The Dancing Curve

An Emerging Paradigm in Cross-stylistic Discourse

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In his work ‘Cybernetics’, mathematician Norbert Wiener (1941) pointed to the interdisciplinary areas between the sciences as a promising field for research; embracing this notion of ‘synthesis’ fifty years later, the research discussed here uses the cornice, a typical element of Classical Architecture as the role-model for a series of experiments with light and shadow in nurbs software. This process encourages the development of digital design methodologies that go beyond current stylistic boundaries and hopes to set a possible threshold towards future design-based exploration.

Keywords: Style; classical; organic; synthetic; assembly; curve; shadow; methodology.

Introduction

The development of architectural aesthetics over time has sustained diverse influences, among which Geometry has consistently partaken in the process of architectural morphogenesis. During the last ten years however, recent software is promoting new models of architectural thought. Buildings are now frequently designed hand in hand with their structural and performative attributes in mind, encouraging a ‘process driven architecture’. Performance is emerging as an important factor in form generation.

Taking into account a building’s performance has generally led architects along a path which seems somewhat a-stylistic, often producing interesting outcomes, as will be discussed later on.

The following experiments formulate a proposal for merging organicist design tendencies with more traditional languages like Classicism, through a controlled transformation of a Classical Cornice using Rhino software.

The choice of Classicism over other sources lies on an existing misconception of Classical language and recent abandonment of its study.

The epistemological revolution of the 17th century and the Enlightenment started what Alberto Pérez-Gómez (1983) calls the ‘functionalization of architectural theory,’ a process that reversed what Vitruvius had accomplished a long time ago through the skilful use of rhetoric: to elevate architecture from a mechanical craft to an ‘ars liberalis’. As a result, architecture has since been largely viewed as a technical entity again, and the architect, once considered a ‘magus’ (< μαγος =‘sorcerer’in Greek), no more than a craftsman. In addition, the ancient rhetoric of Classical ornament that referred to sacrificial ritual (Hersey 1988) has been forgotten and Classicism’s inherently religious connotations have been dispersed.

This paper is a partial attempt to re-consider Classicism within our own temporal framework in relation to current available technologies and methods.
1. Research methods

Classical moldings like an Ionic entablature are re-examined by looking at the potential performative qualities curves acquire when translated into NURBS language, instead of being conventionally represented as segments of conical sections. The ‘parametric’ nature of these curves enables simple experiments about shadow and light in order to explore the nature of moldings, various ways they can perform and some frameworks born out of new technologies, within which they can be perceived.

In ‘The Theory of Mouldings’, one of the few available writings on this subject, Charles Walker (1926) demonstrates the possibility for two different moldings to have a very similar shadow effect (figure 1). Based on this assumption, some tests were designed.

1.1 Process of molding generation

The Classical temples of Greece were designed to respond to particular contextual factors like natural lighting, so a change of latitude would distort their visual effect. I have tried to explore whether a particular building in Athens can maintain the same visual appearance in another city (i.e. Syracuse, NY), by shaping itself to adjust shadow and light accordingly. The possible value of this lies in being able to achieve the originally intended effect of a certain building in multiple locations. By shaping the moldings, the building in Syracuse will in fact be different but cast the same shadows as if it were in Athens.

An Ionic cornice from a temple in Classical Athens (measured in the 18h c. by Stewart and Revett) was used as a testing model.

The morphing process is a form of manual animation. It relies not in the representational but more so in the generative value of digital animation. The experiments essentially involve the repositioning of certain static elements. These transformations are done manually, by selectively moving the control points on the computer-drawn profile sections of a classical cornice (figure 2), but may also be computationally executed with the use of some appropriate algorithms.

1.2 Design techniques for digital fabrication

The original cornice will be referred to as ‘profile a’, any digital profiles as ‘DM’ and laser-cut models of these profiles as ‘LM’. The first models LM.a, LM.b, and LM.c, were a set of extruded profiles, namely, profiles a, b and c, whose purpose was the shadow observation on the new modeled surfaces. The next model, LM.ade, moved on to something more complex, that is, the fabrication of a composite molding, lofted out of three profiles: a, d and e (figure 2).

The digital model LM.ade is sliced in layers parallel to the profile (axis x) and each layer is laser-cut and re-assembled (figure 3). Due to the fragmentation involved, such a procedure can merely approximate perfect curvature. Taking the sections at smaller intervals will naturally produce a smoother surface, but also increase the number of sections, requiring more material and reducing production speed.

The molding ‘ade’ was sliced in 98 layers before fabrication; this meant that a molding 6 inches long, required sections initially taken at 1/16” (equal to the thickness of the museum board that was used in the laser-cutter). Even though we initially used the laser cutter to physically model the

Figure 1
Sketch showing different profiles that produce very similar or even same shadows; this is achieved by maintaining the height where the shadow begins and ends on the molding surface (Walker 1926).
complex double curvatures of the moldings (figure 4), its operational logic can start a new series of experiments that formally determine ‘shape’ through the use of ‘tools’. Depending on the thickness of material used for instance, the same digital model can produce different lengths of physical output: from the DM.ade we modeled the LM.ade, shown in figure 4. This model used the same number of layers (98) with 3-ply chipboard –a material three times thicker than museum board- and the size of the model also changed. Normally, using thicker material would mean that the surface wouldn’t be as smooth, but due to the increase in scale the new model was as smooth as before.

The beauty of the waving line has been discussed in the past by influential artists and scientists in works like ‘The Analysis of Beauty’ (Hogarth 1753) and ‘On Growth and Form’ (D’Arcy Thompson 1917). Here, it can be fully expressed through both the actual form (molding) and the performance of its representation (shadow).

2. Result evaluation

2.1 Hybrid moldings
The transformation of the Classical profiles produced an interesting number of shapes, which in turn were extruded to observe the shadows. All the extrusions are shown below next to each other, starting with the original molding a (figure 5).

One can see that during the later stages of transformation (these being d, e, f, g – profiles i and j had been drawn earlier), the tonal variations become more complex, because the profile curvature changes more frequently. This complexity makes the visual effect more stimulating and therefore is subject to further exploration. An important observation is how the morphed profiles begin to demonstrate differences in tone that would normally be introduced by a change in shadow lines; a ‘shadow line’ is the imaginary horizontal line formed at the intersection of the light beam with the extruded surface and separates the bright from the dark part of the surface (see figure 1). Naturally, these remain fixed for a particular shape in every latitude and their vertical position depends on the angle of the sun.

The shadow lines for the original profile ‘a’ are three, which means there are three parts of the molding in shadow; the rest might seem darker due to the change in tone, but the actual shadow is always determined by the shadow lines. In all the
other extrusions, the parts in shadow seem more than three, which is worth noting, since the shadow lines are exactly the same—the control points were moved so that these would remain unaffected (figure 5).

It became clear that light behaves unexpectedly. The visual effect in practice was not what would be logically anticipated. As a result, the tests may potentially be repeated with new parameters, while also setting up more experiments.

In an attempt to advance this research beyond the original shadow experiments, the morphed profiles have been combined in pairs to achieve variations of repetitive patterns. These arrangements happen in a regular (figure 7) or irregular (figure 8) manner, thus resulting in a less ‘structured’ clustering of elements.

The resulting formations demonstrate a kind of ‘progressive’ randomness, because they directly relate back to a certain logical process which is, however, not immediately traceable.
This type of design brings forward a potential stylistic discourse: the hybrid profiles and the ornamental patterns are unorthodox in terms of their theoretical classification; they originate within the Classical domain but ultimately demonstrate ‘Gothic’, ‘Art Nouveau’ and even Oriental attributes altogether.

The nature of the new molding is interesting because it challenges Walker’s conventional definition of a molding (1926): “The section of the said surface is prolonged uniformly to a considerable extent in one direction”. The molding ‘LM.ade’ does not consist of uniformly prolonged profiles, but is the result from lofting profiles a, d and e. Perhaps this is the point from which the new moldings liberate themselves from strictly classical rules towards a more fluid, Art Nouveau-esque perception.

In addition, and with regard to the three Vitruvian qualities of “commodity, firmness and delight” (utilitas, firmitas, venustas) we should accept that this investigation be dictated by certain rules – i.e. symmetry- as would have been done in Classical times; nevertheless, Vitruvius himself (notwithstanding his rules for proportion and symmetry) was not exceptionally dogmatic and seemed to allow some latitude for the architect to make proportional adjustments where necessary (H. F. Mallgrave 2006). Thus, the divergence from the existing rules, of molding ‘ade’, may not be out of order (symmetry can after all, still be maintained by mirroring the molding ‘ade’ and considering both as a whole module).

3. Stylistic references

3.1 Style development / Otto Wagner

In “Modern Architecture” (1902), Otto Wagner underlined how – according to 19th century public intellectual opinion – an architect should “cultivate a special preference for that stylistic tendency for which he shows an aptitude”. At the same time, he expressed skepticism about this approach, because it might introduce excessive limitations; Wagner observed the fine line that exists between the styles: “Each new style gradually emerged from the earlier one when new methods of construction, new materials, new human tasks and viewpoints demanded a change or reconstitution of existing forms”.

He possibly saw a potential in exploring the transition from one style to another, regarding architecture to be more than a reflection of the ‘Zeitgeist’ -the “flowering of the epoch”, as he calls it. This inquisitive attitude towards design set perhaps the foundations of a more playful language that eventually formulated the principles of Art-Nouveau (figure 10). In this respect, Wagner may have foreseen in cross-disciplinary research what Norbert Wiener did much later, in the 1940s (Wiener 1941 & 1951).

A few years later, another architect – Geoffrey Scot (1914) – embraced Wagner’s views, albeit from a Classical standpoint and not in reference to Wagner’s work. In “The Architecture of Humanism”, Scott blamed the “death of the past” on the “life of the present”, referring to what he saw as a discontinuity in architectural development. He criticized the existence of a style in lieu of a succession of styles: His comment: “…the sequence as a sequence was not studied”, is clearly analogous to Wagner’s preference for working with the transition between stylistic
frameworks over the examination of disparate elements in design.

It is interesting how architecture evolved from neo-classicism to Art-nouveau and onwards to Modernism and so on, because in each ‘style’ one may recognize common factors that merely manifest in different ways. Neo-Classical ornament, for example, like Greek Classical Architecture before, used the egg-and-dart or cyma moldings (figure 11) which demonstrate strong floral references, but so did the Art Nouveau buildings, only in a more literally fluid manner. And modernist architects adopted Classical rules of proportion to achieve a harmony underlying the phenomenal simplicity in their designs (i.e. Louis Kahn).

During the late part of the 20th century this invisible continuity was weakened, or even lost; it may therefore seem appropriate now, to re-negotiate the boundaries of architecture vis-à-vis the technologies available. The introduction within Classicism of a digital dimension and the production of hybrid moldings can somehow expand the evolutionary path of style, encourage design advancement based on scholarship and the charting of a set of rules rather than natural selection.

3.2 Notions of the Synthetic/ Antoni Gaudi
An interesting term introduced by Santiago Pérez in the ACADIA 2005 conference is the ‘Synthetic’; in the discussion, the author makes a distinction between artificial and natural systems by the way their respective ‘assemblages’ are expressed: artificial organizations clearly demonstrate their joining mechanisms in the form of fasteners or connectors. In natural systems, these are replaced by more subtle gradients.

A ‘Synthetic’ system may utilize bio-mimetic principles of organization and assembly (‘…seamless layers or weaves’).

There is clearly a powerful integration between the design, assembly and fabrication within the Laser Moldings that have been discussed earlier, which might qualify these as ‘synthetic’; furthermore, their seamlessness after assembly is frequently found in natural surfaces. The actual joining of the moldings, however requires some sort of fasteners (metal rod and clips to hold the layers tight in place). We may say, in this case, that the assembly needs to be more inherently connected to the laser-cutter logic. It seems that the LMs currently are a kind of hybrid, being fabricated in layers of cardboard.

To satisfy the Vitruvian criteria, and particularly that of ‘firmness’ (or solidity as otherwise described), the models would need to follow a different fabrication technique, like 3d-printing, where a solid artifact is produced, instead of laser-cutting that creates surfaces to be joined. A further option is plaster casting, from which molds can be made and subsequently introduce a variety of materials like concrete or resin.

We can thus, distinguish between the molding displaying ‘firmness’ (3d-print form) or merely creating its impression (laser-cut), depending on the production process. If, nevertheless, the moldings are not laser-cut but seamlessly 3d-printed, they may no longer be viewed as ‘synthetic’ because they do not demonstrate any joints at all.

The whole subject of assembly is also important in relation to the overall placement of moldings within the building system, that is, the realization of a sound tectonic order. Classicism used the Entablature and Capitals to bring forward a tectonic hierarchy. The new laser moldings might therefore deal with the smoother transition/joining between the column and pediment.

During the Renaissance, a building was thought of as an organism, a system where all parts refer to the whole; if this research wishes to adhere to such a rule, the moldings need to relate to the rest of the building. A proportional rule may therefore be defined which dictates the development of the moldings and eventually applies to the overall façade. Only then can the building satisfy the third Vitruvian quality of ‘beauty’, by reaching what Alberti described as ‘concinnitas’, the presence of a style that is ‘skillfully or elegantly put together’.

The issue of natural mimicry and the achievement of a holistic harmony in the assembly of
The work of Gaudi is interesting in respect to its ‘blurred’ classification; the style of his buildings has been debated as both Classical and Gothic. Despite a general perception of Gaudi’s architecture as Gothic – possibly because he was a disciple of Viollet-le-Duc, Joseph Rykwert reveals Gaudi’s self-confessed ‘Classical’ side (Rykwert 1996) that is conspicuously celebrated in the design for Parc Guell (figure 12).

The colonnade in Parc Guell constitutes – according to Rykwert – an explicit reference to Classicism “...not only in detail but also in context and implications of the project”. This is viewed as a personal interpretation of Mediterranean unity, where Gaudi reconfigures aspects of Classicism by improvising – he recombined archaic Greek elements to create the capitals with characteristics from the Hellenistic times for the column shafts. Furthermore, he avoided ‘entasis’ but employed other optical devices with Gothic connotations, like the inwards inclination of outer columns, resembling flying buttresses.

Perhaps Wagner needs to be included in the same group as Gaudi and Sullivan for the sake of comparison. What is more, the ‘Gothic’ style seems more fitting on the ‘Organic’ side of the chart, because both its ornament and vaulted-like structures simulate nature more than their Classical counterparts. The whole system possibly works better as overlapping circles than linear distributions.
There is obviously a blurred line between Gaudi’s influences; he may have been, after all, Gothic in the formal realization of his designs but deeply Classical in his perception of their performance.

The study of the Cornice dealt with in this paper suggests the blending of a Classical point of view with Art-Nouveau, Oriental, digital and contextual references, based on a precedent of similar appropriation by others according to the respective temporal framework (figure 13). In other words, we are only repeating the suggestion of looking at Classicism in a different way, like it has been done before so many times, in both ancient times – the Greeks’ transition from timber to stone temple construction – and modern ones (Perret’s “concrete interpretation of the primitive classical timber archetype” according to Rykwert).

**Conclusion**

In retrospect, the molding experiments not only tackle the issue of ‘Classical element as visual ornament’ (light & shadow, decorative patterns) but also chart the ground for theoretical discourse on emerging methodologies. The introduction of computational techniques in the morphing process and also perhaps during result evaluation and selection of the most successful hybrid may be a way of developing these forms more systematically.

In view of an expertise built in recent years in the field of digital design, one may have to re-evaluate the appropriate subsequent application of this knowledge.

In the recent ‘Non-Standard Praxis’ Conference (MIT 2004), Michael Speaks foresaw within a few years the ‘standardization of non-standard practice’; I can’t help wondering if this will cause the end of ‘digital architecture’. Once an idea has become standard, it is not treated with the same thoroughness and skepticism, but rather accepted as ‘de facto’ and applied to a mass-scale, which may cause its deterioration. An obvious way forward is to develop designs employing the techniques generated by digital tools as fast as possible, to avoid being superseded by new but more naive ‘trends’.

From a theoretical standpoint, this paper suggests another, perhaps equally beneficial possibility that is also complimentary to the first: a re-examination/interpretation of aspects from the architectural legacy we already possess.

Demetri Porphyrios (1991) wrote that “History is not a linear process of progress, nor the sum-total of the spirit of so many different ages”. Continuities in history are often synthesized by elements that every culture decides to appropriate and which may, in fact, have re-appeared in a different manner in the past. We can view history – and in particular the history of style – as a series of partially overlapping, perhaps fragmented circles, continually re-engaging each other.

This work – although somewhat inconclusive – encourages a cross-stylistic dialogue in architecture and tries to re-contextualize not only Classicism, but also the current digital framework of thought. Together, these two working modes may constitute a comprehensive and updated set of knowledge that relies on past theory – including Vitruvian and Renaissance principles – and current research to promote innovative design and determine a new contemporary aesthetic.

Evolution is a dialogue in time. Predicting the future often involves actually shaping it – and this could, in fact require nothing more than using the present to address the past and vice versa.

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References
