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TIME REDUCTION DURING RESTORATION OF THE EXTERIOR OF A HISTORICAL BUILDING

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Emergency management due to partial collapse of facade elements is a great interest topic. The collapse often occurs in unexpected damage to building structures of architectural value within the historic urban centers. The actions often require a long time to implement. After an initial delimitation and isolation of the damaged surfaces are initiated, discovery and design of the restoration are started. The economic coverage, no less important, is often done over the years. We undertake a case study, developed in the intervention performed in front of the Cathedral of Reggio Calabria. The study covered aspects related to the organization of the first measures after the collapse of some decorative elements and the subsequent development of the site. The first phase involved the organization and implementation of protection measures to achieve tight deadlines to allow the use of space for an important and non-deferrable event. Authorization procedures for this first phase were expedited and operating procedure for the management of safety for temporary installations was established. The second phase, managed in a day, involved the intervention to ensure the practicability and ensure the safety of users. The preparation of the construction site optimized the execution time of the procedures. The design of the temporary works optimized the work of the teams involved in work sequencing, which resulted in reduced downtime and possible interference. The result of the design choices and operational programming optimized the execution time.

Keywords: Safety management, Risk assessment, Cultural heritage, Construction site, Public safety, Emergence management.

1 INTRODUCTION

The lack of maintenance and the lack of regular checks on the state of conservation of historic buildings facades often cause collapse. The risk assessment of collapse must fall within a schedule that must consider the occurrence of unpredictable situations. It also becomes important to the planning of measures to ensure safety conditions around the city.

These events are currently repeated frequently in the historic centers of many cities. In some cases, the intervention, if limited, does not create discomfort to the population and traffic. In many cases, it is necessary to postpone the execution time for planning interventions. This situation can occur for two reasons:

- The need to operate for thorough investigations to schedule the intervention;
- The lack of economic resources for the current crisis.

The preparation of temporary works, to protect the public safety, becomes a priority.

Figure 1. Works provisional after the collapses of architectural elements in the St. Patrick's Cathedral in New York (2011).

2 THE CONDITIONS OF RISK IN URBAN CENTERS

The risk analysis in general engineering works is based on the identification of the hazard and generally contains the following phases:

- Definition of the scope
- Hazard identification
- Definition and modeling of hazard scenarios
- Estimation of probability
- Estimate of the consequences
- Risk estimation
- Decide what to do

The first three elements relate to the prediction of the possible damage, the finding of the damage, and its scope and planning of possible hazardous conditions. The next three elements define the condition of risk remembering that:

$$R = f(P, M) \tag{1}$$

where: R = risk, P = probability, M = magnitude of the consequences.

The last item, deciding what to do, involves defining an *open* scheduling capable of providing more convenient operations aimed at achieving the following objectives:

- The preservation of the building

- Public safety through temporary measures
- Identification of resources needed to manage the maintenance or restoration

Risk analysis in cultural heritage buildings, understood as logical process, must therefore consider:

- Identification of all possible anomalous events that occurred in the history of the building
- Estimation of the probability of their occurrence through comparison with similar buildings
- Assessment of the extent and severity of the possible consequences

We can obtain the reduction of risk by acting on one or more of these factors. We can also implement technical measures of prevention. The isolation of the parties and the implementation of emergency plans reduce the negative consequences. The implementation of preventive measures involves a continuous activity of technical staff to perform continuous checks. They decrease the probability of undesirable events through alarm devices, locking, and isolation from stakeholders. The prevention of the risk collapse in buildings has recently been addressed by some Italian Civil Protection reports. They concern the preparation of assessment tools that allow identifying possible "symptoms" of a hazardous condition. The data collected allow technicians to make the necessary arrangements for technological interventions.

Table 1. Elements of the facade and safety measures.

Element	**Patology**	**Damage**	**Safety Measures**
Cornice	Infiltration	Detachment components	Harness with nets fence affected area
Eaves		Detachment elements	Fence affected area
Windowsill	Disconnections stone elements	Detachment plates	
Ledge	Material decay	Detachment elements	Nets
Pilaster	Cracks, bulges	Falling plaster and fragments	
Plaster	Settling, microcraks	Falling fragments	
Balcony	Disconnections stone elements or similar	Falling elementis	Fence affected area
Cantilever		Detachment elements	
Decorations	Degradation stone or similar	Detachment elements	
Windows	Disconnections wooden part	Fall glazing and frames detachment	Valance

Emergency management, understood in the context of the protection measures, involves technical and management measures to reduce the magnitude of the consequences of the damaging event. It is therefore necessary to use a technical structure able to make timely decisions. The immediate identification of the damage, its size, and the areas concerned and measures to be taken are priority. The identification

of the damage to the facade involves the immediate protection of spaces below through appropriate safety measures. Table 1 indicates the necessary safety measures in a building to the onset of the damage.

3 THE MANAGEMENT OF THE EMERGENCY: A CASE STUDY

The collapse of a decorative element of the facade of the Cathedral of Reggio Calabria, on the evening of September 6, 2011, motivated the testing of the above. The Fire Department immediately intervened, and inspected the architectural parts and the decorations placed on the top of the facade. They got worried by the cracks and superficial lesions, thus proposing immediate removal. The architect of the Cathedral was opposed to the removal of unsafe parts. However, to facilitate the removal, firefighters fenced the churchyard and the other nearby properties.

The pending program of a religious solemnity (scheduled three days later) compelled the organizers to launch a plan of action to implement the protection of access to the temple. The Technical Office Diocesan drew up the plan of remedial measures specifying the procedures for implementation and the necessary safety measures. The next morning they inspected, with the officials of the Architectural Heritage, the confirmed that operations could start safely. They provided for the protection of access to the building, using temporary works. To secure access to the Cathedral (the central door and two side doors), a structure was designed consisting of two levels of scaffolding trestle covering the wooden plates and topped by a thick plank.

Figure 2. The large fragments that collapsed were the head of a lion decoration that overhung the rose window.

Detailed operational plans for the machining supported the time schedule. Upon closing design tasks on September 7, the Technical Office obtained the availability of the company construction expert with significant experience in the field of restoration. The plan of the work, which began on the morning of September 8, was implemented through the following steps:

1. Constitution of the team work.
    - The team was composed of two workers for scaffold assembly, by a charge for the execution of the scaffolding, two carpenters for wood paneling, two laborers and a plant worker.
2. Preliminary information to the team to work safely.

- All the workers made aware of the planned operations and tight deadlines for execution.

3. Organization of delivery of materials to the construction site.
   - Because of its poor spaces and the irregularities, due to the presence of stairs, construction site, the materials on arrival immediately placed in work.
4. Fence workspace.
   - The location of the site in an area of high traffic and the need for subsequent disassembly necessitated the use of an enclosed workspace.
5. Check progress of work.
   - The tight schedule of execution required a four-step control of time schedule to check the progress of the structure.

By mid-morning, the work progressed regularly. However, by noon, the work was behind schedule. Other work units received advanced information on the tasks assigned, and reinforced the teamwork. The work was directed to ensure safety in the narrow space of the site. At 10 pm, the teamwork concluded processing and dismounted the fence of the yard, rehabilitating the spaces of the churchyard. Following up the next morning, information was given to the holders of the launches on how to safely access the central passage. At midnight, the heavy launches were carried by over a hundred devotees, and they entered the Cathedral. A large flow of worshipers used the apertures protected to enter the temple.

Figure 3. State of work at noon and late evening.

The provisional structure protected the doors of the Cathedral for over a year. It also ensured the execution of an accurate survey of the damage on the facade of the Cathedral to formulate a correct restoration project.

The protection, with some modifications, later incorporated into temporary works of scaffolding for the implementation of the restoration work that allowed, in August of 2014, the recovery of the monumental façade made secure from possible collapse. At the conclusion of the restoration, completed in August 2014, has been further reformulated programming for identifying risks. Technical Diocesan Office assign preventing future to a monitoring program and periodic checks to do every year.

Figure 4. The provisional structure built to protect the entrances.

4 CONCLUSIONS

The study was based on a comparison of procedures for risk assessment and management of the damage. It contributed to the correct identification of intervention processes through a case study whose methodology became a reference for similar interventions. In the field of historic buildings, the risk assessment is often overlooked over time. This aspect is very important in Italy, which has a great heritage to be protected (archaeological sites, monuments, historic centers, etc.).

Recent initiatives of the Civil Protection point to a careful policy to prevent historic structures from damage. We cannot regularly monitor the phenomenon of collapse of parts of architectural works without reorganizing the management structure of historic structures. Thus a new planning policy manager can promote new processes aimed at conservation and safety.

The case study presented can become a starting point for greater awareness of the need to investigate not only the technical aspects, but also social and economic phenomenon.

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