MULTAN WALLED CITY

Multan, one of the oldest inhabited cities in the Asian subcontinent, is a commercial hub and the biggest city of South Punjab, with a population of over 5 million.

Known as the 'City of Saints', the walled city of Multan, the ancient core, preserve a rich and great heritage of the past.

Table of contents

5 Technical sheet for maintenance, conservation and reuse works 101

Introduction

Mariacristina Giambruno
Sonia Pistidda

The Walled City of Multan is made up of buildings from different historical periods. Some of them have many interesting elements and are important examples of traditional building types.
The state of preservation of many historic buildings is, in many cases, precarious, raising concerns not only about the deterioration of materials and structures but also about poor and unsanitary housing conditions.
The enhancement of the Walled City of Multan should provide synergistic actions for the conservation and rehabilitation of historical heritage and for general improvement of housing conditions.
The historic buildings often have replaced parts, additions and alterations—work conducted under the banner of "modernity" and globalization—that ignore the architectural characteristics of the existing buildings.
Traditional architectural elements —such as plaster facades, coloring, decorations, roofs, paved open spaces, furniture items and so on— are too often replaced with "falsely" authentic ones or destroyed altogether in an effort to modify the historic buildings to make them resemble more-recent projects.
As new elements and functional parts are added to the buildings, we often see the implementation of measures that disregard the buildings' historic characteristics and the consistency of the fabric; moreover, these changes are often of poor architectural quality.
To preserve the historic buildings, it's not enough to impose rules (through plans or laws), and it's

not necessary to propose a "laundry list" of the major elements of a historic building to be reproduced in a literal way that tries to reconstitute a place's expected identity.
On the contrary, it is essential help the buildings' users and designers to recognize the morphological and material characteristics of historic buildings, to govern the transformation of parts that normally are destroyed because they are not recognized as characterizing the built environment and as aspects of the material culture of a defined place and historical moment.
These guidelines aim to advise designers and inhabitants on appropriate ways to rehabilitate and valorize the historic buildings of the Walled City of Multan.
For this reason, the guidelines are addressed to three different types of users.
First, they can be extremely useful for monitoring changes in the Walled City by administrative bodies. Second, they can guide designers and artisans who are not always prepared to work on existing buildings doing conservation and reuse projects.
And last but not least, the guidelines are addressed to the inhabitants, to enable them to participate in the conservation of the place where they live, encouraging their greater understanding and appreciation of the specificities and uniqueness of their historic buildings.

The first chapter (1. Knowledge Process) is dedicated to the process of gaining knowledge about historic buildings. In fact, any restoration work of a building should be preceded by careful studies to define the sizes, geometry, materials and decay phenomena.
The study of the historical development and the transformations experienced by the building over time is essential to understanding its present condition.
The section includes information on performing the historical research, such as which documents should be obtained; on the geometrical survey; and on the material and decay phenomena survey. These studies must be carried out by technical experts, such as architects and engineers.

The second chapter (2. Multan Walled City. Locally available building materials and construction techniques) describes the most important materials and construction techniques that characterize the historic buildings of the Walled City.
An understanding of historic materials and traditional construction techniques is essential to achieving proper conservation and reuse projects.
A general description of the historic materials used in Multan (brick, stone, plaster and mortar, finishes, metals and wood) is followed by a photographic collection that identifies the materials and the construction techniques through pictures of the historic buildings of Multan.
This collection, on one hand, will be helpful to designers and workers, and, on the other hand, can inform and sensitize the inhabitants. In fact, through the photographic collection they can recognize the characteristic features of their own home: this is a first and important step to guide them toward the conservation process.

The third chapter (3. Materials and structural decay phenomena: glossary) is dedicated to a glossary of the main decay and structural issues observed in the historic buildings of the Walled City. Here the problems that plague historic materials are described, divided by the severity of phenomena. This tool can be useful for designers, engineers and inhabitants, to help them understand if the building is affected by serious phenomena that require urgent actions or only by superficial problems that can be easily addressed.

The fourth chapter (4. Best and bad practices) presents the best and bad practices for the conservation and reuse of historic buildings.
It is an immediate and simple tool, illustrated with pictures of the major errors that can be made on the materials and architecture of historic buildings. The goal of this tool is to sensitize the inhabitants and to guide them to undertake correct conservation and reuse interventions.
The first part is dedicated to generally accepted and not recommended interventions; the second part to the best and bad practices in the conservation of materials of the historic buildings (brick, stone, plaster and finishes, metal and wood); the third part to accepted and not recommended reuse works, in particular for re-distribution of interior spaces, added parts, and new cooling systems and other installations.

The fifth chapter (5. Technical sheets for maintenance, conservation and reuse works) discusses the main corrective interventions needed for the conservation of the historic buildings of the Walled City. The data sheets describe the most common problems, explaining what the problems are and what should be done, then give possible solutions.
The interventions are described in a simple way, with step-by-step instructions illustrated by drawings that show how to conduct the operations.
The factsheets include simple operations that can be done by the inhabitants and unskilled workers and also indicate when craftsmen or experts (architects or engineers) are needed.

The sixth chapter (6. Checklists) contains some checklists for technicians and inhabitants. The first checklist, through simple questions and illustrations, is dedicated to the inhabitants to verify if they live in a historic building: if so, it is necessary to follow the indications described in the guidelines. The second checklist, divided into two parts—one for inhabitants, the other for technicians—is designed to determine the building's structural stability and pinpoint areas of vulnerability that could lead to collapse.
The third checklist, dedicated to the inhabitants, gives simple guidelines for the maintenance of their buildings, directing them to the technical sheets for more specific instructions.

2

MULTAN WALLED CITY

LOCALLY AVAILABLE BUILDING MATERIALS AND CONSTRUCTION TECHNIQUES

Historic materials
Brick
general characteristics

Brick masonry is the most common type of construction in Multan Walled City, probably because of the large amount of suitable clay available for the manufacture of bricks.
The brickwork consists of an assemblage of bricks bounded together in mortar to form a homogeneous mass of the structure: in this kind of masonry the loads and stresses are distributed throughout mass. The most commonly used mortar in the brick masonry of Multan Walled City is lime mortar, although, particularly in more recent buildings, it is not unusual to find cement mortar. Brick earth (the earth used in the manufacture of bricks) is molded in rectangular blocks of uniform size and shape, then dried and burned in a special kiln: these are known as **burnt bricks**.
There are also bricks simply dried in the sun, known as **sun dried bricks.**
The firing process gives the bricks strength and durability.
Bricks can be manufactured in any shape and size: the standard size is 19x9x9 that becomes 20x10x10 when including the thickness of the mortar joints on each side.

Type of brick	**Size in cm**
Large bricks	
Brick size in British Period	**22,5 x 10,5 x 7**
	22,5 x 11 x 7,5
	22,9 x 11,4 x 7,6
Small bricks	
Bricks size in Mughal/Sikh Period	**17 x 12.5 x 3**
	20.3 x 12.7 x 3.8
	20.3 x 12.7 x 3.2
	20.3 X 13.3 X 3.2
	20.3 x 14 X 3.8

The most commonly used bricks in Multan are large bricks, small bricks and small bricks with patches of large bricks.

Assembly of the elements
The depression created in the face of a brick during production is called **frog**.
A frog may help to increase the lateral strength of the structure (forming a key of mortar between two adjacent layers of brickwork) and reduce the weight of the bricks.

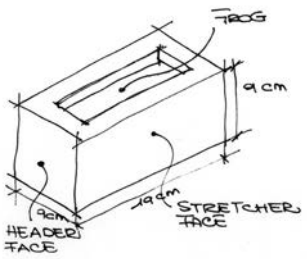
The frog can have a size of 10x4x1 or 2 cm deep. A hand-molded brick has one frog, a pressed brick two frogs and a wire-cut brick has no frog.
The position of a brick with its frog in the horizontal plane is called **brick on bed**.
In general the bricks are laid on their bed in most of the brick wall.
When the brick is laid with its frog in the vertical plane, this is called **brick on side** (stretcher face and side surface 19x9). This kind of laying is generally used for plinth and sills.
When the brick is laid on its header face and surface (9x9) this is called **brick on end**. This position is used for edges or along pavements of roads.

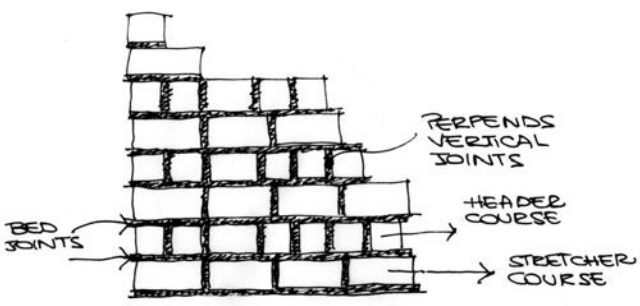
When a brick is laid by its longer side this forms a layer of **stretcher course**: it provides longitudinal strength to the wall. When a brick is laid with its end surface or width in elevation, this forms a **header course**: it gives transverse strength to the wall.
Each course of brickwork is connected by horizontal joints of lime mortar known as **bed joints** with uniform thickness. The vertical joints between bricks are known as perpends. The **perpends** of alternate courses should be in the same vertical line for the stability of the masonry.
The exposed or external surface of the bricks is known as **face**, the unexposed or internal surface is known as **back**, while the interior part between the face and the back is called **hearting**.

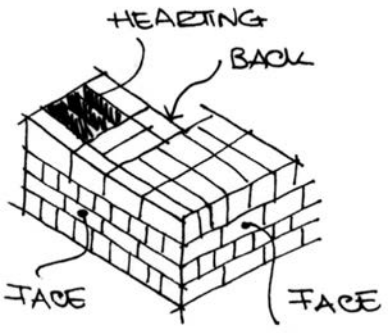
Bond
Bond is the arrangement of bricks in each layer so as to avoid continuity of vertical joints in the successive courses both in the length and thickness of a masonry structure. A bond is provided to ensure longitudinal and lateral strength of the structure and to distribute the load uniformly to its foundation.
Some principles should be observed to ensure a good bond in brickwork:

- All the bricks should be of uniform size and shape.
- The arrangement of laying bricks must be uniform.
- The vertical joints should be vertically above each other in the alternate courses.

It's possible to classify the brick masonry according to:
- the type of mortar used
- the type of bricks used
- the type of construction adopted







Brick

FACADES

Bearing face bricks

- *Small bricks*
- *Large bricks*
- *Small bricks with patches of large bricks*

Bearing face bricks



01 SMALL BRICKS



02 LARGE BRICKS



03 SMALL BRICKS WITH PATCHES OF LARGE BRICKS

Stone
general characteristics

Stone is an important and commonly used material in historic architecture. While there are many ways to classify stone, it can generally be classified in the following three ways:
- physically
- geologically
- chemically

Pakistan has deposits of different types of stone—including marble, onyx and granite—but mainly three types have been used in historic buildings for architectural purposes: sandstone, limestone and marble.

In Punjab there are deposits of marble, granite and, particularly in this region, crystalline grey or grayish white limestone and dolomite.
Each of these types of stone have different characteristics and uses; for example:
- Granite is a very hard and strong stone that can have different colors; it can used for important construction.
- Marble is a quite hard stone available in many colors; it's very expensive and so its use is restricted to monuments and ornamental buildings.

The common building stones in Punjab are:
- granite
- gneiss or stratified granite
- limestone
- marble
- kankar
- sandstone

The historic city of Multan has few stone buildings, structures or elements. Rather, buildings are typically constructed of brick or wood. Only occasionally will one come across decorative elements in stone, such as columns.
In Pakistan examples of stone architecture are seen in monuments and archeological sites (a pavilion at Shalamar Garden, Lahore; Alamgiri Gate, Lahore Fort, Lahore; Naulakha Pavillion Sheesh Mahal, Lahore Fort, Lahore; Taxila archaeological sites, Punjab).

Plaster / Mortar / Wall Coating
general characteristics

General information

Mortar is a mixture of inorganic binders, predominantly fine aggregates, water and any inorganic compounds (or a mixture of binder and water only) in such proportions as to give to the mixture, in the fresh state, an appropriate workability and, in the hardened state, appropriate characteristics and physical, mechanical properties (strength, malleability, adhesion, porosity, permeability to water in the vapor phase and liquid phase, desired appearance, durability and so on).

The mortar is composed of:

• water

• binder: materials that when mixed with water form a plastic mass that serves to connect various materials used in a manufactured product and that, adhering to them and hardening, forms a monolithic assembly adapted to resist mechanical stress

• aggregate: material that is added to a binder to reduce the shrinkage of the dough and to modify the mechanical properties

The aggregate is divided into:

- inert aggregates that do not react chemically with the binder (sand of varying origin and crushed stone or marble)

- aggregates that are pozzolanic reactive (or have “pozzolanic behavior”), which do react with the binder

In the case of lime binder the reaction confers water availability to the mortar; in the case of hydraulic lime or cement binder (pozzolans, surkhi) it contributes to its water availability.

There are aerial mortars that have air binders and non-reactive aggregates, and hydraulic mortars that have hydraulic binders and lime with pozzolanic aggregate (or pozzolanic behavior).

Plaster is a coating composed of several layers of mortar.

It’s possible to classify the plaster as:

• plaster of air lime mortar

• plaster of hydraulic lime mortar

• plaster cast

• mud mortar plaster

Types of Lime

Non-hydraulic lime/fat lime (safady)

Non-hydraulic/fat lime can be obtained from calcinations of nearly pure limestone. Quick lime belongs to the variety of fat lime that, when left exposed to the atmosphere, absorbs moisture and carbon dioxide and thus becomes air slaked. The product thus formed is an inert powder of calcium carbonate called hydrate of lime. It is white in color and contains over 95% calcium oxide. Fat lime, when slaked in water, reacts rapidly with a hissing sound and produces heat sometimes up to the boiling point of water.

Fat Lime Putty

This is the purest form of non-hydraulic lime. Fat lime is usually used in saturated form, known as “lime putty” or lime cream. It is produced by calcination of pure lime, in a kiln.

Hydraulic Lime

Hydraulic lime has the characteristic of setting and hardening under water. Hydraulic lime is not a pure lime, but contains calcium oxide, magnesium oxide, and silica, together with some oxide of iron, etc.

Kankar lime

Kankar is a nodular variety of limestone and is used extensively for producing hydraulic lime. Kankar usually contains carbonate of calcium, clay and sand.

Aggregates pozzolanic reactive

The pozzolanic aggregate or pozzolanic behavior gives a hydraulic behavior to mortar.
The most-used pozzolanic aggregate in Multan, due to the high clay content of the soil in the area, is surkhi.

Surkhi

This is a powdered form of burnt bricks used as fine aggregate in lime mortar. Surkhi is prepared by finely grinding well-burnt good-quality bricks, without particles of soluble salts or coatings of soil or silt.

Use of lime

Non-hydraulic lime/fat Lime
This lime is used for white washing and as lime putty.
Fat lime putty
Fat lime putty is used for plasterwork, lime wash and binding masonry.
Hydraulic lime
Hydraulic lime may be used for stone masonry, plastering and other outdoor work.

Wall coating

01 LIME PLASTER

02 LIME PLASTER

03 MUD PLASTER

Columns, balustrades and other decorative elements