1959

Ceramic screen| Its design and contruction

Richard Huntington Bosard
The University of Montana

A Ceramic Screen

Its Design and Construction

by

RICHARD H. BOSARD

B. A. Montana University, 1958.

ssented in partial fulfillment of the requirements for the degree of

Master of Arts

MONTANA STATE UNIVERSITY

1959

Approved by:

A. Rudy Autio
Chairman, Board of Examiners

Ellis Waldron
Dean, Graduate School

AUG 18 1959
Date

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

TABLE OF CONTENTS

LIST OF FIGURES

Introduction

The purpose of this paper is to explain the design, construction and installation of a screen divider in the library of Montana State University. It describes how ceramic materials were used to solve an architectural problem in the interior of the building.

A wise Oriental is reputed to have said, "One picture is worth a thousand words." Although the pages which follow contain pictures as well as words, neither in this case is as adequate to convey an appreciation of the structure as a look at it in place.

Only time and life can affirm the validity of an architectural work, but in advance of these judgements the artist is entitled to state the premises upon which he built.

The Problem

The problem was first presented to me in an interview with Kathleen Campbell, Head Librarian, and Walter Hook, Chairman of the Art Department of the University. The library has a front hall running east and west across the entire front of the building. Three openings from this hall offer access to the ground floor foyer. Behind the foyer is a room containing encyclopedias and other general reference works on "open shelves." From the foyer a stairway rises to the second and third floors of the building which also contains library materials on "open shelves." The only control which the library maintains over the materials on these shelves is a loan desk located in the foyer adjacent to the most westerly of the three openings to the hall. Materials from the "open shelves" on all floors were being removed without authority from the library through the two uncontrolled openings, especially the most easterly of them, an archway, which was most distant from the loan desk.

Required was a means of preventing the passage of library materials through this archway without unduly restricting the passage of light and air.

I suggested the possibility of constructing a dividing screen of ceramic material. After some further discussions

Miss Campbell accepted the proposal of a ceramic screen and authorized the start of the project. (See letter - Figure 1)

From what has been said it can be understood that the project from its inception was subject to several determinatives. The overall dimensions were set by the size of the archway itself. The requirement that the passage of light and air not be unduly restricted dictated the use of an openwork screen. The dimensions of the openings in the screen were to some extent limited by the requirement that they not be large enough to permit the passage of library materials through them. Finally the architecture of the building demanded something not abusive to it.

June 17, 1959

C O P Y

Mr. Walter Hook, Chairman
Art Department
Montana State University

Dear Walter:

This memorandum confirms my conversation with you this Spring regarding the installation of a Ceramic Screen in the far east archway of the Library lobby. As both Mr. Krieger and I explained to you, the Library has a problem of control on the main floor of the Library building. What both Mr. Krieger and I had in mind, as you know, was an artistic grill work in this archway which would be both attractive and artistic, and at the same time help to meet the problem of library control. To this end, the open work between the tiles in the screen should be small enough so that library materials could not be placed through the open work into the corridor leading to the east entrance of the Library building. To have large open work between the tiles would defeat the purpose of the screen as the ultimate plan is to have control doors at the other arches of the lobby so that all students and faculty must pass by the loan Desk.

Sincerely yours,

(s) Kathleen Campbell
Librarian

KC:fsb

Figure 1

The Screen

The construction of the screen is unique in that it entails an experimental application of ceramics with a structural concept. The production involved hand building sixteen rectangular slab-constructed screen tiles 1' x 2'. Each block was built in a wooden jig so as to secure uniform exterior dimensions. The random interior design of each block which resembles filigree was put in place after a "ceramic frame" had been fashioned in the jig. The forty-eight molding tiles which surround the screen tiles were pressed into a negative plaster mold 1' x 9". The color on the screen block facings is olive green while the color on the exposed surfaces between the facings and the molding is darker green. The screen and molding tiles were fired at the University pottery and then taken to the library where they were set into the arch and mortared.

Selection and Testing of Materials

Ceramic material was selected for the construction of this screen because it is durable and versatile. Clay possesses many desirable qualities; it may be economically made into an endless variety of forms; it is enduring and successfully resists the ravages of water and fire, and it is light and strong.

The characteristics peculiar to ceramics and the extreme difficulties encountered in the vagaries of clay before it is finally conquered and forever fixed by fire hardly can be understood by anyone who has not worked with it. Seldom can a clay be used as it is dug from the ground for it usually contains varying amounts of partially disintegrated rock, flint pebbles, sand and quantities of organic matter. Even when a pure bed is found, such as that at the airport west of Missoula, chances are that poor firing characteristics will restrict its use unless they are compensated by the addition of commercial clays. Tests were made in connection with this project to obtain an inexpensive, suitable clay body that would fit this type of sculptural and structural design.

Before testing it is necessary to be cognizant of the characteristics which a good clay body should possess. Plasticity is of primary importance for upon it depends

the ability of the clay to retain its shape when wet.

Another property of good clay is porosity. An excessively plastic clay body may be too tightly compacted to allow the water to evaporate and the clay will crack during the drying period.

Vitrification at a desired temperature is another important test of a good clay body. The clay must mature at the same temperature the glaze melts.

Clay shrinks as it dries and again when it is fired. Although the amount of shrinkage indicates nothing about the quality of the clay, it is important to know how much it is going to shrink if the product must conform to specific dimensions. If this is the case, tests must be made to determine the shrinkage factor.

For this project six clay bodies were tested for physical properties and shrinkage. (See Figure 2.)

Clay body number four in the test series was chosen because it was found to possess better drying qualities combined with greater dry strength than any of the other clays tested. Because of this project the finished tiles had to conform to specific dimensions, it was absolutely essential to compute shrinkage. The shrinkage factor was determined by striking a ten inch line on a wet test tile and measuring the line after the tile had been glaze fired.

	1	2	3	4	5	6
Denver Fire Clay	40	30	30	30	10	60
Local Airport	25	35	60	50	80	100
#40 Grogite	30	32	10	20	10	40
Feldspar	05	05	05	05	05	20

Figure 2

(See Figure 3.) The line was found to measure 9 1/4". The formula set up to produce the shrinkage factor was:

$$9.25\ X = 10$$

$$X = 1.08 = \text{Shrinkage Factor}$$

The dimensions of the arch were found to be 110" in height and 56" in width.[1] It was decided that the finished tiles should be 4" in depth. The measures of wet clay which would finish to the desired dimensions were computed as follows:

$$1.08 \times 56" = 60.48"$$

$$1.08 \times 110" = 118.80"$$

$$1.08 \times 4" = 4.32"$$

The total volume of wet clay required for the project was determined as follows:

$$60.48" \times 118.80" \times 4.32" = 31039.30 \text{ cu. in.}$$

[1]The curvature at the tip of the arch was not critical and was ignored for the purposes of these calculations.

	Green Length Local Airport	Fired Length Local Airport
1	10"	9 1/4"
2	10"	9 1/16"
3	10"	9"
4	10"	9 1/8"
5	10"	8 3/4"
6	10"	9 3/16"

Figure 3

Determination of the Volume

To determine the total amount of each ingredient to be used a batch of the selected clay body was mixed using the following quantities:

Denver Fire Clay	-	6	lbs.
Local Airport	-	10	lbs.
Grog	-	4	lbs.
Silica	-	.05	lbs.

The batch was formed into a brick 10.5" x 6" x 5" and the volume of the brick computed to be 315 cu.in. The amounts of each ingredient to be used in mixing the clay for the project were then computed as follows:

$$\frac{6}{315} \quad X \quad \frac{\text{Denver Fire Clay}}{31039.30}$$

$$315\ DFC = 186235.80$$

$$DFC = 591 \text{ lbs.}$$

$$\frac{10}{315} \quad X \quad \frac{\text{Local Airport}}{31039.30}$$

$$315\ LA = 310393.00$$

$$LA = 912 \text{ lbs.}$$

$$\frac{4}{315} \quad X \quad \frac{\text{Grog}}{31039.30}$$

$$315G = 124157.20$$

$$G = 394 \text{ lbs.}$$

$$\frac{05}{315} \quad X \quad \frac{\text{Silica}}{31039.30}$$

$$315S = 1551.965$$

$$S = 5 \text{ lbs.}$$

All the ingredients were dry mixed in a mixer and water added. The wet clay was covered with plastic and aged for two weeks before construction was begun.

Technique Used for Making the Screen Blocks

Because it was impossible to render a ceramic structure of the size of this screen into one piece, it was executed in sixteen parts. The parts or tiles were formed separately in a wooden jig with inside dimensions of 13" x 26". These dimensions considered the shrinkage factor so the finished tiles were 12" x 24". The jig was designed for easy removal from the tiles. (See Figure 4.)

First four slabs were inserted along each side of the jig and bonded together at the corners so as to form a "ceramic frame." (See Figures 5, 6, & 7.) Additional slabs, bent and shaped so as to create a filigree design, were then set in place within the ceramic frame and attached to it. (See Figures 8 & 9.) After the piece was completed the jig was removed and the clay set out to dry. (See Figure 10.)

FIGURE 4

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Technique Used for Making the Molding Tiles

The molding or framing tiles were formed in a simple plaster press mold. The mold was made by casting plaster around a model block fashioned from clay. When the plaster had dried, the clay block was removed. (See Figure 11.) Each of the 48 molding or framing tiles was fashioned by pressing ceramic material into the plaster mold. (See Figures 12, 13 & 14.) The plaster absorbed enough water from the surface of the clay to break the bond between mold and tile so that when the clay had set sufficiently to retain its shape it could be extracted simply by inverting the mold. After removal from the mold the blocks were set out on flat surfaces where the drying process was completed. (See Figure 15.)

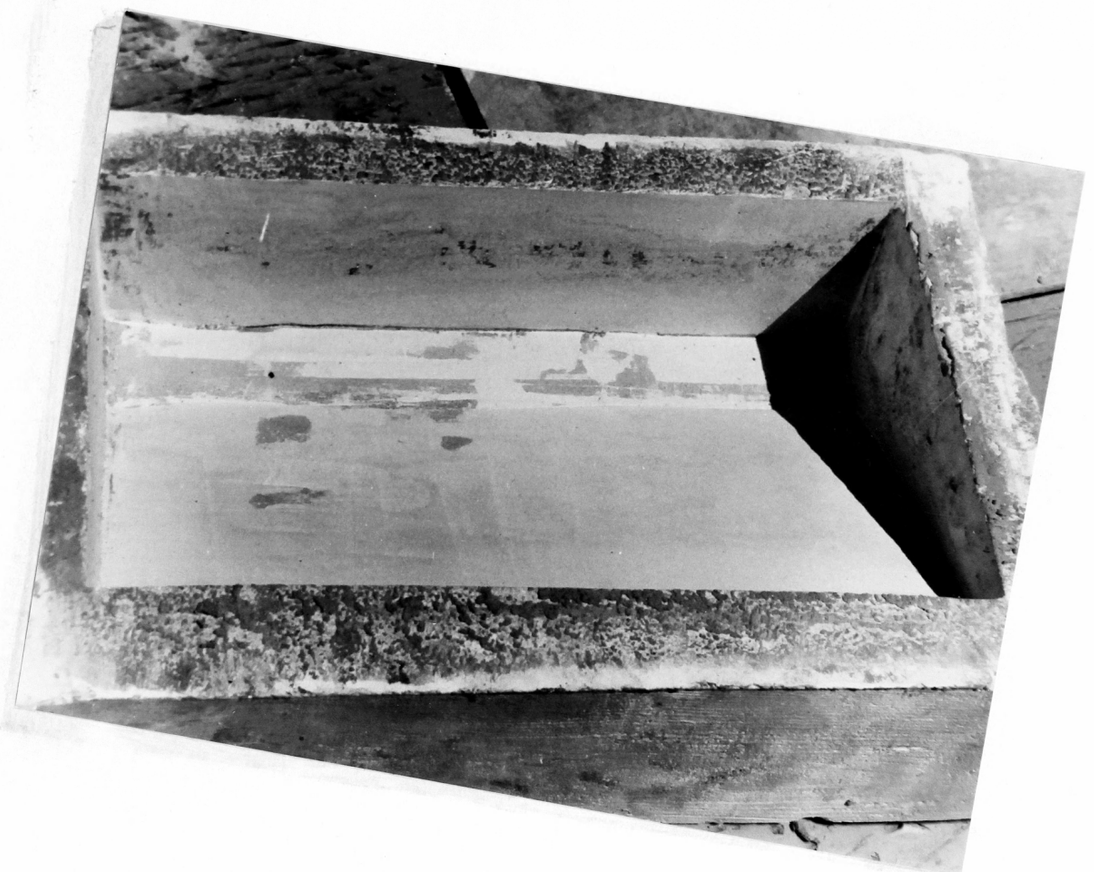

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Bisque Fire

When all the screen and molding tiles were dry, they were placed into the kiln and fired to cone 06 according to the following firing chart:

Time	Prim Burner	Center Burner	Dampers
Water Smoked 48 hours Dampers open Door open 1" on prim			
8:00 A.M.	2	none	Closed ½
9:00 A.M.	3	"	"
10:00 A.M.	4	"	"
11:00 A.M.	5	"	"
12:00 Noon	6	"	"
3:00 P.M.	7	"	"
4:00 P.M.	8	"	"
5:00 P.M.	9	"	Closed to w/in 2"
9:00 P.M.	Cone /06 over, gas off		

Color Tests

Engobe[2] was used to color and decorate the tiles because of its easy application, ability to hold during firing without running and blending into adjoining colors and its qualities of hardness and smoothness. The engobe formula used was:[3]

Kaolin	-	5.0
Ball Clay	-	15.0
Cal. Kaolin	-	20.0
Leadless Frit	-	15.0
Talc	-	15.0
Flint	-	20.0
Zircopax	-	5.0
Borax	-	5.0

This formula was specifically designed to be applied over bisqued ware.

[2]Engobe is a clay in liquid suspension which is applied to a raw body to either change the color or to give a harder, smoother surface.

[3]Dan Rhodes. Clay and Glazes for the Potter. New York: Greenburg, 1957, p. 98.

Many color tests were made. From them two colors were selected - an olive green obtained by adding two percent iron oxide to the engobe and a darker green obtained by adding six percent iron oxide. The olive green was used on the screen tile facings and the darker green on the exposed surface between the facings and the molding. The engobes were applied with a spray gun. The screen and molding tiles were then sprayed with a cone 04 clear glaze. The glaze formula was:

White Lead	-	1950.0 gr.
Corn Wall stone	-	450.0 gr.
Silica	-	600.0 gr.

The Glaze Fire

After all the tiles were glazed they were stacked in the kiln and fired to cone 02 according to the following firing chart:

Cone / 02	Time	Prim	Center	Dampers
	7:00 A.M.	1"	None	Closed ½
	8:00 A.M.	2"	"	
	9:00 A.M.	3"	"	
	10:00 A.M.	4"	"	
	11:00 A.M.	5"	"	
	12:00 Noon	6"	"	
	1:00 P.M.	7"	"	
	3:00 P.M.	8"	"	
	4:00 P.M.	9"	"	Open 2"
	9:00 P.M.	C/02 over		
	9:00 P.M.	Back to 5"		
	7:00 A.M.	off Kiln was banked and cooled slowly. Opened 8:00 Next morning		

Note: Good results. good color

Installation

After the tiles were glazed they were taken to the library. First the bottom molding tiles were layed across the floor of the archway and mortared together. Then the first vertical moldings were set in mortar and attached to the sides of the archway with metal anchors. The first course of screen tiles then was layed on top of the bottom molding tiles and reinforced with wire mesh. Course was layed on course in the manner of masonry construction until the screen was completely installed.

Appraisal of the Project

With architectural sculpture which is an integral part of a building problems of space, surroundings, purpose, scale, harmony and rapport with the exant architecture must be considered. With sculpture light is all important. The orientation of the site, the amount of light, its angle of incidence and its distribution all have an influence on the sculptor and his work. (See Figures 16 & 17.) Working indoors the sculptor rarely finds direct sunlight and must, therefore, make the best of diffused light or consider the use of artificial light. Usually this contends against massive sculpture and dictates the delicate and detailed. When the work is to be located in a public building and is going to occupy as large an area as does this screen, I feel that the sculpture can be bold and dynamic. According to these criteria I feel that this project is a success.

The execution of this work has confirmed a conviction I have long held that decorative ceramic materials may have many more structural applications than are generally realized. To the best of my knowledge the application made of the ceramic materials in this project is entirely unique. I hope that the idea of a ceramic screen constructed in large block units will have a future, and I can

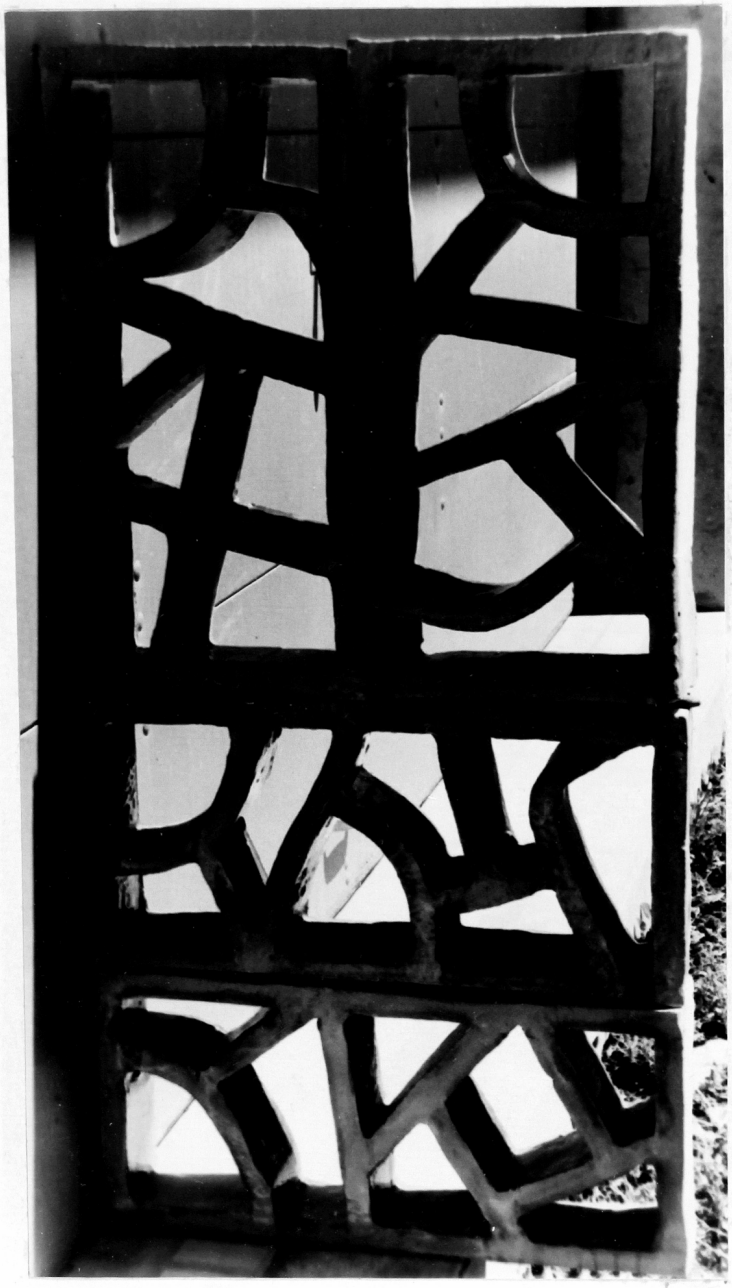

Figure 16

Figure 17

visualize the industrial utilization of similar techniques combined with extrusive processes to produce large unit tiles for facades, stained glass window frames, exterior and free standing walls and structural supports of many kinds.

Bibliography

Damaz, Paul, Art in European Architecture. New York: Reinhold Publishing Corporation, 1956.
A brilliant book showing the three major arts - Architecture, Painting, and Sculpture and their synthesis in Europe. The illustrations alone would be interesting to everybody.

Kenny, John B., The Complete Book of Pottery Making. New York: Greenberg, 1949.
A good general book and step by step pictorial technique of presenting the basic operations of ceramics. Particularly beneficial to the beginner.

Nelson, Glenn C., Ceramic Reference Manual. Minneapolis, Minnesota: Burgess Publishing Company, 1957.
A consideration of the problems of clays and glazes. More valuable to the advanced students and students interested in the technical aspects of ceramics.

Rhodes, Daniel, Clay and Glazes for the Potter. New York: Greenberg, 1957.
A scholarly study of clays and glazes plus formulas. More interesting to the advanced student.