

# **NEED FOR ADAPTATION TRANSFORMATION OF TEMPORARY HOUSES<sup>1</sup>**

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## **Abstract**

*Building permanent accommodation after disasters requires time due to different reasons, such as the removal of debris, lack of available land and resources. In the meantime, affected communities find shelter in different ways. Temporary houses or transitional shelters are used when families cannot return to their pre-disaster houses and no other alternative can be provided. In practice, families stay for years in a standard interim solution while trying to go back to their routines. Therefore, they adapt their houses in order to meet their mid-term needs. Temporary houses in Peru and Chile were analysed in order to illustrate how families modify them with or without external support. The research points out that guidance must be given on how to safely make adaptations and to incorporate the temporary solution into the permanent house, because families modify their houses either if they are designed to be adaptable or not.*

**Key Words:** *Temporary Housing, Transitional Shelter, User-Initiated Transformations, Housing Extensions, Incremental Housing.*

## **TEMPORARY AND TRANSITIONAL**

There is no unique approach to the process of housing families after disaster, because every situation and context is different. Families and communities affected design, build and get shelter in diverse ways, depending on the resources available and the actors involved in the emergency, recovery and reconstruction processes. Therefore, households get shelter by self-building, being supported by governments, being supported by national and/or international organisations, and/or a combination of them. Who gets involved and in which way shelter is achieved is 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 shelter needs (Sphere Project, 2011). Although usually responses are particular to each case, the humanitarian sector has set common practices, such as the use of large structures as collective shelters (schools and community buildings), temporary camps, rented houses or flats, repair of damaged houses, and transitional shelters, among others (Shelter Centre, 2012).

Temporary houses or transitional shelters are used as post-disaster accommodation when no other alternative can be provided, and families affected are unable or unwilling to return to their pre-disaster houses or land (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. While the term 'temporary' refers to a building that will be used for a defined and short lapse of time, the term 'transitional' refers to a process that bridges a gap.

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<sup>1</sup> Article accepted for publication in Journal 'Disasters'  
[http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1467-7717](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1467-7717)

In 1982, Quarantelli noted the lack of conceptual distinctions in the subject of shelter and housing, as well as the lack of specific vocabulary to describe them (Quarantelli, 1982). He defined three categories of accommodation used after disasters and before achieving permanent housing: emergency shelters, temporary shelters, and temporary housing. The difference between emergency and temporary shelter is blurred, but the main distinction is the amount of time the accommodation will be used, and the activities that will be developed there. Quarantelli also distinguished shelter from housing, where housing implies resumption of household responsibilities and activities in the new quarters (Quarantelli, 1982). Thus, temporary housing is defined as a temporary accommodation where families can resume their activities and routines for months or even years, but it is not intended to be permanent.

Temporary housing has been used after recent large-scale disasters, in order to provide quick recovery and to allow time for safe rebuilding (Johnson, 2007a), such as cases 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). However, temporary housing programmes have found conflicting opinions. On the one hand, some argue that the provision of temporary housing is expensive, unsustainable, inappropriate, inadequate, unnecessary, and that it diverts funding from permanent reconstruction (Davis, 1978; Quarantelli, 1982; Bolin & Stanford, 1991; Barakat, 2003). On the other hand, others suggest that the provision of temporary housing can support quick recovery and allow time for communities to rebuild safely (Johnson, 2007a; IRP, 2010; Félix, Branco, & Feio, 2013). Despite criticisms, temporary housing programmes continue to be used in many cases because it is an alternative of cheap, quick and scalable solution that families can use while adequate permanent housing is designed, planned and built, a process that can take years (Johnson, 2007b).

Since late nineties the term 'transitional' was increasingly used to define shelter and settlement as an ongoing process (Saunders, 2004, p. 134). At the beginning of the new millennia, the term 'transitional housing unit' is understood as a more durable solution that can be improved incrementally once the immediate post-disaster phase has passed (Barakat, 2003, p. 16). The concept of Transitional Shelter Approach (TSA) 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), and based on consensus around general approaches to shelter needs (Corsellis & Vitale, 2005). Within the TSA, 'Transitional Shelter' was defined as a "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 & Vitale, 2005, p. 11). The TSA provides a shelter that can be reused later in more permanent structures, promote the transition to more durable shelter, and it can be upgraded, expanded, and relocated (Sphere Project, 2011, p. 252). However, despite being one of the default choices for many large agencies in the last decade, the TSA has become a controversial strategy (Burnell & Sanderson, 2011; Davis, 2015). It can be a useful solution that fills the gap when time is necessary for planning good reconstruction, but in other situations may be possible to eliminate this interim stage by accelerating reconstruction when there is proper pre- and post-disaster planning (Davis, 2015). Also, transitional shelters have been controversial and criticised for being un-appropriate and un-effective, such as shelters built in Sri Lanka in 2004, where some organisations were focused in 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, not being cost-effective in comparison to the cost of a permanent house (Calzadilla & Martin, 2011). However, other approaches such as semi-permanent and core houses or cash vouchers, which could be more appropriate in some situations, are not always feasible for various reasons, and in those cases temporary houses or transitional shelters can be an available alternative (IFRC/ RCS, 2011).

## TRANSITION TO WHAT? AND SECOND USE

The process of building a permanent solution generally requires more than one year due to diverse reasons, such as the time that takes the removal of debris, the lack of available land if there is displacement, the cost of materials due to an increased demand after the disaster, and compliance with building codes, among other issues. Therefore, during the process of recovery, temporary and transitional houses are adapted and modified by families in order to meet their needs, accordingly to their resources, capacities, status and security of tenure (IFRC/ RCS, 2011). These modifications can be seen as an improvement towards a durable solution, but in many cases the changes are done without building knowledge, with lack of technical supervision, and with poor quality materials.

On the one hand, the term 'transitional' used in the TSA emphasises the concept of process, a transition from emergency to permanent communities and houses (Kennedy, Ashmore, Babister, & Kelman, 2008; Leon, Kelman, Kennedy, & Ashmore, 2009). However, the TSA generates concerns about the limits of the humanitarian responsibility and the handover to governments, the process from emergency to the return to sustainable livelihoods, and the lack of attention to the process of transition (Collins, Corsellis, & Vitale, 2010). Past experiences, such as cases in Sri Lanka and Aceh, have shown that the transition is forgotten due to an urgency to implement programmes, which leaves no time to incorporate the full scope of the transitional process, raising the question 'transition to what?' The answer has been formulated by Kennedy et.al. as 'transition to a less vulnerable state than before' (Kennedy et al., 2008, p. 34). Another criticism of shelters provided under the TSA is the lack of flexibility in the designs. Structures deteriorate and turn into permanent poor quality houses, creating slums (Burnell & Sanderson, 2011; Gray & Bayley, 2015). This happens because after shelters are built, few human and economic resources remain, resulting in poor quality permanent housing that do not address long-term problems (Gray & Bayley, 2015). Moreover, this can be a consequence of the lack of guidance, training, and assessment during the process. Besides, key features of the approach are not always necessary. For example, mobility is a characteristic of transitional shelters because it provides a solution when land rights are unclear, so the building can be moved later to a permanent site. However, the best examples of the approach are in areas of secured plots, where mobility is not necessary (Clermont, Sanderson, Sharma, & Spraos, 2011). In that respect, good examples of the approach are very similar to more traditional 'semi-permanent shelter' or 'core housing' approaches that can be later completed as permanent housing.

On the other hand, the term 'temporary' housing means that dwellings are expected to be used for a fixed, short amount of time. But, experience indicates that housing interventions in the early stages after a disaster will affect long-term housing provision because temporary solutions tend to become permanent (Barakat, 2003). Hence, temporary housing raises the question of what to do with the houses when the temporary phase finishes? Some researchers have studied the 'second use' of temporary houses. Arslan and Cosgun identify two possible ways: 'passive measures' in which temporary houses are turned into permanent or take other functions; or 'active measures' in which temporary houses or parts of them are sent to another area or stored (Arslan & Cosgun, 2007). Johnson defines five options, based on cases of temporary houses built in Turkey after earthquakes in 1999: long-term use, dismantling and storage, reuse, sale and demolition (Johnson, 2007a). These options have advantages and disadvantages. Long-term use is considered problematic because can create illegal occupancy when used by displaced groups, as well as other social dysfunctions such as high crime rate in temporary unplanned settlements (Johnson, 2007a). Nevertheless, in land owned by families, it can be used as an extension or as part of the permanent house (IRP, 2010; Wagemann, 2015). Dismantling the unused units and storing them for future disasters is an alternative, but it could be inefficient in terms of resources, due to transportation costs, as well as disassembly and assembly times (Johnson, 2007a). Reusing the units, similarly to

the dismantling option, can imply extra costs in transporting, dismantling and reassembling (Johnson, 2007a). Also, the quality of the houses and their materials after use can be poor, or not good enough to reuse in long-term dwellings. Nevertheless, this option seems to be advantageous as the materials can be used by families or communities as a resource (Félix et al., 2013). The alternative of selling the units or parts of the house can help to recover some of the initial costs. Finally, to demolish the houses is the least efficient option because it means that they are thrown away, and the resources used in the temporary houses are not recovered (Johnson, 2007a).

Experience from temporary housing programmes show that reusing and recycling options can improve the efficiency of the approach. The most sustainable ways of reusing the houses are: a) keeping the same function without changes, i.e. rent to low-income residents, b) using them for the same function and making changes, i.e. additions, use them as core houses, or c) for different functions, i.e. community center or health facility (Arslan, 2007; Félix et al., 2013; Johnson, 2007c). Therefore, alternatives for reusing the dwellings or parts of them can be incorporated in the strategy and design. Nevertheless, if these characteristics are incorporated to the design of temporary houses, the aims of the approach might be even more similar to the transitional shelter concept, where the solution provided is not temporal anymore but a transition to something else.

## **USER-INITIATED MODIFICATIONS**

Examples of modifications made by households to their own temporary houses and transitional shelters can be observed in different countries and contexts around the world. Nevertheless, there are not many studies of them in the mid- and long-term. One reason for this could be that those involved in post-disaster relief and recovery generally do not return to past project sites to conduct evaluations on the long-term impact of early post-disaster programmes, therefore it is unusual to see what happens to the shelters over time (Kelman, Ashmore, Leon, & D'urzo, 2011; Doninger, 2013). Exceptions are case studies compiled in the book 'Still Standing. Looking Back at Reconstruction and Disaster Risk Reduction in Housing', which looks at the impact of programmes several years after they finished, with the aim to learn from past experiences to inform future projects (Schilderman & Parker, 2014). However, most cases studied are permanent- post-disaster houses instead of temporary houses.

Most studies on transformed, adapted and improved houses in the literature are not in the context of disasters but focused on low-cost, social and informal housing, mainly in developing countries. Nevertheless, they provide methodological approaches, and sound conclusions that can be extrapolated to post-disaster contexts. Tipple, Masters and Garrod, conducted a comparison of cases of self-help transformations (alterations and extensions) to government-built houses in Dhaka, Bangladesh; Cairo, Egypt; Kumasi, Ghana; and Harare, Zimbabwe (Tipple, Masters, & Garrod, 2000). The project examined the factors that influenced the modifications and the resources spent on the extensions. Conclusions from the research show that physical characteristics of the house seem to be an important factor to make the changes, even more influential than household's income and household's size (Tipple et al., 2000). The findings support a positive view of transformations, pointing out that, in general, the standards of the extensions are as good as or better than the original house, and that anyone who has the space to transform is likely to do so (Tipple et al., 2000). Another observation is that changes made to the houses produce variety out of uniformity, in terms of house size, space per household, value and cost, uses, tenure and occupants (Tipple, 1999, 2000; Tipple, Owusu, & Pritchard, 2004). The modifications provide households with personalised and customised houses that represent their particular needs and desires. The studies of self-initiated transformations of permanent houses by Tipple et al. show that changes on dwellings create improvements and do not necessarily lead to the creation of slums (Tipple & Ameen, 1999; Tipple et al., 2004). Other studies of modifications made by users to their houses are research of cases in Mexico (Murphy, Finsten, Morris, Pettit, & Winter, 1997), Ethiopia (Shiferaw, 1998), Israel (Etzion,

Portnov, Erell, Meir, & Pearlmutter, 2001; Portnov, Odish, & Fleishman, 2005), Saudi Arabia (Al-Naim & Mahmud, 2007), Tanzania (Nguluma, 2003), Peru (EquipoArquitectura, Garcia-Huidobro, Torres, & Tugas, 2008) and the Soviet Union (Bouzarovski, Salukvadze, & Gentile, 2011). Although methodologies and focus vary from case to case, some elements are analysed in most studies, such as the main changes made to the houses, the factors that influence the transformations, and the motivations to make changes to the dwellings.

In the subject of post-disaster accommodation, there is less literature available on modifications made by households, despite flexibility and adaptation being mentioned as desirable characteristics in temporary housing and transitional shelter programmes. Ikaputra studied adaptations made by families to their post-disaster houses in the village of Ngelepen, Indonesia, provided by an international organisation after the Javanese earthquake in 2006 (Ikaputra, 2008). The study, conducted four months after the shelter was built, shows the way families modified an imported design (a dome), in terms of shape and materials, in order to make it suitable to their needs and culture. The method used in the study for gathering information was a 'community self-evaluation', with the aim of understanding the strengths and the weaknesses of the shelter from the inhabitant's perspective. The main observation was that families made improvements to the dome, adapting it to their culture, climate and need for space. For example, they added canopies, porches, verandas and eaves, which are typical features of traditional tropical houses to protect doors' and windows' frames from the rain (Ikaputra, 2008). Another example is a study conducted in 2014 by Parva and Rahimian focused on the modifications made by families to their permanent post-disaster houses in Lar city in Iran, after the earthquake of 1961 (Parva & Rahimian, 2014). The study comprises an analysis of different time periods and shows similarities and differences between cases, focused on architectural characteristics of the transformations and people's motivations to make changes. The study recommends that the design of post-disaster accommodation should address transformability (to local patterns and lifestyles), adaptability (to add new parts), and capability to reflect different requirements (indoor circulations).

## **ADAPTATION OF TEMPORARY HOUSES IN PERU AND CHILE**

In order to contribute to the understanding of modifications made by users to their temporary houses, fieldwork was conducted in Peru and Chile in 2012. The main objective was to identify steps, similarities and differences in the modifications made by families to their temporary houses through the comparison of cases from both countries. Chile and Peru were selected based on the following aspects: a) the occurrence of a disaster of magnitude in the last years; b) the use of temporary houses as approach; c) the use of the same house model for sheltering after the disaster; d) different climatic zones, to compare the shelter in different contexts (Desert and Oceanic climates) and; e) different type of land situation (displaced in Chile and non-displaced communities in Peru).

Peru and Chile are located in the so-called 'Ring of Fire' region, an area with one of the highest seismic activities in the world. Therefore, they have been hit by many earthquakes throughout their history and it is likely that they will face more in the future. Although the two countries share a history of repeated disasters, they have important differences, such as climate, geography, vernacular architecture, building methods, and building materials. These differences are crucial to consider when designing housing solutions, whether temporary or permanent, because the design must tackle local conditions. Nevertheless, after the earthquakes in 2007 in Peru and 2010 in Chile, prefabricated and flat-pack houses were seen as a fast way to solve the shortfall of housing, although these solutions usually do not consider local characteristics (Barakat, 2003).

In both countries, among other shelter approaches, the same model of temporary house was used: a shack built with prefabricated timber panels and assembled on site by volunteers with

simple tools, called 'mediagua' in parts of Latin America (Figure 1). The term comes from the concept 'media-agua' meaning a shed roof (one slope). Although the mediaguas have currently two slopes, the name remains being used. The temporary house is built with fifteen poles that work as foundation or stilts, eight prefabricated timber panels (two for the floor and six for the walls), a wooden truss for the roof, CGI sheets for the roofing cover, two windows, and one door. The usable area is defined by a rectangle of three by six meters, creating a footprint of 18 square meters. The reason for using this prefabricated solution as temporary house can be explained by need for speed, scale, and economy of resources, limiting the possibility of thinking in more depth other aspects, such as future adaptations in the mid- and long-term. This temporary house has been used in other countries of Latin America and the Caribbean by the NGO TECHO, an organisation that looks to overcome poverty in developing countries. Although disaster recovery is not the main objective of this NGO, the organisation has built temporary houses in different countries after disasters, such as Peru in 2007, and Chile and Haiti in 2010. The temporary house used by TECHO was selected as case study because it is repeatable, prefabricated, and although it was not designed with transition in mind, it has been modified by families in different contexts.

The study of the cases was not an evaluation of the failures or successes of the temporary housing programme implemented, but aimed to understand households' practices in the mid-term. Three questions guided the study: How do families modify their temporary shelters? Why do they modify them? And what are the characteristics of the process? The main objective was to understand how families living in the same type of temporary house adapt it to their different needs and culture.

One of the challenges during fieldwork was to recognise the houses after some years of use, due to the extensive changes they experienced (Figure 2). Specific cases were selected for analysis with the aim to explore the nature of the modifications beyond abstract concepts. A multiple-case study was selected as research design, in order to strengthen the findings and to seek theoretical replication to get analytic conclusions. In terms of methodology, the cases were not considered samples but they were studied in depth, because the aim was not to create a statistical generalisation but to illuminate theoretical propositions (Yin, 2014, p. 36). In total 27 houses were analysed, from ten settlements visited in the two countries. The selection of a diverse range of cases shows a variety of situations from different geographical areas. Although the cases are not necessarily representative of temporary houses used in other countries or regions, they provide empirical information about the modifications, and therefore, they can illuminate ideas of adaptability and flexibility for future designs. The cases were chosen to exemplify a variety of adaptations made to the temporary houses in terms of configuration (front, back or side extensions) and the extent of the modifications (no change, slight change, or extensive changes).

Combined tactics for data collection were used to produce a visual description of the process of modification throughout the years. These tactics were: face-to-face semi-structured interviews with residents; survey of the houses (materials, dimensions, process of construction, and costs); structured observation of the houses; drawings and photographs; and archival documents (reports, journals, and public documents). Based on the information gathered, drawings of the houses were made at the same scale. The comparison shows the process of adaptation in three stages: Day 1 (when the temporary house was built), Stage 2 (in the middle of the process); and Stage 3 (when the house was visited). The study focuses on the changes, additions and improvements made by residents, with or without external support, and how these changes can be extrapolated as patterns of use.



Figure 1. Non-modified temporary house in Peru (after 5 years of use).  
Source: Author



Figure 2. Example of a modified temporary house in Dichato, Chile, 2012.  
Source: Author

## TRANSFORMATION OF TEMPORARY HOUSES AFTER THE 2007 EARTHQUAKE IN PERU

On the 15th of August 2007, the province of Ica in Peru was hit by an earthquake of magnitude 8.0 causing considerable loss of life and livelihood. The most damaged cities were Chincha Alta, Ica and Pisco. In those cities and surrounding areas the earthquake killed almost 600 people and left homeless around 320,000 (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 7). In terms of housing 52,154 houses were destroyed and 23,632 were severely affected, accounting together 75,786 units declared uninhabitable (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 8). The majority of damaged buildings were those built in stone, adobe and brick masonry structures (Kwon, 2008). Some factors that contributed to the severity of the damage were: the precariousness of housing construction; buildings built in vulnerable areas (liquefaction); informality and consequent poor construction practices; the lack of professionals in the design, process and supervision of the construction practices, and the lack of compliance with regulations (Ministerio de Vivienda, Construcción y Saneamiento, 2008).

During the emergency stage, community emergency shelters, tents, and temporary hospitals were set on the area. The National Government coordinated the Civil and Armed Forces (*Sistema Nacional de Defensa Civil-INDECI*) for the immediate response and asked for support from the United Nations. The humanitarian aid was coordinated by the UN, which operated from the air base of Pisco (Talavera & Lopez, 2008). During the second stage, the Peruvian government built around 1,500 transitional homes, which were supplemented with houses built by NGOs such as TECHO, Caritas, World Vision, Red Cross International, PREDES, among other organisations, totaling around 15,000 temporary housing solutions (Ministerio de Vivienda, Construcción y Saneamiento, 2008, p. 16).

TECHO (named 'Un Techo para mi País' at the time of the earthquake) built 1,211 houses, accounting for around the eight percent of the temporary houses provided in the country, between the years 2007 and 2008 in Ica, Pisco and Chincha provinces (interview with TECHO-Peru representatives, 2012). In those provinces, the work of TECHO was mainly for supporting peri-urban villages called *centros poblados*. Although being connected to the main cities by roads, these villages had fewer possibilities of being assisted by many organisations because they are dispersed in the region, and therefore, difficult to reach. The *centros poblados* selected for analysis were chosen with the aim of studying temporary solutions in villages of different scale. Therefore, houses in bigger settlements such as Bernales (Pisco) and Santa Rosa (Chincha) were analysed, alongside with examples from small *centros poblados* that comprise a couple of streets only such as Caucato, Mensía, and El Palmar (Pisco), and Cañapay (Chincha).

From the villages visited, fifteen modified houses were selected for analysis based on their different types of transformation and due to the completeness of information provided by households and field observation. The cases were studied and compared using three categories: socio-cultural aspects, physical aspects (materials and architecture), and economic aspects. A visual description of the changes throughout the years summarises all the cases (Figure 4). Although the analysis was done using the three categories, they showed to be completely interlinked, and some similarities were found in the adaptations (Figure 5), although having different morphologies. For example, physical changes were driven by adaptations to the climate, and the increase on the size of house was driven by the composition of the household, the size of the land or the availability of funds. Frequent transformations observed are:

- An increase in the size of the house by adding new rooms. The dimension of the houses at the moment of the visit ranged between 56 square meters and 131 square meters showing a big difference in the capacity of the families to extend. Most limitations were defined by the plot size, the availability of resources, and the land right situation.



- Removal of the floor panels to use them as extensions. The timber floor was not desirable for families and the panels were seen more adequate to be used as material for extending or improving other parts of the house. Apparently it was easy for residents to build a concrete slab, and therefore, to use the panels for building new rooms.
- Addition of shaded porches. In most cases, one of the early additions was an intermediate shaded space between exterior and interior, like a terrace or porch built with matting of woven bamboo or similar material (Figure 3). The addition of a ventilated shaded space was an essential improvement due to the climate of the region (coastal- desert). They provide a shaded space that helps to cool the house, acts as a buffer between the street and the house, and offers a space for the families to socialise. Back porches or other shaded areas were used as kitchen, dining room or living room.
- Use of the kitchen in an exterior area. Due to the dry and hot climate, kitchen and dining room were seen in many cases as an exterior but covered space. Also, due to the fumes and smokes produced by cooking with coal, it was desirable for some households to have the kitchen as an exterior room.
- Opening new doors and windows. Additions of new windows and doors proved the inflexibility of the design, and were used by families to either have a new accesses, connect the new added rooms to the house, or to provide more light to the house.
- Use of the whole house as an extension on the first floor once the permanent house is built. The transitional house was not seen as a disposable element. Once families achieved the permanent solution, the entire shelter (or some parts of it) was used as an extension or as a first floor.

In terms of morphology, the shape of the plot had an influence in the future expansion. In many cases the plots were narrow and rectangular (i.e. 4 x 20 m), with the short side facing the street, a common feature in settlements of the region. Therefore, the temporary house had few possible ways to be built, and the most common configuration seen was the house 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 with direct access to it. In those cases, an early modification was to open a new door on the back, so the house could have front and back access. The orientation of the extensions appears to be based on the availability of space in the plots instead of other factors, such as solar gain or winds.

In relation to the economic aspects, the cost of the temporary house was approximately 1,000 USD in 2007. The resources used on modifications and extensions of the houses were estimated by families during the interviews. Six families spent between 1 and 500 USD in the extensions, 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. From observation on site it was possible to conclude that the resources spent were not linked to the dimension of the extensions but to the materials used and the source of funding. For example, households living in the biggest houses (131 and 114 square meters) estimated to have spent 500 USD or less. They both covered large areas using lightweight materials, such as bamboo in the main structure, and *esterilla* (woven bamboo mats) and plastic to cover the spaces, which are non-expensive materials in the region. On the other hand, families that spent between 1,500 and 2,500 USD were all supported by the government through the '*Bono 6000*', a donation system to support the affected by the earthquake to buy materials and rebuild their houses. The grant provided 6,000 PEN (2,000 USD) to pay work labour for building and to buy materials from selected hardware stores (Huber & Narvarte, 2008, p. 24). 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.-a). Finally, the case that invested the largest amount of money (more than 2,500 USD) already achieved to build part of the permanent house, with support from the Government and from the local branch of the Red Cross (Cruz Roja Peruana). In that case, the temporary house was used as an extension on the first floor. This family received funding from the government available to low-income families to build new

houses, called '*Techo Propio*'. The grant provided non-refundable funding to buy, build or repair permanent houses to households with a monthly income under 640 USD. It provided different non-refundable amounts depending on the use of the funds, and for building a house the grant was between 4,400 and 5,900 USD (Ministerio de Vivienda, Construcción y Saneamiento, n.d.-b). Households living in the temporary houses studied also received support from other organisations, which focused on improving quality of life and health of affected families. In the cases studied Caritas and IFRC provided materials, construction labour and training. Caritas provided materials to build improved kitchens and toilets to families with children, and IFRC supported the construction of permanent houses using an improved and reinforced version of the traditional *quincha* (cane or timber framework covered in mud and plaster).

Therefore, temporary houses studied in Peru were recycled and reused because they were seen by families as an investment, an endowment, and also as an object loaded with emotions and memories. Some families commented during the interviews the importance of having a temporary house during the recovery stage, and therefore their attachment to it. However, some modifications studied could lead to future problems, although to future improvements too. When the floor panels are removed, the structure of the house is weakened. The house is destabilised because the wall panels are attached to the floor, and the floor panels work as bracing in this structural system. Therefore, a design question arises: how to remove the floor panels without weaken the structural strength of the house? An initial solution would be to design a structure based on frames rather than panels. Another issue is the addition of a ventilated shaded space to the house. Shaded porches were incorporated to the temporary houses, as an environmental, cultural and social element. Bearing in mind these aspects, the resources used for building the floor panels could be used for building intermediate spaces, or larger temporary houses, and therefore, meet basic conditions for living in this region. Moreover, flexibility to expand in the mid-term should be considered in the design, without weaken the structural system.



Figure 3. Porch/ intermediate space built with mats of woven bamboo in front of a temporary house in Peru, 2012. Source: Author

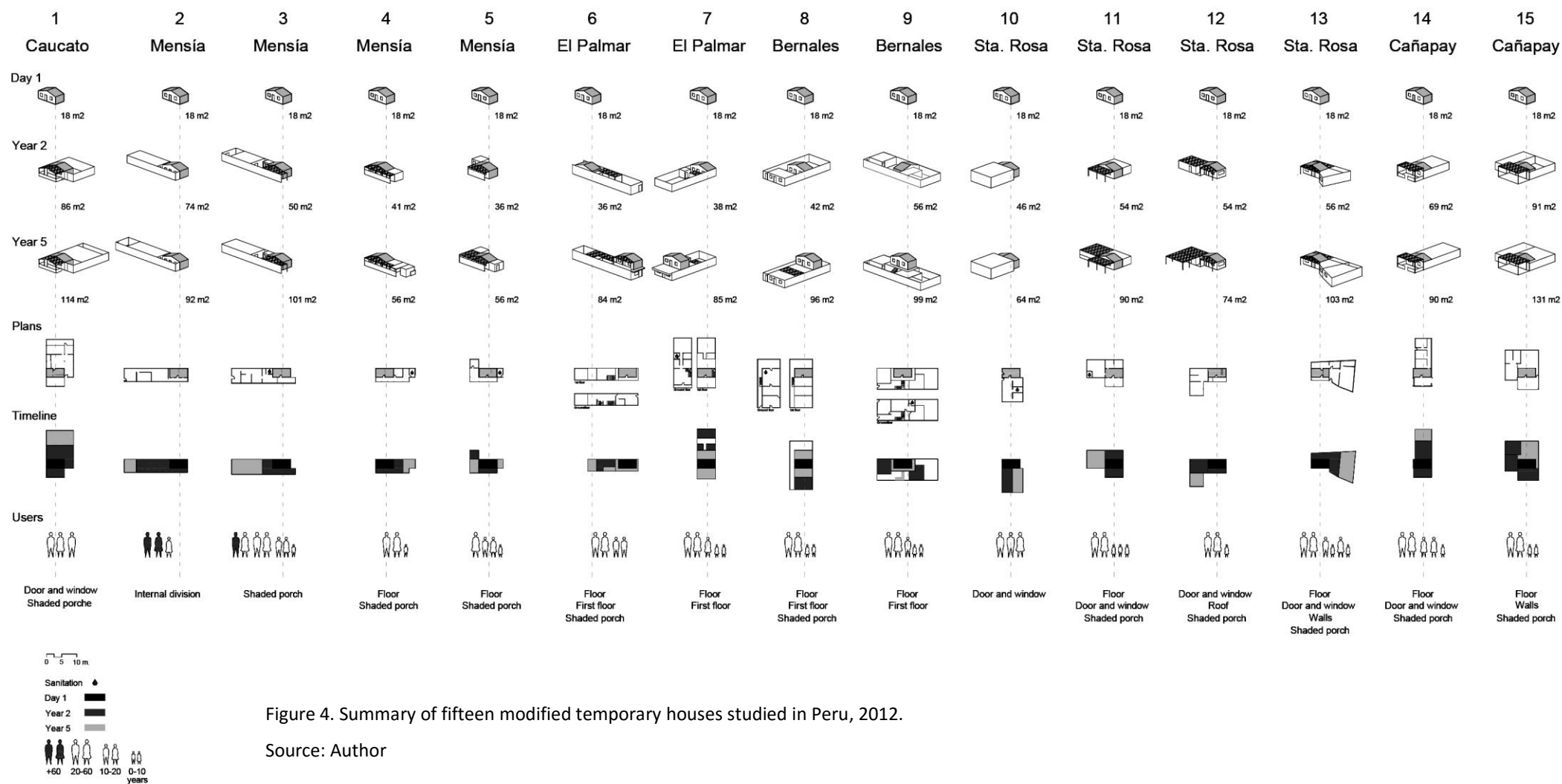


Figure 4. Summary of fifteen modified temporary houses studied in Peru, 2012.

Source: Author

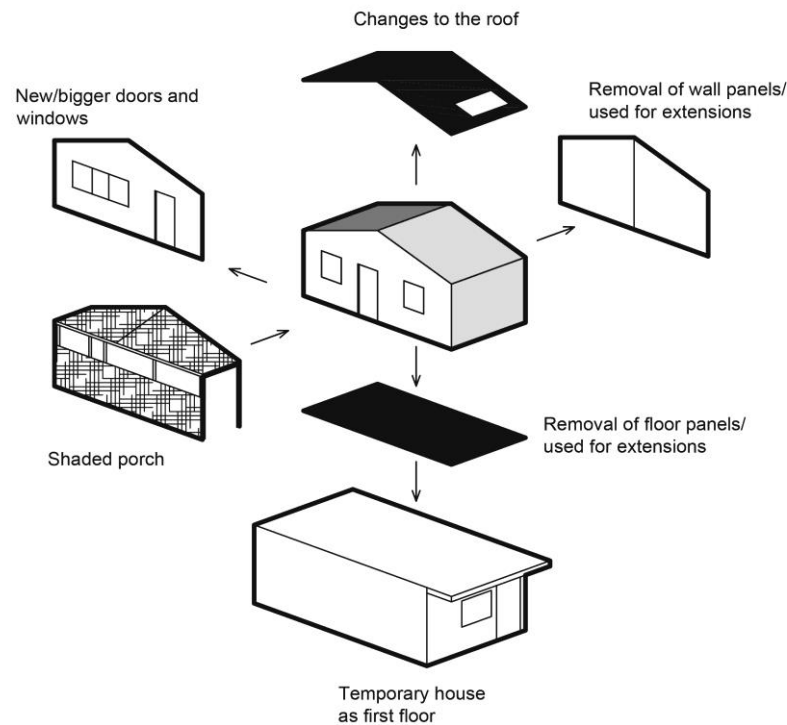


Figure 5. Summary of modifications made to temporary houses in Peru, 2012.

Source: Author

## TRANSFORMATION OF TEMPORARY HOUSES AFTER THE 2010 EARTHQUAKE AND TSUNAMI IN CHILE

Chile is one of the seismically most active countries in the world, with one earthquake above magnitude 8.0 Richter every ten years approximately (Cárdenas-Jirón, 2013). The 27th of February of 2010 an earthquake of magnitude 8.8 Richter and a following tsunami hit the central and southern Chile. The earthquake affected around the 75 percent of the country population, killed 526 people and left more than 222,000 houses destroyed or seriously damaged (Gobierno de Chile, 2014, p. 8,18). The government centralised the provision of emergency shelter and temporary housing. In total, 70,489 temporary houses were built after the disaster, from which around 32 percent (22,256 houses) were built by TECHO, and approximately 65 percent were built by the government of Chile (Gobierno de Chile, 2014, p. 28).

Both displaced and non-displaced families with destroyed houses were provided with temporary houses as mid-term solution. Households with destroyed houses that were able to stay in their own land remained there, and families affected by the tsunami were displaced to temporary settlements due to the extensive devastation in coastal areas. These settlements were called *aldeas* (villages) instead of *campamentos* (camps, which are known as informal settlements built before the earthquake) and they were built on rented land or state owned land. A total of 106 *aldeas* were built in 2010. Two years after the disaster, the government realised that the progress of building permanent houses would take longer than planned and started a programme of subsidised rent for families living in *aldeas* with the aim of closing the temporary settlements before the winter of 2013.

(Gobierno de Chile, 2013, p. 14). However, many families did not want to move to rented accommodation, because they thought it would delay the construction of permanent houses or they would lose any benefit from the government, because the subsidised rent programme was for a limited period (interview with families living in *aldeas*, Bío-Bío Region, December 2012). Three years after the disaster 46 *aldeas* (1,442 families) were in use (Gobierno de Chile, 2013, p. 14), and after four years 12 *aldeas* (393 families) remained being used (Gobierno de Chile, 2014, p. 28).

The construction of *mediaguas* was widely criticised by affected communities, building experts and architects in Chile. Families in different parts of the country rejected the houses, and they preferred to stay in tents because they considered the house to be inadequate for the mid-term and they argued that the provision of temporary solutions would delay permanent housing programmes (Chilevision News, 2010). Even more, some affected families burned their temporary houses in order to demand the government for better solutions because the structures did not resist the first rain (La Nación Online, 2010). Although it was assumed that the magnitude of the disaster required immediate response, and that the fastest and available solution was the temporary house, experts recognised that this shelter was not adequate for the climate of the affected area. One of the main criticisms was that the same type of house, initially designed for poor families living in slums, has been used since 1930 and that current social requirements were different due to the development of the country (Bluth, 2010).

The *aldeas* chosen for analysis were in the Bío-Bío and Maule regions, the most affected by the earthquake and the tsunami. Similar to the Peruvian case, the *aldeas* selected were chosen with the aim of studying the temporary houses in settlements of different scale. The *aldeas* visited in Bío-Bío region were Dichato and Coronel, and in Maule region were Pelluhue and Curanipe. The houses selected for analysis were drawn at the same scale and the same survey applied in Peru was applied in Chile. Twelve illustrative cases were selected for analysis (Figure 7). Some recurrences appeared in the comparison of selected houses and from direct observation. Main changes observed as frequent modifications of the temporary house are:

- Insulation and protection from the rain. The winter in Chile starts in June, and most families received the temporary house between March and May, therefore the first modification was to add layers to resist low temperatures and the rain.
- Extension of the house. All cases increased the usable space, and most households doubled the size of the house during the first year from 18 to 36 square meters. On average, families were living in houses of 60 square meters, being the biggest 84 square meters and the smallest 45 square meters. The temporary houses were settled following a recommended layout from the government and professional guidelines. These recommendations suggested a distance of three meters between houses, leaving a limited space for expansion but the opportunity of using the adjacent house as structural support for extensions. These expansions were seen in several cases, and in some houses the extensions were used by two families as a corridor or intermediate space. Nevertheless, in some cases, when the adjacent temporary house was moved, families used that extra space to expand further. This practice showed that the need for space is crucial, and that families want to expand as much as they can in the available space despite their temporary situation.
- Changes in existing doors and windows and new openings. The fixed location of windows and doors was a problem when families added new rooms or changed the access. Also, most families made the two small windows bigger and added new windows to provide more daylight inside the house. The reason behind could be explained by the amount of time families spend inside the house, especially during the winter.
- Internal divisions. In many cases, the temporary house was divided to separate two bedrooms, or a bedroom from the kitchen or dining room.

- Front porch or front garden with surrounding fence. Half of the cases studied built these intermediate spaces, which provide a separation between the house and the public areas. The front gate is a common feature in houses from central and southern regions of Chile. This element was added to the houses for security and aesthetic reasons.

The cost of the *mediaguas* built by TECHO in Chile was estimated as 907 USD in 2010 (Un Techo para Chile, 2010). During fieldwork families estimated the cost of the modifications between 1 and 500 USD except from one family which spent between 500 and 1,500 USD. There was no connection between the amount spent on the extensions and the size of the houses, and also the quality varied dramatically from one case to another. Nevertheless, one of the biggest houses (70 square meters) made the most expensive changes, with improvements of better quality, in special in terms of insulation. Most families explained that they used their own savings and received support from families and friends to make the improvements. This shows that solidarity was a significant factor in the process of recovery, and how social networks were crucial after the disaster. Despite this, the amount of resources spent on improving the house appears to be small for the scale of the modifications seen. One reason can be the fact that most households received donations of materials from different entities instead of cash. Therefore, the costs of these materials were not considered in the estimation of resources spent. Affected families received materials from local municipalities (timber and insulation) and the 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 area). Also, the fact that the houses were built in land provided for the short-term had an effect on the materials chosen for the extensions, which are less expensive than other materials used in permanent houses in the area. The most used materials were timber and corrugated iron, which could be removed, reused and recycled in the permanent house.

The modifications can be explained by different factors. First, the minimum quality necessary to face the winter in that part of Chile resulted in an imperative to improve the house, through the addition of insulation and waterproof layers to it (Figure 6). 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 workplace besides its domestic use, and therefore, some households needed to expand the temporary house to resume their economic activities and to generate income. Finally, in many cases the modifications were explained by socio-cultural factors, such as the need of identity and the aesthetics of the house.

Modifications made to the houses can create some problems, but similarly to the cases in Peru, possible solutions can be designed for future improvements. When the wall panels are removed or voids are made through cutting beams and columns from the frame of the panel, the structure of the house is weakened. Although cases in Chile are different to cases in Peru because families should not reside in the *aldeas* permanently (they are meant to be temporary settlements) the extensions were similar in scale. Also, most Chilean families mentioned in the interview their interest in keeping the house and to use it as an extension in the permanent house. Therefore, there is an opportunity to make a more flexible design and to show families how to use parts of the house safely and efficiently. In addition, insulation and waterproofing were the main issues for the families, and therefore these aspects should be included when designing a temporary house for climates with a cold winter, such as the South of Chile.



Figure 6. Waterproof layer added to temporary houses in Chile, 2012.

Source: Author

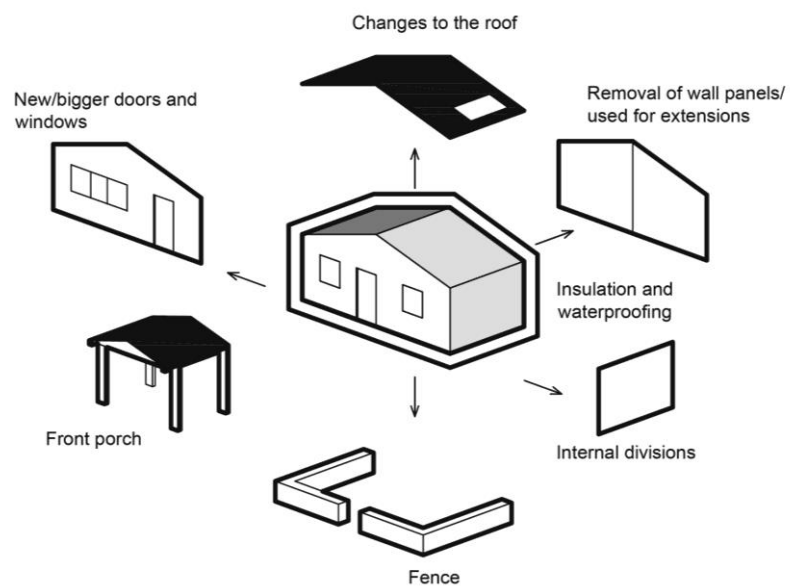


Figure 8. Summary of modifications made to temporary houses in Chile, 2012.

Source: Author

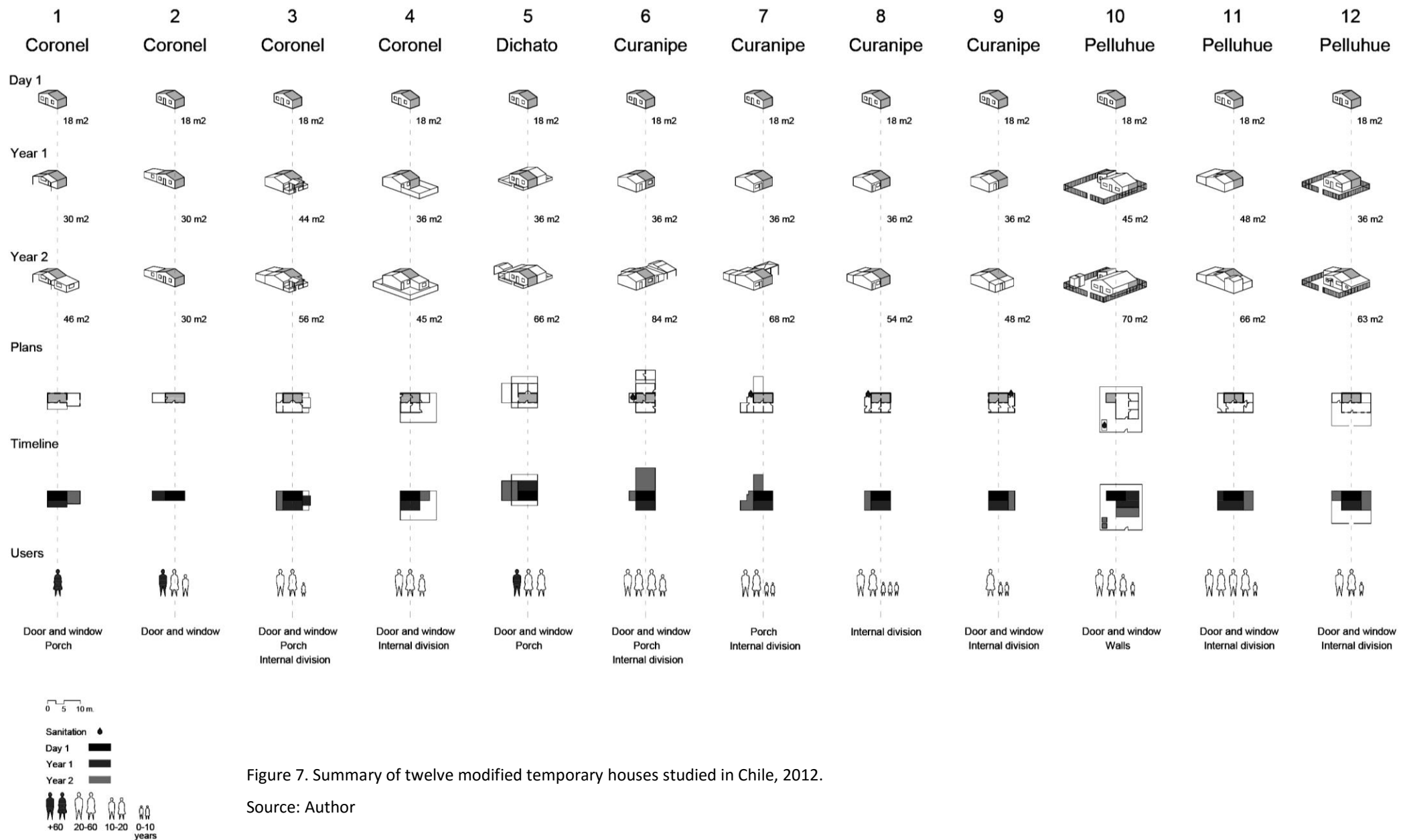


Figure 7. Summary of twelve modified temporary houses studied in Chile, 2012.

Source: Author



## HOUSING AS A CONTINUOUS PROCESS

Temporary houses are criticised for not being flexible enough to include future changes and for being alien to the local context (Ikaputra, 2008; Marcillia & Ohno, 2012). But, even though cases studied in this research were flat-pack and prefabricated post-disaster houses designed to be temporary, they were adapted by families in order to meet their needs in the mid-term while they looked for options to get a permanent solution, either self-built or provided by the government or other institutions. In addition, when families got their permanent solution, the temporary house was used as an extension to the main building, when possible. In Peru, temporary houses studied were set on families' own lands (non-displaced). Families already lived there before the earthquake, and they had social networks established (family and community). In these cases, families stayed in their own land, and used the temporary house as a starter home first and as an extension later. In Chile, temporary houses studied were built in temporary settlements. The government coordinated the temporary settlements in a planned way, and most families applied for subsidised state houses as permanent solution. Most houses were extensively modified, even though residents knew they would have to leave the temporary settlements in the following months or years. In both countries, NGOs and governments invested resources on the improvement of temporary houses that were crucial for families to achieve a minimum quality, such as shading, insulation, waterproofing, and sanitation, among others. Therefore, to recognise the existing needs of the affected population and the sheltering process as a continuum is central to giving effective solutions after disaster.

In both countries, in very different contexts, families adapted the anonymous, prototypical, and repeatable house to their individual needs. In some cases, changes were so extreme that it was difficult to identify the temporary solution. From the comparison of cases, it is possible to identify three similar reasons for modifying the shelters. First, changes are made for expanding the houses, due to the need for space. Second, changes are made for dealing with the local climate, to face the hot summer and the cold winter. And third, changes are made for introducing local traditions, such as front porches and intermediate spaces.

When designing new strategies, the concepts of flexibility, adaptation, and self-build process should be included, even if the 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 normally used for economic reasons, flexibility can be a way to ensure that structures are able to be adapted to a variety of cultural needs and expectations (Ashmore et al., 2003; Barakat, 2003; Leon et al., 2009). Having temporary housing immediately available is crucial, but also it is important to satisfy other objectives such as social needs and long-term, outcomes (Johnson, 2007b). Thus, future designs should consider the capacity of expansion to accommodate family members, different uses, and future upgrading. Flexibility provides families the possibility to customise their dwellings, facilitate transformations and modifications, to use them as multifunctional spaces and to feel attached to them (Félix, Monteiro, Branco, Bologna, & Feio, 2015, p. 14). Some NGOs and manufacturers have built shelters based on frames that can be moved later to a different location and with walls that can be upgraded with more permanent materials, such as examples from Indonesia, Pakistan, Peru, Haiti and Vietnam (IFRC/ RCS, 2011), although the outcomes of these programmes in the mid-term have not been studied in depth.

Flexibility stands out as a crucial and desirable characteristic to either temporary housing or transitional shelter, recognised by researchers and practitioners (UNDRO, 1982; Kellett & Tipple, 2000; Barakat, 2003; Arslan, 2007; Lizarralde & Root, 2007; Johnson, 2007b, 2007c; Arslan & Cosgun, 2008; Félix et al., 2013; Davis, 2015). Nevertheless, guidelines on how to make future changes or to safely adapt the temporary houses are not provided to affected families. Therefore, there is an

opportunity to develop designs incorporating a deeper understanding of the progressive and incremental aspects of post-disaster accommodation.

## ACKNOWLEDGEMENTS

This research has been supported by BecasChile-Conicyt. Fieldwork conducted in Peru and Chile was funded by Santander Travel Grants and the Cambridge University EcoHouse Initiative. Special thanks to Dr. Michael H. Ramage for his support and supervision.

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