

Review of Botswana's building standards

A case for indigenous and/or locally produced building materials



Joseph Jo' Segopa

Principal Housing Officer
South East District Council, Botswana

The Shelter Situation in Botswana

Basic General Data

Botswana has experienced rapid urbanisation over the years and this has had a negative impact on housing development in the country. While most households' housing needs have increased over the years, the households' ability to meet these needs have been curtailed by exorbitant building materials' prices, especially for materials deemed acceptable and prescribed by the Country's Planning statutes.

Botswana is a relatively sparse country with an area of 569 582 square kilometres (km²), and more than two thirds of its land mass is covered by the Kalahari Desert or sandveld. The country's populace (approximately 80%), settlements and economic activities are concentrated in the eastern border or hardveld. According to the national population census conducted in August 2001, the population of Botswana is estimated at 1.68 million people. This represents an increase of 27% since the 1991 census. The annual population growth rate was 2.4% compared to the 3.5% during the previous inter-census period with a decrease in average household size from 4.8 persons in 1991 to 4.1 persons in 2001. This slowdown in population growth was expected owing to a decline in the fertility rate among the population. Other factors such as increased women

participation in economic activities, increased literacy rates, access to better health care may have had a profound effect on population growth (Ministry of Finance and Development Planning, 2003).

The country's urban population has increased rapidly over the years and currently makes approximately 51% of the country's total population. One of the seven pillars of Botswana's long term development strategy, Vision 2016, envisages that by 2016 all Batswana will have access to good quality basic shelter in both urban and rural areas. The National Policy on Housing (Government Paper No. 2 of 2000) seeks to address the needs of the nation with regard to housing in line with Vision 2016. Department of Housing (1997) observed that whilst an analysis of the existing housing stock indicated that the majority of the country's populace has near adequate space by international standards (the average number of rooms per household was 2.6 in 1994 from the same report by the Department of Housing), the distribution is highly skewed in that a few people have too much space while many live in crowded conditions. A consultancy by DCDM Botswana in 2006 (on behalf of Department of Housing) established that in the prevailing cost/pricing regime (for land, building and finance) only one in five households in urban areas could afford even the basic 35 m² house under the SHHA programme. This situation is also relevant in rural areas where the environment is predominantly made up of relatively low incomes and undeveloped financing systems. This situation is also not helped by the incapacity by institutions tasked with housing delivery, both in rural and urban areas.

Shelter Related Fact and Figures

National housing stock (rooms):	933, 846 (as at 2001)
National housing stock (houses):	394, 273 (as at 2003/04)
Total households:	404, 706 (as at 2001)
Adequately housed 75.51%	(305 594 households)
Traditional structures 21.43%	(86 728 households)
Shacks 3.06%	(12 384 households)

Acquisition of Housing by mode

Mode of acquisition	National	
	Number	%
Purchased	5 268	1.3
Rent Botswana Housing Corporation	10 775	2.7
Rent Government	15 236	3.9
Rent Council/Land Boards	8 540	2.2
Rent Individual	77 741	19.7
Rent Company	10 293	2.6
Rent Village Development Committee	3 438	0.9
Free	23 142	5.9
Inherited-owner occupied	13 909	3.5
Self-built-owner occupied	219 849	55.8
Other	6 082	1.5
Total	394, 273	100

Source: 2003/2004 CSO, Household Income & Expenditure Survey.

Housing Policy

According to Kerr and Kwele (2000), Botswana is relatively rich in resources but has been unable to utilize such resources to address the housing problem faced by the majority of the country's citizenry. Despite the country's economic successes Botswana still shows similarities with countries that are not economically well off in terms of the apparent "high levels of poverty and a significant housing problem" (*ibid.*:1314). The National Low Income Housing Coalition (NLIHC) observes that most low-income households in developing countries (and this

includes Botswana) face the most visible problem of homelessness and/or households living in and out of temporary housing, and the rest of the problems include households precariously housed in units that lack basic necessities. These are usually overcrowded, unsafe or physically inadequate (*ibid.*).

In recognition of the importance of the housing sector, housing policy measures were put in place in 1982 following a white paper on housing. This policy elevated the status of the housing sector and laid the foundation for the formation of a Department of Housing; a national department that oversees the implementation of the national policy on housing. This housing policy was reviewed in 1997 and that review was the basis for the current housing policy adopted in 1999.

The main goal of the National Policy on Housing (2000) is to facilitate the provision of decent and affordable housing for all within a safe and sanitary environment. This housing policy seeks to:

- change the emphasis from government as a housing provider to housing facilitator in partnership with other stakeholders;
- apply government resources towards low and lower middle income housing delivery;
- promote housing as an instrument for economic empowerment and poverty alleviation;
- foster a partnership with the private sector and all major employers in home development and facilitating home ownership.

The policy provides direction for the housing sector in Botswana. In line with the National Vision 2016, the policy aims at the provision of decent and affordable housing within a safe and sanitary environment. The policy addresses key elements of the housing sector including institutional capacity building, land, finance, subsidies, rentals, housing standards, building materials, housing legislation, Self Help Housing Agency (SHHA), District Housing, Botswana Housing Corporation (BHC) and private sector participation.

As the country's population grows and becomes more urbanised, policy measures put in place to guide the national housing efforts have become grossly

inadequate. Low-income households particularly face a broad spectrum of housing challenges. Despite the attempts by the Policy in facilitating access to housing to all, the housing sector in Botswana is still faced with the following general challenges:

- **Unaffordability due to adaptation of ‘modern’ infrastructure and building standards**
- Overcrowding
- Shortage of affordable land for housing
- Inaccessibility of housing finance especially for low income households
- Uncoordinated housing delivery strategies

Actors in Botswana Shelter Delivery and their Roles

Since its implementation in 2000, the Policy has brought about some positive changes to the housing sector. Government continues to facilitate the involvement of various stakeholders in the housing sector. This is for the full utilisation of potential and resources from all Governmental and non-governmental actors in the housing sector. The following are the major stakeholders in the delivery of housing in Botswana, with emphasis on low income housing.

Department of Housing: The department’s overall responsibility is to facilitate housing delivery through the formulation of housing policies and programmes. The department also provides leadership and professional guidance on all matters pertaining to housing and is responsible for securing funding for all low income housing programmes and also provide guidelines for implementation of the programmes.

Other responsibilities of Department of Housing include the coordination and monitoring of the management of pool housing for eligible public officers; serving as a source of information and advice to government and other stakeholders on housing matters; and undertaking research on housing.

Local Authorities: These are mainly responsible for the implementation of all low income housing programmes. These include both the Self Help Housing Agency programme and Integrated Poverty Alleviation and Housing Programme. Local Authorities are also responsible for development control in all the country's planning areas and carry out such a responsibility through building inspectors who make sure that all developments carried out are in consonance with the Development Control Code, Building Standards, Town and Country Planning Act and others.

Botswana Housing Corporation (BHC): This parastat was established "*for the provision of housing and to provide for matters incidental thereto and connected therewith*".

Non Governmental/Community Based Organisations: A number of these have been actively involved in low income housing delivery in the country without any defined parameters on how they participate. These institutions have proved to be more cost effective producers and providers of low income housing.

Housing Policy Advisory Council: In line with recommendation 2.1.3 of the 2000 National Policy on Housing, the Council was inaugurated in 2005. The Council is expected to provide guidance and also drive the implementation of the National Policy on Housing through the coordination of the numerous functions that contribute to and influence housing delivery. However, this has not been achieved as the operations of the Council ceased a year after its inauguration and therefore the policy has continued to be implemented in a haphazard manner.

Private Sector : Whilst the current housing policy appreciates the pivotal role played by the private sector in housing delivery, this role has not been fully defined and/or exploited. Contribution made by the private sector has thus been haphazard and targeting only the higher income category of the population.

Shelter Design

According to the draft National Development Plan 10 chapter for Land Management and Housing, good quality shelter is a basic need to which every human being is entitled. It is therefore important that national programmes on shelter provision be delivered to ensure dignity to all members of the society.

In order to ensure orderly, efficient, cost effective and sustainable urban development the government has over the years undertaken the following;

- *Integrated land use plans* to ensure sustainable utilization of land as a finite resource and to guide development;
- More villages have been declared planning areas in terms of the Town and Country Planning Act to minimise unplanned developments and enhance the enforcement of the development control statutes;
- *Review of urban development standards and development control* to better manage and control urban development while at the same time ensuring aesthetically housing developments.

There are also other research institutions like Botswana Technology Center (BOTECH), and the Rural Industries Innovation Center (RIIC) who have commissioned research studies to identify affordable and cost effective alternative building materials and construction technologies. While these institutions have made presentations to relevant government departments, their recommendations have not yet been incorporated into the development control statutes. A number of reasons could be advanced for such an occurrence but it has mainly been due to;

- Uncordianted and fragmented approach in carrying out such research.
- The recommendations with such technologies, especially the building materials has been associated with poverty. It is people's cultural beliefs that these are being introduced for the sole purpose of facilitating affordability for the poor communities/households.

Organization: Department of Housing

The Department of Housing was formed in 1994 as a result of the recommendations of the Organisation and Methods Report (O&M) of June 1991 in order to spearhead national housing development programmes with a view to ensuring adequate safe and sanitary shelter for all population groups. The Department is responsible for designing and formulation of housing policies, monitoring and provision of guidance to Local Authorities (both urban and rural),

private developers and other institutions in the implementation of housing policies. The Department is also responsible for securing funding for programmes such as Self Help Housing Agency (SHHA), Turnkey development, Integrated Poverty Alleviation and Housing (all of which are low income housing delivery programmes). Other responsibilities include securing funding for public officers' housing through District, Institutional and Pool Housing programmes. To cater for the short fall of public officers' housing provided through the three programmes, the Department also leases out accommodation from the private market.

Since inception of the SHHA programme until March 2008, government has disbursed **P206, 041, 006** to benefit **21, 964** households. The target households are those earning annual incomes ranging between **P4, 400 and P36, 400**. Under the programme, beneficiaries could utilise the loan (amounting to a maximum of **P20 000 or USD 3 100**) for extension or renovation of an existing house, purchase of a house, construction of a house and/or completion of a house. The SHHA beneficiaries are expected to have built a **core dwelling, conforming to local building regulations, within two years**, and to pay a service charge and meet loan repayments over a period of 15 years at 10% interest per annum.

Shelter Problem:

Lack of affordable building materials

Prices for building materials has significantly gone high over the years. This has resulted in limited access to housing by most households especially the low income households. For example, it has been observed that the completion rate of houses under the SHHA programme is slightly above 60% (Department of Housing, unpublished). There are numerous reasons that could be attributed to this unfortunate scenario but it is also common knowledge that the prescription of 'expensive' building materials and standards at the expense of locally available and affordable materials has played a major role to the problem mentioned above.

Proposal for affordable building materials

The general proposal change to address the problem above would be to identify alternative but affordable building materials for input into the Development Control Code and Building Regulations. This will enable property developers and the general public, especially SHHA beneficiaries, to utilize these building materials without fear of penalty by the Planning Authorities. The following building materials and technologies are available and have been appraised to determine their acceptability:

- fly ash: a by-product from Morupule Colliery and is currently available for free. RIIC has produced some bricks (albeit on small scale using the same and have carried out some tests which show that the material can be used for house construction). The material is available in bulk from the Colliery. However, there could be a problem as the Colliery is located about 272 kilometres north of Gaborone and there would also be a need for the population to be trained on the handling of the material. It is mixed with lime to produce bricks.
- Enhanced bricks made out of mud and burnt in an open fire. These bricks are currently being produced in mass around Gaborone Dam. These are simpler to produce and would not need any training. Households can also produce these in their homes.
- use of the ecobeam and sand bag building system for residential buildings.
- Use of calcrete as a building material to make blocks

Specific proposal for change will include the following;

Data collection

Fly ash system of construction

According to a report by Rural Industries Innovation Centre (RIIC), a pilot project was entered into between RIIC and one of the Local Authorities (Serowe/Palapye Sub-District Social & Community Development Office) to construct a demonstration house out of blocks made from admixtures and flyash. Fly ash was

collected from Morupule Power Station using collection methods that do not pose health hazard to handlers.

In order to produce blocks for construction, the following constituent materials were mixed together: fly ash (35%), River Sand (25%), Lime (5%), Calcium Chloride (2%), Sodium Silicate (2%), Cement (1%), Water (30%). Due to the fact that Calcium chloride reacts readily with sodium silicate to form a solid substance, care was taken to ensure that the two materials are not be added simultaneously. As per recommendations of the bills of quantity submitted, the brickwork of the proposed structure needed 3 350 blocks to complete and the method of construction was the same as that of conventional brick house.

Eco beam and sand bag building system

According to Hendrie, A.C.B (undated) this building system consists of conventional concrete footings and foundation brickwork; or with sand bagged footings depending on local topography and founding material. However, the floor may be a conventional screed finish on concrete slab, or sand bagged with screed over.

The superstructure is built in what may be termed 'modified timber frame construction', and consists of vertical ecobeams generally 900mm apart and fixed to a sole plate to form the studwork. This standard element comprises two 38mm square timber battens top and bottom separated by the hoop-iron zigzagging between to form a lattice, 270 mm deep. (Internal wall studs are 186 mm deep.) Sand bags nominally 300 x 300 mm are packed neatly in between the studwork in layers and compressed down lightly.

The external wall surfaces are clad with normal sand-cement plaster or timber/fibre cement siding laid ship-lap or beveled. The internal walls may also be plastered or boarded. The completed wall system provides acceptable acoustic and thermal insulation, and wind and impact resistance. Window and door frames are incorporated as in conventional timber frame building, and the roof construction may be of beams and rafters or trusses supporting sheeting or tiles.

Use of calcrete as building material

For the purposes of this project calcrete was blended with cement and three other different materials (kalahari sand, clay soil, flyash and) to improve its workability. Calcrete is an abundant material in Botswana and has been used mainly as a sub base material for road gravelling by Department of Roads (Ministry of Works and Transport). Gwodzi, W and Modisi, M.P (1983) mention that calcrete is predominantly composed of calcite (calcium carbonate) material. Calcrete is formed by cementation of; and accumulation in and/replacement of soil, sand or any weathered material. Near the surface the calcrete prospects and deposits are often characterized by nodular concretions and hard, sheet-like layers, which grade into softer, semi-consolidated material lower down. Calcrete varies from pure carbonate to calcareous sand, sandstone and clayey material. The block making process consisted of grinding the calcrete, batching of ingredients, mixing, moulding, curing and finally testing. Three different types of blocks were formed using calcrete as the base material and are as follows: calcrete kalahari sand cement, calcrete flyash cement and calcrete clay cement blocks. The mix ratios which were adopted in the design of mixes were (8:1:1, 7:1:1 and 6:1:1 respectively).

Comparative analysis of the materials

Fly ash

The ultimate cost of the pilot project was evaluated on the basis of the block production cost and materials for construction of the demonstration house. The labour and transport costs were also factored and the expenses are summarised in Table 1. Table 2 and 3 give an indication of the cost of admixtures and fly ash blocks as opposed to conventional blocks of the same size. The cost analysis made indicated that 40% savings could be achieved from production of blocks and construction is undertaken in the same way as that of the cement/sand blocks. A **40%** saving is made during the production of blocks using fly ash and admixtures because fly ash is collected free of charge from Morupule Power Station. Transport and labour cost remain the same for both conventional method of construction and the use of fly ash.

Table 1 Pilot Project Overall Expenditure

(Note: BWP 7.85 = USD 1)

Item No	Description	Conventionsl		Fly ash	
		Cost BWP	Cost USD	Cost BWP	Cost USD
1	Materials	19 548.00	2 490.19	7 819.20	996.08
2	Labour	3 203.10	408.03	3 203.10	408.03
3	Transport	7 165.60	912.82	7 165.60	912.82
Total		29 916.60	3 811.04	18 187.9	2 316.93

Eco beam and sand bag construction

During this system's performance in fire resistance and acoustic insulation, the following were noted.

- Clearly, the sand is incombustible, as is the plaster. Therefore the combustibility is restricted to that of the internal cladding material. It is argued that should this ignite and transfer to a wall stud member, damage would be limited to that alone, and the sand bagging would not collapse suddenly, but allow ample time for escape.
- As far as sound insulation is concerned, this is quite obviously superior to that of any timber framed structure.
- Finally, regarding condensation, again the thickness of the wall and its composition mitigates against this occurrence.

Calcrete blocks

Tests conducted involved compressive strength, erosion test, dimensional consistency, atterberg limit and saturation test. The atterberg limit test is used to determine plasticity of calcrete. Plasticity determines the cohesiveness of the soil which is the ability of the soil to hold together or ease to be moulded. Erosion resistance is an indicator test where matured blocks are subjected to a water pressure of between 120 and 140kpa for two hours to determine if pitting would occur. If no pitting occurs then blocks have higher erosion resistance that is they can withstand harsh weather like high intensity rainfall. The compressive strength

test is probably the most important indicator test for blocks. The parameter enables the determination of the load carrying capacity of blocks in walls. This test is conducted to determine the dry compressive strength of blocks at 7, 14 and 28 days respectively and in the project the dry compressive strength of blocks was determined and the minimum accepted strength is 2.4Mpa for this class of blocks. Lastly the water saturation test is an indicator test which consists of submerging the blocks in water for 24 hours to assess if they would dissolve or maintain their shape [RIIC, (undated report)].

The atterberg limit test showed that the calcrete used has plasticity index of 4% which translates that it is plastic thus has good workability. The compressive strength test was conducted on blocks at 7, 14 and 28 days. The average strength for Calcrete Kalahari blocks recorded was between 2.6 Mpa and 4.7 Mpa, Calcrete Flyash blocks average strength ranged between 1.9 Mpa and 4.3Mpa, lastly the average strength for Calcrete Clay blocks was between 2.5 Mpa and 6.5 Mpa. These strengths were above the minimum recommended for compressed earth blocks of 2.4mpa at 28 days.

Erosion test showed no pitting for all the three different types of blocks and they also maintained shape when submerged in water. It was noted that most dimensions for the blocks were also consistent and within specifications of the block press of 295 x 140 x 105mm.

It was observed from the study conducted that all the different mix ratios tested produced a structurally successful block and mix ratio 8:1:1 for all the three different types has been recommended as the optimum mix. The calcrete used had good workability [RIIC, (undated report)].

Conclusion and Recommendations

Housing costs are perceived to be relatively high and unaffordable for the low-income households under the current markets. The implementation of stringent housing standards in Botswana has had the effect of further increasing the costs. All urban centres and major villages have been declared planning areas and therefore all developments (including houses) within these settlements require compliance with the Development Control Code, Building Control Regulations

and the Town and Country Planning Act of 1977 (DCDM Botswana, 2006). It is no longer possible to develop houses using traditional construction methods and materials due to the insistence of compliance to these legislative instruments. The increase of prices in the construction sector and the limited use of local building materials in low-income housing, coupled with the high costs of foreign components in housing construction have also been major challenges for the housing delivery process (Department of Housing, 1997). The current costs of infrastructure and associate costs related to set codes, standards and procedures are inappropriate to the housing requirements of the low-income population. It has also been observed that:

“... that the code [fails] to harmonise its aspired standard and affordability as well as its application to the public and societal value systems. Further the code together with the urban development standards, the building control regulations and the SHHA [procedures] have tended to be a technocrats' domain emphasizing culturally new concepts like single family detached house[s and] thereby ignoring the Batswana family set-up as the users of dwelling units” (*ibid.*:63).

Thus the higher servicing standards in terms of private water connections, private connection into the main grid for sewer and electricity in low-income areas has also increased costs. DCDM Botswana (2006: 5) observes “that construction costs range from P1 800 and P2 500 per square metre for a contractor-built mid-range house in Gaborone, and can escalate to P3 500 per square metre for high cost houses.” It is also worth noting that “sometimes the [SHHA beneficiaries] resent the obligation to construct their houses straightaway according to prescribed rules” as they believe those rules are not only restrictive but also increase the construction costs (van der Linden, 1986: 100).

The previous section identified major findings and analyses of data from the investigation. The general Botswana policy framework, especially the Botswana National Policy on Housing of 1999 and the legislative landscape, made famous by all development control codes and associated Acts categorically supports access to basic shelter for all the country's citizens. The Botswana National

Policy on Housing of 1999 goes further and recommends specific programmes to achieve and facilitate housing delivery for the low-income households. The inclusion of that particular vulnerable income group of people is just but one of the pinnacles of democracy that Botswana prides herself on and is a critical success factor in facilitating home ownership by low-income households. The Policy also recommends that '[h]ousing standards should be reviewed in order to facilitate development of affordable housing and the use of durable local building materials without sacrificing health, safety and other quality requirements.'

The current legislative instruments in housing development restrict developers, including SHHA beneficiaries, to the use of expensive and unaffordable imported building materials. Department of Housing (1997) argues that "[g]reater effort needs to be put into promoting materials production locally; inventorying materials sources; researching production possibilities; and developing cost effective technologies." However, the current instruments especially the Town and Country Planning Act of 1977, Development Control Code and Urban Development Standards still do not recognize local materials especially mud and thatch even though it has been proven that the strength of the two can be enhanced. The above instruments still prescribe bricks and mortar for walling and corrugated iron sheets and tiles for roofing, all of which are unaffordable to low-income households. It is therefore **recommended** that building standards must be lowered, since the current ones are modelled after developed countries and the government should also recognise the use of local and traditional building materials. However, emphasis on health, safety, durability and affordability should not be lost in the endeavour to achieve the above.

Connected to the above is the issue of incremental development. At its inception, the SHHA programme was intended to allow for incremental housing development but the Development Control Code does not recognise that. SHHA beneficiaries are not allowed to move into their housing units whilst still under construction. However, it has been observed that they have ignored such conditions as most of the houses in SHHA areas are occupied although they are at different stages of construction. Since beneficiaries are not able to complete their houses from the SHHA loan, they argued that they need to be afforded time to raise funds to enable them to complete their housing units and that in the

meantime they should be allowed to occupy their uncompleted housing units. This makes sense and government should therefore allow beneficiaries to move into their housing units once they have reached advanced stages of construction. This would also enable SHHA plot holders to rent out some of their rooms to raise enough capital to complete their houses.

Advocacy for inclusion in planning statutes

Once the materials have been approved by relevant authorities Department of Housing will advocate for their inclusion into the Country's Development Control Code and Building Regulations. Department of Housing is currently a member of the Reference Group that is appraising the revirew of the Development Control Code and therefore this provides an apportune time to recommend any building materials for inclusion into the Code.

It is also receommneded that Local Authorities should be empowered to consider for approval local materieals. Where these materials meet health and other associate standards, these should be incorporated into the country's planning statutes. In fact, it is recommended that the planning statutes should recommend performance based standards instead of material based standards. That way, it becomes easy to use locally produced materials if they meet certain standards. print and electronic media to sensitise people of their existence.

References

Central Statistics Office

2004 *Household Income and Expenditure Survey*. Government Printer, Gaborone.

DCDM Botswana

2006 *Consultancy services for the Botswana public officers' housing fund feasibility study: Feasibility Report*. DCDM Botswana (Pty) Limited, Gaborone.

Department of Housing

1997 *Review of the National Policy on Housing for the Ministry of Local Government, Lands and Housing*. Government Printer, Gaborone.

Department of Housing, unpublished.

2008 *Report on the disbursement of SHHA loans since inception up to March*, Briefing report to the Permanent Secretary and Minister of Lands and Housing. Gaborone.

Gwosdz, W. and Modisi M.P

1983 *The Carbonate Resources of Botswana*. Published by the Department of Geological Survey, Lobatse, Botswana.

Hendrie, A.C.B

- Rational Design for Ecobeam Wall System: Application to NHBRC, Republic of South Africa.

Kerr, D and Kwele, N.,

2000 *Capital accumulation and political reproduction of the urban housing problem in Botswana*. *Urban Studies*, 37 (8), 1313 – 1344.

Ministry of Finance and Development Planning

2003. *National Development Plan 9: 2003/04 – 2008/09*, Government Printer, Gaborone.

RIIC

- *A report on the feasibility of using calcrete as an alternative building material*, Kanye, Botswana.