STANDARD INDUSTRI PEMBINAAN
(CONSTRUCTION INDUSTRY STANDARD)

CIS 12:2009

QUALITY ASSURANCE FOR
PREFABRICATED LIGHTWEIGHT STEEL
ROOF TRUSS SYSTEM

Descriptors: quality assurance, steel roof truss system, tie-down, fasteners classification,
truss handling, truss fabrication, tie-batten

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QUALITY ASSURANCE FOR PREFABRICATED LIGHTWEIGHT STEEL ROOF TRUSS SYSTEM
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Committee representation

This Construction Industry Standard (CIS) was managed and developed by the Construction Industry Development Board Malaysia with the assistance of the Technical Committee on Development of Standard for Industrialised Building System (IBS). Which comprises representatives from the following organizations:-

Association of Consulting Engineers Malaysia
Construction Industry Development Board Malaysia
Hume Industries (M) Berhad
The Institution of Engineers, Malaysia
Jabatan Kerja Raya Malaysia
Master Builders Association of Malaysia
MTD ACPI Engineering Berhad
Pertubuhan Akitek Malaysia
Setia Precast Sdn. Bhd.
UAC Steel System Sdn. Bhd.
Universiti Teknologi Malaysia
FOREWORD

This Construction Industry Standard (CIS) was developed as a Quality Assurance for Prefabricated Lightweight Steel Roof Truss System with the assistance of the Construction Industry Development Board Malaysia which acted as a moderator and facilitator for the working committee throughout the development process of this standard.

This CIS on quality assurance for prefabricated lightweight steel roof truss system referred from existing Malaysian manufacturer’s on method statement.

The use of this CIS is voluntary and compliance with this document does not of itself confer immunity from legal obligations.
QUALITY ASSURANCE FOR
PREFABRICATED LIGHTWEIGHT STEEL ROOF TRUSS SYSTEM

1. Scope

This document outlines the basic / general requirements for the analysis, design, detailing, drawing, manufacture, 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 that is structurally stable under all the specified combinations of loading conditions. This document is outlined only for non-aggressive environment.

2. Normative References

MS 740:1981 Specification for Hot-Dip Galvanized Coatings on Iron and Steel Articles
MS 1196:2004 Continuous Hot-Dip Aluminum/Zinc-Coated Steel Sheet of Commercial, Drawing and Structural Qualities (First Revision)
AS 1397-2001 Steel Sheet and Strip Hot Dip Zinc Coated or Aluminium / Zinc Coated
AS3623-1993 Domestic Metal Framing
BS5950-5-1998 Code of Practice for Design of Cold Formed Thin Gauge Sections
BS 6399-2-1997 Code of Practice for Wind Loads
JIS G3302–1987 Hot-dip Zinc Coated Steel Sheets and Coil
Uniform Building by Laws 1984

3. Definitions

For the purpose of this Construction Industry Standard, the following definitions apply.

3.1 System Provider

A manufacturer and supplier of a proprietary steel roof truss system, employing third party Quality Assurance procedures in the design, detailing, connection, manufacture light weight steel components, bracing and erection criteria for the structural roofing system provided. The System Provider shall guarantee the due performance of the entire roofing system.
3.2 Installer

A licensed installer of an approved System Provider, who assembles the structural element and assembly details including the truss to truss details, bracing, tie-down, erection, lifting instructions in addition to producing and installing the roofing system. A licensed installer must obtain accreditation certificate from CIDB and System Provider.

3.3 Superintending Officer

Representative of the employer / client of specified project.

3.4 Professional Engineer

Civil and Structure engineer registered with the Board of Engineers Malaysia.

4. General

All prefabricated roof trusses and ancillary roof products employing the proprietary systems shall be only manufactured and assembled by licensed or accredited fabricators of systems approved by CIDB. Prior to manufacture of the proposed roofing system, the Installer shall provide copies of the roof truss design drawings indicating all loads, assembly drawings, connection criteria, bracing and tie-down, together with the particulars of the Fabricator including valid licenses or other certificates to the Superintending Officer for his/her approval. All drawings shall be certified by an independent Professional Engineer.

The Superintending Officer shall reserve the right to reject any of these systems if found to be unsuitable. The Superintending Officer shall also reserve the right to reject any of the Fabricators forwarded if their track record in the sole opinion of the Superintending Officer has been poor.

This quality assurance of handling and installation method is intended to apply to lightweight steel roof trusses with metal fasteners within the following general limitations:

a) Maximum recommended unsupported truss clear span 13 meters.

b) Maximum truss spacing of:
   i. 1200mm for concrete/clay tiles, or
   ii. 2400mm for metal sheet roofs in areas of design wind speed up to 41 m/s;

This specification requires that all roofing systems up to 13 meters span shall have the loading, assembly, stacking, lifting, bracing, tie-down and battening, and truss to truss connections be endorsed by the Professional Engineer and erected by trained erection teams.

Note: For roof trusses exceeding 13 meters but not more than 20 meters, Professional Engineer shall ensure its design, and the erection to be carried out by trained erection teams endorsed by the Superintending Officer.
5. Design

5.1 Design Data
All loads shall be clearly itemized in the Design Calculation as below:

a) Dead Load
b) Imposed Load
c) Wind Load
d) Other related loads

All the above loads are to be in accordance to Malaysia Uniform Building By Law, AS1170 or MS1553 or BS6399 or any other equivalent codes.

The size, length and grade of steel shall be clearly specified in the design.

Load combinations shall be clearly itemized and identified to enable design checking to be carried out upon the most adverse conditions.

5.2 Design Standards

5.3 Design Submissions
Analysis, design calculations and drawings shall be submitted to the Superintending Officer prior to the commencement of work. The calculations and drawing details shall be duly signed by a qualified engineer of the System Provider and certified by an independent Professional Engineer.

6. Detailing and Drawings
The drawings shall be detailed as follows:

6.1 Layout drawings
Layout drawings shall indicate the plan view of all trusses together with ties and bracings. The drawing shall identify the number of the truss or member.

6.2 Design Detail Drawings
The design detail drawing shall clearly indicate the following:

a) Shape of member and truss
b) Span, spacing, pitch, overhang and camber
c) Designed wind load.

Each truss shall be clearly drawn on a separate drawing that clearly itemizes all member sizes, steel grade, lengths, angles, connector sizes, orientations and positions.

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.

The recommended method for each of these items is to be provided in general form to avoid secondary stresses or curvature being introduced to the members after assembly and prior to installation.
6.3 **Bracing Layout drawing**

Bracing layout drawing shall be provided for the total roof structure, which is to specify the type of bracing and the connection details at the apex, top plate splice and the standard connection details. These connection details shall be shown in the drawings and at the positions on the roof structure. Where bracings are provided at different planes on the roof system, then such bracing details, and its typical hold down connection shall be clearly shown in the drawings.

6.3.1 **Tile battens**

Tile battens, wherever applicable, shall be indicated in size and thickness. The spacing of the battens on the top chord or rafter shall be indicated and they shall be fastened with minimum 10-16x16 hex or wafer head self-drilling tek screws.

6.3.2 **Ceiling battens**

Ceiling battens or bottom chord restraints shall, wherever applicable, be indicated in 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 10-16x16 hex or wafer head self drilling tek screws.

6.3.3 **Tie-Down**

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 bolts diameter, length and coatings, if any shall also be specified.

7. **Steel Specification**

The steel used for the truss or roof members shall be in accordance to the Malaysia Uniform Building By Law and conform to:

i) MS 606:1991 Specification for Hot Dip Zinc Coated Sheet and Coil

ii) MS 1196:2004 Continuous Hot-Dip Aluminium/Zinc Coated Steel Sheet of Commercial, Drawing and structural Qualities (First Revision)

For the scope that is not covered under the above Malaysian standards, then the standards below shall be used

iii) AS1397-2001 "Steel Sheet and Strip: - Hot-dipped Zinc Coated or Aluminium/Zinc Coated

iv) JIS G3302–1987 Hot Dipped Zinc Coated Steel Sheets and Coils.

v) JIS G3321-1998 Hot-dip 55% aluminum-zinc alloy-coated steel sheets and coils

or other equivalent standards.

For steel with a base metal thickness of less than and equal to 1.2mm, the steel shall have minimum yield strength of 550MPa. For steel with a base metal thickness of greater than 1.2mm, the steel shall have minimum yield strength of 450MPa.

Unless otherwise specified or shown in the drawings, the steel grade used for the truss or roof members shall be G550 MPa. The System Provider shall submit Mill Test Certificates to the Superintending Officer before installation works confirming the grade of the steel from the steel manufacturer.
7.1 Coatings

For base metal thickness exceeding 1.2mm, the steel shall be galvanized with zinc coating conforming to class Z27 (275g/m²). For base metal thickness less than and equal to 1.2mm, the minimum coating class shall be either zinc coated Z20 (200g/m²) or zinc aluminum coated AZ100 (100g/m²).

7.2 Test

The steel shall be tested for tensile and bend test in accordance with Clause 3.5 of MS 1196. The coating mass shall be determined by the single and triple spot tests as per clause 3.5 of MS 1196. The steel composition test shall be carried out to comply with the requirements of MS 1196.

7.3 Fasteners Classification

All fasteners used shall comply with Australian Standard AS3566-Class 2 or equivalent, and shall be treated with metallic coating to protect against corrosion to a minimum thickness of 12 microns. The method of applying the metallic coatings shall not affect the structural properties of the base material.

Coarse thread fasteners (up to 16 threads per inch) shall be used for fastening steel up to 2.4mm. Fine thread fasteners (more than 16 threads per inch) shall be used for fastening thicker steel sections where the thicknesses are between 2.4mm – 3.2mm. Information regarding the specification of the fasteners (gauge, threads per inch and length) must be specified by the Professional Engineer and confirmed on site.

The minimum pullout strength of the fastener on a G550 steel of 1.0mm thick shall be 2600N.

Screw guns with built-in torque limiter or clutches control should only be used in fastening of these screws. The tension shall be adjusted in order to limit over tightening of the fastener.

7.4 Holding down Bolts

Holding down bolts should be in accordance to BS 7419 or BS EN 10088 or BS EN ISO 898-1 whichever is appropriate.

7.5 Truss Fabrication

All truss support locations and dimensions shall be checked at site prior to manufacture of the sections for fabrication. All fabrication of the trusses shall be carried out using a method statement as prepared by the System Provider. The Installer shall certify that he had carried out checks on the fabrication process by submitting a report to the Superintending Officer.

Camber for all trusses shall be provided as specified with a maximum tolerance of 3 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.

The metal fasteners shall not project outside the outer edges of the truss.

All trusses shall be labeled for identification. In addition, all internal support positions and mid web tie positions shall be clearly marked.
8. Truss Handling and Installation

All trusses shall be handled in such a manner to avoid damage during handling, storage, transportation and installation. The Installer shall submit to the Superintending Officer a Manual/Handbook on the roof truss storage, handling and installation prepared by the System Provider.

All installation of roof trusses shall be checked and certified by System Provider or independent Professional Engineer.

During handling, correct lifting equipment shall be used and steel components must be protected from the cutting effects of chains and wire ropes.

All trusses during lifting, before being located and aligned on the supporting structure, shall be propped in a manner that minimizes lateral bending and distortion, and strain on the joints.

As the trusses are erected, they must be transversely braced to provide stability in accordance with recommended guidelines as in the Manual prepared by the System Provider. Panel points and any change in pitch line shall also be restrained. Some diagonal bracings shall be provided for additional stability. 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.

8.1 Marking of Lightweight Steel Roof Truss Components

All lightweight steel roof trusses components shall be bundled together for delivery purposes by manufacturer and shall be marked and labeled with sticker, stamped, or stenciled to indicate conformance of the followings:- base steel thickness (BST), metallic coating grade (Z,AZ), minimum Yield Strength, product name, project name, customer’s name and name of the manufacturer / system provider.

Truss members used in the steel truss construction shall be individually identified with a legible sticker, stamp, stencil, or embossment, which states the following: - truss component marking, length.

Trusses shall be marked with tags or other eligible markings to document the orientation of the parallel chord trusses, location of special bearing conditions and web member permanent bracing locations. Alternatively, it shall be acceptable for the Truss Designer to provide this information to the Installer by means of indicating in the Truss Design Drawings and/or on a separate detail drawings.

Parallel chord trusses shall have the top chord clearly marked, with tags or otherwise, to prevent upside down installation.

Trusses having bearing locations other than at the end of the heel locations shall have bearing points clearly marked on the truss design drawings in a manner that permits verification during and after installation.

8.2 Bundling Of Materials

Trusses shall be packed and stored at the manufacturer’s facility in a manner so that they will not be damaged.

Loose components shall be bundled together using metal straps spaced at 1200mm centers to a maximum height of 500mm to avoid missing of components and damages.

Trusses damaged during the packaging and/or storage process at the manufacturer’s facility shall be replaced or repaired. Any repairs needed shall be signed off by the Truss Designer, who is designing the trusses prior to delivery of the trusses.
8.3 Transportation Of Lightweight Steel Roof Trusses

Lightweight steel roof truss manufacturers are to produce quality trusses in accordance to manufacturer's quality standards. These standards shall include provisions for tight joints, accurate dimensions, proper plate placement and material storage. Similar provisions to protect the quality should be continued through delivery, storage, handling, erection and bracing in order to maintain the structural reliability and strength of the trusses.

Finished trusses shall be banded with steel straps in convenient bundles. The straps help to maintain truss alignment and the bundle strength minimize damages during the storage and delivery.

Truss manufacturer shall store trusses vertically in racks or horizontally with blocks to prevent lateral bending. Throughout all the phases of construction, care must be taken to avoid excessive lateral bending of the trusses that can cause joint and component damage.

Strapped trusses/truss components for delivery shall be transported to the jobsite on flatbed trailers with a roller deck or a special 'pole-type' trailer to minimize damages to the trusses. If possible, trusses shall be unloaded on relatively leveled ground. They should not be unloaded on rough terrain that would cause undue lateral strain resulting in distortion of the truss joints.

Rough terrain can also cause damage or breaking of overhangs, and/or other parts of the truss. Unloading shall be done as close to the building site as possible to minimize double handling.

8.4 Tolerances

The tolerances detailed below are the maximum acceptable in order to ensure a good roofline and an effective bracing system. If bow or tilt is evident to the naked eye, then it is deemed that these tolerances have been exceeded and the installer shall make good these defects.
8.5 **Verticality** (Fig.1): All trusses shall not be out-of-plumb, or out-of-line, or out-of position by more than the least of the following:

a. Span/200
b. 50mm
c. H/50

![Diagram](attachment:image.png)

\[ \text{MAX. } X = \frac{\text{SPAN}}{200} \text{ OR } 50\text{mm OR } \frac{H}{50} \] (WHICHEVER IS LESSER)

![Diagram](attachment:image.png)

\[ \text{MAX. } Y+Z = \frac{\text{SPAN}}{200} \text{ OR } 50\text{mm OR } \frac{H}{50} \] (WHICHEVER IS LESSER)

**Figure 1: Tolerance on Verticality**
8.6 **Straightness (Buckling)** (Fig. 2): Trusses shall be erected such that at no point does the out-of-line dimension measured from a line between the centers of the supports to the outside edge exceed the lesser of:

a. Span/200  
b. 50mm

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

![Diagram of Straightness Tolerance](image)

**Figure 2: Tolerance on Straightness**

8.7 **Position** (Fig. 3): Trusses shall be erected such that their spacing at centres of support does not exceed the specified spacing by more than 50mm. However, the average spacing of the trusses shall not exceed the specified spacing. Truss spacing shall not vary by more than 10% between adjacent trusses unless so designed or approved by the independent Professional Engineer (designer) in writing.

![Diagram of Position Tolerance](image)

**Figure 3: Tolerance on Position**
8.8 **Squareness** (Fig. 4): The first truss erected 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 so 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. Span/200  
b. 50mm

![Figure 4: Tolerance on Squareness](image_url)

MAX. W = SPAN/200 OR 50mm  
(WHICHEVER IS LESSER)

**Additional Tolerances to be followed and adhered are as follows:**

a. Tolerance on length dimension as per BS 5606  
b. Tolerances on thickness dimension as per AS 4800 and AS 1365  
c. Tolerance on manufactured shapes as per BS 5950 : Part 7  
d. Tolerance on site erection as per BS 5950 : Part 7

9. **Anchoring of Trusses to Supporting Structure**

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. For cases where trusses rest on steel wall plates, these wall plates shall be anchored to the supporting structures which are leveled, to resist all uplift and horizontal forces. The wall plates shall be mounted in such a manner to the supporting structure that there are no gaps between them. Any apparent gaps or spaces between the wall plate and supporting structure shall be packed and evened out using approved bedding mortar.

Wall plates which are made up of open ended and hollow sections are to be filled with approved bedding mortar/grout at each of the support points of the truss up to a distance of 300mm from both edges of the support.

Usage of packing pieces of timber to fill the gap in between the wall plate and the supporting structure shall not be allowed on a permanent basis. Unless otherwise specified, the width of the bearing wall plate shall not be less 75mm.

10 **Roof Frame 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. Erection (temporary) bracing shall be applied wherever necessary during the assembly stage. Bracing hold down connection is to be secured to a rigid structure.
Tiling battens/purlins whenever considered to provide lateral restraints shall be so arranged that on any truss line, not more than one third of the tiling battens/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. (Fig. 5)

**Figure 5: Batten Continuous Unbound by Bracing**

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

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 design drawings. All steel bracing, if specified, shall be laid in opposing pairs. The design of the steel brace shall be fixed to each truss and supports as shown in Fig. 6.

The angle from the bracing member to trusses shall be between 30° and 45°. Bracing bays shall extend from the end trusses of the roof, unless otherwise specified.

**Figure 6: Fixing Details of Steel Brace**
10.1 Tie Batten

All steel braces shall have at least a minimum yield stress of 550 MPa, with minimum thickness of 1.0mm, together with a hot-dipped zinc coating of Z20 (200g/m²) or hot dipped zinc aluminum coating of AZ150(150g/m²) for corrosion resistance.

<table>
<thead>
<tr>
<th>Minimum component capacity</th>
<th>Steel Brace</th>
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<tbody>
<tr>
<td>Steel Tension Capacity</td>
<td>3.5-5.5kN</td>
</tr>
<tr>
<td>End Fixing Capacity</td>
<td>3.5-5.5kN</td>
</tr>
<tr>
<td>Brace to intermediate truss fixing capacity</td>
<td>0.55kN</td>
</tr>
<tr>
<td>Wrap-around splice capacity</td>
<td>3.5-5.5kN</td>
</tr>
<tr>
<td>Brace Cross-Section Thickness</td>
<td>1.0 mm</td>
</tr>
<tr>
<td>Fastener size requirements</td>
<td>10-16x16 wafer or hex tek self drilling screw</td>
</tr>
</tbody>
</table>

Note: For roofs that require a higher bracing design load than the stipulated capacity above are to be designed accordingly by Truss Designer.

The steel brace shall be manufactured from structural grade steel and when installed, shall be such that the sag does not exceed the following:-

\[
\text{Sag} < \frac{\text{Distance between support point}}{500}
\]

Where roof trusses are built-up with saddle back, or cap trusses (Fig. 8), the horizontal top chords of lower trusses shall also be braced according to the design requirements as stated in the design drawings. Unless otherwise provided, all steel battens shall be fastened with 2 nos. of 10-16x16 fasteners as a minimum.

![Figure 7: Typical Main and Capping Truss](image_url)

Figure 7: Typical Main and Capping Truss

In addition to the battens, 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 the tie battens as the case may be and anchored to the wall plates. For suggested roof bracing layout, refer to Fig. 10, Fig. 11 and Fig 12.
10.2 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.

Braced to cross at mid-length to match

Bend Brace Over Chord And Fix To Chord. Typical Both Ends of Brace.
Two Fasteners To Each Web Intersection
Web Ties As Specified Fixed To Each Truss Web Even Spacing With Two Fasteners.

Figure 8: Typical Web Ties Bracing and Fixing Details

Where web bracing is provided, the web steel ties shall be fixed to the web of each truss at even spacing of the web with two 10-16x16mm 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. (Fig 9)

~ 30° on Plan

Ridge 10.0m MAX
Mid splicing of batten/purlin in these areas as far as possible

Figure 9: Suggested Roof Bracing
10.3 Top Chord Bracing

Steel brace for truss members shall only be spliced at positions, so specified by the truss designer.

Short Roof (roof length less or equal to 2X span of truss)

Medium to Long Roof (roof length equal or greater than 2X span of truss)

Notes: I. Angle between bracing and trusses viewed on plan, should be about 30°
II. Avoid splicing of battens/purlins in area not bounded by bracing as far as possible
Figure 10: Suggested Roof Bracing Layout

Notes:

I. Angle between bracing and trusses, viewed on-plan, should be about 30°.
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.

10.4 Multiple Trusses

Where multiple truss (i.e. 2 or more trusses acting together) is specified to support heavy loads 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 truss must act together to support the common load. Multiple truss elements must be fastened or bolted together in the specified manner prior to installation / loading.
11. Exposure of Roof Trusses

All roof trusses must be covered within two weeks from completion of installation. Where trusses are exposed for prolonged periods to the elements; corrosion may occur. In situation where the Installer is unable to comply with the above requirements, the Installer 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 / tiles. All temporary coverings shall be well maintained and adequately ventilated at all times.

Where trusses are stored on site, (Fig. 13), they should be blocked above the firm ground to protect them from ground water as follows:

a. If the trusses are stored horizontally, the blocks should be at 2.0m to 2.5m centres or as required at joints, to prevent bending of the trusses.
b. 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.

![Trusses Rafters Stacked Horizontally](image1) ![Trusses Rafters Stacked Vertically Before](image2)

Figure 11: Storage of Trusses at Site

11.1 Alteration to Trusses

No element of the prefabricated steel 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 system provider.

Where defects exceeding the limits or permitted tolerances are detected, rectification works shall be carried out based on the recommendations made by the independent Professional Engineer and on the approval of the Superintending Officer.

12. Quality Assurance and Control

The Installer shall submit to the Main Contractor who shall then submit to the Superintending Officer a program on Quality Assurance on the roof truss fabrication, handling, storage, transportation and installation. The program shall indicate the nature, frequency and the schedule of all compliance and verification tests to be carried out by the Installer on the Fabricator’s Work Methodology and Quality Assurance. The Installer/ System Provider shall notify the Superintending Officer of the dates of the actual tests and the Superintending Officer may exercise his sole discretion as to whether to witness such tests or otherwise. In any event, the Installer/System Provider shall be fully responsible to carry out such tests and to forward a copy of such test results together with its status jointly certified by the System Provider for the Superintending Officer’s acceptance and approval.
13. Design, Fabrication, Supply and Installation Guarantee

All prefabricated components shall be manufactured only by System Provider producing quality assured products and services to the approval of the Superintending Officer the design, supply, delivery and erection of the trusses shall be in accordance with System Provider specifications.

Prior to the fabrication of the roof truss system, the Installer shall submit to Main Contractor who shall forward to the Superintending Officer copies of the drawings, certified by an independent Professional Engineer as required to be used in the construction and installation of the roof truss system.

As soon as practicable after the completion of the installation of the roof truss system and prior to the issuance of the Certificate of Practical Completion, the Installer shall submit the following documents to the Main contractor who shall submit to the Superintending Officer for information and record:

a. System Provider’s Guarantee against any defects or damages which may arise during a period of ten (10) years (terms and condition applied) 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 Installer may reasonably contemplate but shall not include normal replacement and maintenance. The terms of the Guarantee shall be such as shall be approved by the Superintending Officer.

b. 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 an independent lab accredited by SIRIM.

c. 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 summary for the steel used in the truss system.

d. As built drawings of the roof truss system signed by the System Provider and certified by an independent Professional Engineer.

e. A copy of the System Provider’s current ISO 9001-2000 accreditation certificate issued by an approved and licensed Malaysian body (if available).
14. **Roof Tiles Placement**

Where concrete roof tiles are used as roof covering material, the tiles shall not be stacked higher than 5 tiles at 600mm center to center.

Loaded concrete roof tile pallets shall not be placed on top of finished roof battens and trusses during installation of concrete roof tiles.
<table>
<thead>
<tr>
<th>Fabrication Methods</th>
<th>Photo 1.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Creating a truss template. This template will form the basis of similar trusses in the project. This method will ensure that subsequent trusses will have the same configuration and slope.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Photo 2.</th>
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<tbody>
<tr>
<td></td>
<td>Subsequent trusses are being fabricated over the truss template. Here the installers are arranging the members before fastening them together.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Photo 3.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use inverted stools to align truss members.</td>
</tr>
</tbody>
</table>
Photo 4.
Use a drill gun to fasten the screws at the bottom chord and web members.

Photo 5.
Screws are being fastened at the apex joint.

Photo 6.
Close up of drill gun being used to fasten the web and the bottom chord members.
Photo 7.
For added stiffening members may require boxed up

Photo 8.
Continuing assembly of trusses by stacking over previously assembled trusses to follow the template outline.

Photo 9.
After completing the installation of trusses, the trusses are then moved from the template stack and then to the storing area. These trusses are ready to be installed onto roof beams or transported.
<table>
<thead>
<tr>
<th>Photo 10.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary disk cutter for cutting members and removing flanges.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Photo 11.</th>
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<tbody>
<tr>
<td>Drill gun with a torque limiter control to prevent over tightening of fasteners.</td>
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</table>

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<tr>
<th>Photo 12.</th>
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<tbody>
<tr>
<td>Hand shearer for cutting small areas.</td>
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</tbody>
</table>
Photo 13.

Roof trusses load on to a trailer for delivery.

Photo 14.

Unloading trusses on to the worksite. At least two points of attachment are recommended for lifting of the trusses bundle.

Photo 15.

Trusses bundle is being lifted to the top of the roof beam for installation.
Photo 16.
Trusses are being temporary propped to allow installers to fix the trusses supports into place.

Photo 17.
Trusses are being installed at the gable end first and worked towards to the other gable end.
Acknowledgement

The committee which developed this Construction Industry Standard (CIS) consists of the following representatives:

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