OPEN BIM STRUCTURAL MODELLING AND DESIGN ANALYSIS ON DOUBLE STOREY REINFORCED CONCRETE TERRACE RESIDENTIAL HOUSE

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A project report submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering (Honours) Civil Engineering

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May 2022

DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

I certify that this project report entitled **"OPEN BIM STRUCTURAL MODELLING AND DESIGN ANALYSIS ON DOUBLE STOREY REINFORCED CONCRETE TERRACE RESIDENTIAL HOUSE"** was prepared by **GOH YI HAN** has met the required standard for submission in partial fulfilment of the requirements for the award of Bachelor of Engineering (Honours) Civil Engineering at Universiti Tunku Abdul Rahman.

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ACKNOWLEDGEMENTS

I would like to thank everyone who has contributed to the successful completion of this project. I would like to express my gratitude to my research supervisor, Ts. Dr. Yip Chun Chieh for his invaluable advice, guidance and his enormous patience throughout the development of the research.

In addition, I would also like to express my gratitude to my loving parents and friends who have helped and given me encouragement, love and care throughout my research duration.

ABSTRACT

The construction industry plays a significant role in promoting economic growth and social stability in every country. The conventional construction method which adopts the manual design calculation is proven to be time consuming and inconsistent has led to the events of project delay and over budget. Meanwhile, the building information modelling (BIM) method which utilizes the software in performing modelling and design works is an alternative or replacement to the conventional method. The industry is well aware of the existence of the BIM tools in the market. However, due to factors such as high overhead cost and unexperienced BIM modeller, only a certain number of industry players have invested on the BIM concept design. This study aims to model and design a double storey reinforced concrete house using open BIM tools and compare with the actual as-built design. The open BIM method utilizes software from different vendors whereby in this study, Autodesk Revit and SCIA Engineer is utilized for modelling and structural analysis respectively. The structural frame is constructed in Autodesk Revit based on the architecture and C&S as-built drawings. The structural model which consist of structural beam, slab and columns are exported to SCIA Engineer to perform load assignation and structural analysis on the structural model. Hence, the critical structural elements which comprises of beam, slab and columns are identified. The first model is designed with the as-built reinforcement design. In the meantime, the reinforcement design in accordance to the European Code 2 are performed on the critical structural elements which results in another model with a new reinforcement design. Upon the addition of the new reinforcement designs, capacity check indicates modified reinforcement is required for the first floor beam and column. The two structural model with different reinforcement design are exported back to Autodesk Revit for quantity take off. The result of the quantity take-off present that the cost of structural material usage for the as-built model and the new model are RM 146,497.59 and RM 137,753.63 respectively whereby the percentage difference on the cost for the two design are 5.97%. In a nutshell, this study concludes that the BIM design approach has a more effective material usage which provides a more economical design compared to the conventional design.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS / ABBREVIATIONS

Δc_{dev}	deviation of concrete cover, mm
λ	slenderness ratio
λ_{lim}	limiting slenderness ratio
A_{sw}/s	area of shear reinforcement per spacing
$A_{sw,min}/s$	area of shear reinforcement per spacing
$A_{s,prov}$	area of reinforcement steel provided, mm^2
$A_{s,req}$	area of reinforcement steel required, mm^2
c_{min}	minimum concrete cover, mm
c_{nom}	nominal concrete cover, mm
f_{ck}	characteristic of compressive strength, N/mm^2
g_k	characteristics permanent load
q_k	characteristics variable load
s_{max}	maximum shear link spacing, mm
V_{Ed}	shear force, kN
V_{min}	minimum shear resistance, kN
$V_{Rd,c}$	design shear resistance, kN

AEC	Architecture, engineering and construction
BDS	Building description system
BIM	Building information model
BQ	Bill of quantities
BS	British Standards
BSI	British Standards Institution
C&S	Civil and structure
CAD	Computer aided design
CIDB	Construction Industry Development Board Malaysia
EU	European Union
GDP	Gross domestic product
HVAC	Heating, ventilating and air-conditioning
IEM	Institution of Engineers Malaysia
IFC	Industry Foundation Classes
JSM	Department of Standards Malaysia

LRFD	Load and factor resistance design
MDAX	Mid Cap Dax
MEP	Mechanical, electrical and plumbing
MITI	Ministry of International Trade and Industry
NASDAQ	National Association of Securities Dealers Automated Quotations
QS	Quantity Surveyor
RTI	Recycle tyre isolators
S&P 500	Standard and Poor's 500
SLS	Serviceability limit states
SOCP	Structural optimization computing platform
TecDAX	Technology Companies Index
ULS	Ultimate limit states

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 General Introduction

The construction industry is considered to be an essential sector for the growth of a country's economy. This industry has been growing rapidly and it does not seem to have sign of slowing down. Based on a research paper that states that the construction industry constitutes a $1.7 trillion industry globally and the construction industry alone influence the Gross Domestic Product (GDP) of most countries by 5 to 7 percent (Kenny, 2007). A study proves that the economy of a country is affected significantly by the construction industry. The construction industry is important in contributing to the expansion of townships with proper infrastructures and shelters. On the other hand, job opportunities in the construction industry are applicable to a wide range of people from skilled professionals, medium skilled and low skilled labour (Khan, 2008). Therefore, a sustainable construction industry is crucial in providing a stable social and economic growth of a country. The problems of undergrowth or underdeveloped countries can be overcome by ensuring an effective construction sector management (Alaloul et al., 2021).

A successful construction project involves various professional inputs from different backgrounds. Back in the days when computers were not involved in construction, the collaboration among structural engineers, contractors and architects in a project was complex. The complexity of the project consists of thousands of 2D drawings and documents which were drawn or printed manually. Poor understanding and miscommunication of the 2D drawings would heavily impact the construction project in terms of financial and project timeline. However, in the late 1970, Professor Charles Eastman developed the Building Information Model (BIM) concept based on computer programs to increase the efficiency of a construction project. Figure 1.1 shows the development from Building Description System (BDS) in 1970's to the current BIM that is currently used in the industry. Throughout the years, the computer programs have improved into wider perspectives such as building life cycle, construction technologies, cost estimation and designing work (Aryani, Brahim and Fathi, 2014).

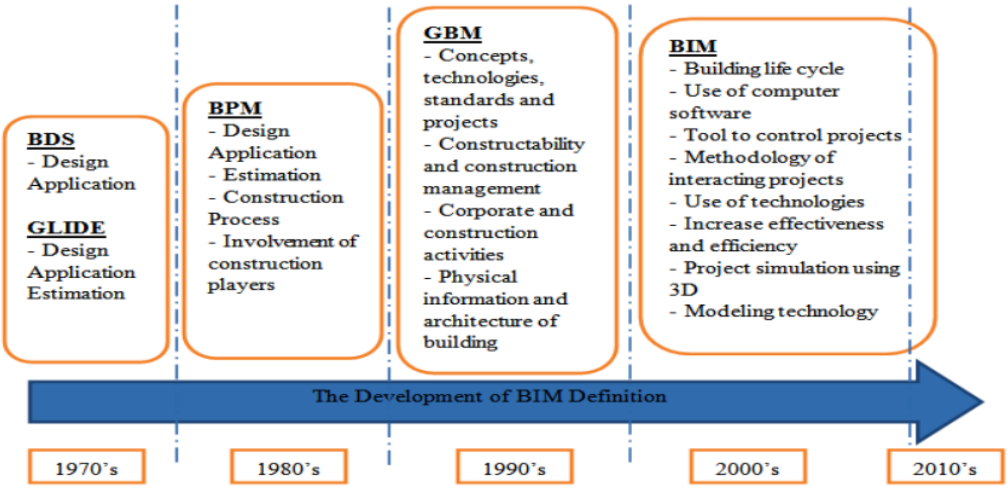


Figure 1.1: The development of BIM definition (Aryani, Brahim and Fathi, 2014)

BIM is one of the most notable achievements in the industry which has changed the perspective of engineers, architects and contractors in a project. The evolution of traditional 2D drawings to 3D virtual models with detailed information is able to give an early preview on a structural design and the behaviour of a structure. In the same time, complications on the design can be identified and resolved in the early stage of the project (Kubba, 2012). Hence, a complete BIM model presents every piece of information in a structure accurately.

Despite the remarkable impact of BIM globally, Malaysia is still lacking behind due to various aspects such as the lack of knowledge, funds and official standardization. A consultant firm had performed a study on 359 construction projects and the result shows that about 55% of the construction projects experience cost overruns. The study also indicates that public sector projects are doing better than private sector projects (Shehu et al., 2014). Figure 1.2 shows the application of BIM in the public and private sector in Malaysia. Both public and private sectors have 8.2% and 4.9% of the organizations which adopt BIM in construction projects respectively. The study and the data both correspond and conclude that the public sector has a better performance as it has a higher application rate of BIM in their projects than private sector projects.

The reasons which lead to this low application of BIM in organization is due to the higher cost, lack of knowledge and the difficulties in shifting from the traditional method. However, the ignorance of organizations which are not willing to change even when the traditional method is proven to have a higher construction material wastage and lower construction efficiency. Therefore, the Construction Industry Development Board Malaysia (CIDB) continues to promote the implementation of BIM actively to increase the efficiency in upcoming construction projects (Othman et al., 2021).

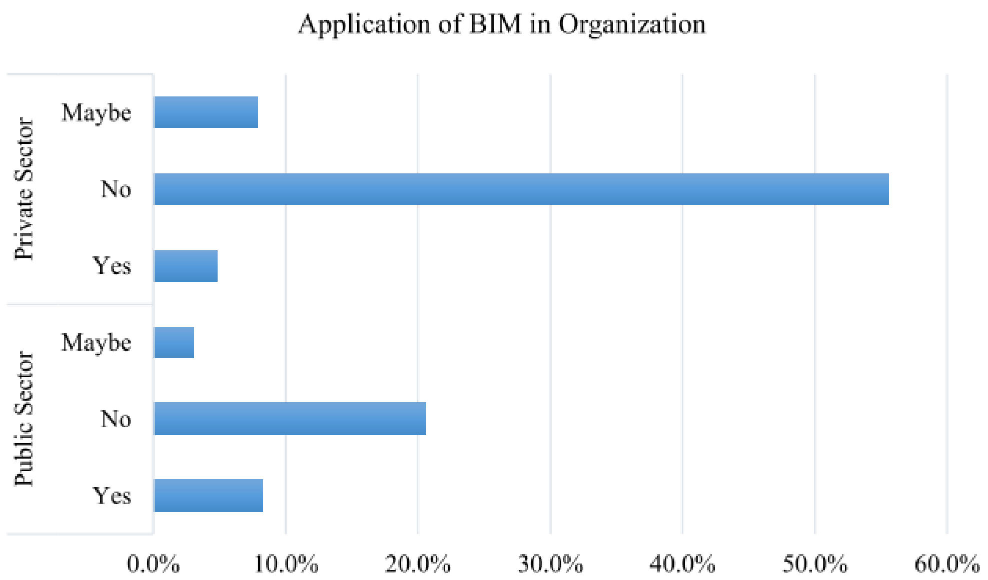


Figure 1.2: Number of organization using BIM in Malaysia (Othman et al., 2021)

1.2 Importance of the Study

The outcome of this study shows the difference in applying BIM tools in the construction industry compared to the traditional construction method. The ability of the traditional method in providing a conventional design when compared to structural analysis by BIM tools is studied as well. This study displays the difference in construction material costing between the as build model and the BIM designed model. The BIM construction methods are examined to understand the impact of BIM in a construction project in providing an economical design. An advanced and modern BIM tools in the industry would greatly increase the value of the construction with better efficiency and reliability. Hence, this study will show the future advantages in the construction industry with the implementation of BIM tools.

1.3 Problem Statement

Datuk Ahmad Asri Abdul Hamid, the chief executive of CIDB mentioned that BIM is only implemented in a few large companies in Malaysia (Bernama, 2019). This statement can be supported with the CIDB report in 2017 that indicates 84% of organizations are willing to change and implement BIM in their projects. However, only 33% of the organization has invested in BIM tools. Besides, 83% of construction organizations have no experience in using BIM tools in their project (Construction Industry Development Board Malaysia, 2017). This report proves that most organizations are willing to make the change but organizations who are really taking the action to make the change are only a minority of them. This is due to the cost of making the changes are too high for some organizations. One of the costs needed is the cost of the BIM tools software and computer technology which is to run the software smoothly. Organizations as well need to pay for employees' training costs to learn about the BIM tools software in order to enhance their modelling and designing skill.

In the current construction industry in Malaysia, the traditional 2D drawings are still implemented in most of the projects. This method is not ideal as inconsistency in the structural drawings may lead to delay in the project progress. The collision detection in the traditional method needs to be identified visually which is less effective compared to BIM tools which can detect overlapped design instantly (Czmoch and Pękala, 2014). Therefore, modelling and design of a double storey reinforced concrete terrace house based on actual as built structural drawing may face inconsistent design.

Design analysis in the traditional method is time consuming as manual calculation needs to be examined. Over the years, engineers speed up the designing stage by using simplified methods (Czmoch and Pękala, 2014). However, this often leads to an uneconomical structural design. Despite utilizing the BIM tools, insufficient knowledge in the BIM software may also lead to design errors. Furthermore, engineers with limited experience on the BIM software may also result in an extensive design duration as users are not familiar with the software interface. Hence, certain projects prefer utilizing the traditional design method due to the lack of exposure to the BIM software.

1.4 Aim and Objectives

The aim of the research is to model and design a double storey reinforced concrete terrace house using open BIM tools and compare the new design with the actual as built structural drawing. The objectives of the study are as follow:

1. To model the terrace structural framing in open BIM tools.
2. To perform the structural analysis in accordance to European Code 2 and identify the critical structural elements on terrace house.
3. To compare the percentage difference in structural material quantity usage between designed versus as build model.

1.5 Scope and Limitation of the Study

The scope of this study is based on an actual as built structural drawing of a double storey reinforced concrete terrace house. Based on the structural drawing, BIM tools such as Autodesk Revit and SCIA Engineer are used to model and design the structure. The structural framing of a double storey reinforced concrete terrace house is modelled and designed in the Autodesk Revit software. Next, SCIA Engineer software is utilized to perform structural analysis in compliance to the European Code 2 and determine its critical structural element. The quantity take-off is performed through the BIM method to obtain the cost estimation of the project. Lastly, the designed structural model is then compared to the as built model to determine the design and cost efficiency of an as built model.

The limitation of the study is the design analysis of the model from ground floor to the roof floor without the consideration of foundation or geotechnical design. This is due to the lack of information on the ground and soil condition from the project site. Another limitation in this study is that the design analysis of roof trusses is not involved due to insufficient information on the roof trusses design.

1.6 Contribution of the Study

The outcome of this study displays the difference between traditional method and BIM method in the design of a 5 units reinforced concrete double storey terrace house. The study’s result is crucial to the existing or new construction industry players in determining the ideal structural design method in the industry. The findings of this study as well serves to gain the trust from the communities on the BIM method which has the potential in replacing the traditional method. Lastly, the result of the research is important to industry leaders and project owners to acknowledge that the utilization of the BIM method is a giant leap in the construction industry.

1.7 Outline of the Report

Chapter 1 Introduction highlights the general introduction and the importance of the study. The problem statement describes the problem faced in Malaysia that limits the application of BIM in the industry. Besides, the aim and objectives of this study is highlighted in this chapter. This chapter as well discussed the scopes, limitations and contribution of the study.

Chapter 2 Literature Review discussed the applications of BIM in the construction industry globally. The various types of BIM tools available in the market which adopt the open BIM and closed BIM approach are reviewed. Next, the Autodesk Revit which is a modelling software while SCIA Engineer which is a structural analysis software are discussed. The design standard MS EN Eurocode is highlighted in this chapter. Besides, the properties of reinforced concrete and structural frames are discussed. Additionally, the earthquake resistance structural frames and failure modes in a structure are highlighted. Lastly, this chapter discussed the bill of quantities and quantity take-off.

Chapter 3 Methodology displays the workflow in order to complete the study. The study starts with the overview of the 5-units double storey reinforced concrete terrace house construction drawing in order to construct a similar structural model in Autodesk Revit. Next, the structural analysis of the model in SCIA Engineer are discussed. The tasks presented are the load assignation, reinforcement design of critical structural members and the reinforcement capacity check of the new design. Additionally, the export and import of models between Autodesk Revit and SCIA Engineer are also presented in this chapter. Lastly, the quantity take-off performed on the two structural models are presented.

Chapter 4 Results and Discussion mainly discuss on the output of the results from the study. The critical structural members and the reinforcement design in accordance to the European Code 2 are discussed in this chapter. The reinforcement capacity check is performed on the critical members and proposed design modification are presented. Lastly, the result of quantity take-off on the two structural models are compared and discussed.

Chapter 5 Conclusion and Recommendations draw conclusions based on the results obtained in this study and provide recommendations on future works.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter mainly evaluates the application of BIM tools in the construction industry globally. For instance, Shanghai Tower, the second tallest building in the world with a height of 632 metre. The complexity of the design with curving appearance makes it known to be the tallest twisted building in the world (Valencia, 2021). The application of Autodesk BIM played a huge role in completing this Shanghai Tower project in 2015. This largest skyscraper in China involves a large scale of project team globally. Autodesk Inc (2012) reported a list of companies involved in the project and their role as shown in Table 2.1. The collaboration among these 9 companies would play a vital role to ensure understanding of the design by different professionals who are on the same page. BIM has come in handy in this project where the software is able to show precise detail of the design accurately. Besides, a case study on the project has proven that the application of BIM has enhanced work coordination, design communication and construction efficiency. Compared to the conventional construction method, this BIM method had successfully saved the building materials by 32% (Autodesk Inc, 2012).

Table 2.1: List of companies and roles in Shanghai Tower project (Autodesk Inc, 2012)

No.	Companies	Roles
1	Shanghai Tower Construction & Development	Owner / Developer
2	Gensler	Design architect
3	Architectural Design and Research Institute of Tongji University	Local design institute
4	Thornton Tomasetti	Structural engineer
5	Cosentini Associates	MEP engineer
6	Shanghai Construction Group	General contractor

7	Shanghai Installation Engineering	Mechanical and electrical general contractor
8	Shanghai Xiandai Engineering Consultants	Design management consultant
9	Autodesk consulting	BIM strategy, training and implementation consultant

2.2 BIM Tools

BIM is a modern day tool in the construction industry whereby most of the things are being digitised to improve work efficiency. The involvement of the computer aided design (CAD) has the ability to present 3D modelling, advanced geometry and complex surfaces in a construction project easily. Models generated through BIM tools are represented or viewed digitally. Besides, components and data of the structural models are analysed through BIM tools as well. In short, BIM tools can be utilized in different stages such as planning stages, designing stages and constructing stages (Sacks et al., 2018). Table 2.2 shows a few types of BIM tools available in the industry and their purpose. For instance, the BIM content management software which acts as a storage, collection, update and sorting of library content is able to ease the design work with minimal disruption. The few BIM content management software available in the market are UNIFI, AVAIL, BIM Object and MagiCAD. The few other types of BIM tools such as modelling software, analysis software, validation software and construction software has their respective purposes. Additionally, the available software for each type of the BIM tools in the market are plenty and the selection of the best BIM tools are crucial to ensure an effective outcome in a project. The two types of software used in this study are the Autodesk Revit and SCIA Engineer.

Table 2.2: Type of BIM tools and the purpose of BIM software

Type of BIM tools	Purpose of BIM tools	BIM software example
BIM content management software	Act as a storage, collection, updating and sorting of library content. Ease the design work with minimal disruption.	- UNIFI - AVAIL - BIM Object - MagiCAD
BIM modelling software	Allow users to present architecture model, structural model, interior design or landscape digitally in 3D.	- Autodesk Revit - SketchUp - ArchiCAD - Tekla
BIM analysis software	Perform structural analysis on 3D structural model in any material. Accurate analysis provides an economical design.	- SCIA Engineer - Robot Structural Analysis - STAAD - Sefaira
BIM validation software	Allow users to combine 3D models from different designers and perform validation checks. Prevent design inconsistency.	- BIM Track - Revizto - Navisworks - BIM Assure
BIM construction software	Optimize the project schedule to improve work efficiency on site. Optimize construction planning.	- Grit Virtual - Alice Technologies - Verity

2.2.1 Open BIM and Closed BIM

A single construction project would require multiple BIM tools at different phases of construction. However, the wide range of BIM tools available in the industry has led to two different approaches which are open BIM and closed BIM. The selection of these two approaches are based on the project owner or project manager's preference.

The open BIM programme is the collaboration among the few leading software vendors such as buildingSMART International and members of Nemetschek Group. This approach is also known as a universal approach whereby a collaborative design among different software vendors are made compatible. The architecture, engineering and construction (AEC) industry is greatly benefited as each project member from different fields is able to use their own respective BIM software. The BIM data from different software are accessible by all users and coordination errors are minimized (SCIA, 2012). In short, a project with this approach is operated among a wide range of different software vendors.

On the other hand, closed BIM which is also known as lonely BIM is the opposite of the open BIM approach. This closed BIM approach uses the same software from a similar vendor in the project. For instance, Autodesk Revit can be used by architecture, structural engineer, mechanical, engineering and plumbing (MEP) engineers to perform design and modelling. The project team members only operate within the similar software for the entire project. Therefore, it will not require any file conversion from different software and the compatibility issue will not arise (UK Construction Online, 2018). This method is said to be not sustainable in a long term run due to the limitation of collaboration among different software users. In short, closed BIM may be suitable for small groups of project teams but in larger firms or organizations, open BIM method is much more practical.

The selection of open BIM or closed BIM approach appears to benefit in different ways. A study has been carried out on two different companies whereby each company adopts a different BIM approach. The result of the study shows that closed BIM are much simpler to be operated within the company while open BIM are more collaborative. However, the issue raised by the two companies is the building physics software which does not support the Industry Foundation Classes (IFC) file. This has caused data losses during the export of data between BIM model and building physics (Kovacic et al., 2014). Therefore, the improvement of BIM tools must continue especially in terms of data exchange to provide an integrated project environment to the industry.

2.3 Autodesk

Autodesk is a company founded back in 1982 by John Walker. Despite being the owner and founder of Autodesk, John Walker has withdrawn in 1986 to be the programmer in Autodesk's advanced research and development division (Markoff, 1994). Autodesk's rapid growth as a software company has led to their current success to be among the top listed technology stocks in National Association of Securities Dealers Automated Quotations (NASDAQ). According to S&P 500 Index Components (2021), Autodesk as well is ranked at the top 123 companies in the Standard and Poor's 500 (S&P 500) list.

Autodesk's core business aims to introduce the application of technology software in the AEC industry. The few software that are designed to serve the AEC industry are Architecture Engineering & Construction Collection, Revit, BIM 360, Robot Structural Analysis Professional, ReCap Pro, Advance Steel, Structural Bridge Design, AutoCAD and Navisworks as shown in Figure 2.1. Autodesk started with their main software AutoCAD which is known for its capability in creating precise and accurate 2D and 3D drawings (Taylor and Covell, 2018). The CAD software generated great success in the company which leads to further development of their business. For instance, Autodesk has now expanded their business into the media and entertainment industry. The long list of software available in Autodesk allows them to widen their users from various project backgrounds globally.

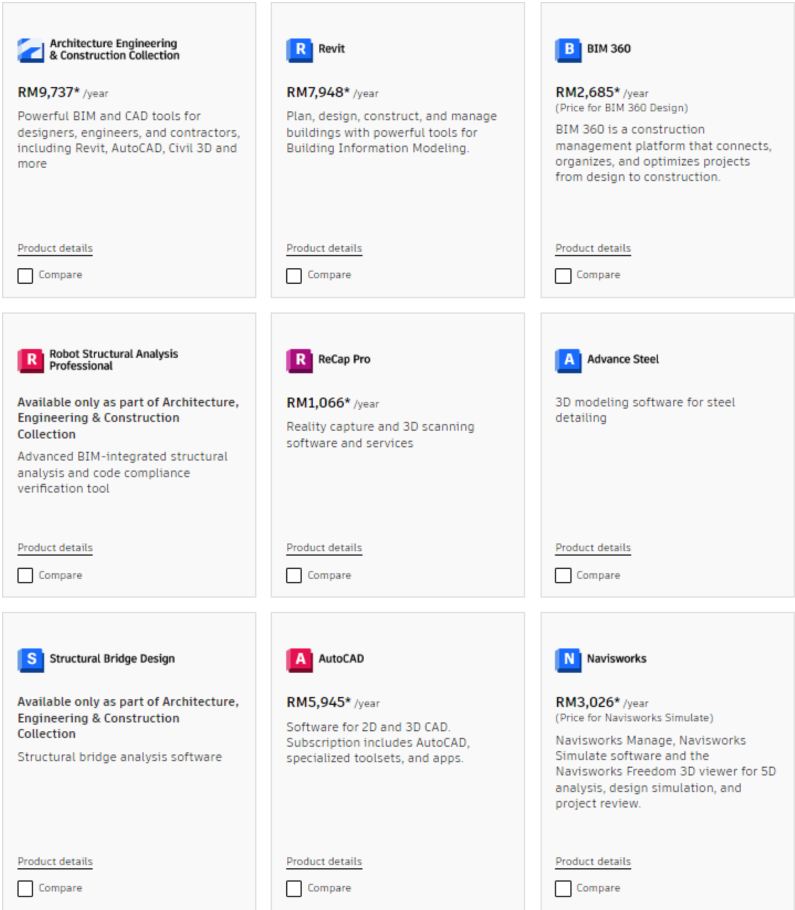


Figure 2.1: Example of Autodesk software in the AEC industry (Autodesk, 2022d)

2.3.1 Autodesk Revit

Autodesk introduced Revit in 2002 and marks a start to the future BIM development in the company. Autodesk Revit is a revolution in the BIM world which allows users to model 3D buildings virtually in the software (Kuijpers, 2018). An industry analyst reported that Revit increases the level of service, design quality and performance for the end user. Additionally, a firm reported that Revit has completed several projects within half the budgeted time and half the budgeted workforce (Khemlani, 2004). Therefore, the AEC industry is slowly in the transition to BIM rather than the traditional CAD as BIM provides better coordination and automation in a project. A project starting from architecture design, structural design, MEP design and lastly construction phase can fully utilize the Autodesk Revit software. In conclusion, Autodesk Revit is able to provide a common BIM environment to engineers and architects at different phases of construction.

2.3.2 Revit for architecture

The Revit software has one of the functions in modelling an architectural design. Architects will be able to model or express their conceptual design into BIM data. Figure 2.2 shows a complete design of architecture model including the interior components such as doors, windows and furniture that is modelled in the software. Due to the advancement of the software technology, the floor plans, elevations, schedules and sections will be generated automatically. This allows estimation of cost and optimization of the building performance in the pre-construction stage of the project. Additionally, rendering of realistic pictures of the building can be generated through the software (Autodesk, 2021a). In a nutshell, the architectural design function is able to provide better coordination in terms of documentation with all BIM data stored in the single modelling file. The design communication as well can be operated smoothly at different stages of a project with professionals from different background.

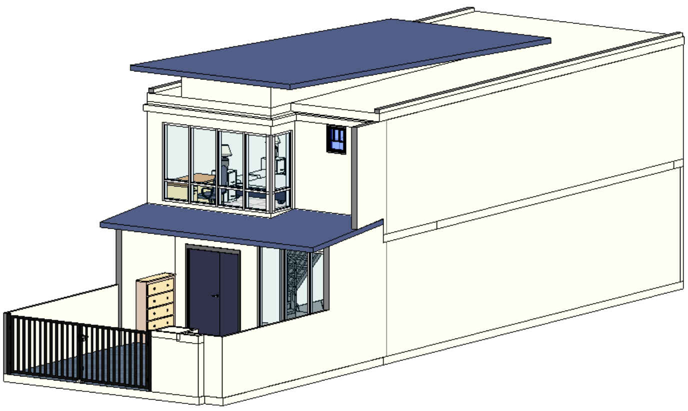


Figure 2.2: Architecture model of double storey terrace house (Tai, Goh and Seo, 2021)

2.3.3 Revit for structural engineering

Revit is also a software built for structural engineers to utilize BIM in their design. The software allows structural engineers to design and model structural framing of a building. Models can be constructed with various construction materials such as reinforced concrete or steel structure depending on the design requirement. Besides when constructing a physical structural model as shown in Figure 2.3, the analytical model will be constructed automatically as well shown in Figure 2.4. This allows structural engineers to export the file directly to Autodesk Robot, a structural analysis tool or even other structural analysis software. Moreover, design documentation such as shop drawing and rebar detailing can be done efficiently with the assistance of BIM data that has been modelled in the structure (Autodesk, 2021c). Therefore, detailed and accurate design of structural models can be presented effectively in the software.

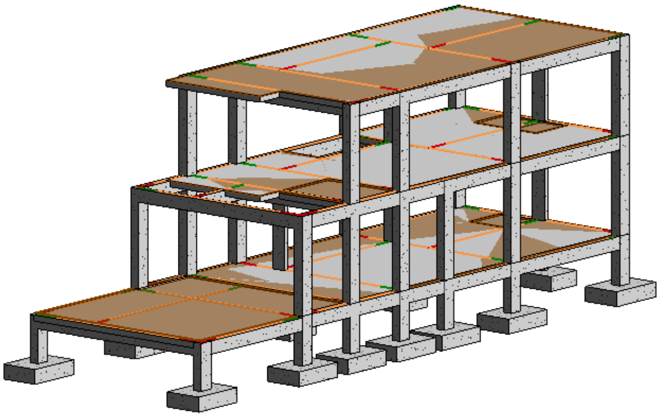


Figure 2.3: Structural model of a double storey terrace house (Tai, Goh and Seo, 2021)

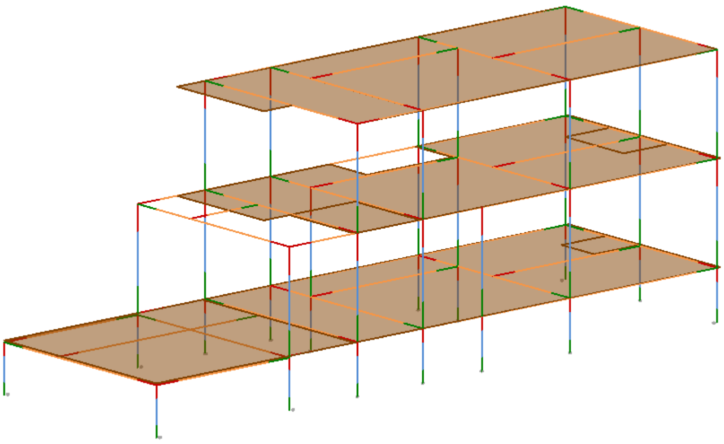


Figure 2.4: Analytical model of double storey terrace house (Tai, Goh and Seo, 2021)

2.3.4 Revit for MEP engineering

Engineers from the MEP industry are exposed to the BIM software to provide better design and installation works in a building. The common complications of MEP engineers in a project are mainly the coordination among their design. The design of engineers in this field includes the design of water pipes, electricity supply, heating, ventilating and air-conditioning (HVAC) duct in a building as shown in Figure 2.5 (Korman, Simonian and Speidel, 2008). Revit software has the ability to allow engineers responsible for each design to have better coordination in a project as the MEP system is designed and modelled in a common BIM software. The inconsistency in the design can be detected instantly during the design phase. Furthermore, Revit software allows the MEP fabrication work to be done on the model automatically using the proper fabrication tool (Autodesk, 2021b). With the help of BIM data of the designed model, time consumed or project delay due to MEP design and fabrication process can be minimized.

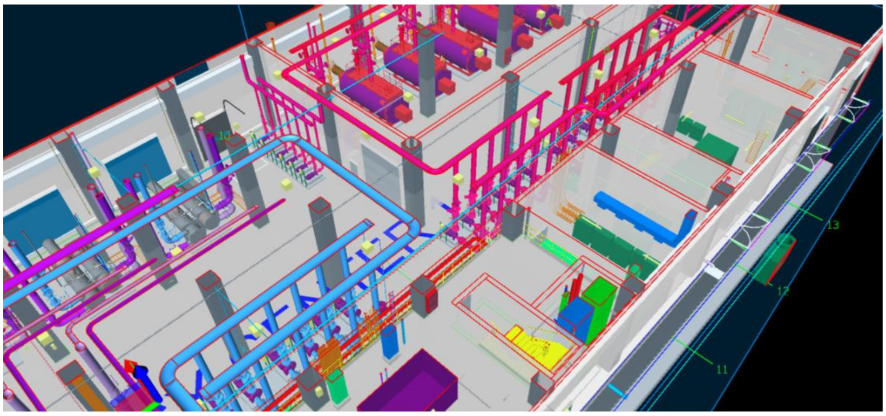


Figure 2.5: MEP system design in Autodesk Revit (FOSCAT, 2020)

2.4 SCIA

Nemetschek Group was established back then in 1963 by Prof. Georg Nemetschek. Since the public listing of the company in 1999 in Mid Cap Dax (MDAX) and Technology Companies Index (TecDAX), they have grown rapidly and have more than 6 million users from around the world. Nemetschek Group aims to digitalise the AEC industry by providing intelligent software solutions. The software that is introduced constitutes the entire building cycle from designing, building, managing and media. Figure 2.6 shows the different types of software companies owned by Nemetschek Group for different purposes (Nemetschek Group, 2021).

Figure 2.6: Software owned by Nemetschek Group (Nemetschek Group, 2021)

SCIA, a software developer company which was found in 1974 has become one of the top developer experts in structural design and analysis software. The company aims to optimize the structural design in providing an effective solution in the AEC industry. SCIA Engineer software is well integrated and suits a variety of projects such as bridges, skyscrapers, office buildings and industrial plants. SCIA software is capable of supporting over 20 national standards including Eurocodes which are applied in Malaysia. Besides, the expansion of the software to provide up to 13 local languages has allowed the software to be distributed globally. The continual innovation and improvement over the decades has led SCIA to its high accountability with more than 5 million users worldwide today (SCIA, 2021a).

2.4.1 SCIA Engineer

The core of the company which has their main software, SCIA Engineer is well known for its ability to perform structural modelling, analysis and design. In other words, the software has the capability to perform a full design process through SCIA software alone. Despite the comprehensive software design, SCIA has also expanded in providing the Open BIM concept to allow users to exchange models from other BIM software (SCIA, 2021c). This promotes different software users to work together in a single project to increase efficiency in design and modelling.

Recently in the year 2021, SCIA has launched their latest version SCIA Engineer 21.0 with the motto “Redefined, Reimagined, Revolutionised”. SCIA claims that this would be a giant leap in the industry which assists structural engineers to work effectively and efficiently by software design. One of the significant updates in the latest version of SCIA Engineer is their redesigned interface which utilizes the working space to the maximum with the new smart toolbar as shown in Figure 2.7. These features are expected to increase productivity of users. Design and analysis of structure as well are improved to allow users to modify to select different load cases in static or seismic condition for model calculation. Steel and concrete designs are enhanced and expected to reduce calculation time of reinforcement in structural members by 50% (SCIA, 2021b). The never ending development and enhancement of SCIA Engineer has led them to be one of the leading BIM structural analysis software globally.

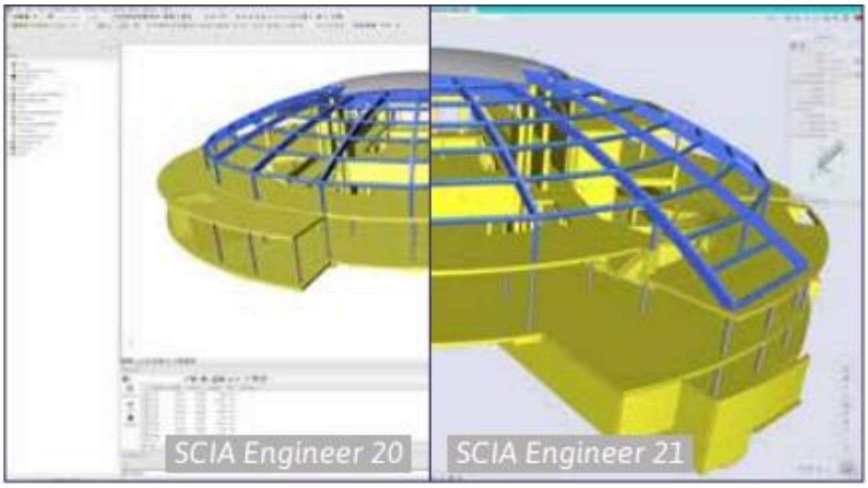


Figure 2.7: Redesigned new interface in SCIA Engineer 21.0 (SCIA, 2021b)

2.4.2 Possible future development of SCIA Engineer

The current SCIA Engineer software has been handy to engineers in terms of designing and modelling of a structure. The program is designed to be user friendly and reduce the burden of engineers in structure analysis. With the saying ‘the sky is the limit’, SCIA Engineer’s software development will not come to an end.

SCIA Engineer has the ability to perform structural analysis checking provided that all structural elements such as beam size has been pre-set by the engineers. The judgement of engineers in this case might not lead to an optimized design solution for the users. Therefore, SCIA Engineer may need to consider providing an optimized solution for users in terms of material cost or construction cost.

A study on the SCIA Engineer software and structural optimization computing platform (SOCP) has been conducted to determine how SCIA and SOCP develop to provide an optimized solution. SOCP is an optimization tool which is able to optimize structure with various algorithms to provide the best feasible solution. Figure 2.8 shows an example of structure from SCIA Engineer where the roof beams will be optimized (pink dotted lines) in this case study. The loading combination based on the load and factor resistance design (LRFD) code is applied in the optimization problem. The result of the optimization is shown in Table 2.3. Therefore, the beam sizing is said to be optimized since the design violation of 0.98 is very near to its limit of 1.0 (Mitropoulou et al., 2020). In short, the study has proven that the SCIA Engineer may consider developing into providing optimized design solution.

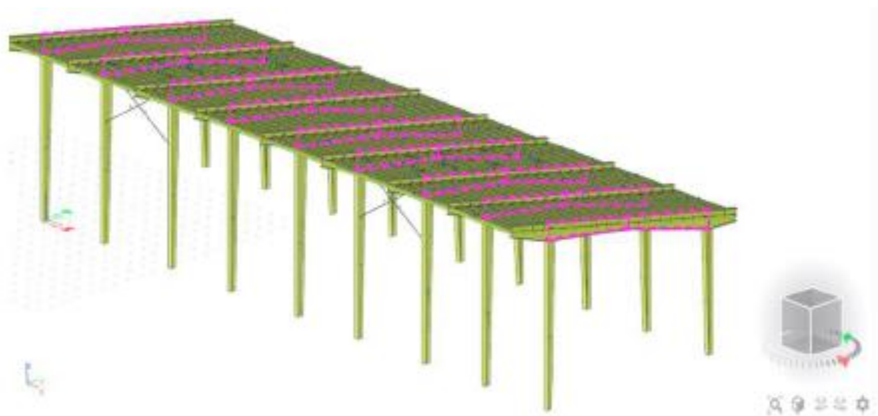


Figure 2.8: Example of structure from SCIA Engineer to be studied (Mitropoulou et al., 2020)

Table 2.3: Optimization result (Mitropoulou et al., 2020)

Design variable	Original value	Final value
Volume	5.61 m^3	5.24 m^3
Position of minimum cross section height	50 %	50 %
Minimum cross section height, H_1	610 mm	666 mm
Maximum cross section height, H_2	915 mm	789 mm
Top flange width, B_h	305 mm	263 mm
Bottom flange width, B_s	305 mm	263 mm
Top flange thickness, t_h	16 mm	9.6 mm
Bottom flange thickness, t_s	16 mm	9.6 mm
Design violation	0.77	0.98

2.5 European Standards

The introduction of European Standards by the European Commission aims to build a competitive environment for the construction companies not only among the European Union (EU) but also in the global market. The implementation of Eurocodes in the construction sectors has standardized the structural design with common technical rules. In particular, it ensures the safety in the construction industry is preserved at the highest level (European Commission, 2021). Eurocode serves as a reference for civil engineers which comprises a diverse range of construction methods. The 10 Eurocodes that has been published are as follows:

EN 1990 – Eurocode: Basis of structural design

EN 1991 – Eurocode 1: Actions on structures

EN 1992 – Eurocode 2: Design of concrete structures

EN 1993 – Eurocode 3: Design of steel structures

EN 1994 – Eurocode 4: Design of composite steel and concrete structures

EN 1995 – Eurocode 5: Design of timber structures

EN 1996 – Eurocode 6: Design of masonry structures

EN 1997 – Eurocode 7: Geotechnical design

EN 1998 – Eurocode 8: Design of structures for earthquake resistance

EN 1999 – Eurocode 9: Design of aluminium structures

The Eurocode is seen to be the future standard to be used widely around the world. Countries such as the United Kingdom and Singapore have withdrawn all British Standards (BS) and replaced them with Eurocodes in structural design (Chiang, 2015). Eurocodes are preferable hereafter as it has the most updated and advanced code in the building construction industry. Whereas, the BS codes are no longer maintained and updated by the British Standards Institution (BSI). The transition of both countries from BS code proves that the Eurocode standards are more reliable and compatible to be implemented.

2.5.1 Malaysia Standards

The Department of Standards Malaysia (JSM) is a National Standards Body under the supervision of the Ministry of International Trade and Industry (MITI). The department is responsible in providing a credible standardisation and accreditation across all sectors of the economy in Malaysia. All economy sectors must deliver reliability, safety, cost-effectiveness and sustainability in products and services according to the standards approved by JSM (Department of Standards Malaysia, 2021). Thereby, the requisite quality of all products and services are delivered and accepted globally.

Back in 2006, the Institution of Engineers Malaysia (IEM) was tasked by JSM to draft the Malaysian Standards MS EN Eurocodes. However, Malaysia has been implementing the BS structural design standards since 1957. In consideration of that, IEM has proposed a transition period which allows flexibility for engineers to implement either standards before the mandatory adoption of Malaysian Standards completely (Chiang, 2015). The transition period allows practicing engineers to acknowledge and familiarize the newly published MS EN Eurocodes. Up till now, IEM has successfully drafted quite a number of MS EN Eurocodes to be implemented in the Malaysia construction industry. Table 2.4 shows the design standard which has been reviewed and approved by JSM.

Table 2.4: MS EN Eurocodes

MS reference	Standard title
MS EN 1990:2010	Eurocode: Basis of structural design
MS EN 1991-1-1:2010	Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings
MS EN 1991-1-4:2017	Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions
MS EN 1992-1-1:2010	Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings
MS EN 1992-3:2021	Eurocode 2: Design of concrete structures – Part 3: Liquid retaining and containment structures
MS EN 1993-1-1:2010	Eurocode 3: Design of steel structures – Part 1-1 General rules and rules for building
MS EN 1993-1-8:2017	Eurocode 3: Design of steel structures – Part 1-8: Design of joints
MS EN 1993-5:2017	Eurocode 3: Design of steel structures – Part 5: Piling
MS EN 1993-1-3:2019	Eurocode 3: Design of steel structures – Part 1-3: General rules – Supplementary rules for cold-formed members and sheeting
MS EN 1997-1:2012	Eurocode 7: Geotechnical design – Part 1: General rules
MS EN 1997-2:2015	Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing
MS EN 1998-1:2015	Eurocode 8: Design of structures for earthquake resistance – Part 1: General rules, seismic actions and rules for buildings

The MS EN Eurocodes published are accompanied by the National Annexes. The Malaysia National Annexes specifies the parameters value to be applied nationally in structural design. For instance, some of the recommended parameters value in Eurocode may differ from the Nationally Determined

Parameters. Thus, MS EN Eurocodes coexist with the National Annexes in providing a standardized parameter throughout the projects in Malaysia.

2.5.2 Eurocode 1

MS EN 1991-1-1:2010 Eurocode 1 is the primary design standard that is required in all building and civil engineering works. Eurocode 1 presents the classification of actions into two types which are permanent actions and variable actions. Permanent action is defined as the load that is consistent throughout the service of the structure. In contrast, variable actions are inconsistent as the magnitude of loads are highly dependent on various factors. Human occupancy, wind loads and snow loads are the few variable actions that are brought into attention in Eurocode 1 (Mosley, Bungey and Hulse, 2012).

Besides, Eurocode 1 describes the load arrangement and load distribution in a building precisely. For instance, in relevant column design conditions, the total loading on a floor in a storey is assumed to be distributed evenly. The loadings are transmitted from each storey to the storey below which end lastly in the foundations of the particular structure. Eurocode 1 indicates that an area for specific use would require a different characteristic value in design. This is due to the occupancy or usage at a specific area would result in different magnitude of actions on a structure. Therefore, the estimation of actions on a structure shall be made conservative based on the standards in Eurocode 1 to provide an adequate and safe design.

2.5.3 Eurocode 2

All MS EN Eurocodes are planned to be used collectively in structural design as they correlate to one another. For example, Eurocode 2 specifies the standards on concrete structures which are also related to other standards such as actions on structures, geotechnical design and seismic design. All concrete related structures including plain, reinforced and prestressed concrete must comply with the standards in Eurocode 2. The principles aim to provide resistance, serviceability, durability and fire resistance in concrete structures. However, Eurocode 2 is not concerned with the concrete’s thermal and sound insulation which does not affect the strength of a structure (Department of Standards Malaysia, 2010). In short, the structural design must comply with the ultimate limit states (ULS) and serviceability limit states (SLS) in Eurocode 2. Legal actions can be taken in cases where structural design does not meet the MS.

Additionally, structural analysis of a structural design must be studied comprehensively based on the MS EN Eurocode 2. According to Cladera and Mari (2007), Eurocode 2 presents a simpler calculation method in the design analysis of shear strength of reinforced concrete beams with stirrups when compared to other formulations such as ACI 318-02 Code. Certain key variables that are neglected in the analysis leads to a simplification of complex formulas. The study results in an over conservative design in prestressed beams and slightly unconservative design in heavily reinforced members. In a nutshell, Eurocode 2 may not be the ideal method in all cases nonetheless it has delivered simplicity in design formulations.

2.6 Reinforced concrete properties

In the current construction industry, reinforced concrete is now the prominent structural construction material which is widely used in various types of projects. Reinforced concrete consists of the two very common construction materials which are concrete and steel reinforcement. Structural engineers from various fields such as building engineering, bridge engineering and foundation engineering are implementing the reinforced concrete in their design. This is due to the high durability of the reinforced concrete with the combined features of concrete and steel. At the same time, engineers are able to provide a sustainable structural design which is aligned with the concept 'delivering sustainable development' that the ICE promotes (Mosley, Bungey and Hulse, 2012). The two materials have their respective role in providing strength to a reinforced concrete member making it one of the best construction materials. In short, innovation of engineers plays a role in the industry in providing sustainable and economical construction solutions.

From Table 2.5, we are able to interpret that each material, concrete and steel has their respective strength and weakness. A reinforced concrete member will experience compression and tension at the same time as shown in Figure 2.9. Therefore, engineers are responsible to utilize the right material to withstand the right forces that a member experiences. The concrete materials which are strong in sustaining compression strength are designed to be on top for a beam member. In the bottom part of the beam member, steel bars are designed to sustain the tension forces when loads are applied. However, steel bars in the bottom part of the beam member are embedded by the concrete which serve as a protection for the steel reinforcement to provide durability and fire resistance. Therefore, reinforced concrete design has achieved a sustainable and economical design as both the material properties of concrete and steel are utilized ultimately. In a nutshell, concrete and steel bars are responsible in resisting the compressive force and tensile force that is acted on a structural member respectively.

Table 2.5: Properties of concrete and steel (Mosley, Bungey and Hulse, 2012)

Properties	**Concrete**	**Steel**
Tensile strength	Weak	Strong
Compression strength	Strong	Strong (Buckling may occur on slender bars)
Shear strength	Moderate	Strong
Durability	Strong	Corrosion occur if not well coated
Fire resistance	Strong	Very weak in high temperature

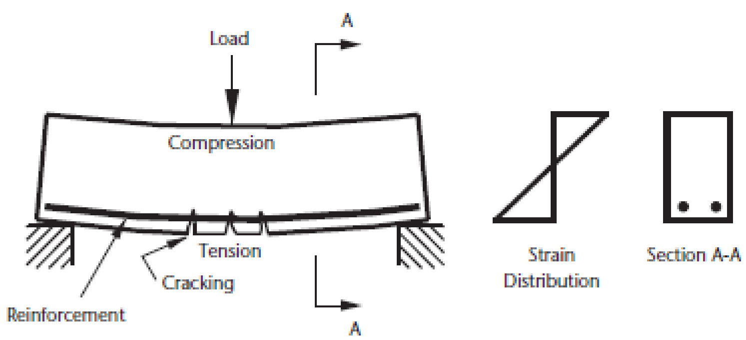


Figure 2.9: Reaction of reinforced concrete beam member due to loading (Mosley, Bungey and Hulse, 2012)

2.6.1 Concrete

Concrete is one of the most crucial components which has existed for a significant long amount of time in the construction sectors. Concretes are made up of Portland cement, water, coarse aggregate and fine aggregate. The water that is appropriate for concrete mixing shall only be potable water. Meanwhile, aggregate types are determined through the sieve analysis. Coarse aggregates are aggregate diameter sizes between 9.5 mm to 37.5 mm while fine aggregates are particles smaller than 9.5 mm (Portland Cement Association, 2019). The following raw materials are mixed uniformly and compacted in a mould to be hardened in the desired shape. Proper curing of concrete with a suitable curing duration is required to promote the cement hydration process. In short, the concrete's compressive strength will be affected by the raw materials quality, design mix proportion and curing process of the concrete.

Concretes can be classified as different concrete classes based on their respective compressive strength as shown in Table 2.6. The standard procedure in determining the characteristic of compressive strength, f_{ck} is by testing the 28-days concrete cylinder strength. For instance, C25/30 shows the f_{ck} for cylinder and cube at 25 N/mm^2 and 30 N/mm^2 respectively. According to Mosley, Bungey and Hulse (2012), substructure requires a minimum of concrete class C30/37 to ensure the durability requirements are met. Therefore, different classes of concrete are used in different scenarios to resist the loading on the structural member.

Table 2.6: Classification of concrete class (Mosley, Bungey and Hulse, 2012)

Concrete class	**Characteristic of compressive strength, f_{ck} (N/mm^2)**
C16/20	16
C20/25	20
C25/30	25
C30/37	30
C35/45	35
C40/50	40
C45/55	45
C50/60	50
C55/67	55
C60/75	60
C70/85	70

Over the years, concrete has been innovated to have different densities which aims to serve for different purposes. The introduction of lightweight concrete, normal-weight concrete and heavy-weight concrete have contributed to the construction industry significantly. Lightweight concrete which has density lower than 1840 kg/m^3 is able to reduce the dead load on structures. However, the normal weight concrete possesses density in the range of 2200 kg/m^3 to 2600 kg/m^3. A study carried out on two concrete with different density has proven that concrete with higher density results in a greater compressive strength. Despite the low density, the lightweight concrete is still able to achieve a compressive strength of 17 MPa (Iffat, 2015). Therefore, the choice of concrete in a structure is highly dependent on the structural condition and design.

On the other hand, heavy weight concrete is not commonly used in the industry in normal structural building due to its high density despite providing a great compressive strength. A study shows that it is possible to produce a heavy weight concrete with a density and compressive strength up to 3745 kg/m^3 and 190 MPa respectively. Heavy weight concrete is commonly designed in nuclear reactor related structures. This is mainly due to its ability to isolate reactors and radiation in an area from the surrounding (Ban et al., 2021). Hence, heavy weight concrete is an effective radioactive shield used in the industry to protect the communities from potential harmful substances.

2.6.2 Reinforcement steel bar

Reinforcement steel bars play a huge role in reinforced concrete structures due to its high tensile and flexural strength. According to Eurocode 2, the characteristic yield strength of steel reinforcement for design and detailing purposes must be within 400 MPa to 600 MPa. The common steel bar diameters are 6, 8, 10, 12, 16, 20, 25, 32 and 40 mm. Therefore, engineers design structures with different steel bar diameters based on the forces experienced in the structure. Figure 2.10 shows the reinforcement steel bars of various sizes at 12 metre length that are manufactured and delivered to site.

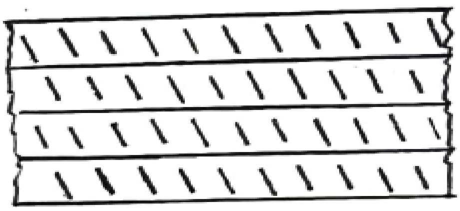
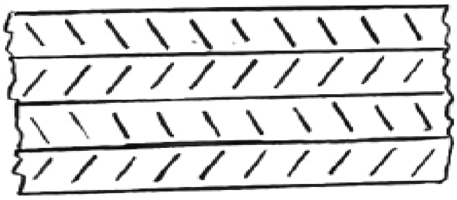
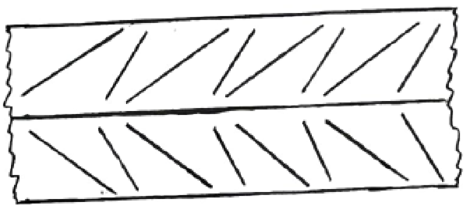
Figure 2.10: Reinforcement steel bar of various sizes

Additionally, all steel bars manufactured must obtain a mill certificate beforehand to ensure the desired strength of the reinforcement steel bar has achieved. The certificate is a test sample report that indicates the completion of quality assurance inspection based on the MS 146:2014. The few tests that steel bars are required to pass according to the MS are fatigue test, bend and re-bend test, bond test and dimension tolerances. The standard as well defines that the steel bars need to be marked which identify its manufacturer, size of steel, type of steel and the grade of steel (Suren, 2015). In short, the quality of steel bars is more reliable when compared to concrete as it is manufactured and inspected in a controlled environment.

Up till early 70s, reinforced concrete structures utilized the plain bars in providing reinforcement to the structure. However, the lack of ductility in the design leads to vulnerability in seismic conditions as the surface of plain bars are smooth. This is mainly due to the poor bond strength between the concrete and steel bars (Hertanto, 2005). Therefore, deformed bars are introduced as a replacement for plain bars. A study on the relationship between the bond strength of steel bars and concrete has concluded that plain bars only have 18.3% of the bond strength of deformed bars (Xing et al., 2015). This proves that deformed bars are preferable in the application of reinforced concrete to provide greater ductility to the structure.

Deformed bars consist of rib patterns on the surface of the steel bars which are designed to improve the adhesion between concrete and steel bars. Table 2.7 shows the three steel bar grades categorized in MS 146:2014 which have different rib patterns A, B and C. The three types of steel bars have a similar yield strength at 500 MPa. However, the tensile-yield strength ratio differs among the steel bars (Suren, 2015). On the other hand, a study on the transverse orientation of the rib patterns relative to the concrete crack has been carried out. The result of the study shows that the influence in the transverse orientation of rib patterns towards the bond strength in reinforced concrete are insignificant (Desnerck, Lees and Morley, 2015). Therefore, despite different rib patterns in deformed bars, the transverse orientation of the steel bar in the reinforced concrete is trivial. This concludes that the rib patterns in deformed bars play a significant role in influencing the tensile strength and ductility in reinforced concrete.

Table 2.7: Identification of steel grade (Suren, 2015)

Steel bar grade	**Tensile-Yield strength ratio**	**Types of deformed bar surface**	**Rib pattern**
B500A	1.05		Parallel transverse ribs with same angle
B500B	1.08		Parallel contrary angle ribs (Fish bone pattern)
B500C	≥ 1.15 < 1.35		Alternate higher and lower angle rib pattern

Steel corrosion is an event where the electrochemical reaction Is induced by the environment. Steel corrosion in reinforced concrete is undesirable as the material will lose its strength significantly. An experiment performed on the bond strength of corroded steel bars and high strength concrete has proven that there is a sharp decrease in the bond strength when compared to normal steel bars. This shows that corrosion of steel displays brittle behaviour and weakens the strength of steel bars (Yalciner, Eren and Sensoy, 2012). Hence, corrosion of steel must be avoided at all cost to ensure the durability of the reinforced concrete is preserved.

Reinforcement steel bars in reinforced concrete are designed to be protected by a layer of concrete. This layer is known as a concrete cover which is crucial in preventing the steel bars from being exposed to the surrounding and high heat during fire events. According to MS EN 1992-1-1:2004 clause 4.4.1, the concrete cover is designed based on the Equation 2.1. The value c_{min} is dependent on a few factors such as the arrangement or size of steel bars, maximum aggregate size, structural class and exposure class of the reinforced concrete structure. The structural class and exposure class must be taken into account as the exposure of a reinforced concrete structure at different environmental conditions are prone to different chemical or physical attack. Meanwhile, the National Annex recommends the Δc_{dev} value to be 10 mm. Lastly, the c_{nom} value is the minimum concrete cover required to provide adequate bond strength, fire resistance and protection to the steel bars. Thus, Eurocode 2 presents a safe design by providing adequate concrete cover to a reinforced concrete structure.

$$c_{nom} = c_{min} + \Delta c_{dev} \tag{2.1}$$

2.7 Structural framing

Every structural building consists of fairly similar structural components which develops a skeletal system of a building. A good structural frame is designed to have substructure and superstructure as shown in Figure 2.11. Substructure in structural building is a component that is built below the ground level. For instance, deep foundations and shallow foundations are substructures that are responsible in transferring the load from the structure to the ground or soil. Therefore, the soil in the ground must have sufficient bearing capacity to prevent any failure or damages due to settlement. Eurocode 7 is used as the standard in design approach for deep foundation and shallow foundation.

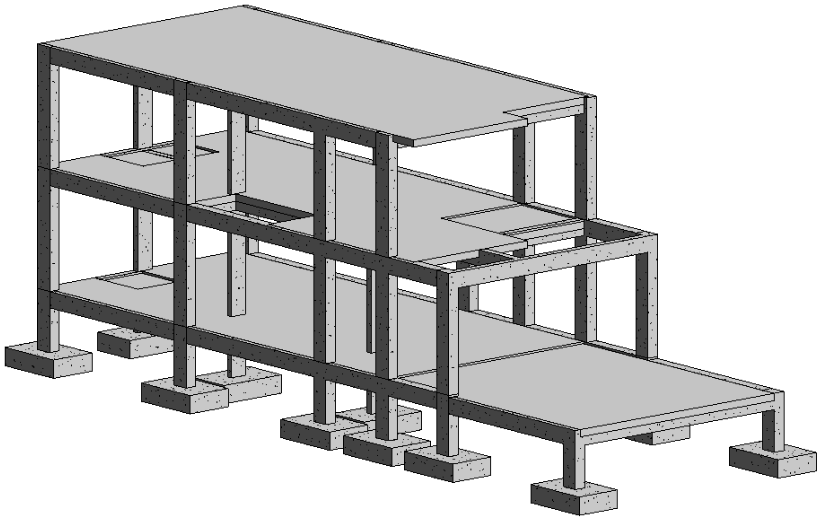


Figure 2.11: Structural framing of a double storey reinforced concrete house (Tai, Goh and Seo, 2021)

In contrast, superstructures are the components that are built above the ground level in a structure. For example, slabs, beams and columns are the few superstructures that are designed to transmit the vertical loading in a structure to the foundations. Meanwhile, shear walls are components that are able to resist horizontal and lateral loads effectively. Each component in a structural frame is equally important and must be designed according to the standards to achieve the ULS and SLS.

2.7.1 Earthquake resistance structural frame

The Eurocode 8 seismic design standard has been implemented in Malaysia despite being a country free from earthquakes. On 11th August 2021, a 5.6 magnitude earthquake in North Sumatera, Indonesia has been reported to cause several areas in the Klang Valley to experience the tremors (New Straits Times, 2021). Therefore, the implementation of seismic design in Malaysia is necessary in order to construct a sustainable structural design.

Seismic design in low rise residential buildings as well need to be considered as they are also vulnerable to earthquakes. The base isolation system is one of the very common methods in seismic design. This system simply separates the structural frame from the base or foundation of a structure. For instance, a laminated rubber bearing serves as a base isolation and damper which dissipates the energy absorbed caused by the earthquake motion (Nakamura and

Okada, 2019). In short, the base isolation system is a highly effective method to be used in preventing failure in structural building and preserving the safety of the communities.

A study was carried out in determining the uses of recycle tyre as a base isolator in low rise three storey building using the ANSYS V16.0 simulation software. The recycled tyres are cut and stacked forming five layers of tyre pads which are known as recycle tyre isolators (RTI). The result of the study proves that RTI is able to reduce the top floor displacement of the low rise building significantly up to by 83% as shown in Figure 2.12. This study concludes that RTI is capable of resisting medium magnitude earthquakes and suitable to be used in low rise buildings (Sow et al., 2016). Thus, the use of recycled material in seismic design is able to reduce the construction cost while further research needs to be done on high rise buildings to determine the effectiveness of RTI in high rise buildings.

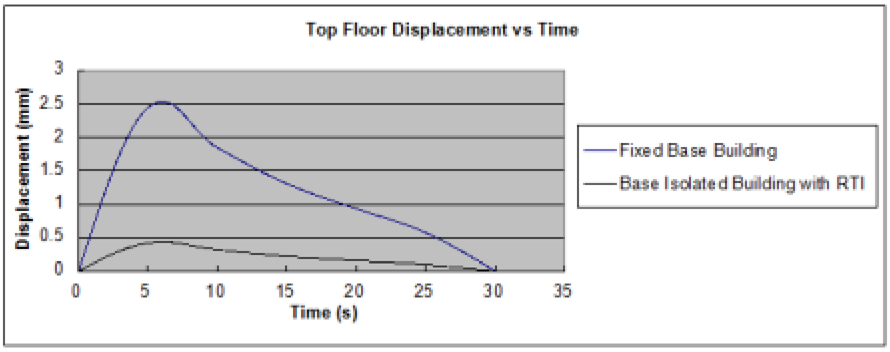


Figure 2.12: Result of top floor displacement between fixed base building and base isolated building with RTI (Sow et al., 2016)

2.7.2 Types of failure in structural frame

Column in a structural frame is crucial in transferring the load from beams and slabs to the foundation. Two designs of columns which are short column and slender column often fail in terms of crushing and buckling respectively. Buckling of slender columns occurs when the end moments cause the column to deflect sideways. When the axial load on the column exceeds the critical value, the constant additional moment and lateral deflection in the slender column will lead to buckling failure. On the other hand, crushing failure occurs due to material failure in the column (Mosley, Bungey and Hulse, 2012). In cases where the axial load exceeds the allowable load in design, the reinforced concrete column will fail eventually if the yield stress is reached. Therefore, a detailed design of column that is able to resist the axial load and end moments must be ensured to prevent any failure in the structural frame.

Besides, failures in reinforced concrete beams are mainly due to poorly designed members. The failure in terms of ULS for beams such as shear failure and flexural failure are rare in a structural frame. However, the failures in SLS such as cracking in beams are more commonly found in the practical world (Mosley, Bungey and Hulse, 2012). According to Eurocode 2, cracks in concrete are considered to be normal as long as the crack widths are not beyond the limits. The recommended limiting crack widths based on the standards is given in the National Annex Table NA4. Hence, the failure in SLS must be monitored and controlled as it might also lead to structural failure.

During seismic events, the formation of plastic hinges in the column ends are considered to be the cause of failure in the structural frame. A design concept of strong column-weak beam philosophy is introduced which implements the design of stronger column than beam instead of constructing an equal strength of column and beam. By applying this design, the plastic hinges at the beam ends or frame shear wall structures are formed before the formation of plastic hinges in column ends occurs during earthquake events (Nie et al., 2020). This results in the failure occurring in beam first, instead of column as column failure will lead to the collapse of the entire structure.

Lastly, the failure in the column beam joints must be avoided as it may lead to catastrophe in the structural frame. A comprehensive analytic study on a developed model to determine the mechanism that led to the failure in the column beam joint has been carried out. The study reveals that the strength of concrete, transverse reinforcement and bond strength between steel and concrete are the factors that will influence the strength of the joints (Yalçin et al., 2019). Thus, the column beam joints must be enhanced to achieve a high joint capacity to prevent failure especially during earthquake events.

(a) (b)

Figure 2.13: (a) Column beam joint failure and (b) Strong beam weak column failure (Saatcioglu, 2013)

2.8 Bill of quantities

Bill of quantities (BQ) is vital in the construction sectors that present the quantities and cost of materials or labours that are involved in a project. BQ is also part of a tender document that provides a comprehensive view on the project cost. During the tendering stage, BQ can be used as a tool for decision making to determine the best bid among contractors. Next, BQ is utilized as a construction management information which includes the planning, labours, budget control and etc. in the post-tendering stage (Adnan et al., 2011). Figure 2.14 shows a summarised bill of quantities for a panel house project (Joshua, 2019).

ITEM	Description	Qty	Unit	Rate	Amount
	SUMMARY OF BILL NO.2			Page	
1	Substructure				1,219,790.00
3	Walls				548,500.00
4	Roof and Construction and Covering				850,570.00
5	Windows				384,495.00
6	Doors				649,200.00
7	Walls Finishes				431,350.00
8	Floor Finishes				437,140.00
9	Ceiling Finishes				261,220.00
10	Mechanical Installation Services				542,740.00
11	Electrical Installation Services				459,740.00
12	External Works				1,130,400.00
	BUILDING			N	6,915,145.00

Figure 2.14: Bill of quantities (Joshua, 2019)

BQ are usually prepared by Quantity Surveyor (QS) and it is not completely accurate at all times as the estimation of the cost is based on the construction drawings and specifications. However, a research in China evaluates a few causes that bring changes to the BQ throughout a project duration. One of the changes that affect the accuracy of BQ is the modification in project design due to client's demand, design errors or unconformities in the construction drawings. Besides, the release of any new policies by the authorities related to the project affect the cost in BQ as well (Ding, Zhang and Wang, 2014). For instance, the mandatory Covid-19 testing for all construction labour workers will definitely increase the cost. This research shows that the cost estimation in BQ is subjected to numerous uncertainties. Thus, the relevance of BQ must be evaluated and concluded with a rational estimation.

2.8.1 Quantity take-off

Quantity take-off is presented in the early stage of a construction project. It is made for the purpose of cost estimation. In contrast with BQ, the quantity take-off is focused on the construction materials in the project. For instance, the volume of concrete and amount of reinforcement steel bars required are presented in the quantity take-off. The traditional method in performing quantity take-off is by making manual calculations and estimation based on the construction drawings. The task requires highly skilled professionals since detailed data management needs to be extracted precisely and accurately from the blueprints (Take-Off Professionals, 2021). Additionally, the traditional method is not favourable since the process is time consuming and susceptible to human errors.

The introduction of BIM tools in the industry have eased the making of quantity take-off in the industry. A study on the comparison between the two traditional and BIM methods in creating a quantity take-off has proven that deviations between the two calculation results are negligible. However, the BIM method has a significant impact in terms of time saved as the BIM method is approximately 80% faster than the traditional method (Bečvarovská and Matějka, 2014). In short, the BIM method is reliable and efficient in performing the quantity take-off as it is able to produce a similar cost estimation within a shorter time frame.

2.9 Summary

In conclusion, the literature review highlights the application of BIM in the construction industry. The BIM tools available in the global market are categorized based on the software's nature. The approach of open BIM and close BIM are presented to serve different project preferences. The business nature of Autodesk and their software Autodesk Revit which is used to construct structural models are highlighted in the literature review. Besides, a software company, SCIA which launches SCIA Engineer that is capable of performing structural analysis. The possible development of SCIA Engineer to optimize the software is also displayed in the literature review. The design code Malaysian Standard Eurocodes is used as the replacement of British Standards. Furthermore, the relevancy of Eurocode 1 and Eurocode 2 in the design of reinforced concrete structures are highlighted in the literature review as well. Next, the properties of reinforced concretes are discussed in this chapter. The properties of concrete and reinforcement steel bars which are the components in a reinforced concrete are also presented. A basic structural framing and earthquake resistance structural frame are highlighted in the literature review together with the several types of failure in a structural frame such as column failure, beam failure, formation of plastic hinge in column ends and column beam joints failure. Lastly, the cost estimation through bill of quantities and quantity take-off is highlighted in the literature review.

CHAPTER 3

METHODOLOGY AND WORK PLAN

3.1 Introduction

This chapter involves the methodology in the construction of a structural model of reinforced concrete double story terrace house in Autodesk Revit software. The model is constructed based on a construction drawing provided by the author's thesis supervisor. The structural model is analysed by a structural analysis software, SCIA Engineer to determine the critical element in the structure. Hence, the installation of licensed Autodesk Revit and SCIA Engineer is required in this study.

3.2 Overview of work plan

Figure 3.1 displays the flowchart of the work plan in this study. Firstly, both Autodesk Revit and SCIA Engineer software needs to be installed and licensed. Next, the construction drawings of 5 units of double storey reinforced concrete terrace house are reviewed and studied thoroughly. Based on the construction drawings, reasonable assumptions are made to replace unclear information in the drawings. Next, the Autodesk Revit software is set up with the structural template to start modelling. The construction of gridlines, elevations, beams, columns and slabs are performed based on the construction drawings. The analytical model of the structural frame is checked for inconsistency. If no inconsistency is detected, the model is ready to be exported to the SCIA Engineer to perform structural analysis. The analytical model is checked again to ensure all data are transferred from the structural model accurately. The load assignation on the structural members are then performed based on MS EN 1991:1:1-2010. The three load cases that are assigned onto the structure are self-weight of members, permanent load and variable load. Thus, load combinations are formed according to the Eurocode standard and the structural analysis are performed to gain the output data. From the result of the structural analysis, critical structural members are identified. Next, two structural model with two different reinforcement design are created. The first model under case A, is the as-built model whereby the reinforcement design is done according to the C&S

drawing and the structural model is then exported back to Autodesk Revit. Meanwhile, the second model under case B, is the new structural model design whereby the design calculations of the critical structural members are done based on Eurocode 2. The calculated reinforcement design of the critical ground floor beam, first floor beam, roof floor beam, column, and slab are then added into the structural model. Based on the new reinforcement design, reinforcement capacity check is performed in the SCIA Engineer software and the unity factor check is observed. If the unity factor check has failed, a new reinforcement design is proposed and modification of the reinforcement design is done before performing the reinforcement capacity check again. The new structural model design is ready to be export back to Autodesk Revit only after all unity factor check has passed. Next, quantity take-off is done on the as-built structural model and the new structural model that are exported to Autodesk Revit. Lastly, the cost and structural material usage of the two quantity take-off result are compared and discussed.

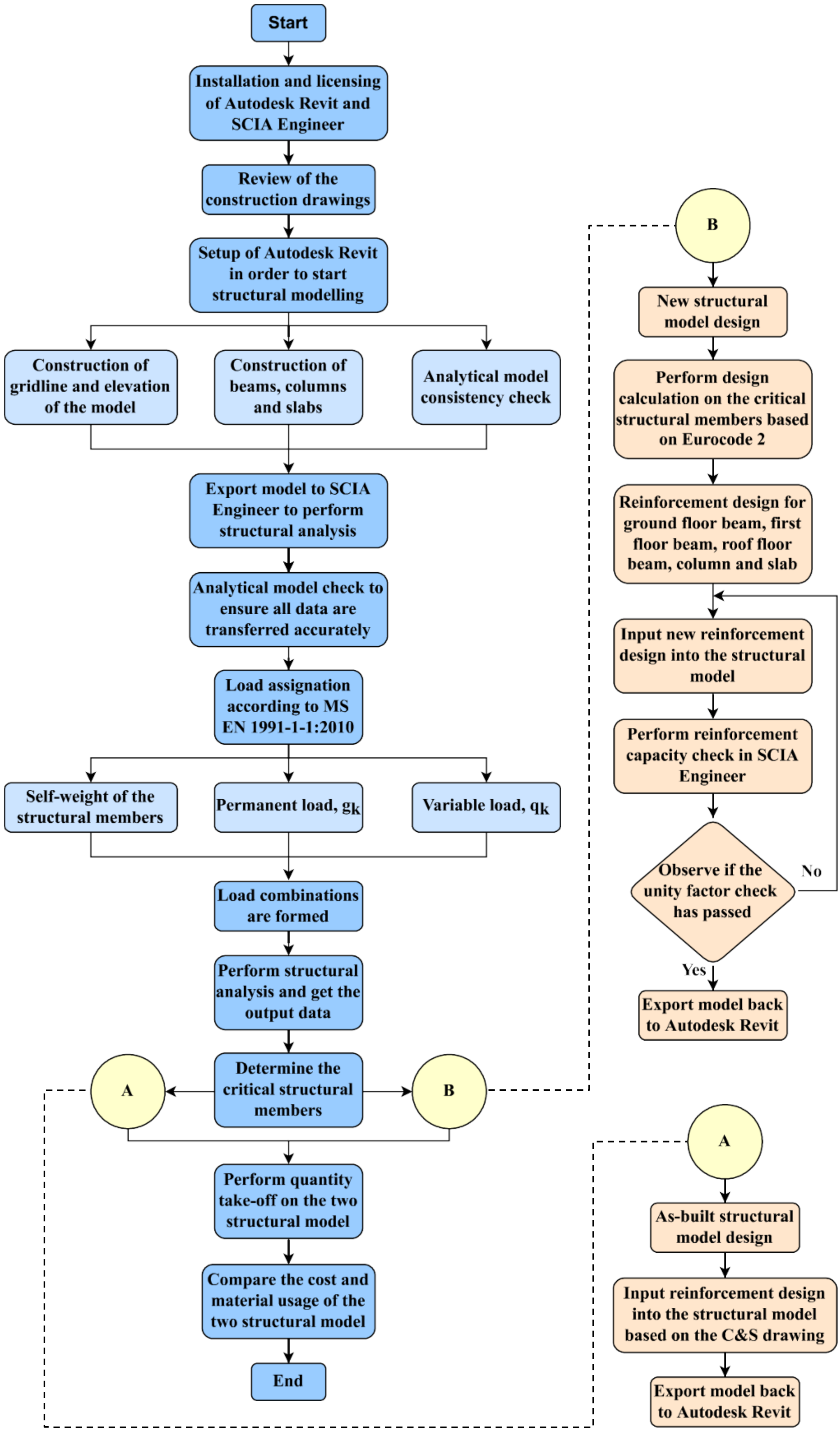


Figure 3.1: Flowchart of work plan

3.3 Overview of construction drawing

The construction drawing presents the construction of 5 units of double storey terrace house in Sarikei, Sarawak. The 5 units of terrace houses consist of 3 units of intermediate lot and two units of end lot houses. The architecture drawings display the view of the terrace houses at different elevations while the civil and structure (C&S) drawings display the orientation of beams and columns in the double story terrace house. The intermediate lot and end lot house has a building span length of 7 metres and 10.5 metres respectively which amounts to a total span of 42 metres for the 5 units of double storey terrace house. Additionally, the detailing of the beam, columns, slabs and staircase of the reinforced concrete structure are also presented in the drawings. Table 3.1 shows the different dimensions of beam and columns that are constructed in the double storey reinforced concrete terrace house. Meanwhile the slabs are constructed to be 110 mm thick. However, the construction of substructure is not involved in this study whereby the consideration design of foundations is not considered. The roof trusses as well are not included in this study. The modelling of the structural frame begins at the ground beam and ground slab up to the roof level. All structural members are designed with C25/30 concrete grade. Hence, the actual construction drawings are studied to replicate the model in a BIM platform.

Table 3.1: Dimension of beams and columns

Structural component	**Dimension (b × h) (mm)**			
Beam	150 × 300	150 × 400	150 × 450	150 × 550
	200 × 400	200 × 450	200 × 600	200 × 700
Column	150 × 150	150 × 200	200 × 200	300 × 300

3.4 Construction of model with Autodesk Revit

Autodesk Revit software is utilized to construct the structural model. At the start of the modelling, the default structural template in Revit is selected as shown in Figure 3.2. The structural template has all defined settings and setups that are required for a structural modelling project. All system families and annotations are preloaded in the Revit project file to ease the modelling process.

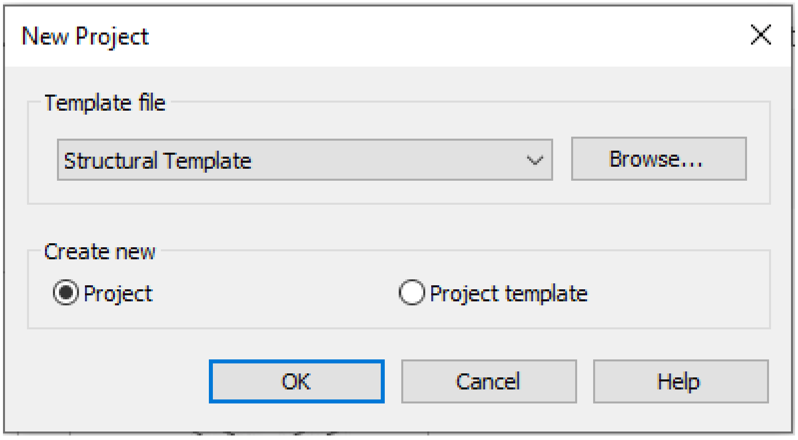


Figure 3.2: New project structural template

3.4.1 Gridline

Gridlines are set up in the new project to ease the modelling of the double story terrace house. Gridlines are extended and offset similarly to the construction drawing. The gridlines drawn will be reflected on every floor of the structural plan. Gridlines give an overall view on the structural plan of the model at each floor. Furthermore, the building elevations of the structural model are constructed based on the floor to floor height in the construction drawing. Due to unclear information from the construction drawings, the floor to floor height of the ground floor and first floor is assumed to be 3950 mm and 3350 mm respectively. Meanwhile, the stump is designed to have a depth of 800 mm below the ground floor. Figure 3.3 shows the gridline of ground floor plan while Figure 3.4 shows the right side building elevation with levels.

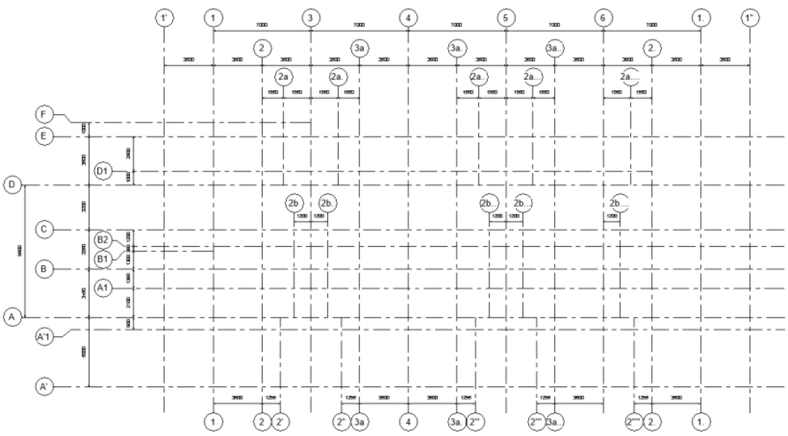


Figure 3.3: Gridline of ground floor plan

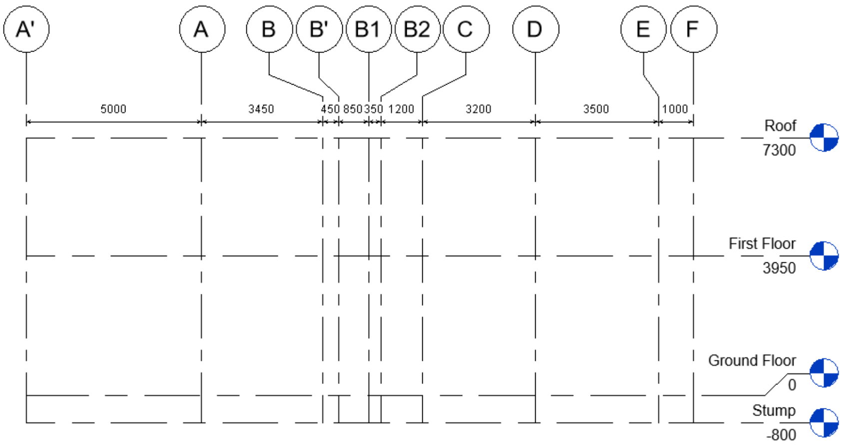


Figure 3.4: Right side building elevation with levels

3.4.2 Orientation of structural member

Structural elements are placed on the gridlines which are constructed in the previous stage. Reinforced concrete rectangular beams, rectangular columns and square columns are selected to construct the model. A total of 179 reinforced concrete beams and 182 units of reinforced concrete columns of various dimensions are constructed in the model. Figure 3.5 shows the orientation of structural model constructed in the Autodesk Revit.

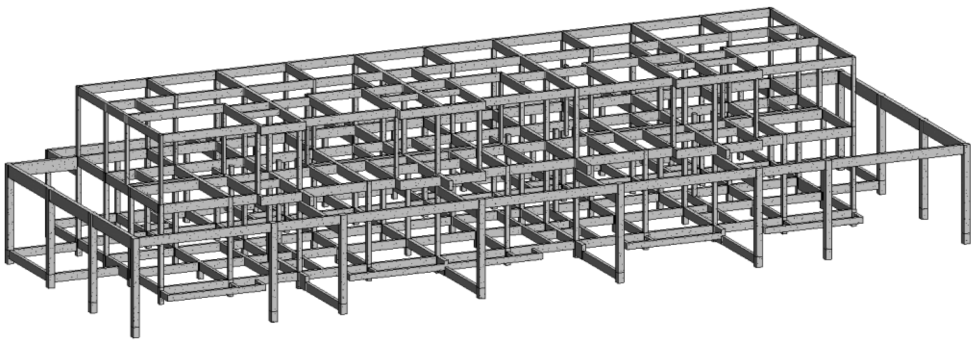


Figure 3.5: Structural model in Autodesk Revit

3.4.3 Analytical model

Analytical models are auto generated during the construction of structural frame models. However, the analytical model may require adjustment due to inconsistency. For instance, analytical beams and columns that are not connected may result in errors when performing structural analysis. In cases where vertical offset of the beam is required, the analytical model of the beam as well needs to be offset. The analytical line in a beam is designed at the top surface of the beam and centre of the element while column analytical line is located at the centre of the element. Figure 3.6 shows the tool available in Autodesk Revit that can be used to check for inconsistency in the model while Figure 3.7 shows the analytical model constructed in Autodesk Revit.

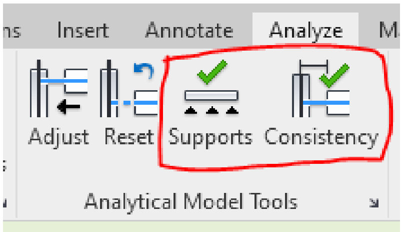


Figure 3.6: Autodesk Revit consistency check tool

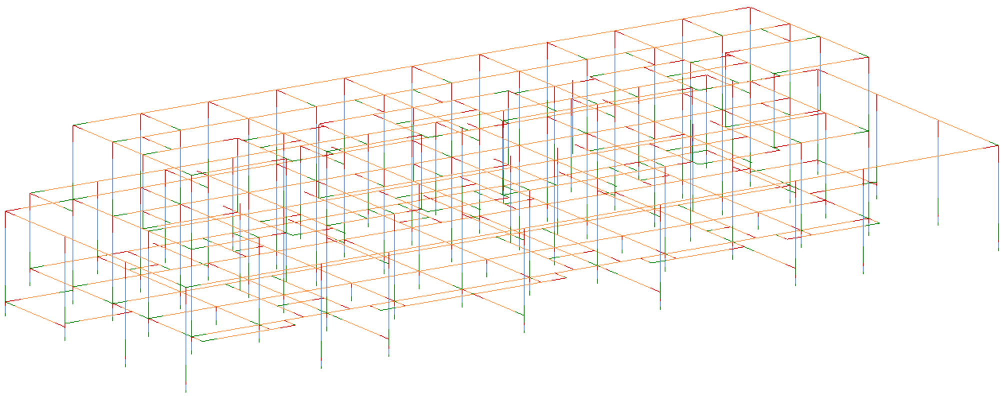


Figure 3.7: Analytical model in Autodesk Revit

3.5 Model export from Autodesk Revit to SCIA Engineer

The software version of both Revit and SCIA needs to be determined and downloaded. Based on the compatibility of the two versions, the Revit plug-in needs to be installed. For example, Revit 2020 and SCIA Engineer 19.1 version requires the plug-in of version 19 (build 485). The plug-in in Revit allows the selection of National Code, export mode and other options before export and import of model to and from SCIA Engineer as shown in Figure 3.8. The National Code selected is the standard used in the design which is Eurocode in this study while the direct exchange mode allows direct transfer of model without any data exchange file. Figure 3.9 shows the process of export of model from Autodesk Revit to SCIA Engineer.

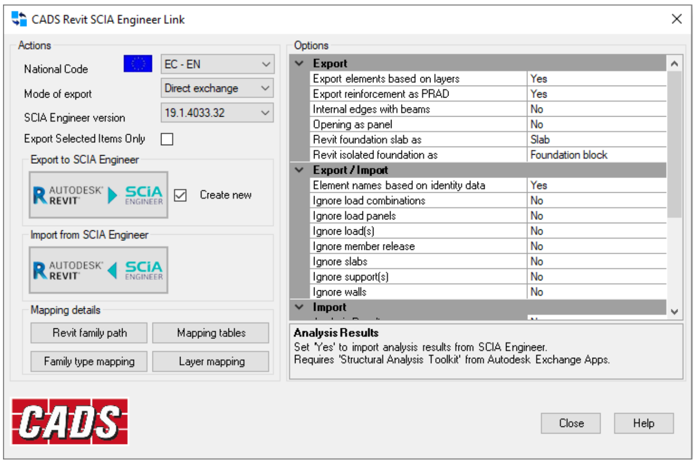


Figure 3.8: Import and export settings in Revit plug-in

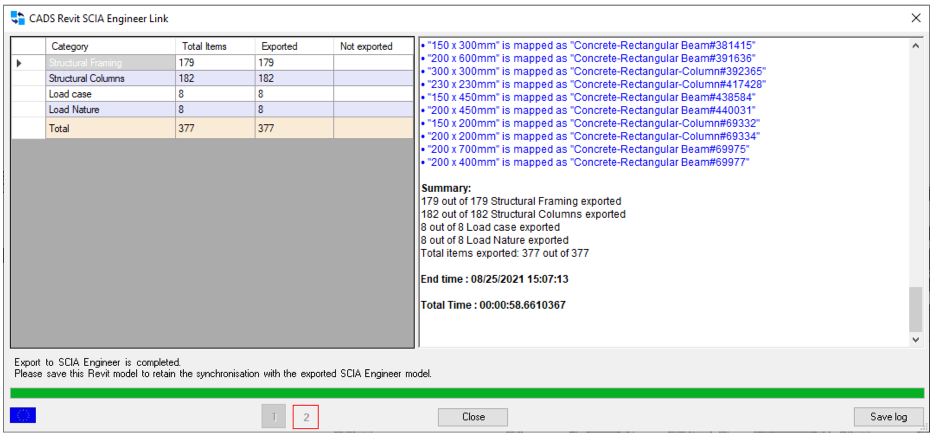


Figure 3.9: Export of structural model from Autodesk Revit to SCIA Engineer

3.6 Structural analysis with SCIA Engineer

The exported analytical model from Autodesk Revit to SCIA Engineer is re-checked again to ensure all structural members are transferred into the SCIA Engineer software. The analytical model as well needs to be examined to avoid issues of inconsistency in the model. Figure 3.10 shows the analytical model that has been exported and viewed in SCIA Engineer.

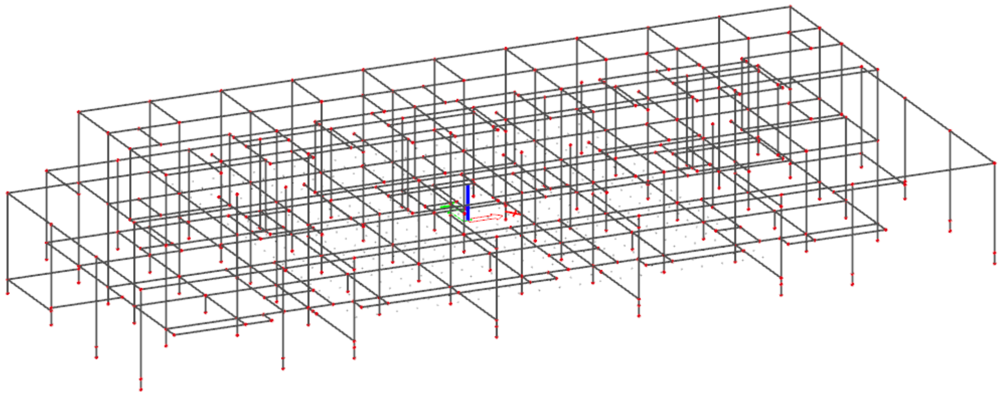


Figure 3.10: Analytical model in SCIA Engineer

3.6.1 Load assignation

Before the load assignation on the structure, the structural slab is constructed in SCIA Engineer and the slabs are designed to be 100 mm thick. The loads assigned on the structure to perform structural analysis is based on MS EN Eurocode 1991-1-1:2010. The load cases that are acted on the structure frame are dead loads and live loads. The structural members are constructed with normal weight concrete which has a density of 25 kN/m^3 which is included in the characteristics permanent load, g_k. According to Eurocode 1 Table 6.1, the residential buildings fall under category A which consist of characteristics variable load, q_k for floors, stairs and balconies. A conservative approach is taken in this design where the q_k value determined to be imposed on floors is 2.0 kN/m^2. The beams are designed to experience uniform distributed line forces across the structural members while the columns experience vertical forces. Next, structural slabs experience surface loads which consist of the g_k and q_k.

Furthermore, the roof of the structure is categorised under category H which is a non-accessible roof except for maintenance work. Eurocode 1 suggests that the variable load, Q_k to be at the range of 0.9 kN to 1.5 kN. The Q_k value of 0.9 kN is determined to be applied on the model as it is recommended by the National Annex. However, internal nodes are created on the roof beams which have a span exceeding 3.5 m before assigning point forces from the roof trusses to the beams. As a result of the loads assigned on the structure, Figure 3.11 shows the loading assigned on the structural model.

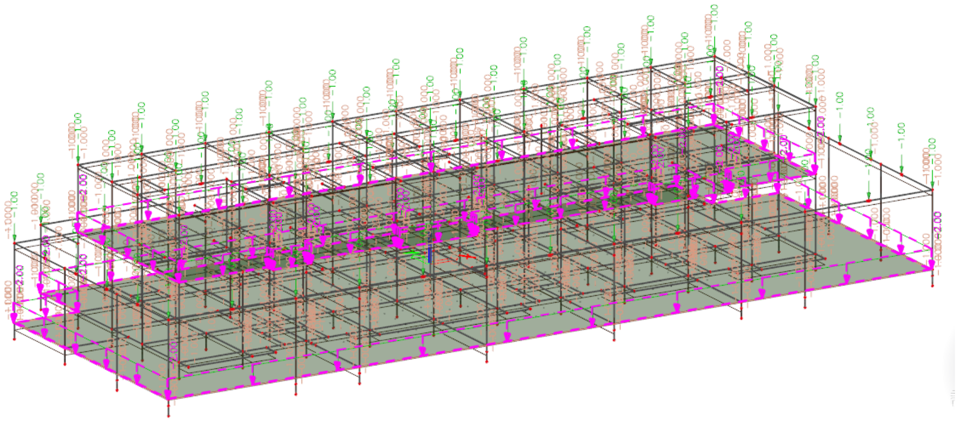
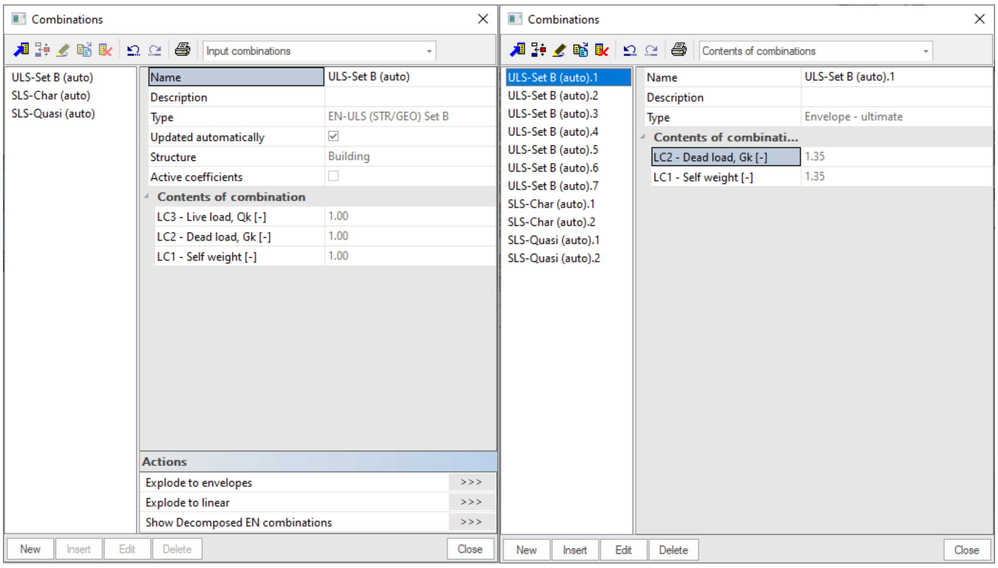


Figure 3.11: Load assigned on the analytical model

3.6.2 Combination of actions

Upon the load cases that has been assigned onto the structure, the three load combinations are generated in the SCIA software automatically based on MS EN Eurocode 1990:2010 – Basis of Structural Design. The three load cases that are involve in this study is the self-weight, dead load and live load. Figure 3.12 (a) shows the load combinations on the ULS and SLS. Whereby, the ULS (Set B) is applied in this case due to the structural design in this study does not involve geotechnical actions. However, the other two load combinations which involves accidental actions and quasi permanent actions are considered in order to determine the SLS. On the other hand, Figure 3.12 (b) shows the contents that load combinations that are auto generated by the software. For instance, ULS Set B load combinations consist of seven different contents of load combinations which comprises of different safety factor to be included in each load cases. Similarly, in the SLS design, the accidental actions and quasi permanent actions both has two different contents of load combinations to be considered in the calculation. Hence, among the contents for each load combinations, only the critical load combinations with their respective leading variable will be considered in the result output.



(a) (b)

Figure 3.12: (a) Load combinations (b) Contents of load combinations

The load combinations factors shown in Figure 3.13 are the factors for permanent actions, variable actions and the reduction factors in determining the design load. Based on the pre-set load combination factors from the Eurocode, the software is able to generate the critical combinations of actions on the structure to compute the structural analysis result.

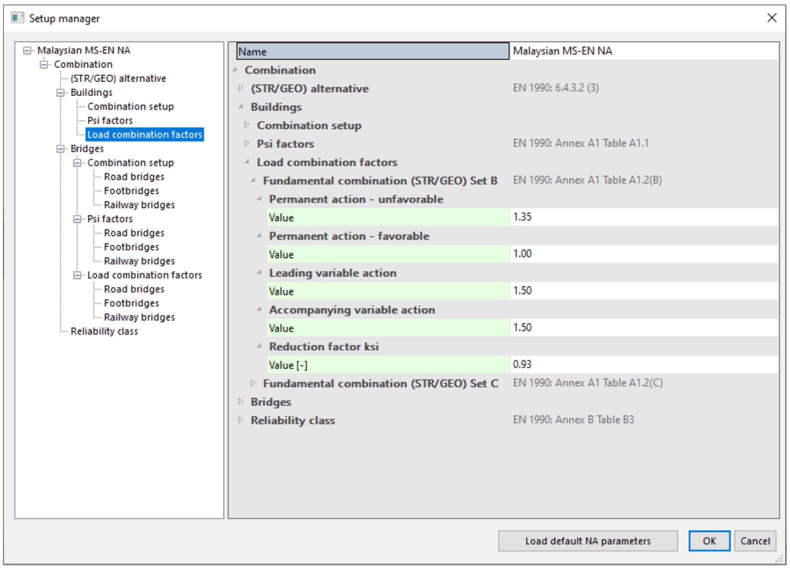


Figure 3.13: Load combination factors

3.6.3 Structural analysis result

Based on the load assigned onto the structure and the load combinations theory from the Eurocode, all result of the structural analysis such as internal forces, shear forces about the *y* and *z* axis and bending moments about the *x*, *y* and *z* axis can be obtained from the software automatically. Figure 3.14 shows the result of bending moment diagram of the entire structure. The results are also computed into a table as shown in Figure 3.15 that indicates the members that has the critical values. Hence, the critical beam on each floor with the largest moments are determined. Meanwhile, the ground floor column which has the critical internal loading and the slab that experience the greatest shear and moment forces are also determined. These members with the critical values are identified to perform further checking on the reinforcement design.

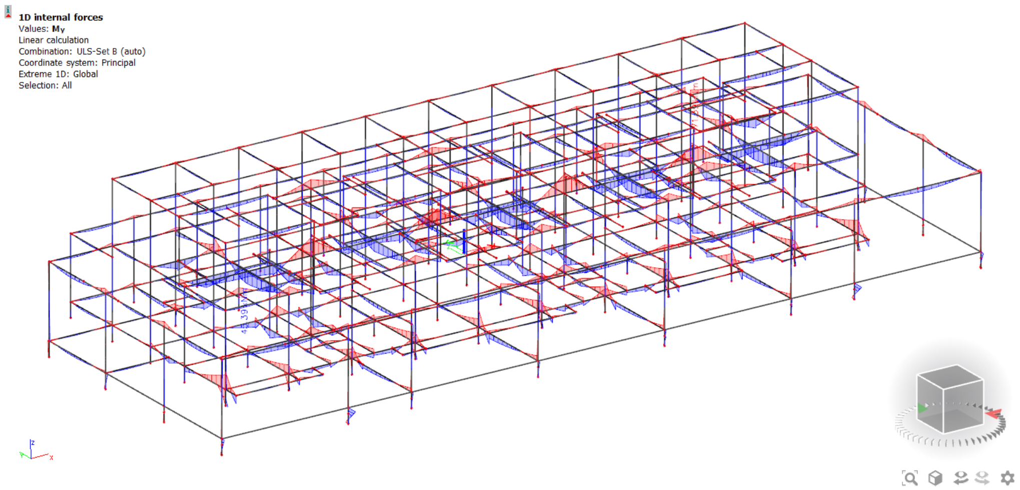


Figure 3.14: Bending moment diagram of the entire structure

	Name	dx [m]	Case	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	Member#425087	0.000	ULS-Set B (auto)...	**-486.04**	9.96	11.50	-0.09	-3.89	-1.96
2	Member#440269	0.000	ULS-Set B (auto)...	**120.78**	0.31	25.23	1.04	-6.31	-0.72
3	Member#386052	0.900	ULS-Set B (auto)...	-7.31	-0.46	**-118.32**	-0.38	-63.14	-0.21
4	Member#445721	4.950+	ULS-Set B (auto)...	54.37	-0.01	**121.48**	-0.01	-24.99	0.01
5	Member#452399	0.000	ULS-Set B (auto)...	-0.29	-0.91	-9.28	**-10.68**	0.48	0.44
6	Member#453840	3.950+	ULS-Set B (auto)...	-2.12	1.47	23.17	**16.63**	-4.84	-0.62
7	Member#467140	28.000+	ULS-Set B (auto)...	32.41	-0.11	55.01	0.31	**-71.39**	-0.04
8	Member#440269	3.450+	ULS-Set B (auto)...	120.25	-2.53	-8.93	1.68	**45.39**	0.35
9	Member#398630	0.300-	ULS-Set B (auto)...	-134.80	**-38.22**	5.00	-0.08	-0.47	**-27.26**
10	Member#398151	0.300-	ULS-Set B (auto)...	-134.31	**37.62**	5.22	0.08	-0.23	**26.87**

Figure 3.15: Structural members with critical values

3.7 Reinforcement design

A consistent steel bar grade B500A is used throughout the design of the reinforcement. The reinforcement design for this study are categorized into two different models which are based on the as-built design and the new design based on the calculation of critical members. The first model whereby the reinforcement designs are done according to the as-built detailing drawings. The input of the reinforcement bars and shear links on the beams, columns and slabs on the structural model are done in the SCIA software as shown in Figure 3.16. This concludes the design of as-built structural model in this study.

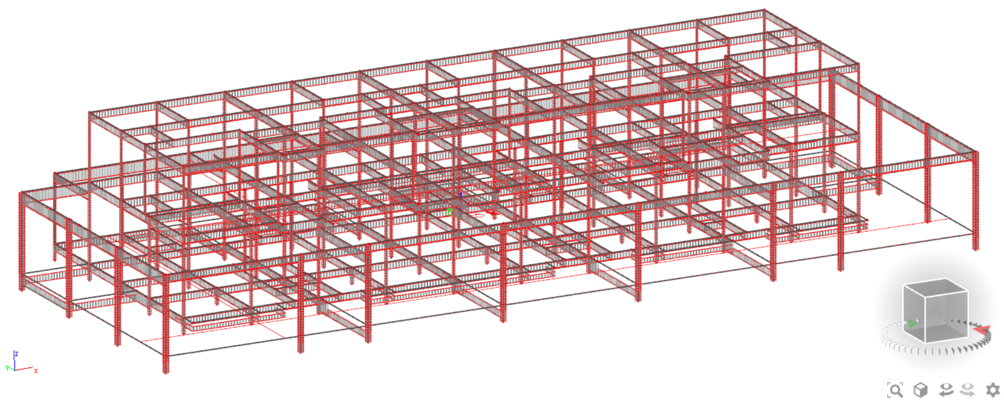


Figure 3.16: Reinforcement design based on detailing drawings

3.7.1 Critical member reinforcement design

On the other hand, the new reinforcement design is based on the critical members of the structural model. The structural beams on ground floor are analysed to identify the critical member that experience maximum hogging and sagging moment. This might result in two different beams whereby each structural beam has the maximum hogging or sagging moment. The following analysis are done on the first floor and roof floor to determine the critical structural beams on each floor. Next, the ground floor columns are taken into consideration in determining the critical structural column that experience the highest internal forces. Lastly, the structural slabs in the ground floor as well are analysed in the SCIA software to determine the maximum moments that the slab experience. These critical structural beams, column and slab are designed manually in Microsoft Excel based on the Eurocode 2 guidelines.

The design of structural beams starts off with the main reinforcement design calculation. By obtaining the beam's moments from the bending moment diagrams in SCIA software, the values k, z and area of reinforcement steel required are calculated by utilizing Equations 3.1, 3.2 and 3.3 respectively.

$$k = \frac{M}{bd^2 f_{ck}} < 0.167 \tag{3.1}$$

$$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d \tag{3.2}$$

$$A_{s,req} = \frac{M}{0.87 f_{yk} z} \tag{3.3}$$

The value V_{Ed} obtained from the shear force diagrams are utilized in the design of shear reinforcement. Equation 3.4 is utilized to calculate the area of stirrup diameters and spacing, A_{sw}/s, for the members. However, Equation 3.5 displays the minimum stirrups diameter and spacing, $A_{sw,min}/s$, that must be provided onto the members. Meanwhile, the maximum spacing, s_{max}, for the shear links are calculated based on Equation 3.6. Therefore, the provided must be larger than the A_{sw}/s and $A_{sw,min}/s$ to ensure shear reinforcement provided to the members are sufficient to resist the shear forces.

$$\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta} \tag{3.4}$$

$$\frac{A_{sw,min}}{s} = \frac{0.08 f_{ck}^{0.5} b_w}{f_{yk}} \tag{3.5}$$

$$Max\ spacing, s_{max} = 0.75d \tag{3.6}$$

Lastly, the deflection checking on the span/depth ratio of structural beam. The calculation of percentage of required tension reinforcement, ρ is done based on the Equation 3.7 in order to determine the basic span effective depth ratio from Eurocode 2 Table 7.4N. Additionally, the modification ratio as well is calculated from Equation 3.8 to determine the modified allowable span/depth ratio, $l/d_{allowable}$. The value of $l/d_{allowable}$ is then used to compared with the actual span/depth ratio, l/d_{actual}. In order to fulfil the SLS requirement, the l/d_{actual} must be smaller than the $l/d_{allowable}$.

$$\rho = \frac{100A_{s,req}}{bd} \tag{3.7}$$

$$Modification\,ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} < 1.5 \tag{3.8}$$

The reinforcement design on structural slabs are similar by determining the k, z and area of reinforcement steel value from Equations 3.1, 3.2 and 3.3. On the shear checking, Equations 3.9 and 3.10 are utilized to determine the design shear resistance and the minimum shear resistance respectively. These checking on shear design are based on Eurocode 1992-1-1 clause 6.2.2.

$$V_{Rd,c} = 0.12k(100\rho_1 f_{ck})^{1/3}bd \tag{3.9}$$

$$V_{min} = 0.035k^{3/2}f_{ck}^{1/2}bd \tag{3.10}$$

On the other hand, the design of critical structural column starts off by determining the slenderness of the column as short column and slender columns has different design methods. Due to the moment experienced by the columns in the structure are minimal, the structural columns are designed with minimum area of steel reinforcement. The reinforcement design requirement for the structural columns are done according to Eurocode 2 part 5.2. One of the criteria for rectangular column is that minimum of four 12 mm reinforcement bar must be provided. Meanwhile, the column's stirrups design requires a minimum stirrup diameter of 6 mm and a quarter of the longitudinal bars diameter. Lastly, the maximum spacing for away from lap region are 400 mm, 20 times of the longitudinal bar diameter and the dimension of the columns while the maximum spacing at the lap region is 14 times of the longitudinal bar diameter. Hence, all these requirements are fulfilled to ensure the design of the reinforcement are sufficient to bear the loadings on the structure.

3.7.2 Reinforcement checks on SCIA Engineer

The new reinforcement design on the critical members are checked under the ULS using the SCIA software. The ULS overall check involves the capacity check on the structural member. The capacity checks are done to verify the ability of a concrete member to support the axial force and bending moments (SCIA, 2022a). Additionally, the response of the concrete and reinforcement members in terms of stress and strain are checked with the limited values according to Eurocode 2 (SCIA, 2022b). The shear checking on the structural members are not done as the torsional effects are not considered in the design. The data of the result are presented in the form of unity factor check. Figure 3.17 shows the overall capacity check of the as-built reinforcement design whereby the parts in red shows that the unity check value greater than 1.0 while the part in green shows that the unity check value is smaller than 1.0.

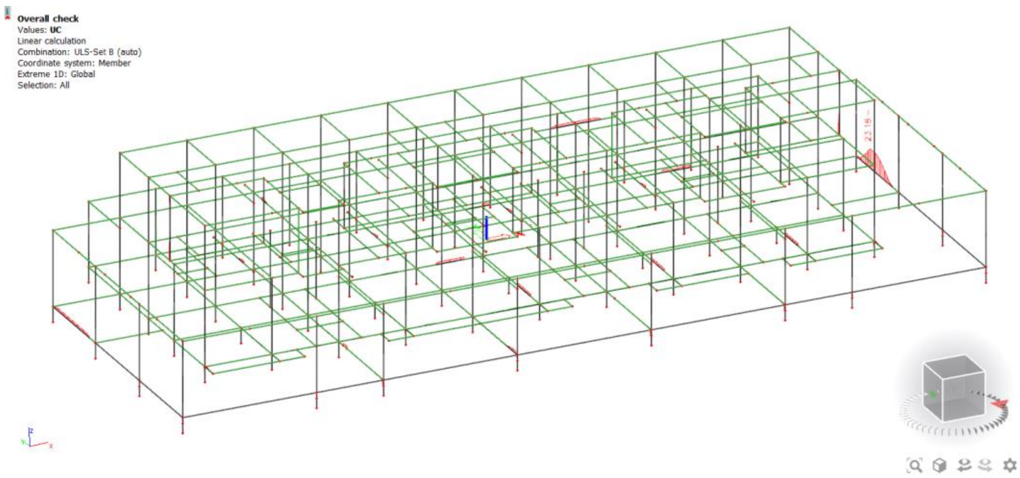
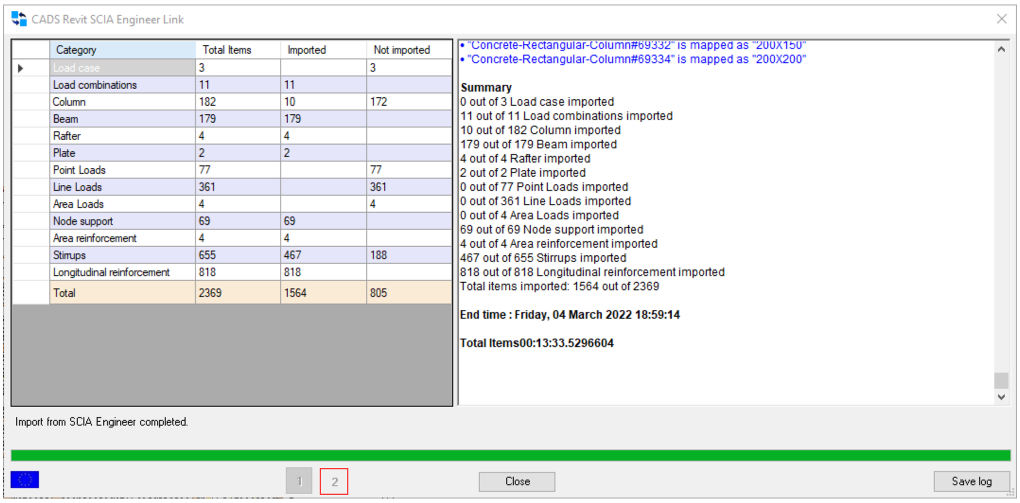


Figure 3.17: Overall capacity check of the as-built reinforcement design

3.8 Model import from SCIA Engineer to Autodesk Revit

The completion of the two structural model are imported back to Autodesk Revit. The process of model import and export are fairly similar whereby the Revit plug in is required in the system. The SCIA Engineer model must be opened in the computer beforehand as Autodesk Revit will identify the SCIA Engineer model will be import. The import process might take up to a few minutes due to the large model data in the structural model as shown in Figure 3.18. The imported structural model includes all structural members including reinforcement steel bar and load cases that are acted on the structure. Figure

3.19 shows the final structural model that has been import into the Autodesk Revit software.



Category	Total Items	Imported	Not imported
Load case	3		3
Load combinations	11	11	
Column	182	10	172
Beam	179	179	
Rafter	4	4	
Plate	2	2	
Point Loads	77		77
Line Loads	361		361
Area Loads	4		4
Node support	69	69	
Area reinforcement	4	4	
Stirrups	655	467	188
Longitudinal reinforcement	818	818	
Total	2369	1564	805

Figure 3.18: Import of model from SCIA Engineer to Autodesk Revit

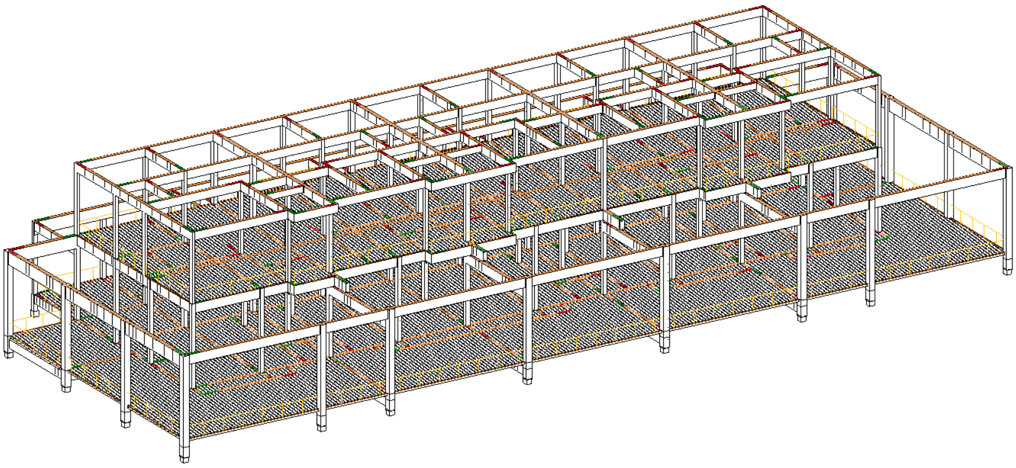


Figure 3.19: Final structural model imported to Autodesk Revit

3.9 Quantity take-off

The quantity take-off on the structural model are done on the Autodesk Revit software. The schedule that are generated from the software are rebar, beam, column and slab schedules. For instance, Figure 3.20 shows the 6 mm diameter rebar schedule that are computed in the software. The similar rebar schedule is done onto all other rebar diameters 8 mm, 10 mm, 12 mm, 16 mm and 20 mm. According to Quantity Surveyor Online (2021), the cost of the rebar not exceeding 12 mm diameter and rebar exceeding 12 mm diameter are RM3.28/kg and RM3.13/kg respectively. By inputting the cost of rebar into the software, the total cost of rebar in constructing the model are computed instantly. Next, Figure 3.21 shows the slab schedule that are prepared in the software. Similarly, schedules of structural beams and columns are prepared in order to compute the total cost of concrete to construct the model whereby the cost of grade 25 concrete are at RM230.00/m^3 (Quantity Surveyor Online, 2021). Hence, this study results in two sets of schedules which are the new design schedule and the as-built design schedule.

<6 mm Rebar Schedule>

A	B	C	D	E	F	G	H
Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost (RM)
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	1.00
T6 - B500A	6 mm	690 mm	5	3.28	3,450 mm	0.766	2.51
T6 - B500A	6 mm	690 mm	5	3.28	3,450 mm	0.766	2.51
T6 - B500A	6 mm	690 mm	5	3.28	3,450 mm	0.766	2.51
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	3.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	3.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	3.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	3.01
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	3.52
T6 - B500A	6 mm	690 mm	11	3.28	7,590 mm	1.685	5.53
T6 - B500A	6 mm	690 mm	25	3.28	17,250 mm	3.830	12.56
T6 - B500A	6 mm	690 mm	25	3.28	17,250 mm	3.830	12.56
T6 - B500A	6 mm	690 mm	31	3.28	21,390 mm	4.749	15.58
T6 - B500A	6 mm	690 mm	31	3.28	21,390 mm	4.749	15.58
T6 - B500A	6 mm	690 mm	31	3.28	21,390 mm	4.749	15.58
T6 - B500A	6 mm	690 mm	61	3.28	42,090 mm	9.344	30.65
T6 - B500A	6 mm	890 mm	5	3.28	4,450 mm	0.988	3.24
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	3.89
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	6.48
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	7.13
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	8.42

Figure 3.20: 6 mm rebar schedule

<Slab Schedule>

A	B	C	D	E	F	G
Floor	Structural Material	Cost (RM per cubic metre)	Area	Thickness (mm)	Volume	Total Cost (RM)
Ground Floor	Cast-in-Place Concrete - C25/30	230.00	732 m²	110	80.47 m³	18,506.95
First Floor	Cast-in-Place Concrete - C25/30	230.00	338 m²	110	37.15 m³	8,545.08
Grand total					117.62 m³	27,052.02

Figure 3.21: Slab schedule

3.10 Summary

The methodology of this study is discussed in this chapter. The entire work flow implements the open BIM method whereby Autodesk Revit and SCIA Engineer are used. The structural model is constructed in the Autodesk Revit based on the as-built structural model from the construction drawings. The structural model is exported into SCIA Engineer for structural analysis and in the same time determine the critical members of the structure. The as-built reinforcement design are inserted into the structural model. Meanwhile, the critical members are design based on Eurocode 2. The critical members are designed with a different reinforcement design which results in two different SCIA Engineer model. The models are imported back at Autodesk Revit to perform quantity take-off. The cost for materials for the construction of the two different models are computed in the software. The result of the quantity take-off and the comparison between the new design and the as-built model are presented and discussed in the next chapter.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this research, a double storey reinforced concrete terrace house is modelled using the open BIM tools, Autodesk Revit and SCIA Engineer. The result of the structural analysis generated from the software are used to determine the critical structural elements in the terrace house. The critical structural elements are designed in accordance to Eurocode 2 which results in a new reinforcement design. The detailed reinforcement designs of the critical structural members are presented as a spreadsheet in Appendix A. Later, the new reinforcement design is compared with the software's design requirements and the as-built structural drawings. Lastly, the final percentage difference in the structural material quantity usage between the new design and the as-built model is presented and discussed in this chapter.

4.2 Ground floor structural beam

All ground floor beams inside the terrace house compound are considered in this study to determine the critical structural beam in the ground floor area. Figure 4.1 shows the load distribution diagram that illustrate the forces that are acted on each beams respectively. Meanwhile, Figure 4.2 and Figure 4.3 show the shear force diagram and bending moment diagrams of the ground floor structural beams.

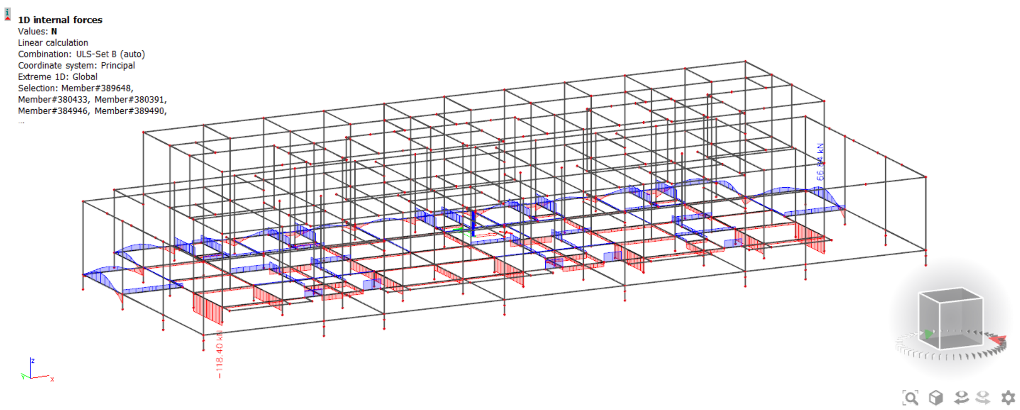


Figure 4.1: Ground floor load distribution diagram

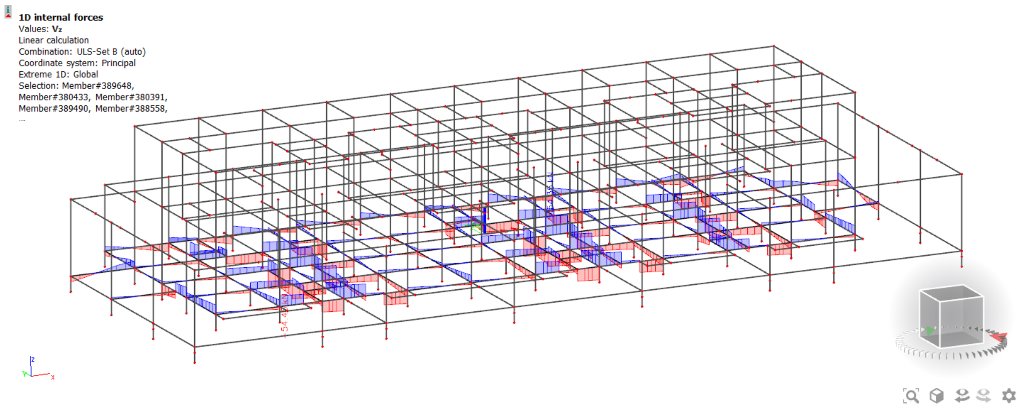


Figure 4.2: Ground floor shear force diagram

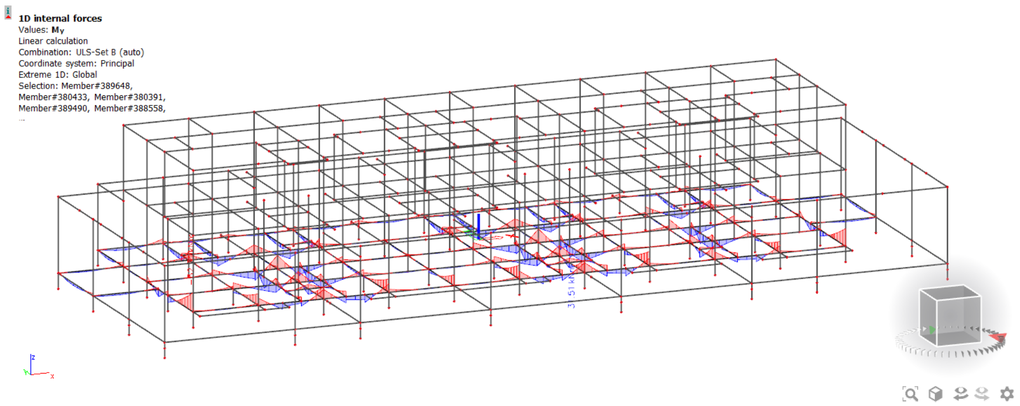


Figure 4.3: Ground floor bending moment diagram

Figure 4.4 shows the two circled ground floor critical members that will be used for the ground beam reinforcement design. The beam that is circled in red (Beam 1) is the beam that experience the maximum hogging moment of 52.51 kNm while the beam circled in blue (Beam 2) experience the maximum sagging moment of 31.51kNm. These two structural beams will be accounted to the reinforcement design of the entire ground floor beams.

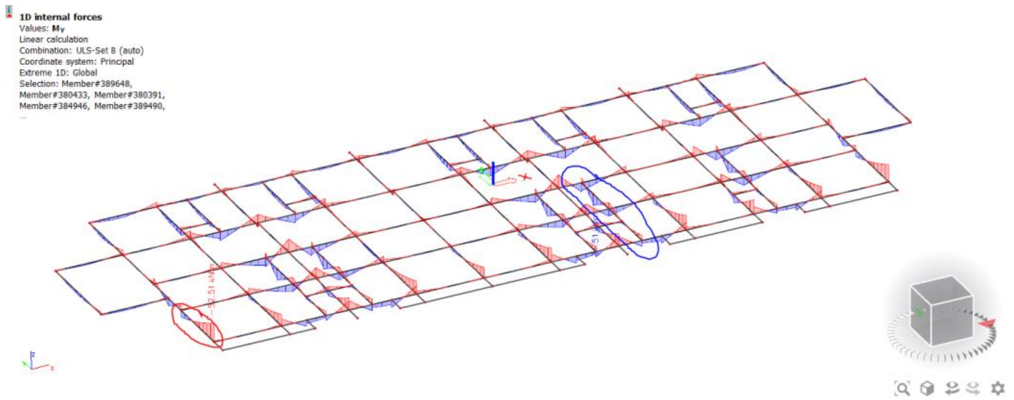


Figure 4.4: Ground floor critical structural beam members

4.2.1 Hogging moment reinforcement design

Beam 1 represent the critical ground floor beam that experience the maximum hogging moment. Beam 1 has a dimension of 150 mm × 400 mm and a span length of 3450 mm. Figure 4.5 shows the bending moment diagram of the simply supported beam. The main reinforcement for the beam is designed with the hogging moment of 52.51 kNm at the support. Manual calculations result in a value of k, z and $A_{s,req}$ of 0.1150, 309.03 and 390.618 mm^2. Since the k value did not exceed 0.167, no compression steel design is required for the beam. Hence, two 16 mm bars with an area of steel reinforcement of 402 mm^2 are provided to resist the hogging moments at the support. The two 16 mm bars will be placed at the top side of the ground floor structural beam to resist the hogging moments.

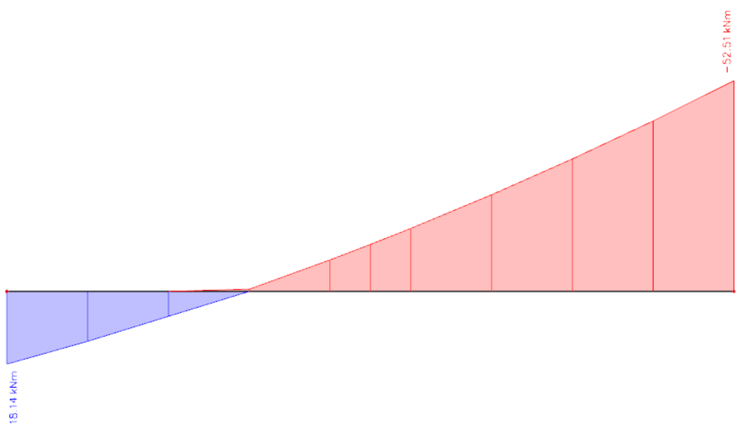


Figure 4.5: Beam 1 bending moment diagram

The deflection checking of the structural beam is done based on the area of steel reinforcement required and provided. The ρ value calculated to be 0.75 which results in a basic span effective depth ratio of 16. With the modification ratio calculated at 1.03, the $l/d_{allowable}$ results is 16.48. Meanwhile the actual l/d is calculated at 9.89 which is smaller than 16.48 and the SLS requirements for Beam 1 is fulfilled.

4.2.2 Sagging moment reinforcement design

Beam 2 represents the ground floor beam that experience the critical sagging moment. Figure 4.6 shows the bending moment diagram of the two span continuous beam. The structural beam experience maximum sagging moment of 31.51 kNm at the centre of the first span beam from the left. The beam size is designed to be 150 mm × 400 mm with a span length of 2850 mm. The manual calculation results with the of k, z and $A_{s,req}$ value of 0.0690, 326.286 and 222 mm^2. Similarly, compression steel is not required for this design as the k value is smaller than 0.167. Hence, three 10 mm reinforcement bar which provides 236 mm^2 of reinforcement area is proposed on the structural beam member. The sagging moments are resisted by placing the three 10 mm bars at the bottom side of the structural beam.

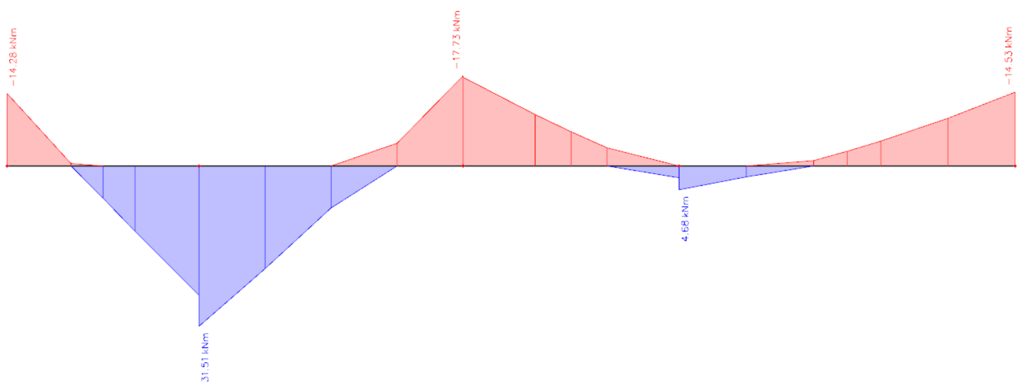


Figure 4.6: Beam 2 bending moment diagram

Meanwhile, the deflection checks result in a ρ value of 0.42 and the basic span effective depth ratio of 19. Since critical beam 2 is a continuous beam at the end span, the k value is defined to be 1.3 according to Table 7.4N. Based on the area of steel required and provided for the design of the structural beam, the modification ratio is calculated to be 1.06. Therefore, the result of $l/d_{allowable}$ and l/d_{actual} is calculated to be 37.05 and 8.17 respectively. This proofs that beam 2 fulfils the deflection checking requirements.

4.2.3 Shear link reinforcement design

Beam 2 is selected to be considered in the shear design as it has a more critical shear force compared to beam 1. Figure 4.7 shows the shear force diagram of beam 2 whereby the greatest shear force is at 35.44 kN. The A_{sw}/s, $A_{sw,min}/s$ and s_{max} calculated are 0.104, 0.120 and 261.75 mm respectively. Thus, the proposed stirrups diameter of 6 mm with spacing of 250 mm is provided in the structural beams whereby the stirrups diameter and spacing provided, $A_{sw,prov}/s$, is 0.226.

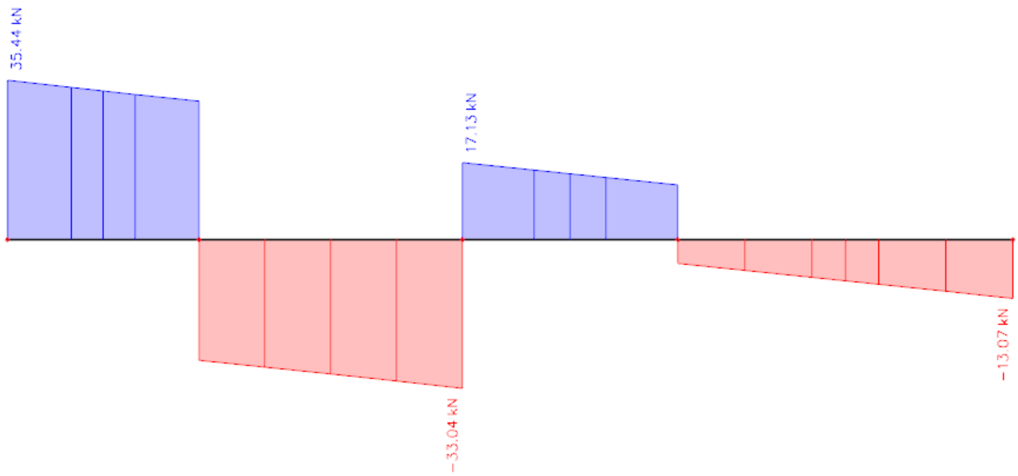


Figure 4.7: Beam 2 shear force diagram

4.2.4 Reinforcement check in SCIA Engineer

Figure 4.8 shows the result of reinforcement design from the critical structural beam members in the ground floor. The detailing presents that the provided top and bottom reinforcement are two 16 mm bars and three 10 mm bars respectively while the shear link provided are 6 mm shear link with the spacing of 250 mm. This reinforcement design is applied to all structural beams that are located in the ground floor.

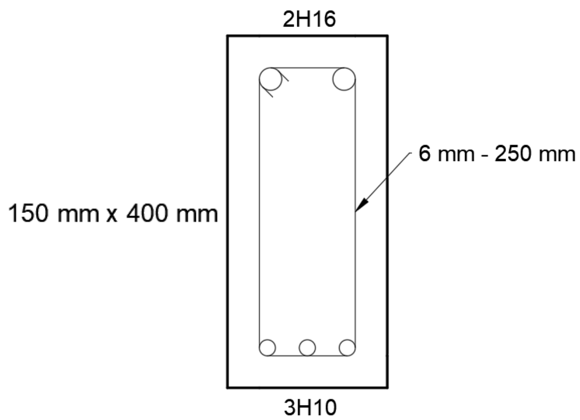


Figure 4.8: Ground floor structural beam reinforcement

Figure 4.9 and Figure 4.10 show the result of capacity check on the new reinforcement design in beam 1 and beam 2 respectively. The results show that the overall structural beams has a unity check value below 1.0. This proves that the reinforcement design for the ground floor beams are sufficient in resisting the loads and moments that are experienced by the structural members.

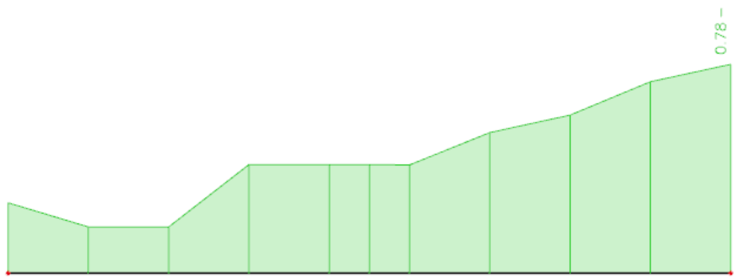


Figure 4.9: Beam 1 capacity check graph

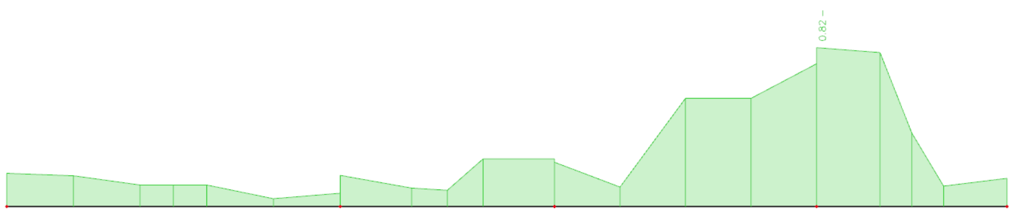


Figure 4.10: Beam 2 capacity check graph

4.3 First floor structural beam

All first floor beams that are within the internal house compound are taken into consideration for the reinforcement design to determine the critical members. The beams at the first floor that are acting as a roof beam are not taken into consideration. Figure 4.11 shows the load distribution diagram which displays the internal forces that are acted onto the structural beams. Similarly, from the software, the shear force and bending moment diagrams are also auto generated as shown in Figure 4.12 and Figure 4.13.

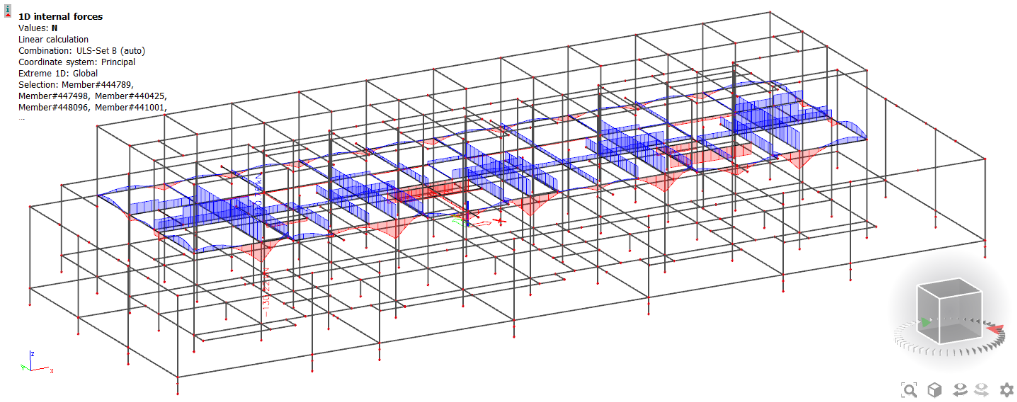


Figure 4.11: First floor load distribution diagram

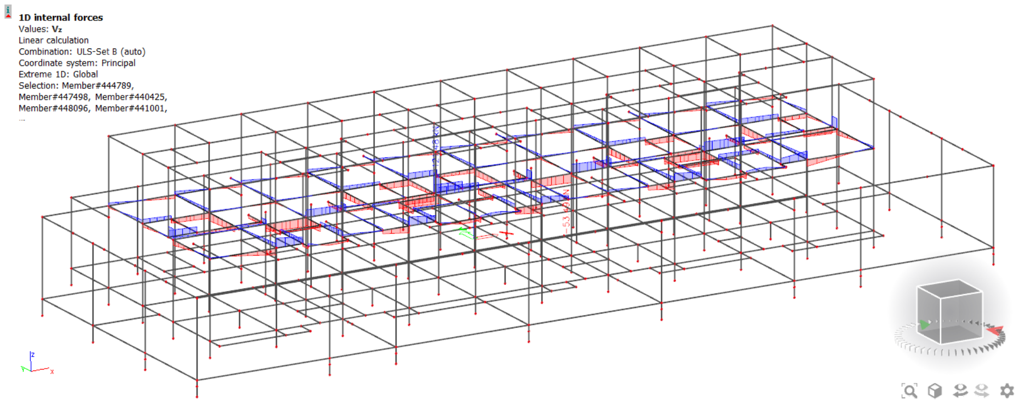


Figure 4.12: First floor shear force diagram

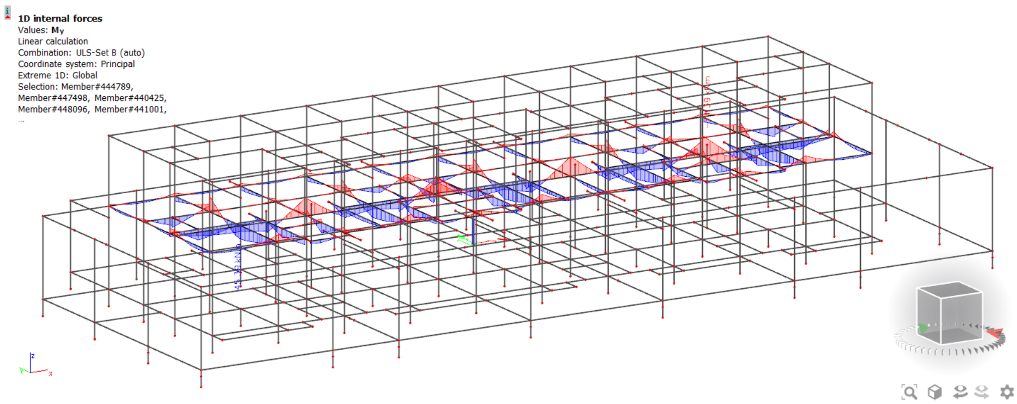


Figure 4.13: First floor bending moment diagram

The critical structural beams on the first floor that experience the maximum hogging and sagging moments are determined as shown in Figure 4.14. The beam circled in red (Beam 3) is the member experience the greatest hogging moment at 71.39 kNm. Meanwhile, the beam circled in blue (Beam 4) experience the maximum sagging moment at 45.39 kNm. The two structural beams with their respective moments are designed accordingly

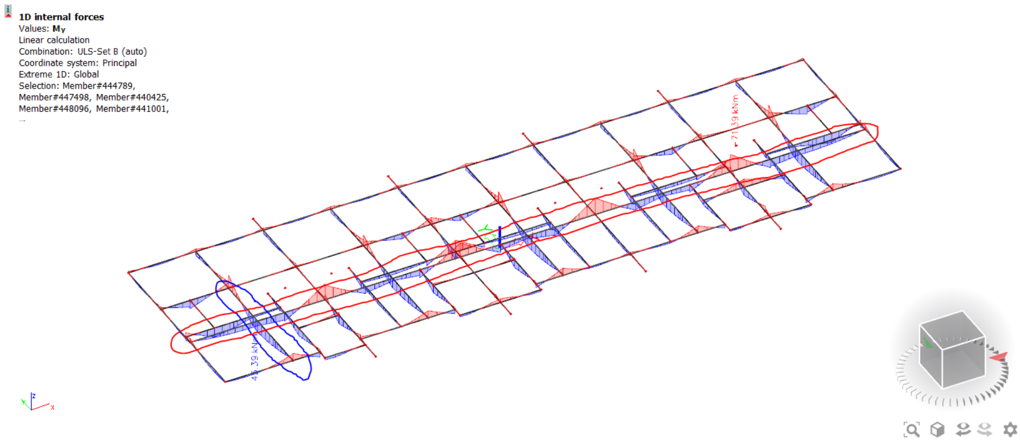


Figure 4.14: First floor critical structural beam members

4.3.1 Hogging moment reinforcement design

The critical structural members in the first floor that experience the maximum hogging moment is identified as beam 3. Figure 4.15 shows the bending moment diagram of a 5 span continuous beam whereby the maximum hogging moment of beam 3 is recorded at 71.39 kNm. Since the maximum hogging moment that occurs on beam 3 located at the first span from the right, only the critical span is taken into consideration for the design calculation. The critical span of the beam is designed to have a size of 150 mm × 450 mm and a span length of 7000 mm. The calculated value of k, z and $A_{s,req}$ are 0.1196, 351.19 and 467.311 mm^2 respectively. In this design, the compression steel is not required as the calculated k value did not exceed 0.167. Hence, two 16 mm diameter bars and one 10 mm bar are proposed in this structural beam design which results in a total area of steel bars provided to be 480.5 mm^2. These bars will be designed on the top side of the structural beams to resist the hogging moments on the structural members.

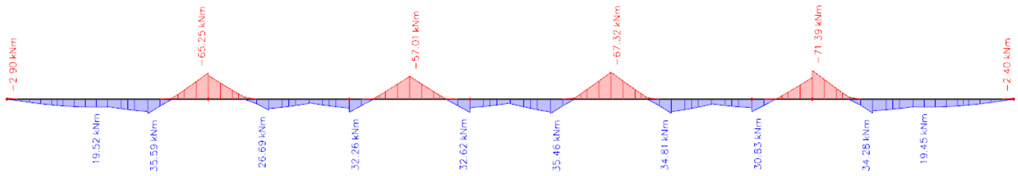


Figure 4.15: Beam 3 bending moment diagram

Besides, the deflection checking is done which results in a ρ value of 0.2. According to the Eurocode, the k value is 1.3 as the structural beam is on the end span of a continuous beam while the basic span effective depth ratio is 22.8. Hence, the result of the calculation for modification ratio and $l/d_{allowable}$ are 1.33 and 39.42 respectively. By comparing to the l/d_{actual} which is 17.54, the deflection check has passed since the $l/d_{allowable}$ is greater than the l/d_{actual}.

4.3.2 Sagging moment reinforcement design

Figure 4.16 shows the bending moment diagram of beam 4 which experience the maximum sagging moment of 45.39 kNm. Beam 4 is designed to be a simply supported beam with a size and span length of 200 mm × 450 mm and 6300 mm respectively. The manual calculations result in a k, z and $A_{s,req}$ value of 0.057, 377.82 and 276.176 mm^2 respectively. Similarly, compression steel design is not required since the k value is below 0.167. Thus, two 12 mm diameter bars and one 10 mm diameter bars are proposed to be provided into the structural beam. This result in $A_{s,prov}$ to be 304.5 mm^2 which is greater than the $A_{s,req}$ value. The following bars are placed at the bottom side of the structural beams to resist the sagging moment that are subjected to the structural members.

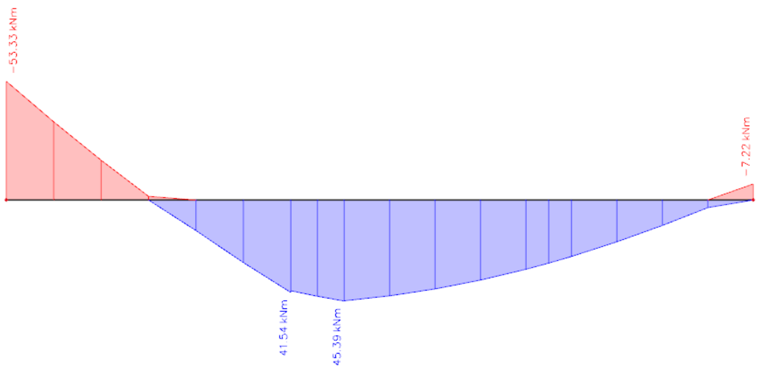


Figure 4.16: Beam 4 bending moment diagram

Next, deflection checking is done based on the A_s required and A_s provided in beam 4. The calculated ρ value is 0.35 which results in the basic span effective depth ratio of 23. From Eurocode 2 Table 7.4N, simply supported beam are designed to have a k value of 1.0. With these data obtained, the modification ratio is calculated to be 1.1 and the $l/d_{allowable}$ is calculated to be 25.3. Meanwhile, the calculated l/d_{actual} is 15.79 which is smaller than the $l/d_{allowable}$. In short, the deflection check requirement is fulfilled for beam 4.

4.3.3 Shear link reinforcement design

Beam 3 is selected for the shear link reinforcement design for first floor structural beam as the shear force in beam 3 is more critical compared to beam 4. Figure 4.17 shows the shear force diagram of beam 3 with a critical shear of 55.01 kN. The manual calculations results in a value of A_{sw}/s, $A_{sw,min}/s$ and s_{max} of 0.141, 0.120 and 299.25 mm respectively. Hence, utilizing the $A_{sw,min}/s$ and s_{max} calculated, 6 mm diameter shear link and 250 mm spacing is proposed to resist the shear force in the structural beam.

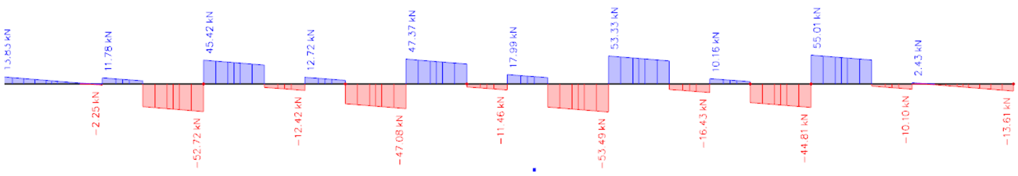


Figure 4.17: Beam 3 shear force diagram

4.3.4 Reinforcement check in SCIA Engineer

Figure 4.18 shows the first floor beam reinforcement design that are based on the two critical first floor structural members. The top side of the beam are design to have two 16 mm diameter bars and one 10 mm diameter bar while the bottom side is designed to have two 12 mm diameter bars and one 10 mm diameter bar. Meanwhile, the shear link of 6 mm diameter bars with a spacing of 250 mm is designed on the structural beams. The similar design is applied on all first floor structural beams to resist the bending moments and shear force that are acted on the members.

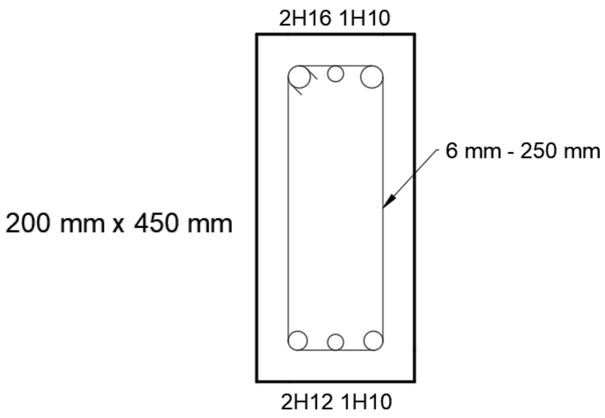


Figure 4.18: First floor structural beam reinforcement

Figure 4.19 and Figure 4.20 shows the capacity check graph of beam 3 and beam 4 respectively. The graph shows that the red portion has exceeded the unity check value of 1.0 while the green portion has a unity check value of below 1.0. This concludes that only the mid-span of the two beams has failed the reinforcement design capacity check and additional reinforcement needs to be added onto the members to resist the high bending moments.

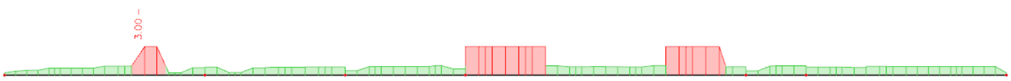


Figure 4.19: Beam 3 capacity check graph

Figure 4.20: Beam 4 capacity check graph

4.4 Roof floor structural beam

All structural beams on the roof floor are taken into consideration for the design of steel reinforcement. Figure 4.21 shows the load distribution diagram of the structural beam on the roof floor that are subjected to loading from roof trusses. Meanwhile the reaction of the beams, shear force diagram and bending moment diagram of the roof floor structural beam are shown in Figure 4.22 and Figure 4.23 respectively.

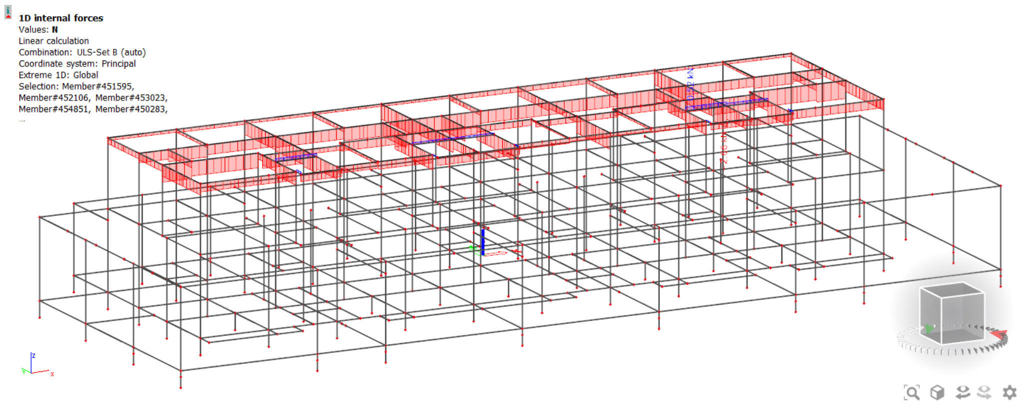


Figure 4.21: Roof floor load distribution diagram

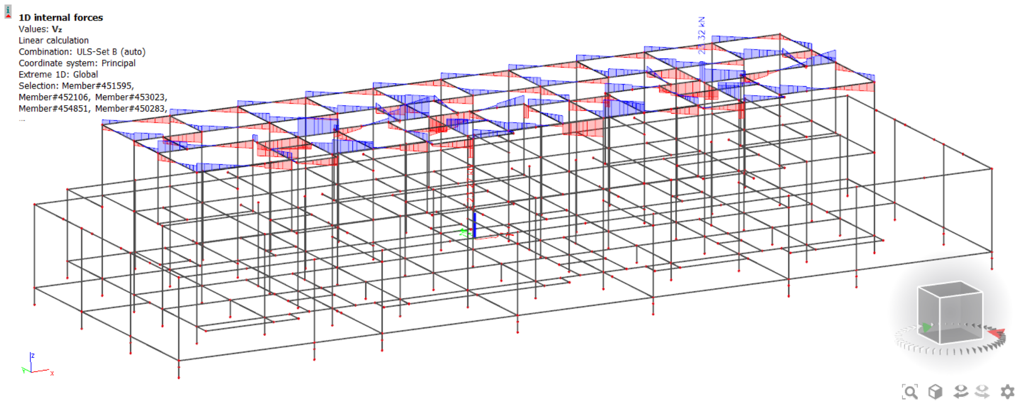


Figure 4.22: Roof floor shear force diagram

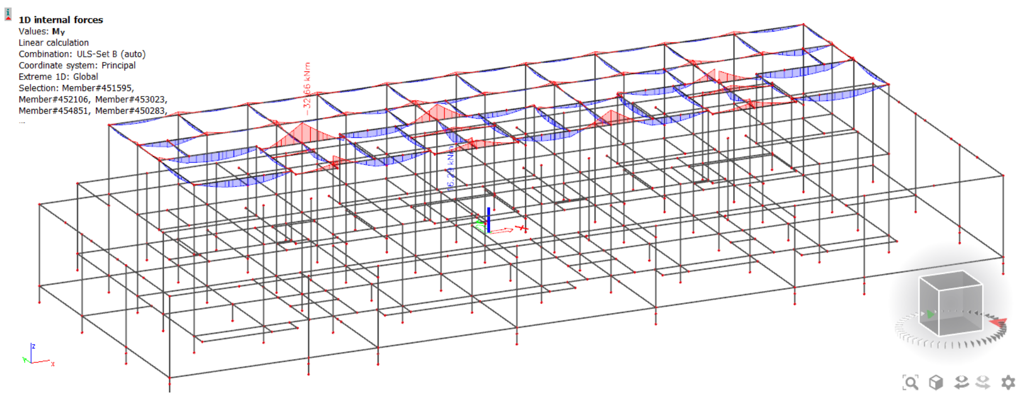


Figure 4.23: Roof floor bending moment diagram

The critical structural beam in the roof floor are labelled as shown in Figure 4.24. The structural beam circled in red is categorised as beam 5 with a maximum hogging moment of 32.66 kNm while the structural beam circled in blue is categorised as beam 6 with maximum sagging moment of 16.29 kNm.

The steel reinforcement for the two structural beam on the roof floor are designed based on the critical moments.

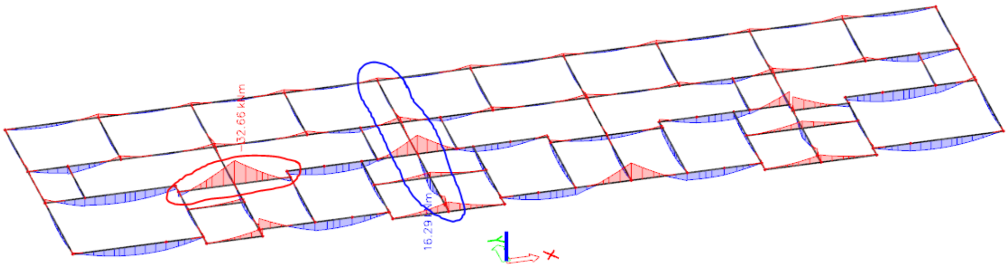


Figure 4.24: Roof floor critical structural beam members

4.4.1 Hogging moment reinforcement design

Figure 4.25 shows the bending moment diagram of beam 5 which represents the critical roof floor beam with the maximum hogging moment recorded at 32.66 kNm. The critical beam is designed as a simply supported beam with a beam size of 150 mm × 400 mm and a span length of 2100 mm. The result of the manual calculation results in a value of k, z and $A_{s,req}$ of 0.0715, 325.399 and 230.734 mm^2 respectively. Given that the calculated k value is smaller than 0.167, compression steel design in the structural beam is not required. A total of 236 mm^2 area of steel reinforcement which consist of three 10 mm diameter bars are proposed to resist the hogging moment of the structural beam.

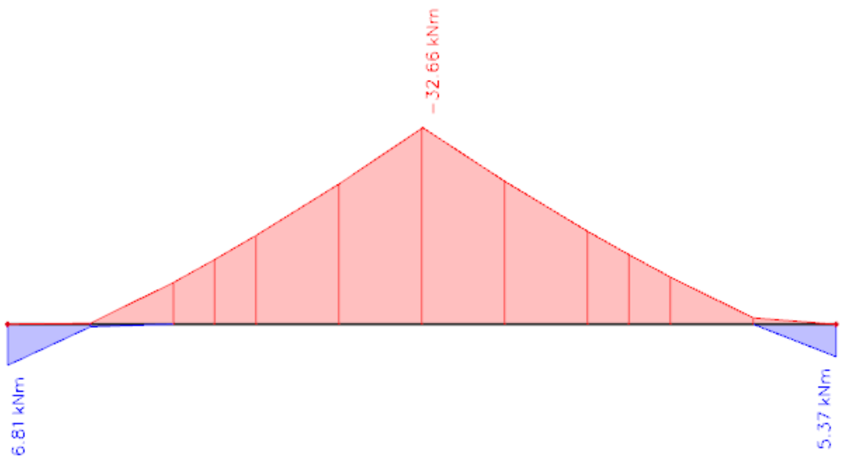


Figure 4.25: Beam 5 bending moment diagram

Moving on to the deflection checking on the structural beam, the ρ value calculated is 0.44 which results in the basic span effective depth ratio of 21. Meanwhile, the k value for beam 5 is 1.3 since the beam is designed as a simply supported beam. The modification ratio calculated based on the reinforcement design results in a value of 1.02. Hence, the calculated $l/d_{allowable}$ and l/d_{actual} are 27.85 and 6.02 respectively. The deflection check requirements are fulfilled since $l/d_{allowable}$ is greater than l/d_{actual}.

4.4.2 Sagging moment reinforcement design

Figure 4.26 shows the bending moment diagram of beam 6. Beam 6 represents the roof floor structural beam that experiences the critical sagging moment of 16.29 kNm. The critical beam is designed as a four span continuous beam whereby only the critical sagging moment on the third span from the right are taken into consideration for the reinforcement design. The critical span is designed with a beam size of 200 mm × 400 mm and a span length of 3900 mm. Hence, the calculated k, z and $A_{s,req}$ value are 0.0197, 331.55 and 83.065 mm^2 respectively. The design of the critical span is done without the need of compression steel due to the value k not exceeding 0.167 and the maximum z value of 0.95d is applied in this reinforcement design. Two 10 mm diameter bars that provides 157 mm^2 of steel reinforcement are proposed in order to resist the sagging moment of the structural beam.

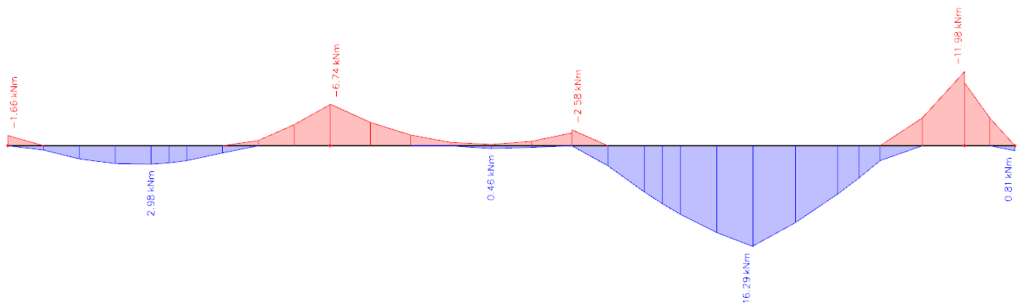


Figure 4.26: Beam 6 bending moment diagram

Beam 6 undergoes deflection checking as well based on the reinforcement design. The ρ value calculated is recorded to be 0.16. Based on the Eurocode 2, the ρ value results in a basic span effective depth ratio 27 while the k value of 1.5 is obtained as the beam span is at the mid span of a continuous beam. Next, the calculated modification ratio is 1.39 which results in the calculated $l/d_{allowable}$ of 56.30. The value of $l/d_{allowable}$ is compared to the l/d_{actual} of 11.17 which concludes that $l/d_{allowable}$ is greater than l/d_{actual}. Thus, deflection check on beam 6 is fulfilled.

4.4.3 Shear link reinforcement design

The shear link reinforcement design is done based on beam 6 which has a more critical shear force than beam 5. Figure 4.27 shows the shear force diagram of beam 6 whereby the critical shear force is 23.27 kN. The result of the manual calculation for the value A_{sw}/s, $A_{sw,min}/s$ and s_{max} are 0.068, 0.16 and 261.75 mm. Given that $A_{sw,min}/s$ has a greater value at 0.16, $A_{sw,min}/s$ is utilized in designing the shear reinforcement for the structural beam. Hence, shear link with 6 mm diameters bars and spacing of 250 mm are provided onto the roof structural beam to resist the shear forces on the members.

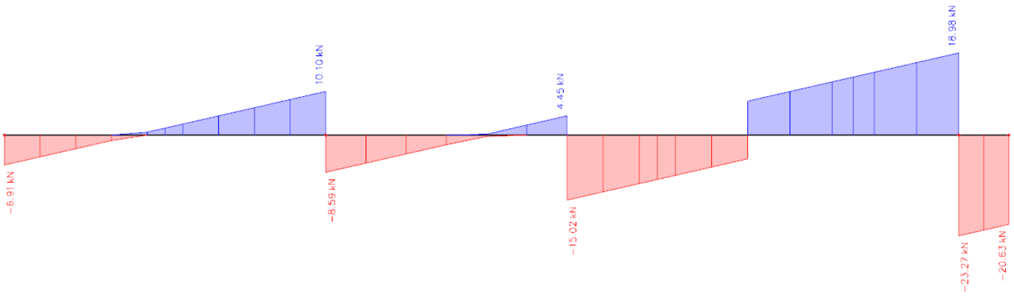


Figure 4.27: Beam 6 shear force diagram

4.4.4 Reinforcement check in SCIA Engineer

Figure 4.28 shows the reinforcement design of a roof floor structural beam that are designed based on the critical structural members. The top side of the beam consist of three 10 mm diameter bars while the bottom side consist of two 10 mm diameter bars to resist the hogging and sagging moment respectively. Meanwhile, the shear reinforcement is provided with 6 mm diameter shear link and a spacing of 250 mm. All roof floor beams are designed with the same steel reinforcement design in order to resist the moments and shear forces that are acted on the structure.

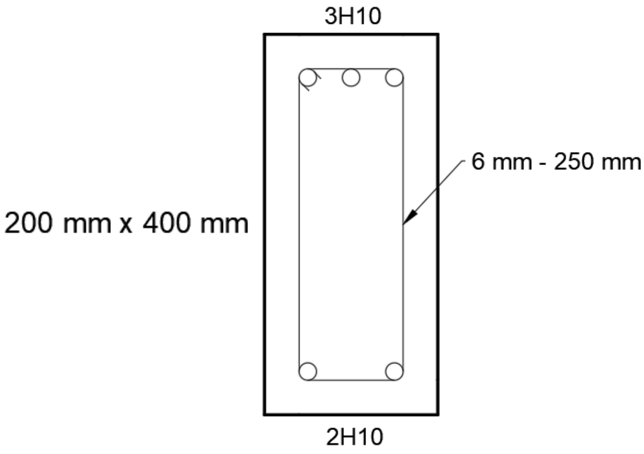


Figure 4.28: Roof floor structural beam reinforcement

Next, beam 5 and beam 6 undergoes the capacity check on the SCIA Engineer software. The result of the capacity check of the two roof floor beams are displayed in form of graph as shown in Figure 4.29 and Figure 4.30. The capacity check graph shows that the unity check value throughout the two structural beams did not exceed 1.00. Hence, the reinforcement design on the two structural beams are sufficient to resist the bending moments.

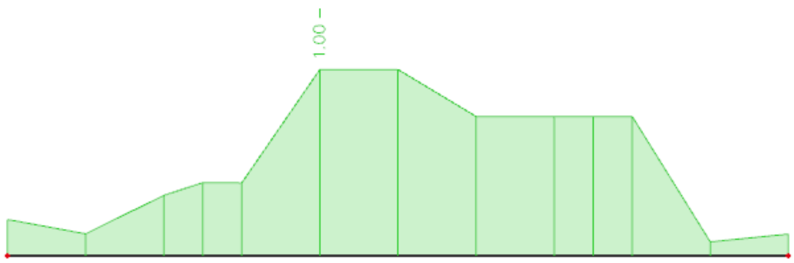


Figure 4.29: Beam 5 capacity check graph

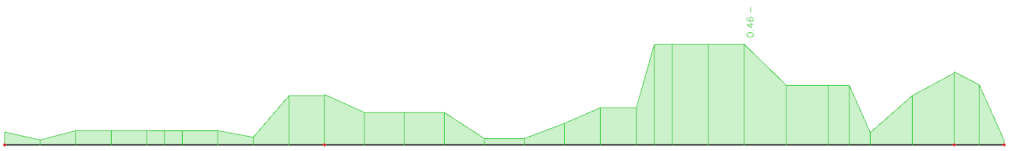


Figure 4.30: Beam 6 capacity check graph

4.5 Structural slab

The ground floor slab within the interior compound of the structure are taken into consideration for the reinforcement design. The thickness of structural slab in the design is kept consistent at 110 mm. Figure 4.31 and Figure 4.32 shows the bending moment of the structural slab about the x-axis and y-axis respectively. Comparing the bending moments from the two axis, the bending moment about the y-axis presents a more critical value whereby the hogging and sagging moment are at 21.15 kNm/m and 6.66 kNm/m respectively. Therefore, these two critical moments are utilized in the reinforcement design.

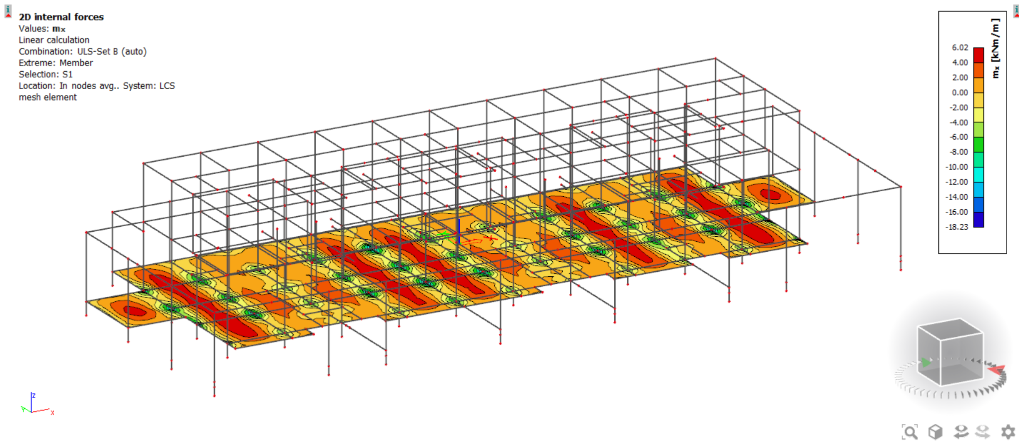


Figure 4.31: Structural slab bending moment about x-axis

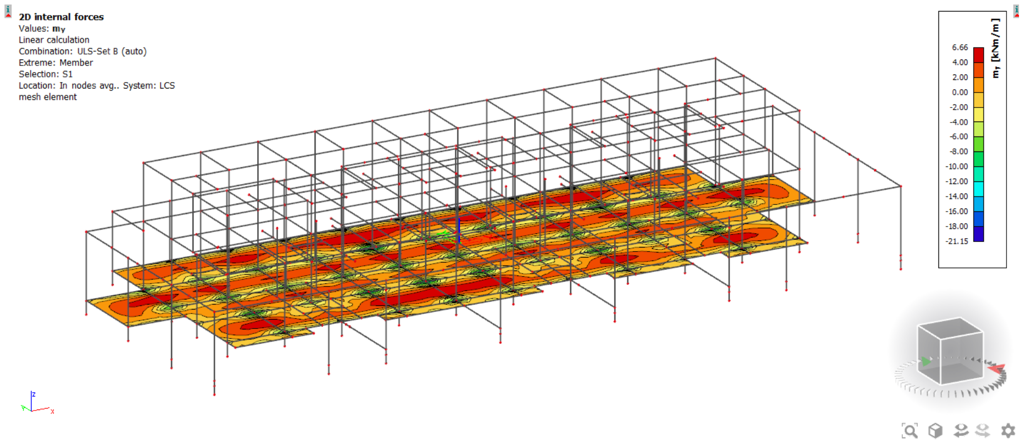


Figure 4.32: Structural slab bending moment about y-axis

4.5.1 Reinforcement design

The reinforcement design for the largest interior slab with the size of 3450 mm × 3500 mm is considered in the design. The design for the critical hogging moment of 21.15 kNm/m results in the calculate k, z and $A_{s,req}$ value of 0.1322, 69.222, 702.388 mm^2 respectively. Hence, 10 mm diameter bars with a spacing of 100 mm which results in an $A_{s,prov}$ of 785 mm^2 is proposed to resist the hogging moment. Meanwhile, the reinforcement design for sagging moment of 6.66 kNm/m is done similarly. The result of the calculated k, z and $A_{s,req}$ value are 0.0416, 76.00, 198.967 mm^2 respectively. The $A_{s,prov}$ of 242 mm^2 is proposed by providing 10 mm diameter bars with a spacing of 325 mm in order to resist the sagging moment in the structural slab. Thus, only these main reinforcement is required for the structural slab design since the k value for the sagging and hogging moment design is below 0.167.

Figure 4.33 shows the structural slab with the critical shear force of 94.54 kN/m about the y-axis. The calculated $V_{Rd,c}$ and V_{min} are 128.55 kN/m and 138.59 kN/m respectively. Therefore, the structural slab has a shear resistance of 138.59 kN/m which is sufficient in resisting the critical shear force of 94.54 kN/m.

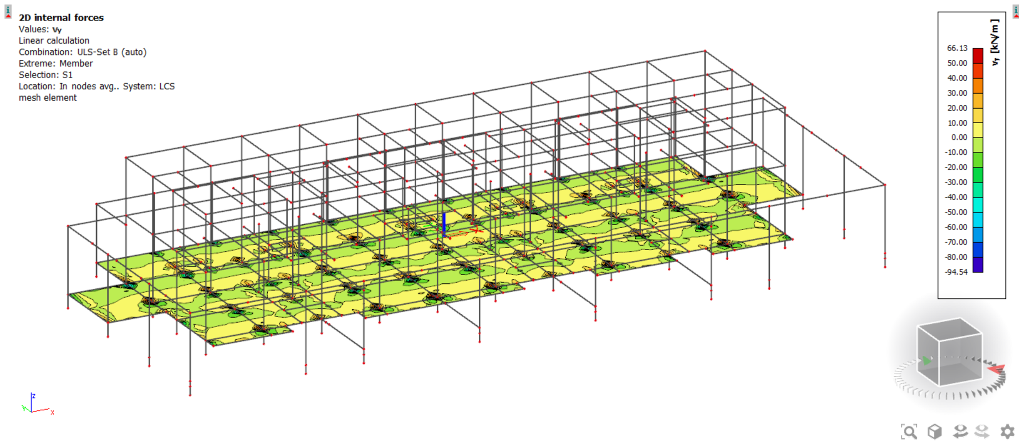


Figure 4.33: Structural slab shear force about y-axis

Next, the checking of the structural slab design on the cracking are done according to Eurocode 2 clause 7.3.3 and 9.3.1 which defines on the thickness of slab and maximum main reinforcement bar spacing. The maximum thickness of slab must be lower than 200 mm while the maximum spacing calculated is 330 mm. Meanwhile, the thickness of slab in this design is 110 mm and the greatest proposed bar spacing is 325 mm. Thus, the cracking requirement check for the structural slab design is fulfilled.

4.5.2 Reinforcement check in SCIA Engineer

Figure 4.34 shows the cross section view of the structural slabs with the reinforcement designed based on the critical moment and shear forces. 10 mm diameter bars with a spacing of 100 mm are placed at the top side of the structural slab at both x-axis and y-axis to resist the hogging moment that are subjected to the slab. Meanwhile, the bottom side is provided with 10 mm diameter bars with a spacing of 325 mm at both x-axis and y-axis to resist the sagging moment. This reinforcement design is placed at the entire structural slab at the ground floor and roof floor.

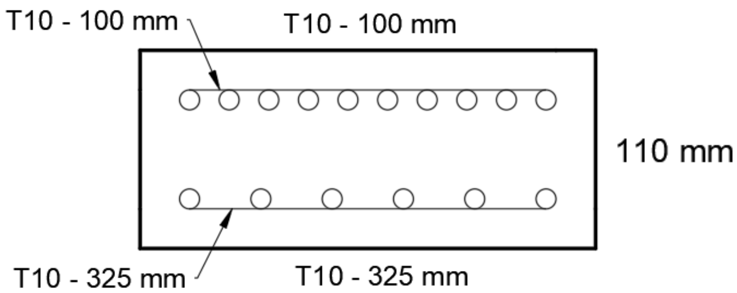


Figure 4.34: Structural slab reinforcement design

Figure 4.35 shows the structural slab crack width check that are performed by SCIA Engineer. The unity check value in most of the structural slab areas are below 1.00. Only a slight area of the slab that is red has a unity check value of 1.00. However, since the small area involved are not in the bathroom area, the crack width is considered negligible. This concludes that the reinforcement design of the structural slab has fulfilled the design requirements.

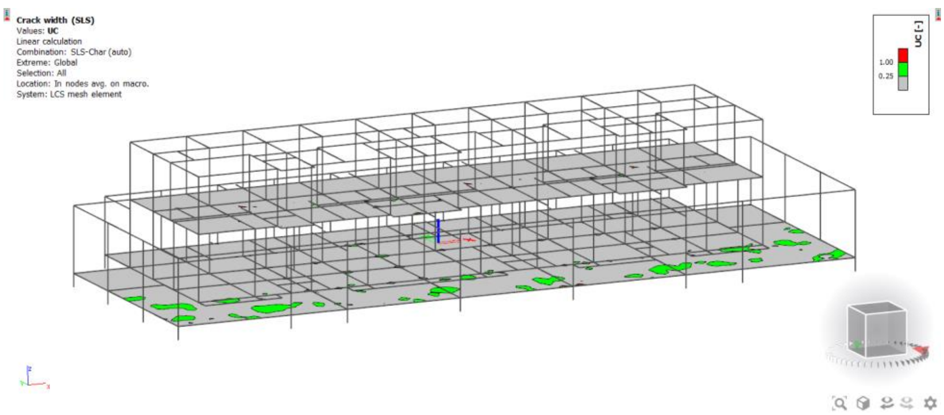


Figure 4.35: Structural slab crack width check

4.6 Structural column

Figure 4.36 shows the load distribution diagram of the structural column from ground floor to the roof floor. Due to the nature of a structural building, the internal forces of columns in the lower level will experience a larger force as loading are transferred from the top floor to the bottom floor. However, in this study, the design of stump is not taken into consideration for the reinforcement design. Hence, only structural columns on the ground floor is considered in determining the critical structural column. Figure 4.37 shows the critical structural column that experience the critical internal force of 352.42 kN.

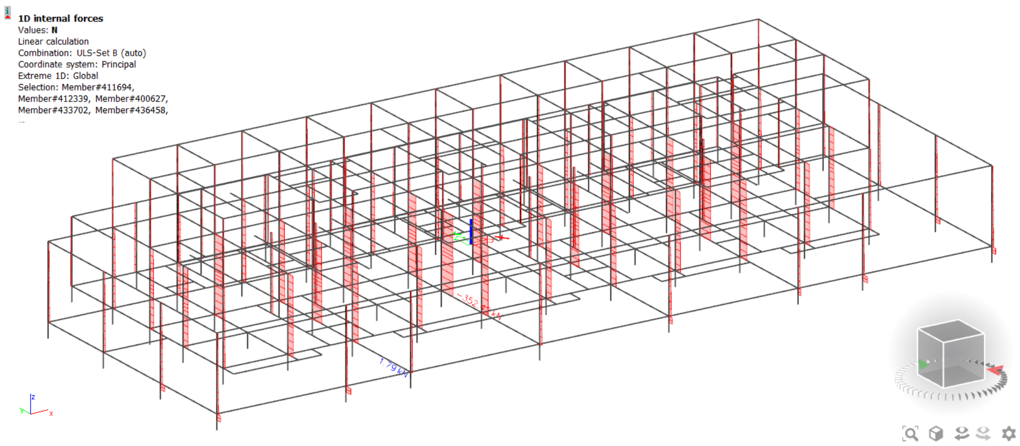


Figure 4.36: Structural column load distribution diagram

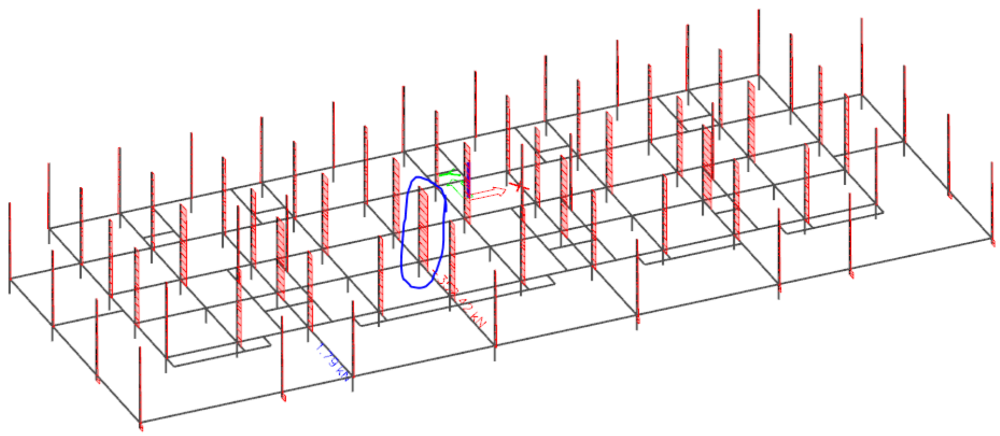
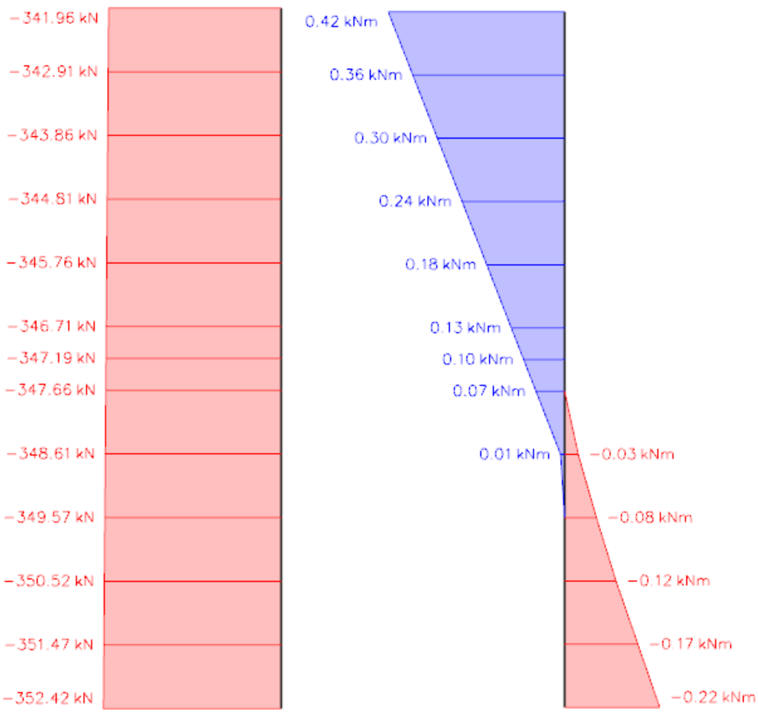


Figure 4.37: Critical structural column

4.6.1 Reinforcement design

Figure 4.38 (a) and (b) shows the internal forces and bending moment that are subjected on the critical structural column respectively. Hence, the column is designed with the design load of 352.42 kN and design bending moment of 0.42 kNm. The critical structural column is designed as a square column with the size 200 mm × 200 mm and a height of 3500 mm. The calculated slenderness ratio, λ and limiting slenderness ratio, λ_{lim} are 35.81 and 52.75 respectively. Given that λ_{lim} is greater than λ, the structural column is designed as a short column. Due to the bending moment in the column is very minimal, the design of minimum area of steel is utilized whereby the calculated $A_{s,min}$ is 80 mm^2. However, Eurocode 2 specifies that a minimum design requirement of 12 mm diameter bar is required and at least one steel bar is positioned at every corner of a structural column. Therefore, four 16 mm diameter bars are proposed on the structural columns.



(a) (b)

Figure 4.38: (a) Critical structural column internal forces (b) Critical structural column bending moments

Next, the stirrups design on the structural column are done based on the design requirement in Eurocode 2 as well. The minimum stirrup diameter for a structural column is designed based on the larger of 6 mm or a quarter of the longitudinal bar diameter which is calculated to be 4 mm. Meanwhile, the maximum spacing of the stirrups is decided based on the lower value of 400 mm, 20 times of the longitudinal bar which is calculated to be 320 mm or the larger width of the column whereby in this case is 200 mm. Therefore, the selection of stirrup design based on the design requirement results in a proposed stirrup of 6 mm diameter bars with a spacing of 200 mm.

4.6.2 Reinforcement check in SCIA Engineer

Figure 4.39 shows the reinforcement design of the structural column based on the critical design loading in the structure. The column is designed with four 16 mm diameter longitudinal bars and the stirrups are designed with 6 mm diameter bars and a spacing of 200 mm. The following design is applied onto all the structural column in the model to resist the internal forces and moments.

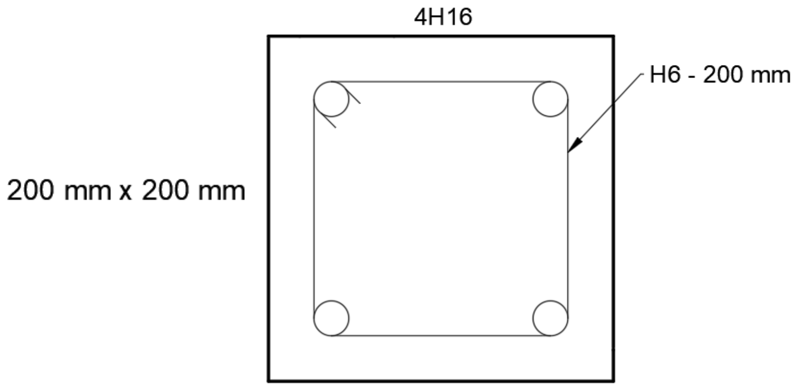


Figure 4.39: Structural column reinforcement design

Figure 4.40 shows the result of the capacity check graph of the critical structural column. The capacity check on the critical structural column with the proposed reinforcement design expresses the result in terms of unity check value. The entire structural column has exceeded the unity check value of 1.00 as the graph shows a full red graph. This concludes that the reinforcement design on the structural column is insufficient and additional reinforcement are required to added onto the structural member.

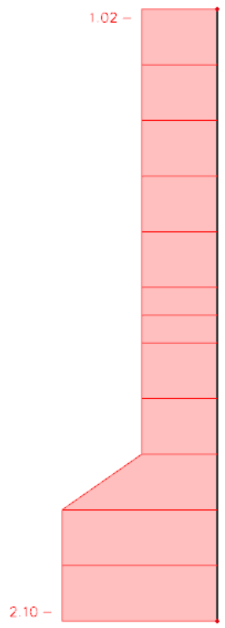


Figure 4.40: Critical structural column capacity check graph

4.7 Design changes on the structural model

Design changes is a very common event that occurs in every construction project regardless during designing stage or during the construction stage. A study reveals that consultants are one of the factors that has contributed to the need for design changes. One of the issues that arises from the consultants are design deficiency and errors which requires modifications (Mohamad, Nekooie and Al-Harthy, 2012). Given that these modifications are considered to be inevitable, each changes of design contributes to the project work delay and cost overrun. In short, the overall project performance will be affected (Muhamad and Mohammad, 2018). Thus, a minimal design changes in a construction project would heavily impact the overall project performance positively.

4.7.1 Comparison between manual calculation and software simulated design

The manual reinforcement design calculations are compared to the simulated reinforcement design in the software to indicate the design deficiency in the critical structural elements. Figure 4.41 and Figure 4.42 shows the software simulated reinforcement design for beam 3 and beam 4 in the first floor which experience design deficiency. The software design illustrates that the $A_{s,req}$ for the critical hogging and sagging moment are 691 mm^2 and 391 mm^2 respectively.

Meanwhile, by referring to the design spreadsheet for beam 3 and beam 4 in Appendix A, the manual calculated $A_{s,req}$ for the critical hogging and sagging moment are 467.311 mm^2 and 276.176 mm^2 respectively. Hence, this indicates that the software has a more conservative approach on the reinforcement design and necessary modifications are to proposed on the first floor beam to ensure sufficient resistance are provided into the members.

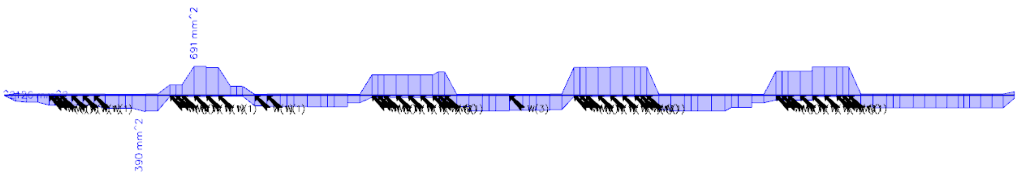


Figure 4.41: Beam 3 software simulated reinforcement design

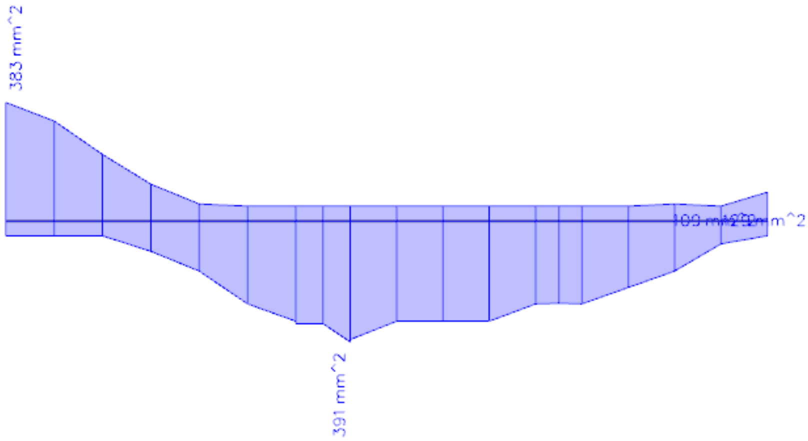


Figure 4.42: Beam 4 software simulated reinforcement design

Likewise, Figure 4.43 shows the software simulated design for the critical column. The software design indicates that the $A_{s,req}$ for the critical column is 938 mm^2 while the manually calculated $A_{s,req}$ is only 804 mm^2 as shown in the critical column design spreadsheet in Appendix A. Hence, this influence the capacity check to display a fail result in the critical column as the reinforcement provided in the critical column is insufficient. In short, the software has a more conservative approach in the reinforcement design which displays the reliability of the software to simulate result for the structural design.

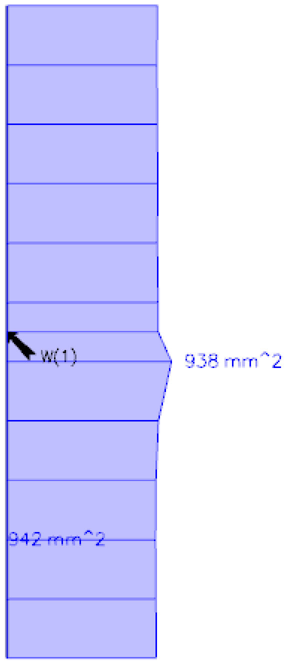


Figure 4.43: Critical column software simulated design

4.7.2 Modifications on reinforcement design

Figure 4.44 shows the overall capacity check of the new reinforcement design that are done based on the critical structural members. The result presents that a few structural beams and structural columns requires additional reinforcement to be modified into the design. Hence, a new proposed design change is done to the structural members that did not pass the design capacity check whereby in this study is the first floor beam and structural column.

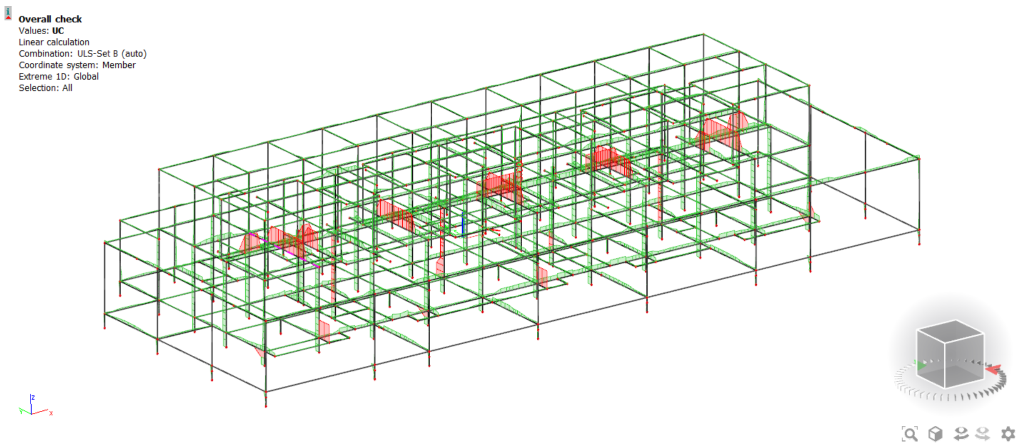
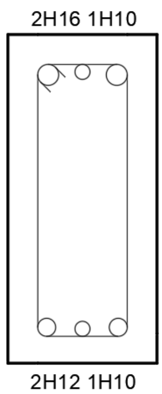
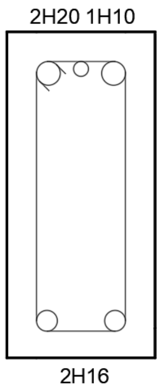
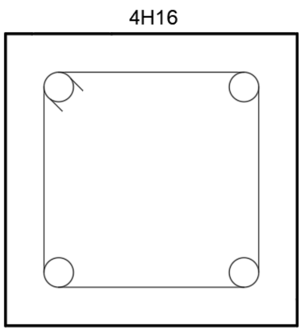
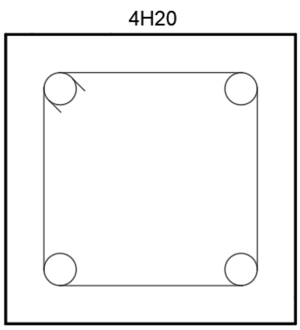


Figure 4.44: Overall capacity check of the new reinforcement design

Table 4.1 shows the current reinforcement design and the modified reinforcement design of the structural member. The reinforcement design for the first floor beam is originally two 16 mm diameter bars and one 10 mm diameter bar at the top side and two 12 mm diameter bars and one 10 mm diameter bar on the bottom side. However, this reinforcement design has failed the capacity check in SCIA Engineer. Therefore, the reinforcement design is modified with a larger area of reinforcement provided in the structural beam. The proposed modified reinforcement is two 20 mm diameter bars and one 10 mm diameter bar at the top side and two 16 mm diameter bars at the bottom side. Meanwhile, the critical column reinforcement design which did not fulfil the capacity check is also modified with a larger area of reinforcement. Thus, the current reinforcement design of the column with four 16 mm diameter bars are changed to four 20 mm diameter bars.

Table 4.1: Current and modified reinforcement design of structural member

<table>
<tr><th>Structural member</th><th>Current reinforcement design</th><th>Modified reinforcement design</th></tr>
<tr><td>First floor beam</td><td>
</td><td>
</td></tr>
<tr><td>Column</td><td>
</td><td>
</td></tr>
</table>

4.7.3 Modified reinforcement check in SCIA Engineer

The modified reinforcement design of the first floor beam and column are edited into the critical structural members again before performing capacity check. Figure 4.45 and Figure 4.46 shows the modified capacity check graph of beam 3 and beam 4 respectively. The two results indicate that the unity check value is below 1.00 along the entire span of the two critical structural beam. Hence, the modified reinforcement design of the critical structural beam has fulfilled the capacity requirement. Next, Figure 4.47 shows the modified capacity check graph of the structural column. Similarly, the critical column has a unity check value of below 1.00 and indicates that the modified reinforcement design in the column has passed the capacity check on SCIA Engineer.

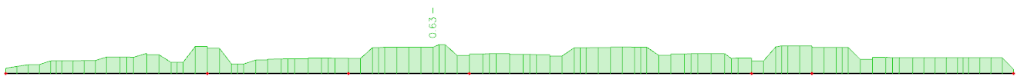


Figure 4.45: Beam 3 modified capacity check graph

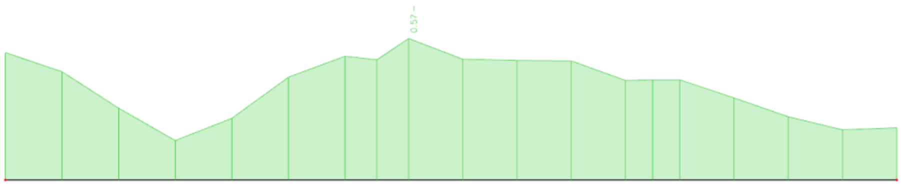


Figure 4.46: Beam 4 modified capacity check graph

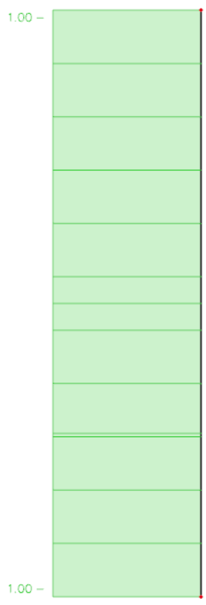


Figure 4.47: Structural column modified capacity check graph

In a nutshell, the ability of SCIA Engineer in performing capacity check will largely benefit the entire construction project. Particularly during designing stage, the reinforcement design in a structure can be counter checked on the software to determine the capacity of the design and any required design changes can be done in the early stage. The importance of identifying the needs of design changes in the early stages is that events such as work delays or re-construction can be prevented. Therefore, the utilization of BIM tools can help to identify any design errors in the structural model early on even before the commencement of the construction work.

4.8 Quantity take off

The quantity take-off presents the structural quantity material used to construct the structural model. In this study, the main material that are calculated are the reinforcement steel bars and concrete. Autodesk Revit is utilized to generate the result of the quantity take off based on the few parameters inserted into the software. For instance, the price of reinforcement steel bar below 12 mm diameter in size is RM3.28/kg while the price of reinforcement steel bar exceeding 12 mm diameter is RM3.13/kg. Additionally, the price of the grade 25 concrete is at RM230.00/m^3 (Quantity Surveyor Online, 2021). Given that the price of each structural material is set, the structural material quantity required can be calculated automatically based on the structural model. Hence, this results in a total structural material cost to construct the structural model. The detailed quantity take-off result is presented in tables in Appendix B.

4.8.1 As-built structural model

Table 4.2 shows the result of the total cost of the structural material required for the construction of the as-built structural model. The diameter of reinforcement steel bar required for the as-built model varies from 6 mm, 8 mm, 10 mm, 12 mm, 16 mm and 20 mm. For instance, 1,286.708 kg of 6 mm diameter bars is required which amounts in a total cost of RM4,220.40 for the 6 mm diameter bars alone. Given that the remaining five different diameter of steel bars with their respective quantity required are computed, the grand total cost of the reinforcement steel bar regardless of size is RM98,625.37. Meanwhile, the

C25/30 concrete are used for the construction of all structural members such as beams, slabs and columns. The Autodesk Revit software is able to compute the volume of concretes that are required for the construction of each type of structural members. For example, the structural beam of the as-built model requires a total of 69.50 m^3 of concrete which results in a cost of RM15,985.20. The total cost of 208.14 m^3 of concrete for all the structural member amounts to a total cost of RM47,872.22. Thus, RM146,497.59 is the grand total of the structural material cost which includes the reinforcement steel bar and concrete that are required to construct the as-built structural model.

Table 4.2: As-built structural model material cost

Structural material		**Material quantity required**	**Cost (RM)**
Reinforcement steel bar (Ø)	6 mm	1,286.71 kg	4,220.40
	8 mm	2,092.43 kg	6,863.16
	10 mm	13,266.91 kg	43,515.45
	12 mm	2,540.27 kg	8,332.07
	16 mm	8,848.71 kg	27,696.47
	20 mm	2,555.22 kg	7,997.82
Total cost for reinforcement steel bar			98,625.37
C25/30 Concrete	Structural beam	69.50 m^3	15,985.20
	Structural slab	117.62 m^3	27,052.03
	Structural column	21.02 m^3	4,834.99
Total cost for concrete			47,872.22
Grand total			146,497.59

4.8.2 New structural model design

The new structural model that are designed based on the critical structural member results in a different design output compared to the as-built drawings. Table 4.3 shows the material quantity required and the total material cost that is required in constructing the new structural model design. The diameter of reinforcement steel bars that are required in the new design are 6 mm, 10 mm, 12 mm and 16 mm. Given that a total of 1,335.72 kg of 6 mm diameter bar is required in the structural model, this will cost RM4,381.16 as the price of the 6 mm diameter bars is RM3.28/kg. The remaining cost of the 10 mm, 12 mm and 16 mm diameter bars are calculated respectively as shown in Figure 4.3. This results in a grand total of reinforcement steel bar to be RM89,881.41. Additionally, the C25/30 concrete which is required to construct the structural beam, slab and column are computed in the software in terms of volume of concrete. For instance, the structural beam requires 69.50 m^3 of concrete and this amount to a cost of RM15,985.20. The volume of concrete required in the structural slab and column are also computed which results in a grand total of concrete cost to be RM47,872.22. Hence, based on the material quantity, the total cost required to construct the entire new structural model is RM 137,753.63.

Table 4.3: New structural model design material cost

Structural material		**Material quantity required**	**Cost (RM)**
Reinforcement steel bar (Ø)	6 mm	1,335.72 kg	4,381.16
	10 mm	19,897.16 kg	65,262.68
	12 mm	450.57 kg	1,477.87
	16 mm	5,420.47 kg	16,966.08
	20 mm	573.04 kg	1,793.62
Total cost for reinforcement steel bar			89,881.41
C25/30 Concrete	Structural beam	69.50 m^3	15,985.20
	Structural slab	117.62 m^3	27,052.03
	Structural column	21.02 m^3	4,834.99
Total cost for concrete			47,872.22
Grand total			137,753.63

4.8.3 Comparison between as-built structural model and the new structural model

From the above result, it is observed that the as-built structural model utilize six different diameters of reinforcement bars whereas the new design only utilizes four different diameters of reinforcement bar. Figure 4.48 shows the graph for the comparison between the usage of different diameter of reinforcement steel bar in the as-built design and the new structural model design. The graph presents that the usage of 6 mm reinforcement steel bar for the as-built and new structural design are almost similar at 1,286.71 kg and 1,335.72 kg respectively. Meanwhile, the 10 mm diameter bars usage in the new structural design is higher compared to the as-built structural design while the usage of 8 mm, 12 mm, 16 mm and 20 mm diameter bars are higher in the as-built structural design compared to the new structural model design. Hence, this concludes that the as-built structural model design utilized a greater amount of large diameter of bars compared to the new structural design which mainly utilizes the 10 mm and 16 mm bars.

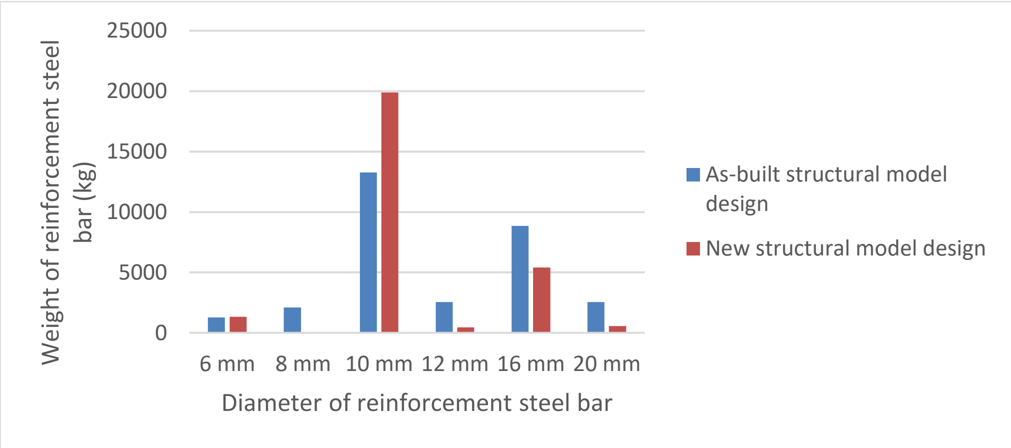


Figure 4.48: Graph of weight of reinforcement steel bar with the diameter of reinforcement steel bar for the as-built and new structural model design

Besides, the total cost of reinforcement steel bar for the as-built model is higher than the cost of reinforcement steel bar in the new structural model design. However, the cost of concrete for the two structural model is similar since the size of the structural members are not changed throughout the design. Table 4.4 shows the percentage difference of the structural material quantity cost for the as-built and new structural model. The as-built structural model has a higher cost at RM146,497.59 than the new structural model design which only cost RM137,753.63. Therefore, the percentage difference of 5.97% indicates that the cost of structural material quantity usage in the new structural model design is 5.97% lower than the cost of structural material quantity usage in the as-built design.

Table 4.4: Percentage difference of the cost of structural material quantity

Structural model	Total cost	Percentage difference
As-built structural model	RM 146,497.59	5.97 %
New structural model design	RM 137,753.63	

Keeping in mind that the new structural model design is only designed based on the critical structural members, the cost of structural material quantity usage has already reduced up to 5.97%. Given that the non-critical structural members do not require as much reinforcement as the critical members, the structural material quantity usage and the cost of the structural design can be further reduced. For instance, a complete design of a structural model will definitely result in a lower cost of structural material quantity usage and a higher value of percentage difference. In short, this concludes that the utilization of the BIM software in the structural design is able to reduce the structural material quantity usage and present a more economical design.

4.9 Summary

In conclusion, this chapter presents the results and discussion into seven main sections. Upon obtaining the result of structural analysis from the software, the first three sections that are discussed are the structural design of the critical ground floor structural beam, first floor structural beam and roof floor structural beam. The longitudinal reinforcement design and shear link design are computed according to the Eurocode 2 and a final reinforcement design for the structural beam on each floor are proposed. The deflection checking is also done to ensure the design meets the SLS design requirement. Next, the structural design of structural slab is discussed on this chapter as well. The longitudinal reinforcement for the structural slab are proposed based on the critical bending moment and shear force in the ground floor structural slab. Meanwhile, the cracking check is done on the structural slab to ensure the SLS design requirements are met. The fifth section is the design of structural column based on the critical internal force that is experience in the ground floor column. The slenderness of the column is determined to be a short column while the longitudinal reinforcement and stirrups are designed according to Eurocode 2. Besides, the design capacity check of the critical structural members that has unity check value greater than 1.00 are re-designed. The proposed design changes on the structural member is done to ensure the members have a sufficient capacity design. Lastly, the results of quantity take off are done to determine the cost of structural materials quantity used in the as-built structural model and the new structural model design. The percentage difference between the two cost are presented and discussed.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study is concluded based on the accomplished aim and three objectives have been established in the early stage of the research. In general, the aim of modelling and designing a double storey reinforced concrete terrace house using open BIM tools and to compare the new design with the as-built structural drawing has been complete and concluded.

The first objective of this study is to model the terrace structural framing in open BIM tools. The two BIM tools that are selected in this study are the Autodesk Revit and SCIA Engineer. Based on the architecture and C&S drawing of the as-built structure, the structural framing of a five lot double storey reinforced concrete terrace house is constructed in the Autodesk Revit modelling software. The modelling works begins with the gridline construction to the construction of structural members such as beam and column. All structural members are design based on their respective sizing based on the C&S drawing with the concrete grade C25/30. However, the modelling of roof trusses and foundations are not included in this study due to insufficient information regarding the two components. Thus, the structural framing is modelled in Autodesk Revit which indicates the achievement of the first objective.

Besides, the second objective in this study is to perform structural analysis in accordance to European Code 2 and identify the critical structural elements on the terrace house. The Autodesk Revit structural frame is exported to SCIA Engineer, the structural analysis software. The loadings on the structural framing such as self-weight of structural members, permanent load and variable load are assigned based on Eurocode 1, design of actions on structures. The permanent loading and variable loading are assigned on the structural slab that has been constructed in the SCIA Engineer software. Based on the load on the structural framing, the software is able to perform structural analysis onto the structural frame in accordance to the design code, European Code 2. Hence, the result of the structural analysis presents the internal forces, shear forces and bending moment forces that are experienced by the model which leads to the determination of critical structural elements on the terrace house. Based on the critical hogging moment, sagging moment and shear force, the reinforcement designs are done in accordance to the European Code 2. The ground floor critical beam is designed to have two 16 mm diameter bars on the top side and three 10 mm diameter bars on the bottom side. Next, the critical first floor beam has a reinforcement design of two 16 mm and one 10 mm diameter bars on the topside and two 12 mm and one 10 mm diameter bars on the bottom side of the structural beam. In the meantime, the reinforcement design at the top side and bottom side of the critical roof beam are three 10 mm diameter bars and two 10 mm diameter bars respectively. Additionally, all critical structural beams are designed with shear links of 6 mm diameter bars at 250 mm spacing. The main longitudinal reinforcement and shear link reinforcement on the structural beam members at each floors are designed adequately to resist the bending moments and shear forces respectively. On the other hand, the structural slab's longitudinal reinforcement on the top is designed with 10 mm diameter bars and 100 mm spacing while the bottom is designed with 10 mm diameter bars and 325 mm spacing. However, the structural slab has does not requires any shear reinforcement design due to the sufficient shear resistance that has already existed on the structural slab. Meanwhile, the critical column is designed with four 16 mm diameter bars and 6 mm diameter bars shear link with a spacing of 200 mm in order to resist the critical internal forces and bending moments. In short, the reinforcement design based on the critical structural members are introduced into the structural model to form a complete reinforcement concrete structure.

Nevertheless, the critical first floor beam and the critical column requires modification in the reinforcement design due to the failure in capacity check that has been detected in the SCIA Engineer software which presents a more conservative design approach. Hence, the modified design of the first floor beam for the top side steel bars are two 20 mm diameter bar and one 10 mm diameter bar while the bottom side steel bars are two 16 mm diameter bars. Meanwhile, the critical column has a modified reinforcement design of four 20 mm diameter bars. The shear link design of the two critical members does not require any modification. The second objective has been achieved since the critical structural elements are identified and the structural analysis are done in accordance to Eurocode 2.

Lastly, the third objective is to compare the percentage difference in structural material quantity usage between designed versus as-built model. Upon completion of the reinforcement input for the as-built design and the new design, the model is exported back to Autodesk Revit whereby quantity take off is performed. The structural material quantity usage is studied and the total cost for the construction of the as-built design and the new design are RM 146,497.59 and RM 137,753.63 respectively. Based on the difference in the reinforcement design from the two model, it is concluded that the as-built design is less cost effective and the percentage difference of the two design is 5.97 %. The new structural model design which solely design based on the critical structural elements has already result in a lower cost by 5.97% whereby an actual complete design using the BIM tools will definitely result in a much lower cost. Hence, the third objective is achieved and this study concludes that the structural model design with BIM tools results is more cost effective design.

5.2 Recommendations for future work

There are several recommendations and improvements that are worthy to be implemented to enhance the outcome of the future works. One of the recommendation is by adopting the closed BIM method in performing the study to identify any differences in the outcome of the research. The outcome of the research can be compared with the current result and determine the more convenient open BIM or closed BIM method.

Additionally, improvement works such as performing a complete design of the structural reinforced concrete building. Given that this study emphasize on the design of critical members, future study that provides a complete design is able to present the difference in the critical member designs with the actual complete BIM design.

Besides, improvements can also be made by determining the duration required for the structural design and compare the conventional method and the BIM methods. However, this improvement requires sufficient information regarding the existing as-built project such as the design timeline and the ability of the researcher in performing BIM design effectively within a time frame. Hence, the time factor on the different methods of design can be studied in depth.

Next, the study on the foundation design and seismic structure design is recommended to be performed as this study has limitations on the foundation design and the seismic design. The purpose of this improvement in the future is to assess the reliability of the software in proposing an economical and practical design.

Lastly, future study on different types of structures are recommended in order to determine the effectiveness of the BIM design. For instance, steel structures or composite structures design can be studied in terms of their structural member design and the cost of the structural material usage. Similarly, the outcome of the study is compare to the existing as-built steel or composite structures and deliver a detailed discussion.

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APPENDICES

Appendix A: Spreadsheet of critical members design

Beam 1

REFERENCE	CALCULATIONS	OUTPUT
	SPAN A-B/1	
	Design assumption	
	Design life 50 years	
	Stuctural class S4	
	Exposure class XC3	
	Fire resistance R60	
	Size of aggregates 20 mm	
Table 3.1	Strength of concrete C25/30 25 N/mm2	
	fyk and fyw 500 N/mm2	
Table 3.1	fctm 2.6	
	Specifications	
	b 150 mm	
	h 400 mm	
	Compression steel bar diameter 12 mm	
	Tension steel bar diameter 16 mm	
	Shear link diameter 10 mm	
	Nominal cover	
Table 4.2	Min concrete cover regard to bond, $C_{min.b}$ 20 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min.dur}$ 25 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd} 25 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min.fire}$ 9 mm	∴ Use C_{min} 25 mm
	Allowance in design for deviation, ΔC_{dev} 10 mm	
	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$ 35 mm	∴ Use C_{nom} 35 mm
	Effective depth of beam, d 349 mm	
	Design for Bending	
EN1992-1-1	Minimum area of reinforcement 70.78 mm2	∴ OK
9.2.1.1	$A_{s,min} = 0.26\frac{f_{ctm}}{f_{yk}}bd\ (< 0.0013bd)$	
	Maximum area of reinforcement $A_{s,max} = 0.04A_c$ 2400 mm2	
	$100\frac{A_{s,max}}{bh} \leq 4.0\,\%$ 4.0 %	∴ OK
	$100\frac{A_{s,min}}{bd} \geq 26\frac{f_{ctm}}{f_{yk}}\%\ > 0.13\%$ 0.14	∴ OK
	0.14 %	∴ OK
	Main Reinforcement	
	Moment at support, M 18.14 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0397	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 336.321 NOT OK	
	0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 125.776	Use 2H10
	Area provided 157 OK	157 mm2

	Moment at centre, M 11.72 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0257	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 340.903 NOT OK	
	0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 81.262	Use 2H8
	Area provided 101 OK	101 mm2
	Moment at support, M 52.51 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.1150	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 309.03 OK	
	0.95d	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 390.618	Use 2H16
	Area provided 402 OK	402 mm2
	Shear Reinforcement	
	Design shear, Ved 26.82 kN	
	$V_{Rd,\max(22)} = 0.124 b_w d\left(1 - \frac{f_{ck}}{250}\right) f_{ck}$ Vrd 146.06 OK	
6.2.3	θ = 22° and cot θ = 2.5	
	$\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta}$ Asw/s 0.079	
9.2.2 (5)	$\frac{A_{sw,min}}{s} = \frac{0.08 {f_{ck}}^{0.5} b_w}{f_{yk}}$ Asw,min 0.12 Use minimum	
	Provide : Links 6 mm Asw/s 0.226 OK	Use H6-250
	Spacing 250 mm	
9.2.2 (8)	$Max\ spacing, s_{max} = 0.75d$ s,max 261.75 OK	
	Deflection	
7.4.1	Percentage of required tension reinforcement ρ 0.75	
	$\rho = \frac{100 A_{s,req}}{bd}$	
Table 7.4N	k 1	
	Basic span effective depth ratio 16	
	$Modification\ Ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} (< 1.5)$ MF 1.03 OK	
	Actual l/d 9.89	Actual < Allowable
	Allowable l/d 16.48	OK

Beam 2

REFERENCE	CALCULATIONS			OUTPUT
	SPAN A-C/2b…			
	Design assumption			
	Design life	50 years		
	Stuctural class	S4		
	Exposure class	XC3		
	Fire resistance	R60		
	Size of aggregates	20 mm		
Table 3.1	Strength of concrete C25/30	25 N/mm2		
	fyk and fyw	500 N/mm2		
Table 3.1	fctm	2.6		
	Specifications			
	b	150 mm		
	h	400 mm		
	Compression steel bar diameter	12 mm		
	Tension steel bar diameter	16 mm		
	Shear link diameter	10 mm		
	Nominal cover			
Table 4.2	Min concrete cover regard to bond, C_{minb}		20 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min.dur}$		25 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd}		25 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min.fire}$		9 mm	∴ Use C_{min} 25 mm
	Allowance in design for deviation, ΔC_{dev}		10 mm	
	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$		35 mm	∴ Use C_{nom} 35 mm
	Effective depth of beam, d		349 mm	
	Design for Bending			
EN1992-1-1	Minimum area of reinforcement		70.78 mm2	∴ OK
9.2.1.1	$A_{s,min} = 0.26\frac{f_{ctm}}{f_{yk}}bd\ (< 0.0013bd)$			
	Maximum area of reinforcement $A_{s,max} = 0.04A_c$		2400 mm2	
	$100\frac{A_{s,max}}{bh} \leq 4.0\,\%$		4.0 %	∴ OK
	$100\frac{A_{s,min}}{bd} \geq 26\frac{f_{ctm}}{f_{yk}}\% > 0.13\%$		0.14	∴ OK
			0.14 %	∴ OK
	Main Reinforcement			
	Moment at support, M	14.28 kNm		
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$	k	0.0313	
			Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$	z	339.085 NOT OK	
		0.95d	331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$	Area required	99.012	Use 2H10
		Area provided	157 OK	157 mm2

	Moment at centre, M 31.51 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0690 Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 326.286 OK 0.95d	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 222.004 Area provided 236 OK	Use 3H10 236 mm2
	Moment at support, M 17.73 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0388 Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 336.62 NOT OK 0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 122.934 Area provided 157 OK	Use 2H10 157 mm2
	Shear Reinforcement Design shear, Ved 35.44 kN	
6.2.3	$V_{Rd,\max(22)} = 0.124 b_w d\left(1 - \frac{f_{ck}}{250}\right) f_{ck}$ Vrd 146.06 OK θ = 22° and cot θ = 2.5	
9.2.2 (5)	$\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta}$ Asw/s 0.104 $\frac{A_{sw,min}}{s} = \frac{0.08 {f_{ck}}^{0.5} b_w}{f_{yk}}$ Asw,min 0.12 Use minimum	
	Provide : Links 6 mm Asw/s 0.226 OK Spacing 250 mm	Use H6-250
9.2.2 (8)	$Max\ spacing, s_{max} = 0.75d$ s,max 261.75 OK	
	Deflection	
7.4.1	Percentage of required tension reinforcement ρ 0.42 $\rho = \frac{100 A_{s,req}}{bd}$	
Table 7.4N	k 1.3 Basic span effective depth ratio 19	
	$Modification\ Ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} (< 1.5)$ MF 1.06 OK	
	Actual l/d 8.17 Allowable l/d 37.05	Actual < Allowable OK

Beam 3

REFERENCE	CALCULATIONS	OUTPUT
	SPAN B/1-1.	
	Design assumption	
	Design life 50 years	
	Stuctural class S4	
	Exposure class XC3	
	Fire resistance R60	
	Size of aggregates 20 mm	
Table 3.1	Strength of concrete C25/30 25 N/mm2	
	fyk and fyw 500 N/mm2	
Table 3.1	fctm 2.6	
	Specifications	
	b 150 mm	
	h 450 mm	
	Compression steel bar diameter 12 mm	
	Tension steel bar diameter 16 mm	
	Shear link diameter 10 mm	
	Nominal cover	
Table 4.2	Min concrete cover regard to bond, $C_{min,b}$ 20 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min,dur}$ 25 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd} 25 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min,fire}$ 9 mm	$\therefore$ Use C_{min} 25 mm
	Allowance in design for deviation, ΔC_{dev} 10 mm	
	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$ 35 mm	$\therefore$ Use C_{nom} 35 mm
	Effective depth of beam, d 399 mm	
	Design for Bending	
EN1992-1-1 9.2.1.1	Minimum area of reinforcement 80.92 mm2 $A_{s,min} = 0.26\frac{f_{ctm}}{f_{yk}}bd\ (< 0.0013bd)$	$\therefore$ OK
	Maximum area of reinforcement $A_{s,max} = 0.04A_c$ 2700 mm2	
	$100\frac{A_{s,max}}{bh} \leq 4.0\,\%$ 4.0 %	$\therefore$ OK
	$100\frac{A_{s,min}}{bd} \geq 26\frac{f_{ctm}}{f_{yk}}\% > 0.13\%$ 0.14	$\therefore$ OK
	0.14 %	$\therefore$ OK
	Main Reinforcement	
	Moment at support, M 71.39 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.1196 Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 351.19 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 467.311 Area provided 480.5 OK	Use 2H16 1H10 480.5 mm2
	Moment at centre, M 19.45 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0326 Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 387.179 NOT OK 0.95d 379.05 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 117.96 Area provided 157 OK	Use 2H10 157 mm2

	Moment at support, M 2.4 kNm $k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0040 Compression steel not required $z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 397.588 NOT OK 0.95d 379.05 OK $A_s = \frac{M}{0.87 f_{yk} z}$ Area required 14.555 Area provided 157 OK	Use 2H10 157 mm2
   6.2.3 9.2.2 (5) 9.2.2 (8)	**Shear Reinforcement** Design shear, Ved 55.01 kN $V_{Rd,\max(22)} = 0.124 b_w d\left(1 - \frac{f_{ck}}{250}\right) f_{ck}$ Vrd 166.98 OK θ = 22° and cot θ = 2.5 $\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta}$ Asw/s (Required) 0.141 $\frac{A_{sw,min}}{s} = \frac{0.08 f_{ck}^{0.5} b_w}{f_{yk}}$ Asw/s (Minimum) 0.12 Provide : Links 6 mm Asw/s (Provided) 0.226 OK Spacing 250 mm $Max\ spacing, s_{max} = 0.75d$ s,max 299.25 OK	 Use H6-250
 7.4.1 Table 7.4N	**Deflection** Percentage of required tension reinforcement ρ 0.2 $\rho = \frac{100 A_{s,req}}{bd}$ k 1.3 Basic span effective depth ratio 22.8 $Modification\ Ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} (< 1.5)$ MF 1.33 OK Actual l/d 17.54 Allowable l/d 39.42	 Actual < Allowable OK

Beam 4

REFERENCE	CALCULATIONS			OUTPUT
	SPAN A-C/2			
	Design assumption			
	Design life	50 years		
	Stuctural class	S4		
	Exposure class	XC3		
	Fire resistance	R60		
	Size of aggregates	20 mm		
Table 3.1	Strength of concrete C25/30	25 N/mm2		
	fyk and fyw	500 N/mm2		
Table 3.1	fctm	2.6		
	Specifications			
	b	200 mm		
	h	450 mm		
	Compression steel bar diameter	12 mm		
	Tension steel bar diameter	16 mm		
	Shear link diameter	10 mm		
	Nominal cover			
Table 4.2	Min concrete cover regard to bond, $C_{min b}$		20 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min.dur}$		25 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd}		25 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min.fire}$		9 mm	∴ Use C_{min} 25 mm
	Allowance in design for deviation, ΔC_{dev}		10 mm	
	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$		35 mm	∴ Use C_{nom} 35 mm
	Effective depth of beam, d		399 mm	
	Design for Bending			
EN1992-1-1	Minimum area of reinforcement		107.89 mm2	∴ OK
9.2.1.1	$A_{s,min} = 0.26\frac{f_{ctm}}{f_{yk}}bd\ (< 0.0013bd)$			
	Maximum area of reinforcement $A_{s,max} = 0.04A_c$		3600 mm2	
	$100\frac{A_{s,max}}{bh} \leq 4.0\,\%$		4.0 %	∴ OK
	$100\frac{A_{s,min}}{bd} \geq 26\frac{f_{ctm}}{f_{yk}}\% > 0.13\%$		0.14	∴ OK
			0.14 %	∴ OK
	Main Reinforcement			
	Moment at support, M	53.12 kNm		
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$	k	0.0667	
			Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$	z	373.96 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$	Area required	326.545	Use 2H16
		Area provided	402 OK	402 mm2

	Moment at centre, M 45.39 kNm $k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0570 Compression steel not required $z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 377.82 OK 0.95d $A_s = \frac{M}{0.87 f_{yk} z}$ Area required 276.176 Area provided 304.5 OK	Use 2H12 1H10 304.5 mm2
	Moment at support, M 7.22 kNm $k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0091 Compression steel not required $z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 395.772 NOT OK 0.95d 379.05 OK $A_s = \frac{M}{0.87 f_{yk} z}$ Area required 43.788 Area provided 157 OK	Use 2H10 157 mm2
  6.2.3 9.2.2 (5) 9.2.2 (8)	**Shear Reinforcement** Design shear, Ved 46.68 kN $V_{Rd,\max(22)} = 0.124 b_w d\left(1 - \frac{f_{ck}}{250}\right) f_{ck}$ Vrd 222.64 OK θ = 22° and cot θ = 2.5 $\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta}$ Asw/s 0.120 $\frac{A_{sw,min}}{s} = \frac{0.08 {f_{ck}}^{0.5} b_w}{f_{yk}}$ Asw,min 0.16 Use minimum Provide : Links 6 mm Asw/s 0.226 OK Spacing 250 mm $Max\ spacing, s_{max} = 0.75d$ s,max 299.25 OK	Use H6-250
 7.4.1 Table 7.4N	**Deflection** Percentage of required tension reinforcement ρ 0.35 $\rho = \frac{100 A_{s,req}}{bd}$ k 1 Basic span effective depth ratio 23 $Modification\ Ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} (< 1.5)$ MF 1.1 OK Actual l/d 15.79 Allowable l/d 25.3	Actual < Allowable OK

Beam 5

REFERENCE	CALCULATIONS	OUTPUT
	SPAN B/2-3A	
	Design assumption	
	Design life 50 years	
	Stuctural class S4	
	Exposure class XC3	
	Fire resistance R60	
	Size of aggregates 20 mm	
Table 3.1	Strength of concrete C25/30 25 N/mm2	
	fyk and fyw 500 N/mm2	
Table 3.1	fctm 2.6	
	Specifications	
	b 150 mm	
	h 400 mm	
	Compression steel bar diameter 12 mm	
	Tension steel bar diameter 16 mm	
	Shear link diameter 10 mm	
	Nominal cover	
Table 4.2	Min concrete cover regard to bond, C_{minb} 20 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min.dur}$ 25 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd} 25 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min.fire}$ 9 mm	∴ Use C_{min} 25 mm
	Allowance in design for deviation, ΔC_{dev} 10 mm	
	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$ 35 mm	∴ Use C_{nom} 35 mm
	Effective depth of beam, d 349 mm	
	Design for Bending	
EN1992-1-1 9.2.1.1	Minimum area of reinforcement 70.78 mm2 $A_{s,min} = 0.26 \frac{f_{ctm}}{f_{yk}} bd \ (< 0.0013bd)$	∴ OK
	Maximum area of reinforcement $A_{s,max} = 0.04A_c$ 2400 mm2	
	$100 \frac{A_{s,max}}{bh} \leq 4.0\ \%$ 4.0 %	∴ OK
	$100 \frac{A_{s,min}}{bd} \geq 26 \frac{f_{ctm}}{f_{yk}} \% \ > 0.13\%$ 0.14	∴ OK
	0.14 %	∴ OK
	Main Reinforcement	
	Moment at support, M 6.81 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0149	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 344.352 NOT OK	
	0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 47.218	Use 2H10
	Area provided 157 OK	157 mm2

	Moment at centre, M 32.66 kNm $k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0715 Compression steel not required $z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 325.399 OK 0.95d $A_s = \frac{M}{0.87 f_{yk} z}$ Area required 230.734 Area provided 236 OK	Use 3H10 236 mm2
	Moment at support, M 5.37 kNm $k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0118 Compression steel not required $z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 345.33 NOT OK 0.95d 331.55 OK $A_s = \frac{M}{0.87 f_{yk} z}$ Area required 37.234 Area provided 157 OK	Use 2H10 157 mm2
6.2.3 9.2.2 (5) 9.2.2 (8)	**Shear Reinforcement** Design shear, Ved 22.22 kN $V_{Rd,\max(22)} = 0.124 b_w d\left(1 - \frac{f_{ck}}{250}\right) f_{ck}$ Vrd 146.06 OK θ = 22° and cot θ = 2.5 $\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta}$ Asw/s 0.065 $\frac{A_{sw,min}}{s} = \frac{0.08 {f_{ck}}^{0.5} b_w}{f_{yk}}$ Asw,min 0.12 Use minimum Provide : Links 6 mm Asw/s 0.226 OK Spacing 250 mm $Max\ spacing, s_{max} = 0.75d$ s,max 261.75 OK	Use H6-250
7.4.1 Table 7.4N	**Deflection** Percentage of required tension reinforcement ρ 0.44 $\rho = \frac{100 A_{s,req}}{bd}$ k 1.3 Basic span effective depth ratio 21 $Modification\ Ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} (< 1.5)$ MF 1.02 OK Actual l/d 6.02 Allowable l/d 27.85	Actual < Allowable OK

Beam 6

REFERENCE	CALCULATIONS	OUTPUT
	SPAN A'2-D/4	
	Design assumption	
	Design life 50 years	
	Stuctural class S4	
	Exposure class XC3	
	Fire resistance R60	
	Size of aggregates 20 mm	
Table 3.1	Strength of concrete C25/30 25 N/mm2	
	fyk and fyw 500 N/mm2	
Table 3.1	fctm 2.6	
	Specifications	
	b 200 mm	
	h 400 mm	
	Compression steel bar diameter 12 mm	
	Tension steel bar diameter 16 mm	
	Shear link diameter 10 mm	
	Nominal cover	
Table 4.2	Min concrete cover regard to bond, C_{minb} 20 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min.dur}$ 25 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd} 25 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min.fire}$ 9 mm	∴ Use C_{min} 25 mm
	Allowance in design for deviation, ΔC_{dev} 10 mm	
	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$ 35 mm	∴ Use C_{nom} 35 mm
	Effective depth of beam, d 349 mm	
	Design for Bending	
EN1992-1-1	Minimum area of reinforcement 94.37 mm2	∴ OK
9.2.1.1	$A_{s,min} = 0.26 \frac{f_{ctm}}{f_{yk}} bd \; (< 0.0013bd)$	
	Maximum area of reinforcement $A_{s,max} = 0.04A_c$ 3200 mm2	
	$100 \frac{A_{s,max}}{bh} \leq 4.0\,\%$ 4.0 %	∴ OK
	$100 \frac{A_{s,min}}{bd} \geq 26 \frac{f_{ctm}}{f_{yk}} \% \; > 0.13\%$ 0.14	∴ OK
	0.14 %	∴ OK
	Main Reinforcement	
	Moment at support, M 2.58 kNm	
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0042	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 347.703 NOT OK	
	0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 17.889	Use 2H10
	Area provided 157 OK	157 mm2

	Moment at centre, M 16.29 kNm		
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$	k 0.0267 Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$	z 340.58 NOT OK 0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$	Area required 112.949 Area provided 157 OK	Use 2H10 157 mm2
	Moment at support, M 11.98 kNm		
	$k = \frac{M}{bd^2 f_{ck}} < 0.167$	k 0.0197 Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$	z 342.828 NOT OK 0.95d 331.55 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$	Area required 83.065 Area provided 157 OK	Use 2H10 157 mm2
	Shear Reinforcement Design shear, Ved 23.27 kN		
6.2.3	$V_{Rd,\max(22)} = 0.124 b_w d\left(1 - \frac{f_{ck}}{250}\right) f_{ck}$	Vrd 194.74 OK θ = 22° and cot θ = 2.5	
	$\frac{A_{sw}}{s} = \frac{V_{Ed}}{0.78 d f_{yk} \cot\theta}$	Asw/s 0.068	
9.2.2 (5)	$\frac{A_{sw,min}}{s} = \frac{0.08 {f_{ck}}^{0.5} b_w}{f_{yk}}$	Asw,min 0.16 Use minimum	
	Provide : Links 6 mm Spacing 250 mm	Asw/s 0.226 OK	Use H6-250
9.2.2 (8)	$Max\ spacing, s_{max} = 0.75d$	s,max 261.75 OK	
	Deflection		
7.4.1	Percentage of required tension reinforcement $\rho = \frac{100 A_{s,req}}{bd}$	ρ 0.16	
Table 7.4N	Basic span effective depth ratio	k 1.5 27	
	$Modification\ Ratio = \frac{500}{f_{yk}} \cdot \frac{A_{s,prov}}{A_{s,req}} (< 1.5)$	MF 1.39 OK	
		Actual l/d 11.17 Allowable l/d 56.3	Actual < Allowable OK

Critical slab

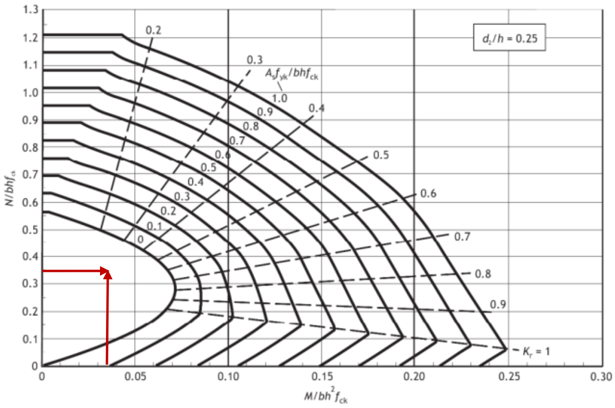
REFERENCE	CALCULATIONS	OUTPUT
	Design assumption	
	Design life 50 years	
	Stuctural class S4	
	Exposure class XC3	
	Fire resistance R60	
	Size of aggregates 20 mm	
Table 3.1	Strength of concrete C25/30 25 N/mm2	
	fyk and fyw 500 N/mm2	
Table 3.1	fctm 2.6	
	Specifications	
	Bar diameter 10 mm	
	Long span, l_y 3500 mm	
	Short span, l_x 3450 mm	
	l_y/l_x 1.01 Two-way slab (< 2)	
Table 5.8	**Slab thickness**	
EN 1992-1-2	Minimum thickness for fire resistance 80 mm	∴ Try h
Table 7.4N	Estimated thickness considering deflection control 88.46 mm	110 mm
	Nominal cover	
Table 4.2	Min concrete cover regard to bond, $C_{min.b}$ 10 mm	
Table 4.4N	Min concrete cover regard to durability, $C_{min.dur}$ 15 mm	
EN1992-1-2	Min required axis distance for R60 fire resistance, a_{sd} 10 mm	
4.4.1.2	Min concrete cover regard to fire, $C_{min.fire}$ 5 mm	∴ Use C_{min} 15 mm
4.4.1.3	Allowance in design for deviation, ΔC_{dev} 10 mm	
4.4.1.1 (2)	Nominal cover, $C_{nom} = C_{min} + \Delta C_{dev}$ 25 mm	∴ Use C_{nom} 25 mm
	Main reinforcement	
	Bending moments : Short span at support M_{sx} 21.15 kNm/m	
	Short span at midspan M_{sx} 6.66 kNm/m	
	Long span at support M_{sy} 18.23 kNm/m	
	Long span at midspan M_{sy} 6.02 kNm/m	
	Effective depth : Short span d_x 80 mm	
	Long span d_y 70 mm	
9.2.1.1	Minimum reinforcement area, $A_{s,min} = 0.26\frac{f_{ctm}}{f_{yk}}bd$ 108.16 mm2/m	Secondary bar: H6 - 250
	Maximum reinforcement area, $A_{s,max} = 0.04A_c$ 4400 mm2/m	113 mm2/m
	<u>Short span at support</u>	
6.1	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.1322	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 69.222 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 702.388	Use H10 - 100 top.
	Area provided 785 OK	785 mm2
	<u>Short span at midspan</u>	
6.1	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0416	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 76.949 NOT OK	
	0.95d 76.00 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 198.967	Use H10 - 325 bot.
	Area provided 242 OK	242 mm2

	Long span at support	
6.1	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.1488	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 59.125 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 708.804	Use H10 - 100 top.
	Area provided 785 OK	785 mm2
	Long span at midspan	
6.1	$k = \frac{M}{bd^2 f_{ck}} < 0.167$ k 0.0491	
	Compression steel not required	
	$z = d\left(0.5 + \sqrt{0.25 - \frac{k}{1.134}}\right) < 0.95d$ z 66.825 NOT OK	
	0.95d 66.50 OK	
	$A_s = \frac{M}{0.87 f_{yk} z}$ Area required 208.106	Use H10 - 325 bot.
	Area provided 242 OK	242 mm2
	Shear checking	
	Design shear force, V_{Ed} 94.54 kN	
	$k = 1 + \left(\frac{200}{d}\right)^{1/2} \leq 2.0$ k 2.58 NOT OK	
	2 USE 2.0	
	$\rho_1 = \frac{A_{sl}}{bd} \leq 0.02$ ρ 0.0028 OK	
6.2.2	Design shear resistance, $V_{Rd,c} = 0.12k(100\rho_1 f_{ck})^{1/3} bd$ 128.55 kN	Ved < Vrd < Vmin
	Minimum shear force, $V_{min} = 0.035k^{3/2} f_{ck}^{1/2} bd$ 138.59 kN	OK
	Deflection	
7.4	Percentage of requried tension reinforcement, $\rho = \frac{A_{s,req}}{bd}$ 0.003	
	Reference reinforcement ratio, $\rho_0 = f_{ck}^{1/2} \times 10^{-3}$ 0.005	
Table 7.4N	Factor for structural system K 1.3	
	$\frac{l}{d} = K\left[11 + 1.5\sqrt{f_{ck}}\frac{\rho_0}{\rho} + 3.2\sqrt{f_{ck}}\left(\frac{\rho_0}{\rho} - 1\right)^{3/2}\right] for\ \rho \leq \rho_0$ 41.87	
	Modification ratio 1.22	
	Allowable span effective depth ratio 51.08	Actual < Allowable
	Actual span effective depth ratio 43.13	OK
	Cracking	
7.3.3	Thickness of slab (< 200) h 110 mm	OK
9.3.1	Main bar: Maximum spacing, $S_{max,,slabs} = 3h \leq 400\ mm$ 330 mm	
	Maximum proposed bar spacing 325 mm	OK
	Secondary bar:	
	Maximum spacing, $S_{max,,slabs} = 3.5h \leq 450\ mm$ 385 mm	
	Maximum proposed bar spacing 250 mm	OK

Critical column

REFERENCE	CALCULATIONS				OUTPUT
	COLUMN B/4				
	Design assumption				
	Design life		50	years	
	Stuctural class		S4		
	Exposure class		XC3		
	Fire resistance		R60		
	Size of aggregates		20	mm	
Table 3.1	Strength of concrete C25/30		25	N/mm2	
	fyk and fyw		500	N/mm2	
	Specifications				
	Top side (1)				
	Beam size:	b	200	mm	
		h	450	mm	
	Column size:	b	200	mm	
		h	200	mm	
	Column height		3500	mm	
	Beam length		2400	mm	
	Beam length		3900	mm	
	Underside (2)				
	Beam size:	b	200	mm	
		h	400	mm	
	Column size:	b	200	mm	
		h	200	mm	
	Column height		3500	mm	
	Beam length		2400	mm	
	Beam length		3900	mm	
	Concrete cover		35	mm	
	Reinforcement bar diameter		16	mm	
	Shear link diameter		6	mm	
	Design load, N_{Ed}		352.42	kN	
	Member stiffness				
	Column stiffness	k_{col}	3.81E+04		
	Beam stiffness	k_{beam}	6.33E+05		
	Beam stiffness	k_{beam}	7.69E+04		
		k_1	0.05	NOT OK	
			0.1	USE 0.1	
	Column stiffness	k_{col}	3.81E+04		
	Beam stiffness	k_{beam}	4.44E+05		
	Beam stiffness	k_{beam}	2.74E+05		
		k_2	0.05	NOT OK	
			0.1	USE 0.1	
	Effective column height		2.07	m	
	Slenderness ratio	λ	35.81		λ,lim > λ
	Limiting slenderness ratio	λ_{lim}	52.75		Short column
	Longitudinal reinforcement				
	Column moment	$M_{col} = Max\{M_{bot}, M_{top}\}$	M_{col}	0.42 kNm	
5.2(7)		$e_i = \frac{l_0}{400}$	e_i	5.18 mm	
		$M_{02} = M_{col} + N_{ed}\, e_i$	M_{02}	2.25 kNm	
6.1(4)		$e_0 = \frac{h}{30} \geq 20$	e_0	6.67 NOT OK	
			e_0	20 USE 20	
		$M_{min} = N_{Ed}\, e_0$	M_{min}	7.05 kNm	
5.8.8.2		$M_{Ed} = Max\{M_{02}, M_{min}\}$	M_{Ed}	7.05 kNm	

	$\frac{N_{Ed}}{bhf_{ck}}$	0.35		
	$\frac{M_{Ed,z}}{bh^2 f_{ck}}$	0.035		
	d'	49 mm		
	d'/h	0.25		



		$\frac{A_s f_{yk}}{bhf_{ck}}$	0 mm2	
	Area of steel required,	$A_{s,req}$	0 mm2	
	Minimum area of steel, $A_{s,min} = \frac{0.10 N_{Ed}}{0.87 f_{yk}} \geq 0.002 A_c$		81.02 OK	
		$A_{s,min}$	80 mm2	
	Minimum bar diameter		12 mm	
	Maximum area of steel:			
	away from lap region, $A_{s,max} = 0.04 A_c$		1600 mm2	
	at lap region, $A_{s,max} = 0.08 A_c$		3200 mm2	
	Area of steel provided	$A_{s,prov}$	804 mm2	Use 4H16 804 mm2
	Stirrups			
	Minimum stirrups diameter (the larger of) :		6 mm	
		$1/4\Phi_{bar}$	4 mm	
	Maximum spacing away from lap region (the lesser of) :		400 mm	
		$20\ \Phi_{bar}$	320 mm	
		Dimension of column	200 mm	
	Maximum spacing at lap region :	$14\ \Phi_{bar}$	224 mm	
	Proposed stirrups away from lap region:	Bar size	6 mm	
		Spacing	200 mm	Use R6-200
	Proposed stirrups at lap region:	Bar size	6 mm	
		Spacing	150 mm	Use R6-150

Appendix B: Quantity take-off schedule

6 mm rebar schedule of as-built structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	RM1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	RM1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	RM1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	RM1.00
T6 - B500A	6 mm	690 mm	2	3.28	1,380 mm	0.306	RM1.00
T6 - B500A	6 mm	690 mm	5	3.28	3,450 mm	0.766	RM2.51
T6 - B500A	6 mm	690 mm	5	3.28	3,450 mm	0.766	RM2.51
T6 - B500A	6 mm	690 mm	5	3.28	3,450 mm	0.766	RM2.51
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	RM3.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	RM3.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	RM3.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	RM3.01
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	RM3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	RM3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	RM3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	RM3.52
T6 - B500A	6 mm	690 mm	7	3.28	4,830 mm	1.072	RM3.52
T6 - B500A	6 mm	690 mm	11	3.28	7,590 mm	1.685	RM5.53
T6 - B500A	6 mm	690 mm	25	3.28	17,250 mm	3.83	RM12.56
T6 - B500A	6 mm	690 mm	25	3.28	17,250 mm	3.83	RM12.56
T6 - B500A	6 mm	690 mm	31	3.28	21,390 mm	4.749	RM15.58
T6 - B500A	6 mm	690 mm	31	3.28	21,390 mm	4.749	RM15.58
T6 - B500A	6 mm	690 mm	31	3.28	21,390 mm	4.749	RM15.58
T6 - B500A	6 mm	690 mm	61	3.28	42,090 mm	9.344	RM30.65
T6 - B500A	6 mm	890 mm	5	3.28	4,450 mm	0.988	RM3.24
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42

T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37
T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37
T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37
T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37
T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	19	3.28	16,910 mm	3.754	RM12.31
T6 - B500A	6 mm	890 mm	19	3.28	16,910 mm	3.754	RM12.31
T6 - B500A	6 mm	890 mm	19	3.28	16,910 mm	3.754	RM12.31
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	20	3.28	17,800 mm	3.952	RM12.96
T6 - B500A	6 mm	890 mm	23	3.28	20,470 mm	4.544	RM14.91
T6 - B500A	6 mm	890 mm	23	3.28	20,470 mm	4.544	RM14.91
T6 - B500A	6 mm	890 mm	23	3.28	20,470 mm	4.544	RM14.91
T6 - B500A	6 mm	890 mm	23	3.28	20,470 mm	4.544	RM14.91
T6 - B500A	6 mm	890 mm	23	3.28	20,470 mm	4.544	RM14.91
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	26	3.28	23,140 mm	5.137	RM16.85

T6 - B500A	6 mm	890 mm	26	3.28	23,140 mm	5.137	RM16.85
T6 - B500A	6 mm	890 mm	27	3.28	24,030 mm	5.335	RM17.50
T6 - B500A	6 mm	890 mm	27	3.28	24,030 mm	5.335	RM17.50
T6 - B500A	6 mm	890 mm	27	3.28	24,030 mm	5.335	RM17.50
T6 - B500A	6 mm	890 mm	28	3.28	24,920 mm	5.532	RM18.15
T6 - B500A	6 mm	890 mm	30	3.28	26,700 mm	5.927	RM19.44
T6 - B500A	6 mm	890 mm	30	3.28	26,700 mm	5.927	RM19.44
T6 - B500A	6 mm	890 mm	30	3.28	26,700 mm	5.927	RM19.44
T6 - B500A	6 mm	890 mm	30	3.28	26,700 mm	5.927	RM19.44
T6 - B500A	6 mm	890 mm	30	3.28	26,700 mm	5.927	RM19.44
T6 - B500A	6 mm	890 mm	30	3.28	26,700 mm	5.927	RM19.44
T6 - B500A	6 mm	890 mm	43	3.28	38,270 mm	8.496	RM27.87
T6 - B500A	6 mm	890 mm	43	3.28	38,270 mm	8.496	RM27.87
T6 - B500A	6 mm	890 mm	47	3.28	41,830 mm	9.286	RM30.46
T6 - B500A	6 mm	890 mm	47	3.28	41,830 mm	9.286	RM30.46
T6 - B500A	6 mm	890 mm	60	3.28	53,400 mm	11.855	RM38.88
T6 - B500A	6 mm	890 mm	60	3.28	53,400 mm	11.855	RM38.88
T6 - B500A	6 mm	890 mm	65	3.28	57,850 mm	12.843	RM42.12
T6 - B500A	6 mm	890 mm	82	3.28	72,980 mm	16.202	RM53.14
T6 - B500A	6 mm	890 mm	82	3.28	72,980 mm	16.202	RM53.14
T6 - B500A	6 mm	890 mm	82	3.28	72,980 mm	16.202	RM53.14
T6 - B500A	6 mm	890 mm	82	3.28	72,980 mm	16.202	RM53.14
T6 - B500A	6 mm	890 mm	83	3.28	73,870 mm	16.399	RM53.79
T6 - B500A	6 mm	890 mm	229	3.28	203,810 mm	45.246	RM148.41
T6 - B500A	6 mm	890 mm	229	3.28	203,810 mm	45.246	RM148.41
T6 - B500A	6 mm	890 mm	229	3.28	203,810 mm	45.246	RM148.41
T6 - B500A	6 mm	890 mm	229	3.28	203,810 mm	45.246	RM148.41
T6 - B500A	6 mm	890 mm	231	3.28	205,590 mm	45.641	RM149.70
T6 - B500A	6 mm	890 mm	231	3.28	205,590 mm	45.641	RM149.70
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	25	3.28	24,750 mm	5.495	RM18.02
T6 - B500A	6 mm	990 mm	25	3.28	24,750 mm	5.495	RM18.02
T6 - B500A	6 mm	990 mm	25	3.28	24,750 mm	5.495	RM18.02
T6 - B500A	6 mm	990 mm	27	3.28	26,730 mm	5.934	RM19.46
T6 - B500A	6 mm	990 mm	27	3.28	26,730 mm	5.934	RM19.46
T6 - B500A	6 mm	990 mm	27	3.28	26,730 mm	5.934	RM19.46
T6 - B500A	6 mm	990 mm	29	3.28	28,710 mm	6.374	RM20.91
T6 - B500A	6 mm	990 mm	29	3.28	28,710 mm	6.374	RM20.91
T6 - B500A	6 mm	990 mm	29	3.28	28,710 mm	6.374	RM20.91
T6 - B500A	6 mm	990 mm	29	3.28	28,710 mm	6.374	RM20.91
T6 - B500A	6 mm	990 mm	30	3.28	29,700 mm	6.593	RM21.63
T6 - B500A	6 mm	990 mm	30	3.28	29,700 mm	6.593	RM21.63
T6 - B500A	6 mm	990 mm	33	3.28	32,670 mm	7.253	RM23.79
T6 - B500A	6 mm	990 mm	34	3.28	33,660 mm	7.473	RM24.51
T6 - B500A	6 mm	990 mm	34	3.28	33,660 mm	7.473	RM24.51

T6 - B500A	6 mm	990 mm	38	3.28	37,620 mm	8.352	RM27.39
T6 - B500A	6 mm	990 mm	38	3.28	37,620 mm	8.352	RM27.39
T6 - B500A	6 mm	990 mm	60	3.28	59,400 mm	13.187	RM43.25
T6 - B500A	6 mm	990 mm	60	3.28	59,400 mm	13.187	RM43.25
T6 - B500A	6 mm	990 mm	60	3.28	59,400 mm	13.187	RM43.25
T6 - B500A	6 mm	990 mm	63	3.28	62,370 mm	13.846	RM45.42
T6 - B500A	6 mm	990 mm	63	3.28	62,370 mm	13.846	RM45.42
T6 - B500A	6 mm	990 mm	64	3.28	63,360 mm	14.066	RM46.14
T6 - B500A	6 mm	990 mm	64	3.28	63,360 mm	14.066	RM46.14
T6 - B500A	6 mm	990 mm	67	3.28	66,330 mm	14.725	RM48.30
T6 - B500A	6 mm	990 mm	230	3.28	227,700 mm	50.549	RM165.80
T6 - B500A	6 mm	990 mm	230	3.28	227,700 mm	50.549	RM165.80
T6 - B500A	6 mm	990 mm	230	3.28	227,700 mm	50.549	RM165.80
T6 - B500A	6 mm	1090 mm	30	3.28	32,700 mm	7.259	RM23.81
T6 - B500A	6 mm	1090 mm	30	3.28	32,700 mm	7.259	RM23.81
T6 - B500A	6 mm	1090 mm	30	3.28	32,700 mm	7.259	RM23.81
T6 - B500A	6 mm	1090 mm	30	3.28	32,700 mm	7.259	RM23.81
T6 - B500A	6 mm	1190 mm	14	3.28	16,660 mm	3.699	RM12.13
T6 - B500A	6 mm	1190 mm	16	3.28	19,040 mm	4.227	RM13.86
T6 - B500A	6 mm	1390 mm	15	3.28	20,850 mm	4.629	RM15.18
T6 - B500A	6 mm	1390 mm	15	3.28	20,850 mm	4.629	RM15.18
T6 - B500A	6 mm	1390 mm	19	3.28	26,410 mm	5.863	RM19.23
T6 - B500A	6 mm	1390 mm	19	3.28	26,410 mm	5.863	RM19.23
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
T6 - B500A	6 mm	1390 mm	20	3.28	27,800 mm	6.172	RM20.24
Grand total: 178					**5,795,980 mm**	**1,286.71**	**RM4,220.40**

8 mm rebar schedule of as-built structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	600 mm	7	3.28	4,200 mm	2.096	RM6.87
T8 - B500A	8 mm	1570 mm	3	3.28	4,710 mm	2.35	RM7.71
T8 - B500A	8 mm	1600 mm	3	3.28	4,800 mm	2.395	RM7.86
T8 - B500A	8 mm	1600 mm	3	3.28	4,800 mm	2.395	RM7.86
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	1000 mm	5	3.28	5,000 mm	2.495	RM8.18
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25

T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	720 mm	7	3.28	5,040 mm	2.515	RM8.25
T8 - B500A	8 mm	1600 mm	4	3.28	6,400 mm	3.194	RM10.48
T8 - B500A	8 mm	1000 mm	7	3.28	7,000 mm	3.493	RM11.46
T8 - B500A	8 mm	1000 mm	7	3.28	7,000 mm	3.493	RM11.46
T8 - B500A	8 mm	1000 mm	7	3.28	7,000 mm	3.493	RM11.46
T8 - B500A	8 mm	1000 mm	7	3.28	7,000 mm	3.493	RM11.46
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	500 mm	28	3.28	14,000 mm	6.986	RM22.91
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50

T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	600 mm	28	3.28	16,800 mm	8.383	RM27.50
T8 - B500A	8 mm	1000 mm	18	3.28	18,000 mm	8.982	RM29.46
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41

T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	600 mm	33	3.28	19,800 mm	9.88	RM32.41
T8 - B500A	8 mm	900 mm	24	3.28	21,600 mm	10.778	RM35.35
T8 - B500A	8 mm	900 mm	24	3.28	21,600 mm	10.778	RM35.35
T8 - B500A	8 mm	1000 mm	24	3.28	24,000 mm	11.976	RM39.28
T8 - B500A	8 mm	900 mm	27	3.28	24,300 mm	12.126	RM39.77
T8 - B500A	8 mm	1000 mm	28	3.28	28,000 mm	13.972	RM45.83
T8 - B500A	8 mm	1000 mm	29	3.28	29,000 mm	14.471	RM47.46
T8 - B500A	8 mm	1000 mm	29	3.28	29,000 mm	14.471	RM47.46
T8 - B500A	8 mm	1000 mm	29	3.28	29,000 mm	14.471	RM47.46
T8 - B500A	8 mm	1000 mm	32	3.28	32,000 mm	15.968	RM52.38
T8 - B500A	8 mm	1000 mm	32	3.28	32,000 mm	15.968	RM52.38
T8 - B500A	8 mm	1000 mm	32	3.28	32,000 mm	15.968	RM52.38
T8 - B500A	8 mm	1000 mm	32	3.28	32,000 mm	15.968	RM52.38
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	1000 mm	34	3.28	34,000 mm	16.966	RM55.65
T8 - B500A	8 mm	900 mm	41	3.28	36,900 mm	18.413	RM60.39
T8 - B500A	8 mm	900 mm	41	3.28	36,900 mm	18.413	RM60.39
T8 - B500A	8 mm	1100 mm	38	3.28	41,800 mm	20.858	RM68.41
T8 - B500A	8 mm	1100 mm	39	3.28	42,900 mm	21.407	RM70.22
T8 - B500A	8 mm	1100 mm	39	3.28	42,900 mm	21.407	RM70.22
T8 - B500A	8 mm	1100 mm	39	3.28	42,900 mm	21.407	RM70.22
T8 - B500A	8 mm	1100 mm	39	3.28	42,900 mm	21.407	RM70.22
T8 - B500A	8 mm	1000 mm	47	3.28	47,000 mm	23.453	RM76.93
T8 - B500A	8 mm	1000 mm	47	3.28	47,000 mm	23.453	RM76.93
T8 - B500A	8 mm	1000 mm	60	3.28	60,000 mm	29.94	RM98.20
T8 - B500A	8 mm	1000 mm	60	3.28	60,000 mm	29.94	RM98.20
T8 - B500A	8 mm	1000 mm	60	3.28	60,000 mm	29.94	RM98.20
T8 - B500A	8 mm	1000 mm	60	3.28	60,000 mm	29.94	RM98.20
T8 - B500A	8 mm	1000 mm	70	3.28	70,000 mm	34.93	RM114.57
T8 - B500A	8 mm	1000 mm	70	3.28	70,000 mm	34.93	RM114.57
T8 - B500A	8 mm	1100 mm	80	3.28	88,000 mm	43.912	RM144.03
T8 - B500A	8 mm	1100 mm	80	3.28	88,000 mm	43.912	RM144.03
T8 - B500A	8 mm	1100 mm	80	3.28	88,000 mm	43.912	RM144.03
T8 - B500A	8 mm	1100 mm	81	3.28	89,100 mm	44.461	RM145.83
T8 - B500A	8 mm	1370 mm	233	3.28	319,210 mm	159.286	RM522.46
Grand total: 215					**4,193,240 mm**	**2,092.43**	**RM6,863.16**

10 mm rebar schedule of as-built structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T10 - B500A	10 mm	2080 mm	3	3.28	6,240 mm	3.85	RM12.63
T10 - B500A	10 mm	2080 mm	3	3.28	6,240 mm	3.85	RM12.63
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	9450 mm	25	3.28	236,250 mm	145.766	RM478.11
T10 - B500A	10 mm	9450 mm	25	3.28	236,250 mm	145.766	RM478.11
T10 - B500A	10 mm	9450 mm	25	3.28	236,250 mm	145.766	RM478.11
T10 - B500A	10 mm	9450 mm	25	3.28	236,250 mm	145.766	RM478.11
T10 - B500A	10 mm	9450 mm	25	3.28	236,250 mm	145.766	RM478.11
T10 - B500A	10 mm	9450 mm	25	3.28	236,250 mm	145.766	RM478.11
T10 - B500A	10 mm	9450 mm	49	3.28	463,050 mm	285.702	RM937.10
T10 - B500A	10 mm	9450 mm	49	3.28	463,050 mm	285.702	RM937.10
T10 - B500A	10 mm	9950 mm	10	3.28	99,500 mm	61.392	RM201.36
T10 - B500A	10 mm	9950 mm	10	3.28	99,500 mm	61.392	RM201.36
T10 - B500A	10 mm	9950 mm	21	3.28	208,950 mm	128.922	RM422.86
T10 - B500A	10 mm	9950 mm	21	3.28	208,950 mm	128.922	RM422.86
T10 - B500A	10 mm	9950 mm	21	3.28	208,950 mm	128.922	RM422.86
T10 - B500A	10 mm	9950 mm	21	3.28	208,950 mm	128.922	RM422.86
T10 - B500A	10 mm	14450 mm	18	3.28	260,100 mm	160.482	RM526.38
T10 - B500A	10 mm	14450 mm	18	3.28	260,100 mm	160.482	RM526.38
T10 - B500A	10 mm	14450 mm	18	3.28	260,100 mm	160.482	RM526.38
T10 - B500A	10 mm	14450 mm	18	3.28	260,100 mm	160.482	RM526.38
T10 - B500A	10 mm	17950 mm	175	3.28	3,141,250 mm	1,938.15	RM6,357.14
T10 - B500A	10 mm	17950 mm	175	3.28	3,141,250 mm	1,938.15	RM6,357.14
T10 - B500A	10 mm	34950 mm	18	3.28	629,100 mm	388.155	RM1,273.15
T10 - B500A	10 mm	34950 mm	18	3.28	629,100 mm	388.155	RM1,273.15
T10 - B500A	10 mm	34950 mm	48	3.28	1,677,600 mm	1,035.08	RM3,395.06
T10 - B500A	10 mm	34950 mm	48	3.28	1,677,600 mm	1,035.08	RM3,395.06
T10 - B500A	10 mm	41950 mm	73	3.28	3,062,350 mm	1,889.47	RM6,197.46
T10 - B500A	10 mm	41950 mm	73	3.28	3,062,350 mm	1,889.47	RM6,197.46
Grand total: 32					**21,502,280 mm**	**13,266.91**	**RM43,515.45**

12 mm rebar schedule of as-built structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T12 - B500A	12 mm	800 mm	2	3.28	1,600 mm	1.421	RM4.66
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	2	3.28	1,800 mm	1.598	RM5.24
T12 - B500A	12 mm	900 mm	3	3.28	2,700 mm	2.398	RM7.86
T12 - B500A	12 mm	900 mm	3	3.28	2,700 mm	2.398	RM7.86
T12 - B500A	12 mm	1000 mm	2	3.28	2,000 mm	1.776	RM5.83
T12 - B500A	12 mm	1000 mm	2	3.28	2,000 mm	1.776	RM5.83
T12 - B500A	12 mm	1050 mm	2	3.28	2,100 mm	1.865	RM6.12
T12 - B500A	12 mm	1050 mm	2	3.28	2,100 mm	1.865	RM6.12
T12 - B500A	12 mm	1050 mm	2	3.28	2,100 mm	1.865	RM6.12
T12 - B500A	12 mm	1050 mm	2	3.28	2,100 mm	1.865	RM6.12
T12 - B500A	12 mm	1200 mm	2	3.28	2,400 mm	2.131	RM6.99
T12 - B500A	12 mm	1200 mm	2	3.28	2,400 mm	2.131	RM6.99
T12 - B500A	12 mm	1200 mm	2	3.28	2,400 mm	2.131	RM6.99
T12 - B500A	12 mm	1200 mm	2	3.28	2,400 mm	2.131	RM6.99
T12 - B500A	12 mm	1200 mm	2	3.28	2,400 mm	2.131	RM6.99
T12 - B500A	12 mm	1250 mm	2	3.28	2,500 mm	2.22	RM7.28
T12 - B500A	12 mm	1250 mm	2	3.28	2,500 mm	2.22	RM7.28
T12 - B500A	12 mm	1250 mm	2	3.28	2,500 mm	2.22	RM7.28
T12 - B500A	12 mm	1250 mm	2	3.28	2,500 mm	2.22	RM7.28
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57
T12 - B500A	12 mm	1300 mm	2	3.28	2,600 mm	2.309	RM7.57

T12 - B500A	12 mm	1400 mm	2	3.28	2,800 mm	2.486	RM8.16
T12 - B500A	12 mm	1400 mm	2	3.28	2,800 mm	2.486	RM8.16
T12 - B500A	12 mm	1400 mm	2	3.28	2,800 mm	2.486	RM8.16
T12 - B500A	12 mm	1400 mm	2	3.28	2,800 mm	2.486	RM8.16
T12 - B500A	12 mm	1400 mm	2	3.28	2,800 mm	2.486	RM8.16
T12 - B500A	12 mm	1400 mm	2	3.28	2,800 mm	2.486	RM8.16
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1500 mm	2	3.28	3,000 mm	2.664	RM8.74
T12 - B500A	12 mm	1550 mm	2	3.28	3,100 mm	2.753	RM9.03
T12 - B500A	12 mm	1550 mm	2	3.28	3,100 mm	2.753	RM9.03
T12 - B500A	12 mm	1550 mm	2	3.28	3,100 mm	2.753	RM9.03
T12 - B500A	12 mm	1550 mm	2	3.28	3,100 mm	2.753	RM9.03
T12 - B500A	12 mm	1550 mm	2	3.28	3,100 mm	2.753	RM9.03
T12 - B500A	12 mm	2100 mm	2	3.28	4,200 mm	3.73	RM12.23
T12 - B500A	12 mm	2100 mm	2	3.28	4,200 mm	3.73	RM12.23
T12 - B500A	12 mm	2100 mm	2	3.28	4,200 mm	3.73	RM12.23
T12 - B500A	12 mm	2200 mm	2	3.28	4,400 mm	3.907	RM12.82
T12 - B500A	12 mm	2200 mm	2	3.28	4,400 mm	3.907	RM12.82
T12 - B500A	12 mm	2200 mm	2	3.28	4,400 mm	3.907	RM12.82
T12 - B500A	12 mm	2200 mm	2	3.28	4,400 mm	3.907	RM12.82
T12 - B500A	12 mm	2250 mm	2	3.28	4,500 mm	3.996	RM13.11
T12 - B500A	12 mm	2250 mm	2	3.28	4,500 mm	3.996	RM13.11
T12 - B500A	12 mm	2250 mm	2	3.28	4,500 mm	3.996	RM13.11
T12 - B500A	12 mm	2250 mm	2	3.28	4,500 mm	3.996	RM13.11
T12 - B500A	12 mm	2300 mm	2	3.28	4,600 mm	4.085	RM13.40
T12 - B500A	12 mm	2300 mm	2	3.28	4,600 mm	4.085	RM13.40
T12 - B500A	12 mm	2300 mm	2	3.28	4,600 mm	4.085	RM13.40
T12 - B500A	12 mm	2300 mm	2	3.28	4,600 mm	4.085	RM13.40
T12 - B500A	12 mm	2350 mm	2	3.28	4,700 mm	4.174	RM13.69
T12 - B500A	12 mm	2350 mm	2	3.28	4,700 mm	4.174	RM13.69
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2450 mm	2	3.28	4,900 mm	4.351	RM14.27
T12 - B500A	12 mm	2500 mm	2	3.28	5,000 mm	4.44	RM14.56
T12 - B500A	12 mm	2500 mm	2	3.28	5,000 mm	4.44	RM14.56

T12 - B500A	12 mm	2500 mm	2	3.28	5,000 mm	4.44	RM14.56
T12 - B500A	12 mm	2500 mm	2	3.28	5,000 mm	4.44	RM14.56
T12 - B500A	12 mm	2500 mm	2	3.28	5,000 mm	4.44	RM14.56
T12 - B500A	12 mm	2850 mm	2	3.28	5,700 mm	5.062	RM16.60
T12 - B500A	12 mm	2850 mm	2	3.28	5,700 mm	5.062	RM16.60
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51

T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3350 mm	2	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3400 mm	2	3.28	6,800 mm	6.038	RM19.81
T12 - B500A	12 mm	3450 mm	1	3.28	3,450 mm	3.064	RM10.05
T12 - B500A	12 mm	3450 mm	1	3.28	3,450 mm	3.064	RM10.05
T12 - B500A	12 mm	3450 mm	2	3.28	6,900 mm	6.127	RM20.10
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39

T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3500 mm	2	3.28	7,000 mm	6.216	RM20.39
T12 - B500A	12 mm	3900 mm	2	3.28	7,800 mm	6.926	RM22.72
T12 - B500A	12 mm	3900 mm	2	3.28	7,800 mm	6.926	RM22.72
T12 - B500A	12 mm	3900 mm	2	3.28	7,800 mm	6.926	RM22.72
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01

T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	4050 mm	2	3.28	8,100 mm	7.193	RM23.59
T12 - B500A	12 mm	4050 mm	2	3.28	8,100 mm	7.193	RM23.59
T12 - B500A	12 mm	4050 mm	2	3.28	8,100 mm	7.193	RM23.59
T12 - B500A	12 mm	4050 mm	2	3.28	8,100 mm	7.193	RM23.59
T12 - B500A	12 mm	4050 mm	2	3.28	8,100 mm	7.193	RM23.59
T12 - B500A	12 mm	4100 mm	2	3.28	8,200 mm	7.282	RM23.88
T12 - B500A	12 mm	4100 mm	2	3.28	8,200 mm	7.282	RM23.88
T12 - B500A	12 mm	4100 mm	2	3.28	8,200 mm	7.282	RM23.88
T12 - B500A	12 mm	4100 mm	2	3.28	8,200 mm	7.282	RM23.88
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4400 mm	2	3.28	8,800 mm	7.814	RM25.63
T12 - B500A	12 mm	4400 mm	2	3.28	8,800 mm	7.814	RM25.63
T12 - B500A	12 mm	4400 mm	2	3.28	8,800 mm	7.814	RM25.63
T12 - B500A	12 mm	4750 mm	2	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	4750 mm	2	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	4800 mm	2	3.28	9,600 mm	8.525	RM27.96
T12 - B500A	12 mm	4800 mm	2	3.28	9,600 mm	8.525	RM27.96
T12 - B500A	12 mm	4800 mm	2	3.28	9,600 mm	8.525	RM27.96
T12 - B500A	12 mm	4800 mm	2	3.28	9,600 mm	8.525	RM27.96
T12 - B500A	12 mm	4800 mm	2	3.28	9,600 mm	8.525	RM27.96
T12 - B500A	12 mm	4800 mm	2	3.28	9,600 mm	8.525	RM27.96
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	5000 mm	2	3.28	10,000 mm	8.88	RM29.13
T12 - B500A	12 mm	5000 mm	2	3.28	10,000 mm	8.88	RM29.13
T12 - B500A	12 mm	5000 mm	2	3.28	10,000 mm	8.88	RM29.13
T12 - B500A	12 mm	5000 mm	2	3.28	10,000 mm	8.88	RM29.13
T12 - B500A	12 mm	5000 mm	2	3.28	10,000 mm	8.88	RM29.13
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95

T12 - B500A	12 mm	6000 mm	2	3.28	12,000 mm	10.656	RM34.95
T12 - B500A	12 mm	6300 mm	2	3.28	12,600 mm	11.189	RM36.70
T12 - B500A	12 mm	6300 mm	2	3.28	12,600 mm	11.189	RM36.70
T12 - B500A	12 mm	6300 mm	2	3.28	12,600 mm	11.189	RM36.70
T12 - B500A	12 mm	6300 mm	2	3.28	12,600 mm	11.189	RM36.70
T12 - B500A	12 mm	6300 mm	2	3.28	12,600 mm	11.189	RM36.70
T12 - B500A	12 mm	6300 mm	2	3.28	12,600 mm	11.189	RM36.70
T12 - B500A	12 mm	6700 mm	1	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	6700 mm	1	3.28	6,700 mm	5.95	RM19.51
T12 - B500A	12 mm	6700 mm	2	3.28	13,400 mm	11.899	RM39.03
T12 - B500A	12 mm	6700 mm	2	3.28	13,400 mm	11.899	RM39.03
T12 - B500A	12 mm	7000 mm	2	3.28	14,000 mm	12.432	RM40.78
T12 - B500A	12 mm	7000 mm	2	3.28	14,000 mm	12.432	RM40.78
T12 - B500A	12 mm	7000 mm	2	3.28	14,000 mm	12.432	RM40.78
T12 - B500A	12 mm	9500 mm	1	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	9500 mm	1	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	9500 mm	1	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	9500 mm	1	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	9500 mm	1	3.28	9,500 mm	8.436	RM27.67
T12 - B500A	12 mm	9500 mm	2	3.28	19,000 mm	16.872	RM55.34
T12 - B500A	12 mm	9500 mm	2	3.28	19,000 mm	16.872	RM55.34
T12 - B500A	12 mm	9590 mm	2	3.28	19,180 mm	17.032	RM55.86
T12 - B500A	12 mm	9590 mm	2	3.28	19,180 mm	17.032	RM55.86
T12 - B500A	12 mm	9800 mm	2	3.28	19,600 mm	17.405	RM57.09
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	13000 mm	2	3.28	26,000 mm	23.088	RM75.73
T12 - B500A	12 mm	13000 mm	2	3.28	26,000 mm	23.088	RM75.73
T12 - B500A	12 mm	13000 mm	2	3.28	26,000 mm	23.088	RM75.73
T12 - B500A	12 mm	13000 mm	2	3.28	26,000 mm	23.088	RM75.73
T12 - B500A	12 mm	13000 mm	2	3.28	26,000 mm	23.088	RM75.73
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
Grand total: 360					**2,860,660 mm**	**2,540.27**	**RM8,332.07**

16 mm rebar schedule of as-built structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	1	3.13	500 mm	0.79	RM2.47
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	500 mm	3	3.13	1,500 mm	2.37	RM7.42
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96

T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	1	3.13	800 mm	1.264	RM3.96
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91

T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87

T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	800 mm	3	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	900 mm	1	3.13	900 mm	1.422	RM4.45
T16 - B500A	16 mm	900 mm	1	3.13	900 mm	1.422	RM4.45
T16 - B500A	16 mm	900 mm	1	3.13	900 mm	1.422	RM4.45
T16 - B500A	16 mm	900 mm	1	3.13	900 mm	1.422	RM4.45
T16 - B500A	16 mm	900 mm	1	3.13	900 mm	1.422	RM4.45
T16 - B500A	16 mm	900 mm	1	3.13	900 mm	1.422	RM4.45
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	3	3.13	2,700 mm	4.266	RM13.35
T16 - B500A	16 mm	900 mm	3	3.13	2,700 mm	4.266	RM13.35
T16 - B500A	16 mm	900 mm	3	3.13	2,700 mm	4.266	RM13.35
T16 - B500A	16 mm	900 mm	3	3.13	2,700 mm	4.266	RM13.35
T16 - B500A	16 mm	950 mm	2	3.13	1,900 mm	3.002	RM9.40
T16 - B500A	16 mm	950 mm	2	3.13	1,900 mm	3.002	RM9.40
T16 - B500A	16 mm	950 mm	2	3.13	1,900 mm	3.002	RM9.40
T16 - B500A	16 mm	950 mm	2	3.13	1,900 mm	3.002	RM9.40
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95

T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95

T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	1	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	1000 mm	2	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	1000 mm	2	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	1000 mm	2	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1000 mm	3	3.13	3,000 mm	4.74	RM14.84
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	1	3.13	1,100 mm	1.738	RM5.44
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32

T16 - B500A	16 mm	1100 mm	3	3.13	3,300 mm	5.214	RM16.32
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	1	3.13	1,200 mm	1.896	RM5.93
T16 - B500A	16 mm	1200 mm	2	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	1200 mm	2	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	1200 mm	2	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	1200 mm	2	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1200 mm	3	3.13	3,600 mm	5.688	RM17.80
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	1	3.13	1,250 mm	1.975	RM6.18
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	2	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1250 mm	3	3.13	3,750 mm	5.925	RM18.55
T16 - B500A	16 mm	1300 mm	1	3.13	1,300 mm	2.054	RM6.43
T16 - B500A	16 mm	1300 mm	1	3.13	1,300 mm	2.054	RM6.43
T16 - B500A	16 mm	1300 mm	1	3.13	1,300 mm	2.054	RM6.43
T16 - B500A	16 mm	1300 mm	1	3.13	1,300 mm	2.054	RM6.43
T16 - B500A	16 mm	1300 mm	2	3.13	2,600 mm	4.108	RM12.86

T16 - B500A	16 mm	1300 mm	2	3.13	2,600 mm	4.108	RM12.86
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1600 mm	3	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	1600 mm	3	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	1600 mm	3	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	1700 mm	2	3.13	3,400 mm	5.372	RM16.81
T16 - B500A	16 mm	1700 mm	2	3.13	3,400 mm	5.372	RM16.81
T16 - B500A	16 mm	1700 mm	2	3.13	3,400 mm	5.372	RM16.81
T16 - B500A	16 mm	1700 mm	2	3.13	3,400 mm	5.372	RM16.81
T16 - B500A	16 mm	1700 mm	2	3.13	3,400 mm	5.372	RM16.81
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1700 mm	3	3.13	5,100 mm	8.058	RM25.22
T16 - B500A	16 mm	1750 mm	1	3.13	1,750 mm	2.765	RM8.65
T16 - B500A	16 mm	1750 mm	1	3.13	1,750 mm	2.765	RM8.65
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	1	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71

T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1800 mm	3	3.13	5,400 mm	8.532	RM26.71
T16 - B500A	16 mm	1900 mm	2	3.13	3,800 mm	6.004	RM18.79
T16 - B500A	16 mm	1900 mm	2	3.13	3,800 mm	6.004	RM18.79
T16 - B500A	16 mm	1900 mm	2	3.13	3,800 mm	6.004	RM18.79
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1900 mm	3	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	1950 mm	1	3.13	1,950 mm	3.081	RM9.64
T16 - B500A	16 mm	1950 mm	1	3.13	1,950 mm	3.081	RM9.64
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89

T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	1	3.13	2,000 mm	3.16	RM9.89
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	2	3.13	4,000 mm	6.32	RM19.78
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2000 mm	3	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77

T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	3	3.13	6,300 mm	9.954	RM31.16
T16 - B500A	16 mm	2100 mm	3	3.13	6,300 mm	9.954	RM31.16
T16 - B500A	16 mm	2100 mm	3	3.13	6,300 mm	9.954	RM31.16
T16 - B500A	16 mm	2100 mm	3	3.13	6,300 mm	9.954	RM31.16
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	1	3.13	2,200 mm	3.476	RM10.88
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2200 mm	3	3.13	6,600 mm	10.428	RM32.64
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74

T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2400 mm	3	3.13	7,200 mm	11.376	RM35.61
T16 - B500A	16 mm	2500 mm	1	3.13	2,500 mm	3.95	RM12.36
T16 - B500A	16 mm	2500 mm	2	3.13	5,000 mm	7.9	RM24.73
T16 - B500A	16 mm	2500 mm	2	3.13	5,000 mm	7.9	RM24.73
T16 - B500A	16 mm	2500 mm	2	3.13	5,000 mm	7.9	RM24.73
T16 - B500A	16 mm	2500 mm	3	3.13	7,500 mm	11.85	RM37.09
T16 - B500A	16 mm	2850 mm	1	3.13	2,850 mm	4.503	RM14.09
T16 - B500A	16 mm	2850 mm	1	3.13	2,850 mm	4.503	RM14.09
T16 - B500A	16 mm	2850 mm	2	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	2850 mm	2	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	2850 mm	3	3.13	8,550 mm	13.509	RM42.28
T16 - B500A	16 mm	2850 mm	3	3.13	8,550 mm	13.509	RM42.28
T16 - B500A	16 mm	2900 mm	3	3.13	8,700 mm	13.746	RM43.02
T16 - B500A	16 mm	2900 mm	3	3.13	8,700 mm	13.746	RM43.02
T16 - B500A	16 mm	3000 mm	2	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	3000 mm	2	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	3000 mm	2	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	3000 mm	2	3.13	6,000 mm	9.48	RM29.67
T16 - B500A	16 mm	3000 mm	3	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	3000 mm	3	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	3000 mm	3	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	3000 mm	3	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	3200 mm	1	3.13	3,200 mm	5.056	RM15.83
T16 - B500A	16 mm	3200 mm	1	3.13	3,200 mm	5.056	RM15.83
T16 - B500A	16 mm	3200 mm	1	3.13	3,200 mm	5.056	RM15.83
T16 - B500A	16 mm	3200 mm	1	3.13	3,200 mm	5.056	RM15.83
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65

T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	3	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	3200 mm	3	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	3200 mm	3	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	3200 mm	3	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	3200 mm	3	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3450 mm	1	3.13	3,450 mm	5.451	RM17.06
T16 - B500A	16 mm	3450 mm	1	3.13	3,450 mm	5.451	RM17.06
T16 - B500A	16 mm	3450 mm	1	3.13	3,450 mm	5.451	RM17.06
T16 - B500A	16 mm	3450 mm	1	3.13	3,450 mm	5.451	RM17.06
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12

T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	1	3.13	3,500 mm	5.53	RM17.31
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	3	3.13	10,500 mm	16.59	RM51.93
T16 - B500A	16 mm	3500 mm	3	3.13	10,500 mm	16.59	RM51.93
T16 - B500A	16 mm	3900 mm	2	3.13	7,800 mm	12.324	RM38.57
T16 - B500A	16 mm	3900 mm	2	3.13	7,800 mm	12.324	RM38.57
T16 - B500A	16 mm	3900 mm	2	3.13	7,800 mm	12.324	RM38.57
T16 - B500A	16 mm	3900 mm	2	3.13	7,800 mm	12.324	RM38.57

T16 - B500A	16 mm	3900 mm	2	3.13	7,800 mm	12.324	RM38.57
T16 - B500A	16 mm	3900 mm	2	3.13	7,800 mm	12.324	RM38.57
T16 - B500A	16 mm	3900 mm	3	3.13	11,700 mm	18.486	RM57.86
T16 - B500A	16 mm	3900 mm	3	3.13	11,700 mm	18.486	RM57.86
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07

T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	3950 mm	3	3.13	11,850 mm	18.723	RM58.60
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54

T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4400 mm	2	3.13	8,800 mm	13.904	RM43.52
T16 - B500A	16 mm	4400 mm	2	3.13	8,800 mm	13.904	RM43.52
T16 - B500A	16 mm	4400 mm	2	3.13	8,800 mm	13.904	RM43.52
T16 - B500A	16 mm	4750 mm	2	3.13	9,500 mm	15.01	RM46.98
T16 - B500A	16 mm	4750 mm	2	3.13	9,500 mm	15.01	RM46.98
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	3	3.13	14,700 mm	23.226	RM72.70
T16 - B500A	16 mm	4900 mm	3	3.13	14,700 mm	23.226	RM72.70
T16 - B500A	16 mm	4900 mm	3	3.13	14,700 mm	23.226	RM72.70
T16 - B500A	16 mm	4900 mm	3	3.13	14,700 mm	23.226	RM72.70
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5000 mm	2	3.13	10,000 mm	15.8	RM49.45
T16 - B500A	16 mm	5050 mm	2	3.13	10,100 mm	15.958	RM49.95
T16 - B500A	16 mm	5050 mm	2	3.13	10,100 mm	15.958	RM49.95
T16 - B500A	16 mm	5050 mm	2	3.13	10,100 mm	15.958	RM49.95
T16 - B500A	16 mm	5100 mm	3	3.13	15,300 mm	24.174	RM75.66
T16 - B500A	16 mm	5100 mm	3	3.13	15,300 mm	24.174	RM75.66
T16 - B500A	16 mm	5100 mm	3	3.13	15,300 mm	24.174	RM75.66
T16 - B500A	16 mm	5600 mm	3	3.13	16,800 mm	26.544	RM83.08
T16 - B500A	16 mm	5600 mm	3	3.13	16,800 mm	26.544	RM83.08
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	3	3.13	18,900 mm	29.862	RM93.47
T16 - B500A	16 mm	6300 mm	3	3.13	18,900 mm	29.862	RM93.47
T16 - B500A	16 mm	6300 mm	3	3.13	18,900 mm	29.862	RM93.47
T16 - B500A	16 mm	6300 mm	3	3.13	18,900 mm	29.862	RM93.47
T16 - B500A	16 mm	6300 mm	3	3.13	18,900 mm	29.862	RM93.47
T16 - B500A	16 mm	6300 mm	3	3.13	18,900 mm	29.862	RM93.47
T16 - B500A	16 mm	6700 mm	2	3.13	13,400 mm	21.172	RM66.27
T16 - B500A	16 mm	6700 mm	2	3.13	13,400 mm	21.172	RM66.27
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24

T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	3	3.13	21,000 mm	33.18	RM103.85
T16 - B500A	16 mm	7000 mm	3	3.13	21,000 mm	33.18	RM103.85
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	3	3.13	28,500 mm	45.03	RM140.94
T16 - B500A	16 mm	9500 mm	3	3.13	28,500 mm	45.03	RM140.94
T16 - B500A	16 mm	9500 mm	3	3.13	28,500 mm	45.03	RM140.94
T16 - B500A	16 mm	9800 mm	2	3.13	19,600 mm	30.968	RM96.93
T16 - B500A	16 mm	9800 mm	2	3.13	19,600 mm	30.968	RM96.93
T16 - B500A	16 mm	9800 mm	2	3.13	19,600 mm	30.968	RM96.93
T16 - B500A	16 mm	9800 mm	3	3.13	29,400 mm	46.452	RM145.39
T16 - B500A	16 mm	10000 mm	3	3.13	30,000 mm	47.4	RM148.36
T16 - B500A	16 mm	10000 mm	3	3.13	30,000 mm	47.4	RM148.36
T16 - B500A	16 mm	10000 mm	3	3.13	30,000 mm	47.4	RM148.36
T16 - B500A	16 mm	10100 mm	2	3.13	20,200 mm	31.916	RM99.90
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	14500 mm	2	3.13	29,000 mm	45.82	RM143.42
T16 - B500A	16 mm	14500 mm	2	3.13	29,000 mm	45.82	RM143.42
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	3	3.13	105,000 mm	165.9	RM519.27
T16 - B500A	16 mm	35000 mm	3	3.13	105,000 mm	165.9	RM519.27
T16 - B500A	16 mm	35000 mm	3	3.13	105,000 mm	165.9	RM519.27
T16 - B500A	16 mm	35000 mm	3	3.13	105,000 mm	165.9	RM519.27
Grand total: 983					**5,600,450 mm**	**8,848.71**	**RM27,696.47**

20 mm rebar schedule of as-built structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T20 - B500A	20 mm	500 mm	2	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	500 mm	2	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	500 mm	2	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	500 mm	2	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	900 mm	2	3.13	1,800 mm	4.446	RM13.92
T20 - B500A	20 mm	900 mm	2	3.13	1,800 mm	4.446	RM13.92
T20 - B500A	20 mm	900 mm	2	3.13	1,800 mm	4.446	RM13.92
T20 - B500A	20 mm	900 mm	2	3.13	1,800 mm	4.446	RM13.92
T20 - B500A	20 mm	1000 mm	1	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	1000 mm	1	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	1000 mm	1	3.13	1,000 mm	2.47	RM7.73
T20 - B500A	20 mm	1000 mm	2	3.13	2,000 mm	4.94	RM15.46
T20 - B500A	20 mm	1000 mm	2	3.13	2,000 mm	4.94	RM15.46
T20 - B500A	20 mm	1000 mm	2	3.13	2,000 mm	4.94	RM15.46
T20 - B500A	20 mm	1000 mm	2	3.13	2,000 mm	4.94	RM15.46
T20 - B500A	20 mm	1600 mm	2	3.13	3,200 mm	7.904	RM24.74
T20 - B500A	20 mm	1600 mm	2	3.13	3,200 mm	7.904	RM24.74
T20 - B500A	20 mm	1600 mm	2	3.13	3,200 mm	7.904	RM24.74
T20 - B500A	20 mm	1700 mm	2	3.13	3,400 mm	8.398	RM26.29
T20 - B500A	20 mm	1700 mm	2	3.13	3,400 mm	8.398	RM26.29
T20 - B500A	20 mm	1800 mm	2	3.13	3,600 mm	8.892	RM27.83
T20 - B500A	20 mm	1800 mm	2	3.13	3,600 mm	8.892	RM27.83
T20 - B500A	20 mm	1800 mm	2	3.13	3,600 mm	8.892	RM27.83
T20 - B500A	20 mm	2000 mm	1	3.13	2,000 mm	4.94	RM15.46
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	2	3.13	4,000 mm	9.88	RM30.92
T20 - B500A	20 mm	2000 mm	3	3.13	6,000 mm	14.82	RM46.39
T20 - B500A	20 mm	2000 mm	3	3.13	6,000 mm	14.82	RM46.39
T20 - B500A	20 mm	2200 mm	3	3.13	6,600 mm	16.302	RM51.03
T20 - B500A	20 mm	2400 mm	2	3.13	4,800 mm	11.856	RM37.11
T20 - B500A	20 mm	2400 mm	2	3.13	4,800 mm	11.856	RM37.11
T20 - B500A	20 mm	2400 mm	2	3.13	4,800 mm	11.856	RM37.11
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29

T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2800 mm	2	3.13	5,600 mm	13.832	RM43.29
T20 - B500A	20 mm	2900 mm	2	3.13	5,800 mm	14.326	RM44.84
T20 - B500A	20 mm	2900 mm	2	3.13	5,800 mm	14.326	RM44.84
T20 - B500A	20 mm	3100 mm	3	3.13	9,300 mm	22.971	RM71.90
T20 - B500A	20 mm	3100 mm	3	3.13	9,300 mm	22.971	RM71.90
T20 - B500A	20 mm	3100 mm	3	3.13	9,300 mm	22.971	RM71.90
T20 - B500A	20 mm	3500 mm	1	3.13	3,500 mm	8.645	RM27.06
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	3500 mm	2	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	4000 mm	3	3.13	12,000 mm	29.64	RM92.77
T20 - B500A	20 mm	4000 mm	3	3.13	12,000 mm	29.64	RM92.77
T20 - B500A	20 mm	4500 mm	2	3.13	9,000 mm	22.23	RM69.58
T20 - B500A	20 mm	4500 mm	2	3.13	9,000 mm	22.23	RM69.58
T20 - B500A	20 mm	4500 mm	2	3.13	9,000 mm	22.23	RM69.58
T20 - B500A	20 mm	4500 mm	2	3.13	9,000 mm	22.23	RM69.58
T20 - B500A	20 mm	4900 mm	2	3.13	9,800 mm	24.206	RM75.76
T20 - B500A	20 mm	4900 mm	2	3.13	9,800 mm	24.206	RM75.76
T20 - B500A	20 mm	4900 mm	2	3.13	9,800 mm	24.206	RM75.76
T20 - B500A	20 mm	6300 mm	3	3.13	18,900 mm	46.683	RM146.12
T20 - B500A	20 mm	6300 mm	3	3.13	18,900 mm	46.683	RM146.12
T20 - B500A	20 mm	6300 mm	3	3.13	18,900 mm	46.683	RM146.12
T20 - B500A	20 mm	6300 mm	3	3.13	18,900 mm	46.683	RM146.12
T20 - B500A	20 mm	6300 mm	3	3.13	18,900 mm	46.683	RM146.12
T20 - B500A	20 mm	7000 mm	1	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	7000 mm	1	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	7000 mm	1	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	7000 mm	1	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	7000 mm	1	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	7000 mm	1	3.13	7,000 mm	17.29	RM54.12
T20 - B500A	20 mm	9500 mm	2	3.13	19,000 mm	46.93	RM146.89
T20 - B500A	20 mm	9500 mm	2	3.13	19,000 mm	46.93	RM146.89
T20 - B500A	20 mm	9500 mm	2	3.13	19,000 mm	46.93	RM146.89
T20 - B500A	20 mm	9500 mm	2	3.13	19,000 mm	46.93	RM146.89
T20 - B500A	20 mm	9800 mm	2	3.13	19,600 mm	48.412	RM151.53
T20 - B500A	20 mm	9800 mm	2	3.13	19,600 mm	48.412	RM151.53
T20 - B500A	20 mm	12000 mm	2	3.13	24,000 mm	59.28	RM185.55

T20 - B500A	20 mm	12000 mm	2	3.13	24,000 mm	59.28	RM185.55
T20 - B500A	20 mm	12000 mm	2	3.13	24,000 mm	59.28	RM185.55
T20 - B500A	20 mm	12000 mm	2	3.13	24,000 mm	59.28	RM185.55
T20 - B500A	20 mm	14500 mm	2	3.13	29,000 mm	71.63	RM224.20
T20 - B500A	20 mm	14500 mm	2	3.13	29,000 mm	71.63	RM224.20
T20 - B500A	20 mm	35000 mm	2	3.13	70,000 mm	172.9	RM541.18
T20 - B500A	20 mm	42000 mm	2	3.13	84,000 mm	207.48	RM649.41
Grand total: 114					**1,034,500 mm**	**2,555.22**	**RM7,997.82**

6 mm rebar schedule of new structural model

Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	490 mm	16	3.28	7,840 mm	1.74	RM5.71
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	3	3.28	1,770 mm	0.393	RM1.29
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87

T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	16	3.28	9,440 mm	2.096	RM6.87
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	590 mm	19	3.28	11,210 mm	2.489	RM8.16
T6 - B500A	6 mm	690 mm	1	3.28	690 mm	0.153	RM0.50
T6 - B500A	6 mm	690 mm	1	3.28	690 mm	0.153	RM0.50

T6 - B500A	6 mm	690 mm	1	3.28	690 mm	0.153	RM0.50
T6 - B500A	6 mm	690 mm	3	3.28	2,070 mm	0.46	RM1.51
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	4	3.28	2,760 mm	0.613	RM2.01
T6 - B500A	6 mm	690 mm	6	3.28	4,140 mm	0.919	RM3.01
T6 - B500A	6 mm	690 mm	15	3.28	10,350 mm	2.298	RM7.54
T6 - B500A	6 mm	690 mm	15	3.28	10,350 mm	2.298	RM7.54
T6 - B500A	6 mm	690 mm	19	3.28	13,110 mm	2.91	RM9.55
T6 - B500A	6 mm	690 mm	19	3.28	13,110 mm	2.91	RM9.55
T6 - B500A	6 mm	690 mm	37	3.28	25,530 mm	5.668	RM18.59
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55

T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	710 mm	3	3.28	2,130 mm	0.473	RM1.55
T6 - B500A	6 mm	890 mm	1	3.28	890 mm	0.198	RM0.65
T6 - B500A	6 mm	890 mm	1	3.28	890 mm	0.198	RM0.65
T6 - B500A	6 mm	890 mm	1	3.28	890 mm	0.198	RM0.65
T6 - B500A	6 mm	890 mm	1	3.28	890 mm	0.198	RM0.65
T6 - B500A	6 mm	890 mm	2	3.28	1,780 mm	0.395	RM1.30
T6 - B500A	6 mm	890 mm	2	3.28	1,780 mm	0.395	RM1.30
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	3	3.28	2,670 mm	0.593	RM1.94
T6 - B500A	6 mm	890 mm	4	3.28	3,560 mm	0.79	RM2.59
T6 - B500A	6 mm	890 mm	4	3.28	3,560 mm	0.79	RM2.59
T6 - B500A	6 mm	890 mm	4	3.28	3,560 mm	0.79	RM2.59
T6 - B500A	6 mm	890 mm	4	3.28	3,560 mm	0.79	RM2.59
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	6	3.28	5,340 mm	1.185	RM3.89
T6 - B500A	6 mm	890 mm	7	3.28	6,230 mm	1.383	RM4.54
T6 - B500A	6 mm	890 mm	7	3.28	6,230 mm	1.383	RM4.54
T6 - B500A	6 mm	890 mm	7	3.28	6,230 mm	1.383	RM4.54
T6 - B500A	6 mm	890 mm	7	3.28	6,230 mm	1.383	RM4.54
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	8	3.28	7,120 mm	1.581	RM5.18
T6 - B500A	6 mm	890 mm	9	3.28	8,010 mm	1.778	RM5.83

T6 - B500A	6 mm	890 mm	9	3.28	8,010 mm	1.778	RM5.83
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	10	3.28	8,900 mm	1.976	RM6.48
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	11	3.28	9,790 mm	2.173	RM7.13
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	12	3.28	10,680 mm	2.371	RM7.78
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	13	3.28	11,570 mm	2.569	RM8.42
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	14	3.28	12,460 mm	2.766	RM9.07
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	15	3.28	13,350 mm	2.964	RM9.72
T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37

T6 - B500A	6 mm	890 mm	16	3.28	14,240 mm	3.161	RM10.37
T6 - B500A	6 mm	890 mm	17	3.28	15,130 mm	3.359	RM11.02
T6 - B500A	6 mm	890 mm	17	3.28	15,130 mm	3.359	RM11.02
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	18	3.28	16,020 mm	3.556	RM11.67
T6 - B500A	6 mm	890 mm	19	3.28	16,910 mm	3.754	RM12.31
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	24	3.28	21,360 mm	4.742	RM15.55
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	25	3.28	22,250 mm	4.94	RM16.20
T6 - B500A	6 mm	890 mm	39	3.28	34,710 mm	7.706	RM25.27
T6 - B500A	6 mm	890 mm	50	3.28	44,500 mm	9.879	RM32.40
T6 - B500A	6 mm	890 mm	50	3.28	44,500 mm	9.879	RM32.40
T6 - B500A	6 mm	890 mm	50	3.28	44,500 mm	9.879	RM32.40
T6 - B500A	6 mm	890 mm	50	3.28	44,500 mm	9.879	RM32.40
T6 - B500A	6 mm	890 mm	51	3.28	45,390 mm	10.077	RM33.05
T6 - B500A	6 mm	890 mm	116	3.28	103,240 mm	22.919	RM75.18
T6 - B500A	6 mm	890 mm	116	3.28	103,240 mm	22.919	RM75.18
T6 - B500A	6 mm	890 mm	137	3.28	121,930 mm	27.068	RM88.78
T6 - B500A	6 mm	890 mm	137	3.28	121,930 mm	27.068	RM88.78
T6 - B500A	6 mm	890 mm	137	3.28	121,930 mm	27.068	RM88.78
T6 - B500A	6 mm	890 mm	138	3.28	122,820 mm	27.266	RM89.43
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	3	3.28	2,970 mm	0.659	RM2.16
T6 - B500A	6 mm	990 mm	4	3.28	3,960 mm	0.879	RM2.88
T6 - B500A	6 mm	990 mm	5	3.28	4,950 mm	1.099	RM3.60
T6 - B500A	6 mm	990 mm	5	3.28	4,950 mm	1.099	RM3.60
T6 - B500A	6 mm	990 mm	5	3.28	4,950 mm	1.099	RM3.60
T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33
T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33
T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33
T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33
T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33

T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33
T6 - B500A	6 mm	990 mm	6	3.28	5,940 mm	1.319	RM4.33
T6 - B500A	6 mm	990 mm	7	3.28	6,930 mm	1.538	RM5.05
T6 - B500A	6 mm	990 mm	7	3.28	6,930 mm	1.538	RM5.05
T6 - B500A	6 mm	990 mm	7	3.28	6,930 mm	1.538	RM5.05
T6 - B500A	6 mm	990 mm	7	3.28	6,930 mm	1.538	RM5.05
T6 - B500A	6 mm	990 mm	7	3.28	6,930 mm	1.538	RM5.05
T6 - B500A	6 mm	990 mm	7	3.28	6,930 mm	1.538	RM5.05
T6 - B500A	6 mm	990 mm	8	3.28	7,920 mm	1.758	RM5.77
T6 - B500A	6 mm	990 mm	8	3.28	7,920 mm	1.758	RM5.77
T6 - B500A	6 mm	990 mm	10	3.28	9,900 mm	2.198	RM7.21
T6 - B500A	6 mm	990 mm	10	3.28	9,900 mm	2.198	RM7.21
T6 - B500A	6 mm	990 mm	10	3.28	9,900 mm	2.198	RM7.21
T6 - B500A	6 mm	990 mm	10	3.28	9,900 mm	2.198	RM7.21
T6 - B500A	6 mm	990 mm	10	3.28	9,900 mm	2.198	RM7.21
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	11	3.28	10,890 mm	2.418	RM7.93
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	12	3.28	11,880 mm	2.637	RM8.65
T6 - B500A	6 mm	990 mm	13	3.28	12,870 mm	2.857	RM9.37
T6 - B500A	6 mm	990 mm	13	3.28	12,870 mm	2.857	RM9.37
T6 - B500A	6 mm	990 mm	13	3.28	12,870 mm	2.857	RM9.37
T6 - B500A	6 mm	990 mm	14	3.28	13,860 mm	3.077	RM10.09
T6 - B500A	6 mm	990 mm	14	3.28	13,860 mm	3.077	RM10.09
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	15	3.28	14,850 mm	3.297	RM10.81
T6 - B500A	6 mm	990 mm	16	3.28	15,840 mm	3.516	RM11.53
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25

T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	17	3.28	16,830 mm	3.736	RM12.25
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	18	3.28	17,820 mm	3.956	RM12.98
T6 - B500A	6 mm	990 mm	19	3.28	18,810 mm	4.176	RM13.70
T6 - B500A	6 mm	990 mm	19	3.28	18,810 mm	4.176	RM13.70
T6 - B500A	6 mm	990 mm	19	3.28	18,810 mm	4.176	RM13.70
T6 - B500A	6 mm	990 mm	19	3.28	18,810 mm	4.176	RM13.70
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	20	3.28	19,800 mm	4.396	RM14.42
T6 - B500A	6 mm	990 mm	37	3.28	36,630 mm	8.132	RM26.67
T6 - B500A	6 mm	990 mm	37	3.28	36,630 mm	8.132	RM26.67
T6 - B500A	6 mm	990 mm	37	3.28	36,630 mm	8.132	RM26.67
T6 - B500A	6 mm	990 mm	37	3.28	36,630 mm	8.132	RM26.67
T6 - B500A	6 mm	990 mm	116	3.28	114,840 mm	25.494	RM83.62
T6 - B500A	6 mm	990 mm	116	3.28	114,840 mm	25.494	RM83.62
T6 - B500A	6 mm	990 mm	116	3.28	114,840 mm	25.494	RM83.62
T6 - B500A	6 mm	990 mm	144	3.28	142,560 mm	31.648	RM103.81
T6 - B500A	6 mm	1090 mm	3	3.28	3,270 mm	0.726	RM2.38
T6 - B500A	6 mm	1090 mm	3	3.28	3,270 mm	0.726	RM2.38
T6 - B500A	6 mm	1090 mm	3	3.28	3,270 mm	0.726	RM2.38
T6 - B500A	6 mm	1090 mm	3	3.28	3,270 mm	0.726	RM2.38
T6 - B500A	6 mm	1090 mm	11	3.28	11,990 mm	2.662	RM8.73
T6 - B500A	6 mm	1090 mm	11	3.28	11,990 mm	2.662	RM8.73
T6 - B500A	6 mm	1090 mm	11	3.28	11,990 mm	2.662	RM8.73
T6 - B500A	6 mm	1090 mm	11	3.28	11,990 mm	2.662	RM8.73
T6 - B500A	6 mm	1090 mm	15	3.28	16,350 mm	3.63	RM11.91
T6 - B500A	6 mm	1090 mm	15	3.28	16,350 mm	3.63	RM11.91
T6 - B500A	6 mm	1090 mm	15	3.28	16,350 mm	3.63	RM11.91
T6 - B500A	6 mm	1090 mm	15	3.28	16,350 mm	3.63	RM11.91
T6 - B500A	6 mm	1090 mm	18	3.28	19,620 mm	4.356	RM14.29
T6 - B500A	6 mm	1090 mm	18	3.28	19,620 mm	4.356	RM14.29
T6 - B500A	6 mm	1090 mm	18	3.28	19,620 mm	4.356	RM14.29
T6 - B500A	6 mm	1090 mm	18	3.28	19,620 mm	4.356	RM14.29
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05
T6 - B500A	6 mm	1090 mm	24	3.28	26,160 mm	5.808	RM19.05

T6 - B500A	6 mm	1190 mm	9	3.28	10,710 mm	2.378	RM7.80
T6 - B500A	6 mm	1190 mm	9	3.28	10,710 mm	2.378	RM7.80
T6 - B500A	6 mm	1390 mm	11	3.28	15,290 mm	3.394	RM11.13
T6 - B500A	6 mm	1390 mm	11	3.28	15,290 mm	3.394	RM11.13
T6 - B500A	6 mm	1390 mm	11	3.28	15,290 mm	3.394	RM11.13
T6 - B500A	6 mm	1390 mm	11	3.28	15,290 mm	3.394	RM11.13
T6 - B500A	6 mm	1390 mm	11	3.28	15,290 mm	3.394	RM11.13
T6 - B500A	6 mm	1390 mm	16	3.28	22,240 mm	4.937	RM16.19
T6 - B500A	6 mm	1390 mm	17	3.28	23,630 mm	5.246	RM17.21
T6 - B500A	6 mm	1390 mm	17	3.28	23,630 mm	5.246	RM17.21
T6 - B500A	6 mm	1390 mm	31	3.28	43,090 mm	9.566	RM31.38
T6 - B500A	6 mm	1390 mm	31	3.28	43,090 mm	9.566	RM31.38
T6 - B500A	6 mm	1390 mm	116	3.28	161,240 mm	35.795	RM117.41
T6 - B500A	6 mm	1590 mm	2	3.28	3,180 mm	0.706	RM2.32
T6 - B500A	6 mm	1590 mm	2	3.28	3,180 mm	0.706	RM2.32
T6 - B500A	6 mm	1590 mm	2	3.28	3,180 mm	0.706	RM2.32
T6 - B500A	6 mm	1590 mm	3	3.28	4,770 mm	1.059	RM3.47
Grand total: 467					**6,016,750 mm**	**1,335.72**	**RM4,381.16**

10 mm rebar schedule of new structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost (RM)
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	900 mm	3	3.28	2,700 mm	1.666	RM5.46
T10 - B500A	10 mm	1200 mm	3	3.28	3,600 mm	2.221	RM7.29
T10 - B500A	10 mm	1550 mm	3	3.28	4,650 mm	2.869	RM9.41
T10 - B500A	10 mm	1550 mm	3	3.28	4,650 mm	2.869	RM9.41
T10 - B500A	10 mm	1550 mm	3	3.28	4,650 mm	2.869	RM9.41
T10 - B500A	10 mm	1550 mm	3	3.28	4,650 mm	2.869	RM9.41
T10 - B500A	10 mm	1550 mm	3	3.28	4,650 mm	2.869	RM9.41
T10 - B500A	10 mm	2080 mm	2	3.28	4,160 mm	2.567	RM8.42
T10 - B500A	10 mm	2080 mm	5	3.28	10,400 mm	6.417	RM21.05
T10 - B500A	10 mm	2100 mm	1	3.28	2,100 mm	1.296	RM4.25
T10 - B500A	10 mm	2100 mm	1	3.28	2,100 mm	1.296	RM4.25
T10 - B500A	10 mm	2100 mm	1	3.28	2,100 mm	1.296	RM4.25
T10 - B500A	10 mm	2100 mm	1	3.28	2,100 mm	1.296	RM4.25
T10 - B500A	10 mm	2100 mm	2	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	2100 mm	2	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	2100 mm	2	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	2100 mm	3	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	2100 mm	3	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	2100 mm	3	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	1	3.28	2,400 mm	1.481	RM4.86
T10 - B500A	10 mm	2400 mm	2	3.28	4,800 mm	2.962	RM9.71
T10 - B500A	10 mm	2400 mm	2	3.28	4,800 mm	2.962	RM9.71
T10 - B500A	10 mm	2400 mm	2	3.28	4,800 mm	2.962	RM9.71
T10 - B500A	10 mm	2400 mm	2	3.28	4,800 mm	2.962	RM9.71
T10 - B500A	10 mm	2400 mm	2	3.28	4,800 mm	2.962	RM9.71
T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57
T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57
T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57
T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57

T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57
T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57
T10 - B500A	10 mm	2400 mm	3	3.28	7,200 mm	4.442	RM14.57
T10 - B500A	10 mm	2850 mm	3	3.28	8,550 mm	5.275	RM17.30
T10 - B500A	10 mm	2850 mm	3	3.28	8,550 mm	5.275	RM17.30
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	1	3.28	3,200 mm	1.974	RM6.48
T10 - B500A	10 mm	3200 mm	2	3.28	6,400 mm	3.949	RM12.95
T10 - B500A	10 mm	3200 mm	2	3.28	6,400 mm	3.949	RM12.95
T10 - B500A	10 mm	3200 mm	2	3.28	6,400 mm	3.949	RM12.95
T10 - B500A	10 mm	3200 mm	2	3.28	6,400 mm	3.949	RM12.95
T10 - B500A	10 mm	3200 mm	2	3.28	6,400 mm	3.949	RM12.95
T10 - B500A	10 mm	3200 mm	3	3.28	9,600 mm	5.923	RM19.43
T10 - B500A	10 mm	3200 mm	3	3.28	9,600 mm	5.923	RM19.43
T10 - B500A	10 mm	3200 mm	3	3.28	9,600 mm	5.923	RM19.43
T10 - B500A	10 mm	3200 mm	3	3.28	9,600 mm	5.923	RM19.43
T10 - B500A	10 mm	3200 mm	3	3.28	9,600 mm	5.923	RM19.43
T10 - B500A	10 mm	3450 mm	3	3.28	10,350 mm	6.386	RM20.95
T10 - B500A	10 mm	3450 mm	3	3.28	10,350 mm	6.386	RM20.95
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	2	3.28	7,000 mm	4.319	RM14.17
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3500 mm	3	3.28	10,500 mm	6.479	RM21.25
T10 - B500A	10 mm	3900 mm	2	3.28	7,800 mm	4.813	RM15.79
T10 - B500A	10 mm	3900 mm	2	3.28	7,800 mm	4.813	RM15.79
T10 - B500A	10 mm	3900 mm	2	3.28	7,800 mm	4.813	RM15.79

T10 - B500A	10 mm	3900 mm	3	3.28	11,700 mm	7.219	RM23.68
T10 - B500A	10 mm	3900 mm	3	3.28	11,700 mm	7.219	RM23.68
T10 - B500A	10 mm	3900 mm	3	3.28	11,700 mm	7.219	RM23.68
T10 - B500A	10 mm	3950 mm	1	3.28	3,950 mm	2.437	RM7.99
T10 - B500A	10 mm	3950 mm	1	3.28	3,950 mm	2.437	RM7.99
T10 - B500A	10 mm	3950 mm	1	3.28	3,950 mm	2.437	RM7.99
T10 - B500A	10 mm	3950 mm	1	3.28	3,950 mm	2.437	RM7.99
T10 - B500A	10 mm	3950 mm	1	3.28	3,950 mm	2.437	RM7.99
T10 - B500A	10 mm	3950 mm	1	3.28	3,950 mm	2.437	RM7.99
T10 - B500A	10 mm	4100 mm	3	3.28	12,300 mm	7.589	RM24.89
T10 - B500A	10 mm	4100 mm	3	3.28	12,300 mm	7.589	RM24.89
T10 - B500A	10 mm	4100 mm	3	3.28	12,300 mm	7.589	RM24.89
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	1	3.28	4,200 mm	2.591	RM8.50
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	2	3.28	8,400 mm	5.183	RM17.00
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	3	3.28	12,600 mm	7.774	RM25.50
T10 - B500A	10 mm	4200 mm	5	3.28	21,000 mm	12.957	RM42.50
T10 - B500A	10 mm	4200 mm	5	3.28	21,000 mm	12.957	RM42.50
T10 - B500A	10 mm	4400 mm	2	3.28	8,800 mm	5.43	RM17.81
T10 - B500A	10 mm	4400 mm	2	3.28	8,800 mm	5.43	RM17.81
T10 - B500A	10 mm	4400 mm	2	3.28	8,800 mm	5.43	RM17.81
T10 - B500A	10 mm	4400 mm	2	3.28	8,800 mm	5.43	RM17.81
T10 - B500A	10 mm	4400 mm	2	3.28	8,800 mm	5.43	RM17.81
T10 - B500A	10 mm	4400 mm	3	3.28	13,200 mm	8.144	RM26.71
T10 - B500A	10 mm	4400 mm	3	3.28	13,200 mm	8.144	RM26.71
T10 - B500A	10 mm	4400 mm	3	3.28	13,200 mm	8.144	RM26.71
T10 - B500A	10 mm	4400 mm	3	3.28	13,200 mm	8.144	RM26.71
T10 - B500A	10 mm	4400 mm	3	3.28	13,200 mm	8.144	RM26.71
T10 - B500A	10 mm	4500 mm	3	3.28	13,500 mm	8.33	RM27.32
T10 - B500A	10 mm	4500 mm	3	3.28	13,500 mm	8.33	RM27.32
T10 - B500A	10 mm	4500 mm	3	3.28	13,500 mm	8.33	RM27.32
T10 - B500A	10 mm	4500 mm	3	3.28	13,500 mm	8.33	RM27.32
T10 - B500A	10 mm	4500 mm	3	3.28	13,500 mm	8.33	RM27.32
T10 - B500A	10 mm	4750 mm	3	3.28	14,250 mm	8.792	RM28.84
T10 - B500A	10 mm	4750 mm	3	3.28	14,250 mm	8.792	RM28.84
T10 - B500A	10 mm	4800 mm	3	3.28	14,400 mm	8.885	RM29.14
T10 - B500A	10 mm	4800 mm	3	3.28	14,400 mm	8.885	RM29.14
T10 - B500A	10 mm	4800 mm	3	3.28	14,400 mm	8.885	RM29.14

T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	1	3.28	4,900 mm	3.023	RM9.92
T10 - B500A	10 mm	4900 mm	2	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	4900 mm	2	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	4900 mm	2	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	4900 mm	2	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	4900 mm	2	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	4900 mm	2	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	4900 mm	3	3.28	14,700 mm	9.07	RM29.75
T10 - B500A	10 mm	4900 mm	3	3.28	14,700 mm	9.07	RM29.75
T10 - B500A	10 mm	4900 mm	3	3.28	14,700 mm	9.07	RM29.75
T10 - B500A	10 mm	4900 mm	3	3.28	14,700 mm	9.07	RM29.75
T10 - B500A	10 mm	4900 mm	3	3.28	14,700 mm	9.07	RM29.75
T10 - B500A	10 mm	4900 mm	3	3.28	14,700 mm	9.07	RM29.75
T10 - B500A	10 mm	5000 mm	2	3.28	10,000 mm	6.17	RM20.24
T10 - B500A	10 mm	5000 mm	2	3.28	10,000 mm	6.17	RM20.24
T10 - B500A	10 mm	5000 mm	2	3.28	10,000 mm	6.17	RM20.24
T10 - B500A	10 mm	5000 mm	2	3.28	10,000 mm	6.17	RM20.24
T10 - B500A	10 mm	5000 mm	3	3.28	15,000 mm	9.255	RM30.36
T10 - B500A	10 mm	5000 mm	3	3.28	15,000 mm	9.255	RM30.36
T10 - B500A	10 mm	5000 mm	3	3.28	15,000 mm	9.255	RM30.36
T10 - B500A	10 mm	5000 mm	3	3.28	15,000 mm	9.255	RM30.36
T10 - B500A	10 mm	5050 mm	3	3.28	15,150 mm	9.348	RM30.66
T10 - B500A	10 mm	5050 mm	3	3.28	15,150 mm	9.348	RM30.66
T10 - B500A	10 mm	5050 mm	3	3.28	15,150 mm	9.348	RM30.66
T10 - B500A	10 mm	5100 mm	1	3.28	5,100 mm	3.147	RM10.32
T10 - B500A	10 mm	5100 mm	1	3.28	5,100 mm	3.147	RM10.32
T10 - B500A	10 mm	5100 mm	1	3.28	5,100 mm	3.147	RM10.32
T10 - B500A	10 mm	5100 mm	1	3.28	5,100 mm	3.147	RM10.32
T10 - B500A	10 mm	5100 mm	1	3.28	5,100 mm	3.147	RM10.32
T10 - B500A	10 mm	5100 mm	1	3.28	5,100 mm	3.147	RM10.32
T10 - B500A	10 mm	5600 mm	1	3.28	5,600 mm	3.455	RM11.33
T10 - B500A	10 mm	5600 mm	1	3.28	5,600 mm	3.455	RM11.33
T10 - B500A	10 mm	6300 mm	1	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	6300 mm	1	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	6300 mm	1	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	6300 mm	1	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	6300 mm	1	3.28	6,300 mm	3.887	RM12.75
T10 - B500A	10 mm	6300 mm	3	3.28	18,900 mm	11.661	RM38.25
T10 - B500A	10 mm	6300 mm	3	3.28	18,900 mm	11.661	RM38.25
T10 - B500A	10 mm	6300 mm	3	3.28	18,900 mm	11.661	RM38.25
T10 - B500A	10 mm	6300 mm	3	3.28	18,900 mm	11.661	RM38.25
T10 - B500A	10 mm	6300 mm	3	3.28	18,900 mm	11.661	RM38.25
T10 - B500A	10 mm	6700 mm	3	3.28	20,100 mm	12.402	RM40.68
T10 - B500A	10 mm	6700 mm	3	3.28	20,100 mm	12.402	RM40.68
T10 - B500A	10 mm	7000 mm	3	3.28	21,000 mm	12.957	RM42.50
T10 - B500A	10 mm	7000 mm	3	3.28	21,000 mm	12.957	RM42.50
T10 - B500A	10 mm	9450 mm	15	3.28	141,750 mm	87.46	RM286.87

T10 - B500A	10 mm	9450 mm	16	3.28	151,200 mm	93.29	RM305.99
T10 - B500A	10 mm	9450 mm	16	3.28	151,200 mm	93.29	RM305.99
T10 - B500A	10 mm	9450 mm	30	3.28	283,500 mm	174.92	RM573.74
T10 - B500A	10 mm	9450 mm	49	3.28	463,050 mm	285.702	RM937.10
T10 - B500A	10 mm	9450 mm	49	3.28	463,050 mm	285.702	RM937.10
T10 - B500A	10 mm	9450 mm	49	3.28	463,050 mm	285.702	RM937.10
T10 - B500A	10 mm	9450 mm	99	3.28	935,550 mm	577.234	RM1,893.33
T10 - B500A	10 mm	9500 mm	1	3.28	9,500 mm	5.862	RM19.23
T10 - B500A	10 mm	9500 mm	1	3.28	9,500 mm	5.862	RM19.23
T10 - B500A	10 mm	9500 mm	1	3.28	9,500 mm	5.862	RM19.23
T10 - B500A	10 mm	9500 mm	1	3.28	9,500 mm	5.862	RM19.23
T10 - B500A	10 mm	9500 mm	2	3.28	19,000 mm	11.723	RM38.45
T10 - B500A	10 mm	9500 mm	2	3.28	19,000 mm	11.723	RM38.45
T10 - B500A	10 mm	9500 mm	2	3.28	19,000 mm	11.723	RM38.45
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9500 mm	3	3.28	28,500 mm	17.585	RM57.68
T10 - B500A	10 mm	9590 mm	3	3.28	28,770 mm	17.751	RM58.22
T10 - B500A	10 mm	9800 mm	1	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	9800 mm	1	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	9800 mm	1	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	9800 mm	1	3.28	9,800 mm	6.047	RM19.83
T10 - B500A	10 mm	9800 mm	2	3.28	19,600 mm	12.093	RM39.67
T10 - B500A	10 mm	9800 mm	2	3.28	19,600 mm	12.093	RM39.67
T10 - B500A	10 mm	9800 mm	3	3.28	29,400 mm	18.14	RM59.50
T10 - B500A	10 mm	9800 mm	3	3.28	29,400 mm	18.14	RM59.50
T10 - B500A	10 mm	9950 mm	6	3.28	59,700 mm	36.835	RM120.82
T10 - B500A	10 mm	9950 mm	13	3.28	129,350 mm	79.809	RM261.77
T10 - B500A	10 mm	9950 mm	13	3.28	129,350 mm	79.809	RM261.77
T10 - B500A	10 mm	9950 mm	21	3.28	208,950 mm	128.922	RM422.86
T10 - B500A	10 mm	9950 mm	42	3.28	417,900 mm	257.844	RM845.73
T10 - B500A	10 mm	9950 mm	42	3.28	417,900 mm	257.844	RM845.73
T10 - B500A	10 mm	10000 mm	2	3.28	20,000 mm	12.34	RM40.48
T10 - B500A	10 mm	10000 mm	2	3.28	20,000 mm	12.34	RM40.48
T10 - B500A	10 mm	10000 mm	2	3.28	20,000 mm	12.34	RM40.48
T10 - B500A	10 mm	10000 mm	3	3.28	30,000 mm	18.51	RM60.71
T10 - B500A	10 mm	10000 mm	3	3.28	30,000 mm	18.51	RM60.71
T10 - B500A	10 mm	10000 mm	3	3.28	30,000 mm	18.51	RM60.71
T10 - B500A	10 mm	10100 mm	3	3.28	30,300 mm	18.695	RM61.32
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	12000 mm	1	3.28	12,000 mm	7.404	RM24.29
T10 - B500A	10 mm	13000 mm	3	3.28	39,000 mm	24.063	RM78.93
T10 - B500A	10 mm	13000 mm	3	3.28	39,000 mm	24.063	RM78.93
T10 - B500A	10 mm	13000 mm	3	3.28	39,000 mm	24.063	RM78.93
T10 - B500A	10 mm	13000 mm	3	3.28	39,000 mm	24.063	RM78.93
T10 - B500A	10 mm	13000 mm	3	3.28	39,000 mm	24.063	RM78.93

T10 - B500A	10 mm	14450 mm	11	3.28	158,950 mm	98.072	RM321.68
T10 - B500A	10 mm	14450 mm	11	3.28	158,950 mm	98.072	RM321.68
T10 - B500A	10 mm	14450 mm	36	3.28	520,200 mm	320.963	RM1,052.76
T10 - B500A	10 mm	14450 mm	36	3.28	520,200 mm	320.963	RM1,052.76
T10 - B500A	10 mm	14500 mm	2	3.28	29,000 mm	17.893	RM58.69
T10 - B500A	10 mm	14500 mm	2	3.28	29,000 mm	17.893	RM58.69
T10 - B500A	10 mm	14500 mm	3	3.28	43,500 mm	26.84	RM88.03
T10 - B500A	10 mm	14500 mm	3	3.28	43,500 mm	26.84	RM88.03
T10 - B500A	10 mm	17950 mm	109	3.28	1,956,550 mm	1,207.19	RM3,959.59
T10 - B500A	10 mm	17950 mm	349	3.28	6,264,550 mm	3,865.23	RM12,677.95
T10 - B500A	10 mm	34950 mm	11	3.28	384,450 mm	237.206	RM778.03
T10 - B500A	10 mm	34950 mm	30	3.28	1,048,500 mm	646.925	RM2,121.91
T10 - B500A	10 mm	34950 mm	36	3.28	1,258,200 mm	776.309	RM2,546.29
T10 - B500A	10 mm	34950 mm	96	3.28	3,355,200 mm	2,070.16	RM6,790.12
T10 - B500A	10 mm	35000 mm	1	3.28	35,000 mm	21.595	RM70.83
T10 - B500A	10 mm	35000 mm	1	3.28	35,000 mm	21.595	RM70.83
T10 - B500A	10 mm	35000 mm	1	3.28	35,000 mm	21.595	RM70.83
T10 - B500A	10 mm	35000 mm	1	3.28	35,000 mm	21.60	RM70.83
T10 - B500A	10 mm	35000 mm	1	3.28	35,000 mm	21.60	RM70.83
T10 - B500A	10 mm	35000 mm	2	3.28	70,000 mm	43.19	RM141.66
T10 - B500A	10 mm	35000 mm	2	3.28	70,000 mm	43.19	RM141.66
T10 - B500A	10 mm	35000 mm	2	3.28	70,000 mm	43.19	RM141.66
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.79	RM212.49
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.785	RM212.49
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.785	RM212.49
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.785	RM212.49
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.785	RM212.49
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.785	RM212.49
T10 - B500A	10 mm	35000 mm	3	3.28	105,000 mm	64.785	RM212.49
T10 - B500A	10 mm	41950 mm	46	3.28	1,929,700 mm	1,190.63	RM3,905.25
T10 - B500A	10 mm	41950 mm	145	3.28	6,082,750 mm	3,753.06	RM12,310.03
T10 - B500A	10 mm	42000 mm	2	3.28	84,000 mm	51.828	RM170.00
T10 - B500A	10 mm	42000 mm	3	3.28	126,000 mm	77.742	RM254.99
Grand total: 307					**32,248,230 mm**	**19,897.16**	**RM65,262.68**

12 mm rebar schedule of new structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost (RM)
T12 - B500A	12 mm	900 mm	3	3.28	2,700 mm	2.398	RM7.86
T12 - B500A	12 mm	2100 mm	2	3.28	4,200 mm	3.73	RM12.23
T12 - B500A	12 mm	2100 mm	2	3.28	4,200 mm	3.73	RM12.23
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	2400 mm	2	3.28	4,800 mm	4.262	RM13.98
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3200 mm	2	3.28	6,400 mm	5.683	RM18.64
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	3950 mm	2	3.28	7,900 mm	7.015	RM23.01
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4200 mm	2	3.28	8,400 mm	7.459	RM24.47
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	4900 mm	2	3.28	9,800 mm	8.702	RM28.54
T12 - B500A	12 mm	5100 mm	2	3.28	10,200 mm	9.058	RM29.71
T12 - B500A	12 mm	5100 mm	2	3.28	10,200 mm	9.058	RM29.71
T12 - B500A	12 mm	5100 mm	2	3.28	10,200 mm	9.058	RM29.71
T12 - B500A	12 mm	9500 mm	2	3.28	19,000 mm	16.872	RM55.34
T12 - B500A	12 mm	9500 mm	2	3.28	19,000 mm	16.872	RM55.34
T12 - B500A	12 mm	9800 mm	2	3.28	19,600 mm	17.405	RM57.09
T12 - B500A	12 mm	9800 mm	2	3.28	19,600 mm	17.405	RM57.09
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	12000 mm	2	3.28	24,000 mm	21.312	RM69.90
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
T12 - B500A	12 mm	35000 mm	2	3.28	70,000 mm	62.16	RM203.88
Grand total: 37					**507,400 mm**	**450.571**	**RM1,477.87**

16 mm rebar schedule of new structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost (RM)
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	500 mm	2	3.13	1,000 mm	1.58	RM4.95
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91

T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91

T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.53	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	800 mm	2	3.13	1,600 mm	2.528	RM7.91
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	900 mm	2	3.13	1,800 mm	2.844	RM8.90
T16 - B500A	16 mm	1200 mm	2	3.13	2,400 mm	3.792	RM11.87
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	1550 mm	2	3.13	3,100 mm	4.898	RM15.33
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2100 mm	2	3.13	4,200 mm	6.636	RM20.77
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74

T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2400 mm	2	3.13	4,800 mm	7.584	RM23.74
T16 - B500A	16 mm	2850 mm	2	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	2850 mm	2	3.13	5,700 mm	9.006	RM28.19
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3200 mm	2	3.13	6,400 mm	10.112	RM31.65
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13

T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3350 mm	2	3.13	6,700 mm	10.586	RM33.13
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63

T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3400 mm	2	3.13	6,800 mm	10.744	RM33.63
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3450 mm	2	3.13	6,900 mm	10.902	RM34.12
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3500 mm	2	3.13	7,000 mm	11.06	RM34.62
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07

T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
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T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
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T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
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T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
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T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07

T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	3950 mm	2	3.13	7,900 mm	12.482	RM39.07
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4100 mm	2	3.13	8,200 mm	12.956	RM40.55
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4200 mm	2	3.13	8,400 mm	13.272	RM41.54
T16 - B500A	16 mm	4500 mm	2	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	4500 mm	2	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	4500 mm	2	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	4500 mm	2	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	4500 mm	2	3.13	9,000 mm	14.22	RM44.51
T16 - B500A	16 mm	4750 mm	2	3.13	9,500 mm	15.01	RM46.98
T16 - B500A	16 mm	4750 mm	2	3.13	9,500 mm	15.01	RM46.98
T16 - B500A	16 mm	4800 mm	2	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	4800 mm	2	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	4800 mm	2	3.13	9,600 mm	15.168	RM47.48
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46
T16 - B500A	16 mm	4900 mm	2	3.13	9,800 mm	15.484	RM48.46

T16 - B500A	16 mm	5050 mm	2	3.13	10,100 mm	15.958	RM49.95
T16 - B500A	16 mm	5050 mm	2	3.13	10,100 mm	15.958	RM49.95
T16 - B500A	16 mm	5050 mm	2	3.13	10,100 mm	15.958	RM49.95
T16 - B500A	16 mm	5100 mm	2	3.13	10,200 mm	16.116	RM50.44
T16 - B500A	16 mm	5100 mm	2	3.13	10,200 mm	16.116	RM50.44
T16 - B500A	16 mm	5100 mm	2	3.13	10,200 mm	16.116	RM50.44
T16 - B500A	16 mm	5600 mm	2	3.13	11,200 mm	17.696	RM55.39
T16 - B500A	16 mm	5600 mm	2	3.13	11,200 mm	17.696	RM55.39
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6300 mm	2	3.13	12,600 mm	19.908	RM62.31
T16 - B500A	16 mm	6700 mm	2	3.13	13,400 mm	21.172	RM66.27
T16 - B500A	16 mm	6700 mm	2	3.13	13,400 mm	21.172	RM66.27
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	7000 mm	2	3.13	14,000 mm	22.12	RM69.24
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9500 mm	2	3.13	19,000 mm	30.02	RM93.96
T16 - B500A	16 mm	9590 mm	2	3.13	19,180 mm	30.304	RM94.85
T16 - B500A	16 mm	9800 mm	2	3.13	19,600 mm	30.968	RM96.93
T16 - B500A	16 mm	9800 mm	2	3.13	19,600 mm	30.968	RM96.93
T16 - B500A	16 mm	10100 mm	2	3.13	20,200 mm	31.916	RM99.90
T16 - B500A	16 mm	12000 mm	2	3.13	24,000 mm	37.92	RM118.69
T16 - B500A	16 mm	12000 mm	2	3.13	24,000 mm	37.92	RM118.69
T16 - B500A	16 mm	12000 mm	2	3.13	24,000 mm	37.92	RM118.69
T16 - B500A	16 mm	12000 mm	2	3.13	24,000 mm	37.92	RM118.69
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	13000 mm	2	3.13	26,000 mm	41.08	RM128.58
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
T16 - B500A	16 mm	35000 mm	2	3.13	70,000 mm	110.6	RM346.18
Grand total: 474					**3,430,680 mm**	**5,420.47**	**RM16,966.08**

20 mm rebar schedule of new structural model

Rebar Type	Bar Diameter	Bar Length	Quantity	Cost (RM per kg)	Total Bar Length	Total Weight (kg)	Total Cost (RM)
T20 - B500A	20 mm	800 mm	2	3.13	1,600 mm	3.952	RM12.37
T20 - B500A	20 mm	800 mm	2	3.13	1,600 mm	3.952	RM12.37
T20 - B500A	20 mm	800 mm	2	3.13	1,600 mm	3.952	RM12.37
T20 - B500A	20 mm	800 mm	2	3.13	1,600 mm	3.952	RM12.37
T20 - B500A	20 mm	800 mm	2	3.13	1,600 mm	3.952	RM12.37
T20 - B500A	20 mm	800 mm	2	3.13	1,600 mm	3.952	RM12.37
T20 - B500A	20 mm	3950 mm	2	3.13	7,900 mm	19.513	RM61.08
T20 - B500A	20 mm	3950 mm	2	3.13	7,900 mm	19.513	RM61.08
T20 - B500A	20 mm	3950 mm	2	3.13	7,900 mm	19.513	RM61.08
T20 - B500A	20 mm	3950 mm	2	3.13	7,900 mm	19.513	RM61.08
T20 - B500A	20 mm	3950 mm	2	3.13	7,900 mm	19.513	RM61.08
T20 - B500A	20 mm	3950 mm	2	3.13	7,900 mm	19.513	RM61.08
T20 - B500A	20 mm	4900 mm	2	3.13	9,800 mm	24.206	RM75.76
T20 - B500A	20 mm	4900 mm	2	3.13	9,800 mm	24.206	RM75.76
T20 - B500A	20 mm	5600 mm	2	3.13	11,200 mm	27.664	RM86.59
T20 - B500A	20 mm	5600 mm	2	3.13	11,200 mm	27.664	RM86.59
T20 - B500A	20 mm	6300 mm	2	3.13	12,600 mm	31.122	RM97.41
T20 - B500A	20 mm	6300 mm	2	3.13	12,600 mm	31.122	RM97.41
T20 - B500A	20 mm	6300 mm	2	3.13	12,600 mm	31.122	RM97.41
T20 - B500A	20 mm	6300 mm	2	3.13	12,600 mm	31.122	RM97.41
T20 - B500A	20 mm	6300 mm	2	3.13	12,600 mm	31.122	RM97.41
T20 - B500A	20 mm	35000 mm	2	3.13	70,000 mm	172.9	RM541.18
Grand total: 22					232,000 mm	573.04	RM1,793.62

Concrete beam schedule

Family	Structural Material	Beam Size	Cost (RM per cubic	Length (mm)	Volume	Total Cost
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.04 m³	RM8.90
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM7.35
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM7.35
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM7.35
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM7.35
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM7.35
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM8.02
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.04 m³	RM9.57
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.04 m³	RM9.57
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.04 m³	RM9.57
Rectangular Beam	Concrete - C25/30	300X150	230	900	0.03 m³	RM8.02
Rectangular Beam	Concrete - C25/30	300X150	230	1550	0.04 m³	RM9.18
Rectangular Beam	Concrete - C25/30	300X150	230	1550	0.04 m³	RM9.18
Rectangular Beam	Concrete - C25/30	300X150	230	1550	0.04 m³	RM9.18
Rectangular Beam	Concrete - C25/30	300X150	230	1550	0.04 m³	RM9.18
Rectangular Beam	Concrete - C25/30	300X150	230	1550	0.04 m³	RM9.18
Rectangular Beam	Concrete - C25/30	300X150	230	2100	0.09 m³	RM19.92
Rectangular Beam	Concrete - C25/30	300X150	230	4200	0.18 m³	RM41.92
Rectangular Beam	Concrete - C25/30	300X150	230	4200	0.18 m³	RM41.92
Rectangular Beam	Concrete - C25/30	300X150	230	4795	0.22 m³	RM49.63
Rectangular Beam	Concrete - C25/30	300X150	230	4795	0.21 m³	RM48.72
Rectangular Beam	Concrete - C25/30	300X150	230	9590	0.42 m³	RM97.70
Rectangular Beam	Concrete - C25/30	400X150	230	900	0.05 m³	RM11.87
Rectangular Beam	Concrete - C25/30	400X150	230	1200	0.04 m³	RM10.26
Rectangular Beam	Concrete - C25/30	400X150	230	2100	0.08 m³	RM19.26
Rectangular Beam	Concrete - C25/30	400X150	230	2100	0.12 m³	RM26.57
Rectangular Beam	Concrete - C25/30	400X150	230	2100	0.12 m³	RM28.64
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.09 m³	RM20.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.09 m³	RM20.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.10 m³	RM22.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.10 m³	RM22.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.10 m³	RM22.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.10 m³	RM22.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.10 m³	RM22.51
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.14 m³	RM31.05
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.14 m³	RM31.05
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.14 m³	RM31.05
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.14 m³	RM31.05
Rectangular Beam	Concrete - C25/30	400X150	230	2400	0.14 m³	RM31.05
Rectangular Beam	Concrete - C25/30	400X150	230	3200	0.18 m³	RM41.40
Rectangular Beam	Concrete - C25/30	400X150	230	3200	0.18 m³	RM41.40
Rectangular Beam	Concrete - C25/30	400X150	230	3200	0.18 m³	RM41.40
Rectangular Beam	Concrete - C25/30	400X150	230	3200	0.18 m³	RM41.40
Rectangular Beam	Concrete - C25/30	400X150	230	3200	0.18 m³	RM41.40
Rectangular Beam	Concrete - C25/30	400X150	230	3450	0.14 m³	RM32.22
Rectangular Beam	Concrete - C25/30	400X150	230	3450	0.14 m³	RM32.22
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.15 m³	RM34.01
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.15 m³	RM34.01
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.15 m³	RM34.01
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.15 m³	RM34.01
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.15 m³	RM34.01

Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.19 m³	RM44.64
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.19 m³	RM44.64
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.20
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.20
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.54
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.54
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.54
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.54
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.54
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.20 m³	RM45.54
Rectangular Beam	Concrete - C25/30	400X150	230	3500	0.14 m³	RM32.83
Rectangular Beam	Concrete - C25/30	400X150	230	3900	0.22 m³	RM51.41
Rectangular Beam	Concrete - C25/30	400X150	230	3900	0.22 m³	RM51.41
Rectangular Beam	Concrete - C25/30	400X150	230	3900	0.22 m³	RM51.41
Rectangular Beam	Concrete - C25/30	400X150	230	4100	0.24 m³	RM54.51
Rectangular Beam	Concrete - C25/30	400X150	230	4100	0.24 m³	RM54.12
Rectangular Beam	Concrete - C25/30	400X150	230	4100	0.24 m³	RM54.77
Rectangular Beam	Concrete - C25/30	400X150	230	4200	0.23 m³	RM53.13
Rectangular Beam	Concrete - C25/30	400X150	230	4200	0.26 m³	RM60.03
Rectangular Beam	Concrete - C25/30	400X150	230	4200	0.24 m³	RM55.89
Rectangular Beam	Concrete - C25/30	400X150	230	4200	0.17 m³	RM38.52
Rectangular Beam	Concrete - C25/30	400X150	230	4200	0.23 m³	RM53.13
Rectangular Beam	Concrete - C25/30	400X150	230	4400	0.25 m³	RM57.62
Rectangular Beam	Concrete - C25/30	400X150	230	4400	0.24 m³	RM55.89
Rectangular Beam	Concrete - C25/30	400X150	230	4400	0.24 m³	RM55.89
Rectangular Beam	Concrete - C25/30	400X150	230	4400	0.25 m³	RM57.96
Rectangular Beam	Concrete - C25/30	400X150	230	4400	0.24 m³	RM55.55
Rectangular Beam	Concrete - C25/30	400X150	230	4500	0.26 m³	RM60.03
Rectangular Beam	Concrete - C25/30	400X150	230	4750	0.27 m³	RM61.41
Rectangular Beam	Concrete - C25/30	400X150	230	4750	0.27 m³	RM61.41
Rectangular Beam	Concrete - C25/30	400X150	230	4795	0.29 m³	RM66.17
Rectangular Beam	Concrete - C25/30	400X150	230	4900	0.29 m³	RM65.55
Rectangular Beam	Concrete - C25/30	400X150	230	4900	0.28 m³	RM65.21
Rectangular Beam	Concrete - C25/30	400X150	230	4900	0.29 m³	RM65.55
Rectangular Beam	Concrete - C25/30	400X150	230	4900	0.29 m³	RM65.55
Rectangular Beam	Concrete - C25/30	400X150	230	4900	0.28 m³	RM65.21
Rectangular Beam	Concrete - C25/30	400X150	230	4900	0.29 m³	RM65.55
Rectangular Beam	Concrete - C25/30	400X150	230	5050	0.24 m³	RM55.64
Rectangular Beam	Concrete - C25/30	400X150	230	5050	0.24 m³	RM55.64
Rectangular Beam	Concrete - C25/30	400X150	230	5050	0.24 m³	RM55.47
Rectangular Beam	Concrete - C25/30	400X150	230	6300	0.27 m³	RM61.53
Rectangular Beam	Concrete - C25/30	400X150	230	6300	0.27 m³	RM61.53
Rectangular Beam	Concrete - C25/30	400X150	230	6300	0.27 m³	RM61.53
Rectangular Beam	Concrete - C25/30	400X150	230	6300	0.27 m³	RM61.53
Rectangular Beam	Concrete - C25/30	400X150	230	6300	0.27 m³	RM61.53
Rectangular Beam	Concrete - C25/30	400X150	230	6700	0.30 m³	RM68.81
Rectangular Beam	Concrete - C25/30	400X150	230	6700	0.30 m³	RM68.81
Rectangular Beam	Concrete - C25/30	400X150	230	7000	0.34 m³	RM78.16
Rectangular Beam	Concrete - C25/30	400X150	230	7000	0.29 m³	RM65.65
Rectangular Beam	Concrete - C25/30	400X150	230	9500	0.53 m³	RM122.82
Rectangular Beam	Concrete - C25/30	400X150	230	9500	0.53 m³	RM122.82
Rectangular Beam	Concrete - C25/30	400X150	230	9800	0.57 m³	RM130.41
Rectangular Beam	Concrete - C25/30	400X150	230	9800	0.57 m³	RM130.41
Rectangular Beam	Concrete - C25/30	400X150	230	10100	0.43 m³	RM99.07
Rectangular Beam	Concrete - C25/30	400X150	230	13000	0.53 m³	RM121.01
Rectangular Beam	Concrete - C25/30	400X150	230	13000	0.53 m³	RM121.01

Rectangular Beam	Concrete - C25/30	400X150	230	13000	0.53 m³	RM121.01
Rectangular Beam	Concrete - C25/30	400X150	230	13000	0.53 m³	RM121.01
Rectangular Beam	Concrete - C25/30	400X150	230	13000	0.53 m³	RM121.01
Rectangular Beam	Concrete - C25/30	400X150	230	35000	1.42 m³	RM327.16
Rectangular Beam	Concrete - C25/30	400X150	230	35000	1.39 m³	RM319.66
Rectangular Beam	Concrete - C25/30	400X150	230	35000	1.42 m³	RM327.16
Rectangular Beam	Concrete - C25/30	400X150	230	35000	1.42 m³	RM327.16
Rectangular Beam	Concrete - C25/30	400X150	230	35000	2.00 m³	RM459.54
Rectangular Beam	Concrete - C25/30	400X150	230	35000	2.00 m³	RM459.54
Rectangular Beam	Concrete - C25/30	400X200	230	4500	0.33 m³	RM76.45
Rectangular Beam	Concrete - C25/30	400X200	230	4500	0.33 m³	RM76.45
Rectangular Beam	Concrete - C25/30	400X200	230	4500	0.33 m³	RM76.45
Rectangular Beam	Concrete - C25/30	400X200	230	4500	0.33 m³	RM76.45
Rectangular Beam	Concrete - C25/30	400X200	230	9500	0.51 m³	RM117.53
Rectangular Beam	Concrete - C25/30	400X200	230	9500	0.51 m³	RM117.53
Rectangular Beam	Concrete - C25/30	400X200	230	9500	0.51 m³	RM117.53
Rectangular Beam	Concrete - C25/30	400X200	230	9500	0.51 m³	RM117.53
Rectangular Beam	Concrete - C25/30	400X200	230	9500	0.71 m³	RM163.76
Rectangular Beam	Concrete - C25/30	400X200	230	10000	0.75 m³	RM172.50
Rectangular Beam	Concrete - C25/30	400X200	230	10000	0.73 m³	RM167.67
Rectangular Beam	Concrete - C25/30	400X200	230	10000	0.73 m³	RM167.67
Rectangular Beam	Concrete - C25/30	450X150	230	2100	0.11 m³	RM26.23
Rectangular Beam	Concrete - C25/30	450X150	230	3200	0.15 m³	RM35.19
Rectangular Beam	Concrete - C25/30	450X150	230	3200	0.15 m³	RM35.19
Rectangular Beam	Concrete - C25/30	450X150	230	3200	0.15 m³	RM35.19
Rectangular Beam	Concrete - C25/30	450X150	230	3200	0.15 m³	RM35.19
Rectangular Beam	Concrete - C25/30	450X150	230	3200	0.15 m³	RM35.19
Rectangular Beam	Concrete - C25/30	450X150	230	3950	0.21 m³	RM47.57
Rectangular Beam	Concrete - C25/30	450X150	230	3950	0.21 m³	RM47.57
Rectangular Beam	Concrete - C25/30	450X150	230	3950	0.21 m³	RM47.57
Rectangular Beam	Concrete - C25/30	450X150	230	4200	0.23 m³	RM52.47
Rectangular Beam	Concrete - C25/30	450X150	230	4200	0.23 m³	RM52.47
Rectangular Beam	Concrete - C25/30	450X150	230	4200	0.20 m³	RM45.16
Rectangular Beam	Concrete - C25/30	450X150	230	4900	0.27 m³	RM61.66
Rectangular Beam	Concrete - C25/30	450X150	230	4900	0.27 m³	RM61.66
Rectangular Beam	Concrete - C25/30	450X150	230	4900	0.27 m³	RM61.66
Rectangular Beam	Concrete - C25/30	450X150	230	4900	0.23 m³	RM53.37
Rectangular Beam	Concrete - C25/30	450X150	230	4900	0.23 m³	RM53.37
Rectangular Beam	Concrete - C25/30	450X150	230	4900	0.23 m³	RM53.08
Rectangular Beam	Concrete - C25/30	450X150	230	5100	0.26 m³	RM58.94
Rectangular Beam	Concrete - C25/30	450X150	230	5100	0.26 m³	RM58.94
Rectangular Beam	Concrete - C25/30	450X150	230	5100	0.26 m³	RM58.94
Rectangular Beam	Concrete - C25/30	450X150	230	5600	0.29 m³	RM67.80
Rectangular Beam	Concrete - C25/30	450X150	230	5600	0.29 m³	RM67.80
Rectangular Beam	Concrete - C25/30	450X150	230	9500	0.53 m³	RM121.28
Rectangular Beam	Concrete - C25/30	450X150	230	9500	0.53 m³	RM121.28
Rectangular Beam	Concrete - C25/30	450X150	230	9800	0.46 m³	RM106.16
Rectangular Beam	Concrete - C25/30	450X150	230	9800	0.54 m³	RM123.33
Rectangular Beam	Concrete - C25/30	450X150	230	35000	1.68 m³	RM387.09
Rectangular Beam	Concrete - C25/30	450X150	230	35000	1.64 m³	RM378.29
Rectangular Beam	Concrete - C25/30	450X150	230	35000	1.96 m³	RM449.71
Rectangular Beam	Concrete - C25/30	450X150	230	42000	2.69 m³	RM619.45
Rectangular Beam	Concrete - C25/30	450X200	230	5000	0.43 m³	RM98.33
Rectangular Beam	Concrete - C25/30	450X200	230	5000	0.43 m³	RM98.33
Rectangular Beam	Concrete - C25/30	450X200	230	5000	0.43 m³	RM98.33
Rectangular Beam	Concrete - C25/30	450X200	230	5000	0.43 m³	RM98.33

Rectangular Beam	Concrete - C25/30	450X200	230	6300	0.41 m³	RM95.40
Rectangular Beam	Concrete - C25/30	450X200	230	6300	0.41 m³	RM95.40
Rectangular Beam	Concrete - C25/30	450X200	230	6300	0.41 m³	RM95.40
Rectangular Beam	Concrete - C25/30	450X200	230	6300	0.41 m³	RM95.40
Rectangular Beam	Concrete - C25/30	450X200	230	6300	0.41 m³	RM95.40
Rectangular Beam	Concrete - C25/30	450X200	230	12000	0.81 m³	RM185.79
Rectangular Beam	Concrete - C25/30	450X200	230	12000	0.80 m³	RM184.78
Rectangular Beam	Concrete - C25/30	450X200	230	12000	0.81 m³	RM186.81
Rectangular Beam	Concrete - C25/30	450X200	230	12000	0.80 m³	RM184.78
Rectangular Beam	Concrete - C25/30	550X150	230	2850	0.17 m³	RM39.77
Rectangular Beam	Concrete - C25/30	550X150	230	2850	0.17 m³	RM39.77
Rectangular Beam	Concrete - C25/30	600X200	230	3500	0.39 m³	RM89.70
Rectangular Beam	Concrete - C25/30	600X200	230	3500	0.39 m³	RM89.70
Rectangular Beam	Concrete - C25/30	600X200	230	14500	1.63 m³	RM375.36
Rectangular Beam	Concrete - C25/30	600X200	230	14500	1.63 m³	RM375.36
Rectangular Beam	Concrete - C25/30	600X200	230	35000	4.00 m³	RM920.12
Rectangular Beam	Concrete - C25/30	700X200	230	900	0.07 m³	RM15.78
Rectangular Beam	Concrete - C25/30	700X200	230	900	0.09 m³	RM21.30
Rectangular Beam	Concrete - C25/30	700X200	230	900	0.09 m³	RM21.30
Rectangular Beam	Concrete - C25/30	700X200	230	900	0.09 m³	RM19.98
Grand total: 183					**69.50 m³**	**RM15,985.20**

Concrete column schedule

Family	Structural Material	Beam Size	Cost (RM per cubic metre)	Length (mm)	Volume	Total Cost
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3350	0.10 m³	RM23.12
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X150	230	3400	0.10 m³	RM23.46
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM7.11
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM6.85
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM6.85
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM6.85
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM6.85
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM6.85
Rectangular Column	Concrete - C25/30	200X200	230	800	0.03 m³	RM7.11
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82

Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3350	0.13 m³	RM30.82
Rectangular Column	Concrete - C25/30	200X200	230	3400	0.14 m³	RM31.28
Rectangular Column	Concrete - C25/30	200X200	230	3400	0.14 m³	RM31.28
Rectangular Column	Concrete - C25/30	200X200	230	3400	0.14 m³	RM31.28
Rectangular Column	Concrete - C25/30	200X200	230	3400	0.14 m³	RM31.28
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM36.09
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM36.09
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM36.09
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM36.09
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.58
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.15 m³	RM35.33
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	200X200	230	3950	0.16 m³	RM35.83
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40

Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.73
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.73
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM8.40
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM9.06
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM9.06
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM9.06
Rectangular Column	Concrete - C25/30	230X230	230	800	0.04 m³	RM9.06
Rectangular Column	Concrete - C25/30	300X300	230	500	0.05 m³	RM10.35
Rectangular Column	Concrete - C25/30	300X300	230	500	0.05 m³	RM10.35
Rectangular Column	Concrete - C25/30	300X300	230	500	0.05 m³	RM10.35
Rectangular Column	Concrete - C25/30	300X300	230	500	0.05 m³	RM10.35
Rectangular Column	Concrete - C25/30	300X300	230	500	0.05 m³	RM10.35
Rectangular Column	Concrete - C25/30	300X300	230	500	0.05 m³	RM10.35
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.42
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.42
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.42

Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.42
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.42
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.99
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.99
Rectangular Column	Concrete - C25/30	300X300	230	800	0.07 m³	RM15.42
Rectangular Column	Concrete - C25/30	300X300	230	3950	0.36 m³	RM81.77
Rectangular Column	Concrete - C25/30	300X300	230	3950	0.36 m³	RM81.77
Rectangular Column	Concrete - C25/30	300X300	230	3950	0.36 m³	RM81.77
Rectangular Column	Concrete - C25/30	300X300	230	3950	0.36 m³	RM81.77
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM87.41
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM87.41
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Rectangular Column	Concrete - C25/30	300X300	230	4250	0.38 m³	RM86.84
Grand total: 182					**21.02 m³**	**RM4,834.99**

Concrete floor schedule

Family	Structural Material	Cost (RM per cubic metre)	Thickness (mm)	Area	Volume	Total Cost
Floor	Concrete - C25/30	230	110	732 m²	80.47 m³	RM18,506.95
Floor	Concrete - C25/30	230	110	338 m²	37.15 m³	RM8,545.08
Grand total: 2					**117.62 m³**	**RM27,052.03**