

Assessment of Heritage Churches in Isabela, Cagayan Valley

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Abstract: *This study focused on the assessment of the present condition of the five (5) heritage churches in Isabela namely: San Pablo de Cabigan Church of San Pablo, St. Rose of Lima Parish of Gamu, St. Matthias Parish Church of Tumauni, Our Lady of Atocha Church of Alicia and Our Lady of the Pilar Church in Cauayan City. Ocular inspections and observations were performed to determine the structural defects, the non-structural defects and damages of the structures. The compressive strengths of these churches were determined by the non-destructive method through rebound hammer. It also includes the profile of the churches and the relationships between the ages of the churches to its compressive strengths were determined. Findings showed that San Pablo de Cabigan Church located at Cabagan is the oldest church while the youngest church is Our Lady of Atocha at Alicia, Isabela. Moreover, Our Lady of the Pillar Parish Church at Cauayan is the largest church in terms of floor area while the smallest is Our Lady of Atocha Parish Church at Alicia, Isabela. Majority of the churches used bricks as building materials. The existences of cracks on walls of the churches were visible which caused the damaged of the structure. Moreover, the non-structural defects such as botanical growth, timber decay, human error and damaged stone details contributed to the deterioration of the building. Most of heritage churches have no beams and columns instead buttresses were constructed which served as the main structural member supporting the walls. Result shows that the length of existence (age) of the heritage churches has no relationship to its compressive strength. Necessary retrofitting and maintenance measures maybe recommended restoring and preserving the original features of the heritage structures. For future researches, an appropriate structural diagnosis using up-to-date techniques for identifying the state and source of damages of the buildings for the preservation of heritage monuments may be considered.*

Keywords: Assessment, heritage churches, structural defects, non-structural defects, retrofit, rebound hammer

1. Introduction

Cagayan valley currently has a wide variety of historical traces from past civilizations of which some of these historical structures have survived in their original form, while some have been damaged because of various influences, and have lost their initial functions. The protection of historical structures and their safe transfer to next generations is one of main challenges of today's world.

Isabela is one of the provinces in the Cagayan Valley Region in Luzon and is the second largest province of the Philippines next to Palawan. Its capital is Ilagan and borders, clockwise from the south, Aurora, Quirino, Nueva Vizcaya, Ifugao, Mountain Province, Kalinga, and Cagayan. Isabela as an agricultural province is the rice and corn granary of Luzon.

Tourism plays a significant role in the formation of the gross domestic product in the province thus, creating additional jobs and providing employment for the population. Isabela with its vast area and population, tourism is relatively a new industry being developed in the province. Support services and accommodation facilities are likewise being developed and heritage structures like ancient churches were preserved and maintained for tourists.

Ferit Cakiret al,(2014) in their study "Assessment of structural performance of historical Ishan church" focused on the investigation of structural behavior of the Church in Artvin, Turkey. The Ishan Church is modelled numerically and analyzed by means of static and dynamic analyses and results proved that the cracks identified in the structure are caused by external effects and excessive load. Moreover, critical stresses are frequently observed in the skewback of

main arches, and these parts are considered to be risky in terms of structural performance.

Aguilar and Briceño (2014) in their paper "Structural Diagnosis of a 16th Century Earthen Masonry Church Using IR Thermography" presents a summary of the structural diagnosis works that were carried out in the Saint Peter Apostle church of Andahuaylillas, Peru which is one of the most representative earthen monuments in South America. Architectural and structural features of the church were presented as well as the structural issues that were initially identified and passive IR Thermography was used in the interior and exterior of the church to assess structural anomalies. The application of this technique successfully allowed the identification of different materials, insertions which acted as reinforcements in the past and that were hidden in subsequent restorations, historical additions/modifications, as well as areas with cracks that were initially not visible.

The study of Brooke (2018), "Thermal Imaging for the Archaeological Investigation of Historic Buildings", used a passive infrared thermal camera to examine several historic buildings that are known or suspected to contain hidden archaeological information and results confirmed that it is possible to detect various types of man-made anomaly and to differentiate building materials.

Thus this study focused on the assessment of the heritage churches of Isabela, Cagayan Valley namely: San Pablo de Cabigan Church – San Pablo, Saint Matthias Parish Church – Tumauni, Saint Rose of Lima Parish Church – Gamu, Our Lady of Pillar Parish Church – Cauayan City, and Our Lady of Atocha Parish Church – Alicia, for the community to

become aware of possible danger posed by the age and structural conditions of these churches.

Objective of the study

The study was conducted to assess the present conditions, structural defects, the non-structural defects and damages of the structure and identified the compressive strength of the five (5) heritage churches in Isabela. It also includes the profile of the churches and determined the relationship between the ages of the churches to its compressive strength.

2. Methodology

The study used the descriptive research design method, ocular inspections and observations were done to describe the defects of the heritage churches found in Isabela among which are: San Pablo de Cabigan Church of San Pablo, St. Rose of Lima Parish of Gamu, St. Matthias Parish Church of Tumauni, Our Lady of Atocha Church of Alicia and Our Lady of the Pilar Church in Cauayan City. The strength of these churches was determined by the non-destructive method through rebound hammer. The walls were tested at every span considering one meter along the horizontal and one meter along the vertical. Correlation was used to determine the relationship between age and compressive strength of the churches.

3. Results and discussion

Table 1: Profile of the Churches in terms of age, location, floor area and material used in construction

Name of Parish Church	Age (yrs)	Floor Area (sq. m)	Materials used
St. Rose of Lima	282	809.36	Bricks
Our Lady of Pillar	275	1672.44	Bricks
Our Lady of Atocha	167	753.48	Bricks
St. Matthias	233	809.76	Bricks
San Pablo de Cabigan	392	903.96	Adobe

Table 1 shows the profile of the churches in terms of age, floor area and materials used in construction. From the five (5) heritage churches, San Pablo de Cabigan Church was considered the oldest (392 years), while Our Lady of Atocha Parish Church was considered as the youngest which 167 years is. Moreover, in terms of the space, Our Lady of Pillar Parish Church got the largest floor area, 1672.44 square meter while the smallest is Our Lady of Atocha Parish Church, having a floor area of 753.48 square meters. It was also noted that the materials used in construction of majority of the churches were bricks, however, San Pablo de Cabigan church used adobe as the main construction building material. This is affirmed by FeritCakir, 2014 that the construction materials used for masonry structures in Turkey Ishan Church are stones and handmade bricks.

Table 2: Main structural members of the churches in terms of beam, column and buttress

Name of Parish Church	Beam	Column	Buttress
St. Rose of Lima	X	X	√
Our Lady of Pillar	√	√	X
Our Lady of Atocha	X	X	√
St. Matthias	X	X	√
San Pablo de Cabigan	X	X	√

Legend: x= not existing
√= existing

√= existing

Table 2 shows the main structural members of the churches in terms of beams, columns, and buttresses. As gleaned from Table 2, most of the churches has no beams and no columns while buttresses were used as main structural members in almost all the churches except for Our Lady of Pillar Parish church. These buttresses support the walls and also it strengthen the whole structure of the heritage churches. Beams and columns are the structural members seen only in Our Lady of Pillar Parish church.



Figure 1: The presence of buttresses at our Lady of Atocha Parish Church

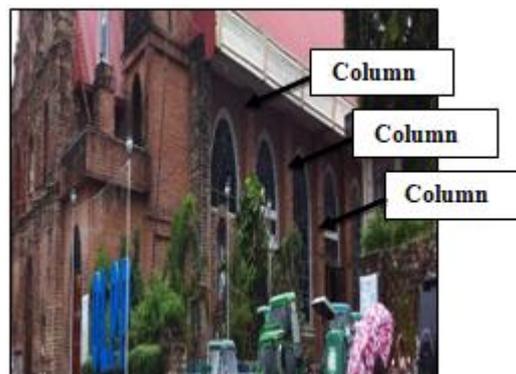


Figure 2: The presence of columns at our Lady of Pillar Parish Church

Table 3: Structural Defects and Damages of the Churches

Name of Church	Cracks	
	Floor/Slab	Walls
St. Rose of Lima Parish Church	X	√
Our Lady of Pillar Parish Church	X	√
Our Lady of Atocha Parish Church	X	√
St. Matthias Parish Church	X	√
San Pablo de Cabigan Church	X	√

Legend: x= not existing
√= existing

Table 3 shows the structural defects and damages of the churches. As observed, cracks were found on walls of all the five (5) churches as shown in fig. 3a and 3b below, while no cracks can be seen in floor slabs of these heritage buildings. From this result, the damaged on the walls of the churches which are caused by the presence of cracks contributes to the deterioration of the structural members of the building.

FeritCakir, et al. observed deteriorations in the church were mainly caused by the damage to structural elements and the

decay of structural materials. Several different-size mature cracks were detected on the upper parts of walls of the structures, and in different zones of the church.

The study of Valerio, Ma. Luisa M NHCP, (2012), assessed the conditions of the church in the Philippines in terms of the causes of deterioration of the structures. It is stated that through the years of the church's existence, the slender trusses, with the roof had deformed pushing the walls outward. Ground movements and earthquake occurrences aggravated the stability of the walls, thus cracks appeared.

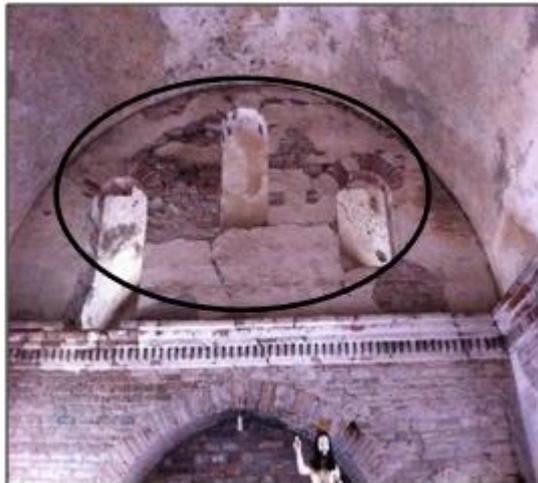


Figure 3 (a): cracks on the walls of the St. Matthias



Figure 3 (b): Cracks on the walls of San Pablo de Cabigan Parish Church

of Our Lady of Pillar Parish Church, St. Matthias Parish Church and San Pablo de Cabigan Church. However, minimal numbers of growing plants were observed at St. Rose of Lima Parish Church and at Our Lady of Atocha Parish Church.

Moreover, there were human errors observed at St. Rose of Lima Parish Church, Our Lady of Atocha Parish Church and at San Pablo de Cabigan Church. An example is the improper installation of electrical wirings which was observed at St. Matthias Parish Church. However, it was observed that only at St. Rose of Lima Parish Church, where decay of timber structures was present.



Figure 4: Timber decay at Saint Rose of Lima Parish Church

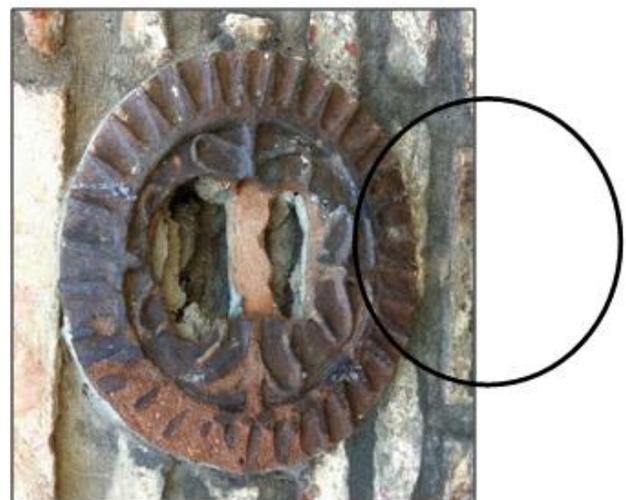


Figure 5: Damaged stoned details St. Rose of Lima Parish Church

Table 4: Non-Structural Defects and Damages of Church

Name of Parish Church	Damaged Stone Details	Botanical Growth		Human Error	Timber decay
		minimal	abundant		
St. Rose of Lima	√	√		√	√
Our Lady of Pillar	√		√		
Our Lady of Atocha	√	√		√	
St. Matthias	√		√	√	
San Pablo de Cabigan	√		√	√	

Table 4 shows the non-structural defects and damages of the churches. As gleaned above, damaged stone details as well as botanical growth are present in all five (5) heritage churches. These botanicals grow abundant in sides and top



Figure 6: Human error (improper installation of electrical pipe) at St. Matthias Parish Church



Figure 7: Botanical growth at our Lady of Atocha Parish Church



Figure 8: Abundant botanical growth at San Pablo de Cabigan Church

Table 5: Compressive Strength of Churches

Name of Church	Average Compressive Strength
St. Rose of Lima Parish Church	34.22 MPa
Our Lady of Pillar Parish Church	33.06 MPa
Our Lady of Atocha Parish Church	34.86 MPa
St. Matthias Parish Church	39.52 MPa
San Pablo de Cabigan Church	35.36 MPa

Table 5 shows the compressive strength of the five churches using the rebound hammer. Based on the result, the church with the highest compressive strength is St. Matthias Parish Church with an average compressive strength of 39.52 MPa while the church with the lowest compressive strength is Our Lady of Pillar Parish Church with an average compressive strength of 33.06 MPa.

Similarly, Jim Brozovsky,(2014) assessed the Compressive Strength of Calcium Silicate Bricks by using the combined nondestructive methods; the ultrasonic pulse method and the rebound hammer method .

Krakow, ul. Warszawska, (2015), A Comparative Study on the Compressive Strength of Bricks from Different Historical Periods. The study presented the results of compressive strength tests for bricks from different historical periods.

Relationship between the age of the church to its compressive strength

A correlation of -0.157 was obtained this implies that age of these heritage churches is not related to the compressive stress of these structures.

4. Conclusions

In view of the foregoing findings, the following conclusions were drawn:

San Pablo de Cabigan Church located at Cabaganis the oldest church while the youngest church is Our Lady of Atocha Alicia, Isabela. Moreover, Our Lady of Pillar Parish Church at Cauayanis the largest church in terms of floor area while the smallest is Our Lady of Atocha Parish Church at Alicia, Isabela.

Majority of the churches were built using bricks. The existence of cracks on walls of the churches were visible which caused the damaged of the structures while non-structural defects such as botanical growth, timber decay, human error and damaged stone details contributed to the deterioration of the building.

Most of the heritage churches have no beams and no columns instead buttresses were constructed which served as the main structural member that support the walls. It found out that there is no significant relationship between the age of the church to its compressive strength.

5. Recommendations

Necessary retrofitting measures should be done to restore and preserve the original features of the heritage churches.

For future researches, an appropriate structural diagnosis using up-to-date techniques for identifying the state and sources of damage of the buildings for the preservation of heritage monuments may be considered.

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