Studies In
DECORATIVE BRICKWORK

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STUDIES IN DECORATIVE BRICKWORK

by

FRANCIS ORLANDO KRUPKA

A thesis report submitted in partial fulfillment of the requirements for the degree

MASTER OF ARCHITECTURE

at the

UNIVERSITY OF WISCONSIN-MILWAUKEE

MAY, 1975

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Thesis

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by

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PREFACE

There is, indeed, "...a tide in the affairs of men," (P, 01), recurrent swells of discovery, rejection and rediscovery that have been noticed and commented upon by many. Nowhere is this phenomenon more pronounced than in the realm of aesthetics. S. Tschudi Madsen restates:

> "As a general rule, it is true to say that the artifacts of one generation appear old-fashioned to the next. However, when they belong to the generation of one's grandparents, they immediately acquire a certain interest, especially if the standard of craftsmanship is high." (P, 02).

what Lewis Mumford had previously stated much more succinctly:

> "The commonest exiom of history is that every generation revolts against its parents and makes friends with its grandparents." (P,03).

This, specifically, is true in the case of architectural ornamentation. So prevalent in the last half of the Ninteenth Century, decorated architecture was violently rejected by the early Modernists in favor of a more 'honest' structuralist aesthetic, an aesthetic which has since shown itself to be as flawed in its omissions as its predecessors were in their excesses.

Decorative, and decorated, architecture has been anathema ever since. But there are signs of a nascent rediscovery of the benefits lack of ornamentation has deprived contemporary architecture of, virtues that were overlooked in the initial wholesale rejection that occured at the turn of the century.

American architectural history of the late Victorian era has long been a neglected study within the broader disciplince of art history: architectural technology, the folk and vernacular aspects, especially so. Lack of authoritative appreciation and an obsessive preoccupation with the immediate precursors of the Modern Movement is one cause. Lack of definitive documentation is another. Conventional knowledge in the building trades was transmitted from one generation to another largely through apprenticeship. Much of it was never committed to paper. Published work is disparate, incomplete and scattered.

It is, of course, obvious that many early American architectural practices derive ultimately from European experience. American design concepts, tools and terminology were derived from those of western Europe, yet information about materials and methods of working them is so widely diffused that it is almost impossible to discover the source of a particular idiom.

Such published sources as do exist seem to have emerged about the beginning of this century, with few texts available prior to 1900. These, as do most modern texts, tend to deal almost exclusively with the basic structural technology of brick masonry rather than with the decorative and aesthetic aspects of working this material. Pattern books, so popular in the last quarter of the Ninteenth Century, do not seem to have included patterned brickwork as a topic of discussion. Thus, since the apprenticeship method of transferring skills has not included the more elaborate ornamental devices of brick masonry with which this study is concerned, those remaining structures which still exist in our cities constitute the only readily-available source for studying the vocabulary of decorative brick masonry construction.

An interest in learning about decorative brickwork requires that one visit many sites and scan innumerable pages of old books and periodicals to extract scanty bits and pieces of information. Typically, such sources contain only fractions of the total amount of data required, and there are many instances of disagreement between them. This study provides a summary of the information collected thus far, information hopefully providing a basic body of knowledge and a point of departure for those interested in a more intensive study of decorative brick masonry construction.

References

P.01 William Shakespeare, Julius Ceasar, Act IV, Scene III.

P.02 S. Tschudi Madsen, Art Nouveau, World University Library, McGraw-Hill Book Company, N.Y.(1967), p. 7.

P.03 Lewis Mumford, The Brown Decades,.Dover Publications, Inc., N.Y.(1955), p. 3.

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INTRODUCTION

Decorative brick masonry construction has all but become a lost art in American architecture. Its rich vocabulary of pattern, form and the techniques of their creation have, through half a century of disuse, largely disappeared. Economic conditions, changing tastes and the need felt by architects of the early Twentieth Century to dissociate themselves from the perceived excesses of their Victorian predecessors all contributed to the waning interest in decorative architecture in general that was so characteristic of the early Modern Movement.

As a result of this neglect, architects and masons are no longer familiar with the entire vocabulary of masonry construction. Available texts describe only the most simplistic construction techniques. What is no longer published and taught can no longer be designed and built. Whole generations of practicioners in the building trades and professions have never experienced or used their full heritage of masonry design techniques. Without such continuing use, skills that were once all but universal deteriorate and ultimately disappear.

Once lost, such skills are recovered only with great effort and for sufficiently compelling reason. That such reason does now, or indeed ever will again, exist is far from certain. Certainly, it is doubtful that masonry will ever re-acquire the pre-eminence it enjoyed in the last quarter of the Ninteenth Century when even the most common commercial structures were encrusted with ornamental brickwork.

However, certain contemporary construction techniques lend themselves quite readily to a similar sort of decorative manipulation. Freed of much of its structural role as a load-bearing element and the necessity of depth concommitant with that role, coupled with the recent development of high strength adhesive mortars and the introduction of factory-assembled masonry panels, brick masonry could again develop into the fanciful, decorative element it has so often been in the course of its 5,000 year history of use, once more producing an integral ornamentation that could do so much to relieve the chronic blandness and uninspired tedium of much modern masonry construction.

Much of this discussion will, by necessity, concern the decorative brickwork that was all but universal in the new construction during the period 1870 to 1900. Although more recent examples will be cited which often equal and even surpass those of the last century, they are invariably isolated exceptions to the general quality of contemporary masonry design rather than being typical or their time as are the older works.

In no way intended as an exercise in sentimental nostalgia, nor as a conservationist argument in the usual sense, nor as a document in architectural history although it does involve each of these to varying extents, rather this is primarily an attempt to point out that there does exist an architectural heritage that ought to be recognized, appreciated and preserved, not as isolated 'museum pieces', but as living textbooks.

This heritage consists primarily of structures of the sort found in virtually every urban area larger than a village which has existed for at least one hundred years. Such structures tend to be one of several types: commercial storefronts, industrial or warehouse buildings, churches and often schools, an occassional apartment building but relatively few houses. Of these, commercial storefronts and churches constitute, by far, the bulk of the better examples. And, as has been previously mentioned, most of these were constructed in the interval between 1870 and 1900.

Whatever the impetus which produced these buildings, one central fact emerges. Except for communities with an unusual abundance of another building material such as wood or stone, and often even then, brick masonry was standard for all nonresidential construction. And, in the period 1870 to 1900, brick masonry construction invariably became highly decorative whenever it was used.

While undoubtably deriving from the skills of immigrant craftsmen retaining their European architectural traditions, by the 1880's the art of decorative masonry had become so pervasive as to constitute not merely a genuine vernacular genre in American architecture, but the dominant one.

These ornamental devices, derived from the eclecticism of the early and mid-1800's, coalesced into a native aesthetic quite distinct and unique from its various sources that became, for a brief period, universal.

It was an orthodox aesthetic with principles and techniques based on 5,000 years' experience with the material and its proper use. But an orthodoxy which yet permitted--even encouraged--inventive experimentation and re-interpretation within the medium. This internal permissiveness occasionally led communities and individual craftsmen to develop ornamental devices and motifs that were uniquely their own, the sources of which often were, and certainly remain, obscure and even anonymous.

To those living at the time, these structures were undoubtably not thought of as architecture at all, much less as architecture of any significance. But concepts of architecture and architectural tastes change, and what were once considered mean, petty little buildings fit only for commerce and lower class habitation have, through long association and service, acquired a significance that would probably astound a proper Victorian.

A large part of this enhanced significance undoubtably derives from a comparison to modern architecture as it has developed since the turn of the century. What the intellectual and aesthetic philosophies of the Modern Movement and the structures these have generated seem to lack, these insignificant little storefronts and warehouses possess in generous measure, and it can be summed up in a single word: DELIGHT. Somehow, in their increasing preoccupation with commodity and firmness, the last dictum of the Vitruvian triad has come to be woefully neglected by contemporary architects. And the consequences of this neglect are everywhere apparent,

not only in the dirth of delight, but in the deterioration of Commodity and Firmness, as well. The triad, it turns out, is an organic whole. One of its keystones cannot be dismissed without diminishing those remaining.

This vernacular tradition in decorative masonry construction, the most recent flowering of which occured in the closing decades of the last century, is now, because of the advancing age, accelerating deterioration and obsolesence of its constituent structures, in danger of eradication. While, admittedly, such structures are not generally of the 'grand' variety in the traditional architectural sense--most being of modest scale and intention--they are never-the-less noteworthy and deserving of consideration in that they constitute the only extant domestic ~~source~~ repository of the vocabulary of decorative masonry construction. Even if such construction techniques were no longer of current interest and applicability, the best of these buildings would still be eminently conservable strictly in terms of their inherent aesthetic value and as examples of the care, skill and inventiveness of master American craftsmen. But such is not necessarily the case. Decorative architecture, after half a century in the shadow of the Modern Movement, appears on the verge of a resurgence. If such is indeed the case, these structures constitute the only extant domestic source for this decorative vocabulary, a vocabulary eminently suitable to the aesthetic sensibilities and easily adaptable to the construction practices of contemporary architectural design.

The vast potential for visual enrichment that brick masonry could hold for contemporary architecture is, I believe, good and sufficient reason to re-examine and record, while outstanding examples still exist, the unparalleled work of the late Ninteenth Century in this medium. However, even if such widespread rediscovery of the medium's potential and recovery of its techniques and forms for use in our own time (as I believe it both possible and desirable) does not occur, if this incredibly rich heritage in decorative brickwork is not maintained as a 'living' tradition in our architecture, then its existence ought to be publicized and its inherent value authoritatively determined so that the best remaining examples of this genre can be preserved for public enjoyment and for further definitive study as a distinct and distinguished period style in our rather brief architectural history.

Hopefully, this cursory look at extant decorative brickwork and the outline of techniques which follows it may provide a partial impetus in initiating the critical review process as well as serving to re-acquaint the building professions in particular and the public in general with the full vocabulary of decorative masonry construction.

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PART I
INTRODUCTION TO BRICKWORK

SECTION 1: History of Decorative Brickwork
SECTION 2: Compositions in Brickwork

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HISTORY OF DECORATIVE BRICKWORK

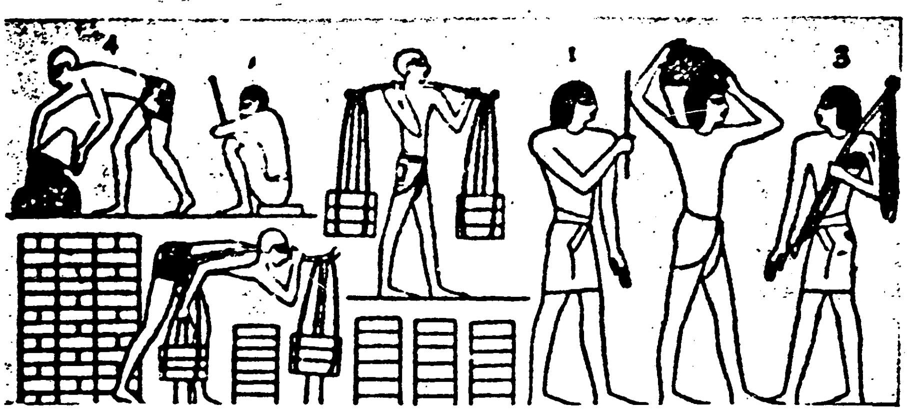
The construction of significant buildings in Western civilization has, until very recently, been almost entirely of masonry. Although timber has played an important secondary role, important and lasting buildings have been constructed of inorganic materials dug and fashioned from the earth: stone, clay, lime and cement.

Brick, a building product manufactured from such inorganic earth materials, is one of two rival masonry construction techniques. Ordinarily considered a humble cousin of its equally ancient rival, stone, such fundamental architectural forms as the arch and the vault were probably translated into stone masonry only after having been first developed in brick made of common clay.

The techniques of brick masonry seemingly developed as the principal method of construction whenever a civilization came into being which lacked a supply of natural materials suitable for permanent construction. Lacking the means to transport these materials from distant sources except at exhorbitant cost, substitutes had to be developed locally to meet local construction needs. Thus, brick emerged as a common building material where sufficient quantities of stone and wood were unavailable.

Brick enjoys several inherent advantages over stone as a building material. Large pieces of stone are difficult to handle, while bricks can be cast or extruded to whatever size and shape are best suited to local transportation and construction requirements. While some antique bricks weighed as much as 90 pounds, most were small and light enough to be held in one hand. Moreover, standardization of size and shape brought uniformity of pattern and modularization of dimenisons. The first prefabricated building element, brick also had the advantage of minimizing on-site cutting and fitting, thus reducing the amount of labor required without being inferior to stone--and definitely superior to wood--in terms of load-bearing capacity and in resistance to fire, deterioration and weathering (1.01). It also has the advantage, over wood, of being virtually maintenance free.

Economics has also played an important role in the prevalence of brick masonry construction. Stone, being expensive to quarry, transport, fashion and erect, has periodically become prohibitively expensive. Thus, in areas with a strong tradition of stone masonry construction, brick will often come to dominate new construction, particularly during periods of economic distress. Quite the reverse seems to occur in areas characterized by an abundance of wood for construction. In such areas, the use of brick and stone becomes indicative of general prosperity in that brick, and certainly



1.01

stone, is more costly to fashion and use than timber.

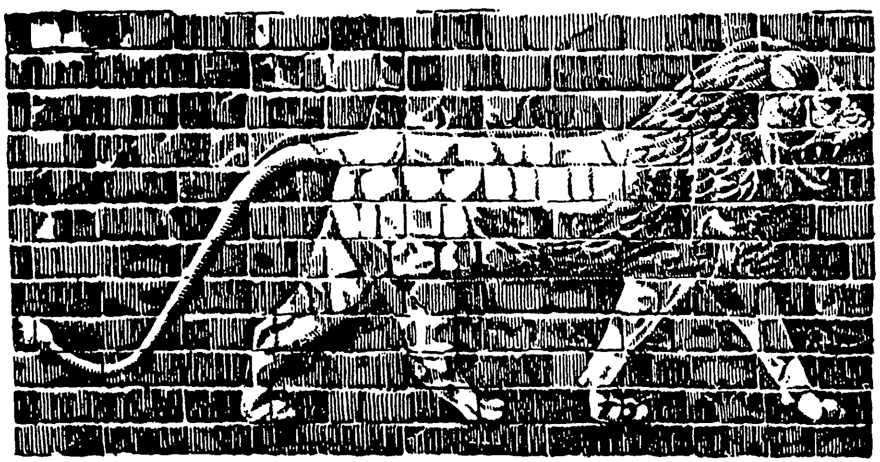
ANCIENT ORIGINS OF DECORATIVE BRICKWORK

The origins of decorative brickwork remain lost in antiquity. New archeological discoveries continually push the period of origin further and further into pre-history with current knowledge indicating that it has been in use for at least 6,000 years. This makes brick one of the oldest manufactured building materials known.

The first brick was made of sun-dried clay, the oldest record of which comes from the ruins of the ancient Sumerian and Chaldean cities of Mesopotamia. Inscribed bricks have been discovered dating as far back as the reign of Sargon of Akkad, founder of ancient Chaldea, 3,800 years before Christ. Yet, even before the reign of Sargon, this country was populated by the Sumerians who had emigrated from Western India, bringing with them an already developed knowledge of brickmaking (1.02).

Brick is related in its origins to rammed earth. Primitive bricks, sun-dried such as in Spanish adobe construction, are highly susceptible to dissolution by water and can only be used in low humidity climates. Kiln-firing, a major advance in brick manufacturing which renders the completed brick impervious to water penetration and its subsequent dissolution, also appears to have been imported into the West from Asia Minor at an extremely early date.

Ancient Egyptian construction as early as the First



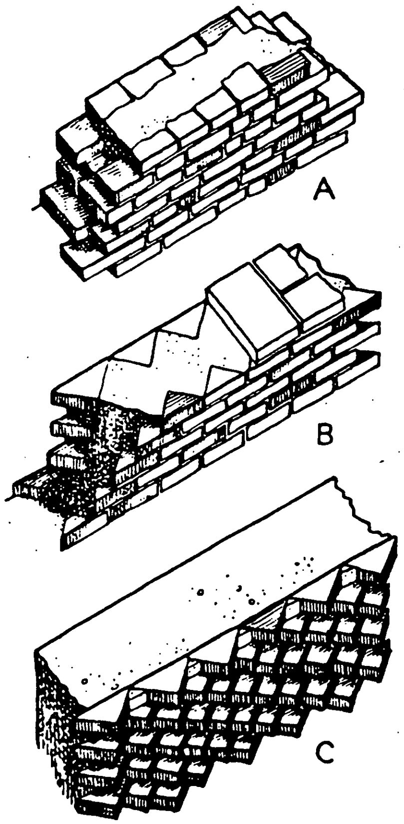
1.02

Dynasty (3,000 B.C.) used both sun-dried and kiln-fired bricks, slightly larger but of the same proportions as modern ones, and employed brick masonry vaults in such utilitarian buildings as the granaries of the Rumesseum at Thebes (1.03). The highly developed and organized state of the brick-making craft in ancient Egypt is illustrated in the painting shown in Figure 1.01.

Marking bricks with a distinctive stamp, or inscription, had been practiced in Mesopotamia from the third millenium B.C.. Such stamps often bear the name of a particular king and give an inscription relating to the particular building in which they were to be used, or a record of some important event. A brick of Sin Gashid, King of Erech, records the building of a Temple for Nannar, the moon god, and the fortification of the City of Ur (ca. 2300 B.C.) (1.04).

It is also probable that the Mesopotamians, motivated by a lack of stone or timber capable of spanning large openings with one member, developed the arch, the vault and the dome at an early date. Mesopotamian vaults were apparently first made by projecting courses of brick into the opening to diminish the span required (1.05), one of the earliest recorded instances of corbeling in brickwork.

Both the Babylonians and the Assyrians from the Ninth to the Sixth Centuries, B.C., made patterned bricks and wall tiles with colored glazes, and the Palace of the Achaemenid Kings of Persia at Susa had brick friezes decorated in relief in this manner. Figure 1.02 illustrates a glazed panel of molded brick taken from the Processional Street at



1.03

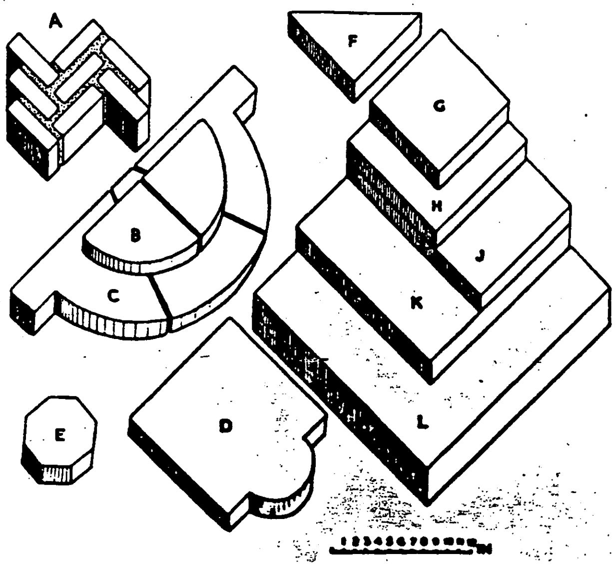
Babylon, dating from late in the Seventh Century B.C.. However, the technique of decorating brickwork died out after the eastern conquests of Alexander the Great in the Fourth Century B.C., and neither the Greeks nor the Romans made use of decorated glazed bricks and tiles (1.06).

Burned bricks did not appear in Greece before the middle of the Fourth Century B.C., and then were used only rarely. As in Babylonia, the first burnt clay products were the more specialized forms such as roof tiling and antefixes. Burnt bricks followed in Hellenistic times (1.07).

The earliest burnt brick constructions in Italy were probably the Etruscan walls at Arezzo. Up to the Second Century B.C. unburnt brick only had been used and although kiln burned brick was used in Rome in the Sullan period (138-78 B.C.) it did not become common until the time of Julius Caesar (1.08).

It seems to have remained for the Romans to develop bricklaying into an art. While the fundamental forms of brickwork (i.e. the arch, the vault and the dome) had been developed elsewhere at much earlier dates, the Romans seem to have been among the first to use mortar. They also developed various bonding patterns and experimented with the laying of alternate rows (i.e. courses) of brick and stone (1.09).

Figure 1.03 illustrates several typical Roman wall constructions. Shown at (a) is a simple brick-faced concrete wall using a combination of fragmented brick and 'through' whole bonding bricks. A similar situation occurs at (b), except here the facing



1.04

brick are of triangular shape. Shown at (c) is a concrete-cored wall wholly faced with a veneer of triangular brick. Reversed, in this instance, with their pointed edge exposed, this is undoubtably the origin of the sawtooth, a device which has been in common use in decorative brickwork ever since (see Sections 2 and 4).

It is in Roman times that the size of bricks became more standardized, but there were many different shapes for special purposes, some of which are shown in Figure I.04. Type A is a small brick used for floors; type B are sections of various angles used in constructing columns; types C and D are for making half columns; type E, an octagonal brick, used in constructing small pillars; type F is a triangular tile popular in Rome for wall facings and, as indicated in the preceding paragraph, probably the source of the sawtooth motive so popular in decorative brickwork of all periods; type G, small bricks about 8 inches square for building pillars; type H, tiles of 'four palms' square; type J, rectangular bricks; type K, bricks a foot and a half square; and type L, bricks two feet square (I.10). Comparing these to the contemporary masonry units shown in Figures 3.01 through 3.10 reveals many instances of similarity and a 2,000 year old precedent for many forms common to recent decorative brickwork.

In Rome, a very high standard of decorative brickwork as attained by the First and Second Centuries A.D., by which time the motives and compositions of classical architecture were being carried out in brick and terra cotta as competently as they were in stone. Special bricks were cut to the desired shapes to form elaborate cornices with dentils, ovoli and brackets, and capitals were carved in the various orders. Bricks were selected for their color and arranged to produce polychrome effects in yellow, red and brown (1.11).

The Romans improved the durability of both bricks and mortar and, in dispersing knowledge of brick masonry construction throughout the ancient empire, were responsible for the introduction of brickwork into northern Europe. However, much of Roman masonry was not pure brickwork but rather a combination of brickwork and mass concrete. The plasticity of concrete stiffened in its lines by an embedded brick skeleton made curved structural surfaces of massive dimensions possible, a practice that was assimilated and developed further by the Byzantines following the decline of Rome and the division of the empire.

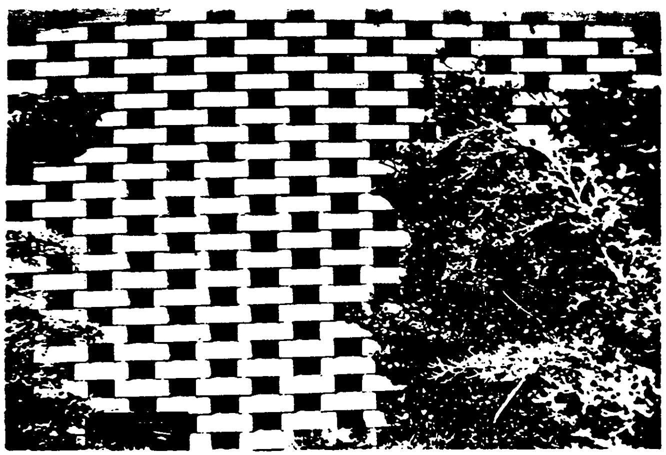
In Fifth Century A.D. Byzantium, new developments again began to take place in decorative brickwork which would eventually have a profound influence on medieval architecture throughout Europe. Ornamentation became much less elaborate than in earlier Roman work. Few carved or molded brick were used. Very simple sawtooth ornament was made by laying bricks corner to corner and large flat wall surfaces were broken up with blind arches and small pendant archlets, decorative devices which, as shown in Section 2 and 6, have remained in common use to recent modern times. Large zigzag surface patterns rendered in ploychrome brickwork, similarly long-lived, were already well developed and in common use in Byzantine brickwork of the Fifth Century A.D. (1.12).

Sassanian architecture, combining the influence of Roman and Byzantine brickwork with traditional techniques of masonry construction that had been in use in Iraq since Babylonian times, produced some of the finest decorative brickwork that can be found, mostly from 750 A.D. until the overthrow of the Abbasid dynasty in the Thirteenth Century. Richly carved and ornamental bricks arranged in elaborate pendants and squinches, ornamental arched work, deeply articulated bays and highly decorative polychrome surface patterns were characteristic of the brickwork of this period (1.13). The Abbasid Palace at Bagdad, erected in the Twelfth Century A.D. is an excellent example, as is the minaret of the Great Mosque, built in the City of Mosul in Northern Iraq in 1172 A.D..

Thus, the Romans acquired a knowledge of rudimentary brick masonry construction from the more remote ancients, developed this knowledge further and passed it on to the Byzantines, who, in turn, influenced the Turks and the post-Roman Italians. Byzantine buildings in Italy furnished prototypes for the great Lombard development of brick architecture beginning in the Eleventh Century. Inspired by the Italian example (and perhaps also by the east through the crusades), brickwork then began to reappear elsewhere in Europe after having virtually disappeared from the time of the collapse of the Western Roman Empire until well into the Twelfth Century. Thus revived, brickwork eventually came to dominate the architecture of northern Germany, Denmark, the Low Countries and parts of England during the Middle Ages. But it was an imported craft, one whose structural techniques and vocabulary of ornament, having undergone a prolonged gestation that began in ancient pre-history and continued to the early Middle Ages, were already well-developed and established by the time of their reintroduction into Western Europe.

MEDIEVAL DECORATIVE BRICKWORK

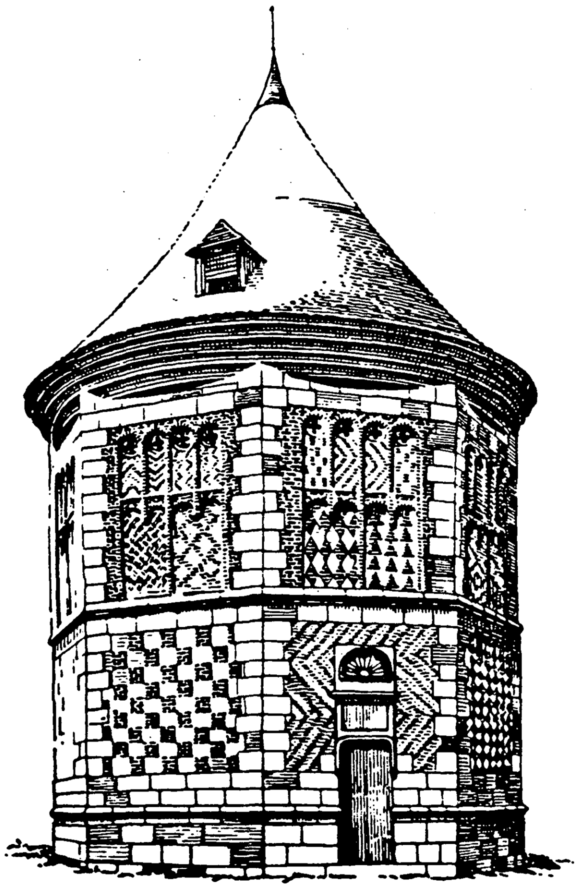
During the unstable early Middle Ages, very little brick architecture was produced except, as noted, by the Byzantines. In Europe, Italy alone possesses a continuous tradition of brick masonry construction. By the year 1,000, however, a brick architecture called Lombard was being produced in the Po valley, a region wehre Roman and Byzantine influences and traditions were strong and building stone scarce. Lombard architecture, in turn, provided the prototypes for a revival of brick building in northern Europe.



1.06

Medieval revivals of brick masonry techniques also occured in Flanders, southern Scandinavia, northern Germany and southwestern France. Spanish brickwork, drawing on its Moorish influences, translated the screen, or grille, into brickwork using an open bond similar to that shown in Figure 1.05 (see also Figure 4.15). And in England, bricks originally imported from Flanders began to be manufactured locally by the late Fourteenth Century.

By the last half of the Fifteenth Century, distinctive brick buildings were being produced quite regularly in Europe and in England. The Fifteenth Century dovecot, or colombier, from Boos, near rouen, France is one highly decorative example. As shown



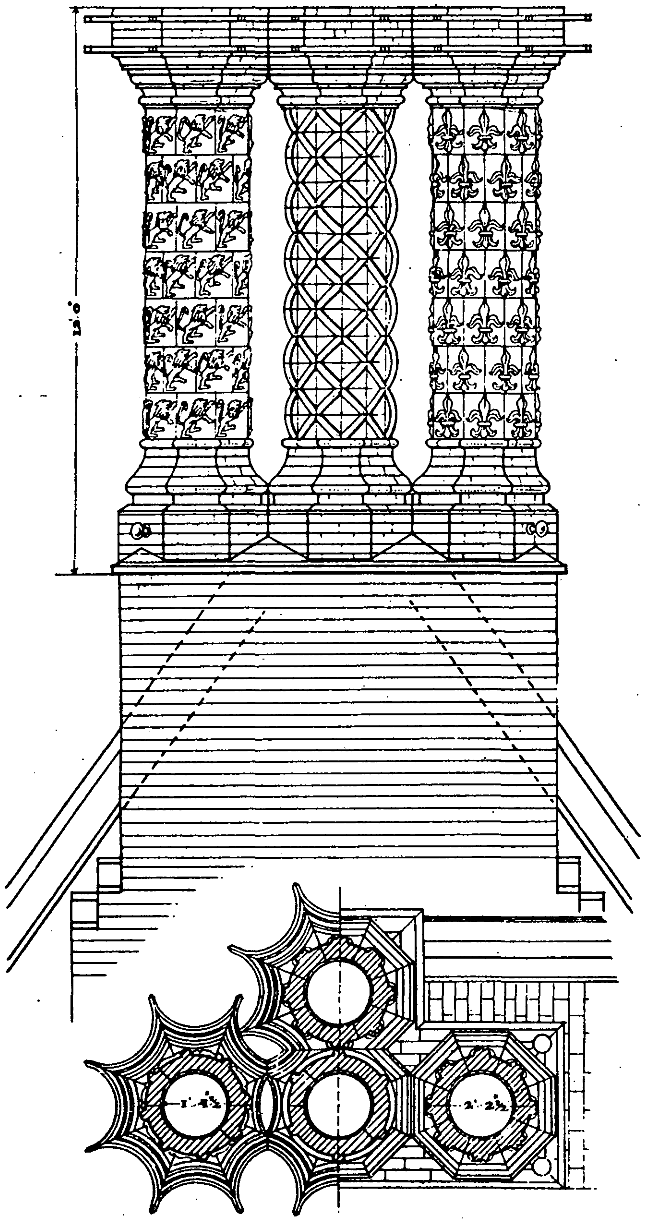
1.07

in Figure 1.07, the design includes checkerboard block patterns, herringbone and diamond bonds as well as a series of eight shallow oriels (see Figures 2.09, 2.10, 2.26 and 2.70) which effect the transition from the octagonally-shaped base to the roof by means of an oriel-supported circular corbel table, all executed in brick.

Elaborate diaper patterns, such as those just seen, began to be widely used. Formed by the patterned arrangement of darker vitrified brick laid in a polychrome wall surface, some of these patterns first appeared in France and were copied later in England. Similar to patterns which occur throughout Islamic art and architecture, it may be that contacts with Moorish culture through the Spanish had some influence on the European adoption of this type of decoration.

English brick building of the time included many period castles, manor houses and churches. A new feature also appeared which came to characterize the period 1500-1550 in English architecture: magnificent chimneys of carved and molded brickwork, as shown in Figure 1.08 (see also Figures 2.52-2.56) (1.14).

The artistry shown in medieval Ruropean churches testifies to the high standards of the brick masonry guildes. Lombard architects invented a great range of elements all based on the brick arch. Their facades were rich with forms admirably suited to workmanship in brick. Northern German brickwork successfully executed tracery, groin moldings and the thin-shell vaults of Gothic architecture. Only the fact that its grain was



1.08

too coarse for carved sculptural detail kept medieval brickwork from full parity with limestone and marble.

RENAISSANCE BRICKWORK

In so far as medieval architecture was concerned with craftsmanship and a sense of fitness of materials, brick masonry was a suitable construction technique. Renaissance architects had different objectives from those of their predecessors, however. Their preoccupation with visual harmony conflicted with interest in materials, workmanship and structural purity. Gothic architects had been master builders: Renaissance architects assumed greater prestige as creative personalities but lost the close association with building craftsmen that had prevailed earlier. Brickwork continued as a reliable and economical structural material, but like the Romans on whom they modeled themselves, Renaissance architects preferred to cover this base structural element with a more elegant veneer of stone, usually marble. Thus, it is difficult to find Renaissance buildings with a character peculiar to brick architecture.

However, much of the minor secular architecture of Europe continued to be executed in brick, sometimes trimmed with stone, terra cotta, stucco and wood. Northern Europeans, lacking the enthusiasm of the southern French and Italians for this Renaissance revival of Roman architecture, continued largely in the medieval crafts tradition. Large cities, such as Amsterdam and Copenhagen, were built almost entirely of brick. England, especially aloof from this revived Romanism, produced decorative brickwork of exemplary craftsmanship almost continuously to the close of the Ninteenth Century.

In few other crafts are the decorative motives as ancient as they are in masonry construction. As pointed out earlier, many such ornamental devices can be traced 4,000 or more years backward in time, with their origins still being obscure. But decorative brickwork is not only an ancient art, but an almost universal one as well. Whenever and wherever the techniques of masonry construction emerged (or re-emerged), whether developed independently by local artisans or derived from the imported skills of immigrant craftsmen, the stark geometry of simple brickwork seems to quickly have been viewed as unsatisfactorily simplistic. In almost all instances, the urge toward the decorative manipulation of brick in masonry construction emerges soon after the introduction of the material, itself, even in the most ancient times and in the most divergent cultures.

This predilection for the ornamental has, as indicated earlier, periodically waxed and waned throughout the millennia that brick has been in common use. The causes of these periodic shifts in preference have been both internal (such as changes in fashion and the popularity of the material, itself) as well as external (such as economic conditions which dictate more or less austerity or extravagance in construction).

The second half of the Ninteenth Century witnessed the latest in a long series of these periodic resurgences of decorative masonry construction which have been recuring in European, and derivatives of European, architecture since the Middle Ages. And the United States, far from being an exception, was as enthusiastic a participant as any in this trend.

Immigrants of all nationalities transplanted this European tradition of decorative brick maosnry construction in the New World colonies from the 1700's on, resulting first, in an incredible mixture of ethnic preferences for various styles, and, second, in an unprecedented cross-fertilization of masonry skills and techniques. The former gave rise to the romanticized eclecticism of much Ninteenth Century American architecture. The latter made possible the brick masonry revival that followed this eclectic splurge, infusing it with a hybrid vitality. All but universal during the period 1870 to 1900, decorative brickwork permeated every aspect of the architecture of the late Victorian era. As had occured earlier in northern Europe, entire American cities were constructed almost entirely of highly-decorative brickwork, drawing heavily on decorative devices ultimately derived from ancient precedents by way of the medieval traditions of European craftsmanship: this, ironically, in a country with a virtually unlimited supply of available timber.

However, growing reaction against this rather aimless Ninteenth Century eclecticism and the often excessive encrustations of Victorian ornamentation stimulated a return to uses of materials, brick included, in more straightforward recognition of their inherent properties. Traditional brickmaking countries produced restatements of the medieval principle of maximum use of a single material. Frank Lloyd Wright's Morris Gift Shop, shown in Figure 2.50, reflects such an attitude, as does the building shown in Figures 2.64 and 2.65.

But the role of brickwork was quickly eclipsed by the introduction of new technology. Steel inevitably became prominent, and the resultant savings in bulk and weight made the building envelope independent of its structural armature. In large buildings, brick began to lose its load-bearing function. Increasingly, it was relegated to the role of enclosing space without supporting it. As shown in Figures 2.43 through 2.44, brickwork could play such a role with great elegance. However, while fireproof, weather resistant and virtually maintenance free, brickwork is ponderously heavy and has to be laid by hand, qualities which have become extravaganses in the mid-Twentieth Century. Heavily dependent on the skill of the mason, these qualities too have tended, in this century, to disappear. Where once quality brickwork was the norm to be found in abundance in every city, one must now search the entire country to find isolated examples. But such do still exist.

Sound and beautiful brickwork of exceptional quality is still being produced, if on a much reduced scale. Certainly less flamboyant than that of the late Victorian era and some of its equally ornate predecessors, and stripped of much of its role as an actively functioning structural element, decorative brickwork, with most of its traditional forms intact, can still provide one of the most physically durable and visually handsome exterior envelopes available. This, in itself, is sufficient justification for the review of decorative brickwork, its techniques and devices, which follows.

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1.03 Ibid., pp. 173-174.

1.04 A History of Building Materials, Norman Davey, Drake Publishers, Ltd., New York (1971), pp. 68-69.

1.05 Encyclopedia Britannicca, p. 174.

1.06 Davey, pp. 68-69.

1.07 Ibid., p. 69.

1.08 Ibid., p. 69.

1.09 Ray, pp. 14-15.

1.10 Davey, pp. 71-72.

1.11 Ibid., p. 76.

1.12 Ibid., p. 77.

1.13 Ibid., p. 78.

1.14 Davey, p. 81.

COMPOSITIONS IN BRICKWORK

Brick masonry has a potential for the visual enrichment of surfaces that has few equals among the materials of construction. This decorative potential, exploited so successfully by past builders, derives from a variety of sources: one, the nature of the material and variations in the color and texture of the masonry units, themselves; two, the standard sizes and shapes of the masonry units and the conventional methods of their assembly (i.e. the various structural and decorative geometries and the surface traceries created by the various mortar joints); three, the use of specially-molded and shaped bricks to obtain such decorative effects as ornamental arched work, belt courses, friezes and cornices; and four, the use of brick in any of the preceeding manners in combination with a variety of other materials (e.g. terra cotta, natural stone, concrete, steel, wood, etc.).

While there is a strong tradition that combines brick with other materials, often with striking results, this study is exclusively concerned with the decorative potential of brick, itself, and will therefore concentrate on items one through three of the preceeding list. The specific elements of decorative brickwork will be discussed in Sections Three, Four and Five. However, preceeding this detailed examination of specific techniques is a photographic survey of these techniques as actually used in constructed buildings.

The photographs and details in this section illustrate many of the techniques commonly used in decorative brickwork. Any attempt to verbally describe ALL such devices would be futile. Even attempting to illustrate most of them photographically presents difficulties. What can be done, with some economy of means, is to describe the fundamental devices commonly used with illustrative indication of the possible variations on these basic themes.

To the chagrin of the compiler and cataloguer of these devices, the variety is practically endless. And there-in lies the magic of this material. The 'afficianado' of masonry construction, no matter how accomplished or knowledgeable, can always find a clever variation on a known theme in which to delight.

This characteristic, as much as any other, is what differentiates most modern architecture from the sort which follows. The bulk of modern architecture is comprehensible at a glance. It is superficial: lacking in depth. It is, too often, tediously straightforward. There is no playfulness, no indication of inventive improvisation, no hidden or subtly-disguised charms. And in these, as the photographs which follow amply show, decorative brickwork abounds.

However, before examining the photographs, a means of discerning significant details ought to be formulated, a method that encompasses the entire range of decorative devices developed and employed by innumerable generations of builders in a wide variety of architectural styles.

DUALISM IN BRICKWORK

There is, inherent in any use of brick as a material of construction, a dual purpose. Traditionally, brick's principal role has been structural: load-bearing masonry constituted the indispensable supportive element of construction. But this has rarely been masonry's sole function nor the exclusive concern of those who worked it. Almost from its initial development, builders have been intrigued, not only with the structural performance of brick masonry, but with its visual impact as well. This has been true from the earliest times to the present. Brick has always had a simultaneous existence as both a structural mass subject to the rules of statics and as an ornamental surface subject to the dictates of fashion and decorative aesthetics.

While masonry construction has been in almost continuous use for many millennia, decorative manipulation of the masonry surfaces created in the course of its use as a structural element has had a much more intermittent history. Technology, economics and fashion each have dictated periodic suppressions and resurgences of emphatic ornamentalism.

More than adequate technical literature exists describing the standard methods of using brick masonry as a structural element. No such abundance exists for the techniques of decorative brickwork. As indicated earlier, such sources as can be located dealing with the aesthetic aspects of working this material tend to be disparate, incomplete and scattered. While such sources may individually contain only fractions of the total information available, a reasonably complete summary can be reconstructed from them.

What emerges from such study is a fuller appreciation of the inherent richness and variety possible in masonry construction and the pathetic shallowness of most modern building practice in this material.

PATTERNS IN DECORATIVE BRICKWORK

Methods of decorative masonry construction all rely on the creation of patterned compositions. Such patterns are of two types. One involves the arrangement of simple elements into three-dimensional forms. The other refers to arranging these three-dimensional forms into an architectural composition. However, regardless of specific type, both varieties can be broadly categorized as being either generative, articulative or decorative in nature.

Generative Masonry Patterns

Generative patterns refer to those which determine geometric shape or form, or establish or enhance the structural integrity of the constructed mass.

2.01

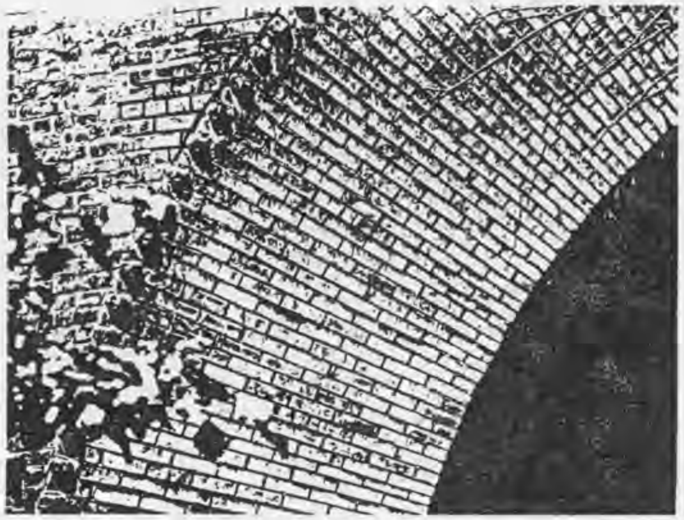
Included in this category is a wide variety of devices usually associated with traditional facade composition.

In older work, such as shown in Figure 2.01, these often take the form of a facade with massive corner piers bounding a graduated series of secondary and tertiary piers and spandrel panels reflective of inner structure, the whole being hierarchically composed and balanced (both horizontally and vertically) with articulative details emphasizing the component parts of the design and decorative patterns texturing the enclosed surface planes. Particularly dramatic effects tend to occur at changes in direction (i.e. at corners), at critical elevation points (e.g. floor levels) and at voids (i.e. windows, doors and other openings) in the wall fabric.

Articulative Masonry Patterns

Articulative patterns represent the interface between the exclusively structural and the emphatically decorative. These are devices used to emphasize the generative patterns by elaborate reiteration or ornamental enhancement of the fundamental forms.

Generative patterns, carried 'ad extremis' (i.e. reiterated beyond structural necessity) constitute one variety of articulative pattern. This is demonstrated in Figure 2.02. Here, in detail, can be seen the extension of the radially-bonded voussoirs of the arch ring culminating at the extrados in an intermittent linear series of portruding, rusticated headers which reiterate the semi-circular geometry of the intrados of the arch.



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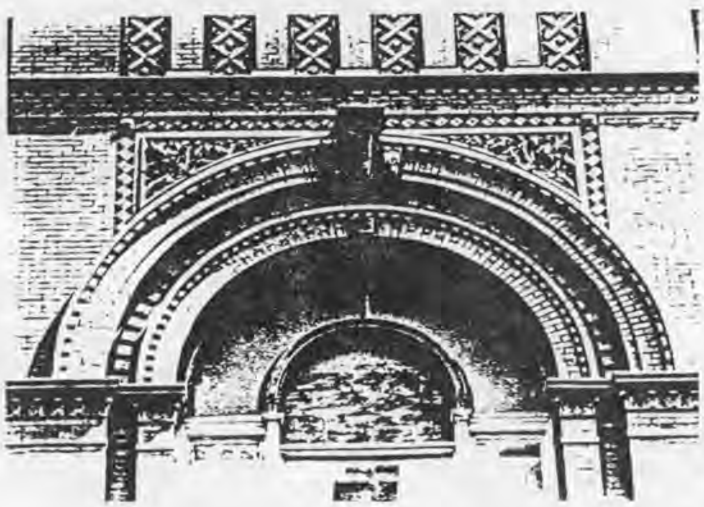


2.03

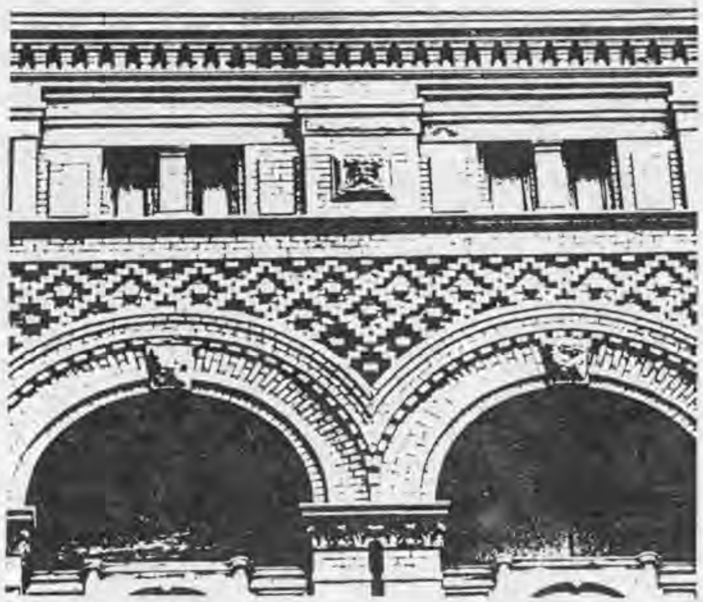
A second variety of articulative pattern is created by means of repetition and an integral change of scale, rather than mere enlargement, a selective reiteration of elements and decorative enhancement of fundamental form, as shown in Figure 2.03. Here, three concentric semi-circular arches, each radially bonded and articulated at the extrados by a denticulated header (or rowlock) course, constitute the basis of the design.

Decorative Masonry Patterns

Unlike articulative patterns, strictly decorative patterns in brickwork usually make no pretensions of structural significance. Rather, they are used as infill to occupy surfaces left unadorned by either the generative or articulative varieties, or they are used to give broad expanses of blank wall an attractively textured surface. Thus, again in Figure 2.03, that portion of the wall panel to either side of the top of the arch is filled in with strictly decorative, molded terra cotta relief panels and circumscribed by decorative, diamond-coursed brickwork.

A second variety of strictly decorative pattern is shown in Figure 2.04. Although from the same building shown in Figures 2.01 and 2.03, as can be seen from the simplified--yet similar--treatment of the arches, here the wall has been completely encrusted with a diamond unit diaper pattern (see Figures 4.40 and 4.41) resulting in a heavily-textured surface design.

These (the generative, articulative and decorative


2.04

patterns) constitute, not a hard classification of specific masonry techniques, but merely a loosely knit conceptual framework the principal function of which is to aid in the comprehension of existing examples and in the design of new brick masonry construction.

FORMS IN BRICKWORK

The structural and decorative bonding patterns, presented in Section Three, remain the basic tools of brick masonry design and construction. The arch, the corbel, the rake (or reverse corbel), the pier and the column are the fundamental forms. Others exist, of course, but these others are composite forms which derive, at least in part, from those in the preceeding list. From these few fundamental devices, a virtually limitless variety of designs can be produced, designs which--different though they may be in specific composition--never-the-less clearly bear close visual and proportional relationships to one another regardless of the specific style assumed in execution.

COMPOSITIONS IN DECORATIVE BRICKWORK

The following analyses present an introduction to compositions in decorative brickwork as demonstrated in two existing buildings. These will be followed by a more general photo section illustrating, through selected details, many of the more common devices of decorative masonry, most of which are described in greater detail in Sections Three and Four.

The first example, the Bahr Building shown in Figures 2.05 through 2.09, is a typical Ninteenth Century commercial structure. Built in 1887, it remains virtually unchanged. While a variety of materials (stone, wood, metal and terra cotta) have been used in this composition, it is on the brickwork, itself, that attention will be focused.

2.05

The dualism inherent in brick's role as a building material is demonstrated quite graphically in Figures 2.05 and 2.06. The load-bearing side walls, shown in Figure 2.06, are rendered in common, or American, bond and common brick with little or no ornamentation beyond the articulation of floor lines by means of decorative linear coursings. The front wall, however, spared the support functions for interior floors and the roof imposed on the side walls, is rendered not in the stronger common bond but in the visually more regular and attractive running stretcher bond and of face, rather than common, brick.

2.06

c

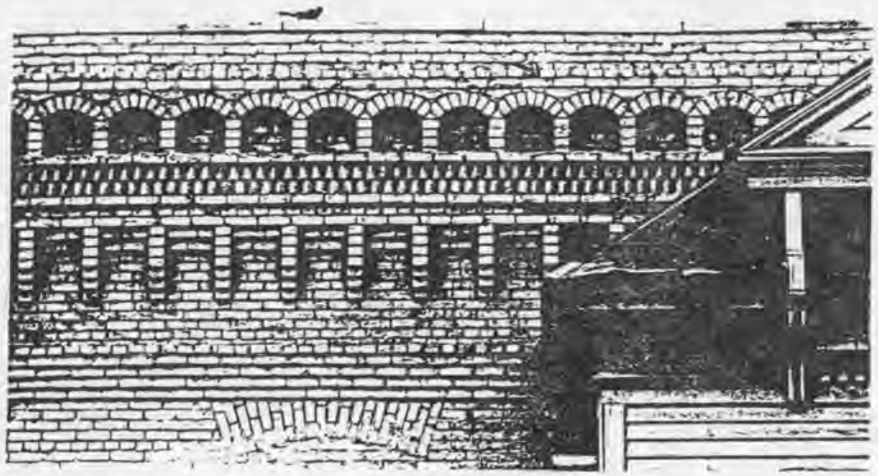
b

a

From this alone it can be surmized that the builders of structures such as this were consciously aware of both the structural capabilities and the visual impact of the various brick types and masonry bonds and that their ultimate choice depended as much on aesthetic as on structural considerations.

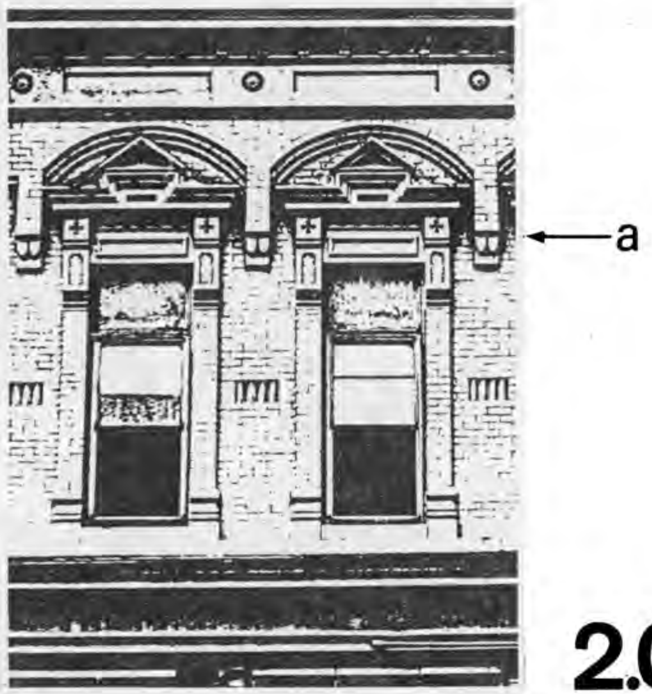
Similarly, this duality in brick's function can be observed in the side wall, shown in Figure 2.06.

2.07



Minor decorative coursings articulating the various floor levels, constitute the only decorative embellishment of the wall fabric. These consist of a sawtooth soldier course and two corbeled stretcher courses topped by a stone belt course at the second floor level, as shown in Figure 2.06(a), and four corbeled stretcher courses topped by a corbeled header course at the second floor ceiling level, as shown in Figure 2.06(b).

However, it is at the parapet level where, relieved of its load-bearing function and the necessity for depth this role imposes, that the side wall becomes highly decorative and deeply sculptural, terminating in the elaborate corbeled arch-frieze shown in Figure 2.06(c) and, in detail, in Figure 2.07. Here, corbeled six inches beyond the face of the wall, individually rubbed brick (voussoirs) are used to form an arcaded series of gauged archlets. Rendered in common--rather than face--brick, the side wall is compositionally separate and distinct from the principal facade, but, in this detail at least, equally spectacular.



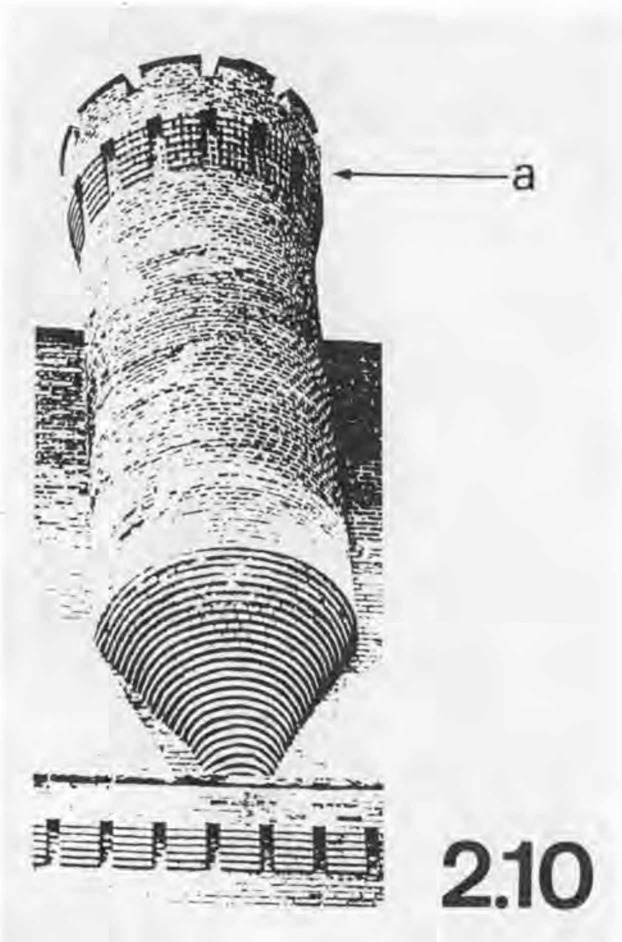
2.08

As is typical of this architectural genre and period, the ground floor facade, consisting of display windows and shop entrances, is compositionally quite independent of the rest of the structure. In terms of its masonry, the design actually begins at the second floor level. Spared the support functions imposed on the side walls, this front wall is thus freed to develop into the highly decorative facade with its elaborately articulated window hoods and fanciful corner oriel turret, as shown in Figure 2.05. Flanked by miniature masonry piers, each second level hooded window is topped by the arched, concentric reveals shown in Figure 2.05(a) and, in detail, in Figure 2.08. Supported on dropped corbels which partially frame each window, as shown in Figure 2.08(a), these constitute the only decorative use of masonry on the facade, with the exception of a relatively inconsequential median sawtooth string course.

The oriel turret, a popular corner embellishment of the period but of curiously diminutive scale in this instance, is of more than passing interest for several reasons. First, rather than springing from a flat wall as is usually the case, this oriel springs instead from an outside corner, creating a three-quarter round cylindrical form. Second, formed at the base of concentric masonry rings with each successive course portruding 1 1/2 inches beyond its predecessor, this is one of the few examples found of corbeling in circular brickwork. And third, as shown in the detail in Figure 2.09, this cylindrical turret is laid in yet a third bond type: a highly specialized configuration known as heading bond (see Figure 4.14).

This is a typical example of the standard techniques and devices and decorative masonry construction sensitively and thoughtfully applied to a very common structure of undistinguished type resulting in an exceptional building, quite distinctive and distinguished for its kind.

2.09

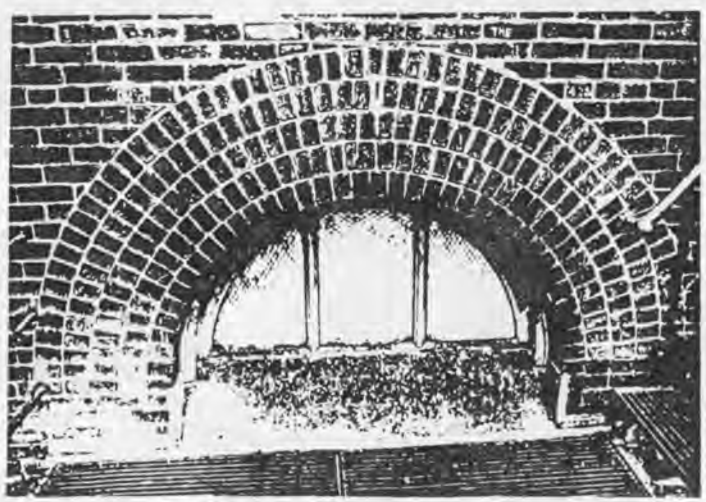


2.10

An even more dramatic example of the oriel turret, similar in form to that of the Bahr Building but much larger in scale, is shown in Figure 2.10. A semi-circular, fan-shaped corbel twenty-five courses high and projecting half its diameter (approximately six feet) beyond the face of the wall from which it springs, supports a cylindrical turret fifteen feet tall topped by a crenelated battlement, itself sitting atop an eight course denticulated corbel table, shown at Figure 2.10(a), projecting an additional foot beyond the face of the turret.

Taken from the same structure as the arch detail in Figure 2.02 (the Armory Gymnasium, University of Wisconsin, Madison), this building dates from the mid-1880's. While not decorated to what might be termed Victorian excess, this structure does contain certain examples of masonry devices which, although dated in terms of specific form, are potentially useful in terms of technique.

2.11



2.12

Several other features are also of interest. While the slender corbeled turret at the apex of the crow-stepped gable and its oriel are both laid in heading bond, the circular corner towers, shown partially in Figure 2.11, are not. Here, the increased diameter permits the use of common, or American, bond (see Figure 4.16) with the slight change in direction between each brick necessary to create the curve formed by a wedge-shaped mortar joint similar to that shown in Figure 4.14.

Several interesting arches, all of semi-circular form, also occur. Already shown in Figure 2.02 is one of the large, radially-bonded arches from the entrance arcade. Shown in Figure 2.12 is one of the small, ground level arches. A plain brick arch (see Figure 6.03), it consists of five concentrically arched rowlock courses with its curved shape being formed by wedge-shaped mortar joints joining uncut standard brick. Figure 2.13 shows a similar arch composed of four concentrically-arched stretcher courses. Yet another semi-circular arch, shown in Figure 2.11, is of standard form (i.e. gauged and radially bonded) but laid in a wall which is, itself, circular. Thus, the arch, itself, is laid on a curved horizontal axis: a most difficult masonry technique.

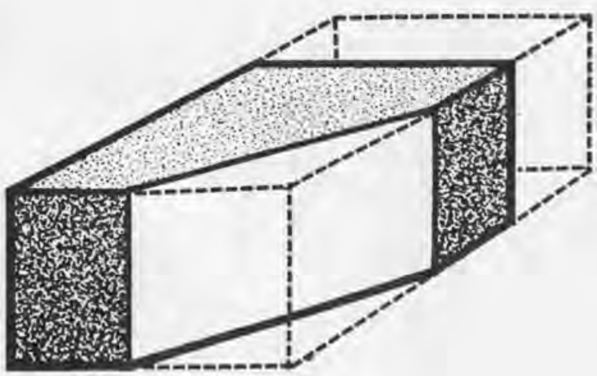
2.13

2.14

One final interesting device from this building is shown in Figure 2.14. This is a sloped pier of raked masonry. A form of reverse corbel, this device is used here to lean the pier against the load-bearing wall it buttresses.

While admittedly rendered in a dated and archaic architectural style, nevertheless these forms are not necessarily anachronistic in themselves. Although they no longer have an active role to play in most load-bearing construction, there is adequate precedent in architectural history to preserve them for use as decorative, albeit vestigial, forms in contemporary masonry design.

2.15

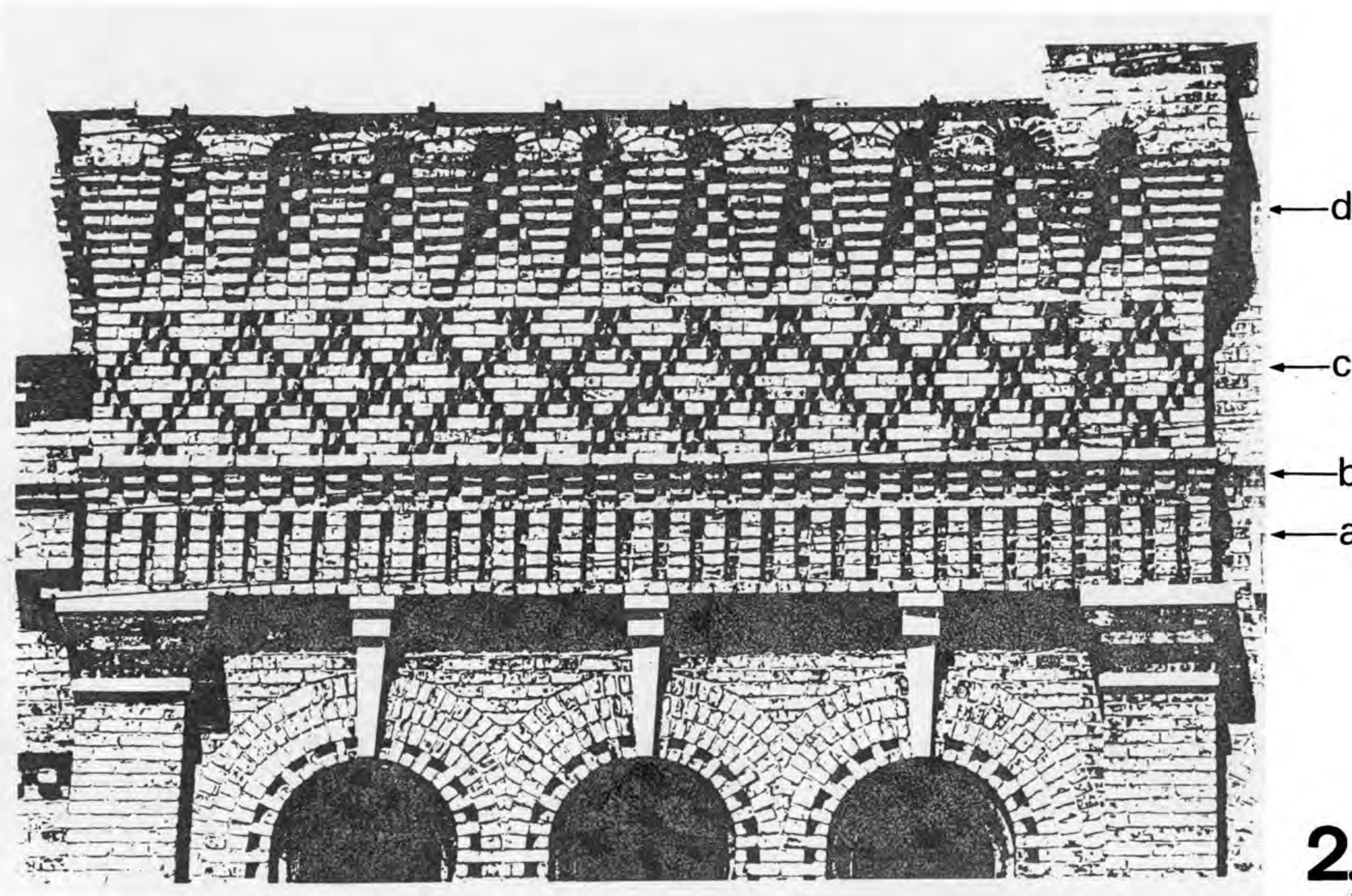


2.16

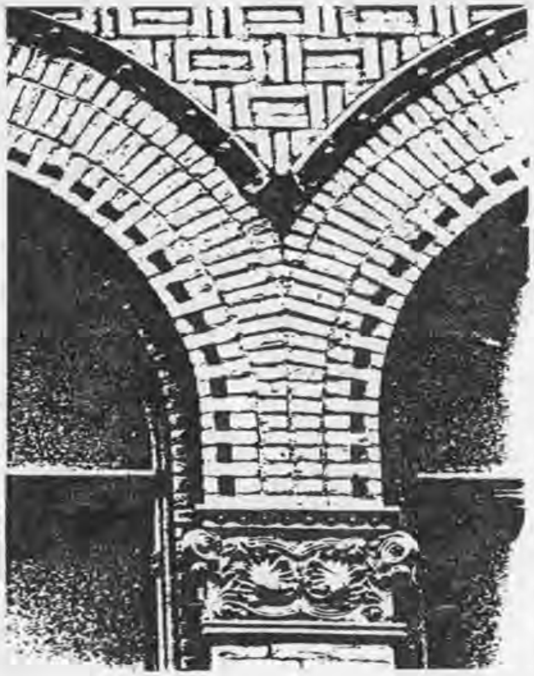
The Puerner Block (jefferson, Wisconsin: 1893), shown in Figure 2.15, is another example of highly decorative brick masonry adorning an otherwise completely unexceptional building. As with most commercial structures of this vintage, the upper levels are compositionally independent of the ground floor. Subjected to several extensive 'remodelings' since the turn of the century, the lower level no longer reflects the original design and can therefore be disregarded.

At the second floor level, the design begins with a triad of arched windows. Flanking the relatively stark central bay and intersecting at their haunches, these are formed of four concentric arched rowlock courses and are virtually identical to the arch shown in Figure 2.12 except for the special articulation created by the use of a special cut brick known as a 3/4 clipped bat (shown in Figure 2.16). Laid in alternating fashion with standard brick, shadows cast in the voids were consciously used to create the recurrent light and dark effect, both in this design and in the building shown in Figure 2.18.

However, the most interesting decorative effects are reserved for the parapet wall that crowns the facade. This is a tripartite design consisting of forms roughly analogous in form to the architrave, frieze and cornice of the classic entablature which it closely resembles. As shown in Figure 2.17. the composition begins with a five course band of denticulated header stack bond supported on corbeled header courses, shown at (a), topped by a two course denticulated corbel table (also of headers) and a projecting stretcher course shown at (b): a



2.17



2.18

Victorian form analogous to an architrave.

Preceeding vertically, a thirteen course diamond pattern diaper frieze follows, as shown in Figure 2.17(c). This is quite unusual in that it is formed entirely of sawtooth brick (i.e. units having their edges exposed rather than with units having exposed ends (i.e. headers) or faces (i.e. stretchers). Visually quite striking, this is a unique and noteworthy deviation from standard practice as explained in Section Four and shown in Figures 4.40 and 4.41.

Crowning the composition, cornice-like, is a ten course tapered, denticulated corbel table joined, the top, by extremely diminutive gauged archlets as shown in Figure 2.17(d). Interspersed within this corbel table is a skintled, header stack bond wall pattern, also known as checkerboard bond, shown at (e) and illustrated in Figure 4.10(c).

Perhaps the most dramatic, and skillfully used, corbeling found can be seen in the Queen Anne townhouses shown in Figure 2.19. Dating from the last quarter of the Ninteenth Century, this elaborate display of decorative banding is unsurpassed in its appreciative use of the material and the high level of craftsmanship displayed.

2.19

Built of relatively straight-forward, standard masonry techniques in all other respects, the running stretcher bonded masonry wall explodes in an ornamental tour de force at the corbel table, as shown in detail in Figure 2.20. Ostensibly supporting the mansard roof above, this three-tiered extravaganza begins simply enough with two, stacked sawtooth string courses topped by a stretcher course, as indicated at (a) in Figure 2.21. And that's as far as convention gets. What happens after that is decidedly unconventional and, by conventional standards, not really good masonry practice. Yet it not only works visually, but this design has proven exceptionally durable as well.

The design is based on several unique features. The first of these is a specially-cut brick similar to that shown in Figure 2.16. Called a whole clipped brick, or king closer as shown in Figure 3.25(f), it is ordinarily used in a stretcher position to secure masonry bonds at their corners. Here, however, it has been used more for decorative effect than for structural purposes.

The second unique feature of this design is the use of blind mortar joints. As diagrammed in Figure 5.17 and explained further in the text which accompanies it, a blind joint is one in which the mortar of the joint is made to resemble, in color and texture, the bricks which surround it. Properly executed, such a joint is virtually invisible from any significant distance.

The third unique component is an unusual technique of laying the units. Each of the projecting (i.e. corbeled) king closers is laid, rowlock fashion, in

2.20

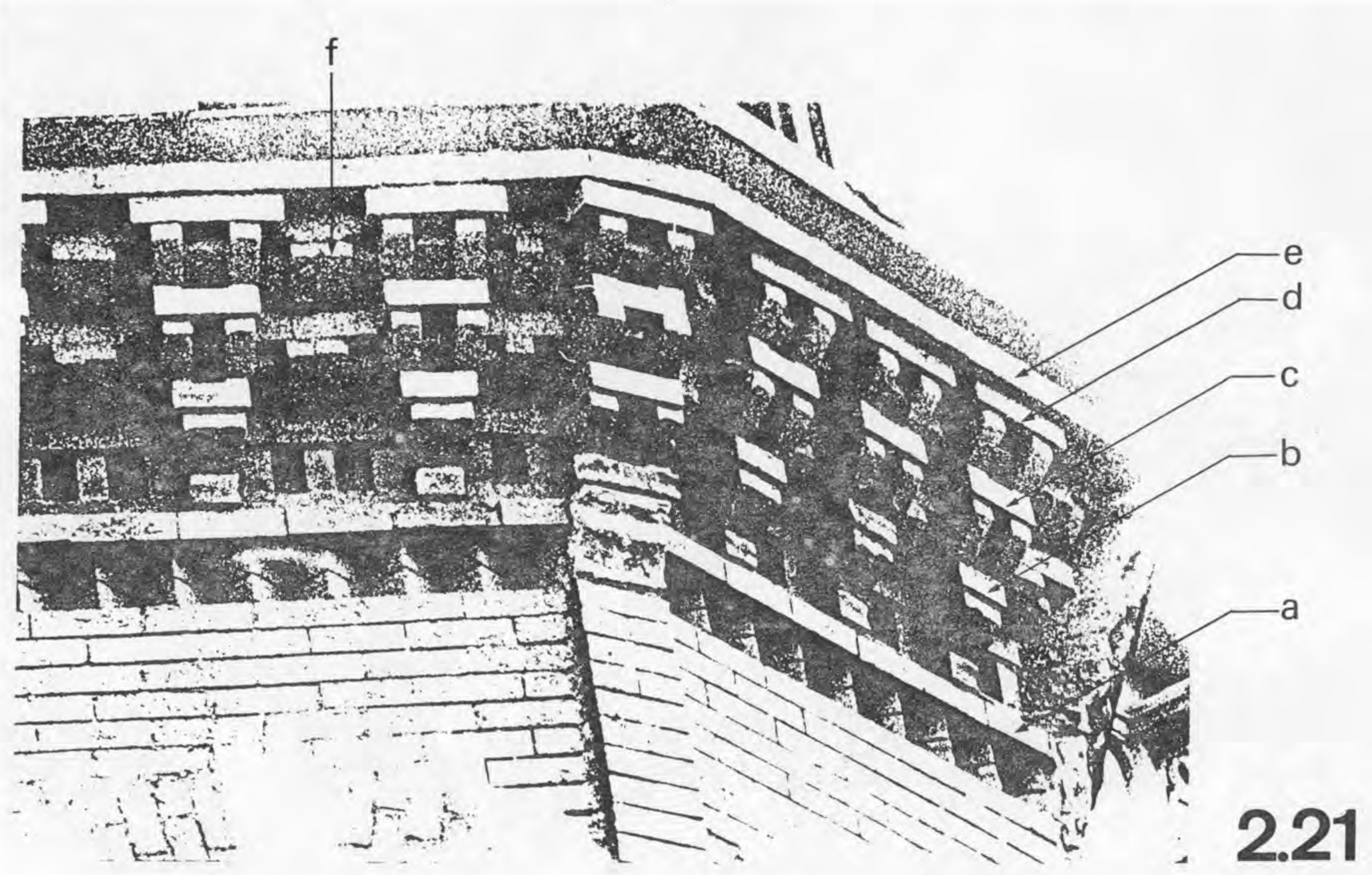
clusters with their clipped ends exposed, expanding as they ascend.

The first tier cluster is composed of two adjacent king closers laid as rowlocks. As shown in Figure 2.21(b), the use of a blind vertical joint between these paired units creates what is, to all appearances, a single unit. Sitting atop this pair is a three-quarter stretcher brick (bat) which supports the next cluster.

Laid in groups of three with the center brick (a fractionally-split rowlock king closer) recessed, the clusters in this second tier, unlike those in the first, are topped with a full (rather than a three-quarter) brick which, in turn, supports the third tier, as shown at (c) in Figure 2.21.

This third tier is compositionally similar to the second, differing only in its dimensions: the recessed center brick being a whole rowlock and the horizontal member above it being a stretcher and a header, again joined by a blind vertical joint as shown in Figure 2.21(d). This part of the composition is completed by a single stretcher course and a rowlock course of king closers, as indicated at (e) of the same illustration.

This complex, three-tiered corbel table is denticulated both within the corbel clusters and between them. The recessed dentiles, like those that are corbeled, are themselves further articulated by a minor internal dentile arrangement of their own, as shown in Figure 2.21 at (f).


f
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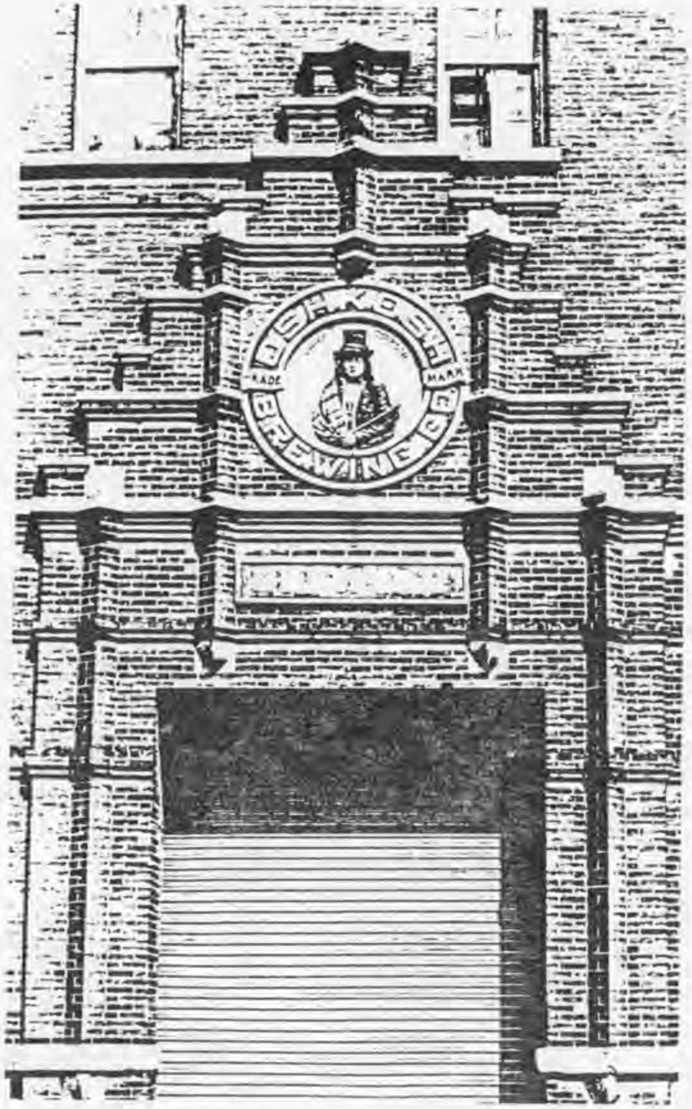


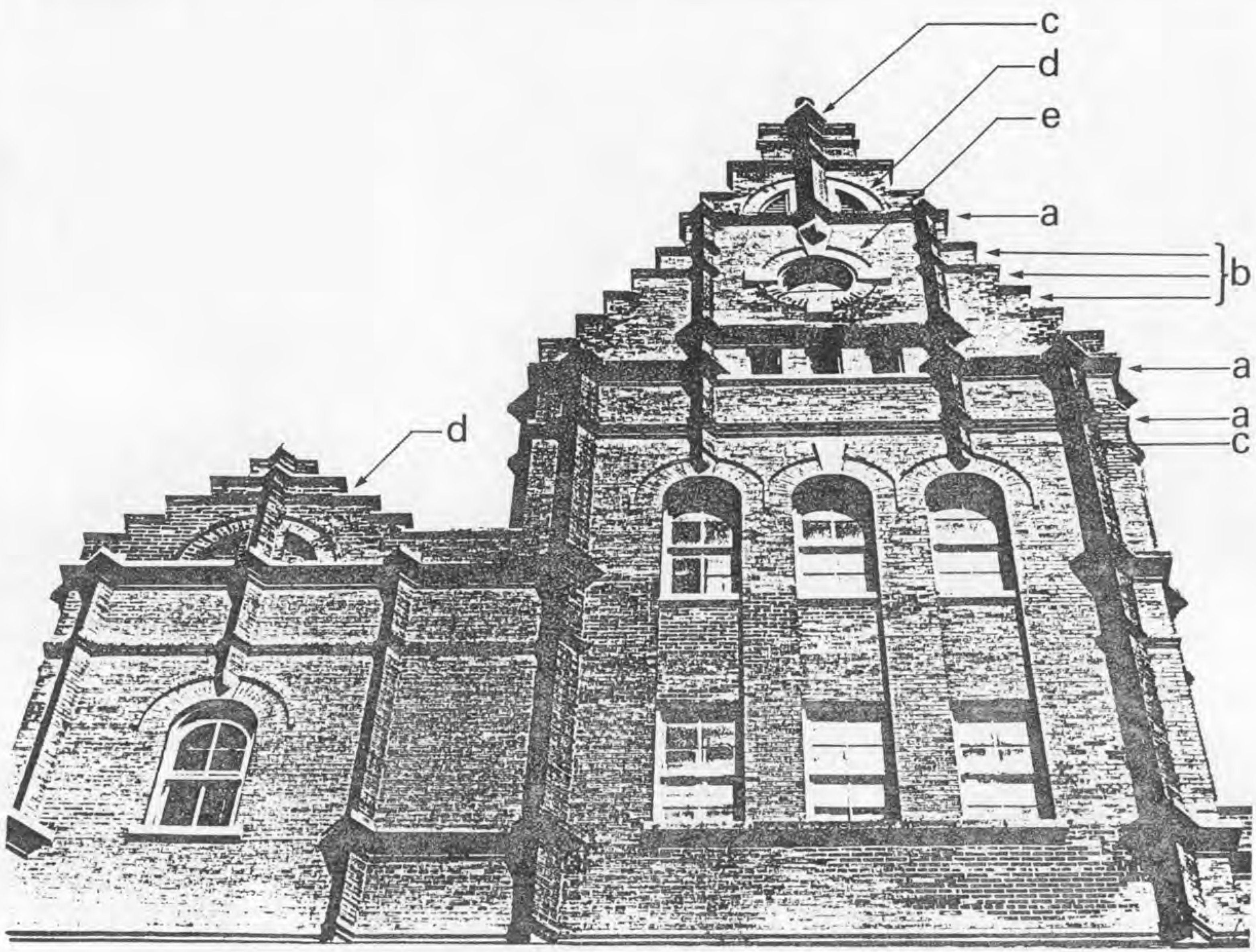
2.22

This particular corbel table is unique in yet a fourth respect: its subtle use of sophisticated masonry techniques to create a highly complex, deeply sculptural composition totally in keeping with the essential character of brickwork.

Thus, the angularity of brickwork, the sense of similar elements repetitively used, the additive--rather than subtractive or molded--character of the construction and the sense of mass in the completed composition, all are characteristics inherent in well designed and well executed brick masonry construction. The adept translation of these essentially structural aspects into a decorative motive demonstrates an uncommon understanding and appreciation of both the nature and the potential of the material and a willingness to explore and expand this potential through the application of a well-disciplined inventiveness.

Such inventive exploration, and exploitation, of brickwork as a decorative building material is characteristic of most masonry construction of the 1880's and '90's. As the photographs which follow will show, these inventive improvisations took the form of variations on certain basic elements (e.g. the arch, the corbel, the rake, pier and column) and on certain specific building components (e.g. the frieze, the chimney, etc.) created from them.

This almost playful manipulation of the masonry surface is demonstrated repeatedly in buildings of the period and is a tradition which has persisted, if often furtively, ever since. Thus, in Figure 2.22, a portal is shown which, in miniature,



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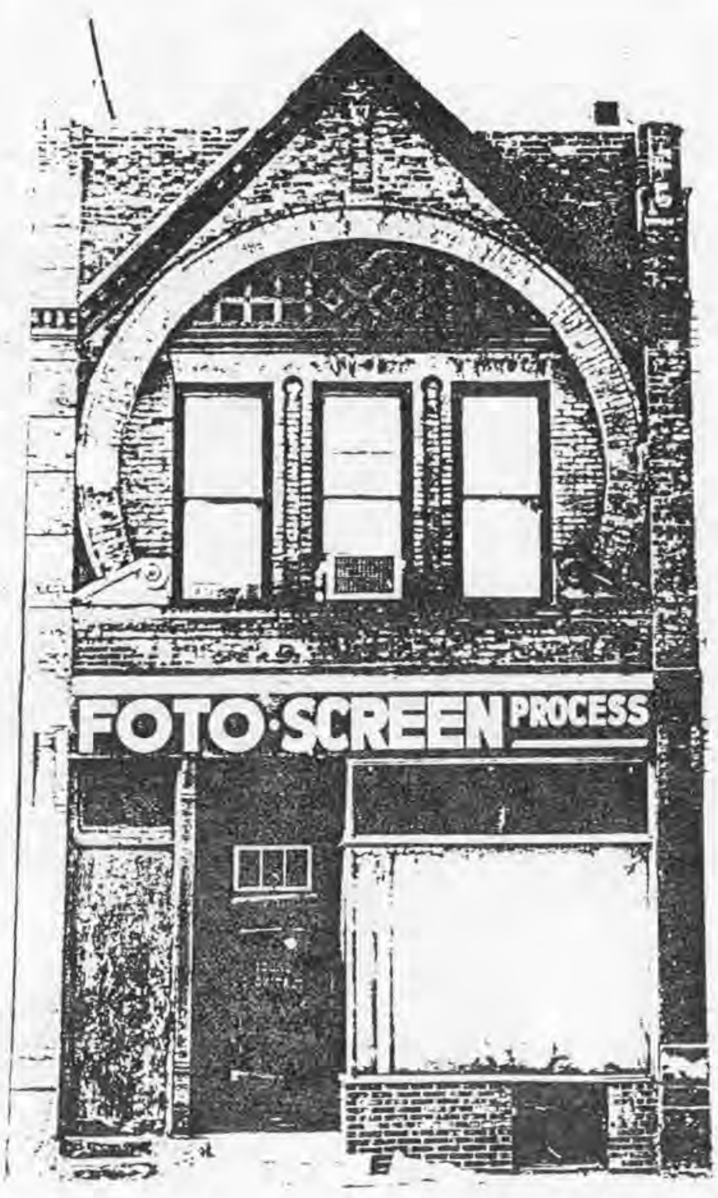
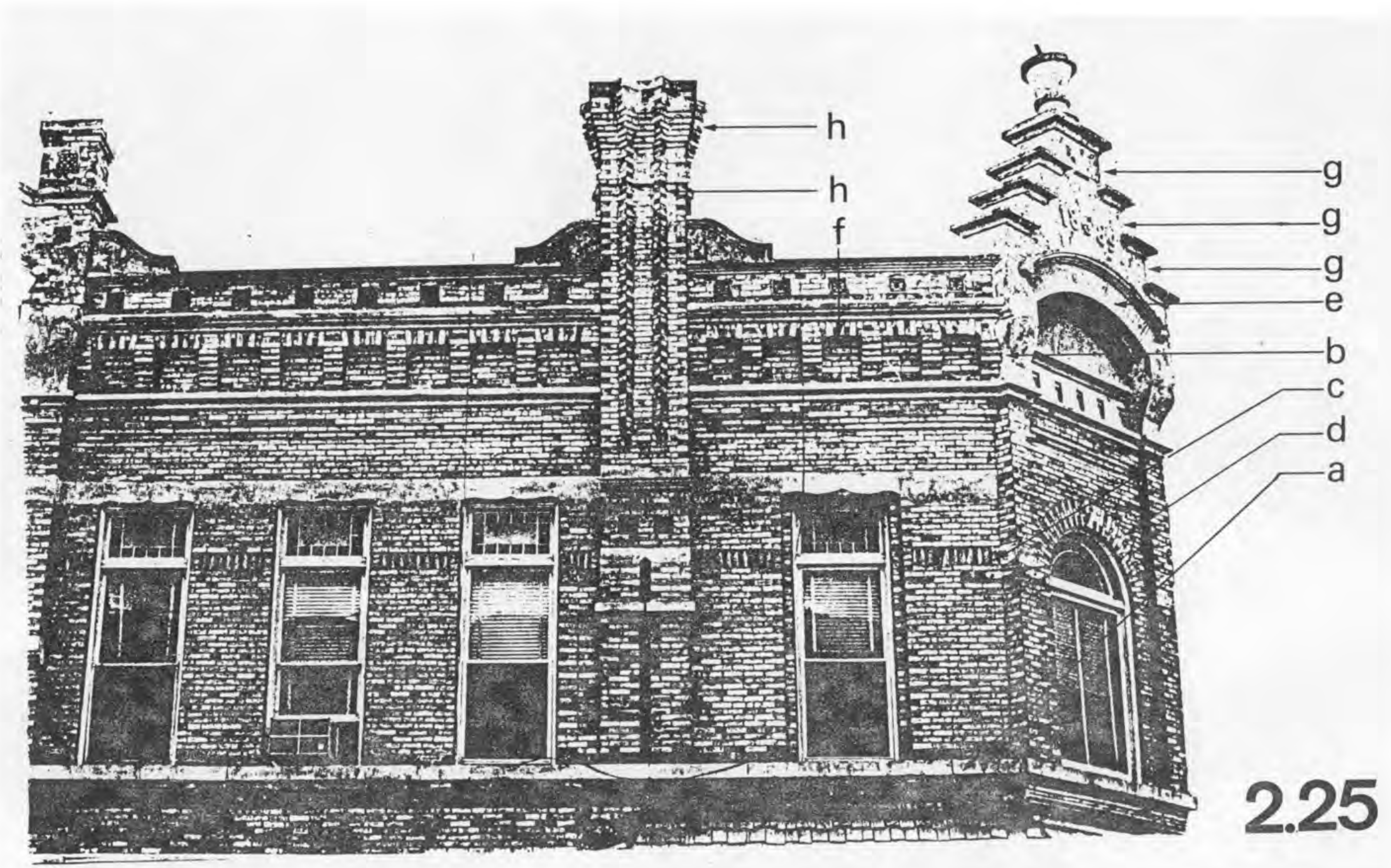


2.24

reflects the whole structure, shown in Figure 2.23, with its emphasis on corbeled strong courses, such as shown at Figure 2.23(a), crow-stepped gables, at (b), and angular pendant piers, shown at (c). Several unusual arch forms, other than the semi-circular, are used. One is a bisected semi-circular arch, shown at (d). The other is the bull's eye arch, shown in Figure 2.23(e), both of which are discussed further in Section Six.

Yet another unusual arch form is shown in Figure 2.24. Called a round horse-shoe arch (see Section Six), this seldom used arch here functions, perhaps as a relieving arch, but more likely as simple applied decoration. Other than the small insert of ornamental masonry relief-work above the second level window band, the arch itself and its elaborately carved impost blocks are the major decorative elements in this compact design.

The Plymouth (Wisconsin) drugstore, shown in Figure 2.25, is another example of inventive manipulation of the masonry surface. Built in 1889, the decorative devices and forms are not individually unique and, for buildings of this period, the composition is quite ordinary. Denticulated corbel tables, shown at (a) and (b), a sawtooth string course, shown at (c), radially bonded semi-circular and segmental arches, shown at (d) and (e), the gauged jack arch, shown at (f), the crow-stepped gable topped with a mortar and pestle finial, shown at (g), the angled pendant piers and flaring corbel cap of the chimney, shown at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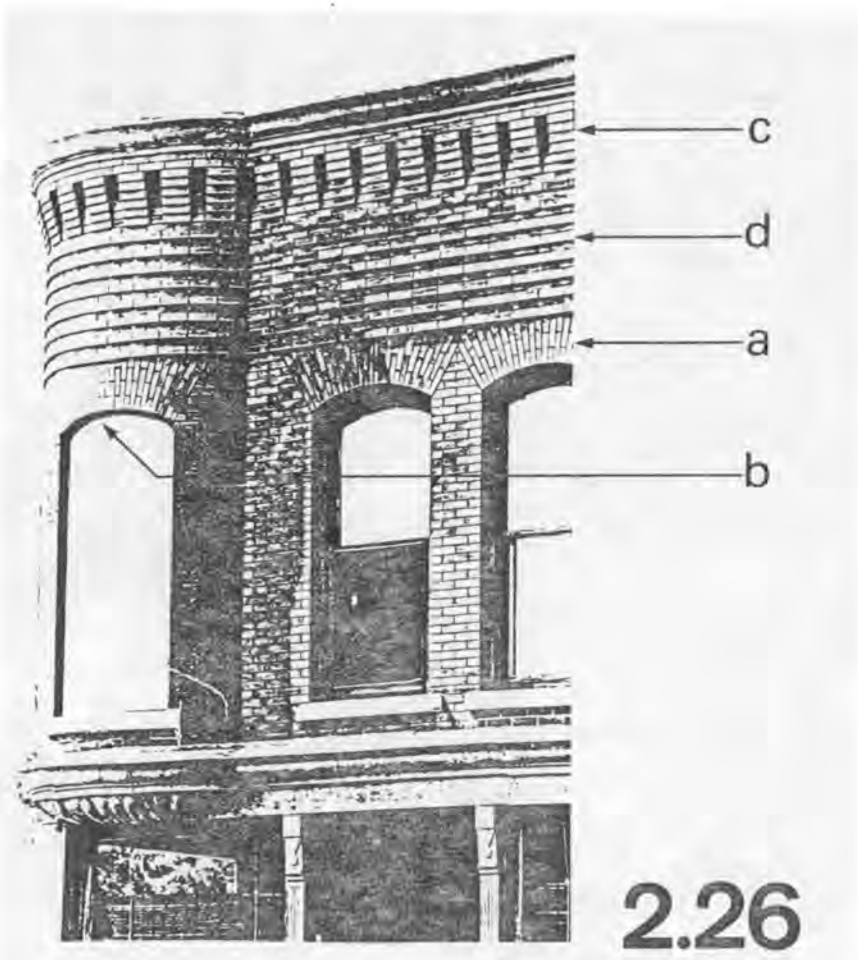
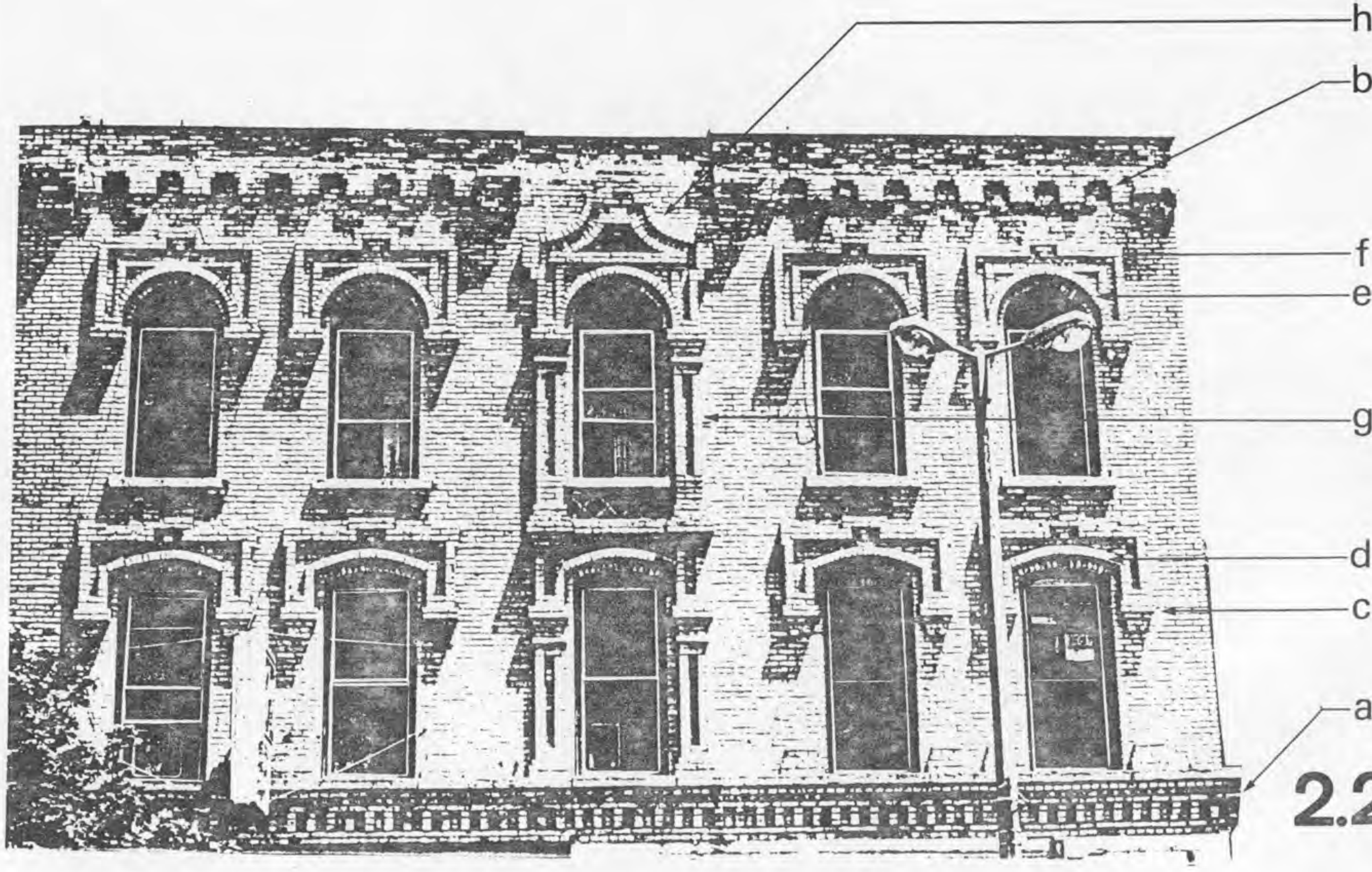


2.26

(h), are all standard elements of Ninteenth Century decorative brickwork.

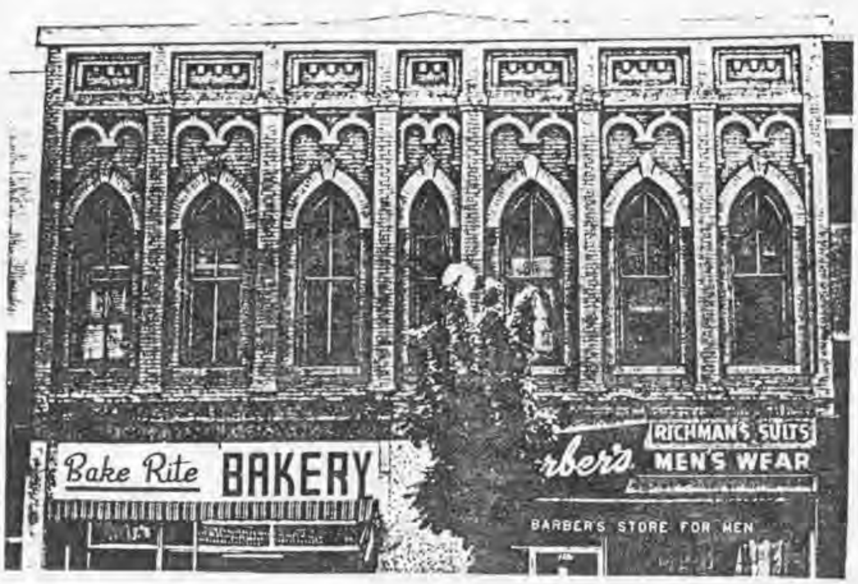
The building shown in Figure 2.26 reillustrates, in slightly different form, several devices already seen, the most obvious of these being the corner oriel turret previously shown in Figures 2.09 and 2.10. Others include the gauged, radially-bonded segmental arches shown at (a), the same segmental arch laid in a curved wall as shown at (b), and the denticulated corbel table, shown at (c). However, the patterned banding immediately below the corbel table, shown at (d), has not been previously discussed. Known as skintled brickwork (see Figure 4.36 and the accompanying text), alternating courses of a running stretcher bond (diagrammed in Figure 4.11) portrude slightly beyond the plane of the wall, creating regularly textured, horizontal bandings at the parapet level. The use of this technique dates this structure in the first decade of this century.

The upper two floors of the Janesville (Wisconsin) commercial structure, shown in Figure 2.27, are typical of late 1890's brickwork. Here, a decorative belt course at the second floor level, shown at (a) in Figure 2.27 (consisting of a header course, a stretcher course, three denticulated header stack courses, another stretcher course, a sawtooth course, and a final header course), begins this composition. A relatively simple frieze of corbeled, pendant jack archlets crowns the facade at the parapet level, as shown at (b).



2.27

However, the most elaborate effects are reserved for the window hoods. Two concentric rowlock courses, springing from flanking impost blocks of corbeled brick (c), define the segmental arches of the lower windows (d) and the semi-circular arches of the upper level (e), with each arch being encased in a rectangular hood of portruding brick (f). More elaborately decorated than the others, the windows of the central bay are flanked by articulated brick piers reminiscent of classical columns (g) and topped by twin inverted arches (h) constructed, like those of the windows, of paired concentric rowlock courses.

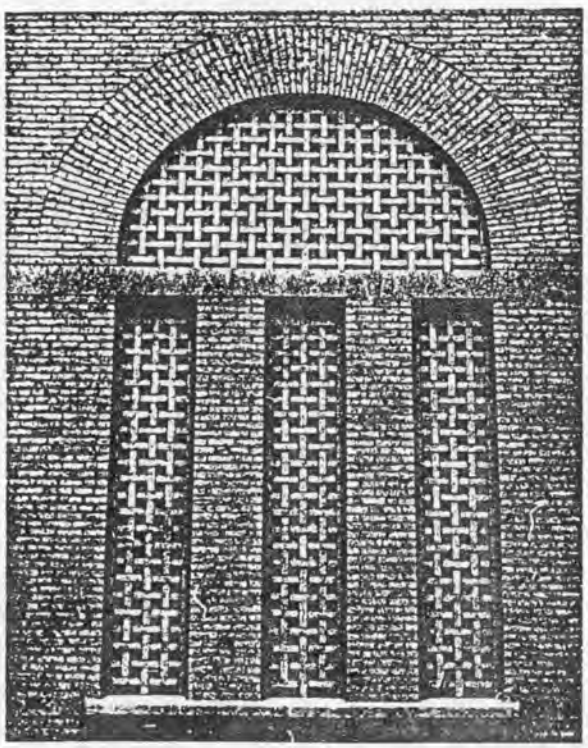


2.28

Dating from the late 1890's, the commercial structure shown in Figure 2.28 has several interesting features. Symmetrical in design about a central axis, this composition is developed from two, generic elements: the pier and the arch.

Divided into seven major bays, each enclosing a second level window and topped by an articulated, inserted panel as shown at (a), each bay and the small panel which tops it are sharply defined by the portruding vertical piers. Within each bay, the window openings are arched in the gothic fashion with equilateral gothic arches at the sides (b) and a lancet gothic arch (c) in the center panel. While these are structurally active in that they actually do support a portion of the wall, the paired semi-circular blind arches (d) above them, being merely decorative, are not.

Such arched work has been an integral and basic structural element of traditional brickwork. Found in virtually every masonry building until recent modern times, the arch was also one of the principal ornamental devices of decorative brickwork. Such universality generated a wide variety of fundamental arch geometries, as described in detail in Section 6, and led to widespread experimentation with detailing, was will be demonstrated in the illustrations which follow.



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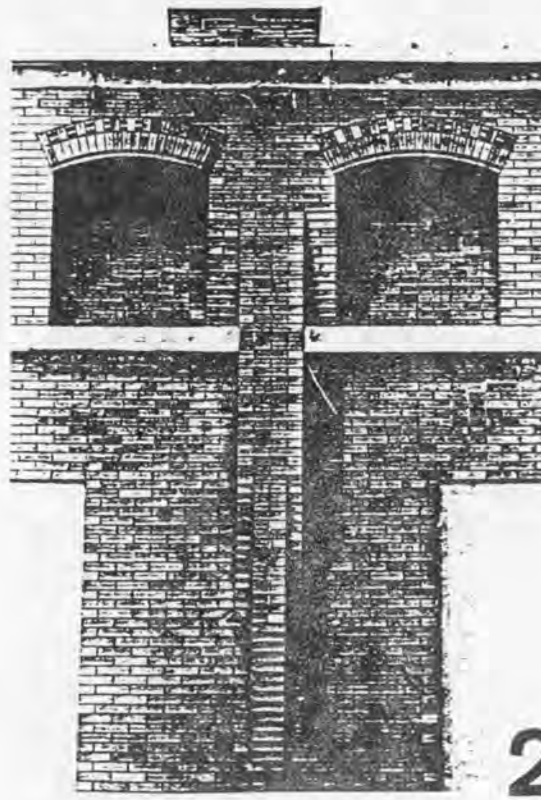
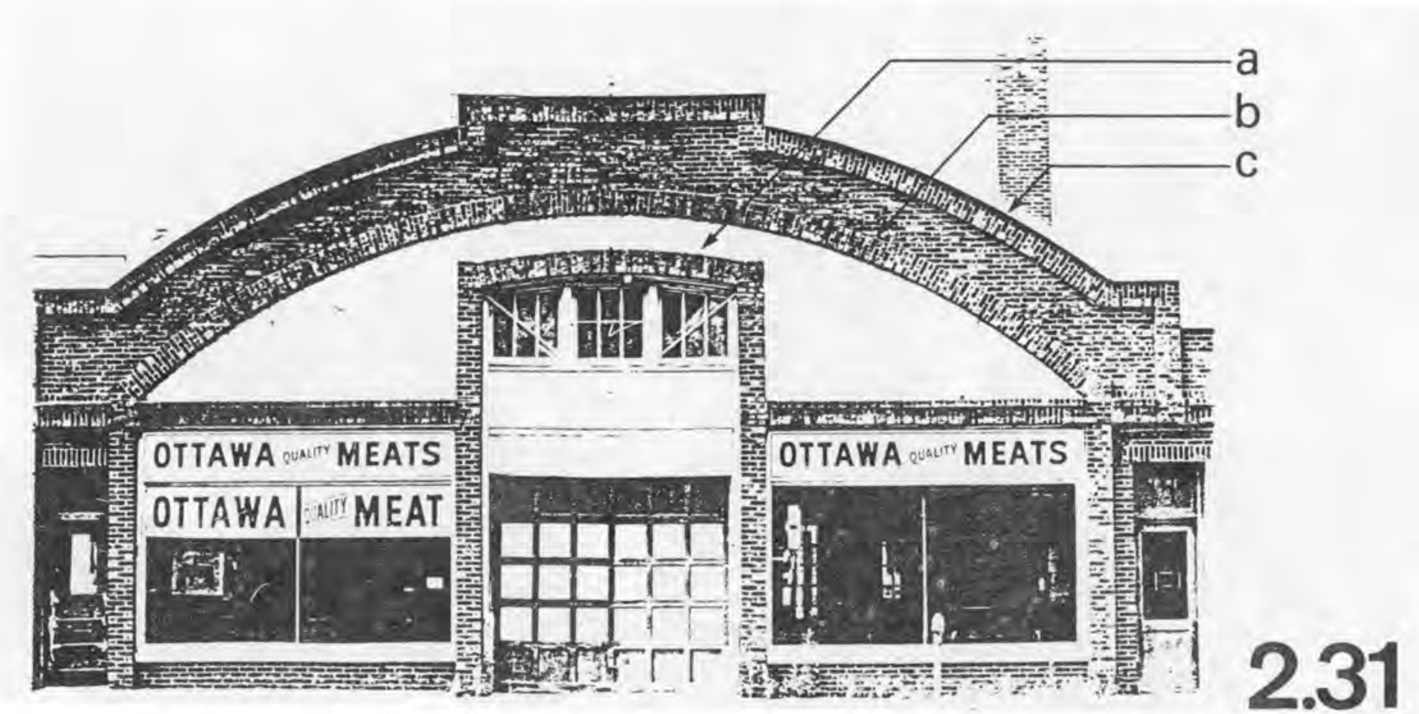


2.30

Shown in Figure 2.29 is a gauged, radially-bonded, blind semi-circular arch with the enclosed panel, also semi-circular, as well as those beneath it rendered in a basket-weave block pattern bond of stretchers and soldiers.

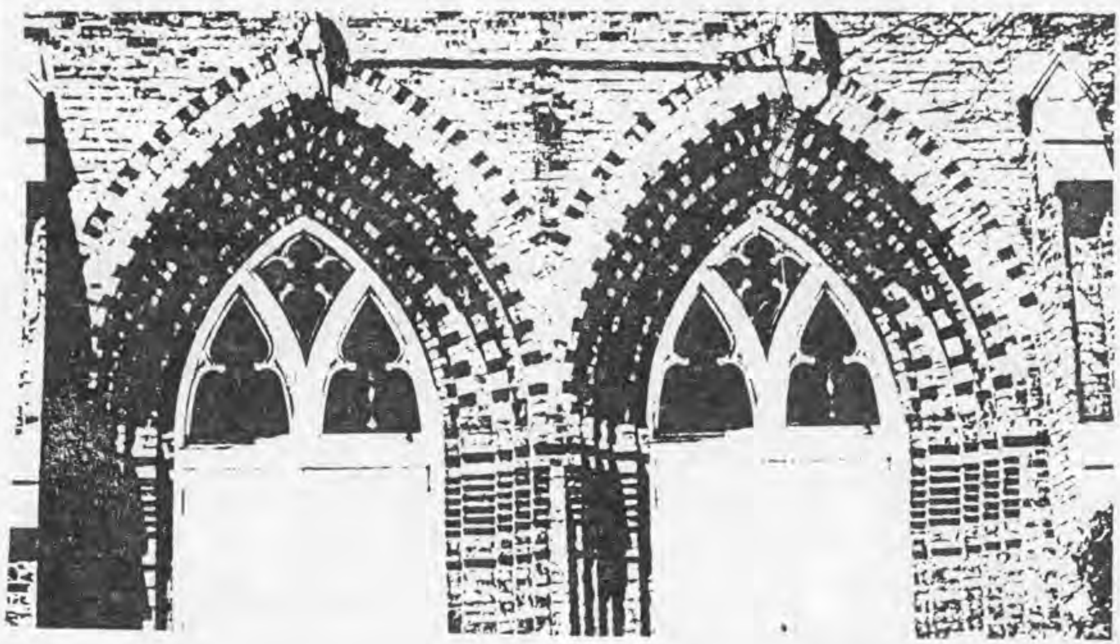
Shown in Figure 2.30 are a pair of gauged, segmental blind arches formed of two concentrically-arched courses of rowlock and soldier specials, flanking an exterior corbeled chimney shaft.

Figure 2.31 demonstrates a composition using three concentric segmental arches of which only that shown at (c) is structurally active.



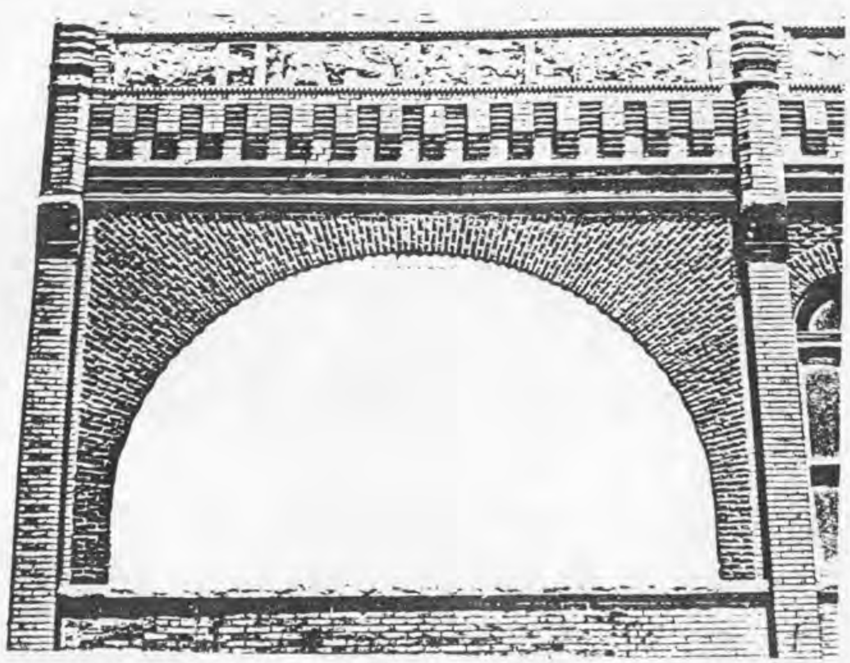
2.31

Equilateral gothic arches, similar to those shown in Figure 2.28 but larger in scale and more elaborately articulated and decorated, are shown in Figure 2.32. Springing from atop a low corbel table, the concentric reveals of the doorways continue into the arches, themselves, to form concentrically arched soffits.



2.32

Figures 2.33 and 2.34 show two decorative variations of a semi-circular arch taken from the same building. In Figure 2.33, the gauged, radially-bonded voussoirs extend from the intrados of the arch to the perimeter of the bay which contains it. In Figure 2.34, the ring of an identical arch is only extended the length of a header and a stretcher, with the remainder of the bay, except for the decorative panels inserted at the corners, being laid up in a running stretcher bond. In both cases, the arch rings (and in the latter, the corner panel inserts) are constructed using a special, rusticated face brick which imitates, in texture, rough-hewn stone.



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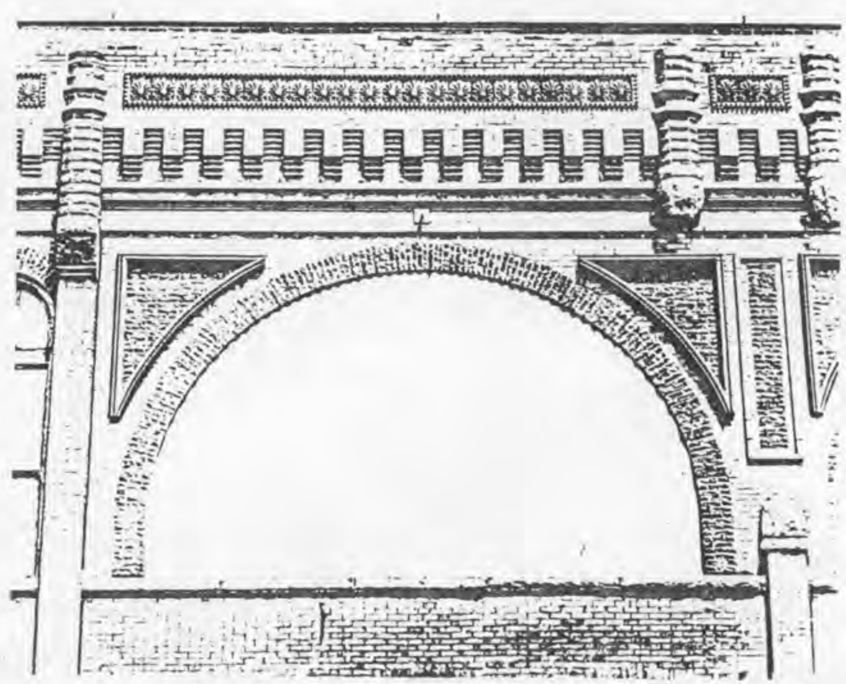
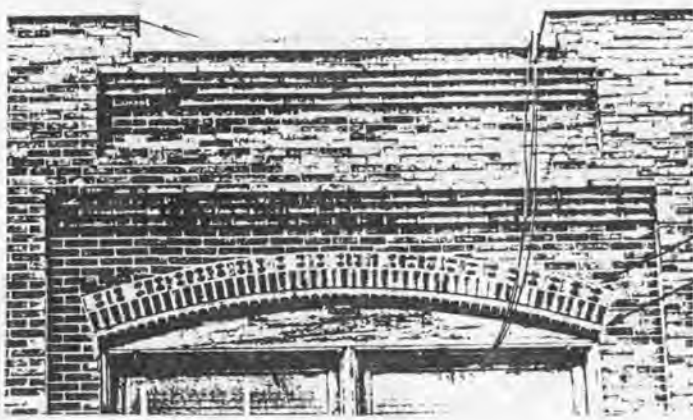


2.34

The Schoenleber Building, built in 1882, carries the concept of concentric arches, begun in Figure 2.31, a bit further through the use of dissimilar, rather than similar, arch forms. Here, semi-circular arches with articulated frames (a) are encased within a cusped arch (b) having a decorative trefoil outline. The central entabulature, bearing the name of the structure, is framed by yet a third variety, the pseudo-three-centered arch, which springs from an unusually detailed parapet level corbel table shown at (d) in Figure 2.35.

2.35



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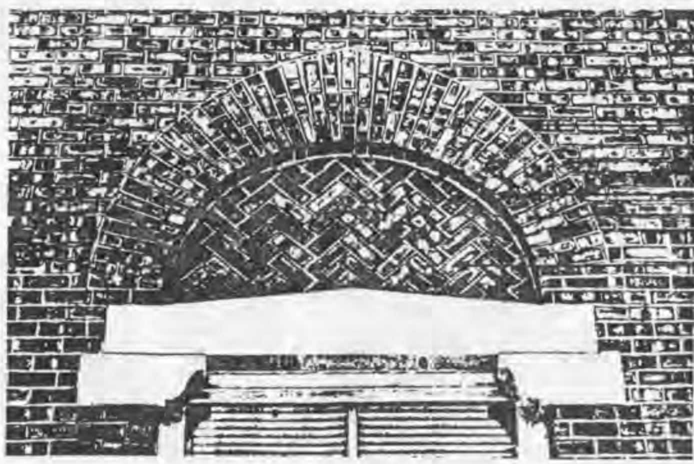


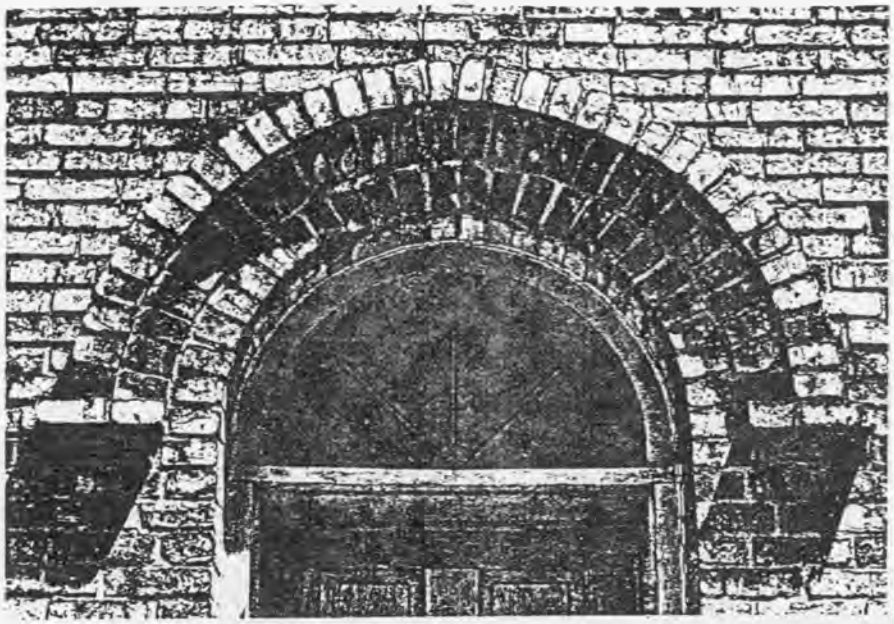
2.37

Further illustrating the decorative use of arches in traditional brickwork Figure 2.36, taken from the same building shown in Figure 2.30, shows a segmental arch constructed of two special brick. The lower one, shown at (a) and known as a hinge brick (see Figure 3.09), is laid as a soldier with its exposed, molded face defining the intrados of the arch, while the other, shown at (b) and known as a jamb brick (see Figure 3.05), is laid as a rowlock with its exposed, molded end defining the extrados of the arch.

A blind semi-gothic arch is shown in Figure 2.37. Defined in Section 6 as an arch having a dissimilar (i.e. eccentric) intrados and extrados (the former being semi-circular (a), the latter (b) being a drop gothic arch), here radially-bonded, gauged voussoirs form the arch ring which encloses a semi-circular panel (c) of herringbone pattern bond (see Figure 4.32) using brick laid as rowlock stretchers, or shiners (see Figure 3.13).

Shown in Figure 3.23 is a depressed three-centered arch, gauged and radially-bonded in its beveled soffit, and flanked at the intrados and extrados with gauged and concentrically-arched rowlock courses. Here again, as in Figure 2.32, the beveled reveal of the doorway is continued vertically to form the soffit of the arch, itself.

Dating from the 1880's, the detail in Figure 2.38 shows a simple, semi-circular arch composed of three concentric rowlock courses. A corbeled, plain brick



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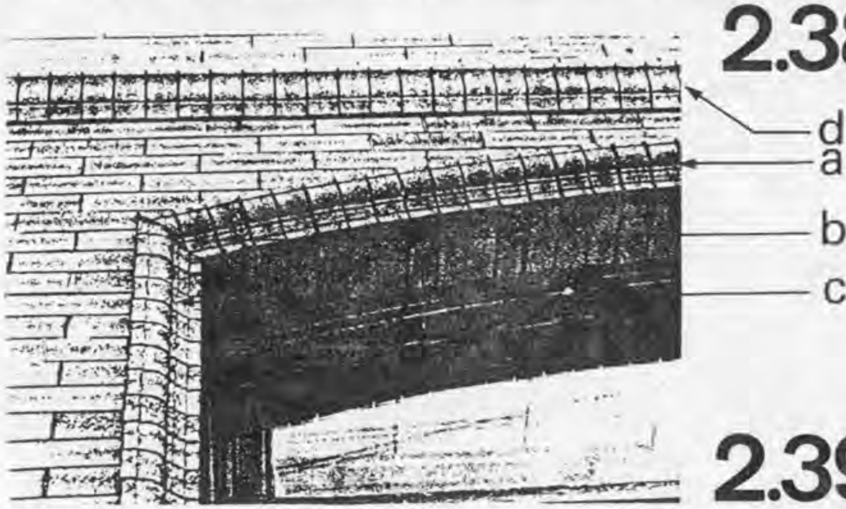
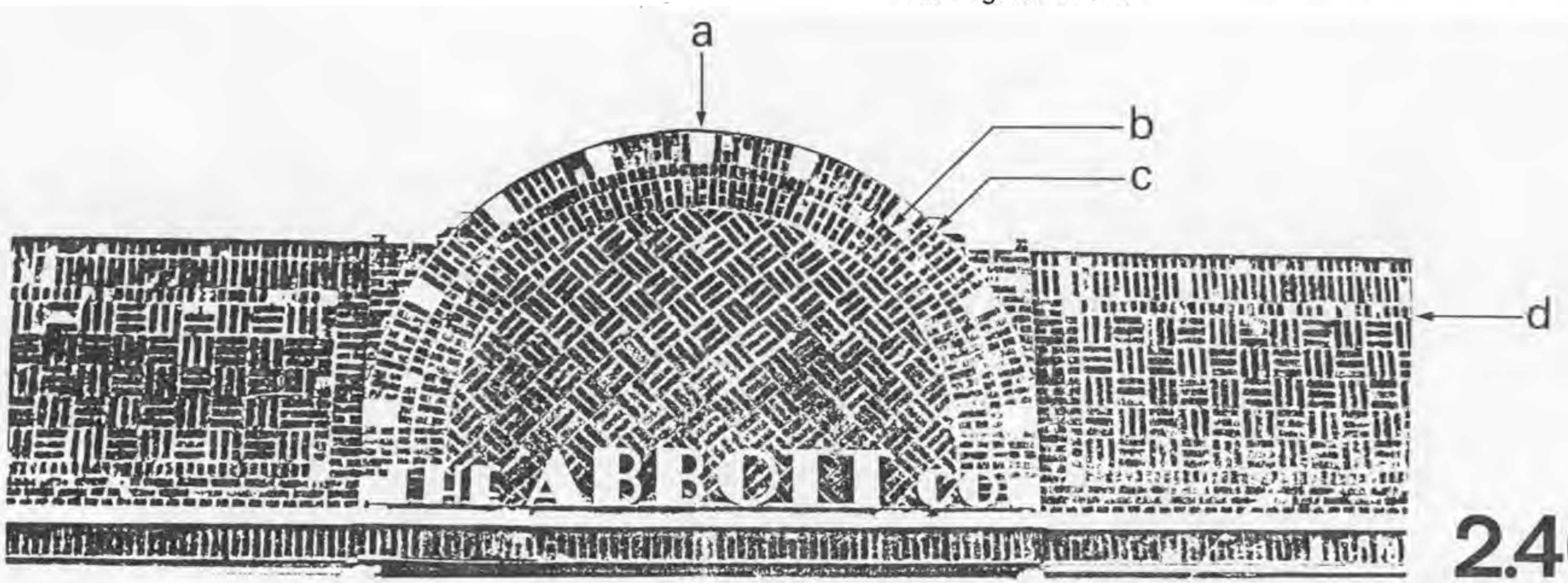


2.39

(i.e. ungauged) arch with wedge-shaped mortar joints, its relatively simple construction does, however, include a center course of cove-molded, or cusped, specials laid as rowlocks with their molded ends exposed.

Another use of specials is shown in Figure 2.39. Here, in a building dating from the late 1930's, a special brick similar to that shown in Figure 3.03 is used both to form the segmental arch ring (a), and, continuing downward from its mitered corner (b), to (c) frame the window opening. This same decorative molding is continued in the string course, shown at (d) using the same specially-formed brick.

Another semi-circular panel (a) laid in a diagonally-oriented basket weave block (or paving) pattern (see Figure 4.34) is shown in Figure 2.40. Here, the enclosing arch ring is composed of compound concentrically arched coursings, the innermost being rowlocks (b), the outermost being alternating stretchers and two headers (c) flanked on either side by a frieze of vertically-oriented basket weave block bond enclosed in a rectilinear frame of decorative coursings(d), similar to those shown in Figure 3.15.



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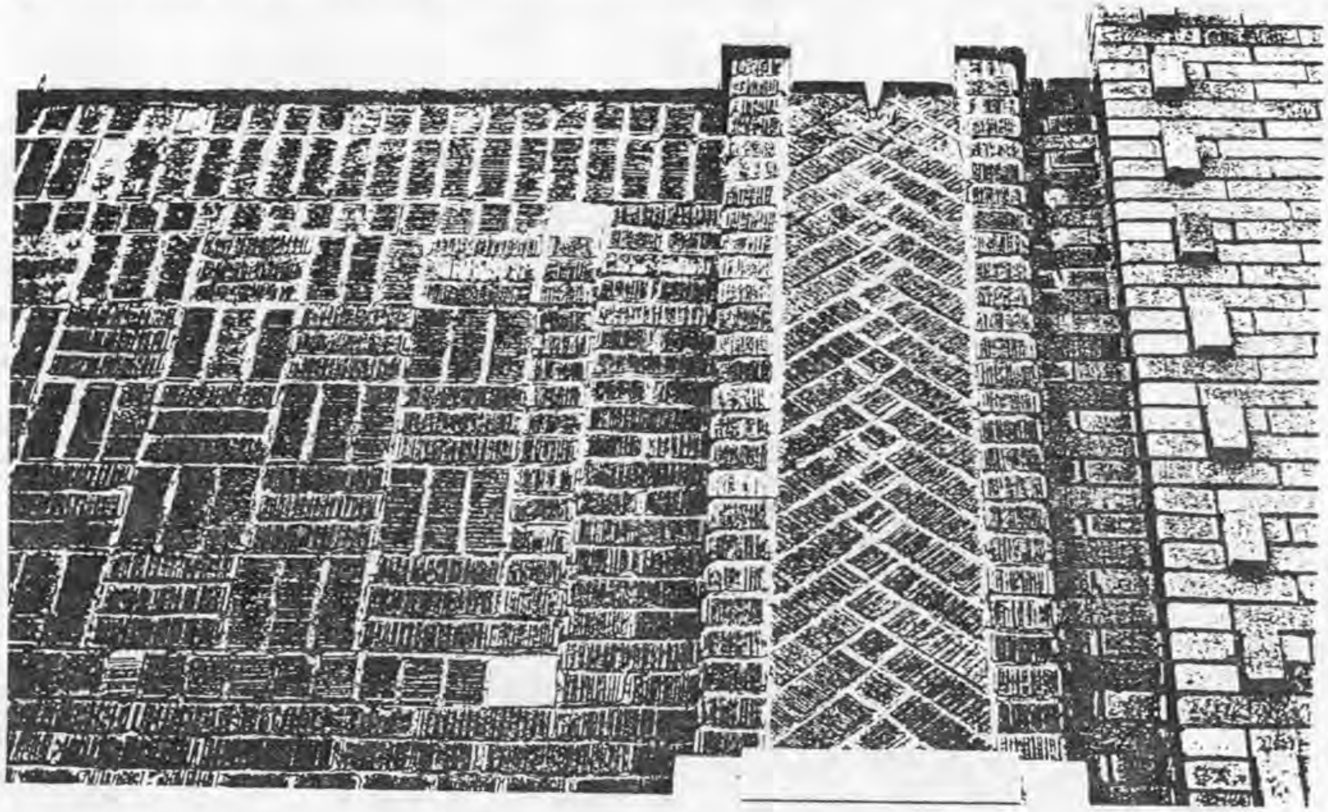
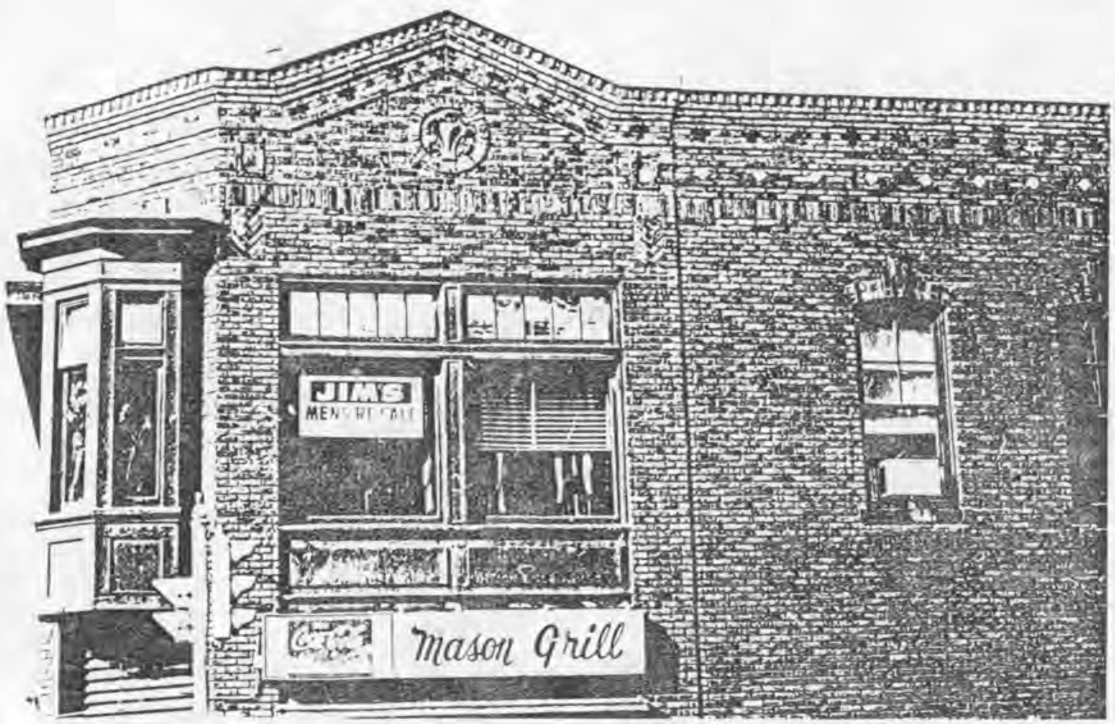
The decorative frieze, partially shown in Figure 2.40, terminates at either end in the diagonally-bonded finial shown in Figure 2.41. Widespread use of the various raking and block pattern bonds



2.41

similar to those shown in Figures 4.32 through 4.34, simple framing courses, and unelaborated shallow corbel tables, such as those shown in Figure 2.36, were prominent features associated with the two-dimensionality and preoccupation with surface texture that characterized decorative brickwork in the 1920's and 30's.

In the first decades of this century, brick masonry steadily lost much of the deep, sculptural quality it had had prior to 1900. Attention, in design, focused more on the texture of the individual bricks, themselves, and on the patterns these generated in the wall fabric. Thus, it was in the twenties and thirties, and thereafter, that many of the specially-textured face brick, such as the so-called tapestry brick shown in Figures 2.41 and 2.42, began to appear. It was in this same period (i.e. the 1920's) that skintled brickwork (another technique for texturing the masonry surface described in Section 4 and illustrated in Figure 4.36) appeared.



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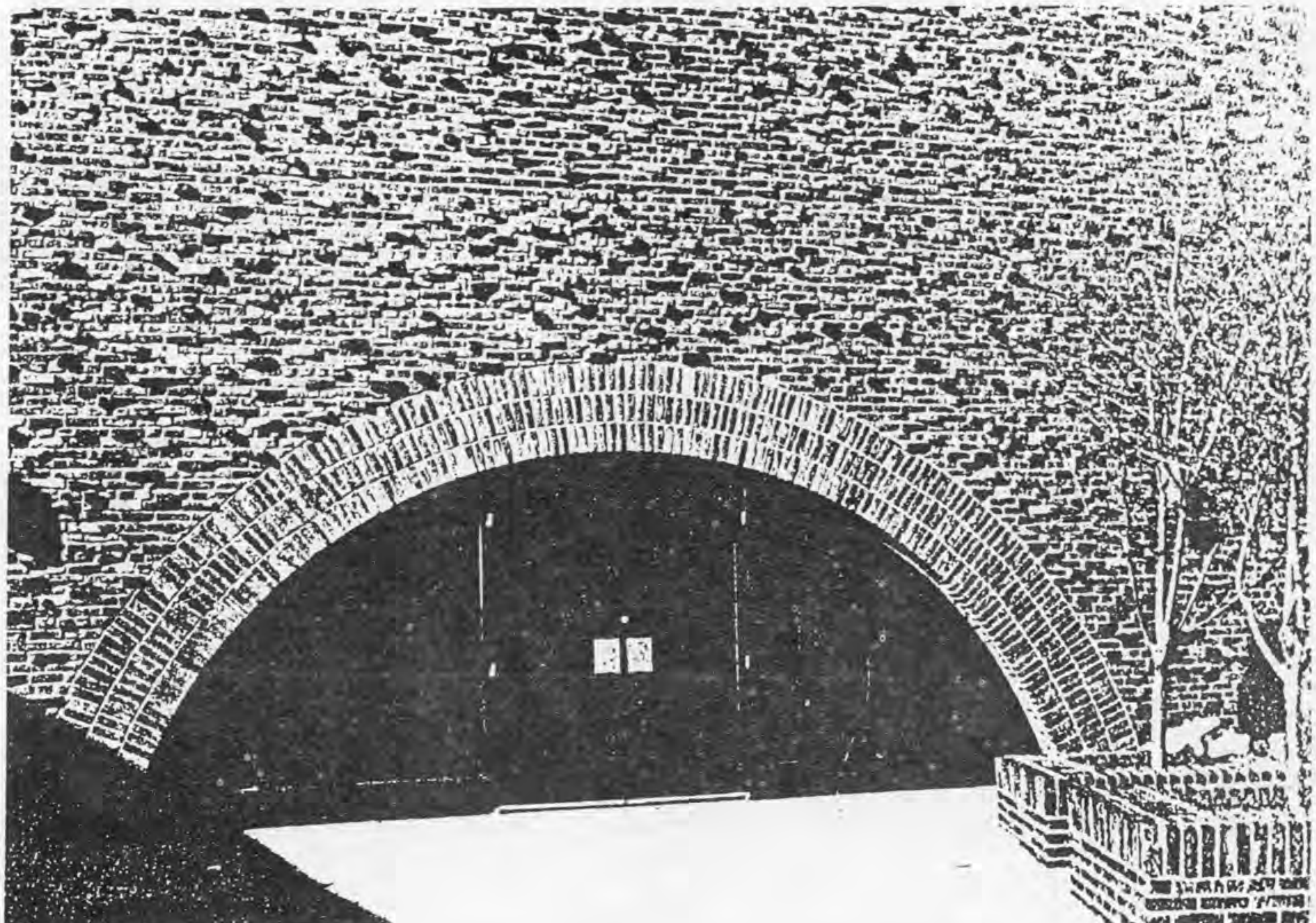

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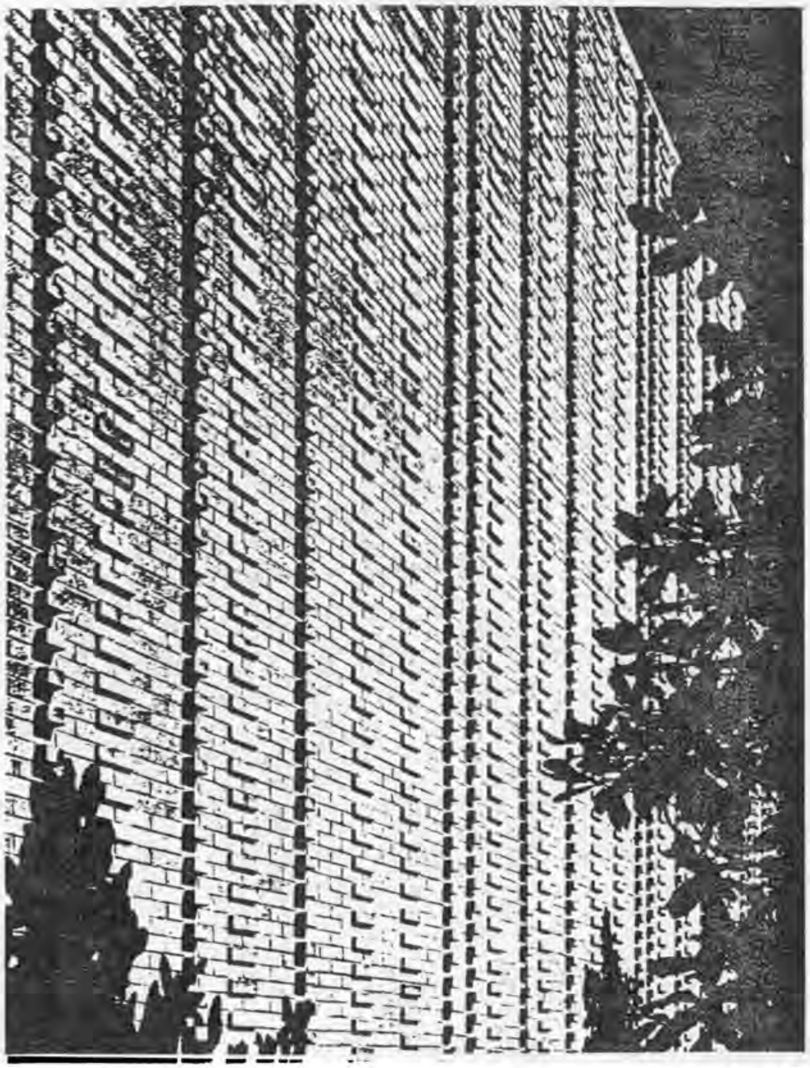


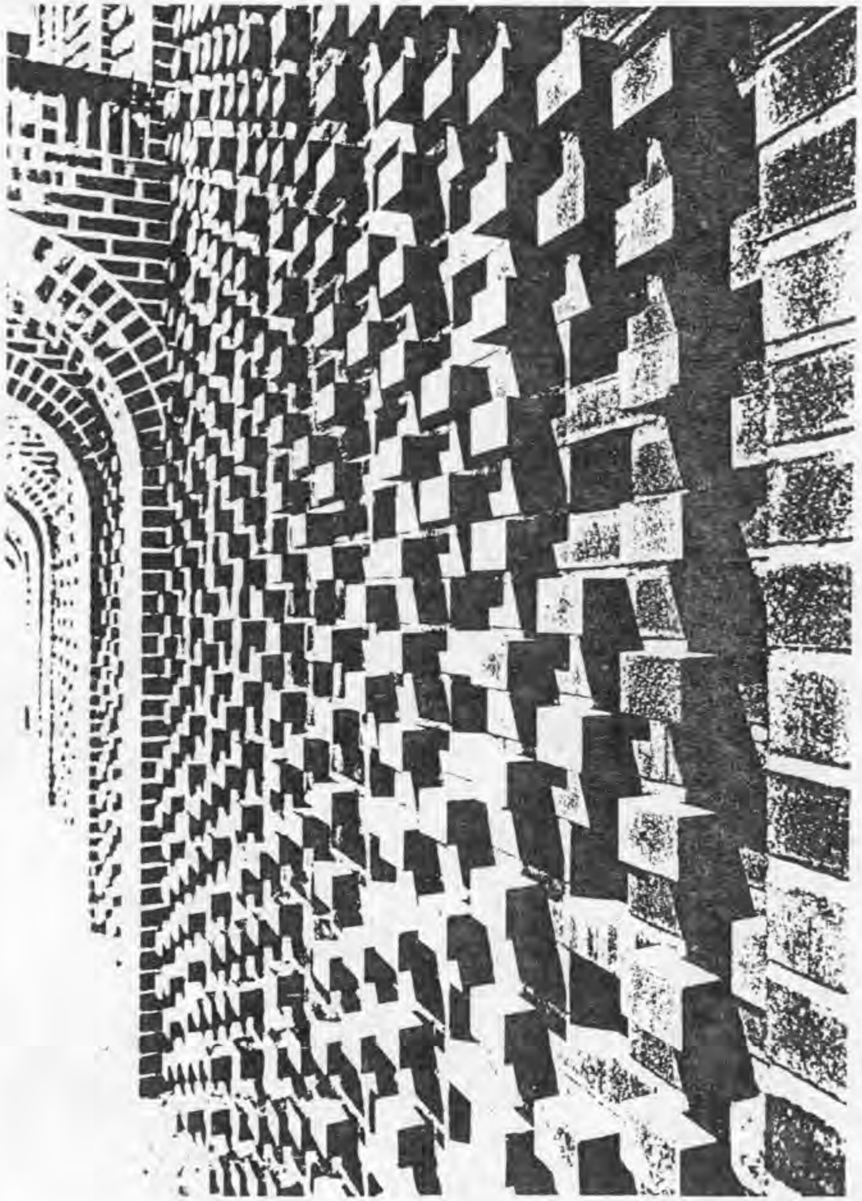
2.44

This preoccupation with surface texture and pattern took several different forms. One, already mentioned, was a concern with the brick surfaces, themselves, which gave rise to a wide assortment of textures created during the manufacturing process, most of which still remain available.

A second, related, consequence was a concern with the texture of the whole wall surface. From this concern arose skintled brickwork, of which there are two, distinct varieties. The first of these results in an irregular, but relatively homogenous, over-all surface texture. One such example is shown, in detail, in Figure 4.36(b). Another, somewhat different, is shown in Figure 2.43. Both use standard bonding geometries in which the rough surfaces of both brick and wall effectively compound each other resulting, each in its own way, in an exaggerated rusticity that neither could effect individually.

The other variety of skintled brickwork, while more closely tied to the structural bonding geometry, often depends for its effect on a deliberate modification of it producing, through repetitive regularity, patterns such as those shown in Figures 2.44 and 2.45.

The skintling pattern produced in Figure 2.44 is based on a variation of the half-lapped running stretcher bond (see Figure 4.16) in which a typical, all-stretcher course alternates with one in which every fifth stretcher is replaced with two headers, one of which protrudes an inch and a half beyond the face of the wall. In the companion courses, every fourth or fifth stretcher is similarly



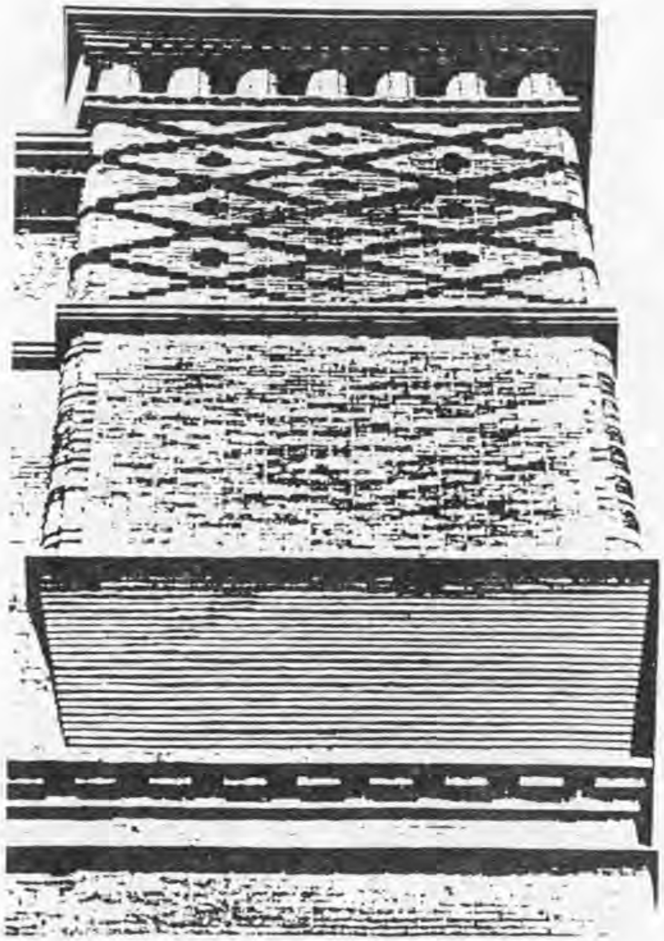
2.45

projected outward. Regular readjustments in this sequence along the length of the wall produces the effect shown in Figure 2.44.

A much less complex skintling pattern is shown in Figure 2.45. Completely contained within the traditional double Flemish bond (see Figure 4.24), the pattern is generated entirely by the headers. Courses with headers portruding two inches beyond the wall plane alternate with those in which alternate headers extend beyond and recede into the wall plane a similar distance. Again, this creates a textured surface in which the pattern is extremely regular and repetitive.

Traditionally a generative element with serious structural purpose, new structural materials and technologies (e.g. steel, reinforced concrete, etc.) were steadily relieving brick masonry of its load-bearing responsibilities to such an extent that, by the 1920's, much masonry construction had been relegated to use as an infill material between structural elements of steel and concrete.

Largely in response to this usurpation of its traditional role, brick masonry as a whole began to reorient itself toward a more exclusively articulative and decorative function. From this arose the renewed concern with texture, and accompanying



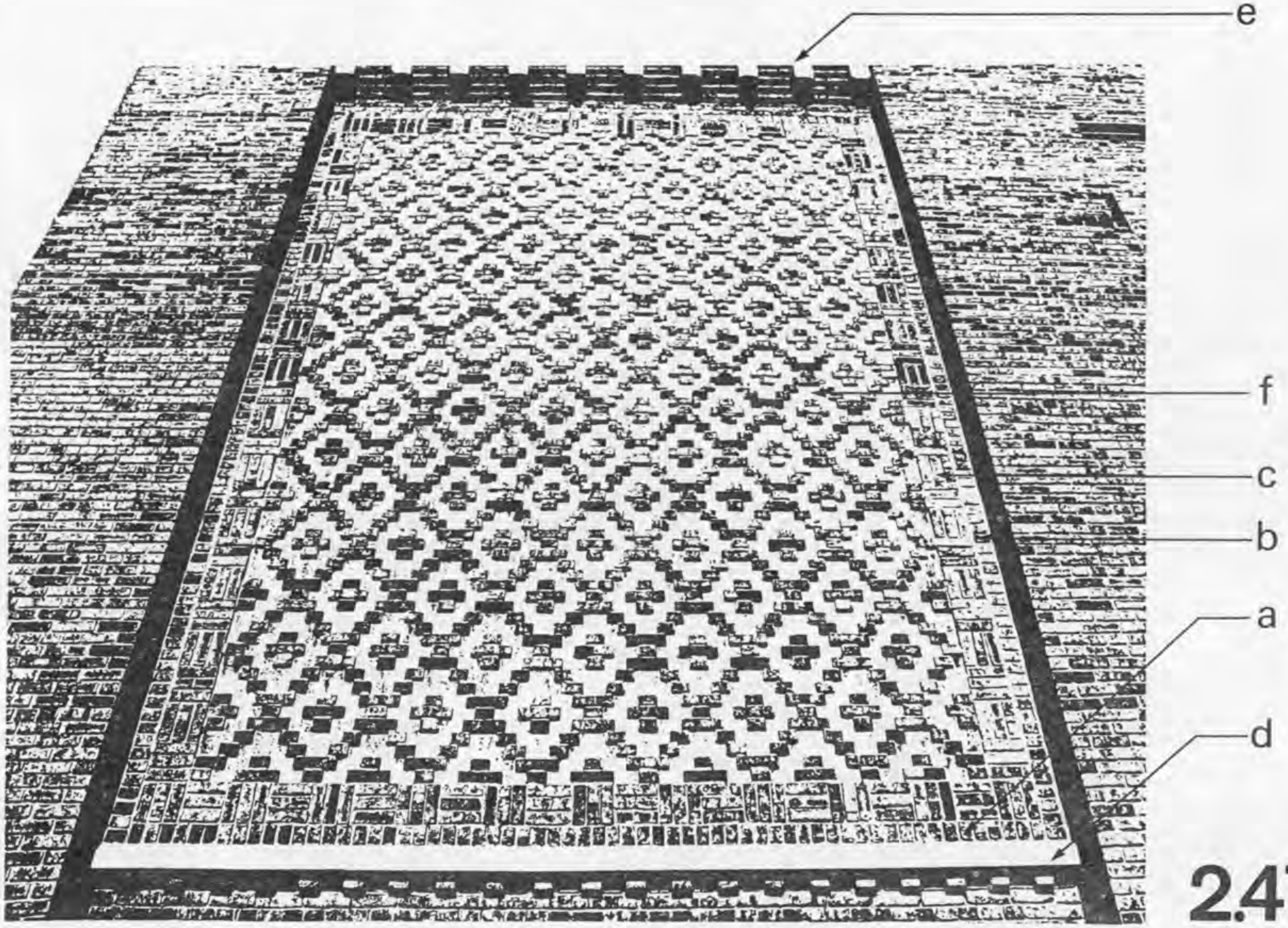
2.46

it was an increased interest in flat pattern design. This latter interest largely focused on the decorative use of the traditional bonding geometries, an interest that quickly became an identifiable trademark of early Twentieth Century brickwork.

This decorative use of bonding patterns took several distinct forms. One such form involved the re-emergence of traditional patterns of ornamental brickwork, an example of which, the diamond unit diaper, is discussed in Section 4 (see Figures 4.40 and 4.41). Whereas, in more traditional use, such as shown in Figure 2.46, such a pattern would normally cover an entire wall surface, in Figure 2.47 the pattern is entirely contained within a recessed panel. This panel is bounded by simple rowlock courses at the top and bottom (a) and a header course (b) at each of the sides, these surrounding an inner band of basket-weave block bond (c). A simple denticulated header course supports a stone sill at the bottom (d) while a denticulated five course corbel table (e) creates a finial at the top. These are typical devices of decorative brickwork of the 1920's and 30's.

One feature is unusual, however. Rather than allowing the masonry wall which generates the diaper pattern to remain visible, as in the example shown in Figure 4.41, it has been concealed beneath a stuccoed suface (f) which tends to enhance the diamond diapers, themselves.

This concern with the use of patterns in brickwork manifests itself in another way: the decorative manipulation of diverse structural bonding geometries within the same building for visual effect.



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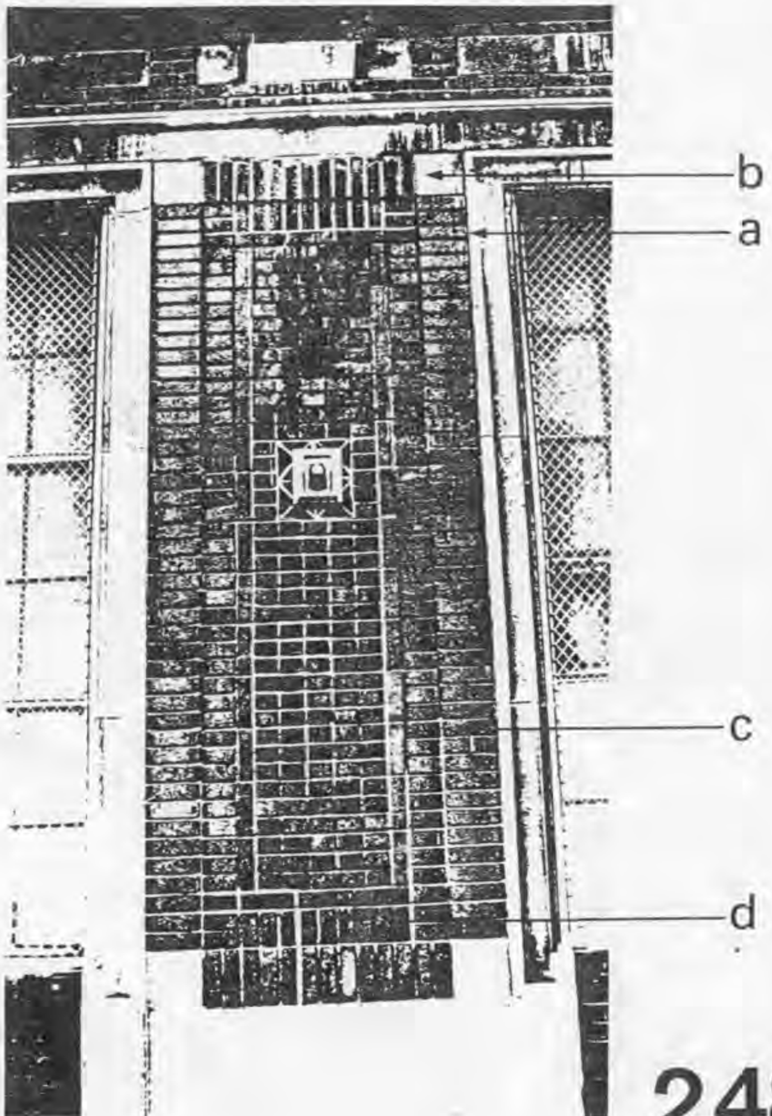


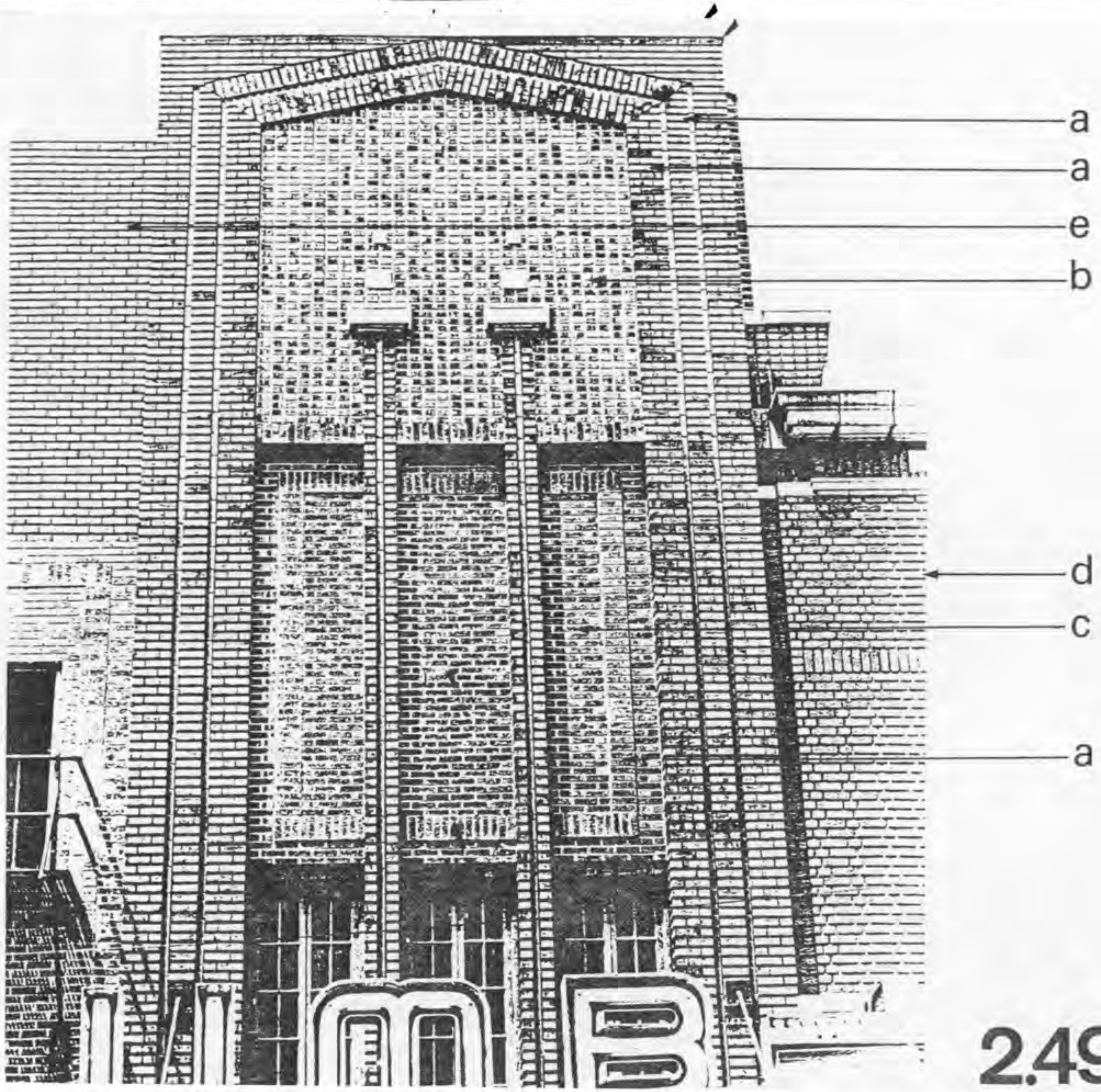
2.48

Thus, in Figure 2.48 is shown a column detail composed entirely of various stack bonds. As illustrated in Figure 4.10, there are six possible varieties of this bonding geometry, four of which have been used in this detail. Stretcher (a), soldier (b), header (c) and rowlock (d) stack bonds form the horizontal and vertical coursings which completely enclose a recessed central panel of header stack bond.

A similar technique is used on the building shown in Figure 2.49. Here, the decorative coursings (a) enclose an upper panel of header stack bond (b) and a lower panel (c) of running stretcher bond. Double stretcher Flemish bond (d), illustrated in Figure 4.25, is used on the exterior wall to the right in Figure 2.49, while a running stretcher bond (e) is used for the remainder of the structure.

Frank Lloyd Wright, in his Morris Gift Shop design of 1948, uses these same techniques, but with an elegant sparseness. Decorative forms are essentially limited to two: one being the denticulated, vertically stacked stretcher course shown at (a); the other being the rampant barrel arch with concentric reveals shown at (b) in Figure 2.50.

This design also demonstrates an early instance of the use of Roman brick (see Figure 3.01) as a pivotal design element. This elongated brick type (2 x 4 x 12 inches), used in combination with colored mortar, concealed vertical and raked horizontal mortar joints (see Figures 5.14 and 5.17, respectively), helps create an enhanced sense of horizontal linear-



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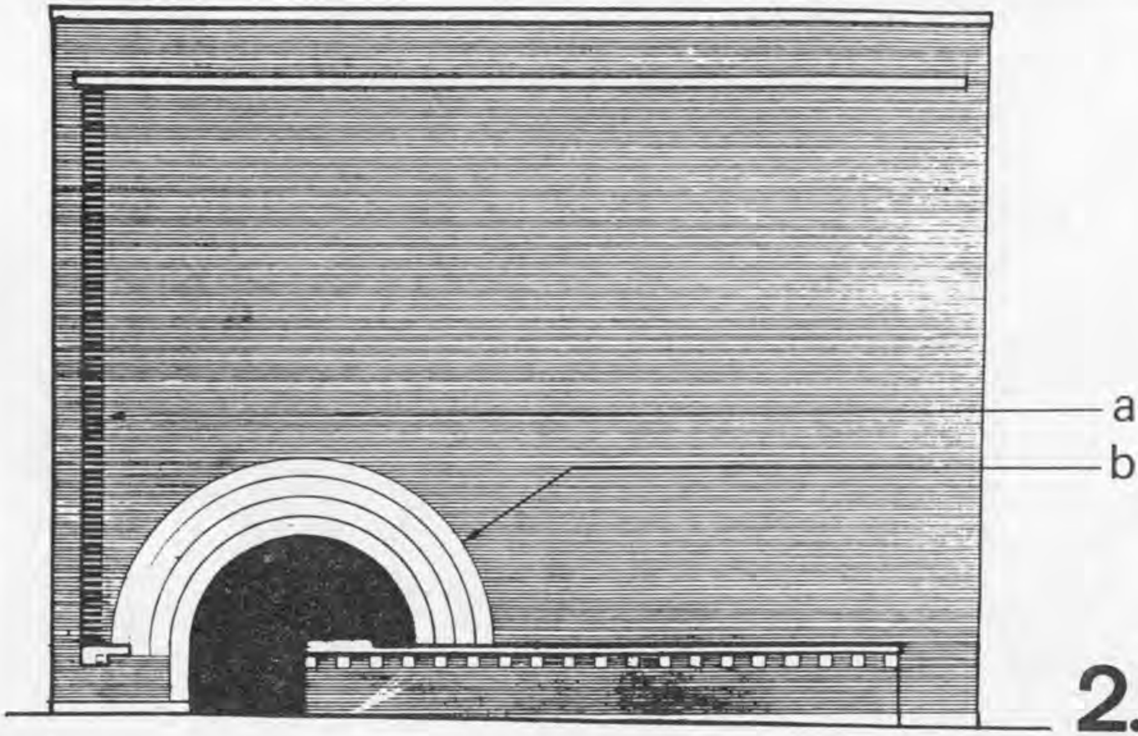


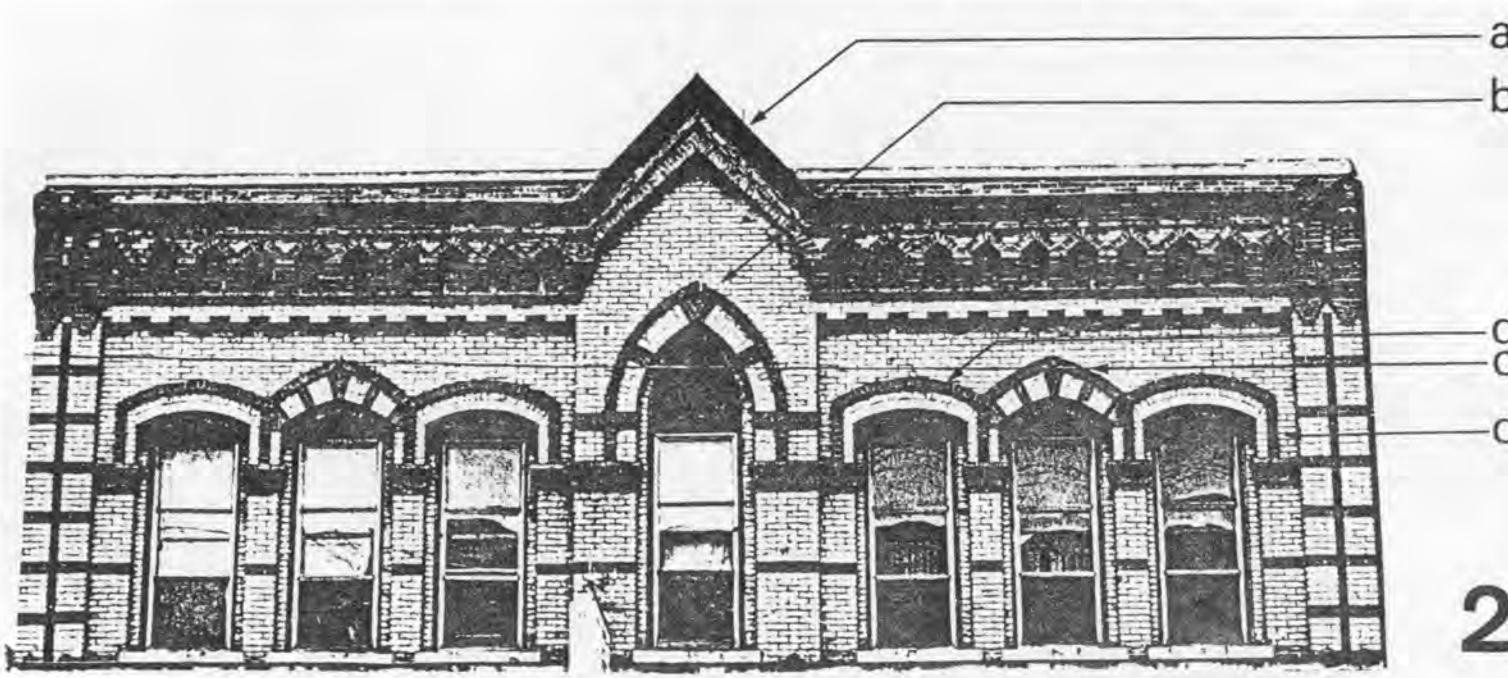
2.50

ity in the half-lapped running stretcher bond of the facade.

There is one other traditional technique of decorative masonry which has not survived the transition from late Ninteenth to Twentieth Century practice: polychrome brickwork, in which color rather than texture or surface patterns is used to emphasize the various ornamental elements of the composition. Figure 2.51 shows an example dating from the late 1890's.

Several distinct arch forms have, again, been used in this composition. The central pediment (a) is formed by a single, corbeled arch. Immediately below it, dominating the second level window band, is an enlarged lancet gothic arch (b). The bays to either side each contain three stilted arches, the center one (c) being a Tuscan arch flanked by stilted segmental arches (d), one on each side.

Constructed of polychrome brickwork, the corbeled arch of the central pediment, the archlets of the denticulated corbel table, the finialed end piers of the cornice and the arched openings and string courses of the second floor windows are all articulated, not only by their bonding geometries, but by a contrasting use of light and dark brick as well.



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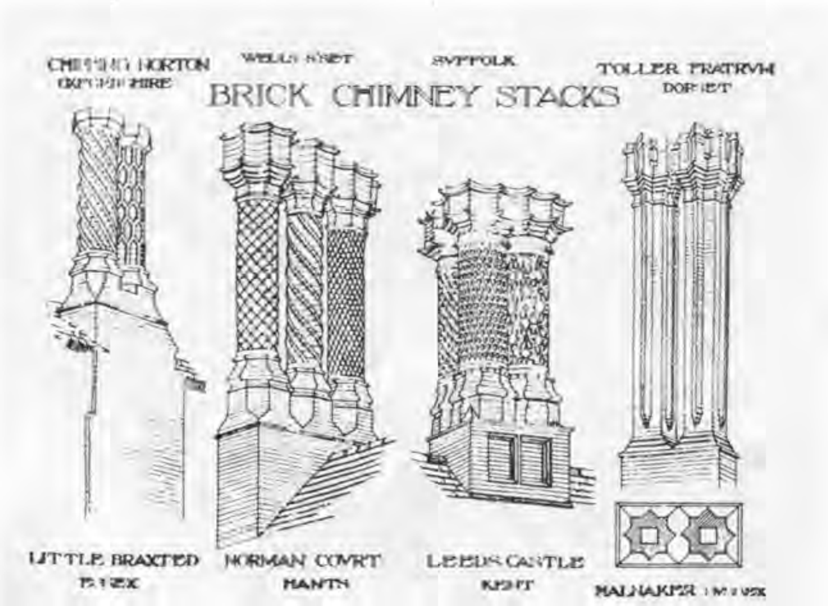


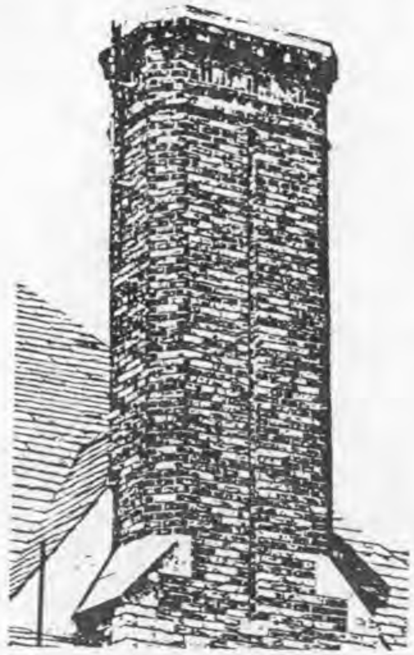
2.52

An integral--even indispensable--element in the highly ornate brickwork of the Gothic, Tudor and Victorian eras, polychrome masonry is perhaps most closely associated with the English architect, William Butterfield (1814-1900). However, the technique did not become as popular in the United States, even at the height of the flambouyant Victorian period, as it had in Europe: Germany, Italy and England especially.

In the United States, communities where the technique was occasionally used can still be found. While most, such as the building shown in Figure 2.51, tend to date from the 1890's, some isolated instances of experimentation can be found dating from the 1940's and 50's. In general, however, these tend to be inferior to older work and exist only as isolated architectural oddities. Textured and patterned monochrome brickwork constitutes the bulk of decorative masonry construction in this country.

Virtually all of the examples of decorative brickwork shown thus far have been of commercial, public or church buildings. There is good reason for this. Decorative brickwork, especially the more extravagant varieties, is relatively rare in residential construction. Domestic brick masonry construction, with few exceptions, has traditionally opted for the more stark idioms. There have been exceptions, however. As already shown in Figures 2.19 through 2.21, the late Victorian era (1890-1900) produced some highly decorative residential brickwork, but the bulk of the effort devoted to residential ornamentation was lavished on timber, not masonry. Even where brick was the principal material of con-

2.53



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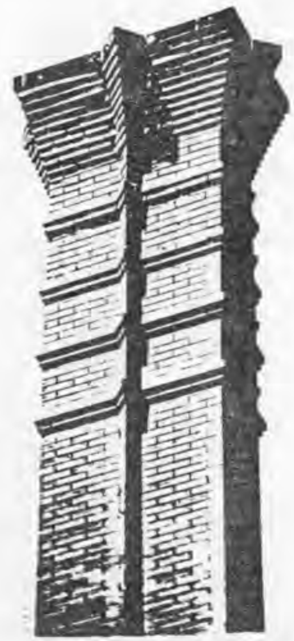

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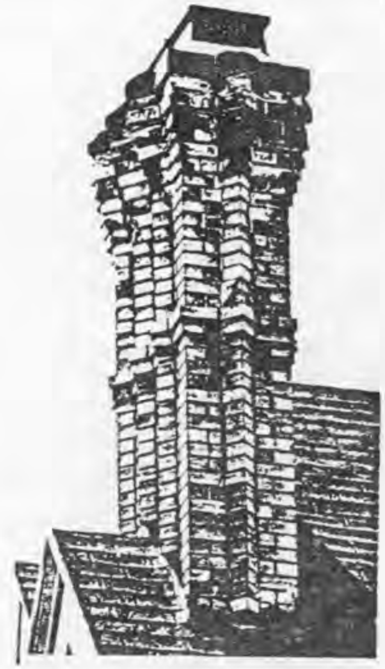
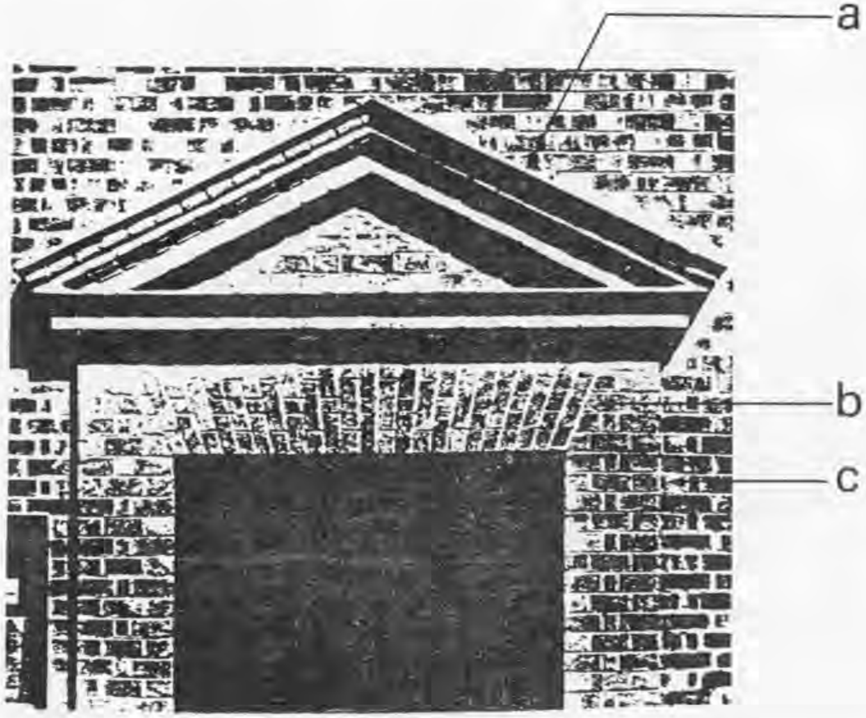


2.56

struction, decorative exterior detailing was usually executed in wood.

Certain of the eclectic styles, popular well into the first half of this century, have been noteworthy exceptions to this trend: those derived from traditional English domestic architecture especially so. And, in this genre, one element received a disproportionate share of attention: the chimney.

Shown in Figure 2.52 are examples of traditional



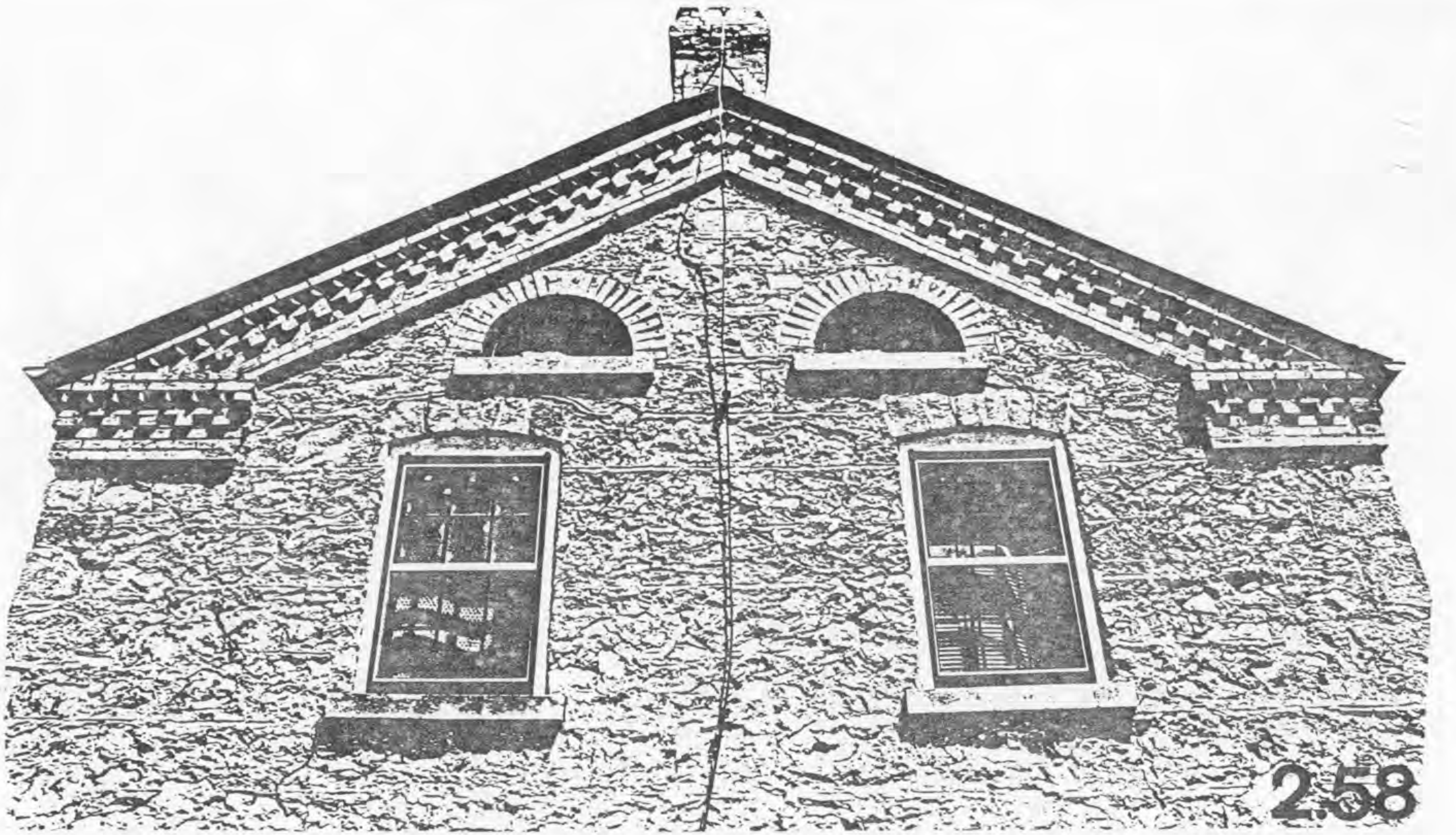
2.57

English chimney stacks. Such extreme ornamentation was quite common in Tudor Period manor houses of Sixteenth Century England. And, as shown in Figures 2.53 through 2.56, similar devices were in common use in fashionably eclectic American residential construction until well into the 1940's.

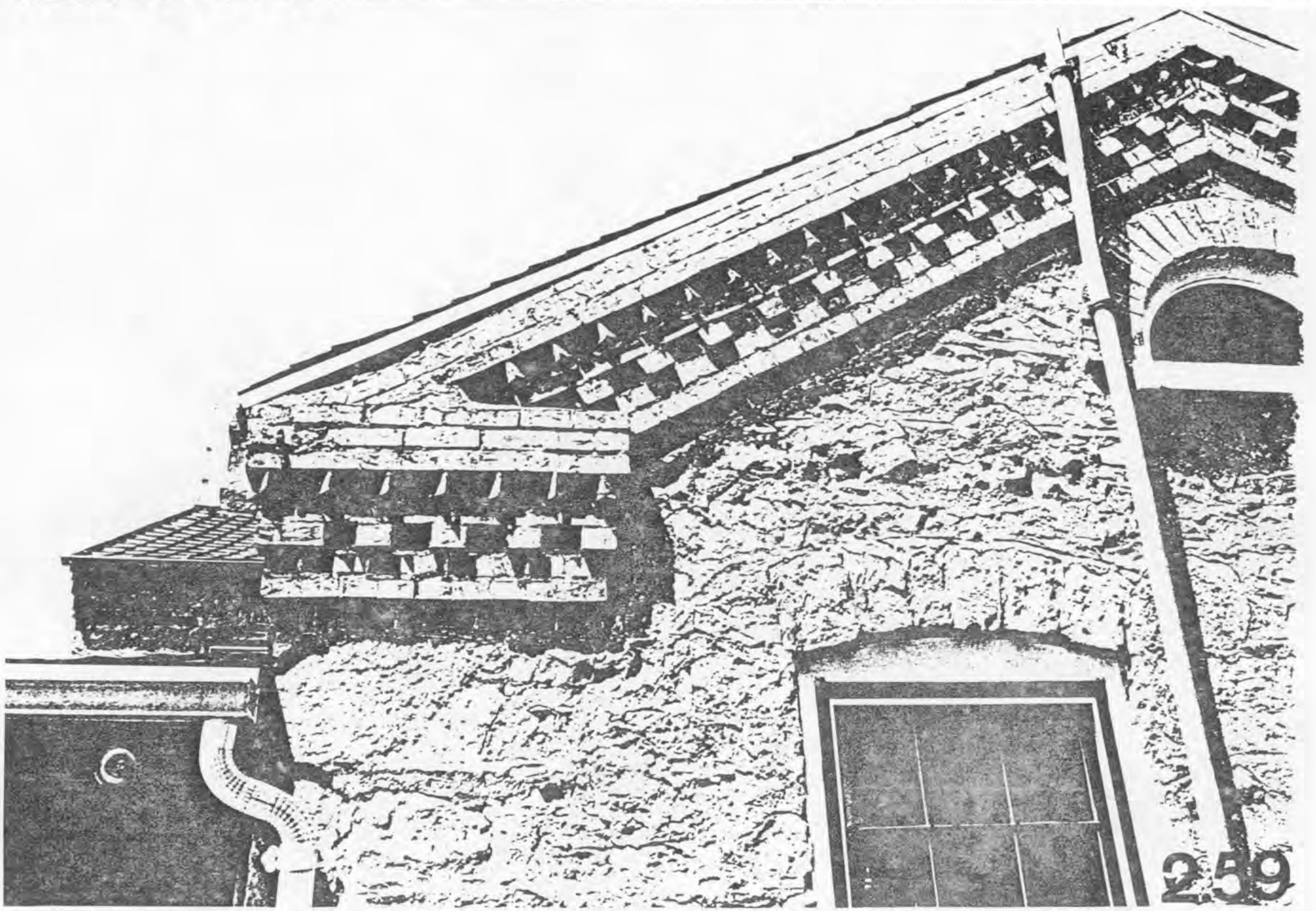
Similar to that partially shown in Figure 3.10, the Neo-Classical detail of a residential entryway, shown in Figure 2.57, is another such exception. Here, a pediment of molded brick (a) sits atop a gauged and laced, jack-arched entablature (b) with simple brick pilasters (c) flanking the door opening.

The houses shown in Figures 2.58 through 2.61 represent another exception. A unique style apparently indigenous to southeastern Wisconsin, these farmhouses, as a group, generally date from the late 1880's. Like most residential masonry construction, they are essentially quite stark. It is at the cornice, in particular, and to a lesser extent at belt courses and wall openings that a highly decorative use of brick occurs. Relatively styleless in other respects, this decorative use of brickwork marks these houses as a distinct and readily identifiable group.

Built in 1875, the house shown in Figures 2.58 and 2.59 is typical of this genre. A denticulated cornice formed of corbeled, ornamental stretcher, header and sawtooth courses is the basis of the design. In this instance, attic windows are rendered in a single course of stretchers arched to form a semi-circle.



2.58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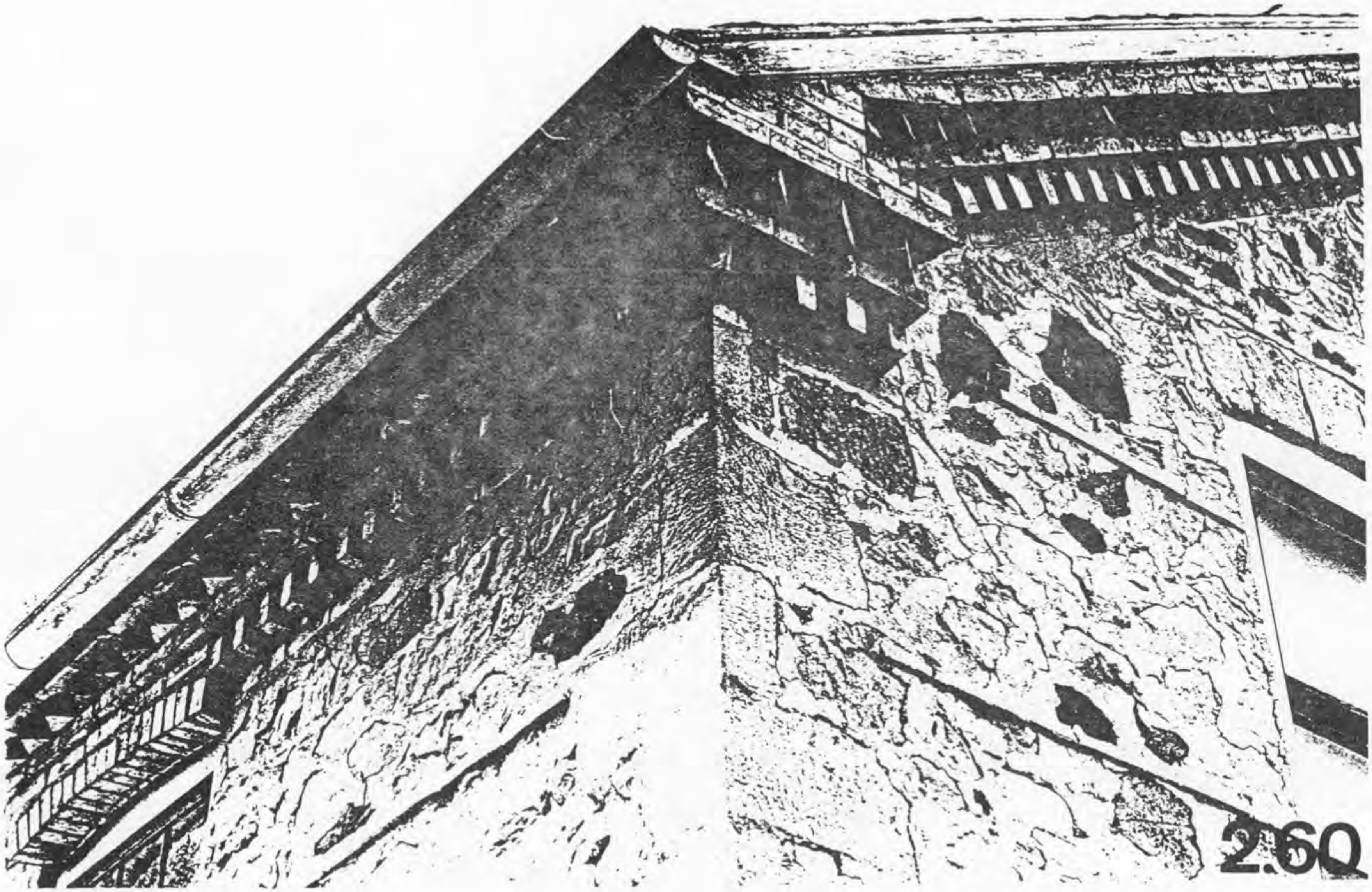
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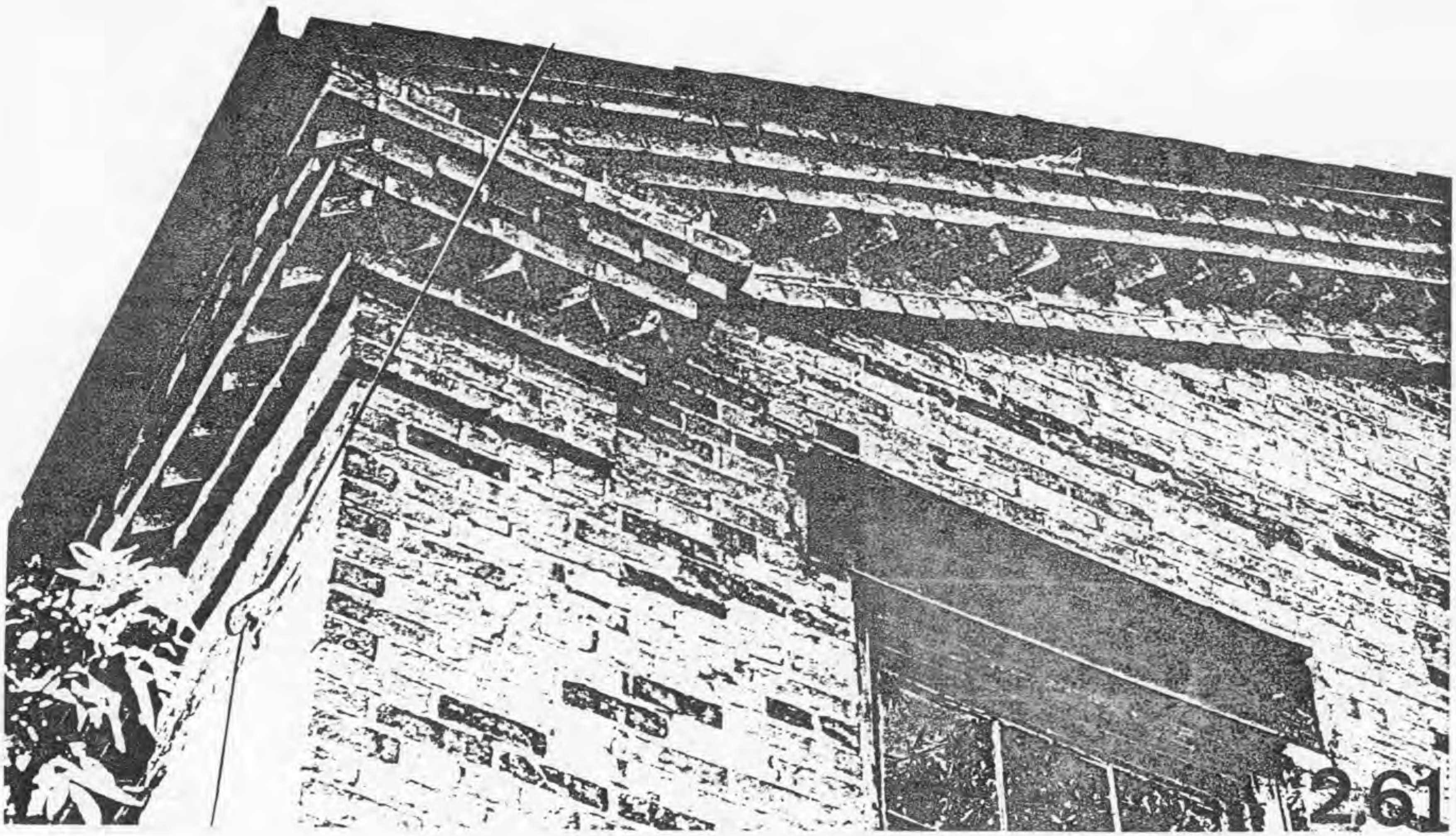

2.61

Shown in Figures 2.60 and 2.61 are two different, yet obviously related, designs of the same type. Composed of essentially identical elements as the house in Figures 2.58 and 2.59, these designs are obviously of the same style, yet the precise origins of that style remain unclear.

What is perhaps the only example of vernacular brickwork found is shown in Figure 2.62. Unlike that shown in Figures 2.58 through 2.61 which, while quite unusual, certainly derives from obscure--but conventional--polite European architecture, this building is definitely the work of an amateur or primitive. Dating from the 1890's, this unlikely collage has a shakey charm and sense of uninformed daring that is seldom found in conventional practice.

2.62

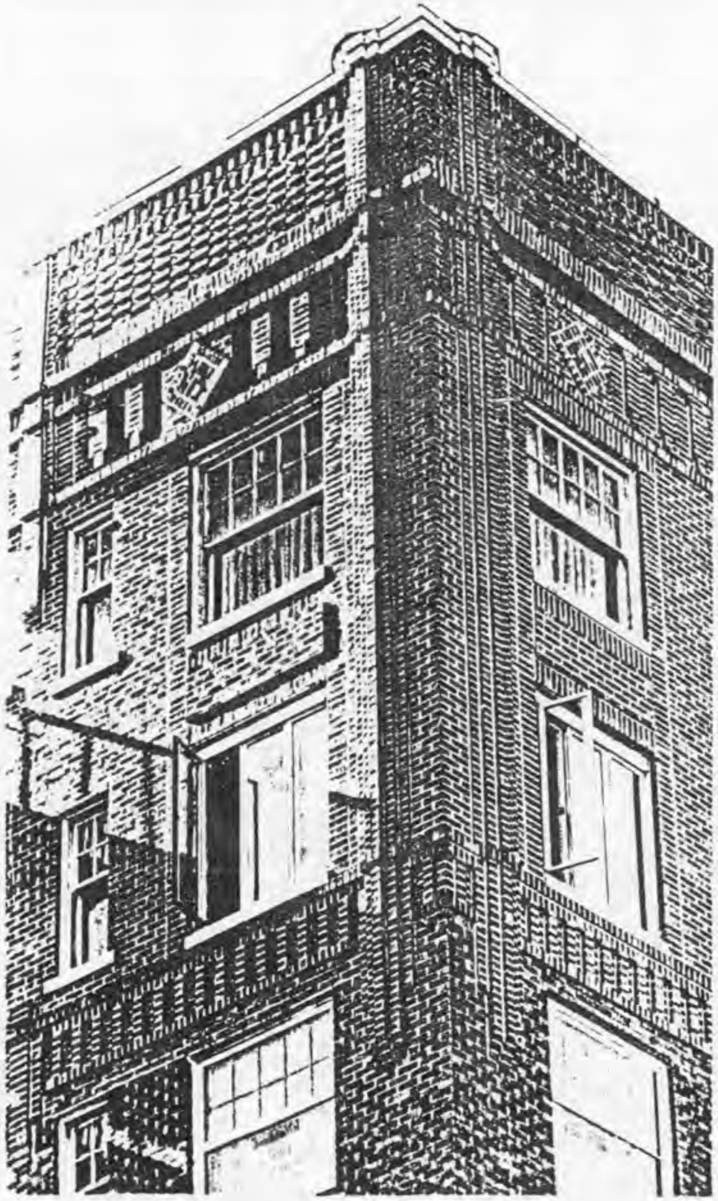
2.63

In terms of the preceding discussion, the building shown in Figure 2.63 is something of a transitional form. Dating from the period 1895 to 1905, it characterizes the transformation of the deep, sculptural forms of late Ninteenth Century brickwork into the more two-dimensional surface patterns of the early to mid-Twentieth.

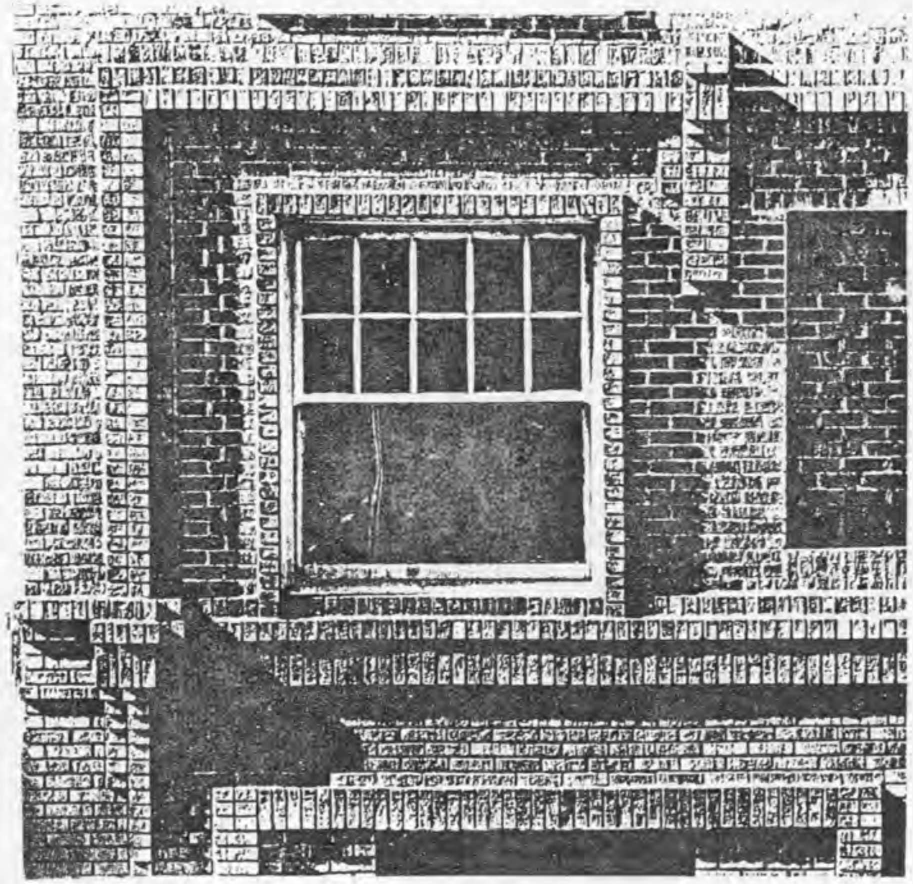
The structure shown in Figure 2.64, and in detail in Figure 2.65, Illustrates a further step in this trend toward two-dimensional articulation and surface patterning. Figure 2.65 illustrates these new developments quite nicely. No longer load-bearing, the masonry exterior walls lack the depth in backing necessary for deeply sculptural effects. Thus, while much of the articulative detailing still uses the corbel, it is a much more shallow variety than, for example, that shown in Figure 2.21. The composition, while still highly ordered and well articulated, is no longer rigidly symmetrical, and explicit references to classical precedents have virtually disappeared. Archwork is no longer the dominant articulative and decorative element. Gone with it is the elaborately rubbed and gauged brickwork associated with hand craftsmanship.

What has replaced these elements is a harder-edged rectilinear design format dependent, not on arches but, on steel lintels and on the restrained manipulation of more elemental coursings as shown in Figure 3.15.

This simplification process, well-begun by the 1920's, continued through the 1960's. By the 1950's and 60's, brick architecture had become quite dull



2.64



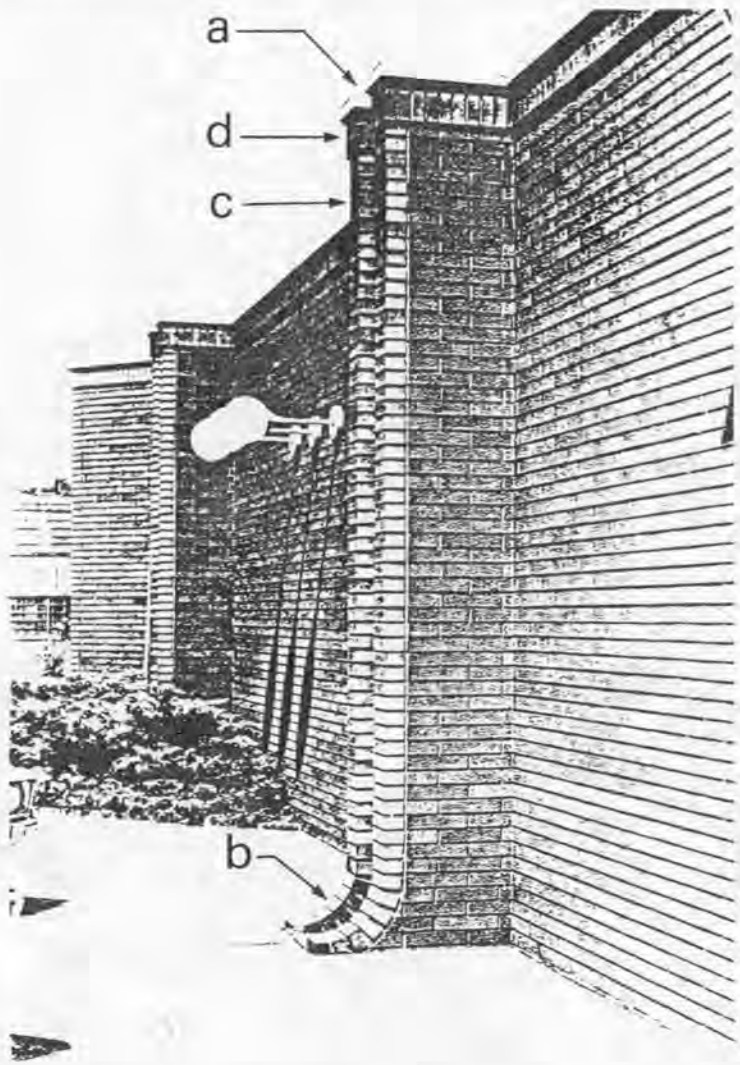
2.65

in terms of its visual impact. Unimaginative in design and often less than skillful in its execution, by the late 60's brick masonry had retreated completely from any hint of the articulative, much less the decorative, elaboration in which it had reveled a scant fifty years earlier. Brickwork degenerated into a mere stacking of undifferentiated units. Craftsmanship had virtually disappeared.

Much of the 'credit' for this impoverishment of modern architectural design in general and contemporary brickwork in particular obviously belongs to the misguided, often misunderstood and dated precepts of the Modern Movement. For those terminally addicted to Bauhaus-style dogma, less may appear to be more, but, more often than not, less is simply that: less. And less is a bore.

If there is anything modern architecture needs less of, it's less. More is more satisfying. Perhaps 'less is more' made sense at a time when, in terms of decorative elaboration, there was often too much, but overzealous application of that dictum has left architecture impoverished. Richness of meaning has been sacrificed for clarity of function. Simplicity has degenerated into bland oversimplification. Stripped of those articulative and decorative details which made visual interpretation of structure a delightful and meaningful experience, modern buildings have become tediously straightforward: devoid of sensible vitality and lacking in interpretive depth.

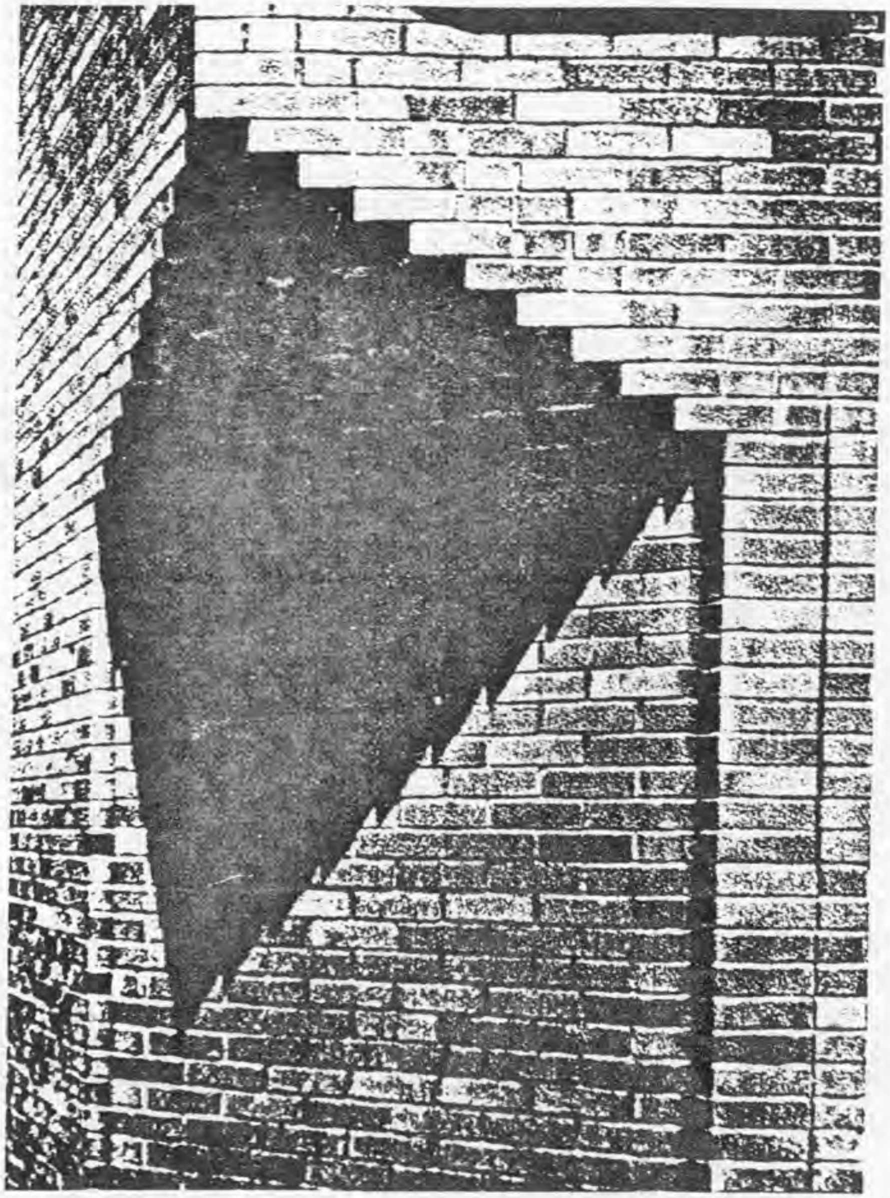
More recent brickwork is seemingly trying to reverse this unfortunate tendency, however. For



2.66

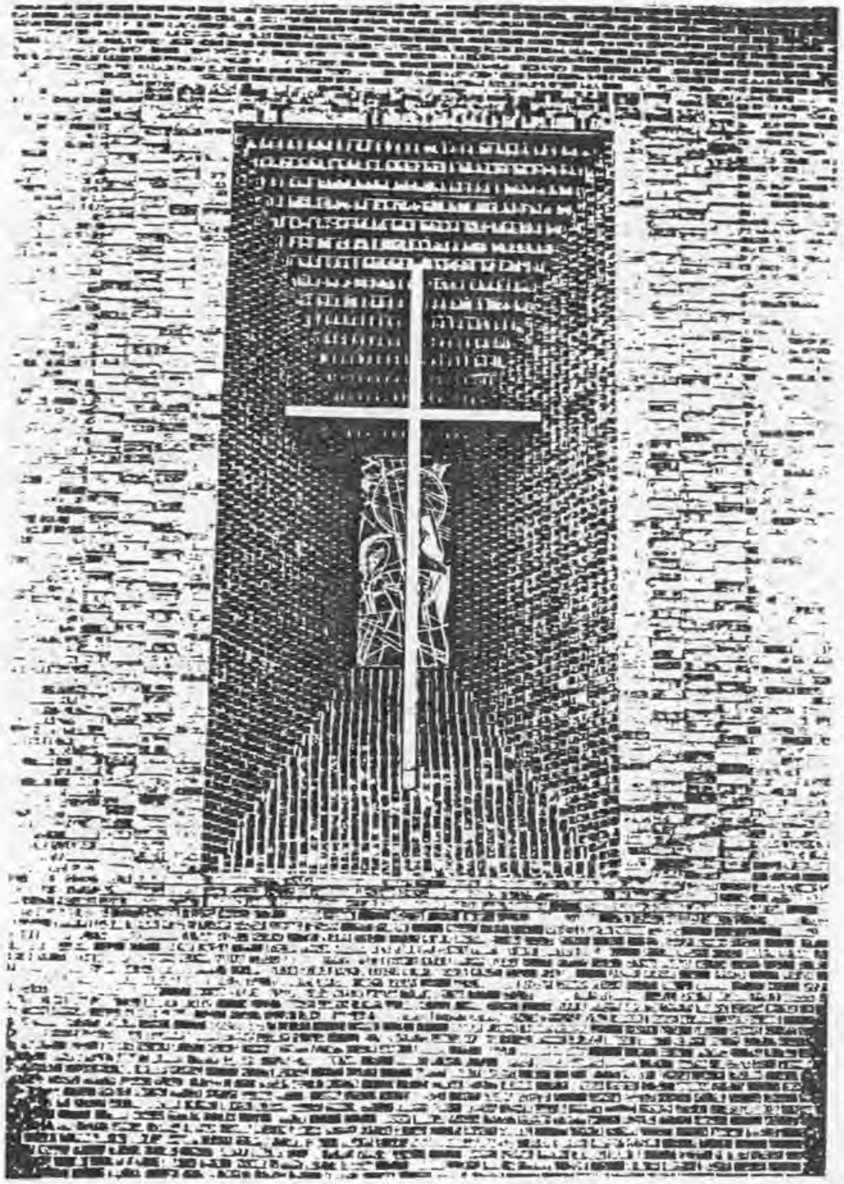
reasons that will be discussed in Part IV, contemporary practice appears to have begun a deliberate attempt to recover some of this missing vitality and depth.

One such instance is shown in Figure 2.66. Built in 1968, this structure uses relatively few elements of brickwork to create an elegantly simple sense of wall. Thus, the same combination of blind vertical and raked horizontal mortar joints described in reference to the Morris Gift Shop (Figure 2.50) is again used to create an enhanced sense of horizontal linearity on the face of the wall. A strong sense of lateral bracing is obtained in the use of twin external buttresses (a). Emerging from the ground in twin, inverted arches (b), their emphatic verticality is tempered by the horizontality of the stacked stretcher course (c) which faces each. A single soldier course (d) provides a decorative finial band at the top. Simple and uncluttered, this design incorporates a sensitive use of basic masonry techniques and an inventively modern application of an ancient structural form, the buttress, here used decoratively to conceal otherwise unsightly expansion joints and as an external expression of internal structure.



2.67

Figure 2.67 shows another example of lively exterior detailing obtained by the inventive contemporary application of traditional decorative masonry forms: in this instance, an unusual combination of corbeled and sawtooth courses. Camfered seven feet six inches above the sidewalk, this wall is then corbeled outward to the normal corner in a dramatic series of sawtooth courses.



2.68

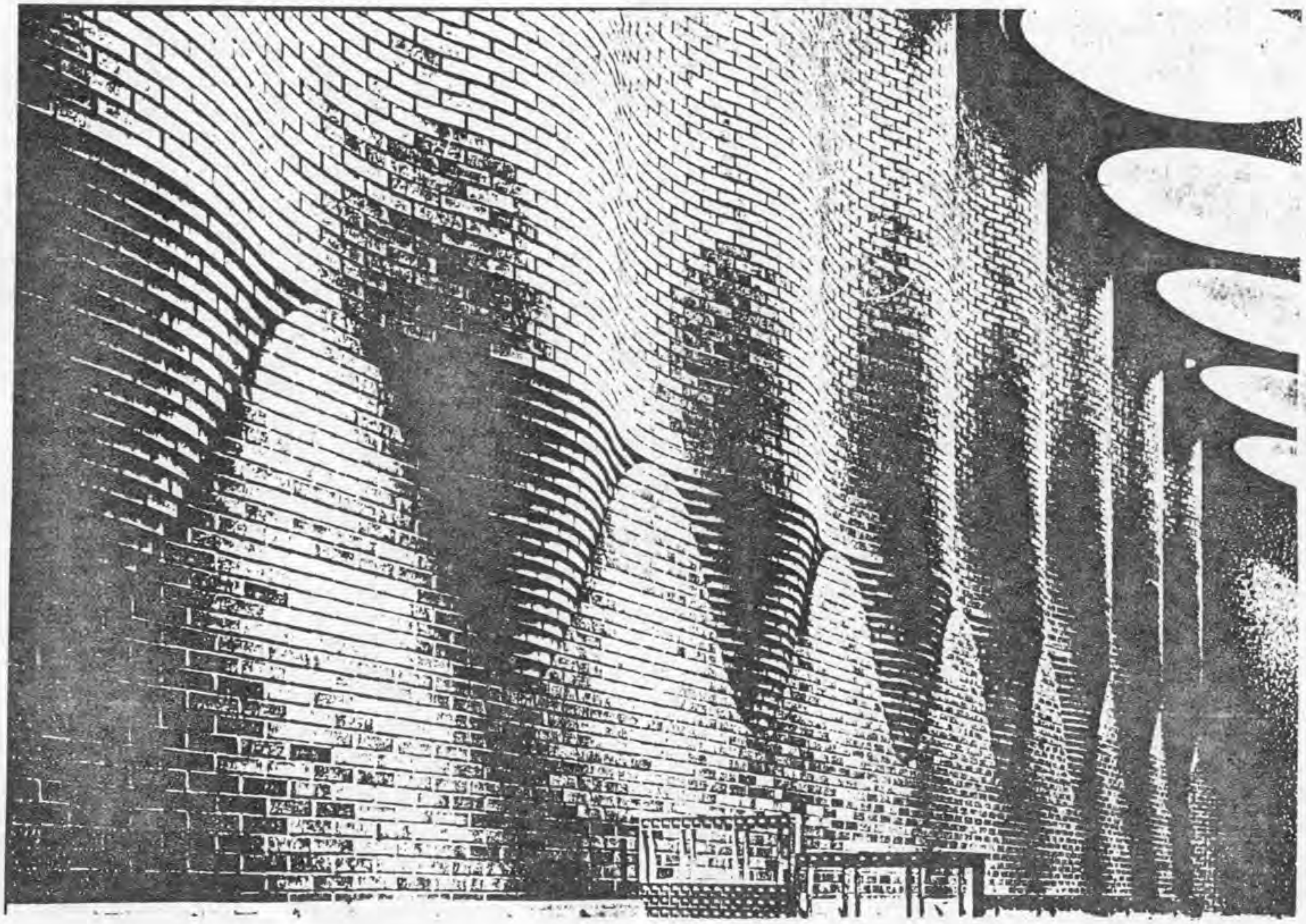
Dramatic effect is again obtained in the splendid splayed altar window, shown in Figure 2.68. Reversing an ancient form common in medieval architecture (i.e. splaying the opening outward rather than inward), the spectacular corbeled and raked courses, mitered at their corners, form an extended series of concentric reveals. Penetrating the wall to the deeply-recessed window opening, they imply a massive depth that, although totally fictitious as structure, is quite magnificent as decoration.

2.69

Similarly, a contemporary reiteration of the ornamented cornice is used as decoration on the contemporary structure shown in Figure 2.69. Consisting entirely of denticulated rowlock and soldier courses, this design, mitered and bracketed at its articulated outside corner, is virtually a literal translation of Ninteenth Century decorative masonry into late Twentieth Century architecture. The total absence of gauged and arched brickwork in the parapet composition is the only feature which clearly marks this as a recent, rather than an 1890's vintage, design.

Earlier in this section the statement was made that, even though dated and archaic in specific style, architectural forms, in themselves, are not necessarily anachronistic. Figures 2.66 through 2.69 have been used to support that assertion. Yet nowhere is that statement more spectacularly confirmed than in the structure illustrated in Figure 2.70.

Here, similar in form but vastly different in context, is the brick oriel previously encountered in Figures 2.09, 2.10 and 2.26. Used not once but repeatedly in linear series, segmentally-curved oriels periodically spring from the flat wall surface to provide the transitional supportive element necessary for mating the flat base wall below to the serpentine wall above. And, although rendered in a totally contemporary style, its fundamental purpose (i.e. the reconciliation of curvilinear to rectilinear form) remains unchanged: as ancient as the origins of the technique itself. Yet there is



2.70

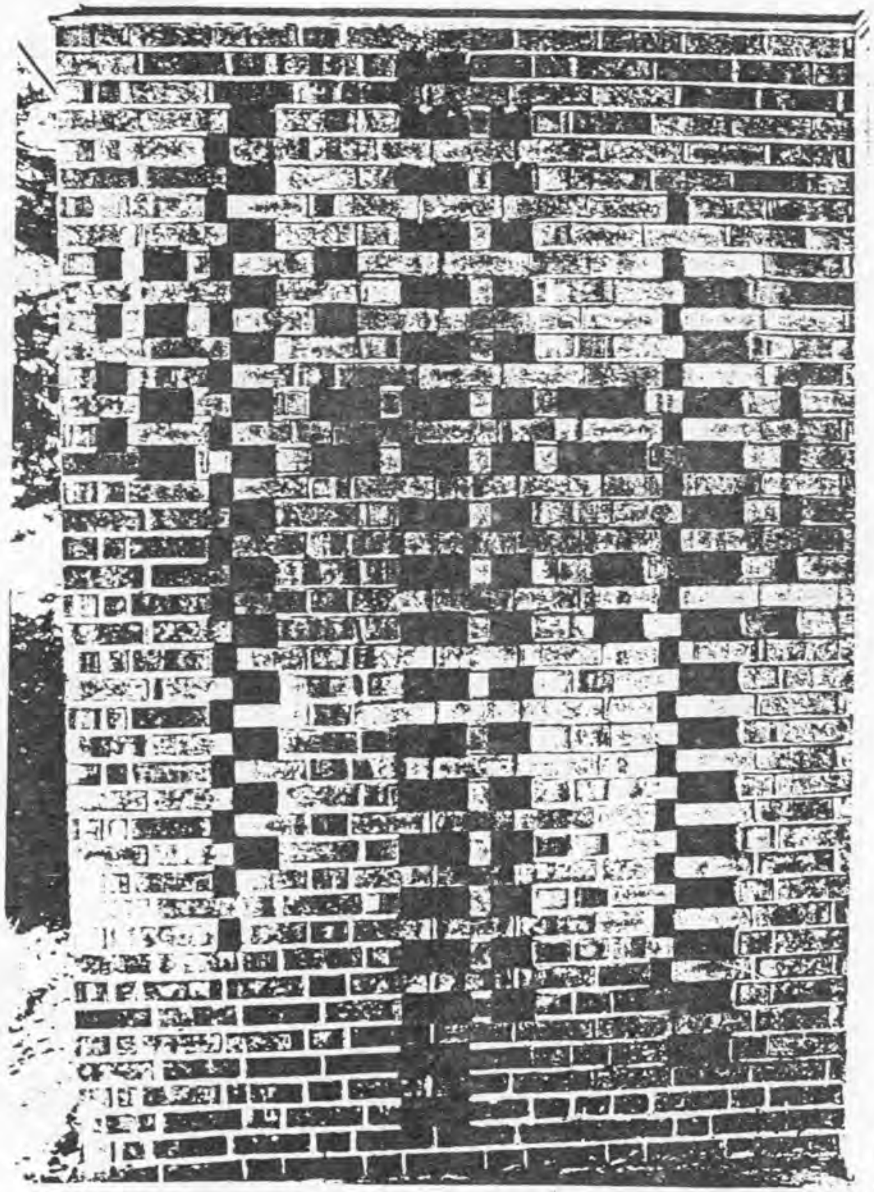
no hint of residual eclecticism nor of a romantic revivalism, attitudes so often mistakenly assumed to be inevitably associated with the modern use of traditional form. Here, in its stead, one can only find breathtakingly innovative and elegant design combined with superlative craftsmanship: an exceedingly rare combination.

ARTISTIC BRICKWORK

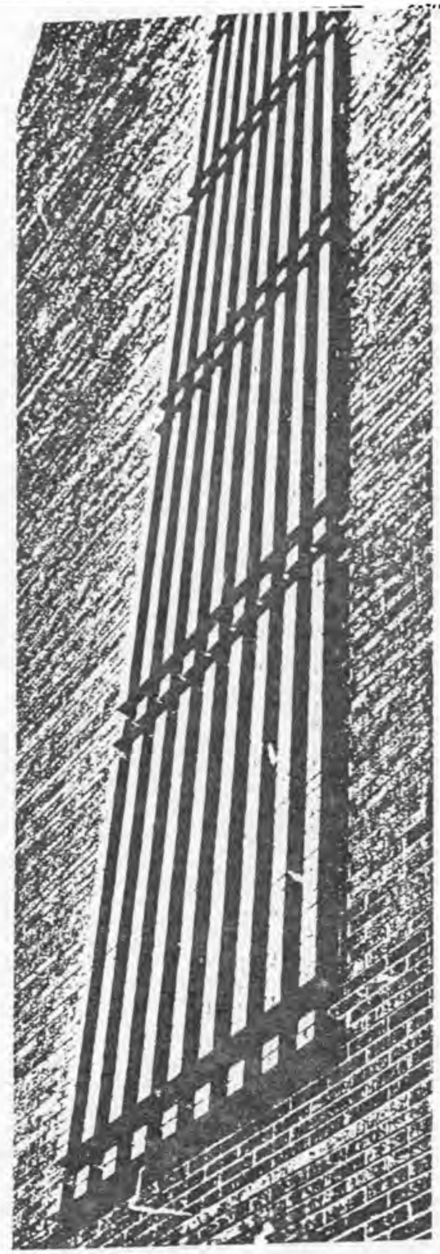
The generative, articulative and decorative uses of brick masonry have now been discussed and illustrated. These constitute the various degrees of brick's functional role as a primary material of construction. One aspect of brickwork remains to be examined. This concerns brick's potential as a medium of autonomous artistic expression.

While obviously inextricably bound to the surface from which it derives its support, decorative brickwork is capable of transcending this inherent limitation. Brick has already been described in its role as a decorator of structure, but from the earliest times, brick has also been used as an artistic medium.

This 'aesthetic' use of brick is a distinction, not merely of degree but of kind, from the decorative use of the material. In this latter context, brick is merely used as ornamental applique. It is an integral extension of structure. But in the former context, brick becomes a sculptural medium, totally divorced from structure. That it remains bound to structure is beside the point.



2.71



2.72

2.73

Shown in the following illustrations are instances of this sort, each differing in the degree of integration with its structural masonry background, or matrix.

In Figures 2.71 and 2.72 are shown two examples of relief work in brick. In the former, the design consists of an abstract composition of voids in the structural masonry surface, while in the latter the design emerges, as corbeled brick, from the surface plane of the building. However, regardless of the degree of integration involved, these compositions are clearly distinct in kind from the decorative patterns previously discussed.

The design in Figure 2.73 illustrates this to an even greater degree. Here, brick has become sculpture in a tradition almost as old as masonry, itself. Special bricks, designed and sculpted at the factory before firing, are incorporated into the bonding pattern as the wall is laid up to form the figural bas relief shown. Although separated from it by almost 3,000 years, this design is identical in technique and effect to that shown in Figure 1.02.

Here, as nowhere else, is dramatized the timelessness and renewability of brick masonry construction. The forms and techniques illustrated in the preceeding pages and discussed in greater detail in the sections which follow are ancient. The origins of many remain lost in pre-history. Yet the remoteness of their derivation does not detract from their applicability and relevance to contemporary construction.

PART II
ELEMENTS OF BRICKWORK

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BRICK IN BRICKWORK

A brick is a solid building unit of burned clay. Its characteristics derive from both the character of the clay of which it is composed and the method of its manufacture. Clays, themselves, vary as to origin, mineralogical and chemical compositions and physical properties. Manufacturing processes vary according to the character of the available clays and the intended uses for the finished product. The bricks that result from the processing and kiln-firing of natural clays can vary significantly in shape, size, weight, strength, color and texture. However, most of the brick now manufactured are of some standard kind and size.

KINDS OF BRICK

Common Brick

The term common brick is applied to bricks made of ordinary clays or shales and burned in the usual manner in kilns. Such brick have no special scorings or markings and are not produced in any special color or surface texture (3.01). Common bricks are also known as hard and kiln-run brick, and are classified either according to their position in the firing kiln as arch, clinker, red, well-burned, soft, salmon, rough-hard, straight-hard, and stretcher, or, according to the uses to which they may appropriately be put, such as hard, soft, chimney, well, sidewalk, veneer and selected brick.

Arch and clinker bricks are those which are overburned and are thus extremely hard and durable. Overburning, however, may cause dimensional changes due to increased shrinkage as a result of which these bricks tend to be slightly irregular in shape and size.

Red, well-burned and straight-hard bricks are well-fired, hard and durable. Stretcher brick are selected from these classifications as the most uniform in hardness, size and durability.

Rough-hard brick correspond to the clinker classification.

Soft and salmon brick are those which were farthest from the fire in the kiln and are, therefore, underburned, soft and not as durable as the other categories described (3.02).

Other classification systems, such as those based on most appropriate use, and nomenclature exist for common brick, but these can vary from manufacturer to manufacturer. Regardless of the terminology used, it is imperative that the hardness and durability of the brick be known since these characteristics determine which uses are most appropriate for brick of each type.

Generally, common brick is used for the backing courses in solid or cavity brick walls. The harder and more durable kinds are preferred for this purpose. In some cases, selected and well-burned common brick are used as face brick. The softer common brick, such as the salmon category, are not used for backing or as face brick in any wall or in locations where they might be exposed to the effects of weather. Good grades of common brick can be used for garden walls, sidewalks, columns, piers, steps and other such typical construction (3.03).

Face Brick

This brick is made of specially-selected materials in order that the color and texture can be controlled, and so that hardness, size uniformity and strength are all of high classification. These bricks may have various markings or surface finishes and are generally used for all veneering and exterior tiers on outside walls and chimneys of residences and other buildings. Often face brick is only used on those exterior surfaces which are visible from the street. In such cases, those surfaces not visible from the street will be laid up using well-burned common brick or a concrete masonry product. Face brick is also used for garden walls, walks and steps, even interiors, whereever exceptionally good appearance is desired (3.04).

Pressed Brick

Both common and face brick can be classified as pressed brick, depending on the materials used, their coloring and method of firing. The dry-press process is used to make this class of brick having regular, smooth faces, sharp edges and perfectly square corners. Ordinarily, all pressed brick are used as face brick and are especially useful when exact dimensions are required in walls or in other structural members (3.05).

Glazed Brick

Also known as enameled brick, these have a colored glaze fused on to one or more surfaces and are mainly used for sanitary and decorative purposes (3.06).

Firebrick

Larger than building brick and often hand-molded, this type of brick is made from a special fire clay which will stand the high temperatures found in fireplaces and furnaces (3.07).

Paving Brick

Also larger than regular structural brick, paving brick are hard-burned and impervious (i.e. very dense in structure and resistant to penetration by water), and are used where wear-resisting qualities are required, such as for roads and walkways (3.08).

Imitation Brick

This kind of brick is similar to common brick in size and use, but is made of Portland cement and sand rather than clay. These are not burned but have the same qualities as a good cement mortar (3.09).

Cutting Brick

Not to be confused with the standard brick cuts to be described later in this section, cutting brick are those manufactured especially for cut or carved brickwork. Soft and finely textured, cutting brick are made with a high percentage of sand in the clay to facilitate shaping. Such carving was done with chisels and rasps, usually at the job site, producing custom-shaped brick for use in a wide variety of decorative details (3.10).

Rubbing Brick

Similar in composition to cutting brick but slightly harder, these bricks were formed to the desired shape by using an abrasive block or rubbing stone. Such bricks were commonly used for window and door jambs, arched brickwork, quoins and other decorative details. Rubbing often produced a brick that contrasted in color and texture with the rest of the wall and were sometimes laid with thinner mortar joints (3.11).

Salvaged Brick

Salvaged brick is, as its name implies, simply used brick: brick taken from some prior construction to be used in new construction. While costs may be a factor in its selection, most salvaged brick is used because irregularities in its shape, variations in color and texture give an aged, rustic character to the structures on which it is used.

The use of salvaged brick should be limited to non-load-bearing or veneer construction, preferably interior work. Engineering criteria mitigate against its use as a structural element or in any position exposed to weather. Good bonding between new mortar and 'cleaned' used brick is unlikely. As a result. water-tight walls are difficult to obtain and dis-integration of poor quality units is a probability, especially with continued exposure to the effects of weathering.

However, in situations where the aesthetic criteria (color, texture, etc.) outweigh engineering consider-ations (strength, durability, water-tightness, etc.), salvaged, or used, brick are often used successfully with striking results (3.12).

While these, generally, comprise the range of brick types available for use by the designer of brick masonry structures, seldom will a single manufacturer offer all types. Rather, each tends to produce a limited range of types, sizes, colors and textures, a selection which can vary widely between individual manufactures. Because of this inherent variability in products, it is best to consult manufacturers catalogues when choosing brick for use in specific design projects.

STANDARD SIZES OF BRICK

Brick has evolved into a highly-standardized modular building product. Until recent modern times, brick sizes had remained relatively standard, with only three (standard, Roman and Norman brick) being generally available. Except for the 'SCR' brick; which was introduced in 1952, all brick units had a 4 inch nominal bed depth. This situation no longer exists. Brick are now available in a wide variety of sizes ranging in thickness from a nominal 3 inches to 12 inches, in height from a nominal 2 inches to 8 inches, and in lengths up to 16 inches (3.13).

Actual brick sizes will vary from manufacturer to manufacturer, depending on their ability to control shrinkage during firing. Fairly close tolerances are maintained by most manufacturers and whatever differences do occur are easily adjusted for by mortar thickness at the time of use. The most frequently used brick has a nominal size of 2 2/3 x 4 x 8 inches in height, bed thickness and length, respectively, with a three course layer measuring 8 inches in height.

For purposes of identification, bricks of characteristic size and shape have been given specific names. These are shown in Figure 3.01 with the nominal and actual sizes listed in the table in Figure 3.02 (3.14). Brick in any of the listed sizes may or may not have have hollow cores, and the full range of shapes and sizes may not be available from all manufacturers.

3.01

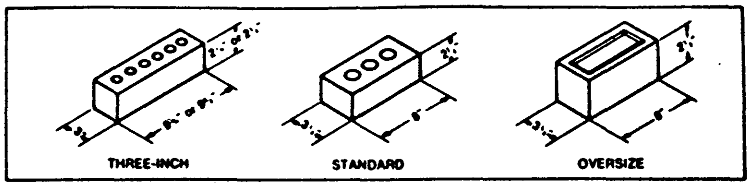


FIG. 1. Non-Modular Brick
(Actual Dimensions)

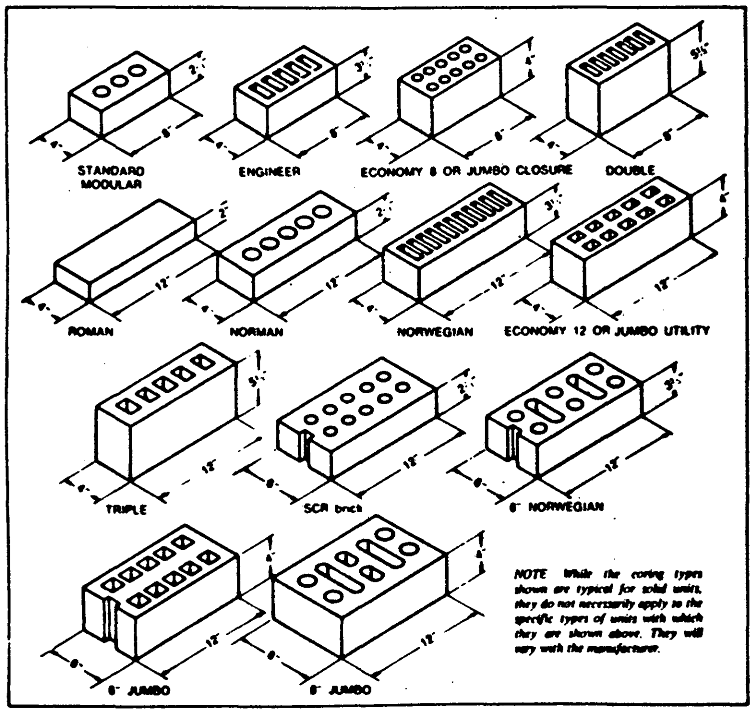


FIG. 2. Modular Brick
(Nominal Dimensions)

3.02

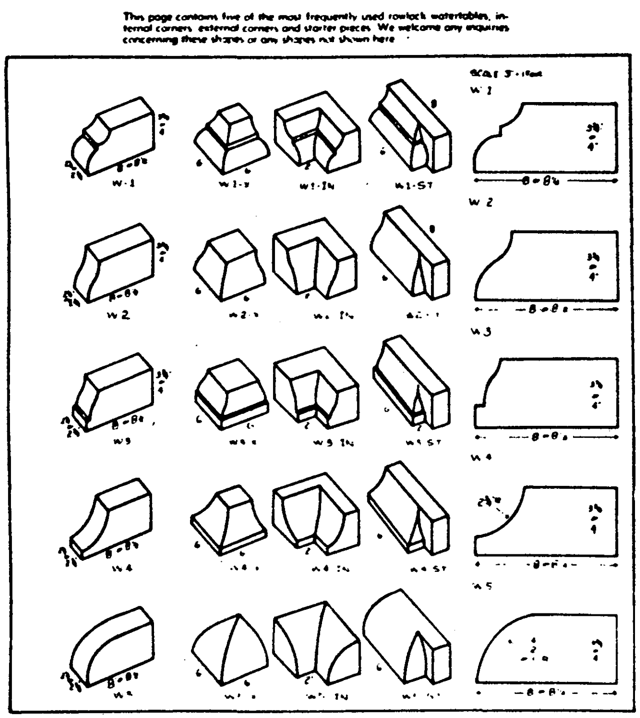
TABLE 2. Sizes of Modular Brick[1]

Unit Designation	Nominal Dimensions, in.			Joint Thickness in.	Manufactured Dimensions in.			Modular Coursing in.
	t	h	l		t	h	l	
Standard Modular	4	2⅔	8	⅜	3⅝	2¼	7⅝	3C = 8
				½	3½	2¼	7½	
Engineer	4	3⅕	8	⅜	3⅝	2^13/16	7⅝	5C = 16
				½	3½	2^11/16	7½	
Economy 8 or Jumbo Closure	4	4	8	⅜	3⅝	3⅝	7⅝	1C = 4
				½	3½	3½	7½	
Double	4	5⅓	8	⅜	3⅝	4^15/16	7⅝	3C = 16
				½	3½	4^13/16	7½	
Roman	4	2	12	⅜	3⅝	1⅝	11⅝	2C = 4
				½	3½	1½	11½	
Norman	4	2⅔	12	⅜	3⅝	2¼	11⅝	3C = 8
				½	3½	2¼	11½	
Norwegian	4	3⅕	12	⅜	3⅝	2^13/16	11⅝	5C = 16
				½	3½	2^11/16	11½	
Economy 12 or Jumbo Utility	4	4	12	⅜	3⅝	3⅝	11⅝	1C = 4
				½	3½	3½	11½	
Triple	4	5⅓	12	⅜	3⅝	4^15/16	11⅝	3C = 16
				½	3½	4^13/16	11½	
SCR brick[2]	6	2⅔	12	⅜	5⅝	2¼	11⅝	3C = 8
				½	5½	2¼	11½	
6-in. Norwegian	6	3⅕	12	⅜	5⅝	2^13/16	11⅝	5C = 16
				½	5½	2^11/16	11½	
6-in. Jumbo	6	4	12	⅜	5⅝	3⅝	11⅝	1C = 4
				½	5½	3½	11½	
8-in. Jumbo	8	4	12	⅜	7⅝	3⅝	11⅝	1C = 4
				½	7½	3½	11½	

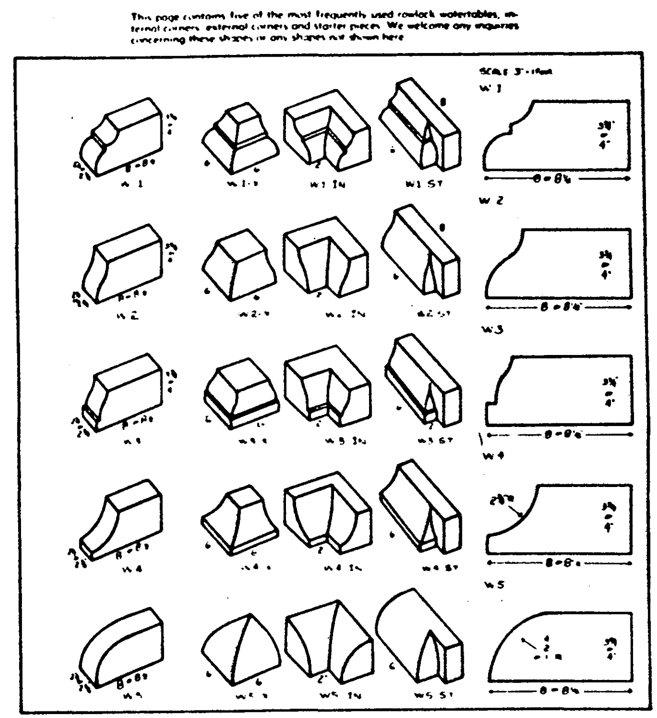
[1] Available as solid units conforming to ASTM C 216 or ASTM C 62, or, in a number of cases, as hollow brick conforming to ASTM C 652.
[2] Reg. U.S. Pat. Off., SCPI.

SPECIALS

Each of the illustrated sizes and shapes of brick are available, not only in the configuration shown, but also in a limited assortment of shapes designed to produce, when laid up, a particular structural or decorative effect. These are collectively known as 'specials', many of which have become, in themselves, standardized through conventional use over long periods of time. Shown in Figures 3.03 through 3.10 are examples taken from the catalogue of one, specific manufacturer: Brickcrafters, Inc. of New Oxford, Pennsylvania.

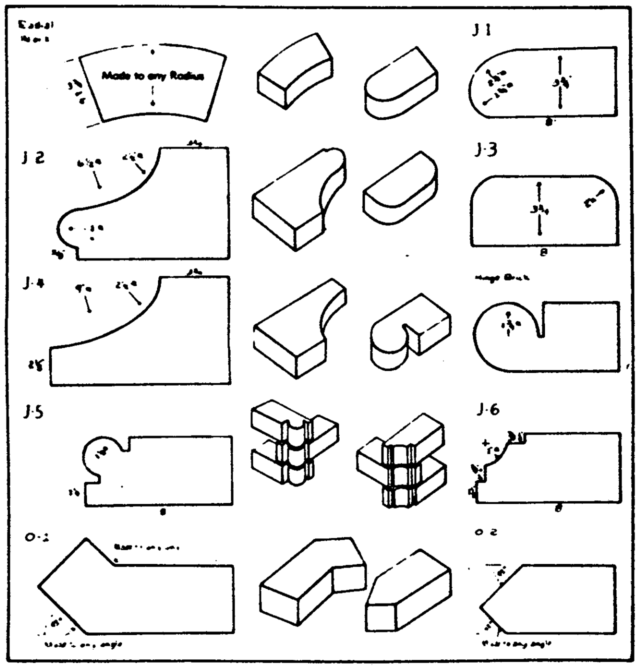


3.03



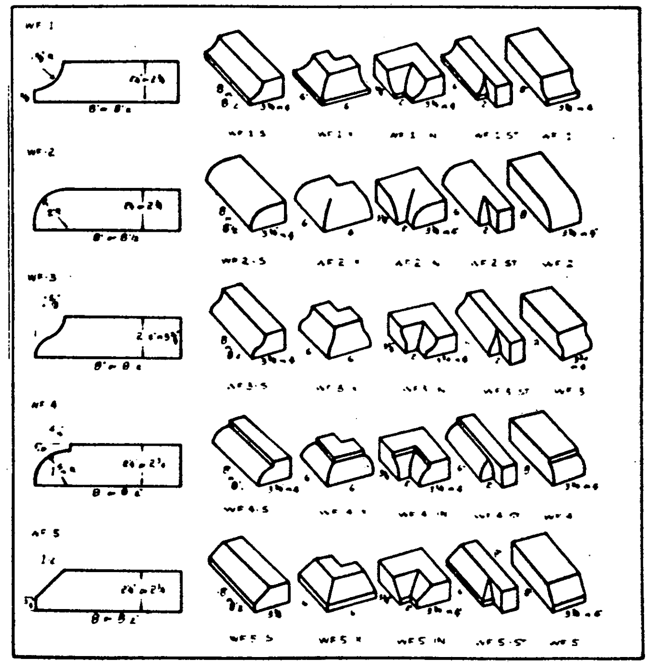
3.04

The radial brick shown here can be manufactured to fit any radius both external or internal according to architects specification. This is also true of the angle brick. The Jamb brick are just a few of the many possible shapes that can be made available. We welcome any inquiries concerning these or other shapes.



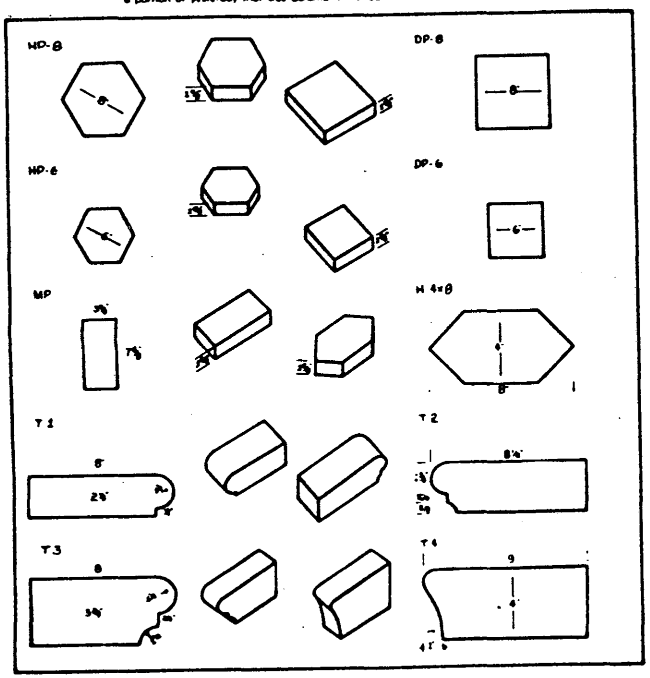
3.05

This page contains five of the most frequently used in the flat watertables including headers, stretchers, internal corners, external corners and starter pieces. Any inquiries concerning shapes not shown here will be given special attention.



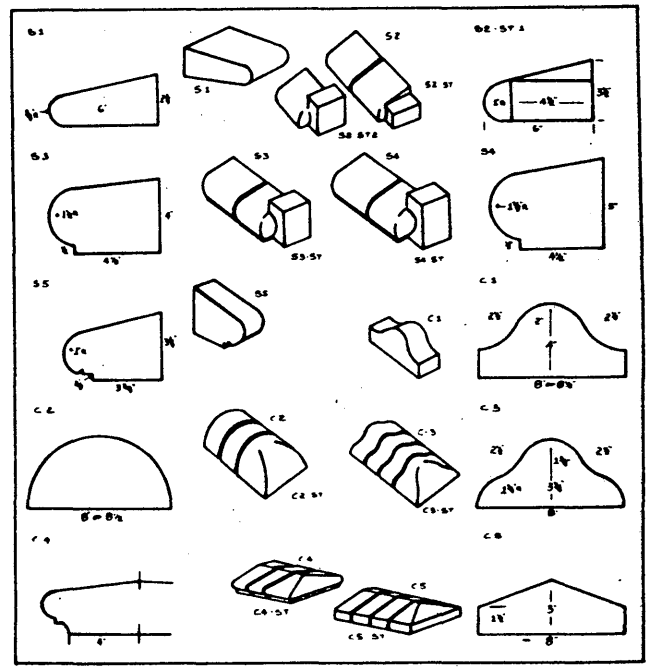
3.06

Brick pavements, patios and floors and stair tread shapes are available as pictured below or with some variations but with certain size limitations. These shapes along with others pictured on these pages can be combined to capture a portion of yesterday that was Colonial America



3.07

For true colonial style and for lasting economy the sill units and wall caping and pier cap units on this page are standard shapes but show only a few of the many possible ideas that can be put to use in this type architecture



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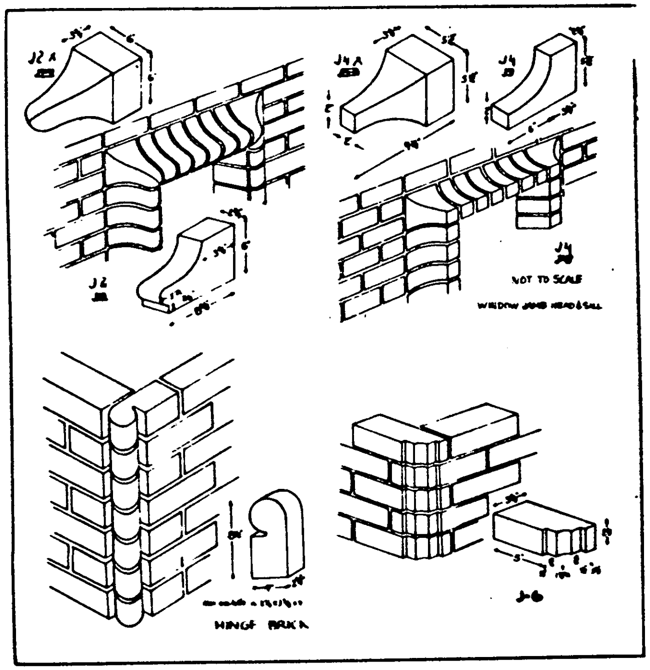
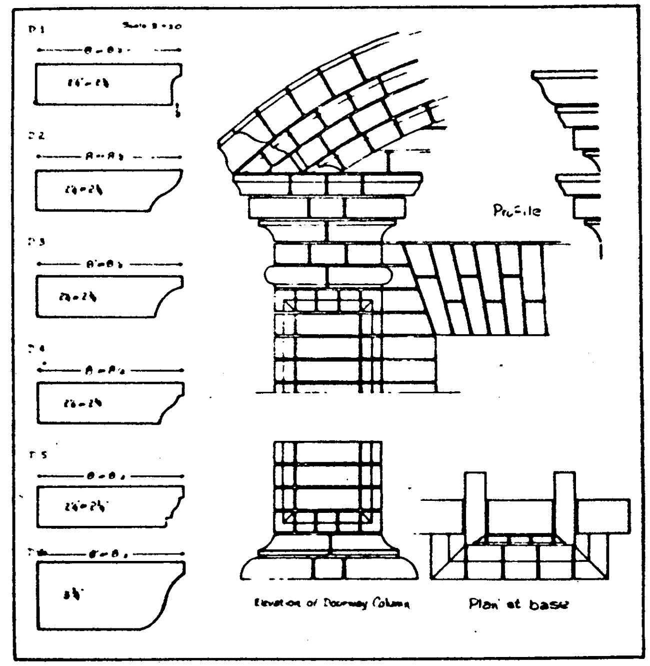
Here are just a few examples of shapes usage of jambs and soffits for windows, doors or fireplaces or complete surrounds for window openings or spandrels.



3.09

The brick entrance shown here is a basic design along with six of the basic shapes can be designed simply or elaborately. Other shapes on these pages can also be used in brick entrance to achieve the desired esthetics. Entrances are assembled and crated in sections for shipment to job site



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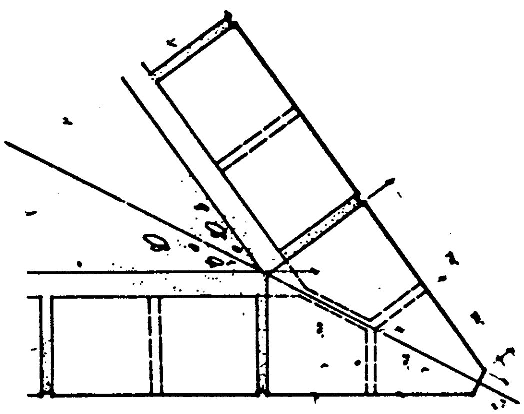
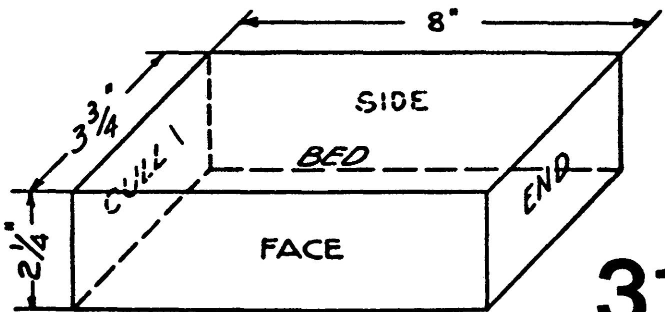


3.11

Another class of specials, created on special request for limited application in the construction of a single, specific building can be obtained from most manufacturers. As might be expected, however, the cost of such custom designed units is somewhat higher than that of standard specials, and significantly higher than the cost of regular brick. Shown in Figure 3.11 are two such custom specials, used by architects Hartman & Cox in the Euram Building, Washington, D.C. (3.15).



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NAMES OF BRICK SURFACES

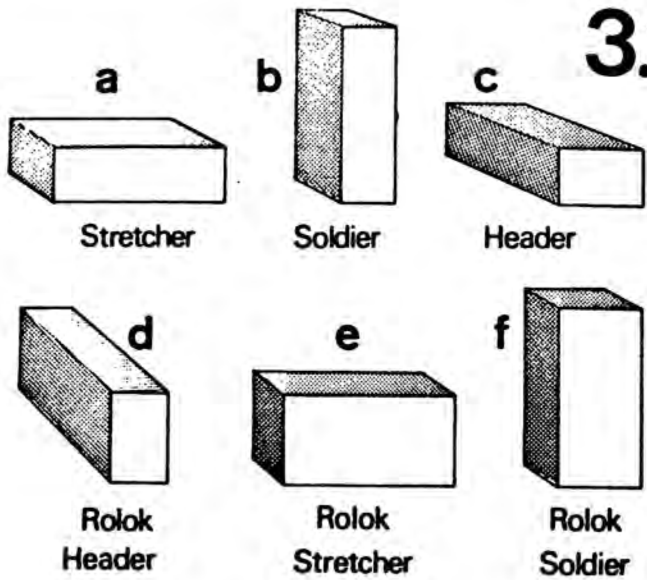
Regardless of its actual size, the standard brick is a rectangular solid having six separate surfaces, with parallel surfaces being dimensionally similar. These six surfaces are identified by the names cull, end, side, face and bed, as shown in Figure 3.12 (3.16), with bed refering to both the upper and lower surfaces. Of these six surfaces, three are usually distinct in terms of size and shape. While there is lack of absolute concurrence, this conventional terminology has been widely accepted in the masonry trades.

ORIENTATION OF BRICK

The arrangement of individual bricks that constitute brickwork, whether structural or decorative, involves the use of a limited number of variable elements. Each of the three distinct surfaces of an individual brick can be laid in but one of two ways: with its primary axis in either a vertical or horizontal position. This produces six fundamental variations for the positioning of a brick, these six positions comprising the basis of all bonding and decorative geometries in brickwork, with but two exceptions which will be discussed later in this section.

These six fundamental positions are as follows:

Stretcher: a brick laid lengthwise resting on its bed surface with its longest edge (face) parallel to the



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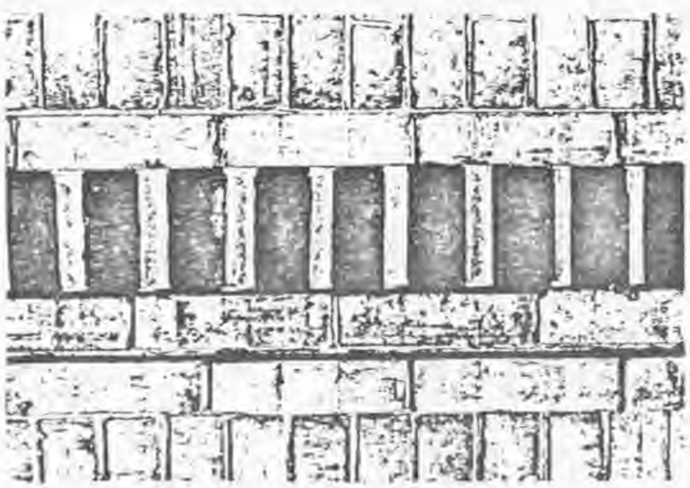


3.14

face of the wall, as shown in Figure 3.13(a);

Soldier: a brick laid resting on its end with its face exposed, as shown in Figure 3.12(b);

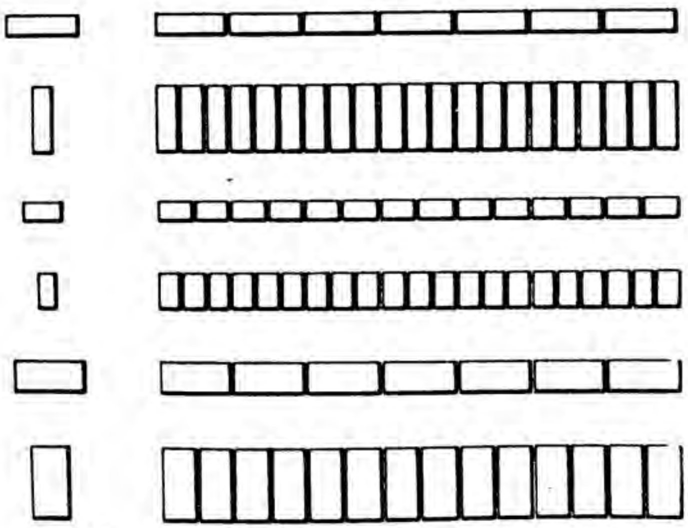
Header: a brick laid at right angles to the stretchers, or across the wall, with its end parallel to the face of the wall, as shown in Figure 3.13(c);

Rowlock (Rolok Header): a header resting on its face rather than on its bed, as shown in Figure 3.13(d);

Shiner (Rowlock Stretcher): a stretcher resting with its bed, rather than its face, exposed (sometimes refered to as a horizontal shiner) as shown in Figure 3.13(e);

Sailor (Rowlock Soldier): a brick laid resting on its end with its bed, rather than its face, exposed as shown in Figure 3.13(f).

Any of the above may be positioned in such a way that, rather than parallel, its surface is at an angle (usually 45°) to the face of the wall. In this case, an edge of the unit rather than one of its surfaces is exposed. This is rarely done with an isolated brick unit, however, but rather as one of a linear series of such units, called a course, creating what is known as a sawtooth string, or belt, course, as shown in Figure 3.14, the purpose of



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3.16

which is purely ornamental.

COURSING IN BRICKWORK

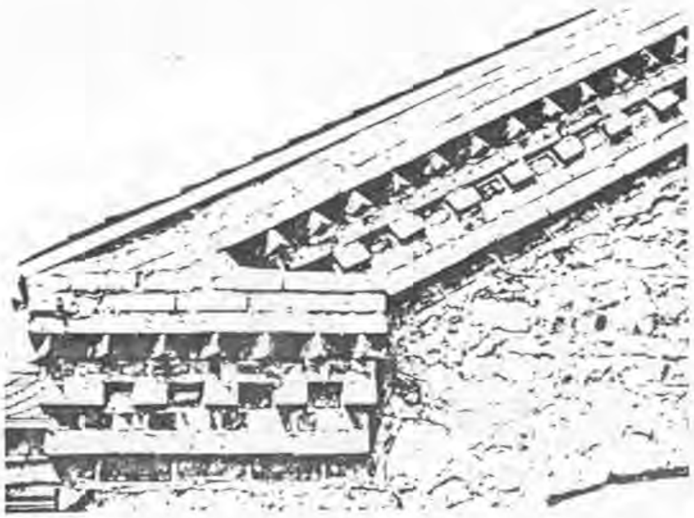
Brick is usually laid in horizontal bands, called courses, of which there are also six fundamental types. These derive directly from the previously-described six positions for laying the individual bricks of which these courses are composed, a simple course being merely the linear repetition of bricks all laid in identical fashion, as shown in Figure 3.15. Such coursings may occur singly as decorative string courses such as those shown in Figure 3.15, or in bands of multiple string courses, as shown in Figure 3.16. In either case, their function remains primarily ornamental.

Simple string courses often occur as the basic design elements in several of the traditional pattern bonding geometries. Examples of this, based on all-header and all-stretcher course combinations, include common (American) bond, shown in Figure 4.16(a), and English bond, shown in Figure 4.18.

Other pattern bonds are composed of repeated compound, rather than simple, coursings. Consisting of two distinct orientations of brick, each having identical vertical dimensions but differing in length and depth, the most conventional of these compound coursings is made up of alternating stretchers and headers in each course. Flemish bond, shown in Figure 4.24, is one such pattern bond: zigzag bond, illustrated in Figure 4.39, is another.

While there are six possible simple brick coursings, one deriving from each of the fundamental unit orientations, there are but three possible compound brick coursings. The header-stretcher coursing being the most common by far, compound coursings based on a rowlock-shiner combination and a soldier-sailor combination are also possible. When laid up as pattern bonds, the former, shown in Figure 4.42, results in a structural bonding geometry known as the Ideal Wall while the latter, shown in Figure 4.43, produces an un-named skintled bond suitable only for application in veneer construction.

In addition to the preceeding simple and compound coursings which relate primarily to structural bonding geometries, there are a number of purely decorative coursing patterns, such as the sawtooth variety previously described, which are used to either relieve the uniformity of the structural bonding patterns or to accentuate prominent features of the wall, such as the decorative masonry frieze shown in Figure 3.17. Both varieties, structural and ornamental coursings, will be discussed further in Section 4.



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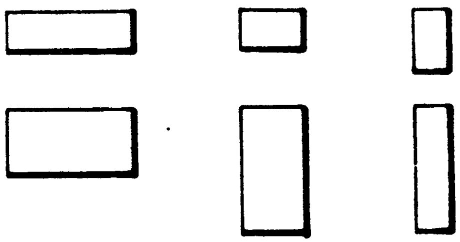

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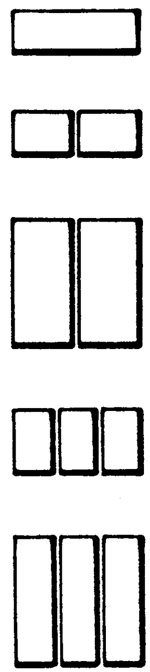

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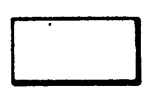

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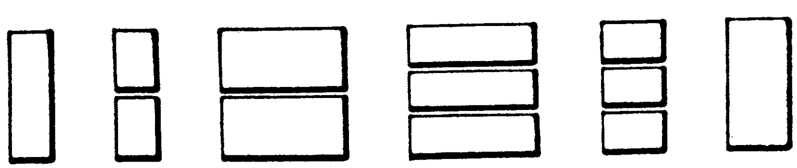


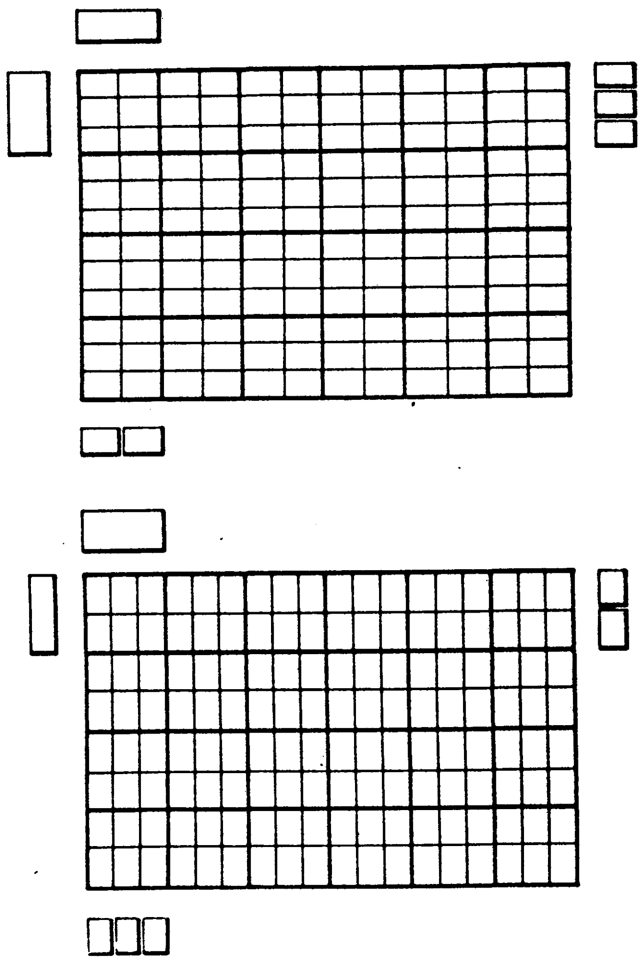
MODULARITY IN BRICKWORK

Modularity is the basis of all design in brick masonry construction. This modularity exists at two distinct levels: the first at the scale of the individual masonry units (bricks), themselves, the second at the building scale, both of which are based on the 4 inch module and nominal dimensioning.

Nominal, as opposed to actual, dimensions refer to the manufacturer's specified dimension plus the thickness of the mortar joint with which the masonry unit is designed to be laid. For example, the actual length of a standard 2 2/3 x 4 x 8 inch unit would be 7 1/2 inches if designed for a 1/2 inch mortar joint, or 7 5/8 inches for a 3/8 inch joint. For design purposes, nominal (rather than actual) dimensions and the 4 inch modular grid are used. The table in Figure 3.03 lists both nominal and actual unit dimensions of conventional masonry units for use with both 3/8 and 1/2 inch mortar joints.

Between masonry units themselves, certain size relationships exist recognition of which is fundamental to design in brick. Using as an example the nominally-dimensioned standard 2 2/3 x 4 x 8 inch unit, it is apparent from Figure 3.18 that a stretcher is the same length (8 inches) as a rowlock stretcher (or shiner), that the width of a header is the same as the width of a sailor (4 inches), and that the width of a rowlock (2 2/3 inches) equals that of a soldier.

In addition to equivalencies between units of similar dimensions, modularity is also additive in that it permits equivalencies between multiples of units, the definitive dimension being 8 inches, the length



3.21

of a stretcher or the height of a soldier. Again using the nominally-dimensioned standard modular brick, one stretcher equals two headers equals two sailors equals three rowlocks or three soldiers equals one shiner, as shown in Figure 3.19. Simply rotating the illustration 90° to a horizontal position redefines the modular relationships again, as shown in Figure 3.20.

MODULAR GRIDS

Modularity in brickwork is predicated on the gridded arrangement of oriented masonry units. Using nominal values, the grid is composed of any combination of two dimensions. A brick having three such dimensions (length, width and depth), there are three possible grid formats based on combinations of any two of these. Thus, patterns can be constructed using length/width as the coordinate axes (the standard format for most bonding geometries) as well as length/depth and width/depth. It should be noted that in brick where two of these dimensions are equal, as in both the Jumbo Closure and Jumbo Utility bricks (nominal dimensions 4 x 4 x 8 inches and 4 x 4 x 12 inches, respectively), the length/width and length/depth grids will be identical, effectively reducing the number of dissimilar grid patterns to two. Two is also the number of dissimilar working grids in actual practice, the third (width/depth) grid being incorporated into the other two, as shown in Figure 3.21.

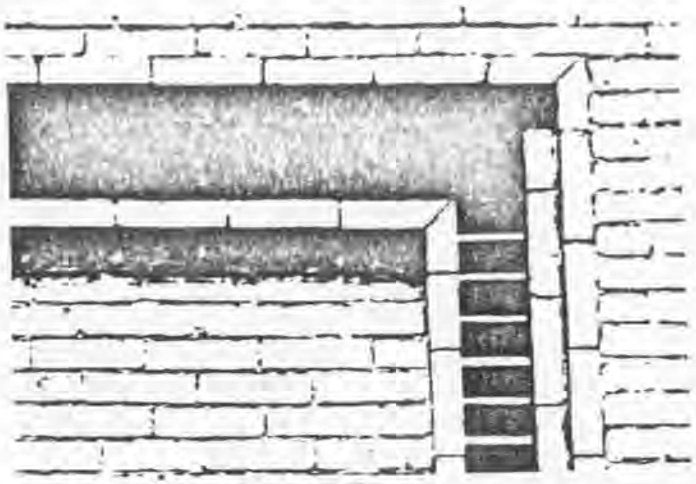
These two basic grid patterns are the basis of all design in brick masonry construction. In standard practice, such a grid will exist for an entire wall

3.22

3.23

or structure. Due to the inter-relatedness of these modules, it is possible to use these grids in combination in the construction of a masonry surface or form. In such cases, the usual practice is to distinguish such changes by restricting them to specific courses or to articulated bays. Such combinations occur most frequently in highly decorative work, the change in grid pattern producing readily-discernible changes in the pattern of the wall, changes that naturally create banded or paneled effects in the completed surface. In one such instance, albeit a very subtle one, a rowlock course is substituted for the usual all-header course in common, or American, bond as shown in Figure 3.22. A comparison with Figure 4.16(a) will reveal the deviation from standard practice. The effect is one of a recurrent discontinuity, which reads as an accentuated (but nonportruding) band, occuring every sixth course as the dissimilar grid is regularly reintroduced into the wall fabric.

More complex use of dissimilar grids occurs in highly decorative masonry work. Often, in these cases, grids do not conform to regular bay dimensions or to specific courses, but vary at a much smaller scale: practically from brick to brick. This decorativeness often relies heavily on gauging (in the case of curvilinear motifs such as archings) and special cuts (such as in mitered corners), as shown in Figures 3.23 and 3.24. Not part of the main wall fabric, itself, which is usually laid up in a more traditional pattern bond, these decorative effects are most often encountered in belt courses, hooded lintels, arched openings and cornices where special articulation is desired. Such complex detailing was especially



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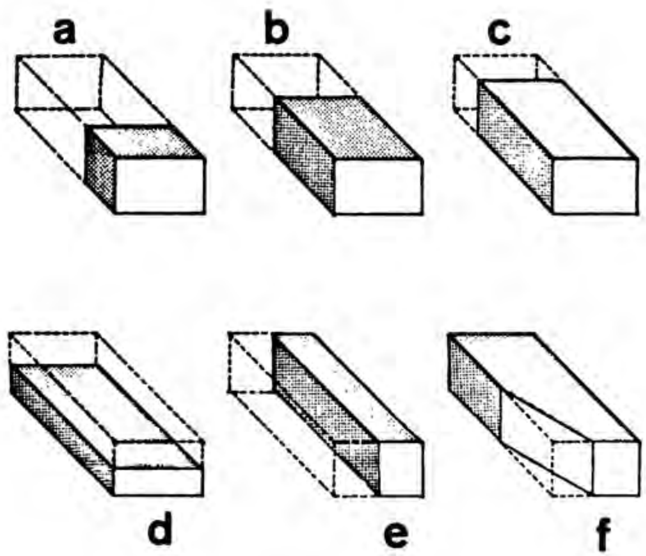

3.25

common in late Ninteenth Century commercial architecture, and will be discussed further in Section 6 of this study.

STANDARD BRICK CUTS

Frequently it is necessary to make adjustments in courses to compensate for the varying running lengths of brickwork produced by the various bonding patterns or to integrate decorative effects into the wall fabric. These adjustments occur at or near the end corners of walls and at openings in them, and are intended to create perfectly perpendicular edges at such corners and end points. This is accomplished by clipping some of the brick to varying lengths in order to fill in irregular spaces and carry the wall to its corner with a minimum of interruption to the bond pattern. Such clipped brick are called closers, the term meaning that they perfectly finish, or close, the length of the courses which have been shifted to obtain the bond. This device also successfully avoids the creation of independent vertical piers of brickwork at the corners of walls in that no two adjacent courses will have joints which are immediately over each other.

The various standard closers are shown in Figure 3.25. The dotted lines represent whole brick of the usual size: 2 2/3 x 4 x 8 inches. When such a standard brick is cut fractionally along its length, the resulting pieces are called bats. When one-fourth of the whole brick is cut off, as at (a), the remainder is called a three-quarter bat. In like manner, the portion remaining, as at (b), is called a half bat, and at (c), a quarter bat. Halving a brick horizontally along its entire length with the break parallel to the bed of the brick, as in (d), produces a standard closer known as a split. A queen closer, shown at (e), results from halving a brick vertically along its entire length, while a king closer, shown in (f), is a brick cut diagonally across its end so that it tapers from a width of 2 inches (the width of a half bat) at one end to a width of 4 inches (the width of a header) at the other (3.17).

The use of each of the various types of closers, or bats, is most commonly associated with one or more of the standard bonding geometries and is the means by which the lap of the brickwork is secured. The particular uses to which these conventional cuts are put will be illustrated further in the following section on bonding. In addition to the conventional cuts, unusual designs may require cuts other than thsoe described above. In these instances, the brick are generally cut in the field to the desired shapes at the construction site.

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3.02 Ibid., pp. 3-4.

3.03 Ibid., p. 6.

3.04 Ibid., pp. 4, 6-7.

3.05 Ibid., pp. 4, 7.

3.06 Practical Bricklaying, Briggs & Carver, McGraw-Hill Book Company, Inc., New York(1924), p. 17.

3.07 Dalzell, p. 4.

3.08 Briggs & Carver, p. 19.

3.09 Ibid., p. 4.

3.10 Introduction to Early American Masonry, Harley

J. McKee, National Trust for Historic Preservation, Washington, D.C. (1973), pp. 53-54.

3.11 Ibid., p. 54.

3.12 Salvaged Brick, Technical Notes on Brick & Tile Construction, Vol. 9, No. 11, Structural Clay Products Institute, Washington, D.C. (Nov., 1958), pp. 1-4.

3.13 Brick Sizes and Related Information, (4.4 Str) Sweet's Catalogue (1971), Structural Clay Products Institute, McLean, Virginia.

3.14 Brick Sizes and Related Information, Technical Notes on Brick & Tile Construction, No. 10B, Brick Institute of America, McLean, Virginia (Oct., 1971), p. 3.

3.15 Brick Architectural Details, Warren J. Cox, Brick Institute of American, McLean, Virginia (1973), p. 25.

3.16 Briggs & Carver, pp. 15-16.

3.17 A Treatise on Architecture and Building Construction, Vol. II, International Correspondence Schools, Colliery Engineering Co., Scranton, Penn. (1899), p. 109-110.

BONDING IN BRICKWORK

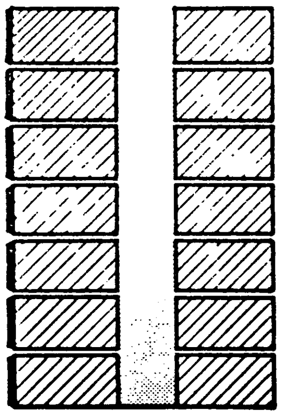
In order that masonry structures be strong, solid and durable it is necessary that bricks be placed in such a manner that they are all tied together to form a cohesive block, or mass. The mortar in the horizontal and vertical joints tend to tie all the bricks together, but unless the individual brick is placed and bonded properly, the resulting structure will not have much strength or durability, especially when subjected to heavy loading. Good bonding is accomplished only by lapping one brick across, or over, at least two others in the course directly below it so that no two successive courses have their vertical mortar joints in allignment, a process known as breaking joints.

Improper bonding produces a series of structurally independent, miniature masonry piers or columns which, while they do abut one another, have no bond between them and are held together merely by the adhesive qualities of the mortar in their common joint. This type of construction will not create the solid, cohesive mass necessary for strong, safe, durable construction. Proper bonding ties the masonry structure together vertically and horizontally, both along its length and in depth to its backing courses (4.01). This requires not only that vertical joints be discontinuous (i.e. broken) from course to course, but also that the masonry be tied to its backing either by means of regularly spaced 'through' headers or by means of mechanical 'tie-back' devices.

This patterned coursing of the built-up brick surfaces called bonding refers to the outside tier of courses only, not to the backing courses. The purpose of this coursing can be either structural, decorative, or both. Brickwork has such great bearing capacity that only rarely is this a factor in the selection of the bond type. The kind and color of the brick and joint to be used, appearance and cost are generally more critical considerations.

TYPES OF MASONRY BONDS

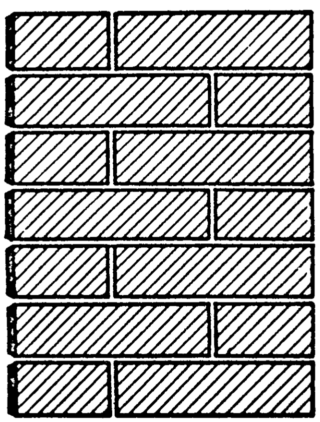
The word, bond, when used in reference to brick masonry, may have any of three distinct meanings. Mortar bond refers to the adhesion of mortar to the masonry units or to the reinforcing steel interwoven with them. The pattern formed by the masonry units and the mortar joints on the face of the wall is referred to as a pattern bond. Structural bond is the method by which the individual masonry units are interlocked, or tied together, to cause the entire assembly to act as a single, secure structural unit (4.02).



4.01

Mortar Bonding

Mortar bond refers to the adhesion of mortar to masonry or to steel reinforcement ties placed in masonry. Alone, it is not strong enough to provide sufficient bonding for secure structures (4.03). The bonding of solid and reinforced brick masonry walls is sometimes accomplished by means of grout (i.e. a highly fluid variety of mortar) which is poured into the cavity, or collar joint as it is called, between wythes of masonry, as illustrated in Figure 4.01. This is one of the few instances of the use of a strict mortar joint in common practice. Usually, bonding of the surface tier is accomplished by means of either structural bonding patterns in the brickwork, itself, by metal ties, or a combination of both (4.04).



4.02

Structural Bonding

Structural bond refers to the interlocking of masonry units by (over)lapping bricks or by metal ties (4.05). This usually implies a solid or cavity masonry wall at least two wythes (i.e. eight inches) thick with internal bonding in depth between the face tier and its backing course(s), as shown in Figure 4.02.

In brick veneer construction (i.e. brickwork one wythe in thickness), structural bonding is accomplished by means of metal ties which firmly attach the masonry to its backing, whether it be concrete, masonry or wood, as shown in Figure 4.02.

Pattern Bonding

Pattern bonding refers to the practice of interlocking and overlapping brickwork following a fixed sequence. Certain bonding patterns for structural purposes have become standardized and have been given names. These usually combine special appearance with some structural bonding qualities. Others are used for appearance purposes only (4.06).

The distinction between structurally oriented and purely decorative bonding patterns is not always a precise one. There are but three fundamental patterns of structural consequence in good brickwork: running bond, English bond, and Flemish bond. From these a number of variations are derived, most of which can still aptly be considered structurally active (i.e. they still fulfill a certain supportive function in addition to their role as a two-dimensional, decorative surface pattern). A wide assortment of such pattern bonds exists in traditional brickwork. An even wider assortment that is, for all practical purposes, virtually limitless can be derived from them.

In addition, many varieties of pattern bond do not derive from any of the standard traditional patterns, but rather from an external design applied to and executed in brick. These purely decorative patterns deviate from traditional bond rhythms and regularity of pattern, often quite dramatically, and are usually executed in polychrome or textured brickwork in order to fully exploit the created patterns.

Because this distinction between the varieties of pattern bonds, so confusing in theory, becomes even more muddled in actual practice, the two categories of pattern bond (i.e. the structural and the purely decorative) will be treated as a composite grouping rather than as being distinct and exclusive.

In presenting the various bond types, an attempt will be made to point out the structural considerations and consequences in addition to describing the method of construction and aesthetic characteristics of each bond type discussed. However, before beginning an examination of bonds, it is necessary to first discuss quoining: that is, the various conventional techniques for the construction of corners in brick masonry construction.

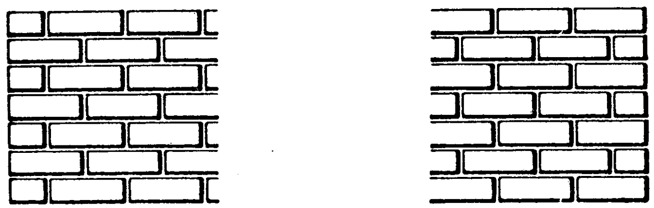
CORNERS IN BRICK MASONRY CONSTRUCTION

A corner is the meeting of the ends of two converging walls. The external angles of wall corners are called quoins. Those other than a right angle (whether acutely or obtusely angular) are called squint quoins.

The creation of the quoin (i.e. quoining) is a pivotal event in the generation of a masonry structure for it is here that the bond is started; it is here that the means must be provided so that the courses may be shifted the amount required by the bond to be employed. This is accomplished by the proper arrangement of the brick at the corner and by the use of special brick (described in Section 2), if necessary (4.07).

There are, therefore, but two generic corner types: quoins and squint quoins. These are simple corners.

a b



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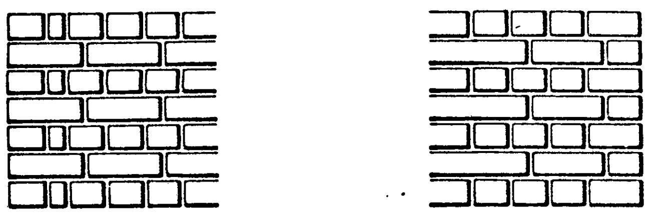

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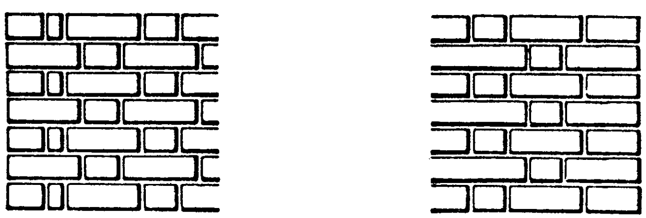


4.05

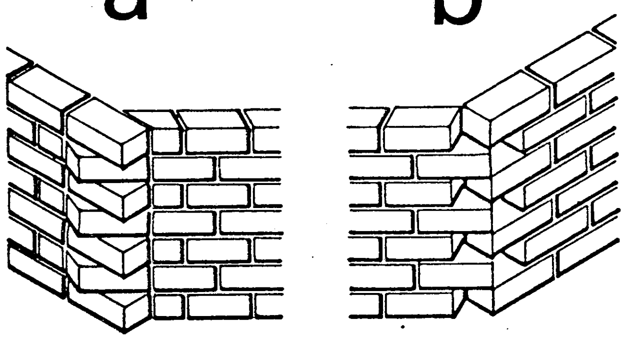
Quoins

There are three types of quoins: the whole stretcher corner, the English corner and the Flemish corner.

The whole stretcher corner is simply one formed by the 90° intersection of two half-lapped running stretcher bonds, as shown in Figure 4.03. In this, the least complex of the quoins, a full corner brick having both its end and face exposed appears as a stretcher in one wall plane and as a header in the other.

In order to correctly locate the vertical joints in both English and Flemish bonds (and in all bond types derived from these), it is necessary to introduce a unit half a header in width at the corner. In English bond, this one-quarter bat as it is called is inserted next to the corner brick in every header course, as shown in Figure 4.04(a), to create an English corner. A Dutch corner in English bond, shown in Figure 4.04(b), is created by replacing the corner header and the quarter bat of the English corner with a single three-quarter bat at the corner. The distinction between the English corner and the Dutch corner is, essentially, an aesthetic one. Both correctly establish the bond (in this instance, English bond). A whole stretcher corner, on the other hand, would not.

Similarly, either an English corner or a Dutch corner, but not a whole stretcher corner, can be used in Flemish bond. All courses in Flemish bond being identical but with a three-quarter (brick) shift of pattern between adjacent courses, the English or the Dutch corners can be started with a b



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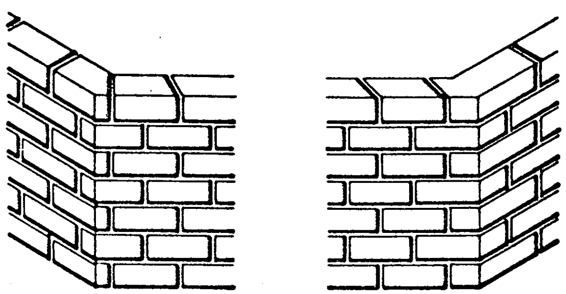


4.07

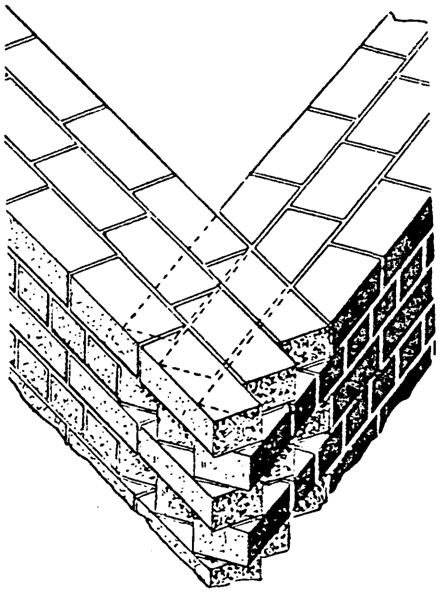
either the first or second course and continued in alternate courses thereafter, as shown in Figure 4.05 (a) and (b).

It should be noted that, while the whole stretcher corner alone cannot correctly establish either the English or the Flemish bond pattern, neither can either the English or the Dutch corners. Rather, a combination of corner types (English-whole stretcher, or, Dutch-whole stretcher) must be sandwiched together in alternate courses, as shown in both Figures 4.04 and 4.05. Whether the end or the face of the whole stretcher corner brick will be exposed in the wall plane depends upon the length of the wall, itself.

Squint Quoins

For angles of 30°, 45° or 60°, specially-shaped brick, called splay or octagon brick, may be obtained from most manufacturers. If for any reason these special shapes are not available, the angles may be formed using brick of standard size and shape, cut or uncut (4.08).

The two methods of using standard brick for outside (i.e. obtuse) corners are shown in Figures 4.06 (a) and (b). While quite striking and expressive in appearance, both create ledges on which dirt and water can collect and should be used with great care, especially for exterior work (4.09). However, while the cantilevered brick units of (a) are not good practice, the bird's mouth voids of (b) are worse in that the effective thickness of the wall is decreased and the holes created may



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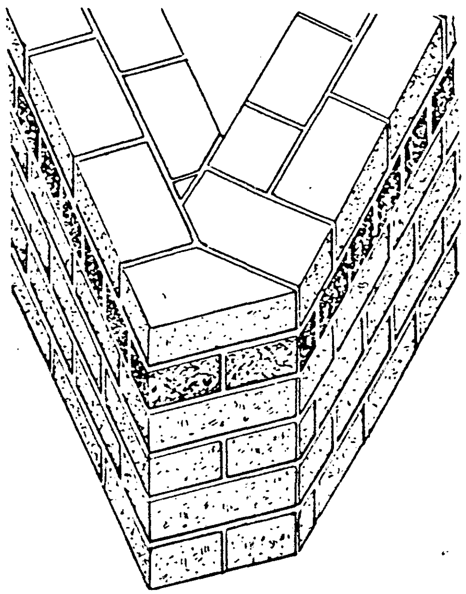


4.09

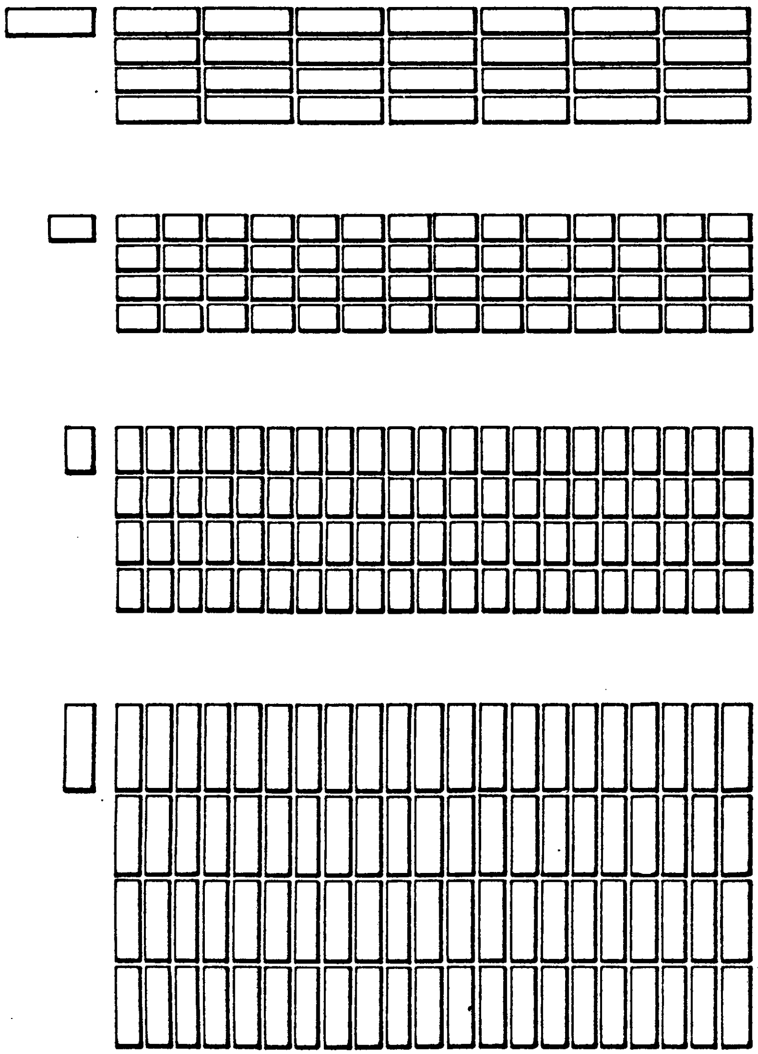
conduct water to the interior of the wall (4.10). Two better methods, shown in Figures 4.07(a) and (b), use standard brick chipped to shape and manufacturers specials made specifically for this purpose, respectively.

Figures 4.08 and 4.09 illustrate the two methods of constructing acute squint quoins from standard brick. Shown in Figure 4.08 is the 'pigeon hole' method in which uncut standard bricks are laid up with square ends instead of using special brick or brick clipped to shape. Such holes form spaces where dirt and water can accumulate, and can result in the rapid deterioration of both bricks and joints. A better method of making an acute corner by clipping standard brick is shown in Figure 4.09. Here the sharp edges and pigeon holes are avoided, improving the appearance and leaving no spaces for the accumulation of dirt and water (4.11).

As with quoins, the dual purpose of squint quoins is to secure the angle of the corner and correctly initiate the bond pattern of the wall beyond.

STANDARD BONDING PATTERNS

A bond pattern is produced by the vertical reiteration and horizontal adjustment of brick arranged in specific, repetitively patterned and regularly varied coursings. While, as previously mentioned, the variety of such patterns is potentially limitless, certain of these have, through long and frequent use, become standard and are identified by name. These familiar bonding patterns include, but are



not limited to, the following:

Stack Bond

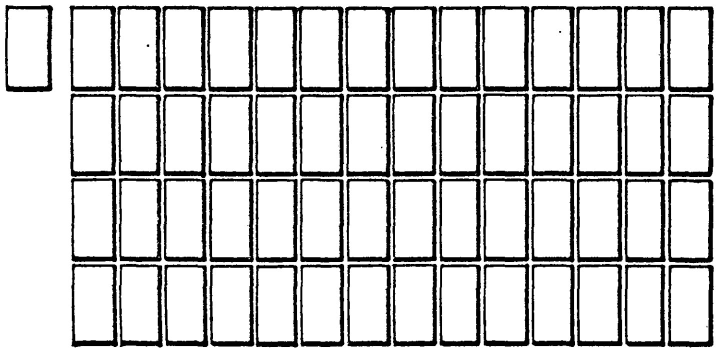
Produced by the unadjusted (i.e. unlapped) vertical repetition of any of the horizontal coursing patterns described in Section 3, this bond consists of bricks stacked vertically and horizontally with no overlap between units, as shown in Figure 4.10(a-f). Bonding strength between bricks and to the layer of bricks or other backing material behind is by means of the adhesive qualities of the mortar or by metal straps or ties. This is exclusively a decorative pattern bond and is seldom used for load-bearing masonry walls where the extra strength of overlapping is a must (4.12).

This bond type, also known as block pattern, can be laid with brick in any of the six possible positions [i.e. brick laid as headers(b), rowlocks(c), soldiers (d), sailors(e) or horizontal shiners(f)], although the stretcher stack bond, shown in Figure 4.10(a), is the most common.

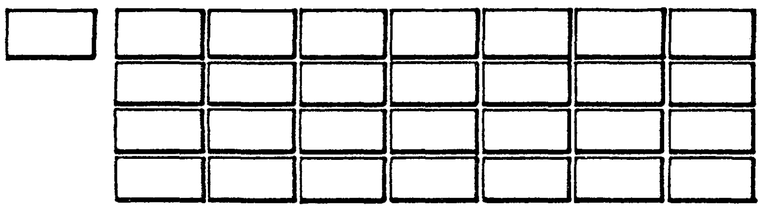
Header stack bond, shown in Figure 4.10(b), another popular variety of stack bond, has often been used to create decorative panels with a checkerboard-like pattern. This pattern is particularly effective when rendered in skintled or polychrome brickwork, or both simultaneously.

Running Bond

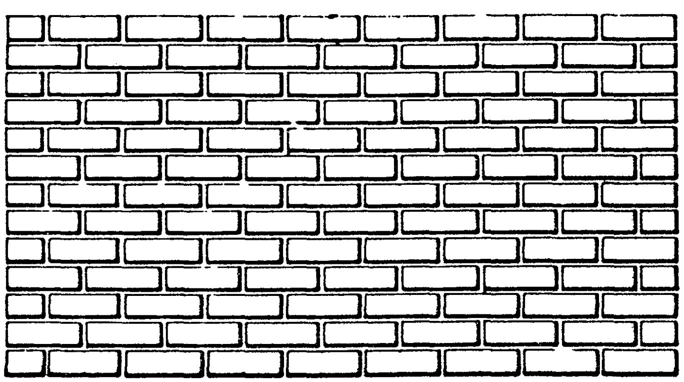
In its most common form, running bond (the first of



e



f



4.11

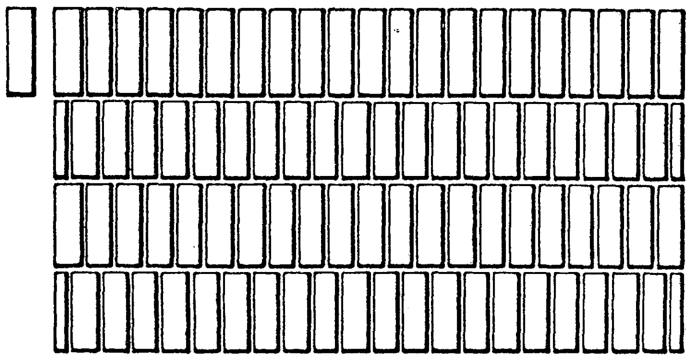
a

the fundamental bond types) consists of stretchers laid so that the end of each stretcher breaks joint at the center of the stretchers in the courses above and below, as shown in Figure 4.11(a). Running stretcher bond, as this variety is known, does not strictly comply with the definition of a structural bond in that, being composed entirely of stretchers, it provides for longitudinal strength only (4.13). It lacks the 'through' headers by means of which it might be secured to its backing courses and must, therefore, rely on mechanical ties.

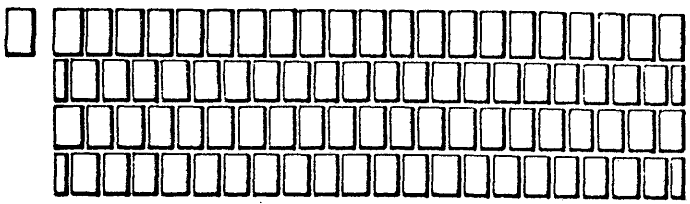
Running bond represents an intermediate step in the implied progression from mere coursing to structural bonding. Stack bond, the unadjusted vertical reiteration of horizontal coursing patterns, is the first such step. Running bond, with its horizontal shift of the pattern in alternate courses to produce lapping (whether one-quarter lap, third lap, half lap or three-quarter lap), is the second.

Running bonds, most commonly running stretcher bond, are used most frequently in veneer and in-fill construction where only one tier of face brick, backed by concrete, concrete masonry or wood frame construction, is needed for aesthetic purposes. Such a running bond can be created using brick in any of the six positions identified in Section 3. Thus, in addition to running stretcher bond (shown in Figure 4.11(a), running header bond and running bonds of brick positioned as soldiers, rowlocks, sailors and horizontal shiners are all possible, as illustrated in Figure 4.11(b-f).

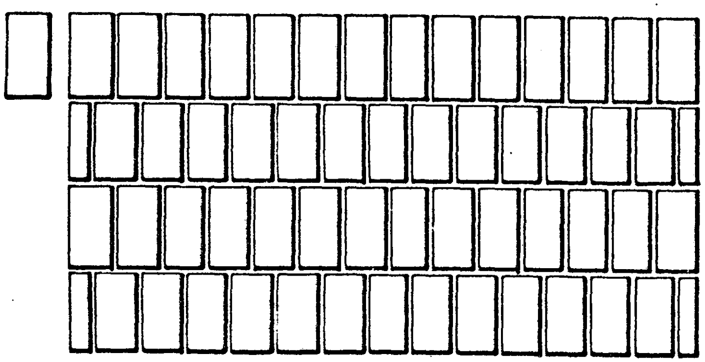
Further variations are made possible by varying the extent of lapping between courses. Stack bond has



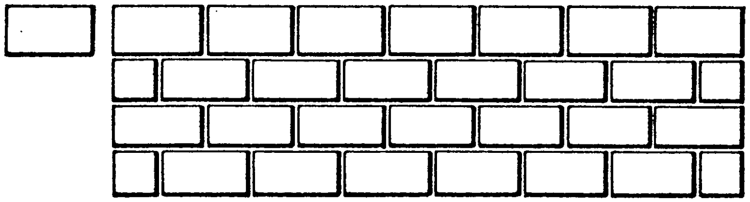
b



c



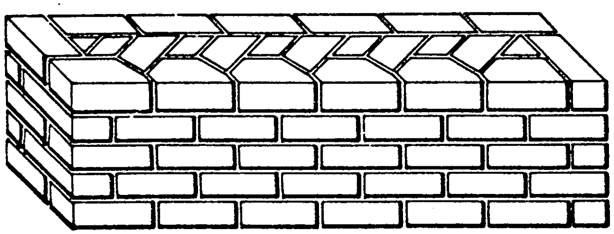
d



e

no lap, the units all being in perfect vertical and horizontal allignment. Standard running bonds use a half (one-half brick) lap, but one-third and one-quarter are both possible as are two-thirds and three-quarter laps. Less than one-quarter lap is not recommended practice.

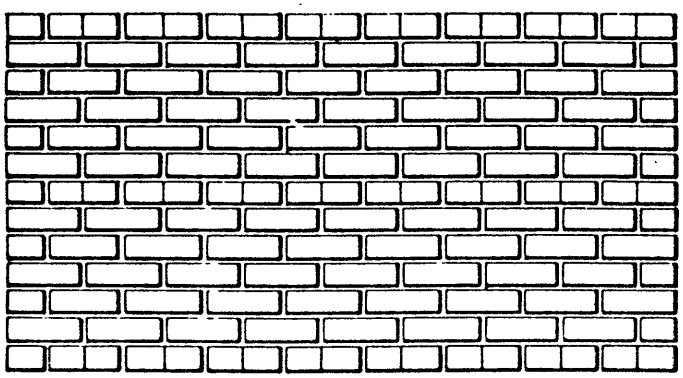
There are several additional variations of running bonds which increase its tying-in qualities.



4.12

Stretching Bond

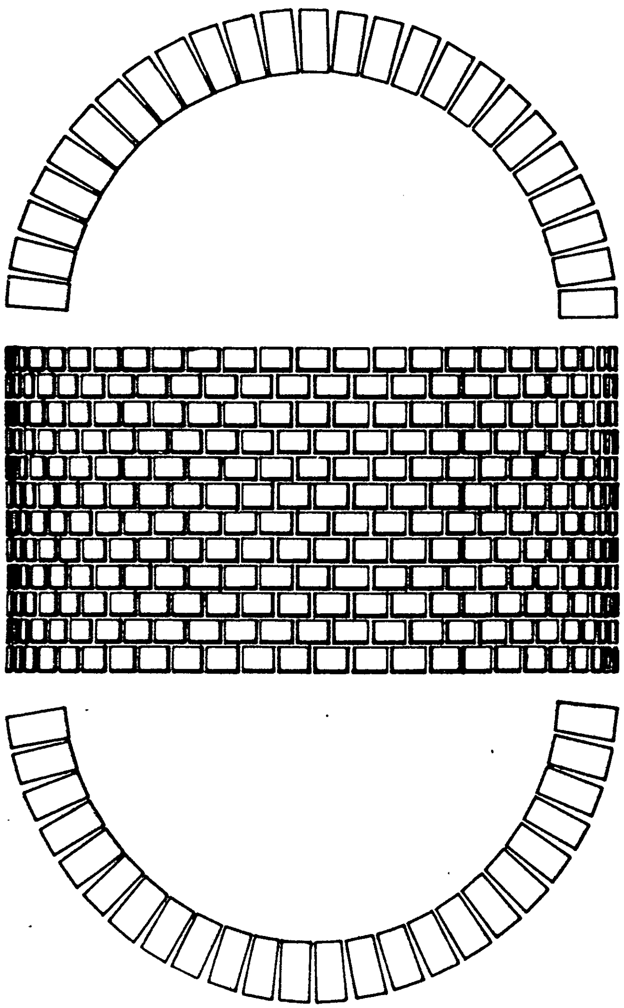
In solid masonry construction, one such method is to tie a running stretcher bond face tier to its backing courses with a clipped, or secret, bond, as shown in Figure 4.12. Also known as a stretcher, or all-stretcher bond, this pattern became fashionable in the United States about the middle of the Ninteenth Century, particularly for use on the principal facade of a building. In spite of the considerable extra labor involved in producing a clipped backing, the resulting pattern is indistinguishable from ordinary running stretcher bond and not significantly stronger (4.14).



4.13

Blind Stretching Bond

Another, more satisfactory, method of bonding the outside tier in a running stretcher, stretcher, stretching, etc. bond, shown in Figure 4.13, is to place a row of headers at every fifth, sixth or seventh course with a blind vertical joint between each pair so that the two headers will appear as a stretcher (4.15). However, the result of this is



4.14

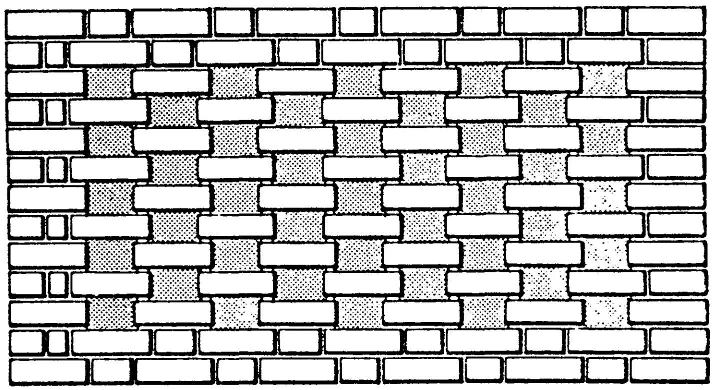
to produce, not a more secure running stretcher bond, but a less conspicuously banded variety of common, or American, bond.

Heading Bond

Also known as header, all-header or chimney bond, this pattern, identical in appearance to running header bond, became fashionable in Eighteenth Century England but has rarely been used in straight wall construction in this country except in Maryland, particularly in Annapolis and Chestertown (4.16)

However, it has been, and continues to be, commonly used where circles of relatively small radius have to be turned such as in smoke stacks, towers and rounded corners. Unless the curve is quite large, conventional stretchers are usually too long for this purpose. Instead, bricks are laid up in a running header bond as has been shown in Figure 4.11(b) with wedge-shaped mortar joints creating the curve of the outer wall surface as shown in Figure 4.14. This bond is used as an economical alternative to custom-manufactured curved stretchers or hand-rubbed wedge-shaped headers (4.17)

This bond gives the minimum, or one-quarter, lap which bonds longitudinally. It has the equivalent of transverse bonding in solid brick when used in an eight inch wall and is, therefore, much stronger than any of the other running bond types. Oddly enough considering this inherent strength, when not used for curved work it is usually confined in panels and used for ornamental effect (4.18).

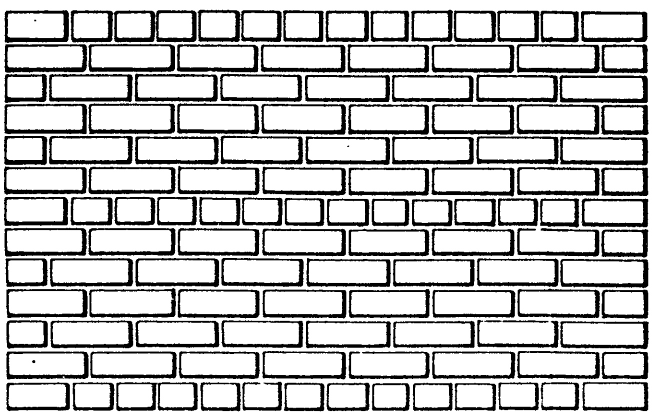


4.15

Open Bond

An open bond is one in which adjustments in the lap or the selective elimination of specific bricks creates a series of 'through' voids in the wall fabric. Various types of open bonds can be formed using almost any of the standard bonding geometries. Eliminating the headers in Flemish bond, as shown in Figure 4.15, creates an apparent variation of running stretcher bond in which quarter-lapped stretchers span a half brick void in the courses above and below. Norman and Roman brick are particularly well-adapted to this type of bond since their greater lengths result in a higher percentage of voids.

Open bonds are particularly useful as sun screens, as venting or concealing walls around exposed mechanical equipment, or as garden or boundary walls. Any situation in which light and air are intended to pass almost unhindered through a wall is an appropriate use for an open bond (4.19).

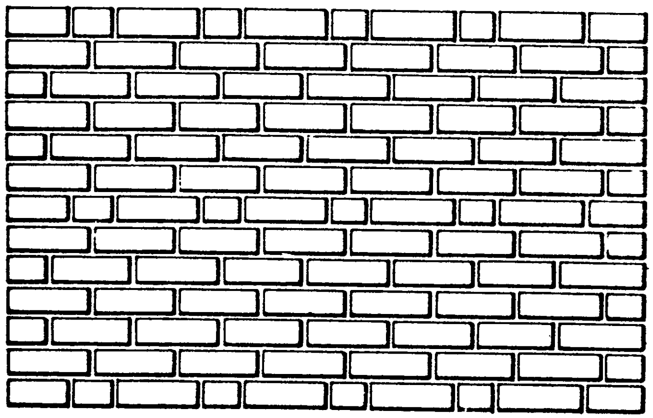


4.16

a

Common Bond

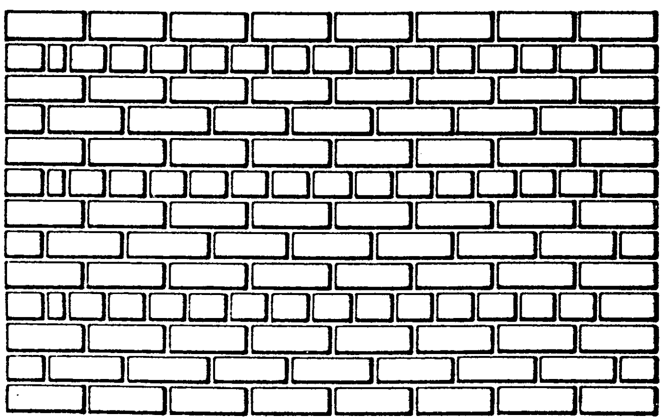
Common bond, or American (common) bond as it is sometimes called, is actually a combination of two running bonds: the running stretcher and running header bonds. As shown in Figure 4.16(a), it is laid as a series of running stretcher courses with header courses interspersed every fifth, sixth or seventh course, although the exact formula may vary from every fourth to every ninth course, according to local practice.



b

This header course may be composed either entirely of headers or of alternating headers and stretchers, as shown in Figure 4.16(b), the latter being called a Flemish header course. The Flemish header course, being less conspicuous, is often used to avoid the banded effect produced by the solid header course. A false Flemish header course, created by using a blind vertical joint for every third joint in the header course, would produce the same visual effect. In either case, it is necessary to use a three-quarter brick (bat) at the corner of the wall in each header course in order to come out evenly with a symmetrical pattern on the four inch module.

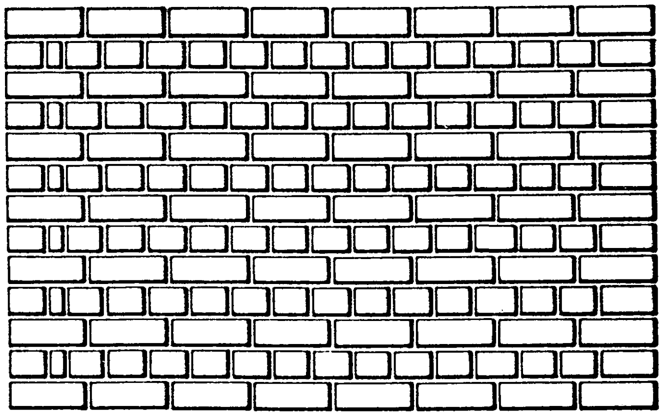
Common bond has probably been the most widely used bonding pattern in this country. It is quicker to construct, as strong as (if not stronger than) other bonds and is among the lowest in cost.



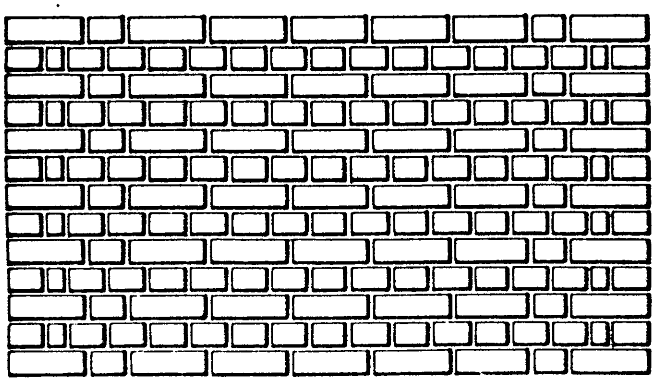
4.17

Liverpool Bond

A variation of English bond, Liverpool bond, as shown in Figure 4.17, consists of header courses alternating with three stretcher courses. Occassionally found in the United States before the middle of the Eighteenth Century but more commonly from then on well into the Ninteenth Century, this bond type represents an interim pattern between common, or American, bond and English bond.that is also known as three-stretcher English garden bond. Increasing the number of stretchers in the bond pattern in relation to the headers results in a significant economy in materials and labor without appreciably diminishing either the bearing capacity or the cohesive strength of the completed wall (4.20).



4.18



4.19

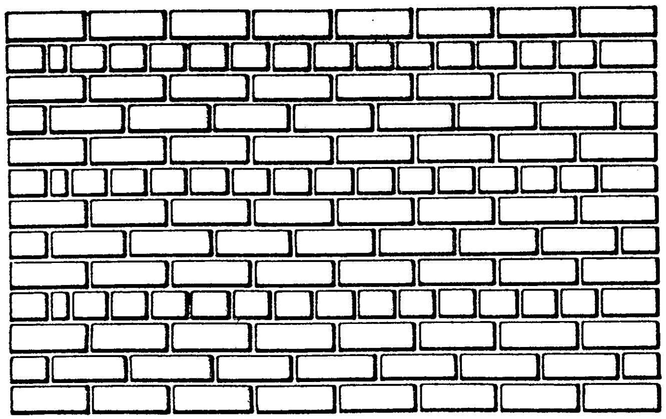
English Bond

English bond, the second of the fundamental bond types, consists of alternating courses of headers and stretchers, the headers being centered on the stretchers, the ends of the stretchers all being in vertical allignment in every course that contains them, as shown in Figure 4.18. A queen closer is placed at the corner of each header course next to the corner brick or a three-quarter brick is used in each stretcher course to take the place of the closer in that course (4.21).

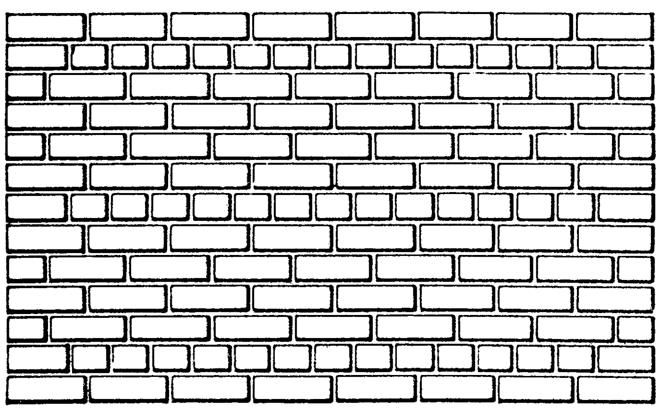
Quite popular in English residential construction English, or Old English, bond as it is sometimes called, is more difficult, time-consuming and expensive to lay up and, for these reasons, has not been used as extensively as either the running or common (American) bonds in this country. This is true despite the fact that it is probably the strongest bond structurally with excellent tying-in qualities and presents many interesting possibilities for decorative patterning on the face of the wall, some examples of which are shown later in this section. Variations of English bond include English cross bond, English garden bond and Dutch bond (4.22).

English Cross Bond

English cross bond is a variation of English bond that, like English bond, consists of alternating horizontal courses of all stretchers and all headers, but the difference lies in their arrangement (4.23). Instead of the ends of all the stretchers



4.20



4.21

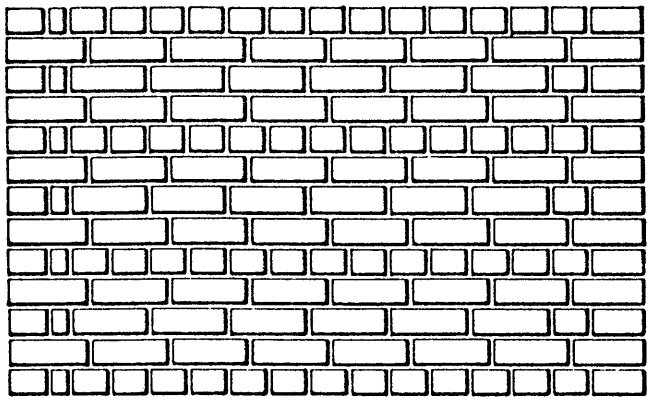
alligning with the stretchers in the courses above and below, they are made to break joint by inserting a header next to the corner brick in every other stretcher course (4.24) while the header course remains unchanged. Thus, as shown in Figure 4.19, the stretchers are spaced so that each header faces the middle of a stretcher on one side and a joint between stretchers on the other. The joints form a series of overlapping 'X's', hence the name, English cross bond (4.25). Illustrated in Figure 4.19.

English Garden Bond

English garden bond, a second variation of English bond, is the kind used for building garden walls which are usually no more than one brick, or about eight thick, thick. Originally introduced to minimize the uneven effect of using through headers of unequal lengths by reducing the number of such headers used, this bond, consisting of one header course to three or four stretcher courses, also results in a more economical use of materials (4.26).

In the three stretcher course version, shown in Figure 4.20, it is identical to an English bond with every other header course replaced by a stretcher course lapped one-half brick with those above and below it.

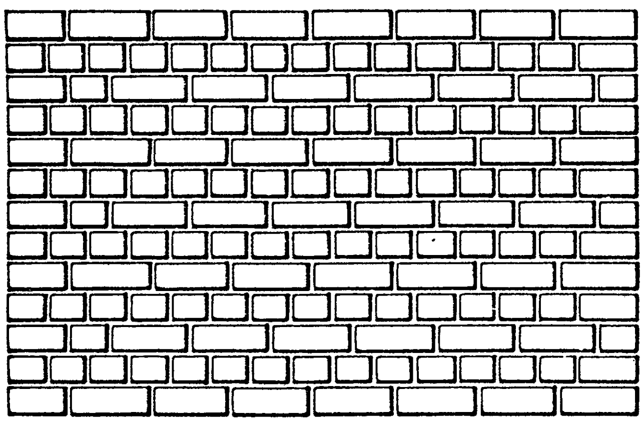
Figure 4.21 illustrates the four stretcher course version of this bond type.



4.22

Facing Bond

Facing bond, shown in Figure 4.22, varies from three stretcher course English garden bond only in the positioning of its center stretcher course which is given a one-quarter, rather than a one-half, lap (4.27).



4.23

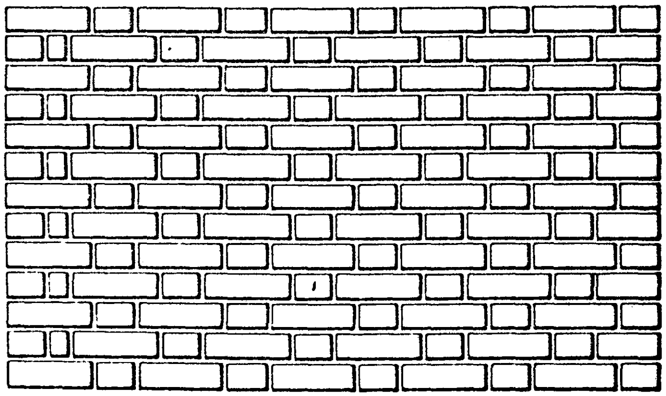
Dutch Bond

Dutch bond, another variation of English bond sometimes confused with English cross bond, is made by introducing a header as the second brick in every other stretcher course, as shown in Figure 4.23. The headers run right from the corners, omitting the closer found in English bond. This gives a better longitudinal tie and causes the wall to have a better appearance on the face (4.28).

Dutch cross bond is another name commonly applied to the bonding geometry described as Dutch bond.

Flemish Bond

Flemish bond is the third of the three fundamental bond types consisting of alternate headers and stretchers in every course, each header centering on the stretchers in the courses above and below (4.29). Closers are inserted in alternate courses next to the corner headers to give the lap (4.30), as shown in Figure 4.24.



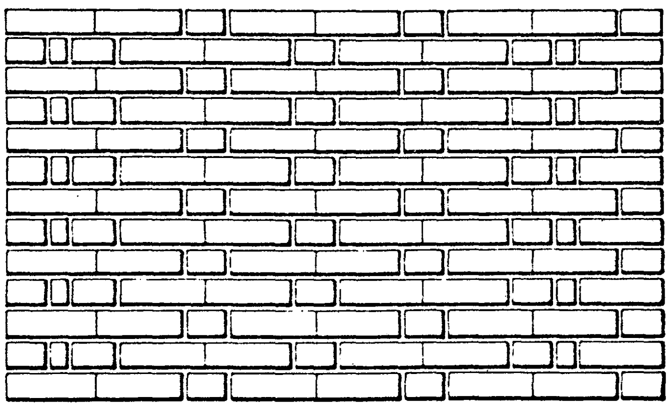
4.24

Single Flemish Bond

Single Flemish bond, the most usual type, consists of obtaining the Flemish bond effect on the outside of the wall only, the backing being common bond and the majority of the exposed headers being bats (4.31).

Double Flemish Bond

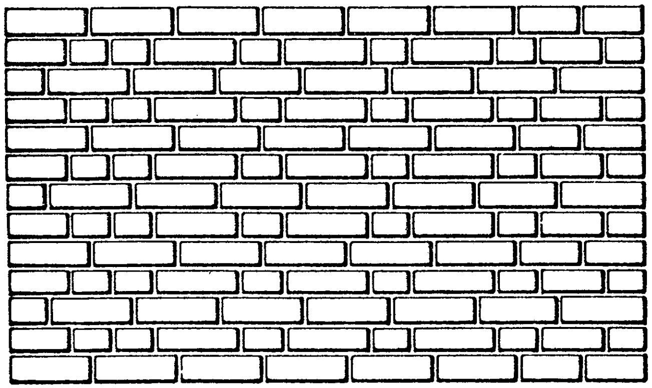
Double Flemish bond is used where both the inner and outer surfaces of the walls are exposed, both being laid in Flemish bond with all the headers being true headers and not bats (4.32).



4.25

Double Stretcher Flemish Bond

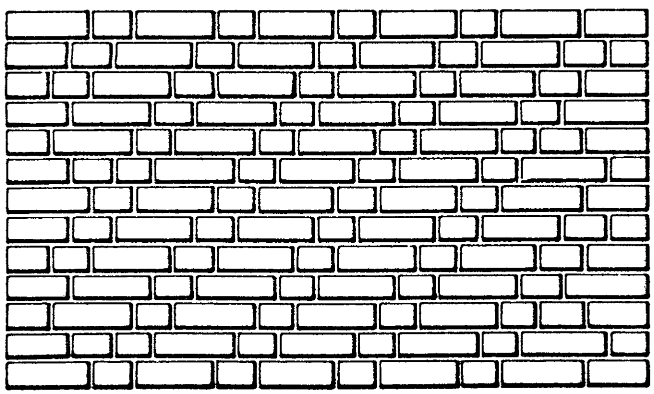
Another type of Flemish bond is obtained by constructing each course with two stretchers followed by a header and centering the headers over the stretcher joints, the joints between each pair of stretchers being concealed, or blind, joints. The concealing of these joints constitute the sole difference between double-stretcher Flemish bond, shown in Figure 4.25, and double stretcher garden wall bond, shown in Figure 4.30, in which the joint has the usual appearance. This bond is also sometimes incorrectly termed 'double Flemish bond' (4.33).



4.26

Flemish Cross Bond

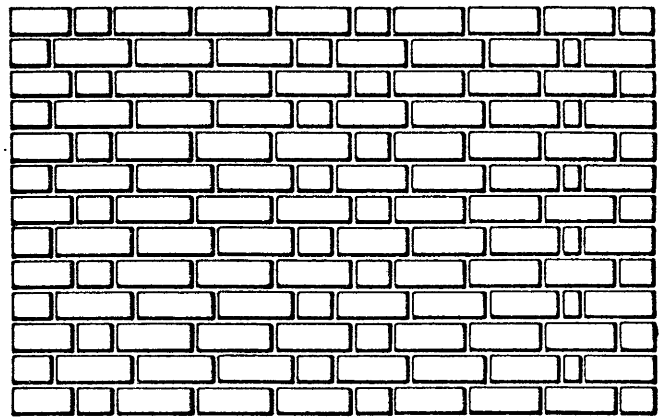
Flemish cross bond consists of alternate stretcher and Flemish header (alternating headers and stretchers in each course) courses in which the headers are all in vertical allignment while the stretchers in each course break joint, as shown in Figure 4.26 (4.34).



4.27

Flemish Spiral Bond

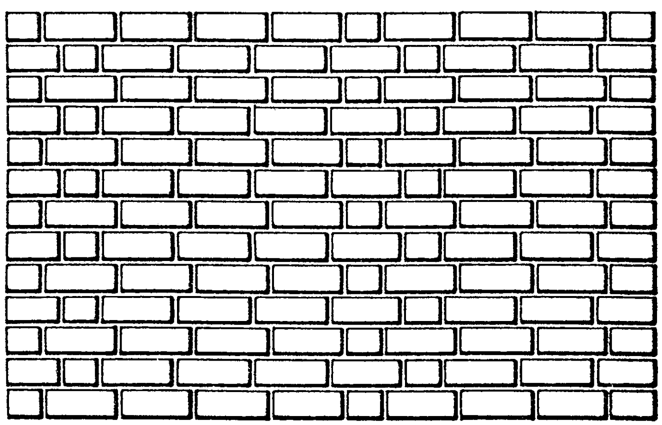
This is yet another variation of Flemish bond in which each course is laid with alternate headers and stretchers, with the headers breaking joint over each other as illustrated in Figure 4.27. By the use of a darker brick for the headers, diagonal lines are formed on the surface. When used for circular work, such as towers and chimneys, a series of linear spirals are created, hence the name, Flemish 'spiral' (4.35).



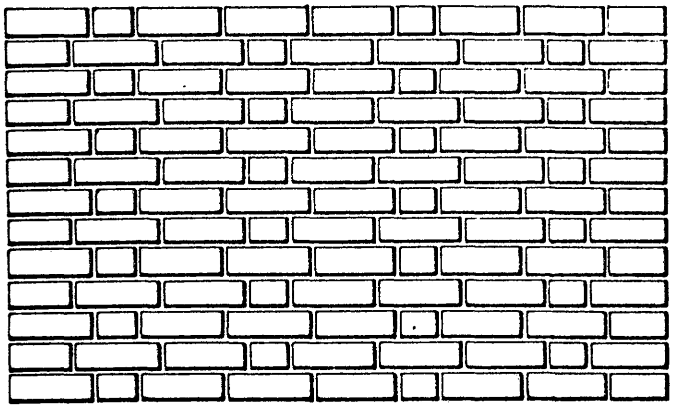
4.28

Flemish Garden Bond

As shown in Figure 4.28 and 4.29, Flemish garden bond contains one header to three or four stretchers in each course. This bond has an advantage in appearance over English garden bond in that the headers are more infrequent, making the eveness of the wall greater than is possible in English garden bond. In addition to the relative infrequency of headers, this bond is also characterized by an absence of closers at the corners (4.36). In its three stretcher form, this bond is also known as Sussex bond (4.37).



4.29

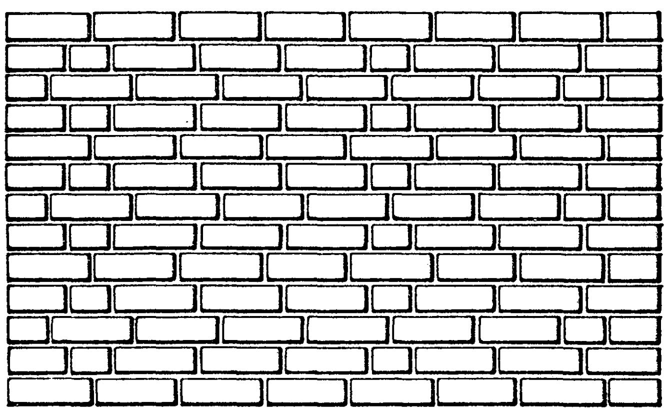


4.30

Garden Wall Bond

This bond, illustrated in Figure 4.30, was commonly used for eight inch garden walls and normally consists of three stretchers in each course followed by a header, the headers in each course centering between the headers in the courses above and below. Where the wall is built with two stretchers followed by a header, it is called a double stretcher garden wall bond. As pointed out previously, Flemish garden bond is identical to double stretcher garden wall bond with the exception that the joint between stretchers is a blind joint in the former and not in the latter.

Garden wall bonds may have from two to five stretchers between headers (4.38) and are also known by the names boundary wall bond, country bond or Scotch bond.



4.31

Garden Wall Cross Bond

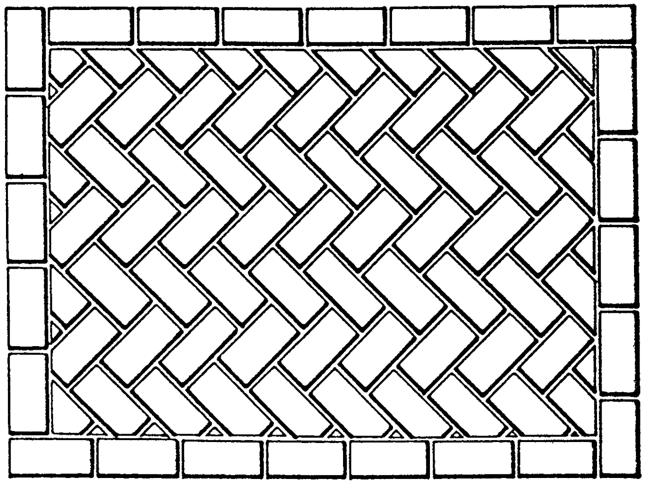
This bond, shown in Figure 4.31, is a variation of garden wall bond in which the courses consisting of a header followed by three stretchers alternate with a running stretcher course (4.39).

The preceding bonding geometries represent many, but certainly not all, of the more common traditional pattern bonds. Wherever a history of brick masonry construction has existed for some considerable period of time, these bond types, whether derived independently in local practice or acquired as imported knowledge, have long since become the fundamental standards of good brickwork.

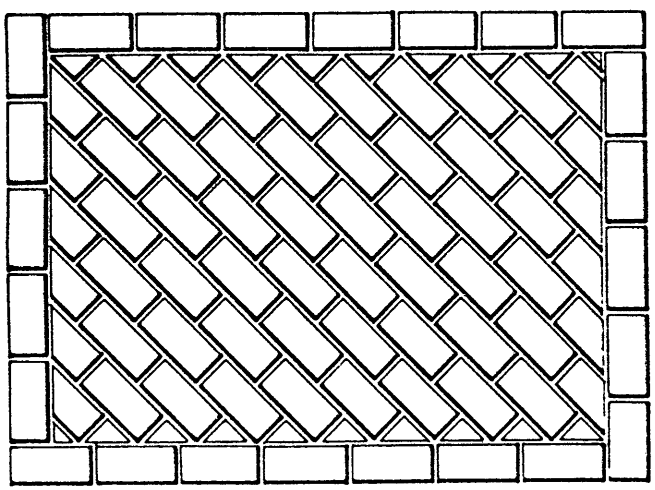
In addition to these, however, another whole group of decorative patterns have evolved over the same centuries of experience in masonry, patterns which are not so regularized and not so easily and specifically categorized. Rather, they constitute a broad range of decorative options, beyond the traditional pattern bonds, available to the designer of masonry structures whose inherent variety is virtually limitless.

This variety quite often depends heavily on an 'interpretive' deviation from the strict geometry of the traditional pattern bond types previously mentioned, the patterns being violated quite casually. Often necessary to obtain the desired surface effect, such deviations from 'orthodoxy' are quite permissible so long as they do not compromise the structural integrity of the building on which they are used. Far from being without precedent, such expressive unorthodoxies are, in fact, more nearly the norm in all traditional examples of highly decorative brickwork.

It would be impossible, and probably highly undesirable, to precisely delineate the scope of these decorative patterns. Thus, while they will be described in the remainder of this section in broad generic terms only, their vast potential for innovative and highly individualistic experimentation should be immediately apparent. Included among these are such devices as raking bonds, paving bonds, skintled brickwork and diaper patterns in an infinite variety.



4.32



4.33

RAKING BONDS

Traditionally, raking bonds were constructed in the interiors of solid masonry walls as a remedy for proportionally decreasing longitudinal strength as walls became thicker (4.40). As the use of load-nearing masonry walls of great size decreased, the structural raison d'etre for the existence of these bonds disappeared until, in contemporary construction, they are almost entirely limited to such applications as decorative wall panels, floors and pavements.

There are two kinds of raking bonds: the herringbone bond and the diagonal bond. In bonds of this type, the bonding brick are characteristically laid at an angle other than 0 or 90°, usually 45° (4.41).

Herringbone Bond

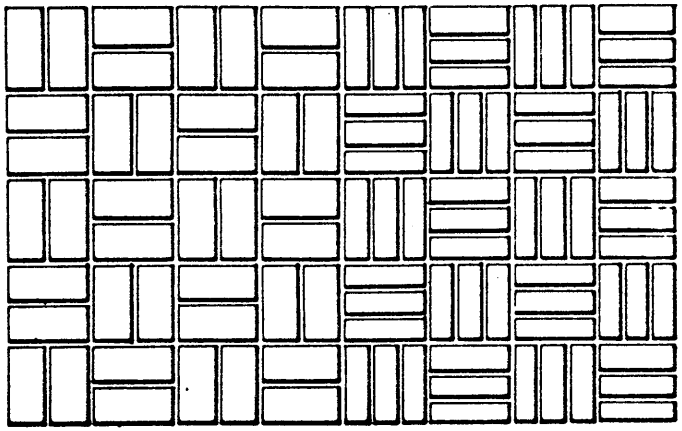
Herringbone bond, shown in Figure 4.32, is often used for brick nogging with half timber, for panels in walls and for pavements. It consists of a zigzag course of brick being laid at right angles against the side of a second brick (4.42), the brick being laid either flat or on edge.

Diagonal Bond

Diagonal bond, shown in Figure 4.33, is used for much the same purposes as herringbone bond, the brick being laid end to end as in running bond, but usually at a 45° angle (4.43).

PAVING (BLOCK) BONDS

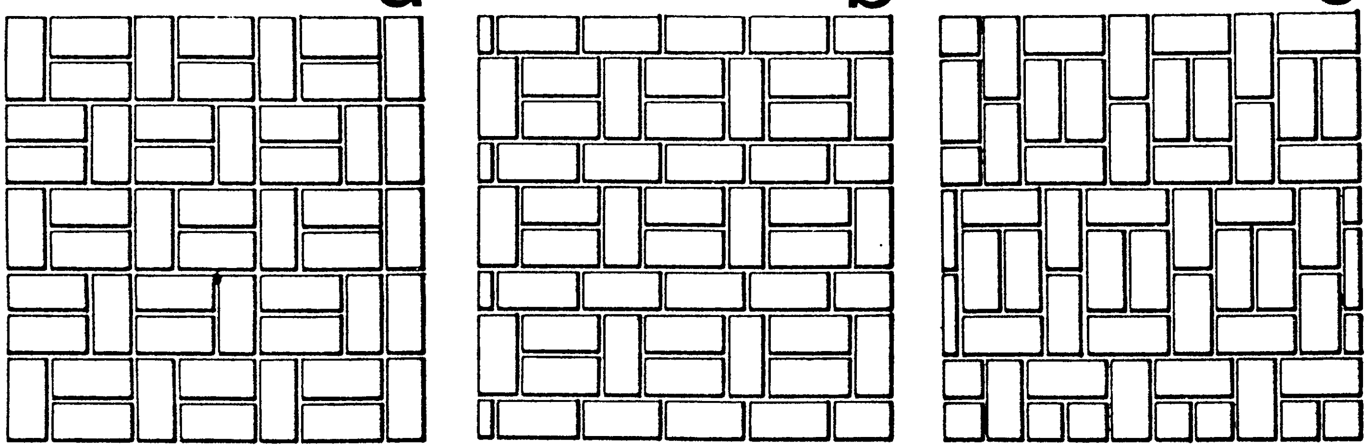
Brick offers variations of paving patterns that lend themselves to almost unlimited effects. One such pattern, basket-weave or block, bond is laid in square blocks of parallel brick, face or edge up, each block being laid at right angles to the block adjoining, as shown in Figure 4.34. Other patterned paving bonds in which brick might be arranged are shown in Figure 4.35(a-f). The patterns shown are generated using brick positioned only as shiners and sailors (i.e. with exposed brick faces having either nominal or actual dimensions of 4 inches by 8 inches). Of course other sizes and shapes, such as those described in Section 3, are also available, including 4 x 12 inch face units, units 4, 6 and 8 inches square, and hexagonal units (4.44). When patterns derived from bricks positioned as headers, stretchers, rowlocks and soldiers are added, the number and variety of these patterns become virtually limitless.

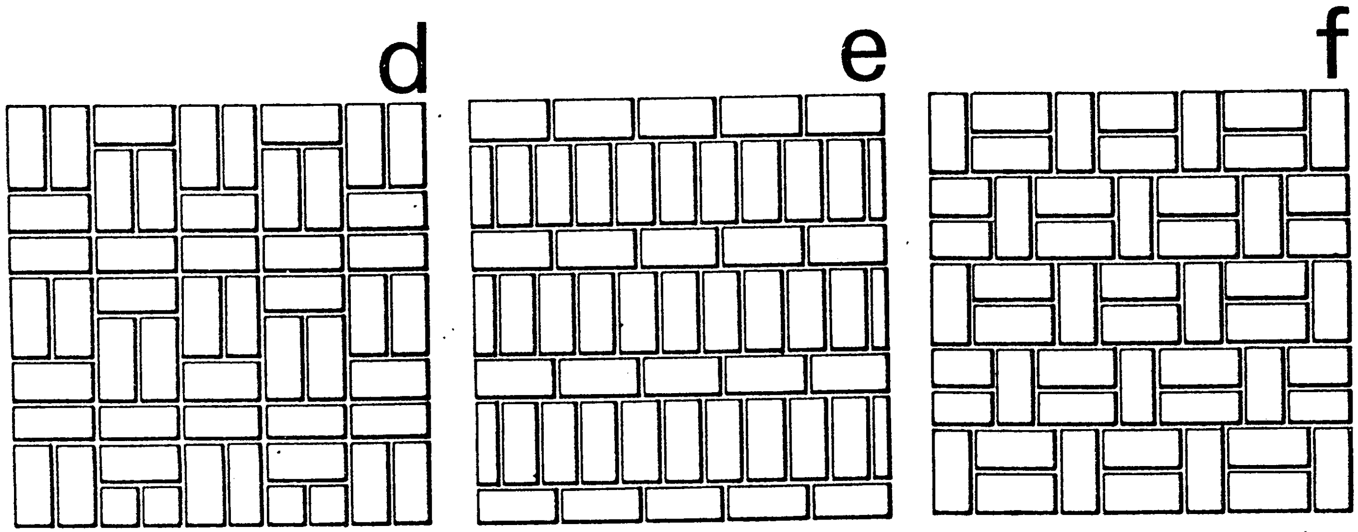


4.34

4.35

a b c

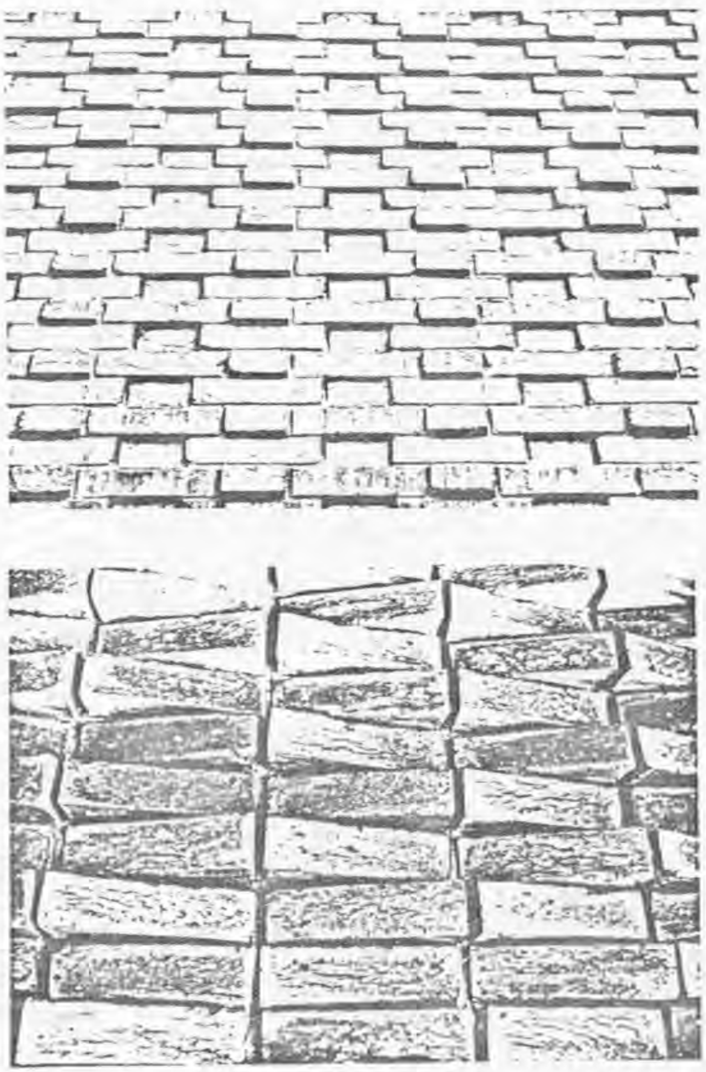




Paving bonds may be used, as the name suggests, as pavings for walks, terraces and other horizontal surfaces. However, such patterns have also been widely and effectively used as decorative infill on vertical wall surfaces, examples of which are shown in Section 2.

SKINTLED BRICKWORK

Another generic decorative device, in addition to raking and paving bonds, is skintled brickwork, development of which is credited to several Chicago architects, prominent about the turn of the century, who saw opportunities for artistic effects with



4.36

a

b

common brick.

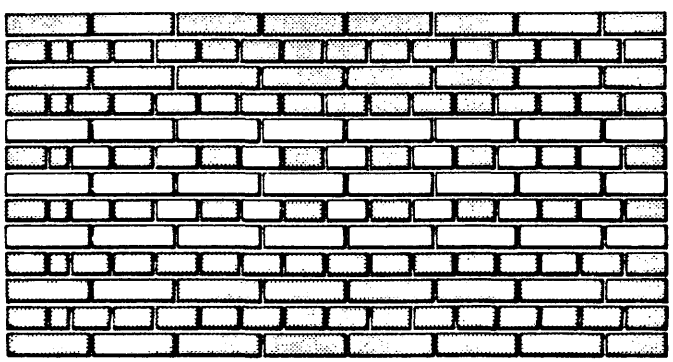
By definition, skintled brickwork is an arrangement of exposed brickwork, in any of the standard bonds or their variations, in which the bricks in the outside tier are laid irregularly with respect to the normal plane of the face of the wall, being set in and out at random or in various combinations to produce an uneven effect, as shown in Figure 4.36 (a,b). However, the name also applies to walls in which a rough effect is produced by mortar, squeezed out of the joints, being allowed to project irregularly beyond the face of the wall in which case the bricks may be laid parallel with the line of the wall as with ordinary brickwork, or laid in and out as well, as previously described (4.45).

While the amount of irregularity rarely exceeded one-eighth to one-half inch, the effect could be greatly exaggerated by the strong shadows produced on the face of the wall. In addition to giving the surface a rusticated appearance, the deliberate irregularities produced by this technique tend to conceal dimensional discrepancies in the masonry units, themselves.

DIAPER PATTERNS

The art of producing decorative patterns on masonry wall surfaces by using bricks of distinctive colors is a practice almost as old as brickwork, itself. It undoubtably derives, at least in part, from the unavoidable irregularities in the earliest kiln-fired bricks. During the ensuing centuries, craftsmen learned to exploit the ornamental potential of these irregularities until, when technological advances in manufacturing processes eliminated much of this heretofore inherent diversity among bricks, designers began to deliberately recreate them. The extraordinary variety of such patterns can hardly be presented in toto, but general pattern types representative of the entire array and guidelines for their creation can.

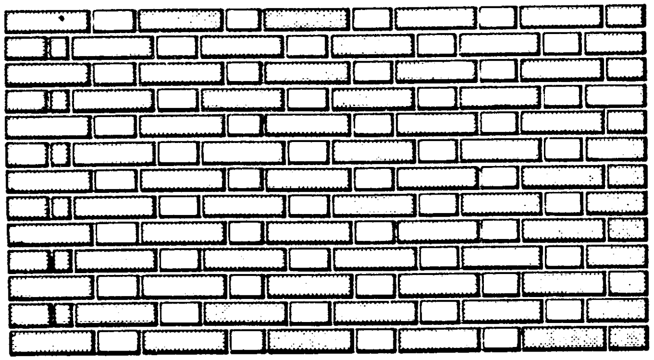
Diapers are decorative patterns obtained through the use of light and dark brick or brick of various shades, and by selective coloring of headers and stretchers in each successive course. Such patterns can be generated from within the standard bonding geometries or imposed on them. In either case, the technique consists of creating alternating light and dark patterns. Pattern bonds are generally monochromatic: diapers are characteristically polychromatic (i.e. rendered in two or more distinctive colors, shades or textures) and can be broadly categorized as being either linear, rectilinear, diagonal or diamond unit patterns.



4.37

Linear patterns are little more than courses of ordinary bonding patterns, or special decorative coursings such as were described in Section 3, executed in polychrome. Such use of color usually creates an enhanced sense of horizontal linearity that could appropriately be used to accentuate, or outline, various features of wall surfaces such as floor levels, window sills, arch outlines, etc., as illustrated in Figure 4.37.

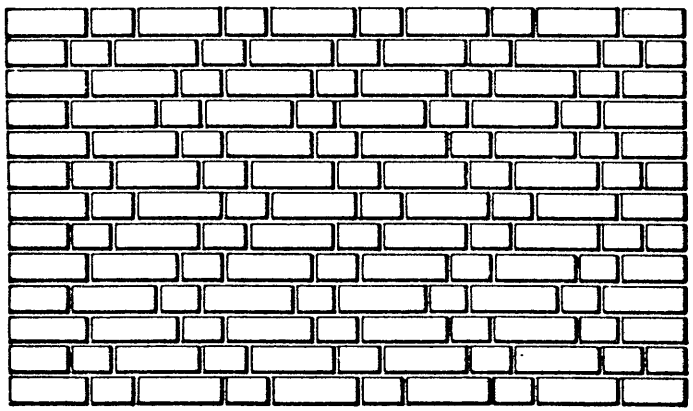
Rectilinear and diagonal diaper patterns are obtained



4.38

when the bonding pattern of an entire wall surface, or panel contained within it, is rendered in polychrome brickwork. Figure 4.38 illustrates a typical rectilinear surface pattern obtained by selective coloring, in this case of the headers in a Flemish bond pattern.

Diagonal patterns are created in much the same manner as the rectilinear. Reversing the shift (i.e. the direction) of the colored units at regular intervals in such a pattern creates V-shaped patterns such as those shown in Figure 4.39. Called zigzag bond, this pattern is identical to Flemish spiral bond with a periodic reversal of pattern (4.46).



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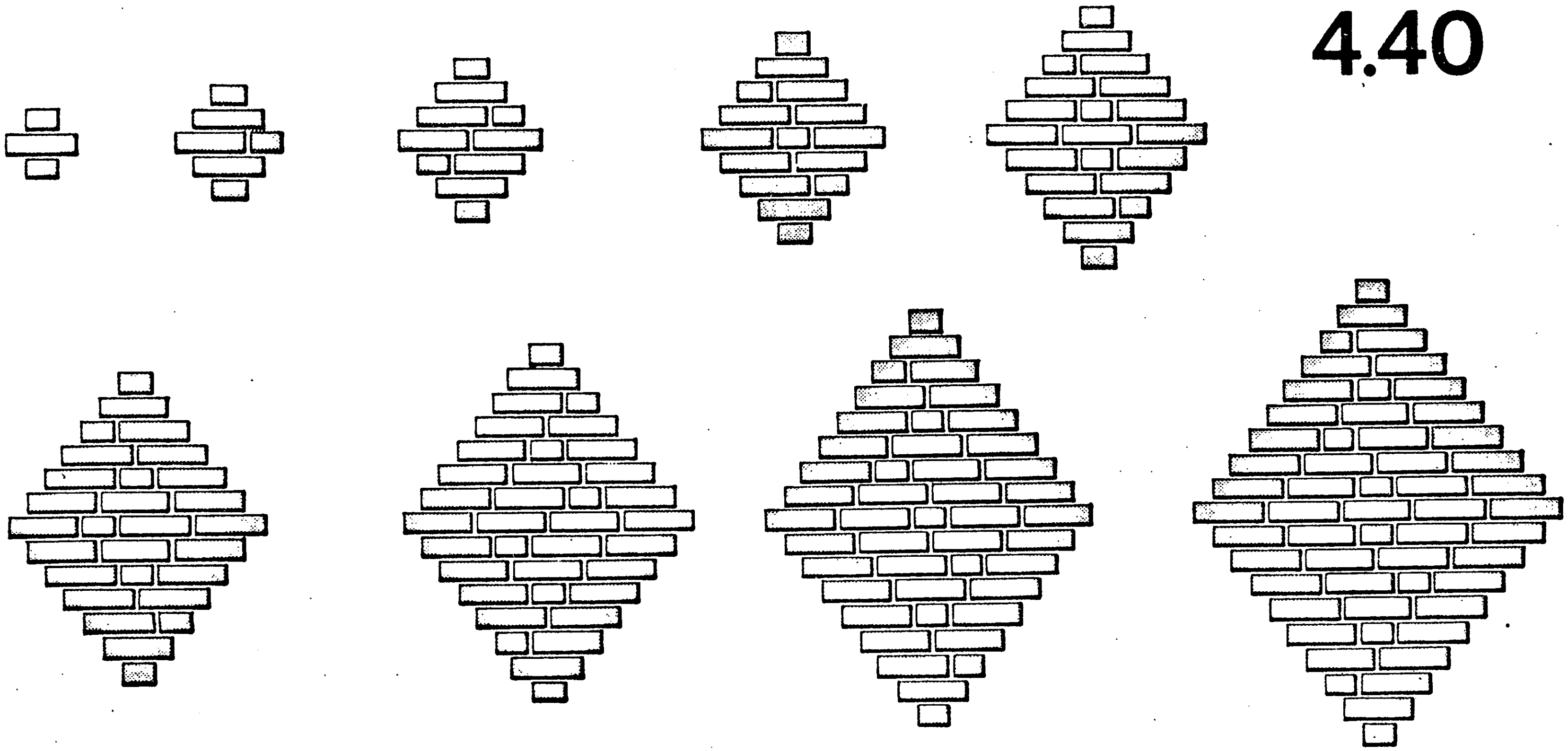
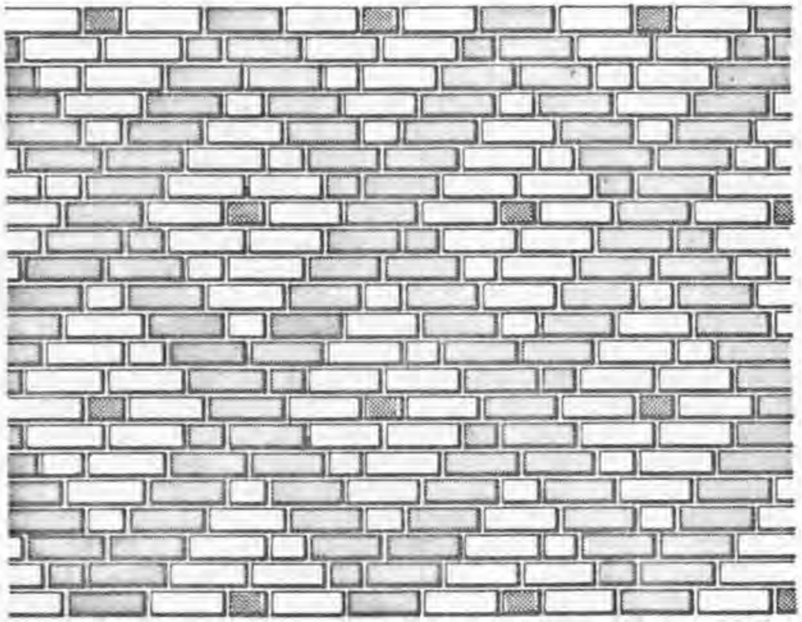


4.40

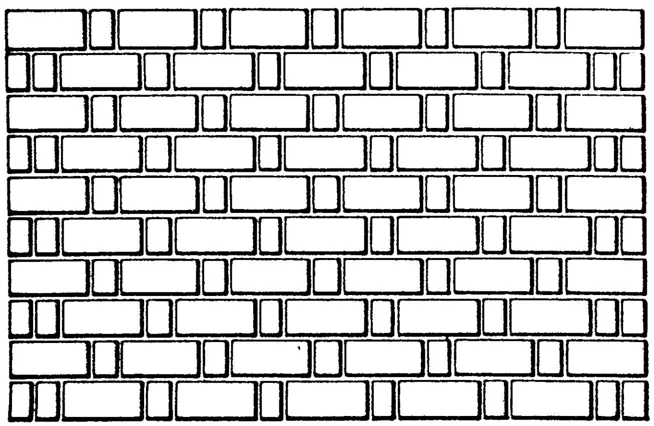
Diamond unit patterns, based on 'eyes' formed by various combinations of headers and stretchers, are the most complex of the diaper patterns and are used principally on large, uninterrupted expanses of wall. As shown in Figure 4.40, the basic unit of such patterns consists of a single stretcher with headers centered above and below it. Each succeeding unit is formed by extending every course of the preceding unit the width of a header, always centering the

4.41



courses on the middle course, regarded as the horizontal axis of the unit, and terminating the whole above and below by a header. As a result, no matter how far they may be carried out, such diagonal unit patterns always bear a proportional relationship to each other.

As these units increase in size, there begin to appear units within units. It is by the treatment of such multiple units, each of which in itself is a bond pattern, that various ornamental designs of great complexity can be worked out on the surface of the wall through the proper handling of the shades aand textures of the brick and mortar joints. Such uunits may be made to intertwine, join or butt each other vertically and horizontally, or they may be separated by introducing between them one or more course borders. When so separated, as shown in Figure 4.41. much of the visual impact of the pattern depends on the skill with which these borders are worked out (4.47).



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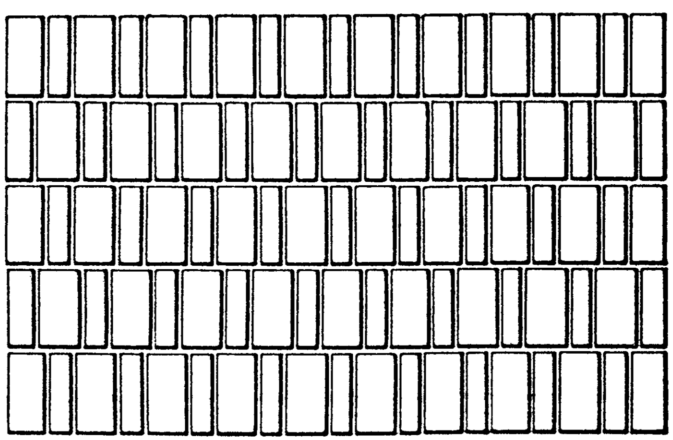

4.43

VARIATIONS DUE TO ORIENTATION

Nominally defined in terms of their characteristic arrangement of headers and stretchers, variants of each of the standard bonding geometries can be produced using brick in any combination of the several positional variations, subject only to dimensional coordination, laid in a manner analogous to any of the standard bonds.

Thus, while Flemish bond is technically composed of alternate headers and stretchers in each course, the headers of each course centering on the stretchers of those above and below, a variation of conventional Flemish bond could be produced using rowlocks and shiners (rowlock stretchers) having, otherwise, the same relationships as the headers and stretchers of conventional Flemish bond, as shown in Figure 4.42. Known as the Ideal All-Rowlock Wall, this bonding geometry forms and eight inch (or more) cavity wall with 'through' rowlocks. Such an analogous bonding pattern effects a considerable savings in both materials and labor, combining the advantages of solid-brick and hollow-unit, or cavity wall, construction at a lower cost than either and with excellent thermal insulation and moisture protection and no sacrifice in strength or durability (4.48).

Similarly, a second variation of Flemish bond can be produced using brick laid up in a combination of soldiers and sailors, as shown in Figure 4.43. Unlike either conventional Flemish bond or the Ideal Wall variant of it, this bonding geometry is suitable only for veneer-type construction. A variation of English bond using shiners rather than stretchers and a sort of Flemish header course of alternating shiners and rowlocks rather than the traditional header course is also possible. Again, the use of 'through' rowlocks gives this bonding geometry many of the same characteristics as the Ideal All-Rowlock Wall laid in Flemish bond. Used in veneer construction, the Ideal Wall, in both instances involving the use of rowlocks will automatically introduce an integral, patterned skintling in the wall fabric which can be avoided, if desired, through the use of half-bats rather than full rowlocks. Similarly, veneer construction using soldiers will also introduce skintling which can be avoided through the use of queen closers rather than full soldiers.

It is in the nature of brick that, given the six fundamental positions in which it can be laid and coursed three of which are horizontal and three of which are vertical in orientation, that there will exist three possible variations of every bonding geometry which is based on the combination of any two of these. Such use of nontraditional variants of standard bonding patterns would normally be restricted to nonload-bearing situations (e.g. simple infill, veneer and hung panel applications) wherein the masonry, with or without structural backing, would be expected to support little more than its own weight. In essence, these applications would begin to treat brick masonry as a mosaic tile, emphasizing its role as a generator of two-dimensional surface patterns, a decorative rather than a structural element.

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MORTAR JOINTS IN BRICKWORK

Jointing, the process of finishing the exterior surfaces of the mortar joints, merits special attention since it has a decisive influence on the appearance of brickwork.

Mortar in brickwork serves four primary functions: it bonds the masonry units together and seals the spaces between; it bonds to and causes reinforcing steel to act as an integral part of the wall; it makes brickwork more waterproof by presenting mortar of the greatest density and compactness to the agents of weathering (wind and water); and it produces a decorative effect on the wall surface (5.01).

Of these various functions, this study will be primarily concerned with the last: the decorative effect of mortar joints on a masonry surface. Ancillary information regarding methods of producing these respective joints and their relative weather-tightness will be included. This information is pertinent in that it indicates how well each of the various joints can be expect to perform over the life of the structure in which they are used. Initial appearance is not the only factor to be taken into account when selecting a mortar joint for masonry construction. One should also consider how such a joint will look and function as the structure ages.

Mortar joints affect the appearance of brickwork in several ways. One, the pattern of jointing on a wall surface draws attention to the individual brick, with its familiar dimensions, as the basic unit of masonry design. Two, the appearance of hatching provided by jointing is of great assistance in giving directional emphasis to the surface, Three, raked and other recessed joints, with their cast shadow effects, relieve the severity of the wall and introduce plasticity into the composition. And four, the use of colored joints, the first step toward the use of color in design, can give fresh emphasis and extend the tonal range of brickwork (5.02).

In terms of both its structural and decorative uses, a mortar joint should be considered in regard to its width, its cross-sectional geometry, its color and its texture.

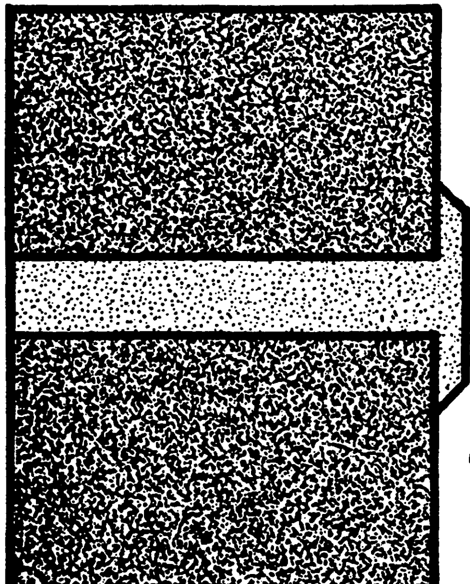
WIDTH OF MORTAR JOINTS

The pattern and detailing of mortar joints on the face of a brick wall greatly affect its appearance and resistance to weathering. Joints vary in thickness for both structural and aesthetic reasons. When a wall is laid with irregular masonry units, joints must be wide enough to accomodate variations in size and shape. Bricks of uniform dimensions can be laid with joints as thin as the properties of mortar permit. The minimum thickness required for masonry joints is about three-sixteenths of an inch in order for mortar to constitute a coherent material that will adhere to porous substances, but a thicker cushion of mortar is often desirable. A joint three-eighths of an inch thick, or more, is usual for brickwork, however mortar in thick joints may shrink appreciably in setting (5.03).

With brick of standard size, a mortar joint of approximately one-half inch plus the width of two headers equals the length of a stretcher. Generally, joints vary in width from one-quarter to three-quarters of an inch in thickness, the exact size specified depending on the dimensional regularity of the brick to be used, the size of these units, the structural requirements that will be imposed and the desired visual effect.

CLASSES OF MORTAR JOINTS

Finished mortar joints fall into either of two classes: troweled joints or tooled joints. In the troweled joint, the excess mortar is simply cut off (struck) with a trowel and finished, if necessary, with the same tool. In the tooled joint, one or more of a variety of special jointing tools other than the trowel is used to compress and shape the mortar in the joint (5.04). Within each of these classifications, mortar joints are in-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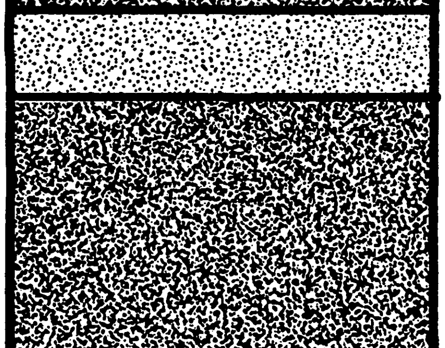
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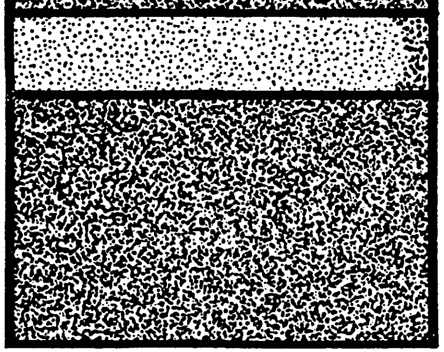

5.03

dividually identified in terms of their cross-sectional geometries, or profiles, as follows:

Bagged Joint

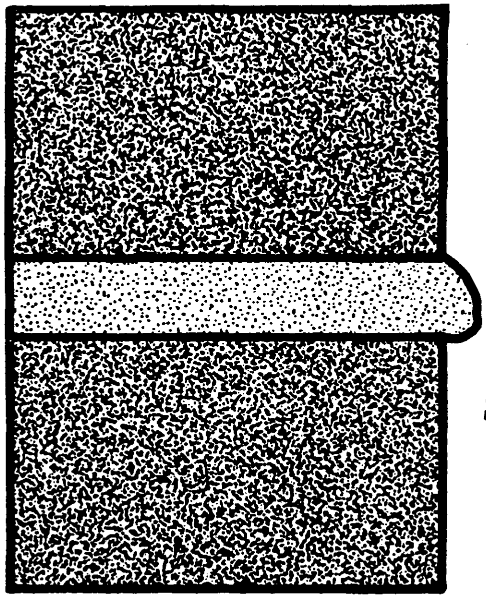
Similar to the rough-cut and flush-cut joints which follow but formed with a much thicker bed and less tidy with smeared corners and margins partially extending over the face of the brick, this joint avoids the characteristic appearance of brickwork, following instead the monolithic lines of a concrete structure with brick assuming the functions and the appearance of an aggregate as shown in Figure 5.01 (5.05).

Plain-Cut Joint

The plain-cut joint, or rough-cut joint as it is sometimes called, is a troweled joint formed by cutting off the excess mortar which oozes on to the wall surface after the laying of the brick. The mortar, left flush with the face of the wall as shown in Figure 5.02, is uncompacted and therefore not as durable as joints formed with greater care.

Flush-Cut Joint

The flush-cut joint, shown in Figure 5.03, is similar in appearance to the rough-cut joint but more carefully and compactly formed. These (the plain-cut and the flush-cut joints) are the easiest joints for the mason, since they are made holding



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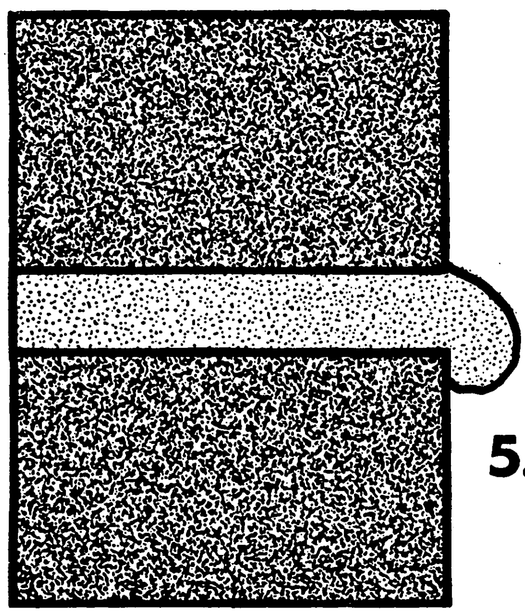


5.05

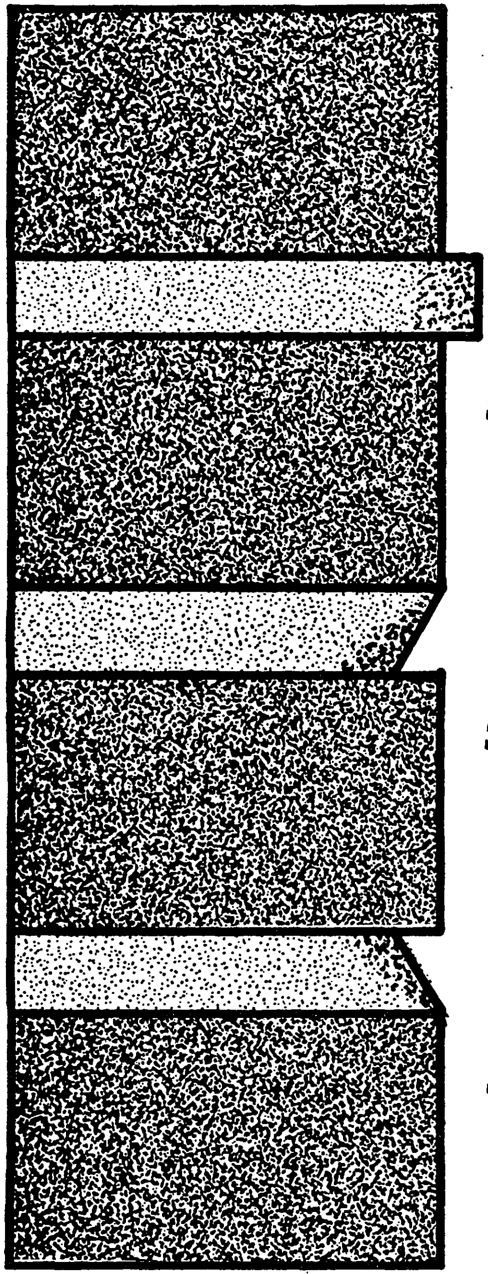
the edge of the trowel flat against the brick and cutting in any direction. This cutting action produces an uncompacted joint with a small hairline crack where the mortar is pulled away from the brick by the cutting action. Because of this, neither the plain-cut nor the flush-cut joint is always watertight (5.06).

Tapped Joint

The tapped joint, shown in Figure 5.04, is so called because it is formed by giving the brick a tap with the trowel after the excess mortar has been struck. This style of joint is ordinarily used with sand mixed into the mortar, giving a coarse texture to the mortar and creating a raised hatchwork of slightly protruding mortar joints on the wall surface (5.07). While deterioration due to weathering may be accelerated somewhat by the exposed position of the uncompacted mortar of this joint, the visual enhancement of the wall surface may be of greater importance.

Extruded Joint

An extruded joint, or squeezed joint as it is sometimes called, is one in which a rough effect is produced by allowing the mortar deliberately squeezed out of the joints in laying to project irregularly beyond the face of the wall as shown in Figure 5.05 (5.08). This joint is often used in combination with skintled brickwork in an attempt to create a rustic, or picturesque, appearance.



5.06

5.07

5.08

Raised Joint

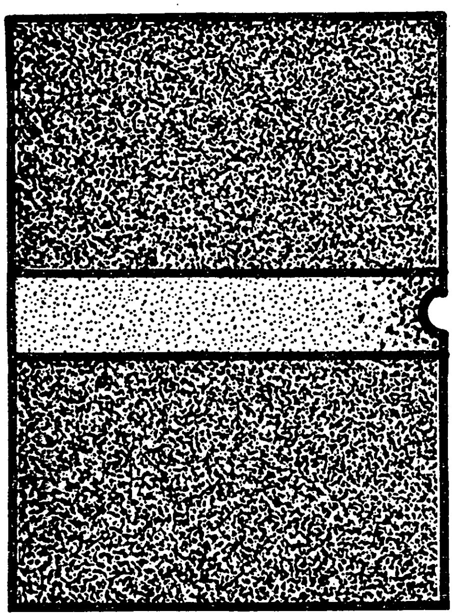
As with the extruded joint, a raised joint is one in which mortar deliberately squeezed out during the laying process is shaped to the configuration shown in Figure 5.06 using a trowel and a straight edge. Such joints, particularly if the color of the mortar used contrasts with that of the brick, in that they stand out in high relief tend to become the dominant pattern on the wall in which they are used (5.09).

Struck Joint

So called because it too is formed by simply striking excess mortar from the surface of the wall with an angled trowel, this is also a common joint for ordinary brickwork. Quickly made and suitable for both inside and outside exposed walls, the angle of this joint, shown in Figure 5.07, is such that it leaves no shadow and brings the top edges of the brick into relief. While some compacting of the mortar does occur in striking this joint, the small ledge created does not shed water readily, resulting in a less watertight joint than in other types (5.10).

Weathered Joint

In terms of its profile, the weathered joint as shown in Figure 5.08 is the reverse of the struck joint and, in that it causes the mortar to be compacted in the striking process and sheds water readily, it is the best of the troweled joints.



5.09

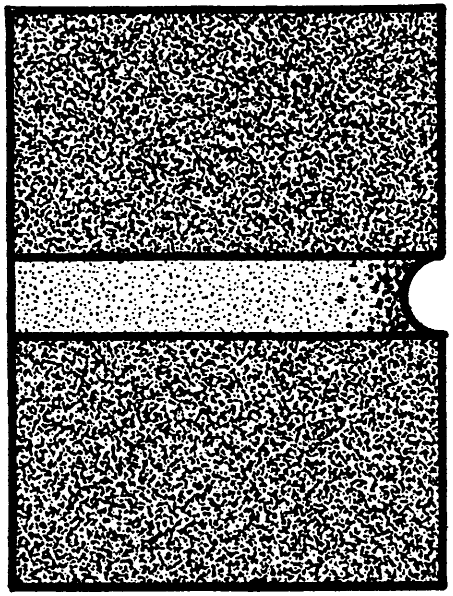
It is, however, more difficult to make and therefore more costly. Keeping a uniform slope on the face of the joint is difficult, and the irregular surfaces usually formed, combined with the shadow of the brick above, tends to show up imperfections in the wall (5.11).

[Originally, the two preceeding joints were both called struck joints. The name weather-struck joint evolved from the superior ability of what is now known as the weathered joint to shed water. What is now called a struck joint was initially used as a visual enhancement even though it was considered bad practice in that water, rather than being easily shed, tended to lodge on the ledge thus formed. Subject to freezing in the winter, such moisture can rapidly destroy the upper edges of the bricks and the joint (5.12).]

Tooled joints of various profiles are formed first by making a flush joint with a trowel and afterwards running a steel jointing tool along the joint close to the top edge of the brick. These joints are normally kept quite small, making them very resistant to rain penetration. They are therefore recommended for use in areas subject to heavy rains and high winds (5.13).

Flat Joint Jointed

This joint, shown in Figure 5.09, is initially



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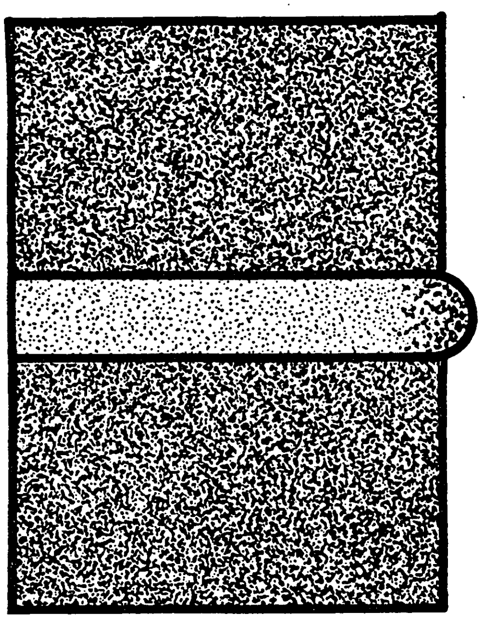


5.11

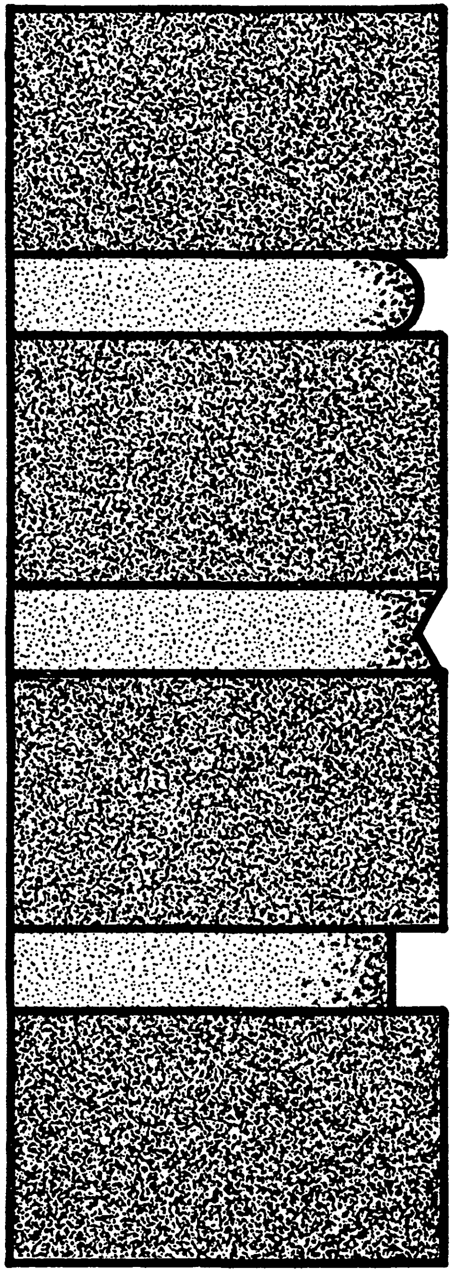
formed in the same manner as a flat, or flush, joint but has, in addition, a small groove running along the center of each joint. This tooled groove, shown as a concave semicircle (although the shape may vary), has the effect of making the mortar more dense and, if brick and mortar are the same color, of reducing the apparent size of the mortar joint (5.14).

Concave Joint

One of a variety of keyed joints, this joint shown in Figure 5.10, is formed by drawing a curved jointing tool the same width as the joint along a preliminary rough-cut (flush) joint. It has the effect of making the mortar more dense and more resistant to moisture penetration. The profile thus formed sheds water quite readily and improves the appearance of the wall by making the joints quite distinct (5.15).

Convex Joint

Also known as a beaded joint, this raised joint, shown in Figure 5.11, is formed by drawing a curved jointing tool along a squeezed joint, giving the protruding mortar a semi-circular profile which extends beyond the face of the wall. As is the case with the concave joint, this tooling operation has the effect of making the mortar denser, enhancing its resistance to moisture penetration. However, its raised position also exposes it to excessive deterioration by weathering.



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5.14

Recessed Beaded Joint

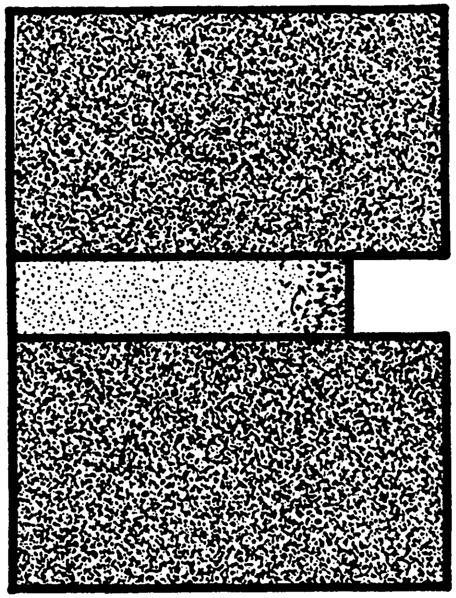
Similar to the convex joint in profile, the recessed beaded joint is however set back behind the face of the wall to some degree as shown in Figure 5.12 (5.16). While this does shield the joint from direct exposure to wind and water, it is still subject to the deteriorating effects of water standing on the ledge created. As is the case with the struck joint, such moisture if subject to winter freezing can rapidly destroy both bricks and joints. Thus, while ideally suited to areas subject to high winds and heavy rains, this joint should probably not be used in areas which experience severe winter freezing.

V-Tooled Joint

As shown in Figure 5.13, this joint with its characteristic V-shaped profile combines those of the struck and weathered joints, avoiding the disadvantages of the former while retaining the advantages of the latter. As with other tooled joints, tooling results in compaction and a denser mortar at the exposed surface. This characteristic, in addition to a profile with an ability to shed water easily and its protective recessed position in the face of the wall make this joint quite suitable for severe weather application.

Raked Joint

The raked joint, shown in Figure 5.14, also begins as a plain-cut joint and is then raked out with a



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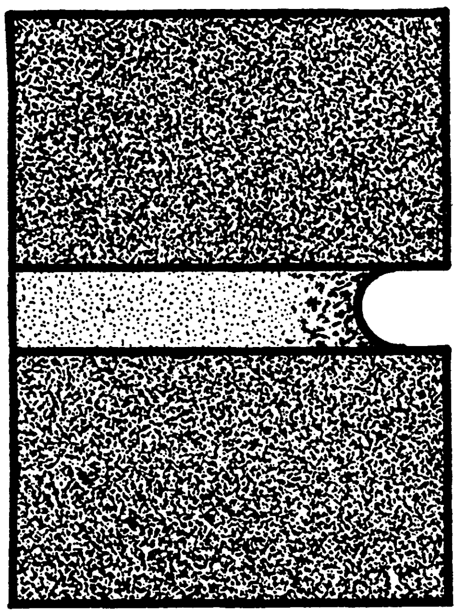


5.16

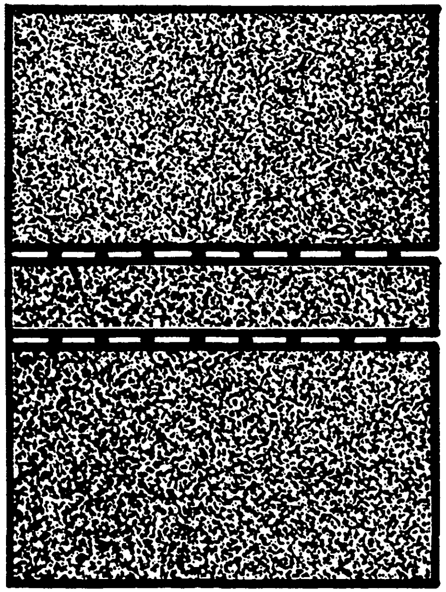
jointer to the desired depth (5.17). While some compacting of the mortar may occur during jointing, the raked joint is difficult to make weather-tight and is not recommended where heavy rain, high winds or freezing is likely to occur. It produces marked shadows and tends to darken the overall appearance of the wall (5.18).

Stripped Joint

The stripped joint, shown in Figure 5.15, is similar in profile to the raked joint, but of greater depth. In making the stripped joint, a strip of wood the thickness of the joint is laid at the front of the wall to the depth of the joint desired and the mortar is spread flush with the top of the strip as the next course is laid. After the mortar has set, the strips are removed. The resulting joint is tidier and cleaner than a raked joint and is of even depth and thickness (5.19). Stripped joints, like raked joints, tend to produce marked shadows and, thus, darken and dramatize the appearance of the wall.

Rodded Joint

Similar in profile to the concave joint but of greater depth, the rodded joint is formed by essentially the same method as the stripped joint with the exception that, instead of a wood strip, a circular metal bar is used to produce the characteristic outline of this joint, as shown in Figure 5.16. Tidier and cleaner than a tooled concave joint and of even depth and thickness,



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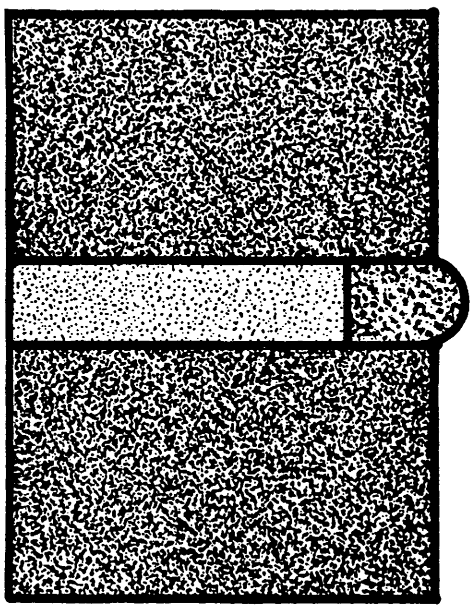


5.18

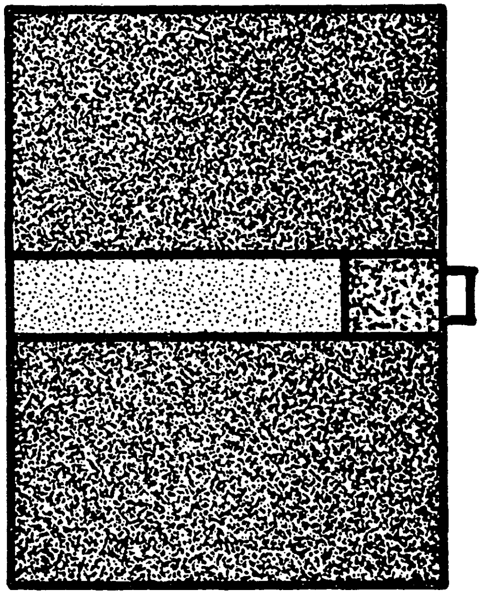
rodded joints, like stripped joints, tend to produce marked shadows and, thus, darken and dramatize the appearance of the wall (5.20).

Blind Joint

Any joint in which, through the use of a very thin mortar joint or a standard joint of mortar colored to imitate exactly the color of the abutting bricks, the presence of a mortar joint is concealed making two or more smaller masonry units appear to be one or more units of a larger size (e.g. two adjoining headers or three rowlocks made to resemble a single stretcher), as illustrated in Figure 5.17. Success in concealing the joint requires that, in addition to the color of the bricks, the surface texture must also be duplicated exactly. To do this, a flush-cut joint textured to match the brick is usually used.

(Re)Pointed Joint

Filling partially exposed joints with mortar after the wall is laid is called pointing, or repointing. Sometimes, in laying new walls, exterior joints are purposely left only partially filled. In very old walls the exposed mortar occassionally weathers away to some extent or otherwise deteriorates, necessitating removal and replacement of the defective material with sound mortar. Pointing, as shown in Figure 5.18, using one of the standard joint types previously described, is the method used in both of these cases (5.21).



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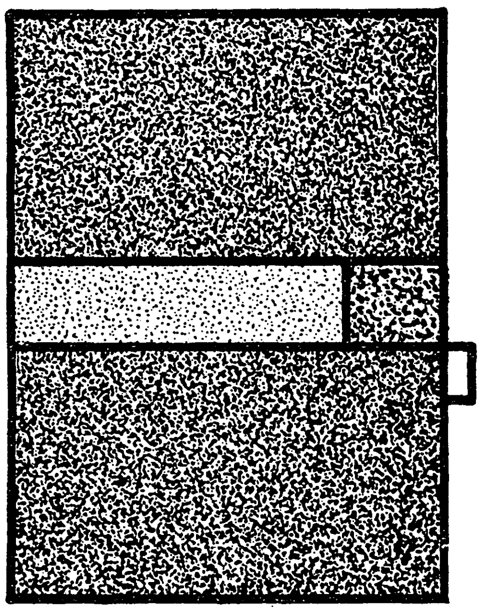

5.20

Tuck Pointing

Tuck pointing is the process of coloring a flush-jointed brick masonry wall so that bricks and joints are the same color followed by the application of lime putty on to the joints in straight lines and the shaping of this material into a raised, false joint as shown in Figure 5.19. The coloring is accomplished by either rubbing down the entire surface of the wall with a soft brick, or, by means of a coloring compound (5.22).

Half Tuck Pointing

A half tuck (or bastard tuck as it is sometimes called) consists of coloring a flush-jointed brick masonry wall as with tuck pointing and making a similar raised false joint with little attempt being made to follow the real joints, the false joints often running across the face of the brick, itself, as shown in Figure 5.20 (5.23). From an aesthetic point of view, the effects of both tuck and bastard tuck pointing are not very good and should be used only as a last resort in cases of extreme deterioration of old brickwork.

COMBINATION MORTAR JOINTS

In order to achieve a desired effect, variations in the type of mortar joint used can occur within the same wall. For example, to accentuate the horizontality of brick coursing in the wall fabric, a deeply-raked horizontal joint might be used in combination with a flush-cut or blind joint. Depending on the effect sought, the mortar may or may not be colored to match that of the surrounding brick. Such a combination would result in an enhanced sense of horizontal banding with little or no emphasis on the vertical.

Other special effects can be produced through variations of bonding geometry, size, color and texture of brick and mortar in addition to combinations of two or more mortar joint types (5.24).

COLOR AND TEXTURE OF MORTAR JOINTS

Colored mortars may be successfully used to either enhance or diminish the effect of patterns in brick masonry construction. Two methods are commonly used: the entire mortar joint may be colored, or, just the exposed surface layer of mortar may be colored through the use of (re)pointing techniques. In the latter case, the entire wall is laid with a one inch deep or more raked joint. The colored mortar is filled in later and the joint finished in the normal manner. Regardless of which method is used, the final effects are identical in appearance.

Textural effects may also be obtained by either of two methods, the most common being the addition of a coarse material, such as sand, to the mortar prior to the laying of the wall. More unusual effects can be achieved by manually reworking the exposed surface of the mortar joint after completion. Examples of such texturing of mortar joints, beyond forming the standard tooled or troweled types, are extremely rare. There are no standard decorative motifs and no standard texturing tools for this purpose. In these cases, the textural effect is usually custom-designed and the required tool(s) produced individually for each job.

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PART III
DECORATIVE FORMS IN BRICKWORK

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PART IV
CONCLUSIONS

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PART V
REFERENCES

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