

## **REFLECTION PAPER**

*OPPORTUNITY IN CHAOS | triggering revival of the damaged historic centre of L'Aquila, Italy*

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## I Introduction

Before elaborating a reflection of my graduation work up to this point, it is relevant to provide a summary of the project.

### I.1 Scope of the project

During a 2009 earthquake in central Italy, the city of L'Aquila was heavily affected. Especially the old town centre was severely damaged, rendering it completely inhabitable. Now, almost nine years later, the historic centre is still a ghost town. The recovery process has been lacking in some departments, especially in long-term planning and in involving the local population. The latter feels ignored and forgotten.

The objective of this project is to provide an alternative after-earthquake recovery plan, that (a) ensures sustainable redevelopment of historic town centres by providing a platform for discussion between all actors involved, and that (b) triggers the revival of the centre by encouraging the city's inhabitants to visit.

The project concerns a multipurpose, temporary and economically circular community (recovery) centre at one of the only open spaces in the damaged town centre: the central Piazza del Duomo. The aim of the project is to give something beautiful back to the people of L'Aquila, to reinstate identity and pride as well as give them hope and trust in the centre's recovery.

### I.2 Research

As the context in which the design is placed has relatively few restrictions, the goal of the research was to develop a conceptual framework for the design. A few decisions have been made beforehand: the community center will consist a wooden roofing structure with a few enclosed volumes underneath to provide for the programmatic components.

Given these boundaries, a quantitative research-by-design has been carried out, using basic wooden portals as input, as well as their accompanying rules of thumb. Numerous designs have been made, varying in core-to-core distances, spans, heights and type of portals; a total number of 168 models have been investigated quantitatively, some of which are presented in Figure 1.



Figure 1 – Quantitative research-by-design at P2-presentation (June 16, 2017)

All 168 models have been assessed using numerical interpretations of the following criteria:

- i. Earthquake-safety  
*Expressed in area of roof expected to fail in case of collapse of one structural element [m<sup>3</sup>]*
- ii. Spaciousness  
*Expressed in maximum free volume [m<sup>2</sup>]*
- iii. Functional flexibility  
*Expressed in maximum free ground area relative to the Piazza del Duomo [%]*
- iv. Structural flexibility  
*Expressed in length of the beams [m]*
- v. Structural modesty  
*Expressed in height of the beams [m]*

Using this input, partial and overall grades have been assigned and compared between all models. After a few elimination rounds, the winning outcomes have been presented in Figure 2. Both of them score similar on earthquake-safety, spaciousness and functional flexibility. The left outcome scores highest on structural modesty; due to the curved shape, the structural elements can be quite slender. The right outcome scores highest on structural flexibility; due to the kink in the spanning element, the actual structural pieces it consists of are quite short.

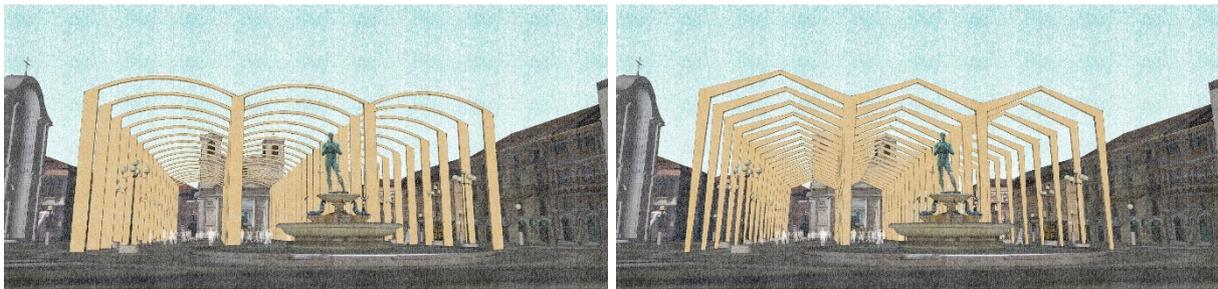


Figure 2 – Outcome of the quantitative research-by-design of the P2-presentation (June 16, 2017)

### 1.3 Design

Taking into account the outcomes of the research, a design has been developed. The direct relation may not be obvious, but this will be elaborated upon in paragraph 2.1.



Figure 3 – Overview of the architectural design (March 9, 2018)

The design consists of short straight timber elements, connected with recycled and reinforced plastic joints under a slight angle. Together they form a perfect half-circle spanning 20 m width of the Piazza. The ends of the half-circle are connected through an elevated wooden floor. This floor both covers the current damaged floor of the Piazza as well as provides space for installations, such as water pipes, electrical wires and ventilation. In order to avoid intrusive foundation in the floor of the Piazza, the structure will be held in place by adding dead weight in the form of old building rubble in containers.

Furthermore, enclosed spaces will be installed underneath the main structure, consisting of a timber framework, room-dividing curtains and some timber sandwich panels to provide stability.

Lastly, the façade consists out of two main elements: a colourful single-layered ETFE-façade attached to the outside of the structure, and a transparent double-layered ETFE-façade hanging from the inside of the structure.

The main set-up can be observed in Figure 4.

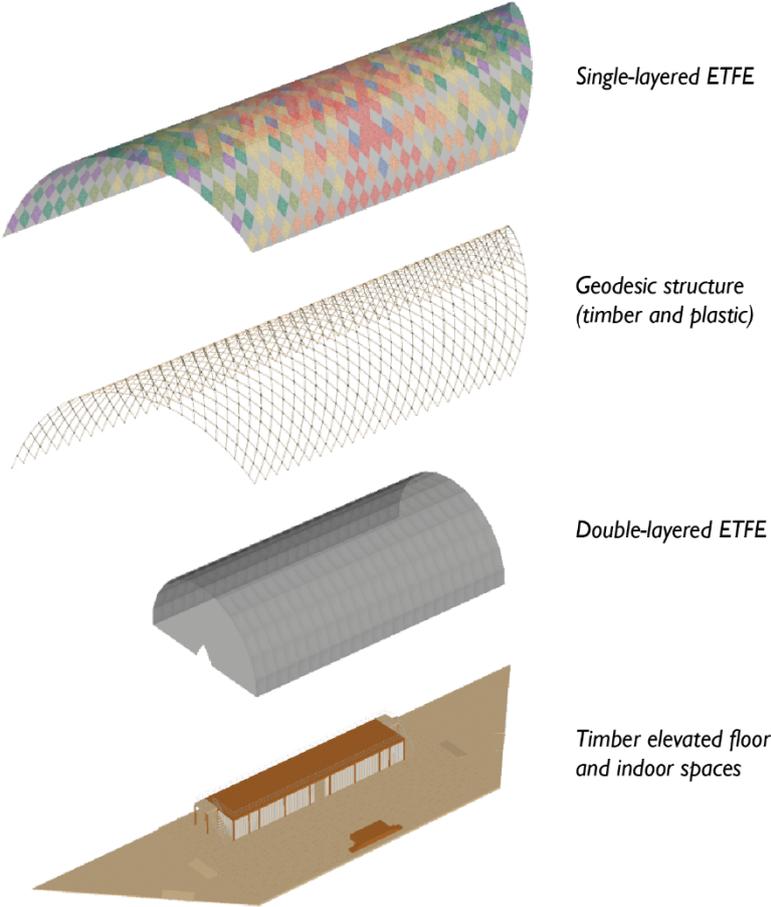


Figure 4 – Exploded view of the architectural design (March 9, 2018)

## 2 Reflection

### 2.1 Aspect I: research vs. design

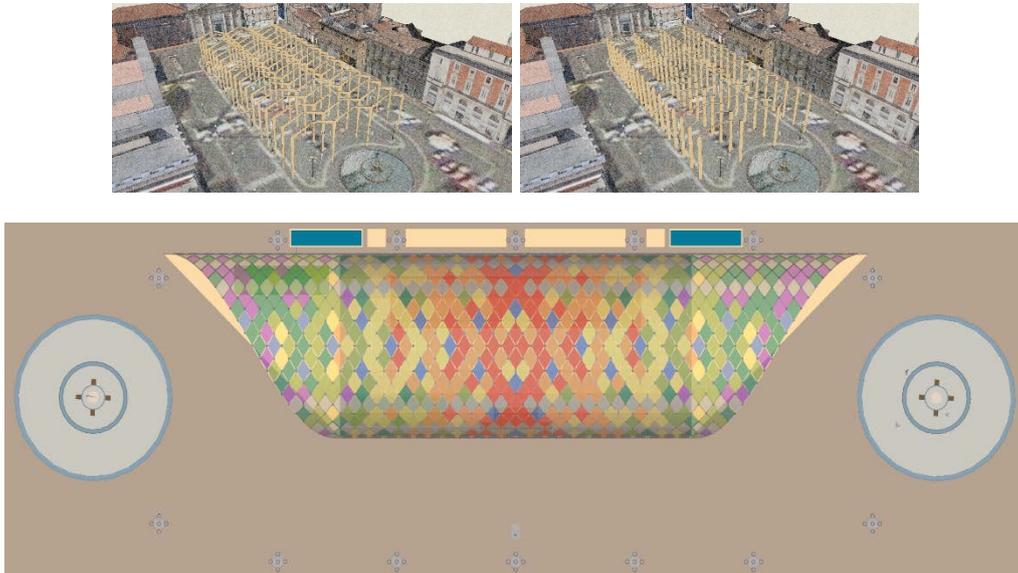


Figure 5 – Research outcome (June 16, 2017) vs. current design (March 9, 2018)

The research outcome comprises two very similar models. Both consist of portals that divide the entire stretch up into three spans. They have a relatively small core-to-core distance and are quite high to account for spaciousness. The difference between the two lies in the slenderness of the structural elements due to the curved shape in one outcome, and the shortness of the structural element due to the kinked shape in the other.

The current design – presented below in Figure 5 – has a completely different look. It does not consist of portals and has only one span, with a bigger width than the research models. So, to what extent has the research outcome had any influence on the design?

As presented in paragraph 1.2, the goal of the research was to develop a conceptual framework for the design. Note that the goal of the research was not to provide a design. Although the models might give the impression they are the first steps toward a design, they are merely visualisations of guidelines. The main result of the research is actually the insight in the different criteria used to assess the models and the positive or negative influence different design choices have on them.

As mentioned in the research paper written after the research of my graduation, this research had a lot of restrictions. By letting go of these restrictions, one could even further optimize all criteria discussed. In order to compare both the research outcome and the current design, all criteria will be shortly reflected upon. Note that though all criteria are expressed very one-sidedly – one of the limitations of the research – that only these criteria will be reflected upon in order to make a good comparison and to show how the insight gained from this research has been used in the design choices.

#### i. Earthquake-safety

For the research, earthquake-safety was expressed in the area of roofing structure that would collapse in case of one failing element. In case of portals, this would mean that the shorter the span is, the safer the structure would be. This had a big influence on the fact that the shorter spans scored higher, resulting in the three-span models as the winners.

However, the current design does not consist of portals, but of a network of arches. The whole structure acts in unison as everything is connected. This also means that if part of the structure fails, there will be a mere distribution of forces and damage will be very limited. As this type of structure is in that sense much more efficient than regular portals, the possibility of a larger span is opened up once more.

## **ii. Spaciousness**

The spaciousness was expressed as the maximum free volume underneath the structure. This is why the higher models scored higher in general than the lower ones. By the necessity to have smaller spans, some of this spaciousness was sacrificed in the outcomes of the research. By opening up the possibility to a one-span structure once more, the spaciousness has improved greatly in the current design.

## **iii. Functional flexibility**

The functional flexibility was expressed in uninterrupted ground area; the bigger, the better. This has vastly been improved by the design choice to make a one-span structure.

## **iv. Structural flexibility**

The structural flexibility was expressed by the length of the structural elements. The shorter they are, the easier they can be used for different applications in the future. In portals this quite directly means: the shorter the span, the shorter the structural elements. By steering away from the 2D-structure of a portal, and working in a 3D grid-like structure, a new world of possibilities opens up. The elements are kept even smaller than the beam elements in the research models.

## **v. Structural modesty**

The structural modesty was measured by the height of the beam elements. The outcome showed that with a curved shape, these dimensions could be kept smallest, due to the even and efficient distribution of stresses in the wooden elements. This realisation was of great influence in the design; to take it a step further, a circle-shaped arch has been constructed. Adding that to the fact that the whole structure is working together in a 3D-network, the elements can be kept most slender.

## **2.2 Aspect 2: graduation topic vs. studio topic / master track / master programme**

Architectural Engineering is one of the more technically inspired graduation studios at the faculty of architecture. I – a double master student who also specializes in structural engineering – was attracted to this studio right from the start.

During the winter of 2016-17, I did a multidisciplinary project in Concepción, Chile, with a group of engineering students from the TU Delft. For the first time in my student career, I got to learn about earthquake-engineering. This inspired me greatly and resulted in me wanting to graduate in the similar field. As I heard from fellow students, Architectural Engineering had one specific studio topic: Seismic Design. Though it turned out the Seismic Design topic was not part of the standard curriculum anymore by the time I started my graduation, I was free to develop my own assignment in that field. Though I am not sure what the development will be in the future, my hope is that the Seismic Design specialisation will be reinstated, as it is also a very trending topic in The Netherlands itself and fits the concept of the studio of Architectural Engineering perfectly.

The concept of my project relates to the ideas behind the studio of Architectural Engineering quite perfectly; inspired and bounded by a technological fascination – earthquakes in my case – the goal is to create something beautiful that works both technologically and architecturally within a complex social situation.

Throughout the process, it became apparent that sometimes my technological fascination with earthquake-engineering and the development of structural systems overshadowed an equally – if not more – crucial aspect of the design: its architectural experience. Therefore, throughout the process, the architectural development of my design stagnated a couple of times. But as my tutors taught me, sometimes you have to take a step back and let go of some ideas in order to bring your design to a higher level.

### **2.3 Aspect 3: method and approach vs. scientific relevance of work**

The project is located in a relatively contextless situation due to the following aspects: (a) though there are surrounding buildings, they are heavily damaged and form a “ghost town”, and (b) the design should be able to be relocated elsewhere.

Thus, there were no direct starting points. The goal of my research was therefore to provide a conceptual framework one way or another. I decided to do a relatively technical approach, researching and comparing numerous models quantitatively (see paragraph 1.2). It has both advantages and disadvantages.

The main advantage of the quantitative research-by-design method is that it provides a lot of insight the aspects investigated and therefore in the influence certain design choices will have. It gave me a starting point for the rest of the design process.

However, the downfall of the method is that it simplifies architectural and technical aspects greatly and can therefore be quite misleading. The results should be very carefully analysed and interpreted and should never be more than a framework for further development.

### **2.4 Aspect 4: graduation project vs. wider social, professional and scientific framework**

Looking at the Italian situation surrounding earthquakes, there are two things to be done: (a) preventing damage to historic town centres in case of a seismic occurrence, and (b) redeveloping the after-earthquake recovery process.

My project focusses on the latter. The situation in L’Aquila (see paragraph 1.1) has proven that the current way after-earthquake recovery takes place is very unsatisfactory. Almost nine years later, the city remains a ghost town, as the government only focussed on decentralised solutions and did not take into account local participation (Alexander, 2010).

The design proposes a different after-recovery approach. Based on a case study after a big fire in Oakland in 1991 (Olshanky et al., 2005), an idea came forward to design a community (recovery) centre in the middle of the damaged area. This both provides the relevant actors with a platform for communication and it gives something back to the people in the sense of functionality, beauty, hope

and pride. The goal is to trigger sustainable redevelopment as well as keeping the damaged area alive during the reconstruction period.

The project is therefore definitely relevant in a wider framework. However, it is hard to say to what extent an approach like this will actually work. Will all-round participation take place? Will people feel motivated to go to the city centre despite all the damages around? It would be interesting to research this more in-depth.

## 2.5 Aspect 5: ethical issues and dilemmas

During the design process, I ran into a big dilemma: bottom-up vs. top-down approach?



Figure 6 – First approach (September, 2017) vs. second approach (October 20, 2017)

After my research, the first design approach was very bottom-up: I took participation of the locals as a leading theme in the structural design. A system was developed consisting of repetitive modular elements, that could form arches of different spans. It was very easy to build up and understand. However, as Figure 6 shows, it became a very uncoherent design, comprising a sum of several pavilions instead of being a whole and uniform design.

The second design, presented during the P3-presentation on October 20, is a completely different approach. It complies with the top-down method, where the design has been decided upon by me as an architect. It shows clearly the architectural expression that I'm striving for as an architect, but as it's very complex and local participation is not taking into account whatsoever, locals are less likely to relate and take pride in it.

Reading up on some of the ideas behind bottom-up and top-down, I realized that it should be a mixed-method approach (Isidiho & Sabran, 2016). The second design has been scaled and simplified to a more understandable structure with light-weight elements, so that locals can actually participate in the construction process. However, the architectural expression has remained, church-like, colourful and peaceful (see Figure 7).



Figure 7 – Current design (December 8, 2017)

### **3 Epilogue**

It seems that one will never stop learning as even during my graduation process I am running into difficulties and design troubles. As I have come across in several discussions with my tutors, I tend to lose the bigger picture as I get overly enthusiastic over a system or technical detail. My tutors' input and critique have always ignited major improvements in my work when I got stuck – both during the research and the design process. I have learned a lot about myself and throughout the entire graduation period, I see a lot of growth and progress both in myself as well as in my design. I would like to thank my tutors for sticking with me and being patient, helping me get the best out of myself and my graduation.

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