Building in 19th Century Philippines

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Abstract

Prominent structures in Philippine history include those constructed during the Spanish colonial period such as churches, fortifications, and "stone houses" or bahay na bato associated with the elite. The archaeological investigations of these structures have increased with the annual Field School of the University of the Philippines-Archaeological Studies Program (UP-ASP). This paper is an outcome of one such Field School conducted in 2011.The UP-ASP Field School 2011 conducted an archaeological investigation of a structure recorded as Structure B located in Barangay Pinagbayanan, San Juan, Batangas. This paper investigates the methods and materials used for the construction of Structure B and compares it with Structure A, an adjacent site previously excavated. Both structures were found to be bahay na bato. This paper sheds light on how building construction went about in 19th century Philippines based on archaeological evidence. It presents the different factors that influenced building construction, the peculiarities found in the construction of these structures, the challenges posed on the construction of a bahay na bato, and the mechanisms used to cope with these challenges in the 1800s.

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Introduction

The archaeological excavations of Spanish colonial structures such as domestic structures, fortifications, and churches in the Philippines have been increasing in frequency especially with the annual Field School by the University of the Philippines-Archaeological Studies Program (UP-ASP). In 2011, the UP-ASP Field School excavated ruins of a structure in Barangay Pinagbayanan, San Juan, Batangas (Figure 1). This structure, recorded as Structure B, was the second structure to be excavated in the area and was eventually identified as a *bahay na bato* based on archaeological evidences and local accounts. Structure A was previously excavated in 2009 and 2010 and found around 40m north of Structure B (Barretto-Tesoro *et al.* 2009; Sales 2013; UP-ASP 2010).

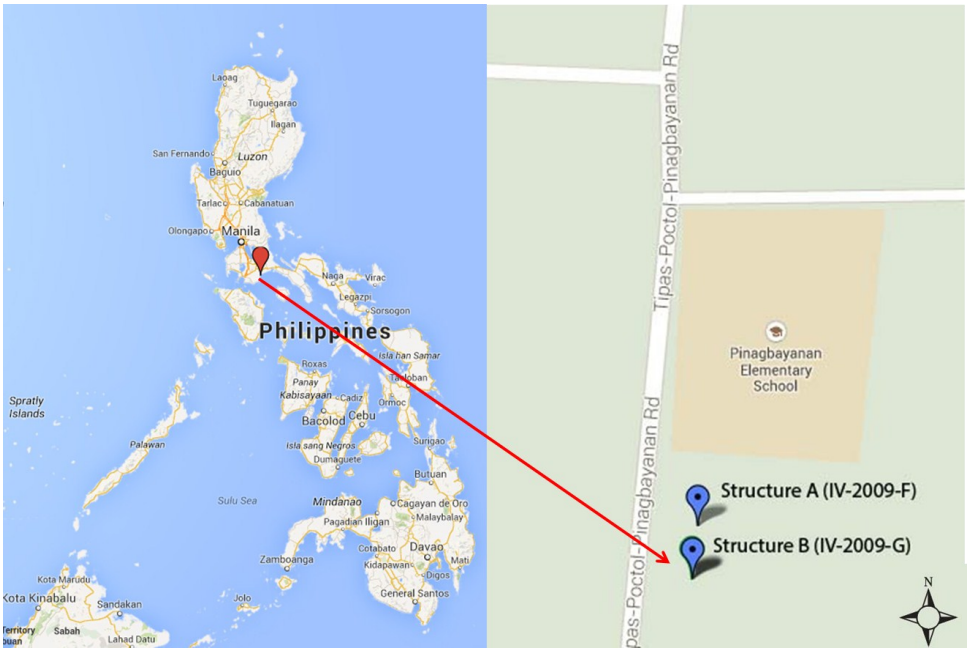

Figure 1: Map of the Philippines showing the location of San Juan, Batangas on the left. On the right is the plan of Structures A and B in Barangay Pinagbayanan (Prepared by ACL Pineda after GoogleMaps 2014).

During the excavation, several questions were raised regarding the structure, one of which was regarding the technology and methods used in its construction. The main objective of this research endeavour is to answer this particular question: what were the methods and technology used in the construction of Structure B?

To answer the aforementioned question, this study's aims are:

1. To identify construction materials found in Structure B;
2. To identify the technology and methods of construction employed in Structure B; and
3. To compare the construction materials and methods in Structure B with Structure A .

With increasing archaeological investigations of structures in the Philippines, this study will contribute to the literature on construction methods employed during the Spanish colonial period and aid in the understanding of colonial structures. It will particularly help in understanding Structure B as well as provide information on building practices employed during the time of its construction. Furthermore, this study may provide a relative date for when Structure B was constructed based on the technology and methods used, and help identify the relationship between Structure A and Structure B. This study will only undertake the investigation of the construction technology and methods used in Structure B. It will not investigate artefacts recovered from the site but will instead make use of archaeological data related to construction gathered from the excavation of Structure B. The entire structure, therefore, will be treated as the artefact. Furthermore, this study will focus on exploring the relationship between Structure A and Structure B, excluding other archaeologically investigated structures. This study will make use of archaeological findings from the excavation of Structure B as primary data. These findings will then be checked against local accounts on Structure B as well as archival research data regarding construction methods and technology used during the Spanish colonial period. For the comparison of Structure A and Structure B, the initial findings of this study and data from previous excavations on Structure A will be investigated.

The *bahay na bato*

The *bahay na bato* was actually a Spanish adaptation of the indigenous *bahay kubo* (i.e. nipa hut) (Huetz de Lemps 1998; Lico 2008; Perez 1989; Valera-Turalba 2005; Zialcita and Tinio Jr. 2002). It followed the post and beam structural system that the *bahay kubo* employs as well as the practice of using only the second floor as the living area (Alarcon 1991; Sales 2010; Yu 1996; Zialcita and Tinio Jr. 2002). The adaptation of

the *bahay kubo* did not come about as a single event, though. The *bahay na bato,* as we know it now, resulted not only from the fusion of Spanish and indigenous architectural styles but is also a product of various events exclusive to the context of the Philippines (Huetz de Lemps 1998; Lico 2008; Manahan 1994; Ordonez 1998; Perez 1989; Sales 2013; Valera-Turalba 2005; Zialcita and Tinio Jr. 2002).

After a series of calamities, like earthquakes and fires that devastated the metropolitan areas of the time, changes to the methods and materials of construction were implemented. In 1583, the city of Manila – with houses and churches made of wood, bamboo, and nipa – were devoured by flames in a matter of hours. This resulted into changes in construction with the city being rebuilt with stone, bricks, and clay roof tiles. By 1645, the walled city of Manila had 600 stone houses (Zialcita and Tinio Jr. 2002). However, a series of earthquakes devastated Manila in 1647, 1658, and 1677, reducing it to rubble. This caused further changes to the design and construction of buildings. Houses were then limited to two storeys with only the first landing of the main stairway made of stone. The second flight of stairs and the second floor were made of wood. Wooden posts were also found to be better adaptive to the shaking ground compared to stone pillars (Lico 2008; Manahan 1994; Ordonez 1998; Perez 1989; Sales 2010; Valera-Turalba 2005; Zialcita and Tinio Jr. 2002). Radical changes in the construction of walls and columns as well as in the roofing material used were primarily brought about by the Earthquake Ordinance passed in 1880 by the then Consultative Council of Public Works. Among the prescribed regulations of the 1880 ordinance were: 1. the use of thinner wood posts; 2. the use of light roofing materials such as corrugated galvanised iron sheets; and 3. the thickness of a wall to be made at least a fifth of its height. Also after the implementation of the Earthquake Ordinance of 1880, foundations were built shallower, running to only about a meter deep (Huetz de Lemps 1998; Yu 1996; Zialcita and Tinio Jr. 2002).

Structure B

The materials used for construction were relatively uniform throughout the structure. Consistent with what is known to be "*bahay na bato*" or "stone house", Structure B was primarily made of volcanic tuff blocks locally referred to as *adobe*. These adobe blocks usually refer to quarried tuff, a pyroclastic igneous rock, commonly used as construction

material in the Philippines since the Spanish colonial period (Alarcon 1991; Valera-Turalba 2005). These adobe blocks are often seen in Spanish-era houses, churches, and fortifications.. However, from an architectural standpoint, *adobe* refers to a material which may be used as plaster or bricks, made of "a heavy soil, composed largely of clay and silt in sufficient quantities to form a matrix in which sand particles are firmly imbedded," (Harris 2006: 13) to which "water is [then] added, and straw, manure, and fragments of tile are sometimes combined with this mixture to provide increased mechanical strength and cohesion when it dries" (Harris 2006: 13). These sun-dried mud blocks could be traced as far back as 8000 B.C. and has been commonly used for construction in Latin America, Africa, some parts of Asia, and Southern Europe (Blondet and Garcia n.d.). Such a conception of *adobe* is very far from the local understanding of the term. Furthermore, during the course of the excavation of Structure B, conglomerate, along with tuff blocks were found to have been utilised. Local residents referred to both types of stone blocks as *adobe*, referring to the conglomerate blocks as "*mahunang adobe*" or "weak adobe". The use of the term *adobe* to refer exclusively to tuff stone blocks is then questionable. It may be that the use of the term *adobe* in the Philippines refers to any stone block. Hence, to avoid confusion, *adobe* will be used in this paper to refer generally to stone blocks. For the construction of Structure B, two types of stone blocks were used. As mentioned earlier, these blocks were either made of tuff or were of conglomerate material.

These stone blocks varied in size. The stone blocks used in the eastern portion of the structure were slightly larger than those on the western side. The sizes of the stone blocks in the western portion, based on what was exposed, ranged from 23 cm to 26 cm x 54 cm to 62 cm x 16 cm while those used in the eastern half ranged from 17 cm to 20 cm x 60 cm to 64 cm x 27 cm. These stone blocks were bound by and plastered with lime mortar and cement for some parts of the structure (Figure 2). Lime mortar and cement were also used as fill for the structure's pillars (Figure 3). Mortar requires aggregates to increase its strength (Figure 4). In the case of Structure B, several types of aggregates were used. *Tisa* or clay roof tile fragments were the most common aggregate in the structure (Figure 5a). *Baldoza* or clay floor tiles were also used, as well as shells, ceramic sherds, and scoria (Figures 5b and 5c).

Figure 2: A pillar base made of tuff stone blocks bound by lime mortar and exhibiting evidence of lime mortar finishing for what used to be a pillar in the southwest corner of Structure B.

Figure 3: Lime mortar fill of a pillar within the eastern half of Structure B. (Photo by K. Tantuico).

Figure 4: Roof tile fragments used as aggregates for a pillar grout. (Photo by K. Tantuico).

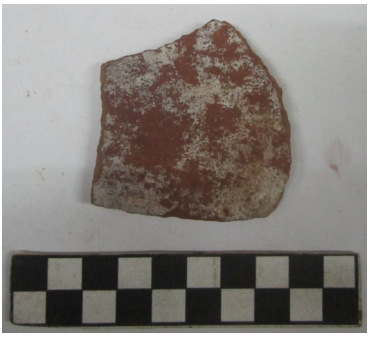

Figure 5a: *Tisa* fragments with evidence of being used as aggregates.

Figure 5b: Scoria collected from Structure B.

Figure 5c: Earthenware sherd with evidence of being used as an aggregate.

Tuff and conglomerate stone blocks, lime mortar, and cement along with various aggregates comprised the structure's foundations, walls, and pillars. Along with these masonry materials, though, locals accounted for wooden posts which they identified as *mulawin* or commonly known as molave (*Vitex parviflora*). These wooden posts were supposedly taken during the destruction of the structure, explaining why the only archaeological evidence found were post holes, post bases, and their foundations. There were six post holes unearthed and one more that could have possibly been a post hole but was no longer explored. These, however, accounted only for the structure's ground floor. According to interviews with local residents, the structure had a second floor made of thick wooden slabs or *tabla*. These, too, were supposedly made of hardwood. Furthermore, according to one account, the second floor was wrapped in *capiz* windows. Consistent with archaeological evidence, worked *capiz* shells were retrieved from the site (Figure 6).

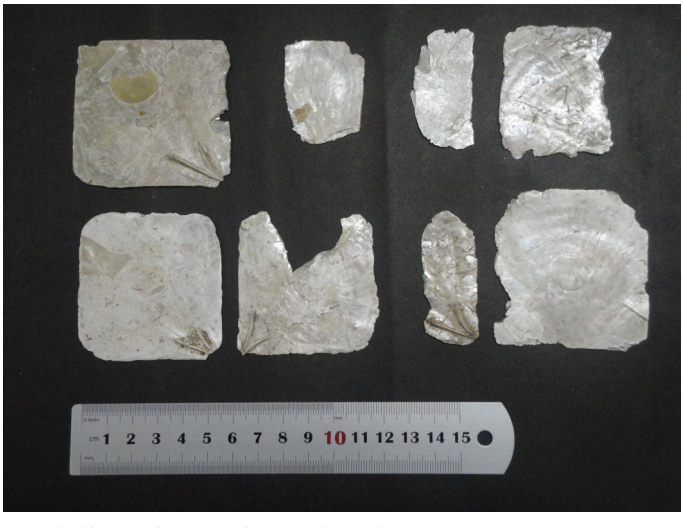

Figure 6: Capiz shells used in windows (Photo by M. Reyes).

The structure's roofing was corrugated galvanised iron (G.I.) sheets. This is supported by a sizeable G.I. sheet fragment recovered from Trench 4 (UP-ASP 2011) (Figure 7) further supported by archival records. According to Mayo (2010), the old town of San Juan, identified as the current Barangay Pinagbayanan, had six families who owned stone houses with metal roofs. With regard to the structure's entryway, local accounts vary. Some said the structure had one entryway on the west facing the current main road. A few said there were two entryways. Archaeological evidence supports that at one point there could have been two entryways.

Figure 7: Corrugated galvanised iron sheet fragment (Photo by H. Valerio).

The south face of the northwest corner had a smooth finishing suggesting that it was the end of the feature and not a result of the structure's destruction. There was also a mortar bed with stone block impressions connecting the northwest corner to the west wall, and leading up to this area from the west are stone block pavers (Figures 8a and 8b). According to local accounts, the entryway was big enough to fit a horse carriage. The distance between the south face of the northwest corner to the edge of the west wall was approximately 165 cm, a reasonable width which may have been wide enough for a horse carriage. Another entryway was directly across the west entryway to the east also with pavers leading up to it. This was smaller though, with a width of 140 cm, and had evidence of being closed off. The door to the main entryway was said to have been made of hardwood. Again, no evidence of this wooden door was found except for metal hinges that are decidedly thicker and bigger than those currently used in houses (Figures 9a and 9b).

With regard to the structure's flooring, there was unanimous account that the second floor was made of wooden slabs consistent with a traditional *bahay na bato*. Regarding the ground floor, however, accounts varied greatly. Some said it had cement flooring; others, a dirt floor; and yet a few said it was made of *baldoza* tiles. A few *baldoza* tile fragments were found during the excavation. However, none of these were *in situ*. What looked to be cement flooring was also exposed in a portion west of the northwest interior pillar. This did not, however, extend throughout the area. The material used for the flooring of Structure B was, therefore, not established.

Figure 8a: West view of the northwest corner.

Figure 8b: South view of the northwest corner with attached pavers.

Figure 9a: A corroded metal butterfly hinge (Photo by H. Valerio).

Figure 9b: Half of a metal hinge.

Construction Methods and Techniques observed in Structure B

There were three construction methods used for the building of Structure B: 1. Grout masonry, 2. Solid masonry, and 3. Dry masonry.

1. Grout masonry is a "multi-unit construction in which the space between masonry units is solidly filled with grout" (Harris 2006: 480). Grout refers to mortar mixed with enough water to make it viscous enough, allowing it to be poured (Harris 2006). This kind of masonry was used for the construction of Structure B's pillars, post bases, and double walls. For the pillars, stone blocks were laid out in a manner forming a square that is hollow in the middle. These blocks were bound by lime mortar, and every few layers, grout is poured into the hollow (Figure 13). A similar method was used for the construction of post bases. However, before the grout was poured, the wooden posts were probably first hoisted up and held in place. The grout, along with stone blocks, helped stabilise the wooden posts. For the double walls, stone blocks were laid side by side with a space in between. Again, these stone blocks are bound by lime mortar, and grout is poured after a few layers of stone blocks (Figure 10).

2. Solid masonry is a method used when masonry units (i.e. stone blocks) are placed directly adjacent to each other to form a solid load-bearing wall system (Ching 1991). It was used for the construction of a single wall in the northwest portion of the structure (Figure 11). Stone blocks were simply laid atop each other in a running bond pattern and bound by lime mortar.

3. Dry masonry is simply "masonry laid without mortar" (Harris 2006: 342). It does not make use of any kind of binding agent and depends largely on the fit of masonry units for its stability. This technique was seen utilised for the foundation of a post base along the northeast wall (Figure 11). The utilisation of rubble for one layer was noticeable in this post base foundation. This was also observed in the pillar foundation in Structure B's southwest corner. Although lime mortar and cement were used to bind the stone blocks of most of the southwest pillar foundation's layers, the penultimate layer was made of irregularly shaped stones with no visible binding agent. Dry masonry was also employed for the pavers on both the west and east sides. Stone blocks were laid directly on the sediment in a running bond pattern with no binding agent or mortar bed. The west and east pavers, however, were oriented differently. The pavers on the east

were oriented north-south while those on the west had an east-west orientation (Figure 15).

Figure 10: This is the eastern half of Structure B where remains (i.e. grout filling) of interior stone pillars and double walls are found.

Figure 11: A portion of the north wall showing a post hole and post base and its foundation which used dry masonry; the only single wall in Structure B constructed through solid masonry. (Photo by M. Sy Cruz).

Inconsistencies in Structure B

Structure B had noticeable inconsistencies in its construction. Just along the south wall found in Trench 3, the double wall east of the exposed post base was 93 cm wide while the double wall directly west of it was only 55 cm (Figure 12). Further to the west closer to the southwest corner of the structure, the wall once again thickens to 62 cm at its widest. Such a drastic change in wall width was also observable along the north walls in Trench 2 (Figure 15).

Figure 12: A portion of the structure's south wall found in Trench 3 exhibiting pronounced differences in wall construction.

Also, the foundation along the south wall was explored. It was found that the wall foundation east of the post hole, referred to earlier, was made of three layers of stone blocks with an elevation of -125 cm DP while that on the west of the post base was made of only two stone block layers with an elevation of -105 cm DP.

Moreover, foundations of two post bases were looked into and it was found that they were constructed differently. The post base foundation along the south wall was constructed in the same way that the wall foundations were built (Figure 12).

The post base foundation along the north wall, however, was constructed similar to the southwest pillar foundation except that the post base foundation did not make use of any binding agent (Figures 13 and 14).

Also noticeable was that pillars within the structure were present only on the eastern half (Figure 15). The only pillar present in the western half was located along the perimeter walls, specifically at the structure's southwest corner (Figure 15).

Figure 13: A post base foundation found along the structure's North wall in Trench 2.

Figure 14: Ruins of a pillar, its base, and its foundation located in the structure's South-west corner in Trench 1.

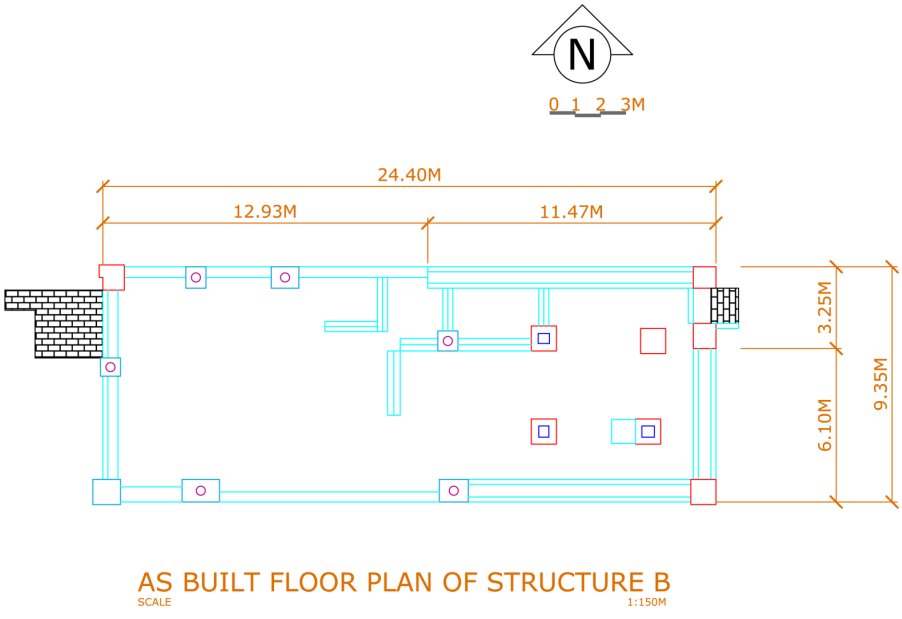

Figure 15: Structure B's floor plan based on the 2011 excavation (Prepared by Angel Sales from UP-ASP 2011).

It was also observed that the number of post bases increased in the structure's western half. Such observations may be indicative of two things:

1. There were two phases of construction with the first being the construction of the eastern half of the structure. The first construction phase probably began prior to the Earthquake Ordinance of 1880 when structures generally depended on deeper foundations, stone pillars, and thick walls. This was a time before thinner wooden posts were prescribed and foundations became shallower.

2. The second floor of Structure B was only on the eastern portion supported by the four inner stone pillars. This would be consistent with local accounts that the second floor did not cover the entire area of the ground floor. This would also explain the enclosures and wall-like features within the structure. They could be what were left of the main staircase with two landing platforms beginning parallel to the north wall, directly in front of the entryway, and then turning right going southwards. This would be consistent with local accounts as well.

Another noticeable inconsistency is in the method employed in the building of walls during the second phase of construction. All of Structure B's walls were double walls except for a portion of the wall in the northwest found in Trench 2. A stretch of the north wall connected to the northwest corner was a single wall (Figure 15).

These inconsistencies may be reflective of how building construction was undertaken in 19th century Philippines. During those times, there were no trained architects, engineers, foremen, or carpenters. The first Filipino architect, Felix Roxas, Sr., left the Philippines in 1840 and came back in 1854 after studying and practicing architecture in England and Spain. He then held several positions such as interim head of the Public Works Office in 1866 and eventually as architect for the Manila Government (Zialcita and Tinio Jr. 2002).

It is thus understandable that, if the construction of Structure B began before the Earthquake Ordinance of 1880, there were not that many trained architects and engineers in the Philippines, and those who were schooled were employed by the government and focused on public works. House builders, then, were not formally trained and only had their practical experience to bank on. As Zialcita and Tinio Jr. (2002:33) put it, "they [builders] often guessed their way through". This may be a reason behind the inconsistencies in the construction of Structure B such as in the case of the corner pillars of the south wall. These builders, however, are not to be belittled. Although oftentimes illiterate and without formal training, *maestros* were recognised for their skills (Yu 1996; Zialcita and Tinio Jr. 2002). A *maestro* was often employed in the countryside from the big towns and cities. He directed the project from start to finish and was his own architect, engineer, and foreman. The typical *maestro*, however, "did not know how to calculate, in advance, the precise dimensions of the building as a whole and in its minute parts. As a result, he has no way of computing the quantity of materials to get" (Zialcita and Tinio Jr. 2002: 39). He, therefore, only ordered the materials as work progressed. This made house-building extremely challenging since getting materials to the construction site was already not without great difficulty (Valera-Turalba 2005; Zialcita and Tinio Jr. 2002).

The circumstances of 19th century Philippines – with the difficulty of acquiring and transporting construction materials as well as a *maestro*'s lack of knowledge on standard cost estimating procedures – undoubtedly had its effects on the construction of Structure B. The aforementioned

conditions are the most probable explanations to Structure B's phases of construction and inconsistencies.

It may be that materials procured when the construction began were insufficient for the entire structure. Construction, hence, had to come to a stop for a while, resulting to the eastern half of Structure B. The rest of the materials probably came during or after the pronouncement of the Earthquake Ordinance of 1880. Hence, the walls were thinner, the foundations with fewer layers of stone blocks were, thus, shallower, and wooden posts were used in the western half.

Such difficulty in accessing materials may also explain why a portion of the northern wall was a single wall as opposed to the double walls of the rest of Structure B. It is tempting to think that the house builders, illiterate and without formal training, were inept. At first glance, this anomalous single wall seems to be a product of such incompetency. However, upon thoughtful inspection, Structure B's single wall actually exhibits the cleverness of its house builders.

As mentioned earlier, Structure B's single wall was located along the northern perimeter. This side of the structure faces Structure A – also a *bahay na bato* previously investigated archaeologically – and is hidden from public view. If the anomalous single wall was located in the west, it would have been facing the main Barangay Road. If it were along the southern or eastern perimeter, it would have been facing an old road now known as *kalsadang putol* and would thus have been open to public view and scrutiny. The single wall's location, therefore, could not have been just coincidental or a product of thoughtless endeavour. Its location was carefully decided upon, hiding it from public view, keeping the structure's grandeur and establishing the owner's status in the community. The only probable reason, then, for why a portion of the wall was constructed differently than the rest of the structure is that materials could have once again run out, and the owners could no longer delay the completion of the structure.

Comparing Structure A and Structure B

Structure A was a *bahay na bato* located north of Structure B. It was archaeologically investigated for two years prior to the excavation of the latter (Barretto-Tesoro *et al.* 2009; UP-ASP 2010). Like Structure B, it was found to be a *bahay na bato* built in the late 1800's (Sales 2013). According

to local accounts, both structures were taken apart. Structure A's stone blocks were recycled by the locals and used to build fishponds as well as *tungko* or outdoor stoves starting in the 1950s (Sales 2010). Structure B, on the other hand, was also said to be taken down in the 1950s. According to local accounts, the materials were recycled in the construction of a house in a nearby town.

Structure A was constructed in a similar manner to Structure B. They both utilised the double wall system, although a portion of Structure B had a single wall. They basically used the same materials, although more conglomerate blocks were observed in Structure B whereas Structure A predominantly used tuff blocks. Both structures had stone pillars as well as hardwood posts. However, Structure A utilised stone pillars as the main structural support of the house whereas Structure B primarily utilised wooden posts.

They both used lime mortar with *tisa* aggregates as binding agent, although it was observed that Structure B also used other materials as mentioned above. There was also evidence that, like Structure B, Structure A had *capiz* windows.

Unlike Structure B, however, Structure A had decorative mouldings along the base of its exterior walls. It also had pilasters on its exterior of which none was found in Structure B. Moreover, Structure A had arches whereas no evidence of such was found in Structure B.

Also, Structure B had no sufficient evidence to establish the flooring material whereas Structure A had several flooring materials *in situ* such as *baldoza* tiles and tuff stone blocks. *Baldoza* tile impressions on mortar flooring were also exposed as well as compact dirt floor of dark reddish colour. These changes in flooring material helped in the analysis of the use as well as the hierarchy of space in Structure A which, unfortunately, could not be established in Structure B. Furthermore, unlike Structure B which used corrugated galvanised iron sheets as roofing material, Sales (2013) would argue that Structure A made use of *tisa* or clay roof tiles. However, archival records do not mention any house in *Pinagbayanan* having clay roof tiles for roofing. Instead, six stone houses with metal roofing were recorded (Mayo 2010). Another major difference is in the method of construction used for the foundations. Structure A made use of wooden planks as formworks, indicated by plank impressions on excavated foundations, while there was no such evidence anywhere in Structure B. Based on these evidences, the owner of

Structure A seems to have had more means to get good quality construction materials such as tuff stone blocks and clay tile flooring. Structure A was also more decorative with its arches, mouldings, and pilasters. This indicates that the owner of Structure A may have been wealthier than the owner of Structure B. On the other hand, these differences may simply be indicative of changing times. Based on the predominance of stone pillars in Structure A and of wooden posts in Structure B, Structure A may have been constructed at an earlier time than Structure B.

Conclusion

Structure B is a *bahay na bato* constructed in 19th century Spanish colonial Philippines. An analysis of its construction shows the challenges of house building in the 1800s. Its construction methods and materials say quite a lot about its social milieu. Its phases of construction show that, consistent with archival records:

1. *Maestros* or master builders of the time relied only on previous construction experiences and did not have sufficient knowledge for estimating, in advance, the amount of materials needed for the construction of the entire structure; and that
2. Raw materials for construction were difficult to come by. From the procurement to the transportation, house builders faced numerous challenges to accessing construction materials; and such difficulties left uncertainties as to how long it would take for completion.

On the other hand, Structure B also exhibits the craftsmanship of house builders of the time. Although without formal training, house builders – or at the least *maestros* – were skilled and experienced. They may have guessed their way through but they worked with careful thoughtfulness.

Although both structures have been archaeologically established as stone houses, there were quite significant differences in their construction. One is in the materials used. Tuff stone blocks are known to be more durable than conglomerate blocks and were more commonly found in Structure A than in Structure B. Furthermore, the predominance of stone pillars as opposed to wooden posts as well as the supposed use of clay roof tiles rather than corrugated galvanised iron sheets for roofing

may be indicative that Structure A was completed prior to the Earthquake Ordinance of 1880 and before the completion of Structure B. Also, the construction of Structures A and B were probably undertaken by different *maestros* as seen in the differences in construction method and design.

Recommendations

The preliminary analysis of the construction methods and technology used in Structure B and its comparison with the Structure A shed some light on how construction of stone houses were undertaken in 19th century Philippines. It also, however, raised several questions.

It is recommended, then, that for further studies, the following may be explored:

1. The peculiar form as well as the use of rubble or irregularly shaped masonry in the construction of the column (i.e. stone pillar and wooden post) foundations;

2. Sourcing of construction materials such as lime, hardwood, *capiz* windows, and roofing materials;

3. The utilisation of various types of aggregates such as ceramic sherds, roof and floor clay tiles, and volcanic rocks; and their effects on the durability and strength of the mortar produced; and

4. The variability in design of stone houses and its possible correlation with the status of the owners.

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