The *Trompe* of the INCIS Building by Saverio Dioguardi, Mediterranean Architect of the XX Century

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MODERN MEDITERRANEAN STYLE

This paper focuses on digital modelling as applied to a case study of the INCIS building (State Employees Building) in Cognetti Street, Bari, Italy, built in 1923 by Saverio Dioguardi. The building is an example of an architectural culture that remains relatively unknown and which evolved during the so-called Modernist Movement in Mediterranean cultural history. Between the two world wars, during the 1930s, a group of architects historically considered as “minor”, but currently being re-evaluated, made a stylistic decision based on precise architectural principles. Foremost among these was coherence, the close link between the adherence to structure-distribution-clarity and that of consistency between elements grouped together. Rather than follow the figurative avant-garde, which leaned toward an architectural style exaggerated by individualism, they chose to conduct their research anonymously in the traditional way of building, yet still bearing in mind a transition to modern styles. The resulting architecture is characterised by the use of massive, opaque natural materials used in carrying construction systems, but updated with the use of new materials such as reinforced concrete and iron. The move towards modern construction systems as set out by the Modern Movement (precise and independent load bearing structures, floors and light infill) was in this phase more theoretical then practical. Frames were in reinforced concrete with stone masonry infill, which from a static point of view ensured a stiffening function. The ensuing relationship between masonry and reinforced concrete frame had extremely valuable results both from formal and technical point of view, as can be seen in the works of Ridolfi, Libera, Vaccaro, Di Fausto, Del Debbio, Limongelli, Di Segni and Saverio Dioguardi.

SAVERIO DIOGUARDI AND MODERN ARCHITECTURE

Saverio Dioguardi (1888-1961) was born near Bari, studied and trained in Rome, Milan and above all Paris. He finally returned to work in Bari, where, using the family construction business, he became the key figure in building modern Bari. **(figs. 1 and 2)** The architectural work of Dioguardi was concentrated in the first 30 years of the century, in an urban culture which paid particular attention to the *representativeness* of the edifice as reflecting an emerging social class, the bourgeoisie. The growth of the Murattiano District (the city centre as a nineteenth century chessboard, the idea of Gioacchino Murat), and the replacement of early-nineteenth century buildings with more modern buildings led to significant architectural production on the part of local architects and civil engineers.

The local culture was still linked to the nineteenth century image of buildings with an extensive use of floral and anthropomorphic ornamental decoration. However, Dioguardi's architecture saw a rise in quality from the very first projects of the 1920s, showing a vital re-elaboration of established architectural styles of the nineteenth century and generally displaying monumental and urban characteristics. Dioguardi's monumentality did not necessarily require the use of decoration, as was often the case in Bari architecture; his first projects as a young man also saw the use of decoration, but with a more critical eye, giving greater emphasis to eclectic sentiment and neo-liberty influences. The idea of monumentality in his later works was expressed through the use of plastic, cornices, wall brackets and bossaged basements, pure materials that projected from the surface of the masonry. In other cases his architecture lacks these plastic elements, but the monumental character remains with the skilful use of pure volume, by adapting the stonework to create chiaroscuro effects and in finding the perfect balance of spaces and built-in areas. These experiments allowed for a study of the complexity of the plastic façade, above all on urban and public buildings, where lower floors of stone reveal a surface that breaks up. Then, through the shadows and overhangs, one can make out the supported floors above. Every element is both construction and decoration. As a result of the successive layers of the façade's floors vertically (the windows are set in the top floor), the building in Piazza Eroi del Mare, built in 1923, is a clear example of a technique in modelling materials that borders on sculpture. The massive bossaged basement is contrasted with a deeply excavated elevation in a way that is almost ethereal.

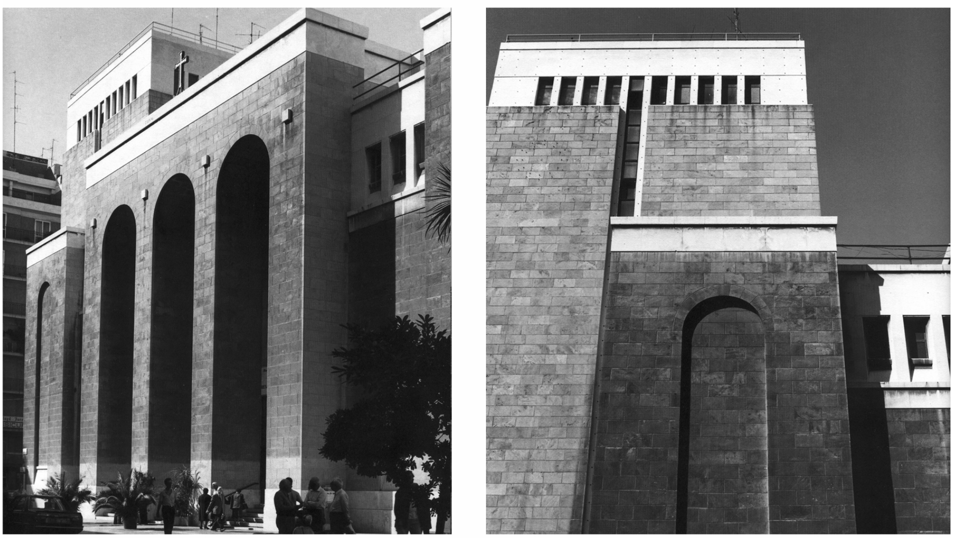

Figure 1. Church of *San Ferdinando* by Saverio Dioguardi, Bari, 1932 (Photo by M. Jodice 1996)

An important aspect of Dioguardi's work is its urban character. His architecture does not hide from the fabric of the city but always seeks, through its expressive characteristics, to become distinctive above all within the rectangular limits of the Murattiano District. The architectural techniques used are extremely effective and define and identify his architectural style. Furthermore, they allowed him to use architectural features that were personal, but also collective: cornices, a rhythmical scanning of the façade's vertical surface, the plasticity of the building and the importance of the height of the base. In particular, cornices are used not only to distinguish the building, but also to emphasise the intersection of two streets of equal importance. This can be seen, with all the necessary angular declinations, in his planning of urban buildings. The cornice is sometimes emphasised by the use of a non-religious dome, as can be seen at the offices of the Gazzetta del Mezzogiorno newspaper, or by a spatial intersection of volumes (closed bases with sharp corners and elevations with extremely rounded corners). Another example is the use of a cornice as a suspended element over a *trompe* as is the case in Cognetti Street. Dioguardi was an architect who aimed to give back vitality to traditional construction in stone during the first era of modern architecture. The INCIS building forms part of a series of buildings that represent a monumental style of planning and construction, as perceived by Dioguardi. The characteristics which typify Dioguardi's monumental architecture are all present in the INCIS building and as such it becomes an appropriate reference point. **(fig. 3)**

Figure 2. *Circolo Canottieri*, Bari, 1933 and *Comando IV ZAT* by S. Dioguardi, Bari 1932 (Photo by M. Jodice 1996)

THE INCIS BUILDING IN COGNETTI STREET, BARI

An initial contrast with the chessboard layout of the nineteenth century city is evident in the building's rapport with the street. The objective to overcome the obstacle of the limits of the Murattiano block was realised not by the construction of two identical buildings on two adjacent blocks, but by the construction of a double building which incorporated the street separating the blocks, shrewdly covering it with an iron or glass gallery - an idea that had been experimented with in that period in important cities such as Naples or Milan. The grandiose building project presented by Dioguardi was very much in line with the mentality of the local ruling class, who in that period considered urban expansion in terms of a master plan. The area around the INCIS building is a case in point, land reclaimed from the sea where the city's most symbolic buildings were concentrated (the Bank of Italy, the Petruzzelli Theatre, The Kursaal Theatre and cinema), and where Bari's architectural rapport with the sea is probably most successful. The rectangular layout of the Murattiano District converges with the sea at a slant, creating a system of triangular gardens and squares. The plans for the building that was actually constructed limited the project to only one of the original two constructions and the gallery was abandoned, mainly for economic reasons **(fig. 4)**.

Figure 3. The *INCIS building*, Bari, 1923

The single building has two rectangular internal courtyards that lead up to the staircase **(fig. 5)**. The INCIS building is strongly characterised by its angular entrances, features that have a determining influence not only formally but most notably on the internal layout. This unusual use of corners was deemed necessary as a sign of recognition and to set the building apart from the uniform styles of the Murattiano District **(fig. 6)**. Indeed, the same criteria were also adopted in the newly expanding areas that were constructed in the first decades of the twentieth century. Of particular interest are those examples (including the INCIS building) in which, as well as performing its formal function, the corner was hollowed out to create the entrance, in strict contrast to traditional forms which recommend a "full" corner for static and structural reasons. The hexagonal shape of the entrance hall **(fig. 7)** above all, in its design as the first room of the building, is the result of internal symmetry combined with the decision to adopt an architectural solution in which the entrance is located diagonally. The logic of the symmetry is confirmed by a third space in which the staircase is located. In fact, the view takes in two perfectly symmetrical staircases but only one leads to the upper floors; the other is merely an outline to balance the composition. The edifice was built using heavy masonry construction techniques with frames in reinforced concrete, and has a clear plastic character **(fig. 8)**. The surface of the facade is divided into a series of floors, which use natural sunlight to toy with light and shadows **(fig. 9)**. The different layers stand out in the background, progressively jutting out, framing the windows, the moulds which surround paintings (which could also have been enriched by a pictorial series), the overhang of the balconies, the corbels in concrete stone, the dentils and the different profiles, not only of the frames, but also of the footing ashlars against the joints.

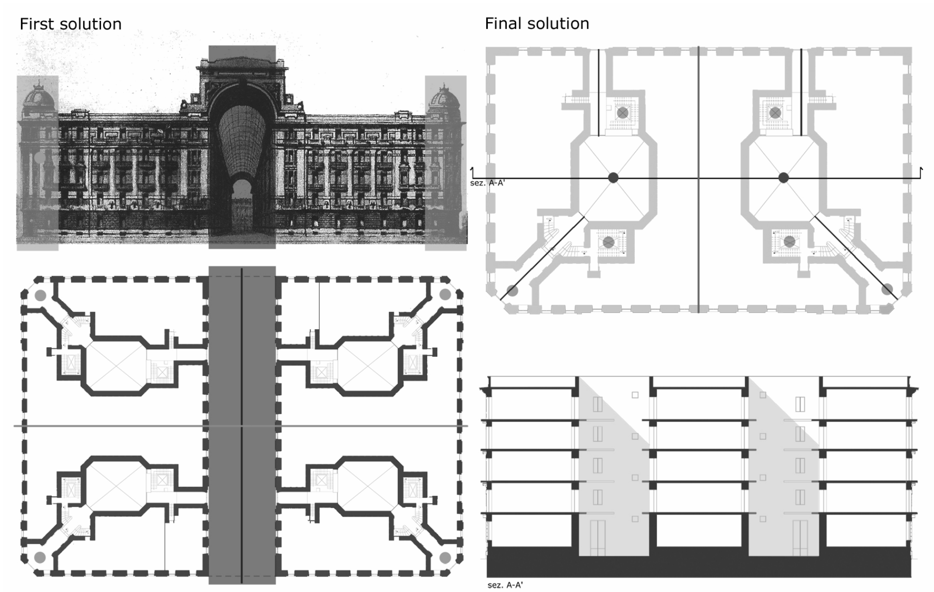

Figure 4. First solution (1922) for the *INCIS building* and the final solution (1923)

THE *TROMPE*.

The presence of a *trompe*, a stereotomic feature of French origins, is unique in Bari **(fig. 10)**. In a constructive sense, such a feature is part of heavy stone brickwork. The *trompe* is a particular type of vault which does not need continuous or punctual support in all the corners, but which when set to correspond with two intersecting walls allows for the support of the rooms above:

> "Toutes fortes de voutes fe peuuent faire en forme de trompe, & toutes fufpendues en l'air, fans auoir fondement par le deffous, finon aux deux coftez qui font l'angle, le tout par vne mefme methode de trait […]" (de l'Orme 1567, book IV, p.89 r)

(All vaults can be built in the form of the trompe, all suspended in the air without the need of support from below apart from the two walls which form the corner, all following a unique method or trait…)

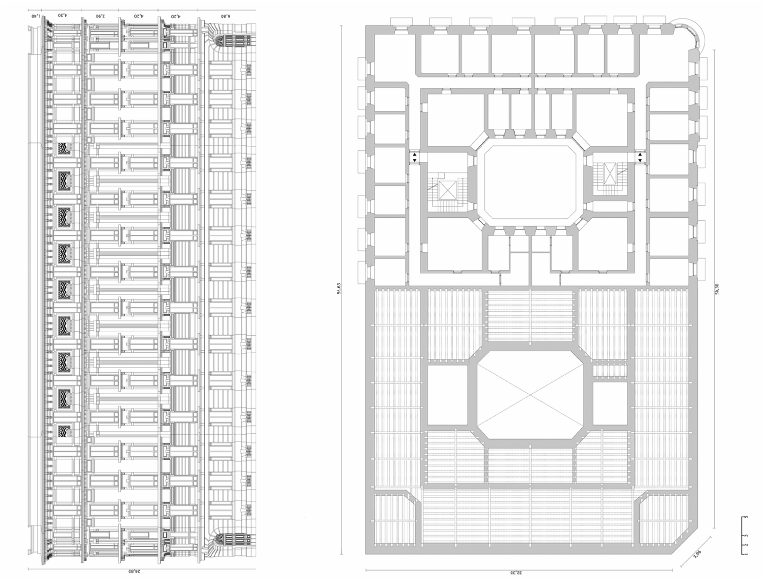

Figure 5. Plan and façade of the *INCIS building*

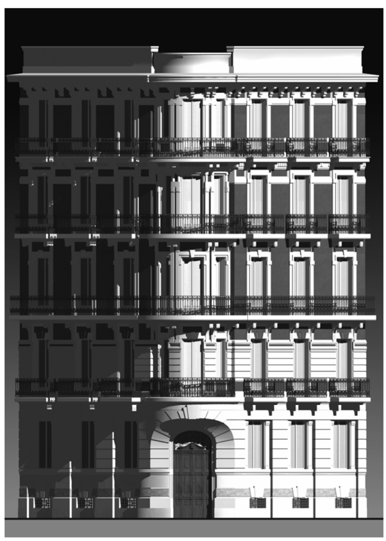

Figure 6. Corner of the *INCIS building*

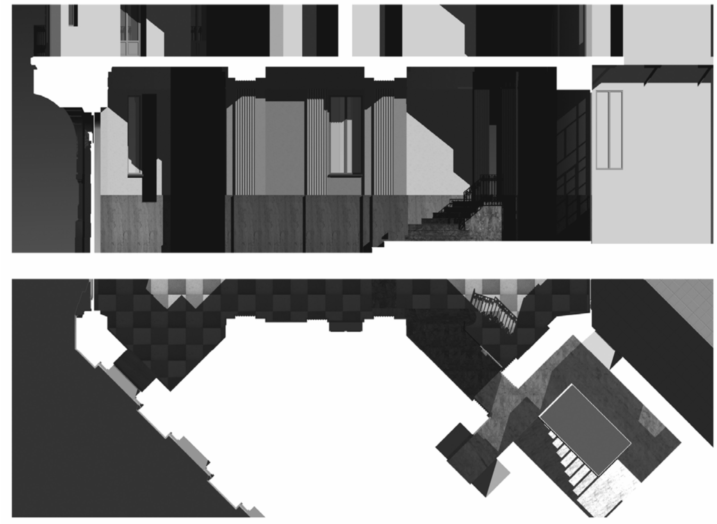

Figure 7. The hexagonal shape of the entrance hall of the *INCIS building*

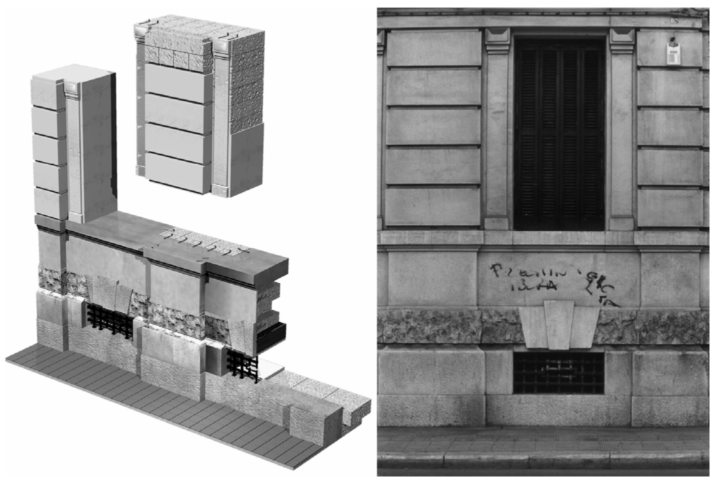

Figure 8. Detail of masonry of the *INCIS building*

There are three parameters in the spatial definition of the trompe **(fig. 11)**, the horizontal lower section (or the plan of the springing walls), the horizontal higher section (or the plan of the supporting structure of the trompe) and the vertical section (or the profile of the intrados of the vault). A feature foreign to traditional local architecture, the trompe makes the INCIS building unique in the city. The apparent geometrical complexity of the intrados surface can, in truth, be calculated by simple operations of addition, subtraction and intersection of solid materials. In situ measurements have shown that the trompe is cylindrical; more precisely, it is based on the intersection of a vertical axis cylinder with a horizontal axis cylinder. A survey was carried out to discover the three parameters of spatial definition and the findings were as follows: the lie of the outside walls (the defining angle is practically straight), the projection of the overhanging semi cylindrical structure with regard to the ground (direct observation revealed that the angle is not obtained geometrically where the two sides of the body of the building meet, but by the lean of the cylinder against the building) and the profile of the intrados (coinciding with the base of the horizontal axis cylinder). Computer assisted restoration showed the absolute precision of the geometry of the vault.

Together with the three-dimensional geometrical model, a study was made on the definition of the stone ashlars and their surrounding surfaces, cataloguing all of the elements that make up the trompe **(fig. 12)**. These differing elements create a strongly organic form where no individual feature could be removed without losing the overall unity. The surface of the intrados was also studied, particularly in considering a potentially formal definition of a formwork where construction is carried out using artificial stone. A solution for the ashlar construction could be found in considering two essential factors: the cost of the work and the final touches using plaster. The solution using plaster would be applicable in cases where the final form (planned respecting stereometric conditions) is in artificial stone, or more precisely concrete and grit moulded in appropriately shaped containers. Following on from this idea, an even more plausible hypothesis could be the application of a single cast of concrete after carrying out about one hundred similarly planned and moulded applications.

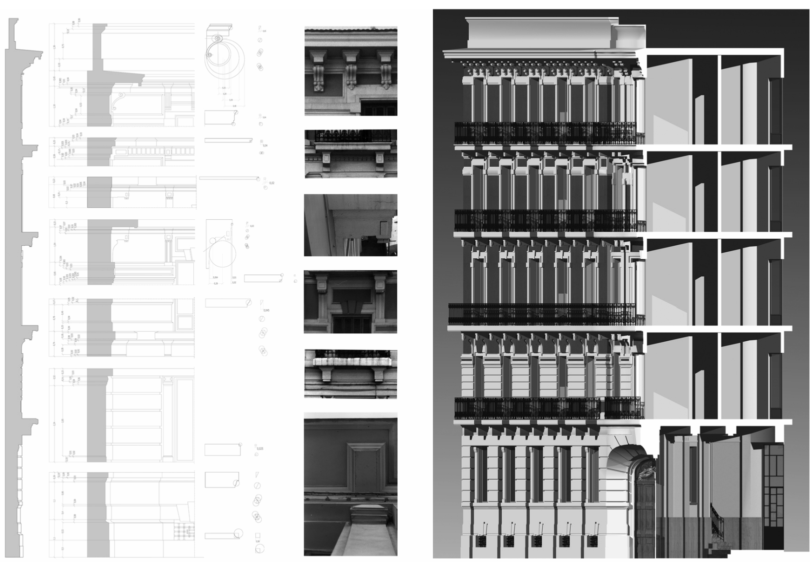

Figure 9. Section and profile of facade of the *INCIS building*

Figure 10. The trompe of the *INCIS building*

The three-dimensional model is also used in intuitive mechanical studies on the static balance of the trompe; in changing the load and therefore the floors of the building above the trompe, the position of the barycentre also changes with respect to the reverse axis, with relative mechanical considerations also to be taken into account. It should be pointed out that a full statics check is extremely complex and in this study will be limited to illustrating the basic and essential criteria necessary to verify the stability in an approximate (even intuitive) way. The mechanical balance of the mass needs to be shown, verifying the position of the centroid (the central point of the resulting load force) with respect to the reverse axis, passing through the springing. In particular, the centroid projection to the ground must fall within the reverse axis. There are a number of possible results in such a check, which depend on the presence of the above parameters, above all in the different load factors which influence how the position of the centroid is determined. Because of this, four different cases have been analysed. First, the equilibrium of the trompe alone was examined; the load of the centroid was found to be out of the reverse axis by 3.2 cm, rendering the structure unstable. Indeed, a characteristic of the trompe is the need to use correctly positioned loads above, which, as well as linking it to the rest of the building, ensure that the structure remains stable.

Following this, the angle structure was analysed, limited to the outside wall and considering the discontinuities. Here the centroid was also out of the reverse axis by a full 27.1 cm. In these circumstances the structure would be highly unstable. If, on the other hand, the same part of the building were considered as a solid entity, the centroid would only be out of the rotation axis by only 0.3 cm. The analysis of the angle area alone tends to exclude the complex links that are found within the building. The phenomenon of construction is so complex that the tendency is to break these links down and simplify them for analytical purposes, ignoring structurally advantageous interacting elements, considering their contribution as an additional safety measure along with stability. In the example under study, therefore, it is useful to evaluate the benefits to the structure brought about by the feature in question and the adjacent bay as well as with the floors. This link between the different parts creates an equal distribution of the forces, which ensures stability. Despite the impossibility of evaluating the anchorage provided by the floors, considering as a whole the angle structure and that of the two spans immediately adjacent to it, it is possible to evaluate the position of the centroid which is located 74.3 cm within the reverse axis. This ensures the mechanical stability of the trompe, a stability which is moreover demonstrated by the building itself.

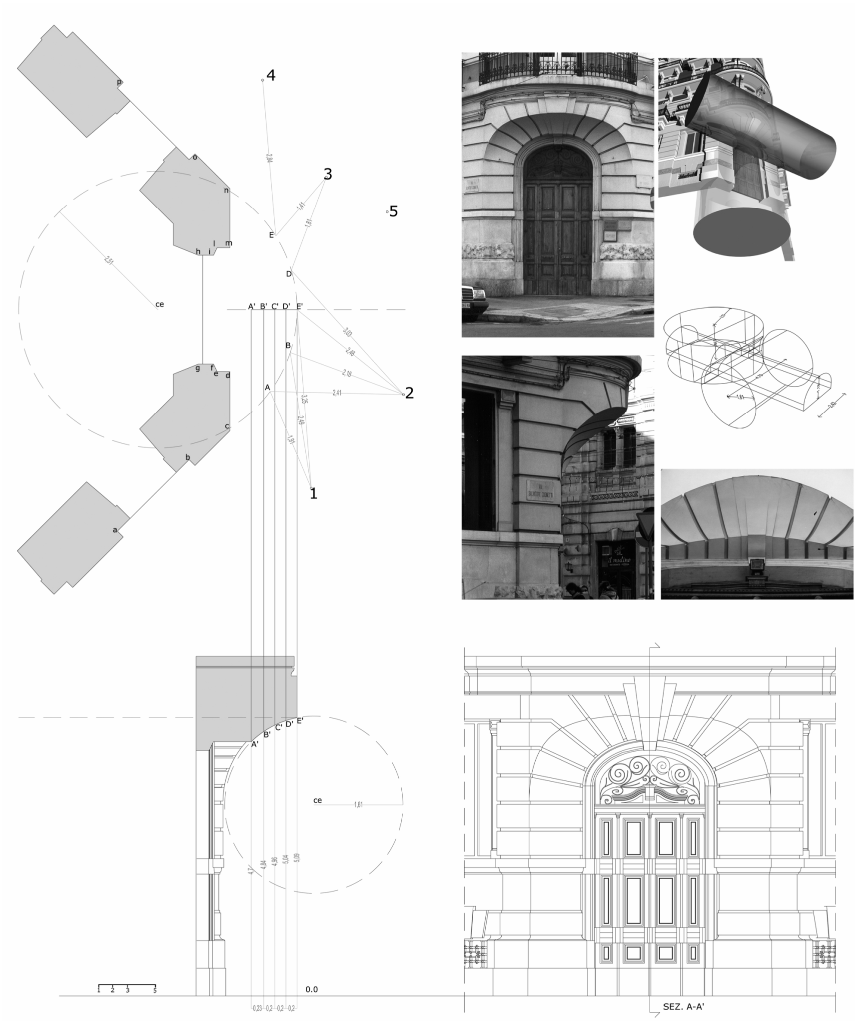

Figure 11. The geometric construction of the *trompe* of the *INCIS building*

PROTOTYPE

The checking phase of the geometrical-constructive model continued with the completion of a scale model using a rapid prototyping machine that confirmed the geometrical accuracy of the three-dimensional model. This, in turn, verified the form of the original construction. The importance of integrated systems, which allow the designer to carry out the work simultaneously, is not only practical; above all it is theoretical. This update of stereotomic study, which originated in and chiefly concerns space, is fundamental in understanding techniques of three-dimensional modelling, that is, where ideas are put into practice through a consistent geometrical model which is transformed into a constructed form. This is a decisive step in the computerization of the working stage, opening up the still relatively unknown world of integrated CAD/CAM systems to allow for the real production of architectural features. The cutting techniques of current CAD/CAM systems can be divided into two categories: techniques for the removal of material with either positive or negative production, using natural and artificial materials respectively, and techniques for adding materials (rapid prototype) with positive or negative production using exclusively artificial materials.

Today architectural design has to reclaim the unity of knowledge. Information technology allows us to shift away from the specialist disciplines that divide and fragment knowledge, thanks to integrated IT systems which permit a simultaneous analysis of geometrical-morphological and static-constructive characteristics. Modern IT modelling helps us to rediscover the unifying act of construction planning, reducing the theory-practice gap between the designer and the builder even to the point of conceptually merging the two roles.

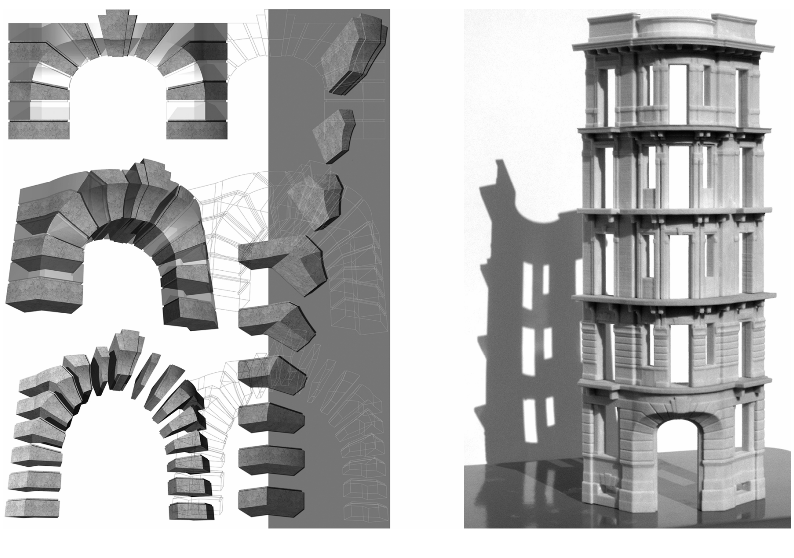

Figure 12. The definition of the stone ashlars and the prototype of the corner of the INCIS building

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