Digital methods to mediate impacts of the relocation of built heritage and their implications for the Perrenoud Homestead in Alberta

Madisen Hvidberg* and Peter Dawsona

*Department of Anthropology and Archaeology, University of Calgary, 2500 University Dr. NW, Calgary, Alberta, Canada, T2N 1N4
*a corresponding author: madisen.hvidberg@ucalgary.ca

ABSTRACT

The disassembly of structurally unsound heritage buildings for the purposes of safety and development is a well-established practice. When this occurs, the intent is often to move, reassemble, or rebuild the structure at some future date. Located just outside of Cochrane, Alberta, the Perrenoud Homestead is one such site, taken apart and placed in storage in the summer of 2017. As the original residence on the property, the homestead is a heritage site valued for its significance to the establishment of early ranching operations in southern Alberta. During its disassembly, the Perrenoud Homestead was documented digitally using terrestrial LiDAR (laser scanning) and drone-based photogrammetry. The 3D data sets created by these methods provide heritage managers and the public with virtual access to the site while the physical structure associated with the homestead is placed in storage. However, to what extent does the digitization of the heritage buildings alter how visitors experience the site, as well as transform its cultural context? In this paper, we explore these questions using the Perrenoud Homestead project as a case study and focus on the implications of using digital methods as risk management tools in the relocation process.

KEYWORDS

Alberta, digital heritage, relocation, authenticity, reality capture technology, digitization, homestead, ranching

1. Project purpose: heritage at risk

Heritage sites throughout the world are threatened by various environmental, political, and social factors including effects of climate change and human-caused destruction (Taboroff 2000:71; McKercher and Du Cros 2002; Dawson et al. 2013:147; National Trust for Canada 2018). In Alberta, two recent and dramatic climatic events have placed many heritage sites at risk. During the summer of 2013, floods in southern Alberta destroyed many historic and pre-contact sites situated along the Bow and Elbow rivers (Government of Alberta 2014; Unfreed and Macdonald 2017). Likewise, the Fort McMurray wildfires of 2016 threatened heritage sites associated with the beginnings of the oil and gas energy sector in Alberta, such as the heritage park at Fort McMurray (White 2017). With studies indicating increasing climatic instability and disasters in the future, these types of risks to Alberta heritage sites are likely to increase (Dumanski et al. 2015; Boulanger et al. 2017; Wotton et al. 2017).

In addition to such natural disturbances, vandalism and development pose near constant threats to many provincial heritage sites. From graffiti carved into and painted over pre-contact rock art panels at the Okotoks Erratic (Brink 2014), to the destruction by fire of buildings that hold historic links to Indian residential schools such as Red Crow College (Saskiw 2015), vandalism is a growing threat to many heritage sites within the province. Globally, it has been estimated that over half of internationally designated world heritage sites are currently at risk from development factors (UNESCO 2017). Within
Canada, development related risks to heritage often stem from neglect, due to a shortage of resources for repair and high upkeep costs, as well as from safety concerns, such as when a collapsing structure poses a danger to persons or adjacent property (National Trust for Canada 2018).

In our project we aim to investigate how reality capture technologies (laser scanning, photogrammetry) can be used to document and, ultimately, manage heritage at risk in Alberta. As a representation of our collective cultural identities, built heritage plays an important role in communicating historic events of significance to the public. For Alberta, heritage sites, such as the Perrenoud Homestead, are the physical manifestations of key events and people in the province’s history. Using reality capture technologies to document these places is an effective and engaging way of capturing and preserving Alberta’s past. By way of illustration, laser scanning allows for the collection of accurate and highly detailed data sets that can be used to create “as built” site plans and photorealistic 3D models (Pavlidis et al. 2007). These assets can be effectively integrated into a variety of risk management strategies such as mitigation, monitoring, and relocation. To illustrate this process, we use the Perrenoud Homestead Provincial Historic Resource (PHR) as a primary case study and examine the applications and implications of reality capture technologies in the documentation and relocation of this site. We argue that digitally capturing heritage sites that would otherwise be lost or inaccessible allows heritage managers and the public continued access to them. However, because the whole is always greater than the sum of its parts, virtual replicas of heritage resources that have been removed/relocated need to be tied to the broader context of the sites from which they were captured. Augmented reality and the scanning of entire sites represent two possible methods for achieving this.

2. Case study: Perrenoud Homestead

The Perrenoud Homestead is located just north of the town of Cochrane in southwest Alberta. Designated as a PHR in 1992, the site is composed of two residences situated on 4.5 hectares of land. The first of these is an 1890s log homestead with a 1902 extension (Stan-Barton 1990:31; Parks Canada 2018; Figure 1). In 1910, a larger two-story home, featuring a hipped roof and wrapping verandah, replaced the log homestead as the primary residence on the property (Stan-Barton 1990:31; Parks Canada 2018). The site also features various outbuildings and machinery, such as a blacksmith shop, granaries, a sawmill, and a cattle chute.

The heritage value of the Perrenoud Homestead lies within its ties to early ranching operations in Alberta in the 1880s and 1890s. The land on which the homestead is located was originally part of a massive grazing lease granted in the early 1880s to the Cochrane Ranch Company (Stan-Barton 1990:32; Brado 2004:60; Parks Canada 2018). When that lease land became open for homesteading, it attracted many settlers to the area, including Charles Perrenoud. Born in France in 1863 and trained as a jeweller, Perrenoud came to western Canada in 1886 to set up a ranching operation (Stan-Barton 1990:32; Parks Canada 2018). In 1888, he was joined by his brother Earnest, and together they amassed a herd of over 1,900 saddle and work horses, including Hackneys, Berman Coach horses, Clydesdales, and Shires (Stan-Barton 1990:31; Parks Canada 2018).

The original homestead, or “bachelor’s shack,” was constructed by the Perrenoud brothers using wood, likely sourced from stands of popular, spruce, and pine located in the nearby Grand Valley (The Perrenoud Homestead 2018). The logs were double-notched and were chinked to stop drafts. While the chinking material had since disappeared on the homestead, materials common in Alberta at the time included moss, small sticks, rags, and plaster covered over in mud or clay (Stan-Barton 1990:50–51; The Perrenoud Homestead 2018). Construction of the bachelor’s shack portion of the homestead began in the summer of 1889 and was completed in 1890. An extension protruding to the south was added in the same building fashion in 1902 (Stan-Barton 1990:32; Parks Canada 2018). Charles Perrenoud lived in this homestead with his wife Laura and their three children until 1910 when he hired the Chapman Brothers in Cochrane to construct the larger home, which was built on the same property in the American Foursquare architectural style (Stan-Barton

Figure 1. Historic photograph from the Glenbow Archives of the Perrenoud Ranch ca. 1904. Credit: Charles Perrenoud Ranch, Cochrane area, Alberta. Image number NA-1130-2, Glenbow Archives online database. Calgary, Alberta.
In April of 1929, Charles Perrenoud died, whereupon his eldest son George took over the ranch and the property (Stan-Barton 1990:35). Upon George’s death in 1981, the ranch was donated to the Province of Alberta to be developed as an historic site (Stan-Barton 1990:35).

In recent years, the original homestead started to collapse, which was most noticeable in the 1902 extension where the roof and most of the walls had slumped in on the structure (Figure 2). While still standing, the original portion of the homestead exhibited a distinct lean and had been braced with various wooden beams along its northern wall (Figures 3 and 4). Due to the state of the structure, the homestead was deemed unsafe and unfeasible to restore on-site. Reality capture methods (terrestrial laser scanning and aerial photogrammetry) were employed to fully document the heritage buildings prior to dismantling the Perrenoud Homestead in July of 2017. The structure was taken apart in sections and the original material was placed in storage for the future rebuilding of the homestead.

Figure 2. Photograph of the Perrenoud Homestead, June 2017.

Figure 3. The bracing along the northern wall of the homestead, June 2017.

Figure 4. The collapsed front door of the 1902 extension to the homestead, June 2017.
3. Methods

Our goals were to digitally capture and record the then current state of the homestead, as well as to provide documentation during the disassembly process. To do this, we used two different types of reality capture technologies. The first method employed was drone-based photogrammetry using images captured by a DJI Phantom 4 drone. The drone was set to fly an automated grid over the site area, at a height of 30 metres above ground, with a camera angle of 70 degrees, creating an image overlap of 90%. The resulting 302 calibrated images captured during the drone's flight were then processed using Pix4D software, in which photographs are triangulated together, based on common markers, to determine where points lie in three-dimensional space (Vallet et al. 2011:2). When processed together across the site, this generates a 3D model of the study area. While we used laser scanning to document each stage of the dismantling process over several days, drone data was collected over one day to document the homestead while it was still intact.

The second method employed was terrestrial laser scanning (TLS) using a Z+F 5010x scanner. This scanner operates through light detection and ranging (LiDAR), whereby it emits pulses of lasers that are then reflected back to the scanner and read by a sensor that records each pulse point and its associated GPS location (Devereux 2005:650). The resulting data are called point clouds. In this method of data capture, paddles are used as stationary targets that the Z+F software uses to register scans together during processing; each scan location must have no less than three paddles visible to the scanner for this purpose. Along with an internal GPS, the scanner has a 360-degree camera that takes pan-sphere photographs for each scanning location. These photographs are later used to detect RGB colour values for each point in the point cloud data, in order to produce realistic looking models.

We used TLS to record the Perrenoud Homestead while it was still intact, as well as during the week-long disassembly process. Overall, our team scanned the site on six different days in June and July, 2017. For each day of documentation, the homestead was recorded using between eight and 11 scanning locations positioned to obtain the most comprehensive data set of the homestead (Figure 5). On July 25th, an additional three scanning locations were added inside the homestead to capture the interior of the structure.

After the in-field documentation, we completed initial data processing with the Z+F Laser Control scanner software, version 8.9.0.19607. We then registered the different scans to assemble them into a single point cloud with sub-millimeter accuracy (Rabbani et al. 2007:335). A rough registration was completed in the field to ensure that all of the structure had been captured. A fine registration was then performed back in the office using Z+F Laser Control software. The registration process is typically completed automatically within the laser control program, which can detect Z+F specific targets within the scanning data. In instances where automatic detection is problematic, such as when a target might have fallen and/or shifted its position between scans, registration can be done manually by picking the targets to which each scan needs to be aligned. Finally, the point cloud data are processed into 3D models (Figures 5 and 6). For the TLS data, this was done using Autodesk ReCap and its scan-to-mesh service (Autodesk 2018). Additionally, models exported from Autodesk ReCap can be saved in different file formats for use in a variety of other 3D software, such as Rhino and Autodesk 3dsMax.

4. Relocation as a means to manage heritage risks

Relocation, as a method for managing risk to heritage sites, involves bringing a building or structure from an area of high risk to a location with either less risk or easier access, to implement other management efforts (Faulkner 2004:55; Gregory 2008:112). This can be done by moving the entire structure, or by dismantling it, moving the pieces, and reassembling the built heritage elsewhere (Faulkner 2004:55). The latter method is commonly used for log buildings, as their construction allows them to be easily taken apart with minimal damage to the structure (Faulkner 2004:55), and was the method employed for the relocation of the Perrenoud Homestead.

The relocation of heritage resources can be an effective risk management tool and it is commonly used within Canada and around the world. However, according to the Burra Charter produced by the International Council on Monuments and Sites (ICOMOS), relocation of a heritage site is acceptable if it is the only practical means to ensure its survival, due to the fact that the physical location of a heritage site is part of its cultural significance (Heritage Victoria 2007; Gregory 2008:112). At the Perrenoud Homestead, only the original homestead was relocated even though there are several other associated buildings at the site. As seen in Figures 5 and 6, the resulting TLS models produced from the documentation of the homestead, show the structure in isolation from other surviving buildings associated with the homestead. While the scanner did capture portions of these surrounding buildings, they were removed from the point cloud to provide an unobstructed model of the homestead, and to reduce file sizes to make the models necessarily more...
Figure 5. A sequence of 3D TLS models illustrating the day-by-day dismantling of the Perrenoud Homestead.

Figure 6. 3D TLS model of the Perrenoud Homestead, accessible at the *Digitally Preserving Alberta’s Diverse Cultural Heritage* (Dawson 2017) website at https://preserve.ucalgary.ca/sites/perrenoud-homestead/.
manageable. In doing so, however, some of the site’s cultural context is ultimately lost within these models.

The physical environment of the Perrenoud Ranch has also been affected by the relocation process (see Figures 7 and 8). The log homestead was centrally located on the property, but since its removal in 2017, the footprint of the homestead has been outlined with wooden boards and filled with sand and gravel. With an interpretive sign about the building still present and the central location of the structure on the farm property, this empty space significantly alters a visitor’s experience of the physical site of the Perrenoud Homestead.

The importance of preserving physical structures at heritage sites, when feasible, cannot be understated. Yet, moving a building from its original location may be a necessary step in preserving it. In the case of the Perrenoud Homestead, relocation efforts and digital scanning resulted in the creation of two different versions of the site. In the virtual realm, the digitized “copy” of the isolated homestead exists in absentia of the surrounding outbuildings and 1910 residence. In the physical world, the outbuildings and 1910 residence exist in the absence of the homestead. The resulting paradox is that the disassociation of the homestead from the surrounding site, for the purpose of preservation, could impact how it is experienced by visitors online.

Figure 7. The location of the Perrenoud Homestead before disassembly of the structure, June 2017.

Figure 8. The location of the Perrenoud Homestead, removed from site with its footprint outlined on the ground, April 2018.
5. Curating digital heritage

The data collected at the Perrenoud Homestead are included with data from other heritage sites in the digital archive, Digitally Preserving Alberta’s Diverse Cultural Heritage (Dawson 2017), which can be accessed at https://preserve.ucalgary.ca/. The overall aim of this online archive is to provide a central repository for Alberta heritage information that will include, not only interactive versions of TLS scans, but also associated modern and historic photographs, maps of site locations, historical information, and the documentation processes implemented at each location. The archive includes historic sites related to different facets of the multicultural settlement history of the province, as well as pre-contact First Nations sites.

On the Perrenoud Homestead page of the archive, there is an interactive video of the TLS scan, a write up about the history of the site in the context of the broader ranching settlement of Alberta, a gallery containing historic and modern photographs, a map of the site location, a description of the capture techniques, videos of TLS models, and a full set of downloadable point cloud data from the initial day of scanning at the site (Dawson 2017). In the process of digitizing the Perrenoud site and disseminating the collected information online, we have altered both the experience of visiting the homestead and accessibility to the site during its relocation.

5.1 The visitor experience

Prior to this project being conducted, those who wished to visit the Perrenoud Homestead would have had the experience of driving through the Alberta foothills to reach the site, seeing the landscape surrounded by local horse ranches with the Rocky Mountains in the background, and walking through the homestead, outbuildings, and ranching house. This experience has been transformed by the removal of the original ranch house. The structure can now be accessed only virtually through our online archive. Thus, understanding how digital heritage is created and how it transforms the way visitors experience the Perrenoud ranch and its heritage, have emerged as important considerations.

To what extent does the virtual experience of the Perrenoud site, via the digital archive, diminish or alter its significance in the eyes of the visitor? This is directly related to decisions about what aspects of the site are scanned, and what is left out. For example, time constraints on the scheduling of the disassembly process prevented us from scanning all the buildings at the site. Therefore, the original homestead became the sole focus of the site’s project page within the archive. Conversely, visitors to the physical site can view everything but the original homestead. These distinct experiences are, in effect, two sides of the same coin, demonstrating that the “virtual” is inevitably tied to the “actual” when digital documentation is used in heritage research.

We currently lack a firm grasp of how visitors experience heritage when they encounter it online. Studies of digital public archaeology coming out of the United Kingdom and Canada have suggested that researchers and heritage managers often do not understand what this public engagement aspect looks like (Bonacchi and Moshenska 2015). Thus, it is especially important for us to consider how the virtual and the physical come together to communicate key messages of significance to the public. Currently, our archive and the remaining physical site each present an incomplete experience for visitors. We need to explore ways to bridge this gap, such as repatriating the digital version of the homestead to the actual site. Using augmented reality (the interactive experience in which computer-generated objects are brought into a real-world environment), visitors with a mobile device (smartphone, tablet) could access the 3D model of the homestead that is georeferenced to the gravel pad marking its former location. Likewise, we could expand the digital data in our archive to include additional buildings found at the site.

5.2 Digital accessibility

While the current digital version of the Perrenoud Homestead provides a somewhat incomplete picture of the entire site, it nevertheless renders the homestead accessible while the original remains in storage. Consequently, digitally capturing heritage buildings—especially those slated for relocation—is a useful way to ensure that they remain accessible to both heritage managers and the public.

Despite the challenges of bringing together the virtual and the actual, we see many opportunities for digital heritage preservation in Alberta. According to the Survey of Albertans on Culture (Advantis 2017), the number of Albertans who get information about heritage sites online has increased from 56.1% in 2016 to 62.4% in 2017. More than ever before, Albertans are using the internet as a source of information for heritage sites. Currently, there is a greater quantity of interpretive and educational information found in our digital heritage archive (Dawson 2017) than is contained within the signage at the physical site of the Perrenoud Homestead, giving value to the digital version of the homestead as a tool for learning about Alberta heritage. Additionally, the online version increases international accessibility to the site dramatically: not only does a webpage allow visitors to the Perrenoud Homestead to access infor-
mation 24 hours a day, but its geographical reach is global. Sharing the Perrenoud Homestead online allows Albertans, Canadians, and those from other countries who may not have the means to easily travel to the physical location of the site, to view and learn about it. While projects are still in the process of being added to the archive, the website has received over 5,500 hits since opening to the public in 2017, with views coming from as far away as Denmark.

As built heritage is an important representation of Alberta’s story, people, and identity, we believe that everyone should be able to easily view and learn about these places. Online sharing allows anyone access to the heritage resources and the values and stories they represent (Poria et al. 2004:19). As more heritage sites are recorded and added to the archive, we hope that visitation to the website will continue to grow and that it can be used by a wide audience as an important resource for learning about many aspects of Alberta’s history. The caveat, of course, is that we need to remain aware that the buildings we capture digitally are parts of a larger whole, and that the absence of associated buildings can potentially alter how a visitor experiences and understands it.

6. Conclusion

The necessary dismantling of a log structure associated with historic ranching in southern Alberta has provided us with a case study for the application of reality capture technologies in managing provincial heritage sites. TLS and drone-photogrammetry at the Perrenoud Homestead Provincial Historic Resource have demonstrated that these techniques provide a rapid and reliable way of recording at-risk sites before disassembly. The interactive 3D models resulting from the documentation of the Perrenoud Homestead, and shared through the online archive, Digitally Preserving Alberta’s Diverse Cultural Heritage (Dawson 2017), allow global access to this heritage resource that would have otherwise been impossible. This is a prime example of how these methods can maintain, and even increase, public accessibility to heritage resources disturbed by relocation, or lost due to human and/or environmental factors. However, online models and repositories provide much different user experiences than physical site visitation. This case study highlights the need for heritage practitioners to reflect on how the virtual relates to the actual, and to explore new ways of bringing these two realms together. We have suggested augmented reality and scanning entire sites when possible as two potential solutions. Until such time as the Perrenoud Homestead is reconstructed, its digital replica will serve as a viable substitute for communicating its significance as a heritage resource to the general public.

7. Acknowledgements

This research was supported by the Social Sciences and Humanities Research Council (SSHRC) as well as the Department of Anthropology and Archaeology at the University of Calgary, and was done in partnership with Alberta Culture and Tourism (ACT).

We thank as well our colleagues Christina Robinson and Kelsey Pennanen who helped with fieldwork during this project.

8. References


Government of Alberta. 2014. Funding to Help Preserve Heritage Treasures in Flood-Impacted Communities. Electronic document,


