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# ANCIENT MESOAMERICAN MORTARS, PLASTERS, AND STUCCOS: FLOOR CONSTRUCTIONS AT UAXACTUN

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ABSTRACT

The precise definition of "floor" as a building unit involving a lime aggregate or mortar (usually called fill) covered by a plaster (usually what is called the floor) the surface of which is treated by a wash coat makes possible detailed study of techniques of floor construction and the correlation of these with various cultural changes. A preliminary study of floors in Structures A–V, A–XVIII, B–XII at Uaxactún indicates that (1) floors improved in quality from Chicanel to Tepeu times, (2) post-Chicanel plasters were treated with a wash coat, especially the painted ones, and (3) the use of many small chips in Tzakol and Tepeu plasters implies extensive stone carving, because it is unlikely that stone would have been broken into such small pieces just for floor construction.

ONE OF THE objectives in studying Mesoamerican mortars, stuccos and plasters is the determination of the building techniques employed and, if possible, to etablish a relation between these techniques or methods of construction and the time or period of their use. The approach to these studies has been through chemical analysis and physical inspection of the building elements as well as through consideration of the function of the element. While the application of chemical and physical tests may, at times, disclose certain techniques employed, they may not be sufficient in all cases to yield information of use in relating the time of construction to the technique employed. As a basis for possible future studies it is, therefore, desirable that comparisons of techniques be started with floors whose dates or at least periods of construction are rather well established. This preliminary investigation was made possible through the kindness of E. M. Shook who made available a number of samples from Uaxactún. Another aspect of floor (and wall) construction which may be of significance in determining the time of construction is the "economics" of the operation as related to the availability of materials of construction and the labor required to erect the structure.

The study of floors appears to present some unique advantages in studying changes in building techniques since they are frequently datable by association with pottery, monuments or structures of known age. A further aid in the study of floors is that they have a single and unequivocal function and are entirely utilitarian. Because of the specific function of a floor and the conditions under which it was used, it is rather easy to establish its required physical characteristics: resistance to weathering and scuffing, load-bearing ability and ease of repair. The fact that floors at least in the Maya area, generally include compacted or fragmentary materials rather than cut stone reflects the consideration given by the original builders to the utility of available raw materials.

Before discussing further the techniques used in laying floors it is necessary to define the term floor as used in this presentation. It has been general practice to consider a floor as that portion of a construction that is walked upon. This broad description is inadequate for purposes of detailed characterization and the descriptive system used in earlier studies of this type (Littmann 1957) will therefore be employed. The present concept of a floor could then include such items as lime-aggregate or mortar (often referred to as fill), plaster (the covering over the lime aggregate or mortar and previously designated as a floor) and a wash coat (a treatment of the surface of the plaster). The sum of these building elements constitutes a building unit, in this case a complete floor. The building-unit concept of a floor is consistant with the functions previously ascribed to the several elements except that the lime-aggregate and mortar may, in this case, perform the same function of providing a monolithic mass (fill) over which a plaster is laid.

The idea that a floor consists of separate building elements permits a more detailed study of techniques and their associations with cultural changes than is possible when only the upper surface is described even though such description may supply valuable information. In using and proposing the concept of a floor as a building unit it is desirable to point out some of the reasons for so doing. The monolithnic portion of a floor (formerly called fill) is in reality a foundation erected to support a weight, to increase height, or simply to obtain a level surface. It must certainly have load-bearing capacity for this purpose. Unless such a foundation is protected from weather and wear it would rapidly disintegrate and lose its function. Protection, in this case, consists of applying a coat or cap of plaster. The nature of the plaster may be such that it also requires protection in which case a thin layer of plaster-like material may be applied which may also serve as a base for decorative painting. A floor is, therefore, analogous to a wall erected through the use of mortar and stone or aggregate which, in turn, are covered with plaster and possibly a wash coat as well.

It is self-evident that the monolithnic base of a floor must be associated with the plaster above it and not with any construction below unless the latter has been ripped up for consolidation with the new unit. Furthermore, the composition of the base is a reflection of the use of available materials. It may, for example contain only naturally occurring stones or a mixture of these with chips.

Such a mixture would probably point to extensive carving or stone cutting in the immediate vicinity. If, on the other hand, fragments of cut stone were present one might conclude that nearby structures, either purposely or accidentally destroyed or modified, had provided raw materials for the base of the new floor. Obviously the structures from which such fragments were obtained must have antedated the floor being studied. By the same reasoning, pottery associated with a floor base may not always be exactly contemporaneous with the floor itself. The re-use of old materials and the use or absence of burned lime are certainly economic factors which must be considered in attempting to correlate technique with time of construction. The use of easily compacted *sascab* or marl as a floor plaster in preference to burned lime represents a distinct saving in labor as well as original construction material. Availability of sufficient wood to burn the lime required for extensive floor construction may well have dictated the use of a substitute. Since the presence of carbon is the only positive evidence for the use of burned lime, its absence is reasonably good proof that it was not used and this criterion is used in the present discussion.

The construction of a floor base, while providing some information on techniques, does not present the opportunity of a plaster or wash coat to demonstrate more subtle changes in sophistication, such as the initiation of the use of burned lime or the use of a wash coat of a composition different from the plaster it covers, or even the probably yet more advanced technique of surface polishing. Whether or not the changes in techniques correlate with other cultural changes remains to be established, especially since little effort appears to have been made in this direction. The building-unit concept of floor construction, as indicated previously, makes possible a more detailed study of changing techniques than was heretofore used. While the composition of the base of a floor might throw some light on the use of available raw materials such as earth, natural rock fragments, re-used stone or broken pottery and yield information on the relation between composition and time of laying, the covering over the base would also be expected to reflect changing techniques and perhaps in a more definitive nature. This point is again illustrated in Table 1 by the change in the floor cap from marl to mortar which provided the incentive for this preliminary study of some of the floors at Uaxactún. It should be pointed out that the building-unit concept of floor construction was developed after the collection of the materials here investigated and that the opportunity for study of the bases of the floors no longer existed because of back-filling of the excavations. It is hoped that future opportunities will present themselves for the examination of complete floors.

Because of the newness of the present approach to the study of floors it is doubtful that many floor descriptions are available in the literature which would contain sufficient detail for the purpose of this work. Nevertheless the desirability of investigating floors in the detail suggested is illustrated by considering the descriptions of the floors of the A–V complex at Uaxactún (Smith 1950). The floors are described in chronological sequence from one to eight, the first six showing Chicanel pottery association and the last two, Tzakol. Table 1 presents, in simplified form, the floor descriptions and permits the making of several observations. There is a definite increase in sophistication or improvement in technique when going from Floor 6 to Floor 7 which is coincident with a change in pottery from Chicanel to Tzakol. Since the Tzakol pottery era covered a period of something over 300 years the entire sequence of eight floors was probably constructed over a period in excess of 500 years. It seems rather doubtful that the first six floors were constructed by the uniform technique implied by Table 1 and the last two by a "suddenly" changed method. It is much more likely that some evidence of a progressive change in technique was reflected in the sequence of floors.

A more detailed analysis of Uaxactún floors is given in Table 2 which combines data from the floors of several structures, grouped according to associated pottery types. Of particular significance in this table is the presence of rounded stones in all plaster samples, indicative of a water-borne material, and the absence in all cases but one, of carbon. This appears to be rather good evidence of the use of *sascab* or marl rather than burned lime. Other interpretations of the data in Table 2 may also be made, but it is felt they should be deferred until confirmation is obtained from further work.

The several floor samples from Uaxactún were, naturally, not collected with the idea of studying them along the lines discussed in this presentation. It is, therefore,

TABLE 1. FLOORS, STRUCTURE A–V, UAXACTÚN

| *Floor* | *Base Thickness* | *Plaster Thickness* | *Wash Coat* | *Base Composition* | *Plaster Composition* |
|---|---|---|---|---|---|
| 1 | 24 cm. | 1 cm. | — | Humus, small stones | Marl |
| 2 | Few cm. | ? | — | Small, dry rubble | Marl |
| 3 | Few cm. | ? | — | Small, dry rubble | Marl |
| 4 | 30 cm. (total) | | — | Dry rubble, pottery | Marl |
| 5 | 40 cm. (total) | | — | Dry fill of brown dirt, stone | Marl |
| 6 | 13 cm. | 5 cm. | — | Dirt stones | Marl |
| 7 | 7 cm. | 8 cm. | †[1] Red Paint | Lime mortar, small stones | Lime mortar, fine gravel |
| 8 | 30 cm. (total) | | — | Dry fill of stones, dirt | Lime mortar |

(1) Assumed on the basis of the floor being polished

not possible to place them in exact sequence as was done in the case of the Main Plaza floors from Tikal (Littmann, in press). As a consequence, the floors were grouped only by their pottery associations. Despite this difficulty a few observations may be made.

1. There appears to be an increase in quality of the floors from the Chicanel to the Tepeu period. Whether or not the improvement was progressive cannot be established since, to do so, it would be necessary to more closely date the individual structures of the Tzakol period.

2. The presence of wash coats is firmly established on Uaxactún plasters. This is especially true in those instances where the wash coats were painted. A singular point, however, is the fact that even in the definite wash coats the acid-insoluble content is higher than in the associated plaster and corresponds rather closely with that found in the Tikal wash coats, namely 8.4–9.2% as compared with 6.4–9.3% previously noted. While the presence of wash coats on plasters later than those associated with Chicanel pottery would tend to confirm an increase in sophistication with time, the single example of this change in technique does not warrant a definite conclusion.

3. The use of chips in the preparation of some of the plasters occurs in both the Tzakol and Tepeu periods and suggests that these periods also represent times of extensive carving activity. It seems unlikely that stone would have been broken into such small pieces just for floor construction.

## FLOOR DESCRIPTIONS

The descriptions presented below are those obtained from laboratory inspections. They include such items as stone content and the appearance of a ground face of an impregnated sample (Littmann 1958). The methods by which these results were obtained will be found in the section on procedures. The descriptions will also be found to contain comments made during the course of an examination since they are, in reality, laboratory notes.

*Uaxactún, Structure A-V*

*Floor 6.* The sample was approximately 40 by 40 by 42 mm. in size and had a flat upper surface which was painted green. The interior was cream-colored, dense, fine grained, but soft and without laminations. The ground face of an impregnated sample showed no evidence of a wash coat and the paint appears to have been applied to the smoothed surface of the floor. Only a few stones were observed in the ground face, but those recovered on crushing were no larger than 1 mm. in diameter. No carbon was observed. Plaster, 88%; stone, 12%.

*Floor 7.* The sample was 33 mm. thick and 30 by 50 mm. in area and had a flat upper surface painted green or blue-green. The interior was cream to light gray, dense, fine-grained, but soft. Along with the major sample were a number of smaller pieces which appeared to have been broken from it and which included a number of angular stones as large as 15 by 25 mm. and which appeared to be chips. There was poor adhesion of plaster to the stone imbedded in it. The ground face of an impregnated sample shows the stones. A wash coat, 0.5 mm. thick, is green throughout and appears to be the source of the surface color. The stones ranged in color from near-white to black, but all were soluble in 12% hydrochloric acid. The same colors were present in the rounded stones also present in the sample. No carbon was observed. It should be noted that the above description is not entirely consistant with Smith (1950). Plaster, 50%; rounded stone, 34%; chips, 16%.

*Temple Court Floor (a).* The sample consisted of one piece 25 mm. thick and 30 by 50 mm. in area and several smaller pieces apparently broken from the underside of the larger. The upper surface appeared to have been painted black, but when examined under the microscope the surface was found to consist of a number of small, black dots as in a half-tone which suggests that the color was due to a fungus growth. The plaster is light cream, dense, fine-grained, fairly hard and contains chips, some as large as 10 by 15 mm. Traces of wash coat were seen which showed the presence of brush marks when examined under a magnifying glass. Neither lamination nor carbon were observed. The ground face of an impregnated sample showed the presence of chips, but

TABLE 2. FLOORS, STRUCTURES A–V, B–XIII, A–XVIII, UAXACTÚN

| *Floor* | *Structure* | *Pottery* | *% Ca* | *% Mg* | *% Insoluble* | *Building Element* | *Round Stones* | *Chips* | *Carbon* | *% Stone* |
|---|---|---|---|---|---|---|---|---|---|---|
| Number 6 | A–V | Chicanel | 36.3 | 0.6 | 4.8 | Plaster | † | – | – | 12 |
| | | | 36.0 | 0.4 | 5.5 | Stone | | | | |
| Room 2 | B–XIII | Tzakol | 33.9 | 0.8 | 9.7 | Wash Coat | | | | |
| | | | 37.3 | 0.6 | 2.5 | Plaster | † | – | – | 40 |
| | | | 37.2 | 0.6 | 2.8 | Stone | | | | |
| Temple Court (a) | A–V | Tzakol | 36.4 | 1.5 | 2.1 | Plaster | † | † | – | 78 |
| | | | 36.8 | 1.5 | 1.6 | Stone | | | | |
| | | | 35.3 | 3.0 | 0.2 | Stone | | | | |
| Temple Court (b) | A–V | Tzakol | – | – | – | Wash Coat | | | | |
| | | | 37.0 | 0.6 | 3.3 | Plaster | † | † | – | 65 |
| | | | 37.5 | 0.8 | 1.4 | Stone | | | | |
| | | | 37.7 | 0.6 | 0.6 | Stone | | | | |
| Number 7 | A–V | Tzakol | 37.4 | 0.6 | 2.6 | Plaster | † | † | – | 50 |
| | | | 34.7 | 0.4 | 1.7 | Stone | | | | |
| | | | 37.3 | 0.8 | 2.7 | Stone | | | | |
| Structure A | A–XVIII | Tzakol | 36.7 | 0.8 | 2.5 | Plaster | † | – | – | 62 |
| | | | 37.6 | 0.6 | 2.1 | Stone | | | | |
| | | | 38.3 | 0.2 | 1.4 | Stone | | | | |
| Room 36 | A–V | Tepeu | 33.9 | 1.1 | 8.4 | Wash Coat (?) | | | | |
| Construction M | | | 36.9 | 0.6 | 3.5 | Plaster | † | † | † | 37 |
| | | | 37.2 | 0.6 | 2.7 | Stone | | | | |
| Room 22 | A–V | Tepeu | – | – | – | Wash Coat | | | | |
| Construction K | | | 36.3 | 0.8 | 3.7 | Plaster | † | – | – | 33 |
| | | | 37.7 | 0.8 | 2.0 | Stone | | | | |
| Room 26 | A–V | Tepeu | 36.1 | 0.6 | 6.1 | Plaster | † | – | – | 36 |
| Construction L | | | 35.2 | 0.6 | 8.2 | Stone | | | | |

no rounded stones, though these were found in a crushed sample. Plaster, 35%; rounded stones, 24%; chips, 41%.

*Temple Court Floor (b).* This sample consisted of a number of small pieces, the largest of which was 20 by 20 by 20 mm. and the smallest about 10 by 10 by 10 mm. Some fines were also present. All the pieces were similar to the other Temple Court sample except that many small, rounded stones were present in the upper surface. The upper surface had the same black color as previously noted. Chips were also present. From the nature of the sample pieces the plaster appeared to originally have been about 20 mm. thick as was the case in the other Temple Court sample. No wash coat or carbon were observed. Plaster, 22%; rounded stones, 18%; chips, 60%.

*Construction K, Room 22.* This sample contained three small pieces about 15 by 15 by 20 mm. all of which had a gray color as if mixed with earth. No large stones or carbon were observed. The ground face of an impregnated sample showed the presence of rounded stones and many small cavities in the interior of the plaster as well as a probable wash coat. The apparent wash coat may also have been the results of laying a very wet plaster and the separation of fine particles on the surface. Plaster, 67%; rounded stones, 33%.

*Construction M, Room 36.* This sample was one large piece 70 by 80 by 50 mm. and appeared to represent a total plaster thickness of 50 mm. The top and one side were dark gray to black, the result of fungus growth as previously observed. The sample was dense, white, quite hard, fine-grained and contained a small amount of carbon. It could be sawed with little breaking. The ground face of an impregnated sample shows the presence of rounded stones, carbon, white inclusions (probably lumps derived from burned lime and not well mixed with water) and a wash coat, 0.5 mm. thick, which could be separated to some extent for analysis. When dissolved in hydrochloric acid it left a clay-like residue mixed with black, gummy material. The wash coat seems much harder than the plaster. Plaster, 63%; rounded stones, 37%.

*Uaxactún, Structure A-XVIII*

*Structure A.* The sample was 45 by 65 by 30 mm. in size and very hard, dense, white, fine-grained, and strong with a smooth upper surface, but free of a wash coat. No carbon was observed, but the ground face of an impregnated sample showed the presence of rounded stones, a few larger than the rest, but also with rounded edges. The upper surface appeared to have been worked while wet. Plaster, 38%; rounded stones, 62%.

*Uaxactún, Structure B-XIII*

*Room 2.* The sample consisted of two pieces about 40 by 40 by 35 mm. in size, and it is estimated the total plaster thickness was about 35 mm. The plaster was dense, very hard, white, and strong and was covered with a green wash coat, 0.5 mm. thick, which could be separated by flaking. No carbon or large stones were observed. The wash coat may actually have been formed by applying two coats since the outer surface was a gray-green, while the area immediately underneath was a bright green. The grayness of the outer surface could also have been the result of contamination. Plaster, 60%; rounded stones, 40%.

PROCEDURES

*Analysis for stone content.* In order to approximate the stone content of a plaster it is necessary first to crush the sample lightly to destroy the adhesion between the stone and the lime without breaking the former and then cleaning the stones before drying and weighing. A 1 to 2 gram portion of plaster is crushed in a diamond mortar type of apparatus consisting of a steel tube about 5 cm. long and 1 cm. internal diameter in which are inserted two pieces of closely fitting, hardened drill rod. One piece acts as an anvil and the other as a hammer. The rods are cut so as to extend beyond the tube. The sample is placed between the anvil and the hammer which is then tapped lightly with a small hammer until, by examination, much of the lime adhering to the stones has been freed from them. The rods are removed from the tube and its contents screened through ordinary window screen. A second crushing of the stone may be required to further remove adhering lime. After a few trials it is easy to gauge the crushing force required to prevent breaking the stones. To further clean the stones, particularly to determine their shape, they should be washed and dried and if desired, weighed. The washing procedure used is as follows: about 1 gram of stone is shaken vigorously in a small, stoppered bottle with about 5 ml. water which is then decanted. The process is then repeated until the water is essentially clear or until the stones are seen to be free of lime. The washed stones may then be dried in the air for 24 hours or in an oven at about 110° C. for 1 hour. The stone content of a plaster determined by the method described is by no means quantitative even though rather large samples are examined. It is, however, indicative of the type of composition employed as a plaster.

*Analysis for calcium and magnesium.* The analyses for calcium and magnesium are based upon their volumetric determination by titration with a Versene solution. The method is described in detail in the study of the Tikal floors (Littmann, in press).

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