The dome of Saint Yves at La Sapienza in Rome. Digital modeling as method of knowledge

Francesco Borgogni, Michele Calvano, Annika Moscati

Abstract

The work presented here was developed as a major training activity of the Seminar of Urban Survey by the students of the XXVIII and XXIV cycle doctorate in Science and the Representation of Survey. Survey is the main tool to understand an architectural work and the several features that rule its spatial concept. The architectural complex of Saint Yves at La Sapienza, original place where was based the University of Rome, is full of interesting information to be learned. The building was designed by Francesco Borromini and implemented in the second half of XVII Century: its shape is characterized by a strong centralization, which is the result of the plan design. The plan of the building was born from the composition and interaction of different geometrical shapes, like the circle, the triangle and the hexagon. These shapes are all pivoting around a strong center but creating a complex weave of lines and curves around it. Centrality is enhanced by the giant coupled responds forming six huge pillars joined by the projecting cornice, directly leaned on the Corinthian capitals of the aforementioned columns. The last fillet of the cornice highlights in silhouette the strong intention of the designer, expressed by the multi-curved shape at the base of the dome. Finally we reach the sky at the top of the dome, where shapes melt in the light coming out of the big windows: here moldings are the only elements which keep together the big vertical columns rising from the ground and disappearing in the shadow. The base of the dome gets together the complexity of architectural elements below, reducing it, as the eye rises to the top, to the simplicity of the circle at the base of the skylight turret. This spatial concept, which is like inviting to look up to the “starry sky of the dome”, expresses itself also outside the building through the geometrical concept of the skylight turret.

The turret is set up on a circle at the base and rises up following an helicoidal trend, being decorated continuously from the base to the flamed crown at the top. The completion of the turret is represented by a spherical element, probably symbolizing the Globe, suspended above the flames, which are symbolizing the Christian Charity operated by Saint Yves and embodied by the Pope. The entire complex is crowned by the more explicit symbol of the Christian tradition which is placed next to the sky: the Cross. In the architectural complex of Saint Yves, every decoration lives on its own, but its position respect to the whole building enhances its symbolic value, more than the simple decorative one.

The virtual reconstruction, both in a bi-dimensional and tri-dimensional way, of the building of Saint Yves at La Sapienza, has been carried out only through a complex integrated survey methodology, made with long-range 3D laser scanners and high-resolution cameras. After some preliminary elaborations of the data resulting from the survey, like organizing and selecting all the points scanned, it has been possible starting the effective virtual reconstruction. Through the analysis of survey data and the selection of appropriate projection planes, horizontal and vertical sections of the model have been extracted to better understand the geometrical concept. This allowed a critical interpretation of the architectural complex, understanding even the most complex shapes and reducing them to simpler ones.

From a practical point of view, the tri-dimensional reconstruction has been executed through an hybrid process, melting the geometrical precision of NURBS surfaces, concerning the architectural aspects, and the adaptability of polygonal modeling applied to the organic shapes of the decorations. This methodology allowed to deeply understand the articulated geometrical solutions designed by Borromini, representing a base for further analysis and studies on these issues.
The dome of Saint Yves at La Sapienza in Rome.
Hypothesis on Chapel’s morphogenesis*

Sara De Felici, Jessica Romor, Wissam Wahbeh

Abstract

The analysis of geometrical genesis of the plan of The Church of Saint Yves, which is expression of Francesco Borromini's genius, was very hard and so full of contradictions that it's still open to many interpretations. After a detailed collection of several hypothesis, formulated in the last two centuries on this issue and composing a sort of history of Borromini’s project’s interpretations we chose to analyze a specific drawing by Borromini, called Cimeli 77, which is stored at the State Archives of Rome. This drawing describes in the best way the real shape and dimensions of the Church and matches almost completely with the plan obtained by the survey operations, except for few details. First of all, the relation between the single elements and the whole plan has been precisely clarified, such as, for example, the presence of the equilateral triangle, on which sides the apses are build, using a radius measuring 1/6 of the triangle side. After resizing the drawing in roman palms, that’s the unit adopted by the Architect, some dimensions related to the main architectural elements have been identified: starting from the width of the pilaster, that amounts to 5 palms, and using number 3 and 7 as multipliers, many other dimensions related to other remarkable elements are resulting (e.g. the diameter of the apses measures 35 palms, the side of the equilateral triangle measures 105 palms). The placement of the main triangle along the longitudinal axis of the church is still difficult to be defined and certain answers to the several questions concerning the geometrical concept of the Chapel are still lacking. However, as demonstrated by more recent analysis carried out on some Borromini’s drawings of the Church’s project, the answer to this intricate question could be very easy, thinking that it could be mostly due to structural conditions. In fact, we must not forget that Borromini worked in a complex architectural context and faced a series of significant constraints given by pre-existing structures: concerning these, he operated with an attitude of integration and continuity. Therefore, these constraints may have suggested the Architect how to design the new Chapel, following structural and logical criteria. Anyway, as everyone can see looking the inner space’s articulation of the Church, the geometrical concept applied to the complex and articulated plan of the building also characterizes, with a growing emphasis, the entire architectural structure and guides the dome’s space development. Regarding the dome, the point cloud were sliced by series of horizontal sections every 50 cm of height. It was easy to recognize that the section elements were straight lines or arcs of circles. Completing the circles of the arcs was the revelation " with minimum approximation All circles are tangent in one point". The point of tangency for circles of the convex segment is inside the church, consequently, going higher the circles become smaller to cover the church. On the contrary, those of the concave segment, which have the point of tangency outside, becomes bigger, that's why arcs becomes less bend. The concept is that the form of the dome is based on horizontal steps. This is the creation of Borromini to overcome his problems with a simple geometrical solution, which is even simple to apply in the site workshop. In addition, the Geometrical analysis of the internal surfaces shows that for Borromini, angels and mouldings were not only symbols and decoration elements of the dome, whereas a very important element to refine his geometrical solution.

* Dottorato di Ricerca in Scienze della Rappresentazione e del Rilievo, Dipartimento Storia, Disegno e Restauro dell’Architettura – Università Sapienza Roma
The base of the dome gets together the complexity of architectural elements below reducing it, so the eye moves to the top, to the simplicity of the point at the base of the entablature. This special concept, which is like trying to look up to the "many sky of the dome", emerges and also outside the building through the geometrical concept of the slightest correct.

The tower is a circle at the base and turns up following an helicoidal trend, being downward constantly from the base in the flamed crown at the top. The completion of the tower is represented by a spherical element, probably representing the Globe, suspended above the Flames, which are symbolizing the Christ-like Charity supported by Saint Yves and esteemed by the Pope. The entire complex is crowned by the most mystical symbol of the Christian tradition which is placed next to the top: the Cross. In the architectural complex of Saint Yves, every decoration is on its own, but its positive impact in the whole building adorns its symbolic value, more that the simple decoration itself.