Preliminary Assessment of the Pilot Structure Approach to Humanitarian Sheltering
Acknowledgments

This assessment report was prepared by Shelter Centre, a humanitarian non-governmental organisation (NGO) based in Switzerland.

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The Shelter Centre assessment project team was co-coordinated by Ghada Elashi, Emma Matthews, Marcela Rocha Figueiredo Neves, Jamie Wright and Sahra Hassan. The team included Mohamed Al-Mokadem, Assia Belguedj, Enrico Dainese, Rocío Garcia, Ravija Harjai, Chloë Lawson, Laurie Martorelli, Andrew Paraíso, Taylor Raeburn-Gibson and Alexander Rosenfeld, with Dr Tom Corsellis as Executive Editor.

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Humanitarian Contribution

This assessment report is intended as a contribution by the Structure project to the humanitarian community, specifically the shelter sector, to inform the continuing evolution of emergency shelter building through the previous experience and knowledge acquired.

This Assessment and the Structure Approach

This assessment serves to inform the design development of an approach to humanitarian shelter termed Structure offered by Better Shelter, a social enterprise based in Sweden, in collaboration with its project partners, notably the Aga Khan Agency for Habitat (AKAH) and Sustainable Environment and Ecological Development Society (SEEDS), India. The Structure approach is currently in its design phase and further design development will be informed through experiences shared by partner organisations that have undertaken implementation of pilot Structure frame shelters in Afghanistan, India and Tajikistan.

This assessment report was prepared by Shelter Centre, an independent humanitarian non-governmental organisation based in Switzerland. Shelter Centre is collaborating with Better Shelter and its humanitarian project partners in this assessment for humanitarian purposes, to produce knowledge that can be shared for a broader humanitarian use. The lessons learned from this assessment may inform a better understanding of humanitarian shelter and settlement. By collaborating in this assessment, Shelter Centre in no way endorses or supports the Structure shelter approach or design, or any other.

‘Transitional Shelter’ and ‘Transitional Tent’ Approaches

Humanitarian shelter, including sheltering in the emergency phase, repair, and reconstruction of permanent dwellings, may be defined as a habitable covered living space that provides a safe, healthy, and dignified living environment for people affected by disaster and conflict1. Approaches and case studies have been explored by academics, innovators, and humanitarian practitioners, presented in publications such as Shelter After Disaster (Davis, 1978)2, The IFRC Shelter Kit (IFRC, 2009)3, Shelter Strategy (SEEDS India, 2010)4, Transitional Shelter Guidelines (IOM and Shelter Centre, 2012)5, AKDN Green Building Guidelines (AKAH, 2020)6, Emergency Shelter Standards (UNHCR, 2021)7, The Shelter Compendium (GSC, 2021)8, and ongoing Shelter Projects compendia of case studies.

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The Structure approach builds upon the ‘transitional tent’ approach\(^9\), which itself is an evolution of the ‘transitional shelter’ approach\(^10\), both introduced by Shelter Centre\(^11\). The distinction between these approaches was made in order to better reflect the needs of affected populations and those assisting them for shelter which can be achieved very quickly, as well as shelter which can be achieved over more time, however both involving local materials to adapt to local culture, climate and context. Neither transitional approach is intended to result directly in permanent housing to national housing standards, but instead to involve materials which may later be used in the repair or reconstruction of permanent housing.

The transitional approach was proposed as a form of assistance for displaced and non-displaced populations, an experience often delayed due to constraints faced around ensuring housing, land and property rights. Since transitional tents and shelter can be relocated, it therefore can provide immediate and continuous support as reconstruction efforts continue. The evolution of transitional tents was informed by the performance standards developed by Shelter Centre following broad sector consultation, and then published by UN/OCHA in the annex of *Tents* (2004). Research into the building physics specific to transitional tentage was undertaken over more than a decade in collaboration with the Department of Engineering of the University of Cambridge\(^12\).

While still in the design phase, the Structure project seeks to form a better understanding of the transitional tent approach, by examining aspects of the project such as the reuse of materials in longer-term housing, possibilities for repairability and potential environmental benefits.

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1. Executive Summary

1.1 Introduction

Better Shelter is a social enterprise that develops and provides temporary emergency shelters for people displaced from their homes due to armed conflicts and natural disasters. As part of its efforts, Better Shelter developed and launched the *Structure* approach, to offer stockpiled shelter units for disaster and conflict responses. The *Structure* project seeks in-part, to explore and move forward the ‘transitional tent’ approach, with reference to the performance standards published in *Tents* (UN/OCHA, 2004). This approach supports local organisations and beneficiaries to upgrade a shelter frame with local materials, in response to local cultures, climates and contexts. For more information, see the Humanitarian Contribution section.

Better Shelter and its project partners recognise that local solutions, using local materials and skills, are preferred. They also recognise that, under specific operational and environmental circumstances, the use of tentage may be appropriate, as part of an integrated shelter and settlements strategy.

1.2 Structure Pilot Project

As part of an ongoing design development process, Better Shelter is currently implementing pilot projects with partner organisations, to test the opportunities and challenges of the *Structure* sheltering approach in the context of Afghanistan, India and Tajikistan.

Each partner organisation received 15 *Structure* units per location, that is, 15 in Afghanistan, 15 in India and 15 in Tajikistan, for a total of 45 shelters. Due to movement restrictions and other impediments, which kept partner organisations from building all 45 *Structure* units in time, the Preliminary Assessment consisted of 29 *Structure* shelters, 23 of which used tarpaulin on the exterior while 6 were upgraded using local materials.

In this pilot phase, focus was placed around adapting the shelters, using local materials and solutions available in the cultures, climates and contexts in which they are being built. Consideration was also given to the dismantling of the shelters and repurposing of constituent materials. There is indication of reusability of these materials, however, this was not proven in this pilot phase.

1.3 Structure Project Partners

Better Shelter collaborated with Aga Khan Agency for Habitat (AKAH) in Afghanistan and Tajikistan, along with the Sustainable Environment and Ecological Development Society (SEEDS) in India.

1.4 Role of Shelter Centre

Shelter Centre, as an independent humanitarian NGO, collaborated with Better Shelter to assess the *Structure* frames implemented in various locations by the AKAH and SEEDS. All partners agreed on

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the publication of assessment results, to inform the humanitarian community in its understanding of the *Structure* approach and the opportunities it offers to the sector.

### 1.5 This Assessment

The purpose of the Preliminary Assessment of the pilot *Structure* approach to humanitarian sheltering was to evaluate the *Structure*’s ability to support incremental, local, and beneficiary-driven shelter processes in contexts where local materials were not available or readily accessible at the onset of emergencies.

This assessment included seven members of AKAH and SEEDS and 19 semi-structured interviews.

These interviews were organised around two semi-structured assessments, where the Design Process Assessment questionnaire comprised of two individual questionnaires developed to assess *Structure*’s performance in different contexts:

- Sphere Coherence Assessment Questionnaire
- Design Process Assessment
  - Design Process Assessment - Tarpaulin Questionnaire
  - Design Process Assessment - Local Materials Upgrade Questionnaire

### 1.6 Key Findings

#### 1.6.1 Sphere Coherence Assessment

The Sphere Coherence Assessment semi-structured questionnaire was intended to explore the degree of coherence of the *Structure* pilot shelters when considering *The Sphere Handbook* (Sphere, 2018), understanding both that these standards were not developed to evaluate family shelter and that this assessment in no way seeks to infer any consistency with those standards.

Key findings from the Sphere Coherence Assessment questionnaire included the following:

**Technical Guidance** (*see Section 8.3*)

Assessment respondents indicated that *The Sphere Handbook* (Sphere, 2018)\(^{14}\) was used as reference throughout the pilot project, as were other national and internal guidelines. While respondents stated that the virtual training provided by Better Shelter was invaluable, they also added that additional print out graphics could be used as guidance for beneficiaries in emergency contexts with limited resources and manpower.

**Site Locations** (*see Section 8.1.1*)

Varied ground conditions across local contexts have prompted construction teams to adapt local methods of site preparation, prior to assembling *Structure*. Assessment respondents indicated that guidance on assessing site locations and natural hazards would be of added value.

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PWSN Considerations (see Section 8.2.1)

The *Structure* frame was found by respondents to be generally flexible and accessible for Persons With Special Needs (PWSN), though improvements and guidelines to inform future adaptations would add value to the current support package.

Thermal Comfort (see Section 8.2.2)

Respondents indicated that the tarpaulin does not achieve thermal comfort by itself, prompting beneficiaries to employ local materials in combination with the tarpaulin to make upgrades and adaptations to improve both ventilation and insulation.

Latrine Solutions (see Section 8.2.5)

Respondents also mentioned the need for a quick-to-assemble latrine solution, on a temporary or upgradable ‘transitional’ basis, enabling more permanent latrines to be developed later with local materials.

1.6.2 Design Process Assessments - Tarpaulin and Local Materials

The Design Process Assessment was developed to inform Better Shelter on *Structure*’s ability to perform in post-emergency contexts and the ease with which it can be upgraded using locally available materials. Key findings will be presented collectively including common findings across the Tarpaulin and Local Materials questionnaires and individually for each of the questionnaires. The same logic has been replicated for the Findings sections (see Sections 9.1, 9.2 and 9.3).

Collective key findings from the Design Process Assessment questionnaires indicated that:

Construction Guidelines (see Section 9.3.1)

Construction guidelines were found by respondents to be comprehensive and easy-to-follow. It was indicated that virtual simultaneous training of unskilled builders may be needed when building *Structure* shelters, involving either tarpaulin or local materials.

Construction Concerns (see Section 9.3.2)

The preparation of the foundation was a unanimous concern of respondents, as ground conditions varied across the assessed locations, and there was a need to ensure the integrity of the shelter unit. Some concerns brought forward by respondents concerning the tarpaulin and local materials shelters included the difficulty of assembling the roof structure and coupling it to the wall frame as well as doubts when punching holes through the tarpaulin.

Respondents also indicated that upon upgrading the shelter with local materials, they feared some of the tarpaulin fixings could break due to the extra weight. Despite this concern, the few occasions of broken pieces were likely due to inadequate handling of the material.
Transportation and Packaging (see Sections 9.3.5 and 9.3.6)

Related to logistics and packaging, respondents stated that they were in favour of a tamper seal on the boxes the *Structure* is transported in, to determine whether or not boxes had been opened during transit. It was also stated that waterproof boxes would also be beneficial and could be reused by beneficiaries. Attention was drawn to the creation of component checklists.

1.6.3 Design Process Assessment - Tarpaulin

The Design Process Assessment - Tarpaulin was developed to inform Better Shelter on how *Structure* performs in emergency contexts, where plastic sheeting has been used to cover the frame.

Key findings from the Design Process Assessment - Tarpaulin questionnaire indicated that:

Tarpaulin Concerns (see Section 9.1.1)

Respondents found the tarpaulin easy to clad to the *Structure* frame, and lasted through mildly adverse weather conditions, thus providing immediate protection against extreme temperatures, water and vectors. It was found, however, that one way to preserve the tarpaulin was to use it in combination with local materials.

Concerning the necessary tools to assemble the *Structure* with tarpaulin, respondents expressed difficulty in making the necessary holes with the hole puncher knife present in the *Structure* kit. This concern stemmed from the fear of creating further tears in the tarp and compromising the integrity of the covering.

PWSN Considerations (see Section 9.1.3)

Concerning Persons With Special Needs (PWSN), *Structure* was found to be generally accessible, given the flexibility in the placement of doors and number of openings. That being said, providing further guidance on how to elevate the *Structure* and construct ramps would be useful for construction teams.

Liveability Adaptations (see Sections 9.1.4 and 9.1.5)

Respondents indicated that doors and windows should be placed in key strategic places of the shelter to improve ventilation and local materials could be used to create and improve insulation. They added that having a WASH facility within their shelter is very important and suggested that the gable ends of the *Structure* could be extended to support a veranda to create spaces for cooking, socialising and WASH facilities.

1.6.4 Design Process Assessment - Local Materials Upgrade

The Design Process Assessment - Local Materials Upgrade was developed to inform Better Shelter on how the *Structure* frame performs in a transitional context, in which local materials are used for an upgrading process and in combination with or in substitution of the tarpaulin sheeting.

Key findings from the Design Process Assessment - Local Materials Upgrade questionnaire indicated that:
Local Materials Used (see Section 9.2.1)

Local materials used to make upgrades to the *Structure* were chosen on the basis of being locally and readily available, easy to install, capable of providing thermal comfort and being inexpensive.

Upgrade Process (see Sections 9.2.2 and 9.2.3)

During the upgrading phase of the projects, standard masonry and carpentry hand tools were used, as well as power drills. GI wire, metal clips, screws, nails and bolts were used frequently when fixing materials to the *Structure* frame. These materials were used by attaching them to the *Structure* frame or by combining them with tarpaulin to make upgrades to the roof, walls, and floor.

Respondents indicated that fixing local materials to the tarpaulin was a concern and that there was a fear that horizontal members of the frame might break or bend as a result of extra weight added to the roof. No such incidents were recorded among the respondents (see Sections 9.2.2 and 9.2.3 for more information).

Liveability, PWSN, and Thermal Conditions (see Sections 9.2.5 and 9.2.6)

Regarding PWSN considerations, respondents stated that there was a need for extra guidance on combining tarpaulin with local materials to make upgrades to the *Structure* in order to better accommodate disabled persons. To improve thermal comfort and liveability, additional openings could be created, and upgrades can be made using local materials and in combination with the tarpaulin.

Cultural Considerations (see Section 9.2.7)

The majority of respondents indicated that, regarding cultural considerations, *Structure* should have one to two doors, as well as anywhere from two to four windows, although the placement, height and number of windows are dependent on local customs for privacy.

1.7 Key Recommendations

The following points are selected and key recommendations that should be considered when scaling up and considering proposals for further R&D about the *Structure* approach. The points represent an aggregation of the full recommendations (see Section 10. Recommendations), derived from the findings of each of the assessments undertaken: Section 8 Sphere Coherence Assessment, Section 9.1 Design Process Assessment - Tarpaulin and Section 9.2 Design Process Assessment - Local Materials Upgrade.

1.7.1 Location and Site Planning (see Sections 10.1.1 and 10.4.3)

Consider collating supporting materials that aid beneficiaries in the assessment of site conditions, hazards, risks, weather and climatic conditions, as well the preparation of *Structure* foundations. Materials should highlight local methods and best practices used when preparing foundation on varied ground conditions.
1.7.2 Building and Construction (see Sections 10.1.3, 10.2.1, 10.2.2, 10.3.2 and 10.4.1)

Consider collating materials that provide information on Structure components, assembly and integrity to allow beneficiaries to more easily conduct quality assurance.

Respondents were largely impressed with the support offered by Better Shelter, indicating that it was adequate and efficient, but expressed that more guidance related to building and construction processes would be of added value.

1.7.3 Upgrades and Cultural Adaptation (see Sections 10.3.1, 10.3.3, 10.3.4 and 10.4.2)

Consider collating guidance on performing upgrades to Structure, detailing the use of local materials, additional facilities, thermal considerations and cultural adaptations. Attention should be given to collating and sharing Bills of Quantities (BoQs) specific to climatic and cultural contexts, as well as creating a knowledge management of resources produced by Better Shelter, national and international guidance and materials created by partners and other agencies.

1.7.4 Structure Alterations (see Sections 10.1.2, 10.2.3, 10.2.4, 10.3.4 and 10.4.1)

Consider implementing design modifications to the Structure frame and other elements to improve structural integrity, enhance liveability, better adhere to Sphere Standards and allow beneficiaries to better adapt Structure to meet local, climatic and cultural contexts.

1.7.5 Maintenance and Material Reuse (see Sections 10.3.3 and 10.4.2)

Collate guidance on the reuse and maintenance of Structure elements and materials to increase the Structure lifespan and create options for reuse and upcycling. Emphasis should be placed on detailing methods in which tarpaulin can be reused in combination with local materials to improve its lifespan and reduce wear.

Undertaking further research or an extension of the pilot phase in order to understand the transitional opportunities offered by selecting materials which can subsequently be upcycled, as part of repair and reconstruction activities of permanent housing.
2. Introduction

2.1 Organisation of the Report

Better Shelter initiated a M&E field test and evaluation assessment to develop and inform the ongoing Structure shelter approach in a collective manner, by involving partner organisations and beneficiaries in the process.

Shelter Centre, as an independent entity, collaborated with Better Shelter to fulfil the purpose of development, preliminary assessment of the pilot Structure approach to humanitarian sheltering, documentation and communication of knowledge and solutions of the Structure frame pilot project implemented in various locations by the Aga Khan Agency for Habitat (AKAH) and Sustainable Environment and Ecological Development Society (SEEDS).

This report includes the assessment findings and recommendations collected from 21 semi-structured interviews with 9 members from partner organisations, namely Aga Khan Agency for Habitat (AKAH) and the Sustainable Environment and Ecological Development Society (SEEDS), and 2 members from Better Shelter. The findings and recommendations included in this report are not exhaustive, and instead seek to inform the ongoing design process of the Structure pilot project.

2.2 The Assessment and Questionnaire Formats

Through an agreement between Better Shelter, AKAH and SEEDS, Shelter Centre developed two assessments (containing 3 questionnaires in total) to better understand design considerations with regards to Sphere Standards, the design and use of the tarpaulin as well as local material upgrades of the current pilot projects implemented in various contexts. Shelter Centre carried out seven interviews concerning the Sphere Coherence Assessment, seven interviews concerning the Design Process Tarpaulin Assessment and five interviews concerning the Design Process Local Materials Assessment.

For a detailed explanation of each assessment questionnaire, refer to Section 5.3 Objectives of Conducted Assessments.

For a complete table including all the participating Structure shelters in this pilot project, please see Table 4: Distribution of Sphere Coherence Assessment interviews per organisation, in 8. Findings: Sphere Coherence Assessments.
3. Better Shelter Structure Approach

3.1 Introduction to the Approach

Better Shelter is a social enterprise that develops and provides transitional emergency shelter for people displaced from their homes due to armed conflicts and natural disasters. Through design, innovation and modern technology, Better Shelter works to create safer, more dignified temporary homes for millions of people worldwide.\(^{15}\)

Better Shelter developed a new shelter approach, building upon a proven 17.5 m\(^2\) modular emergency shelter frame, intended for up to five persons, developed with reference to *The Sphere Handbook* (Sphere, 2018) for humanitarian use. This shelter approach, termed *Structure* was launched to address shelter needs in disaster and conflict contexts where local markets can recover quickly, allowing local organisations and beneficiaries to access building materials in the midst of an emergency and upgrade the temporary shelters with localised solutions. Currently, the *Structure* approach is within its design phase, involving a pilot programme with AKAH in Afghanistan and Tajikistan and SEEDS in India, in order to test its intervention logic, usability, assembly capacity and supply chain needs.

3.2 Partner Organisations and Their Role

The collaborative effort between Better Shelter, AKAH and SEEDS, through their expertise in rolling out shelter programmes in emergency response efforts in their respective regions, seeks to explore and identify new ways of providing incremental shelters to families displaced by conflict or natural disasters. As such, both organisations made significant conceptual and in-kind contributions, as project partners under the overall project lead of Better Shelter, contributing to the development of the *Structure* approach, as well as collaborating in the development and implementation phases of the project.

At an early stage, partner organisations maintained close collaboration throughout the planning, deployment and testing phases of the *Structure* project. As some units of the *Structure* continue to be deployed and built during the drafting of this report, the pilot programme is branching out into localised collaboration projects. The pilot programme is organised along two parallel tracks, with the first one seeking to mobilise technical development and evaluation of the frame structure. The other, a fundraising facility ensures resources for future use of the frame structure, should the pilot be successful.

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\(^{15}\) Better Shelter. (2021). *About us.* Available at: https://bettershelter.org/about/. (Accessed 02 June 2021)
3.3 Design Concept

The Structure steel frame is securely anchored to the ground and clad with sturdy and lightweight roofing vertical steel members. The shelter can be adapted to suit specific contexts and applications, as its modular design means that sections can be added and removed to create different structures.\(^\text{16}\)

Within a phased response context, the unit can be upgraded using local materials, in combination with and in substitution of the plastic tarpaulin. It is easily maintained, and components can be replaced in the event of damage.\(^\text{17}\)

Structure aims to provide a rapid deployment solution of robust materials for emergency shelters in diverse contexts. The design aims to empower local communities by allowing localised upgrades upon the restoration of supply chains and access to materials in the region. Moreover, the Structure shelter design aims to introduce a sustainable dimension to transitional shelters by enabling dismantling and repurposing of the frame and tarpaulin. Complementarily, the flexibility of Structure aims to address long-term transitional contexts, combined with localised solutions and workforce.\(^\text{18}\)

Better Shelter is currently testing the transitionality of Structure in different contexts in Afghanistan, India and Tajikistan to determine whether it can be dismantled and repurposed, effectively coupled with local materials and solutions, and provide a long-term solution to displacement as a result of natural disasters and conflict. The partner organisations have endeavoured to adapt and select material upgrades best suited to their local contexts. To check whether this hypothesis is corroborated by experiences of


\(^{17}\) Ibid.

Structure on the ground, Shelter Centre has developed independent and complementary assessments to gather input from construction crews and communities involved in the assembly process.

Image 2: Structure frame, Haridwar, Uttarkhand, India
Photo credits: Better Shelter and SEEDS
4. The Structure Pilot Project

4.1 Objective of the Structure Pilot Project

The objective of the undergoing pilot programme of the Structure shelter is to test the usability, assembly, capacity and supply chain needs of existing projects being implemented by AKAH in Afghanistan and Tajikistan and SEEDS in India. As these partner organisations have been involved from an early stage, they have been able to participate in the planning, deployment and testing phases of the Structure approach, serving as a valuable source of information and collaboration for the Preliminary Assessment.

For this assessment, Better Shelter collaborated with AKAH and SEEDS to implement simultaneous pilot projects of Structure in different context settings, in an attempt to test the limits and vulnerabilities of the shelter design. AKAH and SEEDS contributed to the evolution of the Structure approach in developing and experimenting with local material upgrades, in addition to various types of foundations and adaptations for Structure. AKAH and SEEDS have now provided feedback through their experience in building the Structure in Afghanistan, India and Tajikistan.

Each partner organisation received 15 Structure units per location, totalling 45 shelters for Afghanistan, India and Tajikistan. These shelters were intended to be tested for both tarpaulin and local materials upgrades. At the time of the assessment, 29 Structure shelters had been built or were programmed for construction, therefore the assessment considers this specific quantity, aware that more Structure units may have been built during the writing and reporting phase. Table 1 below shows the distribution of tarpaulin and local materials shelters, per region and organisation.

<table>
<thead>
<tr>
<th>Partner Organisation</th>
<th>Location</th>
<th>Tarpaulin</th>
<th>Local Material Upgrade</th>
<th>Total Pilot Structure Shelters per Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKAH</td>
<td>Tajikistan</td>
<td>15</td>
<td>-</td>
<td>22</td>
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<tr>
<td></td>
<td>Afghanistan</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>SEEDS</td>
<td>India</td>
<td>3</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>23</td>
<td>6</td>
<td>29</td>
</tr>
</tbody>
</table>

19 This table does not include the shelters delivered but not yet built. It only includes the shelters already built or under construction during the interviews stage.
4.2 Partner Organisations

4.2.1 Aga Khan Agency for Habitat (AKAH)

The Aga Khan Agency for Habitat\(^{20}\) (AKAH) has piloted *Structure* shelters in Afghanistan and Tajikistan for different purposes. The units deployed in Afghanistan’s provinces of Baharak, Kshim, Shugnan, Yakawlang and Ishkashim were used as changing rooms and triage units in support of the medical facilities, as well as family shelters for seasonal disaster affected families. In Tajikistan, the 15 *Structure* units deployed were devoted to the country’s COVID-19 response in Khorugh, Bartang, Roshtqala, Murgab, Debasta, Ishkashim, Vomar and Vanj.

Established in 2016, AKAH represents a conglomeration of several agencies and programmes within the Aga Khan Development Network (AKDN) that have been working on habitat, disaster preparedness and relief since the 1990s. AKAH works with communities to ensure that the locations where they live are safe from the effects of climate change and natural disasters, investing in innovation to help develop and test practical, affordable and scalable solutions for habitat needs. AKAH has conducted hazard, vulnerability and risk assessments (HVRAs) for more than 2,500 settlements accommodating nearly 3 million people, operates 88 community-managed weather monitoring posts to provide early disaster warnings to over 600 avalanche-prone settlements and has developed its own approach to habitat planning integrating community engagement, data-driven decision-making and spatial design\(^{21}\).

\[\text{Aga Khan Agency for Habitat}\]

4.2.2 Sustainable Environment and Ecological Development Society (SEEDS)

The *Structure* units deployed in India were divided geographically in order to test the shelter design resilience and adaptability to different contexts. Two testing units were deployed at the SEEDS HQ office in New Delhi, four were deployed in Kerala to serve as family shelters and one unit was deployed in Uttarakhand, also as family shelters.

Created in 1994, SEEDS’s ultimate goal is to build the resilience of people exposed to disasters. As such, SEEDS has worked on post-disaster shelter response in most of the major emergencies in the recent past, including the Gujarat earthquake, the Indian Ocean tsunami, the Kashmir earthquake, the Rajasthan floods, the Orissa floods and the Bihar Kosi floods\(^{22}\). SEEDS’ humanitarian response helps provide communities with emergency tents, early recovery housing and kits of essential items\(^{23}\).

\[\text{SEEDS}\]

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\(^{21}\) Ibid.


\(^{23}\) SEEDS India. (2021). *What We Do*. Available at: https://www.seedsindia.org/what-we-do/. (Accessed 02 June 2021)
5. Overview of the Assessments Undertaken

5.1 General Objective

The objective of the Preliminary Assessment is to produce a report about the Structure design informed by *The Sphere Handbook* (Sphere, 2018) and include evaluations of the concept of an emergency shelter design and its ability to upgrade incrementally using locally available materials. The report will include findings and recommendations, emerging from consultations with members of the building crews from AKAH and SEEDS teams.

The objective outlined above will be achieved by conducting two assessments, developed by Shelter Centre, in consultation with Better Shelter. The Sphere Coherence and the Design Process Assessments will be explained in Section 6. Methodology below.

5.2 Reference to the Sphere Coherence Assessment

Shelter Centre is not in a position to determine formally whether or not any shelter is compliant with *The Sphere Handbook* (Sphere, 2018), and as such, the objective of the Sphere Coherence Assessment was not to determine adherence of the Better Shelter Structure to standards set forth by *The Sphere Handbook* (Sphere, 2018). Instead, the assessment was used to begin to evaluate the assembly, adaptability, usability, and safety of the Structure in the field by implementing partners, in an effort to identify potential gaps, issues, and opportunities for improvement with regards to the shelter’s design.

In the development phase of this assessment, questions were developed using, as guidance, the standards set forth in the Protection Principles and Shelter and Settlement chapters of *The Sphere Handbook* (Sphere, 2018), focusing specifically on the following sections of the chapters: Protection Principle 1 and Standard 2: Location and Settlement Planning, Standard 3: Living Space, Standard 5: Technical Assistance: Enhance people’s safety, dignity and rights and avoid exposing them to further harm. Along with feedback from Better Shelter, these standards were then interpreted to adapt the questions for interviews to be conducted with members from the partner organisations. This second phase of the questionnaires, focused on thematic categories that were identified in the first phase, later informing the analyses of the findings collected.

The respondents who were selected to undergo the Sphere Coherence Assessment were directly or indirectly involved in the assembly and construction of 29 Structure shelters in Afghanistan, India and Tajikistan.

5.3 Objectives of Conducted Assessments

5.3.1 Sphere Coherence Assessment

The Sphere Coherence Assessment was developed to explore the overall consistency of Structure to the guidance set out in *The Sphere Handbook* (Sphere, 2018), to identify the weaknesses and

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25 Ibid.
26 Ibid.
27 Ibid.
vulnerabilities of the shelter design and process. To better understand the methodology for the development of the Sphere Coherence Assessment questionnaire, see Section 5.2 Reference to the Sphere Coherence Assessment.

The Sphere Coherence Assessment questionnaire contained 39 questions (see Appendix B). Questions 1-3b were ‘pre-interview’ questions to inform the background of the respondents and the subsequent 36 questions were developed as a result of extrapolation from three Sphere Shelter and Settlement Standards (Sphere, 2018)28 namely Standard 2: Location and Settlement Planning, Standard 3: Living Space and Standard 5: Technical Assistance and one Protection Principle also contained in The Sphere Handbook (Sphere, 2018), namely Principle One, Enhance the safety, dignity and rights of people and avoid exposing them to harm.

5.3.2 Design Process Assessment - Tarpaulin

The Design Process Assessment - Tarpaulin was developed to inform Better Shelter on how Structure performs in an emergency and post-emergency context, where plastic sheeting has been used to cover the frame. The feedback provided by the partner organisations is designed to provide recommendations to Better Shelter regarding tarpaulin lifespan, challenges, difficulties and added value.

The Design Process Assessment - Tarpaulin questionnaire contained 26 questions (see Appendix B). Questions 1-13 were ‘pre-interview’ questions designed to gather insight of the respondents’ background in shelter construction, the construction teams and support provided for the construction of Structure. The remaining 13 interview questions (14-26) concerned the experience and feedback of the construction teams with Structure and the tarpaulin covering, including construction and infrastructural challenges, thermal comfort, vulnerabilities, tarpaulin degradation and cultural and context-specific adaptations.

5.3.3 Design Process Assessment - Local Materials Upgrade

The Design Process Assessment - Local Materials Upgrade was developed to inform Better Shelter on how the Structure frame performs in a transitional context, in which local materials are used for an upgrading process and in combination with or in substitution of the tarpaulin sheeting.

The Design Process Assessment - Local Materials Upgrade questionnaire contained 27 questions (see Appendix B). Questions 1-13 were ‘pre-interview’ questions designed to gather insight of the respondents’ background in shelter construction, the construction teams and support provided for the construction of Structure. The remaining 13 interview questions (14-27) concerned the experience and feedback of the construction teams with Structure and the local materials upgrade process. The feedback provided by the partner organisations was designed to provide recommendations to Better Shelter regarding attachment methods of local materials to the Structure frame and tarpaulin, weight and limits for the Structure frame upon upgrading, further necessary guidance and tools, and cultural and context-specific adaptations.

28 Ibid.
6. Methodology

6.1 Research Question

The Preliminary Assessment of the pilot Structure approach aimed to answer the following question: ‘If and how can Structure support an incremental, local and beneficiary-driven shelter process while, at the same time, being possible to implement, in scale, in situations where local materials are not available at the onset?’

To answer this question, Shelter Centre devised two simultaneous and complementary assessments to gather feedback and learn from the experiences of AKAH and SEEDS teams in relation to the Structure.

This report includes the disaggregated and collective findings from the assessments outlined below to inform future design and logistics improvements related, but not limited to, technical performance, logistics, user satisfaction, cost, environment, etc.

For this pilot project, Shelter Centre considered the 29 Structure shelters out of 45 units sent by Better Shelter to the partner organisations, of which 23 were tested for tarpaulin and 6 were tested for local materials upgrade (for more information, see Table 1). Shelter Centre met with 9 members of AKAH and SEEDS and 2 members of Better Shelter, conducting a total of 21 interviews.

6.2 Distribution of Assessments and Respondents

Interviews conducted by Shelter Centre targeted respondents from AKAH and SEEDS that were directly involved in managing and building the Structure units operating in different contexts in Afghanistan (Baharak, Kishm, Shughnan, Yakawlang, Iskkashim and Dushi and Pol.i-khomi provinces), Tajikistan (Khorugh, Bartang Valley, Roshtqala, Suchon Shugnan, Murgab, Ishkashim, Vomar and Vanj provinces), and India (New Delhi, Kerala and Uttrakhand). In addition, to enable Shelter Centre to gather and gain common understanding of the material and guidance provided to the partner organisations related to Better Shelter’s perception of the Structure’s coherence with The Sphere Handbook (Sphere, 2018), Shelter Centre interviewed 2 representatives from Better Shelter that were heavily engaged in the Structure frame design process and supported partner organisations during the implementation of pilot projects.

The selection of respondents from AKAH and SEEDS followed a ‘purposive’ approach and was done solely through Better Shelter due to their better acknowledgment of the job roles of respondents whilst implementing the pilot projects, Shelter Centre had no involvement of any kind in the selection process. The type of assessments conducted by Shelter Centre was informed by Better Shelter, which varied between respondents based on the nature of respondents’ involvement in the implementation of the Structure frame pilot project. Table 2 contains the anonymised names of respondents and the corresponding assessments undertaken by Shelter Centre. Table 3 in the following page contains the corresponding assessments undertaken per participants by Shelter Centre.
### Table 2: Number of respondents respective to partner organisation

<table>
<thead>
<tr>
<th>Partner Organisation</th>
<th>Respondents</th>
<th>Total Number of Respondents Involved in Assessment / Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better Shelter</td>
<td>B-S 1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>B-S 2</td>
<td></td>
</tr>
<tr>
<td>AKAH</td>
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<td>6</td>
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<tr>
<td></td>
<td>AKAH 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AKAH 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AKAH 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AKAH 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AKAH 6</td>
<td></td>
</tr>
<tr>
<td>SEEDS</td>
<td>SEEDS 1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SEEDS 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEEDS 3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total Number of Interviewed Respondents by Shelter Centre</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>
### Table 3: Distribution of assessments per respondents and partner organisations in relation to location of implemented pilot project

<table>
<thead>
<tr>
<th>Partner Organisations</th>
<th>Location</th>
<th>Interviewees</th>
<th>Conducted Interviews by Shelter Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Strategic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sphere Coherence Assessment</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Design Process Local Materials</td>
</tr>
<tr>
<td>Better Shelter</td>
<td></td>
<td>B-S 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B-S 1</td>
<td>1</td>
</tr>
<tr>
<td>AKAH</td>
<td></td>
<td>AKAH 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AKAH 2</td>
<td>1</td>
</tr>
<tr>
<td>Tajikistan</td>
<td></td>
<td>AKAH 3</td>
<td>1</td>
</tr>
<tr>
<td>Afghanistan</td>
<td></td>
<td>AKAH 4</td>
<td>1</td>
</tr>
<tr>
<td>Afghanistan</td>
<td></td>
<td>AKAH 5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AKAH 6</td>
<td>1</td>
</tr>
<tr>
<td>SEEDS</td>
<td>India</td>
<td>SEEDS 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>SEEDS 2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Kerala</td>
<td>SEEDS 3</td>
<td>1</td>
</tr>
<tr>
<td>Total Interviews per Category</td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Total Interviews</td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6.3 Assessment Methodology

With the objective to engage staff members from AKAH and SEEDS virtually, and mindful of the movement and travel restrictions due to the COVID-19 pandemic, Shelter Centre developed a three-step process to achieve the deliverables.

#### 6.3.1 Step 1: Initial Communication

Shelter Centre communicated directly with respondents by sending introductory emails in December 2020 and January 2021, explaining the interview process. Upon response from the respondents, Shelter Centre invited them to propose meeting times most convenient for them and provided more information on the interview process.
6.3.2 Step 2: Written Questionnaires

The questionnaires outlined above in Section 5.3 Objectives of the Conducted Assessments were sent by Shelter Centre to the respondents via email prior to the interview. The purpose was to allow the respondents to familiarise themselves with the type of questions and allow them time to reflect upon the questions and answers. During the interviews, in Step 3 below, any concerns and clarifications were provided to the respondents throughout the conversation.

Respondents were also asked to fill out some information and return questionnaires prior to the interview. This enabled Shelter Centre to focus the interview-time on outstanding aspects of the partner organisations’ experience with Structure.

6.3.3 Step 3: Interviews

Shelter Centre administered the interviews verbally via online communications platforms, including Skype, Microsoft Teams and Zoom, upon receiving an annotated questionnaire from the respondents whenever possible. Separate interviews for each questionnaire were undertaken whenever the respondents’ time allowed.

Each participant partook in a specific number of interviews, from one to three, based upon a selection made by Better Shelter in coordination with AKAH and SEEDS (see Table 3).

6.3.4 Semi-Structured Interviews

To relate and adapt Structure to international standards, The Sphere Handbook (Sphere, 2018) was used as a reference. Data was collected for these assessments through semi-structured interviews, guided by the assessment questionnaires described in Section 5.2 Reference to the Sphere Coherence Assessment

Shelter Centre initiated this project at the end of 2020 by conducting an interview with two Better Shelter members to determine to what extent Structure was informed by The Sphere Handbook (Sphere, 2018). The questions explored the overall consistency of the Structure frame and covering options.

Based upon the questionnaire and interview feedback from Better Shelter, Shelter Centre gained a deeper understanding of the guidance and materials included in the Structure kits delivered to AKAH and SEEDS. This enabled Shelter Centre to further tune the Sphere Coherence Assessment questionnaire to the limitations and services already explained by Better Shelter, to ensure best time and capacity usage when interviewing AKAH and SEEDS staff members.

The semi-structured interviews undertaken with respondents from AKAH and SEEDS retained their flexibility allowing the respondents to guide the discussion and spend more time on specific aspects of Structure which they thought to be successful, troublesome and peculiar.

The decision to request an annotated version of digital questionnaires prior to the interviews enabled Shelter Centre to preview the participant’s overall experience with Structure and highlight points for further exploration and discussion.
As these assessments were not intended as an evaluation of the participant’s work methodology nor their success in building Structure, the semi-structured interviews method enabled respondents to speak freely and guide the discussion as they saw fit.

6.4 Data Processing

The semi-structured interviews enabled the analysis team to filter the respondents’ feedback and learning experiences through thematic analysis, which has been used to categorise the findings and recommendations presented in this report. Each assessment was transformed into an analysis matrix, considering the overarching themes as analytical categories to better compare and contrast the participant feedback.

While each assessment was analysed individually, as a standalone project, intersections and correlations were identified throughout the three questionnaires and have been displayed in Section 7. Intersecting Findings of Assessments. For this reason, it is logical to spot some duplicates or similar findings and recommendations in Sections 8 Findings: Sphere Coherence Assessment, 9 Findings: Design Process Assessments, 9.1 Design Process Tarpaulin and 9.2 Design Process Local Materials Upgrade.

The assessment results have been divided into quantitative and qualitative results, most of which are of the latter, as the questionnaires sought to collect subjective impressions of the shelter assembly process. Having said that, quantitative analysis has been performed to understand certain aspects, such as building capacity, skill level required to build Structure, average size of building crew and others.

6.5 Assumptions, Risks and Mitigations

6.5.1 Assumptions and Risks

In the planning phase of Preliminary Assessment, Shelter Centre considered the following assumptions and risks:

i. Responses to the first contact may stretch beyond the period proposed
ii. A delay in beginning the interview process could derail the subsequent phases
iii. Respondents’ availability could be constrained by conflicting schedules and in some cases, connectivity issues
iv. The Preliminary Assessment was initially approved involving 9-11 respondents and 20-31 interviews
v. The interviews may run longer than the planned 1-hour interview time per questionnaire
vi. The process of transcribing and note-taking of the qualitative and quantitative data, and data cleaning and coding processes could extrapolate the established 5 minutes per qualitative question

6.5.2 Mitigations

In this section, Shelter Centre presents the mitigation measures employed throughout the duration of this assessment to ensure the delivery of the final report.
i. Shelter Centre anticipated any delays or changes in schedule and communicated the adjustments to Better Shelter and aligned expectations. This alignment was done through frequent email, WhatsApp and virtual meetings between the two teams.

ii. Schedule delays were communicated at the earliest date to Better Shelter, and other activities relating to the project were anticipated.

iii. Shelter Centre remained flexible to the best means and methods to meet with the respondents, through getting acquainted with different virtual meeting software and adapting to the local time zones in Afghanistan, India and Tajikistan.

iv. As a result of personal and professional circumstances which impeded some respondents from partaking in this project, in addition to schedule delays and time constraints, Shelter Centre was able to interview 7 respondents and undertake 19 interviews. The small sample size of interviews limited the conclusions which may be drawn, as the sample is not statistically significant\(^1\). Having said this, Better Shelter and related organisations would benefit from a larger-scale assessment with similar goals to inform the design process in a more dependable manner.

v. Shelter Centre reserved extra time for each interview, to avoid cutting the conversation short and interrupting the feedback from the respondents.

vi. Shelter Centre consolidated a multinational and geographically varied team, able to pick up work at different hours of the day and make the most out of our exposure to the respondents.

7. Intersecting Findings of Assessments

The Sphere Coherence Assessment, the Design Process Assessment - Tarpaulin and the Design Process Assessment - Local Materials Upgrade were developed to explore Structure’s ability to support an incremental, local and beneficiary driven shelter process, as well as its ability to be implemented at different scales in situations where local materials are not available at the onset of emergencies. Findings from these assessments revealed similar considerations raised by respondents across all three assessments, demonstrating similar considerations and challenges faced by respondents whether considering Sphere coherence, tarpaulin design or local material upgrades.

As a result, overlapping findings and resulting patterns have been organised under the following thematic categories to demonstrate prominent themes and considerations: preparation and site planning, building and construction phase, use of local materials, use of and concerns regarding tarpaulin, and upgrades to improve liveability and thermal comfort. These considerations are detailed below.

7.1 Preparation and Site Planning

Foundation preparation was a unanimous concern by respondents. Varied ground conditions across local contexts have prompted construction teams to adapt local methods of ground preparation and the respondents indicated that guidance on assessing site locations and natural hazards would be of added value.

While respondents stated that the virtual training provided by Better Shelter was invaluable, they also added that additional printed graphics that beneficiaries could use as guidance would be an added value. Guidance on preparing site locations and constructing the Structure in emergency contexts with limited resources and manpower was also identified as beneficial.

Regarding transport and packaging, respondents stated that they were in favour of a tamper seal on the Structure boxes, stating that it would be helpful when boxes were transported to the final beneficiaries in their respective countries. Respondents also stated that waterproof boxes would be beneficial, as well as components checklists.

7.2 Building and Construction Phase

Difficulties were found when building the roof and punching holes in the tarp. Additionally, there were concerns that the fixings could break and respondents indicated that the tarpaulin does not provide enough insulation or ventilation. Respondents indicated that live training of non-builders may be needed, especially in regard to building the Structure with tarpaulin covering.

7.3 The Use of Local Materials

Local materials used to make upgrades to the Structure were chosen on the basis of being locally and readily available, easy to install, inexpensive, and provide thermal comfort.

During the upgrade phase, standard masonry and carpentry hand tools were used, as well as power drills. GI wire, metal clips, screws, nails and bolts were used frequently when fixing materials to the
Structure frame. These materials were used by attaching them to the frame or by using them in combination with tarpaulin to make upgrades to roofing, walls, flooring, cladding, insulation and cover-ups. AKAH 4 indicated that fixing local materials to the tarpaulin was a concern and that during upgrading there was a fear that horizontal members of the frame might break as a result of extra weight added to the roof. This concern was addressed through the completion of the shelter units, as no respondents spoke of incidents of member failure.

7.4 The Use of and Concerns Regarding Tarpaulin

It was found that the tarpaulin is easy to manoeuvre and clad, lasts through adverse weather conditions, and provides long durability and immediate protection against extreme temperatures, water, and vectors. Respondents indicated that one way to preserve the tarpaulin was to use it in combination with local materials.

Concerning the necessary tools to assemble the Structure with tarpaulin, respondents expressed difficulty in making the necessary holes with the hole puncher knife present in the Structure kit. This concern stemmed from the fear of creating further tears in the tarp, especially when punching holes outside the reinforcement bands, and when the tarp was folded. Further instructions and safety videos on how to ensure the holes’ integrity could ease this difficulty (see Section 9.1).

7.5 Upgrades to Improve Liveability and Thermal Comfort

Regarding concerns over People With Special Needs (PWSN), Structure was found to be generally accessible for PWSN due to the usability of doors and flexibility for adding more openings. Added guidance on elevating the Structure and constructing ramps would be useful for construction crews, as well as guidance on combining tarpaulin with local materials to make Structure upgrades that could work to better accommodate disabled persons.

Regarding thermal comfort and ventilation, respondents indicated that the tarpaulin, when used as a shelter covering, is not very breathable and that beneficiaries typically used local materials in combination with the tarpaulin to make upgrades and adaptations to Structure, as well as creating more openings, to improve both ventilation and insulation.

Respondents indicated that having Water, Sanitation and Hygiene (WASH) facilities within their shelter is very important and suggested that the gable ends of the Structure could be extended to support a veranda to create spaces for cooking, socialising and WASH facilities. Respondents also mentioned that a quick-to-assemble latrine solution, to be implemented for temporary contexts, would be an added-value while more permanent latrines could be built in combination with local material to meet long-term needs.
8. Findings: Sphere Coherence Assessments

The findings are presented in a collective manner, by grouping questions per themes as derived from *The Sphere Handbook* (Sphere, 2018). Original standards quoted from *The Sphere Handbook* (Sphere, 2018), chapter 3 Protection Principles and chapter 7 Minimum Standards for Shelter and Settlement are represented in *italics* followed by section and page number. Likewise, interpreted and extrapolated categories and labels produced by Shelter Centre are represented in normal font.

The answers to each of the questions asked in the Sphere Coherence Assessment questionnaire are easily identified throughout the text parenthesis *(see questions x)*. By the end of these findings, all questions are answered and if not, a caveat concerning lack of information to answer the questions is included.

The respondents who were selected to undergo the Sphere Coherence Assessment were directly or indirectly involved in the assembly and construction of 28 *Structure* shelters in Afghanistan, India and Tajikistan. For a complete table of the *Structure* shelters deployed based on location, usage and material, please refer to Table 4.

<table>
<thead>
<tr>
<th>Partner Organisation</th>
<th>Total Number of Interviewed Respondents</th>
<th>Total Number of Structure Pilot Shelters</th>
<th>Location</th>
<th>Structure Shelter ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKAH</td>
<td>2</td>
<td>15</td>
<td>Tajikistan</td>
<td>TJ1, TJ2, TJ3, TJ4, TJ5, TJ6, TJ7, TJ8, TJ9, TJ10, TJ11, TJ12, TJ13, TJ14, TJ15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>Afghanistan</td>
<td>AF2, AF3, AF12, AF13, AF14, AF15, AF16</td>
</tr>
<tr>
<td>SEEDS</td>
<td>3</td>
<td>2</td>
<td>New Delhi</td>
<td>IN1, IN2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>Kerala</td>
<td>N3, N4, N5, N6,</td>
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<tr>
<td></td>
<td></td>
<td>1</td>
<td>Uttrakhand</td>
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<tr>
<td>Total per Category</td>
<td>5</td>
<td>28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.1 Location and Settlement Planning

(The Sphere Handbook, Shelter and Settlement Standard 2, pg. 249-253, Sphere, 2018)

8.1.1 Infrastructural Preparation

In answer to the preparation of the construction sites on which the shelters were to be built (see question 1), certain conditions and challenges were brought forward by respondents. In the sites surveyed, due to the variety of ground conditions from rocky to loam soil, local teams were forced to adapt to localised methods of ground preparation and water drainage (see questions 2 and 3), particularly with regards to rainwater channelling and stagnant water mitigation.

Respondents also mentioned limited or no availability of hazard maps in the regions where the transitional shelters were being implemented, which could offer guidance around building in floodplains or limiting exposure to rocks and avalanches. One respondent in Afghanistan, indicated that a hazard risk map, internal to his organisation, provided sufficient help in assessing the region and potential hazard risks all throughout their territory of operation.

Additionally, concerning the need to elevate shelter and mitigate accumulation of water (see questions 2 and 3), some respondents reported that site preparation and drainage mitigation efforts were outside the scope of the budget assigned for the project, and as a result, might have been overlooked especially in such contexts of disaster and emergency construction.

The pie chart below revealed that 60% of the interviewed respondents considered elevating the surface of each shelter, using stilts or plinths, in preparation for water overflow during extreme rain, against 40%, answered “No”, (see question 2 and graph 1).

These results can be explained on the basis of the ground conditions on the construction sites in diverse contexts. While respondents in India indicated that loam ground conditions were common and required drainage considerations, respondents in Tajikistan and Afghanistan expressed concerns about rocky ground conditions.

![Graph 1: Consideration given to elevate shelter surface due to terrain conditions](image)
Preliminary assessment of the pilot Structure approach to humanitarian sheltering

Image 3: Ground conditions in Kerala, India
Photo credits: Better Shelter and SEEDS

Image 4: Structure frame built on concrete foundation, Afghanistan
Photo credits: Better Shelter and AKAH
8.1.2 Water Ingress

Concerning Structure’s overall protection against driving rain, respondents confirmed that the shelter, understood as the frame and exterior covering of tarpaulin, is protected against driving rain without need for further adaptation or other forms of water mitigation (see question 17). In interviews with SEEDS 1, the respondent indicated that local communities in Kerala had begun to create water channels, as a method to avoid water accumulation from rain as well as hygiene and cooking activities. In these cases, channels were dug along the foundation of the shelter and directed towards a body of water.

8.1.3 Ensuring Safety and Livelihood Opportunities

All respondents praised the light weight and superior quality of the Structure, which enabled fast delivery and assembly of the frame, allowing families to be sheltered in a relatively short space of time after losing their home (see question 36). Respondents in Afghanistan and Tajikistan appreciated the modularity of the shelters, which were said to be an essential part of the COVID-19 response in remote areas of these countries. Respondents speaking of their experience in India, commented that this fast response of the Structure helped families to recover and stabilise more quickly, allowing them to return to their livelihood activities.

8.2 Living Space

(The Sphere Handbook, Shelter and Settlement Standard 3, pg. 254-257, Sphere, 2018)

8.2.1 Accessibility by Persons With Special Needs (PWSN)

(The Sphere Handbook, Shelter and Settlement Standard 3, Guidance note i, pg. 256, Sphere, 2018)

In response to questions 7-12 concerning consideration for Persons With Special Needs (PWSN), all respondents indicated that Structure is flexible to accommodate PWSN adaptations and naturally accessible to this group of people regarding the size of doors (see questions 10 and 11) and windows and the possibility of rearranging entries and exits according to context-specific needs.

As can be seen in graph 2, 80% of respondents indicated that a ramp or pad elevated between 20-30cm should be built to allow PWSN to access the Structure shelter with ease. This statement was made regardless of the ground conditions and cultural considerations of the different shelters surveyed (see questions 7 and 8).

In graph 3 below, it can be seen that 60% of respondents indicated ‘Yes’ when asked about Structure’s accessibility to PWSN, while 40% responded ‘Partly’. The respondents indicated that the ramp (see question 9) would probably be made with local materials, readily available in the region. They also
reported that a similar ramp should be replicated for PWSN to access latrines and cooking facilities too, if elevated (see graph 2 and 3).

Moreover, in response to question 8, the respondents indicated that other PWSN adaptations, which appeared to have worked in the Structure shelters in India, Afghanistan and Tajikistan, were attaching horizontal bars and rails on the lead-up to the shelter and inside, along with standing posts to provide support for PWSN.

One conclusion from all respondents was that these adaptations would be done on a case-by-case basis, upon request from the beneficiaries.

In conclusion to PWSN questions, some of the respondents expressed their desire to receive, along with the Structure kit, more collected knowledge, and information on PWSN considerations to be circulated within the construction teams but also disseminated with local communities. When asked what form this extra information would take (see question 12) respondents indicated printed booklets in local languages including graphics would be helpful.

8.2.2 Thermal Comfort and Ventilation

(The Sphere Handbook, Shelter and Settlement Standard 3, Guidance note vi, pg. 256-257, Sphere, 2018)

The Structure units deployed in India, Afghanistan and Tajikistan were exposed to varying climate and culture contexts which have enabled Shelter Centre to get a good understanding of the Structure’s exposure to hot and cold climates. One common point which came across in the interviews (see question 15) concerning thermal comfort was that tarpaulin as a shelter covering is not very breathable. It was deemed as a sufficient material for emergency situations, but not for longer-term sheltering.

In the shelters deployed in Kerala, more effective ventilation was sought due to hot weather and humidity in the region all year round. In response to ventilation concerns (see question 16), respondents from India indicated that ventilation had been achieved by creating more doors and larger windows. The respondents were concerned about stabilising larger windows and doors, and they added that the desirable result was achieved by ensuring that the gable ends were made stiffer. One localised solution shared by these respondents added that the community had chosen to support the window frame with local materials such as wood panels.

Feedback from respondents involved in the upgrade process in IN4, IN5, IN6 in Kerala, indicated that these shelters were coupled with a layer of the Corrugated Galvanized Iron (CGI) roof, on top of the Structure frame with bamboo, creating a frame and gap, followed by the plastic sheeting. This sequence of materials has proven to provide roofing insulation and enable a habitable environment within the Structure. The use of coconut leaves was also mentioned by these same respondents, which indicated that they were effective in insulating the roof against heat and excessive sunlight.

From the responses to questions 15 and 16 on thermal comfort and ventilation, it was found that local materials achieved a better thermal comfort when compared with industrialised materials. Respondents
indicated that air gaps in between the CGI and internal roof was a successful option. Nonetheless, this double-ceiling technique was found to be difficult to construct in rural areas. In such cases, thatch was preferable, for its durability and easy replacement upon wearing out. Another insulation technique cited by the respondents in India was the creation of an attic-like space inside the roof for grain storage. This extra compartment was designed to create a buffer for heat transfer. While respondents indicated that building the attic was advantageous, they explained that consideration had to be given to the Structure’s endurance to carry the extra weight.

In cold and dry contexts such as in Afghanistan and Tajikistan, respondents from AKAH indicated that winterising the shelter was one of their biggest challenges (see question 15). In Tajikistan, it was found that Structure shelters, deployed in the summer of 2020, were now exposed to significant snow load. Respondents indicated that the current slope of the shelter’s roof seemed adequate to ensure that the snow could slide down and not accumulate on top of the roof, potentially damaging the frame’s integrity. The insulation of these shelters for extreme winter climates involved EPS, mineral wool and other materials which will be further explained in the results of Design Process Assessment - Local Materials Upgrade (see Section 9.2).

Concerning ventilation techniques in Afghanistan and Tajikistan, respondents indicated that in the summertime, when these shelters were first established, the exposure to high altitude sun led them to explore cladding options of materials such as felt and wool. In India, respondents indicated that a double-layered roof with a ventilated gap in between was used locally to ensure that space inside the shelter maintained a cooler temperature. This was particularly useful in Kerala’s hot and humid climate context (see Section 9.2.2).

### 8.2.3 Vector Control

*(The Sphere Handbook, Shelter and Settlement Standard 3, Guidance note ix, pg. 256-257, Sphere, 2018)*

Concerning the ingress of vectors and mosquitos (see questions 18 and 19), mosquito nets were the preventive solution adapted, where they were fixed on for windows and door frames in warm and humid contexts, such as in India. These shelters, which have already undergone a degree of localisation upgrade, indicated that some local materials can be used to inhibit vector ingress, specially at the foot of the shelter, where the Structure frame meets the foundation. The respondents indicated that tarpaulin flooring or a local flooring method of plastering the floor with mud and cow dung, could be alternatives to deal with vector ingress. They also indicated that this technique has proved to be fire retardant and avoid vector ingress.
In Tajikistan and Afghanistan, respondents indicated that Structure provided an immediate solution against vector ingress (see question 18). They added that in the sites when they have built Structure shelters, vector ingress was not a significant concern. Having said that, they recognised that mosquito nets are readily available in the local markets in case they were to become needed (see question 19).

### 8.2.4 Adaptation of Design to Context

*(The Sphere Handbook, Protection Principle, Principle 1, Guidance note i, iii, iv, pg. 38-40, Sphere, 2018)*

In response to question 30, 31 and 36, concerning further suggestions regarding the construction and assembly process of Structure, all respondents praised the modularity and flexibility of the shelter. Respondents highlighted that the frame was suitable for different contexts varying from provisional dwellings to tent units for medical and clinical support. Moreover, respondents agreed that Structure in combination with tarpaulin provided an immediate shelter against extreme temperatures, and that further adaptation to thermal comfort and ventilation should be implemented on a case-by-case basis.

### 8.2.5 WASH, Laundry and Kitchen Facilities

*(The Sphere Handbook, Shelter and Settlement Standard 3, Guidance note i, pg. 256-257, Sphere, 2018)*

Culture and settlement size played a big role in how WASH and kitchen facilities are planned and integrated in the Structure according to the interviewed respondents. In large shelter settlements or camp-like contexts, respondents indicated that WASH and toilet facilities would be implemented in a communal dimension, whereas one or some Structure units could be used solely for WASH and lavatory.
In settings where fewer or even a single Structure was deployed, respondents have not considered incorporating a WASH unit within Structure, but on the side, or behind it, considering cultural preferences, the Sun-facing wall, and the area chosen for cooking facilities. A key aspect across all interviews was the need for a quick-to-assemble solution, on a temporary basis, whereas more permanent latrines could be built later, in combination with the local materials upgrade phase. Also relating to this point, respondents expressed the need for guidance on blackwater disposal. In answer to questions 4 to 6, all respondents indicated that WASH and cooking facilities could be provided as part of Structure kits, although not necessarily within the frame. That being said, these facilities were built in accordance with cultural preferences. This aspect is further developed in the Design Process Assessments findings (see Section 9).

Regarding cooking facilities (see questions 4, 5 and 6), respondents in India indicated that most beneficiaries had a mud stove within the shelter for the monsoon season and an outdoor cooking area for the remaining seasons. In Afghanistan and Tajikistan, kitchen facilities were built mostly outside and Bukhari stoves were said to be common. In all three locations, a concept of a veranda for the outdoor kitchens was said to be commonplace. Moreover, respondents from all three locations indicated that more guidance on how to incorporate these facilities within or to Structure in different contexts would be useful.

In India, where the temperature can vary significantly from Kerala to Uttarkhand, cooking kits were signalled by respondents as a valuable addition to the Structure kit, especially in locations of extreme climate conditions. Moreover, respondents in Tajikistan and Afghanistan indicated the possibility of a chimney-like device for indoor kitchens, which would also contribute to thermal comfort.
8.3 Technical Assistance

(The Sphere Handbook, Shelter and Settlement Standard 5, pg. 262-264, Sphere, 2018)

8.3.1 Adhering to Local or National Building Codes

(The Sphere Handbook, Shelter and Settlement Standard 5, Guidance note iv, pg. 264, Sphere, 2018)

Concerning the teams’ adherence to local or national building codes for transitional shelters (see questions 20 and 21), all of the respondents indicated having knowledge of and referring to The Sphere Handbook (Sphere, 2018) as basic guidelines. Having said this, they acknowledged that these standards were designed for permanent and large-scale shelter contexts and indicated that some local building codes were useful while building Structure. In India, the NDMA, National Institute of Disaster Management’s (NIDM)30 Management NDMA, 200931, India’s Engineer’s Guidebook were the key guidelines in general construction used as reference. Each of these guidelines contained instructions and information specific to construction in transitional shelters and emergency sheltering. Moreover, different regions in India have regional guidelines, for example the Kerala Building Rules. In Tajikistan, the main building code is SNiP, which according to participant feedback, is outdated for the most part. SNiP does not include any sections on transitional shelters. Beyond this, AKAH has developed some internal building guidelines, with regional consideration to the different ground conditions, weather contexts and standard building practices.

In Tajikistan, the main building code is SNiP, which according to participant feedback, is outdated for the most part. SNiP does not include any sections on transitional shelters. Beyond this, AKAH has developed some internal building guidelines, with regional consideration to the different ground conditions, weather contexts and standard building practices.

When asked if Structure complied with the relevant building codes, 60% of the respondents answered ‘Yes’ (see graph 4).

8.3.2 Increasing Community and Technical Capacity

(The Sphere Handbook, Shelter and Settlement Standard 5, Guidance note iv, pg. 264)

When asked if the deployment of Structure was supported by capacity-training and guidance (see question 22), 100% of respondents indicated that the training delivered by Better Shelter through video calls and written instructions, in addition to constant back-and-forth support through WhatsApp calls, was invaluable.

Respondents informed that the training was sufficient for the number of shelters deployed in all three locations. They added that in the event of a larger scale pilot, short training videos would be helpful to allow information to be disseminated in a more effective way among construction crews and local communities. While connectivity issues should be considered, respondents from SEEDS, indicated that phone connectivity is wide ranging in the areas of the construction sites, therefore the local communities can access phones and subsequently, the training videos.

Another idea coming out of Tajikistan and Afghanistan, where connectivity issues were mentioned, and later reiterated by respondents in India, was the production of easy and mostly graphic print outs to be distributed among the local community, to inform the maintenance of the shelter and the upgrade process with local materials. Further instruction on attaching local materials to the tarpaulin was also mentioned as a beneficial component to integrate the Structure kits. Concerning the type of language in these graphic print outs, preference was given to more layman-style guidance with easy-to-follow instructions.

All respondents were also keen on an idea to create a model or a prototype of Structure to illustrate the desired look of the shelter, at least at the first stage of frame in combination with tarpaulin cover.

### 8.3.3 Packaging

Respondents were largely pleased with the quality, material and weight of the boxes that contained the Structure. Only 20% of respondents indicated having had problems with damaged parts and boxes. 80% of the respondents indicated having no issues (see question 35). No complaints were made in regard to the weight of the boxes, instead, 20kg per box was deemed suitable and easily transportable through different means.

On very few occasions, Structure boxes arrived having suffered damages. On these occasions the boxes suffered damage due to extensive transportation from the airport to the construction site in remote areas, in adverse weather or due to road and transportation conditions (see graph 5). In the episodes of damaged boxes, it was most often the result of water damage. In no cases did the external damage incur on internal damage to the parts of Structure (see questions 33-35).

In the cases of missing parts, such as the case of a missing base plate in India, the guidance provided by Better Shelter to produce the missing part locally was considered efficient.

When asked about the need for a tamper seal, a sealing device designed to reveal if the opening of a box has been interfered with, 80% of respondents were in favour and expressed that this idea would be beneficial in regard to the boxes going through customers in their respective countries (see question 35). Comments were also made with regards to a waterproof cardboard box to ensure protection against rain and humidity.

Respondents were resistant to plastic cardboard boxes and suggested instead the use of a layer of waxing on top of the existing cardboard model. Said material would likely be reused by the beneficiaries as floorboards, mattresses, and storage compartments (see graph 6).
Concerning repackaging the *Structure* when changing site locations, a components checklist was suggested by respondents. This would facilitate in repackaging and repurposing the shelter and checking whether all necessary parts arrived upon assembling it for the first time. Moreover, on the external face of the boxes, a suggestion to number or create an indication of each box was made, to clarify which boxes should go where in the rush of an emergency deployment.

Respondents in all three locations speculated that in a large-scale pilot, storage and warehousing options for the cardboard boxes may have to be analysed. At this stage, stockpiling boxes has not been an issue, but it would be of value to determine the maximum weight load for stockpiling and warehousing processes in India, Afghanistan and Tajikistan.

### 8.3.4 Transportation

In line with the considerations and findings from 7.3.3 Packaging, respondents indicated that the transportation of the *Structure* boxes to their final destination of the construction sites was relatively smooth and without significant problems. They all confirmed that the boxes arrived in great shape to the capitals of Afghanistan, India and Tajikistan and were safely stored in the offices and warehouses of the partner organisations (see question 32).

The second leg of the transportation, which included transporting these boxes to remote areas, faced some challenges that related mostly to adequate or inadequate transportation methods and road conditions. Despite considerations to weather patterns and exposure to water damage, the majority of *Structure* boxes arrived without any damages or minor damages (see question 35).

As mentioned above, respondents envisioned the creation of a components and parts checklist, to facilitate unpacking and repacking and optimisation of efforts in the verification of missing or lost parts.

### 8.3.5 Upgrade and Maintenance

*The Sphere Handbook, Shelter and Settlement Standard 5, Guidance note ix, pg. 264-265, Sphere, 2018*

When asked about the efforts to reuse or recycle materials used along with *Structure* in other shelters or for other purposes (see questions 22 and 23), 60% of the respondents were partly or fully able to reuse or recycle the materials, in comparison with 40% who indicated they had not considered it. For those who indicated the possibility of recycling and reuse, respondents mentioned that the plastic sheeting could be reused later, once the shelter had undergone an upgrade and in combination with the local materials themselves, for roofing and walling (see graph 7).

Another issue mentioned by respondents was with regards to the lifespan of the tarpaulin covering. On tarpaulin degradation and wear, they informed that there was not sufficient evidence that the tarpaulin could be reused for another shelter, especially because of the holes made to attach the tarpaulin to the frame (see questions 24 and 25). Since the shelters have not been deployed for long, there also was
not enough evidence of tarpaulin wear due to extreme weather conditions. In fact, some shelters deployed in Tajikistan in June-September 2020, have now experienced high exposure to sunlight and harsh winters, and remain in perfect condition.

8.3.6 Communal Tools

(The Sphere Handbook, Shelter and Settlement Standard 5, Guidance note x, pg. 264, Sphere, 2018)

The tools included in the Structure kits for the assembly of the frame and tarpaulin sheeting were largely sufficient to assemble the shelter (see question 26). Other tools were used in upgrading processes, depending on which materials were attached to the frame and/or the tarpaulin. In one interview a participant shared that an industrial stapler as an additional tool to the set, would facilitate coupling the tarpaulin to the metal frame. With regards to local materials upgrade however, more tools and materials were required to safely assemble the new materials onto the metal frame. These included plyers, a ledger, rope wires and rubber washers.

While respondents did not refer to specific spare parts or components which should be provided in larger quantities (see questions 27), they did mention that the smaller parts and connectors could get lost in the process. In the episode of a loss of a connector, the construction teams used something similar, made with similar materials and readily available in the local market to substitute the missing or lost piece.
Overall, the experience of assembling the Structure was favourable and successful, based on the feedback gathered from respondents. Challenges mentioned by the respondents concerning fixing new materials related to the combination of tarp and local materials (see questions 28 and 29), which will be further elaborated in 8.2 Design Process Assessment - Local Materials Upgrade. Some of the techniques employed by the respondents to ensure the fixing was sturdy involved using ropes and galvanized iron (GI) wires. The respondents, however, did not state that such extra materials should be included in the Structure kits, as they are commonly available locally.

The following findings were based on the Design Process Assessments that were divided into two separate questionnaires. First questionnaire was the Design Process Assessment - Tarpaulin and the second was the Design Process Assessment - Local Materials Upgrade. This separation of the Design Process Assessments was intended to evaluate the performance of tarpaulin and local materials supported by Structure frame to provide an accommodation in contexts of post-emergency and long-term transitional sheltering.

In the first questionnaire, 9.1 Findings: Design Process Assessment - Tarpaulin, information collected from the questionnaires informed how the plastic sheeting performed with regards to its lifespan, and the successes and challenges faced in its implementation. In the second questionnaire, 9.2 Design Process Assessment - Local Materials Upgrade, information collected informed the feasibility for upgrading processes using local materials and in combination with the tarpaulin sheeting.

Findings from both of the Design Process Assessment questionnaires, 9.3 Comparison between Design Process Tarpaulin and Local Materials Upgrade indicated that construction guidelines were found to be comprehensive, easy-to-follow, and understandable. It was indicated that in-person training of non-builders may be needed, especially with regards to building the Structure with tarpaulin covering.

The findings have been represented under the thematic analysis categories established by Shelter Centre, due to the conversation between one or more questions. The answers to each of the questions asked are easily identified throughout the text parenthesis (see questions x).

9.1 Findings: Design Process Assessment - Tarpaulin

The Design Process Assessment - Tarpaulin questionnaire helped inform the performance of the Structure frame in an emergency context, where tarpaulin was the exterior cladding material. The findings demonstrated the performance of the tarpaulin as a material, as well as the capacity and challenges faced by users in terms of building the Structure with regards to site conditions, construction capacities, and functionality of the shelter.

Table 5 below shows the distribution of Structure shelters with tarpaulin throughout the three locations, Afghanistan, India and Tajikistan.
Table 5: Distribution of Design Process Tarpaulin Assessment interviews per organisation

<table>
<thead>
<tr>
<th>Partner Organisation</th>
<th>Total Number of Design Tarp Interviewed Respondents</th>
<th>Total Number of Structure Pilot Shelters</th>
<th>Location</th>
<th>Structure Shelter ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKAH</td>
<td>3</td>
<td>15</td>
<td>Tajikistan</td>
<td>TJ1, TJ2, TJ3, TJ4, TJ5, TJ6, TJ7, TJ8, TJ9, TJ10, TJ11, TJ12, TJ13, TJ14, TJ15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Afghanistan AF12, AF13, AF14, AF15</td>
</tr>
<tr>
<td>SEEDS</td>
<td>3</td>
<td>1</td>
<td>New-Delhi</td>
<td>IN1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Kerala IN3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Uttrakhand IN7</td>
</tr>
<tr>
<td>Total per Category</td>
<td>6</td>
<td>22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 below builds upon the information presented in Table 5 (above) and provides more information on the shelter usage for the Structure units deployed in this pilot phase.
### Table 6: Structure shelters deployed with tarpaulin covering

<table>
<thead>
<tr>
<th>Structure Shelter ID</th>
<th>Country</th>
<th>Shelter Usage</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF12</td>
<td>Afghanistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>AF13</td>
<td>Afghanistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>AF14</td>
<td>Afghanistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>AF15</td>
<td>Afghanistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>IN1</td>
<td>India</td>
<td>Test unit, Training</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>IN3</td>
<td>India</td>
<td>Family shelter</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>IN7</td>
<td>India</td>
<td>Family shelter</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ1</td>
<td>Tajikistan</td>
<td>Test unit, Training</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ2</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ3</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ4</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ5</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ6</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ7</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ8</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ9</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ10</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ11</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ12</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ13</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ14</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
<tr>
<td>TJ15</td>
<td>Tajikistan</td>
<td>Medical clinic and support</td>
<td>Tarpaulin</td>
</tr>
</tbody>
</table>

#### 9.1.1 Tarpaulin Durability and Lifespan

All respondents agreed that the tarpaulin’s added value lies in its ease to manoeuvre and clad, perceived long durability and immediate protection against extreme temperatures, water and vectors. Concerning the degradation of the plastic tarp (see question 7), respondents agreed that one way to ensure its preservation lies in the combination of tarp and local materials. During the interviews, respondents in India confirmed having used timber, mud, bushes or tree branches on top of or in combination with the tarpaulin to enhance its durability.
When asked where and if the *Structure* with tarpaulin would become worn or rip (see question 10) respondents expressed concern over the exposure of the shelter to high altitude sunlight especially in Tajikistan, extreme weather variations between summer and winter time in some of the pilot locations and the snow load and rain ingress. As it can be seen in graph 8 above, 50% of respondents speculated that wear and tear would take place in the roofing part, while 16.7% indicated wear and tear could occur near the openings, meaning doors and windows. It is important to highlight that no respondents registered tears and tarpaulin degradation since deploying the *Structure* units, thus, the answers to this question were speculative.

Attention was drawn by respondents to the vulnerabilities of the plastic sheeting covering on the roofs, which is exposed to weather conditions and could deteriorate more rapidly (see question 8). This was mentioned specially by respondents in Tajikistan, while in India, this concern was reiterated, in addition to the sun-facing wall of the shelter, prone to degradation due to exposure. In Tajikistan, where 15 shelters have been deployed, the majority to support the country’s COVID-19 response, and have thus experienced summer and winter, respondents indicated that the tarp remains in perfect condition.
9.1.2 Construction Challenges

The respondents identified a key challenge (see question 6) in regard to punching holes in the tarp and cautioned that if one hole is made without attention, it can expand and further cut into the tap, potentially damaging it and the Structure covering. Discussions on the best tools and methods to ensure the hole was punched safely, indicated that industrial hole punchers could be used in the process. The plastic sheeting areas connected to openings, be them doors and windows, were also seen as vulnerable areas too, prone to wear and further tear.

9.1.3 PWSN Considerations

Respondents indicated that the Structure is generally accessible for Persons With Special Needs (PWSN) concerning the size of the programmed doors and the flexibility to add more openings throughout the shelter, if needed (see question 11). They added that any adaptations to the shelter have to be done on a case-by-case basis, based on the needs of the beneficiaries and the shelter usage.

For wheelchair or mobility purposes (see question 11), all respondents indicated that the shelter has to be elevated between 30–50 cm to be accessible. Another improvement to make Structure more appropriate to day-to-day living (see question 12) mentioned by respondents was that the same elevation ramp should be built for WASH and latrines, if outside the shelter. Another key consideration for PWSN included the exploration of smaller and lighter-weight window and door profiles to ease opening and closing mechanisms. Concerning the access ramps, respondents also indicated that guidance on this aspect would be useful for the construction crew. Further instructions could take the form of information packets to be distributed among the local community (see question 2).

As it can be seen in graph 9 to the left, 80% of respondents indicated the door opening to be sufficient to allow access to handicapped persons.

With regards to the placement of doors and windows on the perimeter of the Structure frame, flexibility in deciding the quantity and location of openings was deemed as an added value for respondents. It allowed for flexibility in meeting the needs of the beneficiaries depending on the number of windows and doors that would suit them.

9.1.4 Thermal Comfort and Fire Prevention

Respondents agreed that the tarpaulin itself did not provide enough insulation or ventilation, as it is not a breathable fabric (see question 12). To improve ventilation in hot and humid areas, such as Kerala, respondents indicated that doors and windows were placed in strategic places of the shelter to ensure a corridor of air is formed through the shelter. The number of doors and windows was said to be decided on a case-by-case basis, based on the purpose of use of the shelter and the desire of the beneficiaries.

Regarding insulation in cold climates such as Tajikistan and Afghanistan, respondents with ground experience in these two countries indicated their teams on the ground considered using EPS inside the shelter as it is readily available and is known to reduce condensation issues, unlike other materials such
as mineral wool. As for the external insulation, shelters in Tajikistan, Afghanistan and India have been covered with local materials including thatch and bamboo mats to improve the lifespan of the tarpaulin. These combinations were said to have improved insulation and prevented wear and tear.

The cultural considerations outlined by the respondents were varied (see questions 12 and 13) but converged on the ideas of internal spatial differentiation within the shelter, the need for a WASH and latrine facility whether coupled or attached to Structure, and cooking facilities and their repercussion to the insulation, ventilation and fire prevention within and outside the shelter.

Concerning spatial orientation within the shelter, respondents shared that more information around shelving and internal hanging and use would be useful to be further elaborated and explained (see question 2). While the internal spacing is heavily dependent on cultural aspects, respondents informed that it would be worth knowing the weight and pressure limits of the Structure frame prior to making alterations and adaptations.

9.1.5 Cultural and Context Adaptations

Respondents indicated that having a WASH facility within their shelter is very important, as leaving the shelter at night may not be a possibility (see question 12). While the Structure may not support a WASH facility inside, respondents suggested that the gable ends of the Structure could be extended to support a sun shaded area which could be used for a veranda, a communal space for cooking, socialising and even WASH facilities (see question 13).

The veranda, covered by an extended gable, would allow for shading from the sun as well as a covered space for an outdoor kitchen. Respondents in India indicated that in most of the rural areas, the local community used firewood as fuel for cooking. This practice makes it unlikely to build a cooking area within the shelter, due to fire prevention considerations. In places where outside cooking facilities are not possible, such as in Tajikistan and Afghanistan due to space constraint or weather conditions, respondents seemed willing to receive more guidance on how to optimise internal space and these needs (see question 2).
Throughout the interviews, respondents shared that the spatial needs differed greatly from one region or country to another. While in Afghanistan, it was estimated that 4.5 m² is needed per person in cold regions, in India, there are urban space limitations, which may require outside activities, such as cooking and WASH be shifted indoors. Having said that, respondents once again spoke of Structure’s modularity and flexibility to adapt to these cultural considerations.

9.2 Findings: Design Process Assessment - Local Materials Upgrade

The Design Process Assessment - Local Materials Upgrade findings inform the capacity of end users to gradually upgrade the Structure frame through integrating readily available building materials found within surrounding context or local markets, to serve as a long-term transitional sheltering solution adapting to the evolving needs of the end users. The objective of the assessment is to examine to what extent the Structure frame was durable and flexible at enduring the attachment of additional local materials.

The findings are derived from the Design Process Assessment - Local Materials Upgrade questions that begin to assess the feasibility of Appropriating additional materials to the Structure frame, in conjunction with the use of tarpaulin and in an effort to increase comfort and functionality of the shelter.
Table 7: Distribution of Design Process Local Materials Upgrade Assessment interviews per organisation

<table>
<thead>
<tr>
<th>Partner Organisation</th>
<th>Total Number of Design Local Materials Interviewed Respondents</th>
<th>Total Number of Structure Shelters</th>
<th>Location</th>
<th>Structure Shelter ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKAH</td>
<td>3</td>
<td>0</td>
<td>Tajikistan</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Afghanistan</td>
<td>AF2, AF3</td>
</tr>
<tr>
<td>SEEDS</td>
<td>3</td>
<td>1</td>
<td>New-Delhi</td>
<td>IN2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Kerala</td>
<td>IN4, IN5, IN6</td>
</tr>
<tr>
<td><strong>Total per Category</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Structure shelters deployed in combination with local materials

<table>
<thead>
<tr>
<th>Structure Shelter ID</th>
<th>Country</th>
<th>Structure Shelter Usage</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF2</td>
<td>Afghanistan</td>
<td>Family shelter</td>
<td>Local materials</td>
</tr>
<tr>
<td>AF3</td>
<td>Afghanistan</td>
<td>Family shelter</td>
<td>Local materials</td>
</tr>
<tr>
<td>IN2</td>
<td>India</td>
<td>Test unit, training</td>
<td>Local materials</td>
</tr>
<tr>
<td>IN4</td>
<td>India</td>
<td>Family shelter</td>
<td>Local materials</td>
</tr>
<tr>
<td>IN5</td>
<td>India</td>
<td>Family shelter</td>
<td>Local materials</td>
</tr>
<tr>
<td>IN6</td>
<td>India</td>
<td>Family shelter</td>
<td>Local materials</td>
</tr>
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<td>India</td>
<td>Planned not built</td>
<td>Local materials</td>
</tr>
<tr>
<td>IN9</td>
<td>India</td>
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</tr>
<tr>
<td>IN10</td>
<td>India</td>
<td>Planned not built</td>
<td>Local materials</td>
</tr>
</tbody>
</table>

9.2.1 Local Materials Used

According to responses when participants were asked about which local materials were used to make upgrades to the Structure and why (see question 1), materials were selected on the basis of being widely familiar by locals within the context of operation, follow local construction practices, easily accessible by locals, simple to install, had better thermal capacity properties and affordable. In line with this, a combination of natural and industrial materials was used for the Structure upgrade to improve roofing, walls, flooring, create cladding, provide insulation and cover-ups that made the Structure more aesthetically pleasing.

The most common natural materials used were bamboo, timber, mud and thatch, whilst industrial materials used were plywood, GI sheet, polystyrene (EPS), glass wool and local tarpaulin. Other local
materials used, although mentioned less frequently, included adobe bricks, cement, woollen sheets, gypsum board, felt, tree branches and cement fibre board.

Concerning the opportunity to reuse the materials selected for the Structure frame upgrade when the shelter is dismantled after end of the transitional period (see question 3), 83% of the respondents indicated that the majority of the materials selected for the upgrade process may to be later reused in the repair or reconstruction of damaged permanent housing (see graph 10).

Through the interviews conducted with respondents in India, it was indicated that local communities tend to have a preference for reusing natural materials first, before reusing industrial ones. In addition, SEEDS 1 stated that since no chemical adhesives were used at connecting components it increases possibilities of reusing materials.
9.2.2 Upgrade Process

When respondents were asked how local materials were fixed to the Structure frame, two methods were explained, (see questions 4, 5 and 12). Several upgrading techniques were implemented on the Structure frame as construction skills and material varied between regions. The following methods of upgrade were trialled:

a. combination of Structure frame and tarpaulin with local materials
b. direct attachment of local materials with Structure frame

a. Combination of Structure frame and tarpaulin with local materials

The first method examined local materials upgrading taking place at incremental stages, transforming from its initial state as tarpaulin before adding local materials. The tarpaulin was repositioned on the roofing when a double layer gapped roofing was constructed. Tarpaulin was placed on the exterior layer of the roofing for better insulation and then covered with natural materials such as thatch to protect it from sun degradation. SEEDS 1 also suggested that tarpaulin use at local material upgrade should be minimised and instead stored by beneficiaries whenever the tarpaulin on the roof needs to be replaced. However, in Kerala India parts of the tarpaulin were cut to cover window and door openings, as another way of combining tarpaulin along with local materials. As for cladding walls with tarpaulin and for interior coverings, it was avoided because it is not a breathable material and not fire-retardant increasing risk of the shelter catching fire, in addition, it was preferred to keep the frame columns and beams exposed to enable easier material anchoring. This method was explained by participants SEEDS 1 and SEEDS 3, whilst building the Structure pilot approach in India functioning as a family shelter.
b. Direct attachment of local materials with Structure frame

The second method was the direct attachment of local materials to the *Structure* frame, skipping the gradual transformation phase, where the *Structure* frame on its own was used as a skeleton to support the local material upgrade.

Participant AKAH 6, whilst building the *Structure* pilot in Afghanistan, explained the following construction method. Local materials combined with the *Structure* frame were plywood, polystyrene, mineral wool and CGI, considering they are light materials that the *Structure* frame can withstand. However, the participant suggested that in remote regions such light materials are not accessible, only materials such as stone and masonry are used, which are heavy building materials that the *Structure* frame might not be able to support as dead load.

Participants in India indicated two construction techniques relating to the direct attachment of local materials with the *Structure* frame. First technique, the *Structure* frame along with insulation materials such as straw or plastic bottles were sandwiched between plastering layers of adobe mud. Second technique was splitting bamboo and fixing it directly with the frame with wires and ropes, in case of unavailability of bamboo timber or boards of standard size 1.2m x 1.4m were used.

Concerning construction tools at upgrading the *Structure* frame either method (see question 8), readily available standard masonry and carpentry tools were used. These included hammers, screwdrivers, trowels, saws, chisels, water levels, plumb bobs, etc. While the majority of tools available were hand tools, in some cases, power drills were used. Galvanized Iron (GI) wire and metal clips were used frequently in different regions when fixing local materials to the *Structure* frame, especially in the case of bamboo. Along with these, screws, nails and bolts available in local markets were also used to fix wooden planks, GI Sheet and polystyrene, to each other and to the frame.
9.2.3 Construction Challenges

In this section, presenting the challenges faced by end users engaged in local material upgrade, the challenges are categorised reflecting the two methods of local material explained by participants in Section 9.2.2 Upgrade Process (see questions 4, 5, 12 and 13).

a. Combination of Structure frame and tarpaulin with local material

Respondents indicated that fixing local materials to the tarpaulin presented challenges, however these generally were overcome. Once the Structure frame was covered with tarpaulin, it became difficult to identify where columns stand and subsequently, anchoring materials to the Structure membranes became difficult. Respondents in India also stated that using tarpaulin for internal cladding may increase fire risk and block air circulation within the shelter.

c. Direct attachment of local materials with Structure frame

When fixing the local materials, considering the plastic connectors supplied, the respondents indicated having a preference for other connectors, as they estimated that plastic connectors would not support the weight. In India, such connectors were replaced with metal connectors that were knotted and bolted. Wood connectors were also an option but were not used due to their weight, thus adding further load onto the frame. One future challenge that was mentioned by participants was the fact that the plastering of walls made the Structure relatively immobile, making it difficult to reuse materials after the end of the transitional period.
Participants indicated common challenges despite which method of material upgrade was implemented. Participant AKAH 6 raised a concern when building the Structure frame in cold regions, indicating that the plastic joints used in intermediate parts of the walls may be vulnerable to brittleness caused by cold temperature. Moreover, there was a fear that horizontal members of the frame might break as a result of extra weight added to the roof, as participants from India explained that some end users build an attic on the roof to store food and personal items, or some use the horizontal beams as hangers for their clothes and bags. The overall construction challenges conveyed by respondents were deemed to be minor and required few adaptations to be resolved.
Preliminary assessment of the pilot Structure approach to humanitarian sheltering

Image 14: Attaching the Structure frame to local materials
Photo credits: Better Shelter and SEEDS

Image 15: Attaching methods, with GI wire of the roofing area, Kerala, India
Photo credits: Better Shelter and SEEDS
9.2.4 Thermal Comfort and Fire Prevention

Regarding thermal comfort and climatic adaptations (see question 7), respondents made a series of suggestions to the Structure approach. Adaptations were variable according to the extreme weather differences between regions. None of the participants recorded the thermal temperature differences after the addition of materials, suggestions made were based on their sense of comfort, experience, and cultural practices.

In humid and hot regions parts of India, the interviewee in Kerala suggested that windows could be made bigger to allow for more ventilation. Regarding the use of local materials, respondents indicated that an insulation layer could be made using bamboo mats, mud, timber and others. This insulation layer could be used to create false ceilings. Moreover, experience with heat-reflective paint in India by the construction teams was reported to have been successful.

Image 16: Localised solution employed in Kerala to strengthen the window sill in combination with Tarpaulin, India
Photo credits: © Sameer Raichur

In cold seasons as experienced in regions of Afghanistan, participants explained an issue when connecting local materials with Structure frame membranes: gaps were created that permitted the infiltration of cold air into the shelter and escape of hot air, which cause thermal discomfort for inhabitants. AKAH 6 mentioned that corner joints should be designed so as to be flush with the cladding surface, to avoid these gaps from occurring. Filling the gaps with insulation materials was another
suggested solution. Insulation materials used in these places were mineral wool batts and expanded polystyrene (EPS) for underground structures.

There were concerns expressed by participants about the mineral wool becoming saturated with condensate over time, which will negatively impact thermal comfort, as well as that most commonly-used insulation materials were not fire retardant, which posed a threat to the shelter occupants. AKAH 6 suggested traditional insulation methods inspired by the vernacular architecture of Badakhshan province, one of the coldest regions in Afghanistan, could be incorporated to improve thermal comfort. They used felt produced from animal wool to insulate houses, which was naturally fire resistant and hydrophobic. Another unrelated suggestion participants made was to allow an option for making roof openings, to allow a smoke vent when installing local stoves, used traditionally for both heating houses and cooking food.

Regarding fire prevention (see question 9), 50% of interviewees replied that the Structure approach had no adaptations to improve fire prevention and detection (see graph 11). Respondents in Afghanistan indicated that it would be beneficial to include guidelines on the preparation of shelters in certain local contexts, assessing geographical and weather conditions, types of foundation available, and hazards, that beneficiaries should avoid.

To prevent and mitigate the risk of fire, providing a proper cooking space either inside or outside of the shelter, plastering walls with fire retardant materials and creating more openings in the Structure. Concerning cooking facilities, attention was drawn to the customs of placing indoor stoves near the doors and windows for ventilation.
In Kerala, the option of separating cooking space from shelters to reduce fire risks might not be an applicable solution during all seasons and in all areas, since there were monsoons dissolving the mud stoves and urban space was limited. Confining all activities including cooking stoves would usually be the case. Therefore, respondents suggested creating doors on the front and the back of the *Structure* shelters as escape exits.

**9.2.5 Context and Cultural Adaptations**

When participants were asked to share their knowledge and experience of cultural adaptations, with respect to context, in order that spaces created by the *Structure* approach could be made more liveable (see questions 6 and 13), respondents indicated including WASH and cooking facilities would be an added value. This would entail also the consideration of adding another door to the *Structure* shelter: a front door to act as a main entrance and a back door to allow beneficiaries to access areas for washing, cooking, etc. Participants also indicated there should be anywhere from two to four windows, although the number of windows and their height are dependent on the cultural contexts in which the shelter is built. For example, respondent in Kerala indicated that windows should be built at a height 0.9m-1m, but in regions that are predominantly Muslim practicing, windows are typically built at height more than 0.9m from above the ground.

Respondents from Tajikistan shared the possibility of construction improvements in order for the *Structure* frame to perform better in earthquakes, through being informed by the traditional architecture of the Palmyra houses, where the seismic shocks are redirected from the frame to the walls, while the roof remains standing. This could be implemented by limited structural linkages between the frame and surrounding outward-leaning masonry or mud walls, so that in the event of a seismic event, the frame would push the walls outwards whilst itself staying intact and preventing injury from collapsing roofing.
Preliminary assessment of the pilot Structure approach to humanitarian sheltering

Image 18: Internal spatial distribution of the Structure, Kerala, India
Photo credits: © Sameer Raichur

Image 19: Internal ground preparation, Kerala, India
Photo credits: Better Shelter and SEEDS
9.3  Comparison between Design Process Tarpaulin and Local Materials Upgrade

9.3.1  Construction Guidelines

Construction guidelines provided by Better Shelter were found to be comprehensive, easy-to-follow and understand (see question 1 Design Process Assessment Tarpaulin). Some respondents expressed that live training for non-builders may be needed especially in cases of building Structure with tarpaulin covering (see question 3) (see graph 12).

The video training was found to be sufficient and fast enough to showcase how to build the Structure in a couple of hours and with simple tools. The major challenge identified by respondents was the strength of bandwidth in remote regions and lack of smartphones or devices.

Moreover, the WhatsApp support offered simultaneously while building the shelters was highly appreciated by respondents. It significantly reduced time at solving problems they faced at site. This kind of support was mostly needed at building the first Structure shelter, where most of the time was spent understanding the arrangement of components and connectors.

9.3.2  Construction Concerns

The preparation of a stable foundation was of unanimous concern by the respondents. Respondents presented various ground types they had to deal with in order to prepare an adequate foundation for the Structure shelter. The main challenge in this regard was found to be the relation between ground anchors, ground plates and soil properties. Participants in India indicated being unable to use ground anchors as shelters were built on rented concrete flooring. As a result of this, concrete blocks on which shelters rested were used as an alternative and participants indicated that this solution should be used in all western regions in India, as opposed to ground anchors.
Preliminary assessment of the pilot *Structure* approach to humanitarian sheltering

Image 20: Ground preparation and commencement of Structure parts, Kerala, India
Photo credits: Better Shelter and SEEDS

Image 21: Foundation work for Structure, Haridwar, Uttarakhand, India
Photo credits: Better Shelter and SEEDS
Ground conditions assessment and site preparation, including identifying appropriate foundation options and levelling, were two tasks that respondents strongly recommended the requirement of close supervision and quality assurance by staff from Architecture, Engineering and Construction backgrounds (see questions 1 and 2).

### 9.3.3 Construction Process

Five people was the most common answer to the number of builders needed to complete the shelter (question 4). The skill level required to successfully build *Structure* with tarpaulin varied between skilled and unskilled, as building crews were a combination of trained Architecture Engineering and Construction professionals and local community members. None of the shelters deployed during this pilot were undertaken solely by unskilled builders from the local community.
As can be seen in graph 14 to the right, the composition of the construction crews was made up of skilled builders (42.9%), semi-skilled builders (42.9%) and unskilled members (14.2%). Across Afghanistan, Tajikistan and India, the local communities were involved in the construction process. Shelter Centre does not have enough information about the skills and capacities of local community members.

Graph 14: The skill level rate among the teams

In assembling the Structure, one team would be responsible for assembling the lower body of the frame Structure while the other team assembles the roof. After completion of the lower body, it would require the team as a whole and in some cases with extra help from other members to delicately lift the roof and place it on the lower body of the Structure.
9.3.4 Structure Limits and Challenges

Respondents indicated some challenges in assembling the *Structure*, most of which referred to building the roof on the ground, and then having to lift it approximately two meters in order to attach the vertical components. This was done by dividing the construction team in two smaller groups, then combining those team in order to hold up the corners of the roof and connect the roof components to the wall components. The images above and below offer an illustration of this process.
Another challenge indicated by respondents, once again faced in roofing, was the attachment of the T-shaped connectors (see question 9). That said, respondents indicated these difficulties were mitigated once they had familiarised themselves with the Structure.
Respondents indicated that the *Structure* was overall very stable, sturdy and light, which they understood as indicative of greater resistance to seismic activity. They added that *Structure*'s design to withstand winds of up to 80km/h may represent a weakness in regions where hurricanes and cyclonic winds may reach up to 150-200km/h.

In India, respondents indicated that wind speed varies between 50-100km/h in the most severe storms in the monsoon season. It is important to note that no *Structure* units deployed in this pilot were exposed to extreme conditions for which it was tested to withstand.

Concerning the weaknesses of the *Structure* frame (see question 9), few respondents indicated that fixings could break, putting the integrity of the shelter in danger. As it can be seen in graph 15 to the right, only 33% of respondents answered ‘Yes’ on the possibility of fixings and components breaking.

Another potential weakness mentioned by respondents was the implementation of the foundation, whilst appreciating the range of foundation options available for different ground conditions. They explained that if the ground anchors and ground plates were not linked properly with the frame, it could leave the entire structure vulnerable. In response to this concern, respondents indicated that local teams should carry out supervision or quality assurance activities to ensure the build and stability of the shelter. This will involve checking if the ground condition is suitable for anchors and if the cables are properly fixed to the anchors at adequate depth into the ground. They noted that a checklist supported by photographs would be helpful, when scaling up implementation, ensuring nothing is missed when undertaking quality assurance.

When asked if the *Structure*'s frame or fixings would break as a result of local materials being attached to the frame, respondents largely answered ‘No’ (50%). Once again this speaks to the strength and integrity of the frame (see question 9). Respondents did not mention many episodes in which fixings or other components did break and, when it did happen, they explained it could have been down to unskilled handling of the parts.

Having said this, respondents agreed that more information should be shared concerning the total weight the frame can support, or dead load, when adding local materials in the upgrade process.
10. Recommendations

The recommendations offered below are based on the synthesis of findings derived from partner respondents in the assessments and the inclusion of feedback acquired throughout the preliminary assessment of the pilot Structure approach to humanitarian sheltering by Better Shelter. Shelter Centre has attempted to be neutral in this presentation, however recognises interpretation is inevitable, drawing upon its experience around transitional shelter.

In an attempt to provide a cohesive understanding of the Better Shelter Structure pilot projects currently being implemented in different contexts across the globe, recommendations are organised to suggest opportunities for future development of the design, considerations for implementation measures of the project, as well as potential future assessments that could be undertaken.

10.1 Sphere Coherence Assessment

The following recommendations are based on the findings derived from the Sphere Coherence Assessment (see Section 9. Findings: Sphere Coherence Assessment) to identify potential gaps and opportunities that might facilitate the assembly, adaptability, usability and safety of the Structure. These recommendations are structured around the categories used in the assessment phase of the evaluation based on the standards set forth in The Sphere Handbook (Sphere, 2018).

10.1.1 Location and Settlement Planning

Varied ground conditions across local contexts have prompted construction teams to adapt local methods of site preparation prior to assembling Structure. Respondents indicated that guidance on assessing site locations and natural hazards would be of added value (see Section 8.1.1). Consideration may be given to the following:

- **Guidelines and Tutorials** - The development of guidelines and tutorials that provide assistance to users on understanding site conditions, assessing risks and considering climate conditions to help overcome challenges, faced in preparing the foundations for the shelter.

10.1.2 Living Space

Although the Structure shelter was found to be flexible and accessible for PWSN, a need for improvements and guidelines to inform adaptations to accommodate PWSN was expressed. Furthermore, guidance around adapting the shelter for thermal comfort and ventilation, particularly with regards to the use of tarpaulin and in conjunction with local materials, along with quick-to-assemble latrine solutions was also expressed. Consideration may be given to the following:

- **Thermal Guidance** - Further support to partner organisations in the development of internal and external strategies for insulation and thermal guidance by sharing success stories and best practices of existing projects in different regions (see Section 8.2.2).

- **Persons With Special Needs (PWSN) Adaptations** - The development of PWSN guidelines, with emphasis on what adaptations can be done to encourage safety measures for the space (see Section 8.2.1).
• **Thermal Upgrades** - Collating information and success stories to inform how upgrades can be made to improve the thermal comfort of the *Structure* across different local and climatic contexts (see Sections 8.2.2 and 8.2.4).

### 10.1.3 Technical Guidance

While respondents stated that the virtual training provided by Better Shelter was invaluable, use of additional print out graphics could be helpful in emergency contexts with limited resources and labour. Furthermore, concerns around packaging of the *Structure* were also expressed. Consideration may be given to the following:

- **3D Model** - The production and development of a physical model or prototype of *Structure* to illustrate the completed form of the shelter, as additional guidance for implementing partners (see Section 8.3.2).

- **Compilation of Transitional Building Codes** - Creating a platform for storage and dissemination of transitional shelters building guidelines. Local guidelines from different countries or regions can serve as a base when *Structure* or other transitional shelters are built in places where no local guidelines are offered (see Section 8.3.1).

While the majority of respondents stated that they encountered no problems with the delivery of *Structure* packaging, on a few occasions, *Structure* boxes arrived having suffered damages and with parts missing (see Section 8.3.3). Further consideration may be given to the following:

- **Assembly Support** - The creation of a ‘components checklist’ of the *Structure* parts, to assist construction teams in evaluating whether any components have gone missing or were lost in the event of disassembling and repackaging. Checklists that can easily be understood by unskilled labour could be considered.

- **Packaging Improvements** - Implementing the following design improvements to the *Structure* boxes (see Sections 8.3.3 and 8.3.4):
  
  - a layer of wax on top of the *Structure* boxes to ensure durability and strengthen its resistance against rain, humidity, sharp edges, etc
  - a tamper seal for the *Structure* boxes as a mechanism to minimise the loss of parts and pieces and inform the final receiver or any faults and third-party inquiries
  - a numbering and identification system for the *Structure* boxes to ensure a fast and smooth transition from the warehouse to the construction site

### 10.2 Design Process Assessment - Tarpaulin

The following recommendations are based on the findings derived from the Design Process Assessment - Tarpaulin to identify how the performance of the *Structure* frame might be enhanced, particularly when tarpaulin is used as an exterior cladding material. These recommendations are organised around the application and feasibility of the tarpaulin, enhancing thermal comfort as well as space flexibility of the shelter.
10.2.1 Build Team and Process

Through this assessment, Shelter Centre was able to conclude that the partner organisations used for different purposes, some for clinical and medical support, while other Structure units were intended for family shelters. This difference results in varied requirements and needs concerning assistance on Better Shelter’s behalf. Consideration may be given to the following:

- **Shelter Usage Specifications** - Methods to improve the communication and transfer of existing guidance and guidelines of Structure, considering the deployment method used by the partner organisation. Whether Structure is to be used for clinic and medical support en masse or family shelters on a case-by-case basis, consideration should be given to the technical level and assistance required by the construction teams on the ground (see Sections 8.2.4 and 8.3).

- **Technical Competency** - Better understanding the role of technical competence of the related partners and subsequently their construction teams impact their ability to upscale the deployment of shelters, and how Better Shelter can support their projects individually (see Section 8.3).

10.2.2 Challenges in Construction

A major concern amongst participants was difficulty in punching roles in the tarpaulin during the construction phase, as poorly made holes may result in larger and additional tears in the sheet (see Section 9.1.2). Consideration may be given to the following:

- **Protection of Tarpaulin** - Including a hook pull-through, made from wire or similar, to help inserting wire connections through holes in plastic sheeting, so that it may connect between the frame and local materials.

10.2.3 Structural Vulnerabilities

While respondents indicated that Structure was overall very stable, sturdy and lightweight, concerns were reported regarding the integrity of intermediate parts and plastic connectors, especially when Structure was implemented in locations with harsh weather conditions. Although there were no discoveries of weaknesses of elements of the frame in the findings, particular attention could be given to improving the design of plastic connectors which have shown to become fragile when exposed to harsh weather conditions, in particular cold temperatures (see Section 9.2.3). Consideration may be given to the following:

- **Research and Development (R&D) Initiatives** - Carrying out consultations with partner organisations for R&D activities might help identify methods and materials to strengthen the Structure’s fixings.

10.2.4 Thermal Comfort

It was found that the tarpaulin provided in Structure kits did not provide sufficient insulation or ventilation and that respondents and beneficiaries had resorted to making Structure adaptations and upgrades to address this issue in different local and climatic contexts. Consideration may be given to the following:
• **Ventilation Concerns** - Enhancing thermal comfort of the shelter by incorporating permanent ventilation arrangements in the tarpaulin used on the exterior as well as vents in the roof surface for heat transfer (see Section 9.1.4).

• **Additional Openings** - Accommodating insulation measures when increasing ventilation or creating additional openings in the Structure, particularly in contexts of extreme heat or cold conditions (see Section 9.1.4).

### 10.2.5 Context, Cultural and Traditional Building Adaptations

Respondents indicated that having WASH facilities within or in close proximity to shelters is very important, as it may be difficult for beneficiaries to leave the shelter at night. Additionally, respondents also stated the need for space within shelters for kitchens, laundry and other activities. Consideration may be given to the following:

• **Quick-To-Assemble Latrines** - The creation of ‘quick-to-assemble’ latrine kits for emergency contexts as an addition to the Structure kits. Consultation with partner organisations might help inform the design of such kits (see Sections 9.1.4 and 8.1.5).

• **Longer-term WASH Solutions** - Designing a more permanent and larger latrine component to be built along with the Structure (see Sections 9.1.4 and 9.1.5)

• **Exterior Spaces** - Collating further information on how to strengthen the gable ends to enable the creation of outdoor space, such as a veranda or communal space, which could be suitable for the construction of a guarded outside kitchen, laundry or WASH facilities (see Section 9.1.5).

• **Cultural Components and Climate Conditions** - Developing context and climate specific deployments of Structure, to more easily allow for the implementation of indoor or outdoor WASH and cooking components. Due to climatic and cultural constraints in different local contexts, services and other activities (WASH, cooking, etc.) may be more appropriately carried either indoors, such as in Tajikistan and Afghanistan where weather is colder, or outdoors, such as in India where weather is hotter and spaces are more rural (see Sections 9.1.4 and 9.1.5).

### 10.3 Design Process Assessment - Local Materials Upgrade

The following recommendations are based on the findings derived from the Design Process Assessment - Local Materials Upgrade (see Section 9.2) to bring forth opportunities that might help enhance the application and use of local materials with the Structure. These recommendations are organised around the use of local materials, in parallel to the tarpaulin, as well as concerns centred around upgrading and fireproofing the shelter.

#### 10.3.1 Use of Local Materials

Local materials used to make upgrades to Structure were chosen on the basis of being cheap, accessible by locals, easy to install, and having good thermal capacity. Combinations of natural and industrial
materials were used to make a variety of upgrades to Structure to improve roofing, walls, flooring, cladding, insulation, and cover-ups (see Section 9.2.1). Consideration may be given to the following:

- **Material Upgrade** - Collating and disseminating further information on the use of local materials used to make upgrades to Structure elements, detailing best practices across different contexts, materials used, and easy-to-follow instructions.

- **Material Upgrade Best Practices** - Sharing practices that use commonly available and cheap materials, such as bamboo, timber, Corrugated Galvanized Iron (CGI) sheet, mud, thatch. Existing guidance on common upgrades (i.e. roofing, plastering, insulation, etc.) could be shared.

### 10.3.2 Upgrading Concerns

Respondents indicated that during the upgrading process, there were concerns that certain elements of the Structure may break as a result of the added weight from local materials (see Section 9.2.3). Consideration may be given to the following:

- **Structural Understanding** - Developing and disseminating guidance and technical specifications on maximum weight load supported by Structure, to inform internal spatial orientation, hanging and shelving, snow load support, and the internal and external upgrade of local materials.

- **Stress load of Horizontal Members** - Better understanding the stress load of horizontal members of the Structure frame when weight is added to the roof.

### 10.3.3 Local Materials and Tarpaulin

Respondents brought attention to some issues regarding the tarpaulin used in Structure, including problems when fixing local materials to the tarpaulin and concerns about the tarpaulin lifespan (see Section 9.2.2). Consideration may be given to the following:

- **Tarpaulin and Material Upgrades** - Collating and disseminating successful practices across projects, concerning the combination and fixing of tarpaulin and local materials:
  - consider addressing the concern raised by respondents around connecting local materials to the Structure frame once the frame is draped over with tarpaulin
  - attention might be given to sharing practices that allow for the lifespan of tarpaulin to be extended
  - consideration might be given to the production of layman-style guidance with easy-to-follow instructions on the combination of tarpaulin and local materials

### 10.3.4 Structure Upgrades for Fire Prevention

Respondents made some suggestions to improve fire mitigation and prevention measures within Structure. These included creating additional openings using local materials to make various Structure upgrades (see Section 9.2.6). Consideration may be given to the following:

- **Fire Mitigation** - Developing guidelines on practices which can be implemented to mitigate fire risk including adding more doors and windows to Structure in combination with natural
materials to provide insulation when needed and ventilation to allow for the exit of fumes and vapour.

- **Fire Prevention** - Developing guidelines on practices that can be implemented to prevent fire hazards within shelters, including methods in which local materials may be used to upgrade *Structure* elements to be more fire-resistant and fire-retardant.

### 10.4 Environmental Considerations

In presenting the following recommendations, the AKDN Green Building Guidelines (GBG) were used to develop guidance around potential environmental and climate change impacts relevant to the design and operations of *Structure*. During the assessment phase of the *Structure* pilot project, questions regarding coherence to the Sphere Standards and design processes overlapped with certain programmatic and technical guidelines included in the GBG. As such, a preliminary analysis was used to triangulate the assessments with the guideline to provide insight into how environmental considerations might be incorporated into the *Structure* frame design, material selection, and implementation processes. These recommendations might merit consideration of additional assessments to evaluate the advantages and disadvantages of incorporating environmental strategies into the overall project scope.

#### 10.4.1 Design Considerations

The main concerns shared by respondents were centred around thermal comfort and space flexibility of *Structure* as well as opportunities for enhancing accessibility for PWSN. Concerns were common for proper ventilation methods in hot climates, and conversely, increased insulation strategies in colder climates. Moreover, flexibility of spaces inside the shelter to meet different needs of respondents was a concern in terms of longevity and liveability of *Structure*, particularly with regards to safer kitchens and WASH spaces. Consideration may be given to the following:

- Design strategies may be considered to further develop the capacity of the *Structure* frame for more sustainable use and energy optimisation by maximising the shelter’s design parameters, functional use and lifecycle (see *Section 8.2*).

- Priority may be given to spatial function by allowing users to create different types of spaces as different needs arise as well as allowing *Structure* to be repurposed in the future for alternate use (repurposed from shelter to a future commercial space, for example) (see *Sections 8.2.5, 9.1.5 and 9.2.5*).

- Consideration may be given to strategies for simplifying connection details as well incorporating fittings, fasteners and adhesives that would allow for easier assembly of added materials, like insulation or exterior sheathing, to the *Structure* by users (see *Sections 9.2.2-9.2.3 and 9.3.1*).

- Consideration may be given to enhancing thermal comfort of the shelter by incorporating permanent venting arrangements in the tarpaulin used on the exterior as well as vents in the roof surface for heat exhaust, thereby decreasing costs associated with maintaining heating and cooling (see *Section 8.2.2, 9.2.2 and 9.2.4*).

- Design consideration might be given to facilitating the ability to attach insulative material to the structural members more easily and securely (see *Sections 8.2.2, 9.2.2 - 9.2.4*).
10.4.2 Material Considerations

Use of local materials was seen as common and feasible across all pilot projects in the building of the Structure in general, although concerns were raised around attaching local material upgrades to the tarpaulin and interior Structure members (see Sections 8.3, 9.1-9.2). Consideration may be given to the following:

- Using lighter but more durable materials, as well as increasing the reliance on importing materials where appropriate, to decrease weight of packaging and thereby helping to decrease the energy costs and emissions associated with transportation (see Sections 8.3.3 - 8.3.4 and 9.1.1).

- Encourage recycling and reuse of shelter kit packaging parts in case of upgrades or relocation, and general recycling strategies on site (see Sections 8.3.2, 8.3.5, 9.2.1 - 9.2.2).

- Undertaking further research or an extension of the pilot phase in order to understand the transitional opportunities offered by selecting materials which can subsequently be upcycled, as part of repair and reconstruction activities of permanent housing (see Sections 8.3.2, 8.3.5, 9.2.1 - 9.2.2).

10.4.3 Implementation Considerations

Foundation preparation was of unanimous concern by all respondents, and with that, the need for facilitating understanding of proper processes for site preparation in different contexts and conditions, while also minimising risks for hazards and climatic conditions. Consideration may be given to the following:

- Development of guidelines and tutorials could provide needed assistance to users on understanding site conditions, assessing risks and considering climate conditions might be considered to help overcome challenges users have faced in preparing and building foundations for the shelter (see Sections 8.1.1, 9.3.2 and 9.3.4).

- Hazard mapping could be developed for reference by implementing partners of different regions in an effort to build a resource database for future projects on best practices that could mitigate climatic and site-based risks specific to different regions (see Section 8.1.1).

- Guidance on how to orient shelters with regards to site conditions such as building orientation, maximising natural and cross ventilation, size and orientation of windows might be considered to help users develop their necessary thermal comfort of the shelter (see Sections 8.1.1 - 8.2.2 and 9.1.4).
Appendix A

A1. List of Images

This section provides an overview of the images that are part of the report. The majority of the images were taken by the partnering organisations during the implementation of the pilot in Afghanistan, India and Tajikistan. The images featured in this report capture the assembly and adaptation of Structure shelters using local materials and add a visual element to this assessment.

Image 1: Structure with Tarpaulin, Tajikistan
Image 2: Structure frame, Haridwar, Uttarakhand, India
Image 3: Ground conditions in Kerala, India
Image 4: Structure frame built on concrete foundation, Afghanistan
Image 5: Mud plastering mud on the upgraded shelter wall, Kerala, India
Image 6: Indoor mud stove built within Structure during the monsoon season, Kerala, India
Image 7: Structure with tarpaulin exposed to high altitude sunlight, Tajikistan
Image 8: Structure with tarpaulin covered in snow, Tajikistan
Image 9: Structure with local materials upgrade using the tarpaulin as a veranda cover, Kerala, India
Image 10: Structure upgraded with local materials, Kerala, India
Image 11: Yellow bamboo found in abundance near the construction sites, Kerala, India
Image 12: Illustration of Structure in local materials upgrade process, Tarpaulin used for covering
Image 13: Attachment methods used for the roof, Kerala, India
Image 14: Attaching the Structure frame to local materials
Image 15: Attaching methods, with GI wire of the roofing area, Kerala, India
Image 16: Localised solution employed in Kerala to strengthen the window sill in combination with Tarpaulin, India
Image 17: Structure test unit, upgraded with local materials showing roofing insulation, Tajikistan
Image 18: Internal spatial distribution of the Structure, Kerala, India
Image 19: Internal ground preparation, Kerala, India
Image 20: Ground preparation and commencement of Structure parts, Kerala, India
Image 21: Foundation work for Structure, Haridwar, Uttarakhand, India
Image 22: Ground anchor fixed on a concrete foundation, Afghanistan
Image 23: Construction teams, Tajikistan
Image 24: Assembling Structure’s roofing members, Tajikistan
Image 25: Construction crew lifting the roofing frame to attach to the vertical members, Kerala, India
Image 26: T-section Assembly in Main Joint roof - Assembly manual frame
A2. List of Graphs

All the graphs are based on data collected during the assessment and conducted by the Better Shelter and the implementing partners. They were produced internally based on findings during the process. The graphs were created in Excel to aid with data cleaning, analysis and data visualisation depicted as graphs.

Graph 1: Consideration given to elevate shelter surface due to terrain conditions
Graph 2: Consideration given to adaptation of Structure to PWSN when using local materials
Graph 3: Consideration given to accessibility ramps for PWSN when preparing the construction site
Graph 4: Construction done according to building codes in the locality where it had been constructed
Graph 5: If the packages damaged or lost by the time they reach the site
Graph 6: Value of adding a tamper seal to Structure boxes
Graph 7: Ability to reuse or recycle the materials used along with the Structure frame in other shelters or for other purposes
Graph 8: Areas of the shelter the plastic sheeting might become worn, rip or degrade
Graph 9: The accessibility of the door opening of the Structure for persons in wheelchairs
Graph 10: The ability to reuse the materials selected to upgrade the shelter in order to assist in subsequent repair or reconstruction activities, after the Structure shelter has been dismantled
Graph 11: If the shelter adapted to improve fire prevention and detection
Graph 12: The need for any training or guidance for the build for that someone who is not a builder
Graph 13: The number of people were in the team to build the shelter
Graph 14: The skill level rate among the teams
Graph 15: If the fixings or components or tools might break
Graph 16: If parts of the Structure's frame or fixings might break, when local materials have been added

A3. List of Tables

Table 1: Distribution of Structure shelters per partner organisation
Table 2: Number of respondents respective to partner organisation
Table 3: Distribution of assessments per respondents and partner organisations in relation to location of implemented pilot project
Table 4: Distribution of Sphere Coherence Assessment interviews per organisation
Table 5: Distribution of Design Process Tarpaulin Assessment interviews per organisation
Table 6: Structure shelters deployed with tarpaulin covering
Table 7: Distribution of Design Process Local Materials Upgrade Assessment interviews per organisation
Table 8: Structure shelters deployed in combination with local materials
Appendix B

The questionnaires were divided into three sections: Sphere Coherence Assessment, Design Process Assessment - Tarpaulin and Design Process Assessment - Local Materials Upgrade, as was laid out in 5. Overview of the Assessments Undertaken.

The questionnaires were sent by Shelter Centre to the respondents via email prior to the interviews. The purpose was to allow the respondents to familiarise themselves with the type of questions and allow them time to reflect upon the questions and answers. During the interviews, any concerns and clarifications were provided to the respondents throughout the conversation.

Respondents were also asked to fill out some information and return questionnaires prior to the interview. This enabled Shelter Centre to focus the interview-time on outstanding aspects of the partner organisations’ experience with Structure.

B1. Sphere Coherence Assessment

B1.1 Plastic Sheeting Pre-Interview Questions

1. Name
2. Where are you from originally (country/town)?
   2A. What is your professional background in?
3. Did you ever work on a build project before this experience?
   3A. How experienced are you in construction?
   3B. Have many years of experience have you in humanitarian work (in shelter programming)?

B1.2 Sphere Coherence Interview Questions

1. How did (would) you consider preparation of the site for the drainage system for each shelter and its connection across the entire settlement?
   1A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?
2. Did (would) you consider elevating the surface of each shelter - using stilts or plinth - in preparation for overflow of water during extreme rain? What were the main challenges in doing so?
   2A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?
3. How did (would) you mitigate the accumulation of standing water, such as borrow pits?
   3A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?
4. How did(would) you provide WASH facilities, such as latrines, for households using the Structure shelter? Where would they be in relation to the Shelter?
   4A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?
5. How did(would) you provide kitchen/cooking facilities and laundry space, for the Structure when using tarpaulin?
5A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

6. How did(would) you provide Kitchen/cooking facilities and laundry space, for the Structure when using localised materials?
6A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

7. Have you or how would you adapt the structure to be suitable for PWSN when using tarpaulin?
7A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

8. Have you or how would you adapt the structure to be suitable for PWSN when using localised materials?
8A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

9. When preparing the site, do you take into account accessibility, such as ramps, for persons with disabilities?
9A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

10. In your personal experience, is the door opening of the structure with tarpaulin accessible for persons in wheelchairs? Is it differentiated for persons that are visually impaired?
10A. If not, where would you refer to for guidance? Is any further guidance/training needed?

11. Are the opening and closing mechanisms for doors and windows, suitable for disabled persons?
11A. If not, where would you refer to for guidance? Is any further guidance/training needed?

12. How would you adapt the structure and site to be suitable for people with suitable needs?
12A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

13. Is there any system to mitigate and/or reduce trip hazards affecting mobility for the community around the site/settlement?
13A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

14. How did (would) you adapt the Structure to be suitable for PWSN to minimise these hazards?
14A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

15. How did (would) you adapt the shelter with local materials to improve thermal comfort, in regions with high/low temperatures, and extreme temperature changes?
15A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?
16. In your personal experience, does the Structure ensure that sufficient minimum ventilation can be maintained when the shelter is located in cold climates?
16A. If not, where would you refer to for guidance? Is any further guidance/training needed?

17. In your personal experience, is the Structure with tarpaulin protected against driving rain?
17A. If not, where would you refer to for guidance? Is any further guidance/training needed?

18. In your personal experience, were there issues with disease vectors and dust due to gaps in the floor of the structure?
18A. If so, where would you refer to for guidance? Is any further guidance/training needed?

19. Did (would) you consider equipping the shelter with additional elements such as mosquito nets in order to prevent vector ingress?
19A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

20. In your personal experience, does the Structure comply with building codes in the locality where you constructed it?
20A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

21. Are you aware of international sheltering-transitional building codes that can be considered for the structure project?
21A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

22. Was the deployment of the Structure supported by capacity-training or guidance, sufficient to support the site preparation, and frame construction by builders and users?
22A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

23. Based on your personal experience, have efforts been made to reuse or recycle the materials, such as tarpaulin pieces, in other shelters or for other purposes?
23A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

24. Have you been able to reuse or recycle the materials used along with the Structure frame in other shelters or for other purposes?
24A. If you need support undertaking this activity, where would you refer to for guidance? Is any further guidance/training needed?

25. Based on your personal experience, are there methods to ensure the maximum life span of the structures? If so, explain.
25A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?

26. Are there additional tools or materials that you would like to be added for purposes of future maintenance?
26A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?
27. Are there parts of the structure or tools that should be provided in more quantity to keep as spare?  
27A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

28. What was your experience in fixing new materials to the structure?  
28A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

29. Would you find it valuable to have additional tool (e.g. ropes and wires), provided with the Structure to assist in attaching new materials?  
29A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

30. Can the structure be adapted to accommodate different spatial organisations such as additions and extension? To what level is it flexible enough?  
30A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

31. Can the internal space created by the structure be rearranged in different possibilities to accommodate the needs of the users? Such as adding partitions to create special zones within an internal space?  
31A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

32. Do you have any advice concerning optimising packaging to keep construction elements in good condition, and enabling packaging to be reused for other purposes?  
32A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

33. Would you find it valuable to have a seal proving the boxes have not been tampered with? If so, how do you envision this seal?  
33A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

34. Based on your personal experience, do you consider storing of the packages maintain components in good condition? If not, how can it be improved?  
34A. If you need support undertaking these activities, where would you refer to for guidance? Is any further guidance/training needed?  

35. Are the packages damaged or lost by the time they reach the site?  
35A. Are there any suggestions you would like to share to improve delivery process?  

36. Do you have any additional comments or suggestions regarding the construction of the Structure frame?
B2. Design Process Assessment – Tarpaulin

B2.1 Plastic Sheeting Pre-Interview Questions

1. Name
1A. Where are you from originally (country/town)?

2. What is your professional background in?

3. Did you ever work on a build project before this experience?
3A. How experienced are you in construction?
3B. Have many years of experience have you in humanitarian work (in shelter programming)?

4. How many shelters did you build in total in collaboration with Better Shelter?

5. Please describe the training you received prior to the construction of the first shelter you worked on?
5A. Who provided the training?

6. Can you confirm you worked on the following shelters?
6A. How many people were in your team to build this shelter?
6B. How would you rate the skill level among your team? Please consider the overall skill level of the team responsible for building the Structure frame and executing the coverage with the plastic sheeting and local materials upgrade?

7. Is the shelter situated near any trees or other buildings?

8. Were any of the boxes in which any of the shelters arrived damaged such as by water or impact?
8A. When the boxes, in which the shelter/s were delivered, arrived on site, had they been opened?
8B. When the boxes, in which the shelter/s were delivered, arrived on site were any of the parts missing?

9. What ground condition did you build the shelter on?

10. Did you use the ground anchors provided or did you build on any other kind of foundation?

11. Did you use any tools other than those provided in the shelter kits?

12. Can you refer us the building codes applicable in your country which apply to this type of shelter?

13. How is the shelter being used?

B2.2 Plastic Sheeting Interview Questions

1. Did you build the shelters according to the guidance offered? If not, what changes did you make and why?

2. Do you have any suggestions for improving the guidance given to build the shelter?

3. In your opinion, do you think that someone who is not a builder would need any training or guidance for the build?
4. What do you think is the minimum number of people the shelter would take to build?

5. When building the shelter, can you make any recommendations as to how you could make the construction process safer?

6. When you were building the shelter, what were some major challenges you encountered?

7. Now that the shelters have been deployed for some time, what do you suggest for improving the shelter so the plastic sheeting will last longer, minimising wearing out and degradation from sunlight?

8. In your experience, where do you think the weakest point in the frame is?

9. In your experience, do you think any of the fixings or components or tools might break?

10. In your experience, what area of the shelter do you think the plastic sheeting might become worn, rip or degrade?

11. Considering the shelter as built, is the shelter wheelchair accessible (is the door wide enough for a wheelchair to get through it)?

12. What do you suggest for improving the shelter with plastic sheeting so that it is more appropriate for day-to-day living?

13. Do you have any additional comments or suggestions regarding the construction of the Structure frame in combination with the plastic sheeting?
B3. Design Process Assessment – Local Materials Upgrade

B3.1 Plastic Sheeting Pre-Interview Questions

1. Name
   1A. Where are you from originally (country/town)?

2. What is your professional background in?

3. Did you ever work on a construction project before this experience?
   3A. How experienced are you in construction?
   3B. How many years of experience do you have in humanitarian work (in shelter programming)?

4. How many shelters did you build in total?
5. Please describe the training you received prior to the construction of the first shelter you worked on.
   5A. Who provided the training?

6. Can you confirm you worked on the following shelters? (Please use the table in columns I_L as reference to check the boxes)
   6A. How many people were in your team to build this shelter?
   6B. How would you rate the skill level among your team? Please consider the overall skill level of the team responsible for building the Structure frame and executing the coverage with the plastic sheeting and local materials upgrade?

7. Is the shelter situated near any trees or other buildings? (Please Elaborate in additional comments columns)

8. Were any of the boxes in which any of the shelters arrived damaged such as by water or impact?
   8A. When the boxes, in which the shelter/s were delivered, arrived on site, had they been opened?
   8B. When the boxes, in which the shelter/s were delivered, arrived on site were any of the parts missing?

9. What ground condition did you build the shelter on:

10. Did you use the ground anchors provided or did you build on any other kind of foundation? (Please list for each shelter if different)

11. Did you use any tools other than those provided in the shelter kits?

12. Can you refer us the building codes applicable in your country which apply to this type of shelter?

13. How is the shelter being used?

B3.2 Local Material Upgrade Interview Questions

1. What local materials did you use to upgrade the shelter and why?
2. In addition to the materials used in the Structure pilot project, which other materials available locally might be helpful in upgrading the shelter to meet local requirements? What other materials are available in your locality that would be suitable to constructing buildings that you have not used?

3. Do you think you would be able to reuse the materials you used to upgrade the shelter, to build another shelter, after it has been dismantled?

4. When you upgraded the shelter with local materials, how did you fix back the materials to the frame and what challenges were there?

5. In your experience, do you think any parts of the Structure’s frame or fixings might break, when local materials have been added?

6. How do you suggest the Structure could be upgraded so that it is more appropriate for day-to-day living?

7. How do you suggest the Structure could be upgraded so that the temperature is more comfortable for people using the shelter in the sites you have built them?

8. What standard tools do you usually have available in construction sites?

9. Have you adapted the shelter to improve fire prevention, detection or firefighting and if so, what measures have you taken?

10. For the context in which the shelter is built, and from your experience, how many doors should you have in the shelter?

11. For the context in which the shelter is built, and from your experience, how many windows should there be and what height should they be at?

12. How could local materials be used in combination with the tarpaulin, to reduce the degradation and wear of the tarpaulin?

13. If you were to fix first the plastic sheeting on the frame and then add local materials on top of it, what problems do you think you would encounter and how would you propose to overcome them?

14. Do you have any additional comments or suggestions regarding the construction of the Structure frame in combination with local materials upgrades?