UNIVERSITI TEKNOLOGI MARA (PERAK)
FACULTY ARCHITECTURE, PLANNING AND SURVEYING
DIPLOMA IN BUILDING (AP116)

RAILWAY TRACK INFRASTRUCTURE

Prepared by: -
NUR IZYAN BINTI ABDUL MUKMIN
2019217252

DEPARTMENT OF BUILDING
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
(PERAK)

FEBRUARY 2022

It is recommended that the report of this practical training provided

By

Nur Izyan binti Abdul Mukmin
2019217252

entitled

Construction of Railway Track Infrastructure

be accepted in partial fulfilment of requirement has for obtaining Diploma in Building.

Report Supervisor	:	Cik Nor Azizah Binti Talkis
Practical Training Coordinator	:	Dr. Noor Asma Hafizah Binti Hadzaman
Programme Coordinator	:	Dr. Dzulkarnaen Bin Ismail.

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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 AAY Construction Sdn. Bhd. for duration of 20 weeks starting from 23 July 2021 and ended on 7 January 2022. 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.

…………………………………………………….

Name : Nur Izyan binti Abdul Mukmin

UiTM ID No : 2019217252

Date : 10/01/2022

ACKNOWLEDGEMENT

Alhamdullillah, praise to Allah, the Most Merciful, the Most Graceful.

I would like to extend my heartfelt gratitude for the guidance, advice and help rendered throughout the period of training by the following group of amazing individuals. First and foremost, I would like to thank Mr. Ong Ming Kuan for the opportunity given, to conduct my training in his esteem company. His team have enabled me to learn and develop my understanding, knowledge and feel of real time projects, and the theory involved in analysis of structures and civil works. They are also responsible towards streamlining and assessing my training. It is an honor for me to be given the opportunity to ‘work’ with all of you.

I would also like to thank ALL the UiTM lecturers that have taught and nurtured me in becoming a better student and person. I would also like to extend my deepest appreciation to the lecturers who are directly involved during my training stint. To Cik Nor Azizah Binti Talkis, Supervising Lecturer, Puan Nurhasyimah Binti Ahmad Zamri, Evaluation Lecturer, En. Muhammad Naim Bin. Mahyuddin, Practical Training Coordinator and Dr. Dzulkarnaean Bin Ismail, Programme Coordinator, I value the time, effort, encouragement and ideas that they have contributed towards the successful completion of my training, this report and the valuable knowledge that have been shared over the last few semesters.

Last but not least, my special thanks to my beloved parents for their sacrifices over the years.

Thank you so much.

ABSTRACT

The railway infrastructure that describes the railway track and all the civil engineering structures and systems that ensure the railway traffic. Hence, the railway track comprises successively from top to bottom the rails, the sleepers, the ballast, the sub-ballast, the formation level, and the subgrade. The study aims are to determine the process of the construction of railway track infrastructure in Malaysia. There are the methods of railway track infrastructure, for example stripping of top soil is be done by removing the top layer of soil containing organic material, which be stockpiled for the use of works, i.e. reuse for the soiling of slopes, berms, and/or disposed into the approved dumping sites when there's in excess of required quantity or as directed by the consultant. There are many types of problems and the solution taken to solve the problem during the construction of railway track infrastructure. The one of the solution is about the method of replacing the poor soil is first removed and then the gap is filled up by superior material such as sand, stone, gravel or any other hard material. In order to do this, first excavate a foundation trench of about 1.5 m deep, and then fill the hard material is stages of 30 cm. Then compact the hard material at every stage. This method is useful for foundations in black cotton soils.

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CHAPTER 1.0

INTRODUCTION

1.1 Background of Study

Figure 1.1: Overview for earthworks of railway track

Source: Observation

Rail transport is the most important medium of transportation across the globe. Railways were first introduced to India in the year 1853 from Bombay to Thane. Railways not only carry passengers but also carry goods, emergency services, and army equipment (Naveen, Sandhya, Swathi & Mahender, 2017, p.982). Another study found similar data, in a modernized and globalized world, the mobility of people and goods has been increasing even above economic growth. While millions of people all around the world commute in urban transport networks, millions of products are more throughout the complex, logistic chains. In both systems, railways as a mode of transport play an important role (Andrade, 2008, p. 1).

The infrastructure of a railway is a complex and multi-disciplinary engineering system involving earthworks, bridges, tunnels, steelworks, timber, and track system to form the base upon which the railway runs. To give a train a good ride, the track alignment must be set to within a millimetre of the design. Many different systems exist throughout the world and there are many variations in their performance and maintenance. The track is a fundamental part of the railway infrastructure and represents the primary distinction between this form of land transportation and all others in that it provides a fixed guidance system. The track is the steering base for the train and has evolved from an ancient design of vehicle guidance with origins dating, some historians have suggested, from the Sumerian culture of 2000 BC. The modern railway version is based on a steel wheel running on a steel rail. (McNaughton, Lowe & Mike, 2019).

One of the principal conclusions of the railroad in the mid-1970s was that "with some modifications and good maintenance, the present track design is adequate not only for the present but also for the foreseeable future." Good maintenance, however, is very expensive. Although some railroads can afford good maintenance, there are others that, because of the economic difficulties that beset the industry, are forced to settle for performing only limited maintenance and deferring the rest (Richard Cataldi, p. 13). Last but not least, there are too many scopes of work which is starting from the beginning until the maintenance work for railway construction, however, the study aims are to determine the process of the construction of railway track infrastructure in Malaysia.

1.2 Objectives

1. To investigate the methods of railway track infrastructure work.
2. To determine the problems that occurred during the construction of infrastructure work.
3. To determine the solution taken to solve the problems during the construction of infrastructure work.

1.3 Scope of Study

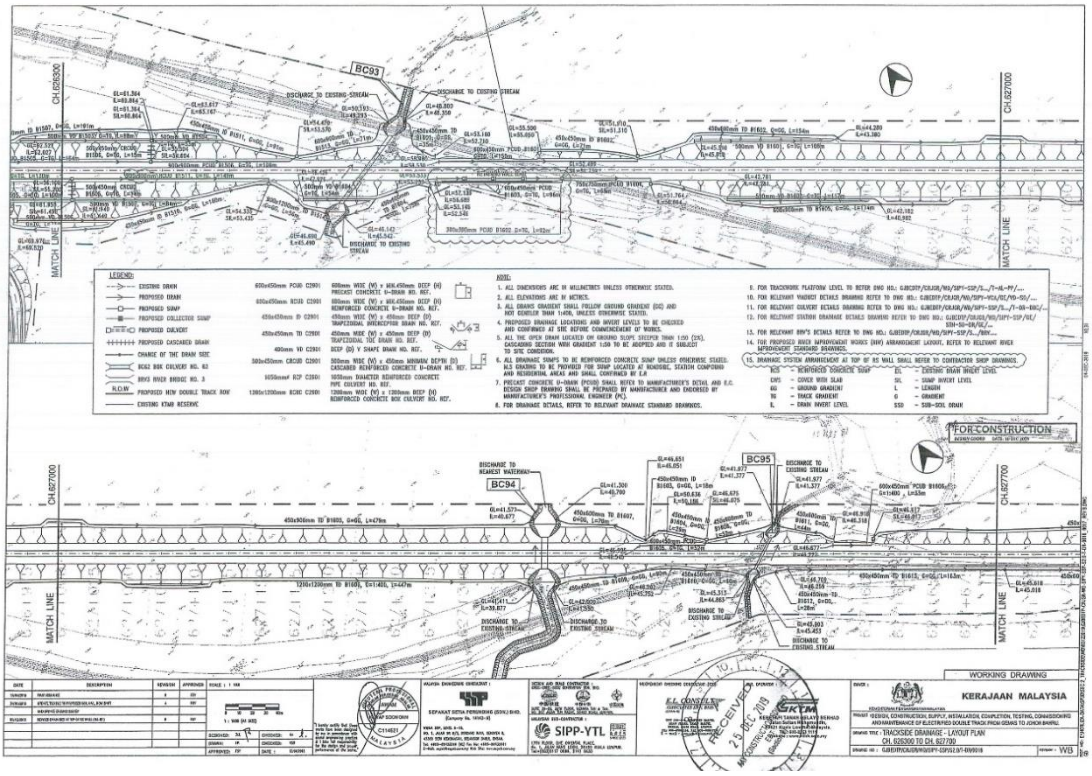

Figure 1.2: Layout plan of Kampung Lenek, Bekok, Chaah

Source: Document review

Figure 1.3: View of Kampung Lenek

Source: Observation

The study was carried out for the construction of railway infrastructure work located in Kampung Lenek, Bekok, 85000 Segamat, Johor (Figure 1.3). The study is on the construction of earthworks also known as infrastructure work methods. It focuses on the process of the methods of railway track infrastructure work including materials and types of machinery that are used during the construction. Figure 1.3a above shows the layout plan that was used for Kampung Lenek, Bekok.

On the construction site, several types of problems happened during work. So, the study also describes the problems that occur during construction and ways to solve those problems well.

1.4 Methods of Study

1. Observation

Observations were carried out by visiting the construction site that conducted by the project manager and quantity surveyor of the company. The description of each item used in the construction of the project has been described clearly for additional information. Some pictures, videos and notes are taken as records. In addition, the method of construction of railway infrastructure has been shown in detail by the project manager. The observations have been done over 3 months of training.

2. Interviews

Some questions were asked while making the observations during doing a site visit. Any inquires have been answered. The question about problems that happen during working on construction site has been clearly interviewed with the employees with experience in this work. This method is considered an unstructured interview. Misunderstanding about the case study has been questionnaire with the project manager, quantity surveyor, and their team. Interviews were conducted during the meeting and during their free time.

Next, there are some questions I have prepared about the scope of work of infrastructure work. The questions were asked during the meeting and the query has been answered from time to time if I have some misunderstanding. This method is known as semi-structured interviews in which questions are prepared beforehand. All the information and data have been recorded and noted.

3. Document reviews

There are several document reviews as references for my case study. For example, layout plan drawings, plan profiles, progress reports by month, company website, and some photos belonging to quantity surveyor that show the past completed work. The data collection obtained from document reviews has more information about the company's project work and details.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Figure 2.1: The founder of AAY Construction Sdn. Bhd.

Source: https://www.aayconstruction.com/history

AAY Construction Sdn. Bhd. is the company that traces its roots to 1962 when it was founded by a local civil engineer who settled in the tenements of Menglembu, Perak. It was a bold move but he saw the huge opportunity as the country began to develop soon after the independence. Under his leadership, the company was able to grow the business and expand the operations. AAY Construction Sdn. Bhd. was then formally incorporated on 1982.

As known today, the founder alongside his sons has overseen AAY's expansion into a full-fledged civil engineering contractor. The company has relied on a tradition passed down from generations of experience, quality and reliability to successfully expand into its chosen market in the industry.

Today, it employs over 100 skilled individuals and maintains a fleet of over 200 units of heavy equipment. With these, it has consolidated its position as one of the leading construction companies in Malaysia. With the commitment to perform and produce the highest quality construction work possible, AAY has all the right fundamentals to take on what the future of construction may hold.

2.2 Company Profile

Over 50 years of experience in the heavy and civil engineering construction industry, AAY Construction is known as a major Malaysian contractor. It has made a significant contribution to the growth of infrastructure in Malaysia. Being a solely owned large fleet of earthmoving equipment, AAY makes it to the leading infrastructure construction company in the country.

AAY's team has many years of experience and has undertaken a wide range of contracts involving highway construction, dams, international standard golf courses, infrastructure works, land formation for housing development and etc. AAY has also ventured into quarries and developments to meet the demand of Malaysia's rapid economic growth.

Figure 2.3 shows the head office is located at No. 12, Jalan 3/8, Bandar Baru Selayang, 68100 Batu Caves, Selangor, Malaysia. For any inquiries, questions or commendations, customers can call the number, +603 6137 2100. Figure 2.2 shows the official logo of the AAY's company.

AAY's company is very concerned with relationships in business. It keeps the lines of communication open and transparent for the clients to establish the healthiest and efficient delivery methods for the projects.

AAY Construction Sdn. Bhd. vision is to continue meeting the needs of the clients by providing a comprehensive service backed by the strength of the experiences. To support the vision, AAY has recently obtained ISO 9001:2008 certification that added credibility to the services to the valued customer.

AAY bases its activities on a strong passion for heavy equipment and construction in general, which is reflected in its offering of core services spanning across large-scale earthworks to comprehensive construction services. AAY has successfully undertaken a vast number of civil engineering projects including roadways and bridges, dams, advanced sanitary landfill, international standard golf courses, major infrastructure and more. Table 2.1 shows the scope for AAY's services:

Transportation
Land formation
Dams and water resources
Landfill and waste management
Infrastructure
Quarrying and material production

Table 2.1: Scope of work

Source: https://www.aayconstruction.com/

Figure 2.2: Company Logo

Source: https://www.aayconstruction.com/

Figure 2.3: Location of the head office (AAY Construction Sdn. Bhd.)

Source: https://www.aayconstruction.com/

2.3 Company Organisation Chart

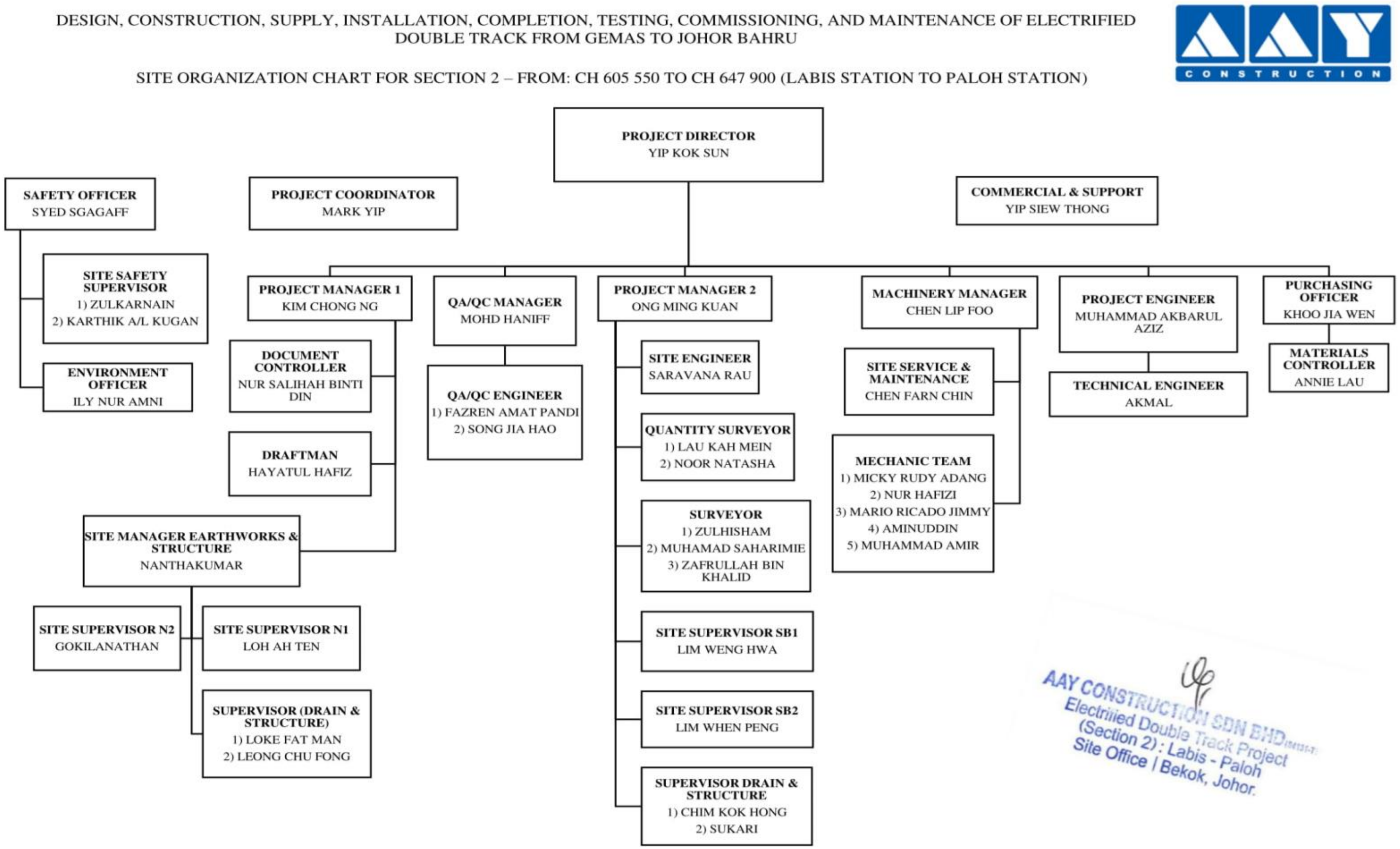

Figure 2.4: Site organization chart for Section 2 area

2.4 List of Projects

2.4.1 Completed Projects

Table below shows the projects that have been successful for the past few years by AAY Construction Sdn. Bhd.:

No.	Project Title	Project Value	Location	Technical Data	Project Duration	Client
1.	Muar Furniture City	RM 132 million	Muar, Johor	a) Site clearance area: 405 hectare b) Excavation and earthworks: 10,200,000 cubic metre	February 2018	Johor Coporation
2.	Sungai Cherok Dam, Genting Highlands	RM 38 million	Genting Highlands	a) Excavation and earthworks: 350,000 cubic metre b) Embankment value: 370,000 cubic metre c) Length of dam crest: 0.32 kilometre d) Water storage capacity: 3,400,000 cubic metre	August 2016 – June 2018	Genting Malaysia Bhd.

3.	Mengkuang Dam, Pulau Pinang	RM 201 million	28KM North – East of Butterworth	a) Excavation and earth moving: approximately 9,000,000 cubic metre b) Embankment volume: approximately 8,000,000 cubic metre c) Length dam crest: 3 kilometre d) Water storage capacity: 22,000,000 cubic metre	January 2011 – January 2018	Jabatan Bekalan Air Penang
4.	Bukit Tagar Sanitary Landfill	RM 75 million	50KM North of Kuala Lumpur	a) Excavation and earth moving: 2,000,000 cubic metre b) Number of Leachate Treatment Plant: 4 c) Volume of Aggregate: 150,000 tonnes d) Air Space Capacity: 120 million metric tonnes	50KM North of Kuala Lumpur	KUB-Berjaya Enviro Sdn. Bhd.

Table 2.2: Completed Projects by AAY Construction Sdn. Bhd.

Source data: https://www.aayconstruction.com/

2.4.2 Projects in Progress

The table below shows the ongoing projects by AAY Construction Sdn. Bhd.:

No.	Project Title	Project Value	Location	Technical Data	Project Duration	Client
1.	East Coast Rail Link (Section 6)	RM 64 million	Pahang	a) Length: 15 kilometre main line b) Total Excavation and Earthworks: 1,000,000 cubic metre c) Total Volume of Aggregate: 2,900,000 tonnes	September 2020	Malaysia Rail Link Sdn Bhd
2.	Electrified Double Track (Section 2 & 5)	RM 416 million	Gemas – Johor Bahru, Johor	a) Section 2: 42.35 kilometre main line + 4.98 kilometre spur road b) Section 5: 21.24 kilometre main line c) Total Excavation and Earthworks: 10,600,000 cubic metre d) Total Volume of Aggregate: 800,000 tonnes	July 2018	SIPP – YTL

3.	East Klang Valley Expressway	RM 91 million	10KM East of Kuala Lumpur	a) Length: 8.33 kilometre mainline + 3.94 kilometre spur road b) Number of Interchange: 2 c) Site Clearance Area: 109 hectare d) Excavation and Earthworks: 4,200,000 cubic metre e) Volume of Rock Excavation: 600,000 cubic metre	January 2016	Ahmad Zaki Resources Bhd.

Table 2.3: Ongoing Projects by AAY Construction Sdn. Bhd.

Source: https://www.aayconstruction.com/

CHAPTER 3.0

CASE STUDY (RAILWAY TRACK INFRASTRUCTURE)

3.1 Introduction to case study

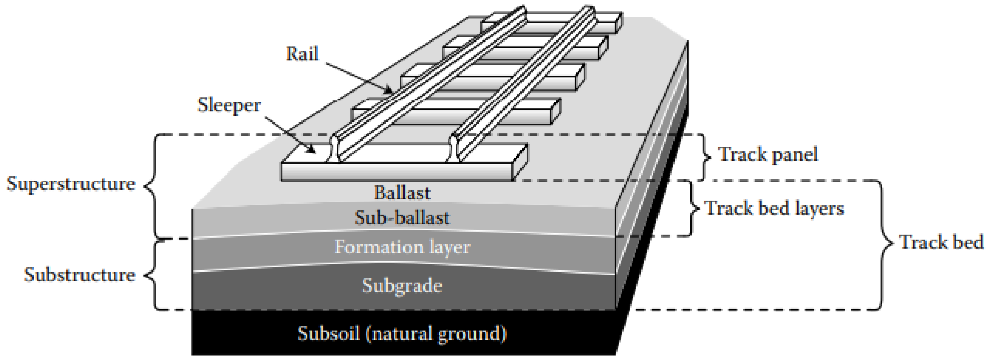

Figure 3.1: Railway track

Source: Railway transportation system book

Figure 3.1 shows the railway infrastructure that describes the railway track and all the civil engineering structures and systems that ensure the railway traffic. Hence, the railway track comprises successively from top to bottom the rails, the sleepers, the ballast, the sub-ballast, the formation level, and the subgrade.

During the observation for the case study, the project is referred from the Electrified Double Track Project from Gemas to Johor Bahru (Section 2). However, the scope of the study is located at Kampung Lenek, Bekok that involves in the project area. The study is about the construction of railway track infrastructure. The date of completion is expected in 2023.

The activities that are carried out on the site are earthworks e.g. infrastructure work, safety and health, installation of railroad track, railway station building, etc. However, the case study is focused on infrastructure work as per observation.

3.2 Methods of Railway Track Infrastructure

Figure 3.2: Site clearing at Kampung Lenek, Bekok

Figure 3.2 shows the site clearing work. The clearing includes removal and disposal of all unwanted material above the ground level, while grubbing consist of removal and disposal of all unwanted vegetation remaining in the soil including roots, stumps logs, or other debris. Stripping of top soil is be done by removing the top layer of soil containing organic material, which be stockpiled for the use of works, i.e. reuse for the soiling of slopes, berms, and/or disposed into the approved dumping sites when there's in excess of required quantity or as directed by the consultant. Machinery utilized for site clearing is hydraulic excavator and bulldozer. Next, soil investigation is required on the existing ground. There are several types of soil investigation test, which is mackintosh probe test, bored hole, piezocone test and trial pit.

Figure 3.3: Earthworks (subgrade and embankment fill)

Before the compaction starts, make sure that the excavated level is free from standing water or excessive moisture. Figure 3.3 shows the embankment fill work. Hydraulic excavator is used for excavation to design formation level as per construction drawings. Excavated material then transport to designated embankment fill area and spread by bulldozer to a lift of more than 300mm in thickness then compacted by vibratory compactor. Once field density test for the area achieving compaction requirement, the work proceed with the next layer to fill. Excavation then proceed on the second half of platform and backfilling to the subgrade level similar to stage 1. Embankment is filled and layered by using suitable material as per approved specification. Field density test for material within 900mm of formation level is carried out in accordance with BS 1377: Part 9: 1990 Clause 3 In-situ Density Test at a rate of not less than one test per 2000 cubic meters following the compaction pattern established in trial compaction tests and one test per 500 sq.m of fill surface for the rest of embankment. The following testing is conducted at the site in accordance with the specification which is California Bearing Ratio (CBR) and Moisture content test. Requirement for compaction of embankment fill are as follows and apply equally to all clayey, silty, sandy or gravelly material placed in embankment which is at least 98% of the maximum dry density for the top 150mm below formation level, at least 95% of the maximum dry density for depth between 150mm or 900mm below formation level and at least 90% of the maximum dry density for the rest of the embankment. d. The soaked CBR value of the subgrade to a depth of 900mm beneath the final formation level shall be at least 5%. The final formation level is regulated and trimmed to a tolerance of ± 20mm. The trimmed surface is compacted with appropriate equipment and all areas of prepared formation approved by consultant prior to the placing of the geotextiles and sand layer.

Figure 3.4: Laying geotextile and sand blanket

Figure 3.2 shows the laying of geotextile and sand blanket. The geotextile that used above the subgrade layer is type (TS 65). This is used to improve soil characteristics before building embankments, roads pipelines, and earth retaining structures. It also prevents intermixing water gets into the soil strata. After that, laying the sand blanket. The thickness of sand blanket is 100mm. the sand blanket is used for controlling subsurface erosion works by reducing the time of flow.

Figure 3.5: Laying sub ballast and ballast

Last but not least, figure 3.5 shows the laying of sub ballast. The aggregate sub ballast layer, situated under the track superstructure that is under the crushed stone ballast layer. The sub ballast material is using crusher run and granular material. The standard ballast aggregate sizes are specified by general and railroad specifications including American Railway Engineering Association (AREA). The sub ballast is highly resistant to weathering action such as freezing and thawing. Usually, the sub ballast is required 300mm thickness.

3.3 The problem that occurred during construction of railway track infrastructure

Common problems affecting slopes are shallow translational landslides caused by high rainfall, settlement due to weak sub-layers, rock falls caused by freeze-thaw effects and deep-seated rotational failures caused by weak sub-soils which are triggered by increased loading and/or changes in the water table.

Deep rotational slope failures typically involve large volumes of material and occur in new construction because of weak sub-soil and on older assets when some change in the boundary conditions occur. The movements were caused by progressive failure triggered by instability in the nearby waste heap. The railway slope suffered a large rotational landslip and the track repairs took six months to complete.

A number of additional issues were highlighted as causing slope stability problems. These included the issue of poorly maintained or blocked drainage, which will allow for the eradication of near surface suctions. Another feature that is becoming an increasing management issue is animal burrowing. The burrow holes allow for rapid movement of water to relatively large depths in earthworks during rainfall or flood events.

The lack or poor levels of maintenance of tunnel drainage can cause a number of problems, including the development of formation level that can obstruct the tunnel. Poor drainage can cause the build-up of pore pressure on the tunnels structure leading to cracking and potential collapse.

Loose compacted is the one of the problems that occur during compaction formation level. It will result the high moisture content. Lastly, is weak subsoil that usually evidenced by ongoing settlement issues. Often these issues are dealt with by re-ballasting. However, ignoring the underlying mechanisms can result in large-scale slope stability failures.

3.4 The solution taken to solve the problem occurred

Increasing depth of foundation is the one of the solution taken. At deeper depths, the over burden pressure on soil is higher; hence the soil is more compacted at deeper depth. As a result, it shows higher bearing capacity. This is applicable only for cohesion less soils such as sandy and gravelly soils. This method of improving bearing capacity of soil is not applicable if the subsoil material grows wetter as depth increase. This method has a limited use because with increase in depth, the weight and cost of foundation also increases.

Compact soil using appropriate method, then there will be increase in its density and shear strength. As a result, the bearing capacity of soil also increases. There are many methods of compacting soils on site. Few of them is by spreading broken stones, gravel or sand and thereafter ramming well in the bed of trenches, using an appropriate roller as per the soil type to move at a specified speed and by driving concrete piles or wood piles and withdrawing piles and subsequently filling the holes with sand or concrete.

The method of replacing the poor soil is first removed and then the gap is filled up by superior material such as sand, stone, gravel or any other hard material. In order to do this, first excavate a foundation trench of about 1.5 m deep, and then fill the hard material is stages of 30 cm. Then compact the hard material at every stage. This method is useful for foundations in black cotton soils.

Increase the drainage system around the construction is the solution of the problem occurred. This is because to prevent from flooding, pollution and to collect surface water or ground water and direct it away, thereby keeping the ballast bed drained. The drainage system must also protect the substructure from erosion, from becoming sodden, and from losing its load-bearing capacity and stability.

CHAPTER 4.0

CONCLUSION

Based on the case study, the term of railway infrastructure, describes the railway track and all the civil engineering structures and systems/premises that ensure the railway traffic. The railway track consists of a series of components of varying stiffness that transfer the static and dynamic traffic loads to the foundation. Hence, the railway track comprises successively from top to bottom the rails, the sleepers, the ballast, the sub-ballast, the formation layer and the subgrade. The rails are mounted on the sleepers on top of elastic rail pads to which they are attached by means of a rail hold-down assembly called the rail fastening. Rails, sleepers, fastenings, elastic pads, ballast and sub-ballast constitute the ‘track superstructure’. The methods of the construction have been investigated. There are many types of problems and the solution taken to solve the problem during the construction of railway track infrastructure.

REFERENCES

Fischer, S. (2015). *Railway Construction*. Retrieved from: https://www.researchgate.net/publication/282246421_Railway_construction

Guerrieri, M. (2014). Railway Ballast Scanning by Means of Dip System. *Journal of Engineering and Applied Sciences*. 9(12):2618 - 2624

Khoshnaw, A. G. (2012). Introduction to Civil Engineering. Retrieved from: https://www.academia.edu/6265310/RAILWAY_CONSTRUCTION

Naveen, N. (2018). *Design of Railway Track with Prototype Model*. Retrieved from: file:///D:/Downloads/Designofrailwaytrackwithprototypemodel.pdf

Pyrgidis, C. N. (2016). *Railway Transportation System*: *Design, Construction and Opertaion*. Publisher: Taylor & Francis Group.