

TABBY ARCHITECTURE: ORIGINS AND CULMINATION

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Recent research [1] by the authors has concentrated on sites associated with tabby architecture. We have inventoried more than 100 tabby structures in Beaufort County. Intensive study (archaeological and architectural) has been made of three tabby groups on Callawassie Island (including a sugar mill), a major plantation complex on Dataw Island (20 structures, including the main house), and two forts in Beaufort. Architectural analyses have been made of the Spring Island plantation buildings and of three extant houses in Beaufort; other architectural studies have been made in Morocco. Each of these sites presents a unique spectrum of information (e.g., industrial architecture, slave settlement structure, definitive 19th century ceramic assemblages, related archival sources, non-tabby architectural elements, plantation organization) of considerable richness. The investigation of tabby architecture itself comprehends material and structural analyses, building methods, functional range, stylistic patterns, chronology, and location. An exhaustive study must consider as well related forms of.

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1. This research is being conducted by a private research organization under the direction of Lepionka and Brooker. We wish to acknowledge the assistance of the University of South Carolina at Beaufort, the South Carolina Sea Grant Consortium, the South Carolina Department of Archives and History, and the American Schools of Oriental Research. Much of the funding and other assistance for research on Dataw and Callawassie Islands has been supplied by Alcoa South Carolina, Inc., and Three Fountainview Corporation; we are particularly grateful to William Cochrane and George Oetterli, presidents, respectively, of these companies. We are very appreciative of all the cooperation and resources so kindly provided by Lucille Hays, owner, and Gordon Mobley, manager, of Spring Island. We would like to thank Brantley and Helen Harvey and George and Connie Trask for information on their homes. The Military Governor in Marrakesh was most helpful in providing access and transportation to sites in that city and surroundings. A debt is owed to Titus Burckhardt for his generous help in Fes. The excellent work of our associates Ramona Grunden, Michael Taylor, and Joe Cavanagh has contributed greatly to our research program.

architecture, regional expressions, and origins and transmission of the method, expanding the research domain by several centuries and to the circum-Caribbean region, Europe, and North Africa.

For this Festschrift presentation we have chosen to concentrate on two aspects of tabby: Its Old World antecedents, based on Spanish and North African research; and the modes of realization in tabby of large, complex structures, based on research in Beaufort County. We propose the following theses: (1) New World tabby architecture is most probably derived from a vernacular Iberian tradition which was itself based on a highly developed Moorish architecture that used tabby extensively in defensive and monumental structures (an alternative hypothesis is subsequently presented); (2) the tabby tradition is defined not by material substance (e.g., shell lime and aggregate) but by the slip-form method of construction that has been in continuous use from at least the 10th century to (in some areas) the present; (3) large multi-story structures in tabby approached the theoretical limits of the material not by massive-ness and solidity of the walls but by a complex intermeshing of timber framing and tabby, i.e., the building and the stability of such structures was vitally dependent upon simultaneous construction of both concrete and frame elements; and (4) Beaufort County tabby houses are interpretations stylistically of ultimately Palladian models.

The appearance of tabby in St. Augustine as a fully developed building technique at the beginning of the 18th century (Manucy 1962:68) has led investigators to seek its origin within indigenous European or African building traditions. Reports (e.g., Spalding 1830:620) have suggested that analogies are to be found in southern Spain and the Maghrib. In an

effort to clarify available material, we have surveyed recent publications concerned with historic construction methods in this geographical area.

Basilio Pavon Maldonado (1978) has drawn attention to a particularly pertinent passage in the Muqaddimah [2] of ibn Khaldun (ca.1377:11,320 Rosenthal Translation, 1967:359-360). Describing the use of earth and lime in building, ibn Khaldun writes:

One builds with it by using two wooden boards, the measurements of which vary according to local custom. The average measurements are four cubits by two. They are set upon a foundation. The distance between them depends on the width of the foundation the builder considers appropriate. They are joined together with pieces of wood fastened with ropes or twine. The two remaining sides of the empty space between the two boards are joined by two other small boards. Then, one puts earth mixed with quicklime into (this /frame). The earth and quicklime are pounded with special mixers used only for this purpose, until everything is well mixed throughout. Earth is then added a second and third time, until the space between the two boards is filled. The earth and quicklime have combined and become one substance. Then, two other boards are set up in the same fashion, and (the earth) is treated in the same manner, until it is ready. (All) the boards are then properly set up piece by piece, until the whole wall is set up and joined together as tightly as if it were one piece. This construction is called tabiyah and the builder of it is called tawwab.

No source is quoted, nor is any indication given as to where such methods were employed. A brief survey of ibn Khaldun<sup>f</sup>'s career before 1377 suggests, however, that this description was drawn from personal knowledge of contemporary construction practices in North Africa and Spain. He was born in Tunis on May 27, 1332. By 1354 he had settled in Fes, where he was part of the literary circle surrounding the Merinid sultan Abu Inan, and was briefly the sultans secretary. Political upheavals prompted a journey to Spain in 1362; before his return to North

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2. Ibn Khaldun states that the Muqaddimah was finished at Qal'at ibn Salamah (present Oran Province, Algeria) in 1377. Internal evidence suggests several subsequent reworkings of the manuscript in Tunis and Cairo.

Africa in 1365, ibn Khaldun enjoyed the confidence and friendship of Muhammad V, sultan of Granada. [3]

Both sovereigns were liberal and munificent patrons of architecture. Abu Inan ruled in Fes during a time of city expansion and enrichment [4] while Muhammad V is best remembered for his superb building cycle at the Alhambra (including the Court of Lions and the Court of Myrtles). Oleg Grabar (1983) has noted how aptly the role of architect responsible for royal building programs is defined elsewhere in the Muqaddimah. It is certainly possible that ibn Khaldun, in this princely environment, had opportunity to observe the progress of his masters' projects.

Archaeological studies confirm the utility of ibn Khaldun's text as a perhaps unique late medieval descriptive document, valuable for interpretation of structural features observed at a wide variety of sites. The Afrag or royal encampment at Cueta (Sabta), Morocco, investigated by Pavon Maldonado (1978) provides a firmly dated 14th century example of the use of tabiya on an extensive scale. Founded by the Merinid sultan Abu Said in 1325, surviving elements comprise part of a defensive wall and tower system. These originally enclosed a vast area of roughly rectangular shape, containing the sultan's palace, a mosque, and ancillary buildings. Square towers and intervening walls consist of a very durable mortar derived from earth and lime.

Horizontal construction levels rising at 80 cm intervals clearly indicate that the material has been cast in successive "lift" levels.

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3. Biographical details are abstracted from the Introduction to the translation of the Muqaddimah (Rosenthal 1967).
  4. The most memorable surviving project of Abu Inan is the Bou Inanina Madrassah, Fes, notable for its exquisite decoration. See Henri Terrasse 1969:821-23.

Rectangular holes left unfilled punctuate the face at the regular intervals marked by the base of the construction levels; they indicate the use of wooden form boards and result from removal of the base framing members of the shuttering. The sole remaining entrance (Bab Fas) is constructed from stone and brick. It abuts the form-cast walls of two flanking towers. A simultaneous use of tabiya, brick, and stone was in habitual practice at Cueta and occurs frequently elsewhere.

As another great Merinid enclosure, the Chella, Rabat (a royal necropolis, garden, and religious complex), tabiya is employed for walls while an impressive gateway flanked by towers is faced with finely dressed stone. Begun by Abu Said, a completion date of 1139 is given in an inscription over the entrance. Personal inspection indicates the gate and walls to be contemporary.

Most commonly noted in defensive works, such as the walls of Fes, tabiya, as ibn Khaldun seems<sup>o</sup> suggest, is very diverse in use, occurring in religious and monumental building contexts. Walls of the Hassan Mosque, Rabat (Pavon Maldonado 1970), are of tabiya faced internally with brick. At the Chella, a zawiya (monastery), closely linked in its decoration to schemes executed for Muhammad V at the Alhambra (Pavon Maldonado 1975), may have had its tabiya walls revetted with complex tile mosaics. Tabiya is used in conjunction with a brick core for the upper level of two tower-like tombs of Merinid sultans situated on el Kolla Kill outside Fes.

Such diversity of use and variety of treatments suggests that by the time of ibn Khaldun construction using tabiya had become part of a traditional building vocabulary. The walls surrounding the medina of Marrakesh may indicate that the method was of some antiquity in Morocco by the

mid-14th century. Originally built by the Almoravid prince Ali ibn Yusuf during 1126-27, they appear to have been cast using an earth based mix set in wooden forms of the tabiya type. Surviving fragments are between twenty and thirty feet high and are regularly buttressed by square towers. A History of repeated repair makes dating difficult, but successive rebuilds seem to have followed the original in form and construction.[5]

Recent archaeological studies in southern Spain have sought to clarify chronological questions and examine tabiya construction on a regional basis. In a partial survey (Bazzana 1980) of 26 castles (10th-13th centuries) in the provinces of Castellon de la Plana, Valencia, and Alicante, the casting method described by ibn Khaldun is found to be ubiquitous. Bazzana concludes that tabiya constructed in wood forms was habitually used in Muslim military architecture before the reconquista. He distinguishes various types of tabiya on the basis of material components. At Gastell Veil de la Magdalena de Castellon, construction is of an earth based mix. A mortar-like, tabiya occurs abundantly throughout the Valencia region. It contains pebbles and small blocks of calcareous material, and is the color and consistency of compact concrete. Examples include the castles of Bairen a Gandia, Alcala de Montserrat, and an observation post at the site of El Castiller a Oliva. A third tabiya category is formed in an identical fashion but contains large blocks of undressed stone.

Regardless of tabiya composition, casting methods remain constant.

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5. In the tangled relationships, both political and artistic, between North Africa and Spain, it should perhaps be noted that Ali ibn Yusuf's predecessor, Yusuf ibn Tashufin, had by the end of the 12th century suppressed most of the Muslim princes of al-Andalus. Under the Spanish Muluk al-Tawaif, tabiya construction including earth based mixes was widely distributed. For chronology see Miles (1954).

Significantly, in the majority of instances from the regions of Valencia and Levantina, individual tabiya construction levels, and therefore form heights, measure between 85 and 92 cm. Bazzana (1980) and Favon Maldonado (1978) suggest that a common modular system governs dimensions, with form-work standardized at a height of two cubits ma'muni. If this is indeed the case, it would follow that: (1) A continuous tradition of form-casting

utilizing standard elements persisted in Arab Spain from the 10th to the 13th centuries; and (2) any definition of what constitutes tabiya is dependent on analysis of formwork construction rather than composition of the material employed.

A break in constructional tradition following the Christian conquests of the mid-13th century has been detected. At the post-Muslim site of Albalat (province of Castellon de la Plana) tabiya is used but formwork heights show a departure from earlier standardization.

Tabiya continued in use on a major scale into the mid-14th century in Granada, which survived as a Muslim kingdom until 1492 (for discussion see Pavon Maldonado 1975, Torres Balbas 1940). Chronological sequences are obscure, but the exceptional preservation of a multi-phased palace complex allows some conclusions to be drawn concerning the persistence of tabiya as a constructional method. By the time of Muhammad V an aesthetic heavily dependent on surface elaboration and enrichment had been perfected in both Granada and Merinid Morocco. While complex in expression, these expansive decorative schemes were achieved using relatively insubstantial materials such as carved and molded stucco, ceramic tile, and wood mosaics. Oleg Grabar (1978) has observed that generally the Alhambra consists of "hastily and cheaply assembled masonry of mortar and friable brickwork". The evolution of a brilliant

yet economical decorative style appears to be related in part to the continuous use of such constructional systems\* While capable of repeated alteration, rapid extension, and possessed of a versatility commensurate with the demands of royal building programs, tabiya, used alone or in conjunction with brick, presented an unacceptable appearance for internal spaces. Decoration served not only to embellish, but conceal and disguise underlying structures. To contemporary observers, economy of means and cheapness of materials went unnoticed. [6]

Christian conquests brought a totally alien aesthetic, as evidenced by the Italianate palace of Charles V in the Alhambra, started in 1527 [7] (Kubler and Soria 1959). Complex decorative schemes might engender

curiosity, even admiration, but were rendered irrelevant in the context of princely and public buildings. [8]

6. The poet ibn Zamrak in a panegyric addressed to Muhammad V in praise of the Alhambra wrote "with how many a decoration have you clothed it, in order to embellish it, one consisting of multi-colored figured work which causes the brocades of Yemen to be forgotten". Translation by J. T. Monroe, 1974:354-355, line 65.
7. Muslim decorative traditions were crucial, however, to the development of the Plateresque style.
8. Our suspicion is, that stripped of its glittering decorative veneer, tabiya was relegated to utilitarian functions in vernacular idioms. That such an idiom has existed in Morocco is adequately documented. Fortified villages, ksour, are common south of the Atlas. A description of contemporary building practices in the Valley of the Dra is provided by Curtis (1983:198-99):

Once the outline of the house and its walls has been fixed, the foundation boulders are set in place, protruding a little above the ground as a damp course. The mud construction work is very arduous, for it is carried out with the most rudimentary tools. The clay is brought to the site in large baskets on the back of a mule. Water is heaved by hand in simple buckets. The shuttering is crude but ingenious. The entire framework is known as a louh, and it consists of three base logs into which six vertical staffs are temporarily

The year 1492 brought the discovery of the New World, as well as the final collapse of Muslim Spain marked by the fall of Granada. Only 17 years later, in 1509, the first building that can be interpreted as tabiya, i.e., erected with the slip form method, was constructed in Caparra, Puerto Rico,

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notched, three along each side of the form. The mold itself is slid between these two parallel rows of staffs and is made from planks. The lateral ends meanwhile are closed off by sliding pieces of wood. The entire system is then bound together at the top with thongs. The lough is usually a meter or so high; its width will depend on the intended strength of the wall. The base of a three-story house can have walls more than a meter thick; the base of a tall tighremt can be nearly twice that. In each case the top of the wall will be about fifty centimeters thick.

The mud is poured into the formwork with a rich mixture of gravel and straw or dung. These materials are then pounded down with an instrument called an imerhoz. When the mud is dry enough, the shuttering is easily removed, except for the three "put logs" at the base, which have to be eased out. The remaining holes are then filled with mud or stones. The resulting wall surface is a rich, textured brown, with lines of holes clearly showing the progress of the work. Thus, as in beton brut construction (inspired, I believe, by mud examples), an even modular surface pattern is created. However, the touch of the hand is felt throughout the ksar in the uneven textures and the slight departures from straight lines. Plumb lines were unknown in the oasis until the French arrived, and even now the traditional method for establishing a vertical is still used: the head laborer dribbles from the top of the wall. If the wall is very rough, simple scrapers are used to make joints more even.

While this method of construction is cheap in terms of the readily available materials, it is costly in terms of water and human time. A team of two principals and twelve laborers may take three months to build an average dwelling in the spring and summer building season, and even longer in the winter, when mud dries more slowly. It has been calculated that from ten to twelve pourings are possible in a single day, while two thousand small mud bricks can be produced in the same time. The traditional ksar construction is predicated on cheap labor; it is possible that in earlier days slave populations were sometimes involved in construction as well as in agriculture.

This description, resembling so closely that of ibn Khaldun, provides a strong argument for continuity of the slip form tradition; we suspect that this argument may be confirmed through the location and dating of intermediate examples.

for Ponce de Leon (Gritzner 1978:136-139). This small residence/fortification is accepted by Gritzner as the earliest Spanish rammed earth structure in the Caribbean (and, by extension, in the New World). The general absence of lime content in the building earths above foundation level excludes it from Gritzner<sup>f</sup>'s definition of tabby, which is based solely on material substance, and she does not discuss technique.

The building was called the casa de tapias [9]; de Leon (cited in Gritzner 1978:137) provides some meaning to the latter term when he of seven tapias with the battlement and merlons". In this context "tapia" can be construed as corresponding to a building level, presumably the space enclosed in some shuttering arrangement. Continuing her emphasis on material, Gritzner (Ibid.,p.139) notes that in later structures a "red earth" was used, and that by 1582 a combination of "red earth, sand, lime and coarse stone" was conventionally used. There is an implication, that this improvement in building earths was an evolutionary development, hypothetically culminating in shell-lime tabby in the next century in Florida. Alternatively, it may have resulted from the location over time of better building earth sources, and not be indicative per se of any technological improvements generated by New World experimentation.

Tapia structures are also reported from Santo Domingo and Guatemala (Gritzner 1978:138). Those in Guatemala were said to be built of pison

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9. It will be noted that the Spanish form of the word, equivalent to Arabic "tabiya", is used.

(pise), or tamped earth, while the constructed wall was called a tapia. If this term was intended to apply to the wall as a whole, there is apparently a different usage from that in Puerto Rico (Markman 1966:24-25). There is no description of building method.[10]

No indisputable link has been established between this circum-Caribbean tradition and Florida; nevertheless, St. Augustine could draw from Spanish tradition both in the New and the Old World, and probability dictates that St. Augustine building methods are most likely derived from these sources, though the late date at St. Augustine (ca. 1700) does not aid in confirming this. A possible original contribution of Spanish Florida was the use of shell as lime source and (later) aggregate, as shell lime was reported in use at Santa Elena in the 16th century and remnants of this roof mortar have been recovered (South 1982:38-39). It is this material with the addition of shell aggregate, that constitutes the typical tabby of the southeast coast of North America.

St. Augustine is generally considered as the immediate source for tabby in South Carolina. Certainly, contact between Charleston and St. Augustine was sufficiently intimate (as noted, e.g., in Harman 1969) to make this a probable inference. However, an alternative source must be considered. An English tradition of earth structures, built primarily by the cob technique (i.e., without shuttering) had a long history, with recorded structures from the 16th century (Mercer 1975: 133-136).[11] There is no direct evidence for this technique in South

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10. It is of interest, however, that Markman, following Toussaint (1946) recognizes the mudejar style of Andalusia, with its Moorish roots, as a primary influence on Guatemalan architecture.
  11. This tradition was not absent in South Carolina. The Reverend Abeil Abbott observed in his Journal (1832:260-261) :

Carolina in the 17th or 18th centuries, and those (cob and pise) known from the 19th century seem to be derived from external sources. It may be suggested that general familiarity with the English (or French) building traditions, if not directly responsible for the adoption of tabby, may at

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After breakfast, we took a walk in a new garden of a couple of acres, enclosed & levelled, & planted since I was here in December. It is a charming spot sloping toward the mansion & in full view, & already presenting a luxuriant prospect. Abutting one corner of this garden, a favorite old servant is building a house for himself in the style of an English cottage. The walls are formed of mud filled with straw. Large rolls of this cheap composition are piled regularly one upon another and pressed together. When a foot or two has been reared, it is left to harden in the sun, & the work continued from time to time till the wall is completed. A roof of wood is usually applied. These walls, so cheaply constructed, the labour being almost the only expense, are imperishable. A church of this construction in England, Mr. I. remarks had remained entire 300 years; & when they had occasion to enlarge it, there was great difficulty in taking it to pieces. Not only cottages, but gentlemen's houses in Cornwall & the South of England are of this material. They are on the outside susceptible of the ornaments of architecture, & on the inside are shaven smooth & papered, & are impervious to wind & weather. This mode of building is called cobbing.

On John's Island, wh is girt with banks of shells, they build the basement story of some of their houses by a composition of shells, lime, & sand, which is very durable, & has a lively appearance. They form a box with the length & thickness, which they choose; & this is filled with the composition. The material preserves the form, in wh the box left it, & slab on slab is piled till the necessary height is attained. Some of their carriage houses & other offices are built in this way. Considering the little cost of materials in these several cases & the little skill necessary to manage them, it would not be strange if cobbing should become common, at least in those parts of our country, where wood & mechanic labour are costly.

The Reverend Abbott's lumping of cob with tabby is most likely to be attributed to his lack as a visitor from the north of prior knowledge of tabby. Because of the late date at which he is writing, his remarks are not directly significant to the origins of tabby in South Carolina, but they do indicate a use of cob architecture that may have earlier local antecedents. A pise house was also built in Stateburg, South Carolina in the 19th century, though apparently based on plans published in 1806 in New Brunswick, New Jersey, Lane 1984.

least have contributed to its ready acceptance.

The oldest unquestionable tabby structure in South Carolina is Fort Frederick on the Beaufort River, built between 1731 and 1734. [12] It is a notable coincidence that Oglethorpe passed through Beaufort on his way south to Georgia in 1733. It is not unreasonable to suggest that Fort Frederick supplied the basic inspiration for the subsequent extensive tabby construction at St. Simons, which Spalding (1830) later acknowledged as his source for the reintroduction of tabby in Georgia. [13]

Tabby construction continued throughout the 18th and 19th centuries in the Beaufort area, and was employed in the full range of structures, including fortifications (e.g., Fort Lyttelton, Lepionka 1979), churches, industrial-agricultural buildings, outbuildings of varied function, enclosing walls, foundation walls, and multi-storied houses. A general survey conducted in 1982 located some 80 tabby sites containing one or more structures (Lepionka 1982); the total number of structures now known are in excess of 100.

12. The Charleston Arsenal, completed by 1713, is described by Gritzner (1978:76-80) as tabby fill between brick walls; as such, it is not in the tradition of slip-form casting. While it may mark the introduction of the material to Carolina, the Arsenal does not represent the method. (It remains possible that thorough re-examination of this much repaired structure would result in a revision of the building sequence given here; the structure may have been cast tabby faced with brick. If so, it raises further problems, for its date argues for a practically spontaneous introduction of tabby into St. Augustine and Charleston.) Two Beaufort houses (Hext Morris and Hepworth Pringle) said to have tabby foundations (Gritzner 1978:81) are listed as dating to 1710 and 1717-1722; in one case the foundation may well not be tabby, and both are almost certainly of later date.
13. The authors question this concept of "decline and revival" (Gritzner 1978:96-110). The continuity of the tabby tradition in Beaufort and the numerous poorly dated structures on the Georgia coast suggest that Spalding may have been emphasizing his personal acquaintance with tabby through Frederica. Extensive further research is required to document this supposed hiatus in use of tabby in Georgia.

Recent archaeological and architectural research has been directed toward detailed examination of specific structures, with the following goals: (1) To fully record with measured drawings tabby structures on Dataw, Callawassie, and Spring Islands; (2) to investigate constructional techniques and restraints amongst this group and related tabby structures elsewhere in Beaufort County; and (3) to analyze plan form and stylistic relationships. The range of building types is wide, embracing single cell units and industrial functions on Callawassie, major plantation assemblages on Dataw and Spring Islands and at Whitehall Plantation, and three story domestic structures in Beaufort.

To meet an urgent need for preservation, studies to date have concentrated on constructional aspects of multi-story buildings. [14] While small tabby structures appear to have presented few problems to their builders once the basic technique of form casting was mastered, it is apparent that building on a larger scale demanded a thorough understanding of the material properties of tabby and a capacity for structural innovation. The following discussion aims first to outline the limitations of tabby as a medium for multi-story structures, and secondly to describe the building methods which in their most developed form overcame such limitations and allowed the realization of the full structural potential of the material.

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14. It is pertinent, however, to note that structural forms previously undocumented for Beaufort County have been found. The tabby roof of an outbuilding on Dataw has long been known, and is unique in this area. Three tabby floors have also been located, one in the basement of the chamber linking the added wings of the main house on Dataw, one in a structure associated with the Dataw kitchen, and one underlying the basement area of "Marshlands" in Beaufort. Finally, woven lath walls, erected on a tabby foundation, and plastered internally and externally, have been found in a Callawassie outbuilding. This is analogous to two wattle and daub structures reported by Manucy (1962:71-73) at St. Augustine.

Tabby is a composite material composed of sand, lime, and whole shell aggregate. Differing proportions of these constituents slightly alter resulting properties, but tabby is generally deficient in both compressive and tensile strength. Core samples taken from well preserved walls of the Barnwell Gough House in Beaufort (an intact structure of ca. 1780) show considerable variation and demonstrate that bearing values are not uniform for any given length of tabby wall. Areas of extreme weakness may occur that cannot be detected visually. Form casting introduces a further structural weakness; adhesion between successive vertical construction levels is frequently poor, resulting in a tendency to dissociation and ultimate separation at pour lines.

The simplest method of maximizing bearing capacity is to use the material in mass. The mill base at the Callawassie sugar works has 24 inch wide walls with exterior buttresses of the same size. Analogy with Georgia mills indicates that the base once supported heavy milling equipment, itself subject to torsional stress. No fracturing or stress induced cracking can be observed (however, bricks are set in at strategic positions on the upper surface, presumably to absorb point pressures where the machinery was attached).

Builders of two or three story structures, however, clearly sought to minimize mass. Heavy tabby construction in the Dataw main house is confined to a pair of chimney bases. Each is a monolithic tabby block ca. six feet square, extending from foundation to first floor level. Above, chimneys were executed in conventional brickwork (tabby bricks are used for window spandrels and in the kitchen chimney). The main house at Spring Island possesses neither chimney bases nor evidence of brick construction. If they were indeed present, chimneys were fabricated of lightweight materials.

Tall, relatively thin walls, while possessing advantages in material economy and enclosed space utilization, are apt to be unstable. Without restraint they have a tendency under load to move out of a strictly vertical plane. Tabby is peculiarly vulnerable to stresses generated by such movement, readily fracturing along lines of greatest weakness (pour levels) or where mass is least concentrated (above and around openings).

In the examples examined, structural equilibrium was achieved through a judicious introduction of timber into building fabrics so as to act in conjunction with the tabby. Timber is resistant to both tensile and compressive forces, while tabby is able to expand and contract with temperature variation without cracking. Observation suggests that structural timbers and lime based tabby mixes expand and contract at very much the same rate. Heavy timbers introduced to gain tensile and compressive resistance are frequently bedded directly into tabby. No stress related damage has been noted at such junctions, indicating a high degree of compatibility between the materials.

Allowing for effects of weathering and possibly inadequate original foundations, massive wall collapse at Dataw and (to a lesser extent) at Spring Island, is primarily a result of loss (through fire) of structural timber. Without wood tying and restraining elements, walls have moved to an appreciable extent, subsequently overturning or dissociating.

Three main categories of timber structural elements constitute essential elements of composite tabby construction:

(1) Floor joists: Structurally these function as intermediate ties, helping to restrain walls from moving outwards and counteracting any tendency towards inward movement. At the Barnwell Gough House, Beaufort, joist ends are bedded directly into tabby walls and seated on broken brick. At Dataw

and Spring Islands [15] joists were again bedded into tabby but given additional support by a slender timber wall plate. This arrangement distributed loads more uniformly and counteracted point concentrations that could have resulted in tabby cracking. The joists tend to be somewhat undersized, but where timber is preserved, it is of a very close grained heart pine of high tensile strength. At the Barnwell Gough House maximum spans are 26 feet and joists are 9" x 3" at 18" centers.

(2) Lintels and frames; Stylistically, the group of buildings studied conform to proportional and massing principles developed during the late Colonial and early Federal periods. Facades are articulated by a regular rhythm of openings, generously sized at main living levels (at Dataw first floor windows measure approximately 3'9" wide by 7'3" high). In heavily fenestrated facades, openings tend to break the continuity of walls and further reduce tabby mass. Timber lintels and window and door frames play an essential part in maintaining structural integrity. Lintels support tabby (with its low tensile strength) at higher levels while frames both support and contribute a strutting effect to surrounding wall areas. Frame size as deduced from surviving fragments at Spring Island is substantial. For window openings up to 3'6" wide and 6'6" high, 5" x 4" frames are employed. Conversely, lintels are shallow, ranging from 2.5" to 3" in depth. Frames were apparently constructed using mortise and tenon joints. [16]

(3) Roofing members: Roofing a large scale tabby house presents

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15. Most timber has been lost at Dataw and Spring Islands. Timber impressions preserved in tabby together with surviving wood fragments have allowed extensive reconstruction of the original framing arrangement.
  16. It is doubtful that any original window sashes survive; early replacements at the Barnwell Gough House are double hung with a fixed upper portion. Mullions are characteristically thin in section and panes relatively large for the period.

difficulties. Tall, relatively thin tabby walls are unable to withstand concentrated loading, yet roofs are very weighty, especially when covering wide spans. Further, in coastal areas wind pressures can on occasion impose massive and shifting loads onto high structures. Almost all traces of roof construction have disappeared on Dataw and Spring Islands, but both houses share planning characteristics allowing minimization of spans and therefore of roof weight. Each house consists of three discrete building units, linked and unified by porches. At Dataw a central building is flanked by two wings; these have a long frontage (ca. 38 feet) but are only 21 feet wide. A drawing by Eugenia Sams shows the units were enclosed separately, the wings with a hipped and the central with a gable roof.

Two closely related three story tabby houses in Beaufort preserve original roof timbers. The Barnwell Gough House (ca. 1780) and Tabby Manse (ca. 1790) have a "T" shaped plan that is almost identical in size though differing slightly in internal arrangement (see Lane 1984:135 for plans). Front elevations measure 48 feet across and rear facades 64 feet across. A roof span of 43 feet is achieved by means of two parallel king post trusses spaced 8\*6" apart. These span from front to rear walls without intermediate support. Each truss receives two principal hip rafters directly and a through-purlin secondary rafter system indirectly. Ceiling joists generally span between exterior walls (where they rest on a continuous timber wall plate) and the bottom string of a truss. At the Barnwell Gough House heavy struts radiate from the king posts.

Floor joists, window frames and lintels, and roofing elements form a complex frame which acts as a load distribution and transference system, minimizing point concentration of stress and restraining walls at their upper levels. Craftsmanship is in the best tradition of the 18th century

and the design expertly conceived. Framing is of close grained heart pine and joints are well cut and fixed with wood pegs throughout. While incapable of exact calculation, engineering analysis suggests that in these structures tabby construction, in terms of wall length, height, and loading, approaches its theoretical structural limits (Weisner 1979).

Restrains imposed by tabby tended to dictate the use of rectilinear layout and a certain looseness of planning. Nevertheless, through experience with the material and an innovative and economical approach to construction, its builders were able to develop a vernacular form of expression capable of utilizing the best qualities of the material and of fulfilling functional requirements of the cultural and economic milieu. They were intended as well to serve an aesthetic principle.

Elegantly and authoritatively seated, these houses classicized the landscape, defined the surrounding space, and set an ordered pattern for ancillary structures. Especially in the plantation context, they were the focus of structure and activity, their architectural and aesthetic predominance mirroring their administrative status and social function. The central house on Dataw, with elongate flanking wings united into a common facade by columned porches, reflects the bilateral symmetry and central emphasis of the Palladian villa form. This centrality is emphasized by the courtyard lying before and on either side of the house, bounded by a low tabby wall that defines residence and sets it off from plantation, while linking outbuildings that are partially founded on it to the architectural sweep of the house, and tying all structures into a common orientation. Spring Island and Whitehall Plantation present very similar patterns.

Sources of the Palladian model were certainly available in the 18th century. An analysis (Dixon 1981:118-142) of the architectural library of

Ezra Waite, believed to be chiefly responsible for construction of the Miles Brewton House (built in 1769), states that he owned several works by proponents of English Palladianism, probably including Robert Morris<sup>1</sup> Selected Architecture, with its section on aesthetic philosophy (Ibid., p.123-124). The Leoni translation (1715) of Palladio was available in Charleston by no later than 1770 (Ibid., pp.130-132).

Most of the architectural books owned by Waite consisted of sets of plans and specifications (Ibid., p.128). No doubt these could have been lifted directly and patched together to form a building, and in fact late 18th century colonial architecture has been interpreted as "bookish" Pierson 1976:123, as quoted in Dixon 1981:142). Certainly these plans were used in the Brewton House; however, they would seem to have served more to set a basic theme than to provide a full model. Conjunctions of architectural detail from diverse sources are used, and the hand and style of the craftsman are apparent-throughout. To quote Dixon (1981:142): "The design is Palladio's, but the ornamentation which gives the house its rhythm and vitality is that of the craftsman-architect...More than simply bookish, the house is pretentious and obviously provincial while at the same time vigorous and richly textured." The Barnwell Gough House and Tabby Manse are equally excellent and very similar interpretations of the Palladian form, executed in tabby; in certain ways, the ashlar marked stucco facades are more apt reflections of the spirit of Palladio than is the brick of the Miles Brewton House.

The plantation houses of Beaufort County illustrate this reinterpretation in the villa form. Possibly as an adaptation to climate, as a solution for minimizing roof span, or simply as an artifact of building in stages (or some conjunction of these factors) the Dataw and Spring Island buildings

are lacking in depth. Nevertheless, there is visual compensation achieved through the setback of the wings from the center and by means of the columned porches. Symmetry of wings about the focal center, the integration into the landscape, and the ordered clustering of ancillary structures fulfills the pattern. [17] Buildings are somewhat coarse, their details frequently clumsy, yet curiously they convey an aesthetic intent that closely approaches that of their prototypes.

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17. There is a remarkable resemblance between Palladio's La Villa Emo di Fanzolo and the Dataw plan (for plans as executed see Bordignon Favero 1970; elevations of the two buildings are distinct). Palladio's intent in the villa design was the proper merger of functional and aesthetic requirements; the villa was a working center, and yet something more. He specifically recommends a central location and convenient access from ancillary structures and the estate as a whole. Dataw and Spring Islands fulfill these expectations. He states: "if one can build on a river, it will be very convenient and beautiful, because one can carry the produce at any time at small cost into the city with boats, and it will serve for the use of the house and the animals, as well as bringing coolness in the summer and making a more beautiful view, and with great profit and ornament one can irrigate the possessions and the gardens and orchards which are the soul and recreation of the villa" (Palladio 1570: 11,45). No better description could be given of the setting of the Dataw House, surrounded by its orchards and focused, over a broad sweep, to the river beyond. With the addition of two detached pavilions that extend the overall symmetry, Spring Island magnificently replicates this union of architecture, landscape, and river.

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Robert Stephenson FRS[1] HFRSE DCL (16 October 1803 – 12 October 1859) was an early English railway and civil engineer. The only son of George Stephenson, the "Father of Railways", [2] he built on the achievements of his father. Robert has been called the greatest engineer of the 19th century. [3]. Robert spent six months at Edinburgh University before working for three years as a mining engineer in Colombia. When he returned his father was building the Liverpool and Manchester Railway, and Robert developed the steam locomotive Rocket that won the Rainhill Trials in 1829. He was appointed chief engineer of the London and Birmingham Railway in 1833 with a salary of £1,500 per annum. Robert Stephenson book. Read reviews from world's largest community for readers. This collection of essays honors the subject... Goodreads helps you keep track of books you want to read. Start by marking "Festschrift in Honor of Prof. Robert Stephenson" as Want to Read: Want to Read saving; Want to Read. DickFest Festschrift Contribution. Thick Descriptions and Judicial Notice of Aboriginal Customary Order Personal and Academic Relationship - Relationship that spans more than forty years - Goals not academic but the means of achieving them often were - Probably best described as mutual fieldwork where I combed Dick's knowledge, experience and opinions for tools for alternately bridging with and protecting from external Euro-Canadian world. - More recently, last six years, devoted to an exploration of Canadian legal system in search of protection and support of Aboriginal (particularly Cree) customary order. - Dick's previous mentoring and influence proved invaluable.