

Mechanized of Interlocking Brick and Its Structural Behaviour as Load Bearing and Non-Load Bearing Element-Review

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ABSTRACT

Conventional bricks are the most elementary building materials for houses construction. However, the rapid growth in today's construction industry has obliged the civil engineers in searching for a new building technique that may result in even greater economy, more efficient and durable as an alternative for the conventional brick. Moreover, the high demands for having a speedy and less labour and cost building systems is one of the factor that cause the changes of the masonry conventional systems. These changes have led to improved constructability, performance, and cost as well. Several interlocking bricks has been developed and implemented in building constructions and a number of researches had studied the manufacturing of interlocking brick and its structural behaviour as load bearing and non-load bearing element. This technical paper aims to review the development of interlocking brick and its structural behaviour. In conclusion, the concept of interlocking system has been widely used as a replacement of the conventional system where it has been utilized either as load bearing or non-load bearing masonry system.

Keywords: *Interlocking brick, load bearing and non-load bearing.*

Conventional bricks are the most elementary building materials for houses construction. However, the rapid growth in today's construction industry has obliged the civil engineers in searching for a new building technique that may result in even greater economy, more efficient and durable as an alternative for the conventional brick. Moreover, the high demands for having a speedy and less labour and cost building systems is one of the factor that cause the changes of the masonry conventional systems. These changes have led to improved constructability, performance, and cost as well. Several interlocking bricks has been developed and implemented in building constructions and a number of researches had studied the manufacturing of interlocking brick and its structural behaviour as load bearing and non-load bearing element. This technical paper aims to review the development of interlocking brick and its structural behaviour. In conclusion, the concept of interlocking system has been widely used as a replacement of the conventional system where it has been utilized either as load bearing or non-load bearing masonry system.

The interlocking brick development is presented in this study and confirmed that this system is utilized in masonry structures. Accordingly, the concept of interlocking system has been widely used as a replacement of the conventional system. It can be concluded that the shape of the

interlocking brick varies with simplicity which result in easy and fast production and assembly in the masonry systems. Moreover, the interlocking mechanism of all the different types of interlocking bricks is sufficient to interlock the assembled bricks in different directions. Based on the researches of the structural behaviour of interlocking bricks, it can be concluded that the interlocking blocks have met the minimum specifications and requirements as per british and American standards. Also, it verified that interlocking brick can be utilized either as load bearing wall or non-load bearing system.

The use of interlocking bricks masonry has gained rapid popularity in many foreign countries as an alternative to conventional bricks for sustainable housing. It is being always challenge for researchers to make interlocking brick light weight, low cost and improve the performance against aggressive environment. An experimental effort made in this concern. This paper gives the results of an experimental investigation in which the compressive strength, water absorption and density were investigated by using varying percentage of fly ash, stone dust, and sand with different mix proportion. A manmade fibre, glass fibre reinforce polymer (gfrp) utilize as reinforcing material to produce the interlocking blocks which gives appreciable results discuss in detail. The experimental results compared with that ordinary burnt clay brick and interlocking brick found durable in aggressive environments and have sufficient strength for their use in sustainable building construction. Key words: fly ash, gfrp, compressive.

Based on the experimental investigation reported in this paper, following conclusions are drawn: 1. Strength of interlocking bricks with increasing fly ash increases with the age. 2. All mix proportions gives satisfactory higher values of compressive strength. 3. At some without gfrp mix ratio 1:11 gives the higher compressive strength greater than 10 n/mm². 4. Interlocking bricks with economically available fly ash in large proportion have sufficient strength for their use in low cost housing, non-load bearing construction and in regions where good quality burnt clay bricks are not available. 5. Water absorption of interlocking bricks without gfrp is found to be in the range of 6.42 to 12.4 percent, whereas the water absorption for ordinary burnt clay bricks should not be more than 20 percent. The water absorption of interlocking bricks increases with the increased fly ash content. 6. The density of interlocking bricks was found to be 7.5 to 25 percent higher than that of the ordinary burnt clay bricks. 7. Interlocking brick with reinforcing agent gfrp increases the compressive strength at maximum utilization of fly ash with the age. 8. The water absorption and density increase with increase in fly ash in gfrp interlocking brick. 9. As density concern the difference between ordinary clay brick and interlocking brick should be minimize with reinforcing agent. Interlocking bricks require no skilled labour and can be moulded in any shape and size depending on the requirements. These bricks have better tolerances and no efflorescence as compared to conventional bricks. A number of other benefits also be ascribed for the prospect of interlocking bricks which includes no consumption of mortars, better efficiency in laying and low cost of finishing. It is further needed to develop the awareness among users, professionals and financial supporters for using these waste materials for solving the housing problems in addition to balance economy and achieve energy conservation. For reducing the density of bricks more experimentation requires with different wasted material with natural reinforcing fibre for considering economy and use for multi-storeyed building.

The high cost of building materials, especially sandcrete blocks in ghana, has made building construction products expensive and Created a housing deficit of about 1.6 million. Meanwhile, the interlocking blocks, which are made up of laterite and cement Abound could be exploited to help reduce the cost of housing construction. Especially, wall construction which is one of the major Components of the entire building process. This paper sought to explore the possibility of adopting the interlocking block wall System as a means of making wall construction of buildings affordable in ghana. A comparative study using interlocking blocks System and sandcrete blocks was made. An observation of the processes was made to identify the extent to which each system Falls in line. A sample size of 45 respondents comprising 20 workers of p-capital estate housing, 5 personnel from consultancy Firms and 20 private individuals were

selected for further confirmatory study with the use of convenience and purposive sampling Technique. To determine whether there were any statistically significant differences between the mean values, paired-sample t-test At the 0.05 level of significance was done. Results showed that, the use of interlocking blocks do not only lead to elimination of a Number of non-value adding activities associated with the use of the sandcrete blocks, but also make the wall construction process Cheaper and faster. It was also discovered that the absence of mortar jointing in the interlocking system reduced the quantity of Materials, like cement and sand, required in the sandcrete wall construction process. Furthermore, there was no statistically Difference between the compressive strength of interlocking blocks and conventional sandcrete blocks. However, there were statistically significant differences between construction cost and speed of construction using the two systems of construction

The elimination of the various non-value adding steps associated with the conventional sandcrete lock wall construction when using the interlocking block system significantly reduce the cycle time of block bonding thus increasing the speed of wall construction for interlocking blocks. Interlocking blocks are affordable in terms of cost and the ability to make the room cooler especially in hot weather conditions compared with sandcrete blocks. There is also a significant reduction in the material requirement for the interlocking block wall construction process due to the absence of mortar jointing. Reduction in the labor and materia requirements in the interlocking block wall construction make the cost associated with the process of building walls using the interlocking blocks less expensive.

The interlocking blocks have almost the same compressive Strength as that of the sandcrete blocks. The following specific conclusions are drawn from the Statistical analysis: There is significant difference between the Interlocking blocks and conventional sandcrete blocks Speed of construction. The interlocking blocks Construction proved to be faster with better Workability after laying the 1st course thereby Ensuring speedy construction. There is no significant difference between the Interlocking blocks and conventional sandcrete blocks Cost of labor. This means that in terms of labor cost, The interlocking block wall construction is within the Range of the conventional sandcrete block Construction. There is significant difference between the costs of Constructing the entire l-wall using interlocking Blocks and conventional sandcrete blocks. This Suggest that interlocking blocks are affordable in Favor of low cost constructions, especially in Developing countries with high deposits of laterite. There is no significant difference between Compressive strength of interlocking blocks and Conventional sandcrete blocks. Indicating that the Compressive strength of interlocking blocks is Comparable to that of the conventional sandcrete Blocks.

On the basis of the above, interlocking blocks provide a very Good economic alternative to sandcrete blocks. Economically, it provides a cheaper means of construction, Low cost resources (materials) and erection process. They Therefore have the potential of supporting the affordable Housing concept in Ghana. Interlocking blocks are also Likely to support sustainable construction concept since they Use materials that are locally abundant, less energy for their Production and use, and make the interior part of the Buildings cooler than sandcrete blocks.

Incinerator ash was investigated for its potential use as a replacement for sand and cement in concrete interlocking bricks. The physical characteristics of the raw materials were examined. Two sets of mixes were prepared. For the first set, sand and water quantities were fixed while incinerator ash was used at 0% to 100% replacement by weight for cement in steps of 10%. In the second set, incinerator ash was used at 0% to 100% replacement by weight for sand while cement and water quantities was fixed. The mixing proportions for cement, sand and water were 1:3:0.7, respectively. Compressive strength and leachability tests were performed on the specimens. Results showed that the replacement of sand by incinerator ash up to 40% exhibited higher compressive strength than the control mix (0% incinerator ash) after 28 days curing. Maximum compressive strength of 33.33n/mm² was obtained after 28 days curing using using 20% incinerator ash substitution for sand. Replacement of cement by incinerator ash up to 20%

exhibited higher compressive strength than the control mix. Compressive strength of 28.2 n/mm² was achieved after 28 days curing period using a 20% ash substitution for cement. Leaching of heavy metals (pb and cd) present in the ash was observed in concentrated nitric acid.

This work has shown that the fly-ash generated from the nigerian petroleum waste incineration plants can be suitably substituted for cement up to 20% replacement in use as interlocking bricks constituent. At this level of replacement, the bricks will achieve a compressive strength of 15.81 n/mm², 22.11 n/mm² and 28.20 n/mm² for 3 days, 7 days and 28 days curing periods respectively which fall under the acceptable values for compressive strengths of interlocking bricks as stipulated by bsi 4550:part 5:1972. The results for leaching show that as the particle sizes of the crushed concrete increases, the leachability of heavy metals decreases being locked in the mass of brick.

This work has presented the evaluation of the compressive strength of hybrid clay bricks from interlocking brick making machine. The mixture of clay and cement at varying proportions was loaded into the mould compartment, mechanically rammed and hydraulically controlled. The raw clay was sourced from ilesa and akure in the south-western part of nigeria. The results showed that when the cement content was 6%, the highest compressive load and energy at break were obtained in hybrid bricks from both ilesa and akure samples. However, the optimum service performance under compressive loading was attained at 6% cement in ilesa hybrid bricks. Ilesa hybrid bricks possess better reliability and workability under loading than the akure bricks.

On the strength of the results presented above, it can be concluded that 1. The optimum service performance under compressive loading was attained at 6% cement in ilesa hybrid bricks. 2. Ilesa hybrid bricks possess better reliability and workability under loading than the akure bricks. 3. Ilesa clay has better binding characteristics and quality than the akure species. Internal splintage of open tibial fractures had gained acceptance as a preferred method of early stabilization of such injuries. Patients and methods: fifty-five patients had been operated upon. They were followed from july 2008 to march 2013 (56 months) with an average time of 39 months. The final results had been evaluated through a scheme including 7 parameters: pain, union, malunion, infection, range motions of nearby joints, implant and technical failure and activity and returning to the same work. Results: according to previous parameters, union was achieved in 52 cases (94.5%) at an average time of 20 weeks (16 - 52 weeks) with 5.5% incidence of non-union. Excellent and good ranges of knee and ankle motions were achieved at final follow-up visit in 49 cases (89.09%). The incidence of complication was acceptable mainly malunion 7.3%, deep infection 12.7%, implant and technical failure 9.1% full activity and returning to the same work achieved in 89.1%. The overall net results of our series are as follows: excellent—19 cases (34.5%), good—27 cases (49.1%), fair—6 cases (10.9%) and poor—3 cases (5.5%).

Unreamed tibial nailing is considered a good method for management of open fracture tibia. The results of our series emphasize that strict adherence to technical prerequisites, proper wound management and frequent use of bone grafting or bone marrow injection may consider that this technique is safe, efficacious and could be the treatment of choice for grade (i) and grade (ii) open tibial fractures.

heat conduction through conventional and interlocking building bricks with cavities was studied in this work. Heat transfer analysis was carried out using matlab® partial differential equation toolbox. Regular and staggered hole arrangements were studied. Results showed that four staggered holed interlocking bricks were effective in thermal resistance into the bricks and increasing the holes beyond four did not give any thermal resistance advantage. For the conventional bricks staggered holes did not give any thermal resistance advantage but the four-holed bricks were also adjudged to be effective in thermal resistance into the brick surface. Increasing the number of holes beyond four in conventional bricks did give some thermal resistivity advantage but very minimal. Structural strengths of holed bricks were not considered in this study.

Conduction heat transfer within ordinary (conventional) and interlocking bricks with hollow cavities was investigated. In conventional bricks, increasing the number of cavities played a substantial role in decreasing heat flow into the building and hence enhanced thermal insulation. After the four-hole arrangement, increasing the number of holes only gave marginal thermal resistance over the four-hole arrangement. In the case of interlocking bricks, it was observed that staggered whole arrangement helped in decreasing heat flow into the brick wall. Four-staggered-hole arrangement gave the same thermal resistance as an ordered eight-hole arrangement. The 8-hole brick arrangement may also tend to compromise the strength of the brick. This paper, taking the directors of listed companies as point of penetration, studies the effects of interlocking directorates on the company's merger decisions. With a focus on interlocking directorates' influence on the selection of M & A targets, a probit regression test was conducted by pairing potential M & A targets to real acquisition sample according to the industry of the real sample. The innovation of this paper lies in the study of whether there is a significant difference in the effect of interlocking directorates through differentiating various M & A modes, including horizontal mergers, vertical mergers and mixed mergers. The empirical analysis concludes that when there are interlocking directorates in Merger Company and potential target company, it is more likely for the potential target to be the object company. What's more, by comparison, when the acquiring company and the target company are from different industries, there is greater impact of interlocking directorates, and the effects are stronger in vertical mergers than in mixed mergers and horizontal mergers.

The main contributions of this paper are as follows: (1) as most existing studies are based on the data of American market, this paper chose A-share listed companies in China as samples. Cross-border mergers and acquisitions were studied in this paper. All this makes this article the earlier studies on interlocking directorates' influence on corporate decisions and on company's M & A decision. (2) previous studies focused more on acquiring company than acquired company. (3) there are relatively few studies on M & A decision conducting comparative studies on different M & A modes. Through this study, it proves that interlocking directorates can help company to choose potential acquisition target from interlocking directorates related companies, which is of great significance in corporate governance and major decision-making. In the current situation that Chinese market has not yet fully marketized and the transmission of information is not sufficient, the board of directors of listed companies can potentially play a role outside the system to affect the operating decisions. Mergers and acquisitions of companies in different industries facing higher costs and risks, enterprises have a tendency to use interlocking directorates to reduce costs and risks. But when the industry is completely heterogeneous, interlocking directorates' influence declines. In such case, the enterprise will take more consideration of qualified acquisition targets in order to select the best fit enterprise as acquisition target.

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Conflict of Interest

None of the authors have any conflicts of interest to declare.

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