

CHAPTER 5

Church of Kuño Tambo

5.1 Summary

The Church of Santiago Apóstol—henceforth referred to as the Church of Kuño Tambo—is the most prominent building in Comunidad Campesina Kuño Tambo, a remote village of 500 inhabitants located southeast of the city of Cusco in the province of Acomayo (Fig. 5.1). Owned by the Roman Catholic Archdiocese of Cusco, the church has been in continuous use as a place of worship since its original construction in the seventeenth century, serving a modest agrarian community. Constructed with thick mud brick walls and buttresses over a rubble stone masonry base course and a wood-framed gable roof, the 500 m² church exhibits many of the design features and materials typical of rural churches in the region (Fig. 5.2). The entire church appears to have been constructed at the same time. Although it has been subject to alterations and decay, it appears to have largely retained its original floor plan and mass, as well as many of its original materials. The structure is in fair condition overall. The preliminary findings indicate that the structural performance of the building is compromised by a leaking roof, inadequate or broken connections at the roof framing, the loss of several exterior buttresses, and settlement of the foundations due to the erosion of the site.

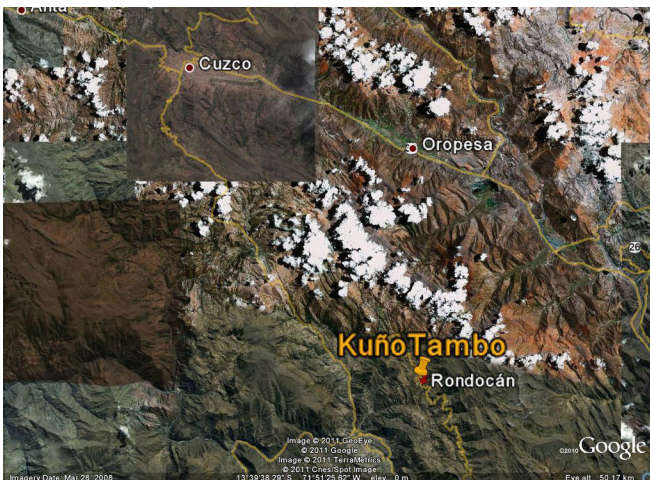


FIGURE 5.1
Satellite image showing the location of Comunidad Campesina Kuño Tambo in relationship to Cusco.
Image: Image © 2011 GeoEye, © 2011 Google, Image © 2011 TerraMetrics, © Cnes/Spot Image.



FIGURE 5.2
Aerial view of the Church of Kuño Tambo, from the southeast.
Image: Wilfredo Carazas, for the GCI.

5.2 Historical Background, Context, and Significance

5.2.1 Historical background and context

The Comunidad Campesina Kuño Tambo is typical of those villages created for the indigenous population in Peru in the sixteenth century under the governance of the Spanish Viceroy Francisco de Toledo.¹ The first reference to the village of Kuño Tambo occurs in a 1577 document on the four *suyos* (regions) of Cusco, where it appears with its earlier name of Cocno and is listed as one of the villages belonging to Condesuyo (one of the four *suyos*).²

When the Spaniards arrived in the New World, they immediately set about trying to organize the indigenous culture in a more political manner. As part of this, they attempted to resettle the indigenous people who had been previously living in small villages or hamlets in new townships called *reducciones*. The name of these new settlements is related to the word *reducir*, meaning “to reduce,” as the idea was to reduce and consolidate the various smaller villages. Each new *reducción* consisted of straight streets and one or two-story houses centered on a main plaza and a church.³ The churches were among the first buildings to be constructed. The Spaniards made several attempts to establish *reducciones* in the Antilles and Mexico,⁴ and they did the same upon arriving in Peru.⁵

In 1552 the *Primer Concilio Provincial Limense* (First Council of the Archdiocese of Lima) enacted the second of the forty *Constituciones de Los Naturales* (laws governing the Indians), requiring that churches should be established in Indian villages and describing how they should be built. The law also indicated that pieces of art should be included in the churches to express the dignity of those places.⁶ In 1567 the *Segundo Concilio Provincial Limense* (Second Council of the Archdiocese of Lima) set the capacity of the churches at 400 “tributaries,”⁷ which according to Reverend Father José Acosta, *Societatis Iesu* (1540–1600), meant nearly 1,500 people.⁸

Churches were typically built with their front façades facing the main plaza; however, they were sometimes built over old temples, which may not have had any relationship to the new plaza.⁹ This probably explains why the Church of Kuño Tambo does not face the village's main plaza, Plaza de Armas.¹⁰ Churches typically included an *atrio* (walled forecourt), *sotacoro* (the area under the choir loft), choir loft, single nave, presbytery with altar, sacristy, storage for ecclesiastical furniture such as stands, and a cemetery. In front of the church there would be a *cruz de caminos* (cross), and, in the Andes, a free-standing bell tower, separate from the church.¹¹

According to documents in the parish archive of Acomayo, the Church of Kuño Tambo was constructed in 1681.¹² Prior to that time, the village of Kuño Tambo was considered an annex to the *doctrina* (rural parish church) of San Juan de Quihuas.¹³ As was typical of the time, the Church of Kuño Tambo owned several properties which were rented out to generate income for maintenance activities.¹⁴ The design of the Church of Kuño Tambo, as described in a 1689 document, followed the typical pattern of churches built in Indian villages:

El Templo Santiago Apóstol conserva una portada principal de dos hojas con arco de medio punto rematados por dos pilares de adobes y con sobrecimientos originales de piedra e interiormente se disponen el sotocoro, coro, baptisterio, nave y sacristía. (The Church of Santiago Apóstol has a main door with two leaves with an arched top with two adobe pilasters and an

original stone foundation. Inside the church there is a sotacoro, choir loft, baptistery, nave, and sacristy.)¹⁵

Mural paintings were also noted at that time:

El anexo de Cunutambo ubicado a una legua del pueblo grande de Rontocan, revestido interiormente de pintura mural, cuenta con pocos ornamentos y tiene cofradías consagradas a Santiago Apóstol, Virgen Rosario y Virgen Purificada del que se sustenta la Iglesia y tiene cien almas de confesión . . . (Cunotambo Annex is located one league from the large village of Rontocan; it has mural paintings inside and it has very few ornaments; there are three brotherhoods—Santiago Apóstol, Our Lady of the Rosary and the Immaculate Conception—who contribute to the maintenance of the church; and it has 100 parishioners . . .)¹⁶

An inventory prepared in 1767 included a long list of liturgical objects, such as chalices and crosses.¹⁷ In the first half of nineteenth century, a new inventory was undertaken, which noted the existence of the following paintings at the main altarpiece: *The Virgin Mary and Child with Angels* and *Saint Dominique Receiving the Rosary from Our Lady*. Sculptures included *Nuestra Señora del Rosario*, *San Cristóbal*, *Virgen Purificada*, *Santa Rosa de Lima*, *San Isidro Labrador*, *Santa Epifania*, *Señor de la Vara*, and *Inmaculada Concepción*. Books and liturgical objects made of silver and other materials were also reported at that time.¹⁸

During the investigations carried out as part of the construction assessment in July 2010, human bones were found beneath the floor level in the southwest corner of the church.

5.2.2 Significance

Although not formally registered as a national monument at the time of the preparation of this report, the Church of Kuño Tambo is valued as a significant building by the community it serves. This was evident during the construction assessment field campaigns, with community members demonstrating interest in the research process, meeting with the project team members on several occasions, and expressing a desire to restore the church. The research carried out as part of this construction assessment has led the Cusco regional office of the Ministerio de Cultura del Perú to begin the process of nominating the church, as well as the entire town, as a national monument due to its originality, authenticity, and preservation of earthen structures and construction techniques.

5.3 Architectural Description

High in the Andes at an approximate elevation of 3,365 m, the village of Kuño Tambo is situated in a shallow valley surrounded by agricultural lands. A narrow and winding road running through the center of the valley connects Kuño Tambo to Cusco and the nearby village of Rondocán. The village consists primarily of vernacular earthen residential and agricultural buildings, constructed on the sloping land flanking either side of the road. The centerpiece of the village is the formal Plaza de Armas, which is bordered by several small civic and residential buildings. The Church of Kuño Tambo is sited to the northwest of the plaza and to the north of main road (Fig. 5.3). The primary façade of the church faces south and addresses the road, rather than the plaza.

The church is built over a natural rock outcropping on the northern slope of the village. The site generally slopes downward 2–3 m from the north to south end of the building and also slopes away from the east and west sides of the building. The church is largely a free-standing structure. Earthen site walls enclosing a farm or storage yard abut the north wall of the church; however, these site walls are not structurally connected to the church itself. The landscape immediately surrounding the church consists of vegetated native ground cover, bare soil, and exposed rock.

The one-storey, 500 m² Church of Kuño Tambo consists of a large rectangular mass (described as the “main church” in this report) oriented along a north–south axis and two smaller wings housing a baptistery and sacristy located along the east lateral wall of the main church (Fig. 5.4). The main church has simple rectangular floor plan with a 1:4 proportion, measuring 7.75 × 31.00 m at the interior, and is covered by a single gable roof. The main church is essentially a single room containing five different functional spaces: a sotacoro, choir loft, nave, presbytery, and altar. Changes in floor level, railings, and interior pilasters are used to separate the different spaces (Fig. 5.5). The church is accessed through a large pair of doors at the south gable wall, and the altar is located at the far north end of the building. The



FIGURE 5.3

Aerial view of the village of Kuño Tambo, showing the location of the main road, the Plaza de Armas, the church, and its free-standing bell tower.

Image: Wilfredo Carazas, for the GCI.

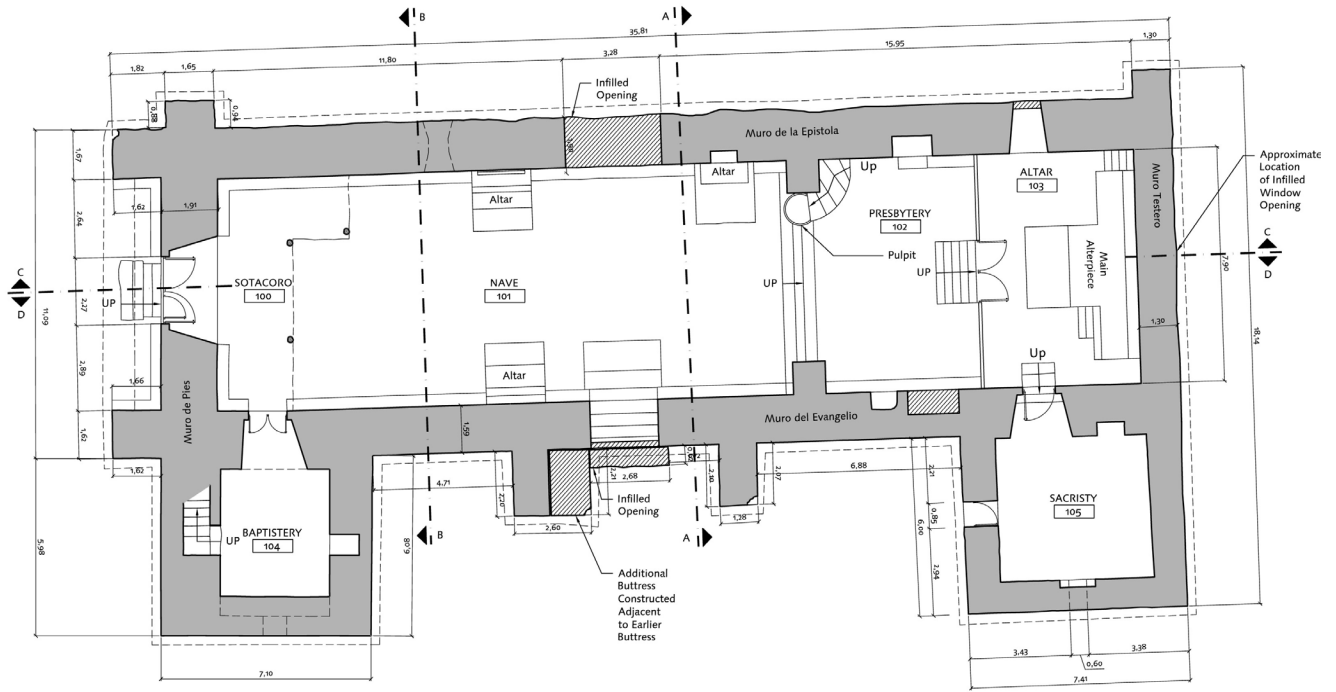


FIGURE 5.4

Floor plan, Church of Kuño Tambo.

Drawing: Base drawing prepared by Ruben Estrada Tapra and edited by the GCI.

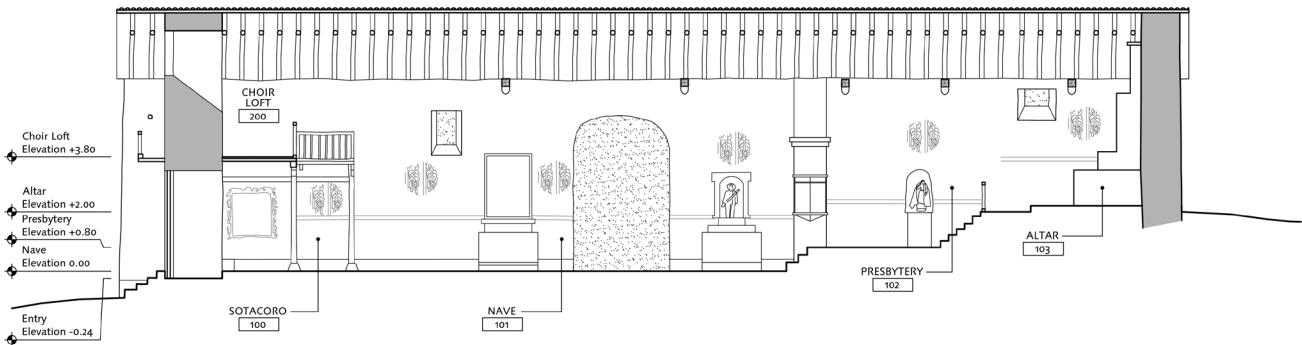


FIGURE 5.5

Cross section C-C, Church of Kuño Tambo.

Drawing: Base drawing prepared by Ruben Estrada Tapra and edited by the GCI.

6 × 7 m baptistery and 6 × 7.5 m sacristy wings each have a nearly square-shaped plan and separate gable roofs that run perpendicular to the main roof. The baptistery is located in the southern-most wing, immediately adjacent to the main entry and sotacoro. A narrow staircase, cut into the adobe wall at the south side of the baptistery, provides access to the wood-framed choir loft above the sotacoro and an exterior balcony spanning across the south gable wall of the main church. The entire church appears to have been constructed at the same time, which is corroborated by historic documents.

The exterior appearance of the church is largely defined by its planar wall surfaces and the form of its gable roofs. The south gable wall is the primary façade and, thus, is more highly articulated than the other façades (Fig. 5.6). It is symmetrical in design, with two large earthen buttresses framing the arched opening at the entry door and wood-framed balcony above. A niche containing a religious statue and a rectangular opening are set in the center of the upper gable wall. Only the door opening providing access to the east end of the balcony breaks the symmetry. The other façades are less articulated, with long spans of uninterrupted wall planes. Several buttresses break up the long lateral walls and small openings occasionally punctuate the upper portions of the walls. Exterior materials include the exposed stone base course, plastered and exposed mud brick walls, and a terra cotta tile roof. The roof system, including the tie beams, wood collar ties and rafters, canes, and a mud and straw layer, is exposed at the underside of the eaves.

The interior walls are more highly articulated than the exterior walls, with low, plastered mud brick banquettes at the base of the walls, earthen bases for the altar pieces along the lateral walls, and numerous small niches cut into the wall thickness. Interior finishes include fired brick floor pavers, plastered mud brick walls, and exposed wood roof framing (Fig. 5.7). The plaster at the east, south, and west walls of the main church is decoratively painted with geometric and figurative motifs (Fig. 5.8), while other plastered areas are painted white. Wood is used for the choir loft construction (Fig. 5.9), doors, and railings separating the nave, presbytery, and altar. Interior furnishings include a monumental wood altarpiece at the



FIGURE 5.6
Primary façade at south side of church, with the baptistery wing to the right.
Image: Sara Lardinois.



FIGURE 5.7
View of interior, from nave looking towards the presbytery and altar.
Image: Claudia Cancino.

north wall (Fig. 5.10), smaller altar pieces along the lateral walls, and a wood pulpit.

The church is part of a larger religious complex, which includes a free-standing earthen bell tower to the south (Fig. 5.11). The church and bell tower are currently separated by the main road running through the village. It is likely that they were originally connected by a church yard; but, if such a yard once existed, it was lost by the later development of the road and construction of various small buildings between the two structures. The bell tower is not part of this construction assessment.

FIGURE 5.8 (LEFT)

Wall paintings at southwest corner of the sotacoro.

Image: Amila Ferron.

FIGURE 5.9 (RIGHT)

View of choir loft and sotacoro, from nave.

Image: Sara Lardinois.



FIGURE 5.10 (LEFT)

Monumental altar piece.

Image: Wilfredo Carazas, for the GCI.

FIGURE 5.11 (RIGHT)

Free-standing bell tower to the south of the church.

Image: Sara Lardinois.





FIGURE 5.12
View of erosion at east side of church.
Image: Mirna Soto, for the GCI.

5.4 Geological and Environmental Description

5.4.1 Geological description and seismic history

The church (lat 13°39'38" S; long 71°51'26" W) is built on a natural rock outcropping, with some compacted clay fill used to level the site. Thus, depending on the topography, the foundation either bears directly on the rocky soil or the compacted clay fill. As a result of the steep topography and use of clay fill, some portions of the interior finish floor are significantly higher than the adjacent exterior grade level. The most extreme differential is at the east side of the church, where the interior floor elevation is approximately 2 m higher than the adjacent grade and large portions of the natural rock outcropping are visible below the base course. The visible outcropping in this area shows signs of sedimentary rock erosion (Fig. 5.12). This erosion may be the result of improper site drainage, which is made worse by the natural slope of the site; however, the water source(s) contributing to the erosion were not immediately clear, as the construction assessment survey was carried out during the dry season. Possible drainage sources include surface water runoff from the upper village, falling water from the roof eaves, or a combination of those two factors. Alternatively, this erosion may be the result of excavations carried out in the past.

The building is located in a level 2 seismic risk zone, as classified by the Peruvian Building Code, which is the middle level on a scale of 1 to 3.¹⁹ As the church was constructed in the seventeenth century, it has been subject to a number of seismic events throughout its history, including the 1950 Cusco earthquake (M_w 6.0), approximately 35 km to the northwest; the 1943 Yanaoca earthquake, approximately 65 km to the southeast; and 1913 Abancay earthquake, approximately 120 km to the west. It is possible that the church was also subject to the 1746 Lima and 1687 Lima (M_w 8.5) earthquakes, approximately 600 km to the northwest.^{20 21}

5.4.2 Regional climate

The weather station in Cusco, approximately 35 km northwest of the village of Kuño Tambo, reports the annual average maximum temperature is 22°C and the average minimum is 3°C; however, in the winter, lows may drop below 0°C. As measured since 1976, the maximum average annual rainfall is 1125 mm and the minimum is 460 mm. It rains over 100 days each year.

5.5 Structural Description

The following sections describe the different structural materials, elements, and systems making up the Church of Kuño Tambo (Fig. 5.13). Their current condition and any irregularities, alterations, damages, and decay observed during the construction assessment survey are described in greater detail in section 5.6 that follows the structural description.

5.5.1 Survey sectors

For the purpose of conducting the construction assessment survey, the church was divided into five sectors (Fig. 5.14). All five sectors appear to have been constructed at approximately the same time and exhibit similar construction materials and techniques. The sectors were selected based upon the architectural configuration, considering differences in the floor plan, height, and connection details. The sectors are as follows:

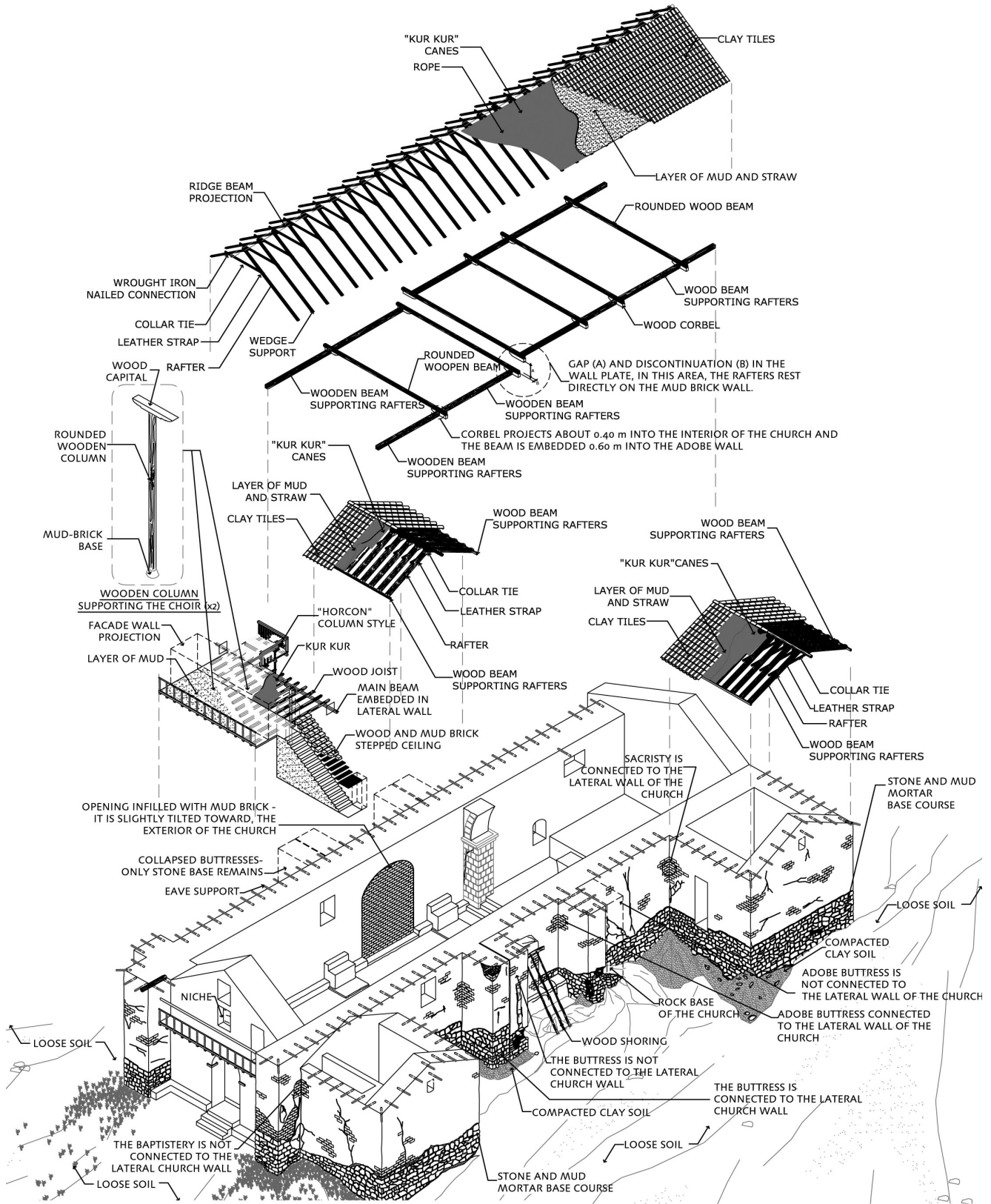


FIGURE 5.13
 Overall structural scheme for the church.
 Drawing: Mirna Soto, for the GCI.

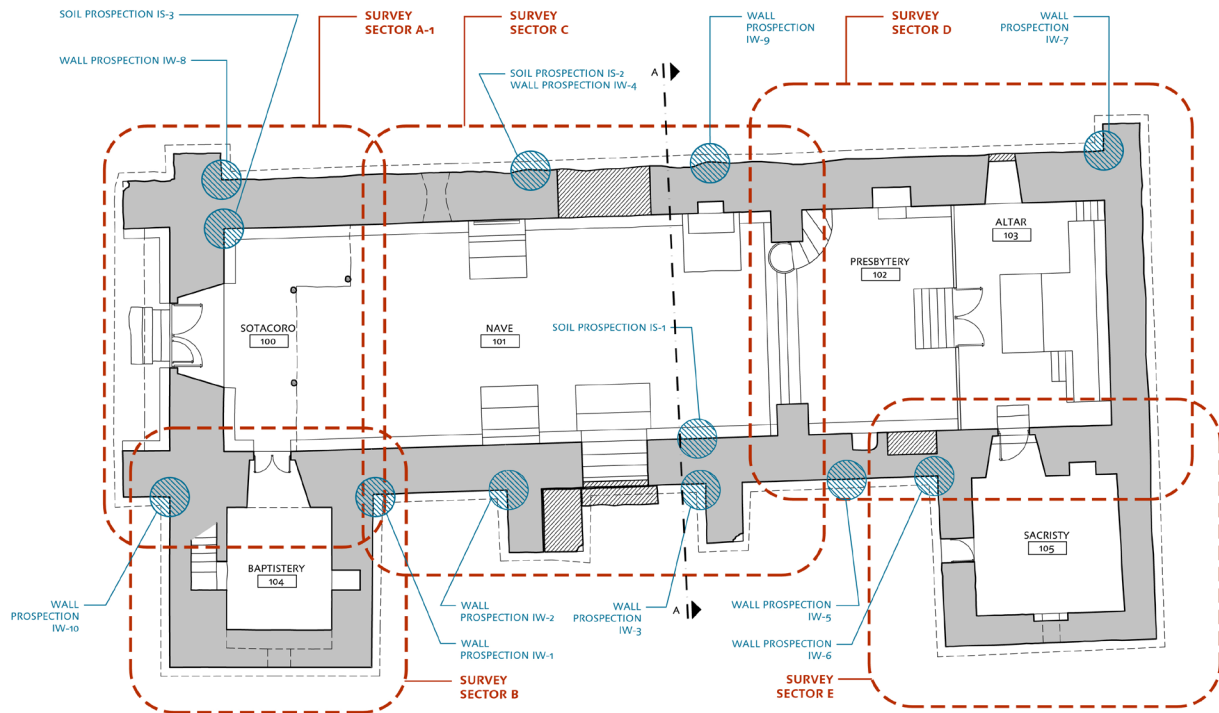


FIGURE 5.14

Floor plan, showing sector and prospection locations.

Drawing: Base drawing prepared by Ruben Estrada Tapra and edited by the GCI.



- **Sectors A-1 and A-2:** The far south end of the main church, encompassing the sotacoro (sector A-1) and the choir loft above (sector A-2).
- **Sector B:** The low baptistery immediately adjacent to the east wall of the sotacoro.
- **Sector C:** The tall, 6.5 m high, rectangular nave, situated in the center of the main church.
- **Sector D:** The presbytery and altar, separated from the nave by two earthen piers and a change in floor level.
- **Sector E:** The sacristy, immediately adjacent to the east wall of the altar.

5.5.2 Foundations and base course

The building foundation and base course are comprised of a stone base course bearing directly on the rocky soil or compacted clay fill. The base course is constructed of rubble stone masonry with a mud mortar. The stones vary in size, with some stones exceeding 0.64 m in width, while the mortar joints vary in width from 20 to 60 mm. The width of the base course matches the width of the mud brick wall above. The base course typically varies in height from 1.20 to 1.50 m, following the natural slope of the site; however, it appears to be taller at the southeast corner of the baptistery and along the east elevation of the nave. The relationship also varies between the bottom of the base course and the interior floor level and current exterior grade level. In some locations, the bottom of the base course extends below both the interior floor level and the exterior grade (Fig. 5.15). At other locations, primarily at the east wall, the bottom of the base course is higher than both the interior floor level and the exterior grade, and the rocky soil or compacted clay fill on which it bears is exposed (Figs. 5.16–5.18).

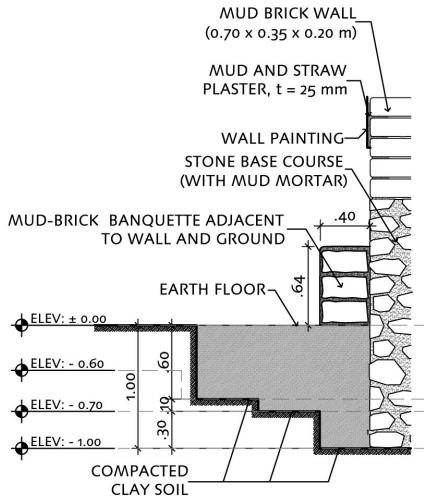


FIGURE 5.15
 Prospection IS-3, section view illustrating the base course at the southwest corner of the main church. Drawing, Mirna Soto, for the GCI.

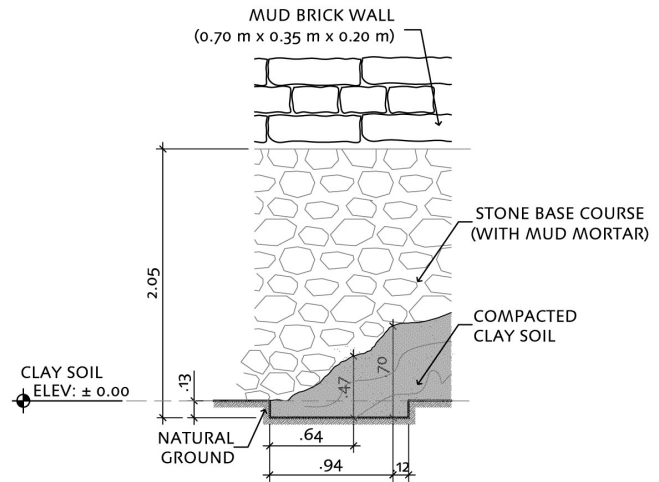


FIGURE 5.16
 Prospection IW-5, exterior elevation view illustrating the base course at the east side of the main church. Drawing: Mirna Soto, for the GCI.

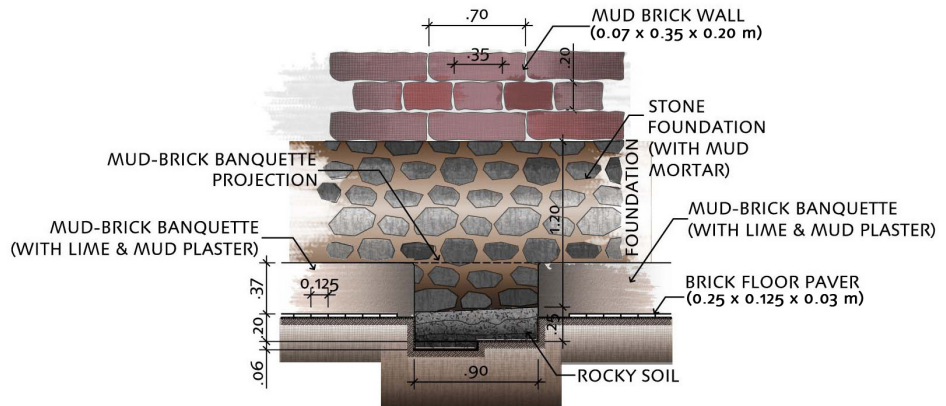


FIGURE 5.17
 Prospection IS-1, interior elevation view illustrating the base course at the east side of the main church. Rendering: Jabdiel Zapata, for the GCI.



FIGURE 5.18
 Prospection IS-1, photographic view. Image: Claudia Cancino.

5.5.3 Walls

The walls are of load-bearing mud brick construction, with a plaster finish at both the interior and exterior faces. The mud bricks are set in an English bond pattern, with alternating courses of header and stretcher bricks.²² A typical mud brick measures 0.70 m long × 0.35 m wide × 0.20 m high. The mud bricks are made of earth with many small rocks in it, reflecting the soil characteristics of the site, and are reinforced with straw. The bricks are laid in a mud mortar, with both the horizontal and vertical joints having an average thickness of 15 mm. In those portions of the wall that have been affected by wind erosion, the bricks are more deteriorated than the mortar joints, implying a difference in material composition and strength. This may be related to a past repointing effort. In their current condition, the exterior faces of the walls are largely unfinished and the mud bricks are exposed; however, some exterior plaster remains in the upper portion of the south façade, which is sheltered by the roof overhang. The interior finish typically consists of one 20–30 mm thick layer of mud and straw plaster and one layer of 1–2 mm thick painted gypsum; however, where later plaster coats have been applied over the original plaster, the thickness reaches up to 60 mm. Much of the interior wall plaster is decoratively painted.

The main church and baptistery walls vary in thickness from 1.4 to 2 m and range in height from 3 to 6 m at the eaves to 5.5 to 8.5 m at the gable ends, as measured from the visible top of the stone masonry base course. The sacristy walls are somewhat thinner at 1.2 m; and they are approximately 3.8 m high at the eaves and 5.7 m at the gable, as measured from the top of the stone masonry base course. All walls can be classified as thick in relationship to their height, with a slenderness ratio of less than six.²³

A low mud brick banquette is located at the interior face of the east, south, and west walls of the main church. This banquette bears directly on the rocky soil or compacted clay fill; and, it is constructed immediately adjacent, but is not connected, to the mud brick walls.

A large arched opening is set in the center of the south gable-end wall. Similar arched openings were also located in the center of each lateral wall; however, these have since been infilled with mud bricks or altered in other ways (see section 5.6.2 for further description). Other smaller openings are located in the upper portions of both the gable-end and lateral walls, and some of them have also been infilled with mud bricks. Closely-spaced wood lintels are used to span the openings. The ratio of openings to the vertical surface area of the façades is provided in Table 5.1.

Table 5.1: Ratio of openings to total vertical surface area of façades

Façade	Area of Openings*/Total Vertical Surface Area of Façade
Main church, north façade	2.8%
Main church, east façade	4.5%
Main church, south façade	12.5%
Main church, west façade	8.9%
Baptistery, all façades	0.5%
Sacristy, all façades	1.3%
Average of all façade ratios	5.1%

* Includes any infilled openings, such as those at the north, east, and south façades of the main church.

The long lateral walls of the main church are reinforced with full-height mud brick buttresses with stone base courses. One buttress flanks either side of the infilled door opening in the center of the east lateral wall; and, at the south side of that infilled opening, an additional buttress has been constructed immediately adjacent to the north of the original buttress (Figs. 5.19, 5.20). The remaining stone base courses and ghost lines in the walls at the west façade indicate that buttresses flanked either side of the infilled west door at some time in the past (Fig. 5.21). Mud brick buttresses have also been used to reinforce the southeast, southwest, and northwest corners of the church. These corner buttresses are essentially extensions of the walls beyond the intersection of the perpendicular wall planes. In addition to the buttresses, the baptistery and sacristy wings provide additional bracing for the east lateral wall.²⁴

FIGURE 5.19

Axometric view of east lateral wall, illustrating locations of existing and lost buttresses.

Drawing: Mirna Soto, for the GCI.

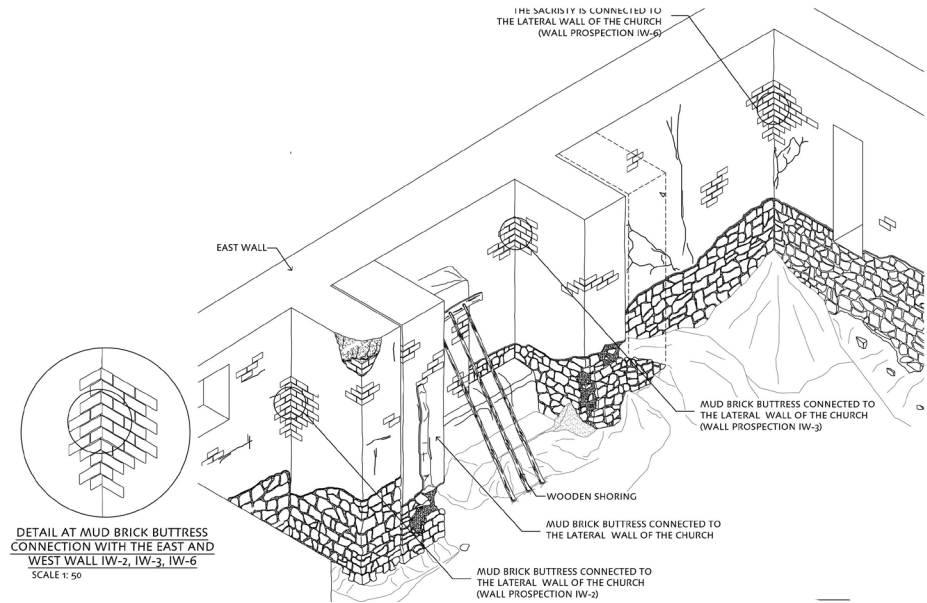


FIGURE 5.20

View of east lateral wall of main church, showing buttresses.

Image: Wilfredo Carazas, for the GCI.



FIGURE 5.21

West lateral wall of main church, showing the infilled opening and collapsed buttresses.

Image: Claudia Cancino.



FIGURE 5.22 (ABOVE)

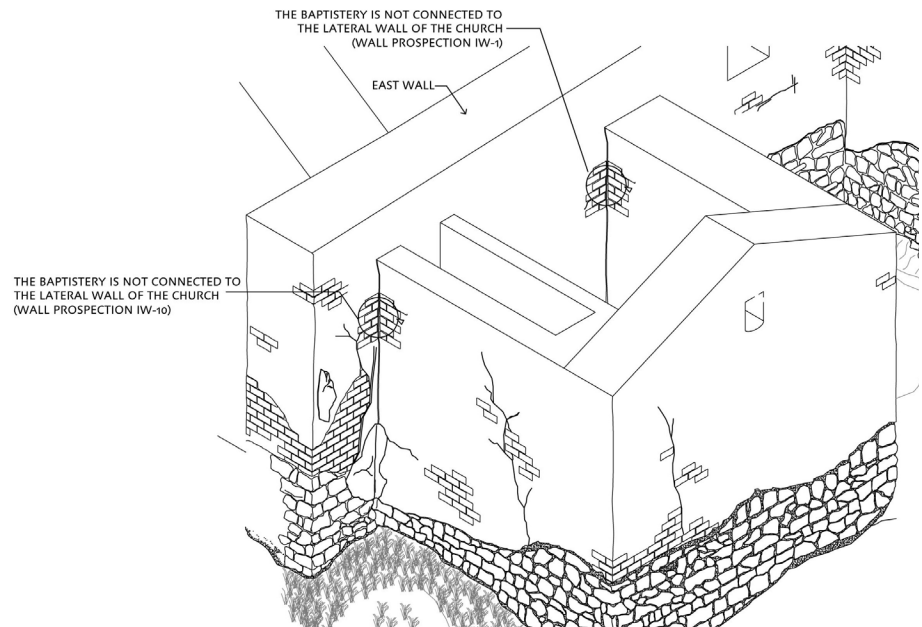
Prospection IW-1, detail at the intersection of the baptistery wall (left) and east lateral wall of main church (right).

Image: Mirna Soto, for the GCI.

FIGURE 5.23 (RIGHT)

View of the east lateral wall of the church and baptistery wing, illustrating the wall connections.

Drawing: Mirna Soto, for the GCI.



The corners of the mud brick walls are woven together with overlapping bricks. The sacristy walls (sector E) are connected to the lateral wall of the nave through a similar connection; however, there is no connection between the baptistery walls (sector B) and the lateral wall of the nave (Figs. 5.22, 5.23). With the exception of the additional buttress at the east and west façades, all buttresses are connected to the nave walls with overlapping bricks.

5.5.4 Floors

The main floor of the church sits directly on top of the rocky soil or compacted clay fill used to level portions of the site. There are four different levels which correspond to both the natural topography of the site and the functional needs of the church: the nave and baptistery at the lowest elevation; the presbytery; the altar; and the sacristy which is approximately 2.87 m higher than the nave floor. The finish flooring consists of fired brick pavers set in earth over rocky soil or exposed clay fill (Fig. 5.24).

The choir loft floor consists of wood planks over wood joists (Fig. 5.25). The joists supporting the main choir loft floor run in the north–south direction, from the south façade wall to a wood beam. The ends of this wood beam are embedded in the lateral mud brick walls and two sawn wood columns with mud brick bases and decorative wood capitals provide intermediate support for it. Joists running in the east–west direction support the northwest corner of the balcony extension. Both the beam supporting these joists and the column below are unsawn tree trunks, suggesting that this extension is a later addition. The underside of the choir loft floor is finished with a decoratively-painted plaster coat.

The floor of the exterior balcony at the south façade consists of wood planks over wood joists that are cantilevered from the mud brick wall (Fig. 5.26). It is unclear if these joists are simply extensions of the interior choir loft floor framing or if they are separate framing elements.



FIGURE 5.24

Fired brick floor pavers, as removed for the prospectations and numbered for reinstalment.

Image: Mirna Soto, for the GCI.



FIGURE 5.25

View of the choir loft framing, looking southeast.
Image: Amila Ferron.



FIGURE 5.26

View of the exterior balcony at the south façade.
Image: Claudia Cancino.

5.5.5 Roof

The main church has a single gable roof with an approximate slope of 8:12. The baptistery and sacristy have separate gable roofs of a similar slope; however, they are set perpendicular to the axis of the main church roof. All sections of the roof are constructed with wood *pares y nudillos* framing, which are trusses composed of two rafters joined with a collar tie (Figs. 5.27, 5.28). The rafters are made from 8" (0.20 m) diameter willow tree trunks; and they overlap one another with half-lap joints at their intersection (Fig. 5.29). The rafters are tied to one another and the ridge beam above with leather straps or ropes and wrought iron nails. The collar ties are simply strapped or nailed to the rafters, without a cut wood joint. Above the trusses are *Kur Kur* canes that are woven and tied together with rope,²⁵ a mud and straw layer (*torta de barro*), and Spanish style terra cotta roof tiles.²⁶

The main church roof consists of 47 *pares y nudillos* trusses and six wood tie beams. The ends of the rafters at the main roof are cut at a 90° angle and sit on 0.17 × 0.17 m wood plates embedded in the lateral mud brick walls (Figs. 5.30, 5.31). These wall plates are neither continuous nor tied together. Therefore, the plates do not function as bond beams; rather, their primary function is to support the rafter ends. The transverse tie beams are made from alder, or birch, tree trunks and also have an approximate diameter of 8" (0.20 m). The tie beams sit on wood corbels, and both the beams and corbels extend approximately 0.60 m into the depth of the mud brick wall. In the central portion of the nave, two of the tie beams are closely placed together, almost forming a pair. There is a gap in the wall plate between the two tie beams, and the rafter ends at the south side of the tie beam pair are at a lower vertical elevation (Fig. 5.32). There are not any tie beams at the far south end of the main roof.

Both the baptistery and sacristy roofs consist of six *pares y nudillos* trusses and one bay of rafters without a collar tie. Unlike the main church, the roof rafters in these two sectors appear to sit directly on the mud brick walls, without a wood plate. The wood rafters of the baptistery and sacristy roof are tied with leather straps to wood elements embedded in the upper sections of the east gable walls.²⁷ The baptistery has one tie beam, without corbels, that connects its north and south lateral walls.

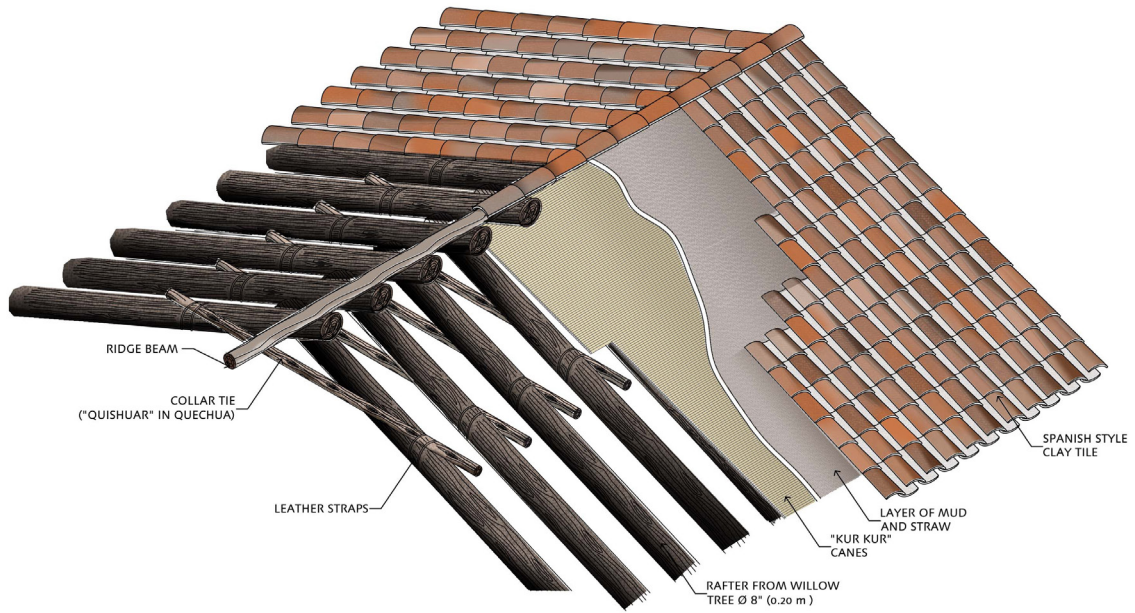


FIGURE 5.27
Detail showing pares y nudillos (rafters and collar ties) framing and roof covering.
Rendering: Jabdiel Zapata, for the GCI.



FIGURE 5.28
View of pares y nudillos framing and tie beams over the nave.
Image: Claudia Cancino.



FIGURE 5.29
Half-lap joint at intersection of roof rafters over main church.
Image: Claudia Cancino.

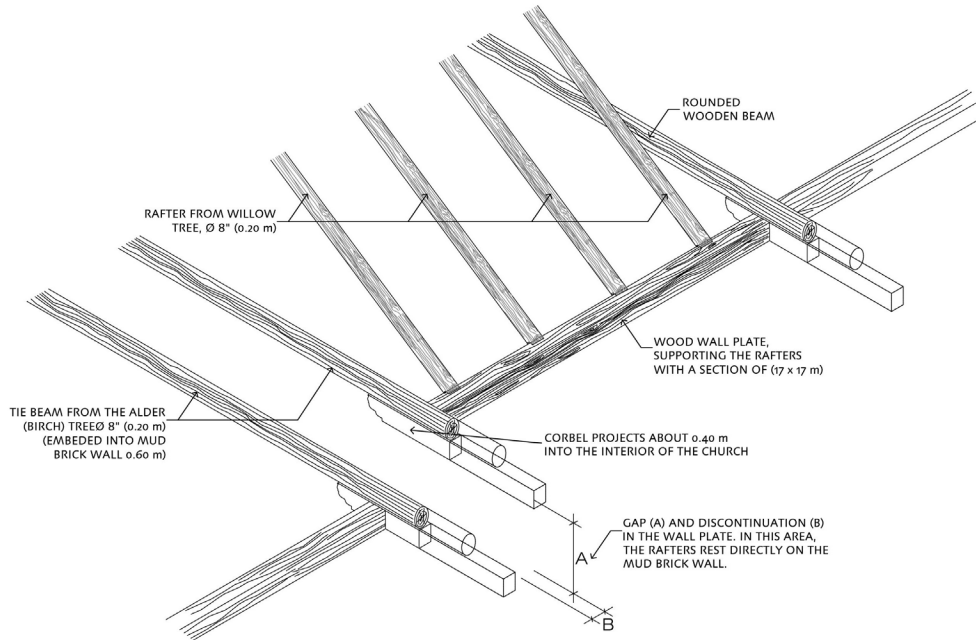


FIGURE 5.30
Prospection IR-2, showing connection between the rafters and wall plate, as well as the tie beam and corbel.
Drawing: Mirna Soto, for the GCI.



FIGURE 5.31
View of rafters and wall plate at the lateral wall of nave.
Image: Claudia Cancino.



FIGURE 5.32
View of the pair of tie beams over the nave.
Image: Mirna Soto, for the GCI.

5.6 Irregularities, Alterations, Damages, and Decay

The following sections describe the current condition of the different structural materials, elements, and systems making up the Church of Kuño Tambo and any irregularities, alterations, damages, and decay that were visually observed during the construction assessment survey.

5.6.1 Foundations and base course

In those sections of the base course that are visible from the exterior or through projections carried out as part of the survey, the base course was observed to be in fair to good condition. The mortar is generally cohesive; however, in some locations, the stones have become loose. There has been some loss of face stones and mortar at the exterior side of the base course. This deterioration is greatest at the east wall of the church and baptistery. The base course of the north buttress at the east wall has been severely compromised by loss of material at its southeast corner. Improper site drainage, erosion, and/or excavation of the rock outcropping in this area may be contributing to the damage (Figs. 5.33, 5.34).

5.6.2 Walls

The walls have been subject to a number of alterations, most of them related to the door and window openings and the buttresses. Alterations to the door and window openings include:

- The large arched door opening at the west lateral wall has been infilled with mud bricks, which are not structurally connected to the adjacent walls. These mud bricks have not been plastered or painted and thus are visible from the interior (Fig. 5.35).
- The large arched door opening at the east lateral wall was modified to create an interior niche. The interior face of the altered wall is plastered and decoratively painted to match the adjacent interior surfaces, suggesting that this alteration occurred earlier than the one at the west door. The thin mud brick wall at the back of the niche has been reinforced by the construction of a separate mud brick wall at the exterior. This exterior wall is unstable, exhibiting outward displacement, and temporary wood shoring has been installed at the exterior face to prevent further displacement.
- It appears that there was originally a door at the west end of the south façade connecting the choir loft and exterior balcony, mirroring the existing door at the east end of the façade. Any such door appears to have been infilled.
- It appears that the window opening at the north elevation has been partially infilled. Although this window is visible from the exterior, it is obscured from interior view by the main altarpiece. What, if any, infill material was used at inside face of the window opening is unknown.

Alterations to the buttresses include:

- At the west lateral wall, two earthen buttresses flanking either side of the infilled door opening have collapsed or been removed; however, the stone masonry bases for the buttresses remain. The buttresses were connected to the lateral walls, as evidenced by the remains of buttress mud bricks woven

into the wall construction. The instability of the stone and mud mortar base may have led to the collapse of the buttresses (Fig. 5.36).

- At the east lateral wall, one earthen buttresses immediately adjacent to the north buttress has collapsed or been dismantled. This buttress is thought to have been a later addition, as it is not structurally connected to the lateral wall of the nave.

FIGURE 5.33 (LEFT)

Deterioration of base course at east lateral wall and buttresses. Also note the modifications and shoring at the former arched opening between the buttresses.

Image: Mirna Soto, for GCI.



FIGURE 5.34 (RIGHT)

Detail view of deteriorated base course at north buttress, east lateral wall.

Image: Mirna Soto, for GCI.



FIGURE 5.35

Infill construction at former arched opening in west lateral wall. Note that infill is not connected to adjacent wall construction.
Image: Amila Ferron.



FIGURE 5.36

View of collapsed or dismantled buttresses at west lateral wall.
Image: Wilfredo Carazas, for the GCI.

It is assumed that the church originally had a quincha arch separating the nave from the presbytery, based upon the extant damage at the top of the remaining earthen piers and the existence of an arch in the nearby Church of Rondocán, which is of a similar overall design to the church of Kuño Tambo (Figs. 5.37, 5.38). The arch has since collapsed or been dismantled, and the remaining west pier exhibits cracking (Figs. 5.39, 5.40).

The adobe walls are in fair to good condition overall; however, the following damages and decay were observed:

- The west lateral wall exhibits outward displacement. The loss of the western exterior buttresses may be a cause or result of this displacement. This



FIGURE 5.37

View of intact quincha arch over mud brick piers, separating the nave from the presbytery at the Church of Rondocán.

Image: Claudia Cancino.



FIGURE 5.38

View of remaining mud brick piers at the Church of Kuño Tambo. It is likely that the piers originally supported an arch above.

Image: Claudia Cancino.

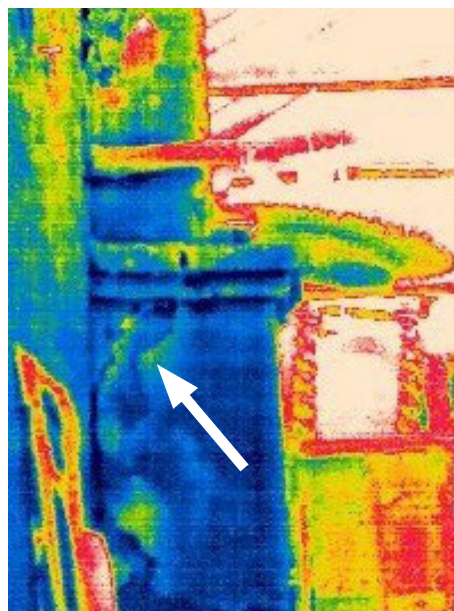


FIGURE 5.39 (LEFT)

Thermal image, showing crack in west mud brick pier of the Church of Kuño Tambo, as viewed from the nave.

Image: Amila Ferron.



FIGURE 5.40 (RIGHT)

Crack in west mud brick pier of the Church of Kuño Tambo, as viewed from the presbytery.

Image: Claudia Cancino.

displacement appears to be related to vertical cracking in the west wall and the separation of the balcony floor framing from the west wall.

- Several other walls exhibit cracking and displacement:
 - At the baptistery wing, there are several vertical cracks, averaging 50 mm in width, in both the south and east façades, near the southeast corner. These cracks appear to be related to settlement of the base course, either due to rising damp and loss of mortar or erosion of the rock soil. These cracks may also be, in part, caused by differences in the thickness of the baptistery walls. The choir loft staircase is set into the south wall of the baptistery, reducing its thickness and causing it to behave differently during seismic events (Fig. 5.41).
 - At the south façade, vertical cracks are present at the corners where the main gable wall intersects with the buttresses and lateral walls.
 - The north gable wall is in good condition, exhibiting only minor cracking.
 - As previously mentioned, the interior piers exhibit diagonal cracking.
- At both the base and tops of the east, south, and west walls, the mud bricks are water-damaged and partially eroded, with an average depth of loss of 50 mm. A leaking roof and rising damp are the presumed sources of this damage. The walls do not appear to be unstable as a result of the water damage; however, the erosion at the top of the wall has led to failure of some roof-wall connections. This water infiltration has also led to biological growth in the tops of the mud brick walls, as well as detachment and loss of interior plaster at the base and top of walls (Fig. 5.42).



FIGURE 5.41
Crack in the south façade of the baptistery wing.
Image: Wilfredo Carazas, for the GCI.



FIGURE 5.42
Erosion at the top of the mud brick wall in the northeast corner of the altar has led to failure of the roof rafter. A wood post has been installed to temporarily support the rafter end.
Image: Sara Lardinois.

5.6.3 Floors

The choir loft floor has been altered by an extension at the northwest corner. The beam and column supporting this extension are made from unsawn tree trunks, which are different from the sawn beams and columns supporting the original choir loft floor.

The choir loft floor framing is in fair to good condition; but, it is separating from the adjacent west lateral wall of the church. The area of separation corresponds to the location where wood keys have been installed to prevent outward displacement of the wall (see section 5.6.4 below for additional discussion).

5.6.4 Roof

The entire roof covering system and most of the original wood framing members have been replaced at least one time in the building's history. When the roof was rebuilt, it appears that its form was altered. Originally, the roof, or a portion of the roof, should have been taller to accommodate the now-collapsed arch between the presbytery and nave. Where wood framing members have been replaced, vegetal ropes have been used to connect the rafters to one another and iron nails have been used to connect the rafters to the collar ties. Leather straps were originally used to connect the different framing elements.

Three wood keys, connecting the roof framing with the mud brick walls, have been installed at the far south ends of the east and west lateral walls, in order to prevent outward displacement of the walls (Fig. 5.43). This alteration suggests that there originally may have been an additional (seventh) tie beam at the south end of the main church; and that it collapsed or was removed, necessitating other reinforcing such as the keys. One wood key has been installed at the north façade of the baptistery wing.

The roof covering is in poor condition with several large areas of missing roof tiles, which have been patched with overlapping metal sheets. The roof framing itself is in fair condition. Some of the pares y nudillos trusses are deformed, giving the roof an irregular profile; and, some of the connections between different roof framing elements and the walls supporting them are broken or nonexistent. At several pares y nudillos trusses, the connection between the collar ties and rafters has failed, and the collar tie is hanging from one of the rafters or is missing. The roof framing is not anchored to the gable-end walls, and the connection between the



FIGURE 5.43
Wood key at south end of
west lateral wall.
Image: Claudia Cancino.

baptistery roof framing and east lateral wall of the main church is compromised or nonexistent.²⁸ As previously noted, water infiltration through the roof has led to detachment and loss of interior wall plasters, as well as erosion at the tops of the lateral mud brick walls. In some cases, the depth of erosion at the mud bricks is so great that the ends of the roof rafters are no longer supported by the walls. Wood rot was observed at some of the wall plates and tie beams ends.

5.7 Preliminary Findings

The following preliminary findings on the structural behavior of the church are based upon qualitative methods, including historical research and direct observations made by the investigative team during surveys carried out in 2010. The investigative team utilized their past experience with historic earthen construction to interpret that data collected through research and observation and develop preliminary ideas on the possible structural behavior of the church. These preliminary findings will be explored further in the next phases of the project through quantitative methods, including static and dynamic testing and numerical modeling analyses. Following the quantitative testing and analyses, the preliminary findings will be revised as necessary and expanded upon to provide a complete diagnosis and safety evaluation.

The preliminary findings are:

- The pares y nudillos roof trusses do not work, due to the failure or lack of connections between the rafters and collar ties. Furthermore, the connection between the rafters and the mud brick wall has failed in some locations, due to erosion of the wall and lack of continuity in the wall plate.
- Roof leaks have eroded the tops of the lateral mud brick walls, reducing the embedment and effectiveness of the tie beams.
- The thick mud brick walls are considered stable, according to the GSAP slenderness ratio criteria; however, several large openings (presently altered or infilled) in the lateral walls of the main church weaken those walls. The loss of some of the mud brick buttresses at the exterior face of those lateral walls further weakens them.
- The cause of cracking in the mud brick walls varies by location:
 - The cracks in mud brick walls at the east side of the building are caused by settlement of the foundation and base course, resulting from the weak connections between the main church and baptistery and humidity and erosion of the ground surrounding the church.
 - The cracks in the south gable-end wall are related to the thrust action of the roof framing on the lateral walls and the lack of connections between the roof framing. The lack of a tie beam in this area may also be contributing to displacement of the lateral walls and associated cracking in the south gable-end wall.

Notes

- 1 Viceroy Francisco de Toledo is considered the organizer of the Viceroyalty of Peru. During his governance, more than 1,000 Indian villages called *reducciones* were created. In Alejandro Malága Medina's *Pueblos de indios, Otros urbanismo en la región andina*, he notes that: "Con el impulso toledano, el reordenamiento administrativo y espacial del Virreinato fue generalizado. La Visita dio como resultado un total de 614 repartimientos, 712 doctrinas y más de 1,000 reducciones o pueblos de indios." Malága Medina's work is quoted in Jurado 2004, 127.
- 2 Zuidema and Poole 1982, 86. This 1577 document on the four regions of Cusco was based in the information provided by *curacas* (Indian authorities) from the *reducciones* (villages) created under the governance of Viceroy Francisco Toledo.
- 3 Regarding the creation of Indian villages in 1567 Juan de Matienzo wrote: "Una plaza de forma cuadrangular en el centro y luego manzanas cuadradas que se dividirían en cuatro solares por lado y sus calles anchas. La iglesia se fabricaría en una de las cuadras o manzanas de la Plaza; a su frente mesón para los españoles que estuviesen de paso en dicho pueblo, y que comprendería cuatro cuartos con techos de tejas y con caballerizos; en uno de los solares de la otra cuadra se levantarán la casa del cabildo; en el otro la huerta y servicio del hospital; finalmente en el último solar, corral del cabildo. En uno de los solares, de las cuatro manzanas que rodean la plaza, se construirá la casa del corregidor; detrás de ésta casa para el Tucuy Ricuy y cárcel, en la que habría dos cepos y cuatro pares de grillos y de cadenas. Los demás solares de la plaza serán para casa de españoles, casados que desearan vivir entre los indios. A cada cacique se le dará una cuadra o dos solares, conforme a la gente que tuviere. Así constituido cada pueblo se procedería a fijar las tasas." De Matienzo writings are quoted in Málaga Medina 1974, 153.
- 4 In the *Real Cedula* (Royal Proclamation) of 1538 given in Valladolid, Spain, Don Antonio de Mendoza committed to create villages for Indians in all the Nueva España (Mexico), with well-planned streets and squares, a church, a jail, and houses for the local authorities, Indian authorities, and mayors. Several intructions were given on how to create these villages (Villacorta Santamato 2005).
- 5 The instructions given by the *Real Audiencia* (Royal Court) of Lima to the visitors on November 15, 1561 reads: "Les dareys a entender que los queremos reducir a pueblos porque tengan mejor gobernación entre sí, y así mesmo dareys jurisdicción para que ellos tengan entre sí su república fundada y se gobiernen de los que entre ellos pasare y tratare y para que se les pueda enseñar la doctrina cristiana y para esto conviene que se reduzgan a pueblos." The text of these instructions are quoted in Villacorta Santamato 2005.

- 6 Constitución 2 of the *Primer Concilio Provincial Limense* states: "Que se hagan iglesias en los pueblos de indios, y en el modo que se han de tener de hacer. – Item por cuanto, por la bondad y misericordia de Dios nuestro señor, en los más pueblos y provincias de indios hay ya muchos de los cristianos, y cada día serán más; y es razón que haya templos e iglesias donde Dios nuestro Señor sea honrado y se celebren los oficios divinos e administren los sacramentos, e los indios concurran a oír la predicación y doctrina: ss. ap. Mandamos que los sacerdotes que estuviesen en la doctrina de los naturales en los pueblos de indios den orden y procuren con diligencia como en cada repartimiento, en el pueblo principal donde esté el principal cacique, se haga una iglesia conforme a la cantidad de la gente en la cual se administren todos los sacramentos si no fuera en caso de necesidad. Y procurará el tal sacerdote de adornarla de arte que entiendan la dignidad del lugar y para lo que se hace, dándoles a entender que es aquel lugar dedicado para Dios y para el culto y oficio divinos, y para que concurramos a pedir perdón a Dios de nuestros pecados, y que en él no se han de hacer cosas ilícitas ni den lugar a ellos. Y en los demás pueblos pequeños donde que no hubiese posibilidad para hacer iglesia, hagan una casa pequeña, a manera de ermita para este efecto, donde pongan un altar adornado con una imagen o imágenes, en la mejor manera que pudieren, y donde fuera tan pequeño que para esto no haya posibilidad, al menos señalen un lugar decente con una cruz, donde se les diga la doctrina y platique las cosas de la fée." Quoted in Vargas Ugarte 1951, 8.
- 7 Constitución 77 of the *Segunde Concilio Provincial Limense* states: "Que a cada parroquia no se le den ni señalen más de cuatrocientos indios casados, con los quales entran los demás que les pertenecen como muchachos, viejos, huérfanos y forasteros." Quoted in Catholic Church, Province of Peru, Concilio Provincial (3rd: 1582-1583) 1982, 169.
- 8 Villacorta Santamato 1987, 116.
- 9 The Third Constitution indicated that old temples should be destroyed; and, if the location was appropriate, a new church should be built in its place.
- 10 The Spanish translation of Plaza de Armas is "weaponry square." This is a typical name for main plazas in many towns in Peru and is derived from the plazas' use for armaments storage during the Spanish Viceroyalty period.
- 11 Villacorta Santamoto 1987, 118–135.
- 12 According to documents located in the Acomayo Parish archive, "el Templo Santiago Apóstol de Cunutambo data del año 1681" (Archivo Parroquial de Acomayo. Sección Colonia. Libro de Fábrica de la Viceparroquia de Cunutambo. Leg. IX 1, 1,7 1681).
- 13 According to a 1689 document, San Juan de Quihuares was the parish which included the villages of Pumaquehuar and Cunutambo. Cited in Villanueva Urteaga 1982.
- 14 According to documents located in the Acomayo Parish archive: "La Iglesia Santiago Apóstol poseía terrenos y propiedades en los sectores del Hanansaya y Urinsaya de Cuñutambo, abarcando 3 topos de cultivos de maíz y 1/2 topo de tierras de cultivos de granos (trigo y cebada)" (Archivo Parroquial de Acomayo. Sección Colonia. Libro de Fábrica de la Viceparroquia de Cunutambo. Leg. IX 1, 1,7 1681.)
- 15 Archivo Arzobispal del Cusco. Libro de Fábrica e Inventario de Bienes y Alhajas perteneciente al Repartimiento de Quispicanchi. Año 1689.
- 16 Villanueva Urteaga 1982, 128.

- 17 The 1767 inventory reported: "dos cálices con sus respectivas patenas, tres cruces de guión, un incensario, un hostiario, un viril para el sacramento, dos copones de plata grande y chico con tapa dorada, crucecita de plata, una corona de plata de la Virgen Rosario y entre sus ornamentos cinco casullas con sus manipulos y estolas de diferentes colores, dos capas de San Cristóbal y Patrón Santiago, dos mangas de cruz, tres frontales de lienzos y dos almaizales" (Archivo Arzobispal de Cusco. Libro de Fábrica y Cofradía. Rondocan. Año 1767–1783: Registro realizado en el periodo del cura Manuel de la Sota).
- 18 The nineteenth century inventories are located in multiple locations, including:
 Archivo Arzobispal de Cusco. Libro de Fábrica y Cofradía. Rondocan 1830–1832.
 Archivo Regional de Cusco. Grupo Documentario Cabildos de Cusco. Leg^o 83. C 16 Año 1816–1817.
 Archivo Regional de Cusco Grupo Documentario Tesorería Fiscal. Libro de Matriculas de la Provincia de Quispicanchi. Año 1830–1838. Libro 01.
- 19 Seismic zones are defined in Capítulo II, Parámetros de Sitio of the *Norma Técnica de Edificación E.030: Diseño Sismorresistente*, which is available online at http://www.igp.gob.pe/web_page/images/documents/ltorres/norma_tecnica_edificaciones.pdf.
- 20 Information on earthquake dates, epicenter locations, and moment magnitudes (M_w) is summarized from United States Geological Survey (USGS), Historic World Earthquakes, Peru, http://earthquake.usgs.gov/earthquakes/world/historical_country.php#peru. Estimates of moment magnitudes for the 1943 Yanaoca, 1913 Abancay, and 1746 Lima earthquakes are not available in the summary.
- 21 According to the local community, the church was affected by an earthquake around 1939. This may be a reference to the 1943 Yanaoca earthquake.
- 22 The term *English bond* is a common English-language architectural word used to describe a type of masonry bond pattern.
- 23 Criteria for determining slenderness ratios are based upon those provided in Tolles, Kimbro, Webster, and Ginell 2000.
- 24 While the baptistery and sacristy wings are beneficial in that they provide additional bracing for the east lateral wall, their added weight also introduces irregularities into the overall structural performance of the church.
- 25 *Kur Kur* is a type of highland bamboo that is commonly used for roof coverings in the Cusco region. The canes are thin and without voids in the center.
- 26 The term *Spanish style* is used to describe roof tiles having a semi-cylindrical shape and laid in alternating courses so that a tile with its convex side up is adjacent to and interlocking with a tile having its convex side down.
- 27 According to Juan Julio García, former director of the Cusco regional office of the Ministerio de Cultura del Perú, this technique is derived from the Incas, who used it to tie roofs to stone gable walls.
- 28 The ridge of the sacristy roof is higher than that of the baptistery roof, and thus intersects with the roof, not the east lateral wall, of the main church.