Hwang, C-C P (2018)
Evaluating the rationality of Boullée through the chasm between conception and perception using digital modelling as a method of analysis: a case study on the Cenotaph of Turenne.


The Conference Convenors received a total of 44 abstracts. Abstracts underwent a double-blind peer review by two members of the Conference Organising Committee. Authors of accepted abstracts (32) were invited to submit a full paper. All submitted full papers (18) were again double-blind peer reviewed by two reviewers. Papers were matched as closely as possible to referees in a related field and with similar interests to the authors. Sixteen full papers were accepted for presentation at the conference and a further 6 papers were invited to present based on submitted abstracts and work-in-progress. Revised papers underwent a final post-conference review before notification of acceptance for publication in these conference proceedings.

Please note that papers displayed as abstracts only in the proceedings are currently being developed for submission to a digital cultural heritage special edition of an academic journal.
Abstract
Between 1780 and 1797 French architect Etienne-Louis Boullée began projecting a vision of the architectural monuments during his twilight years through the use of ink-wash drawings on hot-pressed straw paper. The visionary projects embrace both formal simplicity and expressivity simultaneously. While simplicity of form was believed to be the key for ease of apprehending the work, expressivity was seen as necessary to convey the meaning of the form itself. This research presents a study of one particular project produced during this period: the Cenotaph of Turenne 1782, by reconstructing and analysing the unbuilt paper architecture through physical and digital modelling. It seeks to provide an alternative frame of reference to the discourse that evaluates the metaphoric or the iconographic aspects of Boullée’s project. The goal of this study is to unfold the stereometric forms and examine the reciprocal relationship between the project’s conceptual intention as conceived by Boullée with the effect of the spaces as perceived by the viewer. The paper proposes to investigate Boullée’s Cenotaph through the chasm between the concept of the work and its representative images, the apparent and the literal solidity of structure, and the idealized form and the perceived form by the viewer. The research is organized in two parts. The first part aim to forensically deconstruct the guiding principles of Boullée’s Cenotaph in order to reveal how the Cenotaph is conceived, while second part enable the reading of how the work is perceived. Although the project is well-publicized in books on Boullée through the five known orthographic drawings, very little has been written about it.

Keywords: Visionary architecture; computational modelling; conception and perception; architectural representation
of its technical concern marked a stark difference to the Vitruvian triad (Venustas, Utilitas and Firmitas). Boullée emphatically announced this position in the first paragraph of the Essai. ‘What is architecture? Shall I join Vitruvius in defining it as the art of building? Vitruvius mistakes effect for the cause’ (Boullée 1976, 83).

Nature as the source
Prior to the 18th century, architectural reference to nature is understood to be ‘an amalgam in which imitation of nature, proportion, beauty and orders were all blended’ (Madrazo 1995, 151). In lieu of such ‘application’, Boullée embraces nature as the source of architecture and order, which is to bring a direct connection between them without mimicking through forms of decoration. Boullée distinguishes himself from Piranesi’s arbitrary and whimsical principles of design. He considers Piranesi’s engravings to be the work of a dreamer composed of disconnected and scattered ideas with no particular order (Boullée 1976, 86).

Form of nature
When articulating how nature would govern architectural principles, Boullée describes the use of symmetry as a means of generating the image of order and rationality that conveys a sense of beauty and perfection. It allows the mind—which seeks understanding—to comprehend its form. The simple, symmetrical, perfect and regular form for Boullée is the best iconographic representation of this understanding. It is clear that Boullée acts upon the hypothesis that there is a rational correlation between simple geometry, nature and the human’s perception (Figure 2). The autonomy of architecture through drawing helped to create a distance and independence from its projected building. In this instance, the conceptual project becomes the totality of the work itself.

Scholarship on Boullée
There are three significant research directions in the literature and scholarship on Boullée:

1) study characterises a strand of research by a group of specialists that focuses on translations and editions such as Helen Rosenau (Rosenau 1953);

2) the historically significant scholarships that attempt to reveal ideas behind his sombre imageries and ‘shadow architecture’ in Emil Kaufmann (Kaufmann 1939);

3) those that deal with his theoretical contributions reflected in Architecture, Essai Sur L’Art (1790) and relate them to a context, for example Antoine Picon has situated the work of Boullée within the sibling discipline of engineering (Picon 1992).

Writings by Boullée and subsequent scholars have addressed his ideas from the metaphoric point of view – by associating Boullée’s use of stereometric forms as a way to represent the concept of regularity that is found in the laws of nature; and from the iconographic point of view – through projecting meaning associated with nature behind Boullée’s painterly architectural images rather than substantiate its claim through evidence-based arguments (Rosenau 1953). These reflections are largely formulated upon an overarching argument that Boullée had dedicated a cenotaph specifically for Newton (Figure 1), thus there must be a rational design methodology connected with his works. While his admiration of Newton and reason might be true, it does not prevent us from forming a hypothesis questioning the rationality and perception of his work.

Boullée’s treatise: Architecture, Essai sur l’art
Despite the limited amount of his writing, Boullée’s Essais undoubtedly influential and is often cited alongside other referenced essays from Vitruvius and Alberti. One important contribution of the Essai is that it advocated his views on the a priori nature of thinking and picturesque representation over materialization. The stance of prioritising the pictorial image ahead of its technical concern marked a stark difference to the Vitruvian triad (Venustas, Utilitas and Firmitas). Boullée emphatically announced this position in the first paragraph of the Essai. ‘What is architecture? Shall I join Vitruvius in defining it as the art of building? Vitruvius mistakes effect for the cause’ (Boullée 1976, 83).
Figure 3. Cenotaph of Turenne Floor plan, HA 57, No.11, ink wash on paper (1782) courtesy of Bibliothèque nationale de France.

Figure 4. Geometric principles of the Cenotaph of Turenne (drawn by the author).

Figure 5. Equilateral pyramidal geometry as established through graphic and mathematical method (drawn by the author).

Assertion on Boullée’s rationality

Boullée’s work has been described by Pier Vittorio Aureli as having dealt with the technical requirements of the building as opposed to mere fantasy that embraces the monumental sublime. In Architecture as a state of exception, Aureli warns of misreading Boullée’s drawings as simply visionary, and calls for a wider acceptance of the view that Boullée has in fact articulated the ‘specific conditions’ of each project through adopting technically inventive and individual approaches to functional, programmatic, and even contextual problems (which) demonstrate a concern for public welfare with its unprecedented provisions for egress in the event of a fire’ (Aureli 2011, 142-143). But exactly how did Boullée accomplish that? In the case of the cenotaph, there is certainly no evidence to support such assertion, where the giant spherical space with a span of 160 meters covering some 80,000 square metres of area offers only one means of egress for the entire monument (Figure 3).

Similarly, in Rosenau’s Boullée’s Treatise on Architecture, she notes that ‘it would be erroneous, to classify Boullée as a Romantic, since his individualism was based on a reasoned appreciation of function, and ruled by the recognition of the laws of nature’ (Rosenau 1953, 12). Rosenau argued that the cypress tree in Boullée’s elevation is a good example for his ‘endeavor to include the effects and the products of nature in his composition’ (Rosenau 1953, 19). Critique and assertion as such addresses the issue of ‘nature’ through oblique remark and selective examples. As my analysis reveals, the tendency to rely upon the drawings to confirm Boullée’s intellectual assertions remains highly problematic.

Tracing the conception of the idealized form

The setting-out of the geometry in 2D section can be read as a composed geometric relationship between the triangle and the circle for extrapolating and synthesising the overall stereometric massing. The diameter (Ø) of the dome is half of the circumference (Circ.) that defines the outer extent of the triangle.

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\tan 60^\circ = \frac{h}{a}
\]

\[
\tan \alpha = \frac{\frac{h^2}{(\tan 60^\circ)^2} + h^2}{\frac{h}{\tan 60^\circ}}
\]

\[
\alpha = 63.43^\circ
\]
and atmosphere, as opposed to serving any literal function.

(re)Forming of an idea
Images in the following section are produced through the method of digital modelling to offer a means to perceive and to compare the five drawings presented to us by Boullée. In addition to offering alternative point of views of the Cenotaph, the images of digital modelling also differentiate themselves from Boullée’s hand drawings by minimizing the sublime dramatization, to offer a neutral depiction of the spaces (Figures 10-13).

What the images reveal refutes the notion of regularity and beauty, since it is perceptually impossible to consume the totality of the space at once. The idea of order resulting from the composition of volumes – which forms a part of Boullée’s argumentation – could not be contained within the human perception like the ‘picture frame’ of a drawing. Therefore, the statement ‘The arrangement should be such that we can absorb at a glance the multiplicity of the separate elements that constitute the whole’, as stated by Boullée can only be understood notionally rather than as something that could be experientially perceived (Boullée 1976, 89).

Perceiving the space
Each image frame is rendered in two focal-length settings: 10mm and 24mm positioned at the eye-level. The first set offers a more inclusive view, the near panoramic vision. However, it presents the target (Cenotaph) in a way that is defying any structural and material logic—a condition contravening basic gravitational laws of nature (Figure 8). In this instance, the literal solidity of structure is disregarded. Incoherence is also evident in the ways the dome is represented. One could read this articulation of the dome as either a section or an oblique elevation, but not simultaneously.
his reader consult his plans in place of all possible explanations, for he is persuaded that what should be required of an artist above all is not that he explain well, but he execute well (Boullée 1976, 90).

Materializing the space

In addition to the images generated digitally, a physical model was constructed through sectioning by layering multiple laser-cut sheets of cards, a process best reflective of the construction logic of the Cenotaph (Figures 14-16). The differentiation between inside and outside is further exacerbated through the use of colour that magnifies the reading of the poche. While the staggered exterior implies a system of unitary construction, the austere, unembellished interior suggests a smooth plaster finish, enhancing the scaleless reading of the surface, and to receive a play of light.

Conclusion

This research project began with the premise to search for an alternative frame of reference for reading and evaluating Boullée’s project by investigating the split between the intellectual motivations for how the work is conceived versus how the work is perceived via the idealized form represented through the drawings. The evidence produced and articulated in the analysis—including the challenge of spanning significant distances by the dome, or painting the interior spherical wall with daylighting as if it is a canvas, or the lack of passage for air within the funerary, or an imprecise reference to the use of perfect geometry for the pyramid, or the many inconsistencies and phenomenological impossibilities that lies within the Cenotaph—all points to the fact that Boullée was more invested in the notion of objective perception of form in drawing rather than its experiential perception in space. In Boullée’s attempt to establish a structured-relationship between the concept of his idealised project with an objective perception by the viewer, he has largely overlooked the influence of the experiential perception (Figure 17) as I have argued for

Figure 9. Daylighting study of the reconstructed cenotaph model, images were created in four seasons from top to bottom: vernal equinox, summer solstice, autumn equinox and winter solstice. Three time frames were rendered for each season, from left to right: 9am, noon, 3pm. (images by the author).

Figure 10. View toward the triumphal arch entry shown in the perceptually natural focal–length of 24mm (above) compared with the expansive and inclusive view of 10mm (right).

Figure 11. Rendition within the cenotaph ambulatory with coffer-ceiling, represented by focal–length of 24mm (above) and the expansive and inclusive view of 10mm (right).

Figure 12. View of the cenotaph ambulatory looking toward the rhythmic and alcove-formed circular corridor as represented by focal–length of 24mm view (above) and the 10mm view (right).
An analysis made possible through the use of digital modelling tools. Since the use of computing software became an integral part in the research of architectural heritage beginning in the late 20th century, there are two ways in which the tools have played a role: First, those whom use the software to study and survey architectural heritage sites. Using the collected data file as a way to archive the relics of the city. On another stream, there are those in the likes of Kent Larson, who calls attention to the use of computer-graphic images through the unbuilt work of Louis Kahn with the aim to ‘create new imagery that communicates Kahn’s unbuilt space as it might have been experienced’ (Larson, 2000). What this investigation revealed is, within the two spectra, there lies a third approach where one sees the realization of the rendered images and the models not as an end to itself, but rather, as an alternative perspective to transgress the unchallenged assertion. By all means, Boullée’s architectural drawings and treatise should never be studied independently; they support and complement each other and the reader would fail to grasp the intended meaning without oscillating back and forth in these two modes of signification and it would be erroneous to draw a definitive conclusion discrediting the rational basis of Boullée. Asserting the disclaimer is not to render this part of the research trivial or peripheral. Rather, it highlights the importance of defining the lens for evaluating his work. Finally, the long-term research motivation is to build up a catalogue of analysis on Boullée’s unbuilt architecture to advance the knowledge of this brilliant 18th century master.

Figure 13. Rendition within the cenotaph of the sunken funerary hall as represented by focal –length of 24mm (above) and the expansive and inclusive view of 10mm (right).

Figure 14. A reconstructed section model exposes the atmospheric effect and daylighting qualities of the cenotaph (Image by the author).

Figure 15. View of the physical model from the sunken funerary ground towards the ambulatories on the left. The enormity of the unornamented surface contrasts distinctively with the textured surfaces of the inner conic geometry on the right (images by the author).

Figure 16. Tracing the geometric origins of the coffer ceiling pattern through parameters established and assisted by Grasshopper (images by the author).
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References
