

Heritage Problems, Causes and Solutions

Calogero Bellanca and Susana Mora Alonso-Muñoyerro



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In this volume have collaborated specially these architects:

IGNACIO MORA MORENO, ALEJANDRO INIESTA MUNOZ, MAGDALENA PRIETO DE LA LASTRA

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In copertina | *Cover image: Colosseum, detail. Photo by Susana Mora and Calogero Bellanca.*

Dedicated to our parents

MARIA and ANTONINO

CONSUELO and JUSTO

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CHAPTER 3. DAMAGE MAPS: DEGRADATION PROBLEMS AND TYPES, FISSURE AND CRACK PROBLEMS

DAMAGE MAPS: DEFINITION

The survey and the representation of the degradation of the materials are usually made using cartographic architectural survey, as a basis on which, using synthetic abstract symbologies, is portrayed the perimeter of the areas subject to some typical aspects of degradation, such as surface deposit, cracking, cracking, fracturing, scaling, alveolization, black crusts, pitting, corrosion, spotting, efflorescence, detachment, etc.

Methods of survey of degradation states mainly use the direct method and, in some cases, the photogrammetric method. After having identified on site the perimeter of the areas with different types of degradation, the technician should identify the areas in question with the appropriate symbols.

To delimit these areas it is necessary to use some horizontal and vertical references, using lead and level wires; bearing in mind that architectural surveying is normally carried out as a first operation, some elements already detected can be used as reference points, such as the joints of the walls, string courses, edges of doors and windows, etc.

(1)

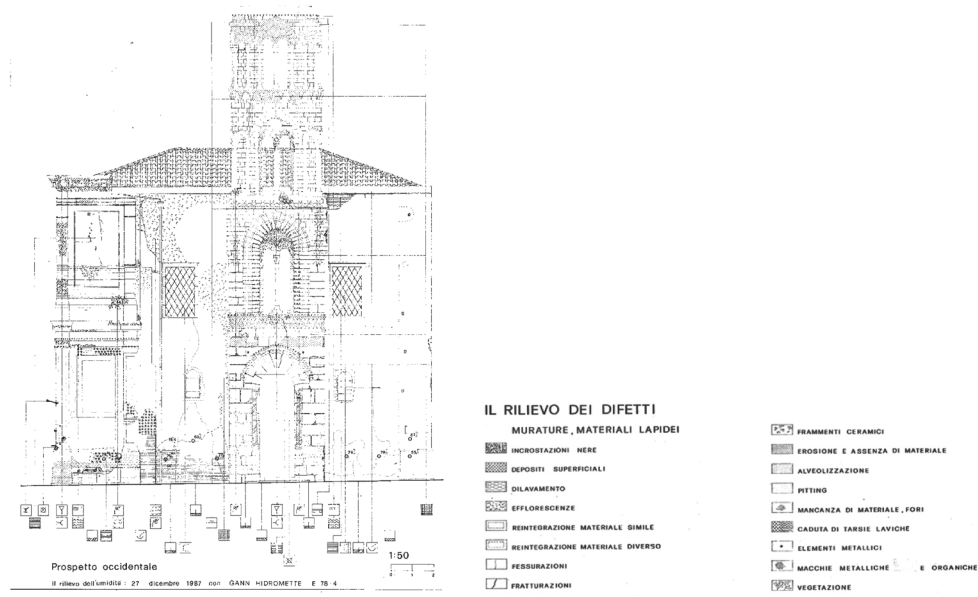


Fig. 1. Church of Martorana. From C. Bellanca, *Methodical Approach to the restoration of Historic Architecture*, Alinea Editrice, Firenze 2011, p. 201. By C. Bellanca 1986 Study and Project

SYMBOLOLOGY

As regards the representation of degradation states, it is necessary to resort to symbologies, which, however, are not yet unified today. A first attempt, in this direction, was carried out by the Normal commission.

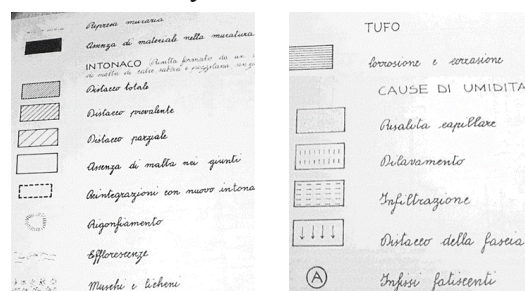


Fig. 2. Types of degradation and its conventional symbols, different degradation of materials. From G. Carbonara, *Restauro dei monumenti. Guida agli elaborati grafici*, Liguori Editore, Napoli 1990, LXIV.

MAP OF DAMAGES: DEGRADATION SURVEY

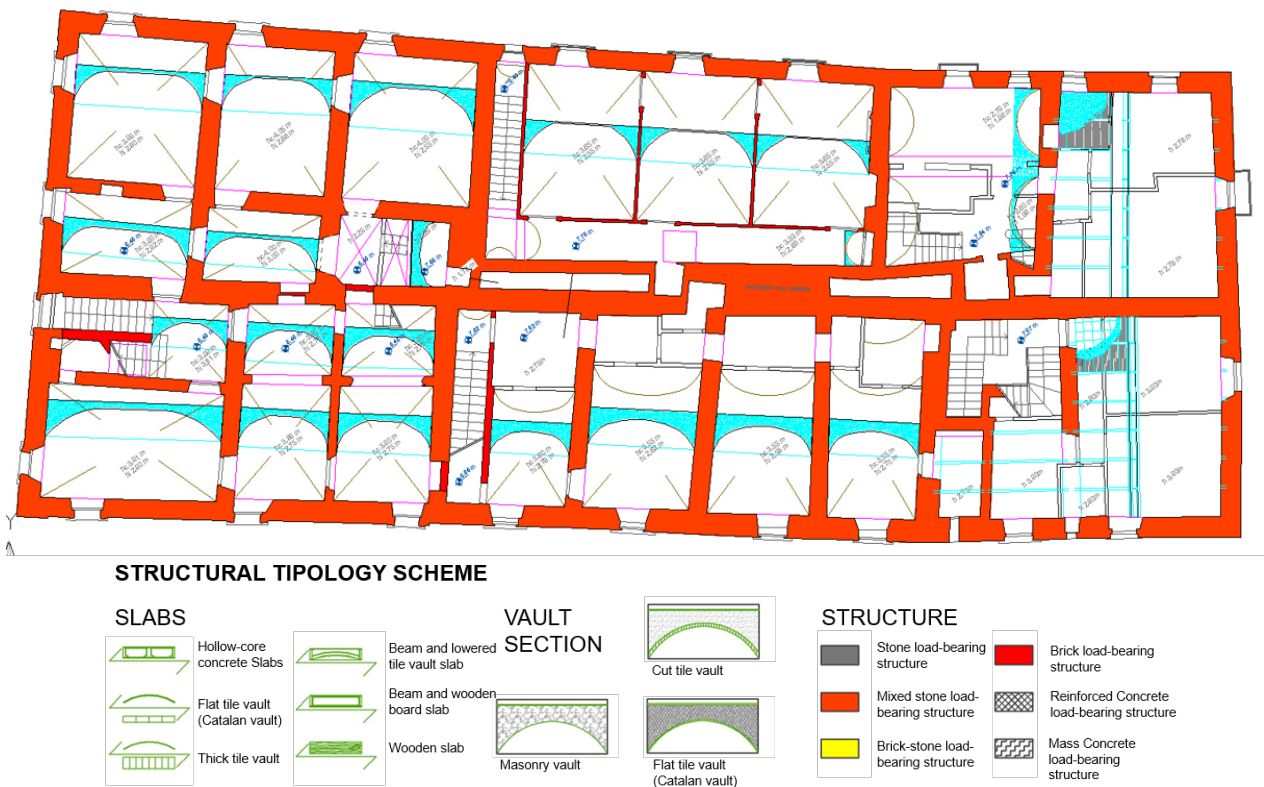


Fig. 3. Plan. Horizontal section and structure legend. Redesigned by Susana Mora. (2)

MAP OF DAMAGES: CRACK PATTERN SURVEY

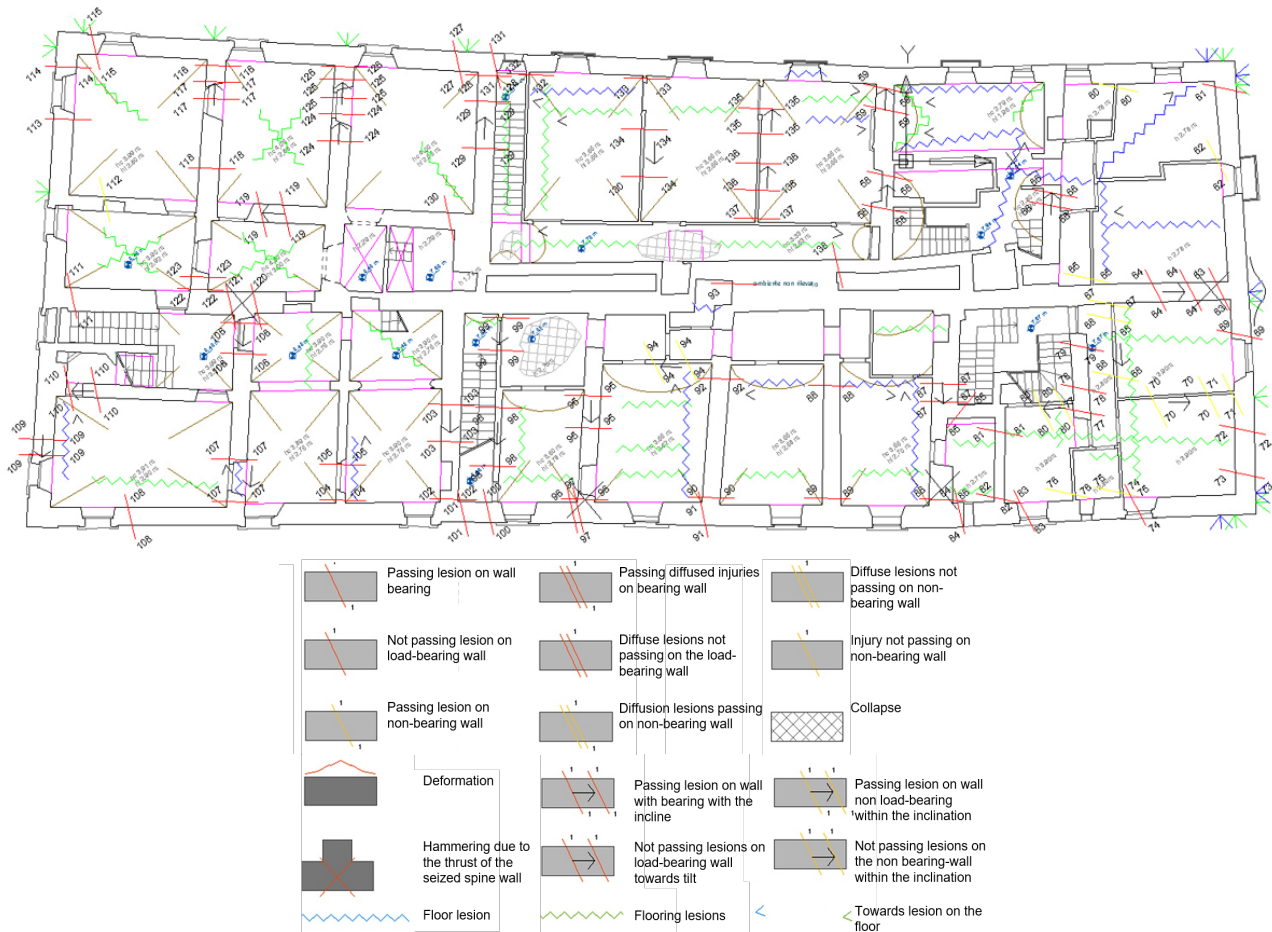


Fig. 4. Plan. Horizontal section and physical damage legend. Redesigned by Susana Mora.

MAP OF DAMAGES: DEGRADATION SURVEY



Fig. 5. Chiesa di S. Maria Maddalena in Capranica Prenestina, Tesi di Laurea, Sapienza University of Rome.

ICOMOS GLOSSARIO FOR DEGRADATION

				
Crack & Deformation	Detachment	Material Loss	Discoloration & Deposit	Biological Colonization

- Crack
- Deformation

- blistering
- bursting
- delamination
- disintegration
- fragmentation
- peeling
- scaling

- alveolization
- erosion
- mech.damage
- missing part
- perforation

- crust
- deposit
- discoloration
- efflorescence
- encrustation
- film
- glossy aspect
- film
- patina
- soiling

- alga
- lichen
- moss
- mould
- plant

Fig. 6. Maps of damage. (3)

DEGRADATION TYPES: DEFINITION

As we have said, the survey and the representation of the degradation of the materials are usually made using cartographic architectural survey, as a basis on which, using synthetic abstract symbologies, is portrayed the perimeter of the areas subject some typical aspects of degradation, such as surface deposit, cracking, cracking, fracturing, scaling, alveolization, black crusts, pitting, corrosion, spotting, efflorescence, detachment, etc.

TYPES OF DEGRADATION



ALTERATION



DAMAGE



DECAY



DEGRADATION



DETERIORATION



WEATHERING

ALTERATION

Modification of the material that does not necessary imply a worsening of its characteristics from the point of view of conservation. For instance, a reversible coating applied to stone may be considered as an alteration.

DAMAGE

Human perception of the loss of value due to decay.

DECAY

Any chemical or physical modification of the intrinsic stone properties leading to a loss of value or to the impairment of use.

DEGRADATION

Decline in condition, quality, or functional capacity.

DETERIORATION

Process of making or becoming worse or lower in quality, value, character, etc.; depreciation.

WEATHERING

Any chemical or mechanical process by which stones exposed to the weather undergo changes in character and deteriorate.

Glossario ICOMOS

The glossary is arranged into 6 families composed of 2 to 11 terms:



CRACK & DEFORMATION

FRACTURING OR FISSURING / Fratturazione o fessurazione

Degradation that manifests itself with the formation of a lack of continuity in the material and which may involve the reciprocal displacement of the parts.



DEFORMATION / Deformazione

Variation of the shape that affects the entire thickness of the material and which manifests itself mainly in sheet-like elements.



DETACHMENT

BLISTERING / Rigonfiamento

Separated, air-filled, raised hemispherical elevations on the face of stone resulting from the detachment of an outer stone layer. This detachment is not related to the stone structure. Blistering, in some circumstances, is caused by the action of soluble salts.



BURSTING:

Local loss of the stone surface from internal pressure usually manifesting in the form of an irregularly-sided crater. Bursting is sometimes preceded by star-shaped face-fracturing.



DELAMINATION / Esfoliazione

Detachment process affecting laminated stones (some sedimentary and metamorphic rocks). It corresponds to a physical separation into layers following the stone laminae. The thickness and the shape of the layers are variable. The layers may be oriented in any direction with regards to the stone surface.



SCALING / Scagliatura

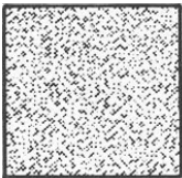
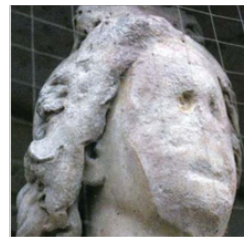
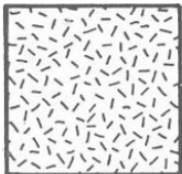
Detachment of stone as a scale or a stack of scales, not following any stone structure and detaching like fish scales or parallel to the stone surface. The thickness of a scale is generally of millimetric to centimetric scale, and is negligible compared to its surface dimension.



DISINTEGRATION / Disgregazione
POWDERING, CHALKING / Polverizzazione

It affects only the surface of the stone or can occur in depth. Damage generally starts from the surface of the material.

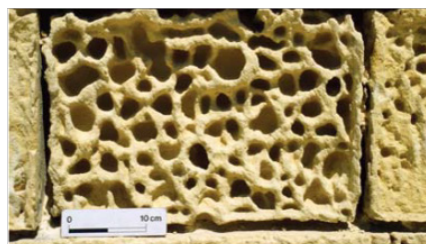
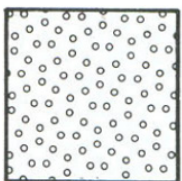
- Crumbling: Detachment of aggregates of grains from the substrate. These aggregates are generally limited in size (less than 2 cm). This size depends on the nature of the stone and its environment.
- Granular disintegration: Occurs in granular sedimentary (e.g. sandstone) and granular crystalline (e.g. granite) stones. Granular disintegration produces debris referred to as rock meal and can often be seen accumulating at the foot of the wall actively deteriorating. The following specific terms refer either to the size, or to the aspect of corresponding grains:
 - » Powdering, Chalking: terms sometimes employed to describe granular disintegration of finely grained stones.
 - » Sugaring: employed mainly for white crystalline marble,
 - » Sanding: used to describe granular disintegration of sandstones and granites.



MATERIAL LOSS

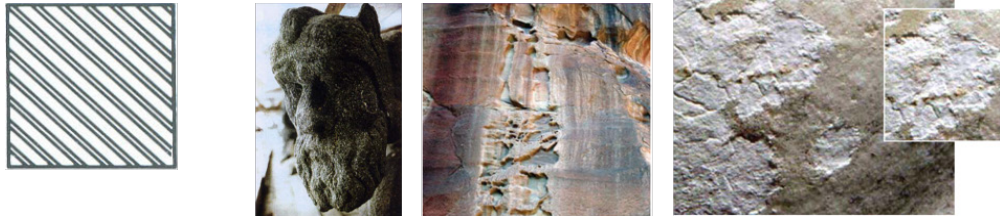
ALVEOLIZATION / Alveolizzazione

Degradation that manifests itself with the formation of cavities of variable shape and size. Alveoli are often interconnected and have non-uniform distribution. In the particular case in which the phenomenon develops essentially in depth with a diverticular course, the term carotene alveolization can be used.



EROSION / Erosione

Loss of original surface, leading to smoothed shapes. Erosion may have natural and/or anthropogenic causes. It can be due to chemical, physical or/and biological processes.

*MECHANICAL DAMAGE*

Loss of stone material clearly due to a mechanical action.

Impact damage: Mechanical damage due to the impact of a projectile

Cut: Loss of material due to the action of an edge tool.

Scratch: Line-like loss of material due to the action of some pointed object.

Abrasion: Erosion due to rubbing away by means of friction.

Keying: Impact damage resulting from hitting a surface with a pointed tool.

*MISSING PART / Mancanza*

Empty space, obviously located in the place of some formerly existing stone part. Protruding and particularly exposed parts of sculptures (nose, fingers...) are typical locations for material loss resulting in missing parts.



PERFORATION

A single or series of surface punctures, holes or gaps, made by a sharp tool or created by an animal. The size is generally of millimetric to centimetric scale. Perforations are deeper than they are wide, and penetrate into the body of the stone.



DISCOLORATION & DEPOSIT

PITTING / Pitting

Point-like millimetric or submillimetric shallow cavities. The pits generally have a cylindrical or conical shape and are not interconnected, although transitions patterns to interconnected pits can also be observed.



CRUST / Crosta

Generally coherent accumulation of materials on the surface. It may include exogenic deposits in combination with materials derived from the stone. A crust is frequently dark coloured (black crust). Crusts may have an homogeneous thickness, or have irregular thickness.



DEPOSIT / Deposito superficiale

Accumulation of exogenic material of variable thickness. Some examples of deposits: splashes of paint or mortar, sea salt aerosols, atmospheric particles such as soot or dust, remains of conservation materials such as cellulose poultices, blast materials, etc.



DISCOLORATION / Alterazione cromatica

Alteration that manifests itself through the variation of one or more parameters that define the color: tint (hue), clarity (value), saturation. It can occur with different morphologies and can refer to large or localized areas.



EFFLORESCENCE / Efflorescenza

Generally whitish, powdery or whisker-like crystals on the surface. Efflorescences are generally poorly cohesive and commonly made of soluble salt crystals.



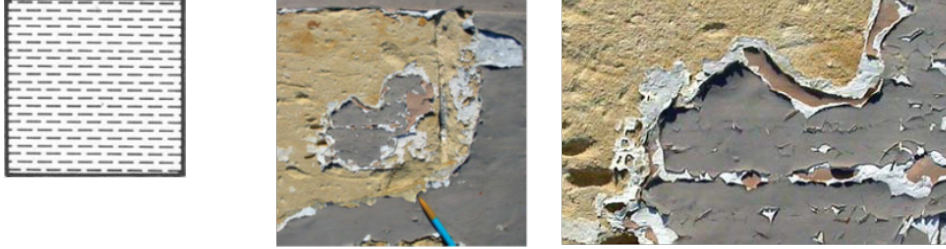
ENCROSTATION / Incrostazione

Compact, hard, mineral outer layer adhering to the stone. Surface morphology and colour are usually different from those of the stone.



FILM / Pellicola

Thin covering or coating layer generally of organic nature, generally homogeneous, follows the stone surface. A film may be opaque or translucent.

*GLOSSY ASPECT*

Aspect of a surface that totally or partially reflects the light, it has a mirror-like appearance. A glossy aspect may be due to previous polishing, (intentional or not), or to the presence of a transparent film which reflects light.

*PATINA / Patina*

Chromatic modification of the material, generally resulting from natural or artificial ageing and not involving in most cases visible surface deterioration.

*SOILING / Macchia*

Deposit of a very thin layer of exogenous particles (eg. soot) giving a dirty appearance to the stone surface. With soiling, the substrate structure is not considered as affected. Soiling may have different degrees of adhesion to the substrate.



BIOLOGICAL COLONIZATION

BIOLOGICAL COLONIZATION / Presenza di vegetazione

Colonization of the stone by plants and micro-organisms such as bacteria, cyanobacteria, algae, fungi and lichen. Biological colonization also includes influences by other organisms such as animals nesting on and in stone.



BIOLOGICAL PATINA / Alga

Algae are microscopic plant organisms without stem or leaves which can be seen outdoors and indoors, as powdery or viscous deposits. Algae form green, red, brown, or black veil like zones and can be found mainly in situations where the substrate remains moist for long periods of time.



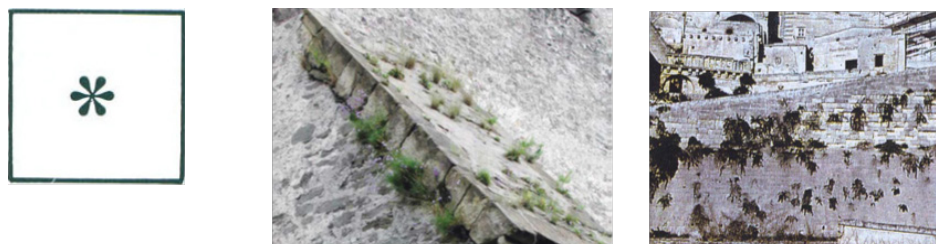
LICHEN / Lichene

Plant organism forming rounded millimetric to centimetric crusty or bushy patches, often having a leathery appearance, growing generally on outside parts of a building. Lichen are most commonly grey, yellow, orange, green or black and show no differentiation into stem, root and leaf.



PLANT / Vegetazione

Vegetal living being, having, when complete, root, stem, and leaves, though consisting sometimes only of a single leafy expansion (e.g. Tree, fern, herb).



MOSS / Muschio

Plant organism forming small, soft and green cushions of centimetric size. Mosses generally look like dense micro-leaves tightly packed together. Mosses often grow on stone surface open cavities, cracks, and in any place permanently or frequently wet (masonry joints), and usually shady.

*MOULD / Muffa*

Microscopic fungus whose colonies, to the naked eye, look like a downy film or a network or star-like millimetric patches of filaments of diverse colours (white, grey, black).



FISSURE AND CRACK PROBLEMS

CRACK PATTERN SURVEY: DEFINITION

Survey of the fissure patterns through plans, sections, elevations and any axonometric representations, to provide a spatial vision of the lesions trend. The reliefs must highlight the slits, the micro-cracks, the wall deformations with possible inflection of the vestments, showing if they are in agreement or discord. For the cracks, you will have to highlight the position, the trend, the inflection and depression points, the trend edges, etc. The representation (4) of the picture (levers use scales ranging between 1:50 and 1:10).

FIGURA 30 • Roma, Ospedale israelitico all'isola Tiberina, prospetto su via di Ponte Quattro Capi, rilievo strutturale e del quadro fessurativo, originale in scala 1 : 50. In alzato assume particolare importanza, accanto alla specificazione dei diversi materiali (mattoni, tufo ecc.) e degli elementi costruttivi (archi, piattabande ecc.), l'indicazione delle soluzioni di continuità, per accostamento o per lesionamento ma, soprattutto, la chiara rappresentazione dei pieni e dei vuoti, per evidenziare i maschi murari. Le lesioni vanno rappresentate mostrandone, oltre allo sviluppo e all'andamento complessivo, a bordi paralleli o divergenti, l'apice fessurativo, il ventre, il fatto che siano passanti oppure no (da P. F. Capolei, E. Noli, tesi di laurea in architettura, Università di Roma "La Sapienza", a.a. 1992-93).

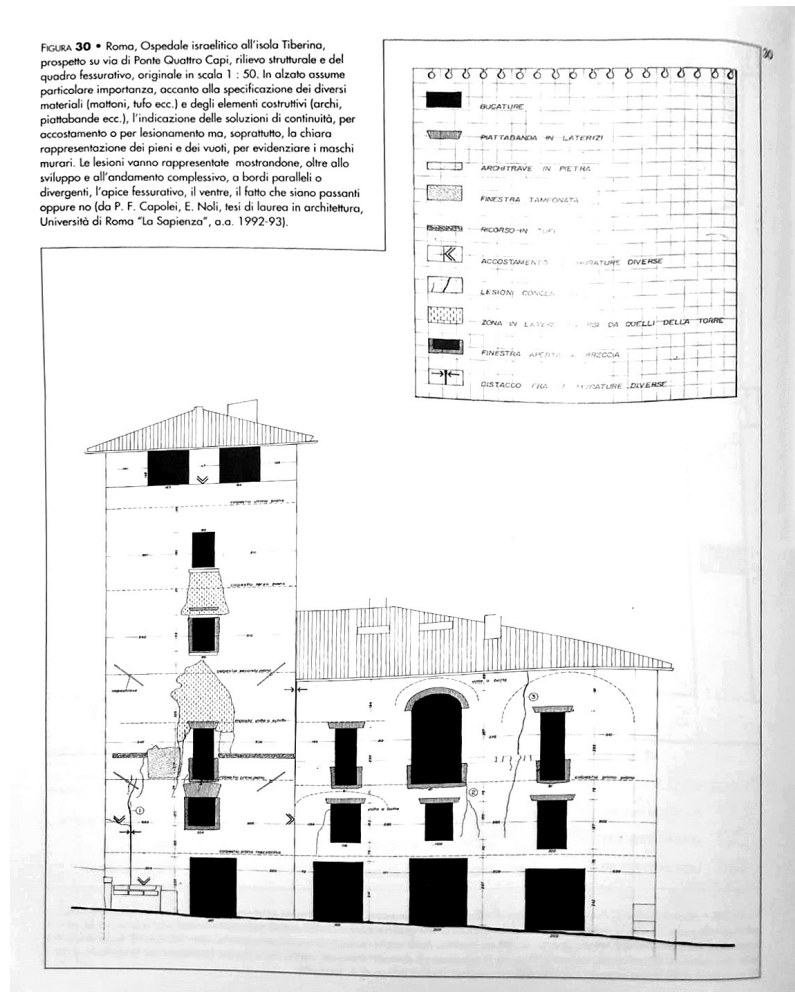


Fig. 7. Ospedale Isola Tiberina, Roma. From G. Carbonara, *Trattato di restauro architettonico*, vol. 2, Utet, Torino 1996, p. 460.

REPRESENTATION METHODS

Survey of the crack pattern must be performed with great care and accuracy, since it is possible to trace the causes that determined it from its analysis. In order to highlight the progress of the lesions, it is also advisable that the drawings contain little information to increase their legibility. The methodologies to be used in detecting the crack pattern are generally direct and, in some particular cases, photogrammetric. In the application of the direct method, the general trend of the lesions should be emphasized, if they cross the wall thickness, or if they are superficial; it is also necessary to highlight whether they are slits or micro-cracks.