A SUSTAINABILITY SPECIFICATION FOR EMERGENCY HOUSING

J. Gibberd, CSIR, South Africa, itshose@gmail.com

Abstract

There is a need to provide emergency accommodation for households in the event of a disaster such as flooding. In South Africa, this is catered for in the National Housing Code developed by the Department of Human Settlements in 2009. Since 2009 there has been an increasing requirement for human settlements and housing to address issues such as climate change, sustainable development, and more recently, COVID-19. This study aims to understand these requirements and how they can be met in emergency housing. It uses the Sustainable Building Assessment Tool (SBAT) to review current provision for emergency housing in the Housing Code. This provides the basis for proposing sustainability specifications which incorporate appropriate technologies for emergency housing. These are critically evaluated and discussed to develop conclusions and recommendations. The study identifies measures that could be incorporated into emergency housing to make a contribution to improving the quality of life of occupants as well as enhancing the sustainability performance of the housing.

Keywords: appropriate technology, emergency housing, estimating tools, South Africa, sustainability

Introduction

Emergency housing is a response to disasters and aims to accommodate displaced households and enable them to restart their lives as soon as possible after an event. Emergency housing, however, is often controversial and criticised for being too expensive, too late and for having negative impacts on local environments (Johnson, 2007). Quarantelli (1995) shows how emergency housing is catered for after a disaster. Initially, emergency shelter, as an immediate response, is provided and this may include temporary accommodation in a hall, school or under plastic sheeting. This is followed by temporary shelters such as tents which are used for a few weeks after the disaster and include the provision of food and medical care. The third stage is emergency or temporary housing which enables occupants to return to normal daily activities such as going to work, school and shopping for food. This accommodation is normally in the form of prefabricated houses. Finally, there is permanent housing, when occupants return to their former homes after reconstruction or move to new homes. These stages may not happen in all cases and there may be situations where occupants move directly from temporary shelters to permanent housing. This study focusses on the third stage, where temporary or emergency housing is provided and where occupants may live for three to five years (Johnson, 2007; Department of Human Settlements, 2009).

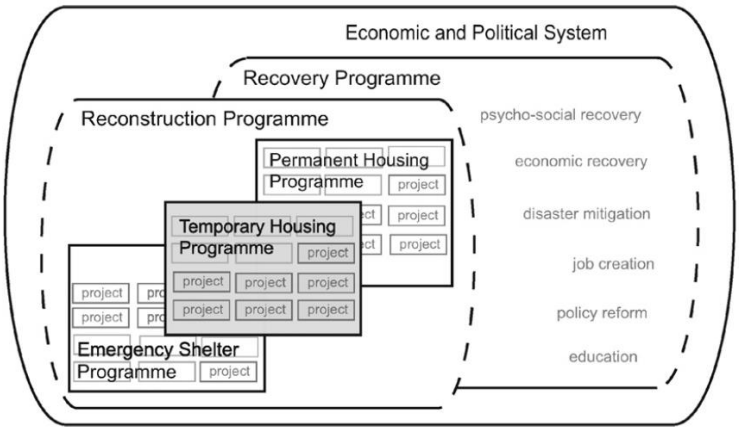


Figure 1: *Temporary and emergency housing as part of a system (Johnson, 2007).*

Johnson (2007) shows that it is important to consider temporary housing as part of a wider reconstruction effort which includes disaster mitigation, economic recovery, policy reform, job creation and education (see Figure 1). By placing temporary housing within a larger context, Johnson (2007) argues that the success of an emergency housing programme is linked to these wider systems and, in turn, the success of these efforts at a local level is dependent on the nature and quality of the emergency housing.

In South Africa, the growth of vulnerable informal settlements combined with natural disasters attributed to climate change such as flooding or the outbreak of disease such as the COVID-19 pandemic has resulted in the growing importance of effective emergency housing strategies (Department of Human Settlements, 2020; National Treasury, 2020). Emergency housing in South Africa is catered for the National Housing Code developed in 2009 (Department of Human Settlements, 2009).

This paper reviews the provision for emergency housing contained in the Housing Code within a context where it is becoming increasingly important to address sustainable development, climate change and COVID-19. The review draws on a sustainable building assessment tool, the Sustainable Building Assessment Tool, to identify ways the existing provision could address sustainability, climate change and COVID-19 more comprehensively and proposes outline specifications for emergency housing that aim to achieve this. These specifications are critically reviewed to ascertain their value in supplementing existing guidance, and conclusions and recommendations are proposed.

Methodology

The methodology is based on the following steps:

1. The Emergency Housing Programme in the Housing Code is introduced and described.
2. The Sustainable Building Assessment Tool (SBAT) is described and the evaluation criteria listed.
3. Results from applying the SBAT to assess the Emergency Housing Programme are provided.
4. Results from the SBAT assessment are used to propose an alternative sustainable emergency housing specification.
5. This specification is critically reviewed.
6. Conclusions and recommendations are developed.

Emergency Housing Programme

The Emergency Housing Programme is Part 3 of the National Housing Code (Department of Human Settlements, 2009). The Programme was developed to support the right to adequate housing enshrined in the South African Constitution. It addresses the needs of households that have had their existing accommodation destroyed or damaged and need immediate shelter. The programme provides grants to municipalities to enable them to respond rapidly to emergencies and can fund land acquisition, settlement planning, basic municipal engineering, the construction of temporary shelters (or the materials for this) and the cost of consumption of water, sanitation, refuse collection and street lighting for up to three years.

Minimum performance requirements for housing provision outlined in the Programme are summarised below:

- Water: the provision of access to a water point or tap for every 25 families.
- Sanitation: temporary sanitary facilities must be provided. Where conditions permit the use of Ventilated Improved Pit Latrines (VIP toilets) must be provided as a first option. An acceptable standard is one VIP toilet per five families.
- Access, roads, and stormwater: a main access road and open lined stormwater management system must be provided.
- Electricity: the programme will only fund the provision of high-mast lighting in special circumstances.
- Temporary shelters: these should be basic, simple in form and easy to construct. The floor area of shelters should be at least 24m² and may vary up to 30m². The temporary shelter should be appropriate for the specific environment and as far as possible be acceptable to beneficiaries.
- Construction: shelters can be provided through the supply of materials to beneficiaries on-site to construct their own shelters or to be constructed for them, depending on the exceptional nature of the situation. The preferred option for the provision of shelter is the supply of prefabricated units. Where beneficiaries have supplied their own materials, advice and assistance can be offered with regard to the construction of the shelters.
- Roof covering: this should be trafficable and waterproof, to suit purlin spacing.
- Side cladding: this should meet OHS Act requirements and be safe, sustain normal weather conditions as well as provide adequate resistance to water penetration. The minimum height should be 2.2 m.
- Column footings: these should be concrete.
- Door: these must be framed, lockable and hinged.
- Windows: a minimum 5% of floor area must be framed and glazed.
- Flooring: this should be level, solid on compacted fill and 150 mm above ground.
- Thermal efficiency: this should suit the roofing material and local conditions.
- Settlement density: up to 5 shelters (per ordinary stand of 250m²) could be considered.
- Ownership: the ownership of temporary shelters to be provided under the Programme should be vested in the provincial department.

The Programme also provides drawings (see Figure 2) and a set of criteria that can be used to measure the performance of emergency housing projects. These are as follows:

- Where applicable, the temporary facilities should be converted into permanent sustainable housing facilities. Where the facilities are not transformed into permanent housing facilities, they should be re-used when future emergency circumstances arise.
- A beneficiary satisfaction survey should be conducted to determine the impact of the development on their lives.
- The willingness and ability of residents to pay for facilities as demonstrated by increased local government revenues and the willingness and ability of government agencies to maintain and operate public infrastructure developed through emergency housing projects should be ascertained.
- The environmental impact of emergency housing projects should be determined.
- Improvements in living conditions should be measured through:
    - Health indicators (particularly a decline in waterborne diseases and infant mortality rates, where these indicators have been recorded and are available);
    - Access to water and sanitation (households having access to "improved" drinking water and sanitation).

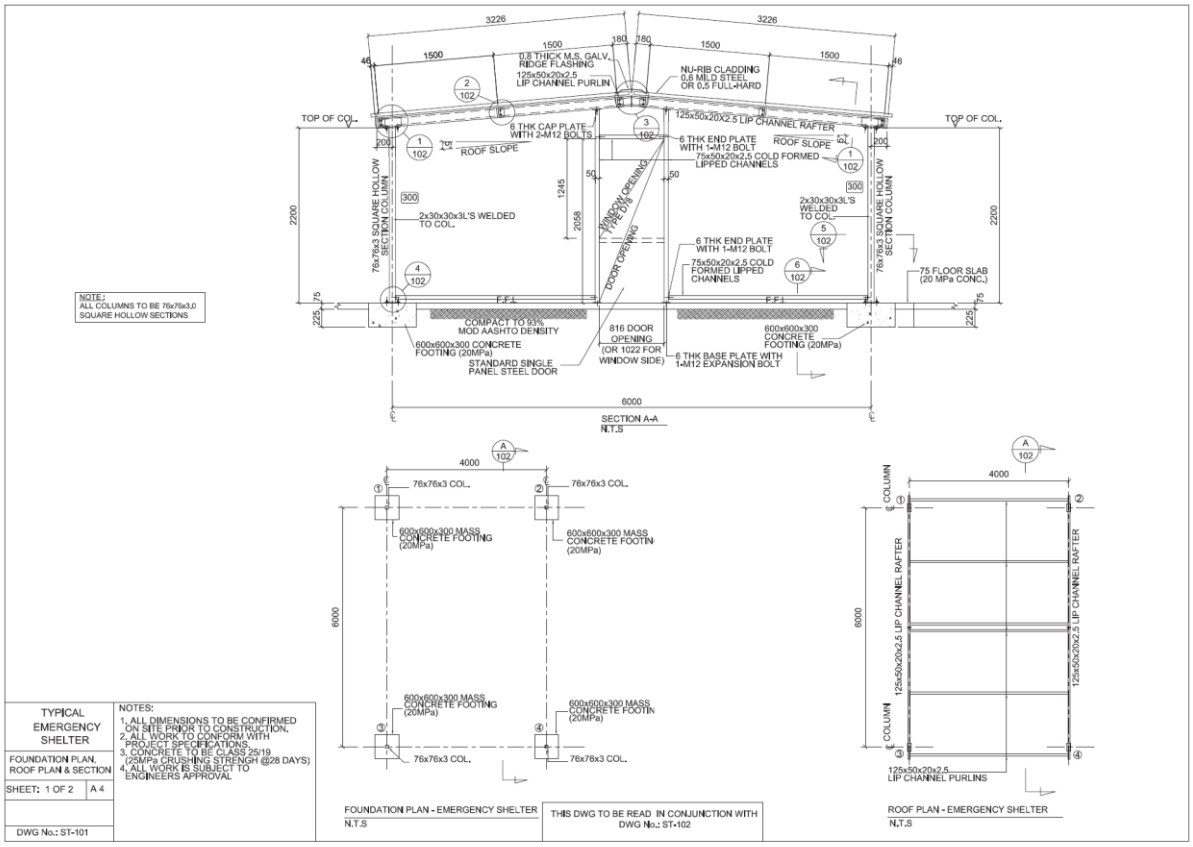


Figure 2: *Drawings of typical emergency housing (Department of Human Settlements, 2009).*

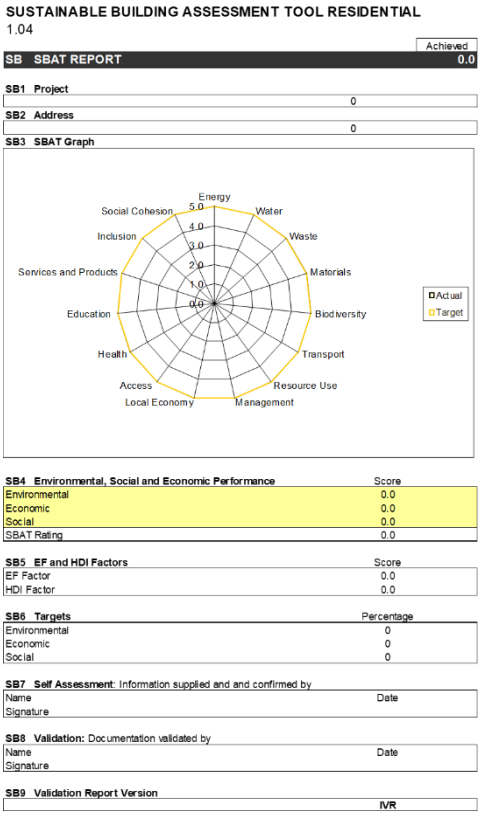
The performance requirements, performance criteria and drawings of emergency housing in the Code are reviewed using the Sustainable Building Assessment Tool.

The Sustainable Building Assessment Tool

The Sustainable Building Assessment Tool (SBAT) or Residential tool was developed by the author to assess the sustainability performance of housing as well as their immediate neighbourhoods (Gibberd, 2002; 2020). This tool is based on an approach that indicates that

buildings and environments are not sustainable in themselves but must enable and encourage sustainable living and the working patterns of their occupants. The tool, therefore, measures the capability of the built environment (characteristics and facilities) which enables users (occupants) to live sustainably. The tool is suitable for developing country contexts and has an equal weighting between environmental, social and economic sustainability performance. The tool explicitly addresses issues such as health, education and employment which are not addressed by green building rating tools. The benefits to the local economy of locally developed, maintained and appropriate technologies for sustainability are recognised in the tool which weights these significantly more heavily than imported technologies which are inappropriate for local conditions.

The tool consists of an Excel-based spreadsheet and manual. Buildings are assessed in terms of 15 criteria which measure the environmental, economic and social sustainability performance of the building. Results of the assessment are presented in a report with a spider diagram shown in Figure 3. Performance in each area is reflected in a score from 0 to 5, with 5 indicating excellent sustainability performance; and 0 no performance.



Area	Indicator
Energy	EN1 Orientation, EN2 Building Depth, EN3 Roof Construction, EN4 Wall Construction, EN5 Floor Construction, EN6 Window to Wall Ratio, EN7 Ventilation openings, EN8 Daylight, EN9 Internal Lighting, EN10 External Lighting, EN11 Installed Equipment Power Density, EN12 Food Cooking, EN13 Water Heating, EN14 Renewable Energy Generation
Water	WA1 Toilets, WA2 Wash Hand Basins, WA4 Showers, WA5 Hot Water, WA6 Landscape, WA7 Rainwater harvesting
Waste	WE1 Recycling Area, WE2 Recycling Collection, WE3 Organic Waste, WE4 Sewage, WE5 Construction Waste
Materials	MA1 Building Reuse, MA2 Timber Doors and Windows, MA3 Timber Structure, MA4 Refrigerants, MA5 Volatile Organic Compounds, MA6 Formaldehyde, MA7 Locally Sourced Materials
Biodiversity	BI1 Brownfield Site, B14 Municipal Boundary, BI3 Vegetation B14 Ecosystems
Transport	TR1 Pedestrian Routes, TR3 Cycling, TR3 Public Transport
Resources	RE1 Site Density, RE2 Area per occupant RE3 Renewable Energy Generation, RE4 Food Production
Management	MN1 Manual, MN2 Energy Metering, MN3 Water Metering, MN4 Recording, MN5 Residents Association
Local Economy	LE1 Locally Sourced Materials and Products, LE2 Small Enterprise, LE3 Construction Workers Support
Services and Products	SP1 Fruit and Vegetables, SP2 Bakery Products, SP3 Beans and pulses, SP4 Milk and Eggs, SP5 Clothing, SP6 Furniture, SP7 Equipment Hire, SP8 Notice Board
Access	AC1 Internet Access, AC2 Banking, AC3 Groceries, AC4 Post Office, AC5 Creche, AC6 Primary Schools
Health	HE1 Exercise, HE2 Health facility, HE3 Fruit and Vegetables, HE4 Bean and Pulses, HE5 Milk and Eggs, HE6 Water, HE7 External Views, HE8 Daylight, HE9 Openings, HE10 Roof Construction, HE11 Wall Construction, HE12 Volatile Organic Compounds, HE13 Formaldehyde, HE15 Construction Worker Health
Education	ED1 Primary Schools, ED2 Secondary Schools, ED3 Ongoing education, ED4 Internet, ED5 Noticeboards, ED6 Space for Learning, ED7 Building User Manual, ED8 Construction Worker Education
Inclusion	IN1 Public Transport, IN2 Groceries, IN3 External Routes, IN4 Entrances and Exits, IN5 Lobby, IN6 Window, door and lighting controls, IN7 Doors, IN8 Bathroom, IN9 Kitchen, IN10 Inclusive Employment, IN11 Affordability
Social Cohesion	SC1 Occupants, SC2 Community space, SC3 External Facilities, SC4 Residents Association

Figure 3: *The Sustainable Building Assessment Tool and Criteria*

Results

A review of the results indicates that the provisions in the Emergency Housing Programme meet the following SBAT criteria: Energy EN10 External lighting; Materials MA1 Building reuse; MA4 Refrigerants; MA6 Formaldehyde; Water WA1 Toilets; Resource Use criteria RE1 Site Density and RE2 Area per occupant; and Health HE5 Water. For other SBAT criteria, these are either not met, or the criteria cannot be assessed because the issue is not addressed in the documentation provided in the Code.

Figure 4 provides shows an extract from the SBAT report of the assessment. This shows that environmental sustainability performance is 1.1 out of 5, the economic sustainability performance is 0.6 out of 5 and social sustainability is 0.3 out of 5. These results indicate low levels of performance. This is attributed mainly to a lack of detail within the Code. This is understandable, as guidance in the Code may only have been provided in outline deliberately, with the intention that detailed decisions would be made by government officials and professionals on the ground. While this may work well in areas where there are strong institutional systems and officials and built-environment professionals with relevant experience and skills, it may not be adequate in situations where there is limited capacity. In these cases, more comprehensive guidance may be valuable in supporting effective local decision-making. This may be particularly important in disaster situations where emergency housing needs to be put in place rapidly and there is limited time to undertake research or consult. This study, therefore, proposes specifications for emergency housing that addresses sustainability more comprehensively. As an input to these specifications, the SBAT assessment of the provision in the Housing Code identifies the following areas where further detail could be provided:

- Energy: energy in the buildings should be addressed as the buildings may be used for up to three years and families will need energy for lighting and cooking.
- Water: washing facilities need to be addressed especially as washing hands is seen as a key precaution against infection during pandemics such as COVID-19.
- Waste: waste should be managed to avoid potential environmental health issues developing.
- Materials: the provision appears to favour a prefabricated steel frame and cladding systems. Other materials such as timber, cellulose insulation and bio-based cladding systems should be also considered. These may have better environmental and thermal performance, be cheaper and support local industries and small entrepreneurs.
- Biocapacity: biocapacity and planting should be addressed as trees can create shading and more comfortable environments. Vegetables can also be planted for food.
- Transport: provision for walking, cycling and public transport should be addressed as it is likely that people in emergency housing are likely to rely on walking and non-motorised transport more than on private vehicles.
- Resource use: the provision emphasises spatial efficiency but does not include a requirement to make use of leftover/available space for food production and the generation of energy. Both of these activities could provide valuable local employment as well as other benefits such as reduced carbon emissions and increased food security, so should be included.
- Management: there is an indication that the government would cover the costs for services such as water, sanitation, refuse collection, and street lighting for emergency housing for up to three years. If these services are not managed they may not be used efficiently and as a result, could place a heavy economic burden on the local municipality. Therefore, the inclusion of management of services should be addressed. Involving occupants in the design and management of the temporary housing and settlement also has other benefits such as the development of housing layouts that are more culturally appropriate, and the speeding up of the reconstruction processes (Turner, 1972, 1976; UNDRO, 1982).
- Local economy: support for the local economy is not addressed. Local content procurement requirements can be used to support local small enterprises and are an important part of government policy.

- Products and services: products and services such as food are likely to be one of the chief concerns of people moving into emergency housing. It is, therefore, important to address this issue.
- Access: facilities such as schools and the internet that may need to be accessed regularly by occupants should be included.
- Health: issues required to support health, comfort and productivity should be addressed to ensure that the health of vulnerable households moving into emergency housing is supported.
- Education: as households moving into emergency housing may include children and unemployed people seeking employment, this issue must be addressed.
- Inclusiveness: displaced households may include vulnerable people such as those with disabilities and old and ill people. It is, therefore, important that facilities are inclusive, safe and easy to use.
- Social cohesion: as households moving into emergency housing are likely to have experienced a disruptive event and be cut off from their normal social networks, it is important that people can interact with their neighbours and form new social networks. Facilities to support social cohesion should, therefore, be provided.

The Outline Specifications for Emergency Housing include the next aim in the issues identified in this review.

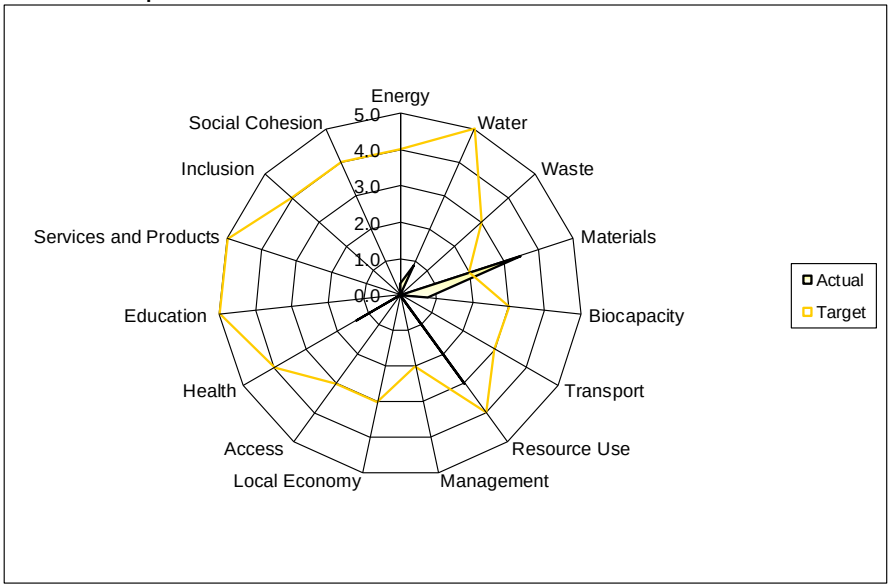
SUSTAINABLE BUILDING ASSESSMENT TOOL RESIDENTIAL
1.04

	Achieved
SB SBAT REPORT	**0.7**

SB1 Project
Emergency Housing

SB2 Address
0

SB3 SBAT Graph



SB4 Environmental, Social and Economic Performance	Score
Environmental	1.1
Economic	0.6
Social	0.3
SBAT Rating	0.7

Figure 4: *The Sustainable Building Assessment Tool report on emergency housing provision.*

Proposed Outline Specifications for Emergency Housing

The following proposed outline specifications for emergency housing aim to address key issues identified through the SBAT assessment of the provision for emergency housing.

Site

The site should be within 2km of social infrastructure such as creches, schools, clinics and recreational facilities. It should also be within 2km of locations where affordable, healthy food can be purchased, where there are opportunities for employment and where affordable public transport can be accessed.

Housing layouts

Housing layouts should be developed and discussed with prospective occupants**.** These should ensure that all houses have good access to daylight and ventilation and therefore housing should be at least 3m apart where there are doors and windows (not party walls). The long face of buildings should be orientated within 15 degrees of north. Densities achieved should be at least 150 persons per ha and building occupancy densities should be 10-19m^2 per person. Layouts should include provision for small businesses, retail, recycling, recreation facilities and creches (Gibberd, 2019). Safe walking routes should be provided between housing, the main facilities and neighbouring areas. Where social facilities such as clinics and schools are not available within 2km, provision for these should be made within the development (Johnson, 2014).

Water

A clean, reliable water supply must be provided within 50m of houses. Designs and management systems should ensure that the supply is as reliable as possible and periods without water should be avoided. Local onsite water supplies from rainwater harvesting should be considered to reduce costs and improve the resilience of supply.

Sanitation

Mains sewage, ecological sanitation or a container-based composting toilet system should be provided for the development. Effective management and maintenance systems must also be put in place.

Electricity

Sufficient electricity to power LED lighting and a radio/computer/tv should be provided for each house. As a minimum, this should consist of a photovoltaic system with batteries, 3 LED lights and 2 sockets for a TV/radio/computer. The system should be guaranteed for at least three years.

Stormwater

Stormwater for the settlement should be designed to avoid any standing water around housing and minimise the risk of flooding.

Building design

Yard and internal house layouts should be prepared and tested for suitability with the intended occupants. These should show facilities for washing, cooking, food preparation, social spaces, homework, sleeping and toilets and ensure that they are safely catered for.

Washing

A private washing space should be provided. This should be drained and provided with cold and hot water. Each house should have at least one facility where hands can be washed easily. Minimum provision should include a 20*l* container with a tap and soap on a stand 1m off the ground near the entrance of the house. Greywater from washing should be collected to be used for irrigation.

Toilets

Toilet facilities should be provided in the house or yard. If these are outside, lighting should be provided.

Food preparation and cooking

A space for food preparation and cooking should be provided. This should include a working surface, storage area and cooking equipment. Support for clean, affordable, safe cooking equipment should be provided as far as possible. This could include gas, solar cookers,

ethanol gel cookers or electrical equipment (where there is sufficient power) such as microwave ovens, or a combination of these.

Social space

Social spaces should be provided for occupants and visitors to eat and socialise together.

Homework and administration

A space for homework and simple administrative tasks should be provided. This should have a workspace, good daylighting and electrical lighting.

Sleeping

Sleeping spaces suitable for the household should be provided. This may include a space for parents and a space for children.

Building structure

The building structure should be designed to meet potential loadings and comply with SABS 0160. The structure could be steel or timber and be designed to enable it to be disassembled and reassembled easily.

Building foundations

Building foundations can be concrete where housing is intended to be permanent, while moveable precast concrete or timber footings can be used where buildings may be relocated.

Roof

A durable smooth roof material suitable for reuse and rainwater harvesting should be used (Centre for Affordable Water and Sanitation Technology, 2011). The roof construction should achieve a minimum total R-value of 2.7 K•m²/W and have a light-coloured external surface with a solar absorbance of 0.55 or less, to minimise heat gains.

Wall construction

Wall construction should have a minimum R-value of 1.9 K•m²/W.

Floors

Floors should have a high thermal mass, or if suspended, should have an R-value of 1.9 K•m²/W.

Materials

The length of time that emergency housing is required should be used to inform the choice of materials. For example, if emergency housing is required for under three years, a frame-based approach with bio-based cladding may be preferable to steel and masonry products as this will be more cost-effective and have a lower environmental impact (Johnson, 2014). Local

materials and products should be used for construction and the value of local content should be 100%. No materials that are harmful to health should be used. Materials such as timber products, paints and varnishes that include Formaldehyde and Volatile Organic Compounds should be avoided.

Ventilation

Windows should be provided on opposite walls and an opening size of at least 10% of the floor area should be provided to enable effective cross-ventilation and cooling.

Daylight

Windows should be located to provide a 2% daylight factor in the house.

Electrical lighting

LED or similarly efficient electrical lighting should be provided inside the house. This should provide at least 200lux on kitchen and homework work surfaces. Where washing, cooking or toilets are provided in the yard of house (outside), external lighting should be provided.

Food gardens

Within the yard or nearby, there should be provision for growing vegetables. This could be irrigated with greywater.

Construction

Where possible, houses should be assembled or built by occupants or by local people to support local development and reconstruction. Designs should ensure that the construction of units is easy and can be carried out by non-skilled people. Designs should ensure that materials and components can be reused if houses need to be moved.

Procurement

Where possible and economically competitive, materials, components, prefabricated systems and construction services should be procured from local manufacturers, suppliers and contractors to support local reconstruction and economic development (Johnson, 2014).

Ownership

The ownership of houses, materials and components should, over time, revert to occupants if they wish to purchase these. This ensures that houses are cared for and costs can be recovered from occupants through low-interest loans (Johnson, 2014).

Discussion

The proposed Outline Specifications for Emergency Housing aim to ensure that emergency housing addresses sustainability more effectively. The specifications, however, should be tested and developed before being applied on a large scale to ensure that unforeseen consequences are avoided. In addition, they should also be reviewed against the latest standards and regulations as these are being updated.

In their current form, aspects may also be difficult to implement. For instance, they require that activities such as washing, cooking, socialising, homework and sleeping are to be shown on the site and building layouts. If there are more than two occupants in a $24m^2$ house, it may be difficult to fit in all of these activities. This highlights a difficulty with the existing provisions which do not appear to take into account daily activities such as cooking, washing, socialising and doing homework. It also identifies the need to have a range of house types to accommodate different-sized households, from individuals and couples to families with children.

The inclusion of the sample house plans within the Code is useful because it indicates what sort of provision would meet requirements. This approach should also be expanded with the proposed specifications and sample drawings provided to show how the proposed specifications could be realised. The process of developing these sample plans could also be used to test and refine the specifications and improve their applicability and practicality.

Conclusions and recommendations

The study reviews the provisions for emergency housing in the Department of Human Settlements National Housing Code using the Sustainable Building Assessment Tool. The review indicates that it may be useful to supplement existing provisions with specifications that address sustainability more comprehensively. To this end, the Proposed Outline Specifications for Emergency Housing are developed. A critical analysis of the proposed specifications indicates that these may play a valuable role in ensuring sustainability is addressed in emergency housing. It, however, suggests that the specifications should be tested and refined through an iterative design process and piloting.

LIST OF REFERENCES

Centre For Affordable Water and Sanitation Technology. 2011. *Introduction to household rainwater harvesting*. [Online] Available from: Wedc-knowledge.lboro.ac.uk, (2020).

CAWSTRWH_Manual_2011-11_en.pdf [Accessed 12/5/2020].
Department of Human Settlements, 2009. *The national housing code.* Pretoria: Government Printer.

Department of Human Settlements. 2020. *Minister Lindiwe Sisulu on government's response to Coronavirus COVID-19 pandemic* [ONLINE] Available at: https://www.gov.za/speeches/minister-lindiwe-sisulu-government%E2%80%99s-response-coronavirus-covid-19-pandemic-29-apr-2020 [Accessed 14/6/2020].

Gibberd, J. 2002. *The Sustainable Building Assessment Tool: Assessing how buildings can support sustainability in developing countries*. Built Environment Professions Convention, Johannesburg, South Africa, 1–3 May 2002.

Gibberd, J. 2019. *Using onsite service enterprises to improve housing affordability and sustainability.* Southern African Energy Efficiency Confederation, Farm Inn, Pretoria, 14-15 November 2019.

Gibberd, J. 2020. *Applying the Sustainable Building Assessment Tool.* Available at https://jeremygibberd.com/2020/05/20/new-online-course-on-the-sustainable-building-assessment-tool/.

Johnson, C. 2007. Impacts of prefabricated temporary housing after disasters: 1999 earthquakes in Turkey. *Habitat International*, *31*(1),36-52.

National Treasury. 2020. *Division of Revenue Act: Transfers for provincial emergency housing grant to Eastern Cape for heavy rain and flooding related relief* [ONLINE] Available at: https://www.gov.za/sites/default/files/gcis_document/202001/42967gon42.pdf [Accessed 14/6/2020].

Quarantelli, E. L. 1995. Patterns of shelter and housing in US disasters. *Disaster Prevention and Management*, 4(3),43–53.

Turner, J. 1972. Housing as a verb. In: J. Turner & R. Fichter (eds). *Freedom to build* (148–175). New York: Macmillan.

Turner, J. 1976. *Housing by people: Towards autonomy in building environments.* London: Marion-Byers.

UNDRO. 1982. *Shelter after disaster: Guidelines for assistance.* New York: UNDRO.