COMPARATIVE STUDY THE EFFECTIVENESS 4D AUTODESK NAVISWORK SOFTWARE WITH TRADITIONAL SOFTWARE PLANNER

NURUL 'AMIRAH BINTI KHALIL

BACHELOR (HONS.) OF CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS AND COPYRIGHT

Author's Full Name : **NURUL 'AMIRAH BINTI KHALIL**

Date of Birth : **19th MAY 1991**

Title : **COMPARATIVE STUDY THE EFFECTIVENESS 4D AUTODESK NAVISWORK SOFTWARE WITH TRADITIONAL SOFTWARE PLANNER**

Academic Session : **2016/2017**

I declare that this thesis is classified as:

☐	**CONFIDENTIAL**	(Contains confidential information under the Official Secret Act 1997)*
☐	**RESTRICTED**	(Contains restricted information as specified by the organization where research was done)*
✓	**OPEN ACCESS**	I agree that my thesis to be published as online open access (Full Text)

I acknowledge that Universiti Malaysia Pahang reserves the following rights:

1. The Thesis is the Property of Universiti Malaysia Pahang
2. The Library of Universiti Malaysia Pahang has the right to make copies of the thesis for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:

_____
(**Student's Signature**)

_____
(**Supervisor's Signature**)

NURUL 'AMIRAH BINTI KHALIL
910519-10-5750
Date: JANUARY 2017

EN. ZAHRIZAN BIN ZAKARIA

Date: JANUARY 2017

COMPARATIVE STUDY THE EFFECTIVENESS 4D AUTODESK NAVISWORK
SOFTWARE WITH TRADITIONAL SOFTWARE PLANNER

NURUL 'AMIRAH BINTI KHALIL

Final Year Report submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor (Hons.) of Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JANUARY 2017

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis report and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of B. Eng. (Hons.) Civil Engineering.

Signature   :

Name of Supervisor   : EN. ZAHRIZAN BIN ZAKARIA

Position   : SUPERVISOR

Date   : JANUARY 2017

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and this is not concurrently submitted for award of other degree.

Signature   :
Name   : NURUL 'AMIRAH BINTI KHALIL
ID Number   : AA13260
Date   : JANUARY 2017

Special dedicated to:

SITI NOR AIDAH BINTI HASHIM

and

KHALIL BIN HASSAN

ACKNOWLEDGEMENT

Alhamdulillah, thank to Allah SWT, with His willingness for giving me strength and spirit to complete my Final Year Project with full of pride and dignity.

I am grateful and would like to express my sincere gratitude to my supervisor En. Zahrizan Bin Zakaria for his germinal ideas, invaluable guidance, continuous encouragement and constant support in making this research possible. He has always impressed me with his outstanding professional conduct, his strong conviction for science, and his belief that a degree program is only a start of a life-long learning experience. I appreciate his consistent support from the first day I applied to graduate program to these concluding moments. I am truly grateful for his progressive vision about my future career. I also sincerely thanks for the time spent proofreading and correcting my many mistakes.

I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifice throughout my life. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals. Special thanks should be given to all my member. I would like to acknowledge their comments and suggestions, which was crucial for the successful completion of this study.

ABSTRACT

Construction industry is the one of the key economic development activities in Malaysia. Before starting any construction, all developer, contractor, and consultant desire a project to run smoothly without any arising problem. However, there are almost same arising problem in most countries including Malaysia. Basically, these problems arise through work program implementation including the clash either between beam and column or wall and beam. These problems contribute to the delay of construction project since it takes a long time to settle the arising problems. For example, a project at United Kingdom of America was to build National Health Service Care where this project was delay because of poor planned. The poor planning of this project cause the budget run. Original budget was $4.68 billion, but when this problem happen this budget subsequently grown to $24 billion, with some observers estimating it could grow to as much as $40B. This project taking 4 years to finish up all the thing. Therefore, an alternative study had been explored to minimize the construction problems before the construction work commences. This study focused on the effectiveness planning in real construction project by using Naviswork. A few related data had been obtained from a real construction data consisting of a structural, architectural drawing, and detailed work program of the project. These drawings were developed into 3D model by using Revit software, followed with the clash detection between these models by using Naviswork. In order to check the sequence of work program, the work program had been attached into Microsoft Project, meanwhile the structural and architectural model into Naviswork. There was about 257 clashes detection between structural and architectural model. Meanwhile, a problem had been detected starting from day 373 week 54 in date 17 July 2015 through the work program simulation where the architectural model started to overtake the structural model. Once the result had been obtained, these problems need to be solved before the project commences. From this simulation, it could be concluded that there was weakness through the traditional project planning since it did not detect the problem immediately. In conclusion, all construction project should take the initiative to decrease the problem prior starting the construction work in order so that the project can run smoothly.

ABSTRAK

Industri pembinaan merupakan salah satu aktiviti utama pembangunan ekonomi di Malaysia. Sebelum pembinaan bermula, semua pemaju, kontraktor, dan perunding menginginkan projek mereka berjalan dengan lancar tanpa sebarang masalah. Walaubagaimanapun, terdapat masalah serupa dalam kebanyakan negara termasuk Malaysia. Secara asasnya, masalah ini terjadi dalam perancangan projek termasuklah pertindihan antara rasuk dan tiang atau antara dinding dan rasuk. Masalah ini menyumbang kepada kelewatan pembinaan kerana ianya mengambil masa yang panjang untuk menyelesaikannya. Contohnya, projek di United Kingdom, Amerika ingin membina Perkhidmatan Penjagaan Kesihatan Negara di mana projek ini mengalami kelewatan disebabkan oleh kelemahan perancang. Kelemahan perancangan projek menyebabkan bajet lari dari harga asal. Belanjawan sebenar sebanyak $4.68 bilion, tetapi bila masalah ini terjadi bajet membesar kepada $24 bilion, sesetengah pemerhati menganggarkan ia boleh meningat sebanyak $40 bilion oleh itu, projek ini mengambil masa selama 4 tahun. Satu kajian alternatif dikaji untuk mengurangkan masalah pembinaan sebelum ianya pembinaan bermula. Kajian ini memberi tumpuan kepada keberkesanan perancangan projek pembinaan sebenar dengan menggunakan perisisan Naviswork. Data berkaitan telah diperolehi daripada data pembinaan sebenar yang terdiri daripada lukisan struktur, arkitek dan penjadualan terperinci perjalanan projek. Lukisan ini telah dimodelkan dalam bentuk 3D dengan menggunakan perisian Revit, diikuti dengan pengenalpastian pertindihan di antara kedua-dua model tersebut dengan menggunakan Naviswork. Untuk memeriksa urutan perjalanan projek, perancangan perjalanan projek perlu dilampirkan ke dalam Microsoft Project, sementara itu model struktur dan arkitek ke dalam Naviswork. Terdapat kira-kira 257 pertindihan antara model struktur dan arkitek. Sementara itu, masalah dikenalpasti bermula hari 373 minggu 54 bertarikh 17 Julai 2015 melalui simulasi program kerja di mana model akitek mula mendahului model struktur. Selepas mendapat keputusan, masalah ini perlu diselesaikan sebelum projek bermula. Dari simulasi ini, dapat disimpulkan bahawa terdapat kelemahan dari perisian perancangan projek tradisional memandangkan ianya tidak dapat mengesan masalah dengan segera. Kesimpulanya, semua projek pembinaan perlu mengambil inisiatif untuk mengurangkan masalah sebelum projek dimulakan supaya projek boleh berjalan dengan lancar.

TABLE OF CONTENTS

CHAPTER 3 METHODOLOGY

CHAPTER 4 RESULT AND DISCUSSION

CHAPTER 5   CONCLUSION AND RECOMMENDATION

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATIONS

BIM	Building Information Modelling
2D	2 Dimension
3D	3 Dimension
4D	4 Dimension
MS	Microsoft
CIPT	Construction Industry Transformation Programmed
RMK-10	"Rancangan Malaysia Ke-10"
RMK-11	"Rancangan Malaysia Ke-11"
CIDB	Construction Industry Development Board
EPP	Entry Point Project
GDP	Gross Domestic Product
RM	"Ringgit Malaysia"
CITP	Construction Industry Transformation Program
QLASSIC	Quality Assessment System in Construction
AEC	Architecture, Engineering, and Construction
CAD	Computer Aided Design

CIC   Construction Industry Council

VDC   Virtual Design and Construction

SSDC   Selangor State Development Corporation

CHAPTER 1

INTRODUCTION

1.1   BACKGROUND OF STUDY

Building Information Modeling (BIM) is the new software that being introduced in Malaysia since 2009 during Infrastructure & Construction Asia's BIM & Sustainable Architecture Conference. BIM has many types of software, for example Revit, Naviswork, Vector Works Architect, Tekla, ArchiCAD and etc. The first infrastructure construction project that used BIM software in 2010 is National Cancer Institute at Sepang, Selangor (Building SMART Malaysia, 2015).

Microsoft project is the traditional software that most of the planner using since 1991 because the first Microsoft Project version was product on 1990 (Azzopard, S, 2013). Once Microsoft Project start being introduced in Malaysia, most construction planner start using this software to facilitate the project planning matter. The number of project planner increase year-by-year that using this software but until now still don't have planner not use this software (Sawyer, T, 2014).

The main problem using traditional software is the clash at the site cannot be detected early before project was started. This problem contribute to the project delay for a few days or maybe a month and sometimes the project must be reworked to resolve the problem. These situations lead to the increasing in the cost of the project (Mind Tools Editorial Team, 2016).

Comparison between this two software which is traditional software and 4D BIM software is to determine which software very relevant to use throughout project planning. This is because in Malaysia construction background related with improper planning project (Sambasivan, M & Soon, Y. W., 2007). This happen maybe because of the project planner do not have experience to handle the project and it maybe cause of the planner cannot detect the problem went checking proses. By using the traditional software, it is difficult to detect the problem because traditional software just word and chart with duration of the project until finish, different with 4D BIM software can detect the problem using visualization with duration the real project.

1.2   PROBLEM STATEMENT

Many construction industries used traditional software planner like a Microsoft Project to produce the project planner starting from site clearing until the building was finish. However, by using this traditional software, the problem like a clash cannot be detected early because this software cannot visualize the problem at the site before the project commences. These problems may contribute to the delay in construction works since it take a long time to resolve this arising problem. For example project at United Kingdom of America is to build National Health Service Care where this project is delay because of poor planned cause the budget run. Original budget was $4.68 billion, but when this problem happen this budget subsequently grown to $24 billion, with some observers estimating it could grow to as much as $40B. This project is taking 4 years to finish this project (International Project Leadership Academy, 2016). This situation may related with the quantity surveyor and the planner is don't have any experience to handle the construction planning project. When the planner can plan this project properly the budget of this construction can be detect early even though they using traditional planning software.

However, the weakness of this traditional software planner can be resolved by using 4D Autodesk Naviswork software. These new alternative software can detect the clash at some place prior the construction work commences. For example, the clash between beam and pipe line at base area in building. This is because Naviswork software can produce

animation of the project starting from site clearing until the project finish. This software is not only give a solution to the arising problem early, but it also can launch the progress of building construction according to flow that had being already planned. Typically, the arising problems involving clash detection at site will lead to a cost overrun of the project. This is because there's no better solution to resolve this clash problem other than re-working the problem until the project finish. Therefore, this study was conducted to do a comparative study between two scheduling software which is MS Project and Autodesk Naviswork.

1.3   RESEARCH AIM & OBJECTIVE

The aim of this study is to compare the efficiency between two scheduling software which are Microsoft Project and Autodesk Naviswork as the best alternative way in preparing a project planning. To achieve this aim, some objectives of this study have been identified:

   i.   To study the function and feature of traditional software, Microsoft Project planner and 4D software, Autodesk Naviswork.
  ii.   To develop the construction planning from traditional software, Microsoft Project to 4D software, Autodesk Naviswork.
 iii.   To compare the effectiveness of planning software between 4D software, Autodesk Naviswork and traditional planning software, Microsoft Project.

1.4   SCOPE OF STUDY

To achieve the objectives of this study, an industrial visit will be conducted to study the current practice of planning by the Malaysian construction industry. All related information and data will be collected from the real construction activities planning developed by the industry at Selangor Darul Ehsan. In this study, MS Project will be used because it's widely used in the Malaysian construction industry compared to others planner software. For 4D BIM software, Autodesk Naviswork will be utilized because of its more affordable compared to other 4D BIM software and the most important, it can be integrated with MS Project.

1.5   RESEARCH SIGNIFICANCE

The importance in this study is to assist a project planner in choosing the best software planner to organize the project smoothly and to decrease the arising problem that can happen at site.

CHAPTER 2

LITERATURE REVIEW

2.1   INTRODUCTION

This chapter covers the issue of the Malaysia construction Industry, detailing about 4D of Building Information Modeling (BIM), benefit of BIM, and also the reason of choosing 4D BIM in this present study.

2.2   MALAYSIAN CONSTRUCTION INDUSTRY

Government issued in a mid-September in a five-year need to modify a plan sector of construction in this country. Construction Industry Transformation Programmed (CIPT) is the scheme that being introduced by the government. This scheme can be measured to increase the productivity and competitive, to be a professional at industry, and also to increase the environment at design and at construction stage (Oxford Business Group, 2015).

In early year 2015, foreign request sustainability is more uncertain following concern towards prospect of world economy that is damp. Sudden fall of price of oil end of the year 2014, noticeable changes in fluctuate global financial market, low and primary commodity price, and foreign capital outflow expectation had further increase risk outbreak by external environment. Realizing economic openness, Malaysia not exempt from receiving global changing environment effect, Malaysian government takes pro-active with implement adaptation to budget manage year 2015 and fiscal adjustment. This move implemented to strengthen global economy changing landscape follow up national economy by stimulating

domestic request especially consumption spending and increase export. Malaysian economy prospect in year 2015 – 2016 predicted strong with growth projection of 4.5% - 5.5% and 5.0% - 6.0% respectively and sped by domestic demand growth that able to last and export demand that is competitive (refer table 2.1) (Prospek Pembinaan, 2016).

Table 2.1: Malaysian economic growth projection in year 2013 – 2016

(Prospek Pembinaan, 2016)

Sector	2013	2014	2015		2016
			Quarter 1 (Real)	Annual (Target)	
Agriculture	2.1%	2.6%	-4.7%	0.3%	3.5%
Mining	0.7%	3.1%	9.6%	3.0%	1.3%
Manufacturing	3.5%	6.2%	5.6%	4.9%	5.1%
Construction	10.9%	11.6%	9.7%	10.3%	10.3%
Service	5.9%	6.3%	6.4%	5.6%	6.9%
Change	4.7%	6.0%	5.6%	4.5% - 5.5%	5.0% - 6.0%

Throughout the duration of four year implementation RMK - 10, construction sector production in economic have increased by average of 11.3% compared to in RMK-9 of 4.9%. This increase following public and private construction a project that is increasingly actively implemented in preparation achieves the Vision in 2020 that draws near. In year 2014, construction sector disclosed endurance with organization as much as 11.6% rates that are encouraging compared to other economic sectors. This increase contributed by project increase of value construction that is high (Prospek Pembinaan, 2016).

Malaysia Construction Industry Development Board, CIBD project data record until the end of March 2015 as much as 2,180 projects worth RM150 billion were awarded. Compared to same period previous year, happen reduction 10.0% in terms of the number

(2013: 8,040 projects), on the other hand this value higher increase totaled 15.0% (2013: RM131 billion). Project value that increase this partly contributed by project size that is large especially public transport infrastructure project, energy service and oil industry and gas. Additionally, also happened building material cost increase and technology increase of consumption follow up employee wages and modern practice in construction sector (Prospek Pembinaan, 2016).

Construction sector project 2015 and 2016 is projected strong with implementation more Entry Point Project, EPP project that was promised and private new investment and public project that had announced in budget 2015 will be realized. This will be followed by public project in RMK-11 which will begin in year 2016. Project implementation RMK-11 expected will be expedited and intensified as RMK-11 is final phase to achieving Vision in 2020. Construction sector projected to develop totaled 10.3% in year 2015 (Prospek Pembinaan, 2016).

Gross Domestic Product, GDP in Malaysia construction decrease to RM11, 992 million in fourth quarter in 2015 from RM12, 125 million in third quarter in 2015. Average GDP in Malaysia construction is RM9, 215.79 million in 2010 until 2015, and the lower recorded is RM6, 464 million in first quarter in 2010 (Trading Economics, 2016).

Figure 2.1: Malaysia GDP from construction chart (Trading Economics, 2016)

2.2.1   FUTURE OF MALAYSIAN CONSTRUCTION INDUSTRY

According to Najib Tun Razak as a Prime Minister, the new Construction Industry Transformation Program (CITP) will have four main fields and will include eighteen different initiatives. This is because to improve construction industrial image on an international level and also local scale. One of the main field in CITP is to focus will be a Quality Assessment System in Construction (QLASSIC) to measure the quantity in this sector. To ensure the level of health and safety the guideline must be strict the effort to decrease the accident and injury while project is running. The Prime Minister said we must ensure all contractor make a tender for project and must explain the additional cost to include the health and safety in the construction project. CITP will push to improve the productivity of the construction because want to bring the Malaysian construction in accordance with the international sector like a China, Australia and United State of America (ITE Building & Interiors, 2015).

2.3   WHAT IS BUILDING INFROMATION MODELING, BIM

Building Information Modeling is a revolutionary concept with a determined commitment to change from top to bottom the traditional practices of the Architecture, Engineering, and Construction, AEC sector. The author of the 2nd Edition of the 'BIM Handbook' state in their extensive work that "*BIM represents a paradigm change that will have far-reaching impacts and benefits, not only for those in the construction industry but for society at-large, as better buildings are built that consume fewer materials and require less labor and capital resources and that operate more efficiently*". In view of what the appearance of BIM is supposing they also state that it is "one of the most promising developments in the AEC industries" (Eastman et al., 2011).

Considering all these definitions important, the author of the present work conceives BIM as a working methodology that aim to improve the way in which information is generated, managed, transferred and visualized throughout the entire life cycle of a building. Furthermore, it pursues to enhance communication between all the centers. Therefore, it is

obvious that the information is the most important among the three letters of BIM. It can be seen as the methodology that makes possible everything seen up to this chapter, and could enable a significant boost for the productivity of the sector.
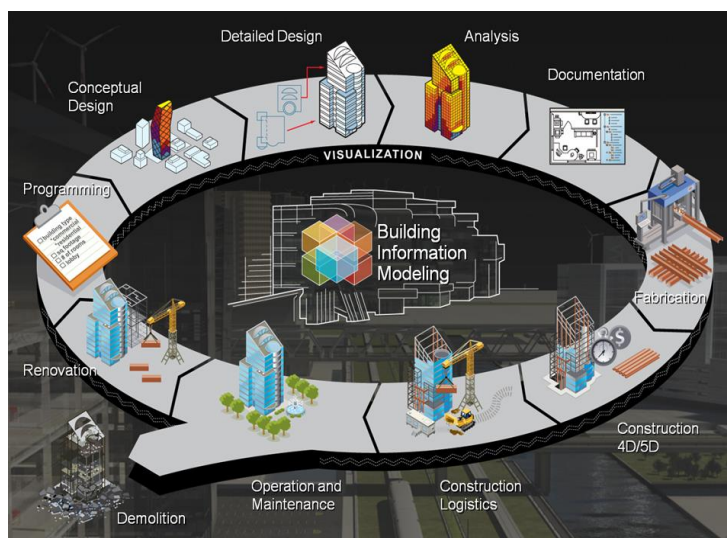

Figure 2.2: BIM Process

Consequently, it is clear that BIM is not a mere shift from Computer Aided Design, CAD to a new modeling technique because it goes far beyond geometry. Unlike in 3D CAD solutions, the model is no longer conceived as a merely graphical representation of the building, but as a database containing all its information to be accessed during the entire life cycle. Indeed, object-based geometry is complemented with parameters including information at the element level, i.e. all the element have an associated database describing their particular features, which is really useful for future stage. In additional, these elements can be considered smart because they closely represent the reality knowing how they must behave in the model: for instance, a window in the model knows that it has to be accommodated in a wall in it would not be possible to place it with the non-existence of such wall. This simple actions help professionals to take better decisions through a better design.

Naming issues are very often a product of an evolution of concepts. In this way, BIM has gathered many ideas that were long since around in the construction sector. Although it

started to be known by this name in the last decade, the concept of Construction Industry Council, CIC was present before BIM, and as it is suggested by Jung & Joo (2011), both terms are closely related and follow the same objective: to improve the effectiveness in construction by means of an integration of information systems, making a better use of them. Virtual Design and Construction, VDC is another term in close relation with BIM which is lately being mentioned very frequently (Khanzode et al., 2008). In fact, BIM encompasses many concepts from VDC that have to do with the virtual environment applied to construction, such as 3D and 4D technologies. These capabilities are especially attractive for the construction stage and thus, are encouraging BIM adoption by contractors during the last 5 year period (McGraw-Hill Construction, 2012).

2.3.1 4D BIM

4D Building Information Modeling, BIM is a project management for next generation, including a scheduling and planning project, data analysis, and management. It integrates detailed spatial data from BIM model. Capacity to visualize the project and analyze dynamic special data in computer before break ground create a training field for delivery team that highly involved and efficient.
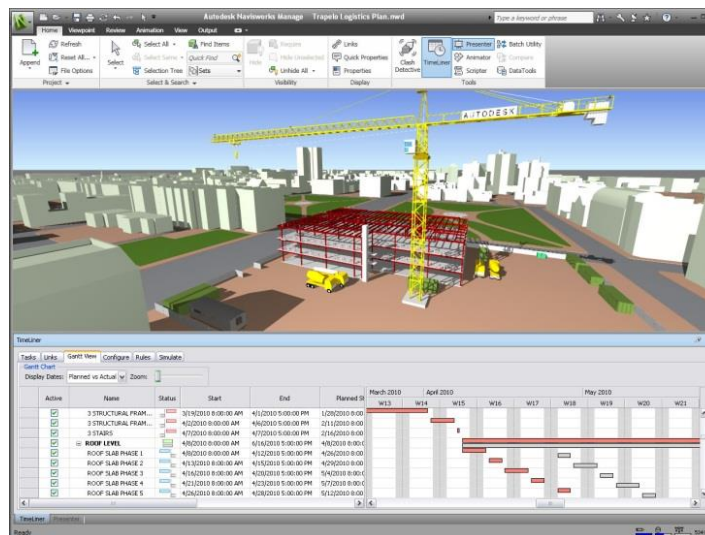
Figure 2.3: 4D BIM using Autodesk Naviswork (Mr as Built, 2015)

4D BIM also is a one of the acronym for 4D Building Information Modeling and a term widely used in Computer Aided Design, CAD industry, refer to smart linking respectively CAD 3D component or assembly with time or relevant information schedule. 4D terminological usage aim to consult fourth dimension: time, i.e. 4D is 3D plus scheduling (time). 4D construction of models enables many of the participants (from architect, designer, contractor to clients) a construction project, to visualize the entire duration of a series and display progress of construction industry activities through project life. BIM–centric approach towards project management technique has a very high potential to improve project management and construction project delivery, from any size or complexity.

2.3.2   BENEFIT AND USES BIM

One benefit of the use of BIM is the capability to check for spatial conflicts. BIM can provide 3D plans and renderings. Three-dimensional plans can be used from the initiation of the design through construction. Three-dimensional CAD is employed by designers, including architects and engineers, to visualize design and identify conflicts. Three-dimensional drawings can also be used during construction by construction contractors to interpret complex design. The benefits of applying 3D drawings to the construction process include (Cory, 2001):

i.   Checking clearances and access
ii. Visualizing project details from different viewpoints
iii. Using the model as a reference during project meetings
iv. Enabling constructability problems
v.   Reducing rework

Figure 2.4: Visualizations from a complex building

(C & S Engineering and Designing Group, 2014)

Figure 2.4 shows the complex visualizations that can be generated using BIM. The figure shows various views of a complex building to enhance the understanding of construction details. Figure 2.5 shows how BIM can be used to generate cross sections at points of interest in a building.

Figure 2.5: 3D cross sections produced by BIM (Monahan Design LLC, 2016)

Identification of conflicts has most extensively been applied to complex process plants, where it may be difficult to visualize how networks of pipes may conflict using 2D drawings. The use of 3D plans has naturally focused on plants and complex commercial buildings. Their use is now being extended to infrastructure design such as highways and railroad alignments.

2.3.3 INFORMATION VISUALIZATION

A 3D building model view is a very effective platform for entering and visualizing management information, particularly for erectors and general contractor staff outside the fabricator's organization. Customizable functions for generating model displays that are colored according to a variety of production status data are highly beneficial.

Two good examples are the use of 4D CAD techniques for micro-planning of a construction operation and the use of a model interface to pull the delivery of prefabricated parts to the jobsite in a just-in-time configuration. In the first, a building model that included the structural members and the resources (cranes) and activities was used for step-by-step planning and simulation of the erection sequence for steel and precast concrete elements for an underground subway station roof in London (Koerckel and Ballard, 2005). Careful planning was essential so that the project team could meet a strict 48-hour time limit for erection, during which train traffic was suspended. Below is the some example of the visualization using BIM software and real project.

Figure 2.6: Visualization versus real project (Facchetti. D., 2015)

Use of building models as a visualization tool is one of its most obvious uses with the clearest advantages. The 3D model of the project helps different parties to better understand the concept and especially the details of the design, forming a common mental picture and understanding far more quickly and effectively than with traditional drawings. The model was made available to all work crews on the jobsite, and they made extensive use of it, coming to the office to view it from time to time to explore the finer details of positioning of formwork, cable anchors, and reinforcement. Large quantities of reinforcement were positioned next to each cable anchor. Planning how to support the cable anchors within the forms in preparation for concrete pouring was much easier with the 3D view, which could be manipulated and cross-sectioned in multiple directions.

2.3.3.1 ADVANTAGES OF VISUALIZATION

Initially, client get an idea what is will get for his money. Apart from that, client can make good choice during project and made sure that critical path of the project they can understand. As a result, that firm can send the specific plan on time, in budget and with minimum issues. Therefore, construction try to implement visualization tactics in all phase of a project and involving all parties is used it. The benefits of BIM are varied for each one in construction industry (BIM Forum,. 2012). Meanwhile it a developed computer aided design for someone, other find it as a model series for different elements of a project. Using BIM, designer explore concept alternative, optimize their design and carry value of engineering.

Benefits for owner about this visualization are contractor can make easy to explain to owner how construction result. This visualization just not only benefits to a construction team but also can affect the good marketing to that company. Because it can show to the client how that building look like when construction finish.

2.4 SOFTWARE SELECTION

This part is to determine which is the best software that will be used in this study.

2.4.1 MICROSOFT PROJECT

This Microsoft Project is a very common software among project planner to produce project plan in construction industry. Since this software being introduced, the number of the company using this software starts increase from year to year because this is the first introduced planning software in industry. With the existence of software, the construction planner can expect the date and the time taken to complete the project. However, there is a possibility to make mistake that will lead to a serious problem in construction site later. This is because this software just discernible through planning journey of a construction planner. It always take a long time to resolve this arising problem properly. Below are the some of the advantages and disadvantages of Microsoft Project:

Table 2.2: Advantage and disadvantages of using Microsoft Project.

(Microsoft Project, 2015)

Advantages	Disadvantages
• Menu is more complete available, which are available planning network, task usage, Gantt chart, and Gantt tracking.	• Only allocation for single user.
• Have been obtained easily in market.	• Although can be accessed by equivalent to a web but only one user can update.
• Multi-platform.	• Because is single user software, so handling the project cannot be effective.
• Can make production tabulation by effective and efficient, because time location information needed to every process.	• Report of the project development indecipherable if file are being dismantled by other user.

• Can be directly obtaining the finance information during project carried out.	• Usage and interface included relative less friendly user for certain group.
• Easy to do modification, if want to rescheduling.	• Every user which open file can see the overall content, software cannot limit data wherever that can be edited, included, deleted or that could only be seen.
• Production schedule arrangement that is accurate will be more have been produced easily in time that is quick.	• Quite expensive.

2.4.2   AUTODESK NAVISWORK

Autodesk Naviswork Manage is a one of the new software that is used to plan the progress of the project. This new software is different compared to the Microsoft Project software. This software is more advanced than Microsoft Project because it can detect the clash from planning prior starting the project at the construction site. In addition, it also can generate an animation of the project starting from the site clearing until the project was completed. This software help a project planner in the real project because he can detect the problem early and can resolve the problem very quick. Autodesk Naviswork are consisted of a few types which are Naviswork Manage, Naviswork Simulate, and Naviswork Freedom. However, only Naviswork Manage was used for this study since this software possesses many advantages compared to other Naviswork. Table 2.3 tabulated the comparison between the different types of the Autodesk Naviswork.

Table 2.3: Difference type of the Autodesk Naviswork.

(Beyond The Paper Naviswork, 2010)

Feature	Autodesk Naviswork		
	Manage	**Simulate**	**Freedom**
Project Viewing			
Real-Time 3D Visualization & Navigation	√	√	√
Whole Team Review	√	√	√
Project Review			
File & Data Aggregation	√	√	
Review Toolkit	√	√	
NWD & 3D DWF Publishing	√	√	
Collaboration Toolkit	√	√	
Simulation & Analysis			
Photorealistic Visualization	√	√	
Object Animation	√	√	
4D Scheduling	√	√	
Coordination			
Clash & Interference Detection	√		
Clash & Interference Management	√		

2.4.3 CONCLUSION

For the conclusion, Autodesk Naviswork Manage is chosen to conduct this study because of the efficiency of this software which is very helpful for the construction planner to ensure the project running smoothly. It also can solve the problem like project journey that irregular or clash early before the project commences at the construction site. This software is very effective to be applied by all construction planners because it will launch at the site project construction journey built.

CHAPTER 3

METHODOLOGY

3.1   INTRODUCTION

Data collection is one of the most important step to make it success in this research. In this chapter, the procedure of getting the data will be described which from the step of deciding the research strategy, research method and until the step of doing data analysis. To achieve the objectives, the project must implement in accordance with the planned methodology.

3.2   RESEARCH METHODOLOGY

This research start from finding the problem that already happen in industry when construction building on progress. The objective can be produced from this industrial problem. Then, the methodology will come out and to achieve the objective, the interview session should be carried out and data also can be collected. The data collected from company is a softcopy traditional planning. This data from traditional should be converted into 4D software. Once the data had been converted into Autodesk Naviswork, the result will come out and this result needs to compare between traditional and 4D software.
.

3.3   INSTRUMENT FOR DATA COLLECTION

In order to achieve the aim and objectives of this research, an interview need to be carried out because the data will be collected from this session. The collected data is in the

form of softcopy of traditional construction planning. The interview session method is very efficient and economical to carry out because all direct information and the credibility by owned from company can be procured. Eventhough it requires long time period, but the information credibility owned is very effective.

3.4   DATA ANALYSIS

Data analysis that being used is from the research about the function and feature between Microsoft Project and Autodesk Naviswork software which software is very efficient. The function and feature that wants to compare between Microsoft Project and Autodesk Naviswork is:

Table 3.1: Difference function and feature between Autodesk Naviswork and Microsoft Project

FUNCTION	MICROSOFT PROJECT	AUTODESK NAVISWORK
VISUALIZATION - can check position / arrangement component at site project regular or not		
ANIMATION - can see the project journey start from early construction until the project finish		
CLASH DETECTION - can detect early before project start - if there is, can solve this problem early - save time		

PROJECT COST		
- can insert the cost every part of work - can be come out after planning was done		
SEQUENCE		
- can be check when the animation of the project on progress		
PROVIDE CHART		
- chart can displayed after construction planning is done		
WALK THROUGH		
- can see the suitability of the furniture layout in the building - this function very efficient to architect		
EDITING		
- can edit the project journey if there is mistake and need to rescheduling		

3.5   RESEARCH FRAMEWORK

Figure 3.1 shows the research step starting from the literature review until research finish. As such, this framework provided the proper steps to find out how to establish the research study.
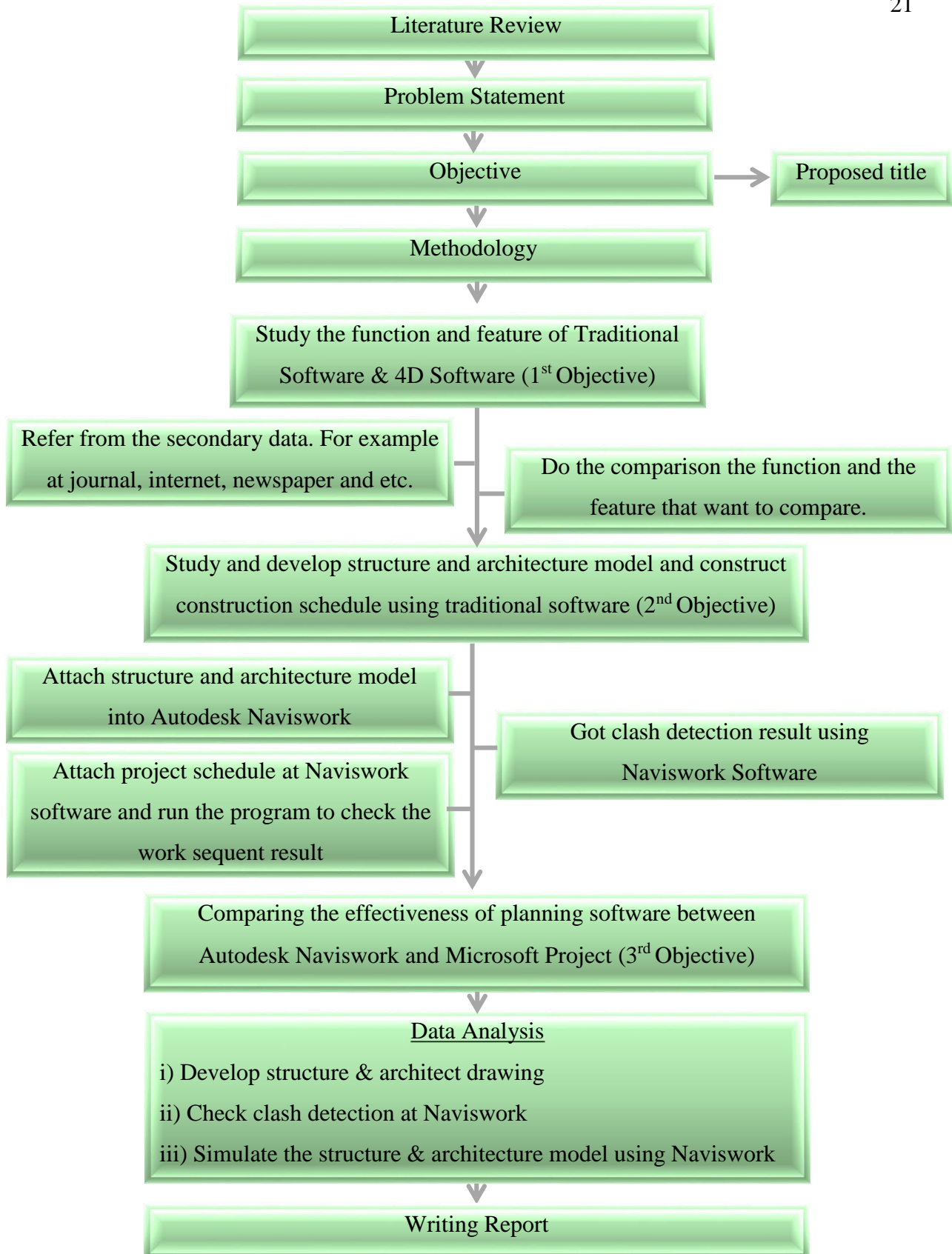
Figure 3.1: Research Methodology Framework

CHAPTER 4

RESULT AND DISUSSION

4.1   INTRODUCTION

This chapter will be discussed about the result and discussion from this study. The case study of this study is a quarter. This project are consisted of five level that need to be developed into the structural and architectural model first by using Autodesk Revit. All the result had been collected from developing structural and architectural model to get the clash detection result and also insert the real work program (Microsoft Project) into Autodesk Naviswork to produce simulation of the project.

4.2   DATA COLLECTION

Data from this study had been collected from two category data which are primary and secondary. Primary data was collected from real construction project where the data was consisted of structural drawing, architectural drawing, and construction work program. These primary data also was procured during interview session with Selangor State Development Corporation, SSDC staff related to the difference project progress before and after using BIM software in terms of the work delay and work program. Meanwhile, the secondary data was collected from journal, internet and etc.
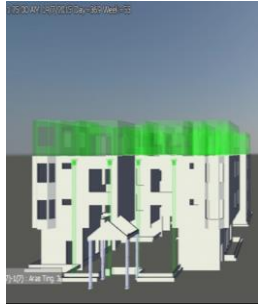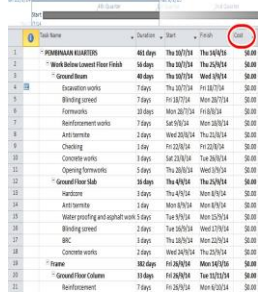
4.3   DATA ANALYSIS AND RESULT
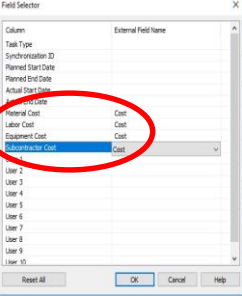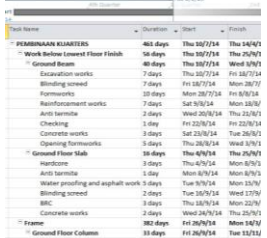
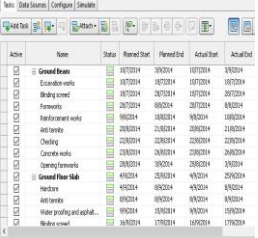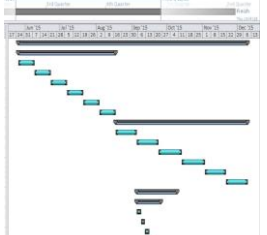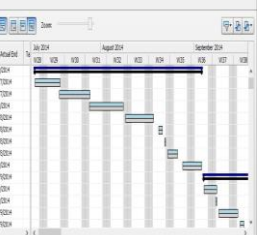From this study, several analysis had been done including developing the structural and architectural model. These two type of model was developed by using the Autodesk Naviswork to get the clash detection result. By using the same the structural and architectural model, the project schedule in the form of Microsoft Project was inserted into Autodesk Naviswork to generate the simulation result.

4.3.1   COMPARING THE FUNCTION AND THE FEATURE

The table below is the result with visualization of the study function and feature to prove the objective one between Microsoft Project and Autodesk Naviswork is achieved.

Table 4.1: The result with picture of the function and feature

FUNCTION & FEATURE	EXPLANATION	MICROSOFT PROJECT	AUTODESK NAVISWORK
VISUALIZATION	Can check position / arrangement component at site project regular or not		
ANIMATION	Can see the project journey start from early construction until the project finish		

CLASH DETECTION	i. Can detect early before project start ii. If there is, can solve this problem early iii. Save time		
PROJECT COST	i. Can insert the cost every part of work ii. Can be come out after planning was done		
WORK SEQUENCE	Can check when the animation of the project on progress		
PROVIDE CHART	Chart can be displayed after construction planning is done		
WALK THROUGH	i. Can see the suitability of the furniture layout in the building ii. This function is very efficient to architect		

EDITING	Can edit the project journey if there is mistake and need to reschedule		
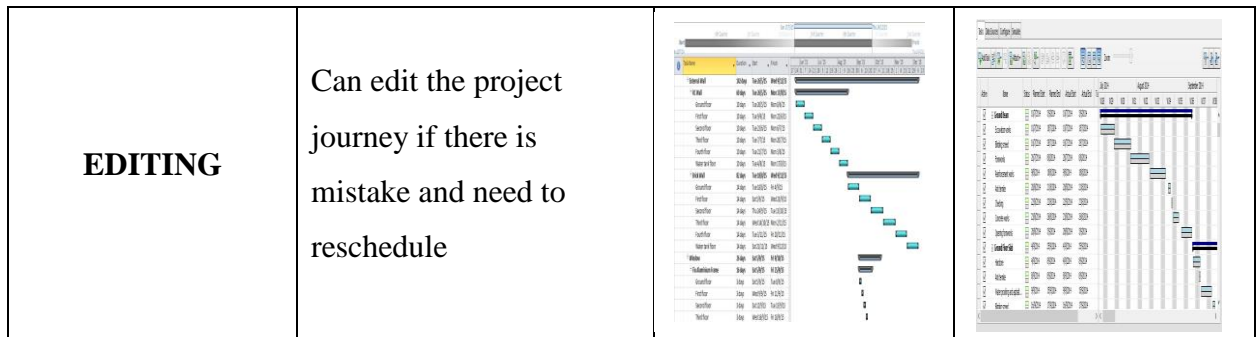
4.3.2 DEVELOP 3D MODEL

There are two types of model had been developed into 3D model which are structural model and architectural model. In developing the 3D model, Autodesk Revit software are being utilized. The process to develop this two model is almost same except for the type of template file chosen. The type of templates used to construct the structural model and architectural model are construction template and architectural template, respectively.
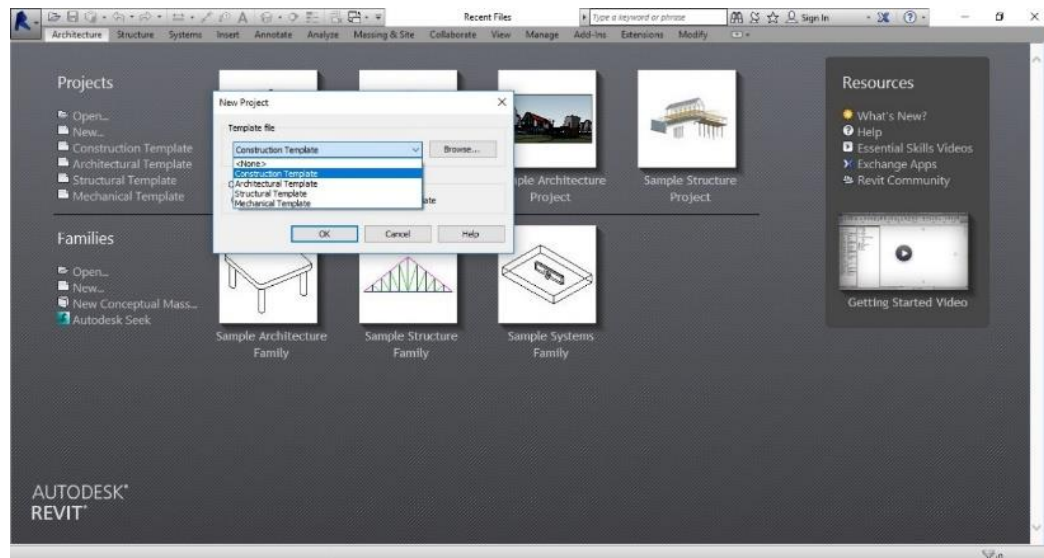
Figure 4.1: Choosing the template file that want to develop

If the construction or architectural template was chosen, the component that need to be developed focuses more at architecture toolbar. This is because the chosen template is

used only to construct architectural model. Meanwhile, a structural model focuses more to use structure toolbar including structure component such as column, beam and slab. If there was a mistake during choosing the type of template, a model cannot be developed. A certain component cannot be produced if choosing the component at architect toolbar while developing the structural model. For example, a structural column need to be developed, but when the structural component chosen at structure toolbar, the command cannot work properly. This is because of the wrong decision in choosing template.
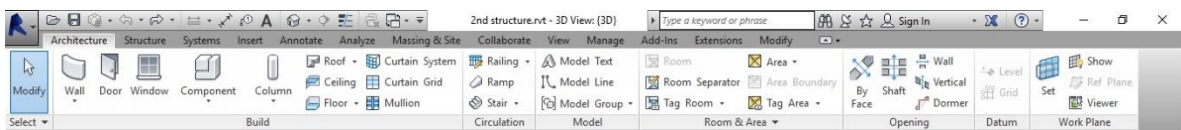
Figure 4.2: Revit toolbar

In this study, the drawing data was procured in the form of pdf file. In this case, the drawing could not be imported into the Autodesk Revit directly unless the drawing was in form of AutoCAD file to enable it to be imported into Autodesk Revit directly. For the first step, the elevation of each level was established by inserting level by level in the elevation view. Meanwhile, a series of grid line was established on the plan view by following the dimension that already stated in the drawing. Once the elevation and grid line was established, the model could be developed.

Figure 4.3: Architecture and structure model

The detailing drawing concerning the type of wall, wall thickness, beam size, column dimension and etc. had been stated at every single component by using the symbol at that construction drawing. This quarter's project are consisted of five level and a top level for the water tank. In this study, developing this architectural and structural model was done to achieve the second objective. This two models were then used to generate another result for this study including getting clash detection result and to simulate the work program.

4.3.3   CLASH DETECTION

In this study, the checking of clash detection between architectural and structural model was done by using Autodesk Naviswork. Firstly, architectural and structural model was appended into Autodesk Naviswork software, followed by clicking the clash detective at toolbar to enable the result can be produced after combining architectural and structural model. If this two model was being separated, clash detection result cannot be generated. Figure 4.4 shows the combination of the architectural and structural model in Autodesk Naviswork where the highlighted one was consisted of the structural model that was already combined with architectural model. After following the procedure to produce the clash detection accordingly, the clash result between this two models was around 257 clashes for the major clashes.

Figure 4.4: Combination of the structural and architectural model
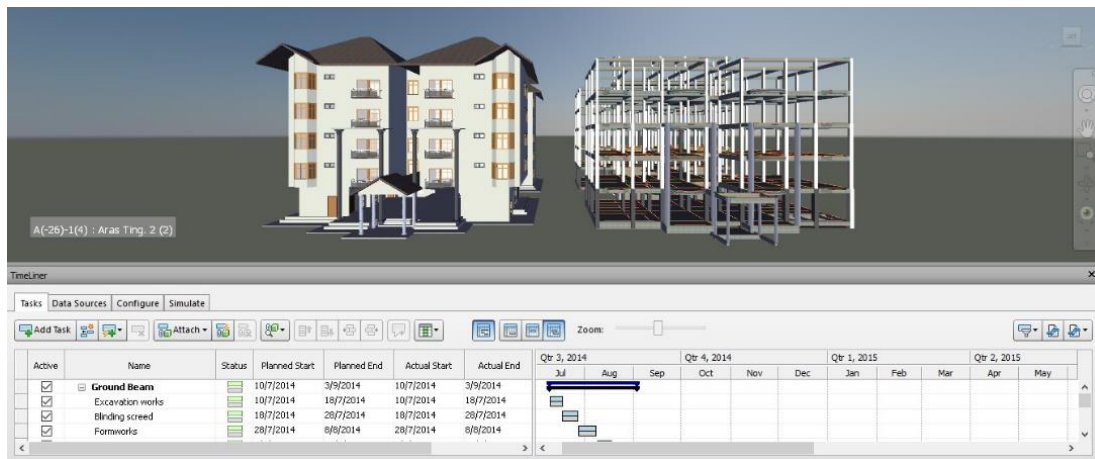into Autodesk Naviswork

The figure 4.5 shows the example of the clash detection result report between wall and beam. This report give the details about the clashes information. These information include where the clashes come from (mention the grid and elevation), the dimension of the clashes, and type of clashes which is hard or light.

Name	Clash1
Distance	-0.634m
Description	Hard
Status	New
Clash Point	-9.434m, -8.102m, 3.366m
Grid Location	E1-8 : Aras Ting. Bawah
Date Created	2016/11/30 05:35:36

Item 1

Element ID	357293
Layer	Aras Ting. 1
Item Name	Concrete, Cast-in-Place gray
Item Type	Solid

Item 2

| Element ID	471321
Layer	Aras Anjung
Item Name	Sand
Item Type	Solid

Figure 4.5: Clash detection report

4.3.4 PROJECT SIMULATION

This part is related with traditional planning software which is Microsoft Project. The work program was attached from Microsoft Project to Autodesk Navistwork to produce project simulation. Firstly, the structural and architectural model was attached into Autodesk Naviswork, followed by clicking button Time Liner in Naviswork and last but not least, the work program was attached.

Figure 4.6: Structural, architectural model and work program already
Inserted at Autodesk Naviswork

Before running the simulation, the setting parameter should be considered for each single thing related with work program. After all setting was match between the model and work program, the simulation was ready to simulate. The main purpose of this simulation is to identify the mistake throughout the work program where the problems cannot traced by using Microsoft Project. Based on the result from this simulation, it had been identified that the architectural model start to overtake the structural model at day 369 week 53 in date 14 July 2015 and at day 523 week 73 in date 14 December 2015. It was found that the top roof beam overtake prior building the column.
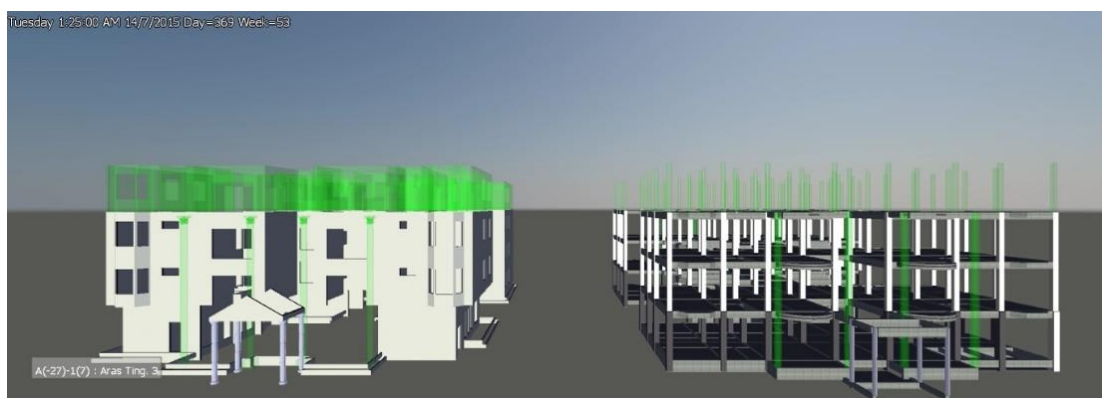
Figure 4.7: Architecture model start overtake structure model

4.4   DISCUSSION

There was a challenging experience in conducting this study especially during the data collection stage. Most of the contractor or construction industry cannot expose and give the project data including structure drawing, architecture drawing, and work sequence even though that project is already finished. This is because the project data and information is private and confidential. Even though I have an official letter from university to prove that I will only use the project data just for the purpose of completing my final year project, the project data can't be procured easily. The proper data was obtained around three month from contractor to conduct this study. Meanwhile, it took around three weeks to complete the structural and architectural model. The same duration goes in producing the simulation project sequence base on project model and using Microsoft Project. This is because there is no reference related with this project simulation and it is compulsary for me to explore and understand it by my own.

4.5   CONCLUSION

As a conclusion in this chapter, the study of the function and feature between Microsoft Project and Autodesk Naviswork was to prove which one the planning software is very relevant to use for all project planner. Meanwhile, developing structural and architectural model, generating clash detection result and simulation were done to achieve the second and third objective. The work program simulation enables the work program error to be detected easily without wasting time by checking one by one at Microsoft Project.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1   INTRODUCTION

This chapter consists of the conclusion and the recommendation for future work of the research.

5.2   CONCLUSION

Overall, this research is successful as all the aim and the objectives of this study had been achieved in the time allotted. Knowledge about project planning should be a compulsory for each project planner. In my suggestion, all construction industry need to hire a BIM engineer or BIM modeller to check the drawing information (structural and architectural) like dimension, height, shape and etc. By using BIM software, this information will be developed into 3D model by using Revit software. Then, the model will be developed into Autodesk Naviswork to get clash detection result of that project and also check the sequence of the project by attaching the project schedule, structural model, architectural model and etc. at timeline. The Microsoft Project cannot walk alone, this is because to draft construction work program using Microsoft Project cannot detect the wrong work sequence. After drafting the work program at Microsoft Project, inserting the work program into Autodesk Naviswork to check the work sequence via simulation. Autodesk Naviswork is also like a supporter to traditional software, Microsoft Project. This is because the Autodesk Naviswork can provide the information related to root of the arising problem and to ensure the real construction run smoothly without any problem.

Objective 1: *To study the function and the feature of traditional software, Microsoft Project planner and 4D software, Autodesk Naviswork.* The advantages of the function and the feature between traditional software and 4D software that already study is more to Autodesk Naviswork. This is because Autodesk Naviswork is more upgrade software compared to traditional planning software. This is because the Microsoft Project start produced since 1990 and almost the planner using this planning software is on 1991 (Azzopard, S. 2013). While, the Autodesk Naviswork began to be sold on 1st July 2007 (Wikipedia. 2016). The comparison between the function and the feature are in the form of visualization, animation, clash detection, project cost, work sequence, provide chart, walk through, and editing.

Objective 2: *To develop the construction planning from traditional software, Microsoft Project to 4D software, Autodesk Naviswork.* Based on the real construction data procured in pdf file including structural and architectural drawing, these drawings then were developed into 3D model by using Autodesk Revit first. If the real data (drawing) obtained in the form of the AutoCAD software, these drawing can be exported into Revit software. This situation will be easier to develop the model. This second objective focuses more on the knowledge of how to use and develop the structural and architectural model by using Autodesk Revit software. Autodesk Revit is known as a part of the Building Information Modelling, BIM software. Prior getting result of this study, this step is compulsory because without structural and architectural model, the result cannot be developed.

Objective 3: *To compare the effectiveness of planning software between 4D software, Autodesk Naviswork and traditional planning software, Microsoft Project.* To achieve this objective, the simulation of real work program had been developed by using the Autodesk Naviswork. The same architectural and structural model were utilized but need to insert the work program that being arranged by using Microsoft Project into Autodesk Naviswork. Once the simulation of the project is running, the date, week, day and time were shown at the simulation. Therefore, this simulation developed through Autodesk Naviswork software help the Microsoft Project to re-plan the work schedule at which part, date and specific detail where the problem start to happen.

5.3   RECOMMENDATION

This research had been established to differentiate which are the best planning software that can be applied to industry. From this research, there are several recommendations that had been suggested for the future research. For the feature research, I suggest to explore more knowledge in deep about the function of Autodesk Naviswork that related to the construction planning other than to get clash detection result, walkthrough, and make the project simulation.

REFERENCES

Azzopardi,S. 2013. The Evolution of Project Management [online].
https://www.projectsmart.co.uk/evolution-of-project-management.php

Sawyer, T. 2014. Construction Managers Embrace 4D BIM for Safety [online].
https://www.solibri.com/construction-managers-embrace-4d-bim-safety/

Sambasivan, M., & Soon, Y.W. 2007. Causes and effects of delays in Malaysian Construction
industry [online]. http://www.dres.ir/fanni/doclib7/causes%20.pdf

Oxford Business Group. 2015. Upgrading Malaysia's construction sector [online].
http://www.oxfordbusinessgroup.com/news/upgrading-malaysia-construction-sector

ITE Building & Interiors. 2015. The future of Malaysia's construction industry [online].
http://www.buildingshows.com /the-future-of-malaysia-s-construction-industry

Mr AS BUILD. 2015. BIM Navisworks Services [online].
http://mrasbuilt.com/MAB_BIM_Navis.html

Williams, T. 2010. *Construction Management Emerging Trends and Technology*. USA: Delmar
Cengage Learning.

BIM Forum. 2012. BIM Modeling leads to reduction coordination time [online].
http://excelize.com/bim-modelin g-leads-to-reduction-coordination-time/

Khoerunnisya, A. 2015. Microsoft Project [online]. http://www.slideshare.net/ichottt28/microsoft-
project-44346850

Beyond the Paper. 2010. Autodesk Naviswork 2011 Product [online].
http://dwf.blogs.com/beyond_the_paper/navisworks/page/2/

Building Smart Malaysia. 2015. BIM in Malaysia [online].
    http://mybuildingsmart.org.my/index.php/2015-01-04-07-24-47/9-bim-in-malaysia

Doug & White, P. 2014. Entrepreneur [online]. https://www.entrepreneur.com/author/doug-and-
    polly-white

Mind Tools Editorial Team. 2016. Project Management [online].
    https://www.mindtools.com/pages/article/newPPM_58.htm

Berita Harian. 2015. Bajet 2016Perkukuh Ekonomi Negara [online].
    http://www.bharian.com.my/node/91300

Trading Economics. 2016. Malaysia GDP From Construction [online].
    http://www.tradingeconomics.com/malaysia/gdp-from-construction

International Project Leadership Academy. 2016. National Health Service-UK [online].
    http://calleam.com/WTPF/?p=2003

Wikipedia. 2016. Naviworks [online]
    https://en.wikipedia.org/wiki/Navisworks

APPENDICES

A1   CLASH DETECTION REPORT

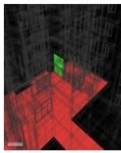|	
Name	Clash1
Distance	-0.634m
Description	Hard
Status	New
Clash Point	-9.434m, -8.102m, 3.366m
Grid Location	E1-8 : Aras Ting. Bawah
Date Created	2016/11/30 05:35:36

Item 1

Element ID	357293
Layer	Aras Ting. 1
Item Name	Concrete, Cast-in-Place gray
Item Type	Solid

Item 2

Element ID	471321
Layer	Aras Anjung
Item Name	Sand
Item Type	Solid

Clash detection report between beam and wall
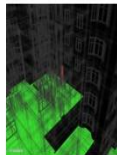
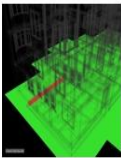|	
Name	Clash7
Distance	-0.479m
Description	Hard
Status	New
Clash Point	-8.162m, 14.423m, 0.692m
Grid Location	F-1 : Aras Ting. Bawah
Date Created	2016/11/30 05:35:36

Item 1

Element ID	380421
Layer	Aras Tanah
Item Name	Concrete-Rectangular-Column
Item Type	Structural Columns: Concrete-Rectangular-Column: C1-400x400

Item 2

Element ID	475900
Layer	Aras Ting. Bawah
Item Name	Floor
Item Type	Floors: Floor: 1. al-kt-js2

Clash detection report between column and slab

Name   Clash11
Distance   -0.441m
Description   Hard
Status   New
Clash Point   -9.434m, 8.953m, 0.541m
Grid Location 2b1-E1 : Aras Ting. Bawah
Date Created 2016/11/30 05:35:36

Item 1

Element ID   393483
Layer   <No level>
Item Name   Analytical Floors
Item Type   Analytical Floors

Item 2

Element ID   470829
Layer   Aras Anjung
Item Name   Default Wall
Item Type   Solid

Clash detection report between wall and slab

Name   Clash21
Distance   -0.441m
Description   Hard
Status   New
Clash Point   -9.412m, -5.510m, 0.100m
Grid Location 7a-E1 : Aras Anjung
Date Created 2016/11/30 05:35:36

Item 1

Element ID   354868
Layer   Aras Ting. Bawah
Item Name   Concrete-Rectangular Beam
Item Type   Structural Framing: Concrete-Rectangular Beam: 20. 200x975mm

Item 2

Element ID   492001
Layer   Aras Anjung
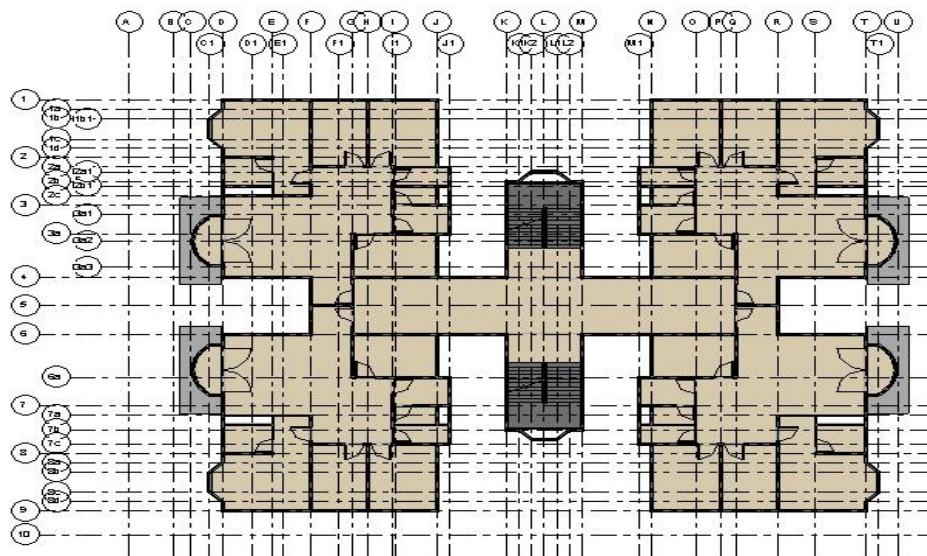Item Name   Floor
Item Type   Floors: Floor: Generic 100mm

Clash detection report between beam and slab
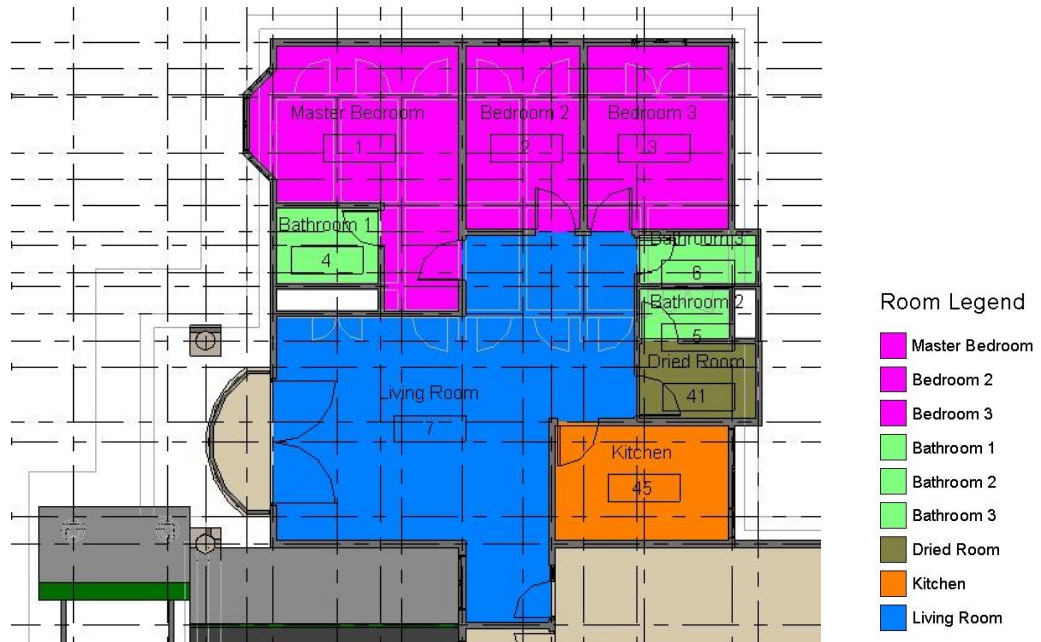
A2   WALKTHROUGH

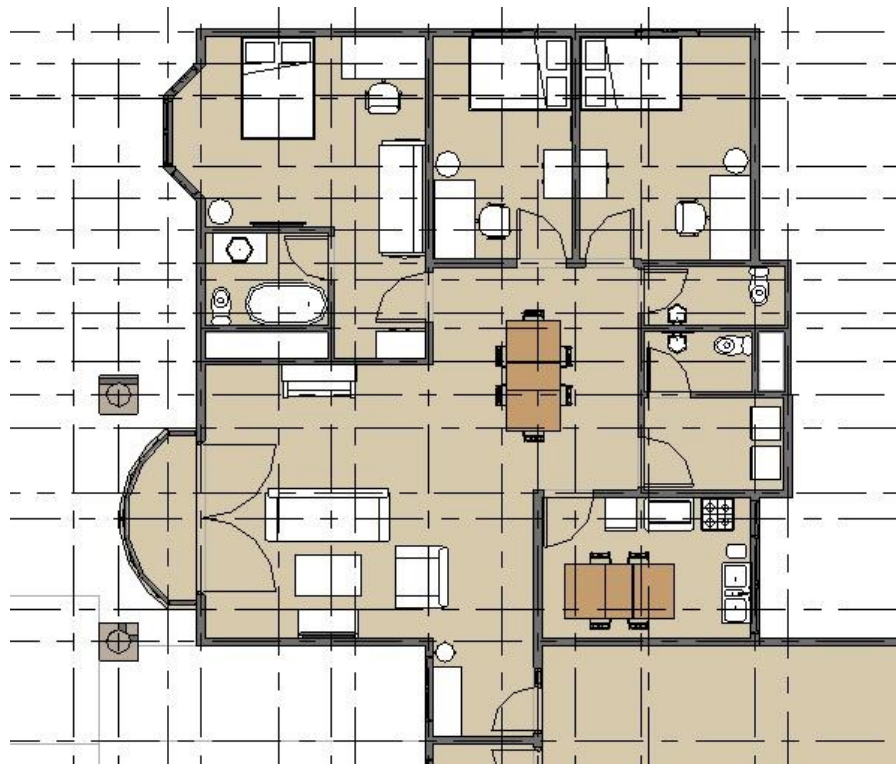Walkthrough inside the model by using Autodesk Naviswork

A3   ARHITECTURE MODEL PLAN VIEW

Same dimension and partition from first floor until fourth floor

Plan view with room tagging in difference color

Plan view with room tagging in difference color

A4 ELEVATION VIEW

North elevation

A5 CROSS SECTION

X-X cross section on second floor

Y-Y cross section on second floor

A6   SECTION BOX CROSS SECTION

Elevation cross section by using section box

Plan view cross section by using section box

A7 VISUALIZATION

Living room

Kitchen

Master bedroom

Toilet