ANALYSIS AND CONSERVATION OF STRATIFIED HISTORICAL CENTERS

Historical town centres deserve special and complex care in their archaeological analysis due to the existing stratification, particularly in the case of still inhabited settlements. Therefore, this research falls within the scope of issues connected to historical and archaeological study of stratified settlements still in use and which are defined overall as urban archaeology, and territory archaeology. Today these settlements are given the same consideration as recognized historical and archaeological sites, and excavation findings which are no longer inhabited.

The concept of archaeology is regarded and used, in this case, with the meaning of source of historical and construction knowledge and the physical form of the stratified town is considered as the necessary correspondence between buildings and site orography. Urban analysis, in its morphological type aspects, is the tool chosen to describe and get to know the elements and parts of complex settlements. Town analysis, derived from the method of urban analysis, is the necessary starting investigation tool to approach the problem of a recovery project in a stratified historical site. This analysis has been carried out in terms of space and time to account for historical and technical processes as well as for permanent phenomena and documented and readable urban facts which took place at different times, and is focused on a case study representative for its geological, geographic and anthropic condition.

THE CASE STUDY: CORATO HISTORICAL TOWN CENTRE

Historical background
Corato is among the settlements placed parallel to the Adriatic coastal line on a system of anthropic terracing in the North of Bari hinterland. The Apulian structure is made of a first range of towns set out along the Adriatic sea - Giovinazzo, Bisceglie, Molfetta, Trani -, and a second system of sub coastal twin settlements - Andria, Corato, Ruvo, Terlizzi, Bitonto. It is a system of twinned towns, the original settlement is in the hinterland, and the other younger one is on the coast and commercializes the products of the former.
The belt construction of the infrastructure confirms the trend of shaping the land in parallel stripes, with interstitial landscapes between roads; this type of infrastructure criss-crosses the transversal connection system to the nearby towns of the first sub-coastal range and to coastal towns. Corato lies on the first step of the highland valley and its territory stretches towards Murgia. Its development can be regarded as the result of landed property structure in the main formed of large and middle-sized cereal and sheep farms and of "parcel" farmers. The settlement is a contrast between urban “solid parts” and large agricultural “spaces”. (B. Salvemini 1989, p.21)

Corato’s foundation is hypothesized to date back to the VII-VI c. B.C. in the Daunian "facies" necropolis of San Magno land, which emerged from archaeological excavations, and its name has uncertain origin: Coratum, Coretum, Curati, Curiata, Quaranta, Corato. Some hypotheses define the word 'Corato' as derived from the Latin for 'squared', 'urbs quadrata', that is the geometrical shape of the town given by the solid town walls surrounding four angular towers, or even the heart-shaped form of the new town or human settlement, ‘Castrum’, translated as ‘Castrum Coratum’, and later simplified in ‘Coratum’. With reference to the studies to reconstruct Roman centuriatio or limitation by Ruta carried out in Italy and concerning Puglia, it can be assumed the original shape of Corato, clearly identifiable through the morphological analysis of the ancient town, was almost square and encompassed in a module referable to submultiples of the centuriatio, namely a square made of four heredia, hence ancient Corato is inscribed in a square having sides of 138 meters. The main axis of the town, presently Via Roma, has an inclination of 57° NE.SW, that is parallel to the Trajan Way and to provincial road Ruvo-Corato. (Striccoli, 1992).

Archive documents would suggest the first settlement of the town of Corato dated back to earlier than 1046, which is the unanimously accepted as the date of its foundation. Parallel to the expansion process of the fortified town, the complex urban morphology was analyzed through map reading, historical documents and the physical reading of the site with instrumental and traditional surveys.

An important date for the historical knowledge of the town urban development is no doubt 1868, the year when a survey was carried out and Camillo Rosalba drafted the first project, which provided the first location plan of Corato (fig. 1) to highlight the extramural urban growth, mainly towards North-East, which allows the dating of town development over the last century and a half. This phenomenon culturally belongs to those transformation processes of ancient settlements affected by deep social and economical upheavals typical of the new industrial era, which marks the passage to modern time.

The plan shows all the parts making up the urban form of the original settlement, its expansions, the median axis, the cardo, the arrangement of insule with the relevant herringbone pathways serving the basic structure, the terraced houses with a road network bent and wedged between the buildings to form cul-de-sacs, the chiostre coratine, and the monuments.
The nature of Corato subsurface

Corato, like other towns in Bari province, stands on a strip of Pliocene and post-Pliocene marine deposits accumulated in a shallow and irregular depression of the cropping out limestone layers, which is the main feature of the Murgia highland as a whole. The nature of these deposits and their stratigraphic (fig.2) sequence explain the existence of a shallow water-bearing stratum, whose presence might be one of the reasons why Corato is located where it is.

Above the limestone layer there is a bed of impermeable clay which makes up the bottom layer of a permeable soil soaked in water. The valley where these materials are contained forms a water basin which is independent from the surrounding land, where a great water amount penetrating the subsurface could find no way to flow out. In the Murgia territory, which is by nature lacking in surface water, the opportunity to enjoy this resource is one of the reasons deciding for the location of a human settlement. Corato, like other towns in Bari province, is an example of this.

Water supply systems

There are essentially two different traditional ways to make available water resources: to build filtering wells directly fed by subsurface water, and to collect and store rainwater. In Corato in the
past, wells and reservoirs were the only way to ensure a water supply. These structures were located in dwelling houses, and also elsewhere for common use. This need to have water available strongly affected the dwelling structure both in the choice of house location and its organization. Indeed, the layout of the reservoir (often with a double chamber) determined the dwelling building in its formal, structural and logistic features, thus becoming the regulating element for the urban form and the cause of its later hydrogeological disaster. In 1022, the so-called Corato disaster took place; the subsurface was flooded and the static equilibrium of all its historical dwelling heritage was endangered.

![Figure 2. Stratigraphy of Corato subsurface.](image)

The absolute dependence of inhabitants on rainfall water was certainly a limitation, which became even worse in periods of scarce rainfall, when the level of the water table decreased. The reconstruction interventions carried out all over Europe and in Corato at the turn of the 19th c., should be considered within the context if other renovation programs with health improvement aims. Corato has been conserved but the different renewal plans have put in place strategies which will prove harmful to the dwelling heritage.

**THE URBAN TOOLS**

**The city plan by Camillo Rosalba**

The engineer Camillo Rosalba drafted a survey and the relevant reconstruction project for Corato town, having recourse to law no. 2359/65 on city plans to be implemented as reconstruction and renewal tools of ancient quarters where there was a “vicious arrangement” to be rectified. On 28 May of that year, the first building regulations were approved and in their summary the following
works and type of works were to be executed: paving of all roads, conduits for rainfall and waste waters, straightening of the thickest and most winding roads and houses with demolition of infection spots, various decorations, tanks for rainwater collection, a new outer road allowing town enlargement and the formation of new quarters for workers' housing. The project plan provided the on final change to the town in that it drew a decagonal external ring road whose corners were enlarged to form squares, junctions between town ways and provincial and state roads. This road replaced the town defence walls in marking its boundary in compliance with the concept of ideal towns internally organized by perspective rules, and it was entirely accomplished at the turn of the 19th century at the time of the greatest growth of the town. The 17th-century logic of knocking down the whole ancient settlement of Corato was repeated by the tearing down of several parts of the town: the Duomo road with the Casale quarter remained the emblem of this project approach and the only interventions of those planned by Rosalba to be actually accomplished. From 1868, Corato has undergone a remarkable transformation, mainly in the design of urban space. This transformation has been caused by the many and simultaneous collapsing of buildings as a consequence of 1922 hydrogeological disaster. Engineer Mario Zocca was entrusted with the drafting of a plan showing graphically Corato’s actual status. A number of photos taken by Antonelli for the Civil Engineers confirm the severity of decay.

In 1921, Corato population was 50,000 people and despite the fact that the town was expanding over a considerable area, it still lacked a city plan with the serious consequence that urban growth was taking place without any organization and without a project for town development. The engineer Mario Zocca was entrusted with the drafting a city plan, which foresaw the demolition, in the ancient centre only, of really run-down houses with the opportunity to rebuild them at the same location according to new indices and criteria. The plan was never completely enforced and thus it has no practical implications.

THE HYDROGEOLOGICAL DISASTER

Corato’s collapsing buildings
Rosalba’s plan drafted in 1869 excluded the possibility of building an aqueduct for collecting water from far-away sources and also the strengthening of the artesian well system to capture water at greater depths; instead, it provided for the building of ten water reservoirs at the ten corners of town extramural polygon. Later the building of the Apulia Aqueduct allowed drinking water to reach Bari in 1915 and Corato in 1916. In the same year, 21 fountains were installed in Corato. (fig.3)

This new and abundant availability of water caused the gradual desertion of traditional water supply systems. It is clear that, because of the characteristics of the water basin, the level of the water table had always been dependent on the quantity of rainwater penetrating the subsurface and on the quantity taken for domestic use. Only a compensation of these two factors could assure the balance of the ecosystem.
Therefore, in 1919 the first cases were reported of water infiltration into cellars and underground rooms. Several buildings of the historical settlement were directly founded on the *carparo* stratum beneath vegetal soil, however most houses had underground rooms, double reservoirs, which sometimes reached (with the foundations) a depth dangerously exposed to the water table increase. Early investigations showed the direct cause of this phenomenon was the progressive desertion of the habit of drawing water from wells and the excessive amounts of water supplied by aqueduct fountains, which leaked into the subsurface due to the lack of a suitable drain network.

The priority for Corato, as in many other cases, had been to provide drinking water rather than to build a waste water network; the town had an old and insufficient wastewater drainage system, which had never been expurgated and whose pipes could not ensure impermeability. The situation worsened in the following years when buildings started to show cracks in door and window lintels, which slowly extended to the nearby walls and the vaults above. First houses started to collapse and then entire blocks. Water raised and invaded building cellars, there were ever more cracks and several buildings were shored up, until in June 1921, in Duomo road, the first cellar collapsed. Fortunately there were no casualties. The true disaster was to take place the following year: in Popolo Square the Pedone palace collapsed with half Pagano palace and two days later the Palazzo Nuovo with the church of Monte di Pietà fell down. (figs. 4-5)
Figure 4. Historical photos of shored building in Ruvo way. The cut-stone outside walls are intact, whereas inner walls are loose due to mortar pulping.

Figure 5. Historical photos of shored building
The hypotheses of Luigi Santarella on the causes of the disaster, written in his report of 1922 drafted after a survey of the collapsed buildings and cracks, excluded a sliding of the limestone bed and ascribed the phenomenon to a softening process of foundation wall mortar as a consequence of contact with water. The mortar, although of good quality, had changed its properties due to a prolonged contact with water. The walls were made of stone layers or permeable tuff, whereas the mortar between the layers was common lime mixed to soil. It is therefore a type of mortar which loses cohesion once drenched in water. The construction technique employed in these walls, made of two faces of good material and an inner filling of formless material and soil, made them highly permeable and subject to water rise by capillarity. If foundation walls flatten, the upper walls become disjointed under the effects of vault thrust.

CONSERVATION AND RECOVERY OF DWELLING HOUSES

Building with double reservoirs
The building type in Corato is strongly characterized and consists in *mature terraced* houses, several floors in height and often with a hypogeum basement. On the ground floor there are limestone barrel vaulted rooms; the first and sometimes the second floors, similar in shape and structure, have wooden ceiling frames with beams of different sizes and common joists; on the underground floors there are one or more wells, commonly called spring water wells, dug into the impermeable clay bed and with walls filtering the water table. The collected water was used for secondary uses and for cattle. Rainwater, called soft water, was collected through house roofs and used to drink. Some types of houses had a separated reservoir, underground, where roof water was collected and stored. Spring water wells had a narrow opening to allow water to be drawn and became larger towards the bottom, thus forming a truncated form. The walls are in dry masonry allowing the drain of the water table. In some special cases the well has a double excavation under the opening. (fig.6)

The first excavation produces a circular with a diameter of about 3 meters and 4.5 meters deep, it has a bell-shaped section with walls coated with watertight plaster. On the bottom of this first cavity there is a round hole, the neck of the second digging which has the section of a truncated cone 4.5 meters deep like the one above. The walls are made of dry stone masonry which filters underground water. The first cavity corresponds to the reservoir, the second one is a draining well. Together with the draining well system, there are also structures for the collection and storage of rainwater. The collection rooms, reservoirs, are underground rooms having a typical bell-shape or dug directly in soft rock as masonry rooms with barrel vaults. In both cases the walls are treated with watertight plaster. Rainwater from roofs is directed to gutters and then through vertical pipes made of clay elements it is made to reach the reservoir. These clay pipes are integrated vertically in the walls and housed in suitable grooves.
Figure 6. Structural and formal system of the construction building type.
On the upper floor, *suppenna*, of houses there are further devices for rainwater collection and use, namely stone basins stuck in the wall. The suppenna is built in tuff with walls set back with respect to the house front, which allow a narrow walkway around it for the management of the total housing quota and the direction of rainwater to the collection system. The front setting back system is often repeated in the lower part of the terraces and used again for water collection. Ceilings are made of a framework of double-pitched wooden beams. In Corato, maybe due to the double water collection system on the front and rear, ceilings often have their axis parallel to the front, in contrast to the construction technique used in other towns north of Bari.

**CONCLUSION**

**Recovery methods and intervention criteria**

The conservation and recovery intervention in historical centres always takes advantage of scientific and technical knowledge. The recovery project is updated on account of new procedures through the control and management of the relationship between the recovery idea and the new design tools, such as the use of computers and automation technology. Up-to-date analysis methods concern the use first of survey procedures and then of reconstruction and finally the *disassembly* procedures of the construction work.

Thanks to this procedure the evolution of structures and of the relevant construction techniques can be described, an approach whose aim is not the improvement of the technological *threshold*, but rather the renovation of traditional construction techniques. The whole urban structure of Corato was planned around the issue of water scarcity, which decided of the formal choices and affected its morphology. Against this scenario and based on the study of morphology and the type of partially collapsed and partially deserted blocks and of the construction type with single or double reservoir, an experimentation with sustainable techniques and systems has been put forward. The technical and construction renovation of the terraced house foresees the technologically advanced use of natural materials such as stone and wood, both as found in nature and as assembled materials.

The reconstruction of the dwelling house in a historical setting should be regarded first of all as a new search for the identity and peculiarity of the place. The project proposal for Corato is indeed based on the reuse and recovery of rainwater usage systems, which were the cause of disaster in the past and can become a recovery tool in the future. Water today is quickly becoming a dwindling resource, hence the dramatic need to *save* it both in terms of quantity and quality. The upgrading project for the management of rainwater in dwelling houses falls within the overall application program of the basic principles of bioclimatic architecture, with respect to the law in force, and using traditional materials while experimenting with energy saving systems.
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REFERENCES


