MAKING HISTORIC DISTRICTS ENERGY EFFICIENT : A CASE STUDY

GLANCE and ASSOCIATES

HISTORIC DISTRICTS MADE ENERGY EFFICIENT

A Case Study

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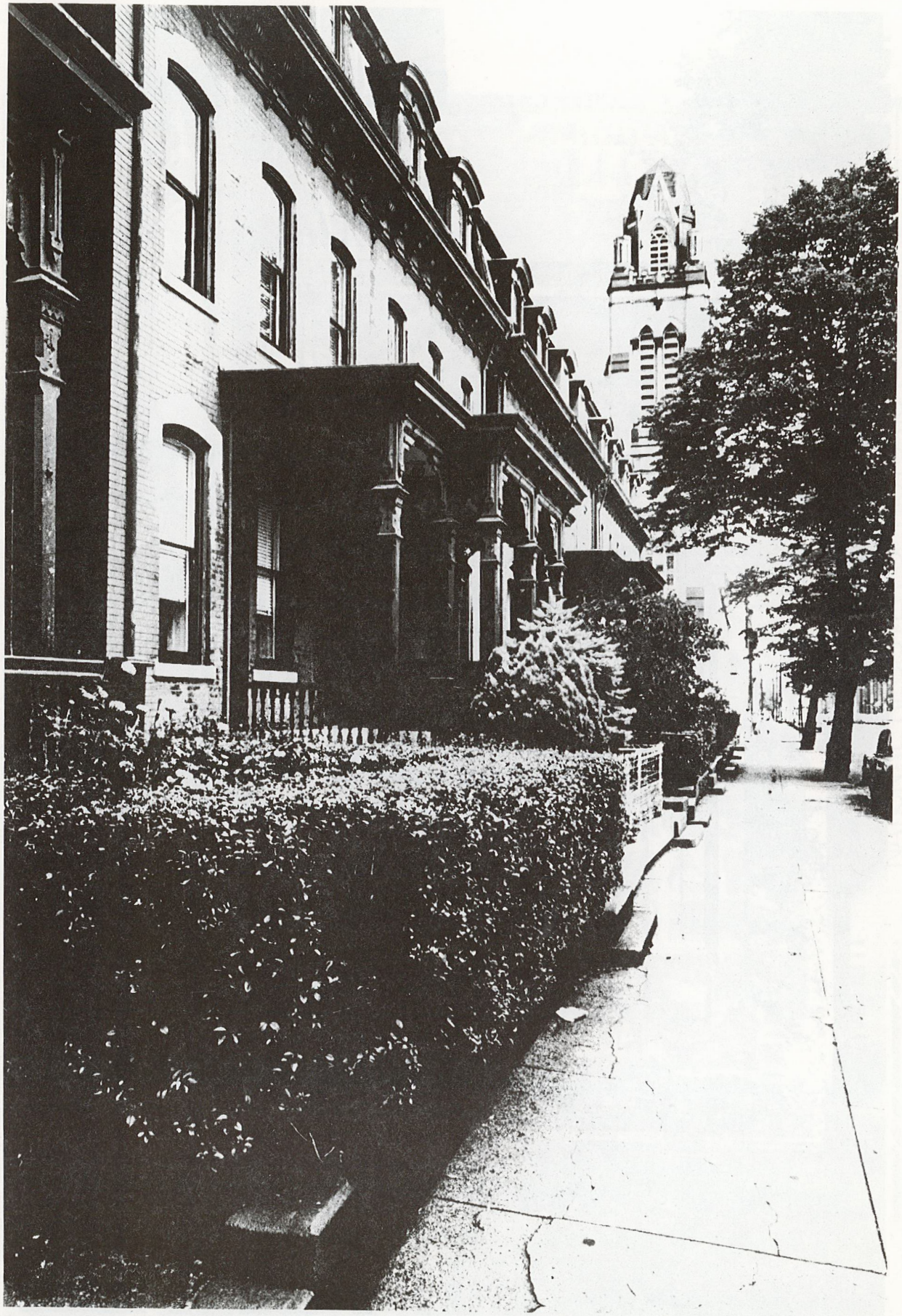
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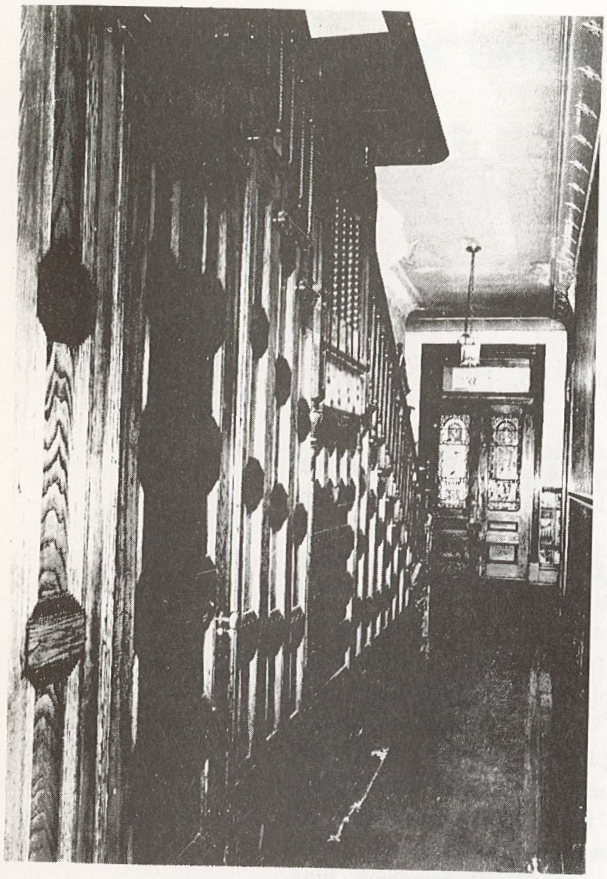
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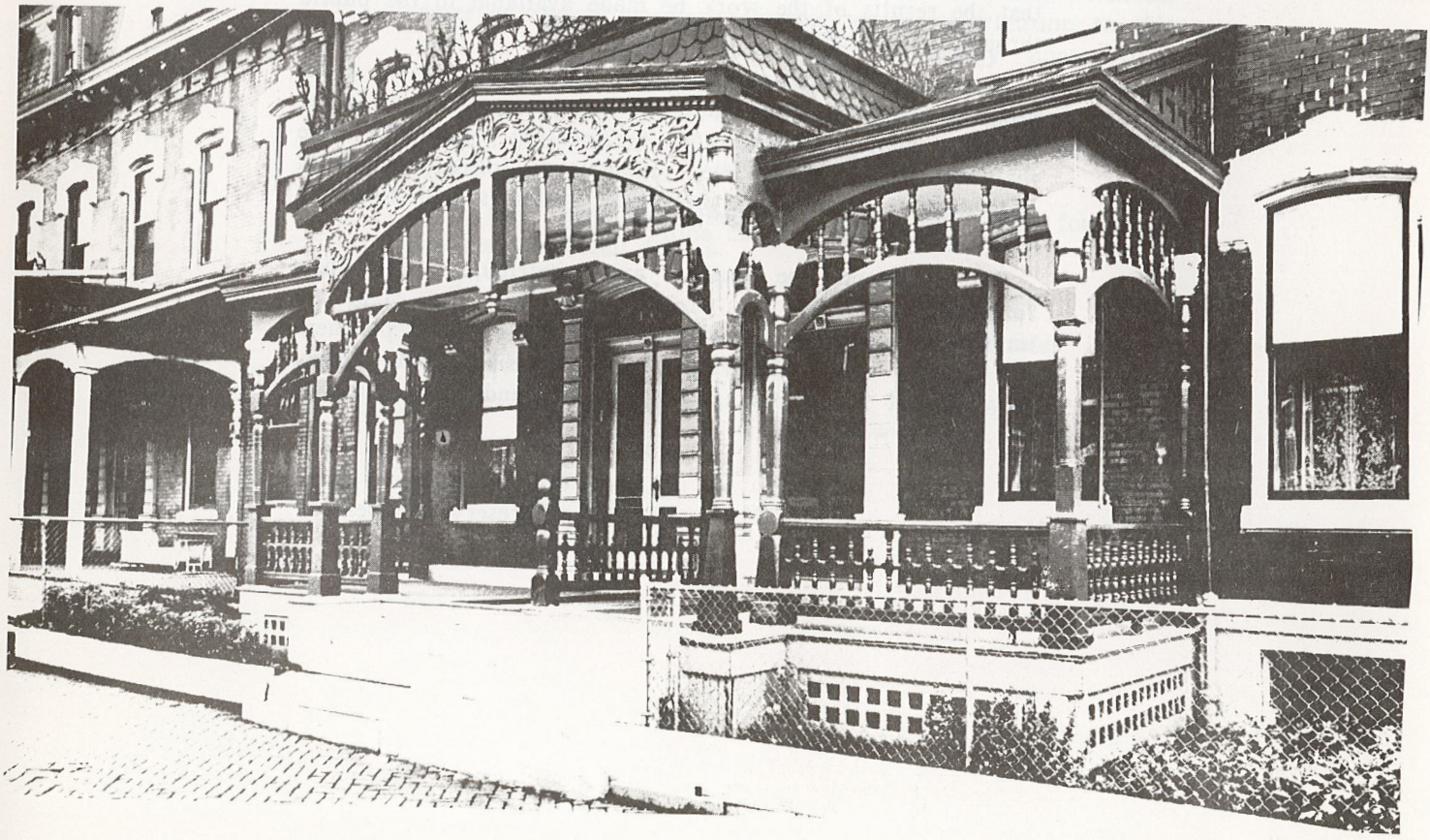

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MANCHESTER NEIGHBORHOOD
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SHEFFIELD STREET STUDY AREA
SCALE








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PREFACE

November 16, 1981

It is with great pleasure that the National Park Service has participated in a preservation/energy conservation demonstration project. We are acutely aware of the potential dangers which future energy shortages might pose to the continued preservation of our cultural heritage and are pleased to support the development of new strategies to address such issues. With this urgent need identified, a grant was awarded to Carnegie-Mellon University and the Manchester Citizens Corporation to develop energy conservation and solar energy options which could be immediately implemented on a neighborhood-wide scale, while still preserving and enhancing the historic character of the district. A requirement of the grant from the 1979 Secretary of the Interior's Discretionary Grant program was that all work be accomplished in accordance with the Secretary's "Standards for Historic Preservation Project" and that the results of the work be made available to the public through a publication.

One of the requirements of the discretionary grant program was the preparation of a report which could be published and circulated to the preservation community. We feel that this is an excellent example to follow because it goes beyond considering individual buildings and looks at solar options involving an entire district.

We commend the author and contributors for their foresight and share in their hopes that the plans be implemented fully. Additionally, we thank the Department of Energy and Department of Housing and Urban Development for providing the bulk of funds to accomplish the retrofit work.

Lee H. Nelson, AIA
Technical Preservation Service
National Park Service

ACKNOWLEDGEMENTS

November 18, 1981

A work of this magnitude is never accomplished without the help of many organizations and individuals. There was first Baird M. Smith, AIA, Chief, Branch of Preservation Technology of the National Park Service who suggested that the monogram I prepared for the Discretionary Grant Program be expanded and distributed to a larger audience. His encouragement and technical assistance was invaluable. The Institute of Building Sciences, under the direction of Volker Hartkopf, provided the computer software and hardware to calculate the energy savings. Ms. Liz Fox of the Institute of Building Sciences, edited and typed the manuscript.

In solving the many technical problems connected with this book, I am indebted to Travis L. Price, III of Price and Partners, architects specializing in active and passive solar design.

Lawrence Hoffman, of the Institute of Building Sciences, deserves special mention for his major contribution to this book. His special knowledge of energy conservation measures and computers provided the basic background information necessary for the successful completion of this book. He was directly involved in its early planning and was a central figure in its production.

To all I have mentioned here, and those I have forgotten, my most heartfelt thanks.

A. Richard Glance
Glance and Associates

1. INTRODUCTION

SCOPE OF THE STUDY

Carnegie-Mellon University's Institute of Building Sciences (CMU) received an $875,000 grant from the U.S. Department of Energy (DOE) in 1980 to make the minority-occupied inner city residences of Manchester more energy efficient. Their major task was to develop energy design guidelines for new and existing structures, and monitor the implementation of these design guidelines. The U.S. Department of Housing and Urban Development (HUD) also provided the Manchester Citizens Corporation (MCC) with a self-help grant which enabled this community-based organization to be the developers for several multi-family unit demonstration projects within their neighborhood.

Carnegie-Mellon University and the Manchester Citizens Corporation then received the Secretary of the Interior's 1979-1980 Historic Preservation Discretionary Grant to insure that the proposed energy conservation retrofit measures developed in the guidelines conformed to the Secretary's Standards for Rehabilitation. The cooperative effort of these three Federal agencies has resulted in the successful rehabilitation of many historic structures within the Manchester neighborhood. Glance and Associates was the historic preservation consultant for the DOE study in addition to being the primary consultant to the Secretary of the Interior's Grant. This booklet, a somewhat condensed version of the above mentioned studies, specifically addresses a wider audience whose primary concern is to make historic structures energy efficient without destroying their architectural character.

The first portion of this report addresses the entire Manchester District as an important historical inner-city neighborhood which, unfortunately, consumes more energy than necessary to heat and cool its buildings. The Sheffield Street was studied in particular because it is the major development thrust for the Manchester Citizens Corporation. This street presents unique design and development problems because several structures were occupied while others were vacant and vandalized. Interspersed among these buildings were several contiguous vacant lots which provided the developer - MCC in this case - the opportunity to construct new structures. The checklist for new construction, included in the last section of the report, helped guide MCC as they reviewed proposed designs for infill houses on the Sheffield Block.

The consultant, Glance and Associates, performed the following tasks related to the previous mentioned studies:

1. Researched the historical development and architectural heritage of the Manchester District.

2. Identified the predominant architectural styles within the district and highlighted the significant architectural details on the facades of the Sheffield Street buildings.

3. Reviewed the Secretary's Standards for Rehabilitation and the accompanying Guidelines and insured that the proposed detailing for energy efficient structures conformed to these regulations.

4. Identified potential conflicts which may arise during the design process as one attempts to sensitively integrate energy efficient measures into a historically significant building.

5. Identified important architectural design elements (scale, proportion, etc.) to insure that the new structures would compliment the adjacent historic buildings.

Finally, the report recommends specific energy strategies for existing historic structures and new construction. A comparison of the potential energy savings is made between the recommended energy strategies and normal construction practices.

BACKGROUND INFORMATION

Manchester is a residential neighborhood within the City of Pittsburgh located approximately one mile from the central business district. The physical fabric of the district encompasses 79 city blocks of which 28 were placed on the National Register of Historic Places in 1975 and is referred to in this report as the Manchester Historic District. Under Section 102 (a) of the National Historic Preservation Act of 1966, as amended, a federal grant-in-aid may be made available to properties listed in the National Register provided that the funds preserve or restore the historic character of a property. Section 101 also requires review and approval by state and federal preservation agencies of the proposed architectural plans. This is done in order to preserve the character of the historic structures. The 1979 census lists 2700 residents in Manchester. There exists a total of 1170 housing structures throughout Manchester, of which 357 are vacant. A map survey located 92 empty lots.

The area was first surveyed in the late eighteenth century and laid out in 1832. In 1843, it became a borough and in 1867 merged with the City of Allegheny which, in turn, became a part of the city of Pittsburgh in 1908.

Because the land is relatively flat, a rectilinear grid street pattern developed. Indeed, the vast majority of towns laid down in America after the eighteenth century used the grid plan because it could be planned from a distance without exact knowledge of the existing topography. It was also popular because it was easily surveyed and land could be subdivided and identified by number. Because the area was an economic mix of working, middle, and upper classes, the houses vary in size, form, ornateness, and sophistication.

Toward 1860, the great construction period of the Manchester district, a combined Italian and French style became popular and remained a favorite for almost thirty years. The 1100 and 1300 blocks of Sheffield Street display the cohesive scale and architectural variety most common to the district. These rather elaborate structures consist primarily of standard three-bay wide, three-story high houses which include a mansard roof. This roof configuration, having a single central gabled dormer and simple Italianate details (coupled brackets on the cornices and projecting windows and lintels), gave the building a visual impression of being only two stories high. For the most part the houses are flush with the sidewalk and the front door is reached by three steps usually constructed of stone. Some structures have turrets to one side of the porch, elaborate stained glass transoms and oval gable windows. Other houses have elaborate, classical cornices modeled in burnt brick while others consists of ornate Italianate brackets. Ornate, low-relief designs of the Eastlake and Queen Anne styles abound on numerous gables and pediments above the porches in addition to classical jigsaw fret work designs.

The simplest housing forms in the district are the worker residences located on portions of Franklin, Decatur and Sedgewick Streets. These two-bay houses have low pitched roofs and are only two stories high. Very few have mansard roofs or dormers. Most of the structures are flush with the sidewalk and have window lintels, portals and cornices which are plain or articulated in a simple classical or Italianate manner and are flush with the building's facade.

Several years ago, Pittsburgh History and Landmarks Foundation conducted a visual survey of the historic buildings of Manchester. Glance and Associates used this information as a basis for its visual survey which it conducted in the fall of 1980.

Conclusions of the consultant's survey are as follows:

1. Of the 1170 existing structures within the entire Manchester neighborhood 540 are of historic importance. They can be categorized as follows:

   a. 88 are singularly outstanding architectural expressions which exhibit qualities of design, style, and/or craftsmanship that make it an outstanding asset to the neighborhood.

   b. 384 structures represent a certain stylistic development and quality of detail normally not found in the area.

   c. 68 buildings are visually and environmentally important when they are viewed as a cluster. Individually, however, they lack significant architectural detailing.

2. The buildings in Manchester give the visual impression of being constructed as a long series of rowhouses, but are actually clusters of two or three buildings constructed within 6 to 8 feet of each other. The cornice and porch lines of the buildings have uniformity of height and design which reinforces the rowhouse appearance.

3. Buildings with third floors have full-height attic spaces which are usually inhabited. This space has a mansard roof at the street facade which gives the building the impression of being only two stories high with a large, ornamental roof. This is particularly true of the Sheffield block.

METHODOLOGY

Maintaining the integrity of historic buildings and making them energy efficient are compatible goals. Maximizing these goals was achieved by conducting two surveys. The first survey addressed the architectural elements the buildings currently possess - or possessed at one time - which gave the buildings their historic character. Such identifiable items would be: mansard roof line, decorative window lintels, and Italianate roof brackets. Dividing these elements into primary and secondary importance helps clarify for the architect the degree of alteration permitted on the building's facade to achieve energy efficiency. Before making specific energy conservation recommendations for historic buildings, a clear understanding of each building's architectural character must be known. Some of the key elements of this character are:

1. A general description of its size, predominant building materials and general structural condition.

2. Location and style of historic architectural elements as they relate to the classical architectural motifs. (ie., second empire-mansard roof, Italianate window hoods)

3. Structural conditions of specific architectural elements (ie., slate roof in fair condition, window frames in good condition).

An energy audit is the second survey to be conducted. There are three categories of audits which should be performed in a residential building:

1. A *Utility Audit* which analyzes the monthly and yearly energy usage as reported in utility billings.

2. An *Envelope Audit* which examines the building's exterior components and includes the thermal properties of its doors, windows, insulation, and air infiltration.

3. An *Energy Use Audit* which evaluates building systems (HVAC, lighting, hot water, appliances) and their performance efficiencies.

By determining where and how energy is used or lost in a building, significant energy conservation opportunities can be identified.

The third component of this methodology is the combination and analysis of these two surveys. Based upon their cost-effectiveness and compatibility with the building's historic components, conservation methods (roof insulation, weatherstripping windows, etc.) and collection systems (sun-space, roof collectors, etc.) are selected.

The consultant applied this methodology as he investigated the Sheffield Street buildings. The degree top which energy conservation elements can be incorporated into these buildings was almost pre-determined as a result of this methodology. *Appendix A, Architectural/Existing Conditions - Analysis*, summarizes the result of the first survey. The importance of this section should not be underestimated.

2. CASE STUDY THE SHEFFIELD STUDY AREA

MANCHESTER NEIGHBORHOOD ITS ARCHITECTURAL STYLES

Buildings can be classified by different architectural styles by identifying their key architectural elements. Some of the most important architectural elements of a building which help place it within a particular style are: scale, proportion, massing, height, floor plan, roof lines, type of construction materials and finishes, textures, color, porches, and entrance columns. Interior clues are found in wainscoting and paneling, flooring color, decorative elements, moldings, mantels, doors, and stair balustrades. Construction methods such as brick bonding practices, structural use of timber or steel and joining of different materials may also be used as guides. The form of the built environment was shaped primarily by the tastes, budgets, available materials, climates, and building skills of the region, thereby producing hybrid architectural styles. What evolved has been buildings which possess predominant stylistic features of a particular architectural style with elements of other styles incorporated into their design.

A comprehensive visual analysis was conducted of the Manchester neighborhood. The predominant architectural styles of the 1170 residential structures located within Manchester were categorized in the following manner:

- **Federal** (311 buildings)
  This style of the early 19th century rejected much of the English-inspired Georgian decoration but retained its symmetry. Windows were framed in a simple manner with undecorated and flat lintels. The window proportions were rather square and boxed. Roofs were often low, sometimes hipped and contain single window dormers in its center. The cornice normally contain details of the ionic order.

- **Italianate** (272 buildings)
  The Italianate villa design was borrowed from the rural architecture of northern Italy and introduced in this country by way of England in the late 1830's. It was the plans of Alexander Jackson Davis which popularized this style based upon the books of Alexander Jackson Downing. The predominant features of this style are: tall,

slender proportions of windows and doors; elaborate, decorative projections on the building's facades; wide, projecting eaves supported by brackets; and roundheaded windows with hood mouldings.

- **Early Victorian** (158 buildings)
  The buildings in this category combine features of the Federal and Italianate styles which made it impossible to categorize the building to either of these specific styles.

- **Gothic Revival** (42 buildings)
  This is a general category which is intended to encompass those design elements used by Richard Upjohn and James Renwick in their church designs during the 1850's and 1870's. Irregular in silhouette and complicated in massing, Gothic Revival emphasized a "truthfulness" in expressing its function and use of materials. Pointed arches sometimes laid in polychrome masonry were used in addition to dramatically overstated porch and eave exterior wood framing. The roof line occasionally uses a multiplicity of gables which vary in size, shape, and pitch.

- **French Second Empire** (5 buildings)
  This style was derived from the models of the French Renaissance which were revived under the Emperor Napoleon III (1852-70) as he transformed Paris into a city of grand boulevards and monumental buildings. One of the first major buildings constructed in this style was the Corcoran Gallery in Washington, D.C. (James Renwick, architect, 1859). This style featured prominent projecting and receding surfaces often in the form of central and end pavillions. Ornamentation usually included classical pediments, balustrades, and windows flanked by pilasters. There is usually a full mansard roof covered with slate often in variegated colors. The interiors were generally elaborations of the Italianate, with bold plaster cornices and medallions.

- **Richardsonian Romanesque** (13 buildings)
  Henry Hobson Richardson (1838-86) interpreted the Romanesque architectural style so that it became a different and uniquely American building type in 1870. Stone construction was emphasized with deep window reveals and round arched lintels. Heavy horizontal massing was emphasized contrasting with a towering gable or tower. Turrets sometimes occurred at the corner of the building. Columns were exaggerated to read tall or short, thin or fat. Corbels and archaeologically correct features such as chevrons and lozenges were borrowed from the Romanesque architecture of Europe.

- **Recent** (369 buildings)
  After 1900, very few residential buildings were constructed in Manchester until the urban renewal/redevelopment process began in the mid 1960's. It is this particular group of buildings - single family detached, one story high, of brick veneer construction with casement or awning windows - that this category addresses. The Manchester neighborhood does not contain any significant amount of any of the architectural styles which flourished between 1900 and 1960.

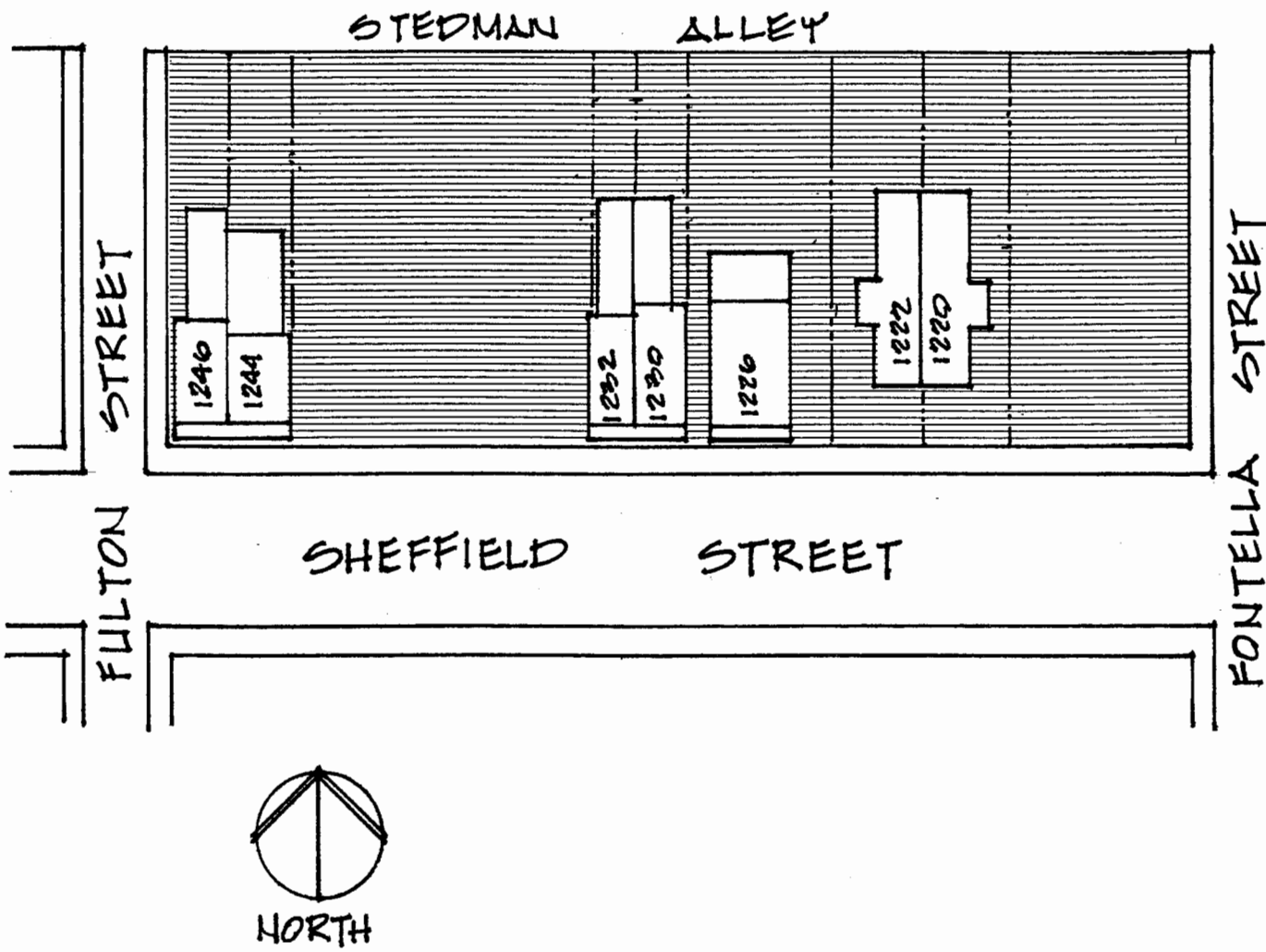
SHEFFIELD STREET STUDY AREA ARCHITECTURAL AND EXISTING CONDITIONS ANALYSIS

SITE PLAN

The case study is the 1200 block of Sheffield Street located almost in the center of Manchester neighborhood. It is 489 feet long and 138 feet deep and encompasses 67,482 sq.ft. or 1.5 acres. It has a north-south orientation as do most of the blocks in Manchester.

Presently, the block includes seven houses of historic quality. Between two of the buildings there exists a 13,800 sq.ft. empty parcel while the eastern portion of the block contains a 24,840 sq.ft. parcel. New infill construction is proposed for both of these vacant lots.

The 1200 block of Sheffield Street is surrounded by occupied residential structures. The buildings to the north and southeast of the block were constructed in 1970 while the remaining residences were built at the turn-of-the-century and have historic significance.

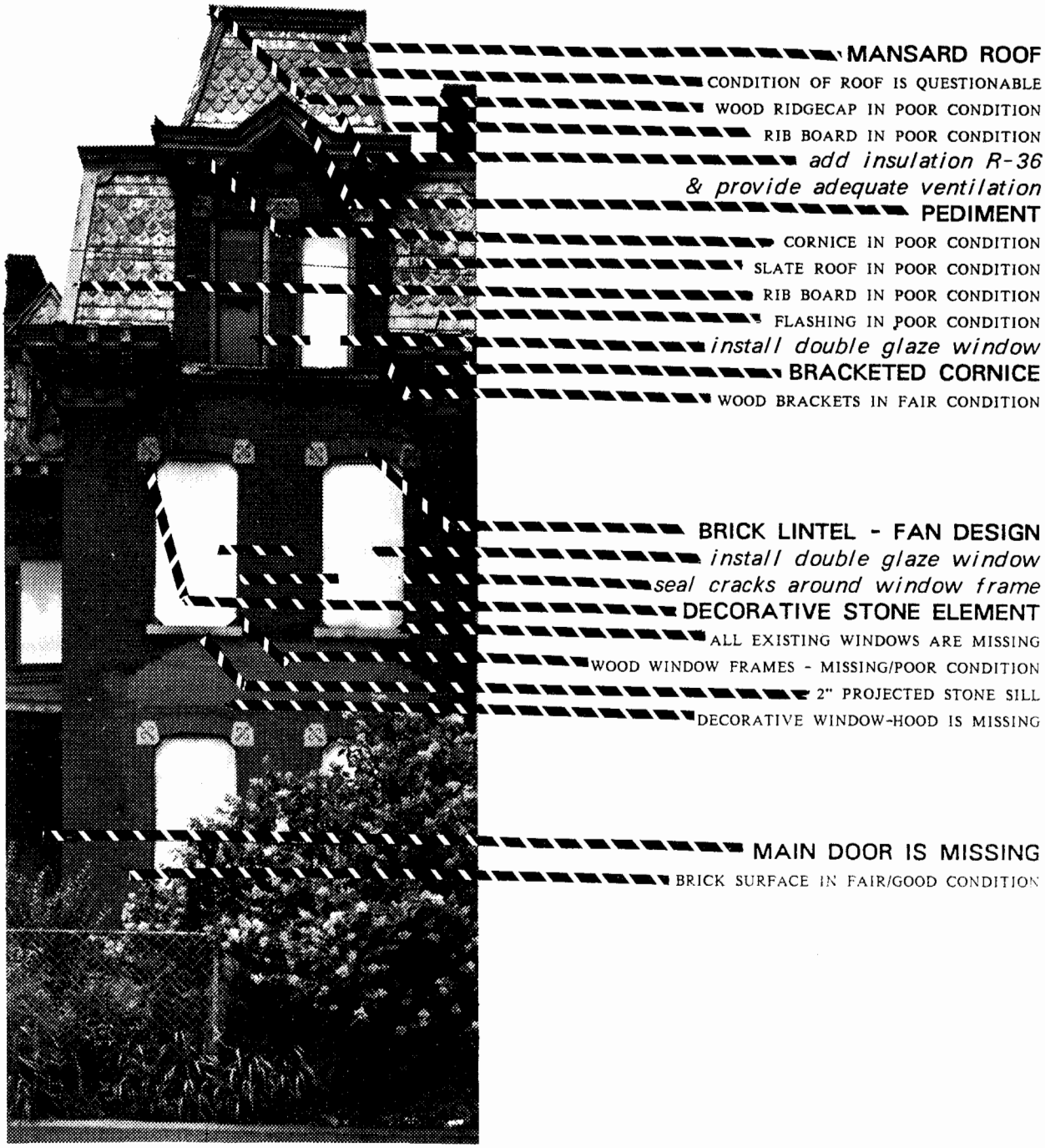


1220 - 1222 SHEFFIELD

DESCRIPTION:

This building is a 2½ story brick structure approximately twenty-six (26) feet wide, forty (40) feet high and seventy (70) feet long. Almost fifteen (15) percent of the front elevation surface area is windows. A brick fan pattern with decorative stone corners constitute the lintels over the windows; the design is flush with the surface wall. The slate of the mansard roof has a fishscale pattern. Excluding the basement, the building contains approximately 3800 square feet. Although the building is vacant, it has been securely enclosed to prevent vandals from entering and destroying its interior.

ARCHITECTURAL ANALYSIS:

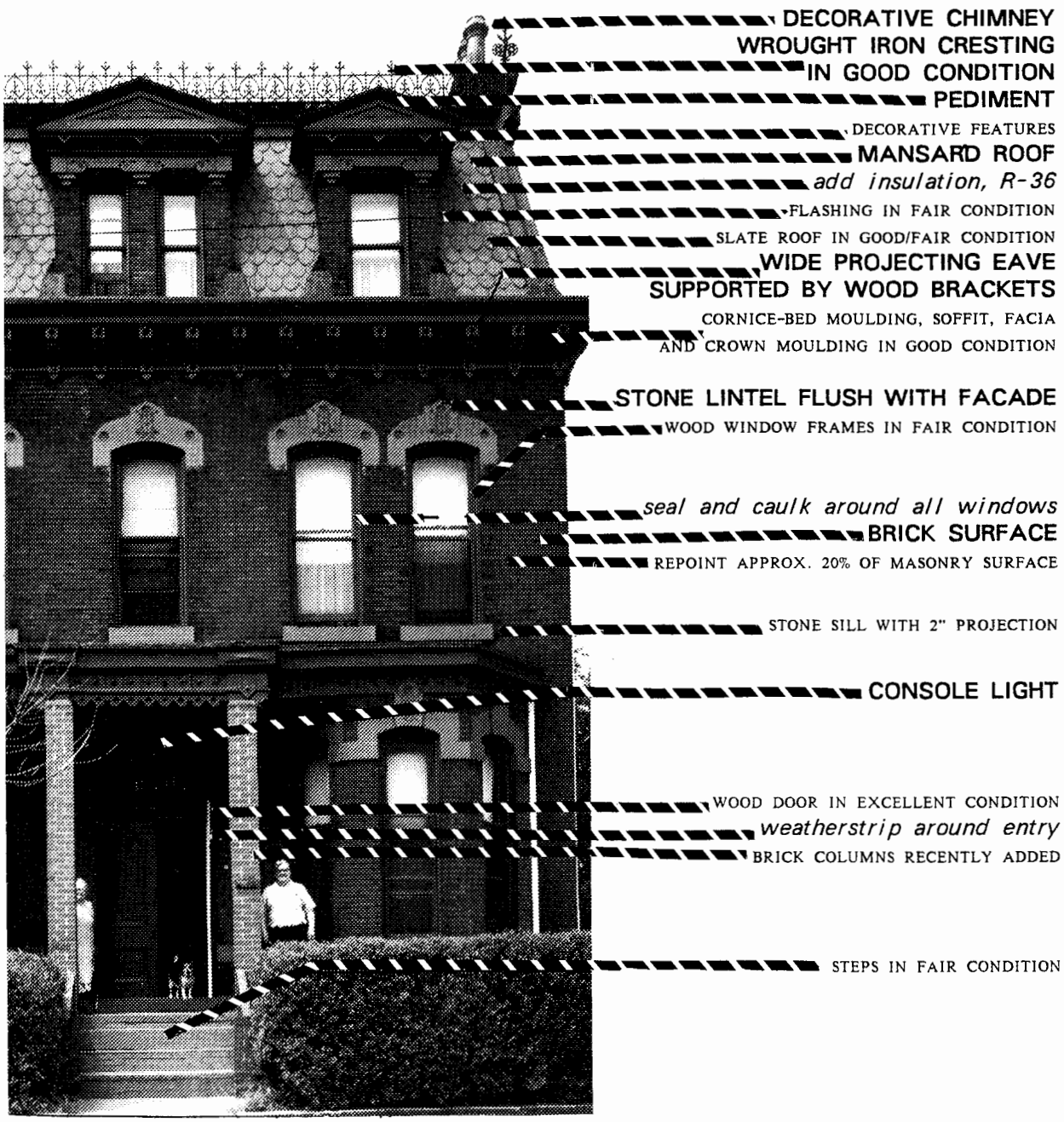


1226 SHEFFIELD

DESCRIPTION:

This brick structure, with a fishscale designed slate mansard floor, is forty (40) feet high, thirty-five (35) feet wide and approximately seventy (70) feet long. The lintels above the windows are constructed of stone and rest flush against the building's facade. However, the stone sills protrude approximately two (2) inches beyond the building's facade. This feature gives the windows the same projection and depth. This building is presently occupied and the interior spaces are in good to excellent condition which mirrors its exterior appearance. The columns holding the roof of the front porch are the only architectural elements which are not original. Excluding the basement, the building contains approximately 4600 square feet.

ARCHITECTURAL ANALYSIS:

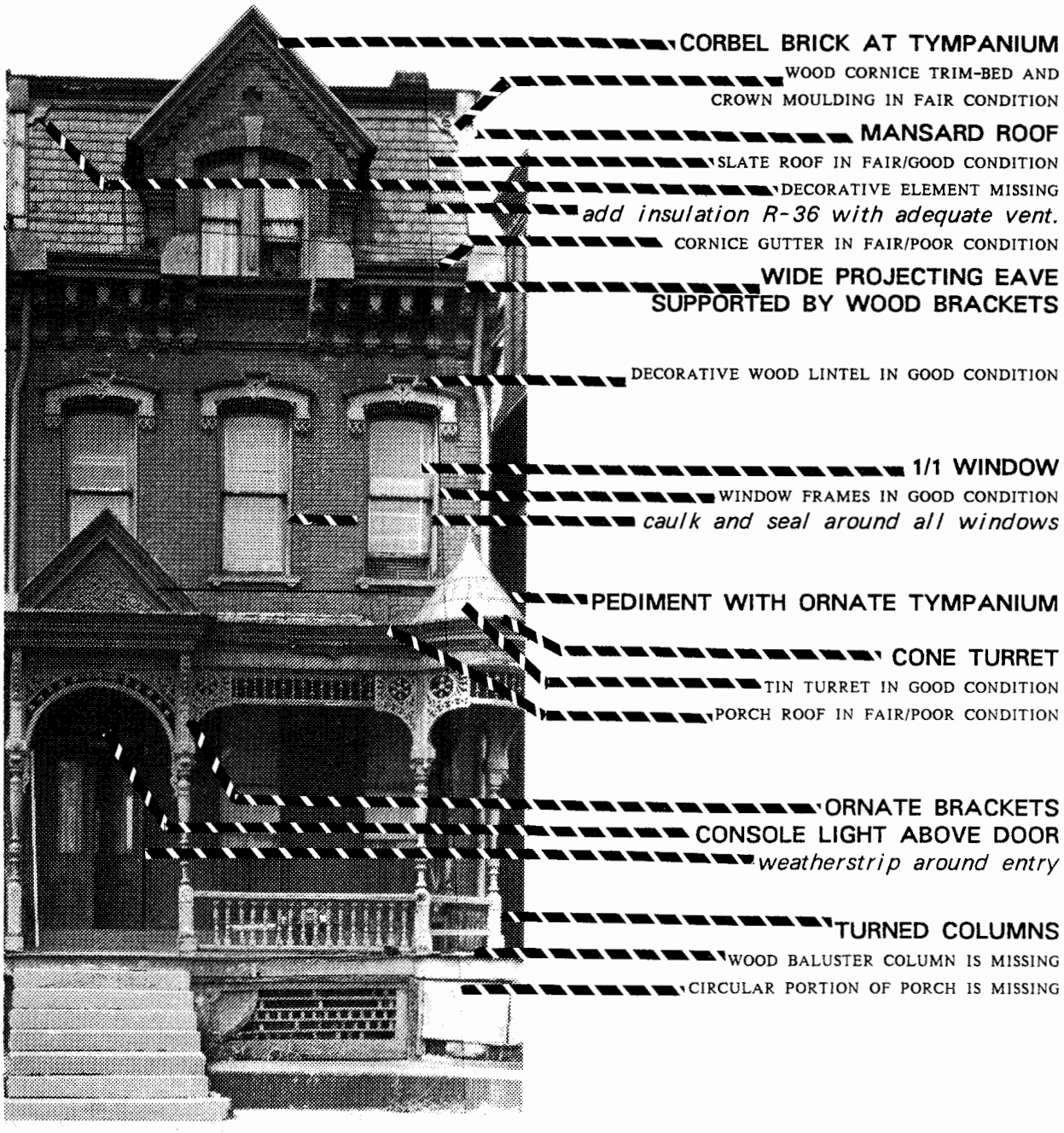


1230 SHEFFIELD

DESCRIPTION:

This building is a 2½ story brick structure approximately forty (40) feet high, twenty (20) feet wide and eighty-one (81) feet long. The lintels and sills which adorn the windows are constructed of wood, which extend approximately 2 inches beyond the face of the wall, and are highly decorative. The single dormer, which punctures the center of the mansard roof, has a steep gabled pitch with an integrated corbeled brick design. The front porch is very ornate in design that is reminiscent of the Eastlake style of architecture. The building was recently vacated and therefore has not been vandalized extensively. Excluding the basement, the building contains approximately 4800 square feet.

ARCHITECTURAL ANALYSIS:

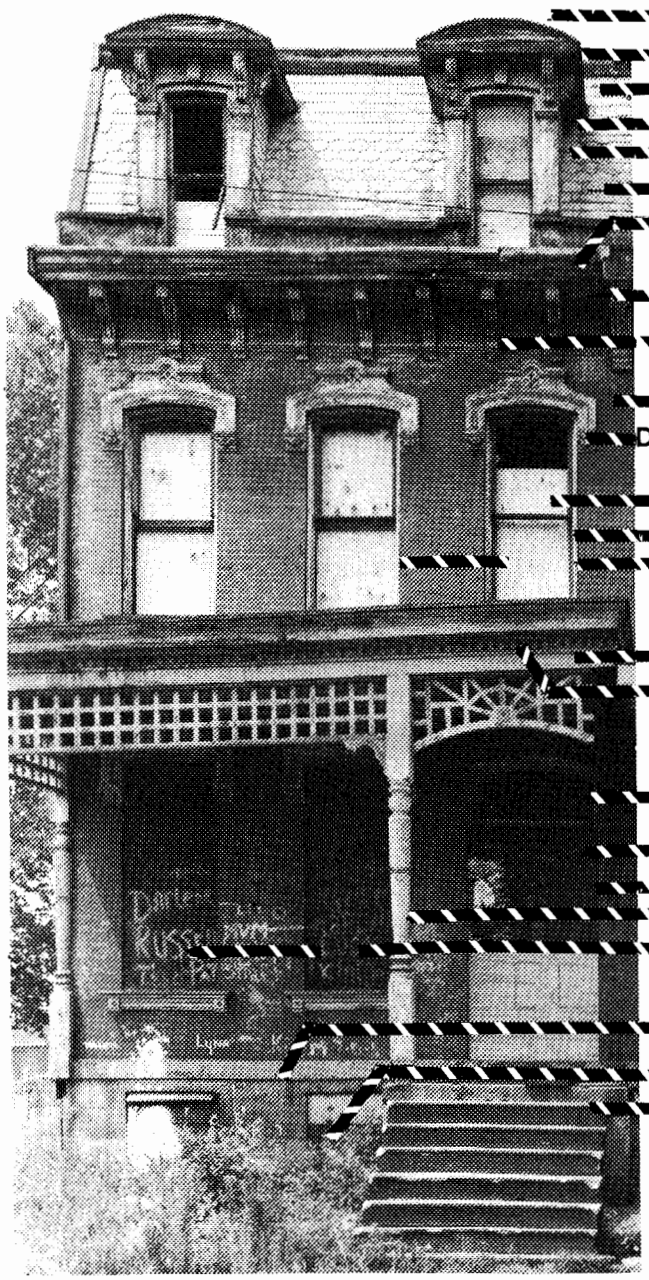


1232 SHEFFIELD

DESCRIPTION:

This building is a 2½ story brick structure approximately forty (40) feet high, twenty (20) feet wide and seventy-five (75) feet long. The windows, which encompass more than 20 percent of the front facade, have brightly decorated lintels and sills. Constructed of wood, these architectural elements are Italianate in form and extend approximately 2"-3" beyond the face of the wall. The two dormers, which puncture the slate covered mansard roof, reflect the Beaux-Art's style. The total square footage of the building (excluding the basement) approaches 4500. The building is basically structurally sound. However, interior portions of it have been somewhat vandalized. The major items which are missing are: windows, wood trim, plumbing, fixtures, copper water lines and fireplace mantels, some of the plaster has deteriorated and has fallen from the walls and ceilings.

ARCHITECTURAL ANALYSIS:

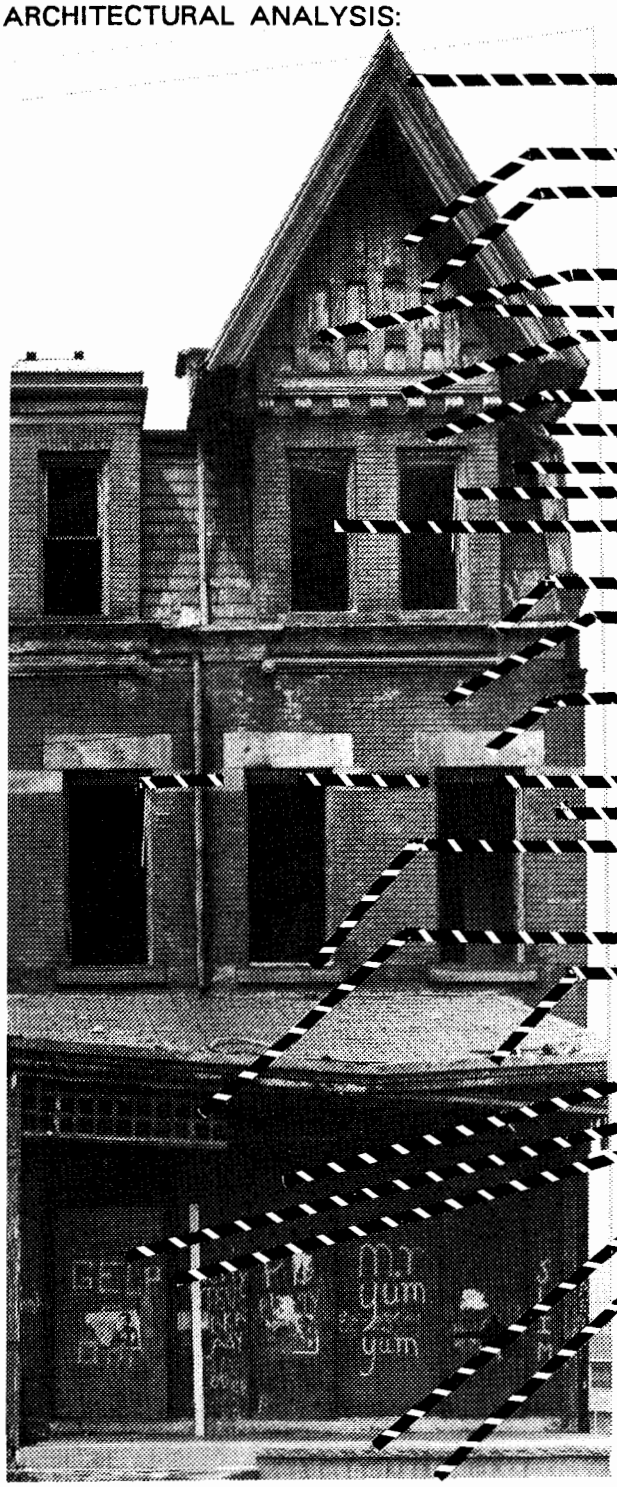


1244 - 1246 SHEFFIELD

DESCRIPTION:

This building is a three (3) story brick structure approximately fifty (50) feet high and twenty-two (22) feet wide and seventy-three (73) feet long. The windows, which encompass almost 20 percent of the front facade, have a flat undecorated trim, stone lintels and sills of a simple design. The mansard roof which adorns the front facade is constructed of mono-chromatic slate. The total square footage of the building (excluding the basement) approaches 4500. As of this date, this building has not been extensively vandalized. Some of the major items which are missing are: windows, wood trim, plumbing fixtures, copper water lines and fireplace mantels. The structural condition of this building is rated good to fair.

ARCHITECTURAL ANALYSIS:



3. CONSERVING ENERGY IN HISTORIC BUILDINGS RETROFIT DETAILS

GENERAL CONCERNS

The historic structures in the Manchester neighborhood are in varying conditions of decay. Some buildings have been vandalized and set afire while other structures are occupied and are in fair-to- good condition. Therefore, the degree of rehabilitation required to make each structure an energy-efficient, habitable space varies considerably. Those requiring extensive rehabilitation due to vandalism and/or fire have lost a significant amount of historic detailing. This affords the designer a greater opportunity to install extensive energy conservation items before he replaces historic details. For example, a wall requiring replastering can be insulated before it is replastered and decorative moulding is applied; or new triple-glazed windows can be installed where the original single glazed windows have been lost with insulation placed in the wall cavity adjacent to the window jambs.

Those buildings which are in fair-to-good condition must be made more energy efficient by "incremental" retrofitting measures which are unobtrusive to the historic character of the building. For example, insulate the attic space, caulk the existing door and window frames with a material whose color and texture complements the existing conditions, or add storm windows which are consistent in detailing and color with the existing window.

In general, successfully accommodating energy conservation concerns and historic preservation guidelines can be more challenging in retrofit conditions because a majority of the historic detailing remains and is in good condition and must be retained. The designer's tasks becomes more difficult in his attempt to successfully integrate modern energy efficient elements into a pre-established historic milieu.

PITTSBURGH CLIMATE

Manchester, located within the City of Pittsburgh, is situated at the foothills of the Allegheny Mountains. Pittsburgh has a humid climate influenced by a polar continental air flow generally coming from Canada. Frequent invasions of air from the Gulf of Mexico create warm humid spells during the summer. The summer months normally reach an afternoon high of 85-90 °F. in July and cool to 65-70°F. in the evening. The January temperature, normally considered the coldest month, ranges from an afternoon high of 30-34°F. to an evening low of 10-0°F.

Winter humidities are very high. In the summer, however, the relative humidities in the afternoon rarely exceed 60 percent except during rainy periods.

Northwest winds from across the Great Lakes bring in cloudy and rainy weather. Thunderstorms occurring in the summer are capable of dumping up to 3.5 inches of rain in 24 hours. During the winter months, about a fourth of the precipitation occurs as snow. The first snow generally falls in late November and the last snowfall occurs in early April. Snow can accumulate up to 15 inches in 24 hours.

Spring and fall winds vary greatly in direction and wind speeds. Storm winds are primarily westerly. Higher wind speeds (7 m.p.h. or greater) occur during the day while calm periods occur from 1:00 to 7:00 a.m. Summer winds have a west and west-southwest direction and are normally less than 6 m.p.h. during the afternoon hours. Winter winds show a definite northwest

bias. There are a few periods of calm wind conditions with the highest wind speeds occurring during the day.

An important climatic factor of a region is its number of degree days. Degree days are determined by subtracting the average daily temperature from a base of 65°F. This number is calculated for the heating and cooling periods. For Pittsburgh, the values are 5930 (heating degree days) and 647 (cooling degree days) based on a record period between 1941-1970. This indicates that the Pittsburgh climate has a rather prolonged heating period while a very short cooling one. By comparison, Anchorage, Alaska has 10,780 degree heating days and 0 cooling days.

The relative high number of degree days for the Pittsburgh climate suggests that buildings in the Manchester neighborhood should be weatherized to reduce heating costs during the winter months as opposed to spending large amounts of money to cool it during the relatively short summer season.

INHERENT ENERGY CONSERVATION BENEFITS OF HISTORIC BUILDINGS

In 1979 the Advisory Council on Historic Preservation published a study which contained formulas to measure the energy needed to restore and rehabilitate existing buildings. The study also investigated the energy needed to demolish existing structures and replace them with equivalent new buildings. In general, renovation of existing structures instead of building comparable new structures results in impressive energy savings. The study demonstrated that the built environment represents a major energy investment.

The embodied energy, for materials and the construction process, of all the existing buildings in the United States is equivalent to the entire world's energy output for about 2 years. Other important factors which this study highlighted are:

- Constructing new buildings, and the associated processing and transporting of materials, represents about 5 percent of our annual energy consumption.

- Preservation of existing facilities, in general, is less costly than demolition and building anew and is therefore more cost effective for the developer.

- Replacing existing buildings with new structures requires additional energy to be consumed in the demolition process.

- Rehabilitation of existing buildings requires much less initial investment of energy than constructing comparable new facilities. For example, it requires 14,300 BTU's of energy to make one standard size brick.

- Properly rehabilitated buildings utilizing comprehensive energy conservation measures, will consume about the same amount of energy as a new structure built with standard conservation measures.

When beginning the actual task of designing retrofit measures to make historic buildings more energy efficient, it is important to remember some of the following facts:

- Because energy was inexpensive, generally those structures built between 1940 and 1970 were not designed to maximize energy conservation.

- Older buildings have a well developed sense of physical comfort and maximize the natural sources of heating, lighting and ventilation.

- The historic townhouse residences in the Manchester District have a glass-to-wall ratio of less than 25% and are designed to provide adequate light and ventilation. This ratio is typical of most buildings designed in this vernacular in the northeastern United States. This approach differs from the design of some modern buildings where the percentage of windows to wall area can approach 75 percent. In general, the higher the percentage of windows on a building's facade, the less energy efficient it is because of the greater potential for heat loss in the winter and heat gain in the summer.

- Walls of large mass (i.e. brick and stone) have a high thermal inertia which lengthens the period of heat transmission.

- Historic buildings in warmer climates were built to minimize heat gain by utilizing: a.) operable windows, b.) exterior balconies, c.) porches, d.) wide roof overhangs, e.) shade trees, f.) awnings, g.) living space on the second floor to catch breezes and escape the radiant heat from the earth's surface, h.) exterior walls painted light colors.

- Colder climate historic buildings were built to minimize heat loss by utilizing: a.) thick masonry walls, b.) minimal number and size of windows, c.) exterior walls painted dark colors, d.) vestibules at the main entrances to act as an air-lock.

- To minimize heat gain or loss from windows and control unwanted direct sunlight, historic buildings often included interior or exterior shutters.

GENERAL ENERGY CONSERVATION OPTIONS

Infiltration accounts for one-third to one-half of the heat loss of a residence. Therefore, sealing the house is just as important, and often less costly, as insulating. Some general rules for preventing air infiltration are:

- Because most infiltration occurs around windows, doors, and wall outlets, their seams and cracks should be caulked, sealed and/or weatherstripped. Because of the strong northwest winter winds in Manchester, it is important to pay particular attention to openings on the north and west elevations of the buildings.

- Caulking around the sill plate (the interface between the top of the foundation wall and the first floor joists) will substantially reduce infiltration. Up to 1,690,000 BTU's can be saved per year by sealing 100 linear feet of an 1/8th inch crack. Many Manchester structures have sill plates exceeding 250 feet in length. Therefore, this option may significantly reduce the heat loss of these historic buildings.

- When using sheets of rigid insulation they should be placed tight against each other to reduce air infiltration between the cracks of the insulation.

- Maintain the integrity of the thermal shell and vapor barrier.

- Seal a wall or ceiling to prevent air infiltration from the living space side when possible. Sealing a warm surface reduces the entrance of warm, moist air into the wall.

- Seal all large cracks and holes in the exterior wall from the inside before adding insulation. It is usually easier to seal openings before insulation is added.

- A house built using standard construction methods and minimal insulation may lose its total volume of heated air almost twice an hour. This is the result of cracks and frame openings around windows and doors which are not weatherstripped or caulked. By caulking and sealing the majority of visible cracks and openings in a historic structure (ie., one constructed at least 50 years ago), it is projected that the air-changes per hour can be reduced to 0.75 and thus substantially reduce heat loss. Please note, 0.50 air-changes per hour is the level stated by government standards below which indoor air pollution may be a problem. Recent surveys[1] show that it is unlikely that historic structures can be made so air-tight that the air quality becomes unhealthful.

- Weatherstrip and seal around all doors and windows.

- Caulk and seal all holes and cracks (to achieve a 0.75 air-change per hour) throughout the building. Pay particular attention to electrical outlet boxes, light switches and heating ducts which puncture exterior walls. Eliminate electrical outlet boxes on exterior walls by integrating electrical raceways into the existing baseboards.

- Replacement windows should be double-hung wood frame, constructed with integral thermal-breaks. Removable, exterior wood frame storm windows should be added whenever feasible.

- Install insulating core doors for all exterior doorways only when not facing the building's public elevation.

Insulation restricts the flow of heat through the building envelope. The appropriate amount of insulation properly installed can substantially reduce the heating and cooling loads of a building. Some general rules for specifying and installing insulation are:

- Insulation should meet and overlap. Where possible, insulation should be continuous across wall studs and between walls and floors. Gaps between insulation will disproportionately increase the thermal losses.

- Moisture buildup in the insulation and framing materials must be avoided. This is achieved by installing a vapor barrier on the interior (warm) side of the wall, ceiling or floor.

- Install 12 inches of batt or loose fill insulation in the attic.

- Install 3½ inches of batt insulation and 1 inch of closed cell rigid insulation to exterior walls requiring substantial replastering. Where interior walls meet exterior, return rigid insulation a minimum of 16 inches on the interior wall when possible.

- Basement ceilings should have 6 inches of batt insulation when the basement space is unheated.

- When the basement is to be heated and a substantial amount of its wall is above grade, then the exterior wall should be insulated with a minimum of 2 inches of extruded polystyrene.

- Seal and insulate with 3½ inches of batt insulation all hot and cold air supply ducts located in unheated spaces.

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[1] see Old House Journal, September, 1981, pp. 197

- Apply moveable insulation on the inside face of the windows with a minimum R-value of 4. These should be designed so as to complement the existing architectural details around the window.

Solar Energy can provide additional energy savings only after air infiltration has been reduced and the structure has been properly insulated.

- The most effective heat gain elevation faces within 17° of either side of due south.
- To avoid overheating, introduce mass in the walls and floors.
- Solar features are generally not acceptable for historic facades which face the main street.[2]
- Domestic hot water is the only active solar system which is economical because it is utilized 12 months of year, rather than during the heating season. These systems, normally mounted on the roof, have the following advantages; they are difficult to vandalize, cast no undesirable shadows and are not visible from the street when properly designed.
- Increasing the glass area on the south facade permits the sun to enter and the warm interior space (direct gain system).
- Provide sufficient amount of massing (normally 100-150 lbs. of masonry per square foot of glass, or a 10" to 16" thick wall) to prevent overheating of the interior spaces in the direct gain system. The proper amount of massing will reduce the temperature differential between the daylight and evening hours.
- Direct gain systems are most often *net energy losers* if moveable insulation is not used.
- Use awnings and/or trees to shade the interior in the summer months to prevent overheating.

Important notes:

- polyethylene vapor barriers should be installed on the warm-side face of all insulated areas, with careful attention to maintain the integrity of the vapor barrier and to eliminate spacing between the seams. Some insulation already contains a foil vapor barrier. Consult the manufacturer instructions before installation.
- provide adequate cross-ventilation in all unheated attic and basement spaces to prevent the accumulation of moisture.
- all high moisture areas (ie., bathrooms, kitchens, laundries) should have exhaust fans with tight sealing automatic dampers which exhaust this air directly to the outside to reduce moisture buildup.
- never pack more insulation into a space than is recommended by the manufacturers.

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[2] See pages 15-22 Energy Conservation and Solar Energy for Historic Buildings: Guidelines for Appropriate Designs by Thomas Vonier Assoc., Inc., Washington, D.C., 1981

- placing too thick a layer of insulation between roof rafters will not allow the roof to properly ventilate.

- it is important to emphasize that the engineer and/or heating contractor work closely with the architect or contractor in order to assure a mechanical system compatible with the new energy efficient units. Under no circumstances should a system be designed and sized according to floor area.

By following these guidelines[3], the homeowner in a major rehabilitation project may expect potential energy savings as high as 63 percent over standard rehabilitation construction practices.[4]

Implementation of many of these guidelines results in more than economic benefits to the homeowner. Though difficult to quantify, improvement in the comfort of the occupant is a tangible result of many of these options.

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[3] Guidelines for other regions can be obtained from Douglas C. Peterson's "How to Save Energy in an Old House," p. 87, New Energy from Old Buildings, The Preservation Press, Washington, D.C., 1981.

[4] See Energy Conservation Guidelines, Volume II, Department of Energy Inner-City Case Study and Demonstration Project, Department of Architecture, Institute of Building Sciences, Carnegie-Mellon University, June, 1981, pp. 11 and Manchester Rehabilitation Project, H.C.R.S. Discretionary Grant 42-DG023 by Glance and Associates, 82 Pilgrim Road, Pittsburgh, PA, 15106, October, 1981, Chapter 19.

GENERAL RETROFIT DETAILS

The following details illustrate how the above guidelines should be applied to specific conditions.

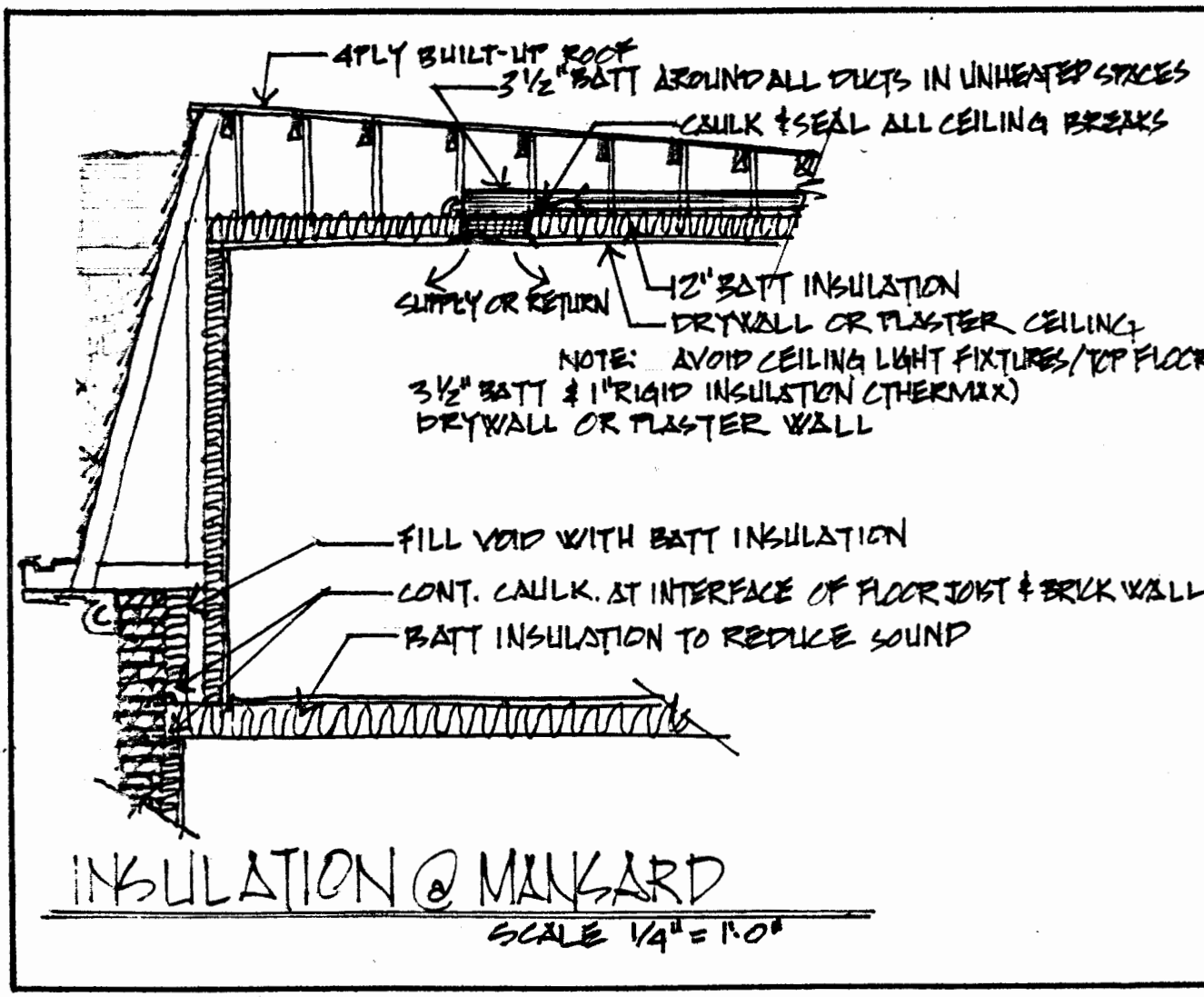
Attic Knee Wall Insulation

Install 9" of fiberglass batt insulation to wood frame knee walls at the third story level. If stud spacing is regular, foil or kraft paper faced batts (vapor barrier) may be stapled to the studs, with paper facing the room side. The existing wall surface must be removed to accomplish this. If the stud spacing is irregular, cut the batts to fit, being careful not to leave gaps. Six mil polyethylene sheets should then be used as a vapor barrier unless cuts in the insulation backing are patched or repaired.

Where the existing wall surface is to remain, the insulation can be installed from the unheated side. If an access door does not exist, cut one between two studs to gain access behind the knee wall.

Making sure that the vapor barrier side of the insulation is placed against the warm side. Do not pack insulation any denser than suggested by the manufacturer. This reduces its R-value. Allow a space for ventilation air to pass between knee wall space and the attic.

The floor beyond the insulated knee wall must be insulated just like the attic, overlapping insulation at floor/wall intersections and caulking intersections of materials.

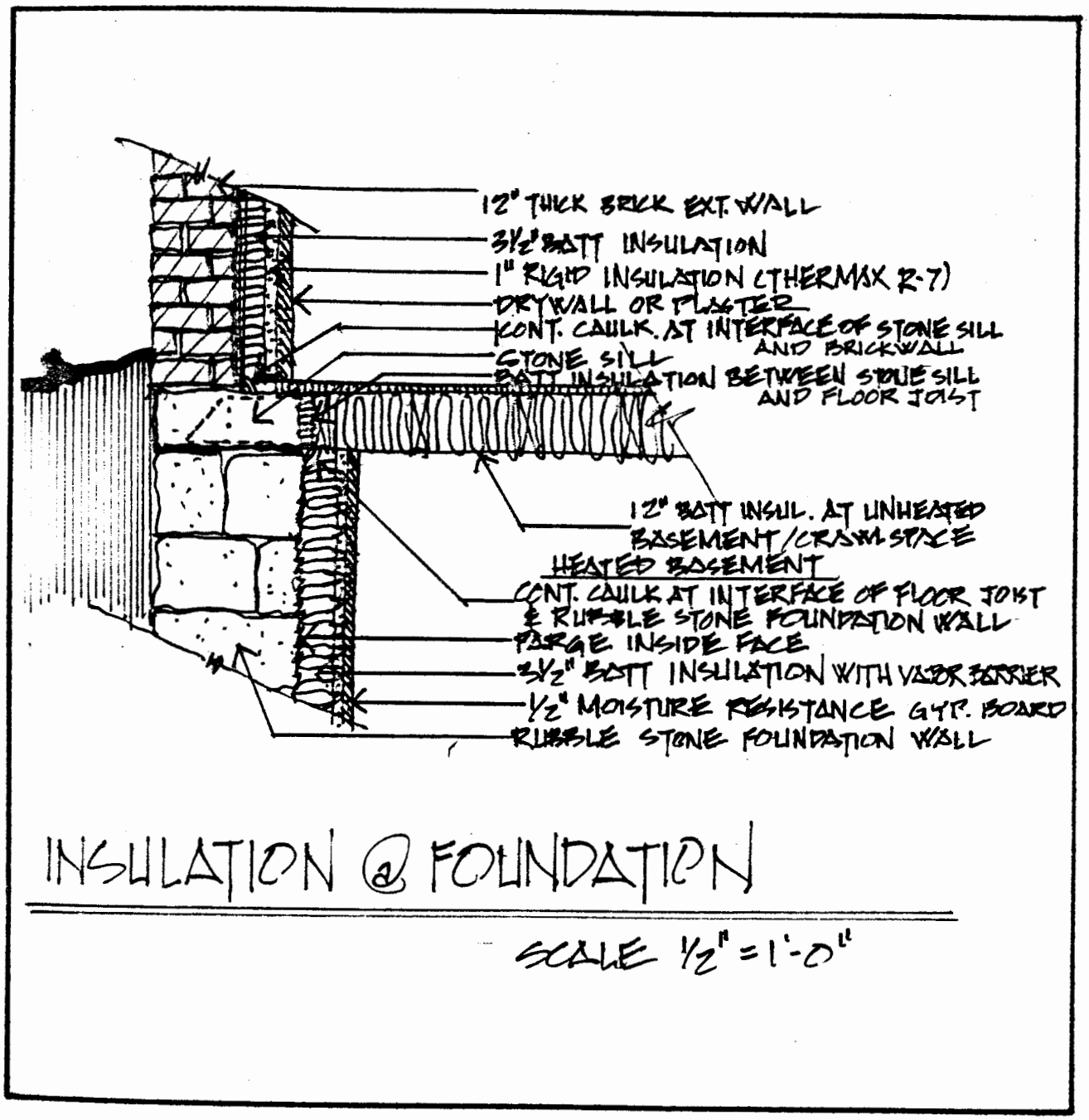


Foundation Walls

Pack compressed fiberglass into voids between sill plates and masonry wall. Seal smaller cracks. This method applies wherever a sill plate/masonry wall intersection occurs.

The frames and sash of basement windows should be caulked. Voids in the framing should be packed with fiberglass batt or sprayfoam. This applies to the framing and sill of basement doors as well.

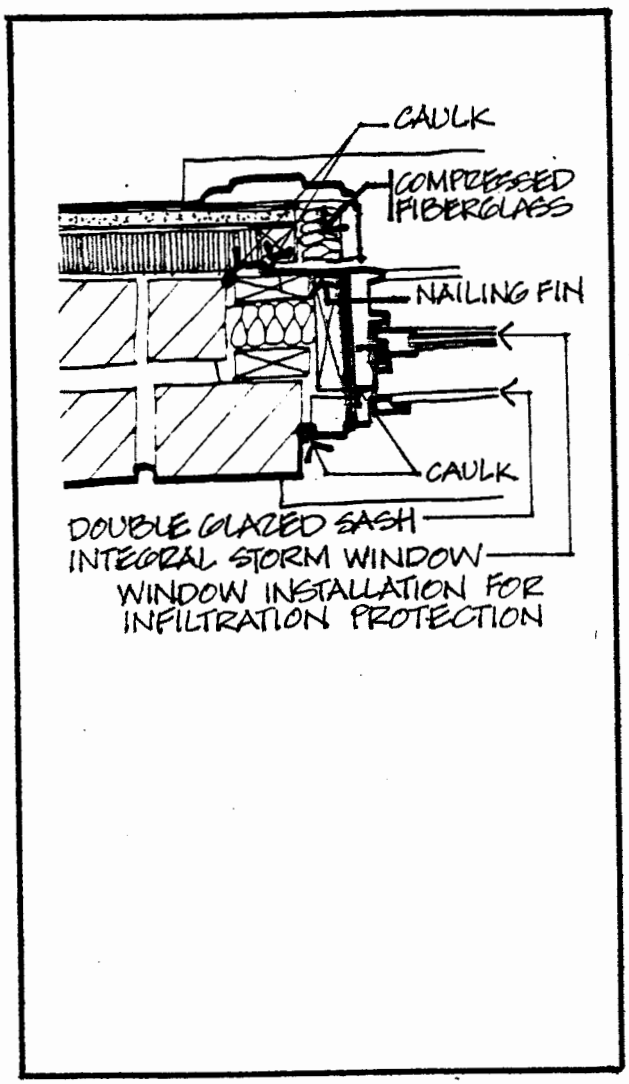
Holes and cracks in block or stone basement walls should be sealed. Pack larger holes with fiberglass batt or spray foam. Caulk smaller holes and cracks throughout. Also caulk and seal the sill plate at the first floor elevation. If possible, caulk the interior cracks at the base of the baseboard and floor before applying the final decorative wood trim below floor baseboards.

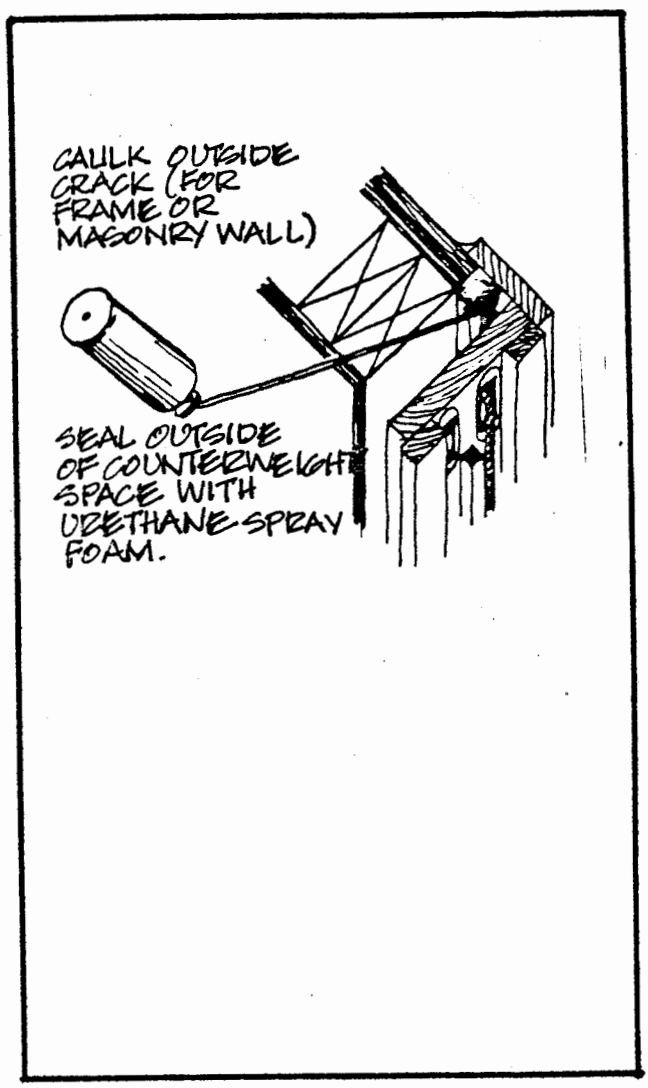


Existing Windows

When weatherizing an existing window, its frame should be investigated for air leaks by carefully removing the inside trim. Chains and counterweights on older windows require a space which allows air infiltration. By replacing this pulley system with an external spring pulley, the void may be packed with insulation and caulked tight without severely hampering window operation. Expandable urethane foam insulation in aerosol cans may be used to fill the void without completely removing the window trim.

Cracks in the exterior window trim should be caulked with a bead which fills the crack and spans the exterior materials. Any loose or hardened putty around individual panes should be removed and replaced with glazing compound, which matches the form of the original putty. Cracks and holes in the window pane of an occupied house should be taped over securely until the pane can be replaced. Existing windows which are not replaced should have weatherstripping placed on all moving joint cracks.[5]





[5] See Preservation Briefs: 9, Technical Preservation Service Division, Office of Archeology and Historic Preservation/Heritage Conservation, and Recreation Services eds., U.S. Government Printing Office, Washington, D.C., 1981 for a more detailed discussion on the repair of historic wooden windows.

Replacement Windows

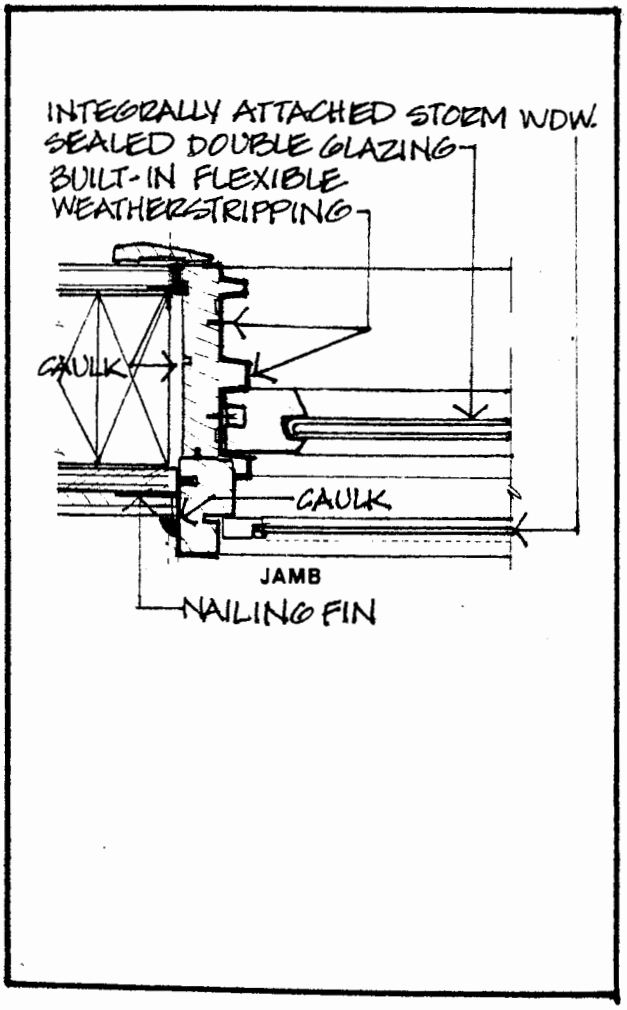
Good quality replacement windows should have built-in flexible weatherstripping which eliminates air leakage through gaps between the window sash and frame. This is particularly important for double-hung windows which have greater crack length and less effective locking mechanisms than casement windows. A nailing fin which attaches to the inside or outside of the frame and helps decrease frame infiltration is another important feature.

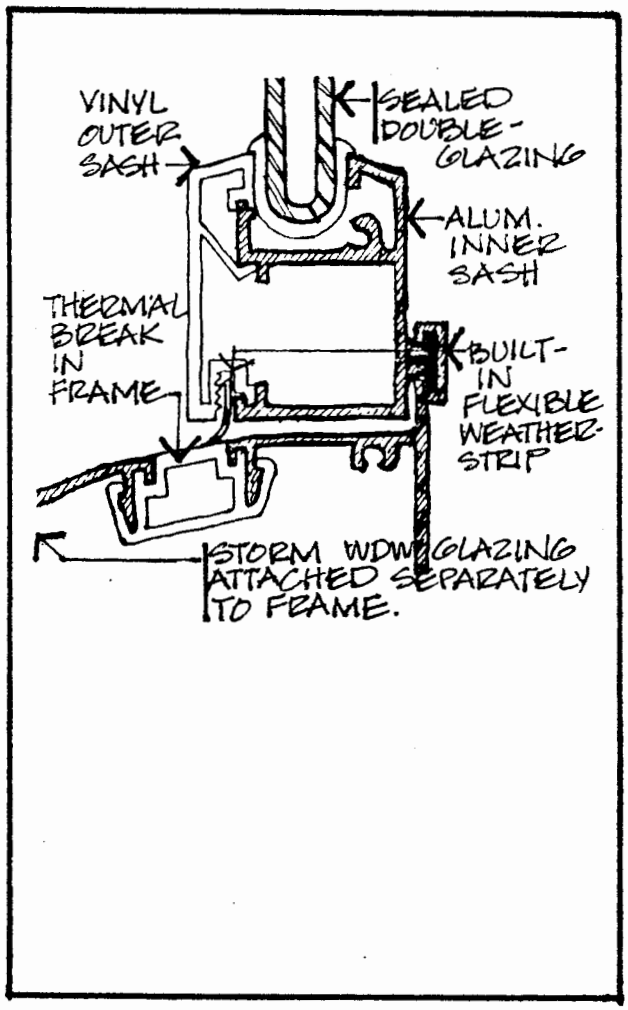
If possible, all replacement windows should be constructed of wood. If aluminum windows must be used they should be of thermal break construction. This means that the exterior and interior of the metal frame and sash are separated by a material with a lower thermal conductance. Conductive heat losses are then minimized through the frame.

All windows to heated spaces should have triple glazing unless night insulation is used. Most manufacturers make a triple glazed wood window consisting of a hermetically sealed double glazed window with an optional storm window attached.

Caulk joints when replacing windows. New replacement window frames should be set in a full caulking bead, with any empty spaces in the framing filled with spray foam or packed fiberglass. Replacement windows should be selected which have a nailing fin which eases installation and reduces infiltration. Window frames should again be sealed and insulated to the finished wall before window moldings are added.

Insulating shades or shutters with tight edge seals reduces window infiltration for new or existing windows on the inside face of the window.





Moveable Insulation

A double-glazed window has insulating properties of R-1.7.[6] Windows are a major source of heat loss when compared to a well insulated wall which may have an "R" value of 30. Improving the thermal performance of windows by triple-glazing only improves the R value to 2.55.

One of the most important ways of reducing heat transfer through windows (after they have been properly sealed and thermal breaks installed between exterior and interior facing materials) is to install moveable insulation on the inside face of the window. The general types of night insulation currently available are:

- pop-in shutters: this is rigid insulation in a frame usually removed during the day
- thermal curtains and shades: infiltration resistant fabrics or film filled with fiber insulation and containing special edge seals
- hinged or sliding shutters: rigid panels are hinged above the window or on sliding tracks on either side of the window[7]

To maximize their efficiency, moveable insulation should:

1. be sealed along the edges, top and bottom to prevent convection currents
2. be reflective
3. have an R value of 4 or greater
4. be non-permeable to prevent water vapor from penetrating[8]

This energy strategy will not conflict with the Secretary's Guidelines (if properly installed) because they are located on the inside face of the window, can be designed to harmonize with the existing architectural detailing and are only engaged during the winter evening hours.

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[6] The "R" value is a unit of thermal resistance used for comparing insulating values of different building materials. The higher th "R" value of a material, the greater its insulating properties.

[7] See Thermal Shutters and Shades by William A. Shurcliff, Brick House Publishing Co., Andover, MA. for a detailed discussion o moveable insulation.

[8] See The Well-Tempered House: Energy-Efficient Building for Cold Climates by Robert Argue, Renewable Energy in Canada, Toronto Canada, 1980.

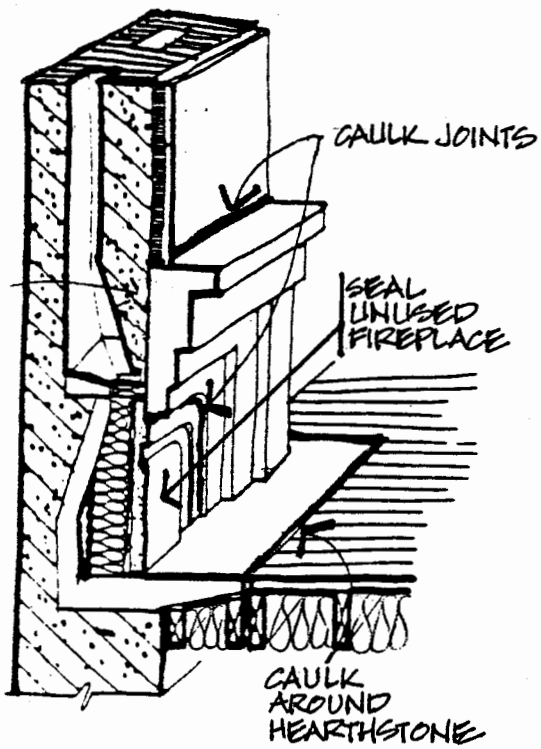
Fireplaces

Fireplaces are generally heat losers. They utilize warm air for combustion. It is therefore recommended from an energy saving perspective that dampers of the fireplace be closed and insulated thereby making it inoperable.

If the fireplace is to remain operable, it is recommended that a new tight fitting damper be added, in addition to the installation of recirculators and a tight fitting glass cover. Consider using outside air for combustion.

Pack and caulk around the joint of the hearthstone with flooring material. Caulk intersections of frame walls and masonry or stone fireplaces after packing any voids between.

If the fireplace is not going to be operable, it is recommended that the mantel and associated architectural detailing be retained but the flue be sealed and insulated at the damper location. All of the cracks and joints normally caulked should also be undertaken.



Heating Zones

Create separate heating zones for apartments with different heating requirements. Long, nar apartments should be divided into separate zones corresponding to general living, sleeping, occasional use zones. Each zone should be controlled by separate timed thermostats which the zone according to the period of use.

Zones used during the day should be placed close to the southern end of the apartment to advantage of natural light and solar heat gain if possible.

Double story apartments may also be zoned by floors, although vertical heat transfer from to second floor rooms is more difficult to control than horizontal thermal flows.

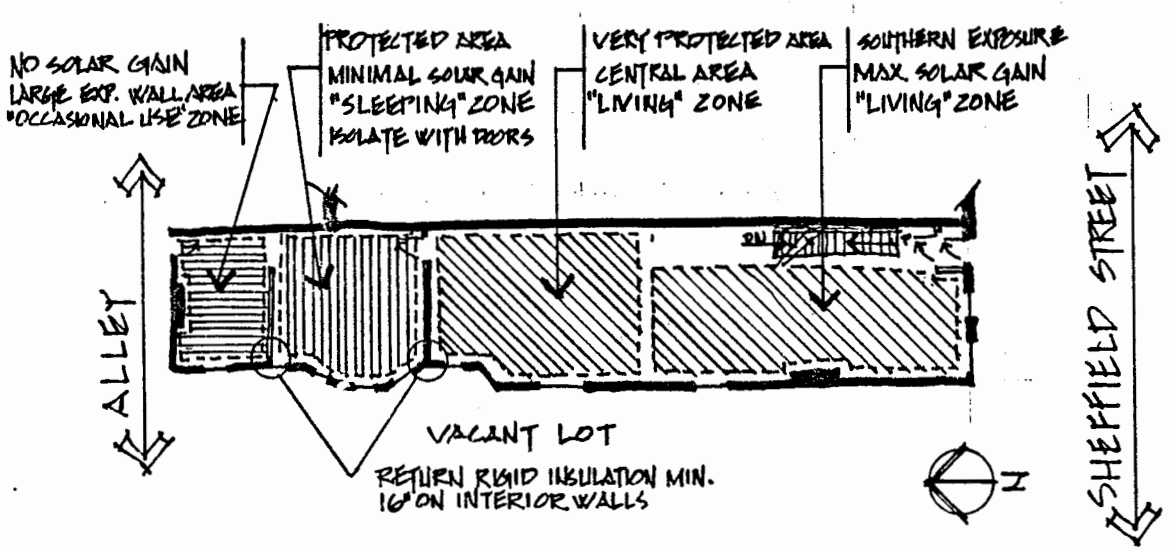
The three zones are broken down by rooms in the following manner:

1. Living zone: includes living room, dining room, kitchen, den, and possibly a playroom and a family room and circulation spaces.

2. Sleeping zone: includes bedroom, bath and circulation spaces.

3. Occasional use zone: includes basement, laundry room, mechanical rooms and storage.

Separation of zones is accomplished by providing tight-fitting or weatherstripped doors bet zones defined by full walls. Horizontal separation of floors is aided by sealing floor and ce cracks and by providing low velocity fans to re-circulate heat which rises from the first floo



Sunspace Addition

A permanent or temporary glazed enclosure may be constructed on an existing porch as a sunspace to provide supplemental heating to the living space. To use the sunspace as a solar collector, it must be isolated from the living area except when conditions are favorable for solar gain. The sunspace can contain sufficient mass to keep temperature swings to a minimum or all excess heat may be allowed to enter the house by way of the existing windows and possibly assisted by fans for better circulation of heated air.

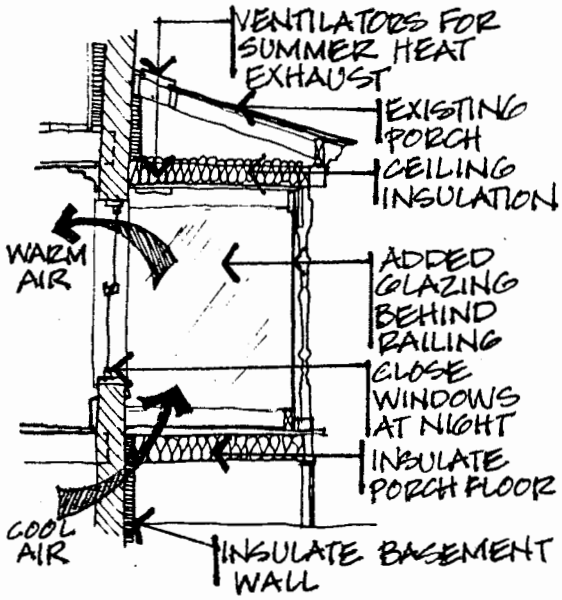
The sunspace should have its unglazed surfaces well insulated. The glazing should optimally be located only on the south wall, but east and west glazing can be used in moderation.

Warm air can be vented into the house through existing windows and return air may be drawn from the basement or through the bottom of a window. Mullions for the glazing material should be minimal and not overly obtrusive. The glazing material should have two layers.

Retrofitting or rehabilitating an existing porch into a sunspace can be much less expensive than building a new one, particularly when the new porch design must meet strict historical design criteria. Sunspaces are not cost-effective solely as a means of heating, but have tangible benefits such as a sunny living space which can be used as a spare room. Construction of a complete new sunspace is roughly the same in cost per square foot area as new construction but will vary according to design features. Glazing should be placed behind the historic details of the porch (ie., handrail, balustrade) to minimize its impact on the historic character of the building's facade.

Porches of major architectural significance should not be enclosed. Minor porches, usually on the side or rear elevations, may be enclosed if they face south.

Of the three options presented (sunspace addition, roof collectors, window box collector) this one is the most cost effective. Another attractive feature of this option is that it provides the occupant additional living space through the winter months.

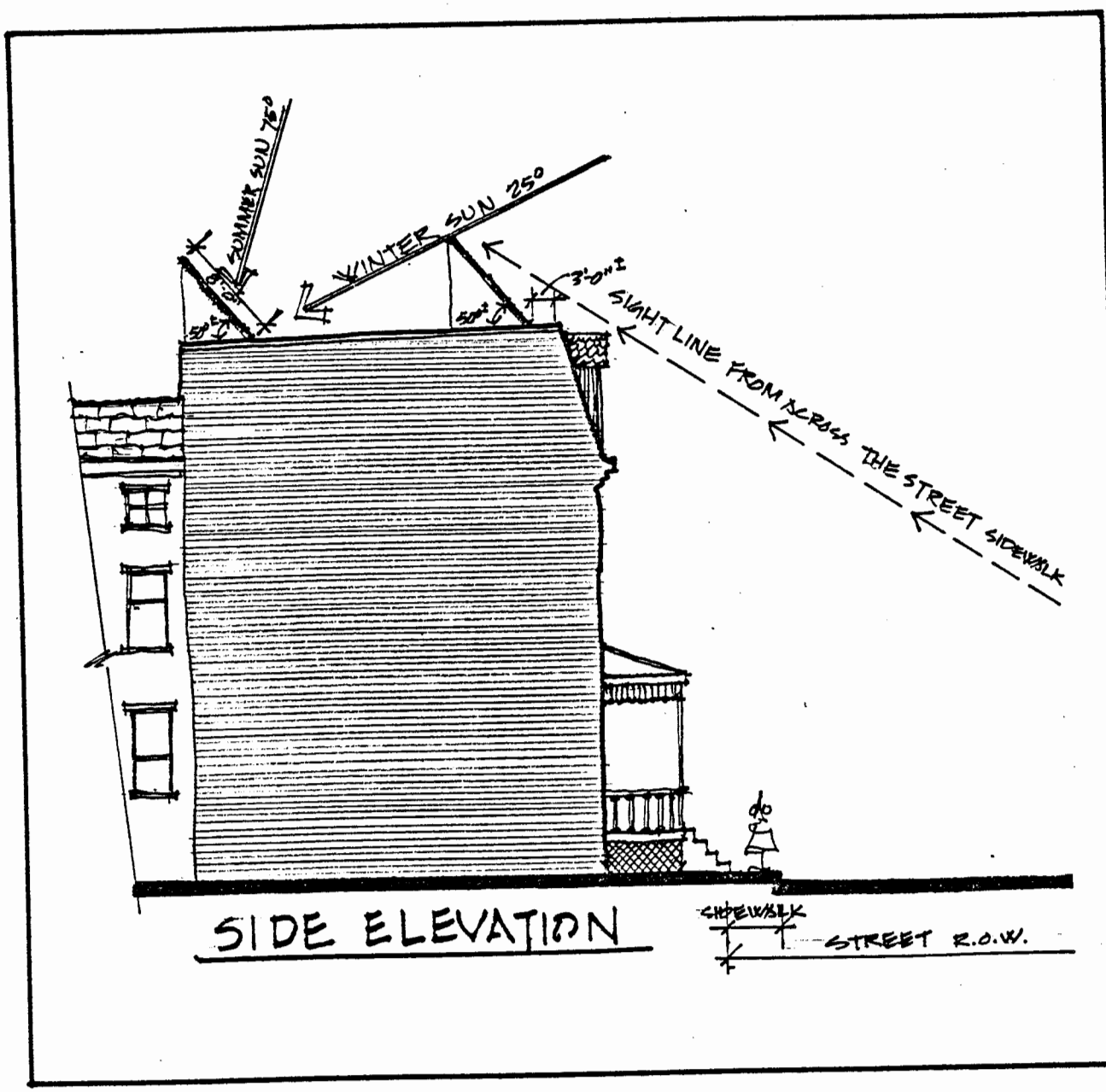


Roof Collectors and Skylights

Solar collectors can be placed on the roof of the existing buildings. The collectors may be used for heating domestic hot water or to supplement space heating. The main criteria for placing collectors on the roof of a building which was not intentionally designed to accommodate them is that they do not detract from the appearance of the historic building and that they are installed at the proper orientation and angle.

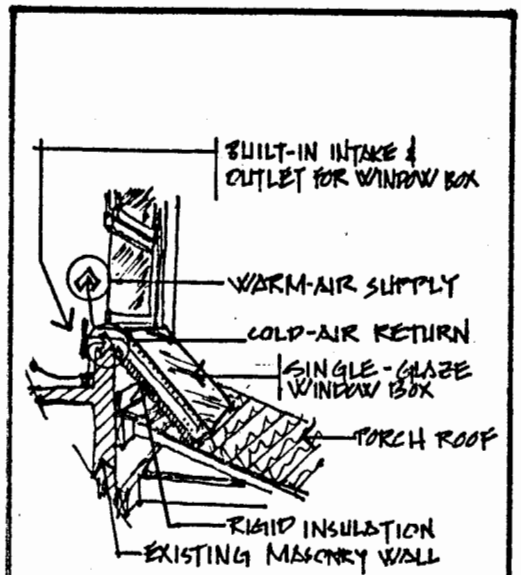
Other means of introducing solar gain into units on the top floors call for punching through the existing roof structure with skylights or clerestories. Rules for proper orientation, winter insulating and summer shading and venting must be followed in order to make the skylight an energy efficient addition rather than one which causes greater heating and cooling loads.

The general rule-of-thumb for sizing a roof collector are: 20 square feet of collector per person, 1.5 gallons of hot water storage (normally located in the basement) per square foot of collector; the angle of the collector to the roof plane should fall between 45 and 60 degrees.



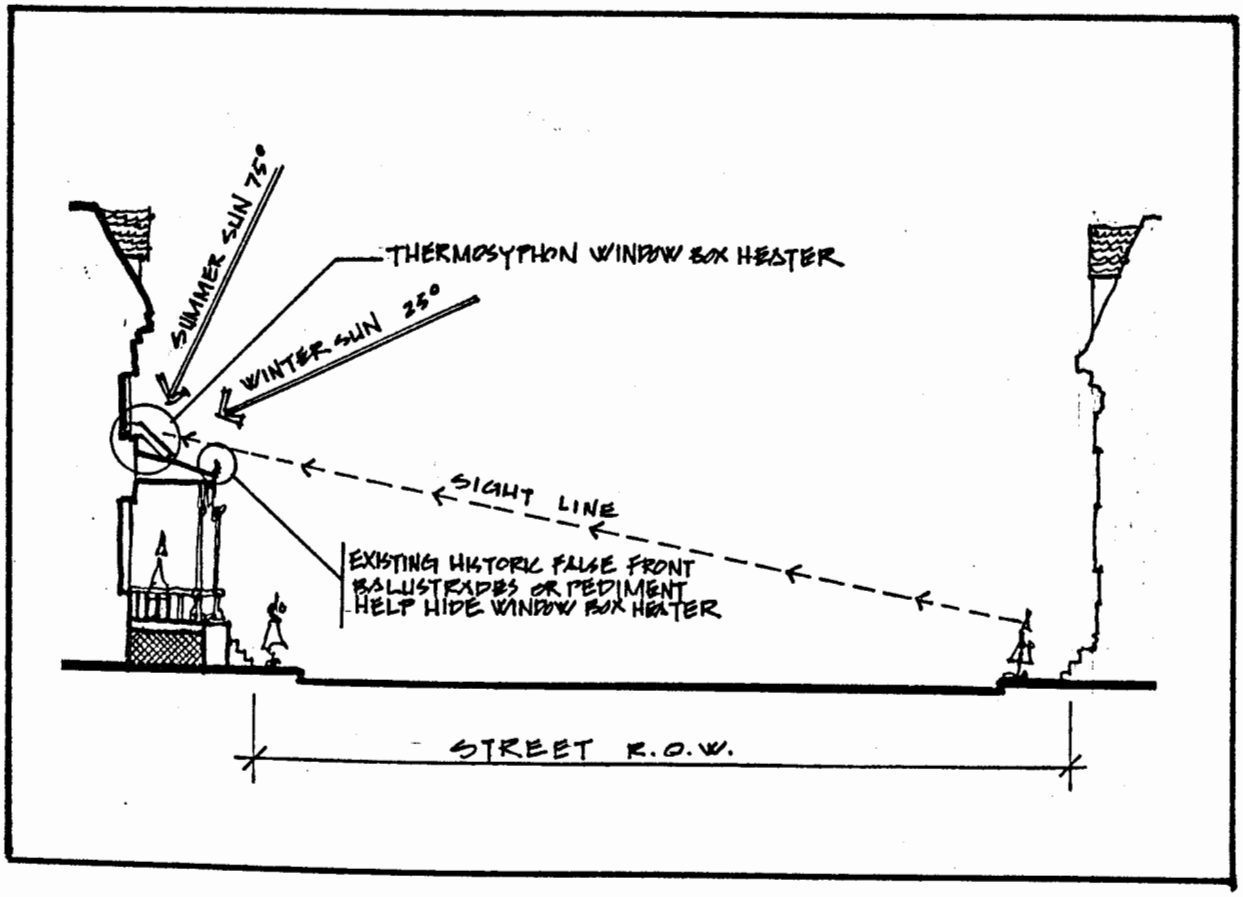
Thermosyphon Window Box Collector

Thermosyphon collector panels for the second floor unit may be built over the front porch roof. The angle at which the collectors are mounted depends on the available height of the window sill from the roof and the size of the thermosyphon panel. A steeper angle of 50 degrees is preferable but lower angles are acceptable in order to conceal the collectors from the street. Air intake and outlet vents may be built into the existing window rough opening, with a smaller window replacement. Operable vents beneath the new window should be installed to control heat gain and closed in the evening to prevent night heat loss. The collector panels should also be vented so that they can be opened in the summer months to allow the warm air collected in the panel can be vented to the outside.



Because of its potential adverse visual impact, this strategy has limited application on the main facade unless the inclination of the porch roof is shallow and/or its architectural detailing along its edge (i.e. balustrade) is of sufficient height to hide it from street level. Its use on rear and side elevations would present fewer conflicts with the Secretary's guidelines.

Of the three solar options presented, this one is the least cost effective.



ENERGY OPTIONS FOR THE SHEFFIELD STUDY AREA

1. The front facades of the Sheffield buildings face south. Because of the historic setting of the buildings and profusion of architectural detailing, the elevations cannot be substantially altered to accept active or passive collection systems.

2. Passive collection systems (sunspaces and window boxes) for the front facades must be scaled-down and integrated into the existing architectural motif to not conflict with the historic character of the building.

3. Active collection systems can be placed on the roof and not be visible from the sidewalk across the street if they are recessed 3 feet from the front roof line. Such systems should have a slope between 40 and 50 degrees and not exceed 8 feet in length or 5 feet in height.

4. Front porches can be converted into sun-spaces without destroying the historical character of the building if the glass is placed on the inside face of the architectural detailing and the new mullions are detailed to match adjacent detail.

5. The second story windows above the existing porch roof can contain solar window-boxes and not be detrimental to the historic facade and not be visible from the sidewalk across the street.

6. The buildings contain vestibules in the front entrances which perform as air-locks.

7. The rear entrances, which face the cold northwestern winter winds, do not have vestibules. However, vestibules can be designed for this area which can conform to the existing or proposed floor plan.

8. Because the exterior walls are solid masonry, one must place insulation on the interior face of the walls (the historic nature of the buildings prevents the use of exterior insulation). However, <u>if</u> the decorative wood wall paneling and the crown plaster moulding are in good condition, it becomes prohibitively expensive and difficult to install interior insulation. One possible solution would be to apply rigid insulation to the inside surface of the exterior walls and maintain a shadow grove of approximately 3/4 inch away from the existing decorative molding. It is recommended that the thickness of the insulation plus the finish surface (i.e. plaster, wood paneling) should not exceed the thickness of the neighboring trim mold. It is important to remember that an uninsulated 12 inch thick brick wall has an R-value of approximately 1.5. By adding 1 inch thick rigid insulation, the R-value approaches 8.

9. Windows should be enclosed only as a last resort (i.e. they are a safety or security hazard, or are located in the shower area of the bathroom). If they must be enclosed, the following practices are recommended.

    a. Do not enclose front elevation windows

    b. From an energy perspective, enclose north and west facing windows particularly if they face the side and rear elevations

    c. In bricking up an old window opening use brick which matches the existing brick and recess this new surface approx. 3/4 of an inch from the adjacent.

d. An alternative to bricking up the window opening (item "c") is to maintain the existing window while enclosing its inside face with wood studs and dry-wall. That portion of the new wall which faces the window should be painted black so as to read from the outside as a darken window. The inside face of the new wall - which covers the existing window - should be flush with the adjacent walls and be finished so as to be undetectable. This detail should be properly ventilated.

e. Moveable insulation can be used on the inside face of the windows for all of the elevations without destroying the building's historic facade and interior elevations.

10. Each building is detailed differently and therefore each has unique energy conservation design conclusions.

4. DESIGN GUIDELINES AND ENERGY CONSERVATION OPTIONS FOR NEW CONSTRUCTION IN HISTORIC DISTRICTS

DESIGN GUIDELINES

There are many different guidelines a designer should follow when designing in-fill housing in an historic district. The height of the new structure or its window placement and proportions are just as important as the selection of the exterior material. However, two of the most important issues most often overlooked by the design profession are:

1. Rhythm of the spacing of the existing buildings on the street.

2. Rhythm of solids to voids of a building's front facade.

Moving past a sequence of buildings, the rhythm of recurrent building masses (the building itself) and the spaces between them. This sequence of building rhythms is experienced much more quickly and in less detail by automobile than if one were walking the site. The sequence of solids to voids is part of the visual impression acquired while passing through an historic district.

Just as the streetscape has a rhythm sequence, so does each individual building. When passing an individual building, one may experience a rhythm of masses (walls) to openings (windows). The building's rhythmatic sequence is comprised of a horizontal and vertical arrangement. The horizontal element is concerned with the width of the doors and windows as they relate to the exterior walls. The vertical element is primarily concerned with the height of the windows and their relationship to the exterior walls in addition to chimney and roof projections.

An analysis of the entire Manchester neighborhood results in the following conclusions:

1. The window proportions normally have a height twice as high as they are wide.

2. The percentage of glazing falls within a range of 22 to 26 percent of the total square footage of the front facade.

3. The roof/dormers (i.e. slate mansard roof and incorporated dormers) encompass approximately 24 to 28 percent of the front facade.

4. The second story windows are normally 10 to 15 percent shorter than the first floor windows.

5. The third story windows are normally equal to or 10 percent shorter than the second story windows.

6. The horizontal spacing between the windows are equal to each other and are 25 to 50 percent larger than the end-wall massing (that solid space between the end window and the edge of the building as read on a horizontal plane).

7. The width of the main entrance doors is approximately twice the width of the windows.

New construction must be designed to fit into its historic neighborhood in addition to fitting into the fabric of the city as a whole. In general, design decisions must originate from the predominate skyline configurations and the massing of the buildings in the general area. Some of the important city wide three-dimensional qualities are:

1. Layout of the streets

2. The city edges shaped by a river or lake

3. Arrangement, size, and configuration of lots as determined by items 1 and 2 above

4. Placement of buildings on the lots

5. Scale and quality of open space which separates buildings

6. Groupings of highrise buildings

7. Rhythm of the street facade

After surveying the city-wide qualities of the region, a detailed analysis of the adjacent neighborhood must be conducted. These can be divided into the following characteristics:

1. Block quality

    a. rhythm of spaces between buildings
    b. front yard landscaping
    c. density
    d. arrangement for automobile parking; alleys
    e. scale of the street
    f. scale and texture of the sidewalk
    g. front yard setback

2. Building quality

    a. height to width ratio
    b. shape of the facade
    c. roof configuration

3. Building treatment quality

    a. color
    b. materials
    c. horizontal projections
    d. distribution of facade openings
    e. proportions of facade openings

4. Facade quality

    a. porch projection and rhythm
    b. entrance projection
    c. amount and type of detailing
    d. texture of the facade

The intent of these guidelines is not to "match" the adjacent buildings, but to undertake a systematic design procedure which will heighten the awareness of the historical context. It must

be emphasized that this design procedure does not foster the common notion that new and old shall have cosmetic similarity.

Historically, architectural styles were derived from five basic factors: climatic conditions, availability of building materials, current building technology, cultural traditions, and the building budget. Once the architect gains this knowledge, as he researches the above items, he is able to exploit it as he sympathetically designs his new building within a historic setting.

The Manchester Citizens Corporation (M.C.C.) was in the process of designing new in-fill housing on the Sheffield block within their neighborhood. MCC asked the consultant to develop a specific set of design guidelines for this block to ensure that the new buildings would compliment the adjacent historic structures.

The following summarizes this analysis:

1. The vertical and horizontal facade rhythms of existing buildings are all similar in scale and proportion. This factor should be recognized when designing the facade of the new building.

2. Two of the existing buildings are duplexes, while the remaining three structures are within a few feet of adjacency to each other. This building arrangement gives the appearance of a dense, row-house environment. New construction should therefore give the appearance of the same type of environment.

3. The existing structures have front porches which normally reach across their entrance facade. The newly constructed units should acknowledge this fact.

4. The existing structures are clustered in groups of twos and threes, thereby establishing a strong visual impression of the historic nature of the neighborhood. Because the visual impression is so strong as a result of this clustering, the designer for the new construction has a strong responsibility to be sympathetic and complimentary to this historic milieu.

5. There exists large expanses of vacant land between clusters of existing buildings. This affords the designer the opportunity to establish a clearly recognizable facade motif for his new structure.

6. Front yard setback lines vary in size for each of the existing buildings. The designer therefore is afforded a certain amount of latitude as he places his new buildings on the Sheffield Block. However, it is recommended that the front yard setback for new construction approximates the average setback line distribution previously established.

7. Wide eave roof projections are common on the existing buildings' to reduce heat gain in the summer months. It is recommended that the newly constructed units duplicate this design item.

8. Some of the existing structures have undulating facades as they pertain to their entrances. One facade is recessed in the center, (1226 Sheffield), while others are recessed at the buildings' edges (1222 and 1220 Sheffield). The designer may wish to incorporate this idea as he attempts to protect entrances from cold winter winds and hot summer suns.

9. Front facades of the existing structures, on the average, contain only 22-26% glazing.

10. In general, the width of existing structures are twice as high as they are wide. The newly constructed buildings should reflect this fact.

11. All the existing buildings are constructed of masonry. Newly constructed units should respect this choice of material.

12. The existing buildings have their main entrance door located on the right, left, or center of the buildings' facade. Therefore, the designer can make his door placement for the new buildings as determined by his building program. At the completion of the project, the Sheffield Block shall read as a streetscape containing small clusters of historically significant Victorian buildings intermingled with a large cluster of 20th Century structures whose height, material and facade rhythm compliment - but do not copy - its setting.

ENERGY CONSERVATION OPTIONS

Substantial energy savings can be realized if the architect is aware of some basic principles as he or she begins the design process. Outlined below are some of the major principles which should be incorporated at the beginning of the project:[9]

1. Increase compactness to reduce external (surface area) this can be achieved by clustering dwelling units vertically and horizontally into compact rowhouses. Build common walls - between the units - as long as feasibly possible with the front and rear facades as narrow as possible. When compared to free-standing dwelling units of comparable size, one can realize an energy savings of 10 to 18 percent.

2. Add significant amounts of insulation (walls R-25, roof R-37) and seal the exposed surfaces to reduce air-infiltration. Windows should be double glazed and contain "night insulation" of a minimum value of R-5.

   By following the above two recommendations (clustering units and super-insulating) one can realize an energy savings of almost 60 percent over standard construction. (i.e. single family detached with walls and ceilings containing an R-value of only 12 and 17, respectively)

3. Strategically open the building's south elevation to receive solar energy during the winter months. The solar gain is maximized if these openings are within $\pm 17^{\circ}$ of due south.

   Have a ratio of glass-to-wall area between 30 and 40 percent on the south elevation while the north elevation should contain no more than 15 percent glazing. This strategy of opening to building to the south becomes a net energy winner only if window insulation is used by the occupants during the night. To prevent over heating in the summer, provide exterior shades and have operable windows to facilitate cross ventilation.

   It is interesting to note that the case-study buildings located on Sheffield Street contain between 22 and 26 percent glazing on their front facade.

   Because the potential of solar energy to contribute to energy conservation is dependent on proper user behavior and is more limited and more costly compared to either building compactness or insulating and sealing the building envelope, the amount of

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[9] See Carnegie-Mellon University's study entitled Energy Conservation Guidelines for the Sheffield Block Development, Volume I, New Construction for additional information.

southern glazing should be determined by other than energy conservation factors. This holds particularly true when working in an existing urban context. Characteristics of the surrounding historic buildings as well as privacy, security, daylighting and human comfort and health considerations become the primary determinants for the amount and kind of southern glazing.

EXAMPLE DRAWINGS

INFILL



Designed by
Urban Redevelopment Authority
of Pittsburgh

NOTE: THE DRAWING ON PAGE 35 IS CONTAINED IN GUIDELINES FOR NEW CONSTRUCTION BY PITTSBURGH HISTORY AND LANDMARKS FOUNDATION, MANCHESTER CITIZENS CORPORATION, PITTSBURGH, PA., DECEMBER 1980.

5. CONCLUSIONS

Energy strategies were presented for two building types: major rehabilitation of existing historic structures and new construction. The case study determined that substantial energy savings can be realized without significantly increasing construction costs by incorporating these strategies in the beginning phase of design and by paying close attention to details.

Given normal construction practices[10] the following savings were achieved by incorporating the energy strategies:

Major Rehabilitation (63% energy savings)

Normal Construction	Proposed Energy Options
walls R-4	wall R-19
ceiling R-13	ceiling R-36
single pane windows	double pane window
	moveable insulation, R-4 minimum
	seal and caulk to achieve 0.75 air changes per hour
	TOTAL ENERGY SAVINGS 63%

New Construction (75% energy savings)

Normal Construction	Proposed Energy Options
single family detached	increase compactness
walls R-12	proper building orientation
ceiling R-17	south elevation, 30-40% glass
single pane windows	north elevation, 15-20% glass
	walls R-25
	roof R-36
	double pane windows
	moveable insulation R-4 minimum (windows, skylights, etc.)
	TOTAL ENERGY SAVINGS 75%

The case study also demonstrates that these energy guidelines do not conflict with the historic

[10] See Standard Housing Construction in Pittsburgh, PA by John E. Roth, Jr., Department of Architecture, Carnegie-Mellon University, Pittsburgh, PA, 1980.

character of the buildings or neighborhood and interfere with the designer's program if incorporated at the inception of the project. New in-fill structures can be successfully incorporated into an historic setting and be energy efficient. Finally, existing historic structures can be converted into comfortable, "energy savers" for their occupants without destroying their historic character.

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7. APPENDIX THE SECRETARY OF THE INTERIORS STANDARDS FOR REHABILITATION

DEFINITION FOR HISTORIC PRESERVATION PROJECT TREATMENTS

Rehabilitation

Is defined as the act or process of returning a property to a state of utility through repair or alteration which makes possible an efficient contemporary use while preserving those portions or features of the property which are significant to its historical, architectural, and cultural values.

GENERAL STANDARDS FOR REHABILITATION

The following standards apply to treatments undertaken on historic properties listed in the National Register.

1. Every reasonable effort shall be made to provide a compatible use for a property that requires minimal alteration of the building structure, or site and its environment, or to use a property for its originally intended purpose.

2. The distinguishing original qualities or character of a building, structure, or site and its environment shall not be destroyed. The removal or alteration of any historic material or distinctive architectural features should be avoided when possible.

3. All buildings, structures, and sites shall be recognized as products of their own time. Alterations which have no historical basis and which seek to create an earlier appearance shall be discouraged.

4. Changes which may have taken place in the course of time are evidence of the history and development of a building, structure, or site and its environment. These changes may have acquired significance in their own right, and this significance shall be recognized and respected.

5. Distinctive stylistic features or examples of skilled craftsmanship which characterize a building, structure, or site, shall be treated with sensitivity.

6. Deteriorated architectural features shall be repaired rather than replaced, wherever possible. In the event replacement is necessary, the new material should match the material being replaced in composition, design, color texture, and other visual qualities. Repair or replacement of missing architectural features should be based on accurate duplications of features, substantiated by historical, physical, or pictorial evidence rather than on conjectural designs or the availability of different architectural elements from other buildings or structures.

7. The surface cleaning of structures shall be undertaken with the gentlest means possible. Sandblasting and other cleaning methods that will damage the historic building materials shall not be undertaken.

8. Every reasonable effort shall be made to protect and preserve archeological resources affected by, or adjacent to, any acquisition, protection, stabilization, preservation, rehabilitation, restoration, or reconstruction project.

9. Contemporary design for alterations and additions to existing properties shall be discouraged when such alterations and additions do not destroy significant historical, architectural, or cultural material and such design is compatible with the size, color, material, and character of the property, neighborhood, or environment.

10. Wherever possible, new additions or alterations to structures shall be done in such a manner that if such additions or alterations were to be removed in the future, the essential form and integrity of the structure would be unimpaired.