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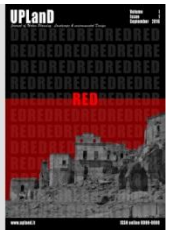

Research & experimentation
Ricerca e sperimentazione

COMMUNITY-BASED INITIATIVES IN POST CATASTROPHE SCENARIOS: POTENTIALS AND LIMITATIONS TO ACADEMIC INVOLVEMENT AND "LEARNING BY DOING"

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HIGHLIGHTS

- Potentials of catastrophe reconstruction in regard of in heritage recovery
- Methodology of "Design-Build", learning by doing
- Experience of interventions in different contexts between 2005 and 2016
- Building debris as an asset
- Up-scaling by community involvement and organization
- Techno-social integration
- Catastrophes as opportunities for rethinking cities

ABSTRACT

Currently the disaster risk management framework is overcoming the purely technical and financial dimension in order to include the social, cultural and environmental spheres. This shifting towards a more holistic perspective calls to develop strategies of emergency and reconstruction management that consider the social acceptance of the interventions respecting the identity of the affected community and their material and immaterial heritage. Ten years of experience in "design-build" initiatives dealing with emergency and reconstruction after catastrophes, is investigated in this article as a good practice of inclusion of population needs in post-disaster process. These range from good-will volunteer reaction turned spontaneously into disciplinary work due to lacking institutional capabilities, to scaling-up of teaching formats to non-profit, community related intervention. The experience underlines the pedagogic and research potentials, as well as the logistic hurdles, the limitations of prototype escalation and the barriers posed by lack in public policies or adequate institutional frameworks. The practices are discussed to support a prospective development of the proposed approach to outline a possible integration of the design-build methodology and the service learning as a bottom up practices in the current framework of emergency and reconstruction.

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1. INTRODUCTION

Post-catastrophes management and reconstruction have in recent time exceeded the technical dimension of building techniques and financing to include social, cultural and environmental elements, thus turning into a complex, multidimensional challenge. While the actions of reconstruction attempt a respond to the immediate need for infrastructure and housing through rapid or temporary construction methods, several other issues arise in dealing with damaged assets such as the appropriateness of restoration and reconstruction of urban fabric and buildings, its social acceptance, its cultural pertinence and its comprehensive sustainability.

After a major catastrophe occurs, the focus is put on emergency responses: restoring infrastructure and communications, providing emergency shelter and recovering operational normality as soon as possible. The process of reconstruction to be conducted after the management of the emergency takes several years, if not decades, and is bound to be partial, with little support and burdened with a number of problems concealed in the process, such as the loss of a valuable built heritage, which occurs widely, yet almost unnoticed behind the chaos of fast demolition during the first days and of practical reconstruction priorities of the months and years to come. Facing the destruction and the urgent need to rebuild, the question arises of how to recover not only the material but also the cultural and social assets damaged or lost in the buildings and houses collapsed.

A common objective of the experiences accumulated in the five projects presented here is the identification of the potentials for innovating in post-disaster emergency strategies, conceived as a fertile moment to start a process of up-grade of the built environment with community-based initiatives in order to reduce future risks and preserve the identity of the affected population. The case studies cover a wide range from the immediate intervention (Tarapacá) after the occurring of a disaster to a 35 years old reconstruction intervention (Naples), exploring the different opportunities of a community-based practices included in restoration and reconstruction phases. Furthermore a particular emphasis is posed on the demolition techniques in order to include subsequent reconstruction as one of its criteria, thus adding value to demolition materials and turning them into a source of materials for reconstruction (Chanco, Croix-des-Bouquets). The hypothesis is that such an increased value can be attained by considering the value of damaged or destroyed heritage constructions directly after the catastrophes for an effective consideration in the restoration and reconstruction phases.

2. METHOD: DESIGN-BUILD AND LEARNING BY DOING

The work was based on “design-build” model, an already established method, widespread as a pedagogic tool for architecture students to learn building construction by building themselves. The “European Design Build Knowledge Network” (EDBKN), a platform documenting many experiences subscribing the method and their results, defines Design-Build Studios (DBS) as “a teaching and research model enabling students to take responsibility for developing balanced future living environments, undertaking architectural projects from design to realization” (EDBKN, n/d). An additional emphasis was put in our case on the enhancement of identity preservation by re-valuing domestic cultural heritage and on the engagement and empowering of the affected community by means of local organization towards economic, social and material resilience.

From the point of view of the methodology, we investigate how to integrate the design-build methodology as a bottom-up practices in the current framework of emergency and reconstruction and more in general in public policies and how the prototypes can be incorporated in a scaling-up process. These range from good-will volunteer reaction turned spontaneously into disciplinary work due to lacking institutional capabilities, to scaling-up of teaching formats to non-profit, community related intervention. The experience underlines the pedagogic and research potentials, as well as the logistic hurdles, the limitations of prototype escalation and the barriers posed by lack in public policies or adequate institutional frameworks.

What started as a pretext for teaching building construction with a "learning by doing" approach developed into a social engagement with the problematics of communities dealing with catastrophes and later scaled-up to an NGO-like approach in a project with as many as 30 families, with a corresponding development of the financial and logistic support.

3. TARAPACÁ 2005-2009: LEARNING FROM TRADITION

On June 13th, 2005, an earthquake struck northern Chile, reaching 7.8 on the Richter scale in Tarapacá. An earthquake of this magnitude would mean a major catastrophe in any country in the world, with hundreds or thousands dead and wounded, destroyed houses and infrastructure, leaving economic losses and widespread devastation. In Chile, however, the earthquake caught public attention only during the first days. In the months that followed, after the immediate emergency caused by lack of accessibility and basic services, little professional support –state or private- was received. After the earthquake, a group of students of Universidad Católica de Chile worked in the affected area and documented it in a cadaster for several villages.

Tarapacá, located in a small ravine of the Atacama Desert, some 2000 km north of Santiago, in the north of Chile, is a town inhabited mainly by farmers and shepherds of Aymara descent who migrate with their flocks to and from the highlands. The town is a homogeneous group of houses of continuous facade built over several centuries in adobe and stone according to traditional methods, so that they are suitable for a climate that is characterized by a wide thermal oscillation and a dry atmosphere.

Figure 1: The village of San Lorenzo de Tarapacá. *Source:* www.proyectotarapaca.org

In the town of Tarapacá, two structural types can be differentiated: the first one built entirely in blocks of adobe, the second mixed technique of construction of wood and adobe. In the case of adobe, the structure is based on raw clay brick masonry walls with some punctual reinforcements in corners and lintels. In the case of mixed techniques "quincha" is the most characteristic, a construction technique of long local tradition, still in use, which is composed of a framework of vertical studs filled in with adobe mixture. Both offer a comfortable living environment suited to the desert climate, yet different performance in face of horizontal acceleration. The purely adobe structures suffered serious structural damage, especially at the intersection of the walls where the efforts are concentrated, which in large part led to collapse.

Figure 2: Before and after the 2005 earthquake in San Lorenzo de Tarapacá. *Source:* *www.proyectotarapaca.org*

In contrast, the mixed structures responded efficiently, presenting only cracking and mortar detachment. One of the cases observed is La Casona in San Lorenzo de Tarapacá. La Casona is an unconventional mixed timber-adobe composed of a double row of timber stud frames like those of quincha and an additional adobe wall in between the two panels. This building presents a structurally viable alternative, thermal and spatially similar to the adobe, and by this combined system seismic resistance is achieved thanks to the flexibility offered by the main structure of timber. The wall offers a high thermal inertia, since the walls are in total 60 cm thick.

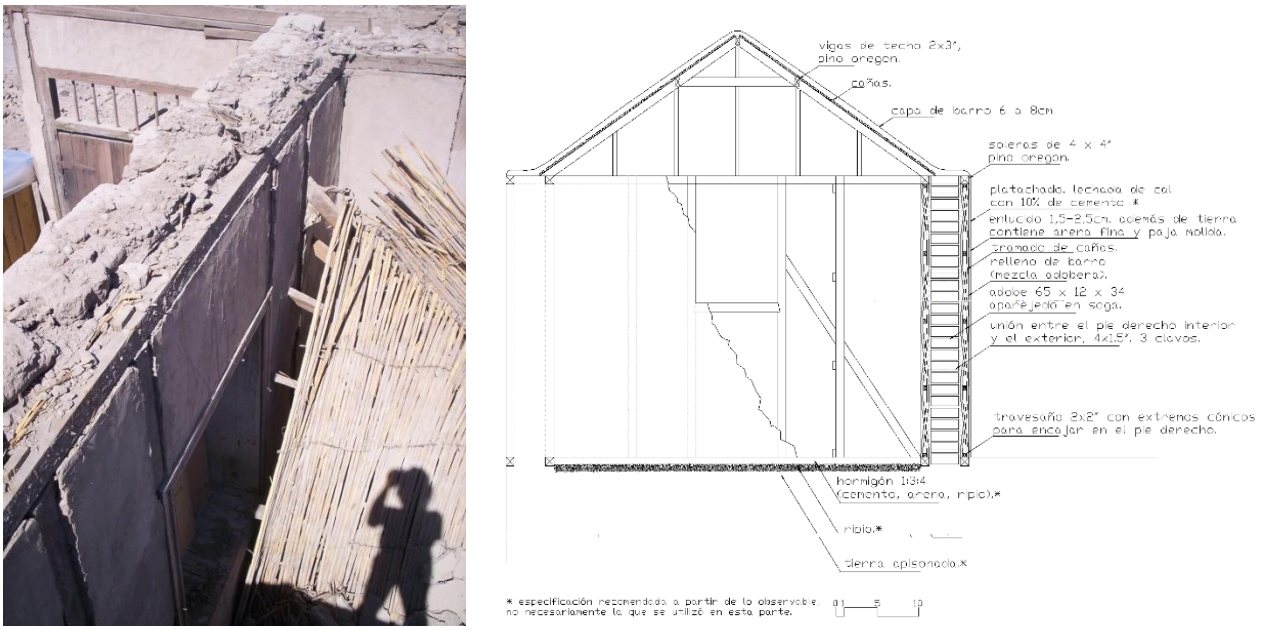

Figure 3: San Lorenzo de Tarapacá. La Casona. Image and section showing the structural elements of a wall section. *Source: www.proyectotarapaca.org*

Our fieldwork experience shows that in Tarapacá, almost entirely built on raw clay, examples can be found of mixed technologies of mixed raw clay and timber framing, a synthesis of the qualities of both, built with local labor, and appropriately integrated into the cultural, physical and climatic context. Moreover, unlike adobe, these cases reasonably resisted the earthquake, without collapsing.

4. CHANCO 2011-2013 BUILDING DEBRIS AS HERITAGE?

In February 27, 2010, a major earthquake of 8.8° Richter scale struck the Maule Region, in Chile. Many of the villages in the region are ensembles of constructions built in adobe, according to traditional techniques: massive load-bearing walls, symmetric plans based on rectangular modules, heavy roof structures with clay tiles tying the walls, exterior corridors protecting from water. Some of them are protected by law as heritage ensembles under the Chilean Ley de Monumentos Nacionales (Law 17.288 of 1970). Starting in 2011, a series of interventions were conducted by a team of students and faculty members of Technische Universität Berlin within the Typical Zone of Chanco, a heritage protected area in southern Chile, including the construction of an alternative reconstruction prototype based on the reuse of traditional materials.

A severely damaged traditional adobe house in the town of Chanco was dismantled by the team and the materials reclaimed were used in the construction of a new house. The main materials obtained from the demolition and used in the construction were timber, adobe bricks, ceramic tiles, doors and windows. The objective of the Chanco prototype was to test the process and gain a firsthand experience on the potentials of such process from an economical and heritage conservation point of view. Finally, a project for the refurbishment of an emblematic building was promoted and is currently under construction, including several community workshops to promote the use and acceptance of traditional materials by enhancing the local knowledge and understanding.

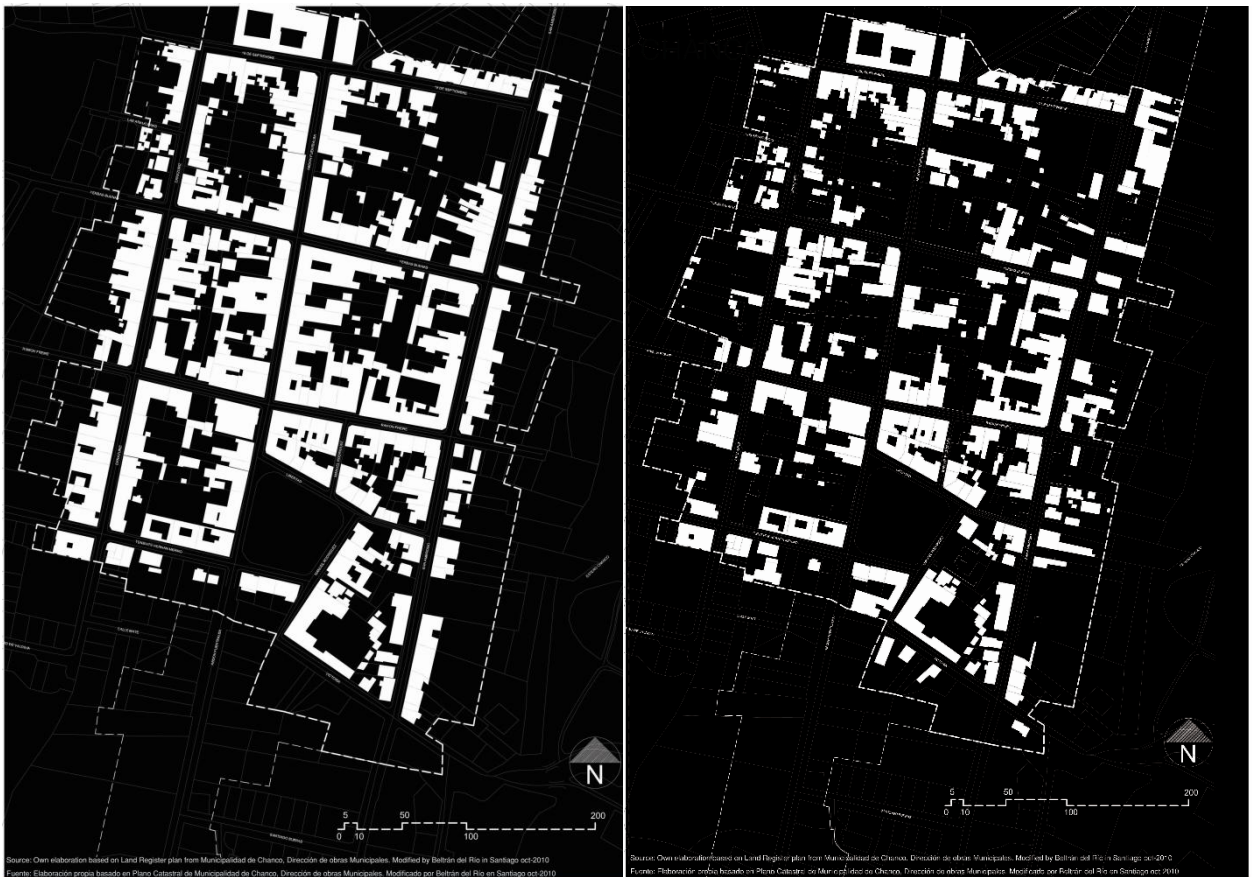

Figure 4: Chanco before (left) and after (right) the earthquake in figure-ground plans. *Source:* www.reclaimingheritage.org

After the earthquake, the inhabitants of the village salvaged and stored materials for further use, rendering thus evident that there is still an economic and heritage value embedded in them for the local community. The work set up then to explore the potentials for the use of debris collected from houses destroyed / demolished, not only for its intrinsic value, but by reusing rubble as a symbolic material relevant in the context of heritage recovery. This led to a 3-point strategy for the intervention, including the collection, sorting and use of debris within an architectural project.

The first step of the project was obtaining materials from a heritage building totally or partially destroyed by the earthquake. The Municipality of Chanco allowed the dismantling of a house formerly one of its offices, located outside the historical area and partially destroyed by the earthquake. The dismantling process should be very careful in order recover as many elements as possible and avoiding building collapse or damage to the materials obtained. Careful disassembling of a building allows transplantation and useful pieces bearing a heritage value. In this case the recovered materials correspond to adobe bricks, wooden beams and clay tiles mostly.

Having already recovered a stock of materials the construction phase was begun, and the study of traditional building techniques and methods allowed an interpretation. In this case, the construction in quincha, reclaimed adobe pieces are filling the wooden timber frame wall skeleton that encases the adobe bricks, which are held in place with metal mesh. A different version was also implemented where an adobe wall was laid (40 cm) encased in an exterior timber frame to improve traction, resulting in a total thickness between 50-60 cm, including a finishing mortar. The structure of a traditional ceramic tile roof is intended to serve weight to compress the adobe walls and prevent them

from getting out of its axis causing a collapse, this was done by using heavy repeated beams along the building and clay tiles.

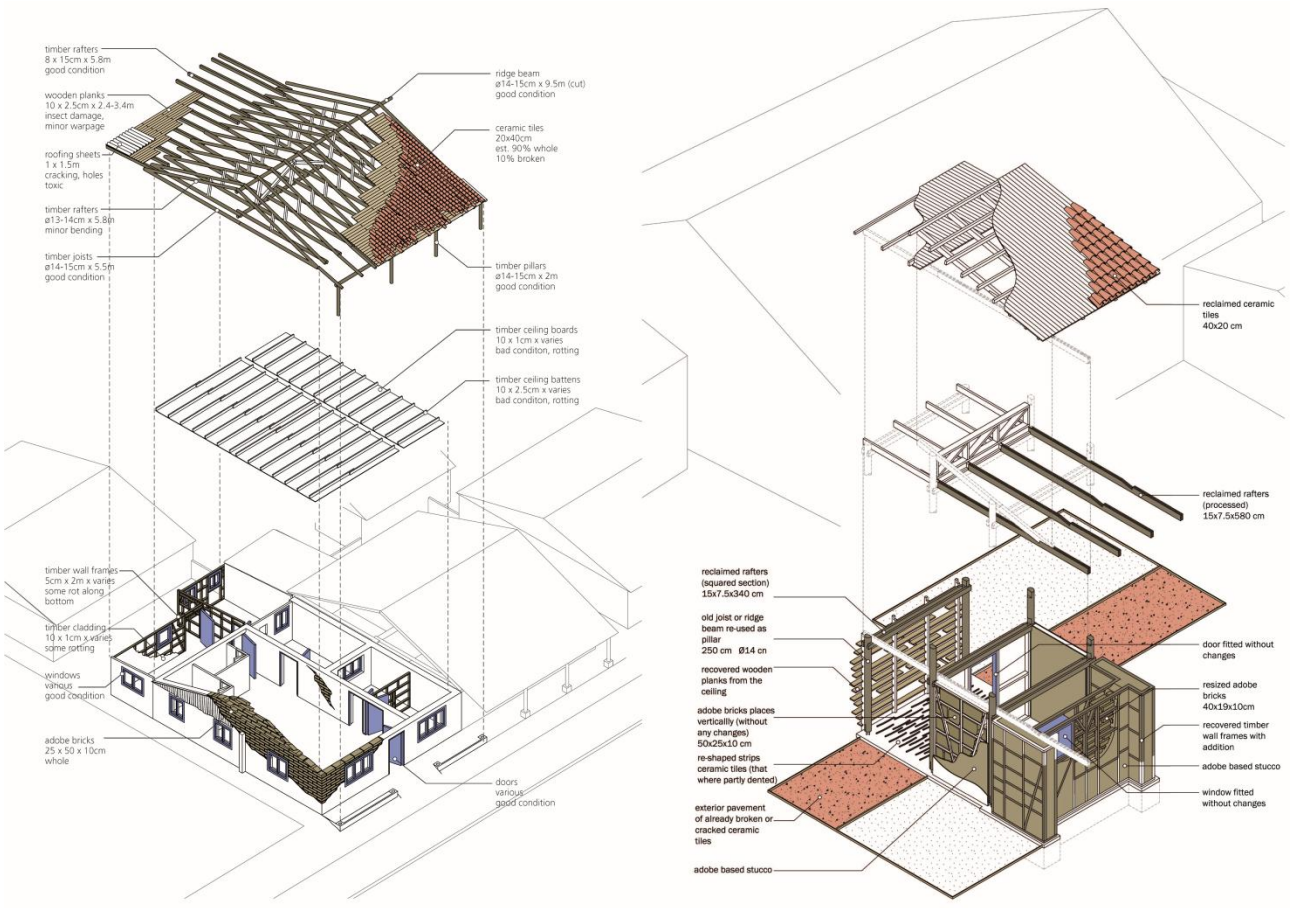

Figure 5: Axonometric of the dismantling of a heritage building with colors highlighting the recovered items (left and the new prototype built with the recovered materials in Chanco (right). Colors highlight reused materials from the house dismantled and in the new building. *Source*: www.reclaimingheritage.org

5. CROIX-DES-BOUQUETS 2013-2015: SCALING-UP, NGOS AND COMMUNITY INVOLVEMENT

2014, an international group of volunteer architects and students based in Technische Universität Berlin set work in the near of Port-au-Prince where the consequences of the 2010 earthquake were still to be dealt with. Working with 30 families and an organized cooperative composed of 20 Haitian volunteers, the team set to recover and refurbish 30 houses in the outskirts of the city, a semi-urban area in Croix-des-Bouquets, funded by the international NGO SELAVIP and by DAAD, the German Academic Exchange Service. The houses, originally built by self-construction between 2006 and 2009, had suffered diverse degrees of damage, from light to complete destruction. The work assumed the existing, destroyed houses as an asset of the families that needed to be recovered and consolidated in order to avoid further damages and losses. The team could experience the whole life cycle of the

buildings, an abstract if not altogether absent concept in their education, by closing the loop from a destroyed to a rehabilitated building.

The intervention was based on a comprehensive evaluation of 136 houses in the Villages of Galette, Digneron, Roche Blanche and La Ferronais. Based on this evaluation and on the situation of the families, 30 cases were selected for intervention, while at the same time a local cooperative of volunteers was organized. Between June and September 2014, a group of 18 volunteers traveled to Haiti and worked with the cooperative in capacity building workshops, organized in groups focusing on masonry and concrete, steel reinforcements, carpentry and finishing. After that, and until April 2015, the cooperative continued to work independently. The main materials recovered and reused were the destroyed houses themselves, in the worst-case scenarios foundations and the floor slabs, but also concrete blocks and rubble, timber beams, tin roofs, doors and windows were reused.

Figure 6: Community construction workshop with cooperative members and volunteers. *Source*: www.reclaimingheritage.org

Departing from the engagement of students and professionals, previous experiences in Chile and in Haiti showed the relevance of engaging the community in the reconstruction work in order to increase not only the relevance and acceptance of the built result, but also the quality and impact of the process of construction itself in social contexts struck by catastrophes. Usual reconstruction practices, in their urgency, tend not to involve the community appropriately, resulting on unsustainable and alienated products, undermining the identity and quality of life of the inhabitants. This questions the role of the user, of foreign aid organizations (as our own), the appropriateness and acceptance of the technical solutions. The loss of valuable built and intangible heritage occurs widely and is part of the effects of

the damage and loss suffered by the victims. While most of the notorious heritage is repaired, the valuable domestic, non-monumental one is unfortunately often neglected. This raises questions on how to recover not only the material but also the cultural assets damaged or lost with a broader scope at a domestic level, in order to prevent the uprooting of the community.

Figure 7: Community construction workshop with cooperative members and volunteers. *Source*: www.reclaimingheritage.org

Building exercises by architecture students usually remain bound to the construction and structural problems, emphasizing the study of a prototype. In this case, we sought to articulate these with the questions of a local context by means of building with a community and not for a community. Our experience suggests an enormous potential is available from an engaged building site experience for the education of young architects in developing the understanding of the user's perspective, the cultural background and expectations in a specific context "real-life" situation. The relevance and impact of this experience can be multiplied when the work is shared with an involved community, provided the appropriate incentives and funding exist; and when the work bears transverse objectives, encompassing the community direct needs and the students' disciplinary aims. In Haiti in particular, the role of international aid is problematic and regarded with skepticism by the locals. The engaged, hands-on role of the students while building with their own hands contributed substantially to build trust and a positive work atmosphere. At the same time material requirements, time, budget, etc., impose constraints to the scope and feasibility of the work, which -being a necessary problem to address- entail a substantial responsibility when working with a community.

6. L'AQUILA 2009-2013: URBAN CLOSURE AND RELOCATION

On April 6th, 2009, a major earthquake hit the center region of Italy. The main shock was rated 5.8 on the Richter scale, with the epicenter near L'Aquila, the capital of Abruzzo. L'Aquila and several villages in the surrounding suffered most damage. The earthquake killed at least 287 people, injured 1,000, left 40,000 homeless and damaged or destroyed 10,000 buildings in the L'Aquila area (U.S.G.S. 2014) and is the biggest ever to have affected a heritage city. L'Aquila sits on the bed of an ancient lake basin, and thus its soil structure is particularly poor in the event of an earthquake. While hard rock shakes with the same frequency and amplitude as seismic waves, the unconsolidated sediments of an ancient lake bed can amplify the shaking or lose their consistency and flow, almost like a liquid. This characteristic marks the history of l'Aquila, which has records of being struck by earthquakes as early as 1315.

The focus during the period after the L'Aquila earthquake was directed to the management of the humanitarian and housing emergency, as well as the rehabilitation of the infrastructures. The rebuilding process began in the months following, starting with securing of collapsing structures and the construction of the Temporary Habitation Modules (Modulo Abitativo Provvisorio, MAP), followed by the Ant-seismic Sustainable and Eco-compatible Complexes (Complessi Antisismici Sostenibili Ecocompatibili, CASE) projects, which seem to have addressed the issue from the mere quantity point of view, with serious problems. On the one hand, a wide relocation of large segments of the population was made, to new apartments in residential complexes often far away from their original villages, work and family networks; on the other hand there was a huge neglect of the possibilities of reuse of existing built heritage, not just as a direct result of the earthquake, but also due to of the decision-making procedures leading to the construction of new houses, temporary and permanent.

Figure 8: Photographic survey of the Temporary habitation Modules (Modulo Abitativo Provvisorio, MAP). *Source*: Rota 2013

The reconstruction processes triggered by the earthquake issues accelerated an already on-going process of depopulation that the L'Aquila region (except for the city itself), due to the lack of working opportunities for the youngest generation in such a rural environment. To understand these urban and material transformations, our research work must consider a deep understanding of the social, demographic and economic complexity of context.

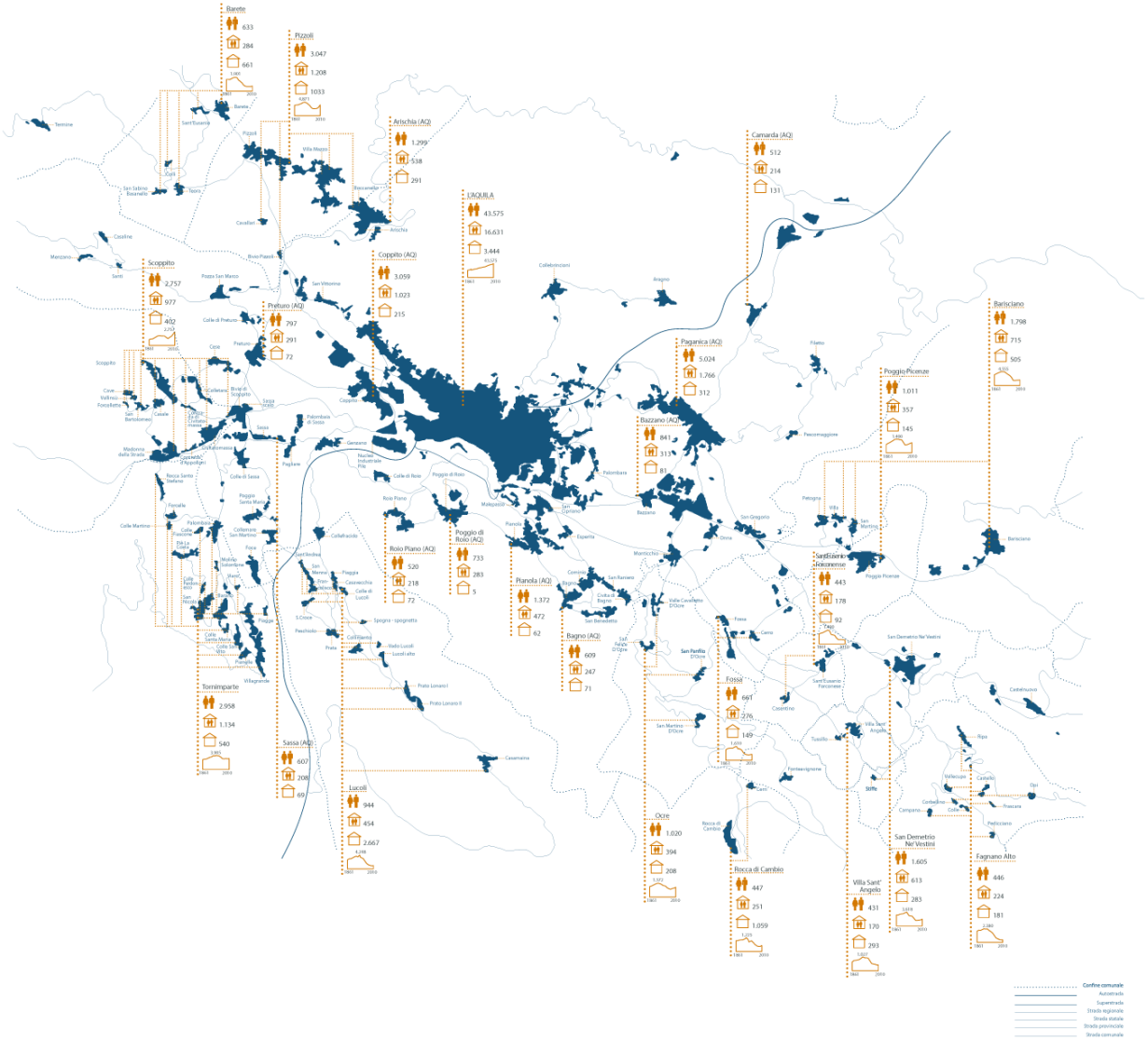

Figure 9: L'Aquila city and territory. The basin after the earthquake damage and tent-settlements (tendopoli) *Source*: Rota 2013

While most of L'Aquila's historical structures suffered damage, it was not only the historic buildings but also many of its modern buildings that suffered the greatest damage, as in the case of the collapse of the dormitory of the University of l'Aquila. Even some buildings that were believed to be "earthquake-proof" were damaged. L'Aquila Hospital's new wing, which opened in 2000 and was thought capable of resisting almost any earthquake suffered extensive damage and had to be closed.

The general objective of the field work in l'Aquila, conducted with 26 graduate students of the Urban Management Program of TU-Berlin, with backgrounds in the fields of architecture, urban design, civil engineering, sociology, international relations, administration, city and regional planning, environmental sciences, was to develop an elaborated field research of the problematic described above. The result of the work was the identification of research topics in the field of catastrophes management and reconstruction after catastrophes in contexts of heritage value, both urban centers and buildings.

Figure 10: Photographic survey of the city of L'Aquila in 2012. *Source*: Rota 2013

7. NAPLES 2016: ARTICULATING THE TECHNO-SOCIAL IN WATER SENSITIVE URBAN DESIGN

The eastern area of Naples was the most extended district included in the Special plan for the Housing (PSER Piano Straordinario di Edilizia Residenziale) that was launched after the Irpinia earthquake of 1980 to relocate 112.000 people evacuated from 6.000 unsafe buildings mostly (70%) situated in the historical neighborhoods of the city.

The plan of Ponticelli zone developed new urban blocks to accommodate more than 18.000 people in a vast scale intervention, generating a massive metamorphosis of the area: the district shifted from an agricultural wet-land structured around productive and housing units of Casali (historical typology of housing unit and farm) to an extended residential zone with an high percentage of sealed soils, lack of vegetation and the disuse of traditional drainage systems of swamps and basins (paludi, vasche.).

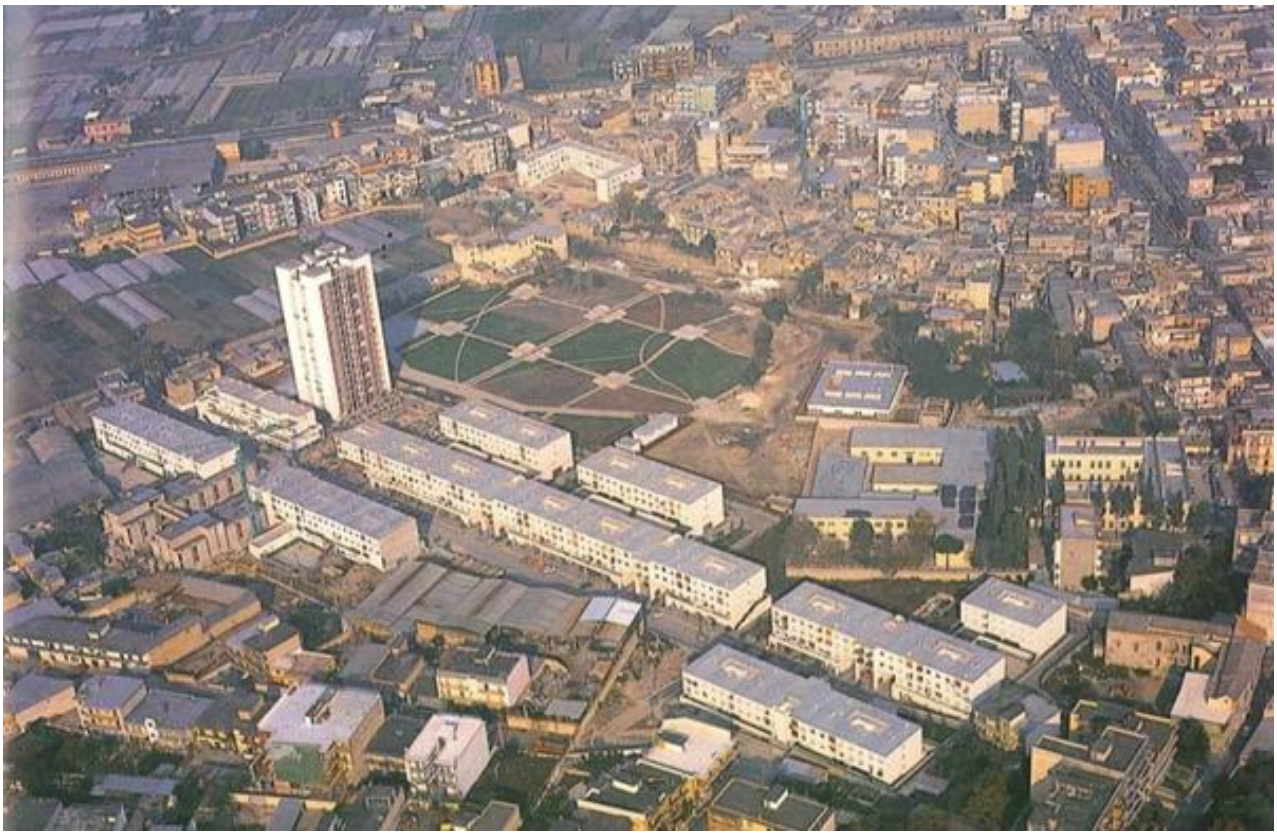

Figure 11: Ponticelli, Post-earthquake interventions: the vast scale of PSER building typology with prefabricated building technologies used to accelerate the construction in order to satisfy the immediate need of the population. The new blocks fragments the urban landscape of agricultural patches and historical centre. *Source*: PSER Journal

Several criticalities are arisen by a complex interaction between the urban morphologies, the housing typologies and the use of private and public spaces, these spatial conditions are stressing the social dynamics and are proofing the failures of the post-disaster interventions that generated a deep socio-cultural deprivation and a process of urban decaying.

Furthermore, the alteration of the socio-ecological pattern of the area is currently exacerbating the emerging environmental risks in particular the climate change related hazards (pluvial floods provoked by heavy rains and lack of drainage) that are added to the high-dangerous volcanic-seismic hazards due to the proximity of Vesuvius volcano. In the last years this area is object of several academic researches and redevelopment plans that aim to offer a possible transition towards a reduction of risks and a sustainable urban regeneration. In particular the project Metropolis, held by DiARC (Department of Architecture, University of Naples Federico II) on the climate change vulnerabilities of the urban system of Naples, is assuming Ponticelli as hot-spot to test an experimental methodology of vulnerability evaluation and proposal for the adaptation. In the perspective of resilience the focus is on coupling built environment and community resilience in multi-risk mitigations measures through the retrofit of existing built heritage.

From the collaboration of Smart-Lab, an on-going participative research laboratory of Metropolis activity, Habitat Unit (TU Berlin) and local associations a proposal for innovative way of actions is being developed to strengthen an on-going process within the community for the reclaiming of a better quality of life. The methodology of design-build is carried on in a learning by doing

experimental workshop, Socio-Technical Resilient Cells, focused on micro-scale devices for rainwater management, self-constructed with recycled materials for the Social Urban Garden of Ponticelli. The concept is a resilient living system which is capable to act in a sustainable way both socially and technically, to adapt, transform, cope and respond to climate change at local level.

Figure 12: Orto Urbano, Ponticelli: Construction of a water harvesting and filtering facility in a community space with participation of the local community.

This ongoing experience intends to structure a proposal for action at the size of the community micro-scale with the aim to set up an operational mode for the retrofit of the built heritage that dialogues with low-tech solutions, self-construction processes, grassroots participation and daily practices to be included in the design of interventions to a larger scale as a tool for building resilience. The Water Sensitive Urban Design approach is subscribed to respond to flash floods phenomena affecting the area of study. The research questions are structured starting from the assumption that the objective of resiliency in a multi-risk scenario of socio-environmental vulnerability requires to promote a transition to sustainable lifestyles to reconcile with the sustainable use of resources, reduce consumption, use of compatible materials and low impact technologies for the transformation of the built environment.

The implementation of small-scale technological solutions for the integrated management of water resources through a self-building process is conceived as a strategy to combine the effectiveness of

low-tech / high performance measures for retrofitting the built environment and the involving of stakeholders, responding to issues of acceptance, direct management and maintenance of systems, ease of construction, replicability.

8. CONCLUSION

The growing complexity of these problems, including new challenges where the technical dimension is expanded to social, cultural and environmental issues needs to be accounted for both in the identification and the synthesis stage. Based on our experiences, three lines of work have been identified as relevant for the work facing catastrophes: a) resilience and disaster risk reduction, b) reclamation and reconstruction, and c) population in action.

8.1. Resilience and Disaster Risk Reduction

In the disaster management perspective, resilience represents the capacity of a community, a territory or a built environment to react while and after facing a disaster event. While most of natural disasters can't be predicted and controlled, there are tools that can be provided and considered during the urban planning to improve the resilience of those environments; this could positively affect both the emergency and the reconstruction phases, fastening and strengthening the capacity to react.

The high exposure of the urban settlements and the damages caused by exceptional events are increasing the awareness about the necessity to implement the risk reduction policies for disaster prone areas to address simultaneously multiple hazards (e.g. climate change related hazards and geo-physical hazards) conceiving an integrated disaster risk reduction framework. This should be promoted through a holistic approach that enhances the resilience of the built environment and community, seen as a key strategy to cope with current environmental challenges. In the current academic and political debate about coupling the disaster risk reduction with the broader goal of resilience and its conceptual framework, it is priority to plan and design strategies for the transformation of the built environment in the perspective not only to prevent human losses and physical damages but also to strengthen the socio-cultural, environmental and economical sustainability of the interventions.

8.2. Reclamation and Reconstruction

The third part of the volume confronts with the concrete, material issues of recovery and reconstruction of the built stock. The hypothesis underlying these experiences is that an increased value can be obtained by systematically reclaiming the heritage value embodied in materials in addition to their material value, in the particular case of destroyed heritage constructions. The common ideas in these projects can be approached in different ways, depending on the scale and focus.

We can say that there is a symbolic approach, and a manufacturing / industry approach, the main idea being in both the recovery of a set of previous cultural and social values by reusing materials. In the case of Chanco the process was conducted at a scale manufacturing and intervention. Although the process proved effective in terms of cost savings related to building materials, the delicacy of manufacturing and design adjustments during construction require long and can be considered to be similar to a process of restoration. The prototype remains a demonstration showing construction processes, most materials were employed reused functionally in which the essence of the material was not modified and the element was merely processed or adapted. Reuse of materials is proposed as an alternative to existing housing construction practices in a post-disaster context because of its ability to

retain cultural and architectural traditions along with economic competitiveness. Socially, it presented issues of acceptability, even if the population does understand the value and quality of the traditional buildings and has slowly become aware of the feasibility of reconstruction when acquiring knowledge of other, more successful case studies; which claims for the need of integrating stronger social focuses within reconstruction processes.

8.3. Population in Action

The dramatic changes in the productive structures and the spatial distribution of the productive activities, especially in Europe, has led in the last decades to a scenario where former industrial plots, conveniently located in central areas, are abandoned and remain undefined, expecting a new use or a redevelopment. Citizen awareness regarding the collective decisions about the city grows increasingly as conflicts of interest and alternative developments are evident in many cities. Awareness and better information are consequently leading to a proliferation of organizations that demand a voice in these developments.

Political engagement has made a foothold in these concrete, relatively small but politically laden causes, and activist tactics have gained a space for them in the public arena, forcing the traditional administration and political structures to negotiate with these organizations on new grounds, and often influencing substantially the decision-making.

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