MYTHIC FOUNDATIONS: ENGAGING HISTORY FOR ARCHITECTURE EDUCATION

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Abstract

The construction of physical models in design studios and workshops is a time-honored tradition in many schools of architecture. The construction of models in history of architecture courses allows for multiple lessons of ordinance, structure and surface elaboration. These lessons become palpably understood by the students through their study and reproduction of orthographic documentation, as well as the translation to construct with contemporary media and mechanisms. This paper highlights the results of a cultural history course in architecture, recently taught, where the students collaborated in groups to construct 1:100 models of the major temples of worship in Medieval Europe. The processes involved and the results documented were indicative of this promising avenue of exploration.

Keywords

Architecture education, cultural history, physical models, temples.

Introduction

The study of history in architecture schools involves much more than understanding the physical qualities of extant or well-known edifices. In some schools of architecture, history courses involve the cross-disciplinary study of contemporaneous literature, pictorial and sculptural arts in addition to studies of the prevalent culture, economics, geography and politics of the time. The extant buildings were most often the grand places of worship that survived the erosion of development and demonstrated many of the predominant and contextual forces of the time. As well, these temples were often encapsulations of mankind's greatest explorations of building technologies. Communities and governments poured their resources, efforts and latest knowledge of technological exploration into their local temples – places worthy of their divine. This can be seen in the many Gothic cathedrals of medieval Europe, the intricate elaborations of Umayyad mosques and the proportioned sobriety of Renaissance churches to name but a few.

How does this relate to contemporary technology? Why study these ancient temples today?

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courses for over a decade and recently taught the Foundations of Europe course to second year architecture students at the University of Waterloo's School of Architecture in Canada. The study of the Foundations of Europe involved the understanding of the complex ordering of people, beliefs, space and worship from the fall of the Roman Empire to the beginnings of the European Renaissance. The variety and the plurality of this era of study required that one look at the different forces that shaped the products of literature, sculpture, painting and sacred spaces that remained. As such, the course included a critical reading of eleven primary and secondary texts written during or about the specific aspects of the era, as well as analysis of eleven films that elaborated upon specific or overarching themes in the course.

The main project for the course was the construction of 1:100 physical models, by students in groups of five or six, of the major temples of medieval Europe and the adjacent region: synagogues, churches and mosques. Students were free to use a variety of materials and were free regarding level of detail and employment of technology in their construction. This paper outlines role of this project within the course and focuses on the processes involved creating these models that allowed the students to assimilate and understand the architectural concepts of ordinance, structure and surface elaboration.

Beginning: Framing Lessons of the Past

History courses in schools of architecture are windows into the past, an opportunity to understand the connection between non-physical factors to physical construction. The Foundations of Europe course taught by the author is one such example. However, history is often not clear, linear or straightforward. Prevalent studies – and education- of medieval European architecture often focused on the linear progression of Early Christian, Byzantine, Romanesque, Gothic which lead up to the Renaissance. Works as early as Viollet-le-Duc's Dictionary of French Architecture from 11th to 16th Century originally published in the mid 19th century (Viollet-le-Duc, E., 1875) to Sir Banister Fletcher's A History of Architecture on the Comparative Method first published at the end of the nineteenth century and later republished twenty times, both evidence a certain perpetuation of a particular, and linear, reading of architectural history (Cruickshank, D., 1996). When studied in this compartmentalized manner, a roster of building elements and technologies can be neatly lined up. However, there are many other approaches taken in contemporary texts on the history of architecture, including phenomenological and hermeneutical readings of space (Barrie, 2010; Jones, 2000) which evaluate historical spaces in more complex terms of user experience and cultural context.

In addition to this, it is important to note that particular 'eras' were not recognized as such during their time and were labeled afterwards by historians. The Florentine artist, architect and historiographer Giorgio Vasari in his sixteenth century publication, Lives of the Artists; biographies of the most eminent architects, painters and Sculptors of Italy (Vasari, 1946) in his glorification of his era was the first to use the term 'Renaissance'. As well, Vasari was the first to use the term 'Gothic' to

refer to the era directly proceeding his, "Then arose new architects who after the manner of their barbarous nations erected buildings in that style which we call Gothic (dei Gotthi)" (Vasari, 1946). The different 'eras' of medieval Europe overlapped and development was not at all linear or simultaneous throughout the continent and region. In addition to this, exterior forces including trade with the Orient and the Crusades dramatically influenced European culture and architecture. As well, the presence of Islamic rule in Southern Italy for nearly two centuries and in Spain for over seven centuries resulted in an amplification of cross-cultural influence within and beyond the geographical constructs of the European continent (Belting, 2011; Essa & Ali, 2010; Maalouf, 1984).

As such, the study of European medieval history requires a nuanced and pluralistic approach to understand the development and expression of building technologies that remain for us today. Although commonalities may be found in any one of the designated periods of medieval history, differences abound and often each building is singular in a particular exploration of design. This may explain how the act of construction of each of the temples was viewed at the time as a great act of worship.

By looking pluralistically, and to some degree circuitously, layered meanings and development can be revealed. For example, included in the reading list for the course were the writings of two twelfth century chroniclers: Abbot Suger and Ibn Jubayr. Suger's was an in depth description of his beloved Abbey St. Denis, regarding the architectural renovations and additions that were carried out as well as a description of the collection of relics and lavish artistic treasury (Panofsky, 1979). Suger himself played an important role in the politics of the time, acting as regent for the King for two years during the second crusade. Nearly contemporaneous, the Andalusian traveler and geographer Ibn Jubayr wrote of the courts, temples and practices in areas of southern Europe and the Levant he was able to visit (Broadhurst, 2003). Much more than description, in these chronicles demonstrates critical analysis of the numerous cultures, including the effects of the rule of Saladin and the recent Norman-post-Arab court of Sicily. Both Suger and Ibn Jubayr left behind written legacies however, the disparity of belief, intention and most importantly the great differences of the documentation of the spaces and temples of Europe demonstrated that Medieval Europe was a complex era beyond characterization of particular labels such as 'Romanesque' or 'Gothic' but was immensely pluralistic.

Using these descriptions and others, a more nuanced reading of the role and relationships of architecture to the prevalent cultures were discussed in the course. For students of architecture, the qualities of space and elements of construction were evaluated and used as an entry portal to grasp concepts of design and simultaneity. Reading about each era from primary and secondary texts importantly served to contextualize and understand the non-physical forces of the time. However, in order to understand the concrete forms of the spaces simply viewing images, in texts or projected in a lecture hall, can be no substitute for physically engaging the spaces. One approach to palpably understand historical spaces was through the construction of large scaled models.

Middle: Present Explorations

The importance of manual model making in the development of visual and spatial cognitive skills in design was, and in places, still is a cornerstone of architectural education, as exemplified by Rowena Reed Kostello's lifelong commitment to design education (Hannah, 2002). Within the context of a cultural history course, manual model making immediately brings the spaces of the past into the present tense: the immediacy of grasping building systems, logic and techniques comes into direct contact with the students existing understanding of contemporary systems, logic and techniques.

Students engaged and re-imagined the assembly of great monuments of history. In addition to this, model making today is not what it was twenty or even ten years ago. Students had at their disposal not only a greater variety of materials but also a increased diversity of construction technologies – from simple knife cutting and hand held tools to mechanical equipment (for cutting, boring, sanding, shaping, surfacing) to laser cutting and Computer Numerical Control (CNC) routers to state-of-the-art 3D printing. However, of these technologies varied in cost and efficiency in time and the students learned to combine the 'low' technologies of hand held tools and mechanical equipment with 'high' technologies of laser cutting, CNC routing and 3D printing. In all of the models, the students learned the processes of pattern making, assembly line and mass production of similar elements such as columns, arches,

Figure 1: CAD work, Laser-cut panels prepared and assembly of elements in Great mosque of Damascus model (Source: Amr elBahrawy)

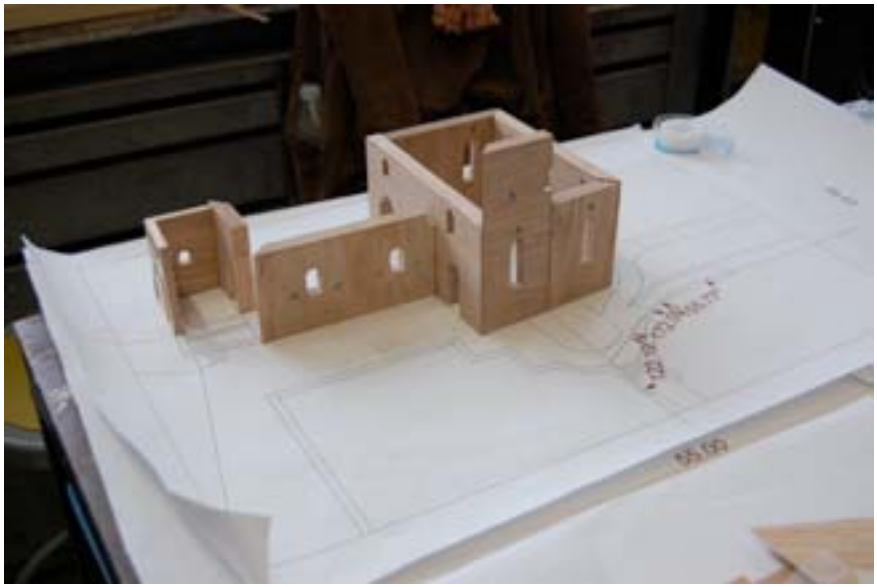

Figure 2: Assembly of Worms Synagogue, based on CAD work.
(Source: Amr elBahrawy).

buttresses and so forth (see Figure 1 and 2). These applications were understood to some degree to parallel 'real world' construction, both ancient and contemporary.

In the process of making the physical model, it was necessary for students to engage three levels of building construction: ordinance, structure and surface elaboration. In each level, the 'past' came to terms with the 'present' through the rendition of materials, building technology and systematic approach.

Ordinance

The meaning and usage of the word 'ordinance' varies from profession to profession, however, when applied to architecture it may generally refer to the building organization in terms of module but also has deeper meanings, especially with the construction of temples. The organization of a building may relate to a repetition of a measuring unit or a rhythmical patterning of proportion and may also refer to pre-determined religious rites, pre-existing sacred elements or other factors that rendered the plan with an organization that was not necessarily continuous or orthogonal. When students became involved deeply in these rich variances, layers and possibilities in ordinance, the depth of architectural space as a narrative emerged. This was demonstrated in the study of the irregular plans resultant of pre-existing sacred buildings or elements and because of development of rituals found in Early Christian and in Umayyad architecture.

Rhythmical and proportioned plans were found in many Byzantine churches that were tied in heavily with new complexities of roof structure and in Romanesque and Gothic works, the rhythmical and proportioned plans related to the vertical structural elements. In addition to this, some of the temples studied and constructed were themselves palimpsests of layers of different religious orders such as the Basilica San Clemente, the Great Mosque of Damascus and the Mosque/Cathedral of Cordoba. Other groups had to grapple with the complexity of growth which related little to any kind of immediate ordinance such as the complex of the Monastery of St.Catherine's with its agglomeration of forms and buildings (see Figure 3).

Figure 3: St.Catherine's monastery model demonstrating agglomeration of buildings and forms in the complex. (Source: Richard Philip D'Alessandro).

Translations of this ordinance into physical model making required the students to comprehend the deeper layers of organization than what might normally be afforded by contemporary design. Students most often had to redraw the plans and sections based on partial or fragmentary documentation. The most efficient method to do this was to digitally scan (or import) existing drawings of plans and sections found in history texts and relevant sources into a Computer Aided Design (CAD) program where there students were able to 'clean' up the image, identify and apply scale and designate dimensions for every element for subsequent construction.

Structure

Following the establishment of ordinance and complete CAD documentation of orthogonal projections of each building, the physicality of the structure needed to be addressed. Using the plan and section drawings, digitized on a CAD program, students began to comprehend and detail the thicknesses and materials used in the original building. The appropriate choice of model materials to reflect the actual materials of their monumental case study was another exercise in past-meets-present translation. The complete model needed to express qualities of mass, void and structure in a convincing manner – such as demonstrating the difference between timber, stone and masonry. Groups such as the one working on the model of Basilica of San Clemente, chose to use a different colored cardboard for each historical layer of construction of the building. Thus, the sectional hinge of the model revealed three strata including the Mithraeum, the first to fourth century church and the 12th century church structures that was clearly discerned in this subtle manner. As well, the group that worked on the model of the Worm's synagogue (see Figure 4), chose to use a variety of dark woods to represent the thick masonry walls and the sectional hinge not only revealed the space below ground of the purification bath, the mikveh, but also aptly demonstrated two different historical orderings of the main interior space.

Figure 4: Worms Synagogue model, opened section-ally to demonstrate underground ritual bathing area, mikveh, and two different interiors historically attributed to the space during different eras. (Source: Amr elBahrawy).

The students grappled with the reality that each building had multiple histories and to simply choose one and reproduce it would have been both inaccurate and irrelevant for this course. Creativity and choice regarding the expression of multiple histories rendered the models acts of dynamic analysis.

In addition to this, many of the case study buildings had complex structural systems. Students thus needed to find a method or a system of expression to demonstrate this and

it was necessary to engage historic concepts and technologies and render them with contemporary approaches. The making of the model became much more than the mere representation of a magnificent building but induced the students to design a system of contemporary construction and assembly that was effective with respect to materials and technology used. Students necessarily learned to understand how the particular, and sometimes complex, structural system of their case study building 'worked' as often this was alien to the students' existing vocabulary.

Structural systems such as the domes on squinches found in Byzantine architecture, or complex vaulting and buttressing in Gothic architecture or complex tiers of multi-lobed arches found in some Umayyad architecture in Spain all brought to life – and to the present – the ancient innovations in structure in a palpable manner. The group that worked on the Byzantine church of Haga Sophia resolved the placement of the large dome on pendentives using a combination of materials (see Figure 5), as did the group which worked on the smaller Byzantine church of S.Vitale (see Figure 6) which contained the dome on squinches. The group that worked on the model of the Beauvais cathedral struggled with the presentation of the

Figure 5: Dome of the Haiga Sophia constructed using a 3D printer. (Source: Richard Philip D'Alessandro).

Figure 6: Model of San Vitale model based on a composition of various materials revealing structure, iconography and materials. (Source: Amr elBahrawy).

Figure 8: Assembly of Cordoba mosque model elements. (Source: Amr elBahrawy).

Figure 7: Assembly of Beauvais cathedral buttresses from laser-cut materials by Adam Simonar. (Source: Amr elBahrawy).

Figure 9: Assembly of Damascus mosque elements by Katherine Holbrook-Smith, from laser-cut materials. (Source: Richard Philip D'Alessandro).

massive buttresses and opted to use plywood to achieve the thickness of the elements (see Figure 7). The models of the Mosque/Cathedral of Cordoba and the Great Mosque of Damascus used a combination of thin wooden dowels for the columns and laser cut cardboard to create the rows and tiers of arches (see Figure 8 and 9).

With the use of comprehensive CAD programs, students moved freely within their digitized building to determine the best location for their sectional hinge and importantly, converted the drawings into physical form. The CAD drawings produced of the assorted building elements were also used to program and cut the model version of the elements on a CNC router or on the laser cutting machines. As well, the CAD drawings of the elements, for some groups, were exported to different formats and used in Computer Aided Manufacture (CAM) programs that programmed the 3D cutting on the CNC router or for 3D printing. Laser cutters and CNC routers precisely cut embossed or created reliefs on various materials according

Figure 10: Intricate Gothic tracery of tower created by assemblage of laser-cut millboard pieces for the model of Frieburg Minster cathedral. (Source: Richard Philip D'Alessandro).

to the CAD drawings. This was extremely effective for intricate tracery, such as the rose windows and spire so delicately carved in cardboard using laser cuts in the model of the Gothic cathedral of Freiburg Minster (see Figure 10). The most advanced technology available in the workshop, 3D printing, was sparingly used due to the limitations in size, the constraints of high costs and the need for a complete and detailed 3D CAD documentation. The group that constructed the model of Haga Sophia used 3D printing to represent the difficult dome form in four precise sections.

Surface Elaboration

Finally, through model making, the students explored an area of architecture that is minimally addressed in contemporary buildings: surface elaboration. With the great temples of medieval Europe it would be an incomplete effort should the models have remained smooth-surfaced volumetric representations. The different case study temples demonstrated diverse approaches to surface ornamentation, from rhythmical repetition of iconographic and vegetal mosaics, to precisely calculate geometric and arabesques made of marble or tiles to carve architectural. Several projects included hand-painted interior detailing such as the painted mosaic patterns on the interior of S.Vitale (see Figure 11) and the painted panels in the Basilica of S.Clemente (see Figure 12). In the model of Kings College Chapel, the group reproduced each of the individual stained glass windows by color printing, to scale, on plastic and framing the interior and exterior with laser cut cardboard tracery (see Figure 13 and14). The group that worked on the Aqsa mosque employed laser cutting on cardboard differently, with assorted depths used to delicately carve surface reliefs in some areas and in other areas the laser cutting was employed to carve out intricate tracery of the windows within the mosque space (see Figure 15).

Ornamentation was not simply used to aesthetically enhance the edifices and through the process of creating their models, the students recognized that like ordinance and structure, there was a system of design that may not necessarily be entirely understood upon first glance. By 'mapping' the iconography on the surfaces of the temple, students found patterns of dogmatic organization, relations to pre-existing buildings on the site, and layers of historical modification such as in Early Christian, Byzantine, Judaic and Islamic temples. As well, when studying the surface ornamentation, the students also found that the elaborations were integrated within the structural system as elements of the architecture, such as the carvings in the tympanum, column capitals, sculptures and chimeras found in Romanesque and Gothic churches and cathedrals. To transform and grasp the system of iconography in the temple the students used CAD programs and scanned images that were immediately mapped out with relation to scaled assignments of the various elements. For example, the digitization of a wall mosaic at a Byzantine temple efficiently described the size and proportion of various iconic motifs. With the digital rendition students were able to decide upon efficient, and contemporary, methods to reflect this elaboration on their model through scaled reproductions.

Figure 11: Detail of S.Vitale model demonstrating hand-painted interiors representing mosaic iconography and surface finishes. (Source: Amr elBahrawy).

Figure 12: Interior view of San Clemente model demonstrating surface elaboration using hand-painted and laser-cut elements. (Source: Richard Philip D'Alessandro).

Figure 13: Model of King's College chapel as viewed from interior demonstrating fanned vaults, stained glass windows and interior detailing. (Source: Richard Philip D'Alessandro).

Figure 14: Detail of stain glass windows, buttresses and tracery in Kings College Chapel model as viewed from exterior. (Source: Richard Philip D'Alessandro).

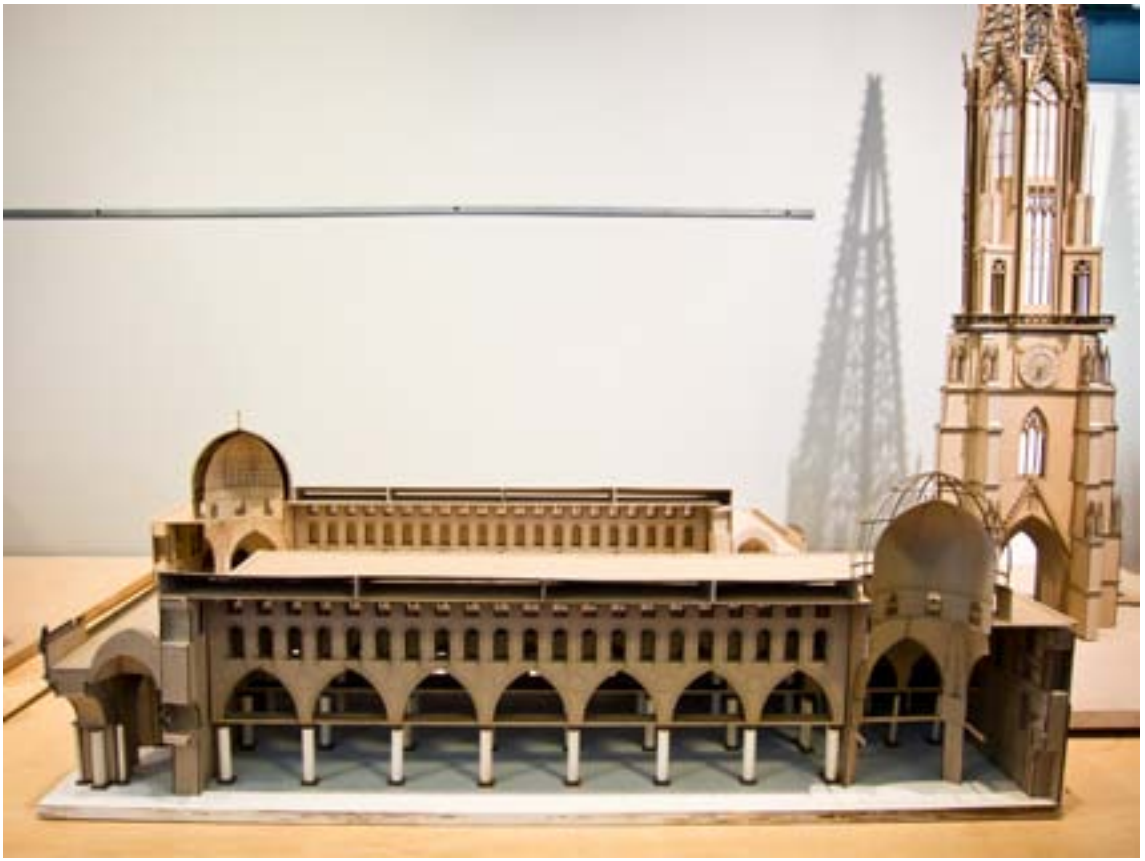

Figure 15: Model of Al- Aqsa mosque in two halves demonstrating differences in construction of dome and detailing of interior spaces. (Source: Richard Philip D'Alessandro).

Tangencies

The overall lessons of model making were multiplied within the context of the class where there were numerous models of Medieval European temples being crafted in the studios and workshop facilities of the school. The process of creating the model was as much a lesson in design and building technologies as the final product was of understanding historical spaces. Physical experimentation and manipulation were essential for the creation of the models, and this required the engagement of the sense of touch, that is often lost in the

vision-dominance of contemporary practice as described aptly by Juhani Pallasmaa in his text, The Eyes of the Skin, Architecture and the Senses (2005). Simply looking at images or drawings of these buildings did not allow for the same depth of understanding as making them – the recognition, memory and ultimately the synthesis of the multiple lessons of order, form and elaboration became engrained. With this immersion in construction and space making, the students utilized various forms of technology including digital and mechanical and took away with them an extended vocabulary of the assembly of elements along the lines of Christopher Alexander's Pattern Thinking (1977). Abstract ideas discussed in these important contemporary texts were understood implicitly through this process of making.

Future: Lessons of the Physical and the Virtual

A question might arise, 'Why not just make virtual models of the historical buildings?' Although this is an exciting avenue of exploration, especially with some contemporary virtual reality and holographic architectural modeling programs, however, for a course of this nature in a school of architecture, students needed an engagement of historical and contemporary technology that went further with physical rendition. The construction of models at a scale of 1:100, were large enough to physically demonstrate the qualities of the spaces in comparison and to understand differences in dimension which is not easily done in the 'zoom in', 'zoom out' digital world. In addition to this, students when making physical models moved back and forth between their own digital and mechanical technologies and found systems of creation that were akin to the 'real world' of the past and the 'real world' of today's model building with respect to ordinance, structure and surface ornamentation.

The outstanding work done by the entire class must be credited to their dedication and intensity of effort. All of the models were completed in very limited time, ranging from two to four weeks, while the students were fulfilling other demanding course work including design studio. The actual temples studied varied from intimate in scale to monumental, thus the 1:100 models ranged in size from having a base of 40 cm2 to bases over 1.5 m2 – accordingly the amount of time dedicated to construction and to embellishment differed greatly. With smaller models, more time was given to craftsmanship, such as the Worms synagogue, and to surface elaboration such as S.Clemente and S.Vitale with their hand-painted interiors. However, the largest models demanded that more time was spent on construction of the massive elements, such as with Haiga Sophia or Beauvais Cathedral (see Figure 16) or time was spent constructing and assembling hundreds of smaller elements such as with the Mosque/ Cathedral of Cordoba and the Great mosque of Damascus. The model was weighted at 30% of the course grade and the subsequent essay written on the same subject was weighted at 20%. Reflecting on the successful results of the students and considering the hefty demand of the workload for this particular assignment, more time was needed, possibly with segmented deadlines and a larger weight assigned to the grades.

The models were displayed, until the remainder of the term, in the atrium of the school of

Figure 16: Model of Beauvais cathedral, two halves open to reveal interior and exterior work. (Source: Richard Philip D'Alessandro).

Figure 18: Model of Haiga Sophia on permanent display in the University of Waterloo's Musagetes Architecture library. (Source: Amr elBahrawy).

Figure 17: Model of Mosque/Cathedral of Cordoba on permanent display in the University of Waterloo's Musagetes Architecture library. (Source: Amr elBahrawy).

architecture. The attention and well deserved admiration of the school's staff and student body allowed for an even larger pedagogic experience and relation of spaces. Many of the models were exhibited in the Cambridge city hall for a short duration and now many of them are on permanent display in the University of Waterloo Musagetes Architecture Library (see Figure 17 and 18). Visitors to the school, especially on open days for potential incoming students and for employers coming in to interview and hire students for their co-operative work placements also recognized the achievement of the students both in craftsmanship and creatively in depicting certain aspects of the building on each side of the hinge.

This specific experience, and previous similar experiences of teaching history in architecture

schools, highlights the opportunity to move between the 'virtual' qualities of both text and technology and the physical qualities of buildings and models. This movement between virtual and physical provided a multitude of lessons in theory, design and technology. Differences of time, place, resources and aspirations nuanced this understanding. Beyond this, there were opportunities to empower students with an expanded vocabulary of volumes, structural systems and surface elaboration that were rendered to contemporary technology by way of the students' construction of the models. Further translation to contemporary technology was demonstrated with the application of digital media such as CAD, 3D or rendering programs. This process allowed students to intensely engage the history of this period so that the mythic foundations of history began to unravel and layers of meaning and order were revealed.

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