C4. Typically, the backshore areas, starting after 400 meters measured landward from the shoreline to coastline, may be considered as atmospheric environments with corrosivity category C4 (high corrosivity). Corrosivity category C3 (medium corrosivity) area is within 400 meters measured landward from the coastline. Coating for corrosivity category C5 (Very high) and CX (extreme) are outside the scope of this specification.

### 7.4. Anchor Requirement

#### 7.4.1. Anchor Specification

All anchors in which all the metal parts directly anchored in the concrete and designed to transmit the applied loads including uplift load are made of carbon steel or stainless steel. The anchors shall be placed into drilled holes in concrete and anchored by torque-controlled expansion and shall come with a marking to allow identification or verification. The anchor properties and anchorage depth shall be based on design requirements with minimum outer diameter of 12mm, excluding sleeves, and a minimum of 100mm nominal bolt length. The anchor shall be manufactured or formed in accordance with BS EN 10269:2013.

The S.P shall submit technical specification from the anchor manufacturer confirming the compliance of dimension, strength and coating properties of anchor to the standard specified in this specification.

#### 7.4.2. Coating

All carbon steel anchors shall be protectively coated by hot-dipped galvanized or sherardized to a minimum thickness of 42 micrometre ( $\mu\text{m}$ ) in accordance with ISO 4042:2018.

### 7.5. Wall Plate Requirement

#### 7.5.1. Wall Plate Specification

Steel grade used for the wall plate shall conform to structural-quality steel in MS 1196: 2020 or MS 2660: 2020 with the minimum base steel thickness 1.2 mm. The minimum base steel lower yield strength shall be 450 MPa. The coating specification shall be in accordance with Clause 7.2.2.

### 7.6. Material Testing Requirements

All relevant material testing requirements shall refer to **Appendix 2**.

## **8. MANUFACTURING**

### **8.1. Manufacturing Capability**

#### **8.1.1. Production Premise**

All production premises shall have appropriate licenses or permits issued by relevant Local Authority allowing the S.P. to conduct manufacturing activities at the premises. The address of the premises as appeared on the Local Authority licenses or permits shall be the same with the address stated in the S.P. application documents approved by JKR. The S.P. shall make available for inspection at the production premises for manufacturing process of the proposed roof component section.

#### **8.1.2. Machinery**

Machines shall be operated, checked, maintained and calibrated in accordance with manufacturer's operating manual. The calibration shall be conducted at least annually by an accredited laboratory. The certificates of calibration and maintenance report shall be submitted to the S.O. for verification.

### **8.2. Production Quality Control**

#### **8.2.1. Material**

Quality of the material shall be checked before and after the production cycle. The records shall be produced as and when required by the S.O.

All documents including PPS, mill certificates, laboratory test results and in-house test results shall be retained by the S.P. for a period equivalent to the roof truss system warranty period.

#### **8.2.2. Material Storage**

The S.P. shall store raw materials on raised supports, protected from weather and covered with waterproof covering. The S.P. shall also ensure adequate air circulation and ventilation are available and no deterioration or damage occur before and during the manufacturing process.

#### **8.2.3. Production Process**

The S.P. shall submit to the S.O. the Quality Assurance Documents together with Quality Control Plan relevant to the production process. The S.P. shall maintain all Quality Reports related to the Quality Control Plan at all times for inspection. Quality audit shall be carried out annually to ensure the Quality Control Plan are implemented and their requirements adhered to. Quality Reports shall be produced as and when required by the S.O.. S.O. reserves the right to do inspection visit the manufacturing factory for verification before giving any approval.

The S.P. shall demonstrate that material traceability records and identification marks on finished products are traceable to the Mill Test Certificate and/or Production Certificate. Such identification marks shall allow relevant information such as but not limited to, sizes, length, steel grade and corrosion protection to be easily identified. The marks shall also be made permanent on surface of the product.

## 9. TRUSS FABRICATIONS

Unless otherwise approved by the S.O., roof trusses preferably assembled and fabricated in the factory against on-site fabrication. All fabricated of roof trusses shall be inspected and verified by P.E.P.C..

### 9.1. Factory Fabrication

Prior to the fabrication of the trusses, the Contractor shall submit the following proposal to the S.O. for approval:

- (i) Truss fabrication drawings endorsed by P.E.P.C.;
- (ii) Factory location;
- (iii) Method statement for fabrication;
- (iv) Method of transporting and handling of roof trusses to the site; and
- (v) Quality Assurance document.

S.O.'s approval does not relieve the Contractor of the responsibility for accuracy of his calculations, details dimensions on drawings, nor the general fit-up of parts to be assembled on site. S.O. reserves the right to visit the factory before giving any approval.

Steel cutting, punching or drilling shall be performed using sawing or shearing type of tools and equipment.

### 9.2. On Site Fabrication

For on site fabrication, the Contractor shall provide:

- (i) Covered fabrication and storage facility;
- (ii) Fabrication equipment;
- (iii) Truss fabrication drawings endorsed by P.E.P.C.;
- (iv) Method statement for fabrication;
- (v) Quality Assurance document; and
- (vi) Qualified S.P. site fabrication team.

The S.O. may withdraw his approval for the site fabrication if the quality of fabrication does not meet the specified requirements.

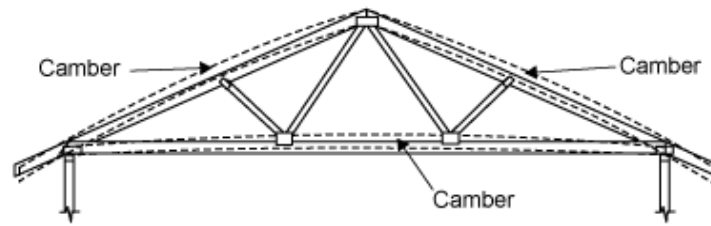
Steel cutting, punching or drilling shall be performed using sawing or shearing type of tools and equipment. S.P. shall ensure all debris from sawing shall be cleaned. The cut edge if required, shall be coated with the anti-corrosion protective coating similar with the parent steel anti-corrosion protective coating.

### 9.3. Site Measurement

All truss support locations and dimensions shall be checked at site prior to fabrication works. P.E.P.C. shall visit and inspects the site as he considers necessary to satisfy himself that the site measurement works are executed generally with good engineering practice.

### 9.4. Camber

Camber for all trusses shall be provided as specified with a maximum tolerance of  $\pm 3.00$  mm. The camber shall not be subtracted from the overall height of the truss. During setting out, the height of the truss (rise) shall be measured from the underside of the bottom chord at the point of maximum camber. In trusses with parallel chords, both the top and bottom chords shall be cambered. The support points are to have zero camber. Special care is to be taken in dealing with trusses with cantilevers, or half trusses in conjunction with full trusses.



**Figure 9.1: Chamber**

*Note: This figure is for illustration only.*

#### 9.5. Identification of Completed Trusses

All completed trusses shall be labelled for identification. In addition, all internal support positions and mid web tie positions shall be clearly marked.

#### 9.6. Splicing

Unless expressly provided for in the design, no splicing of members shall be allowed in the truss.

#### 9.7. Drilling

Unless expressly provided for in the design, no drilling of members shall be allowed in the truss.



## 10. TRUSS HANDLING AND INSTALLATION

### 10.1. Handling

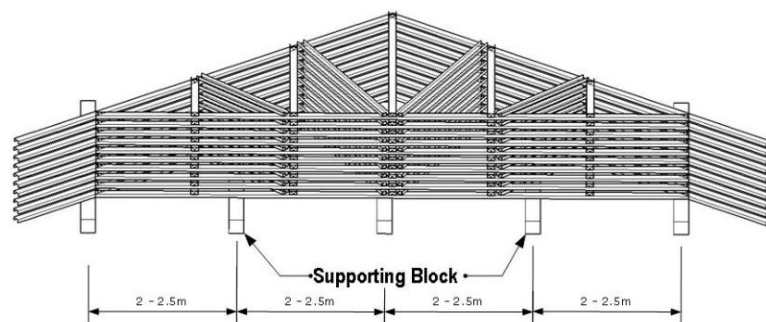
All trusses shall be handled in such a manner to avoid damage during handling, storage, transportation and installation. Members which have been distorted and their structural integrity are impaired or lost shall not be used. The Contractor shall submit to the S.O. a method statement on the roof truss storage, handling, and installation.

During handling, correct lifting equipment shall be used. All roof components shall be protected from damages due to straps, chains and wire ropes. Units which are transported in nested bundles should be separable without damage to the units or their coatings. Care should be taken when handling long units or bundles. Consideration should be given to the use of lifting beams with appropriately spaced lifting points and slings or lifting with properly spaced forklift tines. P.E.P.C. shall well-informed if any handling methods or installation sequence of roof trusses affects the design and corrosion protection of roof truss system and shall make all necessary arrangement for inspection and/or supervision where necessary.

During lifting, all roof trusses shall be propped in a manner that minimises lateral bending and distortion, and strain on the joints.

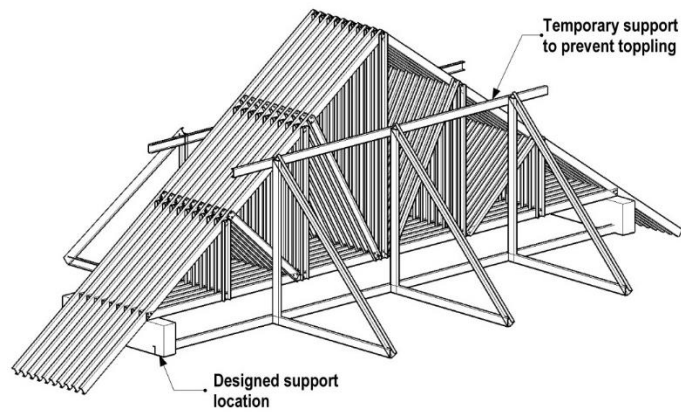
Where trusses are stored on site as shown in Figure 10.1 and Figure 10.2, they should be covered and placed above the firm ground on supporting block to protect them from ground water and weather as follows:

- (i) If the trusses are stored horizontally, the supporting block should be at 2.0 m to 2.5 m centres or as required at joints, to prevent bending of the trusses;
- (ii) If the trusses are stored vertically, they should be supported at the designed support locations or bottom chord panel points and in a manner that will prevent tipping or toppling; and
- (iii) Roof trusses on sites that have not yet been installed should always be covered with plastic to reduce the effect of weather.



**Figure 10.1:** Storage of Trusses at Site (Trussed Rafter Stacked Horizontally)

*Note: This figure is for illustration only.*



**Figure 10.2:** Storage of Trusses at Site (Trussed Rafter stacked vertically before covering)

*Note: This figure is for illustration only.*

## 10.2. Installation

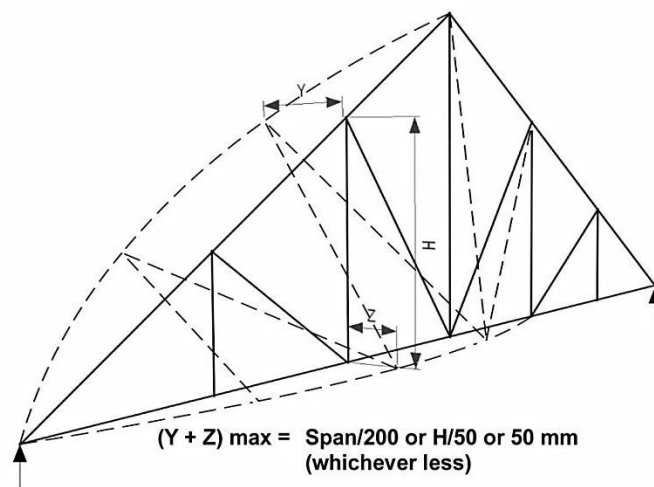
During erection, roof trusses shall be transversely braced to provide stability in accordance with method statement and fabrication drawings prepared by the S.P. and approved by the P.E.P.C.. Diagonal bracings shall be provided for this purpose. Panel points and any change in pitch line shall also be restrained. To avoid inverted installation, all parallel trusses, shall be marked on the side of the top chord, so that such mark will be clearly visible after installation. All installation of roof trusses shall be inspected and verified by P.E.P.C..

## 10.3. Installation Tolerances

The maximum allowable tolerances are as detailed below. If bow or tilt is evident to the naked eye, then it is deemed that these tolerances have been exceeded and the Contractor and S.P. shall make good of these defects.

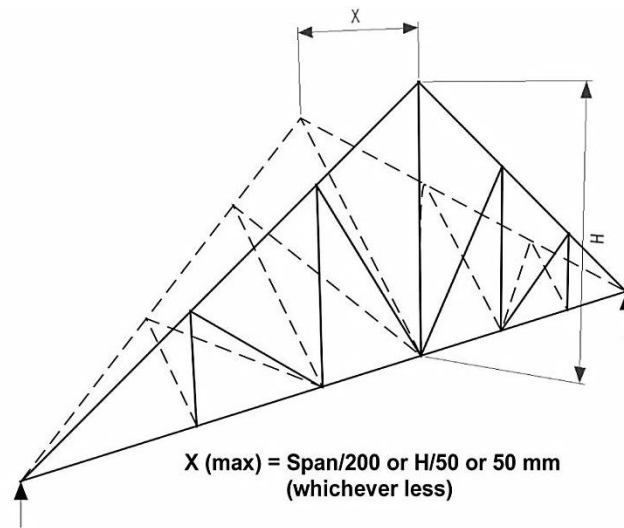
### 10.3.1. Verticality

All trusses, Figure 10.3 and Figure 10.4 shall not be out-of-plumb, or out-of-line or out-of-position by more than the least of the following:



**Figure 10.3:** Tolerance on verticality (local)

*Note: This figure is for illustration only.*



**Figure 10.4: Tolerance on Verticality (global)**

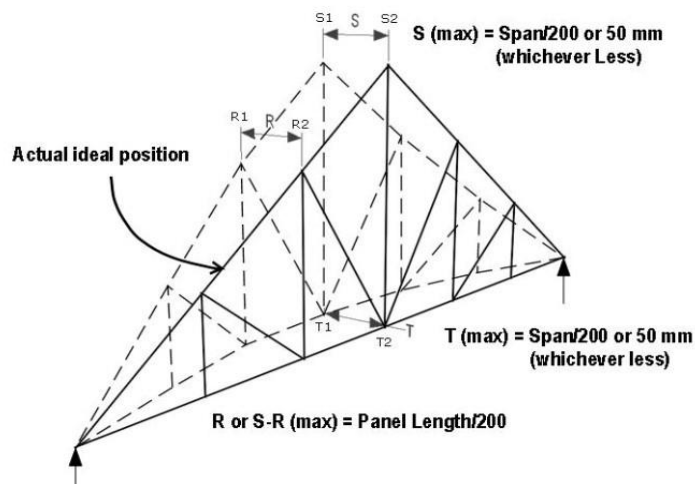
*Note: This figure is for illustration only.*

### 10.3.2. Straightness

Trusses shall be erected as shown in Figure 10.5 such that at no point does the out-of-line dimension measured from a line between the centres of the supports to the outside edge exceed the lesser of:

- a)  $\text{Span}/200$
- b) 50 mm

At no point shall the out-of-line dimension between the centrelines of two adjacent panel points exceed the panel length divided by 200.

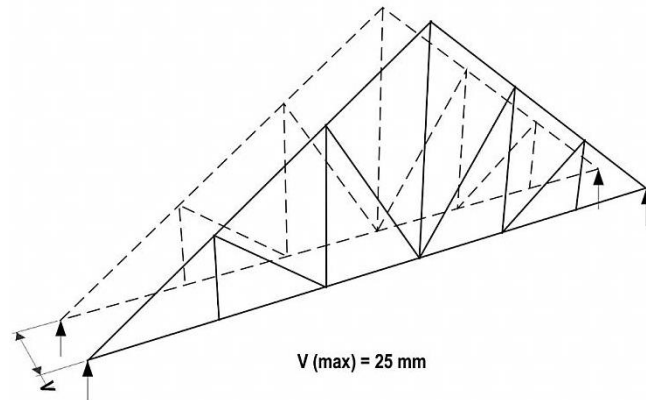


**Figure 10.5: Tolerance on Straightness**

*Note: This figure is for illustration only.*

### 10.3.3. Position

Trusses shall be erected such that their position at centres of support does not exceed the specified truss spacing by more than 25 mm as shown in Figure 10.6. However, the average spacing of the trusses shall not exceed the specified spacing.



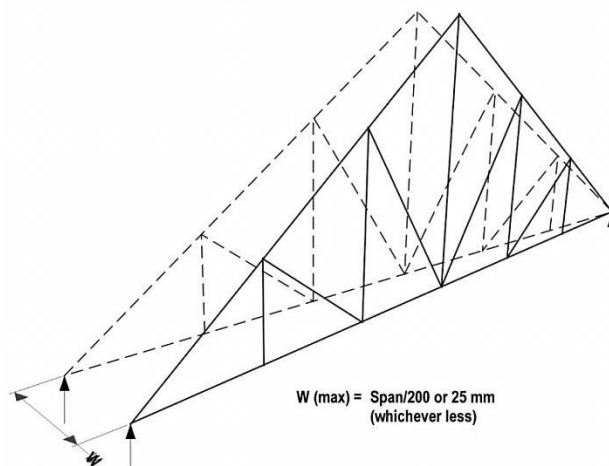
**Figure 10.6: Tolerance on Position**

*Note: This figure is for illustration only.*

#### 10.3.4. Squareness

The first truss erected as shown in Figure 10.7 shall be correctly plumbed and aligned so as to serve as the reference truss from which all subsequent trusses shall be positioned. All subsequent trusses shall be erected such that the out-of-square dimension at the centre of the end supports relative to each other does not exceed the lesser of:

- a)  $\text{Span}/200$
- b) 25 mm



**Figure 10.7: Tolerance on Squareness**

*Note: This figure is for illustration only.*

#### 10.4. Bolted Connection

In the case of bolted connections, the S.P shall ascertain that appropriate hardened washers have been fitted under every bolt head and nut where one is required. The bolts shall protrude by at least one thread above the nut heads.

A random sampling of the bolts shall also be checked for the correct minimum tension as required by means of calibrated hand wrench or impact tool. If it is found that a substantial number of the bolts in the sample require tightening, then the entire bolted connections shall be tested and tightened. The tensioning in the bolted connections shall be inspected periodically by the S.P., and tightened if necessary, particularly during the duration of the defects liability period. All such inspections, which may be witnessed by the S.O., shall be documented and forwarded to the S.O. for his retention.

### 10.5. Anchoring of Trusses to Supporting Structure

The wall plates shall be mounted to the supporting structure in such a manner that there are no gaps between them, and the anchor bolt adequately tied down into the supporting structure. Any apparent gaps or spaces between the wall plate and supporting structure shall be packed and evened out by using approved non-shrink cement grout by the Contractor.

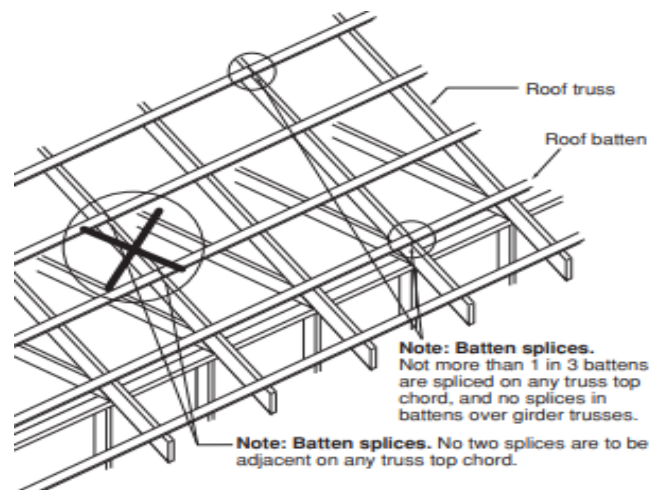
### 10.6. Roof Frame Bracing

#### 10.6.1. Permanent Bracing

Permanent bracing shall be applied to ensure that all the elements on roof frame act together as an integral structure that is stable under specified loading conditions. All bracings used to provide initial stability during installation shall remain and not be removed. The materials for these bracing shall also comply with Clause 2.2 (v).

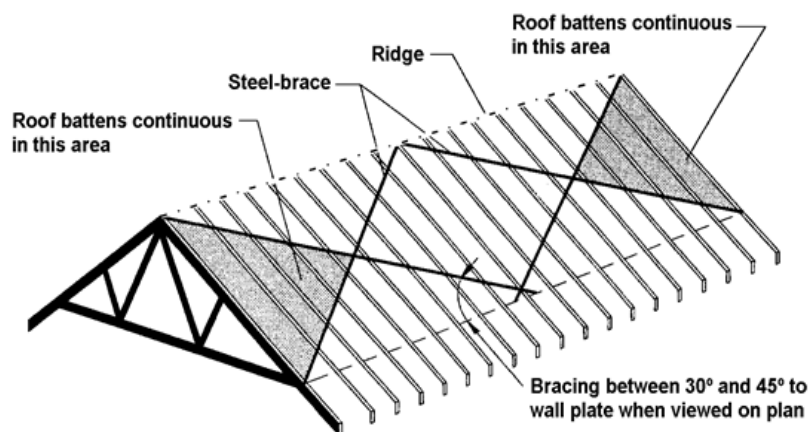
#### 10.6.2. Lateral Restraint

Roof battens or purlins whenever considered to provide lateral restraints shall be so arranged that on any truss line, not more than one third of the roof battens or purlins are spliced and that no two splices are adjacent. Particular attention is drawn to the need to provide lateral restraints on the bottom chord of trusses that are not directly braced by the ceiling frame. In areas where battens are not bound on both sides by diagonal bracing, battens shall be continuous as shown in Figure 10.8 and Figure 10.9.



**Figure 10.8:** Batten Continuous in Areas Unbound by Bracing

*Note: This figure is for illustration only.*



**Figure 10.9:** Batten Continuous in Areas Unbound by Bracing

*Note: This figure is for illustration only.*

Lateral restraints where specified, shall be fastened to truss members at all intersections. Battens or purlins shall be sufficiently connected to trusses in a manner that provides positional stability as well as connection against net up-lifting forces. Stronger connection is required to hold down purlins for roof using sheet roofing.

All lateral restraints shall be braced back to rigid points on the main structure through the use of diagonal ties or bracing laid according to the fabrication drawings.

#### 10.6.3. Steel Brace

The minimum working load for the steel brace shall be as shown in Table 10.1.

**Table 10. 1: Minimum Basic Working Load for Steel Brace**

Working Load		Minimum Value (kN)
i)	Steel Tension Capacity	5.50
ii)	End Fixing Capacity	5.50
iii)	Braced to intermediate truss fixing capacity	0.55
iv)	Wrap-around splice capacity	5.50

The tension steel brace shall be designed such that the sagging does not exceed the (distance between support point) /500 when installed.

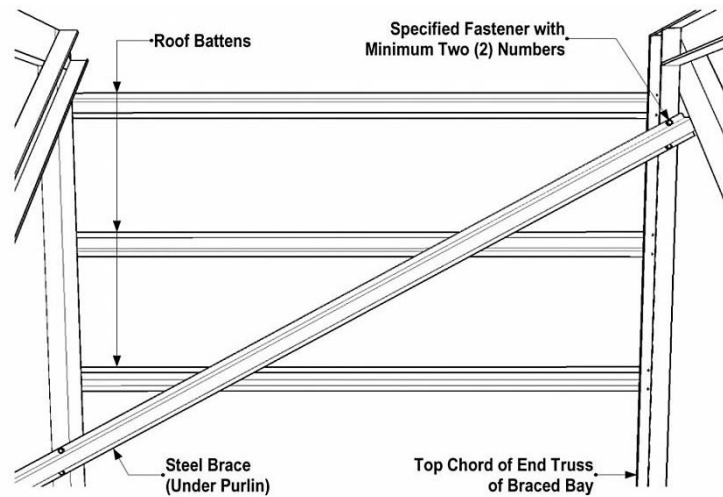
#### 10.6.4. Top Chord Bracing

All steel bracing, if specified, shall be laid in opposing pairs. The steel brace shall be fixed to each truss and supports as shown in Figure 10.10 and Figure 10.11. The angle from the steel brace to wall frame shall be between 30° and 45°. Bracing bays shall extend from the end trusses of the roof, unless otherwise specified.

If lapping of steel braces are required, it shall be positioned and fastened to the truss. The total numbers of steel brace layers at any location of the self-drilling screw at a lap position shall not be more than three (3) layers, with a maximum total thickness of 3.2 mm.

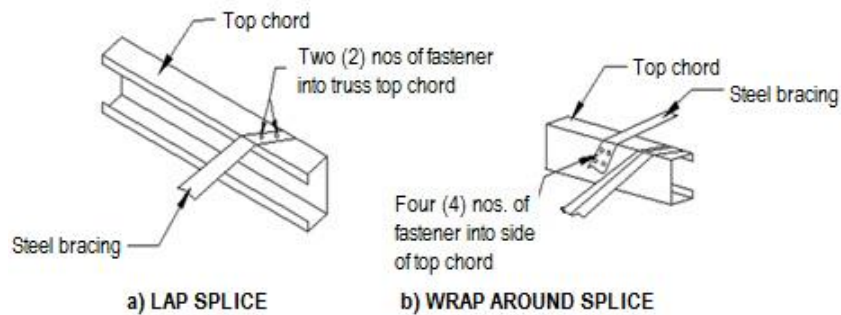
The top chords shall also be braced with diagonal steel braces. All steel braces shall be fixed to the top chord of each truss it crosses or as the case may be anchored to the wall plates. For suggested roof bracing layout, refer to Figure 10.12, Figure 10.13 and Figure 10.14.

Where roof frame is built-up with saddle back, or cap trusses as shown in Figure 10.15, the horizontal top chords of lower trusses shall also be braced according to the design requirements as stated in the construction and fabrication drawings. Where the top chords are tied by continuous lateral battens, the battens shall be adequately fixed at all crossings of the top chords. Unless otherwise provided, all steel battens shall be fastened with minimum two (2) nos. of fasteners.



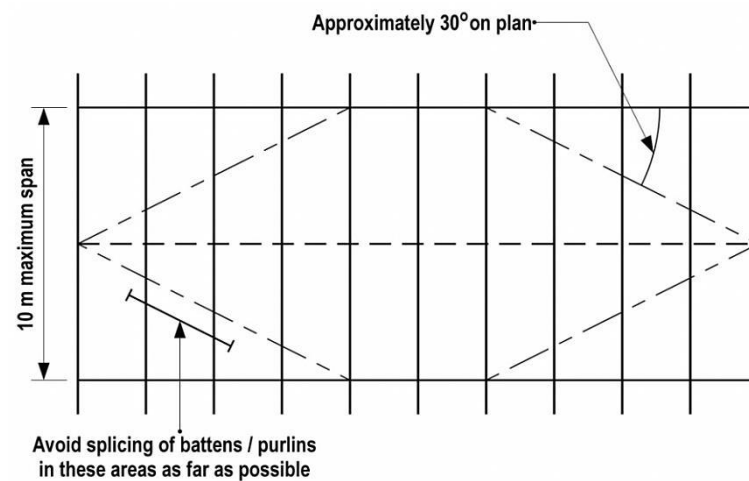
**Figure 10.10:** Fixing Detail of Under-Purlin Bracing

*Note: This figure is for illustration only.*



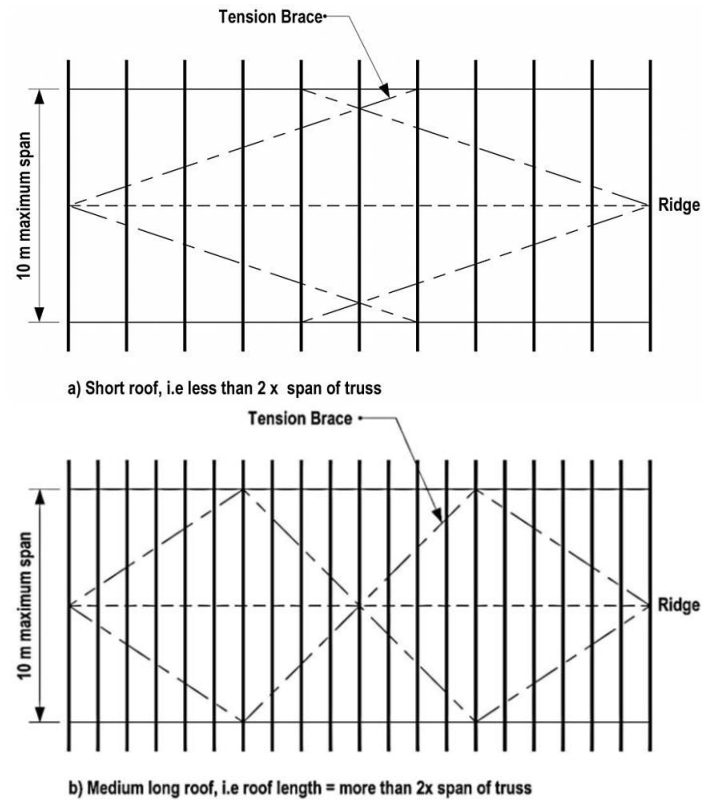
**Figure 10.11:** Typical Spliced Detail of Steel Brace

*Note: This figure is for illustration only.*



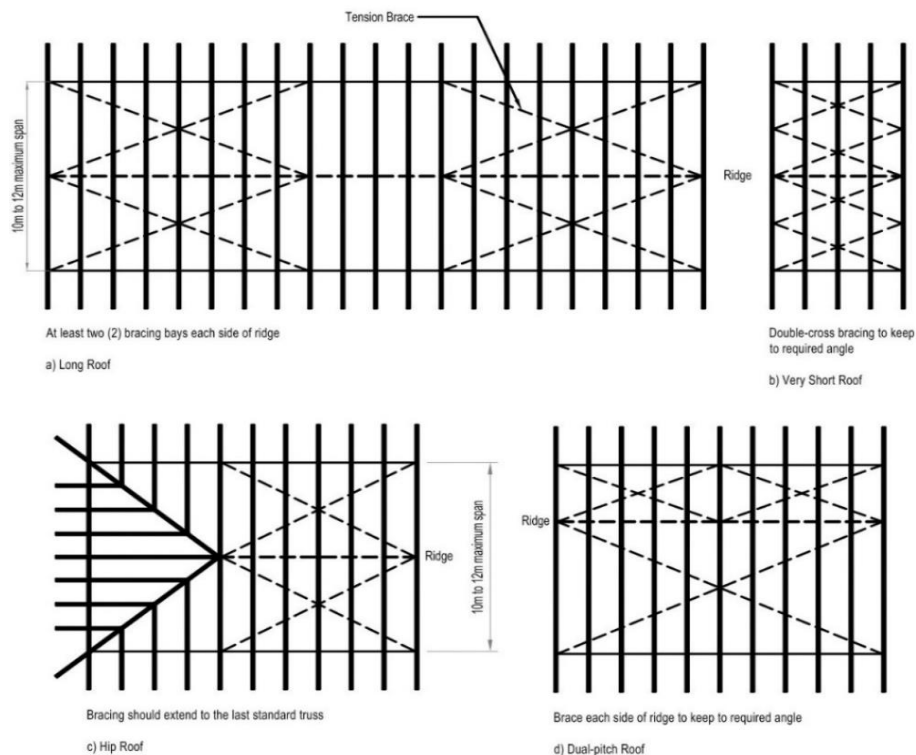
**Figure 10.12:** Suggested Roof Bracing Layout

*Note: This figure is for illustration only.*



- i. Angle between bracing and trusses viewed on plan, should be about  $30^\circ$
- ii. Avoid spacing of batten / purlins in area bounded by bracing as far as possible

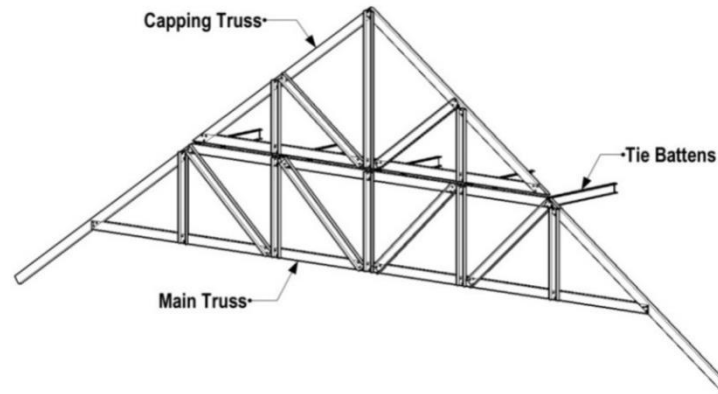
**Figure 10.13:** Suggested Roof Bracing Layout (Tension) Trusses up to 10 m span  
*Note: This figure is for illustration only.*



- i. Angle between bracing and trusses view on plan, should be about  $30^\circ$
- ii. Avoid splicing of battens / purlins in areas not bounded by bracing as far as possible
- iii. All bracing on each side of the ridge should be crosses

**Figure 10.14:** Suggested Roof Bracing Layout (Tension) Trusses Spans 10 m to 12 m  
*Note: This figure is for illustration only.*





**Figure 10.15:** Typical Main and Capping Truss

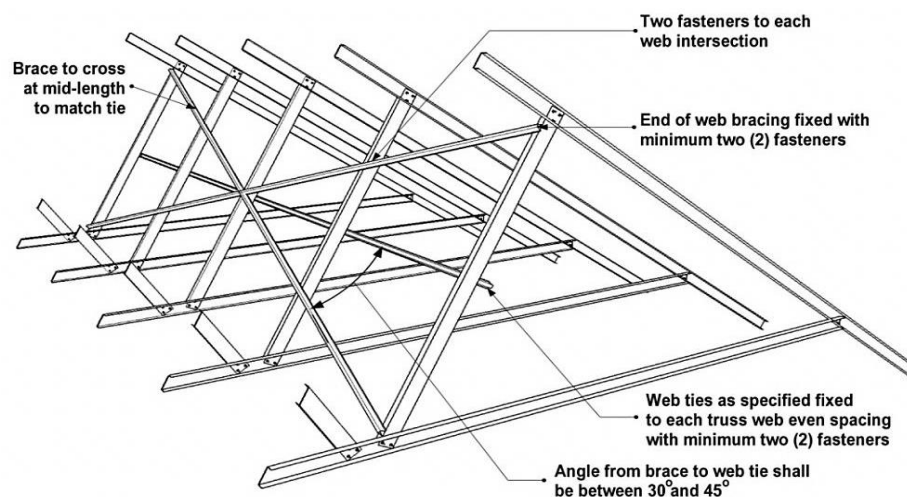
*Note: This figure is for illustration only.*

#### 10.6.5. Bottom Chord Bracing

A permanent bracing at the bottom chord shall be provided to restrain truss bottom chords against lateral buckling under wind uplift conditions if required. Where bottom chord ties are provided, they shall be braced and anchored to a building element such as the wall plate, in the same manner as for top chord bracing or the compression chord bracing of the main trusses.

#### 10.6.6. Web bracing

Where web bracing is provided in design, the web steel ties shall be fixed to the web of each truss at even spacing of the web with minimum two (2) nos. of fasteners and braced to the truss with one bay of crossed steel braced at each end. Steel web ties shall be continuous, or where required, spliced by lapping over at least two adjacent trusses as shown in Figure 10.16

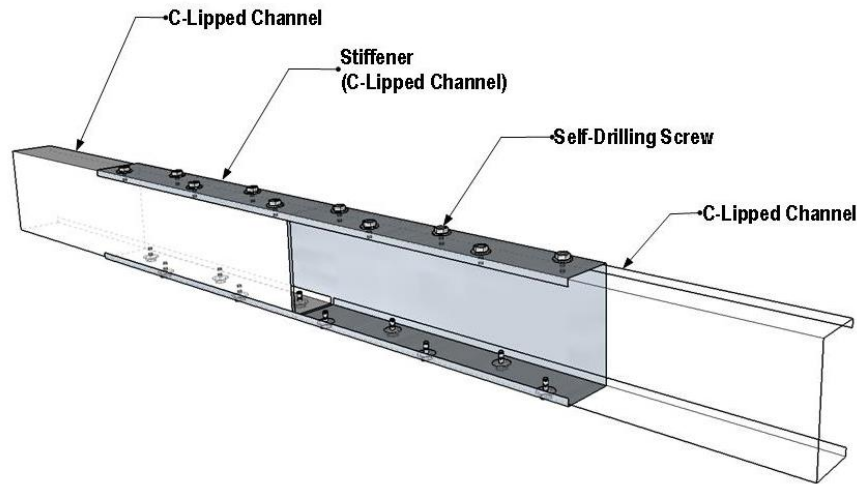


**Figure 10.16:** Suggested Web Ties and Fixing Details

*Note: This figure is for illustration only.*

#### 10.7. Member Stiffener

Steel stiffeners as shown in Figure 10.17 for truss members shall only be positioned and location, as specified by P.E.P.C..



**Figure 10.17:** C-Lipped Section Stiffener Detail with Screw at Spliced Location

*Note: This figure is for illustration only.*

## 10.8. Installation of Roof Covering

### 10.8.1. Exposure of Roof Trusses

All roof trusses shall be covered within two (2) weeks from completion of installation. In situations where the Contractor is unable to comply with the above requirements, the Contractor shall take appropriate steps to cover such trusses with approved temporary plastic sheeting until such time that they are ready to be covered with the permanent roof sheeting or tiles. All temporary coverings shall be well maintained and adequately ventilated at all times.

### 10.8.2. Roof Tiles

Roof tiles shall not be stacked more than five (5) pieces on the roof trusses directly during laying out stage. Crane sling shall always remain taut (tension) throughout the process of unloading the tiles on the roof structure.

The tile stacks shall be distributed in staggered manner and evenly over the roof area. Tile stacks shall not be grouped or bundled into small area which may cause overloading of top chord section. The stack of roof tiles already hoisted shall not be left overnight and the tiler shall have planned enough time for arranging the tiles before finishing off for the day.

A palette only allowed to seat onto trusses provided not more than 150 kg in weight or 30 tiles on the palette at any time during the work. Timber palette sizing shall conform to the spacing of the trusses i.e. the palette legs support shall be able to seat or bear weight on two (2) trusses on each lift.

### 10.8.3. Lightweight Covering

The lightweight covering stacks shall be distributed in staggered manner and evenly over the roof area. Lightweight covering stacks shall not be grouped or bundled into small area which may cause overloading of top chord section. The weight of the lightweight covering stack shall not exceed 25 kg/m<sup>2</sup>. Crane sling shall always remain taut (tension) throughout the process of unloading the lightweight coverings on the roof structure.

The stack of lightweight coverings already hoisted shall not be left overnight and the lightweight covering installer shall have planned enough time for arranging the lightweight coverings before finishing off for the day.

## **11. ALTERATION TO TRUSSES**

- 11.1. No element of the roof trusses, roof frames or roof ancillary members shall be cut or notched or removed or otherwise altered from its original state without the prior written approval of the S.P. and P.E.P.C..
- 11.2. Where defects exceeding the limits or permitted tolerances are identified, rectification works shall be carried out based on the recommendations made by S.P. and to the approval of the P.E.P.C..

**Permohonan Penggunaan Sistem Kekuda Bumbung :**☐ Prefabricated Cold Formed Steel☐ Factory Fabrication☐ Prefabricated Timber☐ On-site Fabrication**A. Maklumat Asas Projek**

- i. Nama projek : .....
- ii. No. Kontrak : .....
- iii. Nama dan Alamat Kontraktor Utama : .....

**B. Maklumat Cadangan Sistem Kekuda**

Adalah saya Kontraktor Utama projek ini memohon untuk menggunakan sistem kekuda pasang siap tersebut sebagaimana butiran di bawah :

- i. Nama dan Alamat Pembekal Sistem : .....
- ii. Nama, Alamat dan Nombor Pendaftaran P.E.P.C. : .....
- (Nombor Pendaftaran BEM)
- iii. Nama dan Alamat Pemasang (Fabricator) Bertauliah\*:

\* (Sila sertakan Surat Perakuan Pemasang Bertauliah dari Pembekal Sistem)

**C. Perakuan Kontraktor Utama**

Adalah saya Kontraktor Utama projek ini yang memohon untuk menggunakan kekuda pasang siap seperti butiran di atas, mengakui bahawa saya adalah bertanggungjawab sepenuhnya terhadap pembekalan, rekabentuk dan pemasangan kekuda pasang siap tersebut.

Tarikh : .....

.....  
(Tandatangan Kontraktor Utama dan Cop)

**D. Perakuan Pembekal Sistem**

Saya mengesahkan bahawa sistem kekuda syarikat kami dicadangkan untuk projek di atas mencapai segala keperluan yang dinyatakan di dalam spesifikasi.

Tarikh : .....

.....  
(Tandatangan Pembekal Sistem dan Cop)

No.	Item	Standard	Validity of Test Certificate (Year)	Check
<b>1.0</b>	<b>Base steel</b>			
1.1	Tensile test of base steel material	MS ISO 6892-1 and MS 1196: 2020 or MS 2660:2020	3	<input type="checkbox"/>
1.2	Determination adhesion and mass of aluminium-zinc base coating	MS 1196:2020	3	<input type="checkbox"/>
1.3	Determination adhesion and mass of zinc base coating	MS 2660:2020	3	<input type="checkbox"/>
1.4	Chemical composition	MS 1196:2020 or MS 2660:2020	3	<input type="checkbox"/>
1.5	Point bending test	Supplier specification (For verification of supplier section properties)	3	<input type="checkbox"/>
<b>2.0</b>	<b>Fasteners</b>			
2.1	Tensile, torsional and surface hardness	AS 3566.1-2002	3	<input type="checkbox"/>
2.2	Shear	AS/NZS 4600:2018	3	<input type="checkbox"/>
2.3	Salt spray	AS 3566.2-2002	3	<input type="checkbox"/>
2.4	Coating composition and thickness	AS 3566.2-2002	3	<input type="checkbox"/>
2.5	Dimensional Test	AS 3566.1-2002	3	<input type="checkbox"/>
2.6	Pull Out Test	AS 3566.1-2002	3	<input type="checkbox"/>
<b>3.0</b>	<b>Anchor</b>			
3.1	Pull out test	ASTM E1508-12a:2019 & ASTM B487:2020 (For verification of supplier specification)	3	<input type="checkbox"/>
3.2	Coating composition and thickness	AS 3566.2-2002	3	<input type="checkbox"/>

**A. Document Submission**

No.	Submission Item	Check
1.	Completed Application Form	<input type="checkbox"/>
2.	Construction Drawing	<input type="checkbox"/>
3.	Analysis and Design Calculation	<input type="checkbox"/>
4.	Curriculum Vitae:	
	i) Professional Engineer with Practising Certificate (P.E.P.C.)	<input type="checkbox"/>
	ii) Installer	<input type="checkbox"/>
5.	Particular of the Fabricator	<input type="checkbox"/>
6.	Base Steel Mill Certificate	<input type="checkbox"/>
7.	Base Steel Lab Test Certificate (if required)	<input type="checkbox"/>
8.	Technical Specification for Screw, Bolt and Anchor Bolt	<input type="checkbox"/>
9.	Fastener Lab Test Certificate (if required)	<input type="checkbox"/>
10.	Quality Assurance and Quality Control	<input type="checkbox"/>

**B. Completeness of submission**

No.	Submission Item	Check
<b>1.0</b>	<b>Application Form:</b>	
	- Completed with type of fabrication	<input type="checkbox"/>
	- Information on P.E.P.C. and Fabricator	<input type="checkbox"/>
	- Endorsed by the S.P.	<input type="checkbox"/>
<b>2.0</b>	<b>Particular and the C.V:</b>	
	- Valid P.E.P.C registration with Board of Engineer Malaysia (BEM)	<input type="checkbox"/>
	- Fabricator appointment document by the S.P.	<input type="checkbox"/>
	- Fabricator acceptance document on the appointment	<input type="checkbox"/>
	- Fabricator registration certificate with CIDB	<input type="checkbox"/>
	- Installer competency certificate from CIDB	<input type="checkbox"/>
<b>3.0</b>	<b>Analysis and Design Calculation:</b>	
	- Endorsed by P.E.P.C.	<input type="checkbox"/>
	- Loading criteria	<input type="checkbox"/>
	- Truss analysis	<input type="checkbox"/>
	- Member design	<input type="checkbox"/>
	- Bracing design	<input type="checkbox"/>
	- Tie down and anchorage design	<input type="checkbox"/>
	- Connection design	<input type="checkbox"/>
	- Fastener and anchor technical specification	<input type="checkbox"/>
	- Base steel mill certificate	<input type="checkbox"/>
<b>4.0</b>	<b>Construction Drawing (minimum content):</b>	
	- Endorsed by P.E.P.C. on every sheet of drawings	<input type="checkbox"/>
	- Layout drawing	<input type="checkbox"/>
	- Section properties	<input type="checkbox"/>
	- Accessories properties (ex. L-Bracket, Triple L-grip etc)	<input type="checkbox"/>
	- Bracing layout	<input type="checkbox"/>
	- Truss configuration	<input type="checkbox"/>
	- Connection detail	<input type="checkbox"/>
	- Support detail (wall plate and anchor)	<input type="checkbox"/>
	- Technical notes on base steel, fastener, anchor bolt and protective coating	<input type="checkbox"/>
<b>5.0</b>	<b>Construction Drawing (Compliance to specification):</b>	
	- Maximum span : 12.0 m	<input type="checkbox"/>
	- Maximum spacing : 1.2 m	<input type="checkbox"/>
	- Minimum base steel thickness (truss member: open section & bracing) : 1.0 mm	<input type="checkbox"/>
	- Minimum base steel thickness (truss member: closed section) : 0.6 mm	<input type="checkbox"/>
	- Minimum base steel thickness (batten) : 0.5 mm	<input type="checkbox"/>
	- Minimum base steel thickness (wall plate) : 1.2 mm	<input type="checkbox"/>
	- Minimum depth of section (open section) : 75.0 mm	<input type="checkbox"/>
	- Minimum width of section : 35.0 mm	<input type="checkbox"/>
	- Minimum section lip : 7.0 mm	<input type="checkbox"/>

No.	Submission Item	Check
<b>6.0</b>	<b>Technical notes and certificate compliance to specification:</b>	
	- Minimum grade for base steel to the requirement of Clause 7.2.1	<input type="checkbox"/>
	- Minimum thread of screw to the requirement of Clause 7.3.1	<input type="checkbox"/>
	- Minimum protective coating for base steel to the requirement of Clause 7.2.2	<input type="checkbox"/>
	- Minimum protective coating for fastener to the requirement of Clause 7.3.2	<input type="checkbox"/>
	- Minimum protective coating for anchor to the requirement of Clause 7.4.2	<input type="checkbox"/>
	- Minimum for wall plate (grade and strength) to the requirement of Clause 7.5	<input type="checkbox"/>
<b>7.0</b>	<b>Quality Assurance and Control</b>	
	- Quality Assurance and Control Plan	<input type="checkbox"/>
	- Method Statement	<input type="checkbox"/>
	- Installation Team Chart	<input type="checkbox"/>
	- Inspection Checklist	<input type="checkbox"/>



Warranty certificate from the S.P. shall have contents not limited to the followings:

- 1) Statement that the S.P. is registered with the regulatory body by stating the registered name, registration type, field, category or class; whichever applicable, registration number and registered business address.
- 2) Statement that the truss system has been designed in accordance with the design standards.
- 3) Statement that the truss system has been designed, fabricated, supplied and installed by the S.P. in accordance with this specification.
- 4) Statement that the warranty will be extended to the Government of Malaysia as the users of the truss system.
- 5) Statements that the period of warranty shall not be less than ten (10) years commencing from the date of Certificate of Practical Completion (CPC) issued to the main Contractor. Commencement and expiry date of warranty shall be clearly written in the warranty certificate.
- 6) Statement that the S.P. warrants all elements encompass the truss system; the steel sections, fasteners, bracing, batten and anchor:
  - i) Will not corrode under the specified environment corrosivity within the warranty period;
  - ii) Will not deflect excessively beyond the specified tolerance or fail under the intended designed parameter within the warranty period;
  - iii) Shall not have any defect and damages; corrosion, perforation, buckle, twisting or distorted, due to workmanship at the time of issuance of CPC.
- 7) Statement that, if truss system under warranty period is found to have defect or damage under the S.P.'s fault, the S.P. will undertake to investigate, test, repair or replace at S.P.'s own cost.
- 8) The S.P. may insert the term and condition in the warranty statement for the warranted item, but shall be limited to the extent that such term and conditions are not effecting or reducing the S.P.'s undertaking in paragraph (7).
- 9) The warranty statements shall be signed-off only by the S.P.'s where information on the names, National Registration Identity Card (NRIC) number and designation shall be clearly stated. The warranty statements shall then be endorsed with S.P.'s seal.

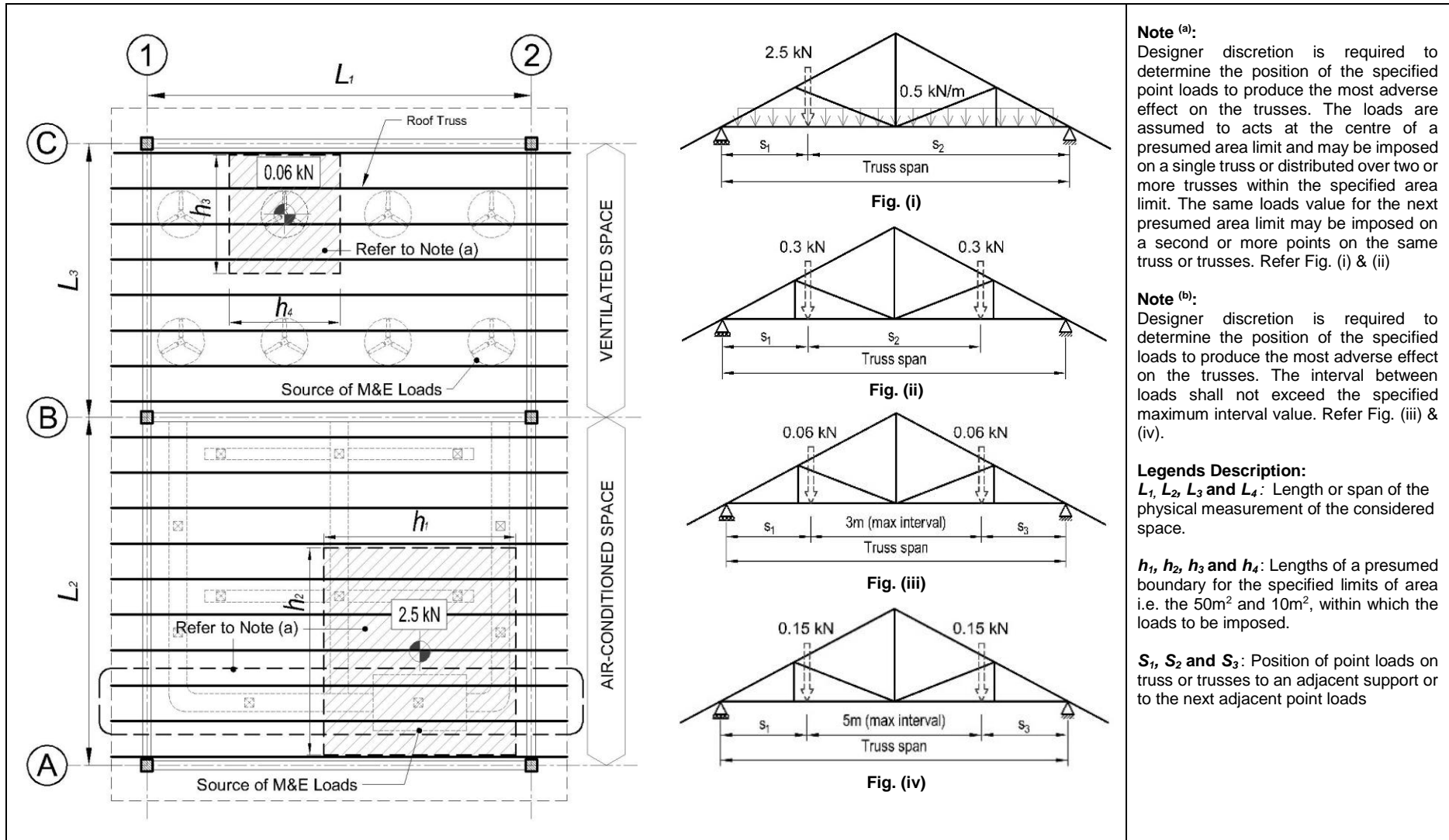
1. Table Appendix 5.1: Mechanical and electrical (M&amp;E) loads on bottom chord of trusses.

Area	Air-conditioned space		Ventilated space	Electrical lighting, conduit, wiring etc.	Fire protection piping system. (Sprinkler cross main pipe)	Audio visual equipment		
	Central air conditioning system (Ducted)	Individual air conditioning system (Ductless)	Ceiling Fan			Projector	Motorized screen	Speaker
Public	<b>0.5 kN/m</b> parallel to truss OR <b>0.4 kN/m<sup>2</sup></b> (Whichever higher)  and <b>2.5 kN</b> for every 50m <sup>2</sup> area <sup>(a)</sup> (Point load)	<b>0.3 kN</b> for every 10m <sup>2</sup> area <sup>(a)</sup> (Point load)	<b>0.06 kN</b> at 3.0m interval <sup>(b)</sup>	<b>0.05 kN/m<sup>2</sup></b>	<b>0.15kN</b> at 5.0m interval <sup>(b)</sup>	<b>0.065 kN</b>	<b>0.25 kN</b>	<b>0.08 kN</b>
Office/ room	<b>0.2 kN/m</b> parallel to truss	<b>0.3 kN</b> for every 10m <sup>2</sup> area <sup>(a)</sup> (Point load)	<b>0.06 kN</b> at 3m interval <sup>(b)</sup>	<b>0.05 kN/m<sup>2</sup></b>	<b>0.15kN</b> at 5m interval <sup>(b)</sup>	<b>0.065 kN</b>	<b>0.25 kN</b>	<b>0.08 kN</b>

**NOTES:**

- (i) The Contractor and S.P. shall collectively ascertain the final requirements of M&E services loads, i.e., the actual weight, location, and route of these services.
- (ii) Unless otherwise confirmed with loads data acquired by the S.P. or/and Contractor, truss analysis shall adopt the minimum load from the table above.
- (iii) The loads as specified in the table is a typical M&E load and shall be treated as the unfactored or characteristic loads.
- (iv) Where higher loads values than the values specified in the table are more appropriate based on design or special requirement, the Contractor and S.P. are collectively responsible to acquire such loads data for the truss analysis.
- (v) "Public" is where people may congregate, Example: Library, lecture room, waiting area or open office area.
- (vi) Linearly distributed (Unit force/length) or Point (force) load shall be assumed to act in vertical plane and perpendicular to bottom trusses.
- (vii) Refer to Diagram 5.1 on the description of notes <sup>(a)</sup> and <sup>(b)</sup>.

## 2. Diagram 5.1: Illustration of the M&E loading



**Requirement of roof truss submission:****1.0 Analysis, design and drawings duly endorsed by P.E.P.C.:**

- 1.1 Actual design load data which also included construction loads; Raw data submission without analysis is unacceptable.
- 1.2 Truss stability design and drawings with information on:
  - 1.2.1 Permanent bracing and ties design at every plane of trusses;
  - 1.2.2 Design for hoisting and temporary stability;
  - 1.2.3 Analytical magnitude of translation or rotation at trusses hill points; at truss support position;
  - 1.2.4 Checking on the truss supporting structure;
  - 1.2.5 Details of bracings termination points;
  - 1.2.6 Deflection limits and camber requirement;
  - 1.2.7 Provision of thermal expansion;
  - 1.2.8 Drawings on the truss layout and bracings; clearly presented to enable checking.
- 1.3 Truss member design and drawings with information on:
  - 1.3.1 Specified position of permanent restraint of compression steel section on both directions of the section's local axes;
  - 1.3.2 Where applicable, a design shall consider effect of construction in stages;
  - 1.3.3 Splicing or stiffeners design at a specified location;
  - 1.3.4 Local buckling check at the location of point load;
  - 1.3.5 Drawings with clear member length for every truss configuration.
- 1.4 Design and drawings of joints with information on:
  - 1.4.1 Type, strength and dimension of fasteners/connector;
  - 1.4.2 Type, strength and dimension of truss accessories whereby connected to the fasteners/connectors;
  - 1.4.3 Where applicable, a design shall consider effect of construction in stages;
  - 1.4.4 Stress distribution at every point of fastener/connector;
  - 1.4.5 Design calculation of joint;
  - 1.4.6 Design of truss accessories;
  - 1.4.7 Design of joint for splicing or stiffeners;
  - 1.4.8 Joint details with specified spacing of fasteners/connectors;
  - 1.4.9 Joint details at support and bracings termination point.
- 1.5 Emphasize should be given to item 1.2.3, 1.2.7, 1.3.2, 1.3.3, 1.4.3, 1.4.7 and 1.4.9 for the design of roof truss exceeding 12.00 meter span.

**2.0 Storage, handling, hoisting, erection and fixing procedure duly endorsed by P.E.P.C.:**

- 2.1 Detailed method statement with information on:
  - 2.1.1 Loadings including construction loadings.
  - 2.1.2 Supporting structure shall be stable and adequately restrained and braced;
  - 2.1.3 Temporary restraint and bracing plan;
  - 2.1.4 Type of lifting equipment and special hoisting requirements;
  - 2.1.5 Competent crane operator;
  - 2.1.6 Hoisting point on trusses as per design;
  - 2.1.7 Temporary interior support;
  - 2.1.8 Procedure for site fixings of joints, supports and splicings;
  - 2.1.9 Maximum stack of tiles during installation;
  - 2.1.10 Construction of on the provision of thermal expansion;
  - 2.1.11 Deflection, movement or rotation check methods during and after the release of temporary supports.
- 2.2 Fabrication process on factory.
- 2.3 Designated fabrication and installation team.
- 2.4 Inspection checklist for trusses pre-installation process.
- 2.5 Inspection checklist for trusses post installation process.

## REFERENCES

### **Malaysian Standard and Eurocodes**

- [1] MS EN 1991-1-1:2010 Malaysia National Annex to Eurocode 1: Action on structures - Part 1-1: General Action- Densities, self-weight, imposed loads for buildings
- [2] MS 1553:2002 Code of practice on wind loading for building structure
- [3] MS EN 1990:2010 Eurocode – Basis of structural design
- [4] MS EN 1993-1-3:2019 Eurocode 3- Design of steel structures- Part 1-3: General rules - Supplementary rules for cold-formed members and sheeting
- [5] MS EN 1993-1-8:2017 Eurocode 3: Design of steel structures – Part 1-8: Design of joints
- [6] MS 1196:2020 Continuous hot-dip aluminium/zinc alloy-coated sheet of commercial, drawing and structural qualities (Third revision)
- [7] MS2660:2020 Continuous hot-dip zinc-coated and zinc-iron alloy-coated carbon steel sheet and strip
- [8] MS ISO 6892-1:2017 Metallic materials - Tensile testing - Part 1: Method of test at room temperature (First revision) (ISO 6892-1:2016, IDT)

### **British Standard and Eurocodes**

- [1] BS 476: Part 7: 1997 Fire tests on building materials and structures Part 7. Method of test to determine the classification of the surface spread of flame of products
- [2] BS EN 10269:2013 Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties

### **Eurocodes**

- [1] EN 1993-1-2:2005 Eurocode 3: Design of steel structures - Part 1-2: General rules - Structural fire design

### **Australia Standard and Australian/New Zealand Standard**

- [1] AS/NZS 4600:2018 Cold-formed steel structures
- [2] AS 3566.1-2002 Self-drilling screws for the building and construction industries Part 1: General requirements and mechanical properties
- [3] AS 3566.2-2002 Self-drilling screws for the building and construction industries Part 2: Corrosion resistance and requirements

### **International Organization for Standardization Standard (ISO Standard)**

- [1] ISO 9001:2015 Quality management system
- [2] ISO 9223:2012 Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation
- [3] ISO 4042:2018 Fasteners – Electroplated coating systems

### **ASTM Standard**

- [1] ASTM E1508-12a:2019 Standard Guide for Quantitative Analysis by Energy-Dispersive Spectroscopy
- [2] ASTM-B487:2020 Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

## ACKNOWLEDGEMENT

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### Cover and Illustration

Muhammad Asyraf bin Amrin	Bah. Pembangunan dan Teknologi Binaan
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A vote of thanks to the chairpersons and members of the organization bodies for their cooperation in providing feedback to producing this user Guide: Specifications For Prefabricated Cold Formed Steel Roof Trusses

Construction Industry Development Board (CIDB)  
 Lotez Engineering Sdn. Bhd.  
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 NS Bluescope Lysaght Malaysia Sdn. Bhd.  
 Malaysia Cold-Formed Steel Institute (MyCSi)



**CAWANGAN KEJURUTERAAN AWAM & STRUKTUR  
IBU PEJABAT JKR MALAYSIA**