Handling mouldings in historic architecture: a matter of geometry, a matter of knowledge?

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1 Introduction

An amateur's observation of a number of historic artefacts would be enough to understand how important mouldings have been in the design of edifices thoughout history. And this observation can be confirmed by writings that would cover several shelves of a library (starting with Vitruvius or Palladio, continuing with Choisy, 1899, Barberot, 1922, Harris, 1977, Ginouvès, 1985, Ching, 1995, Koch, 1996, Rattner, 1998, etc.).
The impact and importance of the notion of moulding has, in the theory of architecture, been clearly assessed: mouldings are described as a tool in the composition of shapes, but also one of the means through which shapes and consequently the artefact itself are given a *meaning*.
Can architects who deal with historic artefacts, and who practice with computer solutions from the engineering world, still handle this notion? Do nurbs and splines fruitfully replace ovolos, ogees, beaks and cavettos, or do they overemphasise geometric features above semantics? Can something be done to integrate the semantics of architecture with the constraints of geometry?
At the end of the day, the issue here is simple: is there more to a moulding than its shape?
The answer is naturally yes, intuitively. But *what* makes the difference?
In this paper we point out possible answers, by cross-examining two experiences that widely differ from one another in terms of corpus and of objectives. Through both these experiences we implemented and evaluated a thorough analysis-modelling-implementation-exploitation process. The contribution underlines the benefits of implementing a robust theoretical model of mouldings in the analysis of historic artefacts, notably in order to facilitate comparative dating, survey operations, typology analysis. Shortly said, our position is that mouldings *become* a matter of geometry *once they have been understood* as a matter of knowledge.

The abstract starts with a short introduction to the vocabulary of mouldings that we will use, and a definition of the research issue, before very briefly presenting the two above mentioned experiences and finally concluding on convergence and outcomes.

2 A vocabulary of mouldings

Literature shows that the word moulding has a rather consensual definition, more or less in accordance with this of (Ching, 1995) : « *Any of various long, narrow, ornamental surfaces with uniform cross sections and a profile shaped to produce modulations of light, shade and shadow* ». Basing complementarily on 2D and 3D aspects underlined by the above-mentioned definition we, in this paper, will introduce four different notions. It appears

necessary in order to facilitate the reading of this contribution to define these notions though an adequate vocabulary:

- Primary curves (curves using only one set of parameters)
- Canonical curves – i.e *a* moulding (composed of one or several 2D primary curves, and corresponding to a canonical, meaningful architectural figure like cymas or reedings).
- Profiles (outline of a 2D arrangement of canonical curves, that can be extruded or rotated to produce volumes, such as an architrave).
- Groups of mouldings (3D arrangements of volumes that can combine rotated and extruded profiles).

3 The issue

If we are to understand and explain where and how geometry intervened in the making of mouldings in historic architecture, we need to understand and represent the way they mouldings were thought, designed. Observing by the sole means of geometry a group of mouldings – *i.e.* the result- is not enough. We need understand the elements a group of mouldings is made of - *i.e.* the means. And these means intersect the language of geometry and the language of architecture. In other words, if we are to understand the artefact's ornament, we need to define shapes that can be *described* by geometric features (profiles, extrusion vector, etc.) but that are *designed* as answers to architectural constraints (light, shadow, but also symmetry, material, culture, etc.). This ambiguity calls for an investigation aimed at better defining relations between an architectural object, and its geometrical definition. A number of issues are raised:

- What is the role of geometry in the differentiation of architectural concepts?
- How are geometric features represented by architects?
- How can geometric / architectural features of objects (here profiles, canonical curves, groups of mouldings) be best compared?

As will be seen, the notion of moulding questions in an accurate and exemplary manner the relations of an artefact's geometrical features to its architectural features, and we expect the two experiments introduced hereafter to provide at useful hints about these relations.

4 A first analysis grid : the wooden ceilings case

In this first part, we detail the experiment we conducted about the wooden ceiling corpus as analysed by J.Tajchman (Tajchman, 1989). The corpus is described by several classifications :

- A classification of canonical objects (beams, joists, decking, etc.).
- A classification of how objects are assembled modes (one to another, or with walls).
- A classification of profiles.
- A classification of endings of groups of mouldings.
- A classification of arrangements of ceilings.

Each classification corresponds to a given point of view on the components of a wooden ceiling. We developed, and introduce, a theoretical model that reinterprets his classification effort, with a particular focus put on the generic description of mouldings of beams. This generic mechanism can be exploited in a traditional architectural representation perspective, but as will be shown can also be exploited in an information visualisation perspective more suitable to comparisons and cross-examination of clues.

5 The second experiment : classical architecture

In this second part we focus on the elements of mouldings of the classical period. Basing on historical sources and on direct observation, (Rattner, 1998) has proposed a classification of mouldings and shown in a systematic manner the role they play in the composition of edifices. He identifies mouldings as the smallest physical units – atoms- of classical architectural (14 types identified), and investigates the way they are combined. He thereby provides a consistent theoretical background that we exploit in order to propose a generic formalism dedicated to the representation and the handling of mouldings in the context of a 3D modelling effort. The formalism proposed bases on a comparative analysis of mouldings of the classical period that allows us to provide a number of statements:

- A moulding results from the combination of linear or curvilinear segments.
- A geometric transition within a profile (or inside a moulding) is based on the perpendicularity of two constructive planes
- Complex curves within a moulding (convex or concave) result from the deformation of its envelope or of a polycentric construction of tangent arcs.
- A surface results from a generating profile and of a path.
- Profiles and paths are orthogonal (even when the latter is a curve)
- A path results from the combination of the same geometric entities as the mouldings themselves, but at a different scale.

The formalism presented identifies several description levels, with a semantic level acting as an integrator of nested geometric levels.

6 Conclusions

Although the two experiments we conducted clearly differ in a number of (corpus, documentary sources, historical periods covered, and implementation) they both underline the necessity to work out a methodological framework aimed at clarifying the relations of an architectural concept to its geometrical features.

Beyond the actual developments achieved, outcomes should really be read as methodological. Let us summarise some of them:

- Handling mouldings using a generic theoretical model of its components allows a better reusability and favours the cross-examination of cases.
- Handling mouldings using a generic theoretical model of its components helps underlining the differences between a moulding's « semantic content » and its « geometric container ».
- Accordingly, the semantic content can be exploited in an information and knowledge visualisation perspective, may the geometric container be fully defined or not (a priority when dealing with historic artefacts, often damaged or incomplete)
- It appears possible to subdue the geometric level of a moulding's description to its semantic level.

Results show that developing *scientific visualisation* practices (in the sense of Spence, 2001), on the corpus of mouldings, appears within reach (for instance in order to allow stylistic / morphological / chronological comparison of cases) provided an appropriate knowledge modelling effort is carried out prior to the handling of geometrical features (and autonomously from it).