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Ameliorating the Nigerian Housing Challenge through the Adoption of the Industrialized Building System

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ABSTRACT
Nigeria faces a rather acute housing shortage. Industrialized Building System (IBS) has been in use for a long time in different countries of the World to provide mass housing. This paper set out to investigate the level of awareness of the professionals in the industry about the IBS and the feasibility of adopting it to provide a rapid solution to the housing shortage problem in Nigeria. The study used responses obtained from structured questionnaires distributed among a sample selected at random from a population of building industry professionals operating in three of the six geo-political zones in Nigeria. A total of 50 duly completed questionnaires were analyzed using descriptive statistics found in the statistical package for social scientists (SPSS). It discovered a fairly high level of theoretical knowledge of IBS among the sample although with little practical use. The study further discovered that even though the technical knowledge may be available, the level of technological development of the country coupled with the unfavourable exchange rate render the widespread use of IBS difficult in the country. It was therefore concluded that in order to be able to achieve the desired speedy reduction in housing shortage which IBS could offer, some support programme must be put in place to make equipment more affordable. It was therefore recommended among other things that equipment leasing companies be given some sort of import duty relief to reduce the cost of procuring the equipment.
KEY WORDS: Housing, shortage, Industrialized Building System, solution.

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I. INTRODUCTION

With urbanization came a series of challenges, one of them being housing shortage. The challenge is even more acute in the developing countries, Nigeria inclusive. The rural - urban migration of young school leavers and others from the villages to the urban centres put a lot of pressure on the existing housing stock and utilities. The activities of armed militia groups in recent years have created a large number of internally displaced persons (IDPs) who need to be housed in their new locations. This level of poverty reflects on the terribly poor state of their housing. (Olotuah and Aiyetan, 2006). Despite the regular review of housing policies over the years, the housing circumstances of low-income earners, who incidentally constitute the vast majority of the population in Nigeria, have not shown any significant improvement as observed by Olotuah and Taiwo (2013) who referred to earlier researches that showed that an estimated 2.3 million urban dwelling units in Nigeria are substandard, only 33% of houses can be considered to be physically sound, 44% require minor repairs and 19%, major ones to bring them to normative and structural quality. Sanitary facilities in most urban dwellings and public services (especially water and electricity supply) are grossly inadequate. Olotuah and Taiwo (2013) further pointed out that even when the focus had shifted from the use of what has come to be known as conventional building materials in Nigeria to locally manufactured ones in the hope that there would a rapid increase in the existing housing stock not much success had been achieved.

IBS had been effectively adopted in Russia and many other European and American countries to produce mass housing during the last century. One major advantage of IBS is the speed with which buildings can be erected. It involves the use of prefabricated members to assemble the entire building so that only joints require fresh in-situ grouting. It involves manufacture of components off- site utilizing industrial processes similar to those involved in the manufacturing sector.

A large majority of the housing development projects are awarded to the indigenous contractors who constitute a large portion of the Nigerian building sector. In the building sector of the Nigerian construction industry, the full use of the IBS is not so common and where they are it is usually partially adopted. It is observed that most building works are done in-situ and with minimum workable number of equipment. The expatriate companies are also observed to be more involved in the use of prefabricated concrete components and the indigenous contractor, hardly at all.

The main task in this study is to determine the level of awareness of the professionals in the industry about the system, the feasibility of adopting the industrialized building system to provide mass housing in Nigeria, the constraints to its adoption for providing the quantum of housing required and the means of achieving an improvement in the current state of practice of the system in Nigeria.

II. LITERATURE REVIEW

DEFINING THE INDUSTRIALIZED BUILDING SYSTEM (IBS)

The term industrialized building system (IBS) alternatively called the industrialized building method (IBM) may be defined as a system or a method of construction in which all components i.e. beams slabs, columns, walls, staircases etc are manufactured completely in a factory or off- site under strict quality control and the brought to site for assemblage thus minimizing site activities. (Rollet, 1986, Trikha,1999). Esa and Nurrudin (2002) pointed at the adoption of the usual manufacturing processes to facilitate production under the system. Warswaski (1999) concurs with the Esa and Nuruddin (1998) pointing out that the industrialization connoted investment in equipment, facilities and technology with the objective of maximizing profit, minimizing labour resource and improving quality while the building system means a set of interconnected elements jointed together to enable designated performance of a building. Simplifying the above definition and putting it in the layman's language was the Junid, (1986) definition which defined the system as an industrialized process whereby components of buildings are conceived, planned, fabricated off-site and transported to site for erection of the building.

ESSENTIAL CHARACTERISTICS OF THE SYSTEM

The system is characterized by a number of easily identifiable terms, procedures and subsystems:

OPEN AND CLOSED SYSTEMS

A system can be described as closed when the components are manufactured based on specifications that make them non- interchangeable. The design is done to meet the client's specifications. The prefabricators standardize their designs but in such a customized manner which may make it incompatible with those of other prefabricators. The components are designed in accordance with the space requirements and functions of the building.

The open system allows more freedom by making use of interchangeable standardized components such that orders could be placed across different manufacturers producing the same type of components. The modular sizes and the jointing system will be the same even though produced by different manufacturers. The prefabricator bases his design on the production of uniform types of building or a group of building variants which can be produced with a common assortment of components. Examples include schools, parking garages, gas stations, low cost housing and any other housing estate utilizing prototype designs. In these cases, large numbers of repetitive and standardized elements are produced; the project is large enough to make mass production of these elements profitable,

STANDARDIZATION AND TOLERANCE LIMITS

To accomplish the requirements of modular coordination, all components need to be standardized. Construction modules are built to standard sizes (modules) and specifications so that design can be made to reflect interrelated patterns in a grid form. Production resources can thus be more efficiently deployed.

Tolerance limits are set at ±5mm signifying a high precision job.

MODULAR COORDINATION

Modular coordination refers to a coordinated unified system for dimensioning spaces so that all components fit together without the need to extend or cut even when they have been supplied by different manufacturers. The full advantage of interchangeability under an open system can be taken of multiples of modules used to assure a repetitive and interrelated pattern.

AUTOMATION AND SPECIALIZATION

The normal industrial processes allow robots and mechanical gadgets to carry out a number of repetitive processes so that full advantage of division of labour can be taken. Similarly, since the procedure of production in the factory is in a manner of speaking detached from assembly of components on site, specialization arising from repeating particular processes by the same team brings about specialization and the attendant advantage of higher productivity. (Chew & Michael, 2001)

SITE WORKS

Since all components are manufactured off- site the job carried out on site is that of assembling the components to the designed form. The components may have followed the box system, the large panel or the frame system.(Chew & Michael, 2001) The procedure of assembly will essentially require the use of equipment to lift the components into position as well keep them in position till fixing and jointing is completed. The jointing

depends on the manufacturers preference, it could be by lapping of reinforcement extensions (tendons), riveting , bolting or welding. In all, only the joints require fresh cement or concrete grouting and this is the only amount of wet job required on site.

MERITS OF THE IBS RELATIVE TO IN-SITU CONSTRUCTION

Compared with the in –situ construction, the IBS has a number of advantages this includes, *inter alia:*

Using the framed structure or the large panel or the box system, large numbers of units of houses can be erected within an amazingly short period. This is because only a little amount of wet job at the joints is required to be done on site.

Quality control is easy to exercise under factory conditions.

Inclement weather which tend to interfere with progress of work has less negative effect on IBS

Time consumed in planning for in- situ works is reduced under IBS.

Pilfering and wasteful deployment of materials which is often encountered in in –situ works in Nigeria is usually less under IBS.

On confined sites the arrival of the components can be timed to occur shortly before it is programmed for erection so that the space needed for storage of materials is drastically reduced.(Cormican,1996)

Automation and mechanization coupled with the adoption of division of labour develops the industry and enhances efficient delivery of building projects

REASONS FOR THE LIMITED USE OF IBS IN BUILDING CONSTRUCTION IN NIGERIA

In spite of the many advantages there are a number of demerits which limits the use of the system in Nigeria. Some of these demerits are listed below:

The joints require careful attention and could be a source of failure in the system if not properly done. This could be a major problem where there is an inadequacy of sufficiently skilled personnel to ensure a good work.

The bad roads in Nigeria and occasional accidents could lead to heavy financial losses when components get broken.

One major drawback is that no research and development efforts have been done in the direction of prefabrication from local building materials. This problem also exists in some other developing countries of the world. (Badir, et al.,2002, Heathcote and Moor, 2004; Al-Sakkaf, 2009, CIBD 2010).

Any careless handling of components on site could lead to accidents and/or financial losses

Except when used for large projects where there are repetitive use of prototype components, the system would not be economical. Economy of scale comes in only when large numbers of a particular article is needed and repetitively produced using the same mould.

The level of technological development of the country makes it difficult and expensive as high cost equipment have to be imported to make the system work.

Transportation of the equipment to site constitutes additional costs which could render the system expensive.

The freedom enjoyed by the architect to create beauty by varying the shapes and heights and dimensions of components will be limited. This could lead to monotonous and uninteresting buildings and streets.

III. METHODOLOGY OF RESEARCH

This study is essentially a field survey. The population consists of all the professionals and other stakeholders in the building sector of the construction industry in FCT, Kaduna, Port- Harcourt, and Lagos. The sample for the study consists of professionals recognized by the national building code (2006) as being relevant in the building industry. These are architects, Engineers, Surveyors (Land, Quantity and Estate) Builders and Town Planners. The sample is randomly drawn from the pool of these professionals operating as consultants, educators and contractors in Lagos in the south west geopolitical zone, Kaduna in the north central, Port - Harcourt in the south - south and the Federal Capital Territory where construction activities are observed to be very active. The method of obtaining data was through the use of structured questionnaires distributed among the sample. Statistical method of analysis called the mean score was used to rank the variables. The SPSS was utilized to facilitate the process of analysis.

IV. FINDINGS

Table 1: **Level of awareness of professionals in the Nigerian construction industry about IBS**

S/N	FACTORS	N	MEAN	RANKING
1	Read about it in textbook/online	50	4.20	1
2	Taught theoretically at school	50	4.02	2
3	Exposed to it theoretically during professional development training sessions	50	3.68	3
4	Watched videos showing the use of prefabricated elements	50	2.88	4

	to construct buildings			
5	Exposed to practical use of prefabricated components as an employee of a construction firm	50	2.45	5
6	Cannot remember anything like IBS	50	2.38	6
7	Learnt practically during industrial training as a student	50	2.24	7
8	Taught with visual aids at school	50	2.20	8
9	Taught with practical site exposures at school	50	1.96	9
10	Involved in on-going building projects using IBS	50	1.46	10

N: No of respondents

Table 1 above shows that majority of the respondents read about IBS on the internet (mean score 4.20), followed by those who learnt about it in classrooms with a mean score of 4.02. Those who learnt about IBS theoretically during the mandatory professional trainings ranked 3rd a mean score of 3.68. A mean score of 2.38 ranking 6th was returned by those who could not even remember anything about IBS. Those who have had exposure to it through audio visual gadgets in classroom posted a mean score is 2.20 ranking 8th, followed by 2,06 for those who had practical site experience while in school. The least ranking, 10th with a mean score of 1.46 from the response of those who are involved in ongoing projects wholly or partially utilizing prefabricated components shows a low level of use of prefabricated components for building in the sampled area.

Table 2: Constraints to the adoption of IBS to solve Nigeria's housing problems

S/N	CONSTRAINTS	N	MEAN	RANKING
1	The need for heavy and costly construction equipment	50	4.72	1
2	Low level of technological development	50	4.24	2
3	Unfavourable exchange rate	50	4.24	2
4	Experienced and skilled manpower not always readily available	50	3.20	4
5	All companies wanting to do everything instead of specializing in either production or assembly of components	50	3.10	5
6	Unsure about marketability of prefabricated concrete components in Nigeria.	50	3.06	6
7	The tendency to limit designs to repetitive prototypes which some condemn for low aesthetic value.	50	2.98	7
8	Loss of certain skills which may have been outsourced once automation and specialization is fully realized.	50	2.92	8
9	Insufficient formal and informal training in IBS	50	2.88	9
10	Lack of supportive policy on the part of the government	50	2.74	10

N= No of respondents

Table 2 above shows that the need for heavy and costly equipment ranked 1st .This is followed jointly by the low level of technological development and the unfavourable exchange rate. Ranking 4th is the non availability of skilled and experienced manpower. Also highly ranked, at 5th position is the tendency for firms to refuse to specialize. The mean score was 3.10. This was followed closely by the non- availability of a ready market for the products of the system with a mean score of 3.06.

The constraints considered least severe by the respondents were insufficient formal and informal training with a mean score of 2.88 which ranked 9th and lack of supportive government policies with a mean score of 2.74 which ranked 10th. The high mean scores shows that all the constraints were of high severity.

Table 3: Ways of making IBS adaptable to resolving Nigeria's housing challenge

S/N	SUGGESTED IMPROVEMENT DRIVERS	N	MEAN	RANKING
1	Effective teaching of IBS in schools to include audio visual aids to be enforced by accrediting authorities	50	4.20	1
2	Exposure to practical involvement in IBS procedures via site visits and video recordings during such visits	50	4.20	1
3	Inclusion of training on IBS as part of mandatory continuous professional development by the various professional bodies	50	3.84	3
4	Improved road network	50	3.28	4
5	Removal/reduction on import duty on construction equipment over a reasonable period of time to encourage equipment leasing companies.	50	3.28	4

6	Encouraging the development of prototype designs in government initiated residential estate projects so that the full advantage of mass production of standardized components can be achieved.	50	2.88	6
7	A mechanism for quality control so that firms may evolve which would specialize in production of components.	50	2.54	7

N= No of respondents

From the Table 3 above, effective teaching using audio visual aids and enforced by the accrediting authorities ranked 1st with a mean score of 4.20. This position is shared by exposure to practical involvement of students and other trainees via site visits and video recordings during site visits. Ranking 3rd with a mean score of 3.84 is the training of professionals on IBS during the mandatory continuous professional development sessions organized by the various professional bodies. Jointly ranked 4th are improved road network and the removal/ reduction on import duty on construction equipment with a mean score of 3.28. Encouraging prototype designs in government projects ranked 6th with a mean score of 2.88 while creating a mechanism for quality control so as to encourage firms to specialize ranked 7th with a mean score of 2.54. The responses above shows that the professionals would be willing to learn, acquire the necessary skills and make use of the IBS provided the right work environment is provided that could make the system function smoothly.

V. CONCLUSIONS

Based on the findings in this study, it has become obvious that the IBS is a feasible means of solving the perennial challenge of housing shortage in Nigeria albeit with some obstacles which would have to be overcome as listed in Table 2.. The peculiar problems that could be encountered include poor road network, low level of technological development, unfavourable exchange rate coupled with high import duties which make importation of equipment required expensive etc. It was further concluded government policies that are favourable to the industrialization of the construction sector is a *sine qua non* to achieving success with the system as has been done in other climes. Similarly important is the role of the training institutions and professional bodies to ensure the adequacy of sufficient quantity and quality of adequately trained and skilled workers to run the system.

VI. RECCOMMENDATIONS

Based on the findings of this research it is hereby recommended as follows:

1) Government should, over a period of time considered reasonable, remove or at least reduce considerably, the amount charged as import duties on construction equipment so as to make them affordable to equipment leasing companies and contractors particularly the indigenous ones.

2) The various schools curricular should emphasize the practical exposure of students to production and use of precast elements. Audio visual aids that could enhance the teaching of construction should be made a compulsory requirement in the various schools and professional institutes where professionals in the building sector of the construction industry are trained. This should be verified during any accreditation exercise to the various schools..

3) The various professional bodies and registration boards should emphasize a good understanding of the IBS in their training programmes and certification examinations.

4) The Government being the largest investor in infrastructural development and the main driver of the industry in Nigeria should lead the way in the journey of adopting IBS to produce buildings in its various housing estate schemes.

5) There is an urgent need to improve on the road network generally in the Country to minimize losses which could occur as a result of accidental breakages of components.

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