

# Materials and technologies in Art Nouveau architecture: Façade decoration cases in Italy, Portugal and Poland for a consistent restoration

## *Materiales y tecnologías en la Arquitectura Modernista: Casos de Estudio de decoración de fachadas en Italia, Portugal y Polonia persiguiendo una restauración racional*

F. Sandrolini<sup>(\*)</sup>, E. Franzoni<sup>(\*)</sup>, H. Varum<sup>(\*\*)</sup>, R. Nakonieczny<sup>(\*\*\*)</sup>

### SUMMARY

The results of a diagnostic survey on the materials of representative Art Nouveau buildings in Italy, Portugal and Poland are here presented and compared, as a contribution to their understanding and, hence, to support compatible restoration. In particular, the façade decorations were investigated for the appraisal of their materials and technologies, often neglected in current maintenance/restoration works and so cancelled, leading to a severe loss in architectural image.

The ongoing diagnostic campaign, in collaboration among different universities, is aimed to set up a database on materials and technologies of Art Nouveau façade decorations at a European scale, as a technical-scientific background for the highlighting of preservation guidelines.

### RESUMEN

*En este trabajo se presentan los resultados de un estudio de diagnóstico sobre materiales representativos de edificios del periodo del Modernismo en Italia, Portugal y Polonia. Con la comparación de estos resultados se pretende contribuir a incrementar el conocimiento de los materiales usados en este patrimonio, que permita realizar más eficazmente las futuras intervenciones de restauración. En particular, se analizan las decoraciones de las fachadas, pasando por el reconocimiento de sus materiales constituyentes y de las tecnologías usadas, que muchas veces no son adecuadamente estudiados en intervenciones de mantenimiento y/o restauración, provocando graves pérdidas en su imagen y lenguaje arquitectónico original.*

*Con la campaña de trabajos de diagnóstico, en colaboración con varias universidades, se pretende crear una base de datos sobre materiales y tecnologías usados en las decoraciones de fachada en el periodo del Modernismo a una escala europea. El material podrá constituirse en una herramienta técnico-científica de soporte al desarrollo de directrices y recomendaciones para la preservación de este patrimonio.*

181-03

**Key-words:** Facades decorations, Art Nouveau, Restoration, Materials, Techniques.

**Palabras-clave:** Decoraciones de fachada, Modernismo, Restauración, Materiales, Técnicas.

<sup>(\*)</sup> Facoltà di Ingegneria, Università di Bologna, (Italy)

<sup>(\*\*)</sup> Universidade de Aveiro, (Portugal)

<sup>(\*\*\*)</sup> Silesian University of Technology. Gliwice, (Poland)

Persona de contacto/Corresponding Author: hvarum@ua.pt (H. Varum)

1. Cement-based façade decorations in the Girasoli [Sunflower] House in Bologna, Italy (Paolo Sironi, 1905).

2. Cement-based particular at the entrance of Villa San Donnino in Modena, Italy (Ferdinando Maserotti Bevenuti, 1910-11).

## 1. INTRODUCTION AND RESEARCH AIM

*Art Nouveau* architecture originated as an avant-garde movement in Belgium thanks to Victor Horta and Henry van de Velde and soon it diffused all over Europe between the end of XIX cent. and the beginning of XX cent. (1, 2). It was characterized by different expressive styles in the European countries (3), hence it was differently named as *liberty* in Italy, *jugendstil* in Germany, *sezessionstil* in Austria, *arte nova* in Portugal, etc.

The foundations of the *Art Nouveau* architecture are generally considered the refusal of traditional styles and, mainly, the new industrial materials (steel, reinforced concrete and

dating back to the *Art Nouveau* period, for possible information on the materials' recipes and placing technologies. This allows to achieve an as much exhaustive as possible knowledge of the building materials in the modernist period as a premise for a future outlining of *repair protocols* for the safeguard of *Art Nouveau* architectural heritage at a European scale (7).

## 2. CASE-STUDIES

At this first stage of the diagnostic campaign, Italian, Portuguese and Polish *Art Nouveau* buildings were examined. In Italy: the *Chalet Restaurant of Giardini Margherita* (Margherita Gardens) and the *Sacro Cuore* (Holy Hearth)



1



2

others) that made new structural and decorative solutions possible (4, 5). The façade decorations (flowery, anthropomorphic, geometric, etc.), in particular, played a very important role in *Art Nouveau* architecture and therefore they embody one of the main features of such architectural style.

Unfortunately, the materials of *Art Nouveau* façade decorations are barely studied: very scarce experimental data are available in literature about their formulation, placing technology, degradation mechanisms in urban aggressive environment, consolidation and repair procedures. This is probably due to the fact that such decorations are currently

branded as "recent" and "cement-made", thus being subject to inaccurate maintenance works or even demolition, often neglecting their true contribution to the *Art Nouveau* architecture spirit, which is often lost.

But are the materials of *Art Nouveau* decorations actually worth of conservation? To give a straight answer, it's basic to investigate their nature and characteristics. For this purpose, a diagnostic campaign on representative European *Art Nouveau* buildings was undertaken. The same holistic approach outlined elsewhere for ancient architecture was used for the diagnostic survey on selected buildings (6), as well as original literature sources



Church in Bologna by Edoardo Collamarini (early years of '900 and 1901-1912 respectively) (8); the *Girasoli* (Sunflower) House in Bologna by Paolo Sironi (1905) (Figure 1); the *San Donnino* House in Modena by Ferdinando Masserotti Bevenuti (1910-11) (Figure 2); and some residential buildings in the towns of Messina and Reggio Calabria,

open porosity and pore size distribution were determined by mercury intrusion porosimetry (MIP, Fisons Macropore Unit 120 and Poro-simeter 2000 Carlo Erba).

The case-studies were selected as (i) they were representative of *Art Nouveau* architecture in the selected countries, (ii) they had different

3. Natural stone decorations at the Casa Major Pessoa in Aveiro, Portugal (Francisco Silva Rocha and Ernesto Korrodi, 1907-1909): a) façade; b) detail previously to the restoration works.



3a



3b

where the *Art Nouveau* architecture had a strong development during the so-called 'Great Reconstruction' which followed the big 1908 earthquake (9). In Portugal: an outstanding example of *arte nova* architecture, *Casa Major Pessoa* (Major Pessoa House) in Aveiro (Figure 3) by Francisco Silva Rocha and Ernesto Korrodi (10) (1907-1909). In Poland: several *Art Nouveau* buildings in the cities of Gliwice and Katowice, Upper Silesia, were investigated (residential buildings in Maja St. (Figure 4), Andrzejka St., Francuska St., Plebiscytowa St., Poczтова St., Sokolska St., Gliwicka St. in Katowice and in Gorzolki St. and Mlynska St. in Gliwice).



4

4. Cement-based façade decorations in a residential building in Maja St. in Katowice, Poland.

The samples withdrawn from the buildings were characterized in terms of composition by powder X-ray diffraction (XRD, Philips Diffractometer PW 1840, 40kV/20mA), carbonate content by Dietrich-Frühling method and thermo-gravimetric analysis (TGA Q50, TA Instruments, nitrogen atmosphere), scanning electron microscopy (SEM, Philips XL20) with energy dispersive X-ray spectroscopy (EDX, EDX 9800 microanalysis). In addition,

final use (possibly influencing the materials choice) and (iii) as the local authorities and/or owners were interested in a sampling and characterization campaign in view of the buildings restoration. The diagnostic survey on further *Art Nouveau* buildings in the selected and in other European countries is presently in progress.



5. a) Precast concrete columns on a weak sandstone base in the Sacro Cuore Church in Bologna, Italy (Edoardo Collamarini, 1912); b) a detail of a column where the external cement-based mortar layer detached and the concrete core can be observed (right).

6. a) Scratched cement-based plaster imitating *sagramatura* in the Girasoli House; b) *sagramatura* finishing in the parish church at Baggiovara, Italy; c) scratched lime-based plaster in the XV cent. Isolani Palace in Bologna, Italy; d) the external brick joints containing potsherd, resembling traditional “*sagramatura*” in the Chalet Restaurant of Giardini Margherita in Bologna.

### 3. DISCUSSION

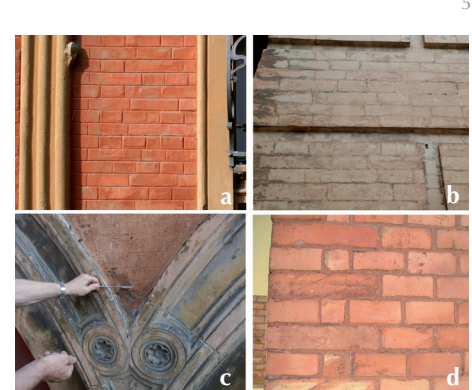
#### 3.1. Materials and technologies

In the investigated case-studies, the *Art Nouveau* movement was interpreted in very different ways in terms of architectural style as well as building materials and technologies. In Italy the ornaments were mainly made of modern materials, i. e. cement-based mortar and concrete (Figure 1-2), purposely designed to resemble natural stone. Cement binder was used to manufacture ‘artificial stones’, which could be reproduced by means of moulds in many exemplars, with great time and money saving. The so obtained agglomerated cement-bound stones could be produced in a large variety of colours and textures, depending on the formulation and manufacturing and laying technology: e. g. the use of coloured aggregates and/or pigments for a final granite effect, the employ of coarse common salt spread on the frameworks to reproduce (after hardening and washing) the travertine surface effect.



However, the series-production of façade decorative elements (columns, ledges, mouldings, flowery style details) was performed with a good dose of craftsmanship. The moulds were often filled in two times, pouring a first layer of fine mortar giving the desired surface effect and then, after a proper compaction and some hardening, filling the internal free space with rough concrete, even reinforced (Figure 5). The external layer usually exhibited fine aggregate (maximum diameter ~0.5 mm) and quite low open porosity (~8-10%), evidencing a careful compaction technology: this was aimed at achieving the desired aesthetic outcome, but also led to a high durability in polluted urban environments. On the contrary, the manufacturing of granite-imitating mortars implied the use of coarser aggregate (maximum diameter up to 4 mm), with a larger final porosity (20-25%).

The moulds technology was very elaborate too, especially when decorations required strong undercut (typically flowers): in such cases, dismantlable moulds or even jelly moulds were used.



was, of course, lime-based. This shows how ancient placing techniques sometimes co-existed with new materials during the *Art Nouveau* age. The link with tradition was also evident in the use of lime-based mortars added with potsherd for the external finishing of the joints among the bricks: while the masonry was built with cement based bedding mortar, the external surface was finished with rose-coloured mortar, again to imitate traditional *sagramatura* (Figure 6d).

As a further example, the *graffito* (scratch-work) technique, likewise taken from a very ancient Italian tradition, was used in some examined buildings to decorate plasters with typically *Art Nouveau* female figures.

Sometimes the mixed use of traditional and new materials reveals a poor knowledge of the latter ones and/or a scarce confidence in them: e. g. in the *Sacro Cuore* church in Bologna a local weak and porous sandstone was used as basis for precast concrete columns.

In the examined Italian buildings the façade decorations were obtained also by means of ceramic tiles or steel elements (especially banisters), but these elements were provided by external artisans or firms belonging to the field of the applied arts and industrial design (such as William Morris “Arts and Crafts” or Italian “*Aemilia Ars*” (13)) and they will be passed over in this paper.

In Portugal the scenario was quite different, as the *Art Nouveau* decorations were mainly realized with traditional materials: hand-carved stone (Figure 3), lime plaster mortars (sometimes reinforced with vegetable fibres, as in the example in Figure 7) and gypsum plaster. Even the ceramic tiles, characterized by typical *Art Nouveau* figures, were manufactured with the ancient technology of *azulejos* (14), simply adapting the decoration motifs to the new fashion. All the loads-bearing structural walls were built mainly with *adobe* bricks, but in some particular locations with fired clay bricks or wood (traditional *tabique*, a wood structural wall coated by thick plaster layers). In fact, as the majority of the constructions of that period in Aveiro region, the main structural system of the *Art Nouveaux* constructions used local building materials and traditional construction techniques, namely *adobe* structural walls and timber systems for floors and roofs. In Aveiro, *adobes* were made as a mixture of a sandy earth and lime (4:1), dried in the sun.

The structure of Casa Major Pessoa was basically defined as described in the following (8): i) *adobe* bearing-load walls (perpendicular to the façades); ii) heavy limestone blocks in the façade, laboriously hand-carved, supported in some particular points by slender stone columns (Figure 3); iii) timber trusses in the roof; iv) timber beams in the floor, bearing directly on the *adobe* walls.

The lime-based plasters were characterised by large thickness (up to about 5 cm) and high porosity (ascribed also to the low binder content, about 15 wt%), both of them probably to give the wall good thermo-acoustic performances (especially in the slim *tabique* walls).

Steel was used for stairs/window rails and for gates, according to the current *arte nova* taste. In Poland the façade decorations were made mainly of cement-based mortars/concrete (Figure 4), while natural stone was only occasionally used, essentially for statues embellishing the external walls. The mortar/concrete decorations were mostly manufactured and cured outside the building site (by small in-series productions) and simply placed during the construction, but in some cases cast-in-place ornamental particulars were detected too.

The cement-based decorations were inserted either in plastered façades or in unplastered brick walls, usually trying to achieve a colour and/or texture contrast between the decorations and the background (Figure 4). The decorations were often colour-painted, hence their purpose was not a simple imitation of stone, as frequently detected in Italy.

Decorative ceramic tiles were used especially for interiors, while steel was used also for façades, especially in rails, but less than in Portugal.



7. Thick lime-based plaster with vegetable fibres in the interior of Casa Major Pessoa in Aveiro.

The differences that were detected above among the examined *Art Nouveau* buildings in terms of materials and technologies seem ascribable to different factors, as highlighted in the following sections.

### 3.1.1. The materials and workmanship availability factor

The local availability of building materials was a basic factor: buying materials from afar was possible, but it led to problems with the local workmanship, not confident about such materials. This was particularly remarkable in a period when the role of workmanship was still very important, as shown above.

In particular, the presence of cement manufacturing plants near the building site strongly influenced the materials selection. In Italy the cement industry was already well developed in early XX cent.: the overall cement production reached 1,380,000 tons/year in 1913 (15) (in Europe 20,000,000 tons in the same year (16)) and the cement manufacturing plants were about 70 in 1916 (17), which explain the wide use of cement in façade decorations during the *Art Nouveau* period.

In Poland the former cement plant (the "Grodziec" plant, near B dzin) was built in 1857 just in the Silesia region, where the investigated *Art Nouveau* buildings are located: in 1913 the total production of cement in Poland was quite high, near 665,000 tons/year, and the quoted plant had a great relevance (18), surely influencing the introduction of cement as a major building material in the Silesia area.

In Portugal, on the contrary, the cement production in 1913 was only 3,600 tons and, when Casa Major Pessoa was built, the main cement plant was in Alhandra, quite far from Aveiro (about 200 km) (19). The mean compressive strength of adobe samples collected at Casa Major Pessoa was 600 kPa (8). This value is within the current strength limits of the adobe traditionally used in the region at that period (22).

The aspects discussed above may be the reasons why natural stone continued to be used in the *Art Nouveau* period.

### 3.1.2. The economic factor

The economic factor is obviously linked to the former one, i. e. to the local availability of building materials, but also to the construction time and, hence, costs. In fact the diffusion of cement-based façade decorations (mainly manufactured in-series) allowed to strongly reduce the construction time and offered to the new urban middle-class the access to fashionable mono-familiar housing at a reasonable price, as detected in many of the investigated buildings in Italy and Poland. Entire new quarters, the so called "garden cities" (as in Bologna), were built in that age following such model.

### 3.1.3. The social factor

Far from being a simple matter of money, the materials selection was done also on the basis of the social position of the commissioner of the building. Traditional materials such as natural stone were considered more suitable for noble, upper-class or clerical commissioners, who wanted to show the *firmitas* (firmness) of their social position or religious message (e. g. Casa Major Pessoa and Sacro Cuore church). Yet, new materials were used for broad-minded, pragmatic commissioners, such as the new urban middle-class, who wasn't biased against new materials, provided that they imply a money saving.

## 4. CONCLUSIONS

During the *Art Nouveau* age, the passage from traditional to innovative building materials was shown to give rise to very interesting and distinctive technological solutions not only in terms of structural materials (4-5) but also of decorative materials, which are thus fully *worth* of preservation. In particular, materials and technologies exhibited local peculiarities, depending on local factors, such as the industry development, the technological know-how and specific cultural implications too, as, to tell the truth, in ancient architecture, where the architectural *vision* was not separated by the *nature* of materials.

Hence, any restoration work on *Art Nouveau* decorations, even though recent, should be consistent with the original materials and technologies and re-propose solutions similar and thus compatible with the original ones (as it's currently done for ancient architecture (20-21)), which requires preliminary diagnostic investigations on materials, the sole ones that can properly address the restoration works. This is compulsory not only to preserve the true *image* of *Art Nouveau* architecture, but also to safeguard an important cultural and technological legacy.

## ACKNOWLEDGEMENTS

Thanks to prof. Elzbieta Niezabitowska (Silesian University of Technology, Gliwice, Poland) for contribution.



## BIBLIOGRAPHY

- (1) Hitchcock, H.-R.: *L'architettura dell'ottocento e del novecento*. Einaudi, Torino, 1989.
- (2) Benevolo, L.: *Storia dell'architettura moderna*. Laterza, Bari, 2002.
- (3) Tafuri, M.; Dal Co, P.: *Architettura contemporanea*. Electa, Milano, 1976.
- (4) Giedion, S.: *Spazio, tempo ed architettura*. Hoepli, Milano, 1965.
- (5) Frampton, K.: *Storia dell'architettura moderna*. Zanichelli, Bologna, 1986.
- (6) Sandrolini, F.; Franzoni, E.; Cuppini, G.; Caggiati, L.: "Materials decay and environmental attack in the Pio Palace at Carpi: a holistic approach for historical architectural surfaces". *Build Environ*, vol. 42 (2007), pp. 1966-1974.
- (7) Sandrolini, F.; Franzoni, E.: "Recovery of Art Nouveau European architecture: materials, technologies, degradation and conservation strategies". In: *Proc. Int. Conference "Heritage protection: construction aspects"*, J. Radic et al. Eds, Dubrovnik, Croatia, 14-17th Oct. 2006, pp. 379-384.
- (8) Dell'Acqua, A. C.; Franzoni, E.; Sandrolini, F.; Varum, H.: "Materials and Techniques of Art Nouveau Architecture in Italy and Portugal: a First Insight for a European Route to Consistent Restoration". *Restoration of Buildings and Monuments*, vol. 15 (2009), pp. 129-144.
- (9) Sandrolini, F.; Franzoni, E.; Manzi, S.: "I materiali e le tecniche all'epoca della 'Grande Ricostruzione'. Diagnostica e tecnologie per la qualità edilizia ed il restauro degli apparati decorativi urbani in rapporto all'Europa". In: *28 dicembre 1908 - La Grande Ricostruzione dopo il terremoto del 1908 nell'area dello Stretto*, S. Valtieri Ed.; CLEAR-Dat Donat Dicat srl Editore, Roma, 2008, pp. 1099-1107.
- (10) M. Sarabando Dias.: *O mistério da Casa Major Pessoa*. Câmara Municipal de Aveiro, Aveiro, 2006.
- (11) Marinelli, L.; Scarpellini, P.: "La sagramatura. Una tradizionale tecnica di finitura delle cortine laterizie bolognesi". In: *Scienza e Beni Culturali. Le superfici dell'architettura: il cotto. Caratterizzazione e trattamenti. Atti del Convegno di Studi Bressanone 30/6-3/7/1992*, Libreria Progetto Editore, Padova (1992), pp. 37-47.
- (12) Marci Vitruvii Pollionis: *De Architectura libri decem, cum Commentariis Danielis Barbaris Venetiis*. Apud F. Franciscum Senense & Ioan. Crugher Germanum (liber II, caput V: 56-60) (1565).
- (13) I. Cremona.: *Il tempo dell'art nouveau: modern style, sezession, jugendstil, arts and crafts, floreal, liberty*. Allemandi, Torino, 1984.
- (14) Veiga de Oliveira, E.; Galhano, F.: *Portugal de Porto. Arquitectura tradicional portuguesa*. Publicaçõe Dom Quixote, Lisboa, 2003.
- (15) Comune di Casale Moferrato (ed.): *Brevi cenni storico-statistici sui mezzi per costruire e sull'industria della calce e del cemento in Italia, con particolare riguardo alla produzione del Casalese*. Tip. Di Miglietta & C.; Milano, 1937.
- (16) Tafunell, X.: "On the Origins of ISI: The Latin American Cement Industry, 1900-30". *J Lat Amer Stud*, vol. 39 (2007), pp. 299-328.
- (17) De-Mattei, V.: "I cementi italiani. Sviluppo-produzione-esportazione". *Atti della Società degli Ingegneri e degli Architetti in Torino*, vol. 4 (1916), pp. 96-106.
- (18) Warsaw Institute for Fuels and Renewable Energy, Workshop Alternative Fuels & Alternative Raw Materials in the Cement Industry - Findings and Results, December 13<sup>th</sup> 2007, Athens, Greece.
- (19) Ferreira Rodrigues, M.; Amado Mendes, J.: *História da indústria portuguesa, da Idade Média aos nossos dias*, Publicações Europa-América, Lisboa, 1999.
- (20) Brandi, C.: *Teoria del restauro*, Edizioni di Storia e Letteratura, Roma, 1963.
- (21) Feilden, B. M.: *Conservation of historic buildings*, Butterworths, London, 1982.

\* \* \*