Digital Applications for Architectural Heritage

Using Location-Based Technologies to Contextualize Digital Cultural Heritage Assets

by

Darcy Charlton, Dipl. Des., B.A.S.

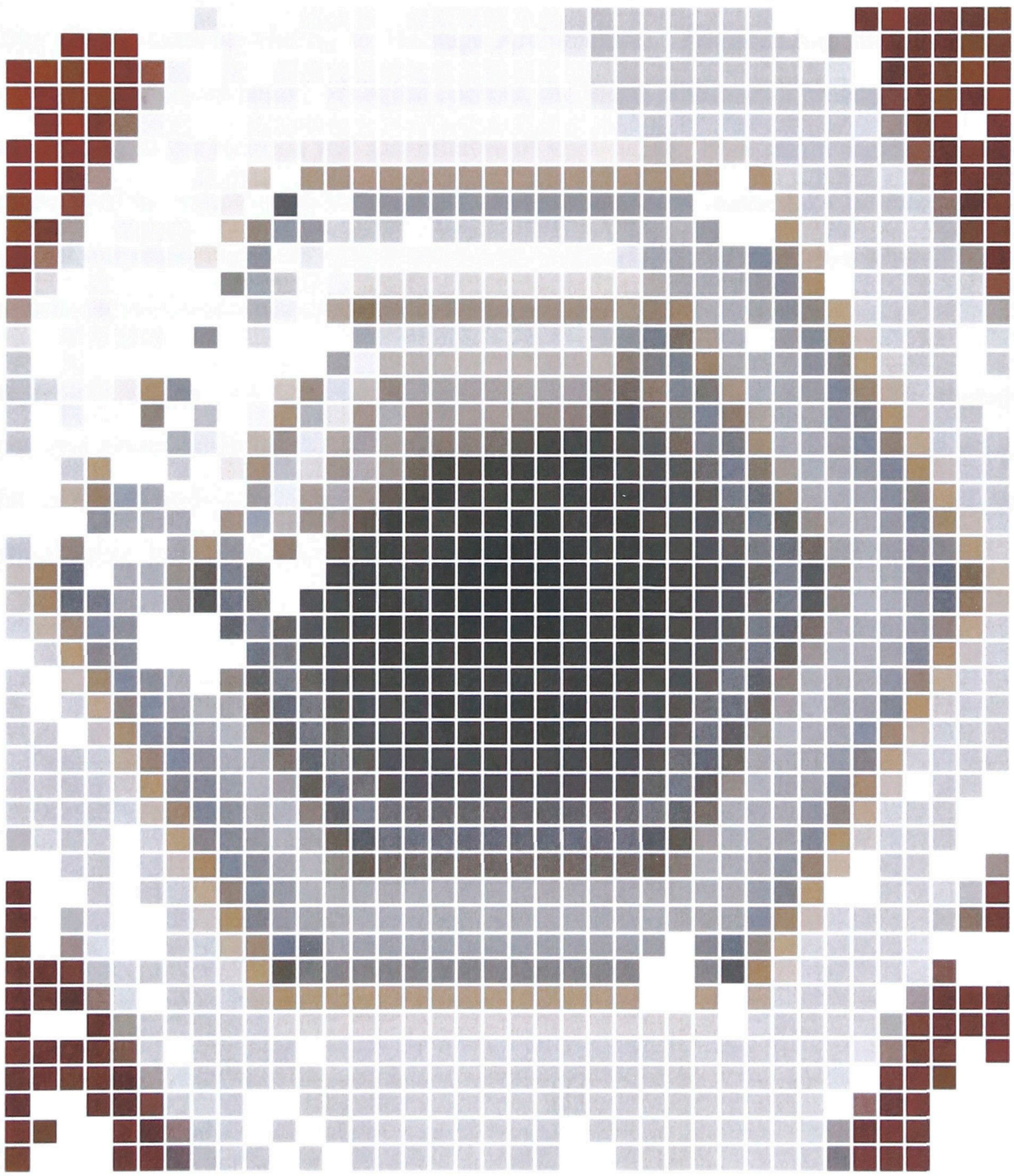
A thesis submitted to
the Faculty of Graduate and Postdoctoral Affairs
in partial fulfillment of the requirements for the degree of

Master of Architecture (M.Arch.) Professional

Azrieli School of Architecture and Urbanism
CARLETON UNIVERSITY
Ottawa, Ontario

Digital Applications for Architectural Heritage

Using Location-Based Technologies to Contextualize Digital Cultural Heritage Assets



Abstract

The project presented in this paper is positioned amidst two branches of study: that of Architectural Heritage, and that of Information Technology. Beginning with the hypothesis that digital data is essentially meaningless unless it is contextualized, the primary aim of the project is to explore alternative methods of creating, organizing, accessing, and navigating digital content relating to Heritage Architecture. Transcending the question of how to manage an inventory of digital content, the thesis addresses a broader set of questions relating to the creation and assimilation of knowledge. How might digital technologies be used to complement the physical environment, how might they be integrated to augment our experience and understanding of Architectural Heritage, and what is the relationship between environment and technology?

The project begins with a survey of current technologies used in the creation, management, and presentation of digital resources. Based on this survey, a proposal for an exhibit on Canadian Ethno-Cultural Architecture is developed to demonstrate the depth and cultural value that contextualized digital information can bring to heritage buildings.

Acknowledgments

I would like to thank my advisor, Dr. Stephen Fai, for his guidance, input, and direction throughout the project. I would also like to thank Marc Leonard and the Carleton Immersive Media Studio (CIMS), the Canadian Heritage Information Network (CHIN), the Mathematics of Information Technology and Complex Systems (MITACS) research network, and Susan Ross (Heritage Conservation Directorate, PWGSC) for her comments and feedback.

Contents

List of Figures

What is missing in the World of Tomorrow, or its latter-day counterpart in cyberspace, or in the anytime-anyplace version of ubiquitous computing, is the world itself.

Malcolm McCullough, *Digital Ground*

Preface

. . . In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that the vast Map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Discipline of Geography.[1]

Jorge Luis Borges tells the story of an empire that is so obsessed with the exactitude of their cartographers that they undertake a one-to-one map of their territory. When the map is completed, the size of the document renders it useless and the citizens lose interest in cartography. While the idea of making a map that is as large as the geographical area that it represents may seem unreasonable, it could be argued that the current obsession with digital archiving is an analogous neurosis.

Does comprehensive digital archiving finally guarantee the preservation of all knowledge, or will it simply lead to an impossible glut of information? Within this broad context, this proposal sets out to avoid the indulgences of Borges' cartographers by beginning with the basic hypothesis that data is essentially meaningless unless it is contextualized. It is suggested that for digital archives, this contextualization is mediated by our method of creating, organizing, accessing and navigating content.

---

[1] Jorge Luis Borges. *Collected Fictions*, ed. Andrew Hurley (New York: Penguin Group, 1998), 325.

1. Introduction

Anytime-anyplace! Equals nowhere[2]

For many people, myself included, computers seem to be a source of endless frustration. In a rather paradoxical way, computer technology can at times complicate matters more than simplifying them. In fact, it seems that over the past 10 years, much of our time and energy has simply been reallocated to more meaningless tasks and procedures. Perhaps this is one of the reasons that I have had such difficulty accepting the very idea of pervasive computing. Though as apprehensive as I may be about computer technology, I am at the same time fully convinced that it is here to stay. A disregard for digital technologies would be foolish, and highly unlikely to produce any worthwhile oppositional effect. It would therefore seem to be a much more logical approach to accept emerging technologies as an inevitable ontological condition, a part of "an ongoing mutation", and to make every effort to apply them appropriately to the field of architecture. In order to do so, the relationship between architecture and computer technology must first be considered.

Digital technologies have at this point permeated nearly every aspect of our lives. Computers have become indispensable in nearly every branch of study, and architecture is not an exception. In fact, it is becoming increasingly difficult to discuss architecture without the mention of computers; for not only are they used extensively in the conception and delivery of architecture, but they are also being embedded within the ambient surroundings of the built environment. Computer technology has become fully integrated with buildings and with the city. We are currently seeing a reconfiguration of physical space; where both a visible and invisible layer of technology is being embedded into the world around us. The city and it's inhabitants are connected via an ever expanding field of

[2] Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing* (Cambridge: The MIT Press, 2004), 18.

technologies and devices: from microprocessors, to electronic ID tags, to sensors and networked information systems. Buildings and cities are being transformed on a physical, cultural and experiential level.

Despite the many changes that such technologies have brought upon the built environment, architects haven't shown a great deal of consideration for the integration of digital technologies with the *experience* of architecture. As this paper will suggest, computer technologies can no longer be regarded as an insignificant layer of the architectural experience. In his book entitled *Digital Ground*, Malcolm McCullough states, "Information technology has become ambient social infrastructure. This allies it with architecture."[3] Architects that don't acknowledge our present technological condition may inadvertently surrender a portion of their jurisdiction to programmers and technologists. Because computer and information technology is such an integral part of the built environment, and of our everyday lives, architects should be concerned with the way in which it is developed and employed.

> Interface design has become interaction design, and interaction design has come into alliance with architecture. Human life is interactive life, in which architecture has long set the stage.[4]

At present, the vast majority of technological developments are driven by business interests and government agencies. For the most part, technological interfaces have been designed with minimal cultural and geographical consideration. Computer programmers and engineers tend to work toward an accumulation of hardware and software rather than the integration of features, leaving the question of how to best use the technology to the end user.

The specific aim of this project is to intermingle architecture with emerging digital technologies to establish a preliminary model for recontextualizing the growing expanse of

---

[3] Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing* (Cambridge: The MIT Press, 2004), 21.

[4] Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing* (Cambridge: The MIT Press, 2004), xiv.

digital data pertaining to heritage buildings so that we may better understand their meaning and significance. Canada has an inventory of over twenty thousand properties recognized as cultural heritage by local, provincial, and federal authorities. The Artifacts Canada database contains close to 4 million object records and approximately 700,000 images from Canadian museums.[5] The more digital information that we accumulate, the greater the need to contextualize it. If we allow data to accumulate without an ongoing process of contextualization, it will gradually become unattainable; effectively vanishing into a binary abyss. As buildings, cities, and devices develop the capacity to sense and record information and activity taking place in and around them, we can be certain that the volume of generated data is going to increase exponentially in the years ahead.

■■■

How then might we begin to contextualize such a vast expanse of information? This project explores the potential for location-based technologies to be used as a means of contextualizing digital cultural heritage assets. The following example gives us a sense of how such technologies have been employed to do so in the recent past.

The Virginia Department of Health's website posts restaurant inspection reports for each and every establishment in the state. Restaurants are categorized by county and listed in alphabetical order. Following the link to a particular restaurant, the inquirer is presented with a chronological list of inspection reports. If a report contains a health violation it is flagged and explained in detail. As informative as this website may seem, it is likely safe to assume that a relatively small number of restaurant goers actually feel it necessary to engage in such thorough investigative research before dining out.

Recently, a mobile smartphone application was developed to disseminate this information to a more targeted audience using location-aware technology. Users that choose to download the application to their mobile device are presented with health report data specific to their ever-changing physical location within the city. The application utilizes the same

[5] Canadian Heritage Information Network, "Artefacts Canada," Professional Exchange, http://www.pro.rcip-chin.gc.ca/artefact/index-eng.jsp

set of information that is available through the State Health Departments website; however its value in this new context is increased because it has been reconnected with the physical location to which it pertains. As this example suggests, the use of location-based technologies may be one means of increasing the value of digital resources by making them accessible to a more focused audience.

■■■

In *Digital Ground*, McCollough acknowledges that although the internet may allow us to interact remotely, it does not do away with the basic human need for place. He explains that it is through 'place' that we are able to understand our own contexts.

> Ubiquitous computing has overlooked the value of context. Humanity has had thousands of years to build languages, conventions, and architectures of physical places. Wave upon wave of technology has transformed those cultural elements, but seldom done away with them. Context appears to have unintended consequences for information technology.[6]

Bearing this in mind our proposal will attempt to reinforce the value of place by shifting digital technologies from the center of our focal attention into the periphery through the implementation of location-based media. The exhibit will demonstrate how location-based services might be used to emphasize (rather than replace) the physical experience of heritage buildings. Digital cultural assets will be embedded with geographic coordinates, a real-world "address" to reconnect it with the physical world. This process of adding geographical identification metadata to various media is referred to as *geotagging*. Typically this metadata consists of latitude and longitude coordinates, however it may also include information such as altitude and bearing. Geotagging associates a digital media file with a geographic location, and conversely it gives us the capability to deliver media that is relevant to a particular location.

■■■

---

[6] Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing* (Cambridge: The MIT Press, 2004), 11.

The following satirical news article (fig. 1) exposes some of the false promise surrounding the online experience, mocking the idea of replacing a national treasure with its virtual counterpart.

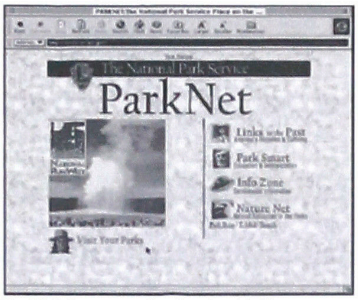
NEWS

New National Parks Website Makes National Parks Obsolete

APRIL 30, 1997 | ISSUE 46•26 ISSUE 31•16

WASHINGTON, DC—In an effort to make America's natural wonders available to all citizens, the Department of the Interior announced Monday the creation of a $2 million National Parks Website.

Enlarge Image



ParkNet, the new national parks website.

The new website clears the way for the wholesale development of the parks: Next Monday, bulldozers will begin leveling more than 100,000 square miles of pristine, federally protected national parkland, finally making it available for industrial use.

Jack Holm, designer of the website, believes nature lovers will find it superior to the real parks in every way. "You will experience the same grand mountains, lush grass and wide variety of fauna, without ever leaving your home," he said. "And when you spot an animal on your cyber-tour, like a majestic elk, you can click on the elk and access information about its habitat and diet. Elks in the wild do not offer this option."

The website, located at www.natparks.gov, will feature 72 pixels-per-inch photos of parks and "hyper text" on the parks' histories and wildlife. It will also offer camping options, with which visitors can set up a "virtual campsite" inside a national park and watch a quick-time movie of the setting sun while RealAudio playback of crickets and coyotes runs at 44.1 kilohertz.

"We digitally enhanced actual recordings of coyotes from Arizona's Saguaro National Park," Holm said. "It should sound better than the real thing."

According to National Parks Destruction Chief Lew Hoffson, countless grizzlies, moose and bison will be incinerated when the 750,000-acre Yellowstone National Park is slash-burned to make room for what he says will be the nation's largest factory outlet mall.

"Yellowstone, like the other national parks, has proven to be a huge financial burden to taxpayers, costing more than $200 million a year to maintain," Hoffson said. "The new Yellowstone Factory Shoppes, on the other hand, are privately funded and should be immensely profitable right from the word go. It just makes sense."

The economic advantage of massive, unregulated development of the parks was only one reason for the website move. Safety was also a factor.

"Every year, between 30 to 40 national parks visitors are killed in accidents, ranging from animal attacks to falls off cliffs," Holm said. "The website will be far safer, with the greatest danger posed to visitors being possible neck and back strain from prolonged sitting at the computer station." To avoid such discomfort when visiting the new cyber-parks, Holm strongly advised taking a "stretch break" every 15 to 20 minutes.

Yet another advantage of web-based camping will be the chance for visitors to enjoy interacting with talking, anthropomorphic wildlife, such as PC Puffin, a friendly, wise-cracking aquatic cartoon bird who gives visitors tours of Alaska's Denali National Park. "Non-cyber-parks do not feature puffin-led tours, for in real life animals do not talk," Holm said.

U.S. Parks Department officials said the department is also planning an endangered-species website, enabling people to observe and study rare species on their computers. Once the website is up and running, the actual endangered animals will either be allowed to die out naturally in captivity or be killed off wholesale by poachers.

U.S. Sen. Spencer Abraham (R-MI), who sponsored the legislation, said that he and his family are planning a trip to the National Parks website this July. "We've never been to Yellowstone," he said, "and I understand we'll be able to download a sound effect of hot, splashing water digitally recorded right at Old Faithful. We're very excited."

ARTICLE TOOLS

DIGG

FACEBOOK

STUMBLE

TWITTER

REDDIT

BUZZ

EMAIL

PRINT

RELATED ARTICLES

Overweight Man Receives 'Lose Weight Fast' Spam E-Mail Featuring His Picture
05.29.02

Rising Home-Heating Costs Hitting Reptile Families Hardest
12.21.05

Figure 1. Satirical news article, The Onion

1.1 Objectives

The following objectives have been established for the project:

1. To review current technologies and data management systems employed in the field of Architectural Heritage.

2. To identify opportunities for the integration of existing technologies; especially those used within the field of Architectural Heritage.

3. To propose an appropriate means of employing digital technologies in order to increase the value and strengthen the significance of digital cultural heritage resources by making them more accessible.

1.2 Our Everchanging Perception of Reality

Recent technological developments have had a profound impact on our perception of reality. From the popularization of the term "virtual reality" in the late 1980s, to the present notion of "augmented reality", computers have unquestionably shifted our understanding of what is "real". This terminology is problematic because of the implicit distinction that is made between two somehow separate realities. "Virtual reality" and "augmented reality" are simply two different ways of construing the same reality. Both should therefore be equally regarded as "reality". The term augmented reality is currently being used to describe a category of technologies in which the elements of our physical, real-world environment are supplemented with computer-generated imagery; but when has our perception of reality not been augmented in one way or another?–whether by a story, a sign, an electric light bulb, or by a pair of eye glasses?

This is by no means the first time that our perception of reality has undergone such profound change and it certainly won't be the last. In *Techniques of the Observer*, Jonathan Crary considers the reorganization of vision in the first half of the nineteenth century, pointing out that the "Problems of vision then, as now, were fundamentally questions about the body and the operation of social power."[7]

> the break with classical models of vision in the early nineteenth century was far more than simply a shift in the appearance of images and art works, or in systems of representational conventions. Instead, it was inseparable from a massive reorganization of knowledge and social practices that modified in myriad ways the productive, cognitive, and desiring capacities of the human subject.[8]

Crary's argument suggests that the way in which we see and perceive the world around us, that is to say our *reality*, is shaped not so much by technology itself, but rather through a complex and ongoing "reorganization of knowledge". Computers and information technology are merely one facet of a much greater "reorganization of knowledge" which is continuously relocating our perception.

In a chapter entitled "Architectural Drawing in the Age of its Mechanical Reproduction", Mario Carpo discusses the proliferation of xylography or woodcut printing in Europe toward the end of the fourteenth century.[9] Although such innovations made possible for the first time unlimited reproductions of identical images, the technology wasn't immediately embraced with enthusiasm. At this time, the humanists were in the midst of memorizing rhetoric of classical authors; classical rhetoric being a necessary tool for a society in which there was a minimal market for books. With the memorization of such texts came a great deal of power; and humanists were reluctant to accept a technology that threatened to strip them of this power. Could it be that we are facing a similar struggle with technology today with notions of open source, open access, and total transparency?

---

[7] Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge: The MIT Press, 1990), 3.

[8] Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge: The MIT Press, 1990), 3.

[9] Mario Carpo, *Architecture in the Age of Printing: Orality, Writing, Typography, and Printed Images in the History of Architectural Theory*, trans. Sarah Benson (Cambridge: The MIT Press, 2001), 42.

Could a loss of power and control once again be at the root of apprehensions toward technology?

1.3 Architectural Heritage

In explaining her understanding of heritage, Barbara Kirshenblatt-Gimblett writes:

> Despite a discourse of conservation, preservation, restoration, reclamation, recovery, recreation, recuperation, revitalization, and regeneration, heritage produces something new that has recourse to the past.[10]

Kirshenblatt-Gimblett goes on to describe cultural heritage production as an industry that produces something *new*, based on the *past*, in order to create *value* in the present. The value she argues is in the "thereness" of the past as opposed to the "hereness" of the present. Cultural heritage essentially transports us to another time and another place; this journey being analogous to a tourist traveling to a foreign country.

Presented with Kirshenblatt-Gimblett's interpretation of cultural heritage, we begin to understand that whether our heritage exists in physical, analogue or digital format, the heritage industry will continuously be confronted with the challenge of disseminating archived material. There seems to be a false optimism surrounding digital heritage archives–an unwarranted faith in the ability of digital technologies to solve once and for all the many difficulties pertaining to the preservation and dissemination of historical material. In order to maintain value, cultural heritage assets must be perpetually adapted to the present-day conditions. "There is no turning back. If heritage as we know it from the industry were sustainable, it would not require protection."[11]

How then might we create something new and of value from our architectural past? How can we (re)present the cities, buildings, monuments, drawings, photographs, architects, tools, materials, and construction techniques of the past, in a way that speaks to the present?

---

[10] Barbara Kirshenblatt-Gimblett, "Theorizing Heritage," *Ethnomusicology* 39, no. 3 (1995): 370.

[11] Barbara Kirshenblatt-Gimblett, "Theorizing Heritage," *Ethnomusicology* 39, no. 3 (1995): 370.

■■■

The topic of heritage goes hand in hand with the topic of conservation. If we truly value that which has been passed down from previous generations–historic buildings, cultural traditions, landscapes, etc.–we will make every effort to protect it. Heritage conservation is then fundamentally about engendering a deep care in someone for something else, as we will only conserve the things that we care about and value. These of course are the places and things that we have formed a relationship with; or in other words, the places and things that we feel have a certain connection to ourselves. The key question surrounding architectural heritage conservation is how can we establish a multiplicity of connections between people and places in order to engender a meaningful relationship?

1.4 The Museum of Architecture

In their book *The Origins of Museums: the Cabinet of Curiosities in Sixteenth- and Seventeenth-Century Europe*, Oliver Impey and Arthur MacGregor expound on the fundamental characteristics of the museum, stating that:

> With due allowance for the passage of years, no difficulty will be found in recognizing that, in terms of function, little has changed; along with libraries, botanical and zoological gardens, and research laboratories, museums are still in the business of 'keeping and sorting' the products of Man and Nature and in promoting understanding of their significance.[12]

In opposition to this standpoint, in which "little has changed", Jo-Anne Berelowitz presents a convincing argument that interrogates and draws attention to the disjunctions and ruptures that mark the museums shifting conceptualizations.[13] Whereas the late sixteenth-century cabinet of curiosities was for the most part a secret place of privilege, today's museum is a "truly public space that seeks to render all things legible." Berelowitz also draws on the difference in the way objects and artifacts were arranged in the cabinets of the sixteenth- and seventeenth centuries. John Tradescant's cabinet of curiosi-

---

[12] Oliver Impey and Arthur MacGregor, *The Origins of Museums: the Cabinet of Curiosities in Sixteenth- and Seventeenth-Century Europe* (London: House of Stratus, 2002)

[13] Jo-Anne Berelowitz, "From the Body of the Prince to Mickey Mouse," *Oxford Art Journal* 13, no. 2 (1990): 70.

ties was so diverse and arranged in such a way that it is nearly impossible for us to grasp the underlying order of the collection.

> Contents are no longer disposed in arcane arrangements, but according to a classification whose order and rationale is visibly apparent---a taxonomy determined by schools or styles, nationalities, and centuries. Synchronicity yields to diachrony.[14]

■■■

The museum of architecture presents a unique challenge to curators. While most museums collect and display original objects, the architectural museum displays works that are representations of the subjects themselves. Typically, these representations include drawings, prints, photographs, models, and books; and it is through the grouping of such that we arrive at an understanding of the building and its significance.

Architectural representations are not single images but groups of images, which combine to form a more complete picture. "Each image adds new information to complete, through a gradual unfolding, the picture of the whole."[15] When the sequence or arrangement of the images is altered, so too is one's understanding of the whole.

In his analysis of the interior architecture of John Soane, Robin Middleton investigates the positive use of fragmentation.

> Fragments may be construed in both negative and positive ways: as remnants of achievements and a plenitude that is irrevocably lost, or as elements of a restorative power that can provide symbolic and poetic meaning to newly constituted wholes.[16]

---

[14] Jo-Anne Berelowitz, "From the Body of the Prince to Mickey Mouse," *Oxford Art Journal* 13, no. 2 (1990): 73.

[15] Eve Blau and Edward Kaufman, ed., *Architecture and Its Image* (Montreal: Canadian Centre for Architecture, 1989), 13.

[16] Robin Middleton, "Soane's Spaces and the Matter of Fragmentation," in *John Soane: Master of Space and Light*, ed. Margaret Richardson and MaryAnne Stevens (Montreal: Canadian Centre for Architecture, 2001), 35.

Soane of course interpreted the "fragment" in the latter, positive light; assembling small pieces of the past in order to create something of new value. Soane's home and museum in London can be seen as an artificial ruin constructed from small, seemingly unrelated pieces of the past. Although the individual contents and artifacts in his museum had little monetary value at the time of acquisition, Soane recognized in them an associational value that could be harnessed through thoughtful juxtapositions.

> I would like to suggest that Soane was stirred by a rebellion against established modes of thinking and making, a rebellion similar to those of artists of the early twentieth century, the Cubists, the Dadaists and the Surrealists, who used the fragments of a world that had become commonplace and devoid of meaning to create new conjunctions and juxtapositions that would articulate their latent meanings once again and provide a new metaphorical and poetic wholeness for the fulfillment of life.[17]

At this point, it might be presumed that John Soane and Barbara Kirshenblatt-Gimblett shared a similar understanding of heritage. It seems that both have recognized it as a value added industry and "a mode of cultural production in the present that has recourse to the past".[18]

1.5 The Here and Now of the Work of Architecture

In his discourse on *The Work of Art in the Age of Its Technological Reproducibility*, Walter Benjamin writes:

> In even the most perfect reproduction, *one* thing is lacking: the here and now of the work of art–its unique existence in a particular place. It is this unique existence–and nothing else–that bears the mark of the history to which the work has been subject.[19]

---

[17] Robin Middleton, "Soane's Spaces and the Matter of Fragmentation," in *John Soane: Master of Space and Light*, ed. Margaret Richardson and MaryAnne Stevens (Montreal: Canadian Centre for Architecture, 2001), 35.

[18] Barbara Kirshenblatt-Gimblett, "Theorizing Heritage," *Ethnomusicology* 39, no. 3 (1995): 369.

[19] Walter Benjamin, "The Work of Art in the Age of Its Technological Reproducibility," in *Selected Writings Volume 3*, ed. Howard Eiland and Michael W. Jennings (Cambridge: The Belknap Press of Harvard University Press, 2002), 103.

Suggested here is an inevitable shift of meaning and significance when a work of art is removed from its original context. Of course a similar argument could be made for the work of architecture; as both are man-made artifacts whose significance is rooted in the cultural context in which they were created. It is however more generally understood that a work of architecture will vary in meaning from one generation to the next, often taking on unintended uses and undergoing extensive renovations and additions–none of which cause a loss of meaning, but simply a shift in meaning. Benjamin's assertion is helpful in assimilating an understanding of architectural heritage in that it reminds us of the futility of attempting to reproduce the conditions of the past. We are only able to incorporate fragments of the past into a contemporary understanding of it.

1.6 The People, Places, and Spaces in Between

The anytime, anyplace nature of the internet has in many ways rendered space and time redundant. As Baudrillard notes in *The Ecstasy of Communication*, "All that remains are miniaturized, concentrated and immediately available effects. ... The landscape, the immense geographical landscape seems a vast, barren body whose very expanse is unnecessary..."[20] In regards to heritage architecture, the people, places and spaces in between are what establish the cultural value of a building. Without the presence of their surroundings, heritage buildings are deprived of a great deal of their original meaning and significance. For Plato, matter and space were the same thing, "and thus place is also reducible to matter: inasmuch as place is thought to be the extension of the magnitude of a physical thing occupying that place".[21]

How then might the value of place be reinforced given the current state of pervasive desktop computing? The Internet's "immediately available effects" disconnect us from the place in which the building stands or once stood. The internet has a tendency to objectify buildings, reducing them to a mere image. We arrive at an understanding of ob-

[20] Jean Baudrillard, *The Ecstasy of Communication*, trans. Bernard and Caroline Schutze (New York: Semiotext(e), 1988), 18.

[21] Edward Casey, *The Fate of Place: A Philosophical History*, (Berkeley: University of California Press, 1998), 52.

jects and artifacts by relating them to back to ourselves; and it is through the firsthand experience of visiting a heritage building that one begins to comprehend what it is that distinguishes it from their own time and place. How does the landscape and climate change from "here" to "there"? How does the daylight differ there and what effect does this have on the overall feeling of the place? How do "their" methods of building differ or compare to "our" methods of building? How did their cultural values differ? And most importantly, what influence does all of this have on the architecture? It is through this internal dialogue that one comes to an understanding of the significance of a building.

2. Methodology

A society is defined by its amalgamations, not by its tools...tools exist only in relation to the interminglings they make possible or that make them possible.[22]

Over the past number of years, a surge of digital innovation has left us more interested in the device than in its product. By the time one acquires and adapts to a new technology, in many cases it has already become obsolete. Consequently, we find ourselves dedicating more and more of our time and energy in search of the next technological breakthrough.

The latest wave of tools for recording, organizing, and presenting building information has left us with the question of how to best employ them. This chapter focuses on current technologies and developments that either have been, or have potential to be applied to the field of heritage architecture.

2.1 Platforms for Acquiring and Creating Digital Data

The following section reviews a number of technological tools that are commonly employed in the recording and documentation of cultural heritage.

2.1.1 Leica Total Station | The Leica Total Station is a surveying instrument used on-site to determine the three-dimensional location of a point of interest. It does this by calculating the angle and distance to the point in relation to the location of the instrument. It is essentially an extension of the traditional theodolite, with the added ability to measure distances. When combined with FieldPro, Leica's software plugin for AutoCAD, points can be combined in 3-dimensional space to create a 3D drawing file in the field. Points

[22] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis, University of Minnesota Press,1987), 90.

can also be identified and labelled within the drawing to save time in the office. It is essentially a pointing device used to locate nodes within a 3-dimensional CAD drawing.

Because the Total Station employs laser technology to record the location of points, it has become an extremely useful tool for preservation research, allowing researchers to remotely measure architectural elements that are fragile or unreachable. Obtaining such measurements with earlier technologies was difficult or impossible as reflective targets had to be positioned on each point of interest.

2.1.2 Leica ScanStation 2 | The Leica ScanStation has in many ways made the Total Station redundant in terms of its heritage documentation value, however, priced in the range of $100,000, the cost of such technology remains prohibitive. The ScanStation is a LIDAR (Light Detection And Ranging) instrument employed by various industries to record 3D environments. The scanner emits thousands of beams of light per second and records the relative angle, distance, location, and light intensity of each point reflected back to the instrument. The resulting image is referred to as a *point cloud*; a file containing millions of points and representing the spatial organization of the objects from which the points were reflected. Typically several scans are conducted from strategic locations in order to create a more complete picture. Proprietary CAD software allows the user to take scans at various resolutions, giving them the flexibility to record important features in extremely fine detail, and less important features at a lower resolution. Scanning at lower resolution not only saves time in the field but also keeps the file size to a minimum to ensure easy manipulation of the model. Unlike the Total Station, the ScanStation records points indiscriminately which may in some cases make the former better suited for a particular application.

This technology has numerous applications in the field of heritage documentation. Emerging softwares allow users to manipulate the point cloud data and to generate 3D views, walkthroughs and extremely accurate plans, sections, and elevations. Point cloud data also has great analytical potential; allowing us to detect even the most subtle changes to the built environment over extended periods of time. If we imagine an accumulation of point cloud data over a span of a hundred years we begin to see even greater potential, such as the ability to visualize the morphology of the built environment. Heritage buildings that were previously difficult to document 3-dimensionally due to their unique textures, materiality or form can now be translated and recorded with survey-grade accuracy using LIDAR technology.

One obvious shortcoming of this technology is its superficiality. The scanner only records information on the surface. Within the field of heritage architecture, point cloud data alone isn't able to tell us a great deal about the internal structure or construction of a building. This is especially true of contemporary buildings, where complex steel structures aren't often expressed on the exterior of the building.

2.1.3 NextEngine Desktop 3D Scanner | Desktop scanners allow us to digitally capture smaller three-dimensional objects in full color with laser precision. The digital models produced are measurable and can be manipulated within digital environments, or they can be used to generate inverse mold files for replica castings.

At this point in time, three-dimensional desktop scanners present a number of limitations. One such limitation is their inability to capture the interiority of small or geometrically complex objects in which the scanning device cannot fit into. Like larger devices such as the ScanStation, desktop scanners only record superficial information which can be problematic when attempting to digitize intricate artifacts with a number of distinct internal components.

2.1.4 Dimension sst 1200es 3D Printer | Combined with the technology of the desktop scanner, researchers are able to replicate many delicate heritage artifacts without the use of invasive, traditional casting methods. Fragile artifacts can be scanned, converted into a mold file, printed, and used to fabricate replica castings.

2.1.5 Autodesk ImageModeler (Image-based Modeling) | ImageModeler is an image-based modeling and photogrammetry software that enables users to generate 3D models from 2D digital images. Extremely accurate 3D models require moderately expensive equipment such as low-distortion, metric cameras, however, reasonably accurate models can be achieved using inexpensive, consumer-grade cameras; making the technology accessible to a wide variety of industries, including that of Architectural Heritage.

Photogrammetry is the process of attaining measurements from photographs and was first developed in the late nineteenth-century for terrestrial purposes. By the early twentieth-century the technology was being used as an aerial tool for mapping, and by the 21st-century, new algorithms had been developed for a process called convergent photogrammetry which could calculate camera positions based on multiple photographs. These images could then be used to determine the 3-dimensional coordinates of points of interest within the photographs.[23]

Image-based modeling has been adopted by preservation researchers primarily because it allows them to digitally reconstruct buildings from the past based on historical photographs. Sourcing historical architectural drawings for measurements can be difficult if not impossible. Photographic records on the other hand are usually a more easily obtainable source of building information. Once a model has been constructed, the photogrammetry software becomes a useful tool for obtaining coordinates and calculating distances between points of interest.

2.1.6 Digital SLR Camera | In spite of more recent technological developments, the camera remains an extremely valuable tool for heritage conservation. As mentioned above, three-dimensional information can be drawn from photographs, but more importantly the camera is one of the best tools for capturing and conveying the overall feeling of a place and its people. Groups of photographs can establish powerful narratives that can communicate a great deal of information about a particular time and place.

2.1.7 Digital Video Camera | The are numerous applications for video recording in preservation research. It can be used to record physical conditions, to log construction tech-

---

[23] Robert Warden, "Towards a New Era of Cultural-Heritage Recording and Documentation," *APT Bulletin* 40, no. 3/4 (2009): 7.

niques, and to document events and interviews. More generally, video recordings can be assembled and edited to tell the story of a place and its people.

2.1.8 3D Modeling Software | Computer models are useful to heritage conservation in a myriad of ways. Computer-generated architectural models can contain a great deal of information in regards to materials, measurements, methods of construction, and spatial relationships. The process of constructing the computer model can be reflective of the physical construction of the building in the breakdown of components, assembly and layering. Unlike a point cloud model which groups all materials and building elements together in a single mass, 3D modeling software allows for each building component to be modeled, viewed, and manipulated individually. Models built with computer modeling software can provide an account of a building through detailed drawings, diagrams, videos, and interactive experiences.

2.1.9 Apple iPhone | Mobile smartphones will play an increasingly important role in heritage documentation. With the ability to generate and record high-quality photographs, video, text, and audio, users can make their own contribution to our cultural heritage. As Claudio Fogu points out, "the formation of collective memories or historical consciousness in the digital age will differ dramatically in a thoroughly interactive cultural environment in which individuals will no longer depend on centralized institutions . . . to develop their collective memories."[24] This of course raises a number of concerns in regards to the authenticity, validity, and accuracy of historical information, however, as always, it will ultimately be up to those at the receiving end of such content to determine its credibility and value.

Although it is possible that individuals won't have to rely on centralized institutions to develop their collective memories, it is more than likely that they will continue to depend on them for verification. For this reason, institutions with well established reputations will continue to play a key role in the shaping of our collective historical consciousness.

[24] Claudio Fogu, "Digitalizing Historical Consciousness," *History and Theory* 47 (2009): 104.

2.2 Platforms for the Preservation and Dissemination of Digital Data

This section examines a small selection of current practices and institutions dealing with the archiving, preservation and presentation of digital media and cultural assets.

2.2.1 Internet-Based Websites, Databases, and Initiatives

2.2.1.1 Virtual Museum of Canada (VMC) | The Virtual Museum of Canada (VMC) is a website that unites Canadian museum collections and assets. It contains virtual exhibits and interactive learning resources created by Canadian museums and galleries. The websites local history exhibits intend to capture Canadian community memories drawn from the collections of small museums and local residents.

Each *Virtual Exhibit* consists of an image gallery, a stories section, and a contact page which allows visitors to email the creators of the exhibit with questions or comments. Each photograph or scanned image is labelled with a title, date, and location and is accompanied by a brief textual and/or audio attachment.

The VMC is essentially a web portal in which small Canadian museums can store and exhibit their digital collections online. At its present stage of development, the VMC falls short of its aspirations of creating a "unique interactive space". This is partially due to the underdeveloped digital collections of the majority of small museums, and to an exhibit platform that isn't conducive to creating an engaging, interactive experience.

The *VMC Lab* section of the page exhibits a small number of exploratory projects initiated by Canadian museums. The purpose of this page is to showcase more advanced developments in the online museum experience. The featured VMC Lab projects demonstrate a much more sophisticated level of interaction, however the cost of developing such sites remains prohibitive to the majority of Canadian museums.

2.2.1.2 Artefacts Canada | Artefacts Canada is a national collective resource containing more than 3 million object records and 580,000 images from museums across the country. The collection includes a diverse set of assets pertaining to archaeology, decorative arts, fine arts, ethnology, and history.

Object records list title, name of object, object type, classification, material, accession number, latest production date, description, narrative, history of use, institution, institution city, institution province, and copyright. At this point, less than 20% of the records are accompanied by a photograph; doing little more than acknowledging the existence of a particular artifact in a particular place. There still remains the question of how to access artifacts of interest once they have been identified.

2.2.1.3 Canada's Historic Places | The Historic Places Initiative (HPI) is a federal, provincial, and territorial collaboration established to address the need to conserve Canada's historically significant places. The initiative has been successful in establishing a strong foundation for the recognition and appreciation of our built heritage.[25]

Each listing contains supporting documentation including links, cross references, images, a detailed statement of significance, location information, and historical information. The statement of significance explains why each place has been identified by the community as having special heritage value, and defining characteristics are listed to promote the conservation of culturally important features. The register is remarkably comprehensive but lacking in terms of its interactivity. Listings might however serve as a portal to more interactive sites and exhibits relating to the building. A *Virtual Exhibitions* page has been initiated but is presently underpopulated, containing only one exhibition.

The Canadian Register of Historic Places (CRHP) regulates the recognition of heritage places through a well established set of standards and guidelines. Going back to an earlier paragraph, these standards and guidelines are an important part of the verification process.

---

[25] Canada's Historic Places, *Historic Places Initiative: Report on Results* (Gatineau: Parks Canada, 2008), 1.

2.2.1.4 Google SketchUp, 3D Warehouse, Earth | Google SketchUp is a free, general purpose 3D content creation tool that is designed to be easy to learn and use. 3D Warehouse is a feature of SketchUp that allows users to either search and download models made by others, or to make their own contribution to the collection. Google Earth is a virtual globe, map and geographic information program that allows SketchUp users to geographically place building models into a global context.

Google's stated mission from the outset was to organize the world's information and make it universally accessible and useful. Combining the three softwares mentioned above, one is able to create 3D content, store, and disseminate the information at a global scale. Contributions made to 3D warehouse consist of a building model, relevant links, a searchable title, and a short description; all of which can be viewed, downloaded, edited, and employed by others who may be able to use the assets in a way that is inconceivable to the contributor. At this point in time SketchUp files are perhaps the most universally accessible, and Google Inc. is a leader in terms of data management. Placing the 3D content into this domain opens up a whole new set of possibilities for future developments. The hope is that others might be able to somehow employ the models in a way that is beyond the capabilities of the contributor.

2.2.2 Physical Museums

2.2.2.1 The John Soane Museum, London | John Soane's Museum in London presents a diverse collection of artifacts in a non-linear and fragmented manner. Soane acquired and rebuilt three adjoining buildings between the years of 1792-1824 to house the collection. The house, museum and library has been a public museum since the early 19th century, when upon his appointment as Professor of Architecture at the Royal Academy in 1806, Soane began to arrange books, casts and models for his students to study before and after lectures. By 1827 Soane's collection was being referred to as an 'Academy of Architecture'.

2.2.2.2 Canadian Centre for Architecture (CCA) | The Canadian Centre for Architecture is an international research centre and museum founded on the conviction that architecture should be a public concern. The CCA promotes public understanding and architectural discourse through its extensive collection, exhibitions, programs, and research opportunities.

2.2.3 Research Projects

2.2.3.1 Design of a Hand-Held Interactive Support for Museum Visitors | In a proposal by C. Ciavarella and F. Paterno, the growing availability of Personal Digital Assistants (PDA) is considered in the museum context.[26] They investigate how to exploit the devices in order to provide museum visitors with supplementary information while moving through the museum space. It is noted that this type of support is typically disseminated by means of a kiosk or by an audio device. The problem that they see in the kiosk is that it is static and immobile. The problem with the audio devices is that they only allow the user to hear predefined audio clips associated with the collection or artifacts.

A number of limitations associated with location-aware systems are identified. Often, an interactive interface changes in an attempt to better support the user, but in doing so it inadvertently causes disorientation and confusion. For example, perhaps the device is providing information on the closest work of art to the visitor when in fact they're looking at another. They also mention the expensive nature of such systems in terms of the initial investment and ongoing maintenance costs.

2.2.3.2 "Architectural Anatomy" Interface | In a paper presenting their preliminary work, five researchers from Columbia University discuss a concept for an augmented reality system designed to improve methods of construction, inspection and renovation for

---

[26] C. Ciavarella and F. Paterno, "Design of a Hand-Held Interactive Support for Museum Visitors," in *Digital Applications for Cultural Heritage Institutions*, ed. James Hemsley, Vito Cappellini and Gerd Stanke (Aldershot: Ashgate Publishing Limitied, 2005), 267.

architectural structures.[27] The augmented reality system is called *Architectural Anatomy*, and its primary purpose is to show users the portions of a building that are hidden behind architectural and structural finishes. Secondarily, the system provides additional information on the hidden objects. Architectural models provide the data for use in this "x-ray vision" demonstration system. The models are based on as-built construction drawings provided by architects. The prototype application overlays a graphical representation of portions of the building's structural systems over a user's view of the room in which they are standing.

2.3 Location-Aware Devices and Applications

Location-aware computing refers to a category of systems that are able to sense the location of a device and deliver programming and digital content in response to this information. Such devices employ GPS, cell phone infrastructure, and wireless access points to identify their geographic location. Navigation devices are likely the best known example amongst this string of technology. The GPS device continuously monitors its current location and provides the user with directions based on the location of the device. A significant reduction in the cost of location sensor technology has brought about an explosion of interest in location-based services. Cell phones have become ubiquitous, and at this point, many have incorporated location-finding technology. The latest Apple iPhone combines a number of sensory technologies which expand the possibilities for location-aware applications even further. The device integrates GPS technology with an accelerometer, compass, and 3-axis gyroscope; which when combined can provide extremely precise positional information. The accelerometer technology senses the movement of tilting from side to side and backward and forward. The gyroscope allows users to virtually pivot around a digital three-dimensional object.

Location-aware applications deliver digital content to users based on their physical location. If users choose to share their positional information with a location-aware applica-

---

[27] Steven Feiner et. al., "Architectural Anatomy," *Presence: Teleoperators and Virtual Environments* 4, no. 3 (1995)

tion, the application can then act as a location-based filter, delivering content specifically related to the users geography. Location-aware applications have a strong potential to enhance cultural heritage awareness and understanding.

2.3.1 Mobile Applications

2.3.1.1 WIKITUDE World Browser | Wikitude World Browser is an augmented reality browser built around location-based Wikipedia and Qype content. It is a useful application for discovering significant landmarks within ones surroundings. Thousands of world-wide points of interest are made searchable by GPS or by address and displayed in a list view, map view, or "augmented reality" camera view.

2.3.1.2 Theodolite | Based on a centuries-old measuring instrument, Theodolite is a multi-function augmented reality application for mobile devices that serves as a compass, GPS, map, zoom camera, rangefinder, and two-axis inclinometer. Theodolite overlays real time information about position, altitude, bearing, and horizontal/vertical inclination on the mobile devices live camera display. Its uses range from land surveying to navigation.

The users directional bearing is updated live on the map with both fixed view and world rotation. The application also includes an "A-B" calculator which is useful for computing the height of landmarks, the distance to landmarks, triangulating position, showing relative angles between observations, and for showing two points on a map.

2.3.1.3 Museum of London Streetmuseum | This mobile application frames hundreds of images drawn from the museum's collection within their original, physical context. As users hold their location-aware multi-media device up to a present day scene of London, a historical photograph taken from a similar vantage point is displayed on screen. This application might be thought of as a veritable window through time.

2.3.1.4 Virtual Graffiti | This application allows users to overlay digital annotations and graphics to physical locations, landmarks and surfaces. The Virtual Graffiti application utilizes location-aware technology to attribute geographic information to the digital overlay. Uploaded digital overlays become viewable through other mobile devices and PDA's. Virtual Graffiti is a novel initiative aimed at delivering digital messages to mobile devices based on the location and identity of the user.

2.3.1.5 Stinky Rag | Stinky Rag is a location-aware mobile application that displays restaurant health inspection reports based on the users physical location. The data is drawn from the state health departments website.

2.3.1.6 NaviCAD | This application allows users to download and view 3D models from Googles 3D warehouse. The application has a location-aware option which delivers search results corresponding to the users location.

Based on this appraisal of current technologies and best practices, the following criteria have been established for the creation of an Exhibit on Canadian Ethno-Cultural Architecture:

1. the exhibit must tie into established frameworks and existing data networks

2. the exhibit must be interactive

3. the exhibit must allow visitors to make their own personal contribution

4. the exhibit must make use of location-based technologies to provide information that is relevant to the visitors physical environment

5. computer-generated imagery must be supplementary to the physical experience

3. An Exhibit on Canadian Ethno-Cultural Architecture

The fundamental role of Architecture is to arrange bodies in space.[28]

This chapter outlines a proposal for an exhibit that employs location-based technologies to organize and present digital heritage assets. Various forms of digital media relating to a selected heritage building will be ascribed to the physical site to establish an interactive Exhibit on Canadian Ethno-Cultural Architecture. The *Apple iPhone* serves as a hypothetical platform for the exhibit. The exhibit is comprised of a collection of location-aware applications that present the visitor with digital cultural assets based on their physical location. Users are able to customize the exhibit to their specific interests by choosing which applications to download to their mobile device. The internet and the desktop computer allow people to interact remotely and indirectly. Location-based services present an opportunity to counter this, thereby reinforcing the value of the physical experience of heritage architecture. Rather than substituting a "virtual" experience for a physical experience, this exhibit aims to augment the experience through the use of digital technologies. The physical building and its surroundings remain central to the overall experience. Supplementary information is presented in the periphery via the mobile multi-media device.

The Architectural Heritage Society of Saskatchewan believes that "people will preserve what they know and value."[29] If we are to have any long-term hope of conserving heritage buildings, it is imperative that we establish tangible relationships with these places of cultural importance.

---

[28] Malcolm McCullough, *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing* (Cambridge: The MIT Press, 2004), 90.

[29] Architectural Heritage Society of Saskatchewan, "The Gift of Heritage," http://www.sahs.ca/

The exhibit has been hypothetically inserted into an existing framework established by the *Historic Places Initiative* (HPI) as illustrated in figure 2. It has also been assigned within a national context in order to suggest the possibility of a more comprehensive exhibition. Grey backgrounds in figure 2 indicate a branch of the exhibition that is outside the scope of the proposal.

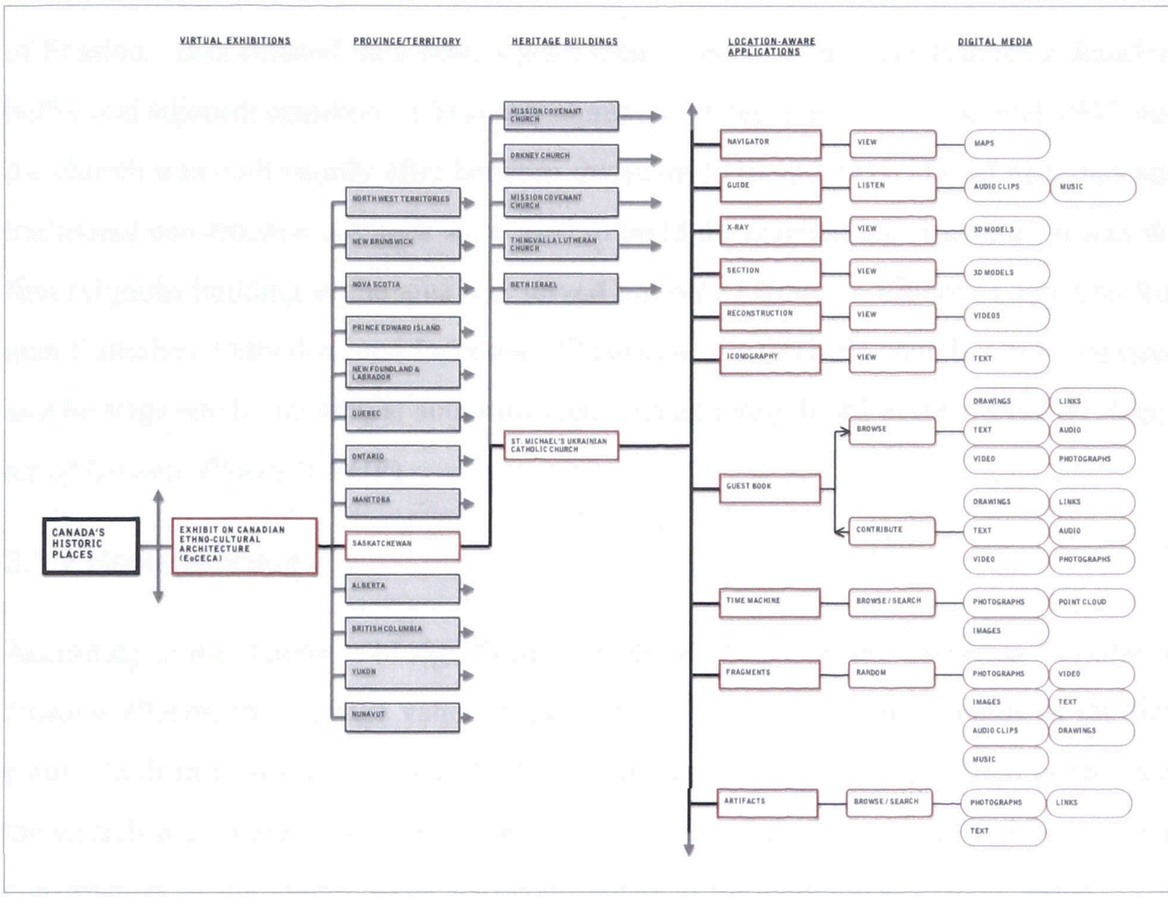


Figure 2. Hypothetical exhibition structure

3.1 St. Michael's Ukrainian Catholic Church

3.1.1 Description

The Ukrainian Catholic Church of St. Michael the Archangel is located in rural Saskatchewan, approximately 180 km due east of Saskatoon, not far from the small village of Fosston. It is situated on a 8093 square meter parcel of land and features a detached belfry and adjacent cemetery. Ukrainian immigration began in the area around 1907, and the church was built shortly after between the years 1910 and 1911. Local materials and traditional construction methods were used to build the original log structure. It was the first religious building in the area and served not only Ukrainian Catholics, but also Roman Catholics, Orthodox, and Protestant Christians. In 1992 the church was recognized as a heritage site by municipal authorities and it is currently listed in the *Canadian Register of Historic Places* (CRHP).

3.1.2 Heritage Value

According to the statement of significance for St. Michael's on the *Canadian Register of Historic Places*, the heritage value of the building lies partially in its status as the first church built in its district.[30] Built by Ukrainian immigrants who had settled in the area, the church was modeled after the churches of the Ukraine. The unique architecture and construction of the church have also contributed to the building's heritage value. The central dome is a typical feature, however, this particular building differs from most other Ukrainian Catholic churches in that it does not have a transept roof to form the traditional cruciform volume and because it was constructed of logs.

---

30 Canada's Historic Places, "Canadian Register of Historic Places: St. Michael's Ukrainian Catholic Church," Government of Canada, http://www.historicplaces.ca/visit-visite/com-ful_e.aspx?id=2671.

3.1.3 Defining Characteristics

The following character-defining elements have been documented in the CRHP's statement of significance:[31]

1. the features reflecting the building's use as a place of worship, including the interior arcades and pilasters and the cross on the roof;

2. the headstones and the defined open green space of the cemetery;

3. the elements that reflect the property's status as a rural church, including the simple form, log construction, and the limited massing and exterior ornamentation;

4. the elements that relate to Ukrainian church architecture, including the vaulted ceiling, cruciform layout and the central dome; and

5. the simple form and wood-frame construction of the detached belfry.

---

[31] Canada's Historic Places, "Canadian Register of Historic Places: St. Michael's Ukrainian Catholic Church," Government of Canada, http://www.historicplaces.ca/visit-visite/com-ful_e.aspx?id=2671.

2009

St. Michael's Ukrainian Catholic Church
Ponass Lake, Saskatchewan

Figure 3. St. Michael's Ukrainian Catholic Church, Saskatchewan

3.1.4 Construction

The original building was constructed in 1910 using local logs and a traditional mud plaster. A nearby homestead was similarly constructed giving a good indication as to what lies behind the churches wooden lap siding. Rough-cut logs were fitted together using a traditional fishtail joint as illustrated in figure 4. The roof structure consists of lumber trusses which bear on the log walls. Figure 5 reveals the construction of a barn roof at nearby homestead. By 1915 the congregation had grow significantly and three appending wood frame additions were added to the original log structure. Subsequently, the entire building was clad with a milled siding and trim.

Figure 4. Traditional log joint used at a nearby homestead

Figure 5. Barn roof construction at a nearby homestead

3.1.5 A Brief History

Following a successful campaign to attract new immigrants to Canada, over 400,000 people immigrated to the province of Saskatchewan between the years 1901 and 1916.[32] Ukrainian settlement began in the Ponass Lake area sometime around 1907, and by 1911, construction on St. Michael's Church was well underway. The church would be the first in the Rural Municipality of Ponass Lake.

The congregation was large and active for many years, but as time went on other churches were built in the area, elders began to pass away, and many people from the younger generations relocated, leaving the church with few members. The final church service was held in 1975, after which time the church began to quickly deteriorate.

---

32 S. Fai, "Material Imagination and Religious Architecture in Saskatchewan," (paper presented at the 2nd International Conference on Heritage and Sustainable Development, Evora, Portugal, June 22-26, 2010).

The building was then completely restored in 1992 following a generous donation to the church fund. Later that year, the church was officially designated as a heritage site.

A few short years later, in 1995, the church was struck by lightning causing significant damage to the building. Donations and a government grant made it possible to repair and restore the church once again.

3.2 Building the Dataset (creating)

This section will give an overview of the dataset and touch upon a few of the inherent qualities in each of the various types of media. What does one type of media reveal or communicate to us that another might not? How might different forms of media and data be combined to create something new? How and what do they contribute to our experience and knowledge of the building, whether individually or in combination with other types of media?

3.2.1 Digital Model

As mentioned earlier, 3D modeling software allows us to build models which can afterwards be utilized in a variety of ways. They are most often used to generate photorealistic 2-dimensional imagery, video animations, construction documents, and interactive environments. Digital reconstructions can also be used however as a means of understanding a building's history, as suggested in a conference paper by the CAD Research Group at the University of Montreal.[33] The paper suggests that digital modeling can be used as a way of transferring historical information, skills, and techniques relating to construction methods used in the past.

The digital model for St. Michael's Church (see fig. 6) was constructed using Google SketchUp and used measurements drawn from a variety of on site documentation. Hand measurements were recorded in both sketches and photographs. Longer and more difficult measurements were taken with a laser *Leica Disto*. Key points were identified and recorded using a *Leica Total Station*. The *Total Station* data was layered into the model and used as a guide in the digital reconstruction.

The model has been constructed and layered in a way that is reflective of the actual building components and construction processes. Each piece of the building was modeled as its own unique entity and assigned a color that is representative of its materiality. The pieces are then grouped together to create larger building components (such as doors and windows) and added to a layer dedicated to the corresponding stage of construction. The layering taxonomy has been set up in a way that allows others to comprehend the different materials, components, stages of construction, and building phases through manipulation. This was achieved using the following taxonomy:

<year of construction>_<sequence number><sequence modifier>_<stage of construction>_<building element>_<material>_<part description>_<part modifier>

---

33 El-Khoury Nada, De Paoli Giovanni, and Dorta Tomas, "Digital Reconstruction as a means of understanding a building's history - Case studies of a multilayer prototype," (paper presented at the 24th eCAADE Conference, Volos, Greece, September 6-9, 2006).

The following gives an example of a typical layer label:

1910_06b_framing_roof_lumber_trusses

The model file itself contains a great deal of information that can either be imported into another project, or simply opened and manipulated as a means of understanding the construction of the heritage building.

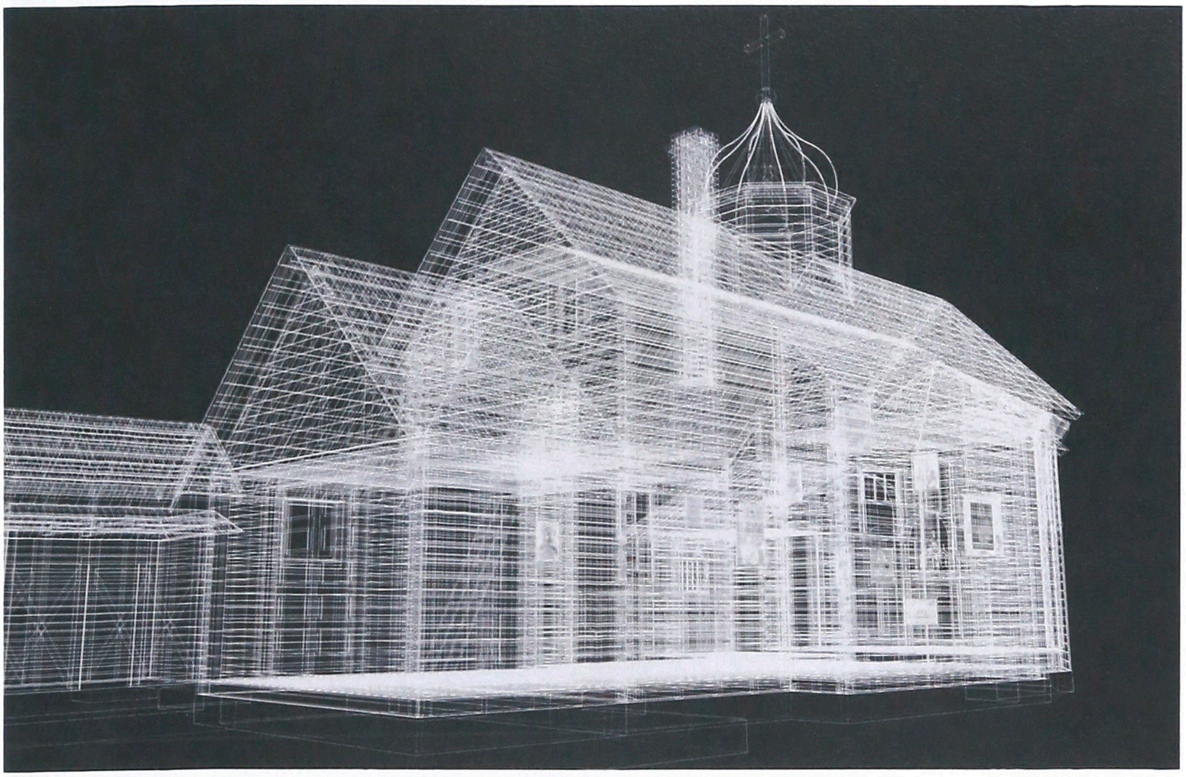


Figure 6. Wireframe view of digital model

3.2.2 Digital Photographs

Digital photographs have been utilized in a variety of ways throughout this project. They have been used to record measurements taken on site, to document the existing conditions of the building for comparison with past conditions, to capture the likeness of area residents and church members, to record the documentation process, to document materials and construction details, and to communicate a sense of place.

The following assemblage of photographs conveys a great deal of information; information that isn't present in the digital model. The photographs record colors, textures, details, weather, mood, light, conditions, and materiality. The images have been printed at various scales which is reflective of the way in which a persons eyes might assess their surroundings. The group of photographs does not give a sense of space, but rather a sense of place. Combining this information with the *SketchUp* model, we begin to get a feel for the building and its surroundings.

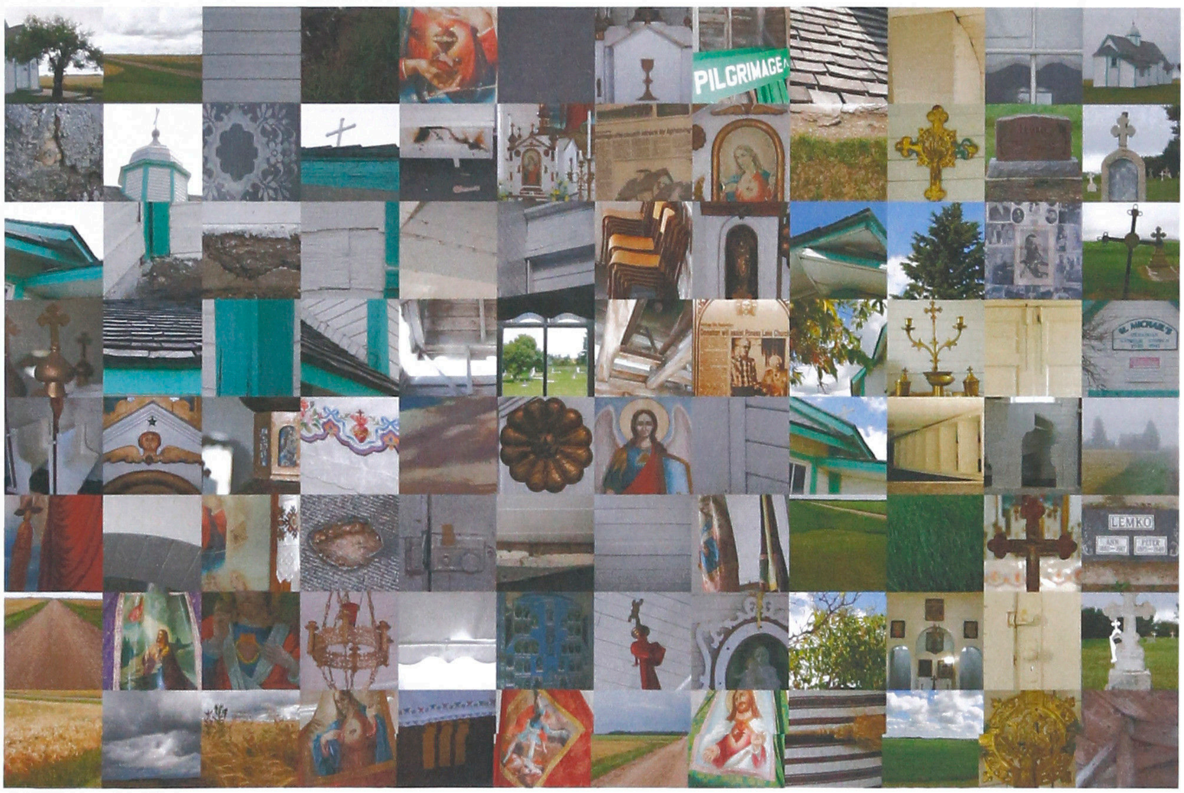


Figure 7. Photo assemblage

3.2.3 Text

The calligram below was pieced together to describe the various elements of Ukrainian Church architecture and their religious significance within the specific context of St. Michael's Church. Each fragment of text relates to a certain area of the church and has been positioned accordingly within the plan.

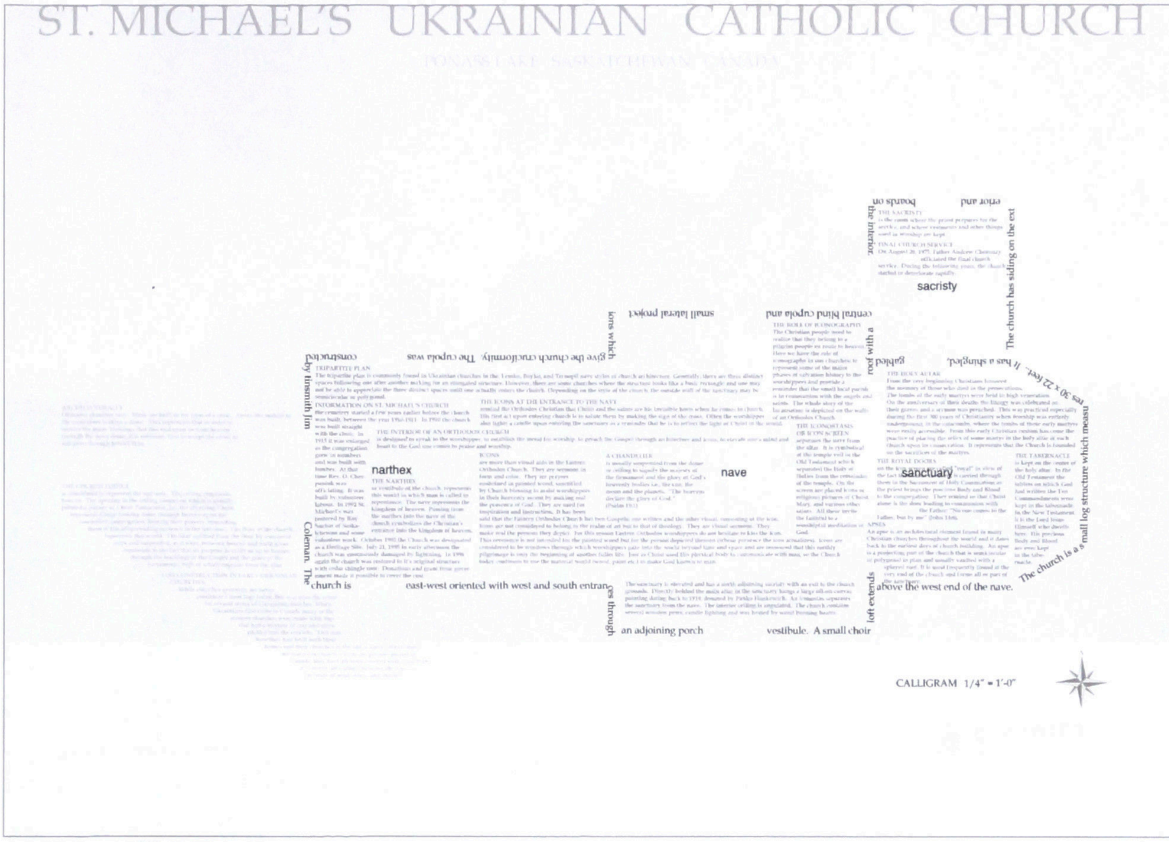


Figure 8. Calligram

3.2.4 Digital Images

A variety of images have been generated using the digital model as the root source of information. The following panels and images have been produced to communicate building materials, architectural elements, and construction processes.

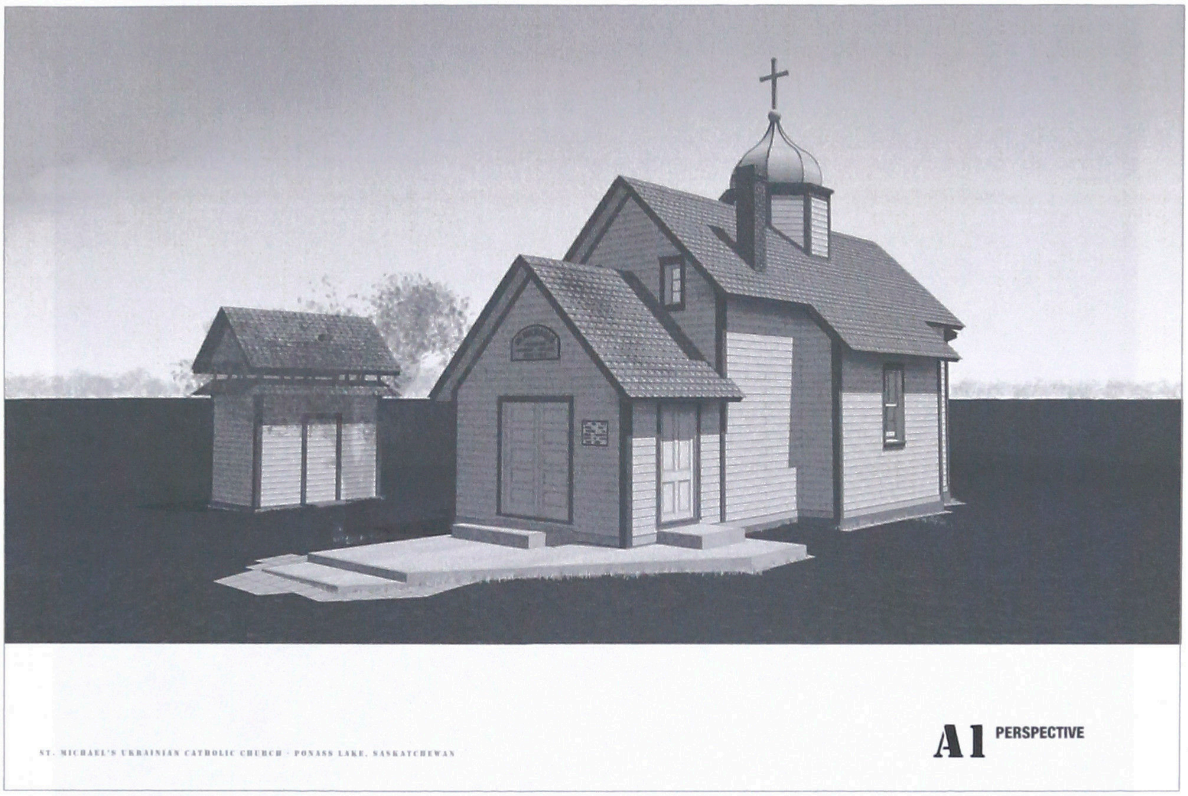


Figure 9. Perspective

Figure 10. Perspective Section

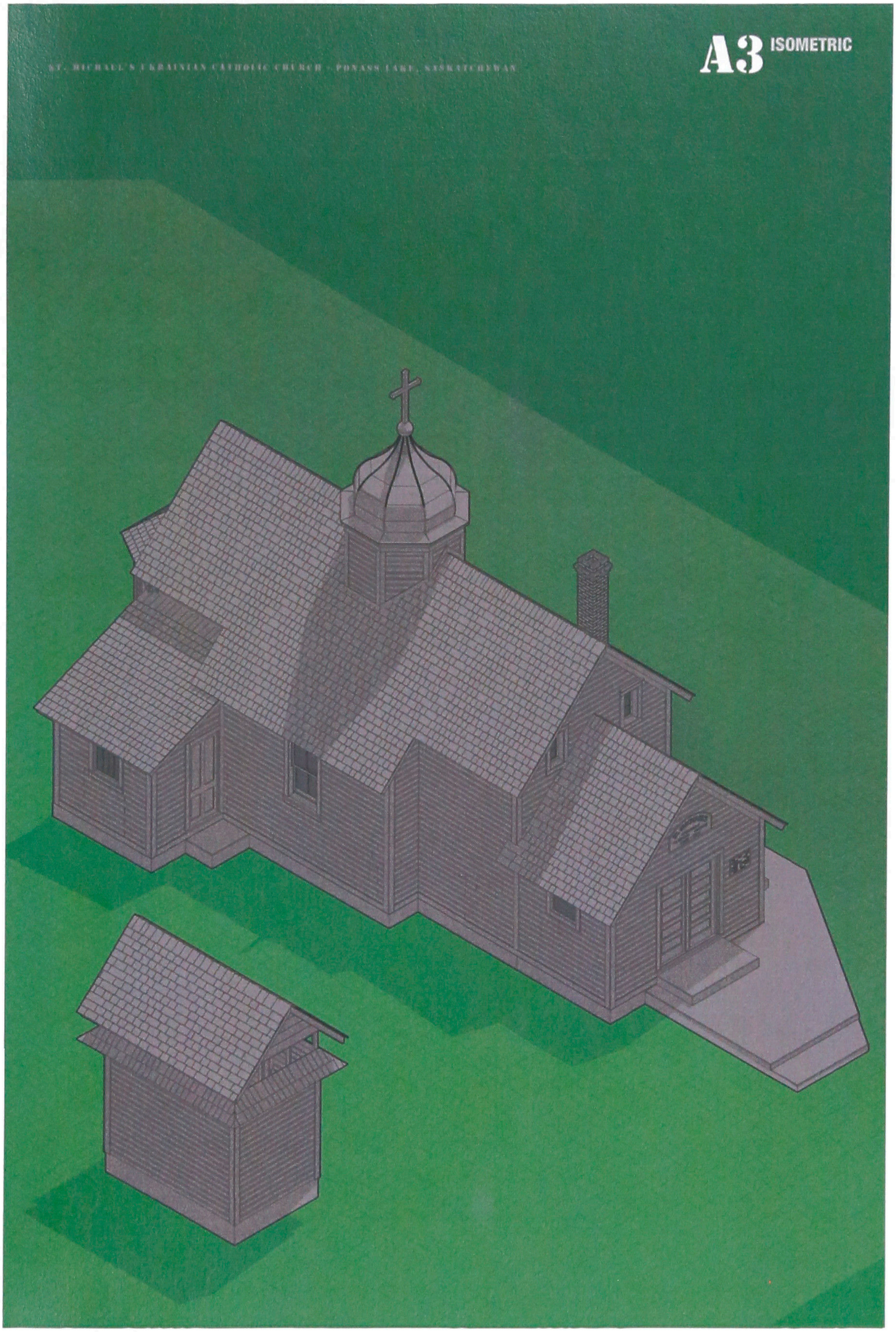


Figure 11. Isometric

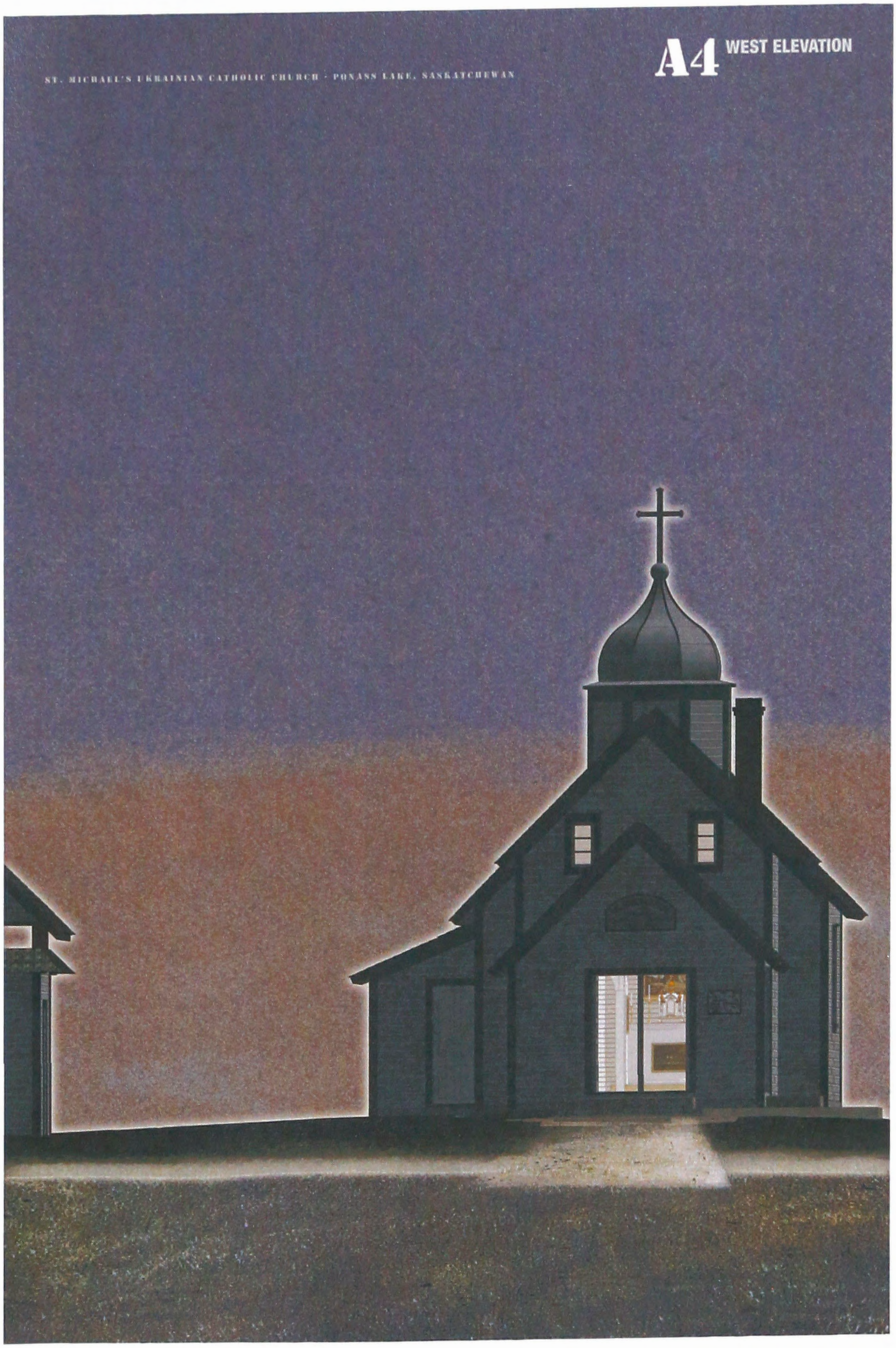
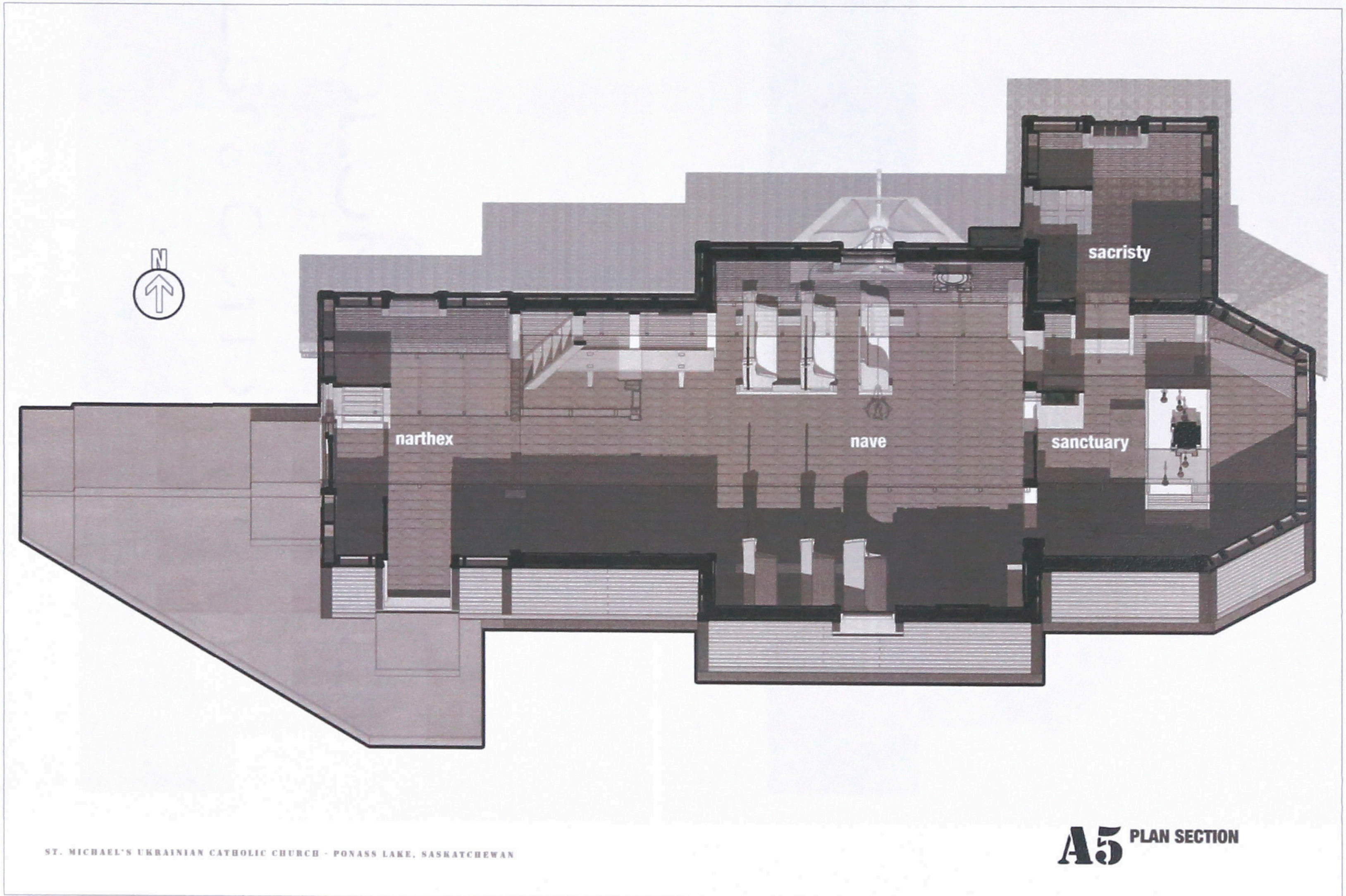


Figure 12. West Elevation

Figure 13. Plan Section



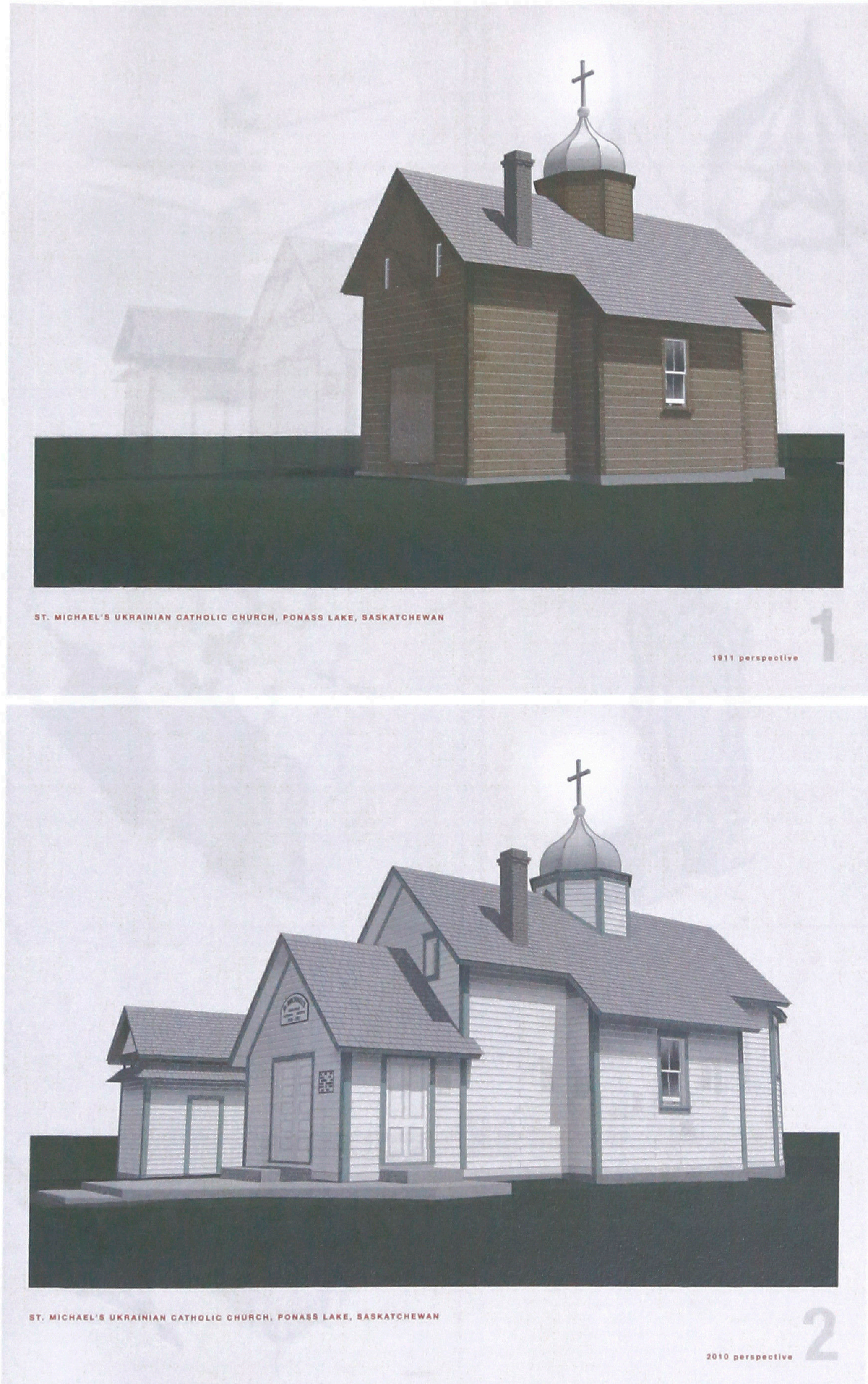


Figure 14. Perspective drawings showing building phases

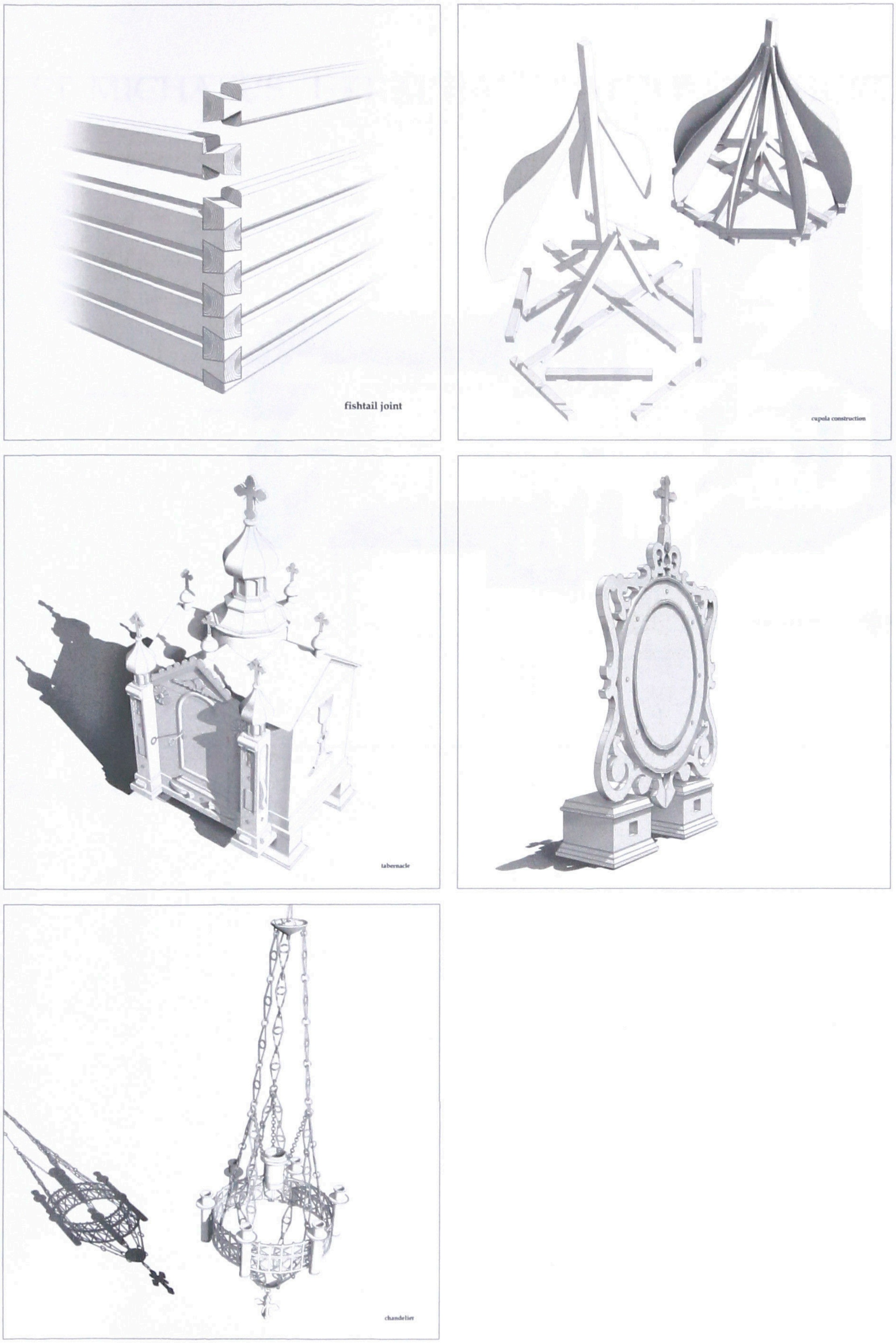


Figure 15. Detail drawings

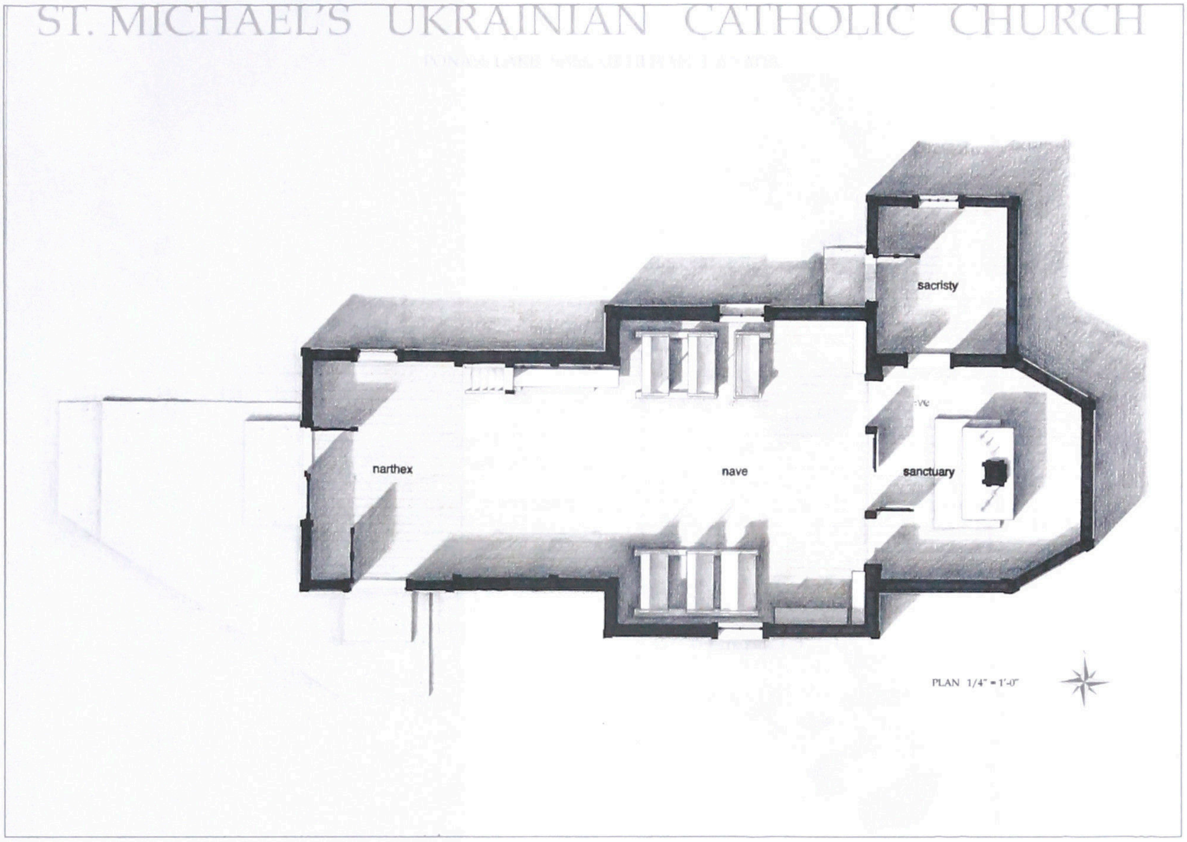


Figure 16. Plan drawing

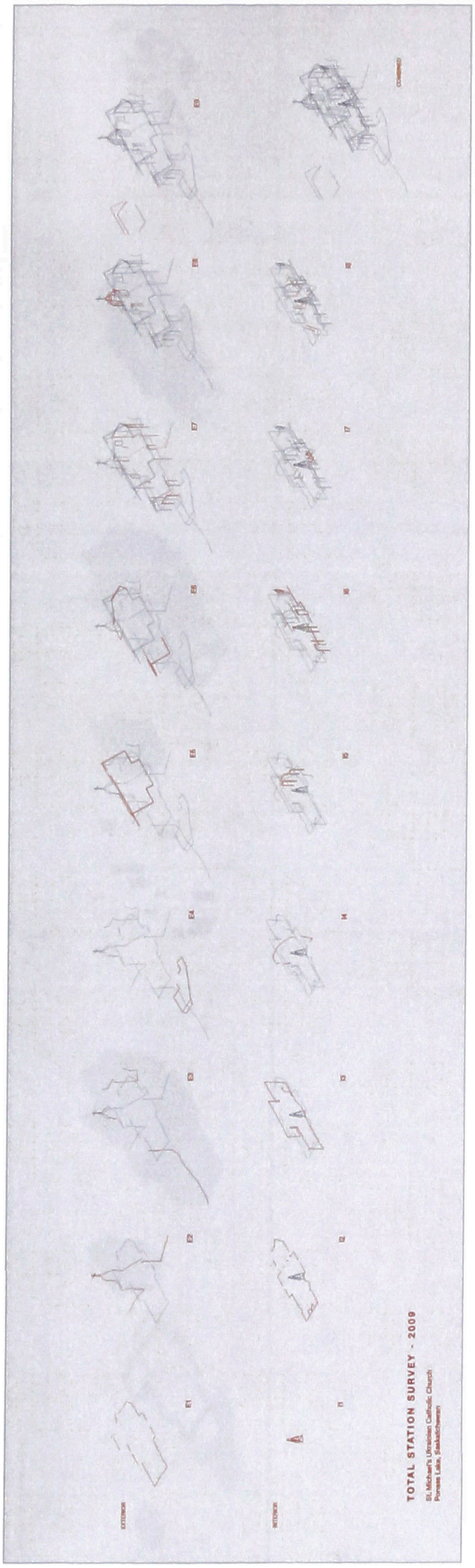


Figure 17. Total Station survey process

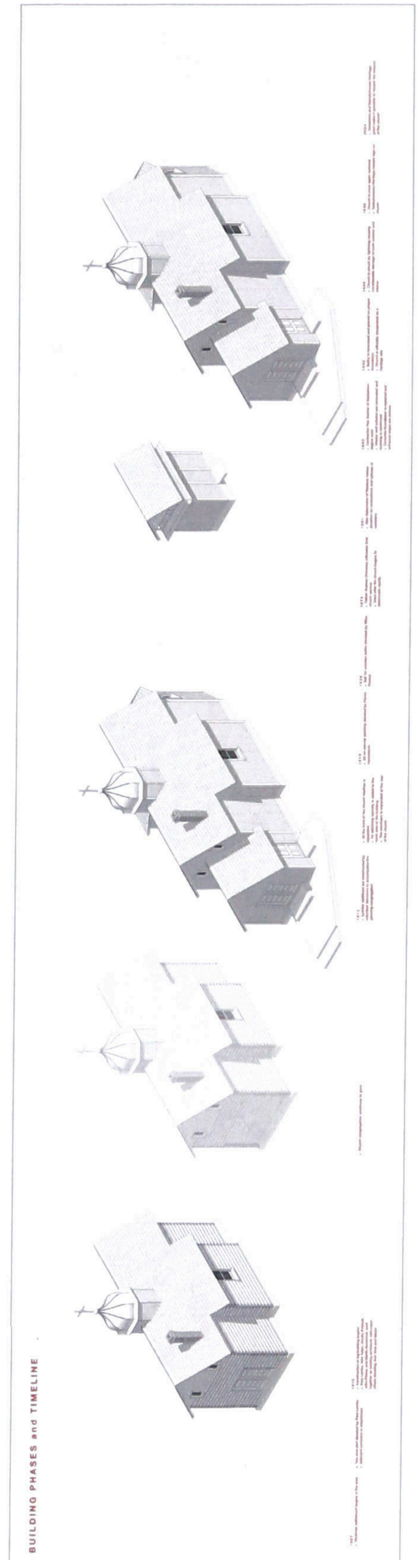


Figure 18. Building phases and timeline

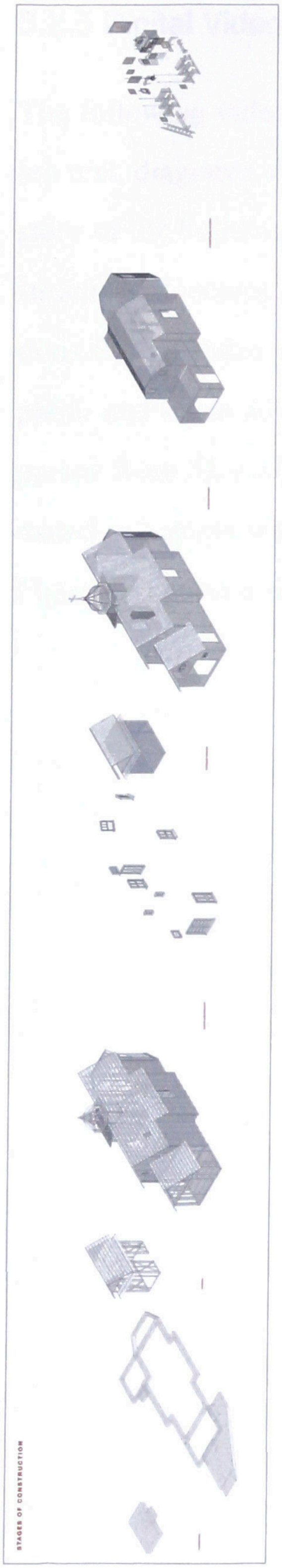


Figure 19. Stages of construction

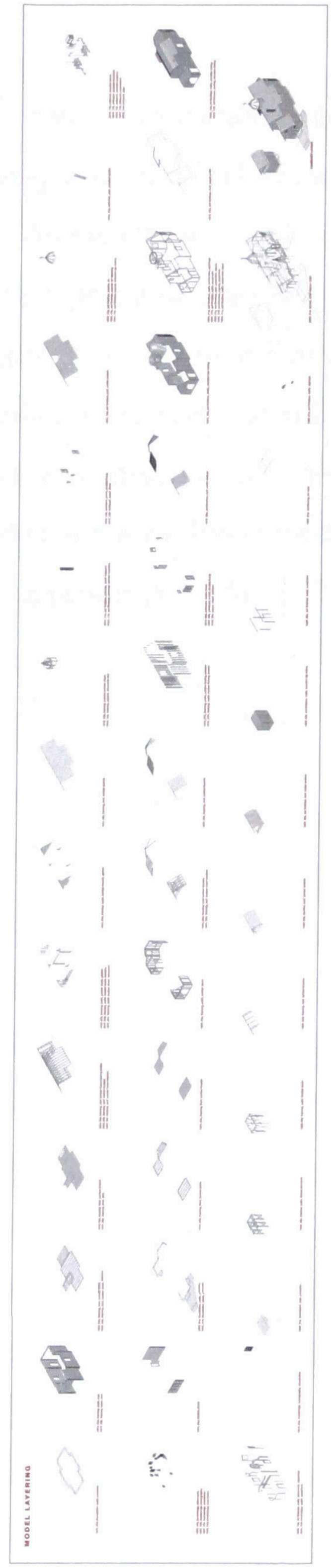


Figure 20. Model layering

3.2.5 Digital Video

The following video combines photographs, animated construction sequences, hand written text, diagrams, drawings, dimensions, newspaper articles, and music, to tell a detailed story of the buildings history and construction. Animations are used to demonstrate construction processes as well as the buildings development throughout time. The animations in this video were created using the digital *SketchUp* model in combination with photo and video editing software. Short animation sequences and still images were exported from *SketchUp* and imported into the video editing project. From here the animated sequences were layered together with other forms of digital media and annotated. Figure 21 shows a selection of frames. Refer to appendix A.1.2 for the DVD video.

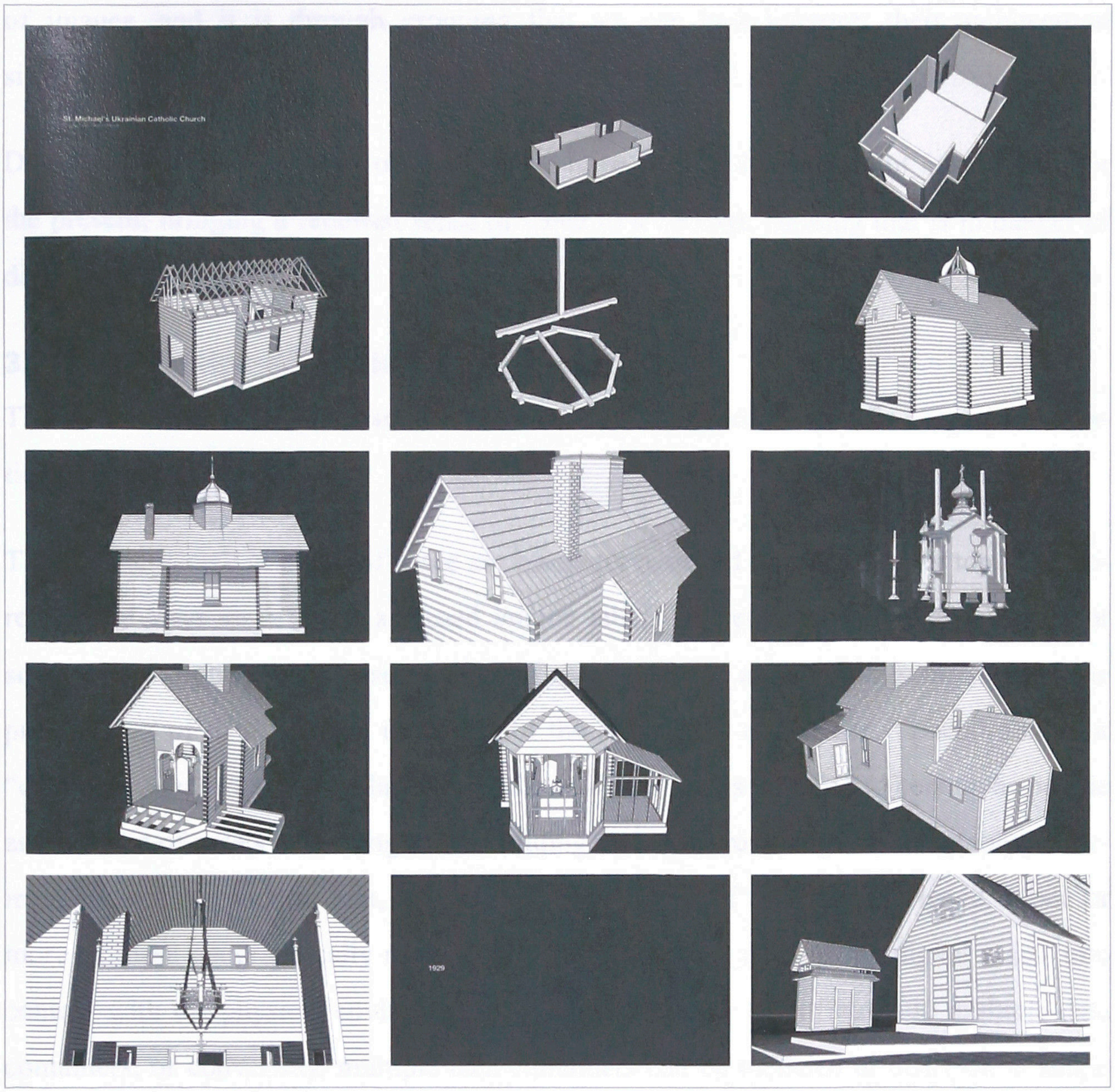


Figure 21. Selection of frames from construction animation

■■■

Each part of the dataset contributes its own interdependent piece of the puzzle. As demonstrated above, the more diverse the dataset, the more nuanced the meaning. Diverse datasets present multiple perspectives, and allow those at the receiving end to arrive at their own unique understanding of the building. As suggested in Blau and Kaufman's introduction to *Architecture and Its Image*, architectural representations consist of groups of images, and it is through grouping that we can best interpret their architectural significance.[34]

Drawing on small fragments of the past, we have produced a new set of information for the present; bringing a renewed sense of value to a heritage building that is in danger of disappearing.

3.3 "Data Container" Modeling (organizing)

This section describes how various media files are attributed to specific geographic locations.

Three-dimensional volumes of space are computer modeled (preferably over top of a geo-referenced base model) and assigned unique labels for referencing within the code or script of the application. These volumes of space establish an invisible framework for the presentation of data, and the unfolding of the augmented experience. Each volume or "data container" may be regular or irregular in shape, and is modeled to contain a specific asset, or set of assets pertaining to the building and its surroundings. Photographs, drawings, audio clips, videos, text, models, and other forms of media are assigned to one or more of these geographically referenced volumes, putting each of the digital assets into context with the physical environment. A single file may be attributed to multiple data containers, or conversely, multiple data containers can be modeled to distribute a single file. The more detailed and accurate the base model, the more articulate the data containers might be; and hence the more nuanced the overall experience.

Once the assets have been spatially organized, location-based applications can be developed to reference and (re)present the media within its assigned context. When a location-aware device enters into the geographic boundaries of a data container, information attributed to that volume is made available to them via the various applications that reference the data. When a device exits the boundary, all attributed data is once again "hid-

[34] Eve Blau and Edward Kaufman, ed., *Architecture and Its Image* (Montreal: Canadian Centre for Architecture, 1989), 13.

den" from the visitor. The overall experience is therefore not one of "immediate transparency", but rather one of covering and uncovering, creating a game of emergence and disappearance.[35]

The following sequence of images (fig. 22 - fig. 26) demonstrates the basic principle behind data container modeling. As the visitor moves through the physical building with their location-aware device, various sets of cultural assets are made available to them. The first of the figures (fig. 22) shows the base model in which the data containers are then modeled on top of.

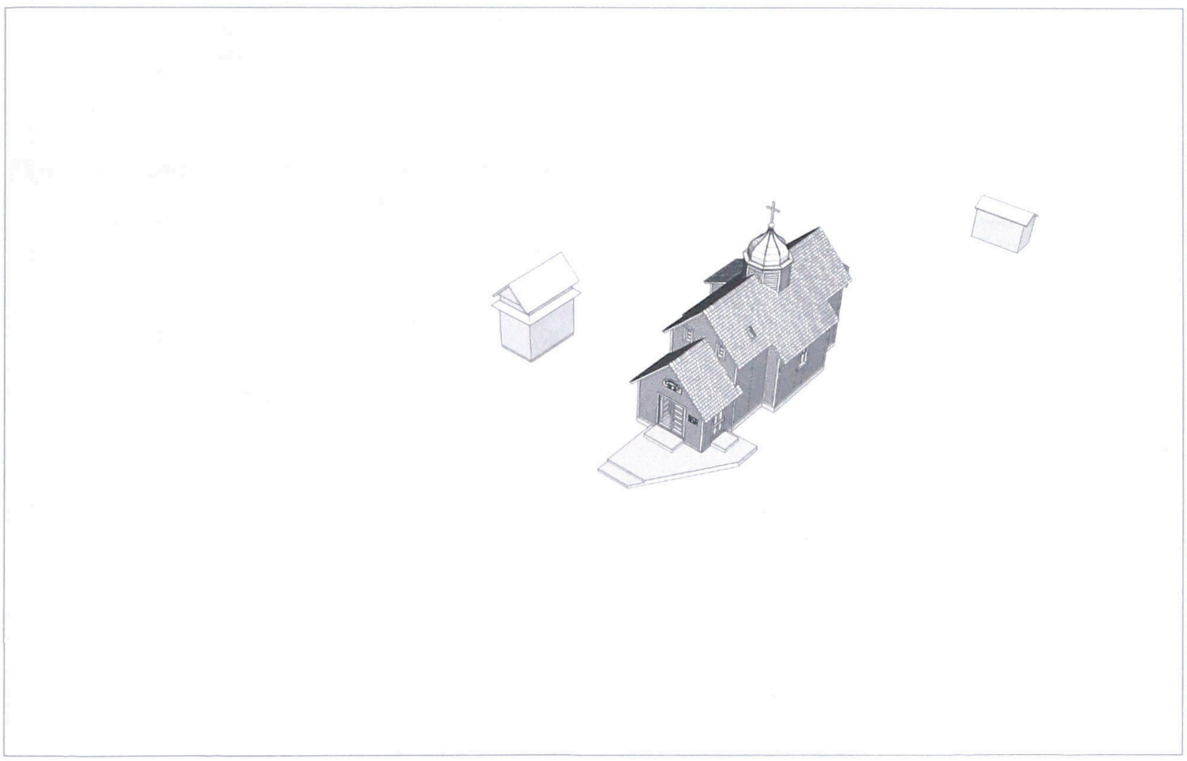


Figure 22. Base model for data container modeling

[35] Jean Baudrillard, *The Ecstasy of Communication*, trans. Bernard and Caroline Schutze (New York: Semiotext(e), 1988), 32.

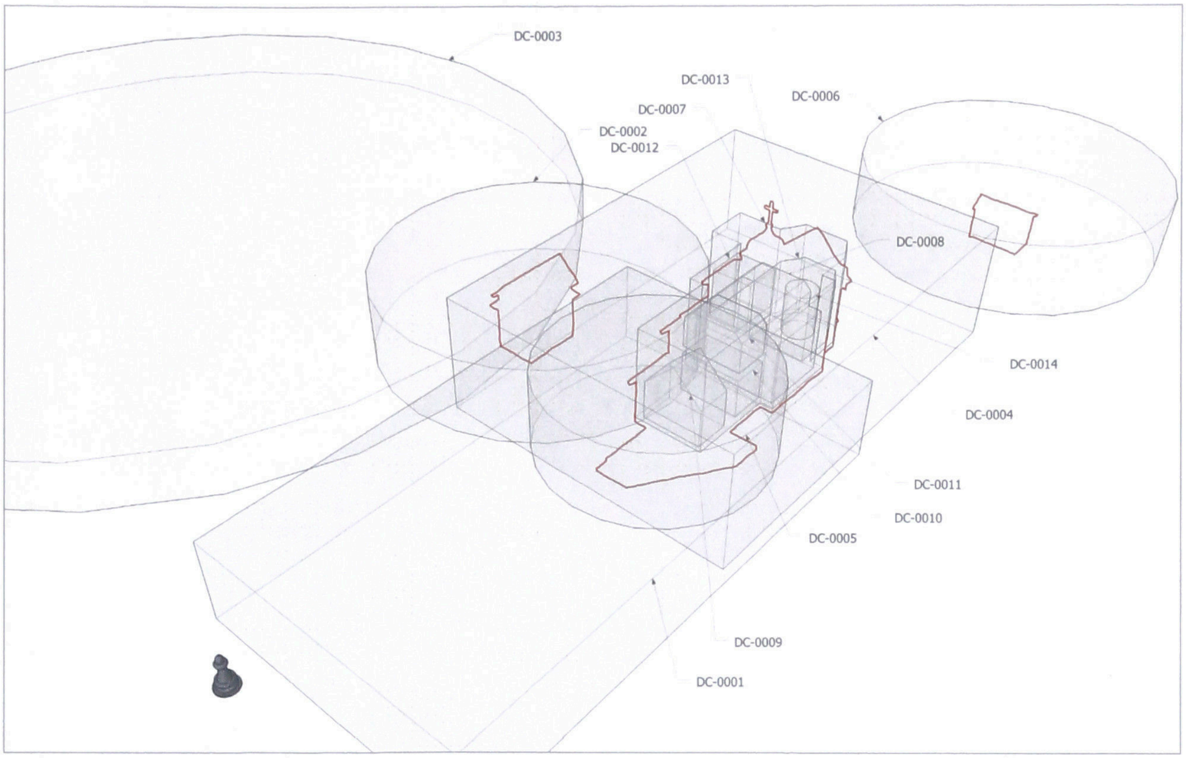


Figure 23. data container modeling - no active volumes

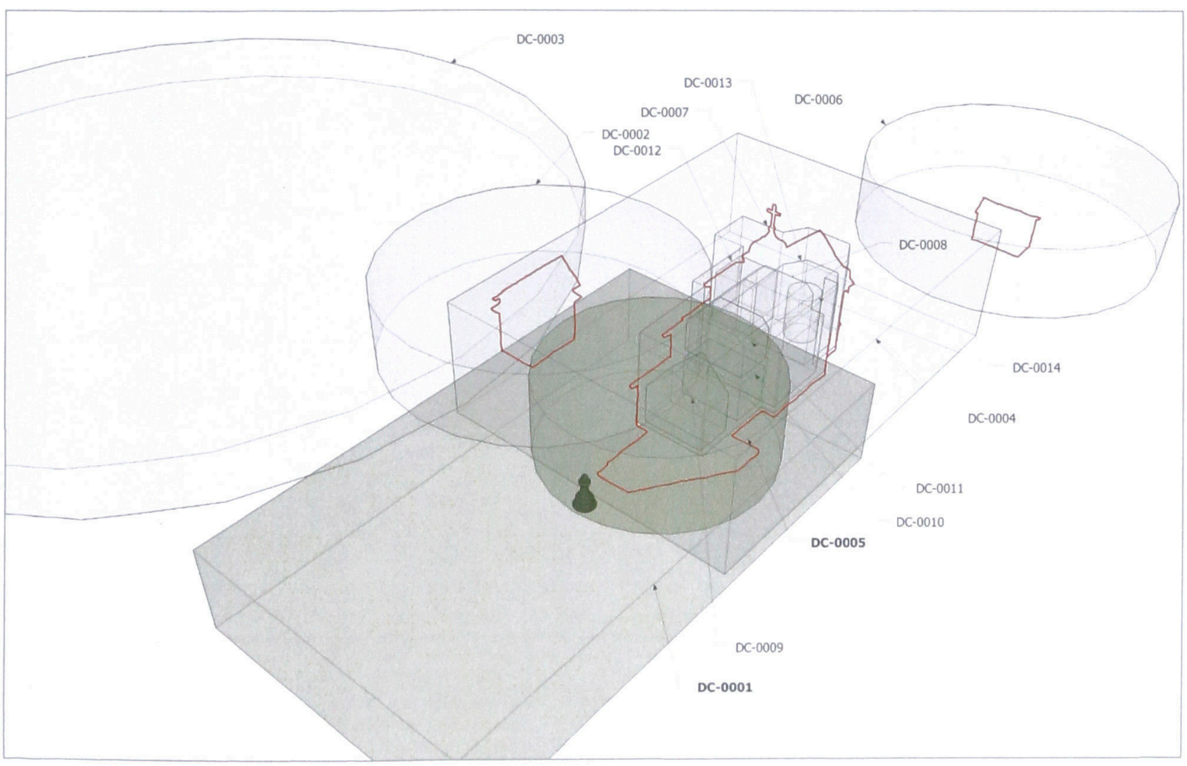


Figure 24. Data container modeling - 2 active volumes

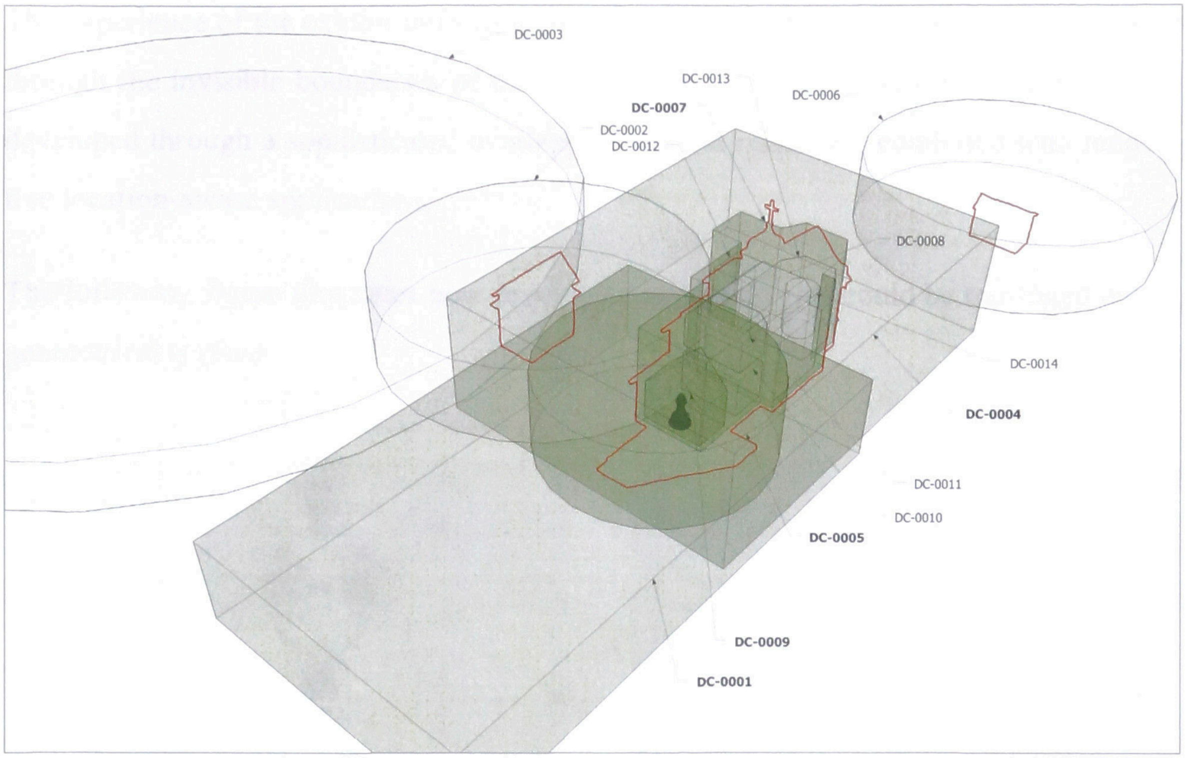


Figure 25. Data container modeling - 5 active volumes

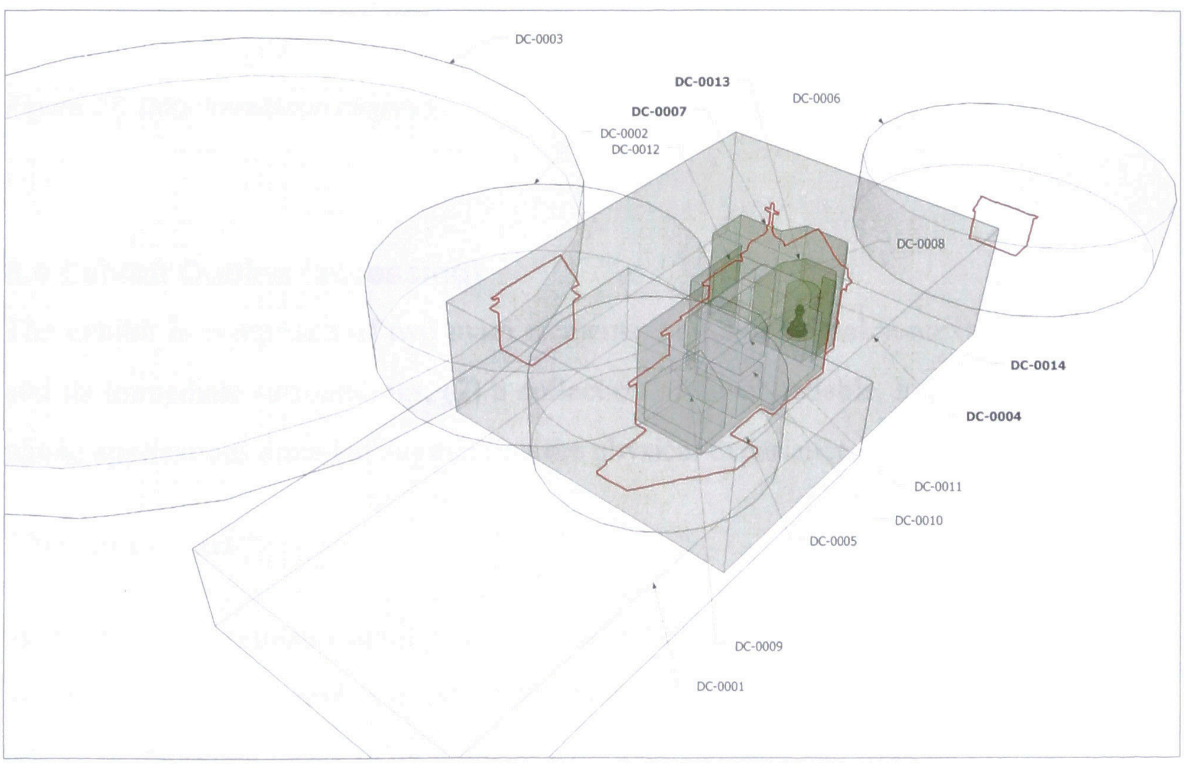


Figure 26. Data container modeling - 4 active volumes

The experience of the exhibit unfolds as the visitor and their location-aware device move through the invisible boundaries of the data containers. Rich, nuanced experiences are developed through a sophisticated overlapping of data containers combined with innovative location-aware applications.

The following figure illustrates how previously structured data could be translated onto a geometrical surface.

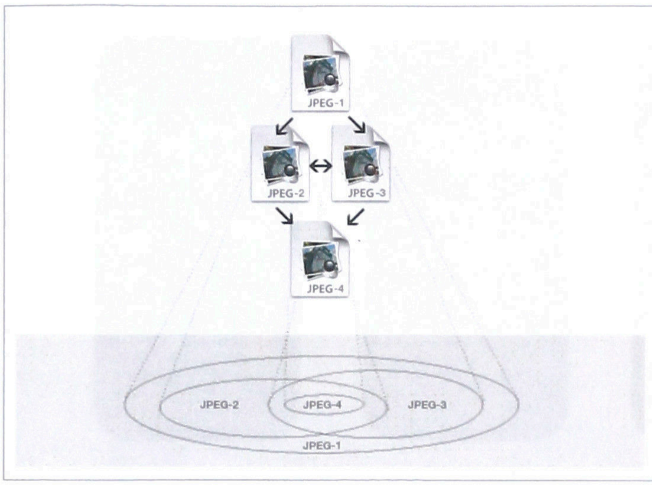


Figure 27. Data translation diagram

3.4 Exhibit Outline (accessing)

The exhibit is comprised of two main elements: (1) the physical context of the building and its immediate surroundings, (2) a collection of downloadable, location-aware smartphone applications aimed at augmenting the physical experience.

Physical Context

St. Michael's Ukrainian Catholic church is an officially recognized site of cultural importance and contains a number of art works and other cultural artifacts. Its unique rural setting is an important factor in its status as a heritage building and shouldn't be overlooked. The doors are never locked, and visitors are free to explore the interior of the church.

Location-Aware Exhibit Applications

The experience of the physical building will be supplemented by a collection of ten location-aware smartphone applications. Each of them makes reference to a data container model in which digital assets are attributed to geographic volumes of space. Exhibit applications are described in the following section.

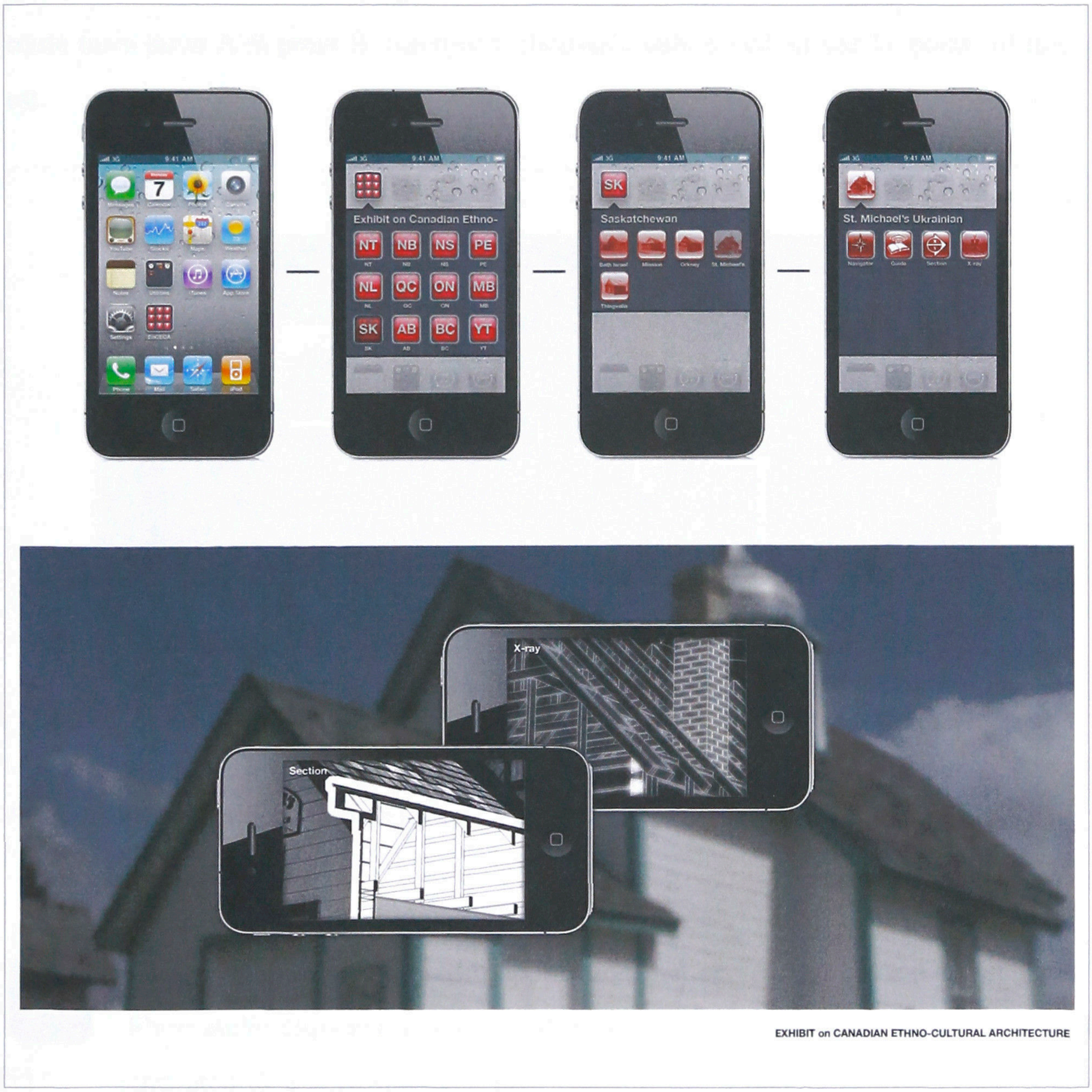


Figure 28. Exhibit interface

3.5 Exhibit Applications (navigating)

Navigator | This application is intended to map out the various heritage sites for visitors and to provide them with visual directions to each of the buildings and related points of interest.

The application references the location of the device and then draws a path between the visitor and the selected building. Whereas standard GPS devices indicate the shortest route from point A to point B, *Navigator* chooses a path based on nearby points of interest.

Figure 29. Navigator application mock-up

Guide | *Guide* is an audio application that serves as a personal tour guide. Short audio clips pertaining to different areas of the building are recorded and attributed to a corresponding data container(s). Visitors can either use headphones or the devices internal speaker. When a device enters within the boundaries of a data container, attributed clips are added to an audio queue. If the device leaves the same boundary before the clip has begun playback, it is removed from the queue. Once playback of a clip begins, it is played to completion and then deactivated to prevent repetition. Audio captions are displayed during playback.

For example, data container DC-0009 as illustrated in figure 25, has been modeled around the narthex of the church. Upon entering this space, an audio clip such as the one described in the following caption would be added to the queue:

> "The narthex or vestibule of the church represents this world in which man is called to repentance. The nave represents the kingdom of heaven. Passing from the narthex into the nave of the church symbolizes the Christian's entrance into the kingdom of heaven."[36]

In the case of St. Michael's, the *Guide* application could be used to present visitors with information on the theological and functional purposes of the various elements of Ukrainian church architecture.

X-ray | The aim of the *X-ray* application is to provide the visitor with an understanding of the buildings materials and methods of construction by revealing its hidden, internal assemblies. The application utilizes computer-generated, georeferenced 3D models along with the 6-axis motion sensing ability of the smartphone to create the illusion of a building x-ray.

Digital models are layered using the construction-based taxonomy described in section 3.2.1, and the application interface allows users to turn each individual layer on and off. Through the isolation or juxtaposition of the various building layers, users can formulate new understandings of the buildings construction.

The following points describe how the application could generate the virtual x-ray:

1. The computer-generated 3D model is geographically referenced using Keyhole Markup Language (KML) or similar

[36] Anthony M. Coniaris, *A Personal Welcome to the Orthodox Church*, (Minneapolis: Light and Life Publishing Co.,1970)

2. The *X-ray* application references the geographic position, directional bearing, and viewing angle of the device

3. The above information is then related back to the geographic location of the 3D model in order to determine the approximate distance between viewer and physical building

4. A model view corresponding to the devices position, bearing, and viewing angle is displayed on screen

Recent application developments such as *Theodolite* and *NaviCAD* suggest the viability of *X-ray*.

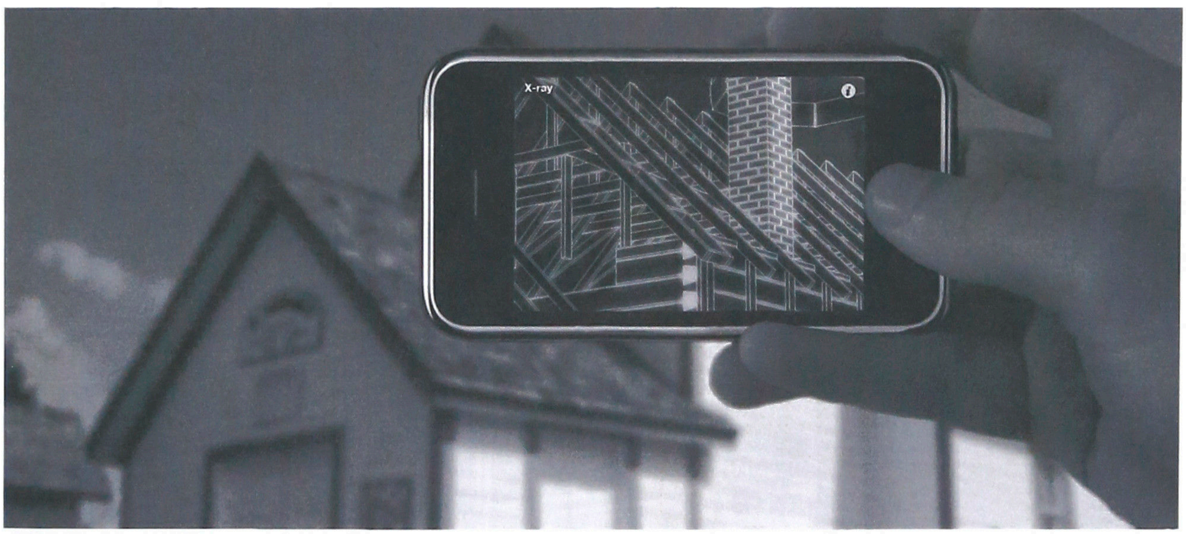


Figure 30. X-ray application mock-up

Section | Along with the *X-ray* app, *Section* promotes a detailed understanding of the buildings construction. The application overlays dynamic, geographically coordinated sectional views of the 3D model with real-time video imagery. Section drawings describe the relationship between the different parts and levels of the building. Users decide where and on what plane to cut the section. The section plane may be longitudinal, cross, or planer. Each cut offers a new way of understanding the buildings construction.

The following points describe how the application generates the dynamic section:

1. The computer-generated 3D model is geographically referenced using Keyhole Markup Language (KML) or similar

2. The *Section* application references the geographic position, directional bearing, and viewing angle of the device

3. The above information is then related back to the geographic location of the 3D model in order to determine the approximate distance between viewer and physical building

4. A perspectival sectional drawing corresponding to the devices position, bearing, and viewing angle is overlaid on top of the real-time video display. The sectional drawing masks the real-time video as necessary (see fig. 33).

Figure 31. Section application mock-up

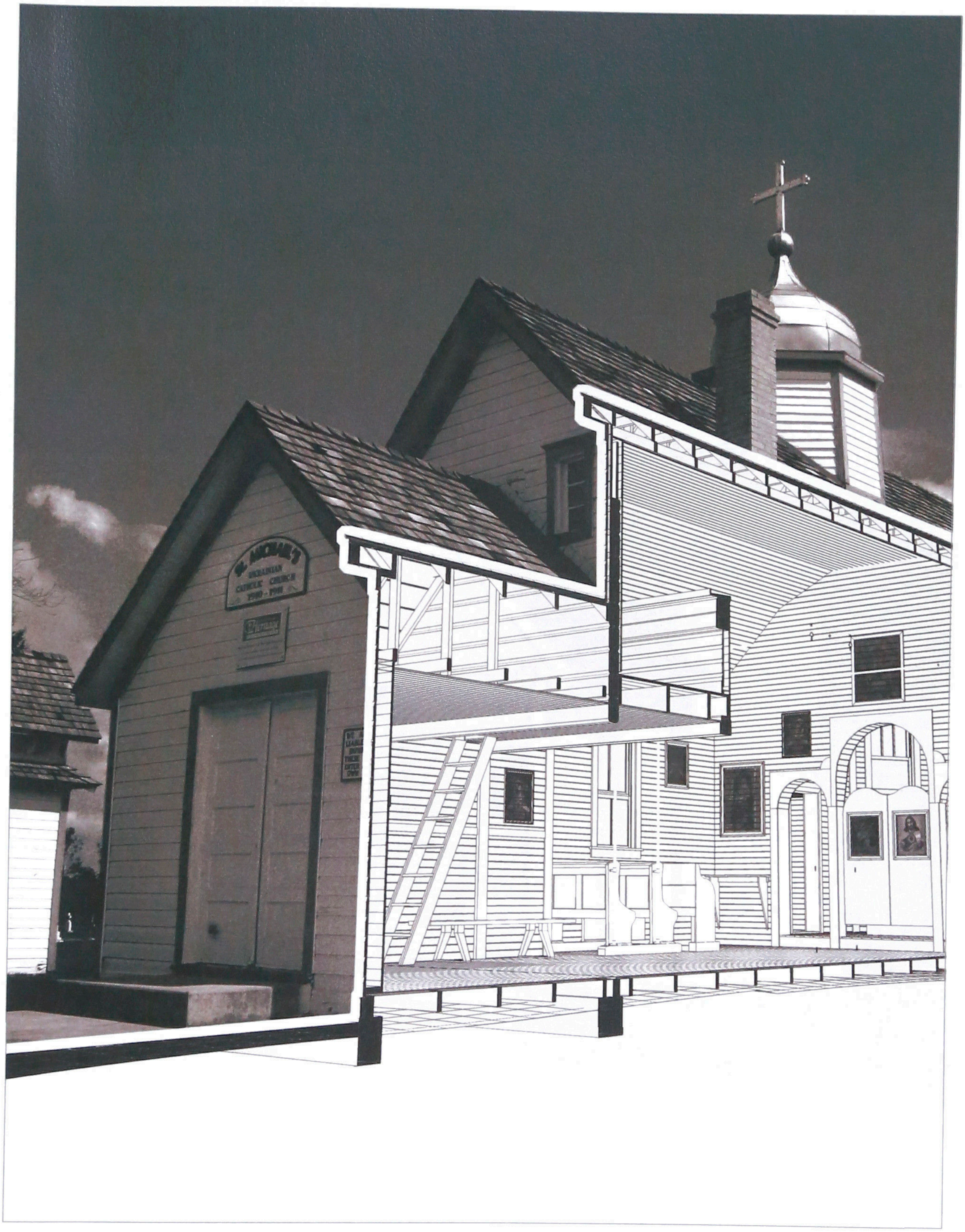


Figure 32. Longitudinal section illustration

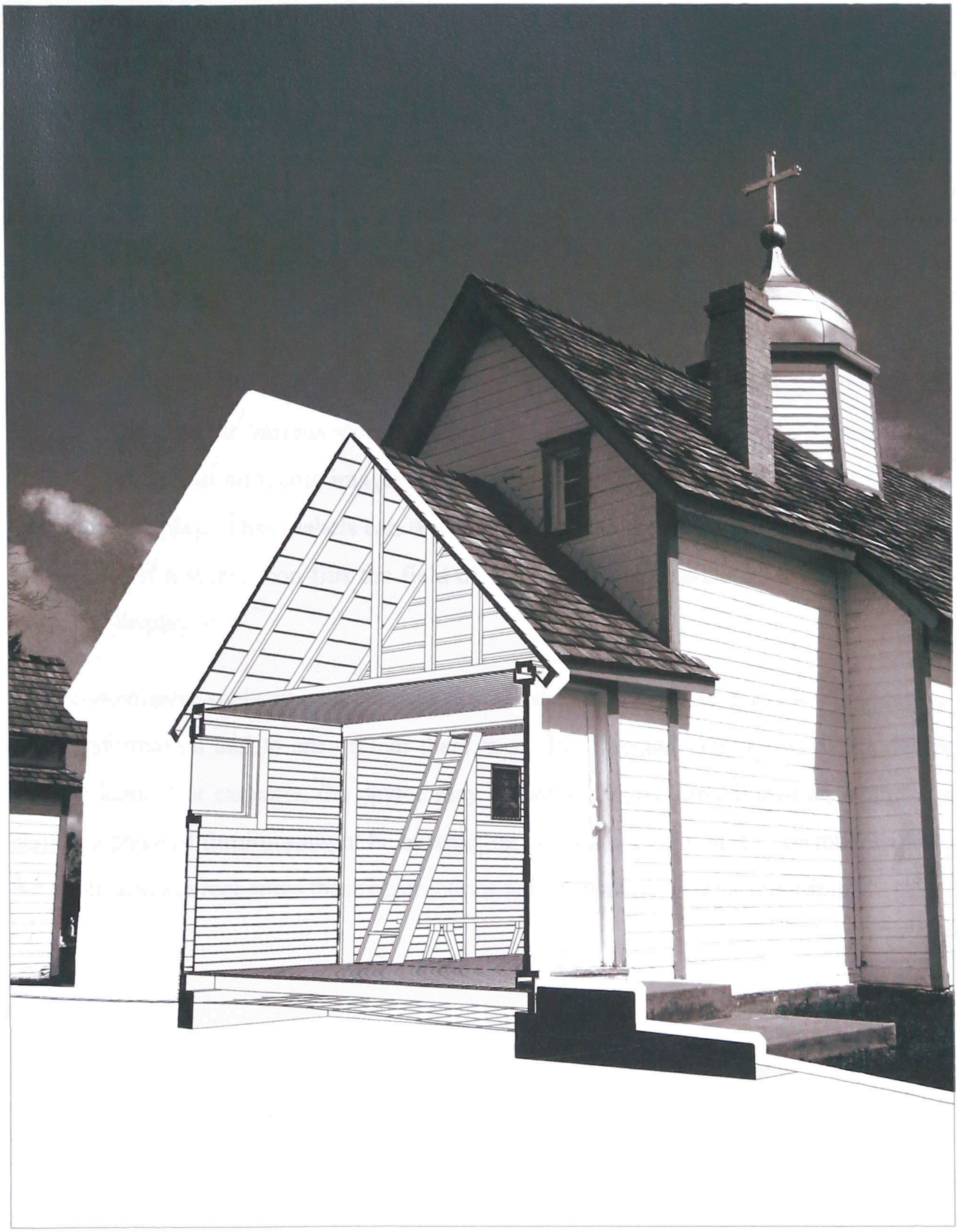


Figure 33. Cross section illustration

Reconstruction | This application uses dynamic imagery from the 3D model to visualize the construction sequence of the building. Individual components and building materials are added to the displayed model in order of construction. This communicates not only the construction process, but also the individual phases of building throughout time. The application is dynamic and interactive, allowing users to move around the building to acquire different viewing angles and to flip through the construction process step by step.

Iconography | This application presents visitors with textual information explaining the various icons associated with the building. When a device is held up against an iconic image, the name of the icon is overlaid on top of the real-time video display. These labels can then be touch-screen activated for more detailed information. If a single icon fills the field of the screen, the detailed information is automatically displayed.

The *Iconography* application references the 3D model in order to provide the location-based information and to ensure that there is an unobstructed view between the device and the icon. For example, the device may be pointed in the direction of an icon, but a wall or a piece of furniture might be obstructing the visitors view of it. The model allows the application to recognize these obstructions and to display the data accordingly.

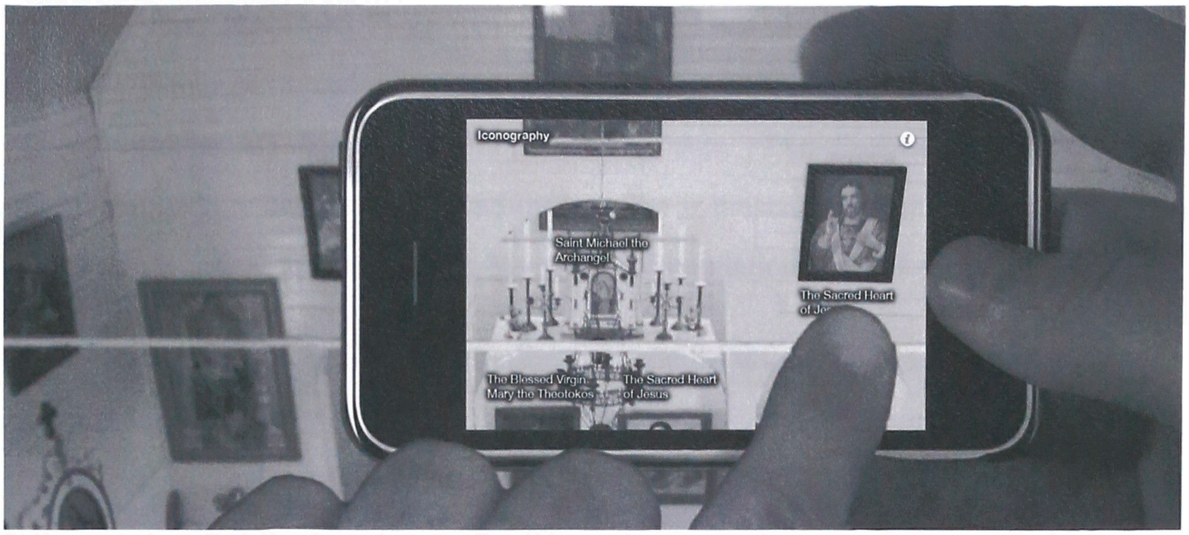


Figure 34. Iconography application mock-up

Guest Book | This application allows visitors to browse the digital contributions of others, and conversely to contribute their own. *Guest Book* promotes the exchange of links, stories, information, photographs, and videos. The application allows visitors to contribute digital fragments from their own experience of the building. Photographs, notes, videos, and audio clips may be recorded on location with mobile devices and uploaded to a browsable archive. Upon uploading a file, contributors are prompted to enter an active radius for the files data container. For example, if after uploading a text message, a user selects an active radius of 2 meters, the message will then only be accessible to others when their device is within a 2 meter spherical radius of the point in which the information was uploaded. In other words, all uploaded information is assigned to a spherical data container whose center is the geographic point in which the contributors device was at the time of upload. The *Guest Book* application creates a physical connection to between past and present visitors through geography. The accumulation of these digital traces that are left behind eventually begin to tell their own story.

Time Machine | This application displays relevant historical imagery based on the location and orientation of the device. *Time Machine* incorporates photographs, 2D images, and 3D point cloud data. Two-dimensional assets are presented statically, whereas point cloud information is presented dynamically; displaying a view corresponding to the changing location and orientation of the device.

Time Machine allows visitors to visualize past conditions, events, and morphologies of a building in their proper context. Figure 35 shows the juxtaposition of a historical photograph from a local newspaper and the church as it exists today. The photograph was taken shortly after the church was struck by lightning in 1995.

Figure 35. Time Machine application mock-up

Fragments | This application displays digital assets attributed to active data containers at random. The dataset contains photographs, images, audio, text, drawings, and video considered to have a looser association with the building. The relevance of the individual assets may not be immediately apparent, however, in combination they contribute to the visitors overall understanding of the building and its significance. In other words, the unorganized whole is perceived as more than the sum of its parts.

Artifacts | This application taps into the preestablished database of *Artefacts Canada* to provide visitors with information on related artifacts from nearby museums. The database contains over 3 million object records from Canadian museums. Many of the records contain images which can be viewed using the *Artifacts* application. The application could work as described below:

1. Search words are attributed to different data containers by exhibit curators.

2. *Artifacts* continuously searches the database for words associated with all active data containers. An everchanging list of results is displayed on screen. Users can then open a record to view an image of the artifact, OR

3. The results may be filtered according to a distance parameter set by the visitor. The distance parameter is the distance the visitor is willing to travel to see the physical artifact. This filter would be activated by visitors intending to travel to the artifacts.

3.6 The Exhibit Experience

The application component of the exhibit is not intended to provide visitors with an extensive knowledge of the building and its complicated history. Rather, it is intended to provide a sufficient amount of information to evoke the significance of the building, giving rise to an increased appreciation of the architectural experience.

It is not uncommon for people to visit historical buildings without fully grasping their significance. It takes a relatively small amount of research for one to begin to recognize the importance of a place. The digital applications are intended to provide visitors with a basic understanding of a buildings construction and significance so that they are able to fully appreciate it’s value.

4. Discussing the Results

Memory content is a function of the rate of forgetting.[37]

4.1 Value and Significance

The exhibit proposal described in the previous chapter addresses the burgeoning relationship between architecture and information technology by exploring a new way of connecting digital architectural representations to their built counterparts. The proposal suggests a way of incorporating architectural visualizations and representations into heritage buildings. The term *incorporate* has been used to suggest the integration of the representations with a larger body or whole. The whole of a building, that is to say the Architecture of a building, has always existed beyond the physical structure; in an amalgamation of stories, emotions, memories, ideas, people, drawings, experiences, values, and so on. In this exhibit proposal, digital assets engage with the building to create a contemporary understanding of its existence. The digital exhibit is not a substitute for the building but rather an integral part of the experience of it. The significance of the project lies partially in the recognition of the architectural representation as an integral part of the ongoing life of a building. It has assembled tattered fragments of the past to create new conjunctions that awaken their latent meaning and give the building a renewed sense of value.

The digital technologies used to add value have connected the heritage production to the present while simultaneously maintaining a claim to the past. "A hallmark of heritage productions–perhaps their defining feature–is precisely the foreignness of the "tradition" to its context of presentation."[38] The overlap of past and present in heritage productions

[37] Norman E. Spear, *The Processing of Memories: Forgetting and Retention* (New York: John Wiley & Sons Inc., 1978)

[38] Barbara Kirshenblatt-Gimblett, "Theorizing Heritage," *Ethnomusicology* 39, no. 3 (1995): 374.

speaks to the values, ideas and customs of contemporary society, and are therefore cultural forms in their own right.

Another way of interpreting the value of this proposal would be to imagine the experience of the exhibit after the disappearance of the physical building. A ghost-like digital record would remain in its place; connected to the surrounding historic landscape in which it once stood.

5. Conclusions

Who controls the past, controls the future: who controls the present controls the past.[39]

5.1 The Future of the Past

The heritage industry puts forth explicit notions of time travel in their advertisements, inviting tourists to "take a trip through history", or "a journey through the past".[40] The exhibit proposal has laid the groundwork for a new way of returning to the past. Historically this illusion of "time travel" has been evoked through storytelling, artifacts, art works, books, reenactments, videos, and photographs. Emerging technologies are allowing us to visit the past in a way that is entirely of our own time. Presumably, these location-based technologies will be developed to a degree that will allow us to fully immerse ourselves in the three-dimensional environments of the past, in a digital living history museum.

5.2 Closing Remarks

In *The Library of Babel*, Borges describes an endless library containing within its volumes, all possible combinations of a set of alphabetic characters, and thus expressing all that is able to be expressed in every language.[41] It is assumed that all possible information, including a detailed history of the future and solutions to every problem exists somewhere in the library; the only trouble is that the leagues of information lack context and therefore the information is unattainable. For every rational line, there exists a sea of incoherency. Mentioned however, is the possibility of deriving meaning from these seemingly incoherent phrases through cryptographic or allegorical readings. The charac-

---

39 George Orwell, *Nineteen Eighty-Four* (London: Penguin Books, 1989), 40.

40 Barbara Kirshenblatt-Gimblett, "Theorizing Heritage," *Ethnomusicology* 39, no. 3 (1995): 370.

41 Jorge Luis Borges. *Collected Fictions*, ed. Andrew Hurley (New York: Penguin Group, 1998), 112.

ters on each page have to be taken *as is*, and it is up to the reader to interpret them and assign them value.

This essay summons a reflection on the value of information and on the subjectivity of meaning. The current perplexity surrounding digital archives is not a new problem initiated by the onset of computer technology. We as human beings are amidst an ongoing, and perpetual reorganization of knowledge to which there is no end-all solution. We will forever be confronted with the task of deciphering the infinite abyss of knowledge, and converting fragments of it into a language that speaks to the present. Heritage offers buildings "a means of participating in the world afresh"[42].

This project has attempted to show how we might (re)present, re-contextualize, and reorganize, existing information and established datasets to make them more accessible "here and now". This thesis acknowledges the impossibility of an ultimate archival solution and accepts the inevitability of this perpetual dilemma. The aim therefore, has not been to propose a long-term solution to the difficulties surrounding heritage archives, but rather to propose a contemporary method for disseminating heritage related content using present-day technologies.

[42] Robin Middleton, "Soane's Spaces and the Matter of Fragmentation," in *John Soane: Master of Space and Light*, ed. Margaret Richardson and MaryAnne Stevens (Montreal: Canadian Centre for Architecture, 2001), 35.

Bibliography

Baudrillard, Jean. *Simulations*. Translated by Paul Foss, Paul Patton and Philip Beitchman. New York: Semiotext(e), 1983.

Baudrillard, Jean. *The Ecstasy of Communication*. Translated by Bernard Schutze and Caroline Schutze. New York: Semiotext(e), 1988.

Benjamin, Walter. "The Work of Art in the Age of Its Technological Reproducibility." In *Selected Writings, Volume 3*, edited by Howard Eiland and Michael W. Jennings, 101-133. Cambridge: The Belknap Press of Harvard University Press, 2002.

Berelowitz, Jo-Anne. "From the Body of the Prince to Mickey Mouse." *Oxford Art Journal* 13, no.2 (1990): 70-84.

Borges, Jorge Luis. "John Wilkins' Analytical Language." In *Selected Non-Fictions*, Edited by Eliot Weinberger, 229-232. New York: Penguin Group, 1999.

Borges, Jorge Luis. "On Exactitude in Science." In *Collected Fictions*, Translated by Andrew Hurley, 325. New York: Penguin Group, 1998.

Borges, Jorge Luis. "The Library of Babel." In *Collected Fictions*, Translated by Andrew Hurley, 112-118. New York: Penguin Group, 1998.

Canada's Historic Places. "Canadian Register of Historic Places: St. Michael's Ukrainian Catholic Church." Accessed August 20, 2010. http://www.historicplaces.ca/visit-visite/com-ful_e.aspx?id=2671.

Carpo, Mario. *Architecture in the Age of Printing*. Translated by Sarah Benson. Cambridge: The MIT Press, 2001.

Crary, Jonathan. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*. Cambridge: The MIT Press, 1990.

Fai, S. "Material Imagination and Religious Architecture in Saskatchewan." Paper presented at the 2nd International Conference on Heritage and Sustainable Development, Evora, Portugal, June 22-26, 2010.

Fogu, Claudio. "Digitalizing Historical Consciousness." *History and Theory* 47 (2009): 103-121.

Heidegger, Martin. *The Question Concerning Technology*. Translated by William Lovitt. New York: Harper & Row Publishers Inc., 1977.

Hemsley, James, Vito Cappellini, and Gerd Stanke, editors. *Digital Applications for Cultural and Heritage Institutions*. Aldershot: Ashgate Publishing Limited., 2005.

Impey, Oliver, and Arthur MacGregor. *The Origins of Museums: the Cabinet of Curiosities in Sixteenth- and Seventeenth-Century Europe*. London: House of Stratus, 2002.

Kirshenblatt-Gimblett, Barbara. "Theorizing Heritage." *Ethnomusicology* 39, no. 3 (1995): 367-380.

Layton-Jones, Katy. "Introduction: Visual Collections as Historical Evidence." *Visual Resources* 24, no. 2 (2008): 105-107.

McCullough, Malcolm. *Abstracting Craft: The Practiced Digital Hand*. Cambridge: The MIT Press, 1996.

McCullough, Malcolm. *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing*. Cambridge: The MIT Press, 2004.

Middleton, Robin. "Soane's Spaces and the Matter of Fragmentation." In *John Soane: Master of Space and Light*, 26-37. Montreal: Canadian Centre for Architecture, 2001

Orwell, George. *Nineteen Eighty-Four*. London: Penguin Books, 1989.

Warden, Robert. "Towards a New Era of Cultural-Heritage Recording and Documentation." *APT Bulletin* 40, no. 3/4 (2009): 5-10.

Webster, Anthony, Steven Feiner, Blair MacIntyre, William Massie, and Theodore Krueger. "Augmented Reality in Architectural Construction, Inspection, and Renovation." Paper presented at the ASCE Third Congress on Computing in Civil Engineering, Anaheim, California, June 17-19, 1996.

Wood, William R. "(Virtual) Myths." *Critical Sociology* 30, no. 2 (2004): 513-548.

Appendices

A.1 Digital Videos and Slideshow

DVD-R attached
technical requirements: DVD player

A.1.1 Data Container Animation

A.1.2 St. Michael's Ukrainian Catholic Church Video

A.1.3 X-ray Mockup Animation

A.1.4 Defense Presentation Slideshow

A.2 Three-Dimensional Model

CD-R attached
technical requirements: Google SketchUp 7

A.2.1 Model of St. Michael's Ukrainian Catholic Church

St Michaels Ukrainian Catholic Church.skp