Proc. of the Second Intl. Conf. on Advances in Civil, Structural and Construction Engineering - CSCE 2015

ISBN: 978-1-63248-042-2 doi: 10.15224/ 978-1-63248-042-2-60

A model for the reuse of disused tanneries

A case-study for the definition of the intervention criteria

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Abstract*—The regeneration of abandoned buildings and industrial areas is extremely topical due to its significant effects on socio-economic issues, urban planning and environmental protection. This contribution presents a model for the reuse of abandoned tanneries. The model considers issues regarding the buildings and their urban environment based on an integrated multidisciplinary approach. In particular, the study is divided into the following phases: compatibility between the choices and urban policies; analysis of the potential conversion of the tannery; assessment of compliance with technical standards (structural safety, fire safety, elimination of architectural barriers, energy efficiency); definition of intervention criteria. The tannery district of the City of Solofra in the Campania region of Italy was chosen to calculate the parameters of the model.

***Keywords*—Reuse, regeneration, abandoned tanneries, intervention criteria.**

I. Introduction

The term *industrial demise* generally indicates a process of partial or total decommissioning of whole areas, agglomerations or individual buildings formerly used in production activities.[1] The complex and large scale process of the demise of industrial buildings began in the second half of the twentieth century with the decline of several traditional productive sectors and a gradual transition from an industrial society based on the “Fordist” model to a post-industrial, society. At present, abandoned industrial buildings represent a major part of our building heritage both in Italy and the rest of the industrialised world. Given the current objectives of regenerative and sustainable urban development we need to discuss what role these buildings in abandoned areas can play in urban transformation and socio-economic development.

II. Recovery and reuse of abandoned industrial buildings

In general, recovering industrial buildings poses several problems: state of conservation (structural elements, systems, envelope); functional and energy-related adaptability; historical and architectural importance; urban context (location, accessibility, services and infrastructures); compatibility between envisaged use and the provisions of town-planning rules, the social, economic and environmental context and the impact of industrial activities (reclamation costs relating to the area significantly affect the economic feasibility of the intervention); difficulties created by excessive fragmentation of real estate ownership or situations of partial decommissioning. The scientific debate about industrial decommissioning and potential reuse of these buildings began in the eighties and still rages today. Many studies have been performed to examine the causes and evolution of these decommissioning processes,[1, 2, 3] to assess the role of these abandoned areas and industrial buildings (with a view to their urban regeneration,[4, 5]) to evaluate their potential recovery and positive impact on sustainability objectives, and finally to consider the intervention methods and rules adopted both for individual buildings and on an urban scale.[6, 7, 8, 9] Several studies were conducted to develop multi-criteria analysis models to assess the technical and economic feasibility of reconversion and choose the best strategies from amongst several alternative reuse options.[10, 11] Several intervention strategies are possible and often the best solution is to reconcile conservation and transformation, paying careful attention to aspects such as environmental requalification and evaluation of the economic benefits of a medium to long term intervention.

When developing a suitable reuse model important information can be gleaned from the analysis and comparison of several Italian and international recovery/reuse projects. Thanks to careful planning of the upgrading project, functional reconversion has proved to be a successful strategy to give the building in question a second life.

The following is a list of several of these successful projects in Europe: the requalification of the industrial region of the Ruhr in Germany between 1990 and 2000; the Tate Modern Gallery in London, the most visited modern art museum in the world, converted from a former power station by the Swiss architects Herzog & de Meuron; the reconversion of the Cable Factory in Finland, a former factory producing electric and telephone cables and now converted into one of the biggest multifunctional cultural centres in Europe. Four former gas holders in the Simmering district in Vienna have been reused as offices and residential flats; the structural parts were maintained but the interior was redesigned and transformed. Several important examples of reuse in Italy include: the Lingotto Fiat factory in Turin converted by the architect Renzo Piano into a multipurpose commercial, cultural and service centre; the former Eridania sugar-beet factory in Parma, again converted by Renzo Piano’s RPBW studio into the “Niccolò Paganini” Auditorium; the former Fiat Mirafiori factory in Turin converted into a multifunctional R&D centre; the former Peroni factory in Rome transformed into the Museum of Contemporary Art by O. Decd and B. Cornette

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III. Applied methodology

A two-step analytical method was used in the recovery of the industrial building discussed in this article (fig. 1). **Level One** identified several possible uses based on the main urban features; **Level Two** assessed the potential reconversion of the building and its most appropriate use, and then drafted the preliminary intervention plans needed to upgrade the building.

In particular, Level One analysed the territory and main requirements and considered the following factors: the position of the area where the building is located; infrastructures and services; town planning provisions. Analysis of the requirements focused on the territorial economy and the environmental context; it also surveyed the needs of the community. Level Two was divided into three phases: potential reuse evaluation; technical feasibility and compliance with legal requirements; reuse planning.

Potential reuse was estimated based on the following “indicators of transformability”: accessibility, presence and distribution of space adjacent to the building, number of floors, geometric characteristics of the rooms, characteristics of the structural system, envelope and installation system. The aim was to assess whether reuse was technically feasible and choose the most suitable uses from amongst those identified during Level One. During phase two tests were run to verify compliance of the new functions with current technical regulations governing structural safety, energy efficiency, fire prevention, elimination of architectural barriers, and hygiene and sanitary requirements. An intervention plan was proposed during phase three based on the eco-compatibility of the materials, energy savings, flexibility of the new building systems, and sustainable maintenance.

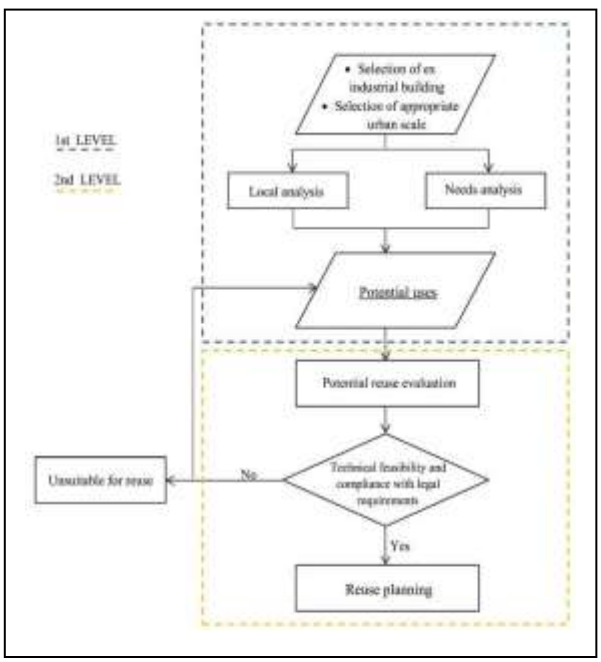

Figure 1. Flow-chart showing the proposed reuse methodology.

This method was applied to a former tannery in the Solofra industrial district (Avellino province) in the Campania region of Italy. Many tanneries built since the 1970s have fairly homogeneous typological and building characteristics; as a result, the case study presented here can be used as a reuse model for similar buildings. The general methodology can also be used to study other types of abandoned industrial buildings.

IV. Case study: former tannery in the Solofra district in Campania

In Campania the main tannery centre specialising in tanning sheep and goat skins for clothing, shoes and leather articles is located in the Solofra Municipality in the province of Avellino. Its turnover accounts for roughly 9% of the total for the sector in Italy.[12]

The industrial site is well positioned logistically between the two provincial capitals, Avellino and Salerno (fig. 2). The Solofra municipality is known as “Skin City” due to its history as a tanning centre, both now and in the past.[13, 14] The case study applied the methodological approach outlined above to an abandoned tannery in the south east zone of the industrial district..

A. *Territorial analysis and possible requalification of the industrial site*

Much like other industrial areas in Italy and abroad, the economy in Solofra was negatively affected by globalisation and the tertiarisation of society. When faced with this social, economic and structural transformation, industries in Solofra were unable to quickly upgrade their obsolete organisational model. As a result, many activities and tanneries were forced to close. The industrial area is currently far too big compared to the number of tanneries required. Most of the area is located in the A.S.I. zone (Industrial Development Area), in other words within the boundaries of the A.S.I. Consortium of the Avellino Province. As a result the urban planning regulations affecting industries in Solofra are governed by the Technical Implementation Regulations of the A.S.I. Territorial Development Plan (currently being updated). These regulations are far too inflexible and binding given the new economic situation of the District; they should be revised so that old tanneries no longer have to be used for activities associated with the tanning industry, but instead can be transformed to satisfy the requirements of local

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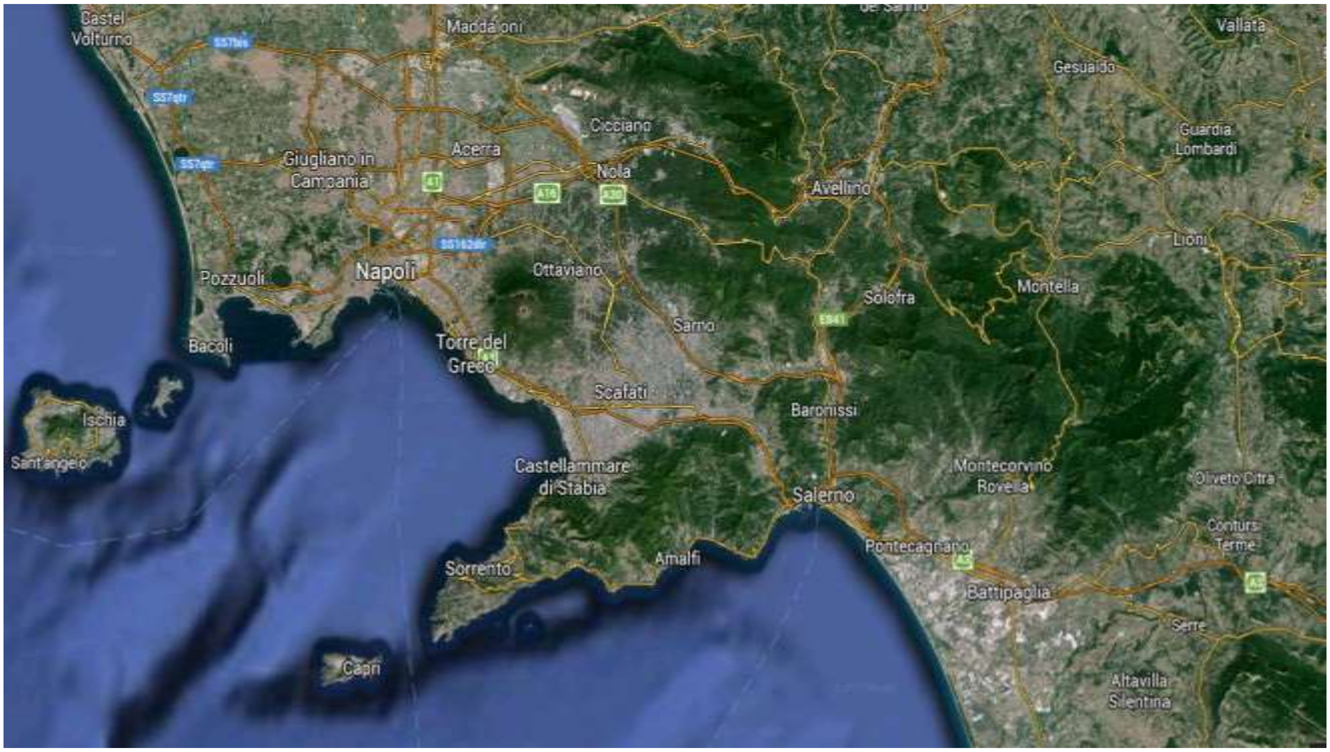

Figure 2. Location of the Solofra Municipality in Campania (image: Google Maps)

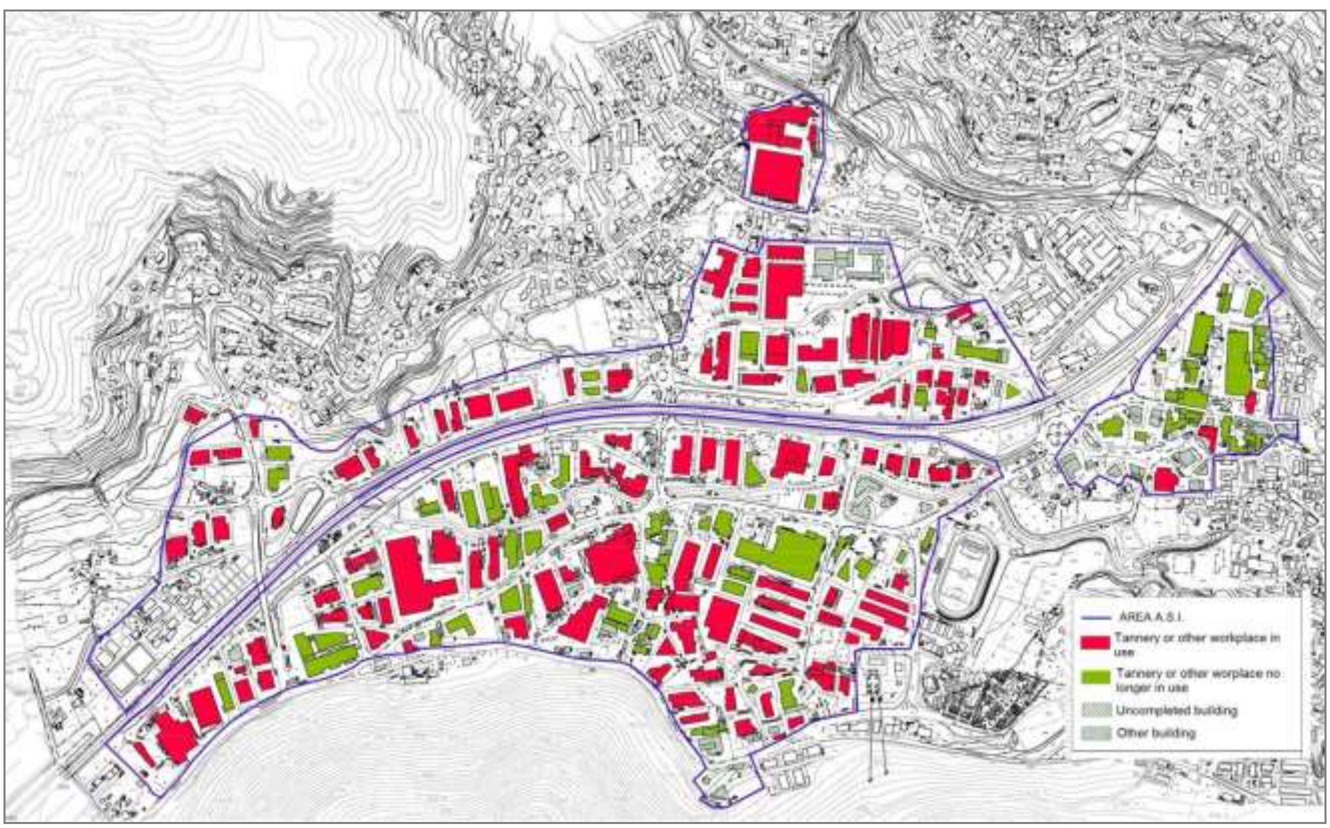

Figure 3. Analysis of the building types in the A.S.I. district. Abandoned tanneries in green.

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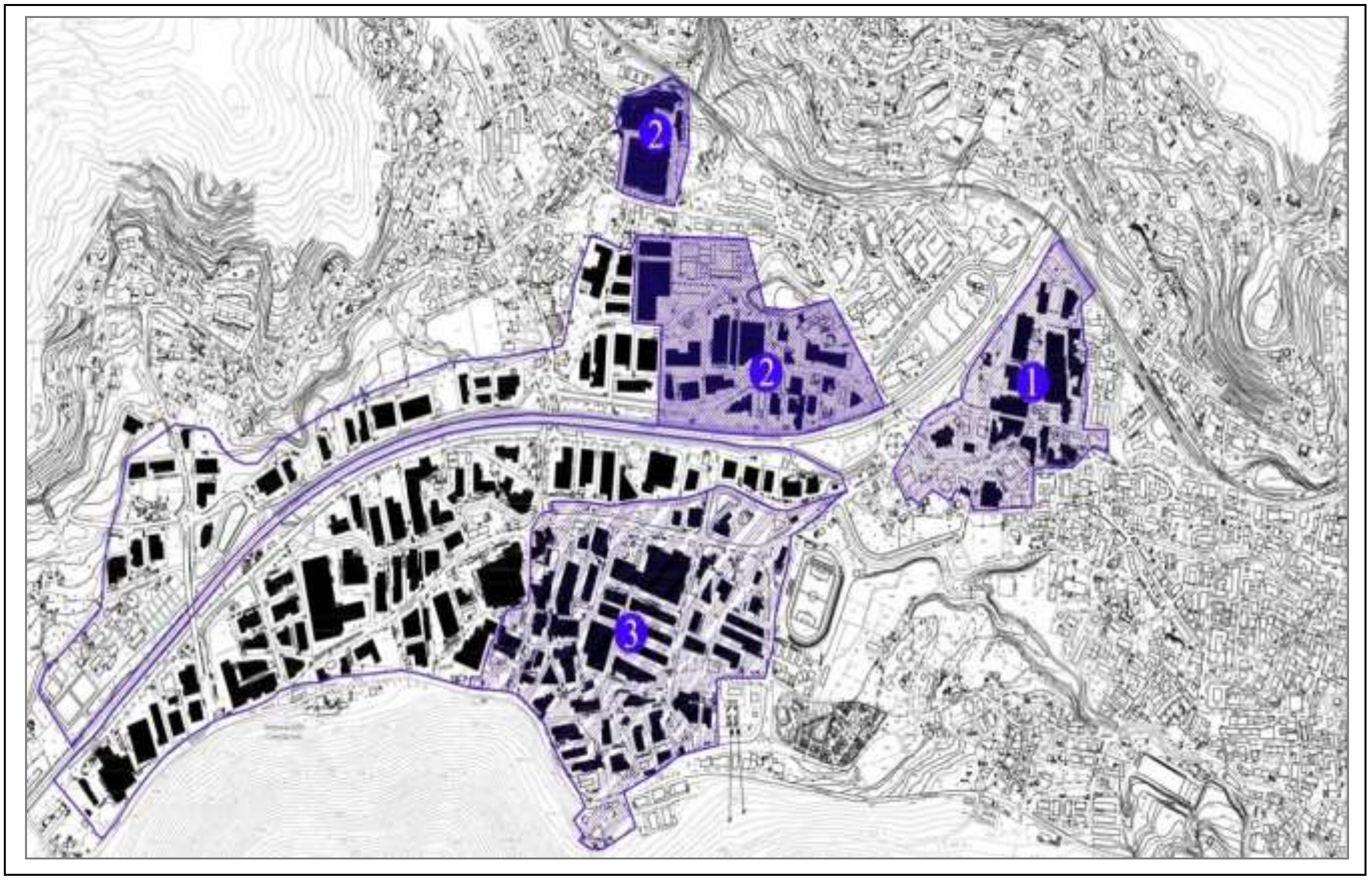

Figure 4. Possible requalification of the industrial area. Definition of the three macro intervention areas: 1. Expansion of the urban centre; 2. Logistics platform; 3. Commercial district.

entrepreneurs and the environmental requalification explicitly demanded by the community. Based on an onsite campaign and data from the records of the Avellino Chamber of Commerce an analysis was performed to assess how many tanneries had closed. The analysis also defined the type of activity (productive and non-productive, abandoned or used for other purposes, e.g., retail shops, houses, warehouses, etc.) and distribution of the tanneries vis-à-vis the urban centre and other major infrastructures. During the second part of the analysis the A.S.I. zone was divided into relatively uniform sub-areas according to the type of activities and whether or not they were still in use or had been shut down (fig. 3). Based on this analysis a possible requalification plan was formulated; the plan envisaged reconfiguration of the industrial district after identification of the following three macro areas (to be deleted from the A.S.I. plan). The first macro area closest to the urban centre was earmarked for urban requalification and potential commercial or residential reuse of the abandoned buildings. A second macro area, near the entrance to the motorway, was marked down as an avant-garde logistics platform for local businesses as well as a service network for a larger user base. The third macro area near the municipal sports ground in the south east area of the A.S.I. zone was tagged to be a commercial pole and fair area (fig. 4).

The tannery in question is located in this third macro area which we examined more in-depth. We identified the main business activities, in particular the abandoned tanneries, the tanneries in use, and the ones under construction. We also established their structural and building types, as well as the number of floors. Based on the characteristics and location of the buildings and socio-economic and territorial requirements we elaborated a requalification strategy divided into two main systems: the built and the green-parking-open areas. There are three main buildings in the centre of the lot with a large square in the middle. Commercial activities are located in the biggest building (multifunctional commercial centre); smaller retail activities associated with the tanning industry are located in the second building, while R&R activities are located in the third building (fig. 5). Existing buildings to the west of the macro area will be turned into offices or adapted to accommodate tertiary activities. The restructured buildings used to sell and promote local products should envisage new uses including buildings for scientific research, marketing and exhibition fairs. The east sector, near the sports ground, will undergo a dynamic transformation process and will be dedicated to exhibitions, fairs and events; it will include both open and covered spaces created by reusing and functionally upgrading existing structures.

The green area will include parking areas, an equipped urban park, and a *large ecological passage* complete with pedestrian and cycling paths. The passage will act as a natural filter between the green areas and the industrial area with fully functional factories; it will also connect the sports ground with places closer to the city centre. This part of the plan aims to

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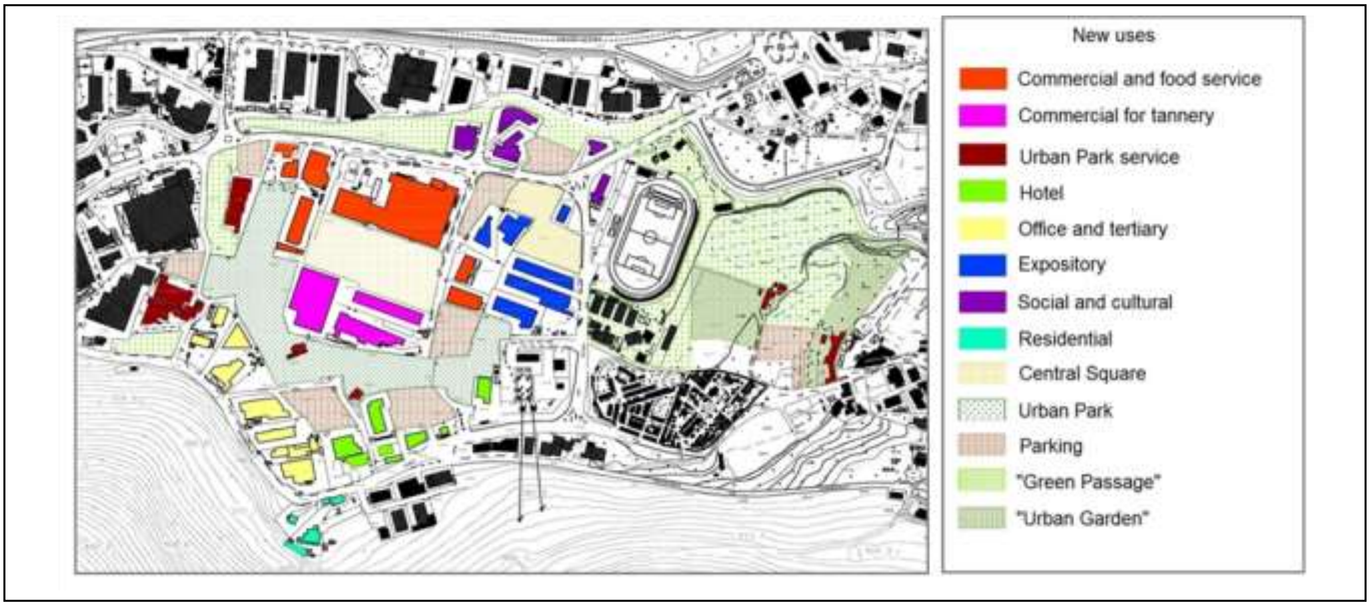

Figure 5. Possible requalification of macro area 3 with new uses (after demolition of several buildings)

equip the municipality with a green network of paths in order to improve the quality of the environment and social relations.

B. *Description of the abandoned tannery*

Built in 1979, the tannery has a reinforced concrete framework and trapezoidal layout; the longer side measures 26.50 m, the shorter side 14.00 m. The building has three floors; the roof stands 13.60 m above ground (fig. 6).

The ground floor has three entrances and is divided into two large spaces with 5 m ceilings; yellow tuff blocks are used as infill in the outer walls; the simple glass and iron door and window frames stretch from one pilaster to another around the whole building.

A single staircase on the short side of the building leads to the first floor; the external first floor walls are made of hollow concrete blocks; the height inside is 5.00 m; there are two rows of ribbon windows at different levels from the floor, one at a height of 1.20 m above ground and another at 1.80 m. These windows run all around the building.

The second floor was never finished: there are no window or door frames; the external walls with a double hollow brick lining and air cavity are missing in many parts of the building; the ceiling is 3.00 metres high and the roof is flat.

Figure 6. The abandoned tannery

C. *Potential for reconversion and adaptability tests*

As part of the general requalification project illustrated earlier, and after critical assessment of the indicators of transformability described in paragraph III), the former tannery proved to be a good candidate for conversion to tertiary activities. In particular, it could be used as a restaurant on the ground floor and offices on the other floors (fig. 7). Before the building can be used for these purposes checks must be run to see whether it complies with the main technical regulations in force in Italy.[15, 16, 17, 18, 19, 20, 21]

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Figure 7. Possible reuse of the former tannery: plan with new uses.

It is obvious that as far as structural issues are concerned the building was designed taking into consideration vertical loads but not seismic activity. The Technical Building Regulations require an assessment of the safety of the building and the drafting of any necessary interventions. As a result it's very important to examine its structure; this is how we proceeded. We performed a historical and critical analysis of any events and changes made to the building over the years; we carried out a geometric-structural survey on the state of conservation of the materials, presence of gaps and fissures, and the mechanical characteristics of the materials (concrete, steel). We examined the following sources to collect data about the building: the original structural diagrams and the original onsite test certificates. All this data provided us with sufficient knowledge, KL2, [22] and allowed us to use all the static or dynamic, linear or non-linear analytical methods envisaged by current Regulations. We performed a linear static seismic analysis using SAP2000 software and 3D modelling of the structure (fig. 8). As expected, the seismic stress tests provided less than satisfactory results; nevertheless, we believe seismic protection can be improved after implementation of several specific interventions illustrated in the next paragraph.

As far as fire prevention measures are concerned, the shape and size of the rooms will easily allow for a good fire escape system. The staircase, however, will need to be made "smoke proof".[20, 21] Limited interventions will be required to eliminate architectural barriers and provide access to all the floors. The current energy performance of the envelope-systems in the building is unsatisfactory based on the energy efficiency required during reuse. Nevertheless, suitable technical solutions can be adopted to avoid demolishing the infill and the flat roof can be used for active and/or passive exploitation of renewable energy sources.

D. *Interventions required for reuse*

Based on the above methodology we drafted a plan for the appropriate reuse of the building. The project provides indications which will be verified during the second level executive design stage. The general criteria behind the requalification interventions are:

- reuse of the building without demolition or additional volumes;
- use of ecosustainable materials;
- flexibility and reversibility of the proposed technical solutions;
- energy efficiency thanks to the joint use of active and passive technologies.

To improve structural safety we proposed intervening on the beam-pilaster intersection by wrapping it with FRP materials so as to increase the shear stress at the ends of beams and pilasters, isolate the ends of the pilasters, and increase the overall ductility of the structure. Furthermore, longitudinal bars will have to be made for the foundation plinths.

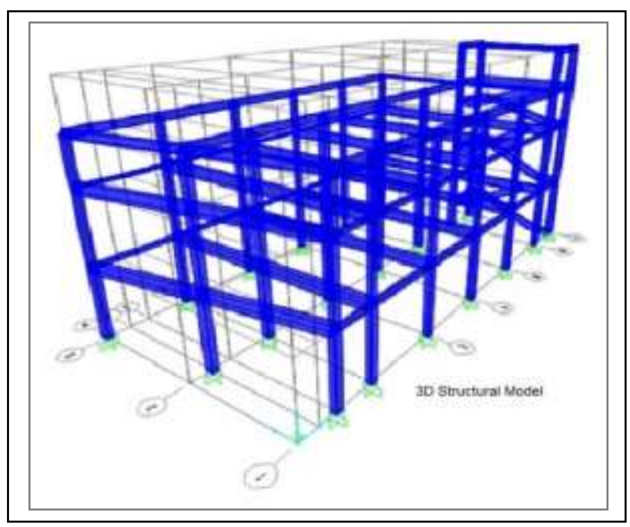

Figure 8. Three-dimensional model of the structure.

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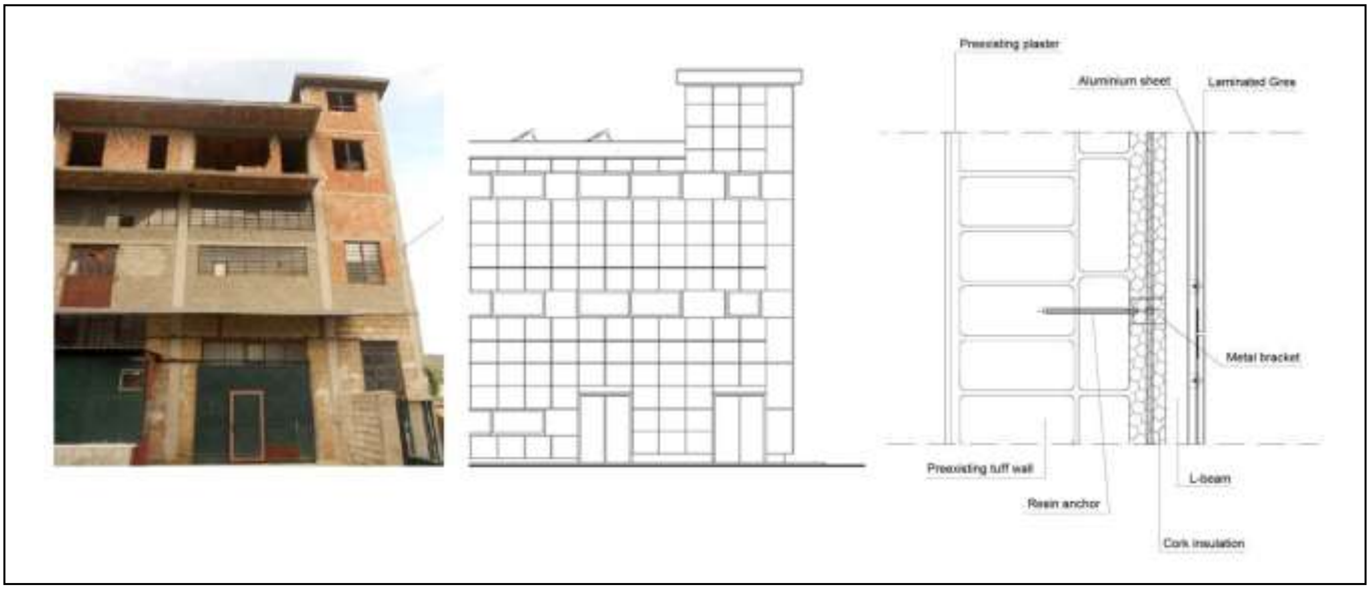

Figure 9. Left: part of the existing façade; centre: requalification of the façade with a ventilated wall; right: detail of the ventilated wall.

A structurally independent elevator will be installed outside the building to allow the disabled to access the upper floors.

With regard to energy savings and sustainability, our strategy involves: a grass grid drain floor in the outdoor areas of the lot to create a microclimate and stop the formation of hot areas; a system to collect rainwater in the existing tank after it has been treated and upgraded; creation of a ventilated façade for envelope retrofitting by exploiting the current infill as a supporting wall (fig. 9); reduction of the glass surfaces and installation of completely new, neo-recycled thermal break aluminium doors and windows with Neotech bars; thermal insulation and ventilation of the ground floor thanks to a crawl space in regenerated plastic domes; an underfloor system to heat/cool the rooms; a photovoltaic system coupled with a green roof.

Statistics show that these measures will provide up to 50% savings on drinkable water thanks to the recovery of rainwater used in bathrooms and as irrigation. The green roof will provide approximately a 40% reduction in heat transfer during the winter, a considerable increase in thermal inertia, and significant benefits during the summer season. The ventilated façade will provide energy savings and avoid demolition of the external walls. The photovoltaic system and green roof will maintain the temperature of the panels around 30°C and improve their energy efficiency.

V. Results and Conclusions

The main aim of the study is to help define methodologies for the appropriate reuse of abandoned industrial buildings as part of a more general programme of sustainable regeneration of the built. In particular, this model represents a support strategy during evaluation and reuse design of a specific type of industrial building: tanneries. Tanneries built between the immediate post-war period and the present day are generally similar in size and design.

Before focusing on a specific building, the methodology envisages a preparatory analysis of the territory. Our aim was to consider various factors and their complex interaction. The most important advantages provided by the model are the excellent reconversion potential of tanneries and the fact conversion can be achieved without “heavy duty” interventions and in full respect of current regulations. Drawbacks include excessively inflexible town plans vis-à-vis compliance with possible reuse. Another study, currently being developed, will focus on the introduction of indicators to assess the cost-benefit of investments and the energy-environmental sustainability of the interventions.

References

[1] E. Dansero, Dentro ai vuoti. Dismissione industriale e trasformazioni urbane a Torino. Libreria Cortina, 1993.

[2] B. Secchi, Le condizioni sono cambiate, Casabella n. 498, 1984.

[3] P. Crosta, Dismissione: la costruzione del problema, Rassegna n. 42, 1990.

[4] V. Gregotti, Architettura come modificazione, Casabella n. 498, 1984.

[5] G. Giovanelli, Aree dismesse e rigenerazione urbana: l’innovazione nelle politiche e negli strumenti di intervento. In: Giovanelli G., (a cura di), Aree dismesse e riqualificazione urbana, Alinea ed., 1997.

[6] G. Riva, Architettura e costruzioni industriali. Tecnologie per un recupero sostenibile. In: Labelli F., Marini S., (a cura di), L'architettura e le sue declinazioni, Ipertesto ed., 2008.

[7] E. Arbizzani, G. Materazzi, La riqualificazione delle aree industriali dismesse. Considerazione di metodo, (h)ortus, 62, 2012.

[8] A. Vallitutti, Tecnologie di riconversione dell’ambiente costruito. Processi, metodi e strumenti di riqualificazione per le aree dismesse, Alinea ed., 2009.

[9] A. Lepel, Changing the function of industrial buildings – Survey. Facta Universitatis. Series: Architecture and Civil Engineering, vol. 4 n. 2, 2006, pp. 71-84.

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[10] G. Materazzi, Metodologie per la riqualificazione e la valorizzazione delle aree industriali dismesse. Un sistema di indicatori a sostegno dell'analisi, PhD Thesis, Università di Roma "La Sapienza", 2014.

[11] M. Daukšys, J. Pilipavičius, A. Daugėlienė, Complex Model for Assessment of Ex-industrial Building Conversion Options Into Lofts, Journal of Sustainable Architecture and Civil Engineering, 1, 2014, pp. 27-33.

[12] UNIC - Unione Nazionale Industria Conciaria, Rapporto di sostenibilità, La Conceria srl, 2014.

[13] V. D'Alessio, Storia della concia della pelle in Solofra, Edizioni G. C.F. Guarini, Solofra, 1989.

[14] V. Ascione, L'industria conciaria di Solofra tra fine Ottocento e primo Novecento: un caso di distretto industriale, Avellino, 2000.

[15] D.M. 14 gennaio 2008, Approvazione delle nuove norme tecniche per le costruzioni, G.U. 4 febbraio 2008, n.29.

[16] D.P.R. 2 aprile 2009, n. 59, Regolamento di attuazione dell'articolo 4, comma 1, lettere a) e b), del decreto legislativo 19agosto 2005, n. 192, concernente attuazione della direttiva 2002/91/CE sul rendimento energetico in edilizia, G.U. 10 giugno 2009, n.132.

[17] D.M. 26 giugno 2009, Linee guida nazionali per la certificazione energetica degli edifici, G.U. 10 luglio 2009, n.158

[18] D.M. 14 giugno 1989, n. 236, Prescrizioni tecniche necessarie a garantire l'accessibilità, l'adattabilità e la visitabilità degli edifici privati e di edilizia residenziale pubblica sovvenzionata e agevolata, ai fini del superamento e dell'eliminazione delle barriere architettoniche, G. U. 23 giugno 1989, n.145.

[19] D.P.R. 24 luglio 1996, n. 503, Regolamento recante norme per l'eliminazione delle barriere architettoniche negli edifici, spazi e servizi pubblici, G.U. 27 settembre 1996, n. 227.

[20] D.M. 22 febbraio 2006, Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio di edifici e/o locali *destinati ad uffici,* G. U. 2 marzo 2006, n.51.

[21] D.M. 9 marzo 2007, Prestazioni di resistenza al fuoco delle costruzioni nelle attività soggette al controllo del Corpo nazionale dei vigili del fuoco.

[22] EN 1998-3: Eurocode 8: Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings (2005)