UNIVERSITY OF CAMBRIDGE

# From Shelter to Home:
# Flexibility in Post-Disaster Accommodation

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*This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the Preface and specified in the text. It is not substantially the same as any that I have submitted, or, is being concurrently submitted for a degree or diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the Preface and specified in the text. I further state that no substantial part of my dissertation has already been submitted, or, is being concurrently submitted for any such degree, diploma or other qualification at the University of Cambridge or any other University of similar institution except as declared in the Preface and specified in the text .*

*It does not exceed the prescribed word limit for the relevant Degree Committee.*

*Total words not including Bibliography and Appendices: 70,582*

# Contents

# Acronyms

ASPEM. Asociación Solidaridad Países Emergentes (Solidarity Asociation Emergent Countries).

CARE. Cooperative for Assistance and Relief Everywhere.

CLP. Chilean Pesos.

COSUDE. Cooperación Suiza de Desarrollo (Swiss Agency for Development and Cooperation).

CRC. Chilean Red Cross.

CRS. Catholic Relief Services.

CWGER. Cluster Working Group on Early Recovery.

DMC. Disaster Management Centre (Oxford Polytechnic, now Oxford Brookes).

ECHO. European Community Humanitarian Organisation.

EGIS. Entidades de Gestión Inmobiliaria Social (Social Housing Management Entities).

FEMA. Federal Emergency Agency, US.

FOSIS. Fondo de Solidaridad e Inversión Social, Ministerio de Desarrollo Social, Chile (Solidarity and Social Investment Fund, Ministry of Social Development).

GTZ. Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency).

GVSS. Grupo de Viviendas Seguras y Saludables (Group for Safe and Healthy Housing).

HPN. Humanitarian Practice Network.

IDNDR. International Decade for Natural Disaster Reduction.

IFRC. International Federation of the Red Cross and Red Crescent Societies.

INDECI. Instituto Nacional de Defensa Civil, Perú (National Institute for Civil Defense).

IRP. International Recovery Platform.

LRRD. Linking Relief, Rehabilitation and Development.

MIDEPLAN. Ministerio de Planificación, Chile (Ministry of Planning, Chile).

MINVU. Ministerio de Vivienda y Urbanismo, Chile (Ministry of Housing and Urbanism).

MSF. Médecins Sans Frontières.

NCEER. National Centre for Earthquake Engineering Research, Univ. of New York at Buffalo.

ODI. Overseas Development Institute.

OFDA. Office of US Foreign Disaster Assistance.

ONEMI. Oficina Nacional de Emergencia, Chile (National Emergency Agency, Chile).

PEN. Nuevos Soles Peruanos (Peruvian currency).

PREDES. Centro de Estudios y Prevención de Desastres (Centre for the Study and Prevention of Disasters).

PUCP. Pontificia Universidad Católica del Perú (Pontifical Catholic University of Peru).

SHOA. Servicio Hidrográfico y Oceanográfico de la Armada de Chile (Hydrographic and Oceanographic Service, Chile).

SINADECI. Sistema Nacional de Defensa Civil, Perú (National Civil Defence System, Peru).

SUBDERE. Subsecretaría de Desarrollo Regional y Administrativo, Chile (Sub-Secretary of Regional Development, Chile).

UNDP. United Nations Development Programme.

UNHABITAT. United Nations Human Settlements Programme .

UNHCR. United Nations High Commissioner for Refugees.

UNICEF. United Nations Children's Emergency Fund.

UN-OCHA. United Nations Office for the Coordination of Humanitarian Affairs.

USAID. US Agency for International Development.

USGS. United States Geological Survey.

# Glossary

*Adobe*. Traditional building material made from earth and organic fibres.

*Aldeas*. Villages in Chile. Temporary settlements built by the government or by NGOs to provide shelter to displaced families after the 2010 earthquake.

*Bono 6000.* Donation system to support the affected by the 2007 earthquake in Peru to buy materials and rebuild their houses provided by the government of Peru and consisting of a grant of 6,000 PEN, approximately 2,000 USD or 980 GBP.

*Campamentos.* Temporary or informal camps in Chile.

*Caña de Guayaquil.* The local name for ‘Guadua’ bamboo in Peru

*Caritas.* Catholic Church NGO.

*Centros poblados.* A term for villages in Peru. Literally means ‘inhabited centres’.

*Chile Unido Reconstruye Mejor.* Reconstruction plan coordinated by the government of Chile after the 2010 earthquake.

*Cholguán.* Local name for a thin hardboard panel made with radiata pine fibres in Chile.

*Cocina ecológica, cocina mejorada or vicharra mejorada.* Improved kitchen provided by Caritas to families in Peru, built with clay bricks or adobe bricks covering the direct fire and adding a chimney that extracts fumes from houses or built areas.

*Comuna.* Administrative division that can include more than one city.

*Estera or esterilla.* Mat made with bamboo or other plant fibres in Peru.

*Fieltro/ Felt.* A fibre textile used in walls and ceilings for insulation.

*Fondo Solidario de Vivienda.* Solidarity Fund for Housing, for the benefit of vulnerable families.

*Geomembrana de polietileno.* High density polyethylene used to protect the temporary houses from the rain after the 2010 earthquake in Chile and provided by the government.

*Hogar de Cristo.* Chilean public charity founded by the Jesuit priest Saint Alberto Hurtado.

*Internit*. Local name for a fibrous cement board used mainly for interior walls in Chile.

*MDF panels/ Medium-density Fibreboard.* Engineered wood panels made by wood fibres.

*Ministerio de Vivienda, Construcción y Saneamiento.* Ministry of Housing, Construction and Sanitation. Government of Peru.

*OSB panels*. Oriented Strand Board panels also known as smartply, are engineered wood particle boards manufactured using a synthetic resin and compressing layers of woodstrands.

*Pesos*. Chilean Currency.

*Plumavit.* Local name for expanded polystyrene boards in Chile.

*Quincha.* Traditional building technique based on a mat or frame made with cane, bamboo or timber covered with mud and used in South America as an anti-seismic structure. Similar to the technique '*Bahareque*' used in Colombia and Venezuela.

*Quincha mejorada.* An improved and reinforced version of the traditional *quincha*.

*Registro Nacional de Contratistas.* National Registry of Contractors, Chile.

*Richter Scale.* Scale that assigns a magnitude number to quantify the energy released by an earthquake.

*Rollo de piso vinílico.* Vinyl loose lay flooring.

*Subsidio Habitacional Decreto Supremo (D.S.) N° 40.* Housing Subsidy Supreme Decree N° 40 for middle-class families.

*Tarjeta Banmat del Banco de Materiales.* Card system linked to the '*Bono 6000*' to buy in a bank of materials. Provided by the government to affected families after the 2007.

*Tarjeta RED.* Pre-paid debit card provided by CRC to affected families after the 2010 earthquake in Chile to purchase construction materials and tools.

*Techo Propio.* Funding system to support the affected by the 2007 earthquake in Peru to buy, build or repair permanent houses for families with a monthly income under 1,860 PEN, approximately 640 USD or 313 GBP. Provided by the government of Peru.

*TECHO.* Non-profit organisation that mobilises youth volunteers to fight extreme poverty in Latin America.

*Unidad de Fomento (UF)*. S. A unit of account adjusted on a daily basis according to inflation in Chile and used for loans and investments, especially real estate items.

*Wiegel Scale.* Scale that quantifies the magnitude of tsunamis.

# List of figures

*(All the figures belong to the author unless otherwise stated)*

# List of tables

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# Summary


One of the most critical issues in housing families after a disaster is the gap between short-term needs (emergency or temporary shelter) and long-term needs (permanent housing). In most cases, the process of achieving permanent accommodation takes years for various reasons, such as the removal of debris and finding available land on which reconstruction can take place. During this time, affected families are housed in interim accommodation, where they attempt to return to their former routines and resume household activities. However, post-disaster accommodation is frequently designed on the basis of universal prototypes unrelated to local culture and climate, and focused on creating an immediately available product rather than taking into account more holistic processes of reconstruction. Further, post-disaster accommodation is designed according to the definitions of reconstruction programmes, which are diverse and overlapping. Therefore, post-disaster solutions frequently fail to suit families' needs, who thus modify shelters and houses over time in order to make them more appropriate. Examples of modifications to post-disaster dwellings can be found in many countries, although research on them is scarce. Previous solutions have been criticised for being insufficiently flexible to adapt to future changes and, in some cases, for being out of place in the local context.

In order to understand the process of housing after disaster and how families adapt their dwellings to post-disaster contexts, I conducted fieldwork in 2012 in Chile and Peru. Adopting a case-study approach, the aim of this fieldwork was to identify steps, similarities and differences in the transition from temporary to permanent housing. Chile and Peru were selected for a variety of relevant criteria: the occurrence of large magnitude disasters in the past years (an 8.0 magnitude earthquake in Peru in 2007 and an 8.8 magnitude earthquake and subsequent tsunami in Chile in 2010); use of the same model of temporary housing in the initial phases of the recovery; the presence of different climatic zones to compare shelter in different environmental contexts; and different relationships to land (displaced groups in Chile and non-displaced communities in Peru). Specific cases were studied with the aim of exploring the nature of the modifications made, in

order to understand how houses are physically modified. Combined methods for data collection were used to produce a visual description of the process of modification over time.

The initial hypothesis of this research was that families would modify their houses in order to produce a sense of normality, as well as to make the shelter more comfortable and suitable to their particular needs. In both countries, Peru and Chile, the climate had an influence on the modifications made and the use of the spaces. In all cases, intermediate spaces were identified as a vital buffer between public and private space, and were incorporated by the residents. The sub-hypothesis of this research was that displaced families would modify their houses in a less extensive way, due to the temporary situation. Nevertheless, the examples show that even when families know they must leave their shelters by a certain date, they invest resources and time to improve the quality of their temporary house, enlarging it and customising it to their needs. Hence, the examples show that creating a 'home' of a temporary house is crucial for overcoming the recovery process, both physically and psychologically. A shelter, although basic and temporary, is more than just a physical building. The shelter represents security, stability and certainty, but also has to reflect a familiar environment, which is important for overcoming the disruption that disasters create. In this context, housing designs ought to be flexible enough to be adapted by families, even if they are intended as short-term solutions only. Building upon this observation, a set of strategies to achieve flexibility in contexts of post-disaster accommodation is analysed.

# Preface

On the night of the 27th of February 2010, Chile, my country of origin, was hit by an earthquake measuring 8.8 on the Richter scale, which led people across the country to rethink their priorities, and led me to rethink my research interests. At that time my research was focused on temporary settlements in extreme situations (mining camps, scientific stations, mountain shelters), and how their characteristics (materials, lighting, orientation) affect the lives of their users.

After the earthquake, many people asked me about applying systems used for temporary mining settlements, such as shipping containers, as housing solutions for families who had lost their homes. Therefore, I started conducting research into post-disaster accommodation, encountering a great number of projects and cases developed by designers, architects and engineers, on the one hand, and by humanitarian organisations and governments, on the other. I realised that proposals developed by architects for temporary housing had been widely published in architectural journals, websites and books, but few had been implemented, and were inadequate solutions for the climate and culture of affected communities, focusing on innovation instead of finding solutions to the real needs of the families affected.

Thus, I studied the gap between idealistic proposals and implemented solutions, with a focus on shelter units, their materials, costs, life-span and living area, taking a broad view of a complex design problem which involves economic, social, and aesthetic factors. I realised that in most cases priority is given to technical and economic issues, whereas socio-cultural aspects are usually left behind. That research led to my MPhil thesis 'Transitional Accommodation after Disasters. Short Term Solutions for Long Term Necessities' in Cambridge, 2012. Thereafter, I began my PhD research with the intention of understanding what happens in the field, from the perspective of the families, and what happens to houses after most of the support provided by NGOs and governments has been withdrawn from the affected areas, a topic that has been less studied and that requires more attention.

Unfortunately, since I started this research, large-scale natural disasters have happened in countries such as Chile, the Philippines, Nepal and Ecuador, leaving many families homeless and showing that preparation, recovery and reconstruction require further development. During my time in Cambridge I have collaborated in different projects as part of the Ecohouse Initiative, designing and building improved temporary shelters for slums in Brazil and Ecuador, and designing and building a prototype of a bamboo house for the Philippines, after Typhoon Haiyan in 2013. The latter was a collaborative project that was used to test the ideas developed in this research.

# Introduction

Building permanent accommodation after disasters requires time and there is no unique approach to the process of housing. While looking for options, affected communities find shelter in different ways. Shelter is crucial for survival in the early stages after disasters, providing security, personal safety and protection from the weather and disease, but it is also essential for providing human dignity, family and community life, and for recovering from the disruption a disaster creates (Sphere Project, 2011, p. 244).

Because every situation and context is different, there is no single, universally applicable approach to the process of housing families after a disaster. The approach will be determined by the type and scale of the disaster, the local context, the climatic conditions, the political and security situation, and the ability of the affected population to meet their need for shelter (Sphere Project, 2011, p. 244). Nevertheless, despite the specificity of each situation, the humanitarian sector – which provide assistance during and in the aftermath of man-made crises and natural disasters – has established a series of common practices throughout the years, such as the use of large structures as collective shelters (schools and community buildings), the construction of temporary camps, renting houses or flats, repairing damaged houses, and building transitional shelters (Shelter Centre, 2012, pp. 4–5).

There are several options for post-disaster accommodation in terms of building system, shape, process and materials, and each has advantages and constraints. When affected families are unable or unwilling to return to their pre-disaster houses or land in the mid-term, they require temporary or transitional shelter and settlement solutions (Sphere Project, 2011, p. 244). Further, when the scale of the disaster is large, sheltering on a massive scale is needed and the local building industry may not cover the shortfall (IFRC, 2011a, p. 4). In these cases, pre-designed solutions can help to provide a safe structure, and a building model that can simplify the construction process, which in several cases is carried out by volunteers and affected families.

The process of building long-term durable accommodation requires time for a variety of reasons, such as the removal of debris, finding available land for displaced populations, and obtaining land rights and materials. For this reason, temporary or transitional shelters are used as post-disaster accommodation when no other alternative can be provided, and therefore, they are adapted and changed over time in order to meet families' needs, according to their resources, capacities, status and security of tenure (IFRC, 2011a, p. 4). Ideally, these structures should be adaptable in terms of materials and technologies in order to enable the affected families to 'transition' into a more durable home (IFRC, 2011a, p. 4).

Nevertheless, temporary and transitional shelters have been controversial and criticised for being inappropriate and inffective, such as the shelters built in Sri Lanka in 2004, where some organisations were focused on quantity rather than quality (D'urzo, 2011). Another example is Haiti in 2010, where some transitional shelters evolved into a more expensive and resistant solution, yet were not cost-effective in comparison to the cost of a permanent house (Calzadilla and Martin, 2011). Also, shelter provision by foreign organisations has been criticised for the lack of coordination and for not considering communities' resources and capabilities. These experiences have demonstrated that, in some cases, extensive resources used in solutions that provide shelter in the short-term can hinder recovery instead of supporting the whole process. Other approaches, such as core houses and cash vouchers, are not always feasible for various reasons, and in those cases temporary or transitional shelters are the only available alternative (IFRC, 2011a, p. 4).

NGOs, governments and affected communities respond to disasters with the aim of returning to normality (in terms of routines) and to improve the pre-disaster situation (building back better), based on the idea of reducing risks from future disasters without rebuilding the same vulnerabilities (Kennedy et al., 2008, p. 25; Hamdi, 2010, p. xi; IFRC, 2011b, p. 7), with vulnerability being broadly understood as

> *'(...) the characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard (and extreme natural event or process).'*(Wisner et al., 2004, p. 11).

The Shelter Cluster, a post-disaster global system of coordination organised by the International Federation of the Red Cross and Red Crescent Societies (IFRC) and the United Nations High Commissioner for Refugees (UNHCR) that supports people affected by natural disasters and internally displaced people affected by conflict, considers best practice to include progressive housing solutions that can be converted into permanent houses, provided that good quality of construction can be ensured (IASC, 2012, p. 14). However, if there is no planning or supervision of the process, and housing is of poor quality, the communities affected can fall into a persistent cycle of vulnerability.

Therefore, on the one hand, a current debate has emerged about the appropriateness of providing temporary or transitional shelters to the affected communities, and on the other hand, when families find themselves in a temporary or transitional dwelling for longer than planned, they try to improve the quality of the provided shelters in order to achieve minimum quality. If the aim is to reduce future vulnerabilities and to support long-term development, the challenge is to find adequate responses considering the efficient use of resources, economic and technical factors, and social implications.

# I. Research framework

## Research questions and hypothesis

Recognising existing needs and the sheltering process of the affected population is crucial for providing effective solutions after a disaster (IFRC, 2011a, p. 4). NGOs, governments and families invest in the improvement of temporary and transitional shelters, in order to meet different needs, such as shading, insulation, waterproofing, and sanitation. In this context, this research seeks to answer some questions that support each other in the definition of concepts for designing flexible post-disaster accommodation:

**a) What are the terms, concepts and definitions relevant to post-disaster accommodation?**

Post-disaster shelter and housing have had diverse definitions, and common terms have changed in recent decades focusing on different aspects of the process. There are different terms used for the same type of accommodation, and there are different housing solutions named under the same term. Although some terms are part of a general consensus, their definitions and roles are blurred. Some examples of terms used are emergency shelter, temporary shelter, temporary housing, temporary accommodation and transitional shelter, among others. The definitions and terms used are relevant because they offer guidance and standards that will be used in the design process. Although some discrepancies exist in the definitions, there are some repetitions and congruencies that can illuminate the way shelter or housing programmes are delivered and developed.

**b) How and why do families modify their temporary shelters, and what are the characteristics of this process?**

In order to understand the process of recovery that families face after a disaster and the adaptations they make to their shelters, fieldwork was conducted to study cases of post-disaster accommodation. Cases in Peru and Chile were selected and studied in 2012 in order to compare the use of the same model of shelter in different contexts, timeframe and climatic zones after recent disasters (earthquakes in 2007 and 2010). The main objective was to identify steps, similarities and differences in the process of transition through the comparison of different cases from both countries.

The aim was not to evaluate the success or failure of the strategies implemented, but rather to understand people's practices after the shelters were built. Results from fieldwork suggest that there are certain patterns in the way families adapt their houses after two or more years of living in them. Families use the temporary house extensively during the temporary phase and then they keep using the house when they manage to get a permanent solution, either as an extension or as material for extensions. Moreover, during fieldwork it was clear that patterns of change were based on usage of space and adaptation to climatic conditions; therefore, modifications that users make to their houses are related to both cultural values and environmental characteristics. Nevertheless, structural strength is not seen to be a main concern for families, whether for the permanent house or for additions to the temporary house, even though they have experienced an earthquake recently. Thus, this aspect should be taken into account when designing accommodation that will be modified by users. Moreover, good designs must be accompanied by capacity building and knowledge transfer in order to prevent the emergence of new vulnerabilities.

Essential features to consider when designing post-disaster accommodation are: the capacity for repetition by the organisation or government (standardisation); flexibility for including local materials and systems; and the possibility of being adapted and customised by families for them to feel 'at home', while maintaining houses' structural integrity.

**c) How to incorporate the concepts of flexibility and 'home' in post-disaster accommodation?**

There is a tension between the provision of a repeatable construction model and fulfilling the particular needs of households. On the one hand, from the perspective of the humanitarian sector, this is seen as a problem, because unique solutions cannot fit all, and usually generic solutions are not adequate. But on the other hand, from a construction and design perspective, it is not possible to provide personalised designs to the large number of families that need shelter quickly after a disaster. Repetition in architecture can be related to mass production, standardisation, prefabrication, and modularity. On the other hand, flexibility can be linked to ideas of uncertainty, incompleteness, potential for growth and modification.

In the humanitarian sector, the concepts of flexibility and adaptation were also incorporated during the sixties, but instead of taking the technological side, they embraced the idea of self-building, inspired by the work of John Turner and Frederick Cuny. In the past decade, the concept of 'transitional shelter' also incorporates the potential for housing to be upgraded, reused, relocated, resold, and recycled (Shelter Centre, 2012, p. 2). These characteristics position the transitional shelter as part of an incremental process. Finally, these ideas create a set of rules that will be used in this research for defining the design concept of flexible post-disaster accommodation. It is argued here that, in order to design a flexible solution, it is necessary to outline a set of strategies for specific climatic conditions and to foresee a series of possible changes, while maintaining structural strength, and informed by experience from the field.

## Research objectives

This research aims to understand how inhabitants of post-disaster temporary housing transition between post-disaster phases through modifying their dwellings.

Secondary objectives are:

- To define the similarities, differences and agreements in definitions of post-disaster accommodation.
- To define the concepts of 'home' and 'flexibility' in the context of post-disaster accommodation.
- To identify patterns in the transition from temporary to permanent housing, through examples studied in Peru and Chile.
- To analyse and compare modifications households make to their temporary houses.
- To define a set of strategies for the development of temporary housing designs which include flexibility while ensuring structural strength.

## Methodology

This research follows an interpretive system of enquiry which focuses on understanding and meaning-making, and assumes that the researcher interprets reality (Bhattacharya, 2008). Post-disaster accommodation is a topic where a complex variety of issues converge (technical, social, cultural, economic, political, aesthetical, among others), and although there are agreed concepts, there is no single understanding about this process. Therefore, the 'Constructivist–Interpretivist' research paradigm is used in this thesis, in which understanding reality is constructed from observing natural settings, also called 'Naturalistic' (Wang and Groat, 2013, p. 95).

The criteria used for assessing research using this approach are credibility, transferability, dependability and confirmability (Wang and Groat, 2013, pp. 84–86). Credibility to accomplish the complexities through a holistic approach, meaning triangulation (using a variety of data sources and a combination of data collection techniques) and member checks (checking interpretation with respondents). Transferability of themes and issues, meanwhile, is the extent to which the conclusions of one study can be applied to another setting or circumstance. Dependability is a notion that suggests consistency within the data, documenting all the processes by which data is collected, analysed and interpreted. Finally, confirmability of data and interpretations arises through the use of triangulation and reflexivity.

Two different research strategies are used to answer the questions posed here: an empirical approach (qualitative analysis and case studies) and a theoretical approach (discussion of concepts). For the theoretical approach, a literature review and a discussion about post-disaster accommodation is provided, in order to describe the concepts used in the field and by academics. Also, the concepts of 'flexibility' and 'home' were studied in order to identify the main concepts to be used in the proposal of design strategies. For the empirical approach, the methodology used was qualitative analysis through case studies. Primary case studies in Chile and Peru visited during fieldwork were compared and analysed for understanding the similarities and differences in the ways that families used and modified their temporary houses. The methods employed for the comparison included combined data collection, such as interviews, surveys, observation, documents, and drawings.

## II. Research contribution and audience

This PhD thesis aims to make a contribution to research on post-disaster accommodation through case studies, theoretical conclusions and empirical elements, different sides of this thesis that support each other. The comparison of cases of post-disaster accommodation in Peru and Chile, years after the disasters occurred, presents a novelty, since there are no studies comparing how the same temporary housing model performs in different cultures and climatic zones, and what families do with their houses after a disaster. The theoretical conclusions aim to define the possibilities of standardised solutions to include in the design the inevitable changes that families will make to them. The concepts of 'flexibility' and 'home' are reviewed under the needs of post-disaster accommodation. The empirical side of this research aims to support these concepts in the design process of a temporary house. Moreover, this research will contribute to define strategies that can guide future designs of post-disaster accommodation.

This study also aims to bridge two areas: on the one hand, the design of customisable and adaptable temporary houses, and on the other hand, the process of sheltering in the wake of disasters. Architects, designers, engineers and manufacturers have designed innovative post-disaster shelters, published widely but without impacting on humanitarian relief practices and with only a limited number built (Sterling, 2008, p. 87). In practice, accommodation implemented for disaster relief in most cases is developed by governments, non-governmental and relief organisations. The solutions used are in general coded in terms of economy, logistics, and material efficiency, and are often less appealing or less innovative in terms of design. Therefore, solutions used in practice are not published in architecture magazines or in design blogs, nor are they shortlisted for design awards, creating a gap between what is recognised as 'good-design' and what is defined as 'appropriate' in practice.

The audience for this research is comprised of researchers, designers, and humanitarian workers as well as other stakeholders and institutions involved in the process of recovery and reconstruction after disasters.

## III. Organisation of the thesis

The thesis is divided in two parts and eight chapters:

**Part One** provides an introduction to post-disaster accommodation and current debates on shelter and housing after disasters, and a discussion of the concepts of home and flexibility and their role in the design of post-disaster accommodation. **Chapter One** presents an up-to-date discussion of post-disaster accommodation. This chapter opens with an introduction of the implications of the loss of housing stock and the different paths to achieve a permanent dwelling after disaster. Then, it discusses the evolution of definitions and approaches to post-disaster accommodation in past decades, highlighting the main publications in the area. Underlining the lack of clear definitions and diversity of terms used for similar approaches, the literature review provides an overview of the key relevant concepts used in the academic and humanitarian sectors. **Chapter Two** examines current debates on post-disaster accommodation, in specific temporary and transitional shelter approaches. **Chapter Three** introduces the concept of 'home' and its importance in the provision of support to families affected by disaster. In addition, this chapter presents the concept of 'flexibility' used in the architectural discourse, and discusses different approaches to support incremental processes through design.

**Part Two** focuses on shelters adapted by families in Chile and Peru. **Chapter Four** introduces the framework and methodology used during fieldwork in both countries, as well as the model selected for analysis: a shelter built by TECHO NGO. **Chapter Five** describes and compares fifteen cases of post-disaster accommodation provided by TECHO to non-displaced families in Peru, and modified after the earthquake of 2007 that affected the Ica Province. **Chapter Six** describes and compares twelve cases of post-disaster accommodation modified by displaced families in Chile, after the earthquake and tsunami of 2010. **Chapter Seven** compares the cases studied in Peru and Chile, and reaches some conclusions about the similarities and differences of the cases, alongside the concepts of home, flexibility and housing as a process in post-disaster context.

## IV. Key terms

Due to the interdisciplinary nature of this topic, terms used in this thesis vary from author to author and between disciplines. The exact terms and their definitions, as used here, are included in the chapters where the subject matter is addressed.

In Chapter One, definitions of shelter and housing in disaster contexts are explained, identifying similar terms such as disaster relief shelter, post-disaster housing, post-disaster shelter, post-disaster temporary dwelling, temporary accommodation, core house, core shelter, emergency shelter, progressive shelter, semi-permanent shelter, temporary shelter, transitional shelter, transitional housing and T-Shelter. In this thesis, the term post-disaster accommodation is used to refer to all typologies of shelter provided after disaster.

In Chapter Three, the concepts of home, flexibility, adaptation and adaptability are defined and linked to experiences of post-disaster accommodation. The meaning of home and the lack of it are defined, and it is pointed out that 'home-making' is crucial to provide hope, opportunity, identity, attachment and sense of belonging. Flexibility, adaptation and adaptability, on the other hand, are similar terms that share the idea of modification, although in different ways and using different theoretical backgrounds. In this thesis, the term 'flexibility' is used as an umbrella term that can incorporate the other terms in its definition.

**Table 1.** Diagram of the research framework and organisation of the thesis.

| | **PART I Post-disaster accommodation, home and flexibility** | | **PART II Adapted shelters in Peru and Chile** |
|---|---|---|---|
| PROBLEM → | Definitions of post-disaster accommodation are ambiguous; terms are used in different ways | Standardised designs hardly include the concepts of flexibility and adaptation to different climates or families' needs | Standardised temporary houses are being customised by users, used as a starter home, without supervision, repeating vulnerabilities |
| QUESTION → | What are the terms, concepts and definitions relating to post-disaster accommodation? | How to incorporate the concepts of adaptation, flexibility and 'home' in post-disaster accommodation? | How and why do families modify temporary shelters and what are the characteristics of the process? |
| OBJECTIVES → | Understand current approaches<br>Find agreements, congruencies and consensus<br>Find discrepancies and main issues | To define the concepts of home and flexibility to be used in post-disaster accommodation<br>To identify a set of strategies for designing flexible post-disaster accommodation including progressive and incremental growth | To identify patterns in the transition from temporary to permanent housing, using temporary houses built in Chile and Peru<br>To analyse and compare modifications of temporary houses |
| METHODOLOGY → | Literature review | Literature review | Qualitative analysis<br>Case studies |
| TACTICS AND METHODS → | Theoretical framework<br>Definitions of Shelter, Housing, Temporary, and Transitional<br>Debate main concepts and issues from literature | Theoretical framework<br>Definition of concept of home in post-disaster context<br>Definition of strategies for flexible housing | Fieldwork<br>Combined data collection: interviews, surveys, observation, documents, drawings<br>Analysis of data and debate |
| PRODUCT → | **Definition of concepts (Theoretical)** | | **Analysis of specific cases that inform theory (Empirical)** |

# Chapter 1

# 1. Post-disaster accommodation: State of the art

## 1.1 Disasters and the loss of housing

Disasters and disaster risk are often caused by diverse factors which can be triggered by natural hazards and influenced by social, economic and political conditions (Shelter Centre, 2011, p. viii). In 1978, Ian Davis, a distinguished researcher on pre-disaster planning, risk reduction, and post-disaster recovery, noted the concern of UN agencies due to the increase in casualties from disasters, and the potential effects that the growth in world population and urbanisation could have in increasing the number of fatalities (Davis, 1978a, p. 17). In recent decades, the number of natural disasters has effectively increased, having an impact on the built environment (Félix et al., 2013). Some researchers suggest that there are three reasons for the increase: a rising frequency of natural phenomena due to climate change, the destruction of the ecological balance and global warming; an increase in the number of people living in vulnerable areas; and an increase in the use of low-cost design and materials (McDonald, 2003, p. 2).

Natural disasters typically result in damage to and destruction of housing, leaving people without adequate shelter, being temporarily displaced or homeless (Ferrer et al., 2009, p. I). For example, increasing frequencies of natural disasters between 2005 and 2010 meant that around twenty million people lost their houses during that period, resulting in the need for approximately five million houses, according to EM-DAT International Disaster Database (EM-DAT, n.d.; Wagemann and Ramage, 2013, p. 130). The effects of disasters on housing have, in turn, significant wider economic and social impact, because they impact many aspects of daily life, such as local businesses and school attendance, and also have psychological impacts (IRP, 2010, p. 5). After such events, short-term housing solutions on a massive scale are needed to shelter affected communities, and the regular local building industry may not cover the shortfall (IFRC, 2011a, p. 4). As Table 2 shows, the number of houses destroyed by recent disasters far exceeds the number of post-disaster accommodation that governments or aid organisations are able to deliver. This means that an important part of the recovery happens without formal support and that communities affected find shelter with families and friends; however that process is not well documented.

**Table 2**. Number of houses destroyed and post-disaster accommodation built after recent disasters of great magnitude.

| Disaster event | Approx. nº of destroyed houses | Approx. nº of temporary/ transitional houses |
|---|---:|---:|
| **US, Hurricane Katrina 2005** | 352,930 (1) | 92,000 (2) |
| **Peru, Ica Earthquake 2007** | 52,154 (3) | 15,000 (4) |
| **China, Sichuan Earthquake 2008** | 6,500,000 (5) | 677,000 (6) |
| **Haiti, Earthquake 2010** | 188,383 (7) | 125,000 (8) |
| **Chile, Earthquake and tsunami 2010** | 222,000 (9) | 70,489 (10) |
| **Japan, Earthquake and tsunami 2011** | 390,000 (11) | 54,000 (12) |
| **Philippines, Typhoon Haiyan 2013** | 548,793 (13) | 195,464 (14) |
| **Nepal, Kathmandu earthquake 2015** | 712,000 (15) | 222,000 (16) |

Source : (1) American Red Cross and National Association of Home Builders, 2006; (2) FEMA, 2010; (3) and (4) Ministerio de Vivienda, Construcción y Saneamiento del Perú, 2008; (5) UNDP; (6) FAFO and CASTED, 2012; (7) and (8) IFRC/EPYPS, 2011 (9) and (10) Gobierno de Chile, 2014; (11) and (12) IFRC, UN-HABITAT and UNHCR, 2013. (13) Philippines Shelter Cluster and WASH Cluster, 2014 (14) HSWG/Shelter Cluster, 2014 (15) Shelter Cluster Nepal, 2015 (16) Shelter Cluster Nepal, 2016.

The loss of housing stock has implications that go far beyond the simple loss of a building (IRP, 2010, pp. 5–6). After a disaster, access to adequate shelter can be critical for survival, and also for providing security, personal safety, protection from the elements and disease, and human dignity (Ferrer et al., 2009, p. I). Nevertheless, the process of sheltering is complex because many issues need to be considered, such as the availability of land, land ownership, the procurement of materials, rubble clearance, the involvement of affected communities and government, and coordination (Burnell and Sanderson, 2011, p. 189). Indeed, providing adequate shelter after disaster may be considered one of the biggest challenges faced by the international humanitarian community (Burnell and Sanderson, 2011, p. 189). However, as Figure 1 shows, the process of housing after a disaster does not follow a unique path towards durable or permanent house, and different strategies are employed in different contexts (Sampo, 2013, p. 66).

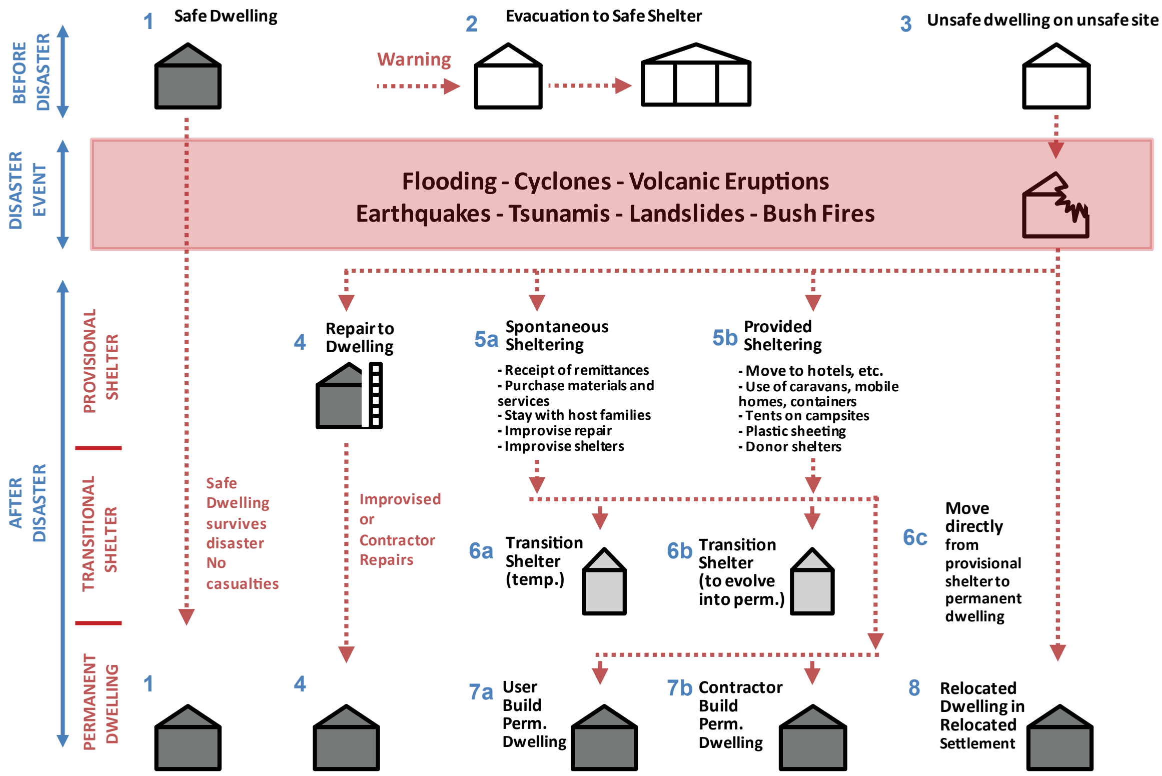



**Fig. 1**. Modes of shelter and housing after a disaster. Source: Based on Davis and Alexander, 2015, p.108.

Affected families achieve shelter and permanent housing in different ways, depending on the actors involved in reconstruction. They do this by self-building; being supported by governments; being supported by national or international organisations; or through some combination of these alternatives. Which actors get involved and in which way shelter is developed depends on the type and scale of the disaster, the local context, the political situation, and the ability of the affected population to meet their shelter needs (Sphere Project, 2011, p. 244). Hence, there is no perfect solution that fits every disaster or affected family (Gray and Bayley, 2015, p. 11). Although responses are diverse and particular to each case, the humanitarian sector has established common practices, such as the use of large structures as collective shelters (schools and community buildings), temporary camps (when relocation is needed), rented houses or flats, repair of damaged houses, and transitional or temporary shelters, among other strategies (Shelter Centre, 2012, pp. 4–5).

When families affected are unable or unwilling to return to their pre-disaster houses or land, transitional or temporary shelters are used (Sphere Project, 2011, p. 244). Although the terms 'temporary' and 'transitional' have been used to refer to both the process and the building solution, some conceptual differences can be found between them. In addition, the words 'shelter', 'housing' and 'accommodation' tend to be used interchangeably. In order to understand the differences and similarities among these terms and their implications in the type of housing and shelter provided, a literature review was carried out focusing on these concepts.

## 1.2 Post-disaster shelter and housing in recent decades

An interest in post-disaster accommodation has risen in the past years due to an increase in the impact of natural disasters (especially in urban areas) and media coverage of these events. However, there are examples of post-disaster accommodation from the early twentieth century and even earlier than that. One of the first images of temporary huts built after a disaster is a drawing of the aftermath of the earthquake that hit Concepción, Chile in 1835 made during Charles Darwin's scientific expedition. The local community coordinated a system of mutual assistance where the most affluent helped the most affected through the construction of temporary dwellings (Wagemann, 2012, p. 45). In the early years of the twentieth century, coordinated efforts to provide post-disaster accommodation came from governments, armed forces and aid organisations, such as shacks built by the Army Corps of Engineers and the Union of Carpenters after the San Francisco earthquake in 1906. Also, there are examples from the First and the Second World War, such as demountable wooden houses; prefabricated houses; yurts; temporary barracks; and Nissen, Romney and Quonset Huts built in Europe and the US.

In the late seventies and early eighties, the role of shelter after disasters received great interest from humanitarian organisations and researchers (Batchelor, 2011, p. 14). In 1976, the Disasters Emergency Committee in collaboration with the Disaster Unit of the Ministry of Overseas Development (UK) held a seminar on **Emergency Housing and Shelter** in London ('Conference Reports', n.d., p. 7). In the meeting, issues such as the complexity of shelter and housing, the lack of research on the topic, problems of coordination, and inclusion of affected communities were discussed ('Conference Reports', n.d., pp. 7–8). In 1977 the Committee on International Disaster Assistance of the National Academy of Sciences (US) sponsored the workshop **'The Role of Technology in International Disaster Assistance',** where a panel coordinated by Ian Davis was devoted to the topic of 'Emergency Shelter' (National Research Council, 1978a). Later, in 1978, Oxfam co-sponsored the largest international conference on post-disaster housing to date, called **'Disasters and the Small Dwelling',** held in the UK ('Editorial: The Oxford Conference 'Disasters and the Small Dwelling,' 1978, p. 97). The same year, a selection of papers presented in the conference was published in the journal *Disasters*, such as 'Disasters and the Small Dwelling: The State of the Arts' by Frederick Cuny (F. C. Cuny, 1978), and 'The Cultural Context of Shelter Provision' by Paul Oliver (Oliver, 1978). In addition, a report of the conference was published in 1980 in the same journal (Gray et al., 1980). These conferences and publications, although they did not define the concepts of post-disaster shelter and housing, introduced some of the issues found in the field relating to the process of reconstruction, and created a framework that has been employed by the humanitarian sector ever since.

During this period, crucial books were published on the topic of shelter. In 1978 Ian Davis published *'Shelter after Disaster'* based on research carried out for his PhD at University College London. The publication had an impact on the shelter sector, and led to conceptual agreements, such as '*shelter is a process, not an object'*, influenced by John Turner's *'Housing as a Verb'* in his book '*Freedom to Build',* 1972 (Davis, 1978b, p. 33; Kelman et al., 2011, p. 262; Kennedy et al., 2008, p. 25; Turner, 1972). In 1981, the Office of U.S. Foreign Disaster Assistance (OFDA) of the Agency for International Development, in collaboration with the Office of Housing published *'Disaster Assistance Manual: Transition Housing for Victims of Disasters'* (OFDA, 1981). This manual, prepared by David Oakley and, containing contributions by Paul Thompson, Frederick Cuny, and Joseph Arington, is one of the few documents from that time that incorporates guidelines for the design of shelters and settlements after disasters.

In 1982, the Office of the United Nations Disaster Relief Coordinator (UNDRO) published '***Shelter after Disaster- Guidelines for Assistance',*** edited by Ian Davis, based on his previous book, and with contributions from Frederick Cuny, Frederick Krimgold, Aloysius Fernandez and Paul Thompson (UNDRO, 1982). This guideline was the first comprehensive overview of humanitarian shelter practice and since then has become essential reading for many practitioners and researchers. Several questions shaped the fourteen principles proposed by the report. These principles are still relevant today, such as the importance of including the resources of survivors for avoiding duplication; the opportunity that reconstruction offers for risk reduction and reform; and the need for the accurate assessment of short term needs to provide adequate support. A revised second edition of this book was recently published in 2015 by the International Federation of Red

Cross and Red Crescent Societies (IFRC) and the Office for the Coordination of Humanitarian Affairs (OCHA) (Davis, 2015). During the launch of the second edition, it was pointed out that many questions and issues raised in the eighties remain un-resolved in practice to this day, such as inappropriate shelters, paternalism, and fragmentation of support ('Book Launch of Shelter after Disasters - 2nd Edition', 2015). Although these references offer guidelines for post-disaster shelter, they do not offer further definitions of temporary and transitional shelter.

The Office of the United Nations High Commissioner for Refugees (UNHCR), also in 1982, published the ***'Handbook for Emergencies'*** (with a second edition published in 1998, a third edition in 2007, and a fourth edition issued online in 2015). The aim of the handbook is to form a reference tool reinforcing common understanding among actors in emergency situations (UNHCR, 2007, p. vii). In the handbook, the term 'emergency shelter' is used to define the minimum dimensions for covered living spaces, per person, in cold and warm climates. This handbook is extensively used by practitioners in the humanitarian sector.

Also in 1982, Enrico Quarantelli, a pioneer researcher in the sociology of disasters based at the Disaster Research Centre (Ohio State University), published a report for the Federal Emergency Management Agency (FEMA) entitled ***'Sheltering and Housing after Major Community Disasters: Case Studies and General Observations'*** (Quarantelli, 1982). In this report, Quarantelli notes the lack of conceptual distinctions within the literature on shelter and housing, as well as the lack of specific vocabulary to describe them, due to the implicit assumption that the terms most commonly used are self-explanatory (Quarantelli, 1982, pp. 1–2). He points out, however, that the words 'housing' and 'shelter' have been given multiple and ambiguous meanings in practice, as well as having been used interchangeably without reference to the disaster life cycle (Quarantelli, 1982, p. 2). Thus, Quarantelli defines three categories of accommodation used after disasters and before achieving permanent housing: emergency shelters, temporary shelters, and temporary housing. He defines emergency shelters as short-term quarters to be used during the emergency period, such as community shelters, schools, and churches; temporary shelters, meanwhile, are quarters for temporary displacement until residents can return to their original homes, long after the peak of the emergency, such as mass shelters, friends' houses and motels (Quarantelli, 1982, pp. 2, 3, 75).

Quarantelli points out that the difference between emergency and temporary shelter is blurred, but the main distinction is the amount of time that accommodation will be used, and the activities that will be undertaken within it. He distinguishes 'shelter' from 'housing', where housing implies the resumption of household responsibilities and activities in the new quarters (Quarantelli, 1982, p. 3). Thus, temporary housing is defined as short-term accommodation in which families can resume their activities and routines for months or even years but which is not intended to be permanent, such as mobile homes, rented apartments or tents (Quarantelli, 1982, p. 3). Finally, permanent housing involves returning to either a rebuilt house or new quarters for the occupation of permanent residential facilities (Quarantelli, 1982, p. 3). Almost ten years later, in 1991, Quarantelli published ***'Patterns of Sheltering and Housing in American Disasters'***, which was based on this report (Quarantelli, 1991). In both publications, he noted that after disasters sheltering and housing phases do not necessarily happen in a linear way and there may be some overlap during the whole process (Quarantelli, 1991, p. 11, 1982, p. 78).

In 1989, the Disaster Management Centre (DMC) of Oxford Polytechnic (now Oxford Brookes University) and the National Centre for Earthquake Engineering Research (NCEER) of the State University of New York at Buffalo organised a second meeting of the conference **'Disasters and the Small Dwelling'**. Their aim was to review the progress on the subject since the 1978 conference and to provide a series of recommendations for the 'International Decade for Natural Disaster Reduction (IDNDR) (Aysan, 1991, p. 77). The use of the term 'small dwelling', referring to rural and traditional housing, was challenged in the light of recent disasters (Aysan, 1991, p. 77). The definition of this term was widened to incorporate urban dwelling and informal housing in big cities, and therefore used as a metaphor for a social and economic unit, a cultural and political entity, and a physical process and product (Aysan, 1991, p. 77). The incorporation of other aspects into the term was a reflection of changes in the sector, which shifted from a narrower technical, social and political focus to an integrated approach (Aysan, 1991, p. 78).

In 1997, a group of NGOs and the IFRC initiated the 'Sphere Project' in order to develop the ***'Sphere Handbook',*** a set of minimum standards in core areas of humanitarian response (Sphere Project, 2011, p. ii). The first edition was released in 2000 as the product of practitioners' collective experiences in the field, with the aim to improve the quality of humanitarian responses in situations of disaster and conflict (Sphere Project, 2011, p. ii). The handbook, revised in 2003 (published in 2004) and again in 2009 (published in 2011), has become a mainstay of humanitarian responses to disasters. Chapter Four of these guidelines is called '*Minimum Standards in Shelter, Settlement and Non-Food Items'*. Its first and second edition contain no definition of post-disaster shelter or housing, but design standards, minimum dimensions and recommendations for different climates are included.

Despite developments in post-disaster shelter practice and research, practitioners and scholars faced significant dilemmas at the beginning of the new millennium, such as the conflict between ‘temporary’ and ‘durable solutions’, the limited recognition of local contexts, and an absence of common terminology (Saunders, 2004, p. 160). The revision process of the Sphere Standards highlighted some challenges arising as a result of the variety of approaches to shelter assistance and to major differences of opinion about the understanding of terms in English and other languages (Saunders, 2004, pp. 161, 163). One example of this problem is the use of the terms ‘emergency’ or ‘temporary’ in the context of shelter, encouraging a focus on short-term needs and short-life shelter solutions, and limiting shelter provision (Saunders, 2004, p. 163). Another example, is the use of the word ‘shelter’ in English, which suggests the provision of a product, like ‘*abris*’ in French and ‘*refugio*’ in Spanish, while it is commonly understood that shelter is a process (Saunders, 2004, p. 134). Therefore, since the late 1990s the term ‘transitional’ was increasingly used to define shelter and settlement as an ongoing process (Saunders, 2004, p. 134), and it was incorporated into the 2011 edition of the Sphere Handbook.

In 2003, Sultan Barakat published the network paper ***‘Housing Reconstruction after Conflict and Disaster’***, commissioned and published by the Humanitarian Practice Network (HPN) at the Overseas Development Institute (ODI). In this publication, Barakat uses the terms ‘temporary shelter’ or ‘temporary housing’ interchangeably. He describes temporary shelters as structures designed for use in the months following disaster or conflict, prefabricated and imported, irrespective of culture or climate (Barakat, 2003, p. 15). Barakat introduces the term ‘transitional housing unit’ as a more durable solution that can be improved incrementally once the immediate post-disaster phase has passed (Barakat, 2003, p. 16).

The term ‘Transitional Settlement’ was defined by the Shelter Centre in 2005 from a consensus around general approaches to shelter needs (based on a process of peer-review) and published in the book ‘***Transitional Settlement. Displaced Populations’*** (Corsellis and Vitale, 2005, p. 7, 10). ‘Transitional Settlement’ is understood as *‘Settlement and shelter resulting from conflict and natural disasters, ranging from emergency response to durable solutions’,* emphasising the need for a transition to durable solutions and local development, and focused on the needs of displaced populations (Corsellis and Vitale, 2005, p. 7). ‘Transitional shelter’ is defined as

> *‘Shelter which provides a habitable covered living space and a secure, healthy living environment, with privacy and dignity, to those within it, during the period between a*

*conflict or a natural disaster and the achievement of a durable shelter solution'* (Corsellis and Vitale, 2005, p. 11).

This approach was introduced by the Shelter Centre, supported by the Department for International Development to United Nations High Commissioner for Refugees (UNHCR), following the Indian Ocean tsunami of December 2004 (Shelter Centre, 2012, p. xvi).

The Shelter Centre, initially based at the University of Cambridge under the name 'shelterproject' and later moved to Geneva, produced a number of publications developing this approach in collaboration with other organisations, such as *'Settlement and Reconstruction after Natural Disasters'* in 2008 (UNOCHA, 2008); '*Transitional Shelter Prototypes'* in 2009 (Shelter Centre, 2009a); '*Transitional Shelter Standards'* in 2009 (Shelter Centre, 2009b); '*Shelter after Disaster. Strategies for Transitional Settlement and Reconstruction'* in 2010 (UK DFID, 2010); '*Urban Shelter Guidelines. Assistance in Urban Areas to populations Affected by Humanitarian Crises*' in 2010 (Suvatne and Crawford, 2010); '*Literature Review for Shelter after Disaster'* in 2011 (Shelter Centre, 2011); and '*Transitional Shelter Guidelines'* in 2012 (Shelter Centre, 2012). In the latter, the concept of 'transitional shelter' is developed, with definitions, examples, recommendations and principles. It is stated in that document that since its introduction in 2005, no guidelines were published that fully explained the transitional shelter approach; this guideline, then, serves to fill that gap, and reflects the consensus of 44 agencies as well as humanitarian specialists (Shelter Centre, 2012, p. viii).

In 2008, an ambitious project overseen by shelter specialists representing key organisations (UNHABITAT, IFRC and UNHCR) started a compilation of cases of shelters used in the field. To date, the project has published five books with 150 case studies (editions in 2008, 2009, 2010, 2011-2012 and 2013-2014), overviews and updates of post-disaster and post-conflict shelters around the world, which are also available on the website www.sheltercasestudies.org (UNHABITAT et al., n.d.). The Shelter Project series provide an important resource of cases of post-disaster accommodation, which illustrate project options available to humanitarian organisations, showing their weaknesses and strengths.

The World Bank published '***Safer Homes, Stronger Communities*'** in 2010, which discusses the term 'transitional shelter', based on the Shelter Centre's definitions. In this publication the concept is defined as a solution that can reduce time pressure (Jha et al., 2010, p. 1). In the document, the differences between 'temporary' and 'transitional' shelter are explained. While the first is occupied immediately after the disaster and understood to be time-limited, the second provides incremental support from the recovery process until the completion of reconstruction (Jha et al., 2010, p. 15). Moreover, it distinguishes 'transitional shelter' from 'semi-permanent shelter', on the basis that the former is generally movable and more flexible than the latter (Jha et al., 2010, p. 15).

In the 2011 edition of the '***Sphere Handbook'***, the term 'transitional shelter' is defined as an approach rather than a phase, a post-disaster solution that may: be reused in part or as a whole in more permanent structures; be moved from temporary to permanent locations; and provide a starter home that can be upgraded, expanded, replaced, disassembled and reused (Sphere Project, 2011, p. 252). It also points out that temporary or transitional shelter solutions may be required to provide adequate shelter for an extended period (potentially years) through different seasonal climates, while ensuring with local authorities that they are not allowed to become permanent housing (Sphere Project, 2011, p. 259). In the 2015 version of the UNHCR Handbook for Emergencies, 'temporary shelter' and 'transitional shelter' refer to frequently used shelter solutions associated with planned and managed camps, alongside the term 'emergency shelter', but without further descriptions (UNHCR, 2015).

Terminologies and definitions are relevant because they provide guidance for the design and descriptions of roles in post-disaster contexts. However, they can also create administrative dilemmas. For example, the Office of U.S. Foreign Disaster Assistance (OFDA) can implement 'shelter' programmes but not 'housing' because the first is seen as lower cost 'emergency' assistance, while the second is considered long term and more costly 'development' assistance (Saunders, 2004, p. 166). For the same reason, the U.S. Agency for International Development (USAID) can support 'housing', but not 'shelter' (Saunders, 2004, p. 166). On the other hand, international legal documents related to post-disaster accommodation use the term 'shelter' and 'housing' interchangeably (Corsellis and Vitale, 2005, p. 16). For instance, while UNHABITAT uses the term 'shelter', UNHCR uses the term 'housing'.

Chapter IV: B of the Habitat Agenda (1996) is entitled ***'Adequate Shelter for All'***, a phrase which refers to the ***'Right to Adequate Housing'*** from the ***'Universal Declaration of Human Rights'*** (1948) (UNCHR, n.d.; United Nations, n.d.). Therefore, based on the right to adequate housing, adequate shelter is defined by UN as more than a roof, because it means:

'(…) *adequate privacy; adequate space; physical accessibility; adequate security; security of tenure; structural stability and durability; adequate lighting, heating and ventilation; adequate basic infrastructure, such as water-supply, sanitation and waste-management facilities; suitable environmental quality and health-related factors; and adequate and accessible location with regard to work and basic facilities: all of which should be available at an affordable cost*.' (United Nations, n.d.)

It is pointed out that adequacy varies from one country to another, since it depends on cultural, social environmental and economic factors (United Nations, n.d.).

As these references show, stakeholders, researchers and practitioners involved in post-disaster housing have struggled to define post-disaster accommodation, even though most agree with the maxim that housing is a continuous process (National Research Council, 1978; Davis, 1978b; Kelman et al., 2011; Kennedy et al., 2008). In 2011 the IFRC published a book called ***'Transitional Shelter: Eight Designs'*** for internal circulation, showing designs available for the organisation. After the document came to be widely used as reference by humanitarian workers, in 2013 a second edition was published called ***'Post-Disaster Shelter: Ten Designs'*** (Saunders, 2013, p. 4). In this publication it is recognised that there exist diverse definitions, referring to the different contexts in which structures are built, such as: emergency shelters, T-shelters, temporary shelters, transitional shelters, progressive shelters, and core shelters/one room shelters (IFRC, 2013, p. 8).

**Table 3**. Summary of main events and publications on post-disaster accommodation from the past four decades.

| **Key events in Post-Disaster Housing and Shelter from the past 40 years** | **Evolution of concepts** |
|---|---|
| 1976. Seminar on Emergency Housing and Shelter. The Disasters Emergency Committee - the Disaster Unit of the Ministry of Overseas Development (UK). London | **Emergency Shelter and the Small Dwelling** |
| 1977. Panel on 'Emergency Shelter' in the workshop 'The Role of Technology in International Disaster Assistance'. The Committee on International Disaster Assistance of the National Academy of Sciences (US) | |
| 1978. International Conference 'Disasters and the Small Dwelling'. Oxfam (UK) | |
| 1978. I. Davis publishes 'Shelter after Disaster' based on PhD research at University College London | **Shelter After Disaster** |
| 1981. The OFDA of the Agency for International Development with the Office Housing publishes *'Disaster Assistance Manual: Transition Housing for Victims of Disasters'*. By D. Oakley, P. Thompson, F. Cuny, and J.Arington | |
| 1982. UNDRO publishes *'Shelter after Disaster- Guidelines for Assistance'* edited by I. Davis, based on his previous book, and with contributions from F. Cuny, F. Krimgold, A. Fernandez and P. Thompson | |
| 1982. UNHCR publishes the *'Handbook for Emergencies'* (with further editions published in 1998 and 2007, and online in 2015) | **Urban Disasters and Phases: Emergency Shelter, Temporary Shelter, Temporary Housing and Permanent Housing** |
| 1982. E. Quarantelli publishes a report for FEMA *'Sheltering and Housing after Major Community Disasters: Case Studies and General Observations'*. Definitions of sheltering and housing. | |
| 1989. Second International Conference *'Disasters and the Small Dwelling'*. The Disaster Management Centre of Oxford Polytechnic and the National Centre for Earthquake Engineering Research (NCEER) of State University of New York (US) | |
| 1991. Quarantelli publishes *'Patterns of Sheltering and Housing in American Disasters'* | |
| 1997. Sphere Project is initiated by a group of NGOs and the Red Cross and Red Crescent Movement | |
| 2000. *'Sphere Handbook'* is published with a set of minimum standards in core areas of humanitarian response (with further editions in 2004 and 2011) | |
| 2003. S. Barakat publishes *'Housing Reconstruction after Conflict and Disaster'* by the Humanitarian Practice Network (HPN) at the Overseas Development Institute (ODI) | |

| | |
|---|---|
| 2005. T. Corsellis and Antonella Vitali from the Shelter Centre publish *'Transitional Settlement. Displaced Populations'* | **Introduction of Transitional Shelter Approach** |
| 2008. The compilation '*Shelter Projects*' is initiated by shelter specialists representing key organisations (UNHABITAT, IFRC and UNHCR) 150 case studies (editions in 2008, 2009, 2010, 2011-2012 and 2013-2014) | |
| 2010. World Bank publishes '*Safer Homes, Stronger Communities*' (Jha et al.) | |
| 2011. The IFRC publishes '*Transitional Shelter: Eight Designs*' | |
| 2012. The Shelter Centre publishes *'Transitional Shelter Guidelines'* | |
| 2013. The IFRC publishes '*Post-Disaster Shelter: Ten Designs*' | |
| 2015. A 2nd edition of I. Davis' *'Shelter after Disaster- Guidelines for Assistance'* is published by the IFRC and OCHA | |

## 1.3 Post-disaster accommodation: current definitions and meanings

In order to understand the current approaches to post-disaster accommodation, a literature review was carried out. The questions that guided this analysis were: What are the terms and concepts used for post-disaster accommodation? And what are their definitions? Initially five terms were used as keywords to identify and collect explanations and descriptions from existing studies from the past 20 years (1995-2015): emergency shelter; temporary shelter; temporary housing; temporary accommodation; and transitional shelter.

After the first search on databases, other terminologies were found in publications related to post-disaster accommodation, and therefore included in this research: core house; core shelter or one-room shelter; disaster relief shelter; post-disaster housing; post-disaster shelter; post-disaster temporary dwelling; progressive shelter; semi-permanent shelter; sites and services; temporary dwelling; transitional homes; transitional housing; T-shelter.

Articles, reports, guidelines, papers and books were reviewed in the process. Then, relevant documents which define the keywords and meet the eligibility criteria were gathered, categories were generated and a final interpretation criterion was produced. The inclusion and exclusion criteria, as well as the databases used, are explained in more detail in the appendices.

Publications that included any of the key words in the title or summary were classified as peer-reviewed articles, books or book chapters, guidelines by NGOs or research institutions, conference papers, and unpublished Bachelor's, Master's and Doctoral theses. From 157 documents found containing the key terms, only 47 included more detailed definitions of these concepts. From those, 42 were selected that passed the quality assessment (peer review, widely accepted guidelines, published books, based on more than one case study and use of references). During the search it was necessary to distinguish between temporary accommodation provided by governments to homeless people for economic reasons and temporary accommodation provided as result of natural disasters. Only documents that referred to the latter were included.

From each of the 42 documents selected, the definitions of post-disaster accommodation were collected, studied and compared in order to find similarities and differences, as well as the frequencies of terms used. Finally, other issues that could help to define these terms were included during the analysis. In the selection process, one of the aims was to encounter a balance between academic papers and documents written by NGOs, in order to have information from

**Table 4**. Classification of publications found, included and excluded in the review.

| Classification | Including keywords | Including keywords in title or summary | Including definitions | Selected for analysis |
|---|---|---|---|---|
| Peer reviewed articles | 45 | 40 | 15 | 15 |
| Books or book chapters | 8 | 3 | 2 | 2 |
| Guidelines by NGOs | 26 | 24 | 16 | 16 |
| Reports by NGOs or research institutions | 38 | 36 | 6 | 6 |
| Conference papers | 27 | 15 | 6 | 2 |
| Thesis (Ba, Ms and PhD) | 13 | 9 | 2 | 1 |
| **Total** | 157 | 127 | 47 | 42 |

both practitioners and scholars. An initial observation was that some publications use general terms to describe post-disaster accommodation types or phases. This general term is not an agreed concept, and four different terms were found: disaster relief shelter; post-disaster housing; post-disaster shelter; post-disaster temporary dwelling; and temporary accommodation. These general terms comprise different types of accommodation or different phases of the housing process after a disaster. Most of these documents provide definitions of the specific terms used, as Table 5 shows. The term ‘permanent housing’ is also included in some of the categories.

A difference was found in the use of terms in academic papers and documents produced by NGOs. As can be seen in Figure 2, the terms most used in the documents studied that come from academia are ‘temporary housing’ and ‘temporary shelter’, while the terms most used by NGOs is ‘transitional shelter’. One of the reasons for this difference might be the incorporation of the ‘Transitional Shelter Approach’ in the past decade, which may have had an influence in the humanitarian organisations, and therefore, the creation of documents seeking to describe and define the new approach. Probably for the same reason, the explanations and descriptions of this term are more extended and detailed than others. Other terms that have wider use in the academic sector are ‘emergency shelter’ and ‘transitional shelter’.

**Table 5**. General terms that refer to post-disaster accommodation.

| General Term | Specific types | Categories | Reference |
|---|---|---|---|
| **Disaster relief shelter** | Emergency shelter<br>Temporary shelter<br>Temporary house<br>Transitional shelter<br>Progressive shelter<br>Core shelter<br>Permanent housing | Alternatives | Abdulrahman Bashawri, Stephen Garrity and Krisen Moodley, 'An Overview of the Design of Disaster Relief Shelters', *Procedia Economics and Finance*, 18 (2014), 924–31 |
| **Post-disaster housing** | Emergency shelter<br>Temporary housing<br>Permanent houses | Phases | Mahmood Fayazi and Gonzalo Lizarralde, 'The Role of Low Cost Housing in the Path from Vulnerability to Resilience', *ArchNet-IJAR*, 7.3 (2013), 146–67 |
| **Post-disaster shelter** | Emergency shelter<br>T-shelter<br>Temporary shelter<br>Transitional shelter<br>Progressive shelter<br>Core shelter - One room shelter | Alternatives | IFRC, *Post-Disaster Shelter. Ten Designs* (Geneva: IFRC, 2013) |
| **Post-disaster temporary dwelling** | Temporary shelter<br>Temporary housing | Phases | Adham Hany Abulnour, 'The Post-Disaster Temporary Dwelling: Fundamentals of Provision, Design and Construction', *Housing and Building National Research Center Journal (HBRC)*, 10 (2014), 10–24 |
| **Temporary accommodation** | Emergency shelter (if household responsibilities are resumed)<br>Temporary shelter<br>Temporary housing | Phases | Cassidy Johnson, 'What's The Big Deal About Temporary Housing? Planning Considerations For Temporary Accommodation After Disasters: Example Of The 1999 Turkish Earthquakes' (presented at the TIEMS Disaster Management Conference, Waterloo, Canada, 2002) |

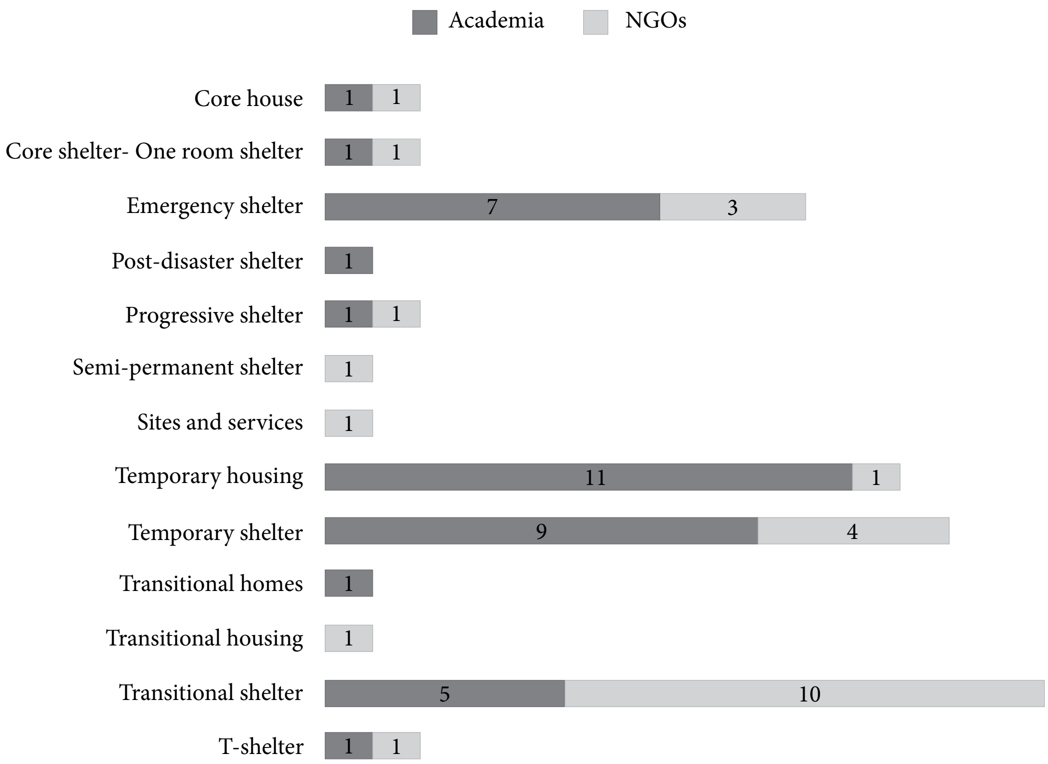



**Fig. 2**. Frequency of terms used in publications analysed.

Definitions for each of the 13 terms were selected from the documents and then compared. In several cases, definitions are based on other documents which are recognised as key literature for the topic of post-disaster accommodation. A summary for each of the definitions was created with reference to key bibliography. The most used terms – emergency shelter, temporary shelter, temporary housing, and transitional shelter – were studied in more detail.

### 1.3.1 Most used terms: Emergency shelter, temporary shelter, temporary housing, and transitional shelter

***Emergency shelter***

Emergency shelter is defined by Quarantelli as a phase in the immediate aftermath of a disaster in which families find shelter for a couple of days, and where regular daily routines are suspended (Quarantelli, 1995). Because the stay is short, in general it does not imply the need for extensive preparation of food or prolonged medical services (Johnson, 2007a; Quarantelli, 1995). Despite its definition, in many cases this phase lasts for weeks or even months. It can take the form of a public shelter, large emergency shelters, such as gymnasiums or schools, emergency group sites using clusters of manufactured housing, a friend's house, a plastic sheet, rental assistance, or other supporting services (McCarthty, 2009; Quarantelli, 1995, p. 2). Although these types of shelter differ greatly one from another, Oxfam has argued that Sphere's shelter and settlement standards should be used, allocating a minimum of 3.5 $m^2$ of covered space per person (Oxfam GB, 2003, p. 2; Sphere Project, 2011).

***Temporary shelter***

Temporary shelter is defined as a place in which the affected families reside following the disaster for an expected short stay before more suitable housing becomes available. It may take the form of a tent, a self-built shelter, a public facility, public mass shelter, a motel, the home of family or friends, or a second home and must be accompanied by the provision of food, water and medical treatment (Félix et al., 2013; Johnson, 2007a, 2007b; Johnson et al., 2006; Quarantelli, 1995). While Quarantelli indicates that temporary shelters are used during the weeks following a disaster, Barakat points out that they are designed to be used in the early months after disasters, and the IFRC states that they must be limited with a specific lifespan, prioritising speed of construction and limiting costs (Barakat, 2003; IFRC, 2013; Quarantelli, 1995).

Although they can take different forms, temporary shelters are usually prefabricated, imported and used throughout the world regardless of culture or climate, and they tend to be small and made from light materials in order to facilitate transportation (Barakat, 2003; Félix et al., 2015). In terms of use, material and construction, there are two main types: temporary shelters with transformable elements that use flexible and rigid elements which are easy to assemble, carry and lightweight; and temporary shelters with non-transformable elements which use rigid materials that are easy to assemble but heavier and more difficult to transport (Félix et al., 2015).

**Fig. 3.** Emergency shelter by Shigeru Ban Architects, East Japan Earthquake and Tsunami.

Source: Shinekenchiku-sha, 2011, p. 122.

**Fig. 4.** Temporary shelter. Haiti earthquake, 2010.

Source: Calzadilla and Martin, 2011.

### ***Temporary housing***

Temporary housing is a shelter in which a family resides temporarily while resuming their household responsibilities and daily activities (Quarantelli, 1991). It is the physical structure that people inhabit after a disaster, it is part of a process of rehousing after disasters, and a place that serves to shelter people from the disaster event until they have a permanent place to live (Johnson, 2007b, 2002; Johnson et al., 2006). It may take the form of a prefabricated house, winterised tent, self-built shelter, mobile home, apartment or the house of a family member or friend (Quarantelli, 1991). However, some authors contend that the form it takes is irrelevant, since it represents the process by which families can begin to recover and reintegrate. Therefore, while the existence of a physical roof is important, so are location, access to services and jobs, proximity to the former dwelling if required, maintenance of neighbourhood ties, and guidance on the options and procedures for achieving permanent housing (Fayazi and Lizarralde, 2013; Johnson et al., 2006; Lizarralde et al., 2009). Following the stages defined by Quarantelli, temporary housing bridges the gap between temporary shelter and the conclusion of the reconstruction, and promotes a return to normality (Johnson, 2007b; Johnson et al., 2006).

Temporary housing is designed to last for periods such as six months to three years, tends to be similar to a permanent house (bigger and more resistant than a temporary shelter), provides essential services such as water supply, drainage and electricity, and in many cases is installed on temporary land (Bashawri et al., 2014; Félix et al., 2015, 2013). In terms of construction systems, there are two main groups of temporary housing: a) ready-made units, which are manufactured in factories, transported and then easily assembled on site, and b) kit supplies, which are elements of the building provided to be assembled on site (Félix et al., 2013).

### ***Transitional shelter***

Transitional shelter is defined as an incremental process that provides shelter to affected families, starting with the first assistance offered during the emergency and extending throughout the period of securing land rights and reconstruction, which can take several years (Shelter Centre, 2012, p. 2). It is considered an approach rather than a phase, and a process rather than a product, which supports self-management and self-recovery of the affected population and promotes the transition to more durable shelter (Collins et al., 2010; Sphere Project, 2011, p. 252). The term 'transitional' emphasises that shelter is a process, a transition between emergency and permanent solutions (Kennedy et al., 2008). This process can take the form of plastic sheeting

**Fig. 5.** Temporary housing in Kisennuma city, Miyagi Prefecture. Japan earthquake and tsunami, 2011. Source: Imakawa, 2014.

**Fig. 6**. Transitional shelter by Habitat for Humanity. Haiti, earthquake 2010.
Source: Habitat for Humanity, 2010.

with basic structural elements, which may be later integrated into a locally designed and produced transitional shelter (Shelter Centre, 2012, p. 84). The design should be as follows: structurally sound; provide adequate protection from the environment; offer safety and security; provide access to water and sanitation; support livelihoods; and achieve agreed standards (Shelter Centre, 2012, p. 96). Transitional shelters predominantly use local materials contributing to local and regional economies, although stockpiled versions can be developed when local markets and environments cannot provide sufficient materials (Collins et al., 2010).

Transitional shelter should be designed to be: upgraded into part of a permanent house; reused for another purpose; relocated from a temporary site to a permanent location; resold in order to generate income; and recycled for reconstruction (Shelter Centre, 2012, p. 2). The transitional shelter approach aims to initiate and support sustainable processes which are driven by the affected families and, therefore, are culturally appropriate (Shelter Centre, 2012, p. 3).

This approach can be used with both displaced and non-displaced populations. For displaced populations, the shelter can be disassembled and reused in new locations or on their original sites when possible; and for non-displaced populations it can provide a basic starter home to be upgraded, expanded or replaced over time (Sphere Project, 2011, p. 252).

Transitional shelters are designed to facilitate the transition to more durable housing solutions; therefore, they offer the opportunity to link relief with development, going from emergency to rehabilitation and, in turn, to reconstruction (Alegria Mira et al., 2014; Zea Escamilla and Habert, 2015a). In terms of life-cycle, they offer a sustainable alternative, because they can be moved, reused, and reassembled, instead of becoming obsolete structures (Alegria Mira et al., 2014).

In terms of construction system, prefabricated shelter units are not considered appropriate for this approach, because they are often produced internationally without the involvement of the community in the design, and without considering the incremental process (Shelter Centre, 2012, p. 8).

Besides the terms emergency shelter, temporary shelter, temporary housing, and transitional shelter, other terms are found in the literature:

- **Core house, core shelter- one room shelter** (Bashawri et al., 2014; IFRC, 2013; Ikaputra, 2008a; Shelter Centre, 2012). Defined as a room that will be part of a permanent house, which can be extended by the family into a larger house and that offers shelter while the remainder of the house is completed. It reaches permanent housing standards and may include parts of the rest of the house, such as foundations and key services.

- **Post-disaster shelter (transitional shelter)** (Zea Escamilla and Habert, 2015b). Rapid post-disaster living quarters built with materials that can be upgraded to or re-used in more permanent buildings or relocated from temporary sites to permanent locations. They are designed to facilitate the transition to more durable housing solutions.

- **Progressive shelter** (Bashawri et al., 2014; IFRC, 2013). Designed to be upgraded to a more permanent shelter through a structure that can integrate future transformations.

- **Semi-permanent shelter** (IFRC, 2013). An approach in which some elements of a house, such as foundations and a roof, are built to offer shelter while the remainder of the house is completed, requiring in some cases the parts to be disassembled in order to complete reconstruction.

- **Sites and services** (Shelter Centre, 2012). Sites and services is an approach according to which the site for the permanent house and services are provided, such as the bathroom, sewage and electrical supply, while the other components of the house are built incrementally, increasing the quality of planning and maintaining hygiene.

- **Transitional homes** (D'urzo, 2011, p. 59). Named as houses designed to last at least two or three years.

- **Transitional housing** (Barakat, 2003). Defined as quick and (ideally) low-cost housing units provided by agencies that beneficiaries can themselves improve incrementally once the immediate post-disaster phase has passed, offering possibilities of permanence.

- **T-Shelter** (Gray and Bayley, 2015; IFRC, 2013). A term used to refer to both temporary shelters and transitional shelters, IFRC points out that this overlap provides flexibility when either of these terms are politically unacceptable.

**Table 6.** Key bibliography for defining post-disaster accommodation.

| Author | Title |
|---|---|
| **Enrico Quarantelli** | 'Patterns of Sheltering and Housing in US Disasters', *Disaster Prevention and Management: An International Journal*, 4.3 (1995), 43–53. |
| **Cassidy Johnson** | 'Strategic Planning for Post-Disaster Temporary Housing', *Disasters*, 31.4 (2007), 435–58 |
| | 'Impacts of Prefabricated Temporary Housing after Disasters: 1999 Earthquakes in Turkey', *Habitat International*, 31.1 (2007), 36–52. |
| | 'What's The Big Deal About Temporary Housing? Planning Considerations For Temporary Accommodation After Disasters: Example Of The 1999 Turkish Earthquakes' (presented at the TIEMS Disaster Management Conference, Waterloo, Canada, 2002). |
| **Cassidy Johnson, Gonzalo Lizarralde and Colin H. Davidson** | 'A Systems View of Temporary Housing Projects in Post-disaster Reconstruction', *Construction Management and Economics*, 24.4 (2006), 367–78. |
| **Oxfam GB** | *Oxfam GB's Guidelines for Post Disaster Housing Reconstruction* (United Kingdom, 2003). |
| **Sultan Barakat** | 'Housing Reconstruction after Conflict and Disaster', Network Paper, 2003. |
| **Daniel Félix, Jorge M. Branco and Artur Feio** | 'Temporary Housing after Disasters: A State of the Art Survey', *Habitat International*, 40 (2013), 136–41. |
| **Daniel Félix, Daniel Monteiro, Jorge Branco, Roberto Bologna, Artur Feio** | 'The Role of Temporary Accommodation Buildings for Post-Disaster Housing Reconstruction', *Journal of Housing and the Built Environment*, 30.4 (2015), 683–99. |
| **Sam Collins, Tom Corsellis and Antonella Vitale** | 'Transitional Shelter: Understanding Shelter from the Emergency through Reconstruction and Beyond. Case Study No.5', *ALNAP Innovations*, 2010. |
| **Abhas K. Jha, Jennifer E. Duyne, Priscikka M. Phelps, Daniel Pittet, Stephen Sena** | *Safer Homes, Stronger Communities: A Handbook for Reconstructing After Natural Disasters* (The World Bank, 2010). |
| **Sphere Project** | *Sphere Handbook, Humanitarian Charter and Minimum Standards in Humanitarian Response*, 3. ed (England: Practical Action Publishing, 2011). |
| **Shelter Centre** | *Transitional Shelter Guidelines* (Geneva: Shelter Centre, 2012). |
| **Abdulrahman Bashawri, Stephen Garrity and Krisen Moodley** | 'An Overview of the Design of Disaster Relief Shelters', *Procedia Economics and Finance*, 18 (2014), 924–31. |
| **Mahmood Fayazi and Gonzalo Lizarralde** | 'The Role of Low Cost Housing in the Path from Vulnerability to Resilience', *ArchNet-IJAR*, 7.3 (2013), 146–67 |
| **IFRC** | *Post-Disaster Shelter. Ten Designs* (Geneva: IFRC, 2013). |
| **Adham Hany Abulnour** | 'The Post-Disaster Temporary Dwelling: Fundamentals of Provision, Design and Construction', *Housing and Building National Research Center Journal (HBRC)*, 10 (2014), 10–24. |

## 1.4 Concurrencies and inconsistencies in definitions of post-disaster accommodation

Although the definitions of post-disaster accommodation help to understand the objectives of each approach and to locate them in the timeline of the reconstruction process, there are some overlaps, especially in relation with the physical form they take (Table 7). For instance, self-built shelters, tents, and the house of family or friends are mentioned as examples in three different definitions: emergency shelter, temporary shelter and temporary housing. Moreover, due to the similarities in their building systems the terms temporary shelter and transitional shelter are used interchangeably. Also, temporary shelters are referred to as emergency shelters, making the differences more blurred (Abulnour, 2014; Barakat, 2003).

**Table 7**. Main terms and the form they take.

| | Family friends house | Public shelter | Kit of supplies | Tent | Self-built shelter | Rental assist. | Manuf. Prefab. Shelter | Mobile home |
|---|---|---|---|---|---|---|---|---|
| Emergency shelter | ● | ● | ● | ● | ● | ● | ● | |
| Temporary shelter | ● | | ● | ● | ● | ● | ● | ● |
| Temporary housing | | | ● | ● | ● | ● | ● | ● |
| Transitional shelter | | | ● | ● | ● | | | |

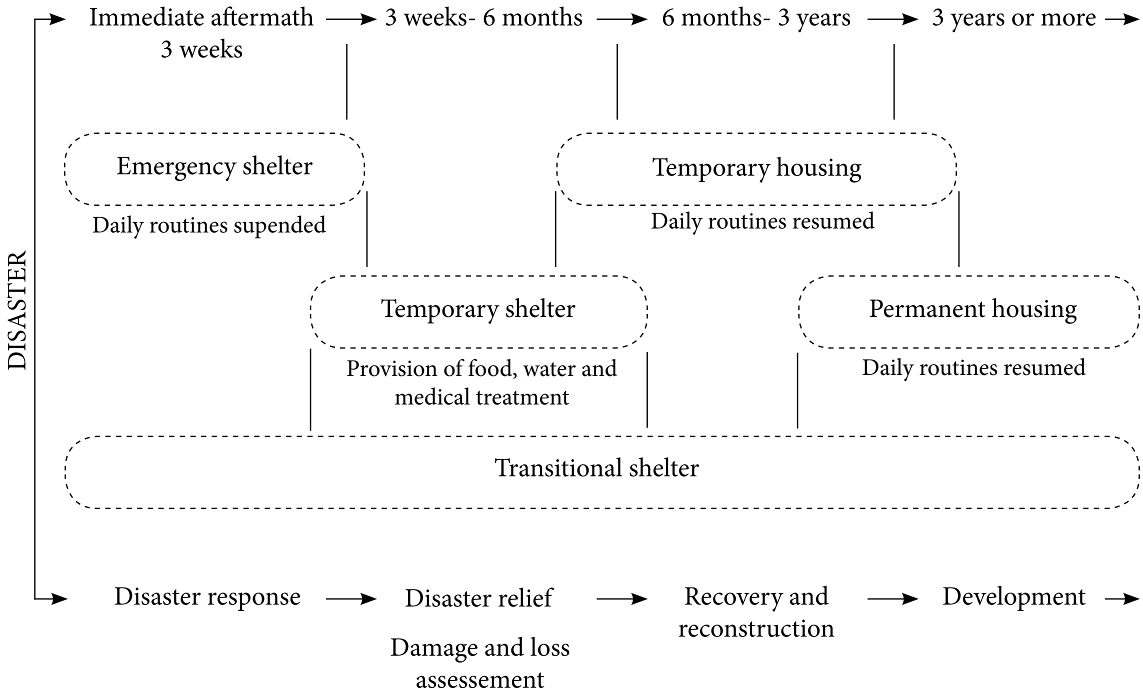



**Fig. 7.** Timeline of post-disaster accommodation.

### ***Timeframe***

The main difference between the four most used terms is their timeline (Figure 7). Although they lie on a continuum, they cover different stages of the post-disaster situation:

- Emergency shelter. Immediate aftermath to few weeks after the disaster.
- Temporary shelter. Few weeks after the disaster to six months (expected short-term).
- Temporary housing. Few months after the disaster to three years, or when the permanent house is built.
- Transitional shelter. Immediate aftermath to the permanent house. It covers the whole process.

The temporal division between emergency shelter, temporary shelter and temporary housing follows Quarantelli's definitions, which are based on observations on the ground instead of suggestions on how to divide the process (Quarantelli, 1995). However, establishing different approaches for different stages is seen as a way to coordinate the process through defined phases instead of overseeing the whole process of reconstruction, which can last for several years and which is extremely complex. An example of this sequence might be the provision of tents for the first months, temporary shelters for the first two years, followed by the construction of a permanent solution. Nevertheless, in some cases these time definitions are artificial and emergency and temporary shelters are used for many years, regardless of any planning.

As a way to fill the gap, the transitional shelter approach seeks to provide a holistic approach to housing, as an incremental process. Nevertheless, in terms of definitions, the details of how, and at which stages, materials and support should be provided are less clear.

#### ***Uses***

Quarantelli makes a distinction between the activities that will be developed in each phase, and these help to define three phases related to the shelter process (Quarantelli, 1995):

- Emergency shelter. Immediate aftermath, daily routines are suspended.
- Temporary shelter. Weeks after the disaster, provision of food, water and medical treatment.
- Temporary housing. Months and years after the disaster, families resume their household responsibilities and daily routines.

The definitions of the transitional shelter approach do not mention when routines are to be established, perhaps because this is understood as a continuous process and therefore the timeframe is more flexible.

#### ***Permanence and impermanence***

What happens with the dwelling after its use is not usually stated in the literature, apart from the transitional shelter approach, which is defined as a continuous process, in which parts can be upgraded, reused, relocated, sold or recycled (Shelter Centre, 2012). Nevertheless, there are some studies that investigate ways of dismantling and reusing the materials of temporary housing, in the context of building waste management (Arslan, 2007; Arslan and Cosgun, 2008, 2007). The definition of impermanence differentiates the four main terms from other approaches found in the literature, such as core house, progressive house, sites and services. The other approaches aim to provide the foundation stage for permanent housing, and therefore have different objectives. Despite the similarities, the transitional shelter is neither a core house nor a progressive house, which both start with the construction of one room and are then transformed into a permanent house, because their design do not consider reuse for another purpose, relocation, recycle or reselling the materials, while the transitional shelter does (Shelter Centre, 2012, p. 8). Also, transitional shelters share some characteristics with the semi-permanent shelters but provide more flexibility, because they can be moved when conditions change after disasters and during the reconstruction process (Jha et al., 2010).

### ***Displaced and non-displaced***

Although the definition of the transitional shelter is the only one that explicitly states that it can be used by displaced and non-displaced families, the four approaches (emergency shelter, temporary shelter and housing and transitional shelter) can be used indistinctively, because they are all meant to serve for a certain period of time, despite the land situation. This means that they can be used either in a temporary settlement, such as a camp, or on the same site as the damaged or destroyed house, if possible.

### ***Building system***

Building systems can be similar from one approach to another, and solutions provided for emergency shelter, temporary shelter or temporary housing can be categorised as follows:

- Kits of supplies. Parts and elements that can be assembled freely or following instructions, such as timber poles and plastic sheeting.
- Lightweight prefabrication. Parts of the building which are lightweight and easy to assemble, such as prefabricated timber panels or frames.
- Heavyweight prefabrication. Ready-made units that use rigid materials. They can be heavier and bigger than the other options but are quicker and ready to use on site, such as containers or mobile homes.

The ready-made unit option is excluded from the transitional shelter approach because it does not, generally speaking, facilitate the incremental process.

### ***Culture, climate and materials***

A difference between approaches is the objective of providing a shelter that integrates the culture and climate in the design, and that uses local materials. While temporary shelter is described as a prefabricated and imported solution that does not take into account culture or climate, the transitional shelter approach aims to incorporate locally designed and produced shelters with the use of local materials that contribute to the local economy (Barakat, 2003; Collins et al., 2010;

Félix et al., 2015). Definitions of temporary housing do not include the idea of fitting within the local culture or climate, but state that this is a stage that promotes a return to normality, in which families begin to recover, reintegrate, and return to work (Fayazi and Lizarralde, 2013; Johnson, 2007b; Johnson et al., 2006; Lizarralde et al., 2009). Therefore, some elements of the local culture and settlements are indirectly considered in this approach. Consequently, this distinction is linked to the objectives of each approach. On the one hand, emergency and temporary shelters are defined as dwellings that will last for a short period of time; therefore, fewer efforts are made to fit within local cultural preferences and the focus is on providing an economic, fast and efficient solution. On the other hand, temporary housing is used for several years before residents obtain permanent accommodation, and transitional shelters are built with the intention of forming part of permanent housing, and thus aspire to be locally appropriate in terms of culture and climate. Although the distinction between temporary housing and transitional shelter makes conceptual sense, in reality affected families use any support provided as an element of permanent housing, and will frequently remain in an interim solution for a longer period than that envisaged by those that provided and designed it.

***Quality***

The quality of the solutions provided may also constitute a key factor in differentiating between approaches to post-disaster accommodation. While emergency shelters are designed to last for months, temporary houses are designed to last for years; hence the quality of construction and materials ought to be different. Nevertheless, as seen in the definitions, both approaches can take the same form, while using materials that can vary in terms of quality. However, this similarity can create confusion. For example, a winterised tent may be perceived by occupants as an emergency shelter, because it has the appearance of a short-term shelter, while providers see it as a temporary housing solution, designed and built with an improved material that will last for years. Its occupants, then, may expect to reside in the improved tent for a short time only, while the institution providing the shelter sees it as medium-term accommodation.

From the definitions and concepts studied here, then, there are two factors that can differentiate the approaches:

- **Timeline and permanence.** Emergency shelter, temporary shelter and temporary housing are all designed for a defined period of time, while the transitional shelter approach is conceptualised as a holistic approach that covers all phases and eventually results in permanent housing.

- **Culture, climate and materials.** Emergency shelter and temporary shelter are designed without consideration for local needs, while temporary housing and transitional shelter are more aware of these factors.

Also, there are similar characteristics:

- **Building systems.** Similar construction methods and systems are used for emergency shelters, temporary shelters, temporary housing and transitional shelters. The main difference is that the latter does not include fixed prefabricated systems.

- **Displaced and non-displaced.** The four main concepts discussed here can be used to shelter both families that stay on their plots of land and families that are displaced by disasters.

Although there is interest in agreeing concepts and terms, it is challenging to find definitions that apply across diverse contexts, due to differences in the way shelters and houses take form. Additional confusions are created by language translation (UNHABITAT et al., n.d.) and difference in institutional aims. Some aspects differ from country to country, depending on the quality of the pre-disaster housing stock, aspirations of the population, different income levels, available materials, levels of development, and regulations, among other issues. For example, a temporary house as described above could take the form of a mobile home in the US, which includes a certain level of insulation and services, while in Peru this can take the form of a timber panel shack with no services at all. In both cases, the house will be temporary and will serve during the same period of time after the disaster, but the way in which it is built, the form it takes, and the quality of the construction will be different. The same situation occurs with the materials used. For instance, in some countries, such as the US and Canada, timber is considered as a material for building permanent houses, but in other countries it is considered as temporary and rural material, and a level of social stigma pertains to it. In the following chapter, current and common debates on post-disaster accommodation are discussed.

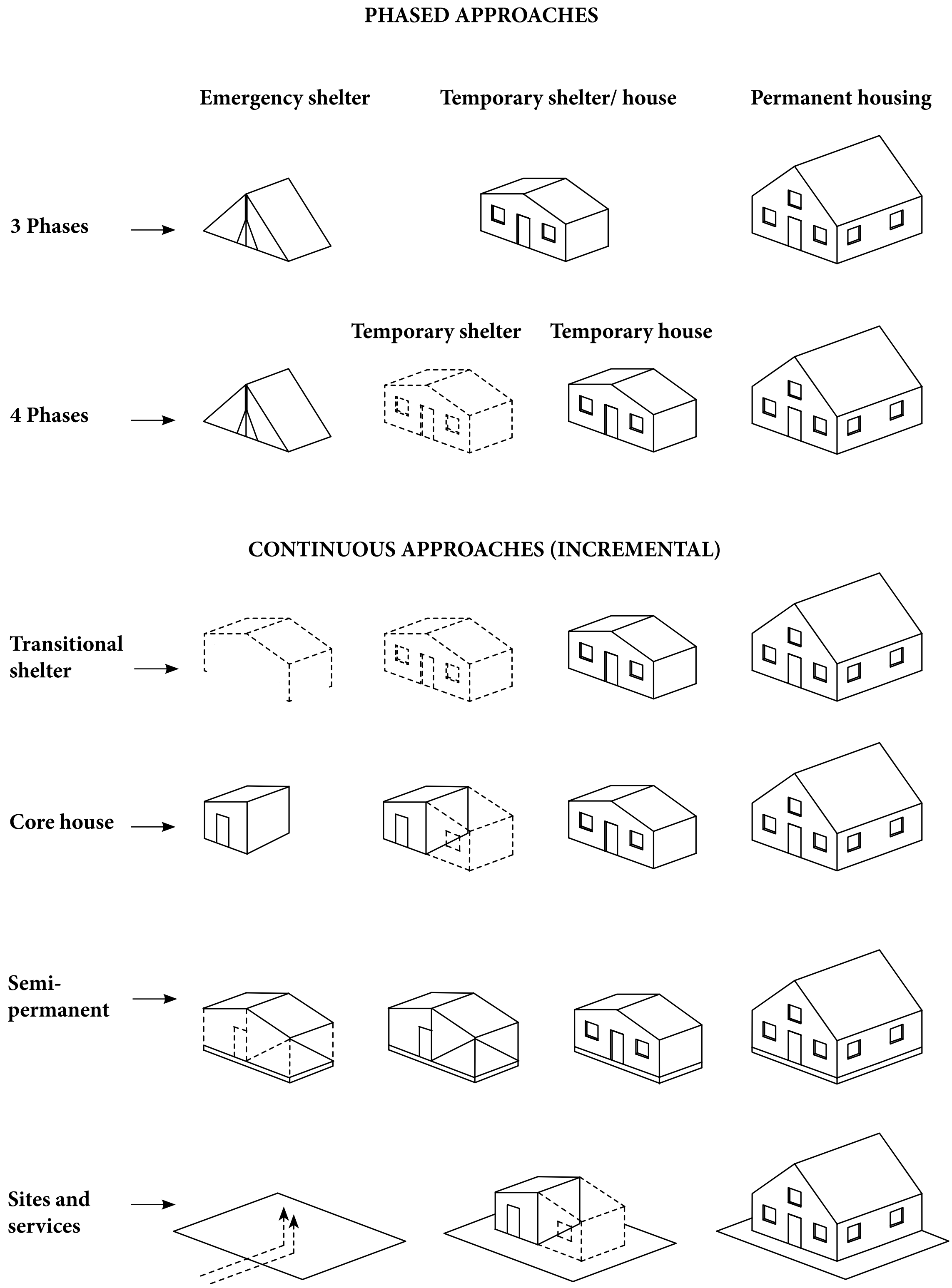



**Fig. 8.** Comparison of post-disaster accommodation terms.

# Chapter 2

# 2. Post-disaster accommodation: What comes next?

In the wake of a disaster, affected groups will be worried, shocked and traumatised due to the loss of relatives, friends and belongings. In this context, losing one's house is one of the most significant sources of stress (Caia et al., 2010; Félix et al., 2015). Despite its important role, the provision of post-disaster accommodation reflects different interpretations of the meaning of shelter (Davis, 1978a, p. 28). Currently there is no agreement on the meaning of these terms, and practitioners point out that terminology needs to be more accessible, be free from gaps and overlaps, and make clear who is responsible for doing what (Cage et al., 2009, p. 4). Nevertheless, as discussed in the previous chapter, there are similarities and differences between post-disaster accommodation approaches. While temporary housing is designed to last for a period of time in order to cover the gap between emergency and permanent housing, transitional shelter is a process that goes from emergency to permanent solution. In this chapter it is argued that in both approaches, the main issue is the process that leads to durable housing. While temporary housing is labelled 'second life' or 'second use', transitional shelter is questioned as 'a transition to what?' These issues linked to post-occupancy highlight the importance of connecting relief and development, and the need to add flexibility in shelter responses in order to adapt to uncertainties.

## 2.1 Temporary housing: Advantages, criticisms and second use

Temporary housing has often been used after recent large-scale disasters, in order to support a quick recovery and allow time for safe rebuilding (Johnson, 2007b, p. 36); this occurred in Iran (earthquake, 2003) Indonesia and Thailand (earthquake and tsunami, 2004); USA (hurricane, 2005), Peru (earthquake, 2007), China (earthquake, 2008); Italy (earthquake, 2009); Chile (earthquake and tsunami, 2010); and Japan (earthquake, 2011), among other examples. However, there has been much disagreement about these temporary housing programmes. On the one hand, some argue that the provision of temporary housing is expensive, unsustainable, and unnecessary, and that it diverts funding from permanent reconstruction efforts. On the other hand, others suggest that the provision of temporary housing can support a quick recovery and allow time for communities to rebuild safely. Despite criticisms, temporary housing programmes continue to be used after major disasters, since affected families need a place to live while adequate permanent housing is designed, planned and built, a process that can take years (Johnson, 2007a, pp. 435–436). To be successful, a temporary housing programme must address factors that exist in the larger environment, such as local living standards, industries, politics, and permanent reconstruction programmes (Johnson, 2007b, p. 37).

### 2.1.1 Advantages of temporary housing

Temporary housing is vital for families to return to their normal activities, such as working, cooking, housekeeping, and socialising (Arslan and Cosgun, 2008; Félix et al., 2013; Johnson, 2007b; Quarantelli, 1995). After a disaster, housing solutions consistent with the common standard of living of the affected community is crucial, even in a temporary location (Félix et al., 2013; Johnson, 2007b). Due to the time gap between the emergency phase and permanent reconstruction, temporary housing seems to be an option to provide security and certainty to families, so that they may reorganise their future (Félix et al., 2013; Johnson et al., 2006). One of the strengths of temporary housing is that allows time for appropriate community planning, so as to reduce future risks and to increase sustainability (Félix et al., 2013; Johnson, 2007c). Other strengths of temporary housing are that it releases communal buildings used as emergency shelters, it can support host families, it can be used to reduce tensions, and some materials used in the buildings can be recycled (Barakat, 2003, p. 17).

Building a temporary house on the same land as the damaged or destroyed house (without interfering with demolition or reconstruction) has some positive effects, such as maintaining community networks and livelihoods, an important component of the long-term recovery (IRP, 2010b, p. 19). Further, affected families are most likely to participate in the design and reconstruction of their house due to their proximity, and materials of the temporary housing can be modified or recycled to improve the quality of the permanent structure (IRP, 2010b, p. 20). When affected families are provided with local materials to build their own temporary houses, they will be able to build something more durable and appropriate, and this can constitute an opportunity to teach them construction skills that can be used to build more resistant permanent houses (IRP, 2010b, pp. 20–22). If the construction process is community-led, it can empower communities to take control of their own recovery, and it can also raise awareness of safe building techniques (IRP, 2010b, pp. 21–22).

### 2.1.2 Criticisms of temporary housing

Temporary housing has been criticised for being unnecessary, too expensive, too late, too long-lasting and diverting resources from permanent reconstruction (Barakat, 2003; Davis, 1978b; Johnson, 2007b; Quarantelli, 1982). These criticisms are not new. In the 1970s Frederick Cuny questioned the cost-effectiveness of the 'one-two-three approach to housing', comprising emergency shelters, temporary houses and then permanent housing (F. Cuny, 1978). He used the example of Guatemala, where the cost of a temporary house was higher than that of a permanent house built by the families (F. Cuny, 1978, p. 37). Furthermore, researchers on the topic have found that temporary housing programmes have recurrent problems, such as cultural or climatic inappropriateness, poor location, the frequent emergence of social conflict inside the camps, delays, lack of available sites, and organisational capacities (Johnson, 2007a; UNDRO, 1982).

Some criticisms have focused on the problems of cost, sustainability, and the cultural inadequacy of temporary housing programmes (Barakat, 2003; Félix et al., 2013, p. 137; Johnson, 2007a, 2007b; Johnson et al., 2006; UNDRO, 1982).

In terms of cost, when units are not produced in the affected region, the cost of importing and transporting the materials or units can be more expensive than that of permanent housing, being inefficient in comparison to their lifespan (Barakat, 2003; Félix et al., 2013; UNDRO, 1982). The debate has focused on whether or not temporary housing is needed, or whether resources should be redirected instead to permanent reconstruction (Félix et al., 2013, p. 138).

In relation to sustainability, when the temporary phase ends, houses are dismantled without planning or concern about the elements left behind. This leaves debris, infrastructure, and foundations without use: an inefficient and environmentally unsustainable approach (Arslan, 2007; Félix et al., 2013). Also, if families remain in a temporary shelter on-site, they may encounter health risks posed by debris and contamination and may have little access to services, communications and transport (IRP, 2010a, p. 23).

Cultural inadequacy is another criticism, due to the emphasis on standardisation and technology-oriented solutions that are not suitable for local inhabitants and neglect local needs (Félix et al., 2013). The lack of understanding of people's housing culture and livelihood has led to abandoned settlements, environmental damage, health problems, and unsafe buildings (Duyne Barenstein, 2011, p. 194). Also, in some cases it has been criticised for constituting a top-down approach in which units are designed as universal solutions produced abroad, ignoring local climate, family size, real needs, and cultural values (Barakat, 2003; Félix et al., 2013; Johnson, 2007b; UNDRO, 1982). 'Ready-made' shelters can undermine the coping mechanisms of a community, and may delay the long-term recovery process (Barakat, 2003, p. 15).

Further, the inadequacy of the solution can create psychological stress. A study comparing imported versus a local designs shows that the shapes and materials used when matching the prototype of the traditional home allow attachment to the house and support psychological well-being in the affected families (Caia et al., 2010; Félix et al., 2013). More frequently than not, temporary housing designs fail to address needs and expectations, thus encouraging families to make changes to the houses through incremental construction (Félix et al., 2013; Ikaputra, 2008b; Johnson, 2007c; Wagemann, 2015, 2012). In many cases, the modifications are of poor quality, because frequently inhabitants lack the building skills and knowledge to build safely, leaving families more vulnerable to future disasters as a consequence (Félix et al., 2013; Stephenson et al., 2011; Wagemann, 2015). In other cases, families abandon their temporary houses, because they are completely unsuitable (D'urzo, 2011; Duyne Barenstein, 2011; Fitrianto, 2011). In addition, moving families from tents to temporary housing and finally to durable accommodation can heighten trauma, weaken community ties, and disrupt the recovery process as a whole (Barakat, 2003, p. 15).

In relation to social issues, in general, due to delays in permanent reconstruction, families are forced to reside in temporary housing units for longer than expected (Félix et al., 2013; Johnson, 2007b). One possible solution to this problem is to produce a housing design which is more comfortable and resistant to last longer than the period for which it will be used (Félix et al., 2013, p. 138). Nevertheless, if the housing solution is better than the houses the families had before the disaster or the permanent options, they may prefer to stay in the temporary ones, creating permanent settlements that were not planned.

### 2.1.3 Second use of temporary housing

'Temporary housing' means that houses are expected to be used for a fixed, short period. What to do, then, with this housing after the temporary phase finishes? This is a vital question; experience indicates that housing interventions in the early stages after a disaster will affect long-term housing provision, since temporary solutions tend to become permanent (Barakat, 2003, p. 37). Arslan and Cosgun identify two types of post-occupancy use: **'passive measures'** in which temporary houses are converted into permanent houses or assume other functions, or **'active measures'** in which temporary houses or parts of them are sent to another area or stored (Arslan and Cosgun, 2007; Parva and Rahimian, 2014). Johnson defines five options, based on cases from Turkey after earthquakes in 1999: long-term use, dismantling and storage, reuse, sale, and demolition (Félix et al., 2013; Johnson, 2007b, p. 49).

These options have advantages and disadvantages. **Long-term** use is considered problematic because this can create illegal occupancy when used by displaced populations, as well as other social dysfunctions, such as a high crime rate in temporary unplanned settlements (Johnson, 2007b, p. 48). Nevertheless, in land owned by families, this option allows to use the house as an extension or as part of a permanent house (IRP, 2010b, p. 20; Wagemann, 2015). **Dismantling** unused units and storing them for future disasters is one potential alternative, but this option can be inefficient in terms of resources, due to transportation costs, as well as disassembly and assembly times (Johnson, 2007b, p. 48). **Reusing** units can be a better alternative, but similar to the option of dismantling, it can imply extra costs in transporting, dismantling and reassembling in a new location (Johnson, 2007b, p. 49). When the reuse of the houses is selected as an option, it has to be supported by the material choice and the construction technique. If the quality of houses after use is poor or not of sufficient quality to reuse as dwellings, this alternative becomes inadequate. Nevertheless, this option seems to be advantageous as a resource for families or communities (Félix et al., 2013, p. 139). The alternative of **selling** the units or parts of the house can help to recover some of the initial costs (Johnson, 2007b, p. 49). Finally, **demolishing** the houses is the least efficient option because this means that they will be thrown away, and the resources used in the temporary houses never recovered (Johnson, 2007a, p. 49).

Past experiences with temporary housing demonstrate that the reuse and recycle options can improve the efficiency of the approach. The most sustainable ways in which to reuse houses is to maintain the same function without changes (i.e. rent to low-income resident), using them for the same function but making changes (i.e. additions, use them as core houses) or for different functions (i.e. community centre, health facility) (Arslan, 2007; Félix et al., 2013; Johnson, 2007c). Alternatives to reusing dwellings or parts of them can be incorporated in the overall strategy and design aiming to improve efficiency and sustainability, as well as being more suitable for the mid-term. If these changes are made to the concept of temporary housing, the aims of this approach might begin to resemble those of the transitional shelter concept, where the solution provided is no longer temporary but is, rather, a transition to something else.

## 2.2 Transitional shelter: Advantages, criticisms and transition to what?

As discussed earlier, the transitional shelter approach was introduced in 2005 based on an agreement concerning common approaches, standards and responses (Collins et al., 2010, p. 2,6). This approach seeks to deal with many challenges posed in the wake of natural disasters, such as the immediate need for shelter, a lack of land rights, the increasing frequency of multi-family dwellings, the lack of aid capacity in shelter and reconstruction, reconstruction being seen only as a long-term issue, and fragmented support for reconstruction (Collins et al., 2010, pp. 2–3). Despite being one of the default choices for many large agencies, the transitional shelter approach has become a controversial strategy (Burnell and Sanderson, 2011, p. 189; Davis, 2015, p. 110). While the rapid reconstruction of permanent housing may be the most effective way to support the recovery of a majority of an affected population, transitional shelter may be beneficial to displaced populations, vulnerable households and other specific groups (Batchelor, 2011, p. 66). In the second edition of *'Shelter after Disasters'*, 2015, Davis states the importance of understanding the value and the limitations of transitional shelter or housing. This can, Davis emphasises, be a useful solution that fills the gap when time is necessary for planning good reconstruction, but in other situations it may be possible to eliminate this interim stage by accelerating reconstruction when there is proper pre- and post-disaster planning (Davis, 2015, p. 38).

### 2.2.1 Advantages of transitional shelter

The appealing aspect of the transitional shelter approach is that, when implemented correctly, it can fulfil various functions: provide a shelter adaptable to a variety of circumstances; transition to a permanent house, bridge the gap between the emergency and reconstruction, be used for training local builders in safe reconstruction, and it can use local materials and resources, supporting the local economy (Jha et al., 2010; Shelter Centre, 2012).

There are many potential advantages to this approach (Shelter Centre, 2012, p. 19; UK DFID, 2010, pp. 108–110). In terms of use, it can span the entire reconstruction period, from disaster until permanent housing is achieved, using materials of sufficient durability. Also, it can provide a secure, healthy living environment that offers dignity and privacy. The transitional shelter approach can be used by displaced and non-displaced families. If used by displaced families, it can be relocated from a transitional settlement site to a reconstruction site. If affected communities are involved in the decision-making process, shelters can be built using familiar materials, construction techniques and standards, considering particular needs and at a speed that does not disrupt their livelihoods. The construction process can be used to demonstrate simple construction techniques that support the 'building back better' concept, introducing hazard-resistant principles supported by technical supervision and inspection, such as cross-bracing and hurricane straps. In parallel to the construction of the shelters, land rights issues can be negotiated, as land may be used on a temporary basis until disputes are resolved and government has the capacity to manage land issues.

In terms of materials and construction, large numbers of transitional shelters can be built incrementally after large disasters using local and regional materials. Transitional shelters may be reused during or after the reconstruction for other uses – for instance, as shops or shelters for livestock. Also, materials used to build the shelters can be procured from local products and suppliers, creating livelihood opportunities and reducing local dependency on external assistance. This can accelerate the recovery of the local economy. Finally, if materials used may be salvaged from damaged or destroyed homes and reused in transitional shelter construction, then they, in turn, may be recycled, upgraded, reused, resold or relocated.

### 2.2.2 Criticisms of transitional shelter

The transitional shelter approach has also provoked criticism. To begin with, many have argued that agencies and governments should prioritise long-term projects instead of short-term structures that result in poor shelter conditions, perpetuating vulnerabilities and hampering long-term recovery and development (Clermont et al., 2011; Doninger, 2013; Gray and Bayley, 2015). Recent experiences have shown that extensive resources have been used in creating transitional solutions that provide shelter in the short-term, thus taking attention away from longer-term recovery efforts, and even increasing vulnerabilities. The case of Haiti after the 2010 earthquake has been frequently presented as an example of such a tendency. In Haiti, the strategy employed consisted of the provision of a transitional shelter, which could be combined with cash or material distribution. In order to incorporate new design parameters for transitional shelters, such as wind resistance and seismic design, the original shelter design evolved into a more expensive, resistant and lasting solution, with longer delivery time, but with the same living area of 18 $m^2$ (Calzadilla and Martin, 2011). The average cost increased from 1,500 USD to 2,300-4,300 USD (743 to 1,140-2,131 GBP) – expensive in comparison to the cost of a permanent solution (Calzadilla and Martin, 2011). Although the transitional shelter could have been revised to take into account a more permanent housing approach, the programmes of the NGOs working in Haiti at that time were not flexible enough to include these changes.

Another criticism of transitional shelter is the lack of transition and flexibility, so that structures deteriorate and turn into permanent poor-quality houses, eventually creating slums (Burnell and Sanderson, 2011; Gray and Bayley, 2015, p. 29). This happens because after the shelters are built, few human and economic resources remain, resulting in poor-quality permanent housing and solutions that do not address long-term problems (Gray and Bayley, 2015, p. 29). Also, this can be the consequence of a lack of guidance, training, and assessment during the process. Moreover, some key features of the approach are not always necessary, and other characteristics would be more useful to add. For example, mobility is a key feature of the approach because it can provide a solution when land rights are unclear and the shelter can be moved later to permanent sites (Doninger, 2013; Jha et al., 2010; Shelter Centre, 2012). However, the best examples of this approach are in areas of secured plots, where mobility is not necessary (Clermont et al., 2011). In this respect, good examples of the deployment of this approach largely resemble more traditional 'semi-permanent shelter' or 'core housing' approaches that can be later completed as permanent housing (Collins et al., 2010, p. 3).

In addition, transitional shelter has been described as a donor-driven approach rather than a people-centred approach, because it suits the budgets, timeframes and marketing needs of NGOs instead of the interests and long-term needs of affected communities (Gray and Bayley, 2015). This approach has been criticised because it indirectly defers permanent reconstruction and places those receiving transitional support at the bottom of the priority list for permanent assistance (Gray and Bayley, 2015, pp. 29–30). Moreover, it has been critiqued as a rural approach used in urban environments, difficult to implement in high density areas where shelters occupy the only space where reconstruction can happen (Clermont et al., 2011; Gray and Bayley, 2015). Transitional shelter programmes have also been blamed for reducing the motivation of governments to build infrastructure and support reconstruction, leaving inadequate shelters without the provision of basic services (Burnell and Sanderson, 2011, p. 189; Clermont et al., 2011; Doninger, 2013; Gray and Bayley, 2015; Jha et al., 2010). Then, despite many positive applications it has been argued that there are many ways in which the transitional shelter approach can go wrong, having very negative consequences for the process of recovery (Doninger, 2013, p. 18).

Therefore, this approach has potential disadvantages, as the Shelter Centre (2012, p. 20), UK DFID (2010, p. 110) and Gray & Bayley (2015, p. 30) point out. Transitional shelter programmes may raise false expectations, as communities may assume that everyone is entitled to a transitional shelter. It may only concentrate on short-term deliverables and distract from a holistic approach because support is not offered beyond transitional shelter due to lack of resources or priority being placed on other methods of assistance. Land rights or tenure may never be resolved, causing affected families to live indefinitely as occupants without legal status. Without proper planning, management or an exit strategy, transitional settlement sites may become slums. Furthermore, this approach may not offer enough time and space to disseminate sustainable building techniques. In terms of resources, the cost of materials may be inflated due to demand or as a result of profiteering practices, resulting in sub-standard shelters and making the materials inaccessible to the population. Local resources may be overexploited, creating environmental problems. Later stages in the process may be delayed by the availability of materials, and there may not be sufficient resources to complete the reconstruction of the permanent house, leaving families living in transitional shelters for longer than planned. Finally, the approach requires significant human resources to coordinate the provision of materials, technical building skills and community participation. If there are insufficient skills or technical capacity among the diverse actors working to respond to a disaster, or little cross-sector coordination among them, the approach can be poorly implemented, resulting in unsafe practices, such as poor construction or unsafe sites.

In 2012 the Shelter Centre, in the '*Transitional Shelter Guidelines*', acknowledges some criticisms and discusses the questions concerning the approach. It points out that most of them arise as a result of misconceptions (Shelter Centre, 2012, p. 25). It explains that transitional shelter is misunderstood as a product rather than a process, and mistakenly described as core housing, sites and services and one-room shelter (Shelter Centre, 2012, p. 6). However, the boundaries between approaches are blurred, as seen in the description of concepts. The guidelines explain that although the initial cost of the transitional shelter approach appears high in comparison to tents or other options, it offers a beneficiary-driven reconstruction process that becomes self-supporting through investment into local economies, becoming a cost-effective way to rebuild if implemented early after a natural disaster (Shelter Centre, 2012, p. 6).

### 2.2.3 Transition to what? And build back safer

The term 'transitional' emphasises ways that 'shelter' and 'settlement' can be understood as processes, forming part of an ongoing transition from emergency to permanent communities and houses (Kennedy et al., 2008, p. 26; Leon et al., 2009, p. 255). However, the transitional shelter approach generates concerns about the limits of the responsibility of humanitarian organisations and their handover of power to governments, the process from emergency to the return to sustainable livelihoods, and the lack of attention often paid to the transition towards reconstruction (Collins et al., 2010, p. 10). Further, the end of the 'transition' is not clear. Examples, such as Sri Lanka and Aceh, have shown that the transition is easily forgotten when faced with the urgency of implementing programmes, which leaves little time to incorporate the full scope of the transitional process (Kennedy et al., 2008, p. 29). Therefore, the approach raises the question 'transition to what?' (Collins et al., 2010, p. 10).

The answer has been formulated by Kennedy et.al. as *'transition to a less vulnerable state than before'* (Kennedy et al., 2008, p. 34). This response is linked to the concept of 'Build Back Safer', based on the phrase 'Build Back Better' introduced in 2006 by the former US president Bill Clinton, after a report on the 2004 Indian Ocean tsunami (Clinton, 2006; Kennedy et al., 2008, p. 34). However, the word 'better' has multiple interpretations, such as more modern, environmentally friendly, aesthetic, resistant to earthquakes and tsunamis, and to all hazards (Kennedy et al., 2008, p. 34). For that reason, Kennedy et al. suggest that 'Build Back Safer' might be a more useful concept. Clinton defines ten propositions to 'Build Back Better' which Kennedy et.al. group as follows: safety, security and livelihoods; transition to what; fairness and equity; and disaster risk reduction through connecting relief and development. Nevertheless, in countries where insurance companies are involved in the reconstruction, they can impose a barrier to build back better, since they only cover to build back 'the same' again. Lessons from experience in transitional shelter programmes show that the question 'transition to what?' should always been asked in consultation with affected communities, in order to aim for the permanent reconstruction that comes after the transitional stage (Leon et al., 2009, p. 256).

## 2.3 Continuum versus contiguum: Relief and development

In both transitional and temporary approaches, the process that leads to durable housing is repeatedly questioned, as in the 'second use' in temporary housing and 'transition to what?' in the transitional shelter approach. The disconnection between relief and development (or 'what happens next') is a problem with a long history and appears in many documents about post-disaster accommodation. In the 1970s Davis identified the provision of help for agencies to refocus from relief provision to pre-disaster planning and post-disaster reconstruction as one of the most pressing needs (Davis, 1978a, p. 34). In the mid-1990s, an interest emerged in linking disaster relief and development, and conferences were held such as 'Linking Relief with Development' at the Institute of Development, Sussex, UK in 1994 (Ross et al., 1994), 'Programming Relief for Development' organised by the IFRC, the Danish Red Cross and the EU in 1995 (Campanaro et al., 2002, p. 12), and 'Aid under Fire' by ODI and UNDHA in 1995. Also in 1995, the European Community Humanitarian Organisation (ECHO) published a paper entitled *'Linking Relief, Rehabilitation and Development'* also called LRRD (Lindahl, 1996, p. 2). The LRRD model describes how the relief phase is followed by rehabilitation and, finally, development, and how stakeholders are responsible for each respective phase in a linear fashion (Gray and Bayley, 2015, p. 8; Lieser et al., 2006, p. 3). The relevant actors are linked as in a relay race, handing responsibility to the organisation in charge of the next phase, conceptualised by the UN as relief-development, which is known as a 'continuum approach' (Batchelor, 2011, p. 9) or 'phased approach' (Doninger, 2013, pp. 9–10; Lieser et al., 2006, p. 3). Nevertheless, experience has shown that, in many cases, the linear model is impractical and somewhat artificial in a post-disaster context, and that short- and long-term should be integrated and implemented simultaneously; this is the basis for the so-called 'contiguum approach' (Doninger, 2013, pp. 9–10; Lewis, 2001; Lieser et al., 2006, pp. 3–4). The contiguum approach was also suggested in 1995 by ECHO to reflect a more dynamic model (Lindahl, 1996, p. 11). Within this approach, all stages of post-disaster response operate at the same time in overlapping juxtaposition which is informed by all potential hazards and impacts (Lewis, 2001, p. 2).

In 2008, the Cluster Working Group on Early Recovery (CWGER), led by the UNDP, defined the concept of 'early recovery' as a *'multidimensional process of recovery that begins in a humanitarian setting'* with the aim of linking relief-rehabilitation and development (Batchelor, 2011, p. 11; CWGER, 2008, p. 4). The early recovery concept is guided by development principles but begins

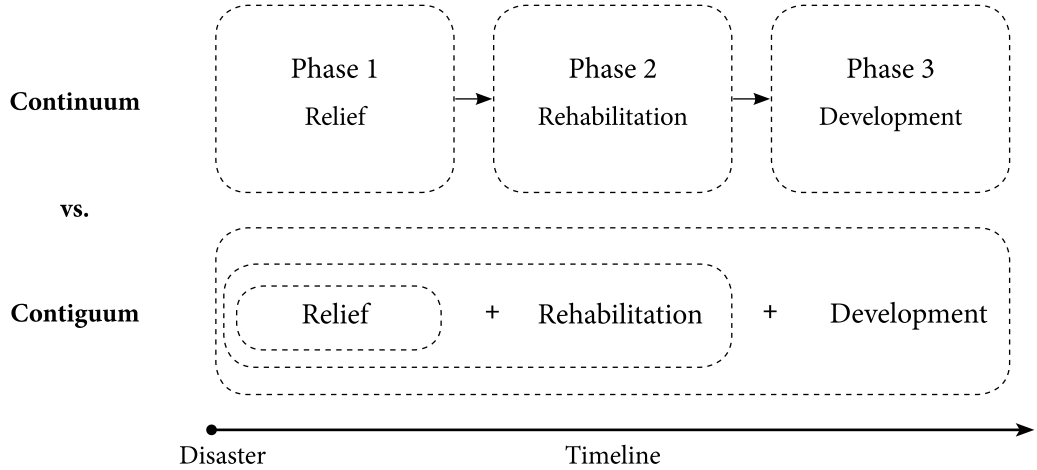



**Fig. 9.** Diagram continuum versus contiguum.

with emergency intervention within humanitarian mechanisms (CWGER, 2008, p. 9). In that sense, it shares aims with the transitional shelter approach in the interest of bridging the gap between emergency and reconstruction, understanding that accommodation after disaster and permanent housing are part of one long-term process.

Although the contiguum approach is becoming popular among agencies, many still focus their efforts on the emergency phase or the continuum approach, due to funding mechanisms, response capacities and political constraints (Doninger, 2013, pp. 9–10; Twigg, 2006, p. 9). The decision to assign funding for emergencies rather than for permanent reconstruction creates a fictional division between concepts that overlap in practice. Furthermore, in general, the fact that emergency relief funds last around one year creates a timeframe that focuses on completing the number of shelters agreed for meeting donor's requirements, instead of ensuring good quality and fulfilling people's needs (Kelman et al., 2011, pp. 272–273). This division also means that, in practice, practitioners in the shelter sector often define themselves only in terms of humanitarian or emergency work without any connection to long-term projects (Harris, 2011, p. 16). Agencies hire short-term specialists during the relief phase who do not become involved in long-term development issues, maintaining a conceptual and practical distance between relief and development (Doninger, 2013, p. 10; Saunders, 2004, p. 166).

In this context, there still exists a false assumption that sheltering assistance can be sub-divided into well-defined stages (or products) such as immediate, temporary, and permanent, when the reality is more complex (Davis, 2015, pp. 39–40). Some understand this sequentialisation of the process to constitute one of the major barriers to the provision of shelter to address relief, rehabilitation and recovery concurrently (Gray and Bayley, 2015, p. 8). Although this division in stages can result from difficulties in engaging with the complex issues that long-term reconstruction involves (Gray and Bayley, 2015, p. 12), the consequence is often that shelter provision is basic, inadequate, and does not help to restore people's livelihoods, while precluding long-term solutions and condemning families to inhabit inadequate shelter for years (Harris, 2011, p. 16). Regarding timelines, many NGOs have adopted a three-year scope as a way to extend their influence. This decision has been criticised for effecting the unnecessary prolongation of basic emergency shelter responses long past the immediate crisis, condemning families to live in a provisional state for longer periods of time (Harris, 2011, p. 16).

Although practitioners and academics agree that, through planning and implementing post-disaster accommodation within the long-term context, vulnerabilities can be reduced, preventing future disasters (Kennedy et al., 2008, p. 32), in reality a connection between relief, recovery and development is difficult to achieve. Providing support for a long-term multi-hazard-proof house that is context-sensitive in the early phases after the disaster requires effort, resources and expertise (Gray and Bayley, 2015, p. 11). No unique solution applies to every disaster, community or even family. Many questions about land rights, location, durability, safety, quality are raised, as well as the influence of social, political and economic factors (Gray and Bayley, 2015, p. 11). Moreover, several actors are involved, such as governments, non-governmental and international organisations, affected communities, and the private sector. In this context pre-planning seems to be crucial, but it is also vital to establish that there are many uncertainties within this process. Therefore, providing the flexibility to adapt to different conditions and situations seems to be viable and beneficial.

## 2.4 Adaptation and flexibility

As discussed above, literature on temporary housing highlights the benefits of reusing units or materials after their intended period of use, and therefore points towards the importance of creating flexible designs, in order to facilitate adaptation and customisation according to families' needs (Félix et al., 2013, p. 140). In addition, the transitional shelter approach is based on the notion of continuous change within the shelter as a process that lasts until a permanent house is built. Although standard, one-size-fits-all approaches are used for economic reasons, flexibility can be a way to ensure that structures may be adapted to a variety of cultural needs and expectations (Ashmore et al., 2003; Barakat, 2003, p. 37; Leon et al., 2009). Thus, designs should consider the capacity of expansion to accommodate family members, storage and future upgrades (Kronenburg, 2013, p. 6). Post-disaster accommodation in many cases is not only used as a house but also as a workplace, and designs might therefore include the possibility of changes in the future. Then, flexibility provides families the option to customise their dwellings, facilitating transformations and modifications, so that they may both use them as multifunctional spaces and feel attached to them (Félix et al., 2015, p. 14).

Housing, whether permanent or temporary, formal or informal, is an incremental process that evolves according to families' needs and possibilities. As Marie J. Aquilino states in *'Beyond Shelter'*, designing for permanence requires an understanding of the whole process, designing for growth and change; building what is most urgent first and constructing a home in stages (Aquilino, 2011, p. 282). Extensions have great potential for increasing the housing stock in a sustainable way, and on balance, transformations can improve housing conditions (Tipple, 1996, p. 375). In developed and developing countries residents improve the quality of their houses by making progressive changes, such as adding insulation, changing windows, and extending spaces. Moreover, experience from informal housing has demonstrated the advantage of flexibility, accommodating a plurality of family sizes that reflect different purchase powers and family priorities, in contrast to formal housing that relies on the repetition of a few models that reduce variations and alternatives (Lizarralde and Root, 2007, pp. 2074–2075). Incremental housing, then, is the most common strategy of the informal sector to customise houses to individual needs and expectations, allowing families to make improvements as their economic situation allows (Lizarralde, 2011, p. 176; Lizarralde et al., 2009). Although incremental core-house programmes have been developed by international organisations since the 1970s, they have not always been successful, due largely to the lack of quality of self-built expansions. There exists a lack of design strategies or guidance for making incremental additions and changes to housing. As a result, incremental construction tends to occur organically, without planning – sometimes creating other problems, such as the obstruction of natural ventilation and lighting, or structural issues (Lizarralde, 2011, pp. 179–180).

In post-disaster contexts, families usually rebuild their dwelling as it had existed prior to the disaster, whether they live in a temporary or a permanent house. However, their previous living conditions may be the cause of their vulnerability. Therefore, adequate training in self-building

**Fig. 10.** Example of transitional shelter that includes progressive changes. Pakistan, flash floods, 2010. Source: IFRC, 2011a.

techniques and supervision should be provided in the process of reconstruction to lower future risks (Batchelor, 2011, p. 65). As discussed earlier, establishing a connection between relief and development may play an important role in this process, and linking temporary or transitional solutions with long-term projects promoting the concept of incremental or progressive housing may support it. Some examples in that direction are recent designs built with frames that can be disassembled and moved later into a different location, and with walls that can be upgraded with more permanent materials, such as cases from Indonesia, Pakistan (Figure 10), Peru, Haiti and Vietnam (IFRC, 2011a). However, assessment of the quality of the designs' resistance to future hazards (IFRC, 2011a) shows that there is room for much improvement. Therefore, flexibility stands out as a crucial and desirable characteristic of both post-disaster temporary and transitional housing, recognised by researchers and practitioners (Arslan, 2007; Arslan and Cosgun, 2008; Barakat, 2003; Davis, 2015; Félix et al., 2013; Johnson, 2007a, 2007c; Kellett and Tipple, 2000; Lizarralde and Root, 2007; UNDRO, 1982). Nevertheless, no available research exists that addresses how to make future changes or to adapt shelters in post-disaster contexts. Therefore, there is an opportunity to develop designs incorporating a deeper understanding of the progressive and incremental aspects of temporary and transitional solutions.

# Chapter 3

# 3. From shelter to home through flexibility

This chapter explores the concept of flexibility and adaptability as key elements for the transformation of shelters into homes. After being impacted by natural disasters, families seek to recover a sense of normality, which is supported by everyday life experiences, routines, familiar objects, and the concept of 'home'. Families seek to make their post-disaster dwelling a home in the broad sense, irrespective of whether they have a temporary, transitional or permanent house. This is even more important when they live in a repeatable and anonymous shelter, because the only way to create an appropriate space is through personalising this space and differentiating it from others' houses. Therefore, flexibility is central for providing families the possibility to adjust to changing needs and patterns (Schneider and Till, 2007) and, as a concept, provides a framework through which to recognise that the future is not fixed and that change is inevitable (Kronenburg, 2007).

## 3.1 Home and home-making

After disasters, shelter consists of more than a roof alone; it is the foundation of livelihoods, a place to learn and recover, and a place to feel part of a society, to develop a sense of belonging, pride and cultural identity (Barakat, 2003; Davis, 2015, p. 163; Félix et al., 2015). Although housing plays an important role in the psychological and physical wellbeing of affected families, little scholarly literature exists outlining about how temporary housing should be ideally arranged and what characteristics these houses should have in order to reduce stress (Caia et al., 2010, p. 61).

The real challenge for designers is to create places that have meaning for their inhabitants; that provide identity, security, and a sense of belonging (Davis, 2011, p. 207). This task is not trivial in post-disaster situations, where affected families have deep social, emotional and psychological needs (Davis, 2011, p. 207). As Duyne Barenstein states, quoting Paul Oliver, a dwelling is more than the materials, the construction, and the time and money spent on it; instead, *'the dwelling is the theatre of our lives'* (Duyne, 2006, p. 1; Duyne Barenstein, 2011, p. 186; Oliver, 1987, p. 15). Therefore, shelter can be considered to be a social mechanism, because it can take the form of emotional protection, and therefore is associated with qualities linked to the concept of 'home' (Davis, 1978a, p. 28).

Although house and home are often used interchangeably, they differ in clear ways as concepts. While 'house' is linked to the physical space in which we reside, 'home' has other connotations. Home has been defined as both a place (physical structure and location) and a set of feelings (meaning and emotion), and also as a relation between these two aspects that ties them together (Blunt and Dowling, 2006, p. 22; Moore, 2000; Rybczynski, 2001). Home is understood simultaneously as a tangible object, and as a concept of belonging to a place that reflects our particular culture, needs, and way of living; a place we are attached to (Lawrence, 1987). The physical element provides security and protection but is also symbolic, because it can represent status in society, dignity and (self-)respect (Kellett and Moore, 2003, p. 134).

Different theoretical frameworks exist through which to study the concept of home: housing studies, Marxism, humanism, phenomenology, feminism and environmental psychology, among others. Housing studies is multidisciplinary and includes housing policy, the economics of housing provision, house design, and the experience and meaning of home (Blunt and Dowling, 2006, pp. 6–9). House design can take many forms, and finds many links with social contexts and cultural norms, while the experience and meaning of home focus on an idea that varies across social divisions such as gender, class and race (Blunt and Dowling, 2006, pp. 6–9). From a Marxist perspective, one may consider 'home' to constitute a space for the reproduction of labour power (where workers are fed, rested, clothed and housed) which ensures that workers are physically and emotionally able to continue working (Blunt and Dowling, 2006, pp. 10–11). Humanistic geographers, meanwhile, focus on the meaning of home as a place, in terms of comfort and belonging, where home constitutes more than a house, it is the anchoring point through which humans are centred (Blunt and Dowling, 2006, p. 11). Phenomenologists describe both dwelling and home as existential states, where home is used to capture the essence of the archetype of shelter as a universal component of the human psyche (Manzo, 2003, p. 49). In addition to these theoretical frameworks, in feminist theory gender is crucial for understanding the experiences and meanings of home, because household and domestic relations are connected to caring and domestic labour, affective relations of belonging, and connections between the individual, household and society (Blunt and Dowling, 2006, p. 15). Further, feminist frameworks emphasise the ways in which home can be key to understand gender oppression, as a space of violence, alienation and emotional chaos which removes women from the world of politics and business (Blunt and Dowling, 2006, p. 15). Finally, from an environmental psychology perspective, home is experiential and refers to physical, social, and cultural contexts (Moore, 2000; Sixsmith, 1986).

While humanists conceptualise the notion of home as a sanctuary from society into which one retreats and finds refuge from work, feminists challenge this notion, pointing out that, for women, home is a workplace where unpaid domestic labour is performed (Blunt and Dowling, 2006, pp. 15–16). Although contemporary life has changed the way domestic labour is produced, gender differences still exist in the ways that home activities are developed. For example, in 2004, British mothers spent on average 62 hours per week washing, cooking, cleaning, shopping and caring for children, whilst British fathers spent only 23 hours performing the same activities (Ironmonger, 1996 cited in Blunt and Dowling, 2006, p. 95). However, others have argued that these ideas of inequality represent the concerns of white, western, middle-class feminists; for African-American feminists the process of oppression from slavery and segregation transformed home into a place of respect where former slaves could grow and develop, thus constituting a space of liberation (Blunt and Dowling, 2006, p. 20). Therefore, as these different frameworks show, the complexity of the concept of home is poorly reflected in binary divisions between public and private, house and work, physical and emotional; indeed, this concept has markedly different connotations in different contexts.

### 3.1.1 The meaning of home

Scholars from various disciplines have been interested in categorising the meanings of home. Hayward defines home as a physical structure, territory, locus in space, self and self-identity, a social and cultural unit (Case, 1996, p. 1). Rybczynski describes the elements that constitute 'home' as privacy, domesticity, intimacy and comfort. Privacy, domesticity and intimacy as concepts emerged in the eighteenth century, when comfort was connected with furniture and technology, intertwining materiality with cultural imaginaries (meanings) and practices (Blunt and Dowling, 2006, p. 103; Rybczynski, 2001). Somerville attempts to define the complex and multi-dimensional concept of 'home' through seven dimensions: shelter, hearth, heart, privacy, roots, abode and (possibly) paradise (Somerville, 1992, p. 532). According to his definition, shelter is connected with materiality, physical protection and roofing; hearth with warmth and relaxation; heart with love and emotional happiness; privacy with control, territory and possession; roots as a source of identity and sense; abode as place and space, and paradise as ideality and spiritual bliss, as seen in Table 8 (Somerville, 1992, p. 533).

On the other hand, Després identifies ten categories of meaning for 'home': home as security and control; as reflection of one's ideas and values; as acting upon and modifying one's dwelling; as permanence and continuity; as relationships with family and friends; as centre of activities; as a refuge from the outside world; as an indicator of personal status; as material structure; and as a place to own, as seen in table 9 (Després, 1991).

The categories presented by Després and Somerville have much in common (Table 10). However, Després explores two connotations of home that Somerville does not include, and that are crucial for this thesis: permanence and continuity, which are linked with the idea of home as a process; and acting upon and modifying one's dwelling, which are associated with the idea of user control and personal connection with the home from a physical, financial and emotional perspective.

**Table 8.** The meaning of home and its six dimensions. Source: Based on Somerville, 1992, p. 533.

| Key signifier | General connotation | Sense of security | In relation to: | |
|---|---|---|---|---|
| | | | **Self** | **Others** |
| Shelter | Materiality | Physical | Protection | Roofing |
| Hearth | Warmth | Physiological | Relaxation | Homeliness |
| Heart | Love | Emotional | Happiness | Stability |
| Privacy | Control | Territorial | Possession | Exclusion |
| Roots | Source of Identity | Ontological | Sense | Reference |
| Abode | Place | Spatial | Rest | Living/Sleeping space |
| Paradise | Ideality | Spiritual | Bliss | Non –existence (?) |

**Table 9.** The meaning of home and ten categories. Source: Based on Després, 1991.

| **Home as :** | **Connotation** |
|---|---|
| Security and control | Physical and emotional security |
| A reflection of one's ideas and values | Symbol of how we see ourselves and want to be seen |
| A acting upon and modifying one's dwelling | Physical, financial and emotional involvement |
| A permanence and continuity | Temporal process and dimension |
| Relationships with family and friends | Social space and emotional experience |
| A centre of activities | Purposive entity for human physiological needs and work, hobby, and leisure |
| A refuge from the outside world | Heaven or sanctuary |
| An indicator of personal status | Socio-economic position |
| Material structure | Physical, structural and aesthetics properties |
| A place to own | Ownership and investment |

**Table 10.** Intersection of the meaning of home between categories defined by Somerville and Després.

| Somerville's key signifiers | Després's Categories |
|---|---|
| • Shelter | • Material structure |
| • Hearth | • Centre of activities |
| • Abode | |
| • Heart | • Security and control |
| | • Relationships with family and friends |
| • Privacy | • A place to own |
| | • Indicator of personal status |
| • Roots | • Reflection of one's ideas and values |
| • Paradise | • Refuge from the outside world |
| ----- | • Permanence and continuity |
| ----- | • Acting upon and modifying one's dwelling |

### 3.1.2 Home, time and home making

Although 'home' is often studied as a static state, in reality it comprises a process of home-making (Kellett and Moore, 2003, p. 127). As pointed out by Després, home is a temporal process that is experienced over time to create a familiar environment, to provide a sense of belonging and roots, and to produce memories (Després, 1991, p. 98). Home does not simply exist, but is made through social and emotional relationships, as well through structures, objects used and placed (Blunt and Dowling, 2006, p. 23). Also, home-making activities are part of a long-term project which, in informal settlements, is expressed through a continuous state of incremental improvement that reflects the social ambitions of the inhabitants (Kellett and Moore, 2003, p. 136). In those contexts, a dwelling is never complete but is rather 'continually under construction', in the same way that life is continually moving forward (Ingold, 2000; Kellett, 2013). In this sense, homes can be understood as places of optimism, hope and opportunity. Home and home-making are shaped by cultural norms and they reflect an intention to belong; to create an identity and a position (Kellett and Moore, 2003, p. 138).

Home is defined by the things that we create and use, but also by the time we spend in physical spaces, whether they are called houses, apartments, flats or dwellings, and whether temporary, transitional or permanent. Memories provide a home with meaning, changing one's perception of that place. Homes are sites of memory, where we place objects in order to remind ourselves about family, friends and events (Blunt and Dowling, 2006, p. 114). And home is a process of creating, producing and understanding ways of dwelling and belonging through everyday practices and material transformations (Blunt and Dowling, 2006, p. 254). Disasters affect the concept of 'home', since the loss of shelter and material possessions create disruptions to individuals' senses of belonging and attachment.

As Somerville points out, if home refers to these complex dimensions, homelessness – as the opposite – can be understood as the lack of them (Somerville, 1992, p. 533). The United Nations has defined homelessness as *'a condition of detachment from society characterized by the lack of affiliative bonds'* and therefore it '*carries implications of belonging nowhere rather than having nowhere to sleep'* (UNCHS/HABITAT 2000, Cited in Kellett and Moore, 2003, p. 126). In that sense, homelessness refers to many things: a lack of shelter and possessions, in many cases a lack of employment, a lack of community ties (family and friends), and a lack of the feeling of belonging; therefore, it contributes to disengagement from the culture, society and identity (Blunt and Dowling, 2006, p. 128; Kellett and Moore, 2003, p. 127). Disruptions in continuity and stability imply losing the familiar, and to some extent, losing identity and privacy (Somerville, 1997). In the case of displacement, by being away from home, the places, activities, people and things that are absent are more apparent (Case, 1996, p. 1). Comfort and security are interconnected to daily rhythms, interactions and routines that appear to be predictable constants when one is 'at home' (Case, 1996, p. 11). Habit and familiarity are crucial elements of our sense of place (Merlau-Ponty, 1962). To be able to return to routines, to sleep on a familiar bed, allow groups affected by a disaster to start recovering a sense of home. Being able to have a physical shelter first and then to transform that shelter into a home can support a process of healing. The capacity to modify one's home can provide a sense of achievement and control, as well as the space for self-expression and freedom of action (Després, 1991, p. 98).

### 3.1.3 Unhomely homes, flexibility, change and adjustment

Home provides shelter and a setting in which people can feel secure and centred, and it consists of a series of feelings and attachments, some of which are connected to a physical structure that provides shelter (Blunt and Dowling, 2006, pp. 6–10). For example, one can live in a house and not 'feel at home' because the environment of this dwelling is oppressive or alienating, or the housing conditions are poor (Blunt and Dowling, 2006, p. 10). While the idea of a 'homely' home is connected to certain types of dwellings and experiences, life in temporary camps, and temporary or transitional shelter, may appear ‘unhomely’.

Home has been idealised, influenced by contemporary western archetypes, as the suburban detached or semi-detached house established on a big plot of land and owned by a (nuclear) family. Also, typical contemporary house designs provide spaces for families with children, and non-family members are not explicitly included, nor spaces for work or other activities (Blunt and Dowling, 2006, p. 106). These ideals influence the characterisation of other domestic building types, such as high-rise apartments, which are perceived as ‘unhomely’ due to their high density, a quality which is seen to be inhospitable and create alienation (Blunt and Dowling, 2006, p. 108). In these alienating contexts, individualising spaces through material transformations allows residents to transform their dwellings into ‘homes’ (Blunt and Dowling, 2006, p. 108).

One might cite several examples of groups modifying alienating environments, such as the transformations of mass produced housing for black South Africans during the apartheid era, as well as the home-making activities of squatters in Colombia and residents of Levittown, New Jersey. In the first of these examples, black South Africans transformed their houses of concrete and brick and made them ‘respectable homes’ through plastering walls, and adding ceilings and flooring as soon as they moved in (Rebekah Lee, 2005 cited in Blunt and Dowling, 2006, p. 117). Later modifications were more substantial, with extensions constructed to create a sense of ‘spaciousness’ reflecting the security of tenure (Rebekah Lee, 2005 cited in Blunt and Dowling, 2006, p. 117). The decision to make changes to a house is not only influenced by practical decisions of space and quality. Priorities can be less apparent, such as the importance of creating a façade before finishing other rooms, or of building a toilet, because ‘home’ also represents ideals and aspirations. Cases studied by Kellet and Moore in Colombia show that some visual role models from the middle class are reinterpreted by squatter settlements, leading to a relative homogeneity of house form and layout, due to adherence to a common set of general principles and conventions (Kellett, 2013; Kellett and Moore, 2003, p. 135). The same ‘home-making’ practices are seen in other contexts, such as Levittown, where fabricated mass-produced houses were enlarged, redesigned and converted by their residents creating a *‘combination of picturesque variety and community harmony’* (Kelly, 1993, cited in Blunt and Dowling, 2006, p. 118). Flexible designs can catalyse these modifications. Flexibility can provide families the opportunity to transform their shelters into familiar spaces to call ‘home’.

## 3.2 Flexibility, adaptability and adaptation

### 3.2.1. Differences between terms

The terms flexibility, adaptation and adaptability have been used in architecture to define buildings that can change, respond, and adjust to their users and environments. However, there are important differences between these terms. While some researchers make distinctions based on the ways that changes are produced (Yiannoudes and Kronenburg), others differentiate these concepts based on physical spaces and their uses (Groák), and others use the terms interchangeably (Schneider and Till).

Yiannoudes (2016) establishes distinctions between these different concepts as follows: 'flexibility' as a deterministic, predetermined and mechanistic approach based on closed system transformations; 'adaptability' as a non-deterministic open-ended form of flexibility based on incalculable practices of appropriation by users in space; and 'adaptation' as spaces that can adapt to changing conditions, implying flexibility but also linked to adaptive environments as understood in information theory, as seen in Figure 11. He states that a *'truly adaptable and open-ended user-determined environments'* are adaptive systems that *'can change and improve their performance, by adjusting their configuration and operations in response to environmental information feedback'* (Yiannoudes, 2016, p. 9,15). He states that the term adaptation in recent decades has referred to the idea of a space that can flexibly adapt to changing conditions and needs, suggesting the modernist concept of flexibility, but also pointing towards concepts of information theory about adaptive systems and concepts inherited from biology and cybernetics (Yiannoudes, 2016, pp. 4–5).

Groák defines adaptable buildings as spaces capable of fitting different social uses, and 'adaptability' as something which is achieved designing rooms or units that can be used in a variety of ways, without making physical changes in general (Schneider and Till, 2007, p. 5). On the other hand, he defines 'flexibility' in buildings to describe spaces capable of allowing different physical arrangements, something which is achieved by temporarily or permanently altering the building, such as extending or joining rooms, or sliding and folding furniture (Schneider and Till, 2007, p. 5). Therefore, within his definitions, adaptability is related to the use of spaces, while flexibility is connected to morphologies and techniques.

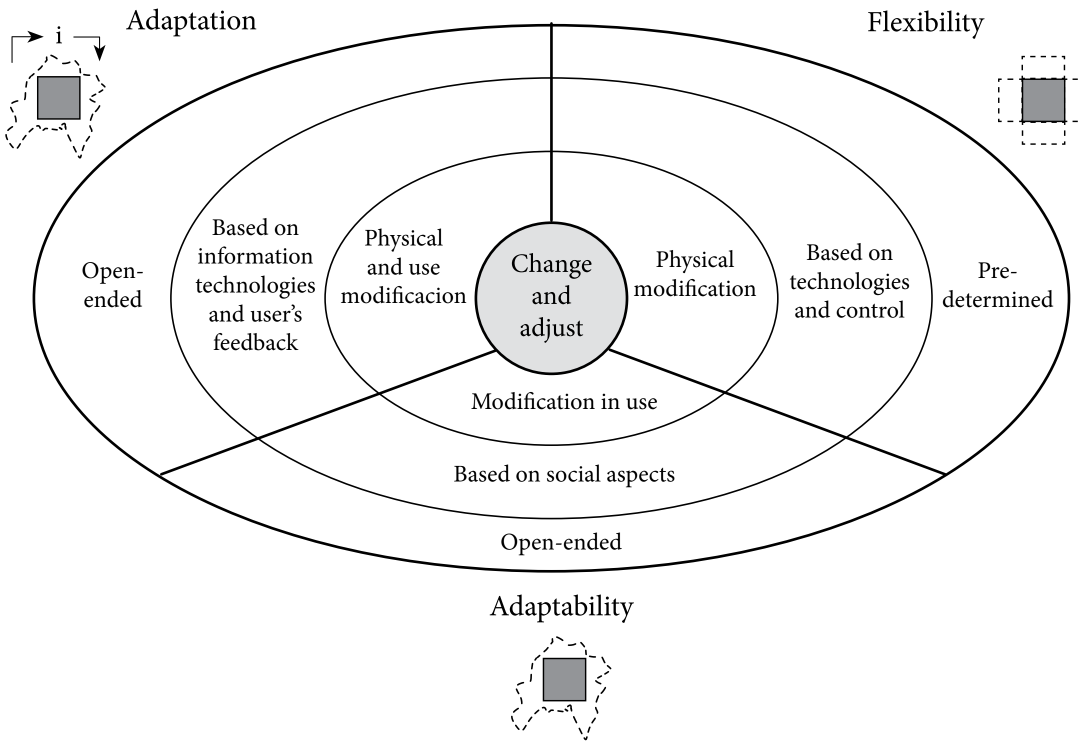



**Fig. 11.** Differences between flexibility, adaptation and adaptability. Based on definitions from Yiannoudes, 2016.

'Flexible architecture' has been defined by Kronenburg as *'buildings that are designed to respond easily to change throughout their lifetime'*; these buildings' designs recognise *'that the future is not finite, that change is inevitable, but that a framework is an important element in allowing that change to happen'* (Kronenburg, 2007, p. 7,115). Therefore, Kronenburg's definition coincides with the concept, as outlined by Yiannoudes, that flexibility occurs under certain rules and in a defined framework. On the other hand, 'flexible housing' is defined by Schneider and Till as *'housing that can adjust to changing needs and patterns, both social and technological'*(Schneider and Till, 2007, p. 4). Although Schneider and Till make explicit the differences between the concepts, based on Groák's definitions, they use the term 'flexible housing' to refer to both adaptability as open-ended changes in use and flexibility as deterministic-physical changes (Schneider and Till, 2007, p. 5). In this thesis, they are considered as connected terms, because physical changes are usually made for changing uses. Therefore, flexibility will be understood here as an umbrella under which adaptability can happen.

### 3.2.2 Flexibility in history

Although most architecture is known for being static and solid, flexible buildings have a long tradition. Humans in many historical contexts have created environments capable of adapting to different situations. Nomadic architecture was crucial to survive in many environments, and buildings had to be mobile, dismountable and transportable for coping with harsh climates and moving with the seasons (Kronenburg, 2007, pp. 10–12). However, sedentary life changed the ways that buildings were conceived. But sedentary life is not static either; the functions and requirements of buildings change over time. If sustainability, efficiency and economy are important issues, the capacity to accommodate change in buildings should also be considered in the designs of buildings.

There is, nonetheless, no single linear history of flexible architecture. Schneider and Till refer to flexible housing 'episodes' that have developed according to two overriding categories: the vernacular approach and the designer approach (Schneider and Till, 2007, p. 13).

The vernacular approach is the result of non-architects developing solutions through long-term adjustments to patterns of use and culture (Schneider and Till, 2007, p. 13). The history of vernacular housing has been extensively studied by Paul Oliver, who notes that with growth and change of the structure of the families the dwellings must change (Oliver, 2010, pp. 166–167). Vernacular architecture has shown itself to be both flexible to changes in usage and open to new adaptations; for example, the use of rooms can vary according to circumstances, and room arrangements can be modified and divided (Schneider and Till, 2007, p. 13).

On the other hand, flexible housing has also been constructed by architects, engineers and designers through the course of the twentieth century. They have developed ideas, techniques and strategies to make flexible buildings, in particular domestic spaces, in order to present possibilities for houses to adjust to changing needs, and to respond to new demographic, economic and environmental circumstances (Yiannoudes, 2016, p. 15). Schneider and Till define three key factors that have motivated the development of flexible housing: European social housing programmes to provide mass housing in the 1920s; the interest in prefabrication and emerging technologies in order to provide mass housing starting in the 1930s and continuing to the present; and the interest in participation and user involvement as a means of providing user choice in the 1960s and 1970s (Schneider and Till, 2007, p. 15). Therefore, while in the 1920s flexibility was driven by social and economic forces, in the 1930s it was motivated by technical development and industrialised solutions, and in the 1960-70s by an interest in social participation and inclusion.

The demand for urban housing after the First World War was solved through mass housing at minimal costs and reduced standards. In order to use the space in an efficient way, the notion of flexibility began to be introduced to mass housing projects. The concept attracted European architects, who analysed domestic activities and incorporated internal variability of dwellings as a key element of their work (Schneider and Till, 2007, pp. 16–17). Flexibility became essential for fulfilling the requirements of the complex modern life, and variable plan forms, driven by both necessity and user freedom, were understood as the true beginning of modernism in architecture (Kronenburg, 2007, p. 17).

In the 1930s prefabrication and emerging technologies led to an interest in modularity and standardisation which, in turn, allowed for the design of a series of hierarchically organised components within a framework that provided formal clarity and order (Schneider and Till, 2007, p. 22). This standardisation implied the provision of choices for the future user, an opportunity to obtain variability in the floor plan, and the potential for arrangement in a seemingly infinite number of ways (Schneider and Till, 2007, p. 22,24). Le Corbusier and Walter Gropius were advocates of standardisation. Walter Gropius saw the house as a set of components rather than a complete product, a way of thinking that would allow adaptation over time, such as the replacement of elements, growing and shrinking, and mobility (Schneider and Till, 2007, p. 23).

The diagrams of components for the 1924 *Haus Auerbach* (Figure 12), and the design of a detached house for the 1927 *Weissenhofsiedlung* illustrate these ideas, which are based on a system called *Baukasten im Großen*, translated as big building blocks (Herbert, 1984, p. 42). The system allowed for different housing solutions to emerge by combining standardised components, based on the concept of children's building blocks (Herbert, 1984, p. 56; Bergdoll and Christensen, 2008).

In 1931 a competition entitled 'The Growing House' (*Das Wachsende Haus*) organised by the German government called for the use of industrialised methods of construction to reduce costs and assembly time, and to guarantee extendibility of use through standardised components. The design had to be an economic expandable house with a core of 25 m$^2$, with the aim of offering flexible houses that were adaptable to economic conditions and constant changes in

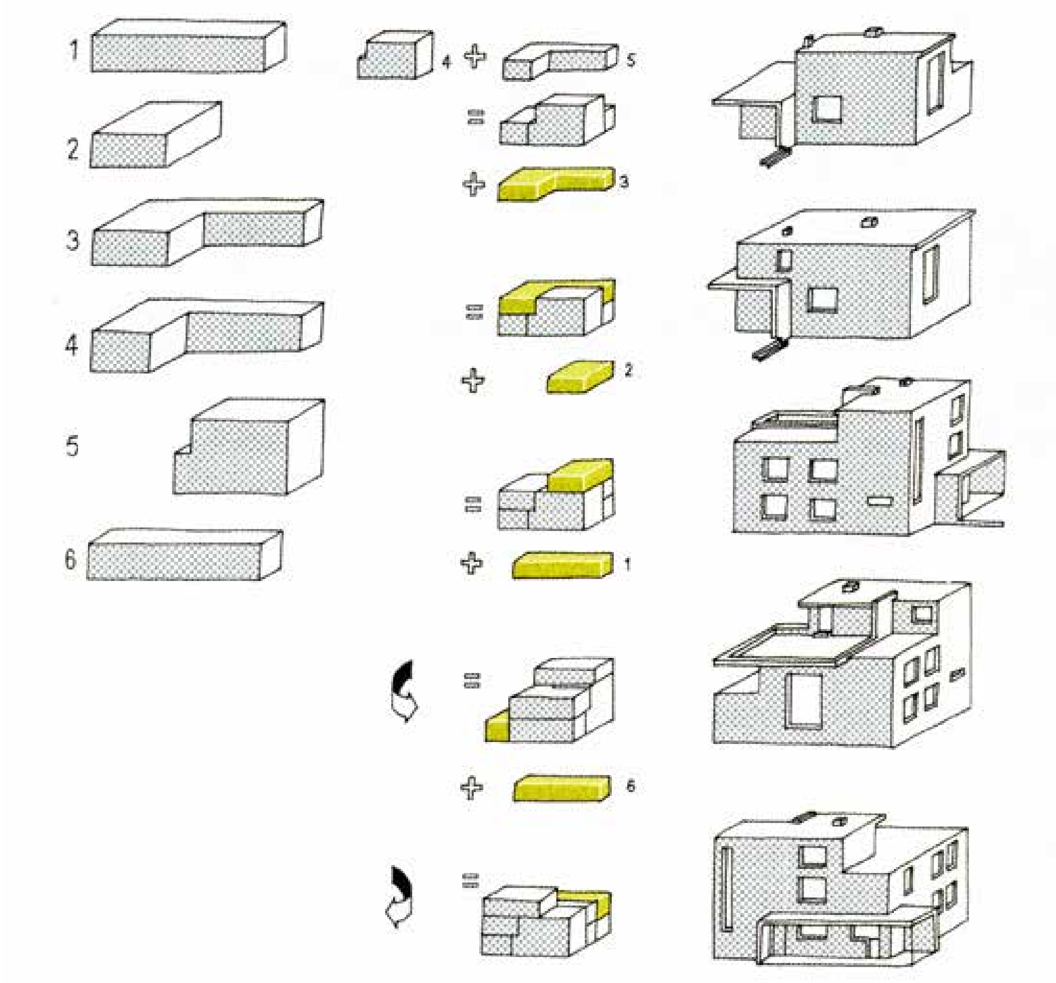



**Fig. 12.** Diagrams of components of the *Haus Auerbach* by Walter Gropius and Adolph Meyer.

Source: Schneider and Till, 2007, p.23.

family structure (Herbert, 1984, pp. 138–146). The proposal submitted to this competition by Gropius gained widespread acclaim, and generated debates about the principle of growth, self-construction and building systems (Herbert, 1984, p. 146). Other notable examples of flexibility and prefabrication from these decades were Otto Bartning's *Werfthaus (*1932), Skidmore, Owings and Merrill's Flexible Space (1942), Maurice Silvy's Sigma System (1969), Jean Prouvé's *Pavillon Démontable*, and Buckminster Fuller's Dymaxion Deployment Unit (DDU) houses, among others.

Nevertheless, neither the explorations from the 1920s nor the projects from the 1930s were applied on a mass scale. In the 1920s, mechanisms to adapt minimal dwellings were mainly for one-off cases, possibly because they developed the concept of flexibility in extreme detail, where simpler versions would have been more realistic in the long term (Schneider and Till, 2007, p. 19). Similarly, prefabrication led by well-known architects in the 1930s was limited to one-off experiments. However, building companies used industrialised methods to produce housing based on consumer choice at the point of sale, thus preserving more influence over the number of houses built (Schneider and Till, 2007, p. 26). Flexibility offered to clients by industrial companies was mainly in the selection of initial options, while providing only limited options for future change (Schneider and Till, 2007, p. 26).

Later, in the 1960s, the ideal of flexibility was pursued by architects and sociologists who supported the empowerment of users through their active involvement in planning and building their own houses (Schneider and Till, 2007, p. 27). Flexibility was seen as a means to promote plurality, tolerance and informality of different lifestyles (Gili Galfetti, 1997, pp. 13–14). John Habraken, Yona Friedman, and the Open Building Movement, among others, promoted the benefits of flexibility. In 1961 Habraken explored these ideas in his book *'Supports: an Alternative to Mass Housing'*, which advances an approach based on the separation of the elements of construction (Figure 13), in which there is a 'support' base structure which is fixed, and an 'infill' that can be changed independently of other parts (Habraken, 1972). The theory of supports was developed into the approach known as Open Building, which understands architecture and the built environment as a series of different levels of processes which are in constant transformation and change (Schneider and Till, 2005, p. 162). Both the theory of supports and Open Building emphasise the use of modern construction techniques and prefabricated elements, also separating the base building, infill system and subsystems, and being easy to assemble and disassemble (Schneider and Till, 2005, p. 162). Nevertheless, the concept was criticised later for being unrealistic (Gili Galfetti, 1997, p. 14).

In the present, one reason to design inflexible buildings is the understanding of static buildings as a long-term asset. In terms of investment, land ownership is crucial and buildings can increase the value of the property, which is based on stability, predictable development and fixed outcome (Kronenburg, 2007, p. 17). Moreover, buildings designed for investment do not have an identified user and therefore provide identical models that should fit all. As a consequence, although designing housing for unknown users could lead to flexible architecture that may vary to

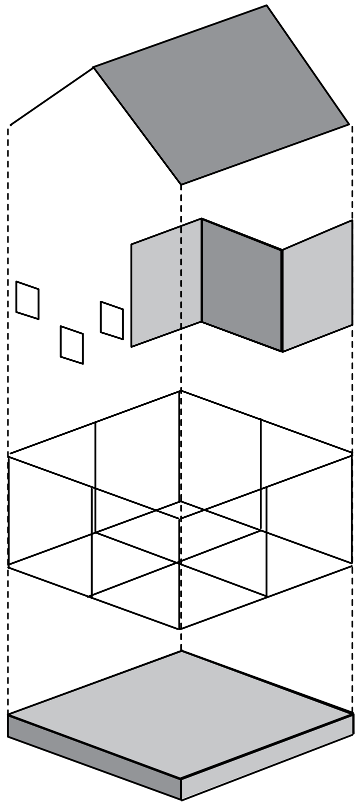


**Fig. 13.** Supports. Separation of the elements of construction.

accommodate user's requirements, it has often resulted in the opposite: inflexible buildings whose existence is due to possible investment and the existence of a rigidly defined programmatic design (Kronenburg, 2007, p. 17).

These historical examples show that flexible housing is often more successful when responding to real needs rather than to imaginary users or self-contained projects. The tension between theory and the reality of designing flexible housing in the 1920s and 1930s, as well as the tension between imposing architectural control and losing the architect's command, remain today. Flexibility has been criticised as an ideology associated with modernity and with the idea of architects extending their involvement and projecting control over their buildings into the future (Schneider and Till, 2005, p. 159). Moreover, 'representations of flexibility' to show progressive modernity have often, in practice, resulted in unaltered spaces due to technical complexity and complex geometries (Schneider and Till, 2005, p. 159). Instead, real flexible approaches work with ordinary, robust and timeless techniques (Schneider and Till, 2005, p. 159). Experiments from the 1960s, such as Piano & Rogers' Centre Georges Pompidou and Price's Interaction Centre showed that, once built, the parts designed to be flexible remained fixed in place (Schneider and Till, 2007, p. 5). However, flexibility is also seen as a way to dissolve the architect's control by giving users the choice to define the spaces they will inhabit instead of predetermining them beforehand (Schneider and Till, 2005, p. 159). Also, different agendas pertain to making 'housing' and making 'a house'; making a house for a known user involves different problems for a designer who wants to provide adaptability to the occupants (Kronenburg, 2007, p. 48). A house designed for one client, or as an experiment, is based on first-hand knowledge and specific desires, while mass housing is based on speculative assumptions about potential users (Kronenburg, 2007, p. 49).

This thesis recommends flexibility as a way to achieve economically, socially and environmentally viable housing designs. Family size, the use of spaces, and the furniture users choose, can vary; therefore, flexibility in housing design is essential to fit the diverse lifestyles of occupants. This idea of empowering users is crucial to participatory design processes, where residents are involved from the design stage (Schneider and Till, 2005, p. 160). If the limitations of such an approach are being acknowledged, flexibility has many benefits with regard to technical, economic, demographic and social aspects of housing. Technical innovation can be used, integrating new technologies and upgrading obsolete ones; it can be economically viable because it avoids obsolescence, investment in reconfiguration or refurbishment; it has demographic benefits, because it can adjust to growing or shrinking families and new living patterns; and it can provide social benefits, through the incorporation of users' experience and interventions to empower inhabitants to take control and to make choices over their dwellings (Kronenburg, 2007, p. 7; Schneider and Till, n.d.). Although it has been argued that flexibility is expensive due to upfront costs, these can be offset against long-term economic calculations, including the capacity to respond to changing needs, lower levels of occupant fluctuation, and higher appreciation of dwellings on the part of users (Schneider and Till, 2005, p. 157). Moreover, user satisfaction increases through allowing spatial flexibility (Schneider and Till, 2005, p. 162). Homes need to be adapted over time, because even if they are designed for a specific user or household, circumstances change (Kronenburg, 2007, p. 55). To enable residents to modify their houses so as to fulfil their own requirements allows them to change anonymous shelters into homes.

## 3.3. Strategies for flexible post-disaster accommodation

There are some basic principles of architecture designed to be modified and expanded: flexibility through movable buildings, such as portable and demountable ones; flexibility through design methods, such as variation, mobility, evolution and elasticity; and flexibility through structural strategies, such as hard and soft systems.

As Schneider and Till point out, there is an ethical imperative for flexibility in housing: dwellers should be able *'to live out their own lives and not that of the architect'* (Schneider and Till, 2007, p. 8). This approach does not suggest that architects should renounce control over housing design, but rather that they should redirect the way flexible housing is conceived and made. Any given building needs to be seen as an incomplete project, its designer accepting that it will be changed in a less determined form. This tactic also introduces the concept of 'home' as more connected to privacy and freedom than to architectural utopias (Schneider and Till, 2007, p. 8).

The changes made by users can be made on many different levels, from discrete modifications to wholesale changes, both being potentially useful alterations to improve inhabitants' quality of life. In general terms, a building designed to avoid obsolescence might avoid forms of roof construction that limit vertical expansion such as trussed rafters; reduce load-bearing or solid internal partitions in order to allow horizontal extensions; reduce non-accessible or non-adaptable services (for instance, those fitted underground); and reduce determined use of the space, such as houses with only one entrance (Till and Schneider, 2005, p. 287).

### 3.3.1 Flexibility through movable buildings

Traditionally, buildings are seen as the most permanent artefacts created by human beings; therefore, the concept of a movable building seems to many to be an oxymoron. However, relocation is not uncommon, and can be found throughout human history. Moreover, in post-disaster accommodation, especially in temporary and transitional housing, movable buildings have been used for different reasons, such as the uncertainty of obtaining land tenure, the need to move temporary houses to a different location, the political demand for non permanence of shelters, and the need for rapid delivery Diverse strategies of movable buildings can be found, such as portable and demountable buildings:

**Portable buildings** are the most direct strategy for moving a building, which are transported in one piece, whole and intact, as a volumetric unit (Kronenburg, 2007, pp. 176, 195, 2002, p. 9). Sometimes the buildings incorporate considerations of this method of transport within the structure (for instance, containing wheels), thus blurring the distinction between vehicle and building. Although this option can be efficient in terms of construction time, it can incur large transport costs. Examples of this strategy used in post-disaster accommodation are shipping containers that have been modified for habitation, such as the project of Shigeru Ban in Onawa, Japan after the 2011 earthquake, or the FEMA trailer used in the US in the wake of Hurricane Katrina in 2005 (Figure 14). However, these buildings are usually difficult to modify or extend, due to the materials used in their construction and their structural system. Therefore, although flexible in terms of location, they are inflexible in other ways.

**Demountable buildings** are a more flexible approach, in which the building is transported in a limited number of parts, and then assembled on site (Kronenburg, 2007, pp. 180, 195). This approach does not limit the size of the finished building or its geographical location; it allows many different forms; and the assembly process follows the kit-of-parts concept. Although this option can be more efficient in terms of transport, houses can take longer to erect and connection details are crucial to achieve good quality. Flat-pack solutions, where panels or surfaces are transported to the site, are frequently used in post-disaster accommodation, such as in the cases studied in Chile and Peru (TECHO house model), the temporary shelters built by the IFRC in Peru, and the temporary housing provided by the government of Japan after the 2011 earthquake (Figure 15).

Also, portable and relocatable buildings can employ different strategies, such as deployable buildings, structures that *'can expand and/or contract due to their geometrical, material and mechanical properties'* (Rivas Adrover, 2015, p. 13). They can change their form and size, and may be developed using different techniques, such as mechanical rigid structures (scissors), or deformable (tensile, pneumatic), flexible and combined systems (Rivas Adrover, 2015). For each of these types of movable building, modular systems can be useful to provide order and flexibility to strategies based on components. The modules can be arranged in different ways, suiting different functions and sites (Kronenburg, 2007, p. 188). The size of the parts is crucial for making the process effective, since large pieces can make assembly and disassembly times more difficult to manage.

**Fig. 14.** Portable building. FEMA trailer used in the US after Hurricane Katrina in 2005. Source: Eaton, 2007.

**Fig. 15.** Demountable building. Temporary housing *Kasetsu Jutaku* provided by the government of Japan after the 2011 earthquake. Source: House of Japan, 2011.

### 3.3.2 Flexibility through design and construction methods

Till and Schneider have outlined six generic principles for flexible housing on the basis of studying terraced houses and speculative commercial offices: amount of space, design for adaptation, generic space, disposition of services, construction techniques and layers of construction (Till and Schneider, 2005, p. 288). These principles can also be subdivided into design strategies and construction strategies.

In terms of design strategies, the first principle is the size of the space. These scholars found a correlation between the amount of space and the amount of flexibility, meaning that bigger spaces allowed greater flexibility than smaller usable areas. However, this principle is in most cases a luxury, especially in post-disaster accommodation. Also, it seems to contradict the seminal introduction of flexibility in post-war mass housing, which involved the idea of flexibility as efficiency in reduced spaces. The second principle is to design for adaptation. Simple design decisions allow for future flexibility without extra cost. Future scenarios and adaptations to the plan have to be evaluated. The third principle is the creation of a generic space, in contrast to a highly determined and specific space, thus allowing internal modifications to be made. The fourth is the provision of services which determine future changes and upgrading. The fifth principle is that of choosing adequate construction systems. The most successful flexible housing schemes rely on simple and robust construction systems which allow changes to be made without skilled labour. Finally, the sixth principle is the identification of layers of construction in order to increase control and flexibility, through defining structure, skin, services and internal partitions.

Apart from these principles, different strategies exist to achieve flexible buildings, from the perspectives of both design and construction. However, to develop real flexibility, design and construction systems need to be considered together. Schneider and Till also classify flexible housing in terms of 'hard' and 'soft systems', mainly in relation to how the building is used. Nonetheless, this division can also be applied to the methods of construction (Schneider and Till, 2007, pp. 6–7).

On the one hand, **hard systems** are determined by the ways in which spaces and elements will be used. Flexibility is controlled by the design, which defines future changes by constructing elements such as sliding doors, moving walls, adaptable partitions and furniture that can be moved, pivoted, reclined, retracted and folded down. Methods of construction used to achieve this flexibility are connected to technological systems, such as modularity and servicing strategies, which may be linked to the theory of support and infill elements (Habraken, 1972). This flexibility through technological systems could also be linked to Open Plan Theory, which is based on 'service' strips or 'thick walls' that allow the remainder of the domestic space to be used freely. These strategies define variable levels of intervention and flexibility: the infrastructure can be fixed, the building frame is stable but replaceable, the building skin can be easily revised, and internal partitions can be quickly relocated (Kronenburg, 2007, p. 100). Formal clarity that follows a logic of construction allows for some flexibility by distinguishing those elements that are fixed from those that are open to change and variation (Schneider and Till, 2005, p. 161).

On the other hand, **soft systems** refer to tactics that allow uncertainties to emerge through the use of an indeterminate plan form. These are less deterministic than hard systems, since control is passed to the inhabitant, while the architect plays the role of 'facilitator'. Methods of construction for this system enable flexible housing to develop in a fashion that is not entirely controlled. Design decisions that allow this approach depend on carefully considering access points (usually in the centre of the plan), the position of servicing (either in specific zones or distributed, but not permanently fixed), and an efficient module that allows for repetition and subdivision (Till and Schneider, 2005, pp. 291–292, 294).

These two approaches to flexibility, hard and soft systems, are not mutually exclusive, but do highlight the tension between determinate and indeterminate concepts (Schneider and Till, 2007, p. 7), as seen in Table 11. While soft flexibility leads to a participatory approach to design which allows tenants a degree of control, hard use is largely determined by the architect, who maintains overall control (Till and Schneider, 2005, p. 293).

## ***Spatial design strategies for flexibility***

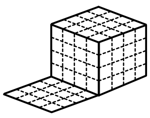
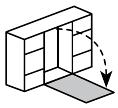
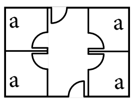
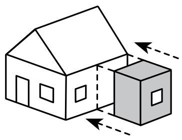
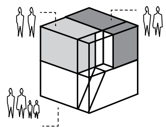
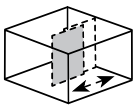
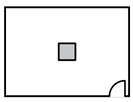
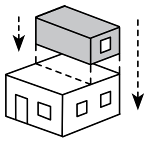
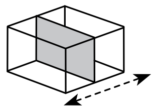
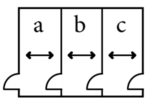
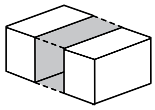
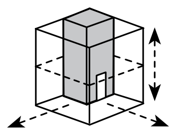
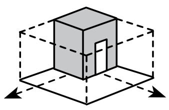
As shown in Table 11, based on definitions from Gili Galfetti, Kronenburg, and Schneider and Till, typologies of flexibility in housing design can be identified as: ‘initial’ (prior-occupation), ‘permanent’ (post-occupation) or both (Gili Galfetti, 1997, p. 13; Kronenburg, 2007, p. 49; Schneider and Till, 2007, p. 181) .

On the one hand, **initial flexibility (prior-occupation)** design allows ‘variation’ within the same architectural form and facilitates future residents to choose and/or contribute to the final design. Prior-occupation flexibility allows for participation and user engagement before the house is built. Flexibility becomes a social issue, and the designers become moderators and technical enablers, supporting users to make decisions on how to arrange elements within the provided empty space (Schneider and Till, 2007, p. 144). This approach supports social empowerment, and it can be useful in post-disaster scenarios engaging affected communities in the design of their new homes, and using the process as an opportunity to educate them about disaster risk reduction strategies. However, the participatory method is not available for most housing designers, who usually design for an unknown user (Schneider and Till, 2007, p. 146). Further, in many countries, the regulatory and planning permission system does not permit this type of user flexibility, since the designer is asked to provide a full set of definitive plans (Schneider and Till, 2007, p. 144). A notable example of flexibility prior to occupation using modular elements is the *Siedlung Hegianwandweg,* by EM2N in 2003 (Figure 16). The project presents 25 different scenarios through the arrangement of walls for different combinations of users (Schneider and Till, 2007, p. 146).

On the other hand, **permanent flexibility (post-occupation)** design allows for future changes, and the possibility for a house to be adapted while it is being used. This typology of flexibility can be subdivided into three categories: ‘mobility’, ‘evolution’ and ‘elasticity’ (Gili Galfetti, 1997, p. 13; Kronenburg, 2007, p. 49).

‘Mobility’ allows spaces to change on a daily basis so as to accommodate diverse activities (Figure 17). In general, it uses hard systems that allow internal and predetermined flexibility using different strategies, such as folding furniture and sliding walls. The built-in furniture facilitates daily changes and uses, such as foldable beds, tables and other elements that can move easily to allow more space or to create different configurations. Further, folding, sliding and movable walls

**Table 11.** Typologies and strategies for flexibility based on Gili Galfetti, Kronenburg, and Scheider and Till.

| | | | | | |
|---|---|---|---|---|---|
| TYPOLOGY | **Prior-occupation/ Initial flexibility** | **Post-occupation / Future flexibility** | | | |
| TYPES | **Variation**<br>of the same model | **Mobility**<br>Day to day<br>Internal flexibility | **Evolution**<br>Long-term change of layout<br>Internal flexibility | **Elasticity**<br>Long-term expansion and/or contraction<br>External or internal flexibility | |
| CONTROL | Architect and inhabitant control | Architect control | Inhabitant control | Inhabitant control | Architect control |
| SYSTEM | **Traditional**<br>although can incorporate soft and hard systems | **Hard systems**<br>predetemined flexibility | **Soft systems**<br>indeterminate flexibility defined by **hard systems** | **Soft systems**<br>indeterminate flexibility | **Hard systems**<br>predetermined flexibility |
| STRATEGIES | Modular elements<br> | Folding furniture<br> | Neutral rooms<br> | Horizontal addition<br> | Dividing up<br> |
| | | Sliding walls<br> | Open plan<br> | Vertical addition<br> | Joining/ dividing rooms<br> |
| | | | Connection between rooms<br> | Slack space<br> | Raw space/ open plan<br> |
| | | | | Service core<br> | |

are a common feature used for providing everyday to semi-permanent changes, although the aspect of acoustics needs to be carefully considered. Examples of predetermined flexibility using hard systems and movable elements are Erich Mendelsohn and Richard Neutra's creation of a device for single detached houses in Berlin-Zehlendorf in 1923, Gerrit Rietveld's 1924 *Schroder Huis* in Utrecht, Le Corbusier's *Maisons Loucheur,* constructed in 1928, Johannes van den Broek's 1929 *Woningenkomplex Vroesenlaan*, and Carl Fieger's apartments at the building exhibition in Berlin in 1931 (Schneider and Till, 2007, p. 19; Yiannoudes, 2016, p. 15). Adrian Forty refers to this kind of arrangement as *'flexibility by technical means'* (Yiannoudes, 2016, p. 15).

'Evolution' allows built-in capacity for mid- and long-term modifications to the basic layout over a period of years based on changes in the structure of the occupying household. It can use soft systems which allow indeterminate long-term internal changes, through the use of strategies such as neutral rooms, open plan and connections between rooms. Neutral rooms are equally sized rooms with a central hall or circulation, which allow residents to decide on each space's use. Open plan is an undefined plan with a service core which allows users to divide and use the space in different ways. This type of strategy is frequently used in the design of commercial offices. Connections between rooms facilitate temporary or permanent linking between an array of different spaces, through sliding doors or panels, and therefore it is critical that doors are positioned so as to allow different alternatives. One obstacle for such indeterminate flexibility is the way that most houses are wired and serviced, which makes future changes more difficult (Till and Schneider, 2005, p. 294). The distribution of services through raised floors can solve this problem, but this can be more expensive in the short-term (Till and Schneider, 2005, p. 294). One notable example of flexibility through evolution is Van Tijen's competition entry for low cost workers' housing, composed of a frame structure with no load-bearing walls, which allows for the adaptation of the dwelling to changing circumstances (Schneider and Till, 2007, p. 16).

'Elasticity' facilitates the expansion or contraction of the inhabitable space through the addition of one or more rooms. It can use soft or hard systems to allow internal or external flexibility. On the one hand, elasticity though soft systems allows indeterminate extension or contraction depending on users' needs, using strategies such as vertical or horizontal addition, the use of empty space (slack space), and service core. Horizontal additions allow extensions at the sides of a given building, as required by its occupants. Considerations to freely extend are how the entrance, light and services are likely to be affected by the extension. Also, the shape of the building allows different types of extension; for instance, a house with a cubic shape allows extensions based on the same size of

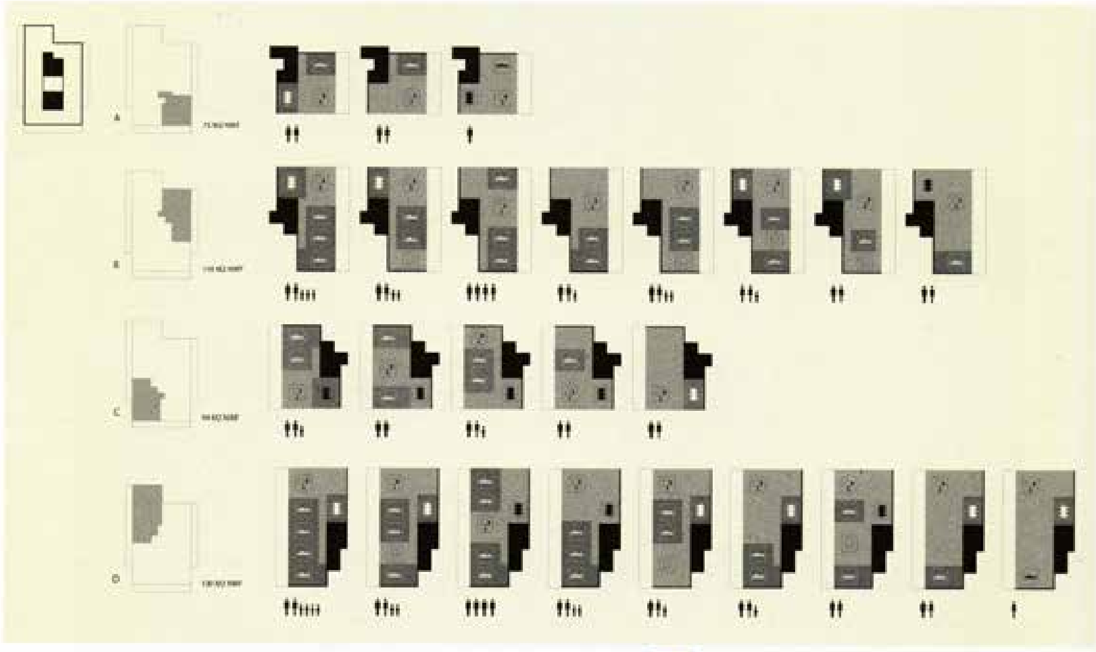


**Fig. 16.** Flexibility prior-occupation using modular elements. *Siedlung Hegianwandweg*, by EM2N, 2003. Source: Schneider and Till, 2007, p.146.

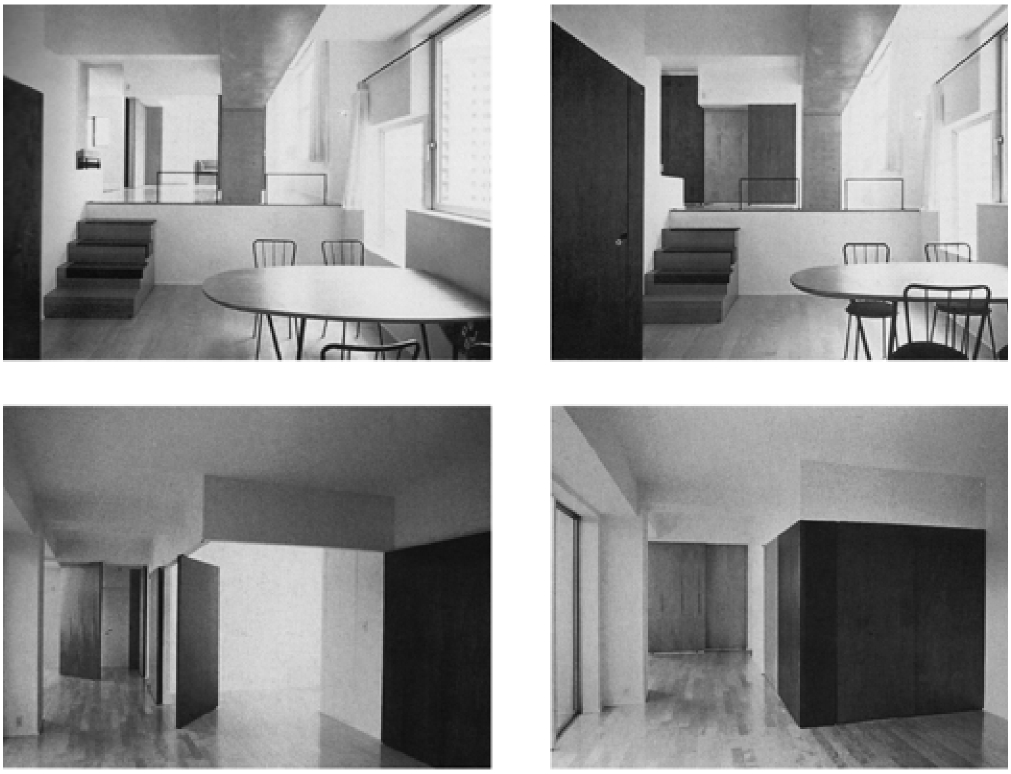


**Fig. 17.** Flexibility through mobility. Daily reconfiguration. Housing in Fukuoka, Japan, 1992, by Steven Holl. Source: Gili Galfetti, 1997, pp. 29–31.

sides, while a house with a cuboid shape allows bigger extensions on the long sides. In addition, an extension in a house with an 'L' shape can block the entrance, sunlight and ventilation. Vertical additions may allow an extension on the roof to be used as a mezzanine or a first floor. This type of extension needs structural and planning considerations, such as the avoidance of rafters, the design of joist for extra loads, and alternative positions for staircases. The slack space strategy (remaining unused space) allows residents to take over sites such as courtyards, roofs, and empty spaces between buildings. So that this option may be well developed, the design must take into account the ways in which the empty space will be appropriated. Finally, the service core strategy provides a small structure with the most expensive and difficult part to build, such as the kitchen and toilet, to allow residents to expand freely, limited only by plot size. The position of the core is crucial for determining future expansion and, therefore, possible extensions should be explored in order to understand the different alternatives and their implications. An example of flexible housing using soft systems and indeterminate plans where social and technical aspects support each other is Diagoon Houses, Delft (1971) by Herman Hertzberger (Figure 18), in which the idea of an 'incomplete building' leaves space for the personalised interpretation of the user to be expressed (Till and Schneider, 2005, p. 295). Another example is the project of social houses developed by ELEMENTAL in Chile, where they provide *'half a good house'* so that inhabitants have to build the other half when they have the resources, allowing families to develop different configurations and aesthetics (Figure 19).

On the other hand, elasticity through hard systems allows room for predetermined flexibility inside a defined module, using strategies such as dividing up spaces, joining rooms, and providing a raw space. Dividing up spaces allows large units to be subdivided for different uses or for accommodating different household types. Design considerations for this type of flexibility are the different possible ways of accessing the units, and future subdivisions. Joining rooms is a strategy that allows smaller spaces to be connected to create bigger spaces for long-term use. To facilitate this kind of change, sections of the walls should be designed in a way that they can be removed easily. This strategy can be used by growing families or extended families: for example, by connecting two house units. A problem with this strategy could be the duplication of kitchens and entrances, and therefore, the design should include alternative uses for those spaces. Finally, the raw space strategy is based on a big space, not completely finished but with provision of basic services. It is similar to the core house, but here the flexibility is internal within the structure provided, rather than external. For this strategy the position of the access and services must be carefully designed, and everything within the spaces has to be adaptable or movable.


**Fig. 18.** Soft systems and indeterminate plans. Diagoon Houses in Delft, Herman Hertzberger, 1971. Source: Schneider and Till, 2007, p.82.

**Fig. 19.** Elasticity through soft systems- Incomplete building. ELEMENTAL houses in Quinta Monroy, Chile. Source: Aravena and Iacobelli, 2012, pp.148-149.

Although designers have explored strategies for flexibility to make better use of small spaces that allow daily changes, such as folding furniture and moving walls, they appear not to have been applied in post-disaster accommodation. This could be explained by inhabitants' lack of knowledge of such techniques, the costs of in-built furniture, and other cultural factors. Moving screens and temporary dividers have a long history in vernacular buildings, such as in Japanese houses or the curtained spaces of the seventh century Dutch interior (Schneider and Till, 2007, p. 152). However, these soft devices became hard devices in the twentieth century (Schneider and Till, 2007, p. 152).

In 2005, the Innovation Centre of TECHO NGO (*Centro de Innovación, Un Techo para Chile*) organised a competition to design furniture for the quality improvement of small houses which was open to architecture students and professionals alike (Un Techo para Chile, 2005). The competition generated a number of good ideas, such as hanging storage, a modular storage wall, a multifunctional wall, a shelf door and a foldable bed (Figure 20). Although the competition received interest from the media and it was exhibited at the Museum of Fine Arts (*Museo de Bellas Artes*), the designs have not been used in real projects, because they never reached the real market and remained as speculative designs.

Each of these typologies allows for social empowerment and engagement with the building, although during different stages of the process and at a different intensity. Projects can incorporate initial flexibility, in which users decide the model they would use, alongside post-occupation flexibility, where users modify the house while they use it.

## ***Structural strategies for flexibility***

Structural and construction techniques are crucial for allowing flexibility in house design, either pre-or post-occupancy. Similar to the classification of strategies relating to the use of flexible housing, 'hard' and 'soft' systems of construction can be identified (Schneider and Till, 2007, pp. 6–7). While hard technology is more deterministic and shapes users' patterns of living, soft technology is open to changes made by the occupants, and does not seek to limit their options.

**Hard systems** can be linked to the concept of support, based on a permanent structure that provides the basic infrastructure for impermanent and adaptable infills, such as the walls, windows, and partitions. In general terms, the system provides a supporting structure that acts

**Fig. 20.** Winning entry in the furniture competition organised by *'Un Techo Para Chile'. 'TES: Tercio Espacial Superior'* by Jose Spichiger and Paola Azocar. Source: Un Techo para Chile, 2005, p.22.

as a frame and skeleton to which services can be attached. The frame can take many forms, such as concrete columns and beams, or timber frames. Structural frames allow a background armature that enables a variety of planned forms to evolve inside; this provides long spans and indeterminate spaces, allowing non-loadbearing partitions (Schneider and Till, 2007, p. 165). The more open the frame, the more possibilities for modification there are, leading to greater flexibility (Schneider and Till, 2007, p. 192). Le Corbusier's Dom-ino House (Figure 21), which allows walls and openings to be positioned independently from the structural system and allows variations of the interior arrangements, is an example of a building system based on a concrete slab and columns (Schneider and Till, 2007, p. 166). When the basic infrastructural system is combined with clear spans, the possible internal combinations allow the internal adaptation of houses as needed.

**Soft systems** can be linked to the concept of layering, where cladding, frame, partitions, services and finishes are separated as independent layers. This separation of elements is based on the idea that they each have different lifespans, and therefore elements should be able to be changed or adapted without altering the whole building (Schneider and Till, 2007, p. 193). However, separating layers should not create complex systems and sets of rules that make construction more complicated. Based on the concept of the six S's developed by Stuart Brand (Figure 22), the layers go from the most permanent to the most temporary: the site, the structure (structure and service connections-risers), the skin (envelope), the services (wiring and pipes), the space-plan (internal partitions), and the stuff (furniture and finishes) (Brand, 1994, p. 13).

The different elements of construction need to be considered in order to allow flexibility, such as foundations, external walls, partitions, roof construction, location of services and service distribution (Schneider and Till, 2007, pp. 195–199). Foundations are the most permanent element of any building, and they should be carefully designed to facilitate future changes. External walls should be designed to be upgraded, replaced or adapted as necessary, especially when horizontal expansion is needed. Panelised external walls separated from the structural system can provide that flexibility. Internal partitions that can be simply moved are one of the main principles of flexible housing. Hence, partition walls should not be load-bearing (they can be knock-out panels in pre-framed openings), they should not contain services (such as electrical connections), they should be modular to allow different configurations (connections should be carefully designed), and floor finishes must be designed to take alternative partitions into account. Roof construction

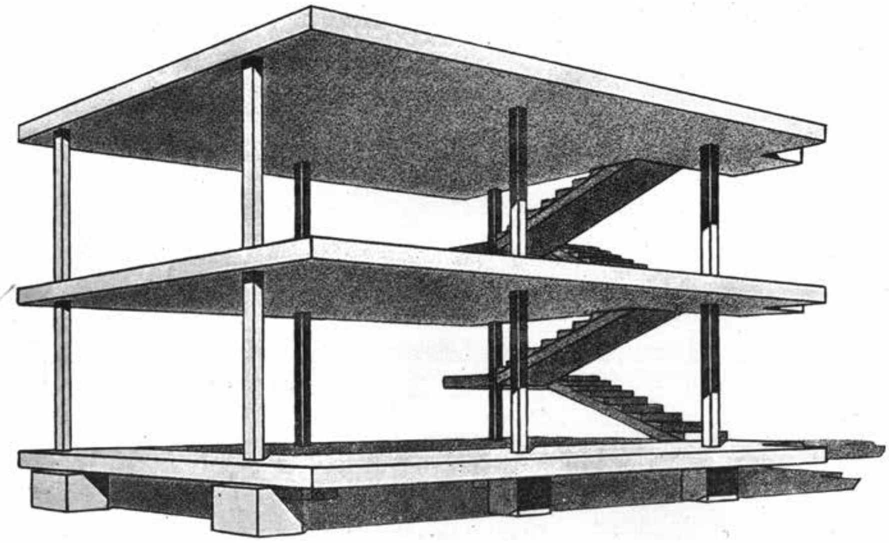


**Fig. 21**. Example of a hard system using a concrete slab and columns, Le Corbusier's Dom-ino House.
Source: Boesiger and Girsberger, 1967, p. 24.

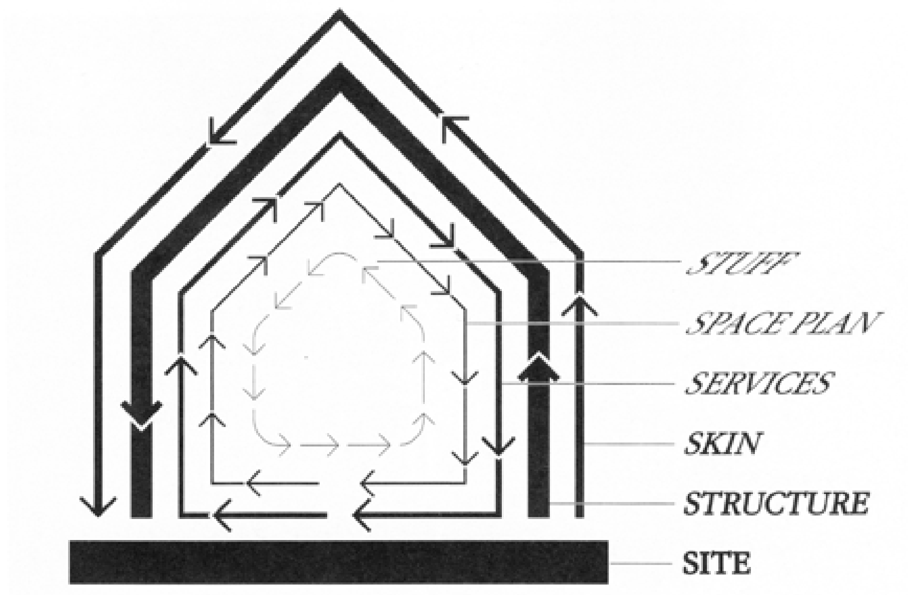



**Fig. 22.** Soft systems.The six S's developed by Stuart Brand.
Source: Brand, 1994, p. 13.

is crucial to allow vertical extensions, and therefore flat roofs have the most potential. However, when pitched roofs are designed, trussed rafters should be avoided to allow future use of the roof space, while always considering the structural implications of this decision. Also, possible openings for future roof-lights should be considered, as well as a pre-designed staircase to give access to a mezzanine or first floor. Services are in general difficult to modify and move freely, and therefore their design, location and possible upgrades need to be considered from the beginning. The distribution of services with future modifications in mind can be achieved through grouping them vertically (in stacks or risers) and horizontally (under a raised floor, or in a dedicated space that runs next to the wall-frame structure), allowing access in the case of future upgrades.

Alongside these building strategies, those designing for flexibility should consider other aspects through which to allow future modification: design for 'simplicity', 'disassembly' and 'exchangeability' (Schneider and Till, 2007, p. 194). On the one hand, successful flexibility depends on the creation of simple construction systems which allow change without skilled labour, instead of specific technical approaches that use the most recent technology developed. These can be based on frames or in a grid structure without loadbearing internal partitions. The building system should be simple enough for non-specialists to understand, so that they are able to make changes to it. Walter Segal's 1987 project Honor Oak Park constitutes a notable example of this 'simplicity' approach (Figure 23), providing a simple modular building system that allowed tenants to build and later adapt their houses (Schneider and Till, 2007, p. 194). Furthermore, there are examples of vernacular architecture that provide variations of the same model using similar simple techniques (Figure 24). On the other hand, design for disassembling and exchanging elements is crucial for providing flexibility in the long term. Elements should be able to be replaced or removed without damaging the rest of the house, at a large and small scale.

This possibility of disassembling and exchanging elements is especially useful in post-disaster situations, where displaced families are often moved to land which they do not own, motivating them to either move back to their own land or use the temporary house given to them as an extension.

In terms of systems of construction, 'modularity' and 'prefabrication' can allow future flexibility. 'Modularity' is a system based on a certain module that is repeated to create the layout, and it can be found in examples as old as the Japanese house, that was based on the repetition of the floor mats (*tatami*) measures. 'Prefabrication', on the other hand, is based on elements of a

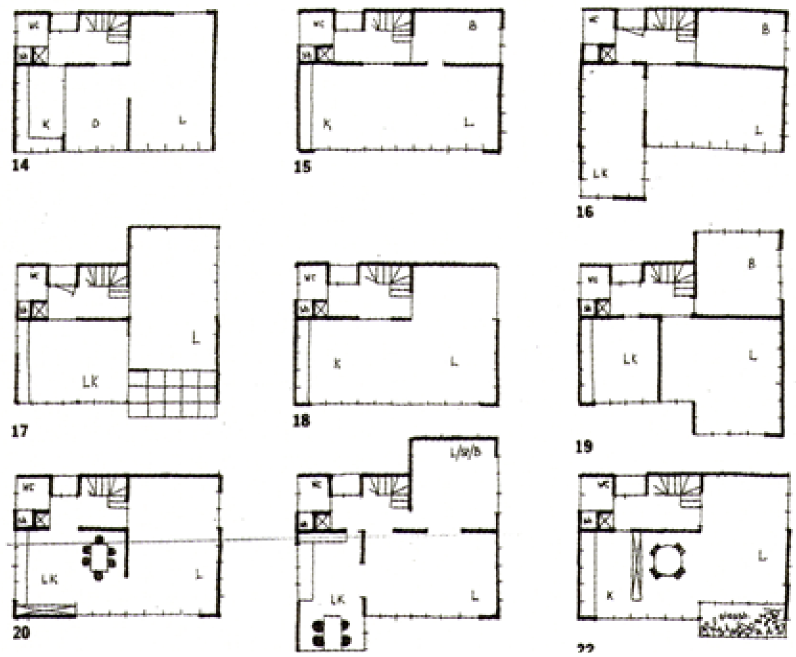



**Fig. 23.** Simplicity  approach. Honor Oak Park by Walter Segal in 1987.

Source: Schneider and Till, 2007, p.194.

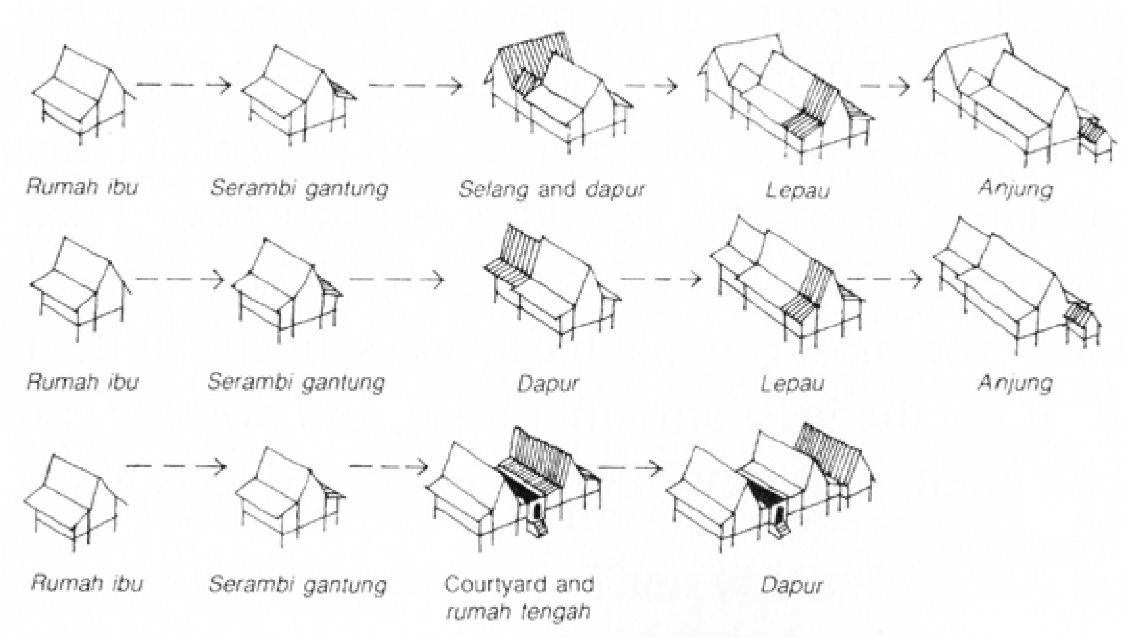



**Fig. 24.** Flexibility in vernacular architecture. Common addition sequences in Malayan houses.

Source: Brand, 1994, p. 137.

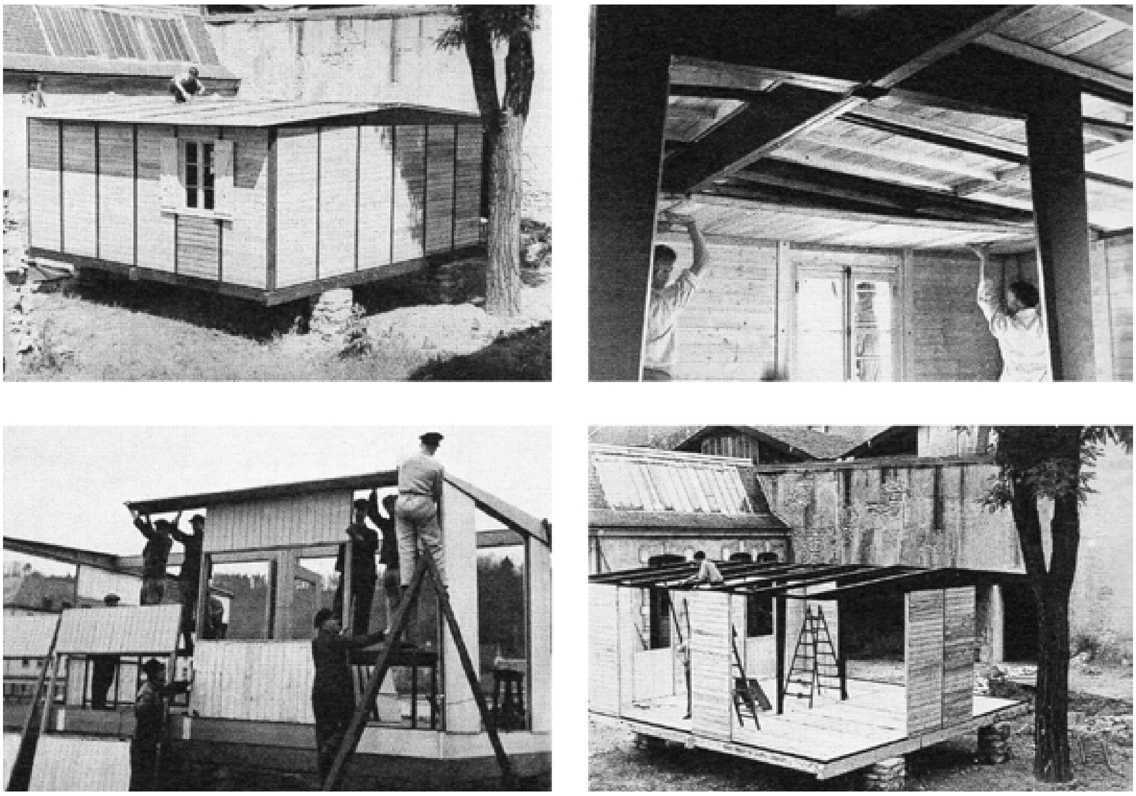


**Fig. 25.** Modularity and prefabrication. Jean Prouve's 6x6 temporary houses for the refugees of Lorraine. Source: Allégret and Vaudou, 2001, p. 136.

building that are manufactured off site, then transported and assembled on site. The problem is that prefabricated building systems often use a panelised approach which tends to bind together the layers of construction (layer, structure, insulation, inner layer and even services) without allowing future modifications, such as Structurally Insulated Panels (Schneider and Till, 2007, p. 176). Some notable exceptions to this tendency are Jean Prouve's houses designed as temporary huts for Second World War soldiers and houses for the refugees of Lorraine, France around 1945 (Figure 25). These houses were based on a central structure and modular timber panels. The structure allowed creating houses with different dimensions based on a module and the reuse of partitions and prefabricated panels. However, these houses remained one-off experiments which were not used in mass fabrication (Schneider and Till, 2007, p. 176). After reviewing hundreds of cases of flexible housing, Schneider and Till concluded that the most productive approach to prefabrication is to use existing standard prefabricated elements that can be easily adapted and replaced, instead of creating new ones (Schneider and Till, 2007, p. 177).

The following chapters investigate cases in Peru and Chile, in order to respond to the questions: How and why do families modify their temporary houses, and what are the characteristics of this process? The study of temporary houses adapted by families over the years allows understanding the process of transformation from a prefabricated shelter unit into a 'home'. Also, this study seeks to identify the strategies for flexibility that families use to transform their houses, and how these modifications are supported (or not) by the design of the temporary house. The aim is to understand the processes of adaptation led by families, and how they can be translated into strategies for future proposals based on the core concept of flexibility.

# Chapter 4

# 4. Adaptation of a temporary house

In order to understand the process of recovery that families undergo after a disaster, temporary accommodation after earthquakes in Peru and Chile was studied. To this end, fieldtrip to these countries was conducted in the months of November and December of 2012, and January 2015. The main objective was to identify stages, similarities and differences in the process of transforming temporary houses by comparing cases from both countries. The questions that guided the study are:

- How and why do families modify their temporary shelters?
- What are the characteristics of this process?
- What features are essential for supporting the transition process?

The goal was to understand how families living in the same type of temporary house adapt it to their different needs and cultural preferences. 27 cases were selected for analysis in both countries, which were studied through observation, measurements, drawings, and pictures of the houses and interviews with families and stakeholders involved in the process. This research focused on the changes, additions and improvements made by families, with or without external support, and how these changes could be extrapolated as patterns of use. This study does not evaluate the success or failure of the temporary housing programme implemented, but rather examines families' practices within the houses with which they were provided after disasters.

## 4.1 References

Few studies of modified post-disaster accommodation have been published by international or local organisations. One reason for the lack of studies on this topic might be that humanitarian organisations or agencies, in general, do not return to the sites of past projects to conduct evaluations of the long-term impact of their programmes (Doninger, 2013, p. 2; Kelman et al., 2011, p. 263). There are, however, some exceptions, such as the case studies compiled in the book *'Still Standing. Looking Back at Reconstruction and Disaster Risk Reduction in Housing'* edited by Theo Schilderman and Eleanor Parker, which examines the impact of reconstruction programmes several years after they finished, with the aim to learn from past experiences in order to inform future projects (Schilderman and Parker, 2014). The diverse examples studied in this book do describe the ways users made modifications to post-disaster permanent houses or core-houses, but the analysis of these modifications is a secondary interest within the book, which focuses on other aspects of reconstruction.

Most studies on transformed, adapted and improved houses, meanwhile, do not examine the context of disasters, but are focused instead on low-cost public housing and informal housing, mainly in developing countries. Nevertheless, they provide methodological approaches and sound conclusions that can be extrapolated to post-disaster contexts. For example, studies with this focus have been carried out on cases in Mexico, Ethiopia, Bangladesh, Ghana, Zimbabwe, Egypt, Israel, Saudi Arabia, Tanzania, Peru, Macedonia and Georgia (Table 12).

In particular, A. Graham Tipple and Peter Kellet have carried out extensive research on the extensions made to social houses by users (Kellett et al., 1994; Kellett and Tipple, 2000; Tipple, 1996). Tipple, Masters and Garrod conducted a comparison of cases of self-help transformations (alterations and extensions) to government-built houses in major cities within four developing countries: Dhaka, Bangladesh; Cairo, Egypt; Kumasi, Ghana; and Harare, Zimbabwe (Tipple et al., 2000). This project examined the factors that influenced the modifications, as well as the cost of the extensions. Conclusions from the research show that physical characteristics of a given house seem to be an important factor in the ways in which it is modified, even more influential than household income and household size (Tipple et al., 2000). The findings support a positive view of these transformations; these authors point out that, in general, the standards of the extensions are as good as or better than those of the original house, and that anyone who has the space to transform their house is likely to do so (Tipple et al., 2000, pp. 1607, 1616). These authors also observe that transformations produce variety out of uniformity, in terms of house size, space per household, value and cost, uses, tenure and occupants (Tipple, 2000, pp. 143–145, 1999, p. 27; Tipple et al., 2004, p. 94).

**Table 12.** Publications of cases of transformed, adapted and improved houses.

| Case study | Publication |
|---|---|
| **Mexico** | A.D. Murphy and others, 'Household Adaptations to Government Housing Designs in Oaxaca, Mexico', *Housing and Society, Journal of the American Association of Housing Educators*, 24.2 (1997), 1–21 |
| **Ethiopia** | D. Shiferaw, 'Self-Initiated Transformations of Public-Provided Dwellings in Addis Ababa, Ethiopia', *Cities*, 15.6 (1998), 437–48 |
| **Bangladesh, Egypt, Ghana, Zimbabwe** | A.G. Tipple and M.S Ameen, 'User Initiated Extension Activity in Bangladesh: "Building Slums" or Area Improvement?', *Environment and Urbanization*, 11 (1999), 165–84; A.G. Tipple, 'Transforming Government-Built Housing: Lessons from Developing Countries', *Journal of Urban Technology*, 6.3 (1999), 17–35;<br><br>A.G. Tipple, S.E. Owusu and C. Pritchard, 'User-Initiated Extensions in Government-Built Estates in Ghana and Zimbabwe: Unconventional but Effective Housing Supply', *Africa Today*, 51.2 (2004), 79–105;<br><br>T.H. Khan and B. Jia, 'Transforming to Variety: Lessons from Self-Built Neighborhoods in Dhaka', in *Proceedings of the Building Stock Reactivation 2007 Conference*, Session B-2: Adaptable Building (Tokyo: Tokyo Metropolitan University), pp. 269–76 |
| **Israel** | Y. Etzion and others, 'An Open GIS Framework for Recording and Analysing Post-Occupancy Changes in Residential Buildings. A Climate-Related Case Study', *Building and Environment*, 36.10 (2001), 1075–90;<br><br>B.A. Portnov, Y. Odish and L. Fleishman, 'Factors Affecting Housing Modifications and Housing Pricing: A Case Study of Four Residential Neighborhoods in Haifa, Israel', *Journal of Real Estate Research*, 27.4 (2005), 371–407 |
| **Tanzania** | H. Nguluma, '*Housing Themselves: Transformations, Modernisation and Spatial Qualities in Informal Settlements in Dar Es Salaam, Tanzania*' (unpublished PhD thesis, Department of Infrastructure, Division of Urban Studies, Royal Institute of Technology, 2003) |
| **Saudi Arabia** | M. Al-Naim and S. Mahmud, 'Transformation of Traditional Dwellings and Income Generation by Low-Income Expatriates: The Case of Hofuf, Saudi Arabia', *Cities*, 24.6 (2007), 422–33 |
| **Peru** | EquipoArquitectura and others, *Time Builds!-¡El Tiempo Construye!* (Barcelona: Gustavo Gili, 2008) |
| **Macedonia y Georgia** | S. Bouzarovski, J. Salukvadze and M. Gentile, 'A Socially Resilient Urban Transition? The Contested Landscapes of Apartment Building Extensions in Two Post-Communist Cities', *Urban Studies*, 48.13 (2011), 2689–2714 |

These examples demonstrate that similar adaptation processes occur across otherwise markedly different contexts. The research methodologies used to study modifications vary from case to case, including statistical approaches, ethnographic research, and classifications of buildings and their morphologies. Further, in all the references reviewed, fieldwork is employed to study the modifications made, with the use of different methods to collect data such as observations, mapping, and surveys. A shared aim can be identified in the literature, which is to study past experiences in order to illuminate future approaches and designs, and in some cases to show that changes to dwellings create improvements and do not necessarily lead to the creation of slums (Tipple et al., 2004, p. 93; Tipple and Ameen, 1999, pp. 181–183). Although methodology and focus vary, some elements are analysed in most references, such as the identification of the main changes made to the houses, alongside the elements influencing the transformations, and residents' motivations for making changes to the dwellings.

### 4.1.1 Analytical themes

In terms of analysis, the cases studied are characterised according to the focus of the research. From examples found in the literature the following aspects can be identified as the main elements for analysis:

- **Socio-Cultural aspects:** household size, household and family composition, rooms per person, demography (age and gender), religious beliefs, traditions, uses and functions (kitchen, toilet, living room, terrace, storage, shop, restaurant).
- **Physical aspects and architecture:** the form and morphology of plans, room arrangement (organisation and number), dimensions and size (total $m^2$ and $m^2$ per person), structure, building materials (primary and secondary), construction techniques, quality of construction, environmental aspects, climatic and environmental conditions, architecture style, adjacent spaces (interior and outdoor), public space (shared rooms and exterior spaces), orientation, services (electricity, sanitation), types of change (added, removed, enlarged, reduced, enclosed), added elements (doors, windows, walls, gates, balcony, roof, terrace, vegetation, parking), location of modification within built context.
- **Economic aspects:** house tenancy and ownership, household per capita income, per capita income, wealth, cost of the house, total spending on transformation, funding, and future plans.

In this thesis, although the main focus is the building form, and therefore the physical aspect of the changes, economic and socio-cultural aspects are also included because they provide information about the factors that influence the transformations, and some changes are connected to the material aspects of the building and its use.

### 4.1.2 Main changes

Transformations frequently discussed in the literature are: an increase in house size, an increase in the occupancy rate ($m^2$ per person); change of functions, such as economic activities, shops, bars and handicrafts; the use of different building materials, such as vernacular, modern, durable and temporary; changes in value and cost; and changes in plan forms or morphologies which are related to functions, access and protection from the sun (Shiferaw, 1998, pp. 442–445; Tipple and Ameen, 1999, pp. 172–181).

These transformations can be analysed as physical, economic and socio-cultural changes. Two types of physical transformation have been identified: 'add-in' which are changes inside the existing building, and 'add-on' which are additions to the building such as changes to the façade, windows and extensions (Brand, 1994; Nguluma, 2003). Meanwhile, in relation to modifications, four categories can be identified: slight adjustment (functional change instead of physical), addition and division (addition of rooms, or subdivision), total conversion (complete change of use), and by reconstruction (total demolition and the construction of a new building) (Al-Naim and Mahmud, 2007, p. 428).

### 4.1.3 Factors and motivations

Six key factors influence housing transformations: security of tenure, financial resources, initial housing design and construction of the original dwelling, infrastructure and support services, labour (hired or self-help), and the availability of space to expand around the original dwellings (Shiferaw, 1998, pp. 445–446; Tipple et al., 2004, pp. 101–102). Motivations for doing the transformations include socio-culturally determined aspirations, growth of family size, the desire to generate income, response to climatic conditions, and the desire to copy prevalent forms of housing (Shiferaw, 1998, p. 446).

The literature emphasises that modifications in buildings typically appear as soon as they are occupied, with residents customising their houses to their needs. Etzion et al. argue that changes are the result of the inadequacy of the initial design and poor performance of buildings under local conditions (Etzion et al., 2001, p. 1075). Users, then, initiate the transformations, becoming efficient producers in terms of cost and ability to afford construction (Tipple and Ameen, 1999, p. 998). Families carry out this process in a phased way, depending on the availability of cash to invest; that is, since loans are not accessible for them to extend the dwellings, they build what can be afforded (Tipple et al., 2004, p. 101). In some cases the extensions are of a good quality and represent an improvement, but because they are not planned, common issues arise such as the lack of lighting inside the houses, problems with ventilation, and the blocking of roads (Bouzarovski et al., 2011, p. 2711; Shiferaw, 1998, p. 447; Tipple et al., 2000, p. 1616). Therefore, if it is the case that extensions are inevitable, the dimensions and shape of the original houses and tracts of land should allow for the construction of new rooms, and the creation of accessible and well-ventilated extensions, as well as the provision of methods and general guidelines for future extensions (Shiferaw, 1998, p. 447; Tipple et al., 2000, p. 1616). In this sense, the design should represent the beginning of a long process of growth and modification (Tipple et al., 2004, p. 101).

On the subject of post-disaster accommodation, less literature is available on modifications made by families, although flexibility and adaptation are seen to be desirable within temporary housing and transitional shelter programmes. One study focuses on adaptations made by families to their houses in the village of Ngelepen, Indonesia, provided by an international organisation after the Javanese earthquake in 2006 (Ikaputra, 2008b). It demonstrates how families modified a shelter with an imported design (a dome) in terms of shape and materials, to make it more suitable for their needs (Figure 26). For this research, 'community self-evaluation' was used as a method for gathering information, with the aim of understanding the strengths and weaknesses of the shelter from inhabitants' perspectives (Ikaputra, 2008b, p. 6). The main observation was that families made improvements to the dome, adapting it to their cultural preferences, the local climate and need for space. For example, Ikaputra describes how they added canopies, verandas and eaves, which are typical features of traditional tropical houses, made to protect the frames of doors and windows from the rain (Ikaputra, 2008b, p. 11).

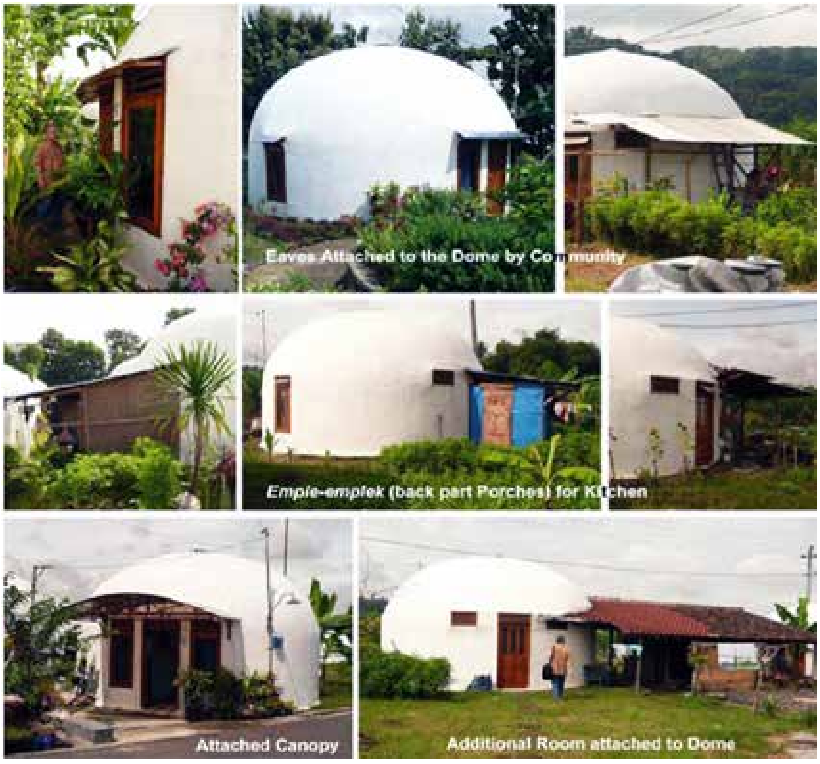



**Fig. 26**. Extensions made by families to the imported dome, to adapt it to their culture, Indonesia, 2006. Source: Ikaputra, 2008b, p. 11.

Another study focuses on modifications made by families to their permanent post-disaster houses in the Iranian city of Lar, in the wake of the earthquake of 1961 (Parva and Rahimian, 2014). The study provides analyses of different time periods, and shows similarities and differences between cases, focusing in particular on the architectural characteristics of these transformations and people's motivations to make changes, using a statistical approach (Parva and Rahimian, 2014, p. 431). The study recommends that the design of post-disaster accommodation should address transformability (to local patterns and lifestyles), adaptability (to the addition of new parts), and the capability to reflect different requirements (indoor circulation) (Parva and Rahimian, 2014, p. 431).

## 4.2 Methodology and research framework

The present study aims to understand processes of housing adaptation by looking at the experiences of families that received the same model of temporary house under different circumstances (displaced and not displaced) in different settlements in Peru and Chile. This study investigates the process of adaptation in each case, documenting the changes in different stages, based on aerial photographs, direct observation, available documents and clarifications made by occupants of these houses. Based on methodologies found in the literature on user-initiated transformations of social and informal houses, qualitative analysis, built around case studies, was selected as the methodology.

### 4.2.1 Methodology: Qualitative case studies

Fieldwork was conducted with the aim of capturing the phenomena involving different perspectives, gaining an understanding of the real situation through an inductive process and qualitative analysis (Wang and Groat, 2013). Qualitative analysis produces findings not arrived at by statistical procedures or other means of quantification, and while some data may be quantified, the majority of the analysis presented here is interpretive (Strauss and Corbin, 1998, pp. 10–11). The process of describing, classifying and connecting information supports the analysis. Moreover, 'case study' was selected as a method to answer 'how' families transform their houses and 'why' they do it. These questions are answered through observation *in situ* of real-world cases, given that they are contemporary phenomena that involve contextual conditions (Yin, 2014, p. 16).

The precise form that 'case study' research takes is related to the purpose of a given study: to illustrate a theoretical point (case as a type); to develop theoretical ideas (detailed and open-ended); to describe or explain a particular situation; or to diagnose a problem in a situation and identify solutions (evaluation and prescription) (Gomm et al., 2000, pp. 4–5). In this thesis, the analysis of cases has two purposes: to describe the situation and to develop theoretical ideas. Therefore, cases were used here as 'instrumental' – wherein the cases are of interest because of the ways in which they may provide support for theoretical generalisations – instead of 'intrinsic' – where research is developed to understand each particular case better (Wang and Groat, 2013, p. 430). The cases were analysed and categorised in order to understand the process of modification affected by social, economic and physical factors.

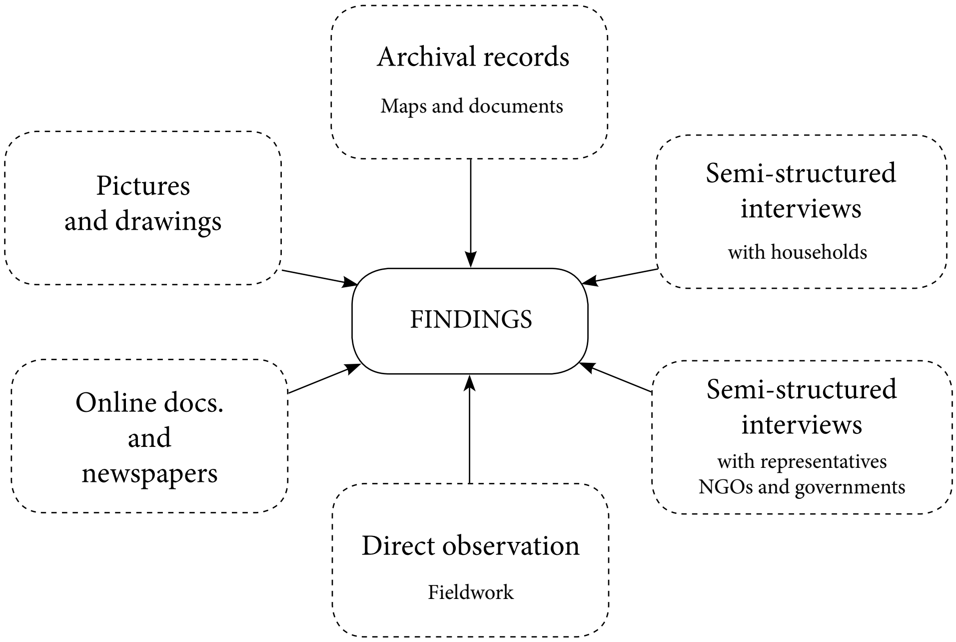



**Fig. 27.** Construct validity through triangulation. Convergence of evidence.

Source: Based on Yin, 2014, p. 121.

The quality of case study research is tested against four criteria: construct validity, internal validity, external validity, and reliability (Yin, 2014, pp. 25, 45). In this research, these criteria were incorporated through the following:

- **Construct validity:** Different sources of evidence were used in order to triangulate information: archival records (maps of the places visited); interviews with families, representatives of the government and NGOs (guided conversations and specific queries about houses); direct observation of physical artefacts (photographs and drawings of houses). Initial conclusions and comparisons of cases have been presented in specialists' conferences to debate the issues found (Figure 27).

- **Internal validity:** Pattern matching was used to compare an empirically based pattern with a predicted one (Yin, 2014, p. 143). Before conducting fieldwork, based on the literature review, adaptation of housing was predicted to be the main tendency, with the sub-hypothesis that displaced families would modify their houses in a less extensive way, due to the temporary nature of their situation. Nevertheless, this prediction was disproved, suggesting that the concept of creating a home is vital, even in a temporary situation.

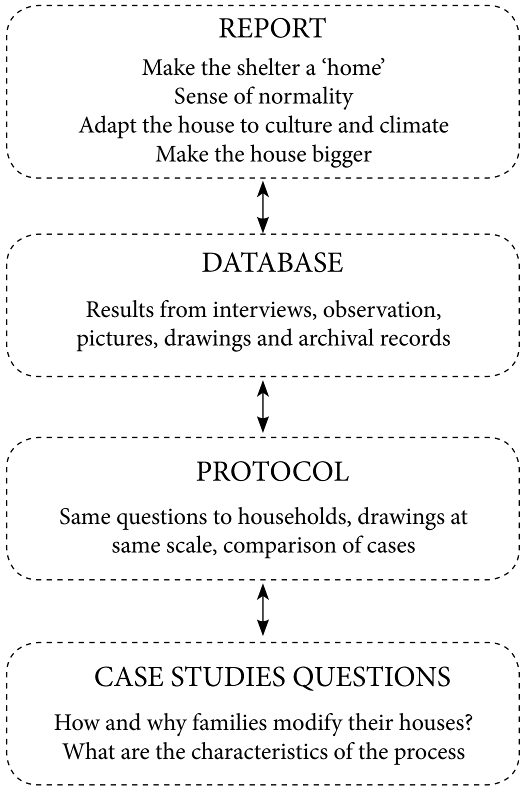



**Fig. 28.** Reliability maintaining a chain of evidence.
Source: based on Yin, 2014, p. 128.

- **External validity:** The cases selected were analysed according to the same logic, systematically tracking the modifications, uses, materials and costs and sizes of households. On aggregate, the cases provide support for the theoretical proposition that connects the idea of flexibility in temporary shelters with the concept of home. The comparison between displaced and not-displaced families shows that modifications are made in a similar way.

- **Reliability:** The initial hypothesis was that families modify their houses by making additions and extensions because they desire to make their shelter a 'home' and to create a sense of normality. The key questions were 'how' and 'why' they modify their shelters, and 'what' the characteristics of the process of transition are. The same questions were posed to households and stakeholders, and the same form was filled in for all cases studied. The evidence and specific data to support the hypothesis was gathered through mapping, drawings, pictures, documents, observation and interviews with families and institutions. That information was analysed and analytical drawings of selected cases in Chile and Peru were produced (Figure 28).

### 4.2.2 Site and case selection

Peru and Chile were the countries selected for comparing similarities and differences related to the use and modification of temporary houses in the wake of natural disasters. These countries were chosen based on the following aspects:

- The occurrence of a disaster with large impact in the recent past: an 8.0 magnitude earthquake in Peru in 2007 and an 8.8 magnitude earthquake and tsunami in Chile in 2010.
- The use of the same model of temporary housing after the disaster in different situations regarding land rights (displaced in Chile and non-displaced communities in Peru).
- To have different climatic zones, in order to compare the use of the same dwelling in different contexts (Desert and Oceanic climates).

Specific cases were selected with the aim of exploring the nature of the modifications made, rather than abstract concepts concerning them, to understand how houses were physically transformed by their inhabitants. Therefore, a multiple-case study was selected as a research design, in order to strengthen the findings and seek theoretical replication, so as to achieve analytical conclusions (Yin, 2014, p. 64). The cases are not considered samples, because the aim was not to create statistical generalisations, but to illuminate theoretical propositions, in the same way that experiments are conducted in laboratories to illustrate theoretical concepts or principles (Yin, 2014, pp. 36, 40).

A comparative approach was facilitated by the use of the same model of temporary house in the two countries. The model selected was the one used by the NGO TECHO. TECHO (which stands for 'roof' in Spanish) is an organisation that works in Latin America and the Caribbean to overcome poverty in developing countries (TECHO, n.d.). The selection of the particular villages to visit was made after meetings with representatives of the NGO TECHO and government representatives. Neither TECHO nor the government could provide information about the ongoing situation of the shelters, but they did have data about the total number and locations of the temporary houses that had been built.

During fieldwork, it became evident from direct observation that the majority of temporary houses had been substantially modified. In Peru it was difficult to locate these houses because they were dispersed across the region and throughout settlements. This presented the challenge, then, of visually recognising temporary houses after years of usage, due to the extensive changes they had undergone and because, in some cases, these initially temporary houses were now embedded in durable or permanent solutions. Since these cases were difficult to locate, while in search of modified houses to study, members of the community were asked to collaborate in searching for a variety of different modified houses within their neighbourhoods.

In total, 10 settlements were visited and 27 houses were analysed. This selection was based on few cases from different settlements rather than several cases from one settlement, in order to be able to analyse diverse house-improvements and a variety of situations across different geographical areas. The criteria for selecting the cases were defined by a precise model of temporary house (TECHO house) provided after two specific disasters in Peru and Chile respectively, modified by the inhabitants, and supported or not by the government or other organisations.

The houses selected for analysis were chosen to show a variety of changes and different household composition. Consequently, in both countries the cases selected are illustrative of: vertical expansion, and expansion on the long or short sides of the temporary house. Also, cases with different household composition were selected, varying from one to seven inhabitants, aiming to illustrate a variety of family sizes.

The analysis clarifies how specific cultural and environmental factors affect the modification of these houses. Although these cases are not necessarily representative of temporary houses in other countries, they provide empirical information about how people transform their temporary accommodation into a home, and ideas that can illuminate future designs.

### 4.2.3 Data collection

In order to produce a visual description of the process throughout the years, this study combines various strategies for data collection:

- Semi-structured interviews with residents.
- Semi-structured interviews with academics, government and NGO representatives.
- ‘Artefactual survey’ of 27 houses (study of the physical object, its materials, dimensions, process of construction, and costs). For each case a form was completed with information gathered through interviews and direct observation (Appendices).

- Visual analysis. Structured observation of the houses *in situ*, drawings made on site and photographs.
- Drawings made off-site at the same scale for comparing the process.
- Aerial maps obtained from Google.
- Archival documents (reports, journals, and public documents).

All the interviews were conducted in Spanish by the researcher and the information was recorded by hand using notes, drawings and a survey (Appendices). Each participant was informed about issues of confidentiality, the objectives of the study, and its implications. Interviewees were reminded that they could stop the interview or ask for clarifications regarding the research. The interviews varied from 90 to 180 minutes depending on the flow of the conversation and the quantity and quality of information gathered for analysis. The data gathered was put into a spreadsheet, described and analysed. The notes, drawings and pictures were used for making detailed CAD drawings and description of each case (descriptions in appendices), which were then compared and analysed.

Interviews with households were conducted between November and December 2012 in the interviewees' homes. The participants were asked questions about their experience after the earthquake in 2007 in Peru and in 2010 in Chile. Usually one member of the family was the main respondent, but on some occasions other family members or neighbours were present during the interviews. The presence of others during the interviews in some cases helped the interviewees to remember dates and specific changes made to the house.

In order to gather information about the process of adaptation and expansion, families were asked to identify the date when they started living in the temporary house, what changes were made and in which year, who supported the families during the process, the cost of the additions and modifications in terms of labour and materials, and what plans do they have for the future (survey in Appendices). This detailed information was then organised as Stage 1, Stage 2 and Stage 3 with the aim to compare how the cases were modified in time, and what similarities or differences could be inferred from this process.

**Table 13.** List of academics, government and NGO representatives interviewed.

| Position | Institution |
|---|---|
| Executive Director | TECHO (Latin-America) |
| Director of Construction | TECHO, Peru |
| Director of Construction | TECHO, Chile |
| District representative | San Clemente-Pisco. Government of Peru |
| President Pisco Branch | Peruvian Red Cross |
| Executive Director | Chilean Red Cross |
| Regional Coordinator | *Aldeas y Campamentos*, Bío-Bío, Chile |
| Executive Director | *Fundación Vivienda*, Chile |
| Technical Advisor | FOSIS, Ministry of Social Development, Government of Chile |
| Director, Department of Timber Engineering | *Universidad de Chile* |

Interviews with academics, government and NGO representatives were conducted between November and December 2012, and in January 2015. Interviews were recorded and conducted in the interviewees' work place. The semi-structured interviews were conducted using a guide. However, a flexible approach was adopted to enable other questions to emerge from the conversations. Academics, government and NGO representatives selected for interview (Table 13) were involved in one or more of the following activities after the earthquakes in Peru and Chile in the areas studied: provision of temporary houses, support in the improvement of temporary houses, construction of permanent housing for affected communities; research on temporary housing.

### 4.2.4 Criteria for comparison

Based on the references reviewed and the information gathered, the criteria for comparison can be categorised into three groups:

***Socio-cultural aspects.***

- Demography (age and gender).
- Household size (persons per house).
- Household and family composition.
- Rooms per person.
- Uses and functions (kitchen, toilet, living room, terrace, storage, shop, restaurant, etc.).

***Physical aspects and architecture.***

- Changes to the plan during the process (timeline). The process of adaptation in three periods: Stage 1 (Day 1), when the temporary house was built; Stage 2 (Year 1 for Chile and 2 for Peru); Stage 3 (Year 2 for Chile and 5 for Peru), the day the houses were visited during fieldwork.
- Dimensions and size (total $m^2$ and $m^2$ per person).
- Type of change (added, removed, enlarged, reduced, enclosed).
- Added elements (such as doors, windows, walls, gates, balcony, roof, terrace, vegetation, and parking space).
- Added services (electricity, water, sanitation).
- Room arrangement (organisation and number).
- Building materials (primary and secondary).
- Adjacent space (interior and outdoor).
- Location of modification within built context and orientation.

***Economic aspects:***

- House tenancy and ownership.
- House cost.
- The total spending on transformation (materials and handwork).
- Main funding (organisations, government, family, friends).
- Future plans.

A description of each case was made based on the information gathered, and drawings of the houses were made at the same scale (Appendices). A meta-analysis was developed, with the description of certain type of transformations that are repeated or fit a recognisable pattern, the identification of different levels of transformation, and the possible motivations for making the changes.

### 4.2.5 Limitations of the study

One limitation of this study is the number of houses examined. Although cases were used to illuminate theoretical concepts, a greater number of cases using other sampling methods would have enabled a quantitative analysis to be correlated with this qualitative study. Residents' responses, furthermore, might have been biased in particular ways by the researcher background and identity. In Chile, I might have been recognised as a middle-class Chilean woman, whereas I entered Peru as a foreigner interviewing low-income households. In the case of Peru, in order to make first contact with residents, the Director of Constructions of TECHO introduced me to some families, something that might have influenced their responses. On the other hand, due to family duties, I had to conduct the fieldtrip accompanied by my children, something that might have favoured the 'openness' of the responses. In some cases, it might have balanced differences between the interviewer and the interviewee. It is possible that interviewees might have found elements in common with me, thus making them feel more comfortable in sharing their ideas, and issues related to their houses and everyday practices within it.

## 4.3 Selected countries and the temporary house

### 4.3.1 Peru and Chile, selected for analysis

Peru and Chile are both located on the so-called ‘Ring of Fire’, an area with one of the highest levels of seismic activity in the world. Both countries are situated at the convergence of the Nazca Oceanic Plate and the South American Continental Plate (Figure 29), corresponding to the subduction zones along the west coast of South America (Cárdenas-Jirón, 2013, p. 2; Edwards, 2003, p. 8). They have faced large magnitude earthquakes throughout their history, and it is likely that they will face them again. The temporary houses studied in this thesis were built after the 8.0 magnitude earthquake in Peru in 2007 and the 8.8 magnitude earthquake and tsunami in Chile in 2010. Although these neighbouring countries share a history of repeated disasters, they have differing climates and different local architecture, and the local construction sector uses distinct building materials. Also, they have different levels of development. While Chile is number 42 in the Human Development Index (2014) out of 188 countries, as a country with ‘very high human development’, Peru appears in number 84 as a country with ‘high human development’ (UNDP, n.d., p. 1).

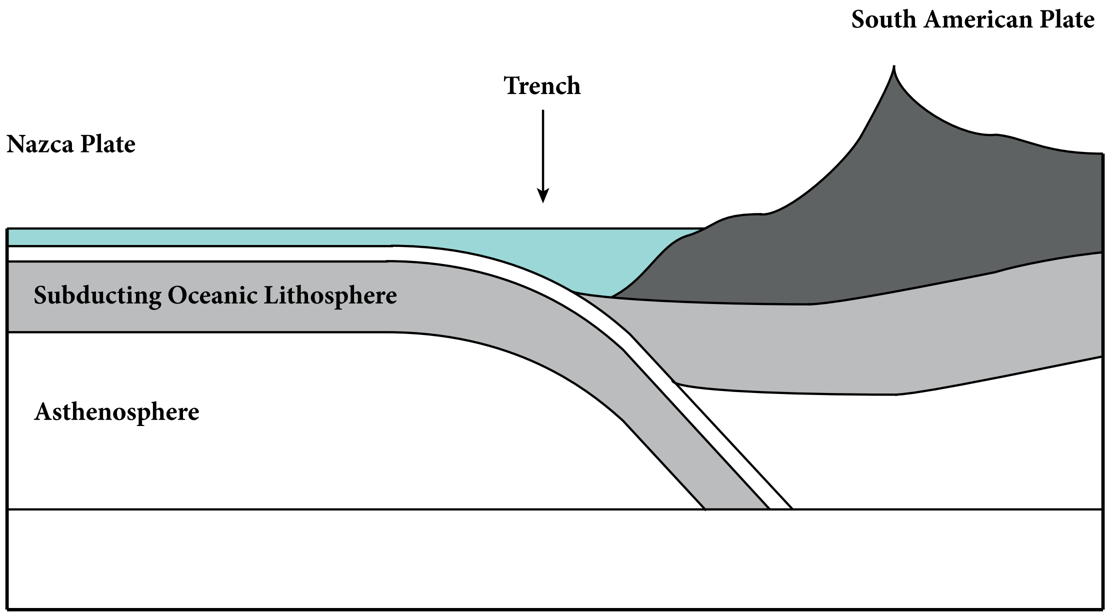



**Fig. 29.** Subduction zones along the west coast of South America. Source: Based on USGS, n.d.

Some important issues to consider in relation with both cases:

- **Damage:** While in Peru the earthquake was the main cause of destruction, in Chile it was the tsunami that followed the earthquake. In general, buildings in Chile performed well during the earthquake. This could be explained by the presence of strong building codes and the building sector's compliance with them. In terms of construction systems, adobe buildings were most likely to be damaged by the earthquakes. Although well-built adobe with proper bracing elements can resist earthquakes, in both countries old houses without proper maintenance were the most affected.

- **Location of the disaster:** The earthquake in Chile affected an extended area, from the centre to the southern regions of the country, areas which have Mediterranean and Oceanic climates. In the case of Peru the damage was concentrated in one region, which is characterised by a coastal-desert climate.

- **Cultural differences between countries:** Each area affected by the earthquakes has its own local traditions, which influence the use of exterior and interior spaces. For example, in some villages visited in Peru, it was common to find kitchens in exterior areas, while in Chile kitchens were always located inside houses. The difference could be stressed by the climatic differences between cases. In southern Chile the kitchen is used as an element to warm houses, while in villages visited in Peru, it was common to cook with charcoal, and kitchens were therefore used in exterior spaces, due to the fumes produced. Despite the different traditions of indoor and outdoor cooking, the same design of shelter was used.

- **Cultural similarities:** In terms of religious beliefs, there is no conflict in the communities visited, therefore, the affected groups were homogeneous in that aspect. Although both countries are secular states, the Christian church is predominant. The church is used as a community centre in the villages for secular congregations. Also, in Chile and Peru, there is a strong sense of extended family obligation, which is very different to other contexts. This was clear in both countries, but especially in the Peruvian examples.

- **Same temporary housing approach used:** In both cases, the context of post-disaster emergency and the need to provide shelter for a large number of people led to the use of predesigned and prepackaged solutions as a rapid means of solving the short-term lack of housing.

### 4.3.2 Temporary house selected for analysis: *Mediagua*

In both countries the NGO 'TECHO' has had an important role in building temporary accommodation either for emergencies after disasters or for providing an improved dwelling to families living in slums. Although development, rather than disaster recovery, is the main objective of this NGO, TECHO has built temporary houses in different Latin American countries that have suffered from disasters, such as Peru in 2007, and Chile and Haiti in 2010.

The model of temporary house built by this NGO after the earthquakes of 2007 and 2010 is a shack built with prefabricated timber panels, and assembled on site by volunteers without previous experience, using simple tools, and it is called *mediagua* in Chile (Figure 30). The term comes from the concept *'media-agua'* meaning a shed roof (one slope). Although the *mediaguas* currently have two slopes, the name has remained. This form of temporary house has been used extensively in Latin America, with slight changes in the design. These changes have responded to the relative availability of materials in each country and the capacities of the local suppliers, while the same dimensions and system have been retained in the design. As already mentioned, the same model was used in the wake of the recent earthquakes in both Peru and Chile, thus it constitutes an apt case study in order to compare transformations that families have carried out on temporary housing. The model was also selected because it is repeatable; it is well known in Latin America; it has been adapted and modified by families; and it can be disassembled and re-assembled in new locations. Nonetheless, the model has also presented some problems when being adapted to different climates.

#### ***Criticisms of mediaguas***

The construction of *mediaguas* was widely criticised by affected communities in Chile, as well as building experts and architects. Some families in different parts of Chile rejected the *mediaguas* (such as in Cerro Navia, Concepción, Constitución, and Talca) and they preferred to stay in tents, since they considered the house to be inadequate in the medium-term, and felt that their provision would delay running permanent housing programmes (Chilevisión News, 2010). In addition, some organised communities asked for better quality shelters, insulated, waterproof and with an area of 36 $m^2$ minimum for families of four (Plataformaurbana, 2010). These actions created a debate about the need to provide better-quality immediate shelter, the concern that temporary camps could eventually became slums, and the time it took for the government to build permanent

**Fig. 30.** Temporary house called *Mediagua.* Source: Herrera et al., 2010.

housing – in most cases more than one year (Plataformaurbana, 2010). Such tensions were most explicitly expressed when some families burned their *mediaguas* after they failed to keep out the rain; these families demanded better solutions from the government (La Nación Online, 2010).

This type of situation was not witnessed in Peru, where families received these temporary houses without disapproval (although other criticisms were aired, mainly in relation to the reconstruction of the coastline). In Chile, it was assumed that the magnitude of the disaster required an immediate response and that the fastest available solution was the *mediagua*. However, experts recognised that this shelter was not adequate for the climate of the affected area. One of the main criticisms made of this solution was that this house design had been used since 1930, and that nowadays requirements are different due to the country's level of development (Bluth, 2010). Another criticism was the poor quality of the shelters due to cost-saving changes to the model, such as the elimination of bracing, overhangs and the lack of treatment of the wooden poles used as foundations (Lawner, 2010). In addition, timber experts have pointed out that non-processed wood is used in the production of the traditional *mediaguas*, using an old technology and building system which does not meet contemporary standards (Bluth, 2010). Studies of the structural and environmental behaviour of this model of temporary house in different countries in Latin America have been carried out by students at the University of Cambridge collaborating with the EcoHouse Initiative.

***New version of mediaguas***

In response to the criticisms levelled at these temporary houses, local firms and universities in Chile developed new solutions. Some examples are: the house *ELEMENTAL-Tecnopanel,* which has an area of 30 $m^2$, and is constructed with insulated panels (Basulto, 2010); *Vivienda de Emergencia Definitiva* (VED), which was designed by John Saffery and has an area of 27.5 $m^2$ (Saffery Gubbins and Baixas Figueras, 2013); and *Vivienda de Emergencia Progresiva* (VEP), designed by students and academics based at *Universidad Católica de Chile* (Grey Avins and Cortes Darrigrande, 2010) as shown in Figures 31 and 32. Nevertheless, none of these innovative projects were used in the field. After the 2010 earthquake, Chile faced several other disasters, such as volcanic eruptions, landslides, fires and earthquakes, and the controversy about temporary shelters both entered the consciousness of the general public and became part of the political agenda. The traditional standard for a temporary house in Chile had been defined by the government according to the cost of the solution, above and beyond other key aspects of housing. Temporary houses, should not exceed 1,350 USD, with an additional 225 USD (approximately 1,200 USD/ 790 GBP for the 2010 earthquake) to be spent if the family affected exceeds five members (Garay Moena, 2015, p. 219). However, public criticism forced the government to redefine this model in relation to the concepts of quality instead of cost. The National Subdirector of the National Emergency Office (*Oficina Nacional de Emergencia del Ministerio del Interior y Seguridad Pública:* ONEMI), in his presentation 'Towards a New Concept of Emergency Housing' (*Hacia un Nuevo Concepto de Viviendas de Emergencia*), highlighted the lack of an agreed definition for emergency housing in Chile (Orellana, 2014). Hence, ONEMI recognised that the provision of emergency and temporary housing required ongoing research and further improvement. *Fundación Vivienda* (Fundación Vivienda, n.d.), the organisation in charge of supplying shelters to both TECHO and the Chilean government, created a new, better-quaility model (ONEMI, n.d.). This model is called *Vivienda Básica* (Figure 33) and it maintains the concept of prefabrication and easy assembly of the *mediagua* (Vergara, 2014). This model has three alternative sizes of 11.5 $m^2$, 19.3 $m^2$ and 38.5 $m^2$, and two cladding options: OSB 9.5 mm and SMART PANEL 11.1 mm (Vergara, 2014). This new model has been previously implemented in 2014 and 2015, but is not included within the scope of this research. From the perspective of this thesis, the government and universities are working in the right direction; nevertheless, the design remains inflexible, and still constitutes a global solution implemented in different contexts without consideration of settlements, orientation, climate, cultural preferences, and other local aspects.

**Fig. 31.** *Vivienda de Emergencia Definitiva (VED)* by John Saffery.

Source: Plataformaarquitectura, 2013.

**Fig. 32.** *Vivienda de Emergencia Progresiva (VEP)* by students and academics of *Universidad Católica de Chile*. Source: Grey Avins and Cortés Darrigrande, 2010.

**Fig. 33.** *Vivienda Básica, Fundación Vivienda.*

Source: Vergara, 2014.

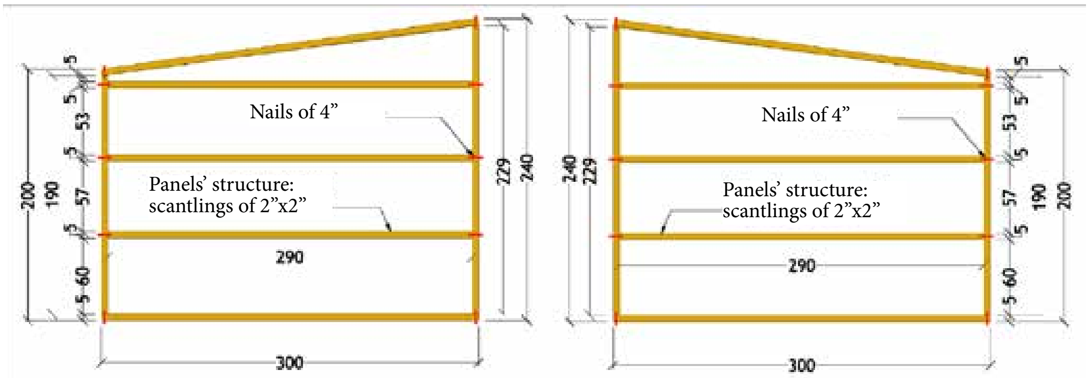
## ***Components of the temporary house***

The plan of the *mediagua* is defined by a rectangle of 3 x 6 m., creating a footprint of 18 $m^2$ (Figures 34 and 35). The elements used for the construction are (Un Techo para Chile, 2010):

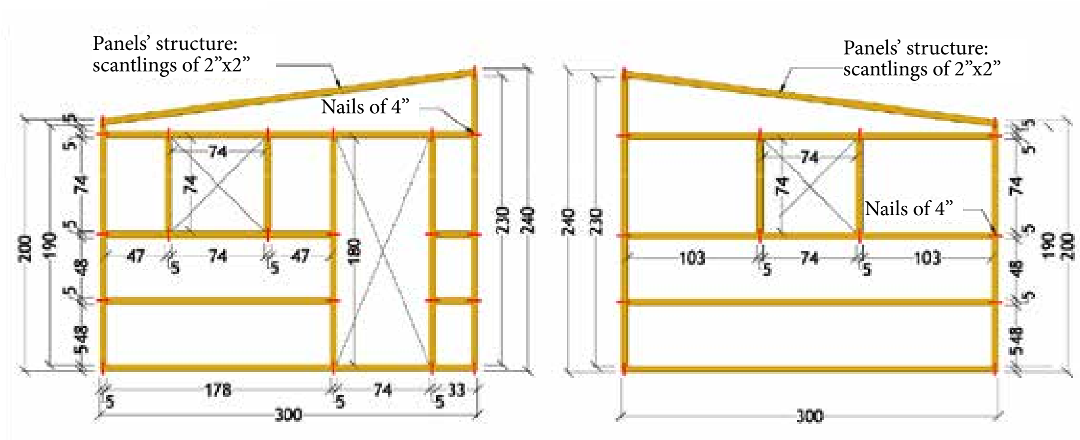
- Poles: Fifteen to seventeen wooden poles are used for leveling the floor and elevating the house.
- Floor Panels: Two floor panels are set on top of the poles. The panels are made with a frame and wood sheathing.
- Wall Panels: Six panels are used for the walls (two side panels, two rear panels, one window panel and one window-door panel). The wall panels are formed by a timber frame and timber cladding. New versions of the *mediagua* use OSB panels instead of timber cladding.

- Roof structure: The roof structure is built with a simple truss made out of twenty wooden scantlings. Eight beams of 1”x4” and 6 joists of 2”x2”.
- Roof: Eight undulated Zinc sheets (5v) of 3.4 m. x 89.5 cm. and 0.35 mm. of thickness.
- Connections: The building elements are joined together with simple nails. The nails that connect the panels and structure are 4’’ and the nails used for doors and windows are 2.5’’.
- Complementary materials: 2 kg. of 4” nails, ½ kg. of 3” nails, 50 nails for the roof, seven hinges and three handles.

Even though the *mediaguas* are designed to be temporary, they are frequently adapted to better suit users’ needs while a more permanent solution is unavailable. In addition, when families obtain a permanent house, *mediaguas* are often used as an extension to the main building. In Peru, the temporary houses studied were established on the lands owned by (non-displaced) families. That is, families already lived in these sites before the 2007 earthquake, and they had established a network of family and community ties there. In these cases, families stayed on their land, and used temporary houses as starter homes first and as extensions later. Meanwhile, in Chile, the temporary houses analysed were established on temporary settlements. Families were displaced due to the total destruction of their houses and neighbourhoods following the 2010 tsunami. In these cases, the government organised temporary settlements in a planned way, and most families applied for subsidised houses from the government as a permanent solution. In the following chapters, cases from both countries are analysed in detail.



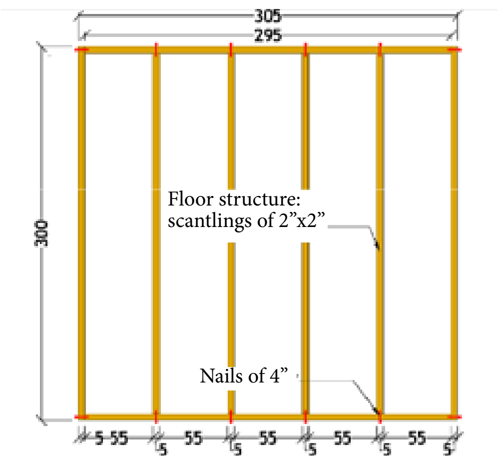

**Rear panels**



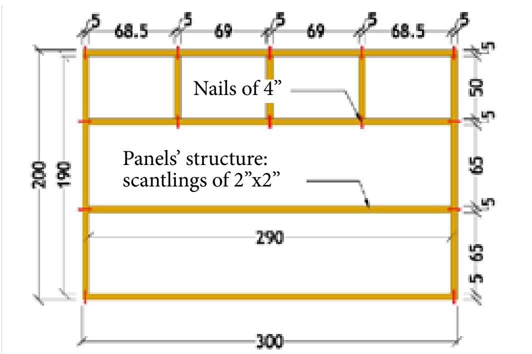

**Front side panels**

**Fig. 34.** Wall panels of *mediagua*.

Source: Based on Gobierno de Chile, Ministerio de Planificación and Un Techo para Chile, 2010.




**Floor panels (2)**




**Side panels (2)**

**Fig. 35.** Side panels and floor panels of *mediagua*.

Source: Based on Gobierno de Chile, Ministerio de Planificación and Un Techo para Chile, 2010.

# Chapter 5

# 5. Peru: Five years after the earthquake of 2007

On the 15th of August 2007, the province of Ica, Peru was hit by an earthquake of a magnitude (Mw) 8.0 (USGS, n.d.). This earthquake was followed by a tsunami of mild intensity, which mainly affected the coastal areas of Pisco and Paracas (Organización Panamericana de la Salud, 2010, p. 33). Those provinces more impacted were Chincha, Ica and Pisco (Figure 36). This was one of the biggest catastrophes to affect Peru in the last decade, causing significant damage to buildings, infrastructure, and loss of lives.

The earthquake killed 593 people, and left 319,886 people homeless (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 7). 140,338 houses were affected, of which 52,154 were destroyed and 23,632 were severely affected, leaving a total of 75,786 units uninhabitable (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 8). Some factors that contributed to the severity of the damage included the location of buildings in vulnerable areas, the soft soils, liquefaction, precarious housing construction, improper foundations, poor quality materials, poor or non-existent structural design, informality and consequently poor construction practices, lack of supervision, and lack of compliance with regulations and codes (Blondet et al., 2008; Ministerio de Vivienda, Construcción y Saneamiento, 2008, pp. 9–11; San Bartolomé and Quiun, 2008).

Although the majority of the destroyed buildings were those built from clay, brick masonry and unreinforced adobe, several reinforced concrete structures also suffered major damage or collapsed (Elnashai et al., 2008; Kwon, 2008). Further, most of the lives lost were caused by the collapse of masonry residential buildings (Elnashai et al., 2008, p. 8).

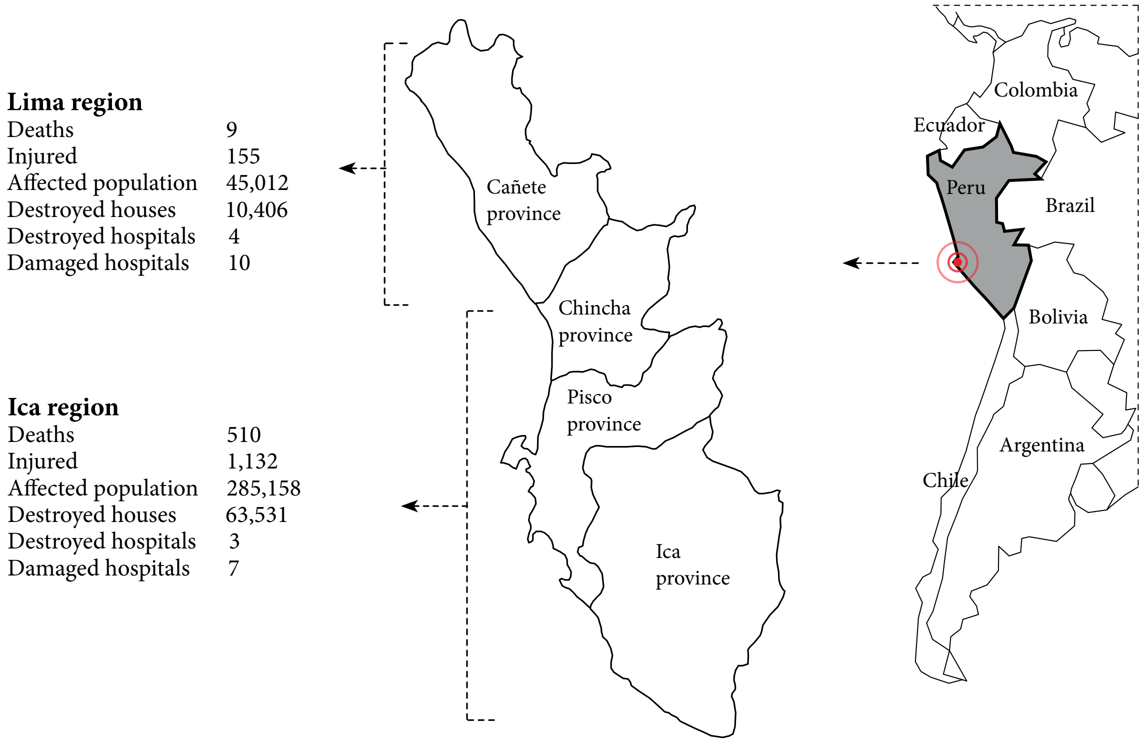



**Fig. 36.** Earthquake in Peru, 5th of August 2007.

Source: Based on *Organización Panamericana de la Salud,* 2010, p.35.

The traditional houses in the affected area are built from adobe, and they became hazardous due to their high mass, the weak materials used for them, lack of reinforcement, poor workmanship, and lack of maintenance (Blondet et al., 2008). Nevertheless, houses built with reinforced adobe, or '*quincha'*, can respond well to earthquakes. *Quincha* is a traditional building technique used in South America based on a mat or frame made from cane, bamboo or timber covered with mud. The system has been used as a traditional anti-seismic structure in Peru, which is similar to the system called '*bahareque'* used in Colombia and Venezuela. Even retrofitted houses with reinforcement consisting of strips of wire meshes nailed externally to adobe walls and covered with mortar have shown excellent seismic behaviour (Blondet et al., 2008). Although adobe buildings were banned and rejected in response to the experience of the earthquake, some organisations and universities tried to incorporate better practices linked to construction with adobe and *quincha*, using prototypes, training and workshops in rural and peri-urban areas. One example is the work of the Group for Safe and Healthy Housing (*Grupo de Viviendas Seguras y Saludables:* GVSS), which also includes the collaboration of institutions such as ASPEm, CARE Peru, Caritas, GTZ, COSUDE, IFRC, PREDES, and PUCP (GVSS, 2009).

During the first stage of aid, tents, community emergency shelters and temporary hospitals were established in the area. The national government led the response through the National Civil Defence System (SINADECI) and coordinated the Civil and Armed Forces (*Instituto Nacional de Defensa Civil-INDECI, fuerzas armadas y policiales*) to provide an immediate response, while also asking the United Nations (UN) for support. Despite the relief effort, the initial response was chaotic due to the lack of coordination and information, but as time passed the response became better organised (Elhawary and Castillo, 2008, p. 10). Humanitarian aid was coordinated by the UN, which operated from the air-base of Pisco (Talavera and López, 2008). The response from international humanitarian actors was substantial, with international NGOs such as Oxfam International, CARE, Action Against Hunger, the IFRC, and *Médecins Sans Frontières* (MSF), taking part alongside UN agencies such as UNDP, WFP, UNICEF, and OCHA (Elhawary and Castillo, 2008, p. 12). Despite the international presence, the UN Resident Coordinator decided not to activate the cluster approach (a post-disaster global system of coordination organised by the IFRC and UNHCR), after conversations with the government (Elhawary and Castillo, 2008, p. 12). This decision might, it has been argued, have responded to the idea that it was in the interest of the government to use disaster response as an opportunity to demonstrate its capacity, and also due to the perception among affected governments and actors of the lack of consultation and involvement when the cluster approach is activated (Elhawary and Castillo, 2008, p. 12). Civil society and the private sector participated actively in the response. Much of the local response came from groups and organisations affiliated to the Catholic Church, and companies of different sizes played an active role (Elhawary and Castillo, 2008, p. 13).

The second stage after the disaster, the period between emergency and reconstruction phases, involved the removal of debris, medical and psychological assistance, restoring temporary public services and economic activities. During this phase the Peruvian government built around 1,500 temporary houses, which were supplemented with houses built by NGOs such as TECHO, Caritas, World Vision, IFRC, and PREDES, totaling around 15,000 temporary houses (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 16). Unfortunately, neither national nor international NGOs involved were well coordinated initially, and therefore, no unified and detailed information exists about all of the various solutions provided (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 16).

For the third stage, the process of reconstruction, the government of Peru implemented two programmes called '*Bono 6000*' and '*Techo Propio*'. The programme '*Bono 6000*' was a donation system to support those affected by the earthquake to buy materials and rebuild their houses, consisting of a grant of 6,000 PEN (*Nuevos Soles Peruanos*), approximately 2,000 USD or 980 GBP in 2007 (Huber and Narvarte, 2008, p. 23; Talavera and López, 2008, p. 38). This amount was not refundable and it was provided through a card system to buy in a bank of materials called '*Tarjeta Banmat del Banco de Materiales*' (Huber and Narvarte, 2008, p. 23). This grant was given to owners of destroyed houses, as well as tenants and informal owners without tenure papers (Ministerio de Vivienda, Construcción y Saneamiento, n.d.). Through the card, the affected could get 6,000 PEN to pay for labour for building the house and to buy building materials from selected hardware stores (Huber and Narvarte, 2008, p. 24). This measure was taken to prevent the use of funds for something other than reconstruction (Huber and Narvarte, 2008, p. 24). This subsidy was provided to a total of 18,000 affected families up until August 2008 (Organización Panamericana de la Salud, 2010, p. 56). The programme '*Techo Propio*' provided funding to buy, build or repair permanent houses to families with a monthly income under 1,860 PEN, approximately 640 USD (313 GBP). It provided different non-refundable amounts depending on intended use (Ministerio de Vivienda, Construcción y Saneamiento, n.d.): to buy a house, between 15,400 and 19,250 PEN (5,000 and 6,300 USD/ 2,440 and 3,077 GBP); to build a house, between 13,475 and 18,095 PEN (4,400 and 5,900 USD/2,150 and 2,880 GBP); and to repair a house, 8,855 PEN (2,900 USD/ 1,415 GBP). Some of the cases studied here used the *Bono 6000* grant to improve the temporary house, while others were applying to the programme *Techo Propio* at the time of research.

An important factor, in terms of the vulnerability of the affected population, was the distribution of economic resources across the population of the country, which is marked by a high level of inequality. In general, the most disadvantaged groups are those living in rural areas, indigenous populations and people living in regions of the rainforest, the *Sierra Central* and the South (Organización Panamericana de la Salud, 2010, p. 11). The communities located in the South of the country and in rural areas were amongst the most vulnerable, and had fewer resources to recover from the 2007 earthquake.

**Table 14.** Stages after the earthquake of 2007 in Peru.

| Stage | Provision of | Organisations involved |
|---|---|---|
| First stage | Tents<br>Community emergency shelters<br>Temporary hospitals | Government: SINACEDI, INDECI |
| | | International Organisations: UN, UNOCHA, Oxfam, CARE, Action Against Hunger, IFRC |
| | | Private and others, such as the Catholic Church |
| Second stage | Temporary houses | Government: *Ministerio de Vivienda* |
| | | International Organisations: TECHO, Caritas, World Vision, IFRC, Predes |
| Third stage | Funding for reconstruction and permanent housing.<br>*Bono 6000*<br>*Techo propio*<br>Other funding, materials and training | Government: *Ministerio de Vivienda* |
| | | International Organisations and others: IFRC, GVSS, ASPEm, CARE Peru, Caritas, GTZ, COSUDE, PREDES, and PUCP |

**Table 15.** Programmes of reconstruction implemented by the Government of Peru.

| Funding | Type | Process | Amount |
|---|---|---|---|
| *Bono 6000* | Non-refundable grant for tenants and informal owners | Through the card '*Tarjeta Banmat*' to buy materials from selected stores and to pay for work labour | 2,000 USD / 980 GBP |
| *Techo Propio* | Non-refundable grant for tenants with monthly income under 640 USD/ 313 GBP | To repair a house | 2,900 USD / 1415 GBP |
| | | To build a house | 4,499 to 5,900 USD / 2,150 to 2,880 GBP |
| | | To buy a house | 5,000 to 6,300 USD/ 2,440 to 3,077 GBP |

## 5.1 Examples of post-disaster accommodation in Peru after the 2007 earthquake

### 5.1.1 The International Federation of the Red Cross and Red Crescent Movement (IFRC)

As part of the response to Peru's 2007 earthquake, international NGO the IFRC built 6,308 transitional shelter units, mainly in the Pisco province (IFRC, 2009, p. 8). Different branches of the IFRC from different countries collaborated with the provision of shelters, using a variety of designs. Although labelled 'transitional', they were temporary solutions that did not evolve into permanent houses, but their materials, when possible, were reused. Shelters from the American Red Cross, the Spanish Red Cross and the International Federation had an area of 18 m$^2$, while shelters provided by the German Red Cross had a footprint of 24 m$^2$ (IFRC, 2009, p. 11). Among them, the most common model was a shelter built with both locally available and imported materials, consisting of a lightweight rigid box of 18 m$^2$ (3 x 6 m. plan and 2 m. high), with a flat roof and braced frames in both directions to provide lateral stability (IFRC, 2011a, p. 51). The structure was a timber frame built with eucalyptus poles and bamboo or palm matting, wire for bracing, nails for the connections, and imported plastic sheeting and staples for covering the space (Figure 37). The floor and foundation consisted of an unreinforced concrete slab with cast in wire ties. The matting, called locally *estera* or *esterilla,* is widely used in this region especially for protecting intermediate spaces, such as terraces, porches, garages and patios. The matting is used to create semi-exterior shaded spaces and allows for good ventilation. Each shelter was built in two days by a construction team of four people, and the cost per shelter was 280 USD approximately 340 CHF or 142 GBP in 2007 (IFRC, 2011a, p. 51). This model had an anticipated lifespan of twelve months (IFRC, 2011a, p. 51). The fragility of the material (bamboo matting without treatment), combined with the high levels of solar radiation in this region, quickly deteriorated the matting (Interview with representative form the Peruvian Red Cross). For that reason, during fieldwork, five years after the earthquake, transitional shelters built by the IFRC with bamboo matting were not encountered, but similar shelters built with the same material were seen in various locations (Figure 38). Affected families which received this type of shelter moved soon to relatives' houses, to other types of shelters, or to permanent houses built either by the government, the IFRC, or other NGOs. Parts of the structure, such as the timber poles, were used as material for extensions.

**Fig. 37.** IFRC Shelter model in Peru with bamboo matting.

Source: IFRC, 2011a.

**Fig. 38.** Bamboo shelters similar to the model from the IFRC in the affected area.

Fifteen months after the earthquake, the IFRC finished the emergency and transitional shelter phases, and in collaboration with the Peruvian Red Cross initiated a participatory process for the construction of low-cost houses, using seismic resistant materials and techniques alongside the provision of land titles (IFRC, 2009, pp. 1–2). Permanent buildings promoted by the IFRC were visited in the villages during fieldwork, some of which were accompanied by a temporary house provided by TECHO, as seen in some of the cases studied here (Figure 39).

### 5.1.2 Peruvian government

In the wake of the 2007 earthquake, the Peruvian government's Ministry of Housing (*Ministerio de Vivienda Construcción y Saneamiento*) built 1,450 temporary houses (Figure 40), mainly in Pisco, Chincha and Ica, accounting for approximately 10% of the temporary solutions provided (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 16). The design used by the government provided 18 $m^2$ of usable space, and its walls were built with 'drywall' (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 16), a material which is used mostly for indoor walls and consists of a gypsum plaster compressed between two sheets of thick paper. Drywall is widely used because it is easy to manage, easy to paint, and does not require specialised skills. In the case of the temporary houses built after the earthquake, this material was used for external walls. However, it is not a structural material and not generally used in exteriors. Therefore, in order to protect the walls and extend the lifespan of the houses, families had to paint the walls.

## 5.2. *Centros poblados* studied

TECHO built 1,211 temporary houses between 2007 and 2008 in the provinces of Ica, Pisco and Chincha, which is around 8% of the temporary solutions provided in total (TECHO-Peru, 2012). The aim of TECHO was to provide shelter to affected families living in villages surrounding the main cities, called '*centros poblados'* (inhabited centres). These villages are dispersed in the area, and some were not included in local authorities' databases of the areas affected by the earthquake (Talavera and López, 2008, p. 38). These *centros poblados* are connected with the main cities by roads, but they were less assisted by other international organisations because they are more distant, and spread in the territory. In total, TECHO built houses in more than 50 *centros poblados* (Talavera and López, 2008, p. 39), of which, six are included in this study.

**Fig. 39.** IFRC permanent house extended with TECHO house.

**Fig. 40.** Temporary house provided by the Government of Peru.

Source: Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 16.

The *centros poblados* selected were chosen with the aim of studying temporary houses in villages of different scales (Figure 41). Therefore, the villages selected for analysis in Pisco province were Caucato, Mensía, El Palmar and Bernales. In Chincha province, the settlements selected were Cañapay and Santa Rosa.

Although these settlements are of different sizes and configurations, most of the houses seen within them were terraced housing, forming long rows which shape the streets. In general, the plots were rectangular, with a small front façade of between 4 m. and 7 m. in length, and sides between 15 m. and 20 m. length. The reason for this configuration could be explained by a planned division of plots, as well as by the arrangement of dwellings so that they are less exposed to direct sunlight, thus limiting solar gain. Common materials used for construction in these areas were adobe, clay brick, *'Caña de Guayaquil'* (the local name for 'Guadua' bamboo), and *'esterillas'* (matting which can be bamboo, rattan or natural fibers). After the earthquake, timber panels and drywall were added to the list of materials used in the area, due to the use of temporary houses as a medium-term solution, and the reuse of these materials in permanent houses.

In Pisco province, the villages Caucato, Mensía, and el Palmar were of a similar size and layout, while Bernales was the largest of the villages studied. Caucato has two main roads which form a 'T' shape. The main facilities in this village were a Christian church and public toilets. The latter had been constructed by an international organisation. Mensía, similar in size to Caucato, also had two main roads forming a 'T' shape, and the main facilities were a community centre and a football pitch, which was used as a site for assembling temporary houses while the rubble from the destroyed houses was removed. In this village, families had to disassemble their temporary houses and assemble them afterwards on their own land. At the time of research, this football pitch had disappeared and new dwellings had been built over this terrain. El Palmar, meanwhile, had one main road with an adjacent football field. Bernales was the biggest of the *centros poblados* visited, with 517 houses in 2008 (Arias and Cardenas, 2008, p. 24). This village had a recently built main square, a school, a police station, some churches, many small shops, and some football fields. This village had a grid configuration typical to planned cities across Latin America. In this case, however, the grid formed by the streets was not of a regular shape, due to the informal growth of the settlement and the topography of the site. The villages visited were all provided with electricity and water, but not sanitation, with the exception of Bernales, which benefited from a formal sanitation service.

In Chincha province, the villages Cañapay and Santa Rosa were visited. Cañapay is bigger than Caucato, Mensía, and El Palmar, and although still a small village, it had a Christian church which also provided a communal space. Santa Rosa had a big main square by which were situated a Christian church and other facilities, and the morphology of the settlement was similar to that of Bernales, formed by an irregular grid due to the topography of the area.

The hypothesis to be tested on the fieldtrip was whether most temporary houses were modified by families based on similar experiences seen in different countries and contexts, such as Indonesia, Turkey and Haiti (Arslan and Cosgun, 2008; Félix et al., 2013; Ikaputra, 2008b; Marcillia and Ohno, 2012). However, prior to this study there was not a clear picture of what happened to the houses in the years following the disaster, and what was the extent of the modifications, because no research had been conducted on this topic in the affected region. During the visit to the *centros poblados*, twenty houses were studied and from them fifteen illustrative cases were selected for analysis. The selected cases were chosen in order to present different types of transformation, and due to the completeness of information provided by the families and field observation. These cases were drawn at the same scale, aiming to compare the process of modification across the years. The same questions were put to each family, with the objective of having similar information to compare.

## 5.3 TECHO houses modified: A comparison

Each case was analysed separately, through a description of the house, drawings and pictures. Detailed information of each case can be seen in the appendices. The cases were studied and compared using three categories: socio-cultural, physical and economic aspects. A visual description of the changes since 2007 including socio-cultural and economic aspects of the overall context, is deployed to summarise each case (Figure 42).

The temporary house and extensions built on the same plot were defined as a housing unit. The household was defined as all the people who occupied a single housing unit. Families within the household, meanwhile, were defined as those members who were related through blood, adoption or marriage. The differences between households and families were therefore considered to be that a household can comprise more than one family; a household may consist of one person but a family must contain at least two members; and a household can be comprised of people living together who are not related to each other (UN Statistical Division, n.d.).

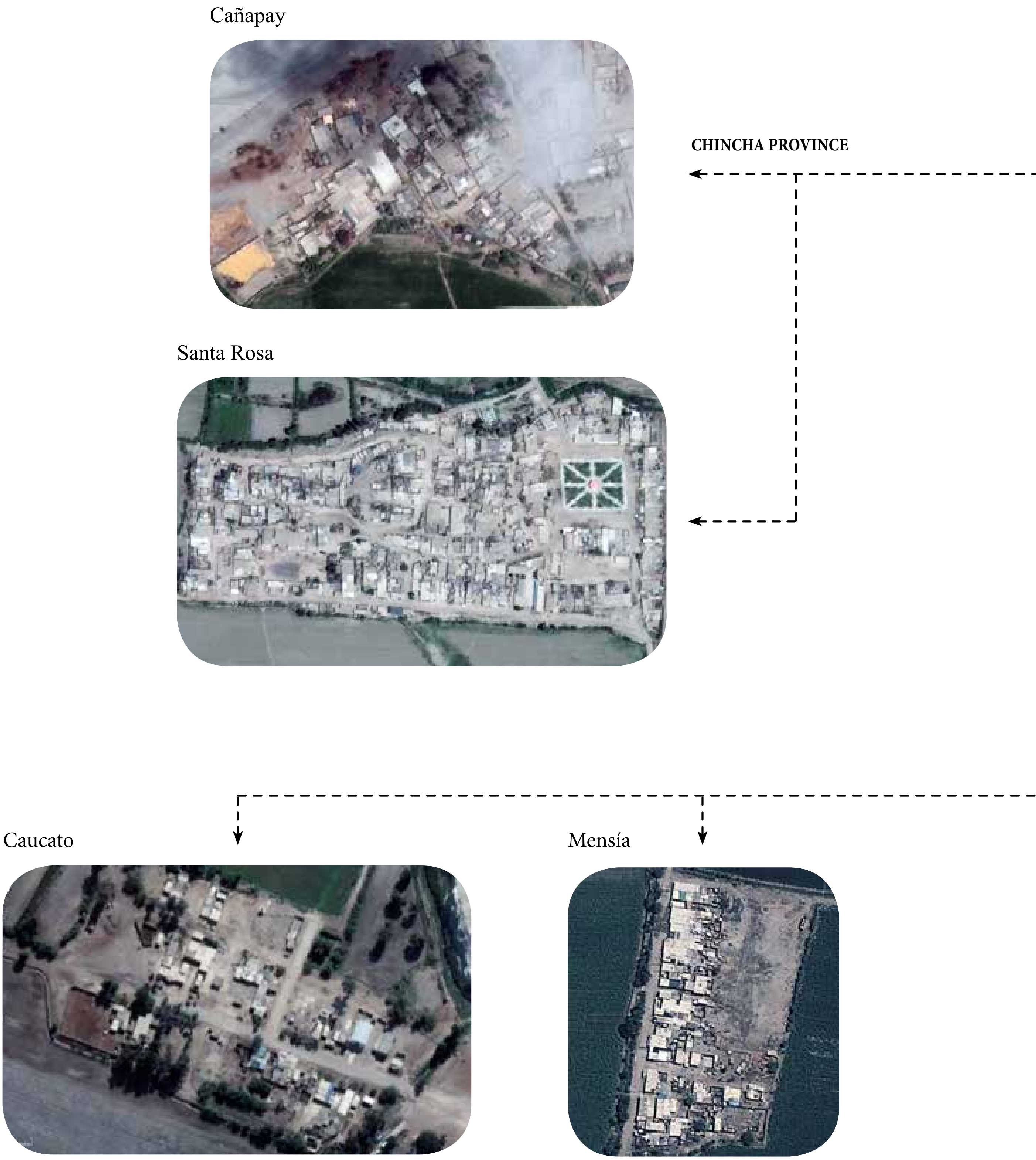
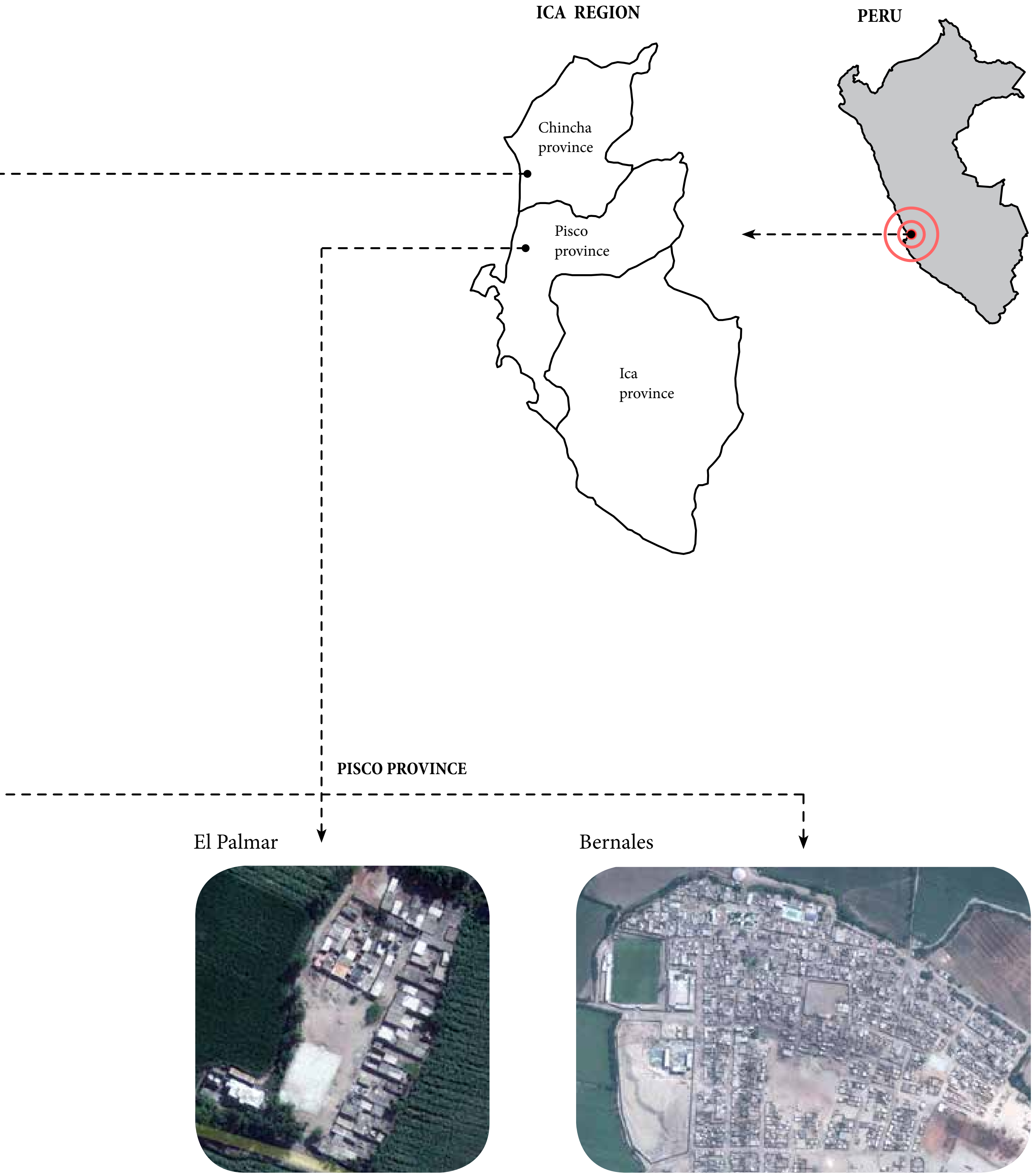



**Fig. 41.** Villages visited in Peru. Cañapay and Santa Rosa in Chincha province and Caucato, Mensía, El Palmar and Bernales in Pisco province. Source: Google maps.


ICA REGION
PERU
Chincha province
Pisco province
Ica province
PISCO PROVINCE
El Palmar
Bernales

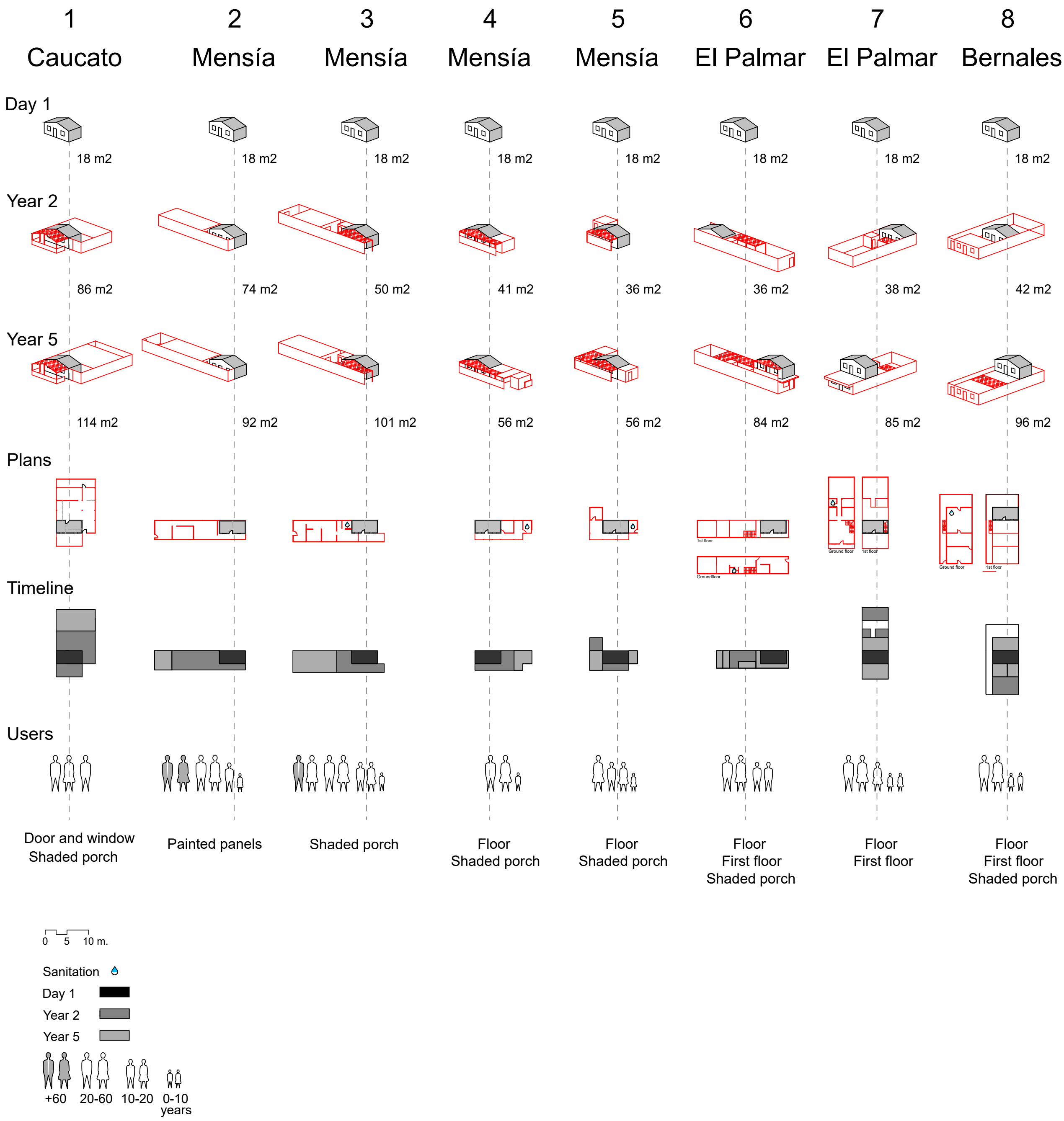
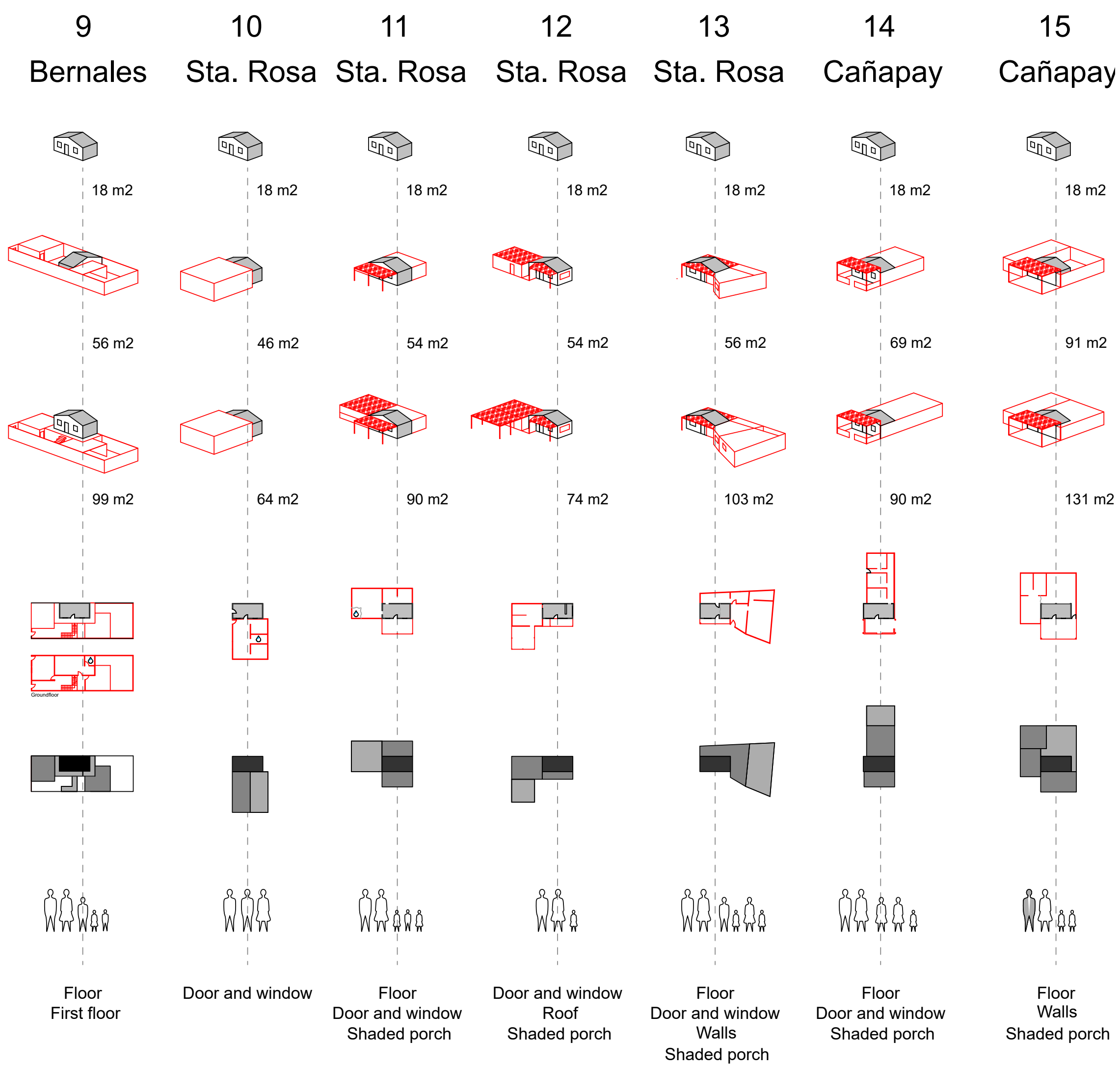



**Fig. 42.** Comparison of the process of adaptation of cases studied in Peru in 2012.


9
Bernales
10
Sta. Rosa
11
Sta. Rosa
12
Sta. Rosa
13
Sta. Rosa
14
Cañapay
15
Cañapay
18 m2
18 m2
18 m2
18 m2
18 m2
18 m2
18 m2
56 m2
46 m2
54 m2
54 m2
56 m2
69 m2
91 m2
99 m2
64 m2
90 m2
74 m2
103 m2
90 m2
131 m2
Floor
First floor
Door and window
Floor
Door and window
Shaded porch
Door and window
Roof
Shaded porch
Floor
Door and window
Walls
Shaded porch
Floor
Door and window
Shaded porch
Floor
Walls
Shaded porch

### 5.3.1 Socio-cultural aspects

Around the time of the earthquake, the average number of members per household in Peru was 4.4 (INEI, 2007, p. 35), with 35% of households consisting of five or more people, and 39% of households consisting of three or four people (INEI, 2008, p. 213). In the Ica department, which includes the provinces of Chincha, Ica, Nazca, Palpa and Pisco, 42% of households comprised three or four people (INEI, 2008, p. 216). The houses analysed for this study, meanwhile, were inhabited by households of between three and seven members. Indeed, the selected cases also show a variety of household types, varying from extended households with a single family nucleus plus grandparents to a single parent with children (Table 16). Nevertheless, most cases studied were nuclear families consisting of a married-couple family with children. Peru's 2007 census showed that 53% of households were comprised of either a single family nucleus or a single parent with children, and that 25% were composed of extended households (INEI, 2008, p. 206).

The NGO TECHO provided houses mainly to families of two or more people, because the organisation considered that individuals could find shelter more easily with family and friends not affected by the earthquake than larger families who had lost their homes (Interview with representative of TECHO-Peru, 2012).

Households consisting of more than four people showed bigger extensions of covered areas, ranging between 80 $m^2$ and 131 $m^2$. Prior to fieldwork, it was expected that large households would be more likely to transform temporary houses than small households, a feature that has been reported in some of the literature on the topic (Tipple, 1999, pp. 22–23). Exceptions to this trend among the cases studied were a house inhabited by three people which was extended to 114 $m^2$, and a house inhabited by four people which was extended to 56 $m^2$. The variation in the areas built in these two cases could be explained by age differences between the families, meaning that inhabitants were at different stages of life and therefore expected houses to fulfil different functions. The bigger house belonged to an older family with an adult son, while the smaller house was inhabited by a mother with three children. Also, the older family added a shop and a restaurant to the house unit in a bid to increase their income. Therefore, this family needed more covered spaces in addition to bedrooms and other family areas. These two aspects could explain why some households had access to more resources for constructing extensions than others, and their economic motivations for having a bigger house.

**Table 16.** Socio-cultural aspects of the cases studied in Peru.

| Case No. | Household composition | Persons per house | Ages | Bed-rooms total | Bed-rooms per person | Total area ($m^2$) | Area per person ($m^2$) |
|---|---|---|---|---|---|---|---|
| **Case 1 Caucato** | Nuclear household: Married-couple family with child | 3 | 27, 50,52 | 2 | 0.7 | 114 | 38 |
| **Case 2 Mensía** | Extended household: Married-couple family with children plus grandparents | 6 | 6,12, 30,35 60,82 | 2 | 0.3 | 92 | 15.3 |
| **Case 3 Mensía** | Extended household: Married-couple family with child plus grandparents | 7 | 6m.,18,18, 28,39, 55,64 | 3 | 0.4 | 101 | 14.4 |
| **Case 4 Mensía** | Nuclear household: Married-couple family with child | 3 | 3, 22,28 | 2 | 0.7 | 56 | 18.7 |
| **Case 5 Mensía** | Nuclear household: Mother with children | 4 | 2,12,16, 37 | 2 | 0.5 | 56 | 14 |
| **Case 6 El Palmar** | Nuclear household: Married-couple family with children | 4 | 16,18, 50,59 | 3 | 0.75 | 84 | 21 |
| **Case 7 El Palmar** | Nuclear household: Married-couple family with children | 5 | 7,9,16, 40,42 | 3 | 0.6 | 85 | 17 |
| **Case 8 Bernales** | Nuclear household: Married-couple family with children | 4 | 2,7, 40,49 | 3 | 0.75 | 96 | 24 |
| **Case 9 Bernales** | Nuclear household: Married-couple family with children | 5 | 1m.,7,11, 32,32 | 3 | 0.6 | 99 | 19.8 |
| **Case 10 Santa Rosa** | Nuclear household: Father with children | 3 | 29,20, 50 | 2 | 0.7 | 64 | 21.3 |
| **Case 11 Santa Rosa** | Nuclear household: Married-couple family with children | 5 | 2,4,8, 32,34 | 2 | 0.4 | 90 | 18 |
| **Case 12 Santa Rosa** | Nuclear household: Married-couple family with child | 3 | 4, 40,41 | 2 | 0.7 | 74 | 24.7 |
| **Case 13 Santa Rosa** | Nuclear household: Married-couple family with children | 6 | 5,9,13,18, 36,50 | 3 | 0.5 | 103 | 17.2 |
| **Case 14 Cañapay** | Nuclear household: Married-couple family with children | 5 | 1,9,10, 32,48 | 2 | 0.4 | 90 | 18 |
| **Case 15 Cañapay** | Nuclear household: Married-couple family with children | 4 | 1,6, 25,31 | 2 | 0.5 | 131 | 32.8 |

Another trend that can be inferred from the cases studied is that families with a grown-up child (of over 16 years of age) tended to desire more rooms due to a need for privacy, in a similar fashion to a household with three adults or more. Therefore, in cases with teenagers or more adults, transformations were oriented around the addition of more bedrooms, or the division of shared spaces into more rooms. Adding more rooms to a house so as to provide privacy to older children is a tendency witnessed in many societies, not only in the case of Peru (Tipple, 1999, pp. 22–23; Tipple and Ameen, 1999, p. 90).

### ***Uses and services***

Temporary houses were used in different ways across the cases studied for this thesis. Although the house was not designed for a unique function, in the majority of the cases inhabitants used it as a bedroom. Nevertheless, as mentioned, some families changed the domestic use of the house. In order to facilitate this type of change, the temporary house had either a window or a door with direct access to the street. The addition of a ventilated, shaded space at the front of the house was seen as a key extension, due to the coastal-desert climate of the region. Moreover, this shaded porch was used as an intermediate place between public spaces (streets) and private spaces (house). In these porches, families participated in shared activities with their neighbours during the warmer hours of the day, adding a cultural and social role to the space (Figures 43 and 44).

In most cases, kitchens were not used inside houses. They were moved to new rooms or used in intermediate spaces, under the bamboo and *esterilla* roof. The possibility of cooking in semi-exterior areas was reinforced by the dry and mild climate. Also, in many cases inhabitants used open kitchens with charcoal before and after the earthquake, and therefore outside kitchens were more suitable.

The availability of services in the houses, such as access to water, electricity and sanitation, as well as construction materials, are indicators of households' economic resources, and are associated with quality of life (INEI, 2008, p. 239). In Caucato, the village was provided with communal toilets and showers by an international organisation, and in some cases – in Mensía, El Palmar and Bernales – individual toilets were provided by Catholic NGO Caritas (not connected to the grid), and built independently on each plot. In other cases, informal toilets were used by families outside the temporary house itself, but inside the plot. In a few cases, families used adjacent open fields as toilets.

**Fig. 43.** Porch in Caucato, Peru, 2012. Case 1.

**Fig. 44.** Porch in Cañapay, Peru, 2012. Case 15.

**Table 17**. Socio-cultural aspects. Uses and services of cases in Peru.

| Case No. | Area ($m^2$) | Functions of the temporary house | Kitchen | Toilets |
|---|---|---|---|---|
| **Case 1 Caucato** | 114 | Bedroom and shop | Outside temporary house | Yes, communal |
| **Case 2 Mensía** | 92 | Bedroom | Outside temporary house | No |
| **Case 3 Mensía** | 101 | Bedroom | Outside temporary house | Yes- outside temporary house |
| **Case 4 Mensía** | 56 | Bedroom and living room | Outside temporary house | Yes- outside temporary house |
| **Case 5 Mensía** | 56 | Bedroom | Outside temporary house | Yes- outside temporary house |
| **Case 6 El Palmar** | 84 | Bedroom | Outside temporary house | Yes- outside temporary house |
| **Case 7 El Palmar** | 85 | Bedroom | Outside temporary house | Yes- outside temporary house |
| **Case 8 Bernales** | 96 | Bedroom | Outside temporary house | Yes- outside temporary house |
| **Case 9 Bernales** | 99 | Bedroom | Outside temporary house | Yes- outside temporary house |
| **Case 10 Santa Rosa** | 64 | Kitchen and laundry | Inside temporary house | Yes- outside the temporary house |
| **Case 11 Santa Rosa** | 90 | Living room | Outside temporary house | Yes- outside temporary house (informal) |
| **Case 12 Santa Rosa** | 74 | Living room and shop | Outside temporary house | No |
| **Case 13 Santa Rosa** | 103 | Bedroom and shop | Outside temporary house | No |
| **Case 14 Cañapay** | 90 | Living and dining room | Outside temporary house | No |
| **Case 15 Cañapay** | 131 | Living room | Outside temporary house | No |

### 5.3.2 Physical features and architecture

***Process***

The process of adaptation of houses was influenced by inhabitants' particular needs, but it was clear that the need for space was an important issue shared by all, because the main modification made was to extend and this happened almost as soon as temporary houses were constructed. Also, during the trip it was clear that recovery and reconstruction after this disaster was a long process. At the moment of the visit, five years after the earthquake, all cases were still undergoing a process of construction and improvement, suggesting that permanent solutions could only be achieved incrementally. This study was able to crystallise a moment in time, which was not the final step of construction. Five years after the earthquake families had different plans for their temporary houses in the medium and long-term. During the trip, it was common to see building materials gathered by families at the back or front of their plots of land, as they waited for the time and resources necessary to continue to build and improve their houses.

All houses studied were modified during the second stage but with different levels, ranging from opening new doors and windows to removing floor and wall panels to use in further extensions (Table 18). The construction of an unreinforced concrete slab was apparently an easy task for families, because in several cases it was one of the initial additions made to houses. Another change that most families made during the second stage was the creation of a front or back porch built with bamboo and covered with bamboo mats or *esterillas*. During the third stage, households that had already constructed a permanent house with brick or concrete used the temporary house as a first-floor extension. This adaptation was seen across various villages, and was also mentioned by families as a future plan for the temporary house. Table 18 shows that during the third stage the use of clay bricks, concrete and adobe was also common.

At the time of the visit, many houses had been developed to a similar extent, but they also varied in terms of materials and families' plans for future construction. In cases where a permanent solution had already been built, families did not want to give away the temporary house. For them, it has been more than just a physical object, and during interviews they commented on their emotional attachment to the house. Some families mentioned that they felt this connection to their temporary house because it had contributed to the recovery process, and therefore, constituted an important part of their lives. Therefore, once they achieved a permanent solution, the entire temporary house, or parts it, were incorporated into the first floor or housing extensions.

**Table 18.** Physical features. process of modification of cases in Peru. The text in red/ italics represents changes carried out directly to the temporary house.

| Case No. | Area (m²) | Changes Stage 2 (Year 2) | Changes Stage 3 (Year 5) | Materials Stage 2 | Materials Stage 3 |
|---|---|---|---|---|---|
| **Case 1 Caucato** | 114 | *Change door position*<br>*Internal division*<br>Front porch (shaded)<br>Back extension (living and dining room) | Back extension (kitchen, restaurant, toilet, storage) | Bamboo<br>Bamboo mat<br>Fabric<br>Paint | Bamboo<br>Bamboo mat |
| **Case 2 Mensía** | 92 | *Internal division*<br>Front façade<br>Side extension (living room) | Side extension (kitchen and dining room) | Clay bricks<br>Fabric<br>Paint | Clay bricks |
| **Case 3 Mensía** | 101 | *Internal division*<br>Front porch (shaded)<br>Front façade<br>Side extension (bedroom) | Side extension (kitchen, dining room and toilet) | Clay bricks<br>Bamboo<br>Bamboo mat<br>Fabric<br>Paint | Clay bricks<br>Adobe bricks<br>Corrugated iron |
| **Case 4 Mensía** | 56 | *Floor panels removed*<br>*Internal division*<br>Front porch (shaded)<br>Side extension (kitchen and dining) | Side extension (kitchen and toilet) | Timber panels<br>Bamboo<br>Bamboo mat<br>Fabric | Clay bricks<br>Adobe bricks<br>Corrugated iron |
| **Case 5 Mensía** | 56 | *Floor panels removed*<br>*Internal division*<br>Concrete slab<br>Front porch (shaded)<br>Side extension (kitchen and dining) | Side extension (kitchen and toilet)<br>Side porch (shaded living room) | Concrete slab<br>Timber panels<br>Bamboo<br>Bamboo mat<br>Fabric | Adobe bricks<br>Corrugated iron<br>Bamboo<br>Bamboo mat |
| **Case 6 El Palmar** | 84 | Front porch (shaded kitchen and dining room) | *House on top*<br>*Floor panels removed*<br>Side extension (kitchen and toilet) | Bamboo<br>Bamboo mat | Clay bricks<br>Concrete<br>Timber panels |
| **Case 7 El Palmar** | 85 | Side extension (kitchen and toilet) | *House on top*<br>*Floor panels removed*<br>Front extension (living and dining room) | Adobe bricks<br>Corrugated iron | Clay bricks<br>Concrete<br>Paint |
| **Case 8 Bernales** | 96 | Front extension (living and dining room) | *House on top*<br>*Floor panels removed*<br>Front extension (kitchen and toilet) | Clay bricks<br>Concrete | Bamboo<br>Bamboo mat<br>Clay bricks<br>Concrete<br>Timber panels |

| | | | | | |
|---|---|---|---|---|---|
| **Case 9 Bernales** | 99 | Front extension (living and dining room)<br>Back porch (shaded) | *House on top*<br>*Floor panels removed*<br>Extension (bedroom and toilet) | Quincha<br>Bamboo<br>Bamboo mat | Concrete blocks<br>Concrete<br>Paint |
| **Case 10 Santa Rosa** | 64 | *New door*<br>Front extension (living and dining room) | Internal division (bedroom and toilet) | Reinforced clay bricks<br>Concrete slab<br>Bamboo | Reinforced clay bricks |
| **Case 11 Santa Rosa** | 90 | *Floor panels removed*<br>*New doors*<br>Concrete slab<br>Front porch (shaded)<br>Back extension (bedrooms) | Side extension (shaded kitchen, dining room and toilet) | Concrete slab<br>Timber panels<br>Bamboo<br>Bamboo mat<br>Paint | Adobe bricks<br>Bamboo<br>Bamboo mat<br>Fabric |
| **Case 12 Santa Rosa** | 74 | *New doors, windows and roof window (shop)*<br>*Internal division*<br>Side extension (bedroom) | Side extension (Kitchen and dining room) | Paint<br>Adobe bricks<br>Bamboo<br>Bamboo mat | Bamboo<br>Bamboo mat |
| **Case 13 Santa Rosa** | 103 | *New doors*<br>*Floor and wall panels removed*<br>*Internal division (shop and bedroom)*<br>Side extension (kitchen, living and dining room)<br>Front and back porches (shaded) | Side extension (bedroom) | Timber panels<br>Paint<br>Concrete slab<br>Clay bricks<br>Bamboo<br>Bamboo mat | Clay bricks<br>Concrete<br>Bamboo<br>Bamboo mat<br>Plastic sheet |
| **Case 14 Cañapay** | 90 | *New doors*<br>*Floor panels removed*<br>Back extension (kitchen and bedrooms)<br>Front porch (shaded) | Back extension (kitchen and corridor) | Concrete slab<br>Timber panels<br>Bamboo<br>Bamboo mat<br>Fabric<br>Plastic sheet | Bamboo<br>Bamboo mat<br>Plastic sheet |
| **Case 15 Cañapay** | 131 | *Floor and wall panels removed*<br>Front porch (shaded)<br>Back extension (kitchen, bedrooms) | Back extension (dining room) | Timber panels<br>Bamboo<br>Bamboo mat | Concrete slab<br>Bamboo<br>Bamboo mat<br>Paint<br>Fabric<br>Plastic sheet |

***Type of change (elements)***

The physical transformations of these temporary houses can be analysed in different ways. From observation, the changes can be divided in two types, of two subtypes each: elements removed (discarded or later used in extensions) or elements added to the temporary house (interior or exterior).

a) **Elements removed from the temporary house**

**Discarded**

- Wall panels used as formwork for extensions made with concrete and then discarded.

**Used as extension (Figure 45)**

- Wall panels:  in exterior walls, in the roof.
- Floor panels: in exterior walls.

b) **Elements added to the temporary house**

**Interior (Figure 46)**

- Unreinforced concrete slab.
- Fabric curtains for internal division.
- Furniture for internal division.
- New doors.
- New windows.
- New roof-windows.
- Paint.

**Exterior (Figure 47)**

- Shaded porch (front or back): built with bamboo, bamboo mat, plastic or adobe.
- Extension (side, front or back): with clay bricks, concrete, adobe, bamboo, quincha, timber panels, bamboo mat and plastic sheet.
- Paint.


**Fig. 45.** Floor panels of *mediagua* used for extension in Mensía, Peru, 2012. Case 5.

**Fig. 46.** Unreinforced concrete slab added to the temporary house in Santa Rosa, Peru, 2012. Case 11.

**Fig. 47.** Side and front extension to the temporary house in Santa Rosa, Peru, 2012. Case 11.

### ***Level of transformation***

The extent of modification varies from case to case, depending on the availability of materials for making extensions, the space that was available into which to expand, the capacity of households to build, and households' future plans and current resources. In some cases, extensions covered big areas, but the transformations made directly to the temporary house were few and limited, such as interior divisions using lightweight materials. In other cases, houses were almost completely disassembled and the panels were used to build new adjacent rooms.

The level of transformation observed on modified temporary houses can be divided into the following categories:

- **Level 0:** No changes to the house.
- **Level 1:** Slight adjustments, such as adding paint or making internal subdivisions with fabric curtains.
- **Level 2:** Mild modifications, such as opening doors and windows in the existing panels or roof.
- **Level 3:** Large modifications, such as removing one or two panels.
- **Level 4:** Extensive modifications, such as  removing three or more panels and the roof.
- **Level 5:** Complete modification, such as disassembling the whole house and using the parts in an entirely different way.

As seen in Figure 48, some households made only minor modifications, and their houses stayed unchanged until the time of the visit. In other cases, families did not make any changes to their temporary houses during the second stage, but they made large modifications during the third stage. Two patterns were found in the way that modifications were made: on the one hand, those households that did not modify the house in the second stage tended to make large modifications during the third stage, when they obtained a permanent house; on the other hand, households that made modifications during stage two often did not make further changes in the third stage. Nevertheless, when asked about their future plans, families that were applying to funds for building permanent houses, were planning to use the house on the first floor, and this, therefore, implied future modifications at level 3 or 4 on the scale used here.

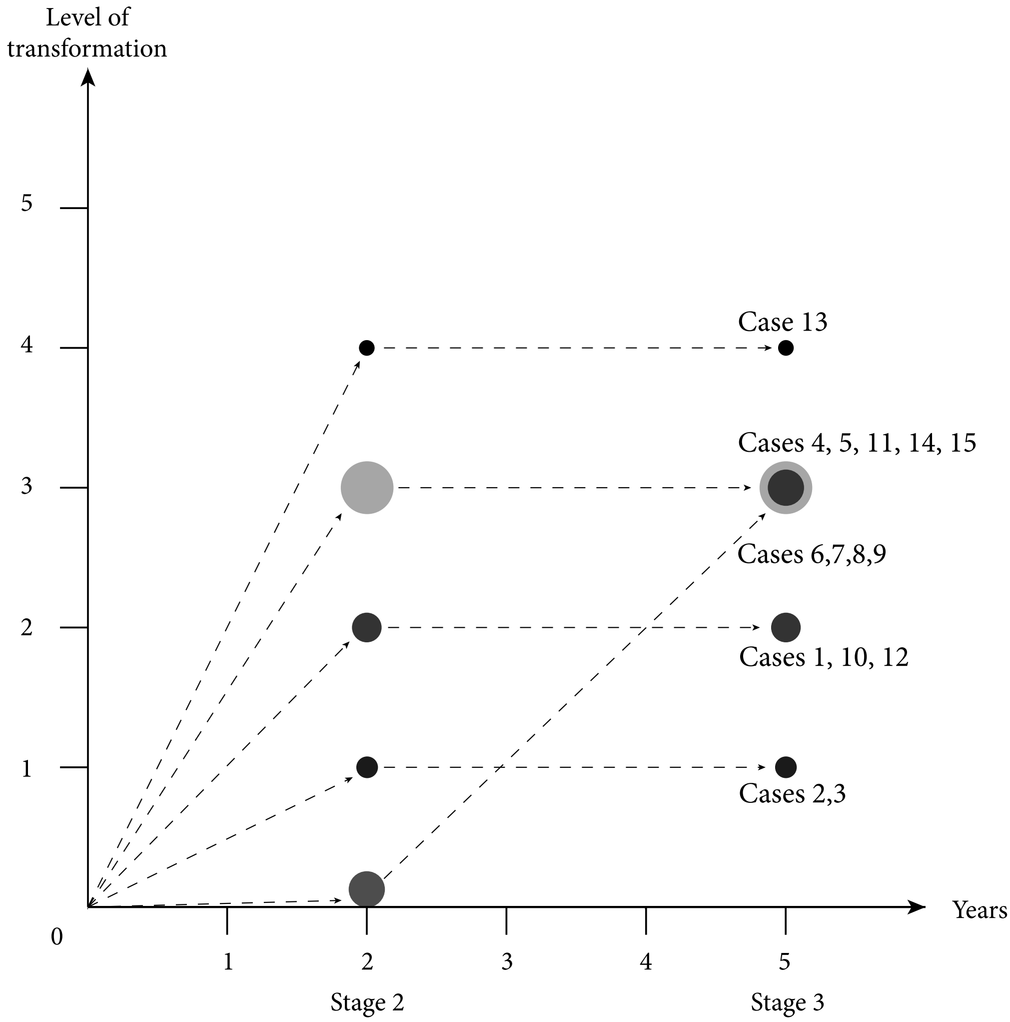



**Fig. 48.** Physical features. Level of transformation of cases in Peru. The graph shows the level of changes in Stage 2 (year 2) and in Stage 3 (year 5).

One problem with modifications at level 3 or 4 is that the structure of the temporary house is made from panels that carry the loads from the roof to the floor. When any of the panels from the temporary house are removed, the overall structure is weakened. Therefore – as observed during fieldwork – buildings supported by structural panels can create future vulnerabilities, since families are likely to remove and reuse them without acknowledging the structural system of their house. A structural system based on frames might be more suitable for inhabitants who are likely to make ongoing modifications, providing possibilities for families to make changes without compromising the structure of the house.

## ***Materials***

Materials used in the extensions varied from lightweight to heavyweight. Lightweight materials used included fabric to subdivide interior spaces, plastic to make divisions, bamboo for the structure of roofs, bamboo mats to form exterior divisions or to create porches, corrugated iron for extensions, and timber panels (recycled from the temporary house) to make extensions. The heavyweight materials used, meanwhile, included concrete for the floor (unreinforced concrete slab), concrete for the structure of reinforced masonry, concrete for walls and roofs, clay bricks for reinforced and unreinforced masonry, and adobe bricks for small walls and vernacular kitchens.

Modifications that affected the temporary house directly used mainly lightweight materials, except for the concrete slabs that replaced floor panels reused to build extensions. During interviews, families mentioned their aspiration to build with 'noble materials' (*materiales nobles*) which were described as concrete, clay bricks or adobe bricks, while timber and bamboo were seen as secondary materials, to be used for future extensions or for building shaded spaces in or around houses. The local perception was that such so-called 'noble materials' lasted longer, were safer and looked more durable, and therefore, these materials were more desirable for permanent housing, even for families that had experienced the destruction of their adobe houses.

## ***Dimensions***

The temporary houses provided by TECHO to all families shared the same basic plan which was not adjusted according to the size of each household nor of each plot. Therefore, each household began the recovery process with a house of 18 $m^2$ in size. As the comparison in Figure 49 demonstrates, all households extended their houses incrementally over the years. The dimensions of the houses were taken, considering all covered spaces (including shaded areas) used by families as living rooms or kitchens. To provide a visual description of cases, the spaces covered by bamboo mats were included in the drawings (Figure 42). During the second stage, each household at least doubled the size of their temporary house (Figure 49). The smallest extension was 36 $m^2$, while the biggest was 91 $m^2$. During the third stage, each house was extended yet further, with the two smallest houses measuring roughly 56 $m^2$, and the biggest reaching 131 $m^2$. The smallest houses were built at the back of plots where families were allowed to settle, but did not have formal tenure. All the other cases were built on plots that families owned or shared with their extended family. In these cases, the extensions covered the majority of the area of the plot. In average, extensions were of around 90 $m^2$ of usable space, for families of 4 and 5 people.

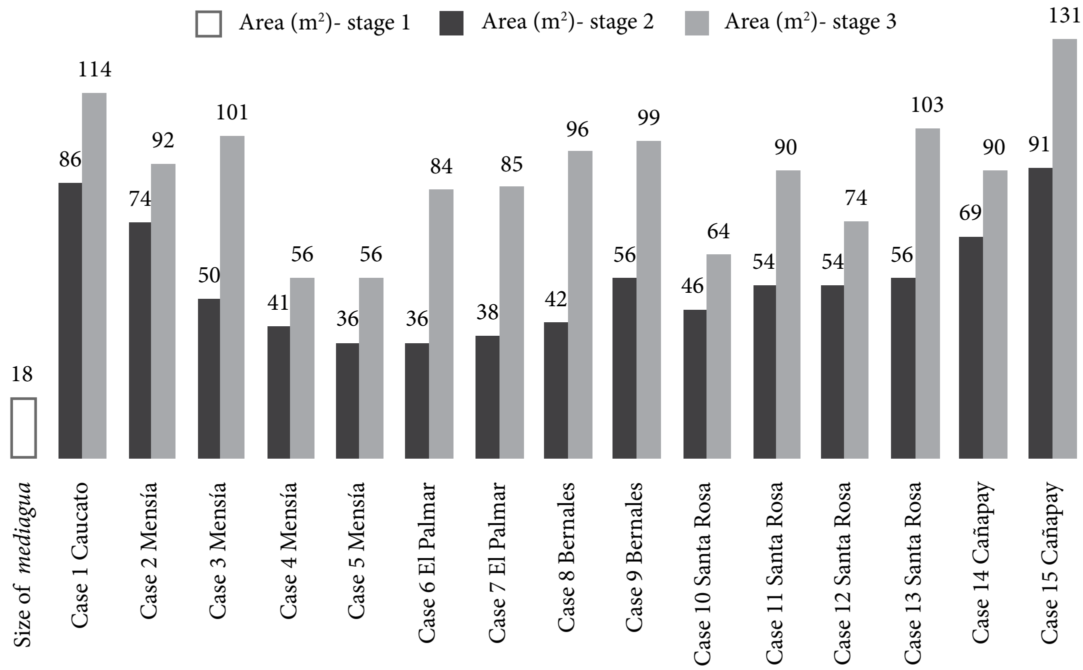



**Fig. 49.** Physical features. Areas of extended houses in cases studied in Peru.

## *Configuration of the extensions*

The shape of families' plots of land had an important effect on the ways in which temporary houses were initially established and later expanded. As already highlighted, in many cases plots were rectangular, with a small façade facing the street and a long side to the back, possibly a common feature in many settlements in the area. Due to this layout, there were only a few ways in which temporary houses could be assembled, and the most common approach witnessed in this context was to build the house parallel to the long side and perpendicular to the street (Figure 51). On bigger rectangular plots, or plots with shapes different to a rectangle, the house was built parallel to the street, thus providing direct access to it. In these cases, many inhabitants modified their house at an early stage by creating a new door at the back, so that they could have front and rear access to their dwelling. Houses built on street corners were, in many cases, modified in a similar fashion, with differences arising due to the shape of plots. Figure 50 shows the different patterns of expansion, and their relation to the main door used to access them. The orientation of the extensions appeared to have been exclusively based on the availability of space within the plots, rather than other factors such as solar gain or strong winds. In cases in which the permanent house had already been built and the temporary house was therefore used as an extension to the first floor, the location and orientation of the house changed from Stage 2 to Stage 3 (Figure 52).

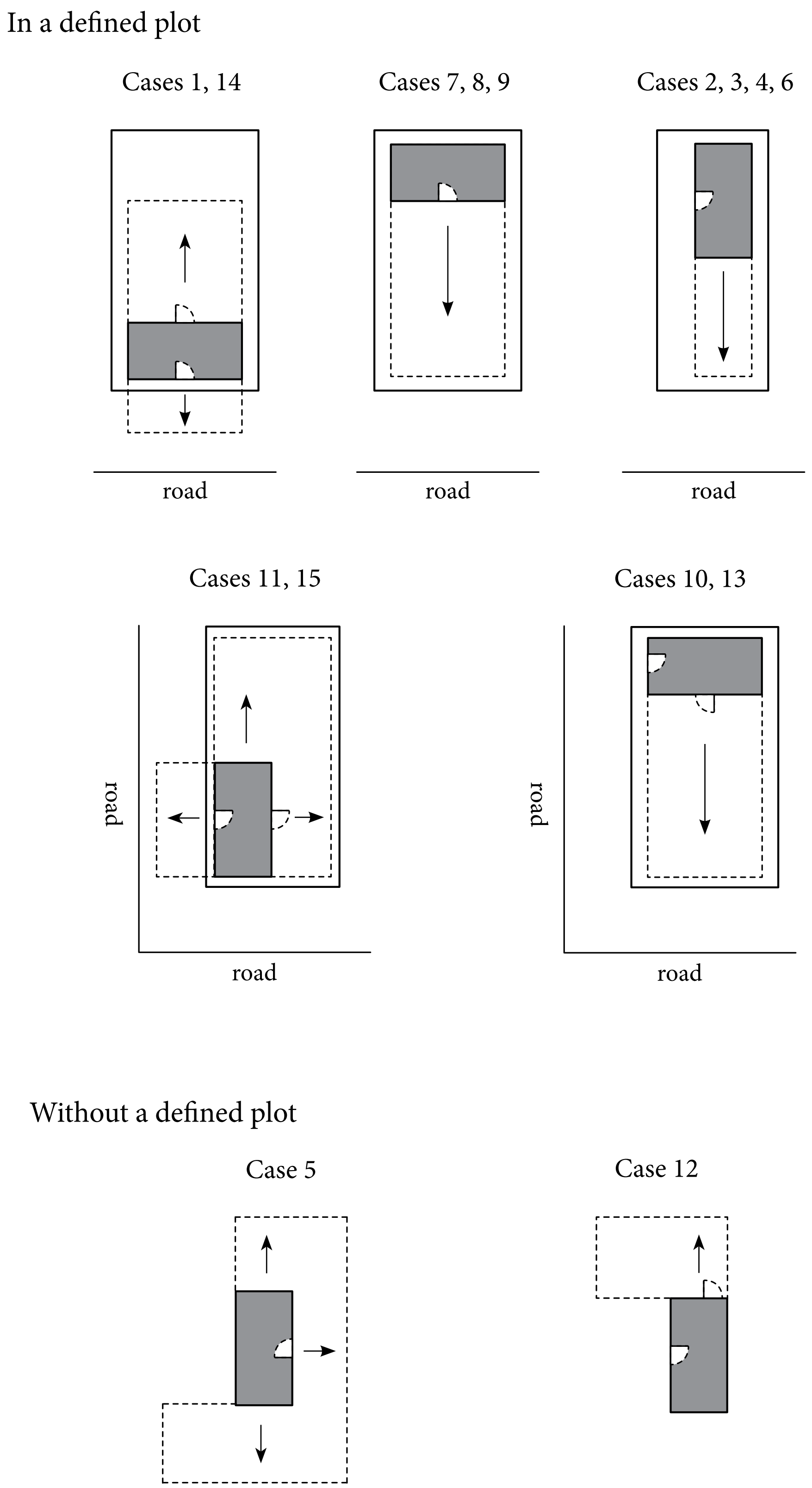



**Fig. 50.** Patterns of modification of cases in Peru.

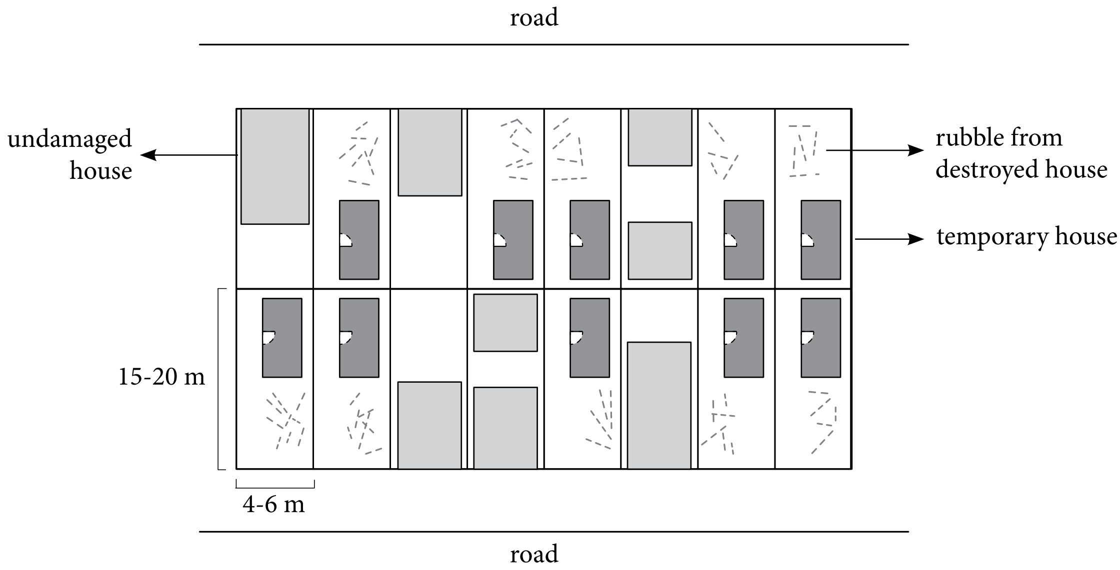



**Fig. 51.** Configuration influenced by the shape of the plots. House built parallel to the long side and perpendicular to the street.

**Fig. 52.** Temporary house used as an extension on the first floor, El Palmar, Peru, 2012. Case 6.

***Architecture style-ornamental elements***

Interventions and elements that were recognised as particular to the region are:

- Modifications to the design of the windows of temporary houses. The modified windows were curved at the edges, a typical feature of some houses in this area of Peru.
- The use of bamboo mats to create porches or shaded spaces, either at the front façade of the house or on other parts of the plot.
- The use of bright coloured paint, either to protect the panels of temporary houses or to lend permanent houses a personalised aesthetic (Figure 53).
- The construction of a small roof extension over the entrance of permanent houses, either to protect the façade from direct sunlight or to provide an intermediate space similar to a front porch.
- The addition of metal bars to the windows to protect the house from burglary. Some of these elements create geometric patterns and provide a personalised façade (Figure 54).

### 5.3.3 Economic aspects

***House tenancy***

During the interviews, families were asked about tenancy, and most declared themselves to be either the owners of the plots upon which their temporary house had been constructed, or relatives of the owners and thus part of the household. In the two exceptions to this overall tendency, houses had been built on lands provided to families by relatives or friends as a temporary location. This situation was also made clear in their responses for future plans; one of these families stated that they did not yet have plans, while the other planned to apply for government funding to build a new house on a different site (Table 19).

***Cost of the extensions (materials and handwork)***

The cost of the temporary house was estimated at 1,000 USD in 2007 (490 GBP). The resources used on modifications and extensions of the houses were estimated by their inhabitants in 2012 as: Cost 1 (1-500 USD/ 1-322 GBP), Cost 2 (500-1,500 USD/ 322-965 GBP), Cost 3 (1,500-2,500 USD/ 965-1,608 GBP), Cost 4 (2,500 USD/ 1,608 GBP or more). Table 19 shows how different

**Fig. 53.** Bright colours to protect the panels and to personalise the temporary house. Case 2.


**Fig. 54.** Addition of metal bars for protection and aesthetics. Case 12.

households allocated resources to modifying their houses. To construct extensions, six families spent between 1 and 500 USD, four families spent between 500 and 1,500 USD, four families spent between 1,500 and 2,500 USD, and only one family spent more than 2,500 USD.

The resources spent on modifying houses were not linked to their size, but to the materials used and the sources of funding available for households to invest. For example, in the biggest houses (case 15 with 131 m$^2$ and case 1 with 114 m$^2$) families estimated to have spent 500 USD (322 GBP) or less. They both covered large areas and used lightweight materials, such as bamboo for the main structure, and *esterilla* and plastic to cover the spaces. Nevertheless, while one family declared that the current house was the permanent one, the other stated that the house was a temporary option and that they were applying for government funding to build a permanent house. Families that spent between 1,500 and 2,500 USD (965-1,608 GBP) were all supported by the government through '*Bono 6000*'. Most declared an intention to incorporate their temporary house into a permanent house as the next step. Finally, the family that spent the largest amount of money on their house (case 9, more than 2,500 USD/1,608 GBP) had already managed to build the bulk of a permanent house with support from the Peruvian Red Cross, and their temporary house was being used as an extension on the first floor. This particular family received the largest amount of government funding available to low-income families for the construction of new houses.

***<u>Source of funding for extensions and improvements</u>***

Most families used savings to make improvements to their houses (Table 19). No loans were taken out in any of the cases studied. Nevertheless, external funding was used either from the government or from other organisations. As mentioned above, some families received the grant *'Bono 6000'* (around 2,000 USD/ 980 GBP in 2007) and, at the time of our interview, were also applying to the programme *'Techo Propio'* (between 2,900 and 5,900 USD/ 1,415 and 2,880 GBP in 2007). The *'bono'* was possible to use in two ways: as part of a broader government housing programme, or for a standalone building project (Huber and Narvarte, 2008, p. 24). Low-income families affected by the earthquake were entitled to apply to *'Techo Propio'*; however, due to misinformation, many families did not know whether the programme was a loan or a grant, and therefore chose the *'bono'* alone, so as not to commit to any obligations of repayment (Huber and Narvarte, 2008, p. 24). In the cases analysed, some families were applying to the housing programme *'Techo Propio'* five years after the disaster, extending the process to attain a permanent house yet further.

**Table 19.** Economic Aspects. Cost of the extensions and source of funding.

Cost 1 (1-500 USD), Cost 2 (500-1500 USD), Cost 3 (1500-2500 USD), Cost 4 (2500 USD or more).

| Case No. | Area (m2) | Cost of extension | Source of funding | Gov. funding | Other sources | Permanent | Future plans |
|---|---|---|---|---|---|---|---|
| **Case 1 Caucato** | 114 | Cost 1 | Savings | - | - | No | Techo Propio<br><br>same site |
| **Case 2 Mensía** | 92 | Cost 3 | Savings | Bono<br><br>6000 | - | No | Techo Propio- same site - house on top |
| **Case 3 Mensía** | 101 | Cost 3 | Savings | Bono<br><br>6000 | - | Yes | Paint |
| **Case 4 Mensía** | 56 | Cost 1 | Savings | | Caritas | Yes | No plans |
| **Case 5 Mensía** | 56 | Cost 1 | Savings | - | Caritas | No | Techo Propio<br><br>other site |
| **Case 6 El Palmar** | 84 | Cost 3 | Savings | Bono<br><br>6000 | Caritas | Yes | House on top |
| **Case 7 El Palmar** | 85 | Cost 3 | Savings | Bono<br><br>6000 | Caritas | Yes | House on top |
| **Case 8 Bernales** | 96 | Cost 2 | Savings | - | - | Yes | Change materials (noble) |
| **Case 9 Bernales** | 99 | Cost 4 | Savings | Techo Propio | Peruvian Red Cross | Yes | Reuse house |
| **Case 10 Santa Rosa** | 64 | Cost 2 | Family and friends | - | - | Yes | House on top |
| **Case 11 Santa Rosa** | 90 | Cost 1 | Savings | - | - | Yes | Build toilet |
| **Case 12 Santa Rosa** | 74 | Cost 1 | Savings | - | - | Yes | Remove floor panels, concrete slab |
| **Case 13 Santa Rosa** | 103 | Cost 2 | Savings | - | - | Yes | Change materials (noble) |
| **Case 14 Cañapay** | 90 | Cost 2 | Savings | - | - | Yes | Add a new room |
| **Case 15 Cañapay** | 131 | Cost 1 | Savings | - | - | Yes | No plans |

The NGOs Caritas and IFRC supported improvements to houses which focused on providing a better quality of life, to this end providing materials, construction and training. Caritas donated materials to households so that they could construct improved kitchens and toilets. As in cases from Mensía and El Palmar, the families selected to receive materials were those with young children. This programme was part of Caritas' plan to promote healthy spaces and ensure good standards of hygiene in food preparation (Caritas International, 2008). In rural areas of the region visited, charcoal was commonly used for cooking, in open kitchens which produce smoke that, if not properly extracted, can be detrimental to inhabitants' health. In addition, the use of open kitchens and charcoal exposed families to the danger of fire. Therefore, the new kitchens provided by Caritas were built with clay bricks or adobe, covering the fire and adding a chimney that extracts fumes from the house or built areas (Figure 55). Interviewed families called the improved kitchens 'ecological kitchen' (*cocina ecológica*). The toilets provided by Caritas were built at a short distance from houses, with corrugated iron walls and a concrete slab floor (Figure 56). On the other hand, IFRC supported the construction of permanent houses, which were built by volunteers, hired workers and the families themselves. Materials and designs used by this NGO were tested by academics from the *Pontificia Universidad Católica del Perú* (PUCP) to study their earthquake resistance (Saunders, 2011). Cases seen in Bernales were built with '*quincha mejorada*', an improved and reinforced version of the traditional quincha. The programme included workshops with the purpose of transferring skills to beneficiaries and community members, and houses were equipped with sanitation (latrines), electricity, and an improved kitchen (Saunders, 2011).

## 5.4 Modifications, patterns, motivations and home

### ***Modifications, patterns and motivations***

Most of the temporary houses built by TECHO in the centros poblados studied were modified by their inhabitants, and only few cases did continue to use the original model – usually households comprised of a single person or one couple. The temporary house was transformed by families adding new spaces to it, using it as an extension of a permanent house, or using the temporary house as a corner-shop, thus changing its domestic use. Although the analysis for this thesis was carried out using three categories – socio-cultural, physical, and economic – these aspects were deeply interconnected. For example, physical changes were driven by adaptations of houses to

**Fig. 55.** Improved kitchen provided by Caritas. Mensía, Peru, 2012.

**Fig. 56.** Toilets provided by Caritas. Mensía, Peru, 2012.

differing local climates, and increases in house size were carried out in order to adapt to the particular composition of the household in question.

Frequent transformations observed were (Figure 57):

- **An increase in house size by adding more rooms.** The dimensions observed were between 56 $m^2$ and 131 $m^2$, showing a big difference in the capacity of families to extend. Most limitations were defined by the area of each plot.

- **Removal of floor panels to use them as extensions.** The removal of the floor panels demonstrated that a timber floor was not completely desirable for families and that the panels were seen to be more suitable material for extending or improving other parts of the house. Indeed, most families removed flooring panels in order to use them in extensions. This means that families considered it to be more important to have more room than to have a timber floor. Apparently for residents it was easy to build a thin concrete slab, and therefore, to use these panels to create new rooms.

- **Addition of shaded porches.** One of the early additions made in most cases was an intermediate shaded space between exterior and interior space, such as a terrace or porch. These additions were built with matting of woven bamboo or similar material. The addition of a ventilated, shaded space at the front of houses was vital, due to the climate of the region: coastal desert. Porches or terraces provided a shaded space that acted as a buffer between the street and the house, providing a space for families to socialise, and also helping to cool the house. Back porches, or shaded areas not directly connected to the road, were used as kitchens, dining rooms or living rooms.

- **Use of the kitchen in an exterior area.** Due to the dry and hot climate, it was not unusual to find kitchens and dining rooms in an exterior but covered space. It was also desirable for some families to have the kitchen in the exterior of the house, due to the fumes produced by cooking with charcoal.

- **Opening or changing doors and windows.** The need to construct new windows and doors drew attention to the inflexibility of the design of these temporary houses. Families added doors and windows to have a new access point, to connect new rooms to the house, or to provide more light inside the house.

- A tendency to **use the temporary house as an extension on the first floor** once a permanent house was built was witnessed in different settlements.

- **Use of clay bricks and concrete in the permanent house.** Families referred to the materials used for permanent houses as 'noble materials'. For them, brick and concrete were chosen for being apparently more durable and resistant than adobe, bamboo or wood. In some cases, reinforced adobe was used.

- **Influence of the shape of the plot on future expansion.** In many cases plots were narrow and rectangular (i.e. 4 m. x 20 m.), with the short side facing the street, a common feature in houses across this region. Therefore, the temporary house could only be constructed in a few possible ways, and the most common layout was the house built parallel to the long side and perpendicular to the street. In bigger rectangular plots, or plots with other shapes, the house was built parallel to the street, providing direct access to it. In these cases, a common early modification was to open a new door on the rear panels, so that the house could have front and rear access. Houses constructed on street corners underwent similar modifications, with the main differences arising as a result of the shape of the plots. The extensions show different patterns of growth, and their relation to the main entrance. The orientation of the extensions seems to be based on the availability of space within the plots, rather than other factors such as solar gain or wind.

On studying houses in different locations across these areas, it was observed that some modifications tend to reoccur in the same villages, while others are repeated throughout different *centros poblados*. For example, houses that were extended in a longitudinal way were defined by the shape of individual plots, whereas those houses that added a kitchen and toilet donated by Caritas were all located in the same village. It might be the case that neighbours copy what appear to be good ideas, and also that organisations tend to provide the same type of support to targeted groups.

One problem that arises from these tendencies was that when wall and floor panels were removed, the structure of the house was weakened. The potential for this type of modification ought to be considered during the design stage, because it was a frequent practice in Peru. How to remove the floor and at the same time maintain the structural strength of a house? Might this create extra costs? One initial design solution would be to base a structure around frames rather than panels. Bearing these aspects in mind, the money used for flooring panels could be used for building an intermediate space, and therefore, meet some basic conditions for families living in this region. Finally, the temporary house and its parts were used for five or more years after the disaster. They became, therefore, part of the landscape of these villages – something to take into account when planning and designing a solution likely to remain part of a permanent house.

The motivations to improve and make extensions to the house are similar to cases studied in self-extended houses from literature, such as family size, the desire to generate more income by facilitating new entrepreneurial activities, socio-culturally determined aspirations (seen also in the addition of decorations), response to climatic conditions, and a desire to copy prevalent forms of nearby housing (Shiferaw, 1998, p. 446). However, modifications made to post-disaster housing have another motivation, which is to re-build the familiar, the known and a place to call 'home'.

***The construction of 'home'***

All of the cases studied were still undergoing a process of construction and improvement, which pointed towards the idea of 'housing' as an incremental and continuous process. Incremental development is common in other contexts in Peru, not only in post-disaster situations. As John Turner realised in the early 1970s, housing as a process is the physical manifestation of the self-help housing model (Williams, 2005, p. 29), which in the cases studied here occurred after the NGOs provided a solution, in order that households could attain an acceptable quality of life. In these examples, and also in the villages and cities visited during fieldwork more generally, many cases were seen in which the rebar from reinforced concrete or reinforced brick emerged from the roof. There were two main reasons to do this: first, extensions could be connected to the structure in the future; and second, occupants of unfinished houses did not pay taxes, because they were classed as habitations 'under construction' (Interview with representative of TECHO-Peru, 2012). For these two reasons, many houses across these areas have the permanent appearance of being unfinished.

This idea of housing as an unfinished and continuous process is linked to the concepts of 'home' developed by Després, where 'home-making' is a long-term project experienced over time (Després, 1991). The temporary house was used by families in Peru as a transitional shelter or core house, as part of an incremental process, instead of a shelter to reside temporarily. As

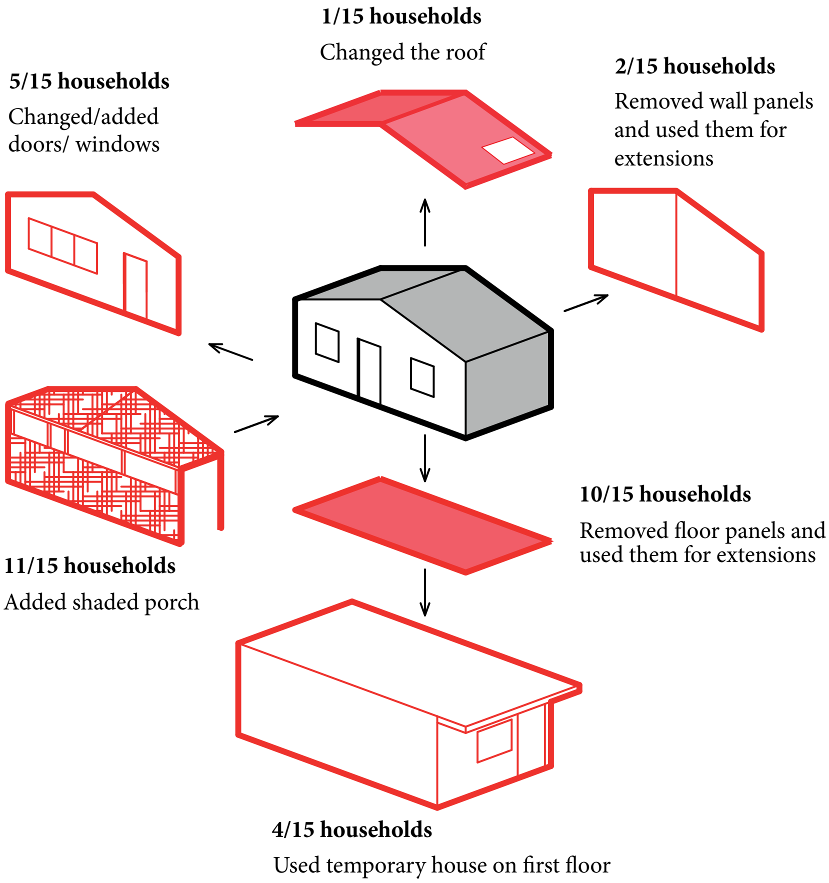



**Fig. 57.** Synthesis of changes made to temporary houses in Peru.

discussed earlier in this thesis, the loss of shelter and material possessions disrupts the feeling of belonging and attachment (Blunt and Dowling, 2006; Kellet and Moore, 2003). Changes were made by families to make the house more comfortable in terms of temperature, light control and space, but also they were made to change its aesthetics, to make it personal, and to rebuild a familiar environment. Therefore, the temporary house was modified by families in Peru to get that sense of belonging and identity. Families felt achievement, control and pride when they were able to modify their own houses and to transform them into a space for self-expression. Interviewed households were proud of showing the changes made to their houses and to explain future plans, especially those with more progress in their modifications.

# Chapter 6

# 6. Chile. Two years after the earthquake and tsunami of 2010

On the 27th of February 2010, an earthquake with a magnitude (Mw) of 8.8 was followed by a tsunami in the central and southern regions of Chile (Figure 58). The earthquake was classified as one of the world's most serious seismic events, and was recorded as the second-strongest earthquake in Chile's history (Verdugo and González, 2015, p. 280). It affected around 75% of the population, killing 526 people and leaving more than 200,000 houses destroyed or seriously damaged (Cárdenas-Jirón, 2013, p. 1). The most severe damage occurred in coastal areas and parts of Chile's central valley (American Red Cross Multi-Disciplinary Team, 2011, p. 12). The tsunami destroyed ports, roads and other structures, and made the immediately surrounding areas uninhabitable or inaccessible (American Red Cross Multi-Disciplinary Team, 2011, p. 24). Many families were displaced to temporary settlements while the government removed rubble from coastal areas and planned the reconstruction process. The destruction left by the earthquake was also severe; however, many damaged buildings left enough surrounding land where affected families could stay during the emergency and reconstruction phases (American Red Cross Multi-Disciplinary Team, 2011, p. 24). Therefore, these families were not displaced and instead were provided with temporary houses to construct on their own plots of land.

Chile is one of the seismically most active countries in the world, with approximately one earthquake above magnitude (Mw) 8.0 every ten years (Cárdenas-Jirón, 2013, p. 1). In the last century, Chile has faced destructive earthquakes, most of them followed by tsunamis, such as those in 1928 in Talca (Mw=7.9), in 1939 in Chillán (Mw=7.8), in 1960 in Valdivia (Mw=9.5), and in 1985 in Valparaíso (Mw=8.0) (Servicio Hidrográfico y Oceanográfico de la Armada de Chile (SHOA), n.d.; USGS, n.d.). As a result, the country's building codes have been revised according to the behaviour of buildings after earthquakes, and new seismic designs were incorporated into the building codes of 1935, 1949, 1972, 1993, 1996, 2003 and 2011. The revision of the building codes

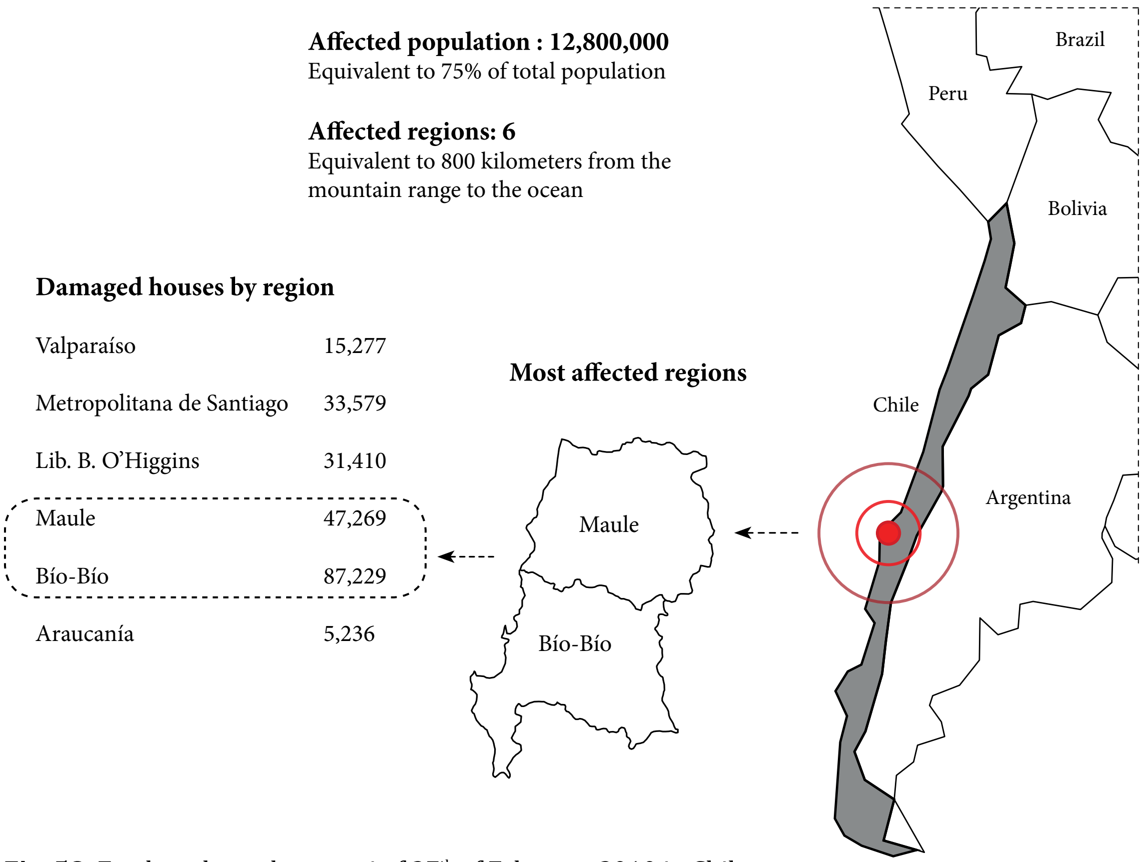



**Fig. 58.** Earthquake and tsunami of 27th of February 2010 in Chile.
Source: Based on Walker and Arrasate, 2013, p. 18.

and the compliance with updated seismic design meant that the general behaviour of high-rise and reinforced masonry buildings was excellent during the earthquake of 2010, while older buildings constructed with adobe were the most affected. Indeed, around 52% of the houses destroyed or seriously damaged were adobe buildings (Saragoni, 2011, p. 39). The large majority of reinforced concrete (RC) buildings performed well during the earthquake, and only approximately 2% of the estimated 2,000 RC buildings in the country taller than nine stories suffered extensive damage (Jünemann et al., 2015, p. 168). Liquefaction affected ports, bridges and roads , most significantly along the coast, and induced ground deformations affected the seismic performance of several modern buildings (EERI, 2010, pp. 3–4; Verdugo and González, 2015, p. 280).

The government of Chile led the post-disaster coordination, which was divided into three phases: **Immediate Emergency** for the provision of assistance to the victims and restoration of public order; **Winter Emergency** to normalise the situation, build temporary houses and prepare houses for the winter; and **Reconstruction** to build permanent housing (Gobierno de Chile, 2013, p. 5).

## 6.1 Temporary Housing: TECHO and the Chilean government

In total, 70,489 temporary houses were built during the first half of 2010. Of these, the government of Chile built 45,769 houses (around 65% of the total) and 24,740 were built by private companies and NGOs, of which 22,256 were built by the NGO TECHO (around 32% of the total) as part of the coordinated disaster response (Gobierno de Chile, 2012, p. 9). The model used by the government and TECHO was the same house as that analysed in the previous chapter and it was provided to displaced and non-displaced families.

During the 'Winter Emergency Phase', temporary settlements were built by the government – or by NGOs supported by the government – called *aldeas* (villages) to provide shelter to displaced families. The government decided to use the term '*aldeas'* instead of '*campamentos'* (temporary camps) to differentiate the settlements built after the earthquake from informal settlements built before the earthquake. Since one of the worries of displaced families and the general public was that temporary camps could become permanent slums, the Chilean government sought to make a distinction between informal and temporary post-disaster settlements.

The *aldeas* were built on rented or state-owned land (Interview with Aldeas y Campamentos' Representative, 2012). In total, 106 *aldeas* were built and the goal of the government was to ensure that all displaced families would have a permanent house before the winter of 2012 (Gobierno de Chile, 2013, p. 14). Nevertheless, this goal was not fully achieved, and 46 *aldeas* (representing 1,442 families in total) were still in use in February 2013 (Gobierno de Chile, 2013, p. 14). In 2012 the government realised that building permanent houses would take longer than planned, and started a programme to subsidise rents for families living in the *aldeas*, with the aim of moving them to other areas and closing the temporary settlements by July-August of 2013 (Gobierno de Chile, 2013, p. 14). However, several families did not want to move to rented accommodation, because they felt that this would delay the construction of permanent houses or that they would lose benefits from the government, because the subsidised rent was for a short period only (Interview with Families in Bío-Bío and Maule Regions, 2012).

The government of Chile, through the National Emergency Agency (*Oficina Nacional de Emergencia,* ONEMI) and the Sub-secretary of Regional Development (S*ubsecretaría de Desarrollo Regional y Administrativo*, SUBDERE), was in charge of the provision of temporary houses, sanitary facilities (prefabricated modules for shared toilets and showers), electricity, and water (water tanks). Although ONEMI and SUBDERE were in charge of the provision, the municipalities were charged with coordination, as well as building fences, drainage and firewalls, with support from the armed forces in some cases (Interview with Aldeas y Campamentos Representative, 2012; MINVU, 2011a). In addition, FOSIS (*Fondo de Solidaridad e Inversión Social, Ministerio de Desarrollo Social*) built greenhouses and vegetable patches, mud ovens, and solar water panels. Moreover, the government and some international and humanitarian organisations, such as Catholic NGO Caritas, provided some families with individual chemical toilets (Interview with Families in Bío-Bío and Maule Regions, 2012).

The government created a handbook for planning settlements entitled '*Basic Guidelines for Emergency Settlements*' (*Lineamientos Básicos para Asentamientos de Emergencia*). These guidelines provide technical advice to support minimum standards in temporary settlements and temporary houses, acknowledging parameters defined by the Sphere Project (MINVU, 2010, p. 5). The guidelines recommend grouping between ten and fourteen housing units, with a maximum of twenty, estimating that each group of houses would provide shelter for 50 to 70 people. Also, the guideline provides four different alternatives for grouping houses, including areas for playgrounds and communal buildings, and the distance between units was defined as 1.5 m. or 3 m. depending on the orientation of the houses in relation to the plot (Figure 59). In addition, the architecture 'do tank' led by Alejandro Aravena of ELEMENTAL provided recommendations with supporting images (Figure 60), including the extension of the mediaguas to the adjacent spaces as a covered intermediate dry area (ELEMENTAL, 2010).The extensions seen in the studied cases far exceed these suggestions.

One of the main issues with the temporary houses provided by the government and TECHO was that they were inadequate for the climate of southern Chile, due to a lack of insulation, waterproofing, and poor quality. This fact was recognised by experts and the government at an early stage during the emergency phase. Therefore, the government, and in some cases other organisations, provided plastic sheets for waterproofing houses, as well as insulation materials. These improvements required additional resources and coordination time – something to consider in future disaster response efforts. Although these changes improved the thermal quality of the temporary house, issues such as the number of family members who might need a bigger house for the mid-term were not considered.

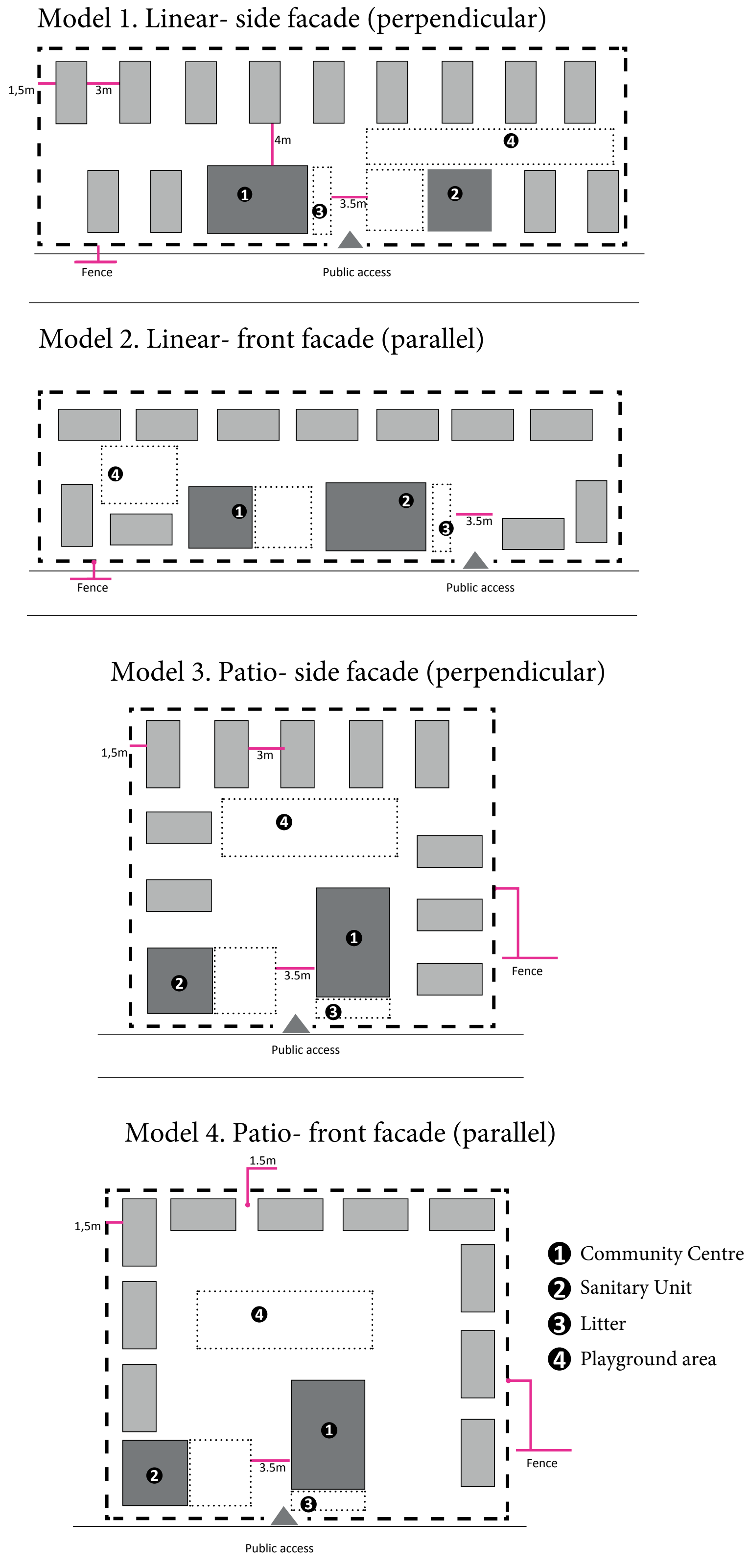



**Fig. 59.** Guidelines for building temporary houses provided by the government of Chile.

Source: Based on MINVU, 2010.

The government provided recommendations to support municipalities and other institutions, through the 'Manual of Technical Recommendations for Post-Earthquake Emergency Housing' (*Manual de Recomendaciones Técnicas para la Vivienda de Emergencia Post-terremoto*) (FOSIS, 2010). These guidelines suggested the addition of bracing to the walls, insulation, and rain protection, as well as electric systems, toilet units and a roof extension with a detailed itinerary of materials, although they did not offer ideas for further extensions. The guidelines also provided some ideas for furniture and other elements used in the house (Figure 61).

The Ministry of Planning (*Ministerio de Planificación,* MIDEPLAN) provided basic equipment to improve the quality of the temporary houses, consisting of insulation, mattresses, kitchens and an electric kits with connection to the electric network as seen in table 20 (Gobierno de Chile, 2010, p. 11; Ministerio de Desarrollo Social, Gobierno de Chile, 2010). In total, the government provided 59,610 insulation kits and 25,000 waterproofing layers to families living in temporary houses (Gobierno de Chile, 2010, p. 11). Organisations interested in improving the quality of the houses also provided materials for insulation, such as *Hogar de Cristo* and Save the Children. The most used material for insulation was expanded polystyrene, locally known as '*plumavit'*, in boards attached directly to the walls or roof ceilings (Figure 62).

**Table 20.** Materials provided by the government of Chile to improve the temporary houses.
Source: Based on Gobierno de Chile, 2010, p. 11.

| Type | N° | Unit Cost (USD) | Total (USD) |
|---|---|---|---|
| **Insulation kits** | 59,610 | 102.2 | 6,094,480 |
| **Waterproofing** | 25,000 | 35.0 | 875,000 |
| **Kitchen and gas** | 12,500 | 38.9 | 486,837 |
| **Kitchen cookware sets** | 2,000 | 21.5 | 42,946 |
| **Beds** | 16,400 | 39.0 | 640,346 |
| **Mattresses** | 22,800 | 23.0 | 525,283 |
| **Blankets** | 75,256 | 5.7 | 427,461 |
| **Total** | | | **9,092,354** |

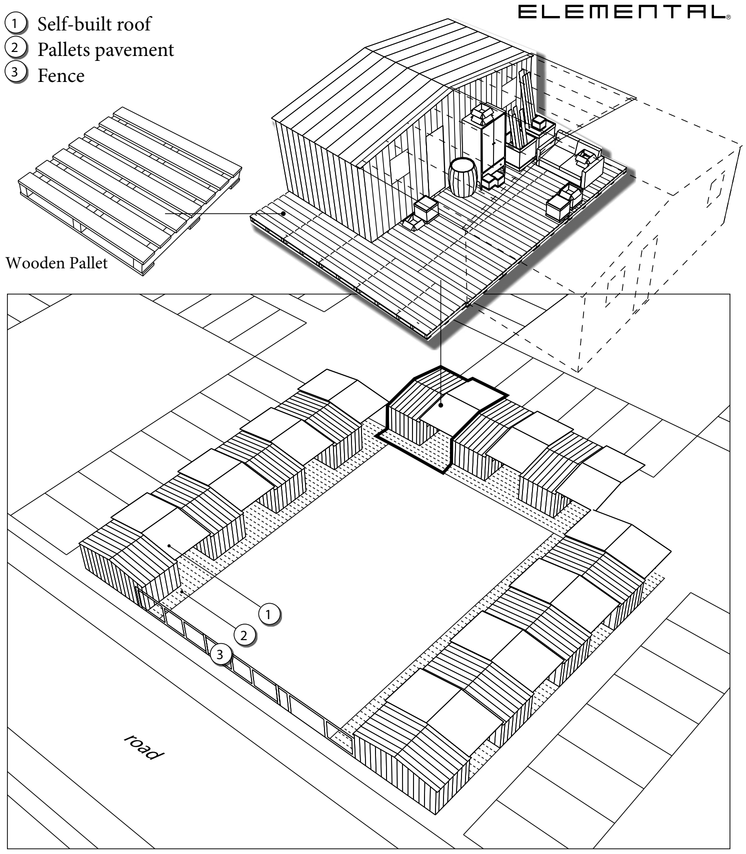



**Fig. 60.** Recommendations for extension of *mediaguas*. Source:  Based on ELEMENTAL, 2010.

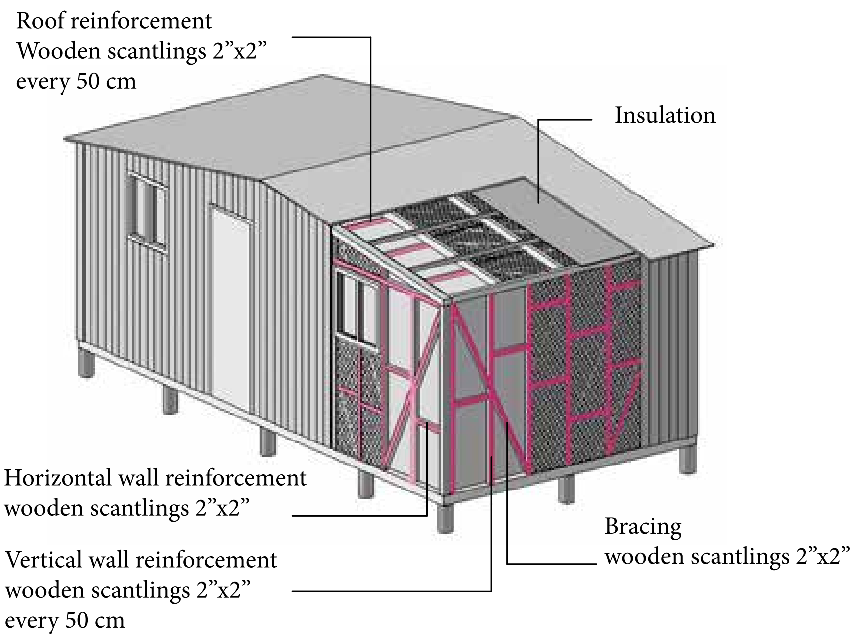



**Fig. 61.** Recommendations for improvement of temporary houses. Source: Based on FOSIS, 2010, p.7.

The government also started a programme for covering the shelters with a waterproof layer made from high density polyethylene locally known as '*geomembrana de polietileno*' (Granadillo, 2010), as seen in Figure 63. These waterproof layers were installed by teams of military officials or skilled workers coordinated by the national and municipal governments. The material had to be installed by skilled workers because the layer was mounted with a specialised stapler, which was as expensive as the polyethylene itself (Fernández, 2010). Therefore, the material was not given to families to install due to the cost of this tool and the government's interest in preventing errors in mounting the layers. However, timber specialists criticised the use of polyethylene layers on the walls, a practice which trapped the humidity within houses, making it more likely that the timber would attract fungi and deteriorate, thus shortening the lifespan of the house (Bluth, 2010). In addition, this practice could cultivate an internal environment which was unhealthy for occupants.

Another organisation that provided support to families living in temporary houses was the Chilean Red Cross (CRC). CRC assisted 8,400 families to improve the living conditions of their temporary shelters or to rebuild and repair their damaged permanent homes (diPretoro, 2011, p. 2). The strategy used by this NGO was a pre-paid debit card called 'RED card' (*Tarjeta RED*) which was used to purchase construction materials and tools. The card had a value of approximately 376 USD (245 GBP in 2010), a limited period of validity, and it could be only used for buying from 40 pre-designated hardware stores located in the affected regions (diPretoro, 2011, p. 2). A recurrent issue in providing this type of support was the need for appropriate technical assistance in purchasing materials and using them to repair houses, and for residents to receive appropriate guidelines for making disaster-resistant houses (diPretoro, 2011, p. 6).

During the reconstruction phase, the Ministry of Housing and Urbanism (*Ministerio de Vivienda y Urbanismo*, MINVU) started a programme called 'Chile Together Builds Better' (*Chile Unido Reconstruye Mejor)* to provide permanent housing (MINVU, n.d.). The target was to provide 220,000 subsidies for repairing, building and buying houses (MINVU, n.d.).

**Fig. 62.** Expanded polystyrene (*plumavit)* used for insulation.

**Fig. 63.** High density polyethylene (*geomembrana de polietileno)* used for waterproofing.

The beneficiaries needed to fulfil the following criteria (MINVU, 2011b, p. 3):

- To be older than 18 years of age.
- To be in the list of those affected by the disaster.
- To get a certificate from the municipality explaining that the house was uninhabitable or damaged.
- Not to have another property.
- Not to be in receipt of any other subsidy by the government.
- To have land tenure in case of applying for building on-site.
- To obtain a record of social protection called *'ficha de protección social'*.

Depending on the type of damage that had been caused to the previous house, the options were to repair, to build a new house, or to buy a new house (MINVU, 2011b, p. 3). The grants provided by the government used a unit of account called *Unidad de Fomento* (UF) which is adjusted on a daily basis according to inflation in Chile and used for loans and investments, especially real estate items. At the end of April 2010, one UF was the equivalent of 21,031.50 CLP (Chilean Pesos), around 30 USD or 20 GBP (SII, 2010). The grant provided for repairs was between 50 and 65 UF (1,470 and 1,910 USD/ 965 and 1,254 GBP). The programme for the families that were unable to repair, meanwhile, was divided in two: 'Solidarity Fund for Housing' for vulnerable families (*Fondo Solidario de Vivienda*), and 'Housing Subsidy Supreme Decree N° 40' for middle-class families (*Subsidio Habitacional Decreto Supremo (D.S.) N° 40*) (MINVU, 2011b, pp. 14–15)

The 'Solidarity Fund for Housing' provided grants for building new houses called 'Subsidies for the Construction of Houses' (*Subsidios para Construcción de Viviendas*), as well as grants for buying new or used houses called 'Subsidies for Buying Houses' (*Subsidios para Compra de Viviendas*). The government created a set of guidelines explaining how to apply for each subsidy, called 'Housing Reconstruction Programme: Guide to Alternative Solutions and Steps to Follow to Get a Housing Subsidy' (*Programa de Reconstrucción de Vivienda. Guía de Alternativas de Solución y Pasos a Seguir para Obtener un Subsidio Habitacional*) (MINVU, 2011b, p. 18). Table 21 shows the alternatives available for families to apply. The minimum area of the new house should be 45 $m^2$, including a main bedroom, a living-dining room, a kitchen and a toilet, with the possibility that extensions could be approved by the local authorities (MINVU, 2011b, pp. 20, 24). The construction, should be done by builders approved by the government, and the house could be an individual design or one of the options provided by the government (MINVU, 2011b, pp. 21, 23).

**Table 21**. Alternatives for permanent housing provided by the government of Chile.

Source: Based on MINVU, 2011b.

| Target group | Grant- subsidy | Type | Amount |
|---|---|---|---|
| **Vulnerable families** | Solidarity Fund for Housing (*Fondo Solidario de Vivienda*) | Subsidies for the Construction of Houses (*Subsidios para Construcción de Viviendas*) | 9,720 to 14,135 USD (330 to 480 UF) |
| | | Subsidies for Buying Houses approved by the Ministry of Housing and Urbanism (MINVU). (*Subsidios para Compra de Viviendas*) | The cost of the house from 22,080 to 27,970 USD (750 to 950 UF) and the grant can vary from 8,540 to 12,660 USD (290 to 430 UF) |
| **Middle-class families** | Housing Subsidy Supreme Decree N° 40 (*Subsidio Habitacional Decreto Supremo D.S. N° 40*) | A grant to support families to access to bank loans (maximum size 140 m$^2$) | The cost of the house from 41,300 to 47,200 USD(1400 to 1600 UF) and the subsidy from 2,950 to 10,325 USD (100 to 350 UF) |
| **Both Vulnerable families and Middle-class families** | Grant to Repair | Programme Protection of Family Assets (*Programa Protección Patrimonio Familiar*) | 1,470 and 1,910 USD (50 and 65 UF) |
| | On top of the Solidarity Fund or *D.S. N° 40* | Historic Preservation Zone (*Zona de Conservación Histórica o Típica o Pintoresca*) | 5,900 USD (200 UF) |
| | | Subsidy to Location (*Subsidio a la Localización*) | 2,950 or 5,900 USD (100 or 200 UF) |
| | | New house built with safe protection in a tsunami-risk area | Another 4,420 USD approx. (150 UF) |

**Fig. 64.** Permanent housing provided by the government of Chile to those affected in Bío-Bío region, with the temporary house disassembled next to it.

During fieldwork, families mentioned that they were applying to the 'Subsidies for Buying Houses' of the 'Solidarity Fund for Housing' for projects approved by the Ministry of Housing and Urbanism (MINVU). Some of these projects were under construction at that time and many families that had previously been living in the *aldeas* had recently moved to their permanent houses (Figure 64).

## 6.2 *Aldeas* visited

The *aldeas* visited in December 2012 were selected in order to understand a variety of situations from settlements of different scale (Figure 65). Displaced families from temporary settlements were selected because the temporary houses were clearly identifiable in the *aldeas*, instead of studying houses spread across urban or rural settings. Further, the analysis of displaced families in

Chile opened up the possibility of understanding the modification of houses in a different situation to that of the non-displaced families in Peru, and therefore to support broader conclusions. The *aldeas* visited in the Bío-Bío region were in the towns of Dichato and Coronel. Temporary houses were provided by the government in both settlements. In the region of Maule the *aldeas* visited were located in the towns of Pelluhue and Curanipe. In these *aldeas*, temporary houses were provided by TECHO. In the *aldeas* studied, the government provided a community hall, shared toilets, and a laundry area, as well as constructing fences to protect the settlement. The toilets and community halls were built with help from the Armed Forces and NGOs.

One of the most devastated towns, Dichato, was reported to have seen more than 80% of built-up areas destroyed by the tsunami (Maruyama et al., 2011, p. 105). Dichato is a medium-size coastal town in which 1,223 families were affected by the tsunami and earthquake, and it had 405 families living in temporary settlements in 2010 (JST-JICA SATREPS Peru Project, 2010, p. 20). *Aldea 'El Molino'* was the biggest temporary settlement built after the earthquake, with 519 housing units. The settlement was divided into six sectors, and the area visited was situated in sector 4. The division by sectors was defined according to the main roads, and groups of houses were organised in a linear configuration with rows of houses facing secondary roads on the one side, and the backs of other houses on the other side, following Model 2 of the 'Basic Guidelines for Emergency Settlements' provided by the government (MINVU, 2010, p. 17). The settlement was surrounded by a forest, located in the peri-central area of Dichato, and connected to it through the main road. Due to the size of the settlement and the process of construction by sectors, the configurations did not follow the same pattern, and no fence existed to define the boundaries of the *aldea* (Fernández Ramírez, 2013, p. 188). Realising that the quality of the houses provided in the first stages of disaster response had been low, the local government intervened and provided an improved version of *mediaguas*. This new version had windows made of aluminium frames, better quality of timber, and had insulation (Fernández Ramírez, 2013, p. 124).

The port of Coronel was heavily damaged, mainly by strong shaking and liquefaction-induced lateral spreading (EERI, 2010, p. 15). In this context, cases of families displaced due to the destruction of their houses by the earthquake were studied. Cases selected for analysis were located in the *aldea 'Camilo Olavarria 3'*, which comprised 15 families, and the aldea *'Merquín'*, which was occupied by 37 families (MINVU, n.d.). *Camilo Olavarría* was small, surrounded by a fence, with a sanitary module built in a reused container, including showers, toilets and laundry area, and a community building. Due to the limited size of the available land, the houses were built close together, with a linear configuration on one side of the settlement. Front façades of the houses of one row faced the rear façades of the houses in the following row, a combination of Model 1 and 2 of the 'Basic Guidelines for Emergency Settlements'. *Aldea Merquín*, meanwhile, was situated on a hill in front of a primary school, and delimited by a fence. This *aldea* had a communal space and a sanitary module in the middle of the settlement. Since this site had an irregular shape, the houses were built on the perimeter, side to side, facing a central space that had some houses built in rows. The configuration is an adapted version of Model 4 provided by the government's guidelines (MINVU, 2010, p. 19).

Pelluhue and Curanipe, in the region of Maule, are two neighbouring coastal resorts situated in the *'comuna'* of Pelluhue. *Comuna* is an administrative division that can include more than one city and which is administered by a municipality. Both cities, whose main economic activities are tourism and fishing, were affected by the earthquake and many buildings and much infrastructure within them were destroyed by the tsunami, especially in the lower areas. Approximately 90% of these cities' built area was flooded during the tsunami, and around 1,770 houses were destroyed (Romero Aravena et al., 2010, p. 142). In the town of Curanipe the temporary settlement was formed by 20 houses (MINVU, 2011c). This *aldea* was built on land available on higher ground next to the town cemetery. The settlement had a shared sanitary unit, a playground and a communal greenhouse. Although the settlement had shared toilet units, the NGO Oxfam provided individual toilets and laundry facilities to families with small children (Interviews with families in Curanipe, 2012). The group of houses were organised following Model 1 of the government guidelines, in a linear configuration with front façades facing each other (MINVU, 2010, p. 17). The aldea built in the town of Pelluhue had 19 temporary housing units (MINVU, 2011c). It was situated next to the main road and in front of a new urban development under construction by the government. The morphology of the temporary settlement was mixed, with one row of houses built side by side, following Model 2 of the 'Basic Guidelines for Emergency Settlements', and with houses built with front facades facing the backs of the other houses, following Model 1. Although the *aldea* in Pelluhue had shared toilets and laundry area, some families also had individual sanitary units outside their houses.

From the *aldeas* visited, twelve illustrative cases were selected for conducting analysis and comparisons. The cases selected were those showing different types of growth and transformation. The houses were drawn at the same scale as their evolution, and the same questions asked in Peru were put to the families living in *aldeas* in Chile, in order to gather comparable information.

## 6.3 Houses modified: comparison

Each selected case was described and analysed separately, through an explanation of the modifications made to the specific temporary house, alongside drawings and pictures. Detailed information of each case is included in Appendices. Similar to the cases from Peru analysed in the previous chapter, each temporary house and extensions built on the same plot were defined as a single housing unit, and the household was defined as all the people living in one housing unit. Individual cases were studied and compared using the same three categories as those used for the cases in Peru: socio-cultural aspects, physical aspects and architecture, and economic aspects. Also, this chapter includes a visual description of the changes, comprising the socio-cultural and economic aspects, that took place in the cases studied (Figure 66).

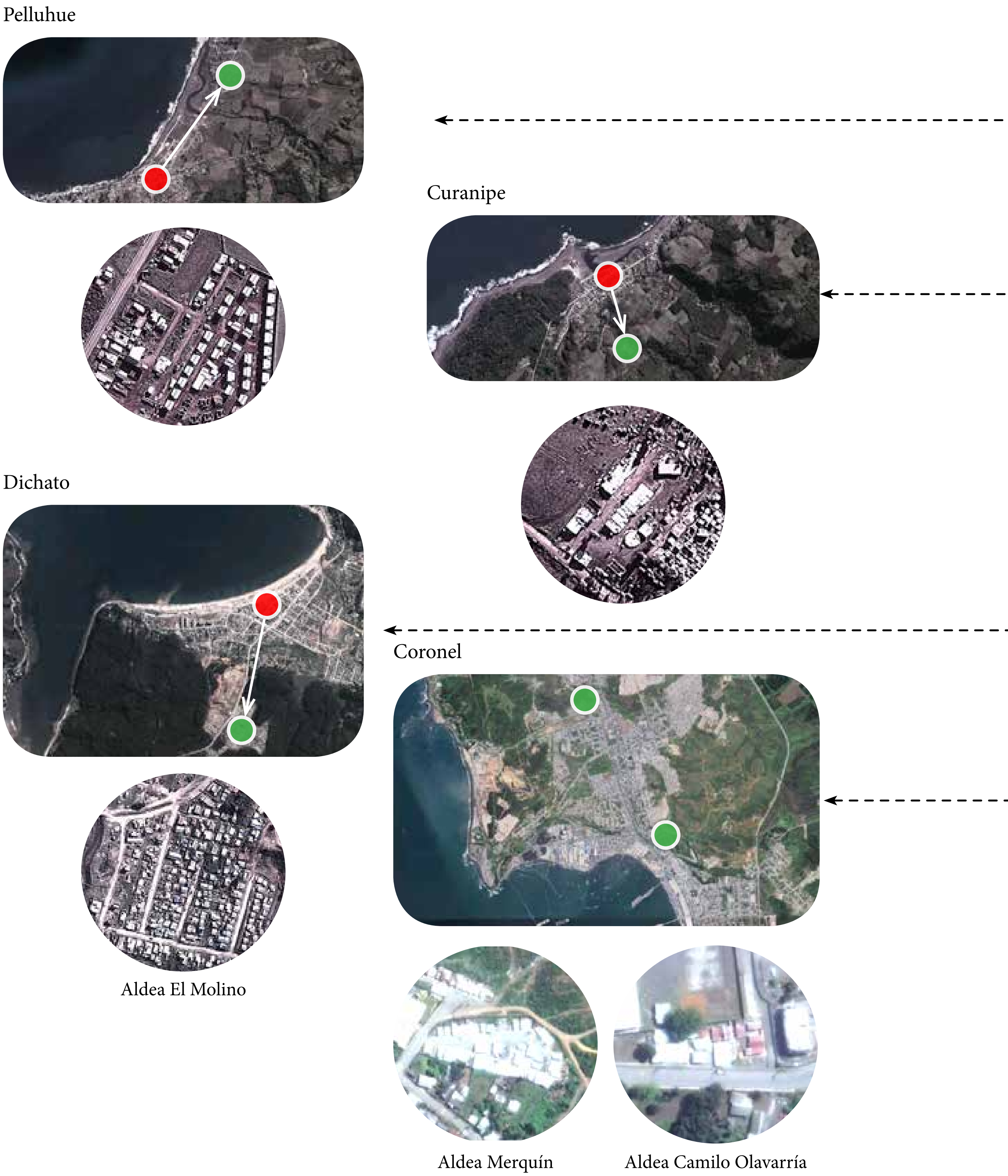



**Fig. 65.** *Aldeas* visited in Chile. Displaced families in Pelluhue and Curanipe in Maule region, and Dichato and Coronel in Bío-Bío region. Source: Google maps.


CHILE
MAULE REGION
BÍO-BÍO REGION
Maule
Bío-Bío
San Felix and San Ambrosio
Sala y Gomez
Easter Island
J. Fernandez archipelago
Oceanic Islands and Chilean Antartic Territory
Diego Ramirez
Chilean Antartic Territory
90
53

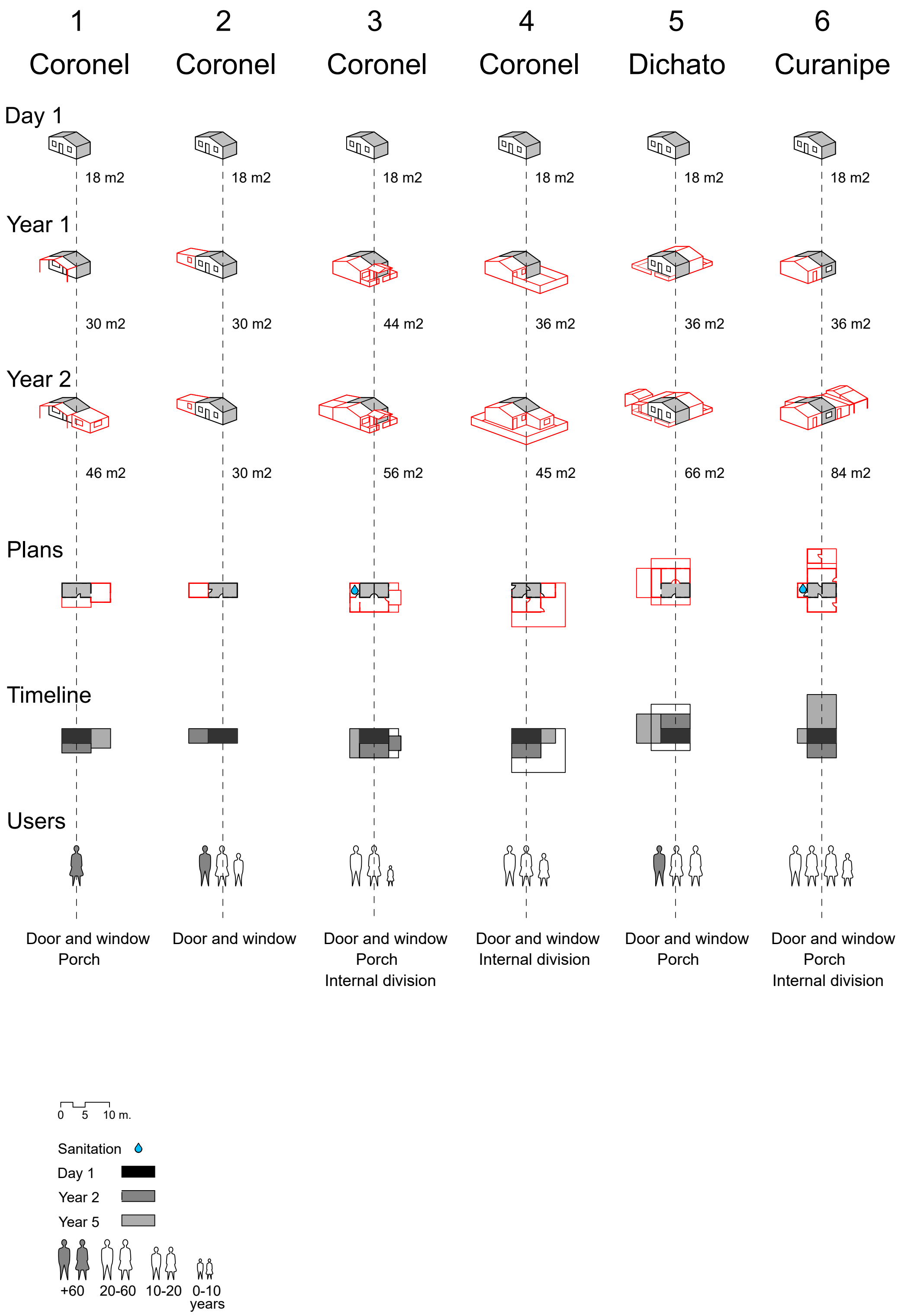
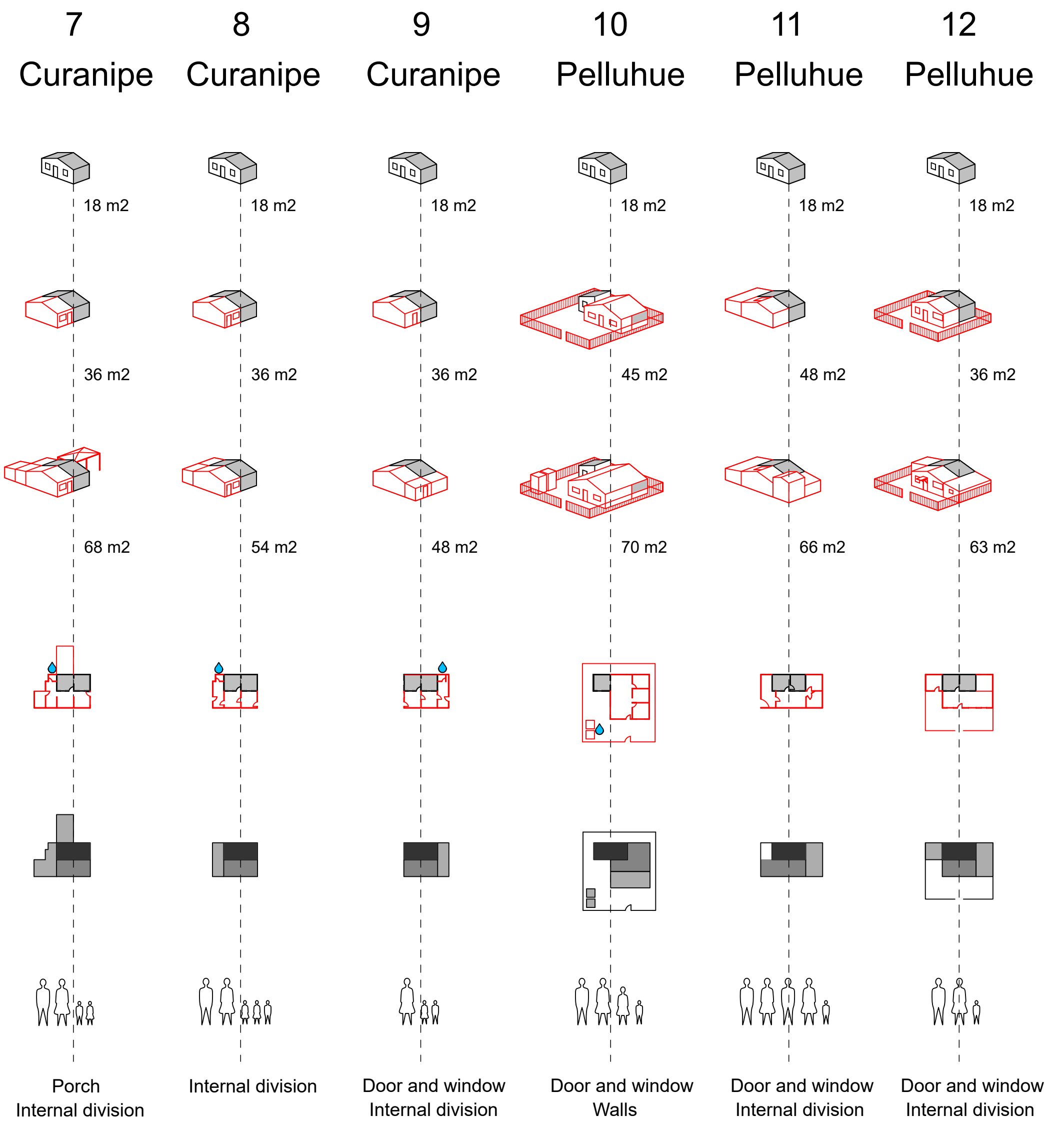



**Fig. 66**. Comparison of the process of adaptation of cases studied in Chile in 2012.


7
Curanipe
18 m2
36 m2
68 m2
Porch
Internal division
8
Curanipe
18 m2
36 m2
54 m2
Internal division
9
Curanipe
18 m2
36 m2
48 m2
Door and window
Internal division
10
Pelluhue
18 m2
45 m2
70 m2
Door and window
Walls
11
Pelluhue
18 m2
48 m2
66 m2
Door and window
Internal division
12
Pelluhue
18 m2
36 m2
63 m2
Door and window
Internal division

### 6.3.1 Socio-cultural aspects

In Chile, the average number of people per household in 2002 was 3.5 (INE, 2003a, p. 44). The census of 2002 shows that 57% of the households in Chile are formed by single families including those with a single parent and their child(ren) and 21.9% are formed by extended family households (INE, 2008, p. 35). The census shows very similar numbers for the Maule and Bío-Bío regions, with households of 3 and 4 members constituting around 47% of these areas' population (INE, 2003b, p. 126). In the cases analysed, the number of people per household varies from one to five, comprising a single person, single family nucleus, a single parent with child(ren), and extended households. The most frequent household composition in the studied cases is three members consisting of a married couple with a child (Table 22).

In terms of size, it was expected to find larger extensions to correlate to the more numerously populated households, but no straightforward links were encountered between these factors. The biggest houses were occupied by households of four, with the largest having an area of 84 $m^2$. Nevertheless, it was observed that despite house size, when families have older children they typically add another room to their house or divide the pre-existing space in order to create more privacy, such as in cases 5, 6 and 11. This need for privacy was also witnessed in the Peruvian cases and across many other cultures (Tipple, 1999, pp. 22–23; Tipple and Ameen, 1999, p. 90). Another trend was that households tended to extend as much as possible when they had available resources, bigger plots or areas next to the house into which to expand. Some limitations for the families to extend further could be explained by the climate of the region; houses required waterproofing and insulation, in particular in the bedrooms. This meant that the cost of extending the houses might have been higher, including quality materials and extra layers. Therefore, it may be assumed that extensions were typically built with the objective to achieve a minimum level of comfort, instead of size.

**Table 22**. Socio-cultural aspects of the cases studied in Chile.

| Case No. | Household composition | Persons per house | Ages | Bed-rooms total | Bedrooms per person | Total area ($m^2$) | Area per person ($m^2$) |
|---|---|---|---|---|---|---|---|
| **Case 1 Coronel** | Single person | 1 | 72 | 1 | 1 | 46 | 46 |
| **Case 2 Coronel** | Married-couple (grandparents) plus child (grandson) | 3 | 16, 45,72 | 1 | 0.3 | 30 | 10 |
| **Case 3 Coronel** | Nuclear household: Married-couple family with child | 3 | 5 25,31 | 2 | 0.7 | 56 | 18.7 |
| **Case 4 Coronel** | Nuclear household: Married-couple family with child | 3 | 20 51,51 | 2 | 0.7 | 45 | 15 |
| **Case 5 Dichato** | Nuclear household: Married-couple family with child | 3 | 21 50,63 | 2 | 0.7 | 66 | 22 |
| **Case 6 Curanipe** | Nuclear household: Married-couple family with children | 4 | 17, 22 49, 51 | 3 | 0.75 | 84 | 21 |
| **Case 7 Curanipe** | Nuclear household: Married-couple family with children | 4 | 4,9 40,41 | 2 | 0.5 | 68 | 17 |
| **Case 8 Curanipe** | Nuclear household: Married-couple family with children | 5 | 2,4,8 33,35 | 2 | 0.4 | 54 | 10.8 |
| **Case 9 Curanipe** | Nuclear household: Mother with children | 3 | 0.5,10 31 | 2 | 0.7 | 48 | 16 |
| **Case 10 Pelluhue** | Nuclear household: Married-couple family with children | 4 | 6,13 36,46 | 3 | 0.75 | 70 | 17.5 |
| **Case 11 Pelluhue** | Extended household: Father with children plus married-couple with child | 5 | 2, 21,21 25 51 | 3 | 0.6 | 66 | 13.2 |
| **Case 12 Pelluhue** | Nuclear household: Married-couple family with child | 3 | 3 32,34 | 2 | 0.7 | 63 | 21.0 |

***Uses and services***

The temporary house was used by families in different ways, either as a bedroom, living room, kitchen or even as a workshop. However, it was used as a bedroom in most cases. Although families added other uses to the houses, such as a corner shop (case 4) or a workshop for fishing-related activities (case 6), most of the new uses were located in the extensions and not inside the original temporary house. One of the reasons for this could be that the insulation and waterproofing kits were provided to fit the temporary houses only rather than the extensions; therefore, in some cases, the temporary house was of better quality than the extensions made by families, which were not suitable to serve as bedrooms.

Due to the layout of the settlements, some houses did not have an intermediate space between public and private areas. This could also be explained by the climate of the area, where most time is spent inside the houses during winter. When porches were built, they were made for the purpose of creating a buffer between the house and the roads, or as a place to hang wet clothes and boots when it was rainy and muddy outside (Figure 67). Also, in some cases these porches were ornamented with plants, and with coloured fences, giving the house a more ‘permanent feeling’.

The government provided access to water, electricity and sanitation to all the formal *aldeas* built after the earthquake. Therefore, in all cases studied households had access to communal toilets and showers. Nevertheless, some organisations, such as Oxfam, provided individual toilets and showers to families with small children, as well as an individual laundry area. These toilets were incorporated into houses as extensions, such that inhabitants had access to them from inside their house (Figure 68). In one case, a family was donated two individual toilet modules, which were installed outside the house (case 10).

An important space in the houses in southern Chile is the kitchen. It is used as a space to cook, to gather socially, and to keep the house warm during winter. Due to the cold climate of the region, kitchens were not seen outside of the house, and in most cases they were incorporated into the temporary house as an extension.

**Fig. 67.** Front porch added to a temporary house in Chile. Case 3, Coronel.

**Fig. 68.** Toilet added as an extension to a temporary house in Chile. Case 7, Curanipe.

**Fig. 69.** Livelihoods. Extension for other uses: fishing gear and equipment. Case 6, Curanipe.

Many of the adults in displaced households in Dichato, Curanipe and Pelluhue made an income as fishermen, and their houses were located near the coast, providing space for their boats, fishing gear and equipment. The tsunami was especially destructive for the small-scale fisheries sector, affecting between 50% and 60% of the fishing capacity within the tsunami-affected area (Marín et al., 2010, pp. 1381–1382). Many of these households lost both their houses and their boats, thus also losing their livelihoods. Some family members in this situation started new jobs, but others continued to work in the fisheries sector, either because it was the family tradition or the only activity they felt comfortable doing (Interview with Families in Bío-Bío and Maule Regions, 2012). Therefore, in some cases, the extensions made to temporary houses incorporated areas for fishing nets and other tools (Figure 69). In other cases, the house or the extension itself was used as a workplace, such as a corner shop and a sewing workshop (Case 1).

**Table 23.** Socio-cultural aspects. Uses and services of cases in Chile.

| Case No. | Area ($m^2$) | Functions of the temporary house | Kitchen | Toilets |
|---|---|---|---|---|
| **Case 1 Coronel** | 46 | Kitchen, living and dining room | Inside temporary house | Yes, communal |
| **Case 2 Coronel** | 30 | Living, dining room and bedroom | Outside temporary house in covered extension | Yes, communal |
| **Case 3 Coronel** | 56 | Bedroom | Outside temporary house in covered extension | Yes, communal and private |
| **Case 4 Coronel** | 45 | Dining room and bedroom | Outside temporary house in covered extension | Yes, communal |
| **Case 5 Dichato** | 66 | Living and dining room | Outside temporary house in covered extension | Yes, communal |
| **Case 6 Curanipe** | 84 | Bedroom | Outside temporary house in covered extension | Yes, communal and private |
| **Case 7 Curanipe** | 68 | Bedroom | Outside temporary house in covered extension | Yes, communal and private |
| **Case 8 Curanipe** | 54 | Bedroom | Outside temporary house in covered extension | Yes, communal and private |
| **Case 9 Curanipe** | 48 | Bedroom | Outside temporary house in covered extension | Yes, communal and private |
| **Case 10 Pelluhue** | 70 | Bedroom, laundry, workshop | Outside temporary house in covered extension | Yes, communal and private (outside house) |
| **Case 11 Pelluhue** | 66 | Bedroom, kitchen | Inside temporary house | Yes, communal |
| **Case 12 Pelluhue** | 63 | Bedroom | Outside temporary house in covered extension | Yes, communal |

### 6.3.2 Physical features and architecture

***Process***

The process of modification has been demonstrated to be continuous and incremental in the case of displaced families. These families modified their houses progressively, despite knowing that their houses were temporary and that they would be expelled from the *aldeas* in the near future. Although households in all cases modified their temporary house during the second stage, they did so at different levels (Table 24). Only one family made changes during the second stage and no changes during the third stage (case 2), confirming that most families considered it crucial to extend the area and improve the quality of the temporary house. During the third stage none of the households studied modified their temporary house directly, focusing instead on extensions. The cases show that when families had space to grow, they made the house as big as they could with the resources available and with the best quality they could achieve. Examples of this approach can be seen in cases 4 and 6, which were expanded further once adjacent houses were removed.

Discussing their future plans, all interviewees expressed an interest in using the materials of the temporary house to make extensions to permanent houses. The exceptions to these plans were some cases in Coronel, in which the solutions provided by the government were apartments in building blocks and, therefore, it was not possible to add temporary houses to permanent ones (legally, at least). In those cases, the resources spent by the government and the families in the materials and improvement of the temporary house were inefficiently used (Figure 70).

In Dichato, because the local government provided a slightly improved model in the area studied, with longer eaves and different cladding, the houses did not employ the '*geomembrana*' in the exterior walls (Figure 71).

**Fig. 70.** Building block built by the government of Chile for families affected next to the temporary settlement. No option to add the temporary house to the flats.

**Fig. 71.** Slightly improved model of the temporary house, with longer eaves and different cladding.

**Table 24.** Physical features. Process of modification of cases in Chile. The text in red/italics are changes carried out directly to the temporary house.

| Case No. | Area (m²) | Changes Stage 2 (Year 1) | Changes Stage 3 (Year 2) | Materials Stage 2 (Year 1) | Materials Stage 3 (Year 2) |
|---|---|---|---|---|---|
| **Case 1 Coronel** | 46 | *New windows*<br>*New door*<br>*Insulation layer*<br>*Waterproof layer*<br>Front extension | Side extension (bedroom, sewing workshop) | Plumavit<br>Internit<br>Geomembrana<br>Corrugated iron<br>Timber | Corrugated iron<br>Timber<br>Internit<br>Paint |
| **Case 2 Coronel** | 30 | *Roof extension*<br>*Insulation layer*<br>*Waterproof layer*<br>Side extension (kitchen and storage) | - | Plumavit<br>Duraloc<br>Geomembrana<br>OSB panels<br>Corrugated iron<br>Paint | - |
| **Case 3 Coronel** | 56 | *Insulation layer*<br>*Waterproof layer*<br>*New windows*<br>*New door*<br>*Internal division*<br>Front porch<br>Side extension (kitchen, living and dining room)<br>Fence | *Internal layer*<br>Back extension (kitchen and toilet) | Plumavit<br>Aislapol<br>Geomembrana<br>Timber<br>Corrugated iron<br>Iron fence<br>Paint | Timber<br>Cholguan<br>Corrugated Iron<br>Vinyl (loose lay flooring)<br>Paint |
| **Case 4 Coronel** | 45 | *New windows*<br>*New door*<br>*Insulation layer*<br>*Waterproof layer*<br>*Roof extension*<br>Side extension (kitchen and corner shop) | Back extension (bedroom and kitchen) | Plumavit<br>Internit<br>Geomembrana<br>OSB panels<br>Corrugated iron<br>paint | OSB panels<br>Corrugated iron |
| **Case 5 Dichato** | 66 | *New windows*<br>*New door*<br>*Insulation layer*<br>*Roof extension*<br>Back extension (bedroom)<br>Front garden | Side extension (kitchen and garage) | Timber<br>Plumavit<br>Cholguan<br>Paint | Timber<br>Cholguan<br>Corrugated iron<br>Vinyl |
| **Case 6 Curanipe** | 84 | *New window*<br>*New door*<br>*Insulation layer*<br>*Waterproof layer*<br>Side extension (bedroom) | Side extension (kitchen, dining room, parking)<br>Back extension (toilet) | Plumavit<br>Geomembrana<br>Cholguan<br>Timber panels<br>Corrugated iron | Cholguan<br>Timber panels<br>Corrugated iron |

| | | | | | |
|---|---|---|---|---|---|
| **Case 7**<br>**Curanipe** | 68 | *Insulation layer*<br>*Waterproof layer*<br>*Internal division*<br>Side extension (kitchen and dining room) | Back extension (toilet and laundry)<br>Side extension (parking) | Plumavit<br>Geomembrana<br>MDF panels<br>Timber logs<br>Corrugated iron | MDF panels<br>Corrugated iron<br>Iron<br>Plastic sheeting |
| **Case 8**<br>**Curanipe** | 54 | *Insulation layer*<br>*Waterproof layer*<br>*Internal division*<br>Side extension (kitchen, dining and living room) | Back extension (toilet and laundry) | Plumavit<br>Geomembrana<br>OSB panels<br>MDF panels<br>Timber panels<br>Corrugated iron | MDF panels<br>Timber panels<br>Corrugated iron |
| **Case 9**<br>**Curanipe** | 48 | *Insulation layer*<br>*Waterproof layer*<br>*Internal division*<br>Side extension (kitchen, dining and living room) | Back extension (toilet and laundry) | Plumavit<br>Geomembrana<br>OSB panels<br>MDF panels<br>Corrugated iron | MDF panels<br>Corrugated iron<br>Geomembrana |
| **Case 10**<br>**Pelluhue** | 70 | *Insulation layer*<br>*Waterproof layer*<br>*Floor and wall panels removed (used for extension)*<br>*New window*<br>Front extension (kitchen, dining and living room)<br>Fence | Front extension (bedroom and living room)<br>Exterior addition (toilets) | Plumavit<br>Geomembrana<br>MDF panels<br>Timber panels<br>Corrugated iron<br>Timber fence | MDF panels<br>Timber<br>Timber panels<br>Corrugated iron |
| **Case 11**<br>**Pelluhue** | 66 | *Insulation layer*<br>*Waterproof layer*<br>*Internal division*<br>Front extension (kitchen and dining room)<br>Side extension (laundry) | Back extension (bedrooms) | Plumavit<br>Geomembrana<br>MDF panels<br>Timber panels<br>Corrugated iron<br>Timber fence | Cholguan<br>MDF panels<br>Timber<br>Corrugated iron<br>Plastic sheeting |
| **Case 12**<br>**Pelluhue** | 63 | *Insulation layer*<br>*Waterproof layer*<br>*Internal division*<br>Front extension (living room, kitchen)<br>Fence | Back extensions (laundry and storage) | Plumavit<br>Geomembrana<br>Timber panels<br>Corrugated iron<br>Timber fence | Timber panels<br>Corrugated iron |

***Type of change (elements)***

The temporary house was used mainly as a core house and the extensions were made surrounding it. No elements were discarded while families were living in their temporary house, and only one family disassembled the house and used parts of it in the extension (case 10). Most families used new or recycled materials to cover the interior walls of the house, either to add insulation or for aesthetic reasons. Some modifications were related to cultural values, such as the creation of fences to form a boundary between public and private spaces.

a) **Elements removed from the temporary house**

**Discarded**

- Window frames and doors. In most cases the original windows and doors were changed.

**Used as extension (Figure 72)**

- Wall panels: in interior, exterior walls, ceiling and floor.

a) **Elements added to the temporary house**

**Interior (Figure 73)**

- Timber, OSB or MDF panels for internal division.
- Furniture for internal division.
- New doors.
- New windows.
- Paint.
- Insulation.

**Exterior (Figure 74)**

- Porch or extended entrance to the house.
- Fence to delimit the plot of the house from the public areas.
- Extension (side, front or back): with timber or metal structure, OSB and MDF panels, corrugated iron, plastic sheets.
- Paint.
- Waterproof layers (*geomembrana*)

**Fig. 72.** Wall panels used for extension: flooring. Case 10.

**Fig. 73.** OSB panels and new doors used for internal division in the temporary house. Case 8.

**Fig. 74**. External extension to the temporary house. Case 6.

### ***Level of transformation***

The level of modifications made to temporary houses differed from case to case, depending on the available resources for making the changes, the vacant space to make extensions, and the interest of the families to make their houses look more aesthetically appealing.

Employing the same grading to that used for Peru, the levels of transformation observed from modified temporary houses can be divided into:

- **Level 0:** No changes to the house.
- **Level 1:** Slight adjustments, such as adding a layer of paint or making internal subdivisions with fabric curtains.
- **Level 2:** Mild modifications, such as opening doors and windows in the existing panels or roof.
- **Level 3:** Large modifications, such as removing one or two panels.
- **Level 4:** Extensive modifications, such as removing three or more panels and the roof.
- **Level 5:** Complete modification, such as disassembling the whole house and using their parts in a completely different way.

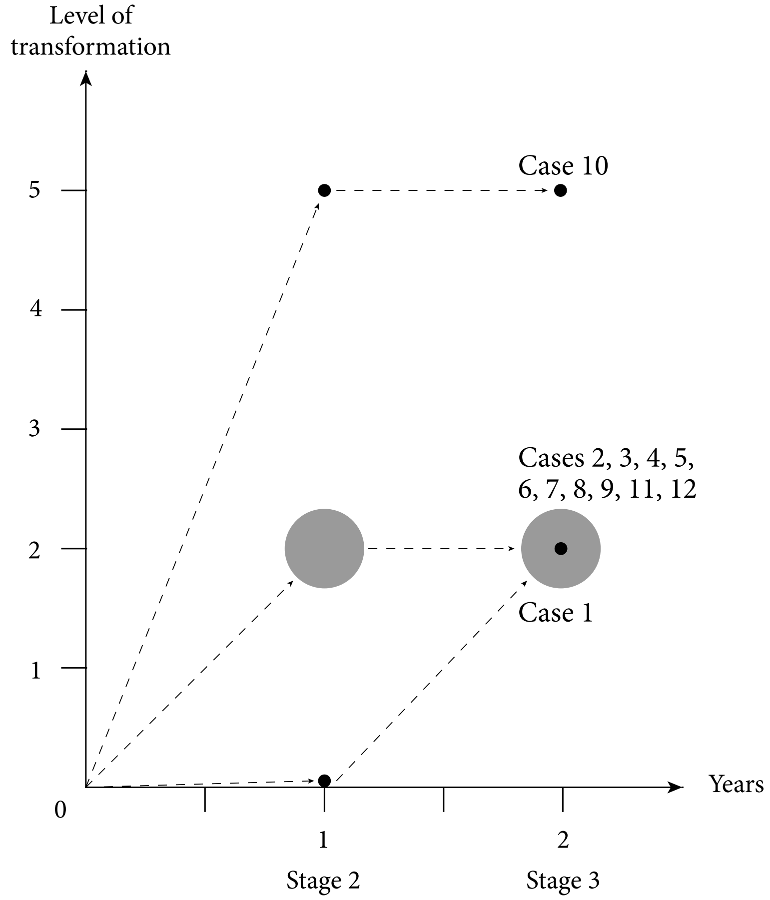



**Fig. 75.** Physical features. Level of transformation of cases in Chile. The graph shows the level of changes in Stage 2 (year 1) and in Stage 3 (year 2).

Figure 75 shows the level of modifications. All changes made to houses were mild, most of them new windows and doors to connect the new spaces with the house, with the exception of case 10, in which part of the temporary house was disassembled and used as an extension. The opening of new windows and doors on the walls weakened the structure of the house, which was based on load-bearing panels. Hence, as also suggested in the previous chapter, a different structure type might better facilitate openings such as these without weakening the structure.

As the figure shows, most families did not modify after the second stage, but all modified the house during the first year. This can be explained by media pressure, as well as the discontent of families and local governments with the quality of the temporary house given to them. The result of this pressure was that either the government or humanitarian organisations contributed to the improvement of the houses soon after the disaster, and soon after the initial delivery of the temporary house. Therefore, most improvements to the house took place during the first months, and families made their own extensions later, depending on the resources and land available.

### ***Materials***

Organisations such as *Hogar de Cristo* and Save the Children supported the improvement of the quality of the houses by providing materials for insulation. Materials for extending and improving the *mediagua* were also donated to households by *Programa Puente* (timber and timber panels), the municipal government of Pelluhue (timber) and *Hogar de Cristo* (timber panels) (Interview with Families in Bío-Bío and Maule Regions, 2012).

The materials used to improve the temporary house in the cases studied are:

- *Plumavit.* Expanded polystyrene, provided by some NGOs.
- *Geomembrana de polietileno.* High density polyethylene, provided by the government.
- *Fieltro* (felt). A fibre textile used in walls and ceilings for insulation, and which comes in rolls.
- *Internit.* A fibrous cement board used mainly for dividing interiors.
- *Cholguán*. A thin hardboard panel made with Radiata Pine fibres. It is manufactured using natural wood resins, and it is strong and flexible (Arauco, n.d.).
- OSB (Oriented Strand Board) panels. Also known as smartply, these are engineered wood particle boards manufactured using a synthetic resin and compressing layers of woodstrands. These boards have good load-bearing properties and cross dimensional stability (OSB, n.d.).
- Panels made of MDF (Medium-density Fibreboard). This is an engineered wood product made of wood fibres, a composite (Composite Panel Association, n.d.). They were seen used in interiors.
- *Rollo de piso vinílico* (Vinyl loose lay flooring). Quick to install and it was seen used in kitchen and toilet areas.
- Corrugated galvanised iron. Used in roofs and for protecting exterior walls from the rain.

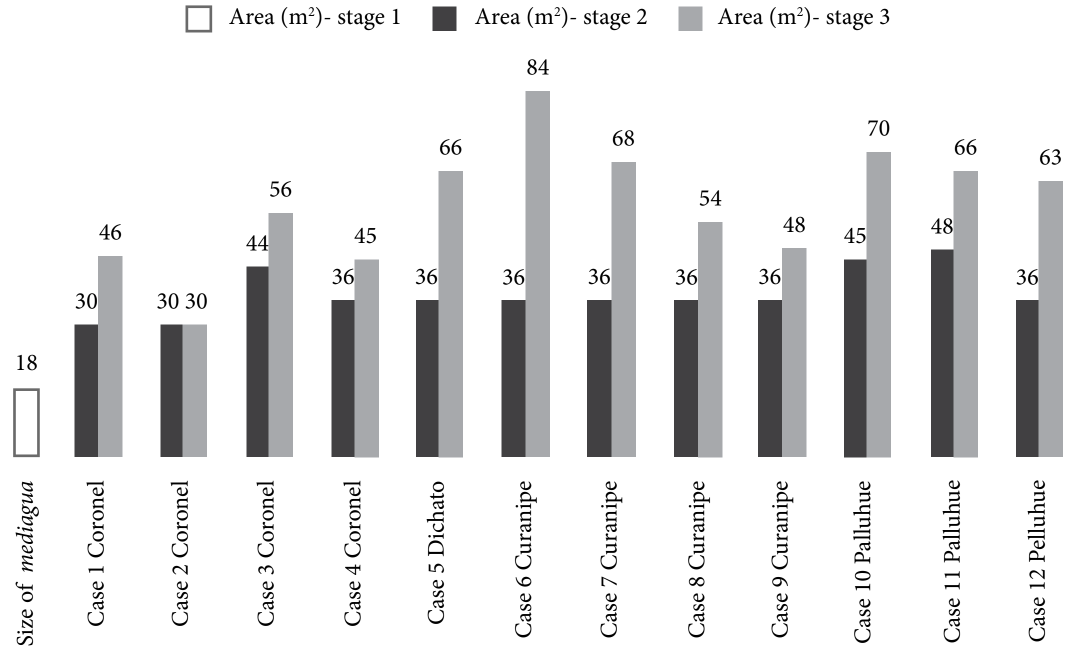



**Fig. 76.** Physical features. Areas of extended houses in cases studied in Chile.

***Dimensions***

The TECHO temporary house provided the same usable area to all families, regardless of the size of the household, the ages of family members, or the size of the temporary land. As the comparison shows (Figure 76), all cases were extended incrementally, although with different types of extension. Most households studied made changes during the second and the third stages, with the exception of Case 2 which retained the same footprint during Stage 3. The measurements of the area of each house were taken considering all covered spaces, and a visual description of the modifications can be seen in the comparison presented earlier in this chapter.

During the second stage, most of the houses doubled their usable space (from 18 $m^2$ to 36 $m^2$), using the remaining space between houses provided by the configuration of the settlement. Later, during the third stage, most houses continued to add extensions to the temporary house. The biggest house studied reached 84 $m^2$ for a household of four members (Case 6), and an average area of 60 $m^2$ for households of three members.

***Configuration of the extensions***

Figure 77 shows different patterns of growth among the Chilean cases studied here. The extensions are linked to available land and the configuration of the settlements instead of other factors, such as strong winds or solar gain. The houses in settlements that followed Model 1 of 'Basic Guidelines for Emergency Settlements' (MINVU, 2010), with a linear configuration and front façades facing each other, tended to grow in two stages. During the first stage, extensions were made at the side of a house, following the guidelines' recommendations, and during the second stage changes were made in a more organic way, depending on the space and resources available. For the houses in settlements with Model 2 of the 'Basic Guidelines for Emergency Settlements', with the front façades of the houses facing the road in a linear configuration, the pattern of extension was not clear, although two type of configurations were seen. In one, families extended to the front or rear side of the house first, and to the sides later. The other configuration showed extensions to the sides only. This happened when the space surrounding the house did not allow growth in other directions. When families had space available, they also built front gardens, or fences around the house, repeating the type of detached house with garden seen in many parts of the country and the region.

***Architecture style-ornamental elements***

Typical domestic architecture in the regions of Maule and Bío-Bío include the use of adobe, timber, reinforced masonry and reinforced concrete. As a result, there exists a variety of housing styles in these regions. Nonetheless, timber houses are common in the coastal areas of both regions, and the material used for building *mediaguas* was, therefore, not as alien as it was in a Peruvian context. Some elements recognised as particular to the areas studied were:

- **The construction of fences around the house** (Figure 78). A common feature found in detached or semi-detached houses is the construction of boundaries between the public space (roads) and the private space (the house and the surrounding land). In the cases studied, when houses were not attached together in a linear configuration, families built wooden or metal fences to separate them. This also happened in linear configurations of attached houses, when the distance between the façade of each house and the road, including the pavement, was greater than two meters, and therefore families created a division to mark the area of the land that pertained to them.

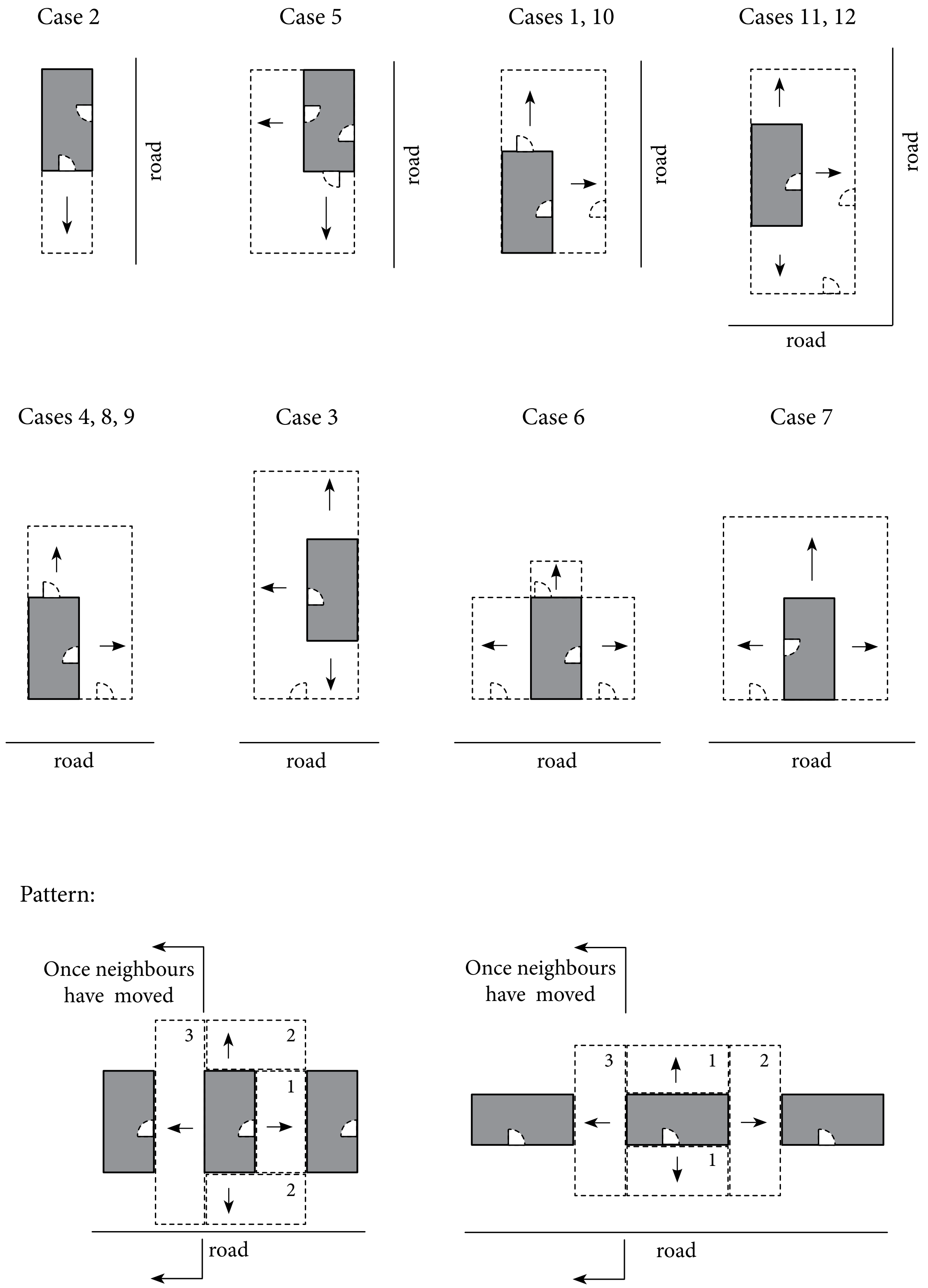



**Fig. 77.** Patterns of growth in temporary houses in Chile.

**Fig. 78.** Construction of fences around the temporary house. Pelluhue, Chile, 2012.

**Fig. 79.** New window frames with bars added to the temporary house. Coronel, Chile, 2012.

- **Modification of the windows.** In most cases new windows were opened, usually bigger than the ones provided by the TECHO temporary house model. The frames were made of timber or aluminium, and in some cases households added iron window bars for protection, especially when the house was used as a corner shop or had valuable items for the family inside. These elements were ornamented or had geometrical patterns, also providing a different aesthetic quality to the house (Figure 79).

**Fig. 80.** Temporary house modified, unrecognisable. Dichato, Chile, 2012.

**Fig. 81.** Waterproof layer provided by the government modified by families. Curanipe, Chile, 2012.

- **Addition of ornamental elements.** Families were inclined to demonstrate their individuality and taste within anonymous prefabricated temporary houses. Some houses were painted, and ornamented with plants, coloured fences, front porches and terraces, providing the temporary house a more 'permanent look', in some cases making it difficult to recognise the temporary nature of the settlement (Figure 80). Even the plastic layer (*geomembrana*) was personalised by families, in order to give the house a different look (Figure 81).

### 6.3.3 Economic aspects

***House tenancy***

In all of the cases studied here, households were applying to the 'Subsidies for the Construction of Houses' (*Subsidios para Construcción de Viviendas*) of the 'Solidarity Fund for Housing' (*Fondo Solidario de Vivienda*), which was intended to provide all of those affected with opportunities to obtain house tenancy. The houses under this programme were built by construction companies approved by the Ministry of Housing (MINVU) or the National Registry of Contractors (*Registro Nacional de Contratistas*) (MINVU, 2011b, pp. 20–21). Furthermore, the municipal government could act as Social Housing Management Entities (*Entidades de Gestión Inmobiliaria Social* - EGIS), charged with supporting and coordinating access to subsidies and the construction of houses (MINVU, 2011b, pp. 20–21).

In relation to future plans, families expressed their desire to use parts of the temporary house to improve and extend the permanent house, if possible (Table 25). Families unable to use the materials of the temporary house, meanwhile, explained that their future home would be an apartment in a building block provided by the government, each of approximately 58 $m^2$ (Interview with Aldeas y Campamentos Representative, 2012), and that they would not have the legal right to make extensions to it. On the other hand, households which applied for subsidies to build new houses described their aim to use the materials of the temporary house in the extension of the permanent house, some of which would have a footprint of only 42 $m^2$ in area (Interview with Aldeas y Campamentos Representative, 2012; Interview with Families in Bío-Bío and Maule Regions, 2012).

During fieldwork, many households that had already moved into their new houses were using the temporary house as an extension (Figure 82). Some of these families explained that in many cases neighbours rejected the use of the temporary house as an extension, due to the *mediagua*'s association with poverty and vulnerability (Interview with Families in Bío-Bío and Maule Regions, 2012). Hence, when possible, they sought to 'disguise' the materials appropriated from the temporary house, to make the reuse less evident.

**Fig. 82.** Temporary house used as an extension (back) in a permanent house provided by the government of Chile.

***Cost of the extensions (materials and handwork)***

The cost of the *mediaguas* built by TECHO in Chile was estimated at 648,000 CLP (Chilean Pesos), approximately 907 USD or 595 GBP in 2010 (Un Techo para Chile, 2010). During fieldwork families were asked to estimate the resources they used on modifications and extensions of the house. These were categorised by families in 2012 as: Cost 1 (1-500 USD/ 1-322 GBP), Cost 2 (500-1,500 USD/ 322-965 GBP), Cost 3 (1,500-2,500 USD/ 965-1,608 GBP), Cost 4 (2,500 USD/ 1,608 GBP or more). Table 25 shows the way different households used their own resources, whether they received financial or material support from other parties, and their future plans. The quality and the cost of the extensions varied dramatically from one case to another. All families spent between 1 and 500 USD except from one family that spent between 500 and 1,500 USD (case 10, area of 70 $m^2$), which made the most expensive changes, with improvements of better quality, especially insulation.

**Table 25.** Economic aspects. Cost of the extensions and source of funding.

Cost 1 (1-500 USD), Cost 2 (500-1500 USD), Cost 3 (1500-2500 USD), Cost 4 (2500 or more USD)

| Case No. | Area ($m^2$) | Cost of extens. | Source of funding | Gov. funding | Other sources (Materials) | Future plans temp. house |
|---|---|---|---|---|---|---|
| **Case 1 Coronel** | 46 | Cost 1 | Savings, family and friends | - | Municipality | No plans |
| **Case 2 Coronel** | 30 | Cost 1 | Family and friends | - | Municipality | No plans |
| **Case 3 Coronel** | 56 | Cost 1 | Savings, family and friends | Municipality | family and friends | Use parts for extension |
| **Case 4 Coronel** | 45 | Cost 1 | Savings | Municipality | - | Use parts for extension |
| **Case 5 Dichato** | 66 | Cost 1 | Savings, family and friends | - | Municipality | Whole house for extension |
| **Case 6 Curanipe** | 84 | Cost 1 | Savings | - | - | Whole house for extension |
| **Case 7 Curanipe** | 68 | Cost 1 | Savings, family and friends | - | Municipality, Oxfam, Hogar de Cristo, Mano de Mujer | Use parts for extension |
| **Case 8 Curanipe** | 54 | Cost 1 | Family and friends | - | Municipality, Oxfam, Hogar de Cristo, Programa Puente | Use parts for extension |
| **Case 9 Curanipe** | 48 | Cost 1 | Family and friends | - | Municipality, Oxfam, Hogar de Cristo, Programa Puente | Whole house for extension |
| **Case 10 Pelluhue** | 70 | Cost 2 | Savings | - | Hogar de Cristo, SUBDERE, Cense | Use parts for extension |
| **Case 11 Pelluhue** | 66 | Cost 1 | Savings, family and friends | - | Municipality, Save the Children | Use parts for extension |
| **Case 12 Pelluhue** | 63 | Cost 1 | - | - | Hogar de Cristo, SUBDERE, Cense | Use parts for extension |

### ***Source of funding for extensions and improvements***

Most families explained that they had used their own savings to make improvements, and also that they received support from relatives and friends. This shows that solidarity was an important factor in the process of recovery, and that social networks were crucial in the wake of the disaster. Despite this, the amount of resources spent on improving the house appeared small in relation to the scale of the modifications. One reason for the small amounts that households declared they had spent on making changes can be explained by the fact that most households received donations of materials, rather than cash, from a number of parties. Families affected by the 2010 disaster received materials from municipal governments and the national government (timber and insulation), from national organisations such as *Hogar de Cristo* (insulation and timber), *Mano de Mujer* (timber), and *Programa Puente* (timber), and from international organisations such as Save the Children (insulation) and Oxfam (toilets and laundry). Therefore, interviewees did not include the cost of such donated materials in their estimates of the costs of the modifications or extensions they had made to their dwellings.

## 6.4 Modifications, patterns, motivations and home

### ***Modifications, patterns and motivations***

During fieldwork conducted in temporary settlements of the Maule and Bío-Bío regions in Chile, no cases were encountered in which the original temporary dwelling had remained untouched. The changes can be explained by a variety of factors. First, the minimum quality necessary to face the winter in that area of Chile resulted in an imperative to improve these houses through the addition of insulation and waterproofing. Second, the size of the house was inadequate for most households, who added new rooms and created bigger spaces. Third, in some cases the previous house was used as a workplace in addition to the domestic use, and some households therefore expanded their temporary houses so as to be able to resume their economic activities and generate income. Finally, in many cases the modifications were explained by socio-cultural factors, such as the need to create a distinct household identity and improve houses aesthetically.

The main changes observed as frequent modifications of temporary houses were (Figure 83):

- **Insulation and protection from the rain.** The winter in Chile begins in June, and most families received the temporary house between March and May 2010. Therefore, the first change in all cases was to add insulation and waterproof layers. Protection from the rain and thermal comfort were the main problems; therefore, these aspects should be included in the design of a temporary house for this type of climate.

- **Extension of the house.** All cases studied increased usable space, and most households doubled the size of their house during the first year from 18 $m^2$ to 36 $m^2$. During fieldwork, most families were living in houses of an average area of 60 $m^2$, the largest measuring 84 $m^2$ and the smallest 45 $m^2$. The temporary houses were constructed according to the recommended layout from the government and professional guidelines. These recommendations suggested a distance of 3 m. between houses, leaving a limited space for expansion but also presenting an opportunity to use the adjacent house as a structural support for extensions. Several cases of such extensions were encountered during this research, and in some they were used by two families as a corridor or intermediate space. In other cases, when the adjacent house was disassembled and removed, the households that remained in the *aldeas* used the extra space to expand further. This practice highlighted the importance of the need for space, and that families would seek to expand as much as they could despite the temporary status of the house; however, they were restricted by the level of comfort permitted by the comparatively low-quality materials afforded to them.

- **Changes in existing doors and windows and new openings.** The fixed location of windows and doors in the temporary houses created a problem when families added new rooms or moved the entrance. Also, the two small windows in the original model do not provide enough daylight. Therefore, most families enlarged the pre-existing windows and added new ones. This tendency could also be explained by the extensive amount of time families spent inside the house, especially during the coldest months of the year.

- **Creation of internal divisions within houses.** In many cases, temporary houses were divided into two rooms, so as to separate one or two bedrooms from other uses, such as a kitchen or dining room. In most cases, the shelter was used as a bedroom, while most extensions were used as kitchens, dining rooms and living rooms.

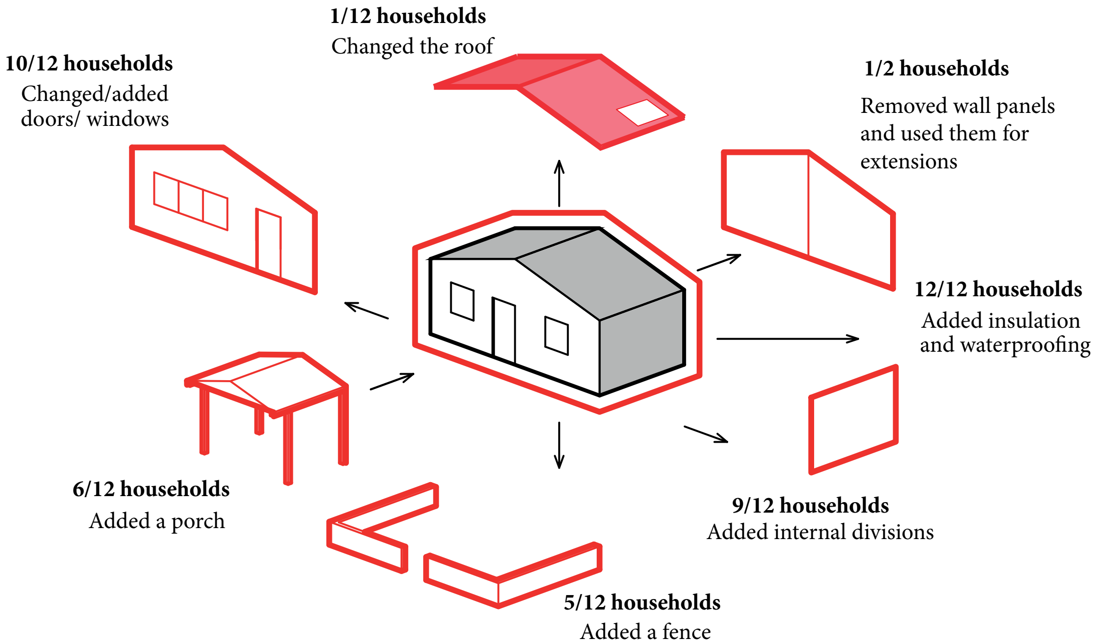



**Fig. 83.** Synthesis of changes made to the temporary houses in Chile.

- **Addition of front porch or front garden with surrounding fence.** These intermediate spaces separate the house and the public areas. The front gate is a typical characteristic of houses from the central and southern regions of Chile, and this feature was added to provide extra security as well as for aesthetic reasons.

The fact that the houses were built on land provided for the short-term had an effect on the materials used for extensions. The most used materials were timber and corrugated iron, which could be removed, reused and recycled in the creation of permanent houses. In terms of budget, in many cases a significant amount of material was donated by NGOs, the government, friends or family. Consequently, the costs of extending and improving temporary houses were reduced. Nevertheless, in order to achieve better-quality temporary houses, some households spent around 1,000 USD (656 GBP) in addition to the donations given to them by the government or NGOs. If the cost of the materials donated were to be included in the cost of a temporary house (materials that were crucial to achieve a minimum standard) the initial cost would be tripled. In particular, families with young children received material support from different institutions targeting health and wellbeing, and many were given individual toilets, kitchens and insulation. Families carried out further extensions and improvements in order to make the house more attractive and livable, as well as to help it feel like a permanent house, adding porches, fences and brightly-coloured paint, even knowing they would live there on a temporary basis only.

Most modifications did not imply the removal of panels. Instead, most changes to temporary housing involved creating new openings. The families interviewed commented on the possibility of changing the orientation of the windows, either to allow ventilation, or to add flexibility to the use of the house. Although families would not reside in these houses permanently, most of them displayed an interest in keeping the house and either using it as an extension in their future dwelling as a whole or reusing some panels (Interview with Families in Bío-Bío and Maule Regions, 2012). Therefore, this situation presents NGOs and government a potential opportunity to teach families how to use the parts of the house efficiently without compromising safety.

### ***The construction of 'home'***

Cases studied in Chile were displaced households residing in temporary houses and settlements. Despite this situation, they modified their houses extensively. Families transformed their temporary environment into buildings that could be recognised as permanent and durable, due to their aesthetics and good quality. Identity and familiarity were achieved adding specific elements to the house, making changes that were beyond the need to achieve basic comfort. New and bright colours, designed fences, decorative elements, and the use of familiar materials all contributed to create personalised houses, easy to identify in the temporary settlement. Although families knew they would be evicted from these temporary settlements in the mid-term, they put effort and care in modifying their temporary houses, showing that they are more than mere shelters to them.

In some cases, the families were planning to use the temporary house as material for extensions to their permanent houses, but in other cases this was not possible. In both cases, households changed and improved their temporary houses, supporting the idea that 'home' is not only about building something permanent and durable, but about identity, familiarity, achievement, control, self-expression and freedom of action (Després, 1991; Case, 1996). Despite the temporary situation, households built a familiar place, a place to return to their routines, and achieve comfort and security through modifying their temporary houses into a place to belong.

# Chapter 7

# 7. Notes from fieldwork: Housing as a process in post-disaster accommodation

The cases of temporary accommodation in Peru and Chile examined earlier in this thesis show that in different contexts, families adapt their houses to make them bigger, to improve their quality so as to deal with the local climate, and to provide them with familiar elements in order to distinguish them from other houses. Although standard 'one-size-fits-all' approaches are used in post-disaster accommodation for economic reasons, flexible and adaptable designs can facilitate modifications by inhabitants. Practitioners from the humanitarian sector are conscious that more substantial links between development and recovery are required. Temporary and transitional housing solutions connected with long-term projects, such as incremental or progressive housing programmes, constitute one potential way in which to reach this objective (Lyons et al., 2010).

Housing, whether permanent or temporary, formal or informal, is an incremental process that evolves according to inhabitants' needs and possibilities. As experience shows, extensions have great potential for increasing the housing stock in a sustainable way, and transformations can improve housing conditions (Tipple, 1996). Moreover, research into informal housing shows the advantage of flexibility to accommodate a plurality of family sizes that reflect different purchasing power and family priorities, in contrast to inflexible formal housing that relies on the replication of a few models that reduce variations and alternatives (Lizarralde and Root, 2007). Incremental housing is the most common strategy of the informal sector to customise dwellings to individual needs and expectations, allowing families to make improvements as their economic possibilities allow (Lizarralde, 2011; Lizarralde et al., 2009).

In the previous two chapters, case studies in Peru and Chile were examined with the aim of understanding how households living in prefabricated 'one-size-fits-all' houses have adapted these dwellings to their specific needs and cultural preferences. The aim was not to evaluate the successes or failures of either the housing strategy implemented or the owners' modifications to their houses, but rather to understand households' diverse experiences and to learn from the extensions and adaptations they make. The questions that guided these case studies were: How and why do families modify their temporary houses? What are the characteristics of this process? What features are essential for supporting a process of transition into permanent houses? A significant difference between the Peruvian and Chilean cases is that households in Chile were living in temporary settlements from which they knew they would eventually be evicted, whereas in Peru most cases studied were households living in temporary dwellings constructed on their own plots of land. Nevertheless, most temporary houses built by TECHO and the government of Chile were extensively modified in both cases, showing that the need for space and for having a customised home was crucial, even when it was expected that houses would be disassembled and moved, or even disposed of, in the near future.

## 7.1 How and why do families modify their temporary houses?

### 7.1.1 How do families modify their temporary houses?

Transformation over the years was predicted before the fieldwork for this thesis was conducted, following the hypothesis that, due to their temporary circumstances, displaced families would modify their houses in a less extensive way than non-displaced ones. Nevertheless, the temporary condition of the displaced households did not have an impact on the quality of the improvements. Some extensions and adaptations in Chile were of good quality and following a 'permanent aesthetic' (Figure 84). These examples strengthen the idea that cultivating a 'home' during temporary living was crucial for families to achieve a sense of normality.

***Extension of the housing space***

Most households doubled the usable area of their temporary houses, and some even tripled the inhabitable space. Bigger extensions were seen in Peru, with an average area of 90 $m^2$, while in Chile the equivalent figure was around 60 $m^2$ (Table 26). Nevertheless, many factors might have an influence on the extent of the modifications made. First, household composition was one such potentially significant factor. Families with older children or more than two adults built new rooms in order to have more privacy, and therefore required more space. Second, the number of members per household was different. While in Peru most cases are inhabited by four people,

**Fig. 84.** A temporary house modified and with a 'permanent aesthetic' in Dichato, Chile.

**Table 26.** Areas of expanded temporary houses in Peru and Chile.

| | **Peru Year 2**<br>**Area (m²)** | **Peru Year 5**<br>**Area (m²)** | **Chile Year 1**<br>**Area (m²)** | **Chile Year 2**<br>**Area (m²)** |
|---|---|---|---|---|
| **Case 1** | 86 | 114 | 30 | 46 |
| **Case 2** | 74 | 92 | 30 | 30 |
| **Case 3** | 50 | 101 | 44 | 56 |
| **Case 4** | 41 | 56 | 36 | 45 |
| **Case 5** | 36 | 56 | 36 | 66 |
| **Case 6** | 36 | 84 | 36 | 84 |
| **Case 7** | 38 | 85 | 36 | 68 |
| **Case 8** | 42 | 96 | 36 | 54 |
| **Case 9** | 56 | 99 | 36 | 48 |
| **Case 10** | 46 | 64 | 45 | 70 |
| **Case 11** | 54 | 90 | 48 | 66 |
| **Case 12** | 54 | 74 | 36 | 63 |
| **Case 13** | 56 | 103 | - | - |
| **Case 14** | 69 | 90 | - | - |
| **Case 15** | 91 | 131 | - | - |
| **AVERAGE** | **55.3** | **89** | **37** | **58** |

in Chile most cases had three residents. The cases studied reflect the average number of people per housing unit provided by the censuses, which is 4.4 in Peru in 2004 and 3.5 in Chile in 2002 (INE, 2003a, p. 44; INEI, 2007, p. 35). Third, fieldwork in Peru was conducted five years after the earthquake while in Chile it was done two years after the disaster. If we compare the dimensions of the extended houses in both countries after two years, the average area is similar (Table 26). Although the magnitude of the modifications cannot be projected from the data collected in this research, it is possible to see the incremental process of construction done by families, whether they live in a permanent or temporary site. Fourth, the size of the plot or space available for extensions played an important role in the size of the extensions. For example, when houses studied in Chile were grouped in a linear settlement with only three meters between houses, the extensions were limited by that space, but when the adjacent house was removed, the temporary houses were extended using the maximum space available. Fifth, most of the examples studied in Peru were inhabited by households living on their permanent land, while in Chile households were living in temporary settlements. And finally, in Chile a compact house is easier to insulate and to heat during the winter season than a large house, something that might have had an influence on the size of the extensions. In that sense, families seem to privilege quality versus quantity of space.

### ***Subdivision of spaces***

Besides the extension of usable areas of the house, most families subdivided their interior space or created new rooms to provide privacy and to distinguish between different uses. The majority of cases featured nuclear families with children, although extended families, single parents with children, and households of one person were also seen extending their temporary houses. As observed in both countries, and shown in previous chapters, the presence of teenagers or more than two adults inhabiting the same house made the subdivision of bedrooms to provide independence and privacy especially important. Therefore, the number of members of the household as well as the ages of the residents should be taken into account in the design and provision of temporary housing.

The selection of materials used for dividing temporary houses into two or more rooms was linked to the resources and materials available. Internal divisions seen in Chile were mostly constructed with timber, OSB or MDF panels, while in Peru many households used lightweight divisions such as curtains or plastic.

**Figure 85**. Use of recovered materials in the improvements and extensions. Curanipe, Chile, 2012.

### ***Use of familiar materials***

Families used the materials that were available to them, either through donations, materials recovered from their destroyed house, or purchased in shops. In Peru, some families received donations of materials from friends and relatives to extend the temporary house or to initiate the construction of a permanent one. However, families did not find it easy to reuse materials from their destroyed dwellings. Most destroyed houses in the villages visited were built with adobe, and families did not use rubble as building material. In Chile, families received donations from local governments and from NGOs. They also used salvaged materials (mainly timber, window frames and doors). Families not only used recovered materials to find a use for available resources, but also to provide their houses a better quality in terms of insulation and to lend their standardised houses the aesthetics of the 'familiar' and 'normal' (Figure 85). Besides donations and recovered materials, households used their savings to buy materials that could improve the quality of the temporary dwelling.

While in Chile the use of timber panels and timber frames was widely accepted, in the case of Peru it was alien. In coastal areas in the south of Chile, there is a long tradition of good quality timber construction which is not considered merely a temporary solution. Therefore, most extensions were easy for residents to make using timber panels and other wood products. Furthermore, displaced families in Chile lived on a temporary site, and any construction therefore had to be carried out with lightweight materials which could be easily disassembled. On the other hand, in Peru no tradition of timber houses existed in the region, and therefore families found it less socially appropriate to live in such houses during the medium term. Here, the materials that families added to their temporary houses to provide a sense of normality were bamboo poles and bamboo woven mats, and once they started building permanent houses they used brick, concrete and adobe. In this sense, timber panels were used as part of temporary houses and later added to permanent houses because they were available, but these materials and systems were not incorporated into traditional construction techniques after the earthquake.

***New windows and doors***

In both countries most residents opened new windows and doors, in order to provide more daylight inside houses and to create extensions or construct an entrance at the rear of the house. In many cases the original windows of the temporary house were enlarged. In Chile and Peru, occupants often replaced the timber frame windows that came with the temporary houses with an aluminium frame. In some cases, metal bars were added to the windows to provide security, especially in houses that were used as shops. One problem with this practice was that it weakened the structure of the house, since columns and beams of the panels were cut to create new openings. To overcome this problem, a different structural system without load-bearing walls would be more suitable for the construction of new windows and doors, thus providing more possibilities for families to adopt their dwelling without compromising its structure.

***Buffer zones, intermediate spaces and porches***

In both countries, buffer areas between public and private spaces were created, but these were built in different ways. In Peru, intermediate spaces were created as areas covered by a shaded roof built with bamboo poles and bamboo woven mats. These spaces acted as a porch or terrace, and families used them to socialise in (Figure 86). In Chile, meanwhile, some houses were seen with a modified extended entrance, although buffer areas were created by the construction of a gate which clearly differentiated the front space of a house (front garden) from the road (Figure 87).


**Fig. 86.** Buffer space added to a temporary house in Peru.

**Fig. 87.** Buffer space added to a temporary house in Chile.

### ***Uses***

The temporary house was adapted to different uses, such as bedroom, kitchen, living room, and other non-domestic uses. In Chile and Peru it was initially used mainly as a bedroom, and then as a dining room, living room, and kitchen. In most cases studied in Peru, the kitchen was built outside the temporary house due to the tradition of cooking with charcoal, which produces smoke and requires a ventilated space. On the other hand, in Chile the kitchen was seen as a crucial element of the house which could keep it warm during the winter and serve as a gathering space.

In Chile and Peru, some inhabitants adapted and extended their house in order to use it as a grocery shop, a restaurant, or for other activities. Some families lost their houses during these natural disasters, together with their livelihoods. Hence, they adapted the temporary house to allow non-domestic activities in order to generate income. For example, in Chile, extensions of temporary houses were used as, variously, a small warehouse in which to store fishing tools, and as a sewing workshop.

### ***Use of the temporary house as part of the permanent house***

In both countries, families did not consider discarding their temporary house in the long-term. Therefore, they used the temporary house in innovative and even unexpected ways, either to extend the dwelling or as material with which to build permanent houses. In Peru, dwellers used the house extensively during the temporary phase and then reused it as part of their permanent house, either as an extension or as a first floor (Figure 88). In Chile, the examples studied were all part of a temporary settlement, but the families interviewed explained their desire to use their temporary house or its panels to improve and extend their future dwellings provided by the government. Some families that already were living in their permanent house after residing in temporary settlements during the early years of the reconstruction were seen trying to incorporate the temporary house to their new accommodation (Figure 89).

### ***Level of transformation***

Transformations took place at a different pace in Peru and Chile (Figure 90). While in Peru many inhabitants did not modify their houses during the second stage (Level 0) but did so later during the process, all of the houses studied in Chile were transformed as soon as resources and

**Fig. 88.** Temporary house as an extension of the permanent house in Peru.

**Fig. 89.** Temporary house as an extension of the permanent house in Chile.

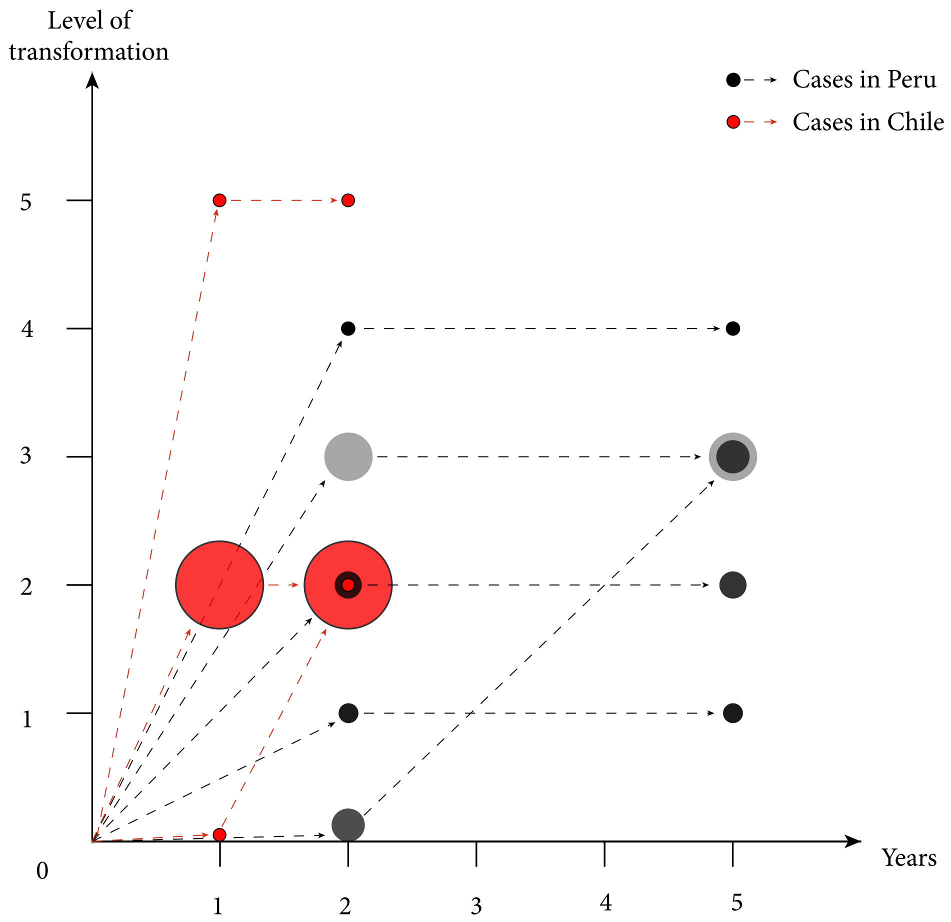



**Fig. 90.** Level of transformation of cases in Peru and Chile. Shorter timeframe in Chile and more diversity in Peru. The graph shows the level of changes in Stage 2 (year 1 in Chile and year 2 in Peru) and in Stage 3 (year 2 in Chile and year 5 in Peru).

materials became available. The difference in the process between the two countries could be explained by the different climates and levels of development of these regions. In Chile, insulation and protection from the rain was considered as a requirement to achieve a minimum quality standard. Therefore, it was considered a necessity to adapt the house quickly after construction. Also, media coverage and criticisms pushed the government to take actions to improve the quality of temporary houses. Therefore, the government and humanitarian organisations participated actively in improving the quality of the dwelling very early in the process. However, over the long term, the modifications made to the temporary houses in Peru were more extensive, with most households making changes up to Level 3.

### 7.1.2 Why do families modify their houses?

The initial hypothesis of this thesis was that families modify their houses by making additions and extensions because they want to make their shelter a ‘home’, and to feel a sense of normality as soon as they can in the aftermath of a disaster. In the field, it was corroborated that both displaced and non-displaced families invested their time and resources into improving the quality of their temporary houses, and that they expanded their houses when space to extend was available. These changes were defined by three main motivations. First, families expanded their houses due to a need for space, creating more rooms and providing greater privacy. Second, houses were adapted to local climates, and to cope with different seasons, especially in the case of Chile. And finally, changes were made by adding elements to provide a personalised home and introducing local traditions and culture.

***Need for space and privacy***

The temporary house provided 18 $m^2$ of usable area. That footprint follows the minimum standard established by Sphere and UNHCR to provide 3.5 $m^2$ per person for a household of four people, but does not meet the requirement of 4.5 $m^2$ per person for cold climates such as southern Chile. Although the minimum space defined by these standards can be achieved with the temporary house provided, in practice families reside in these houses for the medium term instead of the short term, and therefore a different standard should be considered. Living in a reduced space has proven to be insufficient for families, despite presenting a temporary solution, because they are likely to reside there for several years. The need to expand can be also explained by the size of the houses in which families lived prior to the earthquake. Although in the survey employed here the dimensions of the destroyed house were not included, from conversations with families it was possible to infer that very few people lived in less than 18 $m^2$ in formal housing.

Finally, household composition was an important factor for defining the final area, due to the need for separate rooms to provide privacy. In Peru and Chile, the subdivision of rooms was needed when families with older children or more than two adults were living in the same house, as stated previously.

## ***Adaptation to the local climate***

In both countries, residents made changes to provide their house with a minimum acceptable quality in the medium term given the local climate. In Peru, households built shaded areas around the house to cool the interior and to have an intermediate space for carrying out daily activities during the hottest hours of the day. These spaces were not expensive to build, since the materials were easily available (*Caña de Guayaquil* and bamboo mats), and they were easy for families to use. In Chile, families added insulation and waterproof layers to the house in order to resist low temperatures and rain. The government of Chile and other institutions became aware of the need for these layers at an early stage, after the construction of the houses. Nevertheless, the cost of transporting new material to the sites, and to mobilise volunteers and the army, meant that more resources were used on the temporary house in order to achieve a minimum quality for this medium term solution. Fewer resources overall would have used for insulating and waterproofing the house if these necessities had been initially taken into account in the design.

Following criticisms of the quality of the temporary houses provided, the Chilean government realised that it would be more efficient to modify the model and improve the quality of the traditional *mediagua*. Therefore, after subsequent emergencies the temporary houses provided to affected households have been significantly updated, and are now more expensive and of better quality. Although the government is developing temporary housing in the right direction, there remains much room for improvement, since a single design is still used across the whole country without more differentiation than the characteristics of insulation layers. Similarly, the new house is a modular system with three alternatives in size, but it does not respond well to the possibility of expansion by families, or changes in the position of windows and doors, depending on the orientation of the site.

## ***Personalisation: from shelter to home***

The cases studied in Peru and Chile for this thesis show that families sought to create a 'homely' feeling in their shelters through the use of familiar materials, recovered windows and doors, and making the temporary dwellings more comfortable. This research – alongside other research reaching similar conclusions – points to ways that home can be 'created' and can take different forms over time. Here, the concepts of flexibility and adaptability can play a role in providing future possibilities and alternatives that may support a medium-term and long-term recovery.

**Fig. 91.** Colour paint added to the temporary house in Peru.

Changes were made in response to a need to accommodate families and improve the comfort of the houses, but also to develop pride and a sense of ownership. Besides making the temporary house a more adequate space to inhabit in the medium term, families modified houses to make them 'unique', to add their 'signature' to them, and to recognise them as their 'home'. Although some changes were for the purposes of efficiency, safety and protection, such as adding new rooms and adapting the house to the climate, families made other changes in order to feel comfortable and proud. For example, adding paint to the house not only protected the timber from the weather, but also provided a new façade, and therefore colour choice become important for families (Figures 91 and 92). Adding metal bars to the windows proved to be crucial in terms of protection, but families then added geometric designs to these bars, lending their houses a more personalised touch. Therefore, modifications that users made to their houses were related to both cultural and social aspects and environmental features.

In both countries, families used the temporary house intended to be inhabited for a limited period of time either as a core house or as a transitional shelter, that is to say, as part of an

**Fig. 92.** Colour paint added to the temporary house in Chile.

incremental process. The house not only provided families a protection from the environment but a place to belong. After two years in the case of Chile, and after five years in the case of Peru, the temporary house was extensively changed. During these years, the temporary structures were always 'under construction', being modified constantly. The changes, which in some cases weakened the structure, in general improved the quality of the houses, and therefore the life of their users. The houses were transformed into places of opportunity and hope. Transforming an 'anonymous' shelter into a 'home' was a personal process for each household.

As mentioned earlier in this thesis, when families affected by disasters lose their shelters and possessions, they also lose community ties, the feeling of belonging, identity and privacy (Somerville, 1997). Families in Peru and Chile transformed their repeatable, prefabricated temporary shelters into identifiable 'homes', using familiar elements. In the case of displacement, the loss can be more apparent, and maybe that is one reason for families in Chile to put effort and care into making changes to their houses, to support the process of healing, but also to recover their identity.

## 7.2 What are the characteristics of the process?

Changes and modifications to housing are not made all at once; on the contrary, they are part of a process that depends on the quality of the temporary house to cope with the local climate, the availability of funds, the availability of land, and changes in the composition of a household. Families tended to modify their houses progressively, and the need for space was the main issue for all of them, followed by the quality of this space and the addition of elements to personalise it.

Although families made changes to the temporary house during the second stage, they did so on different scales. Nevertheless, similarities can be found in the processes of adaptation studied in both countries (Table 27). Families in both Peru and Chile opened new windows and doors during the second stage, showing that the openings of the original model are either too small or in the wrong location. Then, families added elements to improve the quality of the spaces, either by creating intermediate shaded spaces in Peru or by adding insulation and waterproof layers in Chile. After that, families divided the space in order to separate uses and provide privacy. Research on the transformation of social houses by their own users shows that this process is not very different to the cases of modifications to temporary houses studied here. The original space is initially divided into more rooms and then new rooms are added, doubling the number of rooms and expanding the habitable space (Tipple, 1999, pp. 22–23; Tipple and Ameen, 1999, p. 90). In the cases studied in this thesis, panels were removed to be used as extensions, and finally when a permanent house was built, the temporary house or its parts were used as an extension. In the end, then, the temporary house became embedded in the permanent house, and the materials that could not be incorporated were disposed of or sold.

**Table 27.** Summary of the process of transformation of cases in Peru and Chile.

| | **Peru** | **Chile** |
|---|---|---|
| **1** | New windows and doors<br>Add front porch<br>Internal division | New windows and doors<br>Insulation and waterproof layers |
| **2** | Floor or wall panels removed and used as extension | Internal division<br>Extensions to the temporary house |
| **3** | Temporary house used on top of permanent house | Temporary house used as extension |

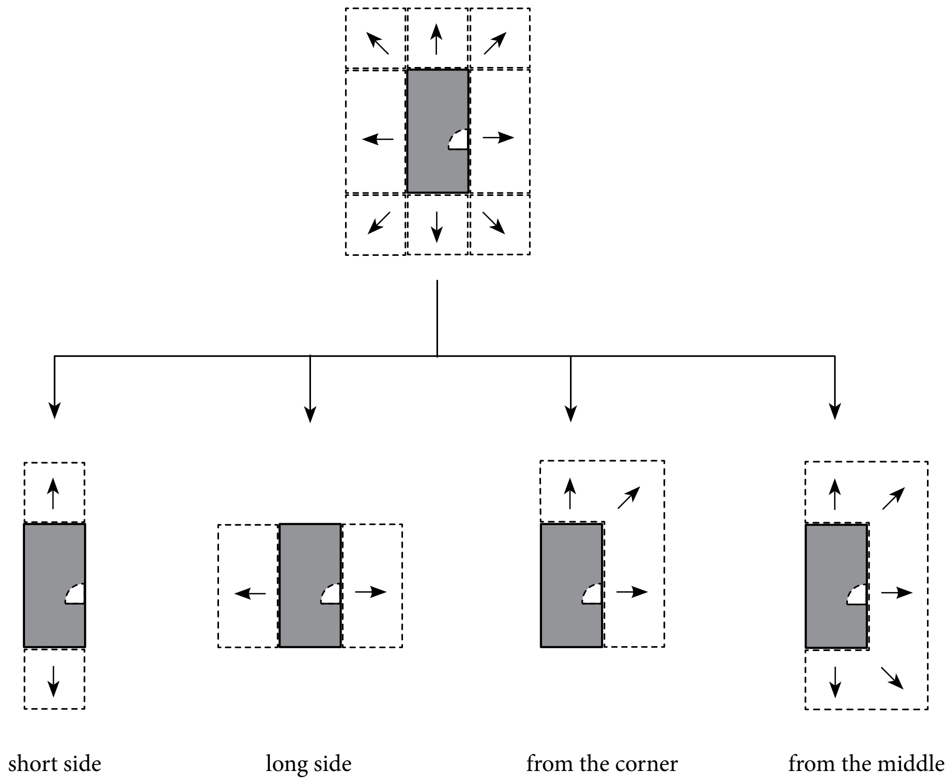



**Fig. 93.** Growing configurations and common extensions.

In terms of growth patterns, in both countries extensions were determined by the space available and the configuration of the settlement or shape of the plot, rather than other aspects such as wind and solar gain. From the many alternatives possible (Figure 93), axial expansion (both short and long sides) was common for temporary houses on narrow plots in Peru, whereas expansion using the long side was most common in the cases studied in Chile (determined by the space available between *mediaguas*). Axial extensions appear to be comparatively simple to carry out, in terms of connections between rooms and roofing systems. More complex extensions seemed to be used when more resources became available to families – often because neighbours moved out, leaving vacant space. As young members of households grew and required more independence, so extra rooms were added, or non-domestic functions given to the house.

## 7.3 What features are essential for supporting the process of transition?

Families modified their houses regardless of location, whether they were placed on a temporary settlement or a permanent site. Although land tenure might seem to be a prerequisite for transformation, the temporary cases studied here show that it is not absolutely necessary, and that families are likely to use whatever dwelling is available as a core house to which to make extensions. However, in all cases studied here, families were the owners of the temporary house, rather than renting this space. Therefore, whether in their own plots or situated on temporary settlements, they had the freedom to modify and extend their dwellings when provided the resources and space. The literature on transformations to state houses mentions that, although ownership does not appear to be a prerequisite to extend, it can constitute a catalyst for the extension process (Tipple, 1999, p. 30).

In the context studied here, modifications were made in a variety of ways. Some families modified their houses extensively, while others made discrete changes. Some temporary houses were used as a whole to add more space to permanent dwellings, while in other cases only parts of the temporary house were used. Thus, a variety of different situations arose, and temporary houses were employed and re-employed in different and sometimes unpredicted ways. Hence, it is a complex challenge to design mass-produced standardised temporary houses that fulfil everyone's needs, because the way dwellings are used and organised are specific to the culture, habits, requirements and desires of individual households. The ways in which traditional houses are built represent the development of each particular culture, and they accommodate and serve specific ways of life (Oliver, 2010, pp. 166–167). However, environmental, social and economic conditions have an effect on the ways houses are finally produced, and some patterns can be recognised and used similarly across societies organised around quite different cultural values, such as extensions of the domestic living space built through porches, verandahs and balconies (Oliver, 2010, pp. 166–167). Also, although houses reflect the needs of specific households, they are not isolated from their surroundings, but rather are affected by and have an influence on the settlements, either rural or urban, of which they form a part. In relation to households' specific needs, these can change over time, due to growth in family size or aging of family members – both circumstances which create new privacy requirements. Most families interviewed stated their interest in keeping the temporary house and using it as an extension in the future, if they had not done so already. In this sense, a good dwelling design should be able to adapt to households' evolving changes and needs, in terms of both organisation and the use of internal and external spaces. On the other hand, structural strength was not seen as an important issue for families, either for permanent houses or for additions to their temporary house, even though families had experienced an earthquake and, in the case of Chile, a tsunami, in the recent past.

One of the problems of post-disaster accommodation, both in the cases studied here and in other examples, is the use of 'one-size-fits-all' solutions for different geographies and cultures, paying little attention to traditions, ways of life and values (Audefroy, 2010). Organisation of functional spaces, housing styles and typology, proper material and construction techniques should be considered to support the reconstruction process. Therefore, the most important element in supporting a process of transition is a flexible house design, accompanied by house ownership, capacity-building and knowledge transfer in order to prevent future vulnerabilities. When designing post-disaster housing, the concepts of flexibility, adaptation, and the process of self-building should be taken into account, even if houses are created to serve only as temporary dwellings. In practice, when it comes to shelter, families use and upgrade whatever is provided to them. In that sense, definitions of post-disaster accommodation should always include the concept of 'change', and therefore the 'Transitional Shelter Approach' better describes the process that occurs after any type of support is provided.

Although 'one-size-fits-all' approaches are typically used for economic reasons, since replication can lower the costs and time of production and construction, flexibility can be a way to ensure that structures may adapt to a variety of cultural needs and expectations (Ashmore et al., 2003; Barakat, 2003; Leon et al., 2009). Moreover, in some cases a 'one-size-fits-all' approach is comparatively inefficient in terms of costs, as examples in post-disaster have shown (for instance, the case of Haiti, where traditional construction was less costly than a prefabricated and fixed design). Also, flexibility has been introduced and recognised by researchers and practitioners as a crucial and desirable characteristic of both temporary housing and transitional shelter (Arslan, 2007; Arslan and Cosgun, 2008; Barakat, 2003; Davis, 2015; Félix et al., 2013; Johnson, 2007a, 2007c; Kellett and Tipple, 2000; Lizarralde and Root, 2007; UNDRO, 1982). Nevertheless, guidelines on how to make future changes or to safely adapt temporary houses are still not, in general, provided to the affected families. Therefore, this situation presents an opportunity for practitioners to develop designs incorporating a deeper understanding of the progressive and incremental aspects of post-disaster accommodation.

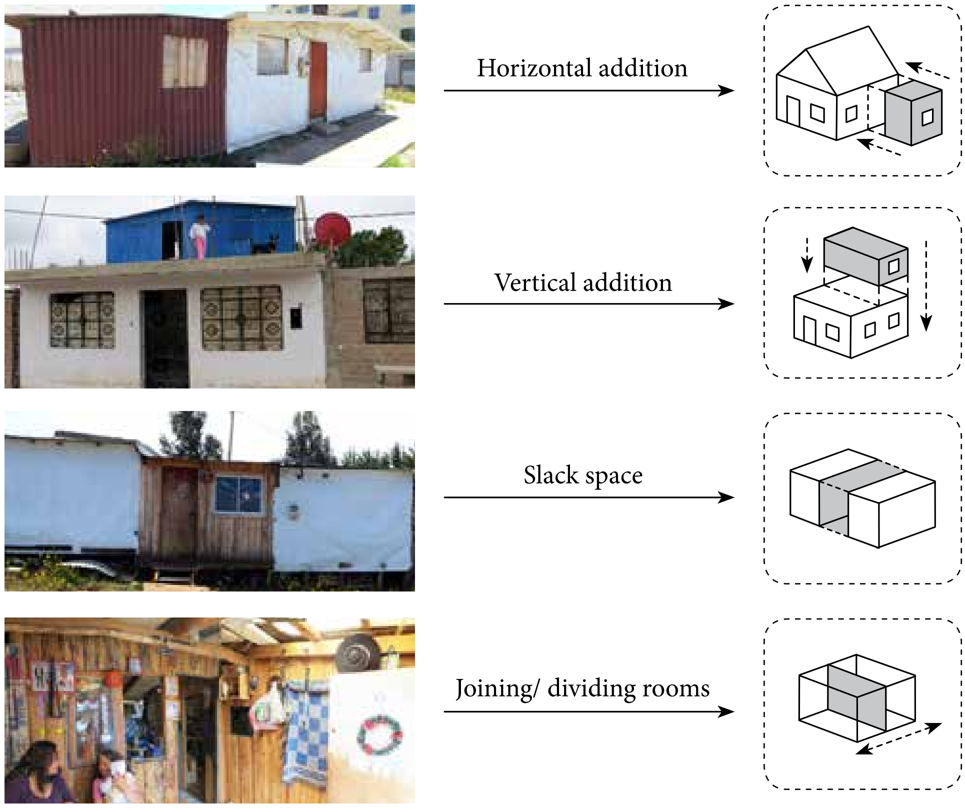



**Fig. 94.** Strategies for flexibility based on the Peruvian and Chilean case studies analysed.

## ***Flexibility as a design strategy for post-disaster accommodation***

The most common types of adaptation seen in the case studies analysed in this thesis are linked to the concept of 'elasticity' showed in chapter 3. Some changes are related to 'soft systems', such as horizontal addition (additions to the sides), vertical addition, and 'slack space', and others are connected to 'hard systems', such as the division of rooms. Families modified the temporary houses using these strategies even though the house was not designed to be extended. Furthermore, as mentioned, residents who already had a permanent house used the temporary house given to them as an extension. Also, families divided spaces in order to differentiate uses, such as bedrooms from kitchen or other activities. These types of extension and modifications can be designed as part of the temporary house, or as a complement to the permanent house, in which the materials of the temporary house are used wisely. Therefore, based on the cases studied, strategies for flexibility in post-disaster housing design should allow: the possibility of horizontal and vertical extension, the use of empty spaces between buildings (slack space), and the division of rooms to differentiate uses or to provide privacy (Figure 94).

**Fig. 95.** Example of a post-disaster house based on structural frames. Prototype with full structure and part of the walling system. Cambridge, 2014. Source: Gatóo , Wagemann and Ramage, 2015.

In post-disaster accommodation repetition and standardisation is essential for shortening production and construction times, however, designs need to be flexible to allow adaptation with local materials and systems maintaining structural integrity. Local resources and building techniques should be incorporated into the design considering availability of materials before and after disaster, local climate, traditional use of spaces, protection from hazards, and flexibility to allow modification.

Systems using frame structures inside which panels, walls and doors can be changed and moved could provide this flexibility (Figure 95). Also, replacement of elements without damaging the structure of the houses should be taken into account. The frame strategy, if designed considering future hazards, can provide a safe roof and structure while allowing modification of walls. However, structural factors might limit the extent of changes that can be carried out, and therefore they might limit the flexibility of the building.

Therefore, in the context of disaster-prone areas a balance between flexibility and safety must be obtained. Also, in terms of systems, strategies for simplicity, disassembly and exchangeability need to be considered. That means simple structures that can be disassembled without damaging the structural elements and the possibility of replacing parts, in case of deterioration or to allow further modifications.

Cases analysed in this thesis showed that families use post-disaster accommodation during the medium and long term, even though they are designed to be temporary only. A house designed as a flexible system to allow variation and customisation to particular needs and aesthetics, can support families to 'make a home' after a disaster.

# Conclusions

This thesis has set out to explore the concept of flexibility in post-disaster accommodation. Temporary houses in Peru and Chile were studied with the aim of understanding how families live during the medium term in housing solutions designed only for the short term. The studies show that households modify their interim houses because they need a place to return to their routines, to resume household activities, and to feel 'at home'. The cases also indicate that the design of temporary houses is crucial in allowing these adaptations to happen, and therefore, more flexibility in the design of post-disaster accommodation would provide better support to families. However, temporary housing design in most cases does not incorporate possible future adaptations.

## I. What is post-disaster accommodation? Terms, concepts and definitions

The lack of flexibility in the designs of the temporary houses studied might be influenced by the terminologies used to describe post-disaster accommodation. Terms such as emergency shelter, temporary shelter, temporary housing, temporary accommodation and transitional shelter are frequently used interchangeably. While temporary housing is designed to last for a period of time to cover the gap between emergency and permanent housing, transitional shelter is understood as a process that goes from an emergency scenario to a permanent house. However, it is difficult to find definitions that apply in different contexts, because each disaster, each country and the way houses take shape is different from case to case. The literature indicates that although the boundaries between different types of housing programmes are blurred, some general consensus may also be found concerning the primary role of shelter in post-disaster, and the idea that the shelter is not a product but a process.

Post-disaster accommodation can take many forms, and this thesis studied houses provided as an interim solution, called temporary houses. After a disaster, shelter provides more than a roof; it gives inhabitants security, livelihood opportunities and a chance for economic recovery, as well as protection from the elements and hazards, physical and psychological health, privacy, dignity, security and feeling of home and community (Batchelor, 2011, p. 61; Félix et al., 2013, p. 136; Gray and Bayley, 2015, p. 7; Kelman et al., 2011, p. 262; Kennedy et al., 2008, p. 25; UNOCHA, 2008, p. 1).

Housing, whether permanent, temporary or transitional, is a process that evolves with households' needs. Therefore, post-disaster accommodation should be designed to be functional and adaptable to these changes. However, in reality it is difficult for policymakers to understand that the same material will be used as an emergency shelter first, as a temporary shelter later and finally as part of a permanent house (National Research Council, 1978, pp. 41–42). Both the literature studied for this thesis and the results from fieldwork conducted for it reinforce the idea that the process that leads to durable housing begins with whatever material or house is available to affected families. Therefore, post-occupancy use should be considered more carefully in early designs. While in temporary housing the period after the 'temporary phase' ends is called 'second life' or 'second use', in transitional shelter this extra time is questioned as 'transition to what?'. Past experiences of temporary housing show that reusing and recycling these houses can improve the efficiency of this approach. If the concepts of reusing and adapting the temporary house are incorporated, the aims of this approach may begin to resemble those of the transitional shelter approach, in which the solution provided is no longer temporal, but a transition to something else. These issues highlight the necessity of connecting relief and development, and the need to add flexibility in shelter responses so as to adapt to future uncertainties. The transitional shelter approach has been criticised for to the lack of flexibility in its designs, so that structures deteriorate and become permanent poor-quality houses. It has also been criticised because the end point of the transition is not clear. However, the truth is that 'transition' as such never ends, as the needs of families constantly change. If more effort is put into the transition, as well as guidance, training and assessment during the process, the positive effects of a flexible and adaptable approach can be significant.

## II. How and why do families modify their temporary houses: Main characteristics of the process.

Fieldwork in Peru and Chile shows that the process of recovery in different contexts, timeframes, climate and development has certain similarities. After two or more years living in a temporary house, families begin to use it in unexpected ways. 27 temporary houses were studied and analysed through observation, measurements, drawings, photographic documentation of the houses, and interviews conducted with the families and stakeholders involved in the transition process. The analysis focused on the changes, additions and improvements made by families to their temporary houses, with or without external support. The objective was not to provide statistical analysis but to learn from real examples to illuminate future strategies.

**How do families modify their temporary shelters?** Empirical findings indicate that interim houses are modified whether they are being used by displaced or non-displaced families. Some of the changes made by displaced families were as good as those modifications made by non-displaced households to their permanent houses. The quality of modifications made to the temporary house, and the care households invested in improving it, strengthen the idea that making a 'home' during the temporary/ transitional phase was crucial for families to achieve a sense of normality. The ways in which inhabitants modified these houses included: extending the usable area, subdividing internal spaces, using familiar materials, opening new doors and windows, creating intermediate spaces, changing uses, and using the temporary house as an extension to the permanent house. Further, inhabitants carried out these changes incrementally.

**Why do families modify their temporary shelters?** These modifications were made for both functional and aesthetic reasons. Households modified their houses to achieve a minimum expected quality, to have more privacy, to provide comfort, to cope with the climate, to create social spaces, to fulfill particular needs, and to make a house that looks and feels like a 'home' in the mid- and long-term. These changes were influenced by various factors, including the ages of the household's members, socio-cultural expectations, the architecture of the region, efficiency of the resources, and the particular economic situations of each household.

**What are the characteristics of this process?** Families sought to return to normality in any way they could. Normality meant to return to their daily routines, using elements that appeared familiar to them, materials that they knew how to use, building the layouts with which they felt most comfortable, and transforming any shelter they had into a 'home'. The Sphere Project states that adequate shelter should give *'sufficient covered space providing thermal comfort, fresh air and protection from the climate ensuring their privacy, safety and health'* (The Sphere Project, 2011, p. 258). From fieldwork observations it is clear that households look for ways of transforming their post-disaster accommodation into an adequate shelter which they can call 'home'.

**What features are essential for supporting the process of transition?** Flexibility stands out as a crucial and desirable feature of post-disaster accommodation, recognised by academics and practitioners (Arslan, 2007; Arslan and Cosgun, 2008; Barakat, 2003; Davis, 2015; Félix et al., 2013; Johnson, 2007a, 2007c; Kellett and Tipple, 2000; Lizarralde and Root, 2007; UNDRO, 1982) and supported by the research presented here. However, there is a lack of guidance and support for adapting these houses. Also, structural strength is not seen as a main concern for families, whether for permanent houses or for additions to temporary houses. Thus, designs that will be inevitably modified by users need to take into account how houses can be altered without compromising the structure. Good design accompanied by capacity-building and knowledge transfer would help to prevent new vulnerabilities from emerging. However, essential features to consider when designing post-disaster accommodation might be a challenge. On the one hand, capacity for repetition (standardisation) is essential, but on the other hand design must include flexibility for local materials and systems, and the flexibility to be adapted by occupants while maintaining structural integrity.

**Table 28.** How and why do families modify their temporary shelters?

| How do families modify their temporary shelters? | Why do families modify their temporary shelters? | They are influenced by |
|---|---|---|
| They extend the usable area. | To achieve minimum quality and standards desired. | Ages of the household's members and if economic activities are developed in the house. |
| They subdivide the internal spaces. | To provide more privacy and to differentiate uses. | Ages of the household's members. |
| They use materials that are familiar to them. | To change the 'alien' aesthetic of the temporary house and make it look 'normal', to make it a 'home'. | Socio-cultural expectations and minimum quality. |
| They add new windows and doors. | To provide more daylight, to give access to extensions, to make it different. | Comfort, functionality and aesthetics. |
| They create buffer zones, intermediate spaces and porches. | To provide the house with a social space, to regulate the temperature of the house, to extend the entrance, to differentiate public from private areas and to resemble traditional housing in the region. | Climate, comfort, traditional architecture in the region, aesthetics. |
| They change and add other uses. | To fulfill their particular needs, to add non domestic activities to generate income. | Need to differentiate areas, resume economic activities, activities before the disaster. |
| They use the temporary house as part of the permanent house. | The temporary house and its materials are considered a resource. | Efficient use of materials, sentimental attachment to the house. |
| They make changes progressively and therefore each house reaches different levels of modification. | Because families extend, modify and improve the house when resources and materials are available. | Particular economic situation of the families, donations and support from NGOs and governments and future plans. |

### III. How to incorporate the concepts of flexibility and 'home' into post-disaster accommodation?

There exists a tension between the provision of a repeatable construction model and satisfying the requirements of particular households: repetition versus customisation; anonymous shelter versus home. Repetition is efficient when thousands of shelters need to be built in a short period of time. But repetition is seen as a problem because generic designs cannot serve all needs, and therefore many households are provided with a shelter that is not suitable for them. On the other hand, it is also impossible to provide personalised designs to the large numbers of families that require shelter quickly after a disaster. In this context, flexibility is a means through which to provide a house with potential for growth and change, through which it may be transformed into a 'home'. Although 'home' is frequently seen as a static entity, in practice it is a temporal process of forming a familiar environment, giving a sense of belonging and producing memories (Després, 1991, p. 98). Home-making activities are part of a long-term project, and a dwelling is never complete but is rather continually modified. The capacity to modify one's home provides a sense of achievement and control, as well as space for self-expression and freedom of action (Després, 1991, p. 98).

The concept of 'transitional shelter' is linked to flexibility, incorporating the potential to be upgraded, reused, relocated, resold, and recycled (Shelter Centre, 2012, p. 2). However, this approach has been criticised for not being clear about when the transition ends, and for not providing enough guidance to users about future possibilities for transforming their homes. On the other hand, 'temporary housing' does not include the concept of modification, even though in practice houses are extensively changed. This thesis argues that flexibility is crucial in post-disaster accommodation, but that this concept is not well understood and supported. Most strategies do not clarify if the houses will be flexible prior to occupation and/or post-occupation, and the systems and strategies that will be used to provide flexibility, and how the structural system will support the changes and adaptations.

Arguments against flexibility are based on cost, manufacturing time, constraints of prefabrication, and the difficulty of including local materials and building techniques. However, it is possible to achieve an economical, easy to build, and flexible design. It is argued here that, to design a flexible solution, it is necessary to outline a set of strategies for specific climatic conditions and to foresee a series of possible changes, while maintaining structural strength; this design process, ultimately, must be informed by experience from the field.

## IV. Contribution

This thesis contributes to the study of post-disaster accommodation, providing original data from case studies and bridging the process of sheltering in the wake of disasters and the design of adaptable temporary houses.

The detailed examination of changes made by families to their temporary houses in Peru and Chile allows reflecting on the definitions of post-disaster accommodation. Although the houses provided by TECHO NGO and the government of Chile are described as 'temporary houses' or even 'emergency shelter', they are used by families as 'transitional shelters' because they are used by families as part of an incremental process, which does not have a clear ending date. Cases studied here show that displaced or non-displaced families upgraded the house as a whole, or some elements of the house, to use them as part of a permanent house. Some families reused the house for different purposes, other families relocated the house from a temporary settlement to a permanent site, and others recycled the materials for reconstruction. These activities, which are described as part of the 'Transitional Shelter Approach' were not planned or included in the design of these 'temporary houses'.

This thesis shows that families use whatever resource is provided to them in the process of reconstruction, beyond the definitions and beyond the short-term plan. In that sense, definitions of shelter programmes might incorporate their long-term impact in the whole reconstruction process. Therefore, the concept of transition is more adequate to describe the process that comes months and years after a disaster, because it has been shown to be an incremental process.

Also, this study contributes to link the process of 'home-making' in post-disaster contexts and strategies of flexibility that can support it. The cases studied here show that the process of home-making becomes crucial for families who seek to rebuild familiar spaces, to personalise their shelters, and to make a home during temporary living. The concept of flexibility, developed by designers throughout the twentieth century and found in vernacular architecture around the world, is brought into this thesis as a reference for the design of post-disaster accommodation. This thesis points out that housing is a process and that the design of the house as a 'product' needs to be aligned with that concept, through providing a flexible structure that can be transformed into a 'home'. The provision of post-disaster accommodation should complement the permanent construction process, because this will occur whether planned or not. Consequently, a flexible approach must take whatever design is provided and incorporate the possibility of adaptation into it, in order to fulfil families' needs in the medium- and long-term.

Finally, the cases studied also show that changes made by families have structural implications. Therefore, the building system of post-disaster houses has to be designed carefully. Modifications made to the walls, floors and roofs show that frames instead of load-bearing walls are better for providing flexibility to allow future changes.

## V. Areas for further development

This thesis does not provide a universal strategy that can be applied in different contexts, but it highlights the need for providing flexibility within each particular situation. It is agreed that providing adequate shelter is one of the most difficult problems to solve after disasters, since housing is part of a larger system and is influenced by land availability, human, institutional and community resources, building materials, technology, and financial resources (Barakat, 2003, pp. 9–10; DfID, 2011, p. 25; Johnson, 2007b, p. 38). Therefore, this research opens the door to study strategies for flexibility in specific cases, and to see how particular post-disaster accommodation can be incorporated into permanent housing solutions, whether provided by the government, NGOs or built by families. Therefore, future research could focus on the feasibility of designing a shelter that includes general interests, technical solutions and a better relation with the culture and society of the affected places, and design a shelter which is easy and quick to build using local materials, following the agreed standards, with the community involved in the design, upgradable, resistant to local hazards, easy to extend, customisable, and culturally acceptable.

## VI. Concluding remarks

When designing new strategies, the concepts of flexibility and self-building should be taken into account, even if houses are planned to be temporary. In practice, families use and upgrade whatever is provided to them in terms of shelter. Although standard, one-size-fits-all approaches are frequently used for economic reasons, flexible approaches can ensure that structures are open to be adapted to local standards and cultural needs. Post-disaster accommodation is crucial in the short-term, but it should also satisfy social needs and long-term outcomes. Thus, future designs should consider the capacity for expansion in order to accommodate family members, different uses, and future upgrading. Flexibility provides families with the option to customise their dwellings, to use their house as a multifunctional space, to feel attached to it, and most importantly to call it ‘home’.

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# Appendices

# Appendix 1: Literature review

A Systematic Literature Review is a comprehensive review of documents selected to address a specific question using a systematic method, comprising 6 phases (Jesson et al., 2011). These phases were used in this thesis, as follows:

| **Phase 1: Mapping the field through a scoping review** | |
|---|---|
| Definition of questions | What are the terms used for post-disaster shelter?<br>What are the definitions of post-disaster shelter?<br>What are the common definitions? |
| Keywords | Emergency Shelter; Temporary Shelter; Temporary Housing; Temporary Accommodation; and Transitional Shelter; Core House; Core Shelter or One-Room Shelter; Disaster Relief Shelter; Post-disaster Housing; Post-Disaster Shelter; Post-Disaster Temporary Dwelling; Progressive Shelter; Semi-Permanent Shelter; Sites and Services; Temporary Dwelling; Transitional Homes; Transitional Housing; T-Shelter. |
| Inclusion and Exclusion Criteria | Timeframe: Between 1995 and 2015.<br>Language: English.<br>Documents that include explicit definition of the shelter.<br>Quality Criteria: Peer reviewed articles and conference papers, NGO reports, guidelines, books, thesis including the terms with references<br>Excluded: non peer reviewed articles, non-peer reviewed conference papers, thesis without referencing. |

| **Phase 2: Comprehensive search** | |
|---|---|
| Selection of Electronic Databases | **Academic texts in bibliographic databases and online repositories**: JStor (www.jstor.org), Directory of Open Access Journals (https://doaj.org), Science Direct (www.sciencedirect.com), Scopus (www.scopus.com), Web of Science (http://wok.mimas.ac.uk/), Google Scholar (https://scholar.google.com/), ERIC (http://eric.ed.gov/), Science Research (http://scienceresearch.com/), World Wide Science (http://worldwidescience.org), Science Research (http://scienceresearch.com), Scielo (www.scielo.org), Science (www.science.gov), Research Gate (www.researchgate.net).<br>**Academic texts in journal catalogues:** Taylor & Francis Online (www.tandfonline.com), SAGE journals online (http://online.sagepub.com)<br>**Academic texts in Libraries, University Catalogues and Repositories**: British Library Ethos (ethos.bl.uk) University of Cambridge (www.lib.cam.ac.uk), University of Cambridge DSpace (www.repository.cam.ac.uk), MIT DSpace (http://dspace.mit.edu), Digital Access Data at Harvard (http://dash.harvard.edu), Oxford University Research Archive (http://ora.ox.ac.uk/), UCL Discovery Repository (http://discovery.ucl.ac.uk).<br>**Texts in websites about disaster research:** i-Rec (www.grif.umontreal.ca/i-rec.htm), Shelter Centre Library (www.sheltercentre.org), ALNAP Website (www.alnap.org), Shelter Case Studies (www.sheltercasestudies.org), Humanitarian Library (http://humanitarianlibrary.org/)<br>**Documents produced by NGOs and United Nations Agencies official websites**: IFRC (www.ifrc.org), UNHABITAT (http://unhabitat.org/urban-knowledge/publications/), UNHCR (www.unhcr.org), World Bank (www.worldbank.org/reference). |
| | **Future research: In Spanish**<br>**Academic texts in Libraries, University Catalogues and Repositories** Repositorio Universidad Católica de Chile (https://repositorio.uc.cl), Repositorio Universidad Catolica del Peru (http://biblioteca.pucp.edu.pe/recursos-electronicos/repositorios-pucp), Repositorio Institucional Universidad Nacional Autonoma de Mexico (www.rad.unam.mx)<br>**Academic texts in websites about disaster research:** LA RED (www.la-red.org).<br>**Texts in websites about disaster research:** TECHO, Fundacion Vivienda.<br>**Documents produced by Governments' oficial websites**: Ministerio de vivienda de Chile (www.minvu.gob.cl), Ministerio de Vivienda, Construcción y Saneamiento de Perú (www.vivienda.gob.pe). |

| Phase 3: Quality Assessment | |
|---|---|
| Hierarchy of research | Papers in and papers out of the review. Explanation for excluding papers.<br>- Type of publication: Peer review or not peer review (grey)<br>- Publication type: Academic journal, professional, book or chapter, Master's or Doctoral Dissertation.<br>- Publication date: after 1995 not included.<br>- International- national. Included if reports are based in more than one case.<br>- Widely accepted guidelines or published books, based in more than one case, use of references. |
| **Phase 4: Data Extraction** | |
| Extraction of Relevant Data | - Bibliographic details.<br>- Organisation or Institutions.<br>- Aim and focus of the document.<br>- Description of post-disaster accommodation. |
| **Phase 5: Synthesis** | |
| Synthesis of data from each document | - Collate and present the extracted data: Text explaining and a tables with information. |
| **Phase 6: Write up** | |
| Write up an impartial and comprehensive report using a systematic review format | - Main concepts and definitions.<br>- Comparison of concepts and terms.<br>- Discussion. |
| Disseminate | - Thesis.<br>- Publish in journals. |

# Appendix 2: Standards and Parameters

International organisations and agencies have agreed on a group of standards that provide minimum guidelines for humanitarian responses, allowing projects to be monitored accordingly. Nevertheless, every situation is unique and, therefore, these guidelines require adjustment to local circumstances, and the agreement of stakeholders, donors and actors involved. At an international level, the Sphere Handbook and UNHCR standards are two of the most used sets of guidelines. The Sphere Project, initiated in 1997 by a group of NGOs, the Red Cross, and the Red Crescent Movement, defines a set of universal minimum standards, with the objective of improving humanitarian responses in disaster and conflict situations. These standards are comprised in the 'Sphere Handbook, The Humanitarian Charter and Minimum Standards in Humanitarian Response', in particular in the Chapter: 'Minimum Standards in Shelter, Settlement and Non-Food Items' (Sphere Project, 2011). The United Nations High Commissioner for Refugees (UNHCR) defines shelter standards in the 'Handbook for Emergencies' including site selection, planning, and shelter, with an emphasis on planned camps and collective centres (UNHCR, 2015). Despite some differences, The Sphere Handbook and the UNHCR Handbook agree on several key points, such as the minimum surface area of camp per person (45 $m^2$) and covered floor (3.5 $m^2$) The Sphere standards also summarise adequate housing as providing (Gray and Bayley, 2015, p. 7):

- Sufficient space and protection from climatic hazards or other threats to health.
- Availability of services, facilities, materials and infrastructure.
- Affordability, habitability, accessibility, location and cultural appropriateness.
- Sustainable access to natural and common resources; safe drinking water; energy for cooking, heating and lighting; sanitation and washing facilities; means of food storage; refuse disposal; site drainage; and emergency services.
- Safe access to healthcare services, schools, childcare centres and other social facilities, as well as to livelihood opportunities.
- Expression of cultural identity and diversity of housing through housing policy and construction.

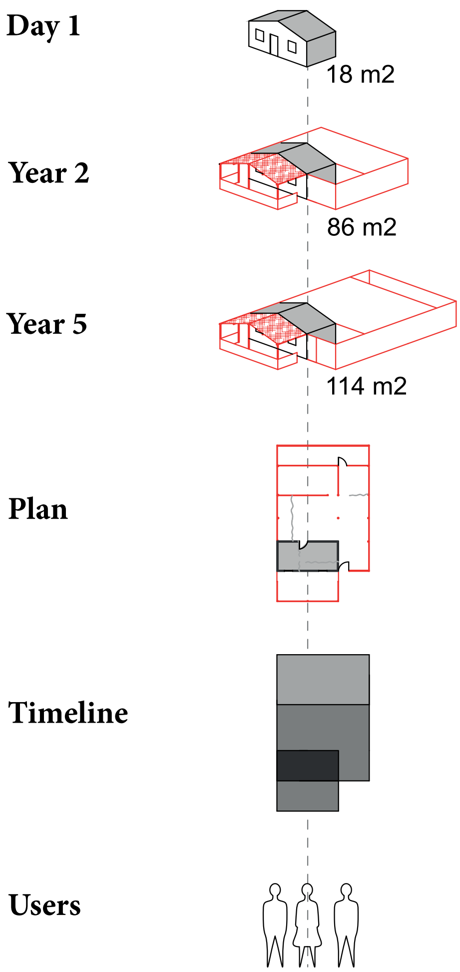
Therefore, the standards define more than just materials and surface area, also including aspects such as quality and safety. Any structural solution should perform well during the intended time of use, and the materials must resist providing enough protection from external factors, such as rain, snow, wind, and high temperatures (Félix et al., 2015, p. 14). The dwelling must suit the needs of each family, enabling different configurations and modifications according to the size of the families (Félix et al., 2015, p. 14). This leads to the idea of flexibility and adaptation. Other issues that need to be revised before building post-disaster accommodation, whether temporary, transitional or permanent, is to revise local building codes, and land building codes. Nevertheless, in some cases such codes do not exist and it may be more achievable to agree on standards for safety, comfort and environmental impact for the reconstruction programme, and to use these standards to develop or update existing building codes (Shelter Centre, 2010, pp. 175–176).

| **SPHERE HANDBOOK (2004) Indicators** | **UNHCR HANDBOOK FOR EMERGENCIES (2007) Standards** |
|---|---|
| **Minimum surface area of camp per person** | |
| 45 m$^2$ including infrastructure (pp.216-17) | 45 m$^2$ per person recommended (including garden). Should not be less than 30 m$^2$ per person (p.210) |
| **Minimum covered floor area per person** | |
| At least 3.5 m$^2$ except in extreme circumstances (pp.219-220) | 3.5 m$^2$ in warm climate. 4.5-5.5 m$^2$ in cold climate or urban situations, including kitchen and bathing facilities (pp.221) |
| **Minimum distance between buildings** | |
| The planning guidance of m$^2$ per person includes firebreaks (p.217) | Minimum twice structure height, three to four times structure height if highly flammable (p.219) |

# Appendix 3: Cases Peru

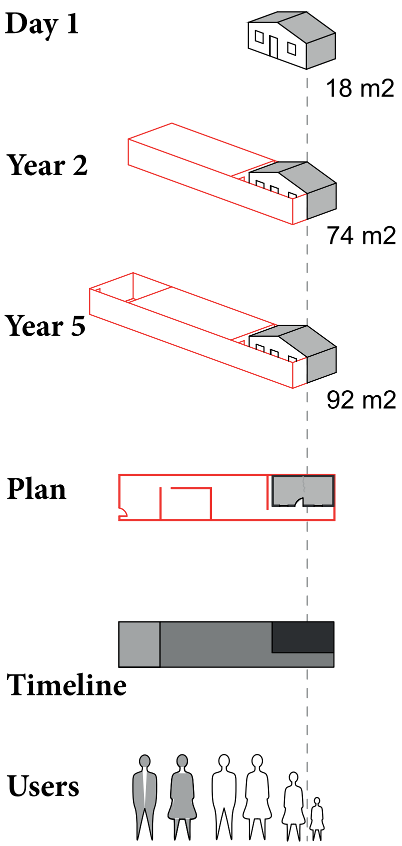
### CASE 1. CAUCATO

In this house live a couple and their adult son. The temporary house was assembled at the front of the plot. In the wake of the 2007 earthquake the position of the door was changed, a front porch was created, and the house was extended with *'Caña de Guayaquil'* and *'esterillas'*. The house was divided in three parts with fabric curtains. Two areas were used as bedrooms and a third as a shop, accessed by costumers through a window. The extension was used as a storage room, living room and dining room. After the second year, the family built a kitchen with lightweight materials. The dining room was transformed into a restaurant and panels of the temporary house were painted. The changes were carried out with help from relatives and friends and the materials were both bought in commercial shops in a nearby village (San Clemente) and donated. The cost of the modifications for the family was in the range of 100-500 USD. At the time of the visit they were applying to the programme *'Techo Propio'* to build a new house on the same parcel of land. The family would like to use the temporary house as an extension on the first floor of the permanent house.



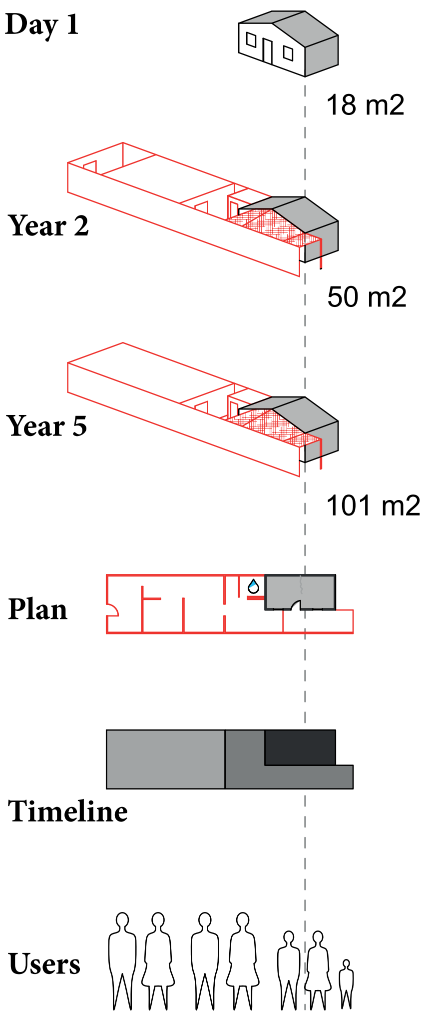

## CASE 2. MENSÍA

On this plot live six people, consisting of a nuclear family with two daughters plus grandparents. Their temporary house was initially located on the village football pitch until the rubble from the destroyed house was cleared up. After two months, the house was assembled at the back of their land. The front part of the permanent house was rebuilt with brick within the first two years, and the living room was built after that, which also provided a new façade facing the road. The house's kitchen and dining room were built from brick between the permanent and the temporary house. The temporary house was used as a bedroom only during the recovery and at the time of the visit. Main changes made to the shelter were a layer of paint to protect the wall panels, the provision of electricity to the house, and internal divisions with fabric curtains. The permanent construction was built by relatives and friends and the materials were bought in San Clemente and Pisco City. The funds used for buying materials were taken from savings and the *'bono 6000'*. The cost of the changes was between 2,000-2,500 USD. This family was applying to the programme *'Techo Propio'* for support to complete the construction of the permanent house in the same plot, and they planned to use the temporary house as an extension on the first floor.



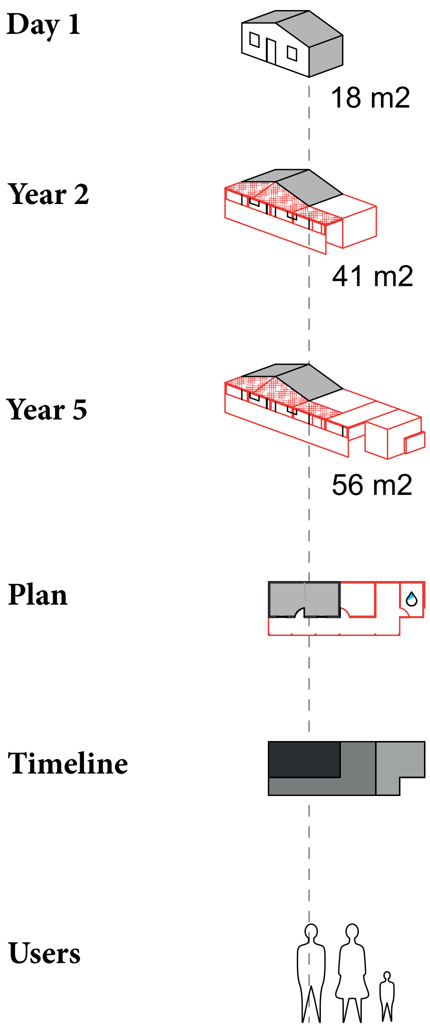

## CASE 3. MENSÍA

Here lives a nuclear family with three children plus grandparents. The temporary house was first built on the football court and then moved to the plot owned by the family. Part of the permanent house was built with brick, and it has a bedroom for the nuclear family. The temporary house, meanwhile, is used by the grandparents. The brick work of the permanent house was built by a mason and the materials were bought using the *'bono 6000'* plus family's savings. A lightweight structure was also built with bamboo and *'esterilla' to* create an intermediate space. The timber panels were painted, the shelter was connected to the electrical network and fabric curtains were used for dividing the space into a bedroom and a living room. The permanent house has one main bedroom, a kitchen, and a dining area between the two houses. In addition, Caritas provided the family with materials for building a toilet and an improved kitchen. The toilet was built from corrugated iron and bricks, and the improved kitchen was built with adobe bricks. The cost of the improvements was between 2,000 and 2,500 USD, without the donation from Caritas. These residents were not applying for a permanent house from the government, and their plans for the temporary house were to maintain it as an extension and paint it again for protection.



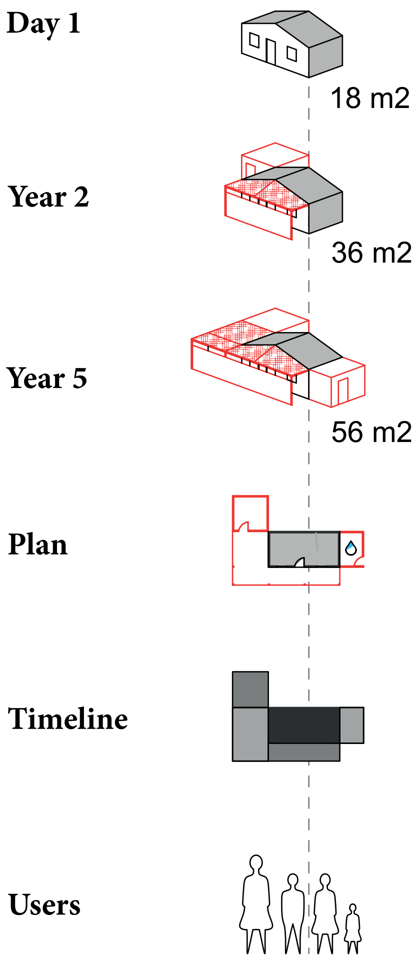

## CASE 4. MENSÍA

This house is used by a family of two adults and a child. This family had no other alternatives for a permanent house, and therefore the temporary house was used as the permanent solution. During the first phase, the floor panels were removed and used for building the walls of the kitchen and the dining room area, adjacent to the shelter. Another initial addition was a lightweight structure built with *'Caña de Guayaquil'* and *'esterilla'* that covered the front of the shelter and the kitchen, to create a shaded space and to cool the house. The shelter was divided into two spaces with fabric curtains, one for the bedroom and the other for the living room. Both the shelter and the kitchen area had electricity. In a second stage, the family built an improved kitchen and a toilet with support from Caritas. The materials used were brick and adobe for the kitchen and corrugated iron for the walls. The cost of the improvements was in the range of 100-500 USD for the extensions, without including the costs of the materials provided by Caritas.



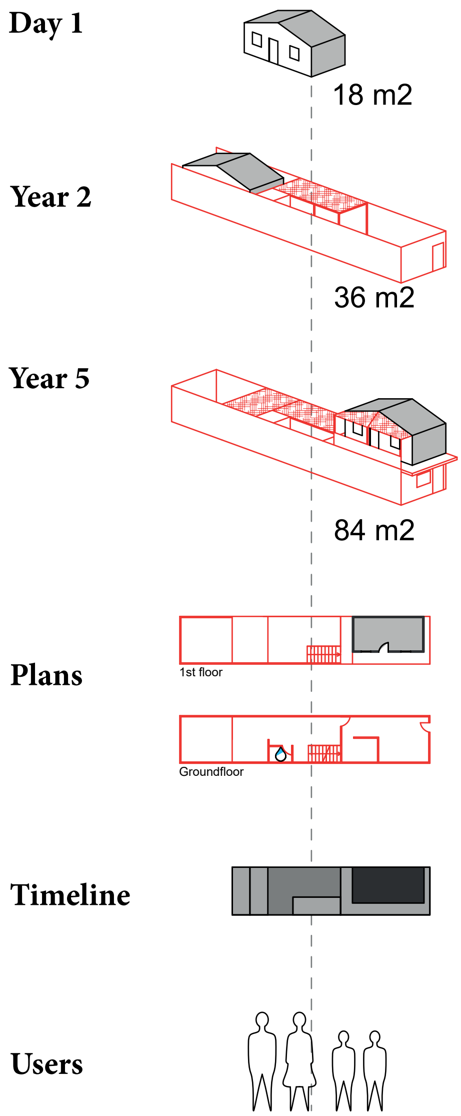

**CASE 5. MENSÍA**

This household consists of a mother and her three children. The floor panels were removed and used as walls for the kitchen, and a concrete slab was built. During the second stage, a front porch was added to the house with *'Caña de Guayaquil'* and *'esterilla'*. During the third stage, the family built an improved kitchen and a toilet, with corrugated iron walls provided by Caritas. The kitchen was built at one end of the house and the toilet at the other. The porch connected the kitchen area to the house and it was used as a living room. This extension created an intermediate shaded space for the family. The shelter was divided into two spaces by a fabric curtain: one bedroom for the oldest child (for having some privacy) and the remaining as bedroom for the rest of the family. The shelter was connected to the electricity network and exterior of the shelter was not painted. The cost of the improvements was around 100-500 USD, not including the materials provided by Caritas. The family was applying to the programme *'Techo Propio'* for support to buy a house on another tract of land. In the future, the family planned to use the whole house as an extension on top of a permanent house to provide a private bedroom for their oldest child.



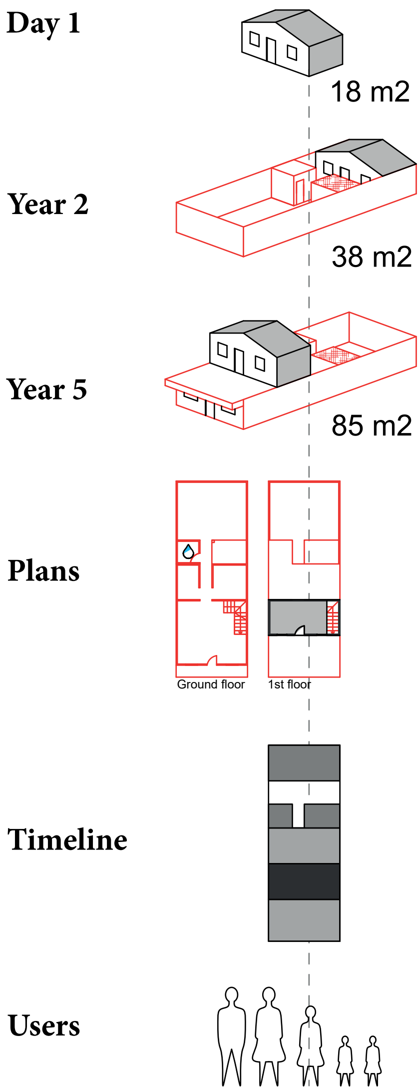

**CASE 6. EL PALMAR**

A temporary house was provided to this nuclear family with two teenagers, living on a narrow and long plot of 4 m. x 21m. Initially, the family erected the temporary house at the back of the plot, while they removed the rubble from the destroyed house. Then they built a lightweight structure with *'Caña de Guayaquil'* and *'esterilla'* in front of the temporary shelter for the kitchen and dining area. The family used the *'bono 6000'* and savings to construct the permanent house during the second stage and hired a mason to build the extension. The new house was built with brick and concrete, and the kitchen and toilet were provided by Caritas. The shelter was moved on top of the permanent house and the floor panels were used as ceiling panels for an interior patio. The patio has a kitchen and dining area, the permanent house has a bedroom and living room, and the temporary shelter is used as a bedroom on the first floor. In total, the cost of these improvements was between 2,000 and 2,500 USD, excluding the materials provided by Caritas. Future plans were to build the first floor with 'noble materials' and to use the shelter as an extension bedroom for the family's oldest son. At the moment of my visit, they were not applying for government funds.



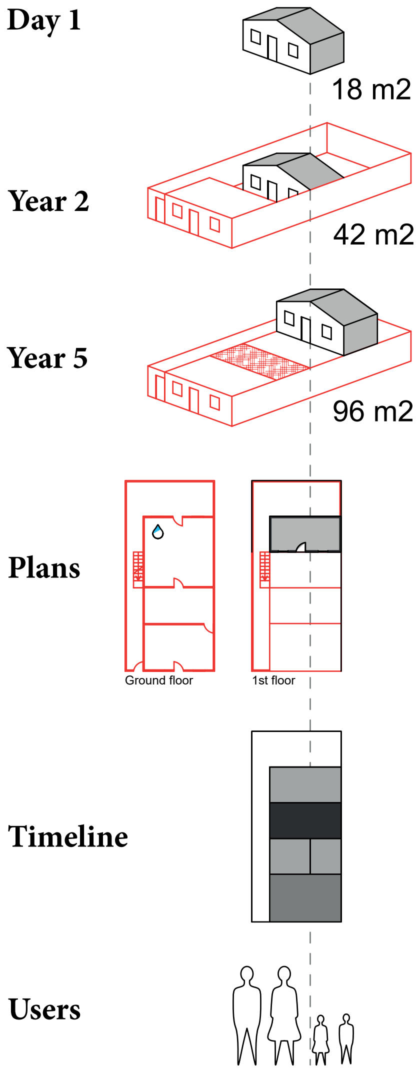

**CASE 7. EL PALMAR**

This household consisted of a nuclear family with three children. The temporary house was initially situated at the back of the plot. During the second phase, this house was used as a bedroom and living room, and the toilet and kitchen donated by Caritas were built in front of the house. After rubble from the destroyed house was removed, and the family received the *'bono 6000'*, they built a permanent house at the front of their tract of land. The materials used for the permanent house were brick and concrete. At the moment of my visit, this permanent house was used as a living room, dining room and bedroom (one for the parents and another for the two younger children). The temporary house was painted, moved on top of the permanent house, and used as the oldest daughter's bedroom. A staircase with concrete was built and the floor panels of the shelter were used in the ceilings for the bedrooms on the ground floor. The cost of the changes was between 2,000 and 2,500 USD, not considering the materials provided by Caritas. This family, meanwhile, was not applying for government funds. Future plans were to build the first floor in brick and concrete and to use the house as an extension at the back of the plot.



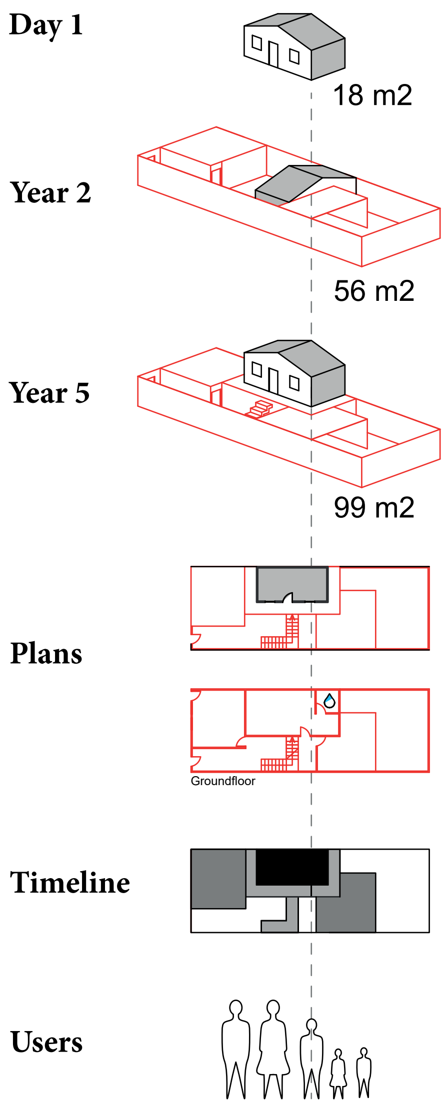

## CASE 8. BERNALES

A temporary house was provided to this nuclear family with two children. The house was built in the middle of the plot to allow space for removing the rubble. In the second phase, the family built the permanent house at front of the plot, leaving an intermediate/open space for the kitchen. The temporary house was used as a bedroom, and the permanent house as a living and dining room. The family used their own savings for the changes. During the third stage, the temporary house was disassembled and the permanent house was extended. The family hired a mason to build the extension. The shelter was assembled on the first floor to be used as a bedroom, while the floor panels were used as division walls in the permanent house. The kitchen area was covered with a lightweight structure of *'Caña de Guayaquil'* and *'esterilla'* between the main bedroom and living room. A timber ladder was built to connect the two floors. The cost of the extensions was around 1,000 and 1,500 USD. This family was not applying for government funds. They wished to build the first floor with 'noble materials' and to use the panels of the shelter for internal divisions and extensions.



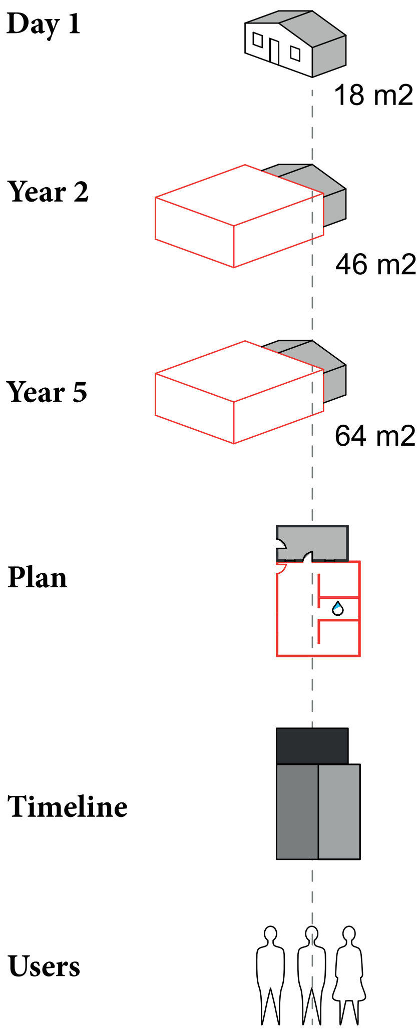

## CASE 9. BERNALES

This house is inhabited by a nuclear family with three children. The shelter has been extensively used during different stages. Initially, the temporary house was assembled in the middle of the family's plot, leaving space to build a permanent house at the front. The permanent house was built with *'quincha mejorada'* and it was used as a living room, while the shelter was used as a bedroom. The permanent house was built by the family and a hired worker with funds from the IFRC. The area between the temporary and the permanent house was used as a kitchen. During the third stage, the family used funds from *'Techo Propio'* and savings to build the rest of the house. The extension was constructed with concrete and concrete blocks and it comprised a bedroom and a toilet. The floor panels of the temporary house were used as formwork for the extensions. The temporary house was painted and used as a bedroom on the first floor. An exterior staircase was built from concrete to connect the two floors. The cost of the improvements was between 7,000 and 7,500 USD, considering the grant from the government and family savings but excluding the materials provided by IFRC. The family planned to keep using their temporary house for future extensions.



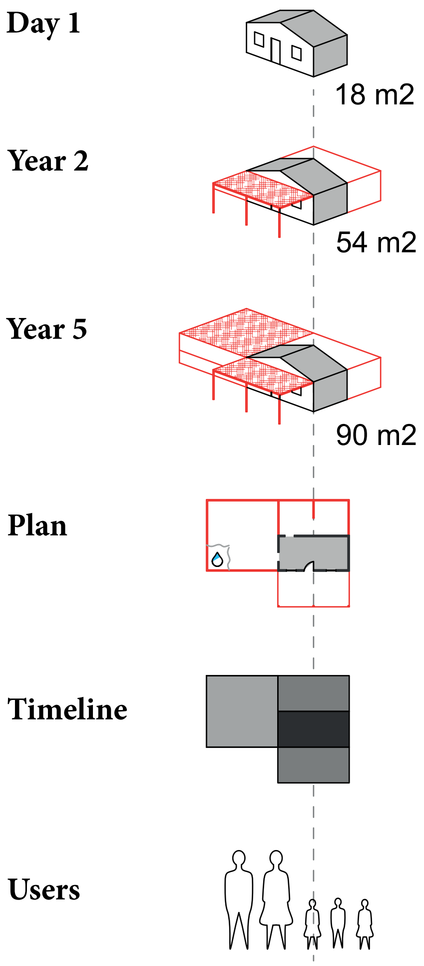

**CASE 10. SANTA ROSA**

This house was provided to a father living with his adult daughter and son. Soon after the earthquake, the family built the exterior walls of their permanent house with reinforced bricks. The temporary house was used as a bedroom and a new door was added to the side of the shelter. The permanent house was built with reinforced brick covered with plaster, bamboo and *'esterilla'*. This space was used as a living room, dining room and kitchen. During the third stage, the family transformed their temporary house into a kitchen and laundry area. They then divided the permanent house into two bedrooms, one for the toilet, and another for a dining and living room. All the materials were bought by the family with savings or were donated by relatives and friends. The cost of the extensions ranged between 500 and 1,500 USD. The construction was carried out by members of the family without support from the government, volunteers or NGOs. At the moment of the visit, the family was not applying to any grant from the government, although they plan to use the temporary house as an extension on the first floor. As seen in other cases, rebars from the brick walls were left coming out of the roof for future extensions.



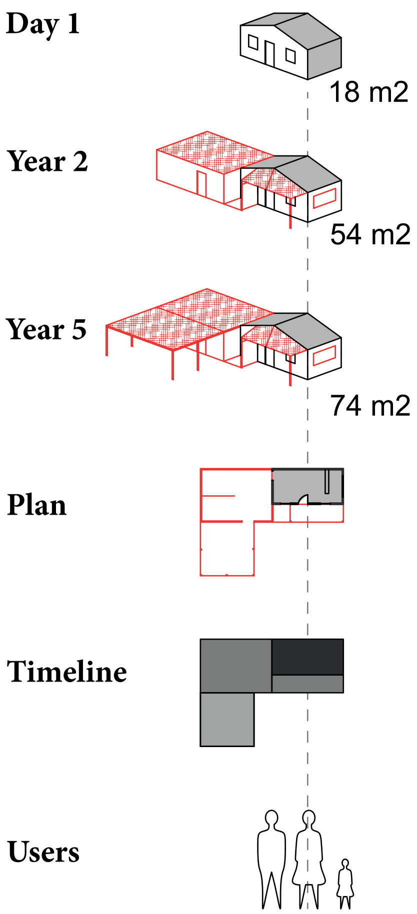

**CASE 11. SANTA ROSA**

In this house lives a nuclear family with three small children. During the second stage, the floor panels were removed and used for building two bedrooms adjacent to the shelter. The temporary house served as a living and dining room. Three new doors were added to the shelter to provide access to it from the bedrooms and a patio. A concrete slab floor was built inside the shelter and the wall panels were painted. During the same phase, a front porch was built with '*Caña de Guayaquil*' and '*esterilla*'. This space is used during the warmest hours of the day for cooling the shelter and for protecting the family car. In the third stage, another extension was constructed with adobe bricks, '*Caña de Guayaquil*', '*esterilla*' and fabric curtains. This extension comprised the kitchen, dining room, and an informal toilet. The roof was built with 'esterilla', creating a shaded space. All of the extensions were constructed by family members. Materials were donated by relatives or bought with household savings, and the cost of the extensions was between 1 and 500 USD. The family was not applying to any funds at this time, and the temporary house was considered to be their permanent solution. Future plans are to separate the kitchen from the dining room and to build a formal toilet.




## CASE 12. SANTA ROSA

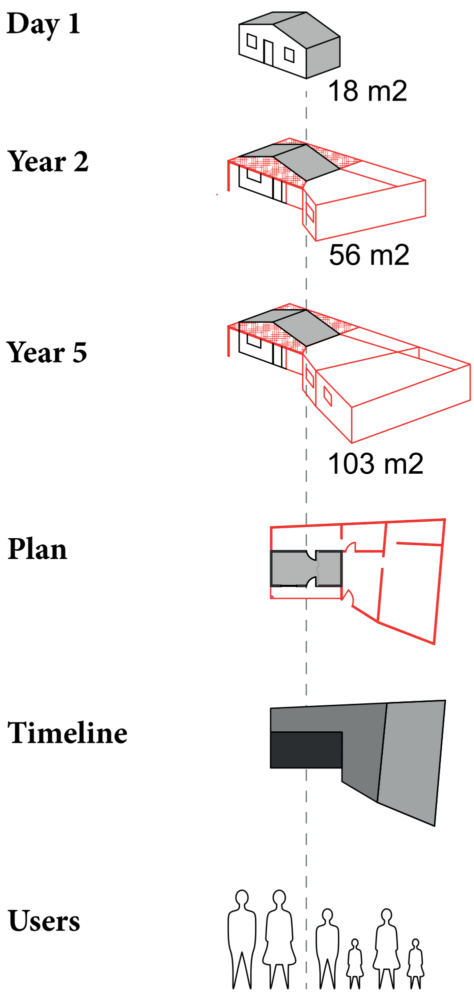
This shelter was provided to a nuclear family with a young child. Soon after the disaster, the family made changes to the shelter to be used as a corner shop. A family member had experience in carpentry, and made a roof window, painted the walls, added another door, enlarged the existing windows, and added metal bars to them in order to protect the shop from robbery. An extension to the shelter was made with adobe and a lightweight roof, to be used as bedrooms. The temporary house was divided into two spaces using furniture: the dining and living room and the shop. During the second phase, another space was added with '*Caña de Guayaquil*' and *'esterilla'*. This place was used as a kitchen at the time of my visit. The family received the *'Bono 6000'* and their plans were to keep improving the house with 'noble materials' and to replace the floor panels with a concrete slab. The cost of the extensions was between 1 and 500 USD. The family told me of their plan to use the materials of the temporary house for an extension on the first floor.





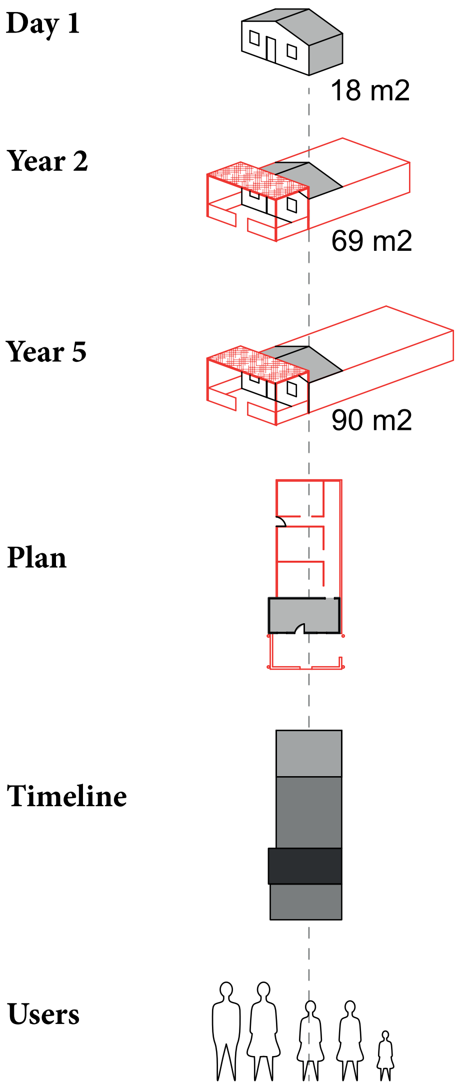
## CASE 13. SANTA ROSA

This house shelters a nuclear family with four children, with the oldest already an adult. The shelter was assembled next to the destroyed house. Some panels of the temporary house were removed and used for extensions in different parts of the plot. Soon after the earthquake, its floor panels were used for dividing a patio and two of its lateral panels were used to build the kitchen. The dining and living rooms were built with clay brick. The temporary house was divided into two spaces with a fabric curtain: a shop and a bedroom. The wall panels were painted and a concrete slab was built inside the shelter. Two intermediate spaces were built with *'Caña de Guayaquil'* and *'esterilla'* at the front and rear of the house. During the third phase, the family rebuilt the destroyed house with clay bricks. A new bedroom was built with reinforced bricks, *'Caña de Guayaquil', 'esterilla'* and plastic sheet. The family used their savings to purchase materials and a family member built the extensions during weekends. The cost of the extensions ranges between 500 and 1,500 USD. At the time of the visit, the family was not applying for any government grant, but their plan was to keep improving the house, to replace the panels of the shelter with brick walls and to use these panels to create internal divisions.



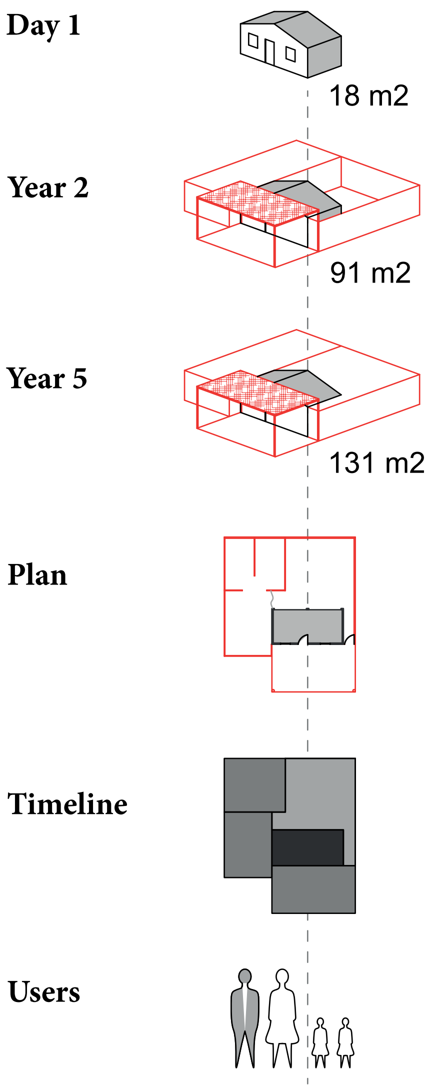

## CASE 14. CAÑAPAY

A nuclear family with three children inhabited this house. The temporary house was assembled at the front of the plot. An early extension was a front porch where the family gathered during the hottest hours of the day. The structure was constructed with *'Caña de Guayaquil'*, *'esterilla'* and fabric. Also during the second stage, the floor panels were removed and used for building two bedrooms, a new door was opened at the back of the house, and a concrete slab replaced the floor panels. The shelter was used as a living room, dining room and kitchen. A lightweight structure built with *'Caña de Guayaquil'*, plastic and fabric forms the roof of the bedrooms. During the third stage, the kitchen was built at the end of the corridor. The kitchen walls were built with *'esterillas'* covered with plastic. This household did not receive funding from the government, therefore they used family savings to purchase the materials for the extensions. The construction was carried out by members of the family during weekends, and the cost of the improvements was between 1,000 and 1,500 USD. At the moment of the visit, the family did not plan to apply for government funds, and the temporary house was considered the permanent accommodation. Their future plan was to build another room with 'noble materials'.




## CASE 15. CAÑAPAY

This temporary house is inhabited by a nuclear family with two children. It was painted during the second stage and a porch was built at the front with *'Caña de Guayaquil'* and *'esterilla'*. This was the biggest intermediate space of all the houses I visited. The family removed the floor panels and two lateral panels to build two bedrooms and the kitchen. During the third stage, the house was mounted on a concrete slab and the openings were used to connect the living room with the dining area, while fabric curtains were used as divisions. Then the family built a structure with *'Caña de Guayaquil'* and plastic in order to connect the extensions and to cover the dining room. The changes were carried out by a hired carpenter, with help from a member of the family. The cost of materials and labour was between 1,000 and 1,500 USD, which the family paid for using savings. This solution was being used as permanent accommodation for the family, and they did not intend to apply to government funds at the time of my visit. In the future, they planned to use savings to improve the quality of the house, to build with 'noble materials', and to use the panels of the temporary house in extensions.




# Appendix 4: Cases Chile

**CASE 1. CORONEL, Aldea Camilo Olavarría 3.**

In this house lives a single woman. An initial addition made to the house was a covered intermediate space shared with the adjacent house and made with corrugated iron and timber. The existing windows were enlarged, and new windows and a door were added. Boards of *'plumavit'* were added to the walls for insulation and *'internit'* boards were used for the ceiling. A layer of *'geomembrana'* was added to the house for waterproofing. During the third stage, a new room was added to the house, which has been used as a bedroom and a workplace (a sewing workshop). The temporary house is used as a kitchen, living room and dining room. Materials from the destroyed house were used for doors, windows, and insulation. The materials were bought using savings and donations from family and friends. The cost of the improvements was between 1 and 500 USD, not including the materials given by the government. The resident planned to move to a flat in a building block under the programme *'subsidio de reconstrucción'*, giving away or selling the temporary house.

**Day 1**

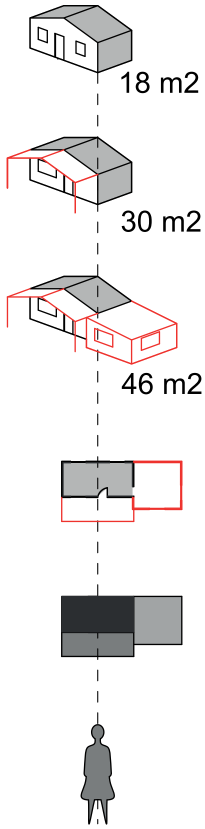
**Year 1**

**Year 2**

**Plan**

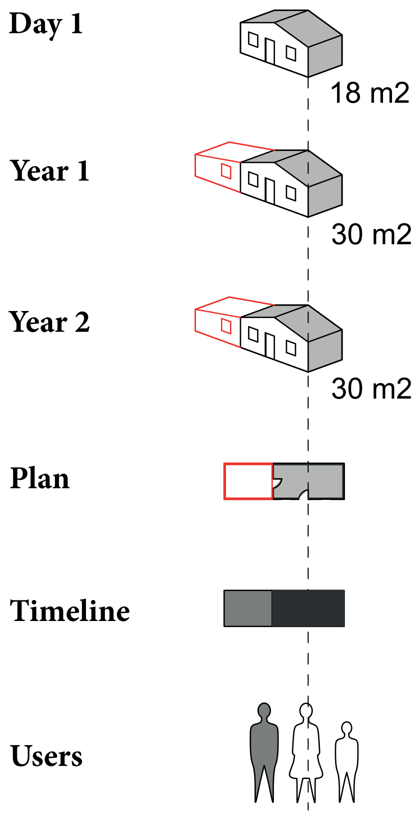
**Timeline**

**Users**



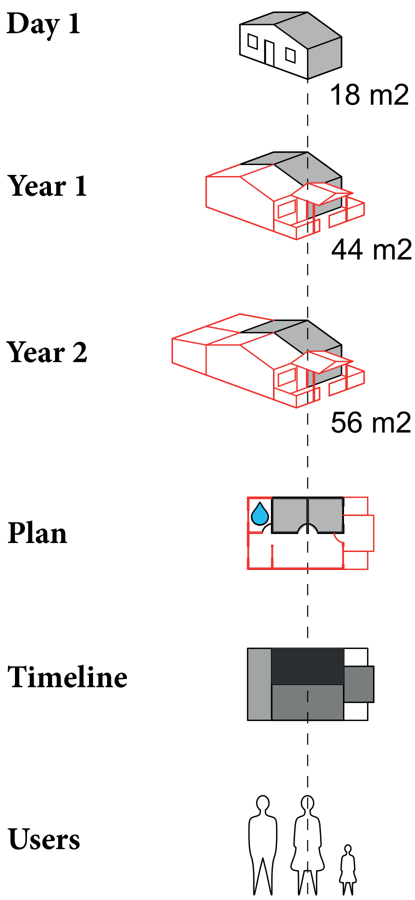

**CASE 2. CORONEL, Aldea Camilo Olavarría 3.**

In this house lived a nuclear family with a teenage son. The modifications were done soon after the temporary house was built, and no more changes were implemented in the following years. The shelter was insulated with *'plumavit'* and *'duraloc'*, and an extension to the roof and a layer of 'geomembrana' were constructed to protect the house from the rain. An extension with OSB panels and painted corrugated iron was made for the kitchen and storage room. The house is used as a dining room and bedroom. The materials were provided by the government and the extension was built with donations from friends and family. The cost of the modifications was between 1 and 500 USD, not accounting for the donations made to the family by the government. This house was not considered a permanent solution for the family and they were applying to the *'subsidio de reconstrucción'* to obtain a flat in the building block next to the *'aldea'*. Therefore, the temporary house would not be used in their future housing solution.



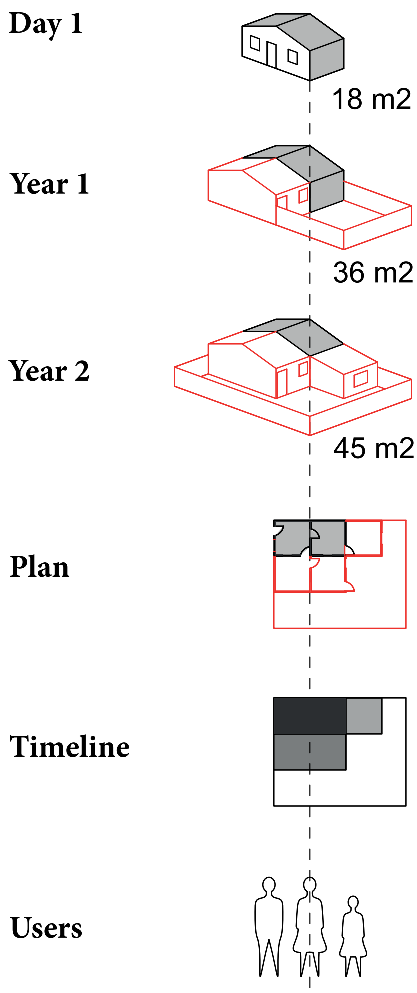

**CASE 3. CORONEL, Aldea Merquín 2.**

This house is used by a nuclear family with a young daughter. During the second stage, the family added insulation *(plumavit* and *aislapol)* and waterproof layers *(geomembrana)*, extended the house to the side, and built a front porch. A metal gate was added and the house was painted blue. The shelter was divided into two bedrooms and the extension was used as a living room, dining and kitchen. A new window and door were opened and the existing windows were closed. During the third stage, the house was extended to the back, for a kitchen and a bathroom. The panels were covered with *'cholguan'* and painted, and the floor was covered with 'Loose Lay Flooring'. Relatives with experience in construction built the extensions, and the materials were purchased in local shops with savings and donations from family and friends. The cost of the modifications was between 1 and 500 USD without including materials provided by the government. Although this shelter looked like a permanent house, the family has plans to move to a new house built by the government under the programme *'subsidio de reconstrucción'*. The household's future plans were to use panels and materials from the shelter to make extensions to the permanent house.



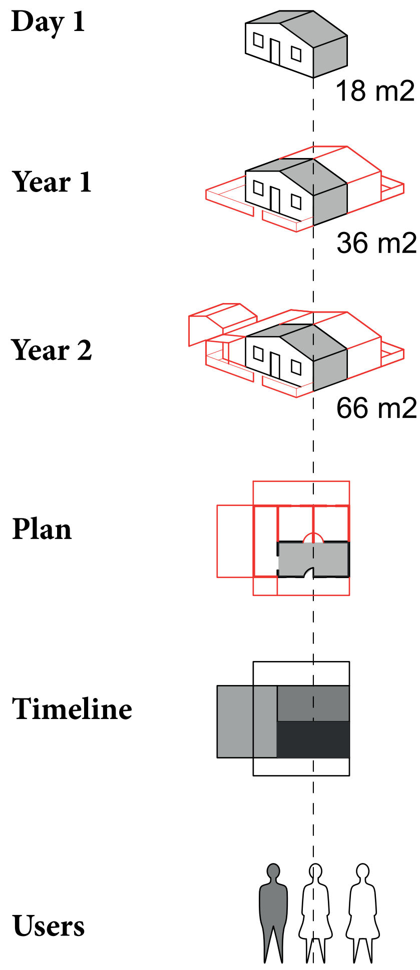

## CASE 4. CORONEL, Aldea Merquín 2

This *mediagua* was provided to a nuclear family with an adult daughter. The house was extended to the side during the second stage, keeping the shelter as a bedroom and living room, and using the extension as a corner shop and kitchen. A new door and window were opened. The temporary house and the extension were covered with *'internit'* and painted for protection. The roof was extended to protect the house from the rain and direct sunlight. Later the family extended the temporary house to the rear, using the shelter as a dining room and living room, and the extension as a bedroom. The materials used were OSB panels covered with corrugated iron. Once the neighbours moved, the family used the vacant space as a back garden. The extensions and improvements were carried out with help from relatives, and materials were either recovered from the destroyed house or bought from local shops. The cost of the improvements was between 1 and 500 USD, without taking into account the materials donated by the government. At the time of my visit this family was applying to the *'subsidio de reconstrucción'*, and wanted to use the panels of the temporary house to construct extensions.



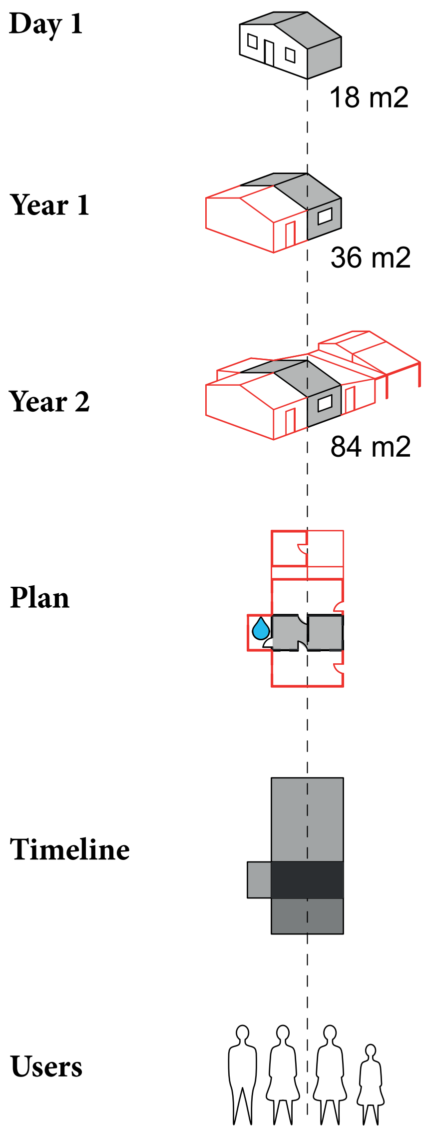

**CASE 5. DICHATO**

This house was inhabited by a family of three adults. During the first year, an extension was made for two bedrooms, and the shelter was used as a dining room, living room and kitchen. This household used materials recovered from the destroyed house such as windows, doors and timber. *'Plumavit'* and *'cholguán'* provided by the government was used for insulation and waterproofing. In addition, the family painted the house inside and outside. A front garden was added in order to differentiate private from public space. During the third stage, the kitchen was built as a new room and a garage was added to the side of the house. This house did not have a bathroom, and the family used toilets provided by the government, which they shared with two other households. The modifications were constructed by family members using materials donated by the government, family and friends and their own savings. The cost was between 1 and 500 USD, not including the cost of materials given by the government. At the moment of the visit the family's permanent house was under construction with the programme *'subsidio de reconstrucción'*. Future plans are to use the materials of the shelter for a new room in the permanent house.



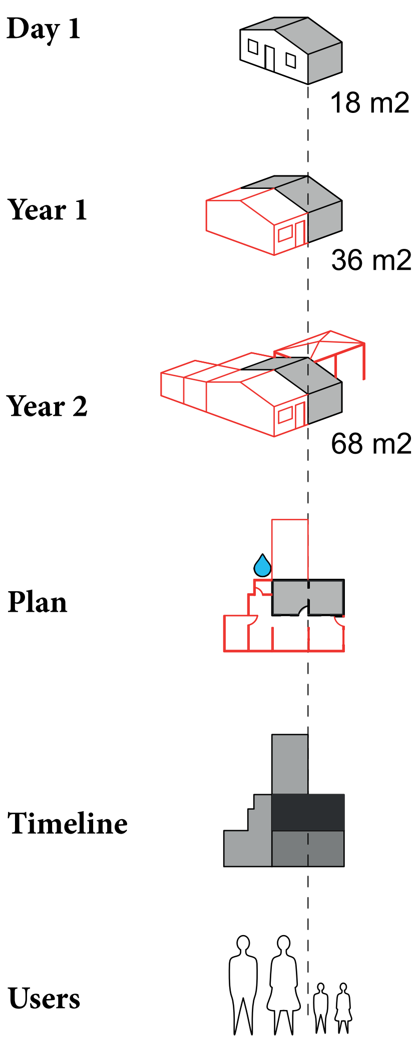

**CASE 6. CURANIPE**

In this *mediagua* lives a nuclear family with two teenagers. The first modification made was to extend the house to the side, using the vacant space between the shelter and the neighbouring. Soon after, insulation and waterproofing were added with *'plumavit'* and *'geomembrana'*. The extension was used as a bedroom and the shelter as a living room. During the third stage, the temporary house on the other side was disassembled, and therefore, the family found more space to grow. A new room was added to the side for the kitchen and dining room, a toilet was built at the back of the house, and a detached room was built to use as storage for fishing gear and tools used in the father's job. In addition, an extended roof was used as a parking space. The extensions were made by the family using materials recovered from the destroyed house and purchased in local shops. Insulation and waterproofing materials were provided by the government and the extensions were made with family savings. The cost of the modifications, not including the materials provided by the government, was between 1 and 500 USD. At the time of the visit the family was applying for a permanent house provided by the government, and was planning to use the materials of the shelter in future extensions.



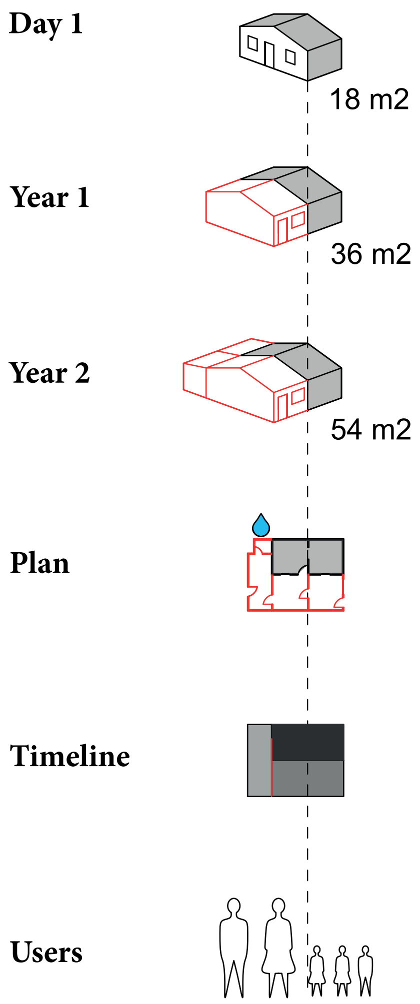

## CASE 7. CURANIPE

In this house lived a nuclear family with two children. The first modification was to extend to the side, in the space between shelters. This extension was used as a dining room and kitchen, which were separated with MDF panels with timber logs as cladding recovered from the destroyed house. The shelter was divided into two spaces with MDF panels, creating two bedrooms. It was insulated with *'plumavit'* and covered with a layer of *'geomembrana'* provided by the government. Materials for the extension were provided by the NGO *Hogar de Cristo*. During the third stage, the house was extended to the rear with a laundry area and a toilet provided by Oxfam. Finally, a parking space next to the house was built with a metal structure covered with plastic. The extensions were made by the family, with help from relatives and friends. Not taking into account government support, the cost of the modifications was between 1 and 500 USD. This family was applying to the *'subsidio de reconstrucción'* and they planed to use the materials from the shelter for future extensions to a permanent house.



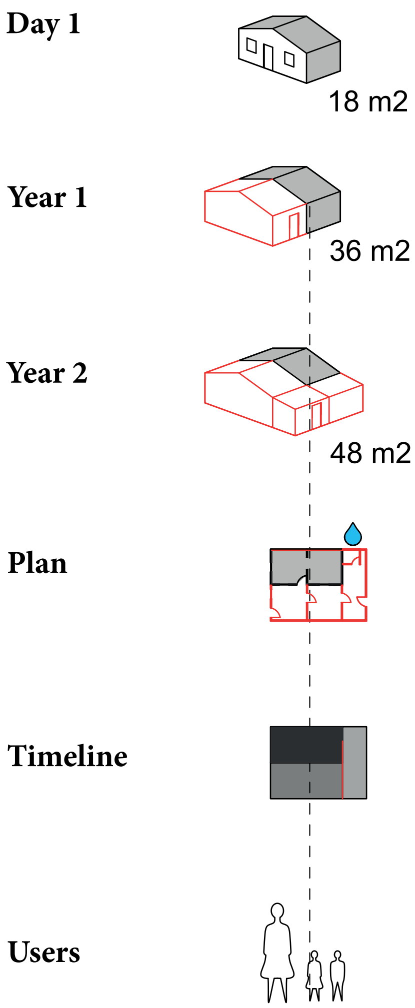

**CASE 8. CURANIPE**

In this house there lived a nuclear family with three children. Initially the temporary house was extended to the side, using the space between shelters. This extended space was divided into two: the living room and the dining room and kitchen. The temporary house was also divided into two, creating two bedrooms. The shelter was insulated and waterproofed with materials provided by the government. The divisions and extensions were made using OSB and MDF panels purchased in local shops, and other materials used in the extensions were recovered from the destroyed house. The ceiling was constructed using timber panels donated by *'programa puente'*. During the third stage the family extended the house to the rear, with a toilet and laundry area donated by Oxfam. The initial extension was constructed by volunteers and the second extension was made by the family. In this case, the residents did not have savings with which to pay for improvements, anatod therefore all costs were covered by the government, NGOs, relatives and friends. The family was applying to the *'subsidio de reconstrucción'* and planned to use the materials of the house in a permanent one, if possible.



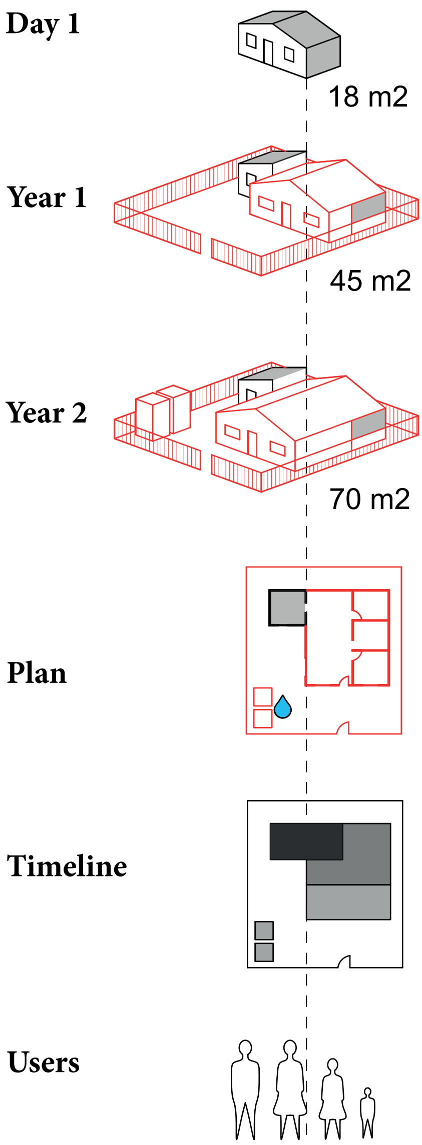

**CASE 9. CURANIPE**

This house was used by a mother and her two daughters. The house was extended to the side, in the space between shelters, and the temporary house was divided into two bedrooms. A new window was added to the side of the shelter and the extension was used as a dining room and kitchen. The shelter and the extension were insulated with *'plumavit'* provided by the government and NGOs. The *'geomembrana'* was also used for covering the shelter and the extension. Other materials used for dividing spaces and for the extensions were MDF and OSB panels. During the third stage the house was extended to the back, including a laundry area and a toilet provided by Oxfam. All the extensions were done by volunteers, and all the materials were donated to the family. This family was applying to the *'subsidio de reconstruccion'* to get a new house, and their plan was to use some materials from the shelter to extend the permanent house.



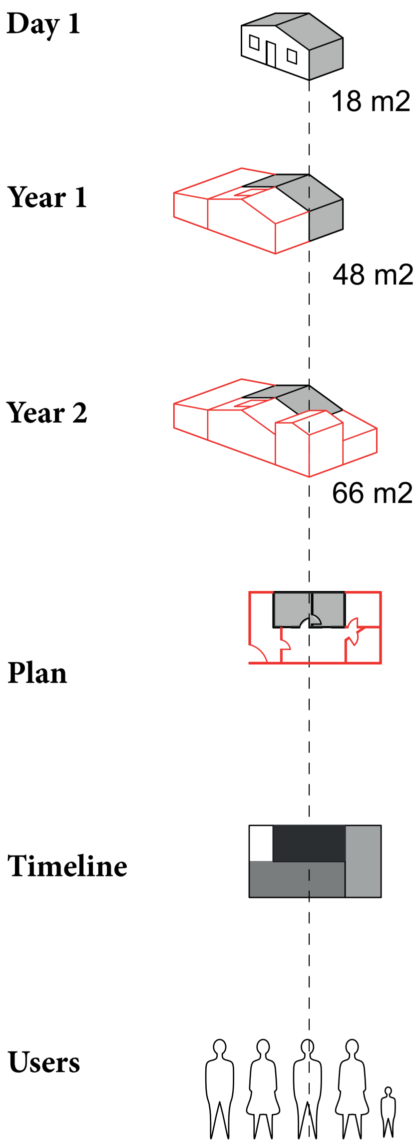

## CASE 10. PELLUHUE

This house is used by a family with two children. The house was initially assembled on a different site. The family moved it after three months and built a wooden fence. During the second stage floor and wall panels of the house were used for extensions. The remaining part of the shelter was used as a laundry and storage room. The existing window was enlarged and replaced with an aluminium frame. The extension was divided into two bedrooms and a space for the dining room, living room and kitchen. *'Plumavit'* donated by the government and *'fieltro'* were used for insulation. *'Geomembrana'* was used for waterproofing. In the third stage a new bedroom was added and the living room was extended. The exterior walls were covered by corrugated iron, and MDF and timber panels were used to divide spaces and for the ceiling. The floor panels were donated by the NGO *'Hogar de Cristo'* and chemical toilets were provided by SUBDERE. All the extensions were made by a family member. The cost of the modifications was between 500 and 1,500 USD, not including donations by the government or NGOs. The household also used savings and materials donated by relatives. The residents were applying to the *'subsidio de reconstrucción'* and planned to use materials from their temporary house in an eventual permanent one.



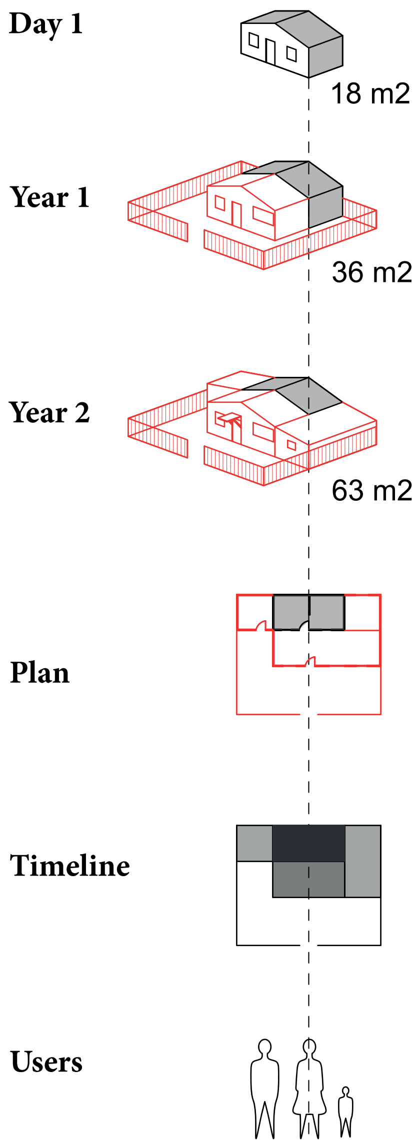

**CASE 11. PELLUHUE**

In this house lived an extended family comprising a father with two daughters, one of whom lived with her partner and her son. The first modification here was to extend the shelter to the front and to the side, to be used as a laundry area covered by a roof. The shelter was divided in two bedrooms and the extension was used as a kitchen and dining room. The interior was insulated with *'plumavit'* and with MDF panels donated by the government and the NGO Save The Children. During the third stage the family added two new bedrooms and the kitchen was moved inside the shelter. *'Geomembrana'* donated by the government and plastic sheets were used to protect the wall panels from the rain. Timber for the structure of the roof was donated by the municipality of Pelluhue. The cost of the improvements for the family was between 1 and 500 USD, without taking donations into account. The family was applying to the *'subsidio de reconstruccion'* to receive a permanent house close to the *'aldea'*. At the moment of the visit, the permanent houses were almost finished. The family was planning to use some materials to extend the future house.




**CASE 12. PELLUHUE**

This house was used by a nuclear family with a child. The family built a wooden fence around the plot, for defining the boundaries between private and public space. In the first year the house was extended to the long side, using the shelter as a bedroom and the extension as a living room, kitchen and dining room. The rear of the house was covered with *'geomembrana'*. The timber panels used for the extension were donated by the NGO *'Hogar de Cristo'*, and other materials recovered from the destroyed house were used in the construction. During the second year the family added a laundry area to one side and a storage room to the other, also extending the living room and kitchen. All of the materials used in the improvements were donated to the family and the extensions were made by family members. At the time of the visit the family was applying to the *'subsidio de reconstruccion'* to obtain a new house next to the *'aldea'*. The family hoped to use materials from the shelter to extend the permanent house, if possible.




# Appendix 5: Survey

## ADAPTABILITY SURVEY

| | |
|---|---|
| **Survey Nº** | |
| **Date** | |

### I. GENERAL INFORMATION

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | **Country/ Region/ Province** | | | | | | |
| 2 | **Town/Villa** | | | | | | |
| 3 | **Address** | | | | | | |
| 4 | **GPS (pics)** | | | | | | |
| 5 | **Shelter type** | **TECHO** | **IFRC** | **GOVERNM.** | **SELF BUILT** | **OTHER** | |

### II. FAMILY/ HOUSEHOLD

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | **Name** | | | | | | |
| 7 | How many people live in the house? | 1 | 2 | 3 | 4 | 5 | 6 or more |
| 8 | How many families live in the house? | 1 | 2 | 3 | 4 | 5 | 6 or more |
| 9 | What are the ages of the people leaving in the house? | | | | | | |

### III. TIMELINE / REFURBISHMENT-ADDITIONS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 10 | When did you receive/build the house? | 2006/before | 2007 | 2008 | 2009 | 2010 | 2011/ after |
| | | January/February/March | | | Summer | | |
| | | April/May/June | | | Autumn | | |
| | | July/August/September | | | Winter | | |
| | | October/November/December | | | Spring | | |
| 11 | What part of the house did you change? | roof | floor | walls | piles | other | |
| 12 | What did you do, what changes? | | | | | | |
| 13 | Did you add some of these to the house | int. division | insulation | electricity | waterproof. | sanitation | other |
| 14 | details | how many | where | how/system | where | ext./int. | |
| 15 | other | material | material | | material | type | |
| 16 | How many external rooms did you add to the house? | 1 | 2 | 3 | 4 | 5 | 6 |
| 17 | How many m2 did you add? | 1-3m2 | 3-6m2 | 6-9m2 | 9-12m2 | 12-15 m2 | 15-18 m2 |
| 18 | Surveyer appreciation | 1-3m2 | 3-6m2 | 6-9m2 | 9-12m2 | 12-15 m2 | 15-18 m2 |
| 19 | What is the use of the extension (s) | bedroom | kitchen | toilet | shop | storage | other |
| 20 | What was the process of adding (what came 1st, 2nd)? | roof | floor | walls | pilotis | other | |
| | changes | int. division | insulation | electricity | waterproof. | sanitation | other |
| | additions | room 1 | room 2 | room 3 | room 4 | room 5 | room 6 |
| 21 | When did you make the first change (s)? | 2006/before | 2007 | 2008 | 2009 | 2010 | 2011/ after |
| | | January/February/March | | | Summer | | |
| | | April/May/June | | | Autumn | | |
| | | July/August/September | | | Winter | | |
| | | October/November/December | | | Spring | | |
| 22 | Who built the improvements? | only me (go to 24) | | me and someone else | | only someone else | |
| 23 | | friends and family | | volunteer | | worker | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | How much time have you used for improving the house? | < 1 week | 1-4 weeks | 1-3months | 3-6 months | 6-9 months | > 9 months |
| 25 | When have you done the changes (mainly)? | week mornings | week afternons | week evenings | weekends | holydays | other |
| 26 | Where did you get the materials? | comercial shops | past house | friend or family | donation | other | |
| 27 | | which | | | who | details | |
| 28 | Have you spent any money in the improvements? | yes | | | no | | |
| 29 | In what did you spend money? | materials | | handwork | | others (land) | |
| 30 | Where did you get the money? | savings | friends and family | government | bank loan | others | |
| 31 | How much approximately? | 1-100 USD | 100-500 USD | 1-100 USD | 100-500 USD | 1-100 USD | 100-500 USD |
| | | 500-1000 USD | more | 500-1000 USD | more | 500-1000 USD | more |

## IV. PROYECTIONS/ FUTURE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 32 | Is this house your permanent housing solution? | yes (go to 33) | | no (go to 36) | | I don't know yet | |
| 33 | If yes, do you plan to make more changes in the future? | yes (go to 34) | | no (go to 35) | | I don't know yet | |
| 34 | If yes, What would you change or add? (then go to 41) | | | | | | |
| 35 | If no, why? (then go to 45) | We have enough room | | We don't have budget | | I don't know yet | |
| 36 | If no, are you applying for/buying permanent housing ? | yes (go to 37) | | no (go to 44) | | I don't know yet | |
| 37 | If yes, what kind of housing programme? | Government | | Another program | | Particular project | |
| 38 | | Which? | | Which? | | | |
| 39 | | | | | | | |
| 40 | | On same site | On diff. Site | On same site | On diff. Site | On same site | On diff. Site |
| 41 | Would you use the current house for improving the next? | yes (go to 42) | | no (go to 45) | | I don't know yet | |
| 42 | If yes, how? (then, go to 45) | The entire house | | | Some materials | | |
| 43 | | as extension | next to new | other | roof | floor | panels |
| 44 | Do you have another alternative? What? | | | | | | |

## V. COMMUNITY/INVOLVEMENT

| | | | | |
|---|---|---|---|---|
| 45 | Did you participate in the selection of the house's site? | yes | no | I don't remember |
| 46 | Did you participate in building the house? | yes | no | I don't remember |
| 47 | It is there a place where people gather together? | yes | no | I don't know |
| 48 | Is the distance between houses adecuate or is crowded? | yes | no | I don't know |

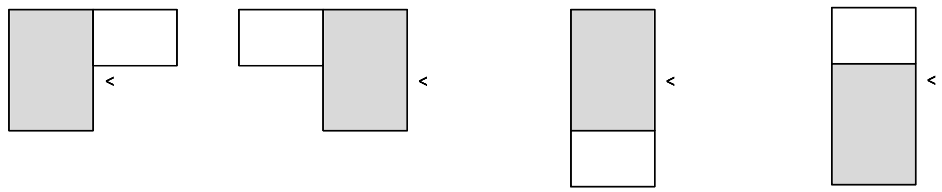
## V. COMMENTARIES

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 49 | Dimensions of the additions | 1-3m2 | 3-6m2 | 6-9m2 | 9-12m2 | 12-15 m2 | 15-18 m2 |
| 50 | Dimensions of the additions (total) | 1-3m2 | 3-6m2 | 6-9m2 | 9-12m2 | 12-15 m2 | 15-18 m2 |
| 51 | Distance between houses | front | | back | | sides | |
| 52 | Public spaces/ semipublic spaces | exterior plaza (s) | | community centre | | others | |
| | | nº | m2 | nº | m2 | | |
| 53 | Infrastructure/ services | electricity | water | sanitation | roads | street lighting | other |
| | | formal/informal | formal/informal | formal/informal | formal/informal | formal/informal | |
| 54 | How many houses are in the community? | | | | | | |
| 55 | How many houses have been adapted?<br>Sample: Nº and /or % | | | | | | |

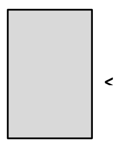
## VII. SCHEMES

**CURRENT ADAPTATION/ DIMENSIONS/ M2**

**A** B C D

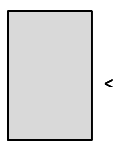


**OTHERS (IN PLAN)**



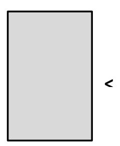
**VERTICAL EXPANSION (ELEVATION)**

**INTERIOR CHANGES (IN PLAN)**



**INTERIOR CHANGES (SECTION)**

**FUTURE CHANGES (IN PLAN)**



**FUTURE CHANGES (ELEVATION)**