Costs of Alternative Methods of Acquiring Sandcrete Blocks for Walling

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Abstract

Alternative methods of building material production without compromising on quality have become vital to researchers lately. Site-manufacturing of 225mm hollow sandcrete block for walls was researched on with the aim of comparing its production cost with that of the outright purchase of the block in the market. Two similar twin 2-bedroom bungalows were designed; their cost estimates and the number of blocks required for each of the buildings were got. While blocks were site-moulded for one building on the acquired site, blocks were bought for the second building. This was done for the purpose of comparing costs of alternative methods of acquiring sandcrete blocks and ultimately comparing costs of 225mm thick blockwalls of the same materials. The walls were built between January and March 2013. Records of costs of labour and material were kept. Each of the two buildings used for the research consumed 4,800 blocks. For the site-moulded block alternative, a total cost savings of N182, 832 was achieved on the blocks used for the building, resulting in cost savings of 27.21 %. This alternative means of acquiring block material for walling is recommended to developers who are interested in cost savings and where time is not of essence.

Keywords: Cost savings, Nigeria, sandcrete block, site-moulded block.

Introduction

As costs of construction are becoming less affordable to average private individuals and organizations in Nigeria, the reason for which can be traced to the global economic meltdown coupled with other complex issues such as the mishandling of the nation's public wealth, alternative ways of achieving affordable decent housing or office accommodations are being explored by researchers and interested stakeholders. For instance the Nigerian Building and Road Research Institute (NBRRI) over the years has been doing very much work in the area of providing alternative materials for walling among others. The Institute had collaborated with other organizations such as the Federal Housing Authority to put up prototypes on which tremendous savings in costs were said to be made. Also, the Raw Materials Research and Development Council (RMRDC) and the defunct Directorate of Food, Road Rural Infrastructures (DFRRI) made remarkable contributions to construction developments in Nigeria, especially in the areas of alternative ways of sourcing for construction materials.

Wall is an element of a building with the specific roles that it performs. Its functions in a building are so vital that they make the wall an indispensable element of any building. Hence the cost of a wall in a building cannot be overlooked. Most common among the functions of walls include: provision of privacy from the glare view of the public, provision of safety and security from both human and animal intruders including reptiles,

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safety from sun, rain, wind, flood, inclement weather and other elements, partitioning of the building into convenient space sizes for the use of the occupants and their visitors and structural functions such as the carrying of the super-imposed loads like the roof members. Enclosing walls also perform the aesthetic function for the building. Walls can be subdivided into internal or external walls. They can also be either load-bearing or non-load-bearing.

Speculations abound in the Nigerian public that there is cost saving in site-moulded 225mm blocks for walls when compared with outright purchase of the blocks. However, the extent of the likely savings on any type of building has not been established for 225mm sandcrete block. The available research report closest to this was the cost-saving of 31.65% established by Lawal (1999) which was for the on-site moulding of 150mm blocks. Other research publications brought to public awareness on sandcrete block, with or without additives, include: its comparative cost with that of laterite interlocking blocks (Raheem et al, 2012); its compressive strength (Wikipedia, (2013); Afolayan et al. (2008), Aho and Utsev, (2008); Abdullahi, (2005); Adedeji and Ejeh, (1998)); its behaviour (Wenapere and Ephraim (2009)); its quality control (Baiden and Tuuli (2004)). This research is aimed at ascertaining the quantitative extent to which savings are made in the cost of manufacturing the 225mm sandcrete blocks on site as compared to the conventional buying of the blocks from the open market and to sensitize housing developers on a cheaper way of obtaining sandcrete blocks. The objectives include:

(i) acquisition of a site for erecting two bungalows
(ii) analyzing costs of materials and labour for the blocks required and
(iii) comparing costs of the blocks under each acquisition method.

Related Literature

There are various materials used for walling in Nigeria, sandcrete block being one of them. Casual observations would reveal that most building accommodations erected in the country within the past thirty years have their walls made of sandcrete blocks. Other walling materials include bricks, stone, plywood, earth (laterite also locally called mud) and the likes. Blocks are of two main types namely; concrete block and sandcrete block. Unlike concrete block whose components are coarse and fine aggregates mixed with cement, sandcrete block is made of only fine aggregate (sand) mixed with cement. The sand and cement mixture is in the proportion of 6:1 (British Standards Institution, 1970). Specifications for moulding sandcrete blocks stipulates that the block is generally to be made in accordance with BS 2028.

Sandcrete blocks are made in three sizes in Nigeria. The sizes are 450 x 225 x 225mm (length, width and height) respectively, 450 x 150 x 225mm and 450 x 100 x 225mm. The first size is mainly used for various types of construction such as fencing, culvert, drainage, abutment, pier, retaining walls and other similar works where it can act as substitute for concrete. Other binding agents such as ashes of rice husk, sawdust, coconut shell and the like have been experimented on to partially replace ordinary Portland cement in the manufacture of sancrete blocks (Aho and Utsev, 2008; Agbede and Obam, 2008; Tyagher et al.; (2011). The focus of this research is on 225mm sandcrete block as a walling material and without any admixtures or binding agent other than ordinary Portland cement.

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Materials and Method

Ilorin, a town in the west midland of Nigeria was chosen for the sighting of the research work. This choice of venue was informed by two reasons, namely the advantage of convenient location for the researchers and the ease of acquisition of site for the experiment. Ilorin is on GPS coordinate N8 29.5038, E4 32.67828 and with a population of 847,582 as at 2007 (Wikipedia, 2013a). The site at Tanke, off the University of Ilorin road, was acquired for the purpose of building two similar houses, each comprising of two bedroom flats and with all walls built of 225mm hollow sandcrete blocks.

Drawings for the two buildings were prepared by an Architect and building approval was sought and obtained from the State Town Planning Authority, see Figure 1). A registered Quantity Surveyor was commissioned to quantify the number of blocks required for each of the two buildings and to supply the current ‘build-only’ rate for 225mm blockwall prevalent in the locality.

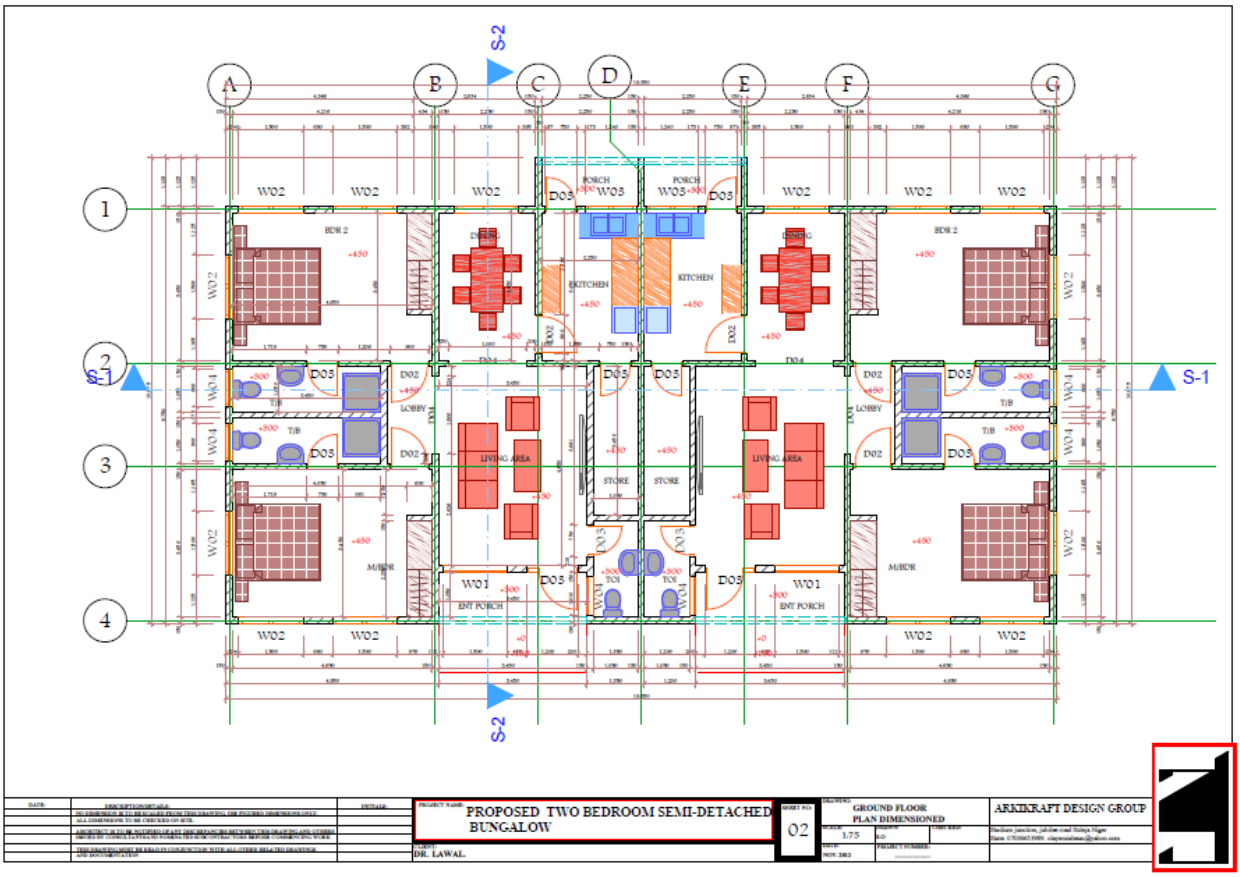

Figure 1. Floor Plan of Twin 2-Bedroom Semi-detached Bungalow

Quality of Materials and Workmanship used for Sandcrete Blocks

Cement

All cement were Portland Cement of Nigeria or other approved manufacture free from lumps – and conformed in every respect with the latest issue of British Standard specifications for Portland Cement B.S. 12 (British Standards Institution, 1971). Cement was delivered on the site in sound, strong, paper and polythene bags and each bag was plainly marked with brand and name of the manufacturers. The cement on the site was stored in a suitable building approved by the Supervising Officer (S O). Each consignment of cement on the site was kept separate and plainly marked with an approved identification mark.

Sand

The sand used in sandcrete block was purchased from local suppliers and complied with B.S.S 882. It was clean, sharp and uniformly graded down from coarse particles not exceeding 5mm in diameter, was free from salt, mica, dirty loam and organic matter and did not contain more than 4% by weight of clay, silt, and fine dust (British Standards Institution, 1992).

Water

Water used was clean and free from all impurities either in solution or suspension and a minimum amount was used in mixing for sandcrete block, sufficient only to give a workable mix. No admixture was used.

Generally

At least two weeks before starting to deliver the materials on the site the contractor submitted for the approval of the S O samples of the sand that he proposes to use on the work and stated the source of supply of each. No materials were delivered until the S O had approved samples, and the materials as delivered were equal in all respects to the approved samples.

The Quantity Surveyor's figure of 4,800 blocks per building was used to engage block moulders for the one building while the same number of blocks was purchased for the second building. Two 'build-only' construction firms were employed for both buildings at the same contract sum. The constituent costs of moulding the blocks were analyzed and comparison was made with the cost of the outright purchased sandcrete blocks for the other building.

Walls for the two buildings were put up on the site to confirm the Quantity Surveyor's figure for the number of blocks required for each building (see Figure 2). The total savings made on the site-moulded blocks required for the entire building was also derived. Moulding and buying of the sandcrete blocks and the construction of the walls of the two buildings were carried out during the months of January – March, 2013.

Figure 2. Twin 2-Bedroom Semi-detached Bungalows

Results and Discussions

From the cost analysis of the site-moulded blocks (see the Appendix), each block was produced at the cost of ₦101.91 whereas a block of the same size was selling at the prevailing market price of ₦140 (transport cost inclusive). This gives a difference of ₦38.09 or a 27.21 % savings on each block. The reduction of ₦38.09 on a sandcrete block implies a savings of ₦182, 83 on the total number of blocks (4800) required for the complete 1No. Twin 2 bedroom semi-detached bungalow

Implications of the Findings

The research findings add to the knowledge that value for money on blockwalling can be optimized by using the site-moulded block alternative. With the savings of 27.21% on the cost of sandcrete hollow block as walling material, direct moulding of blocks on site brings relief to potential house owners who might not have sufficient fund to embark on conventional buying of blocks for the project. A savings of about ₦183, 000 on blocks alone of a typical twin two-bedroom semidetached bungalow is an encouragement to build.

Precautions

To produce site-moulded sandcrete blocks of desirable strength and other characteristics that are favourably comparable to the sandcrete blocks in the market, the production environment must be properly under control. Specifically, on removal from the machine on pallets, the blocks are to be matured in the shade in separate rows one block high with a space between for at least 24hrs and sprayed with water. They may then be removed from the pallets but not stacked or removed from the shade for a further 4 days and sprayed with water at intervals. Following this the blocks may be stacked not more than 5 blocks high in the shade for a further 14 days and allowed to dry out. No blocks are to be built into any part of the building until they have matured in the manner described for at least 21 days.

It is worth noting that if the above stated conditions of curing the blocks are not satisfied, the 27.21 per cent savings cannot be achieved. Deviations from adhering to the stated procedures are most likely to end up in big financial loss as the moulded blocks may not properly cure. For instance, rain falling on the freshly moulded blocks affects the soundness of the hollow blocks negatively. Likewise the space and shade under which to spread and store the blocks for the required number of days should be readily available on the site. A minimum buffer period of 21 days should be available before the need to incorporate the blocks into the building arises.

Conclusion and Recommendation

From the results of the erection of the walls of the two buildings and the cost analysis carried out, the following conclusions can be drawn:

(i). Cheaper alternative means of achieving value for money in sandcrete blockwall construction without compromising quality is by site-moulding of the required blocks.

(ii). Proper control and monitoring of the production process of site-moulding blocks are necessary in order to avoid deviation from the set objectives and also to forestall big financial loss on the long run.

(iii). To further achieve the strength objective of the site-moulded blocks, a minimum setting period of 21 days is required before incorporating the blocks into the building.

For building procurers who have sufficient time and shaded space on site and desire to save costs on sandcrete block, the option of site-moulded sandcrete hollow block is recommended. This option was found to save cost on sandcrete block material to the tune of 27.21% and without compromising on the aesthetic and strength quality of the block.

It is to be noted that developers who do not have sufficient space to keep the blocks during the first five days of production (first day on pallet followed by four days of wetting) should not embark on site-moulded block alternative. Where time is of essence, site-moulding of block is not advised as a minimum period of three weeks is required for the curing of the blocks before they can be incorporated into the work. There are other challenges associated with site-moulding of blocks. These include: compromising quality due to diversion of materials (especially cement), running after operatives to bring them to site, racking (rough/non-linear) of blocks due to uneven site topography, controlling weather condition especially casting during heavy rain downpour, and other contingencies

beyond control. Due to lack of sufficient fund, the experiment which was to be repeated on other sites for proper validation was carried out on only one site. This makes the research a special case.

The site-moulding of blocks is further recommended on the basis of global economic advantage. It allows for employment of more craftsmen (engagement of block moulding specialists) and yet the total expense on the sandcrete blockwall is less than when the conventional method is used.

Areas for Further Research

This experiment was conducted during dry season where curing of the blocks was not having interference from the rain, moulding of blocks during wet season should be carried out and the financial implication of provision of protection of the blocks against direct rainfall in their first five days of moulding could be investigated. Cost implication of close monitoring of the quality of blocks produced on site can be investigated as well.

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Appendix

Analysis of Cost of a 225mm Hollow Block

For the period January-March 2013

Moulding of 225mm sandcrete blocks.

Materials:

1No bag of 50 kg portland cement on site = ₦1700.00

1No lorry load (3 cu.m) of sharp sand = ₦6000.00

1No 11,000 litre tanker load of water = ₦5000.00

No of 225mm sandcrete blocks that can be moulded from 1 bag of cement = 35

Cost of cement in 1No 225mm sandcrete block = 1700/35 = ₦48.57…….....(1)

Labour costs:

Charges (+ overhead, profit & tools) by the 'Specialist' for moulding

1No 225mm block = ₦14.00…..... …….. . (2)

Cost of wetting, lifting and stacking blocks.

Wetting

Consider 1000 blocks – wetting at 4 different periods (a period takes 1 hour)

4 hours unskilled labour at N1000/8hr day =₦500

Labour cost of wetting 1 block = 500/1000 =₦0.50..... (3)

Lifting

Consider 1000 blocks. 1 hour of unskilled labour at N1000/8hr day = ₦125

Labour lifting 1 block = 125/1000 = ₦0.125.....(4)

Stacking

Consider 1000 blocks

3 hours of unskilled labour at N1000/8hr day = ₦375

Labour cost stacking 1 block = 375/1000 = ₦0.375.....(5)

It takes 1 lorry load of sand to mould 200 No sandcrete blocks

Each of the two buildings takes 4800 sandcrete blocks to build (the QS figure).

Thus to mould 4800 blocks, it takes 24 lorry loads of sharp sand at ₦6000 per load = ₦144000

Cost of sand per block = 144000/4800 = ₦30.00.....(6)

It takes 8 tankers of water to mould and wet 4800 blocks at ₦5000 per tanker = ₦40000

Cost of water per sandcrete block = 40000/4800 = ₦8.33.....(7)

Adding all costs 1 – 7. cost per block gives ₦ (48.57+14.00+0.50+0.13+0.38+30.00+8.33) = ₦101.91

Cost of 1No 225mm sandcrete block throughout the period in the area (3 local government areas) was ₦140.

Therefore Cost of commercially produced block – cost of site-moulded block = saving/loss made.

Thus ₦ (140 - 101.91) = ₦38.09 (saving made)

38.09÷140 = 27.21% savings.