



POLITECNICO
DI TORINO

Dipartimento di
Architettura e
Design

Master in Architecture for
Sustainability
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Thesis Title

**Gardella's Lost Legacy:
The Church of Alessandria.**
Study, 3D documentation and
Analysis

Students

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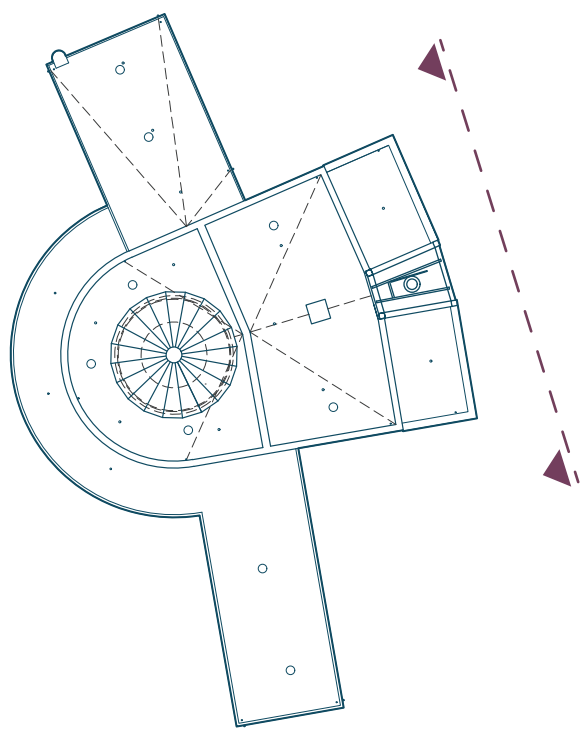
Supervisors

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Board No. 11

- TERRITORIAL CONTEXT
- GEOMATICS SURVEY
- 2D DOCUMENTATION
- HBIM DOCUMENTATION
- MATERIAL ANALYSIS
- CURRENT STATE OF
CONSERVATION ANALYSIS
AND SOLUTIONS
- THE PROPOSAL

The Church Building



Key Plan
Scale: 1:400



LEGEND

DEGRADATION & SYMBOLS

- Plaster change demarcation line
- Visually blocked area
- Wall Perforations
- Scratches/abrasions on paint
- Missing Element
- Cracks - Medium Intensity
- Fissures - Severe Intensity

Detachment

- D1 Minor - Peeling paint
- D2 Moderate - Exposed plaster

Gap (Lacuna)

- Exposed bricks due to loss of continuity of mortar and paint

Chromatic alteration

- C1 Minor - Continuous surface with tonal variations.
- C2 Moderate - Continuous surface with tonal variations.
- C3 Severe - strong discoloration stains

Rising Damp

- Rising Damp causing Detachment

Moisture Stains &Leakage (Colatura)

- Moisture Stains due to dripping water on surface
- Moisture Stains with Biological Colonization
- Moisture causing detachment

Metallic Corrosian

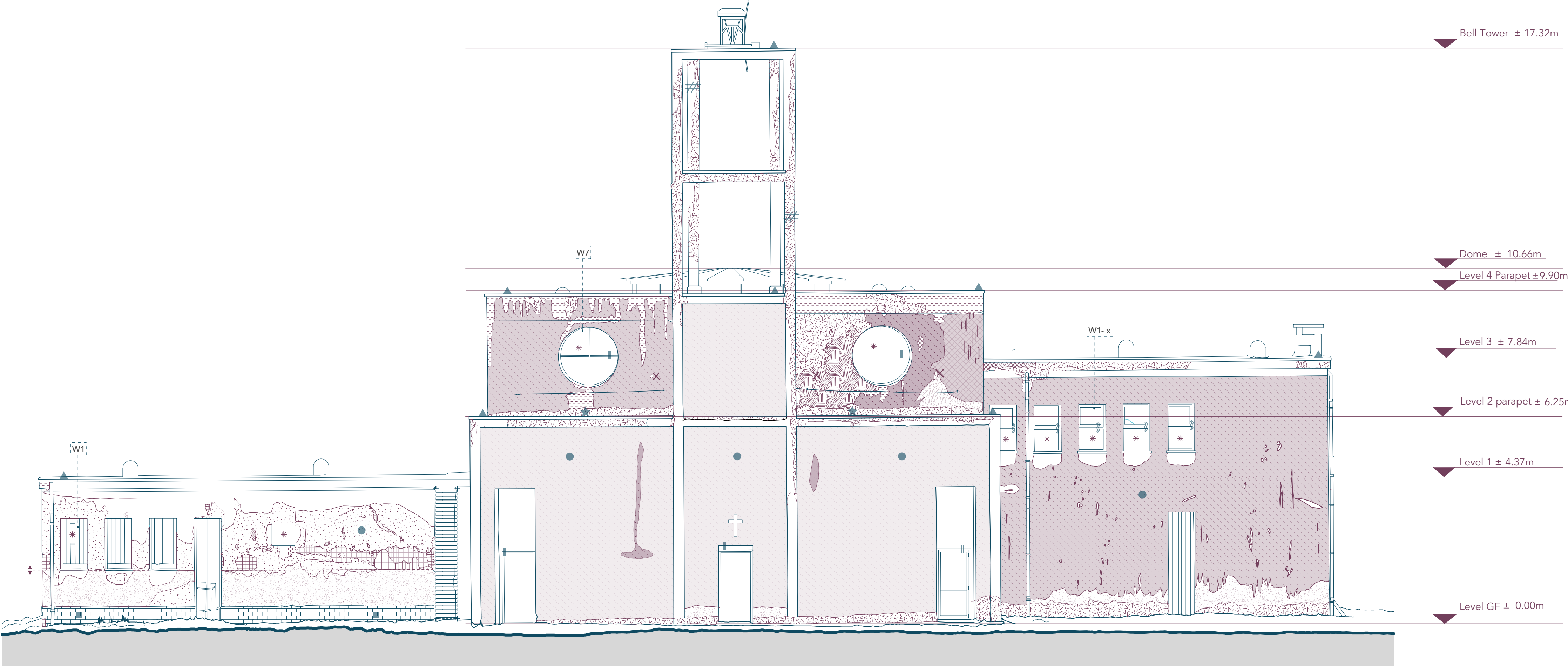
- Corrosion on Metal columns

Biological Colonization

- Biological colonization
- Microbial growth

Superficial Deposit

- Signs of dirt and grime



EAST FACADE

List of Materials and Elements		
Symbol	Photo	Material
●		Brick Wall with plaster and paint finish
■		Ceramic tiles
★		Bituminous water-proof membrane
▲		Metal coping
}}		Wooden window frames
#		Concrete Columns
		Metal Frame
		Wooden planks

Building Services & Systems		
Symbol	Photo	Material
		PVC Pipes (exposed)
		Safeline for restoration works (hypothesis)
		Chimney
		Anchor points

Degradation Analysis			
Pattern / Symbols	Photo	Degradation and Description	Causes
East Facade Windows	W1*	Missing Elements in Windows These windows of size 80 x 150 cm of the south wing are covered with wooden planks. The planks were installed during 2020-2023 restoration probably as a temporary measure to prevent further damage or intrusion while awaiting permanent restoration or replacement of the original frames and glass. The window is a circular opening (90 cm diameter) with remnants of an original metal grid and wooden planks installed inside, likely for temporary closure. The metal grid is intact but exhibits potential <i>corrosion, visible as dark discoloration and possibly rust</i> . The boards show signs of weathering, with uneven coloration and potential warping or deterioration due to exposure to moisture. The edges of the circular opening display <i>staining, moss/algae growth, and surface erosion</i> , particularly along the bottom edge.	The windows were likely left open for an extended period due to vandalism, structural decay, or deferred maintenance, leaving the church vulnerable to weather and environmental damage. The <i>absence of glass and frames</i> over time allowed water and moisture to penetrate the interior and exterior surfaces, leading to, peeling plaster, and biological colonization (<i>visible staining below the windows</i>).
	W7*	The windows are missing the glass and lack of protective coating on the metal grid causing exposure to environmental moisture leading to rust and corrosion, which is evident from the discoloration. The accumulation of rainwater at the base of the circular frame (<i>visible from the dark, damp area and moss growth</i>) has caused moisture-related damage to the concrete and surrounding materials.	
	W1-x*	W1-X windows of size 80 x 150 cm are most likely similar to W1 (original design). The frames are deteriorated, with visible cracking, uneven surfaces, and discoloration likely caused by weathering and lack of maintenance. Some panes appear intact but dirty, while others seem <i>broken or missing</i> . The sill, likely made of stone or concrete, show dark discoloration and <i>moss/algae growth</i> , indicating prolonged moisture exposure.	The missing or broken glass is likely due to either <i>vandalism, structural movement, or environmental impact</i> (e.g., <i>strong winds or falling debris</i>). The discoloration and moss growth on the sills suggest pooling or absorption of water, causing moss and algae growth and leading to plaster degradation
Material Incompatibility		Plaster change demarcation line This part of the facade shows two types of plaster applications. The upper part of the mortar appears smoother and more uniform in texture (likely a cement based mixture). There are visible patches of plaster detachment but overall holds better integrity. The lower part exhibits more pronounced degradation and moisture related damage (likely a lime-based or weaker cement lime mixture). There is also discoloration or possible erosion of plaster in lower part and worse material cohesion.	The two mortars reflect two different times of application, with material quality or composition varying due to factors such as local availability or cost. The lower line of mortar may indicate a repair or restoration phase, where a different, potentially less durable or more porous mortar was used, possibly to address earlier degradation due to rising damp issues.
Structural Degradation	×	Wall Perforations The holes appear small and localized, with dark discoloration or staining around them. The staining suggests potential water ingress, or material seepage from within the wall. They are relatively uniform in spacing and alignment, suggesting an <i>intentional or structural purpose</i> . The discoloration below the holes hints at potential water seepage, mold, or biological growth , indicating moisture-related issues	These holes may have been created to anchor structural elements (e.g., scaffolding, signage, or bracing) during construction or previous repair work that began in 2020. Over time, the absence of proper sealing allowed moisture ingress, leading to staining and potential internal degradation.
		Scratches/abrasions on paint The black marks are irregular and vertical to slightly diagonal. Some are thin and linear, while others are broader or smudged. They appear scattered across the wall surface, with a higher density in certain areas, suggesting external forces or contact with objects. The wall has an uneven finish, and the scratches are superficial, likely not penetrating deeply into the plaster or render.	The marks could result from physical contact with sharp or abrasive objects, such as scaffolding, ladders, or tools scraping against the wall during construction, maintenance, or repair activities. The irregularity and variety in depth/width of the scratches suggest accidental or unintentional abrasion.
	~	Crack - Medium Intensity The crack appears as a horizontal fissure that extends below the parapet-wall junction but does not exhibit significant displacement or crumbling. The formation of these cracks can be linear or rectilinear and their proper intensity can be tested through a series of structural analysis performed by experts.	Major causes can be Thermal expansion and contraction - Daily and seasonal temperature fluctuations can cause materials to expand and contract at different rates. This cyclic movement creates tensile stresses at rigid connections, such as the parapet-wall junction. Water Ingress and Freeze-Thaw Cycles can be another reason. Since there is an obvious rising damp from the ground, this can be due to Settlement or Structural Movement of the foundations as they cause horizontal cracking.
	~	Fissures - Severe Intensity Diagonal Cracks: Typically caused by differential settlement or structural movement, Horizontal Crack: Likely due to thermal stress or weakened structural elements, especially near load concentrations. The cracks show advanced propagation and connect multiple points, indicating compromised structural integrity. Some areas show detachment of plaster, which exposes the underlying masonry to environmental damage.	Foundation movements leading to differential settlement may have caused tensile stresses in the upper masonry layers, leading to diagonal cracks. The alignment of diagonal cracks suggests stress redistribution due to an unstable load-bearing element. It can also be due to the inadequate structural reinforcement in areas like window lintels or slab-wall junctions leading to shear or tensile failures. Other reasons are same as above aggravated to a worse condition

Solutions / Interventions	
<ul style="list-style-type: none">- In these windows, apparently, the whole frame of the windows are missing, hence they need to be replaced with new ones, keeping in mind their thermal properties. The design of the frames and window aesthetics must match the original design. Careful procedure must be taken in order to remove temporary closure with planks and structural durability of the lintel of openings must be tested and fixed before intervention of new windows. A permanent solution for window sills must be planned to avoid water accumulation.	
<ul style="list-style-type: none">- Removing debris and dirt from the metal frame and plaster in the opening using soft brushes and a low-pressure water spray.- Cleaning the metal bars with a wire brush or rust-removal tools to eliminate surface corrosion. Then treating the metal bars to stabilize corrosion and applying corrosion resistant primer to protect from future rusting.- Finally, the desired size of glass can be added to the frame based on the required thermal properties.	
<ul style="list-style-type: none">- First, wood must be inspected for rot and insect intensification and areas of high moisture content must be identified. The frame's structural integrity must also be tested to detect any weak spots.- After removing dust and debris, wood must be repaired for any damages identified (for example, applying wood consolidation agent) and parts of frames beyond repair must be replaced.- The old paint must be removed with help of chemical paint stripper and a suitable primer must be applied to the surface to protect against UV damage. In addition, existing hardware of the windows must also be examined.- Broken or damages glass to be removed, and new glass (ensuring thickness of the frame) must be added.	
<ul style="list-style-type: none">- Conducting laboratory tests to confirm the composition of both plasters and performing moisture mapping to identify areas of trapped water or capillary rise in lower section.- Cement based plasters are not compatible with lime based materials and are less permeable, hence in case it is used in the upper section, it is necessary to remove it carefully without damaging the masonry.- After cleaning the surface, a lime based plaster can be used for both upper and lower section for better compatibility and for enhanced durability, aggregates and pozzolanic additives can be added.	
<ul style="list-style-type: none">- Cleaning the stained surface using Biocidal cleaner to remove Biological growth and discoloration around the perforations.- For rust and other salty deposits, a neutral pH rust remover or poultice with clay and distilled water can be used. There is no apparent efflorescence around the holes, but it is still a good solution to extract salts, just in case.- Holes can then be filled with a suitable lime based mortar, with fine aggregates for structural voids. For smaller perforations, lime putty filler can be used for a finer finish.- final steps are using suitable lime based surface plaster and final paint finish as per aesthetic requirement.	
<ul style="list-style-type: none">- Cleaning of the surface using low pressure water washing and soft natural-bristle brush to remove surface dirt and loose particles without damaging plaster. For persistent grime in scratches areas, mild, non-ionic detergent can be used by diluting in water.- For filling and repair, lime-based filler mortar can be used which is compatible with the original plaster. For example, Hydraulic lime mixed with fine sand. The areas of scratches must be filled with small trowel or palette knife, ensuring smooth texture. To fill shallow abrasions, lime slurry can be filled in abraded areas.- Final surface finishing as per original aesthetics.	
<ul style="list-style-type: none">- Performing structural assessment using Non-destructive techniques such as; Thermograohy or ground penetrating radar to detect moisture or voids. Crack monitors to be used to assess the crack's behaviors over time.- To repair the crack, first cleaning and removal of dirt and debris is required. To fill the crack, it needs grout injection, preferably Hydraulic lime based for material compatibility. It should be injected under low pressure to stabilize internal masonry voids without creating rigid zones.- After this, the surface needs to be re done with polymer-modified lime mortar, which provides flexibility to withstand further thermal stresses. For finishing, breathable lime based plaster is suggested with paint finish to match the original aesthetics.- Conduct a structural analysis using non-invasive techniques as mentioned above.- Install carbon fiber mesh or steel helical bars across the diagonal and horizontal cracks to stabilize the masonry and restore tensile strength.- Secondly, the cleanliness of the cracks and injection of Hydraulic Lime based grout which will allow to consolidate the masonry without compromising breath-ability. In addition, Pozzolan-Enhanced Lime Grouts provides additional strength while maintaining the material compatibility of pure lime, it is a better option for filling larger voids.- For long term solution, discreet expansion joints near structural weak points may be added.	

* The degradation types and solutions continue on the next boards