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HSPV 721 Capstone Studio: Materials + Materialities

Desert Masonry at Taliesin West

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Spring 2023
Graduate Program in Historic Preservation
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Close-up view of the Drafting Studio Vault, showing face stones, goose eggs and rustications. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West,1937–1959, 659AR")

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Water Tower at Taliesin West. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West, 1937–1959, 659AR.")

1. Introduction

1.1 Project Scope

In 1937 American architect Frank Lloyd Wright established Taliesin West, his winter home, studio, and architectural training center located in the Sonoran Desert outside Scottsdale, Arizona (Figure 1.1). As a seasonal complement to Taliesin in Wisconsin, Taliesin West served as Wright's desert laboratory, where he practiced and refined his ideas of organic architecture in tandem with his pedagogical philosophy of "learning by doing." The site's evolv-ing construction and continual alterations, made by the apprentices over the years, reflect Wright's interest in experimentation with form and materials. One such experiment was the deployment of what Wright called "desert masonry" – a method of construction utilizing the local desert stone in combination with poured-in-place concrete to create a hybrid masonry system that was versatile, economical, and relatively easy to build with ample availability of non-professional labor. Desert masonry is arguably one of the principle character-defining features of Taliesin West. Literally made "of the desert" in terms of its use of the local quartzite and sand, Wright deployed these materials in a visually distinctive system to create massive towers and platform bases to support his wood and canvas superstructures as well as entire cave-like buildings with flat stone roofs. This created buildings that were tectonic ground plates tilted upward as battered masses in the landscape.

The scope of this research is to provide a comprehensive understanding of desert masonry as a construction system by examining its materials and techniques, its construction chronology and formal typology, and finally its performance and current conditions. First, we investigate the construction process to understand how this hybrid system was conceived and realized. Second, we trace its typology based on key attributes and how construction changed over time, identifying the evolving pattern that emerged across generations of student builders. And finally, we assess the condition of specif-

Figure 1.1. General view of Taliesin West looking north, showing the landscape of the Sonoran Desert surrounding the site. (Source: "Scottsdale: Taliesin West general view." Retrieved from https://library.artstor.org/asset/ARTSTOR_103_41822000225696.)

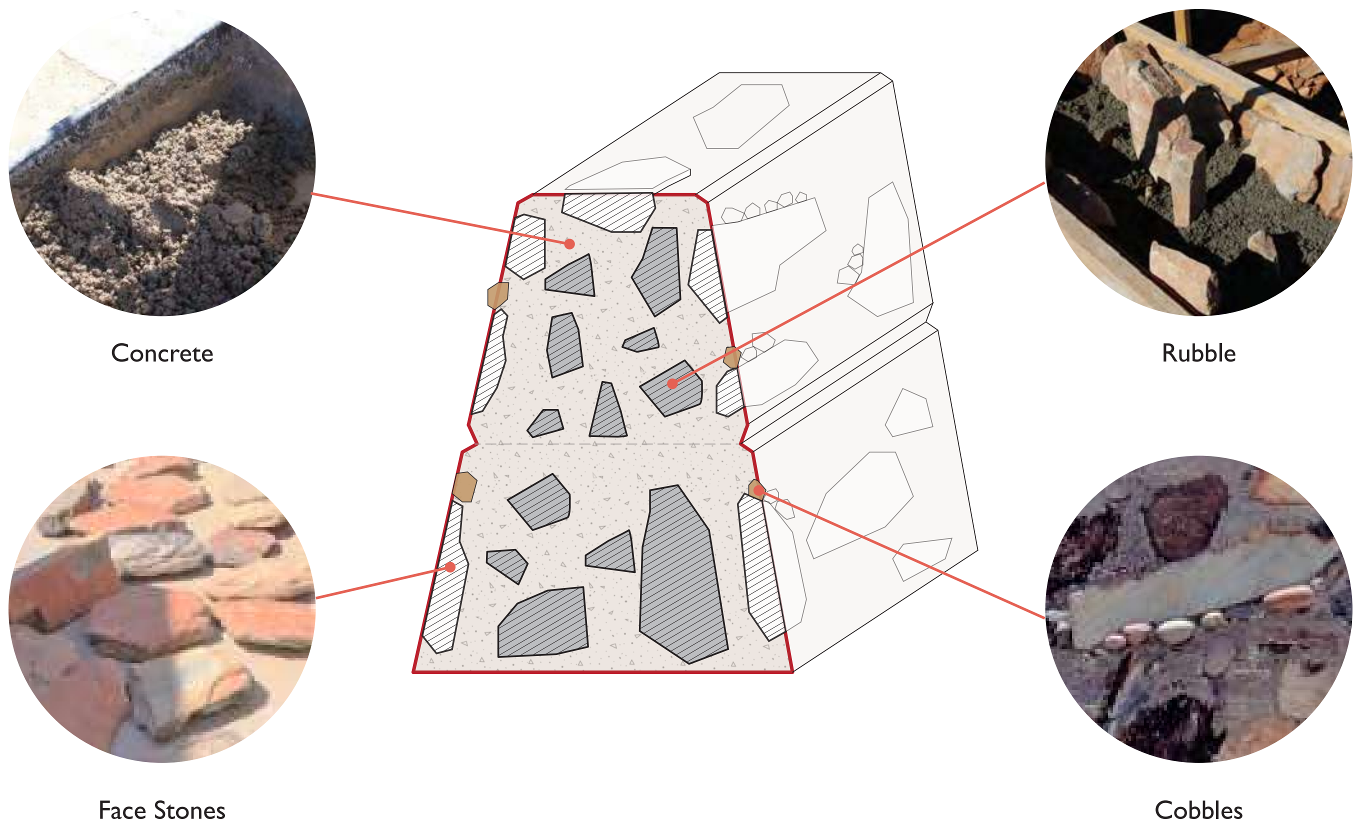

Figure 1.2. Cross-sectional view of a desert masonry wall, showing four different material compositions. (Source: images from franklloydwright.org, "New Desert Masonry Gateway Structure Unveiled at Taliesin West")

ic examples of desert masonry to identify decay mechanisms and propose preservation treatment strategies.

1.2 Material Composition

Desert masonry is a hybrid system of concrete and natural local stone. As shown in Figure 1.2, it consists of mainly four components: the local quartzite desert rock used as face stone and rubble, and cobbles or "goose eggs," local sand, and Portland cement. The concrete mixture is a dry pack consisting of approximately one-part grey Portland cement, four parts local sand (sourced from nearby washes), and minimal water. The face rocks, visible when the formwork is removed, are typically large flat surface rock naturally split off from nearby larger formations. They are relatively thin, flat on one side, and in various colors, from black to rusty red. Rubble, also sourced from the surrounding area, is added to the core of the walls to provide stable fill, control shrinkage of the concrete mass, support the face rocks, and lessen the need for more expensive cement in this hybrid system. Lastly, goose egg cobbles, 3–8-inch smooth round stones, are placed on top edges of the face rocks to prevent the concrete mixture from spilling out and over.[1]

1 Hariri, Gilda. "Taliesin as Text: The Story of the Desert Masonry at Taliesin West." Frank Lloyd Wright Quarterly Volume 29, Issue 1 (2018). 25

1.3 Significance to Taliesin West

Desert masonry embodies Wright's philosophy of organic architecture, which emphasizes the harmonious integration of buildings and landscapes. Used extensively throughout Taliesin West, its incorporation in almost every building makes it a unifying site element (Figure 1.3). Utilizing locally sourced stones and coarse sand, desert masonry is an integral component in shaping the massing and visual appearance of Taliesin West seamlessly blending with the surrounding desert floor. Additionally, the sloping rooflines imitate the shape of the nearby mountains, creating a visual unity and connection with the natural world reflecting Wright's organic architecture vision (Figure 1.4). Its formal references to Meso-American masonry, especially in its battered platform mound forms, grounds it literally given the lack of subsurface foundations and figuratively as an indigenous regional architecture (Figure 1.5).

Desert masonry also represents a distinctive construction system that employs slip-form construction techniques. Slip forming is a masonry method in which stones and mortar are built up in courses or 'lifts' of stone set in a concrete matrix utilizing low wooden formwork that can be "slipped up"

Figure 1.3. Desert masonry structures extensively built thoughout the site. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West, 1937–1959, 659AR" & "Ezra Stoller Archive: Frank Lloyd Wright. Taliesin West, 1950", https://library.artstor.org/asset/ASTOLLERIG.)

and reused in the next level (Figure 1.6-1.7).[2] The technology relates to ancient methods of form-based construction such as rammed earth or pisé and tabby but it was 're-invented' by reform architects such as Ernest Flagg, who employed it for low-cost housing solutions.[3] But unlike the traditional slip-form technique, which primarily attempts to imitate traditional stone masonry, Wright showcased both materials-stone and concrete-equally to create a visually distinctive masonry system that makes no illusion of actual load-bearing masonry (Figure 1.4).

As an innovative response to limited financial resources and semi-skilled labor, the process of constructing desert masonry provided a long-lasting connection between generations of apprentices on site (Figure 1.8-1.11). Each apprentice's placement of stones and the use of different proportions of materials contributed to a visual variability that defined the site's overall character and serves as a tangible reminder of the many Fellows who lived, labored, and learned at Taliesin West.

2 Thomas J. Elpel, "The Art of Slipforming: A Stone Masonry Primer," Mother Earth New, December 1997/January 1998, https://www.motherearthnews.com/diy/stone-masonry-primer-zmaz96djzgoe/, Accessed April 17, 2023.
3 Riley, Terence. "'Frank Lloyd Wright: Architect', Visions and Revisions since 1910." MoMA, no. 16 (1994): 4.

Figure 1.4. Looking northeast at the Pavilion, showing the roofline of the desert masonry structure mimicking the mountains behind. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West, 1937–1959, 659AR")

Figure 1.5. Inca building, Machu Picchu. (Source: Phillips, Ruth Anne, and R. Sarah Richardson. "Stone, Water, and Mortarless Constructions: Frank Lloyd Wright and the Pre-Columbian Inca." The Latin Americanist Volume 57, no. 4 (2013).)

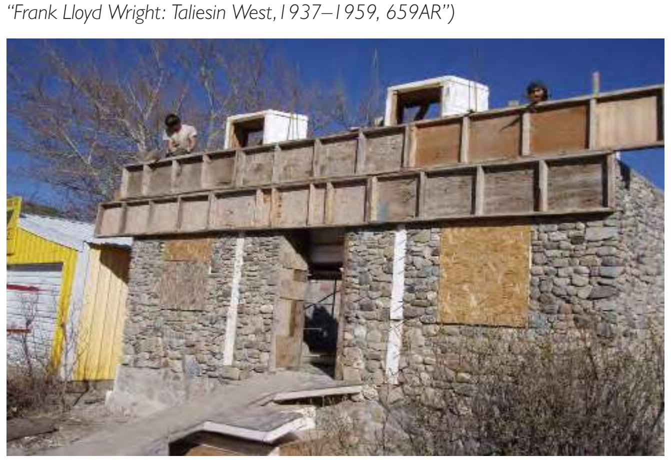

Figure 1.6. Traditional slip-form construction with mainly mortar-filled stones. (Source: "Forms are leap-frogged up the wall", https://commons.wikimedia.org/wiki/File:Forms_are_leap-frogged_up_the_wall.jpg)

Figure 1.7. Chimney Construction at Taliesin West, 1949. (Source: Gottlieb, Lois Davidson. A Way of Life : an Apprenticeship with Frank Lloyd Wright. Mulgrave, Vic.: Images Publishing Group, 2001.)

Figure 1.8. Construction of the Drafting Room piers and vault walls, showing the earliest concrete pours using slip forms. (Source: William Blair Scott. "75 Years at Taliesin West." Journal of Organic Architecture + Design Volume 1, Issue 1, 2013)

Figure 1.9. Construction of the Kiva Bridge, 1947. (Source: "Construction at Taliesin, 1947", https://guerrerophoto.com/portfolio/taliesin-fellowship/)

Figure 1.10. Reconstruction of the Pavilion, 1963. (Source: FLWF Archive, Taliesin West, "Pavilion Construction")

Figure 1.11. Construction of the new Gateway Structure, 2019. (Source: franklloydwright.org, "New Desert Masonry Gateway Structure Unveiled at Taliesin West")

Figure 1.12. Looking northeast towards Drafting Studio, with the McDowell Range behind. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West, 1937–1959, 659AR")

Construction at Taliesin West, with apprentice Arnold Roy on right,1956. *(Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)*

2. Construction

2.1 Methodology : Materials and Techniques

Recording the construction method of desert masonry was the first step foward better understanding its deployment at Taliesin West. Desert masonry is more than a primary building material; it is also a method of construction that Wright interpreted from the slip-form construction method. To fully understand and interpret this construction system, we first researched written records and drawings and especially historic construction photos at the Taliesin West Archives. On site, we looked closely at the physical fabric and observed evidence to confirm our assumptions based on the documentary sources. After the field visit, we combined on-site findings with historical research and interpreted these sources as diagrams with terminology and animation of the construction process.

2.2 Archival Research

The main written source used was Hariri's "Taliesin as Text: The Story of the Desert Masonry at Taliesin West." Historical photos were mainly collected from the Taliesin West Archive database and the photo collection by Pedro E. Guerrero. In 1939, Frank Lloyd Wright hired Guerrero to document his work. (Figure 2.1) Guerrero spent a year with Wright photographing Taliesin and Taliesin West, eventually, becoming a member of the Taliesin Fellowship.[1] A series of Cabaret construction photos were especially helpful in understanding the desert masonry construction processes. The construction diagrams in engineering and construction handbooks of the period were also essential references for understanding formwork-design and component terminology. (Figure 2.2-2.8)

1 Biography – Pedro E. Guerrero. https://guerrerophoto.com/biography/

Figure 2.1. Tansporting face stone using ramp. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

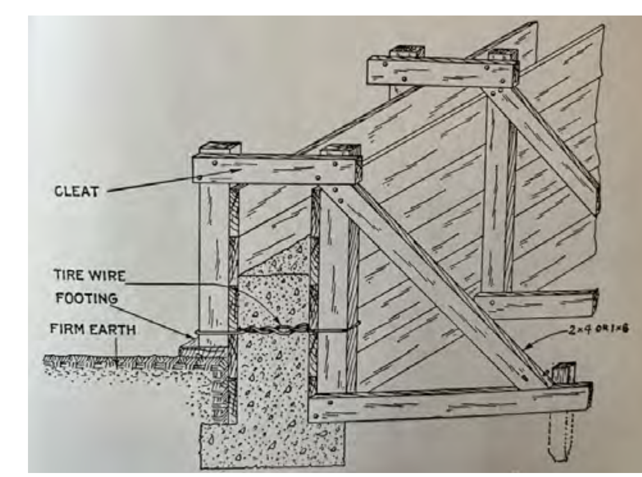

Figure 2.2. Single side foundation form, for foundation built in firm earth. (Source: Concrete Construction, International Textbook Company Ics)

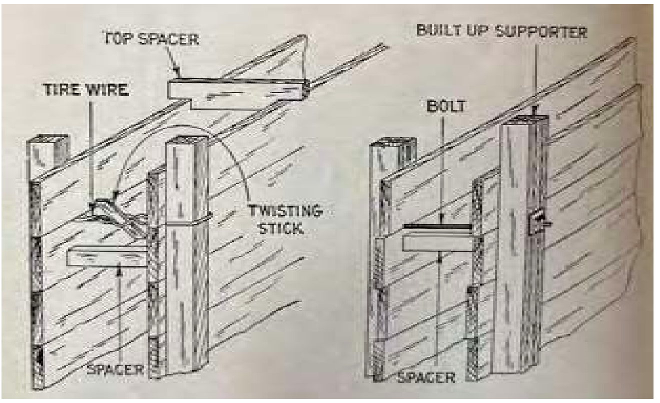

Figure 2.3. Twisted wire and bolt braces as used on concrete forms to insure maintaining the proper distance between the retaining boards. The tie wire braces are tightened by twisting. (Source: Concrete Construction, International Textbook Company Ics)

Figure 2.4. Formwork. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

Figure 2.5. Lowering form into place. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

Figure 2.6. Placing stone into forms. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

Figure 2.7. Packing concrete into forms. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

Figure 2.8. Stripping wood forms. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

2.3 Terminology

Figure 2.9 identifies the principal construction elements and formwork components of desert masonry. Illustrated is a typical knee wall with rustication. The first group of terms describes the wall's construction elements. Batter means the angle of the masonry, creating a slope. Lift refers to the sequential layers of concrete poured and cured on top of one another. In this diagram, there are three lifts. (L1, L2, L3) Rustication refers to horizontal grooves cast into the masonry. These are triangular in section and used as a method to hide cold joints and sometimes individual lifts. A cold joint is the connection between two separate pours of concrete that have been allowed to harden before the next pour is added. These can be sequential and superimposed during construction of a wall or evidence of alterations years later.

The second group of terms relates to formwork details, including board, batten, twisting stick, triangle strip, spreader, spacer and wire ties. With this type of formwork, spacers are used to ensure maintaining the proper distance between the retaining boards. The tie wire braces are tightened by twisting. All these elements make the form rigid against pressure due to the weight of the raw masonry. Wire ties were used to tie the two sides of the formwork together during the construction, and many of them remain visible on the desert masonry surface today.

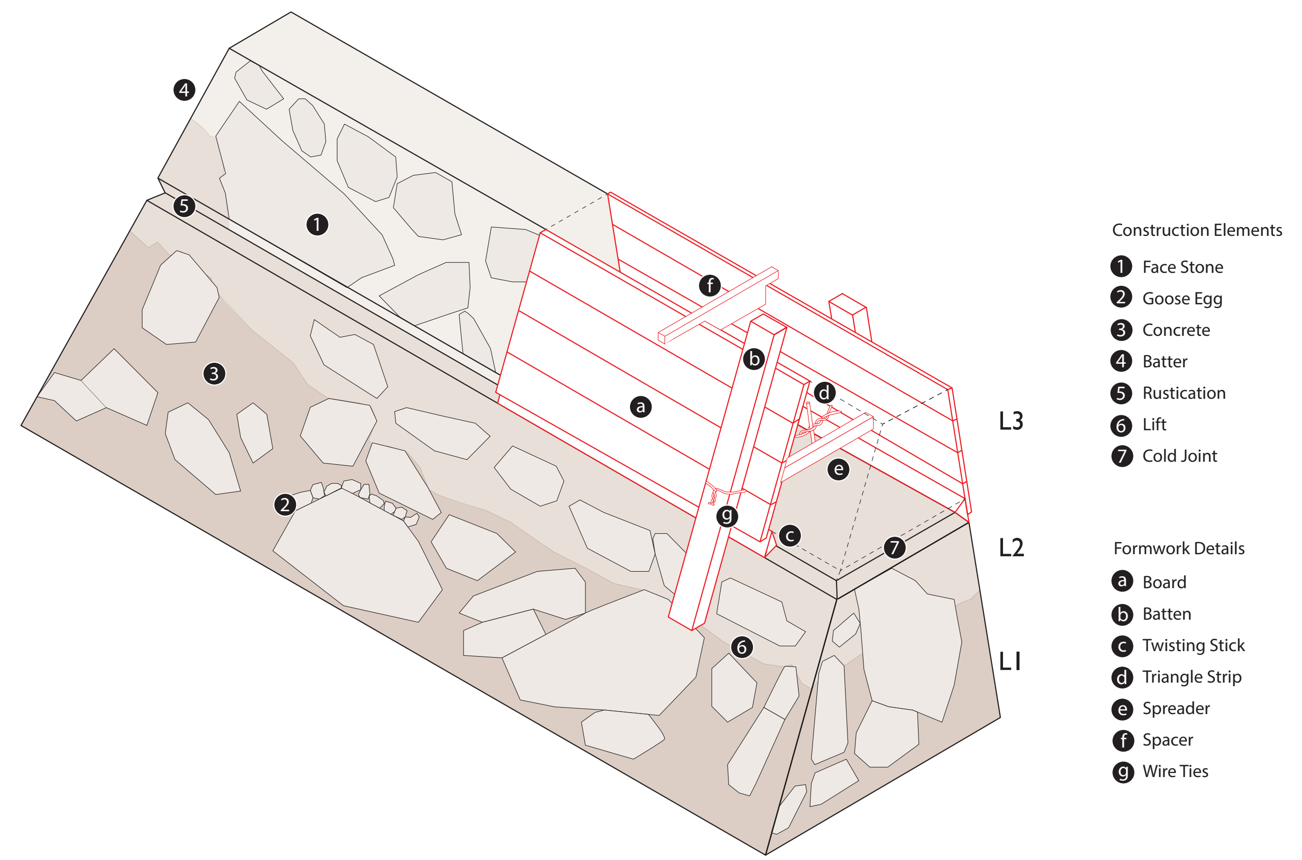

Figure 2.9. Construction diagram with formwork details and terminology (Source: created by authors)

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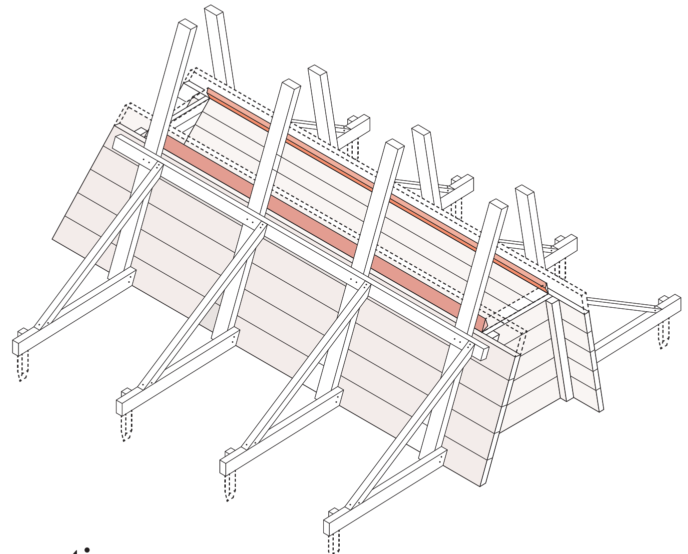
2.4 Construction Process

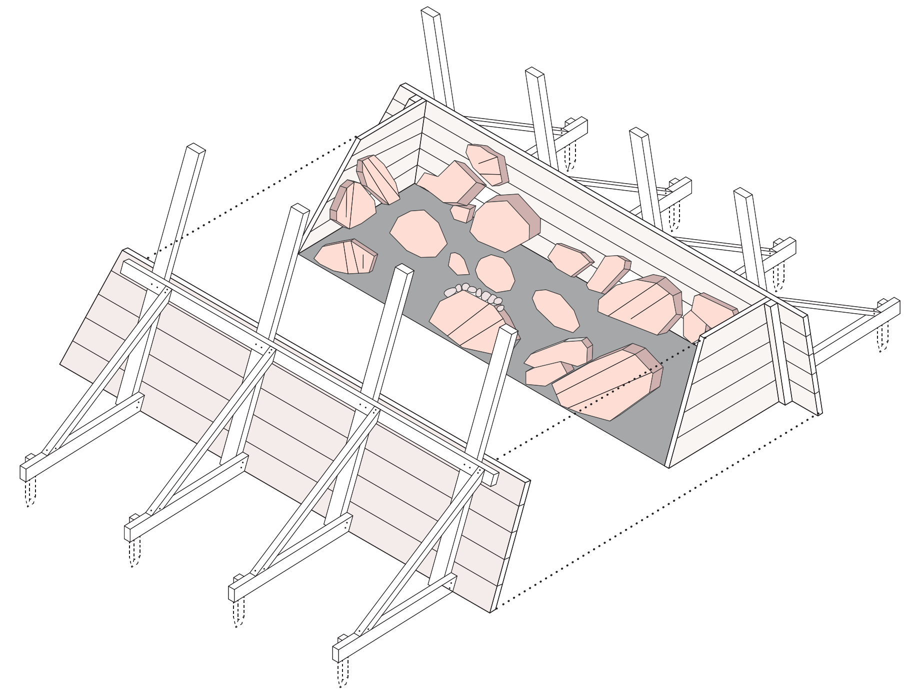


Step 1: Site preparation

The first step is to prepare the site and clear away plants and debris. There was no need for foundations or footings because the soil is dense and hard enough.

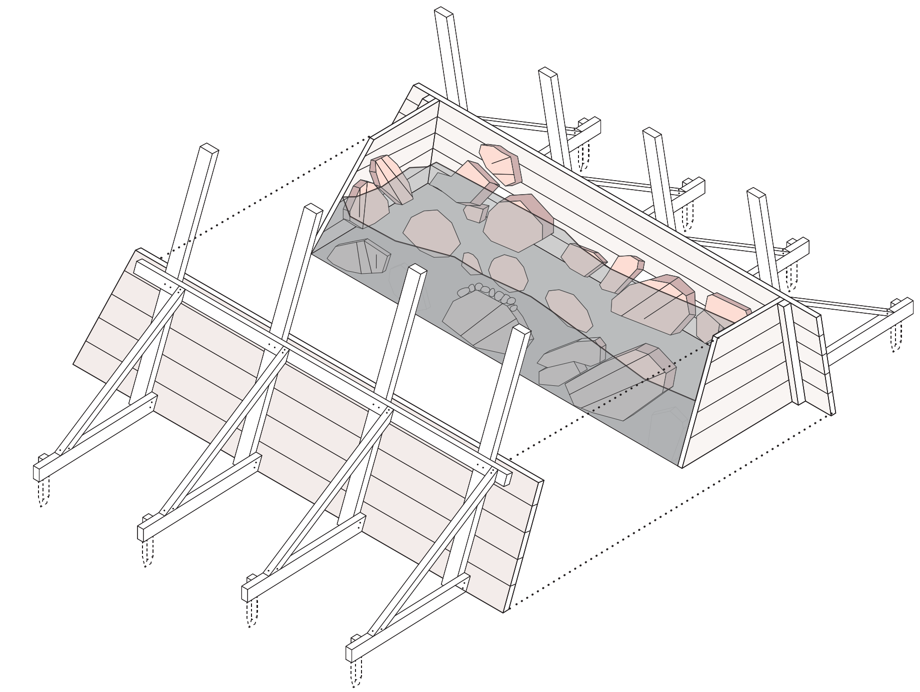
Step 2: Construction of the formwork

In slipform construction, the forms are low and constructed to the height of the first pour, with six inch-wide retaining boards and bracing.



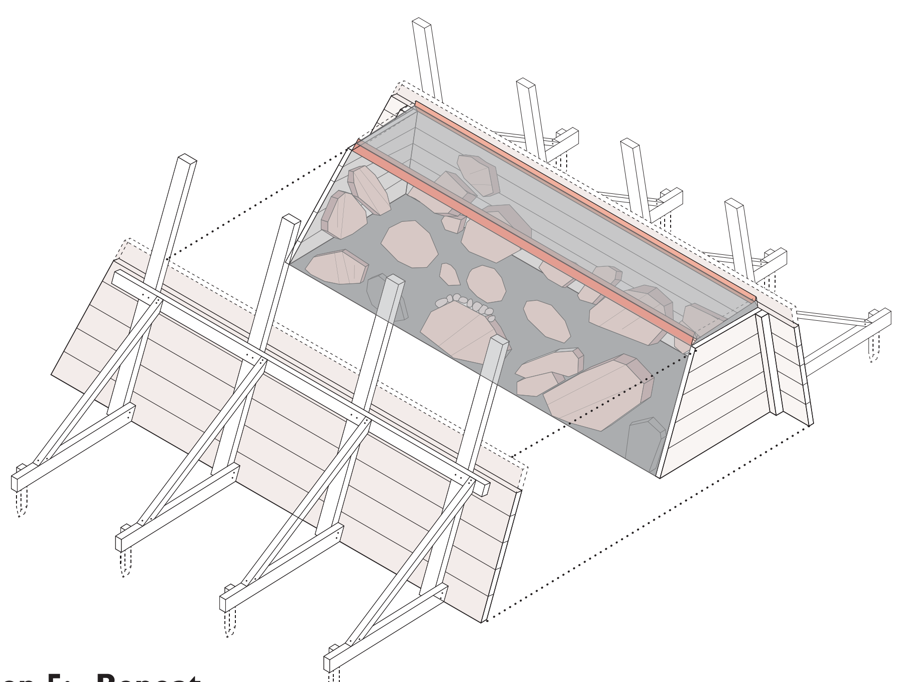
Step 3: Place face stones

The face stones are then placed against the forms and goose eggs used to fill gaps between face stones and the form to prevent concrete spill out. Rubble is placed in the center to fill the core and to hold the face rocks in place.



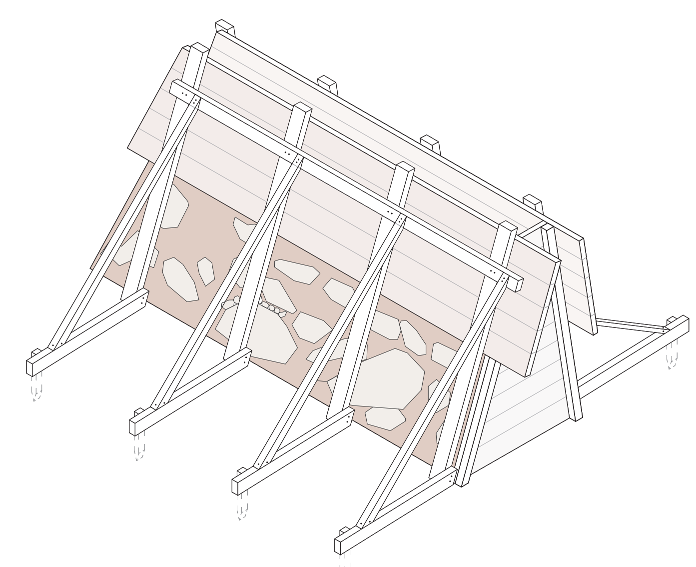
Step 4: Pack concrete into the form

The concrete mix is then packed into the form. A dry concrete mix is shoveled and tamped into the spaces between the stones, preventing the mixture from running down over the outer face of the face stones.



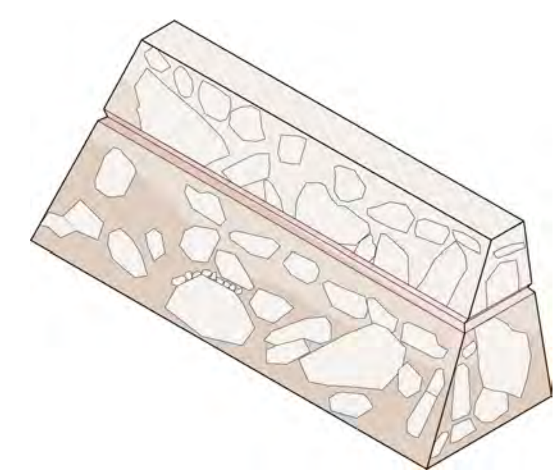
Step 5: Repeat

Stones and packing concrete are added until raised to the height of the triangular rustication strip. (Rustiction was inspired by the striations found in Canyon walls)



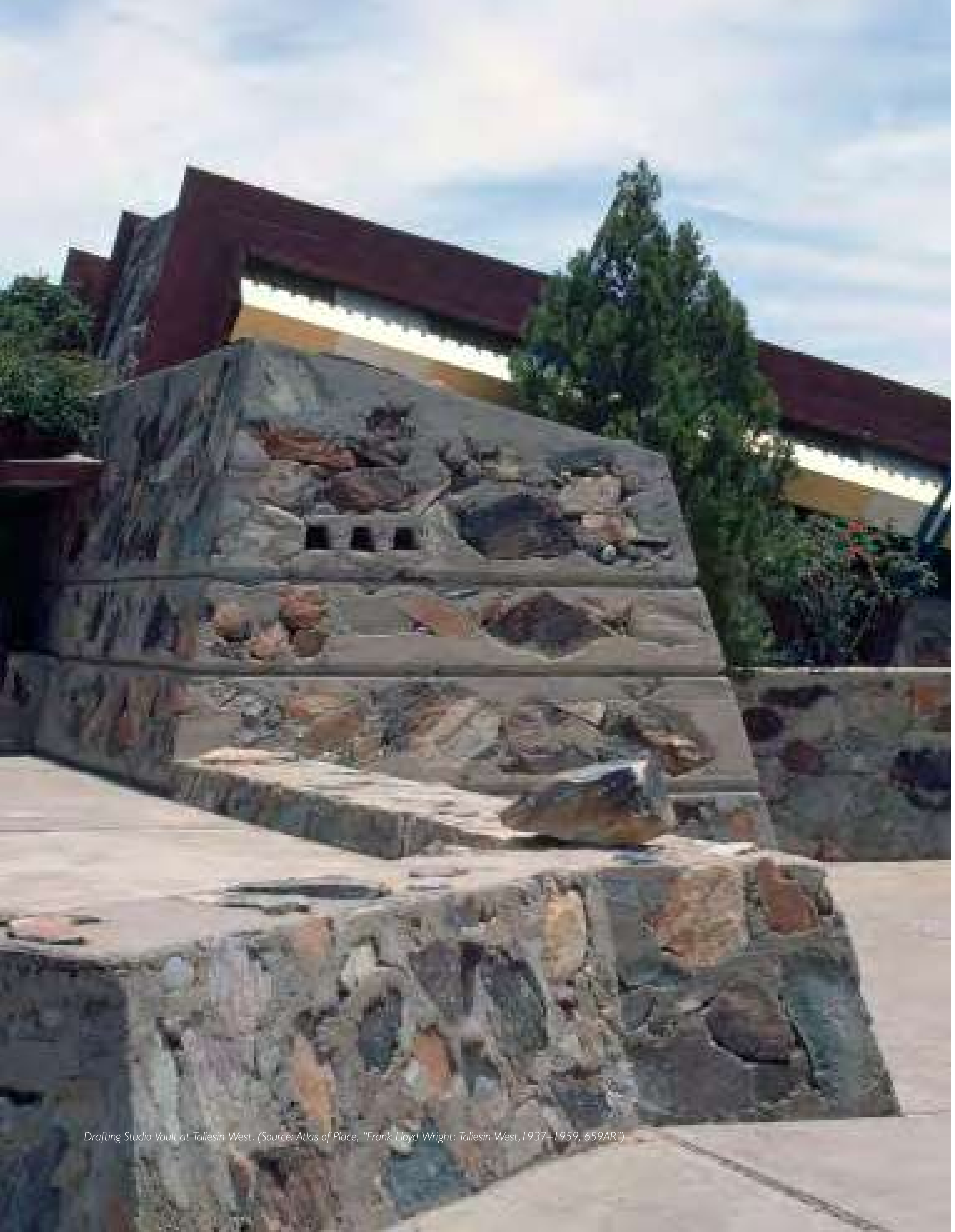
Step 6: Build the second layer

After 24 hours, the formwork is removed, flipped, and positioned at the top of the first lift and the process starts again this time with scaffolding for access. Slipforming allows the reuse of the forms from the lower part and simply reverses it to the second layer.



Step 7: Remove formwork & clean surface

Wooden forms are removed and the surfaces are cleaned. Some walls were finished with a clay slurry to conceal the grey color of the con-crete.



Drafting Studio Vault at Taliesin West. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West, 1937-1959, 659AR")

3. Chronology + Typology

3.1 Methodology

The investigation of the chronology and typology of desert masonry at Taliesin West involved six distinct steps (Figure 3.1). Initially, we established a construction chronology for desert masonry by examining historical records, including photographs, drawings, and written documents, to determine the sequence of construction and alterations overtime. Next, we identified key attributes related to typologies based on materials and construction methods. The third step involved selecting typical areas on site that represented different stages of construction, based on the construction chronology and key attributes determined in the previous step. During the on-site investigation, we collected data for these areas through visual inspection, measurements, photography, and sampling. The collected data was then subjected to visual and statistical analysis to determine any trends or patterns. The final step involved the interpretation and presentation of findings, summarizing significant changes and innovations in the use of materials and construction methods.

3.2 Construction Chronology

To establish the construction chronology of desert masonry at Taliesin West, our study referenced the *2015 Taliesin West Preservation Master Plan* by Harboe Architects.[1] In the Master Plan, four construction phases were identified and used, along with additional written records to guide us in determining the original construction date of most desert masonry structures (Figure 3.2). For phasing purposes, since not all the phases were related to desert masonry, we created a table compiling all desert masonry construction information mentioned in the Master Plan (Figure 3.3). Since the fourth period, from 1986 to 2014, had lvery few examples of new construction in desert masonry, we combined Periods 3 and 4.

The Desert Masonry chronology map presented in Figure 3.5 was developed from the chronology maps in the Master Plan and is divided into three periods. Period I marks the initial construction at Taliesin West, during which time core buildings

1 Gunny Harboe Architects. Taliesin West Preservation Master Plan (October 2015).

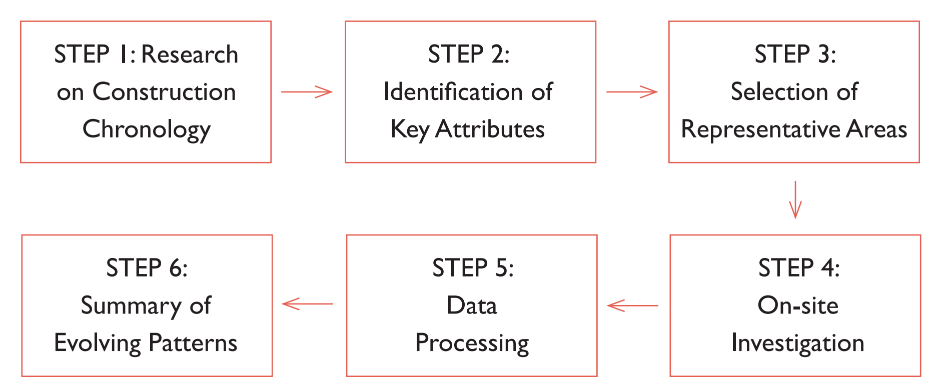


Figure 3.1. Diagram of the six steps of chronology and typology investigation of desert masonry at Taliesin West.

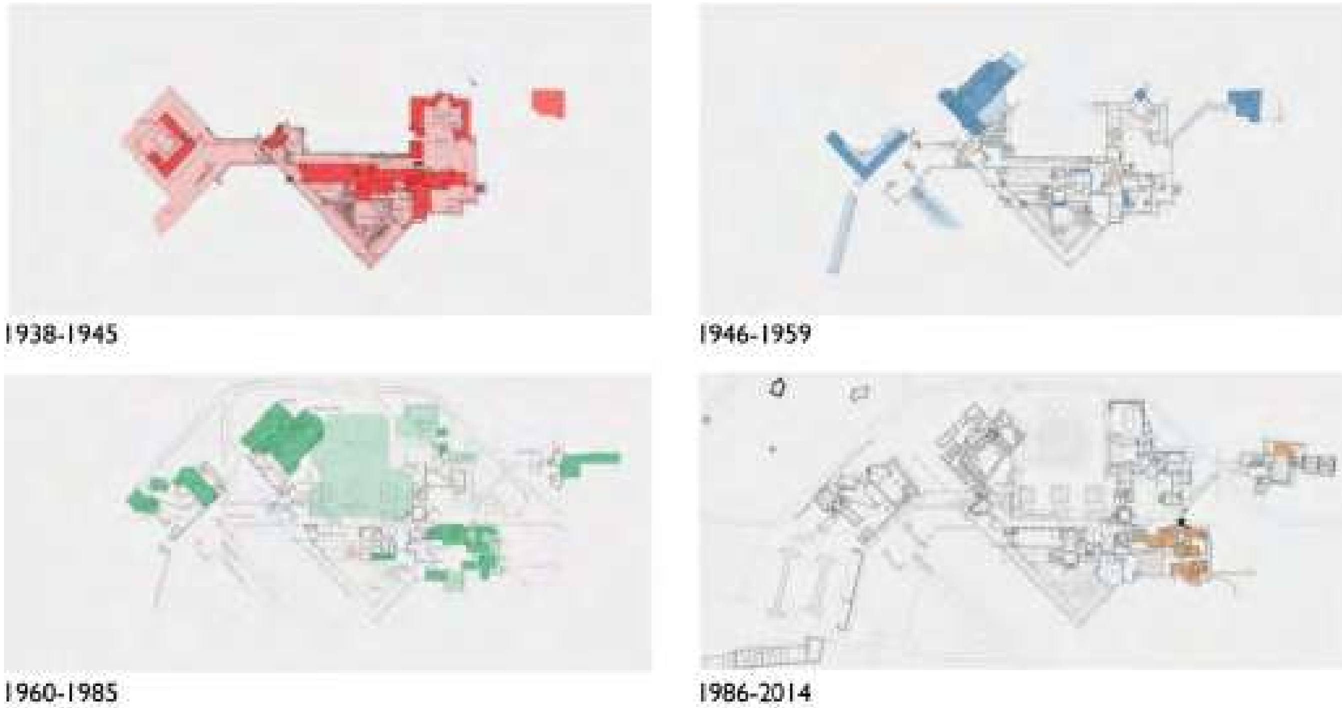


Figure 3.2. Four chronology maps from 2015 Taliesin West Preservation Master Plan, showing four phases of construction at Taliesin West developed by Harboe Architects (Source: Gunny Harboe Architects. Taliesin West Preservation Master Plan (October 2015): 208-211.)

Year	Building	Work Types	Year	Building	Work Types
1938-39	Wright's Office	construction	1946-47	Water Tower	construction
	Drafting Studio	construction		Sun Cottage	construction
	Kitchen	construction	1949-50	Original Dining Room	addition
	Original Dining Room	construction		Cabaret	construction
	WWP Conference Room	construction	1951-52	Men's Locker Room	construction
	Dining Room	construction	1956-57	Pavilion	construction
	Sun Trap	construction		Library	construction
	Shops	construction	1956-57	Atrium	construction
1939-40	Bell Tower	construction		East Wing	construction
	Kiva	construction	1963	Pavilion	reconstruction
	Garden Room	construction	1969-70s	Administrative Offices	construction
	Wrights' Living Quarters	construction	1980	Reading Room	construction
	Light Tower	construction	1985	Bookstore	construction
1940-41	Apprentice Court	construction	2003	Wrights' Living Quarters	renovation

Period 1: 1938-1945   Period 2: 1946-1959   Period 3: 1960-1985   Period 4: 1986-2014

Figure 3.3. Table of the construction chronology related to desert masonry. (Source: information from Gunny Harboe Architects. Taliesin West Preservation Master Plan (October 2015))

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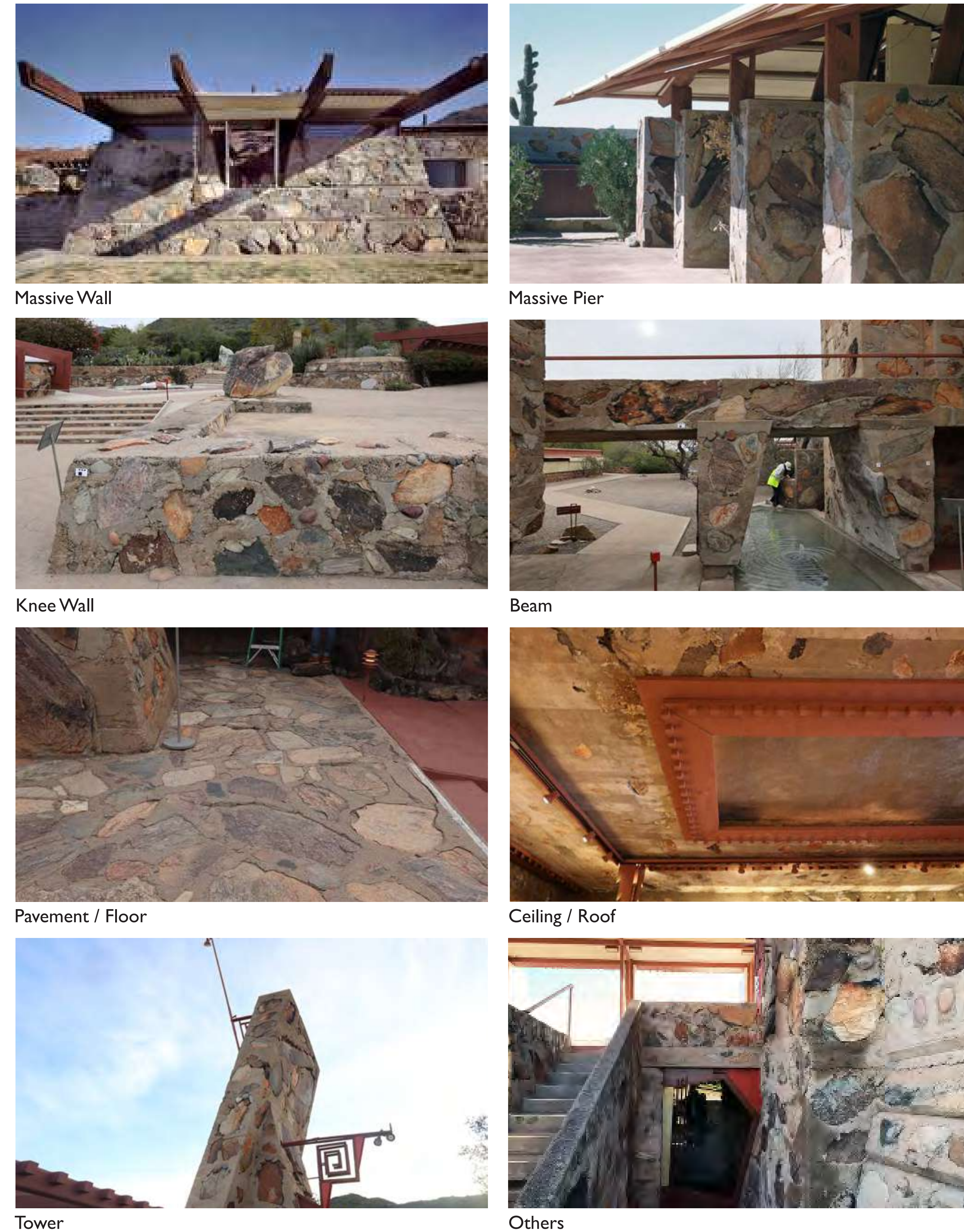

Figure 3.4. Photographs of eight architectural elements present in the desert masonry of Taliesin West. (Source: photos taken by authors)

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Figure 3.5 Desert masonry construction chronology map with three periods. (Source: construction information from the 2015 Taliesin West Preservation Master Plan and drawn by authors)

such as the Drafting Studio, Office, and Kiva were built. The second period witnessed another round of concentrated construction, with the Sun Cottage, Cabaret, and Pavilion being the primary additions. The final period includes new construction and renovations carried out after Wright's death, including the construction of the Bookstore and Administrative Office. These three periods form the basis of our evolutionary study of desert masonry at Taliesin West.

3.3 Key Attributes

To identify the key attributes associated with desert masonry typologies, we considered three aspects: architectural features, materials, and construction methods. A total of fifteen key attributes were established across these areas, with a detailed definition of each attribute provided in the Glossary of Attribute Terms in Appendix B.

Architectural Elements

Regarding architectural features, eight distinct architectural elements were identified as commonly used in both buildings and landscape features at Taliesin West (Figure 3.4). The most prevalent elements include the load-bearing massive wall or pier, which serves as a structural support for the roof or beam, and the non-load-bearing knee wall, which is utilized to divide the landscape or serve as a retaining wall.

Surface Area Ratio

One specific attribute we focused on was the surface area ratio of face rock, which refers to the total visible stone area divided by the total surface area of a given wall surface. This attribute is

Surface Area Ratio

Low ratio

Medium ratio

High ratio

Figure 3.6. Three types of surface area ratio of face rock identified before on-site investigation. (Source: photos taken by authors)

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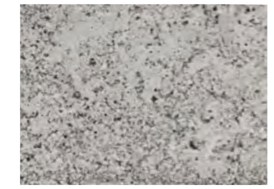
Bulk Color of Concrete



Gray

Pale brown

Pinkish gray

Texture of Concrete

Coarse

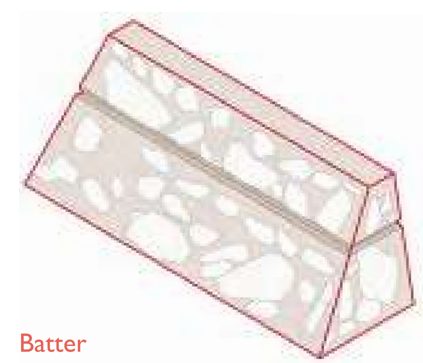
Medium

Fine

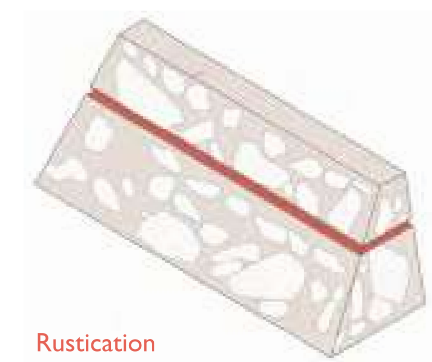
Goose Egg

Protruding goose egg

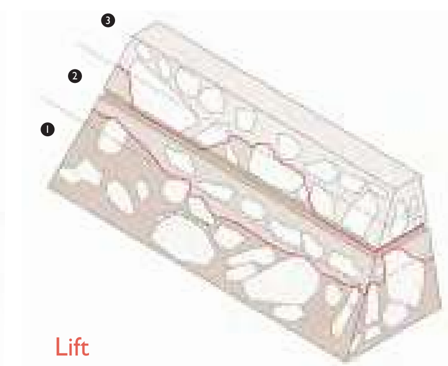
Non-protruding goose egg



Batter



Rustication



Lift

Figure 3.7. Other material and construction attributes. (Source: created by authors)

strongly linked to different construction methods or aesthetic considerations employed by individual builders (Figure 3.6).

Other Material Attributes

In addition to the surface area ratio of face rock, we also considered other material attributes (Figure 3.7). These include the presence of protruding goose eggs, which were added after the formwork was removed, as well as variations in concrete color and texture that may result from differences in material composition, water content, or aggregate size (Figure 3.7).

Construction Attributes

Besides architectural and material attributes, our investigation also examined various construction attributes (Figure 3.7). These attributes include

1 Drafting Studio - north piers
2 WWP - old knee wall
3 WWP - new knee wall
4 Drafting Studio - vault exterior wall
5 Drafting Studio - west knee wall
6 Drafting Studio - south wall
7 Drafting Studio - vault interior wall
8 Kitchen - wall
9 Garden Square - knee wall
10 Apprentice Court - wall
11 Kiva - wall
12 Bridge - pier north
13 Bridge - pier west
14 Bridge - wall
15 Bridge - slab
16 Pavilion - stage wall
17 Pavilion - interior wall
18 Cabaret - ceiling
19 Cabaret - knee wall
20 Cabaret - roof beam
21 Men's Locker Room - wall
22 Reading Room - wall
23 Bookstore - wall
24 Kiva - knee wall
25 Admin Office - outer wall
26 Admin Office - inner wall
27 Sun Cottage - fireplace
28 Sun Cottage - wall
29 Bridge to Sun Cottage
30 Apprentice Court - pool wall
31 Water Tower - wall
32 Living Quater - entrance pavement
33 Living Quater - entrance wall
34 Pavalion - exterior wall
35 Bookstore - knee wall
36 Kiva - ceiling

Massive Wall / Pier
Knee Wall
Other Elements - Beam / Ceiling / Pavement / Free-standing

PERIOD 1: 1938 - 1945
PERIOD 2: 1946 - 1959
PERIOD 3: 1960 - Now

Figure 3.8 Locator map of survey areas with ID No. and corresponding archirtectural elements. (Source: drawn by authors) batter angle, rustication, lifts, metal ties, and visible rebar, all of which were previously identified in the Construction Chapter.

3.4 Representative Areas for Study

Based on identified key attributes, we selected 36 locations for analysis. These survey areas are displayed in Figure 3.8 and span three periods: 13 areas from Period 1 (1938-1945), 13 areas from Period 2 (1946-1959), and 10 areas from Period 3 (1960-now). The survey areas include a variety of building elements and typical examples of some of the key attributes, such as surface area ratio, rustication, and others.

3.5 On-site Investigation

The on-site investigation was conducted from March 4th to March 11th, 2023. For each of the 36 selected areas, we completed a typological survey form to gather information on the architectural features, materials, and construction methods. The survey form was developed based on previously identified attributes and is listed in Appendix C. In parallel, we supplemented the survey form information with photography, visual observation, and non-destructive investigation (Figure 3.9-3.10). We also used the photogrammetry software Agisoft to create three-dimensional point cloud models of surveyed desert masonry structures to facilitate analysis of their construction characteristics (Figure 3.11). In addition, we collected concrete sam-

Figure 3.9. Taking photographs on the Kiva bridge. (Source: taken by authors)

Figure 3.10. Measuring compressive strength of face rocks using Schmidt Hammer. (Source: taken by authors)

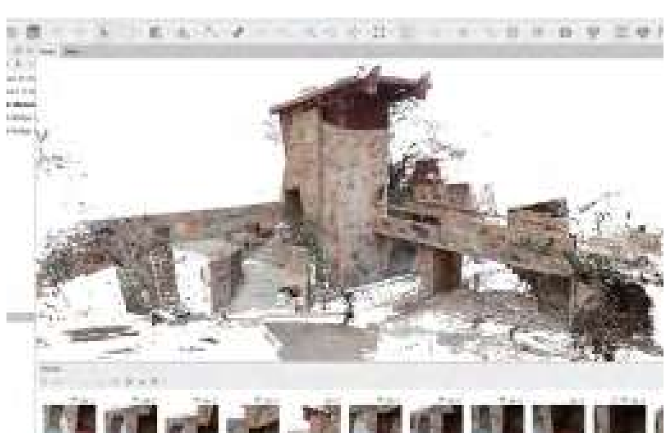


Figure 3.11. Building point cloud models of surveyed desert masonry structures using the photogrammetry software Agisoft.(Source: taken by authors)

Figure 3.12. Collecting concrete samples from less visible areas at Taliesin West. (Source: taken by authors)

Figure 3.13. Spreadsheet of original survey form data. (Source: created by authors)

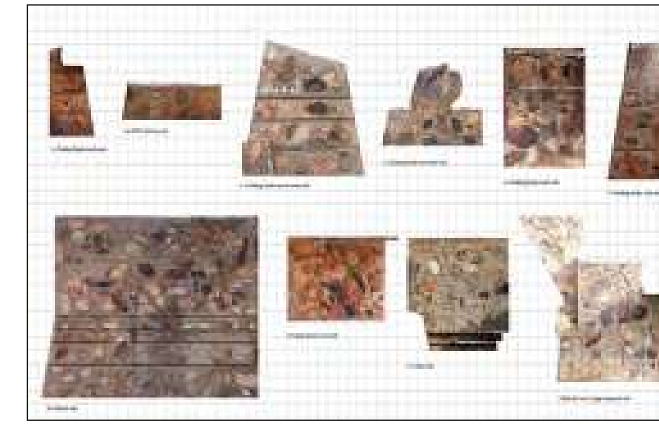


Figure 3.14. Orthoimages of each survey area exported from point cloud models in Agisoft and organized by periods. (Source: created by authors)

Figure 3.15. Spreadsheet of classified survey form data. (Source: created by authors)

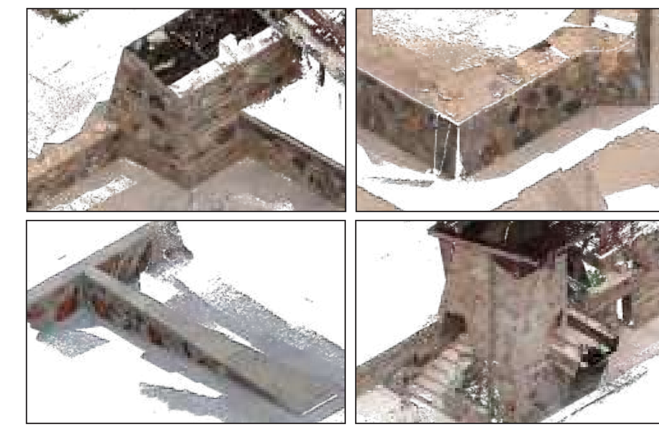


Figure 3.16. Isometric images of each survey area exported from point cloud models in Agisoft. (Source: created by authors)

ples from less conspicuous areas for subsequent analysis in the next Chapter (Figure 3.12).

3.6 Survey Data Processing

After collecting the data on-site, we processed and organized all the survey form data into a spreadsheet (Figure 3.13) and refined the Agisoft models. We exported the Agisoft models to produce orthoimages for each survey area, which were then scaled based on on-site measurements. These scaled orthoimages were organized by period to facilitate comparative studies (Figure 3.14). In addition, we exported the Agisoft models into isometric views to create basic diagrams for further typological analysis (Figure 3.16). The spreadsheet recording the original survey form data and the list of orthoimages for each survey area by period can be found in Appendices D and E.

Using the processed data and orthoimages, we employed a quantitative approach to analyze the surface area ratio of face rock and the lift interval height for each survey area. The surface area ratio of face rock was calculated in Photoshop by enhancing the color difference between concrete and stones and measuring the ratio by pixels of each material (Figure 3.17). For the lift attribute, we measured the height in the scaled Agisoft models and marked lift division lines in orthoimages to calculate lift interval heights (Figure 3.18). By

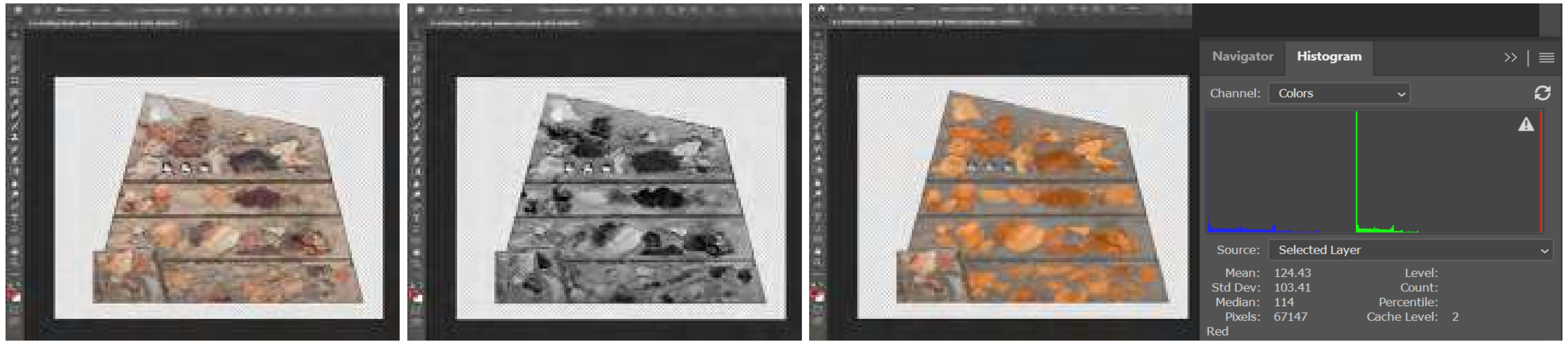


Figure 3.17. Surface area ratio calculation process in Photoshp through enhancing the color difference between concrete and stone and counting pixels for each material. On the left is the original orthoimage, in the middle is the black and white processed image, and on the right are the different colors given to the stone and concrete by the processed image and the number of pixels in the histogram panel for each material. (Source: created by authors)

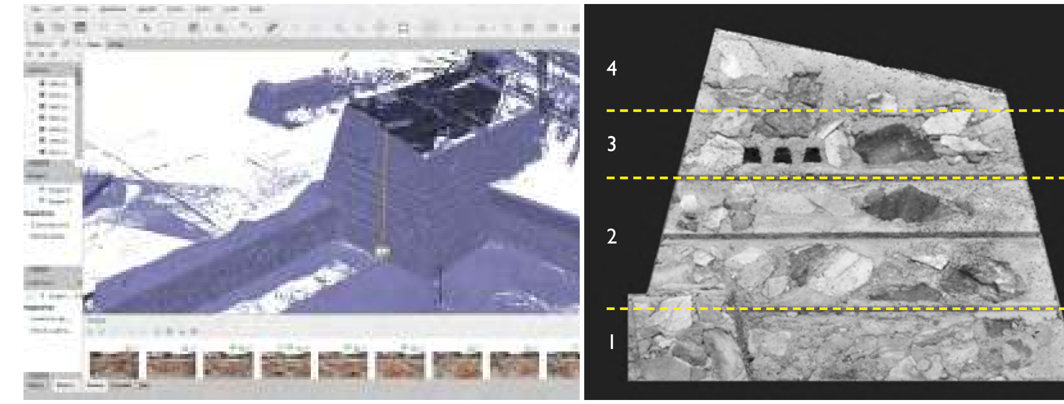


Figure 3.18. Lift interval height calculation process by measuring point cloud model heights and marking lift division lines in orthoimages. On the left is the point cloud model in Agisoft, and on the right is the orthophoto with lift dividers. (Source: created by authors)

obtaining precise measurements of these two attributes, we reclassified the surface area ratio into five types and the lift interval height into three levels to better describe the variations in typology. (Figure 3.19).

We utilized the newly classified data to create a spreadsheet that presents the typology variations based on the survey forms (Figure 3.15). The complete contents of the classified spreadsheet are listed in Appendix D. Furthermore, we developed an attribute map that overlays the corresponding attribute results of each survey area onto the site plan (Figure 3.20). This map highlights clustered features and their relationship with chronology, providing a visual representation of the typology patterns.

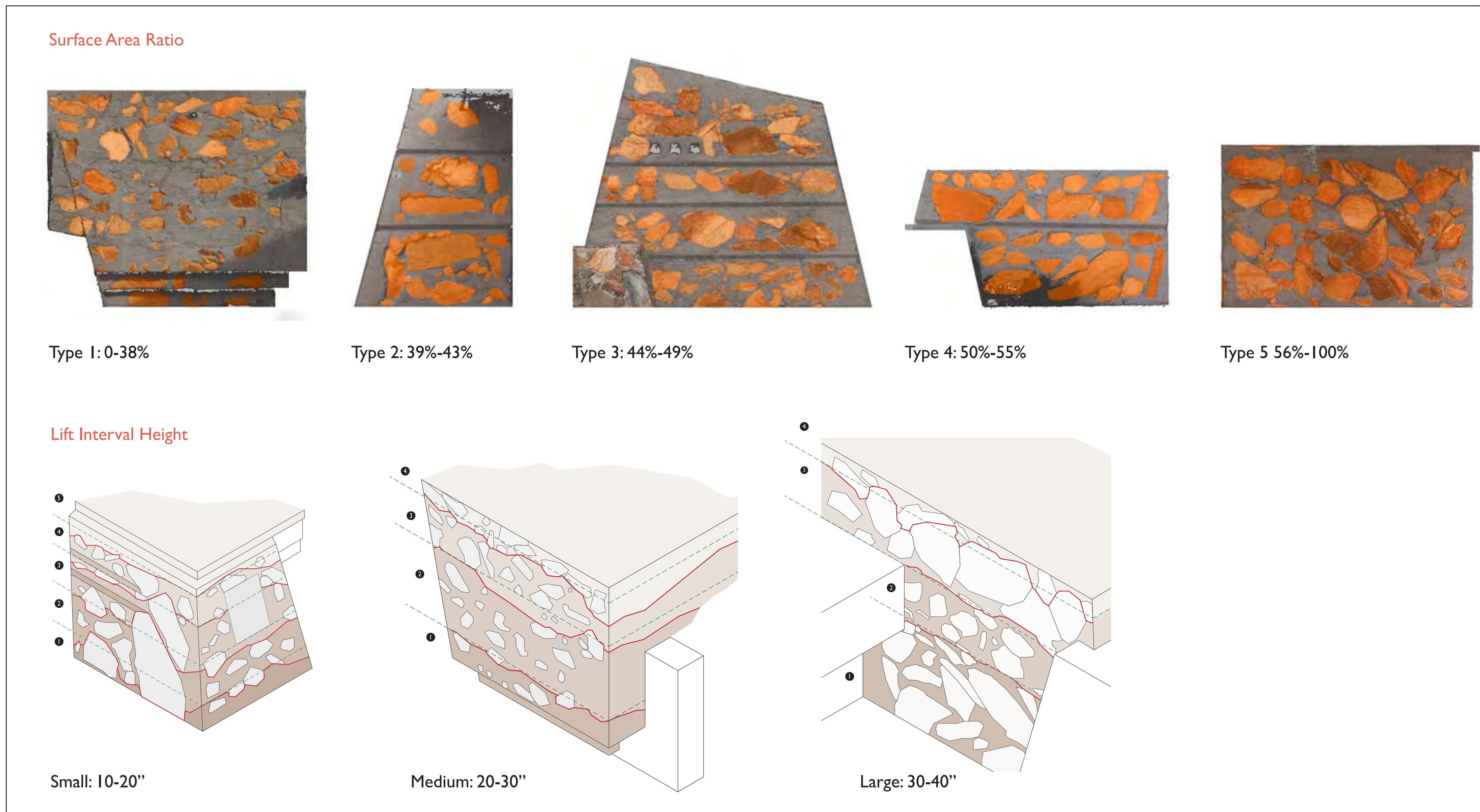
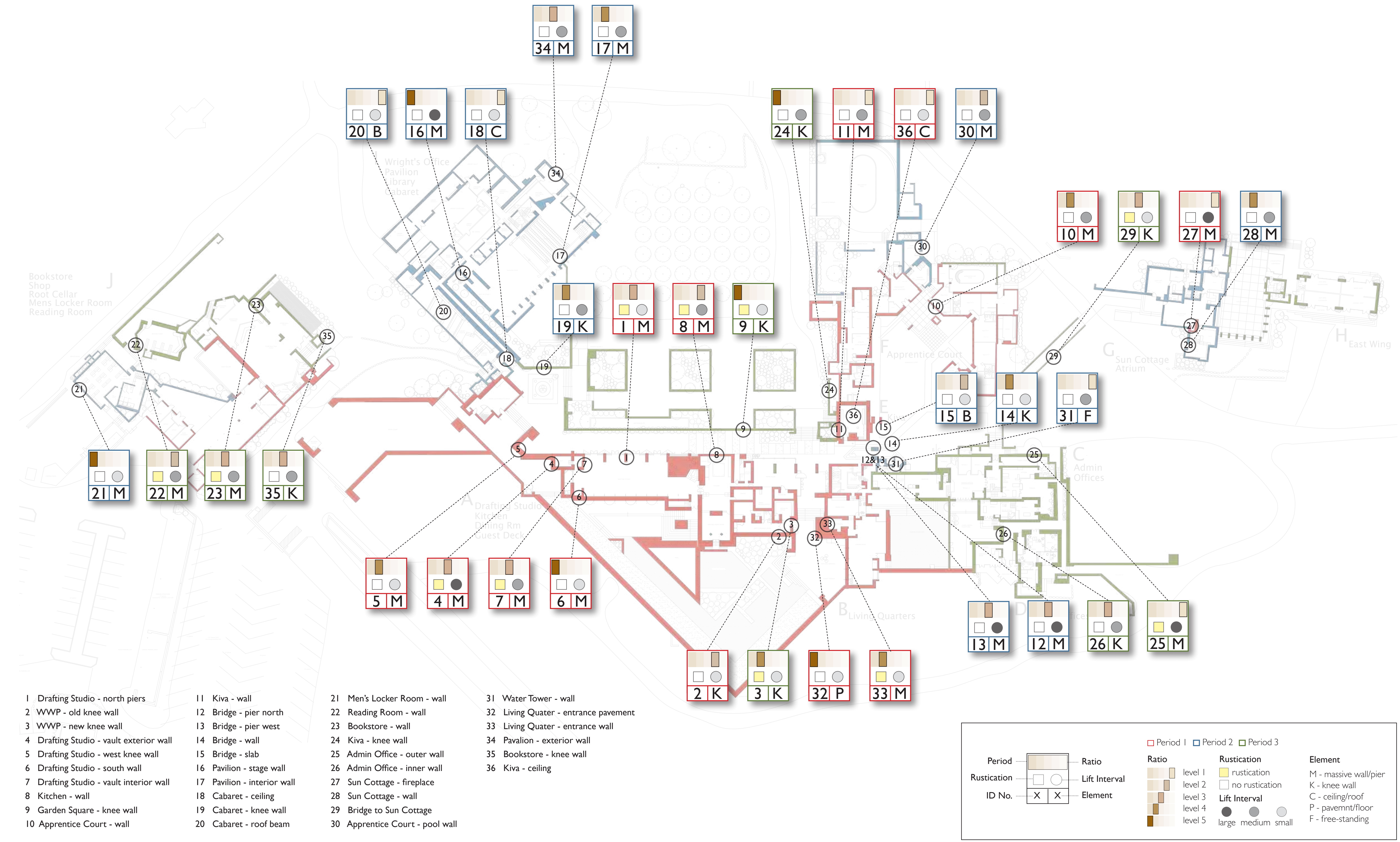


Figure 3.19. Reclassification of surface area ratio and lift interval height. (Source: created by authors)



1 Drafting Studio - north piers
2 WWP - old knee wall
3 WWP - new knee wall
4 Drafting Studio - vault exterior wall
5 Drafting Studio - west knee wall
6 Drafting Studio - south wall
7 Drafting Studio - vault interior wall
8 Kitchen - wall
9 Garden Square - knee wall
10 Apprentice Court - wall
11 Kiva - wall
12 Bridge - pier north
13 Bridge - pier west
14 Bridge - wall
15 Bridge - slab
16 Pavilion - stage wall
17 Pavilion - interior wall
18 Cabaret - ceiling
19 Cabaret - knee wall
20 Cabaret - roof beam
21 Men's Locker Room - wall
22 Reading Room - wall
23 Bookstore - wall
24 Kiva - knee wall
25 Admin Office - outer wall
26 Admin Office - inner wall
27 Sun Cottage - fireplace
28 Sun Cottage - wall
29 Bridge to Sun Cottage
30 Apprentice Court - pool wall
31 Water Tower - wall
32 Living Quater - entrance pavement
33 Living Quater - entrance wall
34 Pavalion - exterior wall
35 Bookstore - knee wall
36 Kiva - ceiling

Figure 3.20 Site plan of Taliesin West with attribute codes (Source: drawn by authors)

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3.7 Findings

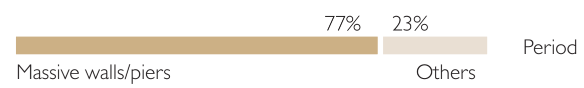
Utilizing the processed data, we identified several patterns of desert masonry based on five key attributes: architectural element, surface area ratio, lift interval height, rustication, and construction details.

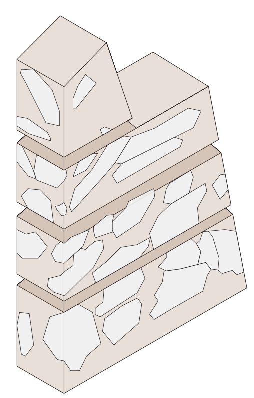
Architectural Element

In terms of architectural elements, our findings indicate that during Period 1, over two-thirds of the new desert masonry structures were designed using massive walls or piers, reflecting the peak of core building construction during this period. However, in Period 3, we observed a decline in the proportion of massive walls and an increase in knee walls. This could be attributed to a shift towards more landscape construction and less new building construction in this period (Figure 3.21).

Figure 3.21. Findings for desert masonry architectural elements in period 1 and 3. (Source: drawn by authors)

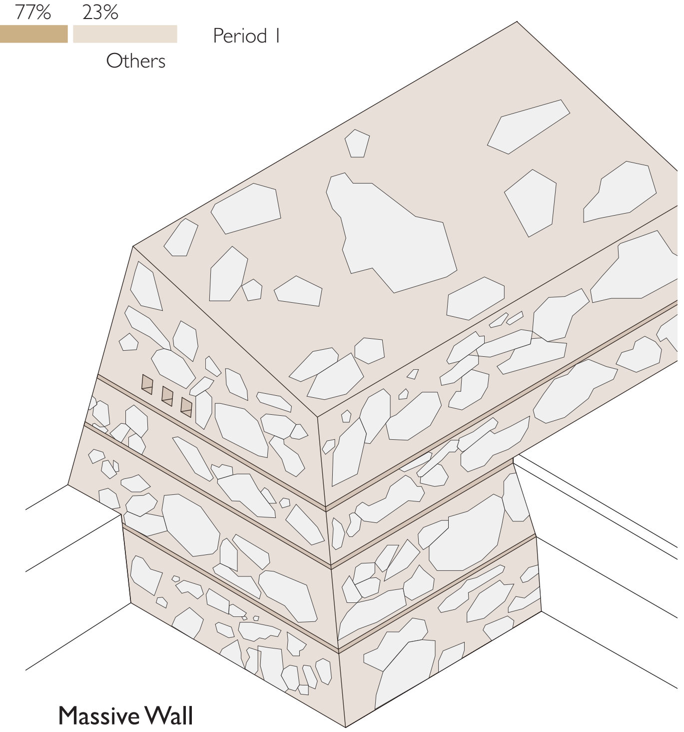
Period 1: Most desert masonry structures in Period 1 are massive walls/piers - a peak of core building construction





Pier

Drafting Studio - north piers



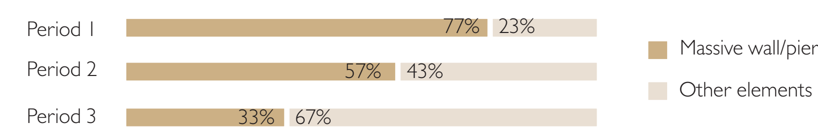
Massive Wall

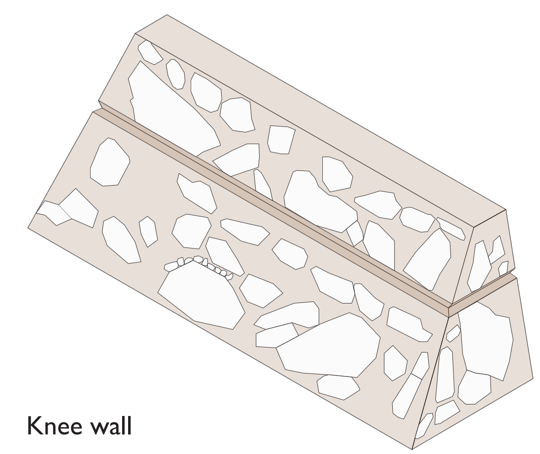
Drafting Studio - vault exterior wall

Construction of the Drafting Room piers and vault walls, showing the earliest concrete pours using slip forms. (Source: Scott, 75 Years At Taliesin West, 2013)

Looking west, from left to right are the southeast corner of the Dining Room and three distinct openings for Wes and Svetlana Peter's room. (Source: Scott, 75 Years At Taliesin West, 2013)

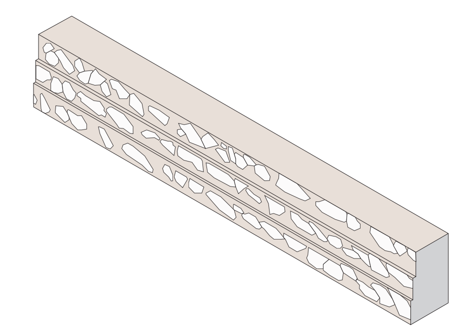
Period 3: The proportion of massve wall/pier decreases in Period 3 - Less new building construction and more landscape construction





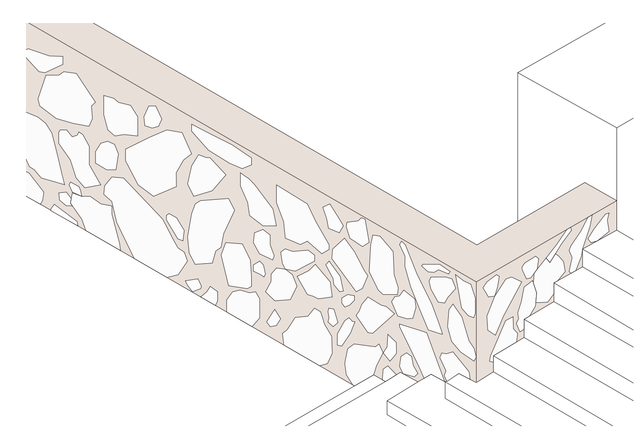
Knee wall

WWP - new knee wall



Knee wall

Bridge to Sun Cottage



Knee wall

Garden Square - knee wall

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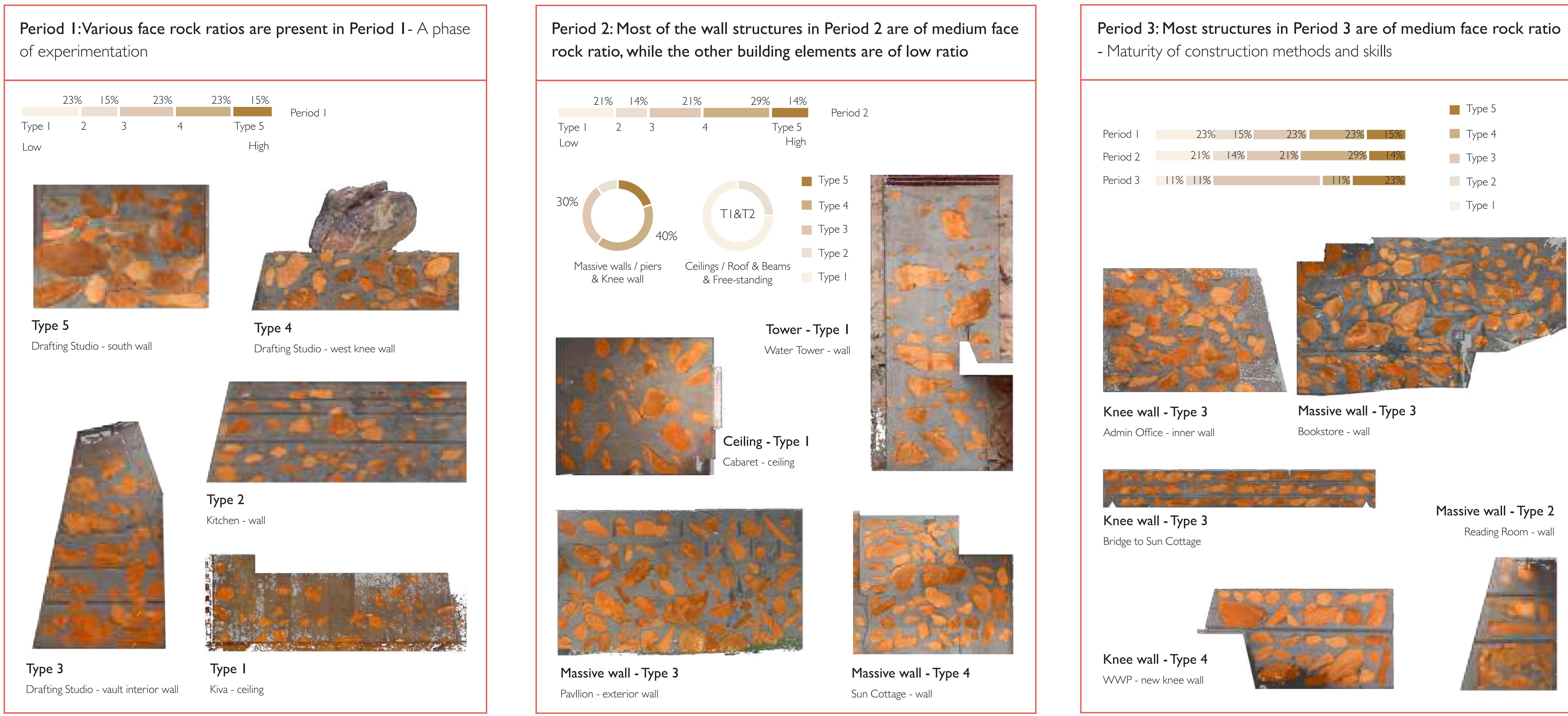
Surface Area Ratio

Regarding the surface area ratio of face rock, we found that the ratio varied in Period 1, with an almost equal distribution across different ratios. This pattern continued in Period 2, with wall structures showing less varied ratios, mostly falling in Type 3 medium ratio. In Period 3, the medium ratio structures account for an even larger proportion, with most of them being Type 3. This trend is evident for Period 3 as well. (Figure 3.21).

Figure 3.21. Findings for desert masonry surface area ratio of face rocks in Period 1, 2, and 3. (Source: drawn by authors)



Additionally, we found that the ratio of face rock differs among various building elements, with low ratios typically found on ceilings or roofs and high ratios on pavements or floors, as seen when comparing the kiva ceiling and the living quarter entrance pavement in Period 1 (Figure 3.22). This variation is understandable in that different elements such as floors require more surface stone and ceilings less for weight.

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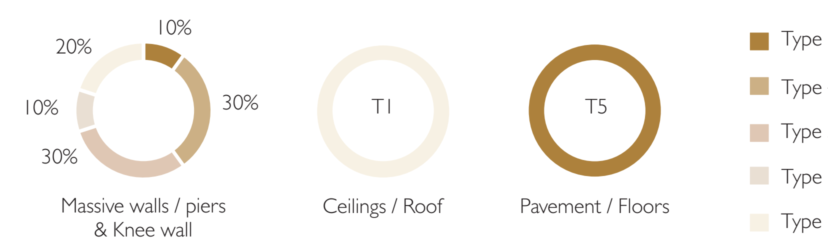
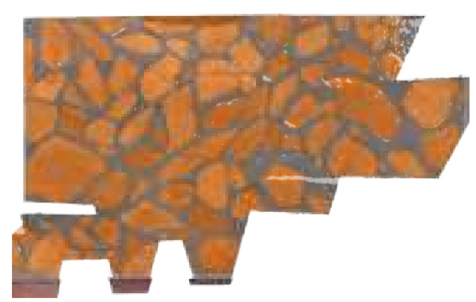
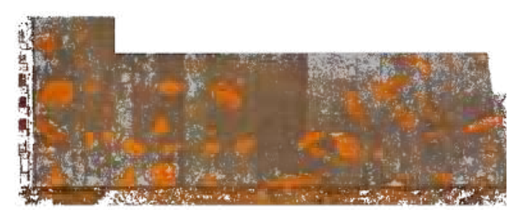
Figure 3.22. Findings for the relationship between desert masonry architectural elements and surface area ratio of face rocks in period 1 and 3. (Source: drawn by authors)

Period 1: Ceilings/roofs in Period 1 are all of low face rock ratio, and pavements/floors are of high ratio - different mechanical property needs of different building elements





Pavement - Type 5
Living Quarter - entrance pavement

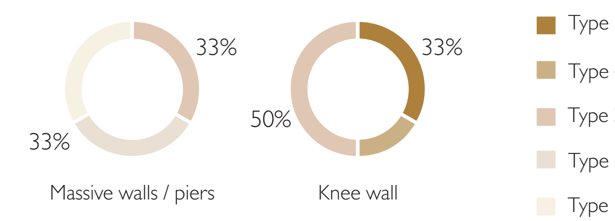


Ceiling - Type 1
Kiva - ceiling

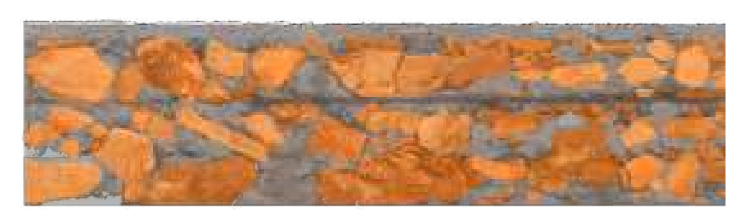
Looking down at the Living Quarter entrance pavement.

Looking up at the Kiva ceiling.

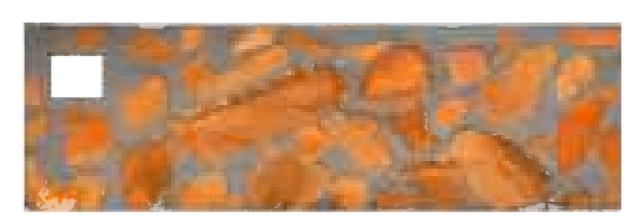
Period 3: Most knee walls have a higher face rock ratio than massive walls



Massive wall - Type 1
Admin Office - outer wall



Knee wall - Type 5
Garden Square - knee wall



Knee wall - Type 5
Kiva - knee wall

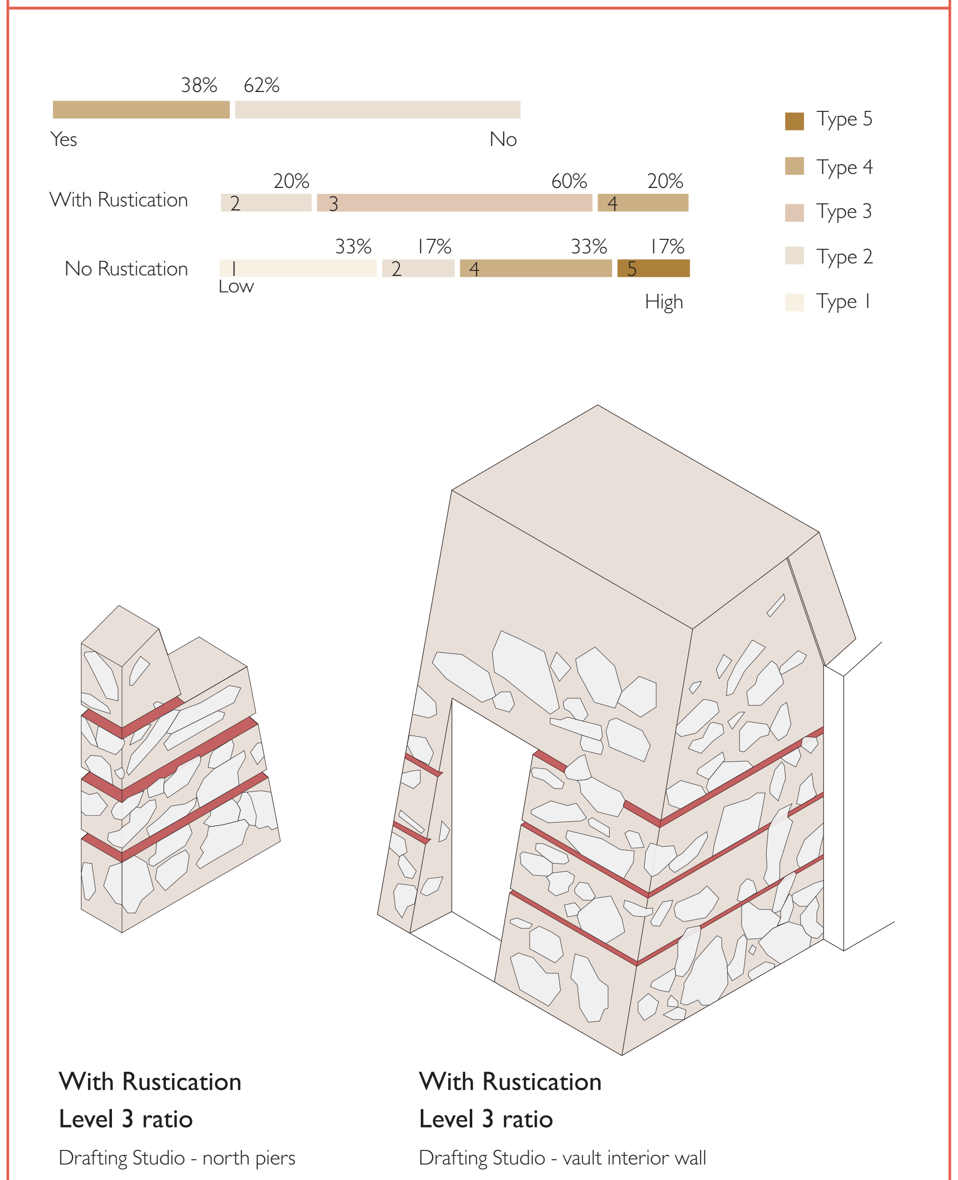
Rustication

Based on our analysis of rustication, we found that in Period 1, approximately half of the desert masonry structures display rustication, with the majority falling into the Type 3 face rock ratio (Figure 3.23).

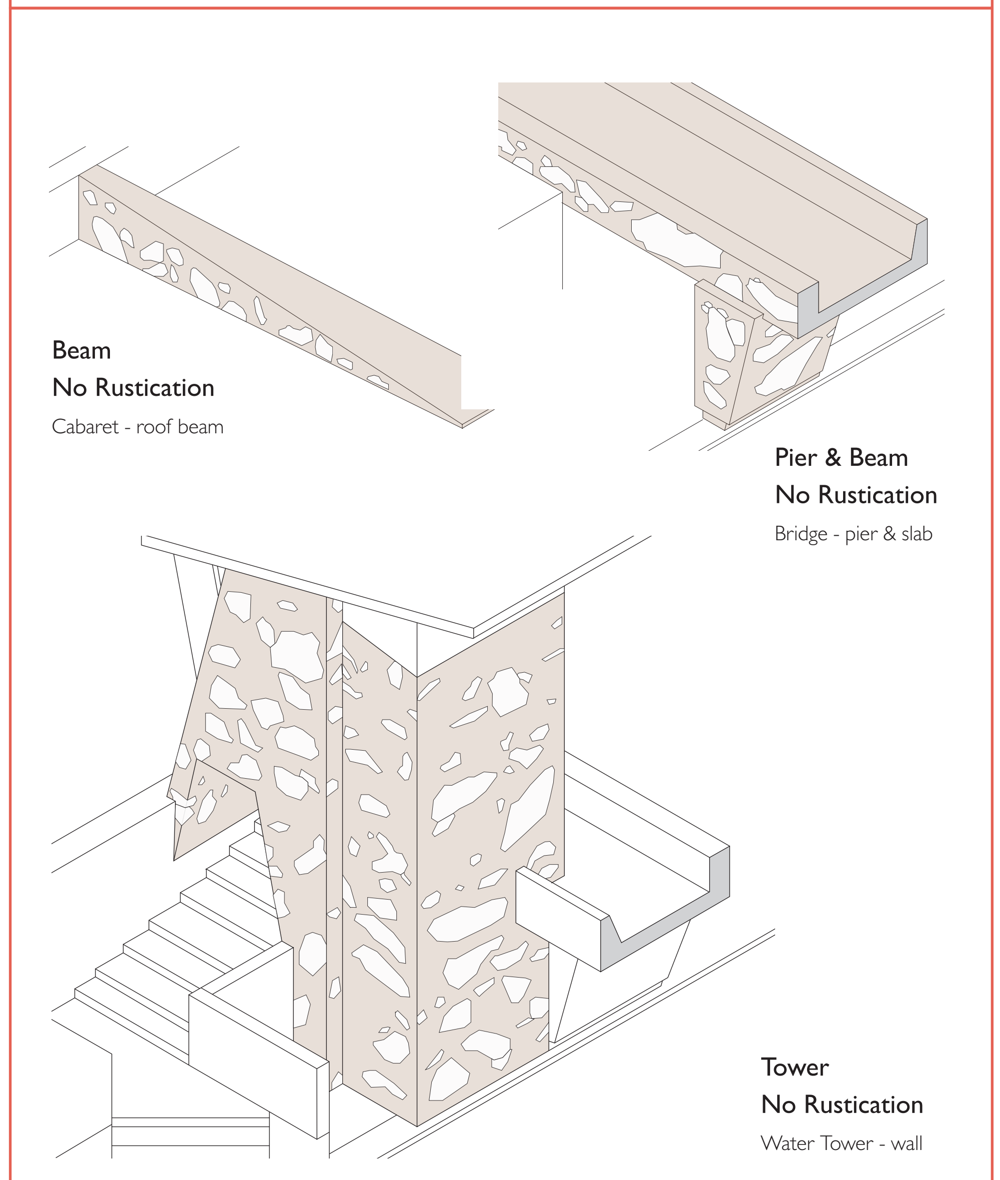
However, in Period 2, no rustication was present in any of the desert masonry structures, whether high walls in the Water Tower or low beams in the Cabaret, as shown in the Period 2 diagram. In Period 3, rustication reappeared, in most of the wall structures.

Figure 3.23. Findings for desert masonry rustication in period 1, 2, and 3. (Source: drawn by authors)

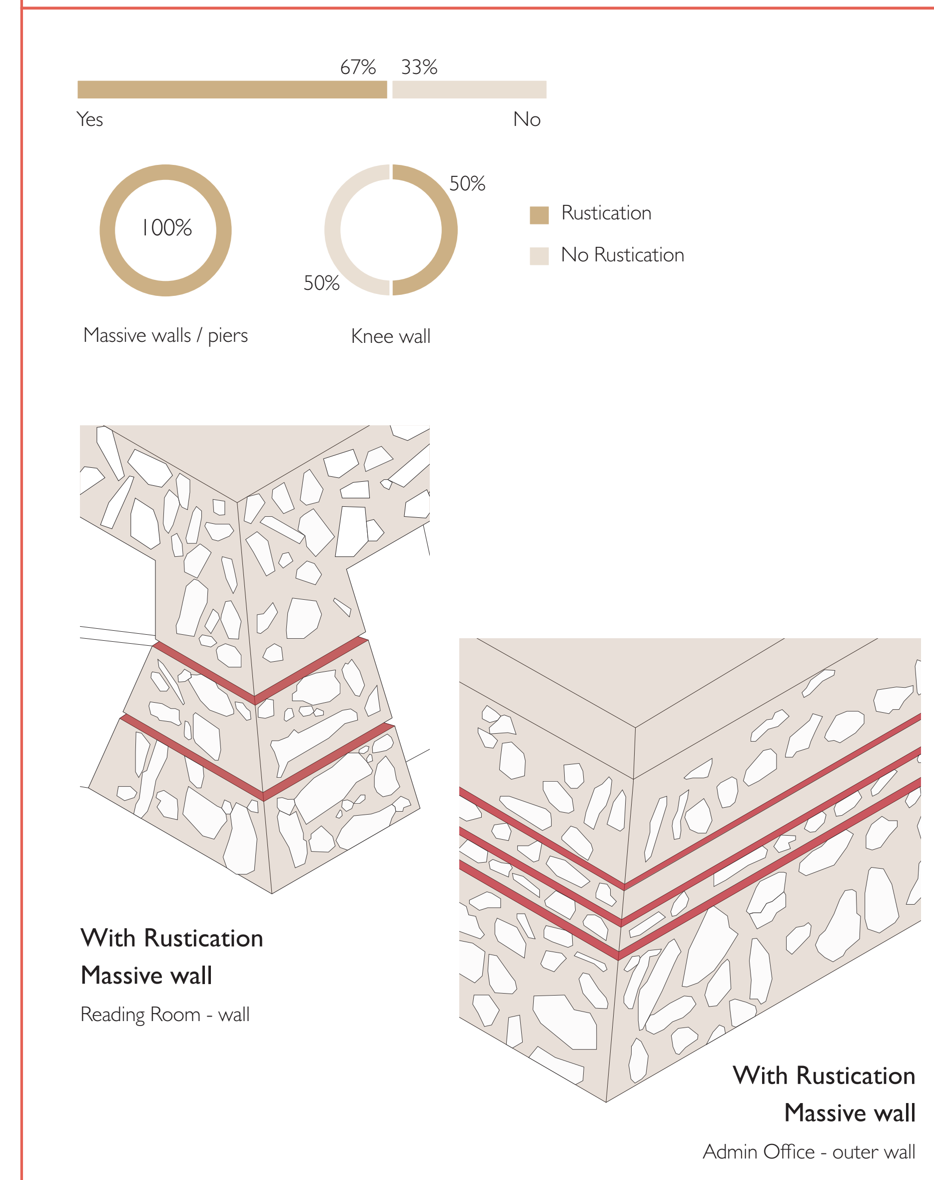
Period 1: Structures with rusticaion in Period 1 are mostly of Level 3 face rock ratio



Period 2: All desert masonry structures in Period 2 have no rustic-aion.



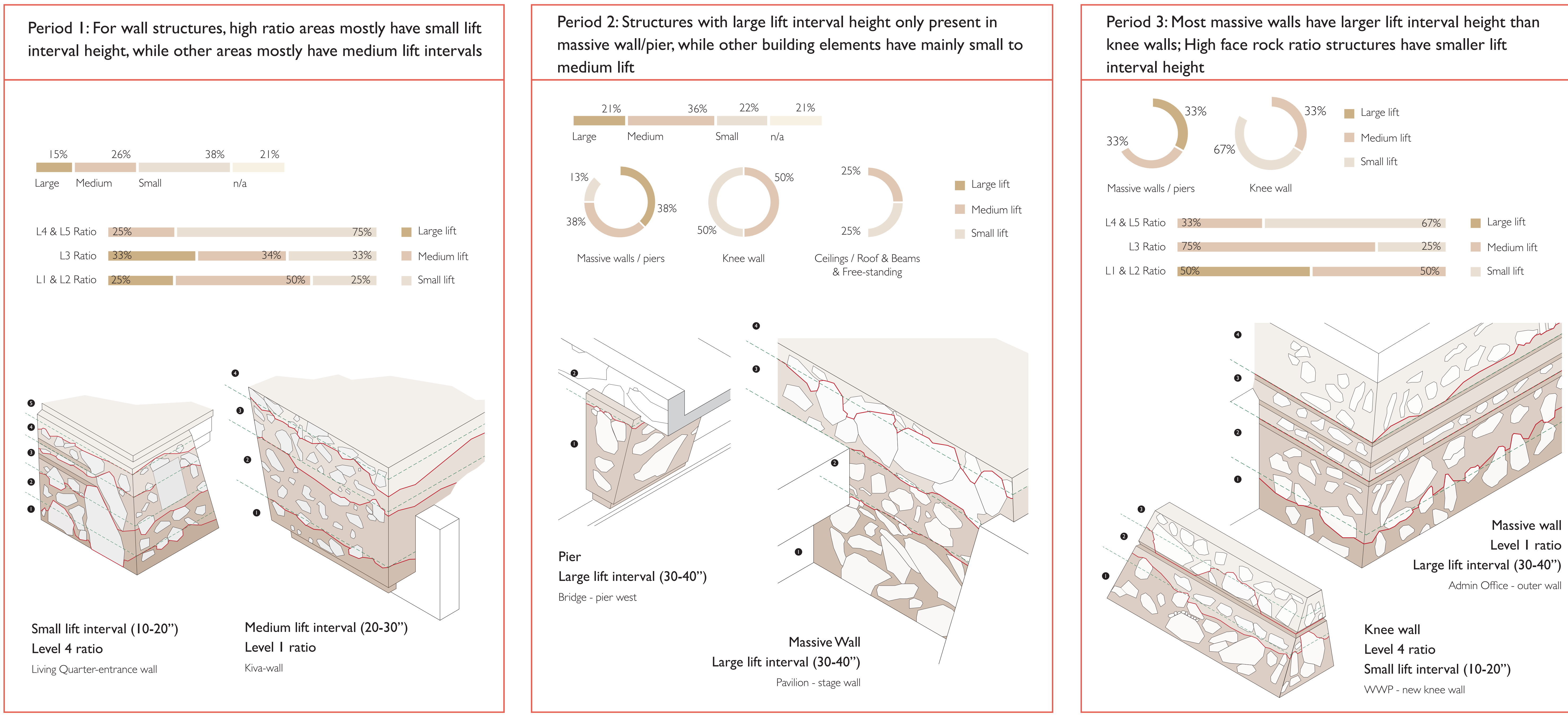
Period 3: All massive wall structures have rustications, and half of the knee walls have rustications - revival of the practice in Period 1



Lift Interval Height

For lift interval height, Period 1 shows that areas with high face rock ratios mostly have small lift interval heights. This is illustrated by the high face rock ratio structure of the Living Quarters entrance wall compared to the low ratio structure of the Kiva wall with larger lifts (Figure 3.24). This pattern persisted in Period 3, where the low ratio wall of the Administration Office outer wall has larger lifts than the high ratio of the WWP conference room knee wall.

Figure 3.24. Findings for desert masonry lift interval height in period 1, 2, and 3. (Source: drawn by authors)



Construction Details

Lastly, we identified some construction details across different periods. During Period 1, we found construction remains in the drafting studio vault, including rustications with cold joints (Figure 3.25, Period1-A), metal ties at the bottom of a lift to enhance formwork stability (Period1-B), horizontal formwork lines showing formwork board size (Period1-C), and rustication with concrete overflow (Period1-D). Rustication with cold joints typically exhibits a white line at the top of a lift and honeycombing at the bottom due to aggregate settlement over time, where the water goes up to evaporate and presents a white line, and the aggregate settles and shows signs of honeycombing at the bottom (Figure 3.25, section of the lift). In Period 2, reinforced steel, metal ties, and formwork for slab construction, as well as signs of previous repair, were identified in the Kiva bridge, providing evidence for construction analysis.

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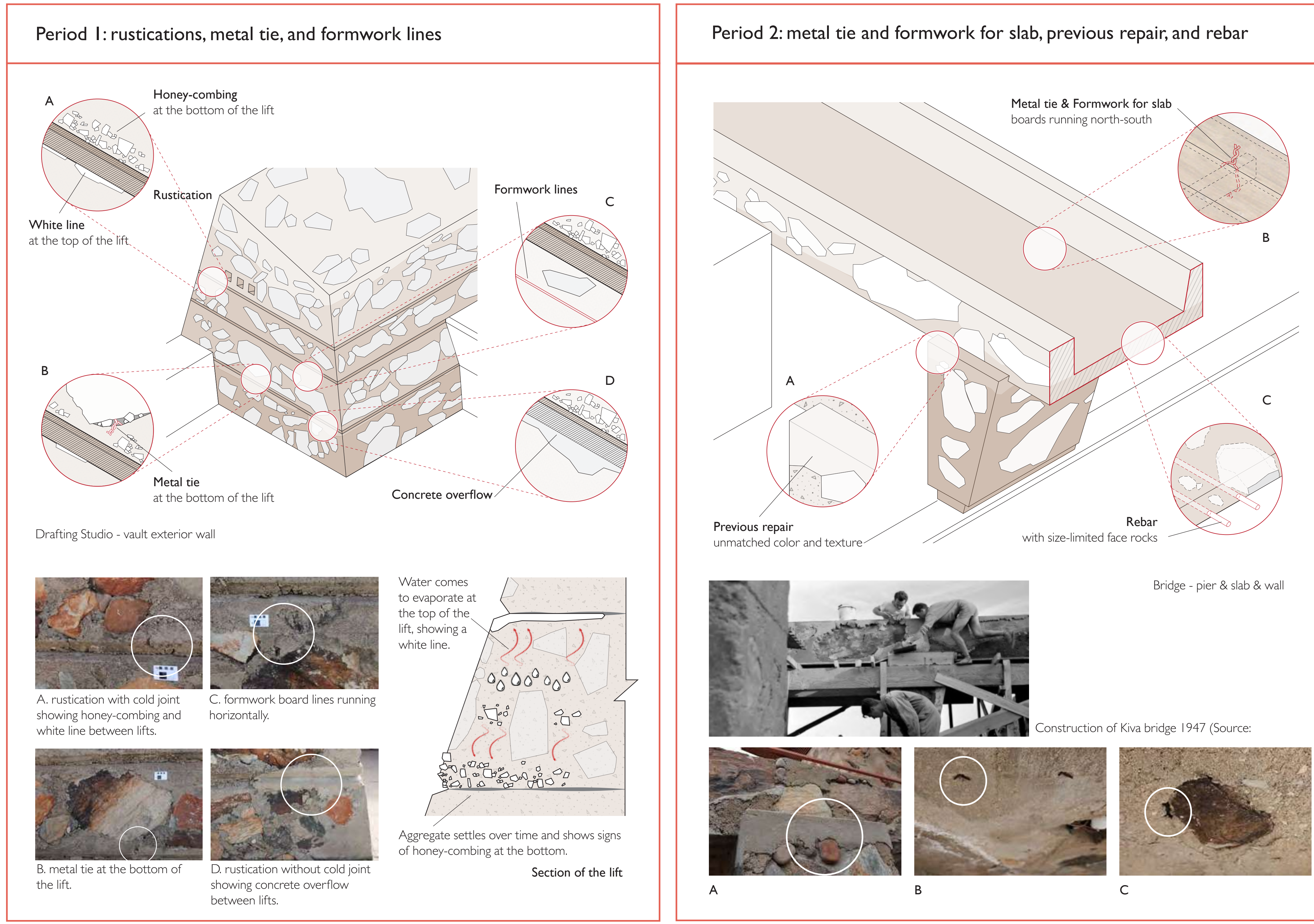
Figure 3.25. Findings for desert masonry construction details in period 1 and 2. (Source: drawn by authors)



Summary

Although the surveyed areas represent a small fraction of the total desert masonry on site, several conclusions can be made regarding construction typology and chronology:

1) All desert masonry was constructed in a similar method, without reinforcement except for horizontal expanses such as roofs and bridges or high vertical towers. Construction details are found in all periods: including rustication with cold joints, metal ties, formwork, and rebar, suggesting a shared construction method over time.

2) Variations in style such as surface area ratio or stone shape and color were largely personal choices although trends in certain building styles can be observed over time. Surface area ratios of face rock to concrete in Period 1 show much greater variability than later periods. This may represent a shift from experimentation to an agreed upon standard of construction while still allowing some variation in stone selection and placement as a function of individual builder agency. This variation across a common element is one of the strongest displays of the dynamic and organic nature of building at Taliesin West which was shaped by generations of apprentices who contributed to its development.

3) Rustication is most prevalent in Period 1, absent in Period 2, and appears to return in Period 3. Rustication depends on the relationship of the wall to overall building form and does not appear consistent within a wall or building.

4) Large lift interval heights of desert masonry are associated with low-face rock ratio masonry and rustication suggesting that rustication not only provided visual horizontality and relief to the concrete surface but also provided control joints for thermal cracking, especially if the volume of concrete was more than the stone.

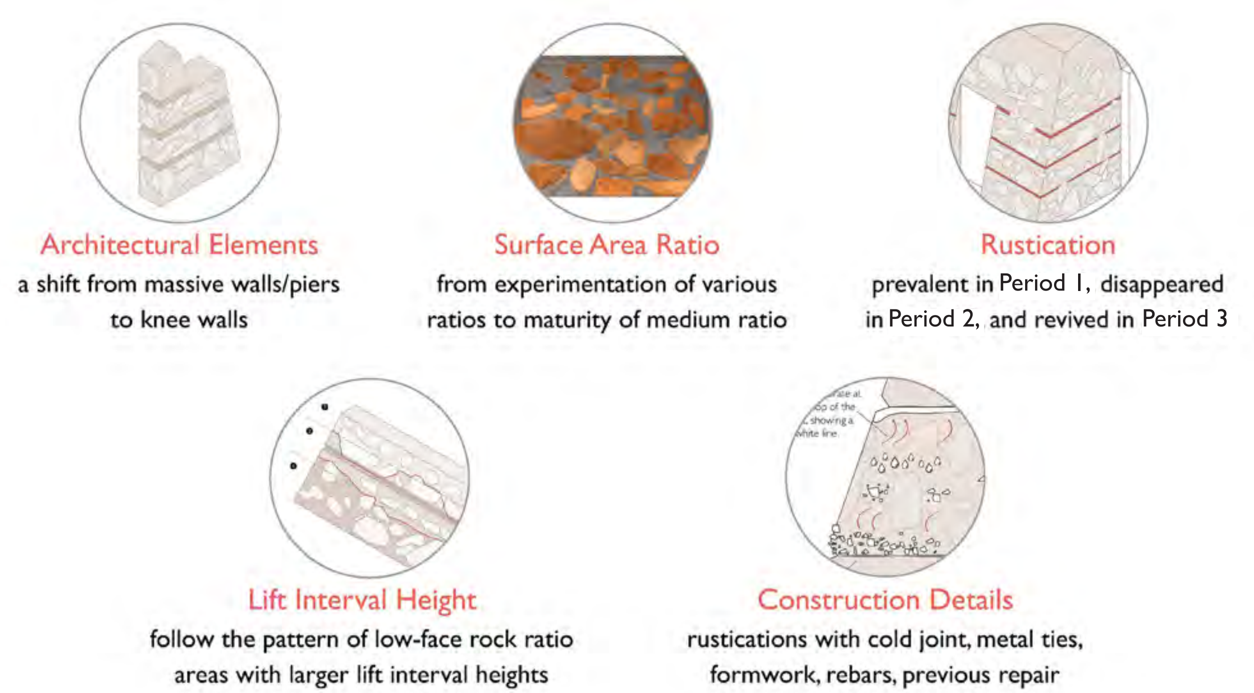


Figure 3.26. Summary of chronology+typology findings. (Source: drawn by authors)

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Kiva-Bridge area at Talieisn West. (Source: photo taken by authors)

4. Performance + Condition

4.1 Methodology

Assessment of desert masonry across the entire site was beyond the scope of this project. Therefore, we decided to select one representative area that exhibits a broad and severe range of conditions in order to conduct an in-depth condition assessment. Thus, we selected the Kiva-Bridge as the representative area and assessed its conditions through mapping and NDE (non-destructive evaluation.) Several concrete samples were also taken for lab analysis. (Figure 4.1)

4.2 Kiva-Bridge

The Kiva was constructed in 1939, among the first buildings built at Taliesin West. Desert masonry was used for the walls, floor, and roof slab. The interior was completed, and a wood-framed projection room was added to the north side in 1941. (Figure 4.2) The Kiva was used as a cinema for the Fellowship until 1949, when it was renovated from a theater into a library for the Fellowship. In the mid-1950s, the Kiva went through several renovations, including the installation of the decorative ceramic Chinese frieze above the entry. In the early 1960s, the concrete stairs to the Kiva roof were constructed on the west side of the building. The Kiva door was replaced with a new wooden door installed in the original door location. The desert masonry pier to the east of the original door was removed. In the mid-1980s, the concrete floor was reconstructed with integrally colored concrete. A wooden bridge was built in 1940 to connect the Guest Deck and Kiva and in 1947, the bridge was reconstructed in desert masonry, replacing the wooden bridge.[1] (Figure 4.3-4.5)

1 Gunny Harboe Architects. Taliesin West Preservation Master Plan (October 2015): 208-211

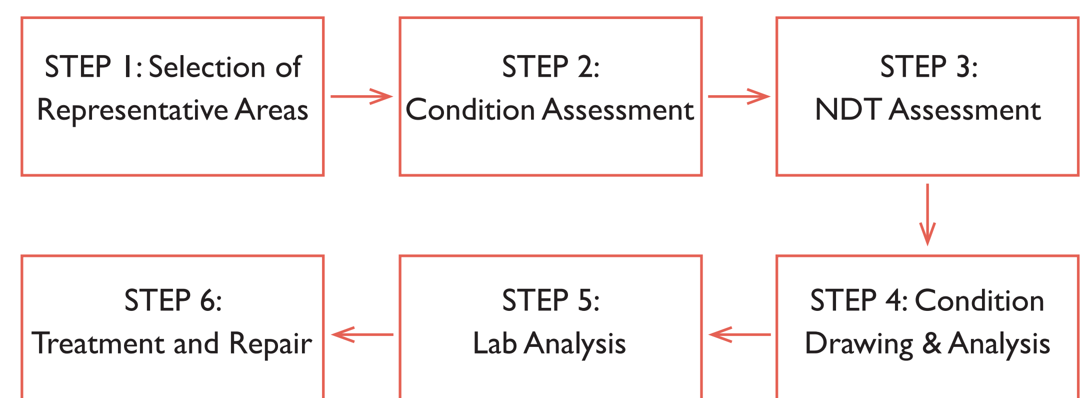


Figure 4.1. Diagram of the six steps of condition investigation of desert masonry at Taliesin West.

Figure 4.2. Original Kiva Bridge, ca 1942 (Source: The Frank Lloyd Wright Foundation Archives, The Museum of Modern Art | Avery Architectural & Fine Arts Library, Columbia University, New York).

Figure 4.3. Kiva Bridge, 2023 (Source: photographed by the author).

4.3 Condition Assessment

As large reinforced horizontal elements are prone to water infiltration, the masonry roof and bridge are more vulnerable to decay than other areas on site. The primary condition issues are efflorescence, loss, honeycombing, cracks, and previous repair. (Figure 4.6) Efflorescence is clear evidence of water infiltration in desert masonry. It refers to crystalline deposits resulting from the dissolution and evaporation of water from a salt solution, which can then crystallize within and on the surface of a porous material exposed to air. This in turn can lead to loss, honeycombing, and cracking. Sources for salts can be the concrete, stone, or water.

Figure 4.4. Underside of the bridge (Source: photos taken by authors)

Figure 4.5. Bridge and column (Source: photos taken by authors)

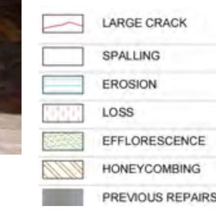
Efflorescence | Honeycombing | Cracks | Previous Repairs | Cold Joint

Figure 4.6. Desert Masonry condition glossary reference images (Source: photos taken by authors)

Clearly, water infiltration and related damage have been a chronic problem at the Kiva. Condition mapping of the two bridge elevations shows large areas of previous repair on the lower part of both sides and some areas of loss on the higher part of the elevation. (Figure 4.7-4.10)

Figure 4.7. Bridge west elevation (Source: photos taken by authors)

Figure 4.8. Bridge east elevation (Source: photos taken by authors)



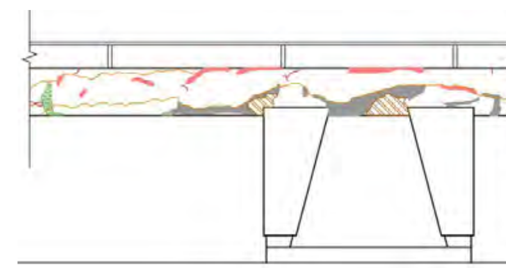


Figure 4.9. Bridge west elevation condition mapping (Source: created by authors)

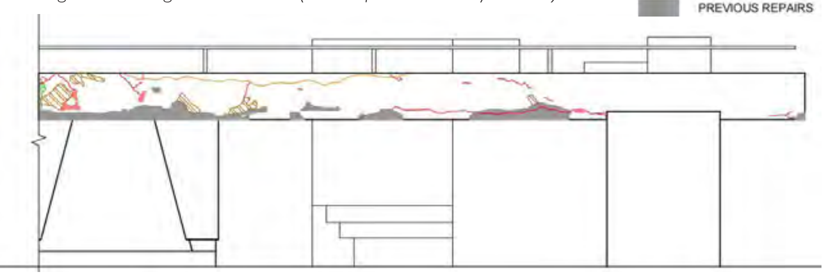


Figure 4.10. Bridge east elevation condition mapping (Source: created by authors)

Three walls near the crossing of the Kiva and the bridge are probably in the worst condition among all the desert masonry. The two mappings on the below show a large area of efflorescence and loss. (Figure 4.14-4.16)

Figure 4.11. Kiva east elevation (Source: photos taken by authors)

Figure 4.12. Kiva east addition south elevation (Source: photos taken by authors)

Figure 4.13. Kiva east addition west elevation (Source: photos taken by authors)

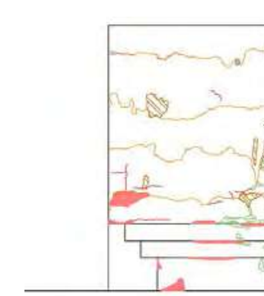


Figure 4.14. Kiva east elevation condition mapping (Source: created by authors)

Figure 4.15. Kiva east addition south elevation condition mapping (Source: created by authors)

Figure 4.16. Kiva east addition west elevation condition mapping (Source: created by authors)

4.4 NDT/NDE Assessment: Ground Penetrating Radar (GPR)

Non-destructive testing (NDT) is generally used to assess the condition of a building and evaluate the properties of a material, component, structure, or system without causing damage to the original fabric. GPR (ground penetrating radar) can detect rebar, back walls, and voids. By changing the frequency of the scan, different penetrating depths and sizes of objects can be detected. We used GPR on the top side and underside of the bridge slab: a line scan on the underside and an area scan on the top side. (Figure 4.17-4.18) The results are plotted on the plan drawings, and the location of the rebar is marked on diagram below (Figure 4.19). The rebar is in both directions, and there is more rebar near the connection between the bridge slab and the column. We also scanned the east and west bridge parapets and found two rebars on each side. (Figure 4.20-4.22)

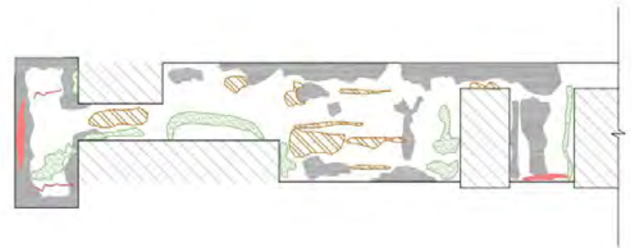


Figure 4.17. Bridge slab underside condition mapping (Source: created by authors)

Figure 4.18. Bird-eye view of Kiva-Bridge (Source: created by authors)

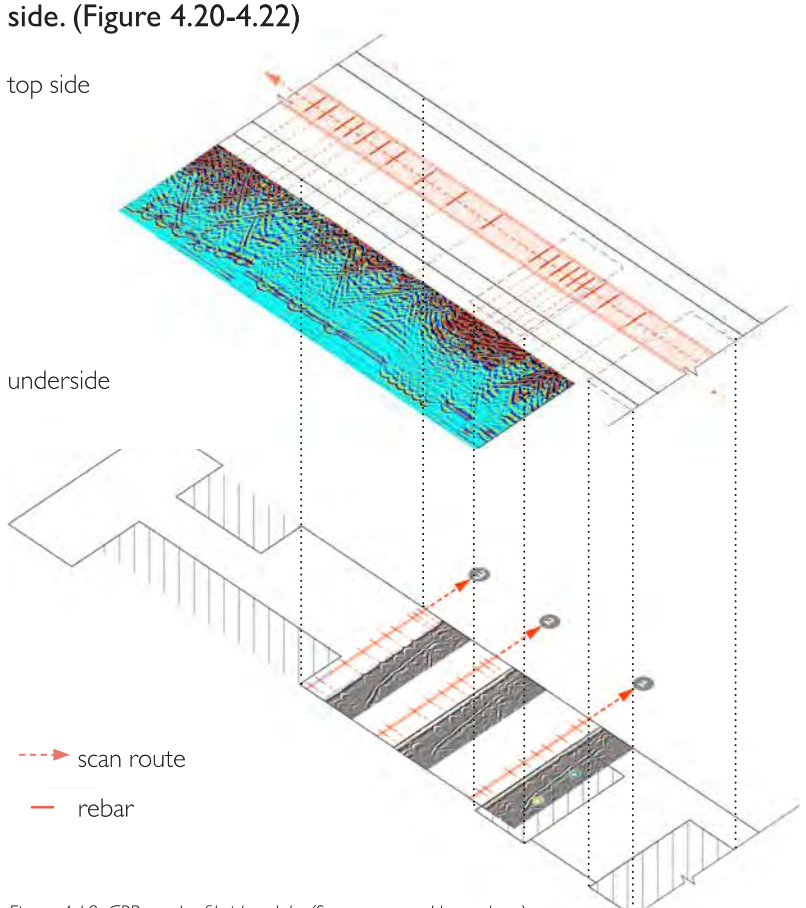


Figure 4.19. GPR result of bridge slab (Source: created by authors)

Figure 4.20. East bridge parapet (Source: photos by authors)

Figure 4.21. West bridge parapet (Source: photos by authors)

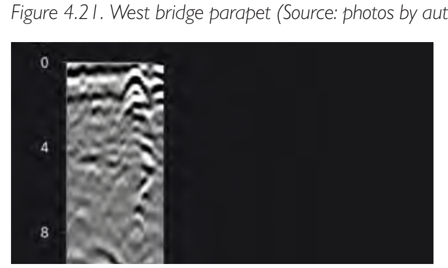


Figure 4.22. West bridge parapet NDT data (Source: created by authors)

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4.5 NDT Assessment: Infrared Thermography (IRT)

We also used infrared thermography and moisture meter to investigate the moisture content of the structure. Surfaces with efflorescence displayed high moisture levels, such as the corner of the Kiva east wall, water tower elevations, and column surfaces above the pool. These areas have the most water infiltration due to the proximity to the pool and the presence of plant boxes on the bridge, which may also cause further deterioration. (Figure 4.23)

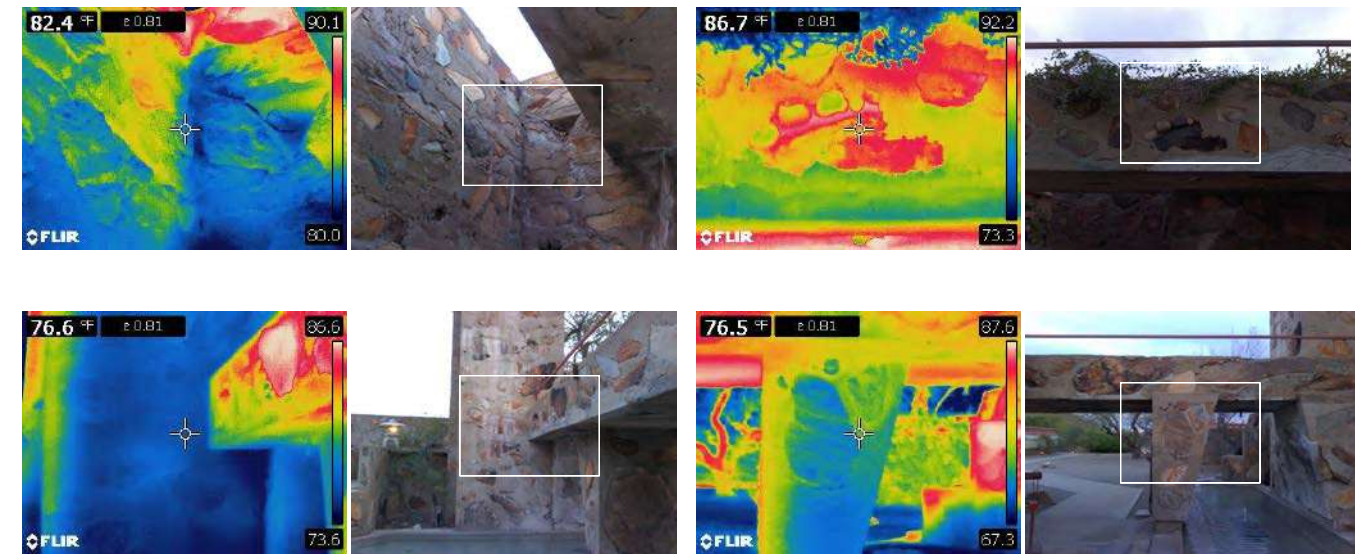


Figure 4.23. Infrared camera images of Kiva-Bridge area (Source: photos taken by authors)

4.6 Salt Analysis

Salt analysis from the bridge revealed the presence of nitrates, sulfates, and chlorides. Nitrates may come from the soil, atmospheric deposition, or plant fertilizers. Sulfates may come from the soil, groundwater, rainwater, or the concrete. The source of chlorides might be the water used in the concrete mix, fertilizers, or cleaning products. (Figure 4.24-4.27)

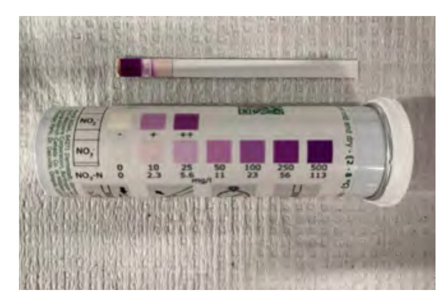


Figure 4.24. Nitrate test strip

Figure 4.25. Sulfate test strip

Figure 4.26. Chloride test strip

Figure 4.27. Sampling location

4.7 Diagnosis

Figure 4.29 shows the sources of water and how water enters the desert masonry of the Kiva walls, roof, and the bridge (Figure 4.29). The fountain and pool under the bridge constantly create high levels of humidity and aerosol which can penetrate the surface of the masonry. The Kiva's roof drainage system is also another source of water infiltration into the ceiling and walls below. Both sources deliver and activate residual salts in the masonry leading to efflorescence, rebar corrosion, and stone and concrete damage.

Figure 4.28. Bird-eye view of Kiva-Bridge (Source: created by authors)

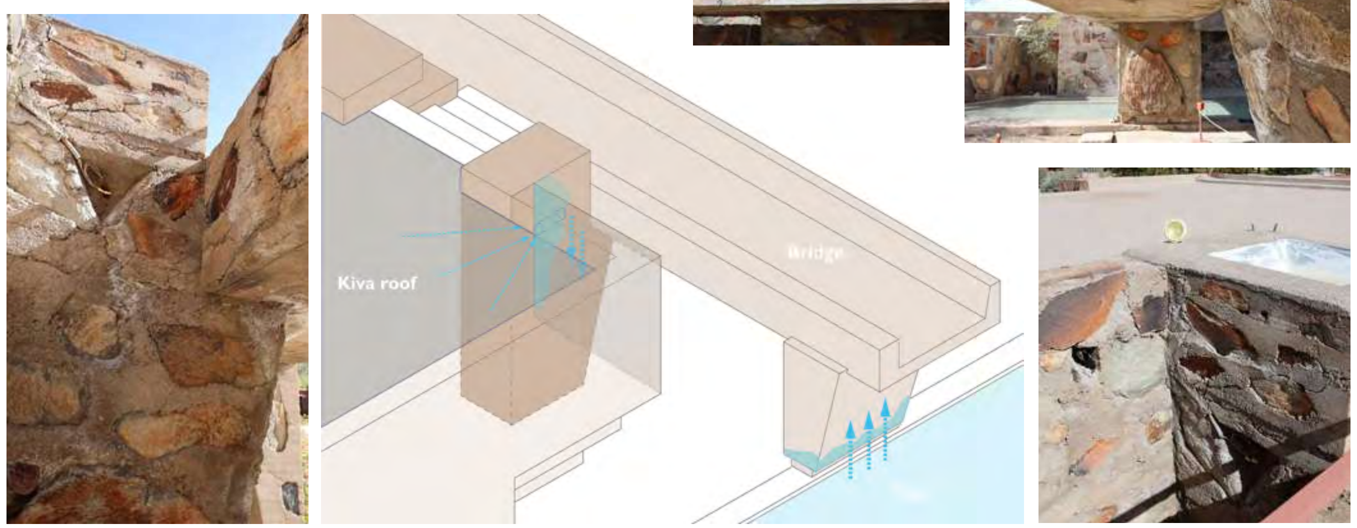


Figure 4.29. Diagram of water infiltration in the Kiva-Bridge area (Source: created by authors)

4.8 Gravimetric Analysis by Acid Digestion

Gravimetric analysis aims to separate composites like concrete by chemical and mechanical means and determine the approximate proportion of the principal components: aggregate, binder, and other fines. The process includes microscopic examination of the samples, acid dissolution of the binder, and mechanical separation of the fines and aggregate. The first step is sampling extraction and general observation, including photomicrography of the bulk sample, texture, bulk color, etc. After the chemical dissolution of the ground sample, fines and aggregate are separated. Finally, the aggregate is sieved to identify its granulometry. (Figure 4.30)

We chose four samples from all three periods and conducted the gravimetric analysis to analyze the ratio of components and characteristics of the aggregate. Analysis revealed similar aggregate in all samples and a similar binder-to-aggregate ratio (Figure 4.31).

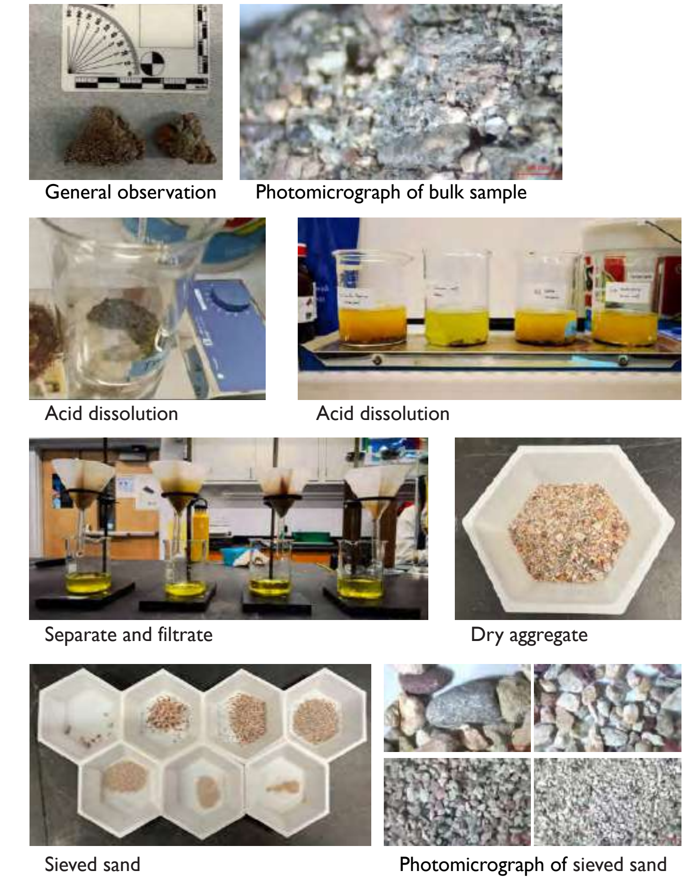


Figure 4.30. Process photos of gravimetric analysis (Source: created by authors)

Survey area	Volume Ratio (portland cement : sand)	Construction period	Surface area density of face rock	Texture of concrete	Bulk color of concrete	Sand color	Sand type
Sample 03- Garden Square knee wall	1: 3.2	Period 3	Type 5	Coarse	pale brown	10YR 7/2 light gray	very fine -gravel
Sample 06- Vault exterior wall	1: 2.8	Period 1	Type 3	Medium	gray	7.5YR 7/2 pinkish gray	very fine -very coarse
Sample 16- Cabrate roof beam	1 : 3.5	Period 2	Type 1	Coarse	pale brown	7.5YR 7/2 pinkish gray	very fine -very coarse
Sample 17- Bookstore knee wall	1 : 4.3	Period 3 (2022)	Type 3	Medium	gray	10YR 7/2 light gray	very fine -very coarse

Figure 4.31. Characterized features of four samples for gravimetric analysis (Source: created by authors)

4.9 Treatment & Repair

In general, the desert masonry of Taliesin West is in good to excellent condition with exceptions where rebar was embedded and in association with water infiltration and /or inappropriate repairs. The following treatment program is recommended: (Table 4.1)
(1) Maintenance and monitoring
(2) Improve the drainage system & manage mount of moisture sources
(3) Cleaning and salt removal by poulticing
(4) Matched mortar repairs
(5) Grouting for cracks

Testing and monitoring
Additional moisture monitoring is necessary to map specific locations of wall moisture and its movement over time. Infrared thermography could prove useful as a nondestructive and versatile method of moisture mapping. We recommend performing corrosion testing to understand the level of corrosion that is occurring at the embedded steel reinforcement. Petrographic analysis of the concrete could identify the source of salts as well as provide base information on concrete performance. For crack monitoring, we recommend using simple crack gauges to monitor crack movement.

Improve roof and bridge drainage and manage the moisture sources.
There are two main sources of moisture in the Kiva-Bridge area. One is from the Kiva roof and the other is from the pool. It is recommended that drainage from the Kiva roof be redirected away from the bridge by downspouts or scuppers and moved away from the base of the building. Backsplash and aerosol from the pool will be more difficult to control however a water repellant applied to the adjacent pier and wall may prove effective. A green roof could also offer an alternative to water collection and removal and provide a positive new design element to the Kiva roof as a garden. (Figure 4.32-4.33)

Cleaning (Table 4.3)
Cleaning of efflorescence, soiling, and metallic staining is recommended. Both small-scale tests and large-scale mock-ups are required before full-scale cleaning begins. For efflorescence, use vacuum/ brush dry removal followed by an aqueous poultice. Quantitative salt test strips can be used as a monitoring tool to confirm salt removal after each poultice application. (Figure 4.34) For soiling, detergent, micro-abrasive, or laser cleaning are all options based on testing. For metal staining, chemical cleaning is typical but concrete is acid-sensitive material, so testing must be performed to ensure no damage results.

Repair or replacement (Figure 4.35)
Composite mortar repairs to replace failing and visually inappropriate existing repairs should be developed and tested before application. The tests should confirm their compatibility with the original material (thermal expansion rate, color, physical strength, cohesion strength, porosity, water permeability, soluble salt content) and service life. Small mock-ups should be completed to assess proper matching with the existing fabric. Small-scale tests and large-scale mock-ups are required.

Condition	Efflorescence	Previous Repairs	Loss	Cracks	Honeycombing
Priority level	High	Moderate	Moderate	Low	Low
Repair recommendation	Cleaning	Repair/replace	Repair	Grouting and Pinning	/

Table 4.1. Prioritized Conditions

Testing	Method/ Equipment
Water absorption	Infrared Thermography cameras; RILEM tubes
Salt analysis for efflorescence	Corresponding test strips
Concrete examination	Petrographic analysis, gravimetric analysis

Monitoring	Method/ Equipment
Crack widths	Measurement
Moisture monitoring	Moisture meter; HOBO

Table 4.2. Testing and monitoring method/ equipment

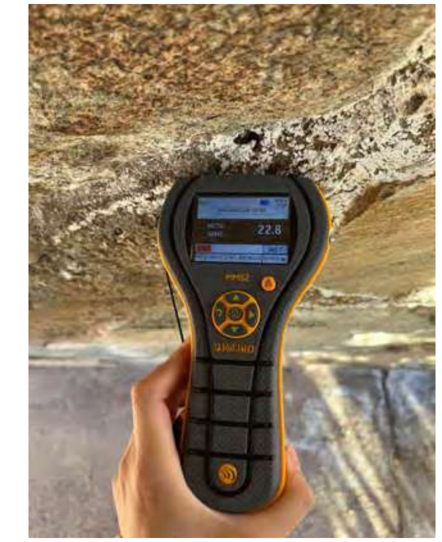


Figure 4.32. Moisture meter


Figure 4.33. RILEM tubes

Condition	Cleaning method
Efflorescence	Vacuum/ bush, Aqueous Poultice (paper pulp), Monitoring (salt test strips)
Atmospheric Soiling	Chemical cleaning (PH neutral chemicals), microabrasive cleaning, laser cleaning
Metal Mineral Staining	Acidic chemical cleaning (concrete is acid sensitive)

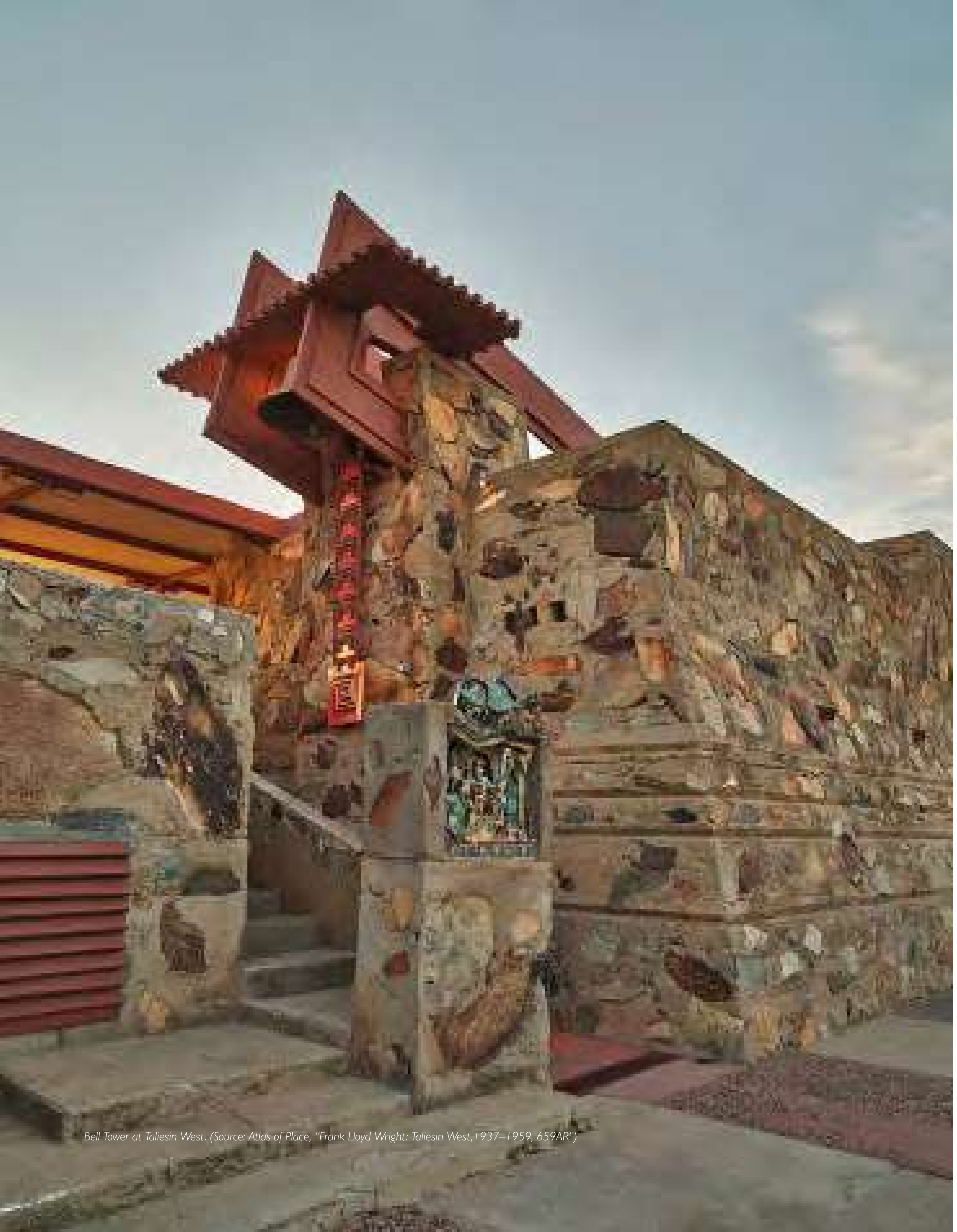
Table 4.3. Conditions recommended with cleaning

Figure 4.35. Concrete replication


Figure 4.36. Grouting


Figure 4.34. Water poultice

Grouting (Figure 4.36)
Large and medium cracks should be treated by micro injection grouting using proprietary commercial grouts and the cracks filled with matching mortar.



Bell Tower at Taliesin West. (Source: Atlas of Place, "Frank Lloyd Wright: Taliesin West, 1937–1959, 659AR")

5. Conclusion

The desert masonry at Taliesin West is a major character defining feature and an essential element of the architectural language of the entire property. Beyond its visual and structural role, desert masonry embodies the collective and individual legacy of making and learning that the Fellowship espoused. It provides tangible expression to the many principles Wright advocated. It also reveals Wight's "borrowing" of his contemporaries and earlier building traditions, even when they were omited in the official record. (Figure 5.1)

Through its constant deployment on site, desert masonry also represents Taliesin's evolving nature and the continual additions and alterations made by Wright and his apprentices over the years. Although no specific chronological style could be identified, the many attributes associated with the construction method reveal a complex and subtle play of choices and typologies of form and aesthetics. Desert masonry techniques were passed down from generation to generation of Fellows through oral tradition and practical experience. As such, desert masonry represents not only a way of building but a concrete testament to the pedagogical system of learning by doing championed by Wright and those who have followed. (Figure 5.2)

Figure 5.1. Slip-form rubble construction (Source: Ernest Flagg. Small Houses: Their Economic Design and Construction. 1922. Internet Archive)

Figure 5.2. Desert masonry mock-up, constructed by Capstone studio students and faculties, 2023

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Appendix A: Historic Construction Photos

Appendix

1963 Pavilion construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1963 Pavilion construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1963 Pavilion construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1963 Pavilion construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1963 Pavilion construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

Typical wall construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

Wall construction (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

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1963 Construction of Music pavilion stage (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1949 Curtis Besinger surveying the roof for cabaret (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1948-1949 Construction of Cabaret concrete roof. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1948-1949 Wes Peter and Joe Fabris lowering the forms into place. (Source: Taliesin Fellowship – Pedro E.Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

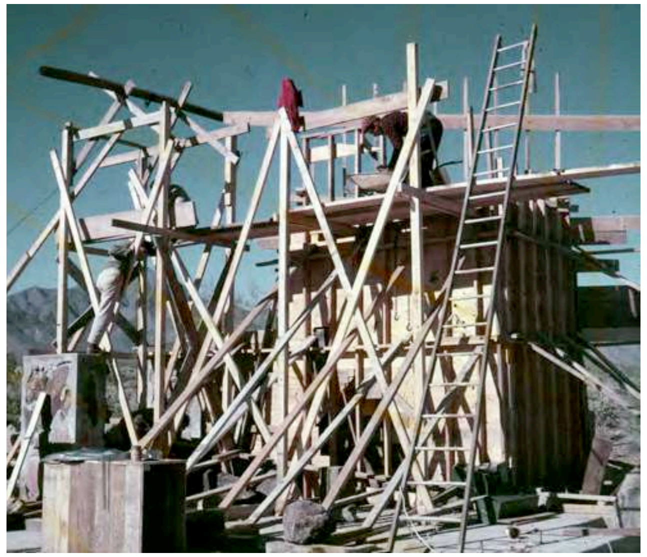
1948-1949 Construction of Cabaret. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1948-1949 Construction of Cabaret. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1948-1949 Construction of Cabaret concrete roof. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1948-1949 Mixing concrete. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

Appendix



1963 Pavilion construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

1963 Pavilion construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

Wall construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

1963 Pavilion construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

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1963 Pavilion construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

Wall construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

Wall construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

Wall construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

1944-1945 Taliesin construction (Source: Taliesin West Archive, “Construction Taliesin West” historic photo collection.)

Appendix

1938 Apprentices clear the desert for sun trap, the first structure on site. (Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection.)

1956 Construction at Taliesin West, with apprentice Arnold Roy on right. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1940 Formwork. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1947 Wes Peter (left) Construction at Taliesin West. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1949 Smoothing out and leveling the concrete floor at Taliesin West. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1947 (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1947 Wes Peter (left) Construction at Taliesin West. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1948-1949 Building the chimey. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)

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1948-1949 Unloading the sand at the cement-mixer. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)

1947 Construction at Taliesin West, Brandoch Peters in the foreground. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1947 Lee Kawahara. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1948-1949 Tony Capucelli delivering the concrete. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1947 Construction of Kiva bridge. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

1947 Making Forms. (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)


1947 (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)


1948-1949 A close-up of the chimney construction. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)


1948-1949 Fende Askell, from Turkey, screeding the concrete. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)


1948-1949 Mansinh Rana applying shellac to the forms for the Cabaret's concrete piers, so the concrete would not stick to them.


1948-1949 Fende and Paffard Keating-Clay Pulling nails from the boards so they could be used again. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)

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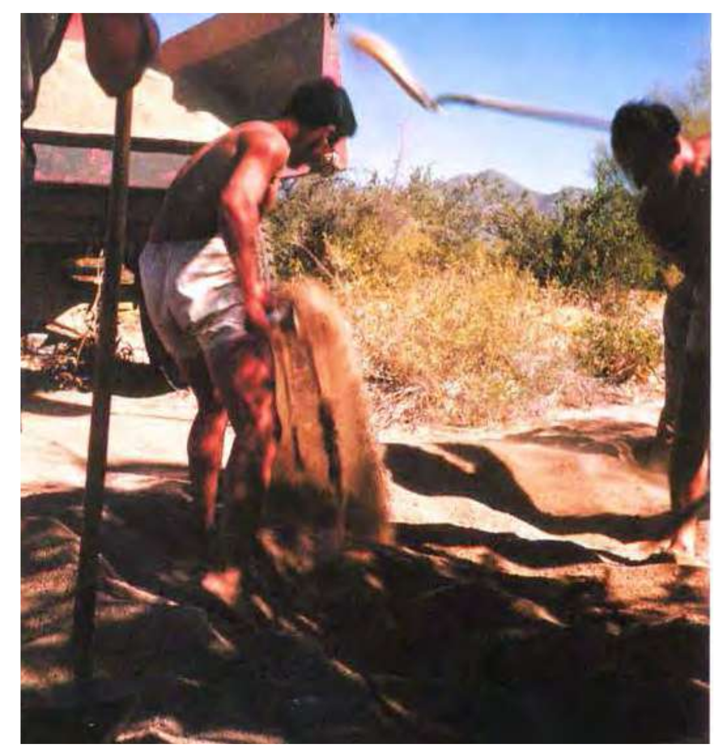
1947 (Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)


1948-1949 Apprentices putting the final touches on the water tower. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)


1948-1949 Sand was collected at a wash (a dry rivered) in the desert, and used to make concrete. (Source: Gottlieb, Lois Davidson. A Way of Life: An Apprenticeship with Frank Lloyd Wright. 1. publ, Images Publ, 2001.)

Appendix

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Appendix B: Glossary of Attribute Term

Appendix

Section 1: Architectural Features

This section identifies the primary architectural elements that were constructed using desert masonry at Taliesin West. Desert masonry is one of the primary construction methods used by Frank Lloyd Wright, consisting of local rock and concrete, set in formwork. The dominant architectural element types are massive walls/piers and knee walls.

Massive Wall/Pier

A massive wall is a load-bearing exterior or interior wall that structurally supports the roof or beam. A massive pier is also a vertical support structure that is used to bear the weight of the building, but it is in "column" or "pier" form.

Knee Wall

A knee wall is a short wall that is non-load-bearing. Knee walls are usually located along the perimeter of the green area, stairs, terrace or platform. Most knee walls are used to divide the landscape or serve as retaining walls.

Ceiling/Roof

A ceiling or roof is the uppermost surface of a building that covers the interior. It is the structural element that provides shelter and insulation to the building, as well as contributes to the overall appearance of the structure.

Tower

A tower is a vertical structure that is not attached to any other structure or building. It is self-supporting and stands independently without any external support or attachment.

Beam

A beam is a structural element that supports a load by resisting bending or flexing. It is a long member that is typically horizontal and supported at both ends. Beams are commonly used to support the weight of floors, roofs, or bridges.

Pavement/Floor

Pavement or floor refers to the hard, flat surface that is constructed on the ground to provide a smooth and durable area for walking, driving, or other activities.

Section 2: Construction Attributes

This section identifies specific aspects of desert masonry that determine its appearance and in some cases, its performance.

Surface Area Ratio

The surface area ratio of stone is the total area of visible stone divided by the total surface area of any given wall plane or surface. The surface areas surveyed range in size 15.5 ft^2 -278 ft^2.

Type 1
The percentage of the stone surface area < 38%.

Type 2
The percentage of the stone surface area is 39%-43%.

Type 3
The percentage of the stone surface area is 44%-49%.

Type 4
The percentage of the stone surface area is 50%-55%.

Type 5
The percentage of the stone surface area > 56%.

Goose Egg

Protruding goose egg

Protruding goose eggs are smooth cobbles that project from the surface plane and were added after the formwork was removed, generally to fill gaps around face rocks.

Non-protruding goose egg

Non protruding goose eggs are smooth cobbles that do not project from the surface plane and were added before the formwork was removed, generally to fill gaps around face rocks and to prevent concrete spill out.

Bulk color of concrete

The color of the concrete is due to the inherent constituents of grey Portland cement and reddish-yellow aggregate and in some cases, the application of slurry of a clay applied to the surface. There are mainly three colors of concrete: gray, pale brown, and pinkish gray.

gray

pale brown

pinkish gray

Texture of concrete

The surface texture of concrete exhibits three categories: fine, medium, and coarse. This is due to the amount of water used in the initial concrete mix, the aggregate, and the formwork.

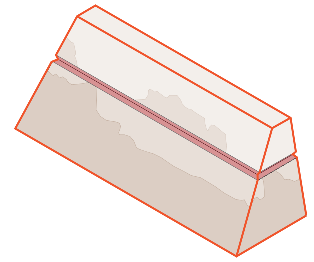
coarse

medium

fine

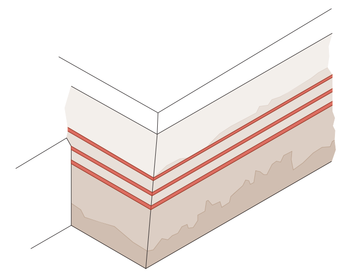
Batter

A batter is achieved by placing the masonry at an angle to the vertical plane, creating a slope. This can be done for a variety of reasons, including improving the stability of the wall, or enhancing its visual appeal.



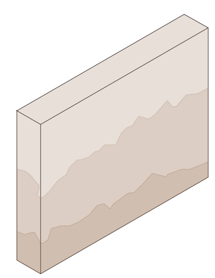
Rustication

Rustication refers to the presence of horizontal grooves, triangular in section. They create deep shadow lines across the wall and served as a method to disguise cold joints and sometimes individual lifts.



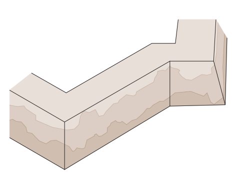
Lift

In concrete construction, lifts refer to the sequential layers or horizontal sections of concrete that are poured and cured one on top of another to form a complete structure.

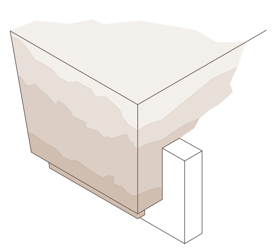


Lift interval height

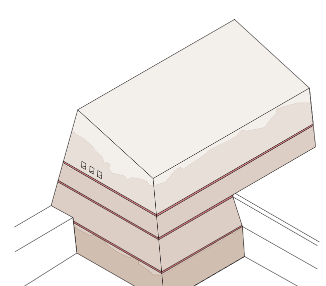
Lift interval height is the average value of the distance between each lift. It has three categories: small, medium, and large.



small: 10"-20"



medium: 20"-30"



large: 30"-40"

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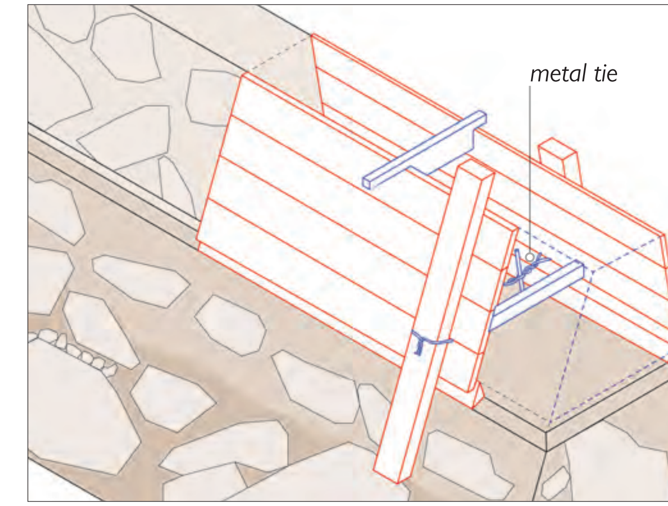
Metal Ties

Metal ties are found exposed on the desert masonry surface. They were used to tie the two sides of the wooden formwork together during the construction.



Visible rebar

Visible rebar is the exposed evidence of ferrous reinforcement. Visble rebar appears at structural elements in long spans, such as ceilings, roof and beams.

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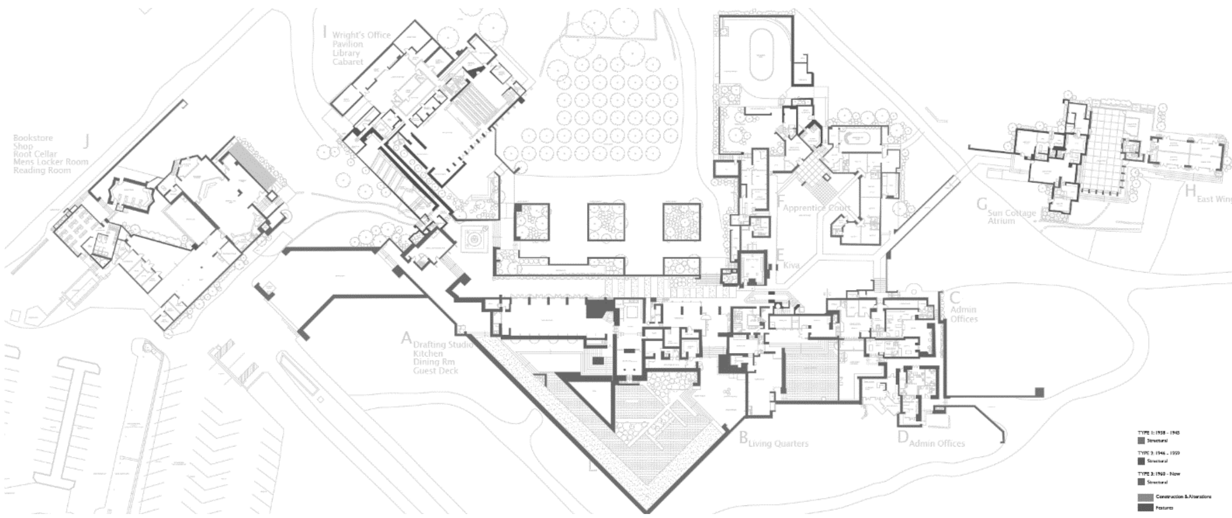
Appendix C: Typology Survey Form

Appendix

Part 1: Primary Identification

1. Survey initials: ____________ 2. Survey date: ______________ 3. Area ID: ____________

3. Section location:



Detailed location sketch or photo

4. Construction period:

☐ Period 1: 1938-45 ☐ Period 2: 1946-59 ☐ Period 3: 1960-now

5. Element(s)

☐ Massive walls/piers ☐ Ceilings/Roof ☐ Beams ☐ Knee walls ☐ Pavement/Floors
☐ Free-standing ☐ Other:____

6. Orientation:

☐ West ☐ East ☐ North ☐ South

7. Section image No.: _______________

Part 2: Materials

1. Sketch or photos of elevation, top and sides (each face rock, goose egg, and other features with overall dimensions)

Exterior surface photo Nos.: ______________

(Sketch or photo)

2. Surface area density of face stone :

Low: ☐0 ☐20% Medium: ☐40% ☐60% High: ☐80% ☐100%

4. Presence of goose eggs: yes or no

5. Bulk Color of mortar: _______________

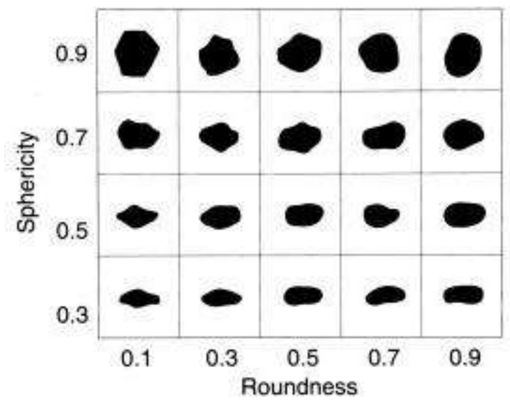
6. Texture of mortar: _______________

Face Stone

7. Color(s): _______________

8. Size Range: ______________________________

9. Shape: (circle most representative)



10. Protruding in contrast to the concrete surface:

☐ Yes ☐ No

Part 3: Construction

1. Sketch of section (with measurement, batter, foundation)

Formwork image No: ______________

(Sketch of additional information if needed.)

HSPV 721 Capstone Studio: Materials + Materialities

1. Thickness of section: _______________ 2. Height of section: _______________

3. Presence of batter:

☐ Yes ☐ No

4. Presence of exposed rebar: (if yes, rebar type _______________)

☐ Yes ☐ No

5. Sketch or photos of construction joists (horizontal grooves, amount, thickness, interval distance)

Contruction joint image No: ______________

(Sketch of additional information if needed.)

HSPV 721 Capstone Studio: Materials + Materialities

Appendix D: Survey Area Contact Sheet

Appendix

1. Drafting Studio-north pier

Peroid 1: 1938-1945

Massive walls/piers

goose egg

long face stone

horizontal grooves

lifts

2. WWP-old knee wall

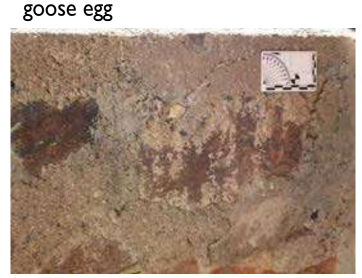
Peroid 1: 1938-1945

Knee wall

goose egg

face stone color &

arrangement



lifts

3. WWP-new knee wall

Peroid 3: 1960-now

Knee wall

face stone color &

arrangement

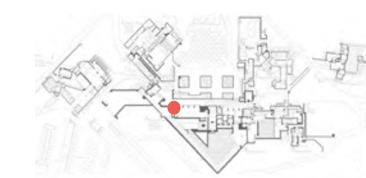
horizontal grooves, lifts

long face stone

4. Drafting Studio-vault exterior wall

Peroid 1: 1938-1945

Massive walls/piers



horizontal grooves, lifts, formwork board

protruding goose egg

face stone color & arrangement

opennings

5. Drafting Studio-west knee wall

Peroid 1: 1938-1945

Knee wall

face stone color & arrangement

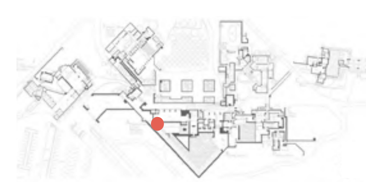
protruding goose egg

lifts

6. Drafting Studio-south wall

Peroid 1: 1938-1945

Massive walls/piers



face stone color & arrangement

lifts, cold joint, honeycombing

HSPV 721 Capstone Studio: Materials + Materialities

7. Drafting Studio-vault interior wall

Peroid 1: 1938-1945

Massive walls/piers

face stone color & arrangement

lifts, horizontal grooves, goose-eggs

8. Kitchen-wall

Peroid 1: 1938-1945

Massive walls/piers

face stone color & arrangement

lifts, horizontal grooves, goose-eggs

Appendix

9. Garden Square-knee wall

Peroid 3: 1960-now

Knee wall





lifts, horizontal grooves,

goose-eggs

face stone color& arrangement

cobbles in the concrete mix

10. Apprentice Court-wall

Peroid 1: 1938-1945

Massive walls/piers



face stone size,

color&

arrangement,

formwork board


goose-eggs

11. Kiva-wall

Peroid 1: 1938-1945

Massive walls/piers



lifts,

formwork boards

face stone size, color& arrangement,

goose-eggs

12&13. Bridge-pier

Peroid 2: 1946-1959

Massive walls/piers






face stone size, color&

arrangement, goose-eggs

HSPV 721 Capstone Studio: Materials + Materialities

Appendix

14. Bridge-wall

Peroid 2: 1946-1959

Beams

face stone size, color& arrangement

goose-eggs

previous repair

15. Bridge-slab

Peroid 2: 1946-1959

Beams

previous repair

ties

exposed rebars

HSPV 721 Capstone Studio: Materials + Materialities

16. Pavilion-stage wall

Peroid 2: 1946-1959

Massive walls/piers

goose-eggs

lift

face stone size, color& arrangement,

formwork boards

17. Pavilion-interior wall

Peroid 2: 1946-1959

Massive walls/piers

face stone size, color& arrangement

black strips

goose-eggs

ties

HSPV 721 Capstone Studio: Materials + Materialities

18. Cabaret-ceiling

Peroid 2: 1946-1959

Ceilings/Roof

face stone size, color& arrangement

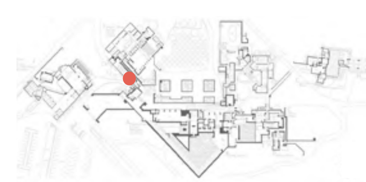
formwork board

ties

19. Cabaret-knee wall

Peroid 2: 1946-1959

Knee wall



face stone size, color& arrangement

ties

goose-egg

20. Cabaret-roof beam

Peroid 2: 1946-1959

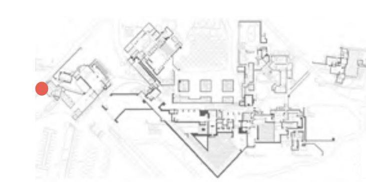
Beams

concrete texture

21. Men's Locker Room-wall

Peroid 2: 1946-1959

Massive walls/piers



cold joint

concrete texture

horizontal

formboard

& goose eggs

Appendix

22. Reading Room-wall

Peroid 3: 1960-now

Massive walls/piers

face rock size & goose egg

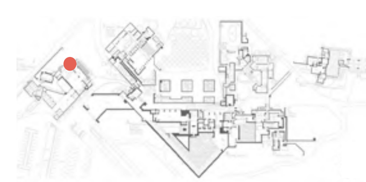
goose egg

horizontal grooves

23. Bookstore-wall

Peroid 3: 1960-now

Massive walls/piers



horizontal formboard

horizontal grooves

HSPV 721 Capstone Studio: Materials + Materialities

24. Kiva-knee wall

Peroid 3: 1960-now

Knee wall

horizontal formboard

lifts

25. Admin Office-outer wall

Peroid 3: 1960-now

Massive walls/piers

face rock size & density

horizontal grooves

Appendix

26. Admin Office-inner wall

Peroid 3: 1960-now

Knee wall

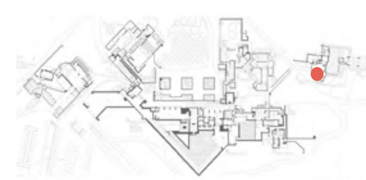
goose egg size

concrete texture & aggregate

27. Sun Cottage-fireplace

Peroid 1: 1938-1945

Massive walls/piers



goose egg

horizontal formboard

HSPV 721 Capstone Studio: Materials + Materialities

28. Sun Cottage-wall

Peroid 2: 1946-1959

Massive walls/piers

concrete color

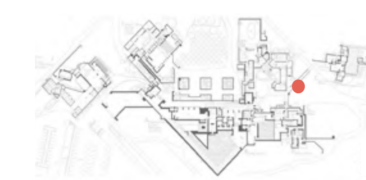
cold joint

lifts

29. Bridge to Sun Cottage

Peroid 3: 1960-now

Knee wall



face rock size

goose egg & horizontal grooves

concrete texture & aggregate

30. Apprentice Court-pool wall

Peroid 2: 1946-1959

Massive walls/piers

face rock size&shape

31. Water Tower-wall

Peroid 2: 1946-1959

Free-standing

goose egg

face rock density

rebar

HSPV 721 Capstone Studio: Materials + Materialities

32. Living Quarter-entrance pavement

Peroid 1: 1938-1945

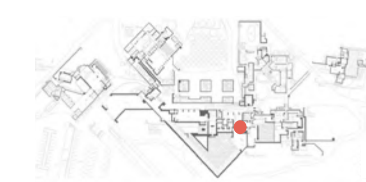
Pavement/Floors

face rock density

33. Living Quarter-entrance wall

Peroid 1: 1938-1945

Massive walls/piers



face rock protruding

goose-eggs protruding

lifts

34. Pavilion-exterior wall

Peroid 2: 1946-1959

Massive walls/piers

face rock density&size

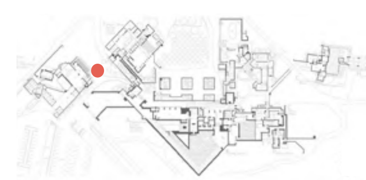
lifts

anchor

35. Bookstore-knee wall

Peroid 3: 1960-now

Knee wall



goose-eggs

concrete color

lifts

36. Kiva-ceiling

Peroid 1: 1938-1945

Ceilings/Roof

face stone density & size

concrete texture

HSPV 721 Capstone Studio: Materials + Materialities

Appendix E: Typology Survey Data Spreadsheets

Appendix

HSPV 721 Capstone Studio: Materials + Materialities

E.1 Original Survey Form Data Spreadsheet

Basic information					Materials											Construction									
No.	Area	Construction peroid	Elements	Oritation	Surface area density of face rock	Face rock protruding	Face rock size	Face rock strength	Presence of goose eggs	Goose egg protruding	Goose egg size	Bulk color of concrete	Bulk color of concrete	Texture of concrete	Concrete strength	Height	Thickness	Batter	Horizontal grooves	Formwork Board	Lifts no.	Lifts interval height	Cold joint	Metal ties	Repair
1	a-middle pier in drafting studio	Peroid 1: 1938-1945	Massive walls/piers	East	Medium-60%	No	21.5''*4'', 26''*9'', 20.5'		Yes			10YR 7/2	light gray	50-320 grit		6'-4''	1'-3''	No			4	19			
2	a-WWP conference room 1972 additio	Peroid 3: 1960-now	Knee wall	East	Medium-61%	No	2.5''*9'', 13	62, 56, 52	No			7.5YR 5/2	grayish brown	50-120 grit	26, 30, 26	2'-8''	2'-8''	Yes			2	16			
3	a-WWP conference room 1940	Peroid 1: 1938-1945	Knee wall	North	Medium-62%	No	10''*8.5'', 8	64, 62, 52	Yes			10YR 5/2	brown	50-220 grit	25, 26, 28	4'-11''	2'-1''	Yes			3	19.6667			
4	a-Drafting Studio-vault exterior wall	Peroid 1: 1938-1945	Massive walls/piers	East	Medium	No	bigger face rocks on th		Yes	Yes	average	10YR 7/1	light gray	Medium		10'-2''		Yes	Yes	horizontal	4	30.5	Yes, 2, hor	Yes, near th	No distinct
5	a-Drafting Studio-west knee wall	Peroid 1: 1938-1945	Massive walls/piers	East	High	No (elevation), Yes (top)			Yes	Yes (elev	average	10YR 6/3, 2	pale brown	Medium		2'-9''	2'-6''	No	No		3	11	No		No distinct
6	a-Drafting Studio-south wall	Peroid 1: 1938-1945	Massive walls/piers	South	High (lower tie	No		55, 48, 42	Yes (uppe	Yes (upper	small	7.5YR 6/2 (u	light gray	Medium	(bottom)	9'-0''		Yes	No		6	18	Yes, 1, hor	Yes	Yes
7	a-Drafting Studio- vault interior wall	Peroid 1: 1938-1945	Massive walls/piers	East	Low	No	smaller than the exteri		Yes	No	average	2.5Y 6/2	light brownish g	Coarse		10'-9''		No	Yes	horizontal	5	25.8	No		No distinct
8	a-Kitchen-wall	Peroid 1: 1938-1945	Massive walls/piers	North	Medium	No	samller face rocks on th		Yes	No	average	10YR 6/2	light brownish g	Medium		13'-9''		Yes	Yes	horizontal	6	27.5	Yes	Yes	No distinct
9	c-Garden Square-knee wall	Peroid 3: 1960-now	Knee wall	South	High			62, 56, 58	Yes	No	small, an	10YR 6/3	pale brown		18, 12, 10	3'-11''		Yes	Yes		4	11.75	No		
10	a-Apprentice Court-wall	Peroid 1: 1938-1945	Massive walls/piers	West	High	No	orange color		Yes	No	big size,	10YR 6/3	pale brown	Medium		6'-4''	1'-3''	No	No	horizontal	3	25.3333	Yes, on the top		
11	a-Kiva-wall	Peroid 1: 1938-1945	Massive walls/piers	West	Low	No			Yes	Yes	sparse a	7.5YR 6/2	pinkish gray	Medium		9'-0''		No	No	horizontal	4	27			
12	b-Bridge-pier north	Peroid 2: 1946-1959	Massive walls/piers	North	Medium	Yes			No	/	/	10YR 6/3	pale brown	Medium		6'-5''	2'-5''	No	No		2	38.5		Yes	repiar with
13	b-Bridge-pier west	Peroid 2: 1946-1959	Massive walls/piers	West	Medium	No			Yes	some protuding		10YR 6/3	pale brown	Medium		6'-5''	2'-5''	No	No	horizontal	2	38.5			
14	b-Bridge-wall	Peroid 2: 1946-1959	Beams	West	Medium	No	some long	56, 34, 48	Yes	No	Medium	10YR 6/3	pale brown	Medium	38, 24, 26	2'-1''	10''	No	No		2	12.5			
15	b-Bridge-slab	Peroid 2: 1946-1959	Beams	bottom	Low	No	very few and small		No	/	/	10YR 6/3	pale brown	Medium			6''		No	running N-S					
16	b-Pavilion-stage wall	Peroid 2: 1946-1959	Massive walls/piers	SW	High	No	big, various		Yes	No	three siz	10YR 7/2	light gray	Coarse		12'-9''		No	No	horizontal	5	30.6	Yes	Yes	
17	b-Pavilion-interior wall	Peroid 2: 1946-1959	Massive walls/piers	East	High	No	big in size,	50, 45, 60	Yes	No	small, ne	7.5YR 6/1 (b	pinkish gray	Medium	21, 18, 24				No		2			Yes	
18	b-Cabaret-ceiling	Peroid 2: 1946-1959	Ceilings/Roof	bottom	Low	No	small to medium size, la		No	/	/	10YR 6-3	pale brown	Fine					No	running NW-SE 7.5''				Yes	
19	b-Cabaret-knee wall	Peroid 2: 1946-1959	Knee wall	South	Top medium, b	No			Yes on bo	No	bottom l	5YR 4/2 (to	dark grayish bro	Medium (top), coarse		3'-11''		Yes	No		2	23.5	Yes, top ar	On top of bottom lift	
20	b-Cabaret-roof beam	Peroid 2: 1946-1959	Beams	NW	Low	No			No	/	/	7.5YR 5/2	brown	Coarse		2'-9''	1'-10''	Yes	No		2	16.5		Yes	
21	b-Men's Locker Room-wall	Peroid 2: 1946-1959	Massive walls/piers	SW	Medium	No	top 1 lift small stones		Yes	No	various s	7.5YR 6/3	light brown	Coarse		7'-11''		Yes	No	horizontal	5	19	top 1 lift		
22	c-Reading Room-wall	Peroid 3: 1960-now	Massive walls/piers	West	Top half low, b	No	bottom 2 big face stone		Yes	No	avarage	4.5YR 6/3	light brown	Medium		11'-0''		Yes	2 horizontal , top one		5	26.4		a line of me	cement pat
23	c-Bookstore-wall	Peroid 3: 1960-now	Massive walls/piers	NE	Medium (top h	No	small amou	48, 48, 38	No	/	/	10YR 6/1	gray	Medium	30, 28, 22			No	one horizo	horizontal	4				
24	c-Kiva-knee wall	Peroid 3: 1960-now	Knee wall	West	Medium	No	size various		No	/	/	10YR 5/2	grayish brown	Medium		4'-11''	11''	No	No	horizontal	2	29.5		Yes	
25	c-Admin Office-outer wall	Peroid 3: 1960-now	Massive walls/piers	North	Top lift mediu	No	small	56, 44, 40, 5	yes on top liftm no on others			7.5YR 6/2 (b	pinkish gray	Medium	35, 28, 22	10'-6''		Yes	3 horizontal		4	31.5	Yes, one o	On top of bottom lift	
26	c-Admin Office-inner wall	Peroid 3: 1960-now	Knee wall	East	Medium	No	avarage size		Yes	No	size sma	10YR 6/2	light brownish g	Coarse		7'-10''		Yes	No		4	23.5	vertical on	Yes	
27	a-Sun Cottage-fireplace	Peroid 1: 1938-1945	Massive walls/piers	West	Low	No	medium size		Yes	No	Large, ne	7.5YR 6/2	pinkish gray	Medium		12'-6''		Yes	No	horizontal	5	30		No	
28	c-Sun Cottage-wall	Peroid 2: 1946-1959	Massive walls/piers	West	Medium	No	various size		No	/	/	10YR 6/1	gray	Medium		8'-9''		No	No	horizontal	4	26.25			
29	c-Bridge to Sun Cottage	Peroid 3: 1960-now	Knee wall	NW	Medium	No	small		Yes	No	small siz	7.5YR 5/2	brown	Coarse		2'-1''	10''	No	2, step like		2	12.5			
30	c-Apprentice Court-pool wall	Peroid 2: 1946-1959	Massive walls/piers	East	Medium	No	big, various		No	/	/	10YR 6/2	light brownish g	Medium		6'-8''		No	No		3	26.6667		No	
31	b-Water Tower-wall	Peroid 2: 1946-1959	Free-standing	North	Low	No	various size, some big,		Yes	No	size med	7.5YR 6/2	pinkish gray	Medium		18'-0''			No	horizontal	8	27			
32	a-Living Quarter-entrance pavement	Peroid 1: 1938-1945	Pavement/Floors	top	High	No	avarage size		No	/	/	7.5YR 5/2	brown	Medium											
33	a-Living Quarter-entrance wall	Peroid 1: 1938-1945	Massive walls/piers	West	Medium	Yes, big one and small one			Yes	Yes	avarage	7.5YR 6/2	pinkish gray	Medium		6'-11''		Yes	2, 2'' by 2''	horizontal	5	16.6	top one lift		
34	b-Pavilion-exterior wall	Peroid 2: 1946-1959	Massive walls/piers	NE	Low	No	mostly small size		No	/	/	7.5YR 6/2	pinkish gray	Medium		9'-6''		No	No		5	22.8	No		
35	c-Bookstore-knee wall	Peroid 3: 1960-now	Knee wall	NE	Medium	No	small size	48, 60, 54, 5	Yes	No	small siz	7.5YR 6/1	gray	Medium	20, 18, 20				No	a whole pi	1			No	
36	a-Kiva-ceiling	Peroid 1: 1938-1945	Ceilings/Roof	bottom	Low	No	small size		No	/	/	10YR 6/2		Fine					No	N-S					

Appendix

HSPV 721 Capstone Studio: Materials + Materialities

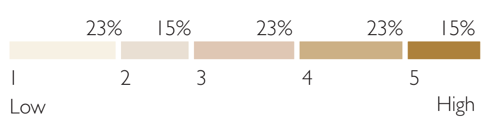
E.2 Classified Survey Form Data Spreadsheets

PERIOD 1: 1938-1945

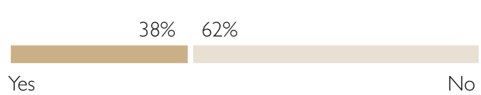
ID No.	Area	Construc-tion year	Construction period	Elements	Surface area ratio of face rock	Presence of goose eggs	Goose egg protruding	Bulk color of concrete	Texture of concrete	Batter	Rustication	Lifts interval distance	Visible rebar
1	a-Drafting Studio-north piers	1939	period 1: 1938-1945	Massive walls/piers	level 3	Yes	No	gray	Medium	No	Yes	Small (10-20")	No
4	a-Drafting Studio-vault exterior wall	1939	period 1: 1938-1945	Massive walls/piers	level 3	Yes	Yes	gray	Medium	Yes	Yes	Large (30-40")	No
5	a-Drafting Studio-west knee wall	1939	period 1: 1938-1945	Massive walls/piers	level 4	Yes	Yes	pale brown	Medium	No	No	Small (10-20")	No
6	a-Drafting Studio-south wall	1939	period 1: 1938-1945	Massive walls/piers	level 5	No		gray	Medium	Yes	No	Small (10-20")	No
7	a-Drafting Studio-vault interior wall	1939	period 1: 1938-1945	Massive walls/piers	level 3	Yes	No	brownish gray	Coarse	No	Yes	Medium (20-30")	No
8	a-Kitchen-wall	1939	period 1: 1938-1945	Massive walls/piers	level 2	Yes	No	brownish gray	Medium	Yes	Yes	Medium (20-30")	No
27	a-Sun Cottage-fireplace	1939	period 1: 1938-1945	Massive walls/piers	level 1	Yes	No	pinkish gray	Medium	Yes	No	Large (30-40")	No
2	c-WWP-old knee wall	1939	period 1: 1938-1945	Knee wall	level 2	Yes	No	pale brown	Medium	Yes	No	Small (10-20")	No
11	a-Kiva-wall	1940	period 1: 1938-1945	Massive walls/piers	level 1	Yes	Yes	pinkish gray	Medium	No	No	Medium (20-30")	No
32	a-Living Quarter-entrance pavement	1940	period 1: 1938-1945	Pavement/Floors	level 5	No		pale brown	Medium		No		No
33	a-Living Quarter-entrance wall	1940	period 1: 1938-1945	Massive walls/piers	level 4	Yes	Yes	pinkish gray	Medium	Yes	Yes	Small (10-20")	No
36	a-Kiva-ceiling	1940	period 1: 1938-1945	Ceilings/Roof	level 1	No		brownish gray	Fine		No		Yes
10	a-Apprentice Court-wall	1941	period 1: 1938-1945	Massive walls/piers	level 4	Yes	No	pale brown	Medium	No	No	Medium (20-30")	No

☐ Element

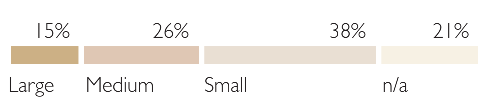
☐ Face Rock Ratio



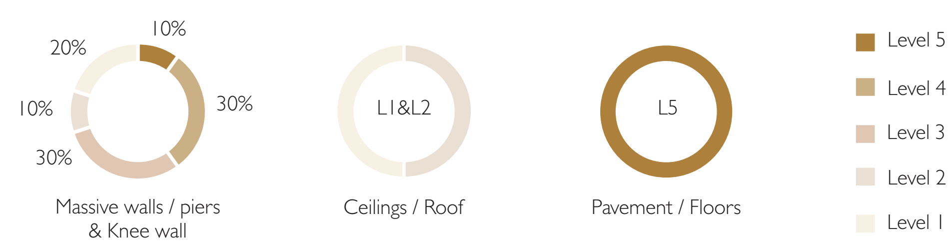
☐ Rustication



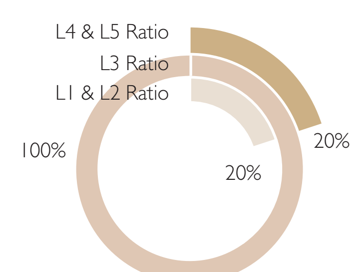
☐ Lift Interval



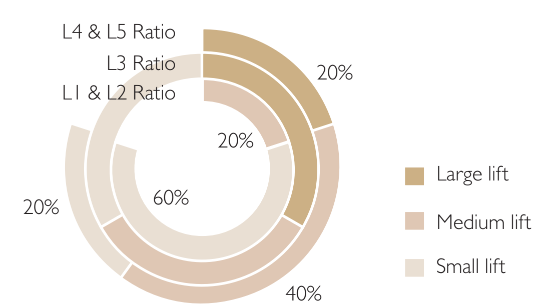
☐ Element v.s. Face Rock Ratio



☐ Face Rock Ratio v.s. Rustication



☐ Face Rock Ratio v.s. Lift Interval



Findings

- Mostly massive walls/piers
- Evenly distributed at different ratios
- Mostly medium to large lift interval distance
- Rarely rustications
- Ceiling/roof of low face rock ratio and pavement/floor of high ratio
- Rustications mainly in Level 3 ratio areas
- Low ratio areas (L1 & L2) have mainly small interval lifts; Medium to high ratio have mainly medium lifts

Appendix

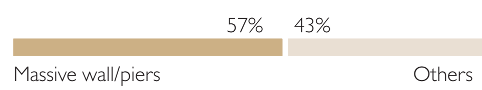
HSPV 721 Capstone Studio: Materials + Materialities

E.2 Classi ied Survey Form Data Spreadsheets (continued)

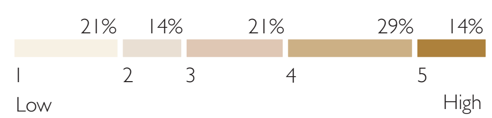
PERIOD 2: 1938-1945

ID No.	Area	Construc-tion year	Construction period	Elements	Surface area ratio of face rock	Presence of goose eggs	Goose egg protruding	Bulk color of concrete	Texture of concrete	Batter	Rustication	Lifts interval distance	Visible rebar
12	b-Bridge-pier north	1947	period 2: 1946-1959	Massive walls/piers	level 3	No		pale brown	Medium	No	No	Large (30-40")	No
13	b-Bridge-pier west	1947	period 2: 1946-1959	Massive walls/piers	level 3	Yes	Yes	pale brown	Medium	No	No	Large (30-40")	No
14	b-Bridge-wall	1947	period 2: 1946-1959	Knee wall	level 4	Yes	No	pale brown	Medium	No	No	Small (10-20")	Yes
15	b-Bridge-slab	1947	period 2: 1946-1959	Beams	level 2	No		pale brown	Medium		No		Yes
28	c-Sun Cottage-wall	1947	period 2: 1946-1959	Massive walls/piers	level 4	No		gray	Medium	No	No	Medium (20-30")	No
31	b-Water Tower-wall	1947	period 2: 1946-1959	Free-standing	level 1	Yes	No	pinkish gray	Medium		No	Medium (20-30")	Yes
18	b-cabaret-ceiling	1950	period 2: 1946-1959	Ceilings/Roof	level 1	No		pale brown	Fine		No		Yes
19	b-cabaret-knee wall	1950	period 2: 1946-1959	Knee wall	level 4	Yes	No	pale brown	Coarse	Yes	No	Medium (20-30")	No
20	b-cabaret-roof beam	1950	period 2: 1946-1959	Beams	level 1	No		pale brown	Coarse	Yes	No	Small (10-20")	Yes
21	b-Men's Locker Room-wall	1952	period 2: 1946-1959	Massive walls/piers	level 5	Yes	No	pale brown	Coarse	Yes	No	Small (10-20")	No
16	b-Pavilion-stage wall	1957	period 2: 1946-1959	Massive walls/piers	level 5	Yes	No	gray	Coarse	No	No	Large (30-40")	No
17	b-Pavilion-interior wall	1957	period 2: 1946-1959	Massive walls/piers	level 4	Yes	No	pinkish gray	Medium		No		No
34	b-Pavalion-exterior wall	1957	period 2: 1946-1959	Massive walls/piers	level 3	No		pinkish gray	Medium	No	No	Medium (20-30")	No
30	c-Apprentice Court-pool wall	/	period 2: 1946-1959	Massive walls/piers	level 2	No		brownish gray	Medium	No	No	Medium (20-30")	No

☐ Element

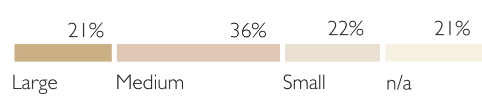


☐ Face Rock Ratio

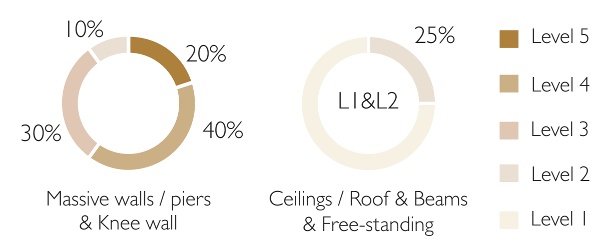


☐ Rustication

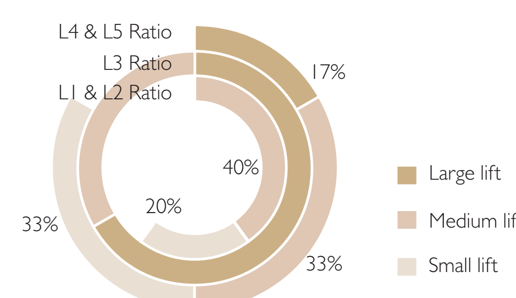
☐ Lift Interval



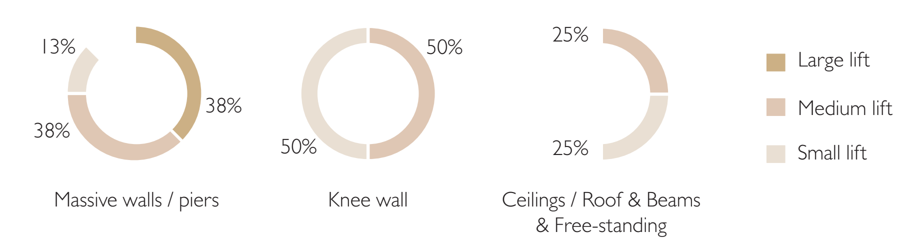
☐ Element v.s. Face Rock Ratio



☐ Face Rock Ratio v.s. Lift Interval



☐ Element v.s. Lift Interval



Findings

- No rustication
- Mainly medium to large face rock ratio (L3 & L4)
- Massive walls have medium to high face rock ratio (L3 & L4); Other elements have low face rock ratio (L1 & L2)
- Massive walls mostly have large to medium lift interval; Other elements have small to medium lift
- Low face rock ratio areas (L1&L2) have small interval lift

Appendix

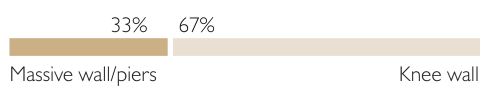
HSPV 721 Capstone Studio: Materials + Materialities

E.2 Classi ied Survey Form Data Spreadsheets (continued)

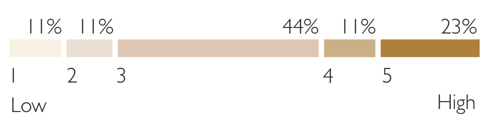
PERIOD 3: 1960-now

ID No.	Area	Construc-tion year	Construction period	Elements	Surface area ratio of face rock	Presence of goose eggs	Goose egg protruding	Bulk color of concrete	Texture of concrete	Batter	Rustication	Lifts interval distance	Visible rebar
25	c-Admin Office-outer wall	1970	period 3: 1960-now	Massive walls/piers	level 1	No		pinkish gray	Medium	Yes	Yes	Large (30-40")	No
26	c-Admin Office-inner wall	1970	period 3: 1960-now	Knee wall	level 3	Yes	No	brownish gray	Coarse	Yes	No	Medium (20-30")	No
3	a-WWP-new knee wall	1972	period 3: 1960-now	Knee wall	level 4	No		pale brown	Medium	Yes	Yes	Small (10-20")	No
22	c-Reading Room-wall	1980	period 3: 1960-now	Massive walls/piers	level 2	Yes	No	pale brown	Medium	Yes	Yes	Medium (20-30")	No
23	c-Bookstore-wall	1985	period 3: 1960-now	Massive walls/piers	level 3	No		gray	Medium	No	Yes		No
35	c-Bookstore-knee wall	2020	period 3: 1960-now	Knee wall	level 3	Yes	No	gray	Medium		No		No
9	c-Garden Square-knee wall	/	period 3: 1960-now	Knee wall	level 5	Yes	No	pale brown	Coarse	Yes	Yes	Small (10-20")	No
24	c-Kiva-knee wall	/	period 3: 1960-now	Knee wall	level 5	No		pale brown	Medium	No	No	Medium (20-30")	No
29	c-Bridge to Sun Cottage	/	period 3: 1960-now	Knee wall	level 3	Yes	No	pale brown	Coarse	No	Yes	Small (10-20")	No

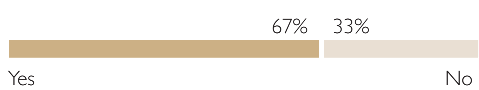
☐ Element



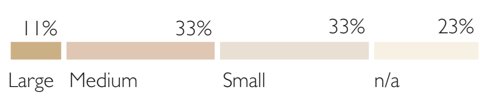
☐ Face Rock Ratio



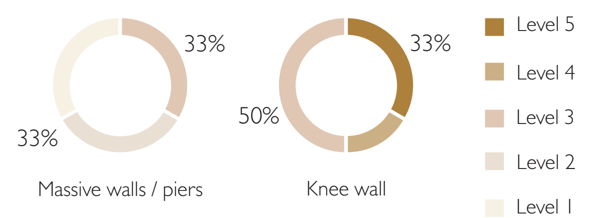
☐ Rustication



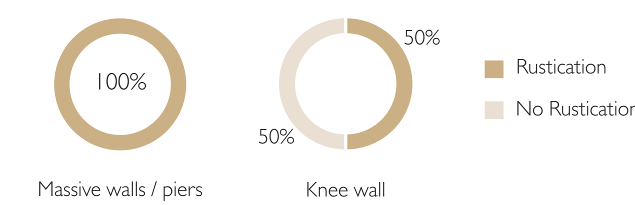
☐ Lift Interval



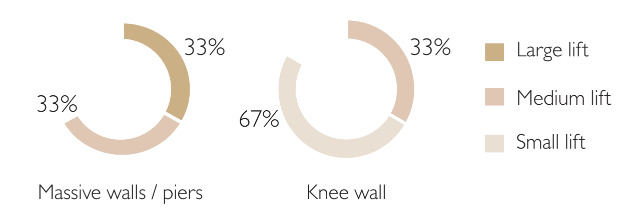
☐ Element v.s. Face Rock Ratio



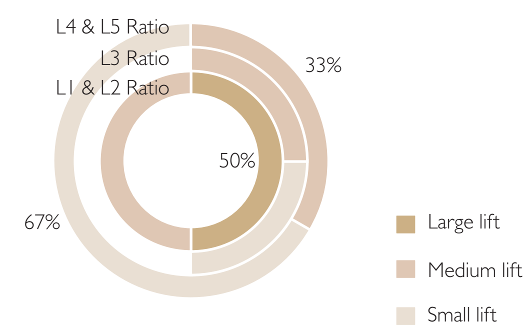
☐ Element v.s. Rustication



☐ Element v.s. Lift Interval



☐ Face Rock Ratio v.s. Lift Interval

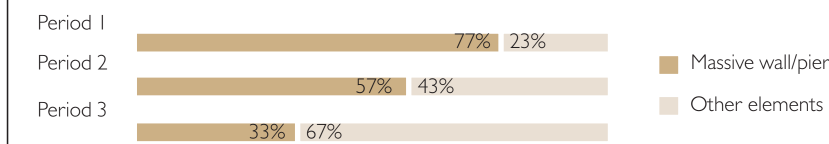


Findings

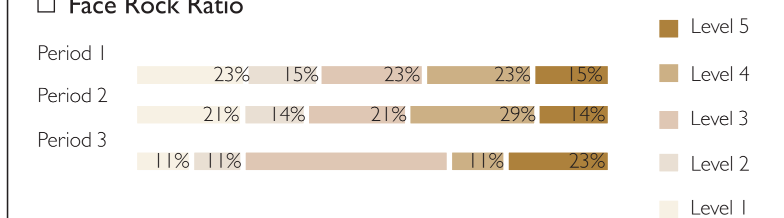
- Mostly medium face rock ratio
- Mostly having rustications
- Knee walls mostly have higher face rock ratio than massive walls
- All the massive walls have rustications; Half of the knee walls have rustications
- Massive walls have larger lift than knee walls
- Low face rock ratio areas have large to medium lift intervals

PERIOD 1 - PERIOD 2 - PERIOD 3

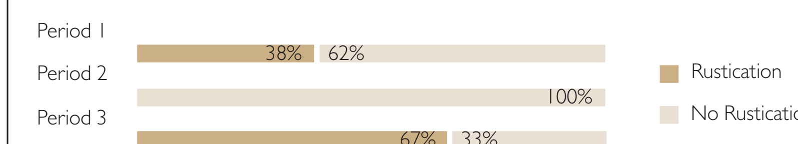
☐ Element



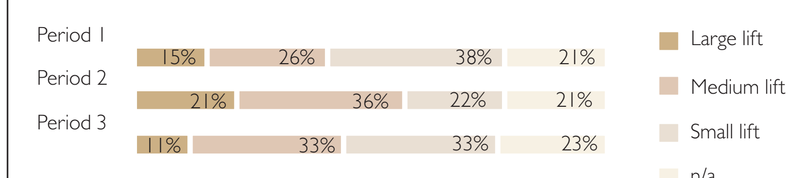
☐ Face Rock Ratio



☐ Rustication



☐ Lift Interval



Findings

- Increase of other elements
- Increase in medium (L3) face rock ratio
- No rustications in period 2

Appendix

HSPV 721 Capstone Studio: Materials + Materialities

Appendix F: Scaled Orthoimage Sheets

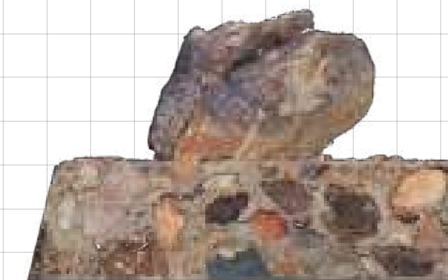
Appendix

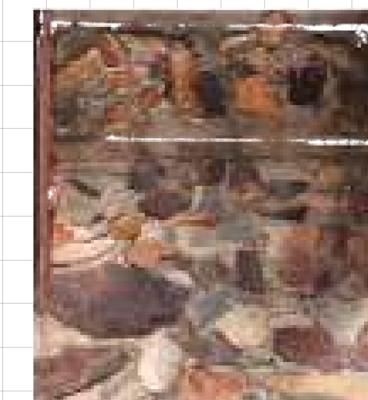
F.1 Period 1 Orthoimages Sheet


1-a-Drafting Studio-north piers


2-a-WWP-old knee wall


4-a-Drafting Studio-vault exterior wall

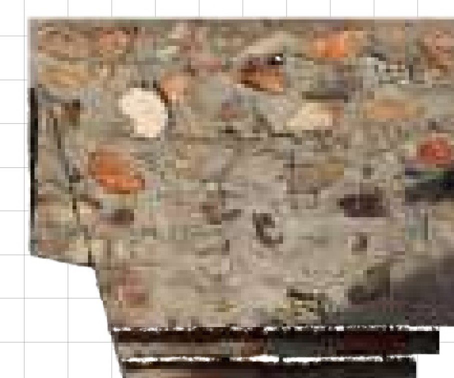

5-a-Drafting Studio-west knee wall


6-a-Drafting Studio-south wall


7-a-Drafting Studio- vault interior wall

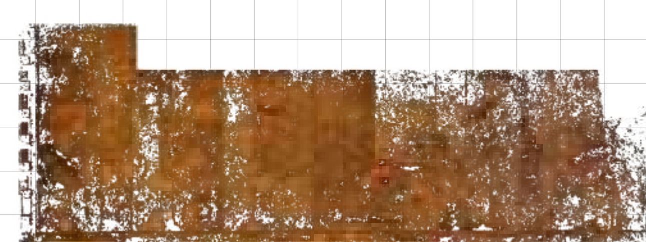

8-a-Kitchen-wall

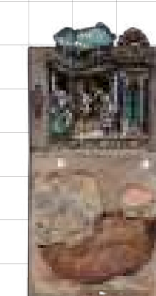

10-a-Apprentice Court-wall

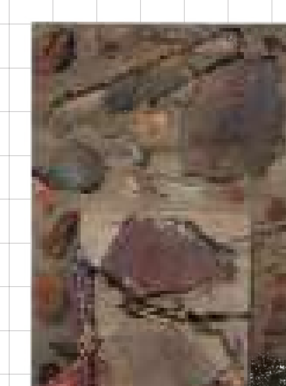

11-a-Kiva-wall


27&28-a&c-Sun Cottage-fireplace & wall


33-a-Living Quater-entrance


36-a-Kiva-ceiling (not in scale)

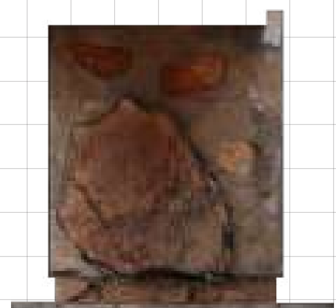

37-a-Bell Tower-ceramics


38-a-Light Tower (not in scale)

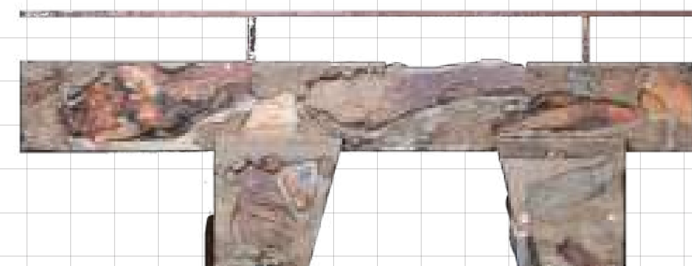
Period 1: 1938-1945

HSPV 721 Capstone Studio: Materials + Materialities

F.2 Period 2 Orthoimages Sheet


12-b-Bridge-pier north


13-b-Bridge-pier west


14-b-Bridge-wall

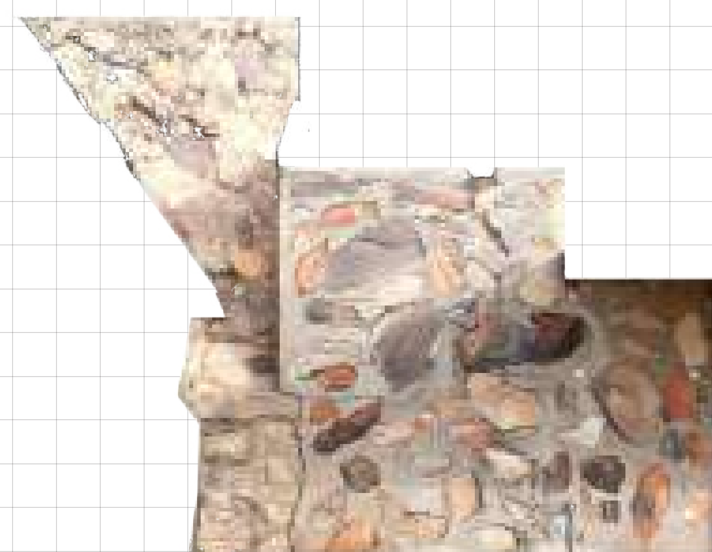

16-b-Pavilion-stage wall


18-b-Cabrate-ceiling


19-b-Cabrate-knee wall

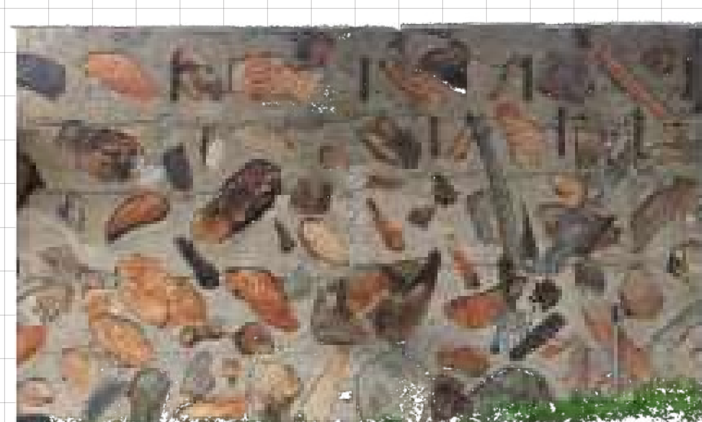

20-b-Cabrate-roof beam


21-b-Men's Locker Room-wall


27&28-a&c-Sun Cottage-fireplace & wall


30-c-Apprentice Court-pool wall


31-b-Water Tower-wall


34-b-Pavalion-exterior wall

0 2' 4' 8'

Period 2: 1946-1959

Appendix

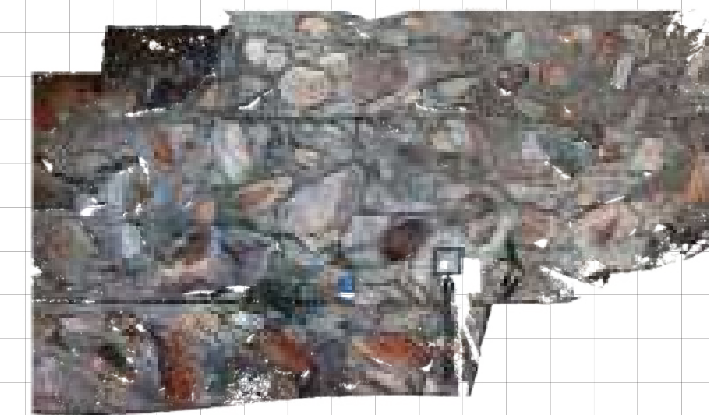
HSPV 721 Capstone Studio: Materials + Materialities

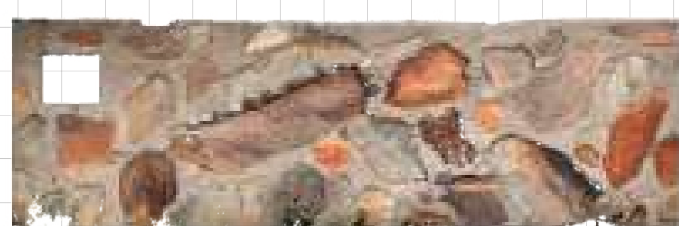
F.3 Period 3 Orthoimages Sheet


3-c-WWP-new knee wall


9-c-Garden Square-knee wall


22-c-Reading Room-wall


23-c-Bookstore-wall (not in scale)


24-c-Kiva-knee wall


25-c-Admin Office-outer wall


26-c-Admin Office-inner wall


29-c-Bridge to Sun Cottage

Period 3: 1960-now

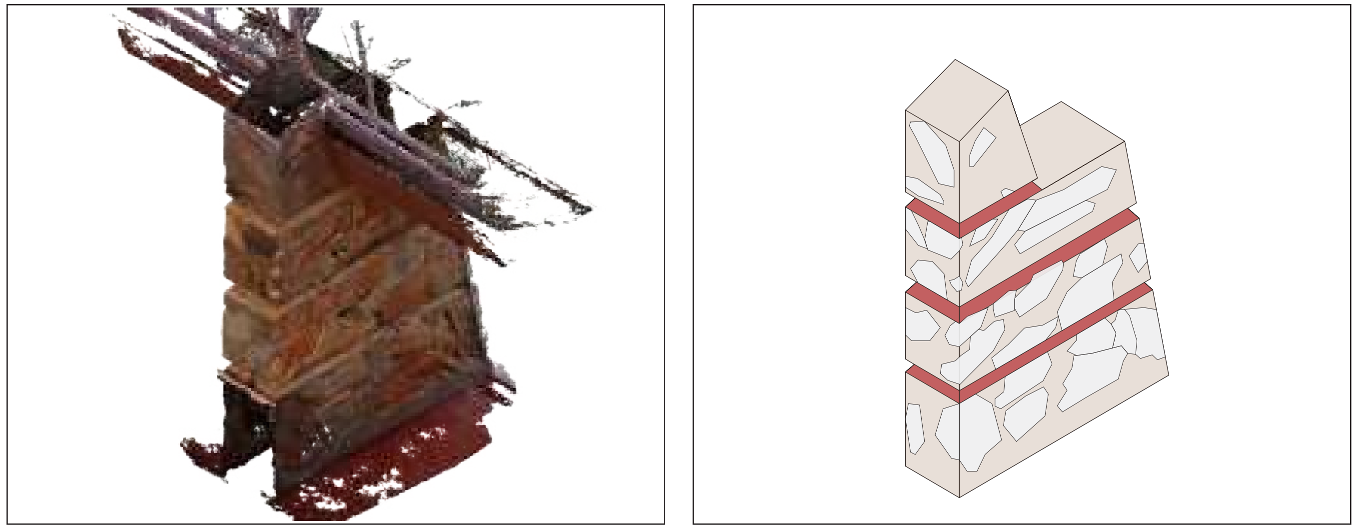
Appendix

HSPV 721 Capstone Studio: Materials + Materialities

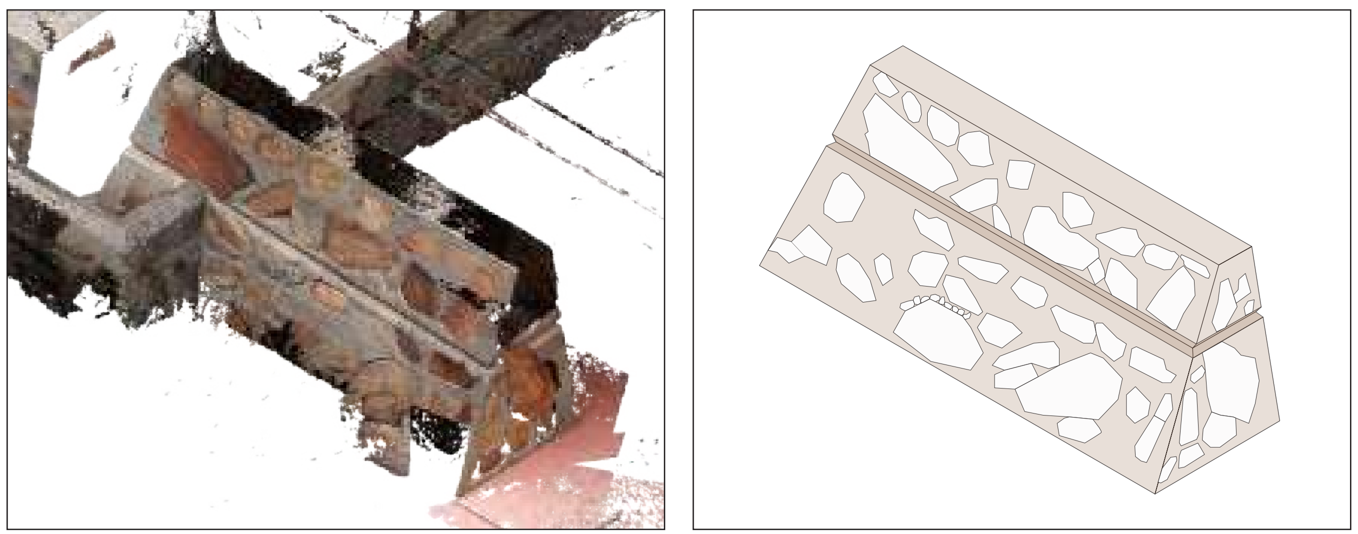
Appendix G: Survey Area Isometric Diagrams

Appendix

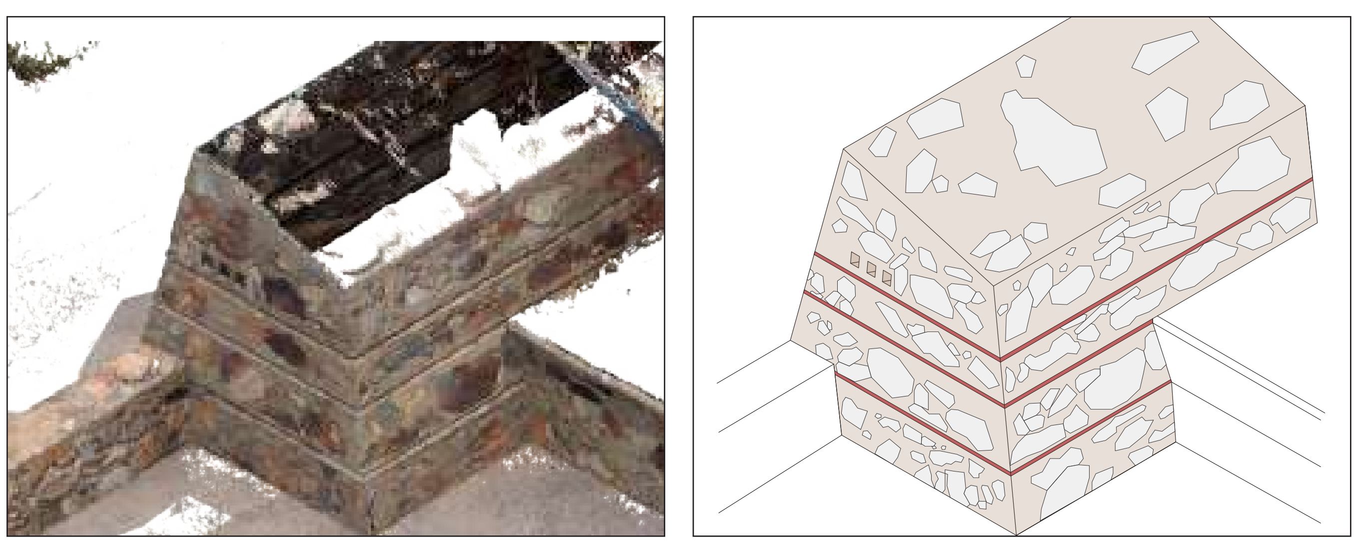
HSPV 721 Capstone Studio: Materials + Materialities



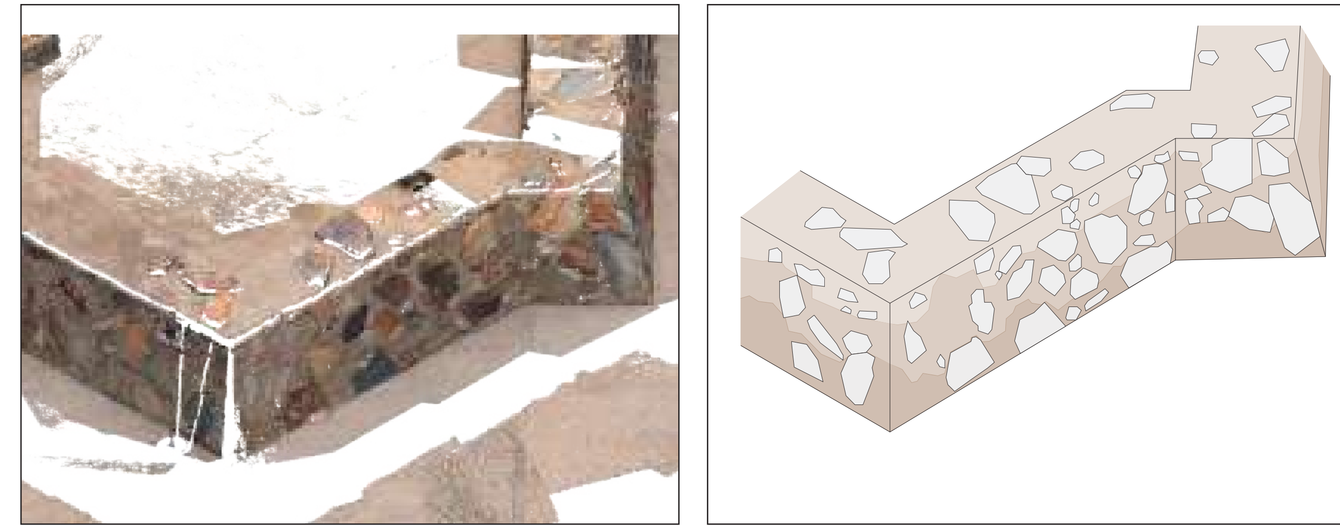
1-a-Drafting Studio-north piers



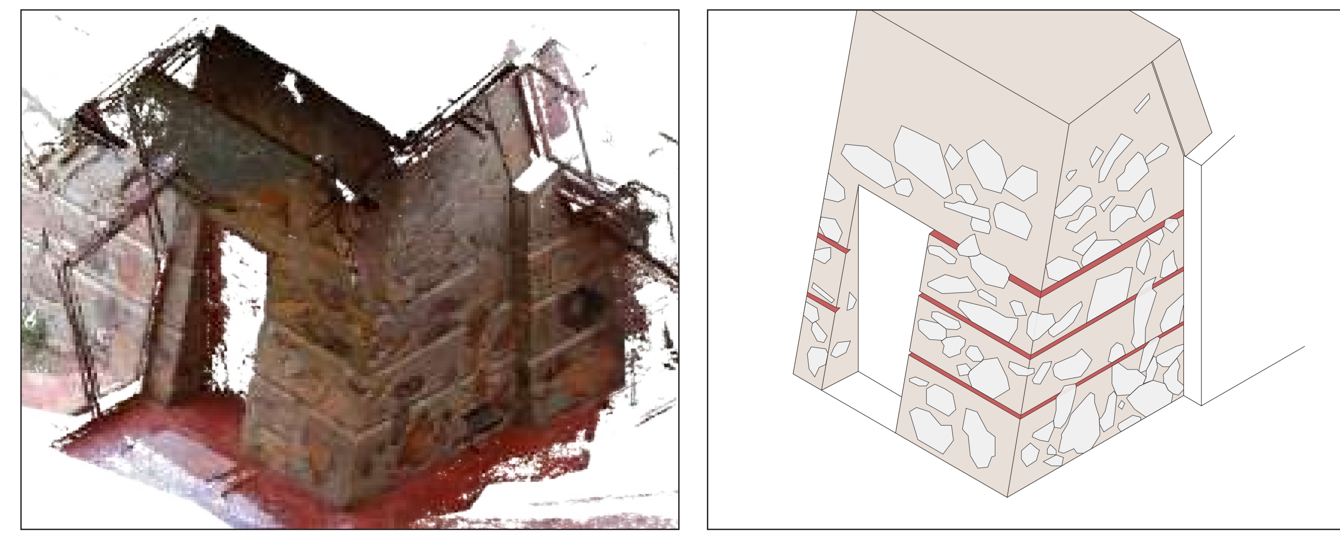
3-c-WWP-new knee wall



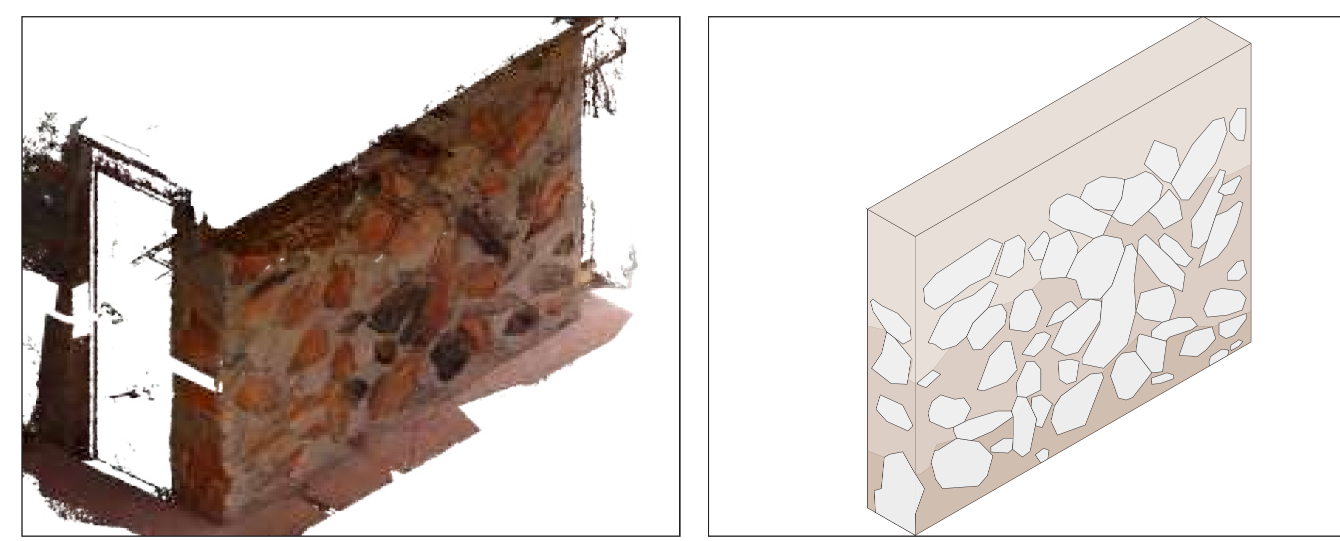
4-a-Drafting Studio-vault exterior wall



5-a-Drafting Studio-west knee wall

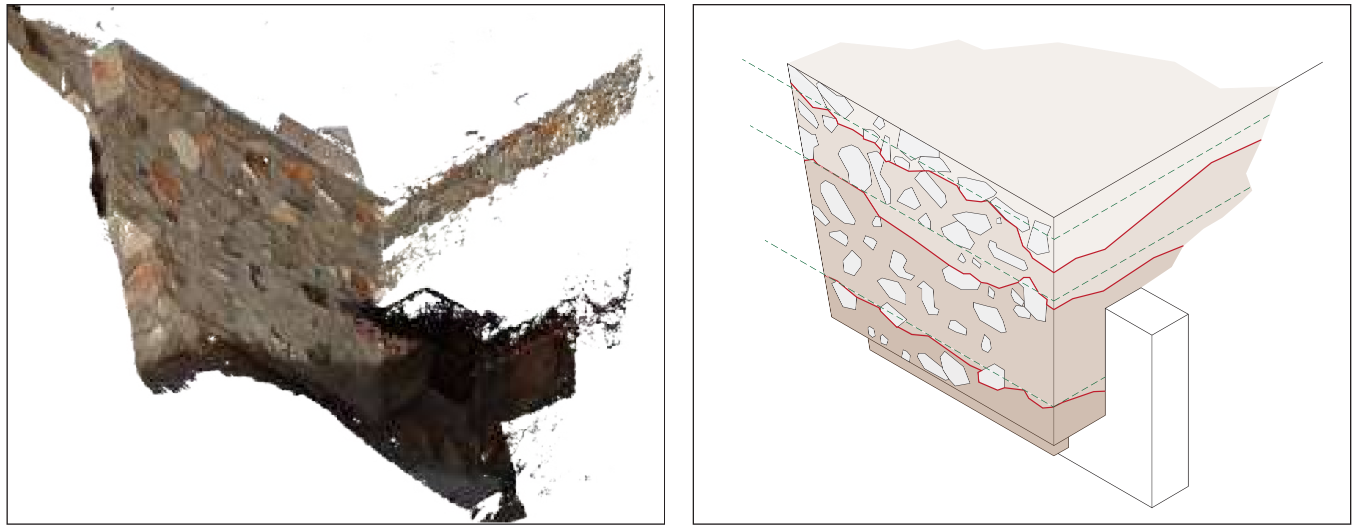


7-a-drafting studio-vault interior wall

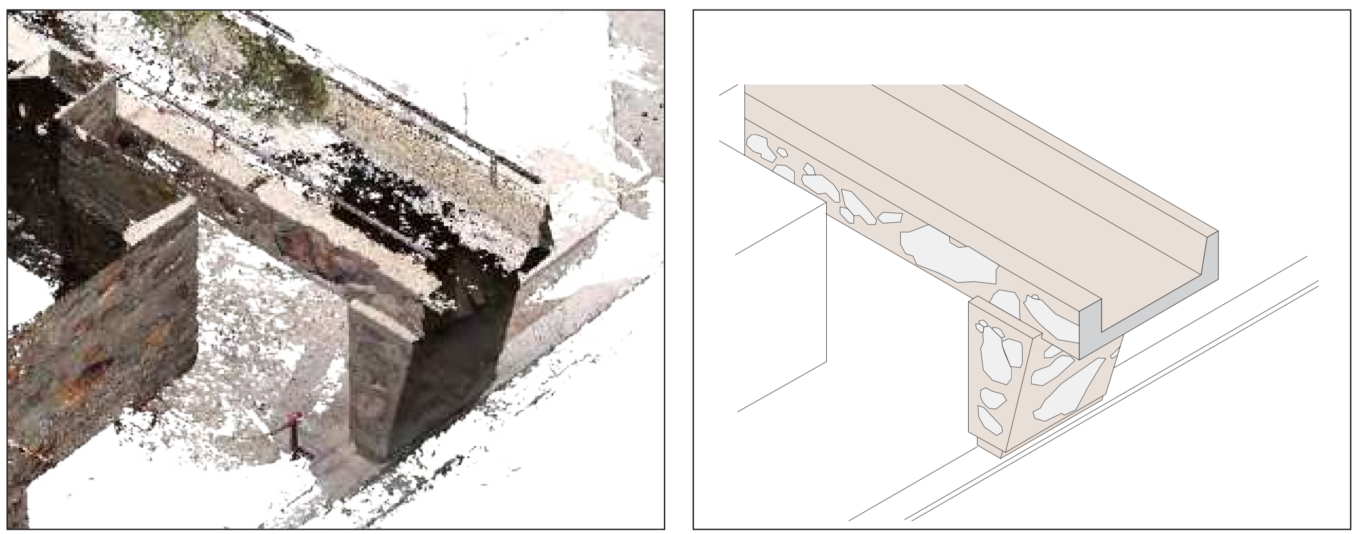


10-a-Apprentice Court-wall

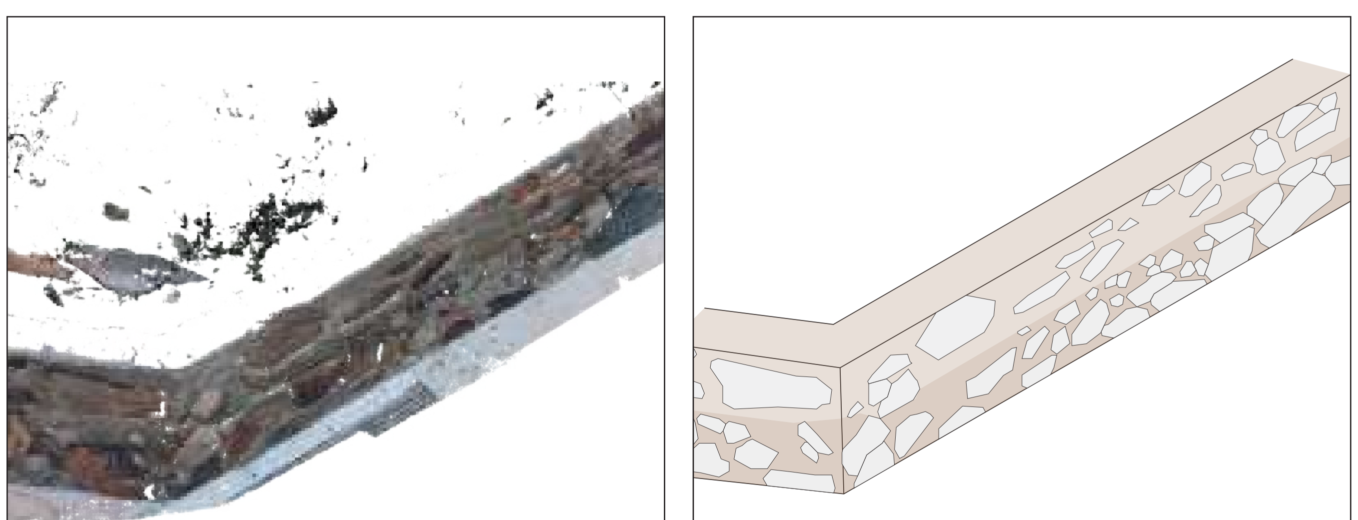
Appendix



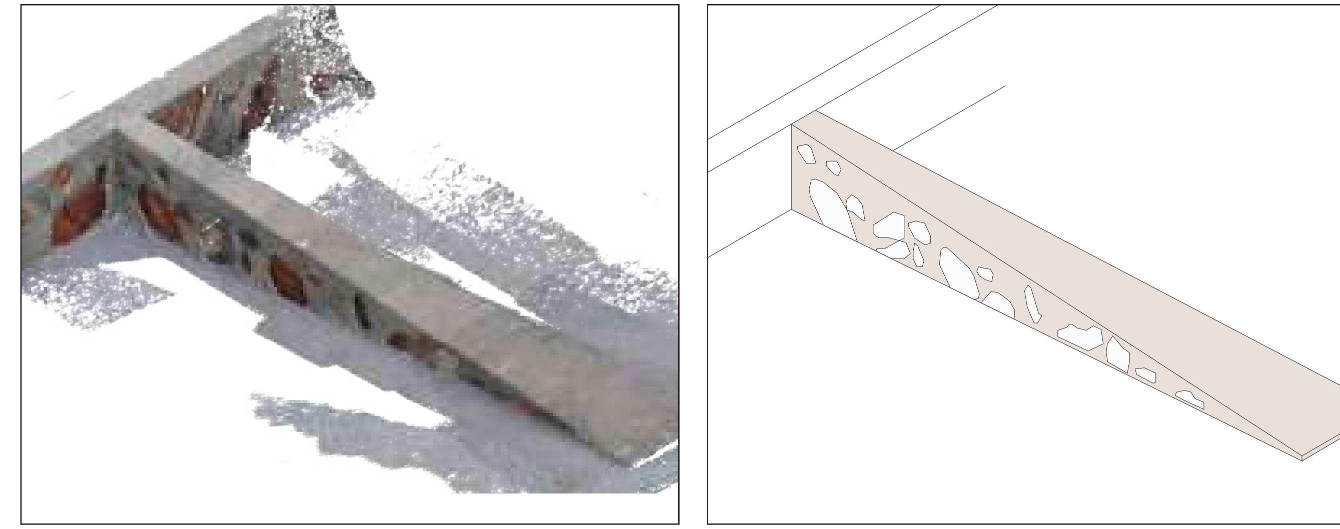
11-a-Kiva-wall



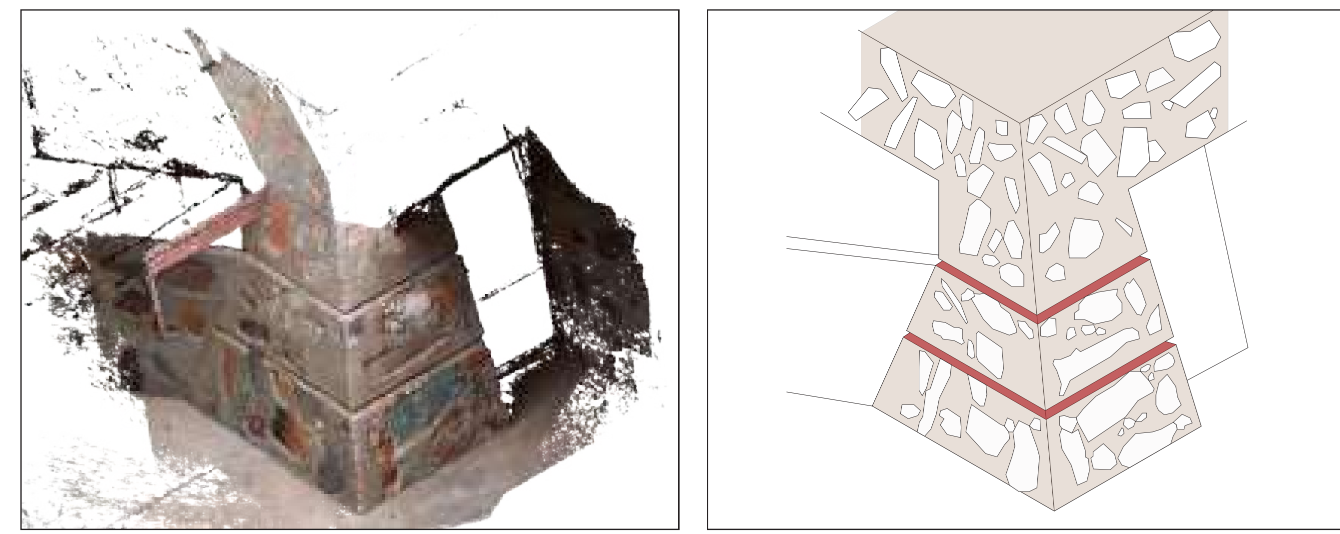
12-b-Bridge-pier north



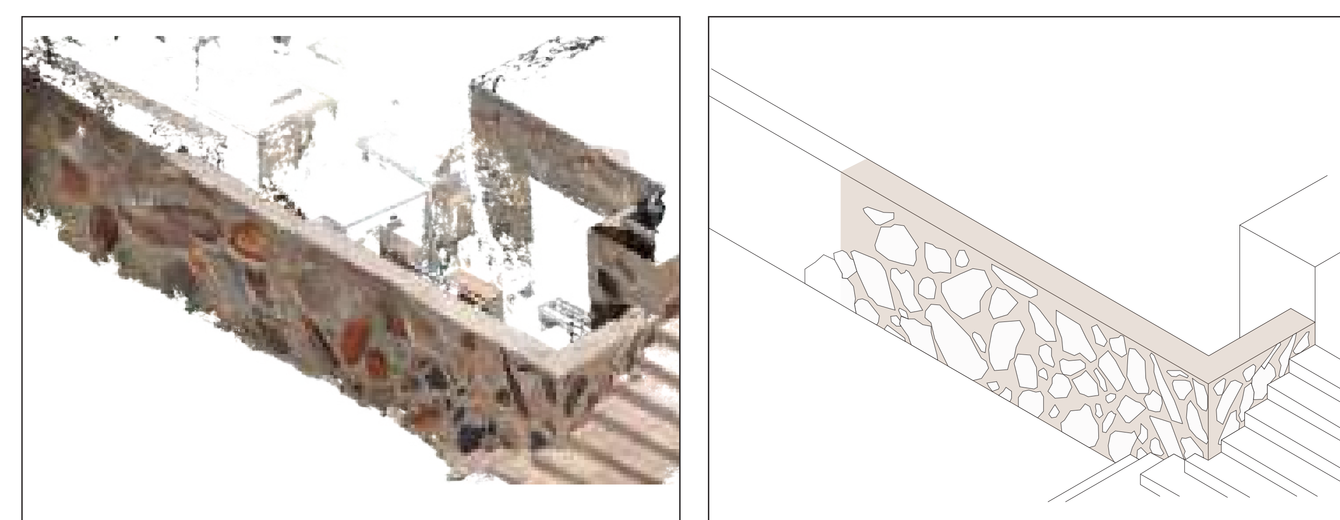
19-b-Cabrate-knee wall



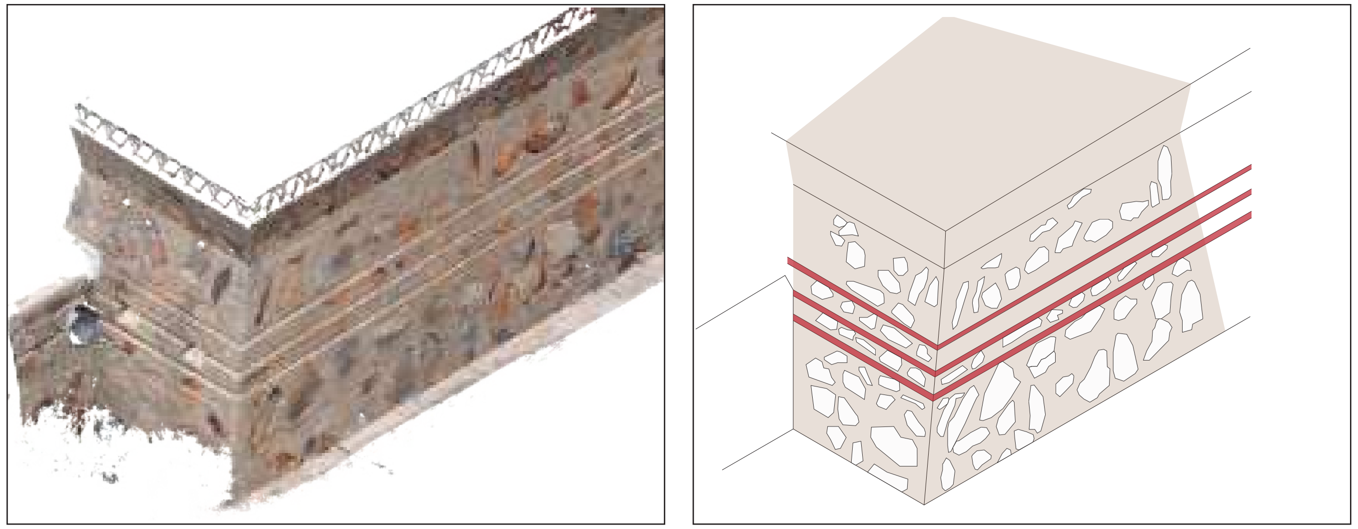
20-b-Cabrate-roof beam



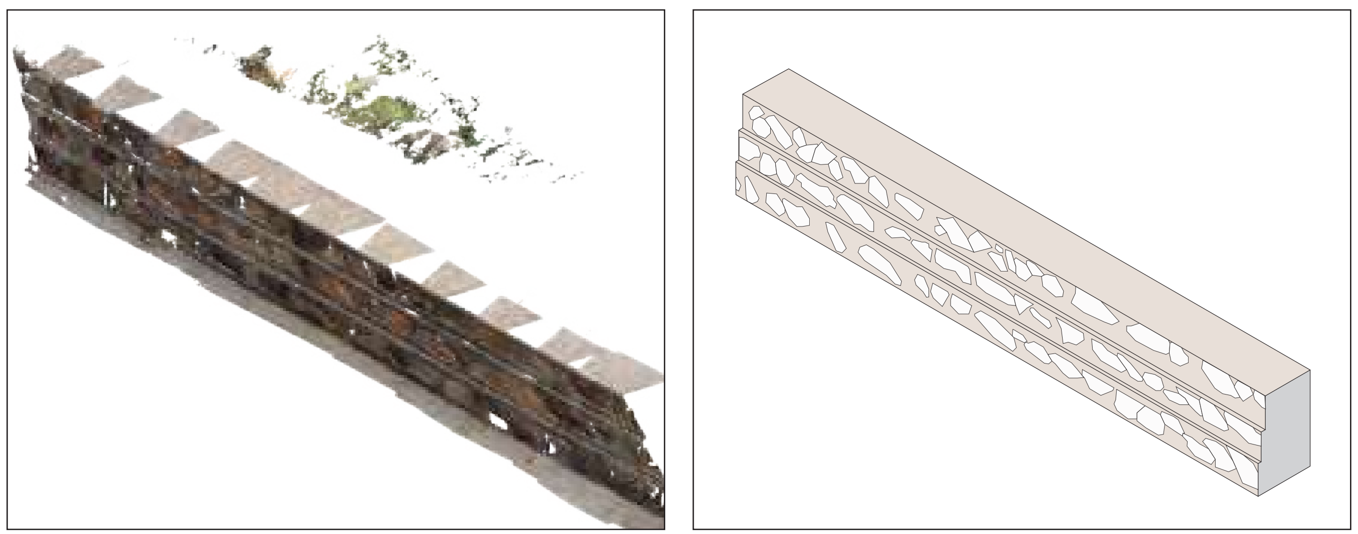
22-c-Reading Room-wall



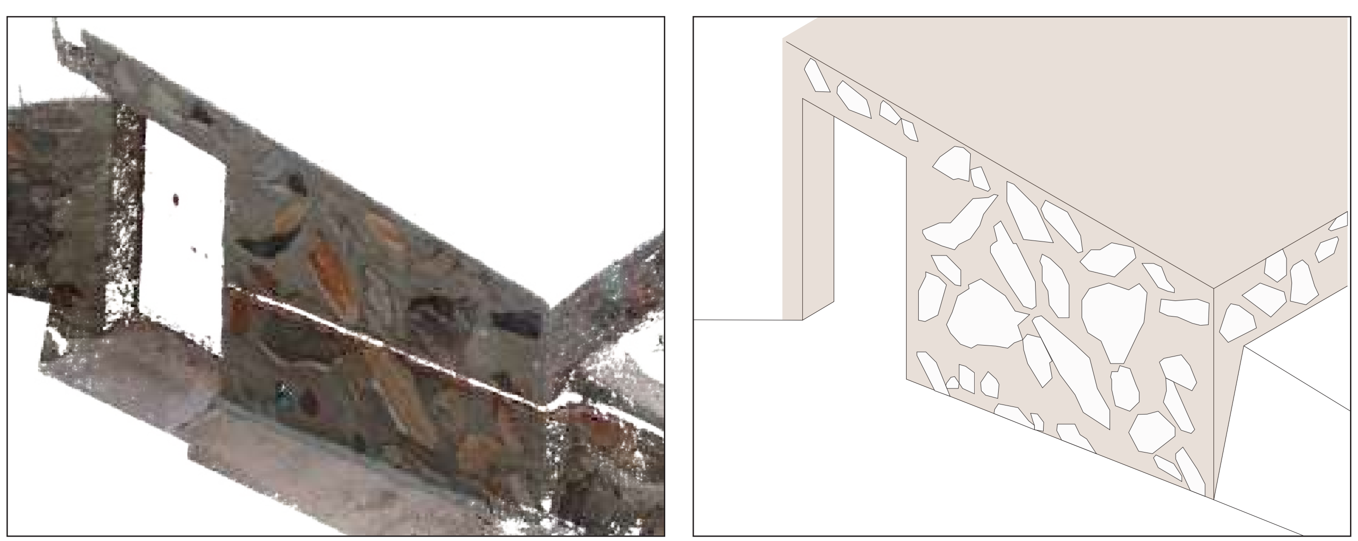
24-c-Kiva-knee wall



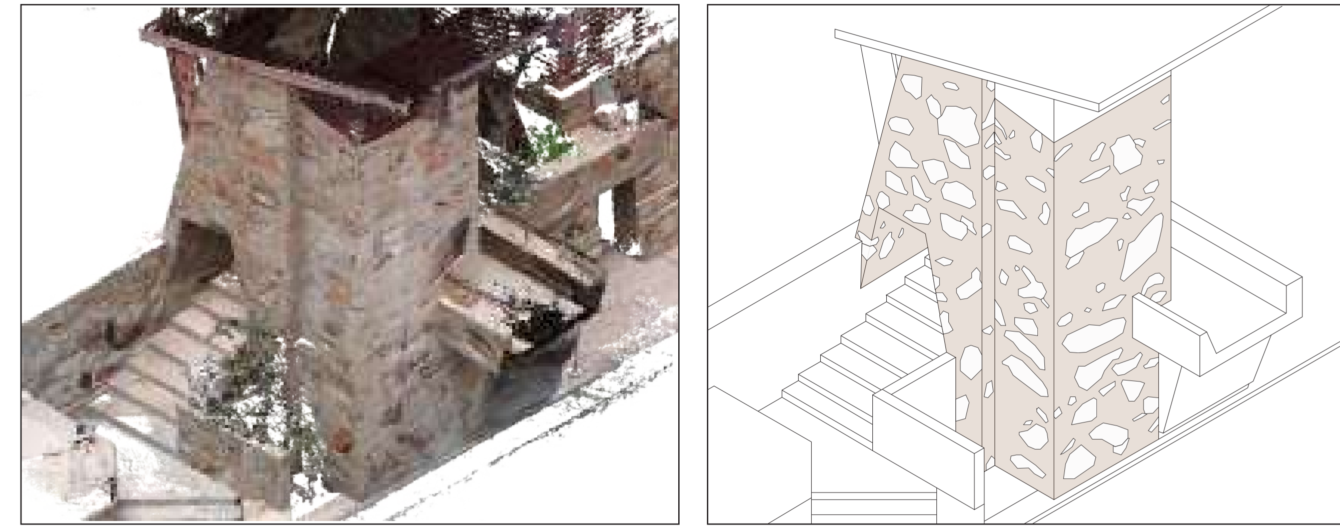
25-c-Admin Office-outer wall



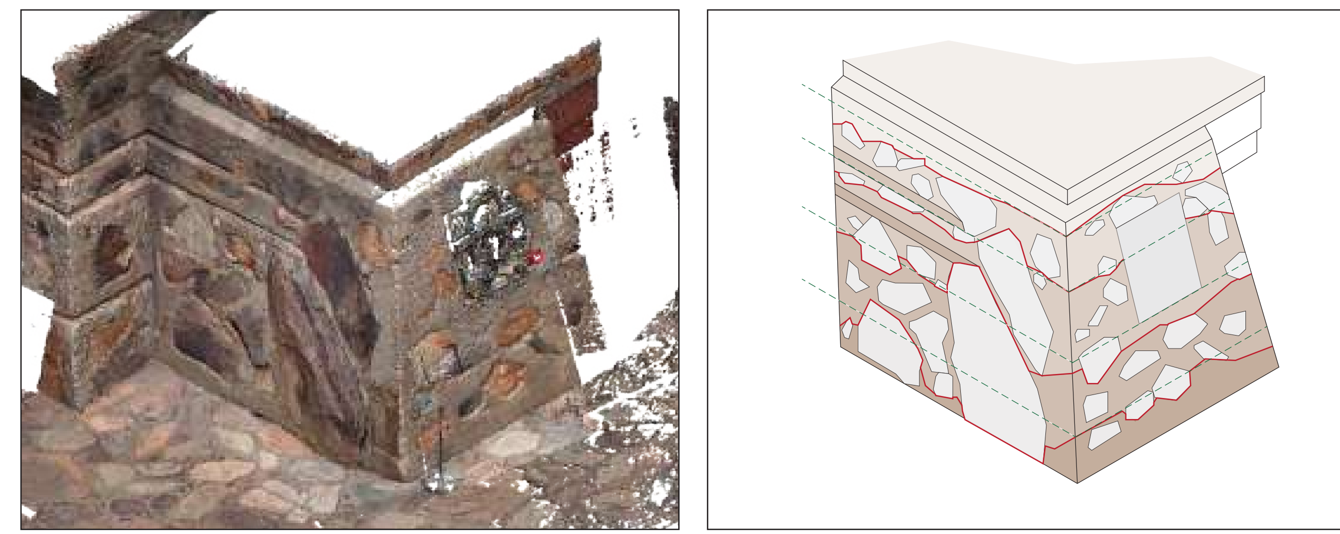
29-c-Bridge to Sun Cottage



30-c-Apprentice Court-pool wall



31-b-Water Tower-wall



33-a-Living Quater-entrance

HSPV 721 Capstone Studio: Materials + Materialities

Appendix H: Surface Area Calculation Results

Appendix

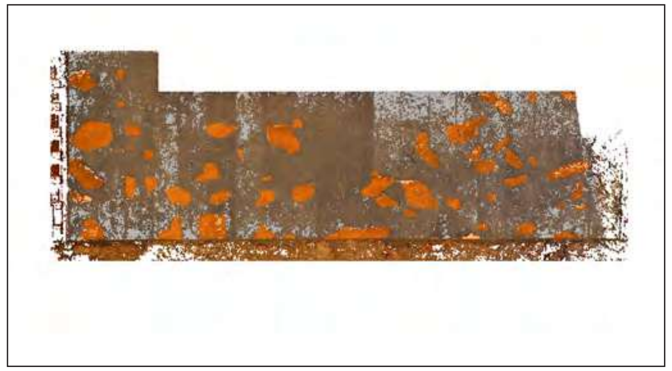
HSPV 721 Capstone Studio: Materials + Materialities

G.1 Surface Area of Face Rocks Calculations

	Survey area	Percentage of stone surface area	Construction year	Period	Element
1	1-a-Drafting Studio-north piers	47.7%	1939	period 1: 1938-1945	Massive walls/piers
2	2-a-WWP-old knee wall	42.9%	1939	period 1: 1938-1945	Knee wall
4	4-a-Drafting Studio-vault exterior wall	43.8%	1939	period 1: 1938-1945	Massive walls/piers
5	5-a-Drafting Studio-west knee wall	52.5%	1939	period 1: 1938-1945	Massive walls/piers
6	6-a-Drafting Studio-south wall (lower area)	60.7%	1939	period 1: 1938-1945	Massive walls/piers
7	7-a-Drafting Studio- vault interior wall	43.4%	1939	period 1: 1938-1945	Massive walls/piers
8	8-a-Kitchen-wall	38.3%	1939	period 1: 1938-1945	Massive walls/piers
27	27-a-Sun Cottage fireplace	34.0%	1939	period 1: 1938-1945	Massive walls/piers
11	11-a-Kiva-wall	30.2%	1940	period 1: 1938-1945	Massive walls/piers
32	32-a-Living Quater-pavement	71.5%	1940	period 1: 1938-1945	Pavement/Floors
33	33-a-Living Quater-entrance	53.4%	1940	period 1: 1938-1945	Massive walls/piers
36	36-b-Kiva ceiling	17.5%	1940	period 1: 1938-1945	Ceilings/Roof
37	37-a-Bell Tower-ceramics	42.4%	1940	period 1: 1938-1945	Free-standing
38	38-a-Light Tower	50.8%	1940	period 1: 1938-1945	Free-standing
10	10-a-Apprentice Court-wall	55.3%	1941	period 1: 1938-1945	Massive walls/piers
12	12-b-Bridge-pier north	46.6%	1947	period 2: 1946-1959	Massive walls/piers
13	13-b-Bridge-pier west	40.1%	1947	period 2: 1946-1959	Massive walls/piers
14	14-b-Bridge-wall	51.7%	1947	period 2: 1946-1959	Knee wall
28	28-c-Sun Cottag wall	49.2%	1947	period 2: 1946-1959	Massive walls/piers
31	31-b-Water Tower-wall	31.7%	1947	period 2: 1946-1959	Free-standing
18	18-b-Cabrate-ceiling	28.4%	1950	period 2: 1946-1959	Ceilings/Roof
19	19-b-Cabrate-knee wall	53.0%	1950	period 2: 1946-1959	Knee wall
20	20-b-Cabrate-roof beam	34.6%	1950	period 2: 1946-1959	Beams
21	21-b-Men's Locker Room-wall	57.4%	1952	period 2: 1946-1959	Massive walls/piers
16	16-b-Pavilion-stage wall	66.5%	1957	period 2: 1946-1959	Massive walls/piers
34	34-b-Pavalion-exterior wall	45.1%	1957	period 2: 1946-1959	Massive walls/piers
30	30-c-Apprentice Court-pool wall	41.2%		period 2: 1946-1959	Massive walls/piers
25	25-c-Admin Office-outer wall (lower part)	32.1%	1970	period 3: 1960-now	Massive walls/piers
26	26-c-Admin Office-inner wall	49.0%	1970	period 3: 1960-now	Knee wall
3	3-c-WWP-new knee wall	52.6%	1972	period 3: 1960-now	Knee wall
22	22-c-Reading Room-wall	38.4%	1980	period 3: 1960-now	Massive walls/piers
23	23-c-Bookstore-wall	44.3%	1985	period 3: 1960-now	Massive walls/piers
9	9-c-Garden Square-knee wall	59.4%		period 3: 1960-now	Knee wall
24	24-c-Kiva-knee wall	61.1%		period 3: 1960-now	Knee wall
29	29-c-Bridge to Sun Cottage	48.2%		period 3: 1960-now	Knee wall

Appendix

G.2 Surface Area Ratio of Face Rocks - Type 1 (0-38%)

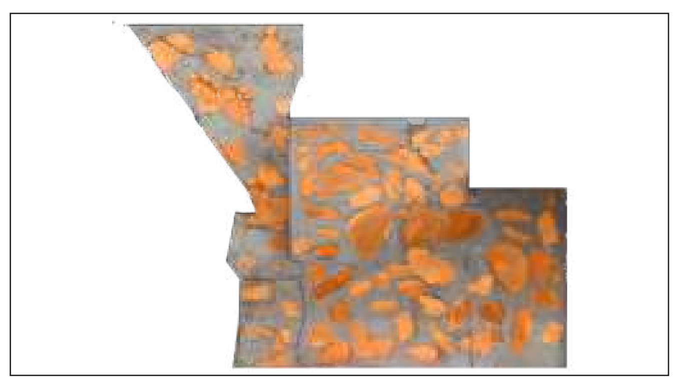

36-a-Kiva-ceiling


18-b-Cabaret-ceiling


11-a-Kiva-wall


31-b-Water Tower-wall


25-c-Admin Office-outer wall

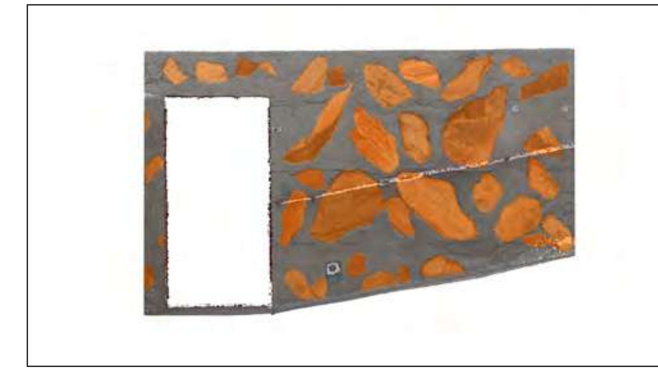

27-a-Sun Cottage-fireplace


20-b-Cabaret-roof beam


22-c-Reading Room-wall

G.2 Surface Area Ratio of Face Rocks - Type 2 (39%-43%)

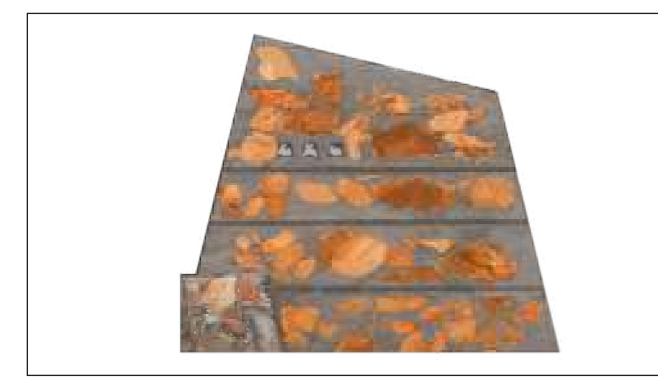

13-b-Bridge-pier west


30-c-Apprentice Court-pool wall

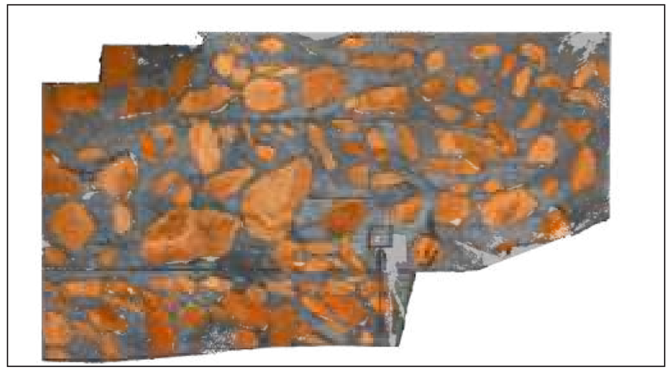

37-a-Bell Tower-ceramics


2-a-WWP-old knee wall

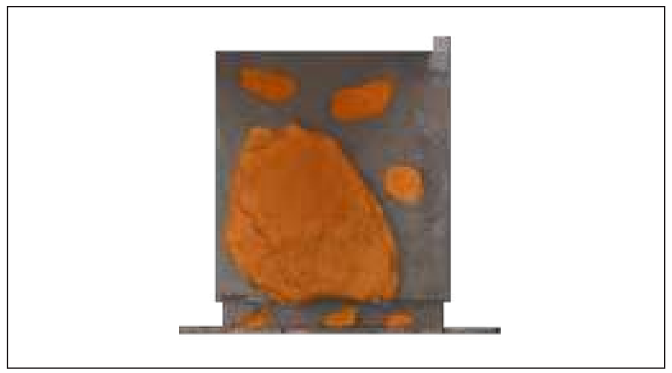

7-a-Drafting Studio- vault interior wall


4-a-Drafting Studio-vault exterior wall

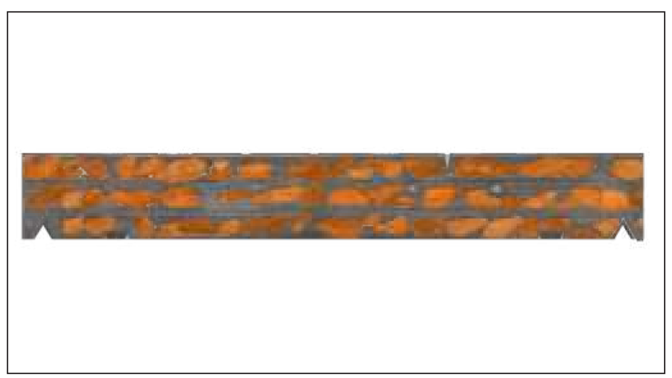
G.2 Surface Area Ratio of Face Rocks - Type 3 (44%-49%)


23-c-Bookstore-wall


34-b-Pavalion-exterior wall


12-b-Bridge-pier north


1-a-Drafting Studio-north piers

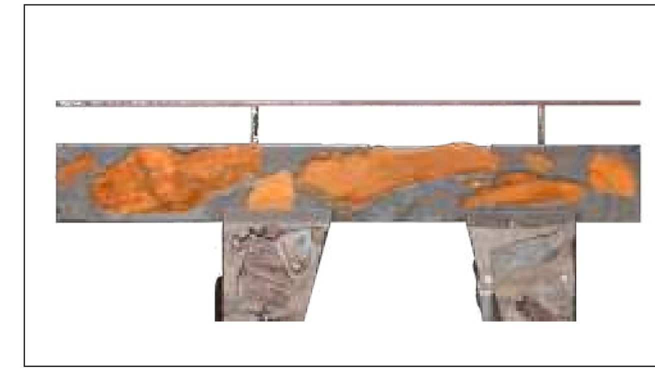

29-c-Bridge to Sun Cottage


26-c-Admin Office-inner wall


28-c-Sun Cottag wall

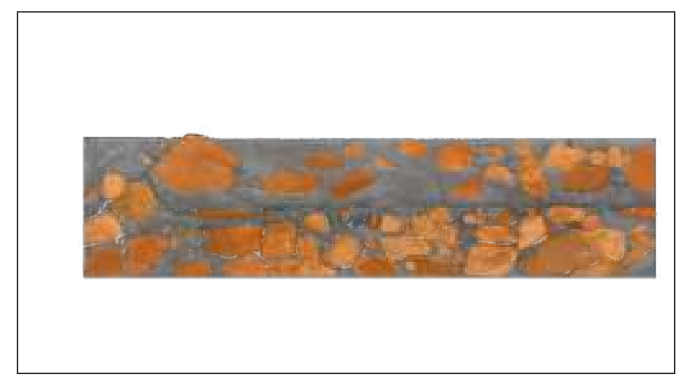
G.2 Surface Area Ratio of Face Rocks - Type 4 (50%-55%)


38-a-Light Tower


14-b-Bridge-wall


5-a-Drafting Studio-west knee wall


3-c-WWP-new knee wall

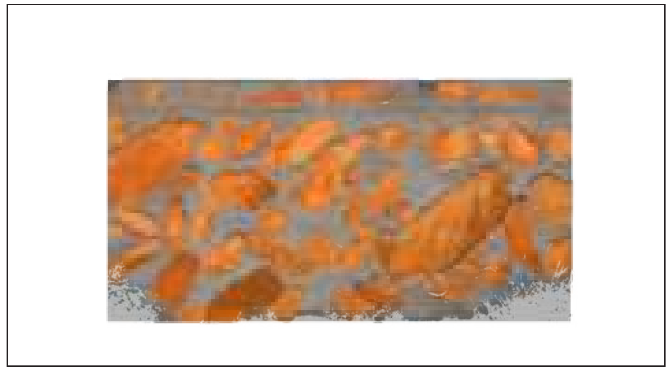

19-b-Cabaret-knee wall

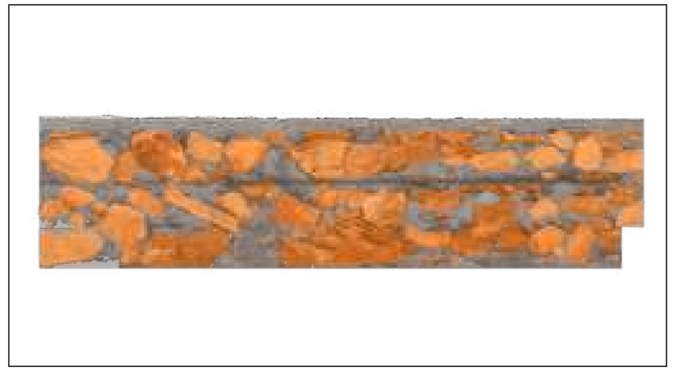

33-a-Living Quarter-entrance


10-a-Apprentice Court-wall

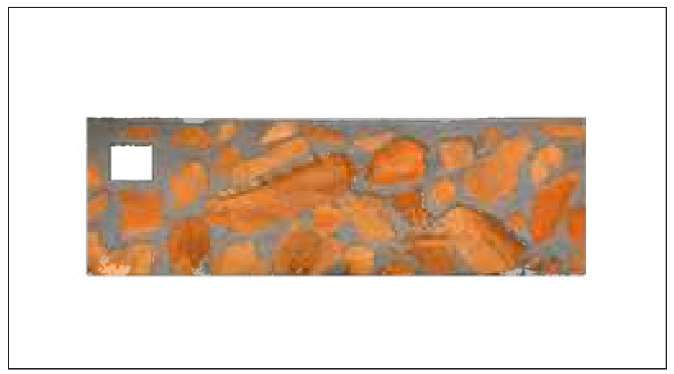
HSPV 721 Capstone Studio: Materials + Materialities

G.2 Surface Area Ratio of Face Rocks - Type 5 (56%-100%)


21-b-Men's Locker Room-wall


9-c-Garden Square-knee wall


6-a-Drafting Studio-south wall (lower area)


24-c-Kiva-knee wall


16-b-Pavilion-stage wall


32-a-Living Quarter-pavement

Appendix

HSPV 721 Capstone Studio: Materials + Materialities

Appendix I: Kiva-Bridge Repotograph

Appendix

Kiva and bridge, 1947

(Source: Taliesin Fellowship – Pedro E. Guerrero. https://guerrerophoto.com/portfolio/taliesin-fellowship/.)

Kiva and bridge, now

(Source: photo taken by authors)

(Source: Scott, William Blair. "75 Years at Taliesin West." Journal of Organic Architecture + Design Volume 1, Issue 1 (2013).)

(Source: photo taken by authors)

HSPV 721 Capstone Studio: Materials + Materialities

Figure 7-102 - Original Kiva Bridge, ca. 1942 (The Frank Lloyd Wright Foundation Archives, The Museum of Modern Art | Avery Architectural & Fine Arts Library, Columbia University, New York).

(Source: Gunny Harboe Architects. Taliesin West Preservation Master Plan (October 2015).)

Kiva bridge, now

(Source: photo taken by authors)

Kiva, 1950

(Source: Gunny Harboe Architects. Taliesin West Preservation Master Plan (October 2015).)

Kiva, now

(Source: photo taken by authors)

HSPV 721 Capstone Studio: Materials + Materialities

(Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection)

(Source: photo taken by authors)

May 1955

(Source: Scott, William Blair. "75 Years at Taliesin West." Journal of Organic Architecture + Design Volume 1, Issue 1 (2013).)

Now

(Source: photo taken by authors)

Water tower, 1948-1949

(Source: Taliesin West Archive, "Construction Taliesin West" historic photo collection)

Water tower, 1950

(Source: Scott, William Blair. "75 Years at Taliesin West." Journal of Organic Architecture + Design Volume 1, Issue 1 (2013).)

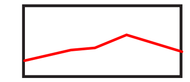
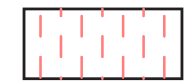
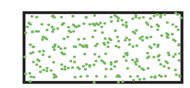
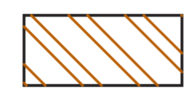
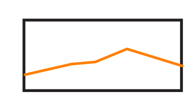
Water tower, now

(Source: photo taken by authors)

Appendix

HSPV 721 Capstone Studio: Materials + Materialities

Appendix J: Condition Glossary

Condition	Symbology		Description	Reference Image
Cracks		CR_03	Cracks larger than 3/16” in concrete surface.	
Loss		LO	Reduction or removal of the surface layer of concrete due to erosion, abrasion, or chemical attack.	
Efflorescence		EF	Crystalline deposits resulting from the evaporation of water from a salt solution, which can form on the surface of a porous material exposed to air.	
Honeycombing		HO	Small voids in the concrete surface, usually the result of poor mixing or compaction.	
Previous Repairs		PR	Small voids in the concrete surface	
Cold Joint		CD	A visible line or discontinuity in the surface of the concrete where two successive pours of concrete meet	

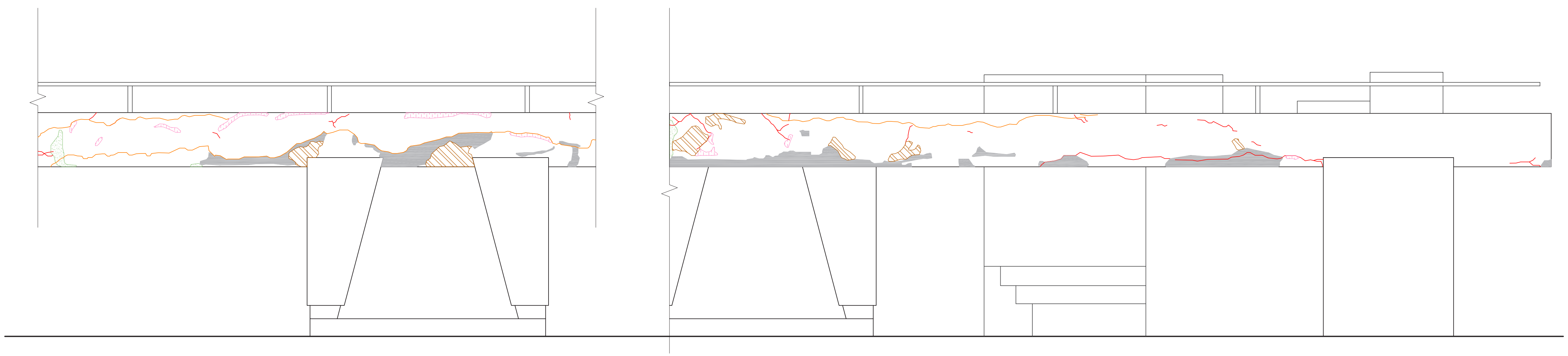
Appendix

HSPV 721 Capstone Studio: Materials + Materialities

Appendix K: Condition Drawings

Appendix

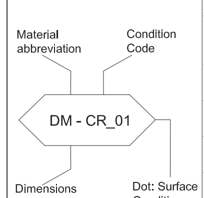
 HSPV 721 Capstone Studio: Materials + Materialities



BRIDGE WEST ELEVATION

BRIDGE EAST ELEVATION

CONDITIONS LEGEND



MATERIAL	ABB.	HATCH	CODE	CONDITION TYPE	NOTES
DESERT MASONRY	DM		CR_02	SLIGHT CRACK	
REINFORCED CONCRETE	RCC		CR_03	LARGE CRACK	
WOOD	WD		SP	SPALLING	
METAL	MT		ER	EROSION	
			LO	LOSS	
			EF	EFFLORESCENCE	
			HO	HONEYCOMBING	
			PR	PREVIOUS REPAIRS	
CONDITION TYPE	CODE		CD	COLD JOINT	
EXISTING HARDWARE	EA		SC	SCALING	
ELECTRICAL FIXTURE	EL		ST	STAINING	
PLUMBING	PL		WI	WATER INFILTRATION	
			DE	DELAMINATION	
			CR_01	HAIRLINE CRACK	
			CZ	CRAZING	

KEY PLAN

HSPV 7210: CAPSTONE STUDIO

SPRING 2023

HISTORIC PRESERVATION PROGRAM
WEITZMAN SCHOOL OF DESIGN
UNIVERSITY OF PENNSYLVANIA

TALIESIN WEST
KIVA-BRIDGE CONDITION MAPPING
SCOTTSDALE, AZ

GROUP MEMBERS:
YING WANG
QIANHUI NI

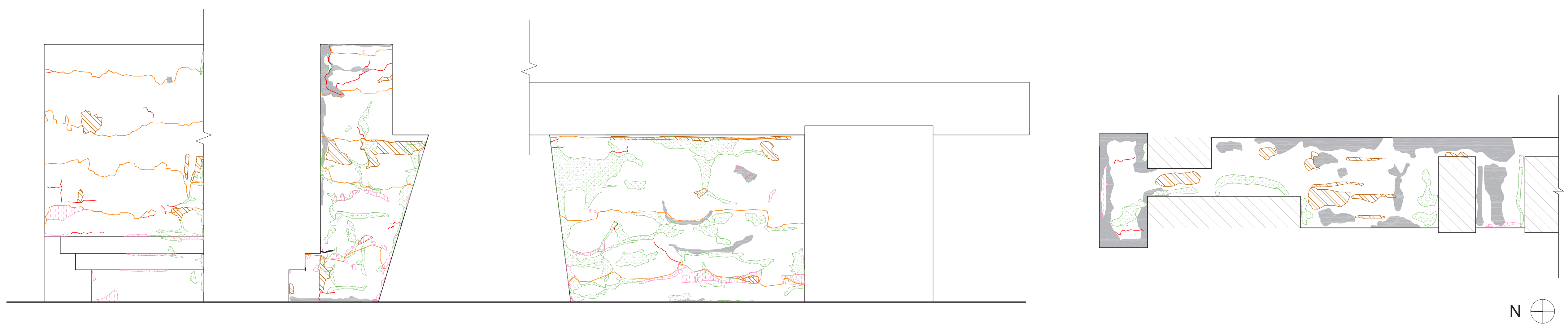
CONDITIONS_ASSESSMENT BRIDGE_ELEVATION

DRAWN BY: QIANHUI_NI
DATE: 04/23/2023
SCALE: 1/8"=1'-0

SHEET_NO.1

 Appendix

HSPV 721 Capstone Studio: Materials + Materialities



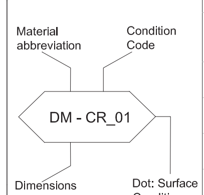
KIVA EAST ELEVATION

KIVA EAST ADDITION SOUTH ELEVATION

KIVA EAST ADDITION WEST ELEVATION

BRIDGE SLAB UNDERSIDE PLAN

CONDITIONS LEGEND



MATERIAL	ABB.
DESERT MASONRY	DM
REINFORCED CONCRETE	RCC
WOOD	WD
METAL	MT

CONDITION TYPE	CODE
EXISTING HARDWARE	EA
ELECTRICAL FIXTURE	EL
PLUMBING	PL

HATCH	CODE	CONDITION TYPE	NOTES
	CR_02	SLIGHT CRACK	
	CR_03	LARGE CRACK	
	SP	SPALLING	
	ER	EROSION	
	LO	LOSS	
	EF	EFFLORESCENCE	
	HO	HONEYCOMBING	
	PR	PREVIOUS REPAIRS	
	CD	COLD JOINT	
	SC	SCALING	
	ST	STAINING	
	WI	WATER INFILTRATION	
	DE	DELAMINATION	
	CR_01	HAIRLINE CRACK	
	CZ	CRAZING	

KEY PLAN

HSPV 7210: CAPSTONE STUDIO

SPRING 2023

HISTORIC PRESERVATION PROGRAM
WEITZMAN SCHOOL OF DESIGN
UNIVERSITY OF PENNSYLVANIA

TALIESIN WEST
KIVA-BRIDGE CONDITION MAPPING
SCOTTSDALE, AZ

GROUP MEMBERS:
YING WANG
QIANHUI NI

CONDITIONS_ASSESSMENT
KIVA_ELEVATION&BRIDGE_SLAB

DRAWN BY: YING_WANG
DATE: 04/23/2023
SCALE: 1/8"=1'-0

SHEET_NO.2

Appendix

HSPV 721 Capstone Studio: Materials + Materialities

Appendix L: Concrete Sample Analysis

Appendix

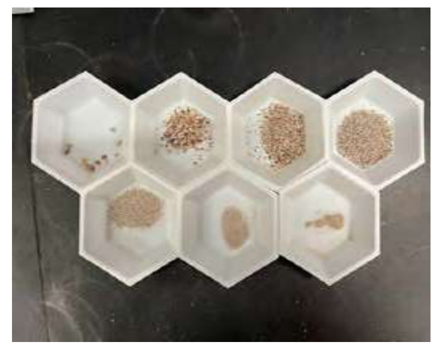
HSPV 721 Capstone Studio: Materials + Materialities

Desert Masonry at Taliesin West

Condition

❏ Gravimetric Analysis by Acid Digestion

Sample 06 Vault exterior wall Period 1



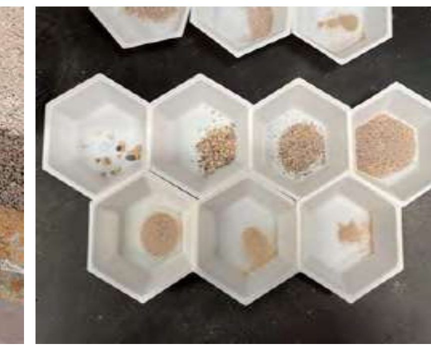
Property	Aggregate	Fines	Soluble
Weight (gr.)	12.1	0.88	4.04
Percentage Total Weight	71.1%	5.2%	23.7%
Volume Ratio (portland cement : sand)	1 : 2.8		

Desert Masonry at Taliesin West

Condition

❏ Gravimetric Analysis by Acid Digestion

Sample 16 Cabaret roof beam Period 2

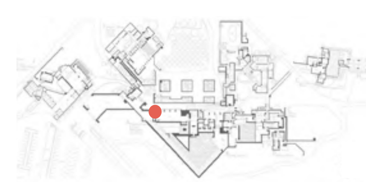


Property	Aggregate	Fines	Soluble
Weight (gr.)	6.9	0.35	2.11
Percentage Total Weight	73.7%	3.7%	22.6%
Volume Ratio (portland cement : sand)	1 : 3.5		

Desert Masonry at Taliesin West

Condition

❏ Gravimetric Analysis by Acid Digestion



Sample 06 Vault exterior wall Period 1

Property	Aggregate	Fines	Soluble
Weight (gr.)	12.1	0.88	4.04
Percentage Total Weight	71.1%	5.2%	23.7%
Volume Ratio (portland cement : sand)	1 : 2.8		

Desert Masonry at Taliesin West

Condition

❏ Gravimetric Analysis by Acid Digestion

Sample 17 Bookstore knee wall Period 3

Property	Aggregate	Fines	Soluble
Weight (gr.)	8.7	0.67	2
Percentage Total Weight	76.5%	5.9%	17.6%
Volume Ratio (portland cement : sand)	1 : 4.3		

Appendix