Photogrammetry Laser Scanning and Reverse Engineering Conrad’s Jewel

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Abstract

Laser scanning, photogrammetry, and other technical tools are staples for cultural heritage documentation and reverse engineering projects. However, manufacturers and even researchers often conflate the data capture process with reverse engineering itself, even though the data alone cannot provide the insight needed for a full reverse engineering or understanding of the historic site. This paper illustrates how laser scanning and photogrammetric applications were used in reverse engineering the construction and details of Conrad’s Jewel, a 1908 Silver/Gold mill in the Yukon, Canada. Analogous to systems and software engineering fields, the reverse engineering process is framed by considering related designs, existing documentation, personal experience, and general external knowledge.

1. Case Study

The Venus Mill in the Yukon is nicknamed after Colonel John Conrad, who headed the construction and operation of the mine and mill site. Located on the Klondike Highway, 94 km south of Whitehorse, Venus Mill was named as his jewel because it boasted the most recent and best ore milling technology of the time. Like most of the operations during the era’s mining boom, Conrad’s Jewel busted after only a few years of operation. The ceased activities left the mill preserved in a mostly unaltered state; yet the years of erosion from wind, ice, and rockslide has left the structure in a state of collapse (ERA, 2023).

Figure 1. Laser scanning Conrad’s Jewel: Venus Mill

In 2023**,** a campaign was launched to document the state of the structure as an act of documentation. Following the first on-site visit, the main difficulties of the data acquisition were assessed as the high number of wood elements and timber joints, the lack of light in certain parts of the buildings, and the current structural condition of the mill and vein structures. Various documentation techniques have been used during the data acquisition process, including laser scanning, terrestrial photogrammetry, aerial photogrammetry, and panoramic photography to document the mill and its surrounding landscape (Figure 1). While the data obtained is now being used to create online storytelling applications for providing the community with safe access and insight to the heritage, this research focuses on how those elements can be captured under constraints of time, access, and safety, as well as, their potential to be used to reverse engineer the historic construction methods of the time.

2. Methodology - Reverse Engineering

The approach of reverse engineering differs depending on the specific field it is being applied in. A simple definition of reverse engineering may be known as: “the process of duplicating an existing part, subassembly, or product, without drawings, documentation, or a computer model,” or “process of obtaining a geometric CAD model from 3-D points acquired by scanning/ digitizing existing parts/products.” (Raja and Fernandes, 2008). This definition and approach is commonly used in mechanical engineering in its corresponding industrial context. It is also commonly used in the architectural conservation field; when researchers are recording and modelling buildings. This approach assumes that a building–or its subassembly–can simply be replicated. Consequently, it's only capable of reproducing a surrogate of a building. In reverse engineering, a surrogate has the same function and fit as the original, but this is only at the terminals. Rekoff (1985) gives the example; the required dimensions for bolt holes to line up. Buildings, especially historic ones, are better thought of as complex systems of parts. A more advantageous understanding of reverse engineering comes from software and systems engineering.

For Chikofsky & Cross (1990), their understanding is applied to the software engineering field when outlining a taxonomy for reverse engineering. Their definition is borrowed from M.G. Rekoff: “Reverse engineering…is the act of developing a set of specifications for a complex hardware system by an orderly examination of specimens of that system… without the benefit of any of the original drawings ... for the purpose of making a clone of the original hardware system ...” (Rekoff, 1985). For Chikofsky & Cross (1990), they recognize that “while the hardware objective traditionally is to duplicate the system, the software objective is most often to gain a sufficient design-level understanding to aid maintenance, strengthen enhancement, or support replacement.” The recovery of a design not only requires the system in question, but also a broad range of information sourced from: related designs, existing documentation, personal experience, and general external knowledge (Chikofsky & Cross, 1990). This combination of object and contextual information is what distinguishes reverse engineering for a clone from reverse engineering for a surrogate. The object and context information is analogous to the dimensional and functional requirements set out by M.G. Rekoff. More importantly, the functional specifications cannot be used to directly manufacture the clone, while dimensional specifications are not useful for describing how the object is used, its operation, its performance, or how it is adjusted (Rekoff, 1985). These are important considerations when investigating a historic structure.

Rekoff’s process for reverse engineering consists of five steps: assimilate existing data; identify elements; disassemble; analyse, test, and dimension; and complete documentation. While assimilating existing information, one can find valuable information from sources like operating instructions, maintenance manuals, training manuals, traditions, training standard practice, prior designs from the original designers, manufacturing methods of the time/place, etc. Another important source is the experts; those who are “skilled in a specific technology will be able to recognize clues that might otherwise escape the notice of someone less knowledgeable.” (Rekoff, 1985). Thus, within the framework of this research, instead of documenting and archiving the as-found condition, this research approached a circular workflow where the digital data was fed by distant knowledge and traditional know-how, which enabled a continuous assessment of the timber structure and its elements.

3. State of the Art

Many publications across different fields employ advanced data acquisition techniques, as well as data processing techniques for reverse engineering of surrogates. For instance, an example from the field of mechanical and industrial engineering compared calibrated camera photogrammetry with structured light scanning for measuring critical structural features of a component that could not be disassembled otherwise (Pavelka and Grešla, 2025). Within the scope of their research, Pavelka and Grešla recorded a 100-ton industrial press, yet their approach was limited to reverse engineering surrogates. In the field of cultural heritage, we observed a trend to use high-tech methods for processing their captured data such as sensor data fusion, digital sculpting, algorithmic hole filling, FEM simulation and so on. For example, the research of Di Paola and Inzerillo (2018), Cardaci and Versaci (2019), and Bishop et al. (2025) aimed to record heritage artefacts for reproduction, and they employed photogrammetry and laser scanning. Yet, their dataset only included the geometry for 3D printing without any contextual sources; which showed that their approach is only capable of reverse engineering for surrogates. Galanakis et al. (2023) recorded the structure at the Temple of Apollo at Delphi with terrestrial laser scanning and aerial photogrammetry Their recording was towards segmenting individual stone ashlars from column shafts at the temple, which also only focused on the geometry without contextual sources. Finally, Massafra et al. (2025) points out the complexity of understanding the historic buildings’ geometric, structural, and technical features. For instance, one might consider structural patterns, cutting procedures, metal connections and member cross-sections to understand and read timber roofs of historic buildings. In the case of reading and understanding masonry structures, one can consider how their half pilasters, buttresses, protrusions, and recesses work. Thus, it is important to understand these building elements, it is also important to consider how to ‘see’ the elements.

The digital recording to CAD pipeline is highly capable for metric accuracy, but lacks the requirements of reverse engineering for complex systems and understanding historic sites. Fortenberry and Leifeste (2020) demonstrated that digital survey tools are capable and accurate enough for measuring inaccessible building components and irregular & non-orthogonal building components, but not enough for architectural details like window frames and door jambs. Conversely, they also presented how analog methods are more precise for recording heritage structures; since the interpretation of the building is happening onsite, rather than in the office with less information. This shows that the lens through which the building is read matters, and that measurement fidelity only goes so far. When sites are inaccessible with time or safety constraints, it is even more imperative to augment our ability to read the site with contextual understanding.

4. Digital Survey of Venus Mill

For the digital survey of Venus Mill, the documentation techniques utilized are: (1) Global Navigation Satellite System (GNSS) and total station survey for surveying ground control points, (2) a Remotely Piloted Aerial System (RPAS) for capturing aerial photography for photogrammetric use, (3) terrestrial laser scanner for overall documentation of the interior and exterior, and (4) mirrorless camera for high-resolution photography for terrestrial photogrammetry and character-defining elements.

4.1 Geo-Spatial Positioning

An *Emlid REACH RS2* Global Navigation Satellite System (GNSS) receiver was used at the Venus Mill Site to cartographically reference the survey data and consequently the laser scan and photogrammetric data. Within the documentation project, three GNSS points were measured over the mill site to improve the precision of the geolocation. Each point was measured for an hour to collect signals from several satellites.

The calculation of cartographic coordinates of the GNSS points was then concluded with the conversion of ellipsoidal elevations into orthometric elevations, using the Earth Gravitational Model CGG2013a. The final data solution resulted in cartographic coordinates in the UTM (North) Zone 8 – WGS 84 reference system.

The control points of the GNSS receiver at the Venus Mill were measured over the survey nails used for the total station setups. This allowed us to cartographically orient the local point system from the total station.

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4.2 Total Station Survey

A *Leica* Geosystems *TS11* total station was used to measure local points at the Venus Mill Site. A control network was established on the Klondike Highway road along the site; multiple setups were established with survey nails to balance distance with visibility to the structure, as shown in Figure 2. The loop error for the network was 11 mm over a 262 m loop length, with the longest leg of the loop at 130 m. Ideally, the control network would have been established around the entire building, but the steep slopes, eroding scree, and time constraints made this impractical. With the limited time and site restrictions, a total of four stations were set up along the highway.

Figure 2. Illustration of Venus Mill survey control network and measured control points

Checkerboard targets were used as points, along with natural points that can be returned to in a future campaign; the checkerboard targets were placed such that they were included as targets in the laser scans and photogrammetry. Nail points were also created by setting survey nails into the ground for the control network. Drone targets were created using brightly coloured tape in an "x" pattern on the concrete barriers.

4.3 Terrestrial Laser Scanning

One Leica *RTC 360* laser scanner was to scan the exterior and parts of the interior of the Venus Mill. Due to the mill being in a state of collapse, the building was not safe to enter, yet we were able to place the scanner inside some of the open doors and windows to capture as much of the interior as possible. Other interior areas were able to be captured through collapsed areas and gaps in the building's sheathing. A total of 67 scans were captured of Venus Mill

The scans were initially all registered together by cloud-to-cloud registration; however, there were some errors in some of the scans on the steep sections of the slope. This may have come from the laser scanner shifting on the slope's scree and/or the high winds in the area. Consequently, the scans were split into three cloud-to-cloud registration bundles and were then registered to each other with the applied control from the georeferenced survey data. The cloud-to-cloud registration networks can be seen in Figure 3. The applied control mean error was 4mm and the bundle error was 4 mm.

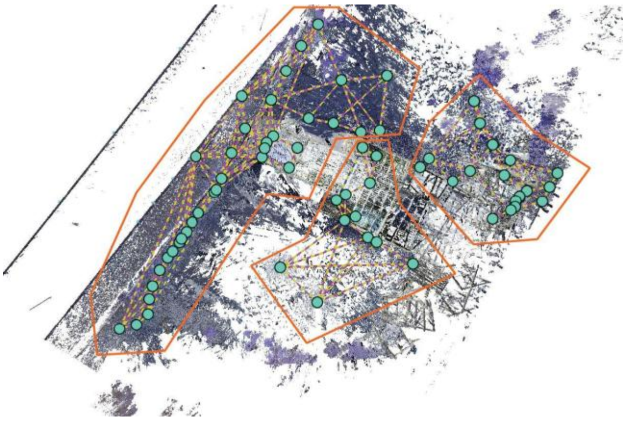

Figure 3. Laser scanning - three cloud-to-cloud registration bundles

4.4 Photogrammetry

Aerial and terrestrial photogrammetry were completed in the Venus Mill Documentation Project. Terrestrial photogrammetry was acquired with mirrorless digital cameras in spot locations - where safe - and aerial photogrammetry images were captured of the exterior structure, roof, the immediate surroundings, and topography.

Where it was safe, terrestrial photogrammetry was captured of the mill with a Sony α7R IV mirrorless camera. Two different RPASs or drones were used to capture the aerial photogrammetry: a DJI Mavic 3, and a DJI Mavic 2 Pro. The Mavic 2 Pro was selected given its portability and performance, specifically in terms of flight duration and image quality. The Mavic 3 was manually piloted for photogrammetry, while the Mavic 2 Pro was piloted manually, and flights were also programmed to capture the site's topography. Since there was no cellular service on-site, the automatic flights had to be pre-programmed before going to the site. Photographs were taken with a 60-80% overlap during the manual flights, at a range of 5-15m from the structures.

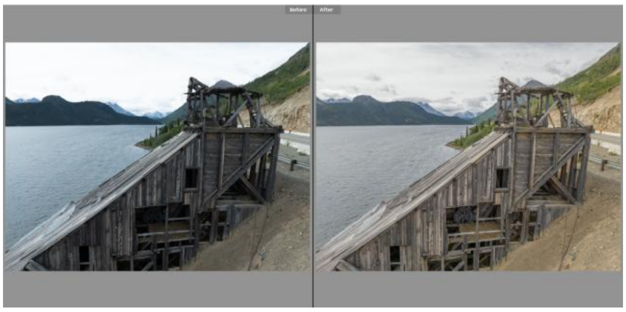

Figure 4. Example of colour and exposure corrected image

The photos from the Sony camera and the Mavic 3 were captured in a native raw format, then converted to DNG files. A Calibrite ColorChecker Passport Photo 2 was used to calibrate the white balance and exposure and then the corrections were applied to the images before converting them into JPEGs for photogrammetric processing. Figure 4 shows the typical colour corrections applied to the captured photos.

The corrected JPGs were input into the Agisoft Metashape and aligned on a 'High' accuracy setting. Then, the photogrammetric model was oriented to the cartographic reference system with georeferenced control points. The mean error of control points was 5mm. The aligned photos were used to generate a point cloud model (Figure 5) for creating measured drawings and a textured mesh for creating orthometric elevations.

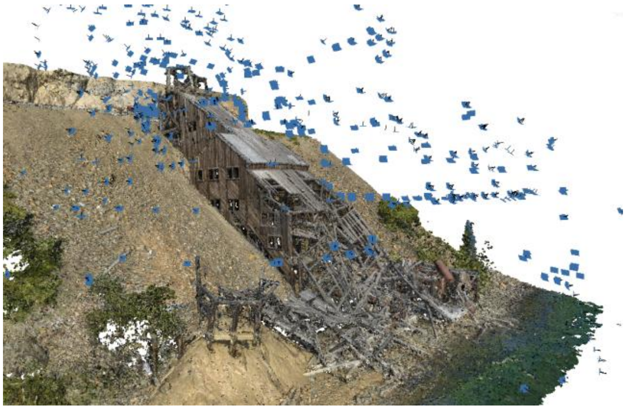

Figure 5. Photogrammetric network and point cloud

5. Reverse Engineering Venus Mill

The reverse engineering of Venus Mill can be considered to have two main aspects: the first is the overall form and construction of the building, and the latter is the design of the structural joinery. Of course, there are many other aspects of the design that can be considered: design and use of the machinery, electrical systems, mechanical systems, timber species, timber manufacturing workflows, etc.

5.1 Reverse Engineering the Form & Construction

5.1.1 Initial Observations: Before going on-site, preliminary research was conducted to gather as much existing information as possible. One major document among others is *Our Yukon Heritage Reserves*, a research report published by ERA Architects (2023). It features the Venus Mill and identifies its location, historical context, management factors, site condition, accessibility, risk to visitors, and past conservation investment. Another important source of reference is a previous assessment sketch provided by G Skuce in 2005 that shows the layout of the levels and the milling equipment found on each level of the Venus Mill. Finally, historic photography guided the on-site documentation.

The initial observations about the timber frame were made onsite by experienced members of the documentation team. These observations were framed by their experience in historic building documentation, timber framing, drafting, and engineering design. The structure is a timber frame construction, using iron fasteners for joinery. The majority of the timber is sawmilled, with carefully cut joinery. Other timber members are left in the round and crudely cut. The frame is sheathed diagonally with milled lumber. The timber seems to be a Douglas fir species, while the logs left in the round are likely local trees.

The onsite documentation was completed with a focus on an architectural survey for producing a set of site plans, floor plans, and photographic documentation of the character-defining elements. As an extension of the onsite observation and documentation, the reverse engineering is completed with the data gathered from the 2023 campaign, along with additional research afterwards.

5.1.2 Contextual Sources: Generally, timber frames are constructed of heavy timber, with large cross-sections, and are joined with pegged mortise and tenons. The timber joints are typically laid out and cut before erecting the building onsite. The timber frame is erected by raising a series of transverse cross-sectional frames called bents. *Historic American Timber Joinery* by Jack Sobon shows the relationship between timber joinery and their respective bents, while *Historic American Roof Trusses* by Jan Lewandoski illustrates the relevant roof trusses and their joinery (Lewandoski, 2006.). This existing knowledge and documentation of timber frames help in interpreting Venus Mill.

Figure 6. Historic photo of intact Venus Mill. Yukon Archives, Mervyn-Wood family fonds, 98/87 #402.

Lastly, historic photography can also be a great source of insight for reverse engineering. For example, a photograph from the Yukon Archives that shows the original form of the Venus Mill before the lower levels collapsed (Figure 6). When attempting to reverse engineer the original construction of the building, the historic photograph guides the virtual reconstruction.

5.1.3 Digital Survey to Reverse Engineering: The point clouds from photogrammetry and laser scanning can be used to create virtual sections of Venus Mill and help identify its characteristic cross-sectional, bent construction. Transverse sections of timber frames typically show the bent pattern with the roof framing. The transverse section in Figure 7 shows what could be a bent; however, it lacks the roof framing. Roof framing is found in the longitudinal sections in a truss form. The truss bottom chords, or tie beams, rest on the top plate beam found in the transverse section. Since the frame is a tie at plate configuration, the transverse section shows the bents that are assembled on the ground and then raised sequentially. This makes sense when trying to raise a frame on the Venus Mill’s steep slope. Additionally, the transverse section shows the top plate resting on four posts, with knee braces between them. These four square posts rest on a floor beam that also spans the width of the building and the floor beam is supported by four more posts that are left in the round. There is no lateral bracing between the round posts and the floor beam; therefore, it is likely that the round posts are piled into the ground, providing lateral stability. This is consistent with the design of industrial timber structures like trestle bridges (Foster, 1897) and mills (Ketchum, 1912). This industrial timber frame in its mining context is reflected in its construction: a series of gabled timber frames supported by trestle frame-foundations.

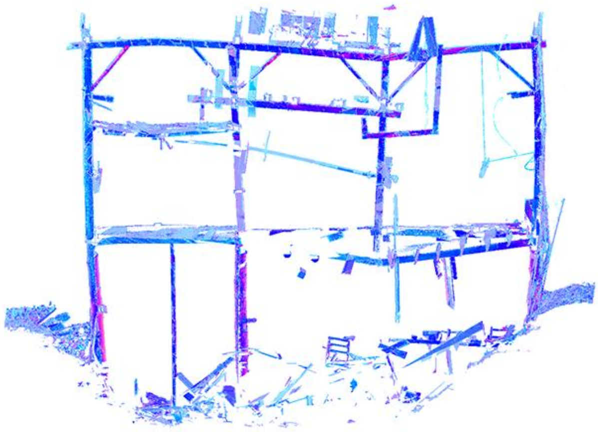

Figure 7. Transverse section

When the longitudinal sections are inspected, like in Figure 8, several sub-frames can be identified. A main characteristic of Venus Mill is its roof truss. The mill uses a king post truss multiple times throughout its design and this pattern is a key for understanding the collapsed levels.

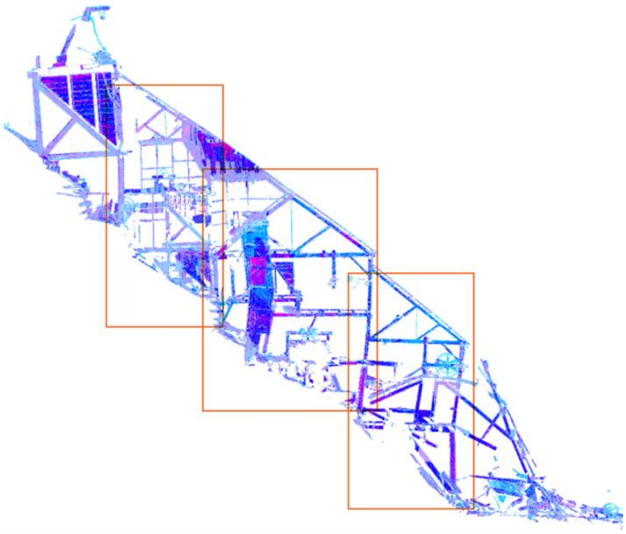

Figure 8. Longitudinal section with ID’d timber sub-frames

By leveraging the laser scanning and photogrammetry data, details that would otherwise have been overlooked on-site can be revealed. Partially intact trusses were identified in the mess of collapsed timbers. Figure 9 shows the part of the collapsed area of Venus Mill, with the signature kingpost truss. The overall dimensions of the truss can be measured and used to reconstruct the dimensions of the original building. This was completed by extending the current roofline by the length of the principal rafter of the truss.

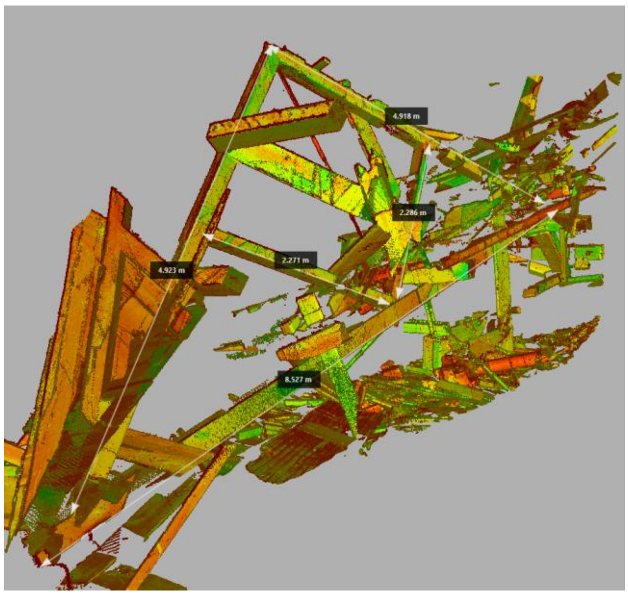

Figure 9. Measuring the laser scan of the collapsed truss

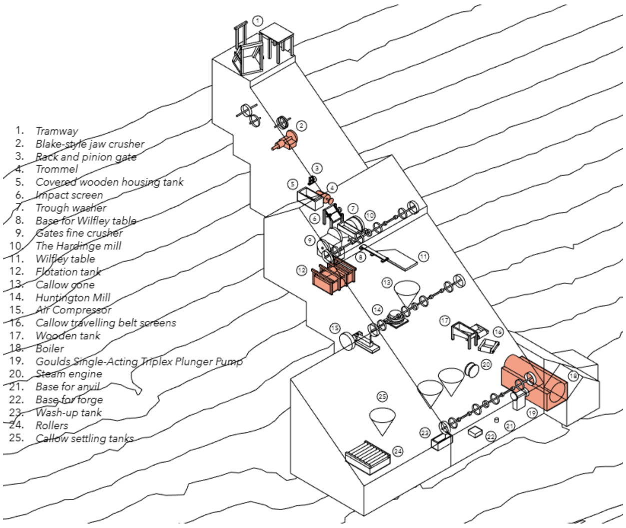

Figure 10. Reverse engineered mill schematic drawn by Jeremie Lafleche

With the historic photograph, working knowledge of timber frame construction, identification of semi-collapsed timbers, and point cloud measurements, a scaled schematic of Venus Mill was reconstructed. The schematic is seen in Figure 10. This schematic was also used as a basis to map the location of the milling equipment located on each level. with previous archaeological research to identify and locate milling equipment on each level.

5.2 Reverse Engineering the Timber Joinery

5.2.1 Contextual Sources: *Historic American Timber Joinery* and *Historic American Roof Trusses* are both foundational guides to understanding American timber frame joinery and joinery situations. Within this context, it is evident that the most basic and common joint used is the mortise and tenon; a joint cut solely from the timber members themselves. The mortise and tenon is characteristic to American timber framing (Sobon, 2002). When the failed joints in Venus Mill are inspected (Figure 11), no mortise and tenons are found. Instead, iron hardware is found to connect the timbers. Although metal fasteners are common today with mass timber structures, they are not consistent with Venus Mills joinery. Without fully disassembling the building, it is hard to determine the joinery configurations.

Figure 11. Failed joints showing iron fasteners

The personal experience of a local Yukon historian pointed out a good resource, *Handbook of Mineral Dressing* (Taggart, 1927). This document provided insight into the realm of mine and mill structure design. Although it didn’t show conventional timber framing, it still showed the construction of timber ore bins. Further investigation of design manuals revealed that trestle frames in bridges (Ketchum, 1912) and marine wharf structures use similar framing and joinery methods (Moffatt and Nichol, Engineers, 1983; United States, 1964). These manuals include details of the specific types of iron fasteners—drift pins, bolts, spikes, nails, and threaded rods. Additionally, an example of a similar industrial timber structure was found in the desert of Nevada. Pioche Mine, which was built in the same era as Venus Mill and features almost identical joinery. Figure 12 shows a withdrawn joint with protruding iron spikes and likely a drift pin.

Figure 12. Withdrawn joint from Pioche Mine

5.2.2 Digital survey to reverse engineering: The contextual sources provide insight into how to interpret the Venus Mill, as well as its laser scan and photogrammetry data, with respect to its joinery. The point clouds from laser scanning and photogrammetry can display the joint configurations, member sizing, and materiality differentiation. Switching between scan colour, normals, and intensity visualization also helps with interpreting the point cloud. Without fully disassembling the joints, evidence of joinery can still be seen: iron spike heads, bolt heads, washers, etc.

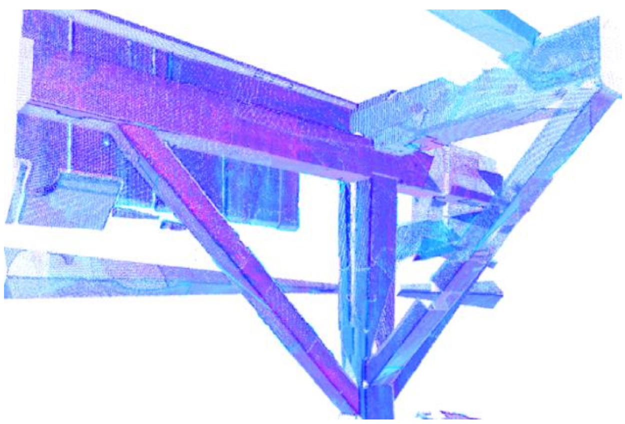

Figure 13. Laser scan of truss tie beam over plate and post

Sometimes it is easier to identify the iron fasteners with the aerial photography that was taken for photogrammetry and 360 photos produced by the scanner. Aerial photography shows the opposite side of a joint that is not visible from below. For example, inspecting the braces in Figure 13 from below, it's possible to see iron fastener heads set into the braces. When the joints are inspected in Figure 14 from above, no iron joinery can be seen; therefore, the braces are almost certainly fastened with spikes. Conversely, the rafter to tie beam joint shows evidence of a bolt head, nut, and washer, seen from both sides; therefore, this is a bolted connection.

Figure 14. Aerial photography of timber joinery

As in the name, CAD software can aid in the design of structures and therefore, can aid in the reverse engineering of designs. For Venus Mill, *AutoDesk AutoCAD* was used to rationalize and communicate the configuration of the joint situations, in a similar format to *Historic American Timber Joinery.* In this document, Sobon breaks down the timber frame into joint situations: Tying Joints: Tie below Plate; Tying Joints: Tie at Plate, Sill and Floor Joints, etc. Sobon (2002) also uses exploded perspective drawings to further illustrate the joint construction. This format is used as a template for analyzing the joints as well as illustrating the joints in Venus Mill, as seen in Figure 15.

5.3 Summary of Timber Frame Joints

The timber joinery tells the story behind how these historic timber structures came into realization. At Venus Mill, this becomes more evident. The digital survey of Venus Mill deepened this reading, uncovered its design process, and demonstrated how such detailed readings can help understanding other similar sites in Western Canada. Venus Mill in its collapsed stage exposed the as-found condition of the multiple timber joints throughout the roof system. Misaligned, separated and fractured timber connections revealed the timber-to-timber connection details that would otherwise be unidentified. Within the context of this research, we specifically focused on different timber frame joints observed in the roof system, as well as scarf joints observed at multiple areas. The scope of the intervention gave us important details on different timber joints and overall design strategy of the site.

During our analysis, we based our categorization on Sobon's *Historic American Timber Joinery*, namely rafter peaks, rafter to tie at plate, strut to rafter, 'king post' to strut, floor tie beam (tie below plate), and scarf joints (Sobon, 2002). First of all, we identified that Venus Mill has a king post roof truss system. A closer reading in the point clouds showed that in the trusses, the **king posts** are replaced with iron rods.

Further on, with the reverse engineering of the Venus Mill, we identified **rafter peaks** where the tie rod bears against the principal rafters with bolts and washers. Additionally, the purlins are secured to the rafters with drift bolts, while the eave purlins are secured with iron spikes. Secondly, we identified the **rafter to tie** connection at the plate. Housings in the tie beam connect the timbers vertically and laterally. The tie beam's bottom is notched to bear onto the plate, and its upper housing is pitched to receive the principal rafter. The column, plate and tie beam are located with drift pins, and the principal rafter is further stabilized with drift bolts. At the **strut to rafter** connections, the rafters are notched to fit the struts. Also, the purlins are fastened with iron spikes. At the **'King post' to strut** connection, the tie rod passes through between two struts and is connected with the tie beam through washers. It acts as a tension member in this connection. The struts, on the other hand, do not have connection with the tie rod, as they would have with a timber king truss.

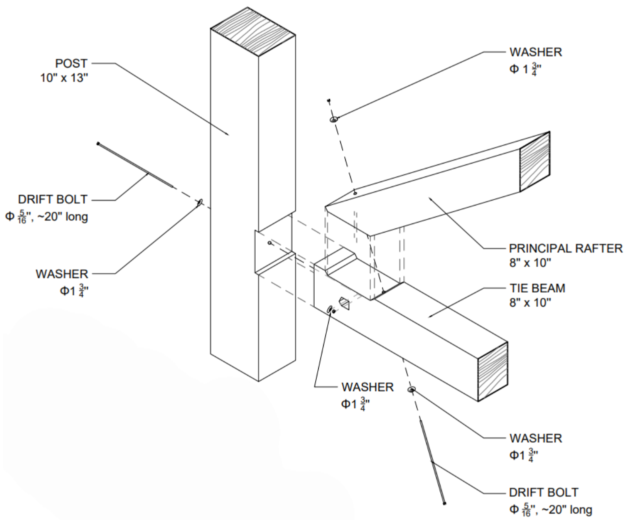

Figure 15. Reverse engineered timber joint drawn by Daniela Castro

In the case of **tie beam below plate** connections, the tie beam is connected to the post with a housing and a drift bolt. An access hole is cut into the tie beam to insert and tighten a nut onto the bolt. This can be seen in Figure 15.

Lastly, we identified several scarf joints during the data acquisition process. Closer digital survey revealed that these are stop-splayed **scarf joints,** which are undersquinted with wedges, and secured with four bolts. According to Sobon (2002), they are one of the strongest scarf joints available and are used to connect two timbers together lengthwise.

6. Conclusion

To conclude, we acknowledge that digital survey techniques like laser scanning and photogrammetry are integral for the reverse engineering of historic sites. We argue that when reverse engineering complex systems, like a historic site or building, more than digital measurements are required. Reverse engineering a surrogate of the building is not sufficient for conservation purposes. We demonstrated how reverse

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engineering can be applied to heritage sites by leveraging a broad range of information sourced from: related designs, existing documentation, personal experience, and general external knowledge. Specifically, we reverse engineer the overall form of Venus Mill and the particular joinery configurations featured in Venus Mill. This is completed by interpreting photogrammetry and laser scanning data with past experience, historic photography, other similar examples, existing documentation, and design manuals.

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8. References

Bishop, S.U., Arshad, M., Lazoğlu, L., Harpster, M., and Rehman, H.U. 2025. *Photogrammetry, Additive Manufacturing, and Sensorization for Archaeological Ceramic Loss Compensation.* Journal of Cultural Heritage. vol. 76. pp. 148–156.

Cardaci, A., and Versaci, A. 2019. *Research and Technological Innovation for the Knowledge, Conservation and Valorization of Cultural Heritage in Sicily.* The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. vol. XLII-2/W15. pp. 247–254.

Chikofsky, E.J., and J.H. Cross. *Reverse Engineering and design recovery: A taxonomy.* IEEE Software, vol. 7, no. 1, Jan. 1990, pp. 13–17, https://doi.org/10.1109/52.43044.

Di Paola, F., and L. Inzerillo. "3D Reconstruction–Reverse Engineering–Digital Fabrication of the Egyptian Palermo Stone Using Smartphone and Light Structured Scanner." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. XLII-2, 2018, pp. 311–318.

ERA Architects, 2023. *Our Yukon - Heritage Reserve Management Priorities Report.* Historic Sites Unit, Tourism and Culture, Government of Yukon

Fortenberry, B. R., and Leifeste, A. 2020. *Querying the Products of Two Recording Techniques: Analog and Digital.* APT Bulletin: The Journal of Preservation Technology, 51(2/3), 47–56. https://www-jstor-org.proxy.library.carleton.ca/stable/26943427

Foster, W.C., 1897. *A Treatise on Wooden Trestle Bridges: According to the Present Practice on American Railroads*. 2nd ed. New York: John Wiley & Sons.

Galanakis, D., Maravelakis, E., Pocobelli, D.P., Vidakis, N., Petousis, M., Konstantaras, A., and Tsakoumaki, M. 2023. *SVD-Based Point Cloud 3D Stone by Stone Segmentation for Cultural Heritage Structural Analysis – The Case of the Apollo Temple at Delphi.* Journal of Cultural Heritage. vol. 61. pp. 177–187.

Ketchum, M. S., 1912. *The Design of Mine Structures*. New York: McGraw-Hill.

Lewandoski, J., 2006. *Historic American Roof Trusses*. Timber Framers Guild, Becket, Massachusetts, USA.

Massafra, A., Prati, D., Gulli, R., 2024. *Reverse engineering workflows for the structural assessment of historical buildings*. International Journal of Architectural Heritage, 19(5), pp. 702–723. https://doi.org/10.1080/15583058.2024.2377295

Moffatt and Nichol, Engineers. 1983. *Construction Materials for Coastal Structures.* Prepared for U.S. Army, Corps of Engineers. Coastal Engineering Research Center. https://doi.org/10.5962/bhl.title.47709.

Pavelka, K., and Grešla, O. 2025. *The Use of Close-Range Photogrammetry and 3D Scanning for Diagnostic Purposes in Mechanical Engineering.* The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. vol. XLVIII-5/W3-2025. pp. 77–83.

Raja, V., and Fernandes, K.J. editors. *Reverse Engineering: An Industrial Perspective*. Springer, 2008.

Rekoff, M.G., 1985. *On reverse engineering*. IEEE Transactions on Systems, Man, and Cybernetics, 15(2), pp.244–252.

Sobon, J., 2002. *Historic American Timber Joinery*. Timber Framers Guild, Becket, Massachusetts, USA.

Taggart, A.F., 1927. *Handbook of Mineral Dressing: Ores and Industrial Minerals*. New York: John Wiley & Sons.

United States. Department of the Army. 1964. *Port Construction and Rehabilitation*. Washington.