MOBA

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URBAN TERRAIN ANALYSIS TRAINING AIDS

Richard Ellefsen
Adolf Carlson
Brenda Thein
Nancy Milligan
James Lein
Alan Kanemoto

September 1981
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Begin Just as analysis of terrain is important to general combat, so analysis of urban terrain is important to combat in built-up areas. This study was conducted to develop a series of graphic training aids which would provide troops with a means of learning the nature of the urban environment. The aids include the identification of building types and characteristics. End

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Richard Ellefsen
San Jose State University

Adolf Carlson
(USA) Berlin Brigade

Brenda Thein

Nancy Milligan
James Lein
Alan Kanemoto
Geography Department
San Jose State University

September 1981
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APPROVED: JOHN D. WEISZ
Director
U.S. Army Human Engineering Laboratory

U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland 21005

PREFACE

This project was undertaken to develop principles and training aids about buildings and their settings as primary components of urban terrain. It is intended to serve the needs of those engaged in conducting training in the area of Military Operations on Urban Terrain (MOUT). The study was initiated in response to an expressed need for written and graphic material to serve as the basis for the development of training aids. (Several units within the U.S. Army conduct MOUT training. Among these are the 7th and 9th Infantry Divisions, the U.S. Army Infantry School, and the Berlin Brigade.)

From the inception of the study, emphasis was placed on graphic presentation of buildings, their floor plans, and the situation of the buildings along streets. The authors elected to represent familiar buildings in the form of drawings and photographs and then to explain their potential military applications. We felt that this would be the most useful form for the soldier in the field who in an urban combat situation needs to know quickly the salient features of the urban terrain on which his own survivability and the success of the mission depend.

The final products of this study were the result of the efforts of a number of people in addition to the authors. First, the authors would like to acknowledge the interest, encouragement, and support of the U.S. Army Infantry School, and in particular, COL Scott, Infantry Doctrine, in the conduct of this project.

The authors also wish to extend their appreciation to the Project Manager, Training Devices (PM TRADE) for both technical and financial support in pursuit of this study. A special appreciation is given to Dr. James Cronholm for his invaluable suggestion on the use of pre- and post-training examinations as tools to improve the training aids.

Thanks need to be given to the participants in the field trials of the draft training aids. A total of 51 soldiers--officers and enlisted--volunteered to serve as test students. We also want to thank their parent organizations: the U.S. Army Infantry School, Fort Benning, GA; several units from Fort Dix, NJ; the 9th Infantry Division, Fort Lewis, WA; the Berlin Brigade; and the 2d Battalion, 30th Infantry, 3rd Infantry Division, Schweinfurt, FRG. The authors wish to recognize the contribution made by these participants. Not only were they responsive students and interested in the project, but they also contributed numerous ideas and suggestions for improvement of the draft training aids. Of perhaps greatest importance to the study, though, the participants proved that the subject matter was teachable. Success with these groups suggests that others given training using the materials provided by this study will also learn vital skills.

CONTENTS

URBAN TERRAIN ANALYSIS TRAINING AIDS

INTRODUCTION

"Exact knowledge of the terrain regulates the disposition of the troops and order of battle."

Frederick the Great
Instructions for his Generals

Research scientists and military planners,[1] from both government agencies and research firms, have been working for the past several years to advance the military community's knowledge of urban terrain. Recognition that combat in cities is a distinct possibility has led to intensive inquiry into the required components for the successful conduct and support of Military Operations on Urban Terrain (MOUT). Studies have been made of such diverse subjects as the characteristics of buildings, the development of weapons, and the defining of logistical problems. In addition, problems related to potential urban combat have been aired at professional meetings and seminars.[2]

Recognition of the need to know the opportunities and constraints posed by the urban environment has led further to an expression of interest in giving training on the significant characteristics of the urban terrain to appropriate military units, especially infantry. Regardless of the broader need for supporting forces in urban combat--aviation, communication, logistics, medicine, etc.--planners anticipate that the complexities and the high densities of parts of cities will mandate that the urban battle will be fought, inevitably, by the foot soldier; i.e., light infantry or dismounted mechanized infantry. Moreover, planners expect that the infantryman will be operating in small units which can become isolated, at least temporarily, from their parent units.

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[1] Several government agencies have conducted and sponsored studies. Examples are the Advanced Research Projects Agency; The U.S. Army Human Engineering Laboratory; Naval Surface Weapons Center; selected U.S. Army divisions and the U.S. Marine Corps Development and Education Center.

[2] Many papers have been presented at professional meetings such as those sponsored by the Military Forces in Urban Areas Working Group of the Military Operations Research Society; the joint DARCOM-TRADOC (U.S. Army) MOUT conferences; and a special MOBA conference sponsored by the American Defense Preparedness Association.

A need is thus identified for the leaders of these small units--squads, platoons, and companies--to be able to analyze and evaluate the intricate urban terrain where they find themselves in order to make maximal use of it. They have a primary, literally vital, need to know the degree of protection the urban environment can provide them. They have a need to know the degree of cover and concealment that a particular kind of building, located within a certain type of urban environment, can afford them. The also need to know the character of the interior of the buildings in order to guide them in making plans (perhaps during a fire fight) for maneuvering and entering and clearing buildings.

Required as support for the establishment of MOUT training programs are the principles that explain the nature of the urban environment. The identification and use of these principles is essential in the design and construction of training aids, explanatory text, lectures, and audio-visual material.

PURPOSE

The primary purpose of conducting the exploratory effort described in this report has been to develop and test a set of principles concerning the nature of the urban terrain as it relates to potential infantry combat needs. Accordingly, emphasis has been placed on the most rudimentary elements of the physical characteristics (morphology) of the city, especially its buildings and streets. Principles governing these are integrated into both text and training aids. But principles alone are not sufficient. Rather, they are used in this report to develop a set of simple, straightforward keys to aid the soldier to identify types of buildings and the configurations of their interiors. These are presented in the report as a series of training aids that could be employed in MOUT training programs. A common sense approach is used in forming the building identification keys. They stem from an understanding of the basics of building construction, and are intentionally kept relatively simple to encourage the teaching of the sort of practical knowledge which the soldier can remember and use during the stress of a combat situation.

This report seeks to place in the hands of small-unit infantry leaders guidance to an understanding of urban terrain with which they can answer real-world tactical questions. This understanding can be useful in training to prepare for the type of operation which would be most effectively used in a given urban combat situation. The trained individual small-unit leader could, should he find himself thrust in an urban combat situation, be able to analyze the terrain around him, form a plan for best use of that terrain, and issue orders accordingly.

Three fundamental tenets provide the supporting rationale for the study. They are as follows:

a. All tactics depend heavily on an understanding of terrain. Urban tactics, being an exception, rely on an understanding of urban terrain.

Because a city's buildings are the principal components of that terrain, emphasis has been placed on providing the salient details of those structures and their settings. Training programs other than those of MOUT teach conventional terrain analysis--the ability to recognize various terrain features (hills, ridges, etc.), evaluate their tactical aspects, and appreciate their advantages and disadvantages for attack or defense. Counterparts of conventional terrain features are represented in cities by buildings, streets, open spaces, utility lines, etc. Relatively little training on the characteristics of this variation of terrain analysis has been conducted. Missing from the training packages in use have been the building fundamentals presented in this report.

b. Although urban areas appear extremely complex to the uninitiated, systematic urban terrain analysis reveals that a definite, relatively simple order can be recognized. There are only a few major types of building construction and these are replicated in cities throughout the world. Identification of these building types is made relatively simple by knowing that each building type is constructed in accordance with a certain set of basic principles. Moreover, these same principles apply universally in all sizes of urban areas, cities, towns, and villages. Although tall buildings are generally associated only with cites where high land values preclude practical construction of low-rise buildings, the basics of building construction for a particular type of building are the same regardless of height and where they are located.

c. Basic construction principles can be learned by small unit leaders. Results of the field trials of the draft training aids, conducted as part of this study, indicated that the representative small-unit leader participants acquired an ability to identify building types, estimate building interior configurations, and evaluate urban terrain tactical situations.

STUDY METHOD

All segments of this study--the forming of principles, the design of the training aids, and the suggested military applications of urban terrain --resulted from a systematic inquiry into a variety of sources ranging from the library to direct field observation. Traditional literature sources were consulted, especially works in architecture and structural engineering, to determine the basic principles of the varying forms of building construction. Particular attention was given to the stated problems of design (within the constraints of a building's intended use, of cost, safety, and esthetics). All buildings, wherever found, have a set of characteristics which represent what was considered at the time of construction to be the best solution to these problems. The concept of finding solutions to problems is familiar to the military audience of this report. By extension, MOUT usage of buildings (and the urban environment in general) can appropriately be stated in terms of finding solutions to problems.

The literature was also consulted in the search for a set of principles to explain the arrangement of a building's interior space. The size and placement of rooms and hallways within a building is best thought of as a series of solutions to a number of design problems. For example, the arrangement of hotel guest rooms and the hallways with which they articulate form an optimum solution to the problem of providing a large number of constant size, relatively small rooms, each with its own window.

Principles on types of construction and on the configuration of interior space are universally applicable in cities throughout the world. The relatively few types of buildings are repeated everywhere (as are floor plans for like building functions) even though there are often cosmetic differences in building appearance depending on local customs and esthetics. Accordingly, training can be standardized: lessons learned can be applied anywhere. Universality has been demonstrated in previous studies.[3,4]

The literature survey, however, was not sufficient by itself to attain the goals of this study. The making of critical observations of buildings in the field--especially relative to framing questions of military applications of urban terrain--contributed heavily to the results of the study. Simply, the point of view--from that of military need--was useful, especially in conjunction with an understanding of the demand placed upon the architect/structural engineer to provide solutions. Many of the small details vital to building type identification were derived directly from field observation. These details receive little attention in the literature mostly because general authors on the subject have not addressed themselves to military questions.

Gaining an understanding of the ways in which characteristics of the urban environment related to military problems was achieved through consultation in the field among the authors. Numerous applications of military tactics to the urban situation were developed. Data concerning the effectiveness of various weapons and munitions on the walls of buildings and employment within buildings were discussed. Simple scenarios, such as firing upon an imaginary approaching vehicle in the street, were placed into real settings using real buildings of various types.

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[3]Ellefsen, R., & Wicks, L. E. Characteristics of urban terrain. (Naval Surface Weapons Center Report NSWC/TR 79-224). San Jose, CA: San Jose State, June 1979.

[4]Ellefsen, R., Coffland, B., & Orr, G. Urban building characteristics: Setting and structure of building types in selected world cities, (Naval Surface Weapons Center Report NSWC/DLTR-3714) San Jose, CA: San Jose State University, 15 January 1977.

Field observations were made in two contexts. Some were made in cities--both foreign and domestic--prior to the initial development of the principles, as manifested in the set of training aids. Others were made in the five particular cities where field trials of the draft training aids were conducted. In these cities, the authors who were assisted by contributions from field trial U.S. Army participants, made several valuable new observations. Many of the observations were incorporated into the training aids as they now stand. In addition, numerous photographs made of building examples and key features served the double duty of forming a data base for drawing graphics and as real-world illustrations for lectures to the participating groups. The variety of locales of the cities --the East, Southeast, and Pacific Northwest in the U.S. and two areas in Germany--served to offset parochialism in the study. The use of diverse areas for field trials also helped to confirm the often-made contention that building technology around the world is more similar than it is different.

STUDY PROCEDURE

The systematic procedure employed in the study consisted of several distinctive steps. First, a large number of building characteristics--derived in previous studies--were listed. These were incorporated into a series of graphics designed to serve as drafts for training aids. Contained within this set were principles of the construction of the major types of buildings--mass and framed construction--along with some pertinent details selected to assist building interior space--the floor plans--were then identified and incorporated into the draft training aids. A selected group of military applications of buildings and other aspects of urban terrain were then added.

Arrangements were made for the training aids to undergo field trails in test U.S. cities to (1) determine the validity and utility of the graphics, (2) the teaching techniques that accompanied them, and (3) to serve as a vehicle for suggestions as to means of improving and augmenting the training aids. The experience in each of the test cities yielded an incremental gain in sharpening the articulation of principles and in improving the training aids. Especially valuable in the field were (1) the opportunity to make continued observations in various urban environments, (2) postulations about potential military usage of the data, and (3) critiques from the field participants, many of whom had been exposed to other MOUT training activities.

The city selected for the first field trial was Atlanta, Georgia. This city was visited in the fall of 1979 for the purpose of selecting groups of buildings and situations about which examination questions could be developed. These questions, developed in the field, were designed to incorporate all of the building types appearing in the draft training aids.

The Atlanta field trial itself, conducted in January of 1980, employed a volunteer group of company grade officers from the U.S. Army Infantry School at Fort Benning. Two of the officers were instructors in the MOUT program, the remaining seven were attending the Advanced Infantry Officer's Course.

The program of the field trials consisted of subjecting the participants first to a written examination covering a wide variety of characteristics for a selected set of buildings in the city of Atlanta. During this first examination, the participants and the authors walked from site to site in and around the downtown area. The examination was administered prior to the offering of any instruction. The participants were not given copies of the draft training aids until the next day. The intent was to establish a data base, in a pre-training situation, against which progress could be measured following formal instruction and the introduction of the draft training aids.[5]

The second day of the trials was devoted to instruction. A 4-hour block in the morning was used to proceed systematically through the draft training aids. An illustrated lecture on the principles of building construction was conducted. The problem of weapons deployment and troop maneuver in and around buildings was addressed as well as weapon effectiveness on structures. In the afternoon, the participants returned to the streets to see real-world evidence of the principles presented in the morning lecture. The route of the examination given on the previous day was retraced to enable the participants to understand why mistakes in identification had been made. Numerous other opportunities arose in the field for discussion of military applications. The participants by this time were able to relate their previous knowledge of tactics and weapons to their new understanding of the nature of the city as a potential site for military operations.

With their new knowledge and understanding of the city, the participants were then given (on the morning of the third day) a post-training written examination. A different, but similar, set of buildings (selected earlier) was used. This set was also located in and around downtown Atlanta. Degree of difficulty of the pre-training and post training examination was kept reasonably constant.

Following the morning-long, post-training examination, the participants gathered with the authors to evaluated examination results and to offer a critical review of the whole instructional package. Numerous ideas for improvement emerged from these sessions.

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[5] The authors learned from this first experience that the pre-training examination had the further advantages of demonstrating to the participants how little they knew about urban terrain and in piguing their interest in the subject.

Precisely the same procedure was followed in the second field trials city, Philadelphia, in March 1980. Again, previously prepared examination questions (for two different sets of buildings located in and around downtown Philadelphia) were used. In addition, the draft training aids had been improved and augmented following the experience in Atlanta. The participants for Philadelphia were volunteers from several U.S. Army units at Fort Dix, New Jersey. Composition of the group was more heterogeneous than that from Fort Benning. Five of the participants were company grade officers (generally with less time in service than those from Fort Benning) and six were noncommissioned officers (E-6's and E-7's). Some of the enlisted men had more than 14 years of service.

The third U.S. Army field trials city was Seattle, Washington. The participants were from the 9th Infantry Division, Fort Lewis. Essentially, the same procedure was followed, that is (1) administering of the pre-training examination, (2) the classroom lecture block, (3) the reinforcement in the field, (4) the taking of the post-training examination, and (5) discussion and critique. The test area was in and around downtown Seattle.

Two minor changes were involved. First, the ability to use a bank of test questions, developed earlier for Atlanta and Philadelphia, obviated the need for visiting the city prior to the exercise. The file of examination questions was simply drawn upon (sometimes with minor modifications) to match the particular buildings selected for both the pre-training and the post-training examinations. The other variation was in the composition of the participant group. Where the other groups had consisted entirely of individuals who had served in line organizations, the Fort Lewis group had 4 of its 13 members from the Military Intelligence Branch.

Originally, only U.S. cities were to be used in the field trials procedure. Later evaluations, however, suggested that an overseas trial was necessary to examine the developed principles in another environment. Two German cities were selected. One, West Berlin, was considered for its unique location. Moreover, the Berlin Brigade has a unique mission and is also one of the leaders in the U.S. Army in development of urban combat techniques and MOUT training. The second city, Schweinfurt, was considered a good example of a West German city and one where a nearby American garrison could be called upon to provide participants.

Exactly the same schedule was followed in both of the German field trial cities. Pre-training examinations were administered using sets of buildings selected in the field by the authors. A classroom lecture, followed by reinforcement in the field, was then conducted. Then, on the third day, the post-training examinations and critique sessions were conducted.[6]

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[6]In all five cities, a 20-hour block of time was used. Four hours were taken for the pre-training exam; 4 hours for the classroom lecture; 4 hours in the field; 4 hours for the post-training exam; and 4 hours for the critique.

The composition of the participant groups was similar to that of the other cities. Of the Berlin Brigade contingent, three were company grade officers and seven were senior NCO's. Participants for the Schweinfurt test were from the 2nd Battalion, 30th Infantry, 3rd Infantry Division. Four participants were company grade officers and four were NCO's.

Although some esthetic architectural details of German buildings were superficially different than cases in the U.S. cities, there was a high degree of conformality among cities of both countries in building structural characteristics. Confirming this was the suitability of examination questions developed for U.S. cases. They were applied with little or no modifications in the German cities. The draft training aids served equally well. Photographs of real places taken in other cities also worked well in the lecture block. Indeed, some of the example photographs, used in both the U.S. and Germany, represented situations found in Europe, Asia, and Latin America.

A principal contribution to the study derived from the German experience was the opportunity to add interesting variations and details to the training aids. The foremost example is the addition of the framed, half-timbered buildings seen especially in villages and towns in southern Germany.

EVALUATION OF RESULTS

Assessment of the collective results of the field trials of the draft training aids indicates that the trials formed an invaluable part of the study. The trials were primarily responsible for the constant progress, improvement, and augmentation of the draft training aids. After each trial, the draft aids were amended and improved. Means were found to state the principles more clearly and useful details, not included in initial drafts, were added. In sheer absolute numbers, the size of the training aids package (comprised in Section 3 of this document) increased from about 25 in the instance of Atlanta, the first trial city, to the present number of 68. Many of the additions came about in an attempt to convey more clearly a principle or an idea that had not previously been stated in sufficient detail. A good example is the detailed drawing of brick shapes and sizes (plate number 8). This illustration proved to be very useful to the participants in their estimation of the thickness of the walls of a brick building.

The examination results were gratifying and confirmed to the authors that the lessons taught were being learned. Strong gains in performance in the post-training examinations (over the pre-training examinations) were made in each field trial city (see Table 1). Taking just the collective means of scores, there was a gain in performance from 49.9 percent correct in the pre-training examination to 83.4 percent in the post-training examination. Moreover, there was little variation from group. Particularly gratifying were the performance improvements of many individuals. Many went from virtually a guess situation in the pre-training examination to one of trained, critical analysis in the post-training examination.

TABLE 1

Pre-Training And Post-Training Examination Results

		Pre-Training		Post-Training		Average
Test City	n[a]	Mean	Standard Deviation	Mean	Standard Deviation	Improvement (Percent)
Atlanta	9	47.33	11.32	86.67	6.71	83.12
Philadelphia	11	49.82	7.29	79.82	6.15	60.22
Seattle	13	53.69	11.92	87.85	11.40	63.62
Berlin	10	48.80	11.18	82.80	7.57	69.67
Schweinfurt	8	49.63	8.93	79.88	17.70	60.95

[a]Number of test participants

Of great value to the authors was the non-quantifiable response from the participants. In each of the participant groups, there were several individuals who were devoted students and became enthusiastic supporters of the study. Several made comments to the effect that they considered themselves competent in urban terrain analysis after having received the training. More importantly, they felt capable to guide and teach personnel in their own units the intricacies of urban terrain. They felt that their potential as combat leaders had been enhanced. In particular, they thought they could improve their unit's chances for survival in the urban environment and could improve their mission effectiveness. As an interesting side note, several of the participants, both commissioned and noncommissioned personnel, became so enthusiastic for the study and the training aids that they immediately began the process of technology transfer in their own units. Most gratifying of all was an instance in Berlin when two of the participants (one commissioned, one enlisted) gave a field lesson on urban terrain to a meeting attended by their commanding officer and unit leaders of their battalion.

In conclusion, the authors hold the view that the field trials were a vital part of the entire study and that they were instrumental in enabling it to progress to its present level. Further, the number and regional distribution of the trials was satisfactory. While more trials would cause some gain, concluding them at this point permits the preparation of this document and its subsequent use. It is certainly expected, however, that situations will be encountered which will require additions and revisions. Extension of training to other units in various parts of the world would also be valuable.

ORGANIZATION OF THE REPORT

The remainder of the report is divided into two main sections. In the first, Section Two, the general principles concerning the design and construction of buildings and their relationships to MOUT are presented. These principles form vital background to Section Three which presents the training aids themselves.

Section Three is the package of training aids and is, in its augmented form, essentially the bulk of the material employed in the field trials. As such, it is designed to form the basic for training aids which can form the nucleus of a training program. After reading Section One and Two, the reader can use it by itself in the field and in the training process. It is designed so that the training aid will always appear on the page on the reader's right. The page on the left contains explanatory information.

Section Four contains conclusions reached and recommendations for further study.

The appendix contains supporting material. Copies of each examination (both pre-training and post-training) for each trial city are included.

PRINCIPLES OF URBAN BUILDING CONSTRUCTION AND THEIR MOUT APPLICATIONS

Prior to examining building types and their relationships to military operations on urban terrain in the following section, it is necessary to introduce the broad underlying principles upon which these relationships are based. These principles proceed logically and orderly from a presentation of the basic structural problems addressed by construction engineers and architects through a variety of possible MOUT applications. Fundamental concepts and practices of both building construction/design and MOUT requirements are delineated first singly and then in conjunction with one another. Focus on principles should produce a level of understanding of the intracacies of the urban environment sufficient to aid the U.S. Army in its MOUT training programs.

This section is divided into the following subdivisions:

- Principles of urban building construction
- Principles of designing a building's function
- Fundamentals of MOUT needs
- MOUT applications of urban buildings
- Principles of field identification of urban building types and their characteristics
- Principles of the settings of buildings within their environments and possible MOUT applications

Principles of Urban Building Construction

Although the body of knowledge concerning building construction and architecture is vast, the basic principles pertinent to MOUT considerations are both straightforward and few in number. Maintaining simplicity in training devices and procedures helps to produce an understanding about the nature of buildings which can be readily applied to MOUT problems. Further, the simple lessons of principle are potentially more easily remembered and applied under the stress of field combat conditions.

Understanding of the principles of urban building construction is best gained through a pragmatic approach. The simplest, most logical way--for both construction engineer and soldier--is to think in terms of <u>problems</u> and their <u>solutions</u>.

The most significant building constructional problem is how to erect a structure which will withstand the natural forces placed upon it, such as gravity and horizontal stress. These forces, plus the building's contents which are constantly exerting lateral and vertical forces on the structure, are summarized under the term load, both dead and live. The vertical dead load is composed of the mass of the structure itself (walls, floors, ceilings, roof, etc.). The live load consists of the building's furniture, equipment, and occupants (both human and inanimate, such as cars in a parking garage). Horizontal or lateral forces are those of the wind and earthquakes.

There have always been, throughout the world, two major solutions to the problem of how to design a structure successfully to withstand these loads. These two solutions which provide the basis for the classifying of buildings into broad types are (1) the construction of walls of sufficient thickness and number to withstand all forces; and (2) the constructing of a frame, composed of columns and beams, upon which the forces of load can be placed. The first solution, that dependent on walls, is referred to as mass construction because of the dependence on bulk (mass) of the wall. The second solution, dependent on columns and beams, employs the principle that all loads can be directed along beams and columns and thus vertically downward through the columns to the earth itself. Because of locked interdependency of columns and beams, this broad class is framed construction.

Throughout the history of designing and constructing buildings, the two major solutions to the load-support problem have been used. Both were employed very early and both have taken separate evolutionary courses as new building materials and techniques became available. With these new materials and techniques came a variety of sub-types. Because of the great longevity of buildings, there exists today in the world's cities extant examples of all the sub-types. Each of these, in turn, has a potential military significance and each is addressed in this document.

It is also worth noting that both mass and framed type structures are being erected today. The choice, by the architect, of one over another is dependent upon a mix of factors consisting of need for functional space, esthetic architectural considerations, availability and cost of materials, and relative cost of construction varying as it does with manpower availability, labor costs, and productivity.

Building sub-types and the general situation in which they exist may be shown graphically (see Figure 1).

Each of the two major types of construction is divisible into several sub-types. Some of these, because of universality of building materials, are found widely throughout the world. Others, because they are positively related to some local condition--a shortage or abundance of material, a shortage or excess of labor, or some cultural reason--are narrower in distribution either temporally or spatially. For instance, concrete tilt-up buildings are the products of the modern age and are found in such places as California where cost-efficient means are sought to offset high labor rates. By contrast, old half-timbered buildings are found where labor was abundant and construction timber was plentiful.

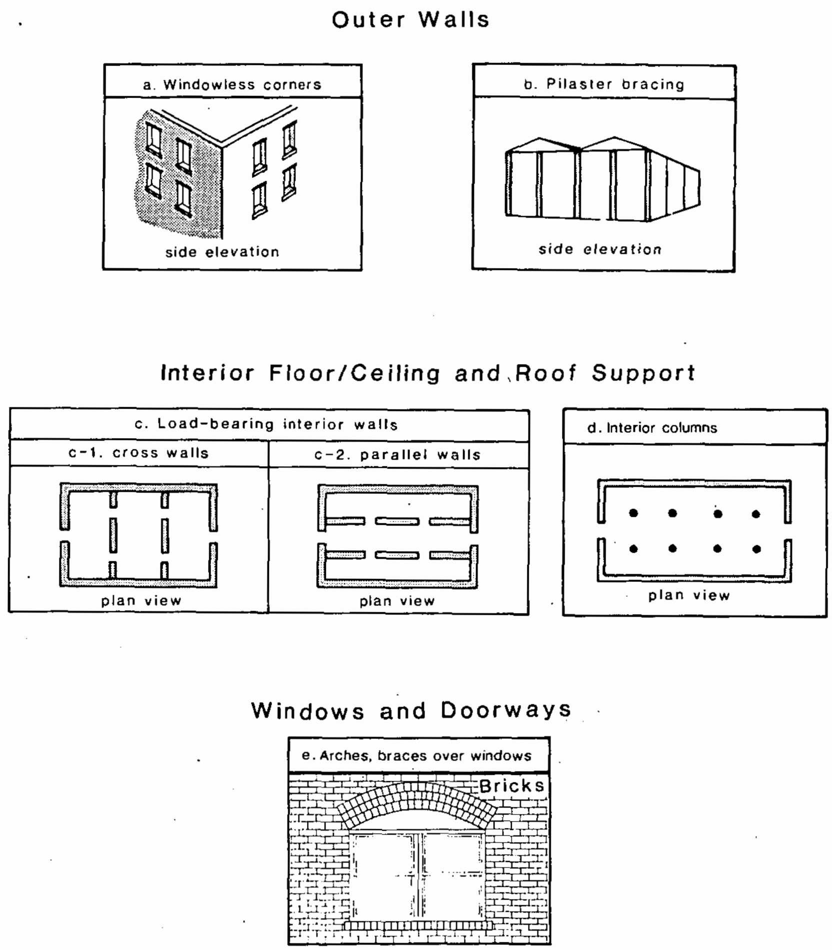

Figure 1. Building type principles.

Sub-type Principles

Each of the sub-types, under the headings of either Mass or Framed, provides a solution in its own individual way. Each is morphologically different from the rest and forms a distinctive type of structure. Further, each demonstrates its own response to the forces affecting it, resulting not only in different physical appearance but in different characteristics. These are of vital interest to such potential military concerns as wall thickness, room size, and interior configuration. The following discussion of each type illustrates these points.

Mass Construction

Mass/Stone: Construction with stone, a building material of classical architecture, employs the principle of mass in the walls to support the load of roof and floors. Its high level of compressive strength makes it a good (although prohibitively costly today) material for the construction of walls. Because of its low tensile strength, joists for ceilings and roofs are made of some other material, usually wood. To gain sufficient mass to support weights associated with institutional buildings (which are often constructed of stone) walls must be thick. Further, they can allow relatively few windows and doors as any such openings reduce the integrity of the wall and its ability to hold up loads.

Because of the inordinately high cost in labor to quarry, transport, and dress stone into building blocks, compared to far lower costs associated with brick or concrete, there are relatively few all stone buildings existing in the world. Exceptions are where stone is easily acquired, where other materials must be imported, and in cities, such as old Jerusalem, where there exists historical and cultural value. In advanced societies, stone is often used for such buildings as churches or public structures where there is a wish to demonstrate the power of the institution.

A common use of stone, however, is in the foundations of brick buildings. In these instances, the cost of providing stone is justified because of its conveying the appearance of strength and because of the solid foundation which it provides because of its high compressive strength.

Mass/Brick: Brick, as a man-made substitute for stone, provides a solution to the problem of load bearing through the employment of mass in walls. As modules, bricks are set in such a way (through bonding) to provide sufficient support for the weight of the walls themselves plus all the transmitted weight of floors, roof, and live load.

The very nature of bricks, as building modules, and the way in which they are assembled cause brick buildings to have a distinctive set of characteristics. Identification of these characteristics is a trainable skill, one which enables the observer to establish first that brick (masonry) construction has been employed and then to infer the building's related characteristics such as wall thickness. Evaluation for military application then follows.

The principles which state that loads of mass buildings are borne by their walls, rather than by frames, is exhibited in many ways in brick buildings. One dominating characteristic is the high proportion of wall space relative to openings for windows and doors. An excessive number of openings in the wall would reduce the weight-bearing integrity of the wall to too great a degree. Placement of windows and doors is also vital. They must be aligned vertically leaving expanses of unbroken wall between to support the vertical loads. A further example of wall strength is the massive nature of the corners of the building. Meeting at right angles provides both mass and bracing. Corner windows are thus precluded.[7]

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[7]The impression of strength of corners of masonry buildings was so deeply engrained at the time of the introduction of steel-framed structures that architects continued their use with framed buildings (whose strength was in the frame and not the walls/corners) in order to convey a notion of stability to the public.

The joists had to be provided with vertical support for any building whose width exceeded this distance. Two common solutions are seen. The first is the provision of weight-bearing interior walls. In a common situation for a fairly large building, such as an office or a hotel, the walls along hallways which parallel the outside walls are composed of brick and are load bearing. Floor/ceiling joists "bridge" from these interior walls to outside walls.[8] The second method is that of providing posts or columns (often made of cast iron, with its high level compressive strength, in the older buildings) where the building function requires large areas of unbroken interior open space. Retail stores, factories, and warehouses are common examples.

Mass/Concrete: Because of its plastic condition during the building process, concrete has been well adapted to handling by machinery and thus the savings of hand labor required in the placement of either stone or brick. It is also a strong material for in addition to its inherent load bearing compressive strength it has high tensile strength through the addition of steel reinforcement. Concrete thus has the capability of being used as a horizontal building member; that is, floors, ceiling, roofs, and beams (in framed buildings).

Despite its versatility and the expectations given it, the use of concrete in mass construction buildings has settled into just three basic physical forms serving but a relatively few functions.

The simplest of these forms is the type of building in which the concrete is "poured-in-place" (on the building site) into forms. The outer walls are thus constructed; interior support of ceiling and roof joists may be accomplished--as with brick buildings--either by load-bearing interior walls or by posts. Although there were some early experiments (around the turn of the century) with constructing tall buildings entirely of poured concrete, the use of the method has been restricted mostly to low structures (one to three stories). Common uses are for storage, industry, and for such public gathering places as auditoriums and gymnasiums.[9]

A variation on this method is the "tilt-up" form of construction in which concrete walls are laid in slabs on the ground (usually on the concrete slab floor of the building under construction) and then lifted ("tilted") into place. This method is particularly favored where high levels of technology exist, where labor is expensive, and where the desired building height is only one or two stories.

The third common form of use of concrete is its use in box-wall principle construction. In such buildings the mass walls and combined floor-ceilings are used to brace one another, as in a framed building. The form

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[8]Joists must be anchored securely to the outer walls and this usually produces some sort of visible feature. These range from a simple plate held in place with a bolt and nut, to elaborate, decorative scroll work.

[9]Perhaps the most widespread use of poured concrete "walls" is in the foundations of wood-framed houses.

of construction is a combination of mass and framed construction methods. These box-wall buildings employ the principle of using a series of weight-bearing, reinforced-concrete walls (although brick is substituted in some instances) across which slab floor/ceilings are placed. Loads of the floor/ceilings are thus transmitted to the vertical walls which, in turn, transmit them to the ground. The weight-bearing walls thus form three sides of a cell (which may be a single room or subdivided into smaller rooms). The floor/ceiling slabs form two more sides of the "box" while the sixth side is enclosed only by some nonweight-bearing, curtain-wall material or glass. A common use is for hotels and apartments which consists of room modules whose function is fixed.

Framed Construction

Origins of modern framed construction are traceable back to pre-historic times with the use of posts to hold up beams (lintels). Posts thus perform the function of bearing loads. Horizontal stresses from both the load of the structure and of its contents are directed along the lintels to the posts and thence to the foundation. A parallel is seen in nature with a tree where the load of the branches with their inherent tensile strength is directed to the trunk with its inherent great compressive strength.

Early examples of post and lintel construction are seen in classic Egyptian and Greek temple architecture. The high density of columns in such structures is required because of the relative tensile strength weakness of the stone lintels; they could not be of great length without bending and breaking. Later uses of materials with greater resistance to bending, such as wood, steel, and reinforced concrete, permitted much wider spacing of the columns and led to the development of framing as a building technique. Indeed, the modern steel or reinforced concrete skeletal framed skyscraper uses a variation of the methods of ancient architecture. The use, throughout history, of framed construction in wooden buildings (where that material was abundant) has meant that both mass and framed construction methods have coexisted for a long time and continue so today.

Framed/Post and Beam: The principle of post and lintel construction is exhibited in the post and beam[10] wooden structures built widely in NW Europe from the 12th through the mid-19th centuries. These structures employed heavy timbers which had great strength and were fire resistant, for posts and beams. They were joined into box-like frames which resisted load forces. Interiors were divisible into rooms which served what was frequently a mixed function of retail, the hand crafting of goods, and residence within the same building. Posts were joined to beams by using the method of fitting a pinion into a mortise and anchoring them with dowels. Because of the use of a frame, the walls and partitions were not load bearing. Accordingly, they were made of lighter material such as boards, panels, light

[10]The term beam is more specific than lintel and refers to a wooden member with given bending strength and thus capable of spanning fairly great distances (20 feet, for example). Accordingly, larger ranges are possible.

screens (in the Orient), bricks, or mud and straw. These nonload-bearing walls perform the same function for these post and beam construction buildings as do the curtain walls (glass and other light materials) of modern framed skyscrapers.

A familiar variety of post and beam construction is the half-timbered building, common to Germany and other parts of northwestern Europe. The distinguishing feature of these buildings is the exposed wooden structural members; i.e., the posts, beams, and usually an extensive number of short wooden braces. These exposed members are often highly decorative and their use (even if artificial) is frequently incorporated into modern construction to impart a "classical" appearance. The nonload-bearing curtain walls of these buildings are no thicker than the depth of the wooden posts and beams (usually about 6 to 8 inches). A common feature of these buildings is an overhang, of about a foot or so, of an upper floor over a lower one. These are used, in part, to protect the lower area from weathering. They also have a structural function in that the cantilevered overhang serves to counterbalance the forces bearing upon the interior parts of the frame.

Light wood-framed construction (balloon type, a variant of the post and beam method) employs studs, rather than massive posts. They are nailed to equally light weight sills and joists. The lightness of the construction requires the use of sheathing of the exterior and interior walls to add rigidity. The frame is not structurally independent, as in a post and beam building.

<u>Framed/Heavy Clad:</u> The introduction of the steel-framed, heavy-clad building in the latter part of the 19th century made possible the modern skyscraper. Collectively these buildings resulted in tall city skylines. The concept of problem and solution can well be used to explain this event. The problem to be addressed in the 1880's (especially in large U.S. cities) was how to increase the multiplication of expensive surface land in the center of the city beyond that possible with masonry buildings which could not be economically built beyond a height of about twelve stories because of the encountering of excessively thick walls in the lower stories. Many forces at that time were combining to make downtown locations attractive to commerce. The U.S. was becoming a world power, great natural wealth was being tapped, industry was expanding (especially following the Civil War), and mass transit lines focused on the downtown area.

The solution to the problem was to return to a form of construction used earlier, mainly framed, but this time with use of structural steel. Columns and beams, joined together by riveting or welding, provided a strong skeletal frame capable of attaining great heights. Equipped with the fairly recently developed safety elevators, these structures provided offices, retail, storage, and manufacturing space for an expanding economy. The era from the mid-1880's through the 1930's was one in which large numbers of brick buildings in central business districts were being razed and replaced with heavy-clad framed structures.

The use of heavy cladding (composed of terra cotta brick, insulation, and a facing of either brick or stone veneer) as a nonload-bearing material over a frame requires explanation. Although this exterior material, placed over the frame, provided no structural support, it did serve the dual functions of protecting the frame from the weather and enhancing rigidity. Its use also expressed a need to retain the outward appearance of the older masonry buildings which the public equated with strength and stability.

To retain this image, and to keep public confidence, several stylistic practices were commonly followed. Masonry materials of brick and stone veneer (especially for the lower floors where they were more noticeable) were used to cover the frame and obtain the outward appearance of a mass constructed building. Classical modes of architecural style were also used. Tall buildings frequently consisted of the three subdivisions of pediment, shaft, and capital. The pediment (literally the foot) was a highly ornamented first one, two, or three floors. It often had decorated classic columns and employed massive looking stone veneer. The shaft comprised the larger part of the building and had little ornamentation. The capital (the head) often repeated some of the decorative features of the pediment. A stated reason for using these classical forms was to disguise the great height which some of these early towers were achieving. Only toward the latter part of the era did architects begin to cease hiding the frame and introduced the notion of the unornamented tower. Such structures as the Empire State Building and the Chrysler Tower in New York are U.S. examples. In Germany, architects not only discontinued use of pediment, shaft, and capital, but they introduced the concept of rounding a building's corner (at a street intersection, for example) to demonstrate that a framed building did not need a massive corner for strength as did masonry buildings.

Although framed heavy-clad buildings were built in major cities throughout the world after being developed in the U.S., their number is relatively small for several reasons. Construction was curtailed for fairly long periods such as during the 1914-1918 war, the period of recovery, and the Depression. Too, European cities did not have such a great growth impetus and in many instances, the large existing number of smaller-masonry buildings provided necessary space for commerce and residence. Also, unlike the case with the often hastily and cheaply constructed brick buildings which were razed to make room for the new framed structures, many of the older masonry buildings of European cities were of such high quality that their replacement was infeasible.

Framed/Light Clad: A second revolution in the vertical dimension of the world's cities has resulted from the introduction and spread of framed light-clad buildings. These structures--with their curtain walls made of glass, plastics, aluminum, and other light materials--frequently reach heights of fifty and more stories and greatly increase the concept of the multiplication of expensive surface space. Their great numbers reflect the high level of need for such functions as offices as business expands, and the significance of large corporation increases (many of the older heavy-clad buildings were put up to serve the general office needs of small companies and individual professionals). The high demand for city hotels and apartments has also created a strong market for many of these buildings.

The change in construction mode from heavy cladding to light cladding also marks a new level of maturity in esthetics. Allowing frames to be seen (and indeed, decorating them on occasion) expresses the architect's desire to state that the frame itself is an object for admiration. The lightness and the vast expanse of glass of most of these structures also adds to the beauty and general effect. Many of these effects have been made possible only by parallel developments in the materials used.

The great height possible with these structures, has indirectly had a bearing on military concerns. Because of a structures great height, some of a building's lot can be left unused. In other words, the tower can be set back from the property lines. As such, it not only fulfills the architect's wish to have the building viewed from all sides, but it increases potential fields of fire from the building.

While the building style of the framed light-clads is commonly associated with recent times, it had its origin in the 1920's. Though a few buildings of modern style were erected in the 1930's (quite a few of these being in Germany), poor economic times followed by World War II prevented their being built more broadly. In the few years following the war, construction moved forward rapidly to serve the sometimes combined needs of replacing war devastation and responding to rapidly expanding economies. German and Japanese cities reflected the former while commerical impetus explains the rapid development of such cities as Houston, Hong Kong, Sao Paulo, and Johannesburg.

Not only is the exterior of these buildings a departure from earlier structures, office buildings of this type have different interior arrangments than their heavy clad predecessors. Instead of having small, individual offices situated between the frame members, the light clad buildings (with their longer reaches between columns) often have larger open-bay offices which are designed to serve better the space needs of large corporations. Because loads are borne by a frame, interior walls can be placed to create any desired size modules.

Principles of Designing a Building's Function

The previous section dealt with structural solutions. This section refers to solutions to the problem of creating specific types of space for particular functions.

Several options to the solution of providing space for a particular function may be present at the time of design. Choice of the optimum is based upon cost, materials available, consideration of the possibility of there being any possible change in function, the matching of function to specific building characteristics, and esthetics. The mix of parameters which help to determine a choice also varies from time to time and from place to place.

A list of requirements can be prepared for virtually all functions. Several examples illustrate the point. Some functions, such as offices and factories (of certain types), require a maximum amount of natural light. For the offices, this requires that all rooms have windows. To achieve this, it is necessary in large volume buildings to have either a series of "wings" or large interior light wells. Because of their need for large areas of wall space to support vertical loads, framed, rather than mass, construction is preferred. Factories, if but a single story in height, can use a series of rows of pitched roof surfaces with canted windows on the short reach of the pitch.[11] Multistory factory buildings require framed structures with full window venting on each floor; the windows often cover most of the area lying between columns and beams of the skeletal framed structure. The required interior columns of such a structure present little problem as machines, storage, and other related functions can be worked around them. The presence of interior weight-bearing walls (associated with mass buildings) would hamper most factory operations.

For some functions, such as hotels and apartment buildings, the set of requirements is different. The provision of natural light into each room (each of which by necessity must be fairly small) means that buildings (or "wings") must be fairly narrow. Further, if an apartment unit is to have several rooms, a long linear shape (as a hotel will ordinarily have where each rentable unit consists of only a single room) is not feasible for that would make for an awkward circulation pattern from one room to another. Rather, an apartment unit should either occupy a corner (or a short "wing") or should have rooms facing both sides of the building. Another design requirement for apartments is that the size of the units and of the individual rooms must necessarily be fixed. Accordingly, a common current choice of construction type selected for apartment usage is box-wall principle in which walls are weight bearing and thus must remain fixed and intact.

That these walls are thick and dense has the further advantage of serving as sound barriers between apartment units. A further advantage, one exploited in housing-short USSR, is the adaptability of buildings of this type to factory construction of prefabricated modules to be assembled on site.

Innovations in box-wall principle construction are relatively new, however, and many high-rise apartment buildings in cities throughout the world employ framed construction. In these structures, there are no load-bearing interior walls. Functional needs, however, still require that apartment units and room sizes remain fixed.

Another distinctive type of function, with its own peculiar set of morophological requirements, are buildings providing space for public assembly. Requirements of the particular use of the building add a further dimension. For instance, a large retail store, while it must provide a

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[11] Called sawtooth skylights.

large open area for the display of its merchandise and the accommodation of its customers, can allow the supporting columns associated with a framed structure for they can be circumvented in pedestrian traffic circulation and can be disguised by merchandise or contained by stone fixtures. Other public assembly places--such as a theater, church, or athletic center--require a pillar-free interior. Such buildings may often employ mass construction walls heavy enough to support the beams or trusses required to hold up a long span of roof. A strong frame will also meet design requirements and is a common solution to the problem. Buildings of this type usually consist of only a single story, although usually quite high, and there is no further load beyond that of the roof. Providing a truly large non-pillared open space in the ground floor of a high-rise building becomes costly if not physically prohibitive.

Fundamentals of MOUT Needs

The preceding sections have developed principles which serve to gain an understanding of the generally applicable principles concerning the nature of construction of buildings as determined by the attempts to provide solutions to the general problems of structural engineering and the provision of functional space. These fundamentals are essential to any general military understanding of buildings as well. In addition, however, there is the specialized view of buildings which the Army must take to help it solve the specialized problems of fielding military operations on urban terrain.

Specifically, the U.S. Army has a need to view urban buildings as providing certain opportunities for defense of a city while recognizing that there are certain constraints which buildings impose on operations. Further, a full understanding of the nature of the defensive problems could well serve to increase understanding of the urban environment should U.S. forces find themselves in the role of attacker to retake cities lost to attacking forces.

Analysis of the very complex urban environment, relative to requirements of the Army, is best treated by subdividing the types of problems encountered by ground forces operating in the city and relating these to the identified characteristics of buildings. Table 2 indicates these relationships.

Building Defense

The problem of defending buildings is subdivided here into the two headings of (a) troop protection, and (b) tactical. The former relates to the survivability of individuals within the buildings engaged in defensive actions while the latter seeks to identify those building characteristics which must be considered in the use of tactics and the deployment of weapons from within urban buildings.

TABLE 2

MOUT Requirements Related To Urban Building Characteristics

MOUT Requirements	Building Characteristics
Defense:	
Troop Protection	
Cover	1. Proportion of walls to windows 2. Wall composition, thickness 3. Interior walls and partitions, composition, and thickness 4. Stair and elevator modules
Concealment	1. Proportion of walls to windows 2. Venting pattern 3. Floor plan (horizontal & vertical) 4. Stair and elevator modules (framed high-rise bldgs.)
Escape	1. Floor plan (horiz. & vert.) 2. Stair and elevator modules
Tactical Sniper Positions	1. Wall composition, thickness of upper floors 2. Roof composition, thickness 3. Floor/ceiling composition, thickness
MG Positions	1. Wall composition, thickness 2. Local terrain
Antitank Weapon Positions	1. Wall composition, thickness 2. Room dimensions, volume 3. Function related interior furnishings, etc. 4. Fields of fire (relative position of building) 5. Arming Distance 6. Line-of-sight
Antiaircraft Weapon Positions	1. Roof composition, thickness 2. Floor plan (horiz. & vert.) 3. Line-of-sight
Offense:	
Tactical	
Building Entry	1. Wall composition, thickness 2. Floor/ceiling composition, thickness 3. Floor plan (horiz. & vert.) 4. Circulation pattern
Building Clearing	1. Floor plan (horiz. & vert.) 2. Circulation pattern 3. Interior walls and partitions, composition and thickness

There are four major considerations in the element of cover provided by buildings. In the first which is evaluating the proportion of walls of windows, it is necessary to know first the proportion of non-windowed wall space which might serve as protection. A check against the fundamentals of building construction would indicate, for example, that mass construction buildings with their high proportions of walls to windows would afford more substantial cover than framed buildings with both a lower proportion of wall to window space and thinner (nonload-bearing) walls.

Composition and thickness of both exterior and interior walls also have a significant bearing on the assessment of cover possibilities. Again, a knowledge of the principles of building characteristics provides an indication of the degree of cover which can be expected of various types of buildings. Mass constructed buildings with their strong weight-bearing walls give more cover than do the curtain walls of framed buildings. Within framed buildings, however, interior walls of the older, heavy-clad, framed buildings are stronger than those of the new, light-clad, framed buildings.

Cover within these light-clad framed buildings is very slight except in and behind their stair and elevator modules, usually constructed of reinforced concrete. Knowing location, dimension, and form of these modules would be vital in consideration of cover possibilities.

Concealment considerations involve some of the same elements of building construction but add an awareness of the venting pattern, the floor plan, and the building circulation pattern. Knowing the venting pattern, the organization of the windows is essential to evaluate the amount of concealment opportunities provided. These patterns vary both with type of construction and with function. In older, heavy-clad framed buildings, for instance, office buildings frequently have as full a venting as possible while the designers of hotel rooms sought only to provide one window per room. In the newer, light-clad framed buildings, there are numerous types of window patterns used by the architects (see the training aids in the next section). Some of the basic types provide considerably more concealment than others; the frame-obscured type would--if the windows were all broken--provide no concealment possibilities at all.

Undetected movement within the building, another aspect of concealment, is dependent on a knowledge of the floor plan and the circulation pattern for traffic within the building both on each floor and from floor to floor. Principles developed in the training aids can be applied in assessment of possibilities here.

The planning for escape also must take into consideration characteristics of buildings. Again, the floor plan and circulation patterns are relevant. Moreover, the relationships between building exits and the surrounding environment must be considered. Possibilities range all the way from small buildings with exits only to the street in front (where unacceptable risks might be encountered) to high-rise structures which might have exits on several sides above grade and subterranean connections with other buildings as well.

Beyond those considerations relating to troop survivability, an understanding of the characteristics of buildings is essential to make optimal use of them in planning tactics and in deploying various weapons systems.

A common, almost traditional, military operation in urban areas is the placement of snipers. Snipers are, of course, vitally concerned about cover and concealment; an upper floor area of a tall building generally provides sufficient fields of fire, although corner windows can usually command more area. The concern for protection from the possibility of return fire from the streets requires that the sniper know the composition and thickness of the building's outer wall. Load-bearing walls offer more protection, in general, than do the curtain walls of framed buildings, although the relatively thin walls of a low brick building (only two bricks thick--8 inches) may be less effective than a 15-inch thick nonload-bearing curtain wall of a high-rise framed structure. In the event of a very tall brick building, the walls of the upper floors, which are thinner than the lower floors, suggests the evaluation of the trade-off between the better protection of the lower floors and the greater field of fire from the upper floors. The sniper is also concerned about the amount of overhead protection, and accordingly, needs to know about the properties of roof and floor/ceiling materials. These vary with the mode of building construction. In brick buildings, for instance, the material for the ceiling for the top floor is far lighter than that for the next floor down which must perform as both ceiling and floor and thus be capable of holding up the live load of the room. In another example, the ceiling and roof of a box-wall principle building is strong because it is composed of the same reinforced concrete of the floor/ceilings of successive floors below and thus provides a fair degree of cover (although, of course, not as much as one or two floors down).

Establishment of machine gun positions presents a variation on the requirements for other types of weapon deployment. The machine gunners are concerned about cover to an even greater degree than snipers because of the difficulty of reestablishing positions. Fortunately, in order to achieve grazing fire, they must usually be located on the ground floor. If a brick building is selected as a defensive position, it is the lower floors which have the thickest walls and thus the greatest degree of cover. In framed buildings, walls are the same thickness on every floor and thus the ground floor provides no advantage. A second item of consideration is the nature of the local terrain. Should a building to be selected as a site for a machine gun position lie over the crest of a hill, the achieving of grazing fire may not be possible from a ground floor. In such instances, depending on the position of the slope angle of the area in question, grazing fire can be achieved only from some floor higher than the ground floor.

Considering the potential threat from tanks, a need exists to examine the prospect of positioning antitank guided missiles and other weapons within buildings. There exists, as with other types of weapon deployment, a need for cover. Unfortunately, the type of buildings which have fairly thick walls--such as brick office and hotel buildings and heavy-clad framed offices, hotels and apartments--because of the nature of the functional space they provide, have rooms which are too small in linear and volumetric dimension to permit the firing of heavy antitank missiles which have heavy associated back blasts. Thus, only the light and medium antitank guided missiles and the 90mm recoilless rifle can be fired from many of the large open-bay like spaces common to light-clad framed buildings, but these structures, by definition, offer little cover to the gunners.

The position of a building, relative to its surrounding, has an important bearing on the lines of sight and fields of fire. For heavy antitank guided missiles (the TOW) designed to be effective up to 3,000 meters and an arming distance of 65 meters, there is an acute need to select buildings which command considerable fields of fire. Ground observation experience has shown that the type of building ideal for this situation, the free-standing, light-clad framed structure, will often stand above lower surrounding buildings. The setting of such structures in urban redevelopment sections (as in areas suffering extensive war damage; e.g. near the main railroad station in Bremen, is often such that long, clear lines-of-sight are possible.

The deployment of antiaircraft weapons can also be related to a consideration of building characteristics. An ideal type of building for such deployment is a modern parking garage (one with rooftop parking). It offers sufficient cover, a circulation pattern favoring such weapons carried on light vehicles, and frequently offers good lines of sight.

Considerations for the Offense

Should U.S. Army ground forces find themselves in a position to attack or counterattack, certain other military operations must be considered, each relative to the building characteristics which are important to the conduct of that operation. Of extreme importance are building entry and building clearing.

The key building characteristics to consider relative to the problem of building entry (as listed in Table 2) are (1) the physical strength of the building's exterior and how walls may be breached to allow entry, and (2) the nature of the interior of the structure to know how to maneuver once inside the building. First, wall composition and thickness must be evaluated to determine what would be required (should that method be selected) to gain entry. Again, load-bearing walls present more of a challenge than do the curtain walls of framed buildings. The types of projectiles or charges and means of delivering them to the wall target need to be determined and evaluated. Should rooftop penetration be considered as the appropriate means of building entry, consideration needs to be given to the type and characteristics of the roof, as well as the type and vulnerability of the building.

Once inside the building, attackers would have well in mind the floor plan and circulation system. Astute observation and compliance with principles (as stated in the training aids) should permit the forecasting of these characteristics in advance.

Clearing of the building requires an extension of this knowledge. In addition, application of a knowledge of building principles will be useful to predict the composition and thickness of interior walls and partitions. Large brick buildings, with heavy load-bearing interior walls, present quite a different level of problem from the lightweight partitions commonly employed in the new, light-clad framed structures.

Principles of Field Identification of Urban Building Types and Characteristics

The ability for troops in combat in an urban situation to identify the types of buildings they encounter could well be vital for their own survival and for the success of the mission. Knowledge of the buildings and their characteristics is necessary in the making of correct decisions regarding choice of tactics, selection of defensive positions, and weapons deployment, to name but a few.

The need for offering training in this vital skill of building identification is best extended down through platoon level and squad level because of the oft stated concern that in an urban combat situation communication among units might be severed. Accordingly, leaders of small units need to have a sufficient level of knowledge about the character of urban terrain (the buildings and their characteristics) to permit them to direct their troops in an optimum fashion.

The stated goal of this study--to point the way for the training of MOUT troops to handle themselves in cities--can be met through the careful organization and execution of a course of study. That study consists of the elements (seen in the following section) of (1) principles of construction, (2) building type identification, (3) principles of identification of building interiors, and (4) potential military applications.

Through the course of this study it has been the intent of the organization of the training devices (in the next section) to develop a comprehensive understanding of the urban environment by the trainee. Responses from many of the field verification participants have served to help confirm the validity of this approach. They have recognized the value of being able to recognize not only the building type but also all related characteristics. The thrust of the effort has been to develop an understanding that there exists numerous conditions and characteristics which are related to each building type. Moreover, these conditions and characteristics replicate. They are common to the same type of building not only throughout a given city but from one city to another, even in different parts of the world. Finally, it is the long-range goal of the kind of training suggested by this study that trained troops responding to virtually any urban combat situation would know immediately what they face and how best to survive and succeed in the urban environment.

The Identification Process

Every attempt has been made in this study to avoid the rote process of identification where a table of keys is consulted. Rather, the use of keys is far more effective if set against well defined principles. Thus, the order of the training device proceeds (for each basic type of structure) from principles to identification keys for the entire building to principles and then identification keys for building interiors.

In a typical building identification problem in the field, the soldier would first make the broad distinction between mass and framed construction. He would than refer to the identification keys for the types within these two broad families. If knowledge of the interior were deemed necessary (if building entry and clearing were planned), he would follow the same logical progression from reference to principles of interior configuration to particular cases.

Because many of these are a product of the function of the building, it would be necessary to determine what the use of the building was (or had been). Again, certain principles come into play. For example, street level retail stores are generally narrow because each is competing for exposure to the passing trade, and accordingly, land values are too high for many to afford more than the minimum of frontage. In another example, hotel rooms are generally about the same size in cities all over the world (at least within class levels). Configurations of building interiors, as discussed earlier, also follow common practices and principles.

Buildings in Their Spatial Context

Particularly for MOUT requirements with need to consider such spatially related facts as lines-of-sight, fields-of-fire, and arming distances, buildings cannot be considered only in the abstract but rather relative to their situation within the city. The spatial nature of buildings follows certain fairly well prescribed principles. For instance, modern light-clad framed structures are often set back from their lot lines thus giving them longer distances from their neighbors. Older commercial brick structures lying within the central city almost always have no set back and occupy their entire lot. A good general principle is to be observed here; namely, that large numbers of the new buildings were part of whole, planned developments, one which had architectural esthetics as well as efficiency in mind. Older sections, by contrast, are a product of growth by accretion, one building at a time. Each building's relationship is with the street in front and not with the other buildings.

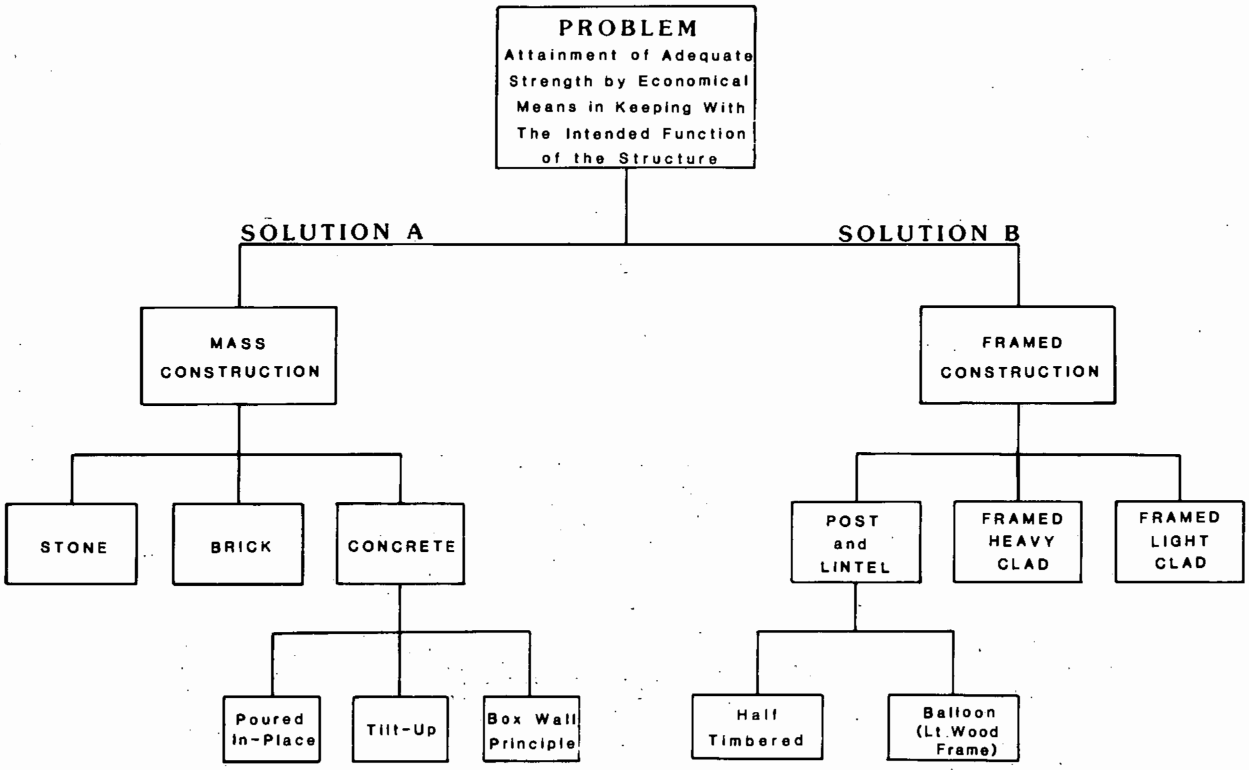
Numerous military applications are to be asssociated with the setting and type of buildings. Several cases appear in the training aids. In one instance, the large volume of air space in retail shops facing a commercial arterial would not impose any back-blast limitations on the firing of light and medium antitank weapons at vehicles passing by. In another, the broad fields of fire from high-rise, light-clad framed buildings would favor the use of a heavy antitank weapon. Large volume interiors of buildings of this type would impose no back-blast limitation. In yet another instance, broad fields of fire are often possible from public gathering places because of their common location overlooking large squares and parks.

TRAINING

AIDS

The principal types of building construction, indicated on plate number 1 on the opposite page, are explained in full in the previous sections.

BUILDING TYPE PRINCIPLES



The use of load-bearing exterior walls (plate number 2) is a very simple means of enclosing space, one in use continually and universally from antiquity through the present. Protection from the elements can by accomplished by the simple expedient of laying a flat roof on top of joists which bridge the exterior walls. Or, in a more elaborate way, rafters can be used to provide a pitch to the roof. Enclosing of yet a larger interior volume is achieved through use of trusses, arches, vaults and domes.

In all instances, however, all the load of the roof is borne by the bulk of the mass construction walls. The further loads of the wall itself and all of the contents of the building are also directed to the walls and thence to the ground.

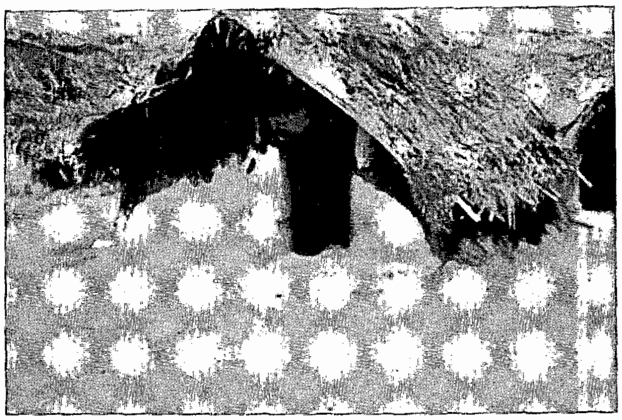
Building materials vary with time, place, and level of technology. Simple mass construction buildings have walls constructed of mud, stone, or logs. Somewhat more complex is the use of bricks, a man-made form of stone. Employment of building blocks made of concrete, cinder, and a variety of other materials follows the same principle. Concrete, also achieving the same effect, has the added advantage of being easy to handle in its plastic form; i.e., before hardening. Tensile strength is added to concrete by emplanting reinforcement steel bars. Further strength is gained by stretching (pre-stressing) the reinforcement bars during the hardening of the concrete.

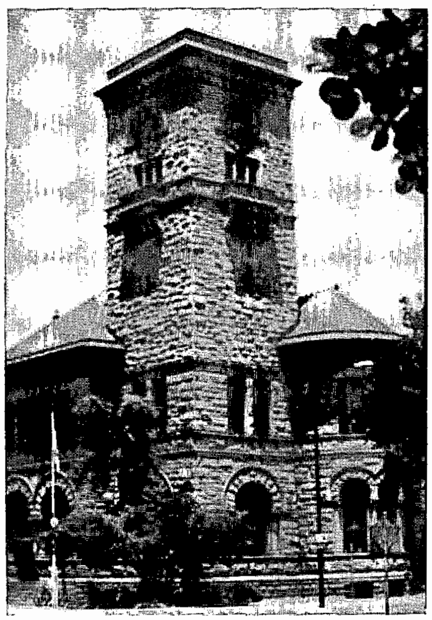
Photo a: This hut in India uses the most rudimentary form of mass construction, a wall made of mud. The wall carries its own weight plus the weight of the thatched roof.

Photo b: Walls of this mass construction building are made of stone. They bear their own weight, the roof, the floors, and the live load.

b.

a.





2

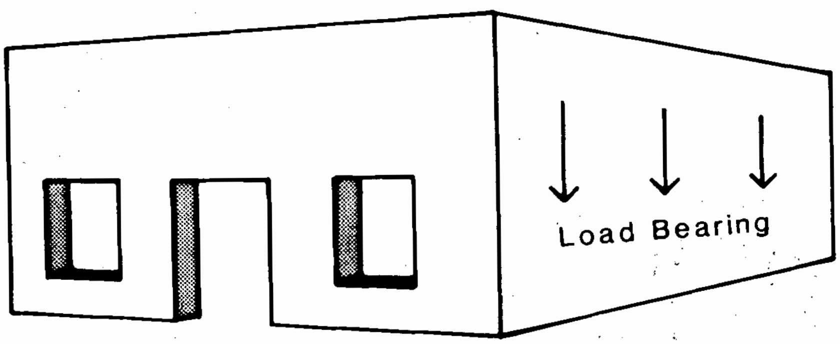
PRINCIPLES: MASS CONSTRUCTION

Exterior Walls Bear Load of:

a. Structure

b. Roof

c. Building Contents



Awareness of certain details of mass construction buildings (plate number 3) is useful in identifying these buildings in the field.

Outer Walls

a. Windowless Corners

The corners of all mass construction buildings are their strongest points. Because they provide vital load-bearing support, their integrity cannot be violated by having windows placed in them.

b. Pilaster Bracing

In some mass construction buildings, additional support is achieved by adding buttress-like bracing (called pilasters) along the wall at periodic intervals. When placed on outside walls, as is common with a free-standing factory or storage building, they are readily identified in the field. Pilasters may also be placed on the inside of the main walls where the intent is to keep the exterior side of the outer wall smooth, an approach necessary when buildings abutt one another along a street.

Interior Floor/Ceiling and Roof Support

In situations where the width of a mass construction building cannot be spanned by unbroken ceiling joists, it is necessary to introduce some device to add support. One method is to construct load-bearing interior walls; another is to emplace columns at periodic intervals.

c. Load-bearing Interior Walls

Load-bearing walls are used where the intended function of the building requires a subdivision into rooms whose dimensions remain constant; an apartment is a good example. Remodeling interiors requires the introduction of frame-like support beams to replace the loss of structural integrity caused by removal of the interior load-bearing wall(s).

Depending on the shape and size of the building, the load-bearing walls may either be placed perpendicular to or parallel to the outer walls. Parallel load-bearing walls are often found in large brick office buildings; large German Army barracks are an example.

d. Interior Columns

Interior columns are used to support joists and rafters in buildings where the designed function would not permit use of load-bearing interior walls. Common examples are retail stores, factories, and warehouses. Diameter of the columns is kept to a minimum to preserve interior space. Because these columns support only the weight above them, they are often made of cast iron, a material of high compressive strength.

Windows and Doorways

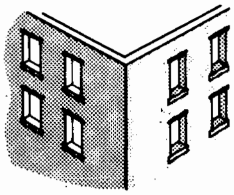
Providing openings in a mass construction wall for windows and doorways creates areas of weakness for which some compensation must be made. The usual devices are either the emplacing of a short beam above the opening (often a stone lintel), or a brick or stone arch. Their function is to transmit the load above to the unbroken wall on both sides of the opening (see e. Arches, braces over windows).

PRINCIPLES: MASS CONSTRUCTION

Supplementary Support

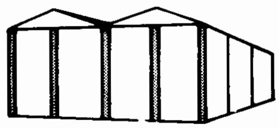
Outer Walls

a. Windowless corners



side elevation

b. Pilaster bracing

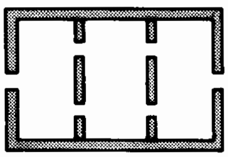


side elevation

Interior Floor/Ceiling and Roof Support

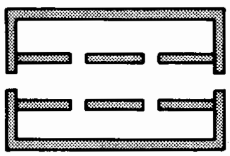
c. Load-bearing interior walls

c-1. cross walls



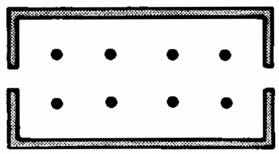
plan view

c-2. parallel walls



plan view

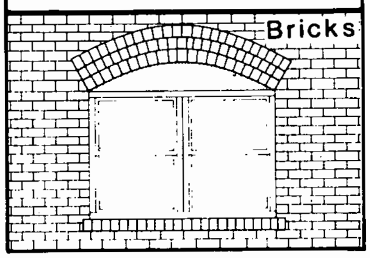
d. Interior columns



plan view

Windows and Doorways

e. Arches, braces over windows



Three methods of erecting mass construction buildings (plate number 4) are demonstrated here. All are currently in use.

a. Walls Built in Place

The oldest method of the three and one with universal distribution is the construction of walls in place (on site). Erection of the wall may simply involve the placing of construction modules--logs, stone, or brick --one upon another. Or, concrete, in its plastic condition, may be poured into forms and then allowed to harden.

b. Prefabricated and "Tilt-up"

Advances in techology, particularly the forming of wall modules in factories and the development of means of delivering these modules to the building site, have resulted in new methods of erecting structures. Prefabricated concrete walls are erected on site. Common examples are houses in the Federal Republic of Germany and apartments in the Soviet Union.

A variation on the theme is the tilt-up structure in which wall modules are either brought to the site from a factory or laid in forms on the existing floor slab and then "tilted" up into place. They are propped up temporarily prior to construction of the roof to which they are affixed.

c. Box-wall Principle

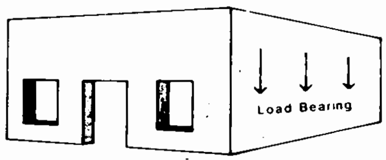
In box-wall principle construction, mass construction walls and floor-ceilings brace each other and thus perform in a manner similar to that of columns and beams in a framed structure. Because of this, walls have the same thickness throughout the height of the structure. Building materials may be either bricks (or building blocks) or concrete. End walls, made of concrete, are usually poured in place but interior walls may be prefabricated.

4

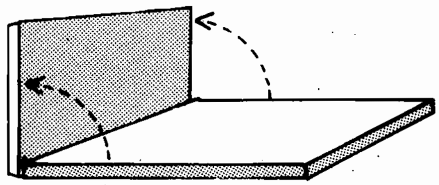
PRINCIPLES: MASS CONSTRUCTION

Methods

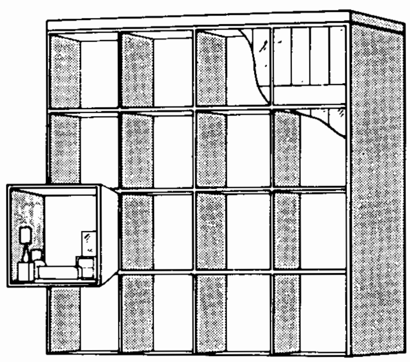
a. Walls built in place



b. Pre-fab, and "tilt-up"



c. Box-Wall Principle



Because of the nature of their interiors, mass-construction buildings offer a good solution to the problem faced by architects to provide space for certain functions. Examples here (plate number 5) represent common uses of mass construction buildings.

a. <u>Industry</u>

Industry throughout the world uses mass construction buildings to meet the need to have large, open spaces in which to conduct the manufacturing process. The necessity of providing pillars to support ceilings (necessary in large volume buildings) does not usually present a problem to the placement of machines, raw materials, etc. Building materials are usually brick, building block, or poured-in-place concrete.

b. <u>Storage, Light Industry</u>

A similar situation is encountered with buildings designed for storage and light industry. These functions also require large, open spaces; interior support pillars are not excessively inconvenient. In addition, this type of building is well suited to structures of only a single story in height. They are, thus, ideal for light industry and storage functions because their shape is compatible with the conversion from vertical intra-building movement (with elevators and hand trucks) to horizontal movement with fork lift trucks.

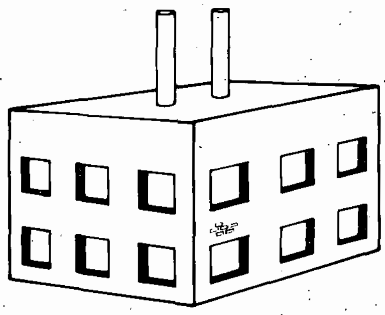
All of the common building materials are used in construction; brick, building block, reinforced concrete, "tilt-up", and poured-in-place reinforced concrete.

c. <u>Hotels, Apartments</u>

Box-wall construction provides a ready solution to the architect who seeks to provide space for human occupancy in the form of hotels and apartments. First, the cells, a product of this type of construction cannot, structurally, be of a size larger than a single room. They are, thus, ideal for hotel guest rooms. Providing for more than one room (as with apartments) requires either subdivision of the cells by non-weight bearing interior walls or forming the apartment from two or more cells. Second, the thickness of the mass walls gives good sound deadening between units. Structures may be built entirely of concrete or they may be combinations; e.g., brick walls and concrete slab floors.

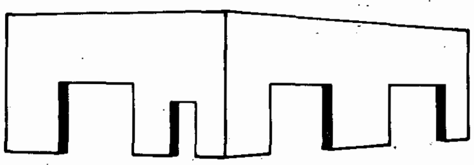
COMMON USES: MASS CONSTRUCTION

a. Industry



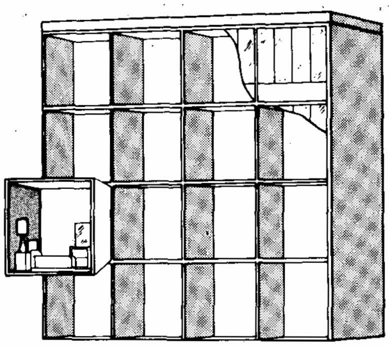
Brick, building block, or poured-in-place concrete

b. Storage, Light Industry



Brick, building block, reinforced concrete "tilt-up," or poured-in-place reinforced concrete

c. Hotels, Apartments



Box-wall principle type concrete or building block

Brick buildings (plate number 6) have a distinctive set of characteristics. These aid in their identification.

I.D. Key Number 1: Because of the dependence on the exterior wall for structural strength, it is not possible for windows and doors to exceed more than one-third of that wall unless special measures are taken (as seen in plate number 7). This characteristic is readily seen in the field and enables the observer to determine construction type from a considerable distance away.

I.D. Key Number 2: Wall integrity can be maintained only if windows are aligned vertically. The amount of wall lying between the windows provides the required load-bearing strength.

I.D. Key Number 3: The walls of a brick building are load-bearing and must be sufficiently thick to withstand loads. However, because there is more aggregate load on the lower stories than on the upper stories, the lower part of the wall must be thicker. The wall on the top story is thin (approximately 12 inches). In this example, note that the wall of the ground floor is six bricks thick (approximately 24 inches). Second and third stories are five bricks thick, the fourth floor is four bricks thick, and the top floor is three bricks thick.

I.D. Key Number 4: Differences in wall thickness may be seen and measured in wall openings. An identification problem can occur where the glazing (glass) is placed either flush with the wall's exterior or at the same distance from the face of the wall on each floor. In such instances, however, identification can be made by looking through the glass at the window's sills (bottom, side, or top).

I.D. Key Number 5: Brick arches or stone lintels above windows and doors are usually present. These help to replace wall integrity lost when openings are made for windows and doors (see details in plate number 10).

I.D. Key Number 6: Floor joists must be anchored in the side walls by some device (see details in plate number 11). Plates or wedges are used for this purpose and are often decorated.

Field Identification Procedure

Bricks are sometimes covered with a stone veneer. Because of the high expense involved, this stone veneer is placed only on the side facing the street. The true character of the building can be seen always from the rear.

Also, brick buildings are often covered with plaster to protect them from the weather. Close observation usually reveals that in some places the plaster has eroded away exposing the bricks underneath.

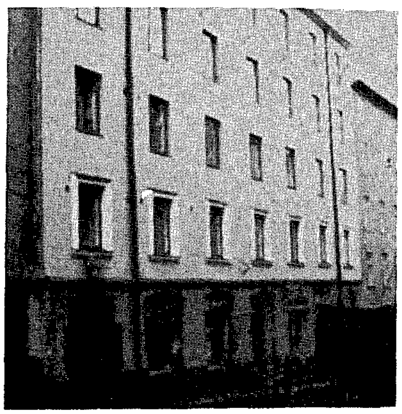
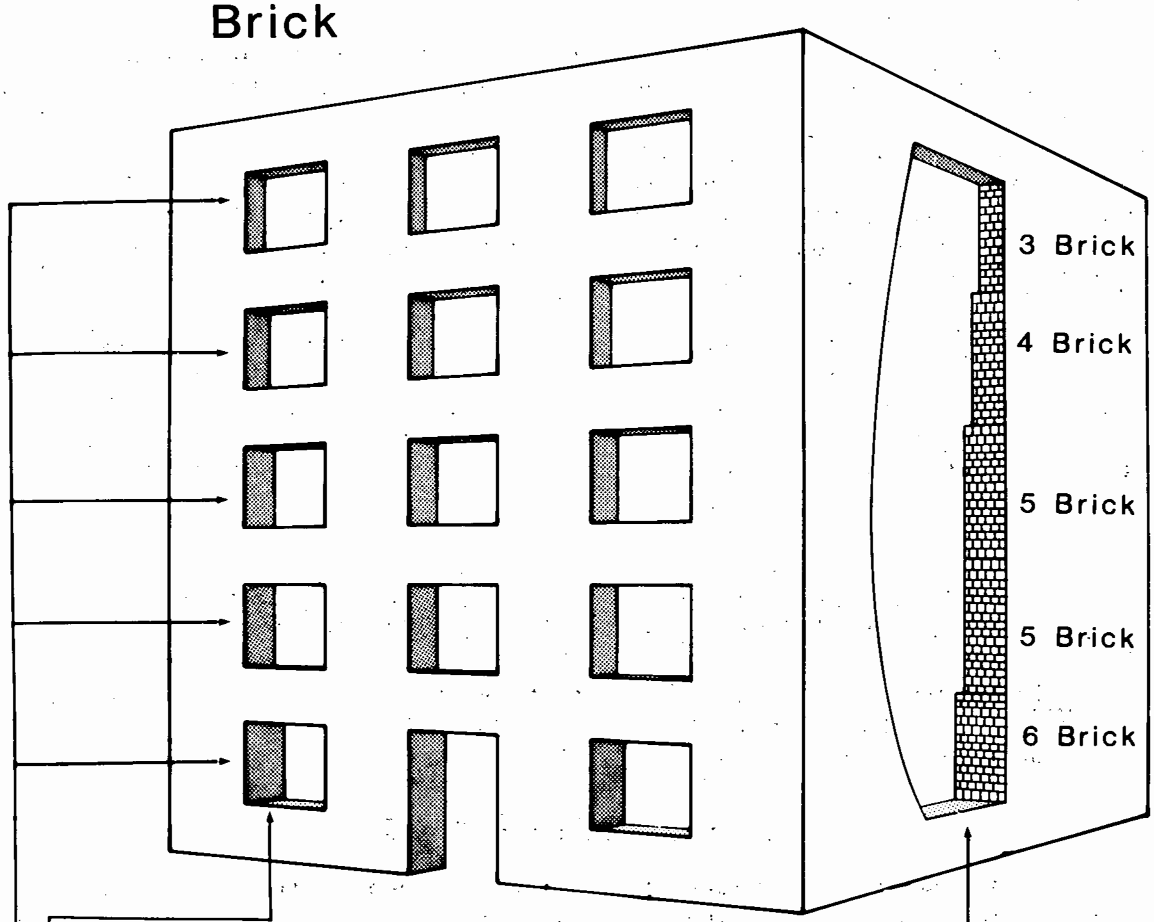


Photo: a brick building (in Helsinki, Finland) has several of the i.d. keys.

BUILDING TYPES:
I. D. CHARACTERISTICS

Mass Construction

Brick



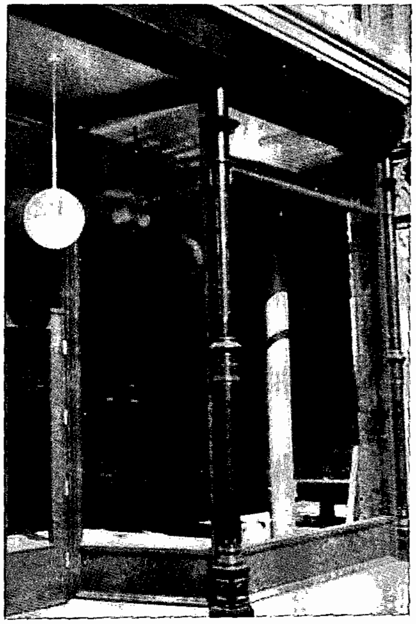
BUILDING TYPE I. D. KEYS

1. Does window area exceed 1/3 wall area?
2. Are windows aligned vertically?
3. Are lower story walls thicker than upper story walls?
4. Are windows (or doors) recessed?
5. Are there arches or other supports above windows?
6. Are there metal plates or other anchors at floor joists?

The use of the ground floor of brick buildings for retail stores (plate number 7) encounters the problem of how to provide for the full front windows required for display of merchandise, and yet allow for the support of the weight of the wall above. The solution is to place a strong horizontal beam (usually steel) at the top of the windowed area. This beam forms a "bridge" between the walls. Part of the load is directed to and borne by the side walls. Additional support for the beam is gained by pillars placed along it, within the building.

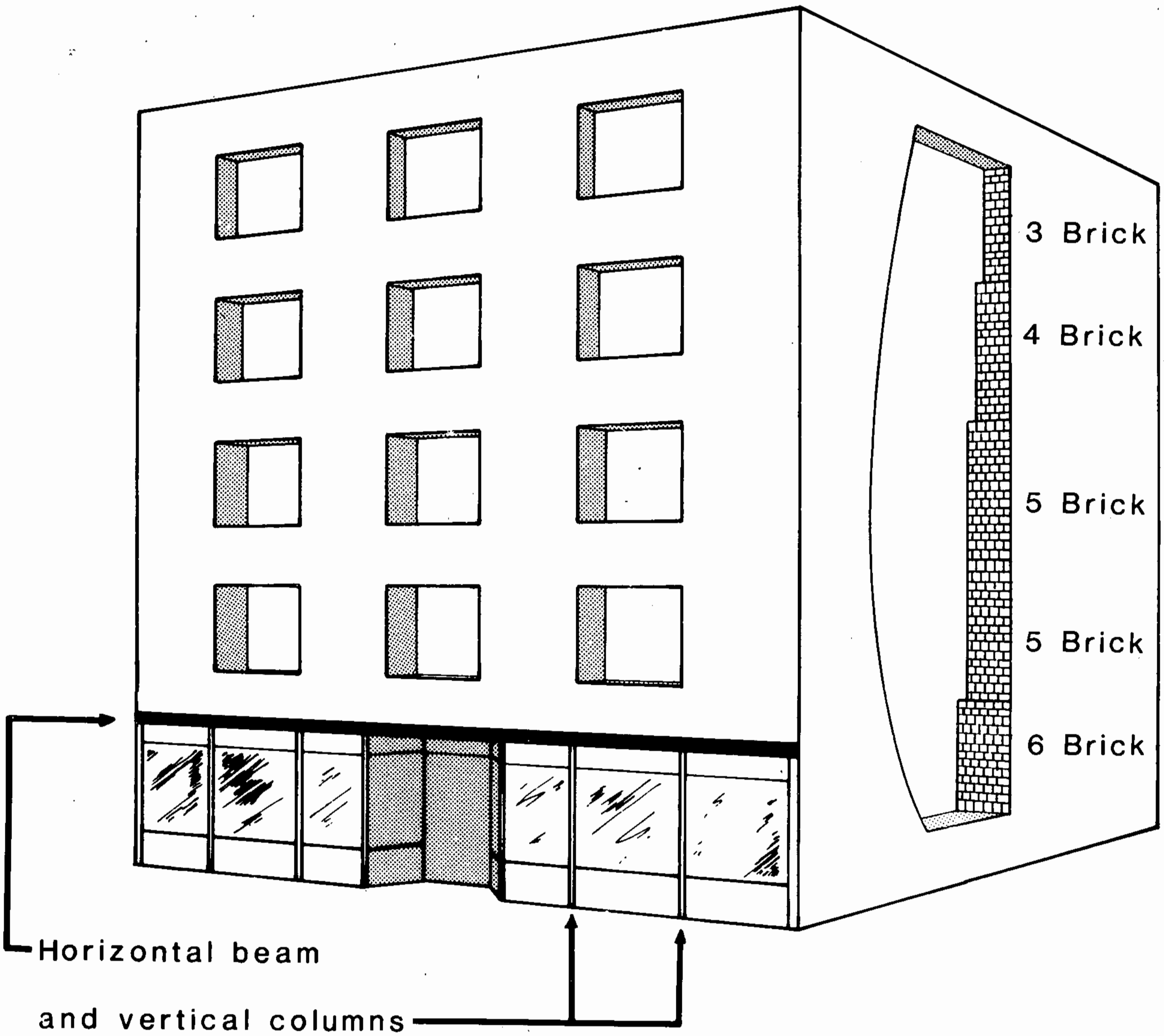
In the identification process in the field, the observer should first examine the second floor and above to locate the general identification keys associated with brick structures. He should then proceed to confirm his identification through finding the keys associated with storefronts. A note of caution: because retail stores have been modified so much and are often heavily decorated, the revealing identification may be well disguised.

Photo: A steel I-beam, lying along the top of the display window, supports the wall above it. One iron column supports the I-beam. Inside the building, another iron column supports a beam on which the floor joists lie.



BUILDING TYPES:
I. D. CHARACTERISTICS

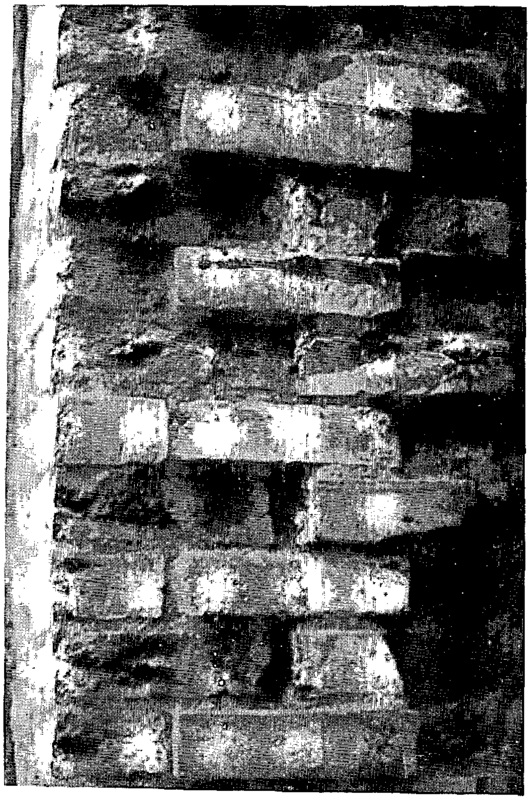
Mass Construction
Brick -- Storefront Variation



Wall thicknesses of brick buildings (plate number 8) can be easily calculated by counting the number of exposed bricks (as in a window or doorway opening). The standard method of measurement used by architects and builders is to classify a wall thickness by the number of headers (widths) involved. Thus, a two-brick wall is composed, in a normal bonding situation, of two widths (headers) or one length (stretcher) which is equal to two headers plus mortar. A three-brick wall is composed of three headers, or one stretcher and a header. A four-brick wall has two headers and one stretcher, or two stretchers. A five-brick wall has one header and two stretchers. The pattern may vary with the method of bonding used but the principle remains the same.

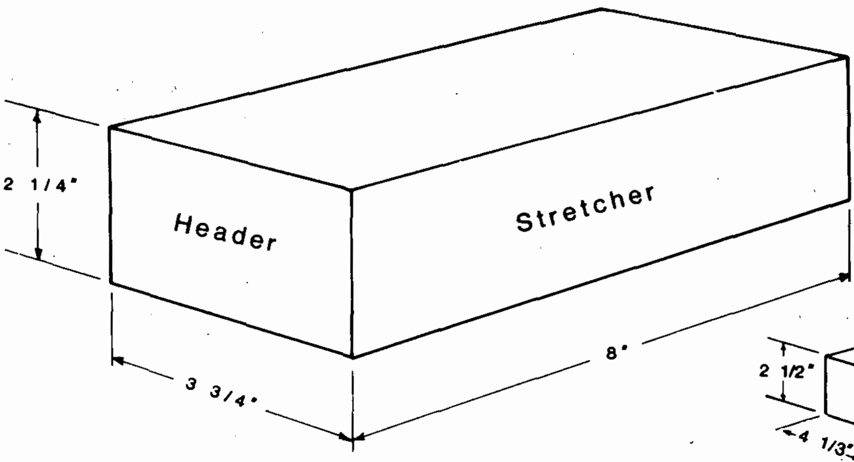
The same principle of calculating wall thicknesses of brick buildings also holds for foreign cities. Often, however, the standard foreign brick is larger than the U.S. standard; the dimensions may relate to broader building codes expressed in metric measurements. In the two examples given, the header dimension or its stretcher equivalent would be used in calculating wall thickness. Note that the larger size foreign brick does not necessarily mean that all walls are thicker than those in the U.S. Two-brick foreign walls would be 1-inch thicker than the U.S. version, but in tall buildings the thickness of ground floor walls may be the same in both instances; German walls, for instance, would just consist of one brick less.

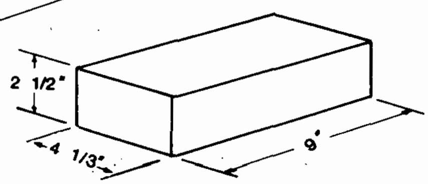
<u>Photo</u>: This wall (in Costa Rica) is classified as being four bricks thick. With mortar this example is about 18-1/2 inches thick.



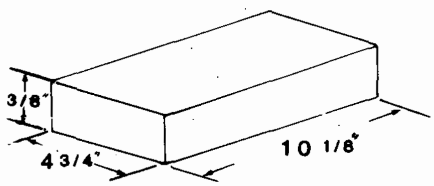
8

The Standard Brick (U.S.)





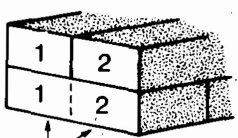
A Latin American Brick
(Costa Rican)



A German Brick

BRICK WALL THICKNESS

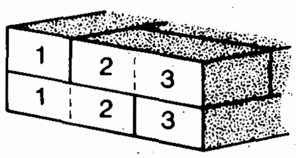
2 Brick



= 8″

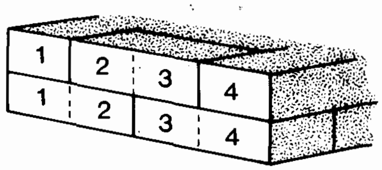
Count header equivalents

3 Brick



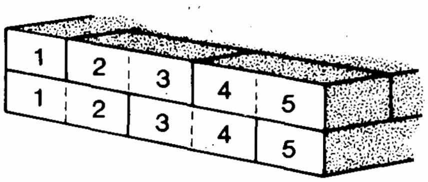
= 12″

4 Brick



= 16+″

5 Brick



= 20+″

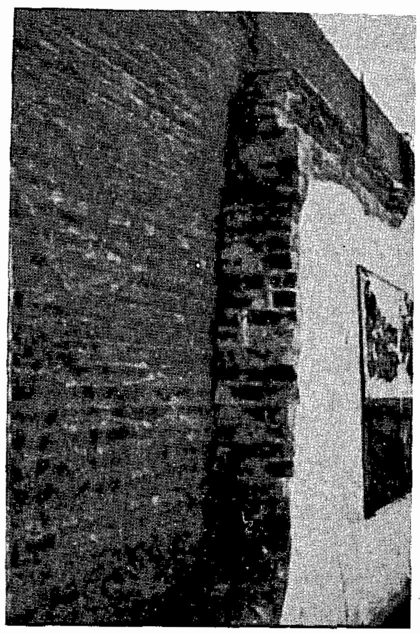
Brick buildings facing a street may have either thick or thin side walls. They are "thin" when all the building units were constructed as part of a planned whole which results in "common walls" or "party" walls between units. These walls share the loads placed upon them from both sides. A common thickness, for buildings two or three stories high, is three bricks. Row houses in cities are often constructed in this way.

The occurrence of "thick" walls, the more common situation, is where several brick buildings, along a street, have been constructed independently. Their construction must adhere to the principles set forth previously, and thus, the wall thickness of the ground floor must be sufficient to support the building as though it were a free-standing structure.

Accordingly, anyone needing to breach walls of adjoining brick buildings would encounter a "double wall." In the example, (plate number 9) (of two low buildings) a total thickness of six bricks (24 inches) would be faced. Two tall buildings could readily have a combined wall thickness of over 40 inches.

The general rule to remember (the principle being indicated in number 6) is that the breaching of walls of upper stories is easier than breaching those of lower stories.

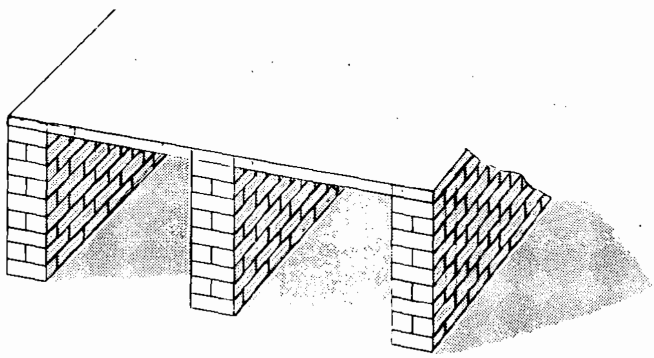
Photo: "Double wall" configuration is seen in this example where a remnant of a razed brick building abutts the side wall of a neighboring brick building.



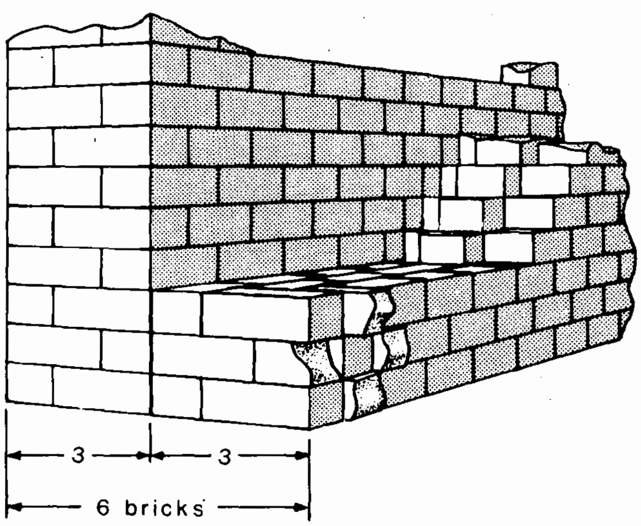
PRINCIPLES:
MASS CONSTRUCTION

Adjoining Brick Buildings

Common Wall ("Party Wall") Example



Double-Wall Example

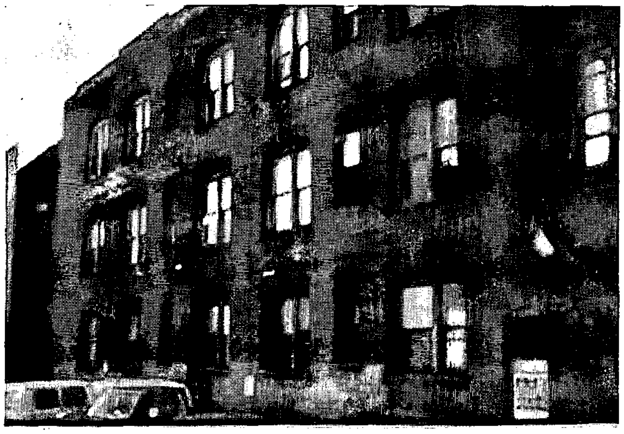


Arches over windows in brick buildings (plate number 10) serve to replace wall strength lost when window openings were made. Other means--stone arches with a keystone and flat stone lintels--are not shown.

The photos show two examples.

a.

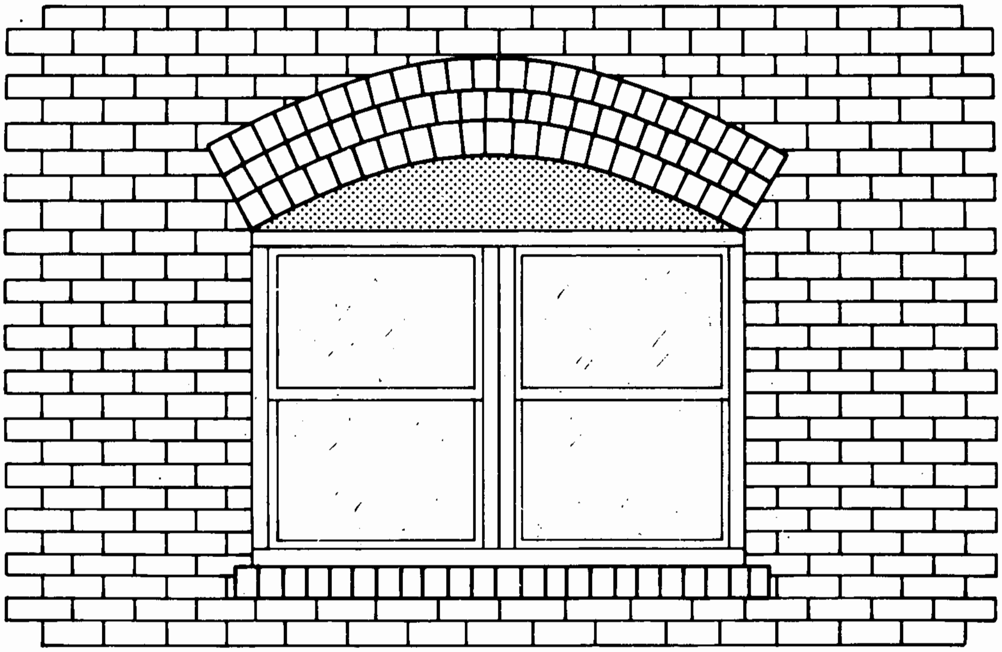
b.



BUILDING TYPES:
I.D. CHARACTERISTICS

Brick Buildings

Architectural Details



Arch Above Window Provides Strength

While brick walls have great compressive strength, they are unsuitable for floors and ceilings unless erected in the form of arches, vaults, or domes, as has often been done in constructing large buildings; e.g., churches. For buildings of lesser stature, however, the common means of supporting floor/ceilings (and flat roofs) is to use joists to "bridge" the space between the load-bearing walls. Floors, ceiling, and roof materials are then placed on the joists. Wooden timbers have been used widely throughout the world for this purpose because of their high tensile strength and ease of shaping.

The drawing (plate number 11) illustrates how the shaped ends of the joists (the pinions) are fitted into prepared niches (mortises) in the brick walls. They are then anchored with a bolt placed through a hole drilled in the wall. A plate (or similar device) is then attached to form a permanent, rigid anchor. The photos provide examples of both inside and outside.

Photo a: The holes (mortises) into which joists were fitted shows in this view of an exposed inner face of a wall in Schweinfurt, FRG.

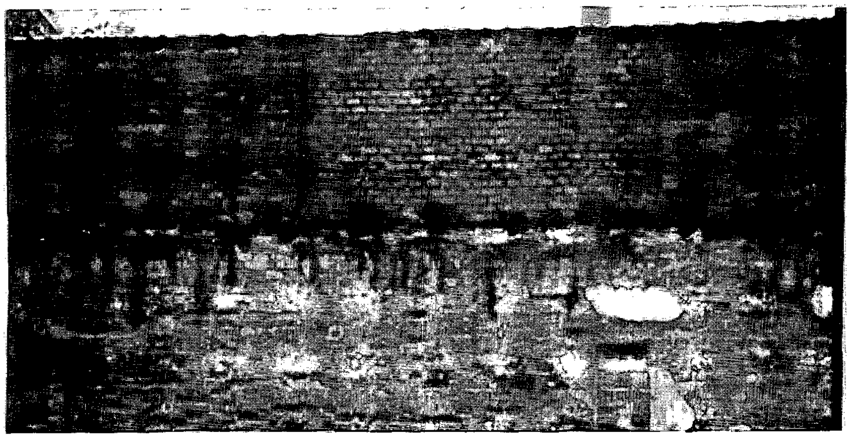
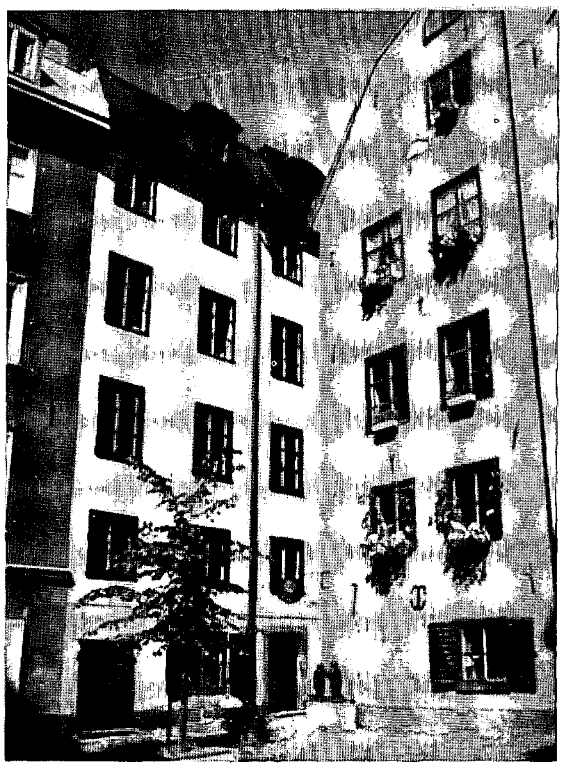


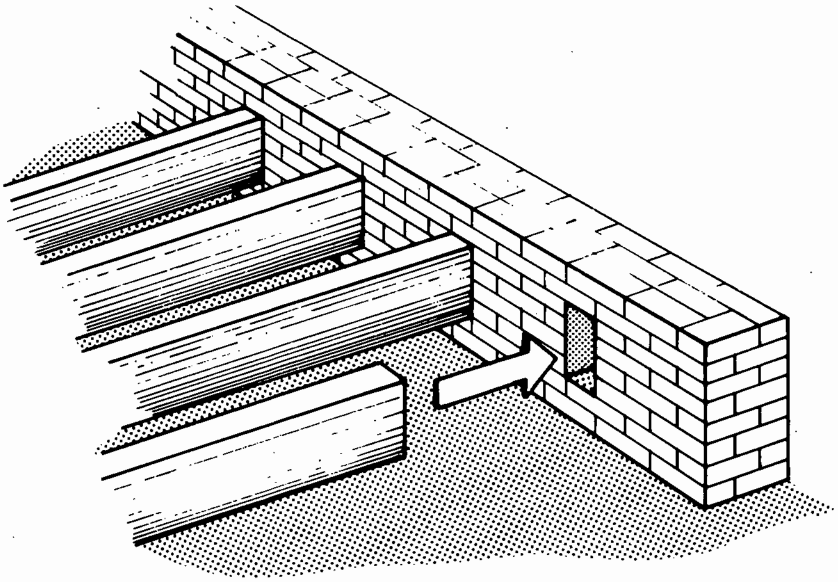
Photo b: Decorative joist anchors are visible here on an outer wall of a brick building in the old city, Stockholm, Sweden.



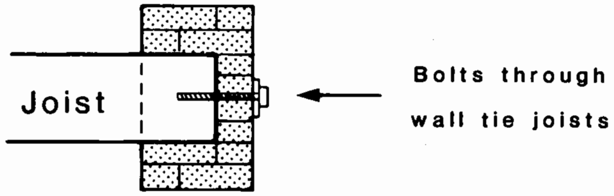
BUILDING TYPES:
I.D. CHARACTERISTICS

Brick Buildings

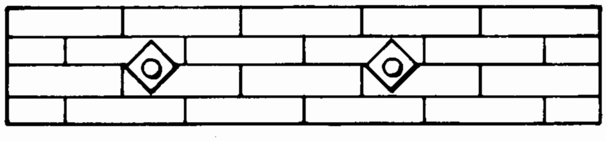
Architectural Details



Joists inserted into walls to support floors



view in section



end view of metal plates on outer wall

Both construction characteristics and function (plate number 12) are used to identify these buildings.

I.D. Key Number 1: Buildings of this type are frequently used for storage or light industry and thus have little requirement for natural light. Or, large area structures of the type used for industry will provide light to the entire floor area through the employment of "sawtooth skylights" placed in rows. As with any mass construction building, window and door openings in the walls detract from building structural integrity.

I.D. Key Number 2: Also, in accordance with construction principles, the walls must be strong enough (therefore, thick enough) to support loads. In addition, these walls may have reinforcement bars within them but the presence and amount varies regionally with building codes, and these, in turn, reflect allowance for local conditions; e.g., earthquakes or general levels of the economies of regions and countries.

I.D. Key Number 3: These buildings are usually simple in design and are normally box-like in shape. Excessive indentations and corners are not present because there is no need to add "wings" to provide natural light to all rooms. Also, the simpler the design, the lower the construction cost, an important fact in buildings designed for mundane functions.

I.D. Key Number 4: There is no need to give these buildings high pitched roofs. The usual device is to support the roof with a low arch, or a truss. Or, they may have a "sawtooth skylight" roof.

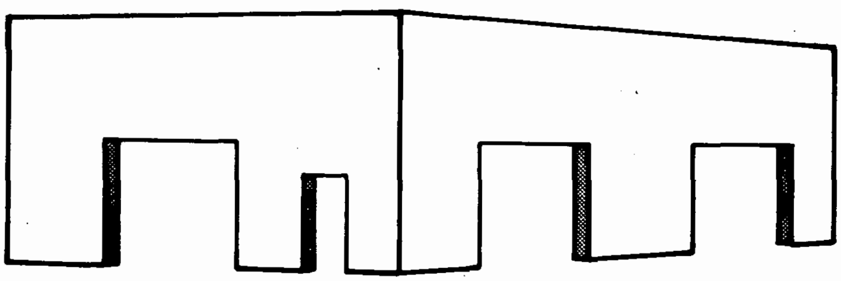
I.D. Key Number 5: Most of these structures consist of but a single story. Because of the functions they serve, however, they are often fairly tall (up to 20 feet).

A recent advanced variation is to place a second floor in these structures to be used for office space. Interior load-bearing support is then employed.

BUILDING TYPES:
I. D. CHARACTERISTICS

Mass Construction

Reinforced Concrete "Tilt-Up"/
Poured-in-Place Reinforced Concrete



BUILDING TYPE I. D. KEYS

1. Is there a large area of unvented wall?
2. Are the walls thick (8" - 10")?
3. Does the building have an angular shape?
4. Does the building have a low roof profile?
5. Does the height exceed 1 - 2 stories?

Box-wall principle buildings (plate number 13) have several distinctive features which aid in their identification. Also, not only is their form of construction very simple but, being a recent development, they follow the mode of modern planning in that they frequently are placed well back on their lots. They are thus readily visible from all sides.

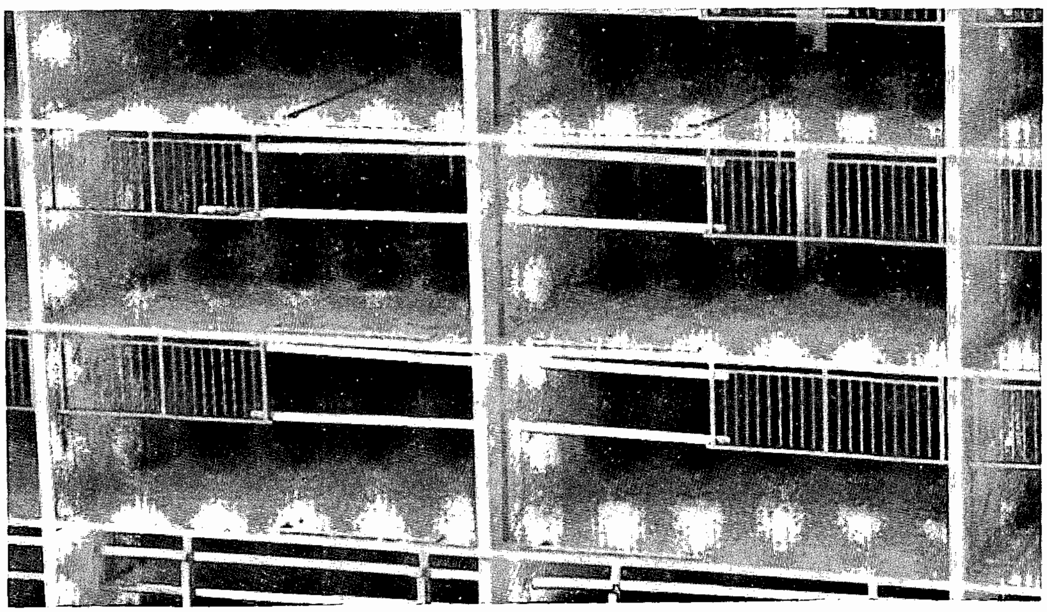
I.D. Key Number 1: The most obvious key to identification is that commonly all the cells of which the building is composed are the same size. The outer edges of all four sides of these cells (floor, ceiling, and walls) can usually be seen. Each cell contains but a single room (e.g., a hotel); small ("studio") apartments may have internal nonload-bearing partitions. Each cell is often fully vented on the side of the cell facing the outside as this is the only place to gain natural light.

I.D. Key Number 2: Because of the need for mass to support the structure, the structural members (both walls and floor/ceilings) must be fairly thick (usually 6 to 8 inches); walls are ordinarily a little thicker than floor/ceilings.

I.D. Key Number 3: The use of floor/ceilings as part of the structural support means that, unlike brick buildings, the walls have the same thickness throughout the whole height of the building. This feature is most obviously seen in the end walls.

I.D. Key Number 4: To keep their structural integrity, all the walls, both external end walls and internal walls, have few if any openings for doors and windows. Often, end walls have small windows vertically aligned in the center where they provide natural light to stairway landings on each floor.

Photo: In this studio apartment, box-wall construction building under construction, the walk and floor/ceilings are seen. Note also the studs to form nonload-bearing portions within the cells.

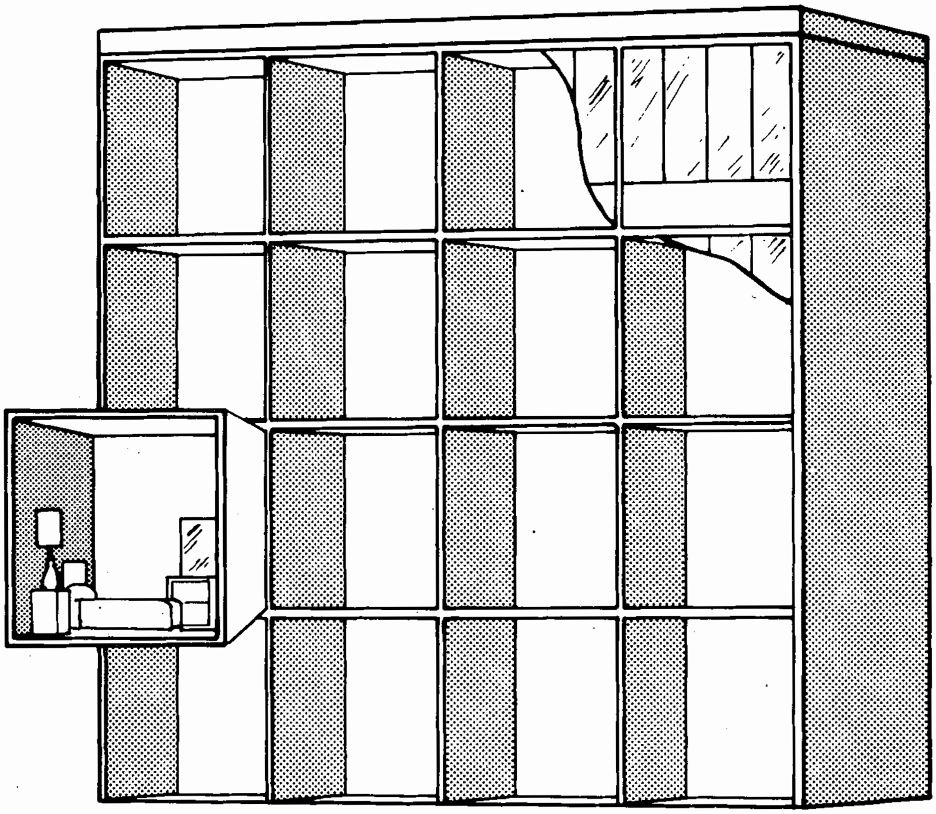


BUILDING TYPES:

I.D. CHARACTERISTICS

Mass Construction

Box-Wall Principle Type



BUILDING TYPE I. D. KEYS

1. Are building cells uniform in size (often fully vented)?
2. Do the floors, walls, and ceilings have a uniform thickness of 6" - 8"?
3. Do the walls have the same thickness on each story?
4. Do the end walls usually have few windows?

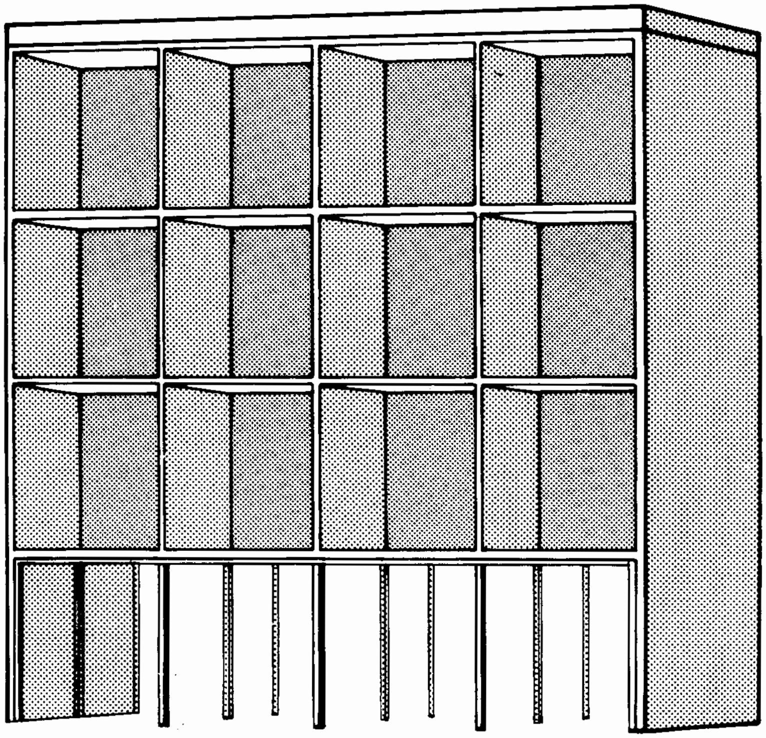
The natural internal pattern of cellular rooms of the box-wall principle buildings (plate number 14) is well suited to providing small, fixed, hotel guest rooms. However, these same small cells are poor solutions to the problem of forming the large, flexible spaces needed for public assembly rooms, hotel lobbies, and automobile parking. The solution usually employed in these instances is the use of heavy reinforced concrete columns for the lower story or two. Nonload-bearing walls can thus be used to enclose the large area rooms required. The columns are capped by a slab ceiling on which the cells, which constitute the remainder of the structure, can rest. Field identification is usually quite straightforward for little attempt is made to disguise the form of construction of these buildings.

BUILDING TYPES:
I.D. CHARACTERISTICS

Mass Construction
Box-Wall Principle Type

Hotels and Apartments

Ground Floor Variation



Often ground floor has framed construction -- allows for lobbies, meeting rooms, offices, parking, etc.

Note: Rooms are usually larger than those of upper stories.

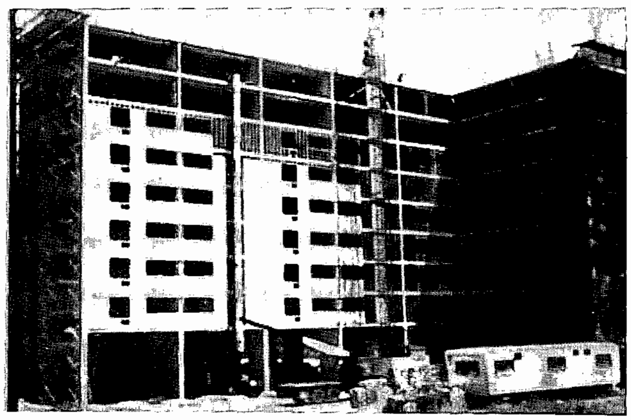
The use of box-wall principle construction for apartment buildings, (plate number 15) rather than hotels, results in some variations in external appearance. In the upper drawing, the use of balconies is demonstrated. Balconies are very commonly employed in apartment design providing a unit's only outlet for fresh air and "outside living."

Also illustrated in the cutaway is an example of the studs used to support an interior nonload-bearing wall. In this instance, the room so enclosed is vented by the window: the sliding glass door gives access to the balcony.

Another approach to design of box-wall principle apartments is seen in the lower drawing. Here, the structural members are covered by a thin curtain wall. Determination that this is a box-wall structure can usually be made on close inspection based on such clues as the thinness of the curtain wall material, the linear shape of the whole building, some exposure of slab floors, or an exposed end wall at ground level.

Photo a: This box-wall principle apartment building in Berlin has balconies.

Photo b: Cladding on this apartment building under construction obscures view of the edges of the walls and floor/ceilings.



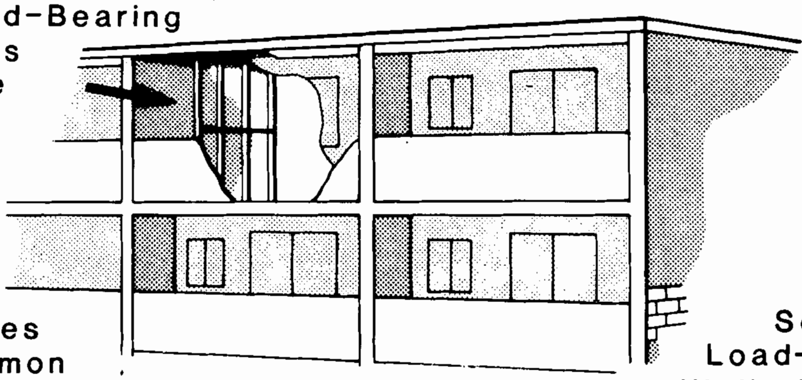
15

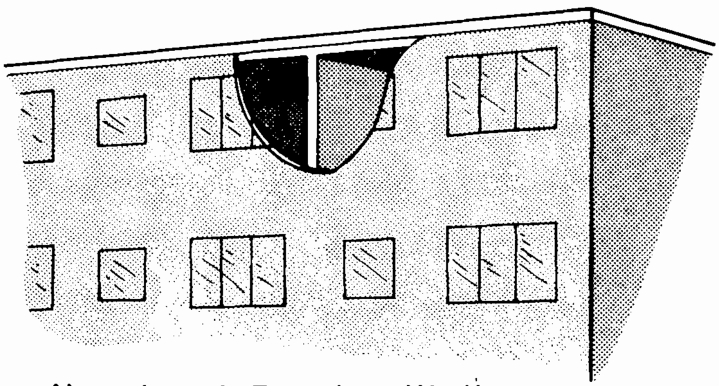
BUILDING TYPES:

I.D. CHARACTERISTICS

Mass Construction
Box-Wall Principle Type

Apartment House





Sometimes Non-Load-Bearing Walls:

a. Obscure "cells"

b. Have different window sizes

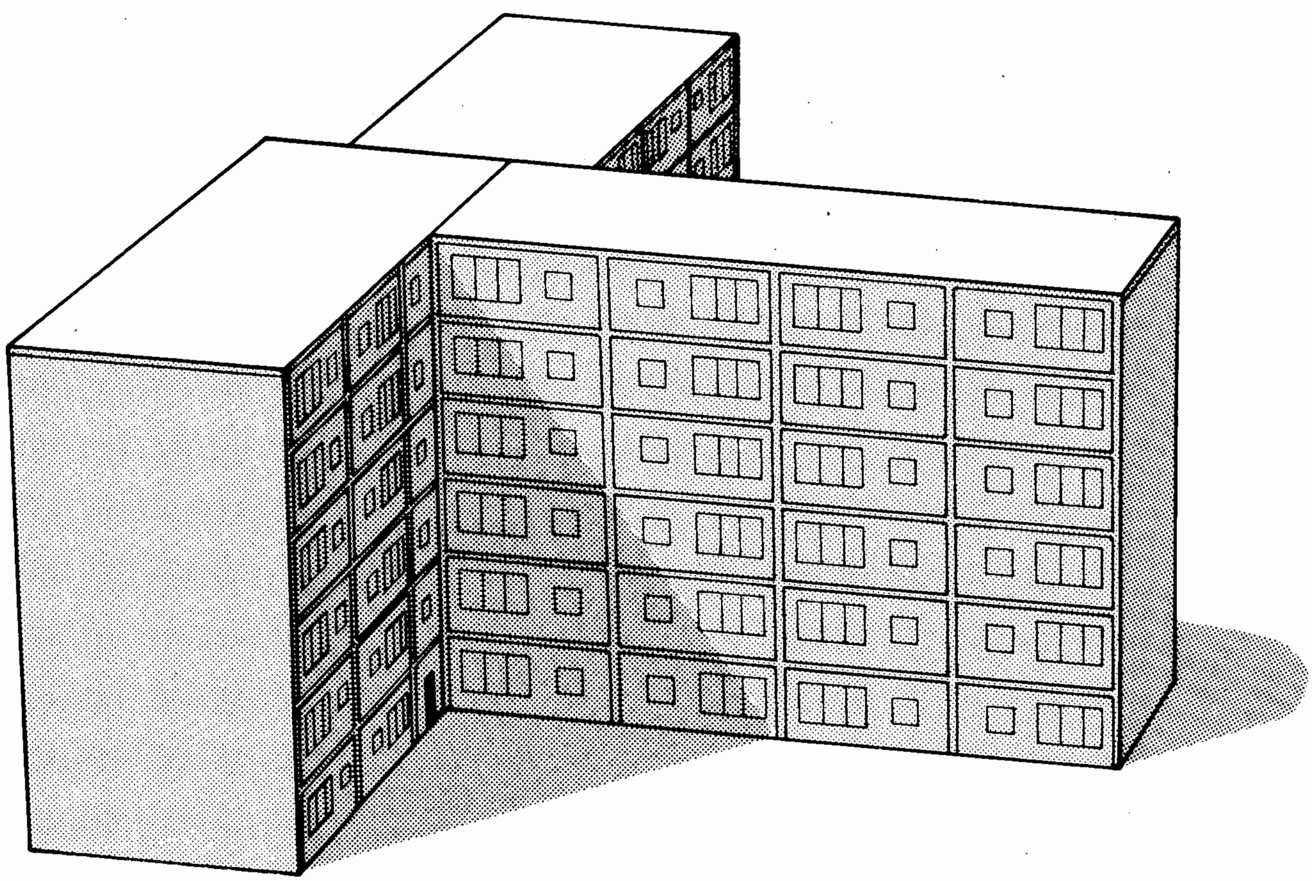
The box-wall method of construction is becoming popular in many parts of the world. The basic theme has also been elaborated upon. Most important among these is the use of several modules of cells to form a building with several "wings" or subdivisions. The purpose of this drawing (plate number 16) is simply to alert the observer that not all box-wall buildings have the simple rectangular shape shown in the preceding drawings. Fortunately, for the observer, the same individual identification keys of dominant features are still to be found.

16

BUILDING TYPES: I.D. CHARACTERISTICS

Mass Construction
Box-Wall Principle Type

Multiple Module Variation



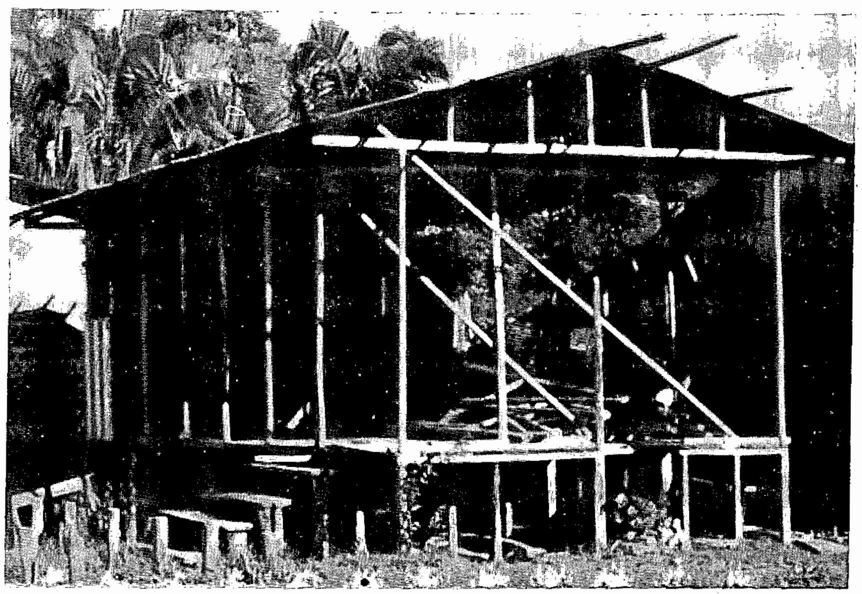
The other major solution to the problem of supporting load is framed construction (plate number 17). While in mass construction technique the entire weight of all loads is borne by the outer walls (with secondary support of floors from interior posts where necessary), all of the load in framed construction is carried by framed members, columns, and beams. The drawing illustrates how both forms of load--horizontal and vertical--are directed along horizontal beams to the vertical columns and thence to the foundation solidly anchored in the ground itself.

The bearing of load by frame members has the vitally important characteristic of removing any weight (load) bearing responsibility from the walls. The nonload-bearing walls are thus only "curtains" whose main function is to provide protection from the weather. Accordingly, there is no need for these curtain walls to have any bulk or mass.

Several characteristics which are important for military purpose thus accrue. First, unlike what is true for mass construction buildings, wall thickness is unimportant. Because there is need only to protect the frame and the interior of the building from the weather, the walls need only to be thick enough to perform this task. A wide variety of materials meets this need. Glass windows alone are sufficient. Or, where greater protection against the elements is required or insulation is desired, these curtain walls may be made of other light weight materials, such as fiberglass or aluminum. However, for esthetic purposes or to achieve an appearance of a mass construction building, curtain walls made of brick or light-weight concrete material are employed.

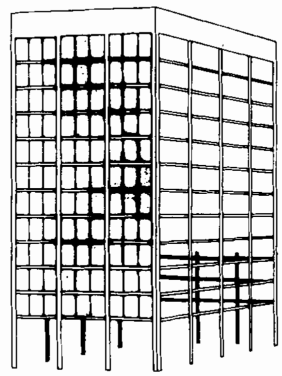
A second primary characteristic is that curtain walls have the same thickness throughout their entire extent. This contrasts sharply with mass construction buildings with their load-bearing walls which are thicker on the lower stories than they are on the upper stories. Thus, curtain walls provide far less cover than do mass construction walls.

Photo: The simplest possible frame is seen in this example from the upper Amazon region of Peru.

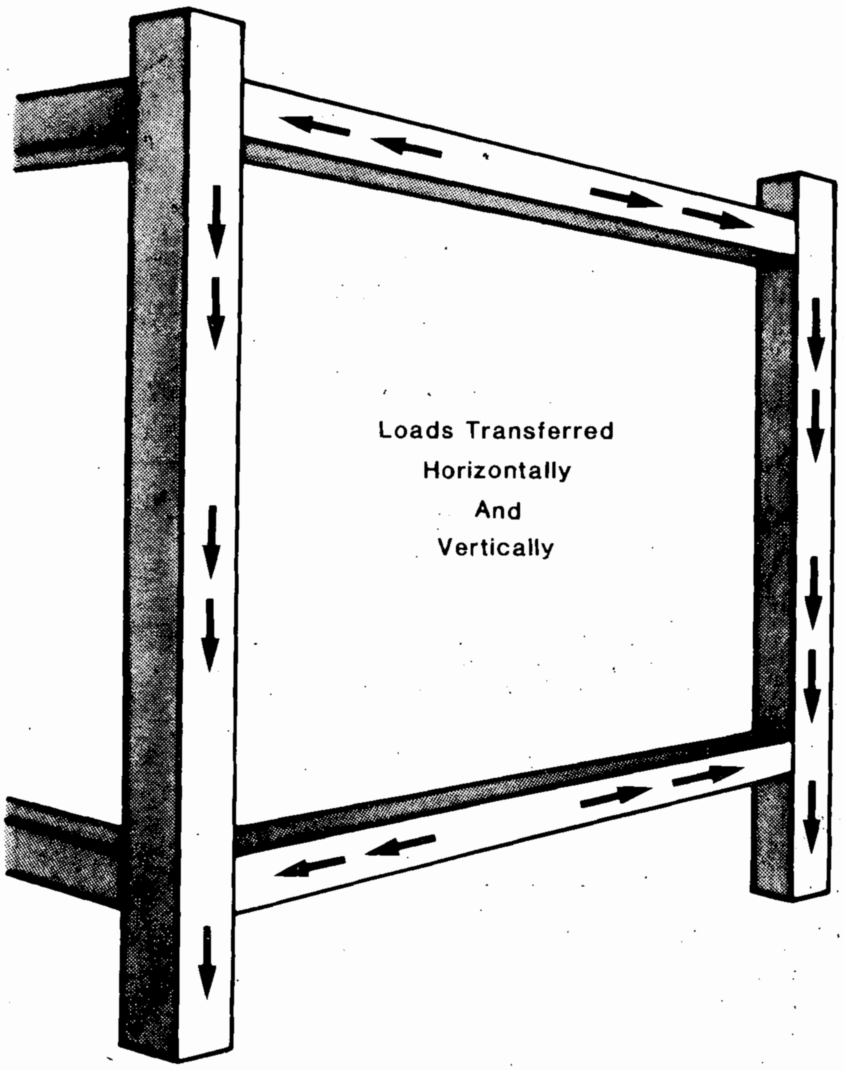


17

PRINCIPLES: FRAMED CONSTRUCTION



Load Bearing



The practice of employing framed construction techniques for load bearing is not new. The use of wooden timbers for columns (called posts in this case) and beams was widespread in various parts of the world where wood was abundant. Excellent examples are still standing today in many villages and towns in northwestern Europe.

The principles of this construction method, for a typical post and beam building in Germany, are portrayed in the drawing. The posts and beams, and their bracing, are placed upon a mass construction principle foundation of either stone or brick; the same technique is commonly employed in the U.S. today with balloon frame houses whose foundations are low concrete walls. In the example, (plate number 18) shown here, properly called a "half-timbered" structure, the vertical members are not long, continuous members but rather extend for only one story at which point they are butted into the beams. This is accomplished by the placing of a fitted end of the column (a pinion) into a cavity cut into the beam (a mortise). The bond between the two is anchored with a dowel. Rigidity to the frame is added through the use of diagonal bracing.

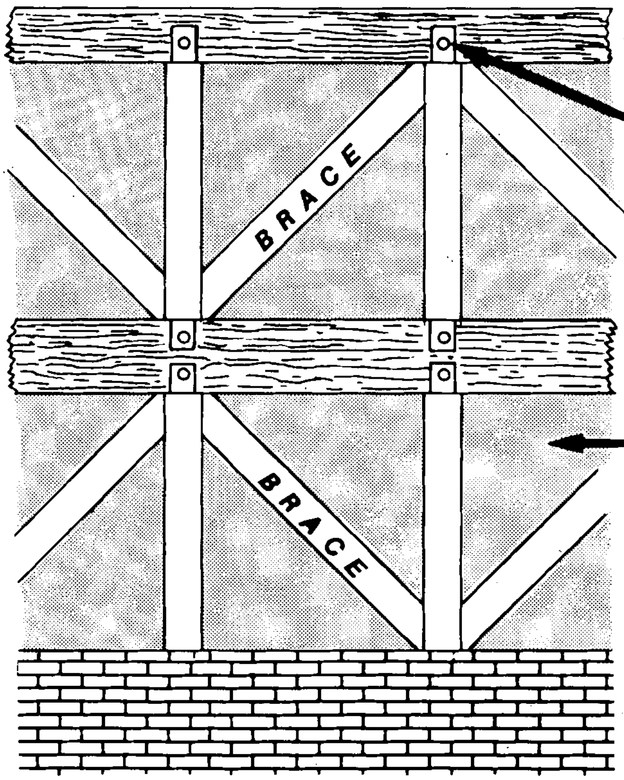
Buildings of this type, especially those seen in the older sections of European towns, often have one or more stories extending outward by a foot or two over the story below. The floor, therefore, is cantilevered. This was done for the practical reasons of (1) providing more floor space than was possible on the ground floor (and, incidentally, more natural light, a desired feature in gloomy northwestern Europe), (2) protecting the lower floor from the weather, and (3) to counterbalance the load which the upper part of the building and the roof exert upon the frame in the interior part of the structure.

As with any framed structure, the use of a frame obviates the need for structural strength in the walls. Wall material, accordingly, is often only straw and mud, or brick. The principle holds that these walls are fairly thin, only as thick as the posts and beams (some 6 to 10 inches depending on the quality and size of the building). All walls in buildings of this type should be easily breached, even with hand tools. Clearly, they provide little cover to defending forces.

Photo: Doweled half-timbers form the frame; in-fill made of straw and mud forms the nonload-bearing wall.

PRINCIPLES: FRAMED CONSTRUCTION

General: Wood Post and Beam Principles



Brick or Stone Foundation

Sometimes Cantilevered To:

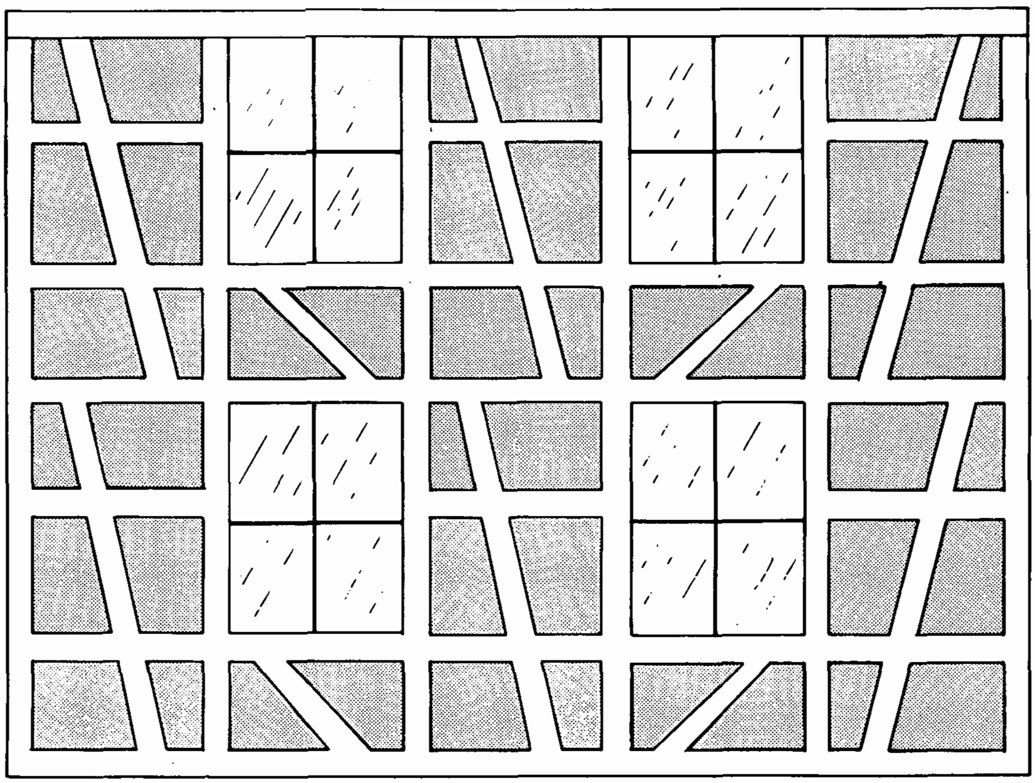
1) Provide More Space
2) Protect Lower Floor From Weather
3) Counterbalance Load On Inner Part Of Frame

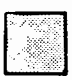
Post and beam construction buildings, especially those built with short posts, beams, and braces and conventionally titled "half-timbered," often exhibit on their exterior walls the sort of intricate patterns demonstrated in the drawings (plate number 19). There are also many examples, however, where both the timbers and the in-fill material are commonly covered with plaster or stucco. The construction method is the same, and in both cases the walls offer very little cover and should be easily breached.

Photo: A framed (half-timbered) form of construction sits atop a mass construction ground floor. Note arches over doorway and window on ground floor and that the ground floor wall is obviously much thicker than the framed wall above.

Sub Type:

Half-Timber - Typical Wall





Non Load Bearing In-fill

Frame Members And In-fill May Be Covered With Plaster

Half-timbered houses with exposed frame members are easily identified. Those whose framing is plaster covered can be identified by using the identification keys. Complicating the procedure, however, some structures have the ground floor of mass construction and an upper floor with framed construction (plate number 20).

I.D. Key Number 1: The walls are no thicker than the frame members (some 6 to 10 inches). An old masonry building of two or three stories would have floor walls about 16 inches thick.

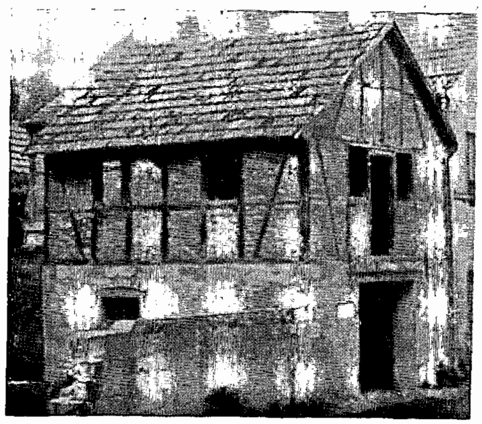
I.D. Key Number 2: For the same reason, the thickness of the walls is the same throughout the height of the building. They are not load-bearing and thus do not need to be thicker on the lower floors.

I.D. Key Number 3: The framing or bracing is commonly visible at some point on the building. Even if the structure is plaster covered, there is often some point at the rear of the building where the timbering is revealed. Sometimes, a part of the frame is exposed where the plaster has been worn or chipped away.

The part mass, part framed building has equally distinctive characteristics. They are, in fact, excellent text book examples of the two primary forms of construction existing within a single building.

I.D. Key Number 1: In such structures, the walls of the ground floor are noticeably thicker than those of the upper floor(s). The general appearance is markedly different as the photo illustration indicates.

I.D. Key Number 2: The walls are thick because of the need to bear the load of both sections of the building (usually visible in window or door frames). Arches over windows and doors may be present and there are few windows.



20

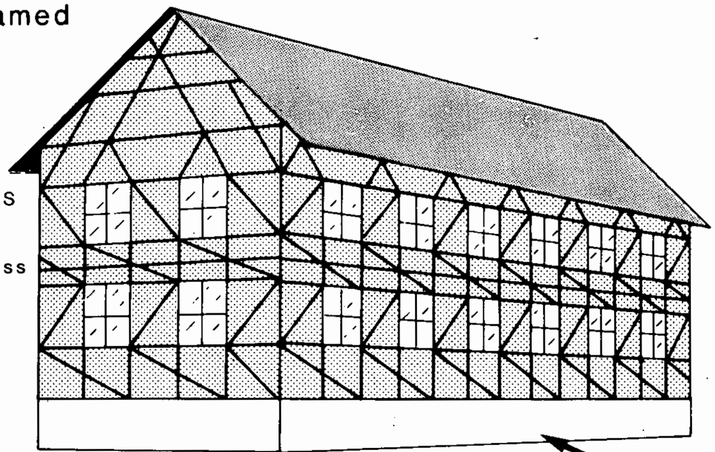
BUILDING TYPES: I.D. CHARACTERISTICS

Half Timbered and Partly Half Timbered Houses

All Framed

Building Type I.D. KEYS

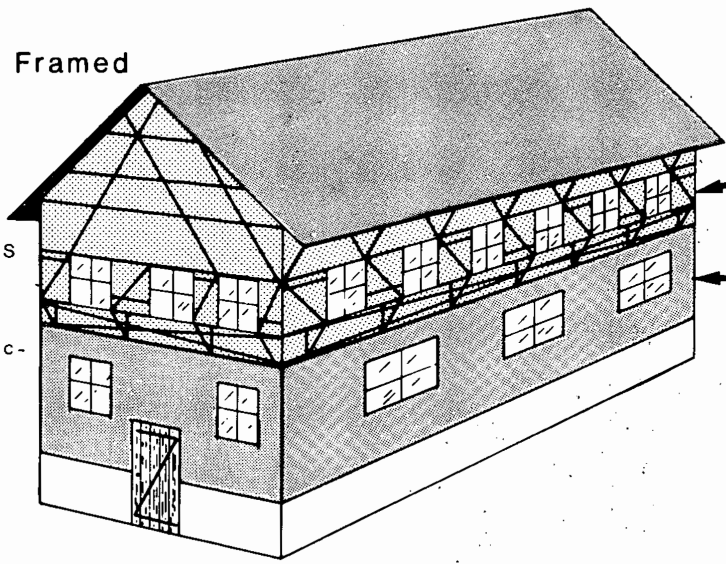
1) Walls appear thin
2) Walls same thickness all floors
3) Framing or bracing showing anywhere



Part Mass, Part Framed

Building Type I.D. KEYS

1) Ground floor walls thicker than upper stories
2) Other mass construction keys evident
   a) Thick walls
   b) High proportion of wall



NOTE: BOTH TYPES MAY BE PLASTER COVERED

The introduction of skeletal frames for large buildings (in the 1890's) ushered in the era of the skyscraper. To overcome the general public belief that framed buildings were not as strong as mass construction buildings, the designers obscured the frame with a masonry-like heavy cladding made of brick and/or stone veneer (plate number 21). Note the insets of wall material. The ground floor often has a stone veneer cladding and the upper floors commonly have brick cladding. Accordingly, the identification of such buildings must depend on the observation of a series of other identification keys.

I.D. Key Number 1: The first step in identification is to note the height of the building. The observer should suspect that most buildings taller than six stories are framed.

I.D. Key Number 2: Being framed, these buildings have a high proportion of windows because the frame, rather than the walls, bears the loads of the building. This is especially true of office buildings; hotels, however, usually have fewer windows (commonly only one window per guest room).

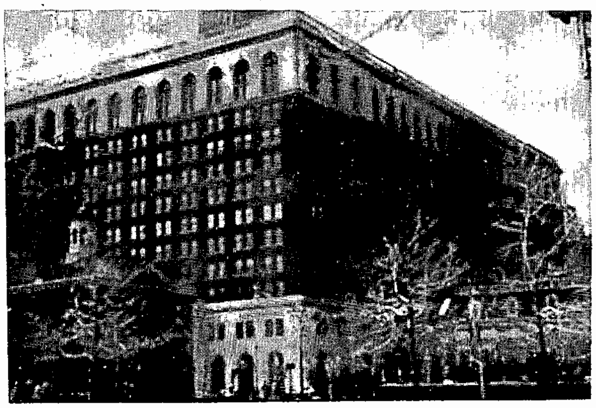
I.D. Key Number 3: The exterior walls have the same thickness throughout the entire height of the building.

I.D. Key Number 4: The uniform thinness of the walls is also apparent by the fact that the windows are not recessed. The observer must look into the windows to note the thickness of the wall into which they are set.

I.D. Key Number 5: Frame members (the columns) are commonly visible at some point usually on the ground floor. They are also evenly spaced (20 to 25 feet apart). The eye should be allowed to follow observed columns at ground level upward in the structure. Windows are always set between the columns.

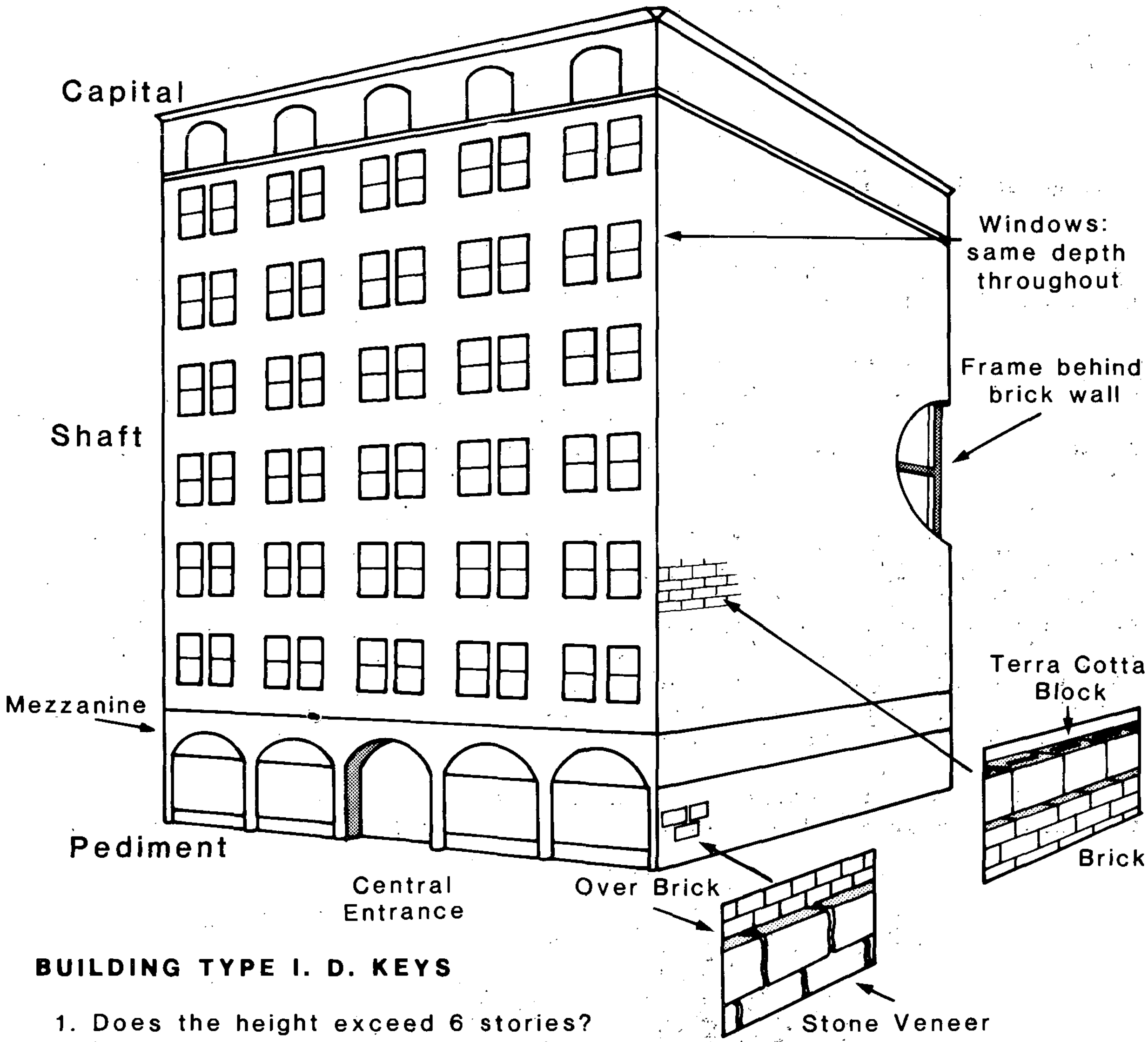
I.D. Key Number 6: The style of framed, heavy-clad buildings often followed classical lines. To make the building appear more massive, the ground floor forms a heavy looking base called the pediment. It usually has large windows, heavy appearing columns, and often has a mezzanine (partial second floor). The main part of the building is the shaft and is uniform in appearance with the same type of cladding throughout. The top floor(s) (the capital) is a lesser version of the pediment and may have large windows and decorative columns.

Photo: Classic features of pediment, shaft, and capital are seen in this framed, heavy-clad office building in Philadelphia.



BUILDING TYPES:
I. D. CHARACTERISTICS

Framed, Heavy Clad



BUILDING TYPE I. D. KEYS

1. Does the height exceed 6 stories?
2. Is there a high proportion of windows (if office or store) on the stories above the ground floor?
3. Is the thickness of the outer wall the same throughout the building?
4. Are windows not recessed?
5. Are frame members showing?
6. Does the building have classic styling (pediment, shaft, capital)?

Experimentation was conducted by architects with framed high-rise buildings during the 1920's and 1930's in an attempt to get away from the stereotyped forms which had developed. Their efforts produced these first modern appearing heavy-clad framed buildings (plate number 22). Several features serve to identify these buildings.

I.D. Key Number 1: Recognizing that the proportion of venting in framed buildings could be quite high, the architects opted to fill all the wall space between columns with windows.

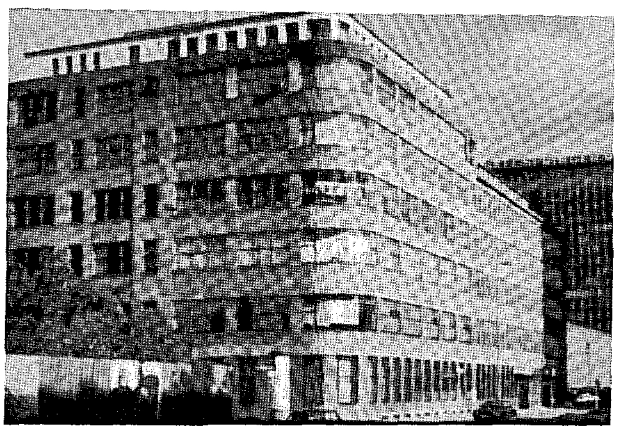
I.D. Key Number 2: The intentionally large area of windows gives these structures an appearance closer to that of the more recent light-clad structures which were built following World War II. Early attempts in Germany used spandrel-type window treatment (see plate number 29).

I.D. Key Number 3: A further refinement and one adding to the modern appearance, was the use of curved windows. Opaque glass bricks were sometimes employed.

I.D. Key Number 4: A modified structural appearance was also achieved by placing curved windows at the corner of the structure. This bold architectural statement demonstrated that the strength of framed buildings (unlike those of mass construction buildings) was not dependent on massive corners.

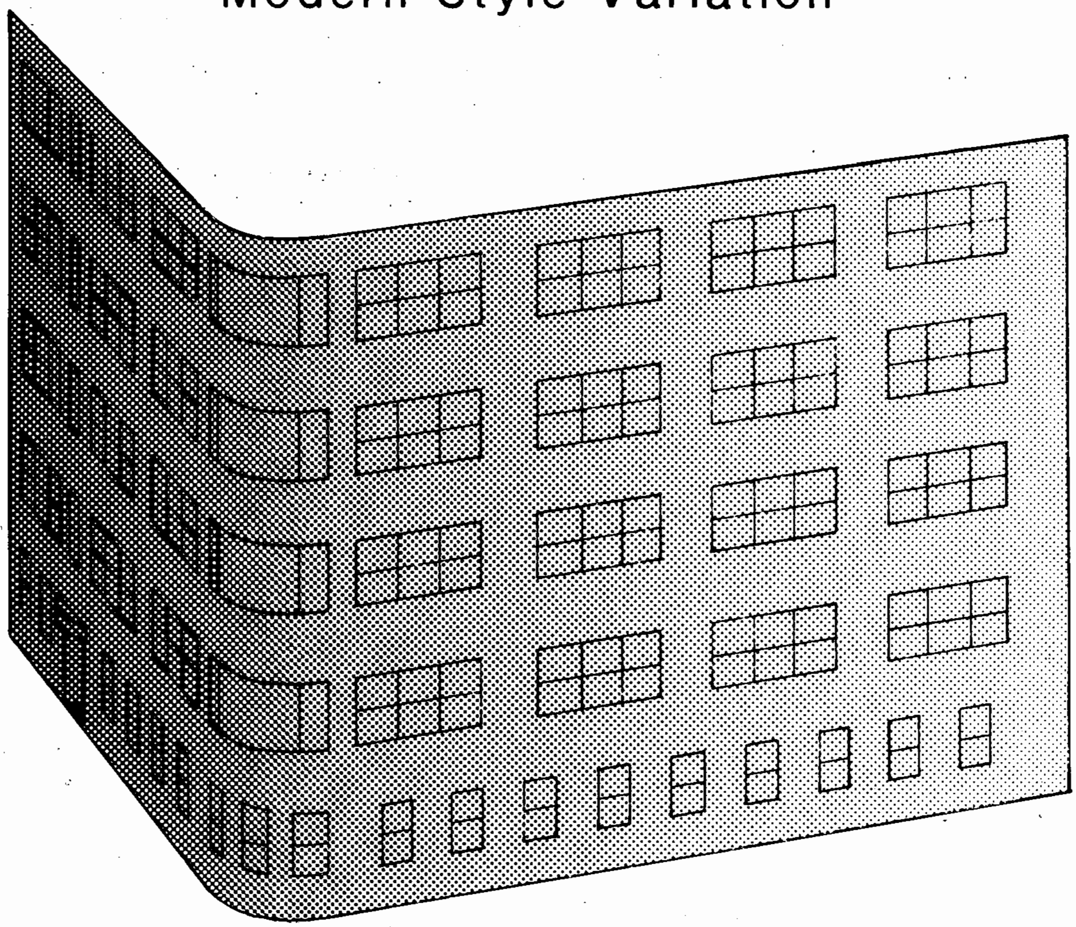
I.D. Key Number 5: The break with tradition was completed with the elimination of the classical forms of pediment, shaft, and capital. All the lines of the building were smooth and modern and were of a type possible only with the use of framed construction. The departure, seen in light-clad buildings, of giving the structure only a curtain wall "skin" awaited the introduction of post World War II designs.

Photo: This building in West Berlin (located, incidentally, only a short distance from the wall) is a good example of the 1930 German "modern" architecture and illustrates well the points made here. Some semblance of pediment, shift, and capital were retained in the design.



BUILDING TYPES: I.D. CHARACTERISTICS

Framed, Heavy Clad
Modern Style Variation



BUILDING TYPE I. D. KEYS

1. Is there a high proportion of windows?
2. Is the window pattern similar to those found in framed light-clad buildings?
3. Are there curved windows?
4. Does the building have a curved corner?
5. Are classical features (pediment, shaft, capital) absent?

Framed, heavy-clad structures have proven to be ideal solutions to the problem of providing space for conducting the functions of manufacturing, warehousing, and vehicle parking, (plate number 23). Of particular importance are the lack of interior load-bearing walls and the possibility of receiving the maximum amount of natural light through large windows. Accordingly, these buildings have very distinctive features and are easy to recognize in the field through application of the identification keys.

I.D. Key Number 1: Commonly, these buildings will have a maximum proportion of their exterior walls devoted to windows to provide maximum light as deeply inside these large structures as possible. The cladding between the windows simply covers columns and beams.

I.D. Key Number 2: With the large area devoted to windows, it is usually possible to see the columns inside the building. Because of their role in supporting the balance of the frame of the building and not just the floor above, columns are either steel I-beams or fairly thick reinforced concrete; buildings with a similar function but having mass construction (and thus thick exterior walls) would have thin iron columns.

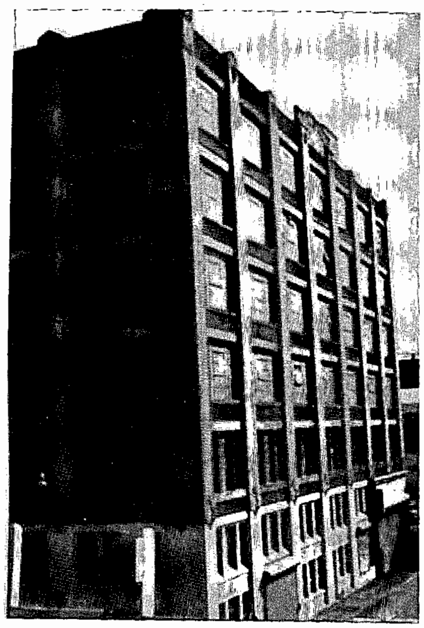
I.D. Key Number 3: The big advantage of framed construction, here, is the provision of large open-bay interior space, especially for manufacturing, storage, and vehicle parking. This character is usually readily seen through the large windows.

I.D. Key Number 4: Note the presence of loading docks and large doors on the ground floor as another positive identification key.

I.D. Key Number 5: The top of the roof of such structures will usually have ventilation devices as required by the functions and the usual broad dimensions of such buildings.

Photos: a and b show examples of the I.D. keys.

b.

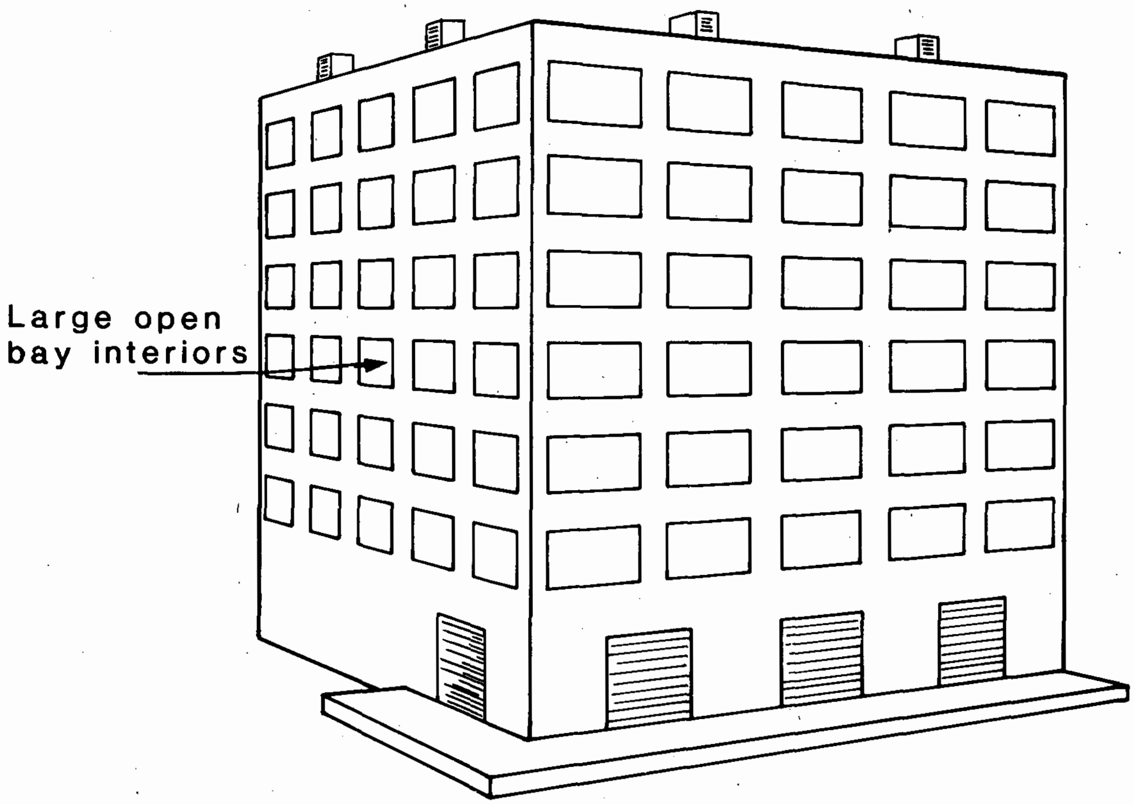


a.

BUILDING TYPES: I. D. CHARACTERISTICS

Framed, Heavy Clad

Factory, Storage or Parking Garage Variation



BUILDING TYPE I. D. KEYS

1. Is venting as full as possible (for natural light)?
2. Are columns visible through the windows?
3. Does the building have open bay interiors?
4. Are there loading docks and large doors on the ground floor?
5. Are there ventilation devices on the roof?

Framed, light-clad skyscrapers, (plate number 24) the symbol of the downtowns of modern cities, have been built in great numbers since the early 1950's in cities throughout the world. They are important to urban terrain analysis because of their large numbers in the valuable core areas of cities and because of both the opportunities and constraints they present for military operations. They present an ideal solution to the problem of multiplying expensive land space several fold as they can attain great heights at relatively low cost and provide large interior areas for office space.

I.D. Key Number 1: The style is almost quite simple and without ornament; classical forms such as pediment, shaft, and capital are lacking.

I.D. Key Number 2: The exterior walls of the building are kept intentionally thin (where there are no windows, walls are but a few inches thick; although, on occasion, there may be several inches of air space between inner and outer elements of the wall causing the walls to appear thick). This thinness is readily perceived by the observer, particularly in contrast to heavy clad and mass construction buildings.

I.D. Key Number 3: Columns and beams can ordinarily be observed somewhere in the structure. The most likely place to look is on the ground floor where columns may be exposed either in large rooms or in arcades open to the outside. Columns are also usually visible through the large windows.

I.D. Key Number 4: These structures normally have high proportions of windows. (See section on venting types.)

I.D. Key Number 5: To aid identification, the observer should consult the section on venting types. These buildings will have one of those types or some variation.

I.D. Key Number 6: This form of construction is used especially for tall buildings (exceeding at least four stories).

I.D. Key Number 7: In many instances, these buildings have been placed in newly built or in redeveloped areas where modern planning practices call for considerable air space between structures. There are many instances in older cities where framed structures have replaced older individual buildings and have been built to fill the lot completely, thus exposing only the front and rear of the structure.

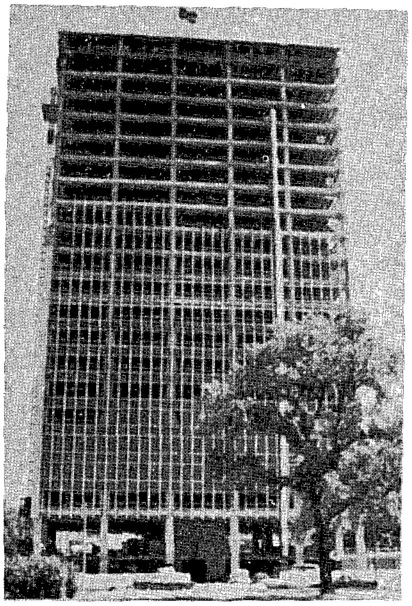
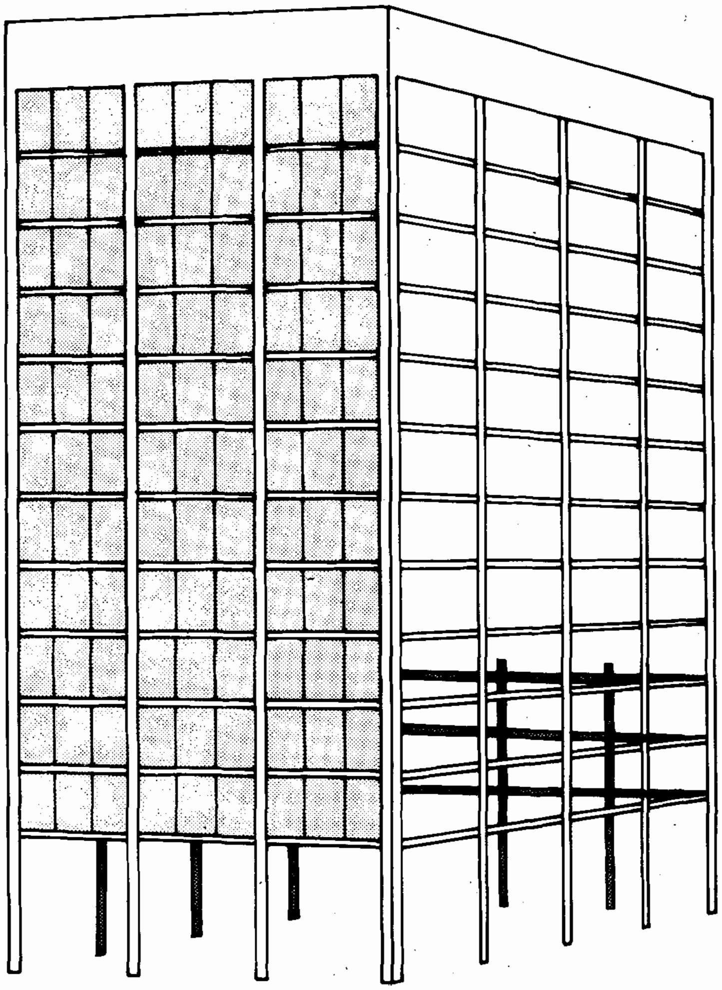


Photo: A framed light-clad building under construction in Kansas City.

BUILDING TYPES:

I. D. CHARACTERISTICS

Framed, Light Clad



BUILDING TYPE I. D. KEYS

1. Does the building have a simple, modern style?
2. Does the outer "skin" appear thin?
3. Is the frame visible? On the ground floor? Through the windows? At the sides, rear?
4. Is there a high proportion of windows?
5. Is the window pattern one of the major classes for framed, light-clad buildings?
6. Does the height exceed 4 stories?
7. Is the building physically separated from others?

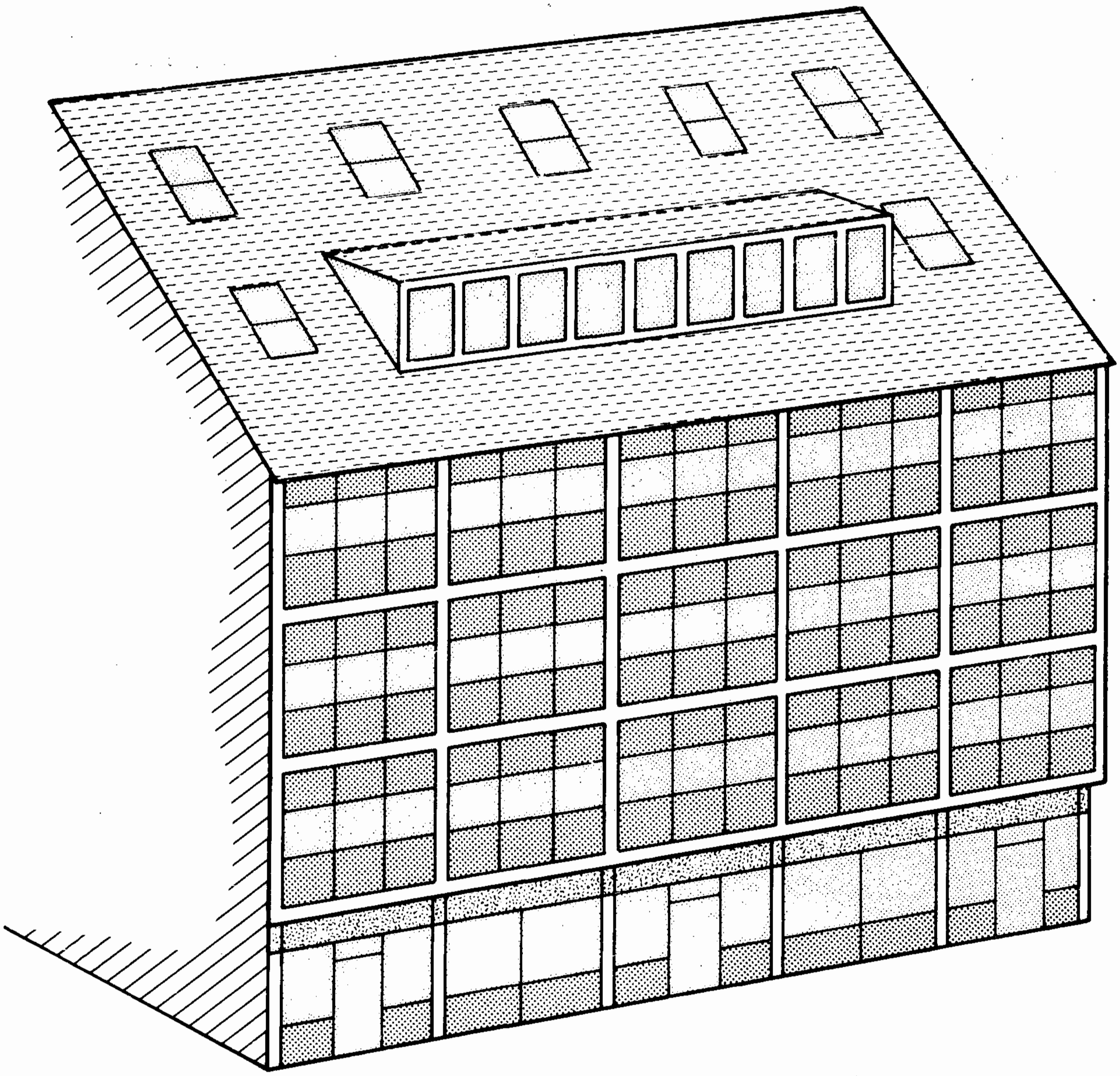
Although framed, light-clad buildings usually have a modern style, there are instances when the architect will impart a different style to the building. In this example (plate number 25), in Germany modern framed construction is employed because of its efficiency and low cost but the styling is traditional in keeping with existing, older structures. In such instances, these buildings are replacements for older structures and thus have only the front wall exposed; the side walls being abutted to adjoining buildings. This variation is used in Germany only in older sections of cities where architectural homogeneity is sought. Also, these buildings, because they are meant to conform to older, generally low-rise buildings, are only a few stories in height. Many high-rise, framed, light-clad structures in Germany have flat roofs and a modern appearance.

The principal departure in style is the use of the pitched roof; with a flat roof, these buildings would look like their modern styled counterparts elsewhere. The pitched roof, presence of sky-lights, and dormer windows presents a departure from the traditional.

Photo: A framed, light-clad building used as a furniture store in Schweinfurt, FRG.

German Variation:

Light Clad With Pitched Roof



Represented here are several examples (plate number 26) of uses of large buildings employing framed construction methods. Heavy- and light-clad framed structures combined form a large proportion of all buildings in city core areas.

There are two variations of the framed, heavy-clad structures; one an office and the other a hotel. They are essentially the same type of structure with the difference in function being manifested in different venting types. The office has two (or more) windows per room to allow for more natural lighting while the desire for privacy and less street noise causes hotels to have but a single window per guest room.

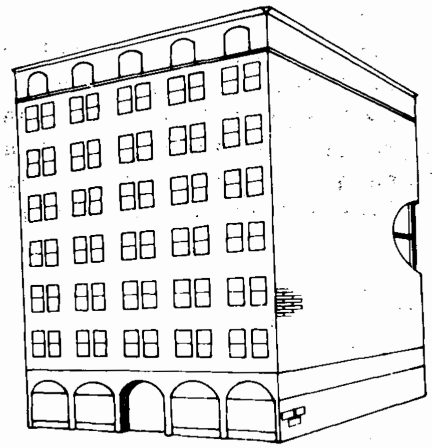
The example of the framed, light-clad structure is that of an office building; a very common type.

The modern, framed parking garage example has no windows at all and may be said to have no cladding. Structurally, however, it is the same as any framed building with the exception that floors and frame are made extremely heavy to withstand the high load factors of automobiles. Also, the roof is, thus, many times stronger than an ordinary roof. Therefore, it has the potential military advantage of providing a considerable degree of cover and could support a helicopter.

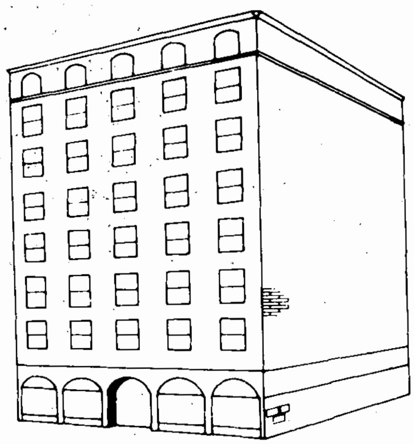
COMMON USES: FRAMED CONSTRUCTION

Large Building Examples

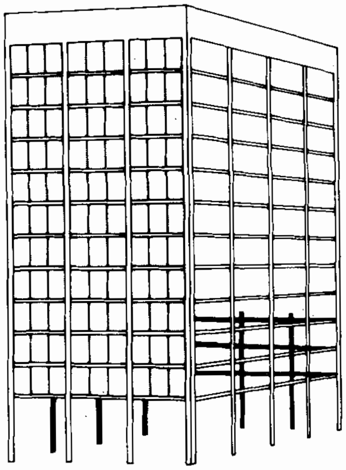
Heavy Clad
Office



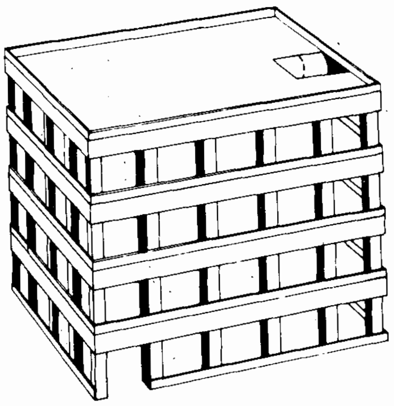
Heavy Clad
Hotel



Light Clad
Office

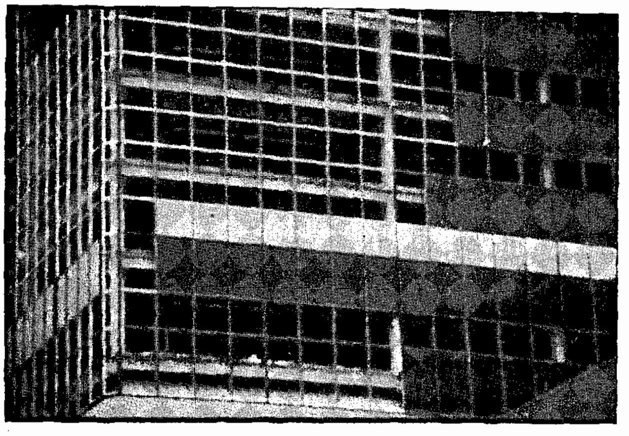


No Cladding
Parking Garage

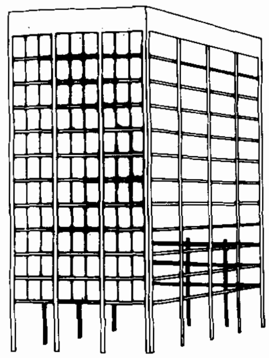


The concept of a "curtain wall" is seen most clearly in the framed obscured type of venting on framed, light-clad structures (plate number 27). The "curtain wall" has simply been hung on the outside of the frame. The columns may be visible through the windows unless they are of the mirrored variety which allows the interior to be seen only when backlit artificially at night. The "curtain wall" may be made entirely of glass, some clear and some opaque, or the non-window section may be composed of some other lightweight material such as fiberglass or aluminum.

Photo: A curtain wall being placed on a framed, light-clad building in Nashville, Tennessee.



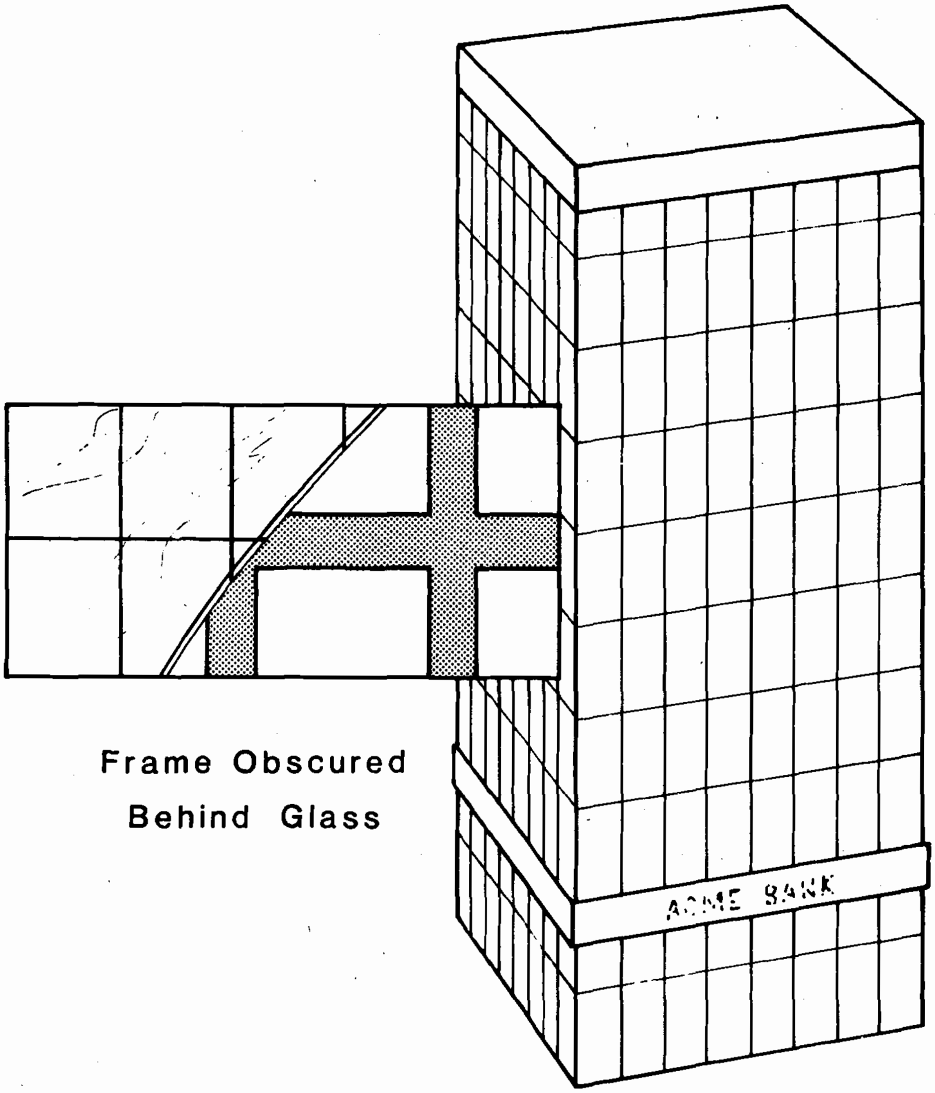
FRAMED CONSTRUCTION



Light Cladding

Venting Types

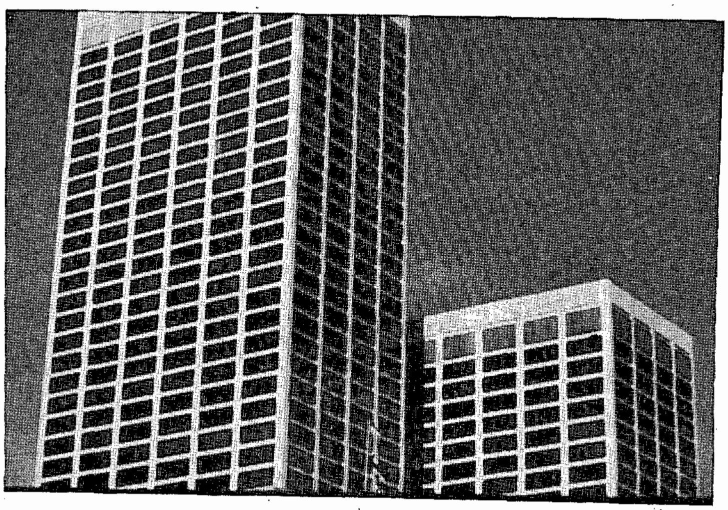
Frame Obscured



Frame Obscured
Behind Glass

A very common solution to the venting problem of framed, light-clad structures is simply to place the glass between columns and beams. The term <u>in-fill</u> is applied here (plate number 28). It comes from its usage to indicate the filling in of solid material between frame members, as in the case of half-timbered houses. The entire space between the frame members may be glass, or part of it (usually the lower section) will be composed of some lightweight opaque material.

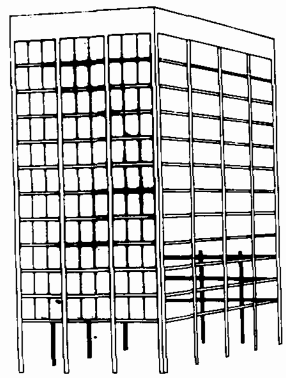
<u>Photo</u>: Two buildings with in-fill windows in Atlanta.



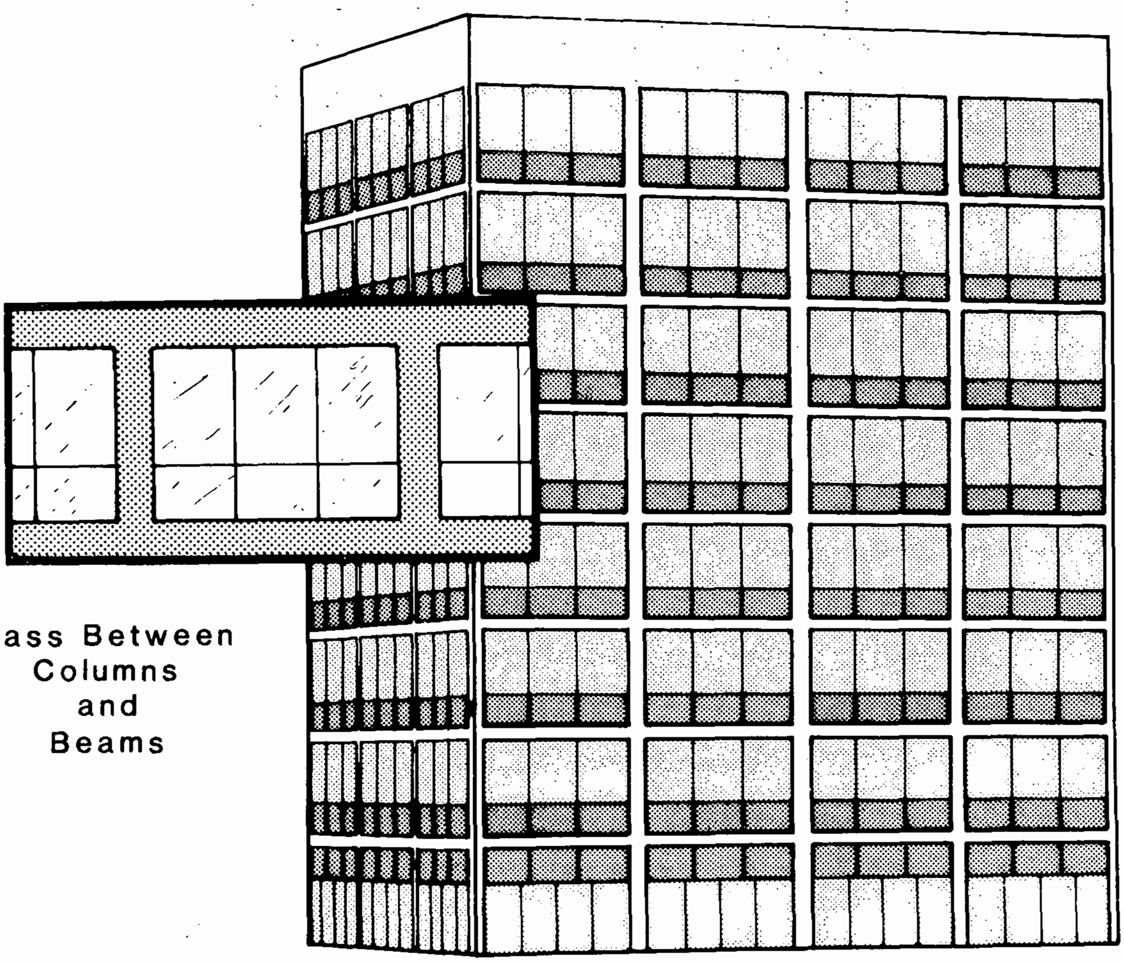
FRAMED CONSTRUCTION

Light Cladding

Venting Types



In-Fill



Glass Between
Columns
and
Beams

A form of venting particularly common in Europe is that called spandrel (plate number 29). The name is applied because the windows are horizontal in form and the area between them covers the principal horizontal beams (the spandrel) for each floor. As the window line is generally long and unbroken, it is possible to see columns sitting at their regular intervals behind the windows.

The windows in this type generally form only one-half or less of the height of a single story. Therefore, venting patterns of this type provide a greater degree of concealment than the two previous types. Because of the lightweight nature of the opaque wall, however, the amount of cover provided is minimal.

Photo a. This office building in Stavanger, Norway, has a spandrel window pattern.

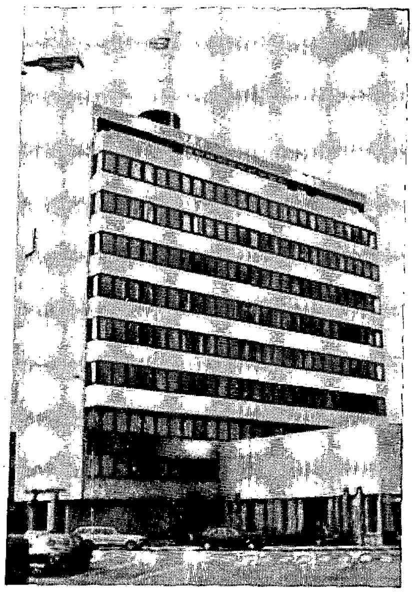
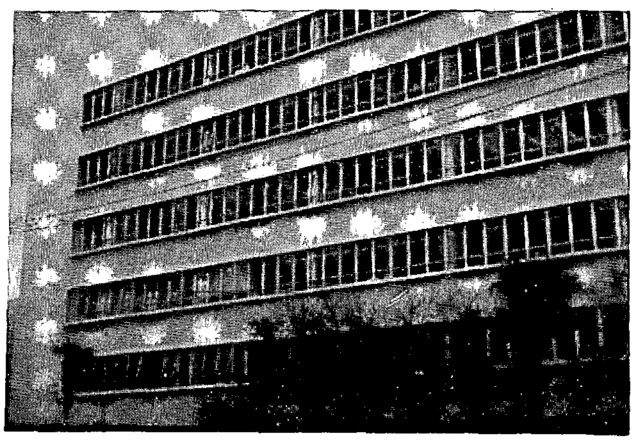


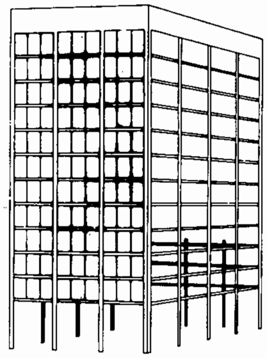
Photo b. Columns (of the frame) are seen through the spandrel windows of this building.



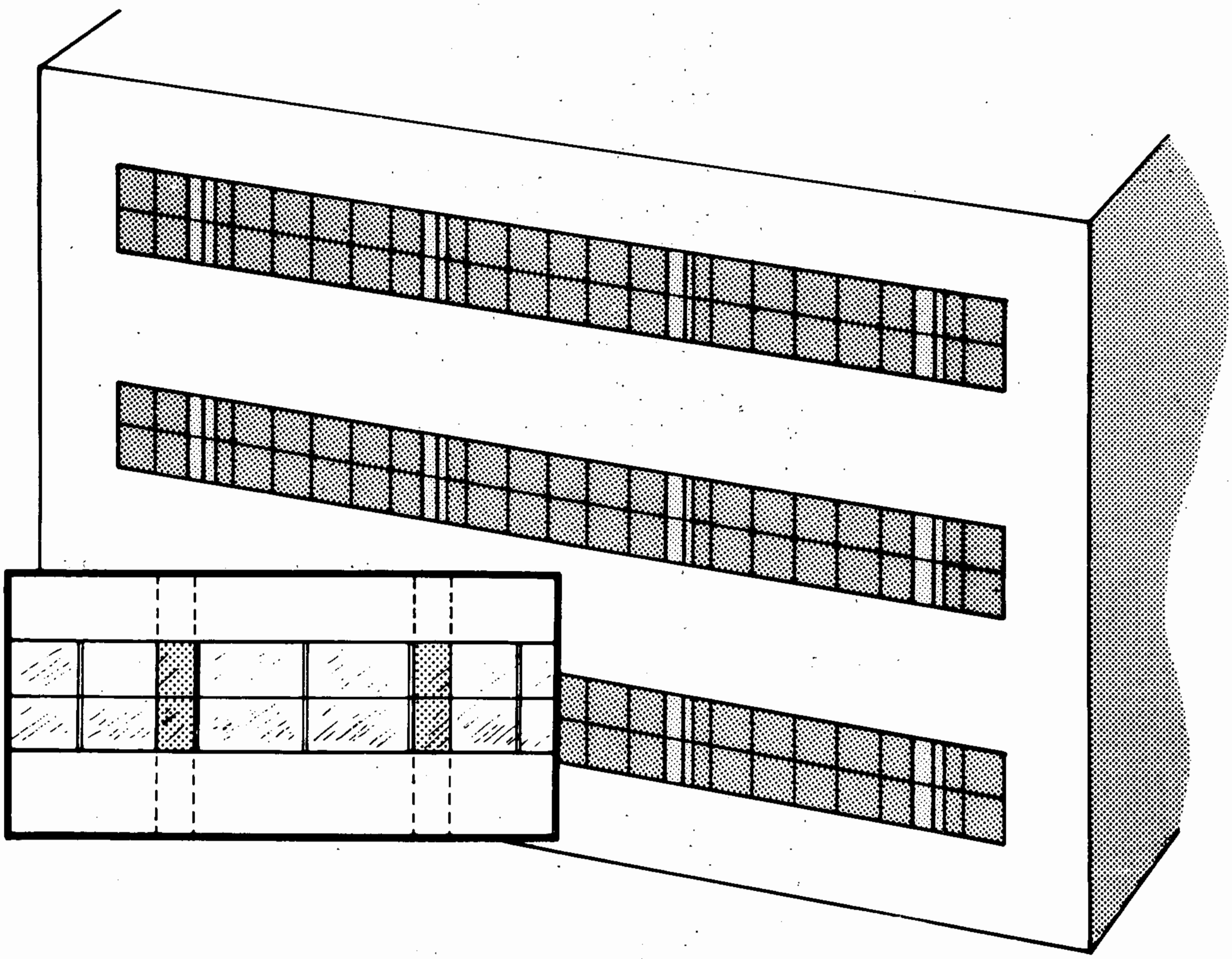
FRAMED CONSTRUCTION

Light Cladding

Venting Types



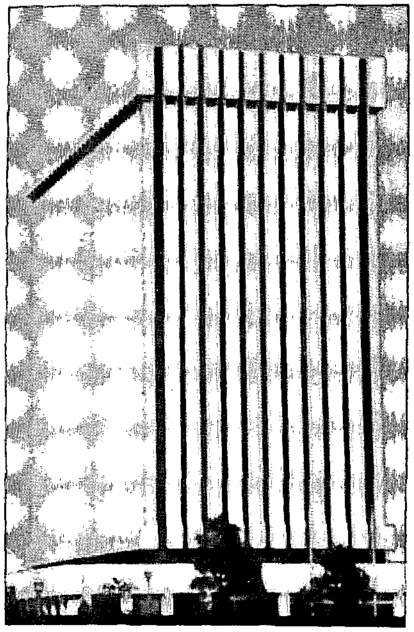
Spandrel



Columns Visible Behind Windows

The mullion type of venting (plate number 30) takes its name from the mullions (vertical nonload-bearing member) which lie between the structural columns. Windows are placed between these and the structural columns. The effect is a series of long, narrow windows. They provide a little more concealment than either the framed obscured or the in-fill type.

Photo. The long, narrow window pattern of this mullion-type venting pattern is visible from a great distance away.



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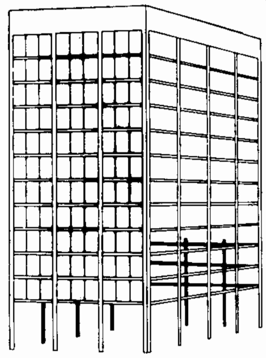
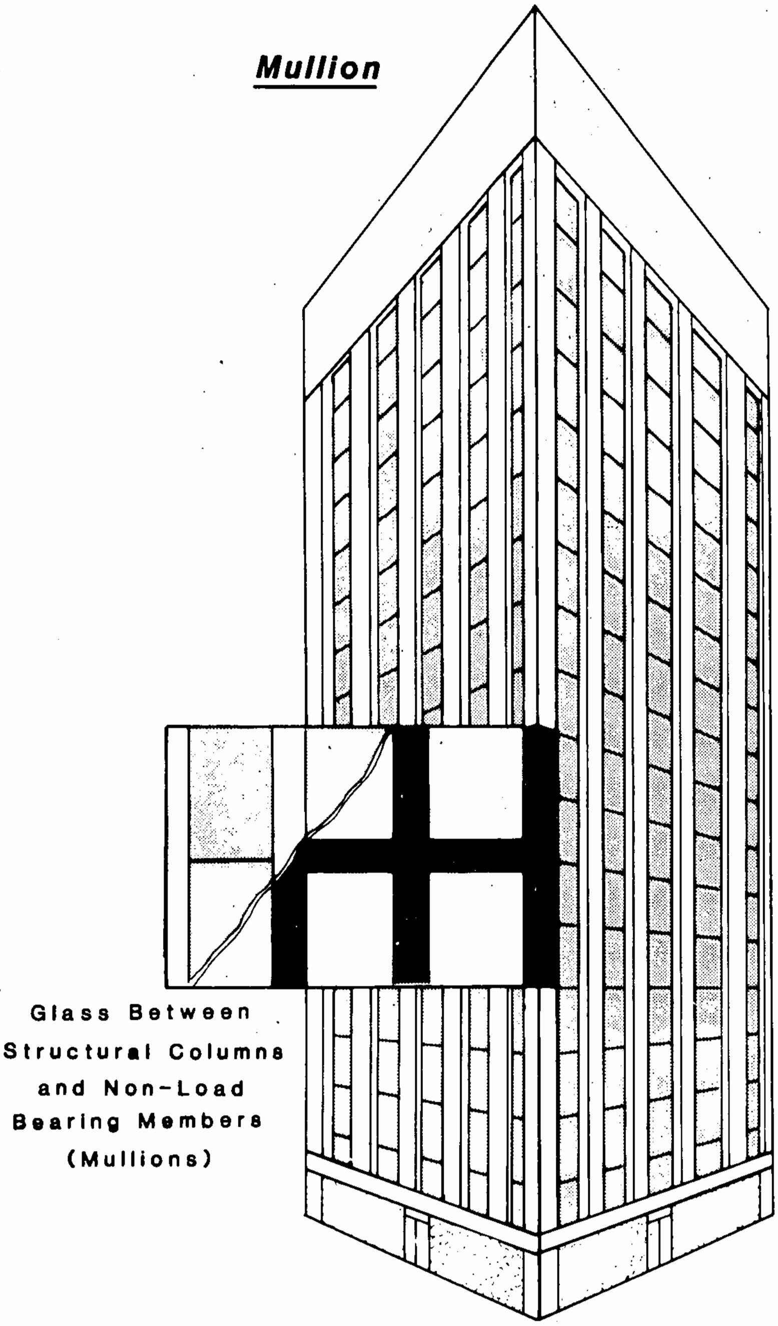


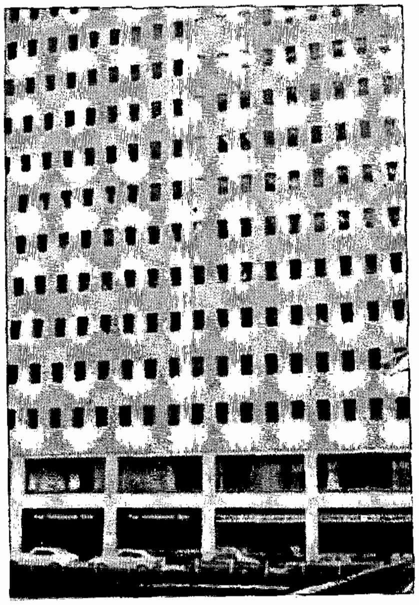
Light Cladding

Venting Types



The minimum window type (plate number 31) is a variation of the frame-obscured type. The non-window part of the "curtain wall" is often composed of a lightweight concrete. This type provides a considerable amount of concealment, but again, little cover as the wall is easily breached.

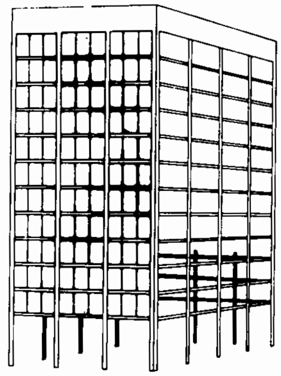
Photo: Some of these framed, light-clad office buildings bear some resemblance to older, framed heavy-clad structures.



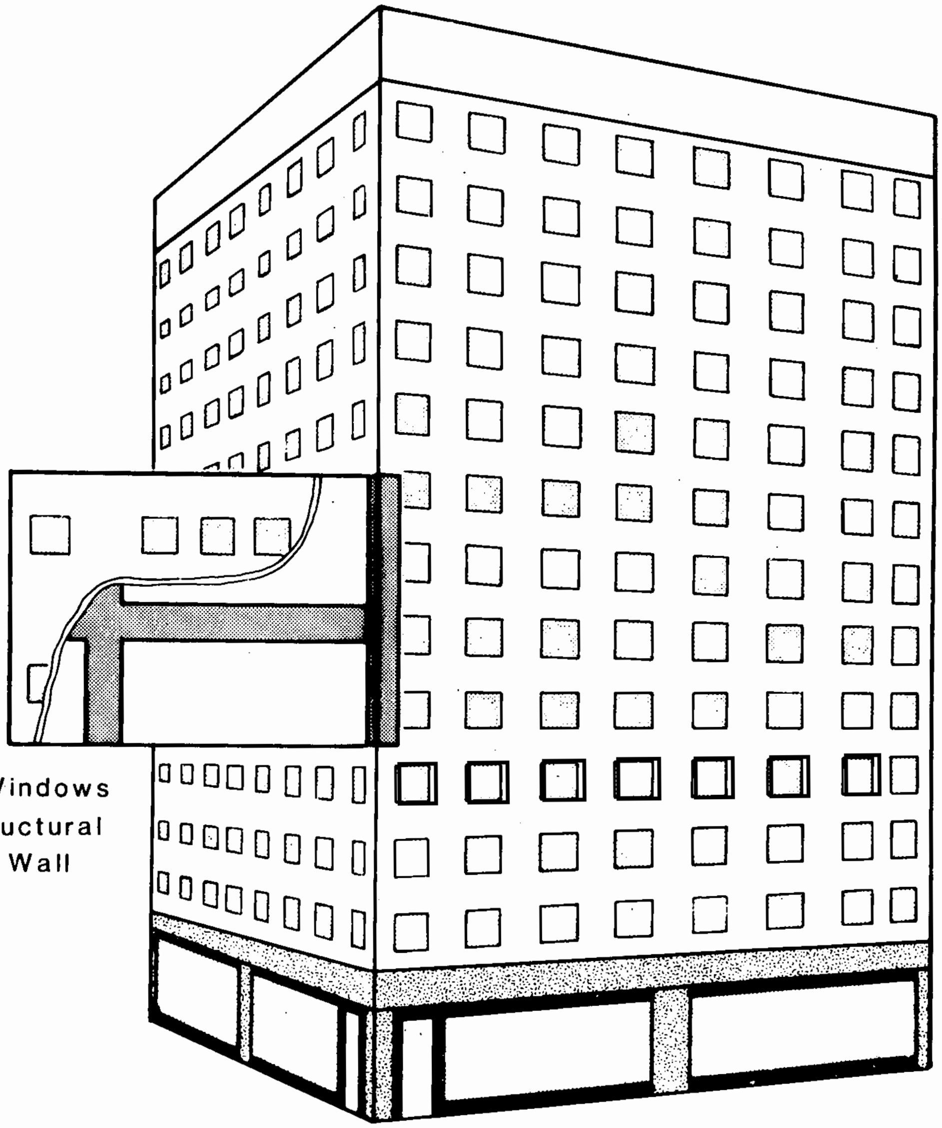
FRAMED CONSTRUCTION

Light Cladding

Venting Types



Minimum Window



Small Windows
Non-structural
Curtain Wall

Sometimes either for esthetic purposes or in such structures designed to house functions where natural light is not required, as in modern department stores, there is little or no venting on upper floors (plate number 32). In these instances, the "curtain wall" is opaque and is made of lightweight concrete aggregate. The outer surface may either be a fluted or corrugated concrete or, sometimes, decorative brick.

The amount of concealment is high, but again, the thinness of the wall material provides little cover.

Photo a: A segment of a hotel in Atlanta; a framed structure with concrete-aggregate cladding.

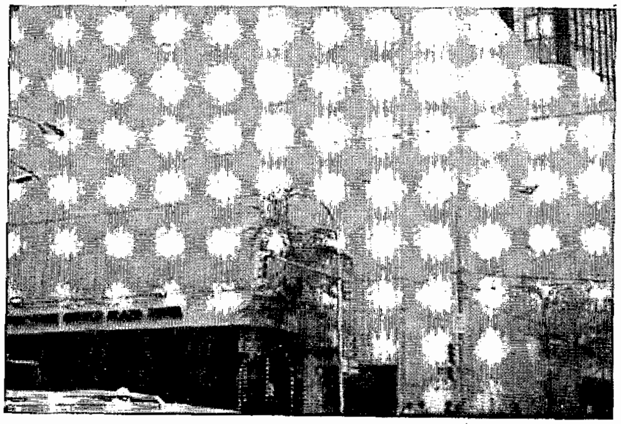
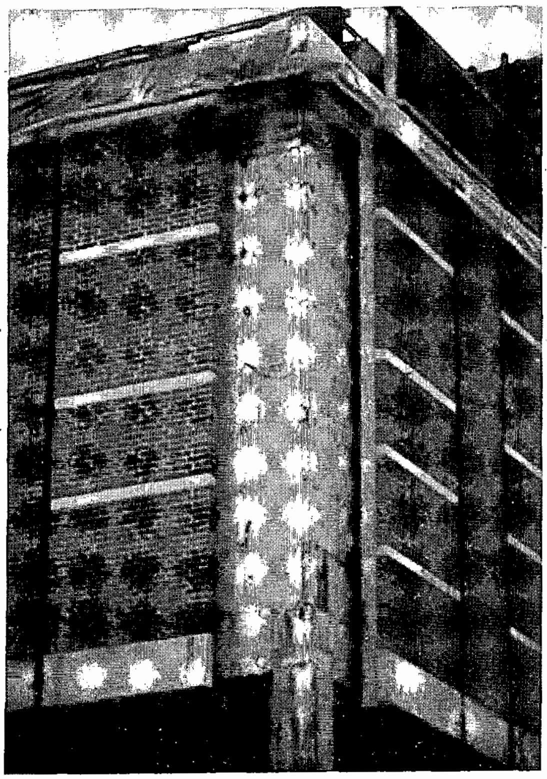
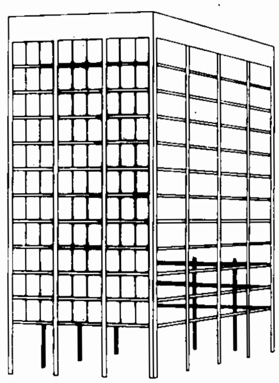


Photo b: The thin nature of the cladding is demonstrated in this building in West Berlin.

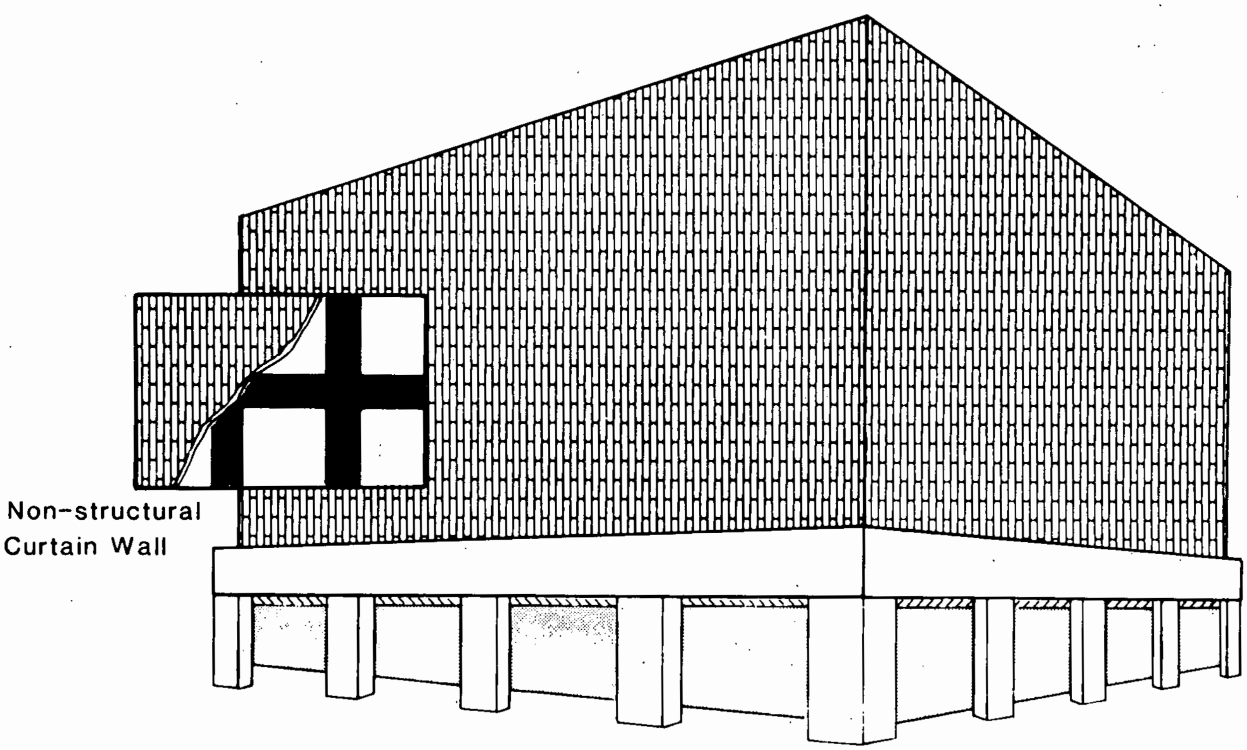


FRAMED CONSTRUCTION

Light Cladding
Venting Types



No Window



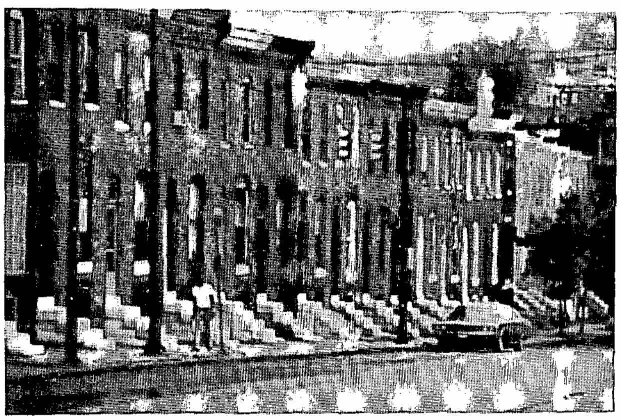
City buildings take two basic forms: urban and rural. Recognition of these forms is fundamental to the analysis of urban terrain for military uses. Principles and examples of each are illustrated on the following pages.

Urban form (plate number 33) epitomizes the city itself. General characteristics are full use of the building lot and a squarish appearance. Maximum use is thereby gained of the expensive land of cities, a natural product of high concentration of the activities found in the city.

The residential example seen here demonstrates these characteristics. (1) The angular shape of the entire block is carried through to the flat roof; some exceptions exist as in the German style referred to previously. (2) To gain full use of valuable land, buildings are placed flush to the sidewalk. This lack of setback has the further effect of narrowing the width of the whole street area (considering building front to building front) and thus reduces the line of sight. (3) To gain maximal use of the lot, the walls of adjoining buildings are either butted one against another--if the structures were built independently at different times--or they may have common walls ("party walls") if all the units were built at the same time. (4) The necessity to provide each unit with access to the street results in very narrow frontage; giving every unit adequate floor space requires that each be long and narrow. (5) As a result of this narrowness, buildings are often only a single room wide.

Because of adherence to the stated principles, urban form buildings are found throughout the cities of the world where land values are high, as in core areas and along arterial streets.

Photo a: "Row houses" in Baltimore are excellent examples of urban form.



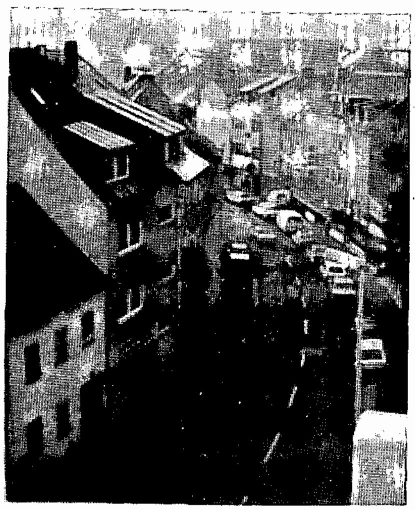
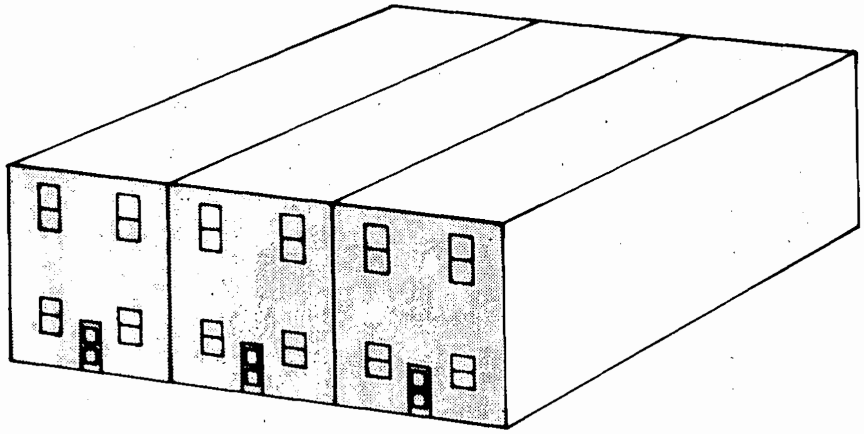


Photo b: Mixed land use in Schweinfurt, FRG, has a similar form.

GENERAL CHARACTERISTICS URBAN FORM

Residential Example



CHARACTERISTICS

1. Angular form, flat roofs
2. Little, or no, setback from sidewalk
3. Adjoining walls (often "party" walls)
4. Narrow, set end-wise to street
5. Floor plans: often only one room wide

Location:

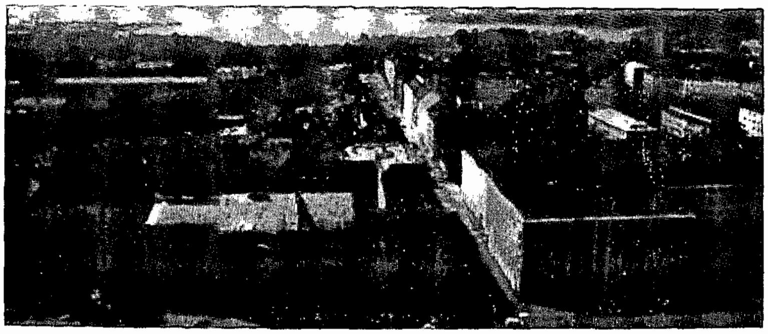
High land value areas of cities

European hof-style construction (plate number 34) offers an excellent solution to the problem of providing open space for apartment dwellers where the demands of the city require the use of urban form. Intensive use of the land is obtained to a high degree but some privacy and utility space result from the use of an inner court (hof).

Each characteristic illustrates the point: (1) There is no set back from the sidewalk. Filling an entire block is not uncommon (although the effect may be achieved through use of several independently built units that together form a perimeter around a court). (2) The court (hof) normally serves the functions of the apartments such as storage of fuel, clothes drying, automobile parking, and a protected place for children to play. Entry is normally provided by one or more tunnels. The opportunities for use of the concealment provided by these hofs is significant. (3) In order to gain a maximum amount of natural light, each apartment unit has windows facing both outward to the street and inward to the court. Entry to the units is ordinarily within the tunnel of the hof rather than directly to the street. Planning of clearing maneuvers should recognize this fact. (4) Because most of these structures were built prior to the widespread modern use of framed construction, they are mostly built of bricks; tall buildings, therefore, have very thick walls on the lower stories.

Hof-style apartments are particularly common in central and northern Europe. Some cities, such as Prague and Helsinki, have large areas of them.

An apartment area in Helsinki, Finland, is seen in Photo a showing urban form angularity and lack of setback. The hof is visible as well.



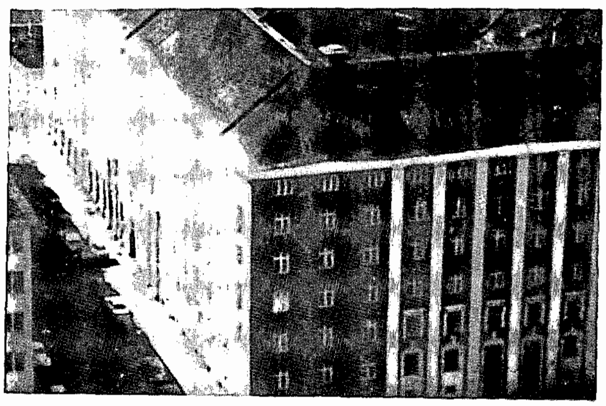
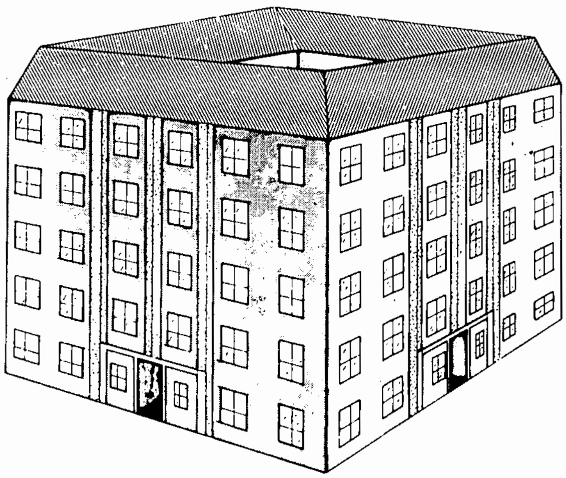


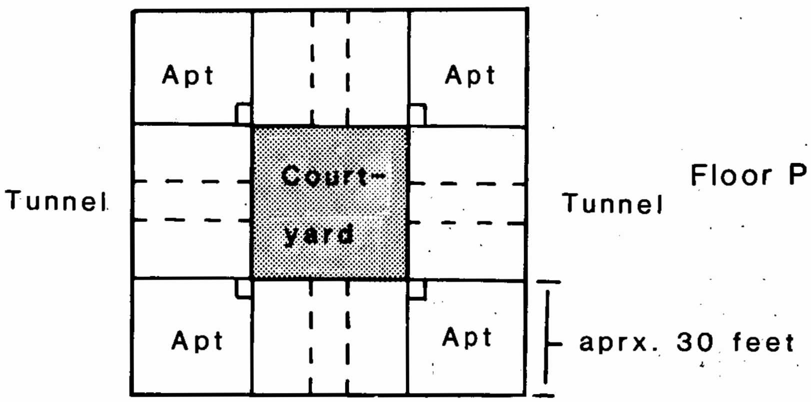
Photo b is a close-up of one building.

GENERAL CHARACTERISTICS: URBAN FORM

Hof-Style Apartment Building Example



Perspective View



Floor Plan

CHARACTERISTICS:

1. No set back, occupies full block
2. Has inner courtyard (hof): provides concealment and cover
3. Apartment units face both courtyard and street
4. Construction: usually brick

Area found:

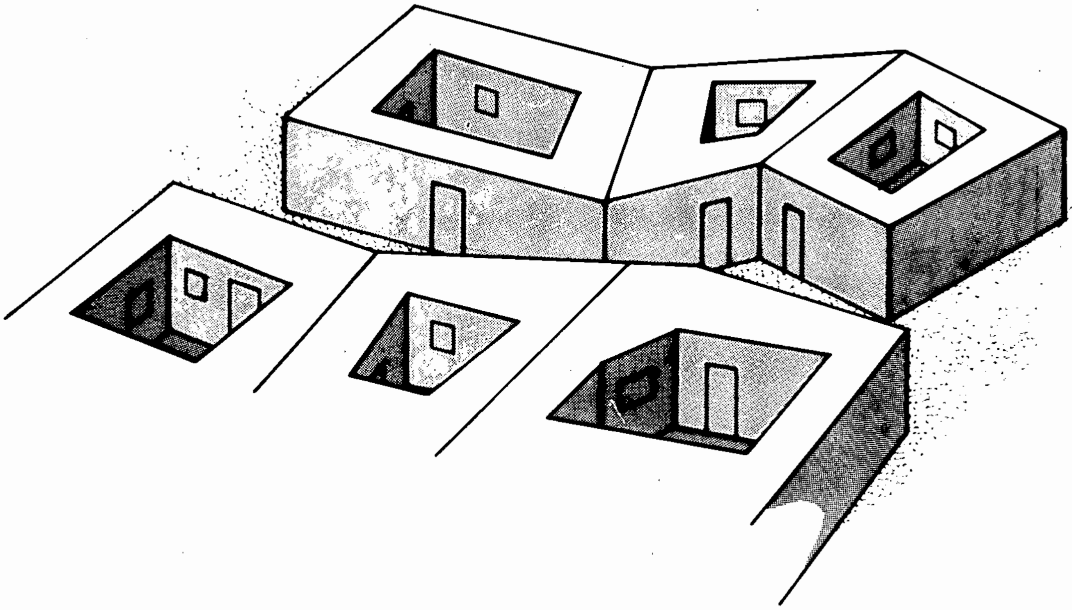
Central and Northern Europe

An architectural variation on the urban form of residences, again with an enclosed courtyard, exists in the Middle East and in the countries around the Mediterranean Sea both in Europe and North Africa. Variations are seen in Latin America where it was introduced by Spanish colonists.

A distinctive set of characteristics (plate number 35) is to be observed: (1) Typical urban form is obtained in the lack of setbacks from the street. Buildings are set on extremely narrow streets causing a very high density. (2) Urban form is further carried out by the flat roofs; houses situated in dry climates, moreover, do not require pitched roofs. (3) Buildings are generally low-rise, one and two stories, though they may reach three and four stories in areas of high land value. (4) Following the customary desire for privacy in these areas, there are no windows on the street side of the house. (5) Outdoor living space is provided in the enclosed courtyards; access to the rooms of the house is through the courtyard as well. (6) Street patterns are normally quite irregular; horizontal lines of sight are extraordinarily short. Accordingly, cover and concealment opportunities are high both on the street and within the houses.

GENERAL CHARACTERISTICS: URBAN FORM

Enclosed Courtyard Style (Middle East & Mediterranean)



CHARACTERISTICS:

1. No set backs
2. Flat roofs
3. One to two stories tall
4. Windowless outer walls, inner courtyards
5. Floor plan: all rooms open on to courtyard

Location:
on narrow, curving streets with short horizontal lines-of-sight

Area found:
Middle East, North Africa, and Mediterranean (with variations in Latin America)

The other primary design--rural form--occurs broadly throughout the world. It consists of detached structures and is found wherever the pressure of high land cost (or a cultural need for protection or privacy) is not found. The form is common for residential structures (as indicated in plate number 36) but does occur for commercial buildings in areas away from the center of the city.

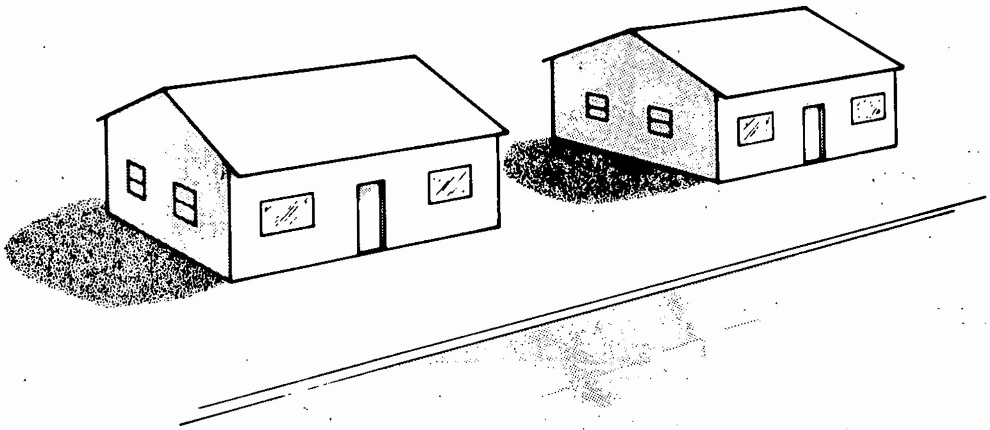
The characteristics stand in contrast to those of urban form and constitute a distinctive list: (1) Buildings are detached from one another and form a pattern of low density. (2) Accordingly, they are set back from the street thus increasing its effective width (when viewed as being from one house front across to another). (3) Except in areas of dry climates where tradition calls for flat roofs, the roofs are generally pitched. (4) While urban form structures are placed end-wise to the street to gain maximal access, rural form dwellings are usually set width-wise to the street giving a broad appearance and providing abundant possibilities for the house to have natural light in rooms facing outward in all directions. (5) The wide variety of locales in which they are found opens countless possibilities to floor plans; examples are seen of many varying arrangements.

The form is common in Europe, North America, and throughout the world where European colonists took their approach to building with them. Within given cities, rural form solution is usually found in a broad zone surrounding urban form structures of the core.

Photo: A typical residential street represents the concept of rural forms.

GENERAL CHARACTERISTICS: RURAL FORM

Residential Example



CHARACTERISTICS:

1. Detached buildings -- open space between
2. Set back from street
3. Pitched roofs
4. Broad appearance -- set width-wise to street
5. Floor plans: varies with style, age

Area found:

NW Europe, North America - in suburban areas of large cities and often throughout small towns

In Germany, there are a large number of detached, rural-form houses located away from the core areas of cities. They are seen especially in new housing tracts both at the edge of large cities and in newly built areas where small towns and villages are expanding. Just as in American suburbia, there is a manifested desire of people to have a detached private dwelling. In some instances, bowing to high cost requirements, the structures contain two dwelling units.

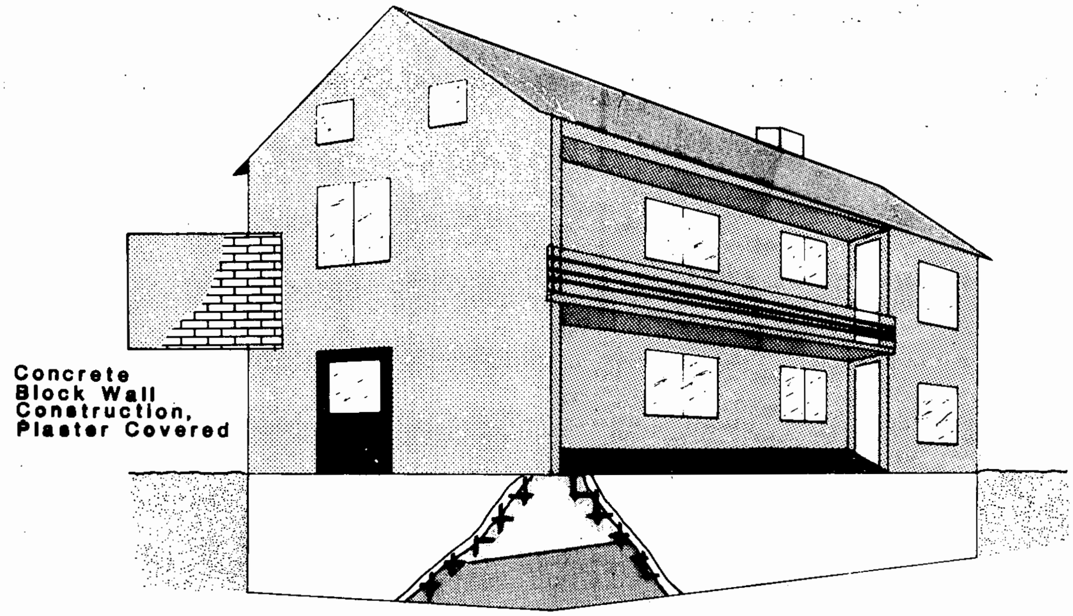
Two construction forms are illustrated in the drawing (plate number 37). In the upper one, building blocks are used in a traditional mass construction way. In the lower, modern technology is employed to erect buildings from factory built pre-cast modules. While both house types are substantial, the latter provides more cover to defenders.

Photo: A new German suburban house situated at the edge of Northeim, FRG.

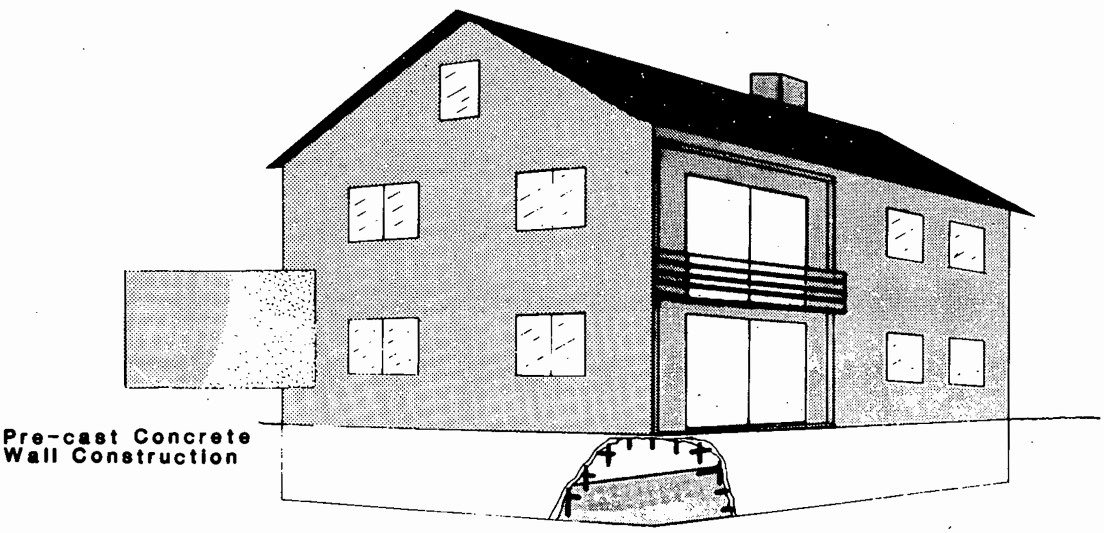
GENERAL CHARACTERISTICS: RURAL FORM

German Residential Examples

Building Block Construction



Prefabricated Concrete Construction



The internal arrangement of space--the floor plan--of a building follows a set of principles. Use of these principles enables the soldier observer to determine the general characteristics of the floor plan by noting certain features of a building from the street. Although the variety of building interiors is fairly broad, the patterns are both logical and straightforward.

The key to be used by the observer is to understand the types of decisions made by the architect in trying to find solutions to problems of design. The architect is presented with the problem of designing a building's interior space to fill specific requirements of the user. The selection of the optimum solution to the problem must, however, be made within the context of the physical properties of the type of building selected. These physical properties--shape, size, and type of construction --singly and in combination, dictate what sort of interior arrangements can and cannot be made by the architect.

The problem faced by the soldier observer in the field, especially in a combat situation when the building in question may be held by unfriendly forces, is to predict the building's floor plan by interpreting the observed external physical and functional characteristics of that building. The most logical procedure to pursue is to follow through with the same sort of problem solving approach used by the architect in the original planning and design of the building.

After first determining the function of the building (as it functioned prior to the outbreak of hostilities), the observer should note the physical characteristics of shape, size, and type of construction. He should then reason how the architect has provided space for the particular function involved as modified by the opportunities and constrains of the physical characteristics of the type of building construction selected. [An example is shown in plate number 52 where the upper floor arrangement of an office building (with a wide rectangle or square shape, of medium size, and being framed, heavy-clad in construction) has to be as it is depicted in the drawing. All of the questions in the Building Interior I.D. keys section at the bottom of the page are applied. The relative size of the office modules may vary but the general pattern is predictable.]

Each of the physical characteristics of buildings is explained in detail and illustrated in the following pages beginning with plate number 38. Numerous examples which combine the physical characteristics and various types of function further demonstrate building interior principles. Variety in the real world is endless but all cases encountered relate to the principles set forth here.

BUILDING INTERIORS: FLOOR PLANS - PRINCIPLES

Floor plans of buildings result from choice of optimum solution (at the time) to problem of need for space by varying functions (uses). Choice of solution is made within constraints and opportunities posed by the characteristics of the building of (1) shape, (2) size, and (3) type of construction.

Therefore, these factors which determine the floor plan of a building must be considered by the observer in the field. They are:

SHAPE

1. Narrow rectangle
2. Wide rectangle
3. Square
4. Combined modules

SIZE

1. Small - 1 room wide
2. Small - 2 rooms wide
3. Medium - less than one city block
4. Large - occupying full city block

TYPE OF CONSTRUCTION

1. Mass construction - stone, brick, concrete, box-wall principle
2. Framed construction - wood, steel/concrete heavy clad, steel/concrete light clad

FUNCTION

Office, store, warehouse, public gathering place, factory, hotel, apartment, house

Because of the nature of construction materials and the technologies available, most buildings in the world are angular in shape; round buildings and other non-angular shapes are seen in widely varying situations ranging from primitive huts to artistic architectural creations but they are not significant to problems addressed here. Within the broad family of angular shapes there are the two basic types: (1) narrow rectangles; and (2) either wide rectangles or squares. Not only are these forms conventional, ones for which solutions to functional needs have long since been found, but their shapes permit making maximal use of ordinarily angular city lots. Further, although many buildings are more complex in nature --such as L-shapes or attached groups of square units--their modules still conform to the basic shapes illustrated here.

Angular building shapes provide workable solutions to the related problems of providing rooms both with natural light and access to hallways. Recognition of this fact is important in determination of building interiors.

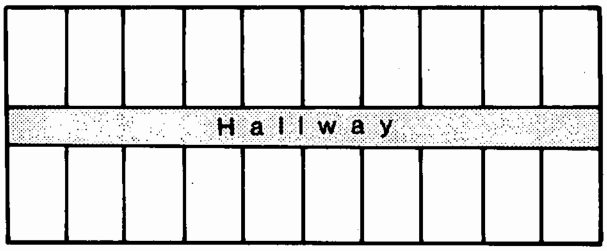
The narrow rectangle example shown here in plate number 39 (Illustration 1) achieves light and articulation for each room by using the simple expedient of a long narrow hall in the center of the building. Hallway-width is kept to a minimum as it provides no useable living space. In the wide rectangle or square shape (Illustration 2), the rooms can receive natural light and yet be connected with a hallway only with the type of plan indicated in the illustration. In this instance, the plan is for upper floors of a tall building. The structure has a central elevator/stairway module.

BUILDING INTERIORS:
FLOOR PLANS- PRINCIPLES

Determining Factors

BUILDING SHAPE

1.Narrow Rectangle

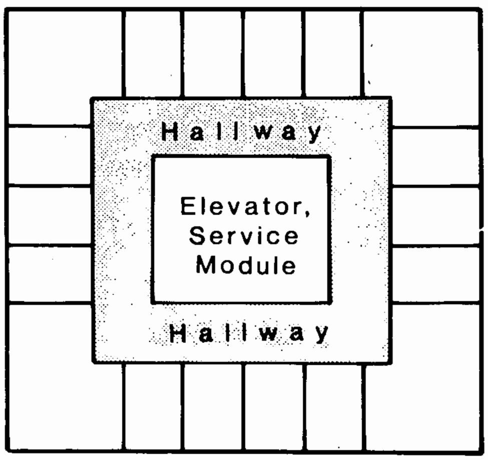


Linear Hallway

PRINCIPLE: All rooms have access to:

1. Window for natural light
2. Hallway

2. Wide Rectangle or Square



Central Circulating Hallway

As with building shape, building size is also related to providing rooms with natural light and hallway access. With small buildings, there are obvious limitations as to how light and access can be provided for the rooms within the limitations of the overall size of the structure. Large buildings, on the other hand, reach such great dimensions that they must resort to other devices to provide light and circulation. The examples shown in plate number 40 demonstrate these points.

Illustration 1. <u>Small One Room Wide</u>: In small buildings, there is understandably a need to make maximal functional use of limited space. Hallways add no functional space and are thus eliminated. Also, the inherent narrow nature of such buildings--especially those which have urban form--means that natural light can be provided only at each end of the building, thus effectively limiting the floor plan to two rooms (per floor). Articulation between the rooms is achieved by the simple expedient of a doorway rather than a hallway. If the building is multistoried, the stairway is exposed within the room.

Illustration 2. <u>Small Two Rooms Wide</u>: In this variation, the same principles of light and hallway access apply as with the narrow rectangle building (plate 39). All rooms have outside windows (at the ends of the building if not on the sides) and all are reached from a central hallway.

Illustration 3. <u>Medium - Less than One Block</u>: In this example, a wide rectangle or square type building, light and access are provided by a central circulating hallway. A great number of high-rise buildings of this size group are found in the core areas of major cities. Even though several such structures may be found on a block, they usually have "towers" for the upper floors. These are separated enough to permit access to natural light.

Illustration 4. <u>Large - Full City Block</u>: When a building is seen which occupies a large space, such as a full city block, the observer should immediately question how a structure of this dimension can provide natural light to all the rooms within. The device (seen in number 3 above) of providing a central hallway must be ruled out simply because if it were used, the rooms (whose windows are seen on the outside of the building) would be too deep for the entire room to receive enough natural light. Moreover, they would be larger than required for many functions such as rented general office space or hotel guest rooms.

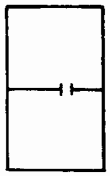
Therefore, natural light and interior circulation can be provided only with the devices of a light well in the center of the structure or with indentations in the perimeter which result in "wings". Some exceptional buildings, such as the Pentagon, have a series of successive light wells. The lightwell example allows both "outside"and "inside" rooms to have natural light. These lightwells, if they extend to ground level, can provide a high level of concealment for small military units. The "wings" building with its narrow embayments can also provide a small, local amount of concealment as well as some cover.

FLOOR PLANS: PRINCIPLES

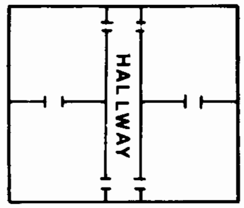
Determining Factors

BUILDING SIZE

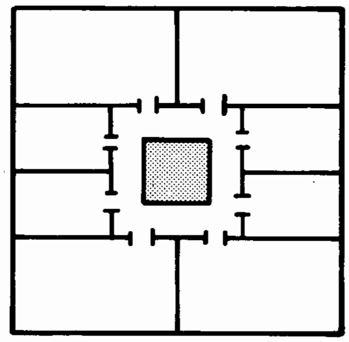
1. Small, 1 Room Wide <20′



2. Small, 2 Rooms Wide



3. Medium < 1 Block

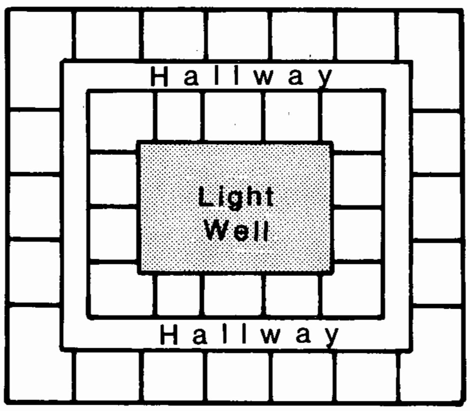


Rooms off hallway

All rooms have outside windows

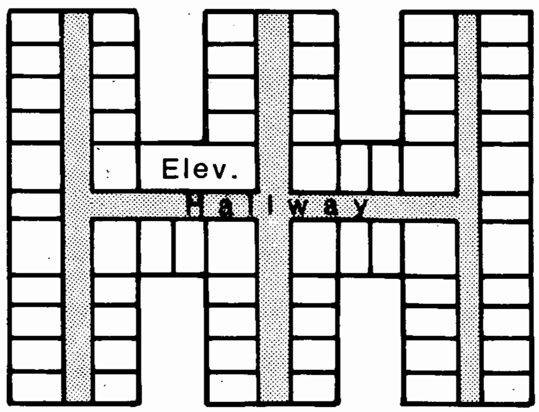
4. Large–Full City Block

Central Light Well



OR

"Wings"



All rooms have outside windows

PRINCIPLE: All rooms have access to natural light

Detail, beyond that of the basic generalizations, of particular examples is provided in plate number 41 and in the remainder of the series through number 60.

Several keys to the configuration of this example building's floor plan (plate 41) are presented in the perspective view drawing. This example of shape, as the important factor in determining floor plan, has either mass or framed construction, is tall enough to require an elevator, and functions as a hotel, apartment, or office building. The externally visible keys to its floor plan are (1) the presence of a structure on the roof to house the elevator lifting device; (2) an entry way in the center of the building leading to a central hallway (for fire safety there would also probably be entrances at both ends as well); (3) small windows in vertical alignment in the center of the building ends indicating a stairway articulated with a central hallway.

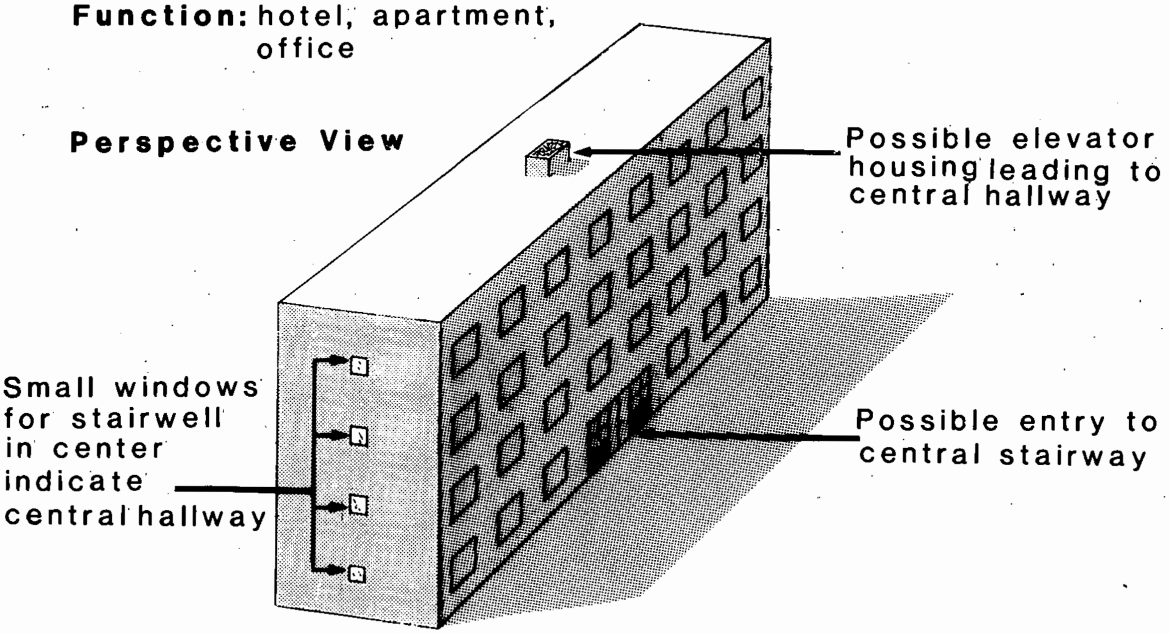
The Building Interior I.D. Keys ask questions which the observer can answer by noting the exterior features described above. If answers to the questions are yes, the building will have a floor plan as indicated. The first two questions are self-explanatory. The third question requires a detailed consideration of function. In this example, it is logical that such functions as hotels, studio apartments, and offices consist of but single rooms (or with a minor interior partition to separate, for example, bedroom from bathroom) and therefore conform to the principles stated earlier on building size and shape.

BUILDING INTERIORS: FLOOR PLANS - I. D. KEYS

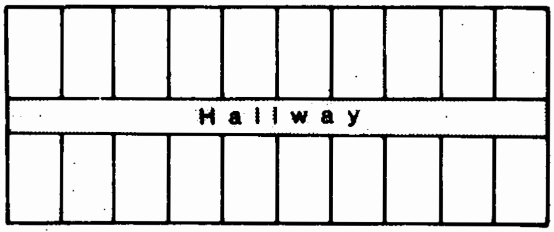
Example of **SHAPE** (narrow rectangle) as a determining factor

Construction Type: mass or framed
Function: hotel, apartment, office

Perspective View



Floor Plan View



Linear Hallway

BUILDING INTERIOR I. D. KEYS (this example)

1. Is shape so long and narrow that rooms can gain natural light only if served by a central, linear hallway?
2. Is there an indication of a stairway (or elevator) in the center of building?
3. Is function of a type which would have units only 1 room deep (e. g. hotel, studio apartments, offices)?

This example of shape (plate number 42) as being the dominant factor in determining floor plan is a common type of situation in which the building has either mass or framed construction, functions as a hotel or an office, and is of medium size. Two indications of a central hallway surrounding a central elevator/stairway module are (1) elevator housing in the center of the building, and (2) an entry way in the center of the building which leads to a hallway giving access to elevator and stairs.

<u>Building Interior I.D. Key Number 1</u>. The square or wide rectangle shape suggests that there must be a central hallway.

<u>Building Interior I.D. Key Number 2</u>. Evidence of the elevator in the center of the building and the central entry are further indications of the anticipated floor plan.

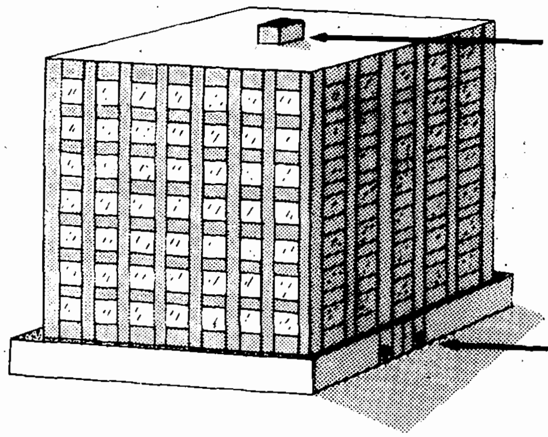
<u>Building Interior I.D. Key Number 3</u>. Again, this arrangement favors the subdivision of the interior into small rooms facing on the central hallway. Subdividing space into multi-room apartments to be placed in this configuration requires a short hallway inside the unit paralleling floor's main central hallway. Such a practice is wasteful of valuable interior space.

BUILDING INTERIORS: FLOOR PLANS - I. D. KEYS

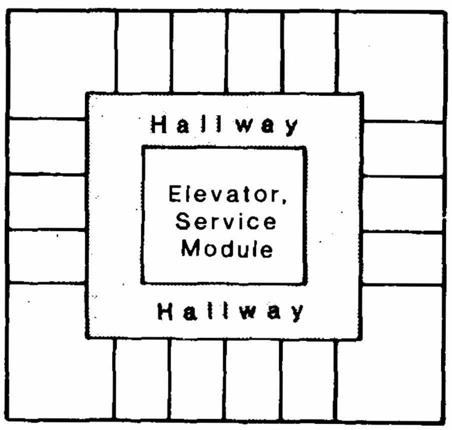
Example of **SHAPE** (wide rectangle or square) and **SIZE** (medium - 1<block) as a determining factor

Construction Type: mass or framed
Function: hotel or office
Size: medium (<1 block)

Perspective View



Floor Plan View



Central Circulating Hallway

BUILDING INTERIOR I. D. KEYS (this example)

1. Is shape wide enough so that rooms can gain natural light only if served by a central hallway encircling elevator?
2. Is there an indication of a stairway (or elevator) in the center of the building?
3. Is function of a type which would have units only 1 room deep (e. g. hotel, studio apartments, offices?

An L-shaped building simply represents a variation of the narrow rectangle. Such buildings are common in cities and are frequently prescribed by architects to be built on corner lots or where there is a need for an open courtyard in the rear. This example (plate number 43), which could have either mass or framed construction, is of medium size. It is a classroom building with room sizes being larger than would be the case in an office or hotel. Also, because of its service to large numbers of people, there is ample stairway access to the outside and all stories. The location of the elevator housing and the venting of the stairwells (in the building's center) are indications of the presence of a central hall. The shape of the building and the presence of windows on both sides serve to confirm the floor plan.

Again, yes answers to the questions posed under the heading Building Interior I.D. Keys assist in determining of the building's function and its floor plan.

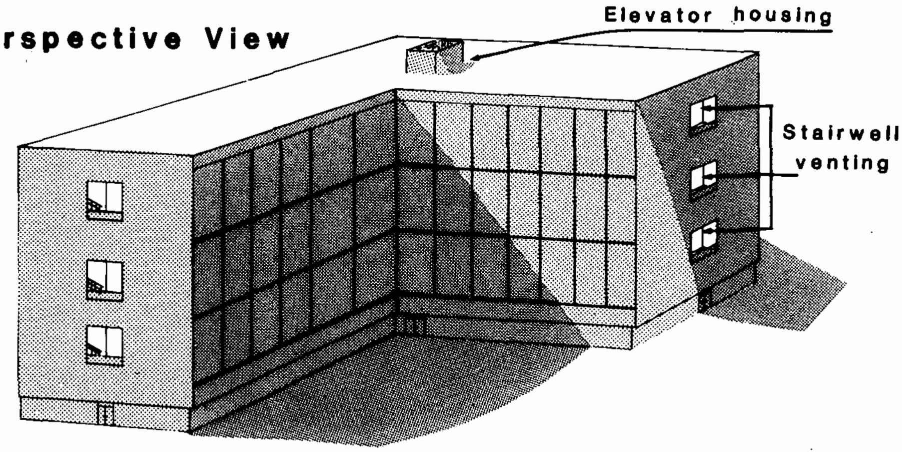
Photo: A building in Philadelphia serves as an example.

BUILDING INTERIORS: FLOOR PLANS - I. D. KEYS

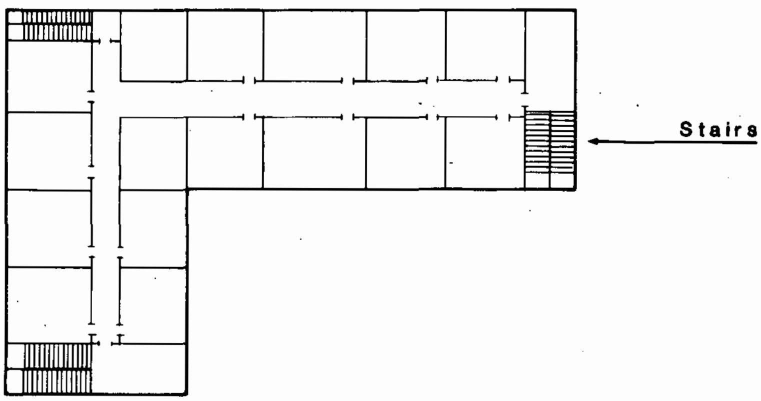
Example of **SHAPE** (L-shape) as a determining factor

Construction Type: mass or framed
Function: Size: classroom building medium (<1 block)

Perspective View



Floor Plan View



BUILDING INTERIOR I. D. KEYS (this example)

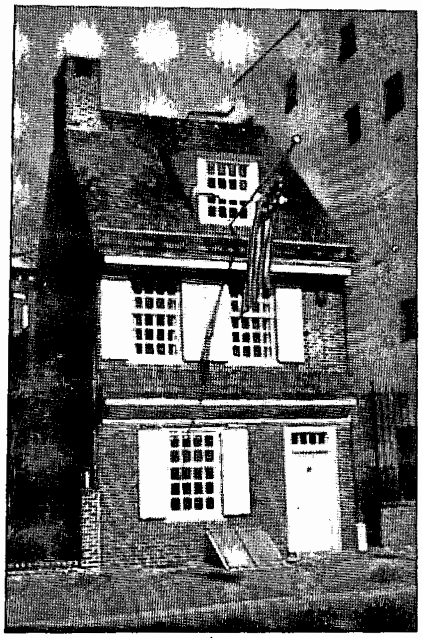
1. Are extensions of building so long and narrow that rooms can gain natural light only if served by central, linear hallways?
2. Are there several entrances – as required for fire safety for large number of occupants?
3. Does function (classrooms) indicate that rooms are large?

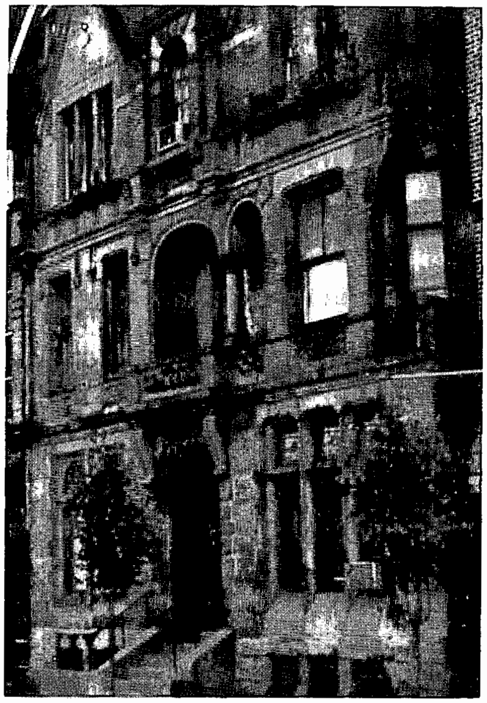
This example, plate number 44, of size as a determinant of interior floor plan is an elaboration of the principles introduced with plate number 40. The type of construction is either mass or framed and the function is residential.

Small buildings, only one room in width, frequently have the entry door at one side with a single window on the other. The keys ask the vital questions. An answer of yes confirms the floor plan indicated in the drawing.

The two-room wide building will almost invariably have the entry in the center where it opens either onto a hall (as illustrated) or into the living room in which case a hallway will be found farther back in the house to provide circulation to the smaller rooms. The principles of access to light and interior articulation are implicit in yes answers to the questions on the identification keys.

<u>Photo a</u>: A simple house in Philadelphia just one room wide.





<u>Photo b</u>: An example of a central entry house two rooms wide.

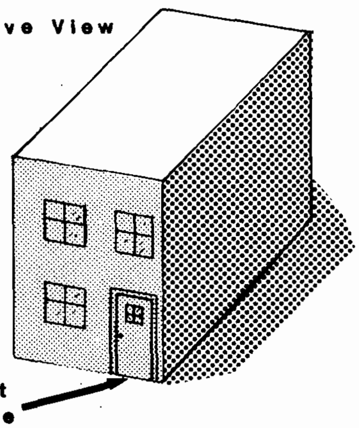
BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

Example of **SIZE** (small - 1 room and 2 rooms wide) as a determining factor

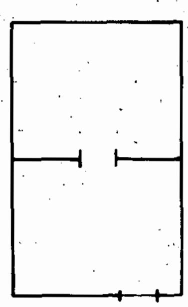
Construction type: mass or framed
Function: residential

Small-1 room wide

Perspective View



Floor Plan View

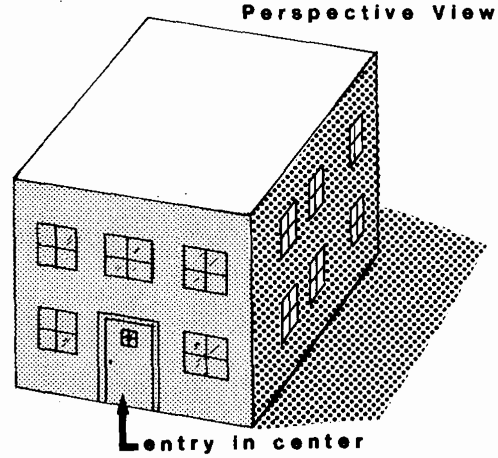


Building Interior I.D. Keys(this example)

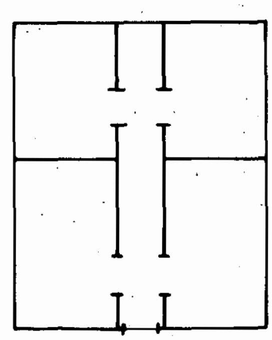
1. Is building so narrow that 1 room spans whole width?
2. Is building long enough to accommodate 2 rooms lengthwise?
3. Is entry at one side?

Small-2 room wide

Perspective View



Floor Plan View



Building Interior I.D. Keys(this example)

1. Is building wide enough to accommodate 2 rooms widthwise?
2. Is building long enough to accommodate 2 rooms lengthwise?
3. Is entry in center?

The importance of observing detail is demonstrated again in identifying the floor plan of this example (plate number 45) building. It has framed, heavy-clad construction and functions as an office. Such buildings are common in core areas of large cities.

Building Interior I.D. Key Number 1. In accordance with the principles illustrated earlier, the building has such a large overall dimension that provision of light to rooms facing the inside would not be possible without a light well.

Building Interior I.D. Key Number 2. The observation of an elevator housing at one edge of the building--and not in the center--is a further indication of the presence of a light well.

Building Interior I.D. Key Number 3. Close observation should reveal that the entry hallway leads primarily to the elevator. It may, of course, extend to the light well. This presumes that the light well extends to ground level (instead of starting one or two stories above ground) and that it has some function requiring access (such as a garden court, restaurant, etc.).

Photo a. Full view of large office building with a light well.

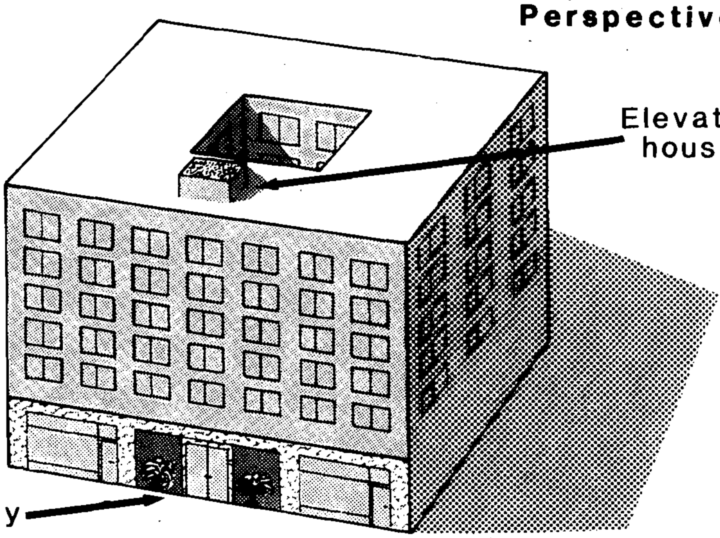
Photo b. Close up view of the light well.

BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

Example of **SIZE** (large-full city block with central lightwell) as a determining factor

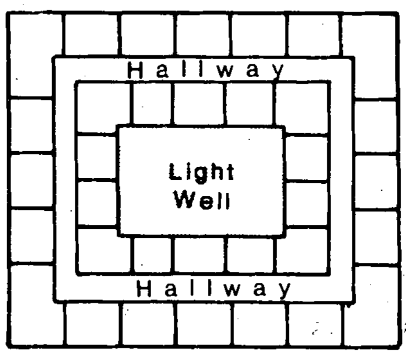
Construction type: framed, heavy-clad
Function: hotel or office

Perspective View



Floor Plan View

Central Light Well



BUILDING INTERIOR I. D. KEYS (this example)

1. Are overall dimensions so great that it would require a central light well for all rooms to receive natural light?

2. Is elevator housing toward one edge building and **not** in center?

3. Does entry hallway lead toward elevator?

The use of "wings"--to provide all rooms with natural light--on large structures such as these (often occupying an entire block) is readily apparent to the field observer. The presence of these wings further serves to determine the characteristics of the floor plan.

The floor plan view (plate number 46) demonstrates the solution to the problem of providing natural light to each room. Hallways are in the center of the main part of the building and along each wing, and all rooms face either directly outward or into the space between the wings.

The circulation pattern on each floor originates from the central position of the elevators. The entrance to the building, on the ground floor, leads to the elevators. Floor plans of these structures are straightforward and the keys to identification are easily seen in the field.

Photo a: This hotel, in Philadelphia, exhibits all of the characteristics of buildings with "wings." Note the elevator housing in the central part of the building.

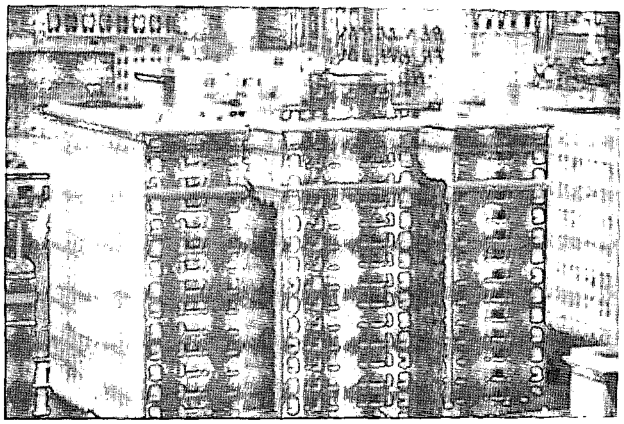
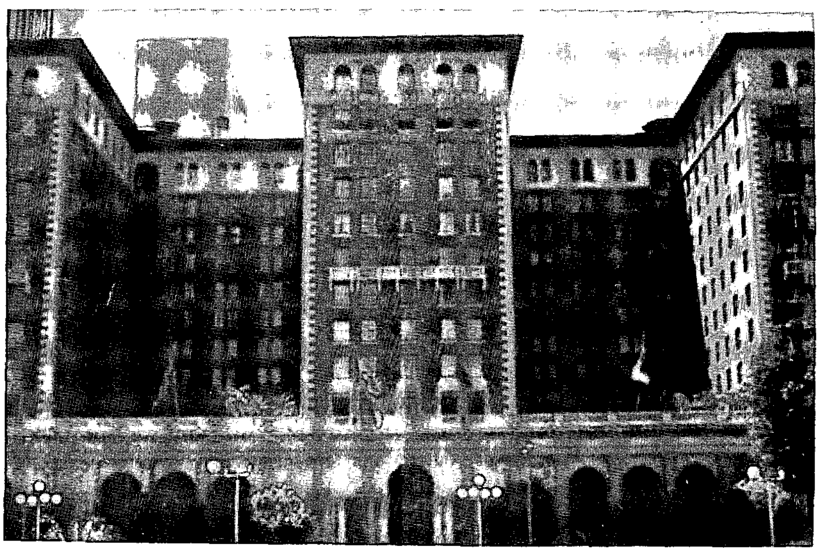


Photo b: A hotel in Los Angeles is simliar.

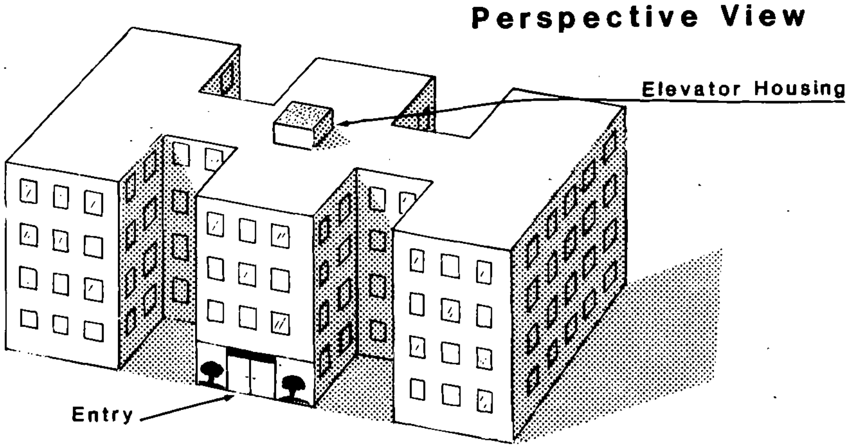


BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

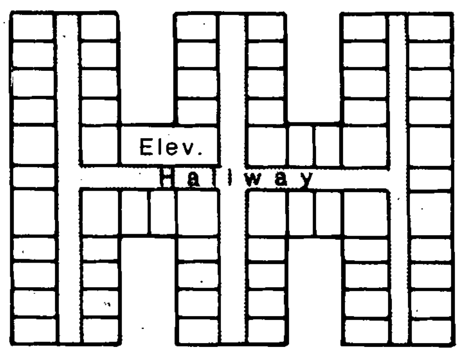
Example of **SIZE** (large-full city block with "wings') as a determining factor

Building type: framed heavy-clad
Function: hotel or office

Perspective View



Floor Plan View



Building Interior I.D. Keys(this example)

1. Is solution to problem of providing natural light to each room made through use of "wings" ?
2. Is elevator housing in center of building ?
3. Is entry hall long enough to reach center of building ?

This example (plate number 47) represents a German variation of the principles of buildings with long rectangular shape and central hallways. Of interest in this example are the thick, load-bearing walls forming the long, linear hallway (paralleling the exterior walls). The exterior walls, are, of course, load bearing. Also, some of the cross walls may be load bearing. Accordingly, interior walls will have a thickness of at least two brick headers (approximately 10 inches).

Building Interior I.D. Key Number 1. Long, linear shape prescribes the need for a central hallways.

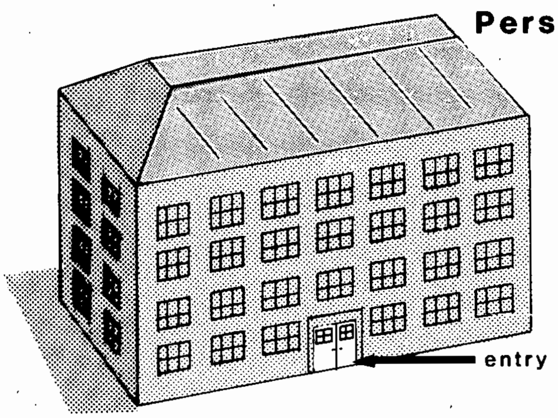
Building Interior I.D. Key Number 2. The presence of a central entry and stairway is a further indication of floor plan.

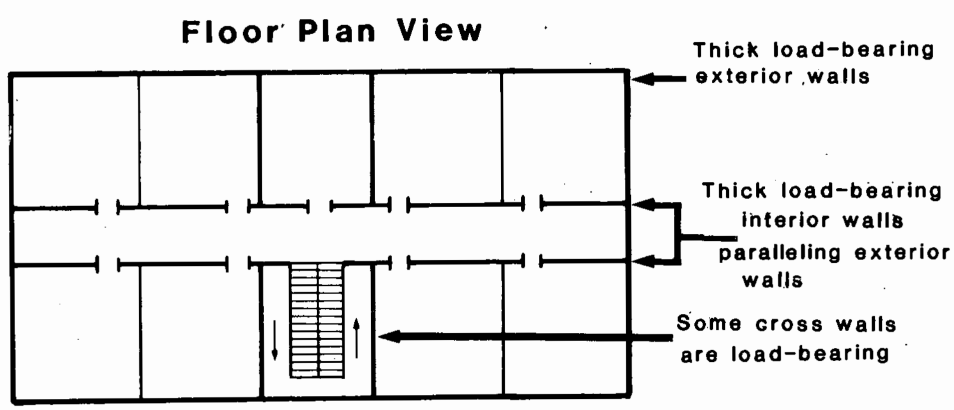
Building Interior I.D. Key Number 3. The functions listed here (office, school, hospital, or barracks) would all require small rooms, each entering onto a hallway.

BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

Example of **CONSTRUCTION TYPE** (brick- common in Germany) as a determining factor

Construction type: mass (brick)
Function: office, school, hospital, barracks
Shape: long rectangle





BUILDING INTERIOR I.D. KEYS(this example)

1. Is shape so long and narrow that rooms can gain natural light only if served by a central linear hallway?
2. Is there an indication of a stairway in the center of the building?
3. Is function of a type which would have units only 1 room deep (e.g. office, school, hospital, barracks - in this case) ?

In this example (plate number 48) the mixed function of buildings along arterial streets serves as the principal determining factor in shaping the subdivision of interior space. First, there is a vertical separation of function. The ground floor is devoted to retail sales: the less accessible upper floors are used for offices or residences. Lower and upper floor functions have markedly different space requirements and very different floor plans. The ground floor is composed mainly of open space for displaying merchandise. Full venting (windows) on the ground floor is used for merchandise display. Upper floor offices and residential rooms are small.

The Building Interior I.D. Keys provide information on the nature of the interior of the ground floor.

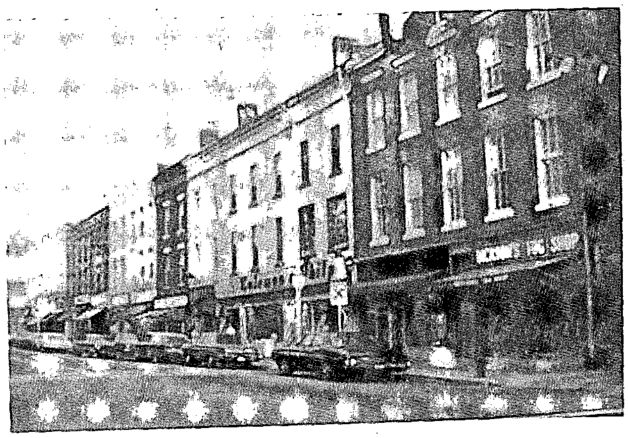
Building Interior I.D. Key Number 1. Building in settings like this are long and narrow in shape so that each can gain some exposure to the business street; exposure is so prized that property is sold by the "front foot." Buildings are often three times as long as they are wide. Note that one unit in the example is wide enough to require interior supporting columns.

Building Interior I.D. Key Number 2. Looking into the front window will reveal if all of the ground floor interior is used for selling space.

Building Interior I.D. Key Number 3. If a partition is detected near the rear of the building, the space behind is used for storage.

Building Interior I.D. Key Number 4. Often, especially where there is a high density of buildings in congested parts of cities, the observer may have difficulty in determining the location of doorways which lead to upper floors of buildings of this type. Sometimes there is a separate, often inconspicuous doorway. In other instances, the access to upper floors is either directly from within the store itself or from a rear entrance. Identification is important if there is a need to enter and clear such buildings.

Photo. An example (from eastern Canada) group of buildings exhibits all of the characteristics listed above.

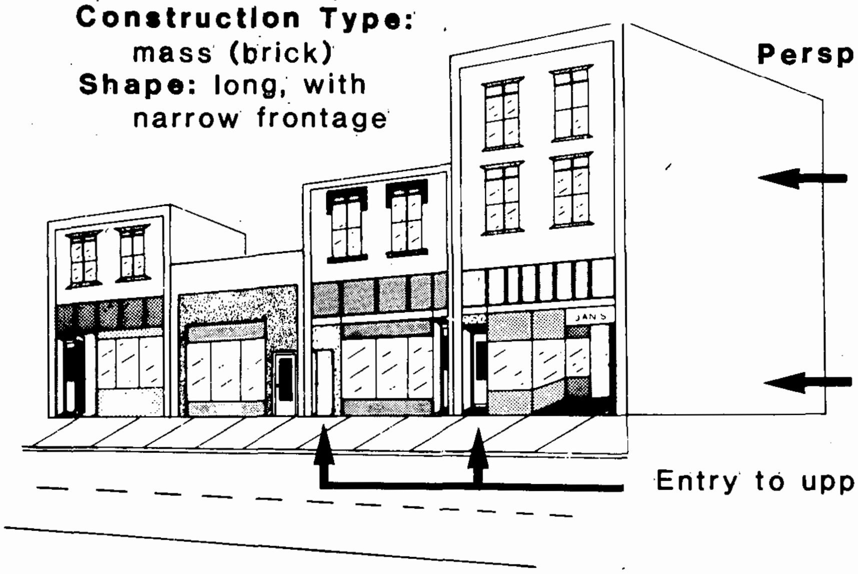


BUILDING INTERIORS:
FLOOR PLANS - I.D. KEYS

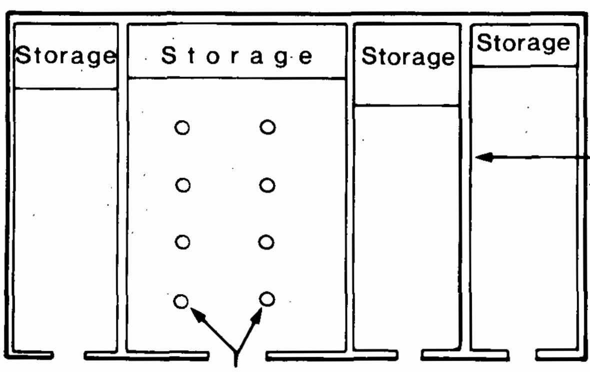
Example of **FUNCTION** (stores on ground floor, offices or residential on upper floors) along arterial streets as a determining factor

Construction Type:
mass (brick)

Shape: long, with narrow frontage



Floor Plan View (ground floor)



BUILDING INTERIOR I. D. KEYS (this example)

1. Are buildings long and narrow?
2. Is full length of store used as selling space?
3. Is there an indication of a partition to separate selling from storage space?
4. Are there separate doors to give access to upper floors or is stairway inside store?

Plate number 49 is a German variation of the previous plate. The response to economic forces is the same as elsewhere in that ground floors are used for display and sale of merchandise while upper floors serve office or residential purposes. The stores have traditional full display windows while the offices and residences have smaller windows.

The differences between this example and the previous one are both esthetic and structural. Obviously, the highly ornamented half-timbered fronts are distinctly European. Wooden-framed construction is evident and the buildings have the expected physical characteristics. In addition, they combine rural and urban forms by having pitched, rather than flat, roofs.

Response to the questions in the building identification keys reveals several similarities, and one important difference, to similar situations elsewhere.

Building Interior I.D. Key Number 1. Unlike the previous example, these buildings are shallow to the point where they are just about as deep as they are wide. This phenomenon results from the common German practice of constructing buildings around the perimeter of a block (leaving space for an interior courtyard). Accordingly, stores have less depth and less volume than is found elsewhere.

Building Interior I.D. Key Number 2. Observation of store interiors, through the front window, will reveal how much of the ground floor interior is used for selling space.

Building Interior I.D. Key Number 3. As elsewhere, if a partition is detected near the rear of the building, that space behind the partition is probably used for storage or store office space.

Building Interior I.D. Key Number 4. Access to upper floors may be through a separate door, through the store itself, or, as often occurs in Germany, through the courtyard behind the building(s). Access to the courtyard, in turn, will be through an archway located as far as several stores away.

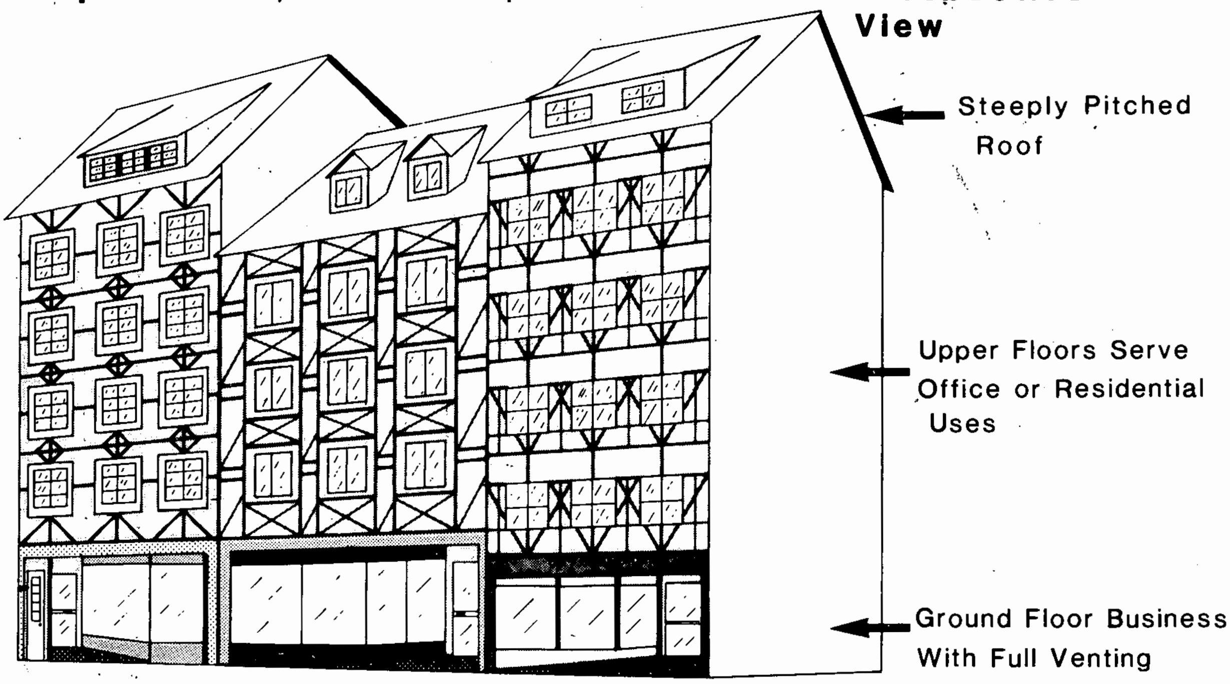
Photo: An example from Nordthein, FRG.

BUILDING INTERIORS:
FLOOR PLANS - I.D. KEYS

Example of **FUNCTION** (stores on ground floor, offices or residential on upper floors) along arterial streets – A German example

Construction Type: half-timbered framed
Shape: narrow, but not deep

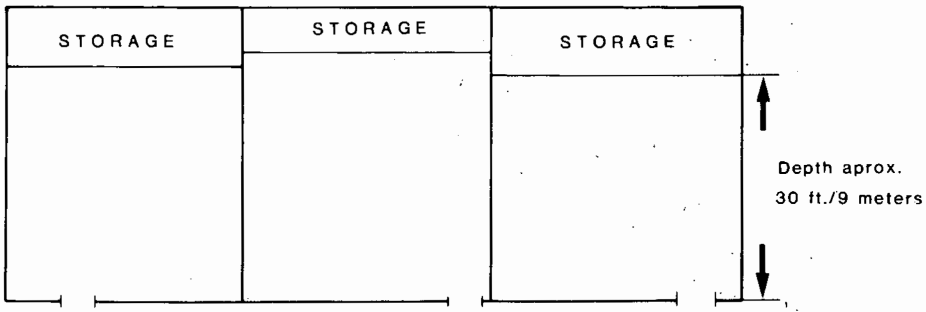
Perspective View



Long Axis of Buildings Parallels Streets

Floor Plan View

Often Open to Courtyard Behind



BUILDING INTERIOR I.D. KEYS (this example)

1. Are buildings about as deep as they are wide?
2. Is full length of store used as selling space?
3. Is there an indication of a partition to separate selling from storage space?
4. Are there separate doors to give access to upper floors or is stairway either inside store or at the rear of the building (from within courtyard)?

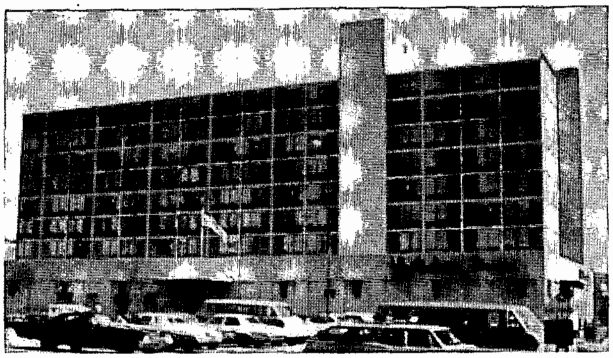
Function--in this case a hotel (plate number 50) is seen as a predominant factor in determining floor plan. The building represented, an example of box-wall principle, is characteristically long and narrow with its individual structural cells forming the hotel's guest rooms. An ideal solution to the access problem is to have hallways run the length of the building. All of the rooms are the same size and all have thick (6 to 8 inch) walls and floor/ceilings made of concrete, brick, or concrete building blocks.

The identification keys ask the questions which further aid in interior determination.

Building Interior I.D. Key Number 1. The principle of long, narrow buildings is applied here indicating that interior function can be served only by a linear hallway.

Building Interior I.D. Key Number 2. The functioning of the building as a hotel means that the area between hallway and outer wall (for guest room floors) is only 1 room deep.

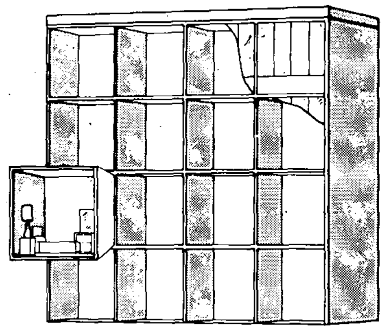
Photo. This U.S. example of a box-wall hotel is replicated broadly in cities throughout the world. It is an inexpensive, yet effective, way of providing hotel and apartment space.



BUILDING INTERIORS:
FLOOR PLANS- I. D. KEYS

Example of **FUNCTION** (a hotel)
as a determining factor

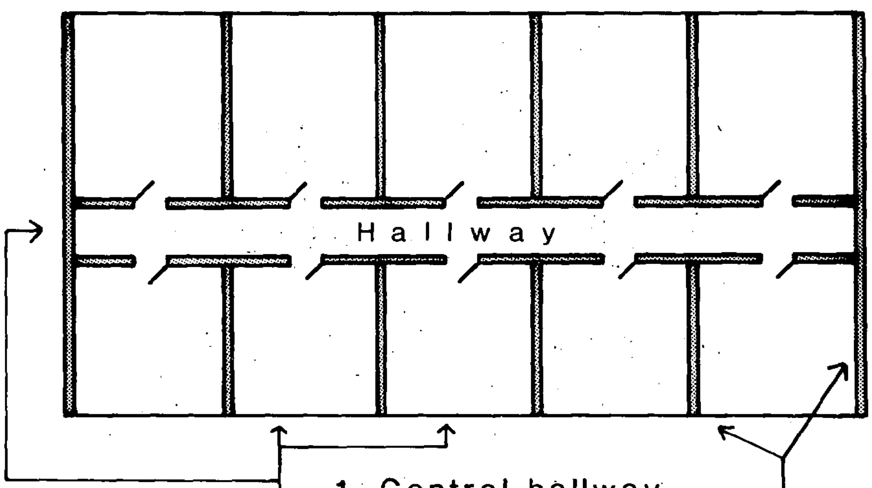
Perspective View



Construction type:
mass (box-wall principle)

Shape: long, narrow rectangle

Floor Plan View (above ground floor)



Floor Plan Characteristics

1. Central hallway
2. All rooms same size
3. Thick, load bearing partitions and walls

BUILDING INTERIOR I. D. KEYS (this example)

1. Is the shape so long and narrow that rooms can gain natural light only if served by a central, linear hallway?
2. Is the function of a type which would have units only 1 room deep?

A common type of building, a framed heavy-clad, with a common function (office) is seen in this (plate number 51) and the following example. Buildings of this type and function often have a wide rectangle or square shape and are often of medium size.

The floor plan depicted is common for ground floor usage of such buildings. The leasing out of ground floor space to shops is in direct response to the high value placed on exposure to the passing trade along the street. Because some customers can come into these shops from the hallway of the building itself, there are rear entrances as well. The main entrance for the building occupies only the width of a single shop; its size is kept to a minimum as it attracts no rent.

Observation of the identification keys serves to predict the floor plan.

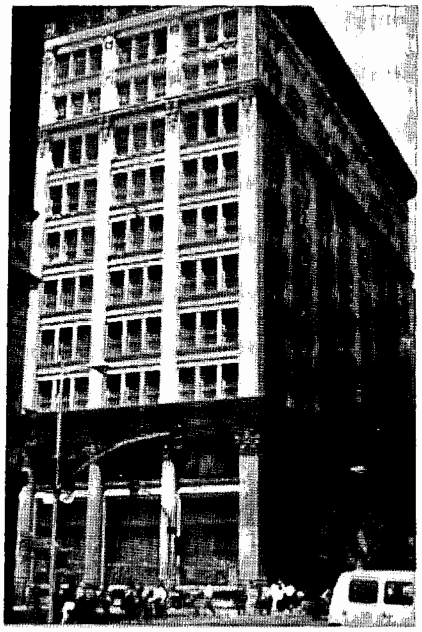
Building Interior I.D. Key Number 1. The building shown here, being of medium size, is not large enough to generate a need to have a central lightwell. Thus, the building has a hallway around the stair/elevator module.

Building Interior I.D. Key Number 2. The key to the fact that the stair/elevator module is in the center of the building lies in observing the location of the elevator housing on top of the building.

Building Interior I.D. Key Number 3. Keen observation from the outside will reveal that the entry way penetrates to the center of the building, the location of the stair/elevator module.

Building Interior I.D. Key Number 4. Shops are separated from each other by lightweight partitions. Because these partitions are not load-bearing--in a framed building such as this--they are easily breached.

Photo: Large windows on the ground floor of a shop contrast with the small windowed offices on the upper floors.



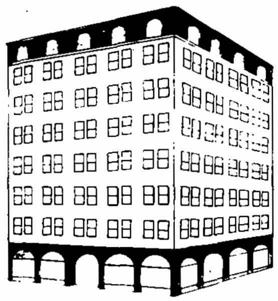
BUILDING INTERIORS:

FLOOR PLANS- I. D. KEYS

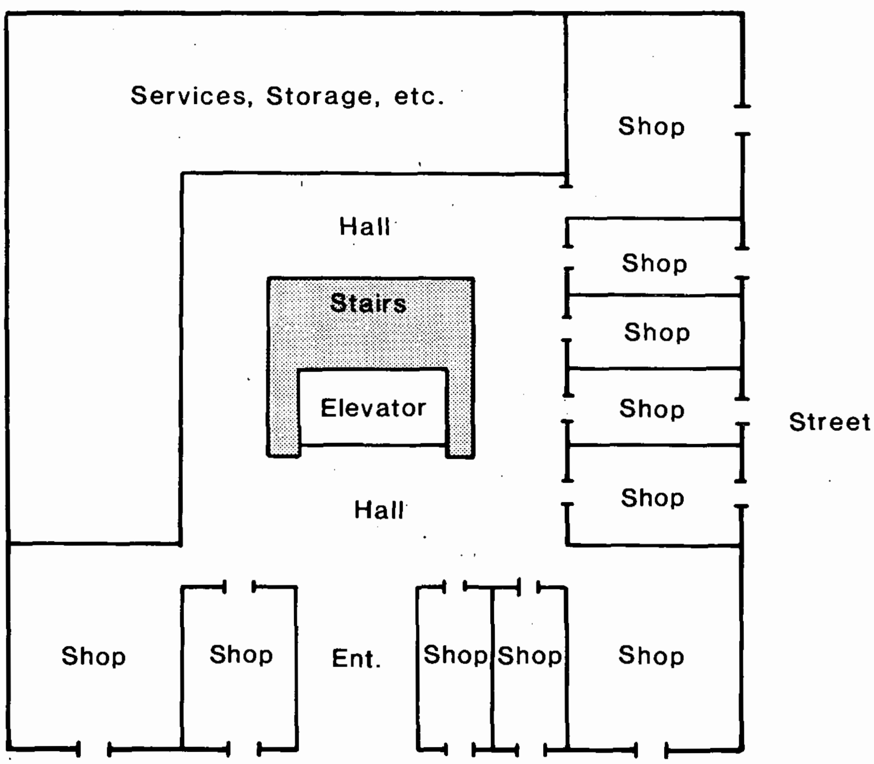
Example of **FUNCTION** (office building, ground floor) as a determining factor

Construction type: framed, heavy-clad
Shape: wide rectangle or square
Size: medium (<a full city block)

Perspective View



Floor Plan View (ground floor)



BUILDING INTERIOR I. D. KEYS (this example)

1. Are building dimensions small enough to preclude need for central lightwell to provide natural light to rooms?
2. Is there an elevator housing in the center of the building?
3. Is central entrance deep enough to reach center of building?
4. Do shops have entrances on street side?

This example (plate number 52) presents the upper floor plan of the same building (plate 51). Throughout the entire shaft segment of the building, there is a repetition on each floor of the arrangement of hallway and offices. The most efficient floor plan in such cases is for the offices to be placed around the building's perimenter. Articulation is provided by a hallway enclosing the stair/elevator module.

Dimensions of individual offices vary with the needs of the individual occupant. Because the load is borne by the frame, partitions between offices may be moved to suit space requirements. Careful observation from the street (through the windows) can reveal the varying sizes of offices.

Identification keys 1, 2, and 3 are the same as on the preceding page.

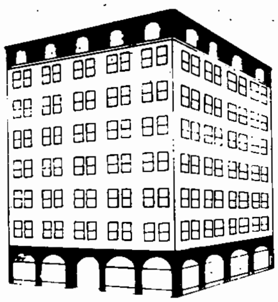
Photo. This building, in Philadelphia, is a good example of the principles expressed here. The elevator housing (and the stairway module) are located in the center of the building: offices are located around the building's perimeter.

BUILDING INTERIORS:
FLOOR PLANS- I. D. KEYS

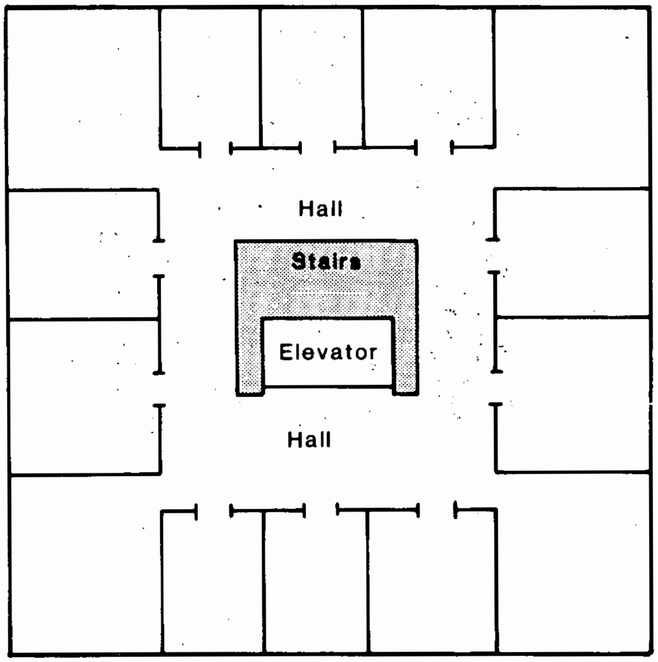
Example of **FUNCTION** (office building, upper floors) as a determining factor

Construction type: framed, heavy-clad
Shape: wide rectangle or square
Size: medium (<a full city block)

Perspective View



Floor Plan View (upper floor)



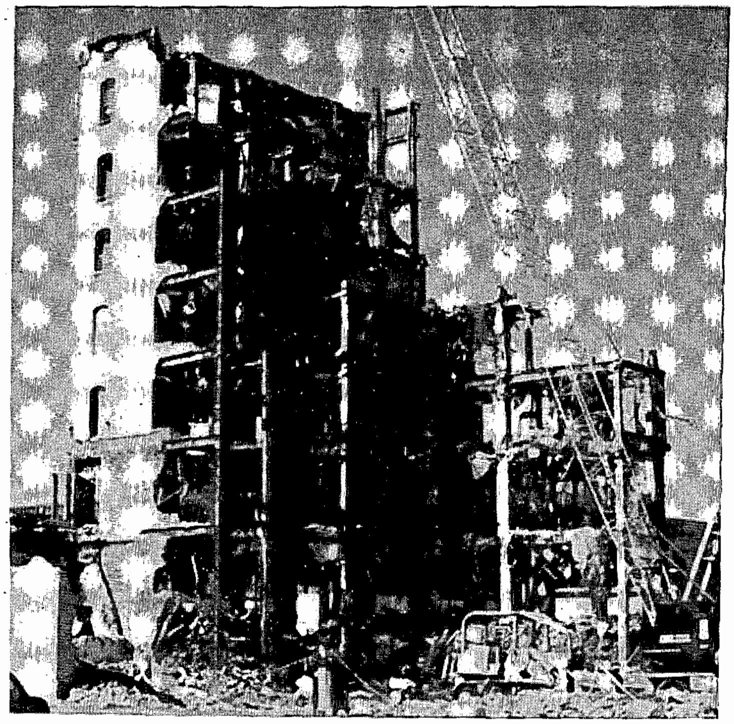
BUILDING INTERIOR I. D. KEYS (this example)

1. Are building dimensions small enough to preclude need for central lightwell to provide natural light to rooms?
2. Is there an elevator housing in the center of the building?
3. Is central entrance deep enough to reach center of building?
4. Can room partitions be seen through windows?

In detail even greater than that of building floor plans, this example (plate number 53) portrays a single office from a framed, heavy-clad structure. Commonly, offices of this type are separated from one another by partitions placed along a line of columns; this practice permits concealing the columns. Extending offices beyond the reach of a beam between columns would have the effect of leaving columns standing awkardly within the room. Only in the more modern light-clad framed buildings--with their open-bay type offices--are columns left exposed. Offices in the older framed, heavy-clad buildings were usually designed as general rental and were thus purposely kept small (in the range of from 15 to 20 feet per side).

The heavy-clad nature of the exterior wall is also shown in the illustration. Interior walls, composed of such lightweight materials as terra cotta brick and lath and plaster, are lighter than exterior walls but still heavier than the lightweight, interior walls of the new framed, light-clad office buildings.

Photo. The cellular nature of framed, heavy-clad building being razed is evident. Most "cells" were occupied by individual offices.

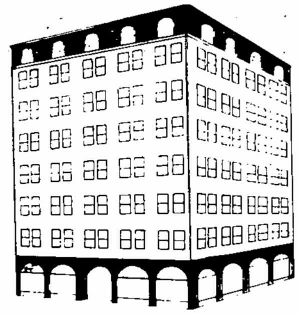


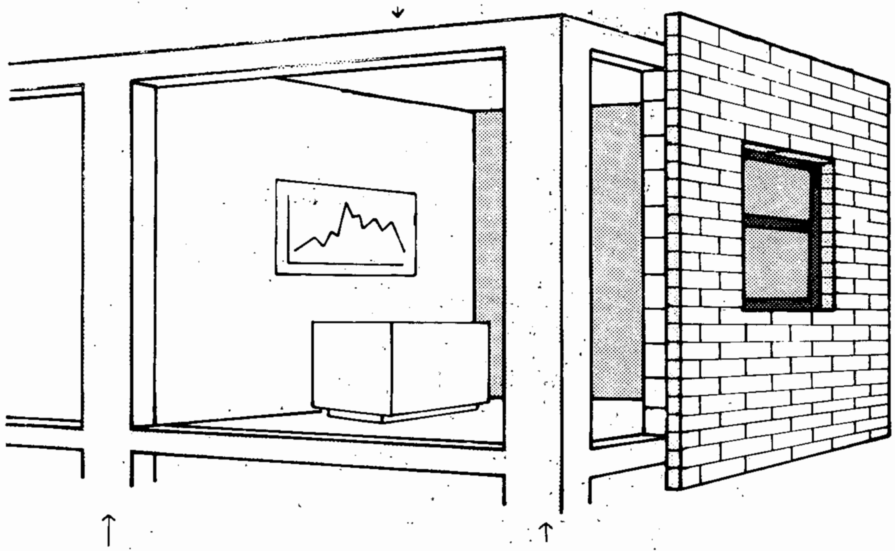
BUILDING INTERIORS:

Example of a single room

Construction type: framed, heavy–clad
Function: office

Perspective View





One Office per "Cell" Between

Frame Members

Department store floor plans are simple because of the goal of the designer to provide ample unobstructed interior space for merchandising.

In this example (plate number 54) of a framed, heavy-clad department store--many large examples of which are extant in large cities throughout the world--the floor plans of both the ground and an upper floor are illustrated. They are similar in that the structural columns that support the building are visible and both have a bank of elevators (and escalators). The fire wall which separates units of the building is found on every floor. Its purpose is to contain fire, to keep it from spreading. At the necessary ports to permit passage from one segment of the building to the other, there are fire doors which close automatically when temperatures reach dangerous levels.

The differences between the two sections are (1) the ground floor (in this example) has a partial, or mezzanine intermediate floor which has windows to the street located above the ground floor venting; and (2) the upper floor has part of its area devoted to merchandise storage.

Upper floors also have more, smaller departments than do ground floors. When these are partitioned from one another, they provide more intra-building concealment than exists on the ground floor.

The identification keys point out these features.

Building Interior I.D. Key Number 1. This directs attention to the presence of the structural columns on each floor.

Building Interior I.D. Key Number 2. The partial windows above the main windows will indicate the presence of a mezzanine section.

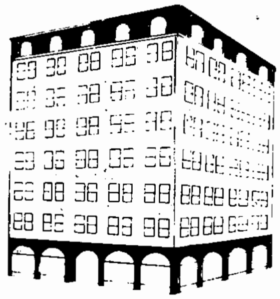
Building Interior I.D. Key Number 3. The detecting of the presence of fire walls and doors is significant for they could be used effectively in a military operation to provide cover within the building. Conversely, attacking forces should be aware of their presence and be prepared to counter them. Interior fire walls of older buildings were fairly thick and present a potentially formidable barrier.

BUILDING INTERIORS:
FLOOR PLANS- I. D. KEYS

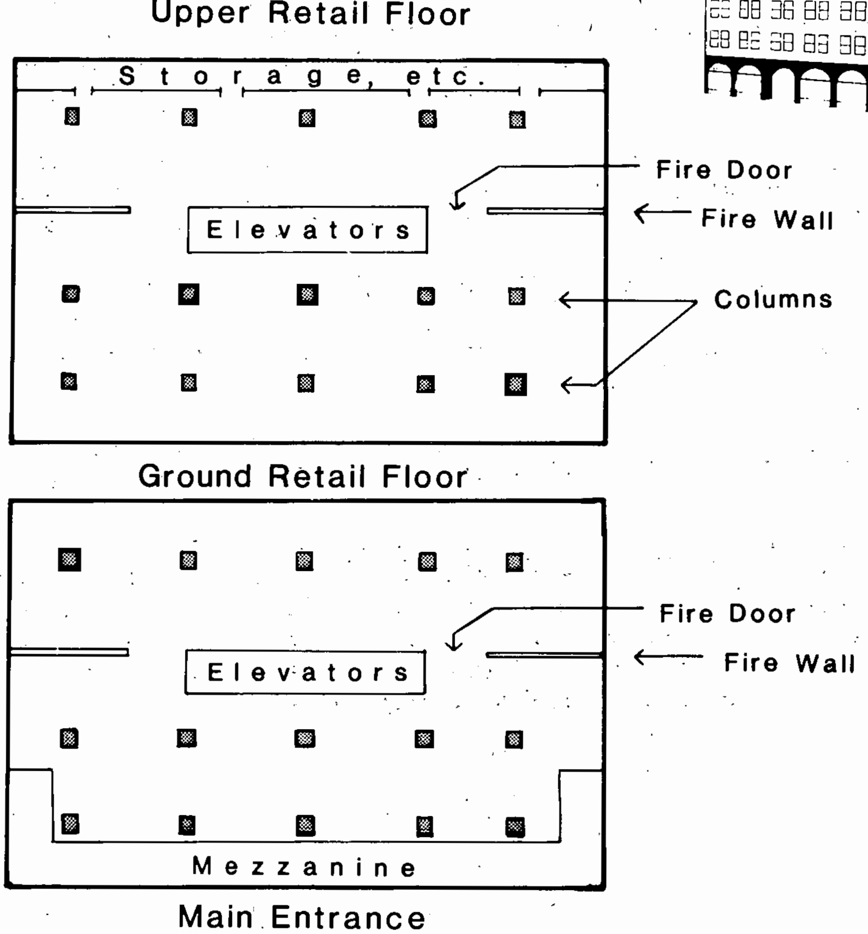
Example of **Function** (a department store) as a determining factor.

Construction type: framed, heavy-clad

Perspective View



Floor Plan View



BUILDING INTERIOR I.D. KEYS (this example)

1. Are structural columns visible in large, open interior areas?
2. Are there partial windows located just above ground floor indicating presence of a mezzanine?
3. Are fire walls and fire doors present?

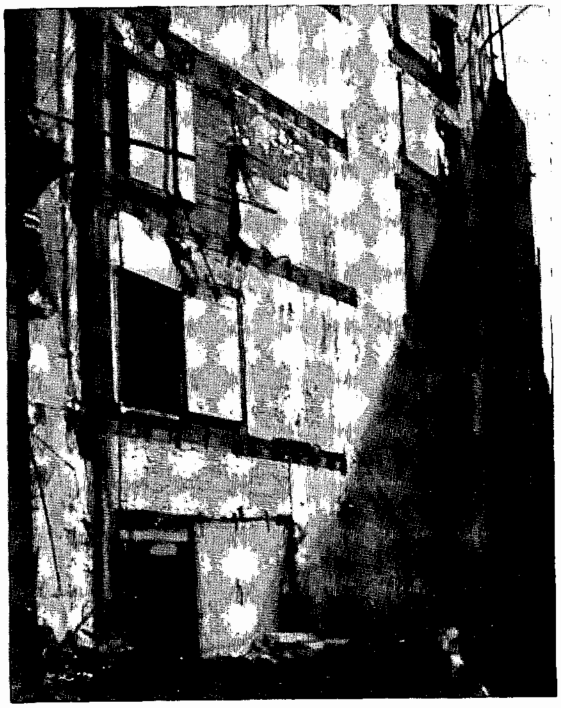
Details are illustrated here (plate number 55) of the type of fire door mentioned on the previous page.

Fire doors are designed to close automatically in the event of fire by sliding down a track and fitting into a seat in the fire wall, thus sealing the doorway. In a non-fire threat situation, the door is held in the open position by a chain, one link of which is fusible; that is, made of a material which will melt at a known high temperature and cause the chain to be broken and the door to shut.

Fire Door Specifications. To be effective in holding out fire, these doors are necessarily thick (from 2 to 4 inches) and are steel cladded. Accordingly, they are heavy and would be difficult to move up the track manually should defensive forces have closed them intentionally.

Tactics to Defeat. The recommended solution to holding such doors open is simply to drive wedges into the wheels along the track. Opening them, even under normal situations, is a difficult task. In a combat situation, this might best be done with explosives or by placing a heavy pry bar into the door seat and exerting force upward (up track).

Photo. Several fire doors are seen along a standing wall of a building being razed.



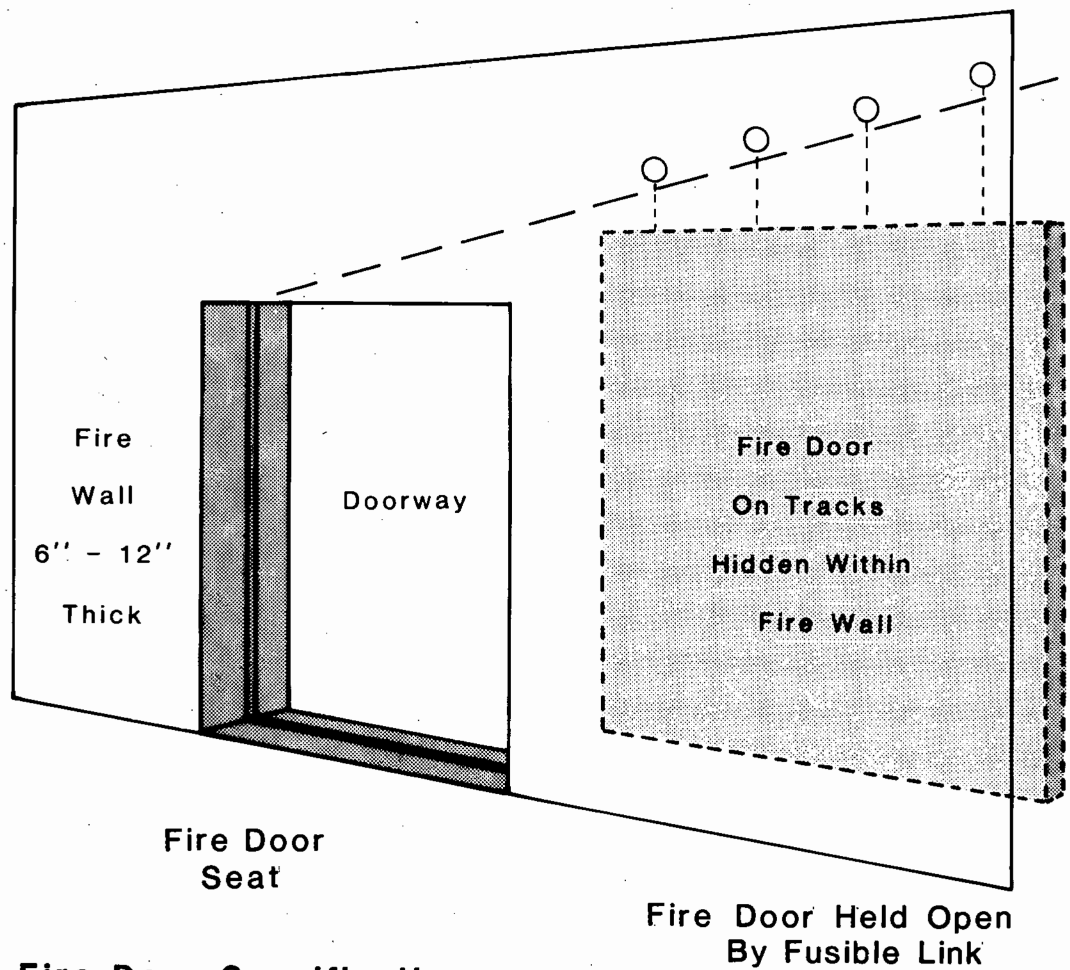
BUILDING INTERIORS:

FLOOR PLANS- I. D. KEYS

Example of a fire wall and fire door

Construction type: framed, heavy-clad

Function: department store



Fire Door Specifications

1. 2–4 inches thick
2. Steel clad

Tactics to defeat

1. To prevent closing: Use wedge
2. To open: Use explosives or a pry

Function is the principle determinant in interpreting the floor plan of this example building (plate number 56), a framed, light-clad structure. The shape is of the wide rectangle or square type and the size is medium.

The ground floor has a large area of open space on all sides of the elevator and stair module. The upper floor plan features large, open-bay offices. Partitions are movable and in many instances do not extend from floor to ceiling. There are small rooms such as executive offices and specialized rooms used for computing and duplicating equipment.

Answering the identification key questions will reveal the nature of the floor plan.

<u>Building Interior I.D. Key Number 1</u>. The building is not of sufficient breadth to require a light well to serve interior offices; much of the lighting requirement of structures such as these comes from artifical sources.

<u>Building Interior I.D. Key Number 2</u>. The presence of an elevator housing in the center of the building indicates the position of the hallways, and thus the offices. In some instances, especially where large corporations occupy one or more complete floors, the elevators simply open directly into the office or to a receptionist's area. In these instances, there is often no hallway in the traditional sense.

<u>Building Interior I.D. Key Number 3</u>. Even from some distance, thanks to large window openings and the large size of the elevator modules, it is readily possible to identify these modules. Their location, in the center of the building, in this case, can be noted and applied to infer the floor plan.

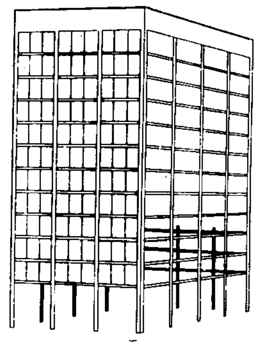
<u>Building Interior I.D. Key Number 4</u>. Because of the usually large window area, it is possible to see room partitions from the street. The arrangement of offices on each floor can thus be determined.

<u>Photo</u>. The ground floor lobby of a large office building.

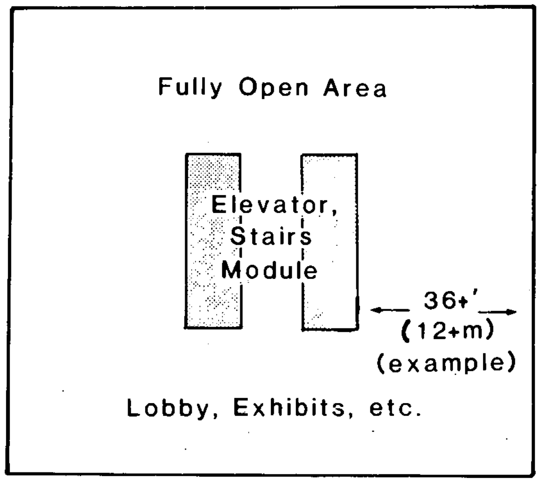
BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

Example of **Function** (office building–ground floor and upper floors) as a determining factor
Construction type: framed, light–clad
Shape: wide rectangle or square
Size: medium (<a full city block)

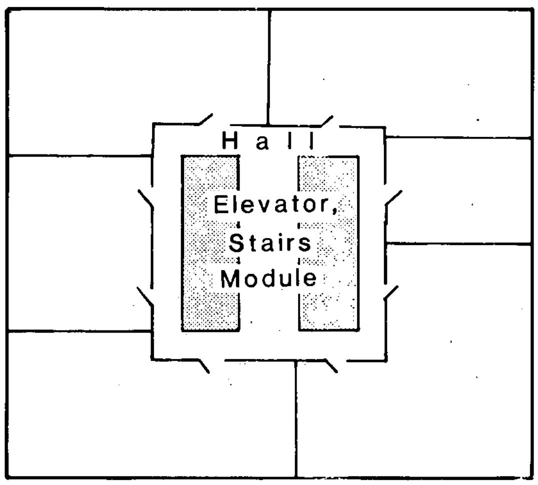
Perspective View



Floor Plan Views
Ground Floor



Upper Floors



Large, Open–Bay Offices

Partitions are Modular

Office Size Varies

BUILDING INTERIOR I.D. KEYS (this example)

1. Are building dimensions small enough to preclude need for central lightwell to provide natural light to rooms?
2. Is there an elevator housing in the center of the building?
3. Is elevator/stair module visible through windows on ground floor?
4. Can room partitions be seen through windows?

Framed, light-clad buildings also have a characteristic type of office (plate number 57); one that is different in degree from those found in framed, heavy-clad structures.

Two factors account for larger individual offices in these buildings. The first is purely physical and is a product of the longer beam size possible today using various forms of reinforced concrete; distances to 36 feet are common. The second is economic. Large, open-bay offices are popular and considered to be efficient.

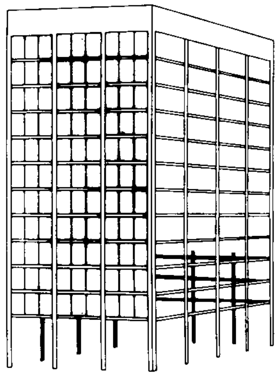
BUILDING INTERIORS:

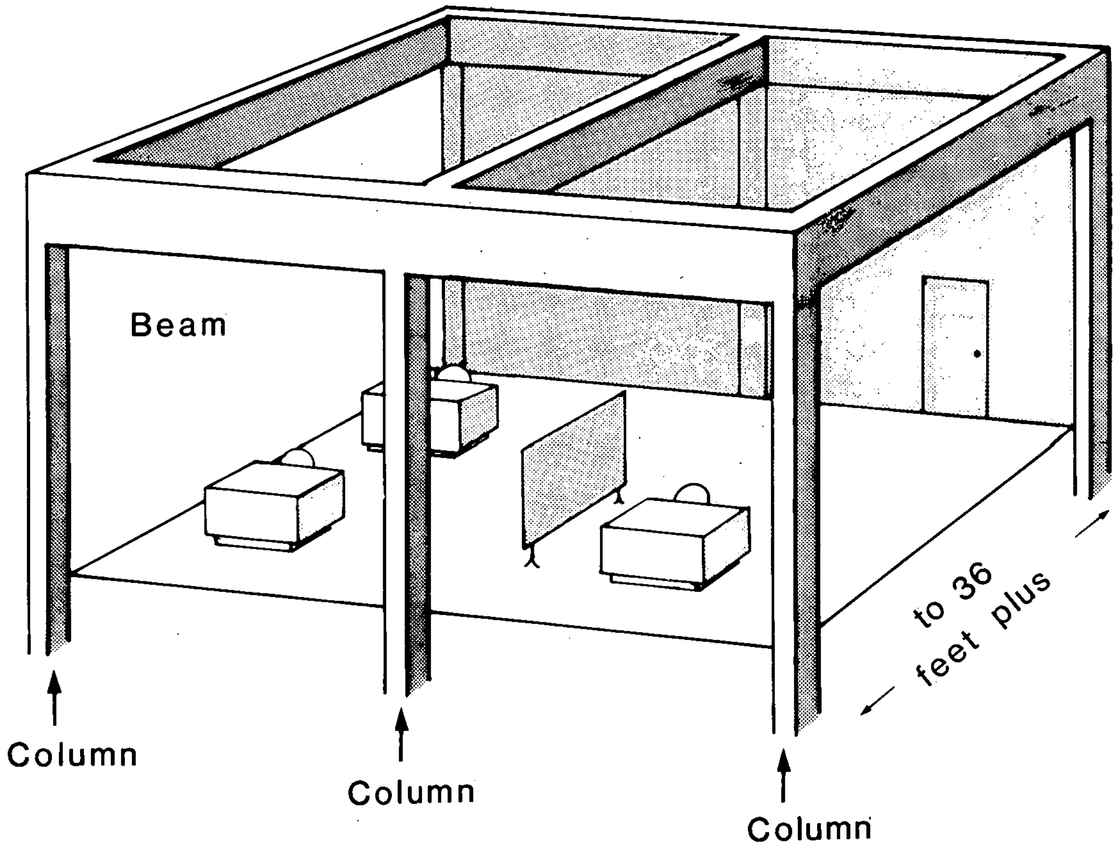
Example of a single room

Construction type: framed, light-clad

Function: office (open bay type)

Perspective View





Buildings for public gatherings (plate number 58) have certain characteristics. Good examples are theaters, auditoriums, sports arenas, and school gymnasiums. They all have a large open-interior area, usually devoid of structural columns, and have few, if any, windows. There is usually a lobby inside the main entrance, and frequently, there exists an area devoted to a stage, offices, etc. at the opposite end of the building. Because of the need for a large unobstructed interior open space, support of the roof can be achieved only through employment of heavy beams or trusses. The weight of these, in turn, is commonly borne by heavy, mass construction walls, usually made either of concrete or brick.

These buildings, highly specialized in design, are found universally in cities throughout the world. Several military applications, discussed in the following sections, may be made of these structures.

These buildings are readily identified in the field. Those with a mass type of construction conform to the identification keys listed here.

Building Interior I.D. Key Number 1. If the building has been erected in accordance with mass construction principles, there will ordinarily be some of the usual associated evidence. Examples are recessed windows and doors and pilasters along the wall.

Building Interior I.D. Key Number 2. The nature of use of these structures, a theater for example, means that there will be few windows, particularly on the sides of the building.

Building Interior I.D. Key Number 3. Because of the need to accommodate large numbers of people, these buildings will have large doors in front. They frequently occur in multiple sets.

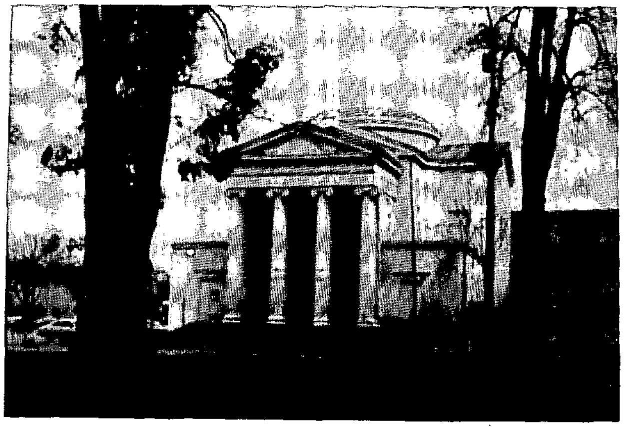
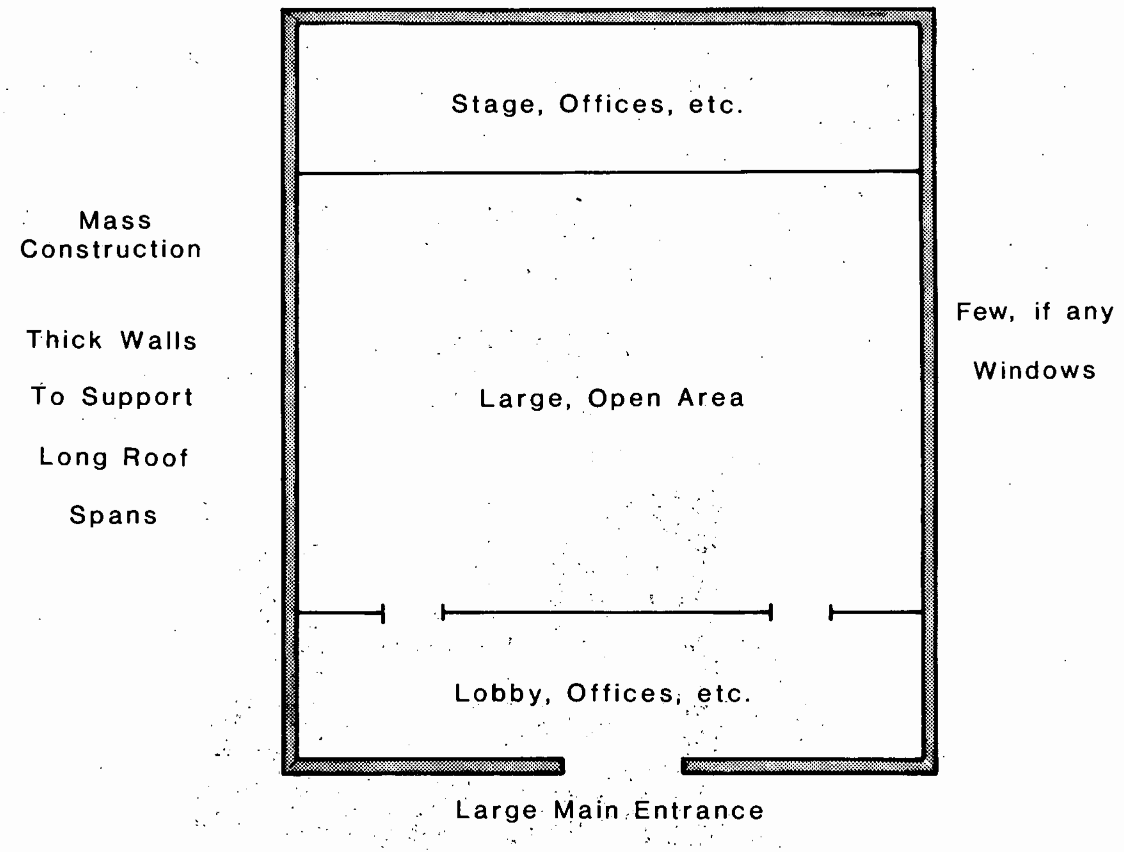


Photo. This classically styled public-gathering type building (an auditorium) has a situation--facing a park--which is common with this type of structure.

BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

Example of **FUNCTION** (public gathering place-theater, auditorium) as a determining factor

Construction type: mass(stone, brick, concrete)



BUILDING INTERIOR I.D. KEYS(this example)

1. Does building show evidence of mass construction?
2. Are there only a few windows?
3. Are there large doors in front?

As with any function, the design of apartment buildings presents the architects with a certain set of problems for which he must find solutions. These solutions result in a set of special characteristics which are peculiar to buildings of this type. A principal problem in apartment design is satisfying the need for each room to have at least one exterior window. Apartment units consisting of several rooms cannot attain this goal in long, linear buildings served by a central hallway. The most common solutions are seen in this and the following illustrations. There are several variations on the theme, especially when a single building consists of several joined modules.

This example apartment (plate number 59) is of the wide rectangle or square shape variety. Its construction may be either mass or framed: either can accommodate this floor plan. The building contains four apartment units per floor, each with three rooms.

Close attention to the identification keys will reveal the character of the floor plan.

Building Interior I.D. Key Number 1. By interpreting the size and shape of the building, the observer can reason that this example would have four apartment units per floor. Window size and shape is a further clue; the function of bathrooms and kitchens are usually readily identified.

Building Interior I.D. Key Number 2. Windows on both the side and the front of the building for each apartment unit can be seen. It is especially necessary to locate the entry and the stair landings.

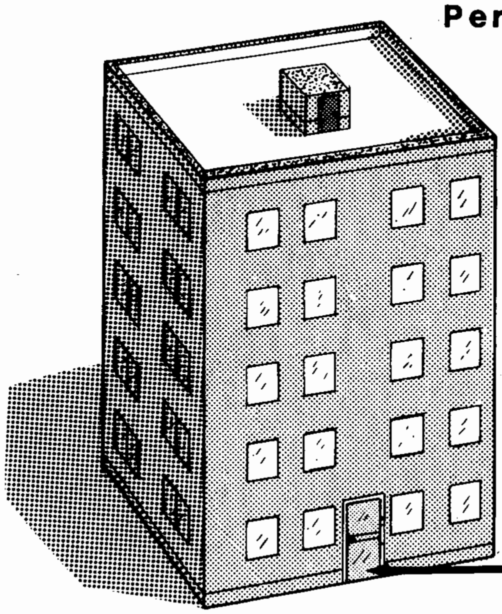
Building Interior I.D. Key Number 3. For the plan depicted here, there is a central stairwell with landings at each floor to serve the four apartments. The entrance from the outside will be a central door and hallway leading to the center of the buildings.

BUILDING INTERIORS: FLOOR PLANS-I.D. KEYS

Example of **FUNCTION** (apartment)

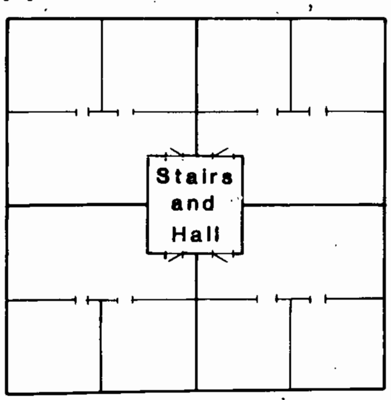
Shape: wide rectangle or square
Construction type: mass or framed

Perspective View



Shared entry for each 4 apts. per floor

Upper Floor Plan View



BUILDING INTERIOR I.D. KEYS(this example)

1.Does building shape and size allow 4 apartment units per floor?

2.Does each unit have windows on both side and front?

3.Is there a shared entry for each 4 apartments?

This form of apartment house (plate number 60), a very common one in Europe, finds a solution to the problem of each room gaining access to natural light by keeping the building so narrow that each apartment unit has rooms facing outward of both sides of the building. To avoid the waste of space of each unit having its own stairwell, one is shared by each two apartments (per floor).

The shape which results from employing this solution is a long and narrow building. Actual width depends on the quality of the apartment. Those with greater space are generally the more expensive. This example, a common one, is but 30 feet deep.

As with the square-shaped apartment building, adherence to the identification keys reveals the nature of the interior.

Building Interior I.D. Key Number 1. The shallow depth of the building is an immediate signal to proceed to check the other identification keys. If the building is a long rectangle, but fairly deep, the observer can suspect a central hallway and begin to look for appropriate clues.

Building Interior I.D. Key Number 2. The multiple number of entrances, evenly spaced along the length of the building, should be noted. The pattern shown here cannot be present if there is but a single entry in the center of the building (as is the case demonstrated in plate number 50).

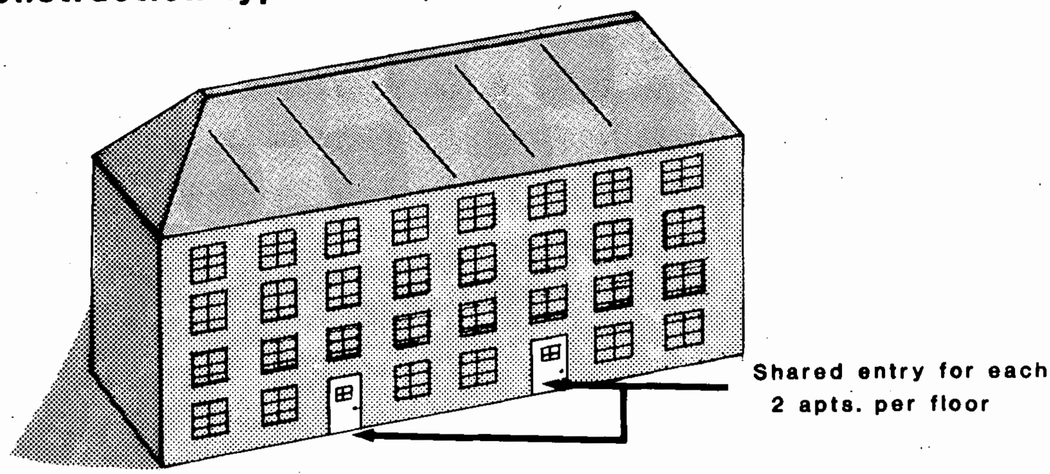
Building Interior I.D. Key Number 3. A useful exercise is to determine the total number of apartment units in structures such as this. Multiplying the number of entrances (one for each two units) times the number of floors will yield the answer.

BUILDING INTERIORS: FLOOR PLANS - I.D. KEYS

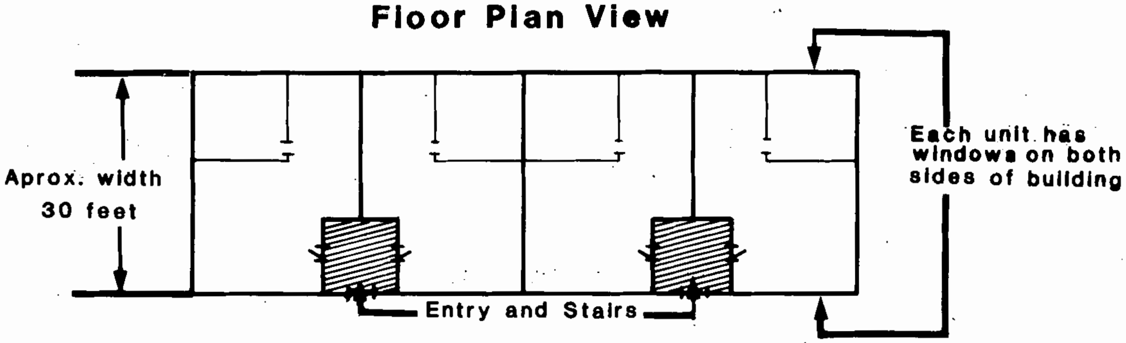
Example of **FUNCTION** (apartment - European style - free standing)

Shape: linear and narrow
Construction type: mass(brick)

Perspective View



Floor Plan View



BUILDING INTERIOR I.D. KEYS (this example)

1. Is building width so narrow that multi-room apartments must have windows on both sides of building?

2. Are there multiple entrances?

3. Can the number of apt. units be determined by considering keys 1 and 2?

Possibilities of weapons deployment are illustrated here (plate number 61) for situations where a series of independently constructed brick buildings face an arterial street. Individual buildings are long and narrow. Stores, with full display windows on the street side, occupy the ground floor. The upper floors, devoted to offices and residences, are divided into small rooms.

The example is composed of brick buildings which have a set of characteristics important for military considerations. First, because the brick buildings have been constructed independently, each has its own side wall. Thus, there exists a double wall between each two buildings. Accordingly, a great deal of cover is provided to defenders on each side. Second, as interior space on the ground floor has neither frame members not partitions, there is a considerable volume of air space to absorb antitank weapon back blast. Third, the nonload-bearing partitions on the upper floors are fairly light but do provide some level of protection against the effects of small arms and light shrapnel. Fourth, the roof of buildings such as these is made of material (ceiling joists, rafters, and roofing) which is meant only to hold out the weather and thus provides little overhead cover to riflemen.

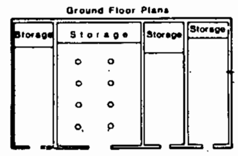
Weapons deployment opportunites differ on the two floors. On the ground floor, the open areas will accommodate the back blast of LAW's, and in the larger store units, DRAGONS or 90mm recoilless rifles. Note though, these buildings are normally located on a narrow street with fields of fire too short for antitank guided missiles. Corner entrances which dominate intersections may favor the employment of machineguns. Upper floor rooms usually have too little volume to permit firing antitank weapons, but they do provide a good degree of cover for soft-skinned systems such as riflemen or snipers. The top floor should be avoided if possible because of the lack of overhead cover.

Maneuvering between buildings of this type can be easily accomplished by going over the roof tops and then breaking through the roof, the weakest part of each building. The easiest place to break the walls between buildings is on the upper stories where the walls are thinnest. Finally, if ground-floor doors are to be used to gain entry, there is usually more cover at the back of the buildings than at the front. If front entries must be used, it should be realized that the entrance to the upper floors is normally not the same as the entrance to the ground floor commercial area.

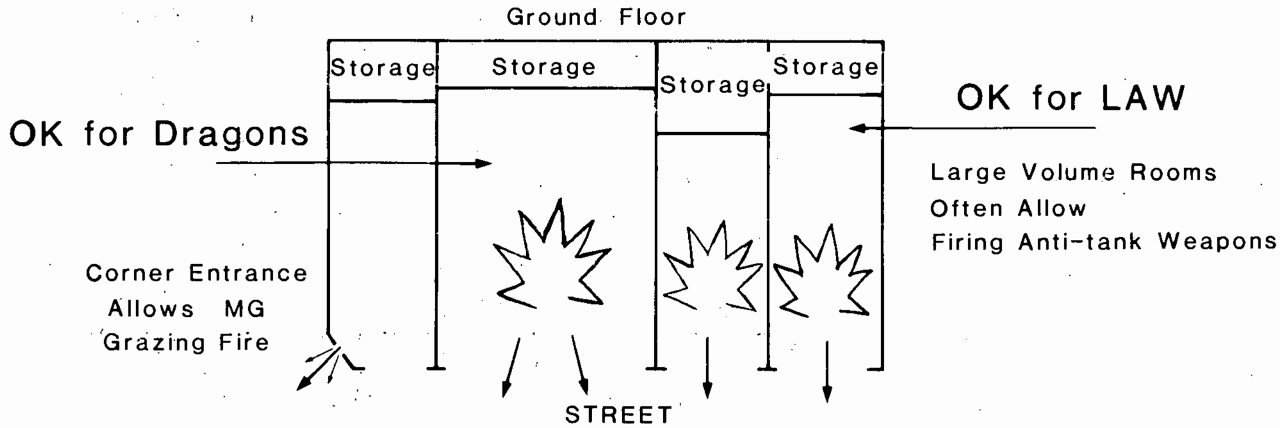
Maneuvering within the buildings will require room-to-room clearing, except on the ground floor with its one large open bay.

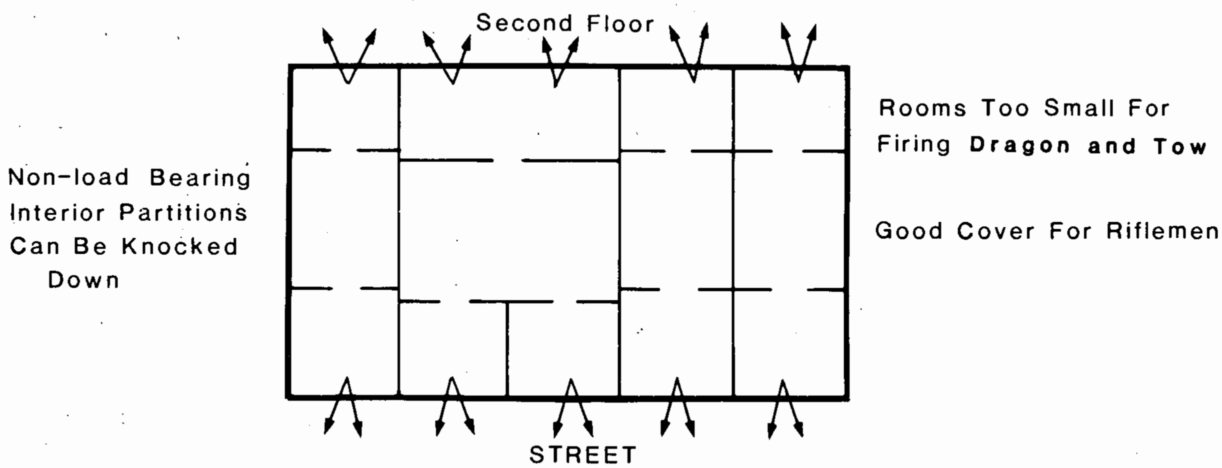
Brick residential buildings have the same characteristics as brick commercial buildings, except that the ground floors are like the upper floors instead of being large open areas.

MILITARY APPLICATIONS



Weapons Systems Usage
(Brick Construction)





Large volume buildings of this type (plate number 62) afford certain opportunities for military usage. First, the thickness and strength of the walls (8 to 10 inches of concrete and often steel reinforced, or from 12 to 16 inches thick of brick) provide a considerable amount of cover and concealment. Second, the floors of these buildings are commonly concrete slabs (poured on the ground and without basements) and may be capable of supporting the heavy weight of tanks or self-propelled artillery pieces. The general lack of windows also adds to the degree of concealment afforded. Third, the large open volume of the interiors of these buildings will accommodate the back blast of antitank weapons. Location of these buildings away from the crowded center of cities usually insures broad fields of fire as well.

The roof, designed only to hold out the weather, is vulnerable to mortar, artillery, and air attack and provides little cover.

An attacking force entering these buildings would use free maneuver within, rather than being faced with a room-to-room clearing sitation.

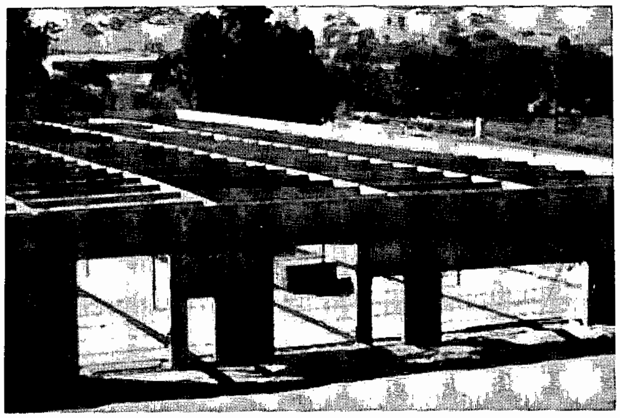
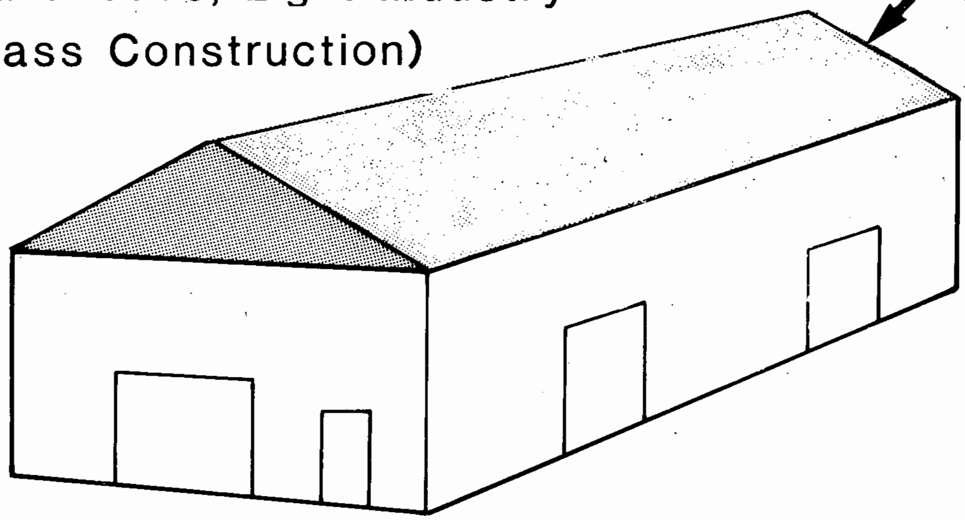


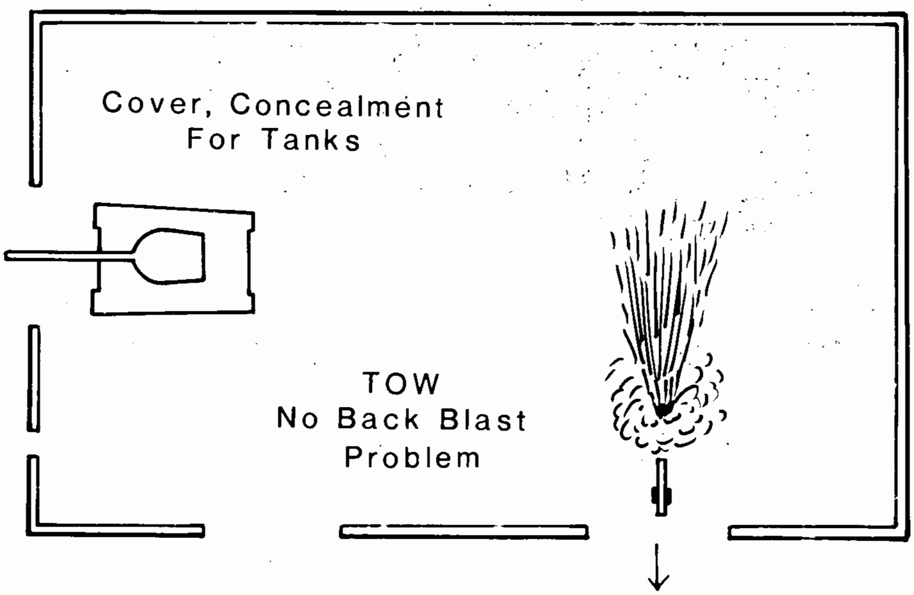
Photo. A concrete-walled warehouse, under construction, displays its concrete floor, large doors, and the light construction of its roof.

MILITARY APPLICATIONS

Weapons System Usage

Warehouse, Light Industry (Mass Construction)





In box-wall principle buildings (plate number 63)--consisting of mass floors, walls, and ceilings from 6 to 8 inches thick--each room is a cell which provides good protection overhead, under foot, to either side, and to the rear. There is virtually no protection, however, provided by the light curtain wall and windows on the exterior facing side of each cell.

The rooms of box-wall principle buildings are normally too small and inadequately vented to permit the firing of antitank weapons with a heavy back blast; that is, a TOW. They favor employment of other infantry systems provided some provision is made to compensate for the lack of frontal cover.

Maneuver in a box-wall principle building must allow for its common floor plan, a central hallway with rooms on each side. The protected hallways and stairwells facilitate interior maneuver. For example, a sniper could engage a target from one room, and then move to a different room, even on a different floor, before the enemy could counter-fire.

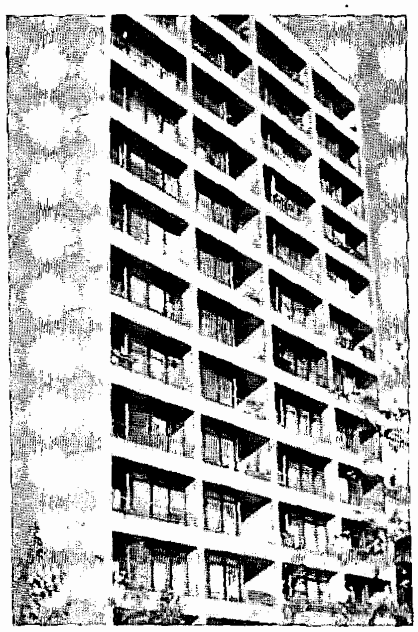


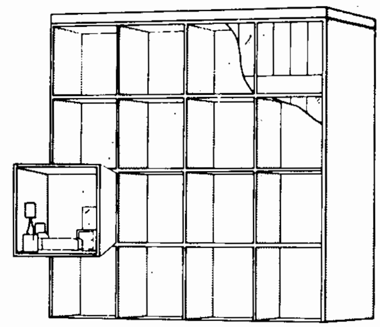
Photo. The cellular shape of apartment units in this building in W. Berlin is readily seen.

MILITARY APPLICATIONS

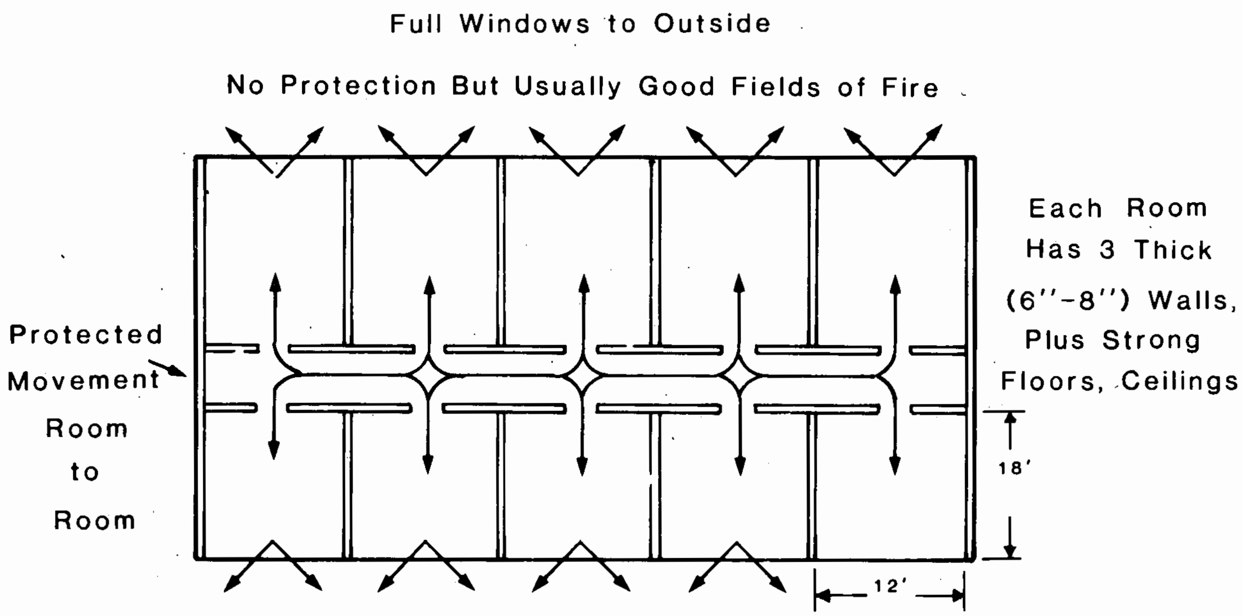
Weapons System Usage

BOX-WALL PRINCIPLE

Box-Wall Principle Type



Hotel



Rooms O.K. For Small Arms, LAW and DRAGON

Too Shallow For TOW

Public gathering places (plate number 64)--theaters, auditoriums, gymnasiums, etc.--possess a set of unique characteristics which provide opportunities for certain military operations. Because their construction usually employs mass construction techniques, they have thick load-bearing walls which provide a high degree of cover. Also, because of the desirability of having only a few windows, they offer a considerable amount of concealment as well. Further, the very nature of their interiors means that there is ample volume to absorb back blast, thus allowing the firing of antitank guided missiles. In addition, their common location overlooking large clear areas means that there are often wide fields of fire. The interior wall, separating the lobby from the main public assembly area, could be partially removed to increase back blast area for firing out the front doors.

The principal disadvantage is the weakness of the roof and the fact that it presents quite a large target to aerial bombardment and to artillery and mortar fire.

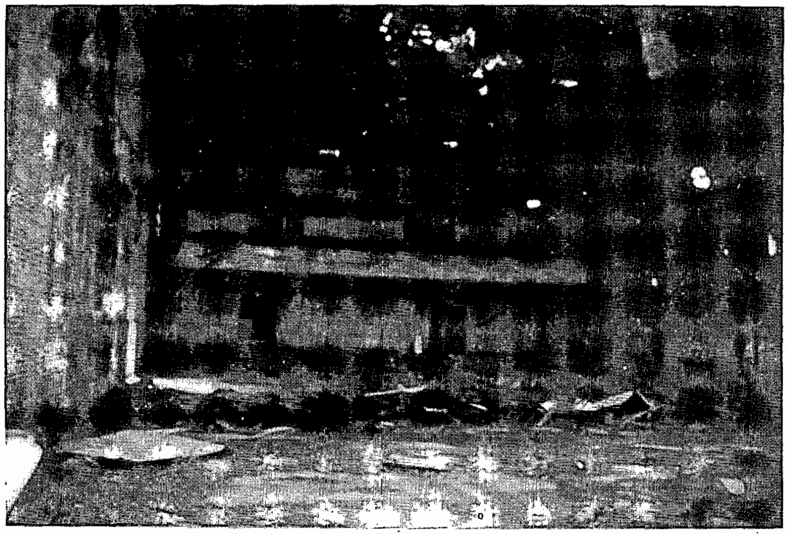
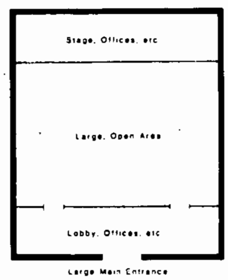


Photo. This scene on the main floor of a theater being demolished illustrates well the large, open interior.

MILITARY APPLICATIONS

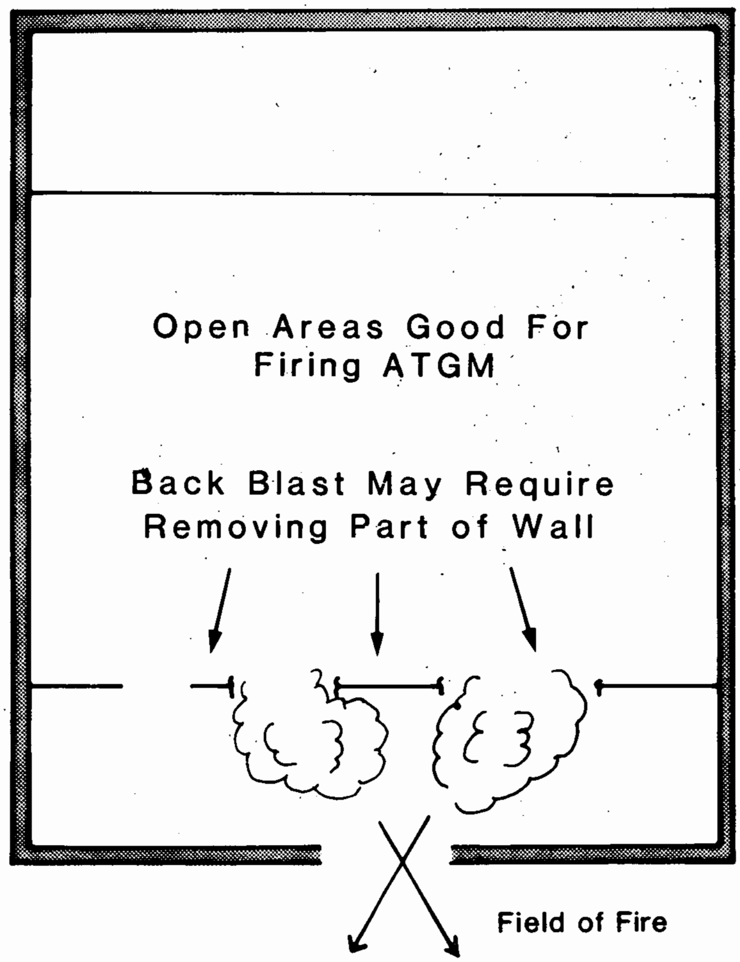
Public Gathering Places

General Features



Weapons System Usage

Public Gathering Places



Framed heavy-clad buildings provide both opportunities and constraints for military applications. Exterior walls, being thicker, provide more protection than do those of framed light-clad buildings. Good cover exists for thin-skinned systems, such as snipers. Interior walls of these buildings are also generally thicker than those of light-clad buildings and provide some protection from small arms and light shrapnel. The multistoried height of these buildings is important in providing considerable overhead protection to a defender located a few floors from the top.

In this example of an office building (plate number 65), the individual offices are usually too small to accommodate the back blast from antitank guided missiles. In most of these buildings, however, there are usually a few rooms with sufficient volume to absorb weapon back blast.

The maneuver pattern inside these buildings, repeated on each floor, requires that rooms be entered from a hallway and that room-to-room clearing is necessary. The presence of a hallway of this type also could serve snipers who could change firing positions while remaining undetected.

In other types of heavy-clad buildings--department stores and factories, for example--there are fewer partitions, and thus less interior protection. On the plus side, however, there would be more opportunities for employing antitank weapons and a reduction of the requirement for room-to-room maneuver.

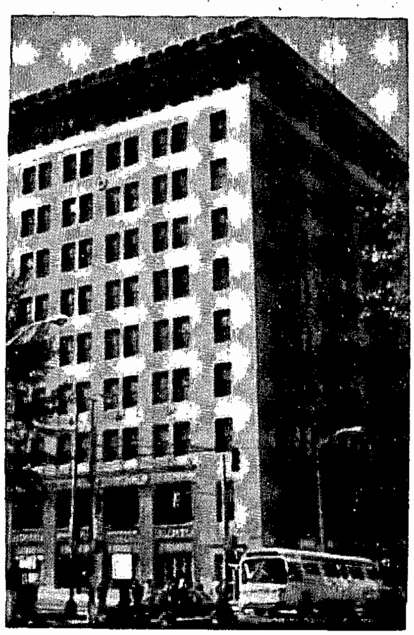


Photo. A typical framed heavy-clad office building (in Atlanta).

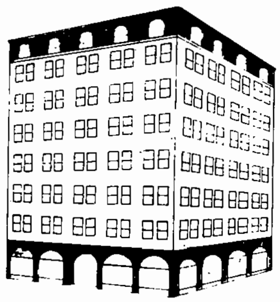
MILITARY APPLICATIONS

Weapons System Usage

Framed Heavy Clad Office Building

—

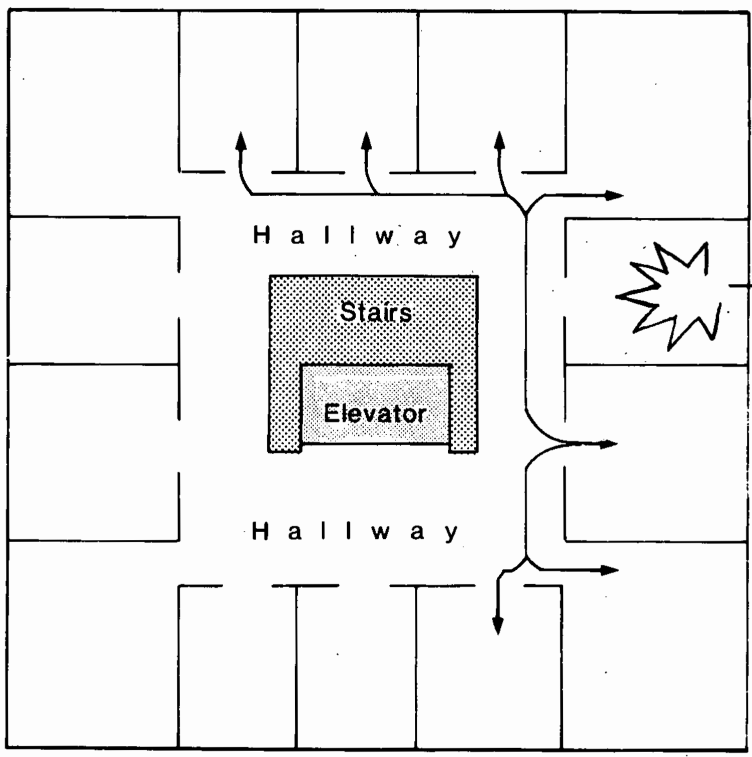
Upper Floors



OFFENSE

Room to Room Clearing-Required

Hall Partitions Resistant to Ball Ammo



DEFENSE

Shallow, Narrow Rooms Means Possible Back Blast Problem for DRAGON, TOW

Good Cover For Snipers

Easy Room to Room Circulation (Arrows)

Light-clad buildings (plate number 66) provide the least protection of any of the buildings considered because both the exterior walls and the interior partitions are very light. The stairway and elevator shaft are the only parts of these buildings which are not lightly constructed. A degree of overhead protection can be attained by remaining a few floors from the top of the building.

The large rooms commonly found in light-clad framed buildings favor the employment of weapons with a back blast. This is especially true on the ground floors where there are often no interior partitions at all. On upper floors a partition can normally be removed using hand tools. This, coupled with the fact that light-clad buildings are normally built "free standing" and afford good fields of fire, means that they may have great tactical significance as antitank and antiaircraft positions even though they afford little protection.

As was the case in the heavy-clad buildings, maneuver in light-clad buildings will normally revolve about a central stairwell or elevator module. Tight control of maneuver forces here is crucial since the interior partitions will not stop bullets or grenade fragments, and the chances of inadvertently wounding friendly troops is thereby increased.

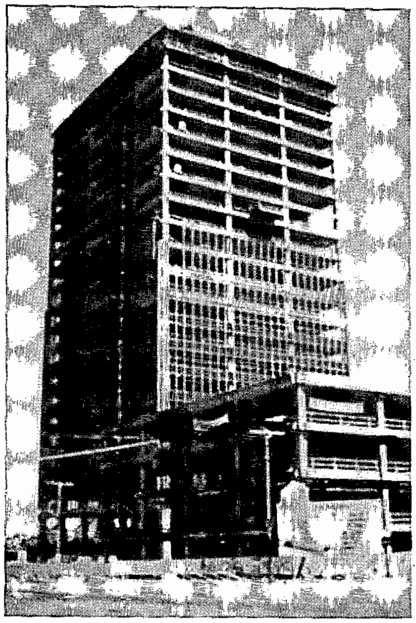
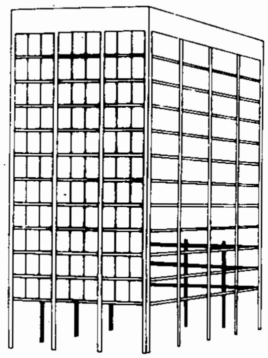


Photo. The extreme thinness of the "curtain wall" of this framed, light-clad office building is apparent. The central elevator shaft (in the tower) provides the most protection.

MILITARY APPLICATIONS

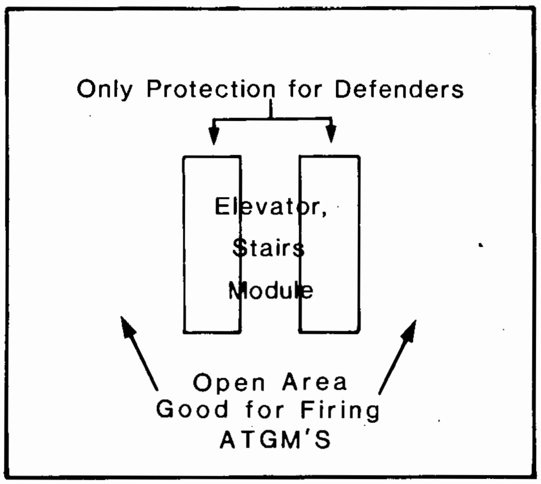
Weapon Systems Usage



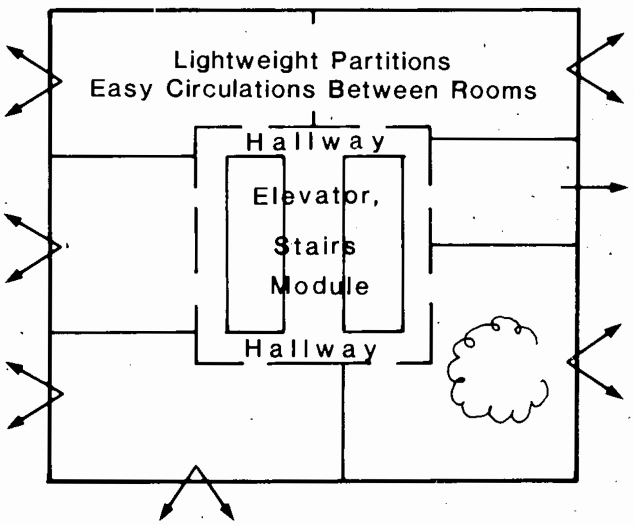
FRAMED LIGHT CLADDING

Office Building

Ground Floor



Upper Floors



Deep Rooms

ATGM's May

Be Fired From

Any Room

Fields of Fire

Usually Good

in

All Directions

The framed "light-clad" parking garage (plate number 67) is a special structure that provides some unusual opportunities for specialized military usage. Built strong enough to hold the heavy live loads of vehicles, these buildings with their thick, heavy reinforced concrete floors offer a high degree of overhead cover. A specialized use of this quality is the deployment of surface to air antiaircraft weapons, such as Redeye or Stinger. These weapons could "hide" on the floor just under the open-roof parking surface, be taken to the roof long enough to engage an aerial target, and then returned to the cover of the floor below before the target aircraft (or any escorting aircraft) could counter fire.

Another possible weapon deployment would be that of Jeep-mounted TOW's. These could be fired from any floor without fear of back blast. Some cover and concealment would come from the concrete parapets which are often found on each floor.

As is the case with other buildings with no interior partitions, there would be no requirement for room-to-room maneuver.

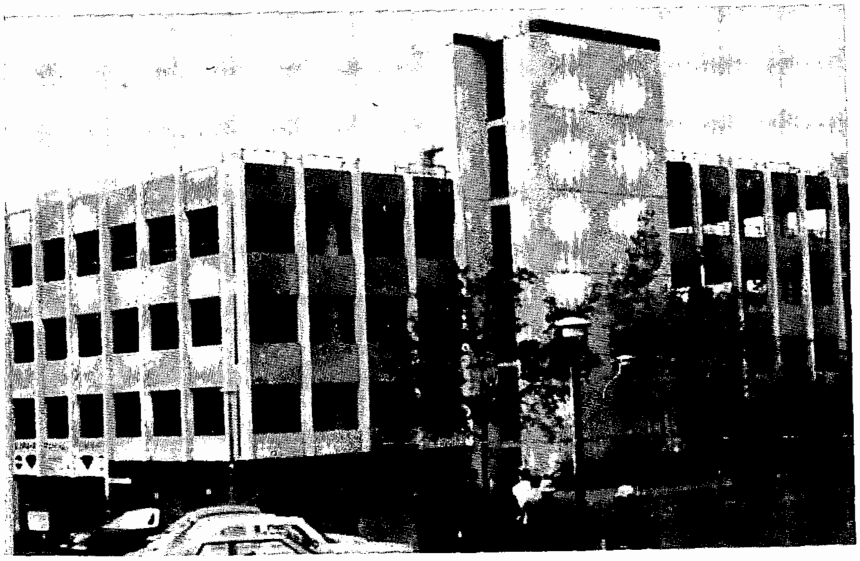


Photo a. A parking garage (in Schweinfurt, FRG).

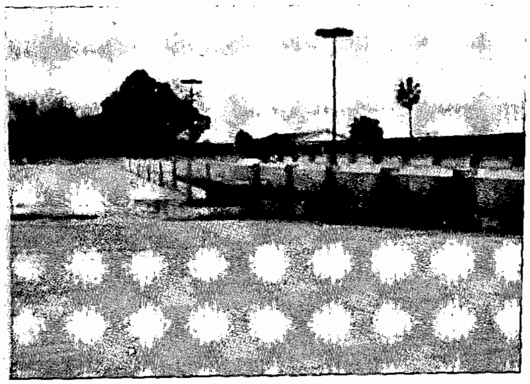


Photo b. The open, heavy-duty roof floor.

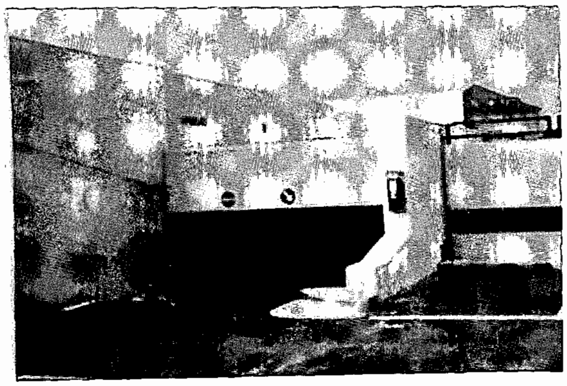
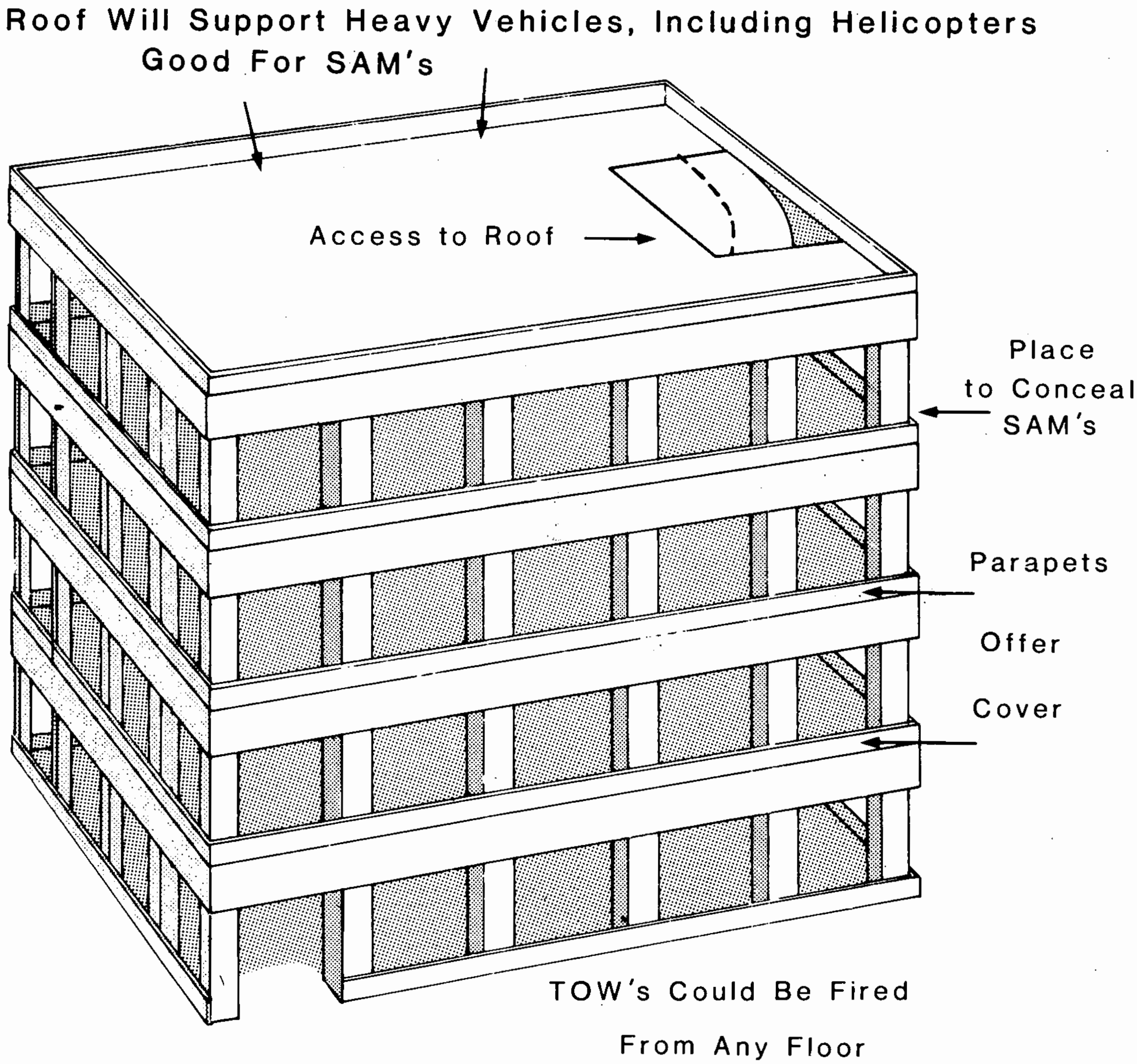


Photo c. The driveway access to the roof.

MILITARY APPLICATIONS

Weapon System Usage

FRAMED PARKING GARAGE (No Cladding)

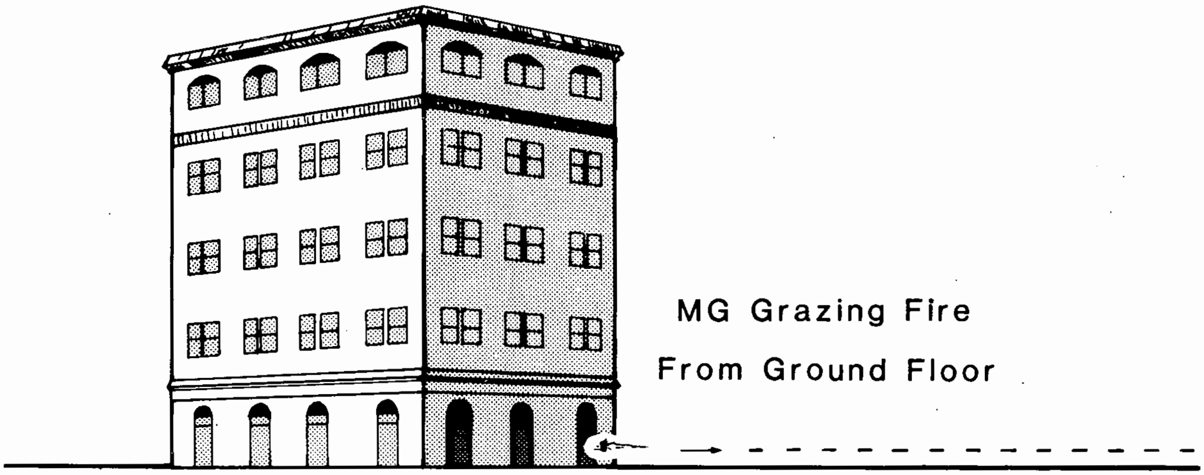


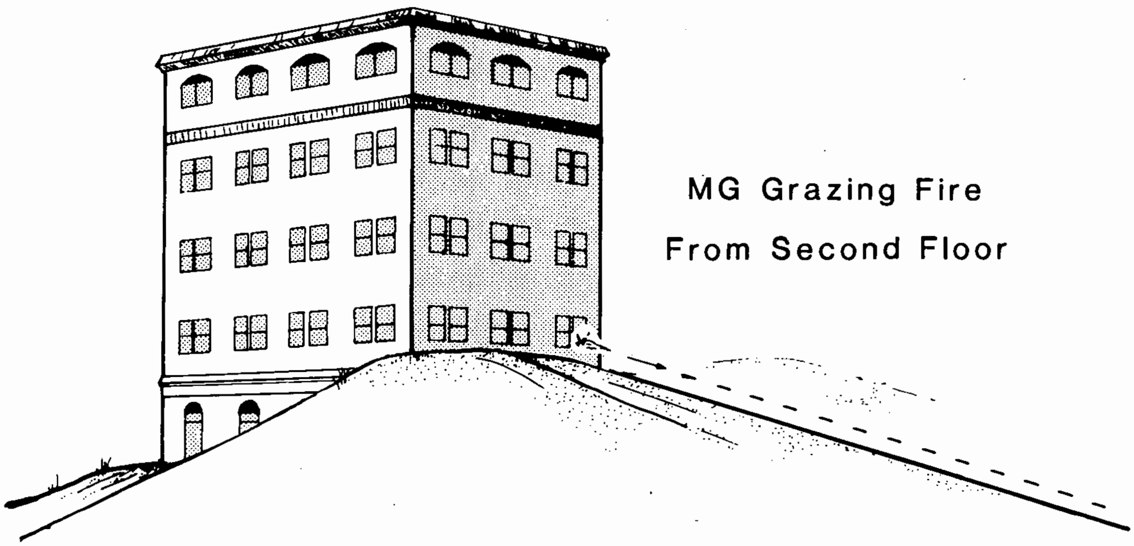
The purpose of this diagram (plate number 68) is merely to act as a reminder that since urban areas are built on neutral terrain, the military aspects of that terrain cannot be ignored in the city fighter's analysis. Rather, the urban considerations are superimposed as additional characteristics.

In this example, a machine gun is being employed to achieve grazing fire from a building. If that building is located in a flat area, the machine gun should be located on the ground floor. It is often the case, however, that the natural relief of the surrounding terrain will require that the machine gun be elevated as the lower diagram suggests. Advantage is taken of the vertical nature of the building, although locating a machine gun in an upper story of a nearby building may accomplish the desired effect.

MILITARY APPLICATIONS

Effect of Natural Terrain





CONCLUSIONS

Two major areas of conclusions emerge upon review of the study. These are (1) conclusions drawn from knowledge gained about the physical nature of the urban terrain, primarily the buildings; and (2) conclusions based on the experience of conducting training sessions using the training aids developed in the course of the project. Recommendations are offered under this heading on the conducting of use of the training aids, the technology transfer of the information and, in general, its inclusion in MOUT training programs, both those already in use by several U.S. Army units and those planned.

Conclusions based on the physical nature of the urban terrain:

Conclusion one. The principles governing the construction of buildings everywhere are universal simply because of the requirement for structures to withstand the forces of nature, principally gravity. Each building type is constructed in accordance with a certain set of basic principles. Moreover, these principles apply universally in all sizes of urban areas: cities, towns, and villages. Although tall buildings are generally associated only with cities where high land values preclude practical construction of low-rise buildings, the basics of building construction for a particular type of building are the same regardless of height and where they are located. Choice of which solution to the problem to select is a function of the economy of an area and the level of technology attained, although increasingly in the world there has been virtually a universal diffusion of modern methods and building materials. Local variations of building types found in an urban landscape are either a product of the old buildings having been built with local construction materials or where the economy is too poor to permit the importation of such universal materials as concrete or structural steel for the newer buildings.

Conclusion two. An identifiable order in building classification exists for cities throughout the world. Although urban areas appear extremely complex to the uninitiated, systematic urban terrain analysis reveals that a definite, relatively simple order can be recognized. There are only a few major types of building construction and these are replicated in cities everywhere. This discerned order further eases the organizing of a training program because the building types presented are basically familiar to trainees. The generalized physics of construction and the pertinent identification keys for the buildings can readily be learned as they form a rational and ordered body of knowledge.

Conclusion three. The subject of buildings as the most important feature of urban terrain is best treated through reference to the principles which govern their construction. The most generalized of these principles uses terminology employed by architects and structural engineers who are concerned with finding solutions to problems. They state that the basic problem in building construction is how to attain adequate strength in a building by economical means in keeping with the intended function of the structure. The concept of finding solutions to problems is especially useful to U.S. Army personnel who employ the same concept in their approach to military problems.

Conclusion four. The primary distinction of building types commonly used by architects and construction engineers--mass and framed--is easily understood and is particularly well suited to usage by Army personnel because of its strong bearing on the two major areas of interest in MOUT combat: (1) survivability; and (2) mission effectiveness. Under the heading of survivability, the soldier is keenly, literally vitally, interested in the concepts of cover, concealment, avenues of approach, and avenues of escape. Under the heading of mission effectiveness falls the operations of maneuver, building entry and clearing, and weapons deployment.

Conclusion five. Buildings, even though they are primary elements of the urban terrain, must not be thought of as abstractions isolated from their immediate environment. Rather, comprehensive attention needs to be paid to the buildings in their settings on lots and along streets. Only in such a way can proper relationships be drawn to considerations of buildings from the viewpoint of both defense and attack. Particularly important are such items as clear lines-of-sight, ranges to targets, and fields of fire. Also, relationship to the natural terrain in the city--e.g. slope--should not be overlooked.

Conclusion six. The use of keys to identify building types and floor plans is useful and provides an orderly approach to the problem. A caveat is offered, however. Identification keys should not be thought of as items to be learned in a rote fashion. Rather, they should be considered as supporting learned principles. A good procedure in building identification in the field--especially in an inherently confusing combat situation--is the employment of the keys as a check list to be used in conjunction with a well grounded knowledge of the fundamentals of building construction.

Conclusion seven. Building construction identification keys are best thought of as consisting of the two major levels of a macro and a micro view. The macro consists of long distance observation of a building (important to use in planning an operation from up to several blocks away, or at headquarters based upon aerial photography and other intelligence). The focus is on the general patterns a building presents; for instance, the window pattern which serves as a clue to identifying building construction type. At the micro level, a number of building construction details are identifiable that can aid in knowing a building's salient characteristics. A good example is the practice of calculating the thickness of a wall of a brick building by counting the number of bricks and multiplying by the appropriate figure.

Conclusions based on the field trials training experience:

Conclusion one. The results of the field trials proved that this subject matter was trainable. The high post-training scores indicated that urban terrain analysis skills taught in the training sessions were learned.

Several related conclusions support this principal contention. First, the information taught is not of an unfamiliar, exotic character. Soldiers were able to understand it and relate it to previous knowledge gained either formally in school or through experience. Second, the field trial participants demonstrated special rapport with the parts of the training affecting them personally; namely, the concepts of survivability and mission effectiveness. Third, and also related, the participants demonstrated that they could successfully handle the material in the training packages without benefit of previous academic training in either architecture or structural engineering.

Conclusion two. Training on the character of the urban environment was seen as a valuable adjunct to previous knowledge of the tactics and techniques of conducting urban warfare. The addition of a knowledge of the opportunities and constraints of the urban environment also served to reaffirm previous lessons on urban combat. For instance, the prescribed entering of buildings from the top--that is through their roofs, the weakest part--was made much more significant when participants were shown the physical nature of real buildings. As another example, application of the principal of differential thickness of exterior walls of brick buildings related directly to previous training on the breaching of walls.

Conclusion three. The length of the training block--4 hours of training coupled with 8 hours of testing--will produce an effective level of familiarity with urban terrain. The presumption is made, however, that some reinforcement of training can be given periodically and also that some written materials can be used to refresh the memory on lessons learned.

Conclusion four. The participating soldiers profited from having a set of training aids with them in the field when confronted with the assignment to analyze the urban terrain. Best use of the aids, however, can be made only after being exposed to the training session. The aids then become valuable reference material for the individual looking up a point in question. The training aids are not designed to be used in the absence of lecture and field reinforcement.

Carrying the full set of training aids into the field would be awkward because of their volume. Some experimentation was done with reduced size versions, but these were not designed expressly for pocket guides. Something along the lines of the familiar range card or engineer guides to bridges would have given the concept a better field test. Simply providing a reduced size version of the training aids would be inadequate as their design would not make maximal use of a pocket size format.

RECOMMENDATIONS

Review of the completed document and all the activities involved in the project has pointed the way to the listing of a number of recommendations.

Recommendation one. The training aids developed in this study should be used in MOUT training programs being conducted by various units in the U.S. Army. While many units have MOUT training facilities (such as Doughboy City in Berlin and Regensberg at Fort Lewis) for the training of techniques of such maneuvers as entering and clearing buildings, there are no training devices which simulate either the wide variety of buildings delineated in this study nor the great size that many real-world buildings attain. Clearly, economic considerations would not allow the construction of even a single high-rise training facility building. Nor is it feasible to create the type of heavy "double wall" brick buildings that are so common in cities. A need does exist, however, to make troops fully aware of the characteristics of all the types of building construction and building setting and to provide them with suggestions as to the constraints and opportunities they have relative to anticipated kinds of military operations. Thus, the pointed recommendation offered here is for units to use these training aids to support a program designed to familiarize troops with all the complexities of urban buildings and urban environmental situations. This might best be done by each unit performing urban terrain analysis on a city nearest their station. Such a city would have to be large enough and complex enough to comprise all of the situations demonstrated in this study. The logical approach would be for small unit leaders to conduct urban terrain analysis walk-through exercises and TEWT's. The creation would serve to enrich these training sessions.

Recommendation two. Specifically, the third chapter of this volume is designed to be used as a "stand along" unit to be taken into the field to help make identifications of buildings and floor plans. However, the user should not do so before reading the balance of the report to gain a requisite theoretical background. Chapter Three is meant as a graphic summary, annotated with check lists, rather than as a unit complete unto itself.

Recommendation three. Consideration should be given to the development of a pocket version of the material in Chapter Three. A device frequently suggested by the participating soldiers in the field trials was a folded piece consisting of several pages of a size small enough to fit in a field jacket/fatigue breast pocket and printed on weatherproof material. Obviously, a wise selection would have to be made of the training aids (from among the 68 total). Also, bulk could be saved through employment of a design to conserve space while maintaining readability.

Recommendation four. A broad recommendation, consisting of several components, is the establishing of a program to train instructors in the use of the material of this document for training soldiers in their respective units. A method similar to that employed in the field trials is envisioned. Such a program would consist of conducting a combination classroom lecture and field reinforcement in the city with examples from existing buildings. Examinations, both pre-training and post-training, would be integral to this program. In addition, following an experience gained after this volume was completed (working with a group of small unit leaders from the 9th Infantry Division from Fort Lewis), a third day could be used to provide practice training for the participants. In this recent experience in the city of Seattle, example blocks were assigned to individuals. They first conducted a reconnaissance to analyze the urban terrain, evaluated the buildings relative to attack and defense scenarios, and then lectured on the site to their colleagues. In each city selected for the conducting of these programs, there would be a necessity for a skilled person to select the areas (and the specific buildings) to be used as examples. The locale would be the core area of cities (large enough to have well defined skylines) and the peripheral area extending far enough away to embrace such low-rise buildings as mass construction factories and warehouses.

Recommendation five. Finally, consideration should be given to developing and preparing an instructor's manual to accompany the training developed in the field trials segment of this study. Advice and tips could be given to the instructors to enhance both their own understanding and their ability to teach these fundamentals. Typical, recurring situations, such as the spatial relationships between and among buildings of certain types, could be offered. The high degree of universality in cities suggests that cases similar to those appearing in the instructor's manual could be replicated in the city chosen by the MOUT trainers.

APPENDIX A

GLOSSARY OF TERMS

Glossary of Terms

Architectural

architect - literally, one who builds arches

capital - the crown, or upper part of a building of classical style (Construction type is brick in some cases but is especially associated with framed, heavy-clad structures.)

cladding - the outer cover of a framed building. It protects from the weather and adds bracing.

curtain wall - lightweight material covering a building's frame

elevation - a scale drawing of the front, rear, or side of a structure

elevator housing - the small structure on the roof of a building containing the elevator's lifting mechanism

fire door - a metal-sheathed, fire-resistant door which seals off one portion of a building from another

frame-obscured - a type of curtain wall, usually glass and other lightweight material, that obscures the frame (of a framed building)

fusible link - weak link in chain holding a fire door open, melts at certain temperature

heavy cladding - brick (often backed with terra cotta brick) curtain wall covering a framed building

hof-style - buildings constructed around the perimeter of a block thus forming an interior courtyard

in-fill - a type of window pattern in which glass fills space between columns and beams in a framed building

light cladding - lightweight materials (including glass) forming a curtain wall covering a framed building

light well - an opening in the middle of a building to allow rooms facing the light well to receive natural light

mezzanine - a floor between ground floor and an upper floor, or a partial floor above the main floor mullion - nonload-bearing member between windows

open bay - a large open area in a light-clad framed building, often an office

parapet - a low wall around the perimeter of a flat-roofed building

partitions - a partial or full (floor to ceiling) <u>interior</u> wall

party wall - an adjoining wall of two units of a mass construction building which shares the load from both units

pediment - the lower floor of a classically designed building, often has classic Greek columns, other decoration

plan view - the view from overhead, the planimetric view, of a building or city street pattern

rural form - term used to describe buildings which do not fully occupy their lots; they are detached from one another and are "set-back" from the street

shaft - the central part of a classically designed building

spandrel - the space from the top of a window sill on one floor to the bottom of the window on the floor above

urban form - term used to describe buildings which fully occupy their lots (no setbacks, adjoining side walls); they are usually angular in shape, often with flat rooftops

venting - windows and doors of a building

walls - exterior walls (as opposed to partitions within a building)

wings - extensions of a building to allow natural light to penetrate

Building Materials

brick - in U. S. 4" x 8" x 2" usually somewhat larger in Europe, elsewhere

building blocks - molded, aggregate material, often a mix of concrete and other materials. Size varies with use: outer walls are often 8" thick, inner walls are thinner

header - the end or width of a brick

lightweight concrete aggregate - concrete for curtain walls of framed buildings made of <u>foamed</u> concrete. Non-weight-bearing masonry - term applying to both stone and brick construction

re-bar - steel reinforcement bars to strengthen concrete

stretcher - the length of a brick

terra cotta - clayware made into hollow bricks to serve as the inner part of the curtain wall of framed buildings; also molded into decorative exterior items

veneer - a thin coating of material, often stone placed over other structural material

Building Types

box-wall principle - a mass construction building in which there is mutual support of loads from the combination of walls and floor/ceilings

brick building - a mass construction building in which the loads are carried by walls of brick (usually thicker in the lower floors, getting thinner as building height increases)

framed construction, heavy cladding - a framed building with a curtain wall made of brick, stone, terra cotta, or a combination

framed construction, light cladding - a framed building with a curtain wall made of glass, plastic, lightweight concrete aggregate or other material

poured-in-place concrete - a building constructed by first erecting forms and then filling these with concrete

stone - a mass construction building in which walls made of stone support loads

tilt-up - mass construction building whose walls are made of concrete poured in horizontally lying forms and lifted "tilted" into place

Structural

balloon (light wood frame) - a form of framed construction where building support comes from large numbers of narrow, closely spaced members nailed together instead of heavy timbers joined by mortises and tenons

beams - horizontal frame members in a framed building central pylon - a reinforced concrete module in the center of a framed light-clad building serving as the inner support anchor for floor joists

columns - vertical frame members in a framed building

dowel - a pin (wooden, used with post and beam construction)

framed construction - building in which the load is carried by a frame

half-timbered - a building having the frame made of short timbers; infilled walls are made of some light material and are not load bearing

mass construction - the method of construction where loads are carried by thick walls rather than by a frame

mortise - a rectangular cavity in a wooden beam or post for receiving a corresponding projection (tenon) from a beam or a post. Used in post and beam construction.

post and lintel - structural members of a framed building in which posts are the vertical members and lintels the horizontal supporting members above doors and windows

poured-in-place concrete - refers to a concrete building built from concrete poured into frames on site

prefab - refers to concrete (and other buildings) where principle members are made off-site and transported to building under construction

tenon - a rectangular projection in a wooden beam or post placed into a mortise to form a joint

APPENDIX B

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APPENDIX C

FIELD TRIALS EXAMINATIONS

PRE-TRAINING EXAMINATION

ATLANTA

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Peachtree and International Streets (Lane Bryant Store)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place reinforced concrete
3. Framed construction: brick cladding

1 B. Approximately how thick are the brick walls: 2 pts.

1. 4" - 8"
2. 8" - 16"
3. More than 16"

II. Site 2: Peachtree Center Plaza Hotel (Peachtree and International Streets)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: prefabricated concrete cladding
2. Mass construction: poured-in-place reinforced concrete
3. Mass construction: brick with concrete cladding

1 B. Approximately how thick are the exterior concrete walls: 2 pts.

1. 4" - 8" (Same thickness for entire wall)
2. 8" - 16" (Same thickness for entire wall)
3. Thickness variable with height of building

4 C. What is the best weapon choice for providing troop access through the wall (on ground floor level, fired from across the street): 3 pts.

1. Caliber 50 machinegun (numerous rounds)
2. LAW (single projectile)
3. TOW (single projectile)
4. 105 tank round

III. Site 3: Davison's Department Store (on Peachtree Street)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place reinforced concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

1 B. Do walls have same thicknesses on all stories (second story and above): 1 pt.

1. Yes
2. No

3 C. The interior of which story affords defenders the most protection (excluding air attack): 3 pts.

1. Ground floor
2. Second floor
3. Fourth floor

2 D. Which section of the building provides the best combination of fields of fire and protection for defenders to deploy ATGM's against armored vehicles: 3 pts.

1. Ground floor
2. Middle floor
3. Top floor

IV. Site 4: Standard Building (Fairlie and Luckie)

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Framed construction: brick cladding
3. Mass construction: poured-in-place reinforced concrete with brick cladding

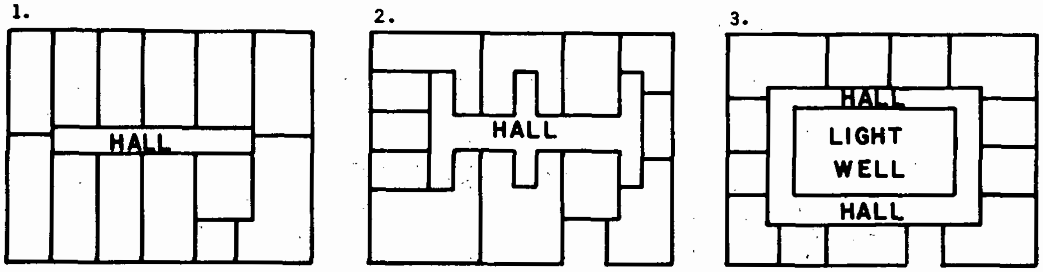
2 B. Approximately how thick are the walls: 2 pts.

1. 4" - 8"
2. 8" - 16"
3. 16" - and more

1 C. Do walls have the same thicknesses on all stories (third story and above): 1 pt.

1. Yes
2. No

1 D. Determine plan of upper floors by viewing building from outside; select diagram which best depicts that floor plan: 4 pts.



1 E. Estimate average room dimensions on floors three and above: 3 pts.

1. 12' x 15'
2. 20' x 27'
3. 30' x 36'

V. Site 5: Richman Clothing Store (Broad Street)

3 A. The type of construction of this building is mass construction: load-bearing brick. How can this be confirmed: 4 pts.

1. By observing exposed brick only
2. By observing placement pattern and characteristics of venting only
3. By observing exposed brick and placement pattern and characteristics of venting
4. By observing type of interior columns

VI. Site 6: Court House Building (on Forsyth Street)

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: stone
2. Mass construction: brick with stone cladding
3. Framed construction: stone cladding

VII. Site 7: Healy Building (on Forsyth Street)

3 A. What type of construction does this building have: 3 pts.

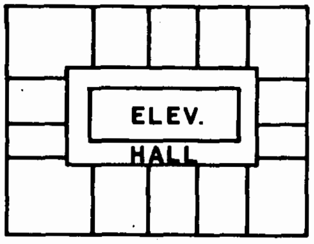
1. Mass construction: stone
2. Mass construction: brick with stone cladding
3. Framed construction: stone cladding

3 B. Of what material are the wall partitions made which separate the small stores at street level: 2 pts.

1. Brick (load-bearing)
2. Concrete block (load-bearing)
3. Other materials (nonload-bearing)

2 C. Determine plan of upper floors by viewing building from outside; select diagram which best depicts that floor plan: 4 pts.

1.



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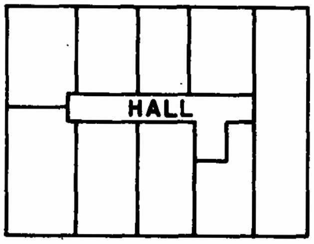

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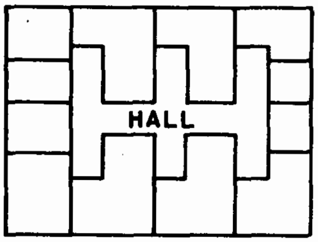


2 D. What device or material would probably be required to provide troop access through interior walls, between hallway and offices: 2 pts.

1. Hand tool, (axe, etc.)
2. An explosive charge
3. Small arms fire

VIII. Site 8: C & S Building (Marietta and Forsyth Streets)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete with stone and brick facing
2. Mass construction: load-bearing stone and brick
3. Framed construction: stone and brick cladding

1 B. Do walls have same thicknesses on all stories (fourth story and above): 1 pt.

1. Yes
2. No

1 C. What is the function of this building (based on observation of venting pattern--(fourth story and above): 2 pts.

1. Office
2. Retail store
3. Hotel
4. Storage
5. Light Industry

3 D. A firing position on the ground floor (against a vehicle on Marietta Street) would favor the use of which weapon system: 4 pts.

1. Snipers
2. Machineguns
3. LAW
4. ATGM's

IX. Site 9: First Federal Savings (Marietta and Forsyth)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick with concrete facing
2. Mass construction: poured-in-place concrete
3. Framed construction: concrete cladding

2 B. Of what material, probably, are the interior wall partitions made: 2 pts.

1. Concrete block
2. Plaster board (dry wall)
3. Lath and plaster

2 C. Which statement best describes the interior arrangement of offices: 3 pts.

1. Non-modular--all offices about the same size with full partitions
2. Modular--with low partitions
3. Modular--with full partitions

1 D. The interior arrangement of the building poses no restriction to the deployment of ATGM's: 1 pt.

1. True
2. False

1 E. How would you rate the degree of protection this building provides for defenders: 1 pt.

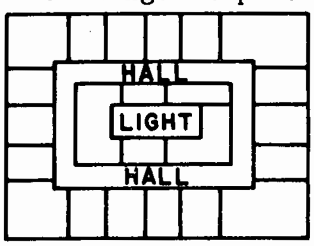
1. Low
2. Medium
3. High

X. Site 10: Glenn Building (Spring and Marietta)

4 A. What type of construction does this building have: 3 pts.

1. Mass construction: stone
2. Mass construction: poured-in-place with stone facing
3. Mass construction: brick with stone facing
4. Framed construction: stone cladding over brick

3 B. Which plan best depicts the plan of the upper floors of this building: 4 pts.



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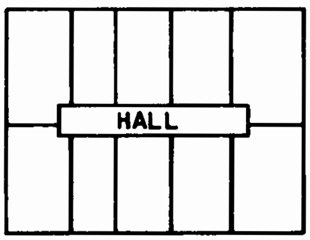

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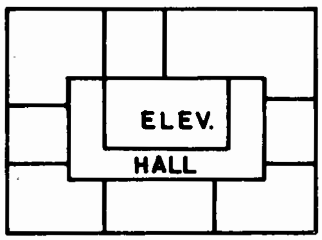


3.

2 C. What is the optimun section of the building for placing machine-guns to provide grazing fire facing southeast on Marietta Street: 3 pts.

1. Ground floor
2. Second floor
3. Middle floors
4. Rooftop

XI. Site 11: Omni International (Marietta Street and International)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: brick with concrete facing
3. Framed construction: concrete cladding

XII. Site 12: Bona Allen Building (Spring Street and Luckie Street)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: stone with brick cladding on upper floors
2. Mass construction: brick with stone cladding on lower floors
3. Framed construction: with stone and brick cladding

2 B. How many columns are there on the front (Luckie Street side) of the building: 2 pts.

1. 5
2. 6
3. 10

1 C. Do columns indicate the location of partitions separating individual offices: 1 pt.

1. Yes
2. No

XIII. Site 13: Group of buildings (on Luckie Street at International)

A. Matching: Match the type of construction to the building: 1 pt. each

Answer		Building		Construction Type
c	1.	Beck & Gregg Hardware	a.	Mass construction: brick
a	2.	Adjacent building (to the east)	b.	Mass construction: concrete
b	3.	Next building (to the east)	c.	Framed construction: brick cladding

XIV. Site 14: Looking eastward on International Street and assuming you are responsible for defending the city center from attack along International from the west.

3 A. Which building would be the best choice as a defensive position: 4 pts.

1. The tall cylindrical tower
2. The tall building with few windows
3. The parking garage

POST-TRAINING EXAMINATION

ATLANTA

Score: 113 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Atlanta Furniture Store (on Peachtree Street between Alabama and Martin Luther King, Jr. Streets)

1 A. What is the type of construction of this building: 3 pts.

1. Mass construction: brick
2. Mass construction: wall and slab
3. Framed construction: with brick cladding

3 B. What is the surest clue as to the type of construction: 3 pts.

1. Windows set at varying depths
2. Brick showing between windows
3. Iron columns inside store

1 C. Could a Dragon be fired from within the store without danger from back blast: 1 pt.

1. Yes
2. No

2 D. To fire a recoilless weapon at another building from the ground floor of the furniture store, two of the following would present a problem. Which one does not: 3 pts.

1. Line of sight
2. Back blast
3. Angles of obliquity

3 E. From an attacker's point of view, what would be the best way to enter these buildings: 3 pts.

1. From the ground floor
2. By providing troop access holes through the walls between the buildings
3. From rooftops

II. Site 2: Pryor Building (on Pryor Street, SE of Central City Park)

3 A. What is the construction type of this building: 3 pts.

1. Mass construction: stone
2. Mass construction: poured-in-place concrete with stone facing
3. Framed construction: with stone cladding

III. Site 3: C & S Hurt Building (Edgewood Avenue, SE of Central City Park)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: concrete with brick cladding
3. Framed construction: brick cladding

1 B. As viewed from the west (along Edgewood Street), do you think that this building has either a light well or wings: 2 pts.

1. Yes
2. No

1 C. What is the function of this building, as indicated by the venting pattern: 2 pts.

1. Office
2. Hotel
3. Retail

3 D. Where, at the corner of the building facing Hurt Park, is the optimum location for snipers to fire along Edgewood Street: 3 pts.

1. Ground floor
2. Second floor
3. Fourth or fifth floor
4. Rooftop

IV. Site 4: Auburn Street Parking Garage (East of Park Street)

2 A. Where is the best place for deploying a TOW to fire at a tank on Houston Street: 4 pts.

1. Ground floor
2. Next to the top floor
3. Top floor

3 B. Where is the best location for keeping a Redeye (to be fired from top floor): 3 pts.

1. Ground floor
2. A middle floor
3. Next to top floor

V. Site 5: Capital Hotel (on Park Street, NE side of Central City Park)

1 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: box-wall principle
3. Framed construction: heavy cladding

2 B. What is there in the venting pattern which serves as a clue to the type of construction: 2 pts.

1. Exposed columns
2. Arches above windows
3. Mullions

3 C. Approximately what is the thickness of the wall on the ground floor: 2 pts.

1. 8"
2. 12"
3. 16"

2 D. Approximately what is the thickness of the wall on the third floor: 2 pts.

1. 8"
2. 12"
3. 16"

1 E. What is the best position for placing a machinegun to achieve grazing fire over Central City Park: 3 pts.

1. At corner of hotel on second floor
2. On roof
3. On the ground floor

3 F. What would be the best use of mortar fire: 2 pts.

1. To breach hotel's walls
2. To breach hotel's roof
3. To deny ingress & egress on north side
4. To deny placement of weapons on ground floor of parking garage

VI. Site 6: Equitable Building (on Peachtree Street)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: glass cladding
2. Framed construction: heavy cladding
3. Framed construction: light cladding

1 B. Does it have a central pylon: 2 pts.

1. Yes
2. No

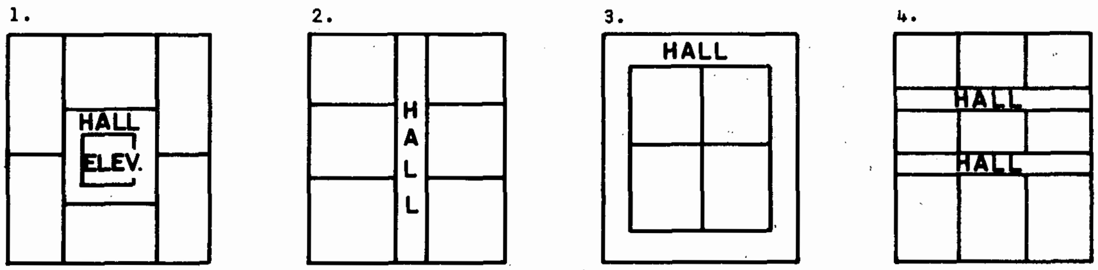
1 C. What is the class of window type: 2 pts.

1. In-full
2. Spandrel (horizontal)
3. Mullion (vertical)

3 D. Which best describes the organization of offices sizes in the building: 2 pts.

1. Large open bays
2. Small, uniform sized offices
3. A combination of large and small offices

1 E. By viewing building from outside, select diagram which best depicts that floor plan: 4 pts.



VII. Site 7: Candler Building (north end of Central City Park between Park and Peachtree Streets)

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: with stone facing
2. Framed construction: heavy cladding
3. Framed construction: light cladding

3 B. What is the main purpose of the two wings of the building which extend southward: 3 pts.

1. Design esthetics
2. To permit better placement of utilities
3. To gain natural light for most of the rooms

2 C. Approximately how thick are the walls: 2 pts.

1. 3" - 6"
2. 6" - 12"
3. 12" - 18"

2 D. At what level would snipers best be placed within this building: 2 pts.

1. Rooftop
2. Top three stories
3. Bottom three stories

VIII. Site 8: Rhodes-Haverty Building (on Peachtree NE of Equitable Bldg.)

2 A. Based on venting pattern, what is building's function (third floor and above): 2 pts.

1. Retail
2. Office
3. Apartment
4. Light Industry

3 B. If you're on an upper floor, what would be the best weapon system to use: 2 pts.

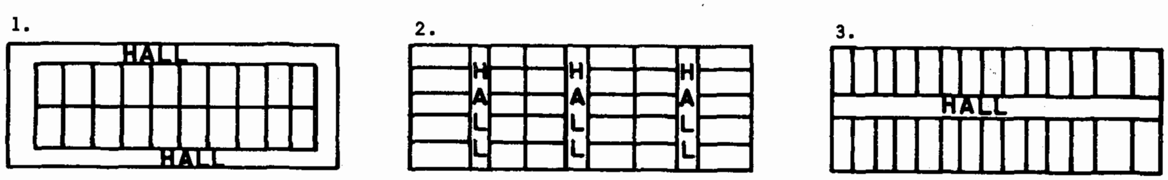
1. Machineguns
2. ATGM
3. Snipers

IX. Site 9: Mariott Inn (Piedmont and Ellis)

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: concrete box-wall principle
3. Framed construction: concrete clad

3 B. By viewing building from outside, select diagram which best depicts that floor plan: 4 pts.



3 C. What is main defense advantage of this building: 3 pts.

1. Highly complex hallway pattern
2. Good fields of fire possible for ATGM's
3. Protection afforded by numerous cells, each with three resistant walls and floor/ceilings

X. Site 10: Landmark Building (Piedmont Avenue & Cain Street)

2 A. What is the function of this building: 2 pts.

1. Office
2. Apartment
3. Hotel

3 B. What is the best clue which reveals its function--viewed from a distance: 2 pts.

1. Shape
2. Height
3. Venting pattern

1 C. What is the approximate width of each room whose outside wall faces you: 2 pts.

1. 10 to 15 feet
2. 15 to 25 feet
3. 25 to 40 feet

4 D. Which weapons could not be fired in the main part of the building (excluding the ground floor): 3 pts.

1. Rifles
2. Machineguns
3. LAWs
4. TOWs and DRAGONS

XI. Site 11: C & S Building (on Piedmont Street)

1 A. What is the class of window type: 2 pts.

1. Spandrel (horizontal)
2. In-fill
3. Mullion (vertical)

3 B. If a building's columns are not exposed, what is the quickest way of determining that it has framed construction: 2 pts.

1. Height
2. Configuration
3. Venting pattern

1 C. Could a TOW be safely fired from one of the middle floors of this building: 1 pt.

1. Yes
2. No

XII. Site 12: Oxford Building (Piedmont Street near Harris)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place reinforced concrete
2. Mass construction: brick with concrete cladding
3. Framed construction: with concrete cladding

1 B. Approximately how thick are the walls: 2 pts.

1. 2" - 4"
2. 4" - 8"
3. 8" - 16"
4. More than 16"

3 C. How many windows are there per office in this building: 1 pt.

1. One
2. Two
3. Three or more

XIII. Site 13: Atlanta Center and Hilton Hotel (Harris and Piedmont Streets)

1 A. What do the two buildings have in common method of construction: 3 pts.

1. Both have framed construction
2. Both have box-wall principle construction
3. Both have concrete poured-in-place construction

2 B. How are the interiors of the two buildings alike: 2 pts.

1. They have nearly the same room dimensions
2. They have nearly similar composition of floor materials
3. They have nearly similar floor plan

1 C. What divides the windows in the Hilton Hotel: 1 pt.

1. Columns and mullions
2. Mullions only
3. Columns only

1 D. Assuming equal fields of fire and a position on a middle floor, which of the two buildings would most favor the deployment of an ATGM: 3 pts.

1. Atlanta Center
2. Hilton Hotel

PRE-TRAINING EXAMINATION

PHILADELPHIA

Score: 150 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. <u>Site 1:</u> Ben Franklin Hotel (Chestnut and 9th Streets)

<u>3</u> A. What type of construction does this building have: 3 pts.

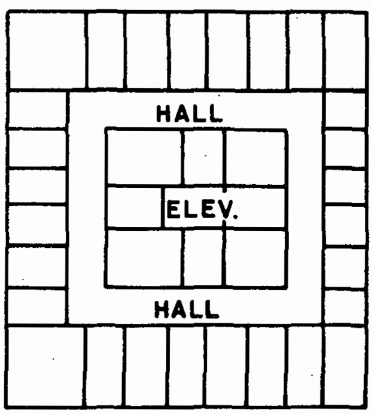
1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

<u>3</u> B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on all upper floors, fourth and above): 3 pts.

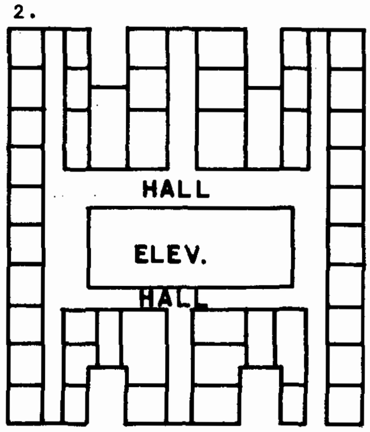
1. 3 inches
2. 7 inches
3. 12 inches
4. 25 inches
5. more than 30 inches

<u>2</u> C. Which drawing is the best representation of the floor plan (upper floors) of this building: 4 pts.

1.



2.



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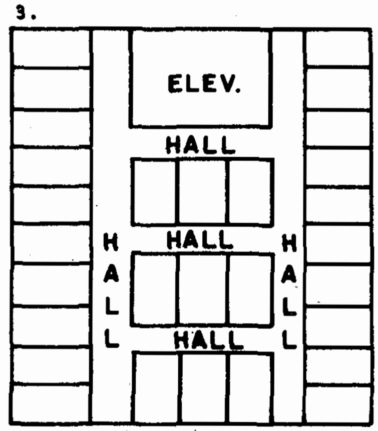


<u>2</u> D. Which of the following dimensions comes closest to being the actual width of Chestnut Street (measured building to building): 2 pts.

1. 10 meters
2. 15 meters
3. 25 meters

3 E. From what floor in this building is the optimum location for snipers to fire along Chestnut Street: 3 pts.

1. Ground floor
2. Second floor
3. One of the middle floors
4. Roof

II. Site 2: Abandoned building at the corner of 8th and Market Streets[1]

2 A. What type of construction does this building have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

3 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the second floor): 3 pts.

1. 8 inches
2. 12 inches
3. 20 inches

2 C. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the 5th floor): 3 pts.

1. 8 inches
2. 12 inches
3. 20 inches

4 D. Based on observation of the venting (doors and windows) pattern, what was the function of this building: 3 pts.

1. Office
2. Hotel
3. Combination of stores and offices
4. Department Store

III. Site 3: Strawbridge and Clothier Department Store (Corner of 8th and Market Streets)

Strawbridge and Clothier Department Store is composed of two parts. Use this information to answer the questions.

2 A. Do both segments have the same method of construction: 1 pt.

1. Yes
2. No

[1]Building has since been razed

3 B. What type of construction does the eastern segment of the store have: 3 pts.

1. Mass construction: brick with stone veneer
2. Mass construction: stone
3. Framed construction: stone cladding

3 C. What type of construction does the western segment of the store have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

2 D. Do the walls of the western segment of the store have the same thickness on all floors: 1 pt.

1. Yes
2. No

1 E. What structural features lie between the two segments of the store: 3 pts.

1. Fire doors and fire walls
2. Light, non-fire resistant partitions
3. Only columns (no partition wall)

2 F. The interior on which floor is the most divided by partitions and thus gives greater protection to defenders: 2 pts.

1. Ground floor
2. Upper floor

IV. Site 4: Complex comprising The Gallery, Strawbridge and Clothier, parking garage, and subway.

5 A. Which combination of the above units could be linked together to form the best defensive position: 4 pts.

1. The Gallery and Strawbidge & Clothier
2. Strawbridge and Clothier's and the parking garage
3. The Gallery and the parking garage
4. The Gallery and the subway
5. All of the elements comprising the complex

3 B. Where is the best location, in the parking garage, for keeping a Redeye (to be fired from top floor): 3 pts.

1. Ground floor
2. A middle floor
3. Next to top floor

2 C. Where, from this parking garage, is the best place for deploying a TOW to fire at a tank located on Vine Street between 8th and 9th Streets: 4 pts.

1. Ground floor
2. Next to top floor
3. Top floor

D. Matching: Make the best match between weapon system deployment or military operation and the given situation. (Each has a best fit and each is used only once): 1 pt. each

Weapons System/Military Operation			Situation
5	a.	Tanks	1. West segment, Strawbridge & Clothier (upper floors)
6	b.	Moving personnel	2. Gimbel's ground floor
2	c.	TOW's	3. The Gallery (basement level)
1	d.	Snipers	4. Parking garage
4	e.	Redeye	5. Under walkway between Gimbel's and Strawbridge and Clothiers
3	f.	Storing supplies	6. The subway

V. Site 5: Philadephia National Bank (Market and 5th Streets)

1 A. What type of construction does this building have: 3 pts.

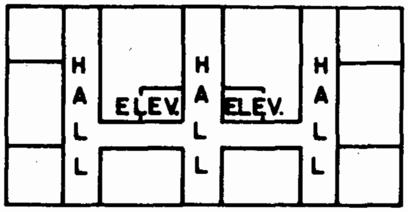
1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

2 B. What is the class of window type in this building: 4 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel
4. Mullion

3 C. Which drawing is the best representation of the floor plan of this building: 4 pts.

1.



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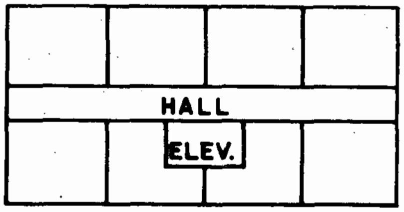

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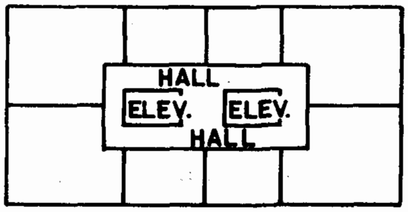


3 D. What is the best position for placing a TOW to fire at a tank on Market Street to the west: 3 pts.

1. On the ground floor
2. On the second floor
3. On one of the middle floors
4. On the roof

VI. Site 6: Block of buildings on Arch Street (near 2nd along east side)

2 A. What type of construction do these buildings have: 3 pts.

1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

2 B. Which of the following is not a clue to the identification of the type of construction: 4 pts.

1. Window depth decreases as building height increases
2. Frame members are visible on side walls
3. Windows and columns between are aligned vertically (above ground floor)
4. Wall thickness decreases as building height increases

The following scenario applies to the buildings in this site:

a. Given that all the buildings are constructed independently

b. Given that the gray building is occupied by friendly forces

c. Given that the remaining buildings are held by unfriendly forces and must be captured

d. Given that the common arsenal of light infantry weapons is available

1 C. What is the preferred method for clearing buildings such as these: 3 pts.

1. Breaking into the roof of each building
2. Entering each building from the front
3. Entering each building from the rear
4. Penetrating the side walls from within each building

4 D. Which of the methods would require the greatest amount of explosives: 2 pts.

1. Breaking into the roof of each building
2. Entering each building from the front
3. Entering each building from the rear
4. Penetrating the side walls from within each building

3 E. If the method of penetrating adjoining walls were to be used, on which floor would this be most easily done: 3 pts.

1. Ground floor
2. Second floor
3. Third floor

VII. Site 7: Bourse Building (facing the park, on 5th Street)

4 A. Which would be the best of the following military uses to which this building could be put: 4 pts.

1. Deploying Redeye missiles
2. Deploying TOW's
3. Establishing machinegun positions
4. Concealing vehicles

VIII. Site 8: Lafayette Building (Corner of Chestnut and 5th Streets)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: stone and brick

3 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building: 3 pts.

1. 3 inches
2. 7 inches
3. 12 inches
4. 25 inches
5. more than 30 inches

IX. Site 9: The Philadelphia Bank (Chestnut Street between 4th and 5th Streets)

3 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

3 B. Which part of this building would be the most practical place to breach a man-sized hole for entering: 2 pts.

1. Wall on the ground floor
2. Wall on the second floor
3. Roof

X. Site 10: Houses on 3rd Street

1 A. What type of construction do these bulidings have: 3 pts.

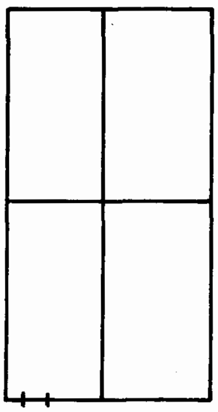
1. Mass construction: brick (load-bearing walls)
2. Mass construction: concrete block with brick veneer
3. Framed construction: wood with brick veneer
4. Framed construction: steel framed with brick cladding

3 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building: 3 pts.

1. 3 inches
2. 7 inches
3. 12 inches
4. 25 inches

2 C. Which drawing is the best representation of the floor plan of this building: 4 pts.

1.



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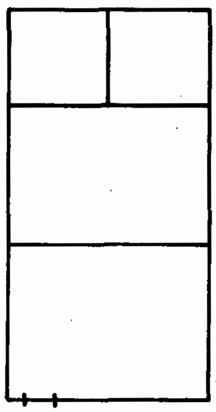

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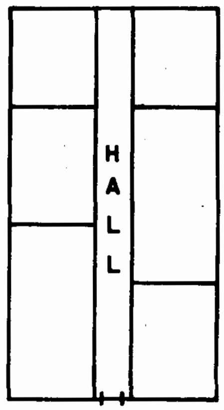


XI. <u>Site 11:</u> Society Towers (Locust Street and Philip Place)

2 A. What type of construction do these buildings have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: concrete cladding

4 B. What is the class of window type in these buildings: 4 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel
4. Mullion

2 C. Is interior partition placement determined by location of the vertical structural columns: 2 pts.

1. Yes
2. No

XII. <u>Site 12:</u> Lippincott Building: (6th Street across from Washington Square)

2 A. What type of construction does this building have: 3 pts.

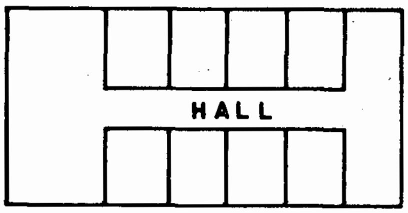
1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

3 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the ground floor): 3 pts.

1. 7 inches
2. 12 inches
3. 25 inches
4. more than 30 inches

1 C. Which drawing is the best representation of the floor plan of this building (upper floors): 4 pts.

1.



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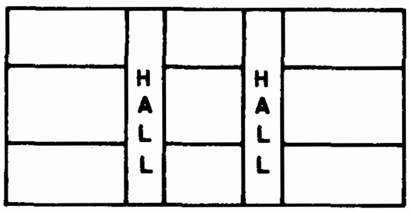

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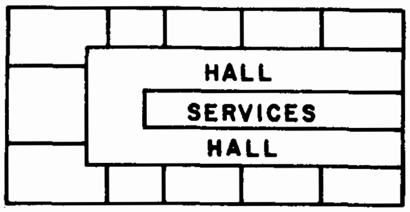


XIII. Site 13: Hopkinson House: (South side of Washington Square)

3 A. As viewed from the eastern end, what clue does the venting give that this building cannot have mass construction form: 2 pts.

1. Windows are too large
2. Windows are too small
3. Windows are offset

2 B. What is the approximate dimension of the largest room in each apartment unit: 2 pts.

1. 10 by 12 feet
2. 12 by 15 feet
3. 15 by 20 feet

3 C. Which weapon could be both safely and effectively fired from the largest apartment rooms (at targets on the other side of the street): 3 pts.

1. TOW
2. Dragon
3. LAW
4. None of the above

XIV. Site 14: Curtis Building (Walnut and 6th Streets)

1 A. What is the best position in this building for placing a machine-gun to achieve grazing fire across the three blocks of the park to the east: 3 pts.

1. On the ground floor
2. On the mezzanine floor
3. On the second floor
4. On one of the middle floors

XV. Site 15: The Public Ledger Building (Chestnut and 6th Streets)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick and stone
2. Mass construction: poured-in-place concrete with brick and stone veneer
3. Framed construction: brick and stone cladding

3 B. What is the architectural term for the segment of this building forming the first two floors: 2 pts.

1. capital
2. shaft
3. pediment

1 C. What dimension comes closest to being the actual size of most of the offices in this building: 2 pts.

1. 15' by 20'
2. 30' by 50'
3. 100' by 150'

1 D. Judging by its breadth, this building has: 3 pts.

1. Either a light well or wings
2. No light well or wings
3. "Hof-Style" configuration

POST-TRAINING EXAMINATION

PHILADELPHIA

Score: 150 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Victory Building (Chestnut and 10th Streets)

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

3 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the ground floor): 3 pts.

1. 7 inches
2. 12 inches
3. 25 inches
4. more than 36 inches

2 C. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the upper floors, fourth and above): 3 pts.

1. 7 inches
2. 12 inches
3. 25 inches
4. more than 30 inches

2 D. What is the best position for placing a machinegun to achieve grazing fire to the east along Chestnut Street: 3 pts.

1. On the ground floor
2. On the second floor
3. On one of the middle floors
4. On the roof

II. Site 2: Second and third buildings eastward from corner of 10th and Chestnut Streets (on the south side)

2 A. What type of construction do these buildings have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

1 B. How many rooms wide are these buildings (on upper floors): 2 pts.

1. One
2. Two
3. Three

2 C. Are there center post supports: 1 pt.

1. Yes
2. No

2 D. Where are the entrances to the upper floors: 2 pts.

1. From inside the stores only
2. On one side of each building
3. At the rear of the buildings only

III. Site 3: Jewelers Row, a block of buildings on Sansom Street (north side)

2 A. What type of construction do the 15 adjoining buildings (starting at the 8th St. corner) have: 3 pts.

1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

2 B. Which of the following is not a clue to the identification of the type of construction: 3 pts.

1. Window depth decreases as building height increases
2. Frame members are visible on side walls
3. Windows and columns between are aligned vertically (on second floor and above)
4. There are arches or other supports above some windows

2 C. Presume you are standing on the sidwalk next to buildings on the south side of the street and are trying to fire rifle rounds into second floor windows of buildings across and down the street to the west. In which building would an excessively high angle of obliquity prevent you from doing so: 4 pts.

1. Eagle Restaurant
2. Norman Kivitz and Company
3. Alex Krause Lapidary

4 D. Which method of entering the building (for purposes of clearing) would encounter the most solid barrier: 4 pts.

1. The roof of each building
2. The rear of each building (ground level)
3. The front of each building (ground level)
4. The side walls (between one building and another from inside each)

IV. Site 4: Building (contains Lotus Inn) on south side of Arch Street between 9th and 10th Streets

1 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick (load-bearing walls)
2. Mass construction: concrete block with brick veneer
3. Framed construction: wood with brick veneer
4. Framed construction: steel framed with brick cladding

3 B. Which dimension comes the closest to being the actual thickness of the walls of this building on the second floor: 3 pts.

1. 12 inches
2. 20 inches
3. 28 inches
4. 36 inches

2 C. Which dimension comes the closest to being the actual thickness of the walls of this building on the fourth floor: 3 pts.

1. 12 inches
2. 20 inches
3. 28 inches
4. 36 inches

2 D. The interior arrangement of this building poses no restrictions to the deployment of ATGM's: 1 pt.

1. True
2. False

V. Site 5: Reading Terminal Building (on Market Street)

3 A. This building has been remodeled and has both old and new sections. What is the construction type of the new section: 3 pts.

1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

2 B. Which of the following dimensions comes closest to being the actual thickness of the exterior wall of the new section: 3 pts.

1. 8 inches
2. 12 inches
3. 18 inches
4. 24 inches

1 C. The second floor of which section of this building would provide defenders the greatest amount of protection: 2 pts.

1. Old section
2. New section

2 D. From what floor in this building is the optimum location for snipers to fire along Market Street: 3 pts.

1. Ground floor
2. Fourth floor (corner window)
3. Sixth floor

VI. <u>Site 6:</u> Small square on 12th Street between Market and Chestnut Streets

1 A. Third building from 12th Street on south side of park. What type of construction does this building have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete

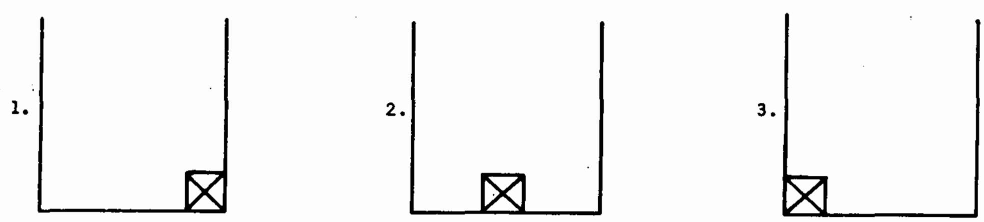
2 B. Second building from 12th Street. What type of construction does this building have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

3 C. Which of the following dimensions comes closest to being the actual thickness of the exterior wall of this building (on the ground floor): 3 pts.

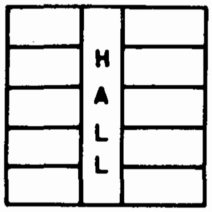
1. 12 inches
2. 18 inches
3. 24 inches

1 D. Which diagram correctly shows the location of the rear stairway of this building: 2 pts.



2 E. Stephen Girard Building (on east side of 12th Street)
Which drawing is the best representation of the floor plan of the upper floors of this building: 4 pts.

1.



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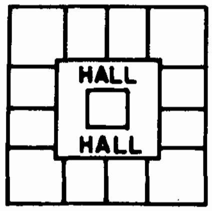

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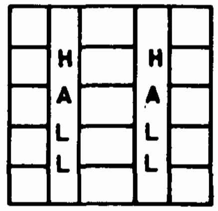


2 F. What is the venting pattern of the modern building to the north of the square: 4 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel
4. Mullion

VII. Site 7: Wanamaker's Department Store (Market Street at Penn Square)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

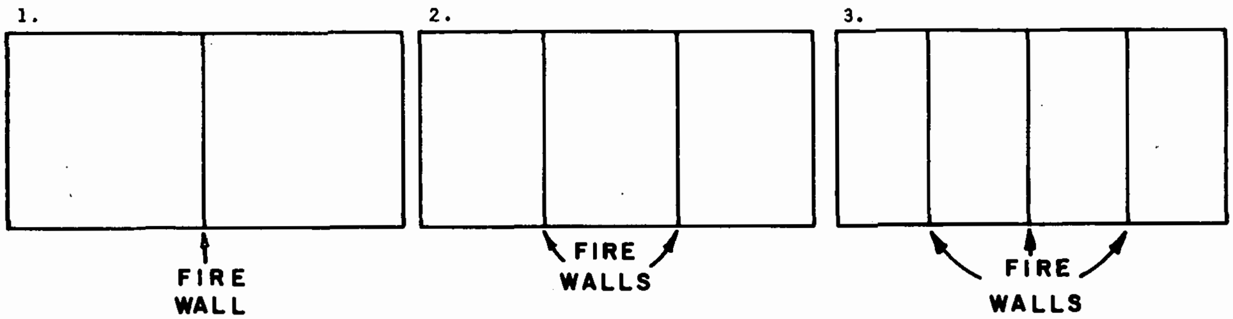
3 B. What is the architectural segment of this building forming the top two floors (above the protruding horizontal decoration): 2 pts.

1. Pediment
2. Shaft
3. Capital

2 C. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on all upper floors, third and above): 3 pts.

1. 7 inches
2. 14 inches
3. 28 inches

2 D. Which drawing is the best representation of the plan of the ground floor of this building: 4 pts.



1 E. Are there interior fire doors on the ground floor: 2 pts.

1. Yes
2. No

4 F. Which of the following is not an advantage which the mezzanine has--over the other floors--as a suitable place to position a TOW: 4 pts.

1. Better field of fire than ground floor
2. Large area to absorb back-blast
3. Few combustibles in back blast zone
4. High enough to acquire distant targets

3 G. From what floor in this building is the optimum location for placing snipers to fire towards Penn Square: 3 pts.

1. Ground floor
2. Second floor
3. One of the middle floors
4. Roof

VIII. Site 8: City Annex Building (Filbert and Penn Square)

2 A. Given that this building is made of stone (load-bearing walls), what is its strongest point: 2 pts.

1. At the entrance
2. At the corners
3. The towers

3 B. What is the building's weakest point and thus the easiest place to penetrate: 2 pts.

1. Ground floor
2. Second floor
3. Roof

3 C. What is the best position for placing a machinegun to achieve grazing fire to the west along JFK Blvd.: 3 pts.

1. In the doorway
2. In the tower
3. In a corner window on the ground floor

IX. Site 10: City Hall (Penn Square)

3 A. This building is constructed of brick with stone veneer. How many bricks thick (a 4-inch width of brick counting as one) is the wall at the ground floor: 3 pts.

1. Three
2. Six
3. Nine

2 B. Could ATGM's be fired from most of the offices: 1 pt.

1. Yes
2. No

2 C. Which dimension comes closest to being the actual depth of upper floor offices in this building (measured from hallway to outer wall): 3 pts.

1. 15 feet
2. 20 feet
3. 30 feet

X. Site 12: UGI Building (Arch and Broad Streets)

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick and stone
2. Mass construction: poured-in-place concrete with brick and stone veneer
3. Framed construction: brick and stone cladding

3 B. Without going into the building, determine from other evidence where elevator is located: 3 pts.

1. At the east end
2. At the west end
3. In the center

XI. Site 13: Penn Center Plaza (JFK Blvd. and 16th Street)

1 A. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on all upper floors): 3 pts.

1. 4 inches
2. 12 inches
3. 24 inches

3 B. What is the class of window type in this building: 4 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel
4. Mullion

XII. Site 14: Fidelity Building (Broad and Sansom Streets)

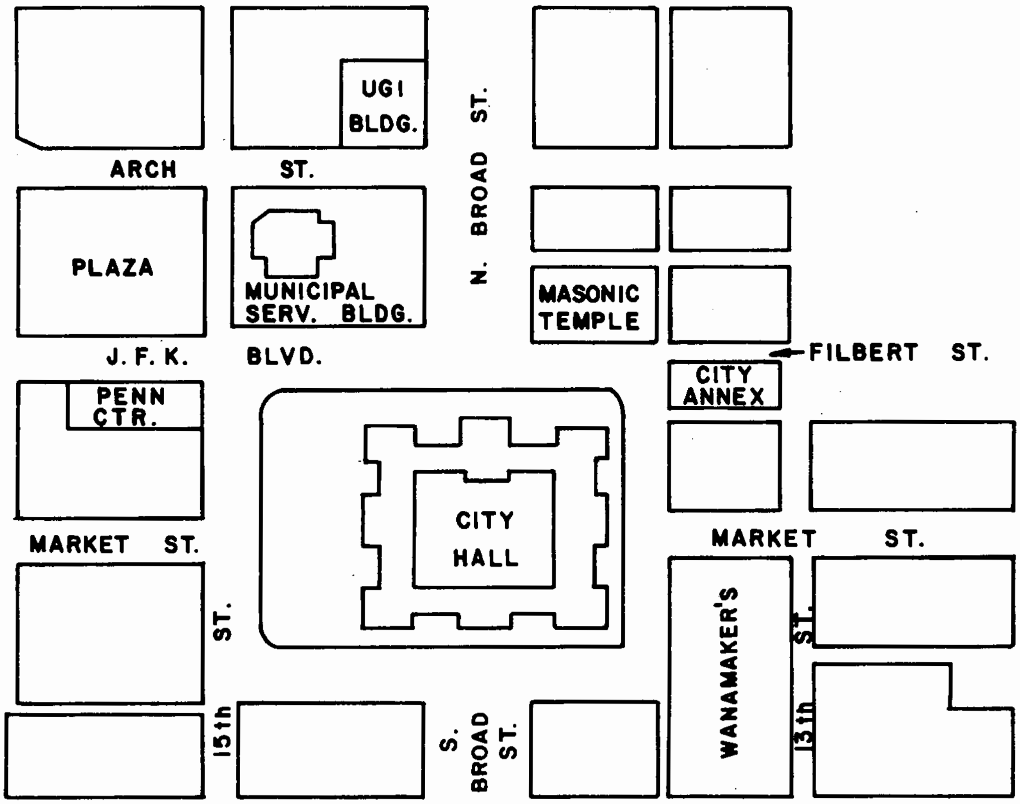
1 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

2 B. Comparing the first two floors of this building to the first two floors of Wanamaker's Department Store, does this building have a higher or a lower proportion of windows: 2 pts.

1. Higher
2. Lower

Map of Penn Square and Environs



XIII. Site 15: Penn Square and Environs

A. Matching: For the listed buildings (shown on the map), make the best match between weapon system deployment or other military operation and the building or other feature. (Each has a best fit and each is used only once): 1 pt. each

Weapon System/Military Operation

3 a. Concealed position for tanks to fire along arterial streets

5 b. Firing position for achieving machinegun grazing fire along an arterial street

4 c. Place to deploy TOW's to fire along several streets

1 d. Provides possibility of sealing off one section of building from another

7 e. Place to deploy LAW's to cover several streets

2 f. Allows concealment for moving personnel between buildings

6 g. Place conceal vehicles and supplies

Building/Other Feature

1. Wanamaker's
2. Subway system and underground walkways
3. City Hall entrances
4. Municipal Services Building
5. Masonic Temple
6. Inner courtyard of City Hall
7. City Annex Building

XIV. Site 16: Building on north side of JFK Blvd. at 22nd Street

1 A. The venting pattern of this building indicates that the intended function was: 3 pts.

1. Industry
2. Retail
3. Office

1 B. Could a TOW be safely fired from one of the middle floors of this building: 1 pt.

1. Yes
2. No

XV. Site 17: Assume you are responsibilie for defending the City Hall area from attack along JFK Blvd. from the west.

3 A. Which building would be the best choice for a TOW position: 3 pts.

1. The apartment building on the north side of the street
2. The apartment building on the south side of the street
3. The parking garage

PRE-TRAINING EXAMINATION

SEATTLE

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: YWCA (Seneca and 5th Streets)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

3 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on all upper floors, third and above): 3 pts.

1. 3 inches
2. 7 inches
3. 12 inches
4. 25 inches
5. more than 30 inches

1 C. What is the architectural term for the segment of this building forming the first two floors: 2 pts.

1. Pediment
2. Shaft
3. Capital

2 D. On what floor in this building should snipers be positioned to fire northward along 5th Street: 3 pts.

1. Ground floor
2. One of the middle floors
3. Top floor
4. Roof

II. Site 2: IBM Building (Seneca and 5th Streets)

2 A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: masonry cladding

4 B. What is the class of window type in this building: 4 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel
4. Mullion

2 C. Comparing the YWCA and the IBM buildings, which one has the larger rooms on the upper floors: 2 pts.

1. YWCA
2. IBM

III. Site 3: Building on corner of 5th Street and University Plaza

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

IV. Site 4: Rainier Bank

1 A. What is the class of window type in this building: 4 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel
4. Mullion

V. Site 5: Frederick & Nelson Department Store (5th and Pine Streets)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

2 B. The interior on which floor is the most divided by partitions and thus gives a greater degree of protection to defenders: 2 pts.

1. Ground floor
2. Upper floors

1 C. Could a DRAGON be safely fired from one of the middle floors of this building: 1 pt.

1. Yes
2. No

VI. Site 6:

Compare building at corner of 3rd and Stewart with building at corner of 2nd and Stewart. Based upon observation of the venting pattern of the upper floors of each, what are the functions (uses) of the upper floors of each:

1 A. Building at corner of 3rd and Stewart: 2 pts.

1. Office
2. Residential
3. Retail

VII. Site 7: The Josephinum (2nd and Stewart)

1 A. What is the situation of weapon deployment from this building: 3 pts.

1. DRAGONs and LAWs could be fired from any floor
2. DRAGONs and LAWs could be fired from the upper floors but not the ground floor
3. DRAGONs and LAWs could be fired from the ground floor but not the upper floors

1 B. Where is the best place for putting a machinegun to get grazing fire southward along 2nd Avenue: 3 pts.

1. Ground floor
2. 2nd or 3rd floor
3. 4th or 5th floor

VIII. Site 8: At corner of 1st and Virginia Sts. Terminal Sales Building

3 A. How is the interior space of this building arranged: 3 pts.

1. Into a series of uniformly sized offices
2. Some large offices and some small offices
3. Large open bays and some offices

2 B. The Virginia Inn: From what floor could grazing machinegun fire be provided along 1st Avenue to the north: 3 pts.

1. Ground floor
2. Second floor
3. Third floor

3 C. New apartment building on Virginia Street. What type of construction does this building have: 3 pts.

1. Mass construction: concrete block
2. Mass construction: poured-in-place concrete
3. Framed construction: with concrete block in-fill

IX. Site 9: Ocean Trading & Pacific Marine (1st St. & University)

3 A. What is the construction type of these buildings: 3 pts.

1. Mass construction: brick and concrete
2. Framed construction: steel
3. Framed construction: reinforced concrete

X. Site 10: Building at corner of 1st Ave. and University Street

2 A. What is the thickness of the wall (remaining from a former building): 3 pts.

1. 10 inches
2. 20 inches
3. 30 inches

XI. Site 11: Building at 1st St. and Spring Street

2 A. What type of construction does this building have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

2 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the ground floor, rear of building): 3 pts.

1. 10 inches
2. 20 inches
3. 30 inches

XII. Site 12: Buildings along 1st Ave., south of Spring Street

1 A. In moving laterally from one building to another by breaching holes in the walls, on which floors would this most easily be done: 4 pts.

1. Top floors
2. Middle floors
3. Lower floors

XIII. Site 13: Olympic National Life Building (2nd and Madison)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

1 B. On what floor would snipers best be placed to fire to the west: 2 pts.

1. Ground floor
2. Middle floors
3. Top floor
4. Roof

XIV. Site 14: Parking Garage at 1st and Columbia

3 A. Wh re is the best location, in this parking garage, for keeping a Redeye (to be fired from top floor): 3 pts.

1. Ground floor
2. A middle floor
3. Next to top floor

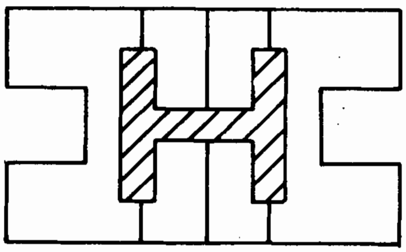
XV. Site 15: Square at Jefferson and 3rd Ave.

3 A. Which of the three buildings (King County Court House, Frye Apts., or the parking garage) would be the best choice as a place to deploy a Redeye: 2 pts.

1. King County Court House
2. Frye Apartments
3. Parking garage

3 B. The Frye Apartment Building: Which drawing is the best representation of the floor plan (upper floors) of this building: 3 pts.

1.



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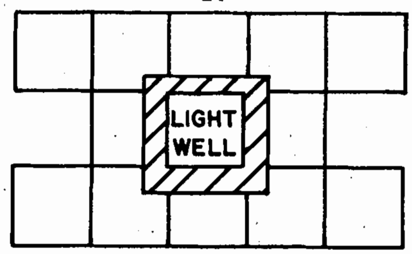

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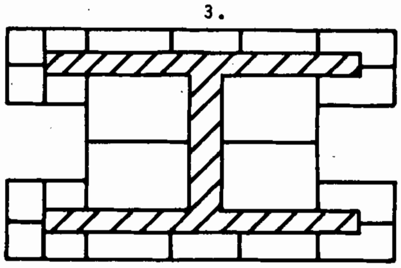


1 C. The triangular building to the east: Judging by its breadth, this building has: 3 pts.

1. A light well (or wings)
2. No light well (or wings)
3. "Hof-Style" configuration

XVI. Site 16: Looking to the SW from the overpass

1 A. Looking at the brick buildings, identify their weakest and strongest points in terms of protection for defenders. Which provides the most protection: 2 pts.

1. Walls
2. Roofs
3. Floor/ceilings

2 B. Which provides the least protection: 2 pts.

1. Walls
2. Roofs
3. Floor/ceilings

XVII. Site 17: Smith Tower

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

2 B. What type of antitank weapon could NOT be fired from rooms on the upper floors of this building: 3 pts.

1. TOW
2. DRAGON
3. LAW
4. All could be fired

XVIII. Site 18: Across from the KINGDOME

1 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: concrete box-wall principle
3. Framed construction: concrete cladding

2 B. Which would be the best place to deploy a DRAGON to fire at a tank located where we are now standing: 3 pts.

1. The Flat-Iron Building
2. The Oyster Bar
3. The Alaska Building

POST-TRAINING EXAMINATION

SEATTLE

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Kennedy Hotel

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: brick cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

2 B. What is the best position to place a machinegun to achieve grazing fire southward along 5th Street: 3 pts.

1. The ground floor
2. The floor at the Y in Kennedy (sign at corner of building)
3. The floor at the K in Kennedy (sign at corner of building)

II. Site 2: Seattle First National Bank (4th Ave. and Madison)

2 A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: masonry cladding

3 B. Which dimension comes closest to being the actual depth of offices in this building (from hallway to outer walls): 3 pts.

1. 12 feet
2. 18 feet
3. 30 feet

1 C. The interior arrangement of the building poses NO restrictions to the deployment of antitank guided missiles: 1 pt.

1. True
2. False

III. Site 3: Seattle Library

1 A. What is the thickness of the concrete aggregate wall: 2 pts.

1. 4 inches
2. 12 inches
3. 16 inches

IV. Site 4: Dexter Horton Building

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: masonry cladding

1 B. What is the function (use) of this building, as indicated by the window pattern: 2 pts.

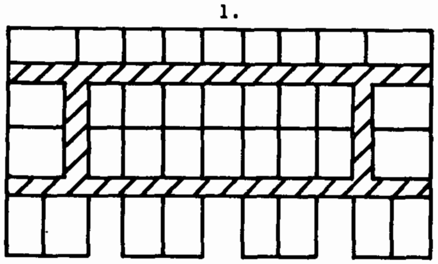
1. Office
2. Hotel
3. Retail

1 C. Which of the following dimensions comes closest to being the actual depth (from outer wall to hallway) of an office in this building (on upper floors): 3 pts.

1. 15 feet
2. 23 feet
3. 32 feet

3 D. Which drawing is the best representation of the floor plan of the upper floors of this building: 3 pts.

1.



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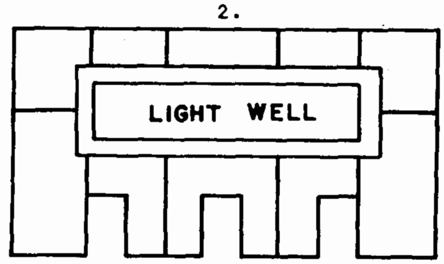

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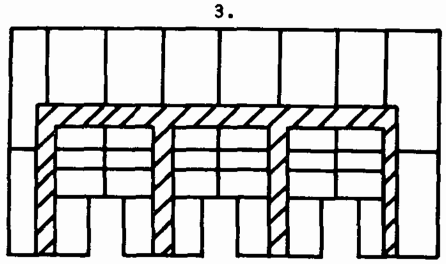


V. Site 5: Camlin Hotel (the lower building of the two main units)

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: concrete box-wall principle
3. Framed construction: concrete cladding

1 B. An advantage to defenders of this type of building is: 3 pts.

1. Each cell provides protection in walls and floor/ceilings
2. Walls are thicker than in old brick buildings
3. Room size varies within building

VI. Site 6: Roffe Building

3 A. Based on observation of the venting (window) pattern of this building, what is the function: 3 pts.

1. Office
2. Combination of stores and offices
3. Light industry

2 B. Which building would provide defenders with more protection: 2 pts.

1. Roffe Building
2. Rogers Printing Company

VII. Site 7: Bon Marche Department Store

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: masonry cladding

1 B. Which floor has the fewest interior partitions and therefore has the greatest volume of air space: 2 pts.

1. Ground floor
2. Any of the upper floors

2 C. Would back-blast restrictions prevent the firing of a TOW from the ground floor: 1 pt.

1. Yes
2. No

VIII. Site 8: Parking garage across from Bon Marche

3 A. What type of common building construction method has been used in erecting this building: 3 pts.

1. Mass construction: concrete
2. Framed construction: heavy cladding
3. Framed construction: light cladding

3 B. Where is the best location in the parking garage for keeping a Redeye (to be fired from top floor): 3 pts.

1. Ground floor
2. A middle floor
3. Next to top floor

2 C. Where, from this parking garage, is the best place for deploying a TOW to fire at a tank located on Pine Street (to the east): 4 pts.

1. Ground floor
2. One of the upper floors
3. Top floor

IX. Site 9: Building at 3rd and Seneca

1 A. What type of construction does this building have: 2 pts.

1. Framed construction: with concrete aggregate cladding
2. Mass construction: concrete aggregate over brick
3. Mass construction: poured-in-place load-bearing walls

1 B. What is the class of window type in this building: 2 pts.

1. Minimum window
2. Mullion
3. Spandrel

X. Site 10: King County Court House (Jefferson and 3rd Ave.)

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: brick and stone cladding
2. Mass construction: brick
3. Mass construction: poured-in-place concrete with brick cladding

3 B. What is the architectural term for the segment of this building's uppermost floors: 2 pts.

1. Pediment
2. Shaft
3. Capital

2 C. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of the building (of the middle stories): 3 pts.

1. 4 inches
2. 15 inches
3. 24 inches

1 D. Which dimension comes closest to being the actual size of most of the offices in this building: 2 pts.

1. 15 by 20 feet
2. 30 by 50 feet
3. 50 by 80 feet

XI. Site 11: Building across 3rd Avenue

4 A. This is a mass construction brick building. What, if any, are the clues which enable you to determine its type of construction: 3 pts.

1. Depth of window in-set decreases going upward
2. Arches are present over some windows
3. Metal plates indicating floor joists are present
4. All of the above

XII. Site 12: Building at Cherry and 2nd Avenue

3 A. What type of construction does this building have: 3 pts.

1. Framed construction: stone cladding
2. Mass construction: stone
3. Mass construction: brick with stone veneer

XIII. Site 13: Line of buildings along 1st Avenue at Washington

Assume friendly forces occupy the J & M Building on the corner and that buildings along the street to the south are to be taken.

* - Given that all the buildings are constructed independently
* - Given that the common arsenal of light infantry weapons is available

2 A. What type of construction do these buildings have: 3 pts.

1. Mass construction: poured-in-place concrete with brick cladding
2. Mass construction: brick
3. Framed construction: brick cladding

1 B. What is the preferred method for clearing buildings such as these: 3 pts.

1. Breaking into the roof of each building
2. Entering each building from the front
3. Entering each building from the rear

4 C. Which of the methods would require the greatest amount of explosives: 2 pts.

1. Breaking into the roof of each building
2. Entering each building from the front
3. Entering each building from the rear
4. Penetrating the side walls from within each building

3 D. If the method of penetrating adjoining walls were to be used, on which floor would this be most easily done: 3 pts.

1. Ground floor
2. Second floor
3. Third floor

2 E. What is normal access from the street to the upper floors: 2 pts.

1. Through the stores
2. Through a separate door on the front side
3. From the rear of the building only

XIV. Site 14: Building at corner of 1st and Main

3 A. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (for the basement floor): 2 pts.

1. 8 inches
2. 16 inches
3. 24 inches

XV. Site 15: Warehouse at overpass along Alaska Way

1 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: concrete box-wall principle
3. Framed construction: concrete cladding

1 B. What problem would be encountered in breaching a hole in the wall of this building: 2 pts.

1. Reinforcement bar would be encountered
2. Wall is backed with heavy brick
3. Wall is backed with stone

XVI. Site 16: Along north-south street at overpass

This area has been designated as an antitank kill zone.

3 A. Where would DRAGONs best be deployed to engage tanks in this kill zone: 3 pts.

1. In the "flat-iron" building
2. In the hardware company
3. In the "frame obscured" framed light-clad building (located 600 meters up the street)

2 B. Where would LAWs best be deployed to engage tanks in this kill zone: 2 pts.

1. In the frame-obscured, framed light-clad building
2. In brick buildings on both sides of the street

XVII. Site 17: At corner of Kennedy Hotel

3 A. All three of the listed buildings are about the same height. Which one would be the best place for landing a utility helicopter: 2 pts.

1. YWCA
2. Kennedy Hotel
3. Olympic Hotel Parking Garage

PRE-TRAINING EXAMINATION

BERLIN

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. <u>Site 1:</u> Green building across from Walter Schreiber Platz U-Bahn station.

<u>2</u> A. Which is the best aid to identifying the building type as brick: 3 pts.

1. Frame members are visible on side walls
2. Wall thickness decreases as building height increases
3. Window sizes differ

<u>2</u> B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building (on the second floor): 3 pts.

1. 10 inches
2. 20 inches
3. 40 inches

<u>2</u> C. What is the best location for placing a sniper to fire to the southwest: 3 pts.

1. Ground floor
2. Fourth floor
3. Top floor

II. <u>Site 2:</u> Steglitz Forum

<u>2</u> A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Framed construction: light cladding
3. Mass construction: box-wall principle

<u>2</u> B. Is the interior partition placement determined by location of the vertical structural columns: 1 pt.

1. Yes
2. No

2 C. Which is the best location for firing a 90mm RR at an APC going along the street: 3 pts.

1. Second floor
2. Third floor
3. Top floor

III. <u>Site 3:</u> Buildings across from Steglitz Forum

3 A. These buildings join to form a "hof-style" configuration. What would be the best use of the inner courtyard: 3 pts.

1. A hiding place for tanks
2. A place to employ Redeye systems
3. A hiding place for a motor pool

1 B. What is the construction type of the gray Bank building: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Frame construction: concrete cladding

1 C. What is the construction type of the Polster Richter building: 3 pts.

1. Framed construction: light cladding
2. Framed construction: heavy cladding
3. Mass construction: box-wall principle

3 D. Where is the best place to breach the adjoining walls of the two gray buildings: 3 pts.

1. Ground floor
2. Second floor
3. Third floor

3 E. What is the best place to breach the adjoining walls between the Polster & Richert and the Peak & Cloppenburg Building: 3 pts.

1. Ground floor
2. Second floor
3. Makes no difference, all floors are the same

1 F. What is the thickness of the front wall of the Peak & Cloppenburg Building: 3 pts.

1. 3 inches
2. 10 inches
3. 17 inches

IV. Site 4: The Ebbinghaus Building

1 A. What is the construction type of this building: 3 pts.

1. Framed construction: light cladding
2. Framed construction: heavy cladding
3. Mass construction: box-wall principle

3 B. Which dimension comes closest to being the actual depth of most of the offices in this building: 2 pts.

1. 12 feet
2. 20 feet
3. 35 feet

1 C. Could a DRAGON be safely fired from one of the middle floors of this building: 1 pt.

1. Yes
2. No

V. Site 5: Old style Bordicke Building

3 A. What is the construction type of this building: 3 pts.

1. Framed construction: heavy cladding
2. Mass construction: poured-in-place concrete
3. Mass construction: brick

2 B. Where is the best place to locate a sniper: 3 pts.

1. Second floor
2. Third floor
3. Fourth floor

VI. Site 6: Pelz Gusik Building

1 A. What is the construction type for this type of building: 3 pts.

1. Framed construction: light cladding
2. Framed construction: heavy cladding
3. Mass constuction: box-wall principle

2 B. What is the class of window type on this building: 3 pts.

1. In-fill
2. Spandrel
3. Mullion

2 C. Why couldn't a DRAGON be fired at a tank directly across the street: 3 pts.

1. Backblast
2. Arming distance
3. Inadequate line-of-sight

VII. Site 7: Where highway overpass crosses Schloss Strasse

Assume that a defensive complex has been established here. Make the best match between military operations or weapon system deployment and given urban feature: 1 pt. each

	Military Operation/Weapon System	Urban Feature
4	a. Covering movement, one side of street to the other	1. Highway overpass
1	b. To hide tanks from air observation	2. Tower on highway overpass
2	c. Forward observation	3. Parking garage
3	d. Firing a LAW	4. Underground pedestrian walkway
5	e. Bringing in reinforcements from elsewhere in city	5. Subway tunnels

VIII. Site 8: Along Schloss Strasse

3 A. Tall office building. What type of construction does this building have: 3 pts.

1. Mass construction: box-wall principle
2. Framed construction: heavy cladding
3. Framed construction: light cladding

1 B. What is the class of window type in this building: 3 pts.

1. Frame obscured curtain wall
2. Spandrel
3. Mullion

1 C. Where would DRAGONs best be deployed to engage tanks along this street (presume removal of trees and poles): 2 pts.

1. In the tall office building
2. In brick buildings on either side of street

IX. Site 9: Tourotel

1 A. What do the Tourotel and the tall office building have in common: 3 pts.

1. Both have framed construction
2. Both have box-wall principle construction
3. Both have concrete poured-in-place construction

X. Site 10: South of Tourotel

2 A. What is the type of construction of this building: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: box-wall principle
3. Framed construction: heavy cladding

1 B. An advantage to defenders of this type of building is: 3 pts.

1. Each cell provides protection in walls and floor/ceilings
2. Walls are thicker than in old brick buildings
3. Room size varies within building

XI. Site 11: Steglitz Rathaus

2 A. What type construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete with brick veneer
2. Mass construction: brick
3. Framed construction: heavy cladding

1 B. What dimension comes closest to being the size of the offices in this building: 3 pts.

1. 20 by 20 feet
2. 35 by 35 feet
3. 50 by 50 feet

1 C. Room to room clearing of this building would encounter the problem of: 2 pts.

1. A mix of load-bearing and nonload-bearing interior walls
2. All interior walls have the same thickness as exterior walls

XII. Site 12: Apartment building on Peschke Strasse

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: stone
2. Mass construction: brick with a stone veneer
3. Framed construction: stone and brick cladding

XIII. Site 13: Building farther along Peschke Street

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: box-wall principle
3. Framed consrtuction: heavy cladding

2 B. Which dimension comes closest to being the actual size of the rooms: 3 pts.

1. 8 feet by 10 feet
2. 15 feet by 15 feet
3. 20 feet by 25 feet

1 C. Assume window glass is removed. What is best choice of a weapon to fire at an APC moving along street in front: 3 pts.

1. 90mm RR
2. DRAGON
3. LAW

XIV. Site 14: Apartment on Frege Strasse

4 A. Which identification key is not in evidence concerning this building: 3 pts.

1. Floor joist anchors
2. Vertical window alignment
3. High proportion of wall (on broad side of building)
4. All the above are in evidence

POST-TRAINING EXAMINATION

BERLIN

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Ka de We Department Store

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: heavy cladding

2 B. What figure comes closest to being the actual dimension of the wall thickness on the second floor: 3 pts.

1. 4 inches
2. 14 inches
3. 24 inches

II. Site 2: Across Tauenzien Strasse from Ke de We

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: box-wall principle
3. Framed construction: light cladding

1 B. Which figure comes closest to being the actual thickness of the exterior walls of this building: 3 pts.

1. 5 inches
2. 12 inches
3. 19 inches

3 C. What is the class of window type in this building: 3 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel

2 D. Is interior partition placement determined by location of the vertical structural columns: 1 pt.

1. Yes
2. No

III. Site 3: Office Building - Bayreuther Strasse & Wittenburg Platz

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick with concrete cladding
2. Mass construction: poured-in-place concrete
3. Framed construction: light cladding

2 B. Which of the following dimensions comes closest to being the actual depth of an office in this building: 3 pts.

1. 15 feet
2. 25 feet
3. 40 feet

2 C. What would be the best choice of a weapon to fire from one of the upper floors at a tank on the street near Kaiser Whilhelm Church: 2 pts.

1. LAW
2. DRAGON
3. 90mm Recoilless Rifle

IV. Site 4: Philips Building (tall section)

3 A. What type of construction does this building have: 3 pts.

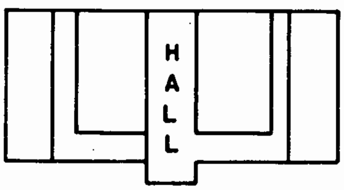
1. Mass construction: box-wall principle
2. Framed construction: heavy cladding
3. Framed construction: light cladding

1 B. What figure comes the closest to being the actual thickness of the walls (on the upper floor): 3 pts.

1. 5 inches
2. 12 inches
3. 19 inches

3 C. Which drawing best represents the floor plan of this building: 3 pts.

1.



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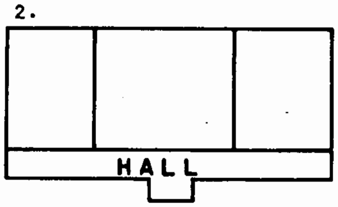

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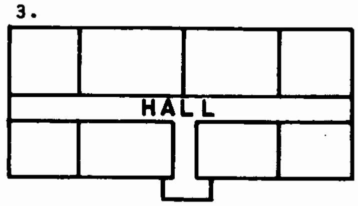


V. Site 5: Hotel Berlin

2 A. What type of construction does this building have: 3 pts.

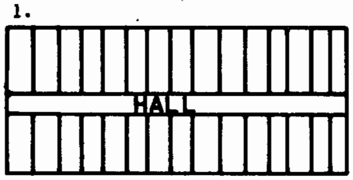
1. Mass construction: brick
2. Mass construction: box-wall principle
3. Framed construction: concrete

1 B. Which of the following dimensions comes closest to being the actual thickness of the exterior wall panels (on the side of the room facing the outside: 3 pts.

1. 5 feet
2. 12 feet
3. 19 feet

1 C. Which drawing best represents the floor plan (of the upper floors) of this building: 3 pts.

1.



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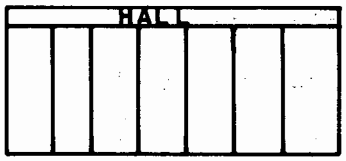

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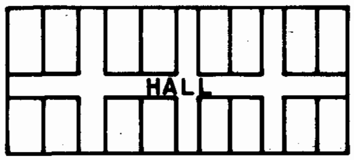


1 D. An advantage to defenders of this type of building is: 3 pts.

1. Each cell provides protection in walls and floor/ceilings
2. Walls are thicker in old brick buildings
3. Lower stories have thicker walls than upper stories

VI. Site 6: Police Station

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: stone veneer over brick
3. Framed construction: heavy cladding

2 B. Which of the following dimensions comes closest to being the actual thickness of the exterior wall (ground floor): 3 pts.

1. 10 inches
2. 20 inches
3. 30 inches

1 C. Which dimension comes closest to being the actual size of most of the offices in this building: 2 pts.

1. 15 x 20 feet
2. 30 x 50 feet
3. 75 x 100 feet

VII. Site 7: Apartment of Wichmann Strasse

3 A. What type of construction does this building have: 3 pts.

1. Framed construction: concrete
2. Mass construction: brick
3. Mass construction: box-wall principle

2 B. Which dimension comes the closest to being the actual thickness of the exterior walls on the second floor: 3 pts.

1. 1 inch
2. 3 inches
3. 6 inches

1 C. Assuming window glass is removed, what is best choice of a weapon to fire at an APC moving along street in front: 2 pts.

1. 90mm Recoilless Rifle
2. DRAGON
3. LAW

VIII. Site 8: Joachimstaler and Lietzenberger Strasse

3 A. The building on the corner: What is the type of construction: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: light cladding

1 B. Next building to the left: What is the type of construction: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: concrete

1 C. Exterior side wall of front building is: 3 pts.

1. Same thickness on each floor
2. Thicker on bottom floors than on top floors
3. Thicker on top floors than on bottom floors

3 D. On which floor would it be easiest to breach walls to go from one building to another: 3 pts.

1. Ground floor
2. Third floor
3. Fifth floor

3 E. Compare the type of construction of these two buildings. Which choice is true: 3 pts.

1. Both are mass construction
2. Left building is box-wall, right building is brick
3. Right building is concrete framed, left building is brick

1 F. Of these two buildings, which one has easiest roof to breach: 1 pt.

1. Left building
2. Corner building

3 G. Building on corner: What is the best place to position a sniper: 2 pts.

1. Ground floor
2. Second floor
3. Fourth floor

IX. Site 9: Bank for Handel and Industry

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: box-wall principle
3. Framed construction: light cladding

1 B. Assume trees and light poles along street to north are removed. Could a TOW be fired from this building: 1 pt.

1. Yes
2. No

X. Site 10: Building on Nurenburger Strasse

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick with veneer cladding
2. Mass construction: poured-in-place concrete with brick and veneer cladding
3. Framed construction: heavy cladding

1 B. Which dimension comes closest to being the actual size of the most common rooms in this building: 2 pts.

1. 12 x 15 feet
2. 25 x 50 feet
3. 75 x 100 feet

1 C. Do the exterior walls have the same thickness throughout: 1 pt.

1. Yes
2. No

2 D. Could a DRAGON be used to fire at a tank moving on the street in front of this building: 1 pt.

1. Yes
2. No

XI. Site 11: Along street from in front of Woolworth Building

2 A. Presume that you are standing on the sidewalk next to the Woolworth Building on this side of the street and are trying to fire M16 rounds into the second floor windows of the brick building across the street. In which building would an excessively high angle of obliquity prevent you from doing so: 2 pts.

1. Tapatan
2. Tall building before first store
3. Coiffure

XII. Site 12: Across from Europa Center

3 A. Which of the following is NOT a key to the fact that this is a brick building: 3 pts.

1. It has a high proportion of wall surface (relative to window)
2. Windows are aligned vertically, some have arches
3. Support columns are visible

3 B. Where is access to upper stories: 2 pts.

1. Through the store
2. At rear of building
3. From a door leading to a stairway at front of building

2 C. Could a DRAGON be fired from an upper floor at a tank moving along Budapester Strasse: 1 pt.

1. Yes
2. No

XIII. Site 13: Parking Garage

2 A. Where is the best location in the parking garage for keeping a Redeye (to be fired from top floor): 2 pts.

1. Ground floor
2. Next to top floor
3. Top floor

PRE-TRAINING EXAMINATION

SCHWEINFURT

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Intersection of Landwehrstrasse and Fredrich Strasse:

2 A. What type of construction does this building have: 3 pts.

1. Framed construction: heavy cladding
2. Mass construction: box-wall principle
3. Mass construction: poured-in-place concrete

3 B. Where would be the best place in this building to employ a sniper to cover the underpass: 3 pts.

1. Top floor
2. Bottom floor
3. Seventh floor

II. Site 2: Avia Building on Hauptbahnhofstrasse:

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: box-wall principle
2. Framed construction: heavy cladding
3. Framed construction: light cladding

1 B. What window pattern does this building have: 3 pts.

1. In-fill
2. Spandrel
3. Mullion

III. Site 3: FAG Office Building on Hauptbahnhofstrasse:

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: box-wall principle
3. Framed construction: light cladding

1 B. Could TOW's be safely fired from this building to overwatch the street: 1 pt.

1. Yes
2. No

IV. Site 4: SKF Building (newest building):

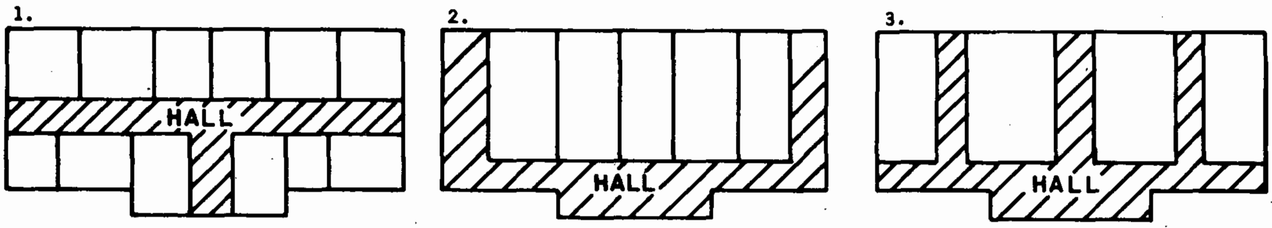
3 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: box-wall principle
3. Frame construction: light cladding

1 B. What window pattern does this building have: 3 pts.

1. In-fill
2. Spandrel
3. Mullion

1 C. Which drawing best depicts the plan of the upper floors: 4 pts.



1 D. Which of the following comes closest to being the actual thickness of the exterior walls of this building: 3 pts.

1. 3 inches
2. 10 inches
3. 17 inches

1 E. Which statement best describes the organization of the offices in this building: 4 pts.

1. Office units are large open bays
2. Office units are small rooms
3. The office units on the ground floor are small rooms, but the office units on the upper floors are large open bays.

V. Site 5: SKF Factory on Schrammstrasse and Cramerstrasse:

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Framed construction: heavy cladding
3. Framed construction: light cladding

1 B. Which of the following is true: 3 pts.

1. Wall thickness and material are the same for each story.
2. Wall thickness decreases as height increases.
3. Wall thickness is same on all stories but material in lower stories is stronger than on upper stories.

VI. Site 6: SKF Walkway at Sattlerstrasse:

A. You are setting up an antitank ambush looking to the north along Sattlerstrasse. Match the weapons available to the best place to employ them (one answer per weapon): 1 pt. each

2	A. DRAGON	1. Ground level under SKF sign
3	B. LAW	2. Third story above SKF sign
1	C. Tank	3. Buildings on either side of Sattlerstrasse.

VII. Site 7: Old SKF Factory Building at Fiedenstrasse

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Framed construction: heavy (brick) cladding
3. Mass construction: poured-in-place concrete with brick veneer

2 B. Which dimension comes closest to being the thickness of the exterior walls: 3 pts.

1. 4 inches
2. 16 inches
3. 24 inches

1 C. What is the interior floor plan of this building: 3 pts.

1. Large open bays with vertical columns
2. Small rooms with interior load-bearing walls
3. Large open bays with no vertical columns

VIII. Site 8: Brick building across from SKF walkway:

2 A. Which dimension comes closest to being the thickness of the walls on the second floor: 3 pts.

1. 12 inches
2. 20 inches
3. 36 inches

2 B. Where is the best place to position a sniper: 3 pts.

1. Second floor
2. Next to top floor
3. Top floor

IX. Site 9: Finanzant Building

1 A. What type of construction does this building have: 2 pts.

1. Framed construction: light cladding
2. Mass construction: stone
3. Mass construction: box-wall principle

X. Site 10: Bavarian Bank at Rufferstrasse and Schultestrasse:

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: stone
2. Mass construction: brick with stone veneer
3. Mass construction: building block with stone veneer

2 B. Which of the two buildings is most likely to permit DRAGON's to be fired from the inside: 1 pt.

1. Old
2. New

2 C. If a sniper were positioned in the new building, he should be in position on what level: 1 pt.

1. Ground level
2. One of the two middle floors
3. Top floor

XI. Site 11: Kroneneck Building

3 A. This building has what type of construction: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: heavy cladding (brick)

2 B. Which dimension comes closest to being the wall thickness on the second floor: 3 pts.

1. 4 inches
2. 8 inches
3. 18 inches

2 C. The walls of the Kronenck Building provide more protection than do the walls of the Apoteke: 1 pt.

1. Yes
2. No

1 D. Where would be the best position for an element supporting an attack toward the Rathaus with rifles, M203's, and machineguns: 4 pts.

1. Kroneneck
2. Apoteke
3. Jewelers

XII. Site 12: Rusengasse

1 A. The main structural difference between #6 and #10 Rusèngasse is that: 3 pts.

1. One is mass construction (brick) and the other framed construction
2. One is mass construction (brick) and one is old concrete
3. Both are mass construction (brick) but number 6 has thicker walls.

XIII. Site 13: Schweinfurt Center Parking Garage:

2 A. What is the general class of construction type of the parking garage: 1 pt.

1. Mass construction
2. Framed construction

2 B. Which statement is true of the parking garage: 3 pts.

1. The side walls (parapets) provide more protection than do the floors/ceilings
2. The floor/ceilings provide more protection than do the side walls
3. There is no difference in the protection provided by the side-walls and the floors/ceilings

2 C. Is the interior partition placement (in the retail/commercial part of the center) determined by location of the vertical structural columns: 1 pt.

1. Yes
2. No

XIV. Site 14: Market Place

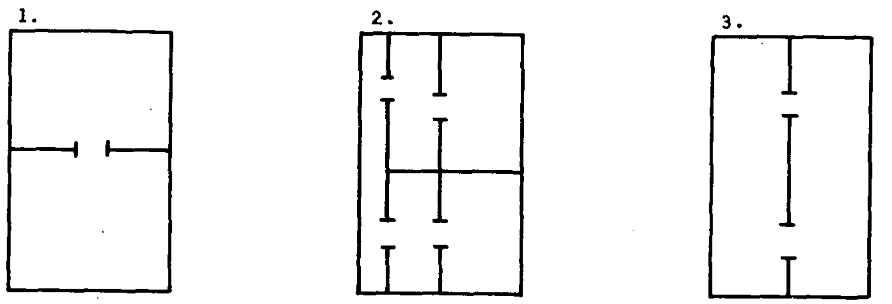
3 A. Wall breaching from building to building on the west side of the market place would be easiest on which floor: 3 pts.

1. Ground floor
2. Second floor
3. Top floor

1 B. Clearing buildings to the west along Zehnstrasse, on which side of the street would it be easiest to breach the walls between buildings: 3 pts.

1. North side (right)
2. South side (left)

2 C. Which drawing best depicts the floor plan of the upper floors of these buildings (on the west side of Market place): 4 pts.



1 D. If you were defending the west side of the market place firing toward the east, where would be the best place to position machineguns: 4 pts.

1. Ground floor
2. Second floor
3. Top floor

XV. Site 15: Rathaus

1 A. Where in the Rathaus would be the best place for your company CP: 3 pts.

1. Cellar
2. Ground floor
3. Top floor

POST-TRAINING EXAMINATION

SCHWEINFURT

Score: 100 Possible

DIRECTIONS: Place the number of the selected answer in the blank.

I. Site 1: Hotel Ross

1 A. Which of the following features is the surest indication that this building is constructed of brick (the main, northern part of the hotel): 3 pts.

1. Wall thickness decreases as building height increases
2. Wall is plaster covered
3. Building has a pitched roof

2 B. Does the southern part of the Hotel have the same method of construction as the northern part: 1 pt.

1. Yes
2. No

2 C. Where would be the best place to position a sniper in the northern section of the building: 3 pts.

1. Ground floor
2. 3rd floor
3. Top floor

II. Site 2: Furniture store on east side of Market Place

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: light cladding

III. Site 3: Row of buildings on west side of Market Place (first three buildings from north)

2 A. What type of construction do these buildings have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: brick
3. Framed construction: concrete

3 B. What is the easiest place to break into one of these buildings (not counting windows and doors): 3 pts.

1. Front wall
2. Back wall
3. Roof

3 C. If the method of breaching adjoining walls (between buildings) were to be used, on which floor would this be most easily done: 3 pts.

1. Ground floor
2. Second floor
3. Third floor

IV. <u>Site 4:</u> Rathaus

3 A. The Rathaus has all but one of the following characteristics: Which one does NOT apply: 3 pts.

1. Interior load-bearing walls
2. A weak roof, only one tile thick
3. Post and beam construction

1 B. Room to room clearing of this building would encounter the problem of: 2 pts.

1. A mix of load-bearing and nonload-bearing interior walls
2. All interior walls have the same thickness as exterior walls

2 C. Compare the Rathaus and the bank at the north end of Market Platz. Which statement is true: 3 pts.

1. Exterior walls of the Rathaus provide less protection than do those of the bank
2. The rooms in the Rathaus are smaller than those in the bank
3. The rooms in the Rathaus are bigger than those in the bank

V. <u>Site 5:</u> House on Ruckerstrasse corner

3 A. The upper part of this house has post and beam construction. That fact is implied by all but one of the following. Which one does NOT apply: 3 pts.

1. Window depth
2. Bulge on the south side of the street
3. Roof type

VI. Site 6: Building in alley

3 A. This is a framed building. Which is NOT a key to this fact: 3 pts.

1. Windows are not vertically aligned
2. Walls are same thickness on all floors
3. Building's exterior is covered with plaster

VII. Site 7: Grassberger Store

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: box-wall principle
2. Mass construction: poured-in-place concrete
3. Framed construction: concrete

3 B. On which floor are the smallest rooms located: 2 pts.

1. Ground floor
2. Second floor
3. Third floor

VIII. Site 8: Parking Garage

3 A. What type of common building construction method was used in erecting this building: 3 pts.

1. Mass construction: box-wall principle
2. Mass construction: poured-in-place concrete
3. Framed construction: concrete

3 B. Where is the best location in the parking garage for keeping a Redeye (to be fired from the top floor): 3 pts.

1. Ground floor
2. A middle floor
3. Next to top floor

1 C. Which building would be the best suited for landing a helicopter: 3 pts.

1. Parking garage
2. Building to the south
3. Building to the east

IX. Site 9: Bavarian Bank

1 A. What type of construction does this building have: 3 pts.

1. Framed construction: light cladding
2. Framed construction: heavy cladding
3. Mass construction: box-wall principle

2 B. What is the class of window type in this building: 2 pts.

1. Frame-obscured curtain wall
2. In-fill
3. Spandrel

2 C. Judging by its breadth, this building: 3 pts.

1. Has a light well (or "wings")
2. Does NOT have a light well (or "wings")
3. Has "Hof-Style" configuration

X. Site 10: Horton Store

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: concrete

2 B. Which would be the greater problem in deploying DRAGONs from within this building: 2 pts.

1. Insufficient back blast area
2. Minimum arming distance

XI. Site 11: Building to west of Court House

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick with stone cladding
2. Mass construction: poured-in-place concrete with stone cladding
3. Framed construction: with stone cladding

1 B. Which of the following dimensions comes closest to being the actual thickness of the exterior walls of this building: 3 pts.

1. 4 inches
2. 10 inches
3. 16 inches

XII. Site 12: Apartment on Ludwig Strasse

2 A. What type of construction does this building have: 3 pts.

1. Mass construction: poured-in-place concrete
2. Mass construction: box-wall principle
3. Framed construction: concrete cladding

1 B. An advantage to defenders of this type of building is: 3 pts.

1. Each cell provides protection in walls and floor/ceilings
2. Walls are thicker than in old brick buildings
3. Lower stories have thicker walls than upper stories

XIII. Site 13: Block of buildings on Ludwig Strasse

3 A. What advantage does this entire block have to its defenders: 4 pts.

1. Provides opportunities to deploy antitank weapons
2. Provides good overhead cover on upper floor
3. Provides cover plus concealed routes going from position to position within the block

XIV. Site 14: Old brick building

2 A. Which figure is closest to being the actual wall thickness on the second floor: 2 pts.

1. 9 inches
2. 14 inches
3. 19 inches

2 B. Which figure is closest to being the actual wall thickness on the third floor: 2 pts.

1. 5 inches
2. 9 inches
3. 14 inches

XV. Site 15: FAG Building

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: brick over poured-in-place concrete
3. Framed construction: heavy cladding (brick)

2 B. Which figure comes closest to being the actual dimension of the wall thickness on the upper floors: 3 pts.

1. 4 inches
2. 14 inches
3. 24 inches

3 C. Considering its function, the interior of this building is probably composed of: 3 pts.

1. Fixed cells with heavy partitions
2. Numerous interior, artificially-lighted rooms
3. Large, naturally lighted, open-bay spaces

XVI. Site 16: One story structure

3 A. What type of construction does this building have: 3 pts.

1. Mass construction: brick
2. Mass construction: poured-in-place concrete
3. Framed construction: concrete

2 B. What is the best tactical use of this building: 3 pts.

1. Setting up a strongpoint defense
2. To conceal a company maintenance section
3. As a hide position for a Redeye

XVII. Site 17: Along Ludwig Strasse

3 A. On what floor of the FAG building would DRAGONs best be deployed to engage tanks in this kill zone: 3 pts.

1. Ground floor
2. Third floor
3. Next to top floor

1 B. Where would LAWs best be deployed to engage tanks in this kill zone: 2 pts.

1. In brick buildings on both sides of the street
2. In the parking lot
3. In the FAG building

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