UNIVERSITI TEKNOLOGI MARA

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA PERAK

KAMPUS SERI ISKANDAR

GREEN BUILDING INDEX (GBI) CERTIFICATION FOR DAMANSARA - SHAH ALAM ELEVATED EXPRESSWAY'S TOLL PLAZAS

Prepared by :

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

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(PERAK)

FEBRUARY 2022

It is recommended that the report of this practical training provided

By:

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

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FEBRUARY 2022

STUDENT'S DECLARATION

I declare that this report is genuinely my own work, apart from the extracts and summaries for which actual sources are included, was prepared throughout the 20-week practical training program at Projek Lintasan Kota Holdings Sdn Bhd which began on August 23rd 2021 and completed on January 7th 2022. It is presented as one of the necessary requirements for BGN310 and is approved as part of the Diploma in Building requirements.

…….

Name : MUHAMMAD LUKMAN HAKIM BIN AHMAD SHAHRUL NIZAM

UiTM ID No : 2019210274

Date :10th January 2022

ACKNOWLEDGEMET

First and foremost, all praises to The Most Almighty and Most Merciful Allah SWT for His divine blessings of good health and strength which allowed me to succesfully complete the practical training period. And Alhamdulillah, with His blessings I have also managed to complete the practical training report assigned by our practical training lecturer.

After that, I'd want to express my gratitude to En. Baharuddin bin Shamsuddin, my practical training supervisor here at PROLINTAS, specifically at Projek Lintasan Damansara – Shah Alam Elevated Expressway, as well as the whole DASH office staff. With their help and advice, not only I was able to get a lot of information about the Projek Lintasan Damansara – Shah Alam Elevated Expressway, I also gained tons of significant experience working with huge project including how to manage the building process of the DASH mainlines and toll plazas and be responsible for its Green Building Index certification process.

Aside from that, I'd want to express my deepest gratitude to Miss Azizah binti Talkis, my practical training supervising lecturer, for assisting me and my groupmates in writing an improved practical training report. Not only that, but I'd want to express my heartfelt gratitude to Dr. Nor Asma Hafizah Bt. Hadzaman (Practical Training Coordinator) Ezzat Fahmi bin Ahmad (Evaluation Lecturer) and Dr. Dzulkarnaen bin Ismail (Program Coordinator) also assisted us throughout our practical training period

Finally, I want to express my sincere thanks towards my family and friends for their unwavering support and assistance, which has greatly aided me along my practical training period.

From the bottom of my heart, thank you.

ABSTRACT

Energy has become one of the most vital and significant aspects of a country's growth; nations with a large proportion of energy and resources are seen as powerful; currently, a country's energy and resources are a major indicator of its strength and progress. Economic development has become increasingly important in today's globe, as natural resources are becoming increasingly scarce, and available housing space is shrinking as the world's population grows. As a result, there is a greater demand for green building construction to ensure sustainable growth and minimise resource consumption. Green building is the process of constructing buildings and employing techniques that are environmentally friendly and resource efficient throughout a building's life cycle, from design to construction, operation, care, renovation, and deconstruction. Although some world-class green buildings have been constructed in Malaysia in recent years, the concept of green buildings for the general public is still in its infancy.

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CHAPTER 1.0

INTRODUCTION

1.1 Background of study

Pertubuhan Arkitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM) created the Malaysian Green Building Index (GBI) in 2009 to help the Malaysian property market become more environmentally friendly. Its goal is to promote sustainability in the built environment by raising knowledge of environmental concerns and the necessity of green technology in buildings among individuals in the development, construction, and design industries, as well as the general public.

Around the world, there are several green building rating systems. Energy Star, LEED (US), Green Globes (Canada), Beam (Hong Kong), BREEAM (UK, EU), CASBEE (Japan), Green Mark (Singapore), and Green Star are some of the most well-known ones (South Africa).

Why isn't there a standardised or international green building rating system? This is simply due to the fact that each country is distinct, necessitating the development of its own set of instruments to assess and meet the country's needs. Geographical landscape, energy consumption, culture, climate, transportation, resources, and many other factors will be taken into account. Even though the climate and culture of Malaysia and Singapore are fairly similar, there are significant variances in infrastructure, transportation, resources, and land that necessitate a unique set of metrics and ratings for each.

Green buildings meant to conserve energy and resources, recycle materials, and reduce harmful chemical emissions while also blending in with local climates, customs, culture, and the environment. Green buildings, it should be emphasised, help to preserve the ecosystem's capacity at both the local and global levels, while also making optimal use of resources, saving money on operations, and increasing workplace productivity. Most significantly constructing green communicates the appropriate message about a company or organisation: that it is well-run, responsible, and dedicated to the future.

Green buildings aren't all built the same way. The GBI assigns a point system to buildings, with the number of points defining the building's GBI grade. There are now four green categories available, with 'GBI Certified' being the most basic and Platinum being the most prestigious and toughest to obtain.

1.2 Objectives

1) To elaborate the significance of sustainability in building development

2)To discuss about the procedures needed to be followed for GBI submissions and certification process

3) To describe the criteria checklist and submission format needed to followed for GBI certification

1.3 Scope of study

The Green Building Index (GBI) Certification of Damansara – Shah Alam Elevated Expressway is taken place at each Toll Plaza, which are Denai Alam Toll Plaza (TP1), RRIM Toll Plaza (TP2) and Kota Damansara Toll Plaza (TP3). The scope of study emphasizes the step-by-step procedures of certification process for each of the packages of toll plazas. Other than that, it focuses on the explanation of criteria and submission format needed for the certification. Moreover, to elaborate the importance of Green Building Index Certification

Figure 1 : View of Denai Alam Toll Plaza (TP1) taken a drone

Figure 2 : View of RRIM Toll Plaza (TP2) taken from a drone

Figure 3 : View of Kota Damansara Toll Plaza (TP3) taken from a drone

1.4 Method of study

i) Literature Study

During the preparation of this report, I researched necessary informations from the internets based on Green Building Index Official Website, Wikipedia, online reading materials and PDF research papers regarding Green Building Index Certification. Aside from that, I also searched for relevant details about Green Building Index through my company's file archives

ii) Observation

On-site inspections were made to evaluate if the topics highlighted during internal Green Building Index meetings were correctly implemented on the building site.

iii) Interviews with relevant parties

For further details about Green Building Index (GBI) items and status of pending document submissions, I directly contacted the responsible contractors, consultants and other relevant parties regarding the said topic.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Figure 4 : Logo of Permodalan Nasional Berhad (PNB)

Figure 5 : Logo of Projek Lintasan Kota Holdings Sdn Bhd

Figure 6 : Logo of Projek Lintasan Damansara-Shah Alam Sdn Bhd

PROLINTAS, or Projek Lintasan Kota Holdings Sdn Bhd, was founded in 1995 as an investment holding company. As members of Permodalan Nasional Berhad (PNB), PROLINTAS have been deeply involved in nation-building since its inception. Projek Lintasan Kota Holdings (PROLINTAS) develop, build, manage, and maintain vital expressways utilised by tens of millions of people each year through our companies. These roads, which are AKLEH, GCE, LKSA, and Kajang SILK need no introduction because Malaysians rely on them on a daily basis. Soon, there will be another two expressways scheduled to complete its construction, which are Damansara- Shah Alam Elevated Expressway (DASH) and Sungai Besi-Ulu Kelang Elevated Expressway (SUKE).With this, PROLINTAS is now in fifth gear on its way to becoming the nation's premier road infrastructure developer.

PROLINTAS visions to be the leading highway concessionaire in Malaysia. The group also holds a mission to build and operate highways that will become the routes of choice to motorists and commuters. They are highly committed to meet all relevant quality, safety and regulatory requirements and standards, excellent customer services, effective cost management, continuous business growth, effective management of assets and resources and impactful CSR initiatives

The company have also made strides in digitalisation as Malaysia's first highway concessionaire to introduce PROLINTAS Smart Surveillance System (S3) which is a fully integrated artificial intelligence and machine- learning based system that drives operational efficiency and safety further forward. PROLINTAS Integrated Maintenance Escalation (PRIME) based on a proven Microsoft platform, is yet another innovation that advances everything from incident reporting to automation of maintenance schedules.

While PROLINTAS are in the business of creating advanced and convenient mobility solutions , the company is driven by a far greater mission which is 'Elevating Lives'. The new focus is centred on creating a safer, convenient and enriching user experience that encompasses all segments of PROLINTAS's customers.

Beginning its operation in 1995; PROLINTAS enjoyed their role transforming the urban landscape. Being a massive-scale infrastructure concessionaire, PROLINTAS work on a Build-Operate-Transfer basis for the good of public, allowing the private sector to be part of nation-building while also reducing the financial burden of the government.

2.2 Company Profile

PROLINTAS was founded in 1995 as an investment holding company to support the country's top investment and asset management firm expand road transportation infrastructure. Permodalan Nasional Berhad (PNB) owns all of its special purpose subsidiaries, which are responsible for the building, operation, and maintenance of key roadways around the Klang Valley.

PROLINTAS is a prominent private sector development partner assisting the Malaysian government in its efforts to build a world-class road network infrastructure. PROLINTAS, in conjunction with the government, is enabled to help in the construction of highway networks based on a Build-Operate-Transfer (BOT) arrangement, which is based on the economic model of Public-Private Partnership in Development. This BOT system relieves the government's financial load, allowing the private sector to participate in nation-building.

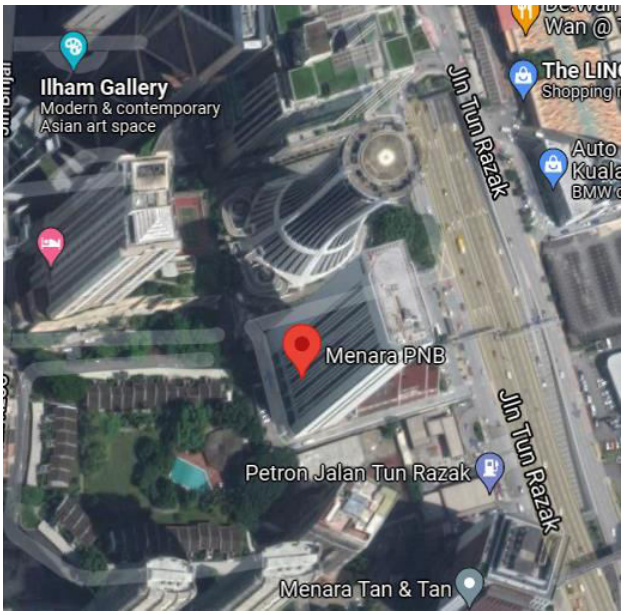

Figure 7 : PROLINTAS Headquarters located at Menara PNB

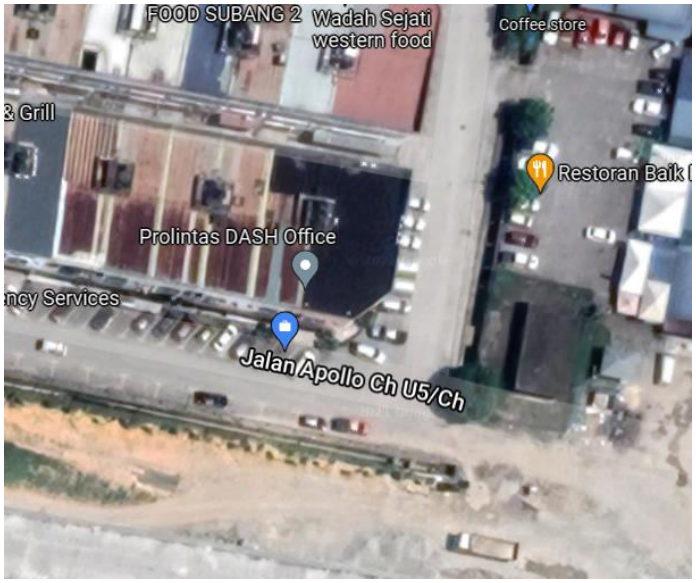

Figure 8 : Location of Projek Lintasan Damansara Shah Alam site office

PROLINTAS has a clear goal for long-term profitability, financial growth, and business health. It has weathered economic cycles thanks to its immense resources and reputation for business stability, enabling it to develop from strength to strength. PROLINTAS is a well-known business name thanks to its track record of building, managing, and maintaining roadways.

PROLINTAS has established itself as a catalyst for economic progress, thanks to its keen foresight, sharp commercial acumen, and innovative approach. It is staffed by a professional workforce that is committed to its purpose and values integrity above all else. PROLINTAS is an entity that is sensitive to the demands of society, which wants companies to be responsible and contribute back to the community. Its corporate rules include a love of community and the environment.

2.3 Company Organization Chart

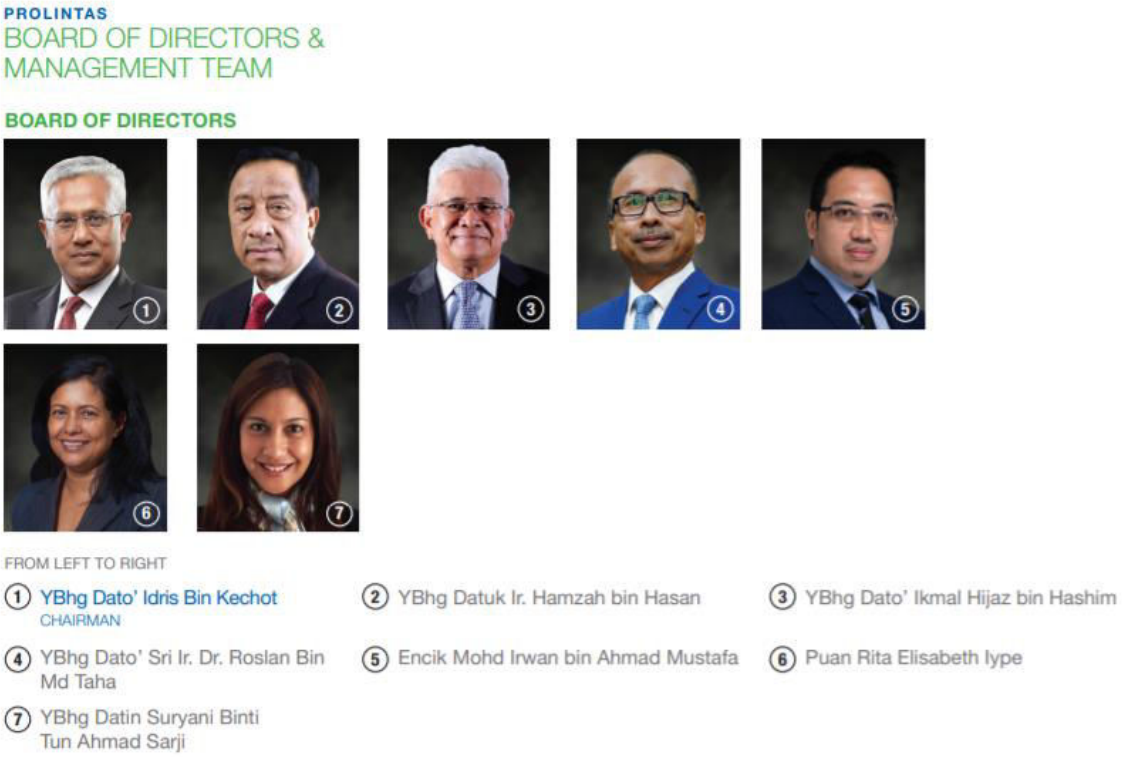

Table 1 : PROLINTAS Board of Directors

YBhg Dato' Mohammad Azlan Abdullah

Group Chief Executive Officer

Malik Parvez Ahmad Nazir Ahmad

Chief Operating Officer

Commercial & Finance

Ir. Rostam Shahrif Tami

Chief Operating Officer

Project & Operations

Jamaludin Mohd Nor

General Manager

Finance Division

Azhari Karim

General Manager

Corporate Services Division

Syamsul Farizz Bin Nadzeri

General Manager

Contract Management

Azmee Nin

General Manager

Highway Operations

Dr. Rozaidi bin Abdul Rahim Razali

General Manager

Integrity & Governance Department

Ts. Baharuddin Samsuddin

Deputy General Manager

DASH

Ir. Dr. Md. Zarulazam Bin Md. Eusofe

Deputy General Manager

SUKE

Table 2 : PROLINTAS Management Team

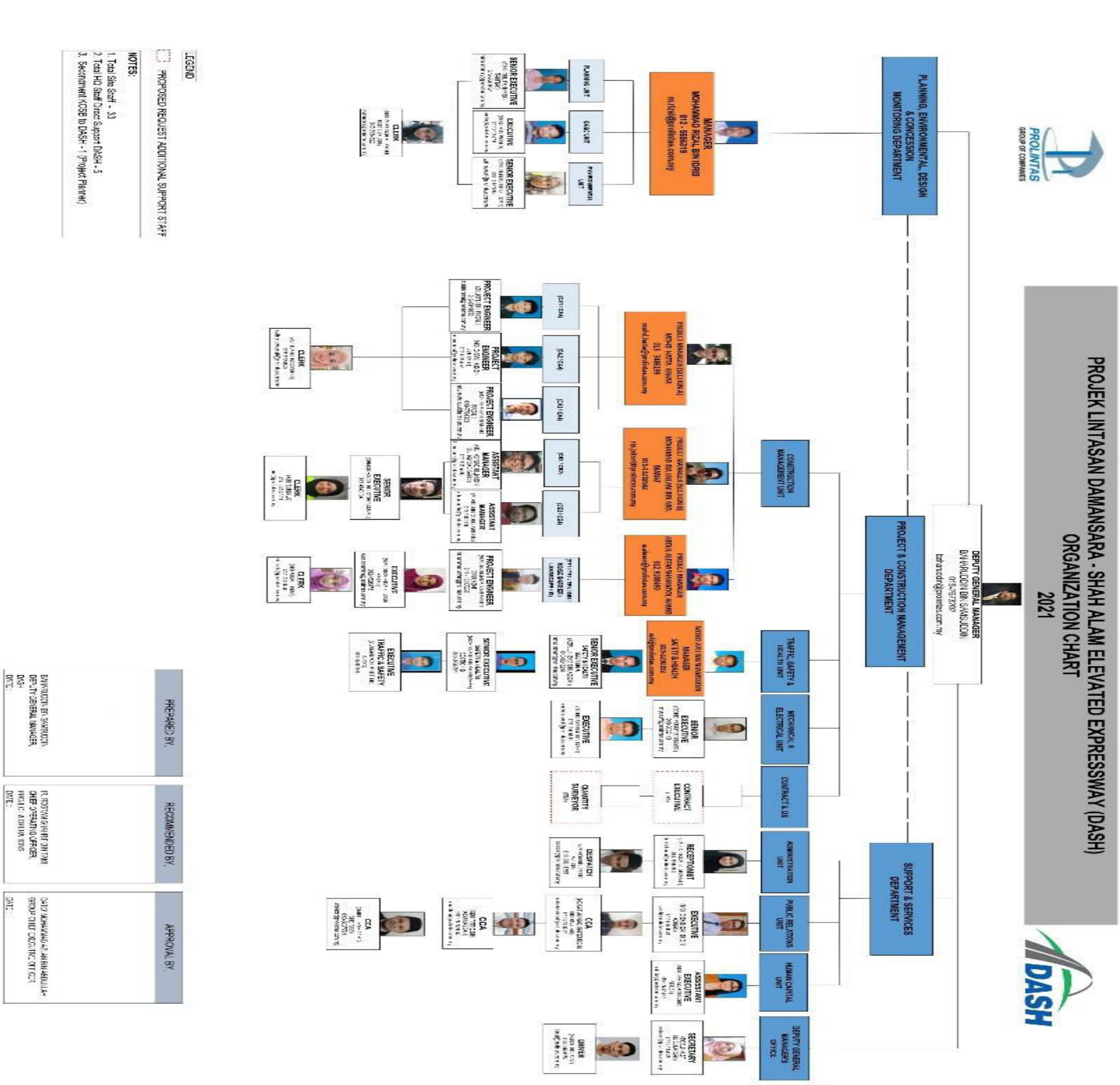

Table 3 : Projek Lintasan Damansara Shah Alam (DASH) Organization Chart

2.4 Completed and Ongoing Projects

2.4.1 Completed Projects

Bil.	PROJECT NAME	CONSTRUCTION PERIOD	END OF CONCESSION	COST	LENGTH OF HIGHWAY
1.	Ampang – Kuala Lumpur Elevated Highway (AKLEH)	1996 - 2001	2029	RM 751 million	7.9 km
2.	Guthrie Corridor Expressway (GCE)	2003 - 2005	2035	RM 501 million	25 km
3.	Lebuhraya Kemuning – Shah Alam (LKSA)	2007 - 2010	2047	RM 750 million	14.7 km
4.	Kajang Dispersal Link Expresway (KAJANG SILK)	2002 – 2003	2037	RM 800 million	37 km

Table 4 : List of Completed Projects

2.4.2 Ongoing Projects

Bil.	PROJECT NAME	CONSTRUCTION PERIOD	END OF CONCESSION	COST	LENGTH OF HIGHWAY
1.	Damansara – Shah Alam Elevated Expressway (DASH)	2016 - 2022	2087	RM 4.18 billion	20.1 km
2.	Sungai Besi – Ulu Kelang Elevated Expressway (SUKE)	2016 - 2022	2087	RM 5.3 billion	24.4 km

Table 5 : List of ongoing projects

3.1 Introduction to Case Study

The case study for this report is to elaborate the construction of the 20.1 km expressway which spans from Denai Alam to Kampung Penchala. The highway that costs about RM 4.1 billion consists of thirteen (13) interchanges and three (3) toll plazas along its mainline. The highway initiated its construction in 2016 and was expected to meet its completion in 2019. However, due to the recent Covid-19 outbreak, it affected the progress of the highway construction resulting the completion be delayed and expected to finally finish in the middle of 2022. The development of this project is managed by Turnpike Synergy Sdn. Bhd and is separated into sections, which are Section A and Section B and each of them are divided into a number of packages where different contractors were employed to handle the construction. However, the Green Building Index (GBI) certification process focuses mainly on the construction of the the toll plazas.

Figure 9 : Full alignment of Damansara-Shah Alam Elevated Expressway

Projek Lintasan Damansara-Shah Alam Sdn Bhd (DASH) provides an incredibly smooth driving experience through improved road networking, increased mobility, and larger road capacity. The expressway spans or about 20.1 KM and contains 13 interchanges which provides necessary traffic dispersal options in an exceedingly congested zone such as Puncak Perdana, Alam Impian, Alam Suria, Denai Alam, Kampung Melayu Subang, Pinggiran Subang, Subang Dua, Subang Airport, Rubber Research Institute Malaysia (RRIM), Surian, Seksyen 5, Kota Damansara, Sunway Damansara, Damansara Perdana and Penchala.

The expressway will provide an improved access to and from Persiaran Mokhtar Dahari , Guthrie Corridor Expressway, Jalan Sungai Buloh, Jalan Lapangan Terbang, Persiaran Surian, New Klang Valley Expressway (NKVE), Damansara-Puchong Expressway (LDP) and Penchala Link.

Projek Lintasan Damansara-Shah Alam (DASH) will be the icing on the cake for the Klang Valley ring of highways which are The Penchala Link, Duta-Ulu Kelang Expressway (DUKE), Sungai Besi-Ulu Kelang Elevated Expressway (SUKE), Shah Alam Expressway (KESAS), Lebuhraya Kemuning-Shah Alam (LKSA), Federal Highway and also the Guthrie Corridor Expressway (GCE)

Road users will benefit from a shorter travel time from the beginning to the conclusion of the route through the under-construction expressway, with cars taking only 17 minutes while utilising this route, compared to regular travel time, which might take up to 90 minutes. Route users will also have less to worry about traffic congestion, as most locations, including Persiaran Mokhtar Dahari, Jalan Sungai Buloh, and Persiaran Surian, would see a small drop in car traffic percentage.

In summary, the Damansara-Shah Alam Elevated Expressway (DASH) passes through multiple interchanges which are Alam Suria interchange, the Denai Alam Interchange, which is known to be connected with Guthrie Corridor Expressway (GCE); Kampung Melayu Subang Interchange, Pinggiran Subang Interchange, Subang Two interchange and the Subang Airport interchange which will give access to Sultan Abdul Aziz Shah Airport Sky Park Terminal. The RRIM interchange, together with the proposed new development, will generate a need for increased road capacity in the near future. The Surian Interchange is located near Segi University, Thomson Hospital Kota Damansara, Seksyen 5 Kota Damansara, and the Sunway Damansara Interchange.

The Damansara-Shah Alam Elevated Expressway (DASH) route will finish at the Penchala interchange, with a ramp particularly designed to improve traffic flow along Jalan PJU 8/1 Damansara Perdana.

The highway delivers a faster, less hazardous, and better driving experience, and when completed, the expressway will be supplied with high-quality facilities such as rest and service areas, as well as multi-lane free flow. Aside from that, it will be outfitted with a

contemporary traffic monitoring centre and an administration building that has been approved by the Green Building Index, resulting in a pleasant working environment for PROLINTAS personnel.

General Information

The Proposed Damansara-Shah Alam Elevated Expressway (DASH) is a three-lane-dual carriageway which spans 16.3 km from Puncak Perdana to Damansara Perdana. The expressway will be equipped with:

- Three lane dual carriageway
- 85 percent of the main alignment will be on elevated structure
- Consists of 13 Interchanges
    - Puncak Perdana
    - Alam Suria
    - Denai Alam
    - Kg Melayu Subang
    - Pinggiran Subang
    - Subang Dua
    - Lapangan Terbang Subang
    - RRIM
    - Surian
    - Seksyen 5 Kota Damansara
    - Sunway Damansara
    - Damansara Perdana
    - Penchala

- Consists of 3 toll plazas
    - Denai Alam
    - RRIM
    - Mutiara Damansara

The highway begins at the Puncak Perdana/Nusa Rhu interchange and travels through Nusa Rhu, Sunway Kayangan, Sunway Alam Suria, and the Cahaya SPK development region. The

Proposed Damansara-Shah Alam Elevated Expressway (DASH) will create a network of route to connect these development areas to Subang via a number of interchanges at Jalan Sungai Buloh to reach the highly developed residential and business centres at Kota Damansara, Mutiara Damansara and Damansara Perdana. The expressway will finish near Damansara Perdana, with an interchange connecting Lebuhraya Damansara Puchong (LDP).

The expressway is divided into two separate sections, which are Section A and Section B.

- Section A spans from Puncak Perdana to Kota Damansara
- Section B spans from Kota Damansara to Sungai Penchala

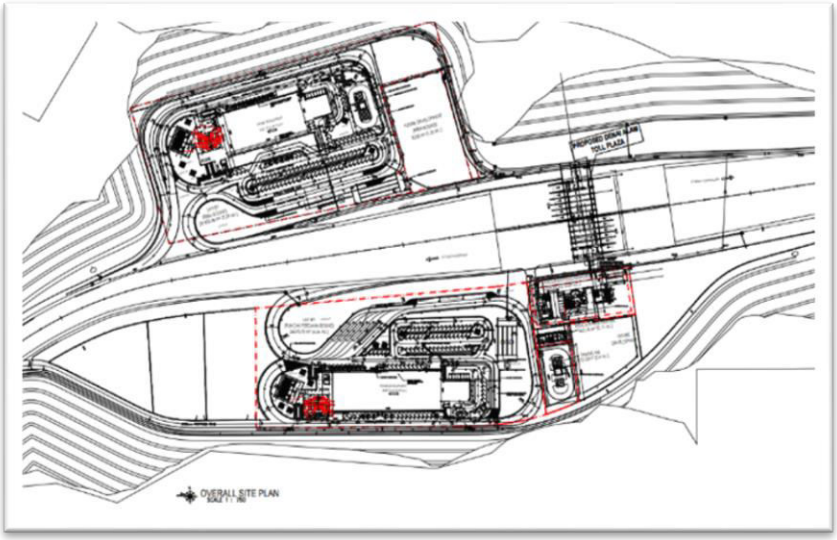

Figure 10 : Denai Alam Toll Plaza (TP1)

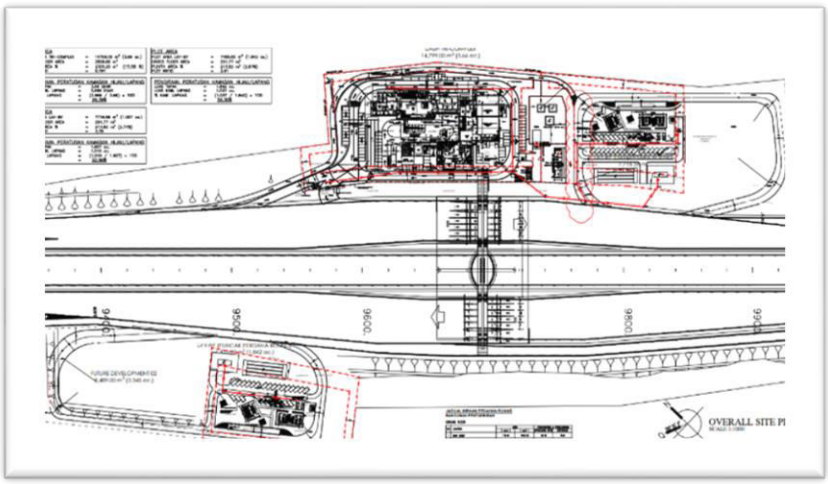

Figure 11 : RRIM Toll Plaza (TP2)

Figure 12 : Kota Damansara Toll Plaza (TP3)

3.2 The Significance of Sustainability in Building Development

Sustainable development is defined as development that satisfies current demands without jeopardising future generations' capacity to meet their own. Furthermore, a sustainable development should reduce current levels of energy and resource consumption, as well as waste reproduction, in order to avoid harming natural systems that future generations will rely on to provide them with resources, ingest their waste, and provide safe and healthy living conditions. Sustainable development is highly important in terms of saving to ensure that future generations will be able to enjoy the same benefits as the current generation.

Seeking ecological sustainability through the application of green technology in economic and social development not only helps to preserve non-renewable fuels, protects and reduces environmental degradation due to carbon emissions, but it also generates a strong green economy and industry, in line with the country's vision as well as the rest of the world's economies.

3.2.1 Objectives of Sustainable Buildings

Green building is a term that encompasses a wide range of activities, techniques, and abilities aimed at reducing and eventually eliminating the negative impacts of construction on the environment and human health. It usually emphasises on utilising renewable resources, such as consuming sunlight through passive solar, active solar, and photovoltaic technology, as well as utilising plants and trees through green roofs, rain gardens, and rainwater run-off reduction. Other methods are used, such as adopting low-impact construction materials or using packed gravel or permeable concrete instead of standard concrete or asphalt to improve floor water replenishment.

Saving Energy

There are two ways to save energy by using the environmentally friendly construction idea. The first step is to reduce energy use in lighting, air conditioning, and other building functions. The second step is to employ energy sources that do not emit greenhouse emissions and are renewable. Green buildings place a greater emphasis on natural lighting, temperature management, and efficient design in order to decrease carbon emissions and operating costs.

Saving water

Sustainable buildings implement a variety of techniques to minimise water consumption, treat and reusage of sewage, and filter rainwater. The goal is to have no negative influence on the water table as a result of green architecture.

Waste Reduction

Sustainable buildings apply a variety of techniques to minimise water consumption, treat and reuse sewage, and filter rainwater. The goal is to be able to reach zero waste. One of the most pressing challenges to be addressed is waste minimization. The sustainable construction idea focuses on enhancing product design, reusing, and recycling resources. It leads in significant waste reduction as well as a reduction in the building's environmental impact. Green construction has a detrimental influence on the table.

Enhancing Productivity and Health

Human productivity is also boosted by cleanliness and adequate conditions within the structure. As a result, many companies place an emphasis on this factor. The Green Building idea ensures that employees and other residents have clean and healthy workplace environment.

3.3 Green Building Index (GBI) Certification Procedures

Project teams must comprehend the needed criteria of the key components of the Green Building Index (GBI) Rating Tool in order for a project to be Green Building Index (GBI) certified. In order to get the requisite credit points, each of the primary six requirements is further broken into sub-sections. In order for a building to be Green Building Index (GBI) classified, project teams a required to follow these procedures :

Stage 1 : Application and Registration

Stage 2 : Design Assessment (DA)

Stage 3 : Completion and Verification Assesment (CVA)

3.3.1 Stage 1 : Application and Registration

The DASH side must complete and hand in the GBI Application Form with their contact details, project information and supporting documents to Greenbuildingindex Sdn Bhd (GSB). GSB would request for more information from DASH if the application form was not completed. Once completed, GSB processes the application and alerted DASH of the registration fee. DASH is required to make necessary registration fee payment to GSB and submit other additional information. After that, GSB registers DASH's Application to certify Denai Alam, RRIM and Kota Damansara Toll Plaza and handed a GBI Registration Number to DASH. A GBI Agreement between DASH and GSB was signed. At the end of this stage, GSB assigned a GBI Certifier for certification process.

3.3.2 Stage 2 : Design Assesment (DA)

During this stage, DASH appointed IEN Consultants as the GBI Facilitator for Design Assessment (DA) to GSB. Inside this period, the coordination between the client, contractors and consultants for items and necessary document submissions is highly needed in order to secure points for the GBI Assesment Criteria scorecard which consists of 6 different items to be looked into. Failure to submit the required items and documents to the GBI Facilitator would cause point deduction in the scorecard, thus decreasing the chances of achieving higher GBI Classification.

PROLINTAS DASH TP02
Green Building Index (GBI) Score Summary
02-Jun-21

Item	Area of Assessment	Maximum Points	TP02 Target Score	TP02 Confirmed/ Likely	TP02 Pending/ Outstanding	Required Supporting Documents	PIC
	ENERGY EFFICIENCY	**35**	**31**	**1**	**30**		
EE1	**Minimum EE Performance**	1	1		1	1. Insulation materials apporval form, specification & thickness	SBSB
EE2	**Lighting Zoning**	3	3	1	2	1. Confirmed number of motion sensor & photo sensor 2. Shop drawings, eg layout plan & schematic drawings	KC & SBSB
EE3	**Electrical sub-metering & Tenant sub-metering**	1	1		1	1. Confirmed number of DPMs 2. Shop drawings, eg schematic drawings	KC & SBSB
EE4	**Renewable Energy**	5	5		5	1. Catalogue of solar PV, inverter, solar logger 2. Solar PV shop drawings, eg. Layout plan to show locations & schematic 3. Solar energy yield simulation by supplier	SBSB
EE5	**Advanced EE Performance** - To have > 55% reduction from Base Case's Building Energy Intensity (BEI) - Install solar PV with total capacity of > 220 kWp (rought estimation) **(however, the capacity of solar PV required depends on all the equipment used eg. AC, lighting. oluc. MV. etc. pending documents from Contractors)**	15	15		15	1. Specification, locations & quantity of AC, lighting, plug, etc. 2. Michellaneous load eg. Pump, lift, mechanical ventilation, etc	SBSB
EE6	Enhanced Commissioning	3	0	0		Not targeting. No appointment of CxS.	
EE7	**Post Occupancy Commissioning** - Design engineers to review tenancy fit-out plans to ensure design intent is not compromised, and upon completion of fit-out works, verify and fine-tune the installations to suit.	2	1		1	1. Documents to show the fit-out plans have been approved, stamped & signed by design engineer.	KC
EE8	**EE Verification** - Fully commission Energy Management System (EMS) & Maximum Demand Limiting Programme	2	2		2	1. Verify data of DPMs, DWMs, EMS & BEI 2. Include Maximum Demand Limiting Programme on EMS	KC & BMS Supplier
EE9	**Sustainable Maintenance**	3	3		3	1. Organization chart of maintenance team 2. Letter of appointment of maintenance team (must be before practical completion) 3. 3-year facility maintenance & preventive maintenance budget	DASH
	INDOOR ENVIRONMENTAL QUALITY	**21**	**15**	**9**	**6**		
EQ1	Minimum IAQ Performance	1	0	0		Not targeting. No outdoor air supply system.	
EQ2	**Environmental Tobacco Smoke (ETS) Control**	1	1	1			
EQ3	Carbon Dioxide Monitoring and Control	1	0	0		Not targeting. No CO2 sensor.	
EQ4	**Indoor Air Pollutants**	2	2		2	1. Specification of materials eg. Paint, sealant, flooring, adhesives, coatings, etc 2. Green certificate, eg. SIRIM Eco Label, Singapore Green Label, etc. 3. VOC content test reports 4. Finishes schedule	SBSB
EQ5	**Mould Prevention**	1	1	1			
EQ6	**Thermal Comfort: Design & Controllability of Systems** - Provide individual thermal comfort controls at location where occupants can adjust the temperature according to their preferences - Place the remote control of AC at places where occupants can see it and use it to adjust the temperature. label the remote control	2	2	2			
EQ7	Air Change Effectiveness	1	0	0		Not targeting.	
EQ8	**Daylighting**	2	1	1			
EQ9	**Daylight Glare Control**	1	1		1	1. Floor plans & sections showing position of blinds 2. Blinds specification	AAT & SBSB
EQ10	**Electric Lighting Levels**	1	1		1	1. Lux simulation report	KC & SBSB
EQ11	**High Frequency Ballasts**	1	1	1			
EQ12	**External Views**	2	1	1			
EQ13	Internal Noise Levels	1	0	0		Not targeting. Difficult to score with split units.	
EQ14	**IAQ Before & During Occupancy** - To carry out flush-out upon completion & duting initial 14 days of occupancy (Contractors to provide their own portable exhaust fans specification to IEN for duration required calculation) - To purchase at least 5 units of portable exhaust fans with 6000 CFM & keep at site for future flush-out	2	2		2	1. Exhaust fan specification & quantity for IEN to calculation duration required 2. Carry out flush-out before & during occupancy, record duration & take photos 3. PO/DO of portable exhaust fans 4. Portable exhaust fan specification	SBSB & DASH
EQ15	**Post Occupancy Comfort Survey: Verification**	2	2	2			

Table 5 : Sample of RRIM Toll Plaza (TP2) Score card

Once the Design Assesment (DA) submission is completed the GBI Certifier undertakes the Design Assesment (DA) and later on notifies DASH of the result. Just in case the result was unfortunate or the applicant requests review for higher rating, the applicant is able to submit Appeal Form and Fees to be reviewed once again.

The DASH toll plazas were able to secure silver rated GBI Certification, and there was no further appeals from DASH. After that, GSB issued the Provisional Silver Rating GBI Certificate to DASH. GSB records and publishes the certification in GBI Register.

3.3.3 Stage 3 : Completion and Verification Asessment (CVA)

When the construction of Denai Alam, RRIM and Kota Damansara toll plazas met its completion later on, DASH will submit Completion and Verification Assesment (CVA). The same process will take place where the GBI Certifier undertakes the CVA and notifies DASH of the CVA results. If the CVA was a failure or DASH appeals for a higher rating, they need

to submit appeal form and fees for it to be processed. However if appeal was not issued by DASH, GSB proceeds to issue the Silver Rating GBI Certificate to DASH and record in GBI Register

3.4 The Assesment Criteria Checklist For GBI certification

Buildings are given Platinum, Gold, Silver, or Certified grades based on specific standards established by the GBI authority. Buildings must be re-assessed every three years to preserve their ratings, thus this does not end after construction is over. This way, buildings will be consistently be well-maintained.

Before appointing a GBI certifier, developers would have to submit an application for GBI assessment and pay a fee. They will subsequently submit the project design to the GBI certifier for review. After that, an assessment panel will provide a provisional GBI Design Assessment certification along with a score sheet. After the project is finished, the final award will be issued following the completion of a Completion and Verification Assessment (CVA). Because buildings are used in different manners, there are distinct assessment techniques and scorecards for residential, commercial, and industrial constructions.

For a GBI certification, six criteria are analyzed to measure how "ecofriendly" a structure is listed as follows :-

1. Energy Effeciency

- Design
- Commisioning
- Verification and Maintenance

2. Indoor Environmental Quality

- Air Quality
- Thermal Comfort
- Lighting, Visual and Acoustic Comfort
- Verification

3. Sustainable Site Planning and Management

- Site Planning
- Construction Management
- Transportation

- Design

4. Materials and Resources

- Reused and Recycled Materials

- Sustainable Resources

- Waste Mananagement

- Green Products

5. Water Efficiency

- Water Harvesting and Recycling

- Increased Efficiency

6. Innovations

Energy Effeciency

The building's location for best natural lighting, the use of heat-insulating construction materials, and the utilisation of renewable energy sources such as solar are all factors to consider when designing an energy-efficient structure. During the building process, energy efficiency is also considered.

Figure 13 : Proposed location for Solar Panels at Kota Damansara Toll Plaza (TP3)

Indoor Environmental Quality

A green building's interior must provide excellent air quality, acoustics, visual, and thermal comfort. These are attained by the use of materials with low volatile organic compound content and the use of high-quality air filtration. Temperature, movement, and humidity must all be controlled properly.

Sustainable Site Planning and Management

By redeveloping existing lands, property developers can avoid ecologically sensitive locations. To safeguard the neighbouring surroundings and decrease the load on existing infrastructure, they should conduct efficient construction management and stormwater management. For example, a residential complex should be well-planned, with community facilities, open spaces, and attractive landscaping. It also is crucial to have easy access to public transit, such as the MRT or LRT, from the property site to encourage inhabitants to lessen their carbon footprint.

Materials and Resources

Encourage the use of environmentally friendly products based on renewable resources, as well as recycling. Implement effective construction waste management by storing recyclables, collecting them, and reusing building formwork and debris.

Water Effeciency

Rainwater harvesting, water recycling, and water-saving fixtures should all be included in buildings to improve water efficiency.

Innovation

To accomplish the GBI's goals, developers must implement green innovation into their design and construction.

CHAPTER 4.0

CONCLUSION

In summary, Sustainable buildings would certainly steadily be the most widely used structural engineering structure today. Green construction will be a critical focus for property owners and even governments all over the world. Although some world-class green buildings have been constructed in Malaysia in recent years, the concept of green buildings for the general public is still in its infancy. Because of this fact, the Green Building Index is a great way to expose developers into planning and constructing energy efficent and eco friendly structures that would definetely benefit not only civilians but also the surrounding nature.

By following carefully the procedures stated by Green Building Index, there would be a high chance of the building to achieve a better rating, which would also effect the productivity rate positively of that particular building since it happens to be an eco friendly structure.

In conclusion, Green Building Index Certifications is a stepping stone for local developers to attain a better development without having to worry about environmental issues.

Reference

1. PROLINTAS Official website, 2022

https://www.prolintas.com.my/

2. Damansara – Shah Alam Elevated Expressway,2021

https://en.wikipedia.org/wiki/Damansara%E2%80%93Shah_Alam_Elevated_Expressway

3. The Objective Of Green Building Concept Environmental,2022

https://www.ukessays.com/essays/environmental-sciences/the-objective-of-green-building-concept-environmental-sciences-essay.php

4. GBI Assesment Process,2020

https://www.greenbuildingindex.org/how-gbi-works/gbi-assessment-process/

5. Green Building Index,2011

https://www.slideshare.net/erazedrus/green-building-index

6. Review of Green Building Index in Malaysia; Existing Work and Challenges, 2016

https://www.researchgate.net/publication/328556644_Review_of_Green_Building_Index_in_Malaysia_Existing_Work_and_Challenges

7. Green Building Index (GBI) Non Residential New Construction (NRNC) Design Reference Guide and Submission Format, 2011