

Safety Matters Concerning Timber Scaffold Board Application in National Oil and Gas Industry

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Abstract— Recently, Timber Engineering Laboratory of Forest Research Institute Malaysia has received several requests from timber companies to evaluate the mechanical properties of timber scaffold boards for offshore constructional works. Timber boards are more preferable compare to metal due to the resistance quality of wood material in marine environment. Being one of the most lucrative businesses in the country, oil and gas engineering occupied the most stringent safety measures throughout their operations. Surprisingly however, the national standard document on the specification of timber, acceptable grades, test method for the mechanical properties determination and other references concerning the safety measures of timber scaffold board is seriously lacking. Forest Research Institute Malaysia has initiated a research project venturing into the technology and issues on the subject of timber scaffold board application. Information regarding timber as scaffolding material was obtained through literatures search, verbal and written discussions, sharing of pictures and visits to scaffold board yard. As a result, a number of safety issues and deficiencies were observed. This article is a bona fide discussion concerning the safety matters of timber scaffold board application in Malaysian oil and gas industry. Major issues such as wood species, timber grading and handling and storage were addressed and elaborated. This assessment was not only about fulfillment of safety regulations, but also about the global recognition and future earnings for national timber products.

Index Terms— Construction safety, scaffold plank, timber quality

1 INTRODUCTION

OIL and gas business is one of the twelve key areas for national economic (NKEA) growth and the activities are greatly expanding. As one of the most profitable businesses in the country, oil and gas engineering occupied the premier technologies and the most stringent safety regulations throughout their operations. Considering this trend, the timber industry seized the wealthy opportunity from the use of timber in oil and gas industry, particularly scaffold board for offshore constructional and maintenance works.

Lately, Timber Engineering Laboratory of Forest Research Institute Malaysia (FRIM) has received several requests from timber businesses to evaluate the quality of timber scaffold boards for oil platform construction works. Timber scaffold boards are more preferable compared to metal due to its outstanding specific strength value and resistance to corrosive marine environment. However, the scenario has brought to awareness that national standard protocol regarding the use of local hardwoods as scaffold boards is lacking. Eventually, it was found out that the standard document on the quality specifications, acceptable grades, method for mechanical properties test and other references concerning the timber scaffold board application was written merely in one page.

Regulation 72 of Factories and Machinery Act (Anon. 1967) pointed out a few parameters regarding the use of solid timber designed for scaffold board. It was stated that timber used for scaffold board shall be sound, straight-grained, free from dry-rot, or other defects impairing its strength or durability. Literally, the statement is too brief and unquantifiable. In practical, grain angle deviation of large size tropical timber boards is difficult to avoid (Ravenshorst and van de Kuilen 2010). The regulation also stated that timber used shall be of keruing or equal or higher strength. Some light hardwood species of nyatoh and white meranti demonstrate higher mechanical properties values than keruing, thus the statement is ambiguous. In term of strength grouping, rubberwood and balek angin are also in the same category as keruing, however these timbers are inappropriate for structural uses (Wong 1982). Therefore, the statements in Regulation 72 are literally too brief and exceptionally unclear even for experienced timber practitioners. Imperative details on the dimensions, manufacturing tolerances, moisture content and acceptable grades are not found.

Examination on some samples obtained from timber supplies revealed that even ara and pelong timbers of Strength Group 7 were being exploited as scaffold boards. Albeit the specific timber species has been stipulated, regrettably there were no on-site personnel with adequate knowledge on timber to confirm the supplies. The scenario is worsening since there is no detailed grade or criteria being ruled for the intended application. Currently in Malaysia, not only documented procedures to regulate the use of timber scaffold boards are lacking, but also hardly researches done on the application of timber as scaffolding boards.

Solely use of basic mechanical properties for the classification of all forest products is not practically ideal (Leicester 1987). For example, the strength and stiffness of keruing scaf-

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fold boards are not always possible to be evaluated through existing mechanical test records. The mechanical properties of the timber vary with species, size and supplies. Furthermore, the existing properties of each timber group were normally derived from a single species, whereas the actual supplies are consisted of numerous species. For instance, there are more than 50 species of keruing timber in the country, but instead the reference values for the mechanical properties of keruing were derived from ultimate stresses of a single species of *Dipterocarpus baudii*. Hence, from these considerations it appears that for a better technical criterion of scaffold boards, visual inspection is essential to establish a reasonable variation in strength and quality of the timber. Although the intended prescription may not be an exact science but it is nonetheless necessary and inexpensive to apply.

National regulations and procedures to facilitate the use of Malaysian timbers as scaffold boards are very loose. The guideline for the intended application should specify the requirements that measure as closely as possible in-service performance of the product. Realising the need for a standard protocol, FRIM has initiated a research project venturing into the technology and issues of timber scaffold board application. The vision is to provide a standardised guideline for the construction industry, simultaneously promotes a value added product for Malaysian timber trade. This paper specifically discusses on the safety matters concerning timber scaffold board application in Malaysian oil and gas industry.

2 PROCEDURE

A groundwork study on the application of timber scaffold board has been conducted by Forest Research Institute Malaysia since June 2013. The project was designed to answer several inquiries from the industry concerning the quality evaluation of timber scaffold board. Information was obtained through literatures search, verbal and written discussions, sharing of pictures and visits to scaffold board yard. Safety issues regarding the application of timber scaffolding were addressed and discussed in this article. The results were categorised into 3 major issues; wood species, timber grading and handling and storage. Each of the topics will be elaborated in the later chapter. Eventually, some recommendations will be discussed for a better utilisation of timber scaffold boards particularly in offshore application.

2.1 Confidentiality

Most of the data gathered during this study were obtained through series of discussions with several engineering companies and contractors. In a way, this article highlights on deficiencies occurred in the application of timber as scaffold board. Nevertheless, it was not our intention of blaming any individual or group, professionally or ethically. Although the misconducts discussed here might have been performed by merely a few parties, however revealing any particular name will presumably create provocations in the commercial world. Thus the details of involvements in this study are considered as classified and are not mentioned anywhere in this article.

3 RESULTS AND DISCUSSION

3.1 Wood species

The right timber species is not only about safety, but it also offers advantage in term of cost. For example, in wet-offshore environment, an inferior timber species could possibly lasts for 6 months of service and could be reused twice. Eventually a new procurement has to be made to replace the whole lot of worn-out boards. On the other hand, a superior timber species could lasts much longer and could be reused more than twice. With respect to thousands of units of scaffold boards, the amount of money that could be saved by selecting a proper timber species is very significant. In tandem, with regards to the safety measures of scaffold board application, selection of the right timber species will minimises fatality. Without doubt, that would be immeasurable in Ringgit and cent.

Suitable timber species also means timber with appropriate density for the intended usage. In fire-sensitive zone, fire retardant scaffold boards are very much preferred. Fire retardant quality depends highly on the density of the wood material. During contingencies, fire retardant scaffold boards will last longer in the flame, allowing way for survivors and delaying collapsion. Thus, a proper selection of timber species is also a selection of fire safety feature.

Our informal inspection on a few samples demonstrated that inappropriate timber species were being utilised as scaffold board. Some species were classified in Strength Group 7 which is the most inferior timber group and obviously unsuitable for structural applications. However, the details of the assessment are concealed due to the confidentiality issue. Regulation 72 of Factories and Machinery Act 1967 stated that timber scaffold boards shall be constructed from keruing or equal or higher strength. Set aside the vaguely documented instruction, even the awareness of the decree among timber practitioners is somewhat doubtful. Nevertheless, the ignorance is rational since the regulations were written on one negligible page within laws of Malaysia act instead of being documented in a specific timber manual. Even if there is a detailed guideline for timber scaffold board documented somewhere and not known to the authors, the scenario clearly dictated that the instruction is either inadequate or not being implemented.

Through our professional observation and discussions with involved parties, we summarised some of the factors resulted with the species inappropriateness. However, these evaluations may perhaps be different for each corporation.

1. In oil and gas businesses, the enforcement of most regulation (including the use of timber scaffold boards) is administered by the stake holders. Since the safety rules were developed in-house, thus monitoring and approval of the safety measures are also conducted by internal personnel. Consequently, 'third party audit' system does not exist with respect to the use of timbers for scaffold application. Even if there were third party audit being implemented, based on the peculiar timber species identified, we must say that the competency of the assessor in evaluating the timber quality was inadequate.

2. Basic knowledge on timber among personnel, both onshore and offshore is considered necessary. It appeared that some of them were even unable to differentiate between low and high density wood material. Thus the contractors will simply utilise whatever delivered by the timber suppliers, either it suitable or not. Although it is unlikely for inappropriate timber species being supplied intentionally, but still oversights could occur. Judging from the actual scenarios we encountered during the task, without doubt, basic learning and training concerning timber science are critically required by the personnel.

3. Procurements for the timber scaffold boards were restricted to a number of species. The limitation arose when corporations rely on one or two familiar species based on their working experience. In view of the wealthy deal with oil and gas businesses, timber suppliers struggle to grasp the opportunity while in reality it is extremely difficult to acquire bulk supply of one particular timber species. Thus pressure on the demand and supply chain regrettably ended up with inclusion of improper timber species.

3.2 Timber grading

Although suitable timber species had been procured, the quality of the boards varied widely. Even when every provision has been considered to avoid all factors known to influence the mechanical properties of timber, it will still be found that one board is 10% to 15% stronger than another (Thomas 1931). Low quality boards are not much different compared to improper timber species. Two critical issues observed during the assessment are;

1. Moisture content (MC)
2. Wood quality

Occurrences of stain were observed on unexploited scaffold timber boards. Presumably the supplies were stacked in green condition without prior drying process. Since supplies were sent in large quantity, the boards were stored in yard for some times before being shifted gradually to offshore platform. Thus, the rate of stain was higher particularly without the use of stickers. Green timber stacking should be handled with extra concern since wet boards are prone to rot and insects attack.

Mechanical properties of timber in the published data were derived at estimated 15% moisture content (Lee et al. 1993). Timber properties are distinctly correlated to MC. Several empirical studies had reported that strength variation above fibre saturation point is insignificant. Below the fibre saturation point, however, the strength increases with the reduction in MC. The MC of timbers in air-dry state here in Malaysia is within the range of 15% to 19%. Thus, evaluation of the strength values based solely on published data is rather inappropriate due to the variation of MC in each specimen.

Visual grading assessment is crucial to distinguish good and poor quality timber boards. Apparently, grading was not implemented for scaffold board application. Although a specific grade has not been established for timber scaffold board application, but the existing Malaysian Standard for visual strength grading of tropical hardwood (MS 1714 2003) could be put into practice. It specifies the permissible limits of timber characteristics designated as Select Structural Grade (SSG),

Standard Structural Grade (ASG), Common Building Grade (CBG) and Hardwood Structural Grade (HSG). Any board beyond the designated limits, it will be rejected.

Destructive test on selected samples is a good indicator for timber quality as well. Mechanical properties of random samples from each batch could be determined to represent the quality of overall supplies. The disadvantages of destructive testing are the production of sample wastes, results are highly influenced by the selected samples and personnel in charge, and the outcome is dependent on the percentage of sampling.

We also observed presence of wane on several scaffold boards. Even though waness are normally acceptable, but the number of occurrences for scaffold board application will affect the evenness and stability of the working platform. Uneven platform introduces the risk of tripping. Furthermore, debarking after installation could loosen the fixing and probably end up with accident. The repeated amounts of waness were caused by the approach of timber log cutting. Practically, a customised log cutting pattern is being employed to minimise the rate of bowing and cupping due to the width of scaffold boards.

The quality of scaffold boards should be evaluated with extra concern compared to permanent structures. Although loads may be applied for relatively short periods, their magnitude is often very great compared to its self weight (Mohd Hanim 1998). One particular type of load to be considered is steadily intensifying applied load of construction equipments and materials. Another potential type of load application on scaffold board is dynamic load, which is the resultant of impact, surge and vibration. This load occurs from activities such as pouring of wet concrete or movement of construction worker and equipment. Besides, unlike common structural timber components, the duration and point of loads on scaffold boards are practically randomised, thus the quality of each board should be assessed over the whole length.

3.3 Handling and storage

We must highlight that through our observations, handling and storage manner of the scaffold boards had resulted with futile flaws. Stacking allowance was overlooked as an important step in timber scaffold board storage. Some stacks were located at the very end of roofed space and were susceptible to rainwater and splatter. Besides, each stack was piled alongside and on top of each other regardless of the moisture condition. The moist encouraged fungi on the wood surface and eventually the timber will be easily attacked by insects and deteriorated. The situation was worsening when some timber batches were stored in green condition without proper drying beforehand. In addition, we found that the stacks were too close to the ground, some were even in touch with the weeds. The result was a matrix of higher moisture environment. Again, timber deteriorates and attacked easily when it is wet.

There was also a concern regarding the size of the stickers, although they were probably arranged by the timber supplier. Stickers of different thicknesses were used which automatically developed warp into the boards. Moreover, some were misaligned from top to bottom resulted with uneven support be-

TABLE 1
MALAYSIAN TIMBER SPECIES THAT SUITABLE FOR SCAFFOLD BOARD APPLICATION

Timber name	Botanical name	Strength group	Air-dried density (kg/m ³)	Common Uses
Balau	<i>Shorea</i> spp.	1	850-1155	Boat building
Bekak	<i>Amoora</i> spp.	3	705-1025	Boat decking
Belian	<i>Eusideroxylon zwageri</i>	2	835-1185	Marine piling, Wharf
Bitis	<i>Madhuca</i> spp.	1	820-1200	Pier
Chengal	<i>Neobalanocarpus heimii</i>	1	915-980	Boat building
Giam	<i>Hopea</i> spp.	4	865-1220	Heavy duty flooring
Keranji	<i>Dialium</i> spp.	3	755-1250	Heavy construction
Keruing	<i>Dipterocarpus</i> spp.	5	690-945	Heavy construction
Kulim	<i>Scorodocarpus borneensis</i>	3	640-975	Marine environment
Malagangai	<i>Eusideroxylon malagangai</i>	na	590-850	Boat building
Merbatu	<i>Parinari</i> spp.	2	690-975	Salt water piling, marine construction
Mertas	<i>Ctenolophon parvifolius</i>	2	800-930	Marine construction
Pelawan	<i>Tristania</i> spp.	na	915-1250	Marine construction
Penaga	<i>Mesua ferrea</i>	1	945-1185	Heavy construction
Penyau	<i>Upuna borneensis</i>	3	945-1040	Heavy construction
Resak	<i>Vatica</i> spp.	4	655-1155	Heavy construction
Tembusu	<i>Fagraea</i> spp.	5	640-1075	Heavy construction
Tempinis	<i>Streblus elongatus</i>	na	915-1025	Heavy construction

tween each boards. We also observed that some timber stacks were only stickered at both ends, thus creating sagging-look boards at mid section. Technically, the improper use of stickers has trivial effects on the strength of the timber boards. Nevertheless, it created unwanted shapes and irregular dimension for the timber scaffold boards. Since scaffold boards are installed alongside as one platform, irregular dimension boards resulted with uneven and unsafe scaffold platforms.

The scaffold boards were deployed on the platform once transported offshore. Space is very limited on the oil rig thus under shade location is not easily available to place the boards before the installation. Again, the boards were mismanaged when being stacked and exposed to rainwater.

4 RECOMMENDATIONS

Wong (1982) had compiled the Malaysian timber species to attain greater utilisation of national timber resources. The book covered a large array of timbers, containing some of the physical, mechanical and processing properties of each species. It also presents the current and possible uses of most species recorded. Table 1 shows a list of some timber species that suitable or potentially suitable for scaffold board application.

Nevertheless, the application of timber for scaffold boards is not limited to the abovementioned species. A simple 'verification practice' is recommended to ensure the appropriate timber species are being used. Administrators are suggested to perform random sampling of each supply batch for wood identification test provides by FRIM.

A proper stacking characteristic is suggested to facilitate the movement of moisture away from the board surface, subsequently minimise the introduction of fungi and insects (Figure 1). A solid, dry and leveled surface is recommended, perhaps constructed using concrete cement or other solid materials. It

does not only reduce the humid of the surroundings, but also it lessens the maintenance works for clearing out the weeds. In addition, stickers should be uniform for the whole stack to form a leveled air flow between the timber stacks. Moreover, green and dried stacks should be piled up separately with some allowance in between them. The roof should be extended to avoid contact with rain.

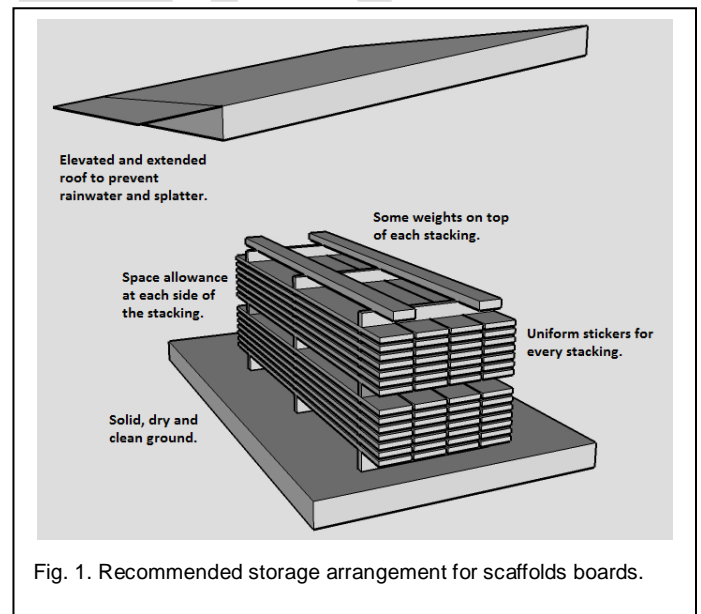


Fig. 1. Recommended storage arrangement for scaffolds boards.

5 CONCLUSIONS

The discussions were made based on our professional judg-

ment and years of working experience in the timber engineering study. Through literatures search, verbal and written discussions, sharing of pictures and visits to scaffold board yard, some deficiencies regarding the technical aspect of timber scaffold board application were addressed. Issues such as wood species, timber grading and handling and storage were discussed and elaborated. Again, our intention was neither to point out nor to blame any individual or group for the flaws, instead the text is meant to initiate awareness and assist oil and gas community concerning the utilisation of timber as scaffold boards.

This assessment was not only about fulfillment of safety regulations, although the aim of The National Timber Industry Policy (NATIP) is for the timber material to be managed in compliance with laws and regulations. Nevertheless, the study was also about the global recognition and future earnings for the national timber products. Governmental agencies should by now foresee the prospective market for Malaysian timbers as the premier scaffold boards. The nation is endowed with a range of world-class hardwoods for a variety of uses. Numerous species were scientifically and practically recognised for intense usages and marine related applications. Globally, timber scaffold boards are being utilised not only in oil and gas work, but also for construction and maintenance of sea bridges, power plants, coastline sites and below ground works. It is high time for Malaysian timbers to make way into those markets.

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