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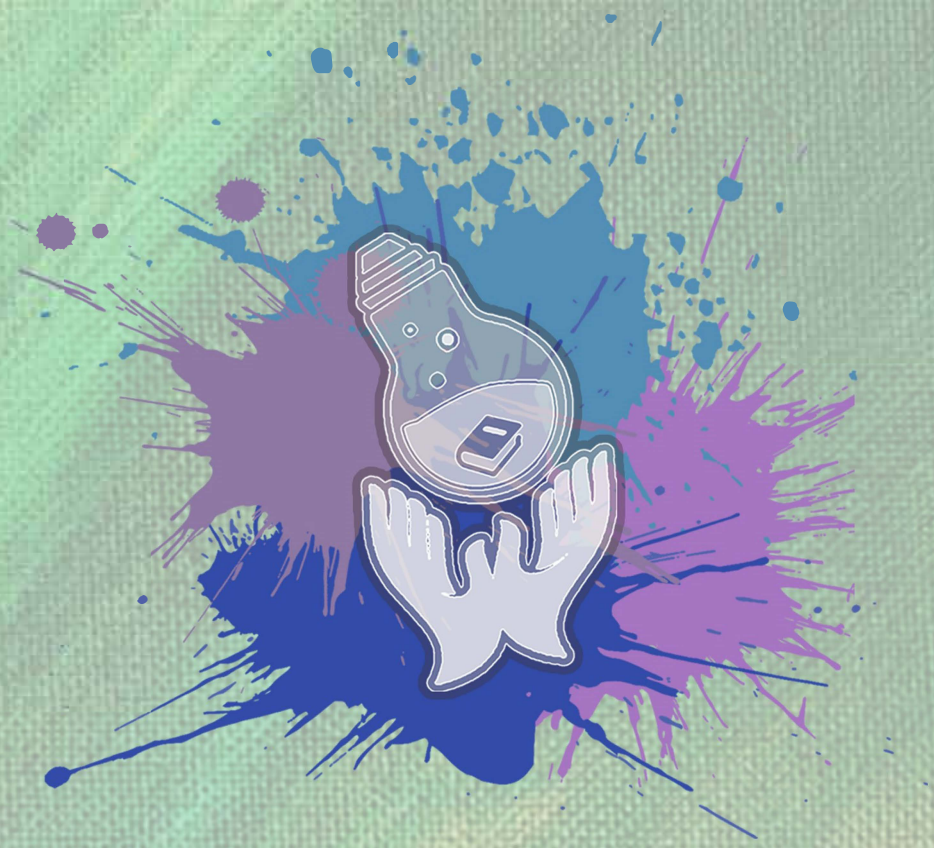

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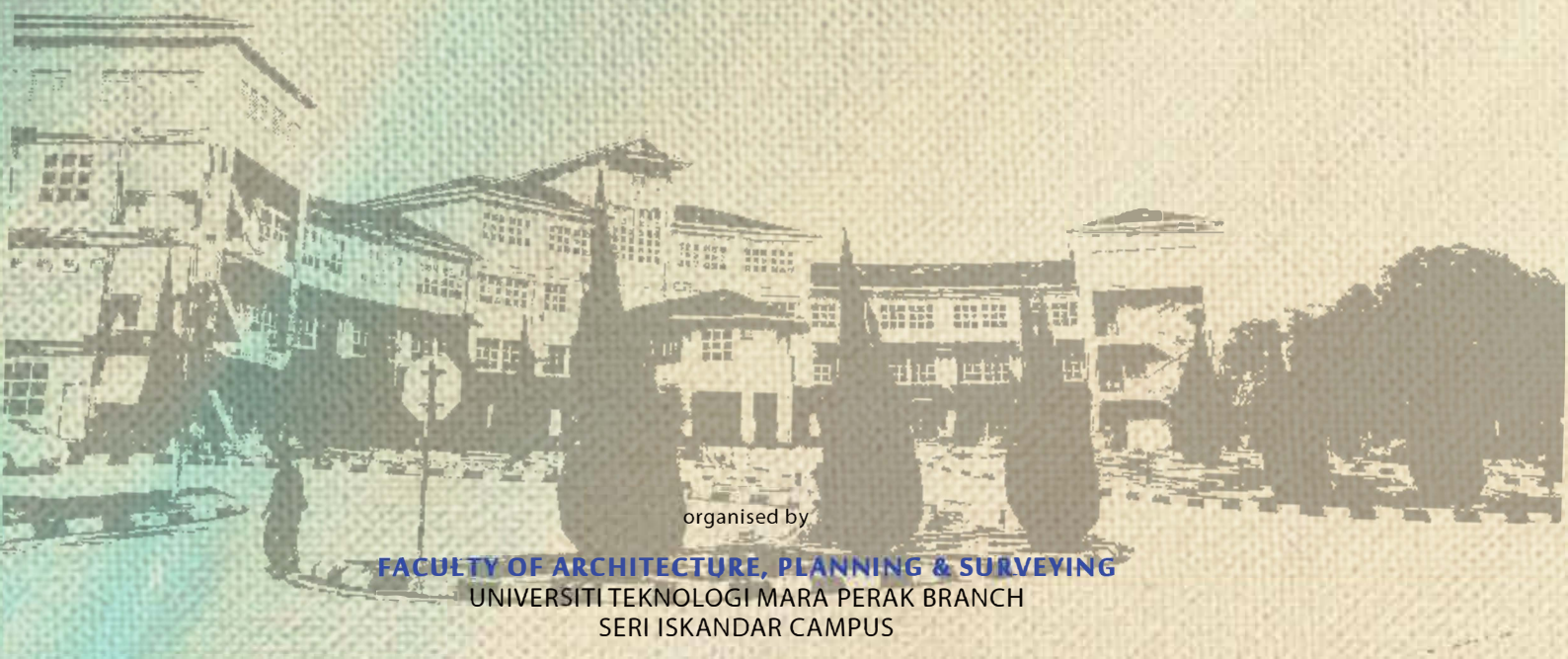

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SELF-LOADING SUSPENSION RACK FOR PRODUCTION STORAGE & DELIVERY OF PRECAST COMPONENTS

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Abstract:
Industrial Building System (IBS) bring forward the conventional method of construction to new modern installation of building components that were previously casted off-site. This technique does bring advantages such as cut of cost, time and enhance quality. However, regardless of IBS's advantages, it does have some critics, certain weakness that lead to misperception in construction society. Things goes worse, if IBS being conducted in a wrong way or disguise the standard of operation. These were usually done by worker or particularly categorized as gross error. These can lead to product defects, and most commonly cause is crack. To solve this problem, a self-loading suspension rack (SLSR) is proposed with aim to minimize material handling and human interference which generally helps to avoid defects such cracks. SLSR shall be created with merging concept of suspension system with innovation of automation moving rack. The nature of precast concrete construction entails thorough preconstruction planning. As the various aspects and phases of the project are interrelated, its success will depend largely on how effective is the linkage between each construction phase during implementation. Construction sequences, production storage and delivery process are therefore important and need to be closely monitored to obviate costly double handling such rectification work in site progress.

Keywords:
Crack; rack; suspension; loading; storage; delivery.

1.0 INTRODUCTION

Poor material handling leads to occurrence of defect. Major defect in precast concrete system are cracks. Cracks are a major quality control problem, regardless of whether a building component is casted onsite or offsite production. Many researchers have agreed that concrete spall in precast segment were categorized as normal defect to be recorded during the manufacturing and delivery stages (Razak & Ismail, 2015). The researcher added that defects such spall and cracks will require a high attention of rectification work. This scenery would take time on completion, the need to pay worker wages on repair work, to find suitable grouting, while in worst situation could lead to product returns. These are generally considered as double material handling. Factors contribute to cracking during storage would probably cause by interference of human and machine during loading and unloading. Meanwhile, cracks that occur in transportation process might cause by vibration which can be solved by suspension elements. Cracks in storage are considered to be gross error in material handling. In any case, precast components should be stored with careful consideration on protection to ensure components delivered without damage. Thus, to reduce crack effects, minimizing material handling in term of workmanship and machineries usage shall be comply.

2.0 LITERATURE REVIEW

It is important to make provisions to store the precast components for subsequent delivery process. Casting offsite product enhance monitored quality issue. However, the occurrence of crack can still be found when delivered to site.

2.1 Occurrence of Crack in Precast Concrete

A survey on product quality has been carried out on case study of Tunnel Segment Klang Valley MRT Project, 2015 via precast steel fiber reinforce concrete (SFRC), and the results came out that 84% of

precast product were stacked without protection such as rubber pad, and 12% respondent believes that precast segments was cracks due to uneven thrust load during shoving and 4% respondents say that crack were already occur during casting phase (Razak & Ismail, 2015). Risk analysis based on supply chain operation references (SCOR) was conducted, and the result of total risk of priority index (RPI) for defective products during production; product returns from customers; damage when shipping is about 30% of supply chain activities (Hatmoko et al, 2018).

2.2 Minimizing material handling

Almost every component and material used in construction is transported on site by mechanized lifting or hauling equipment of one kind or another. The types of lifting equipment that may be monitored include cranes (top-slewing and bottom-slewing tower cranes, crawler, and truck-mounted mobile cranes), hoists, concrete pumps, and material handlers (Sacks et al., 2005). Material handlers for storage in precast industry include run off carriage, forklift, and palletizer. Most casted concrete will be stacked from its conveyor via forklift. When times comes for delivery, the forklift will again be functioned to move the components into truck. Instead of having few machineries to lift a panel, it is more economic to have one rack that can be portable and controlled for motion.

2.3 Human Interference; Unsafe Act

Human errors that could potentially cause an accident are called unsafe acts may be defined to be a human action that departs from hazard control or job procedures to which the person has been trained or otherwise informed, which causes unnecessary exposure of a person to hazard (Joel, 1997). Wherever human interference takes place, there will be risk of hazards. The safety in workplace is one of the most essential issues that cannot be taken lightly. Some might be minor accident, some may cause serious and huge effect to the organization especially within the industry involved machinery handling including of prime movers, trucks, forklifts and cranes that is very much related with the issue of safety and health awareness (Zakaria, Mansor & Abdullah, 2012).

75,000 industrial accident were recorded, 88% of the industrial accidents were caused by unsafe acts, 10% of the accidents were caused by unsafe conditions, and another 2% of industrial were due to unavoidable case; acts of God (Heinrich, 1980). Human factors are likely to contribute to this problem on a number of levels including factor relating to individuals (e.g. drivers and pedestrians), the nature of the job (e.g. design of the workplace and vehicle), and the organisational (e.g. training procedures and management systems) (Male, 2003). Study found unsafe act causing or contributing to nearly all injuries (DuPont, 1991).

3.0 METHODOLOGY

Desk study is one of proven data collection method, to gather information on defects during storage and transportation of precast components. This is done by reviewing previous research articles, journal, magazine, books, bibliography to find out research question. Most articles shall be about defect, loading mechanism and mechatronic sense to create an idea of self-loading suspension rack. Literature review helps to gain understanding for significance of problem solving.

4.0 ANALYSIS AND FINDINGS

Workplace transport or machinery is the second biggest cause of accidents in the workplace, accounting for about 70 fatalities each year (HSE, 2005). Thus, few machineries for storage were analysed.

4.1 Machineries for precast concrete storage

Forklift might have benefits to improve productivity and reduce manual material handling, however, they also result in occupational hazards, especially when there is interaction with pedestrians (Harberry et al., 2004). Forklift has large amount of interaction with pedestrian workers. Then, it also requires driver's full attention. When carrying a load in reverse, the driver has simultaneously monitored the balance of his load at the back and watch the direction of travel driving with their left hand on steering wheel and right hand on the load control and they must monitor their blind spot (Miller, 1988). Poor design of machineries will lead to poor posture of handler, leading to driver fatigue and spinal and abdominal trauma (Ashley & Lawton, 1971).

A palletizer is a machine which means for stacking cases of goods or products onto a pallet. Production pallets with freshly poured concrete elements are stacked in a rack. The stacker lifts the pallets onto the required rack level and moves them in and out again. Next, the run-off carriage is designed to receive the finished wall and floors panels. The precast panels can either be transported individually or on transport racks to the open-air storage area. Adding artificial intelligent for this rack could ease more on user where the machine can process where it must go and detect any obstacle to reach destination.

4.2 Suspension system

Suspension element were usually be found in vehicles. However, this study will apply the concept of suspension system for self-loading suspension rack on precast product. Suspension system is the system of springs and shock absorbers by which a vehicle is supported on its wheels. Suspension protects the vehicle and its carriage from damage. An independent suspension system allows the wheel on the left and right side of the vehicle to move vertically independent up and down while driving on uneven surface. This type of suspension usually offers better ride quality and handling due to less unspring weight. Meanwhile, dependent suspension is a type of suspension system where there is a rigid linkage between the two wheels of the same axle. It can bear shocks with a great capacity than independent suspension. Semi-independent system has both the characteristics of dependent as well as independent suspension. The wheel moves relative to one another as in independent suspension but the position of one wheel has some effect on the other wheel. (Aermech, 2014). Future study shall be carried out to identify which types of suspension system suitable to be merge on self-loading suspension rack.

5.0 CONCLUSION

Innovation shall be mechanism to ease people's life. Self-loading suspension rack somehow would contribute a lot in construction industry especially in prefabricating factory. It allows huge cut cost for usage of machineries such as forklift and run off carriage. It provides better storage system of precast panel. Curing can be done easily. Quality can be controlled comprehensively. Furthermore, it can reduce stress effect which eventually creates cracks. The suspension will be functioned as absorber of impact forced to the panel. Lifting would not be a petty thing anymore since the idea proposed self-loading concept. For future improvement, technological evaluation shall be carried out.

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