Critical Housing Analysis
Volume 9 | Issue 2 | 2022 | 18-29
Available online at www.housing-critical.com
https://dx.doi.org/10.13060/23362839.2022.9.2.546

# Housing Quantum and Innovative Building Systems in South Africa – the Affordability Perspective for 2020

Emmanuel Kabundu (corresponding author)

Department of Building and Human Settlements, Nelson Mandela University, Gqeberha (Port Elizabeth), South Africa
kabunduemmanuel@gmail.com
https://orcid.org/0000-0001-6201-465X

Sijekula Mbanga

Department of Building and Human Settlements, Nelson Mandela University, Gqeberha (Port Elizabeth), South Africa
sijekula.mbanga@mandela.ac.za
https://orcid.org/0000-0001-9439-7552

Brink Botha

Department of Construction Management, Nelson Mandela University, Gqeberha (Port Elizabeth), South Africa
brink.botha@mandela.ac.za
https://orcid.org/0000-0001-9497-7872

Gerrit Crafford

Department of Quantity Surveying, Nelson Mandela University, Gqeberha (Port Elizabeth), South Africa
gerrit.crafford@mandela.ac.za
https://orcid.org/0000-0002-5372-0808

**Abstract:** *The adoption of innovative building technologies (IBTs) and social welfare policies in South Africa has facilitated an increase in decent homeownership among low-income groups, thus improving their quality of life. However, due to the escalating costs of building materials, the capital and lifecycle costs of implementing these technologies may no longer be affordable. This research aims to provide a comparative evaluation of the affordability of some readily available IBTs in the South African construction industry, relative to existing homeownership subsidy grants. The method used involved the use of secondary data for these IBTs and the income constraint methods. The results showed that, apart from the technologies suitable for the provision of temporary structures, most of the other technologies were not affordable for the complete subsidisation of the top structure when both capital and lifecycle costs were used, except the Moladi and Robust structure IBTs under some low-income homeownership programmes. Further analysis using credit-linked subsidies revealed that the minimum household income required to achieve affordable homeownership (and their rankings) depends both on the evaluation technique (lifecycle or capital costs) and technology used. To improve affordability, any implementing government can either raise the amount of the top structure subsidy grant, promote the use of cheaper but durable*

*IBTs, or promote the use in incremental building methods, such as the Enhanced People's Housing Process (EPHP) for the case of South Africa.*

**Keywords:** housing affordability; housing finance; welfare policy; homeownership; Innovative Building Technologies (IBTs).

## Introduction

Many countries have adopted low-income subsidy programmes as a form of homeownership finance in an effort to help low-income groups acquire decent shelter. South Africa is no exception (DHS 2009). This social welfare policy has the potential to solve the problem of homelessness and improve the quality of life among beneficiaries (Brueckner 2011). The homeownership subsidy quantum costs should be dependent upon the household characteristics, the costs of the building materials (which depend upon selected IBTs), and labour with respect to time. Failure to take this into account has resulted in a mismatch between the quantum cost structure and the different housing typologies.

This research aims to evaluate the affordability of some readily available IBTs in 2020, and thus, determine the government intervention required to make the IBTs affordable.

## Housing affordability and innovative building technologies (IBTs)

### Housing affordability

Housing affordability is a measure of the ability of a household to secure some standard of housing at a price or rent that does not impose an unreasonable burden on household incomes (Maclennan and Williams 1990: 9). The standard is a figure set by the government or by a financial institution. In South Africa, this ratio is 30%. Households with ratios below 30% have affordable homeownership. This method of establishing affordable homeownership is called the percentage of income method or the income constraint method (Jewkess and Delgadillo 2010). The method, however, has some limitations, such as non-applicability over the entire household lifecycle and a failure to consider the opportunity costs of non-housing consumption (Bogdon and Can 1997; Thalmann 2003; Chen 2007).

On the other hand, the mortgage underwriting criterion for establishing affordable homeownership is based on how affordable the down-payment deposit is for a household when mobilising finance for homeownership. Both methods can be combined when evaluating affordability.

### IBTs in South Africa

There are several examples of IBTs that are currently being used in South Africa. What follows is an evaluation of some of them.

#### *Moladi walling and building systems*

The Moladi system involves the use of a removable, reusable, recyclable, and lightweight formwork mould that is filled with an agreement-certified aerated mortar approved by the South African Bureau of Standards and used to form the wall structure of a house. The aerated mortar comprises a mixture of graded river sand, cement, water, and a chemical called 'Moladi Chem'. Each of the panels can be re-used as many as fifty (50) times, which reduces the construction costs. The use of this system allows for much less time to be spent on construction (duration is one week). It has a predictable accuracy and enables a constant supply of material, the use of unskilled labour, increased productivity, minimum wastage, and the maintenance of quality. A housing unit with a floor area of 52 $m^2$ in 2020 (excluding the plot price) could be constructed at a cost of R 204,959 (NHBRC 2009; Moladi 2020).

### *Robust building system*

The Robust building system utilises a patented, metal core mesh in a W-profile configuration, which has mortar applied to it, using specialised Robust spray equipment (NHBRC 2009; NHBRC 2018). The Robust system's walls are steel reinforced mortared walls that are monolithic, continuous, and therefore provide a far stronger structure than conventional brick or block walls. The system allows walls to be assembled at a rate of 20 m2 per hour per team of five (5) labourers, with the mortar and plaster being applied mechanically. It minimises material wastage and is easier to apply because the robust core material is lightweight. About 95% of the labour used can be local, unskilled labour (Robust Structure 2020).

### *National and overseas modular construction technology (NOMCT)*

There are about twenty (20) design types under this technology, with varying prices for construction excluding Value Added Tax and land price. The cheapest one is called the 'CALYPSO' housing unit with a 54 $m^2$ floor area and a construction price (top structure) of R 341,910. Most materials used are already industry-manufactured products that are assembled on site. This enables a significant reduction in construction time and cost (20-30%), increased flexibility of location, and the possibility to relocate any assembled buildings. Gypsum rhino boards with fibre insulation in the cavities are used for the outer walls. Face brick panels or outer fibre cement sheets are used to enhance the outer appearance. The windows used have aluminium window frames. The roof is usually made from Harvey tiles while the ceilings are made from rhino boards with fibre glass insulation on top of the ceiling boards. It takes about seven (7) days to assemble the building (NOMCT 2020).

### *Abod home designs*

The Abod housing units are made up of arched steel frames covered in corrugated sheeting with a wooden ladder leading to a loft. The facades consist of fibre-cement boards, wooden doors, and plastic sheeting (NHBRC 2009). The Abod unit can be raised from the floor using concrete plinths, or it can be fixed on top of a normal concrete foundation (Abod 2020). The duration of construction of one unit could take from 1 to 4 days. According to the 2006 rates, one of the built units on a 233 m2 plot, that had an upstairs sleeping area, usable space, and a 19 m2 floor area was constructed at a rate of R 1263 per m2, excluding the plot value (NHRBC 2009).

### *Hydraform*

Hydraform development falls under a class of construction technologies that employ mortarless walling. They are easy, fast, cost-effective ways of constructing walls using dry stack interlocking bricks (Kitingu 2009). Compared to conventional brick and mortar technologies, Hydraform is simple, more cost effective, and faster to implement. It leads to skills transfer and job creation, draws on existing local resources, and reduces waste, consumption of non-renewable resources, and deforestation. Compared to conventional brick technology, interlocking brick technology reduces construction expenses by as much as 50% (Hydraform 2020).

#### *Other building technologies*

There are other IBTs that use containers and wooden materials for the building structure. There are several providers of these IBTs in South Africa (Homify 2020; Eco Log homes 2020; Privateproperty 2020; Nutec 2020; Mobilehomes 2020).

## Research methodology

The research methodology used involved the collecting of information both on several existing IBTs in South Africa that have been approved by the NHBRC and on the existing low-income subsidy programmes in South Africa as specified in the National Housing Code of 2009 (DHS 2009). These technologies included the Abod, Moladi, Hydraform, Robust, the National & Overseas Modular Construction Technologies, containers, Nutec, and other wooden technologies.

Each of these technologies was analysed to assess its affordability status in relation to the various low-income subsidy programmes by computing the difference between the costs of implementing the technology to build a low-income housing unit and the respective low-income subsidy grant level (assuming they were non-credit linked subsidies). The technologies that were found to be not affordable under non-credit linked subsidies were further analysed, assuming the subsidies were credit-linked. The income constraint criterion variant (equation 2) was used as the statistic for ranking them across the low-income subsidy programmes. Equation 1 summarises the income constraint criterion:

$$\mathrm{t} = \mathrm{PY} - (\mathrm{V} - \mathrm{D})\left(\frac{\mathrm{r}}{1 - \frac{1}{(1+\mathrm{r})^{n}}}\right) \tag{1}$$

Parameter *Y* refers to the income from sources other than liquid investments; *P* is the maximum portion that can be spent on mortgage payments; r is the mortgage interest rate; *n* is the loan term. If *P* is greater than the affordability threshold (say 30%), then that IBT is considered non-affordable for the household with an income of *Y*. The term *V* is the property value (or capital costs) less the subsidy (homeownership finance from government) provided, and *D* is the down payment on *V*. If *t* is greater than or equal to zero, then the IBT is affordable for the household under the prevailing market conditions. Otherwise, the IBT is not affordable. It follows that the minimum marginal household income required for the technology to be affordable is given by equation 2 below.

$$\mathrm{Y} = \frac{(\mathrm{V} - \mathrm{D})}{P}\left(\frac{\mathrm{r}}{1 - \frac{1}{(1+\mathrm{r})^{n}}}\right) \tag{2}$$

The lifecycle costs of any technology were evaluated using equation 3:

$$C = V + Rp - Rs + L \times Mt \qquad (3)$$

The lifecycle costs are represented by $C$, the capital (initial) costs by $V$, the replacement costs by $Rp$, the residual value at the end of period of analysis by $Rs$, the length of period of analysis (50 years) by $L$, and the operation, maintenance, and replacement costs by $Mt$. The capital costs, $V$, were then replaced with lifecycle costs, to re-evaluate $Y$ using equation 2. Although sensitivity analyses of the income constraint criterion statistic were also carried out to ascertain in detail how each of these technologies withstands lower incomes and higher interest rates while remaining affordable, the results without sensitivities were sufficient for conveying the information.

## Findings and discussion

### The affordability of building technologies towards subsidisation of the whole top structure

Table 1 shows the different government low-income homeownership finance (subsidy) programmes and the respective subsidy quantum grant levels for the top structure (PMG 2018). The price of land has been omitted since the grant amount for it is the same for all applicable programmes in the year 2018 (about R 6000). The grant is the same for all subsidy types except for Disabled Wheelchair Houses (DWH), Military Veteran Houses (MVH), Temporary Shelter (TSH), and the Replacement of Houses (RH). The land is provided by the government for free based on principles of integrated human settlements that are aligned to the Spatial Planning and Land Use Management Act (SPLUMA) of 2013. One of the goals of the Act (section 3) is to promote social and economic inclusion.

**Table 1: Subsidy quantum grant levels in 2018/2019**

| *Subsidy Programme* | *Maximum Top Structure Quantum Grant Level (2018)* |
|---|---|
| IHS: Individual Housing Subsidy | R 116,867.00 |
| IRDP: A Grade Services | R 116,867.00 |
| IRDP: B Grade Services | R 116,867.00 |
| CS: Consolidation Subsidy | R 116,867.00 |
| IS: Institutional Housing Subsidy | R 116,867.00 |
| EPHP: Enhanced People’s Housing Programme | R 116,867.00 |
| RHS: Rural Housing Subsidies | R 116,867.00 |
| FRHS: Farm Residents Housing Subsidies | R 116,867.00 |
| DWH: Disabled Wheelchair Houses | R 172,929.00 |
| MVH: Military Veterans Houses | R 199,014.00 |
| TSH: Temporary Shelter | R 57,790.00 |
| RH: Replacement of Houses | R 115,568.00 |

*Source: PMG 2018.*

The top structure refers to improvements made on vacant land that are related to building construction but exclude the land itself. The quantum grant level is the amount of financing provided by the government for the construction of a single top structure corresponding to a given subsidy programme.

Table 2 shows the details of the different IBTs that were extracted from various sources (Moladi 2020; Robust Structure 2020; National & Overseas Modular Construction, 2020; Abod 2020; Homify 2020; Eco Log homes 2020; Privateproperty 2020; Nutec 2020; Hydraform 2020; Mobilehomes 2020). The estimated costs of the technologies were compared to the estimated value of the top structure grant of 2020 based on 2018 values using an annual inflation value of 9%. The affordable technologies for the provision of complete top structures based on ranking were the Wendy wooden homes, Nutec prefab homes, the Abod shelters, and the Robust building technology (under disabled wheelchair and military veteran's houses). However, the quality and durability of the Wendy wooden homes and Nutec prefab homes as permanent shelters is yet to be ascertained.

## The affordability of building technologies in relation to credit linked subsidies

The rest of the technologies that were not affordable under the complete top structure grant were then tested under the credit-linked form of affordability scheme to evaluate the minimum monthly household income required for a household to afford each of the technologies using both the capital costs and the lifecycle costs scenarios. The default global parameters used were a down payment of 0%, a loan term of 240 months, a mortgage interest rate of 7.75%, a maximum ratio of housing expenses to income of 30%, and an income of R 3,500 per month. The developer's profit was assumed to be part of the quoted prices. Table 3 shows the results. The capital costs (including labour) scenario results are the ones that are indicated in brackets.

The results show that the best performing technologies (in order of preference) based on lifecycle costs were Robust Structures, Hydraform, Moladi systems, NOMCT, Wooden homes (Privateproperty), Wooden homes (Ecology homes), Highway Parkhome Containers, and Containers (Homify). However, the rankings based on capital costs differed from those based on lifecycle costs for most IBTs. Robust structures still performed best under both scenarios. Since the maximum income limit for households to be classified as low-income households that are eligible for a 100% housing subsidy grant is R 3500, most of these technologies were not affordable. While lifecycle MHIs were greater than capital-costs MHIs for most IBTs, the Hydraform IBT had the opposite pattern. Therefore, the relative values of the lifecycle and capital MHIs are IBT dependent. On the other hand, the method for evaluating affordability (lifecycle or capital costs) may influence the affordability status (as indicated by the NOMCT technology). Affordability can be improved by raising the top structure subsidy grant and using cheaper technologies that have long lifespans (thus reducing lifecycle costs).

**Volume 9 | Issue 2 | 2022 | 18-29**
Available online at www.housing-critical.com
https://dx.doi.org/10.13060/23362839.2022.9.2.546

**Table 2: Relative costs in the top structures (excluding land) for 2020 estimated prices**

| | *Abod* | *MOLADI* | *HYDRAFORM* | *ROBUST* | *Hi-Way Parkhome Containers* | *NOMCT* | *Containers (Homify)* | *Wooden home (ecology homes)* | *Wooden home (privateproperty)* | *Nutec prefab homes (nutechomes)* | *Wendy wooden homes (nutechomes)* | *Top Structure subsidy/ Grant* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Individual Housing Subsidy | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| IRDP: A Grade Services | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| IRDP: B Grade Services | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| Consolidation Subsidy | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| Institutional Housing Subsidy | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| EPHP | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| Rural Housing Subsidies | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| Farm Residents Housing Subsidies | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 138,850 |
| Disabled Wheelchair House | 113,247 | 177,368 | 292,616 | 156,973 | 365,625 | 295,873 | 482,143 | 495,000 | 428,576 | 42,750 | 31,950 | 205,457 |
| Military Veterans Houses | 125,830 | 197,076 | 325,129 | 174,415 | 406,250 | 328,747 | 535,714 | 550,000 | 476,195 | 47,500 | 35,500 | 236,449 |
| Temporary Shelter | 50,332 | 78,830 | 130,051 | 69,766 | 162,500 | 131,499 | 214,286 | 220,000 | 190,478 | 19,000 | 14,200 | 68,660 |
| Replacement of Houses | 100,664 | 157,661 | 260,103 | 139,532 | 325,000 | 262,998 | 428,571 | 440,000 | 380,956 | 38,000 | 28,400 | 137,306 |

*Source: Authors.*

**Volume 9 | Issue 2 | 2022 | 18-29**
Available online at www.housing-critical.com
https://dx.doi.org/10.13060/23362839.2022.9.2.546

**Table 3: Minimum required household incomes (MHIs) under various technology scenarios**

| Minimum income (Rands) that will ensure affordable homeownership | *Floor Area* | *Top Structure Subsidy Grant (2020)* | *Abod* | *MOLADI* | *HYDRAFORM* | *ROBUST* | *Hi-Way Parkhome Containers* | *NOMCT* | *Containers (Homify)* | *Wooden home (ecology homes)* | *Wooden home (privateproperty)* | *Nutec prefab homes (nutechomes)* | *Wendy wooden homes (nutechomes)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HIS, IRDP, CS, IS, EPHP,RHS,FRHS | 40 | 138,849.7 | 0 (0) | 3,031.5 (514.8) | 2,428.4 (3,318.1) | 973.2 (18.7) | 16,952.1 (5,094) | 6,738.7 (3,397.3) | 23,565.3 (7,928.2) | 8,993.5 (8,241) | 7,276.8 (6,625.2) | 0 (0) | 0 (0) |
| Disabled Wheelchair Houses | 45 | 205,456.9 | 0 (0) | 2,062.7 (0) | 1,384.2 (2,385.1) | 0 (0) | 17,723.4 (4,383) | 6,233.3 (2,474.2) | 25,163.3 (7,571.5) | 8,769.9 (7,923.3) | 6,838.6 (6,105.6) | 0 (0) | 0 (0) |
| Military Veterans Houses | 50 | 236,448.5 | 0 (0) | 2,068.5 (0) | 1,314.6 (2,426.7) | 0 (0) | 19,469.3 (4,646.6) | 6,702.5 (2,525.8) | 27,735.8 (8,189.4) | 9,521 (8,580.3) | 7,375.1 (6,560.7) | 0 (0) | 0 (0) |
| Temporary Shelter | 20 | 68,660.3 | 0 (0) | 1,536.7 (278.3) | 1,235.1 (1,680) | 507.5 (30.3) | 8,497 (2,567.9) | 3,390.3 (1,719.6) | 11,803.6 (3,985) | 4,517.7 (4,141.4) | 3,659.3 (3,333.5) | 0 (0) | 0 (0) |
| Replacement of Houses | 40 | 137,306.3 | 0 (0) | 3,073.7 (557) | 2,470.6 (3,360.3) | 1,015.5 (60.9) | 16,994.4 (5,136.2) | 6,781 (3,439.5) | 23,607.6 (7,970.5) | 9,035.7 (8,283.2) | 7,319 (6,667.5) | 0 (0) | 0 (0) |
| Lifespan (Years) | | | | 100 | >100 | 50-100 | 25-30 | 35-100 | 25-30 | 80-100 | 80-100 | | |
| Ranking with lifecycle costs | | | | 3 | 2 | 1 | 7 | 4 | 8 | 6 | 5 | | |
| Ranking with capital costs | | | | 2 | 3 | 1 | 5 | 4 | 7 | 8 | 6 | | |

*Source: Authors.*

Volume 9 | Issue 2 | 2022 | 18-29
Available online at www.housing-critical.com
https://dx.doi.org/10.13060/23362839.2022.9.2.546

### Special consideration for emergency (temporary shelter: TSH) subsidies

The Abod, the Nutec prefabricated house, and the Nutec Wendy wooden house IBTs are best suited for emergency (temporary homeownership shelter: TSH) subsidies. They take less time to erect and have lower costs. The huge price differences between the Nutec technologies (wooden and prefabricated technologies) and other similar technologies (like the wooden ecology homes, wooden homify homes, and the NOMCT Calypso house) may suggest a significant difference in the quality and durability of the Nutec houses, which may also affect their user acceptability as permanent structures.

## Conclusion and further research

Most of the IBTs considered for permanent homeownership in South Africa, were not affordable for low-income households in 2020. The minimum household incomes required to achieve affordable homeownership depend on both the evaluation technique (lifecycle of capital costs) and the IBT used. An increase in the subsidy grant for the top structure, and the use of cheaper and more durable IBTs, could improve affordability. Alternatively, this social welfare policy could be combined with progressive build methods such as those based on the Enhanced People's Housing Process (EPHP), in the case of South Africa, to reduce labour costs (DHS 2009). Future research can be done to include embodied energy and emissions in the lifecycle cost analysis.

## Acknowledgements

Acknowledgements go to the Department of Human Settlements for their support.

## Funding

This research received no external funding.

## References

Abod 2020. *Abod Homes*. Retrieved May 26, 2021, from http://www.abod.co.za.

Bogdon, A. S., A. Can 1997. 'Indicators of Local Housing Affordability: Comparative and Spatial Approaches.' *Journal of Real Estate Economics* 25 (1): 43-80. DOI: 10.1111/1540-6229.00707

Brueckner, J. K. 2011. *Lectures on Urban Economics*. Massachusetts: Massachusetts Institute of Technology Press.

Chen, D. 2007. *Econometric measure of Housing Affordability*. Retrieved June 27, 2021, from https://www.kth.se/polopoly_fs/1.113631!/Menu/general/column-content/attachment/361.pdf

DHS 2009. *National Housing Code, Volume1*: *Simplified Guide to the National Housing Code 2009*. Department of Human Settlements, Republic of South Africa. Retrieved June 27, 2021, from http://www.dhs.gov.za/sites/default/files/documents/national_housing_2009/1_Simplified_Guide_Policy_Context/1%20Vol%201%20Part%201%20Simplified%20Guide%20to%20the%20National%20Housing%20Code.pdf

Eco Log Homes 2020. *Plans & Pricing*. Retrieved June 15, 2021, from http://ecologhomes.co.za/plans-pricing/

Homify 2020. 23 *Small and affordable South African Homes*. Retrieved June 15, 2021, from https://www.homify.co.za/ideabooks/2598799/23-small-and-affordable-south-african-homes

Hydraform 2020. *Our Offering*. Retrieved June 15, 2021, from https://www.hydraform.com/

Jewkess, M., L. Deldadillo 2010. 'Weaknesses of housing affordability indices used by practitioners.' *Journal of Financial Counselling and Planning* 21(2010): 43-52.

Kitingu, S. H. 2009. *Design Of Interlocking Bricks for Enhanced Wall Construction Flexibility, Alignment Accuracy and Load Bearing.* PhD Thesis, University of Warwick. Retrieved June 16, 2021, from https://wrap.warwick.ac.uk/2768/1/WRAP_THESIS_Kintingu_2009.pdf

Maclennan, D., P. Williams 1990. *Affordable Housing in Britain and America.* York: Rowntree Foundation.

Mobilehomes 2020. *Welcome to mobile home supply*. Retrieved June 15, 2021, from https://mobilehomesa.co.za/

Moladi 2020. *Moladi Construction Technology*. Retrieved May 26, 2021, from http://www.moladi.net

NOMCT (National & Overseas Modular Construction) 2020. *Prices*. Retrieved June 27, 2021, from https://noversea.co.za/modular-homes/prices/

Volume 9 | Issue 2 | 2022 | 18-29
Available online at www.housing-critical.com
https://dx.doi.org/10.13060/23362839.2022.9.2.546

NHBRC (National Home Builders' Registration Council) 2009. *Eric Molobi Housing Innovation Hub Brochure, 2009*. Retrieved August 28, 2021, from http://www.nhbrc.org.za/files/nhbrc_final_brochuredec2009.pdf

NHBRC (National Home Builders' Registration Council) 2018. *Innovative Building Systems Database.* Retrieved August 26, 2021, from https://www.nhbrc.org.za/innovative-building-systems/

Nutec 2020. *Nutec Homes*. Retrieved June 15, 2021, from https://www.nutechomes.co.za/nutec-homes

Privateproperty 2020. Retrieved June 15, 2021, from https://www.privateproperty.co.za/advice/lifestyle/articles/all-about-timber-homes/4167

PMG. 2018. *National Assembly question to Minister of Human Settlements, for written reply: Question Number PQ1367*. Cape Town: Parliamentary Monitoring Group. Retrieved May 24, 2020, from https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstatic.pmg.org.za%2FRNW1367-180917.docx&wdOrigin=BROWSELINK

Robust Structure 2020.*The Robust Building System*. Retrieved May 26, 2021, from http://www.robuststructure.com/home.html

Thalmann, P. 2003. ''Housing Poor' or simply 'poor'.' *Journal of Housing Economics* 12 (4): 291-317. DOI: 10.1016/j.jhe.2003.09.004