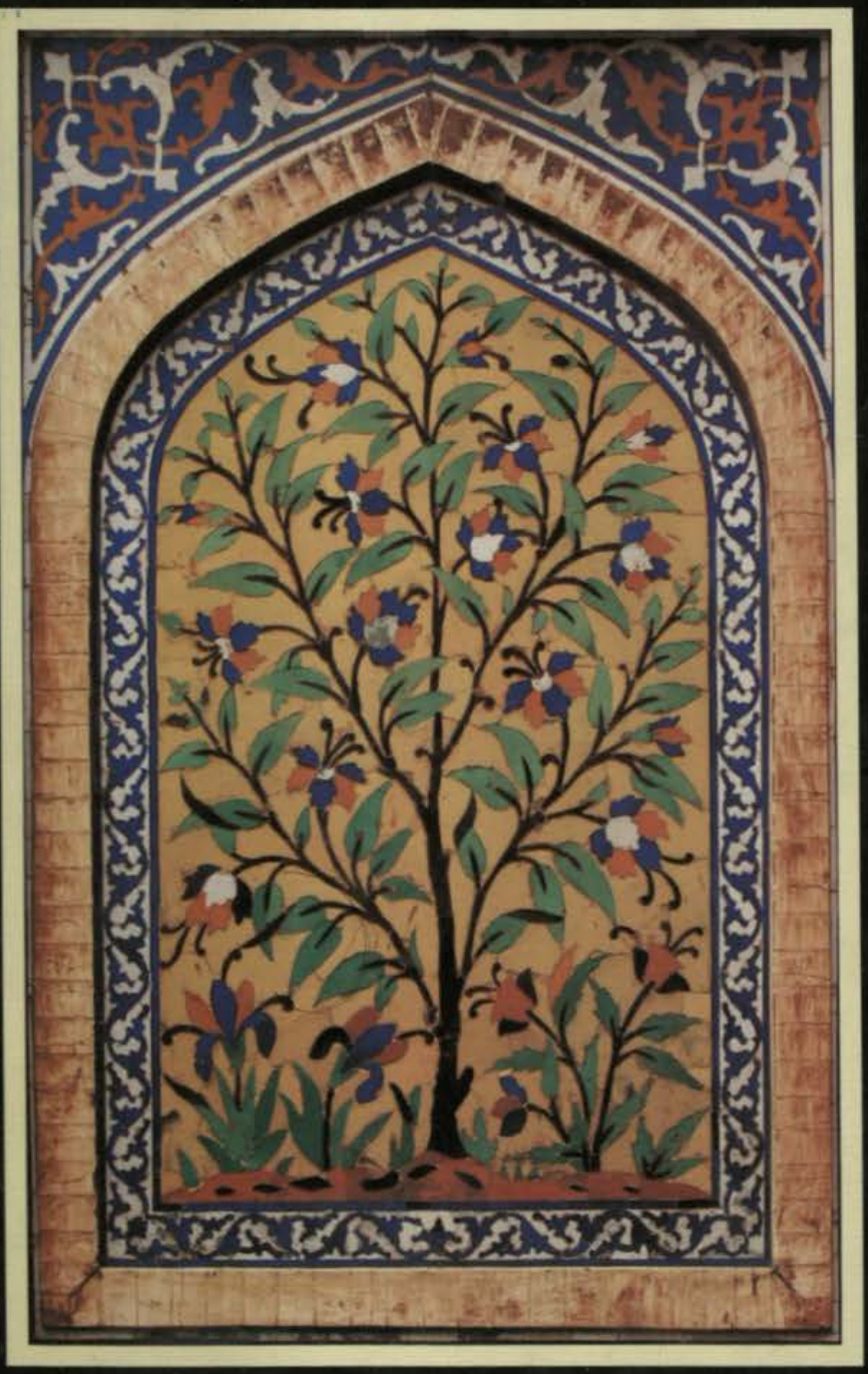
TRADITIONAL ARCHITECTURAL CRAFTS OF PAKISTAN

HISTORY & TECHNIQUES



Talib Hussain

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HISTORY & TECHNIQUES

Talib Hussain

M.I.E (Pak) Civil Engg. M.A. History(Pb), M.PEC

Al-Faisal Nashran
Ghazni Street, Urdu Bazar,
Lahore, Pakistan.

LOK VIRSA
Garden Avenue, Shakarparian,
Islamabad, Pakistan.

Author
Talib Hussain

Executive Editor/Publisher
Khalid Javaid

Title Designed
S. Muhammad Ali

Publication Officer
S. Muhammad Ali

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Al-Faisal Nashran
Ghazni Street, Urdu Bazar,
Lahore, Pakistan.

Garden Avenue, Shakarparian,
Islamabad, Pakistan.

Dedications

I would like to dedicate this book to my parents who made me what I am today

&

Late Muhammad Wali Ullah Khan who trained me in conservation of historical monuments.

Contents

FOREWORD

As our arts, historically speaking, are inseparable from our crafts, so are our crafts inseparable from our architectural embellishments. Unlike Western World, our artists and craftsmen do not form two separate entities. Instead of being two different individuals, one being an artist and the other a craftsman, in our history and society, it was invariably one individual doing both jobs, acting as an artist or a craftsman as the occasion demanded. Our arts and crafts have always been interlinked, inter-connected and inter-dependent on one another. This has been particularly so, in the field of architectural decorations. In our history, all buildings -forts or palaces, havelis or caravan-sarais, gardens or hunting grounds, mosques or mausoleums have in them incorporated some elements of decorations, both in their exteriors as well as interiors . The number of crafts used in a particular building and the extent of their application, their exuberance and excellence largely depended upon the public status of the building, its decoration and the financial status of builder and his/her sentimental and spiritual attachment with building thus constructed. Kings and queens have always been in the forefront in such activities and following the precepts set by their masters, their governors, courtiers, businessmen and other philanthropists and followers of great saints constructed a galaxy of such buildings which, as seen today, stand as embodiment of artistic achievements of an age.

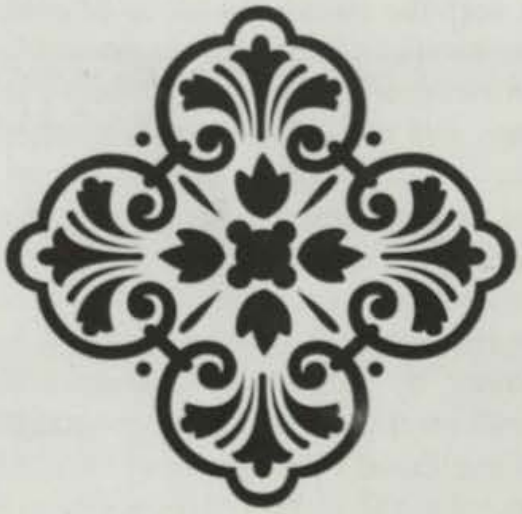
Now a days it has become a fashion among certain circles of intellectuals to condemn all such cultural and artistic activities of our predecessors. For them resources spent on the construction of Taj Mahal ultimately caused the downfall of the Mughal Empire and that Shalamar Garden was built with the sweat and blood of common men of Lahore. But we forget that in an age when there were no industrial estates and huge factories, when there was no WAPDA, Railways and Airways who engage great man-force, buildings of forts, palaces and huge mansions, mosques and mausoleums and strangely though, maintaining huge armies were the only means of controlling unemployment, and keeping hundred and thousands of engineers, artist and craftsmen, artisans and their families, as well as ordinary labour engaged in their respective professions. It was this patronage that helped promote arts, crafts and culture of which today we feel ourselves as proud possessors. Through these cultural activities there were fed hundreds and thousands of families of craftsmen. It is this class of our society which now, by and large, has started diminishing and disappearing because it has become difficult for them to find patrons and promoters. But it is not only a question of loosing jobs and livelihood for majority of our craftsmen, but also the danger of loosing a whole body of knowledge and secrets of these crafts, which so far has been proudly, and secretly too, protected by the traditional families of our artists and craftsmen.

Those who are currently engaged in protection and preservation of our cultural heritage are fully aware of this danger of vanishing families of craftsmen along with them the secrets of their crafts. Lok Virsa has always been preoccupied with this problem facing our craftsmen, particularly those connected with architectural crafts. Till very recently, it has been almost an annual feature to invite those craftsmen and artisans to exhibit their skills. The visitors used to see the artisans at their work and patronized them by buying their

products. The Govern-ment also identified the promising artists, craftsmen and artisans and honoured them with honorific titles, awards, prizes and certificates.

But there has always been felt a dire need of printing prestigious books about these crafts--- particularly the technique of such endangered crafts involved in the embellishment of our architectural heritage. But there was always a problem of finding a suitable person for this purpose. Finally, it is gratifying to see that Mr. Talib Hussain, a renowned Conservationist of our country, took responsibility on his shoulders and has ultimately come out with a beautiful book on the 'Traditional Architectural Crafts of Pakistan'. More than that I feel honoured that he selected Lok Virsa to be the publisher of this prestigious contribution by him. He is an engineer, a conservator and a historian - all in one. I am confident that this book will go a long way to meet the need, both of our teachers and students in the art institutes, departments of the archaeology, architecture, history and culture in universities and other intellectual circles.

(Khalid Javaid)
Executive Director
Lok Virsa, Islamabad



PREFACE

Use of different crafts in architecture is as old as the history of mankind. Pakistan is no exception to it. Each period of our history had its own set of crafts used in its architecture. As time advanced, architectural crafts became more varied and diversified - each period enriching itself by learning and borrowing from the periods and then leaving a richer legacy for their successors. Today, we are the owner of a compendium of architectural crafts which history has preserved for us in the form of standing monuments, the practicing craftsmen and, rare though, among the pages of manuscripts and printed books. But, the most effective source of learning about the traditional architectural crafts in Pakistan is the families of craftsmen who have been clinging to their ancestral crafts despite great odds. The modern age of commercialism and mechanical reproduction has greatly endangered the future of all such crafts but architectural crafts are in a more serious danger of extinction because these hardly find any honourable place in modern buildings - private or public. Mausoleums and mosques are the only edifices which require traditional architectural embellishments. But the number of these crafts used in such buildings is extremely limited. Day by day, these are decreasing in number. However, the departments and organizations responsible for the maintenance, up-keep and conservation of historical buildings are still the maximum users of these crafts. Some modern architects are also trying to revive a number of these crafts adopted to embellish new private and public places designed by them. But, day by day it is becoming difficult to locate genuine craftsmen and find patrons and persuade them to invest in such projects.

It is also fortuitous that some art departments in universities and art institutions in country have finally been convinced about the necessity of initiating their students into the beauty, intricacies and complexity of our endangered traditional arts and crafts, miniature painting, calligraphy, fresco painting, wood carving, etc. But they are facing great difficulty in guiding their students to provide them appropriate text books and engaging qualified teachers for the purpose particularly, the teachers imparting practical lessons. Some institutions are judicious enough to engage some old masters of certain crafts for this purpose.

For some times in past, Lok Virsa, Islamabad had been doing a useful service by bringing most of the craftsmen in the country on a national platform, providing them an opportunity of exhibiting their skills before public and by honouring the best among them with awards and cash prizes and above all printing a Directory of Craftsmen of Pakistan. Currently, the Punjab Small Industries Corporation has also undertaken a program of surveying, cataloguing and studying traditional crafts and craftsmen of Punjab and printing prestigious books on some selected regions under the able guidance and supervision of scholar like Dr. Saifur Rahman Dar. Out of eight proposed volumes, some volumes on crafts and craftsmen of Murree, Bhera, Multan, D.G. Khan & Rajanpur have already been published while some more are in press.

The present book "Traditional Architectural Crafts of Pakistan" is a humble contribution from my side in this changing environment. For the four decades I have been engaged in the service of conservation and restoration of historical and archaeological buildings in the country. Although architectural heritage of Pakistan is varied and long, ranging from the prehistoric sites of Mohenjo-daro and Harappa, early historic period sites like Taxila and Takht-i-Bahi, monumental forts, palaces, mausoleums and mosques of Islamic period and shrines of the Sikh regime. But most of my time has been consumed by caring and repairing standing monuments of Islamic period - some of them of outstanding grandeur - like the Mausoleum of Rukn-e-Alam, Multan, Jalal-ud-Din Bukhari at Uch Sharif, Badshahi Mosque and Wazir Khan Mosque, both in Lahore. What distinguish the Muslim monuments from buildings of earlier period are their engineering technicalities, architectural complexity and, above all the great diversity of the architectural crafts used to embellish both their exteriors as well as interiors. To be a conservator of Muslim buildings is not an easy job. You must have the technical knowledge and know-how of a civil engineer, the beatitude of an architect, aesthetics of an artist and be a practitioner like a craftsman - the last quality itself involves expert knowledge about more than a dozen disciplines- stone carving, brick carving, wood carving, glazed tile work, fresco painting, calligraphy, glass-work, *tarseem bandi* etc. and each craft further sub-divided into several sub branches. My greatest difficulty, throughout these years, has been to get right craftsmen for the right work and then to get maximum and best of them to match the restored work nearest to the original. There is no text book to guide you to master your knowledge about all these crafts. Most of the books on arts and crafts mostly deal with their history but not their technicalities, procedures and materials used in them. About majority of the traditional crafts, craftsmen, more often them not, were reluctant to divulge secrets of their crafts which their respective families have taken centuries to master. They reveal their traditional knowledge only to their own children or to those whom they adopt as their *'shagird'*- pupil. A *'shagird'* must be remained respectful to his *'ustad'* (teacher) throughout his life, he must remain patient; he must wait for his *'ustad's'* convenience to teach him and be content to what his teacher opts to teach him. A *'shagird'* has no option. Indeed, in matters of crafts *'ustad - shagird'* (teacher-student) is a special institution in our country. My relationship with my workmen was apparently that of an employer and employee. A plain "officer subordinate" attitude would never have allowed me to learn what I actually did and which I have endeavoured here to present to my readers. I had to keep a balance between my official responsibilities and my spirit of learning from my 'ustads' the workmen. It was a hard job but I managed it - thanks to the cooperation of most of the craftsmen of different disciplines with whom I had the chance to work and learn. Here I record my gratitude for what I learnt from late Haji Rahim Bakhsh, mason of Multan, late Allah Dawaya *kashi kar* of Multan and late Haji Abdul Aziz mason of Lahore. Among these *ustads*, late Haji Rahim Bakhsh was especially master of thumb rules on design guidelines for reconstructing Islamic period buildings.

When I had collected this data I was still shy to put it in black and white. I never dreamt of becoming a writer. But then, some of my seniors encouraged me, guided me,

and at times goaded me to convert my life long experience which I prefer to call 'learning' in the form of this book. I am thankful to all of them - though some of them are no more there to see the result of their persuasions. I take this opportunity to acknowledge my debt of gratitude to all those who have helped me in completing my work.

I am greatly indebted to Dr. Saifur Rahman Dar, the Ex. Director, Lahore Museum and Ex. Director General of Archaeology, Government of the Punjab, who not only guided at all stages of writing this book but also went through the manuscript painstakingly and made textual improvements and removed several inconsistencies.

A number of photographs were made available by my friends and colleagues, namely Professor Dr. Abdul Rahman, Director School of Architecture and Design, University of Engineering and Technology, Lahore, Architect Mr. Rashid A Makhdum, Mr. Maqsood Ahmad Malik, Senior Architect, Deptt. of Archaeology and Museums, Mr. Sajjad Butt, Photographer, Mr. Haq Nawaz and Mr. Ghulam Muhammad Malik SDO's, Directorate General of Archaeology, Govt. of the Punjab. I am greatly indebted to all of them.

I am also thankful to Mr. Zahoor Ahmad Stenographer, Punjab Archaeology, for typing the manuscript of this book and Mr. Naeem Ahmad Draftsman Punjab Archaeology for the preparation of some of the drawings.

My gratitude included in this book is also due to Mr. Rana Nisar Ahmad, Director, Building Research Institute, Lahore for providing me copies of the Chemical Analysis of the mortars used in various historical monuments and Syed Abbas Sultan of Atomic Energy Mineral Center, Lahore for Petrographic Analysis.

And not the least, my thanks go to my wife Razia, my sons, Asif, Kashif , Atif and my daughters Iram and Rashiqa for their cooperation.

Many thanks are also due to Mr. Khalid Javaid Executive Director, Lok Virsa Islamabad for making my manuscript book-worthy as well as its publication.

In the end, I crave the indulgence of the readers for my inadequacies and any shortcomings which might have escaped my attention and found their way in this publication.

(Talib Hussain)

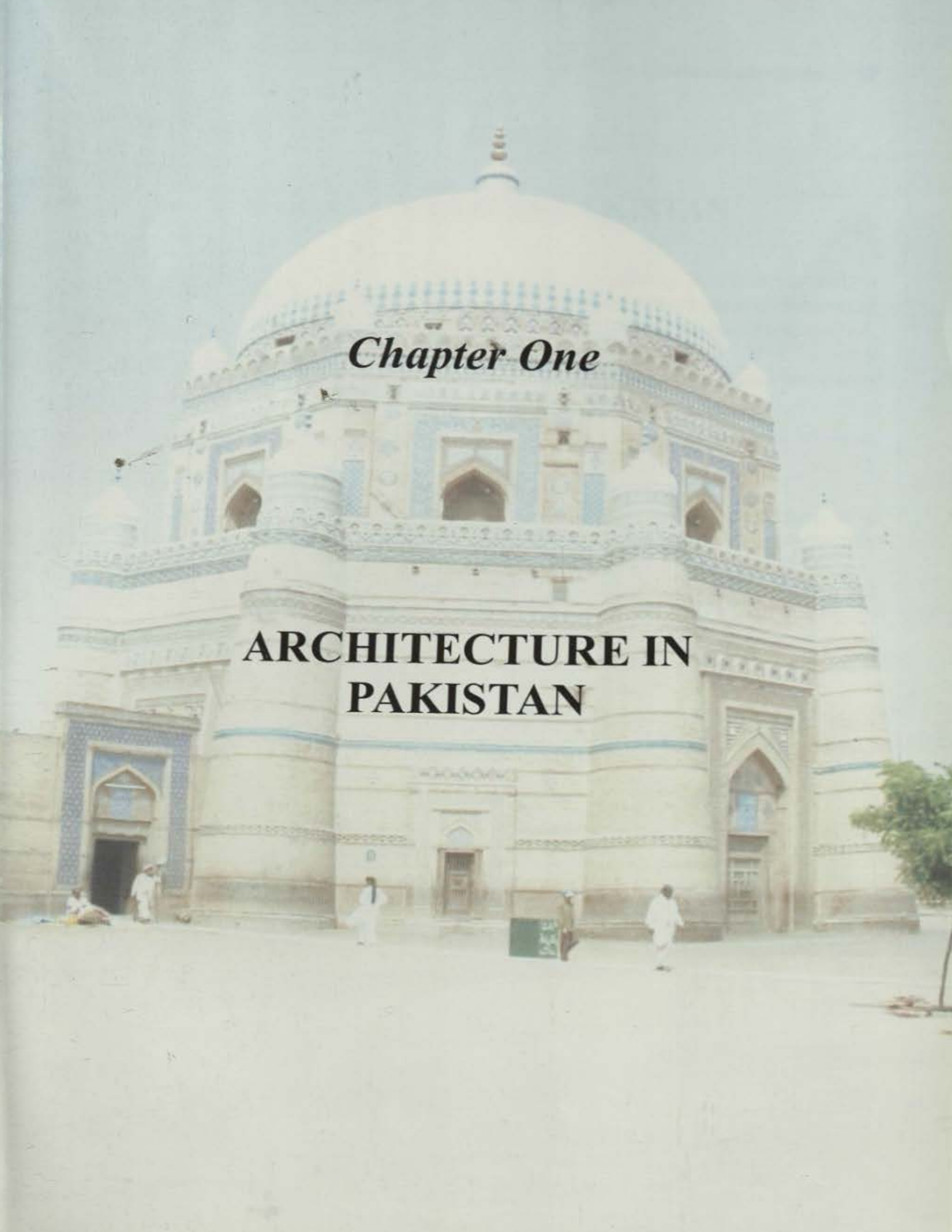
150-C Marghzar Colony,
Multan Road, Lahore.
31st July, 2009

List of Illustrations

Pl.88 Stone carving.
Pl.89 Tools for stone cutting and carving.
Pl.90 Lahore Fort - Stone fret work.
Pl.91 Tomb of Emperor Jahangir, Lahore - Stone fret work.
Pl.92 Craftsman preparing stone fret work.
Pl.93 Cenotaph of the grave of Jahangir, Lahore - Pietra dura work.
Pl.94 Nau Lakha Pavillion Lahore Fort - Pietra dura work.
Pl.95 Semi precious stones.
Pl.96 Cutting of semi precious stone with wire bow.
Pl.97 Grinding of semi precious stone to required shape.
Pl.98 Engraving in marble for fixing semi - precious stones.
Pl.99 Fixing of semi-precious stone.
Pl.100 Mausoleum of Jahangir, Lahore - Stone inlay work.
Pl.101 Badshahi Mosque, Lahore - Stone inlay work.
Pl.102 Shish Mahal Lahore Fort - Tesselated floor.
Pl.103 Mausoleum of Jahangir, Lahore - Tesselated floor.
Pl.104 Engraving for inlay work.
Pl.105 Fitting of inlayer.
Pl.106 Laying of tessellated floor.
Pl.107 Tomb of Hazrat Shah Rukn-e-Alam, Multan - Lattice wood work.
Pl.108 Tomb of Hazrat Jalalud Din Bukhari, Uch Sharif - Wooden screen.
Pl.109 Wooden scantling.
Pl.110 Manufacturing of lattice wood work.
Pl.111 Tomb of Hazrat Shah Rukn-e-Alam, Multan -Carved wood work.
Pl.112 Tools.
Pl.113 Wood carving.
Pl.114 Tomb of Hazrat Sakhi Sarwar, Dera Ghazi Khan - Inlay work on door frame.
Pl.115 Tomb at Wassay Wala, District Rajan pur - Showing inlay work on door frame.
Pl.116 Ghazi Mosque Bhong, Rahim Yar Khan - Inlay wood work.
Pl.117 Tomb of Hazrat Shah Rukn-e-Alam, Multan - Lathe and lacquer work.
Pl.118 Craftsman working on lathe.
Pl.119 Lacquer on wood.
Pl.120 Tomb of Miran Badshah, Lahore - Wooden ceiling in *Tarseem Bandi.*
Pl.121 Tomb of Hazrat Kh. Ghulam Farid, Kot Mithon - Detailof painted ceiling.
Pl.122 Preparing pieces for *Tarseem Bandi.*
Pl.123 Preparing of wooden panel in *Tarseem Bandi.*
Pl.124 Painting on wooden ceiling.
Pl.125 Tomb of Shah Sadiq Nahang,Shorkot - Glazed lime plaster.
Pl.126 Traditional kiln for manufacturing lime.
Pl.127 Tank for slaking lime.
Pl.128 Burning of *kankar* for *kankar* lime in shape of heap.
Pl.129 Kiln for burning of *kankar.*
Pl.130 Coarse *kankar* lime, fine *kankar* lime,slaked white lime, choped jute.
Pl.131 Applying *kankar* lime plaster.
Pl.132 Applying glazed lime plaster.
Pl.133 Applying glazed lime plaster in Multan region.
Pl.134 Tomb of Hazrat Baha-ud-Din Zakariya, Multan - Stucco Tracery work.

Figures

Tables



Chapter One

ARCHITECTURE IN PAKISTAN

ARCHITECTURE IN PAKISTAN

Man is a born builder as much as he is a born destructor. Architecture seldom develops and flourishes in isolation. There is a constant chain of borrowing and lending between countries and nations. As all buildings are outcome of one craft i.e. the craft of a mason, architecture of a region provides a common look between neighbouring countries where similar geographical, geological and climatic conditions persist and where similar socio-economic environment exists.

Architecture is the matrix of civilization. It is a mirror, which reflects the height of civilization, history, social and religious status, development of arts, crafts and the planning capacity that a nation or a country has attained.

Human existence in Pakistan is traceable back to about half a million years. It is supported by the find of man-made stone implements. The centre of this primitive civilization was the Soan Valley. How these people lived is a matter of speculation. Perhaps in caves or in huts made by tying saplings or made of reeds and rushes and beehive huts as found in other countries in that age. However, during the periods of glaciations, all man-made dwellings were washed away leaving no traces of them. Again, at Rewat, District Rawalpindi, sculls of long headed Safians, indicating human activity in this region during Neolithic period, (about 10000 BCE).

The history of architecture of Pakistan starts about 7000 BCE. at the head of Bolan Pass at Mehrgarh. The development of architecture in Pakistan can be divided into following phases:-

1. Prehistoric Architecture of Neolithic period 7000 BCE to 3500 BCE
2. Indus Valley Architecture 3500 to 1000 BCE
3. Gandhara Architecture 300 B C to 800 CE
4. Hindu Architecture 9th - 10th century CE
5. Late Sassanian and early Muslim Architecture
6. Muslim Architecture
   - (a) Arab Period (712 - 1021 CE)
   - (b) Ghazanvid Period (1021 - 1186 CE)
   - (c) Sultanate Period (1186 - 1526 CE)
     - i) Multan Style (1150 - 1325 CE)
     - ii) Summa Rajput Period (1340-1520 CE)
     - iii) Arghuns and Tarkhan Period (1520-1593 CE)
   - (d) Suri Interlude (1540-1545 CE)
   - (e) Mughal Period Architecture (1526 -1848 CE)

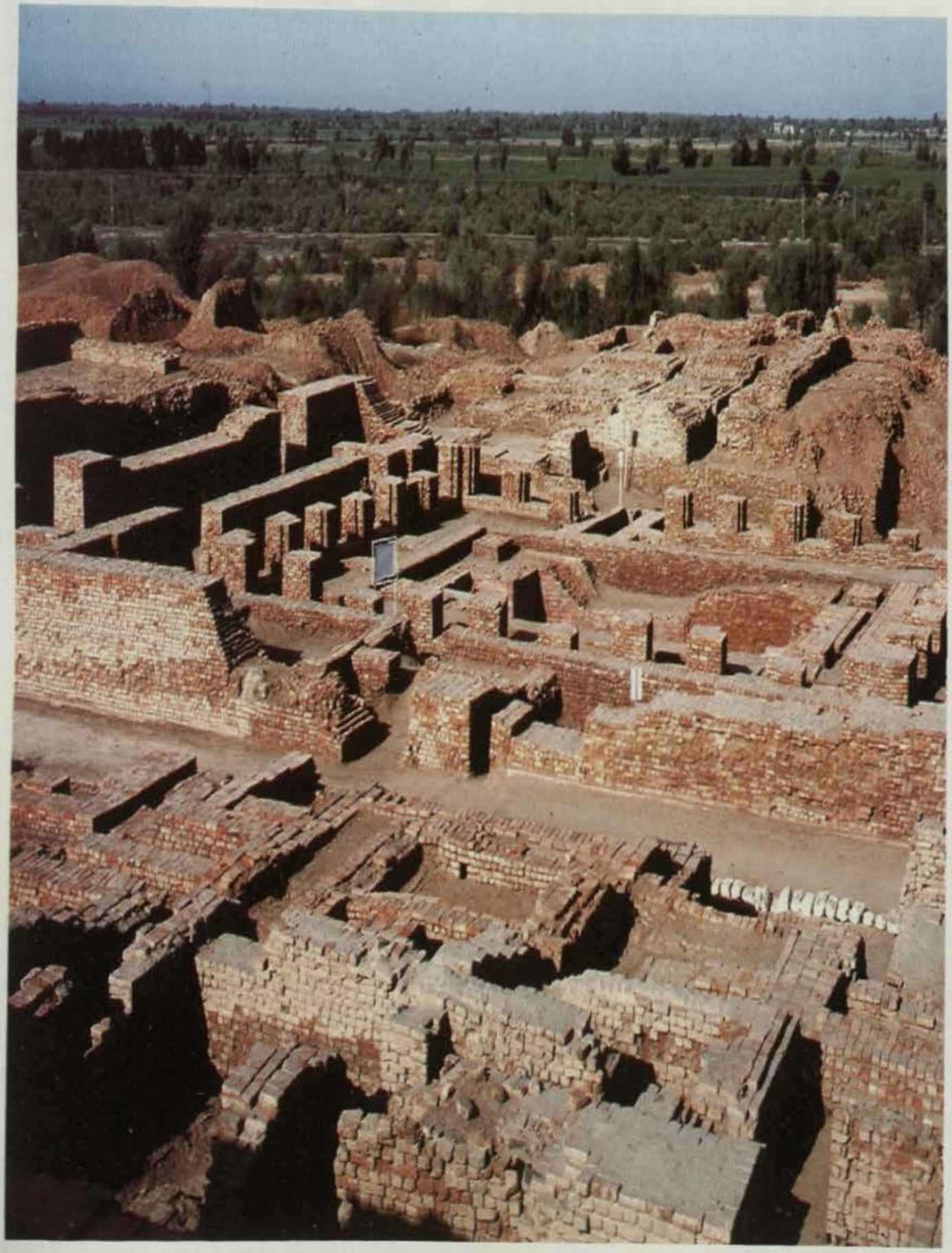
(f) Kalhora Period (1996 - 1783 CE)
(g) Talpur Period (1783 - 1834 (CE)
7. Sikh Architecture 19th Century CE
8. British Period Architecture 19th - 20th Century CE

1. Prehistoric Architecture of Neolithic Period

As late as 12,000 years ago, men lived in groups of families or small tribes and sustained themselves on hunting and gathering their food by using stone tools and implements. This way of life, remained unchanged for a few thousand years. After the discovery of farming, their ways of life radically changed. This revolution, named by the scientists as New-Stone-Age or Neolithic period is considered a landmark in the human civilization and has been heralded as a continuous chain of progress in human life.

In Pakistan, the most representative Neolithic period site is Mehrgarh at the mouth of Bolan Pass. Mehrgarh excavation consists of eight prehistoric periods, covering a total period of over 4000 years i.e. from seventh millennium BCE to the middle of third millennium BCE. The oldest settlement at Mehrgarh shows that multi-room houses made of cigar shaped mud bricks with finger marks probably for keying the mortar. Some structures were very small, square on plan probably used for store rooms. Some of the houses had a courtyard.

P1.1 Mud brick structures of houses at Mehrgarh.



Pl . 2 Remains of Mohenjo- daro - General view.

During the period 5500-5000 BCE, the rectangular structures have been found which are sub-divided into narrow and doorless compartments. (Pl. 1)

An interesting house of three rooms dating back to 4000 BCE has been unearthed at Merger. It is backed by a huge wall about 2.6 meters wide. This might be a platform or terrace. The wall was constructed in moulded bricks.

2. Indus Valley Architecture

This phase of architecture began with the rise of the Kot Diji Culture, also called the Early Indus Civilization, about 3200 BCE. The peak period, however, dates from 2250 to 1500 BCE. It was a purely utilitarian architecture - simple, solid and without any pretensions. Mohenjo- daro (Pl. 2) and Harappa in Pakistan represent different aspects of their architectural development, prevailing social conditions, religious aspects, arts and crafts. The unit of construction in the Indus Valley was brick. It was manufactured with mathematical proportions-- the width being half of the length and the thickness half of the width. The building was usually one storey high with broad stairs leading to the roof. Rooms were arranged around an open courtyard and baths were provided with cut brick floors of fine joints. Rooms had flat ceilings borne on beams and battens. Mortar used was mud. Walls in the interior were plastered with mud mixed with straw. The use of cut and dressed bricks with fine joints in construction of Great Bath shows that they were past masters of brick building. Gypsum was used in thread like joints in the Great Bath.

The Aryan Interlude

The Aryans in the ancient times mostly developed wooden architecture which, therefore, could not survive. Their material culture is known only in the form of their graves and grave-furniture.

3. Gandhara Architecture

A) Pre-Buddhist Period

During this period i.e. before the first half of the 3rd century BCE, unit of construction was stone laid in mud in random rubble and coursed rubble. Walls have no taper and were plastered with mud mixed with small shells. Rooms were small, built around an open courtyard. Lanes were narrow and not straight, as seen in remains of Bhir mound in Taxila.

B) Buddhist Period

It starts about 258 BCE (date of Ashoka Rock Edicts at Mansehra and Shahbaz Garhi) but no building belonging to this period has survived. Buildings belonging to the later period i.e. from Ist century BCE to 8th century CE are abundant. A large number of structures have survived in the form of cities, like upper strata of the city of Bhir mound, walled cities of Sirkap (2nd century BCE), Sir-Sukh at Taxila and Sahri Bahlol in district Mardan, monasteries, stupas and chapels such as at Jaulian at Taxila and Takht-e-Bahi remains in District Mardan and forts like Giri at Taxila. The type of masonry used was an improvement over random masonry as used at Bhir mound (6th to 2nd century CE). In the 2nd century CE this masonry developed into semi-ashlars. The first and the earliest

Use of ashlars stone masonry is found in the Jandial Temple (Ist century BCE to Ist century CE). The walls of this temple are built in coarsed rubble masonry but its portico was carried on high round columns in perfect ashlar masonry. Use of lime mortar mixed with white grit on the wall and use of black slate as a plinth protection laid on wall moulding of Cyma Reversa (*ghalta-gola*) are also the earliest examples not only in Pakistan but in the whole subcontinent.

Sirkap city was founded by Indo-Greeks in the 2nd century BCE. The whole city was well planned and was divided into blocks by means of the main street and cross lanes intersecting at right angle. Sirkap city was built in rubble masonry prior to 25 CE and in small diaper afterwards. Kushan city of Sir-Sukh shows a new development in the military architecture in the form of projected rounded bastions of ashlar masonry.

One significant observation about the type of masonry and walls in Gandhara is that there is no use of semi-ashlar masonry on the west of the river Indus. Instead, there is always a slope in the walls, which is absent in the architecture on the east of the same river.

At Takht-e-Bahi (Pl. 3), in the lower stupa court the walls of the chapels on the east have a thin finished coat of stucco plaster. Crushed quartz as grit has been used in this plaster. Near the roof, on the modillion, there are traces of vermilion paint, a beginning of fresco work.

The highest achievement with the development of the Mahayana Buddhism is the remarkable skill in the art of sculpturing and carving which depict the contemporary life and culture in stone like miniature painting.

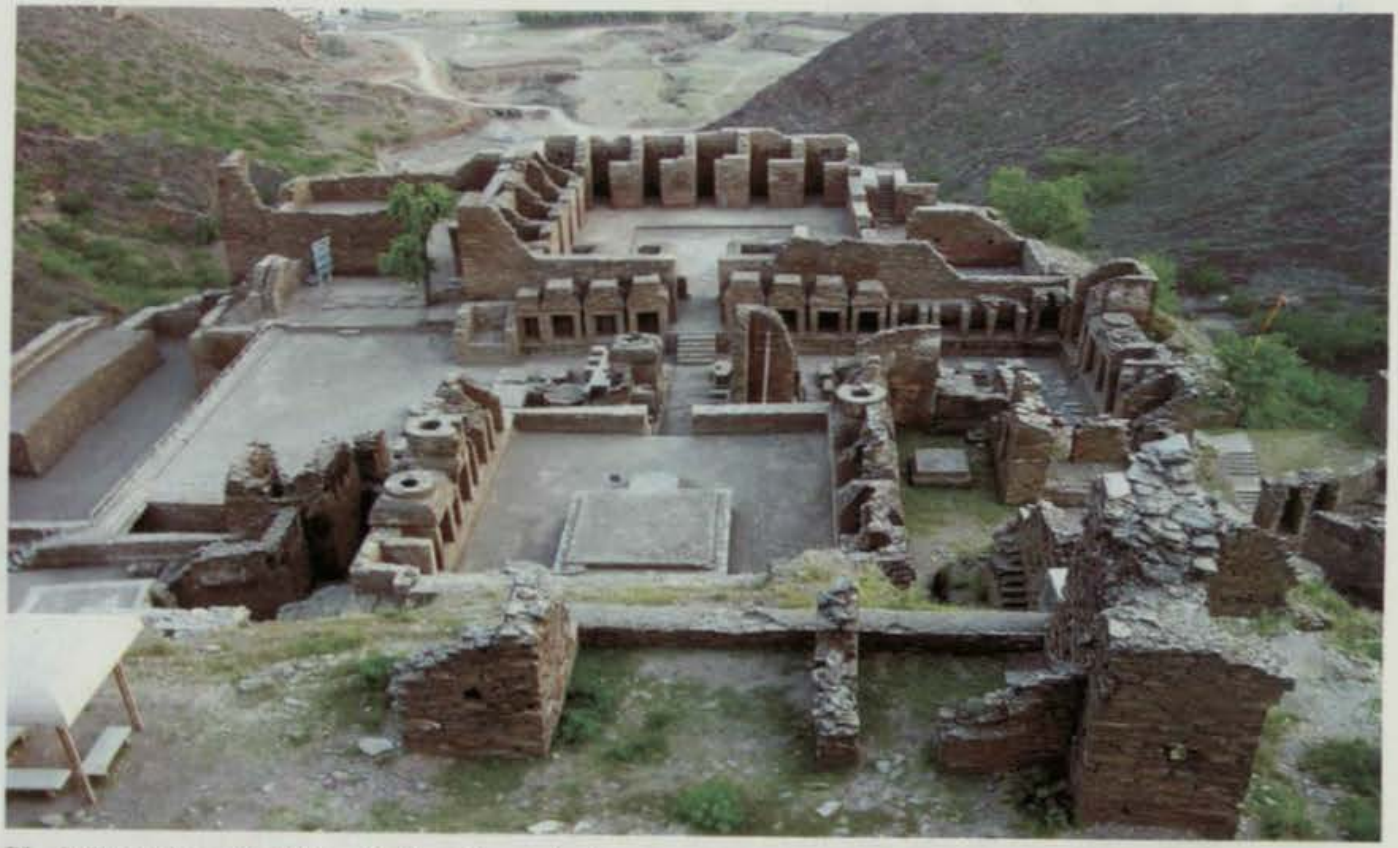
Most of the stupas are built in stone (Pl. 4) but the one at Malkamala village near Hazro is in bricks. Other examples of brick built stupas are at Sui Vihar near Bahawalpur, at Mohenjo daro and Mirpur Khas in Sindh.

4. Hindu Architecture (9th-10th Century CE)

The revival of Hinduism started after the destruction of the Buddhist Sultanate usually attributed to the White Huns in the middle of 5th century CE and annihilation of Buddhists and their monuments. Head of Shiva and Lingams have been discovered from the Buddhist remains of Sahri Bahlol dating back to 3rd to 5th century CE.

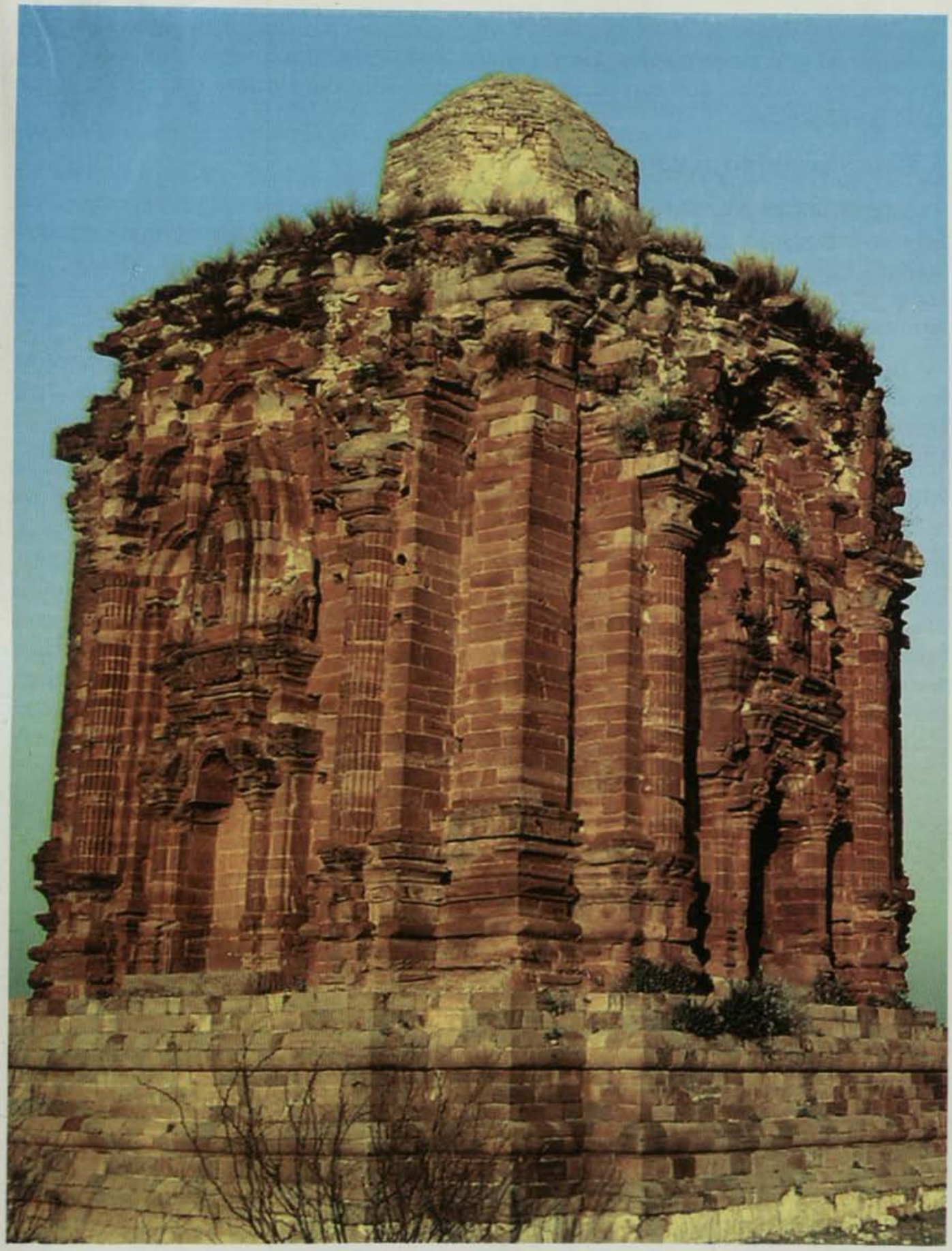
King Lalitaditya (725-60 CE) was a powerful ruler of Kashmir. He defeated and killed Yasovarman of Kanuj and thus gained lordship over northern India including Punjab; specially Salt Range area and present district Hazara. Lalitaditya built the well known Sun Temple at Martand near Sirinagar. The style of this temple was followed in the Salt Range area.

During the 9th and 10th century CE a number of temples and forts were constructed at Nandana, Malot (Pl. 5), Sassi-da-Kallara, Katas, Kafirkot and Bilot (in Dera Ismail Khan).



Pl . 3 Remains of Takht-e-Bahi - General view.

Pl. 4 Dharmarajika stupa, Taxila.



Pl. 5 Temple at Malot - General view.

Most of the temples in the Salt Range were constructed with dressed stone, embellished with stone carving. However, the Sassi-da-Kallra temple is built in bricks embellished with cut and carved brick work, probably the earliest example of brick carving in Pakistan.

5. Late Sassanian and Pre-Islam monuments

Apart from the pre historic mounds and settlements, the monuments of Sassanian and Islamic periods are also found in Balochistan. The monuments have some common features at least in one particular form - the funerary memorials. The Muslims of Balochistan, apparently took influence from the Sassanian in the field, established a typology which later affected the shape of Muslim architecture throughout South Asia.

Brig. (Retd.) Usman Hasan, a free-lance archaeologist, has located a number of ancient cairns near Turbat in Makran, Kali Chal near Baker on Rakhni Baker-Dera Bughti road, and Sar Skandkar on Dhadar-Sunny-Sheran road and identifies them as Dukmas - the Zoroastrian place for disposal of their dead.

Nikodari Tombs (Pl. 6)

Nikodari tombs are also associated with Zoroastrian rites. These are located in Kharan along the Makran Coast, Panjgoor and in Nushki, Pali Kalat, Sorab, Las Bela, Ladgasht and some other places. The tombs around Ameeri north of Dalbandin are built of mud bricks whereas those at Panjgoor, Ladgasht and Pali Kalat are made of burnt bricks. The Nikodari tombs have also been called community tombs as the dead bodies were deposited here without any arrangements. The tombs are square in plan, then crowned with a hemispherical dome and decorated with ornamental terra cotta plaques. Some of these tombs are very old whereas the others are of recent origin. These tombs can be classified on the basis of decoration into three categories, namely:

(a) The ones having scenes of every-day life and figures of deities in the form of animals and abstractions gods.

(b) The ones having animals and birds but no gods and deities, in their place, simple geometrical patterns are depicted.

(c) Those decorated with simple geometrical patterns.

The tombs belonging to the first two types are mostly double storied structures having vaulted lower chamber to which entrance has been provided in the shape of small arched opening in the center on the east. This chamber is divided into oblong cells created on the right and left, and in between having narrow passage with opening for access to the chambers. In the lower chamber dead bodies were kept in heaps of bones. The dead bodies in the upper chamber were normally dressed or wrapped in coarse cloth and preserved with some chemicals. Bodies of the children were put in niches cut in the thickness of the tomb-walls. Scholars believe that the first two categories belong to the fire-worshipping community of the area and not the Muslims and might have been constructed during the rule of Muslims in the region. The second category might have

Belonged to the converted Muslims from the Zoroastrian faith and had retained many traits and tradition of their previous religion, even the burial practice.

The third categories of tombs, which have no figural decoration, are single storey structures where graves are laid in typical Islamic fashion.

Nikodari tombs at Rachil, some 24-kilometre southeast of Kharan, are probably older and least disturbed. Other well-preserved tombs are at Mashad in Kharan, at Jhalawan, at Mir near Sorab, at Marband and Washuk.

Some Nikodari tombs, built of mud bricks, have been found in areas north of Dalbandin.

6. Muslim Architecture.

a) Arab Period Architecture (712-1021 CE)

Tomb of Muhammad Ibn-e-Haroon (Pl. 7) is the earliest period tomb of a Muslim General Ibn-e-Haroon, which is located at Lesbela old Urman Bela. Muhammad bin Haroon was the ruler of Makran at the time of the conquest of Debal by Muhammad Bin Qasim. He was ordered by Hajjaj bin Yusuf to assist Muhammad Bin Qasim in his expedition. He proceeded towards Debal but on the way he died in 95AH./711 CE at Umran Bela and was buried there.

The tomb is located on a high mound in the midst of a graveyard, the tomb is square in plan, and the square is crowned by a hemispherical dome. The exterior has been divided into two parts. The lower part has recessed rectangular panels. The upper part has cut and moulded brick ornamentation in dentils, chevrons and chain design.

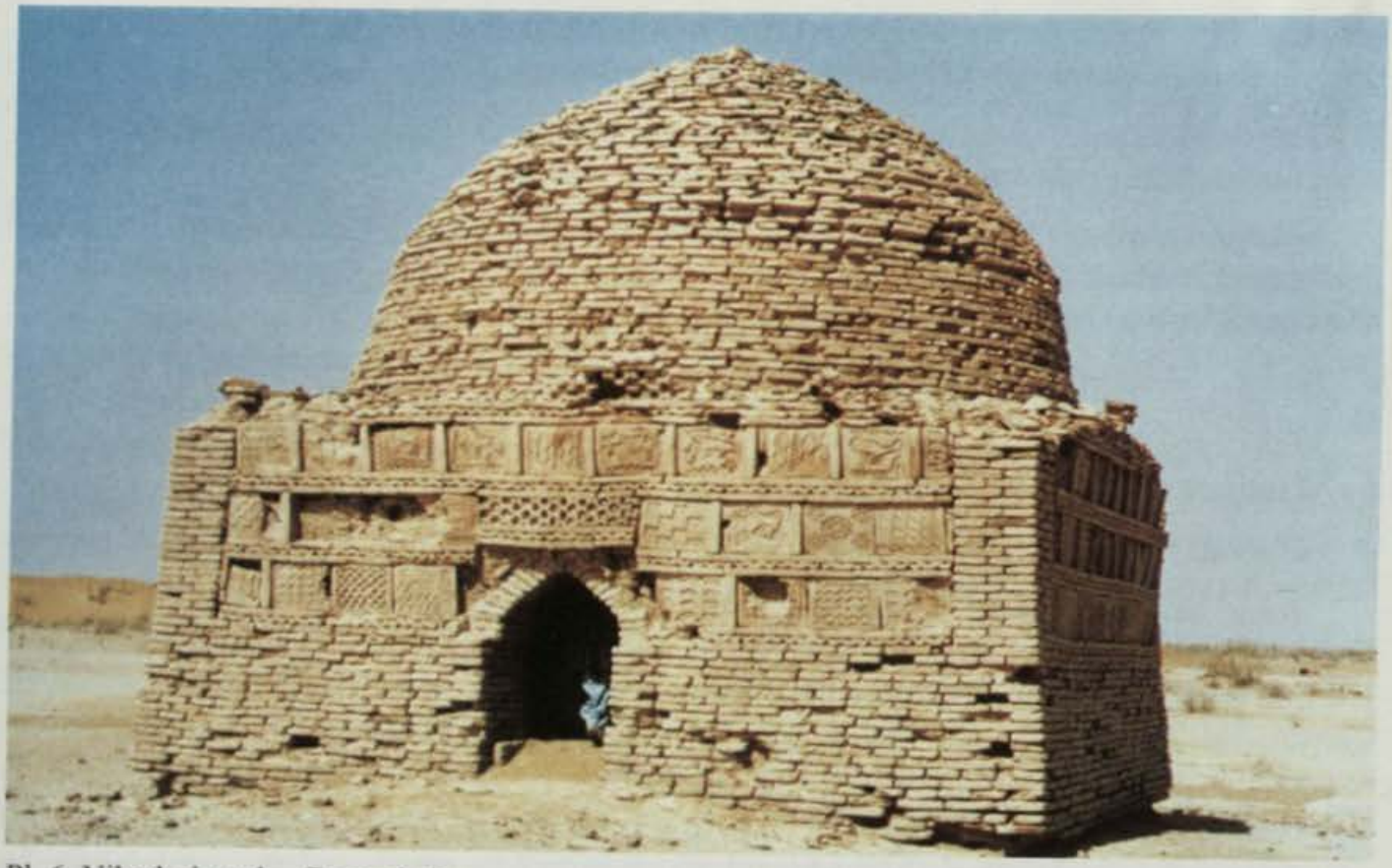
For the zone of transition, in the interior, the square has been converted into an octagon by providing squinches in the corners. On the top of the octagon is placed the round base of dome.

Muhammad Bin Qasim built mosques at Debal, Nirun (Hyderabad), Al-ror, Rohri and Multan. A few more mosques are attributed to other Arab governors of Sindh. But this architecture is not known.

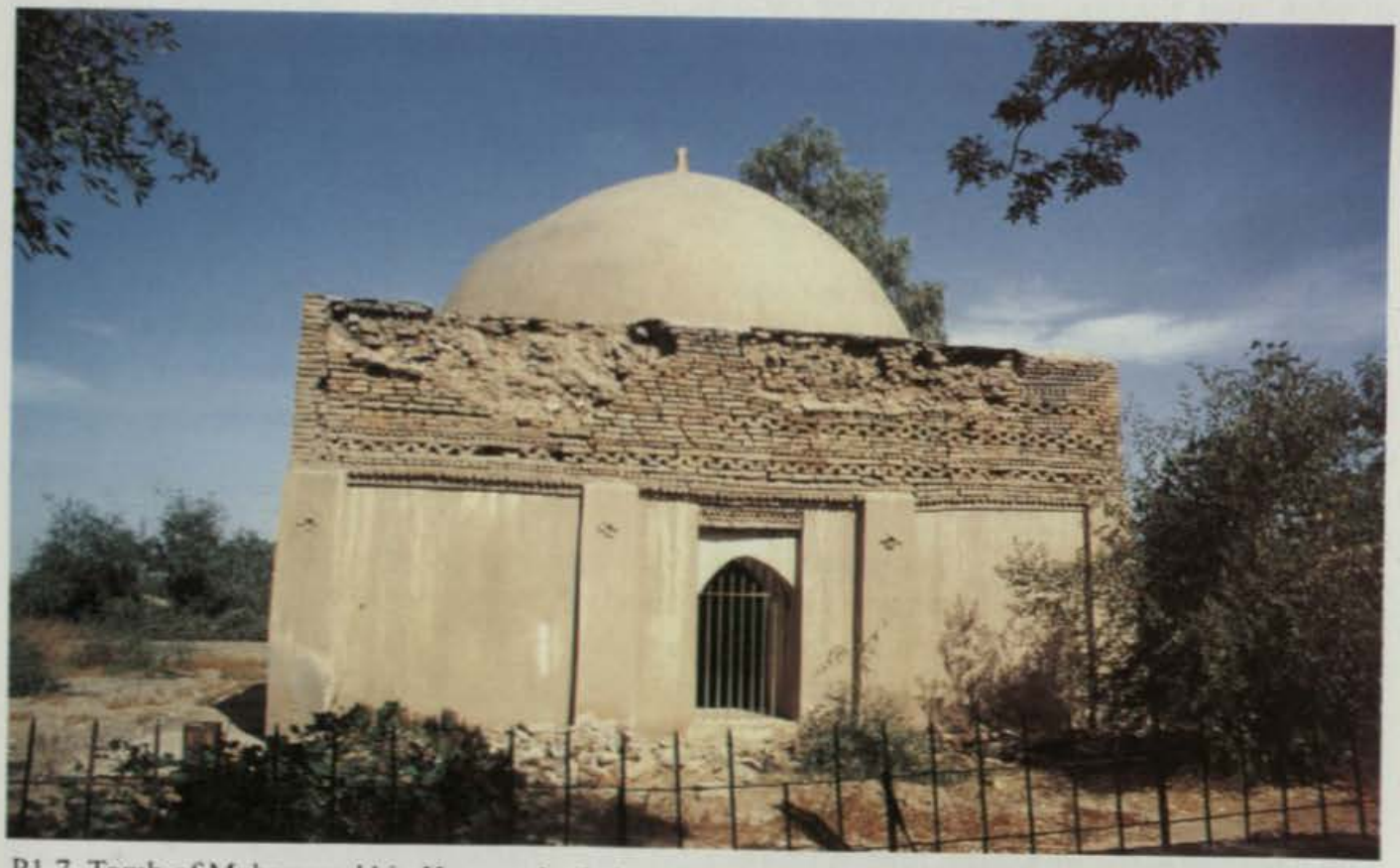
The remains of a mosque which seems to have been constructed shortly after the conquest of Sindh have been exposed at Bhanbhore. Ornamental Kufic inscription found inside the structure makes it the earliest mosque of the subcontinent. The remains of another mosque exposed at Brahmanabad (Mansura) (Pl. 8) belonged to Abbasid period. Ornamental *Kufic* inscription and plaster decoration in stucco tracery *(Munabbat kari)* have been found as the main decorative features. Use of rubble and coarsed stone masonry, brick work and lime plaster was also made during this period.

b) The Ghaznavid Period Architecture (1021-1186 CE)

The monuments of this period have totally disappeared, in the red fire of Ala-ud-Din's revenge; the only structure of this period which has survived is the west wall of the



Pl. 6 Nikodari tomb - General view.



P1.7 Tomb of Muhammad bin Haroon, Lesbela.

Pl. 8 Mosque at Brahmanabad (Mansoora) - The *aiwan* showing the mehrab.

Plate. 9 Mosque at Giri, Taxila.

tomb of Saif-ud-Daula Mahmood near village Zairan in Parachinar, a mosque in Giri (Pl. 9) on the Margala hills and another mosque in the fort of Audigram near Mingora in Swat.

The wall of the tomb of Saif-ud-Daula Mahmood provides us very useful information about Ghaznavid architecture. It consists of a tall recessed four centered arch with a window in the masonry wall. The structure was constructed in stone using lime mortar.

The small mosque at Giri near Taxila was constructed by Mahmood as a token of victory. The mosque is square in plan and constructed in stone masonry. The arches and dome had been constructed with brunt bricks. There is an arched entrance in the east wall and a semi-circular *mehrab* in the west wall.

The mosque is interesting because true arches and true squinch arches have been used for the first time. From some literary references however, it can be presumed that the architectural features were mostly the same as of the building remains discovered at Ghazni in Afghanistan i.e. tapering minarets and surface decoration in geometrical pattern in stucco tracery or inlay stone surface.

c) Sultanate Period Architecture (1186-1526 CE)

The important cultural centers which emerge in this period were Multan and Lahore.

There is no complete example of this style in Lahore but there are groups of buildings in Multan and its surroundings.

I) Multan Style (1150-1325 CE

There are following types of Multan School of Tomb Architecture:

Type-I

This style is represented by new class of buildings, the mausoleum introduced into the subcontinent by the Muslims. The earliest building of this type is the tomb of Shah Yusuf Gardezi, (Pl. 10) which is believed to have built about 1152 CE. The tomb is situated inside Bohar Gate, Multan. This building is believed to be the earliest example of rectangular tomb with flat roof in Pakistan. The four walls on its exterior are fully covered with glazed tiles in geometrical patterns presenting in a rich plastic appearance. The walls on its interior have been recently decorated with floral painting. The flat roof is composed of wooden beams and batten system provided with wooden false ceiling in *Tarseem bandi* design decorated with floral paintings.

The influence, of this tomb is found in the tomb of Hazrat Bibi Rasti at Multan and flat roof mausoleums at Uch Sharif.

Type-II

The second type of this style is mausoleum built in three tiers: the ground one square in plan, the drum or second storey octagonal and then surmounted with hemi-spherical

dome. Mausoleum of Hazrat Khalid Walid (Khaliq Wali) (12th century CE), Hazrat Baha-ud-Din Zakariya (d. 1267 CE), Hazrat Shah Dana Shahid (1270 CE), Hazrat Shah Shams Sabzwari (1276 CE) and tombs at Lal Mara Sharif in Dera Ismail Khan (13th century CE) are the best examples of this style.

Tomb of Hazrat Khalid Walid (Khaliq Wali) at Mauza Khatti Chor (Pl. 11)

According to the epigraphical evidence on the *mehrab* of the monument, it was built by Ali Karmakh, governor of the area of Multan under Shahab-ud-Din Ghauri sometimes in the last decades of the 12th century CE.

It is a fortress-like mausoleum, erected on a high cultural mound. The tomb consists of a rectangular fortified brick structure having semi-circular bastions at irregular intervals on four corners and one each in the centre of three sides except west. On the fourth, the west is a projected frame indicating the back of *mehrab*. The entrance lies in the north wall.

The main square chamber of the tomb is in the centre flanked on the north and south by two halls, augmented with a barrel-shaped vaulted gallery running on all four sides. On the main chamber is placed a dome with a high perpendicular neck.

The most important part of the tomb is its *mehrab* sunk in the centre of the outer wall of the western gallery. It is decorated with cut and carved brick work representing Quranic verses as well as historic details of the person and the age responsible for the erection in floriated and foliated Kufic characters.

In the interior, the square chamber has been converted into an octagon by providing squinches in the corners, then into sixteen sides to provide circular base for the dome. The tomb on its exterior has lime plaster.

Tomb of Hazrat Daud Gardezi at Adam Wahan (13th century CE)

It is located in the village of Adam Wahan near Lodhran. The square ground storey and octagonal drum have been built in mud bricks with its outer surface with burnt bricks. The dome has been built with brunt bricks. The entrance lies in the eastern wall. The south east corner has another opening for the staircase leading to the top of the first storey.

Tomb of Hazrat Baha-ud-Din Zakariya (d. 1267 CE) (Pl. 12)

The mausoleum has been constructed in three storeys. The ground storey is almost square measuring 53 ft. 6 in. x 52 ft. 3 in. externally and 34 ft. x 33 ft. 9 in. internally and is 35 ft. high. The entrance door lies in the southern wall. Above the square storey is placed second octagonal storey, surmounted with a hemi-spherical dome, 39 ft. external diameter, resting on a 4 ft. 6 in. high perpendicular neck. In the interio,r for the zone of transition, the square is converted into the octagonal structure by providing squinches embellished with stalactite work. This octagon is further converted into 16 sides which finally supports the dome.

Pl. 10 Tomb of Hazrat Yousaf Gardezi, Multan.

Pl. 11 Tomb of Hazrat Khalid Walid, Kabirwala - General view.

Tomb of Hazrat Shah Dana Shaheed (d. 1270 CE)

Hazrat Shah Dana Shaheed was a disciple of Hazrat Baha-ud-Din Zakariya. The mausoleum, situated inside Delhi Gate is built in three storeys. The ground storey is square in plan measuring 19 ft. x 19 ft. internally and 22 ft. x 22 ft. externally. On lower storey is placed the second octagonal storey, then surmounted by a hemi-spherical dome crowned with a lantern and a finial. The exterior and the interior have been finished with lime plaster.

Tomb of Hazrat Shah Shams Sabzwari (d. 1276 CE)

It was built in 730 A.H./1329 CE by his grandson, Sadr-ud-Din. It has been recorded that in 1194AH /1779 CE the tomb was almost entirely re-built by Syed Mehr Ali.

The plan of the mausoleum is the same like that of the tomb of Hazrat Baha-ud-Din Zakariya i.e. the square ground storey is followed by the second storey which is octagonal which in turn, is surmounted by a hemi-spherical dome. Around the mausoleum a verandah has been added, evidently at some later period possibly in 1779 CE. The exterior of the mausoleum is decorated with glazed tiles and plaster. The whole exterior of the dome has been covered with light green square tiles fixed with iron nails in the centre a feature not seen anywhere else.

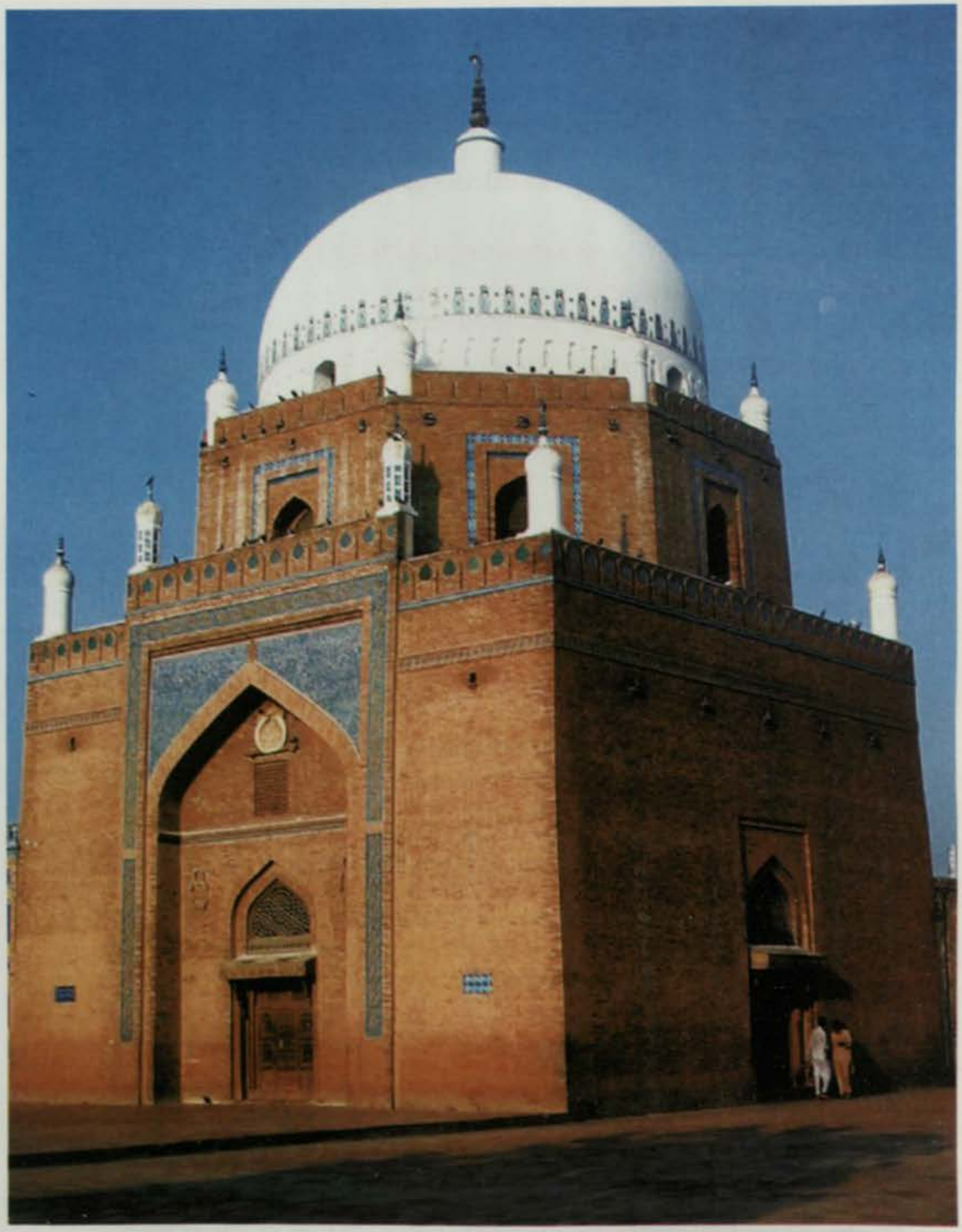
The interior of the mausoleum was decorated with glazed lime plaster and floral fresco paintings. More recently a dado of white marble tiles has been added in the interior whereas the second storey and soffit of the dome have been provided with a fresh mirror work..

Type-III

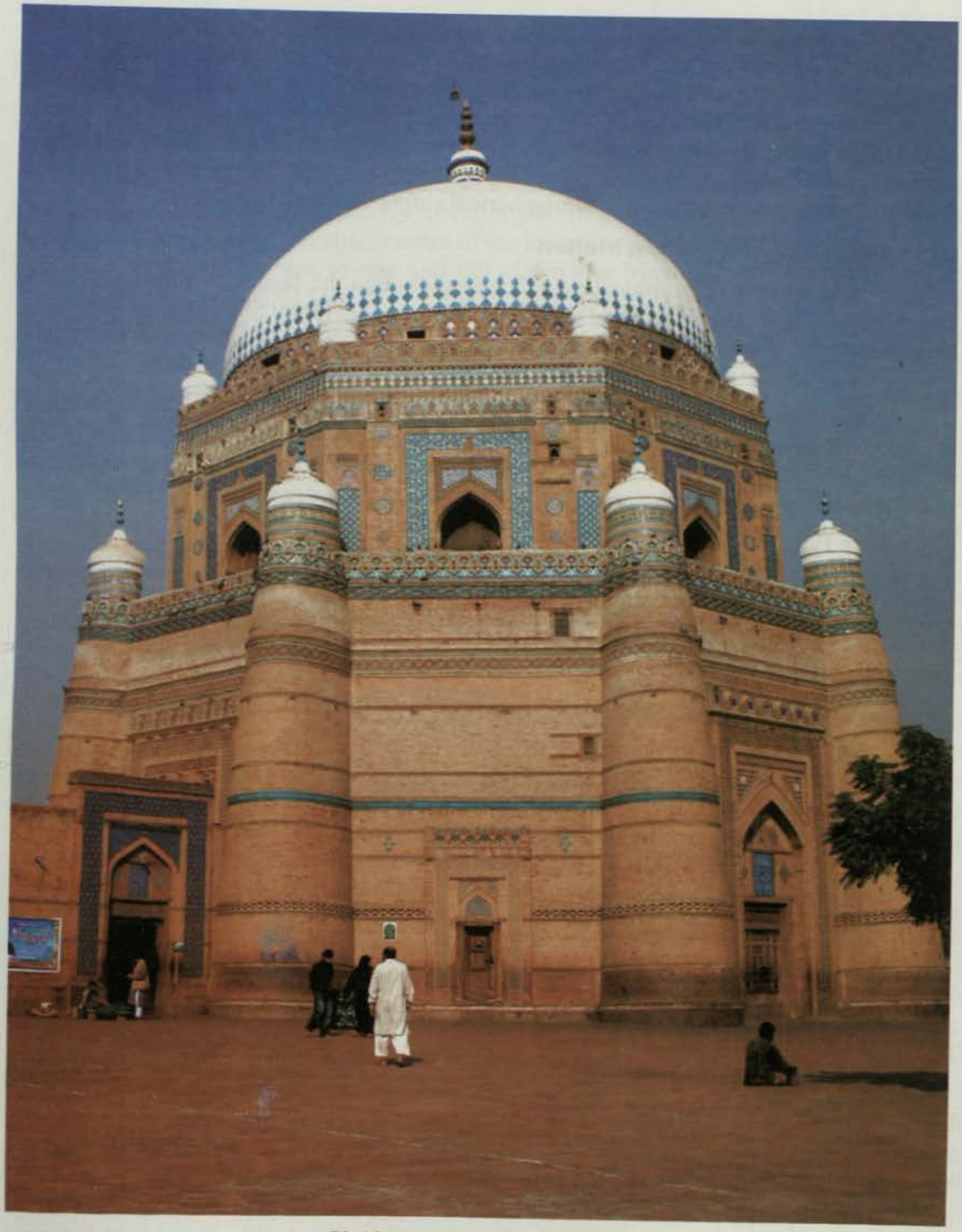
The third type is an octagonal mausoleum built in three tiers. The ground storey is octagonal in plan. The drum or second storey is also octagonal and then followed by a dome. The earliest example of this type is the mausoleum of Hazrat Shah Rukn-e-Alam (1320-24 CE). This type is the climax of Multan style of Tomb Architecture. There are numerous monuments of this style in Multan, Dera Ghazi Khan, and Bahawalpur divisions. The important monuments of this type are tomb of Hazrat Shah Rukn-e-Alam and the tomb of Sultan Ali Akbar at Multan, tomb of Bibi Jiwindi at Uch, tomb of Tahir Khan Nahar at Sitpur, tomb of Hazrat Abdul Wahab Bukhari at Daira Din Pinah and tomb of Hazrat Rajan Shah in District Leiah. Brief description of some monuments is as below:

Tomb of Hazrat Shah Rukn-e-Alam, Multan. (Pl. 13)

Shaikh-ul-Islam Rukn-ud-Din alias Shah Rukn-e-Alam was the grandson of Hazrat Baha-ud-Din Zakariya. He was born in Multan on Friday 9th Ramazan 648 AH /26th November 1251 CE. He was appointed Shaikh-ul-Islam by Ala-ud-Din Khilji and maintained this position throughout the Khilji regime as well as the Tughlaq period. He died at the age of 86 on Friday 7th Jamadi-ul-Awwal 735 AH/3rd January, 1335 CE. The mausoleum of Hazrat Shah Rukn-e-Alam, the climax of Multan Style of Tomb



Pl. 12 Tomb of Hazrat Baha-ud-Din Zakariya at Multan.



Pl. 13 Tomb of Hazrat Shah Rukn-e-Alam at Multan - General view.

Architecture, is unique for its architectural embellishments and the architectural hit and glory of Multan Style. This mausoleum has been admired by R.E.M. Wheeler as "one of the most splendid memorials ever erected in honour of the dead". It is said that this tomb was built by Ghias-ud-Din Tughluq in 1320-24 CE for himself but later it was gifted to Shah Rukn-e-Alam. It is octagonal in plan with sloping turrets at angular points ending in domelets with pinnacle. Over the octagonal ground storey there is another octagonal storey, surmounted by a hemispherical single dome of 58 ft dia.

Tomb of Sultan Ali Akbar, Multan.

According to the epigraphical evidence available on the façade of the mausoleum, Hazrat Sultan Ali Akbar, was one of the great grandsons of Hazrat Shah Shams Sabzwari. The mausoleum is situated in Suraj Miani at a distance of about 3 miles to the west of the Fort and was built by the saint in his life time.

The mausoleum is almost a replica of the mausoleum of Hazrat Shah Rukn-e-Alam in plan as well as elevation. The mausoleum is decorated with glazed tiles of floral, geometrical and calligraphic designs. The interior of the mausoleum is decorated with glazed lime plaster embellished with fresco and stucco tracery work.

Other Type

There is another type of Tomb Architecture in Multan region. In this type the tomb consists of two storeys i.e. ground storey surmounted by a dome. Tomb of Sheikh Sadan Shaheed in District Muzaffargarh ,Tomb of Awais Khugga at Multan and Tomb of Syed Ahmad Kabir near Dunyapur are the best examples of this type.

Tomb of Sheikh Sadan Shaheed , District Muzaffargarh.

The tomb is situated in mauza Jilaran Shimali in District Muzaffargarh. According to a local tradition, Sheikh Sadan Shaheed was the descendant of Hazrat Tamim Ansari, a companion of Holy Prophet (Peace Be Upon Him). The saint died in 674 AH/1275 CE. The tomb was constructed in two storeys. the ground storey is square in plan measuring each side 20'- 8" internally, 29'-2" externally and has been raised on a solid platform 8'-6" high above the ground level. The exterior of the tomb is decorated with cut and delicate carved brick work in floral, geometrical and calligraphic designs. Above the ground storey was dome, which has fallen. The interior of the tomb is square, then converted into an octagon by providing squinches in the corners for the zone of transition, then circular for the base of the dome. The interior of the tomb is devoid of ornamentation except a terra cotta inscription.

The characteristics of this style

1. Baked bricks as the unit of construction,
2. Enamelled tile decoration both flat and relief used in geometrical pattern,
3. Filigree work,
4. Delicate carved and lattice wood work,
5. Intricate carved brick decoration in calligraphic, floral and geometrical designs,

6 Lathe and lacquer work.
7. Gilding work.

(ii) Samma Rajput Period (1340-1520 CE)

Thatta is mentioned as a flourishing city as far back as 1351 CE when Muhammad Tughluq, the Sultan of Delhi died in its vicinity while pursuing the ringleaders of a revolt in Gujarat. It remained the chief centre of the lower Sind from 14th century to 1739 CE and witnessed the successive rise and fall of the four Muslim ruling dynasties. These were Samma Rajputs (1340-1520 CE), the Arghuns (1520-1555 CE), the Tarkhans (1555-1592 CE) and the Mughal emperors of Delhi (1592-1739 CE).

The Sindh architecture of this period was derived more from Persia and occasionally from Gujarat. It represents an independent development, which started before the Mughals.

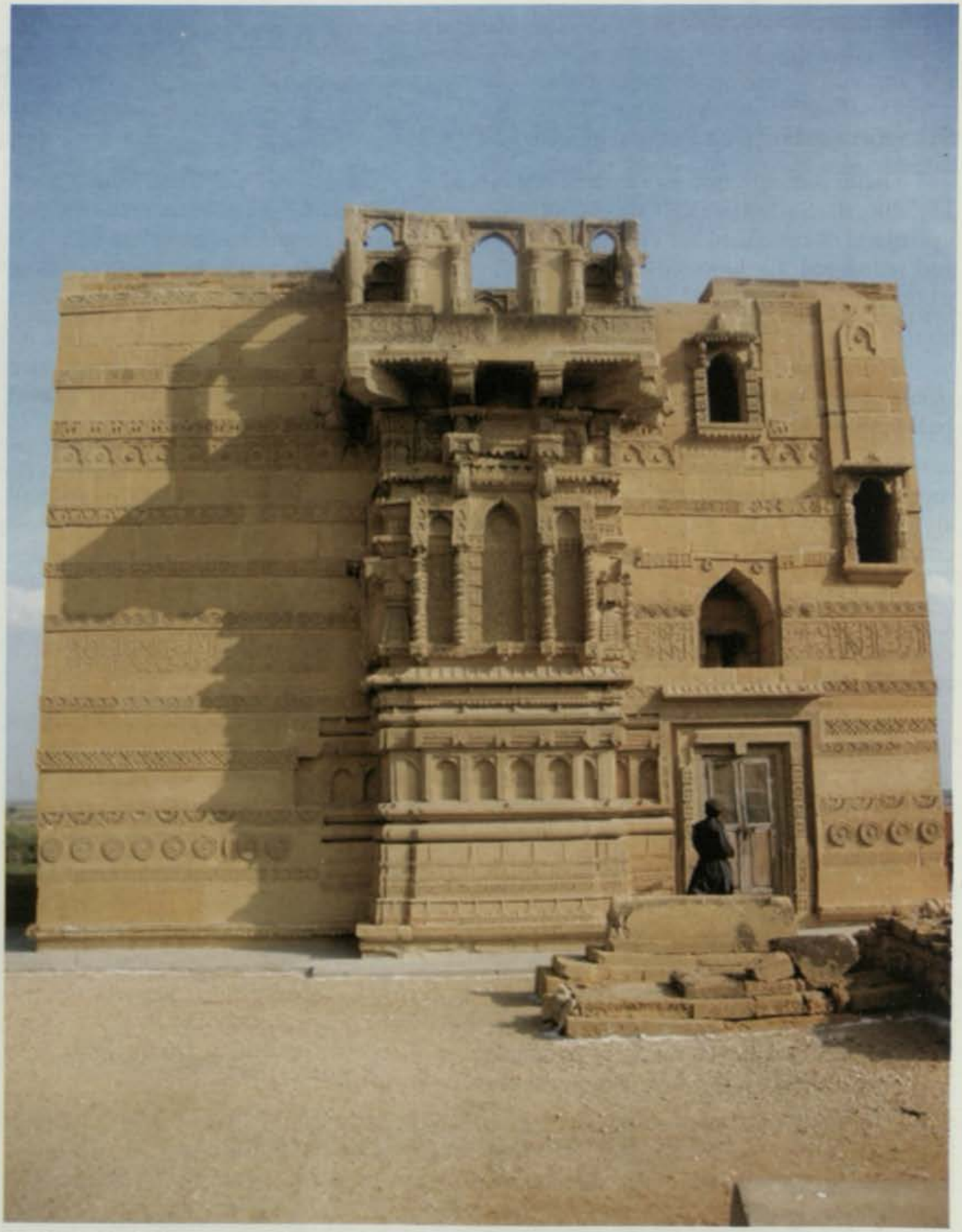
Sammas contributed a great deal to the evolution of the style of architecture. The monuments built during this period are both in stone and brick and follow two different styles, one in stone and the other in brick. The stone monuments fall under four categories. These are:

Madrassah type Pavilions (*Chattries*):To this category belong Shaikh Isa Langoti's Madrassah pavilion and Hamad Jamali's Madrassah pavilion. All these constructions are in dry stone masonry. In this style, we have simple pillar-based porch and elaborately carved stone door jambs.

Tomb Pavilions (14th century CE): These stone pillared pavilions are hexagonal or octagonal in plan with one pillar on each corner. The pillars have four armed bracket supporting lintels. These lintels also support a projected *chajja* (eave). The canopy is made of overlapping stones. The pavilions are decorated with carving. For example see hexagonal pavilions of Bhitta Yaro and Qazi Abdullah and octagonal pavilion south of the tomb of Isa Langoti, Makli Hill.

Tomb enclosure: The first example is the dated stone tomb of Mubarak Khan. According to the Arabic inscription over the eastern entrance of the enclosure, the foundation of this enclosure was laid in 895 AH /1490 CE by Khan-al-Azam Mian Mubarak Khan and completed by his son in 1519 CE. The building consists of tomb enclosure built of uniform limestone blocks on a high terrace approached by seven steps. The enclosure walls are plain except two friezes of carved decoration. The top of the wall is embellished with merlons. The entrances are very ornate.

The brick tomb enclosure lies to the south west of the tomb of Jam Nizam-ud-Din. It is enclosed on stone foundation. The walls are plastered both inside and outside. Some indications of plain purple blue enamelled tiles are in the southeast corner on exterior and interior.



Pl. 14 Tomb of Nizam - ud - Din at Makli.

Brick built tombs: The most important monuments of this type are the tomb of the sister of Fateh Khan (1492 CE) and of the Tomb of Qaus-as-Sultani (919 A.H./1513 CE). The tomb of the sister of Fateh Khan is built of bricks. It is square in plan and has three entrances on the north, south and east. The southern arched entrance has a stone doorframe fitted into it. It is an innovation introduced for the first time in Samma architecture. The dome rests on an octagonal drum. For the zone of transition, in the interior, the square is converted into octagon by providing squinches in the corners. The southern façade is decorated with vertical panels.

The tomb of Qaus-as-Sultani is of the same style except for a little variation in decoration.

Square stone tombs: This is the type in which attempt has been made to copy the brick style in stone. In the form of the tomb of Jam Nizam-ud-Din, Samma architecture reached its climax (Pl. 14). Nizam-ud-Din was an important Samma ruler who ruled under the Hindu and Gujarati influence in lower Sindh. The structure of his tomb consists of an enclosure wall, containing a square chamber converted into octagon by means of squinches and then into sixteen sides. There was a dome. The walls surfaces are decorated with narrow carved motifs including geometric pattern, a row of geese, sunflowers and calligraphy. The highlight of the decorative scheme is the richly carved projection of the *mehrab*.

(iii) Arghuns and Tarkhan period (1520-1593 CE)

Arghuns and the Tarkhans were Turks hailing from Central Asia. They came to Afghanistan in the wake of Amir Taimur's invasion. When the Arghuns and Tarkhans moved to Sindh they brought with them Taimurid taste, new methods of constructions and new style of architecture. They came from an area where brick style was dominant. Ovoid, domical and accurate forms were their patrimony. Use of glazed tiles for decoration was sought in adding colours to the buildings. Thatta was a place where stone was easily available and stone carver's art had been a long tradition, so the stone work continued in this period as well. The older technique of dome construction appears to have improved. A change in the ornamentation of the grave cenotaph is seen.

At the end of this period when the Mughal Emperor Akbar conquered Sindh and annexed it to his empire, the Tarkhan accepted services under Mughals. When the Tarkhan governors were posted outside Sindh, they brought back with them to Thatta new techniques of building construction. The new method of dome construction is seen in the tombs of Tughril Beg and Jani Beg. The design of the tomb of Isa Khan II Tarkhan is wholly based on Gujarati style of architecture. Stone buildings of this period are divided into following categories:

Single domed square tomb: An unidentified tomb of this type is located to the north of Shaikh Jia's tomb in a lonely place. It is constructed in stone and has an arched opening on each of the four sides. There is a single frieze of carved stone decorations.

Tomb enclosure: The tomb of Isa Khan Tarkhan I, the first ruler of the Tarkhan dynasty (1555-1565 CE), tomb of Amir Sultan Muhammad (died 1556 CE), tomb of

Mirza Suleman (died 1557 CE), tomb of Mirza Saleh (constructed in 1565 CE), tomb of Baqi Beg Tarkhan (1586 CE) and tomb of Ahinsa Bhai (1586 CE) are best examples of this style. The tomb enclosures are quadrangular in plan. The walls of the enclosure are decorated with carved stone work.

Tomb pavilion: These tomb pavilions follow the earlier design but introduce new types of pillars and new decorative motifs. These pavilions are octagonal and square in plan. The pillars support the plain lintels having central block in the centre to take the load of dome. Carved stone decorations are found in these pavilions. The graves inside the pavilions are also decorated with stone carving.

The examples of octagonal pavilions are unidentified tomb of Badi-uz-Zaman inside the bigger enclosure of Baqi Beg Tarkhan, tomb of Badi-uz Zaman (died 1602 CE) and pavilion inside the enclosure of Isa Khan Tarkhan 1. The examples of square type pavilions are unidentified tomb pavilion to the south of Sultan Ibrahim's tomb, unidentified pavilion to the west of Mausoleum of Abdullah Shah Ashabi.

Chaukhandi type graves (Pl. 15): Such graves are few and far between on Makli hill.The basic type is a pyramidal grave of super-imposed stone blocks set one above the other in receding order. Externally these blocks are profusely and minutely carved in floral and geometrical patterns. One example is located to the west of the tomb of Mubarak Khan. Such types of graves are found at several places in Sindh and Balochistan and are mostly constructed in buff sand-stone. Chaukhandi type graves are found at Liari at a distance of about 29 kilo-metres from Karachi to the left of the National Highway. At Bhawani Serai Graveyard located on Karachi-Lesbela road some five miles from Chowki near Bhawani Sarai, the graves are, in typical pyramidal shape in yellow sandstone, oblong vault type chambers. The graves are profusely decorated with carving in floral and geometrical designs.

Hinidan Tombs are located on the right bank of Hub River some 57 miles from Hub Chowki. The Hinidan type of Chaukhandi graves are a class by themselves, having their own method and technique for their erection and decoration. They contain several features which are not found in other graveyards. Head-Stones of these graves are in a variety of designs, especially depiction of sunflower carved in pronounced high relief is very common, resembling a fortification with merlons, in the form of pointed columns. The central portion of these graves is in the form of coffin-carrier with handles projecting outwards on both sides.

Some graves have carved decorations of human and animal's representations both in naturalistic and stylished forms. Hinidan graves are also decorated with mounted horse-men flanked by attendants like other Chaukhandi type graves. The earlier graves are decorated with primitive male figures with stylished animals and antique weapons while the later period graves have fully developed human figures wearing more sophisticated dress along with naturally formed horses and weapons like musketry.

Stone built tombs: Tomb of Jan Baba and the tomb of Isa Khan II Tarkhan are the most impressive stone buildings of this period.

The tomb of Isa Khan II Tarkhan, a fine example of considerable originality is placed in the centre of a large square court, surrounded by high stone walls with an arched *iwan* in the centre of each side one of which, in the southern side, serves as entrance. The massive structure is built of very large stones. It comprises a domed chamber surrounded by a two-tiered gallery. The pillars of the interior walls are almost covered with surface tracery similar to the work at Fatehpur Sikri. The double storey pillared galleries have a group of three graceful multi-cusped arches in the center of each side surmounted by a wide parapet. The lofty dome over the central chamber is flanked by a cluster of smaller domes, which cover the two-tiered gallery. The carving on the yellow lime stone is delicate with the whole adding up to a remarkable fusion of Hindu and Muslim techniques and shows the influence of Akbar's architecture.

Brick built Structures: Brick built monuments were also built on Makli hill. During the time of Arghuns and Tarkhans brick building received particular attention and we find new varieties introduced from outside. The most important changes are found in the height and shape given to the dome, new technique for the zone of transition from square to octagon, to give prominence to the drum and shape the dome in conical form. No double dome is ever seen to have been constructed at Thatta. The second change is the adoption of octagonal building. Alcoves were introduced to give delicacy to the building and an effect of lightness but the structures were not weak. New form of decoration was entirely given to glazed tiles. Band of glazed tiles in multiple colours gave a new glittering look to the buildings.

Satcharni (meaning "seven stairs") built in second half of 16th century CE and tomb of Baqi Beg Uzbek (1640 CE) are the examples of brick built tombs in this period.

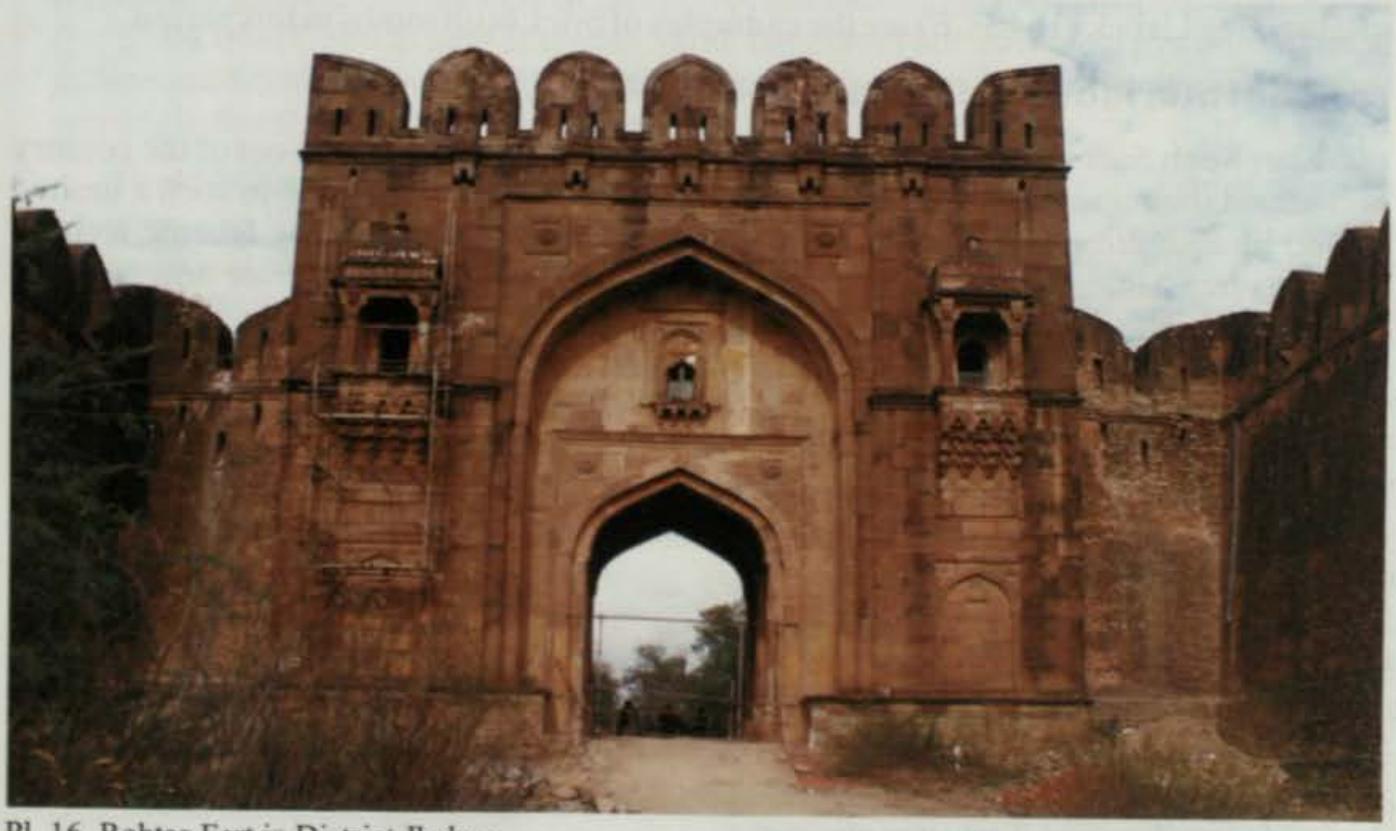
(d) The Interlude Suri Period (1540-1545 CE)

Sher Shah Suri interrupted the Mughal rule and pushed Humayun out of the country and seized the throne of Delhi. The Suri Dynasty reigned for 15 years. In such a limited period he introduced a decisive movement in the development of the Islamic style of architecture. Almost all the outstanding buildings of the Suri period are now in India except two: the Rohtas Fort and a mosque of the time of Saleem Shah Suri at Shahdara,Lahore. The Rohtas Fort (Pl. 16) situated about 12 miles northwest of Jhelum, was constructed purely for military purpose with perimeter of about two and half miles. The wall is supported by 68 semi-circular bastions and twelve gates. The chief characteristics of the style are high graceful drop type arches, oriel windows, kiosks and use of ashlar masonry. It was a start towards a new style, which was later adopted and developed by the Mughals.

(e) The Mughal Period (1526-1848 CE)

Babur was a great lover of gardens and orchards. He took interest in their construction. These works were of a secular nature and by the passage of time they fell into decay. The first phase of the Mughal architecture under Emperor Babur must have been of a late Timurid-Turkistan character.

Pl. 15 Chaukhandi Type graves.



Pl. 16 Rohtas Fort in District Jhelum.

Persian artists accompanied Humayun, after his return from Iran. The Mughal style was influenced by Persian traditions. There are no buildings of this period.

The important monument in the time of Akbar which still exists is the Masjidi (Masti) Gate built in 1566 CE, as one of the entrance to Lahore Fort. It has an archway opening between two massive semi-octagonal bastions. It has battlement and machicolation. Another building of the Akbar period in Lahore Fort is double storey back portion of *Diwan-i-Aam* including the *Jharoka* which shows influence of Hindu Architecture. The interior of this building was originally decorated with stucco tracery and gild work. Marble work in the building is the earliest example at Lahore. Attock Fort was also built during Akbar's period and completed in 1583 CE. The fortification wall of the Fort is constructed with locally available stone laid in lime mortar while bricks were used in the construction of arches, vault and domes.

A tomb of the time of Akbar is found in Gumbad Kile near Dilazak. The ground storey is octagonal in plan with four entrances. The entrance facade is beautifully relieved with multi-cusped ached panels, flat arch and trefoil design. The drum is sixteen sided surmounted with a low dome. The interior is square, each side being relieved with a high arched panel. The interior was embellished with paintings.

Mughal period monuments are also in a number of places in Khyber Pakhtunkhwa. The tomb of Asa-i-Sakhi Shah-i-Mardan (d. 970 AH /1562 CE) Peshawar is square in plan measuring about 32 feet externally. From outside, the walls are decorated by recessed panels of which the tallest, accommodating a window screened with stucco *jali,* takes the central position. The entrance lies in the southern wall. The drum is octagonal and each side is decorated with lozenge pattern. Above the drum is a hemispherical dome having lantern in the shape of inverted lotus and finial. Originally, the drum and dome were covered with glazed lime plaster. Recently, the dome has been covered with glazed pottery shards laid in cement mortar. Internally, for the zone of transition, the square is converted first into an octagonal by providing corner squinches and then into sixteen sides, which provide a circular base to the dome. This zone is decorated with stalactite work and recessed panels.

The Hund Fort situated near Attock on the west bank of the river Indus was built in 1586 CE in the reign of Akbar. It is built of country bricks and now is in a ruinous condition.

Jahangir added *Makatib Khana* (Clerks' Room) and *Daulat Khana* (Jahangir's Quadrangle) in Lahore Fort. The later was started by Akbar but completed by Jahangir in 1617-18 CE. Its frontage of red sandstone with richly carved columns and elaborate animal type brackets is the best example of carved and sculptured stonework. The tomb of Anarkali, located outside the Fort, was built in 1024 AH /1615 CE. This is an octagonal building surmounted by a huge dome on a vertical high neck. Each corner of the building is supported by octagonal turrets having kiosk on the top. This tomb is one of the earliest examples of double dome in Pakistan. The other notable monuments of this period are Maryam Zamani Mosque built by Maryam Zamani, the Hindu mother of Jahangir in

1614 CE famous for its fresco paintings, a *baoli* (stepped well) at Wah, Begum-ki-Sarai at Attock and a small fort at Sheikhupura and Hiran Minar near Sheikhupura.

Persian influence, in the shape of architecture, received great setback during Akbar's period. But it made a great come back in the reign of Shah Jahan (1628-1659 CE). Shah Jahan's interest in construction of buildings led to the creation of numerous monuments, some of which can still be seen in Lahore and Thatta.

During this long period several buildings were built in Thatta and nearby on Makli hills. They continue architectural style of other earlier monuments.

Khizri Mosque in Sindh was built by Nawab Abdul Razzaq Muzaffar Khan in 1022 AH/1613 CE. It is brick built and is decorated with glazed tiles. The mosque complex has a small domed entrance in the southeast corner of the courtyard, which has high enclosure walls. Some indications of glazed tile work exist in arch panel. The prayer chamber has three arched entrance openings under high alcoves under a rectangular frame. The central one is higher than the side ones. The arches have six limestone nook shafts but the central arch which has enamelled tile decoration at the spandrels, has a dome. The central bay is bigger than the side ones. The central *mehrab* has three air shoots leading air into windows. Similarly, each side bay has one air shoot. This is a typical type of mosque of the Mughal period in this part.

Among such monuments stone building of Jan Baba Isa Khan II Tarkhan and Tughril Beg are important ones that actually fall in the Mughal period. Similarly, brick buildings of Jani Beg, Baqi Beg Uzbek and Dewan Shurfa Khan also belong to the Mughal Period. An enclosure tomb, built of brick and decorated with glazed tiles belongs to the sixth Mughal Governor, Nawab Amir Khan (1628 CE). Another brick building of unusual type is the tomb and Mosque of Miran Shah. The building is white plastered. It represents a new pattern. The mosque is on the west, whereas an open courtyard and graves are on the east side. The rectangular mosque is covered with a *chauchala* roof (four segmented vault) with two finials on its top.

The mosque of Amir Muhammad Khan, Thatta was built in 1039 A H /1629 CE. It is single chamber square structures measuring 16 ft. 3 inches x 16 ft. 3 inches internally and 23 ft. 6 inches externally. The exterior was finished with cut and dressed bricks alternating with blue linings. The eastern façade has three rectangular frames, the central one higher than the side ones. They were originally decorated with enamelled tiles. Entrance door has a carved stone door jamb and lintel. For the zone of transition, the square is converted into octagon by providing squinches in the corners, then circular for the base of the dome. The walls on its interior are decorated with enamelled tiles in different motifs showing plants with blossoming flowers, fruit vases and *guldastas* on separate panels. These motifs are derived from the imperial Mughal buildings in Delhi and Agra. The soffit of the dome has herring bone design and rosette at the apex. This is the first monument in Thatta where the Mughal imperial motif has been introduced for the first time.

Shah Jahan added *Diwan-i-Aam* (Hall of Public Audience), the *Shish Mahal* (Palace of Mirrors), the *Naulakha, Khilwat Khana*, the *Moti Masjid*, the *Hammam-i-Shahi* and the *Diwan-i-Khas* in the Lahore Fort.

The Shah Burj (Shish Mahal) built in 1631 CE served as royal residence and the *harem* portion of the fort. The interior of the building is elaborated with mosaic of convex mirrors set in stucco tracery and gild work. The pietra dura work on the spandrels of the arches and bases of the columns give a pleasant look. Similarly, the beautiful marble screens (*jalies*) having geometrical and tendril designs testify the skill of its builders.

Naulakha pavilion was also built in 1631 CE. It is famous for its minute and delicate pietra dura work wrought in semi-precious stones such as lapis lazuli, jade, agate etc.

Wazir Khan's Mosque, Lahore is one of the most beautiful mosques of the world. Built of brick masonry in 1634 CE, it is planned on the unusual lines. Its eastern gateway and four octagonal minarets place it in a class by itself. Every portion of the mosque on its interior and exterior has been decorated with colourful fresco paintings, stucco tracery, brick imitation and tile mosaic work in floral, geometrical and calligraphic designs.

Two other tombs of Shah Jahan period are located in Kotla Mohsin Khan near Bhanamari on Kohat Road, Peshawar. The eastern one is assignable to Abdul Qadir Roshnai (died in 1633-34 CE) and the western one is assignable to Karim Dad Roshnai, Both tombs are built on a raised platform and originally stood within a *Chahar Bagh* enclosed by four walls with an entrance gate. The tomb of Abdul Qadir is 35'-9"x 28'-5" externally. The door lies in the east wall. The face is decorated with 14 recessed panels arranged in five rows. The unique feature of this tomb is a corridor, which runs around the drum and lighted through windows fitted with screens. Above it is a single dome.

Shah Jahan in 1637 CE erected the tomb of Jahangir (Pl. 17) in 1637CE . The tomb occupies the center of a garden, square in plan measuring 1500 feet a side. It is enclosed by a high brick wall with a gateway in the middle of each side. The garden is one of the largest and most conventional of its kind. It is divided into sixteen sub squares by means of pathways and water channels. The actual tomb is a single storey structure, square in plan measuring 325 feet a side with four beautiful minarets in corners. Internally, it consists of a verandah leading to a range of rooms around the building, while the tomb chamber is in the center. Externally, the building is decorated with white marble motifs (such as *aftaba* (ewer), *qab* (fruit dish) and *gulab pash* (rose water sprinkler) incised in red sandstone. Internally the surface is decorated with fresco paintings, stalactite, pietra dura and tile mosaic works.

The Shalamar Bagh (garden) in Lahore occupies about forty acres of land and was laid out in 1642 CE It consists of three receding terraces and numerous pavilions and other structures. The upper most terrace of the Garden is called *Farah Bakhsh* (Pleasure Giving). In this terrace, the present day main entrance was originally the *Aramgah* (Rest Room) of Shah Jahan. The building in the east now known as the *Naqqar Khana* was

Pl. 17 Tomb of Jahangir, Lahore - General view.

Pl. 18 Shahjahan Mosque at Thatta - General view.

originally the *Jheroka-i-Daulat-Khana-i-Khas-o-Aam* (the Window of the Hall of Special and Common Audience) and that on the west was the residence of the Empress. The middle terraces is called *Faiz Baksh* (Bountiful). The middle terrace is the most spectacular one. Its great reservoir contains one hundred and fifty two fountains, with a marble platform approached by a narrow causeway in the center. The garden was irrigated by means of a canal water known as the Shah Nahar. It was brought from Rajpur (present Madhupur), at a distance of more than a hundred miles by Ali Mardan Khan and Mullah Ala-ul-Mulk Toni. This garden is unique for its hydraulic system.

The Diwan-i-Khas (Private Hall of Audience) in Lahore Fort built in 1646 CE, is an arched pavilion wrought in choicest marble. Its beauty is further enhanced by marble screens, the decorated parapets with inlay work and the ornamental tessellated floor.

The Pictured Wall of Lahore Fort is only one of its kind in the world. Its construction was started by Jahangir and completed in the reign of Shah Jahan. The pictures are done in enamelled tile mosaic work in various colours. The wall displays wonderful rendering of Mughal court life, animals, celestial and human figures along with geometrical and floral elements. Here we can see bull fight, elephant fight and camel ride together with a game of *chaughan* (polo).

The great Jami Mosque at Thatta (Pl. 18) is superb example of glittering tile art. The construction of the mosque was started by Shah Jahan in 1647 CE and completed by Aurangzeb in 1653-59 CE. It is large complex of domed and open spaces centered around a courtyard 169 feet by 97 feet. Its plan differs from the usual mosque plan.

In order to balance the main prayer chamber on the west, an equally large two aisles deep chamber was provided on the east. These are linked by means of a double arcade. The ninety three domes which cover the whole structure are said to be the cause of a remarkable echo. The voice of the Imam in front of the *mehrab* can be heard in any part of the mosque. The mosque on its interior and exterior is decorated with glazed tile in floral, geometrical and calligraphic designs. The soffit of main dome is a superb starry vault in blue and white.

The Thatta style is a combination of Gujarat Hindu architecture with added Muslim features like Tudor type arches, shouldered low pitched type of dome, *Guldastas,* alcoves, turrets and ashlar stone masonry, elaborately carved in floral, geometrical and calligraphic patterns. There is also cut brick work and elaborate enamelled tile work. The chief characteristics of construction show a combined system of beam, bracket, arch and dome.

There is a group of Mughal monuments at Palosi Piran near the University of Peshawar on the old Michni Road. The most important building of this group is the tomb of Sheikh Imam-ud-Din (d.1050 AH /1640 CE). The construction of the tomb was completed in 1658 CE. It is square in plan and built on a raised platform having vaulted rooms underneath. The second storey or drum is octagonal. The tomb is plastered with lime mortar. Traces of fresco work are found in spandrels of the arches. Another building on the west of the tomb is the mosque with three openings. It is rectangular in plan with Indian style pavilion type of domical roof. It is also lime plastered.

Another building located in the Afghan Mission Hospital Peshawar belongs to the period of Shah Jahan and is attributed to Nawab Saeed Khan (Pl. 19). It is octagonal in plan with four high arched entrances one at each side. It is built on a raised platform. Above the ground storey is an octagonal drum surmounted by a double dome

The tomb of Kaka Sahib, Peshawar was constructed in 1661 CE in the reign of Aurangzeb Alamgir. The tomb is built in three tiers. The ground storey is square in plan having four minarets, one on each corner above the roof level. The entrance lies in the east. On the western side the minarets are smaller and square in plan while on the front (eastern) side the minarets are taller and octagonal in plan. The second storey has sixteen sides having turrets on each corner. Then it is surmounted by a fluted dome having lantern and finial. Internally, for the zone of transition, the square is converted into octagonal, then into sixteen sides, which acts as circular base for the dome. The present decoration and paintings seem to belong to a later period. No enamelled tile work has been used for decoration on any monument in the KPK province.

Mahabat Khan's mosque (Pl. 20) in Peshawar is an outstanding monument. It was probably built by Mahabat Khan, a well know figure in he Mughal history of the region in the times of Shah Jahan and Aurangzeb. This is rectangular in plan 185 feet by 163 feet and stands on a raised terrace approached by a flight of steps. It has entrance and a row of *hujras* on three sides except west. The prayer chamber is in the west. It is rectangular in plan having two high minarets, one at the either end of the eastern facade.

The façade and minarets are decorated with recessed panels. The top pavilion of the minaret is carried over eight columns. The whole structure is built in country bricks laid in lime *surkhi* mortar.

The interior consists of two deep and long halls. The front portion has *qalamdani* roof with the margin in concave shape. The back portion is divided into bays. The prayer chamber has three fluted domes. The central one is bigger than the side ones. The domes are covered with lime plaster on its exterior. The interior of the prayer chamber is decorated with beautiful fresco paintings. Originally, the prayer chamber and courtyard was paved in small country bricks laid on edge.

The tomb of Karim Dad Roshnai is almost square in plan measuring 34 x 28.5 ft. externally. The door lies in the south wall. The southern façade is decorated with 11 recessed panels with cusped arches arranged in five vertical rows. Above five vertical rows, the parapet is embellished with false crenelation. Above the ground storey is placed 12-sided drum of the dome. It is decorated with recessed panels, then surmounted with a single dome.

Badshahi Mosque, Lahore (Pl. 21) 567 feet square in plan with four corner minarets built in 1673-74 CE adjacent to Lahore Fort is the largest ancient mosque of the subcontinent. The entrance is a double storey edifice of the traditional Mughal style approached by a flight of 22 steps. It is decorated with framed and carved panelling on all its sides. On each corner is the octagonal minaret surmounted by red sandstone pavilion with marble cupola. The interior of the *deorhi* (vestibule) is decorated with stucco tracery and fresco paintings.

The prayer chamber measuring 275 feet x 85 feet with four corner minarets lies on the center of the west side raised above the outer courtyard. The central arched entrance is divided into panels enriched with carved and marble inlay in lineal, floral and geometrical patterns. The interior consists of two deep and long halls. The back portion is divided into seven intercommunicated bays, three of which have bulbous domes with marble veneer. The ceiling of the central bay is lime plastered bearing in relief a floral network of excellent workmanship. It is tastefully painted with subdued colours in fresco. The courtyard is flanked all around by *hujras*, 80 in all. The floor of the prayer chamber and courtyard was originally laid with cut and dressed country bricks set on edge in *musallah* form.

Other buildings built during the period of Aurangzeb in Lahore are the so called Budhhu's tomb, Bahadar Khan's tomb, Nusrat Khan's tomb, Dai Anga's tomb and Alamgiri Gate of the Lahore Fort.

The monument of the period of Muhammad Shah is Saruwala Maqbara (the Cypress Tomb), so named for its ornamentation of cypress trees. These cypresses, four on each side, are intercepted by smaller blossoming flower plants, and enamelled tile mosaic work. This tomb is the last of the monuments of Mughal period in Lahore.

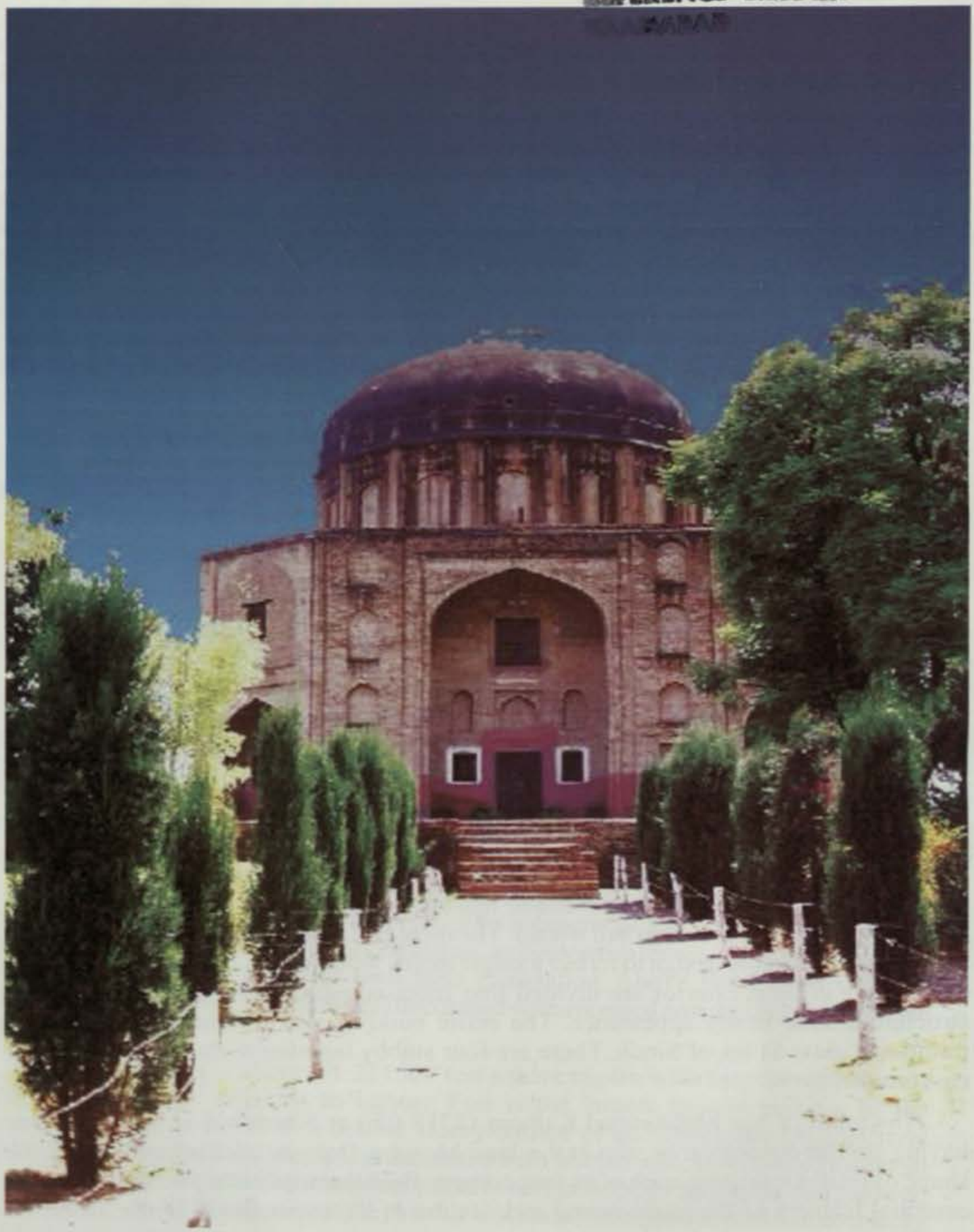
(f) Kalhora Period (1696-1783 CE)

After the decline of the Mughal power, Sindh came under the Kalhoras. The upper Sindh in the 17th and the 18th centuries evolved a style of architecture different from that of the south. The early phase of the provincial style of architecture of upper Sindh seen in the monuments at Sukhur, associated with the family of Ma'sumi Sayyids. The most impressive of these structures is a monumental tower built for the pleasure of observing, the countryside around, and for the greater glory of its architecture. Beside Mir Ma'sum's tower is a domed octagonal building called the *Aramgah* (Rest House) or Faiz Mahal. The elements in this building characterize later buildings in upper Sindh in particular the tall proportions, glazed tiles and decorative merlons.

The Jami Masjid at Khudabad is a massive structure which has suffered from vandalism and lack of care. The mosque has three arched entrances with an intricate domed roof covering the main hall within. The three tall arched openings of the entrance show an unmistakable design to reflect a single storey volume of the prayer chamber. The other walls in their exterior are divided into recessed panels with arches, giving the structure a three storey appearance. The entire building was lavishly decorated with traditional glazed tiles of Sindh. There are four stubby tapering minarets crowning the east facade.

The tomb of Yar Muhammad Kalhora (1718 CE) at Khudabad is square in plan having similar decoration as seen in the Jami Mosque. Only an addition is found in the shape of small kiosks atop each of its four corners. Both these monuments established the essential features of the monumental architecture of the upper Sindh for the next two centuries.

For the first time a dome crowned with a lantern was introduced in the tomb of Shah



Pl. 19 Tomb of Saeed Khan, Peshawar - General view.

Pl. 20 Mahabat Khan Mosque at Peshawar - General view.

Pl. 21 Badshahi Mosque at Lahore - General view.

Baharo (d. 1735-36 CE) at Sukhur. In 1768 CE the capital of Sindh was shifted to Hyderabad by Mian Ghulam Shah Kalhora. The monuments of this period at Hyderabad are the tombs of Ghulam Shah Kalhora, Ghulam Nabi (Pl. 22) and Sarfraz Khan. The earliest of these tombs is that of Ghulam Shah Kalhora. It is square in plan externally. Originally it was topped by a dome with a tile encrusted three storey façade. It is the upper Sindh Mausoleum. It has a carved *jali* in yellow limestone, much typical of lower Sindh. The tomb is built within massive fort like mud wall having bastions and a protected entrance.

Internally, the tomb of Ghulam Nabi Khan is almost identical to that of Ghulam Shah, but externally it is an octagon with four tall and shallow arched recesses on alternate side. There are small arched deep set niches in the remaining sides.

(g) Talpur Period (1783-1834 CE)

In 1783 CE the Kalhoras were overthrown by Mir Fateh Ali Khan Talpur, who founded Talpur dynasty. Talpurs ruled Sindh till the British occupation in 1843 CE. The tombs of the Talpurs are located in Hyderabad and Khudabad. The tombs at Hyderbad are divided into two groups: Northern Group and Southern Group.

The northern group includes, the tomb of Mir Karam Ali Khan, Mir Murad Ali Khan, Mir Noor Muhammad Khan, Mir Muhammad Nasir Khan, Mir Shahdad Khan, Mir Hussain Ali Khan, Mir Sohrab Khan, their ladies and relatives. All these tombs are situated at Hyderabad.

The southern group includes the tomb of Mir Muhammad Khan, Mir Shah Nawaz Khan, their ladies and relatives. These are also situated at Hyderabad. These two groups of Talpur tombs are better preserved than the Kalhora tombs.

Tomb of Mir Karam Ali Khan (d. 1244 AH/1828 CE): The tomb was constructed in 1245 AH. The approach to the tomb is through an arched portal. The tomb is square in plan and surmounted by a dome with an octagonal drum. There are square kiosks with domelets over each corner of the roof. The outer surface of the walls has arched sunken panels decorated with multicoloured enamelled tiles. Yellow and brown colour tiles have been introduced in this tomb. The tomb chamber is built on a low plinth of stone while the walls are built of bricks laid in lime mortar. The dado is of yellow sandstone. Railing of stone fretwork surrounds the marble sarcophagus resting on a raised platform. There is a marble canopy supported by carved pillars. For the zone of transition, the octagon is converted into sixteen sides to make it circular for the base of dome. The interior of the tomb is lime plastered embellished with fresco paintings. The floor is of marble and yellow stones.

Tomb of Mir Muhammad Nasir Khan and other Talpur chiefs: Mir Muhammad Nasir Khan was the last ruler of Sindh. Talpurs were defeated in a battle between Talpurs and Sir Charles Napier in 1843 CE. Mir Muhammad Nasir was taken to Bombay as state prisoner. He died at Culcutta in 1262 AH. He was buried at Pune as *amanat*. His dead body was brought to Hyderabad during 1855 CE and buried in the family graveyard. The

building is rectangular in plan covered with enamelled tiles in white, blue, green and brown colours depicting floral and geometric patterns. In the interior, the walls are lime plastered. The grave of Mir Muhammad Nasir Khan is of marble decorated with fretwork. The graves of other chiefs are also made of marble decorated with carving and enclosed by railing.

In addition to the tomb, there are *tajars* of the *derah* of Mirs. The *tajar* is a small rectangular building having flat roof composed of beams and battens system. The outer surface is mostly lime plastered and decorated with enamelled tiles. The *tajar* enclosing the graves of *derahs* of Mir Shahdad Khan Talpur has a vaulted roof.

Tomb of Mir Muhammad Khan and Mir Shah Nawaz Khan Talpur: The plan of this tomb is similar to that of the tomb of Mir Karam Ai Khan. The only difference is found in arched panel decoration on exterior of the walls. Its walls are also decorated with enamelled tiles in multi-colours. The walls on its interior are decorated with paintings in geometrical designs and Quranic verses.

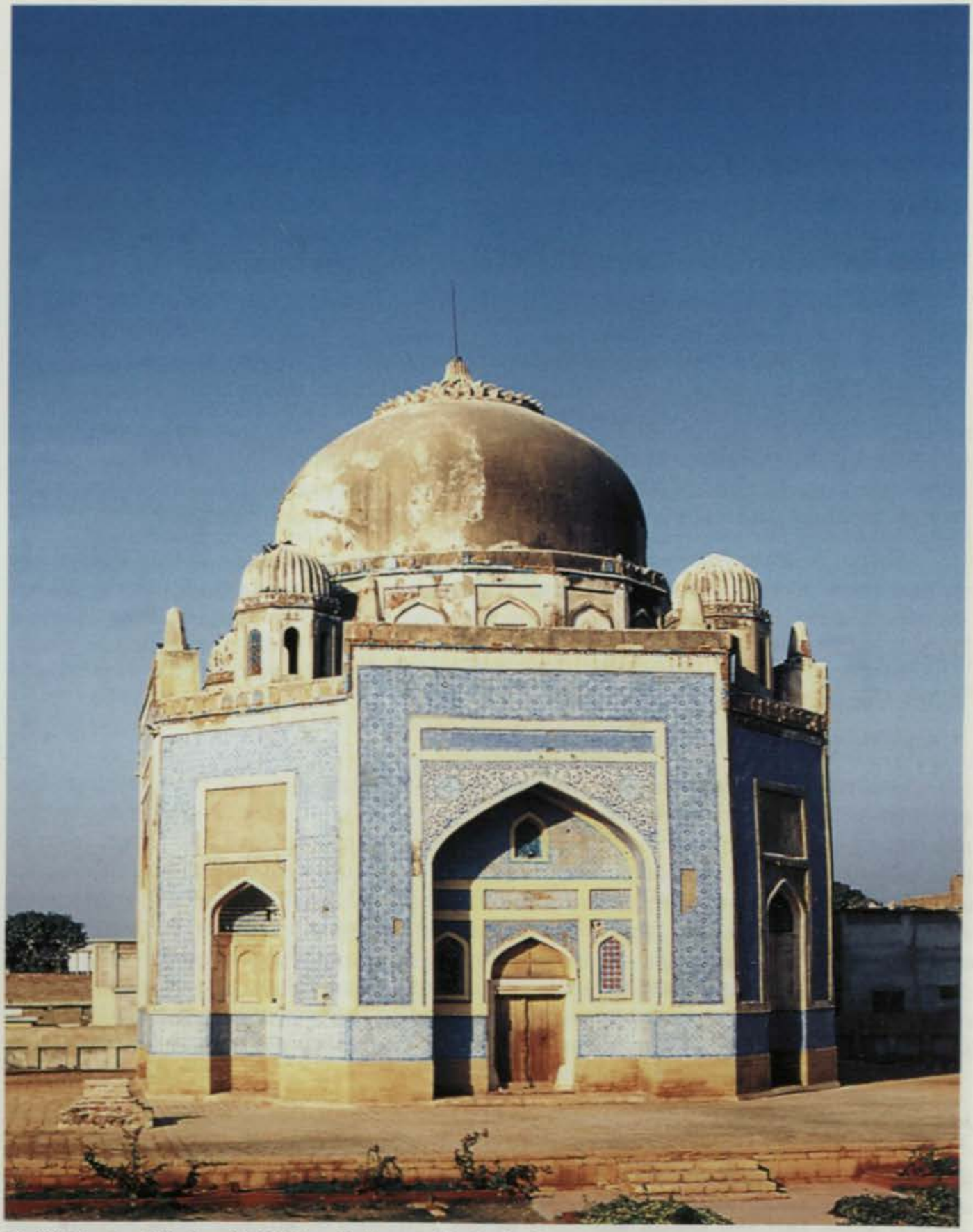
Tomb of Mir Ghulam Hussain Khan (Third) and others: The plan of the tomb is almost the same like others. The exterior of the walls is decorated with carved stone slabs in yellow colour. The walls on its interior are decorated with floral paintings.

There are some *tajars* in the southern group of the same style to that of northern group. Sindh style of the architecture of Kalhoras and Mirs with proportionally higher elevation, panelled decorations, skyline crowded with *guldastas*, *merlons*, kiosks, turrets, balustrades and top lanterns. The last named being a feature belonging to Sindh. The chief decorative elements being crowded on the exterior are enamelled tile work and on the interior fresco paintings.

7. Sikh Period Architecture (19 th century CE)

The religious architecture of the Sikh represents an interesting development. It is mixture of Hindu and Muslim architecture, mostly composed and constructed in conformity with Hindu tastes. The *gurdawara* is built in the centre of an open court or pool. The main building is often double storeyed on a square plan with identical facades on each side. The inner square chamber on the ground and first floor is usually repeated on the second floor, then surmounted by a fluted bulbous dome. For the transition the inner square is converted into circular base of the dome providing double curve form like *bungla*- a roof introduced into Mughal architecture by Shah Jahan. This curvilinear form, projected to form eaves, is one of the most distinctive features of Sikh architecture. The best known buildings of Sikh period are *smadhs* of Arjun Dev and Maharaja Ranjit Singh located on the western side of the Lahore Fort.

Smadh of Ranjit Singh, Lahore (Pl. 23): Ranjit Singh, the Sikh, ruled Punjab from 1799 to 1839 CE. The construction of the *smadh* was commenced by Ranjit Singh's son Kharak Singh and completed in 1848 CE during the reign of Raja Dalip Singh. The square roof with a central fluted dome is crowned with small pavilions, kiosks, stone lanterns and cupolas and the whole enclosed by an elaborate balustrade. The ceilings are decorated with glass mosaic or plain glass work. The arches in the interior are of marble.



Pl. 22 Tomb of Ghulam Nabi Khan Kalhora at Hyderabad.

Pl. 23 Samadh of Ranjit Singh, Lahore - General view.

Pl. 24 Baradari in Hazoori Bagh, Lahore - General view.

The interior of the *smadh* is also decorated with fresco paintings depicting mostly the life stories of the Sikh Gurus. Marble door frames in the building had been pilfered apparently from various Mughal buildings, specially the Lahore Fort.

Secular buildings: Among Sikh secular buildings, the while marble *baradari* (pavilion) in the Hazoori Bagh (Pl. 24) is the fine example of the degree of derivation of Sikh buildings from the Mughal precedent. It was constructed in 1818 CE by Ranjit Singh from material obtained by despoiling the Mughal buildings in Lahore, specially the tomb of Nawan Kot and Shah Sharaf's tomb. The building is square in plan having two storeys with underground chambers. It was built entirely in white marble.

The Baradari in Sheranwala Bagh, Gujranwala represented an interesting development of the indigenous mainstream. It was constructed by Maharaja Ranjit Singh. It was built on a platform having three storeys. The exterior of the building was decorated with glazed lime plaster whereas the interior was embellished with fresco paintings. Unfortunately this *baradari* has been demolished.

The *Haveli* of Naunihal Singh in the walled city of Lahore, is one of the most outstanding representations of Sikh domestic architecture. It is double storey structure having approximately square plan with a central court. Externally, it is decorated with relief patterns in brick and internally fresco paintings on lime plaster depicting human, animal and mythological figure.

Mai Jindan's Palace in Lahore Fort represents the last expression of the grand tradition of indigenous architecture.

8. British Period Architecture (19th - 20th century CE)

During this period emerged a form of architecture with some of the features of the Mughal and European style with the European motifs super imposed on Mughal design became the popular architectural style for public buildings especially public halls, hospitals, colleges, courts of justice, museums and railway stations. High Court and Aitchison College in Lahore, Islamia College in Peshawar and Chief Court, Mohatta Palace, Municipal Office and Hindu Gymkhana at Karachi are good examples of the so called "Anglo Indian" style. During this period, the lavish use of ornamentations, which were the prominent features of the Mughal architecture in this country, has gradually gone out of fashion. So this period is not important with respect to traditional architectural decoration crafts.

Aitchison College (Pl. 25): The foundation stone of this residential college, named after Lt. Governor Charles Aitchison was laid in November, 1886 CE. It was designed in Anglo-Mughal style. The ground plan was furnished by Col. Swinton Jacob, Executive Engineer at Jaipur and an elevation by Bhai Wasti Ram of the Mayo School of Arts, Lahore. The ensemble of three blocks is symmetrically arranged. The central block rises in three tiers with verandahs on the east and west upto the height of classrooms on either side of the main hall. A double storey portico lies between the central block and the small block. Over the portico is a high domed clock tower. The third block is to the south of the central block. The structure is built in brick with some elements in red sand stone. The

building with its facing of brick work presents an extra ordinary ensemble of clusters of brick domes and cupolas, corner kiosks and *chajjas* over openings. Terra cotta tracery used in this building is remarkable.

Islamia College, Peshawar (Pl. 26): The Islamia College, Peshawar, initially named Darul-Uloom, Islamia Sarhad, commenced functioning in the year 1913 CE. In the presence of its founder, the celebrated Sahibzada Abdul Qayyum Khan, and other elites of the area, the foundation stone of the building was laid by Mr. George Roos Keppel, the then Chief Commissioner, Peshawar.

The entire building is built in baked bricks. It was designed in Anglo-Mughal style. It consists of a big hall called Roos Keppel Hall, classrooms, offices and arcaded verandahs. The Roos Keppel Hall is decorated with an ornamental horizontal frieze below parapet. The parapet is built in the shape of a balustrade. Over the staircase is a domed clock tower

The building with its charming figure embellished with domes, kiosks topped with cupolas and finials, creates a wonderful sight to the eye.

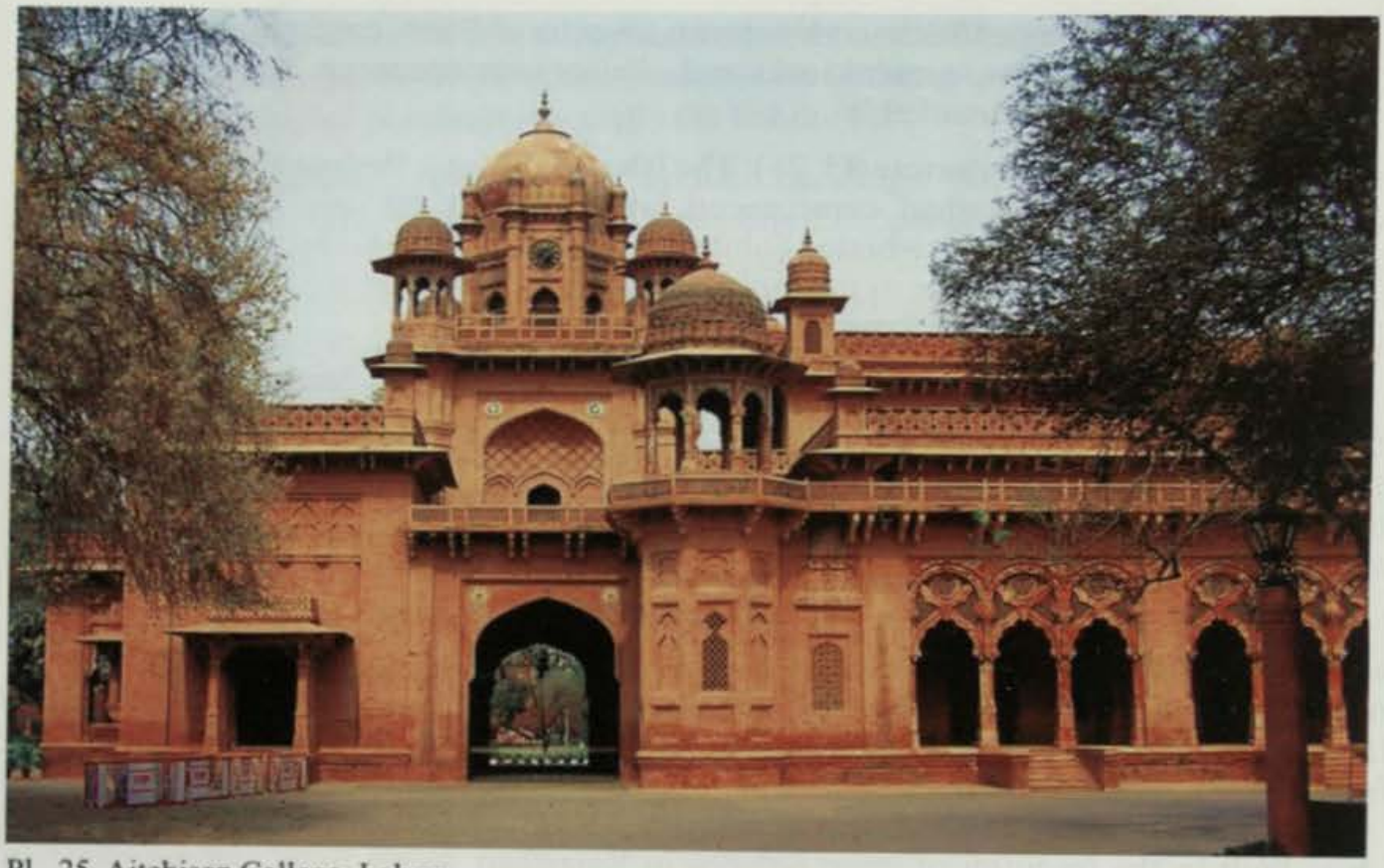
Mohatta Palace, Karachi

The Mohatta Palace is located in Karachi, Sindh. It was lovingly built by the eccentric millionaire Shiv Ratan Mohatta in the late 1920s. However, Mohatta could enjoy this building for only about two decades before independence of Pakistan and he left Karachi for India. The architect of the palace was Agha Ahmed Hussain. The palace was built in the tradition of stone palaces in Rajasthan, using pink Jodhpur stone in combination with the local yellow stone from Gizri. The amalgam gave the palace a distinctive presence in an elegant neighbourhood, characterised by Mughal architecture. It contains large stately rooms designed for entertainment on the ground floor and more private facilities on the first floor like bed rooms and reception room. The large terrace on the first floor overlook the Arabian Sea. A *baradari* topped by cupolas provides an enclosure and shade from intense sunlight to the central part of the roof terrace. The movement inside the building is through the great entrance into a spacious corridor that runs around a huge hall with ornate ceilings and a staircase on the South side.

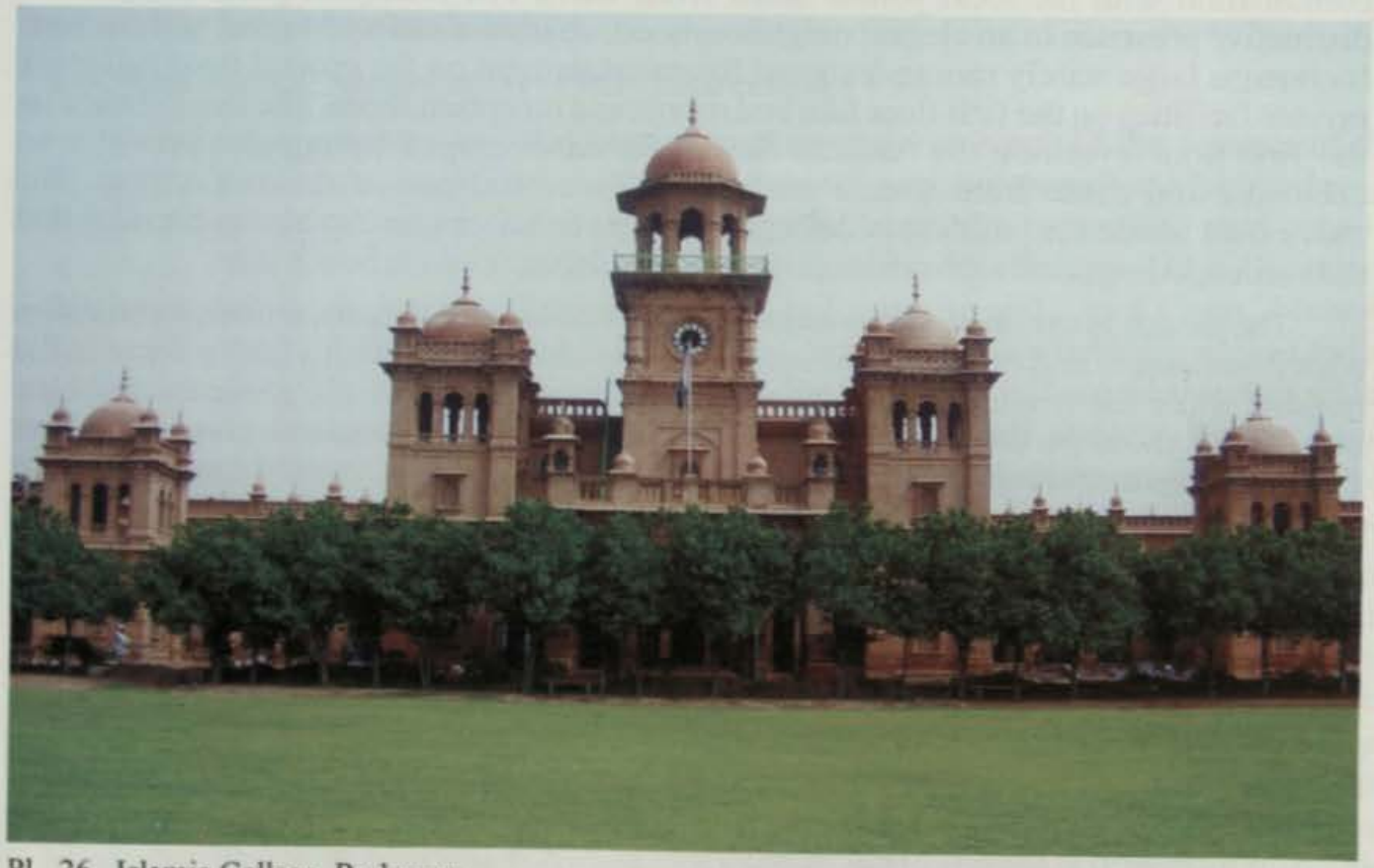
The facade is trimmed with windows, stone brackets, spandrels, domes, balustrades with floral motifs and exquisite railings. There are nine domes, with a centre dome in the middle; while the windows in the front portion opening out into the garden are of blue colour and those in the rear area are arched windows with stained glass. The four octagonal towers, although treated differently in the lower part, have the upper portion topped with projecting balcony and *chattris*.

After Mohatta's departure to India, the Government of Pakistan acquired the building to house the Ministry of Foreign Affairs in 1947. Fatima Jinnah, the sister of the Quaid-e-Azam Muhammad Ali Jinnah, moved into it in 1964 In the '60s Mohatta Palace was dubbed Qasre-e-Fatima, becoming the hub of her presidential campaign against President Ayub Khan. After her death, her sister Shireen Jinnah moved in to occupy the ground floor for many years. With her passing away in 1980, the palace was sealed.

In 1995 it was purchased by the Government of Sindh for its conversion into a Museum devoted to the arts of Pakistan..



Pl . 25 Aitchison College, Lahore.



Pl . 26 Islamia College, Peshawar.

Chapter Two

Brick work

Cut and dressed brick work

Brick carving

Diaper Pattern Geometrical Flooring in Cut and Dressed Brick Work

CUT AND DRESSED BRICK WORK

Burnt bricks were made by the Babylonians in the fourth millennium BCE, whereas here in Pakistan these came in vogue in the third millennium BCE. Islamic architects used baked bricks in the early centuries and for long thereafter. They inherited the types of bricks used in the Roman and Sasanian worlds.

In Persia, kilns have been unearthed in Siyalk and Susa dating back into the first millennium BCE. Bricks had been used for decoration from early Islamic times laid in different planes to give light and shade effect on the facades of buildings. The climax of this technique is reached in the tomb of the Ismail Samanid (10th century CE) at Bukhara. An 11th century Seljuq tomb at Qarraqan, Iran is another example of this kind of work. Cut and dressed brick work has a very ancient history in the land of Pakistan. It has been used in the Great Bath of Mohenjo-daro (2750 -1500 BCE) with joints as fine as 1/32 of an inch laid in gypsum mortar. The alluvial soil of the Pakistan is suitable for making burnt bricks. Similarly ample wood is available for brick kiln. During the long period of about 5000 years, a lot of experiments have been made with the size and shape of the brick to make it thick, medium thick and thin bodies bricks, square and oblong etc. shapes.

All over the Pakistan there are numerous monuments embellished with cut and dressed bricks. This mode of decoration was started during Buddhist and Hindu periods. In the Hindu temple named Sassi da Kallara, dating back to 10th century CE, at Shah Muhammad Wali in southern Attock district (Pl. 27) elaborate cut, dressed and carved brick work has been used. Further this type of work has been extensively used at the mausoleums of Hazrat Khalid Walid (Khaliq Wali) (12th century CE) in tehsil Kabirwala, Sheikh Sadan Shaheed (1274 CE) in district Muzaffargarh, tombs at Lal Mara Sharif in district Dera Ismail Khan (Pl. 28), Tomb of Hazrat Rukn-e-Alam (1320-24 CE) at Multan (Pl. 29), Sheikh Ala-ud Din Mauj Darya (14th century CE) at Pakpattan and tomb of Sohaghan at Alore in district Sukhur (Pl. 30) with rather greater skill, and perfection.

In the Mughal period this craft became popular and common with fine joints or with *jibbi* pointing (pointing in relief) in white lime cream as seen in various monuments at Lahore, especially Lahore Fort.

Manufacturing of bricks

Various steps in the manufacturing of bricks are involved. In general, manufacture of brick needs six main operations:

Selection of suitable clay, preparation of clay, moulding, drying ,firing or burning and cooling. The details of these operations are given below.

Pl. 27 Temple Sassi da Kallara at Shah Muhammad Wali, Attock.

Pl. 28 Temple Sassi- da -Kallara at Shah Muhammad Wali, Attock - Showing cut and dressed brickwork.

Pl. 29 Tomb of Hazrat Shah Rukn-e-Alam - Showing cut and dressed brickwork.

Selection of Suitable Clay

The clay is carried form the pit near the kiln. The clay free from pebbles and grit is selected.

Preparation of Clay

This is done by mixing clay with water and storing it in a damp condition for at least 24 hours. Then it is well kneaded. Damp storing doubles the strength of the original clay and gives plasticity. The sand is added to make the clay lean. Thus a homogeneous mass capable to hold the shape and weight and easy to press into a mould is prepared.

Moulding (Pl. 31)

The mould is made either of wood or iron plates with inside dimensions about 1/10 larger than the actual required brick size to allow shrinkage during drying and firing. The prepared clay is dashed into the mould to avoid the possibility of voids and surplus quantity is scrapped off. The mould is then lifted up leaving the brick on the leveled ground.

Drying

The natural method of drying is used. The raw bricks are left in the open air for at least 24 hours, and then they are turned on edge and are kept in this position for three days to achieve even drying and to prevent cracking and bending. Some space is kept around each brick for circulation of air.

Firing or Burning

The dried bricks are carried, usually on donkey back to the kiln. All the bricks are stacked with spaces between them to allow the circulation of heat. The last row of bricks on top is laid very close and joints are filled with clay except an area about 3 x 3 feet, which serves as an outlet for the smoke.

Traditional kiln (Pl. 32)

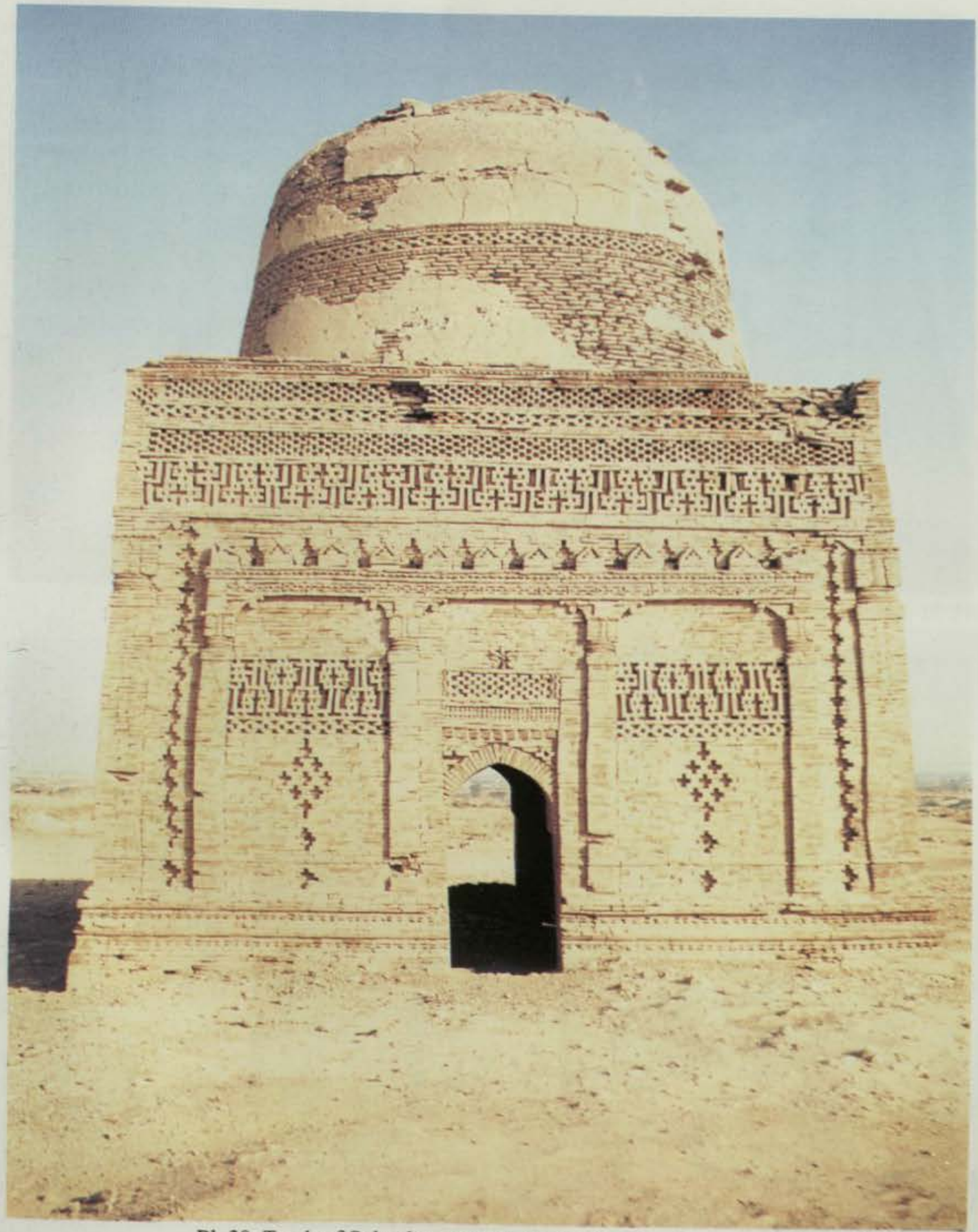
The base of the kiln goes about 6 feet below the ground level and forms the fireplace. It is accessible by a number of steps leading down to it. A vault arch is built having many holes. The walls are built on four sides leaving opening for stacking purpose. The bricks are stacked over vaulted roof. The roof of vaulted arch is made flat. Firewood is used for burning the bricks

Cooling

After burning, cooling is done at a uniform and slow rate to avoid warping and cracking of brick. Period of five days is necessary for cooling.

Technique of Cut and Dressed Brick Work

In this work bricks are cut to exact one size with the help of sharp edge of *tesi* (Pl. 33) and finally their size is carefully checked and corrected with a gauge named *badhhali* (Fig. 1a to d) the Sanskrit word *baddha* meaning bound, tight, checked (sketch). Thereafter corborundum blocks are used to have the correct size.

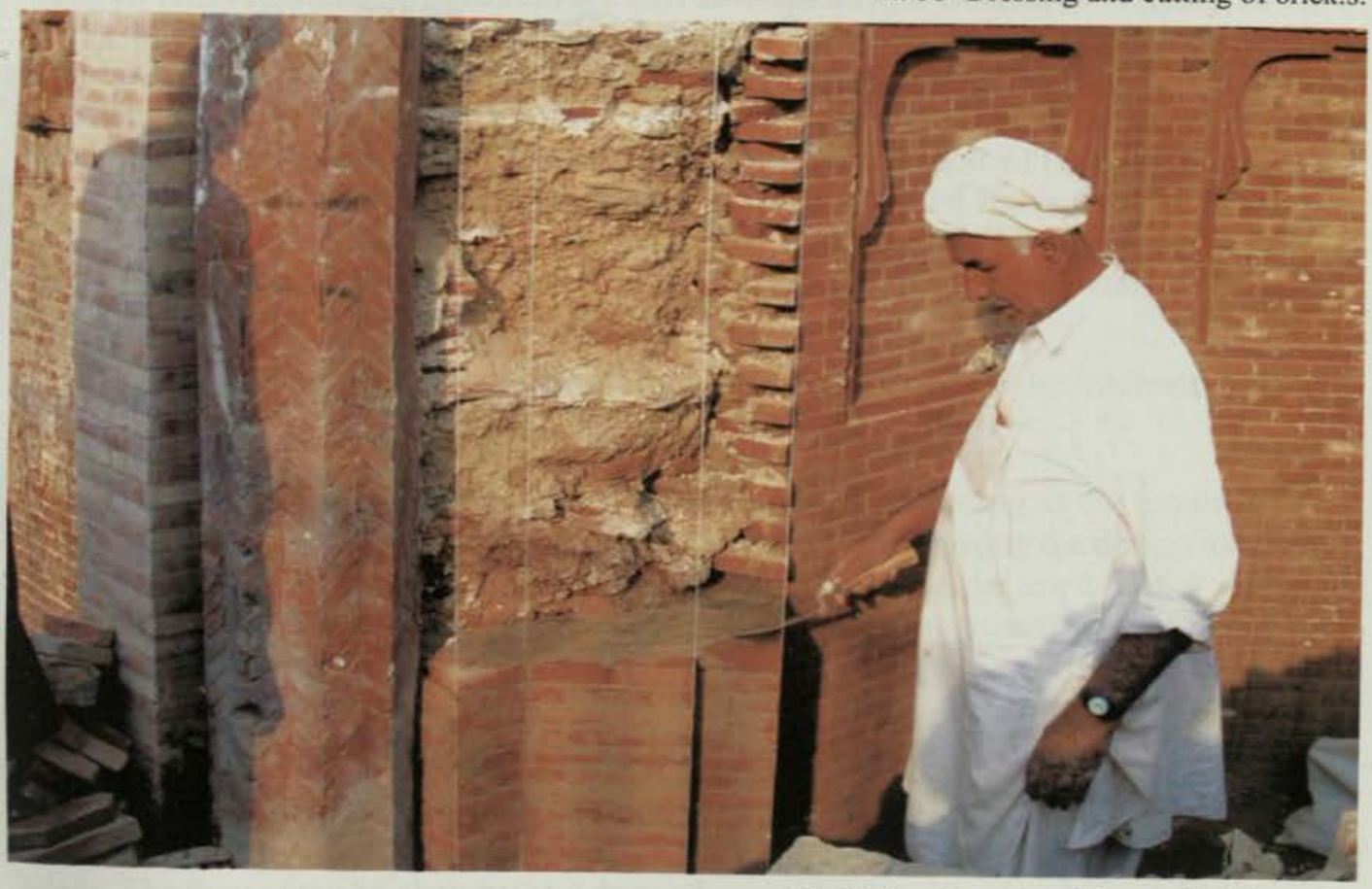


Pl. 30 Tomb of Sohaghan at Alore (Sukhar) - Showing cut and dressed brick work.

Pl. 31 Moulding of brick.

Pl. 32 Traditional kiln.

Pl. 33 Dressing and cutting of brick.s.



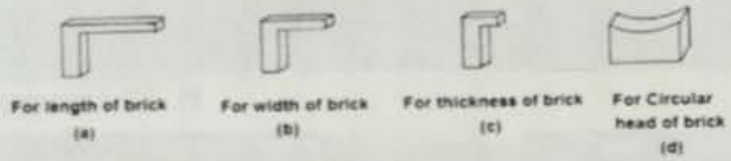
Pl. 34 Laying cut and dressed brick work..

Masonry in ancient time is mostly laid in header bond and the bricks are tapered to have fine joints on the surface (Pl. 34)

Thereafter they are laid in mortar on the wall having precise horizontal and vertical lines which are repeatedly checked during the progress of the work with *sal* (plumb bob) and straight edge (*master*) of wood.(Fig. 2a)

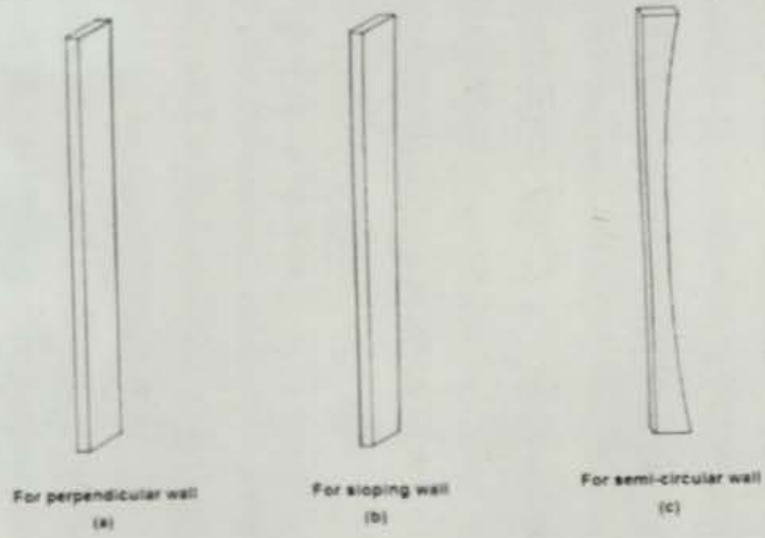
For sloping walls, the slope is checked with *sal* and *master* having one edge straight and the other tapered according to the slope(Fig. 2b). The *sal* is kept on the straight face

In case of semicircular masonry, the faces of the bricks are dressed in curved shape according to the curvature of required brick masonry. To check the dressed face of brick in required form, a curved edge gauge named *baddhali* is prepared. The masonry should be checked with a template prepared according to the required curvature(Fig. 2c)



MEASURING GAUGE (BADHALI)

Fig. 1



STRAIGHT EDGE

Fig. 2

BRICK CARVING

This ancient mode of decoration is a speciality of Multan architecture in Pakistan over which they possess mastery. They carve out of ordinary bricks geometric as well as calligraphic designs in a neat and workman like way. The required designs are obtained by laying the carved bricks in a number of ways, laid one above the other in a perfect scale and order as demanded by the available space to form the words like *Kalimah*, Quranic verses, and phrases like in Urdu, Persian or Arabic. Chess-board, *Seh khani* (three-squrared) i.e. the squares number three when counted form sides or top to bottom), *Panj khani* (five-squared) *Haft khani* (seven-squared), *Nau khani* (nine squared), Saw-tooth (*Kingri*), Chain design (*Zanjirah*),Tassel (*Sehra*), Lotiform including lotus and sun-flower, *Shamsa* (Sun-design), *Nalisar* (sunken decorative border around the door or window), Merlon or battlement (*Kangura*), various medallions, three tiered design locally called '*Ara Matti*' on the neck (*Gardana*) of the domes, creepers etc. are carved out in a perfect workmanship manner. This carved brick craft was a popular brick decorating art along with brick patterns in Central Asia during the period of Samanids (874-999 CE) and Ghaznavids (962-86 CE) as we find on the tomb of Ismail Samanid (10th century CE) at Bukhara and Ghaznavid Victory Tower of Mas'ud-III (1115-CE), all decorated with ornamental or diaper pattern brick work. It was such ornamental patterns that this craft reached Multan where it still survives. The best surviving examples of this charming work in Pakistan appears at the tomb of Hazrat Khalid Walid at Kabirwala (12th century CE) (Pl. 35) and tomb of Hazrat Sadan Shahid, Muzaffargarh (1274 CE)(Pl.36), mausoleum of Hazrat Syed Kabir Bukhari, Dunyapur (13th century CE), mausoleum of Hazrat Shah Rukn-e-Alam at Multan (1320-24 CE)(Pl. 37), mausoleum of Hazrat Ala-ud Din Mauj Darya at Pakpatan (14th century CE), and the unidentified tomb at Depalpur.

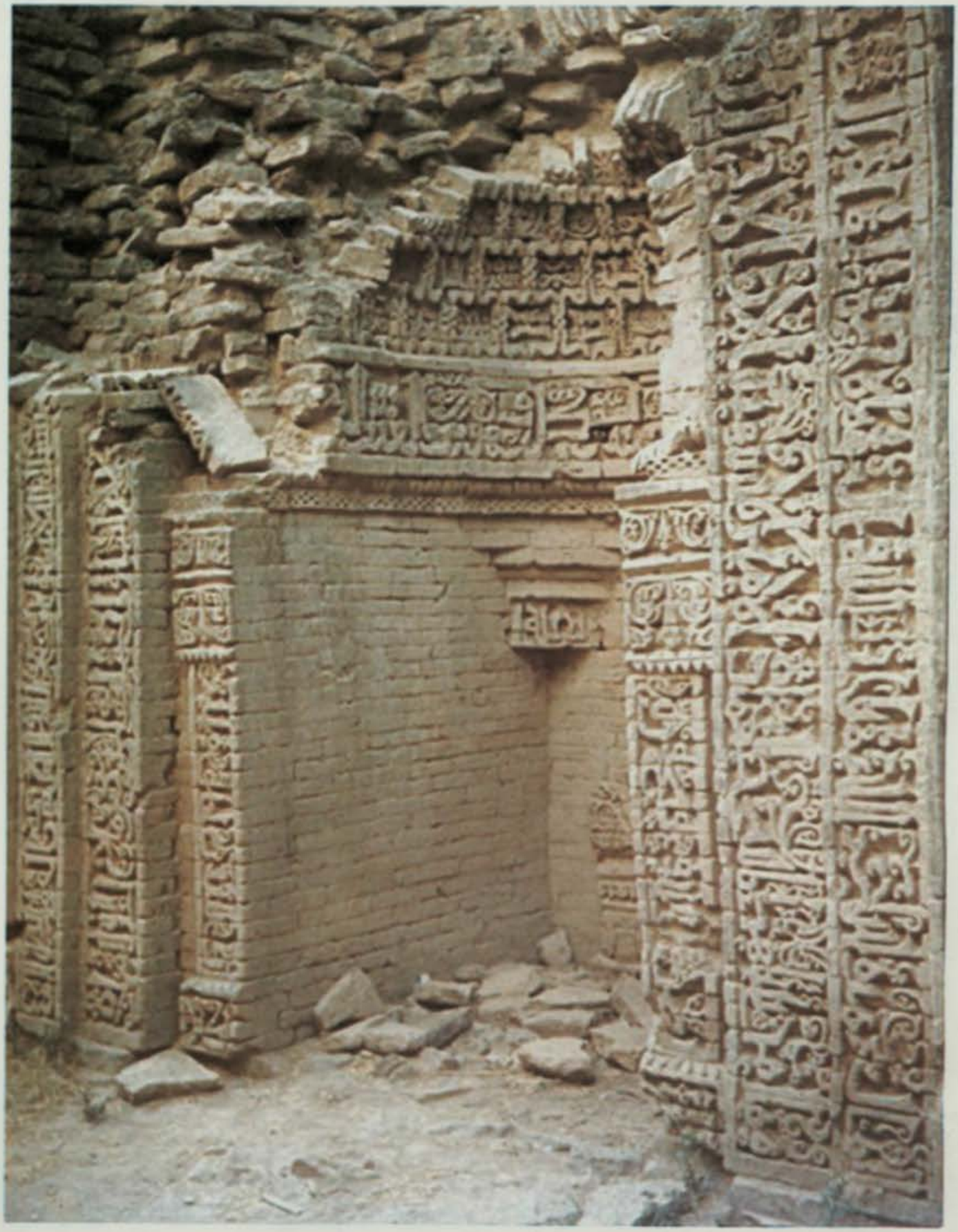
In Lahore the best example of surviving carved brick work is the Aitchson College.

Process of Brick Carving

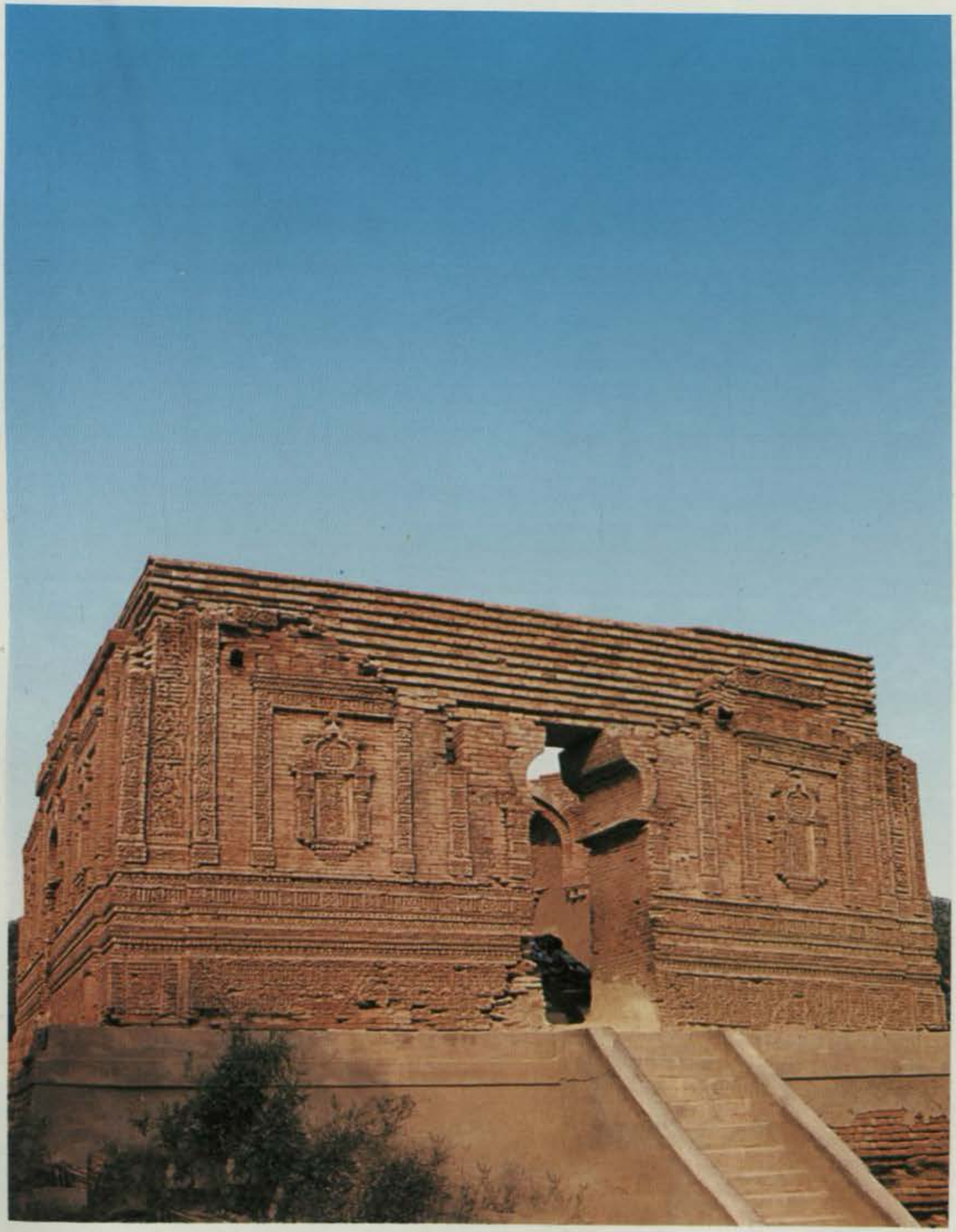
For brick carving rough bricks are cut and dressed according to the required shape. These bricks are then assembled in loose condition for composing the design as a whole. Stencils made of card board, tin sheets or even of tracing paper are used for giving the required shape to the bricks. For example the *Kalimah* at the mausoleum of Shah Rukn-e-Alam is composed of seven layers of cut and dressed bricks. The process of brick carving is composed of:

1. Cutting and dressing of bricks

The bricks are cut according to the exact size in length, breadth and thickness. Measuring gauges for accurate length, breadth and thickness are used for sharpness of edges. The face of the brick is cut and dressed.



Pl. 35 Tomb of Khalid Walid Kabir Wala - Showing mehrab in carved brick work.



Pl. 36 Tomb of Sheikh Sadan Shaheed, Muzaffargarh - Detail of brick carving.

Pl. 37 Tomb of Hazrat Shah Rukn-e-Alam, Multan - Showing carved brick work.

2. Shaping the bricks

In case the carved pattern is ornamental, the bricks are first cut according to the design/drawing and then carved according to the design. Chisels of different sizes, files, carborundum pieces and sand paper (*regmal*) are used in executing the work (Pl. 38).

3. Assembling the shaped bricks

For ornamental pattern, the carved bricks are temporarily assembled keeping the allowance of mortar in each layer to check the design.

4. Laying of carved bricks

Finally laying the bricks with mortar is done to form the required design. The joints are kept as fine as possible by the technique of leveling i.e. giving an inward slope to the bricks to form a sharp outer edge of them.

The same designs are found in enamelled tile work in decorative motifs of Multan style. But, it may be remembered that their base is always of carved brick work.

Pl. 38 Carving of bricks.

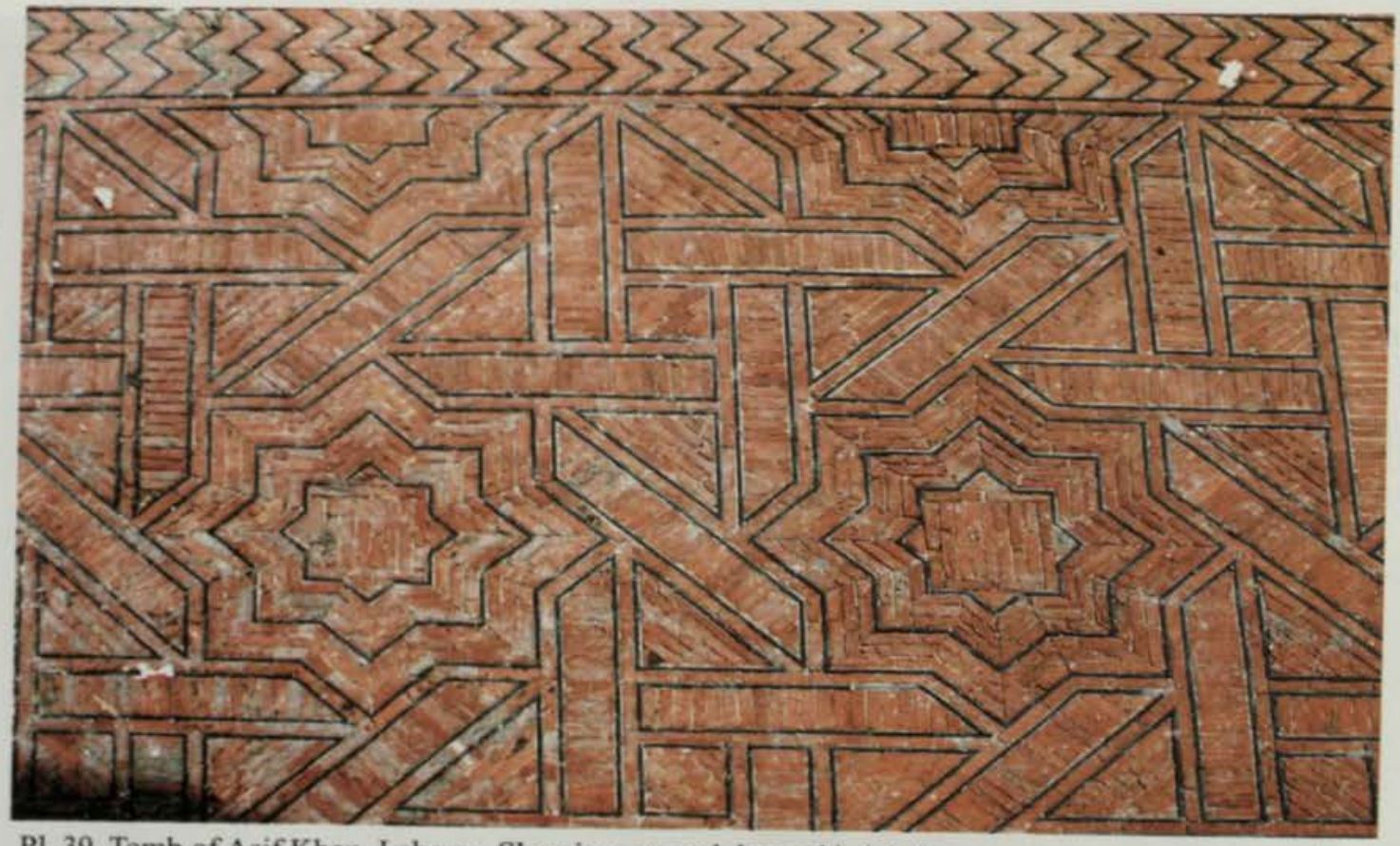
DIAPER PATTERN GEOMETRICAL FLOORING IN CUT AND DRESSED BRICK WORK
(chal ka khishti farsh)

It is a work of great care and of precise nature in which well burnt small bricks are cut and dressed to a very correct size and laid on edge to form geometrical figures, like squares, cubes, pentagons, hexagons and octagons etc. which are lined with either black stone, slate or specially manufactured black brick. Sometimes these geometrical figures are overlapping and interwoven making the whole a work of very complicated execution such as in Tomb of Asif Khan (Pl. 39), Tomb of Jahangir, Masjid Wazir Khan, Lahore (1634-35 CE) (Pl. 40, fig.3 to 12)which is the best work of this class and in various patterns. Cut and dressed geometrical flooring is also found in Lahore Fort (fig. 13), Shalamar Garden (Fig. 14) at Lahore. The floor in Lahore Fort and Shalamar Garden is laid in octagon and square pattern but the gaps in the bold lines are filled by bricks in different styles. The floor of Badshahi Mosque, Lahore was originally laid with cut and dressed brick work. The floor of the verandah of the tomb of Shah Shams Sabzwari, Multan and mosque at the tomb of Hazrat Jalal-ud-Din Bukhari, Uch Sharif is laid with cut and dressed bricks in *musallah* design. The floor of the Mahabat Khan Mosque, Peshawar was originally laid with cut and dressed bricks.

Process of Laying (Pl. 41)

Before starting the laying of floor, each brick is made wedge shaped i.e broader on the upper side and narrow at bottom side. When two wedged shaped bricks are placed side by side their top edges give a thread line joint but provide space for mortar in their sides underneath. The bold outline of geometrical pattern or *chal* is established and laid on prepared ground, which is water proofed by a concrete layer and then the interior is filled with bricks. When ready, the surface is smeared with a solution *(dogha)* of *kankar* lime passed through muslin cloth and then the pieces and joints of brick work are filled up and the pavement take the shape of a well burnt brick showing only the thread like joints.

No mortar is visible on the surface while laying bricks, the mortar is kept back and recessed.



Pl. 39 Tomb of Asif Khan, Lahore - Showing cut and dressed brick floor.

Pl. 40 Wazir Khan Mosque, Lahore - Showing cut and dressed brick floor.

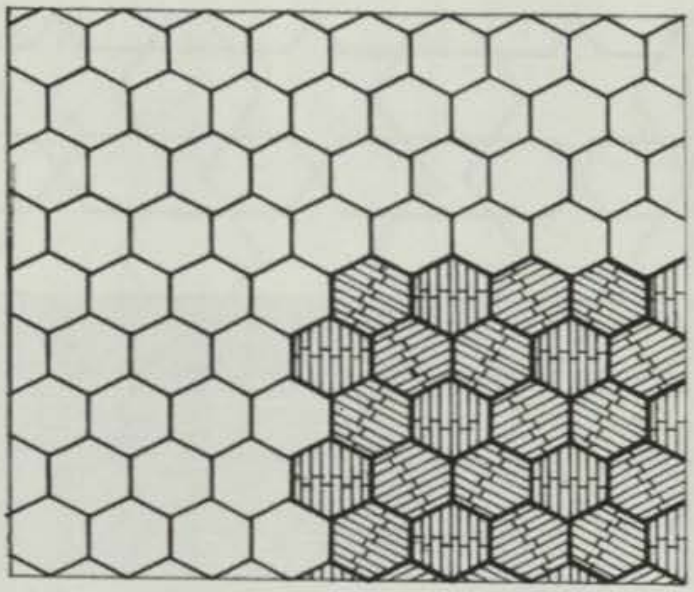


Fig. 3 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

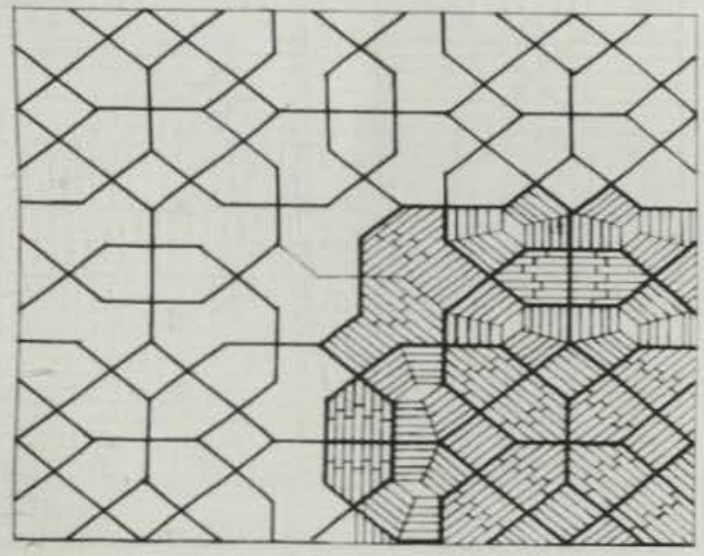


Fig. 4 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

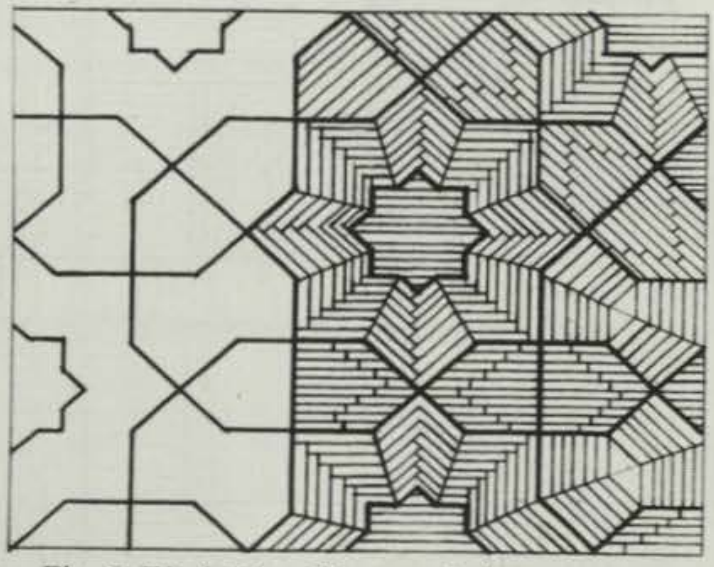


Fig .5 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

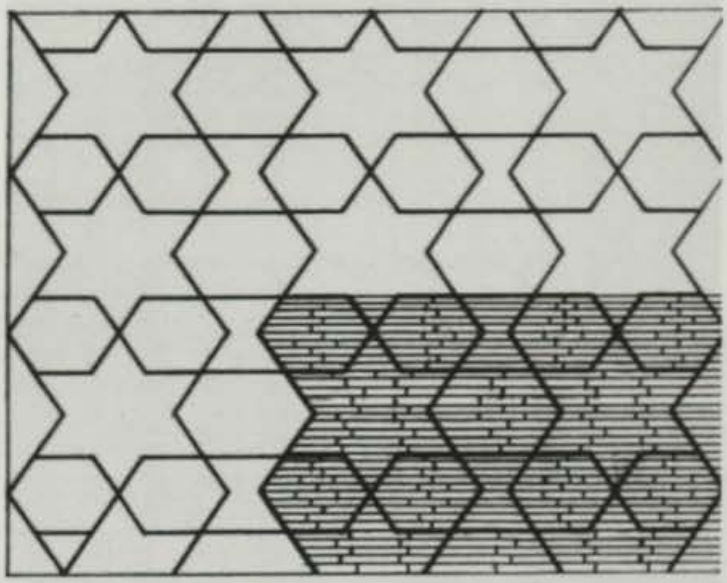


Fig. 6 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

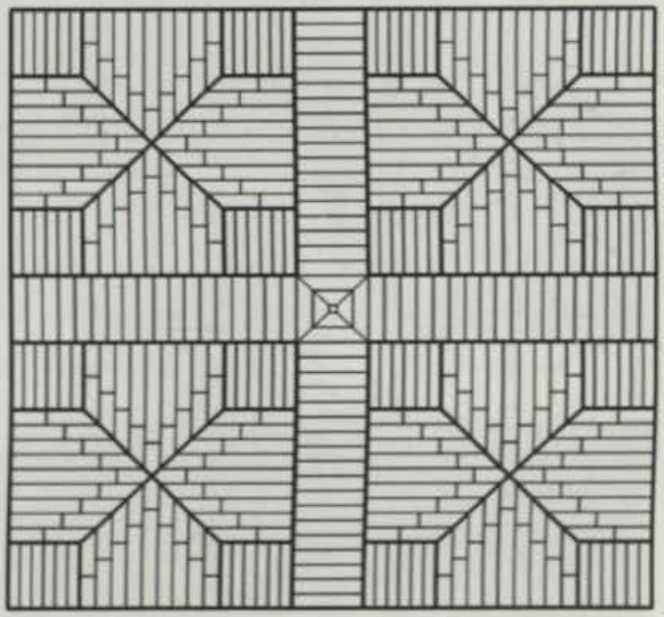


Fig.7 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

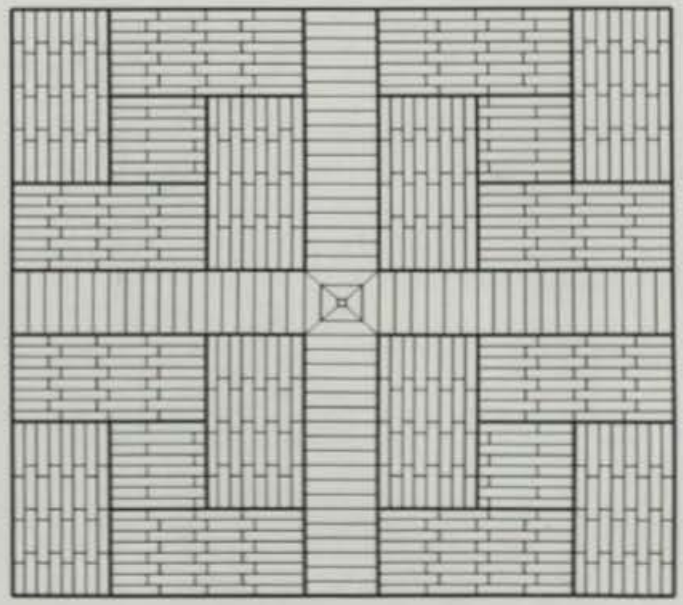


Fig .8 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

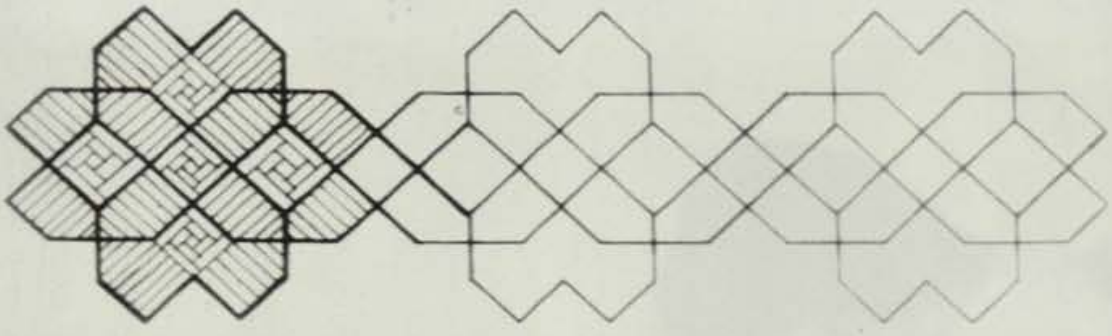


Fig. 9 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

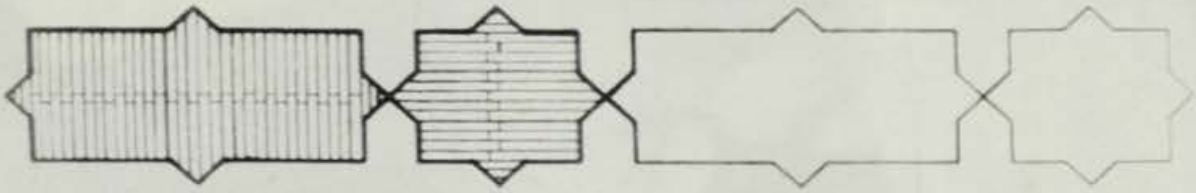


Fig.10 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

Fig. 11 Wazir Khan Mosque, Lahor -: cut and dressed flooring in geometrical pattern.

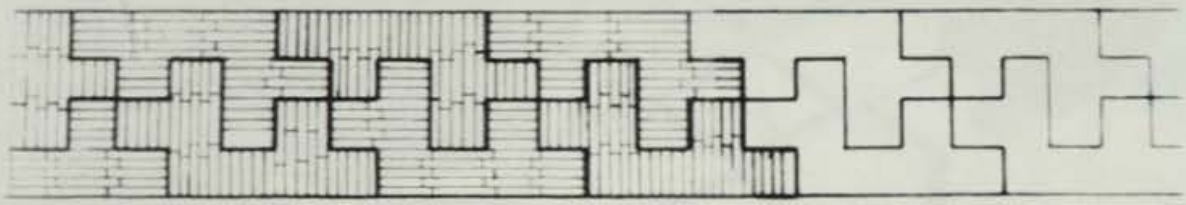


Fig. 12 Wazir Khan Mosque, Lahore - cut and dressed flooring in geometrical pattern.

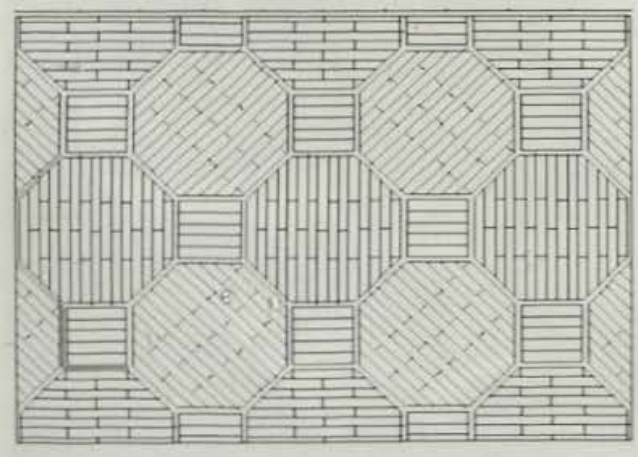


Fig. 13 Lahore Fort, Lahore - cut and dressed flooring in geometrical pattern.

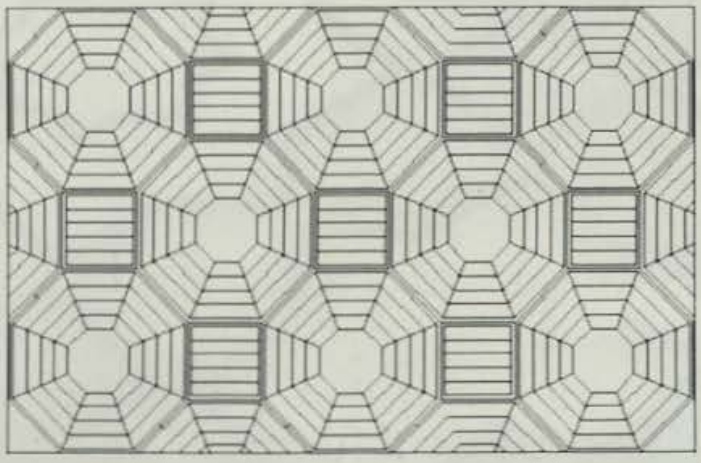


Fig. 14 Shalamar Garden, Lahore - cut and dressed flooring in geometrical pattern.

Pl. 41 Laying of cut and dressed brick flooring in geometrical pattern.

Chapter Three

Tile work

Enamelled tile work

Multan tiles

Sind tiles

Enamelled tile mosaic work

Lahore tiles

Filigree work

ENAMELLED TILE WORK (*KASHI KARI*) MULTAN TILES

Kashi Kari is the term applied to the enamelled tile work on terra cotta base. *Kashi* is a Persian word designating the tiles or trimmed to the form pieces of faïence serving to cover entire or partial fabric of a building in a design principally decorative. This term, which also exists in Turkish language, is an abbreviation of Kashani, derived from Kashan, the most important and most famous centre of production of this work in Iran.

The origin of glazed tiles goes back to ancient times. The earliest specimens of glazed tiles are found in Egypt and Mesopotamia. The discovery of glazed pottery excavated from a site near Thebes in Egypt shows that the art of glazing was well known to the Egyptians even in the pre-dynastic period before 4777 BCE. Glazed or enamelled tiles were found at Naqada Abydos temple. The stepped pyramid of Zoser at Sakara near Cairo (4155 BCE) had glazed ware decoration in the interior. The best example of architectural enamelled tiles was discovered at the New Kingdom site of Tell-el-Amarna (1550-1400 BCE). Enamelled tiles have also been found from Gurob, Memphis, Thebes and from the Temple of Rameses III.

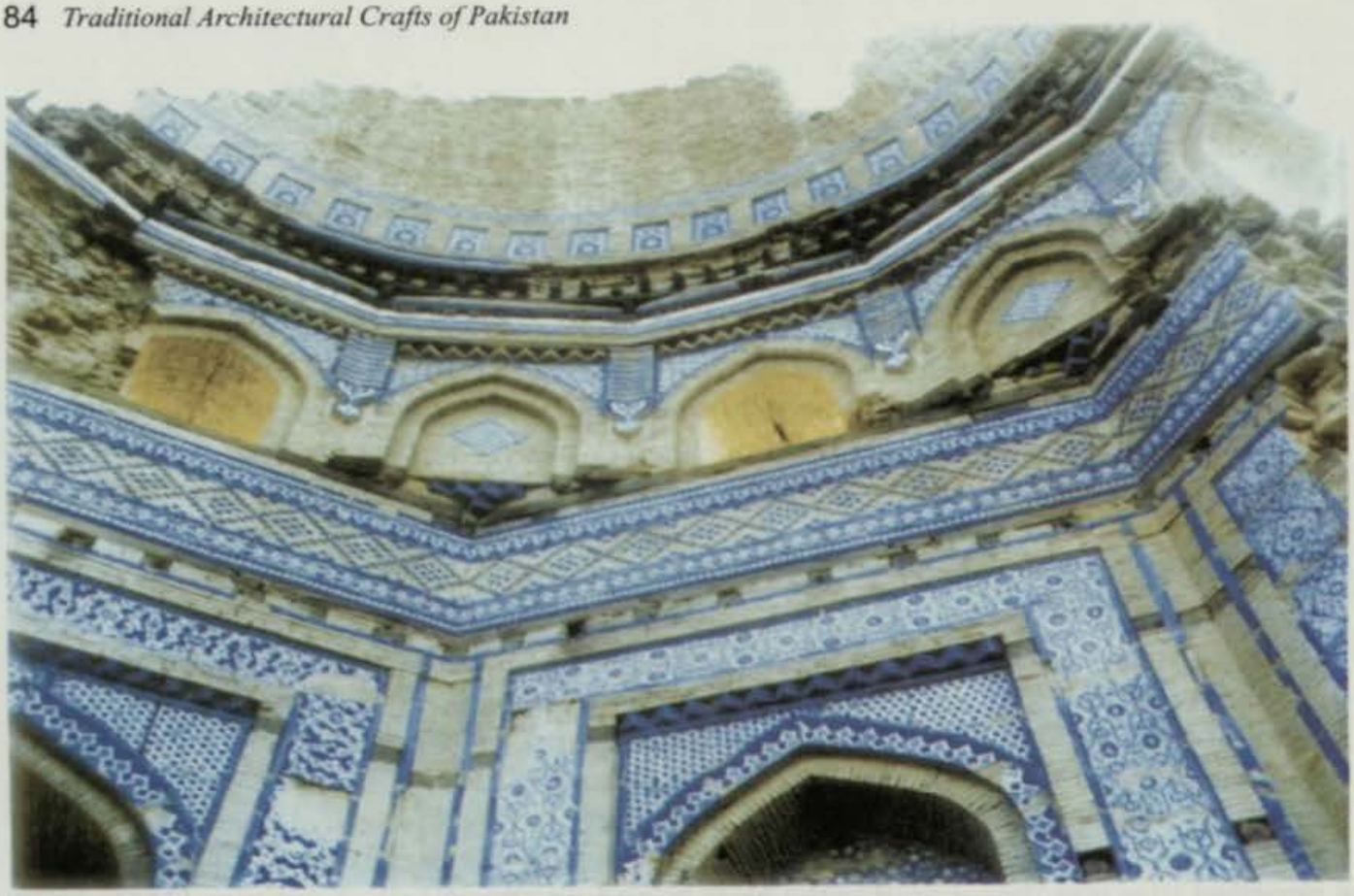
In Mesopotamia glazed ware bricks were used for architectural decoration. Fragments of enamelled tiles have been found at Warka in ancient Chaldea. In Mesopotamia, design and figures were painted on the tiles before applying a coat of glaze.

In ancient Babylon, architects used enamelled tiles on the Tower of Babil at Nimrud (604-562 BCE). The city gate of Babylon, built by Nebuchadnezzar was embellished with enamelled tiles in dark blue, turquoise, yellow and white colours.

The Assyrians also used glazed tiles in palaces and temples to form friezes and in an inscription attributed to Tiglath Pileser (114-1076 BCE), where he refers to his palace decorated with coloured glazed bricks.

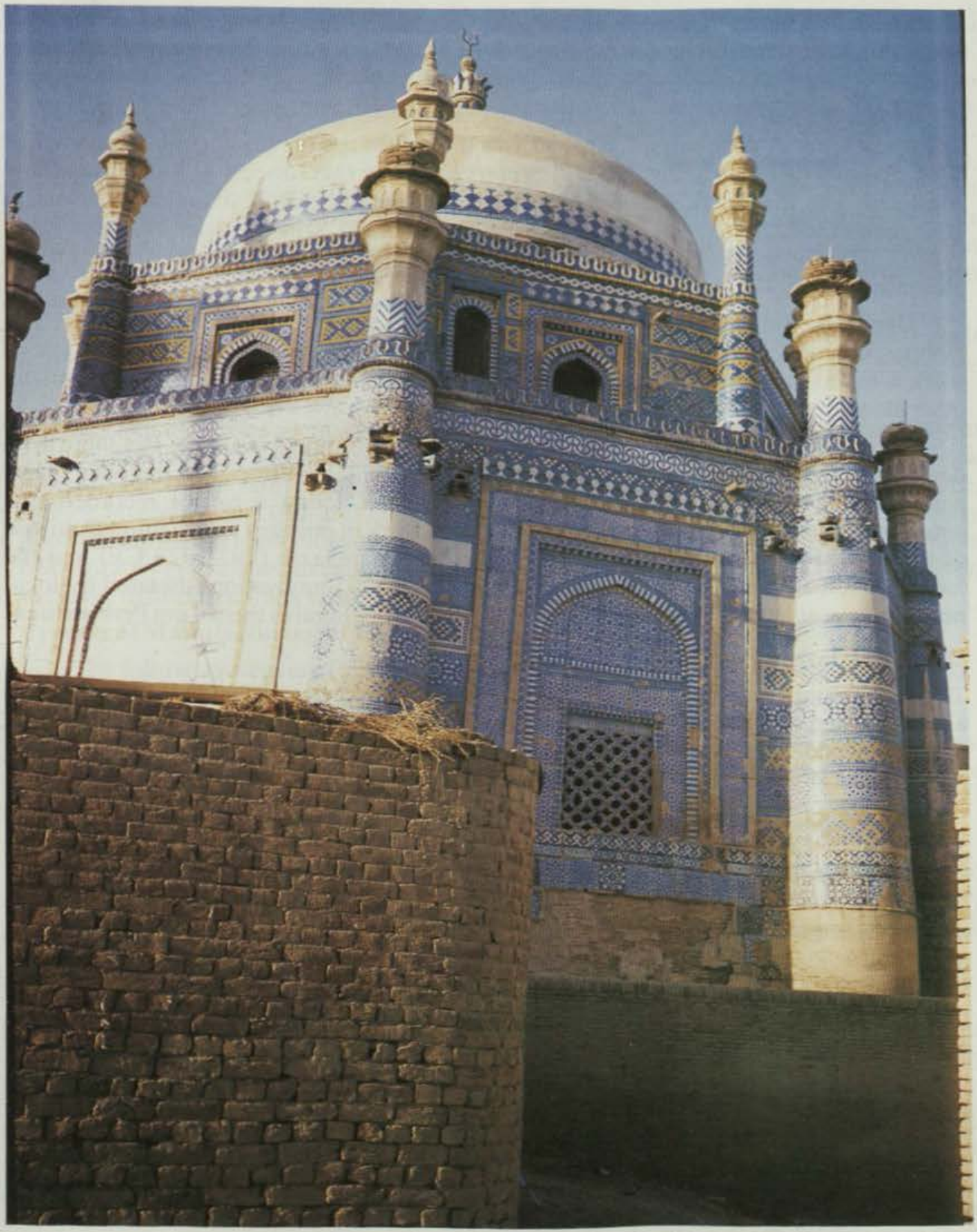
Glazed tiles decoration in Iran was inherited from Mesopotamia. According to Furnival decorative panels in faience revetment in Persia were used in Elamite cult architecture in the second millennium BCE. They were also a feature of the Achaemenid palaces at Susa and Persepolis. No proper use of glazed tiles is found in Parthian (however see Taxila specimens at Pl. 72) or Sasanian periods. By the beginning of Islamic period, the glazed tiles were no longer an architectural feature in Iran. The Abbasid (750-1256 CE) introduced glazed tiles decorations in their buildings. Baghdad, Kufa and Basra were the main centres for manufacturing glazed tiles during Abbasid period. This art was spread later in Egypt, Syria, Morocco, Algeria and Spain.

By the 10th century, the ceramic art was highly developed in Iran. After the 11th century, enamelled tile decoration increased and it became one of the striking



Pl. 42 Tomb of Baha-ul-Haleem,Uch Sharif - Tile decorations.

Pl. 43 Tomb of Hazrat Shah Rukn-e-Alam, Multan - Tile Decorations.



Pl. 44 Tomb of Tahir Khan Nahar, Sitpur - Tile decorations.

characteristic features of Muslim architecture in Iran. The best examples of enamelled tile decorations are found on Jami Masjid (1106-7 CE) at Damgan and a mosque at Sinmar in Isfahan.

Under the Seljuk period artistic tile work was produced increasingly throughout Iran and other areas of their empire. Kashan was the centre for the production of enamelled tiles. Specimens of such tiles are still preserved in the monuments of Qum, Najaf and Mashhad. The tiles of IL Khani period belong to the shrines of Imamzadah Jaafar in Damghan (1267 CE), Abdus Samad (1307 CE) and the IL Khani palace of Abaka Khan (1270 CE) to the south of Tebriz. Seljuk established their rule in Syria and Anatolia in the eleventh century. They introduced tile tradition there.

Under the Safavids (1501-1732 CE) tile mosaic work remained very popular. The composition of decorative work was depicted almost in a picturesque way. This type of work is found in the monuments of Kashan, Tebriz, Isfahan, Shiraz, Mashhad and many other places.

By some, this craft is believed to have been first introduced in China. But there is no doubt that the main development took place in Iran. Iranian world, then included major parts of what now-a-days is called Central Asia. Thus, today, it can be recorded as a common heritage of Iran and Central Asia. At time, work in one area was distinct from that of the other. For instance, at the Mausoleum of Arsalan Jazib (997-1028 CE) and the facade of Rabat-i-Malik (second half of 11th century CE) innovations dictated by local needs and tastes have given their features which easily distinguish them from Persian tiles.

Origin of Glaze in Pakistan

A large amphora from strata II of Sirkap tests the earliest use of glaze in Pakistan. It is a two-handled amphora of buff-coloured clay carved with buff slip & thin glaze both inside & outside. The glaze is of green and buff colours. It is of Mesopotamian and Syrian origin -Rakka* to be more precise. It has been discovered from the Parthian level.

In the country now known as Pakistan it was brought and introduced from Iran in the 12th century CE or a bit earlier. No enamelled tiles have been recovered from the excavations carried out at the Arab cities of Bhambore and Mansura, showing thereby that this craft was not brought into this country by the Arabs, despite the fact that they were aware of this mode of decoration. In Pakistan, the important centres of this craft are Multan and Lahore in the Punjab, Thatta, Hala and Nasarpur in Sind and Mahra Sharif in D.I.Khan, KPK Province. According to the present state of our knowledge, a panel decorating the facade of the eastern entrance of the tomb of Hazrat Baha-ud-Din Zakariya at Multan (1262 CE) may be taken as the earliest known specimen on the soil of Pakistan.

Most of the monuments of Multan style, mosques and tombs and even secular buildings were decorated with enamelled tile work in various vivid colours and attractive designs including calligraphy. It was then almost regarded as a mode of decoration of Muslim architecture. The shrine of Hazrat Shah Rukn-e-Alam at Multan excels all other

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* Marshal, Taxilla Vol. II, p 407, plate 129-A

monuments in faience and faience mosaic revetment. The geometrical patterns executed are stars, crosses, lozenges, meanders, pentagons, hexagon and isometric tessellation, decagons etc. While floriated patterns include *shamsa*, scrolls, tendril, circle and rosettes. (Fig. 13 to 15) Excellent specimens of Multan enamelled tiles decorations in Pakistan are found on the mausoleums of Hazrat Shah Yousaf Gardezi (d.1150 CE), Hazrat Baha-ul-Halim at Uch (13th century CE) (Pl. 42), Hazrat Shah Shams Sabzwari (d.1276 CE), Hazrat Shah Rukn-i-Alam,(Pl. 43) Sultan Ali Akbar (1585 CE) at Multan, mausoleum of Hazrat Lal Eisan (15th century CE) at Karor, Pir Rajan Shah, district Leiah, tomb of Tahir Khan Nahar (1530 CE) at Sitpur (Pl. 44), Abdul Wahab Bukhari (1602 CE) at Daira Din Panah, monuments at Uch, specially the tomb of Bibi Jiwindi or Jawandi, tomb of Sultan Ahmad Qattal at Jalalpur Pirwala (Pl. 45) and monuments at Mithan Kot.

The Multan school of enamelled tiles is distinguished for use of three colours - cobalt blue, turquoise (Persian blue) and white. Sometimes yellow, amber, green and chocolate brown were also used.

In Thatta the tiles were applied flat to the building to give an even surface, but in Multan themain tile patterns are in relief, in some places half an inch above the back ground. The tombs and mosques at Thatta, namely Sultan Ibrahim's Tomb (1558 CE), Dabgir Mosque (1588 CE) and Jani Beg Tarkhan's Tomb (1599 CE) are some of the early good examples of Thatta industry. In them only three colours haye been used. At all centres of *kashi kari* in Pakistan, except Lahore, clay forms the main material, in Lahore however, the same material is Silica sand.

Process of Manufacturing of Enamelled Tiles

The following steps are followed for the preparing of Multan enamelled tiles: -

Selection of Clay

Pure clay is the most important item for the preparation of durable and good tiles. Clay selected for this purpose should be free from salts, coarse grit, lime stone, iron ore and calcareous nodules.

Plasticity of Clay

Plasticity is of primary importance since it helps in maintaining the form and shape of mould. The simple test for checking plasticity of the clay is to make a roll of the wet clay about a centimeter thick, and then to coil it around finger. If no cracks appear, it is good. The clay, which breaks while opening the coiling, is not suitable for tile work.

Salt free Clay

Because of a network of canals, generally the soil in the country is now badly affected by salinity. Even the percentage of salt has now increased. To sort out salts from the clay collected for preparing tiles the following process should be adopted.

Two small size reservoirs (size 8'x8'x4') be constructed, one 12" higher than the other. There should be an outlet at the floor level of the upper tank with arrangement to block it. The earth collected should be filled up in the upper tank and tap water poured liberally so that it flushes the earth which then should be thoroughly mixed and peddled.

Thereafter it should be left in the same condition for a night. In the morning, the outlet

Pl. 45 Tomb of Hazrat Sultan Ahmad Qattal. Jalalpur Pirwala - Detail of tile work.

Pl. 46 Kneading of clay.

Pl. 47 Planing of tile with *khurpa*.

in the upper tank should be opened. The surplus water of the upper tank will ooze out in second tank taking along with the salts and thus the earth will be free of salts.

Preparation of Clay

After this, the clay should be mixed with water and stored it in a damp condition does this. Damp storing nearly doubles the strength of the original clay and enhances its plasticity. A small percentage i.e. 2% of pure sand may be mixed to increase adhesiveness of the prepared clay which also helps in avoiding shrinkage and cracking as well as to give the tile good terracotta colour when burnt. The wet clay should be well kneaded to ensure proper mixing and plasticity (Pl. 46).

Moulding

The tiles are used in different shapes, i.e. square, rectangular, arched and other geometrical patterns. For this purpose, moulds of different shapes and sizes are required.

a. Rectangular and Square Shaped Tiles

The rough tiles, slightly larger than the actual size, are prepared with the help of a wooden mould on a levelled ground or platform made for the purpose. They are made with wet clay prepared for this purpose. While still in moist state but well set and in near dry condition with only a little quantity of moisture. They are tapped with *thapy*. The surface of the tile is levelled with the help of *khurpa*. (Pl. 47)

b. Arched or Other Ornamental Shape Tiles

The rough tiles about 1/10 inch larger than actual sizes are prepared. When still moist and near dry condition, they are tapped with a special shaped wooden *thapy* to consolidate the material as well as to avoid voids. The surface of the tile is levelled with the help of *khurpa*.

The design and the shape of tile are prepared on a tracing paper. This traced out design is then perforated. This perforated design (*Sozan kari*) is now fixed over the levelled and smooth surface and pounced with a small bag of muslin cloth filled with some fine coloured powder (say lamp black). Through this process, the design is transferred to the surface of the tile. This perforated tracing is then removed and the tile is cut with special tools (Pl. 48) to give it the required shape. The back surface of the tile is made rough for proper bondage of mortar.

In case of carved tile, the desired carving is done before the tile is dried up (Pl. 49)

Drying

Drying of the tiles should be done under shade set in natural hot atmosphere. Drying by direct exposure to the sun should be avoided.

Filling of Depression

After drying the tiles, all small depression on the surface, which is to be glazed, should be filled by the same moist material. The damaged edges should be repaired. This is called in local term *puly* (Pl. 50).

Engobing (*Astar Kari*) (Pl. 51)

Engobe is a layer of composite powder white in colour applied on the body of the tile to obscure its actual colour in order to obtain a white surface under the transparent glaze.

Engobe is called *astar* in the language of *kashi kars*. For applying *astar* the *kashi kar* uses quartzite stone locally called *Kurund*. This corundum stone is sort of whitish quartz, brought from a quarry near Taunsa Sharif, District Dera Ghazi Khan. This stone is first crushed and then grounded to a fine powder of 200 meshes. The formula of the engobe is as under:-

a) Quartzite stone powder 1/2 part.

b) Glass/glaze powder 1/2 part.

c) Fine wheat flour glue 1/4 part of a+b

This powder is mixed in water to a suitable consistency. Engobe is ready. It is laid by hand i.e. by slipping method.

Preparation of Glaze (Pl.52)

The *kashi kars* of Multan are very conservative, rather rigid in their profession and craft and do not allow any interference or improvement in their working process. They do not use imported glazes and colours and prepare their own. They prepare glaze from a special stone called *kurund* (corundum stone). Big chunks of this stone are broken, powdered and then burnt in the form of lumps mixed with 50% *sajji* (impure carbonate of soda, locally called *khar*) in a kiln at a temperature of about 800°C (for production of *khar* see below). This gives crystals of glass locally called *kanch,* which are separated in a rending grinding *chakki* (mill) (Pl. 53) and mixed dry with *maidah* (fine wheat flour passed through a muslin cloth) glue. This mixture, when solved in water takes the form of the required 'glaze'.

Frit Furnace

The furnace is built in small size. The frit furnace in Multan is built like a *matka* (large pot) .The firebox (fireplace) is below ground in the form of hole in the ground. This hole is covered with a slab of clay mixed with straw. There are five openings, which act as flame throats. These throats are connected the firebox with the chamber above. The central flame throat is about 10 inches in diameter but tangential to the walls of the chamber. The chamber is in the form of a dome about 3 feet in diameter with walls about 4 inches thick. A central opening about 12 inches in diameter is kept at the top of the dome. This opening is for placement of crucible of frit inside the furnace. This opening is closed before the furnace is put into operation. The flame is exhausted through flues in the walls of the chamber.

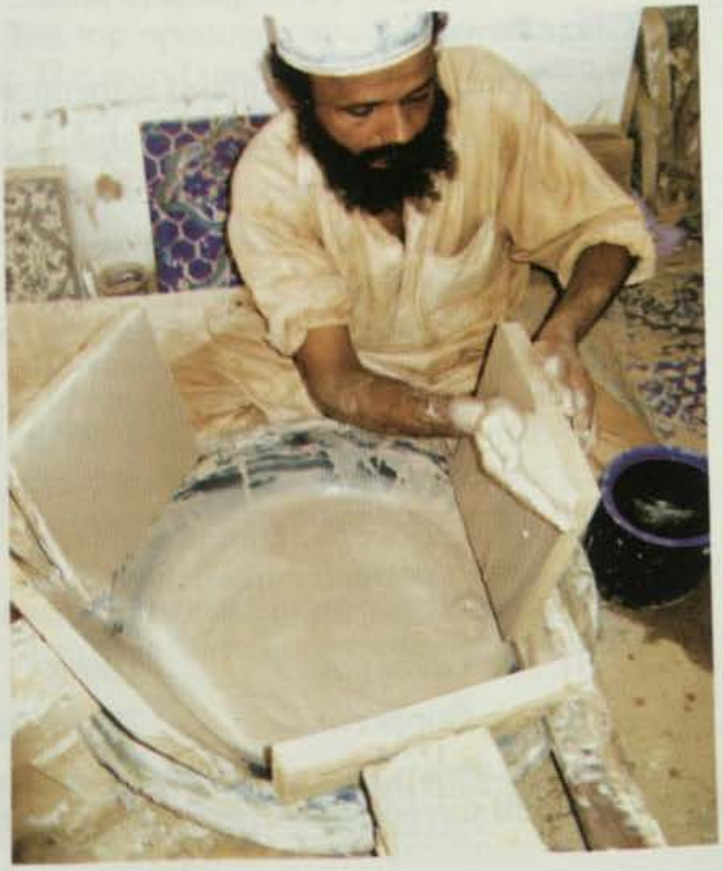
Production of *Khar* (Sintered Plant Ash)

Plant ash *(haloxylon recurvum)* has been in use since long in many parts of the world as a source of alkali (Potassium and Sodium compounds). The plant has been extensively used in glass and glaze making. The *khar* bushes are about 2 feet high and 3 to 4 feet diameter at harvest time, during the months November to January.

Pl .48 Tools.

Pl. 49 Carving in tile.

Pl. 50 Filling of depressions (*pulying*)



Pl. 51 Applying layer of engobe *(astar)* on tile.

The bushes are cut off at the stem, near to ground level and stocked in heaps for 15 to 20 days to dry in the sun before burning. After drying bushes are burned in pits (*khadda*). The circular pits are about 5 feet deep and 5 to 10 feet in diameter. When the best quality of *khar* is required, a smaller pit is dug at the base of the circular pit. This pit is enough to contain about 40 kg of the product. The lower pit is covered with an earthen lid having series of the holes each about 1.5 to 2 inches in diameter. The lid is further plastered over with cow dung.

For burning the bushes of plant ash, a small fire is lit at the bottom of the pit (*khadda*). Then, bushes are thrown in successive layers, so that the material is burnt as slowly as possible. More bushes are added only as the fire is burnt down each time. A liquid locally called *ras khar* (liquid *khar*), drips down into the lower smaller pit or well. Burning of a lot of about 400 kg of bushes would produce about 40 kg. of *khar*. When the burning is complete, the fire is allowed to die down naturally and the ash left to cool over night. The next day, the blocks of *khar* are broken up with a hammer and the pieces are removed from the pit. The best quality of the product is removed from the lower pit (well) after breaking the lid. The first grade *khar* is of red colour. It is called *sua khar*. Sometimes, it assumes a whitish or green ting having greatest porosity with a non-lustrous, earthy appearance. The second grade is called *rota*. It is usually whitish in colour. The third grade is called simply as *khar* and is of dark green colour. It is dense, non-porous and has the appearance of charcoal.

Preparation of Glaze Powder

The following are the formulae for preparing glazed powder. Perhaps, these are being put into blue and for the first time: -

Glaze Powder

(I) Powder of *kanch* (glass) as mentioned above. 75%

(II) *Maidah* (fine wheat flour) glue 25%

The above, when mixed together when still dry, is termed as 'glaze' powder. To give the colour to the glaze powder following additives are used.

White colour

Pure glaze powder, mixed with water, gives the base or ground white colour.

Cobalt Blue Colour

(I) Glaze powder 100%

(II) Cobalt oxide 2.5% of glaze powder

First, the above two components are well mixed dry. Then, water is added and well stirred to have perfect consistency. This then gives the glaze for Cobalt blue.

Persian Blue Colour

(I) Glaze powder 100%

(II) Copper oxide 7% of glaze powder.

First, the above two components are well mixed in dry condition. Then, water is added and well stirred to have perfect consistency. This is the glaze for Persian blue.

Painting of designs on the tiles

If the tiles are to be decorated in floral design, first the design is transferred on to its surface with the process of *sozan kari* as already described above (Pl. 54) Through this process, the design is transferred to the engobed surface. The broad out line of the design is then marked in cobalt blue, but in a little of third consistency. The requisite colours i.e. metallic oxides mixed with a small quantity of acacia gum are then filled with a soft brush. (Pl. 55)

Glazing of tiles

After painting in case of more than one shade, a coat of the glaze (formula 1 above i.e. powdered glaze + fine wheat flour glue mixed in water) is applied over the surface (Pl. 56)

Stacking and Baking of tiles

The *kashi kar* of Multan bakes tiles in one single firing. Double firing, as done in Iran, etc., is not practiced here. While stacking of tiles in the furnace, the tiles are kept vertically instead of horizontally. Before putting the tiles in furnace, the backs of the tiles are fixed with a slight gap between them for circulation of heat.

A special kind of wood called *Obhan* available at Ghazi Ghat in Dera Ghazi Khan is used for firing upto 1000^{0} C

The Multani *kashi ka* does not use any instrument (e.g pyrometer) to check the temperature. Instead, he uses his own judgement for the purpose.

Furnace (Pl. 57)

Updraft furnace is used for baking of tiles in Multan. The flame from the firebox enters in the upper chamber through a large central opening in the chamber floor. Some *kashi kars* had modified the furnace, which has top opening extending to one side and continuing down the side as an open doorway. The *mori* (stockhole) lies in the base at the furnace but on an adjacent side. Usually, the *kashi kar* builts the furnace having cylindrical chamber. In modified furnaces, the chamber is built in rectangular shape with rounded corners.

The stockhole leads to the firebox and is locally called *khau*. The floor of the chamber is made of fire bricks. The top of the floor is made flat and the bottom in the shape of an arch. The floor, in the shape of slab, is supported at two ends i.e. the door and the back wall. Narrow openings are provided along the sides of the slab, which act as flameway between firebox and chamber. The walls of the chamber are built with sun dried bricks laid in mud mixed with straw mortar and a corbelled roof at the top. The chamber is plastered on its interior with refractory materials. The capacity of the chamber is about 35 cubic feet. The top of the furnace is closed with fire tiles before burning. The flue passes up through the holes around the chamber.

It is necessary for the clay body to develop to the proper point of hardness at the same temperature at which the glaze will melt, to form a uniform glassy coating over the tile. The well baked tile gives high clear ringing.

Testing the quality of the finished tile

A simple test is to tap the tile, if it gives high clear ringing, it means that the clay body and the glaze are properly mixedup to form a consolidated enamelled surface.

Pl. 52 Showing *khar*, quartzite or *kurund* glaze, copper oxide and cobalt oxide.

Pl. 53 Grinding of glaze with stone quern.

Analysis of Materials

1.Emission Spectroscopic Analysis

The Emission Spectroscopic Analysis of glaze powder, ground glass, quartzite stone and sintered plant ash recorded by Owen S. Rye and Clifford Evans is as under.*

Table 1

Element	Ground Glass	Powdered Glaze	Quartzite	Sintered Plant Ash
Si	M	M	M	M
Al.	1.00	1.00	1.00	1.00
Fe	0.15	0.20	0.15	0.20
Mg	1.00	1.00	0.30	1.00
Ca	1.00	1.00	1.00	1.00
Na	1.00	1.00	0.70	1.00
K	1.00	1.00	1.00	1.00
Ti	0.20	0.50	0.00	0.00
P	0.10	0.10	0.10	0.10
B	0.25	1.00	0.01	0.05
Pb	0.25	1.00	Tr.	Tr.
Ba	0.20	0.20	0.10	0.20

Tr=Less than 0.01

M = Major constituent

Underlined values = greater than 1.00%

All values below 1% have a precision of ± 50% from reported value and all above 1.00% are reported as either greater than 1% (underlined) or M (major constituent).

2.Electron Microprobe Analysis of Fired Glaze

The aim of this test is to evaluate the application of the electron microprobe to the study of glaze sample removed from a vessel or a tile for which technological history was known. It is also used to determine, whether the technique could provide useful comparative data in the study of older vessels or tiles. An Electron Microprobe Analysis of fired glaze collected from white and painted surface of the vessel of present day potter from Multan recorded by Owen S. Rye and Clifford Evans, is as under.**

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* Owen S. Rye and Clifford Evans, Traditional Pottery Techniques of Pakistan, Washington ((U.S.A), 1974. Page. 142

** Ibid Page 150

Pl. 54 Transferring of design on tile.

Pl. 55 Painting on tile.

P1. 56 Glazing on tile.

Pl. 57 Furnace.

Table II
Electron Microprobe Analysis

Mineral composition	Clear alkaline glaze				Under fired alkaline glaze			Frit	Glaze before firing		
	3	18	24	26	2	19	27	6	40	42	43
Sio_2	70.20	64.00	61.30	63.20	62.90	65.20	64.0	64.10	59.30	64.60	55.20
AL_2O_5	2.65	3.04	1.98	2.35	1.94	2.31	2.14	2.28	2.42	2.83	3.85
FeO	0.53	0.95	0.54	0.50	0.65	0.60	0.80	0.67	0.65	0.61	1.27
MgO	1.84	1.39	1.84	1.70	2.67	2.43	2.50	1.95	3.83	3.53	4.43
CaO	6.20	5.00	6.20	6.00	6.40	6.00	6.00	2.54	4.46	4.63	4.64
Na_2O	10.30	12.00	8.50	8.60	9.00	9.00	9.60	19.80	21.50	20.60	21.00
K_2O	3.86	2.88	3.77	3.88	4.58	4.64	4.79	3.56	2.42	2.78	2.70
TiO_2	0.17	0.20	0.12	0.20	0.15	0.19	0.18	0.10	0.17	0.17	0.21
MnO	TR	TR	TR	TR	TR	TR	TR	TR	NS	NS	NS
P_2O_5	0.12	TR	0.25	0.14	0.17	0.13	0.17	0.32	0.32	0.27	0.38
CoO	TR	ND	ND	ND	TR	0.74	ND	ND	NS	NS	NS
Cr_2O_5	ND	ND	ND	ND	ND	ND	ND	ND	NS	NS	NS
SnO_2	TR	ND	0.70	0.41	0.11	0.13	TR	ND	NS	NS	NS
CuO	0.15	ND	4.65	1.50	2.69	1.42	0.23	ND	NS	NS	NS
PbO	4.42	3.66	3.38	2.52	2.76	2.38	3.79	ND	NS	NS	NS
Total	100.4	93.12	93.23	91.00	94.08	95.17	94.20	95.32	100.32	100.02	93.68

18 = Sample from area on back where the glaze had been applied directly on body
24 = Sample from the area with turquoise underglaze decoration.
26 = Sample from area with blue underglaze decoration.
2 = Sample from area with turquoise decoration underglaze on interior (upper) surface.
19 = Sample from area with blue under glaze decoration, upper surface.
40,42,43 = Grains of powdered glaze prepared for use.
ND = Element sought in analysis but not detected;
NS = Not sought in analysis;
TR = Present in trace amounts (below 0.1%) values have been rounded off to one decimal place for high (greater than 5%) lead glazes and all values above 5%. Other values are rounded off to two decimal places.

Table III

Composition of glaze from Multan, expressed as Molecular Equivalents of Oxides (calculated from data in Table II)

Mineral composition	Clear alkaline glaze				Under fired alkaline glaze			Frit	Glaze before firing		
	3	18	24	26	2	19	27	6	40	42	43
Sio_2	3.04	2.93	2.92	3.09	2.71	2.91	2.71	2.37	1.80	2.02	1.64
Al_2O_5	0.07	0.08	0.06	0.07	0.05	0.06	0.05	0.05	0.04	0.05	0.07
FeO	0.02	0.04	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03
MgO	0.12	0.10	0.13	0.12	0.17	0.16	0.16	0.11	0.17	0.16	0.20
CaO	0.29	0.24	0.32	0.32	0.29	0.29	0.27	0.10	0.15	0.16	0.15
Na_2O	0.43	0.53	0.39	0.41	0.38	0.39	0.40	0.71	0.63	0.62	0.60
K_2O	0.11	0.08	0.12	0.12	0.13	0.13	0.13	0.08	0.05	0.06	0.05
TiO_2	Z	0.01	Z	0.011	Z	0.01	0.01	Z	Z	Z	Z
P_2O_5	Z	Z	0.01	Z	Z	Z	Z	Z	Z	Z	Z
SnO_2	Z	Z	0.01	0.01	Z	Z	Z	Z	NS	NS	NS
PbO	0.05	0.05	0.04	0.03	0.03	0.03	0.04	Z	NS	NS	NS

Z = Below 0.005 molecular equivalents;
NS = Not sought in analysis;

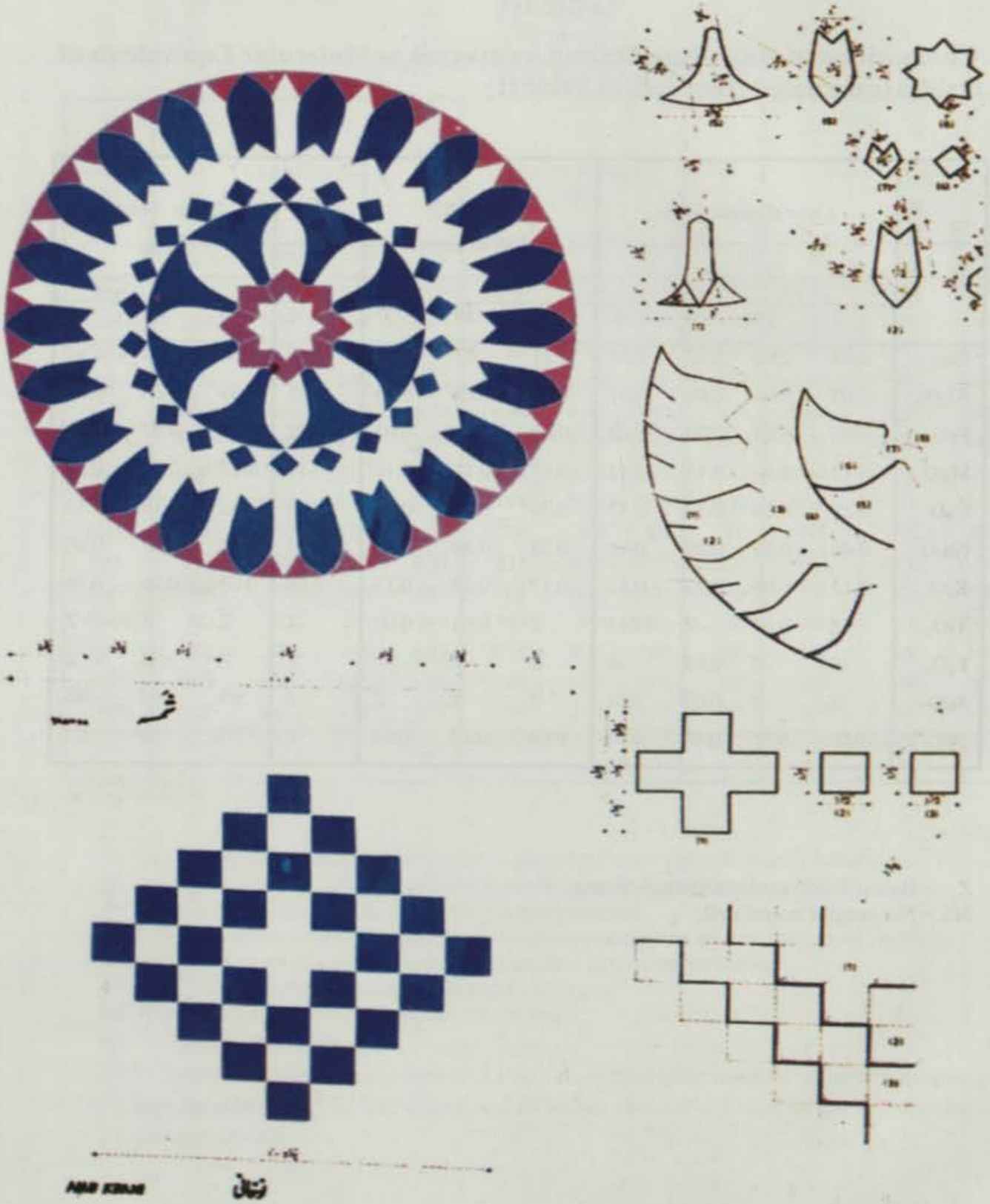


Fig .15 Tomb of Shah Rukn-e-Alam, Multan - Analysis of decorative design in faience mosaic.

Fig .16 Tomb of Shah Rukn-e-Alam, Multan - Analysis of decorative design in faience mosaic..

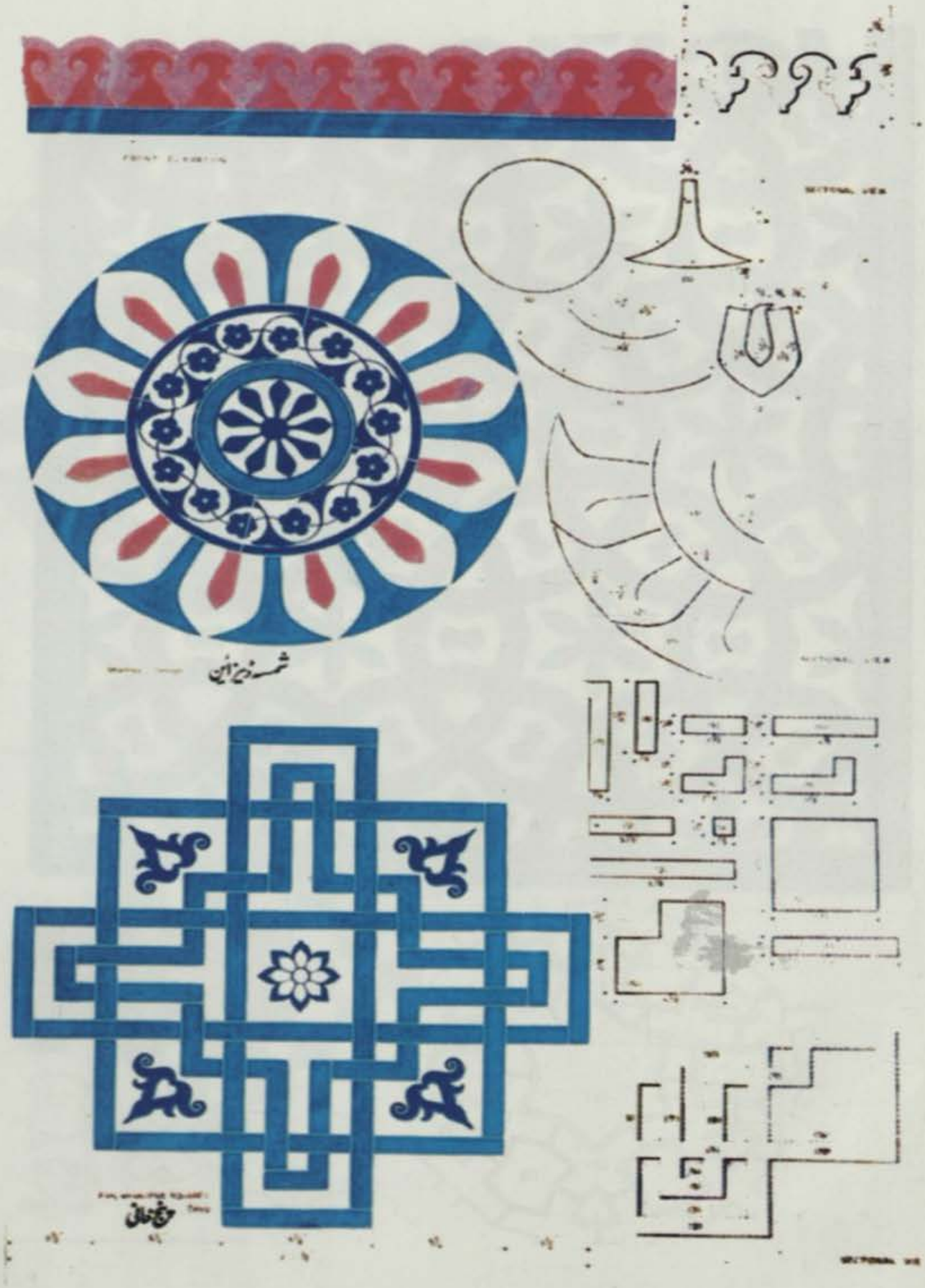


Fig.17, Tomb of Shah Rukn-e-Alam, Multan - Analysis of decorative design in faience mosaic.

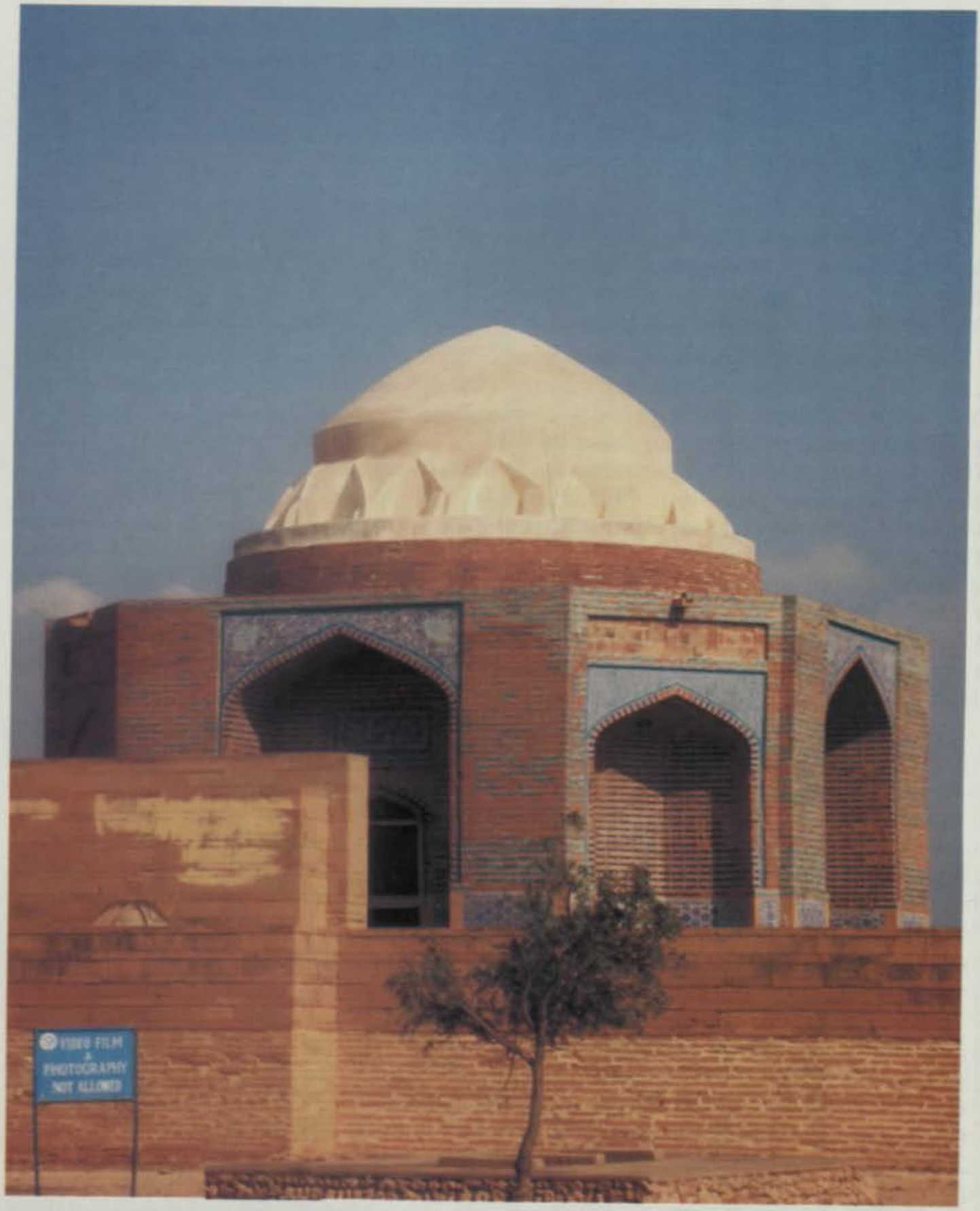
SINDH TILES

Glazed and painted tiles are a distinctive characteristic of Islamic architecture. The great heavy massive buildings, which the Muslims built, can not be said to be conspicuous for either gracefulness of design or artistic merit, and they are only saved from mediocrity by their decorative surfaces. The coloured enamelled tiles, so lavishly used are the chief characteristic features of nearly all Islamic building in Sindh.

Hala, forty eight kilometres north and Nasarpur, twenty nine kilometres to the north east of Hyderabad are centres for manufacturing enamelled tiles. At present there are only a few families of craftsmen who continue to manufacture these tiles. The tiles are still used upon the shrines and mosques but to a very limited extent. The tile makers of Hala, the chief place of tile manufacture in Sindh are called *kashigar*. They claim their descent from some prehistoric Chinaman, who was induced to settle in Sindh by one of the Amirs. It is said that the Amir had to pay a handsome amount and rich presents to the first settler and that the present generation of potters/tile-makers is directly or indirectly descended from him. The feature, the stature and the general appearance of the race, bear no trace of Chinese blood. The workmanship has more influence of the Persian than the Chinese ceramic ware. Probably these traditions came with the tiles from Persian where in certain localities there are still said to be legends of the introduction of this art in Persia from China.

In India and Pakistan tile work has been used mostly on tombs and mosques specially used as dadoes, panels, string courses, arch ring, paving of floors and at times even the entire surface of the building. In Sindh we find the designs are confined strictly to geometric forms and foliage. The tile shapes are usually square and the decorations take the shapes of flowers, and geometrical patterns. In Sindh and Multan the body of tile is hard-baked red. The Mosque of Wazir Khan and the Fort at Lahore, on the other hand, are of different make, being made up of a composition of silica sand and other ingredients. In Sindh the tiles are laid flat to the building, their surface being on the same level; but at Multan a variety has also been introduced by raising the main parts of the pattern half an inch above the ground work.

The earliest examples of the tile work in Sindh, are seen in the old Dabgir Mosque (circa 1509 CE) and Mir Jani Beg's Tombs (circa 1599 CE) (Pl. 58), Shah Jahan Mosque at Thatta (Pl. 59) and Khudaabad Mosque (Pl. 60) are confined to two colours a deep rich blue and Persian blue (turquoise) on a white background. Green, brown, orange, and purple were introduced at a later date, and are found in the Talpur Tombs (1783 -1843 CE), Tomb of Lal Shahbaz Qalandar at Sehwan Sharif, Tomb of Sachal Sarmast, Tomb of Tahir Khan Nahar (1530 CE) at Sitpur, in District Mazaffargarh. Asif Khan Tomb at Shahdara, Lahore (1650 CE) is a good example of this kind of work and shows that these additional colour were introduced into the Punjab earlier than in Sindh.



Pl. 58 Tomb of Mirza Jani Beg at Makli - Tile decorations.

Pl. 59 Shah Jahan Mosque Thatta :- Tile decorations.

Pl. 60 Masjid Khudaabad.

Process of Manufacturing Tile

The following steps are followed for the preparation of enamelled tiles in Sindh.

Selection of Clay

Pure clay is the most important factor for the preparation of durable and good tiles. Clay selected should be free from salt, pebbles, coarse grit and calcareous nodules. The lumps are broken up, so that no piece remains larger than 1 inch across. An iron bar, 10 inches long and 1 inch in diameter is used to break up the clay. Locally it is called *bhananu.*

Preparation of Clay

Preparation of clay is done by mixing clay with water and storing it in a damp condition (Pl. 61) for increasing the plasticity of the clay. The wet clay is well kneaded by foot, the process locally known as *lat bhananu.*

Forming Techniques

Tiles are made through several different procedures. Different craftsmen use different method directly on the floor. Tiles are cut slightly larger than the actual required size. The *kashigar* uses metal sheet templates for tiles. The templates are for each size and shape of the tile but slightly larger in size in order to compensate for the drying and firing shrinkage of the clay. The shape of the tile is marked out on the surface of the blank clay, then the tile from the blank is cut with the help of a steel-bladed knife to provide key. The back surface of the tile is made rough to provide key for proper bondage of mortar.

Some craftsmen use Plaster of Paris moulds for some shapes of tiles. Now a days, Plaster of Paris is available in the market but they had previously made their own plaster from gypsum (*chirori*) obtained from Sehwan Sharif. The gypsum is calcined in a kiln, then removed, crushed and ground in a stone quern (*chakki*). Tile makers of Hala also use a mould for standard rectangular or square tiles. This mould has a flat wooden base with a raised lip of steel border around the edges according to the thickness of tiles. The plastic clay is pressed into the mould and the top of the tile scraped smooth with the edge of a straight piece of wood. Then the tile is taken out and when the tile is dried to leather hardness, it is smoothened with the help of a steel bladed knife. The shapes are known *chhako* (hexagon), *dal* (chevron), *adho chhako* (half hexagon), etc.

Drying and Filling of Depressions

Drying of the tiles is done under shade but in natural hot atmosphere. Direct drying under the sun is avoided. After the tiles have dried to leather hard, all small depressions on the surface are filled using the same moist material. The damaged edges are also repaired. The surface is smoothened by rubbing with a wet cloth.

Engobing

Different slips are used for alkaline and lead glazes. Engobing is done by using various slips.

Slip for Alkaline Glaze

The *kashigars* of Sindh use *chakmak* i.e chert stone for engobing .*Chakmak* is a flint stone found in Sukkur quarries. It is found in the form of large nodules weighing between 1-10 kg. Stone having iron particles are discarded. Flint nodules are placed at the floor of the furnace for calcining. Calcining makes the flint easier to crush. After breaking in an *hawan dasta* or *hamam-dasta* (iron mortar and pestle), it is ground into a powder form in a stone *chakki* (quern). This powder is mixed with fine wheat flour and water glue for application to the tiles.

Slips for Lead Glaze: There are four types of slips used for lead glaze.

i. White Slip

It is based on white firing clay. The clay is slaked in a small drum until it is completely broken, then the paste is transferred to an iron mortar pan. Water is added to make it suitable for application. The slip is then sieved through a piece of *malmal* (muslin) cloth to remove grit particles.

The formula of the white slip is as under.

White slip	10 kg
Soda ash	60 gm

The soda ash acts as deflocculating, causes the clay to settle and allows excess water to be poured off. The white slip gives white and sometimes yellow colour when applied under lead glaze.

ii. Black Slip

Adding iron oxide to the white clay makes it black. White clay is normally used for white slip. The formula for the black slip is as under.

White clay	4 kg
Hematite (red iron oxide)	1 kg

The iron oxide is added to the slaked white clay. The black slip is prepared in the manner as already explained for the white slip.

iii. Green Slip

Mixing copper oxide with the white clay makes it green. The formula for the green slip is as under.

White clay	1 kg.
Copper oxide	60 gm.

It gives green colour when applied under lead glaze.

iv. Pinkish Brown Slip

This is made from yellow ochreous clay commonly known as *peeli matti*. The clay is available in the market in powder form. The slip is prepared using by the same method as already explained for white slip. It gives pink brown colour under lead glaze.

Preparation of Glaze

In Sindh, two types of glazes are used

I. Alkaline glaze

ii. Lead glaze

Like their fellow craftsmen of Multan, the ***kashigars*** of Sindh too are very rigid in their profession. They do not use imported glazes. Instead, they prepare their own.

Alkaline Glaze

The alkaline glaze was made from local stone (Pl. 62) called *channioh* obtained from Sehwen Sharif and *khar* brought from Cholistan. Now the ***kashi*** *kars* or kashigaruse soda ash instead of *khar* and locally quartz sand. The quartz sand and soda ash is mixed in equal quantity by weight. This mixture is placed in a crucible.

The crucible is placed in the kiln and the glaze is melted. This gives crystals of glass (frit). This frit is then broken up and ground finely in a ***chakki*** (stone quern). The powder is mixed with *maidah* (fine wheat flour) and water glue and applied by pouring over the tile.

Lead Glaze

Lead glaze is prepared from quartz sand obtained from a deposit near Hala or from Sehwen Sharif and ***sandhur*** (red lead). The sand is ground in a ***chakki*** (stone quern). The powdered quartz sand and red lead are then mixed in the proportions of 2 parts red lead and 5 parts quartz sand. The mixture is then placed in a crucible and melted in a kiln during a firing. This fine frit, which is then broken up and ground in *chakki*. This powderd is ready for application to tile when mixed with water.

Painting on Tile

Colour is grinded in a stone *kharel* (Pl. 63). If the tiles are to be decorated in floral design; first the design is traced or sketched on a tracing paper. This traced out design is then perforated with the help of a needle or pin. The process is called *sozan kari*. The perforated tracing is fixed over the tile and pounced *kashigar* with coal dust. Through this process the design is transferred on the tile. The outline of the design is done with cobalt oxide with brush. (Pl. 64) The *kashigar* of Sindh uses camel hair brush made by for painting while the of Multan uses squirrel hair brush. Painting is done over white slip Sometimes the painting is done with *kheri* (Pl. 65) and the lead glaze is applied over it.

Colours

The following metallic oxides are used for various colours.

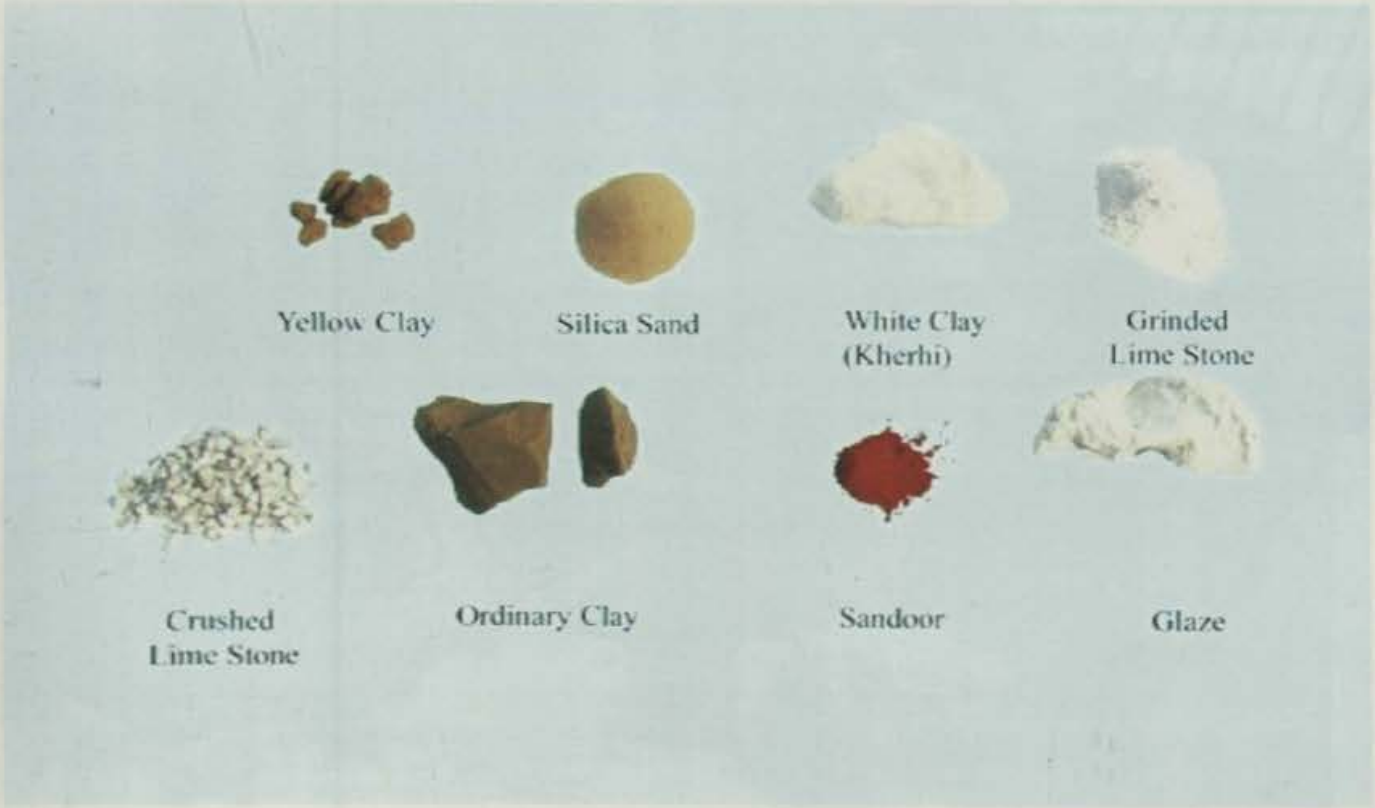
Cobalt Oxide: It gives blue shade.

Copper Oxide: It gives Persian blue (turquoise) shade.

Chromium Oxide: It gives green colour shade.

The colours are used only under alkaline glaze.

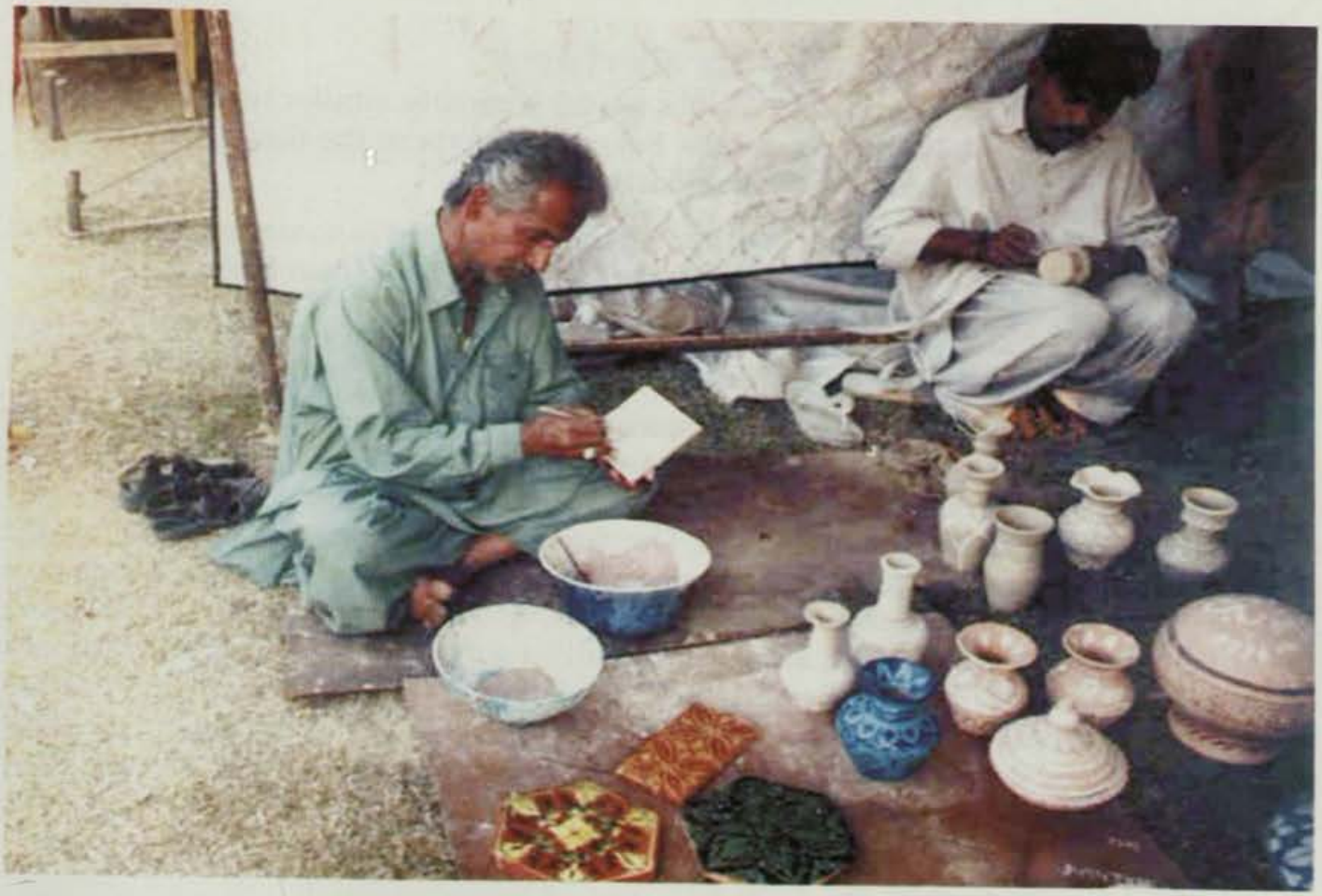
Plate. 61 Slaking of clay.



Pl. 62 Materials used for preparation of glazed tiles.

Pl. 63 Grinding of colour in *kharal.*

Pl. 64 Painting on tile.



Pl.65 Painting with *kherhi*.

Pl.66 Furnace.

Furnace (Pl. 66)

In Hala, the furnaces for baking of tiles are all basically similar to one another in design and operation. Only their sizes vary. Functional parts of the furnace, such as the chamber, flue system and firebox vary in minor details.

Mostly the furnaces are updraft and above ground level but in some areas the firebox is partly excavated and the upper part of the furnace is constructed over the hole.

The detail of a furnace constructed above ground level is given as under:-

Main features of the designs of a furnace constructed above ground are circular chamber with hemispherical dome, the main access to the chamber through a hole in the centre of the floor and outlet flue at floor level in the chamber. The front opening (the stockhole) is twice the width in height. The firebox itself is of same width as the stockhole. The floor of the firebox slopes upwards from front to back, so that the ash falls at the front portion of the firebox. It is easy to remove ash during a firing. The sloping floor of the fire angle. The firebox also requires only a simple arch. This kind of furnace is not a simple updraft but the flame path is semi-updraft. The flame travels upward through a central hole in the chamber floor. The flame passes up through an open area in the centre and then diverted downwards along the chamber walls, through flues at floor level. The flues lead to chimneys at four corners of the furnace. The structure of the furnace is built with sun dried bricks laid in mud mortar.

Stacking and baking

Furnace is set from the top. The ***kashigar*** climbs down inside the furnace. Another man carries the tiles to him. Tiles are set on edge in a radial system around the chamber. The central area of the furnace is kept open to allow flame from the central floor throat (hole) to travel free up to the top of the chamber. When stacking or setting is complete, the access hole at the top of the furnace is covered with a slab made of clay mixed with straw. The slab is sealed with slurry to prevent any draft at the top of the chamber and remained in place until after firing. About one third hole of the chimney is also covered with the tile before beginning of firing. When the firing is completed and the cooling started then the total area of the chimney is exposed. The firing takes several hours. It takes at least two days to cool. After firing the opening of the firebox is closed. After cooling the furnace, it is opened. The baked tiles are removed from top layer to the bottom. Mostly the fuel used for firing is *kikar (*acacia) wood. It is better than the other fuel wood because *kikar* wood burns with clear flame, whereas the other fuel woods with a smoky flame.

Analysis of Glaze

Electron Microprobe Analysis

Table. IV

Electron Microprobe Analysis of fired glaze from Hala of present day potter is reported by Owen S. Rye and Clifford Evans is as under.*

Mineral composition	Lead Glaze			Alkaline glaze		Alkaline glaze			Frit	
	10	14	15	1	4	11	12	17	7	8
Sio_2	29.3	27.0	27.8	70.30	68.20	69.40	56.3	73.40	69.90	70.00
AL_2O_3	2.2	1.6	1.4	1.73	1.70	4.13	4.3	2.52	0.86	0.66
FeO	0.8	3.3	1.0	0.78	1.22	0.87	0.9	0.73	0.35	0.27
MgO	0.4	0.4	0.4	0.42	0.17	0.45	0.5	0.33	0.13	TR
CaO	0.6	1.6	0.6	2.80	1.02	1.15	0.9	1.42	0.75	0.29
Na_2O	0.3	0.3	0.3	16.20	18.90	19.60	13.5	18.60	9.80	9.50
K_2O	0.3	0.1	0.1	2.56	2.07	2.88	2.3	3.42	0.58	0.62
TiO_2	0.4	0.3	0.3	0.14	0.20	0.31	0.3	0.20	0.13	0.12
MnO	TR	0.2	TR	ND	TR	ND	ND	ND	ND	ND
P_2O_5	0.2	0.2	0.2	0.23	TR	TR	0.1	ND	ND	ND
CoO	0.1	0.1	0.4	ND	0.29	1.14	ND	ND	ND	ND
Cr_2O_3	0.1	0.1	0.3	ND	TR	ND	0.2	ND	ND	ND
SnO_2	0.3	0.3	0.3	0.42	0.79	ND	ND	ND	ND	ND
CuO	0.5	1.8	0.7	4.54	4.03	ND	1.3	ND	ND	ND
PbO	68.0	68.6	71.3	0.39	0.60	0.20	16.1	0.20	ND	ND
Total	103.5	105.9	105.1	100.51	99.19	100.13	96.7	100.82	82.50	81.46

10 = Simple from area without painted slip i.e. background area with white slip under the glaze,
14 = Sample from the area with dark brown slip under glaze decoration.
15 = Sample from area with light brown pinkish slip under glaze decoration.
1 = Sample from light blue, turquoise, glazed area on the face of tile.
4 = Sample from an area with blue underglaze decoration on face of tile.
11 = Sample from area with blue under glaze decoration on face of tile.
12 = Sample from area with green under glaze decoration on face of tile.

*Owen S. Rye and Clifford Evans, Traditional Pottery Techniques of Pakistan, Washington (U.S.A), 1974. Page 151

17 = Sample from white undecorated area on face of tile
7 = Small peace broken from block of frit near top of crucible.
8 = Small peace broken from block of frit near base of crucible.
ND = Element sought in analysis but not detected; NS = not sought in analysis; TR = present in trace amounts (below 0.1%) values have been rounded off to decimal place for high (greater than 5%) lead glazes and all values above 5%. Other values are rounded off to two decimal places

Table V

Composition of glaze from Hala, expressed as molecular equivalents of oxides (calculated from data in Table IV.*)

Mineral composition	Lead Glaze			Alkaline Glaze		Alkaline Glaze			Frit	
	10	14	15	1	4	11	12	17	7	8
Sio_2	1.45	1.26	1.32	3.34	3.22	3.04	2.72	3.29	6.44	6.97
Al_2O_3	0.07	0.05	0.04	0.05	0.05	0.11	0.12	0.07	0.05	0.04
FeO	0.04	0.13	0.04	0.03	0.05	0.03	0.04	0.03	0.03	0.02
MgO	0.03	0.03	0.03	0.03	0.01	0.03	0.04	0.02	0.02	0.01
CaO	0.03	0.08	0.03	0.14	0.05	0.05	0.05	0.07	0.07	0.03
Na_2O	0.02	0.02	0.02	0.75	0.87	0.84	0.63	0.81	0.88	0.92
K_2O	0.01	0.01	0.01	0.08	0.06	0.08	0.07	0.10	0.03	0.04
TiO_2	0.01	0.01	0.01	Z	0.01	0.01	0.01	0.01	0.01	0.01
P_2O_5	0.01	0.01	Z	Z	Z	Z	Z	Z	Z	Z
SnO_2	0.01	0.01	0.01	0.01	0.01	Z	Z	Z	Z	Z
PbO	0.91	0.86	0.91	Z	0.01	Z	0.21	Z	Z	Z

Z = Below 0.005 molecular equivalents;
NS = Not sought in analysis;

*Owen S. Rye and Clifford Evans, Traditional Pottery Techniques of Pakistan, Washington (U.S.A), 1974. Page 151

LAHORE TILES
ENAMELLED TILE MOSAIC WORK

This very impressive, charming and durable decorative work took its origin in its broader form during the Achaemenian period in Iran in the 6th century BCE. However in its minute form it became the chief decorative feature in the monuments of Safvid period (1491-1722. CE) in Iran from where it was brought to Lahore in the 17th century CE. It is worked with small pieces cut to the desired shape from enamelled tiles of various vivid colours and then joined to form different flowery, geometrical calligraphic and figural forms in one plane. However at Lahore it surpassed even the scope of Iranian works.

In Lahore the only example of the Multan School tile decoration is found on the mausoleum of Hazrat Musa Ahangar (d. 1519 CE) built during Akbar period.

The second phase of the history of tile decoration started with the advent of Mughal rule in the Sub-continent. Thatta and Lahore flourished as the major centres of Mughal architecture. According to R.Nath, the glazed tiles were first introduced during the reign of Akbar. The dome of Nila Gumbad, Sabz Burj, Mosque at Delhi, Jodhbai palace at Fatehpur Sikri and Jahangir Mahal at Agra, are a few examples of this period.

The tile work of Lahore of Shah Jahan period is of a much richer and more elaborate than of other periods.. Entire facade of most of the buildings is decorated with tile mosaic work arranged in square and rectangular panels. The tiled panels display geometrical, calligraphic and flower patterns. The main cause of the development of tile mosaic was the Iranian family of Ghias Beg whose daughter, Nur Jahan became the celebrated queen of Jahangir. With the rising influence in the court, many architects, engineers and artisans migrated from Iran to India. The popularity of tile mosaic was a manifestation of this influence. The Iranian tiles have terra cotta base while the Lahore tiles are unique silica sand body like plaster base.

The most graphic and realistic representations showing flora, fauna (animal and human) games such as polo, hunting, animal fights, processions worked at the north and west wall (1st half of 17th century CE) of Lahore Fort (Pl. 67), flowery, plant life and calligraphic decoration in Masjid Wazir khan, Lahore (1634-35 CE) are the specimen of unsurpassed beauty, skill and workmanship of this craft in Pakistan (Pl. 68). The octagonal minarets with their cypress and star shaped decoration and the enamel glistens in the light of the sun.

The other buildings in Lahore decorated with tile mosaic work are Mausoleum of Emperor Jahangir (1627-1630 CE) (Pl. 69), Mosque of Dai Anga (1635 CE) Two gates of Shalimar Garden (1637 CE), Nawan Kot Gateway (middle of 17th century CE) (Pl. 70), Chauburji (1646 CE) (Pl.71), Mosque of Mohammad Saleh Kumboh (1656 CE), Gulabi Bagh Gateway (1655 CE) (Pl. 72), and Tomb of Dai Anga(1671 CE) at Lahore.

The beautiful tile work on Terracotta base at Asif Khan's Tomb (1645 CE) at Shahdara is unique. It gives the impression of tile mosaic work .It is said these tiles were

directly borrowed from Iran. Such tiles were also used in the complex of Hazrat Mian Mir at Lahore. Some tiles removed from this complex have been displayed in Lahore Museum. The Ghulabi Bagh gateway is remarkable for the excellence of rich and vivid tile mosaic work.

The dome of Buddhu's Tomb (1671 CE) and the dome of Dai Anga's tomb (1671 CE) has been covered with tile mosaic work in zig zag or chevron pattern.

After Shah Jahan this craft shows definite decline. No notable work of Aurangzeb's reign is preserved in Lahore. The faience revetment, however continued in the later Mughal period. The Tomb of Sharfun-Nisa Begum locally known Saruwala Maqbara is a unique work of tile mosaic of this period in Lahore. An outstanding example of the mid 18th century CE is the Begumpuri Masjid built in the time of Muhammad Shah.

Manufacturing Technique

For the body of tiles, now a day, the following materials are mixed. The mixture is sieved to make it homogenous. If tile is to be prepared by a dye and pressed by a press machine, the water is added upto optimum moister. If it is to be prepared by hand mould, the mixed materiel is put in the mould and tapped with a wooden *thapy*.

Silica sand	1 part
Pottery clay	1 part
Glass powder	1/2 part
Soap stone	1/2 part

Drying

Drying of the tiles is done in natural hot atmosphere but under shade. Drying by direct exposure to the sun is avoided.

Pl. 67 Lahore Fort - Tile mosaic decoration.

Pl. 68 Wazir Kahn Mosque Lahore - Tile mosaic decorations.

Bisquing of Tile

After drying the tiles are baked in the furnace upto the temperature of 850° C. The tiles are kept on the slabs called *'Tawas'*. The baked body of the tiles is called *'bisque'*.

Engobing of Tile (Pl. 73)

Engobe is clay like slip, which is applied to obscure actual colour of the tile. The following composition is used for engobing the tiles:

Glass powder	1 part
Pottery clay	1/2part
Soap stone	1/2 part

These materials are mixed in water to a suitable consistency and this matter is termed as engobe. The engobe is laid either by hand or by spray machine.

Glazing of Tile (Pl. 74)

A glaze is a continuous layer of glass, or glassy crystals, on the surface of a ceramic body. It is applied as a suspension of the glaze-forming ingredients in water, which dry on the surface of the piece in a layer. Upon firing, the gradients react and melt to form a thin layer of glass. There are two kinds of glazes:

1. Alkaline Glaze

An alkaline glaze is one which depends on the alkalies i.e. Sodium or potassium or Litum for its flux (materials which are added to lower the melting point) rather than Lead.

2. Lead Glaze

A Lead glaze is one for which Lead is used for its flux.

Composition of Glaze

The composition of the glaze used on the tiles is as under:

Glaze	85%
Kaolin	5%
Feldspar	5%
Zinc oxide	5%

Maida (fine flour of wheat passed through a muslin cloth) and water glue is mixed for slipping purpose.

The above mentioned components are well mixed dry then water added and is well stirred to have perfect consistency It will be better, if the above components are well grinded.

Colours

Generally metallic oxides are used to colour the glaze. The following oxides are used for obtaining various colours:-

Red Iron Oxide

Hematite is its mineral name. It is also called Feric Oxide. Colours, which are produced by Feric Oxide range from tan to yellowish brown. In low-fired glazes, which are high in lead, rather brilliant tones of amber can be produced, by addition of 2 to 3% of iron oxide.

In the range of 1110° C to1180° C when lead content of the glazes is less, the colours produced by iron oxide are more subdued.

Black Iron Oxide (Ferrous Iron Oxide)

Ferrous iron or black iron oxide may also be used as glaze colorant and in most cases it gives the same colours when used in the same amount.

1% iron oxide added to glaze would give noticeable tint:-

3%..... will give medium tint

5%..... will give strong tint.

7%.....will give dark brown or black

In lead glazes, Iron Oxide gives warm, soft colours of tan, yellowish brown, amber, reddish brown or dark mahogany brown. 3 to 15% iron oxide gives yellow glaze.

Copper Oxide

It produces Persian blue and green in glazes.

Copper Carbonate

It is the most common source for Copper Oxide. It is a light green powder and very fine in particle size. Black copper oxide yields more Copper per unit of weight than does Copper Carbonate. Copper Oxide, is highly soluble in glazes. It mixes thoroughly with the molten glaze during firing, even when not well ground into the raw glaze batch. Copper Oxide, like Iron oxide, is a strong flux and its addition may make the glaze noticeably more fluid and bright or surface.

Cobalt Oxide

It is the most stable and reliable and also powerful colouring oxide.

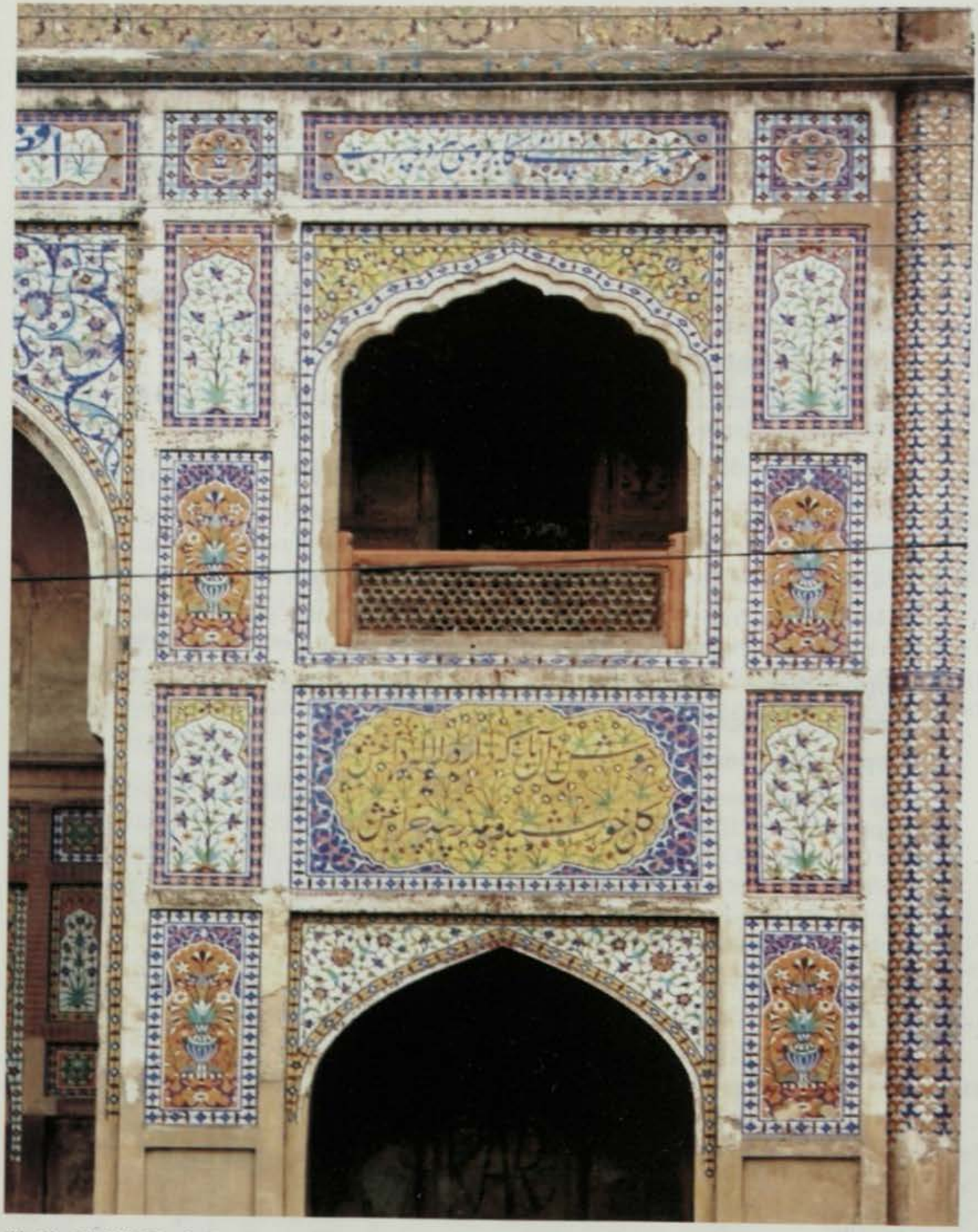
1/4% in a glaze gives a medium blue

1/2% -do- strong blue

1% -do- dense blue-black or black

In alkaline glazes, Cobalt Oxide produces on extremely brilliant blue.

The usual forms employed are coablt carbonate, a light purple powder or black cobalt oxide.



Pl. 69 Ghulabi Bagh Gateway - Tile decorations.

Pl. 70 Chauburji, Lahore - Tile decorations.

Glazes containing cobalt oxide need to be thoroughly ball milled to eliminate a speckled or matted appearance in the finished glaze.

Chrome Oxide

It is the most versatile colouring oxides and a veritable turn coat. It will produce yellow, pink, brown, or green glazes depending on the kind of glaze used and the temperature of firing.

Low fired lead glazes which have above 0.7 equivalents of lead oxide and low alumina content, may give brilliant orange or red colour.

The firing temperature of chrome red glazes must be low, preferably below cone 08.

Low fired lead glazes, which contain some Soda as well as lead oxide, may give a brilliant yellow when about 1% of chrome oxide is present.

Manganese Oxide

It gives a purple or brown colour in glazes. The usual source is Manganese carbonate which is very fine pink coloured powder or black Manganese dioxide 2% or 3% is usually required to give a pronounced colour.

In highly alkaline glazes, Manganese gives a rich blue-purple or plum colour.

Nickel Oxide

The common forms of Nickel Oxide used in glazes are green Nickel Oxide Nio or black nickel oxide. Nickel oxide gives quite a wide variety of colours in glazes, but its most typical colour is brown. The colours derived from Nickel are rather uncertain.

Vanadium Oxide

Vanadium stain gives a yellow colour in glazes 5% will usually gives a weak yellow, and 8 to 10% strong yellow.

Iron Chromate

Iron chromate is used to produce shade of grey, brown, or black. In most glazes 2% will give a pronounced darkening of colour Iron Chromate is commonly used in engobes to give a grey colour.

Formula used for preparation of tiles for gates of Shalamar Garden, Lahore

For body of the tile

Silica Sand	3 kg.
Pottery Clay	5 kg.
Glass Powder	1 kg

For engobe

Quartz powder	25%

China clay	30%
Feldspar	25%
Zirconium silicate	10%
Zinc Oxide	10%

For glaze

Lime	20%
China clay	15%
Feldspar Soda	40%
Quartz	20%
Zinc Oxide	5%

Colours

Blue	3% cobalt oxide of glaze
Green	6% chromium oxide
Persian blue	6% copper carbonate
Yellow	6% yellow oxide
Purple	8% Manganese dioxide

Stacking and Baking of Tiles

The tiles are kept on the slabs called '*Tawas*' for baking. The updraft furnace is used for baking of tiles .the detail of furnace is already described in Enamelled Tile work. The tiles are baked upto 1000 C.

Analysis of Tiles

Some samples of the tile mosaic from Masjid Wazir Khan, Lahore were sent to the *Azmaish Gah Kashi Sazi,* Tehran Iran for suggestions regarding the manufacturing of tiles for the restoration work of the said Mosque. Suggestions received from *Azmaish Gah Kashi Sazi*, Tehran, Iran are as under:-

Base of tile mosaic from Masjid Wazir Khan, in Pakistan is composed of flint + flux (melter) + silica + 50% gum of Katira. If gum is less than 50% the composition is weak.

Samaq (chakhmaq)+melter +silica(mavad-i-shisha) + 50% Gund Katira.

Glaze (Tual)

It is composed of frit made of quartz or flint with metallic oxides for colour.

Lead oxide is used for obtaining yellow colour.:

(I) Glazes are made of Frit + 4 to 7 parts lead oxide and one part calcium).

(ii) 3 to 15% iron.

Pl. 71 Tomb of Emperor Jahangir : - Tile decorations.

Pl. 72 Nawan Kot Gateway - Tile decorations.

Pl. 73 Applying coat of engobe on tile.

Pl. 74 Applying glaze coat on tile.

Blue and Lapislazuli

1 to 5 % cobalt oxide.

Purple

1 to 10% manganese or 1 to 5 % cobalt of the frit.

Mushki, Dark of Sable Hue

-Iron + Copper and manganese equal parts 3 to 5% of the frit.

Messrs.T.H. Thornton and J.L. Kipling's Lahore (pp.148-150) contains the following 'Analysis of Kashi work by the late Dr. Center, Chemical Examiner to the Punjab Government.' As the book in which it appeared is scarce, Dr. Centre's note is reproduced here in full.

"The Kashi work consists essentially of a layer of glass spread on a hard kind of plaster,-something on a material porcelaineous in structure. On analysis the glass was found to be an ordinary silicate colored by metallic oxides. The plaster was found to be composed of a mixture of lime and siliceous sand, the hardness being due to silication, which accounts for its bearing the heat required to fuse glass. It is remarkable that an old Buddhist cast was found to be composed of a similar material. I got specimens made at the laboratory by an old man who practises the art at Lahore, but the work was very inferior. The glaze wanted purity and polish, and he made his plaster as hard as a stone. The finest specimens in Lahore are to be seen on Wazir Khan's Masjid, where the glazing is very fine, but the plaster is easily broken, so that it has been destroyed in many places.

"The work consists of three parts: 1st, the plaster called khamir;2nd, the glass called kanch; and 3rd, a materiel called asthar, put between them. (The three terms employed here are of various origins. That used for the plaster is Arabic-Persian khamir meaning in Hindustani "leaven, earth clay". The word for "glass" is evidently derived from Sanskrit kancha meaning "glass" The term asthar. I presume to be Persian astar meaning"a coating, a lining'. The first operation is to make an easily fusible glass by melting powdered siliceous sandstone with carbonate of soda. Portions of the glass are pounded, mixed and fused with metallic oxides to produce glasses of various colours. Considerable skill was shown in producing the oxides from the metals or from the raw materials of the bazar. In particular, a species of black sand got from Ajmer is used to furnish three colours- black, green and blue. It contains sulphured of copper and according to their specific gravities, and was reduced to oxides in the furnace.

"The khamir is made by mixing siliceous sand, lime and a quantity of the pounded glass first prepared, and according to the quantity of glass

used it turns out a hard kind of mortar, or has a porcelaneous structure. It is made into a paste with rice water, and cut into pieces suitable for the pattern. It is then dried at a gentle heat, and afterwards covered with asthar, which consists of lime or pounded glass containing a large quantity of lead. This is suspended in a viscid fluid and painted on the plaster, and its use is to cover small inequalities and to act as a medium to unite the glass and the plaster."

"The coloured glasses are then pounded, suspended in a viscid fluid, made from mucilaginous plants and painted over the asthar, and the whole is placed in the furnace till all the glass on the surface is fused. The pieces of the pattern are then put in their places and fixed by cement".

Petrographic Analysis

Petrographic Analysis of a piece of tile from Shalamar Garden Lahore was made by the Atomic Energy Minerals Center, Lahore. See Appendix I

Fixing of Tile Mosaic Work

The drawing of the tile mosaic design is prepared. The stencil of each piece of different colour is made. Either the raw tiles are cut according to the design or the baked tiles of different colours are cut with cutter according to the design (Pl. 75). Before cutting the tiles are marked with the help of stencils.. The edges of the cut tiles are sharpened with files of different shapes and sizes.

The design of tile mosaic to be laid is also traced on a plain wooden plank or sheet. The prepared pieces are temporarily assembled on this traced design (Pl. 76). The design of tile mosaic work is traced and perforated. This perforated design (*sozen kari*) is now fixed over the smooth surface where pieces of the tiles are to be laid and pounched with a small bag of muslin cloth filled with coal dust. Through this process, the design is transferred to the surface. The perforated design is then removed. The prepared pieces are then laid one by one with lime mortar according to the design.

Pl. 75 Cutting of tile according to design..

Pl. 76 Temporarily as sembling of pieces according to design.

FILIGREE WORK
(*Mina kari or Binnat kari*)

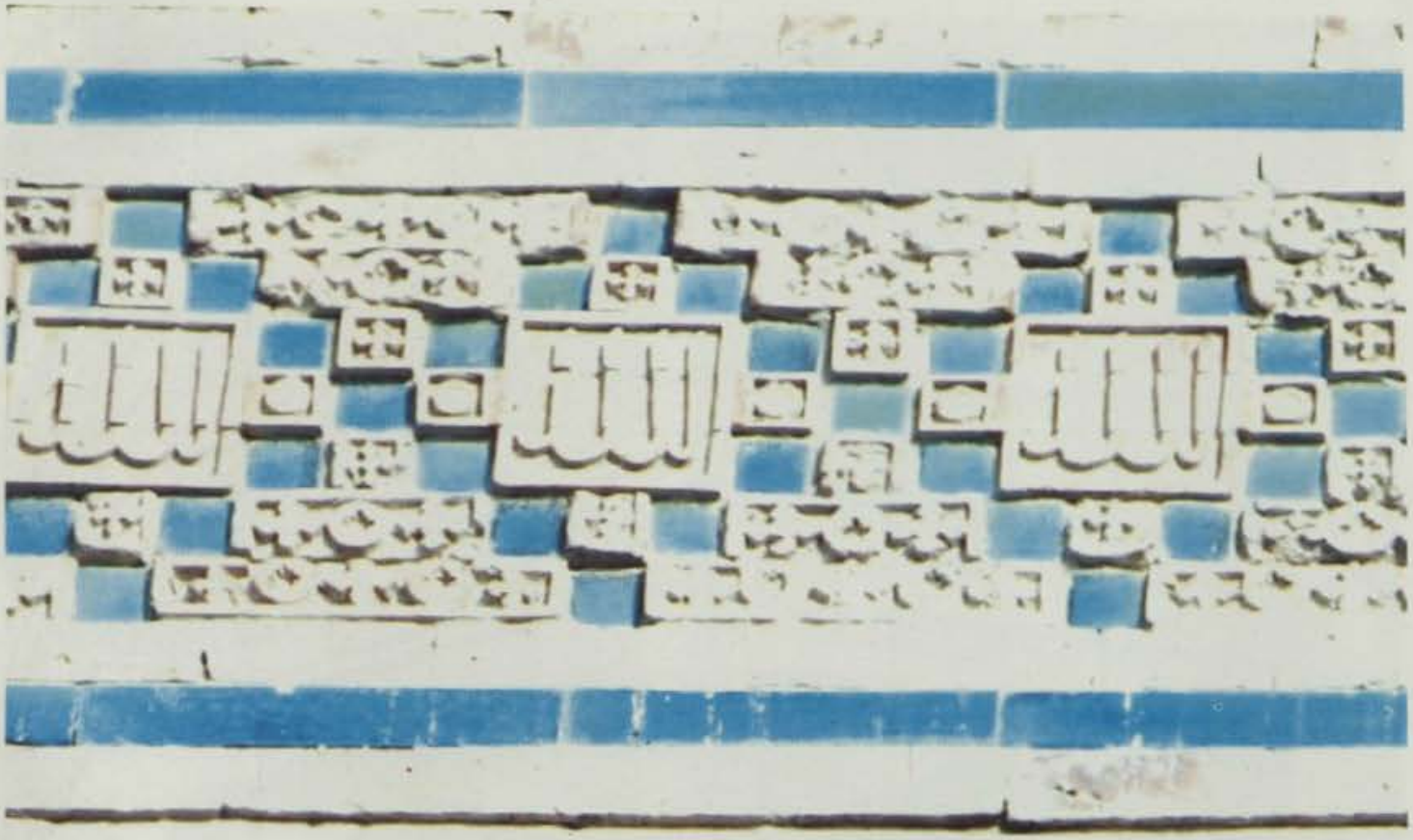
Filigree work is a rare type of surface decoration on Muslim monuments. In local terminology, this kind of decoration is also called *mina kari* as well as *binnat kari* - both names derived from Iran and Central Asia respectively. This is basically a play of chess-board design work with its origin in wood and terracotta work of the same nature. In this design one *Khana* (square) or some *Khanas* i.e. squares are left open or incised and the other blocked according to a pre-designed scheme. The open *Khana* and *Khanas* are then filled up or inserted with pieces of coloured tiles cut and reduced to the size. It then becomes the filigree (*Mina Kari* or *Binnat Kari*) in calligraphic and decorative design.

Filigree work is very old craft in Pakistan used in Gandhara (2nd to 5th century CE) decorative work in stone and stucco, followed by adoption in *Hindu,* Jain temples and Nikodari tombs in Balochistan. The early Muslims borrowed the technique for decorating their tombs such as the Tomb of Sohaghan at Alore (Sukkur). The Gandhara filigree work is always in black stone whereas the filigree work of Nikodari tombs in Balochistan and Tomb of Sohaghan at Sukkur is in terracotta only. The filigree work in Multan and Lahore, on the other hand is a combination of terracotta and glazed tiles borrowing the idea from Central Asian Muslim works.

The filigree work of this type in Pakistan is seen in Hazrat Rukn-e-Alam's tomb (1320-24 CE) at Multan (Pl. 77) and in a very elaborate form and designs on the north and west wall (early 17th century CE) of Lahore Fort, (Pl. 78), on the minarets of Masjid Wazir Khan, Lahore (1634-35 CE) as well as on the minarets of Chauburji Garden Gateway, Lahore (1646 CE) (Pl. 79) .

Technique

The pieces for this work in raw form are prepared according to the design (Pl. 80). The terracotta pieces are baked. The glazed tiles pieces are prepared according to the technique as prescribed for tile work. First the terracotta pieces are laid according to the design and then gaps are filled with tile pieces. The glazed pieces are always laid sunken.

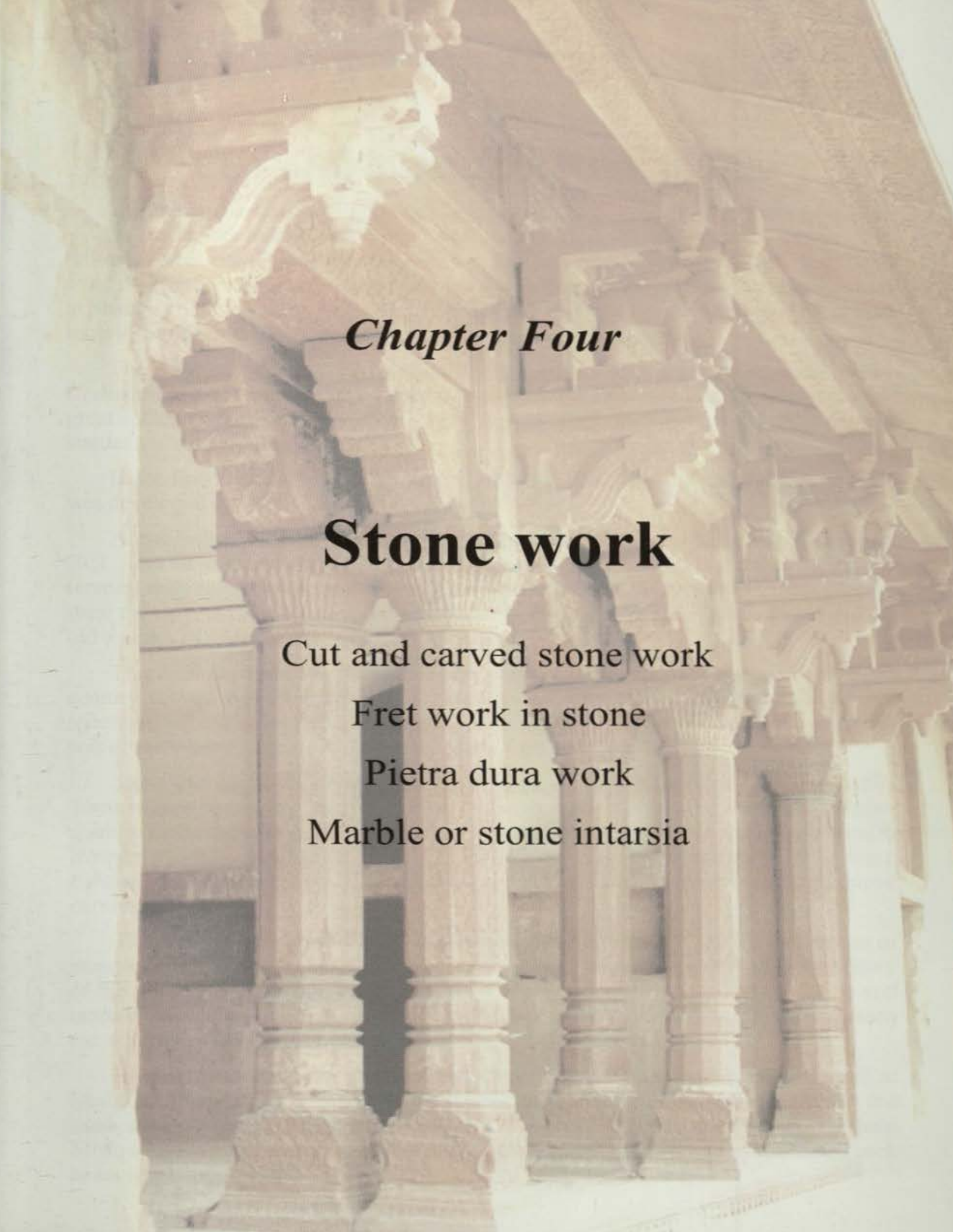


Pl. 77 Tomb of Shah Rukn-e-Alam, Multan - Filigree work.

Pl. 78 Lahore Fort - Filigree work.

Pl. 79 Chauburji, Lahore - Filigree work.

Pl. 80 Preparing a sample of filigree work.



Chapter Four

Stone work

Cut and carved stone work

Fret work in stone

Pietra dura work

Marble or stone intarsia

CUT AND CARVED STONE WORK

Pakistan has many varieties of stones - sand stone and various formations of lime stone like marble etc. The basis of stone craft can be said to have been started in this area, when man learnt to help himself with stone tools called "choppers" and "hand axes". A number of such tools have been found in Soan Valley of Pothohar. Excavations at Shangao have revealed a number of quartz tools. The earliest use of stone other than tools is found in the latter Zhob and Nal settlements for foundation.

The stone carvers and engravers had developed the stone craft during Indus Valley Civilization. The fine tiny steatite seals found at Mohenjo daro and Harappa are their great achievement. For hundreds of years the stone craftsmen remained busy in carving statues and story of the Buddha.

In the first centuries of the Christian era, stone masonry with cut and carved stone was developed in Gandhara region and parts of Sind.

According to Ferguson, there was no stone architecture in India before 3rd century BCE, and he contends that Ashoka introduced it. The rich stone carving in the old temples fully testify to the high art of stone mason. In India Rajasthan and Uttar Pradesh were the main centres of stone carving for architectural purposes. Quttab Minar and the old temples of Ajmer are the best examples of stone carving.

This craft flourished under the Muslim rulers. There remain several pieces of eighth century carved stone for mosque at Mansura and Bhambore. These are the earliest specimens of Muslim stone carving of eighth century pieces carved for mosques which was developing simultaneously in Iraq, Spain and Central Asia.

Stone carving in Thatta area, at Chaukhundi, stone built tombs at Makli especially Tomb of Jam Nizam-ud-Din (Pl. 81) and Isa Khan Tarkhan II (Pl. 82) are of much higher quality. In Balochistan ancient graves are also decorated with stone carving. In Punjab temples at Malot and Amb as well as Badshahi Mosque and Mausoleum of Jahangir, Lahore Fort (Pl. 83), Hazoori Bagh Baradari (Pl. 84) at Lahore are best examples of stone carving.,

The art of cut stone in Mughal architecture evolved from the age old traditions of stone carving originally based on Xylography (the art of carving on wood) in the history of the South Asian subcontinent. The Mughals, however, preferred red sandstone and marble, instead of the black and green schist, soap stone, basalt, light brown sandstone etc. which was the chosen medium of the Hindu-Buddhist arts.

In Mughal monuments such as Badshahi Mosque, Lahore and Jahangir's tomb at Shahdara, the outer facades show the tradition of the marble inlay on the surface of red sand stone. As seen on the outer facade of the vault of the main chamber of Badshahi Mosque, Lahore, it has been used as a decorative element or motif that can be traced back to ancient Hindu origin.

Pl. 81 Tomb of Jam Nizam-ud-Din at Makli - Stone carving.

Pl. 82 Tomb of Isa Khan Tarkhan II at Makli - Stone carving.

Pl. 83 Old Fort Lahore - Stone carving.

Pl. 84 Hazoori Bagh Baradari at Lahore - Stone carving.

Buddhist craftsmanship, is quite different in its nature form the Islamic craftsmanship. Red sandstone as well as marble fret work is mainly seen as screens (*jalis*) used to cover oriel window (*Jharokas*) or to divide interval spaces beneath arched openings, or to serve as railings or parapets. The marble *jalis* extensively used over *Jharokas* in *Diwan-khas* and Shish Mahal in Lahore Fort to create a pleasing effect as these allow subdued light (without sharp glare) as well as the cooling breeze to avoid suffocation.

This trend in Muslim decorative art was an outcome of the neoplatonic revival of Philosophic thinking in Spain, Syria and Persia in about the tenth century CE. It found wide popularity in the Mughal architecture in India.

Techniques for Dressing of Stone

The stone blocks are carried to site manually with the help of bamboos fasten with ropes (Pl. 85). When a thick block of stone is needed to be split up is marked on the thickness of stone block with the help of colour and the two parts are separated with great care with the help of chisels and hammer. During this process water is poured to keep the stone soft (Pl. 86).When a rough stone comes into the hands of a stone mason, he first selects the side of stone on which there is minimum cutting. He marks a line with mason's Try Square along the selected side. Then, he cuts the stone with *Pitcher* beyond marked line. Lines are marked along other edges of stone with mason's Try Square. Similarly, these sides are also cut with *Pitcher.* Three level points are marked on the stone surface with the help of *Tepa* and string. Cutting or engraving of stone is done upto the desired depth with reference to these points. One inch wide strip along the edges upto the required depth is marked. The other portion of stone is cut and dressed according to design, using *Pitcher, Takla, Dranti, Tanki and Takl* simultaneously (Pl. 87).

Water is also used with brush for softening of stone during the cutting and dressing process of stone. In this way, a fine dressed stone is prepared according to the required size. Designs such as arches, panels etc. are also made with the help of templates known as *furma* and then cutting and engraving is done according to the design

Carving

In the case of carving, the design is marked with a stencil on the smoothened dressed surface and then by using different chisels and working with a light hammer (Pl. 88). When the desired design is achieved, it is finally rubbed and dressed with corborundum blocks and files to bring the same to its desired shape.

Tools

The following tools are used for the cutting and dressing of stones (Pl. 89).

Stone Mason's Hammer

It is a special type of hammer. There is a hole in the handle. The hammer is used for striking off the dust from corners.

Pl. 85 Carrying of stone block with traditional method.

Pl. 86 Splitting of stone.

Pl. 87 Dressing of stone.

Pl. 88 Stone carving.

Scabbling Hammer

It is used to cut irregular edges of the stone.

Spalling Hammer

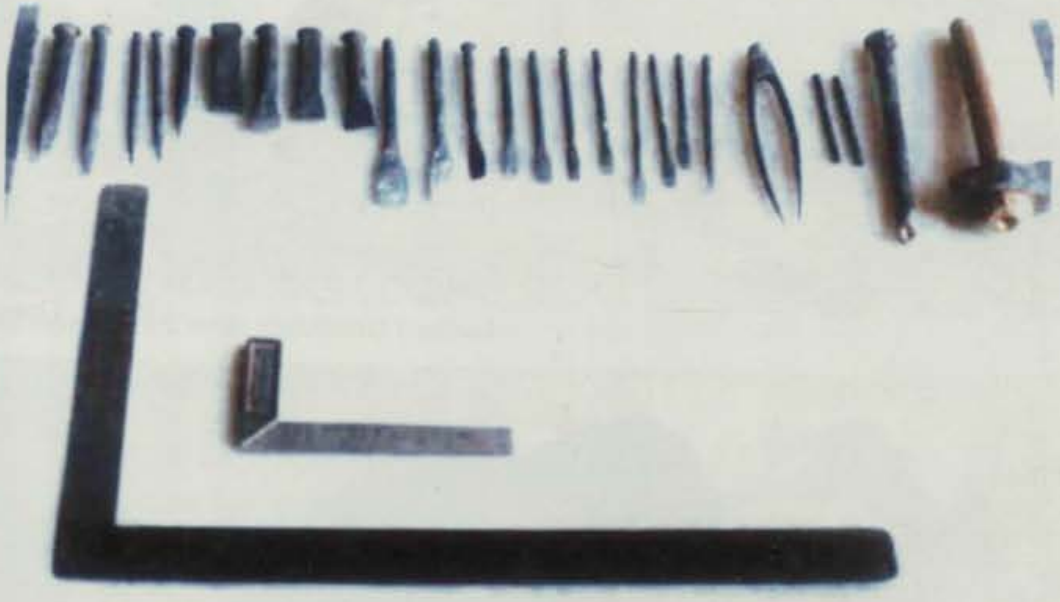
It is a heavy hammer used for rough dressing and cutting big stones.

Mallet

It is wooden headed hammer and is used for driving wooden headed chisels.

Mason's Try Squares

These are of various lengths. Two iron strips with scale are welded together finely perpendicular to each other. These are used to check corners of stone whether they are perpendicular to each other or not.



Pl. 89 Tools for stone cutting and carving.

Pitcher (Pitching Tool)

It is used for rough cutting of stone. It is of varying length and size as given below.

Length	Breadth of sharp edge	Thickness of sharp edge	Dia. from top
9"	1-1/2"	1/8"	1-1/4"
6"	1"	1/8"	3/4"
4-1/2"	1/2"	1/8"	3/4"

Punch (*Takla*)

Takla or Punch is used for rough dressing of stone. It is of following size:

Length	Breadth of sharp edge	Thickness of sharp edge	Dia. from top
9"	1"	1/8"	1-1/2"
6"	3/4"	1/16"	1"
4-1/2"	1/2"	1/16"	1-/2"

Claw Chisel (*Dranti*)

It is used for rough dressing after use of *Takla*. It is also of various sizes:

Length	Breadth of working edge	Thickness of working edge	Dia. from top
9"	1-1/2"	1/8"	1-1/4"
6"	3/4"	1/8"	1"
4-1/2"	1/2"	1/8"	1"

Tanki or *Dhacha*

It is used for dressing of stone after using *Dranti* and before final dressing. Varying sizes of *tanki* are as follows:

Length	Breadth of sharp edge	Thickness of sharp edge	Dia. from top
10"	1-1/2"	1/16"	1"
6"	3/4"	1/16"	3/4"
4"	3/4"	1/16"	3/4"

Boaster (*Takli* or *Thalk*)

It is used for final dressing of stone. These are available in following sizes:

Length	Breadth of sharp edge	Thickness of sharp edge	Dia. from top
10"	1-1/2"	1/8"	1-1/4"
6"	3/4"	1/16"	1-1/8"
4-1/2"	1/2"	1/16"	1-1/8"

Point (*Narja*)

It is used for fretwork, and in carving and dressing of floral patterns. It is of following sizes

Length	Breadth of sharp edge	Thickness of sharp edge	Dia. from top
9"	1/2"	1/4"	1/2"

Narji

It is used for final dressing in fretwork. Its measurements are as above.

Bhain Para

It is used for making of corners and floral pattern. Its size is given below:

Length	**Breadth of sharp edge**	**Thickness of sharp edge**	**Dia. from top**
9"	1/4"	1/4"	1/2"

Tepa

It is mild steel bar 4" to 6" long and 1/2"diameter with smooth faces. These are used for marking level points on stone surface with respect to which engraving of stone is done.

Pick

It is a long head pointed at both ends. It is used for rough dressing of hard stone such as granite.

Jumper

It is used for boring holes in stone.

Wooden Handle Chisel

It is used for dressing soft stones.

Gads

These are small iron wedges used for splitting of stone.

***Kandi* (Trowel)**

It is used for laying mortar on courses of stone blocks.

***Saal* (Plumb-bob)**

It is used by masons to check the verticality or incline of the masonry work.

Spirit Level

It is used for levelling purpose

STONE FRET WORK

The craft of fret work (*jali*) in stone in Mughal architecture has been evolved over centuries - long tradition of stone carving in the history of the South Asian Sub continent specially in India in the Hindu - Buddhist temple architecture.

Jali was an invention of the Muslims. No stone fretwork is found in the ancient Hindu and Buddhist monuments Muslim architect ultimately used this style of architectural decoration to a hitherto unreached level.

Delicate *jali* work or fretwork tracery in sandstone or marble is a speciality of stone mason. This work is seen in many parts of India. The Muslims first introduced it at Agra and Fatehpur Sikri. Geometrical designs, which are easy to carve, predominate, but these are also found in the shape of motifs based on flowers and foliage as in the stone work of Ahmadabad.

In the Mughal period most of the royal buildings were constructed in marble or red sandstone instead of the black and green schist, basalt, etc. which were mostly the chosen medium of the Hindu - Buddhist art.

Stone fretwork in Mughal architecture was both utilitarian and aesthetic. The delicate fretwork is mainly seen as screens (*jalies*) used to cover *jharokas* (balconies) or to divide inter spaces within a big arched opening and to serve as railing or parapet .The frets produce a pleasing effect, as they allow sufficient light and cool air while excluding sharp glare.

The shape of honey-comb holes or fret (*jali*) is known according to the design of its openings. These openings are hexagonal known by the artisans as (*Chheh Mass*) and octagonal (*Aath Mass*) etc. and there are also other designs according to the various geometrical, floral and plant pattern.

Sometimes frets are specially used in a mosque as *Pardah Jalis* for ladies or as sloping one, and the slope is towards outside.

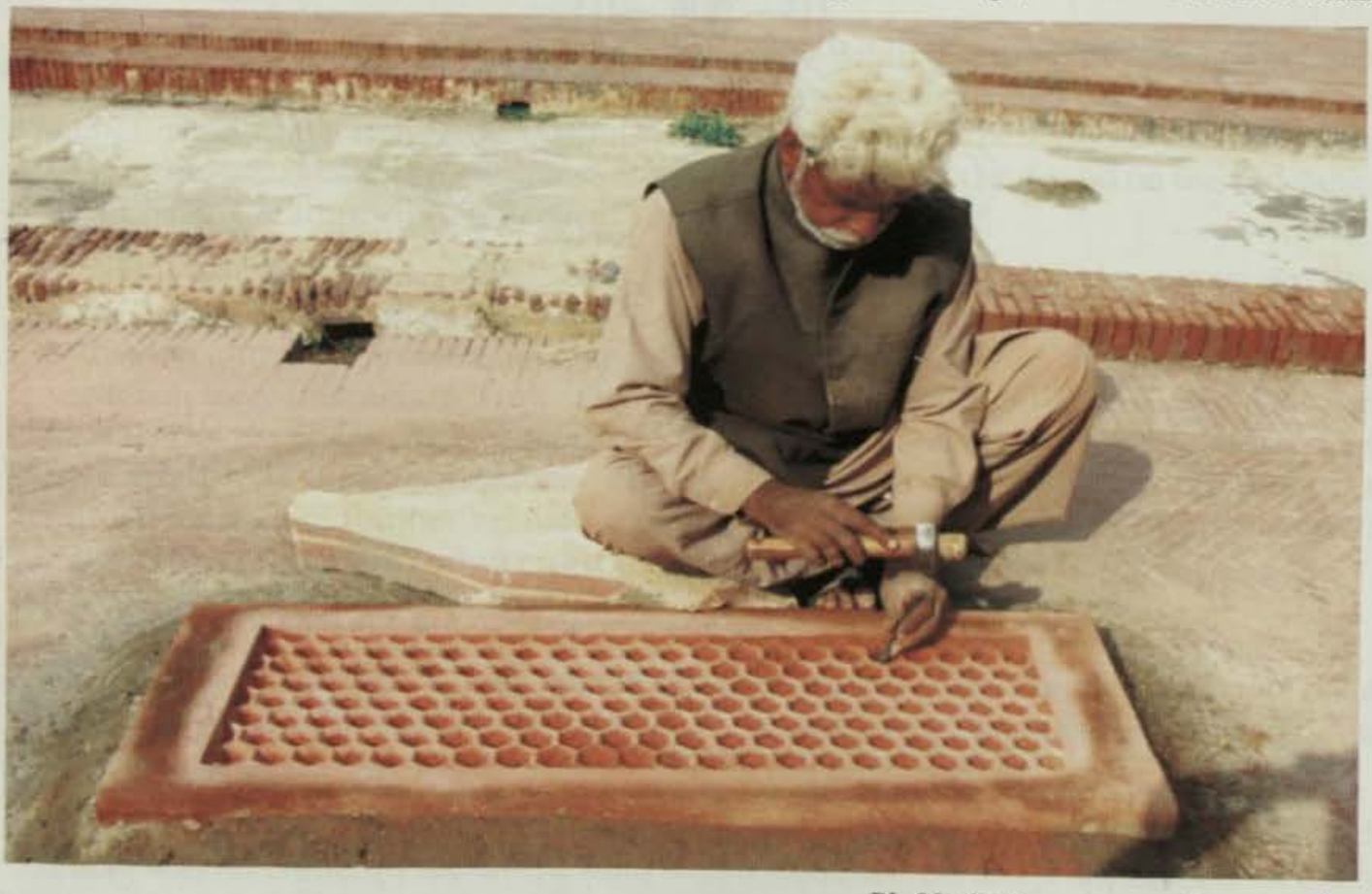
The perforated marble screen used around the tomb in Taj Mahal is a perfect and best example of stone fretwork in Shah Jahan's time. *Jali* work in marble is found at the tomb of Hazrat Salim Chishti dating from 1581 CE. In Pakistan best specimen of stone fretwork are found at Lahore Fort (Pl. 90), Mausoleum of Jahangir (Pl. 91), Badshahi Mosque and Hazoori Bagh Baradari, all at Lahore. Fret Work is also found in Mausoleum of Kh. Ghulam Farid at Kot Mithon.

Technique

First of all a slab of stone having fine grains either of marble, red sandstone or any other kind is selected and after cutting and dressing, it is prepared according to the size where the fret (*jali*) is to be fixed. A uniform space for the border is left and the remaining

Pl. 90 Old Fort, Lahore - Stone fret work

Pl. 91 Tomb of Emperor Jahangir, Lahore - Stone fret work.

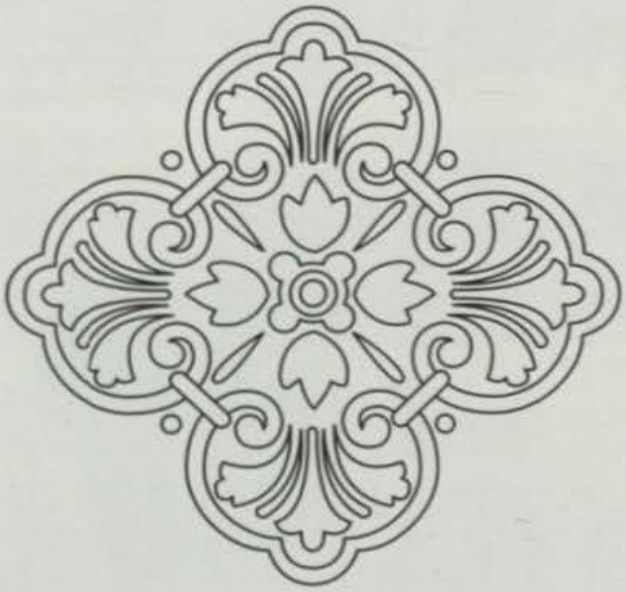


Pl. 92 Craftsman preparing stone fret

piece is divided. This process is called *allacha bandhana*. Then design of the fret is marked with the help of this graph. Sometime the desired pattern of the fret is prepared on metal sheet of the size of the stone surface. The pattern is then firmly glued to the marble plate.

The stencil serves as a guide for engraving and carving into the stone block with a very sharp round chisel which is known as *nurji* in the language of artisans. This process of marking the design of the fret is known as *danday bandhna*. Then all the holes are made deeper and deeper skillfully with the help of sharp round chisel in different grade of fineness. (Pl. 92) When these holes are about 2/3 deep then the slab is turned over and the same procedure of earmarking and making holes is repeated exactly against the pattern on reverse, till the holes are completed by means of various files such as round, half round, flat etc. according to the requirement of the design.

Finally this fretwork is rubbed and finished by using emery (coarse corundum for polishing) powder and carborundum and abrasive stone pieces.



PIETRA DURA

Pietra dura literally means hard stone used in commesso (mosaic) work. The word 'commesso' is derived from the Latin "commissus" meaning put together or assembled. This word was first introduced in sixteenth century to identify types of inlay where tiny piece of hard stone were tightly placed together into prepared grooves without visible joints to form a pattern with some adhesive. The term pietra dure also signifies hardness of the stone used in the pietra dure decoration.

Mr.John Terry in his book **The Charm of Indo-Islamic Architecture** mentions that this mode of decoration was created and developed in India. He says "Pietra dure was certainly practiced in Florenca, and as Italian craftsmen certainly worked for Shah Jahan in the construction of Jahangir's Tomb where Pietra dure is used on a small scale but of fine quality. The truth may be that a technique evolved independently in India was brought to its final perfection by Italians".

The art developed into a kind of eternal painting in marble because of its three dimensional effect and figural perspectives obtained from natural colours of stone. The first example of pietra dura in India is found in the tomb of Itemad-ud-Daulah at Agra built by Jahangir.

The finest example of pietra dura work is found in the Tomb of Jahangir at Lahore (1637 CE). The marble cenotaph is decorated with delicate and colourful pietra dura; embellished with ninety-nine attributes of God (Pl. 93). It is perhaps the earliest example of inscriptions inlaid into marble. Similar type of work is also found on the cenotaph of the grave in the Tomb of Asif Khan at Lahore built in 1645 CE.

During Shah Jahan's reign, his palaces in Agra, Delhi and Lahore were profusely embellished with pietra dura inlay. In Lahore Fort, the Shish Mahal built by Shah Jahan is a fine specimen of architectural vocabulary. The spandrels of the arches of its main verandah have pietra dura work. The Nau Lakha pavilion at Shish Mahal in the Lahore Fort has an excellent work of pietra dura. Its exterior and interior are embellished with beautiful pietra dura decorations (Pl. 94). The motifs used in pietra dura are greatly influenced by the Iranian miniature paintings as mentioned by Mr. Muhammad Wali Ullah Khan in his book **Lahore and Its Important Monuments.**

The Taj Mahal at Agra has also outstanding pietra dura decorations.

The art of pietra dura inlay spread from the capitals of the Mughals to Rajput States, where some of the princess used this type of decorations in their palaces between 17th and 19th centuries.

The Great Mughals had the mineral stones and gems of the entire known world. There was no corner of the world from which stone dealers and jewel merchants did not come.

Pl. 93 Cenotaph of the grave of Jahangir, Lahore - Pietra dura work

Pl. 94 Nau Lakha Pavilions Lahore Fort, Lahore - Pietra dura work.

Pl. 95 Semi precious stones.

Pl. 96. Cutting of semi precious stone with wire bow

Mr. A. Aziz mentioned in his book **Imperial Treasury of the Indian Mughals** says that the ruler of Balkh, Nazar Muhammad Khan presented one hundred maunds of Lapislazuli alongwith other hard stones as gifts to the Emperor Shah Jahan. Special varieties of hard stones and semi-precious stones were brought from Yeman, Baghdad, Herat, Iran leading emporium of Europe and Africa.

The different colour effects are achieved by using a wide variety of semi precious stones as inlay pieces (Pl. 95) , such as Agate (*Sang-i-Gawa, Sang-i-Ghori, Sang-i-Panghan*), Black marble (*Sang-i-Musa*), Blood stone(*Sang-i-Dogasra, Sang-i-God, Sang-i-Pitonia*), Carbuncle, Garnet (*Sang-i-Tambra*), Carnelian *(Sang-i-Aqiq*), Conch shell (*Sankh*), Coral(*Munga*), Glass *(Sang-i-Sitara*), Jasper (*Sang-i-Jalswar, Sang-i-Rataq, Sang-i-Tilai*), Light yellow or gold (selected out of *Rataq, Sang-i-Udha*), Lapislazuli (*Sang-i-Lajward*), Malachite (*Dana-i-Farang*), White Marble (*Sang-i-Marmar*), Mother-of-pearl (*Sip*), Onyx (*Sang-i-Lahsani*), Serpentine (*Sang-i-Margaz*), Shell (*kauri*), Turquoise *(Firoza), Sang-i-Abri, Sang-i-Ajuba, Sang-i-Chitla, Sang-i-Gudarla, Sang-i-Khattu, Sang-i-Simaq, Sang-i- Zahrmuhra or Sang-i-Paizahrmuhra*, jadeite (a variety of Jade such as *Sang-i-Yashab*) etc.

Technique for Pietra dura Work

The marble stone is smoothened and levelled with chisels according to the required shapes. The technique of pietra dura requires the tracing of the desired pattern upon a tin sheet of the size and outline of the marble surface. The pattern is cut out to form a stencil on the tin sheet, which is then firmly glued to the marble surface. The stencil serves as a guide for engraving the pattern into the marble block with sharp chisels of different grade and fineness. Some times the craftsman takes the help of bow saw (wire-bow) in cutting the stones. The depth and breadth of engraving varies according to the size of the features shown in the pattern. The marble block thus prepared serves as the matrix for the inlay stone pieces of required size, shape, and colours. The semi-precious stones used in inlay are first cut roughly by the craftsman, who uses a wire bow (*Turkmani*) (Pl. 96). These small pieces are then fastened on with shellac lac to steel patterns. The stone with the steel pattern adhering is then applied to the grinding shape of the steel pattern. There is a separate steel pattern for every petal of a flower, every class and feature of a bird for the minuteness of the work. Each piece is separately carved, observing the greatest care for its exact fitness into the relevant part of the cavities in the marble block (Pl. 97). The tools consist of a number of chisels of different shapes and fineness known *as Nirji* and *Nirja*, together with a compass and right angle (Pl. 98). The pieces are rubbed and smoothened by using emery powder and set into the cavities with lac in various kinds of glues (now we can use *Alfi* or Magic stone etc.) available in market which is placed on their under surface.

After removing the tin pattern, the piece of inlay is tested for size and corrected by filing until it is an exact fit. The edges are then roughened so as to grip the cement, and the piece is embedded in the recess with a special cement, the ingredients of which are given below, and driven home by means of a light wooden mallet. (Pl. 99). The surplus cement

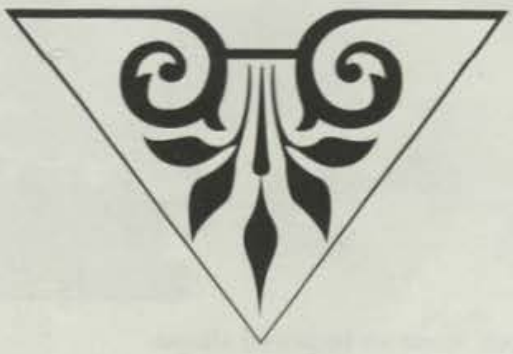
having been removed, the inlay is allowed to set for at least a week, after which the surface is cleaned and rubbed with a *'thapi'* made of emery powder and *lac* and washed with water. Sir John Marshal in his **Conservation Manual** gives the details of the ingredients as below:-

White lime of marble:	1/2 seer	(470 gm)
Powdered marble:	6 chhittanks	(360 gm).
Burnt zinc powder:	5 "	(300 gm)
Gum:	1 "	(60 gm)
Gurh:	1 "	(60 gm)
Dal Urd:	2 "	(120 gm)
Patasha:	1 "	(60 gm)
Mastagi:	1/2 "	(30) gm
Tukhm-i-balanga	1/2 "	(30) gm

The gum is first soaked in water while the other ingredients are ground in the gum water to form a thick paste. The above quantity of cement takes two men two days to prepare. When ready, it is kept in earthen pots well soaked in water and taken out as required. The cement will remain fresh for a week or ten days. Such a medicine like prescription might have been used in the Mughal days, but now with the introduction of white cement mixed with white lime cream in suitable proportion say 1:6 (1 part of lime mortar and 6 parts of white cement) with a touch of *Soda Ash* is a popular mortar.

After completion of the work, the inlaid block is finally rubbed with corborundum block of different grades to remove any irregularity in the surface of the matrix and the inlay pieces. In finest specimens of pietra-dura it is difficult to feel the break of surface between the matrix and the inlaid gems even with the tip of one, finger nails or touch by hand.

The art of pietra-dura work bespeaks of the patience and exactness of the craftsman. A piece if pietra-dura of the size, shape and pattern of a single face of the base of a column of Shish Mahal, for instance, would require the period of about 14 months to complete by one craftsman.



Pl. 97 Grinding of semi-precious stone to required shape.

Pl. 98 Engraving in marble for fixing semi- precious stones

Pl.99 Fixing of semi-precious stone.

STONE INTARSIA

MARMARI, *SANG-I- KHATAM SAZI* OR *KHATAM BANDI*

Khatam Sazi is an Iranian term for the inlaid or mosaic work in combination stone pieces with different colours. Stone mosaic was originated in the Roman world during early years of the Christian era. The Arabs have taken it from the world era. It reached the subcontinent through Central Asia.

In the Mughal architecture it is applied to the type of pavement in which marble and stones of different colours are laid and joined in geometrical forms intervened by a fine line of black or some coloured marble. It really needs a very careful and precise laying and adjustment of different pieces in diaper pattern (*chal*) to form one harmonious plan of small pieces of various colours of stones set together.

For the extension of Cordovan Mosque, they used western elements like Byzantine columns and capitals in its various parts until the late 10th century CE. In the beginning the walls were covered with marble tiles and marble mosaic work. Inlay work executed at the Dome of Rock and in the courtyard of Umayyad Mosque at Damascus is laid in novel composition and adopted to the Islamic context.

In South Asia, the Turks or better known as Seljuks laid the actual foundation of Islamic art and architecture. They brought with them their own traditions and utilized these with local building traditions. The Mughals introduced marble inlay work.

The earliest example of inlay work is found on Alai Darwaza near Delhi (1305 CE) built during the period of Ala-ud-Din khilji. The top most storey of the Qutab Minar constructed in the time of Feroze Shah Tughluq was decorated with marble inlay.

The Timurid elements were merged with local building traditions in particularly with regards to the facing of buildings and architectural decorations. The main source of inspiration here was the revival of the ornamental sand stone style of early Delhi Sultanate which was gone out of fashion during the 14th and 15th centuries at main centre of architectural heritage from which early Mughal and Suri architecture got their influence and inspiration. Their chief characteristic of style is a highly ornate cladding of buildings with red buff sandstone inlaid with white marble or other coloured stones. Typical example is in Qila Kohna Mosque in the Purrana Qila (Old Fort) at Delhi (1533 CE). It was constructed by Sher Shah Suri around 1542 CE. It is decorated with coloured stones. For the development of this architectural decoration in the subcontinent, the Mughals contributed a lot. The Tomb of Humayun (1562-1571 CE) is clad in red sand stone highlighted with white marble.

Stone intarsia established under Akbar was as an important branch of Mughal

architectural decoration. The geometrical and floral motifs were used side by side. Impressive early examples of Akbar period are Akbri Darwaza and Hathipol of the Agra Fort (later 1560 CE). The Jami Masjid and several 16th century palaces at Fatehpur Sikri are decorated with inlay work. In all these monuments, the decorations are both the tessellated and inlay.

During the reign of Jahangir, the craft was further developed and refined. The tomb of his father, Akbar, constructed by Jahangir in 1605-12 CE at Sikandara near Agra is decorated with marble inlay. The façade of the tomb is inlaid with white and yellow marble on red sand stone surface. The spandrels of the main arch are also decorated with floral arabesque inlay work. The southern, eastern and western gateways of the tomb are also decorated with tessellated mosaic, chiefly in geometrical designs and inlay work.

Stone intarsia or inlay work continued until 1673-74 CE in all important buildings of the Mughal period. The climax was reached under Shah Jahan.

The Tomb of Jahangir built in 1637 CE presents superb inlay work (Pl. 100). The gateway of the complex is decorated with marble inlaid and stone mosaic. The tomb is excellently inlaid with white marble on the motifs such as *aftaba* (ewer), *qab* (fruit dish) and *gulab pash* (rose water sprinkler) incised in red sand stone surface. The floor of the tomb chamber, four vestibules and the roof of the tomb are embellished with tessellated pavement.

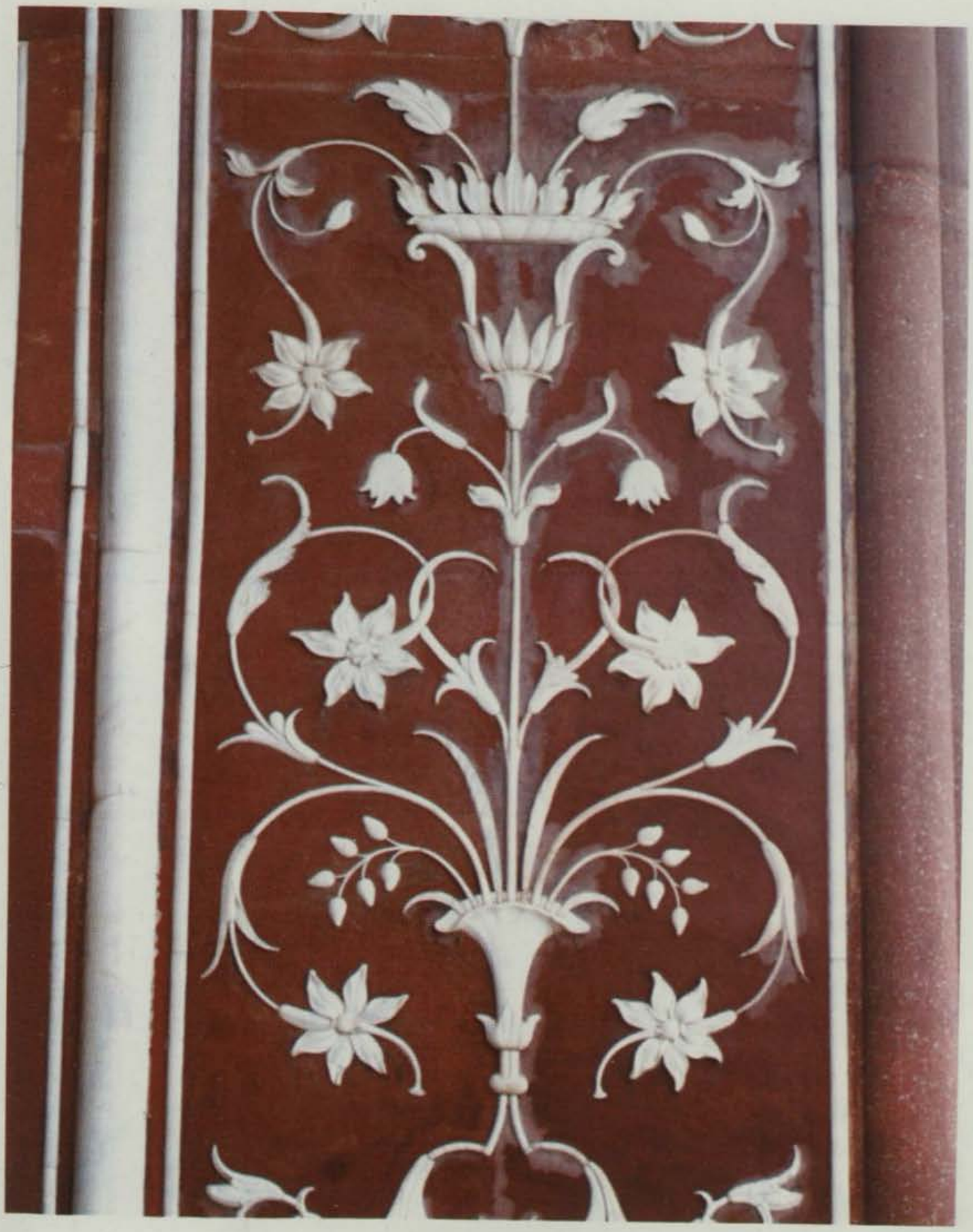
The inlay work in the Tomb of Noor Jahan, built in 1645 CE was also superb marble inlaid with floral designs in black marble on red sand stone. The dome of the Tomb of Ali Mardan Khan at Lahore built in 1645 CE was originally finished with white marble. During the period of Shah Jahan the stone inlay work was more delicate, or precise. Marble inlay work besides other decorations carried out in Taj Mahal at Agra (1632-52 CE) is superb.

The red sand stone façade of the prayer chamber of Badshahi Mosque, Lahore built in 1673-74 CE during the reign of Aurangzeb Alamgir is marble inlaid in lineal, floral and geometrical patterns. All treated in bold relief, it is a unique work unsurpassed in beauty and workmanship in the Mughal architecture (Pl. 101).

Good specimen of tessellated flooring can be seen in the courtyard and interior of Shish Mahal (1631 CE), *Diwan-i-Khas* (1645 CE) (Pl. 102), Nau Lakha pavilion inside Lahore Fort and the roof and verandah of Jahangir's mausoleum Lahore (1637 CE) (Pl. 103) and Shalamar Garden (1642 CE) etc.

Pieces of white marble, *Sang-i-Marmar*, *Sang-i-Badal* (shaded marble), *Sang-i-Abri* (variegated marble), *Sang-i-Khattu* (yellow marble) etc, are generally used for this of mixed work and black marble for the intervening or separating lining. It really needs a very careful and precise laying and adjustment of different pieces in their *chal* (diaper pattern) to form one harmonious plane of these small pieces of various colours of stones set together.

Pl. 100 Mausoleum of Jahangir, Lahore - Stone inlay work.



Pl. 101 Badshahi Mosque, Lahore - Stone inlay work.

Pl. 102 Shish Mahal Lahore Fort: - Tesselated floor.

Pl. 103 Mausoleum of Jahangir, Lahore - Tessellated floor.

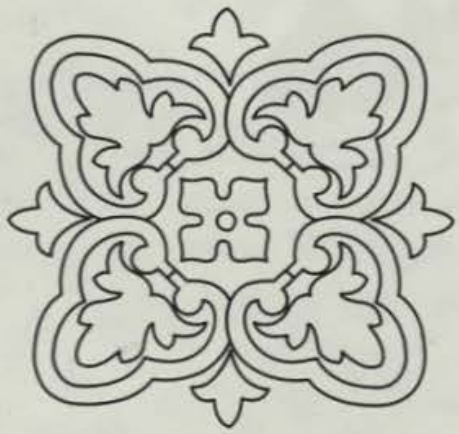
Technique

Inlay Work

The technique of marble intarsia is similar to pietra dura. In stone intarsia, instead of semi-precious stones, marble or other stones are inlaid. The stone is smoothed and levelled with chisels according to the required shape. The technique requires tracing of the desired pattern. The pattern is cut out to form a stencil on the tin sheet. The stencil serves as a guide for engraving the pattern into the stone block with sharp chisels of different grades and fineness, (Pl. 104). Pieces to be inlaid are cut out according to their desired shapes. Each piece is separately carved observing the greatest care for its exact fitness into the relevant part of the cavity in the stone block (Pl. 105). The pieces are rubbed and smoothened by using emery powder and set into the cavities with lime mortar.

Tessellated floor

The technique of this work requires first the bold outline of the desired pattern called *chal* on a plain smooth platform in full scale. (Pl. 106) Then, stencils of each kind of stones are prepared out of tin sheet. By the help of these stencilled patterns, stones are prepared of desired shape. Again, the bold outline of the requisite patterns, or diaper (*chal*) is established and laid on prepared ground, water-proofed by a *kankar* lime concrete layer (1:2:4) underneath and then the black or separating lining is laid first, and afterward various stones are laid at their positions with mortar on their sides and underneath . The mortar is kept back. For this purpose stones are cut in wedge shape to provide space for the mortar. When ready, the surface is smeared with a solution (*dugha* in mason's terminology) of *kankar* lime passed through muslin cloth. When this floor is ready then after two or three days it is rubbed and dressed with carborandum blocks of different grades for getting uniform and smooth surface showing neat thread like joints.



Pl. 104 Engraving for inlay work.

Pl. 105 Fitting of inlayer.

Pl. 106 Laying of tessellated floor.

Chapter Five

Wood work

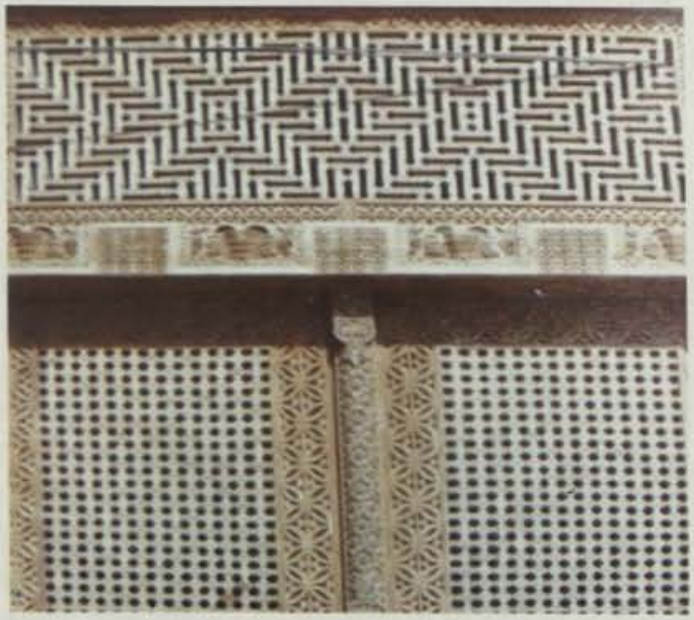
Lattice wood work
Wood carving
Inlay wood work
Lathe and lacquer work
Ornamental panelled wooden ceiling

LATTICE WOOD WORK

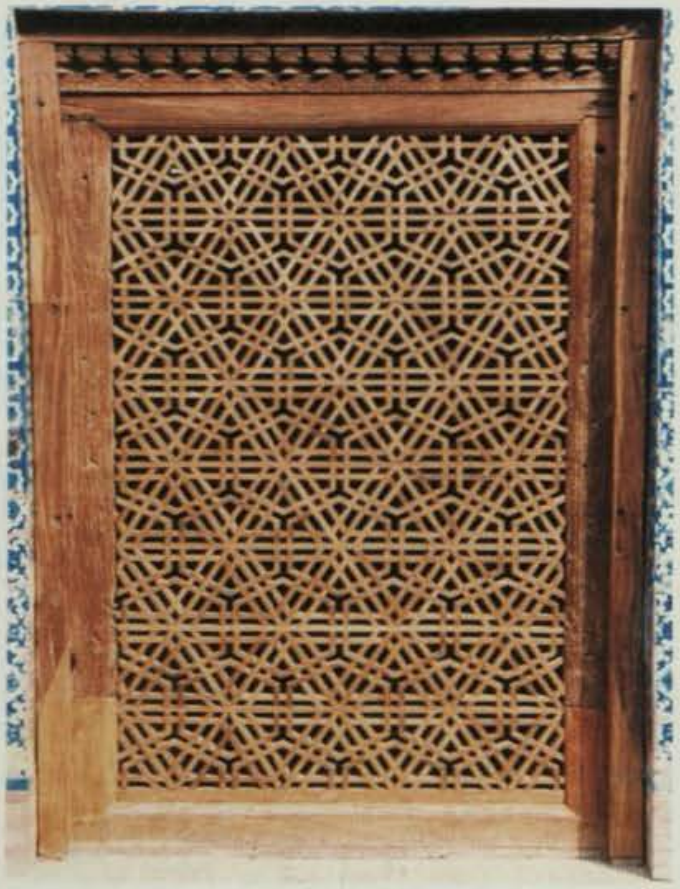
In Muslim countries, the wooden *jali* work is called mashrabiyya, i.e., lattice work, formed of small pieces of wood joined together. This craft at Multan appears to have been introduced by the 'Arabs in the early 8th century CE. when they occupied Multan and formed their government. It is very similar to the lattice or *Jali* work still seen almost encasing the facades of some old houses at Jeddah and Mecca, where in the zeal of modernizations it is now being ignored and sometime even destroyed. It was used there as a facing of buildings and heavy *Rowshans* (air catches), shutters, balconies and heavily carved doors and windows in teak wood called *Khashab Javi* in Arabia primarily for preventing scorching heat and sun shine, catching breeze, but also for ventilation and decoration.

The lattice work *(pinjra)* was used for ventilation without affecting the privacy of the house. Over the centuries the craftsmen have evolved many patterns for lattice work.

A study of architecture as depicted in the Gandhara sculpture in stone (1st to 5th century CE) of the Peshawar and Swat Valley provides ample evidence that art of trellis and carved wood work in the form of balconies, eaves and balustrades was a common feature of the secular and religious buildings then. The survival of this craft can still be seen in Swat where wooden balconies, complete facades of houses, and specially mosques and cenotaphs of the graves, are beautifully worked out in trellis and carved wood work of a peculiar and local nature. This type of



Pl. 107 Tomb of Hazrat Shah Rukn-e-Alam, Multan - Lattice wood work.



Pl. 108 Tomb of Hazrat Jalal-ud- Din Bukhari, Uch Sharif - Wooden screen.

work is found at the mausoleums of Hazrat Shah Rukn-e-Alam (Pl. 107), Hazrat Baha-ud-Din Zakariya, Hazrat Shah Shams Sabzwari at Multan and many other tombs in Multan and Dera Ghazi Khan divisions. Best examples of this craft are found at the mausoleums of Hazrat Jalal-ud-Din Bukhari (Pl. 108), Hazrat Rajan Qattal, Hazrat Makhdoom Jahanian Jahan Gasht at Uch Sharif and Hazrat Sakhi Sarwar in district Dera Ghazi Khan.

Process of manufacturing of lattice wood work

It generally has square or oblong perforations and is made like chess-board design with small size wooden scantlings (Pl. 109). The wooden scantling are planed and dressed. If the grooved lines are to be marked on the face of the *Jali,* the faces of the scantlings are given grooves with marking gauge *(khat kashi)*. Two types of scantlings are prepared. One having the full length of the *Jali* and other of small size joined to the long scantlings with mortise and tenon joints according to the required design. *Sresh* is also used for fixing. The sides of the frame of *Jali* are also given grooves to fix the scantlings (Pl. 110). The other patterns of lattice wood work, scantling are prepared according to drawing and joined together with the help of cross joints. The lattice wood work is made in different geometrical. (Fig 18 to 25)

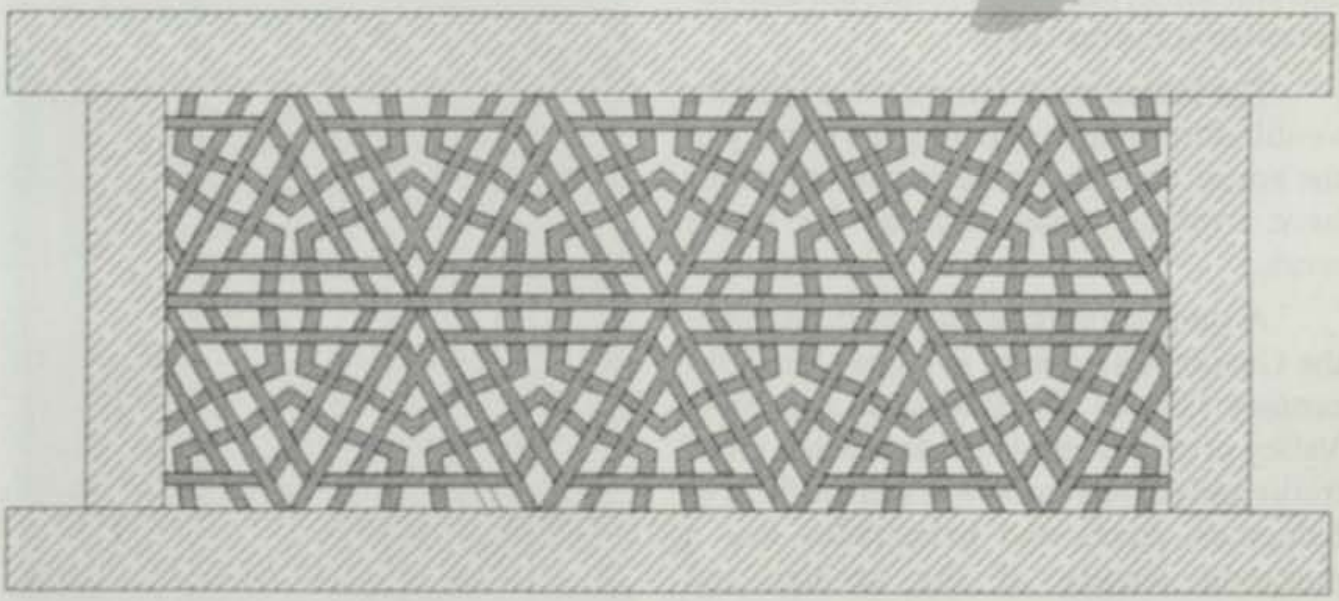


Fig.18 Drawing of wood screen in six corner star geometrical pattern.

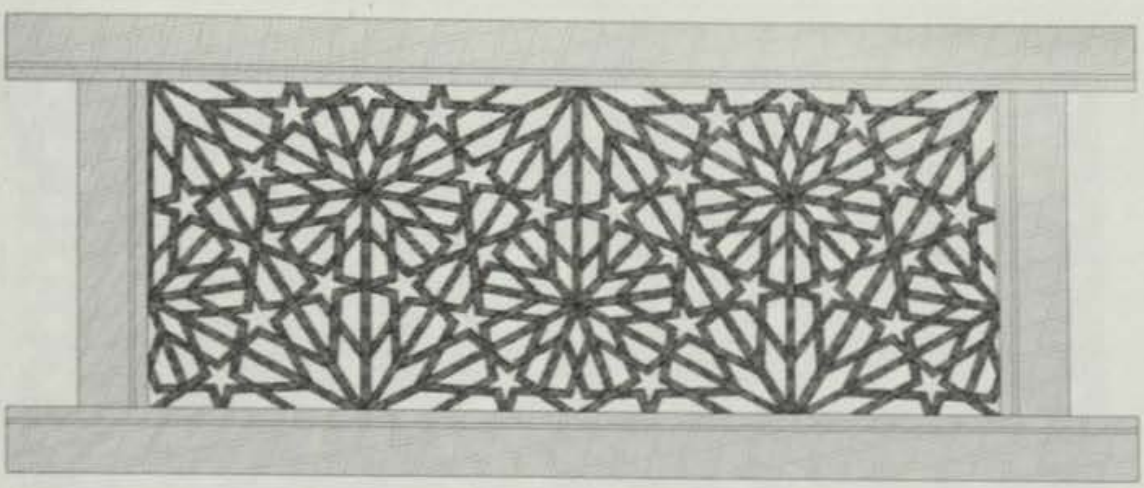


Fig. 19 Drawing of wooden screen in nine corner star geometrical pattern.

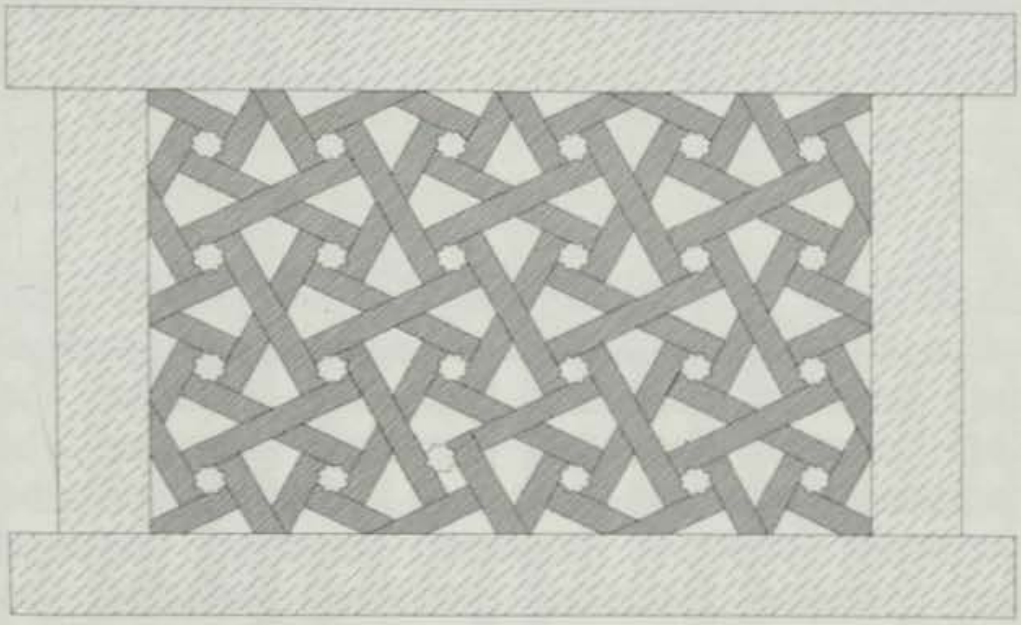


Fig. 20 Drawing of wooden screen in geometrical pattern.

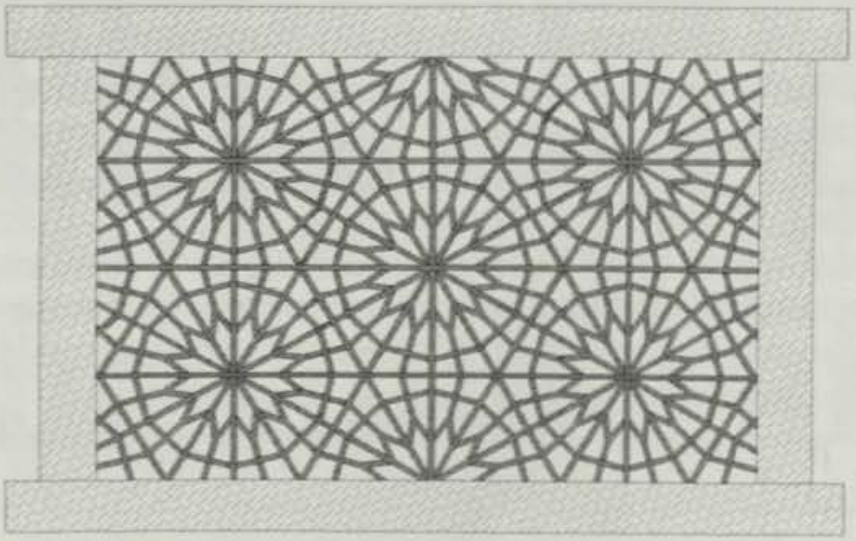


Fig. 21 Drawing of wooden screen in twelve corner star geometrical pattern.

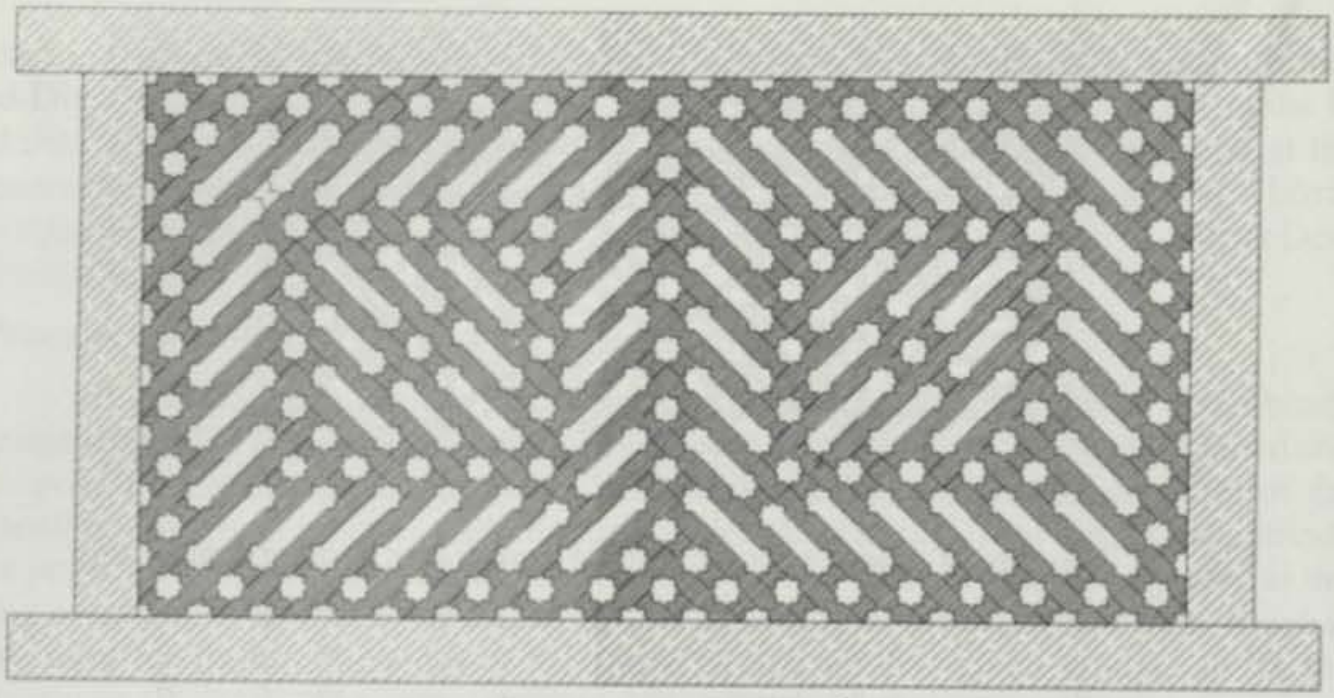


Fig. 22 Drawing of wooden screen in geometrical pattern.

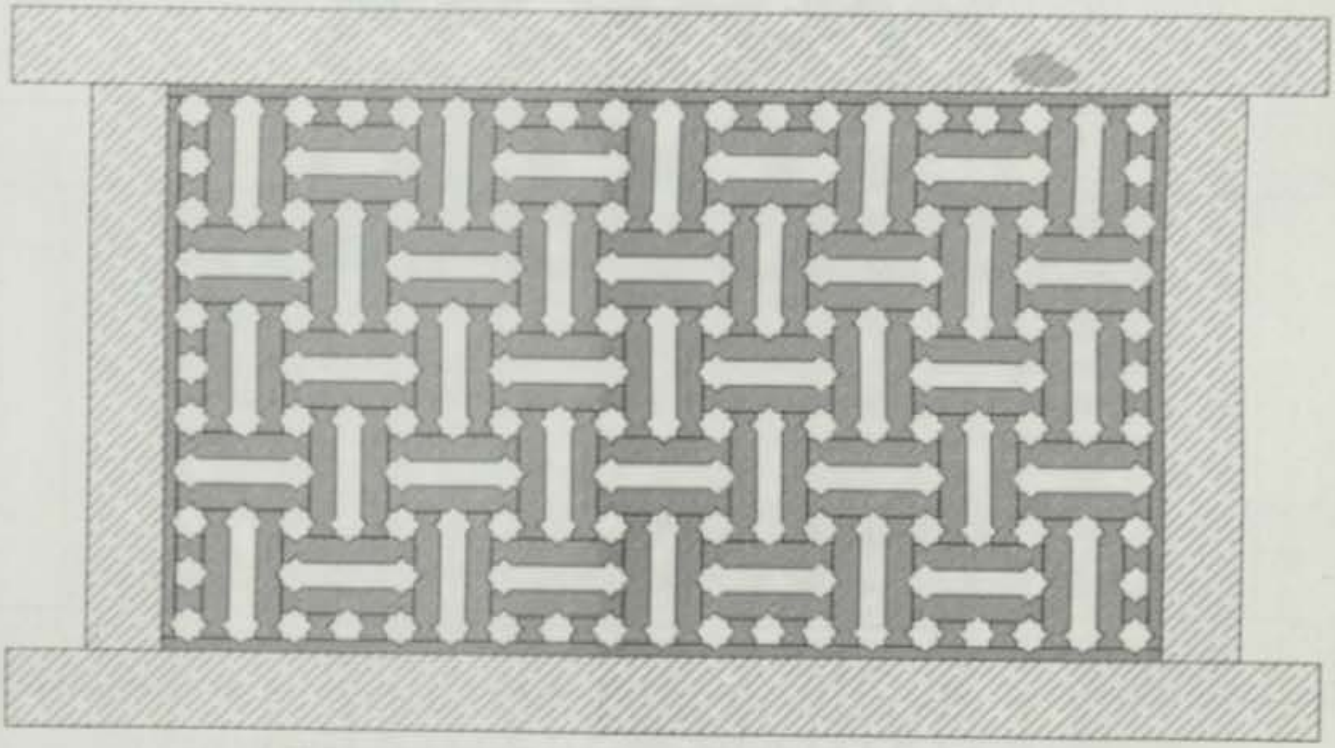


Fig. 23 Drawing of wooden screen in geometrical pattern.

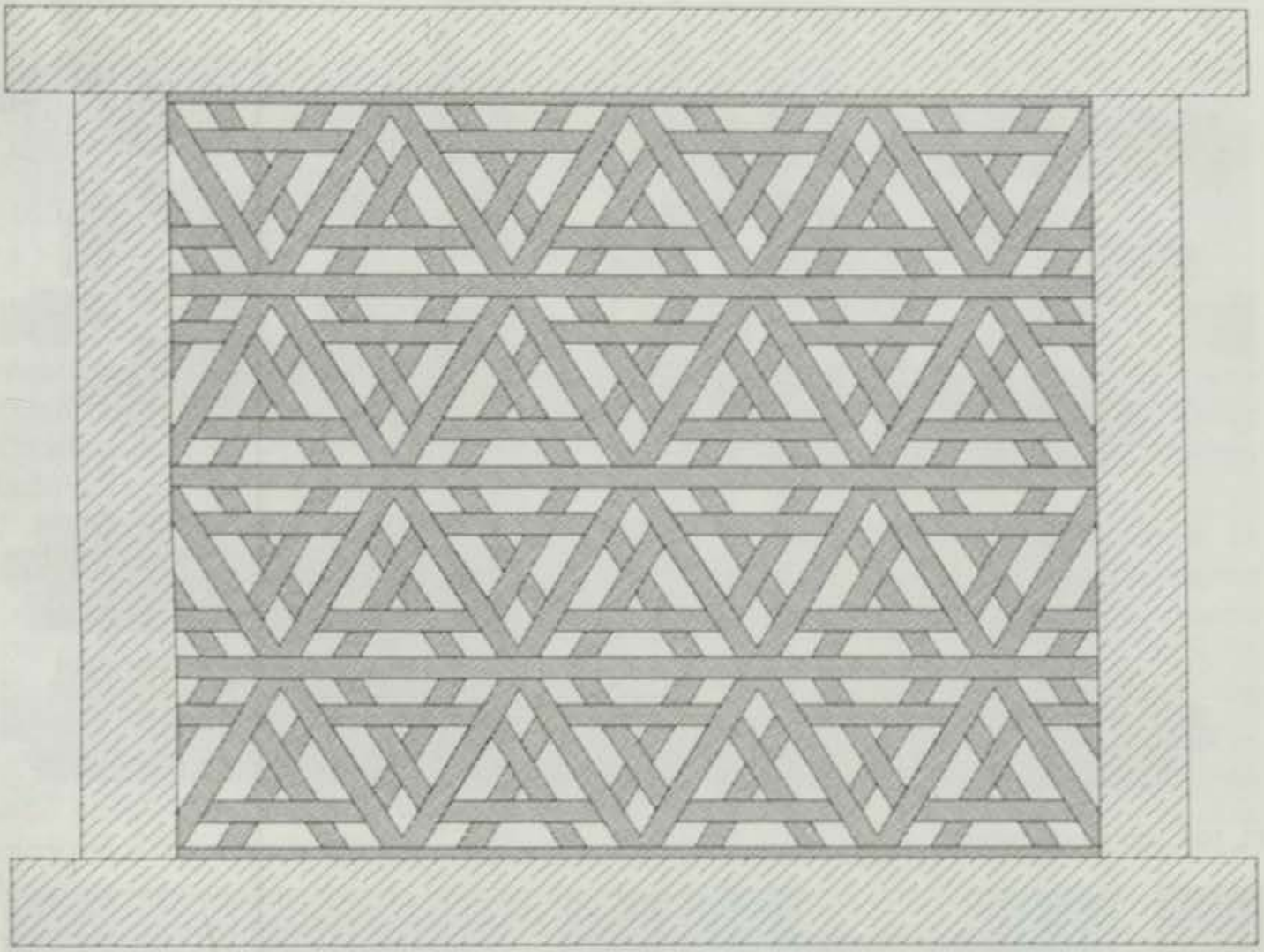


Fig. 24 Drawing of wooden screen in geometrical pattern.

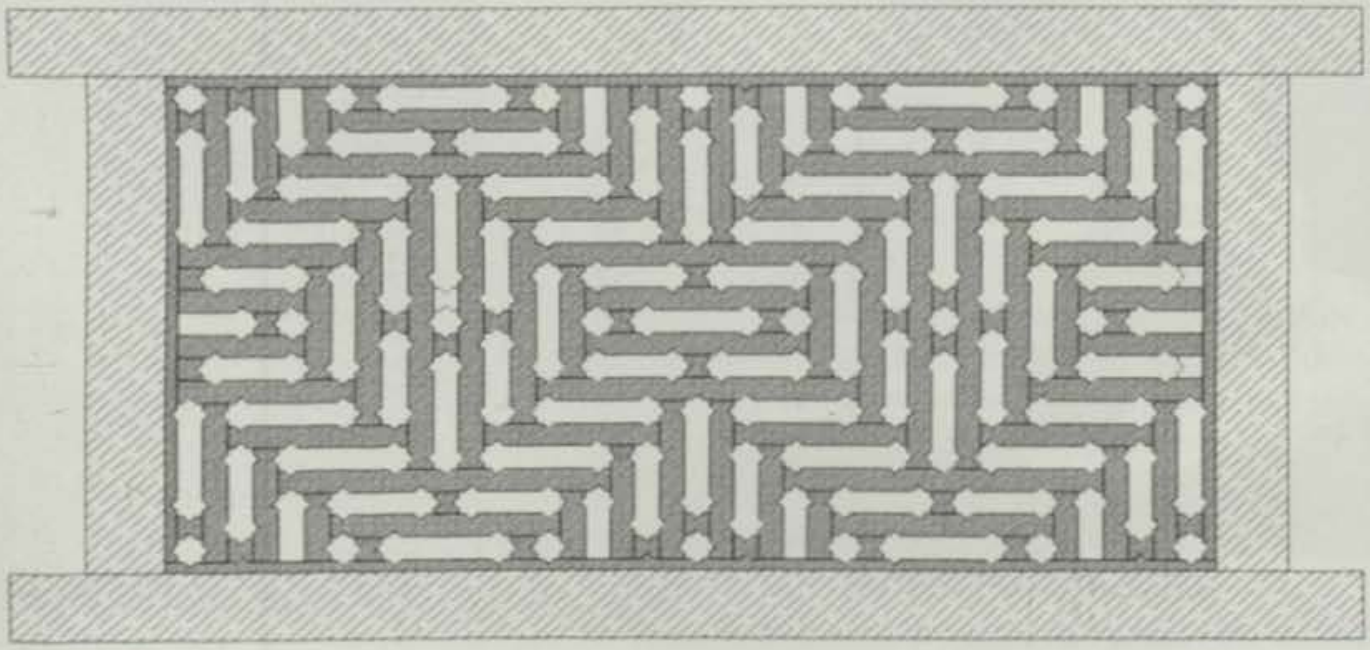


Fig. 25 Drawing of wooden screen in geometrical pattern.

Pl. 109 Wooden scantling.

Pl. 110 Manufacturing of lattice wood work.

WOOD CARVING

Carpentry is one of the world's oldest crafts. Carpenter has always been the most important artisan. Due to peculiar climate, geology of the region and perishable nature of wood, ancient specimens of the wood crafts are not found. But wood was extensively used in the construction of houses at Harappa and other Indus Valley Civilization centres like Mohenjo daro about 5000 years ago. The doors, windows beams, the docks and planking of the granary at Harappa were of wood.

The Aryans settled in the Punjab during the first half of the 2nd millennium BCE. In the Vedic literature, compiled by Aryan, wood work has been mentioned. In Sanskrit, the carpenter (wood worker) is referred to as a *Sutradhar*. The *Sipla Sastra,* a Treatise on arts and crafts, gives full directions not only on the making of wooden articles and carvings but also on the selection of trees for felling and for seasoning. It is not possible to date the *Sipla Sastra.*

Around the 500 BCE, the first architect, Mahagovinda enters records as the man who planned wood carved towns in Northern India. In Buddhist literature, the Jatakas mention a carpenter's village outside Benares. Matsya Purana gives details of motifs to be carved in wood.

The first visual evidence of the Pakistan's wood craftsmanship comes from Gandhara art in the Punjab and KPK Province. Many specimens of carved friezes which represent in two dimensions, carved wooden doors, windows, balconies and furniture are found. A set of four wooden cot legs has been actually found in excavations at Axial, which is now placed in Taxila Museum.

After the eclipse of Taxila civilizations in the 6th century CE. There is no factual evidence to help reconstruct the history of wood work in Pakistan.

In the northern area numerous wooden sculptural figures of deities and rulers have been recovered. Far more impressive workmanship is to be seen in Swat style in the form of doors, windows, balconies etc.

In South India, the emphasis on the wood carving is in the exterior and interior of religious shrines. In addition to general embellishment, carved on fluted columns, wooden brackets, capitals, lintels and figure sculpture is most outstanding and realistic in the subcontinent. Some of the earliest structures in Trivandrum with intact wood carving are the Mahadev Temple at Katinmakulam 1214 CE, Shiva Temple at Kazhakiluttam (15th.century CE) and Temple dedicated to Narasima near Chengannur (19th century CE).

Under the Muslim rule, the evolution of new architectural design made a heavy demand on the wood workers skill.

Plate. 111 Tomb of Hazrat Shah Rukn-e-Alam, Multan - Carved wood work.

Pl. 112 Tools.

Pl. 113 Wood carving.

In Pakistan, mostly, the shrines and mosques are decorated with carved wood work in addition to other decorations especially with carved wooden doors. Doors of the mausoleum of Hazrat Shah Rukn-e-Alam, (Pl. 111) mausoleum of Hazrat Baha-ud-Din Zakariya at Multan and carved wooden friezes embellished with Quran verses at the Tomb of Hazrat Ala-ud-Din Mauj Darya, Pakpattan are early example of sultanate period in Pakistan.

There were many wood carving centres in Pakistan, specially in Punjab. Each centre is famous for its own characteristic motifs, designs and techniques. The most famous centres include Multan, Chiniot, Jhang, Lahore, and Bhera, etc. Lahore Museum has the oldest, largest and varied collection of wood carving from 16th to 19th centuries.

Carved wood was the only means of decorating a house, *Haveli* for the middle class. Gateways, doors, windows, *Bukharchas* (bow window), *Seh-daras*, balconies and screens were carved in wood.

The common types of wood carving in Pakistan are relief in which the design is either sunk into the ground or the ground is etched high to stand out, round in which the design is detached from the background wood, chipping, in which a design is evolved by chipping to the desired depth. Incising, in which a design, mostly flowers etc. are cut into the wood without ground wood

Kipling describes the difference between the carved wood work done in Bhera and Chiniot, the two famous wood craft centre: Bhera work differs from that of Chiniot in that the projectures are flatter, pilasters and other details being often merely indicated in relief instead of half or quarter section being imposed, and the whole of the surface is completely covered with boldly outlined forms of foliage and geometric diaper made out, for the most part, with a v-section cut. There is something rude and simple about the mode of execution; but, though there is no attempt at high finish, the general design and proportions are so good, and the decorative scheme is so full and complete, that the technical imperfection of the work, as carving, is scarcely noticed.

Technique

The rough wood is planed and dressed. For carving purpose stencil is made to draw the sketch of the required design. The planed wood is given a coat of white clay *(gachi)* to dominate the sketch on wood. Special type of chisels called *Sathri, Rambi, Nah, Birha* etc. are used for carving (Pl. 112) . The required pattern is carved with these chisels with the help of small wooden hammer *(Thapi)* (Pl , 113). For finishing, various types of files are also used.

INLAY WOOD WORK

Inlay is meant embedding of minute pieces in or wood making them smooth with the surface. Other woods may accomplish inlaying by bone, ivory and mother of pearl or by metals (brass or copper). The inlay material may be in large pieces or in fine wire. The former becomes a kind of encrusting and the latter a form of damascening. Sometimes marquetry and veneering to resemble inlaying. Veneer is composed of many parts and materials, first separately prepared and then overlaid as desired.

Since it is a flat surface decoration perhaps it did not gain acceptance in ancient India. Only a reference of ivory itself inlaid with coloured paste is available in Indus valley researches.

Inlay crafts was given importance in the Islamic period. Since figural sculpture in religious buildings was not generally acceptable to Muslims, therefore flat surface decoration became the focus of the artists. The mosque furniture *mimbar* (pulpit) and *rahl* (stand for Quran) were made of wood and inlaid with iron or shell. Similarly doors, windows and balustrades of mausoleums and shrines were carved with Quranic verses and inlaid with geometrical patterns in ivory and various coloured woods.

In Iran, this craft is called *Khatam bandi*. It comprised minute inlay of ivory, mother-of-pearl, bone, metal (brass, silver) and coloured wood into the grooved base of wood. This craft was promoted in Iran during the Abbasid Caliphate between 8th and the 9th century.

Pl. 114. Tomb of Hazrat Sakhi Sarwar, Dera Ghazi Khan - Inlay work on door frame.

Pl. 115 Tomb at Wassay Wala, District Rajan pur - Showing inlay work on door frame.

Pl. 116 Ghazi Mosque Bhong, Rahim Yar Khan - Inlay wood work.

The pulpit of Al-Aqsa Mosque (12th century CE) was decorated with inlaid with ivory and mother of pearl. This pulpit was originally made for Jami Mosque of Aleppo but personally brought by Ghazi Salah-ud-Din to Al-Aqsa Mosque. A 13th century CE door with beautiful inlay from Asia Minor and mosque doors from Bursa, Turkey (15th century CE) are the earliest examples of inlaid wood work.

In Iran Mughals brought this craft in 17th century CE. For the first time, the architectural uses of inlay on wood are noted on the shrines of Muslim saints.

Around 1608-9 CE Murtaza Khan, one the Akbar's nobles possibly added a wooden canopy in Dargah of Nizam-ud-Din Aulia, Delhi. This kind of work is also found on the canopy in the mausoleum of Saleem Chishti, Fetah pur Sikri. This wooden canopy was inlaid with mother-of-pearl. The Mughal Governor Murtaza Khan built wooden cenotaph with inlay work of grave of Shah Alam and Sheikh Ahmad near Ahmadabad in 17th century CE.

In India, Hoshiarpur and Jallundhar are the main centres where ivory or bone is inlaid on *Shisham* (sisu) wood. In the old palace of Bikanir, an entrance door is richly inlaid and overlaid with ivory. It is one of the most beautiful and perhaps the most ancient examples of Indian inlaid work. Certain doors in the Amber Palace Jaipur which dates from 1630 CE are inlaid with ivory and Sadeli work. These doors are the oldest examples of this work in India. The other example of inlaid door with ivory work in India is the door ways of the Ashar Mahal of Bijapur (1580 CE).

In Pakistan, the inlay work is not commonly used on doors and windows. Only an old door with ivory inlaid is displayed in Lahore Museum. An example of inlay work is found in the mausoleum of Hazrat Shah Rukn-e-Alam in the wooden ceiling over the passage. But the inlay wood is in a bit relief. The other examples of inlay wood work are found on the frame of the door of the shrine of Hazrat Sakhi Sarwar in District Dera Ghazi Khan.(Pl. 114) and tomb at Wassay wala in District Rajan pur (Pl. 115). Here the inlay material is ivory. Inlay work is also found on the door leaves of Ghazi Khan Mosque at Bhong in District Rahim Yar Khan. (Pl. 116)

Ivory inlaid furniture and other decoration piece are still produced in Pakistan but very limited due to non-availability of imported ivory. The common materials used for inlay are brass and plastic. Chiniot and Peshawar have been the tradition centres of brass inlaid wood work.

Technique

First the drawing of inlay pattern is prepared on paper preferably on cardboard. This is then perforated or cut out to make it a stencil. Then the cut out pattern is transferred to the smoothened wooden surface. The pattern is engraved or incised to the required depth of inlay material. The pattern is also transferred to the sheet of inlay material. The inlay pieces are cut and then fixed with an adhesive in the incised places.

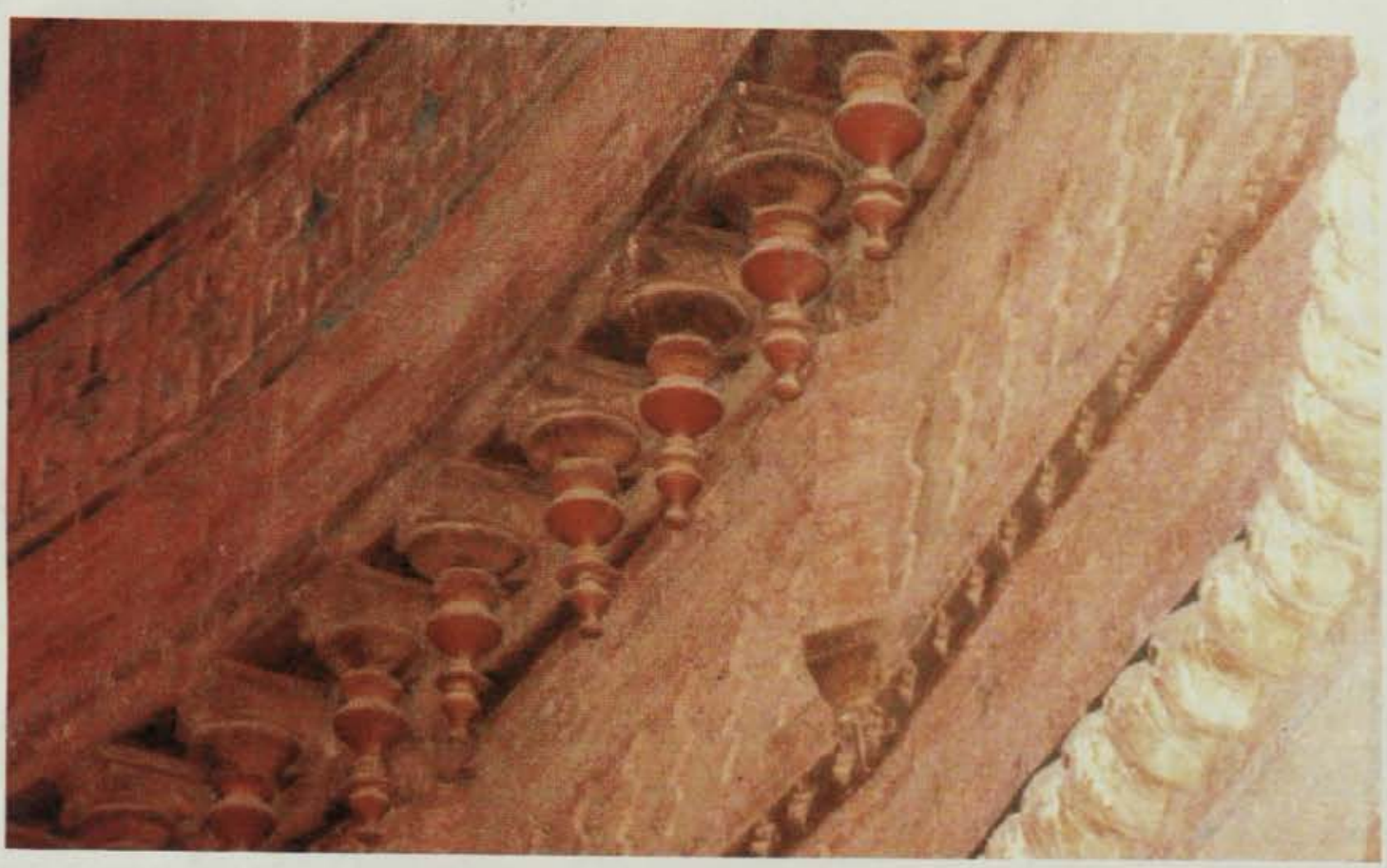
LATHE AND LAQUER WORK

Lacquer work is an important industry of Pakistan. The work is done on a variety of things like wooden boxes, furniture, lamp stand etc. The lathe and lacquer work is also found in the mausoleum of Hazrat Shah Rukn-e-Alam, Multan (1320-24 CE) in the shape of a row of wooden pendant at the spring level of the dome (Pl. 117). All turned on lathe and painted with lacquer in orange and yellow by way of dry process. It is the earliest existing specimen in Pakistan and India. Similar lacquered pendants are also found in the mausoleum of Hazrat Awais Khaggha at Multan. Lathe work is found in the mausoleums of Sultan Ghias-ud-Din alias Pir Adil (15th century CE), Hazrat Syed Ali, Hazrat Sakhi Sarwar in District Dera Ghazi Khan and Sultan Ahmad Qattal, Jalalpur Pirwala (1745 CE),

In Pakistan, Jampur (Dera Ghazi Khan), Multan, Dera Ismail Khan, Kashmor and Hala are the famous centres of the work. The lathe wood work is also used in manufacturing of wooden screens. The craft of lathe or turnery is not very difficult. The wood turner uses a simple lathe. The turner's lathe is called '*adda*' in the Punjab. It consists of two bars (*killa*) of iron. One fixed in the ground and the other adjustable for distance. On the inner surface of the each bar is iron spike for fixing the wood to be turned. Between the adjustable bar and the block of wood and over the spike a cylindrical peg *(chharhi)* is fixed, round which the thong of a bow (*kaman*) is passed. Running a taut string held in the bow backward and forward turns the lathe.

The wood to be used is fitted into lathe. The craftsman works with his left hand while his right hand holds the chisel. (Pl. 118) The heavy chisels for turning are locally called *nan* and *nihan*. The light chisel is called *mathna*. The wood is turned into the shape then polished with a fine powder, made of crushed pottery. If the piece is to be lacquered, the cracks in the wood are filled with a composition of wood dust (*bhoora*), lac etc. and pieces of thin cloth glued on the imperfections. The piece is polished by applying the repeatedly coat of wood dust and glue with a palm wood stick following each coat. After it, the lac colour, locally called *batti,* is applied (Pl. 119). The *batti* is pressed against the revolving wood. Naturally, heat is produced due to friction, which melts the lac and coats the wood irregular. A piece of hard wood is applied to the revolving article to make the colour uniform and diffuse. Finally a piece of cotton cloth moistened with sweet oil or gingerly oil is rubbed against the revolving article. This gives the lac a fine polish. If the floral and geometrical designs are required on the lacquer work, the layers of desired colours, one on the top of other are applied, while turning the lathe. Then the colours are scraped away with the help of pointed chisels to have the colour for the flowers.

For making the *batties,* shellac is melted till it is plastic. Then it is placed on a stone and a small amount of desired pigment, previously dissolved in oil or water depending on the substance used, then it is placed within closed by drawing the hot wax



Pl. 117 Tomb of Hazrat Shah Rukn-i-Alam, Multan - Lathe and lacquer work.

Pl. 118 Craftsman working on lathe.

Pl 119 Lacquer on wood.

over the hole. The lac is strenuously hammered and kneaded till it achieves a consistency of rubber. Then the lac is made into sticks of required size. These sticks are known *batties*.

Mineral colours are used for mixing with the lac. In the Punjab the following formulas are used for making *batties*. The formulas were recorded round about 1890 CE. by M. F. O 'Dwyer:

Yellow:

1/4 seer (240 gm)of shellac, 2 chhittank (120 gm) of arsenic sulphide called *hartal*. The latter is well pounded, the shellac added and warmed gently.

Red:

1/4 seer (240 gm) of shellac and 2.5 chhittank (150 gm) of cinnabar pounded with water for several hours, when dry mixed with the shellac.

Green:

1 chhittank (60gm) yellow *batti* warmed and mixed with indigo.

Black:

1/4 seer (240 gm) of shellac and 2 chhittank (120 gm) of carbonate of lead pounded and mixed with indigo.

ORNAMENTAL PANELLED CEILING

(TARSEEM BANDI)

Tarseem is an Arabic word meaning painting and calligraphy. As generally speaking in the ceiling composed of small wooden panels of some geometrical shape, floral or calligraphic designs were painted, this mode of decoration was named and introduced by the Arabs along with trellis and carved wood work in the 8th century CE at Multan.

The earliest specimen of it is found in the Mausoleum of Shah Yousaf Gardezi, Multan. It is composed of small wooden panels of some geometrical shape embellished with floral painting. This mode of decoration of the ceiling was not popular during the Sultanate or Mughal periods, but it became in vogue in the Sikh period (1799-1848 CE) and its many examples exist in the building of Sikh period at Lahore. *Tarseem bandi* work done on the ceiling of the verandah in front of the Mausoleum of Hazart Ishaque Gazruni alias Miran Badshah, Lahore (Pl. 120) built during Sikh period (18th century CE) is a mixture of coloured wooden geometrical panels and patterned pieces of mirrors. This kind of ceiling is found in *Aath Dara* in Lahore Fort and in *Aiwan* in Shalamar Garden both in Lahore built during Sikh period. Such type of work is also found in the varandah of the mausoleum of Hazrat Sakhi Sarwar in District Dera Ghazi Khan and in the verandah of the Mausoleum of Hazrat Abdul Qadir Sani Mehboob Subhani at Uch Sharif. This, in fact, is a joinery work with decorations in painting art. This kind of decoration is also found in the flat roof monuments at Uch Sharif, monuments at Kot Mithon and Derawar Fort in District Bahawalpur. Best specimen of this type of painted ceiling is found at the Shrine of Hazrat Kh Ghulam Farid.(Pl. 121).

Technique

First, the drawing of the pattern is prepared. It is always laid in geometrical pattern and like false ceiling. The roof is laid composed of beams and battens system. Planned wooden planks are fixed on a wooden frame underneath the beams. The drawing of the design is prepared. Then the design/pattern is marked on the ceiling. *Tarseem Bandi* is composed of small wooden panels of some of the wooden pieces about ½ inch thick. Each piece is prepared according to the required shape (Pl. 122). The edges are tapered; then the pieces are fixed on the ceiling according to marked pattern. Between these fixed pieces, ornamental wooden bars are fixed to make it a continuous design (Pl. 123). The whole surface of this ceiling is painted in floral designs (Pl. 124).

Pl. 120 Tomb of Miran Badshah, Lahore - Wooden ceiling in *Tarseem Bandi.*

Pl. 121 Tomb of Hazrat Kh. Ghulam Farid, Kot Mithon - Detail of painted ceiling.

Pl.122 Preparing pieces for *Tarseen Bandi.*

Pl.123 Preparing of wooden panel in *Tarseen Bandi.*

Pl. 124 Painting on wooden ceiling.

Chapter Six

Plaster work

Glazed lime plaster

Stucco tracery

Brick imitation

GLAZED LIME PLASTER

(PUCCA QALAI)

Having its origin in the Sassanid period (226-652 CE) of Iran, this craft was introduced from Central Asia in the part of the country and was perhaps first used in 13th century CE at Multan. In India first used in Tughlaq period (14th century CE) at Delhi. It is a kind of glazed plaster extensively used both in the interior and exterior, especially during the Mughal period. It is a sort of finishing coat applied on the plaster with lime cream cured and submerged in water for months.

The glazed lime plaster was mostly used for the finishing of the exterior surface of the domes in southern part of Punjab province. The dome of the tomb of Hazrat Baha-ud-Din Zakaria (1262 CE),Shah Rukn-e-Alam (1320-24 CE), Sultan Ali Akbar (1585 CE) at Multan, Lal Eisan (1464 CE) at Kot Karor, Rajan Shah in District Leiah, Abdul Wahab Bukhari (1602 CE) at Daira Din Panah in Tehsil Kot Addu, Tahir Khan (1530 CE) at Sitpur in District Muzaffargarh, Ala-ud-Din Mauj Darya (1336 CE) at Pakpattan and the unknown tomb (1484 CE) at Depalpur and Shah Sadiq Nahang (Pl. 125) in Tehsil Shorkot are the best example of this kind of work.

In the region glazed lime plaster was used for the exterior as well as interior finishing of the old building. Tomb of Mauj Darya (16th cent CE), Hazrat Aishan (1642 CE), Shah Chiragh (17th cent CE), Abdul Razzaq commonly known at Nila Gumbad at Lahore, Daud Karmani (1574 CE) at Sher Garh and Tomb of Abdul Nabi (17th century CE) in District Gujranwala are the best examples of glazed lime plaster finish.

In KPK province and northern part of Pakistan, the glazed lime plaster has also been done on exterior as well as interior finishing of the old building. Such kind of work is found on the dome of the Tomb of Saeed Khan, Mahabat Khan Mosque and Sethi Mosque at Peshawar.

In Sindh Province, the glazed lime plaster has been done mostly for the finishing of the exterior surface of the domes. The dome of the Tomb Isa Khan Tarkhan II, Jani Beg, Shaikh Isa Langoti, Dabgir Mosque, Shah Jahan Mosque at Thatta and Khuda abad Mosque at Dadu are finished with glazed lime plaster.

Classification of Lime

There are two kinds of limes:-

I) Fat lime

II) Hydraulic lime

I. Fat lime

Fat lime is obtained by calcination of purely lime stone ($CaCo_3$) to drive off carbon

dioxide. Which is more or less calcium oxide (CaO). It is produced by burning sea-shells, coral deposits, chalk lime stone and other calcareous substances composed of calcium carbonate.

It is called Fat Lime because it swells two or three times its original bulk when slaked. When left exposed to the atmosphere absorbs moisture and carbon dioxide from air and thus **becomes** air slaked.

Fat Lime is hydrated calcium oxide and sets by the absorption of carbon dioxide from air. The lime cycle is as under:-

i) Calcination Process

Lime Stone ($CaCo_3$) burnt in kiln at 900°C - $CaO + CO_2$ (quick lime)

ii) Slaking Process

$CaO + H_2O$ Heat $= Ca(OH)_2$ (slaked lime)

iii) Carbonation Process

$Ca(OH)_2 + CO_2$ _____ $H_2O + CaCo_3$

Classification of Fat Lime

Fat lime can be classified into two categories depending upon the impurities present.

1. Eminently Rich Lime

This consists of less than 5% impurities in clay form such as silica alumina and high percentage of calcium oxide. It slakes rapidly, evolves much heat and expands two to three times of its original volume. It has good plasticity, and is slow in setting and hardening.

2. Lean or Poor Lime

This contains more than 5% clayey impurities and other impurities like alumina, silica, iron oxide magnesium oxide exceed 11 percent. Due to large number of impurities it slakes slowly. It also sets and hardens very slowly.

Manufacturing of Fat Lime

Fat lime is produced by burning of lime stone in a kiln, by calcining the stone to expel carbon dioxide and moisture. It is the simplest form of lime. Lime stone selected for calcination should be free from impurities like sand, phosphates, iron, clay and organic carbon. Presence of higher percentage of regions Dolomite (magnesium corbonate) content in lime stone do not produce a good quality of fat lime.

Kiln

There are a number of different shapes of kilns used in different regions of the

country. The cylindrical type of kiln (Pl. 126) is the most popular. The kiln is constructed at the edge of a high mound. Excavation is made for the shaft and hearth of the kiln according to the production requirement of the material. If the earth is hard enough the sides of excavation will stand vertical and no lining is required. Otherwise they are built with stone or sun dried bricks in mud. The sides are plastered on the inside with mud and cow dung. An opening on the higher ground side is left for stacking

The raw material is stacked in the kiln. The lime stone stacked into the kiln in a way that layer of stones (of about 15 inches size) are laid at the bottom and the size of stones gradually decreases as it goes higher with the top layer consisting of stones of about 4 inches size. Sufficient space is left between them to allow free passage of combustion gases. Vertical flues are formed by arranging lumps of stones one upon another. An intense fire is maintained for 12 to 24 hours according to the size of kiln. Desert shrubs are used for fuel. When the firing is complete the kiln is given sufficient time to cool after which the material is taken out from the kiln.

Lime Putty

Fat lime is used for plaster work in saturated form which is called lime putty. For slaking of quick lime water tank or container is used (Pl. 127). Water is not added to quick lime but quick lime is added to water in small quantities. The soaking of lime depends on the requirement of the quality of lime. It takes days to months. The slaked lime is stirred daily with the help of bamboo for few days and then sieved to remove large particles. The lime settles under water and lime putty forms beneath a clear water.

Hydrulic Lime

Hydraulic lime is a lime containing clay from 5% to 30%. It is called hydraulic lime because it possess the important property of hardening or setting, where there is no access of air, for example a thick or under water.

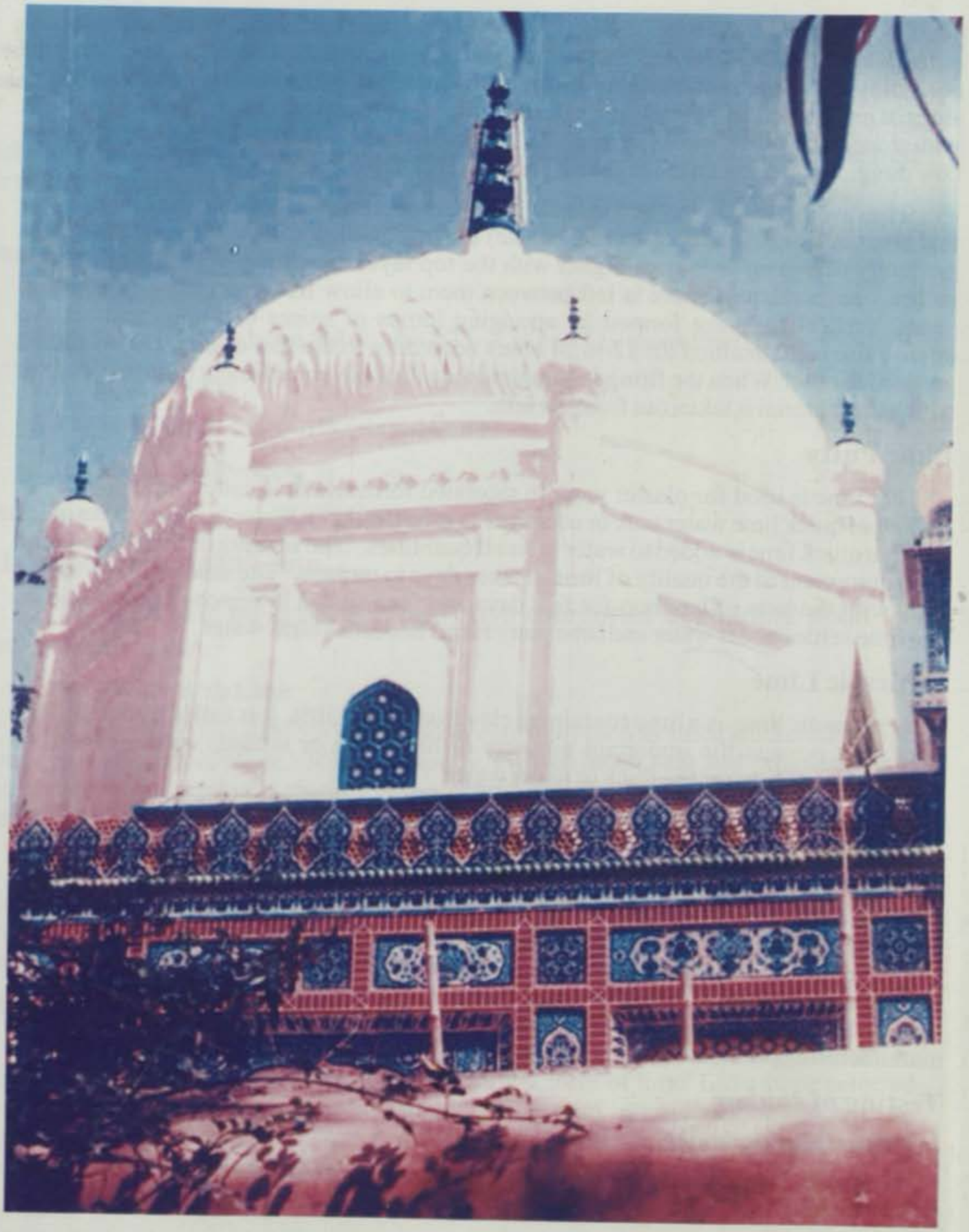
Kankar lime is a of hydraulic lime which found mainly manufactured from *kankar*. *Kankar* is found in shape of nodules within all classes of soil either on the surface or a few feet below ground in the low-lying portions of catchment or *nallas* etc.

The pure *kankar* lime is not easily available in market. Only one or two parties are manufacturing the *kankar* lime at Kasur. The manufacturing of *kankar* lime is a laborious job, i.e. collection of nodules *kankar*, as well as cow dung cakes. Nodular *kankar* as a rule is superior, but to get it in large quantities is very laborious. It is found in the surrounding of Lahore and mostly around Kasur. Kasur has been a major centre for manufacturing of *kankar* lime, which is commonly called *Kasuri Choona*.

Testing of *kankar*

Physical Properties

Colour: The *kankar* should be of bluish-grey or buff or yellow or of some darkish colour except white.



Pl. 125 Tomb of Shah Sadiq Nahang, Shorkot - Glazed lime plaster.

Pl. 126 Traditional kiln for manufacturing lime.

Pl. 127 Tank for slaking lime.

Texture: It should be free from glittering particles in a fresh fractured. Shining particles indicate presence of insoluble sand. It will have an earthy texture and weather brown after a time.

Taste: When the surface is wetted, it should taste clay when applied to the tongue.

Smelling: - When the sample is wetted or breathed upon, it should smell earthy or clayey.

Burning of *kankar*

The *kankars* are burnt in open air in the shape of heap or in the kiln. The *kankars* are stacked in the two methods.

The first method is alternate feed system which is very popular. In this method alternate layers of *Kankar* and fuel are spread. While in the second method the fuel is mixed with *kankar* that is called mixed feed.

Burning of *kankar* in shape of heap (Pl. 128)

In alternate feed method, alternate layers of *kankar* and fuel are spread. Horizontal flues are provided both longitudinally and crosswise at the bottom. The flues are covered. In the centre a vertical flue is also kept to exhaust the flame of fire .It remains a little above the top layer. The remaining floor between the cross flues is also covered with bricks laid on edge to make channels for heat on all sides uniformly. The first layer of fire wood and cow dung cakes about 9" thick is placed. Then the second layer of *kankar* is laid about 6" in thickness. The third layer of cow dung cakes and wood chips about 7" is laid. Then the fourth layer of *kankar* about 6" is laid. Similarly other layers are laid.

In mixed feed method 15-25% coal of the quantity of nodules/*kankars* is mixed for burning of *kankar*. Flues are kept as already explained.

Burning of *kankar* in kiln (Pl. 129)

Special kilns are also made for calcining or burning of *kankar*. Before burning the nodules are cleared of any sticking mud. The fuel used for calcination is generally coal, wood or cow dung cakes. The quantity of fuel depends on the nature and size of nodules. About 15 to 25 percent coal of the quantity of nodules/*kankars* is mixed for burning of *kankar*. A special type of kiln having diameter of 10 to 12 feet is made with bricks and plastered with mud or fire clay. Horizontal flues are provided both longitudinally and crosswise at the bottom. The flues are covered and then connected to a vertical flue in the center which is kept to exhaust the flame of fire. The vertical exhaust of flue is kept higher than the top layer. The remaining floor between the cross flues is covered with bricks laid on edge to make channels for heat on all sides uniformly. A layer of cow dung cakes is given on floor with a thin layer of coal on the top. Then the kiln is loaded with mix of *kankar* and coal.The *kankars* are burnt at a temperature of 800°C to 1000°C. When the kiln is cooled, the burnt *kankars* are taken out and screened.

In alternate feed method, alternate layers of *kankars* and fuel are laid as already explained .

Classification of Hydraulic Lime

There are three classes of hydraulic lime according to the percentage of silica and alumina present: -

1. Feebly hydraulic
2. Moderately hydraulic
3. Eminently hydraulic

1 .Feebly Hydraulic Lime.

Feebly hydraulic lime contains 5% to 15% of clay content. It slakes after a few minutes with cracking and sets in 2 or 3 weeks. It becomes soft hard after a year.

2. Moderately Hydraulic Lime.

Moderately hydraulic lime contains 15% to 20% of clay content. It slakes after an hour or two and slowly sets in a week. Becomes hard as soft stone in one year. Stronger than Feeble type, it is suitable for good class of mortar, brick work and masonry.

3. Eminently Hydraulic Lime

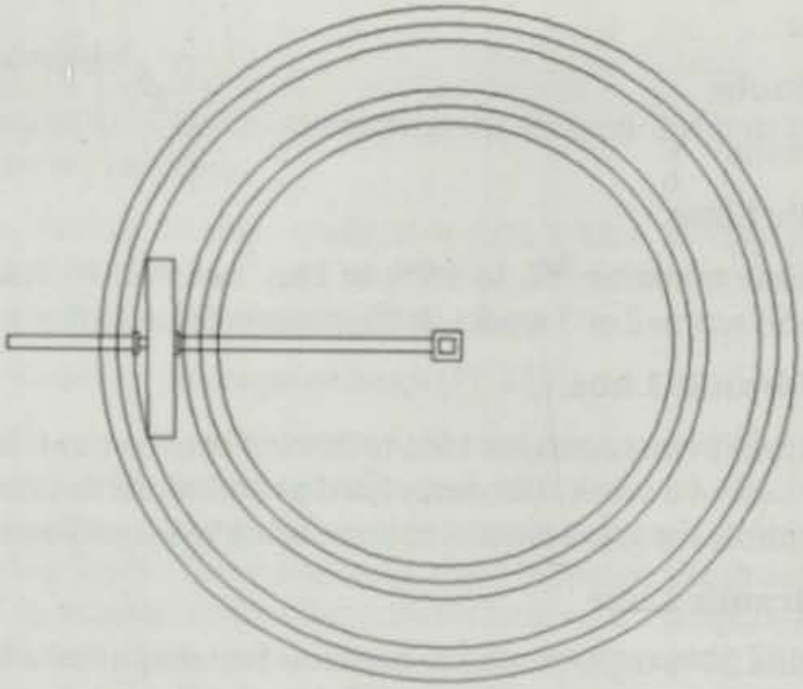
This kind contains 20% to 30% of clay content. It slakes after a long period and sets in 7 days. Becomes like hard stone within six months.

Grinding of Mortar

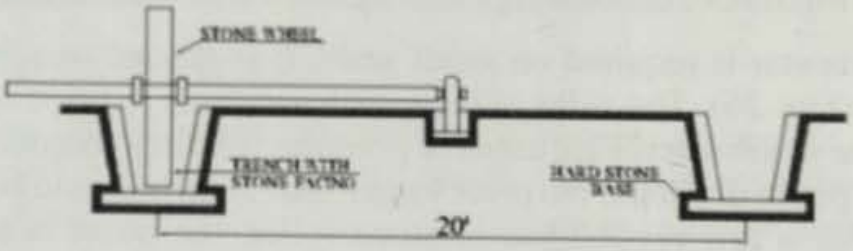
The grinding of the mortar is necessary to crush particles of unslaked lime as well as to make an intimate mixture of the binding material with other material like *surkhi* etc.

When lime mortar is required on small scale. It is ground in a bullock driven circular trench mill (Fig. 26). The sides of the trench are made in brick work and faced with solid stones. The stone wheels are used for grinding. The ingredients in the required proportions are first put in dry state. No piece larger than ¼ inch should be introduced in the mortar mill. After a few revolutions of stone roller, the water is added in small quantities but in any case the consistency of a paste must not be disturbed. The mixture should be ground for at least 180 revolutions. During grinding, the mortar must be continually turned over manually by or by means of an iron rod with a flat end attached to the axel of the mortar mill by a rope and used in a vertical position for scraping and turning.

For large works machine mortar mill is used instead of bullock driven mortar mill. Mortar must be used within the same day it is prepared.



PLAN



SECTION

Fig.26 GRINDING MILL FOR LIME MORTAR

Pl. 128 Burning of *kankar* for *kankar* lime in shape of heap.

Pl. 129 Kiln for burning of *kankar.*

Historical References for Technique/ Composition of Lime Plaster.

Ain-e-Akbari

In **Ain-e-Akbari (Vol II)**, it has been mentioned that for *Astar Kari* of one yard square*:

Slaked lime	*10 seer (9.4 kg.)*
Surkhi or crushed brick powder	*14 seer (13.2 kg.)*
Putson or chopped jute	*¼ seer (235 gm)*

It is also mentioned that " Lime is usually prepared by burning kankar which is a type of clay, more or less like the stone in hardness and sresh-e-kahi or glue is used for lime plaster. Gound or gum, preferable of babbool (kikar) or neem is also mixed in lime plaster.

Matla-ul-Aloom, Majma-ul Aloom

In this book, the composition of the lime plaster is given as under

Aik surkh (*surkhi*)	*1 maund (37.5 kg.)*
Aahak sufaid (white lime)	*10 seer (9.4 kg.)*
Qundh siah (black jiggery sugar)	*½ seer (470 gm)*
Aard maash (pulse mash)	*½ seer (470 gm)*
Belgari (a kind of fruit)	*½ seer (470 gm)*
San (chopped jute)	*½ seer (470 gm)*

Pl. 130 Coarse *kankar* lime, fine *kankar* lime, slaked white lime, chopped jute.

*Abual Fazal, "Ain-e-Akbari", Vol. II, translated by Balochmann, Delhi, reprint 1989,p-335,337&339

** Naul Kishore," Matla-ul-Aloom,Majma-ul Aloom", Lakhnau, 1848, p-399.

Jharoka

In Jharoka (An illustrated Glossary of Indo Muslim Architecture) the mortar is described as a mixture of Gypsum or burnt lime, sand and ash. For plaster and masonry purposes, following material are mixed with *kankar* lime*.

Curd (Dahi used for soft finishing)

Dal Urd (Pulse is used as plasticizer)

San (jute fibre for better bonding)

Gond (Gum from plants used as retarder)

Gurh (Jaggery sugar for hardening)

Batasha (raw sugar used as bonding agent)

Sirish-i-Kahi (Glue to increase bond strength)

Bhus (straw used for reducing cracks)

No quantity of the material and ratio is mentioned.

Engineering Material

Mr. M.A Zaman wrote in his book " Aid to Engineering Material" the composition of Mughal period plaster as under:-**

> *Mughal plaster consists of lime, sand and surkhi in the proportion of 4:3:1. These ingredients are ground in a mortar mill and mixed with some jaggery (coarse sugar) glue, powdered gall nut (soaked in water for about 10 hours) and finely chopped fibrous material like gunny or rope. Moghul plaster is generally applied in two coats. The surface is first made wet and the first ½ in. coat is applied by beating it and sprinkling jaggery water. The second coat also ½ in. thick, is applied above the first by rendered smooth. For smooth surface rubbing is done by applying jaggery and gall nut water freely. It is then kept wet for 20 days in order to obtain glossy, hard crack proof surface.*

Technique of the work in the Lahore region

Base Coat

The wall surface on which the treatment of *pucca qalai* work is to be done is first cleaned and racked with hard brush not only to remove the dust and loose material, but also to roughen the surface so that the thick layer of lime plaster may adhere to it. White lime, fine *kankar* lime, coarse *kankar* lime and chopped jute are well used for base coat. (Pl. 130). A layer of coarse *kankar* lime mortar as a base coat in a ratio of 3:2 (three fine lime and two coarse lime) strengthened with fully slaked lime in the ratio of 8:1 is applied over the wall. Chopped jute or goat hair ½ seer (480 gm) per maund (37.6 kg) in the above mentioned mortar is also added for the purpose of reinforcement and to avoid the development of cracks in this base coat. The thickness of the base coat is normally from

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* R.Nath, Jharoka (An illustrated Glossary of Indo Muslim Architecture),Jaipur,1986,p-81

** Zaman, M.A, "Aid to Engineering Materials", Lahore,1975, Page 212

1" to 2". The thick layer of *kankar* lime is allowed to remain on the wall for an initial setting and then tapped with the edge of *thapi* (small piece wood of triangular shape). This process gives it a rough but well set surface, which is rendered plain by a small *sandhla* or *garmala* (a wooden or metal trowel). The surface is made smooth before setting of mortar. (Pl. 131).

The base coat can also be done in the ratio of 1:2:3 or 1:1:2 (slaked white lime: fine *kankar* lime: semi calcined *kankar*)

Second Coat

Then a thin layer of fine *kankar* lime strengthened with well-slaked white lime in the ratio of 3:1 (three *kankar* lime and one slaked white lime) is applied over it, when the base coat is not set. The technical term in the local language for the second coat is *dugha*. This coat is made rough with wire brush.

Final Coat

Over the second coat is given a coat of fine lime cream of 1/16" to 1/8" thick. (Pl. 132) This coat is carefully smoothened with a small flat but thick iron trowel called *nehla*.

The lime cream for the final coating requires very careful preparation. It must be perfectly slaked. The lime is kept in the water for months, a year is said to be desirable for the best work. The curds are mixed with the lime in the preparation of one-seer (0.94 kg) curds to twenty seer (18.8 kg) of dry lime. The mixture is well stirred and kept in the water over a night. Next day the water is drained off and fresh water is added and let it stand under water till next day. This process is continued for at least a week. The purity of lime depends upon the number of times this operation is repeated. Care must be taken that the lime thus prepared is always kept under water. If allowed to dry, it will be useless.

Analysis of *Kankar*

Mr. Ali Muhammad, a Research Scholar during his research for his PhD thesis, made analysis of *kankar*/fat limes available in various localities in Pakistan. The results of his analysis are reproduced in Appendix II.*

He also made analysis for chemical composition of mortars used in historical buildings in Pakistan. The results are reproduced in Appendix III.**

Petrographic Composition of Lime Mortar

Petrographic and Materials Laboratory at the Postgraduate Centre for Earth

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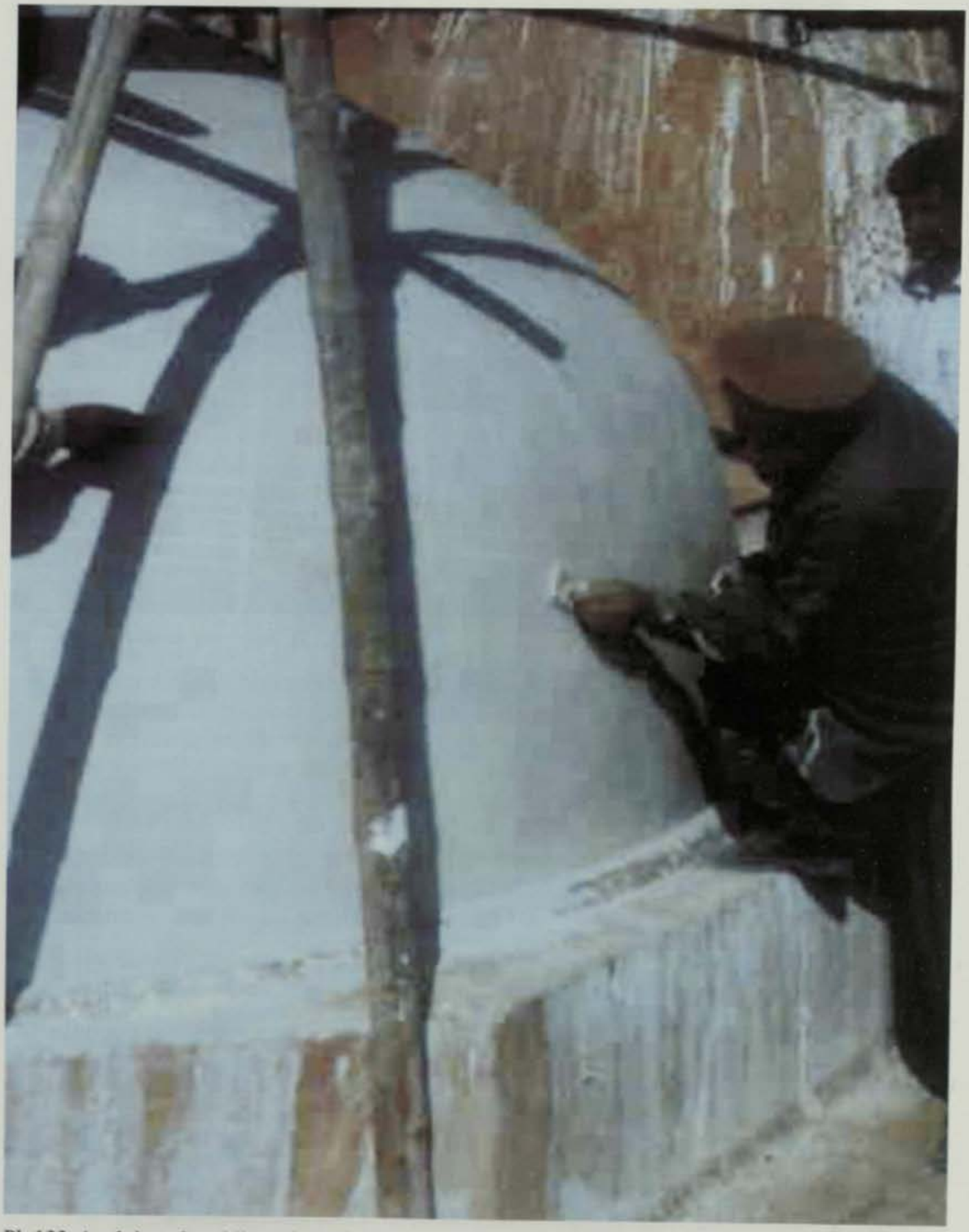
* Muhammad ,Ali, 'Cheap Indigenous Substitutes of Portland Cement', a thesis of PhD, unpublished, 1987, page 63-65.

** Ibid, page76-80.

Pl. 131 Applying *kankar* lime plaster.

Pl. 132 Applying glazed lime plaster.



Pl. 133 Applying glazed lime plaster in Multan region.

Sciences, Punjab University, Lahore made Petrographic analysis of samples of lime mortar from various historic buildings in Lahore Fort. Results of one of the samples as informally communicated to the author are given below:

Illite/Mica	16.0
Carbonate	60.0
Quartz	11.8
Gypsum	2.5
Biotite	2.3
Muscovite	2.2
Chlorite	0.9
Hematite	2.0
Magnetite	1.0
Zircon	0.2
Argillite	1.3
Fluorite	traces

THE TECHNIQUE OF THE WORK IN MULTAN REGION

In Multan region instead of *kankar* lime (hydraulic lime), Fat lime (White lime) is used for lime plastering even for the base coat. It is done in three coats. The formula for the base coat, which is locally, called *Marva* is as follows:-

1. Well slaked white lime	1 part
2. *Surkhi* (powder of burnt bricks)	1 to 2 parts
3. *Jangli Rore* (*kankar*)	3 to 4 parts

Suitable quantity of chopped jute is also added for reinforcement of the plaster. *Jangli Rore* is a calcareous material like *kankar* and found in this region under the sand dunes.

After well mixing the material is laid in a thickness of about two inches, well pressed by small wooden bat (*Thapi*), while sprinkling water occasionally during this operation. Afterwards the whole surface is also kept moist for some time. If the thickness of plaster is more than two inches, it is laid in coats, well beaten and treated as said above till the required thickness is obtained.

Second coat, which is locally called *Batana* is composed as following:

Cream of white lime cured forat least one month.	1 part
Marble powder.	½ to 2 parts
Jute (chopped).	1/16 part

This second coat is applied over the base coat. In fact the second coat is a part of the finishing coat and is about ½ inch in thickness.

Third or finishing glazed coat which is locally called *Jila* (glass) is about 1/8 inch thick. This coat is applied very carefully, while rendering, the surface is frequently dusted with *Sang-i-Jarahat* (soap stone or steatite) kept in a *potli* (a small pouch of muslin cloth) and the surface then finished with repeated and quick movement with a small trowel of special hard wood named *Kareer* or with a thick iron trowel called *Nehla* till it is glazed (Pl. 133).

TECHNIQUE OF LIME PLASTER IN KPK PROVINCE

Lime *surkhy* mortar was used for the plaster work in historical buildings of the KPK Province. For thick lime plaster, small size grit (*Bujri*), small size brick grit instead of *kankar* and chopped jute were also used. The techniques of plaster work and glaze plaster the same as described for Multan region.

TECHNIQUE OF LIME PLASTER IN SINDH PROVINCE

In Sindh the following composition of lime plaster was used in historical buildings.

Base coat

Slaked white lime	2 parts
Calcined *Chiroli* (gypsum)	½ part
Brick grit (chips)	1 part

Chopped jute was also used for strengthening.

Finishing coat

For finishing coat the material used was the same as explained for other region.

STUCCO TRACERY
(*MANABBAT KARI*)

Manabbat is an *Arabic* word meaning a place where plants grow and also for ornamental work done in relief i.e. embossed. Stucco is a term used for a fine plaster. From earliest times stucco was one of the major elements in Persian architectural ornamentation. It was extensively used in carved, moulded and painted patterns.

Romans knew stucco tracery in the 1st and 2nd century CE. However Iranians in the Sassanid period (224-642 CE) introduced this mode of decoration from where Arabs adopted it and made the first extensive use of it in *Masjid-i-Samra* (848-52 CE) near Baghdad. From there it spread in Central Asia and in due course was brought to this region.

In the early Islamic period, stucco was of great beauty. The carved stucco was widely and expertly developed throughout the whole Islamic world. It was coloured and frequently lavishly gilded. In the Madrassa Haydariya of Qazvin, Iran where the (11th century CE), stucco was used for the superlative inscription frieze, for the facing of arches and *mehrab*. Remarkable carved stucco is found in the Alaviyan, Iran, where the architectural form here is fundamentally clear and forceful. In Persian stuccowork, the variety of components used in stucco decoration is quite astonishing than in the stucco of Western Islam. Early splendid examples are found in Cairo, Baghdad and Jerusalem where the stucco is mostly in geometric pattern. The full development of floral magnificence carved stucco was chiefly due to Persian inspiration and workmanship.

In Central Asia, carved stucco and terra-cotta were developed with variety and perfection of finish. The varied panels in the soffit of arches of the mausoleum of Sanjar at Merve (1157 CE) alleviated the severity of the ponderous cube, but in many small tombs in Samarkand, the terra-cotta ornamentation is over whelming.

It appears that in the world famous and noblest work of the fine minute stucco tracery at *Al-hamra* (1334-91 CE) Spain, the gypsum formula was used which in the course of time takes an ivory colour.

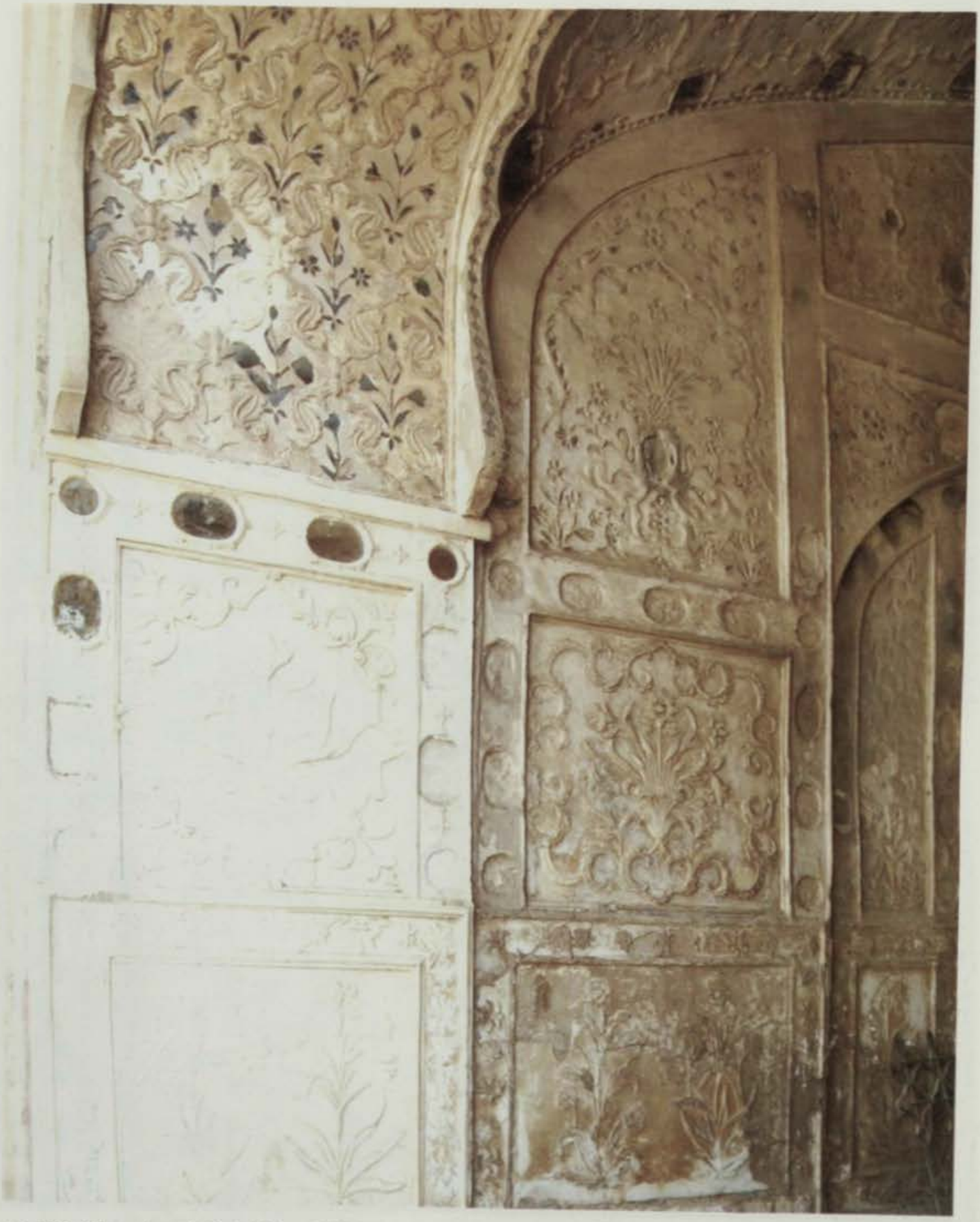
In Indo-Pakistan stucco was known as early as 1st century CE as is evident from the stucco statuary discovered from the Apsidal temple (1st. century CE) at Sirkap at Taxila and stucco troughs found at Chirtope Taxila, but the work of stucco tracery in the sense we use now, was not practised in Indo-Pakistan before the Muslim rule in India.

The early examples of stucco tracery are found in Mausoleum of Hazrat Baha-ud-Din Zakariya (1267 CE) at Multan (Pl. 134), Sher Shah's Tomb (C. 1540 CE) at Sasaram, India, Tomb of Asif Khan (Pl. 135), Sheikh Hazrat Musa Ahangar's Tomb at Lahore (mid 16th century CE), Tomb of Hazrat Daud Karmani (1574 CE) at Shergarh and Tomb of Sultan Ali Akbar (1585 CE) at Multan (Pl.136).

Pl. 134 Tomb of Hazrat Baha-ud-din Zakariya, Multan - Stucco tracery work.

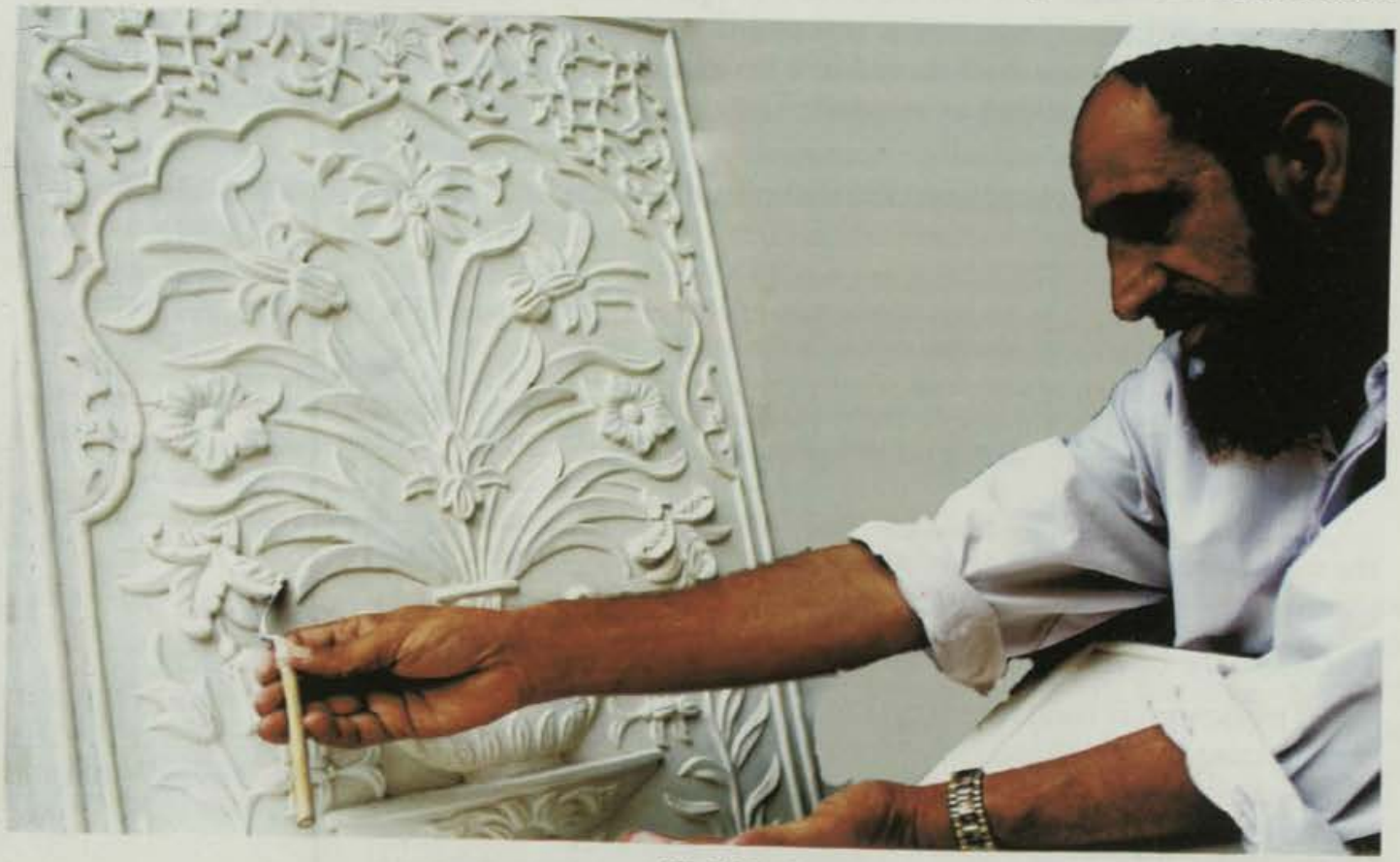
Pl. 135 Tomb of Hazrat Ali Akbar, Multan - Stucco tracery work.

Pl. 136 Tomb of Asif Khan at Lahore - Stucco tracery work.



Pl. 137 *Khawab gah* Shah Jahan Old Fort, Lahore - Stucco work.

Pl. 138 Adding mortar for relief stucco.



Pl. 139 Cutting of mortar decorative stucco work.

It is during early Shah Jahan period that we find the stucco tracery work of remarkably minute nature along with the *Aiena kari* with convex glass in the decoration of the walls and ceiling of Shish Mahal (1631 CE) and bold type in medium relief in the Shah Jahan's sleeping room (*Khwab Gah Shah Jahani* -1633 CE) inside Lahore Fort (Pl. 137). But the work done in the interior of Badshahi Masjid (1673-74 CE) touched with fresco is perhaps superior to all of the rest in its beauty and bold expression. Carved stucco and gilding is found on the *mehrab* of Ghazi Mosque Bhong in Tehsil Sadiqabad.

Technique

This plaster mix is composed of either of fine sand, powdered marble, and gypsum mixed with water or as in Indo-Pakistan white lime cream, *surkhi* (powdered brick) and fine grit mixed water. The former formula is however more effective and affords quick working and results in a uniform and glossy surface.

For minute stucco tracery work as carried out in Shish Mahal Lahore Fort, the following composition is used:-

Belgian chalk powder	3 Table spoon
White lime cream	1 ½ Table spoon
Ispaghol (seed of fleawort)	1 Table spoon
Seep (shell) powder	½ Table spoon
White sugar	½ Table spoon
White of egg	one

For preparation of mortar for stucco tracery work *Ispaghol* is soaked in water a day before. All gradient are well mixed in a bowl to form a paste. For good work ability the water of *Ispaghol* is added as needed. The mortar can be kept under a shallow layer of water for few days.

Mr. M. A Zaman explained the technique in his book "Aid to Engineering Material" as under:*

> This is a kind of plaster made of a mixture of lime, powdered marble and talc (soap stone). It sets extremely hard and when finished and polished, gives exact effect of marble. Sometimes whites of eggs, *ghee* and soured curdled milk are also added.
>
> Stucco is usually laid in three coats. The first base coat which sticks with the wall, provided strength, second coat makes the surface plain upon which final finishing coat is given. This third coat provides texture, glass, smoothness and decorative appearance. The three coats make a total thickness of 1 in. or 1 ½ in.
>
> Polishing stucco requires skill. This is done by a pad containing moist chalk, and then with oil. The rubbing is done by means of an abrasive to render great smoothness.

Technique of Stucco Tracery

The design is transferred on the s0urface of plaster through the process called sozan kari. In case of relief stucco decoration, mortar is added according to the design (Pl. 138). When the mortar is almost set, it is carved with special type of tools (Pl. 139). When the stucco is in geometric pattern, the plaster surface is cut.

*Zaman, M.A, "Aid to Engineering Materials", Lahore,1975, Page 212

BRICK IMITATION WORK
(*KHISHT NIGARI* OR *TAZA KARI*)

To avoid tiring view of the vast plastered surface of walls, as well as to improve appearance of decayed rough brick work and just to make fresh the sight of old walls, this new mode of decoration was introduced in the early 17th century CE, most probably in Jahangir's time (1605-1627 CE), but it became extensively popular in Shahjahan's time (1627-1658 CE).

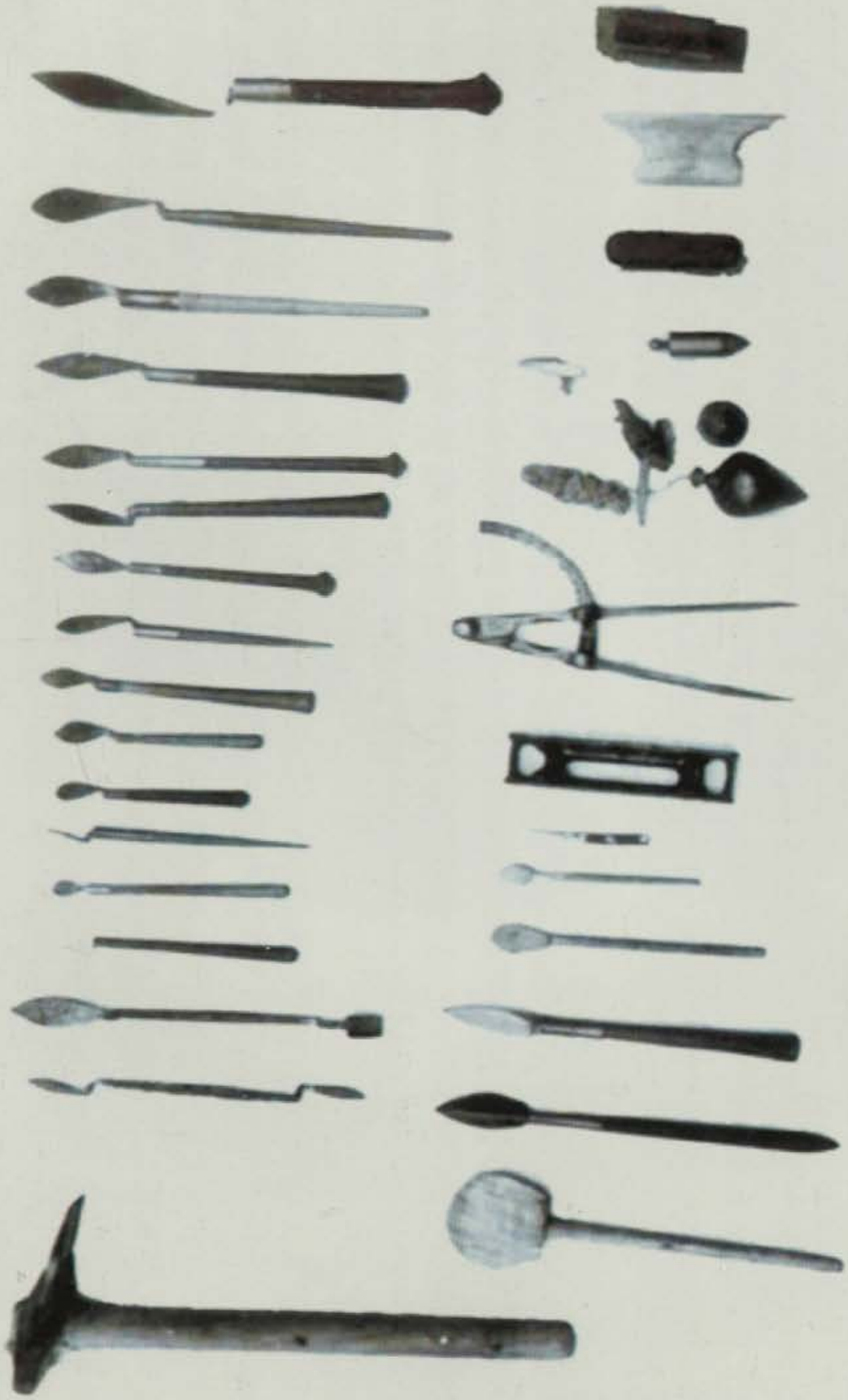
The decoration known as *Khisht nighari* or *Taza kari* (brick imitation work) is found in India on a tomb near the Tomb of Humayun at Delhi. It is also to be found at Mausoleum of Jahangir, Lahore Fort, Masjid Wazir khan, Lahore (Pl. 140), Mausoleum of Hazrat Shah Shams Sabzwari and Mosque of Nawab Ali Muhammad Khan at Multan.

Technique

The wall surface on which the treatment of brick imitation work is to be done is first cleaned and joints racked with hard brush not only to remove dust and loose material but also to roughen the surface so that a layer of lime plaster may adhere to it. Then after curing the surface a layer of *kankar* lime mortar strengthened with fully slaked lime cream in the ratio of 2:1 is applied over the wall. Chopped jute or goat hair @ ½ *seer* (480 gm) per maund (37.6 kg) in the above mentioned mortar is also added for reinforcement in order to avoid cracks in the base coat. The thickness of the base coat is normally about ½ inch. Over this base coat is given another coat of fine lime cream of 1/16 inch thick mixed with a little quantity of *Zardgil* (yellow oxide). This gives the joints, later marked and exposeds a bit yellowish colour or tint. This coat is carefully smoothened with a small flat but thick iron trowel called *Nehla* (Pl. 141). On this smooth surface a final layer of new brick red colour, *shingrafi* (vermilion) obtained from pure *hurmizi* mixed with some 6% lamp black is applied. Lamp black is not soluble in *hurmizi* easily and in order to make it soluble a few drops of double boiled linseed oil is added while *hurmizi* is grinded in a *kharral*, then distilled water is added in it and well stirred and mixed. This solution (*neru*) is applied on the required surface.

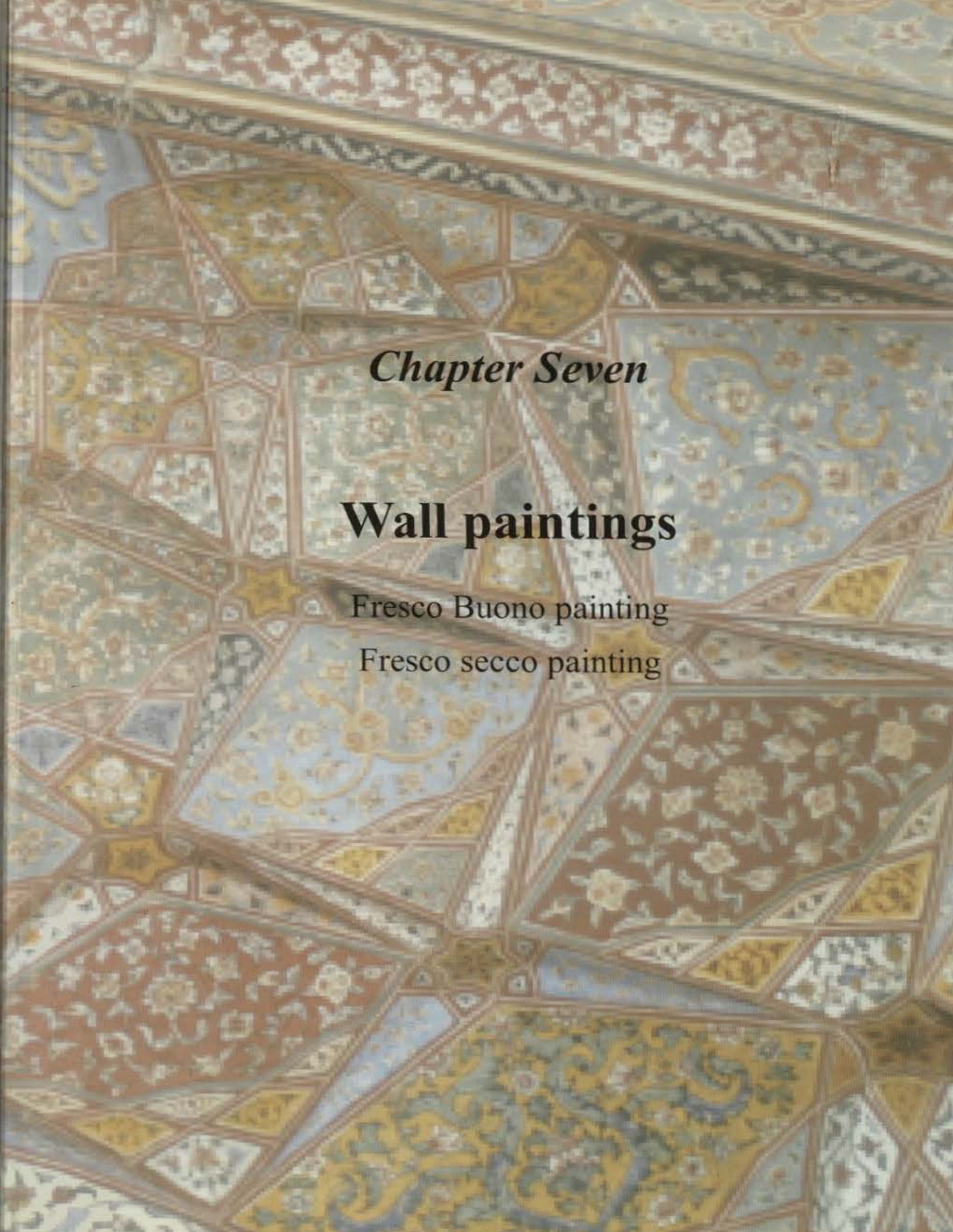
The surface is rendered by sprinkling fine powder of *sang-e-jarahat* (steatite or soap stone) on the working surface. Brick like uniform joints are etched both horizontally and vertically, using a fine pointed chisel thus creating the impression of dressed brick work and for this reason it is termed "Brick Imitation" (Pl. 142). As the surface of old walls was also made attractive and fresh with this process, it was also termed *Tazah Kari* i.e. Making *Tazah* (fresh).

Pl.140 Wazir Khan Mosque, Lahore - Brick imitation work.



Pl. 141 Mason's Special tools.

Pl. 142 Brick Imitation work in progress on soffit of arch.



Chapter Seven

Wall paintings

Fresco Buono painting

Fresco secco painting

FRESCO BUONO PAINTING

History of fresco work as an art of surface decoration in the subcontinent goes as far back as 2nd century BCE as preserved in Ajanta Bagh in India. The recent discoveries in the excavations at Butkara in Swat and at some sites at Afghanistan prove its existence even in the 1st century BCE.

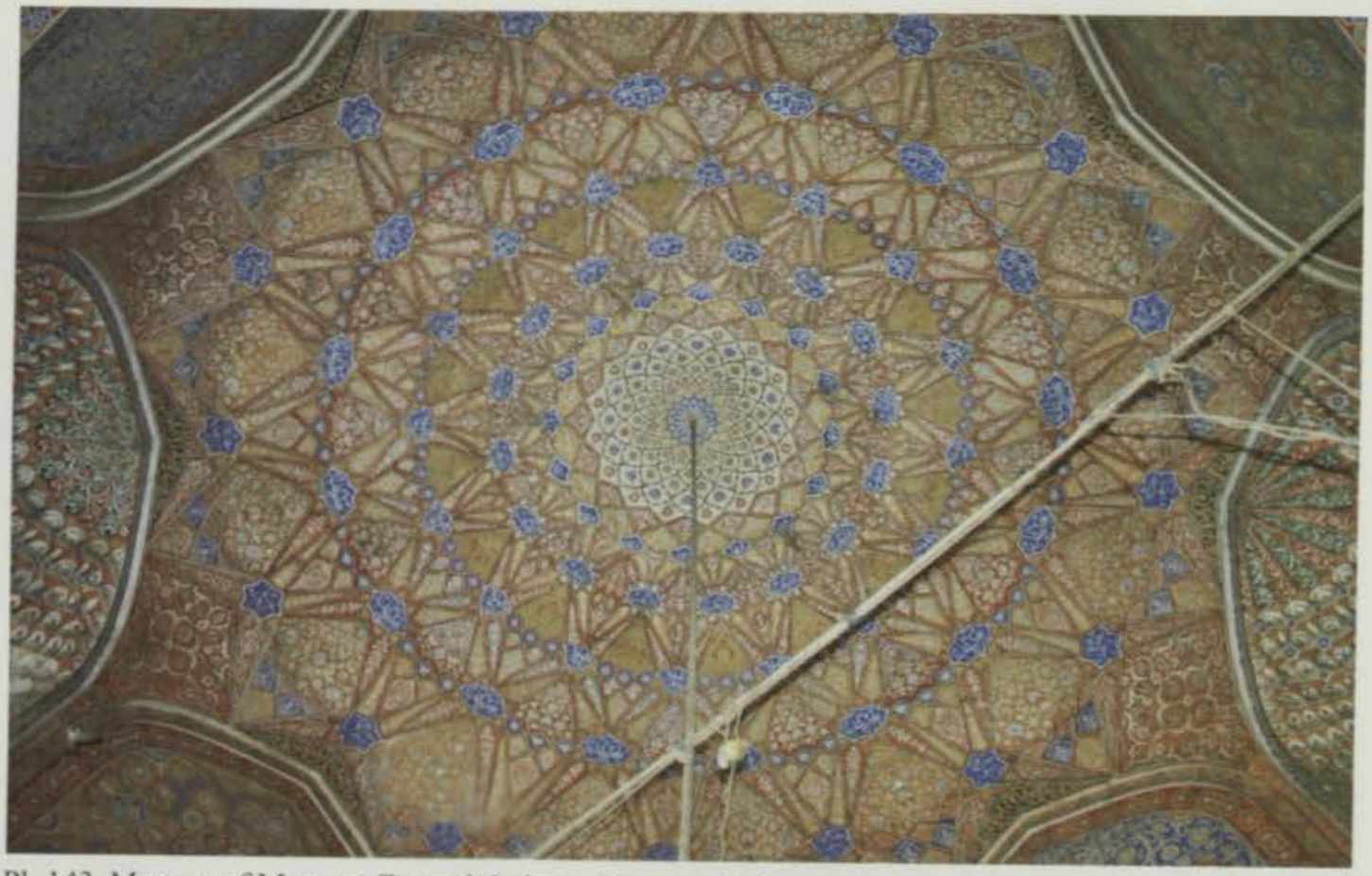
The technical traditions of painting have been recorded in series of Sanskrit text. The oldest of these, the *Visnudharmottara Purana*, dates between 4th and the 6th century CE. It contains an entire chapter entitled *Chitrasutra* devoted to painting. It includes various styles of painting, the preparation of walls and plaster, the defect of paintings etc. The *Abbilashitartha Chintamani*, probably written in the 12th century CE has an important chapter on painting describing the preparation of the walls, media colours and their mixing , tools, gilding and burnishing. The other text *Samarangana Sutradhara,* as written by king Bhoja, concerns with architecture but includes paintings. The *Silparatna* of the 16th century CE contains a chapter on the characteristic of painting (*Chitra Lakshana*). The *Aparajita Praccha* is a treatise on architecture with a chapter on painting, a *Sarasvata, Chitrakaramasastra* and the technique of paintings is also mentioned in the *Naradsilpa.*

In Pakistan, a specimen preserved in Butkara (Swat) is the earliest example of fresco painting as practiced by Buddhist in the decoration of their religious buildings, stupas and monasteries. However, the later phase of Islamic architecture in this country is replete with the use of fresco painting. The interior surface of the dome of the mausoleum of Hazrat Baha-ud-Din Zakariya (1262 CE), Sultan Ali Akbar (993 AH/1585 CE), Hazrat Shah Shams Sabzwari at Multan and Hazrat Musa Pak Shaheed (1001 AH/1592 CE) at Uch Sharif, Tahir Khan Nahar at Sitpur are decorated with fresco paintings.

Fresco decoration got real momentum with the establishment and spread of the Mughal supremacy in the subcontinent. The important buildings built by the Mughal Emperor Akbar and his successors at Lahore, Delhi, Agra, Fatehpur Sikri and other places possess this type of decoration.

The best preserved fresco paintings belong to the period of Jahangir and Shah Jahan. We have best specimens at the Mosque of Maryam Zamani (Begum Shahi Mosque) (Pl. 143), Lahore .The mosque was built under the patronage of Maryam Zamani, a consort of Emperor Akbar in 1613 CE. The entire interior surface of the prayer chamber of this mosque is embellished with fresco paintings in floral, geometrical and inscriptional designs. The paintings are executed in perfect technique.

Other fresco paintings of Jahangir's period are found in Lal Burj in Lahore Fort. The soffit of the dome possesses some very rare specimens depicting winged figures in addition to other floral patterns. The walls of the *Daulat Khana-e-Jahangir*i (1617-18 CE) in Lahore Fort are decorated with beautiful floral and lineal motifs in fresco.



Pl. 143 Mosque of Maryam Zamani, Lahoe - Fresco painting.

Pl. .144 Wazir Khan Mosque, Lahore - Fresco painting.

During the reign of Shah Jahan when the Mughal architecture reached its zenith, fresco paintings served as one of the most favourite medium of decoration.

The monumental buildings like Tomb of Anarkali (1615 CE), Tomb of Jahangir (1637 CE), Mosque of Dai Anga (1635 CE), Wazir Khan Hammam (1638 CE), tomb of Nadira Begum (before 1659 CE), Badshahi Mosque (1673-74 CE), Gateway of the Nawan Kot (1763 CE) Lahore, Baradari at the royal hunting resort at Sheikhupura, Tomb of Abdul Nabi in District Gujranwala, Shahi Mosque and Tomb of Shah Burhan at Chiniot were embellished with fresco ornamentation. The noblest example of this work in Pakistan is presented in Masjid Wazir Khan, Lahore (1634-35 CE) (Pl. 144) which to the artists is a grammar of designs and colour compositions.

Technique of Fresco Painting

The fresco work is done on the base of white-lime plaster when it is not fully dried up by transferring the design on the surface of the plaster through the process called *Sozan kari*. The technique of the work is as follows:-

The Ground (Base Coat)

The wall surface on which the treatment of fresco work is to be done is first cleaned and racked with hard brush not only to remove dust and loose material but also to roughen the surface so that the thick layer of lime plaster may adhere to it. A layer of course *kankar* lime mortar in ratio of 2:3 (course : fine) strengthened with fully slaked lime in the ratio of 3:1 (fine +course *kankar* lime : white lime) is applied over the wall. Chopped jute or goat hair @ 1/2 kg. per 40 kg. in the above mentioned mortar is also added for reinforcement and to avoid the cracks in the base coat. The thickness of the base coat normally varies from 1" to 2". The thick layer of *kankar* lime is allowed to remain on the wall for a day. Next day, it is moistened with water and then tapped with the edge of small piece of wood of triangular shape (*thapy*). This process gives it a rough but well set surface, which is rendered plain by a small *sandhla* or *garmala* (a wooden or metal trowel).

The base coat can also be done in the ratio of 1:2:3 or 1:1:2 (slaked white lime : fine *kankar* lime : semi calcined *kankar*)

In Multan region fat lime (white lime) is used for base coat instead of *kankar* lime. The base coat is locally called *marva*. The layer of base coat consists of slaked white lime, crushed *surkhy* (brick powder) and *jungli rore* (*kankar*) in the ratio of 1:2:4 or 1:1:3.

Second Coat

For the second coat a thin layer of fine *kankar* lime strengthened with well-slaked white lime in the ratio of 3:1 (*kankar* lime: slaked white lime) is applied over it. The technical term in the local language for it is *dugha*. This coat comprises a fine white lime cream of 1/4" thick. This coat is carefully smoothened with a small flat but thick iron trowel called *nehla*.

In Multan region the second coat which is locally called *batana* is composed of well slaked lime, marble powder and chopped jute in the ratio of 1:1 to 2:1/16.

Sometimes the second coat *dugha* or *batana* is not applied. The final coat is applied direct over the base coat.

Final Coat

Over the second coat is given a coat of fine lime cream of 1/16" to 1/8" thick. This coat is carefully smoothened with a small flat but thick iron trowel called *nehla*. The smooth surface is now ready for transferring the desired design on it.

The lime cream for the final coating on which the painting is done requires very careful preparation. It must be perfectly slaked. The lime is kept in the water for months, a year is said to be desirable for the best work. The curds are mixed with the lime in the ratio of one kg curds to twenty kg of dry lime. The mixture is well stirred and kept in the water over the night. Next day the water is drained off and fresh water is added, let it again stand under water till next day. This process is continued for at least a week. The purity of lime cream depends upon the number of times this operation is repeated. Care must be taken that the lime thus prepared is always kept under water. If allowed to dry, it will be useless.

A portion of the final coat thus prepared which is to be painted and finished in a day is cured. If the ground is too wet it will come off with the rubbing stone, if the surface is too dry, the colour will not be permanent.

Transferring of the Design

First the design is traced or sketched out on a tracing paper (*momi kaghiz*). This traced out design is then perforated with the help of a needle or pin. This process is called *sozan kari* (Pl. 143). The perforated tracing is now fixed over the wall surface and pounced with a small bag of fine linen filled with some fine coloured powder, say lamp-black (Pl. 144). This perforated tracing is then removed.

Painting

The out-line of the design is then corrected with a soft pencil or brush and filled with the desired colour and ultimately is rendered and finished with a particular kind of small trowel (*nehla*) (Pl.145). Rubbing and tapering by *nehla* results in a chemical action between colour and white lime layer. This makes the painting work part and parcel of plaster and therefore of permanent nature which withstands washing. Powder of *Sang-e-Jarahat* (steatite or soap stone) is dusted occasionally by a small bag or pouch (*potli*) on the surface while it is being rendered.

PIGMENTS.

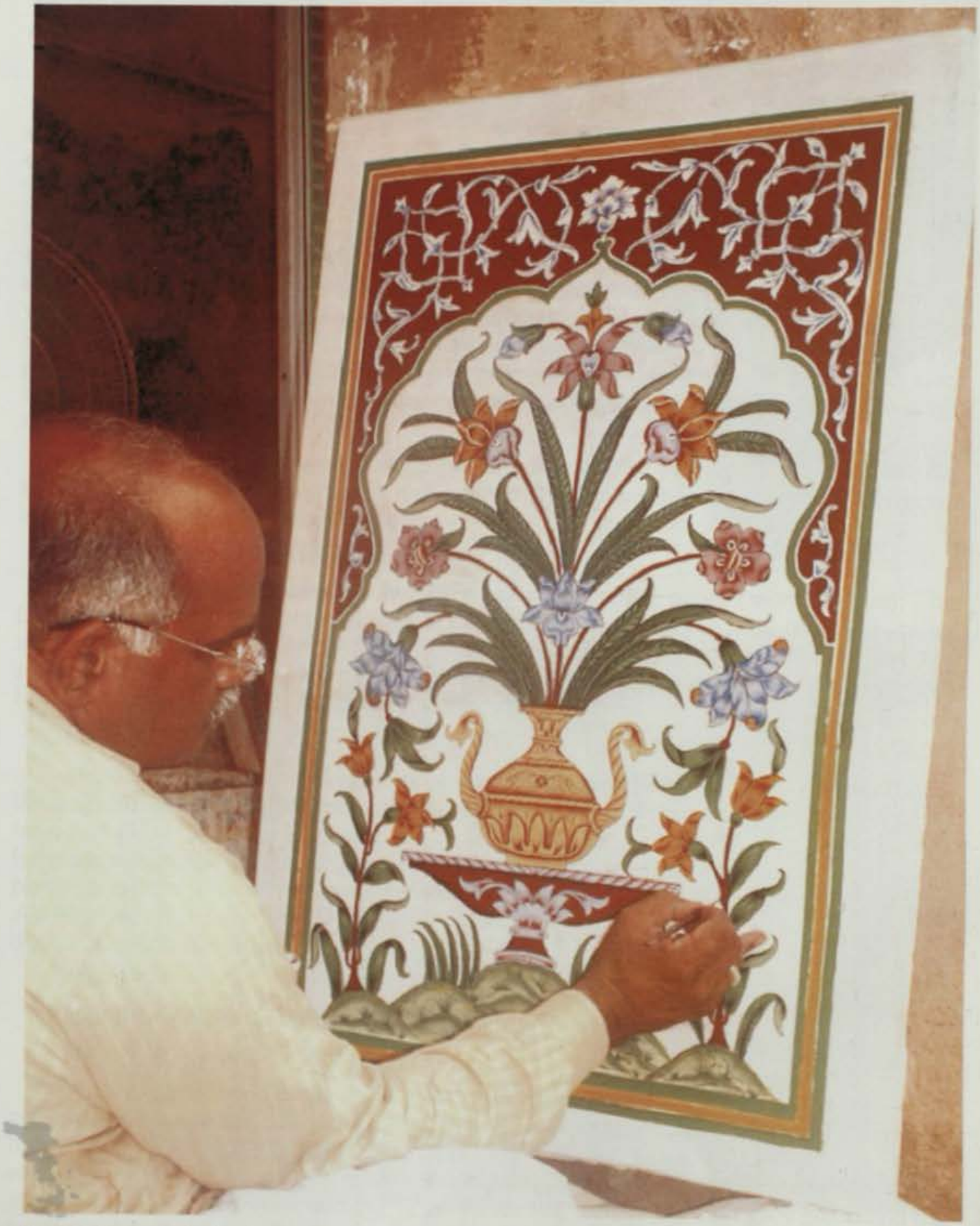
The following natural pigments are used for fresco paintings:

Terre Verte (*Hara Pathar*)

Green pigment used in fresco is Terre Verte. It is natural green earth. Earth pigments, and green earth in particular, are most permanent colours. These colours are not affected by sunlight or by atmospheric conditions. They do not react with solvent and have reasonable tinting strength. They have the capacity to screen ultraviolet rays. It is found in two varieties, Terre Verte and old Terre Verte. The former is a coal grey green and the latter much yellower.

Pl. 145 Perforating of the design (sozan kari).

Pl.. 146 Transferring of design.



Pl. 147 Fresco painting in progress.

Lamp Black (*Kajal*)

Lamp black is used as black pigment for painting. Black from the lamp black soot is prepared in the following way

A lamp filled with the mustard oil is lighted and put inside an earthen pitcher and covered with a bowl. The lamp black sticks to the bowl. Carbon is the commonest colouring ingredient of black pigments. It is brought from burning wood etc. (collecting in a basket arrangement fixed in the chimney). Rosin, resinous woods, hydrocarbons, oil, peach-stones etc. may also be used to make black of many grades.

Yellow Ochre

It is a natural earth and has been used from the ancient times. It is a permanent colour but even so it should not be used in places where the painting is much exposed to the air.

Ivory Black

It is obtained originally by calcining scrap ivory in a closed vessel. Modern pigment is likely to be made from bones.

Indigo (*Neel*)

It is a vegetable die and is composed of carbonate of copper, alumina and lime. It is used for blue colour. The colour is extracted from certain plant known in modern botany as indigo frae. It has fair tinting strength and may fade rapidly when exposed to strong sunlight.

Red Lead (*Sandhur*)

This pigment is prepared by carefully roasting of litharge. This colour is not good for fresco because of two reasons. Firstly, it tends to blacken in impure air and secondly, it is actually decomposed by daylight thus returning to the dull brownish.

Cinnabar (*Vermilion*)

Cinnabar or Sulphide of mercury is one of the commonest ore and is found in pieces of fine red colour when ground. Vermilion should not be used in places exposed to the inclemency of weather because in a few days it will lose its beauty and turn to a dull mulberry colour.

Raw Umber

The umber is natural earth consisting chiefly of a hydrated oxide of iron and some oxides of manganese. Raw umber is chiefly used as an under colour. Its unique quality of coal brown is invaluable. It varies from a greenish to a natural brown.

Burnt Umber

It is used for brown colour. It is similar to ochre but containing a certain amount of manganese dioxide. Deep colour is developed by burning.

Ultramarine Blue (Lapis Lazuli)(*Lajvard*)

It is a natural form of ground lapis lazuli or *lajvard*. It is composed chiefly of the deep blue mineral lazurite embedded in a matrix of white calcite and usually also

contains small specks of pyrite. It occurs in only a few places in crystalline lime stones as a contact metamorphic mineral. It is quite a lovely colour.

Azurite

It is used for blue colour and found in natural form. It is basically a soft, deep copper mineral produced by weathering of copper ore deposits. The blue of azurite is exceptionally deep and clear, and for that reason the mineral has tended to be associated since ancient times..

Naples Yellow

It is of two kinds. A native mineral pigment found in the neighbourhood of volcanic area. The artificial pigment now in use is composed of oxide of lead and antimony.

Raw Sienna

Sienna is a form of limonite clay. Its yellow-brown colour comes from ferric oxides contained within. As a natural pigment, it was one of the first pigments used by humans, and is found in many cave paintings.

Kesar (Saffron)

It is used for orange colours.

Indian Yellow

This colour was obtained by the unique method of evaporating the collected urine of cows fed for ten days on mango leaves. The resulting paste made into balls called *gaugolis,* which gave a very brilliant yellow when diluted with water. The preparation was later banned as the process proved damaging to the health of cows, considered holy by the Hindus.

Though the natural colours used in fresco are not brilliant, but derive their beauty from the harmony of the arrangement and the judicious positioning of the colours.

The best colours are those of earth and oxide of iron which also offer a large scale of shades ranging from yellow to brown and from delicate pink to the deepest rose.

Now-a-days, pigments prepared commercially are available in the market. Some are mineral while others are vegetable pigments. These pigments are being used in fresco work.

During Mughal days, artisans normally used mineral colours ground with rice or linseed with a little quantity of molasses (*gurh*). This compound was then mixed with water and used for painting.

FRESCO SECCO PAINTING

The word secco is Italian and means dry. Italian painter Cennino Cennini (circa 1370-1440 CE) frequently uses the word secco for painting on dry plaster.. Other Italian authors denote touching up a dry fresco painting. The technique of secco sometimes goes by the rather contradictory name, fresh. Secco is done with colours ground in a binder and applied to set plaster and gives a pleasing mat surface of moderately bright colour, that resembles the effects of fresco. Secco is a surface ceasing so it is much less permanent than fresco buono, in which the colours are absorbed into wet plaster and become an integral part of the wall. Secco is a technique of great antiquity; it is regarded as a substitute of fresco buono, for use when limitations of time, money, precede the use of true fresco.

In a widely popular version of the secco technique, recorded as early as the 11th century, a finished, dry wall of pure lime plaster is drenched with lime water. Painting is done with casein colours. The colours combine with lime in a permanent bond. This method is also called lime wash painting.

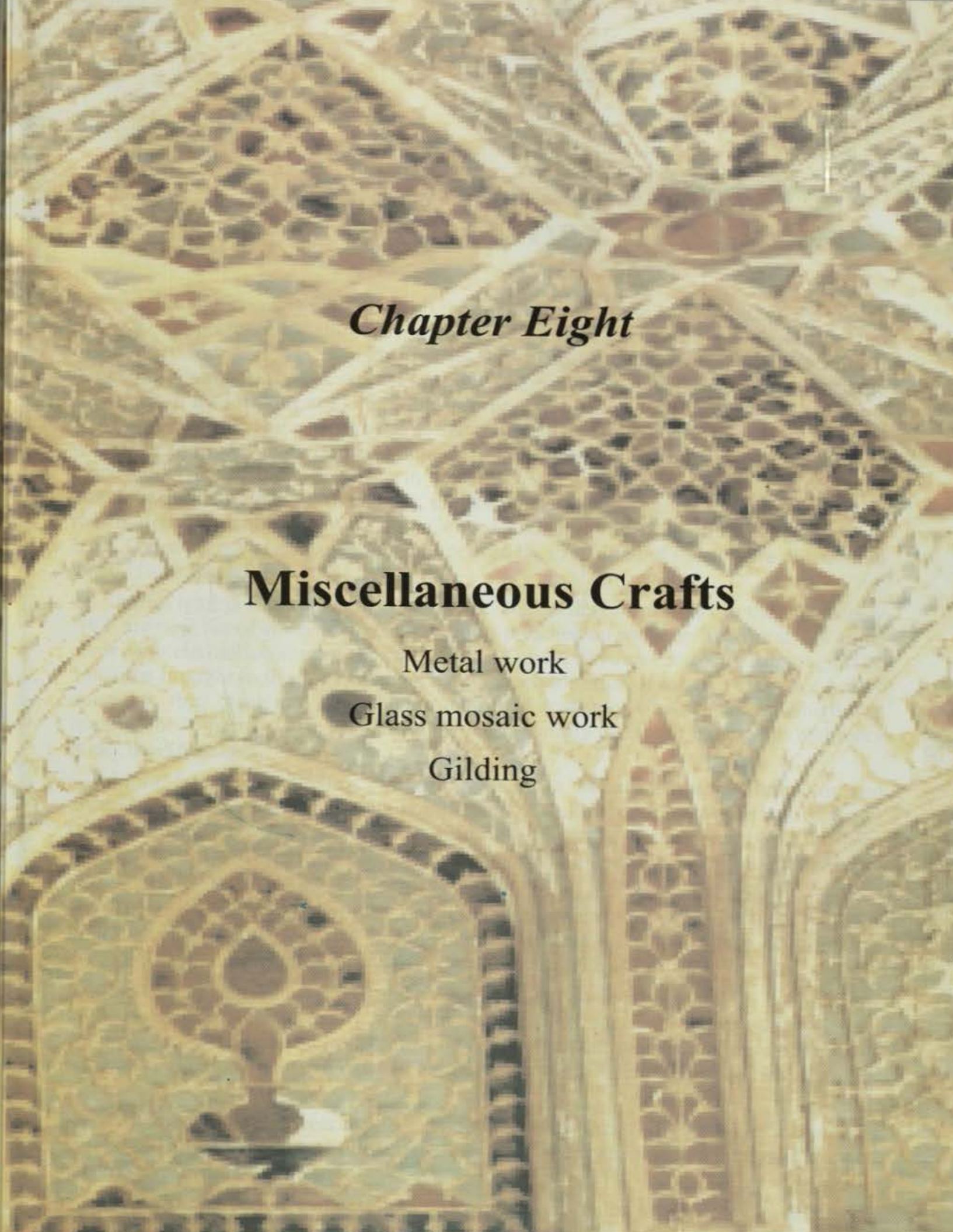
In another technique of secco painting, water and ground colours are mixed with milk of lime. For black and blue colours, a small amount of weak casein solution is added. This type of painting is usually executed in two coats. The first coat is of lighter shade than the final colours.

In Pakistan, it is widely used in southern Punjab in religious monuments. It is locally called *burani* in the language of artisans. Secco painting is found in the mausoleums of Hazard Abul Wahab Bukhari at Daira Din Pinah, Kot Addu (1602 CE), Hazrat Makhdum Rashid in District Multan, tomb of Ghulab Bibi at Bahawalpur, Hazrat Lal Eisan at Karor in District Leiah, Tomb of Pir Adil in Mauza Pir Adil, Jami Mosque at Choti Zaireen, both in District Dera Ghazi Khan, Mosque of Nawab Ali Muhammad Khan, Multan (Pl. 148), Tomb of Kh. Ghulam Farid and Kh. Dur Muhammad at Kot Mithan. The secco painting is also found in the *Zanana* (ladies) Mausoleum at Shergarh.

Technique of Secco Painting

The secco painting is done on the base of white lime plaster when it is fully dried by transferring the design on the surface of the plaster through the process called *Sozan kari*. The process of base coat and finishing coat is the same as described in fresco painting. The Mineral colours are used for paintings. *Sresh* (glue) is added as bonding material. Sometimes varnish paints (enamel paints) of different shades are used for secco paintings on dry plaster.

Pl. 148 Mosque of Nawab Ali Muhammad Khan, Multan - Secco painting.



Chapter Eight

Miscellaneous Crafts

Metal work

Glass mosaic work

Gilding

METAL WORK

The metal craft was known to the metalsmiths of the Indus Valley. The use of copper and its alloys by the people of the Indus Valley is proved by the discovery of numerous well-made utensils at Mohenjodaro and Harappa. The technique of casting sculptural figures was also known. The eight inch statue of dancing girl and the fragment of a foot with anklelet, both in bronze are an outstanding example of Indus Valley metal craft. The use of metal in that culture was limited because the raw material was to be imported from Iran and other areas. When the north western part of Pakistan came under the Achaemenid rule in the 6th century BCE, the metal work technique developed by the Persian, the Greek, the Bactrian and the Sogdians. Large quantity of raw material was also received from Central Asia, gold from Siberia and copper from Iran. The progress of craft continued as proved by a rich haul of metal ware of Kusahan period from Taxila.

Metal craft is also represented by coins. The earliest coins made in the 5th century BCE are bent bar of silver with a few symbols punched on one side. The die struck coins came into circulation during the rule of Indo-Greek, Scythian and Parthian kings. The Muslims brought to the sub continent a developed tradition of metal craft. After Arab's conquest, they came into contact with the metal craftsmen of Asia Minor, which was famous for its metal work. The craft developed rapidly under the Umayyads and more under the Abbasides.

Metal has a subordinate's place in architecture. Mostly it is concentrated on and around door hinges and catches, nails, pull rings, knockers, door plates and bosses. Rows of bosses often cover the heads of bolts holding together the wooden member of the door. Hinges were of two types. Pivot hinges were common in the area under Iranian influence while the other types were common in remainder world

The earliest examples of metal work used in architecture in Pakistan are the door knockers discovered from the Dar-ul-Imara, (Almansure) Sindh. These knockers are decorated with superb calligraphy in Kuffic character. (Pl. 149).

Nails, pull rings, door plates and bosses are found in doors of Old Fort, Lahore gates of the Hazuri Bagh complex (Pl. 150) and Derawer Fort. Metal sheets are also applied on door leaves. Such type of work is found on the doors at the mausoleums of Hazrat Farid-ud Din at Pakpattan, Hazrat Mian Mir at Lahore and Kh. Ghulam Farid at Kot Mithan (Pl. 151).

Gold plated silver sheets applied on door leaves of Hazrat Ali Hajvairi at Lahore and Hazrat Shahbaz Qalandar at Sehwan Sharif - though these are of recent manufactures and are imported from Iran.

Brass has played a great part in the decoration of Muslim armoury and architecture.

Pl. 149 Mansura Door knockers.

Pl. 150 Gate of Hazoori Bagh Lahore.

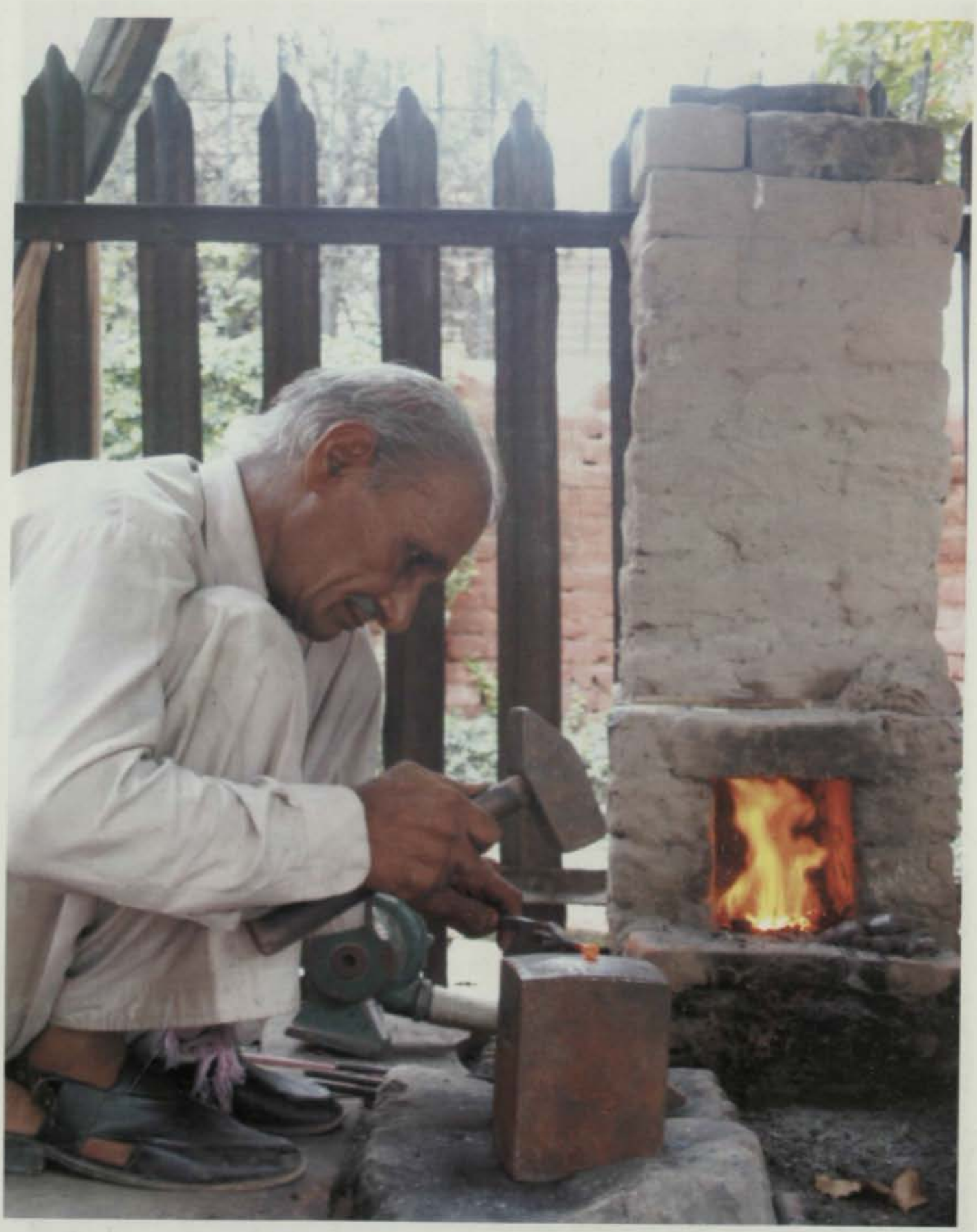
Pl. 151 Tomb of Kh. Ghulam Farid, Kot Mithan - Door covered with silver sheet.

Doors and windows of the houses and mosques were decorated with the brass knobs of various designs and also with brass work in floral and geometrical designs, either incised or applied over the door leaves. A survival of this craft can still be seen in the city of Chiniot.

In the rooms of mansion halls of mosques and other places brass chandelier (*fanoos*) or ornamental lanterns were hung both for lighting and decorative purposes. These *fanoos* were very skillfully and tastefully manufactured in a variety of designs embellished with delicate floral and *jali* designs either engraved, perforated, appliqué or inscribed and sometimes overlaid with arabesque cut in silver or bright copper.

Technique

The nails, pull rings and plates are prepared after heating the iron bars. The bar is kept in a special type of furnace and heated untill the bar gives reddish colour. The bar is then taken out with the help of *sanni* (plier). Then the bar is hammered to form the shape on an iron platform (Pl. 152).



Pl. 152 Craftsman making iron nail.

GLASS MOSAIC WORK

The art of mosaic received great impetus under the rule of Romans. During the period of their ascendancy, this art advanced to the mosaic of stone and marbles in different colours or formed the tesserae made of melted glass instead of marble pieces. The superb specimen of colour glass mosaic on a golden background in the churches of Constantinople (Turkey), and Salonika (Greece) may be mentioned. The best specimens however come from Ravenna, Italy. Object of glass have been discovered from Taxila (Pakistan) and Begram (Afghanistan).

The art of glass mosaic developed in the areas under the Byzantine Empire. This art was used for decoration in secular as well as in religious buildings in Eastern Europe.

Glass mosaic, as interior decoration was not in vogue during Akbar the Great and Jahangir. The glass work traveled from Iran to India and Pakistan.

This mode of decoration in small plain mirror glass pieces with floral and calligraphic designs is of Iranian origin where it has been in practice from at least 17th century CE. Now a days this craft is becoming a vogue in Pakistan, especially in the mosques. Our craftsmen have adopted it and have also prepared beautiful specimen of it very skillfully. One room of Governor House Lahore and the interior of shrine of Hazrat Data Ganj Bakhsh, Lahore is decorated with mirror/glass work. The interior of the Ghazi Khan Mosque at Bhong has also been decorated with plain and convex mirror work in addition to other modes of decoration.

The Mughal period glass mosaic work is in convex mirror called *Pachchi ka shisha,* which was specially manufactured for this purpose for use in the Shish Mahal, Lahore Fort (Pl. 153). This type of work is also found in the Samadh of Maharaja Ranjit Singh at Lahore (Pl. 154).

Manufacturing of Glass

Ancient glass was composed of Silica and glass modifiers (oxides of Sodium, Potassium and Calcium). Now-a-days the glass is manufactured from Silica and Soda ash. The alkaline materials are used to reduce the melting point and to impart viscosity to the molten mass.

Glasses are classified as Soda Lime Glass and Lead Glass. The proportion of the materials for these two varieties is given below.

Soda Lime Glass

Silica	70%
Sodium oxide	10%
Barium oxide	10%
Calcium oxide	8%
Alumina	2%

This type of glass is used for ordinary work.

Lead Glass

Silica	50 %
Potash	17 %
Red Lead	33 %

This type of glass is used for high class work. Now a days, for colour glass, the metallic oxides are added in the above mentioned compositions. The constituents mentioned above are fused together in a small furnace (Pl. 155). The melted glass is poured in to the mould of required shape and pressed. In old times, for the coloured glass, the back side of the glass was given a coat of lac mixed with pigment of required shade.

For convex mirror big size glass tumblers were prepared and their exterior was turned into mirror by the usual method as described below. These tumblers were then broken at random by throwing them on *pucca* surface and the broken pieces were then collected in a reed basket or *pachchi* and therefore called *pachchi ka shisha.*

Preparation of Mirror

For preparing mirror, the glass sheet is cleaned with diluted Nitric acid (*shoray ka tazab*) and washed with distilled water. It is further cleaned with alcohol or petrol.

In ancient times the glass was given a layer of mercury and tin. The cleaned glass was put in the basin of mercury and tin sheet of the size of the glass and kept under the weight for at least 24 hours. In the meantime a shining layer was applied on the glass and it was converted into mirror.

Applying a coat of silver nitrate on the cleaned glass can make the mirror. It is easily available in the market. The layer of silver nitrate can be easily scraped or damaged. To prevent this, a layer of Red lead (*sandur*) mixed with varnish is applied.

Fixing of Mirror Work

A drawing is prepared for glass/mirror work in full scale for each pattern of design. Then it is perforated along the outline of the design. This perforated drawing (*Sozen kari*) is now fixed over the leveled and smooth surface and pounched with a small bag of Muslin cloth filled with some fine powder, say lamp black. Through this process the design is transferred to the surface. The perforated drawing is then removed. Stencils are made for each small piece of different shape. Each design is marked on the mirror with the help of stencil and then cut it with the help of a diamond edge marker (Pl.156).

These small pieces of mirror are then applied with lime gypsum mortar on walls and soffits according to a scheme having floral, geometrical and figural designs (Pl. 157) and the joints are treated with minute stucco tracery work and sometime gilded too in case of convex mirror work. For minute stucco tracery work special tools are used (Pl. 158). The flat mirror work is mostly kept flush without stucco tracery work.

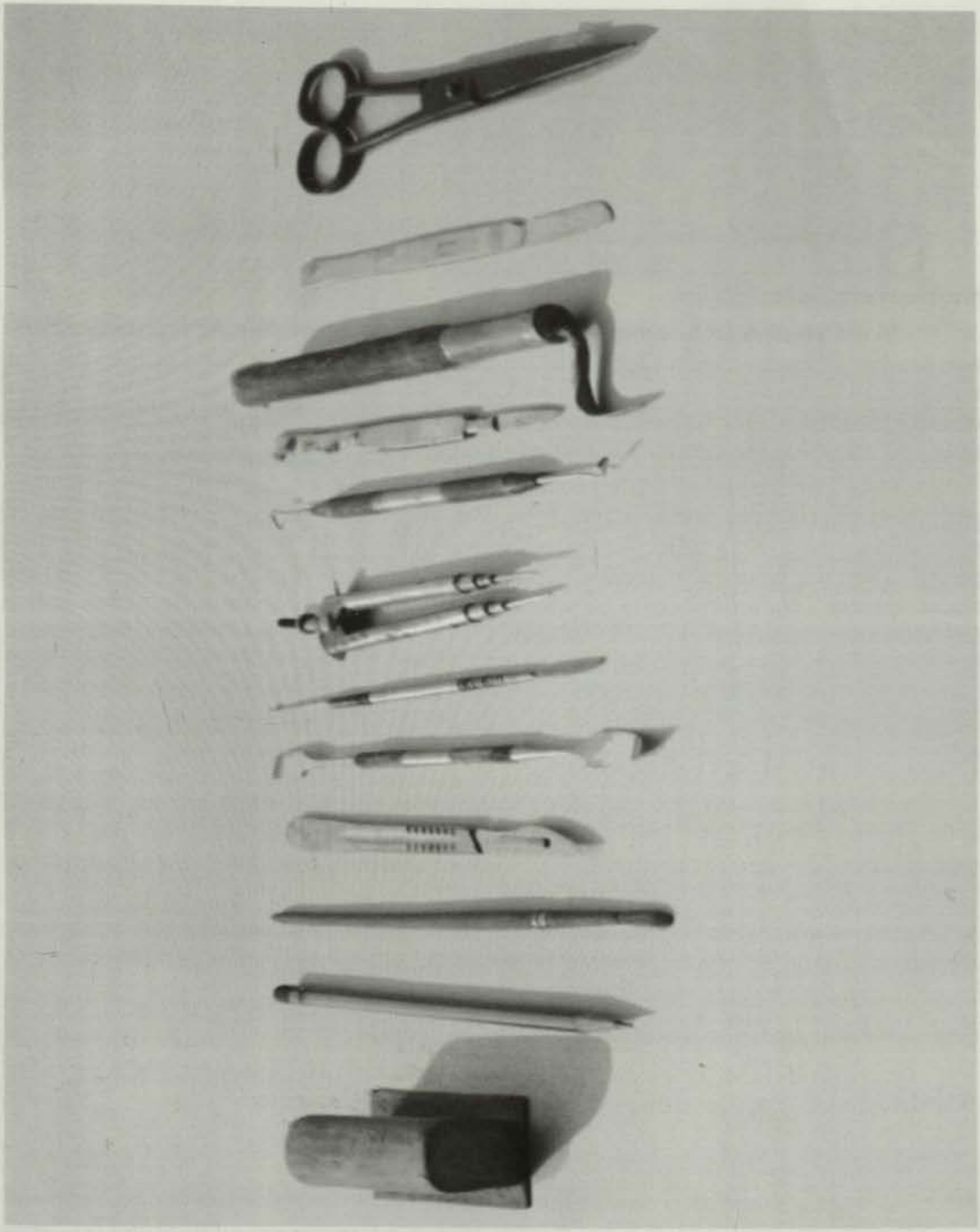
Pl. 153 Shish Mahal old Fort Lahore - Glass mosaic work.

Pl. 152 Samadh of Raja Ranjit Singh, Lahore - Detail of glass mosaic .

Pl. 155 Furnace for melting glass.

Pl. 156 Preparing stencil for application of glass work.

Pl. 157 Fixing of mirror work.



Pl. 158 Tools.

GILDING

(Mulamm'a Sazi)

Gilding with gold leaf is an ancient art of this region. In Taxila Museum there is a statue of standing Buddha dating back to 2nd -3rd century CE on which there are traces of gold leaf gilding.

In the Muslim architecture, the earliest example where gilding on copper sheets was used is the Dome of Rock (691 CE). In Pakistan the earliest gilding used in Muslim architecture is found in Hazrat Rukn-e-Alam's Mausoleum (1320-24 CE) at Multan where a piece of wood worked in the form a small branch of tree and hanging from the apex of the dome in the interior was gilded with gold leaf.

However, the use of gilding became popular during the Mughal period when the gilding was extended besides metal, to stone, stucco and wood. Traces of gilding on stone surface exist in the gallery of *Diwan-i-khas-o-aam* (1566 CE) Lahore Fort of Akber period. Then we have the marvelous glittering ceiling of Shish Mahal (1631 CE) the stucco tracery (*Munabbat kari*) of which is so tastefully and skillfully gilded that it astonishes the on lookers. (Pl. 159). Gilding is found on the pinnacle fixed on the dome of Badshahi mosque, domes of Samadh of Arjun Dev (Pl. 160) and Sonehri Mosque at Lahore (Pl. 161). Gilding on carved stucco is found in the Ghazi Mosque at Bhong in tehsil Sadiqabad.

Process of Making Gold Leaves

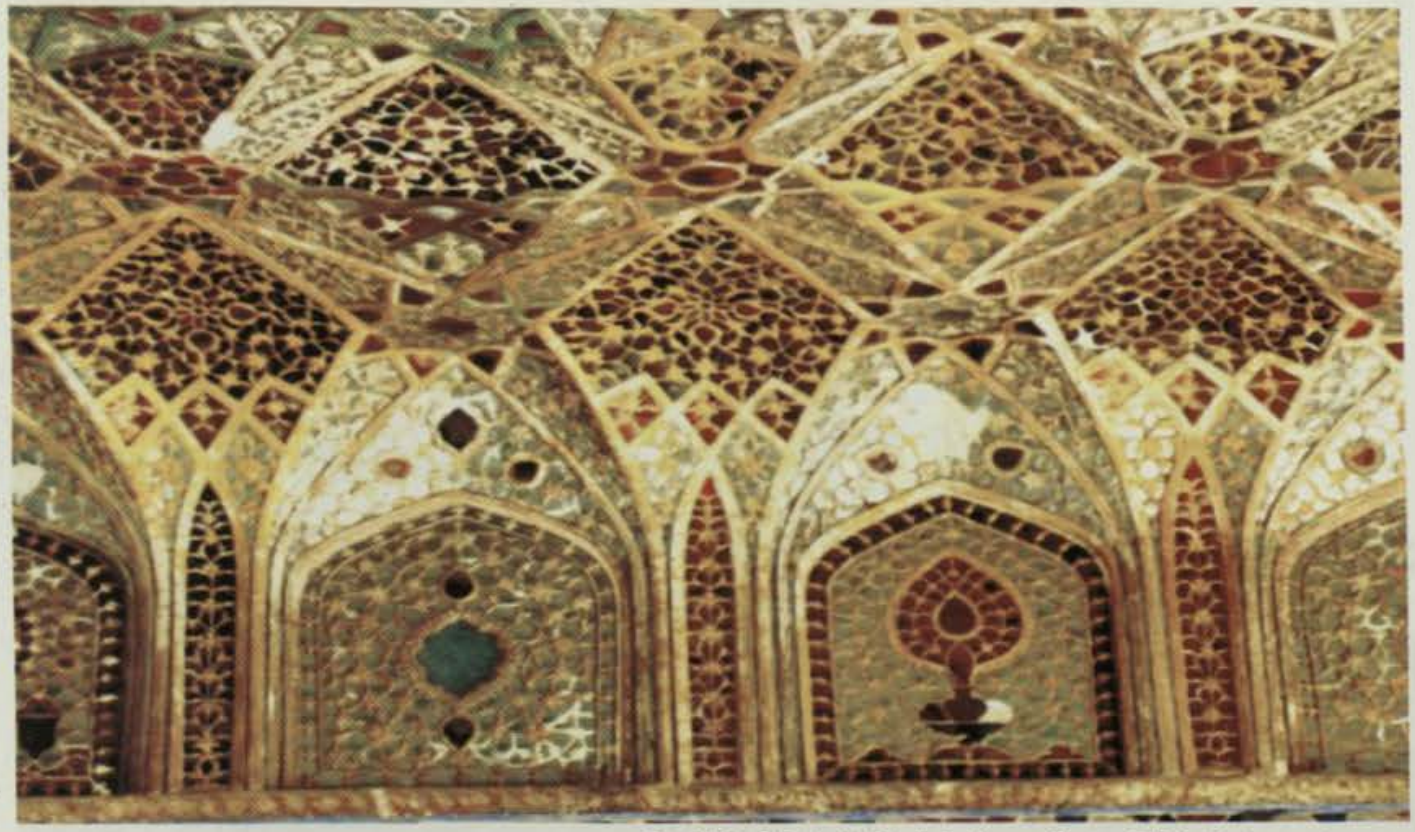
First of all one *Tola* (11.6 gm) gold (24 carat) is converted into a strip and is divided in 96 pieces of about 1/4"x1/4" size each. Then, these small cut pieces are placed in a special type of covering known as an *auzar* which is manufactured in India with the inner lining of skin of deer after tanning it (Pl. 162).

These small pieces of gold are now placed in the covering and are hammered continuously till these pieces spread in the shape of leaves 4"x4" in size. Now these leaves are ready for application on the required surface.

Preparation of Base and the Binding Material

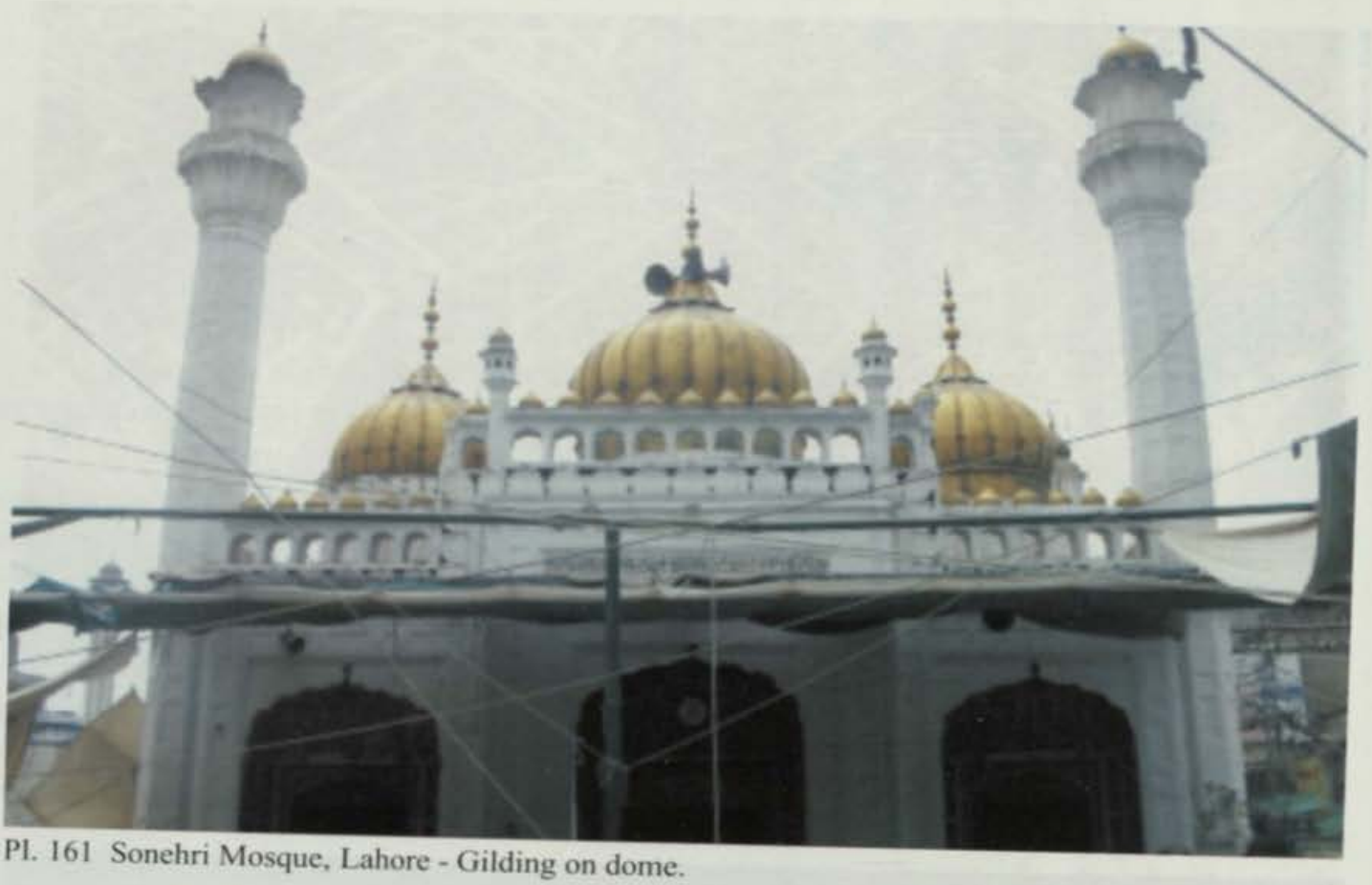
The preparation of the base and the binding material is different for gilding applied on metal, stucco, glass, wood and stone etc. as explained hereunder:-

Copper is usually used as a base metal to receive gilding. Original copper is cleaned with a solution of *Imli* (Tamarind) and Lemon, which is cured for 3 days in an earthen pot. After thoroughly cleaning, washing and buffing, it is heated on a *Keekar* coal fire and mercury treatment is given as a basic coat. Then gold leaves are applied and rendered with a special tool called *Mohra*.



Pl. 159 Shish Mahal, Lahore Fort - Gilded stucco tracery.

Pl. 160 Smadh of Arjan Dev, Lahore - Gilding on dome.

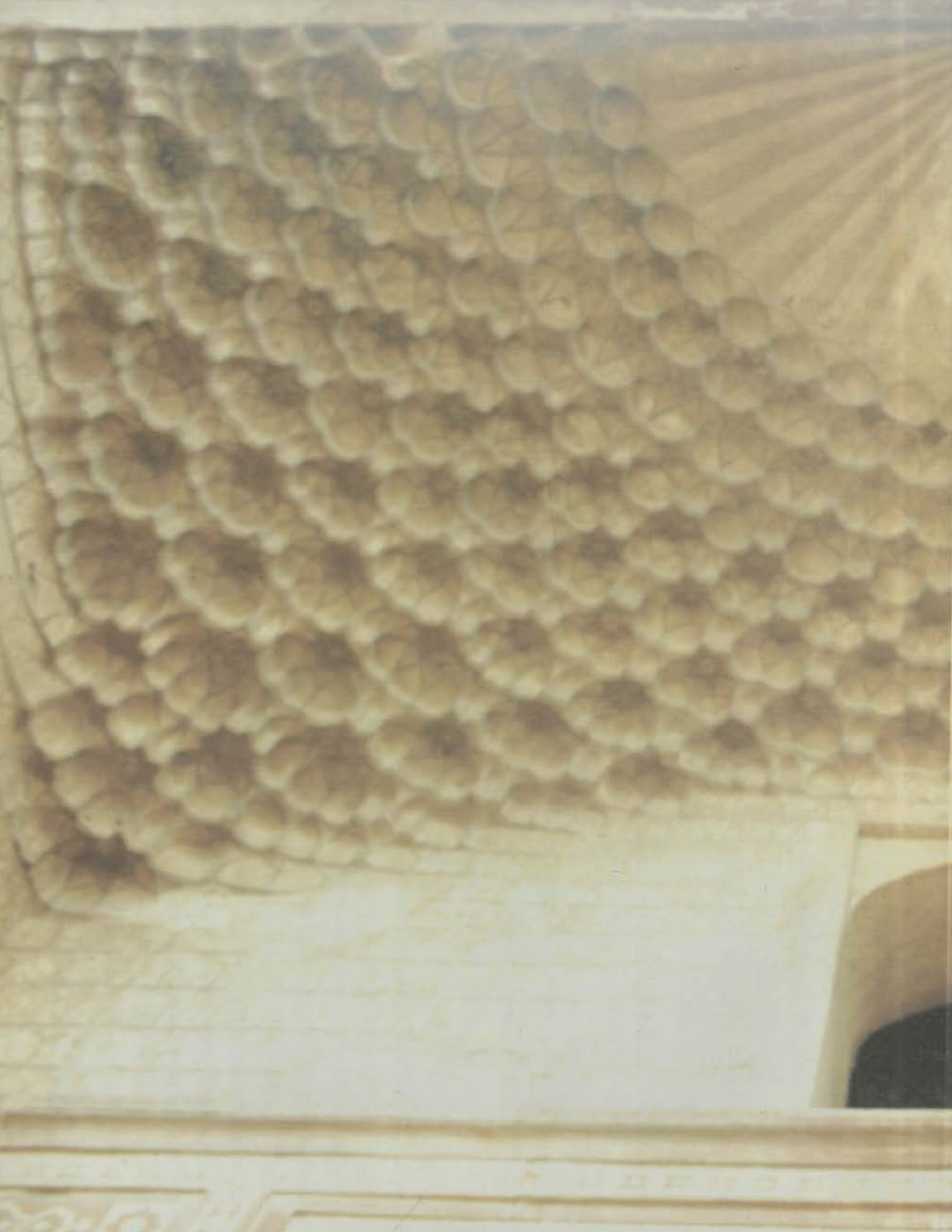


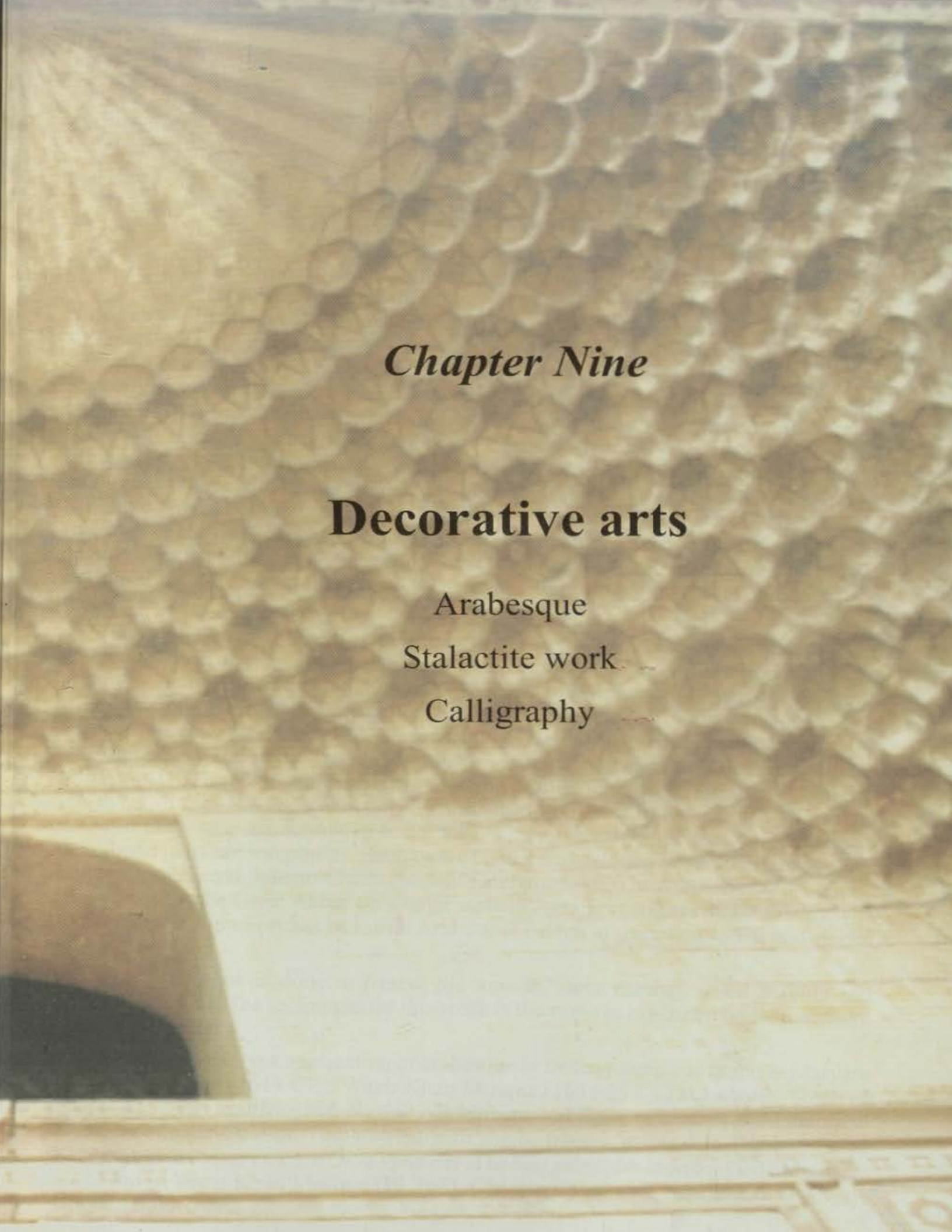
Pl. 161 Sonehri Mosque, Lahore - Gilding on dome.

Pl. 162 Craftsmen preparing gold leaf.

In the case of stucco, for the lime and plaster of Paris base coat, the binding material is prepared with the mucus of seeds of fleawort (*Isalptage Isapghol*) mixed with a very diluted sugar syrup. Varnish and glue is also used as a binding material. Then gold leaves are applied and burnished.

In case of wood after cleaning it with methylated spirit and thinner, a base coat of shellac lacquer (*lac)* saturated in methylated spirit in the ratio of 5 oz *lac* mixed in one liter of methylated spirit and kept for three days till the lacquer is fully dissolved and then applied as binding material. After applying this, gold leaves are pressed with cotton pad so that the leaves stick to the surface firmly. The binding material mentioned above can also be used for gilding on stone.





Chapter Nine

Decorative arts

Arabesque

Stalactite work

Calligraphy

ARABESQUE

As Islam does not allow portraiture of living being, this led the early Muslim Arab craftsmen to introduce the type of decoration known as Arabesque. It is called *canda* by the local artisans. It is a rhythmic design of curved lines spread over a surface, with reciprocal repetition and insertions of geometric inter-laying. In Arabesque designs a balanced and fully aesthetic design is obtained by inter-winding different types of petals, flowers, Quranic verses, the attributes of God, name of the Prophet (Peace Be Upon Him) as well as geometrical figures. The designs in flush (*hamsatah*), in relief (*burjasta*) or engraved (*paivasta*) are done in fresco, stone carving, stucco tracery, and tile mosaic, glass mosaic, wood carving and brick carving. The Arabesque was largely employed as an ornament in early Islamic period in Egypt, Syria, Iraq and Persia. It fully developed in the buildings of Seljuks in northern Persia and Transoxiana, of the Fatimid in Egypt and of the Moors in Spain in the 11th century CE. It is mostly used in the spandrels of the ornamental arches and soffits of the domes, both in religious and secular buildings of Muslim architecture. There are four stages in the evolution of the arabesque. (Fig. 27).

The earliest examples of this art can be seen as early as 691 CE in the Dome of Rock at Jerusalem. However, its most beautiful application is seen in the Turkish mosque architecture, like Masjid Hagia Sophia (1453 CE) and Mosque of Bayazid (1497-1505 CE). In India the arabesque was for the first time employed by the Muslims on the Maqsura screen of the Quwat-ul-Islam Masjid at Delhi in carved stone in the beginning of 13th century and in the spandrels of the ornamental arches of the Tomb of Iltutmish (C.1236 CE). The most exquisite representation of the Arabesque in *jali* work is found in the *jalies* of Sidi Sayyed's Mosque at Ahmadabad (Gujrat) in India. Such *jalies* with graceful arabesque are foundt in India only, where the arabesque was introduced and developed in its earliest phases. Such type of work is also found in the Jodhabai's palace and tomb of Hazrat Saleem Chishti both at Fatehpur Sikri. The Arabesque was used by the artisans of the Great Akbar on a large scale in Agra Fort and at Fatehpur Sikri. The Delhi Gate of Agra Fort has beautiful Arabesque design in stucco on soffits and arched niches.

The Arabesque is done in fresco, tile mosaic, stone carving, wood carving and stucco tracery etc.The technique for this work is the same as explained under the above mentioned crafts.

In Pakistan the best application of arabesque in fresco painting is found in Maryam Zamani's Mosque (1614 CE), Wazir Khan Mosque (1634-35 CE) at Lahore, Tomb of Shams Sabzwari and Mosque Nawab Ali Muhammad Khan (1752CE) at Multan and Shahi Mosque at Chiniot. The arabesque in stucco tracery is found in Tomb of Daud Kirmani (16th century CE) in Okara District .The best examples in enamelled tile mosaic are found in Wazir Khan Mosque (Pl .163), Chauburji Gateway, Nawan Kot Gateway, Ghulabi Bagh Gate

Pl. 163 Wazir Khan Mosque, Lahore - Arabesque in tiles mosaic work

Pl. 164 Masjid Nawab Ali Muhammad Khan, Multan - Arabesque on enamelled tile.

at Lahore. The arabesque on enamelled tiles in paint design especially on spandrel of arches, are seen in Eid Gah, Mosque of Nawab Ali Muhammad Khan Multan (Pl.164) and other monuments.

Arabesque in carved brick work is found at the tomb of Hazrat Khalid Walid in Tehsil Kabir Wala (Fig. 28), in wood carving at the tomb of Hazrat Shah Rukn-e-Alam at Multan (Fig. 29) and Tomb of Hazrat Ala-ud Din Mauj Darya at Pakpattan (Fig. 30).

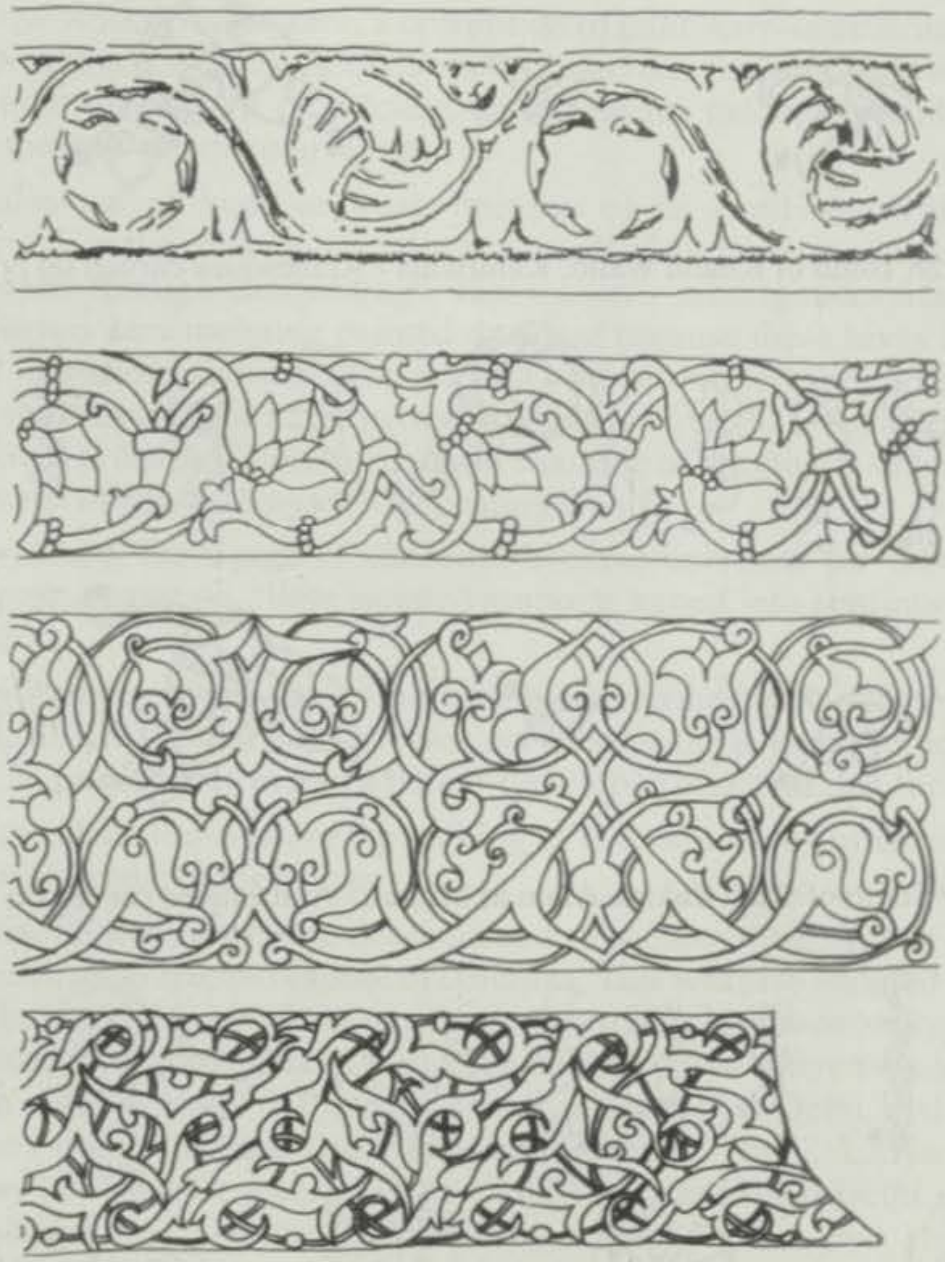


Fig. 27 Four stages in the evolution of the Arabesque. The decoration of the mosque of Amr-at-fustat (top). A 13th century panel of wood carving from Egypt and a detail from the mosque of Sidi Ukha at Qaurouan show the basic pattern developing into the free serpentine forms. In the last example of 15th century Quran from Granada.(Courtesy Architecture of the Islamic World).

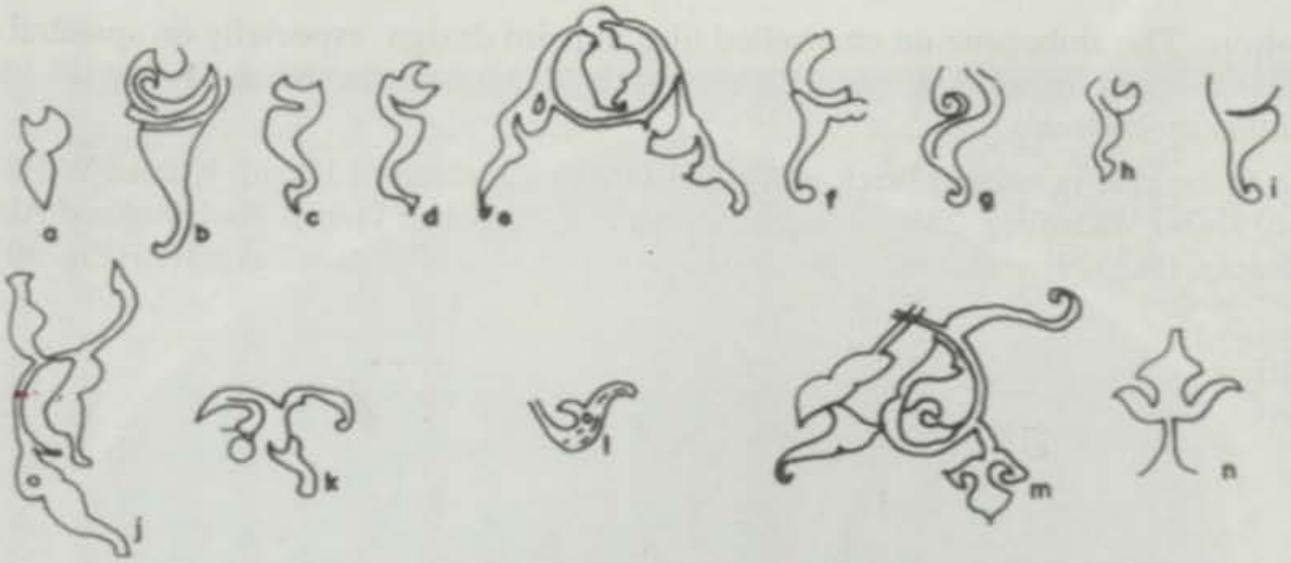


Fig. 28 Tomb of Khalid Walid, Kabirwala - Arabesques carved on bricks.

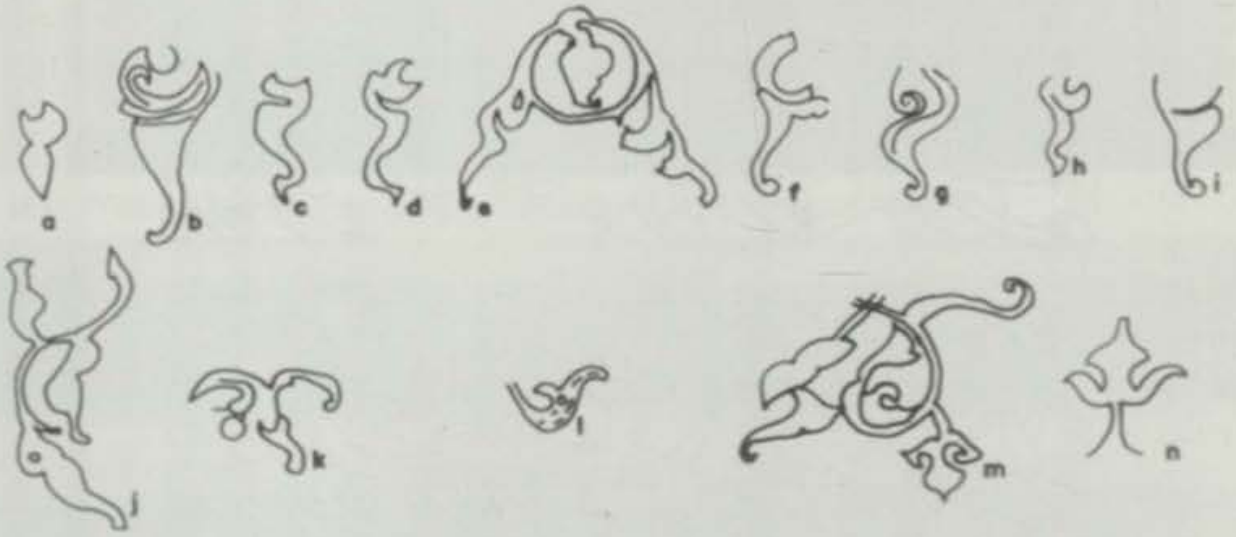


Fig. 29 Tomb of Shah Rukn-i-Alam at Multan - Arabesques carved on wood.

Fig. 30 Tomb of Ala-ud-Din at Pakpattan - Arabesques carved on wood.

STALACTITE WORK
(*GHALIB KARI)*

Stalactite work (*Ghalib kari* , a corruption of *qalib kari* or centring) is one of the most original inventions of Islamic architecture. Stalactite is from Greek word Stalaktos'-meaning a deposit of calcium carbonate (as calcite) resembling an icicle hanging from the roof or sides of a cavern.

This is also called beehive work because of its similarity with the pendant downward growth in the ceilings of caves as a result of the deposit of calcium carbonate passing with water through their ceilings. This mason's art originates from Iran where it is called *Moqarnas kari* meaning painted or inlaid because these hives or niches were painted there in various colours. The earliest and primitive example of this type of decoration in stone dates back to the period of Medes in Iran (825-559 BCE) and is found in a tomb situated at *Sarpul Zahab.* An early example of the stucco stalactite in Islamic Iran is in the vault of Masjid Nayin (10th century CE).

In 13th century, the usage of stalactite became universal for the ransom of all overhanging parts. Later on, these isolated seaports turned into continuous supports in numerous layers.

It was employed decoratively on the minaret and on the facades of the mosque of Al-Jaycee (c. 1085 CE) at Cairo. Its use became universal in the whole Islamic world in early 13th century CE, particularly in Iran where it developed into its higher form.

In India, the stalactite work of the balking of the each storey of Qutub Minar is the distinctive characteristic of the Minar.

This technique was adopted to decorate and strengthen the soffits of arched niches, squinches, vaults, *mehrabs* and capital of columns. This was also adopted in wood work, especially in the wooden *mehrabs* of mosques. From Iran this mode of decoration spread to other countries of Central Asia as well as to Indo-pakistan where the earliest example of this work in stone is found in Iltutmish's tomb (1235 CE) at Delhi, in the form of tiny niches in honey comb pattern, Tomb of Hazrat Baha-ud-Din Zakariya (1262 CE) at Multan and at Sher Shah's mosque (1540-45 CE) in *Qila Kuhna* Delhi, in the form of pendentives. Tthis mode of decoration became very popular and common during Mughal period. Mughal builders used the stalactite work on the capitals of pillars, on cornices, on the semi soffits of alcoves and portals and on the soffits of the domes and cupolas. Mostly used universally from the Great Akbar to Shah Jahan, this craft is used in the buildings during Shah Jahan reign on a very large scale and we find most exquisite and delicate specimens in marble in the *Nau Lakha Bangla* (1631 CE) pavilion in the Shish Mahal inside Lahore Fort, which is minutely decorated with *Pietra dura* work and in stucco in the Tomb of Emperor Jahangir, (Pl. 165), in the *mehrabs* of Masjid Wazir

Khan (Pl. 166),Wazir Khan's Hamam, Tomb of Dai Anga and Tomb of Nadira Begum, Lahore and Mahabat Khan Mosque at Peshawar (Pl. 167). This craft, when done in plaster, falls under stucco art and is termed as *Gach Bari* in Iran, where stucco is called *gach.*

Technique for Stalactite Work

For stalactite work, the brick structure is plastered after proper surface preparation in varying thickness according to the patterns by using various stencils to maintain and create the designs in the required thickness. In case of relief stucco decorations, *kankar* lime mortar or lime gypsum mortar is added according to the required thickness of patterns. When the plaster is almost set, then it is carved in required pattern with special type of craft tools (Pl. 168). The rough surface is smoothened by applying a layer of about 0.25 to 0.5 inches thick mortar consisting of one part of well slaked white lime and three parts of fine *kankar* lime or gypsum. In case of engraved lines, after the application of base and top layer of plaster, the lines are engraved according to the design with a sharp edged tool. The surface is then finished with glazed lime plaster using the same technique as described for glazed lime plaster work. Finally, the lines with sharp edge tool are engraved.

Pl. 165 Tomb of Emperor Jahangir, Lahore - Stalactite work.

Pl. 166 Masjid Wazir Khan, Lahore - Stalactite work.

Pl. 167 Mohabat Khan Mosque, Peshawa - Stalactite work.

Pl. 168 *Ghalib kari* (stalactite work) in progress.

CALLIGRAPHY
(*IMARTI KHATTATI*)

Calligraphy is considered the most important of the arts in the Islamic world. The use of calligraphy in architecture is the element of decoration feature on the monuments usually done by the mason craftsmen. Muslims in their construction included calligraphy in the form of verses of Holy Quran, attributes of God, *Kalmah* and the names of first four caliphs etc. in different scripts of calligraphy such as *kufic* and *naskhi*.

Calligraphy like other Islamic decorations is closely linked to geometry. In Arabic it is called 'the geometry of line', implying that the proportions of the letters including curved strokes are governed by mathematical proportions. Inscriptions are found incorporated in the decoration of almost every Islamic building. The inscriptions were generally written in angular, sabre and monumental *kufic* scripts or, later on in more cursive styles, like *naskhi* and *thuluth*. The change in these basic types varies from century to century and from region to region.

Calligraphy is applied to all parts and for building in different kinds of materials such as stucco, stone, wood, mosaic and painting.

The first, rather the very first appearance of calligraphic decorations is as early as 691 CE in the Dome of Rock, at Jerusalem. It is simple and in squat *kufic* character, letters having angular regularity. Since then this mode of decoration has been widely used all over the Muslim buildings. In fact Muslim craftsmen and builders valued the calligraphic decorations more than any other form of embellishment. By the 10th century calligraphy became a part of arabesque composition, and letters became floriated and foliated having background of vegetal scroll. In the later development the vertical shafts of individual letters are plaited to form a type of linear band decoration having regular rhythmic and symmetrical proportions.

In the early period, polychrome effects were achieved by painting or in mosaic work or by differences in materials, but after 14th century the tile mosaic and marble inlay provided thinness of line and subtle colour combination. The inlaid mosaic technique helped calligraphers as an opportunity to show their skill design in architectural decoration on a very large scale .

Inscriptions are mostly used on a frame along the top and sides of the doorways or around the main elements of the building. Arabic reads from right to left, but in architecture is frequently placed vertically. Inceptions are also need to decorate portals and cornice in particular. They look like a part of an overall design in a diaper pattern on the whole of facade, but sometimes also arranged in a single panel. Single words like

"Allah" and "Muhammad" are also repeated and arranged into patterns over the entire surface of wall. This type of calligraphy was mostly used in tile decorations in Persia but after the 13th century it was widely used in Egypt, in Mamluk buildings, in Anatolia and in North Africa.

Inscriptions have to be considered an essential element for the study of the iconographic content of Islamic architectural decoration. Calligraphy in Islam in architecture not only identifies a building, its builder but also identifies the function of the building.

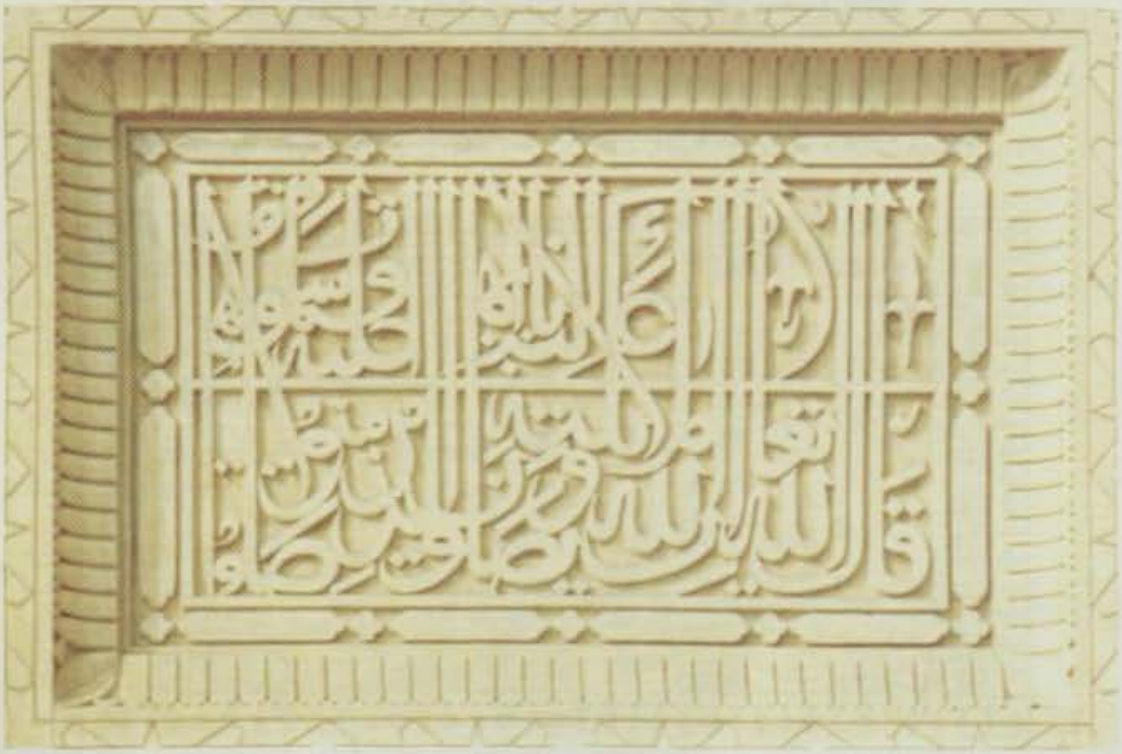
In India one of the finest calligraphic decorations in architecture is at the great arch of the mosque at Ajmer. Fine calligraphic decorations are also found around the base of Qutb Minar, Delhi in foliated *Kufic* character, in undulating bands of carving having verses of Holy Quran.

The fine examples of calligraphic decorations in Pakistan are found in the *mehrab* of mausoleum of Hazrat Khalid Walid (Khaliq Wali) in tehsil Kabir Wala (12th century CE), mausoleum of Syed Kabir near Dunyapur (13th century CE), mausoleum of Hazrat Sheikh Sadan Shaheed in district Muzaffargarh (1274 CE), mausoleum of Hazrat Shah Rukn-e-Alam at Multan (1320-24 CE) (Pl. 169), mausoleum of Hazrat Ala-ud-Din Mouj Darya at Pakpattan (14th century CE), mausoleum of Hazrat Daud Bandgi at Shergarh (Pl. 170), Masjid Wazir Khan at Lahore (1634-35 CE) (Pl. 171), Ghulabi Bagh Gateway (Pl. 172) at Lahore, Masjid Mahabat Khan at Peshawar (17th century CE) and mosques and tombs in Sind at Hyderabad, Thatta and Makli Hill. Shah Jahan Mosque (1644-58 CE) Thatta, presents the best examples of this mode of decoration. It is in the form of *Tughra* panels and arabesque carved in stone, wood, plaster, bricks enamelled tiles and glass. These are worked either in relief (*burjasta*), flush (*hamsatah*) or incised (*paivasta*).

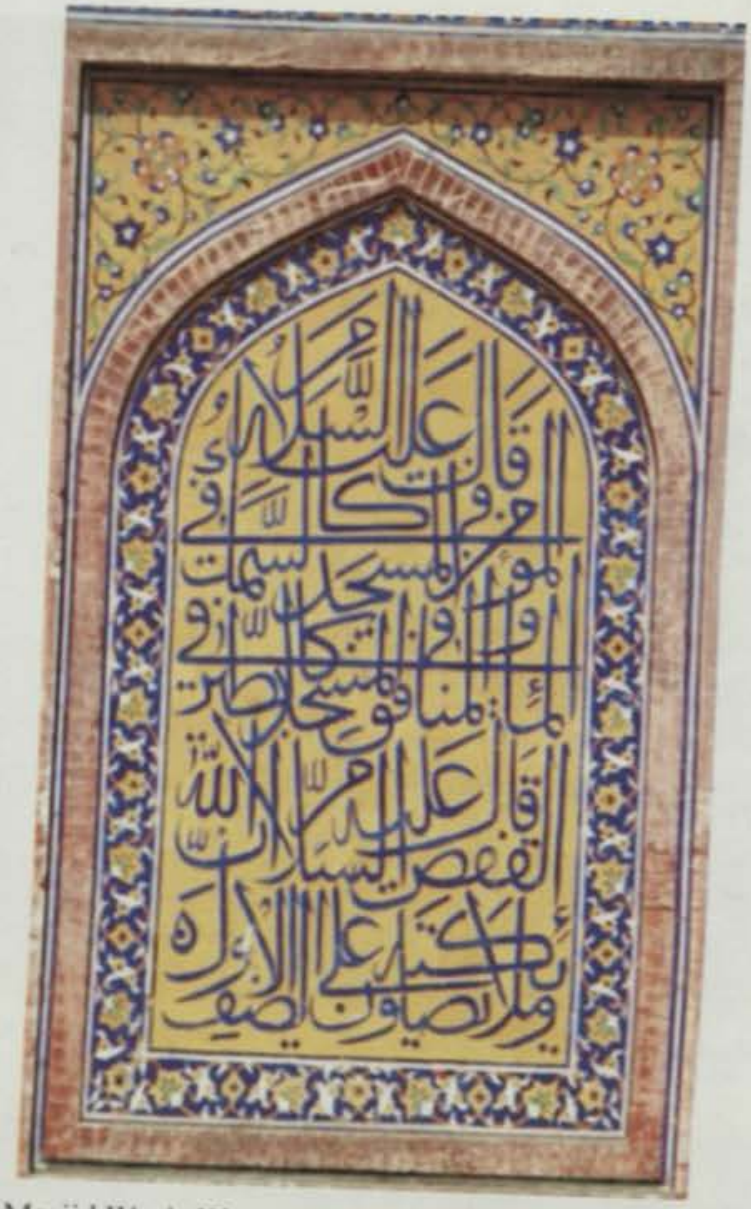
Technique of Calligraphy

For calligraphic work in fresco or stucco work etc, calligraphy on full scale is done on tracing or ordinary paper by a good calligrapher. The outlines of the words are then perforated with the help of a needle. This process is called *sozan kari*. The perforated tracing is then placed over the plastered surface, wood or stone as the case may be, where calligraphy is to be done, then some lamp black charcoal powder in muslin cloth pouch *(potli)* is puffed over the drawing, the powder penetrates through the perforations and imprints the exact lines. The perforated tracing is then removed. The design is thus transferred over the surface where it can be finished by painting for fresco or by carving in stone or wood using techniques as described under respecting crafts.

Pl. 169 Mausoleum of Hazrat Shah Rukn-e-Alam at Multan - Calligraphy work in wood.



Pl. 170 Mausoleum of Hazrat Daud Bandgi at Sher garh - Calligraphy work in stucco.



Pl. 171 Masjid Wazir Khan, Lahore - Calligraphy work in tile mosaic.

Pl. 172 Ghulabi Bagh Gateway, Lahore - calligraphy in tile mosaic work.

Appendices Glossary & Bibliography

Appendix-I

PETROGRAPHIC ANALYSIS OF TILE MADE BY ATOMIC ENERGY MINERAL CENTRE, LAHORE.

Microscopic Examination

The sample consists of three different layers. The top layer is a green coloured layer. It has dull to glazed finish. This layer was separated and a thin section was prepared. Later, the material was analyzed in XRD Laboratory for the identification of the material. The liquid clay used to decorate a ceramic piece before it has been fired and usually applied before the piece has dried is called engobe. The layer just beneath the green coloured layer is a white coloured material. This layer looks different from other phases therefore, it was separated and examined under stereomicroscope and was identified as quartz. However, for further confirmation it was given to XRD Laboratory for identification of mineral.

The bulk portion of the tile is pinkish white to off-white in colour, with occasional brown spots. A baked thin section was prepared and was studied under polarizing microscope (Olympus Model **BX 51**). A detailed study of the thin section is described later. The material from this portion was also separated and was first studied under stereo microscope and later various fractions were run on **X'Pert Pro** X-Ray diffiractometer (Phillips). Photomicrographs were also taken at various stages and of different materials.

Petrography

Two thin sections were prepared. One thin section was made from the bulk of the material in order to determine the ingredients of the material from which the tile was manufactured and another thin section was made from the chip of the green coloured material.

In order to preserve the original setting and avoid removal of clay content, if any, the bulk material from the body of the tile was impregnated with Araldite to hold the specimen together while thin sectioning. The thin section studies reveal that it consists of mainly quartz and feldspar. The grain size varies from 0.020mm (20um) to 0.93mm (930um). The constituent grains are rather closely packed and there is apparently no cementing material. However, at few places siliceous cement matrix can be seen.

The quartz grains are sub-angular to sub-rounded in shape. They are usually fine grained but some medium-grained and few coarse-grained quartz is also seen. The grain boundaries are usually diffused; however, some medium-grained quartz crystals have well-defined grain boundaries.

Feldspar grains have identical grain morphology. They are usually fine to medium-grained but few are up to 0.930mm (930um), in length. The feldspar has been identified as orthoclase (K $[AlSi_3O_8]$). It may be added that few composite grains consisting of

quartz and feldspar are also seen, which may have formed due to heating of the material during baking process. Evidence of heating and re-crystallization is seen at few places in the thin section.

There is no cementing material seen in the thin section. It is assumed that the mixture of quartz and feldspar has been crushed and then baked in a kiln to make the tile.

The approximate modal composition of the thin section is as follows:

Quartz (SiO_2)	=41%
Feldspar ($K[AlSi_3O_8]$)	=27%
Voids	=31%

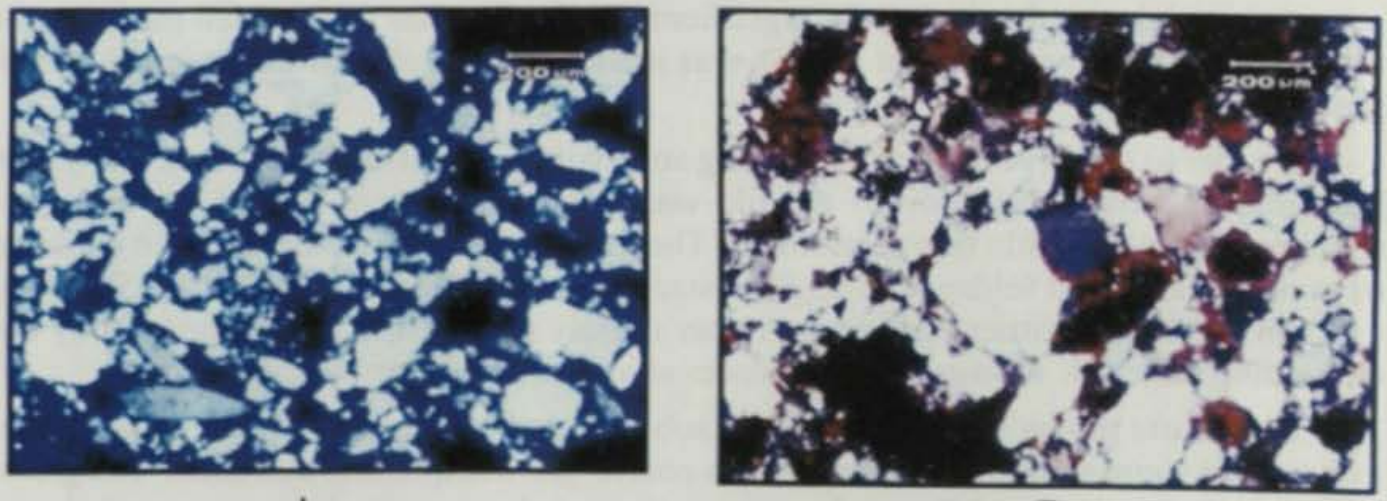
The number of voids / empty spaces is quite large and can be seen in every view. Minerals seen in accessory amount are hematite, muscovite and calcite.

A chip-mounted section of the green-colored glazed material was also prepared. It was found that it consists of very fine-grained quartz and green to yellowish green clay-grade / amorphous material, which can not be identified under polarizing microscope. The fine-grained quartz has diffused grain boundaries. The grain size of quartz in this fraction varies between 0.002mm (2um) and 0.35mm (350um).

A composite grain of quartz and feldspar seen in the middle. Few individual feldspar and quartz grains are also seen. The picture is taken in the cross-polar light.

Photomicrography

The photomicrography of the thin sections was carried out with the help of **Olympus DP12** camera, attached with the Olympus Polarizing



A B

Microscope **Model BX 51**. The scale is available on each photomicrograph.

Photomicrographs of two different views of the thin section. The white and gray grains are of quartz; the earthy gray grains are feldspar; while black portions are voids / empty spaces. Occasionally, brown-coloured hematite is also visible in the middle right side of the second photomicrograph. These are taken in cross-polar light.

C

D

The evidence of heating and re-crystallization in quartz grains. A small flake of muscovite is visible on top-left side. The picture is taken in cross-polar

The above two photomicrographs are taken from the chip mounted section of the green glazed material. In "E" amorphous green coloured material is visible; while in "F" only quartz grains, with diffused grain boundaries are visible. The green-coloured material has been removed due to slight polishing of the thin section.

X-ray Diffraction Analysis

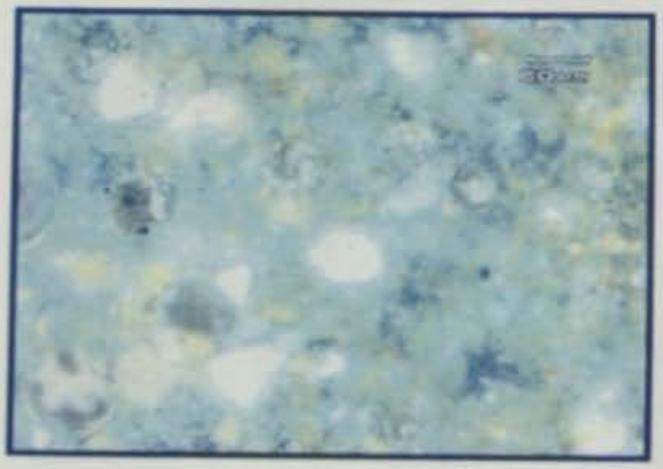
The tile was carefully examined under the stereo microscope and four fractions, on the basis of their color were separated. Afterwards these fractions were separately grounded, to fine powder and the XRD analysis of each individual fraction was carried out.

Pinkish White Fraction

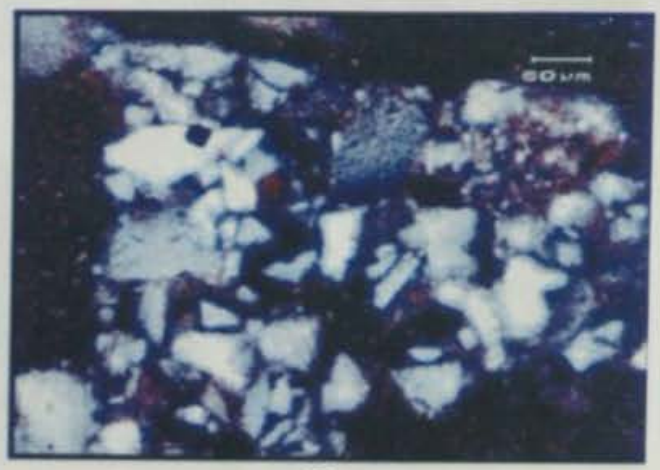
The major portion of the tile is pinkish white colour. The sample was analyzed on **X'Pert Pro X-Ray diffractometer (Phillips)** and the final result is obtained through "**HighScore Plus**" Software. The material identified is **Quartz**.

Brown Fraction

Few grains of rusty brown colour were seen scattered in different portions of the tile. These grains were separated under stereo-microscope. It may be noted that few drops of 10% diluted HCI were poured upon the sample and it was observed that it gives effervescence, indicating the presence of calcite. As the quantity of the sample was very small therefore, the **X-Ray Camera Technique** was used to identify the unknown material. The major pattern again is identical to the pattern of **Quartz.** However, few lines of **Calcite** and some impurity, which could not be identified, due to insufficient lines are recorded. It is concluded that the rusty brown portion consists of quartz, calcite and the brown colour is the staining effect of hematite, Hematite is also seen in the thin section



E



F

White fraction

The third fraction (engobe) is a white coloured layer, which lies just below the green portion. This layer looks different from other phases therefore the XRD analysis of this layer was also carried out but it is also identified as **Quartz.**

Green Color Fraction

A layer of green colour (GLAZED) on the top of the sample can easily be distinguished from the whole sample with naked eye. This layer was separated and cautiously observed under the microscope. The green colour substance looks like an amorphous material and some white grains embedded in this green layer. This layer was ground to fine powder and run on **X'Pert Pro** X-Ray diffractometer. The mineral identified is **Quartz** by using **HighScore Plus** software and few diffraction lines of some unknown phase were also recorded..

In order to confirm the green coloured material's nature, it was given heat treatment at 600° C for one hour in air. Its chance of being organic material has been nearly ruled out as green coloration remained unchanged in spite of the heating. The white portion again was identified as quartz.

Conclusion

The bulk material of the body of the tile consists of quartz (SiO_2) and feldspar (K $[AlSi_3O_8]$), grains which are usually fine to medium grained. At places, hematite, calcite and muscovite are also present but their quantities are in accessory amount only. The engobe consists of quartz (SiO_2), which is fine grained. While the green-coloured glazed material also consists of quartz (SiO_2) and some amorphous material. It could be any pigment, for which we do not have facility to identify

Sr. No.	Description of sample	Loss on ignition (%)	Insoluble & Silica (%)	R_2O_3	CaO (%)	MgO (%)	Hydraulicity ($SiO_2 + R_2O_3$) (%)	Lime /Silica Ratio	Classification EH-Eminently hydraulic. S/MH-Semi/Moderately hydraulic. F=Fat.
1.	Bichuoa Kankar (N-i) Kasur.	22.3	37.9	8.5	24.19	2.19	46.4	0.64	EH
2.	Kankar Nodules (N-ii) Kasur	26.2	38.0	7.3	28.98	2.52	45.3	0.76	EH
3.	Kankar (N-iii) Kasur.	13.8	44.2	9.0	23.18	2.18	53.2	0.52	EH
4.	Bhila Eittar Kankar.	27.2	38.0	4.1	16.16	1.8	42.1	0.43	EH
5.	33-L-FL-Road, Kasur.	26.0	37.6	5.0	19.19	2.71	42.6	0.51	EH
6.	Palto-Kallan Lead 13 Km Kasur-Lahore Road	24.3	40.2	4.9	20.06	1.28	45.1	0.50	EH
7.	Kankar, Being used for renovating work at Lahore Fort (1986).	24.26	46.64	8.76	34.01	-	55.4	0.72	EH
8.	Dera Ismail Khan Division	43.46	2.6	0.75	55.5	0.1	3.35	21	F
9.	Peshawar Division.	43.1	2.29	2.15	43.55	8.6	4.44	19	F
10.	Salt Range, Sargodha.	41.93	5.06	2.34	49.6	1.57	8.4	10	F
11.	Hyderabad Division	44.74	1.65	2.65	50.54	0.76	4.30	30	F
12.	Mango Pir, Karachi.	42.10	3.0	1.20	32.7	0.3	4.20	18	F
13.	Rohri.	43.3	2.1	1.5	53.7	0.3	3.60	26	F

Appendix-III

CHEMICAL CONSTITUENTS OF MORTARS FROM HISTORICAL BUILDINGS

Lab. Sample No.	Description of sample.	Age (Year)	Loss on ignition	Silicon dioxide insoluble matter	F_2O_3 (%)	CaO (%)	MgO (%)	SO_3	$C_aO:SiO_2$ Ratio.	Remarks /Type of cementing materials.
1.	Wall-I, mortar, upper level, Mohenjo Daro.	4500	9.029	72.8	3.6		Negligible	0.42	0.1	Mud
2.	Wall-II, mortar, middle level, Mohango Daro.	4500	9.670	73.2	3.9	7.40	"	0.52	0.1	Mud
3.	Wall-I, mortar, middle level, Mohenjo Daro.	4500	9.220	72.5	4.2	11.188	"	5.136	0.15	Mud
4.	Wall-II, mortar, about 1.75 m height Mohenjo Daro.	4500	9.859	69.6	4.0	12.644	"	0.757	0.18	Mud
5.	Wall-II, mortar, floor level, Mohenjo Daro.	4500	9.982	68.9	2.8	10.89	"	0.422	0.16	Mud
6.	Wall mortar, white Mohenjo Daro.	4500	-	2.31	0.36	31.98	Traces	47.85	-	Gypsum.
7.	Harappa mortar from near an existing Mazar.	4500	34.82	47.95	6.95	49.0	2.15	1.17	1.02	H. Lime
8.	Lahore Fort Cell.	400	22.23	55.80	7.54	16.61	1.98	2.311	0.29	K
9.	Lahore Fort Darbar.	400	22.08	55.40	8.712	16.12	2.42	1.67	0.29	K
10.	Lahore Fort Bath.	400	21.60	65.95	8.75	21.90	1.90	0.75	0.33	K
11.	Lahore Fort room near Moti Masjid.	400	25.62	40.20	6.90	25.37	2.12	Negligible	0.63	K
12.	Lahore Fort Akbari Period.	400	14.24	24.15	0.5	24.24	-	32.32	-	Gypsum
13.	Jahangiri Ahata Lahore Fort (mortar)	400	24.24	37.08	7.32	22.34	-	0.54	0.60	K
14.	-do- (plaster)	400	28.24	40.84	8.73	19.15	-	0.62	0.47	K
15.	Shah Jehan's Khawab Gah in Lahore Fort.	350	18.64	56.30	8.08	14.47	-	0.74	0.26	K+S
16.	Lahore Fort Alamgiri Gate.	315	19.85	45.1	4.2	22.79	2.67	Negligible.	0.51	K
17.	-do-	315	19.25	45.9	4.1	22.1	2.1	"	0.48	K
18.	Sample from original pipe line of Shalimar Gardens.	350	37.57	56.24	34.68	27.85	14.36	Traces	0.5	Mangnesian/ Dolomite with surkhi.
19.	White plaster below kashi kari, Shalimar Gardens.	350	33.5	27.08	4.12	29.54	9.36	0.634	1.09	F/ Magnesian.
20.	Plaster over walls without coat of white lime, Shalimar Gardens.	350	37.57	14.74	4.78	27.85	14.38	Traces	2.1	Fat/Magnesian Dolomitic.
21.	Plaster over walls with cost of white lime, Shalimar Gardens	350	33.19	24.95	2.46	31.36	2.09	"	1.25	Fat.
22.	Kashi Kari (Mosaic Work) from floor of West Gate, third Terrace, Shalimar Gardens.	350	19.29	55.72	9.54	3.7	1.82	1.13	0.07	Siliceous earth.
23.	Mortar between bricks Shalimar Gardens, Lahore	350	21.11	44.12	9.27	26.53	2.35	3.47	0.6	K
24.	Huzauri Bagh, Roshani Gate, Lahore	325	16.72	44.00	5.1	23.63	3.52	-	0.54	K
25.	Mahabat Khan's Tomb, Baghbanpura, Lahore.		17.71	40.0	6.5	26.60	2.33	-	0.67	K
26.	Ali Mardan Khan's Tomb, Loca Workshop, Lahore	350	18.25	35.95	9.2	22.90	2.67	-	0.64	K
27.	Chauburji Gardens, Lahore.	320	19.30	52.2	3.6	23.13	3.29	-	0.44	K
28.	Nadira Begum's Tomb near Mian Mir Sahib, Lahore.	325	22.25	39.9	6.4	24.30	2.71	-	0.61	K
29.	Prince Prevez's Tomb Kot Khawaja Saeed, Lahore	325	15.38	43.0	5.7	24.02	2.33	-	0.56	K
30.	Budhu's (So called) Tomb, Baghbanpura, Lahore	325	23.50	41.2	5.5	23.65	3.19	-	0.57	K
31.	Ranjeet Singh's Smadhi,, sample from well side	150	21.85	41.3	6.5	27.44	2.71	-	0.66	K
32.	Jani Baig Tomb, Baghbanpura, Lahore.		17.10	47.4	7.3	23.46	2.33	-	0.50	K
33.	Old Eid Gah, Kot Khawaja Saeed, Lahore		23.35	42.2	6.3	23.63	2.43	-	0.56	K

GLOSSARY

This glossary includes only those terms used in the text. The terms are in Urdu, Punjabi,Persian,Saraiki and Sindhi language. The translation should not be considered definitive and are included for convenience.

Aahak sufaid	آہک سفید	White lime
Aath Mass	آٹھ ماس	Octagonal
Aard maash	آرد ماش	Pulse mash
Adho Chhako	آدھو چھکو	Half hexogan
Aftaba	آفتابہ	Ewer
Aina Kari	آئینہ کاری	Glass mosaic work
Aik Surkh	ایک سرخ	Surkhy (Brick Powder)
Aik Sufaid	ایک سفید	White Lime
Arad Mash	اردماش	Pulse Mash
Allacha Bandhn	الاچا بندھنا	Making graph on stone after leaving border for making the pattern of the fret work.
Amanat	امانت	Trust
Ara Mati	آرا مٹی	A three tired design
Aramgah	آرامگاہ	Rest room
Aster-Kari	استر کاری	Engobing
Auzar	آوزار	Tool
Badhhali	بڈھالی	A gauge to check the size of brick
Bagh	باغ	Garden
Baoli	باؤلی	Stepped well
Batana	بتانا	Second coat for lime plastering
Batti	بتی	Stick made of melted shellac and pigment and used for lacquer work
Batasha	شہتا	Raw sugar
Bangla	بنگلہ	Curvilinear roof
Belgari	بیلگری	A kind of fruit
Bhain Para	بھین پارہ	A tool used for floral carving in stone
Bhananu	بھنانو	Breaking of lumps
Bhoora	بھورا	Wood dust
Binnat Kari	بنت کاری	Filigree work
Birha	بڑا	A chisel used for wood carving
Bisque	بسک	Baked body of the tiles
Burani	بورانی	Secco painting
Burjasta	برجستہ	In relief
Canda	کانڈا	Arabesque

Chakki	چکی	Rendering grinding mill or stonequern
Chakmak	چقماق	A flint stone found in Sukhar quarries, chert stone
Chal	چال	Diaper pattern
Channioh	چنی اوہ	Quartz sand obtained from Sehwan Sharif
Chau Chala	چاؤ چالا	Four Segmented Arch
Chahar Bagh	چہار باغ	Garden divided in four sections
Chhako	چھکو	Hexagon
Chheh Mass	چھ ماش	Hexagonal
Chirori	چیروری	Gypsum in the language of Sindhi artisan
Dal	دال	Pulses
Dana-i-farang	دانہ فرہنگ	Malachite
Danday Bandhna	ڈنڈے بندھنا	Process for making the design of fret
Diwan-i-Aam	دیوان عام	Hall for public audience
Dranti	درانتی	Claw chisel used for rough dressing of stone
Dugha	دوغہ	Solution of *kankar* lime passed through muslin cloth
Faiz Baksh	فیض بخش	Bountiful
Fanoos	فانوس	Chandelier
Farah Baksh	فرح بخش	Pleasure giving
Firoza	فیروزہ	Turquoise
Furma	فرما	Template
Gachi	گاچی	White clay
Gaugoli	گاؤ گولی	Balls of yellow colour by evaporating cow urine
Gads	گاڈز	Iron wedges used for splitting stone
Gardana	گردنہ	Neck of the dome
Ghalta-gol	غلطہ گول	Moulding of cyma reversa
Gulab pash	گلاب پاش	Rose water sprinkler
Gound	گوند	Gum
Gund Katira	گوند کتیرہ	Gum of Katira
Gurdwara	گوردوارہ	Sikh place of worship with hospice and school
Gurh	گڑ	Raw sugar

Guldasta	گلدستہ	Bouquet
Haft khani	ہفت خانی	Seven squared
Ham satah	ہم سطح	Design in flush
Hammam	حمام	Turkish bath
Hara Pathar	ہرا پتھر	Terre verte / natural green earth
Haveli	حویلی	House, Mansion
Hawan dasta	ہاون دستہ	An iron mortar and pestle
Hurmizi	ہرمزی	Red oxide
Hujra	حجرہ	Room, cell
Imli	املی	Tamarid
Ispaghol	اسپغول	Mucus of seeds of fleawort
Jali	جالی	Fret work
Jamper	جمپر	A tool used for boring holes in stone
Jungli rore	جنگلی روڑ	Lime nodules
Jharoka	جھروکہ	Oriel window, balcony
Jharoka-I-Daulat	جھروکہ دولت	The window of the hall of special and common audience
Jibbi	جبی	Pointing in relief
Jila	جلا	Finishing, making the surface glazed
Kajal	کاجل	Lamp black
Kanch	کانچ	Glass
Kandi	کانڈی	Trowel used for laying mortar
Kankar lime	کنکر لائم	Hydraulic lime manufactured from lime nodules found naturally
Kangura	کنگورہ	Merlon or battlement
Kareer	کریر	A special hard wood
Kashi Kar	کاشی کار	Enamelled tiles maker
Kauri	کوڑی	Shell
Kasha	کاشہ	Sun dried brick
Kesar	کیسر	Saffron
Kha	کھڈا	Pit
Khamir	خمیر	Leaven

Kharal	کھرل	Grinding pan
Khau	کھاؤ	Fire box of the furnace
Khisht Nigari	خشت نگاری	Brick Imitation work
Khurpa	کھرپہ	Weeding knife, scraper
Kikar	کیکر	Acacia wood
Kingri	کنگری	Saw tooth design
Kurund	کرنڈ	Quartzite stone
Lakh	لاکھ	Shellac
Lat bhananu	لت بھنانو	Foot kneeded
Maidah	میدہ	Fine wheat flour
Mahal	محل	Palace
Makatib Khana	مکاتیب خانہ	Clerks room
Marva	ماروا	Base coat for lime plastering in Multan area
Masjid	مسجد	Mosque
Mastagi	مصطگی	A kind of gum
Mathna	مٹھنا	A heavy chisel used for lathe work
Matka	مٹکا	A large pot
Mehrab	محراب	Nich or arched recess denooting the direction of Makkah for prayer
Mina Kari	مینا کاری	Filigree work
Master	مسطر	Straight edge
Mohra	موہرا	Rendering
Momi Kaghiz	موی کاغذ	Tracing paper
Mori	موری	Stock hole
Munabbat Kari	منبت کاری	Stucco tracery
Musallah	مصلہ	Prayer mat
Muqarnas	مقرنس	Honey combed cornice
Nah	ناہ	A chisel used for wood carving
Nali sar	نالی سار	Decorative border around window or door

Nahn	نہن	A heavy chisel used for turning in lathe work
Narja	نرجا	A tool used for carving and fret work
Narji	نرجی	A tool used for final dressing of fret work
Neel	نیل	Indigo
Nehla	نہلا	Small iron trowel
Nihan	نہان	A heavy chisel used for turning in lathe work
Obhan	اوبھان	A special kind of wood
Pachchal	پچھل	Ornamental lantern
Pachchi ka sheesha	پچھی کا شیشہ	Convex glass
Panj khani	پنج خانی	Five squared
Patasha	پتاشہ	Sugar pulm or confectionary
Paivasta	پیوستہ	Engraved
Phully	پھلی	Knobs
Peeli matti	پیلی مٹی	Yellow clay
Pick	پک	Tools used for dressing of hard stone such as granite It is long headed pointed at both ends
Pitcher	پچر	A pitching tool used for rough cutting of stone
Potli	پوٹلی	A small pounch of muslin cloth
Pucca qalai	پکا قلعی	Glazed lime plaster
Puly	پُلائی	Filling of small depression
Qab	قاب	Fruit dish
Qila Kohna	قلعہ کہنہ	Old fort
Qundh Siah	قندسیاہ	Black jaggery sugar
Rambi	رمبی	A special type of chisel having half round edge used for wood carving
Ras khar	رس کھار	Liquid khar
Reg mal	ریگ مال	Sand paper
Rore	روڑ	Lime nodule
Rota	روٹا	Second grade khar
Rowshan	روشن	Air catche

Sajji	سجی	An impure carbonate of soda
Sal	سال	Plumb bob
San	سن	Chopped jute
Sandhur (Sindhur)	سندھور	Red lead
Sang-i-Abri	سنگ ابری	Variegated marble
Sang-i-Aqiq	سنگ عقیق	Carnelion
Sang-i-Badal	سنگ بادل	Shaded marble
Sang-i-Dagasra	سنگ دگسرا	Blood stone
Sang-i-Gewa	سنگ گیوا	Agate
Sang-i-Ghori	سنگ غوری	Agate
Sang-i-Gad	سنگ گاد	Blood stone
Sang-i-Yashab	سنگ یشب	Jade
Sang-i-Jarahat	سنگ جراحت	Steatite or soap stone
Sang-i-Julswar	سنگ جلسوار	Galsper
Sang-i-Khattu	سنگ کھٹو	Yellow sand stone
Sang-i-Lajward	سنگ لاجورد	Lapislazuli
Sang-i-Lasani	سنگ لاشانی	Onyx
Sang-i-Margaz	سنگ مرغز	Serpentine stone
Sang-i-Marmar	سنگ مرمر	White marble
Sang-i-Musa	سنگ موسیٰ	Black marble
Sang-i-Phagan	سنگ پھاگن	Agate
Sang-i-Pitonia	سنگ پتونیہ	Blood stone
Sang-i-Sitar	سنگ ستار	Glass
Sang-i-Talai	سنگ طلائی	Gold
Sang-i-Tambra	سنگ تامبرا	Garnet
Sang-i-Udha	سنگ اودھا	Light yellow stone
Sankh	سنکھ	Conch shell
Sannhi	سنہی	Plier
Satcharni	ست چرنی	Seven stairs
Sathri	ستھری	A chisel used for wood carving

Se khani	سہ خانی	Three squared
Sehra	سہرا	Tassel design
Shamsa	شمسہ	Sun design
Shingrif	شنگرف	Vermilion
Shoray ka tezab	شورے کا تیزاب	Nitric acid
Sip	سپ	Mother of pearl
Sozan kari	سوزن کاری	Perforation of tracing paper along the design with the help of a needle or pin
Sua khar	سوا کھار	Khar of red colour
Surkhi	سرخی	Powder of burnt bricks
Sresh-i-Kahi	سریش کاہی	A kind of Glue
Takli	تکلی	A boaster, a tool used for final dressing of stone
Tanki	تنکی	A tool used for dressing of stone after using dranti and before final dressing.
Tawa	توا	Slabs for putting tiles for baking.
Taza Kari	تازہ کاری	Brick Imitation work
Tepa	ٹیپا	A tool used for making level points on stone surface.
Thapy	تھاپی	A special kind of wooden hammer.
Tual	توال	Glaze
Turkmani	ترکمانی	Wire bow for cutting of semi-precious stone.
Zanjira	زنجیرہ	Chain design.
Zardgi	زردگی	Yellow oxide

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About the Author

Talib Hussain is a renowned Conservation Engineer in Pakistan. He has basic qualification in civil engineering and an additional master's degree in history, with the specialty in the conservation and restoration of architectural crafts used in historic monuments.

He started his career in 1971 in the Conservation Cell of Auqaf Department (now the Directorate General of Archeology, Government of the Punjab) serving for the last about 39 years has conserved/restored more than 60 monuments in the province of Punjab. His most prestigious work has been the conservation and restoration of 14th century Tomb of Hazrat Shah Rukn-i-Alam, Multan. Besides restoring the building itself, he also under took the stupendous task of reviving 11 rare architectural crafts used in this imposing monument. For this extra ordinary job, he was awarded the prestigious International Aga Khan Award for Architecture in 1983 and an Appreciation Letter from the Governor of the Punjab.

In addition to his official responsibilities, he worked with UNESCO as Project Engineer on the Conservation and Preservation of Lahore Fort Project -- a project of UNESCO - Norway-Government of the Punjab -- and was awarded Merit Certificate. In 2008 and 2009 he was the National Project Coordinator for UNESCO on the project "Conservation of Shalamar Gardens Lahore," a project of UNESCO - Getty-Government of the Punjab. He was also the text contributor for the end project report "Conservation of Shalamar Gardens Lahore" published by UNESCO in 2009. Presently he is Director, Cultural Heritage in the Project Management Unit, Sustainable Development of Walled City Lahore Project- a project of World Bank-Government of the Punjab - Aga Khan Trust for Culture.

He has also served as Member of Expert Committee of the Government of N.W.F.P for the preservation and conservation of Mohabat Khan Mosque, Sethi Mosque and Islamia College, Peshawar.

He has written a number of research papers published in the national and international journals.

About the book

Pakistan has a number of monuments which are renowned for the colourful decorations both on the exterior and interior. The repertoire of these decorations covers a large number of crafts which vary widely in material, colours and techniques of their application. The secrets of majority of these crafts are now-a-days being jealously guarded by the descendants of a limited number of families of craftsmen in Multan, Lahore and some parts of Sindh.

This book is the first endeavor of a Conservation Engineer to uncover the secrets of these crafts and decorative arts. It was not an easy job to persuade these craftsmen and artists to unfold the secrets of their profession which their families have been guarding for centuries. The author has spent 39 long years in association with these artists, lived day and night with them, helping them, guiding and supervising them on their works. Together, both the author and his craftsmen have worked at more than 60 monuments and engaged in studying and restoring more than 21 crafts including stonework, brickwork, glazed tile work, lime plaster work, stucco tracery and fresco painting etc. Thus this book is the result of life long experience and association of the author and his craftsmen.

The book shows a complete picture of traditional architectural crafts in vogue in Pakistan. It covers nine chapters besides a comprehensive Bibliography and Glossary of technical terms in four different languages. Each chapter is profusely illustrated with photographs of relevant monuments, crafts used on them and the tools used by the craftsmen. There are 172 illustrations, all in colour, and 30 drawings which help explain different technicalities of this subject.

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