OPPORTUNITY IN CHAOS  triggering revival of the damaged historic town centres of Italy

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Number
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Architectural Engineering | Intecture
Studio 18
P5-Presentation
April 20, 2018

Examiners
Anne Snijders
Paddy Tomesen
Hendrik Ploeger
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<th>CONCEPT</th>
<th>DESIGN</th>
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</table>
CONTEXT
L’AQUILA

Inhabitants
70,967 (2013)

Characteristics
university, cultural institutions, ski resorts

<table>
<thead>
<tr>
<th>L’AQUILA</th>
<th>vs.</th>
<th>DELFT</th>
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</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>693 m</td>
<td>2 m</td>
</tr>
<tr>
<td>Climate</td>
<td>Temperate oceanic climate</td>
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</tbody>
</table>

**Temperature**

**Precipitation**

Source: https://www.meteoblue.com/
L’AQUILA EARTHQUAKE

April 6, 2009
A medium-power earthquake occurred, disproportionally heavy damage

Killed       308
Injured      1 500 +
Homeless    65 000 +
2018: GHOST TOWN

Source: https://danilo.blog/2017/05/11/aquila-zaona-rossa/4/
CAUSE

Missing element (Alexander, 2010):
local participation

Consequence:
town centre forgotten

What could have been done instead?
ASSIGNMENT
OBJECTIVES

Stimulating all-round participation

Giving back to the people

Maintaining life in the centre
INTERVENTION

Case study
After 1991 Oakland fire: “community development centre” (Olshanksky et al., 2005)

Intervention
A temporary and central community (recovery) centre

Overall design question
How could a multipurpose, temporary and economically circular community (recovery) centre be designed in the earthquake-damaged historic town centre of L’Aquila, Italy, which will encourage after-earthquake urban revival and which will stimulate participation in the recovery process?
Free and safe areas in the town centre: Piazzas

Central and important Piazza: Piazza del Duomo
PIAZZA DEL DUOMO

Duomo
Cattedrale dei Santi Giorgio e Massimo
13th century

Palazzo Arcivescoville
18th century

Palazzo dell Poste
20th century

Church
Chiesa di Santa Maria del Suffragio
Chiesa delle Anime Sante
15th century

La Fontana Vecchia
20th century

78.0 m

35.0 m

Palazzo Federici
18th century

Palazzo Betti
18th century
ARCHITECTURE

Left
Duomo
Cattedrale dei Santi Giorgio e Massimo, 13th century

Middle
Twin fountains
Fontana Vecchia, 20th century (last modification)

Right
Church
Chiesa di Santa Maria del Suffragio Chiesa delle Anime Sante, 15th century
FIRST CONCEPTUAL IDEAS

Flexible design

Light and spacious roofing structure

Independent volumes

Primary material: Timber
Psychological benefits (Rice, 2004; Song & Fei, 2016)
Contrast with surroundings

How to go on from here?
RESEARCH
GOAL

Creating order in the chaos

Thematic research question
How can a conceptual framework be specified using quantitative analysis for a light and temporary timber roof structure at the Piazza del Duomo in the earthquake-prone city of L’Aquila, Italy?
RESEARCH METHOD

Quantitative research-by-design
A large amount of models have been compared quantitatively, narrowing it down the best models.
INPUT

Six portal types
Four different spans
Three different core-to-core distances
Three different column heights
Rules of thumb

168 models
QUANTITATIVE ASSESSMENT

1. Earthquake-safety [m²]
   Measured in area of roof expected to fail in case of collapse of one structural element

2. Spaciousness [m³]
   Measured in maximum free volume

3. Functional flexibility [%]
   Measured in maximum free ground area relative to Piazza del Duomo

4. Structural flexibility [m]
   Measured in length of beams

5. Structural modesty [m]
   Measured in height of beams
## Output

<table>
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<th>Weighting</th>
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<tr>
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<th>Functional flexibility</th>
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<th>Structural modesty</th>
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RESULTS

Portal 3 | G = 12,0 m | L = 11,7 m | c.t.c. = 4,3 m

Advantage: short structural elements

Portal 5a | G = 12,0 m | L = 11,7 m | c.t.c. = 4,3 m

Advantage: efficient curved shape
CONCLUSIONS

Curved shape

Short and straight timber elements
CONCEPT
CORE VALUES

PARTICIPATION

HARMONY

OFF-THE-GRID
CORE VALUES | PARTICIPATION

- PARTICIPATION
- SIMPLICITY
- FUNCTIONALITY
- FLEXIBILITY

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CORE VALUES | OFF-THE-GRID

OFF-THE-GRID

SELF-SUFFICIENCY

DEMOUNTABILITY

RE-USE
PROGRAM

Outside
  Market
  Terrace
  Greenery

Underneath structure
  Cultural, social, religious events
  Cafeteria
  Meeting rooms
  Restrooms
  Kitchen
  Storage
  Services
  Greenery
INSPIRATION

Markthal, Rotterdam, MVRDV

Hannover Expo Pavilion, Shigeru Ban

Rainbow Hallway, Miami Airport, Christopher Janney

Gethsemane Lutheran Church, Seattle, Olson Kundig Architects
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DESIGN PROCESS

First design (Sep. 2018) | Bottom-Up Method

Second design (Oct. 2018) | Top-Down Method

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DESIGN | GENERAL DESIGN
SITUATION
VIEWS
BUILD-UP
ZONING
ORIENTATION | PIAZZA
ENTRANCE
ROOM DIVIDERS
FLOOR PLANS | OPTION A

Ground level

First floor
FLOOR PLANS | OPTION B

Ground level

First floor
DESIGN | STRUCTURAL DESIGN
PRINCIPLES

MATERIALISATION

Primary       re-used timber & recycled reinforced plastic
Secondary     steel

STRUCTURAL SYSTEM

Using modern techniques to create an easy-to-assemble structure
GENERAL LOADS
STRUCTURAL JOINT | SIDE VIEW
UPLIFTING FORCE
DIMENSIONING

Length: 1.5 m
Section: 10 cm x 10 cm
Weight: 8 kg
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
CONSTRUCTION
FRONT FACADE | WIND LOAD TRANSFER
EARTHQUAKE SAFETY | FLEXIBILITY, REDUNDANCY & MASS
INDOOR STRUCTURE  |  COLUMNS
INDOOR STRUCTURE | FIRST FLOOR
INDOOR STRUCTURE  |  STABILITY
INDOOR STRUCTURE | WALLS
DESIGN | CLIMATE DESIGN
GOAL
CHANGING FACADE | SUMMER VS. WINTER

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FLOOR INSULATION
VENTILATION | INCOMING AIR
VENTILATION | OUTGOING AIR
DESIGN | OFF-THE-GRID DESIGN
CIRCULARITY

- Compost
- Toilets
- Kitchen
- Non-potable water
- Potable water
- Electricity
- Water system

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WATER SYSTEM

- Rain gutter with screen
- Non-potable water
- Slow sand filtration
- UV-purification
- Potable water
- Water storage

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GREENERY
IRRIGATION SYSTEM
INSTALLATIONS
REFLECTION
RESEARCH vs. DESIGN

Research conclusion is still applicable
Curved shape, straight elements

Different set-up than research outcomes
Explicable by turning to a 3D- instead of a 2D-configuration
CONCEPT VS. DESIGN | PARTICIPATION

SIMPLICITY

FUNCTIONALITY

FLEXIBILITY

CONCEPT VS. DESIGN | PARTICIPATION

SIMPLICITY

FUNCTIONALITY

FLEXIBILITY

CONCEPT VS. DESIGN | PARTICIPATION

SIMPLICITY

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CONCEPT VS. DESIGN | PARTICIPATION

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CONCEPT VS. DESIGN | PARTICIPATION

SIMPLICITY

FUNCTIONALITY

FLEXIBILITY

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CONCEPT vs. DESIGN | HARMONY

- PROTECTION
- PEACEFULNESS
- NATURE
CONCEPT vs. DESIGN | OFF-THE-GRID

SELF-SUFFICIENCY

DEMOUNTABILITY

RE-USE

CONTEXT | ASSIGNMENT | RESEARCH | CONCEPT | DESIGN | REFLECTION

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REFERENCES


Song, S., & Fei, B. (2016). The psychological effects of different types of housing environment under different weather conditions. Wood Research, 105-120.
STRUCTURAL JOINT