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DEPARTMENT OF BUILDING

FACULTY ARCHITECTURAL, PLANNING AND SURVEYING

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It is recommended that this practical report provided

By

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Entitled

FABRICATION PROCESS OF STEEL TRUSSES FOR MATRADE EXHIBITION CENTRE

Accepted in partial fulfilment of the requirements for obtaining a Diploma in Building.

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DEPARTMENT OF BUILDING

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(PERAK)

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STUDENT DECLARATION

I declare that this practical report is the result of my own research except as express through practical training that I went through for four month from 12 May 2014 to 29 September 2014 at PRESERVER BINA SDN BHD. It is also as one of the requirement to pass the course DBN307 and it submitted in partial fulfilment for obtaining Diploma in Building.

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Date : 30 September 2014

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and also to my sisters for their endless love, prayers and encouragement. Also not forgetting my visiting lecturer,

for his support and time. To those who indirectly contributed in this report, your kindness means a lot to me.

Thank you.

ABSTRACT

In engineering, a truss is a structure comprising five or more triangular units constructed with straight members whose ends are connected at joints referred to as nodes. External forces and reactions to those forces are considered to act only at the nodes and result in forces in the members which are either tensile or compressive forces. Moments (torques) are explicitly excluded because, and only because, all the joints in a truss are treated as revolute. (Wikipedia)

A study of the fabrication process of steel truss, with main focus on Matrade Exhibition Centre Project, which is the design and build is one (1) block of three (3) stories Matrade Exhibition Center with 1 ½ level of basement. This led to further project of problem arise and identify the solutions during fabrication works.

Structural steel fabrication can be carried out either at the company's workshop or at the construction site itself. Fabrication of steelwork carried out in workshops is precise and of assured quality due to fabricated in controlled environment, whereas fabrication at the construction site is comparatively of inferior in quality due to fabricated in open air. Structural steel undergoes through various process during the course of its fabrication. Depending on the type of fabrication require, the sequence and importance of the fabrication work will vary. All these processes are explained briefly in the Chapter 3.

The goal of this report is to learn the sequence step by step the processes involved in fabrication of steel trusses. During fabrication works, the steel are divided into a few procedure. The observation from this process find that the problem arise from the very first step. Hence, there are several recommendations can apply to wage the flow of fabrication process.

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LIST OF ABBREVIATIONS

SMAW	Shielded Metal Arc Welding
FCAW	Flux Core arc Welding
CIDB	Construction Industry Development Board
MAA	Malaysia Architects Association
MRO	Maintenance Repairing and Overhaul
DSSB	Defense Services Sdn. Bhd.
CNC Profile	Computer Numerical Control Profile Cutting
ASTM	American Society for Testing and Material
AWS D1.1	Structural Welding Code steel
BS-EN ISO	British Standard European Normal International Standards Organizations
SSPC	Society for Protective Coatings

CHAPTER 1

PREFACE

1.1 Introduction

Steel trusses are commonly used in commercial construction. They are pre-manufactured to order and are made in an open web design. They are essentially axially loaded members which are more efficient in resisting external loads since the cross section is nearly uniformly stressed. They are extensively used, especially to span large gaps. Trusses are used in roofs of single storey industrial buildings, long span floors and roofs of multi-storey buildings, to resist gravity loads. (Structural Analysis and Design of an Industrial Building, 2008)

Usually the steel trusses is a part of Industrialized Building System or simply known as IBS. In this report, the main point of which is be selected is the fabrication process of steel trusses for Matrade Exhibition Centre. In addition, it will show more detail about the joint or welding of the steel during the fabrication works. The details of the connection will be seen in Tekla software that is can create a detailed, constructible 3D model of any steel structure. (http://www.tekla.com/us/company/news/risa-technologies-and-tekla-partner-offer-steel-connection-design-tekla-structures)

In preparing for this report, there are three types of methodology, which is an observation works, references and interview session to complete this report. Other than that, this report also tell about the problem that had during the fabrication works is running and how to solve the problem to avoid from the delay.

1.2 Objective

- To study the welding joint in fabrication process of steel trusses for Matrade Exhibition Centre at Preserver Bina Sdn. Bhd. factory.
- To identify the problem and solution during the fabrication works.

1.3 Scope of Study

Scope in this project is divided into a few main component. This report practically a review on fabrication process of steel trusses. It will show from the starting process until the materials is ready to be delivered to the site. The highlight for this process is about welding's type that will be used to fabricate the steel trusses. Finally, about the problems arise and ways to overcome the problems will be covered entirely in this report.

1.4 Method of Study

1.4.1 Observation

First and foremost, observation is needed to ensure all the details work are run properly. Observation at factory must be done and the photograph must be taken as a proof in case they have a problem on the site. This method will give better understanding which can't be obtain through reading materials solely.

1.4.2 References

Many references that be used to complete this report such as reference from shop drawing from the factory and internet. Reference from shop drawing is most important because it will lead the process starting from the cutting raw material until it finish (Appendix A). Besides, some of the references does not give enough information which I must browse the internet to get more information. Therefore, references is important to ensure this report is complete and accurate.

1.4.3 Interview sessions.

Interview was carried out in verbal to gain accurate information. Through the interview, it will give me the specific information about the process of fabrication steel trusses. This interview sessions has involved many important individual at the factory such as site supervisor, engineer, and workers.

CHAPTER 2

COMPANY BACKGROUND

2.1 Introduction

Preserver Bina Sdn. Bhd. (610805-M) was incorporated in April 2003 as a general contractor with a steel fabrication factory. Its long list of services includes the construction of Factories and Warehouses, Power Generation, Petrochemical and Oleo Chemical Plants, Heavy Equipment Installations, Bridges and Infrastructural, Architectural Steel Structures, Commercial Buildings and High Rise Buildings, High-end Show Units, Bungalows and Residential Buildings. It's registered as a Grade 7 Contractor with the Construction Industry Development Board Malaysia (CIDB) and within a decade, this company has secured the prestigious ISO 9001:2009 Award. Preserver Bina assures the best performance to deliver results as promised and work towards win-win deals.

Preserver Bina Sdn. Bhd. is located at Lot 8292, No.2, Tingkat 1, Jalan Istimewa, Kg Batu Belah, 41150 Klang, Selangor Darul Ehsan. This company also have their own Steel Fabrication factory which is located at No.22A, Jalan Tiara 5, Bandar Baru Klang, 41150, Klang, Selangor Darul Ehsan. This company is headed by a Chairman of Preserver Bina Sdn Bhd, Mr. Khoo Aun and three members of the Board of Directors which are Mr Wong Kok Meng, Mr Soon Kian Eng and Mr Khoo Beng Seong.

In 17th April 2009, Preserver Bina Sdn. Bhd. had established a new subsidiary to facilitate their work of the construction as known as Alubina Sdn. Bhd. Alubina's range of aluminium & glazing works. Their services include fabricate and install of Aluminium and backed by very experienced technicians and professional knowledge to ensure high quality products to fulfil client needs.

2.2 Company Mission and Vision

Preserver Bina Sdn. Bhd. dedication is to constantly improve in all aspects of operations more than just a daily lived philosophy. It's what keeps Preserver Bina Sdn. Bhd. ahead. This company goes the extra mile, design and delivers what clients expect, and a great multi-talented team with ultimate potentials backs it. Together this company will drive to take on the most challenging of projects and keep getting better and stay ahead.

2.3 Company Awards

The Awards and accolades Preserver Bina Sdn. Bhd. has won over the years to prove their capabilities. Among the significant, which are two awards from the Malaysia Architects Association (MAA) – Excellence in Architecture – Winning Showroom Building PAM 2007 for the Ameera Residences Sales GalleryOthers award their achieve are achieved 3,000,000 and 2,000,000 Man Hours Without A Lost Time Incident in its Coal Fired Power Plant from TAISEI CORPORATION (in 30th September 2007 and 21st February 2008 respectively) and achieved 2,500,000 Man Hours Without Lost Time Accident Safety Performance For the Superstructure Works – 3A University Technology Petronas, Tronoh, Perak. Recognition by NAMFATT-ZAQ JV (31st March 2004). Preserver Bina Sdn Bhd also won numerous Recognition for Architectural excellence, outstanding reliability and superior performance from numerous other leading developers.

2.4 Organizational Chart

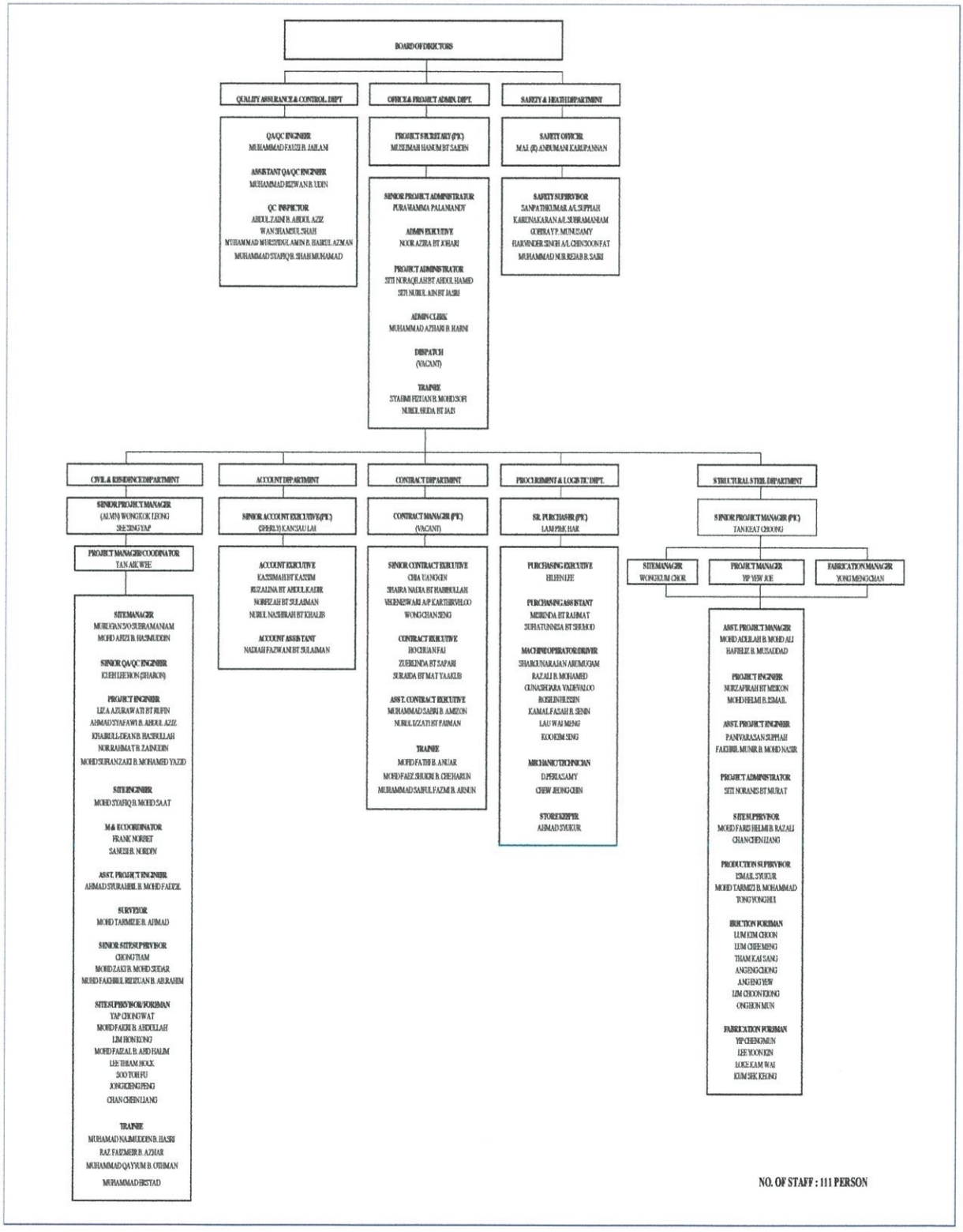


Figure 2.1: Company Organizational Chart

Source: Preserver Bina Sdn. Bhd. (2014)

2.5 List of Completed Projects

Table 2.1 List of Completed Projects

No.	Project	Client/ Architect/ Consultant	Contract Value	Completion Date
1.	**Pentamaster Perlis Northern Corridor Factory** Proposed Single Storey Factory on Plot 1, Taman Teknologi Pauh, Kurong Anai District, Perlis.	**Gemilang Land Development Sdn. Bhd.** **Perlis SEDC Northern Corridor** **B L Tay Architect**	RM 22.60 Million	June 2011
2.	***Binaraya Builder HQ & Factory Klang*** Proposed Development of 2 Units of Warehouse with a Iron Framework Structure for a single storey & Double storey Rubbish Chamber & Guard House in Klang Selangor.	***Binaraya Builder Sdn. Bhd.*** **Perunding Rekamaju**	RM 10.00 Million	Feb 2011
3.	**Ann Joo Warehouse-PKFZ 2** Proposed Development of Single Storey Warehouse with Office & Dining Room & Electric Substation at Jln PKFZ Pulau Indah, Selangor.	**Ann Joo Metal Sdn. Bhd.** **Ascend Engineers Consulting**	RM 4.20 Million	Jan 2011

No.	Project	Client/ Architect/ Consultant	Contract Value	Completion Date
4.	**ALH HQ & Factory Shah Alam** Proposed 3 & 4 Storey Office with 1 Storey Factory at Jln Batu 3, Bukit Cerakah, Shah Alam, Selangor.	**ALH Corporation Sdn. Bhd.**	RM 3.80 Million	Dec 2010
5.	**Matomek Precision Die-Seri Kembangan** Proposed Renovation of A Single Storey Factory With An Existing 3-Storey Office at Seri Kembangan Industrial Area.	**Matomek Precisiom Die Sdn. Bhd.**	RM 0.80 Million	Nov 2010
6.	**French School Renovation Segambut** Proposed French School Renovation Works on Lot 1959, Jln 1/38B, Off jln Segambut, Kuala Lumpur.	**LFKL Berhad** **YHSA Sdn. Bhd.**	RM 0.60 Million	Oct 2010

Source Preserver Bina Sdn. Bhd. (2013)

CHAPTER 3

FABRICATION PROCESS OF STEEL TRUSSES FOR MATRADE EXHIBITION CENTRE

3.1 Introduction

A truss is essentially a triangulated system of straight interconnected structural elements. The most common use of trusses is in buildings, where it support to roofs, the floors and internal loading such as services and suspended ceilings, are readily provided. The main reasons for using steel trusses are long span, lightweight, controlled deflection and opportunity to support considerable loads. (http://www.steelconstruction.info/Trusses)

The steel trusses is a part of Industrialized Building System because can be defined as construction systems in which components are manufactured in a factory, on or off site, positioned and assembled into a structure with minimal additional site works (IBS Survey, 2003). Furthermore, the word 'prefabrication' also frequent used while define Industrialized Building System which carried the means "the manufacture of component parts of a building and its services prior to their assembly on site" (Wilson, Smith and Deal, 1998).

Furthermore, by using steel trusses over other material, there is no problem such an insect infestation and no chemical treatments are necessary to maintain the trusses. For example, wood when used as trusses in construction will offers several problems, including termites. Steel trusses also can span longer than timber and can be manufactured to exact standards. Moreover, they are also lighter, thus allowing larger shipments and reducing the time it takes to get to the project. Steel also one of non-flammable material and compatible with nearly any type of roofing system. Another advantage is, steel can be easily recycled, making it greener and environmentally friendly.

There are many type of roof shapes such as pitched, curved and mansard. The different types are suitable for different concepts and when choosing a shape factors like aesthetics, span length, required volume and height must be considered. The curved shape is another common roof type. The curvature of the rafter results in a redirection of the transverse load, meaning that the load will be carried via axial force instead of bending. Hence the member will only be subjected to compression which makes the curved roof very material efficient. The compression forces will increase around the supports and the rafters can be optimized for this by changing the sections of the members along the span (SCI, 2008).

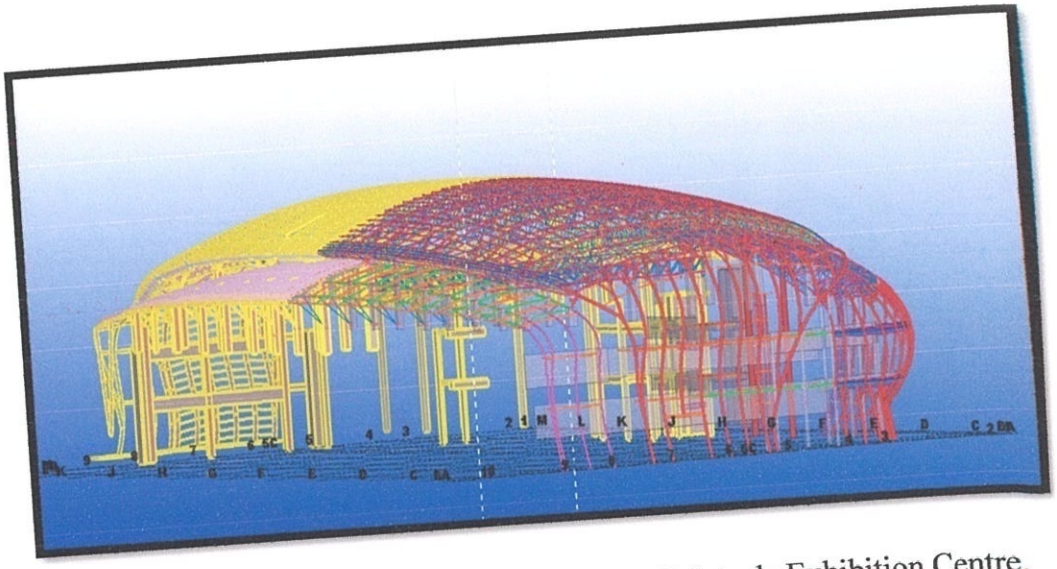


Figure 3.1 The curved shape for roof trusses of Matrade Exhibition Centre.

For this Matrade's project, it will consists of 16 of main trusses. The main trusses is then divided into two zone which is called as zone A and zone B. Each of this trusses will be separated according to segment. For each steel that being used will having different weight due to having different dimension. Besides that, it will ease and help in fabrication works and installation at the site. This segments will be separated according to its total weight, to facilitate the lifting process by cranes which has different load lifting capacity and (the cranes) being placed at specific spot at the site. This segments is fabricated by weld using Flux Core Arc Welding (FCAW) method. FCAW process is being done by weld will require a special wire which is Flux Cored Arc Welding Wire to fed the weld spot.

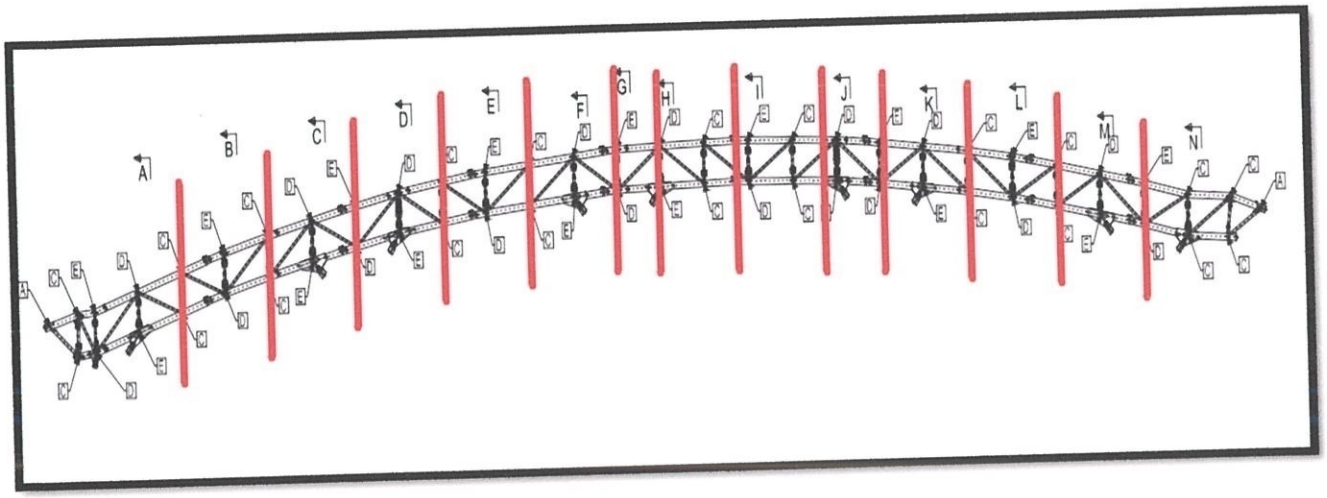


Figure 3.2 Example Main Trusses 13 divide by segment. (Refer to Appendices A)

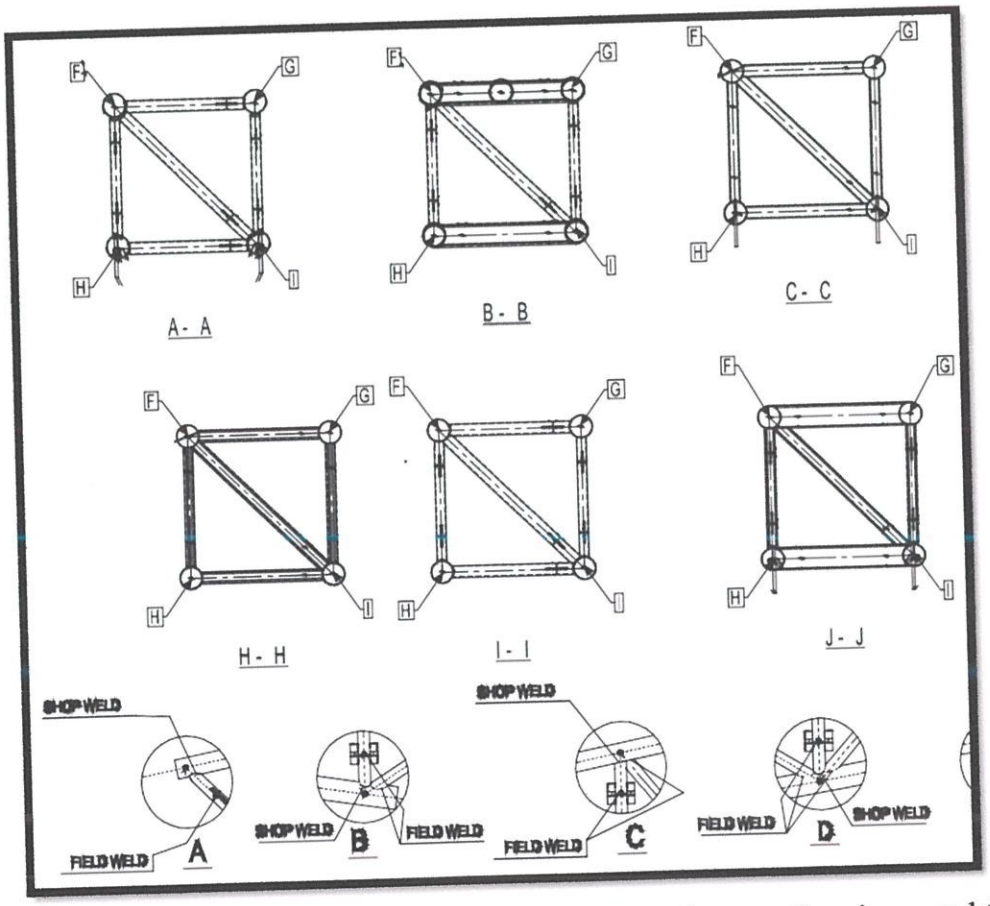


Figure 3.3 Example for Main Trusses 13-3 that have been cut by pieces and the pattern for joint.

3.2 Background of Project

Project title is to "Proposed Design & Build the One Block of 3 Storey Matrade Exhibition Centre with 1 1/2 Storey Basement" is located at Lot 50978, Jalan Dutamas 2, Mukim Batu, Wilayah Persekutuan Kuala Lumpur. The client for Matrade Exhibition Centre Project is Ministry of International Trade and Industry. Total cost for this project is RM26 million and is estimated to be complete on January 2015.

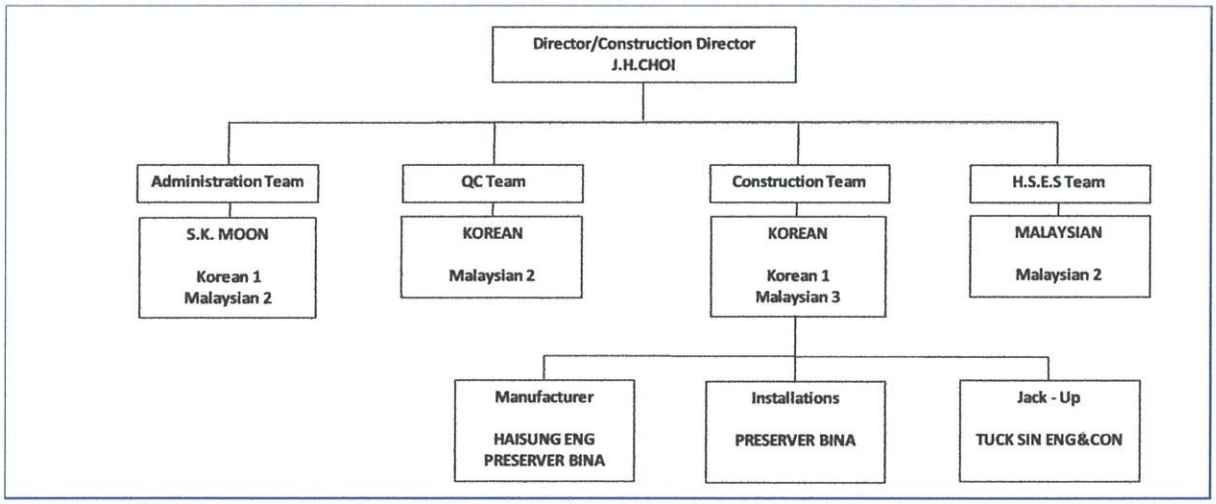


Figure 3.4 Site Organization Chart for Matrade Exhibition Centre.

Source: Preserver Bina Sdn. Bhd. (2014)

Above is organization chart for project Matrade. The main contractor is from company of Haisung which is based in Korea. Preserver Bina Sdn. Bhd. is as sub-contractor of fabrication works and erection for steel. Each shop drawing made by the consultant will be review and check by the main-contractor for approval before being handed to sub-contractor which is Preserver Bina Sdn. Bhd.

Preserver Bina Sdn. Bhd. structural steel project team is responsible for providing the client and owner services date and reports necessary to complete the work within the establish cost budget and scheduled completion date. In particular, Preserver Bina Sdn. Bhd. realized the importance to schedule every project step, will develop in the early stages of the project a schedule to cover procurement for critical or

priority items or activities and within short period from contract award provide a detail schedule for procurement and steel work.

Preserver Bina Sdn. Bhd. will make the fabrication works of steel trusses from step 1 which is from the receiving of raw material till the delivery works at the Matrade's site. This steel trusses will be fabricate by welding. Before the welding is started, each pipe steel will be combined one by one leaving only a small gap between each other. This is to give space for the welding works. Each combined gap will following standard spec which has been set by Structural Welding Code Steel (AWS D1.1). If the specification is not followed, it will compromises the steel trusses in term of its strength and will be dangerous if being installed in building.

This fabricating works is being run by 15 worker which is competent in completing one segment of steel trusses. During the combination process between steel pipes, two persons will be in charged to give order for making an accurate installation works of the steel pipes. It is require 3 days of work solely to complete one segment.

Photo 3.1 One segment which is complete being combined and waiting for welding works.

3.3 Case Study Fabrication Process of steel Trusses

3.3.1 Loading and unloading of steel material.

The quality of materials used should followed the client's specifications and the drawings. The steel must be free from loose mill scale, surface defects, flaky rust, slag inclusions, laminations, pitting and be of full weight or thickness within tolerances specified in standard. For this reason, only steel from Approved Steel Suppliers will be used for this project. As a normal practice mill certificates will be made available for steel ordered. An approval from the Owner/Engineer is needed for any substitution (if required) on sizes or quality.

All steel procured will be store in a safe condition with proper handling during storage to ensure that no damage will occurred to the steel, to prevent the steel from unserviceable and can't be used for fabrication work. All steel material will be stored in the factory at the **'STORAGE AREA 1'** and **'STORAGE AREA 2'** above the ground on the platforms, skids or concrete blocks.

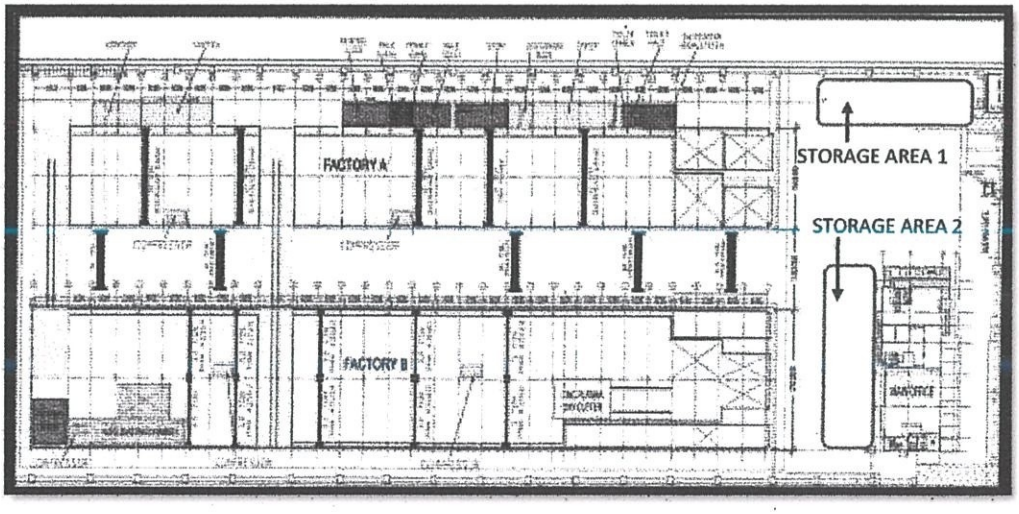


Figure 3.5: Main factory layout.

Materials for this project will be marked for isolating it from the other project's material. And systematic identifying and marking system is used for this process. All steel material procured shall be properly documented to ensure its conformity to the specifications and it will be the responsibility of the control foreman or staff. This step must be done because the raw material is directly purchased from the suppliers, as mistake can in delivery process can happened from the supplier's side. As the company has capability of mass production, different suppliers will supply the raw material needed for the fabrication process, so delay can be prevented in case of raw material run out.

Photo 3.2 Material lay down in the factory.

3.3.2 Material identification and traceability.

After receiving the raw material at warehouse, the raw material shall be verified and the inspection report on the raw material shall be forwarded to quality acceptance. Project engineer will inspect the raw material and verify the heat number correlation and material specification. Mostly the raw material is supplied by suppliers and it's according to standards, but if some wrong material or the material does not meet the company requirements is found, it will be informed to supplier and sent back. On acceptance, quality staff will give a Material Code number for punching as part of the Identification and Traceability Procedure.

Photo 3.3 Material inspection by the engineer.

3.3.3 Marking.

Marking is essential process and shall be carried before cutting the raw material. The first and main stage of the fabrication process for the workers who do the marking job are well experienced. The fabrication foreman shall approved the marking made and followed subsequently by verification from the fabrication engineer prior to cutting process. Before marking process can be done, the material is checked for its identification to avoid wrong material being used. All dimension shall be carefully and accurately marked in accordance to the shop drawings or templates.

Photo 3.4 Marking process must be done to prevent from wrong cutting of the raw material.

3.3.4 Cutting.

The cutting process is carried after an accurate marking has been made. The cutting can be carried out either by shear, plasma, CNC Profile Cutting and drilling machine, pug cutting machine. The edges on the material from the cutting process should be perfectly straight and uniform throughout. The edges shall be visually examined for any laminations and inclusions. All corners shall be file or grind so it will be notch free and sheared or cropped edges shall be dressed so that they are free from distortion and burrs. Edge preparations for field welding shall be done in the shop.

In this method of Cutting by Computer Numerical Control Profile Cutting (CNC) Machine, the steel to be cut is heated locally by flame produced from pressurized mixture of oxygen and a combustible gas such as propane or acetylene, which passes through a ring of small holes in a cutting nozzle. The heat of the flame is focused on to a very narrow band and the steel melts at 1500^0 C when a jet of high-pressure oxygen is released through a separate hole in the center of the nozzle to blast away the molten metal in globules. The desired cuts are obtained quickly by using this process. However due to a rapid thermal cycle of heating and cooling, residual stresses and distortion are introduced and hence structural sections that are fabricated using flame cutting are treated specially in the design of structural steelwork.

Photo 3.5 Cutting by Computer Numerical Control Profile Cutting (CNC) Machine.

3.3.5 Straightening.

During transportation and handling operations of the raw materials, it may bend or may even undergo distortion and deformation. Therefore before attempting for further fabrication, the material should be straightened before it can be used. To perform straightening, we could use either rolls or gag presses on the materials for shaping it back to serviceable state. All of the steel material should be straight and free from bends or twists if the sections are distorted or twisted during transit, storage etc.

Photo 3.6 A steel free from bending and twist being placed on the jigs.

3.3.6 Assembly.

Structures such as steel trusses are particularly important, and it is necessary to be temporarily assembled before being fabricated to its final shape. This has to be done to ensure the overall dimensions of the structure including alignment, squareness, camber etc. should be confirmed to the drawing.

The steel trusses will be assembled on jigs or on suitable surfaces plates with proper layouts. The section shall be brought into correct alignment before it can be joint by groove weld to avoid mistake. The members to be welded should be held in the correct and firm position either using bolts, clamps or wedges whichever practicable. Any wedges used to space the root gaps will be removed immediately after tack welding and before making the root run.

The fabricated trusses should be assembled in such manner where they free from any external force such as bending and twist. In order to minimize the distortion in the trusses, it should be positioned by using clamps, clips, jigs and other suitable manner and fasteners shall be place in a balanced pattern.

Steel trusses will undergo trial assembled as per approved assembly drawing (section by section), keeping in view the actual site conditions prior to dispatch to site for erection, so that, they can be conveniently preassembled before erection. Necessary match marks should be made on these components before disassembly process in the shop and dispatching can be made.

Photo 3.7 Preassembled steel trusses.

Photo 3.8 Assembly area for the steel trusses.

3.3.7 Welding.

Performance qualification test should be made on the overall welding procedure and welding operator to ensure it is following the safety standards, which is the American Society for Testing and Material (ASTM) standards.

a) Edge Preparation Inspection

The edges or surfaces of the parts to be joined by welding shall be uniform, smooth and free from any defect and foreign particles such as moisture, slag, oil, grease, paint, scale or rust. Edge preparation should be verified for proper groove angle and root face dimensions prior to welding. Welding groove dimensions shall be inspected as per shop drawing under tack-welded condition before it can be weld. The allowable tolerance of misalignment of adjoining plates to be butt-welded should be in accordance with Structural Welding Code Steel (AWS D1.1) or British Standard European Normal International Standards organizations (BS-EN ISO).

b) Fit-up Assembly

The sections or plates to be welded are fit-up, aligned and retained in position for the whole welding operations. The location of integral parts/members to be assembled shall be checked dimensionally prior to full welding. Tack welds is used for secure the alignment of the parts/members. Generally, the tack welds should be subjected to the same quality requirement as the final welds unless otherwise specified. If the tack welds containing any cracks, it will be removed thoroughly and replaced with sound tack welds. Size and location of tack welds performed is based on specification of the drawings.

Photo 3.9 Fit-up process.

c) Backing Strip Inspection

Back-stripped surfaces should be visually checked for the root gap prior to start of the welding process.

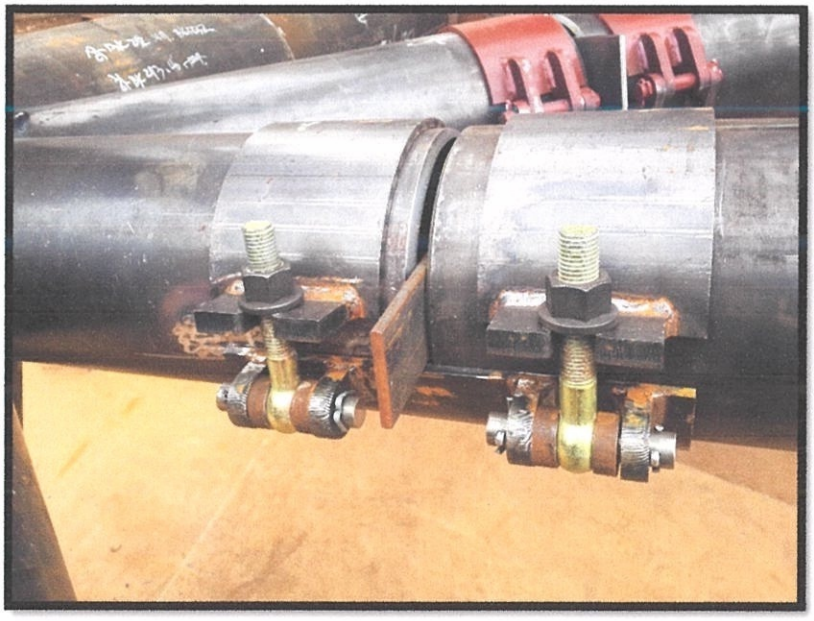


Photo 3.10 A visual of root gap prior to welding process.

d) Welding Process

The following practices shall be used before the welding can be made. Run-on and run-off plates will be welded at the ends of weld lines of crucial butt welds. The surface to be welded and its filler material to be used should be checked to ensure the quality weld made. Prior to welding root opening, groove angle and the crucial dimensions should be checked and groove face shall be free from foreign particle such as oil, water and dirt.

The weld current should be selected to the most appropriate welding condition (current & voltage) and shall be maintained with ammeter and voltmeter throughout welding work. To ensure the quality of the weld, all of welding work has to be carried out in an approved environment and if necessary, additional protection may be required. All joints are left to be dry before any welding work is done in damp climatic condition.

Photo 3.11 Flux Core Machine for welding works.

During welding work, the most appropriate arc length, angle and welding speed must be maintained at constant parameter, so that welding defects could be avoided and arc energy requirements are satisfied. Fillet weld terminating at the end of members should returned continuously around the corner for a distance of not less than twice of the size of the weld.

Photo 3.12 One of opening which has been welds.

Surfaces of butt joints required to be flush and must be performed without reducing the thickness of the inner base metal or weld metal than 1mm or 5% of the thickness whichever is the smaller and not leave reinforcement that exceed 1mm. All reinforcement have to blend smoothly into the plate surfaces with transition areas free from undercut defect. Chipping and gouging shall be used, provided grinding will follows them.

In the case of multi-layer welding, slags and spatters on each completed bead must be removed prior to the start of welding before the next following weld layer can be made. This is to ensure the strength of the weld being made. All slag and craters must be filled to the full cross section of the welds for this process.

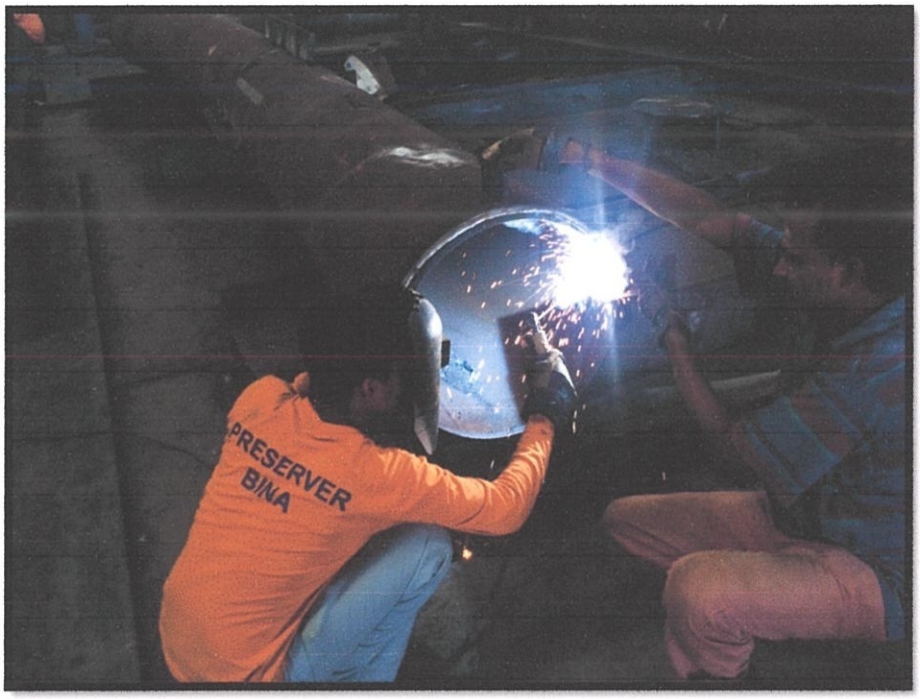


Photo 3.13 Welding process made by the workers.

e) Type of Welding Process

All welding works should be carried out as per the approved welding procedure specification. There are many type of welding process used in fabrication works which has its own advantage such as Shielded Metal Arc Welding Process (SMAW), Submerged-Arc Welding (SAW), Metal-Active Gas welding (MAG) and Flux Core Arc Welding Process (FCAW).

For fabrication works at our factory, we has opted to do it by using Flux Core Arc Welding Process using Flux Cored Arc Welding Wire. This wire is specific wire that being used as this wire is suitable and following the criteria set by the consultant. Flux-cored arc welding (FCAW or FCA) can be done by semi-automatic or automatic arc welding process.

FCAW requires a continuously-fed of consumable tubular electrode containing a flux and a constant-voltage or, less commonly, a constant-current welding power supply. An externally supplied shielding gas is sometimes can be used to protect the weld, but often the flux itself is relied upon to generate the necessary protection from the atmosphere, producing both gaseous protection and liquid slag protecting the weld being made. The process is widely used in construction because of its ease of process, high welding speed and has a good portability.

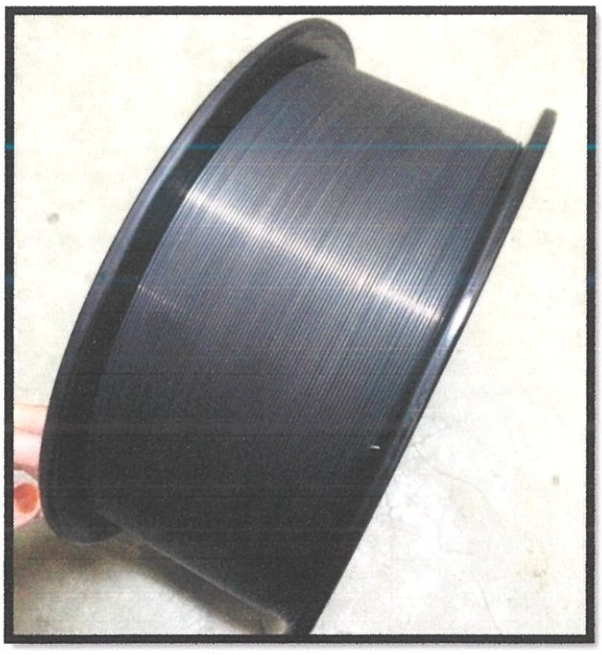


Photo 3.14 Flux Cored Arc Welding Wire.

Photo 3.15 A label and description on Flux Cored Arc Welding Wire.

f) Sequence of Welding (Control of Distortion and Shrinkage)

The sequence of welding shall be followed to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed in the weld part. When assembling and joining parts of a structure and welding reinforcing parts to members, the procedure and sequence of welding will minimize the distortion and keep the shrinkage under controlled state.

In so far as practicable, all welds shall be deposited in symmetrical sequence so that shrinkage on both sides of the structure will be in equal manner. Joints which expected to have significant shrinkage shall be welded before the joints which expected to have lesser shrinkage and with as little restraint as possible.

All shop splices in each component part of a cover plate beam or built-up members shall be made before such component part is welded to other components parts of the member to overcome distortion and shrinkage defect.

All welding shall be carried out continuously to completion or to a point that will ensure the weld's freedom from cracking before the joints is allowed to cool below the minimum specified preheat and interphase temperature of the steel. Butt weld in flange plates and/or web plates must be completed before the flanges and webs are welded together.

The ends of butt welds should have full throat thickness. This must be obtained on all main butt welds by using run off and run on pieces adequately secured on either side of main plates. Additional metal remaining after the removal of extension pieces must be removed either by grinding or by gas cutting.

Photo 3.16 Grinding process to smoothen the surface and to remove excess welding material.

3.3.8 Painting Application.

Painting should be applied as per the project specification to protect the trusses from rust and finishing look. Recommended coating materials will be used for the particular surface and to suite its condition of exposure. Painting shall be carried out with skilled and experienced workers. All coating materials must be applied evenly in a continuous full coat to ensure the process free from over-spray, dry-spray, wrinkling, sagging, curtaining, holidays, thin spot, pinholes and other film defects.

Photo 3.17 Steel trusses after paint.

3.3.9 Packing and Delivering.

The painted structures after fabrication must be protected from any damage during transportation, otherwise the structure can't be used for installation at the site. The structures will be loaded onto the trailers by using timber supports and separators and secured properly to prevent any damage occurs to the material while transportation to site. Fabricated items will be delivered loose to avoid stress in the item and deformation. Meanwhile, minor fabricated items, which are not likely to be subject to permanent deformation during handling operations (i.e. bracing etc.) may be bundled or hoped. Lastly, small items (i.e. bolts, loose, cleats etc.) will be packed in crates/drums or loaded on pallets.

Photo 3.18 Delivery process of the steel.

3.4 Problems and solutions.

A few problem arise in during fabrication works of steel trusses, this is because it's parts of the IBS system. The following list is the common problems happen:-

a) The approval process is slow.

Every shop drawing which is made by consultant must first been approved by both the consultant itself and the main contractor. In process getting the approval, it took a long period of time as an accurate calculation must be put as priority to avoid an unwanted accident from being happens.

To keep the fabrication works on track, we (Preserver Bina Sdn. Bhd.) shall always keep in contacting with the main contractor for getting know the status of drawing made by the consultant whether it has been approved yet. Failure in doing so will resulting in delay and causing the fabrication works on hold.

b) Late materials delivery made by the supplier.

For this Matrade's project, we getting the material (steels) from the Korean supplier, as this is the client's requirement itself. These raw steel is manufactured in Korea and being delivered to our factory to do the fabrication works on those steel. As it being imported from Korea, it took a long duration and time consuming to make a delivery. Even worse, sometimes the Korean supplier is late in manufacturing the raw steel that we need, and thus causing even more delay for the material to be received in our hands.

I am suggesting supplier from Korea should plan their manufacturing works of the steel and the delivery more efficiently and they should obey the time schedule that has been made. They should not change their delivery time as this can cause difficulties in our hand. As the delivery made is covering a long distances, it have to be on time and can't be behind the schedule to avoid increasing in cost and time consumed.

c) Supplier doesn't have the stock available.

Sometimes, the consultant want to use material, which the supplier don't have a stock. This causes difficulties for us to make a purchase of material from the supplier. But then, when we suggest to opt using different material, the consultant will not agree and causes the installation process of the steel trusses becomes longer in time.

For a win-win situation, the consultant should cooperate with sub-contractor to work out some practical solution (for example by finding alternative material). In this way, misunderstanding between two party is not occurs and fabrication works can be proceed with ease.

d) Incorrect installation of the steel.

As the project is still on going, fabrication works must be carried as fast as possible. There are so many segments need to be fabricated, thus a few mistake from the worker is unavoidable. The mistake is including connection made is not following the spec, wrong way of welding which causes the steel trusses is not strong enough to be use and a few other problems.

Thus, a worker who is given task to do the fabrication works must be chosen based on their skill level so problems during the fabrication can be avoid or reduce. In addition, these workers should be supervised so the fabrication works can proceed smoothly. Lastly, engineer in charge at the factory should make an inspection from time to time and maintaining their quality, before the main contractor itself came for the inspection, to keep earning their trust on this company.

3.5 Conclusion and Recommendation

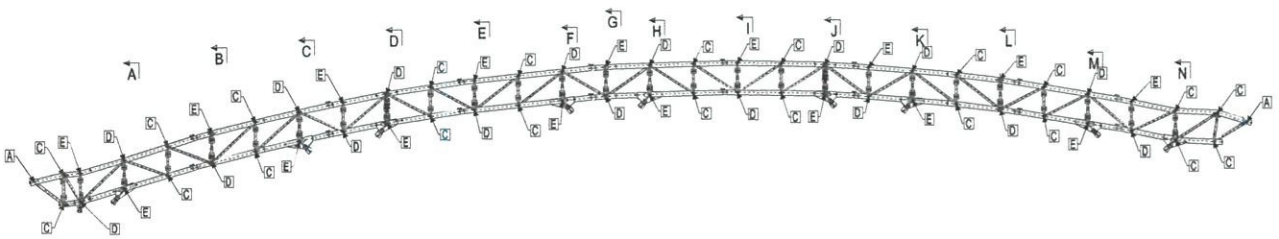
In this project report, fabrication process of steel truss is discussed in details. This report is all about the fabrication processes step by step, how steel fabrication can be carried out, identify the problem and solution during fabrication works.

Starting from loading and unloading material to the Matrade Exhibition Centre Project takes about a few weeks to be completed, so this report is about all the field of structural steel fabrication. Almost everything was learnt about fabrication process during practical training in the company named as Preserver Bina Sdn. Bhd. situated in Klang, Selangor.

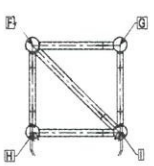
This report highlighting on how the raw material for this project in the factory till the end of factory storage, logistics and transportation till the site. Furthermore, this report also highlighting on about what the kind of problem arise, when and how is solve the problem during fabrication works are discussed in details to get the deep knowledge in the field of structural steel fabrication.

On the other side, there are few problem arise during the fabrication work is executed. These problem should be avoided because it will introduce delay in manufacturing the steel trusses. For a recommendation, a better communication can be used throughout the entire fabrication work to combat the said problems as this can reduce mistake made by the workers. Moreover, a more systematic system should be implemented for purchasing, and storing the raw material and finally shipment to increase the overall speed of this project.

APPENDIX A SHOP DRAWING FOR MAIN TRUSSES 13-3.



MTR13 MAIN TRUSS WELDING
MTR13-3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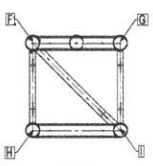
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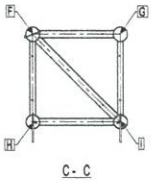
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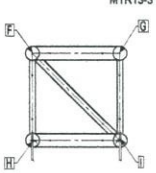
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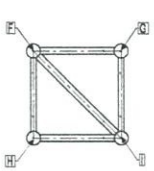
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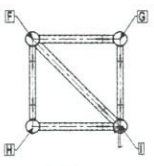
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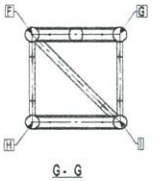
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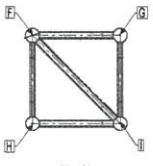
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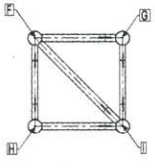
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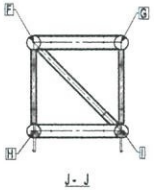
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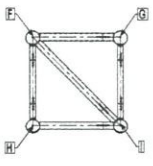
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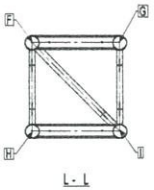
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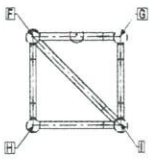
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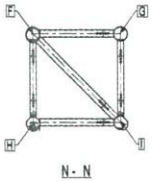
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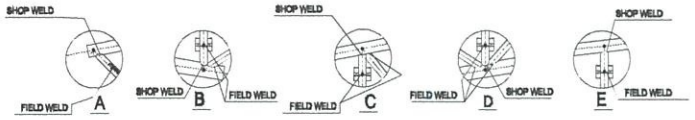

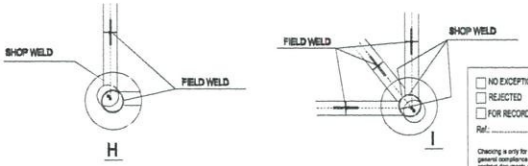

SEE WELDING STANDARD W-001,W-002

*WORK THIS DWG.WITH DWG: A-EMTR13-1,2

☐ NO EXCEPTION TAKEN	☐ MAKE CORRECTIONS NOTED
☐ REJECTED	☐ REVISED AND RESUBMIT
☐ FOR RECORD PURPOSE	☐ SUBMIT SPECIFIED ITEM

Ref.: .....

Checking is only for general conformance with the design concept of the project and general compliance with the information given in drawings and specification in the contract documents pertaining and limited to the structural works designed by T.Y.Lin INTERNATIONAL Sdn. Bhd.. Any action shown is subject to the requirements of the structural plans and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques and sequence of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

T.Y.LIN INTERNATIONAL SDN BHD

Date _____ By _____

NO.	ITEM	DATE

SHOP DWG

TAJUK CADANGAN :
CADANGAN MEREKABENTUK DAN MEMBINA 1 BLOK PUSAT PAMERAN MATRADE 3 TINGKAT (DOUBLE VOLUME) DENGAN 1½ TINGKAT BASEMEN TEMPAT LETAK KERETA DI ATAS SEBAHAGIAN LOT 50978, JALAN DUTAMAS 2, MUKIM BATU, WILAYAH PERSEKUTUAN KUALA LUMPUR.

UNTUK :
TETUAN TTDI KL METROPOLIS SDN. BHD.

PEMILIK :
MINISTRY OF INTERNATIONAL TRADE AND INDUSTRY (MITI)

PENAJU :
TTDI KL METROPOLIS SDN. BHD.

PERUNDING PROJEK :
NRY Architects Sdn. Bhd.
PM Link Pte. Ltd.

ARKITEK :
RSP Architects Sdn. Bhd.

JURUTERA STRUKTUR & AWAM :
T.Y.LIN INTERNATIONAL SDN. BHD.

JURUTERA PERUNDING MEKANIKAL & ELEKTRIKAL :
PERUNDING KOTTERI SDN. BHD.

ARKITEK LANDSKAP :
THE BIG GROUP ASIA SDN. BHD.

JURUKUR BAHAN :
J.U.R.M. SDN. BHD.

SUB KONTRAKTOR UTAMA :
HABUNG Engineering Co. Ltd.

TAJUK LUKISAN :
MTR13 MAIN TRUSS WELDING - A-EMTR13-3

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