Metropolitan Cathedral of Cochabamba

Conservation and maintenance plan

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Abstract
The Cathedral is the main religious building of Cochabamba city. Constructed in 1701 in the heart of historical center, the building has suffered additions, interventions, and damages. The historical district inhabitants, the municipality and the archbishopric are making efforts to recover the technological, formal and spiritual values of the building.

The objective of the conservation project not only will be the fixing of structural problems but also the following of a maintenance program. This monument should be self sustainable, having new tourist and educational uses including abandoned spaces.

Fig.1 Cathedral location in front of the main square plaza

Introduction

Cochabamba in Virreynal times regarding its geographical position as a valley between the highland plateau and the tropic region, becomes an convenient place to live or visit. Agriculture was the main activity of its inhabitants, at the beginning the urban development was very slow. The noble families used to live on rural areas were they construct manor houses and supported religious building constructions.

The "*Villa de Oropeza"* founded in the late XVI century by Gerónimo de Osorio, adopted the reticular trace and the distribution of the Villa sites according with the Spanish crown regulations.The Cathedral was located in the main square plaza called "*14 de Septiembre*".

Background

This church was reconstructed two times at the same place. The first one built before the foundation of the *Villa de Oropeza*, was described as: "*little and provisional*". In 1618 the structure was wick and the archbishopric agrees to build a bigger church in accordance with the number of inhabitants.

Fig 2 Main facade with mestizo baroque style

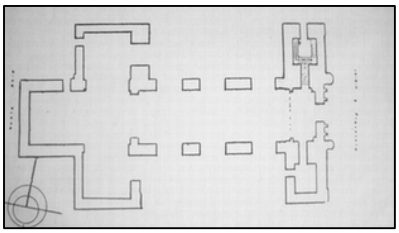
After one hundred years the church was deteriorated and dangerous again, its demolition and reconstruction was commanded.

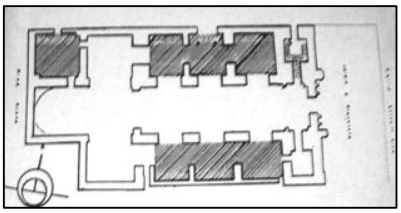
The construction of the actual church, begins on 1701, supposed following the drawings of Canedo y Mazo, and concludes on 1735. It has a renaissance style with Latin cross plan design; the nave and the lateral chapels were covered by vaults; the four storey tower and the baptistery were flanking the main entrance, both of them and the transept were covered by domes. The façade reflects the fusion between Spanish baroque and indigenous style, now called "*mestizo* baroque style". The cemetery was located in the southern part.

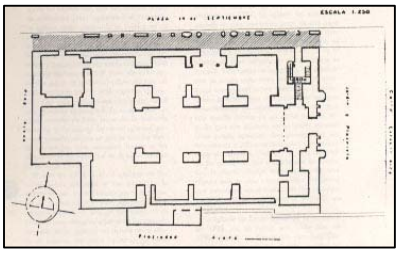
At the end of XVIII century, two lateral naves and the sacristy were added.

In 1847 the church becomes Cathedral by Papal Bull.

In 1922, the lateral stone facade was removed and replaced by an arch gallery.







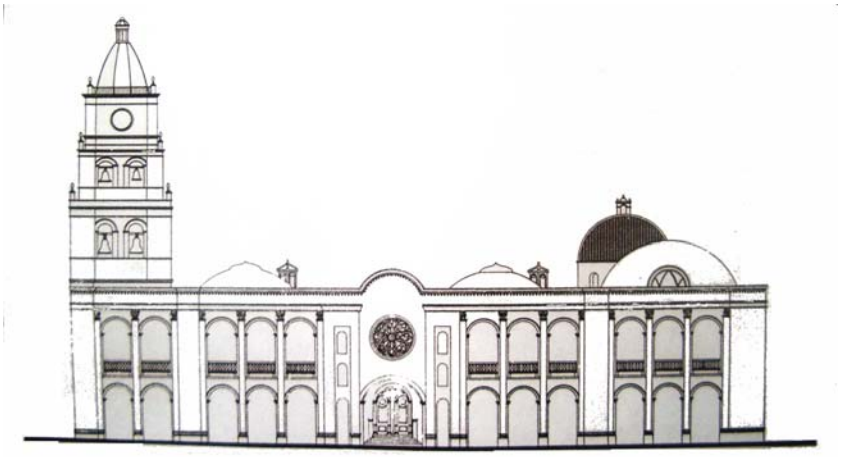


Fig. 3 Lateral façade in front of the plaza

Geography

The department of Cochabamba is located in central Bolivia, west of La Paz and north of Sucre. It has an area of 55,631 sq. km and 1,671,860 habitants.

The capital is the city of Cochabamba, the third largest city in Bolivia, longitude 66° 09' west, latitude 17° 23'. Located along the Rocha river in a valley of the Andes, 2,600 m a.s.l.

Fig. 4 Bolivia's location

Climate

Cochabamba is known as the "City of Eternal Spring" due to its spring-like temperatures year round most of the year. In the rest of department the climate it's warm and varies with the altitude, cold and snowy in the mountains range and temperate on the valleys. The southeast zone is the least rainy with warm and dry weather.

Architecture

The cathedral was built with stone and adobe masonry structure, 2,00 - 2,50 meters of thickness. Tenth vaults and three domes were made with brick and lime mortar all covered by "colonial" ceramic tiles, lying over a bed of mud. In the outside, walls were covered by a first base of mud cover and lime plaster finish. Inside the finish was made by gypsum plaster.

The church has three naves, parallel to the square plaza. Two access, the main one with an atrium located on Esteban Arce street and the other (the most used), in front of the main square.

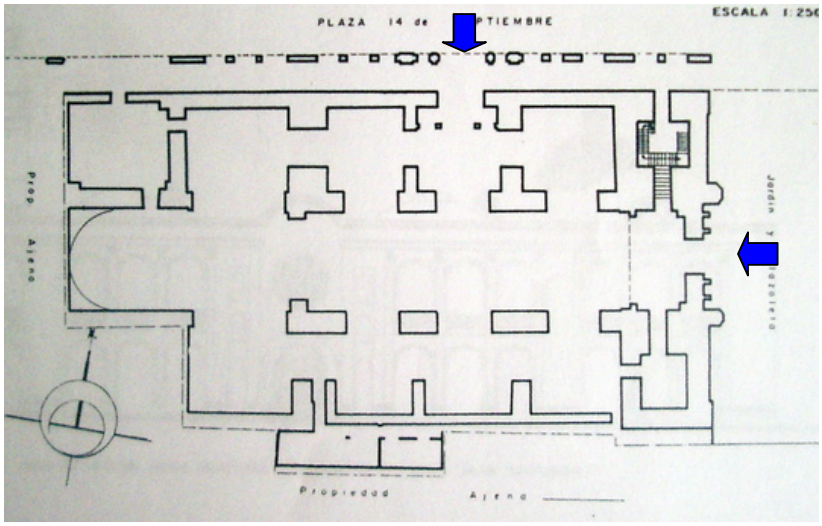


Fig. 5 Drawing of architectural floor plan

The last structural intervention was made on 1990-94, at that time the building was in similar conditions as today: it had humidity on walls, fissures in main and lateral vaults, detachment of plaster and paint and detachment of floor tiles.

The works executed were: construction of a new concrete structure over the vault and reposition of roof ceramic tiles; construction of a concrete bed and replacing of floor material; interior consolidation and reposition of plaster; restoration of paints; and main stone facade cleaning.

Archaeological works has been performed in the last intervention, two layers of floor were founded, one with ceramic tiles and the other with square brick tiles, and beneath them, remains of bones.

In 2006, the southern façade was cleaned and lime plaster removed completely leaving the stone wall unprotected.

The main façade and the tower belong to the Virreynal time. The façade with *mestizo* baroque style, divided in three parts is ornamented with lateral pairs of columns.

Fig. 6 Main facade

In the interior, old sculptures of Virgin of *La Merced* and Christ tied to the column. On the ceiling, there are republican fresco paintings of Avelino Nogales.

VALUES

- Historical

One of the oldest churches in the city. Is the symbol of the Diocese of Cochabamba, and has been always the center of religious and cultural life in town.

- Architectural values

The Cathedral reflects different architectonic periods of time such as colonial and republican, some parts of the building still conserves the original materials.

The four sides of the plaza present arch galleries and buildings from XIX and XX century, which combined with the cathedral, constitute a homogeneous and well-conserved patrimonial area.

- Landmark

This building is a landmark of the city, it's a religious and architectonic reference.

- Social

Is special for people, because the most important celebrations take place there.

The gathering at this place, unify people because it helps to spread the Christian faith and spiritual values.

The cathedral as a tourist attraction has a vital role to emphasize the area as a tourist spot.

This church provides an identity and pride to the citizens.

- Educational

The building is an interesting investigation object of architecture and helps to understand the design and development of the city.

Problems

Institutional

The economical problem between historical center inhabitants and municipality, they didn't come to an agreement and whit out it, no project can be done.

The actual major have been facing problems with the law for bad economical management.

Today, works of restoration in other buildings are still been made by no specialists professionals or even by priests, but lately people have been aware of the necessity of a Conservation professional with specific and accurate approaches about old buildings.

Architectonic

After 14th years since the last intervention, the building is facing almost the same deterioration problems.

Fig. 8 Roof drainage system

Roof

Plane triangle roofs between lateral vaults, (made for water drainage), mortar; and ceramic tiles have been damaged by exposure and lack of maintenance.

The effects outside are fissures, detachment of roof material, and plant growth, all of them producing leaking of water.

Inside the building, humidity, detachment of gypsum plaster and paint, and gradual weakening of arches structure.

Fig. 7 Detachment of roof material

Walls

Fig. 9 Dampness and detachment of wall plaster.

Before the last intervention, walls were in the same condition as they are today. Dampness climb over the stone plinth, about 1,40 m. in every wall of the building. Salt white stains appear on the stone.

The last intervention with a concrete floor layer could be the reason of ascendant humidity on walls, also the cement plaster cover over the walls is making the problem even worse.

Detachment of plaster and paint. Weakening of wall structure produced by moisture problems, which may lead to cracking and disintegration of the masonry.

Arch and vaults

Fissures on internal part of arches located in the transept, the presbytery, lateral chapels and arch windows.

Fig. 10 Fissure on arch

Detachment of plaster ornaments and paint. Weakening of structure.

Tower

One of the oldest parts of the cathedral made of stone and lime mortar.

The stone structure is stable, but the plaster, paint, and stone ornaments are damaged by exposure and lack of maintenance. Also in the interior, stairs and landings are in extremely bad conditions.

Fig. 11 Unsafe stairs and landings

It's dangerous to go to the upper levels of the tower.

The facade shows an old and neglected image.

The gallery

The same problems as the church with roof filtrations, also walls with cement plaster cover, another issues climate exposition and human misuse, beggars use it a urinal. Lack of maintenance.

Fig. 12 Lateral facade

Detachments of plaster and paint, deteriorated image of the building.

Recovering of spaces

The second level of the gallery and spaces over the lateral naves, are abandoned or used as deposits. Recovering those spaces to create a Museum of old paints, religious ornaments and clothes, will help wit the maintenance costs.

Method

Investigation

Research and gathering information about the historical backgrounds of the church, looking for construction books in the Cathedral archives, also in the Municipal Historical Archive. Newspapers, old paintings and photos will be important too.

Survey

The measurement work will be out based on old drawings, but we have to verify the accuracy of the measurements made on 1990, after that, create digital drawings of actual status on AutoCAD.

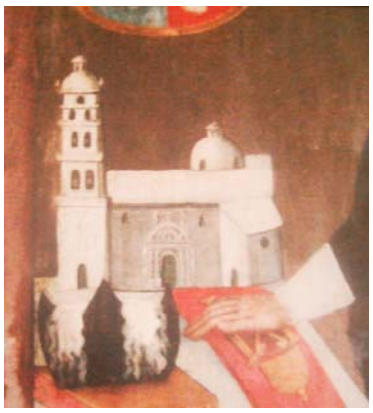


Fig. 13 Lateral façade.- Old paint showing a model of the Cathedral and Francisco Urquiza the benefactor.

The study of structural condition after 14th years has to be conducted by an engineer, based on soil and structural test.

Floor and wall diggings to determine the source of water.

Analysis of each space in the building whit pictures and drawings, showing the quantity of damages.

Proposal

Making an analysis of investigation and survey documents, the proposal will be carried out as follows:

Architectonic proposal

Roof

Ceramic tiles and mortar have to be removed from the roof. After that select the reusable ones, then put over the vault a waterproof layer, and replace mortar and tiles.
Remove plant growth.
Cleaning and fixing up drainage system.
In the inside fissures on vaults and arcs will be filled up, plaster and paint.

Walls

After excavations works and the determining of dampness causes, the solution has to be in terms of attacking the problem not only the consequences. If the cause, is the existence of veins of water under the church soil and the concrete layer, the procedure will be to take of floor tiles and concrete base, after that conduct and drain the water outside the building. But, if the cause is as Konrad Fischer suggest, lack of ventilation,

the procedure will be (as he explained), to desiccate the wall: 1) taking of the stone plinth, the plaster and clean the wall; 2) watering the wall in order to make the salt come out; 3) retire the salt, clean the wall; and repeat the procedure until there is no salt. After that put back the plaster but no cement, only lime plaster and no paint, 4) put back the stone plinth if required.
Also is important to replace and fix old gutters.

Tower

Deteriorated plaster outside and inside, have to be removed and replaced with lime plaster.
Demolition of deteriorated brick and wood stairs and landings. The project design will determine the high of each level, in order to leave the openings free.
To protect from pigeon damages, it's necessary to cover openings with metallic net.

Fig. 14 First floor gallery

The gallery and the recover of spaces

The intervention on cathedral roof and gutters reconstruction and cleaning will fix the filtration problem. Cement plaster over the stone walls have to be removed, desiccate the wall, and replaced with lime mortar.

Social problem of poor people "living" on cathedral corridor requires political, economical and institutional changes and compromises; meanwhile the maintenance will be the palliative.

It's possible to involve the community into works of restoration helping with the carry of materials and so on, and after that a daily participation whit the guided routes inside the Cathedral.

New cultural, educational and economical uses are required, not only to earn money but to give live to the entire building. After the explanation of the project to archbishopric they totally accept the proposal to adequate a part of the second floor of the gallery to use it as exposition rooms, where old paints and objects will be exposed, also the idea of the guided rout inside the church. Both activities shall be paid by visitors.

Fig. 15 Lateral entrance

The global intervention implies a route outside and inside the monument. The inside route should start on the main entrance and then: 1) walk inside the church; 2) visit the sacristy; 3) up in the second floor visit the exposition rooms; 4) walk the gallery with a close and beautiful view of the main square; 5) visit the chorus; 6) go up to top level of the tower, admiring the old clock machine and of course the amazing views of the city; 7) walk on the roof, go down and finish the visit.

Fig. 16 Gallery

Doors and windows carpentry, altars
Cleaning up and restoration of: carpentry elements, altars and ornaments that has been damaged.
Repair joints around doors and windows.

Information and didactical binder
Dick Sandberg show as a very useful tool to describe, understand an maintain the Cathedral, a binder which should be reachable for everybody.

Document about the old technical ways of construction, with description and specific drawings of every single item in the building, for example roofing: how the tiles were build and fixed to the vaults and domes. This will help in the future to know how to reconstruct and to teach next generations how an old building was constructed.

The project must involve a multidisciplinary staff of professionals, and participation of the owners (church and people), to make an appropriate and global intervention in the building.

Budget
The project of conservation and maintenance will be made with the archbishopric support, but the execution shall be paid by taxes of the historical central district as soon they make an agreement with the municipality. A group of professionals, a priest and the head of the historical center district has been already formed and they will decide which company will carry out the project and works of restoration.
The available budget is 100,000 dollar and will be used for:
Structural and soil studies and diggings, 6,000 U$;
Works of intervention on the roof need about 65,000 U$;
Walls and the gallery need more or less 20,000 U$ it depends of the source of the damage;
Binder and documentation of technical ways of construction at least 2,000 U$, the rest will be reserved for unexpected or emergency works.

For restoration of ornaments about 10,000 U$, and the recovering of tower image need at least 40,000 U$, but this works shall wait for the next money donation.

Maintenance

The church must carry out the maintenance works, supporting the work with money from entrance tickets, and at least a 5 % of the district taxes should be destined to this kind of works.

Daily
- Floor sweep
- Remove of dust and dirt from reachable parts of walls and altars.

Weekly
- Vacuuming floors and narrow spaces between walls, also cleaning altars and mouldings with the help of ladders or scaffolds.
- Every week the floor must be polished

Every month
- Removal of dirt and garbage from gutters and downspouts allows drainage systems to function properly, and prevents water infiltration. In case of leaking, careful examination of the area may involve the removal of some roofing material.

- Checking of walls, mortar joints and vaults.

Every three months

- Inspect roof, gutters and downspouts.
- Wood elements also should be examined, rooting or decayed parts can easily be detected through visual examination
- Doors and window joints around the frame must be tight to prevent water or air from entering.
- Checking of deterioration on mortar of tiling floor and stains.
- Façades cleaning with no abrasive product

Every six months

- Test of drainage systems condition, checking of corrosion, holes, faulty connections on gutters and downspouts, especially before the rainy season.

Every year

- Checking if the alignment of structural elements is correct.

- Scrapping and repainting of old painted elements to prevent weathering of the original wood or metal frames.

- Electrical equipment should be cleaned and evaluated. Change bulbs and fuses.

- Maintaining exterior wall finishes is critical to preserve a historic building. Lime mortar need a timely repair of cracks, is necessary to check and immediately replace the mortar with the exactly same strength of the original. Sagging is also a sign of structural failure.

Active masonry cracking as a sign of structural problems should be early detected and fixed by skilled professionals.

This entire works must be carried out with non-toxic and abrasive products in order to preserve not only the historic fabric of the building but also the health of the inhabitants.

Every five years

The architect in charge of maintenance plan should make a revision and present a full report every five years about the actual state of the building, detecting structural defects, pointing out the problems that should be kept under observation. Also propose the immediate, urgent, necessary and desirable works.

At least 10 % of the total budget must be assigned to emergency activities due to unexpected problems.

Hypothesis

The cathedral as an important patrimonial and religious building of Bolivia has to be in perfect conditions, recovering its structural stability and beautiful integral image. This can be achieved with the conservation project and a maintenance program. The maintenance need a year round budget for periodical works and should be covered by introducing other functions to the building, like a museum, guided tour and crafts.

Results

Increase the identity of population, reinforcing the feeling of proud for having and using an important historical monument. Also allowing people to walk around the building will help to appreciate it even more.

After works of conservation and constant maintenance, the building will be safe and free of further interventions, except the periodical ones i.e. painting or replacing of roof tiles.

The income from entrance tickets should cover the maintenance cost.

A binder with detailed data about the building will help to the owners and visitors to appreciate and maintain the monument.

Conclusions

After conservation works people will be aware about the value of this historical building and also the necessity of working the same way with other patrimonial buildings.

It's important to reconsider the use of new materials and techniques, we have to respect and learn about traditional ways of construction and materials in order to make a good intervention in the historic building.

The Cathedral will continue "alive" for another 300 years or more if works of maintenance and interventions will be carried out at adequate time and if people cares about its conditions.

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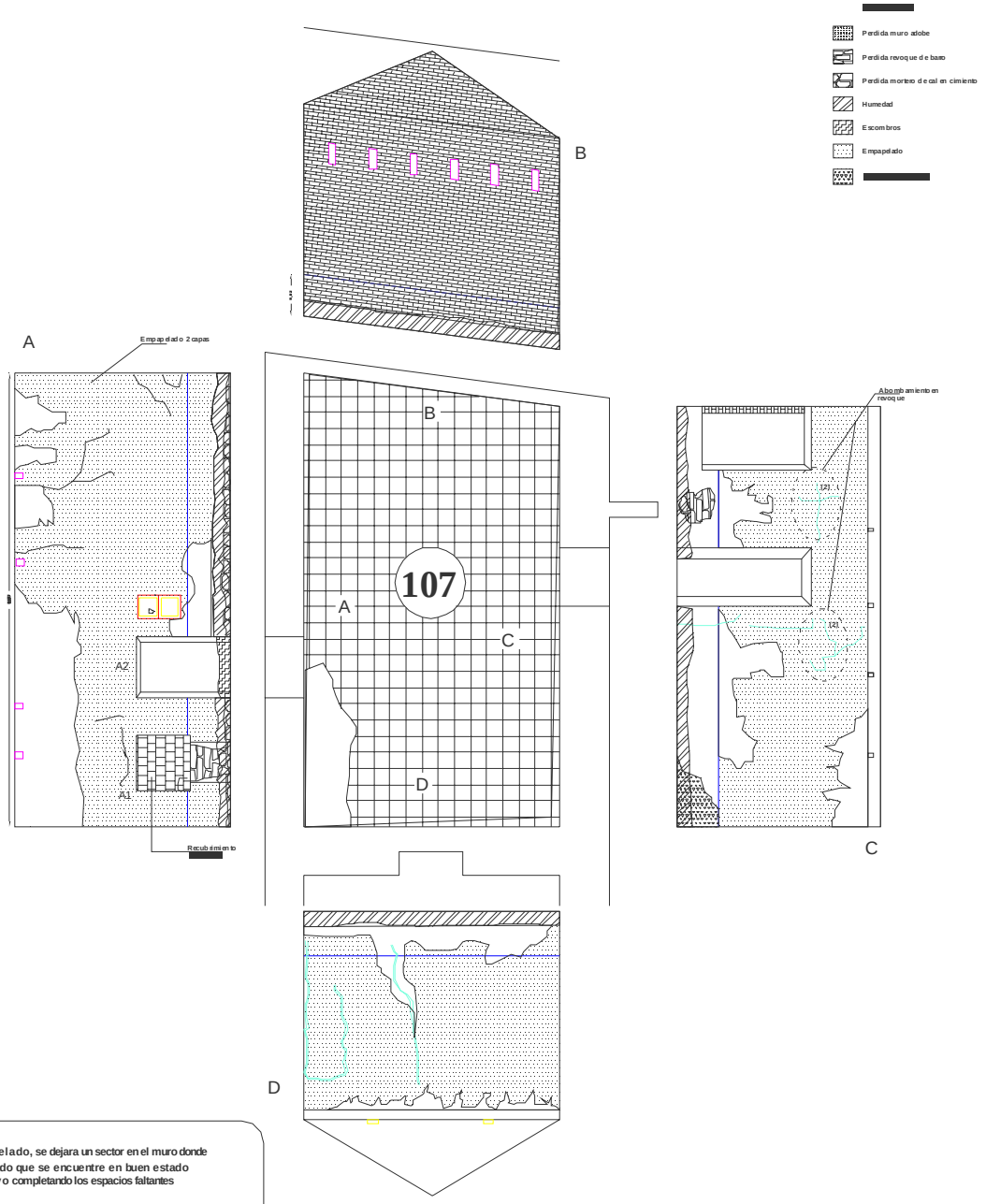
Annex 1

- Pathologies detection and quantification of damages. Based on Konrad Fischer: Room equipment Catalog 3



OBSERVACIONES

Muro A presenta dos capas de empapelado, se dejara un sector en el muro donde se observaran ambas capas. El empapelado que se encuentre en buen estado se mantendra y se integrara uno nuevo completando los espacios faltantes para mantener la imagen del ambiente.

Grietas en muros deben ser reparadas costurando con adobe de las mismas caracteristicas del original.

Se debe determinar si las fisuras son solamente en revoque o si estan afectando el muro.

(1) El muro B pertenece al vecino, es necesario construir uno colindante.

(2) Los sectores del muro C con abombamiento de revoque por aplastamiento de material de muro seran intervenidos retirando el material danado de revoque y adobe, para ser repuestos y adecuadamente reforzados con vigas de madera e hiladas de ladrillo con mortero de cal.

Piso de tierra debe ser nivelado y el piso de ladrillo faltante repuesto.

ELEMENTOS CONSTRUCTIVOS			DETERIOROS										INTERVENCIÓN			
			Desplome	Disgrega.	Humedad	Pérdida	Desgaste	Fisuras	Grietas	Sin Trabaj	Flexión	Sin Daño	Reposición	Demolición	Reconstruc.	Remoción
CIMIENTO	Cal y Canto	A			2.30								2.30			2.30
		B			(1)											
		C			2.70	0.10							2.80			2.70
		D			1.50								1.50			1.50
		TOTAL			6.50	0.10							6.60			6.50
MUROS	Adobe	A						4								
		B			■											
		C						6								
		D							2				7.20			7.20
		TOTAL						6	2				7.20			7.20
	Ladrillo															
	Piedra															
Hº Aº	Vigas															
	Columna															
PISOS	Ladrillo															
	Ladrillo Pastelero 25 x 25 cm.					2.60	38.8						2.60			
	Tierra															
	Cemento															
ENTR.	Viga de madera, maguey, barro															
	Viguetas Pretensadas															
REVESTIMIENTO MUROS	Revoque barro															
	Revoque cal															
	Revoque yeso	A				2.20							2.20			
		(1) B														
		C				4.10							4.10			
		D														
		TOTAL														
	Pintura															
	Empapelado	A				10.80							10.80			
		B														
		C				10.90		6					10.90			2.40
		D				4.70	20.40						25.10			
		TOTAL				26.40	20.40						46.80			(2) 2.40
CUB.	Teja Colonial					65.0							65.0			
	Calamina															
	Vigas madera (Par y nudillo)						4						?			
VENTANA	Dintel															
	Marco															
	Ventana															
	Celosía / Enfarolado															
PUERTA	Dintel	A1					■						?			
		A2					■						?			
		C3					■						?			
	Marco	A1					■						?			
		A2					■						?			
		C3					■						?			
	Puerta															
INSTAL.	Electricidad															
	Agua															
	Alcantarillado															