ABSTRACT

Methods of architectural representation are often considered fixed, scripted and defined. Methods are learned and acquired through the memorization and comprehension of specific rule sets. While these rules and conventions allow for legibility and communication between various sites, participants and drawings, they also have tendency to produce similar results. This paper considers the potential of manufacturing architectural methods through a detailed study of historic modes of representation. It examines the drawings of the Italian architect Guarino Guarini (1624-1683) and demonstrates the means by which he adapted stereotomic methods and Euclidian propositions to respond to specific architectural conditions. It argues that Guarini’s engagement with the details of both method and instrumentality offer potential to the current studies in the development of form finding methodologies. If we are to continue to expand the methodological framework of architectural production through slow and tedious instrumental work, we must apply the same level of analysis to our historical precedents. Doing so will enable a finer grained manipulation of instrumentality through an increased focus not on the manufacturing of form but rather the manufacturing of method. Examples of drawings by the author and of students explain and support the text.
In a recent essay, Mario Carpo describes a relative lack of innovation in contemporary formal discourses. He argues that formal inventions of the last ten years have been “repeating arguments that for the most part are twenty-years-old” (Carpo 2013). The statement seems to indicate that to repeat is by nature to not innovate. However, the last twenty years in architecture have more than proven the value of repetition to innovation. Surfaces and geometric configurations discovered in the 19th century have played out in array of contemporary projects. Nonetheless, this asynchronous pairing has been underplayed. Architectural advances in representation and fabrication are figured as cutting edge and innovative, despite that the geometries being deployed are at times upwards of a hundred years old. This is not to undermine the innovations in novel form that are emerging, but rather to focus on the historical relationship between geometry and architectural method. Geometry is precise, rule based and abstract. Architectural method can be precise, rule based and abstract but it can simultaneously be malleable and adaptive. This is not a flaw, but rather architecture’s distinct advantage. Architectural methods can use old geometries to produce new forms by re-appropriating and adapting their underlying concepts to specific formal and spatial agendas.

Nonetheless, Carpo provides a key insight to the current state of the discipline: the problem lies not in the act of repetition itself but the chronologic proximity of the “original” to the “repeat”. We are not looking outside or beyond the field of the digital innovation developed in the 1990’s. Our descriptive language and its constituent formal counterparts appear to have emerged out of the ether with the adoption of animation and computational software. However, these adoptions and the mathematical models that they include are by no means new. As others have pointed out, what appears to be innovative in architecture may in fact be as much as a century behind the developments in mathematics from which they borrow (Picon 2011). We now have the instruments capable of representing and fabricating forms that originated in the mathematical work of the 19th century. Contemporary work has used technology to adapt these old geometries into novel architectural forms. This has come in the form of an increased disciplinary interest in instrumentality. Paradoxically, this increased interest in the instrumentality of the present has not yielded a parallel study of the instrumentality of the past.

Contemporary discourse on form finding tends to focus on specific methods, including algorithms and fabrication techniques used to generate form. However, when history is referenced, often through connections to the Baroque, Stereotomy, or Descriptive Geometry, little discussion is given to method or instrumentality. Vaulting and Stereotomy are referenced as sources for an array of contemporary projects. These analyses tend to focus on issues of formal organization or the volumetric properties of the material.
Stereotomy is also indexed as a historical moment that ties architecture to fabrication. While these are all important links between a now defunct historical technique and contemporary practice, they rely on tying an object oriented analysis of the past to a methodological analysis of the present. If we are to continue to develop and expand the methodological tool kit of architectural production through slow and tedious instrumental work, we must apply the same level of analysis to our historical precedents. It is no longer adequate to understand the geometry of given historical form through the instrumental logics of the present. We must also develop a means of understanding the specific methodological and instrumental details that allowed the form to emerge at the onset. Doing so will enable a finer grained manipulation of instrumentality through the increased focus not on the manufacturing of form but rather the manufacturing of method.

Method moves beyond instrumentality to define specific relationships between steps in a design process. Methodologically generated work reassembles and reframes existing instruments to its own ends. As instrumentality continues to hold sway over the work of the current generation, we need to look back towards historical instances in which instrumentality was manipulated and reframed through the manufacturing of method.

The discipline of Stereotomy, thought to be developed in France during the latter part of the 15th century, offers a ripe example of an instance where geometric principles are deployed precisely within a loose and adaptive framework. Stereotomy is a drawing practice that enables the precise cutting of solids (stones). It precedes the codification of Descriptive Geometry by Gaspard Monge (1795) by at least two hundred years. Unlike Descriptive Geometry, the practice of Stereotomy does not rely upon an abstract apparatus of imagined planes to understand and represent true (normal) views of an object, but is largely dependent on the redeployment of the geometric principles of Euclid set out in 300 B.C. (Scacchi 2001). In fact, Stereotomy is barely concerned with objects at all. Its primary focus is on the measurement, by any means possible, of the individual lines that direct and generate surfaces. While the objective of this process is to produce form and space from a heavy volumetric material, its instrumental practices depended greatly on the abstract manipulation of lines and the physical manipulation of light paper models (Scolari 2012). The practice of drawing and modeling is often conflated with the process of actually cutting stone, thereby erroneously transmitting the instrumental characteristics of one discipline (stone cutting) to another (drawing). Therefore, the two characteristics lightness and abstraction, allowed the drawing practice a degree of flexibility and experimentation that could not be afforded in the actual material practice of cutting stone. As Stereotomy emerged and progressed through the 15th and 16th centuries, it developed as...
an innovative representational method, dependent on old math (Euclid), with an instrumental framework that was continually adapted to produce new architectural forms (Evans 1995). A clear example of this adaptive redeployment can be found in the work of the Italian architect Guarino Guarini (1624-16883). Posthumously published, *Architettura Civile* (1737), delves into an array of topics: methods for the design of columns, the survey of land, Guarini’s works of architecture and the construction of various two and three-dimensional geometric figures (Meek 1989). Tractate four of the work, “Dell’ Ortographia Gettata” is devoted entirely to the explanation and demonstration of the methods of obtaining the precise drawings of stone cutting templates from an array of three-dimensional surfaces. It is often cited as an instance in which orthographic projection is utilized as a means of generating more complex forms from less. By projecting circles and other geometric figures onto non-planar abstract surfaces, Guarini was able to derive an array of nameless curves. Importantly, by pairing that transformative process with the reversibility of orthographic projection, complex curvature was resolved through the maintenance of a continuous link with its flat and measurable source figure (Hersey 2000). Guarini used orthographic projection to transform recognizable geometries, so that the order and organization of these simple forms could allow the unrecognizable to be measured and built (Gargus 1989).

The intent of Guarini’s project is compelling, but what is most relevant to our contemporary engagement with instrumentality is exactly how he got there. The title of tractate four is “Dell’ Ortographia Gettata”. As the presence of the word “ortographia” suggests, the process depends heavily on the use of parallel and perpendicular lines, but not entirely. In “Observation Nine” of Chapter Three in the Fourth Tractate, Guarini describes the process of obtaining the drawings for a vault that intersects a cylinder at an oblique angle (Figure 1). Through text and drawings, he explains the means by which the oblique angle of intersection is configured in three views. Guarini then leaves the parallel lines behind, and introduces a new drawing technique. He begins by describing the oblique section of a cylinder as an ellipse and references Euclid as his source for the information. He goes on to explain that since we can measure the height and breadth of the ellipse in the orthographic drawings, we have the necessary information to construct the ellipse that would be the section through the cylinder at the plane of intersection with vault. At this point, Guarini is setting out an argument based on Euclid’s propositions. This is also where Guarini leaves both Euclid and “ortographia” behind. He provides a template for the semi-ellipse and instructs the reader to make a drawing instrument out of “strong card” using the template as a guide (Guarini 1737). This new instrument can be used to project points located on a base line along the elliptical section of the cylindrical surface. Rather than project from section

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8 MMethod – A student’s analysis of Guarini’s stereotomic distortion. 9 MMethod – A student’s analysis of stereotomic subdivision.
and plan until sufficient number of points of intersection could be obtained, Guarini has adapted Euclid to create an instrument that draws curves specific to the geometric object under study. His drawing method adapts and responds to the task at hand, generating elliptical intersections that are not approximations but rather precisely related to curvature of the cylinder. It is not a general method of architectural representation. It is a case-specific method that has been formed through an innovative redeployment of mathematical principles nearly 2,000 years old. It is an instance of innovation through repetition and adaptation.

While the difficulty of drawing a line at an oblique angle along a cylindrical surface offers little technical challenge within our current instrumental framework, it does point to the significance of both methodological and instrumental details. Current practices offer an array of tools by which complex curved surfaces can be analyzed, measured and built. However, in many cases these techniques result in the production of lines that are not directly related to specific geometry of the surface. Instead, they are the result of standardized tool kit of formal analysis. The lines represent the intersection of a surface with an abstract blade that has only a coincidental relationship with the surface, or they are simply engendered by the computational bias of a particular software (Legendre, 2002). Alternately, host surfaces are utilized as the receptors of subdivisions whose individual order is not tied to the geometry of the figure. Had Guarini located the points of the intersection between the vault and the oblique cylinder by orthographically projecting the vertical and horizontal points until they intersected and then plotted the curve, he would have followed a standardized route in which the logic of drawing was independent of the logic of the figure. Instead, Guarini adapted new drawing instruments from old geometric knowledge that allowed him to construct the curvature according the endemic
geometry of the situation. Guarini’s method was adaptive and re-configurable: constructing tools and techniques specific to needs of each design problem.

In a recent seminar at Woodbury University in Los Angeles, we explored historical repetition and analysis as a means of manufacturing and adapting drawing methods to specific ends. The initial research conducted prior to teaching the class consisted of recreating the drawings of the fourth tractate in Architettura civile so that all of the projective relationships in a given “observation” were continuous. Probably due to the economy of page layout, Guarini’s drawings are often fragmented, separating the unrolled surfaces of the vaults from their projective sources. By reassembling the drawings into continuous projective entities, the specific details of Guarini’s method emerged (Figures 2-5). These drawings were then distilled into a manual entitled “The Stereotomic Primer” that demonstrated the process to the students (Figure 6). The primer explained the principles of Guarini’s methods, but also provided examples of adapting the method to deal with geometries that were not present in Architettura Civile, such as the hyperbolic paraboloid (Figure 7). Because of Stereotomy’s complete absence of object-oriented representation, students were forced to engage method in a specific and detailed manner. All of the drawings were two-dimensional orthographic projections. Therefore objects emerged only through the translation of the drawings into models, and only when all of the steps in the process had been methodically constructed. Visualization of the object never became central to the work, as the eye could no longer verify the accuracy of form through figural definition (Figure 8). The locus of the work shifted from product to process. Students then adapted the methods of Guarini to their own ends. One student, interested in the relationship between contemporary discussions of subdivision and the analogous process in Stereotomy, began exploring stereotomic subdivision as a means of developing thickened surfaces from entirely two-dimensional figures (Figures 9-10). Another student focused on Stereotomy’s dissolution of objects into lines, and set out to develop a drawing practice by which the measurement of the true-length of the lines became an obsessive pursuit capable of producing surfaces in its own right (Figures 11-12). In both cases, the focus of the students’ work came in the form of a discrete adaptation and modification of the stereotomic process at the detail level. Guarini’s methods were learned through a process that focused on the malleability of its rule sets, asking students not only to acquire but also to manufacture methods specific to their individual projects and interests.

Guarini’s drawing method manipulated Euclid’s propositions within a loose and adaptive framework. Method was something that was manufactured, tested, and altered. Instrumentality was adaptive and reconfigurable. Figuration was subsumed by a drawing practice that focused more on geometry and dimension than appearance. Current practices of scripting operate within an analogous framework, placing an emphasis on the development of malleable rule sets and logics that are as much a part of the outcome as any figure produced. Nonetheless, history’s role within much of contemporary discourse remains object-oriented. Vaulting is frequently examined and referenced, but the instrumental practices that are at the core of vault geometry are scarcely discussed. Mining architecture’s long-standing relationship with both instruments and methods will allow for the development of work that moves beyond the construction of adaptive form towards the manufacturing of method and adaptive instrumentality.

WORKS CITED

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