

PUBLIC-PRIVATE PARTNERSHIP IN HOUSING DELIVERY USING CEMENT-BONDED COMPOSITES BUILDING MATERIALS.

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ABSTRACT

The advent of a new concept based on public-private partnership in almost all the sectors of the socio-economic spheres of Nigerian industrial development calls for provision of low-cost core housing units using cement-bonded composites as building materials cannot be overemphasized. This paper is targeted at public-private partnership (PPP) as it relates to provision of social housing for low-income earners. The paper highlights the fundamental issues relating to housing, types of public-private partnerships in practice, and the benefits of public-private partnership to the citizens and the sustainability of the public-private partnership in housing delivery. The use of cement-bonded composites building components such as wall panels, ceiling boards and floor tiles were emphasized in this study. Recommendations were proffered on housing delivery through the public-private partnership using the cement-bonded composites effectively as alternative to sawn timber.

KEYWORDS:

Public; Private; Partnership; Cement-bonded; Composites.

INTRODUCTION

Housing is one of the three necessities of life needed to be given its due attention, and it should be provided for people at the cheapest possible price. Its delivery has been plagued over the years with the problems of availability and affordability. For a very long time, until recently the government has been saddled with the enormous responsibility of providing housing for its citizens. Recently, the private sector has been showing considerable interest in the provision of housing, but with making returns on their mind. The above situation brought about the cooperation between the government and the organized private sector in delivering affordable housing to Nigerians using cement-bonded composites building materials. Housing is a critical component in the social, economic, and health fabric of Nigeria and other nations. No country can claim to have provided adequate housing to the various socio-economic groups that make up its population, especially the low-income earners. Thus, most nations of the world, in one form or another continue to place access to affordable housing at the top of their priority lists. Housing in developing nations and other parts of developed countries continues to be of insufficient quality and quantity to meet increasing demand. Poverty caused underdevelopment, such as those in the slums of Mexico City, is common in the large cities of South America, Asia and Africa. Thus, the demand for low-cost housing is generally unmet. This is true for developing countries as well. As more people move to already overcrowded cities, shantytowns are built on the edge of the city to accommodate the new migrants, but they often do not have electricity, running water, sewage systems, or social amenities such as schools and health clinics.

This paper is targeted at public-private partnership (PPP) as it relates to the social housing delivery using cement-bonded composites building materials. Ajayi (2004) asserted that cement-bonded composite has been accepted as panel products for constructional works for interior and exterior purposes. The main interest in boards manufacture in Nigeria is associated with the availability in large quantities of the two major production variables (Portland cement and wood wastes) and the low cost of cement compared with that of the resin binder usually used in the production of resin-bonded particleboards. Wood wastes of various grades (sawdust, off cuts, slabs, defective logs, thinning, prunnings and shavings) form the main raw materials base, and such wastes are derived from wood processing and forest industries. Different agricultural residues are being used as raw materials for boards manufacture, for example Banana stem with saw dust (Ajayi 2003), Maize stalk (Ajayi 2006a), bagasse (Sandermann 1970, Simatupang et al, 1993), coffee chaff (Ajayi,2006c) and yam strands (Ajayi, 2006b). The inherent excellent characteristics of cement-bonded boards, particularly its high resistance to moisture, fire, termites, fungi and other forms of degrading agents have made it versatile construction material for roofing, ceiling, flooring, partitioning, cladding and shuttering (Badejo, 1986; Dinwoodie and Paxton, 1990; Ajayi, 2000).

The Public-Private Partnership is the collaboration between the public and private sector for the purpose of delivering a project or service which was traditionally provided by the public sector. The concept of partnership in housing delivery system is predicated on the pooling together of resources from the various stakeholders, each party making inputs, thereby minimizing wastages and maximizing results achieved. Ikekpeazu (2004) noted that the expediency of the increased adoption of the Public-Private Partnership for housing delivery in the present socio-economic circumstances of shortage of housing in Nigeria is now even more glaring. With the increasing demand of the population on the national economy and the government's propensity for enlarging the multi-sectoral allocations in terms of finance, it is becoming more obvious that government alone can no longer provide adequate housing for all categories of her citizens. Thus, the public-private partnership will facilitate the provision of housing delivery.

The Concept of Public-Private Partnership

One of the most important developments in this twenty-first century is the increasing promotion of the concept of partnership especially between the public and the private sectors. The second United Nations Conference on Human Settlements (dubbed HABITAT II) which took place in Istanbul, Turkey, in June 1996 represented an important milestone in canvassing support for this strategy especially in respect of housing provision. According to the Global Plan of Action resulting from that conference, the seventh principle and goal of action stated that:

Partnership among all actors within countries from public, private, voluntary and community based organizations, the cooperate sector, non-governmental organizations and individuals are essential to the achievement of sustainable human settlement development and the provision of adequate shelter for all and basic services. Partnership can integrate and mutually support objectives of broad-based participation through inter alia, forming alliances, pooling resources, sharing knowledge, contributing skills and capitalizing on the comparative advantages of collective actions.

From the above, it is evident that the goal of sustainable housing development will be attained through a collaborative effort of the public and the private sector. However, Warah (1997) asserts that partnerships should not be viewed as a panacea for all urban ills. Warah (1997) further stressed that the responsibility of ensuring the right enabling environment for partnerships to flourish still rests with Governments, who need to provide the right legal, fiscal and regulatory frameworks required to mobilize the energies resources of all the various sectors so that these sectors can develop their communities or cities in a safe, healthy, productive and sustainable manner. From the Irish website (2005) on Public-Private Partnership, a public private partnership is defined as a partnership between the public and private sector for the purpose of delivering a project or service which was traditionally provided by the public sector. The Canadian Council for Public-Private Partnership website (2005) defines a Public-Private Partnership as a cooperative venture between the

public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards. Furthermore, the Europa website Internal market on public procurement (2005) defines public-private partnerships as forms of cooperation between public authorities and the world of business which aim to ensure that infrastructure projects can be carried out or that services of use to the public can be provided. The Europa website (2005) stresses that these forms of partnership have been developed in several areas of the public sector, such as transport, public health, education, public safety, waste management and water distribution. The free encyclopedia Wikipedia website (2005) on the other hand defines the public-private partnership as a variation of privatization in which elements of a service previously run solely by the public sector are provided through a partnership between the government and one or more private sector companies. Unlike a full privatization scheme, in which the new venture is expected to function like any other private business, the government continues to participate in some way.

As part of Ireland government's commitment to developing the public-private partnership approach as an important element in delivering infrastructure investment under the National Development Plan (2000 – 2006 (NDP) for Ireland, local authorities have been asked to consider the potential for using PPP arrangements in a range of housing areas, including social and affordable housing provision, the management of housing estates, the provision of rental accommodation and the carrying out of remedial works and regeneration schemes (Day, 2005). Private sector innovation and technological, financial and management expertise can be gained through using a public private partnership approach to projects traditionally within the sphere of local authorities as Day (2005) further stresses. He says that public private partnership is another element in the general moves to effectiveness and ultimately a better quality customer service. German Development Organizations (GTZ Asia Networks) in Partnership in Thailand states on a website (2005) that public-private partnerships (PPP) form a cooperation of the state and the private sector. It further states that they are based on the insight that business not only creates shareholder value but also invests in stakeholder value such as human resource development, environmental sustainability and social development. Hence, public-private partnerships contribute to developmental goals and simultaneously meet the interest for long-term economic growth of private companies. These partnerships are said to be founded on a deep shared interest in the success of cooperation.

In Canada, the Canadian Council for Public-Private Partnership (CCPPP) (2005) is a national non-partisan, non-profit organization founded on the belief that the capacity of government to meet its current and future infrastructure and service obligations can be enhanced through public-private partnership. The Canadian Council for public-private partnerships span a spectrum of models that progressively engage the expertise or capital of the private sector. At one end there is a straight contracting agreement as an alternative to traditionally delivered public services. At the other end, there are arrangements that are publicly administered but within a framework that allows the use of private finance, design, building, operation and possibly temporary ownership of the assets.

Public-private partnership can be defined in the Nigerian context as the association and sustainable cooperative partnership design to appropriate through joint financing of developmental projects and provision of infrastructure and services of great benefits to all the parties involved in planning, execution and utilization of the cooperation and assets. The public-private partnership for housing delivery under Nigeria's current housing policy is still at infancy. Abdulsalam,(2008) asserted that it confers certain identifiable roles on both the public and the private sector.

The Roles of The Public Sector (Government) are:

- i. Withdrawing from direct production of houses and diverting focus on the creation of enabling environment for the private sector to perform this role;
- ii. Carrying out legal reforms that result in an enabling legislative mortgage environment;
- iii. Putting in place a regulatory framework that facilitates mass, decent and affordable housing delivery;
- iv. Developing housing infrastructures as a matter of social responsibility;
- v. Simplifying access to land and make land title registration and documentation processes efficient and quicker;
- vi. Providing incentives for the private sector to invest in housing and
- vii. Executing general reforms that facilitate housing delivery.

The Roles of the Private Sector are listed below:

- i. Responsible for production of physical houses;
- ii. Responsible for primary mortgage lending;
- iii. Required to invest mortgage securities and
- iv. Responsible for the production and supply of building materials, particularly local content.

From the preceding paragraphs, an essential characteristic of public-private partnership is the cooperation between government and the private sector. Public-private partnership is not an objective in itself, but an instrument for carrying out important projects such as housing delivery to the low-income members of the society. The advantages which public-private partnership bring are concerted management, the spread of risk, the attraction of risk-bearing capital and the pooling of knowledge. In the absence of such valuable inputs the chances of servicing schemes which exceed beyond the average in terms of quality, are considerably reduced. The exchange of knowledge, the search for new possibility and, above all, clarity about each other's capabilities and restrictions, are vital ingredients. While research and development are making all the efforts available to research into the use of wastes or raw materials from agricultural products, forests, wood and agricultural industries for the production of cement-bonded boards for housing and other uses. The public-private partnership can now massively produce the cement-bonded boards at affordable prices and accessible to major and minor building construction industries. This will further enhance the development and orientation of the cement-bonded boards in construction and industrial development of Nigeria.

Production of Cement-bonded Composites Materials for Building Industry

Cement-bonded particleboard is a value-added wood product made from the combination of two or more raw materials such as particles from wood and agricultural byproducts, cement and a catalyst. Research into development and manufacture of this product is due to the following: 1) Recognition of the suitability of a wide range of raw materials for board production, to reduce pressure on existing forest resources; 2) Desire to increase wood resources utilization; 3) Use of products as alternative to sawn timber for core and low cost housing (see sketches attached as appendices 1& 2). This core housing can be defined as a structure that is somehow incomplete, and most importantly that is minimal in its size and professionally designed with the intention that residents or their direct agents add more spaces to it after occupation. The house can also have minimal levels of finish or services which are designed to be upgraded over time. 4) Meeting the wood products needs on a sustainable basis and 5) The growing desire to protect forest biodiversity.

The use of agricultural wastes could have the following benefits: 1) Increase farmers' income and alleviate poverty, 2) Increase raw material supplies for low cost housing and other construction works, 3) Create job opportunities, 4) Increase food production and reduce pressure on other forest resources.

Cement-bonded board is produced from strands, particles and wood fibres mixed together with cement and manufactured into panels, bricks tiles and other products used in the construction industry. Cement-bonded product can be classified into cement-bonded board, wood-wool excelsior boards and gypsum-bonded board. The excellent properties of cement-bonded made it useful for ceiling, walling, roofing, flooring, claddings, partitioning and shuttering. Board can be applied for internal and external works as it is resistant to termite, insect, fungi, moisture movement, fire, good insulating properties, durability and excellent nailing ability. Dusts are non-aggressive and non-contagious.

Wall Panels

Wall panels are vertical elements within a building that serve the function of walls. They can be produced in different ways and with various materials. In most cases, wall panels are pre-fabricated, factory-built units produced in an indoor environment. Panel can be made from various materials which include; timber, veneer, concrete, glass, polystyrene, polyurethane, aluminum, acrylics and composite materials among others. Wall panels serve many functions, from providing descriptions of exhibits in museums and galleries to hiding away electronics such as stereo speakers. As a decorative element, wall panels are excellent way to break up wall space (Adedeji and Ajayi 2008).

MATERIALS AND METHODOLOGY

Raw materials are: Wood and grass stems agriculture wastes, Cement and Calcium chloride. The wood or agriculture by products (in green or dry form) is processed into billets, chips and particles using hammer mill. Particles are treated with hot water to remove inhibitory chemicals and air dried to moisture content of about 12% approximately. Thereafter, cement and additives are mixed together based on experimental design e.g. 3 x 3 experimental design meaning 3 levels of mixing ratio (1.0:1, 2.0:1, 3.0:1) and 3 levels of additive concentration (1%, 2%, 3%). The mixture is then formed into mat inside a wood mould of 350mm x 350mm square and to targeted thickness. The mat is pre-pressed to reduce the thickness and cold press under a pressing pressure of 1.23N/mm² for 24 h. Board formed is therefore removed from the mould for post-curing for 24 h. Test specimens are cut to determine the following properties: Strength- modulus of rupture (MOR), modulus of elasticity (MOE), dimensional movement by soaking in water to measure the thickness swelling (TS), water absorption (WA), linear expansivity (LE) and by accelerated aging (AA) through introduction of severe test conditions. In 2001, 2002, 2003, and 2004, the total yam tubers harvested was put at 26.42 million, 27.59 million, 28.98 million and 32.55 million tons respectively (Central Bank of Nigeria, 2005). This therefore indicates the quantity of waste materials that could be available for cement bonded board manufacture from this sector alone.

Results of the Investigation

Table 1 shows that increase in AC and BD caused decrease in TS, WA, LE and increase in MOR and MOE. The strongest and most dimensionally stable board was produced at the highest AC and BD of 3.0% and 1200kg/m³ respectively. The findings further show that yam stem is a suitable raw material for cement composite boards production which could be used as alternative to conventional building construction materials.

Table 1: Mean values for TS, WA, LE, MOR and MOE examined

Additive conc. %	Board Density kg/m ³	TS %	WA %	LE %	MOR N/mm ²	MOE N/mm ²
1.0	1000	3.28 ± 0.02	18.05 ± 0.80	0.29 ± 0.01	6.99 ± 0.86	6052.50 ± 815.01
1.0	1100	3.19 ± 0.01	17.59 ± 0.81	0.27 ± 0.14	7.90 ± 1.38	6249.70 ± 695.12
1.0	1200	3.02 ± 0.02	16.89 ± 0.85	0.24 ± 0.02	8.01 ± 0.81	6525.20 ± 102.14
2.0	1000	2.98 ± 0.01	17.88 ± 0.75	0.26 ± 0.02	8.72 ± 0.72	6648.10 ± 101.21
2.0	1100	2.75 ± 0.02	17.48 ± 1.48	0.25 ± 0.02	9.02 ± 1.39	6782.50 ± 129.01
2.0	1200	2.63 ± 0.01	16.58 ± 0.75	0.22 ± 0.01	9.62 ± 0.82	7025.40 ± 37.72
3.0	1000	2.21 ± 0.11	15.98 ± 0.79	0.23 ± 0.02	10.15 ± 0.04	7525.50 ± 164.11
3.0	1100	2.00 ± 0.03	14.57 ± 0.35	0.19 ± 0.01	11.02 ± 0.03	7628.30 ± 155.78
3.0	1200	1.96 ± 0.02	14.01 ± 0.02	0.17 ± 0.01	13.99 ± 0.01	7724.80 ± 7523

Source: Ajayi 2006

Fundamentals of Housing

The fundamental purposes of housing are the provision of shelter for the performance of human activities; safety and security, space and privacy and for the conditions which promote good health and dignified living. This will also check the spread of contagious diseases and provide security, as well as anticipate and provide for emergencies such as electrical and fire hazards as well as construction defects. Good housing is essential for human dignity and self fulfilment. It provides the physical framework in which human, social economic and cultural resources are realized, enriched and integrated. Such needs should cover the provision of adequate space(s) for living, good ventilation along with lighting, recreation, maintenance of cleanliness of the dwelling and its environment.

Next to the question of housing need is its demand. The demand for housing is referred to the type and cost of housing a person or a household is able and willing to pay for. The ability of households to meet their housing need in the private market are usually influenced by effective housing demand and supply, were there to be a shortfall between housing demand and supply, then it means that, the housing need of the people cannot be met. However, the important point here is that housing demand is influenced by income, price(s), rents, credit availability, wealth, demographic factor such as household composition and distribution in terms of age/ sex/ size and so on. These parameters for determining the type of design/ structures suitable for the prospective owner(s) or users of the shelter or house; are interpreted in the form of space/ form manipulations, locations, quantity and quality, material choices and construction methods amongst others.

Housing supply describes the availability of houses or housing units in the right quantity and quality at different prices for sale, rent or lease. The supply of housing usually involves the private and public institutions. Real Estate agencies including mortgage and related financial bodies constitute the bulk of the formal private investors in housing, while the informal sector includes the individual who invest in construction of commercial properties through personal savings and/ or loans.

At present, there is both a demand for housing and a supply of reusable structures that are going unclaimed. This situation is a good example of the complex role housing plays in society. Its primary function was to serve the need for shelter, security, and privacy, but housing must now offer other advantages such as: (1) location, including proximity to the workplace, shopping, businesses, schools, and other homes; (2) environment, for example, the quality of the neighbourhood, including public safety and aesthetics; and (3) investment potential, or the degree to which home ownership may affect capital accumulation.

Benefits of Public-Private Partnership

Public-Private Partnerships introduce the disciplines and efficiencies of private sector management and methods to the provision of public services. By harnessing the complementary skills of public and private sectors, experiences from other countries now point to significant advantages in terms of cost, value and quality of the delivered services. Such participation aims at improving the quality of services provided to citizens, alleviating the burden on the State budget without affecting the state ability in providing services at fair social prices, creating job opportunities, stimulating investment and consumption thus boosting growth.

Throughout the Public-Private Partnership the Government's retains close control over the delivery of the specified level and standard of services. The Government is expecting a higher quality of service delivery from Public-Private Partnerships. Policies on free access and user charges, however, will be the same for facilities provided under Public-Private Partnerships or by normal methods. For the reasons above and because PPP's open up new channels of finance, the Government will have more latitude in bringing forward its investment programme. This in turn will open up opportunities for the domestic contracting and financing sectors, including smaller contractors who are expected to benefit considerably from the programme.

In Nigeria, where Public-Private Partnership is relatively new and developing, an ultra-modern 450 housing units was recently commissioned, aimed at providing cheap and accessible homes in and around the Federal Capital Territory, FCT. Here the partnership involved the government providing the land and other primary facilities, and a private developer, Adkan services was tasked with the construction of this mass housing scheme. Earlier on, in 2002 to be precise, the government had made parcels of land available to private developers in the Federal Capital Territory (FCT), with an allocation measuring 100 hectares in Galadimawa District for the provision of 2000 housing units.

Conclusion

The Public-Private Partnership concept of housing delivery if properly harnessed will solve the problems associated with the issue of acute housing materials and social housing. The intention of providing alternative building materials to the conventional ones using locally sourced non-conventional raw materials with the use of adaptable technology is a right step in the right direction. Cement-bonded composites boards serve a suitable alternative for core housing construction as raw materials for board production are available and affordable. Attached to this paper as appendices 1 & 2 are sketches showing a low-cost core house. The paper highlighted the experiences of the public-private partnership in several developing countries where they had practiced this system of delivery of services to the public. The public-private partnership for housing delivery under Nigeria's current housing policy is still at infancy. However, if the government and the general public accept the use of this innovative building product, the public-private partnership can now massively produce the cement-bonded boards at affordable prices and accessible to the majority of the populace. This will further enhance the development and orientation of the cement-bonded boards in construction and industrial development of Nigeria. This will also serve as a mitigating effort for climate change.

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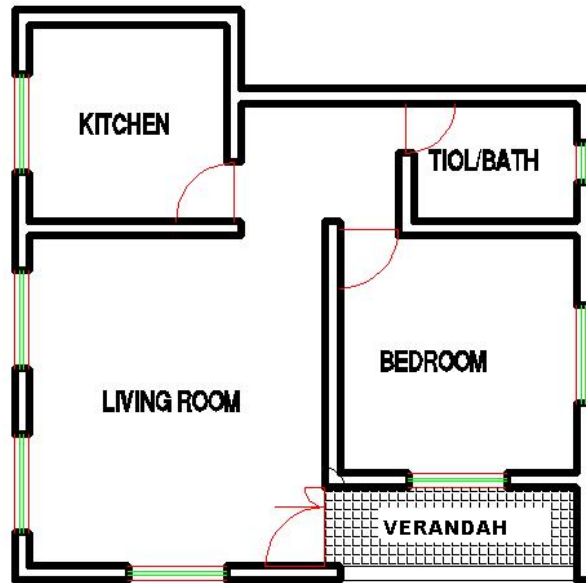
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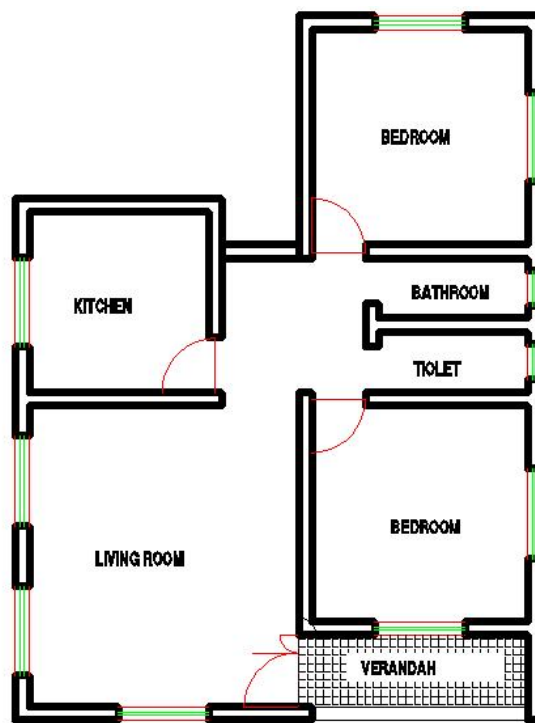
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APPENDIX ONE

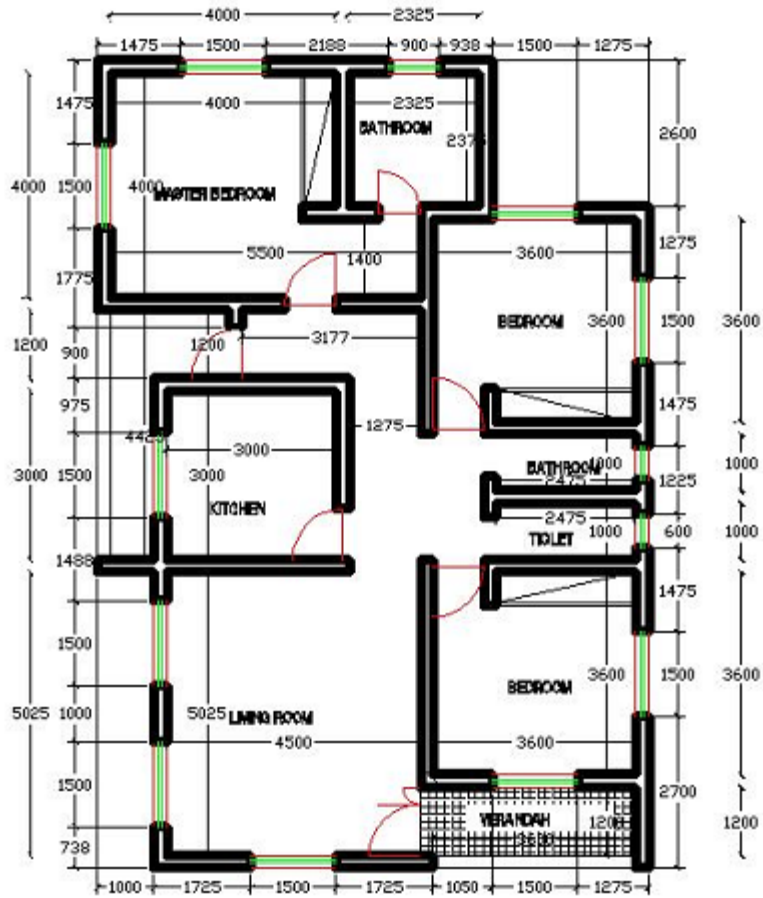


ONE BEDROOM CORE HOUSE

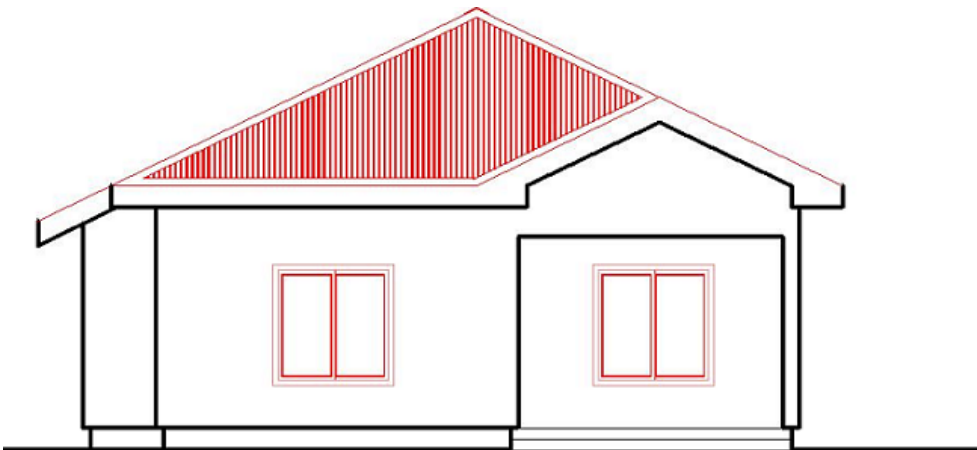


TWO BEDROOM CORE HOUSE

APPENDIX TWO



 **THREE BEDROOM CORE HOUSE**



 **FRONT ELEVATION OF THE CORE HOUSE**