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About SustaIN 2017

The 1st International Conference on Sustainable Infrastructure and Engineering (SustaIN 2017) is held on 10th October 2017 at Renaissance Hotel, Jalan Sultan Ismail, Kuala Lumpur. The conference is organized by the UTM Razak School of Engineering and Advanced Technology (UTMRS) in conjunction with UTMRS - International Advanced Technology Conference (UTMRS-ICAT 2017) with the theme of "Sustainable Development Practice: Issues and Challenges".

In line with one of UTM Strategic Thrusts to reflect a more focused attention to the current developments in the higher education at both national and international stage. Thus, SustaIN 2017 is created to inspire a government institutions, industrial partners and members of the public on the issues and challenges of sustainable infrastructure and engineering. Also, this conference aims to become a platform of technology and idea-sharing between UTM and the stakeholders.

A total of 20 papers that have been through blind review are accepted for the proceedings and the papers are grouped in two sub-themes: (1) Sustainable Design and Construction (2) Sustainable Technology and Engineering. An index of keywords from all papers is included at the end of the proceedings. All participants and readers can enjoy reading the proceedings and gain inspirations for further research and application into education and practice.

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I

SUSTAINABLE DESIGN AND CONSTRUCTION

UTM Razak School of Engineering and Advanced Technology
Kuala Lumpur, Malaysia
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A REVIEW OF ECO-COSTS PER VALUE RATIO IN MALAYSIAN CONSTRUCTION INDUSTRY TOWARDS SUSTAINABLE DEVELOPMENT

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ABSTRACT

Process to minimize environmental impact always a question mark. One of the methods to overcome this issue is by implementing eco-cost for construction waste management. Stressing sustainable development in the construction industry is due to construction wastes which produced from the site during the total duration of construction period which drastically increase yearly. Waste generation is becoming a pressing issue in Malaysia. There is a lot of construction waste generated in the country because of rapid development in the construction industry. Demand of houses and major infrastructure projects make the amount of construction waste getting increased. To make sure the construction waste generated to the right channel for disposal, higher preliminary cost in contract sum need to be captured by construction companies. By implementing eco-costing in development, it is ready to reduce the construction cost from starting stage and will make more potential outcomes to decrease the construction cost in preliminary. However, there are very few publications are available for modelling in eco-costing of construction waste generation as such Eco Cost per Value Ratio (EVR). Therefore, this study shall review on past publications on waste generation control measuring tools and EVR assessment for eco-costs as a result on waste produced particularly in Malaysian Construction Industry.

Key words: Construction, Waste, Management, Sustainable, Eco-costing

INTRODUCTION

This paper examines the past review paper on waste generation control measuring tools and eco-costing implementation in construction industry. This is because eco-costing provides a different dimension of handling construction waste which leads to sustainable construction waste management. Construction waste is a conspicuous issue all-inclusive and has an unfriendly impact on general execution of a task and additionally the general public and nature. Waste can be created in different structures. The waste happens as material, time and cost losses. The major physical waste created from development is recognized as material waste like concrete waste, demolished debris, steel scrap and others. Studies demonstrate that material waste has a critical effect to the cost of the task and

additionally an unfriendly effect on condition. One of the implications created from huge quantities of material waste is illegal dumping. It was identified that 70% of contractors did not practise the waste separation, unless mandated by any specific private contract preliminary (Begum et al., 2009 and Mah Chooi Mei et al., 2016). The EVR is a LCA-based technique to analyse utilization designs, business procedures, and design outline choices regarding eco-effective esteem creation. According to Masudi Ahmad (2012), EVR is likewise used to analyse or benchmark items and service systems. EVR is a marker to sustainable and unsustainable utilization designs, though the eco-cost is a pointer for the natural contamination of the items, and the esteem is the cost paid for them. Eco-cost is categorized as indirect and direct environmental cost generated from the use of resources. It is pointed out that poor waste management can lead to hazardous environmental impact as well as direct financial losses which make the eco-costs become greater (Boussabaine et al., 2006 and Hultman et al., 2012).

MAIN RESULTS

The important key factor is to implement eco-costing of construction waste in construction industry during the contract period which carries high contract sum. This review paper will help on distinguishing the EVR strategy which can be received in the construction waste management process. This is because, account of construction industry devours huge characteristics of raw material. The kind of material delivered to serve the business is extending from raw goods as such sand, aggregates, brick, plasterboard, metals, timber and cement. By implementing EVR in construction projects sites, the costing of the construction waste can be controlled. Table 1 shows a review papers on construction waste management tools in Malaysian construction industry.

Table 1: Review papers on construction waste management tools in Malaysian construction industry

Reference	Tools	Description
Mah Chooi Mei et al., (2016)	Framework for waste generation rate (WGR)	Theoretical framework demonstrate the waste generation rate
Noor Yasmin Zainun et al., (2016)	Geographical Information System (GIS)	Mapping the construction waste illegal dumping
Noor Zalina Mahmood et al., (2011)	Global Index spreadsheet	To measure total waste produced at site
Anis Adila Bt Abdullah et al., (2011)	Framework site waste management plan (SWMP)	Sustainable waste management at site
Masudi Ahmad Firman et al., (2011)	Benchmarking on construction and demolition waste generation	Identify the waste index and waste level in various sites in Klang valley
Masudi Ahmad Firman et al., (2012)	Wastage EVR benchmark	Wastage analysis at construction site in Klang Valley
S.A.Mahayuddin et al., (2008)	NOLAN ITU Density	Waste management in construction site

The review on the papers have been based on the sample benchmarking, framework or software tools in determining the construction waste type and waste management process. The assessments are quantitative and categories all the analysis are reliable to similar tools and case study. For example a study on framework of waste generation rate between conventional and mixed method by adopting Waste Generation Rate (Mah et al., 2016). Another study stated construction waste generation and benchmarking can serve as tools to evaluate the waste generation for overall site and EVR has been adopted to conduct assessment for construction waste in Klang Valley (Ahmad et al.,2012). All Authors are using different tools to justify the construction waste which produced at site and has identified that EVR benchmark for Malaysian construction industry shall lies at around 0.0024-0.0028.

CONCLUSION

Construction waste era postures more extreme effects than it was for the most part seen. This investigation discloses the construction waste issue from an alternate edge of viewpoints rather than the general strong waste issues broadly examined, detailed and distributed. Construction waste management is an important element in the construction industry towards sustainable development. The intention to develop sustainable waste eco-cost model based on case study approach in construction stage. Reviewing the type of assessment tools which implemented in Malaysian construction industry, in order towards sustainable development not only for construction process but for waste management too. The detail of assessment on the waste disposal cost saving between conventional and sustainable building material projects by using EVR method will be discussed in detail in the near future work. The assessment will provides a different dimension of handling construction waste which leads to sustainable construction waste management.

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A GAME BASED LEARNING FOR SUSTAINABLE PROJECT MANAGEMENT TRAINING: A PRELIMINARY SURVEY

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ABSTRACT

Digital technology is changing many aspects of human life nowadays whether at home or at work. It also impacted organization capability to remain relevant in any industries, especially with the emergence of fourth industrial revolution age. Therefore, adaptation to change must be quick and aligned with current technology. In this study, technology is used to enhance project management competency via game based learning approach. The objective of this study is to investigate the potential of this approach for project managers by introducing Project Management World, an online platform for learning project management best practices. A presentation of this approach is made using low fidelity prototype during a project management course conducted at Government Technical Department in Malaysia. Questionnaires were distributed and a dialogue session was conducted. The results revealed that 91% of the respondents perceived that the learning approach is useful, 81.9% respondents perceived it is easy to use and 81.9% respondents have intention to use it. The dialogue session enable researcher to obtain detailed comments and recommendations for this learning approach. The finding generate good indications that game based learning approach is acceptable and beneficial for the project management field and future actions are needed to improve the prototype.

Key words: Digital technology, Game based learning, Low fidelity, Human resource development

INTRODUCTION

The world we live in is constantly changing. The advancement in technology impacted our daily life, whether at home or at work. This is due to the tremendous change in data, communication and network technologies since the third industrial revolution which had taken place during late 1960s (David, 2016). Followed by the fourth industrial revolution, we see the emergence of digital systems, information technology and automated production. An example of this industrial revolution is where technologies have become part of our lives in connecting billions of people via mobile phones technologies (Schwab, 2017). Communications technology is continuing to advance at an accelerating rate (Rogers and Junga, 2017). On top of that, the birth of new technology discovery such as artificial intelligence, robotics, the Internet of Things, autonomous vehicle and etc., will

change how people work (David, 2016; Schwab, 2017). Comparatively the growth in information technology also changes how people learn (She, 2017). Hence, the need to gain new knowledge and skills has an utmost importance in any industries.

Construction industry is also impacted by the digital technologies, just like any other industries. The significant impact of digital technology in construction could be seen via the application of Building Information Modelling (BIM). BIM involves the building of 3 dimension modelling by integrating non graphical object data into the model (Demian and Walters, 2014). BIM could be used throughout the project life cycle in many forms, i.e. as design, monitoring and training tools. Another digital technology that changes the construction industry is the visualization technology (Guo et al., 2017). This technology assists employees towards understanding the construction processes realistically, accurately and effectively in 3 dimension ways via virtual reality tools. Moreover, the integration between visualization and game technologies contributes to an interactive learning approach. This approach stimulates 'learning by doing' and as result enhances the learning effectiveness.

The understanding of project management could be enhanced through an interactive project management learning application i.e. 'Project Management World', by using game technology concept and project management processes. The content of this application includes project management knowledge areas (based on Project Management Institute Standards), tools, templates and best practices (PMI, 2008). The challenges in Project Management World are developed using various project scenarios in the different phases of a project life cycle. However, for this prototype, the focus is on planning phase. The learning application is run via low fidelity prototype, i.e. Microsoft PowerPoint, without any interactive function for respondents to test (Walker *et al.*, 2002). Later, the learning application is presented to a group of Government professionals in the objective to investigate the potential of game based learning and to obtain detailed comments for further improvement of the prototype.

MAIN RESULTS

A presentation of Project Management game based learning prototype was conducted at the end of the day during the 3-days project management course for Malaysian Government professionals. Figure 1 and 2 show the screen captures of Project Management Game prototype.

Figure 1. The screen capture for entering Project Management World

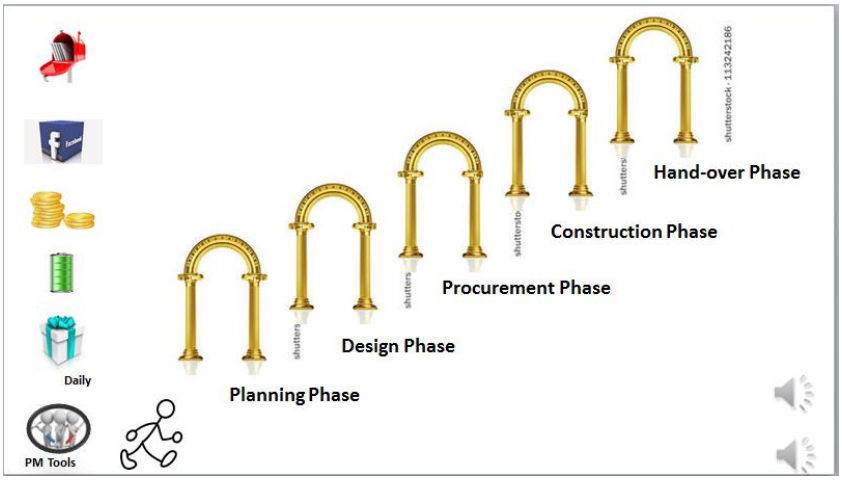

Figure 2. The screen capture for various phases in a project life cycle

Questionnaires then were distributed and followed by a dialogue session. Although 30 professionals participated in the course, only 11 professionals are keen to participate and give valuable feedbacks. Even though the number is small, the feedbacks received are essential for initial introduction of the game based learning approach and the improvement of the prototype.

Demographic data of the professionals are as below:

- 82% are male professionals.
- 73% are professionals categorized as Generation Y (20 – 31 years old); 18% of Generation X (32 – 49 years old) and 9% of baby boomers (50 years old and above).
- Participation based on level of management: 9% are from top level; 36% at middle level and 55% of first level management.

Three criteria were taken into account in considering the possibility of game based learning as learning tools, i.e. perceived usefulness (PU), perceived ease of use (PEU) and intention to use (ITU) (Baharum, 2013). The results from this study show that 91% of the professionals perceived the game is useful. 81.9% of them perceived that it is easy to use. Finally, 81.9% have the intention to use the game in the future.

Many comments were given during the dialogue session with the respondents. Improvements and recommendations generated are:

- The game narration should be clear at the start of the game.
- The outcome of the game and rewards received should be explained from start of the game.
- The game content should have been more detail.
- The project management game should focus only on one category of construction, e.g. building/road/bridges etc.
- The game should have a ‘help’ icon.

CONCLUSION

The study indicates that game based learning has the potential to be a learning approach in project management field. Since the technology is advancing, innovation in the way people learn should be together enhanced. Henceforth, further improvement need to be carried out for the prototype. This must be followed by another survey to investigate the effectiveness of this better improved prototype.

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PREFABRICATION TECHNOLOGY FOR SUSTAINABLE AFFORDABLE HOUSING SUPPLY IN MALAYSIA

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ABSTRACT

The insufficiency of housing supply for the middle-income group in the Malaysian housing market has been an agenda of the Malaysian government since 2012. Various housing programmes and purchasing schemes are provided by many bodies including the federal government of Malaysia and state governments to facilitate urban dwellers in owning a houses. However, the method for producing affordable housing supply is inadequately discussed. Thus, this paper seeks to explore the potential of using prefabrication technology as a method to increase affordable housing supply in providing sustainable housing development. Various sources from journals, articles, and news pertaining to the aim of this paper were reviewed. A further recommendation that highlights the strategies to be carried among stakeholders in using prefabrication technology for affordable housing supply is also discussed in this paper.

Key words: Prefabrication technology, Affordable housing, Housing supply, Sustainable housing

INTRODUCTION

The current demand calls for affordable housing especially in the urban area and the application of prefabrication technology is believed to be able to supply affordable housing to meet the needs. This is due to the current situation of Malaysian housing industry which is facing insufficient supply of affordable houses, particularly for middle income group (Bahadir and Mykhaylova, 2014; Bank Negara Malaysia, 2016; Baqutayan, 2016). Almost a million units of houses were targeted to be constructed in a five-year duration (2016-2020), which is approximately 2.5 times from the numbers of houses being built annually in the last five years (2011-2015) (Bank Negara Malaysia, 2016). Hence, a strong push mechanism such as prefabrication technology could accelerate the numbers of house unit production, though the study on the implementation of prefabrication technology for affordable housing supply still remains unknown in Malaysia.

METHODOLOGY

This paper covers a general review on the issues addressing the current demand for affordable housing in Malaysia. Reviewed articles are identified using the themes based on "demand and supply of house in Malaysia", "affordable housing" and "prefabrication technology". The issues highlighted are reviewed using literature review from journals articles, conference proceedings, reports and news especially those that covers and provide general reviews in addressing existing issues.

AFFORDABLE HOUSING DEMAND

The population growth and urbanisation factors create the demands of house especially in the urban area per year (Economic Planning Unit, 2015; PR1MA, 2015; Shuid, 2015). It has been projected that the population in Malaysia will increase from 28.3 million in 2010 to 41.5 million in 2040 (Department of Statistics Malaysia, 2016). Moreover, it is estimated that 37 million or 87% Malaysians will live in urban areas by 2050 (PR1MA, 2015). The statistical projection was analysed that the necessity for sustainable housing initiative should be applied to meet the current and future needs. According to Choguill (2007), "in order to be sustainable, housing initiatives must be economically viable, socially acceptable, technically feasible, and environmentally compatible". By embracing sustainable housing initiatives, the use of prefabrication technology is theoretically in line with the endeavour of providing sustainable affordable houses. The notion of sustainable housing initiatives is also embedded in prefabrication technology, which is familiarly known as an Industrialised Building System (IBS). Yunus and Yang (2012) studied critical sustainability factors in IBS and identified 18 critical sustainability factors for the improved implementation of IBS.

However, providing sustainable affordable housing supply involves the acquisition of lands, whereby the current situation faced is the high land prices. The housing locations within the centre of the city portray the difficulty faced by developers in providing affordable house prices. Affordable house price could be achieved by alternatively reducing the construction cost in urban housing development. Although it is tough as the price of materials has increased, the standardisation of building components and design is possible to minimise the construction cost with faster completion. For that reason, prefabrication technology is a great alternative construction method that believed to reduce cost due to the standardisation and frozen design implementation in the early stage (Tam et al., 2007).

PREFABRICATION TECHNOLOGY ISSUES IN MALAYSIAN HOUSING SECTOR

The benefit of prefabrication technology is plausible typically providing faster construction time, high productivity, lowering production cost, better quality, less wastage and sustainability (Agren and Wing, 2014; Atkin, 2014; Kolo et al., 2014; Lessing, 2006; Thanoon et al., 2003; Goulding et al., 2014). Despite the theoretical advantages of using prefabrication technology, its implementation should further be strategized. This is due to the bad past experience of the Malaysian construction industry in using the prefabrication technology (Haron, et.al, 2005; Mohammad, 2013) and the application is still at a low level despite the fact that the implementation historically began in the 1960s in Malaysia (Mydin

et.al, 2014). The strategies should further consider housing initiatives because the house-building sector in Malaysia has been experiencing drawback issues of IBS such as leakages, low quality, abandoned projects, delays in production, low profit margin, reluctance of contractors due to high initial cost, transportation, coordination, insufficient knowledge of installation and component assembly which are frequently discussed (Fathi et al., 2012; Jabar et al., 2013; Lou and Kamar, 2012). While the Construction Industry Development Board (CIDB) has been continuously playing a role in promoting IBS under its roadmap effort, the government keenly encourages the usage of IBS in all construction sectors including housing projects. In the aim to achieve Malaysian housing unit target, the excessive workforce is required.

The implementation of IBS will create less dependency on manual labours, which is achieved through leverages on technology (Jalil et al., 2015). As this proved that it is relevant to use prefabrication technology in supplying affordable housing, strategies and planning should also be equally in focus since the projected population growth and urbanisation factor increase per year. A study by Goulding et al. (2014), which developed a research roadmap for new production and business models for the construction uptake, asserted that the people, process and technology were drivers continuously used the prefabrication approach. Hence, the strategies in providing sustainable housing supply by using prefabrication technology should include the three major areas, namely people, process and technology.

RECOMMENDATION AND CONCLUSION

This paper presents some identified issues that hinder the potential of prefabrication technology application to realise sustainable affordable housing production and supply in an effort to potentially meet the spike in housing demand. Despite the mass demand for affordable housing due to the factors of urbanisation and population growth, strategies and planning on prefabrication technology should be further studied in order to avoid drawback issues. Although prefabrication technology definitely shows beneficial potential in increasing affordable housing supply, the implementation of this technology still remains unknown in the principle of tackling affordable housing shortage in Malaysia. Therefore, the implementation of prefabrication technology within Malaysian housing supply should be further studied in relation to people, process and technology factors so as to provide preparedness among stakeholders.

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KNOWLEDGE MANAGEMENT: THE CHALLENGE FOR IMPLEMENTATION IN CONSULTANT FIRMS IN MALAYSIAN CONSTRUCTION INDUSTRY

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ABSTRACT

In recent years, a major challenge in the field of knowledge management (KM) has been the way in which KM is implemented. Individual and organisation are starting to understand and appreciate knowledge as the key elements in the emerging competitive environment. As a preparation for the competitive industrial nation, KM is an important countenance that should be the point of convergence for the industry players. This paper wishes to draw the attention on the current situation of KM practice by focusing on consultant firms in Malaysian construction industry. Questionnaires were distributed to about 200 respondents working in the industry, with the aim of investigating the challenges for KM implementation in the Malaysian consultant firms. In this paper, the data is analysed using Statistical Package of Social Sciences (SPSS) version 20.0 on various statistical analysis tools, namely descriptive analysis, reliability analysis and relative important index (RII). The analysed results from questionnaire survey and focus group clearly showed that the biggest challenges are KM is difficult to implement, lack of awareness on the benefit of knowledge sharing and technology limitation. This paper is beneficial to overcome the challenges and barriers in KM practice.

Key words: Knowledge management (KM), Consultant firm, KM challenges, KM implementation

INTRODUCTION

Knowledge is recognised as a source of competitive advantage in a dynamic and changing business environment today (Burton, 1999). Individual and organisational knowledge is important for business entrepreneurship and for managing change (Nonaka and Takeuchi, 1995). Knowledge Management (KM) is very important in the construction industry in order to satisfy the requirements of quality, cost and time. Basically KM is defined as a process that focuses on knowledge-related activities to facilitate knowledge creation, capture, transformation and use, with the ultimate aim of leveraging organisations' intellectual capital to achieve organisational objectives (Cavaleri, 2004).

There are different types of consulting firms serving different sectors. This study mainly

focuses on construction industry which falls under civil engineering fields. A successful construction can only be achieved with good civil engineering design and consultations, which require decent engineering knowledge and experience. KM in construction projects is a challenging task due to several factors. The construction project consists of numerous people from different companies with different professional backgrounds such as clients, architects, project managers, designers, site managers, and workers. Furthermore, the project organisation is unstable over time and becomes often completely changeable from phase to phase during the project.

However, barriers and challenges are inevitable in KM. According to Chong and Besharati (2014), barriers to knowledge building mostly stem out from the existence of poor organisational culture. Most companies find it challenging to create an environment in which people both want to share what they know and make use of what others know (Fadilah, 2012). Most project-related problems, solutions and experiences are usually not documented or stored in a system database and the process of capturing and storing them in usable forms is not easy (Eardley, 2001). Therefore, there is a need of continuous efforts to improve the use of KM integration in construction industry and overcome projects diversity, complexity and non-standard production methods.

KM systems and related initiatives have become a popular focus in many firms, yet many KM systems initiatives fail to achieve their goals. Therefore this paper focuses on investigating the challenge of implementing KM in order to improve the performance of KM and make sure the implementation succeed.

MAIN RESULTS

Since that the average values were in the range of 1.51 to 4.50, it showed that the level of the indicators was in the range of Disagree to Agree levels. In addition, majority median values for indicators were 4.00. It is indicating that more than 50 percent of the respondent's respond to agree with these majority indicators in this instrument. Furthermore, the RII comparison was completed for the set of indicators. In the analysis, the higher value of RII indicated that the indicator was more challenging. On the other hand, lower value of RII described the indicator was less challenging. The result of the RII analysis showed that "difficult to implement" (RII = 0.763), "lack of awareness of the benefit of knowledge sharing" (RII = 0.749), "technology limitation" (RII = 0.744), "lack of interaction" (RII = 0.736), and "no sharing culture" (RII = 0.735) were the top five challenges of KM implementation based on the respondents' opinion and experience. On the other hand, Figure 1 shows the line chart of the RII assessment of the challenges to implement KM instrument.

Table 1: Summary result of descriptive analysis and Relative Importance Index (RII) for understanding the Knowledge Management (KM)

Code	Indicator	Min	Max	Mean	SD	Med	RII
D.1	Technology limitation	1	5	3.70	0.83	4.00	0.744
D.2	No sharing culture	1	5	3.66	0.95	4.00	0.735
D.3	Difficult to implement	1	5	3.80	0.99	4.00	0.763
D.4	Document contents are difficult to understand	1	5	3.64	1.08	4.00	0.731

D.5	Difficult to capture knowledge during informal discussion	1	5	3.62	1.02	4.00	0.726
D.6	KM is not well understood	1	5	3.60	0.96	4.00	0.723
D.7	Lack of communication skills	1	5	3.57	1.01	4.00	0.717
D.8	Lack of social network	1	5	3.27	0.99	3.00	0.658
D.9	Differences in culture	1	5	3.40	1.05	3.50	0.684
D.10	Lack of time	1	5	3.62	1.02	4.00	0.727
D.11	Lack of trust	1	5	3.35	1.15	3.00	0.675
D.12	Lack of motivation	1	5	3.58	1.07	4.00	0.720
D.13	Lack of awareness of the benefit of knowledge sharing	1	5	3.73	1.03	4.00	0.749
D.14	Lack of interaction	1	5	3.66	0.95	4.00	0.736
D.15	Fear of not receiving recognition	1	5	3.35	0.97	4.00	0.674
D.16	Fear of knowledge insecurity	1	5	3.32	1.03	4.00	0.668
D.17	Fear of causing internal conflicts	1	5	3.46	1.06	4.00	0.696
D.18	Keeping data accurate and relevant	1	5	3.63	0.96	4.00	0.730
D.19	Difficult to determine where KM belongs to (HR/IT/etc)	1	5	3.50	0.94	4.00	0.700

Note: Min = Minimum value; Max = Maximum value; SD = Standard deviation; Med = Median; RII = Relative Importance Index (%).

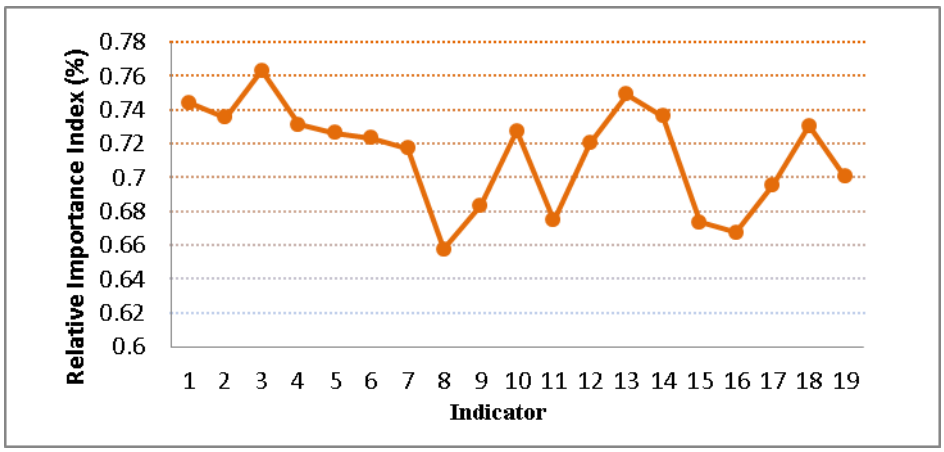

Figure 1. Line chart of Relative Importance Index (RII) for challenge of implementing Knowledge Management (KM) indicators

CONCLUSION

This paper has successfully achieved its aim to investigate the challenges of Knowledge Management (KM) implementation in the Malaysian consultant firm. It is expected that this paper will bring forward the ideas of eventually developing a conceptual framework of KM for consultant firm in the Malaysian construction industry by taking into account the quantitative elements of KM challenges to improve company performance and efficiency. It is hoped that the discussion on challenges of KM implementation would lead to the successful implementation of KM practice amongst consultant firms in the Malaysian construction industry.

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CONTRACTOR ASSESSMENT FOR CONSTRUCTION PROJECTS: A SUSTAINABLE APPROACH

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ABSTRACT

In the realisation of sustainable business practices, the concept of sustainability has recently been linked to project management. Since contractors are the one who is going to undertake critical project activities and has a significant impact on project outcome, it is thus seen important to integrate sustainability value while assessing contractors for a construction project. Hence, to ensure that contractors play their part in promoting sustainable development, it is reckoned by this study that it is necessary to lay out a set of sustainable contractor assessment criteria that could be used throughout the construction industry. Therefore, this paper is aimed to investigate the assessment criteria, which integrate sustainability values in assessing contractors. Over a comprehensive literature review involving extensive content analysis of various sources related to sustainability and contractor assessment, a total of 21 assessment criteria were identified. The result of this paper is hoped to become a standardised reference in assessing contractors, which integrates the economic, environment and social values with respect to the construction industry.

Key words: Sustainability, Contractor assessment, Construction, Project management

INTRODUCTION

Sustainability in construction management is the incorporation of elements that are standardised by the International Standards Organisation (ISO), the UN Global Compact's Ten Principles (UNGC) and Global Reporting Initiative (GRI G4) Reporting Framework to a project management process which can be measured and applied (GPM Global, 2014). Brundtland (1987) came out with one of the most broadly used definitions, which state that sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Successful organisations have long understood the commercial value of sustainable project management practices, and by making sustainability a required and measured part of that process, organisations will be able to deliver environmental, social and financial benefits to the business (Lennep, 2011). Today, the concept of sustainable project management has been expanded to almost all industries, particularly in the construction industry. Sustainable project management is thus seen by this paper as critical to a construction project.

One essential process in managing projects, especially in the construction industry, is the assessment of contractor. Contractor assessment is an important process in the procurement management of construction projects and the recent emphasis on sustainability has made this process more intricate (Bai and Sarkis, 2010). Thus, it is substantial to supplement that intricacy by presenting a review of sustainable contractor assessment for construction projects, and this paper is materialised in achieving the aim of investigating it, which is hoped to become a standardised reference in assessing contractor.

MAIN RESULTS

A qualitative content analysis was done on articles from previously published journals, which conferred the sustainable contractor assessment topic. Essential assessment criteria related to the idea of sustainability were identified on each literature. Next, coding was done to group them into similar themes, corresponds to the three pillars of sustainability, namely the Economic Values, Environmental Values and Social Values. The result of the literature review is summarised in Table 1.

Table 1. Summary of sustainable contractor assessment criteria

	Verdecho *et al.* (2013)	Neumüller *et al.* (2016)	Govindan *et al.* (2013)	Ibadov (2015)	Puri and Tiwari (2014)	Jafari (2013)	El-abbasy *et al.* (2013)	Bai and Sarkis (2010)	Idrus *et al.* (2011)	Watt *et al.* (2010)	**Times Referred**
Economic Values	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	10
- Client-contractor relationship		¤	¤		¤		¤		¤	¤	6
- Financial strength		¤		¤	¤	¤	¤		¤		6
- Past experience				¤	¤	¤	¤		¤	¤	6
- Technical competency		¤		¤	¤	¤			¤	¤	6
- Health and safety management	¤		¤	¤	¤		¤		¤		6
- Management capability				¤	¤	¤			¤	¤	5
- Quality	¤		¤	¤		¤		¤			5
- Work method and technology	¤		¤			¤			¤	¤	5
- Resources		¤			¤	¤	¤				4
- Cost	¤		¤					¤			3
- Reputation					¤	¤				¤	3
Environmental Values	¤	¤	¤	¤	¤		¤	¤	¤		8
- Environmental management	¤	¤	¤	¤				¤			5
- Time completion	¤		¤				¤	¤	¤		5
- Pollution prevention	¤		¤					¤			3
- Environmental practices	¤	¤	¤								3
- Safety					¤			¤			2
- Risk management				¤			¤				2

Social Values	¤	¤	¤					¤	¤		5
- Communities involvement		¤	¤					¤			3
- Employment practice			¤					¤			2
- Human resource development	¤	¤									2
- Political consideration									¤		1

CONCLUSION

This paper has successfully achieved its aim of investigating the sustainable contractor assessment criteria for construction projects. From the literature review carried out, it is found that 21 criteria had been identified as the critical contractor assessment criteria that relate to sustainability. These criteria are then separated into three main categories correspond to the three sustainability values, which are the economic, environment and social. Further study is suggested, particularly in the area of analysing and obtaining the rank of each criterion based on its importance and impact to the sustainable development.

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RELATIONSHIP BETWEEN PROJECT STAKEHOLDER MANAGEMENT, STAKEHOLDER'S SATISFACTION AND PROJECT PERFORMANCE IN THE RESIDENTIAL CONSTRUCTION PROJECT OF IRAN

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ABSTRACT

Stakeholders' issues and their expectations need to be managed as key influence-drivers in project success. Whenever terms such as "project stakeholder management" and "project performance" are used, there is a fundamental issue that needs to be identified with serious. The proper definition of these two correlates along with stakeholder's satisfaction is the fundamental issue. Taking measures to improve the project performance can only be developed by understanding the project purpose and stakeholder's satisfaction. This paper therefore aims to appraise the relationship between project stakeholder management, stakeholder's satisfaction and project performance in the residential construction project of Iran by using a quantitative methodology. Structural Equation Modeling (Smart-PLS focusing on confirmatory factor analysis (CFA)) applied to show the causal relationships between variables. The primary data were collected from a stratified random sample of 384 developers and buyers with the overall response rate of 44.1 percent. The Statistical Package of Social Sciences (SPSS) used on various statistical analysis tools, namely descriptive analysis, validity and reliability. Results show high correlation between project stakeholder management, stakeholder's satisfaction and project performance. Moreover, the results disclosed that the implementation of PMBOK standard through the mediating variables of stakeholder's satisfaction has a positive effect on project performance.

Key words: Project stakeholder management, Stakeholder's satisfaction, Project performance, PMBOK, Construction industry

INTRODUCTION

In the project-oriented environment, project success is defined by the overall project objectives, namely the customers' and other key stakeholder's satisfaction, on time delivery and project completed within budget (Ephrem et al., 2012). Stakeholder's satisfaction is one of the many aspects of project management that demands the project manager's attention on the essential element of successful projects. This has important implications on the project performance in delivering project outputs. In this sense, a

project can be considered as a transient endeavour that is undertaken to create a unique product, services or a result (PMI, 2013). There are many challenges and difficulties in the construction industry with regards to safety, quality and cost. To meet these demands, construction project companies need to constantly seek new directions and business models in construction management (George et al., 2012). According to the literature, frequent reports on the poor project performance (Ofori, 2011; Olanrewaju et al., 2014), neglect to satisfy the key stakeholder interest (Masrom et al., 2013; O'Halloran 2014), poor quality and reluctance to pay compensation for late delivery (Chai et al., 2015) are recounted in the main construction project in the world, including the residential construction projects in Iran. The aim of this paper is to appraise the relationship between project stakeholder management, stakeholder's satisfaction and project performance in the residential construction project of Iran. This will be achieved by determining the effect of project stakeholder management and stakeholders' satisfaction on project performance. To measure the project performance, the application of Structural Equation Model (SEM) using Smart Partial Least Squres (Smart-PLS) was utilised. Primary data was collected using the stratified random sample with 384 selected developers and buyers in Iran residential construction projects.

MAIN RESULTS

A pilot-test was performed to test the viability, process, resources, and potential problems of the study in a scientific manner (Thabane et al., 2010). Moreover, exploratory factor analysis (EFA) was run to confirm that scale selected for the present study is supported by the data. The overall reliability of the instrument within piloting was $\alpha = 0.965$ which is above than the recommended threshold of 0.7 suggested by Nunnally (1978). The individual construct reliability ranges from 0.876 to 0.965 as shown in Table 1.

Table 1. Measurement of sampling adequacy and total variance

Factor	No. Of items	Cronbach's alpha	KMO	Bartlett's Test Sphericity	Variance Explained
SM	14	0.965	0.965	0.000	66.884
SS	51	0.876	0.908	0.000	68.407
PP	20	0.894	0.935	0.000	69.142

The results of the EFA revealed that Kaiser-Mayer-Olkin (KMO) statistics, which are the measurement of sampling adequacy, were higher than minimum recommended value of 0.60 by Kaiser (1974) for all of the constructs. In addition, significance of Bartlett's test of Sphericity in all of the constructs indicate that the correlation among the measurement items was higher than 0.3 and were suitable for EFA following the suggestion by Hair (2010). The total variance extracted by the questions within construct was higher than 69.142 percent.

Based on the pilot study, Mann-Whitney-U-test in every one of the twenty items were higher than 0.5 likelihood value and propose no distinction between respondents in every one of these items. By closely comparing the Z-score of the questions, it has been seen that none of the variable is absolutely higher than the other. Hence, it can be concluded that respondents did not faced any difficulty with respect to the length of the instrument.

Moreover, as usual practice in statistical analysis for multivariate normality, Skewness and kurtosis were conducted as shown in Table 2. The results indicate that they were in a range of -2 to +2, which demonstrate normality of the data.

Table 2. Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PP	0.091	134	0.001	0.964	134	0.0001
SM	0.115	134	0.000	0.952	134	0.000
SS	0.144	134	0.000	0.923	134	0.000

a. Lilliefors Significance Correction

During the multivariate analysis, homoscedasticity using Levene's test of equal variance was calculated through non-metric variable and show that all scores were higher than the minimum significant value i.e., $p < 0.05$, which propose that variance for all the variables was equal within groups and had not violated the assumption of homogeneity of variance. To check for multicollinearity problem, Pearson's correlation has been utilised to calculate the bivariate correlation matrix. It demonstrated that none of the bivariate relationship was higher than 0.8 for exogenous variable.

The summary of descriptive statistics is presented in Table 3. Besides, t-test was conducted to compare the means of constructs with medium level of the seven-point scale (i.e. = 3.5) in order to provide more information on the status of the constructs. As shown in Table 3, all variables were above medium level ($p<0.01$) in seven-point scale (i.e. Mean = 3.5). By using reliability test of SPSS 22, item-to-total-correlation, and all items correlated with their relevant construct in medium to high level.

Table 3. Descriptive statistics and T-Test

Variables	Mean	Std. Deviation	t	Sig. (2-tailed)
pp	4.0893	.62571	10.942	.000
SM	3.9131	.87634	5.477	.000
SS	5.2848	.99529	20.836	.000

A summary of hypotheses and results of related analyses are shown in Table 4.

Table 4. Results of main hypotheses testing

Hypotheses No	Hypotheses Description	Path Coefficient (t-value)	SE
H1	Stakeholder management is positively affected on the project performance in residential construction project.	0.7767 (9.5234)	0.0816
H2	Stakeholder management is positively affected to the stakeholder's satisfaction in residential construction project.	0.9594 (217.552)	0.0044
H3	Stakeholder satisfaction is positively affected to project performance in residential construction project	0.1893 (2.2624)	0.0837

CONCLUSION

This study seeks to examine whether the project stakeholder management has a direct and positive effect on project performance, or whether the effect is indirect and through improved stakeholder satisfaction resulted from the Project Management Body of Knowledge (PMBOK). In this paper, four different objectives have been established. Firstly, an attempt has been made to demonstrate whether stakeholder management has a positive effect on project performance. Secondly, this study tried to find whether project stakeholder management has a positive effect on stakeholder's satisfaction. Thirdly, this study made an effort to understand if stakeholder's satisfaction has a positive effect on project performance. Lastly, this study sought to bring more scholarly evidence about mediating effect of stakeholder's satisfaction on the relationship between project stakeholder management and project performance. The results indicated that stakeholder management is positively affected on the project performance in residential construction project (β = 0.1893; t =2.2624). The second hypothesis investigates the effect of Stakeholder management on stakeholder satisfaction the results of the hypothesis indicated that Stakeholder management has positive and significant effect on stakeholder satisfaction (β = 0.9594; t = 217.552). The third hypothesis The Stakeholder satisfaction is positively affected to project performance in residential construction project. The results of this hypothesis examined the effect of Stakeholder satisfaction on project performance. The results publicized that Stakeholder satisfaction is positively and significantly affected on project performance (β= 0.7767 and t = 9.5234). This paper sheds new to developers, owners and the board of company in the construction industry. Since the companies want to implement the guideline to manage their projects, thus, knowing the capabilities of the standard can help them adopt to an effective approach to implementation of the standard. Furthermore, remind to them of their mutual responsibilities for effective implementation of the standard. The findings of this study were obtained from the Iranian residential construction projects point of view. Future researchers can replicate similar study for other countries and another sampling frame. Further research could also be conducted to determine the effects of other project management segment to the project performance in the residential sectors of construction industry.

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TECHNOLOGY TRANSFER IN THE KLANG VALLEY MASS RAPID TRANSIT PROJECT: KEY SUCCESS FACTORS

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ABSTRACT

The Klang Valley Mass Rapid Transit (KVMRT) Project is the largest infrastructure project in Malaysia's history. The development of the KVMRT project requires not just local resources but as well as the involvement of foreign expertise. The government in recognising the need to reduce the dependence on foreign expertise in the local rail industry has introduced several measures for technology transfer in the KVMRT Project. The purpose of this paper is to review and identify the key success factors in the technology transfer program in the KVMRT project. Key personnel directly involved in the planning and implementation of technology transfer program in the MRT project were interviewed. A qualitative analysis using NVIVO 11 was done based on the findings from the interviews. Nine key success factors have been identified based on the analysis which are; recipient's characteristics, provider's characteristics, communication channel, coordination and monitoring, transfer environment, government's policy, learning environment, mode of transfer and planning of transfer. Findings show that even though the program is well coordinated, the initial planning is one of the key factors that need to be improved. Proper measurement also needs to be established to measure the effectiveness of the technology transfer program.

Key words: Technology Transfer, Technology Transfer Model, MRT, Rail project

INTRODUCTION

The Klang Valley Mass Rapid Transit (KVMRT) project is one of the key projects identified for the Greater Kuala Lumpur under the Government of Malaysia's Economic Transformation Program (PEMANDU, 2012). The construction cost totalling at RM23 billion, the KVMRT Line 1 project is considered as one of the largest infrastructure projects in Malaysia (Kaur, 2016). The Government in recognising the huge amount of money being spent on the infrastructure have introduced a technology transfer program as a way to capitalise on the government's outflow of money (MOF, 2014). It was estimated that the KVMRT technology transfer program for Line 1 would bring the country RM3.53 billion worth of benefit from six main contractors involved in the project (Nee, 2013). The technology transfer program consists of seven areas mainly from design and development, human capital development, global market access, local work packages, investment, parts and component manufacturing and transfer of technology (Nee, 2013).

MAIN RESULTS

Due to the completion of the KVMRT Line 1 project on 17th July 2017 (Ahmad and Sivanandam, 2017), this paper is aim to review and identify the key success factors in the technology transfer program that was implemented during the planning, construction, and testing and commissioning of the project. A case study approach was used in understanding the technology transfer process in the KVMRT Line 1 project. As stated by Yin (Yin, 2003), a case study approach used as a pilot study can help to identify important variables in a complex situation and develop hypotheses for further research.

Data was collected through a face-to-face interview with key personnel in MRT Corp Sdn Bhd. Five (5) personnel have been selected for the interview in which all these five (5) are the key people involved in the planning and implementation of the technology transfer program for Line 1 in MRT Corp. One of the key criteria for the selection of the respondents was that they must have at least three (3) years of experience and involvement in a technology transfer program. The interview was done based on a structured questionnaire with open ended questions. The questionnaire also allows the respondents to add their observation to the technology transfer program not contained in the structured questionnaire. The questions are structured based on the technology transfer factors that have been identified in a study by Waroonkun (Waroonkun, 2007). The interview questions were emailed to the respondents earlier on before the interview has taken place. The interview was recorded using a digital voice recorder, and later the interview was transcribed. NVIVO 11 is the software used for the interview analysis based on the transcript of the interview.

From the analysis of the interview, about nine (9) key success factors have been identified that affect the overall implementation of the technology transfer program in the KVMRT project as shown in Table 1. Weight was given to each of the factors based on how many respondents acknowledged its importance.

Table 1. Identified Key Success Factors for the KVMRT Technology Transfer Program

	Item	Weightage
Factor 1	Recipient's Characteristics	20% (1/5)
Factor 2	Provider's Characteristics	20% (1/5)
Factor 3	Communication Channel	80% (4/5)
Factor 4	Coordination & Monitoring	100% (5/5)
Factor 5	Transfer Environment	80% (4/5)
Factor 6	Government's Policy	20% (1/5)
Factor 7	Learning Environment	40% (2/5)
Factor 8	Mode of Transfer	100% (5/5)
Factor 9	Planning of Transfer	100% (5/5)

From the analysis of the interview also, key findings were made based on the impact and result of the technology transfer program. Three (3) out of the five (5) respondents stated that the impact of the program is the improved salary and career progression of the trainees that was involved as a recipient in the technology transfer program. From the interview

findings also, the key factors that need to be improved are the technology transfer planning and measurement. All the five (5) respondents highlighted that initial planning is the most important aspect that needs to be improved. Regarding measurement factor, two (2) of the respondents stated that there is no proper measurement that was established to track the effectiveness of the program.

CONCLUSION

The findings show that the technology transfer program in the KVMRT Line 1 is well coordinated. However, a certain improvement was suggested due to the lessons learnt from the program. From the nine (9) key success factors that were identified, "coordination and monitoring", "mode of transfer" and "planning of the technology transfer" are considered the most important key success factors. Future studies can be recommended to investigate the relationship between these identified factors and determine which key factors contribute to the overall success of the technology transfer program.

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BUILDING ASSESSMENT TOOL IN TROPICAL COUNTRIES: A COMPARISON BETWEEN MALAYSIA AND SINGAPORE

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ABSTRACT

Malaysia and Singapore both are tropical climate countries which known for the sufficient source of natural sunlight and rainwater throughout the year. These two countries have established rating tools in enforcing the sustainability in construction and development. Two rating tools involved for this study are Green Building Index (GBI) in Malaysia and BCA Green Mark in Singapore. This comparison is to gather findings on the efficiency of the implementation for the future possible improvement on GBI in Malaysia. This comparison study is designed to provide understanding on the differences and similarities of the rating tools for sustainable buildings in tropical countries. Each country's rating tool is responsive to its climatic and development status and is tailored specifically to its building by-laws and standards, cultural relevance and social needs. The outcome can help developers, investors, tenants, and government bodies in making informed decisions about sustainable buildings.

Key words: Building Assessment Tool, Green Building Index, BCA Green Mark

INTRODUCTION

Malaysia has undergone rapid economic, social and environmental change over the last fifty years as the nation strives towards the new direction. The construction industry has a great impact not only on the Malaysian socio-economic landscape but also to the environment.

Industrial sectors, including the building sector, started to recognize the impact of their activities on the environment in the 1990s. Significant changes were needed to mitigate the environmental impact of the building sector. When aiming to reduce environmental impacts, a system for measuring environmental performance was needed (Haapio & Viitaniemi, 2008).

As the global construction industry is also responsible for contributing 35-45% of CO_2 emissions throughout the world, since 1990's, built environment related institutional body or NGO's around the world has been developing various assessment tools to evaluate

various kin of buildings in a framework of Sustainable and Green Building Agenda (Khamidi, 2007). Fauzi and Abd Malek (2013), opined that 'green building' primarily having energy efficient usage, water conserving, the use of recyclable materials, non-toxic and other features that contribute to the environmental, social and economics. Cole (1998) stated that the specific definition of the term "building performance" is complex since different actors in the building sector have differing interests and requirements.

GBI is still in its infancy stage compared to other global rating systems. It is evident that GBI had referred to US Leadership in Energy and Environmental Design (LEED) and Green Mark as the basis for the establishment of criteria as there are many similarities. Since GBI is custom designed to suit Malaysian's tropical climate, it is logical to do a research on Green mark which is the only rating tool operating in tropical climate before GBI.

DISCUSSION

This study focuses on the Green Building Index (GBI) in Malaysia and Green Mark (GM) in Singapore to provide a comparison between them and a better understanding of assessment criteria and the scope of these two guidelines. Green Building Index (GBI) and Green Mark (GM) are rating tools to be used for labeling building in the tropical region. The difference of assessment criteria creates difference scores and rating as shown in Table 1.

From Table 1, the score between GBI and GM. GBI rating is divided into four different award categories including Platinum, Gold, Silver and Certified. GM rating in the other hand, has also four different award which slightly different with GBI rating which include Platinum, Gold Plus, Gold and Certified award. The table shows that GM Rating has higher number to score in order to get the Platinum award for each building certified as compared to GBI rating index. The value of each building does affected by the award received, therefore, the criteria to meet each rating point does affect the design and development process.

Table 1: The difference of score between GBI and GM rating

Score	GBI Rating	GM Rating
90 and above	Platinum	Platinum
85 to < 90		Gold Plus
75 to < 85	Gold	Gold
65 to < 75	Silver	Certified
50 to < 65	Certified	

The Green Mark priorities on energy and water efficiency were to customize Singapore's situation. Malaysia differs in this situation thus it can be concluded that rating systems of different countries depend on the country's situation and allocation of resources (MBAM, 2008). The general comparison is shown in Table 2.

From Table 2, the GM in Singapore is mandatory and each building in Singapore required to be evaluated and will be certified accordingly. GBI in Malaysia in the other hand is an optional. These two differences made a huge different between the current development scenario in Malaysia and Singapore. The mandatory requirement by the local government

of Singapore will encourage each development to be built respond to the sustainable factor whereas, in Malaysia, as the implementation is voluntary, the existing of GBI will be less affective.

Table 2: General comparison between GBI and GM

Rating System	GBI		GM	
Year	2009		2005	
Origin	Malaysia		Singapore	
Ratings	• Platinum • Gold • Silver • Certified	85 and above 75 to <85 65 to <75 50 to <65	• Platinum • Gold Plus • Gold • Certified	90 and above 85 to <90 75 to <85 50 to <75
Criteria	Energy Efficiency Indoor Environmental Quality Water Efficiency Sustainable Site Planning and Management Material and resources Innovation		Energy Efficiency Indoor Environmental Quality Water Efficiency Environmental Protection Other Green Features	
Assessment	Accreditation panel		Trained Assessors	
	Voluntarily		Mandatory	
Rating Valid	3 years		3 years	
Governance	GBI Sdn. Bhd.		BCA	

CONCLUSION

In conclusion, it is clear that the building assessment tool are customised to suit the current state of development and existing resources in the country. GBI is still new to the country and was based on the research on GM as well. New improved versions are always being developed and released. Rating tools would still need to be customised to match local needs. Imposing standards from the developed countries on developing countries would result in non-compliance.

In order to assure the affectiveness of the existance of these sustainable evaluation system for building and development industry to move toward sustainability, a strict implementation and enforcement including mandatory as GM in Singapore will increase the affectiveness. Therefore, GBI in Malaysia in this state shall be improvised accordingly for a better future of sustainable development.

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MILESTONE PAYMENT AND MONTHLY PROGRESS PAYMENT FOR CONTRACTOR: A PROJECT PERFORMANCE COMPARISON STUDY

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ABSTRACT

Payment method is very crucial factor in determining success in a construction project performance. Payment method has become a main issue for performance of construction projects because ineffective payment method of construction projects will due to the projects completed behind the stipulated timeframe. Thus, this study conducted to compare the construction project performance related to two types of payment methods used; milestone payment (MP) and monthly progress payment (MPP) methods including the performance critical factors between the two payment methods approached. The methodology adopted in the study were site observation, data collection and interviews. Based on the findings, milestone payment (MP) method give better construction project performance in terms of controlling time, quality, and cost. MP provides better quality performance compare to MPP in site management, administration, planning, facilities given, structure, and infrastructure works. The findings are very beneficial in enhancing the performance of the construction project in the construction industry in Malaysia.

Key words: Project performance, Project payment, Milestone payment

INTRODUCTION

In the new era of global economy, the construction industry had contributed significantly to the economic growth of the country. Contribution of construction industry to a country not only as a main play role to the socioeconomic growth but also to improves the quality of people life by providing the necessary infrastructure such as roads, hospitals, school and other basic and enhanced facilities (Abdul Rahman et. al., 2013). However, construction industry in Malaysia facing chronic problems including poor performance of time and cost, construction waste, poor productivity and over dependent of foreign workers (Memon et. al., 2012; Rahman et. al., 2012). Project performance has become a main issue for national development. This is due to the projects in construction industry were completed behind time. The reasons of these are because of the payment issues, land acquisition, additional works and relocation of public services and change of original designs by client.

There are many types of progress payment method practices such as Monthly Progress Payment (MPP) and Milestone Payment (MP). MPP method is a monthly interim payments made to the contractor for certified work done on site for that particular month of valuation while MP method is a schedule of payment based on Milestone events achieved in the approved Work Program. Currently, some projects are using the MPP meaning that the client had to pay monthly accordingly to what is actual finished work done up to the valuation date by the contractor. However, there is another alternative payment called MP where payment is subject to the satisfactory performance. The value of works completed and payment be made upon certain events being achieved. For this reason, the MP will represent the true value of the works completed.

MAIN RESULTS

Table 1 indicates that the grade given by Superintending Officers that managed and supervised the works on sites. Project A scored four excellent remarks for the quality of planning, structure, finishing works and also the quality of Nominated Sub Contractor. For Project B, average remark is good for quality work done on site. Project C scored six excellent remarks for their best quality in planning, civil structure, finishing works and also the quality of Nominated Sub Contractor works while for Project D average remark is good for all quality criteria.

Table 1. Comparison of quality performance in MPP Project and MP Project

Quality Performance	MPP Projects		MP Projects	
	Project A	Project B	Project C	Project D
Quality of Site Management	Good	Good	Excellence	Good
Quality of Administration	Good	Good	Excellence	Good
Quality of Planning	Excellence	Good	Excellence	Good
Quality of Facilities Given	Good	Good	Excellence	Good
Quality of Structure	Excellence	Good	Excellence	Good
Quality of Finishing Works	Excellence	Good	Good	Good
Quality of Infrastructure Works	Good	Moderate	Excellence	Good
Quality of Nominated Sub Contractor	Excellence	Moderate	Good	Good

CONCLUSION

There is an urgent need to widely implement the MP method in order to enhance project performance. MP will give better performance if being implemented with proper guidelines, standard and must be enforced in the contract clause for the contractor to compulsory use in project.

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THE CHALLENGES OF IMPLEMENTING BIM IN MALAYSIAN CONSTRUCTION ORGANISATIONS: STAKEHOLDERS' PERSPECTIVE

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ABSTRACT

Building Information Modelling (BIM) is transforming how buildings are designed and constructed and can facilitate multi-disciplinary coordination, and integrate 3D design, analysis, cost estimating, and construction schedule. Currently, due to poor coordination among its project participants, the construction industry is still unproductive, fragmented and lacks collaboration. With the introduction of BIM, the performance of the industry, its coordination and collaboration among the construction players, the productivity of the projects could be better improved. However, the lack of understanding from the construction players about BIM, which include the wide spectrum of benefits and barriers that could be encountered have made industry players reluctant to proceed with its implementation. This research studies the challenges which could be encountered and the benefits of BIM adoption from the construction stakeholders' perspectives. Accordingly, a pilot interview interviewing five BIM practitioners from different organisations has been carried out whereby the respondents have agreed that although there are plenty of benefits and advantages of BIM adoption, the Malaysia construction industry is still in its infancy and developmental stage. In short, the main reason is that there are still major barriers to be overcome in particular the construction players' mindset and thinking.

Key words: Building Information Modelling, Construction industry, Malaysia, Collaboration

INTRODUCTION

The Malaysian authorities have turned their attention to implementing Building Information Modelling (BIM) in the Malaysian construction industry. BIM has even been highlighted as one of the strategies to transform the construction sector in the 11th Malaysia Plan (Economic Planning Unit 2015). During the Infrastructure & Construction Asia's Building Information Modelling & Sustainable Architecture Conference on 19th August 2009, the Malaysian Public Work Department (PWD) director-general, Datuk Seri Dr Judin Abdul Karim said that BIM is

considered as one of the focus areas identified in its strategies (The Star Online, 2009). On 10th September 2015 when Prime Minister Datuk Seri Najib Razak launched the Construction Industry Transformation Programme (CITP), Malaysia's last five-year plan for the construction industry before 2020, he mentioned that BIM will be made mandatory in the year 2020 (Tamboo 2015). However, up to date the BIM adoption in its earlier stages has yet to be wide-spread (Ahbabi and Alshawi 2015).

Unfortunately, the majority in the built environment professions nowadays are facing significant changes to meet the current trend and needs of the construction industries. The main changes are the job scope of parties in the construction industry is no longer limited to cost planning, measurement, issuing Bills of Quantities, ensuring every stage of the on-going project to be completed on time but they also must be able to master certain information technology skills (Takim, Harris, and Nawawi 2013). Besides that, the fragmented construction industry has poor coordination among its project participants (Razif et al., 2015; Ding et al., 2015, Hughes & Thorpe, 2014, Solomon et al., 2015; Ntayi et al., 2013). Hence, despite the importance of BIM in improving the coordination, the lack of understanding about it makes the construction players in Malaysia reluctant to adopt it. This leads to the low adoption of BIM in architectural firms which stands at 20%, and quantity surveying firms at 10 % (Grant 2016).Therefore, the researcher finds that it is essential to provide a better understanding of the BIM implementation by studying the advantages of BIM adoption and the barriers which might be encountered.

MAIN RESULTS

Methods

This research has conducted a pilot interview with five BIM practitioners who have been selected to give their professional opinions about the implementation of BIM. The BIM experts are from different professional backgrounds and organisations. Two of them are academicians and doctorate holders. The other two are from government agencies who are involved in BIM projects and one is from the private sector of a BIM consultant firm. The researcher has asked all the interviewees 13 questions and the conversation duration is about 1 and half hour for each participant. Basically, all the interviewees are very responsive to the questions being asked.

Findings and Arguments

Table 1. Challenges from construction stakeholders' perspective and their descriptions

Challenges	Description
Lack of cooperation	The current implementation of BIM in Malaysia, from the theoretical aspect, while we have implemented BIM in terms of coordination between the stakeholders such as the consultant, client and contractors, however, in reality, there is still a lack of cooperation between the structural or M&E consultants, architects and designers.
Lack of understanding and knowledge	The consultants, architects, contractors and designers still lack understanding and knowledge about the implementation of BIM, and this has led to misconceptions concerning the adoption of BIM. But this does not apply to all. There are still some consultants who agreed with BIM adoption because BIM can enhance coordination. In reality, it is difficult. If the developers are tied by traditional

	methods, architect will develop their drawings, then pass them onto the C&S consultant for developing the structural drawing, and then to the M&E engineers. By right all the drawings will be superimposed for endorsement as should be the way.
Sharing culture is immature	When BIM has been implemented, issues can be resolved from the beginning. Differences cannot be resolved because the core issues currently lie with the sharing culture among all the parties which are still at a developmental stage and yet to be matured.
Lack of communication between main contractor and subcontractor	It is difficult to secure input from the subcontractor. Once construction has been conducted only then the problem-especially the clashes in piping can be identified by the Nominated subcontractor. However, architectural and structural parts do not have such problems.
Lack of guidelines	In theory, BIM is a process, as such BIM should proceed to the design stage. But currently, the most critical issues lie with the fact that the consultant is not yet ready to implement BIM. There is a lack of guidelines and enforcement to cater for the construction players.
Late involvement of Client	The appropriate approach requires certain consultants to monitor and control the project. This means all parties concerned have to set up what they want to do. Accordingly, the client should take part from the beginning and cater to all significant issues and route. In this way, most issues and disagreements can be resolved. In the event should there be future development-such as an extension of the building, it is important for the client to set his or her resolution from the beginning.
Lack of statement or enforcement	All parties involved are concerned about costs. But in their contracts, there is no statement that addresses the mandatory requirement for the use of BIM. There is also no solid procurement project delivery that specifies that BIM must be used. All the projects must be contractual based. If a client asks the contractor to use BIM for Design and Build or Design Bid Build projects, how the contractual based should be provided.
Lack of the previous record on BIM	Most of the construction players have acknowledged that BIM is beneficial for coordination, however, there is no tangible data to prove that the implementation of BIM is problem free.

CONCLUSION

The significance of this paper is that it reviews and provides insights as to the benefits of BIM implementation and the barriers that could be encountered. Notably, BIM specifically highlights a lot of current issues and problems that could be minimised. Therefore, based on previous studies gleaning from the perspectives given by the interviewees, this research is a critical review on the comparison of the benefits that can be gained by the adoption of BIM – in its different stages and barriers. Conclusively, the construction stakeholders have acknowledged the wide spectrum of benefits through the adoption of BIM albeit the fact that its implementation in the Malaysian construction industry is still in its infancy. They have, however, unanimously agreed that the main challenge could be the construction players' mindset and thinking. Hence, the future research could look into the culture of construction industry or cover the soft issues which might affect the tendency of BIM implementation in the Malaysian construction industry.

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II

SUSTAINABLE TECHNOLOGY AND ENGINEERING

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ANALYSIS SHAPE AND DEVELOPMENT TIME OF DAM BREACH AT JATIBARANG DAM

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ABSTRACT

Dams have many benefits, however dams can cause big problems. One of the problem is dam failure. Dam failure can cause loss of lives and materials. For example, the 1963 failure of Vajont dam in Italy caused 2600 deaths, the 1976 failure of Teton dam in America caused hundred deaths and economic loss about 1 bilion dollars, and the 1993 failure of Gouhou dam in China caused 300 deaths. Government of Indonesia have regulations about damsafety, which one each dam must have the document "Rencana Tindak Darurat" (RTD) in order to anticipate loss of lives and material. This study was conducted to know the shape (wide and slope) and time development of the dam breach. Therefore the dam break analysis could be performed for purpose to fit up the document "Rencana Tindak Darurat". The method of this study was Froehlich (1995 & 2008), MacDonald and Langridge-Monopolis (1984), Von Thun and Gillete (1990), Xu and Zhang (2009).

Key words: Dam, Dam breach, Dam failure

INTRODUCTION

A dam is a barrier that stops or restricts the flow of water streams then collect to be used for many benefits. Benefits from dam is to be used for flood control, power plants, source of irrigation and clean water, fish cultivation, tourism, and etc. Dams have many benefits, however dams can cause big problems. One of the problem is dam failure. Dam failure can cause loss of lives and materials. For example, the 1963 failure of Vajont dam in Italy caused 2600 deaths, the 1976 failure of Teton dam in America caused hundred deaths and economic loss about 1 bilion dollars, and the 1993 failure of Gouhou dam in China caused 300 deaths (you, 2012).

Government of Indonesia have regulations about damsafety, which one each dam must have the document "Rencana Tindak Darurat" (RTD) in order to anticipate loss of lives and material. This study was conducted to know the shape (wide and slope) and time development of the dam breach. Therefore the dam break analysis could be performed for purpose to fit up the document "Rencana Tindak Darurat".

Jatibarang dam located at Semarang City, Indonesia. This dam located in highland of semarang city that makes the dam dangerous for city itself because can make the city sink if the dam failure. Due to jatibarang dam have spillway that able to serve Qpmf flood, then assumed jatibarang dam will failure because piping only.

MAIN RESULTS

Jatibarang dam have some parameters, which shown at Figure 1.

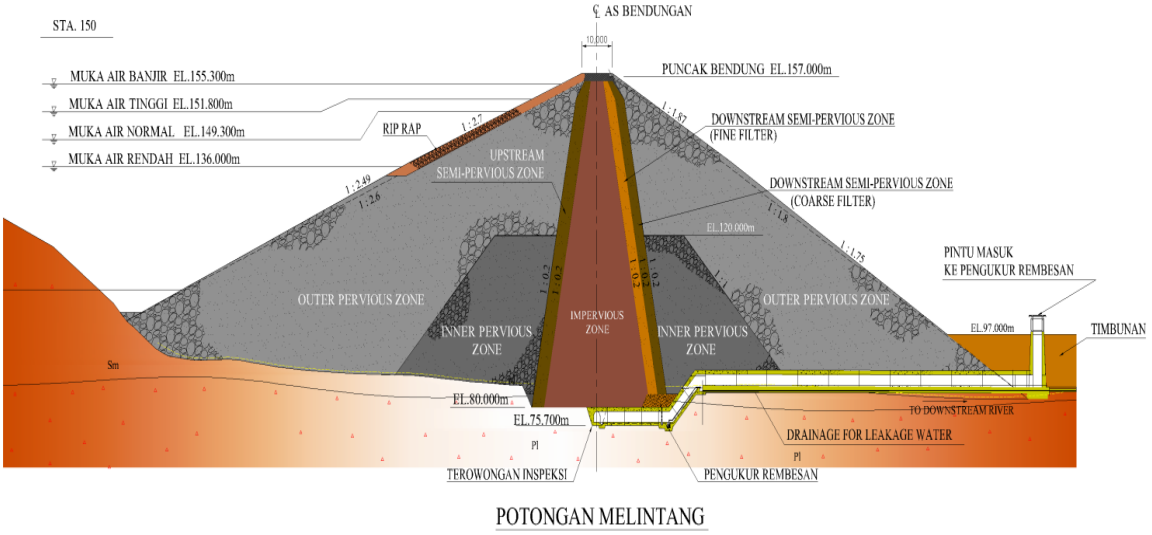

Figure 1. Cross section Jatibarang dam

The method of this study was Froehlich (1995 & 2008), MacDonald and Langridge-Monopolis (1984), Von Thun and Gillete (1990), Xu and Zhang (2009).

Froehlich (1995): Utilized 63 earthen, zoned earthen, earthen with a core wall, and rockfill data sets. The data that Froehlich used for his regression analysis had the following ranges: height of the dams 3.66 – 92.96 meters and volume of water at breach time 0.0130 – 660.0 $m^3 \times 10^6$. Froehlich regression equations for average breach width and failure time are:

$$B_{ave} = 0.1803\, K_0 V_w^{0.32} h_b^{0.19} \; ; t_f = 0.00254 V_w^{0.53} h_b^{-0.90}$$

Froehlich states that the average side slopes should be 1.4H:1V (for overtoping failures) and 0.9H:1V (for otherwise i.e., piping/seepage)

Froehlich (2008): Utilized 74 earthen, zoned earthen, earthen with a core wall, and rockfill data sets. The data that Froehlich used for his regression analysis had the following ranges: height of the dams 3.05 – 92.96 meters and volume of water at breach time 0.0139 – 660.0 $m^3 \times 10^6$. Froehlich regression equations for average breach width and failure time are:

$$B_{ave} = 0.27\, K_0 V_w^{0.32} h_b^{0.04} \; ; t_f = 63.2 \sqrt{\frac{V_w}{g h_b^2}}$$

Froehlich states that the average side slopes should be 1.0H:1V (for overtoping failures) and 0.7H:1V (for otherwise i.e., piping/seepage)

MacDonald and Langridge - Monopolis (1984): Utilized 42 data sets (predominantly earthfill dams with a clay core, rockfill dams) to develop a relationship for what they call the "Branch Formation Factor". The data that MacDonald and Langridge – Monopolis used for his regression analysis had the following ranges: height of the dams 4.27 – 92.96 meters and volume of water at breach time 0.0037 – 660.0 $m^3 \times 10^6$. MacDonald and Langridge - Monopolis equation for volume of material eroded and breach formation time, as reported by wahl (1998):

$$V_{eroded} = 0.00348\,(V_{out}h_w)^{0.852}\ ; t_f = 0.0179\,(K_0 h_w)^{0.769}\ ;$$

$$W_b = \frac{V_{eroded} - h_b{}^2(CZ_b + h_b Z_b Z_3/3)}{h_b(C + h_b Z_3/2)}$$

MacDonald and Langridge - Monopolis states that the average side slopes should be trapezoidal 0.5H:1V.

Von Thun and Gillette (1990): Used 57 dams from both the Froehlich (1987) paper and the MacDonald and Langridge – Monopolis (1984) paper to develop their metodology. The data that Von Thun and Gillette used for his regression analysis had the following ranges: height of the dams 3.66 – 92.96 meters and volume of water at breach time 0.027 – 660.0 $m^3 \times 10^6$. The Von Thun and Gillette equation is:

$$B_{ave} = 2.5h_w + C_b\ ; t_f = 0.015\ h_w\ ; t_f = \frac{B_{ave}}{4h_w + 61.0}$$

Von Thun and Gillette states that the average side slopes should be trapezoidal 0.5H:1V.

Xu and Zhang (2009): contained 182 earth and rockfill dams from the U.S and China, with nearly 50% of the dams greater than 15 meters in high. The data that Xu and Zhang used for his regression analysis had the following ranges: height of the dams 3.2 – 92.96 meters and volume of water at breach time 0.105 – 660.0 $m^3 \times 10^6$. The Xu and Zhang equation is:

$$\frac{B_{ave}}{h_b} = 0.787\left(\frac{h_d}{h_r}\right)^{0.133}\left(\frac{V_w{}^{1/3}}{h_w}\right)^{0.652} e^{B_5}\ ; \frac{B_t}{h_b} = 1.062\left(\frac{h_d}{h_r}\right)^{0.092}\left(\frac{V_w{}^{1/3}}{h_w}\right)^{0.508} e^{B_2}\ ; Z = \frac{B_t - B_{ave}}{h_b}$$

$$; \frac{T_f}{T_r} = 0.304\left(\frac{h_d}{h_r}\right)^{0.707}\left(\frac{V_w{}^{1/3}}{h_w}\right)^{1.228} e^{B_5}$$

Xu and Zhang states that the average side slopes should be trapezoidal "Z"H:1V.

Shown in table.1 is a summary of the breach parameters computed from the regression equation.

Table 1. Summary of Breach Parameter Estimates

Method	Breach Bottom Width (meters)	Breach Top Width (meters)	Average Breach Width (meters)	Breach Side Slopes (H:1V)	Area (m2)	Breach Failure Time (hours)
Froehlich (1995a)	20.55	159.15	89.85	0.90	6918.45	0.381
Froehlich (2008)	16.23	124.03	70.13	0.70	5400.01	0.329
MacDonald and Langridge - Monopolis (1984)	37.30	114.30	75.80	0.50	5836.56	1.610

Von Thun and Gillette (1990)	193.28	270.28	243.15	0.50	17847.06	0.671
Xu and Zhang (2009)	53.70	198.78	126.24	0.94	9720.44	0.633

CONCLUSION

All five sets of parameters should be entered into the HEC-RAS software and run as separate brench plans. This Will result in five different brench outflow hydrographs. However, once the hydrographs are routed downstream, they will begin to converts towards each other. There are two main reasons for this convergence: (1) the total volume of wáter in each of the different hydrographs is basically the same (being the stored wáter behind the dam at the time of failure, plus whatever inflow occurs; (2) as the hydrographs move downstream, a Sharp hydrograph will attenuate much more quickly than a flat hydrographs.

For a risk assessment study, the user select the set of breach parameters that are considered to be most likely for each event/ pool elevation. This will require engineering judgement. If all of the breach estimates, for a given event/ pool elevation, end up converging to the same flow and stage before getting to any populations at risk and potential damage areas, then the selection of final set of breach parameter should not affect the computations and a simple mean value should be used. However, if the varios sets of breach parameters produce significantly different flow and stage values at downstream locations (population at risk locations and potential damage zones), then engineering judgement will need to be used to pick a set of values that are considered most likely. Conservatively high or low values should not be used, as this will bias the overall results.

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SOIL NAILING DESIGN AND TECHNIQUE FOR CUT SLOPE STABILIZATION: A REVIEW

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ABSTRACT

Soil nailing has been used to reinforce and strengthen slopes by placing steel rods into drilled-hole walls and grouted. The reinforcement is grouted in place to improve the stability of slopes, strengthen excavations and retaining walls. Better selection of soil nailing can solve issues related to limited buffer zone to construct building, boundary issue, slope cutting that encroaches neighbouring side, rental cost of machineries and trucks to export the cut soils, and non-economical method. Other challenges such as heavy rainfall, unexpected pore-water pressure and additional excavation and temporary dewatering can increase cost and time of work. With regards to the issues, this paper aims to review the soil nailing design and technique for slope stabilization in housing and infrastructure construction industry. From the presented different methods and advantages of soil nailing techniques, some methods are found very fast to be constructed but no corrosion protection and only suitable for temporary slopes. The review also indicates that economy structure of soil nailing and utilization of different optimization design methods are required to achieve an optimum design. The availability of software programme purposely for soil nailing reanalysis also capable to determine the soil nailing design performance and achieved the required safety factor (FOS). In depth reviews on selected soil nailing technique and software analysis such as SLOPE/W that used finite element method are recommended in future study.

Key words: Soil nail, Optimum design, Slope failure, Cost effective and Construction slope

INTRODUCTION

Slope failure potentially occurred in the hillsides and steep slopes (Mokhtar Jaafar et al. 2011). Normally, fill slopes should be constructed with a 1.5:1 ratio and if a slope is steeper than this, it is difficult to be stabilized. Filled material, over-steep slopes, weak material zones and cuts in natural soils that have high groundwater level are several causes of construction failure (NTL, 2013). Retaining walls or structures are designed and constructed to solve the problems and a best slope strengthening method is selected to avoid any landslide. Soil nailing is known as a cost-effective construction technique to strengthen weak slope (Jelusic and Zlender, 2013). Constructing a retaining system in deep excavations steep slopes has been proven to be less difficult, cost-effective and has been

extensively used in stabilizing cut slopes in infrastructure projects (Jaya and Joy, 2013). Soil nailing is defined as a passive method to strengthen existing ground by placing steel rods into drilled-hole walls and grouted (Stauffer, 2015; Jaya and Joy, 2013; Zhou et al., 2009). Soil nailing reinforcement is grouted in place to improve the stability of slopes (Geoguide 7, 2008) and strengthen excavations and retaining walls (Fan and Luo, 2008; Ghareh, 2015; Giacchetti et al., 2013; Giri and Sengupta, 2009; Huang, 2012; Lin and Liu, 2017; Kim et al., 2013).

Before using soil nailing as a retaining wall, clients may faced problems related to limited buffer zone to construct building, boundary issue and slope cutting that encroaches neighbouring side. Reducing slope inclination can increase costs due to involvement of rental cost of machineries and trucks to export the cut soils. This also increases duration of the construction work that limiting clients' desire to get more profit (FHWA 2015). Since many slopes in Malaysia are exposed to heavy rainfall, water is one of the root causes of slope failure. Therefore, unexpected pore-water pressure becomes a big challenge and additional excavation and temporary dewatering can increase cost and time of work (Chan et. al, 2017). The stability of temporarily unsupported cuts can be affected if groundwater is present (FHWA 2015).

This paper aims to review the soil nailing design and technique for slope stabilization in housing and infrastructure construction industry. The review is limited to soil nailing technique that is used in cut slopes. This technique is not suitable for fill slopes because loose fills may lose strength when exposed to shearing at a certain degree of slope. Moreover, forces that mobilized in the nails cannot recover the loss of shear strength in the fills (HKIE, 2013). Fixing soil nails in loose fills can be difficult and involved careful monitoring. More grouting work is required and some ground movements during installation are unavoidable (HKIE, 2003). In soil nailing design, all parameters obtained from site investigation are used for design requirement such as gradient of slope (ß), nails inclination (*i*), diameter (Ø), length and spacing of nails (FHWA, 2015). In the design, safety factor (FOS) requires margin of safety against failure (Geoguide 7, 2008) and the actual load-bearing capacity of a structure.

MAIN RESULTS

The selection of slope stabilization method is very important depending on site situation. Several retaining walls can be constructed but suitability method should be taken into consideration. As discussed earlier, soil-nailing technique is selected due to its cost effective. Five types of soil nailing techniques with different methods and advantages as presented previously by Prashant and Mukherjee (2010), are shown in Table 1. Some methods are very fast but no corrosion protection and only suitable for temporary slope. For the optimal design, designers consider structure of soil nailing that is economy and utilize different optimization design methods during design stage by comparing the structural design (Chan and Raman, 2017). According to JKR Slope Design Guideline (2010), the minimum local and global FOS for treating slopes shall be 1.5. Requirement listed in Table 2, should be complied to achieve an optimum design. A few existing software programme for soil nailing technique as shown in Table 3 commonly used by engineers to analyse the soil nailing design performance. From the listed software, SLOPE/W shows potential advantage to researchers as this software provides analysis of pore-water pressure conditions, soil properties, and slope stability problems. Through the optimization of trial and error method, parameters are

adjusted to achieve FOS of 1.5. According to Jin (2014), when the horizontal spacing design of soil nailing is 1.4 m, the slope with soil nailing support is exceptionally steady and the most extreme level spacing only could be add is within 1 to 2 cm. The design can guarantee engineering safety, but it was not economical. Reproducing design and contrasting through computer-generate analysis of soil nailing support and distinctive separation by software can get a sensible decision in reduce project cost (Jin et al., 2014).

Table 1. Soil nail technique, method and different (Prashant and Mukherjee, 2010)

Type of soil nailing	Method	Differences
Grouted Nail	The nails are placed in the pre-drilled hole after excavation of the first hole in the slope.	Cement grout is then filled in the holes at the end.
Driven Nail	Nails are mechanically driven using vibropercussion pneumatic or hydraulic hammer to the wall during excavation.	Installation is very fast but no corrosion protection is offered. Suitable for stability of temporary slope.
Self-Drilling Soil Nailing	During the drilling, hollow bars are driven and at the same time, grout is injected through.	Better corrosion protection than Driven Nail and faster than the Grouted Nail.
Jet Grouted Soil Nailing	Using high frequency vibropercussion, driving and high-pressure jet grouting is performed during installation.	Jet grouting is performed during installation and provides corrosion protection to the nail.
Launched Soil Nailing	Bars are launched into the soil with very high speed using compressed air launcher.	Installation is very fast and no grouting is needed to the nail and nail installation can be optimized with minimum site destruction.

Table 2. Design requirement for an optimum design and practice (FHWA, 2015; Geoguide 7, 2008)

Soil nailing reinforcement	Requirement	Optimum design and practice
Develop Wall Layout	Determines the height range, wall length and wall alignment	Cost-saving detection, limitations to the drilling equipment, and site survey will be carried out to identify to encounter obstruction during desk study.
Wall Batter	Face wall can be vertical or nearly vertical.	Can use shorter nails if 10 degrees batter is applied to lower down the forces transferred to nails.
Soil Nail Spacing	Ranges from 1.5m to 2m. For nails spacing in both directions.	Rows of soil nails should be staggered. Suggestion spacing nail is a 5 ft. centre to centre.
Soil Nail Inclination	Inclination at 10 to 20 degrees from the horizontal slope.	An inclination of < 10 degrees should be avoided.
Soil Nail Length	Approximately 0.7H; H = Height.	Nail lengths < 0.5H should be avoided. The common nail length is 0.6H.
Soil Nail Diameter	High yield deformed steel bars of	Diameter nail over 20m or 40 mm should

	diameter 25 mm, 32 mm and 40 mm.	be used due to tendency to bend excessively during installation.
Distribution in Elevation	Subsurface and geometric conditions are depending on selection R < 1.0.	i) 0.15 ≤ R ≤ 0.30 is for very dense, coarse-grained granular soils. ii) 0.25 ≤ R ≤ 0.40 is for silty sand, sand, to gravelly sand. iii) 0.30 ≤ R ≤ 0.45 is for fined-grained soils.
Sellect Pattern on Wall Face	Square pattern or staggered pattern.	Staggered pattern results in better soil arching effects, provides a slightly larger resistance and more uniform earth-pressure distributions.
Evaluate Horizontal Splaying	Avoid obstructions and other utilities. Avoid external corners due to interference with adjoining nails or at internal corners, possibly improves the stability.	Before using a design computer programme, nail splaying angle must be considered.
Select Type, Diameter drill hole and Material Properties	To provide bond resistance for stability, a practical minimum drill hole must be estimated. The diameter of drill hole is between 100mm to 200mm.	To accommodate a tremie pipe, tendon couplers, and centralizers.

Table 3. Existing available software analysis

Numerical model	Description of Model	Numerical formulation	Provider	Reference
PLAXIS	Design and analysis of soil and rock deformation and stability, soil structure interaction, and groundwater and heat flow for 2-Dimensional and 3-Dimensional engineering,	Limit Equilibrium Method	Iman Systems	(Da Costa and Sagaseta, 2010)
ABAQUS	Used for both the modelling and analysis of mechanical components and assemblies (pre-processing) and visualizing the finite element analysis result.	Finite Element Method	Dassault Systèmes	(Stauffer, 2015; Su, 2006)
SNAP_2	Evaluates the internal and external wall stability (including limit-equilibrium global slope stability) based on the current standards in the ASD method. Used to evaluate verification and proof field test results.	Limit Equilibrium Method	The Federal Highway Administration (FHWA)	(FHWA, 2010)
SLOPE/W	Used to analyse slip surface shapes, pore-water pressure conditions, soil properties, slope stability problems, analysis methods and loading conditions. Overcome some limitations of the purely limited equilibrium formulations.	Finite Element Method	GEO-SLOPE International Limited	(Geo-Slope, 2012)

CONCLUSION

This review has summarized the soil nailing application, design and its software analysis. The optimization of soil nailing design is presented to ideally propose a cost-effective method. By using this soil nailing technique, construction cost can be reduced because of optimum design and practice implemented. Selected method of soil nailing technique and software analysis such as SLOPE/W that used finite element method are recommended in future study.

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INVESTIGATION OF LANDSLIDE TRIGGERING FACTORS USING GEO-RESISTIVITY METHOD

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ABSTRACT

Since Indonesia is located on the equator, causing it has a high annual rainfall approximately about 3500 mm/year. In addition, Indonesia also has many mountainous areas that causing it has a steep topography and also a various geology condition in each region. Those two factors are indicated as a trigger of natural landslide disaster. Another factor that also triggers the occurrence of the landslide is the changing of land function on catchment areas and slopes. The landslide disaster in Indonesia is increasing continuously in the last decade with the number of the event reach up to 3875 events. For example, in 2014 in Trangkil, Semarang City, the landslide was occurred and destroy at least 32 houses, and in the same year in Gombel Lama, Semarang City, 21 peoples were found buried by the landslide. In 2016 in Bukitsari Housing, landslide causing two peoples dead due to the collapse of the retaining wall. This research was conducted to visualize the form of the subsurface of soil layer by comparing the result of geo-resistivity and geological map that could be used as a reference to determine the location of the slips field.

Key words: Landslide, Geo-resisitivity, Wenner-Schlumberger

INTRODUCTION

Indonesia is one of the countries located on the equator and has high annual rainfall approximately about 3500 mm/year. Other than that, Indonesia also has numerous mountainous area that makes its topography tends to steep as well as makes each region has a diverse geological condition therefore it is indicated as the cause of the landslide. In addition climate change affects the stability of the natural and artificial slopes that resulting in landslides (Gariano, L.S and Guzzety F, 2016). There are numerous causes of the landslide, caused by natural namely are the topography location, rock layer condition, soil condition, geological shape, rainfall intensity, groundwater, earthquake, etc. Meanwhile, caused by human or artificial, namely are excavation or displacement of rocks, and landfill (Bromhead, 1992).Landslide disaster in Indonesia continues to increase in the last decade with a total of 3875 incidents (BNPB, 2017). The city of Semarang is a region that has a various topographical condition such as coastal areas, plains, and hills. The hilly topography conditions with the angle of slope range in 0% - 45% resulting in many unstable slopes. This instability occurs due to the geological structure in Semarang City which consists of normal

faults, rising faults and shear faults. Because of this shear faults and rising faults, the movement of the land occurs. The example of a landslide incident in Semarang, in 2014 at Trangkil region of Semarang, landslide damaged 32 houses, in the same year in Gombel Lama region of Semarang 21 people were found buried in landslides, and in 2016 in Bukitsari Housing, 2 people were killed due to collapse of retaining wall (BPS Kota Semarang, 2016). This research was conducted to visualize the form of the subsurface of soil layer by comparing the result of geo-resistivity and geological maps that could be used as a reference to determine the location of the slips field.

METHODOLOGY

The research location is located in TAMAN UNNES Gunung Ledek, Trangkil, City of Semarang. The research focuses on red zone area at point 178 with the altitude of 139 meters above sea level. The coordinate of the location is located at 7°2'7" S - 110°23'27" E.

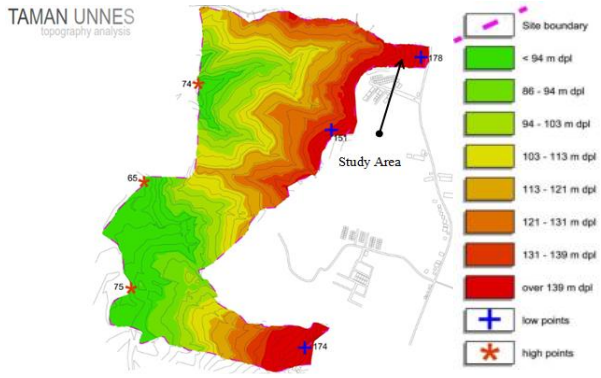

Figure 2. Topography map of research location

Figure 3. The condition of research

The research location have a various tilt angle of slope with the biggest angle is >30°. Based on the geological map on research site that consists of volcanic rock (Qb) such as breccia, lava flows, tuffs, sandstone, and clay so that results in weathering of rocks of slit clay reddish-brown with a thickness of more than 3 meters. Marin layer (Tm), consists of alternating clay, marl, sandstone, conglomerate, breccia, and limestone. Marin layer is dominated by clay with alternating sandstone and marl. Generally, clay on Marin layer is effortless to decay and destroyed when it exposed to air contact. Meanwhile, sandstone on this layer, generally have a fine-coarse-grained and mostly is tuffs. The stratification of the limestone on this layer is can not determined.

Damar formation (Qtd), consists of tuffs-sandstone, conglomerate, breccia, and tuffs. The composers of tuffs-sandstone are consists of feldspar and mafic mineral grains, sandstone, and tuffs in compressed conditions. Breccia is consist of alkaline volcanic rocks that are likely deposited as lava. Breccia is usually decayed in the form of silty-sand to brownish-red clayey-silt with 2.5 meter of thickness (Figure 4).

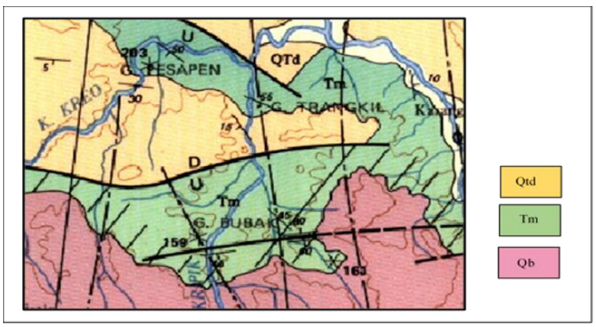

Figure 4. Map of geological condition

The geoelectric investigation is a soil investigation for obtaining estimates on soil subsurface layer based on the pseudo resistivity value of each layer of rock/soil that influenced by the configuration factor. With equation formula as follows :

$$\rho = k \frac{\Delta V}{I} \quad \text{.....} \quad (1)$$

explanation, ρ is apparent resistivity (ohm.m), ΔV is voltage difference (volt), I is currents (ampere), k is configuration factor. The configuration that was used in this research is Wenner-Schlumberger configuration that is intended that the vertically and horizontally sensitivity values are better than the other configurations. The formula equation of geometric factor (k) is as follows,

$$k = 2\,\pi\,n\,(n+1)a \text{.....} \quad (2)$$

where as, k is geometric factor, n is multiplier, a is distance of the electrode. The spacing between 2 electrodes is 2 meter with path length 50 meter with the value of n is from n = 1 up to n = 12. The data that was obtained from field investigation with geoelectric is the value of the potential difference of electrode (volt) and value of current-voltage (ampere).

RESULT AND DISCUSSION

The geoelectric analysis was done by using RES2DINV software for Win 98 / Me / NT / 2000 / XP, and the result of a 2D model of the subsurface layer was obtained (Figure 5).

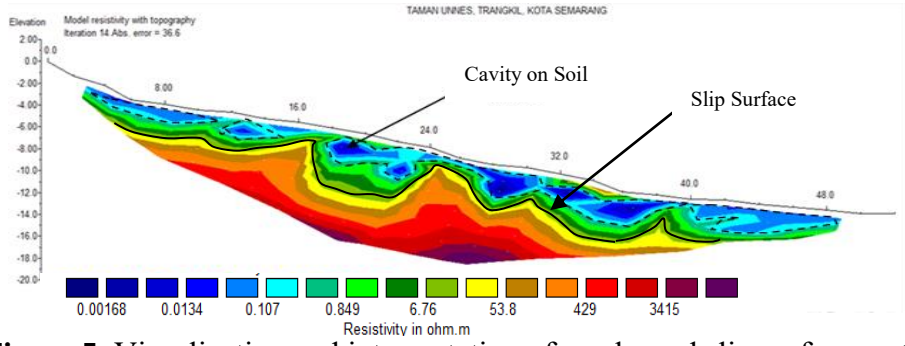

Figure 5. Visualization and interpretation of cracks and slip surface on the slopes

From these results, the interpretation of a resistance value of pseudo rocks type on the slope of Taman UNNES. Based on the geoelectric testing result on 0.5 – 2.5 meter in depth, the resistivity value of soil is 1.7 x 10^{-3} – 0.846 Ωm and is interpreted as clay. This testing result is influenced by the presence of the cavity in the soil so that when in the raining season, the soil tends to store a lot of water content and when in the summer season the soil is shrinking so that resulting in cracks in the soil (Figure 6).

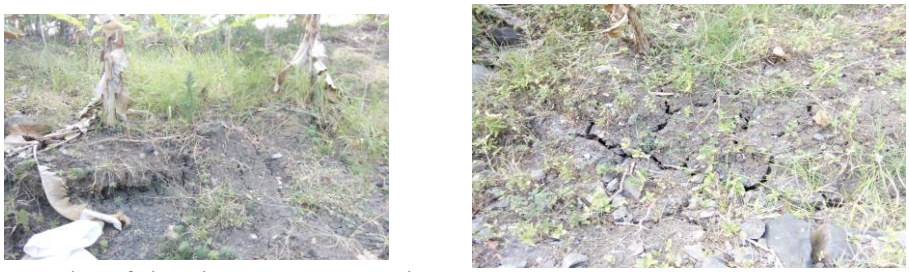

Figure 6. Cracks of the slopes on research location

On 2,5 – 5 meter in depth the resistivity value of 6.76 Ωm is interpreted as clay, on 5 – 15 meter in depth, the resistivity value of 53.8 Ωm is interpreted as sandy tuffs, and on 15 – 20 meter in depth, the resistivity value of 429 – 3415 Ωm is interpreted as sandstone. The layer

that was indicated experienced a sliding occur on the boundary between clay layer and sandy tuffs layer has a resistivity value between 6.76 – 53.8 Ωm.
The correlation between the geoelectric result and geological map can predict that the geological structure on the subsurface on the research location is consists of clay and sand.

CONCLUSION

Based on the analysis result it can be seen that the topography with slope >30° is considered as a steep slope that could cause a landslide. Another factor that based on geo-resistivity analysis can be seen that the resistivity value of 1,7 x 10^{-3} – 6,76 Ωm is classified as clay on 0 – 5 meter in depth, 53.8 Ωm is classified as sandy tuffs on 5 – 15 meter in depth and 429 – 3415 Ωm is classified as sandstone on 15 – 20 meter in depth. On soil with clay type that has a resistivity less than 1 is known that when in the rainy season tends to store a lot of water content and in the summer season tends to dry and also has cracks. It is indicated as the cause of the landslide. On the average, the depth of sliding field is located on 6 until 10 meters in depth. The soil layer that experienced a sliding field is consist of silty sand.

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FACTORS INFLUENCE FIRE EVACUATION TIME FOR HIGH-RISE BUILDING: TELEKOM TOWER

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ABSTRACT

Building evacuation is a critical element of a high rise building's emergency safety. Hence, it is important to have a deep research on the full-scale evacuation from a high-rise building as it assists in gaining better understanding on how prepared and fast can a high-structure be evacuated fully. This study is undertaken to identify all possible contributing factors that result in lengthy evacuation time and to recommend appropriate evacuation procedures for shorter evacuation time at Telekom Tower, the third tallest building in Malaysia. The current evacuation procedures implemented at the tower were examined using mixed-methods approach, incorporating both qualitative and quantitative analysis. Results of the factors that influence the evacuation time is summarized into three main categories: individual factor, organizational factor and structural factor. Based on the outcome, this study propose further recommendations for the building management of Telekom Tower to implement on new egress strategy such as phased evacuation as well as new vertical egress methods such as helicopter and escape chute system as an effort to improvise the evacuation time at Telekom Tower.

Key words: High-rise building, Evacuation, Egress time, Assembly area, Fire safety

INTRODUCTION

In recent decades, urbanization process due to rapid development of economic has contributed to the growth of many big cities around the world. As a result, this has caused limitations in land space due to the increase in the population of occupants in these major cities. Therefore, many ultra large scale high-rise building over 100-meter have been constructed unceasingly by the developers. These high-rise building comprises of residential, office and commercial buildings such as hotel and shopping complex.

National Fire Protection Association (NFPA), the United States Trade Association defined high-rise buildings as a building which is built greater than 75 feet in height (approximately 23m or about eight or ten stories and more), where the building height is measured from the lowest level of fire department vehicle till to the highest accessible floor (NFPA 2012). In Malaysia, buildings that built above 12 floors are considered as

high-rise category (Bernama 2011). Examples of high-rise building in Malaysia are the Petronas Twin Tower, Kuala Lumpur Tower, Telekom Tower and many more. Hence, a research was conducted at Telekom Tower located at Jalan Pantai, Kuala Lumpur as it is considered as third tallest building in Malaysia with 55 floors and more than 10,000 occupants.

On the other hand, the development of these high-rise building have also proportionally contributes to the increase in potential safety hazards. Some of the example of dangerous hazards that pose serious challenge and being associated with high-rise buildings are such as fire outbreaks, terrorist attack, release of toxic gas and others. Particularly in Malaysia, fire outbreak is one of the common hazard that can cause enormous causalities and property loss and hence influences the social stability and economic development of the country (Prashant 2007).

Generally, most of the high-rise buildings in Malaysia are equipped with standard safety features that able to facilitate for minor or moderate emergency evacuations as it is governed by the Uniform Building By-Law, UBBL 1984 regulation (Bernama 2011). Therefore, a major emergency evacuation from a high-rise building is very unlikely to be practiced, which subsequently results in less knowledge on the readiness, capabilities and effectiveness of fast evacuation from a high-rise building. The factors that may influence the length of time for evacuation from a high-rise office building is still remain under-studied. Knowledge from these finding is very vital as it can be used to improvise emergency evacuation procedures and save people from any injury or causalities.

Hence, the main aim of the present work is to identify the possible contributing factors that may results in lengthy evacuation time of high-rise office building and then investigate the ways to improve safety evacuation and proposed a new evacuation procedure for shorter evacuation time.

MAIN RESULTS

The primary method is data collection through semi-structured interview where the building safety officer and the Representative from Fire & Rescue Department was interviewed to obtain their opinions on current evacuation procedures at Telekom Tower. The secondary source is based on data collected through questionnaire survey form that were distributed randomly to the occupants residing from varies floor at Telekom Tower. The questions mainly focus on the awareness and knowledge of the occupants on subjects pertaining to emergency fire evacuation at Telekom Tower, opinions on factors that might influence the length of evacuation time as well as their personal experience in participating in the previous fire drill practice that was being conducted.

Lastly, observation and visual inspection on the condition and structural of Telekom Tower building were carried out to identify the environmental factors that contribute to lengthy evacuation time. In a nutshell, all these possible contributing factors that leads to delay in evacuation time was gathered, summarized and developed as a framework as shown in Table 1. Results show that factors such as human behaviors and response, lack of coordination between multiple tenants, physical ability, lack of awareness and commitment contributes largely to the lengthy of evacuation time during fire drills. This is proved when

only half of the tenants agreed to evacuate immediately from the building when hearing fire alarm.

Table 1. List of identify factors that influence the length of evacuation time at Telekom Tower

Factors	List of factors
Individual Factor	- Physical Limitation – Age, gender, obesity, fatigue and pregnancy - Disability & Medical Condition – visual & Hearing Impairment, Mobility Impairment - Lack of Awareness, Commitment & Involvement - Human Behaviors & Responses-Delaying. Negligence & Inconsiderate - Sensory Cues - Lack of perception of risk-Exit choices. Route taken, stopping and others - Low level of knowledge on Emergency Preparedness
Organizational Factor	- Lack of coordination and involvement from multiple tenants - Inadequate risk communication - Delay and lack of cooperation among the Emergency Response Team members
Environmental Factor	- Situational features – Evacuee density, conditions of escape routes. Confusion and judgments of using exit choices - Engineering features – no. of exit choices, poor lighting at escape routes, unilluminated staircase and location of the building – encircled in between of major highways and etc.

CONCLUSION

In conclusion, the current evacuation procedure being implemented at Telekom Tower is complete, sufficient and adequate to have a systematic and well-organize emergency evacuation at the building. However, certain amendments and revision such on designated assembly point and re-assignment of designated exit staircase choices to be used based on the density of the occupants in each floor can be considered for future works. Primarily, new strategies and techniques need to be developed in order to increase the awareness as well as increase the effectiveness on implementation of evacuation procedures among the multiple tenants residing at the building.

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A REVIEW ON CONCEPTUAL DESIGN OF OCEAN THERMAL ENERGY CONVERSION (OTEC) PLATFORM

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ABSTRACT

Recent technological discoveries have made ocean thermal energy conversion (OTEC) a possible source of sustainable energy in the near future. OTEC utilize temperature differences between ocean surface water and cooler deep water to produce energy continuously. For each megawatt of generating electricity, it can produce up to 2 million liters per day. Also, no products of combustion are generated during the process since OTEC has less environmental impact than other sources of energy. All these aspects caused a revival of interest in OTEC, thus in line with the Sustainable Energy Development Authority Act (2011) of Malaysia that focus on the development of renewable energy. The commercialize OTEC platforms are land based and floating types, located in Japan and Hawaii. The platform type is according to the availability of the selected site to utilize enough temperature different for energy generation. Since Malaysia has a different water depth profile, this research will review the relevant conceptual design of the OTEC platform to be utilized in Malaysia region.

Key words: Ocean thermal energy, Offshore structure, Renewable energy

INTRODUCTION

Malaysia is dependent on fossil fuel for industrial and transport sector, generating 94.5% electric power. The electrical energy is commonly generated based on heat energy extracted from the combustion of fossil fuel. Instead of using the non-renewable energy sources, OTEC take advantage of the temperature gradient that occurred naturally in the ocean to produce electricity, with an ideal temperature's different of 20°C (Kempener and Neumann, 2014). One of the of OTEC's greatest advantages is that it allows the co-production of drinkable water, in addition to electric power through desalination. For each megawatt of generating electricity, it can produce up to 2 million liters per day (Cohen, 1982). Also, no products of combustion are generated during the process since OTEC has less environmental impact than other sources of energy. All these aspects caused a revival of interest in OTEC, thus in line with the Sustainable Energy Development Authority Act (2011) of Malaysia that focus on the development of renewable energy (Chen, 2012; Chong and Lam, 2013).

DEVELOPMENT OF OTEC POWER PLANT

In OTEC plant, the warm seawater from the ocean surface being pumped through heat exchangers to vaporize a secondary working fluid (such as ammonia, propane or chlorofluorocarbon (CFC)) creating a high-pressure vapor to drive a turbine. The vapor is subsequently cooled by seawater to return it to a liquid phase. The process was repeated in a one complete cycle. Hence, an appropriate location must be considered in the planning of OTEC facility where the facility must be located in a region with access to warm surface waters and cold water, where generally located at deep sea area (with the minimal difference about 20°C).

OTEC plant can be located on land if adjacent to a shelf or rapid decrease in depth, but it needed the long length of the cold water intake pipe to reach the required temperature (NOAA, 2009). To date, five land-based OTEC plants are in operation with energy generated between 15kW to 105kW, initiated by Xenesys and Saga University in 1980 (Ikegami, 2015). Alternatively, an offshore, floating, moored, facility with a vertical cold water intake pipe may be more practical. Technological advancements in the offshore oil industry have made floating OTEC platforms a possibility. Floating platforms can be located virtually anywhere above deep water as long as they can be adequately moored, and the power cable can reach a land-based power grid for electricity generation (NOAA, 2009). To this end, 2 major floating OTEC facilities are under construction at La Martinique (France) and Tarawa Island (Kirabati) with potential energy output up to 11MW. To be summarized, the current developments of the OTEC power plant are briefly listed in Table 1.

Table 1. Current development of Ocean Thermal Energy-driven

Development status	OTEC structure	Description	Output energy	Platform type
Operational	La Réunion, France	Operational since 2012- with the purpose of research and development	15 kW	Land based prototype
	Gosung, Korea	Operational since 2012- with the purpose of research and development	20 kW	Land based prototype
	Saga, Japan	Operational since 1980 with the purpose of research and development	30 kW	Land-based
	Kumejima Island Okinawa, Japan	Operational since 2013 with the purpose of research and development for electricity production	100 kW	Land-based
	Biq Island, Hawaii	The first true closed-cycle OTEC plant to be connected to US electrical grid	105 kW	Floating Plant
Under Construction	La Martinique, France	Pilot plant awarded under NER300 program by the European commission for NEMO project	10.7 MMW	Floating Plant
	Tarawa Island, Kiribati in the South Pacific Ocean	The first practical level of plant on a pathway to building a 100 MW commercial system	1 MW	Floating Plant
Planned & Proposed	Int. Airport Curaçao	Expected to provide reduction of approx. 2500 of tons of CO^2/ year	500 kW	Pilot Plant
	Zambales, Philipines	The first OTEC plant in Philipines and is expected to start operate commercially by 2018	10 MW	Floating Pilot Plant
	Kumejima Island Okinawa, Japan	For a 1 MW plant, the plant would make 1.3 – 1.5 MW power and 1 MW nett	1 MW	Land-based

		power		
	Maldives	The first commercial OTEC system to be install in an-eco resort,	2 MW	Floating Plant **NAJIB**

In the perspective of Malaysia region, OTEC has a great potential to be discovered as a possible source of sustainable energy in the near future (Jaafar, 2016). But, the suitable type of OTEC plant that relevant to Malaysia seawater profile need to be identified. Since fixed platforms are already well established and have been validated in other industries (e.g., offshore oil, wind farms), its capability to be used in an OTEC application is uncertain.

METHODOLOGY

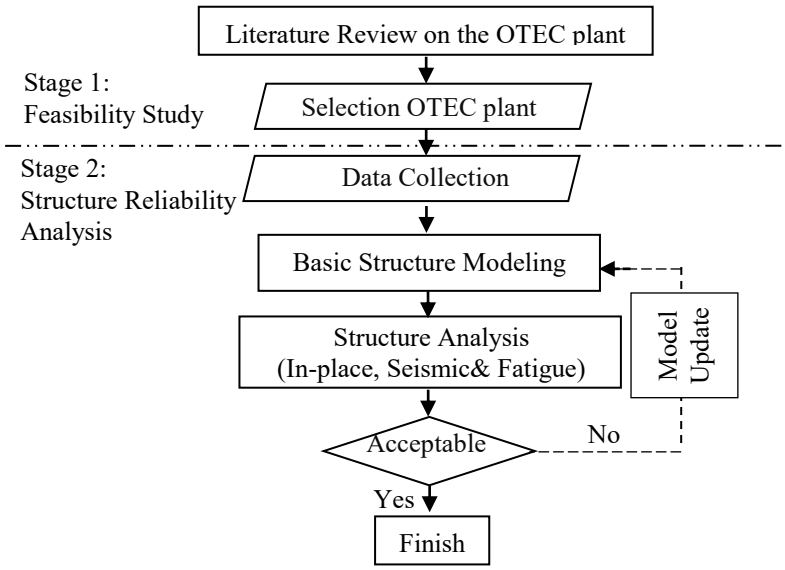

Figure 1. Research flow chart

This research focused on the conceptual design of OTEC power plant to be utilized in Malaysia, according to the review of commercialized OTEC power plant in the worldwide as discussed in the previous section. Figure 1 illustrated the research flow chart that consists of two stages; feasibility study and structure reliability analysis. In stage 1 during the feasibility study, a critical review of commercialized design of OTEC platform has been done. It involved the type of platform used and the seawater profile of the site selected. This leads to the commercialization of land-based and floating OTEC power plants. With the availability to access on sufficient temperature gradient as OTEC requirement, fixed offshore platform was being selected to be used in Malaysia with the depth of 100 m from seawater level and deep water pipeline extension for cold sea water intake.

At the end of stage 1, the conceptual design of fixed OTEC power plant was determined with an aimed to utilize both electric power and water production. In order to ensure that the platform can operate well, according to its service life with a maximum production, stage 2 is required for the purposed of structural reliability analysis (Al-Farisi and Zikra, 2015). Begin with the data collections of both structural data and environmental data, the

basic structural modeling will be carried out according to the industrial application based on a software package such as SACS, SESAM and USFOS. Then the structural analysis will be done followed standard code requirement such as API-RP2A and ISO 19902. However, this paper was only focused on the conceptual design of the fixed OTEC platform regarding on the structure and operational concept. While for the stage 2, it will be discussed in details in the next future work.

MAIN FINDINGS

Fixed offshore OTEC plants can be mounted to the continental shelf at depths up to 100 meters. This type of construction is already commercially used for offshore oil rigs. The complexities of operating a fixed OTEC plant in deeper water may make them more expensive than land-based approaches but economical than floating plant. However, the land-based OTEC plant is not suitable for Malaysia region since the water depth for sufficient temperature's different far from the shoreline. The key challenges of a fixed plant include the stress of open-ocean conditions, heavy load due to OTEC equipment and difficulties of product delivery.

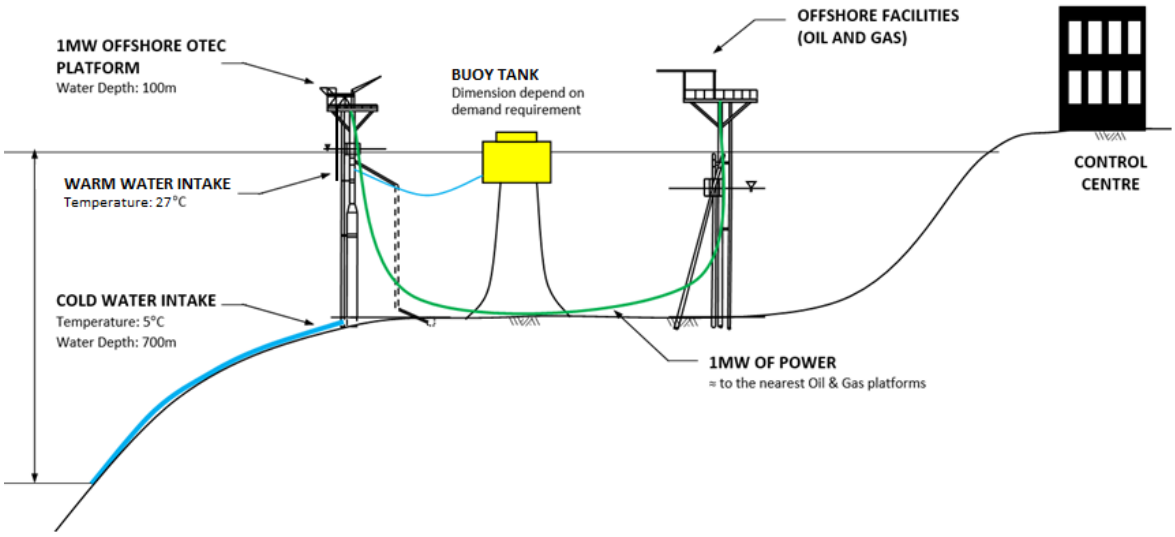

Figure 2. Fixed OTEC power plant concept

Figure 2 illustrated the conceptual design of the fixed OTEC platform, according to the one leg tarpon platform that is capable to withstand up to 310 ton load. The two decks of topside structure provided the facility for OTEC plant equipment, consist of working fluid evaporator and condenser, water production evaporator and condenser, turbine and generator. The equipment capabilities to generate 1MW of electric power that can be supplied to the nearest oil and gas platform.

Since, it has been a one leg platform, bigger diameter of the caisson is needed to withstand load due to OTEC equipment itself. Meanwhile, the buoy act as a transit to store the excess cold water intake for the use of water production and crop plantation due to its abundance of nutrients and minerals. The buoy tank help to reduce the load, cater by the platform so that the OTEC platform was successfully operated as the power electric generation and water production system continuously.

CONCLUSION

Malaysia has a great potential to utilize the OTEC operation. Based on the review of existing OTEC power plant, the seawater profile of Malaysia makes it possible to install a fixed offshore platform as the OTEC power plant. In order to utilize both electric and water production, the fixed OTEC power plant need to be able to withstand weight load due to OTEC equipment and sea water contain. The process of product delivery also needs to be accounted. As the outcome, the fixed OTEC power plant concept has been proposed in this paper with the application of tarpon structure and additional of buoy tank. However, the details on the structural reliability analysis of the fixed OTEC power plant need to be discussed in the next future work to complete the design work.

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SIMULATION ON CLOSED KALINA CYCLE OF AU/TIO$_2$ AND AG/TIO$_2$ OF AMMONIA-WATER HYBRID NANOFLUIDS

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ABSTRACT

Simulation analysis of the turbulent flow of heat transfer in a heat exchanger tube will develop to analyse the thermal performance. Meanwhile, the existing working fluid ammonia-water was prepared by mixing Au/TiO$_2$ and Ag/TiO$_2$ hybrid nanocomposites. In this study to investigate the heat transfer coefficient and Nusselt number for forced convection heat transfer between two working fluid of Au/TiO$_2$ and Ag/TiO$_2$ ammonia-water hybrid nanofluid. The range of Reynolds number selected were 20 000 and 40 000 in a horizontal straight tube of diameter 0.01m with a constant heat flux of 1000 W/m^2. The volume fraction of nanoparticle considered were 0.1%, 0.3%, 0.5%, 0.7% and 0.9%. This problem also considered the nanoparticle size 10nm and temperature operated at 100°C. Finally, the results were compared with the theoretical values obtained from Ayub Equation by using the tool of the package from ANSYS-FLUENT which show similar results.

Key words: Volume fraction, Heat transfer coefficient, Skin friction, Nusselt number

INTRODUCTION

Heat is the amount of energy that transferred from higher temperature to lower temperature. Besides that, heat transfer is widely used in many industrial and consumer product such as heat exchangers, automobile industries, power systems, solar water heater, solar air heater, heating and air conditioning, chemical engineering, electronic chip cooling and aerospace. This subject has received considerable attention to get high efficiency, small size, and light weight. The inherently poor thermal performance of conventional fluids puts a limitation on heat transfer and restricted in developing energy efficient heat transfer fluids that are required for ultra-high performance cooling. Well-designed cooling systems are prerequisites for optimum running operation, keeping operating temperatures and friction of all moving parts within predetermined acceptable limits. High performance and high output operation is the trend of recent design due to its thermal conductivity (Azwadi and Adamu, 2016).

Therefore, scientists and engineers have made a great effort to break this fundamental limit by conducted to increase the thermal carrying capacity of conventional heat transfer fluid to overcome the stated restriction on liquids. This concept of new kind of

fluid called nanofluids that were introduced by (Choi, 1995) in 1995. In order to commercialize this new kind of fluid, many researchers have attempted study on heat transfer performance and flow characteristic of this fluid. Introducing nanofluids in various applications will have increase heat transfer besides limited measurement size product hence reducing fuel consumption and higher efficiency to get better performance. From the previous publish report of nanofluid; they have claimed that nanofluids thermal properties are higher than base fluid such as water or mineral oil (Turgut et al., 2009). Eventually, nanofluids technologies have offered a great potential for further development of high performance, compact and cost effective cooling to utilizing in industrial applications (Wu and Zhao, 2013) and (Wen et al., 2009). Ferrofluids are colloidal liquids made of nanoscale ferromagnetic, or ferrimagnetic, particles suspended in a carrier fluid (usually an organic solvent or water). Ferrofluids usually do not retain magnetization in the absence of an externally applied field (Albrecht et al., 1997).

MAIN RESULTS

This study investigates the behavior working fluid would be affected to heat transfer performance. Simultaneously, the impact of different types of volume fraction on heat enhancement and fluid flow characteristics will be analyzed. In this paper, a comparison will be conducted by using two working fluids, Au/TiO_2 and Ag/TiO_2 + ammonia-water nanofluid in a horizontal circular pipe of 0.01m diameter with constant heat flux, $1000W/m^2$ is investigated. Reynolds number of 20 000 and 40 000 were implemented with six volume fractions nanoparticles which are 0.1%, 0.3%, 0.5%, 0.7% and 0.9%. CFD simulation analysis of enhancement of turbulent flow heat transfer in a horizontal circular pipe by convenient software as Ansys-Fluent was used to predict the heat transfer coefficient and Nusselt number for forced convection heat transfer.

A cylindrical tube in a horizontal position with dimensions of 0.01m diameter and a 0.8m length is considered in the current study. A constant heat flux is applied to the tube wall. The three-dimensional (3D) axisymmetric geometry has been assumed. As the result, a rectangular domain with dimensions of 0.005m x 0.8m is created.

The Nusselt number and heat flux coefficient were calculated by the given equations below. Nusselt numbers based on the present study were calculated as follow:

$$\bar{Nu} = \frac{\bar{h} D}{k} \tag{1}$$

Average heat transfer coefficient (h_x) is defined as:

$$\bar{h}_x = \frac{q''}{(\bar{T}_w(x) - \bar{T}_b(x))} \tag{2}$$

Based on the result obtained from the fluent report, the average of both temperature of wall and bulk can be found from Ansys-Fluent simulation.

Which solved iteratively using finite volume method (FVM) and a SIMPLE scheme was adopted for the treatment of pressure. The Reynolds number studied in this work

is high as the turbulent viscous such as k-ε model has been employed. In this work, converged solutions were considered for residuals lower than 10−6 for all the governing equations. The results of simulation for nanofluid were compared with the theoretical data available for the conventional water. The theoretical data of water were simulated in FLUENT software too. Data were compared with Ayub correlation (Ayub, 2013).

$$f = \left(n / Re^{m}\right)\left(-1.89 + 6.56R - 3.69R^{2}\right) \quad (3)$$

The modelled cases were solved using ANSYS FLUENT. It's first involves creating a system of algebraic equations through the process of discretising the governing equations for mass, momentum, and scalar transport. The finite volume method was a particular finite differencing numerical technique and is the most common method of flow calculations in CFD codes. In this project, SIMPLE algorithm was used in the calculation process. A standard pressure interpolation scheme and SIMPLE pressure velocity coupling were implemented. A residual root-mean-square (RMS) target value of 10^{-6} (10^{-6} for energy equation) was defined for the CFD simulations. All the problems case, the results show that heat transfer coefficient and Nusselt number in graphically.

CONCLUSION

The modified original working fluid properties of ammonia-water with combination two types of nanocomposites (Au and Ag with TiO_2) have increased their thermophysical properties totally. As a result of the review of the nanoparticles impact, it is also found that the presence of nanoparticles is a key factor which is capable of changing the flow and heat transfer capability of the base fluids. From this study, there are some areas that arise for further analysis and development likely radiation influencing, interaction magnetic field (Magnetohydrodynamics) or supported by others reliable sources (the wind, wave and solar) that would be increased heat transfer performance.

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RESIDUAL SOIL SLOPE STRAIN SENSING USING DISTRIBUTED OPTICAL FIBRE

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ABSTRACT

A fully distributed sensing technology named Brillouin Optical Time Domain Analysis (BOTDA) has been introduced into the optical technologies since 1980s, with one of potential applications of this tool is to be used in monitoring the performance of slope stability. In this paper, BOTDA is used to investigate the mechanism of progressive development of soil slope plane failure in a laboratory-based experimental programme. A continuous ribbon optical fibre was embedded with three parallel-arranged fibre segments at different elevations in a 1-g soil slope model of 27 degree inclination. For the pilot test, 1 hour and 2 hour duration of simulated rainfall event was applied on the slope model and eventually the slope model was loaded until failure. The changes in pore water pressure and strain in the soil mass was monitored and measured by using miniature tensiometer and the optical fibre, respectively. It is observed that the rain water infiltration has initiated movement of soil within the slope. The optical fibre was able to detect a mobilisation of soil strain to signify the shear plane progressive development within the slope. It can be summarized that the soil-embedded optical fibre has been able to detect mobilisation of strain in the soil mass which mainly related to progressive development of shear stress in slope.

Key words: Distributed optical fibre, BOTDA, strain development, rainfall infiltration, pore water pressure

INTRODUCTION

Brillouin Distributed Optical Strain Sensing technology which are the Brillouin Optical Time Domain Analysis (BOTDA) and Brillouin Optical Time Domain Reflectometry has been proposed in 1980s by Horiguchi and Tateda (1989). This modernized technology shows positive aspect rather than the traditional sensors due to its long distance measurement, high resolution and low cost of the optical fibers. Zeni et al., (2015) reported a laboratory instrumentation using BOTDA technology for a small-scale model slope in loose unsaturated granular soils where failure triggered by rainfall.

They used a 0.9mm tight buffered single mode telecommunication fibre for the testing. The optical fibre sensor was buried and plastic grid glued for every 20 cm apart to introduce anchoring system in order to determine possible maximum tensile strain in the optical fibre. It was found that the strain readings along the fibre increased with time along with the rainfall infiltration. Then, a feasibility study on strain-based slope stability evaluation has been initiated by Zhu et al., (2016) using BOTDA-based optical fibre sensor been embedded in a two-dimensional (2D) physical slope model. The measurements of horizontal strain averaging from three parallel-arranged fibre segments at different elevations in the model were subjected to axial surcharge load as in previous research done by Zhu et al., (2014). Then, a numerical modelling was done to verify the 1-g physical model results. Their numerical result showed the slip surface occurred in front of where maximum strains had appeared. The occurrence of maximum strain in these parallel segments was an indication of the progression development of shear plane.

Also, Yan et al., (2016) conducted a research on the effect of rainfall infiltration to deformation of soil slope using BOTDA. The slope has been instrumented with two moisture probes, four horizontal parallel-arranged and three upright-planted of 2-mm polyurethane tight-buffered optical fibre. The laboratory results showed that the rainfall infiltration do contribute to slope failure mechanism as the strain has been observed to accumulate corresponded to water infiltration area in the slope body mass.

MAIN RESULTS

The recent study involves a laboratory instrumentation programme to monitor the deformation behaviour due to rainfall infiltration and surcharge load using distributed optical fibre. The study is limited to the local condition of residual soil slope. The material is selected from weathering grade of Grade VI known as residual soil. The samples are attained from university area and rainfall intensities variation is based on the Intensity-Duration-Frequency curve (IDF Curve) of the Johor station. The soil slope model size is designed based on the Jabatan Kerja Raya 'Guidelines for Slope Design' (JKR, 2010) specification on cut slope and fill slope. This study is aimed on obtaining the mechanism of the progressive development of slope plane failure under coupling effect of rainfall infiltration and loading using optical fibre.

From the preliminary tests, a 1 hour and 2 hours artificial rainfall simulation with a rainfall intensity of 2.46×10^{-5} and 1.51×10^{-5} m/s were allowed to infiltrate into the model. The mobilization of strain inside the soil slope was occurred due to the occurrences of soil movement based on differences of soil self-weight from dry to wet condition. Then, the model was loaded with a uniform surcharge load by imposing axial load on 0.15m by 0.3m load plate size. Figure 1 shows a 2D view of maximum strain distribution at three-parallel arranged optical fibre segment; A, B and C at different elevations (L1, L2 and L3) and the features obtained when the soil model was failed (Figure 2). The progression of peak strains from the crest to the slope toe have illustrated how the soil shear stress mobilized and resisted the driving stress from the surcharge load and finally created a shear band within the soil slope.

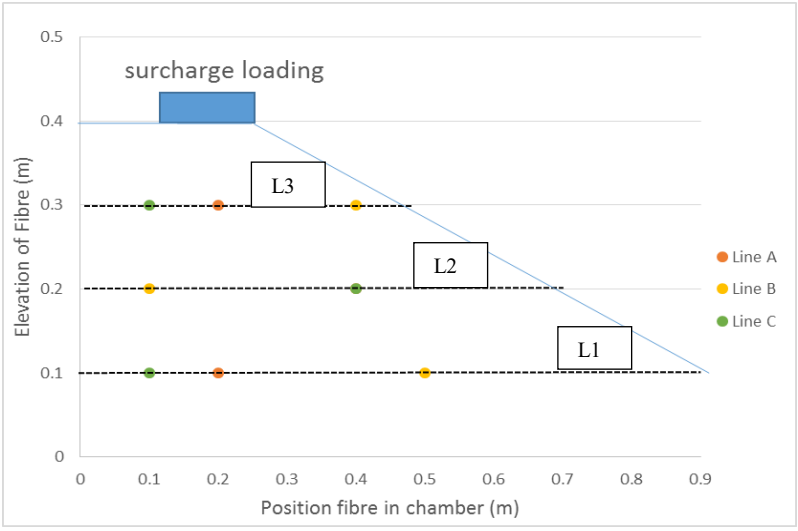

Figure 1. Maximum strain at three-parallel arranged fibre segment; A, B and C subjected to 2 hours rainfall

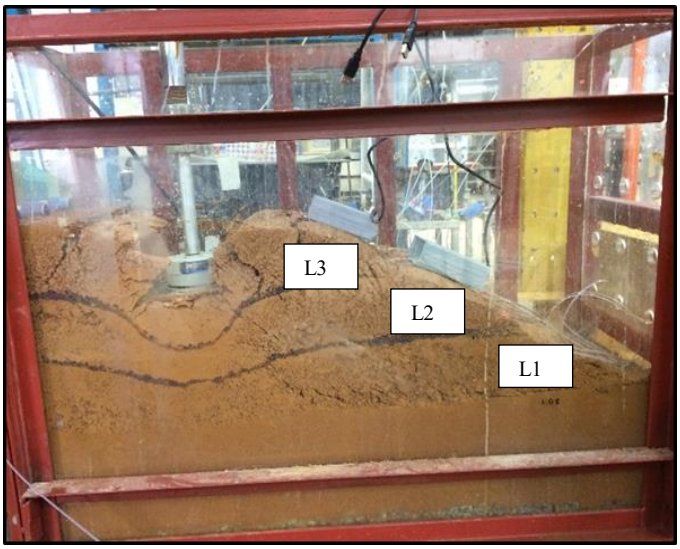

Figure 2. Slope failure features

CONCLUSION

From the preliminary testing programme, it can be concluded that the soil-embedded optical fibre has been able to measure strain in soil mass due to rainfall infiltration and under staged loading. The infiltration had caused an increase of soil weight and subsequently made the soil particle deformed from its original state. The deformation of soil particles in the slope mass were detected by the optical fibre as a strain readings which have been converted from laser frequencies differences. Also, the position of maximum strain in the cable has illustrated the progression development of shear plane within the soil mass.

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RELIABILITY SYSTEM FOR FIXED OFFSHORE STRUCTURES IN MALAYSIAN WATER

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ABSTRACT

Offshore jacket platforms are commonly used for oil and gas production in the shallow water depths of Malaysia. Over 250 installations have been operating for more than 20 years. In view of the continuous production required beyond the design life, life extension of these facilities is inevitable. To manage safety and integrity of these structures, the following two methods have been accepted by most major marine operators in the offshore industry: a) Reliability-Based Design and Assessment (RBDA) method and b) Global Ultimate Strength Assessment (GUSA) method. Both approaches are based on the design code for fixed offshore structures by utilising limit state equation of probabilistic model based on load model (wave load) and structure's strength (load resistance). The outcomes of comparison, i.e., reserve strength ratio (RSR) and the probability of failure (POF) from the two methods contribute to risk management and safety level.

Key words: Probabilistic model, reserve strength ratio, probability of failure

INTRODUCTION

Further development of the oil and gas industry while resources are becoming scarcer is challenging. Thus, the increase in development cost has demanded companies to enhance the recovery of oil and gas from developed fields and discover and develop new reserves from existing oil and gas platforms (PETRONAS Research & Scientific Services Sdn. Bhd., 1999). Utilizing existing platforms to recover and enhance oil and gas resources has its challenges, mostly due to space limitation and structural integrity. Structural integrity is one of the major issues for ageing platforms, particularly in the presence of significant modifications or fatigue damage to jacket members (Abu Husain et al. 2017). The results from GUSA and RBDA analysis are required to give a high confidence level of structural strength for extended design life and additional years of production. In this paper, the probability of failure on the ageing existing jacket platform is investigated to evaluate the possibility for life extension using GUSA and RBDA procedures.

STRUCTURAL RELIABILITY ANALYSIS (SRA)

Optimum mitigation measures shall be established through adequately detailed structural integrity reassessment analysis together with an in-depth understanding of structural failure mechanisms (Ayob et al. 2014). In practice, SHELL was a pioneer in the industry when it started to introduce the Reliability-Based Design Assessment (RBDA) since early 1995 for all worldwide facilities. Later, PETRONAS developed the Global Ultimate Strength Assessment (GUSA), in use since 2012 in the region of Malaysian waters.

Global Ultimate Strength Assessment, typically known as GUSA, is a comprehensive methodology established to support reassessment activities. Three (3) integrated analyses, i.e. nonlinear plastic collapse (NPC), member importance analysis (MIA) and structural reliability assessment (SRA). The result of these analyses can efficiently assist the understanding of the structure's failure mechanisms and correctly define the appropriate type of mitigation required (Ayob et al., 2014).

While, the Reliability-Based Design and Assessment (RBDA) is an analytical technique for structural reliability assessment, criteria for design and reassessment are derived regarding the required platform collapse strength and corresponding failure probabilities. This method consists of Type I and II uncertainties used to determine the probability of failure for the structure over its remaining service life. Criteria are derived by reducing risk to a level that is as low as reasonably practicable (the ALARP principle) (Efthymiou and Van de Graaf, 1997).

MAIN RESULTS

The flowchart presented in Figure 1, the process begins with a literature review on structural reliability analysis (SRA). Data of met-ocean and model of in-place analysis from linear analysis gathered and reviewed. Followed by non-linear pushover analysis to determine reserve strength ratio (RSR) as per prescribed return period (RP) and calculate the probability of failure (POF) under GUSA or and RBDA, for both results as output outcomes. Finally, the decision made under risk management and safety level is identified and categorised by operator or owner.

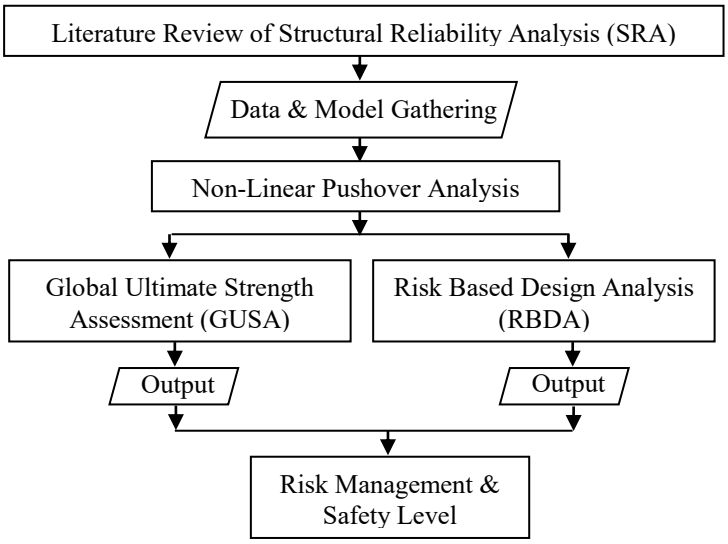

Figure 1. Structural Reliability Analysis (SRA) Process

One of example ageing platform (6 legged with water depth is 27m) in Malaysia water, where due to the demand to prolong the production for further 25 years and it has been evaluated in design level with major modifications and fatigue issues. The result in Table 1 shows the different probability of failure (POF). However, both result still meeting their safety acceptance criteria for target reliability, i.e. the platform is extremely reliable and apparently acceptable for operation. Thus, No cost requires for ad-hoc monitoring and inspection integrity. No loss in production due to No shutdown and decommissioning to be planned.

Table 1. Result from both reliability assessment

Type of Reliability	Return Period (RP)	RSR	Base Shear (MN)	Probability of Failure (POF)
Risk-Based Design Analysis	100	7.76	1.79	1.95E-18
	1000	5.86	2.31	
	10000	4.23	2.83	
Global Ultimate Strength Assessment	100	7.76	1.79	1.37E-16

The accuracy and effectiveness of this approach will assist the industry, especially operators, for decision-making and, more specifically, for their outlining of action items as part of their business risk management. The results of these analyses can efficiently assist the understanding of the structure failure mechanism and correctly define the important types of mitigation required.

The key challenges of fixed offshore structures when it experiences with subsidence and at same time ageing condition due to exceeding the design life. It should be noted that this paper will only present the basic idea of the structural reliability analysis. The detail of assessment will be discussed in details in the next future work.

CONCLUSION

GUSA and RBDA methods have been accepted by most of the major marine operators in the offshore industry to manage safety, integrity and reliability of their structures. This study confirmed that both methods give the check and balance in increasing the high confidence level of the result as far as ensuring the safety of these assets to be continued in service.

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PROCESS PERFORMANCE OF LANDFILL LEACHATE TREATMENT USING UP-FLOW ANAEROBIC SLUDGE BED

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ABSTRACT

In most countries, sanitary landfilling is nowadays the most common way to eliminate municipal solid wastes (MSW). In spite of many advantages, generation of heavily polluted leachates, presenting significant variations in both volumetric flow and chemical composition, constitutes a major drawback. Year after year, the recognition of landfill leachate impact on environment has forced authorities to fix more and more stringent requirements for pollution control. In the present study, an up-flow anaerobic sludge bed (UASB) was used for the treatment of matured landfill leachate. The process performance of the treatment was characterized in terms of pollutant removal before and after the treatment process. The results showed that VA (volatile acid) concentration was low when operated at OLR in the range of 0.125 to 1.25 kg COD $m^{-3}d^{-1}$ (157.7 to 156.0 mg L^{-1} mg HOAc L^{-1}). An increase in OLR beyond 1.25 kg COD $m^{-3}d^{-1}$ resulted in higher VA concentrations in the effluent. When the OLR was reduced to 0.375 kg COD $m^{-3}d^{-1}$ the VA concentration started to reduce and recovered to 157.3 mg HOAc L^{-1}. For the COD removal efficiency, at OLR 0.125 kg COD $m^{-3}d^{-1}$ (HRT of 4 d) the average COD removal efficiency was 65.70%. Further increase of the OLR from 0.375 to 1.250 kg COD $m^{-3}d^{-1}$ resulted in a low COD removal efficiency, until 9.33% was observed at an OLR of 2.50 kg COD $m^{-3}d^{-1}$.

Key words: Landfill leachate treatment, Up-flow anaerobic sludge bed reactor, Pollutant removal

INTRODUCTION

The disposal of municipal solid waste by sanitary landfilling is the most common method due to such advantages as simplicity, low price, and landscape-restoration of holes from mineral workings. However, its major weakness is the production of leachate in landfills (Aziz et al., 2010; Halim et al., 2009; Wiszniowski et al., 2007) . Leachate is defined as the liquid formed by the percolation of precipitation through an open landfill or through the cap of a finished site. Leachates could contain huge amounts of pollutants such as organic substances (measured as chemical oxygen demand (COD) and biochemical oxygen demand (BOD_5)), ammonia, high concentrations of heavy metals, and inorganic salts (Renou et al., 2008; Foul et al., 2009; Aziz et al., 2009) . Leachate is also rich in phenols, total dissolved salts (TDS), total alkalinity, total acidity, total hardness, chloride, sulfide and phosphorus (Aziz et al., 2010. Obviously, as landfill age increases, the biodegradable fraction of organic pollutants in leachate decreases due to anaerobic decomposition occurring in a landfill site. Thus, mature leachate contains much more refractory organics than young leachate. In this respect, young landfill leachate (age < 5 years) is typically characterized by high BOD_5 (4000–13,000 mg/L) and COD (30,000–60,000 mg/L) concentrations, fairly high amount of ammonia (< 400 mg/L), high ratio of BOD_5/COD (0.4–0.7), and a pH value of < 6.5. In contrast, stabilized landfill leachate (age > 10 years) normally contains high quantity of ammonia (> 400 mg/L), moderately high strength of COD (< 4000 mg/L), and a low BOD_5/COD ratio of less than 0.1 (Guo et al., 2010, Foo et al., 2009)

MAIN RESULTS

The UASB used in this experimental study was 18 cm in internal diameter (i.d.) and 110 cm in height, with an active volume of 20 L. The reactor had a 3-phase separator baffle (pore diameter of 2 mm) placed 2 cm below the effluent ports to prevent floating granules from being washed out with the effluent. Sampling ports were placed at 8 cm intervals (lowest being 21 cm from the base) that allowed biological solid and liquid samples to be withdrawn from the sludge bed. The influent wastewater entered through a 2.7 cm i.d. down comer tube in the head plate that extended to within 105 cm of the reactor base and allowed feed to flow upward through the sludge bed. A temperature controller and heater were installed to maintain a reactor temperature of 37°C. The UASB reactor can work in a wide range of temperatures, supporting a range of microorganisms from mesophilic to thermophilic species. For this study, a temperature of 37°C was chosen to support mesophilic microorganisms in the treatment of the matured leachate due to its treatment efficiency and lesser energy requirement.

Table 1. Characteristics of leachate

Parameter	Results	Units
pH	8.0	-
Temperature	26.0	°C
COD	2500	mg L^{-1}
BOD5 @ 20°C	486	mg L^{-1}
Total Suspended Solids	220	mg L^{-1}
Oil & Grease	0.6	mg L^{-1}

VFA	500	mg L^{-1}
Arsenic (As)	9.40	mg L^{-1}
Cadmium (Cd)	0.43	mg L^{-1}
Formaldehyde (FA)	8.60	mg L^{-1}
Iron (Fe)	12.80	mg L^{-1}
Nickel (Ni)	0.50	mg L^{-1}

CONCLUSION

This study demonstrates that the UASB reactor can be used to treat matured landfill leachate; however, the treatment efficiency of the reactor was negatively affected at an OLR of 2.5 kg COD $m^{-3}d^{-1}$, probably due to the inhibition by heavy metal and formaldehyde in the leachate at high OLR. It is recommended that the microbial activity of the reactor sludge to be evaluated in future study to determine the correlation of heavy metal and FA removal by different microorganisms.

Acknowledgment: The authors desired to show the highest gratitude to to Universiti Teknologi Malaysia for funding this study. The authors also thank the Ministry of Education Malaysia for the Research University Grant (Vote number: Q.K130000.2510.13H42).

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Keywords Index

THANK YOU

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