Temporary Housing Innovations within the Post-Disaster Housing Recovery Process: An International Comparison

3rd International Conference on Urban Disaster Reduction
Boulder, Colorado

Liz Maly, Tohoku University
Tomoko Matsushita, University of Tokyo

2014.9.30
Outline and framing questions

• Wooden temporary housing after the Great East Japan Earthquake
  what are the impacts of temporary housing policies on the process of post-disaster housing recovery?

• Examples of temporary housing in U.S., Indonesia, Taiwan, and New Zealand
  what commonalities and differences are there from the case in Japan in comparison to cases from U.S., Indonesia, Taiwan, and New Zealand?
1995 Great Hanshin-Awaji Earthquake, Kobe

- 6,434 killed, 639,686 damaged houses
- the government provided 49,681 mostly pre-fabricated temporary housing units.
- most temporary houses were located far from the affected area, en masse

Earthquake affected area
1995 Great Hanshin-Awaji Earthquake, Kobe

Problems of Temporary housing:
• Inconvenient location
• Massive numbers of housing units
• Residents entered by lottery (destroy community)
• Many elderly, vulnerable people had no other choice but to move into temporary housing
• Solitary death
• Some lived there for 5 years or more.

One of the outcomes:
All 47 Prefectures made an agreement with Prekyo*, to provide temporary housing in case of future disaster

* = Japan Prefabricated Construction Suppliers and Manufacturers Association

http://www.city.kobe.lg.jp/foreign/english/disaster/5year/phase1/sub1-5-2.html
2011 Great East Japan Earthquake, Tohoku

- March 11, 2011
- 9.0 magnitude earthquake
- tsunami-40 meters run up
- fires
- Fukushima nuclear accident
- Almost 20,000 people died
- 470,000 evacuated in the first days
- 3.5 years later, 245,622 people are still living in a temporary, interim situations.

Transition of Number of evacuees since March 2011
Temporary housing includes:
- 52,000 units of pre-fab temporary housing
- 13,000 units of wooden temporary housing
- (6,700 in Fukushima Prefecture)
- 67,000 rental apartment units used as temporary housing (national government pays the rent)

Permanent housing includes:
- moving in public housing
- building a new house, often part of land relocation project
- in most cases, requires waiting for land readjustment and relocation, land raising and preparation in high land area.
2011 Great East Japan Earthquake, Tohoku

“Innovative” solution:
(Temporary housing) + (wooden) + (local builders)
How were conditions right for this innovation?

- Typically Japanese houses are built with wood and many builders are skilled at small scale wood housing construction.
- Wood housing construction in Japan is highly systematized.
- Tohoku is known for its abundant lumber production.
- After Kobe, many problems with prefabricated housing were acknowledged by professionals and experts and better quality was much needed.
- The popular idea of “locally produced, locally consumed” (地産地消).

- In Fukushima, a government-led program of promoting a regional construction style using local materials was already in place before the disaster.
- Fukushima expected to have a longer term displacement because of radiation.
How did necessity bring about policy change?

“necessity is the mother of invention”

• Despite previously arranged agreement with the pre-fab. association (prekyo), the demand for temporary housing exceeded the capacity and the government had to look for other means to meet the needs.

• Professionals and builders proactively approached and lobbied the government to let them participation in the construction of temporary housing

• Public calls for builders to participate in the construction of temporary housing were carried out for the first time by the prefectural governments of Fukushima, Iwate and Miyagi. The criteria for selection included:
  • Participation of local builders
  • Use of locally available materials
  • Ideas for reuse, etc.

• The public call promoted the actors to collaborate, forming joint-ventures with architects, contractors, and suppliers of lumber and building materials.
Public calls for construction of wooden temporary housing in Fukushima Prefecture

- The carefully set criteria for selection has determined the outcome.

<table>
<thead>
<tr>
<th>Criteria for Selection</th>
<th>Public Call 1</th>
<th>Public Call 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>period of public call</td>
<td>2011.4.11 - 4.18</td>
<td>2011.7.12 - 7.19</td>
</tr>
<tr>
<td>Finalist announced on</td>
<td>4.22</td>
<td>7.26</td>
</tr>
<tr>
<td># of housing needed</td>
<td>4000 units</td>
<td>1000 units (later increased to 2,000)</td>
</tr>
<tr>
<td># of applicants</td>
<td>27 contractors</td>
<td>36 contractors</td>
</tr>
<tr>
<td>Result of selection</td>
<td>12 contractors</td>
<td>15 contractors</td>
</tr>
<tr>
<td>1. Match the required specification</td>
<td></td>
<td>1. Should be wood structure (including mixed structure)</td>
</tr>
<tr>
<td>2. Cost should be max. 6 million yen for construction, 5.2 million yen for lease for 2DK</td>
<td></td>
<td>2. Should be easily dismantled and relocated</td>
</tr>
<tr>
<td>3. Consider using subcontractors in Fukushima</td>
<td></td>
<td>3. Should consider accessibility for elderly</td>
</tr>
<tr>
<td>4. Consider hiring disaster-affected people as workers</td>
<td></td>
<td>4. Cost should be max. 5.6 million yen for 2DK</td>
</tr>
<tr>
<td>5. Consider using local materials</td>
<td></td>
<td>5. Consider using subcontractors in Fukushima</td>
</tr>
<tr>
<td>6. Provide maintenance after residents moved in</td>
<td></td>
<td>6. Consider hiring disaster-affected people as workers</td>
</tr>
<tr>
<td>7. Consider using local materials</td>
<td></td>
<td>7. Consider using local materials</td>
</tr>
<tr>
<td>8. Provide maintenance after residents moved in</td>
<td></td>
<td>8. Provide maintenance after residents moved in</td>
</tr>
</tbody>
</table>
Advantages of (temporary housing) + (wooden) + (local builders)

**Local economy**
- Revitalizes local economy by using **local timber** and local builders

**Flexibility**
- Wood is easier to handle on site, allowing builders to modify as necessary, no need for special equipment

**User-friendly**
- Users can make changes themselves, add shelves, to make it their ‘home’

**Psychological effect**
- Positive effect of natural materials, warm feeling, etc.
The National Wooden Construction Association (全国木造建設事業協会) is now actively making agreements with each Prefecture, similar to those agreements with prekyo, in order to provide wooden temporary housing in case of next disaster.
Mutual support systems help revitalization the local industry

Groups of local “producers” are created in Fukushima, Miyagi and Iwate prefectures, similar to the group formed for the construction of temporary housing

Information is open to public and for the smooth procurement

Each group consists of locally based builders, manufacturers, suppliers and designers
We identified:

• The context and conditions in the case of Japan that led to the innovation of wooden temporary housing.
• Two byproducts of this new policy.

Next:

• What innovations and evolutions in the processes of temporary housing after disaster can we see from examples of other countries?
• What commonalities emerge?
More than 1,863 people died
More than 1,000,000 people displaced
600,000 people in shelters 1 month after disaster
1,000,000 housing units damaged/destroyed, more than 200,000 in Mississippi alone
From standard FEMA trailer to ‘innovative’ temporary to permanent Mississippi Cottages

1. FEMA trailer

2. Mississippi Cottage (proposed)

3. Cottage-temporary use

4. Cottage-Permanent use
Temporary housing after 2012 Hurricane Sandy

- New York State, New Jersey State, did not provide prefabricated temporary housing at any scale
- New York rejected the idea of using prefab housing
- A small number of THU (temporary housing units) used in New Jersey (around 45 units)

photo from FEMA website [http://www.fema.gov/media-library/assets/images/69004](http://www.fema.gov/media-library/assets/images/69004)
Housing innovations after 2012 Hurricane Sandy

- Rapid Repairs (NYC) or STEP (Sheltering and Temporary Essential Power--FEMA) allows people to stay in their houses while small but needed repairs are made.

- Sandy (DHAP Sandy) DHAP (Disaster Housing Assistance) provided vouchers-limited use in a very tight housing market.

- NY City relied on the use of hotels, follow by rental subsidies provided through the voucher progra (TDAP-Temporary Disaster Assistance Program) intended as an extension of DHAP.)
2006 Central Java Earthquake, Yogyakarta

- Magnitude 6.1, May 27, 2006, 5:55 am
- 5749 people lost their lives
- 1,100,000 people's homes were destroyed
2006 Central Java Earthquake, Yogyakarta

Innovation: providing temporary housing in the form or T-Shelters/Transitional Shelters

Source: Ikaputra, from the 2009 UGM/IRP, Yogyakarta and Central Java Earthquake 2006 Recovery Status Report
2010 Merapi Volcano Eruption,

- In October and November 2010, volcanic eruptions of Mt. Merapi, north of Yogyakarta
- destroyed 45 villages
- killing more than 350 people,
- burying/destroying 2682 houses.
after Merapi Eruption, 2010

- innovation: collective “temporary neighborhoods”

- with support for livelihood recovery

- attempt to keep communities together through temporary and permanent housing recovery phases
permanent resettlement after Merapi
1999 Taiwan 921 Earthquake and 2009 Typhoon Morakot

- The Chi Chi EQ struck central Taiwan, killing close to 2500 people and destroying 105,000 housing units.
- Residents could choose from several interim options including purchase of public housing, moving into prefabricated temporary housing. 80% chose rental assistance.
- Typhoon Morakot caused landslides in southern Taiwan, killing 699 people and making 1766 housing unlivable. Many of the disaster-affected people were from indigenous tribes in mountain villages.
- Housing recovery after Morakot focused on permanent housing, with the attempt to minimize the use (and time) in temporary housing.
- Housing was provided by NGO on land provided by the Taiwan government.
2011 Christchurch Earthquakes, New Zealand

The post-disaster housing reconstruction system in New Zealand differs from other cases and insurance compensation is used to rebuild or to relocate if the land was in the hazard zone.

A unique system of “temporary villages” was introduced, providing prefabricated temporary houses that residents can rent while they build their homes.

<table>
<thead>
<tr>
<th>Location</th>
<th>Housing Reconstruction Scheme</th>
<th>Relocation Required?</th>
<th>Introduced in Response to What Problem?</th>
<th>Compared to Standard/Default Temporary Housing</th>
<th>Promoted Benefits?</th>
<th>Livability and Comfort of Housing Units (Compared to the Local Standard, If Available)</th>
<th>Material and Construction Method</th>
<th>Outcome? Residents' Ability to Expand/Reuse/Adapt (In Case of Transition to Permanent Use)</th>
<th>Further, Subsequent or Long-Term Effects on Policy?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Market driven private housing recovery, government prepares residential areas, option of public housing</td>
<td>yes, in some cases, relocation distance varies</td>
<td>Need for more housing than the prefabricated builders could build. Need for improve over low quality prefab.</td>
<td>Prefabricated temporary housing, usually barracks style, varied (often low) quality, often low quality and uncomfortable</td>
<td>Local materials, local labor, housing industry, reduce waste</td>
<td>Wooden temporary houses are more comfortable for daily life, some are larger with more usable spaces. Detached units are more comfortable compared to standard barracks type of pre-fab.</td>
<td>Wooden construction, using high quality materials, compared to standard prefabricated temporary housing.</td>
<td>Wooden temporary housing may be reusable/adaptable.</td>
<td>There are now agreements between local government and Wooden temporary housing may become a base for future response?</td>
</tr>
<tr>
<td>U.S.</td>
<td>Market driven private housing recovery, some government compensation available for selling through Road Home.</td>
<td>no, but residents can place the Cottages in former or new areas</td>
<td>Need for a better system; need to provide another solution for people still living in trailers 2 years later.</td>
<td>Travel trailers or mobile homes used as temporary housing after Hurricane Katrina; small and uncomfortable, no kitchen, bedroom, not hurricane proof.</td>
<td>Can use the same house for temporary or permanent; movable cot can be easier to reuse.</td>
<td>Mississippi Cottages are more comfortable than travel trailers. Cottages have a full kitchen, separate bedrooms, porch. The can also be used as permanent housing, so residents don't have to move (if they can keep them for the permanent stage)</td>
<td>Prefabricated units</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated, build additions</td>
<td>Pilot Project not very successful, not included in subsequent policy. Later after 2012 Hurricane Sandy, very few pre-fab housing used. Other policies: Rapid Repairs, voucher, disaster case management.</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Community-based on-site housing reconstruction; support by gov, international funds</td>
<td>no</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>No temporary housing included in official government plan. T-Shelter introduced as a stop-gap measure</td>
<td>Local materials, system that residents can modify; accountable to residents' resources and priorities</td>
<td>The T-shelter and core house programs, both using a combination of provision of basic structures/supplies, which could be complemented by additions/modifications chosen by the residents.</td>
<td>T-shelter: “roof first” strategy with lightweight bamboo structure</td>
<td>T-shelter is upgradable; core house is expandable</td>
<td>Later example after 2010 Merapi Eruption: collective temporary housing settlements, transition to collective relocation.</td>
</tr>
<tr>
<td>Taiwan</td>
<td>Houses (part of relocation) provided by NGOs, Land Provided by Government</td>
<td>yes</td>
<td>Bad experience with prefabricated temporary housing after the 921 Earthquake</td>
<td>Prefabricated housing provided</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Residents moved from shelters to permanent housing</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>Relies heavily on government and private insurance to provide some support</td>
<td>some yes, in the red zone</td>
<td>Need for short term temporary housing</td>
<td>Provide some temporary housing for use while residents are still waiting</td>
<td>Fills housing gap.</td>
<td>High quality construction</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Temporary housing innovation

<table>
<thead>
<tr>
<th>Location</th>
<th>Reconstruction Scheme</th>
<th>Relocation Required?</th>
<th>Introduced in Response to What Problem?</th>
<th>Compared to Standard/Default Temporary Housing</th>
<th>Livability and Comfort of Housing Units</th>
<th>Material and Construction Method</th>
<th>Outcome?</th>
<th>Residents’ Ability to Expand/Reuse/Adapt (In Case of Transition to Permanent Use)</th>
<th>Further, Subsequent or Long Term Effects on Policy?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wood temp. housing in Japan after Great East Japan Earthquake 2011</strong></td>
<td>Market driven private housing recovery, government prepares residential areas, option of public housing</td>
<td>yes, in some cases relocation distance varies</td>
<td>Need for more housing than the prefabricated builders could build. Need for improve over low quality prefab.</td>
<td>Prefabricated temporary housing, usually barracks style, varied (often low) quality, often low quality and uncomfortable</td>
<td>Local materials, local labor, housing industry, reduce waste</td>
<td>Wooden construction, using high quality materials, compared to standard prefabricated temporary</td>
<td>There are now agreements between local government and Wooden temporary housing may become a base for future response?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temporary to Permanent Mississippi Cottage after Hurricane Katrina 2005 (compared to FEMA Trailers, later to Hurricane Sandy)</strong></td>
<td>Market driven private housing recovery, some government compensation available for selling through Road Home.</td>
<td>no, but residents can place</td>
<td>Need for a better system; need to provide another solution for people still living in trailers 2 years later.</td>
<td>Travel trailers or mobile homes used as temporary housing after Hurricane Katrina; small and uncomfortable, no kitchen, bedroom, not hurricane proof.</td>
<td></td>
<td></td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated, build additions</td>
<td>Pilot Project not very successful, not included in subsequent policy. Later after 2012 Hurricane Sandy, very few pre-fab housing used. other policies: Rapid Repairs, voucher, direct housing management.</td>
<td></td>
</tr>
<tr>
<td><strong>T-shelters in Yogyakarta after Central Java EQ 2006 (later compared to Merapi Eruption)</strong></td>
<td>Community-based on-site housing reconstruction; support by government, international funds</td>
<td></td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>No temporary housing included in official government plan. T-Shelter introduced as a stop-gap measure</td>
<td>木质材料，系统允许居民根据其资源和优先事项进行修改; 使用可再生或可适应的材料，木质临时住房可能被重复使用。</td>
<td>T-shelter: “roof first” strategy with lightweight bamboo structure</td>
<td>T-shelter is upgradeable; core house is expandable</td>
<td>Later example after 2010 Merapi Eruption: collective temporary housing, transition to collective relocation</td>
<td></td>
</tr>
<tr>
<td><strong>Minimize temporary housing after Typhoon Morakot (compared to the 921 EQ)</strong></td>
<td>Houses (part of relocation) provided by NGOs. Land provided by Government</td>
<td>yes</td>
<td>Bad experience with prefabricated temporary housing after the 921 Earthquake</td>
<td>Prefabricated housing provided</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Christchurch Earthquake</strong></td>
<td>Relies heavily on government and private insurance to some yes, in the red for short term temporary housing</td>
<td>Provide some temporary housing for use while residents are provided with permanent housing</td>
<td>Fills housing gap.</td>
<td>High quality construction.</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary housing innovation</td>
<td>Permanent housing reconstruction scheme</td>
<td>Relocation required?</td>
<td>Introduced in response to what problem?</td>
<td>Compared to standard/ default temporary housing</td>
<td>Promoted benefits?</td>
<td>Livability and Comfort of Housing units (compared to the local standard, if available)</td>
<td>Material and construction method</td>
<td>Outcome? Residents’ ability to expand/reuse/adapt (in case of transition to permanent use)</td>
<td>Further, subsequent or long term effects on policy?</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------</td>
<td>---------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Wood temp. housing in Japan after Great East Japan Earthquake 2011</td>
<td>Market driven private housing recovery, government prepares residential areas, option of public housing</td>
<td>yes, in some cases, relocation distance varies</td>
<td>Need for more housing than the prefabricated builders could build. Need for improve over low quality prefab.</td>
<td>Prefabricated temporary housing, usually barracks style, varied (often low) quality, often low quality and uncomfortable</td>
<td>Local materials, local labor, housing industry, reduce waste</td>
<td>Wooden temporary houses are more comfortable for daily life, some are larger with more useable spaces. Detached units are more comfortable compared to standard barracks type of pre-fab.</td>
<td>Wooden construction, using high quality materials, compared to standard prefabricated temporary housing.</td>
<td>There are now agreements between local government and Wooden temporary housing may become a base for future response?</td>
<td></td>
</tr>
<tr>
<td>Temporary to Permanent Mississippi Cottage after Hurricane Katrina 2005 (compared to FEMA trailers, later to Hurricane Sandy)</td>
<td>Market driven private housing recovery, some government compensation available for selling through Road Home.</td>
<td>no, but residents can place the cottages in former or new areas</td>
<td>Need for a better system; need to provide another solution for people still living in trailers 2 years later.</td>
<td>Travel trailers or mobile homes used as temporary housing after Hurricane Katrina; small and uncomfortable, no kitchen, bedroom, not hurricane proof.</td>
<td>Can use the same house for temporary or permanent; movable cottage can be easier to reuse.</td>
<td>Mississippi Cottages are more comfortable than travel trailers. Cottages have a full kitchen, separate bedrooms, porch. The can also be used as permanent housing, so residents don't have to move (if they can keep them for the long term).</td>
<td>Prefabricated units</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents expand, elevated, build additions.</td>
<td>Pilot Project not very successful, not included in subsequent policy. Later after 2012 Hurricane Sandy, very few prefab housing used. other policies: Rapid Repairs, voucher, better land management.</td>
</tr>
<tr>
<td>T-shelters in Yogyakarta after Central Java EQ 2006 (later compared to Merapi Eruption)</td>
<td>Community-based on-site housing reconstruction; support by govt, international funds</td>
<td>no</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>No temporary housing included in official government plan. T-Shelter introduced as a stop-gap measure</td>
<td></td>
<td></td>
<td></td>
<td>T-shelter is upgradeable; core house is expandable</td>
<td>Later example after 2010 Merapi Eruption: collective temporary housing settlements, transition to collective relocation</td>
</tr>
<tr>
<td>Minimize temporary housing after Typhoon Morakot (compared to the 921 EQ)</td>
<td>Houses (part of relocation) provided by NGOs, Land Provided by Government</td>
<td>yes</td>
<td>Bad experience with prefabricated temporary housing after the 921 Earthquake</td>
<td>Prefabricated housing provided</td>
<td>housing not included in the recovery plan.</td>
<td>housing not included in the recovery plan.</td>
<td>shelters to permanent housing</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Christchurch Earthquake</td>
<td>Relies heavily on government and private insurance to some yes, in the red</td>
<td>Need for short term temporary housing</td>
<td>Provide some temporary housing for use while residents are provided</td>
<td>Fills housing gap.</td>
<td>High quality construction</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**attempt to eliminate temporary housing**
<table>
<thead>
<tr>
<th>Temporary housing innovation</th>
<th>Permanent housing reconstruction scheme</th>
<th>Relocation required?</th>
<th>Introduced in response to what problem?</th>
<th>Compared to standard/default temporary housing</th>
<th>Promoted benefits?</th>
<th>Livability and Comfort of Housing units (compared to the local standard, if available)</th>
<th>Material and construction method</th>
<th>Outcome? Residents’ ability to expand/reuse/adapt (in case of transition to permanent stage)</th>
<th>Further, subsequent or long time effects on policy?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood temp. housing in Japan after Great East Japan Earthquake 2011</td>
<td>Market driven private housing recovery, government prepares residential areas, option of public housing</td>
<td>yes, in some cases, relocation distance varies</td>
<td>Need for more housing than the prefabricated builders could build. Need for improve over low quality prefab.</td>
<td>Prefabricated temporary housing, usually barracks style, varied (often low) quality, often low quality and uncomfortable</td>
<td>Local materials, local labor, housing industry, reduce waste</td>
<td>Wooden temporary houses are more comfortable for daily life, some are larger with more useable spaces. Detached units are more comfortable compared to standard barracks type of pre-fab.</td>
<td>Wooden construction, using high quality materials, compared to standard prefabricated temporary housing</td>
<td>Wooden temporary housing may be reusable/adaptable.</td>
<td>There are now agreements between local government and Wooden temporary housing may become a base for future response?</td>
</tr>
<tr>
<td>Temporary to Permanent Mississippi Cottage after Hurricane Katrina 2005 (compared to FEMA Trailers, later to Hurricane Sandy)</td>
<td>Market driven private housing recovery, some government compensation available for selling through Road Home.</td>
<td>no, but residents can place the Cottages in former or new areas</td>
<td>Need for a better system; need to provide another solution for people still living in trailers 2 years later.</td>
<td>Travel trailers or mobile homes used as temporary housing after Hurricane Katrina; small and uncomfortable, no kitchen, bedroom, not hurricane proof.</td>
<td>Can use same hot for temp or permanent movable cotta, but be easier reuse.</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated build additions</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated build additions</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated build additions.</td>
<td></td>
</tr>
<tr>
<td>T-shelters in Yogyakarta after Central Java EQ 2006 (later compared to Merapi Eruption)</td>
<td>Community-based on-site housing reconstruction; support by gov, international funds</td>
<td>no</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>No temporary housing included in official government plan. T-Shelter introduced as a stop-gap measure</td>
<td>Local materials, system that residents can modify; accountable to residents’ resources and priorities</td>
<td>The T-shelter and core house programs, both using a combination of provision of basic structures/supplies, which could be complemented by additions/modifications chosen by the residents.</td>
<td>T-shelter: “roof first” strategy with lightweight bamboo structure</td>
<td>T-shelter is upgradeable; core house is expandable</td>
<td>Pilot Project not very successful, not included in subsequent policy.</td>
</tr>
<tr>
<td>Minimize temporary housing after Typhoon Morakot (2009 compared to the 921 EQ)</td>
<td>Houses (part of relocation) provided by NGOs, Land Provided by Government</td>
<td>yes</td>
<td>Bad experience with prefabricated temporary housing after the 921 Earthquake</td>
<td>Prefabricated housing provided</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Residents moved from shelters to permanent housing</td>
<td>Residents moved from shelters to permanent housing</td>
<td>Later example after 2012 Typhoon, collective relocation settlements, transition to collective relocation</td>
<td></td>
</tr>
<tr>
<td>Christchurch Earthquake</td>
<td>Relies heavily on government and private insurance to provide some temporary housing for use while residents are providing some temporary housing gap.</td>
<td>some yes, in the red</td>
<td>Need for short term temporary housing</td>
<td>Fills housing gap.</td>
<td>High quality construction</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Temporary housing innovation</td>
<td>Permanent housing reconstruction scheme</td>
<td>Relocation required?</td>
<td>Introduced in response to what problem?</td>
<td>Compared to standard/ default temporary housing</td>
<td>Promoted benefits?</td>
<td>Livability and Comfort of Housing units (compared to the local standard, if available)</td>
<td>Material and construction method</td>
<td>Outcome? Residents’ ability to expand/reuse/adapt (in case of transition to permanent use)</td>
<td>Further, subsequent or long time effects on policy?</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Wood temp. housing in Japan after Great East Japan Earthquake 2011</td>
<td>Market driven private housing recovery, government prepares residential areas, option of public housing</td>
<td>yes, in some cases, relocation distance varies</td>
<td>Need for more housing than the prefabricated builders could build. Need for improve over low quality prefab.</td>
<td>Prefabricated temporary housing, usually barracks style, varied (often low) quality, often low quality and uncomfortable</td>
<td>Local materials, local labor, housing industry, reduce waste</td>
<td>Wooden temporary houses are more comfortable for daily life, some are larger with more useable spaces. Detached units are more comfortable compared to standard barracks type of pre-fab.</td>
<td>Wooden construction, using high quality materials, compared to standard prefabricated temporary housing.</td>
<td>Wooden temporary housing may be reusable/adaptable.</td>
<td>There are now agreements between local government and Wooden temporary housing may become a base for future response?</td>
</tr>
<tr>
<td>Temporary to Permanent Mississippi Cottage after Hurricane Katrina 2005 (compared to FEMA Trailers, later to Hurricane Sandy)</td>
<td>Market driven private housing recovery, some government compensation available for selling through Road Home.</td>
<td>no, but residents can place the Cottages in former or new areas</td>
<td>Need for a better system; need to provide another solution for people still living in trailers 2 years later.</td>
<td>Tricomes: Housing not included in the recovery plan.</td>
<td>Wooden temporary housing introduced as a stop-gap measure</td>
<td>Homes are not just temporary, also be beneficial in the recovery plan.</td>
<td>Prefabricated units</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated, build additions</td>
<td>T-shirt: “roof first” strategy with lightweight bamboo structure</td>
</tr>
<tr>
<td>T-shelters in Yogyakarta after Central Java EQ 2006 (later compared to Merapi Eruption)</td>
<td>Community-based on-site housing reconstruction; support by gov, international funds</td>
<td>no</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>No temporary housing included in official government plan. T-Shelter introduced as a stop-gap measure</td>
<td>System that residents can modify; accountable to residents’ resources and priorities</td>
<td>House programs, both using a combination of provision of basic structures/supplies, which could be complemented by additions/modifications chosen by the residents.</td>
<td>T-shelter: “roof first” strategy with lightweight bamboo structure</td>
<td>T-shelter is upgradeable; core house is expandable</td>
<td>Later example after 2010 Merapi Eruption: collective temporary housing settlements, transition to collective relocation</td>
</tr>
<tr>
<td>Minimize temporary housing after Typhoon Haiyan (compared to the 921 EQ)</td>
<td>Houses (part of relocation) provided by NGOs, Land Provided by Government</td>
<td>yes</td>
<td>Bad experience with prefabricated temporary housing after the 921 Earthquake</td>
<td>Prefabricated housing provided</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Residents moved from shelters to permanent housing</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Christchurch Earthquake</td>
<td>Relies heavily on government and private insurance to provide some temporary housing for use while residents are in the red zone.</td>
<td>some yes, in the red zone</td>
<td>Need for short term temporary housing</td>
<td>Provide some temporary housing for use while residents are in the red zone.</td>
<td>Fills housing gap.</td>
<td>High quality construction</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**use of vouchers or private rental units**
<table>
<thead>
<tr>
<th>Temporary housing innovation</th>
<th>Permanent housing reconstruction scheme</th>
<th>Relocation required?</th>
<th>Introduced in response to what problem?</th>
<th>Compared to standard/ default temporary housing</th>
<th>Promoted benefits?</th>
<th>Livability and Comfort of Housing units (compared to the local standard, if available)</th>
<th>Material and construction method</th>
<th>Outcome?</th>
<th>Residents' ability to expand/reuse/adapt (in case of transition to permanent use)</th>
<th>Further, subsequent or long time effects on policy?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood temp. housing in Japan after Great East Japan Earthquake 2011</td>
<td>Market driven private housing recovery, government prepares residential areas, option of public housing</td>
<td>yes, in some cases, relocation distance varies</td>
<td>Need for more housing than the prefabricated builders could build. Need for improve over low quality prefab.</td>
<td>Prefabricated temporary housing, usually barracks style, varied (often low) quality, often low quality and uncomfortable</td>
<td>Local materials, local labor, housing industry, reduce waste</td>
<td>Wooden temporary houses are more comfortable for daily life, some are larger with more useable spaces. Detached units are more comfortable compared to standard barracks type of pre-fab.</td>
<td>Wooden construction, using high quality materials, compared to standard prefabricated temporary housing.</td>
<td>There are now agreements between local government and Wooden temporary housing may become a base for future response?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary to Permanent Mississippi Cottage after Hurricane Katrina 2005 (compared to FEMA Trailers, later to Hurricane Sandy)</td>
<td>Market driven private housing recovery, some government compensation available for selling through Road Home.</td>
<td>no, but residents can place the Cottages in former or new areas</td>
<td>Need for a better system; need to provide another solution for people still living in trailers 2 years later.</td>
<td>Travel trailers or</td>
<td>Can use the</td>
<td>Mississippi Cottages are more comfortable than</td>
<td>Prefabricated units</td>
<td>Cottages have been reused in several ways (affordable rental housing, shops, affordable for-sale housing) by non-profit organizations. Some residents can expand, elevated, build additions</td>
<td>Pilot Project not very successful, not included in subsequent policy. Later after 2012 Hurricane Sandy, very few pre-fab housing used. other policies: Rapid Repairs, voucher, disaster case management.</td>
<td></td>
</tr>
<tr>
<td>T-shelters in Yogyakarta after Central Java EQ 2006 (later compared to Merapi Eruption)</td>
<td>Community-based on-site housing reconstruction; support by gov, international</td>
<td>no</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>No temporary housing included in official government plan. T-Shelter introduced as a stop-gap measure</td>
<td>Woods and core house programs, both using a combination of provision of basic structures/supplies, which could be complemented by additions/modifications chosen by the residents.</td>
<td>T-shelter: “roof first” strategy with lightweight bamboo structure</td>
<td>T-shelter is upgradeable; core house is expandable</td>
<td>T-Shelter is not used. other disaster case management.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimize temporary housing after Typhoon Morakot (compared to the 921 EQ)</td>
<td>Houses (part of relocation) provided by NGOs. Land Provided by Government</td>
<td>yes</td>
<td>Bad experience with prefabricated temporary housing after the 921 Earthquake</td>
<td>Prefabricated housing provided</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Need for temporary housing not included in the recovery plan.</td>
<td>Residents moved from shelters to permanent housing</td>
<td>N/A</td>
<td>Later example after 2010 Merapi Eruption: collective temporary housing settlements, transition to</td>
<td></td>
</tr>
<tr>
<td>Christchurch Earthquake</td>
<td>Relies heavily on government and private insurance to some yes, in the red</td>
<td>Need for short term temporary housing</td>
<td>Provide some temporary housing for use while residents are</td>
<td>Fills housing gap,</td>
<td>High quality construction</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>
Key Findings

Despite diverse conditions, several common drivers for policy change related to temporary housing emerged:

1) to improve temporary housing quality;

2) to provide more options and flexibility for residents;

3) to keep communities together during relocation.
Concluding remarks

1. If residents can expand/adapt/modify/reuse their houses, it can lead to better outcomes (residents’ needs are matched better, satisfaction is higher).

2. Innovative measures in the temporary housing phases will be most effective if they are considered holistically, in advance, as part of overall housing recovery process.

3. To improve housing recovery after future disasters, it is also important that innovative solutions be reflected back into recovery policy.

4. Countries with differing socio-economical backgrounds (including developed and developing countries) face similar problems and we can learn from these various examples.
Next steps

• We have used a broad understanding of what is an “innovation”
  • considering it as attempts to improve the temporary housing process…
  • In the cases we looked at this if often in response to past experiences.

• This presentation did not focus on theoretical debates on temporary housing implementation and relative merits of different approaches such as 1 step, 2 step process, or transitional housing.
  • Bringing these conceptual debates together with detailed examples of how implementation processes of temporary housing has evolved in local contexts is still rich territory for further exploration.