DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

STEEL STRUCTURES

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(PERAK)

DECEMBER 2019

It is recommended that the report of this practical training provided

By

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entitled

Steel Structures

accepted in partial fulfillment of requirement has for obtaining Diploma In Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Muara Atur (M) Sdn Bhd for duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Date 13 DISEMBER 2019

ACKNOWLEDGEMENTS

First and foremost, I am expressing my thankfulness and praise to Allah for His guidance and blessings throughout my entire industrial training. I would like to sincerely thank Muara Atur (M) Sdn Bhd for giving me the wonderful opportunity to undergo internship in their organizations.

My deepest appreciation and gratitude to Engineer and also architect of Muara Atur (M) Sdn Bhd that also act as my supervisor during practical training, Mrs. Nur Syafikah Binti Zulkifli for her guidance, generosity to share their tremendous knowledge. I express my deepest thanks to Mr. Abu Rhoan Bin Abu Bakar, Construction Manager of Muara Atur (M) Sdn Bhd for giving continuous and unlimited motivation from the starting of the internship until the end of the program and Mr. Amier Aizatt Bin Samsuri, the Site Supervisor for the help to complete every task. My next gratitude will to the all of the staffs Muara Atur (M) Sdn Bhd for their willing to accept me into their family.

In this opportunity, I would like to express my appreciation to Dr. Siti Akhtar Binti Mahayuddin, Supervising Lecturer for giving such knowledge and guideline to finish this report with success. I want to thank Mr. Mohd Naim Mahyuddin, Practical training coordinator for helping arrange, giving brief and information about this practical training. My next appreciation goes to both of my parents for giving such support whether I need it, giving help on funds and always encourage me to do the best in anything.

I become cognizant of this opportunity as a first step in my career development. I will use all comprehension and skills gain, and I will continue to work on my ability and knowledge development in order to carry out career objective.

ABSTRACT

This practical training report describe about the experience gained during five months practical training period undertaken at Muara Atur (M) sdn bhd. The purposed of this report is to studied and do research about steel structures. Being assigned under Civil and Structure, main task given is to get involved in any project and helped Project Engineer with some construction work. The main finding that had been studied was the installation method of steel structures for sports centre. This report will also look at the problems isolation taken for steel structures and it will focus on the solutions of the problems related in order to complete the tasks. This report also focus on about observation was performed at the site office especially with the Site Supervisor. This observation commonly being done at the site during working hours on weekdays. All the data is being recorded by written a short notes. The steel structures are important for this project because it has been used in most of the buildings for sports centre.

CONTENTS **PAGE NO**

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1.0

INTRODUCTION

Steel is considered a "green" product in that it is entirely recyclable. In fact, a builder will be able to buy recycled steel for a new commercial building or home.

The material provides strength that is unavailable for buildings built with wood frames and brick walls. It does not warp, buckle, twist, or bend and is flexible and easy to install. Because of it is increased quality and ease of maintenance steel is an attractive building material. It resists mold and mildew, a plague that sometimes afflicts wood frame buildings. Steel is sturdy enough that it resists the damage caused by natural disasters, such as tornadoes, hurricanes, and earthquakes. Steel buildings are much more resistant to fire and termites. Because of steel's greater durability, the owner of such a building could get a better deal on insurance.

Because of steel's strength and durability compared to wood, architects have more flexibility in designing buildings and homes, creating greater spaces.

Building with steel has some drawbacks, however steel is more costly than conventional materials. How Stuff Works notes that a steel building is 14 percent more costly than an equivalent structure constructed with more conventional materials. To make a steel building truly energy efficient requires additional insulation because of the material conducts heat and cold more than conventional materials. If a steel building is not designed well, it may be prone to corrosion.

The trick to building with steel is to find a contractor who is experienced in using the material, as well as plumbers and electricians willing to work on a steel building. But

building with steel is a worthwhile investment if one is willing to spend the money up front.

There are many types of steel structure, the first one is Z-shape, L-shape (angle), Structural Channel (C-beam, Cross Section), Rail Profile and Open Joist of Web Steel. However, the aim of this is to discover the construction of I-beam steel structure at a conjected area in Malaysia.

1.1 Background and Scope of study

This study was carried out at Muara Atur (M) Sdn Bhd which is located at Taman Impian Emas, Johor. The study aims to the installation method of steel structure for sport centre. This study will be specified to problems isolation taken by the employees while in workplace. The study covers the solutions of the problems related.

1.2 Objectives

The objectives of this study are:

1. To identify the installation method of steel structure for sport centre.
2. To identify the problems isolation taken for steel structures.
3. To identify the solutions of the problems related.

1.3 Research Methods

The collection of data for this study is using few method such as observation, interviews and document review.

1.3.1 Interview

Structured interview was carried while doing work or during lunch hour. The interview will take only about five to ten minutes duration and the information obtain were written as a short notes. The interviews were mostly managed at the site office with the Engineer and Site Supervisor. All information obtained were written in a note book.

1.3.2 Observation

The observation was performed at the site office especially with the Site Supervisor. The observation was focused on method and the types of steel structures. This observation commonly being done at the site during working hours on weekdays. All the data is being recorded by written a short notes. The observation is normally done on Monday and Tuesday every week.

1.3.3 Document Interview

Document that have been reviewed were company profile, construction drawing, standard operating procedures, progress report and the picture of the progress. These documents were very important for the employers and employees as a references.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Muara Atur (M) Sdn Bhd was registered on 23rd April 1994 as a private limited company under Akta Perniagaan 1965 which specializes in Civil & structure and Mechanical & Electrical Works.

Lead by experienced Engineers, Muara Atur (M) Sdn Bhd provides the services and see the project through in every aspects with hands on practices from construction to renovation to upgrading.

Muara Atur (M) Sdn Bhd has been established and succeeded in managing many mega projects, which include buildings & infrastructure, design and built, and civil engineering works. Registered with Pusat Khidmat Kontraktor (PKK) and Lembaga Pembangunan Industri Pembinaan Malaysia (CIDB) as a G7 Contractor.

2.2 Company Profile

In year 2010 we are expanding our service to landscape construction works to compete the others in participation of our country economic development. Lead by experienced landscape architect and supervised by well-trained and capable staffs, the aim is in providing high quality of landscape work.

As an established ISO 9001. ISO 14001 & OHSAS 18001 company by the DAS Certification Ltd on March 2010, the company shall pride on the high-level quality and professionalism to be achieved in every project. Every area of construction is designed and built to be functional, lasting, conducive to be ideal environment of modern day demands with up to date material, machinery and expertise contribute to the long term vision and sustainability that is required to achieve exemplary standards.

2.3 List of Completed Project

Table 2.1: List of Completed Projects

No	Project Description	Client	Contract Period	Contract Amount (RM)
1	Membaiki dan Menurap Semula Jalan Masuk Parit, Kerja-kerja yang berkaitandi Ibusawat Telekom Taman Muhibbah, Kulai, Johor	Telekom Malaysia Bhd	17/09/1996 – 13/03/1997	559,100.00
2	Cadangan Membaiki Jalan Berlubang di Zon Timur Majlis Bandaraya Johor Bahru	Majlis Bandaraya Johor Bahru	01/10/1997 – 30/09/1999	750,000.00
3	Membina lorong memotong di laluan Persekutuan 3, Seksyen 47 -82 Jalan Kota Tinggi –Mersing, Daerah Kota Tinggi, Johor	Jabatan Kerja Raya Negeri Johor	14/03/2007 – 04/12/2007	3,285,955.00
4	Membina dan Menyiapkan Satu(1) Blok Bangunan Tambahan Empat(4) Tingkat dan Kerja-kerja yang Berkaitan di Sek. Keb. PerumahanTampoi 2, Johor Bahru, Johor Darul Ta'zim.	Jabatan Kerja Raya Negeri Johor	09/10/2007 – 06/10/2008	2,539,446.60
5	Menaiktaraf Cerun Runtuh di Jalan Mutiara Emas 8, Taman Mount Austin, Johor Bahru, (Peruntuhan Persekutuan).	Majlis Bandaraya Johor Bahru	28/01/2008 – 31/10/2008	4,486,930.00
6	Kerja-kerja pembaikan Kerosakan dan Peningkatan Kemudahan bagi Projek Perumahan Rakyat (PPR) Taman Sri Stulang, Johor Bahru, Johor Darul Ta'zim.	Kementerian Perumahan Kerajaan Tempatan	07/05/2009 – 06/11/2009	4,065,374.63

2.4 List of On-going Project

Table 2.2 : List of On-going Projects

No	Project Description	Client	Contract Period	Contract Amount (RM)
1	Cadangan Membina Klinik Kesihatan (Jenis3) Dan Kuarters di Kg. Kenangan, Muar, Johor.	Jabatan Kerja Raya Malaysia	27/03/2017 – 27/01/2020	20,695,500.50
2	Mereka Bentuk, Membina dan Menyiapkan 700 Unit Rumah Pangsa Berbilang Tingkat Serta Kerja-kerja Berkaitan Dengannya Untuk Program Perumahan Rakyat (PPR) Ulu Tiram, Johor Bahru, Johor.	Kementerian Kesejahteraan Bandar, Perumahan Dan Kerajaan Tempatan	10/01/2018 – 09/07/2021	130,274,000.00

2.3 Organizational Chart

Muara Atur (M) Sdn Bhd is an established company and has many department in this company. This company is led by Mr. Hj Musa Bin Elias and being helped by other board of director and departmental manager as shown in Figure 2.1.

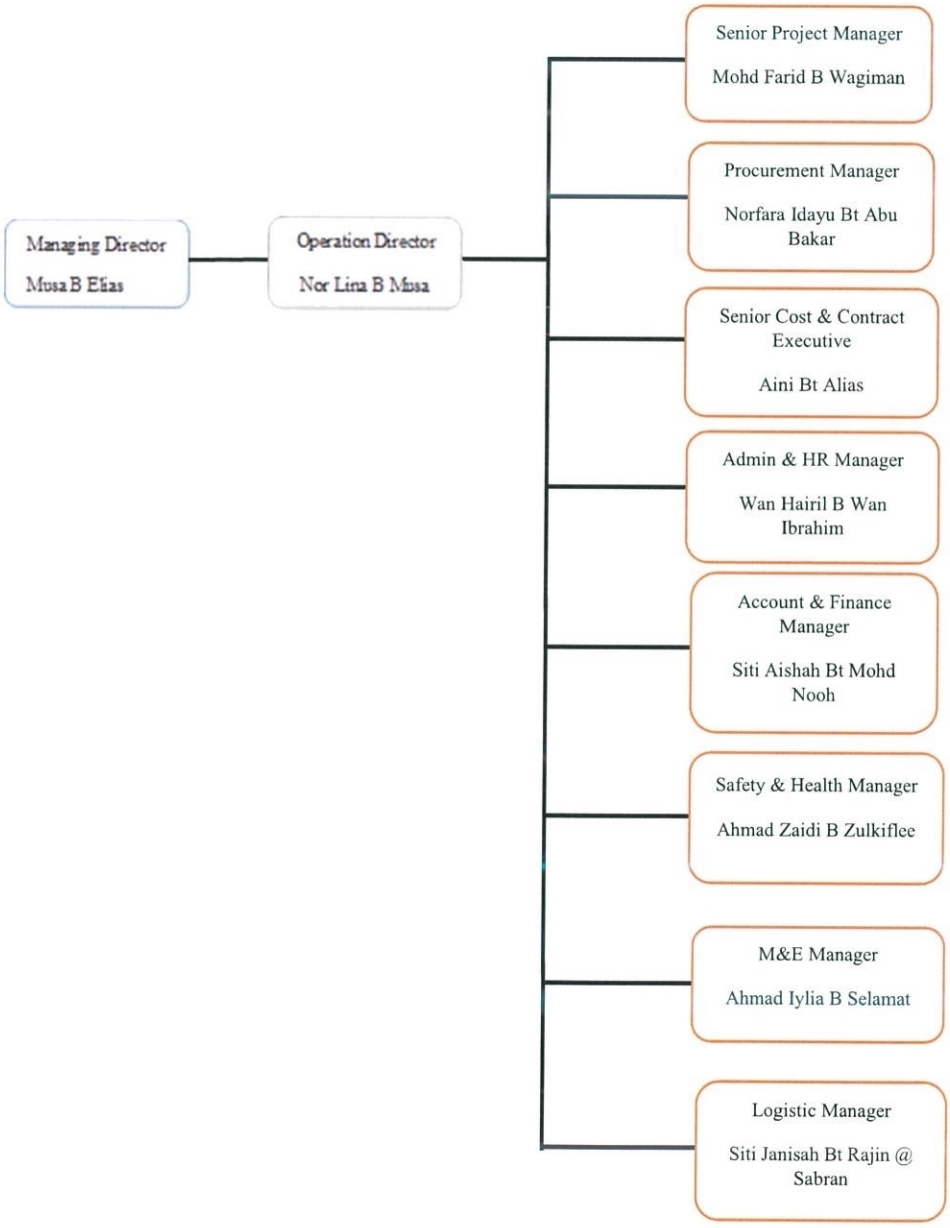

Figure 2.1: Organizational Chart

CHAPTER 3.0

CASE STUDY

3.1 Introduction to Case Study

The case study is a description about Arena Emas site under Muara Atur (M) Sdn Bhd company and would be specified about Steel Structures. The client of this project is Kumpulan Prasarana Rakyat Johor (KPRJ) Sdn Bhd. This construction site is handled by Construction Manager, En Abu Rhoan bin Abu Bakar and Site Supervisor, En Amier Aizatt bin Samsuri. The location of site is at Tapak Perkhemahan LOT 143932, Taman Impian Emas, Mukim Tebrau, Daerah Johor Bahru, Johor Darul Takzim.

Figure 3.1: Location of sites

Source : Google Maps 2019

This site is currently doing sport centre for SUKMA 2020 and there are several sports such as Lawn Bowl, Squasy, Petanque and Archery. The project started on 15th February 2019 and will be end on 14th December 2019, and the total duration is about ten months. Move on to the cost and budget part, the overall Arena Emas project cost RM24 million ringgit and for the steel structure itself, cost RM4.1 million ringgit. The total manpower for this site construction is 109, and for the steel structure is only 15. There are two supervisor of steel structure, three crane operator, two skylift operators and ten installer. For the plant and machinery to do the steel structure work, it needs three mobile cranes, welding set, spanar, torque wrench and hydraulic jack.

As there is currently one site that need to be done by end of December, all works were very tight and have a limited time. Steel structures installed at every sports centre started from Lawn Bowl until Main Pavillion. It needs thousands of steel structure from the supplier, Dash & Wand to build the buildings. The components that connected with each other to carried loads and provide full rigidity. Structural steel has multiple applications in the construction industry. It is also used in designing and building industrial spaces. The installation of steel structures was quite difficult because the workers have to follow the safety equipment such as eye protection, protective footwear, safety helmet and safety harness to complete the work. This work was really took efforts and struggles to make sure it can be done in a timely manner.

There are few work execution process for the steel structure, the first one was job site planning and preparation. The plan for unloading and materials storage on the site suitable and dry location. Materials was stored in designed areas for each building and clearly identified for their location and there were space and firmed pathway for truck delivery, crane truck erection operation. Second, received of materials at site. All the delivery materials to the site informed to the site supervisor or manager to have the plan for unloading. A spreader ought to be used for long steel components. Lifting nylon or cloth belts used for unloading materials to minimize the damage. All materials receipt at the site visually inspected by the site supervisor or manager for any damage after unloading.

For the methodology, there are three erection and installation of steel. For unloading, the fabricated portal frame unloaded by using 25 tonnes crane. Before unloading materials

out of trucks, the platform or access road prepared properly for crane and trucks by term safely load. For arrangement, to avoid materials being moved so much on the job site, that might cause unexpected damages of paint or discoloured and shapes, they unloaded and arranged close to the designed erection point. Last but not least, for the storage and protect material, to preventing and protecting materials from damage during storage that exposed to environment factors such as storm water, dust, and anything which can cause the rust, stain, discoloured, the proper storage provided to avoid the steel materials damage, deformation and contamination.

The characteristic of steel were very strong and stiff, the methods of construction was different from other material such as concrete and timber. Steel structure usually have been made at factory with outside of the site then deliver to the site and need a huge plant for installation process. The skilled labor also required for joint the steel members.

3.2 The installation method of steel structures for sport centre

3.2.1 Site Clearance

With increasing scarcity of land resources, the work for site clearance and compensation for power transmission transformation projects becomes more difficult due to the cost for the work goes up continuously which became the main factor for the rise of the cost of power grid projects. The process of site clearance (as shown in figure 3.2) is a part of enabling works to prepare a site for place the steel structure. It required the clearing site to put the material and machinery on the ground (as shown in figure 3.3)

Figure 3.2: Process of site clearance

Figure 3.3: Material arrived at site and put on the ground

3.2.2 Levelling Platform

This method is done to make an area a suitable height and level for a specific construction purpose (as shown in figure 3.4). It can be performed by cutting into or excavating an area of ground or by constructing a new area. In this method, its performed by excavating an area of ground and constructing a new area for levelling the platform.

Figure 3.4: Leveling work at main pavillion

3.2.3 Excavation

For this building, it was not a deep excavation and the depth of excavation is 1m (as shown in figure 3.5). For hard soils, if the depth is no exceeding 1.5m (as shown in figure 3.6), the sides of trench do not need any of visible support. Excavation from existing level for this method is do not exceed 1m due to uneven levels.

Figure 3.5: Site supervisor and safety officer monitoring the excavation work

Figure 3.6: Excavation work at level 1m by using excavator

3.2.4 Concreting Pad Footing

The purpose of this method (as shown in figure 3.7) is to transfer the forces accomplished by the structure. This process was no trenching for footings, no cleaning of trenches and no pre-soaking of the pad (as shown in figure 3.8). Concrete pad footing basically carried a structural column throughout a structure.

Figure 3.7: Concrete pad footing at level 1m

Figure 3.8: Worker measuring the level

3.2.5 Concreting Stump

This process for extracting stumps (as shown in figure 3.9) from the ground. The hole was fill with the concrete and no need to brace the stump until the concrete sets, unless it is really long. Pour the concrete into the hole, the push the stump down until the laser tells it's level. It help if the string line is close to the ground.

Figure 3.9: Concrete stump at level 1.2m

3.2.6 Installation of J-bolt

The J-bolt installed (as shown in figure 3.10) at the ground beam according to the gridline. In order for J-bolt to be used correctly it was inserted into wet cement. The J-bolt inserted into the wet concrete at a slight angle with the hook at the bottom of the bolt. The concrete around the J-bolt was smooth out with a small float. The J-bolt been checked continuously until the concrete has dried.

Figure 3.10: J-bolt installed into the form and has been layered with a concrete floot

3.2.7 Installation of I-Beam Column

The column locations at each end and under the beam as well (as shown in figure 3.11 and 3.12). A steel truss structure comprised upper and lower chords, each of which was grooved on the side facing opposite chord. The process required a minimum of two people to accomplish the task safely.

Figure 3.11: Installation work of lawn bowl column

Figure 3.12: All column for lawn bowl has been installed

3.2.8 Installation of Tie Beam

Tie beam is connecting two or more columns(as shown in figure 3.13) for making it more stiffens to make the structure as a frame for stability. Tie beam was also slot exactly over the diaphragm starter bars to avoid the trouble. It was not carried and vertical load of slab or walls but took axial compression load so some time act as a horizontal column.

Figure 3.13: Installation work of tie-beam at lawn bowl

3.2.9 Installation of Portal Frame

The realistic strength and deflection behavior of commercial portal frame buildings if the effects of rigidity of end frames and profiles steel claddings were included. It were characterized by a beam or rafter, supported at either end by columns. In this method (as shown in figure 3.14 and 3.15) , portal frame were low-rise structures, comprising columns and horizontal or pitched rafters, connected by moment-resisting connections.

Figure 3.14: Installation work of portal frame at lawn bowl

Figure 3.15: Portal frame has been installed at lawn bowl

3.2.10 Installation of Bracing

The bracing were installed between the portal frames. Bracing is required to resist longitudinal actions due to wind and cranes (as shown in figure 3.16), to provide restraint to members. The side rails and cladding attached, it made the rails can in turn provide stability to the columns (as shown in figure 3.17). The other purpose of installation bracing is it can provide temporary stability during erection. The bracing located at one and both ends of building, within the length of the building and in each portion between expansion joints, where these occur.

Figure 3.16: Bracing has been installed at lawn bowl

Figure 3.17: Bracing has been installed at main pavillion

3.2.11 Installation of Purlin

Purlin installed with the tie rod (as shown in figure 3.18). The tie rod were capable of carrying tensile loads only. The purlin bring up to roof framing members than span parallel to the building eave (as shown in figure 3.19), and support the roof decking or sheeting. The purlin was supported by rafters or walls.

Figure 3.18: Installation work of purlin at lawn bowl

Figure 3.19: Purlin has been installed at main pavillion

3.2.12 Installation of Polycarbonate Framing

Polycarbonate framing is a type of framing that is often clear and it is available in many colours. The function of polycarbonate framing is to allow the sun to heat up the inner space without subjecting the plants to the exterior condition. It can be installed on gabled or curved roof (as shown in figure 3.20), provided the radius of the curve meets the specifications of the framing material.

Figure 3.20: Progress installation of polycarbonate frame at lawn bowl and main pavillion

3.2.13 Installation of Roof Gutter

The process was so easy because the sections are joined on the ground rather than to work from the top of ladder (as shown in figure 3.21). Modified standard gutter systems created stronger, better-looking gutters. The minimize joints made assemble strong and sleek-looking seams (as shown in figure 3.22). Roof flashing added to keep water flowing into the gutters where it belongs.

Figure 3.21: Installation work of roof gutter at lawn bowl

Figure 3.22: Roof gutter has been installed at petanque

3.2.14 Installation of roof covering

Roof covering (as shown in figure 3.23) was the most visual part of the whole system and made the majority of waterproofing and protection. Selection of a proper roof covering was one of the most important aspects of getting the roof covering redone. The materials of roof include slate tiles, metal deck, wood shakes and also green roofs. In this method, metal deck was used for the installation of roof covering (as shown in figure 3.24).

Figure 3.23: Progress installation of roof covering at petanque

Figure 3.24: Progress installation of roof covering at lawn bowl

3.3 Problems and challenges isolation taken for steel structures

There were many problems during the installation of steel structure. The first one was defect on steel. The steel structure arrived at site with some defect on it such as faded colour (as shown in figure 3.25), faded metal roofs, bad scratches, and cracks.

Figure 3.25: Defect and faded colour on steel

Second was the amount of steel. The lack of number of steel (as shown in figure 3.26) made the installation work had to be delayed while waiting for the other ordered to arrive. It was caused by the supplier that misunderstood and wrong calculated during the shipping process.

Figure 3.26: Steels had to be put aside and hold the progress of installation

Next, the erratic weather during installation work (as shown in figure 3.27). Since it was the monsoon season, the workers can only work half a day each day. The unpredictable weather that a bit hard to continue the installation work which causes the work to be delayed over a given period.

Figure 3.27: The bad weather during installation day

Furthermore, incorrect installation method. During the installation day, the workers were misplaced the steel and installation error (as shown in figure 3.28, 3.29 and 3.30) because they did not understand how to install the steel properly. The result was so bad that it caused many deflections.

Figure 3.28: Unstructured column at lawn bowl

Figure 3.29: Unregulated purlin at lawn bowl

Figure 3.30: Unstructured portal frame at lawn bowl

Lastly, the wrong size of span. The span arrived at site with the larger size than what had ordered. Due to time constraints, the installation work had to carry out by using the same span. Unfortunately, the result was unsatisfying because the thickness was very thick (as shown in figure 3.31), did not same as the drawing and the self-weight was very heavy.

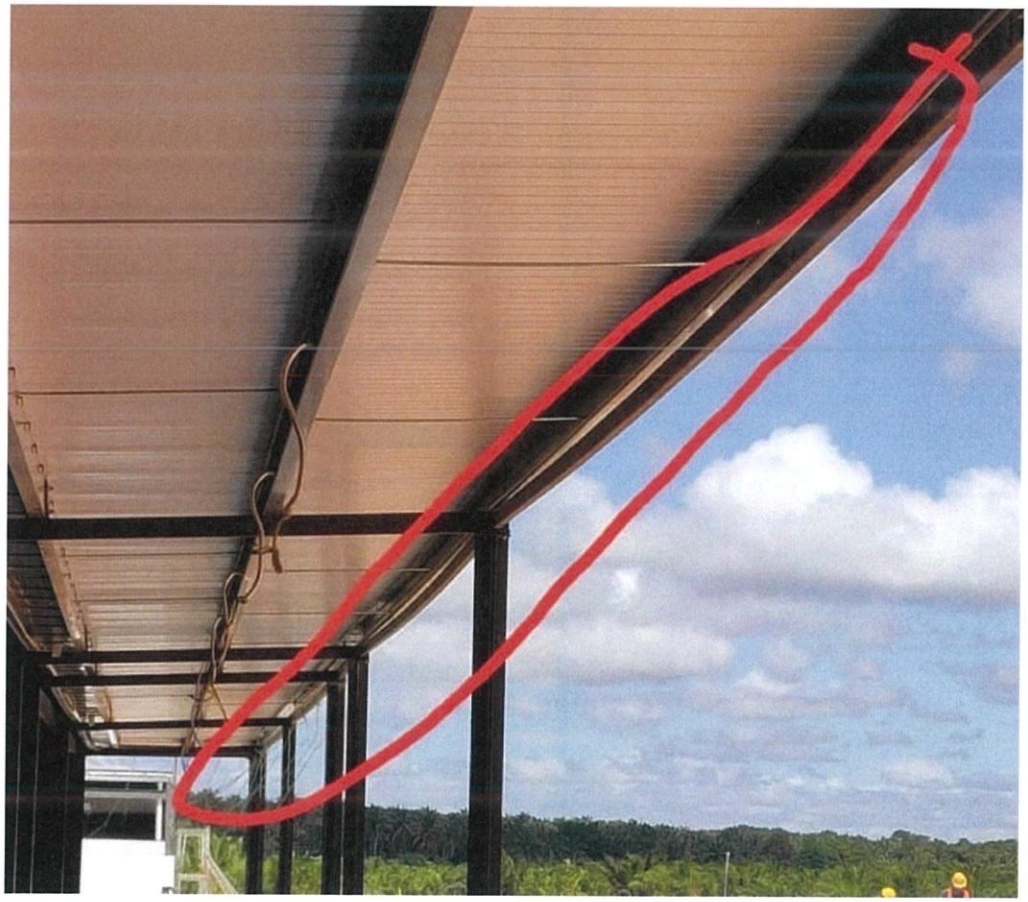

Figure 3.31: The span at main pavillion and lawn bowl look bigger than the actual size

3.4 The solutions of the problems and challenges related

The solution of the problems related for the first one was, the worker painted the steel again (as shown in figure 3.32) to cover the faded and defect on steels and the worker also repaired the defect (as shown in figure 3.33) on the steel. The steel was dried under the sun for rapid drying and continued the work immediately.

Figure 3.32: Worker is painting the steel to cover the faded colour

Figure 3.33: Worker is repairing the defect of steel

Move to the second solution, the manager contacted the supplier of steel and informed about the misunderstood of amount of steel. The supplier took a few days to process the delivery and the steel safely arrived (as shown in figure 3.34) at site.

Figure 3.34: The steels arrived and placed on the lawn bowl arena

Furthermore, after discussed, the construction manager and site supervisor had to reduce and maximize workers' rest time, from three break time to two break time a day. They also had to cut the overtime of worker's and they can go back to their shared home at 5 PM.

Last but not least, since the span was installed at few sport centre already, the Project Engineer asked the architect to change the thickness in the drawing. After one week we received the new drawing which the thickness of span has been edited according to the span thickness on the site.

CHAPTER 4.0

CONCLUSION

4.1 Conclusion

Steel structures is a modern version of post and beam. It has a high strength to weight ratio which means it has high strength per unit mass. So now matter how large the overall structure is, the steel sections will be small and lightweight, unlike other building materials.

The steel can be easily repaired by the workers if it has the minor defects or even faded colours. Its also can be easily install and produced massively. This can be saves time and increases the efficiency of the overall construction process.

In conclusion, the steel structure can be re-used without effecting the environment on construction site or the surroundings itself. Other than that, the construction with steel components is very fast compared to the other materials. Steel structure of buildings with steel components is also resistant to termites and other destructive insects. As many do not know, steel constructions are way cheaper than any other construction methods. Last but not least, steel construction is a fast method of construction since it has limitation of elastic method.

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