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Using shipping containers to provide temporary housing in post- disaster recovery: Social case studies

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Abstract

Housing that makes use of the ubiquitous general purpose shipping container is becoming more commonly seen as a useful way of reusing the empty vessels as valuable accommodation. In particular, the application of shipping container temporary housing is suited to post-disaster situations, design examples of which can be found in the literature. However, ensuring the success of implementing such projects in a post-disaster setting requires investigation into the social considerations of temporary housing. This research takes a qualitative approach, focusing particularly on case studies of temporary housing experiences following the Hurricane Katrina in 2005, the Christchurch Earthquake in 2011 and a field study of 2009 Black Saturday bushfire-affected communities in Victoria, Australia. Key social factors found to be significant to the success of shipping container temporary housing projects relate to flexibility in ownership, reuse and siting arrangement, in addition to robust pre-disaster planning by authorities, taking into account the varying characteristics of different types of disasters.

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1. Introduction

Often, in the event of natural disasters such as bushfires, flooding and earthquakes, large numbers of people are displaced from their homes and require temporary housing. Current practice for post-disaster emergency shelter

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usually involves the use of large communal areas like stadiums or showgrounds, where relief centres and temporary accommodations (usually tents) are provided, as seen in the case of Hurricane Katrina (Nigg et al., 2006). Whilst these are quick to set up, disaster survivors also need accommodation and facilities set up for longer term recovery.

Shelter and housing provided for victims of disasters falls along a continuum usually including four categories from pre-disaster emergency shelters, temporary shelters, temporary housing to permanent rehousing (Quarantelli, 1995; and Nigg et al., 2006). This research assesses the utilization of used shipping containers in post-disaster housing applications, particularly temporary shelters and temporary housing. However, discrete categories for post disaster shelter are becoming decreasingly relevant. It has become apparent that long term and long distance displacement, like that seen after Hurricane Katrina, can create a grey area between immediate shelter and permanent housing (Levine et al., 2007). Following natural disasters, reconstruction projects are sandwiched between the immediate necessity to act promptly and the long-term need for sustainable community development, resulting in policy-affecting realities of conflicting paradigms (Johnson et al., 2006). These trends reflect the increasing demand for innovation and flexibility in the traditional post disaster housing response.

Many temporary housing projects (Davidson et al., 2007; Christensen and Worzala, 2010) are geared towards community engagement to enable better social outcomes for disaster victims, but the implementation of projects such as these is fraught with issues relating to proper skill utilization and effective management. Although it is widely accepted that success of temporary housing projects lies in community participation, in reality this does not translate into practice despite the fact that "... the participation of users in up-front decision-making ... leads to positive results in terms of building process and outcomes" (Davidson et al., 2007). In addition, Lindell and Prater (2003) highlight the need for community cohesion in disaster situations, as being the key to lessening the impacts of disasters. This has relevance here in the mobilization of social capital in the community self-determination of temporary housing needs post-disaster. Yet it is often seen that disaster reconstruction is driven by technology, restricting wider engagement with cultural and social issues (Hayles, 2010). Further to this, true sustainability comes from utilization of local knowledge and labour which can create micro-economies that aid in the recovery process (Johnson, 2007a). This is pertinent to every temporary housing project with goals of sustainability.

The use of modified shipping containers is not yet widespread in post-disaster temporary housing applications. Much knowledge exists about using shipping containers in housing applications; yet, for the most part approaches inadequately address the multifaceted economic, social, and logistical issues inherent in using shipping containers as dwellings, and few focus on the additional complexities associated with post-disaster temporary housing (Christensen and Worzala, 2010). In addition, many are prohibitively expensive for application in disaster relief applications. One example is the Future Shack, developed by an Australian architect Sean Godsell, which was one of the first attempts to utilize shipping containers in temporary housing, being assembled in 24 hours and having minimum cuts necessary in the container. However, the cost of one Future Shack exceeds \$30,000 (Sean Godsell Architects, 2001), which is hardly suitable for true post disaster applications. In addition, Global Portable Buildings offers disaster recovery temporary housing solutions fashioned from shipping containers (Global Portable Buildings, 2011), however these are also prohibitively expensive in many post-disaster applications and are made from new shipping containers, eroding the benefits of reusing those empty containers stockpiled in ports all over the world.

In a post disaster context, the higher the level of resources being invested in temporary housing measures, the less are available for permanent reconstruction. This highlights the merit in strategies that both reduce the cost and improve the prospects of reuse or of evolution of shipping container temporary housing into permanent housing. There are several other design examples in the literature of post-disaster temporary housing incorporating the use of shipping containers, including designs for whole villages made up of modular units designed with families in mind. Pena et al. (2012) show temporary housing design solutions that aim to exploit shipping containers inherent benefits relating to strength, reusability and portability. Although these designs are technically sound in terms of structural integrity, services and logistics, little available literature seems to look into the broader issues surrounding social suitability of implementing a shipping container temporary housing project. Research into practical social aspects of the implementation of such plans, with which the current paper is concerned, will enable a greater understanding of some of the key social issues which are inherent in top-down reconstruction approaches. A useful insight relevant here is from Davis (1978), whose work on post disaster sheltering is central to today's understanding of the issue – *"Survivors priorities in order of importance are: to remain as close as possible to the site of their ruined homes and means of livelihood, to move temporarily into homes of families or friends, to improvise temporary shelters as close*

as possible to the site of their ruined homes (these shelters frequently evolve into rebuilt houses) and to occupy emergency shelters provided by external agencies.”

Increasing the knowledge base in terms of implementing appropriate shipping container temporary housing and examining how communities function post-disaster will allow a higher level of successful, holistic and sustainable design solutions that balance technical feasibility, affordability and social appropriateness. This paper looks into the practical aspects of implementing post-disaster temporary accommodation using modified shipping containers by examining social considerations and lessons learned from key case studies. It does not propose new designs for shelters or delve into in-depth logistical study, but rather looks at how designs may be successfully implemented to ensure culturally appropriate solutions to the issue of temporary housing post-disaster and could lead to higher levels of comfort, sanitation and social cohesion post-disaster, as well as contribute to quicker, more organized provision of shelter in overall disaster response. Methods used include a qualitative field study into temporary housing experiences of the 2009 Black Saturday bushfire affected communities in Victoria, in addition to case studies looking into housing experiences following Hurricane Katrina in 2005 in the US, and the Christchurch Earthquakes of 2011. The context of this research sits within broader areas of knowledge relating to post-disaster housing and community cohesion, as well as shipping container architecture.

2. An RMIT research project

The study consists of two main qualitative research components: a field study of housing experiences of Black Saturday bushfire affected people involving focus group discussions and a multiple site case study. The study aims to answer the following research questions:

- What factors affect suitability of using shipping containers for post-disaster temporary housing?
- What lessons have been learned in terms of key social outcomes from temporary housing for Hurricane Katrina and the Christchurch Earthquakes of 2011?
- Would shipping container temporary housing be suitable for disasters similar to Victoria's Black Saturday bushfires in February 2009?
- What social issues are paramount in the implementation of a shipping container temporary housing project?
- How could these issues be addressed to ensure the best possible social outcomes?

For this topic, a significant volume of information is needed in order to make learned conclusions about social aspects of post-disaster temporary housing. The combination of case study and focus group discussions as a field study enables a significant amount of data to be analysed, beyond that practical to achieve by primary data collection methods alone. The case study uncovered key issues in provision of post-disaster temporary housing which would prove difficult to investigate on a first-person, primary data basis as the disasters occurred in different countries. These issues are contrasted with insights from focus group discussions to enable conclusions to be drawn about social suitability of shipping container emergency housing for post-disaster applications. A summary of research methods can be found in Table 1.

Table 1. Summary of research methods

	Case Study		Field Study
Site:	Christchurch	New Orleans	Callignee/Traralgon South/Koornalla
Disaster type:	Earthquake	Hurricane- flood	Bushfire
Data type:	Qualitative	Qualitative	Qualitative
Data source:	Secondary	Secondary	Primary
Procedural requirements:	No	No	Yes
Sample size:	N/A	N/A	17

1. 3. Case studies – Christchurch and Katrina

The two sites chosen for this study are the 2011 Christchurch earthquakes and Hurricane Katrina in the U.S. (2005). These were chosen as good counterpoints to the Black Saturday investigation being examples of natural disasters in developed countries, and thus temporary housing and support experiences could be comparable. This multi-site study enables cross case comparisons of the constructed picture of the sites and also informs the Black Saturday field study in terms of lessons learned.

1.1. 3.1 Factors affecting suitability of using shipping containers for post-disaster temporary housing

From research into available literature on temporary post-disaster housing, and categorizing shipping container housing into the modular housing group suitable for longer time frames than emergency shelters, the following points affecting suitability have been identified. It is important to note that these factors are not an exhaustive list of those affecting temporary housing suitability but provide a broad picture of variables relevant to the use of modular temporary housing such as shipping container units. They are drawn from studies by Gionvinazzi and Stevenson (2011) in Christchurch and Johnson (2007b) and Nigg et al. (2006) after Hurricane Katrina.

Level of damage to homes: Use of modular temporary housing such as shipping container units will be determined by the need for temporary housing options post-disaster- whether the damage to homes is sufficient to require displacement.

Numbers of displaced people and scale of disaster area: Modular housing options such as shipping container units are useful for a range of impact areas, for a large-scale disaster involving high numbers of displaced such as Hurricane Katrina, or smaller numbers of displaced. This is due to the inherent modularity of shipping container housing options and the flexibility of arrangement. It is estimated that around 1.2 million people were displaced by Hurricane Katrina within hours or days of the disaster (Nigg et al., 2006). Thus, the speed of displacement is also an important factor affecting demand for temporary housing.

Availability of rental properties or vacant accommodation in surrounding areas: As was seen during the recovery after the Christchurch earthquakes, a service was set up to match victims seeking temporary accommodation with available rental properties, the majority being holiday homes and the like (Gionvinazzi et al., 2011, p. 3). However, many disasters are of such scale that the displaced people cannot be accommodated with existing vacant dwellings. In such cases, modular designs like those involving the use of shipping containers may be a useful option.

Projected timeline for damage repair/housing replacement: Modular and shipping container emergency housing is inherently suited to the medium term, as provision is not as fast or cheap as using tents. Therefore it may be better suited to disasters with a long timeframe for rebuilding of permanent dwellings, or even scope for incorporation into permanent dwellings.

Table 2. Analysis of suitability for shipping container temporary housing

Type of Disaster	Key characteristics (U.S. Occupational Safety & Health Administration, 2013)	Predicted lead time	Suitability for shipping container temporary housing
Flooding-Inundation	Large land areas inaccessible for long periods, lower destruction than flash flooding	Several days	Medium - depending on inundated area
Flash flooding	Transient, structurally destructive	None	Medium to Good - depending on ground conditions
Bushfire/grassfire	Can be structurally destructive. No significant change to ground conditions.	Several hours to several days	Good to very good
Earthquake and landslide	Highly structurally destructive. Can accompany landslide, fire, flood or tsunami	None - depending on early warning systems	Medium to Good - depending on aftershocks
Wind storm (incl. Hurricane, Tornado)	High displacement of debris, structurally destructive, sometimes accompanied by flooding	Several hours to Several days	Good

A review of key characteristics of typical disasters against the above factors gives the suitability for using shipping container temporary housing, as shown in Table 2. It can be argued from Table 2 that shipping container temporary housing is less suited to disasters that render large areas inaccessible for long periods of time like inundation. More suitable are disasters like bushfires that have up to several days warning lead time, and the affected area can be accessed relatively quickly after the disaster.

1.2. 3.2 Lessons learned in terms of key social outcomes from temporary housing

Published material on temporary housing experiences post-disaster in the two cases were analysed and synthesized. The lessons have been grouped into temporary housing implementation lessons and planning lessons, which are central to the success of shipping container temporary housing projects.

Planning

- Reliable estimates of temporary housing/sheltering requirements are needed. For Katrina, government planning failed to anticipate the need for shelter and temporary housing adequately (Nigg et al., 2006).
- Planning needs to accommodate the possibility of far and wide displacement and extended dislocation as in the case of Katrina - "... evacuees were registered in every state and almost half of the ZIP codes in the United States ... tens of thousands were more than one thousand miles away from New Orleans" (Nigg et al., 2006, p.117).
- Mechanisms set up to coordinate housing relief had not been tested prior to Hurricane Katrina, and also to a lesser extent in Christchurch. Decision-makers responsible for housing relief need to develop working relationships with counterparts during non-disaster times to ensure cooperation (Gionvinazzi et al., 2011).

Temporary housing implementation

- Temporary housing often ends up lasting longer than intended, sometimes decades, with negative social consequences for the displaced persons. Gionvinazzi et al. (2011) put forward the growing trend of skipping medium-term housing, which is a major drain on the resources available for permanent housing, and proceeding from temporary sheltering straight to reconstructing housing to a similar standard of permanent housing but with a cost on par with provisional housing.
- Temporary housing efforts must take into account the fluid and dynamic nature of sheltering needs, as described by Quarantelli (1995). Shipping container temporary housing needs to be adaptable to these changing requirements. For example, shipping container units can be used as both centralized temporary shelter and longer term temporary housing on victim's properties.
- Aldrich and Crook (2008) brought up the issue of siting the temporary housing post Katrina, which was supplied by FEMA in the form of mobile home trailers (caravans) - "...most citizens recognized the need for facilities like trailer parks and modular homes, but many sought that these facilities be placed elsewhere". The lesson here is reflective of the complexities of post-disaster social structures and any shipping container temporary housing project must be flexible in its siting options in order to avoid unwanted social effects of creating social hierarchies or enclaves.

2. 4. Field study – Black Saturday

Three focus group discussions were undertaken with volunteer participants drawn from communities affected by the Black Saturday bushfires of February 2009, in the Glendonald Road Fire (Victorian Government, 2010) area communities of Callignee, Traralgon South and Koornalla. These focus groups were held at the Callignee Hall and covered community dynamics post-disaster, experiences of temporary housing support and how housing situations affected recovery. The participants of focus group were recruited from a range of community groups, including from positions of authority within the community. Gender balance was also sought in recruiting participants.

2.1. 4.1 Suitability of shipping container temporary housing for Black Saturday bushfires

Drawing on factors affecting suitability uncovered the previous case study, and exploring this in the focus groups, the results indicate mixed suitability of shipping container temporary housing to the example of the 2009 Black Saturday bushfires, for the area researched (Callignee, Traralgon South and Koornalla). The level of damage

to homes resulted in displacement of a large proportion of the community, with data suggesting around three-quarters of the homes in the fire affected area being destroyed (Victorian Government, 2010). However, the population density of the area is quite low, being mixed semi-rural and farming. Thus, the number of displaced people from the 139 homes was low enough that they could largely be absorbed into rental properties and friend/family homes in the neighbouring towns of Traralgon and Morwell, as no communal temporary housing facilities were set up in the aftermath. It would seem that there were enough available rental properties to absorb those displaced. Renting seemed to be the first option explored by many focus group participants who lost their homes:

"On the Sunday afternoon we got a phone call from an acquaintance who said he had a house that was vacant that we could rent if we'd like... [we thought] there's going to be a lot of people that are going to try and get a place to rent ..."

In addition, focus groups indicated that the fire affected area was inaccessible for up to several weeks after the fire due to the coroner's lockdown of the area where fatalities occurred, which would prohibit access for any temporary housing work to be carried out.

2.2. 4.2 Social issues in the implementation of a shipping container temporary housing project

A key recurring theme arising in the focus groups was that of the wish to stay in the community after the fire - either on their own blocks or as near as they could get.

"I would have preferred to stay in the community... we felt like we were away from all that was happening [in the community]". - Focus group participant who experienced displacement.

Further to this, there was some resistance to the idea of a centralized temporary housing camp - with objections relating to the social issues arising from having a high density of victims living in close proximity for several months to years, as well as a yearning to get back on their own blocks of land -

"We were out there for the lifestyle... the peace and quiet. Post-disaster we wanted to get back to that lifestyle as quickly as possible."- Focus group participant

Flexibility in temporary housing arrangements was also a key theme. Avoidance of a "one size fits all" approach was underlined, and also it was identified that assistance with temporary housing be fair as well as flexible - some people won't want to live in a shipping container, and grants towards alternative solutions like renting in a nearby area was brought up as a solution. The provision by authorities of advice and facilitation of time for victims to think about how to choose their preferred temporary housing assistance was also brought up, and emphasis was put on facilitating self-determination of temporary housing choices by victims. Temporary housing initiatives having the characteristic of being community driven was also identified as an important positive factor to aid in the recovery process. That being said, it was brought up that temporary housing solutions, although they should be flexible in some aspects, should have a specific time frame for use to encourage reconstruction in a timely way. Reports arose of some victims living in provisional housing (converted sheds, etc.) at the time of the study, over 4 years after the bushfire. Further to this, economical use of shipping container temporary housing units was raised as an important factor to get right- with ideas to have units on victim's blocks with the possibility of incorporation into permanent housing, or a system of government buyback for reuse in another disaster application. This ties in with earlier themes of flexibility in ownership.

Another important recurring issue with temporary housing experiences in the groups was the duplication of information and resources for victims by the authorities. Victims reported being asked to detail their needs or experiences multiple times to different agencies that meant well but failed to have sufficient inter-agency coordination to avoid duplication.

2.3. 4.3 Strategies to address the issues to ensure the best possible social outcomes

Drawing from focus group data and the social considerations raised in the discussions, one of the key issues relates to the wish of victims to stay in the community after the disaster and to return to their properties. This could be addressed by designing a temporary housing system that allows for deployment of shipping container units onto individual properties, provided that a suitable space exists and services are available. This would mean a lag time

after the disaster when destroyed houses have to be cleared to make way for the shipping container unit, and also for the unit to be connected to the existing services to the block. While this was happening, those displaced would have to be accommodated in short-term temporary shelters or other means. That being said, securing suitable locations for temporary housing camps has been identified as often taking the longest time in the temporary housing provision schedule (Barakat, 2003) and so skirting this issue by avoiding central camps in favour of units on victim's properties could have a positive effect on scheduling as well as being socially appropriate.

Flexibility in ownership, another important consideration raised in the focus groups, could be achieved through creative post-disaster relief policy design. Provision could be made in temporary housing assistance for victims to receive a shipping container unit, or instead use the assistance towards rent or other housing measures should a unit be unsuitable for their circumstances:

"Not everyone wants to live in a shipping container - they should get alternative assistance to keep things fair".

- Focus group participant

Construction of an opt-in government buyback policy of the shipping container units after permanent rebuilding has been achieved could offer increased flexibility and the purchased units could be stored ready for use in another post-disaster application. This is one way to minimize the diversion of resources away from permanent reconstruction efforts, another key issue raised in focus groups, as money generated from the buyback could be used by victims to continue their house rebuilding or repair.

Yet another method of ensuring relevance and usefulness of shipping container temporary housing to affected communities is provision in the design for future incorporation into permanent rebuilding. This would aid in addressing not only the flexibility in ownership issue, but also economic use of resources and reducing the incidences of resources being diverted away from permanent rebuilding to provide temporary housing. Incorporation of units into permanent buildings is also inherently flexible due to the inbuilt modularity of shipping containers.

3. 5. Discussion of results

The purpose of this study was to systematically examine post-disaster temporary housing experiences to reveal the social suitability of utilizing shipping containers in post-disaster temporary housing applications. From the results, it can be seen that there is scope for suitability in certain situations, providing the design of such a project addresses key societal issues surrounding ownership, flexibility, policy planning and economic use of resources.

These findings enhance the picture of existing knowledge of community issues surrounding post disaster temporary housing in the wider disaster literature, as well as furthering knowledge about shipping container architecture and its application in real-world contexts. This research contributes valuable insights to the implementation of shipping container temporary housing, which could improve practical social outcomes of post disaster housing and aid in the overall recovery process.

The transferability of these research outcomes is somewhat dependent on the context of the disaster, and further work would need to be done in terms of the best post-disaster situations for using shipping container temporary housing. However the main findings of the field study are relevant to a wide range of settings because concepts such as ownership arrangements and sustainable use of housing resources tie in with basic human tendencies in community organization. The limitations of this study lie in the restricted scope and sample size of the field study with the focus group data representing the community experiences of only one area affected on Black Saturday. To minimize the possibility of bias, larger studies of increased scope are required, although effort was made to include a wide cross-section of community members in the focus groups. Nevertheless, the study has been structured to include case studies to distill other key lessons and data themes in addition to the field study in order to broaden the context of the results. For the case studies, there was a reliance on previous work looking at temporary housing experiences of Christchurch and Katrina and so any limitations of those studies will carry through in this study.

Points of interest in the data include the international trend of, in post-disaster housing provision, skipping medium term housing in favour of rapidly built permanent housing constructed to a similar budget of provisional housing, as was the case after the L'Aquila earthquake in Italy in 2009 (Gionvinazzi et al., 2011, p.5). This ties in with the idea of constructing temporary housing in such a way so that it is possible for it to evolve into permanent housing to a suitable construction standard, as identified in the focus groups. Both approaches minimize a pitfall of many post-disaster temporary housing projects: diversion of precious resources away from permanent

reconstruction. Further research that will improve knowledge in this area has uses in tying together the social considerations uncovered in this study with designs for shipping container temporary housing systems that can facilitate successful community outcomes.

4. 6. Conclusions and recommendations

The research outcomes presented in this paper provide insights into the suitability and social issues surrounding shipping container temporary housing projects in post-disaster situations, relating to the need for flexible, coordinated planning for temporary housing that utilizes community social capital and is innovative in siting, reuse and ownership structure of shipping container units. In addition, acknowledgement exists that these are not suitable for all post-disaster applications and that more research is needed for suitability in different contexts. Implementation of such temporary housing projects need a focus on knowledge management to build on past lessons from other disasters and to avoid the tendency to focus efforts on technical innovation at the expense of social appropriateness. Disaster relief temporary housing policy needs to be developed in partnership with affected communities, with those experiencing disasters in the past contributing firsthand knowledge to enable a reconstruction response based on socially appropriate solutions. This will greatly benefit future disaster survivors.

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