

# Student Handbook For Architectural Design

COMPUTER AIDED DRAFTING DESIGN



**BUILDING CODES**

**THE DESIGN PROCESS**

**SPACE PLANNING WITH THE IRC (International Residential Code)**

**MEANS OF EGRESS**

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**INTERIOR FINISHES/MATERIALS**

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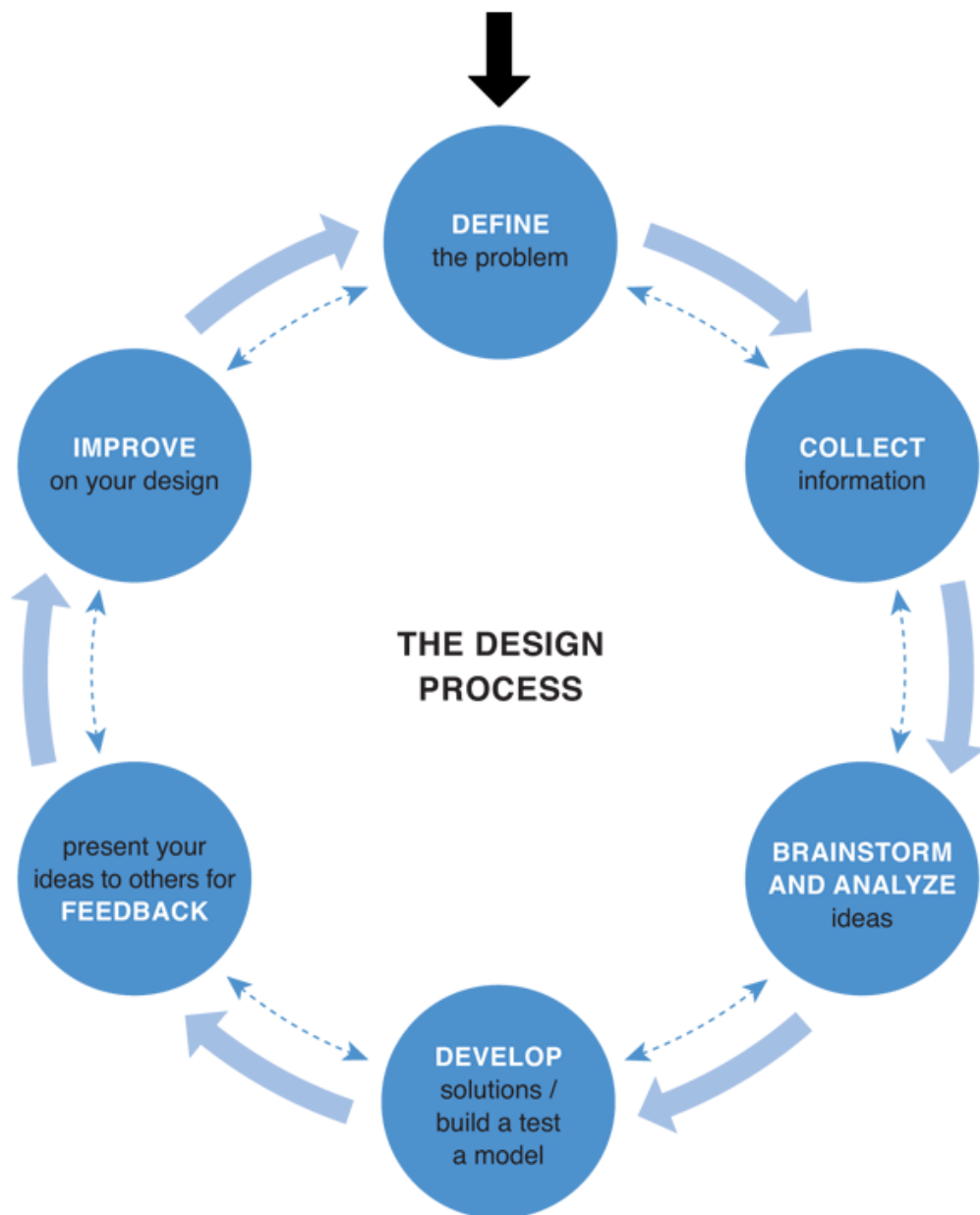
**HEATING COOLING SYSTEMS**

**LIGHTING BASICS**

**ELECTRICAL DESIGN FOR RESIDENCES**

**ELECTRICAL DESIGN FOR COMMERCIAL SPACES**

**RESIDENTIAL & COMMERCIAL BUILDING COMPONENTS**



## *New Jersey Adopted Codes and Standards*

Code	Adoption Date
<b>BUILDING SUBCODE</b> <a href="#">(NJAC 5:23-3.14)</a> <a href="http://www.state.nj.us/dca/divisions/codes/">http://www.state.nj.us/dca/divisions/codes/</a> <a href="#">International Building Code/2015, NJ ed</a> (IBC w/ NJ edits from 3.14) * <a href="#">Corrected pages</a> <a href="#">International Building Code/2015</a> , unamended ed ( <i>for comparison purposes</i> ) <a href="#">International Fire Code/2015</a> <a href="#">ICC/ANSI A117.1-2009</a>	Sept. 21, 2015
<b>PLUMBING SUBCODE</b> <a href="#">(NJAC 5:23-3.15)</a>  National Standard Plumbing Code/2015 (Since an electronic version is not currently available, here is a link to the previous edition <a href="#">NSPC/2009.</a> )	Jan. 04, 2016
<b>ELECTRICAL SUBCODE</b> <a href="#">(NJAC 5:23-3.16)</a>  <a href="#">National Electrical Code (NFPA 70)/2014</a>	Sept. 21, 2015
<b>ENERGY SUBCODE</b> <a href="#">(NJAC 5:23-3.18)</a>  <a href="#">International Energy Conservation Code/2015</a> (Residential) <a href="#">ASHRAE 90.1-2013</a> (Commercial)	Sept. 21, 2015
<b>MECHANICAL SUBCODE</b> <a href="#">(NJAC 5:23-3.20)</a>  <a href="#">International Mechanical Code/2015</a>	Sept. 21, 2015
<b>ONE-AND TWO-FAMILY DWELLING SUBCODE</b> <a href="#">(NJAC 5:23-3.21)</a> <a href="#">International Residential Code/2015, NJ ed</a> (IRC w/ NJ edits from 3.21) * <a href="#">Corrected pages</a> <a href="#">International Residential Code/2015</a> , unamended ed ( <i>for comparison purposes</i> )	Sept. 21, 2015
<b>FUEL GAS SUBCODE</b> <a href="#">(NJAC 5:23-3.22)</a>	Sept. 21, 2015



<a href="#">International Fuel Gas Code/2015</a>	
<b>REHABILITATION SUBCODE</b> <a href="#">(NJAC 5:23-6)</a> <a href="#">NJUCC, Subchapter 6</a>	Updated Yearly
<b>BARRIER FREE SUBCODE</b> ( <a href="#">Chapter 11 of IBC/2015</a> & <a href="#">NJAC 5:23-7</a> ) <a href="#">ICC/ANSI A117.1-2009</a>	Sept. 21, 2015
<b>ELEVATOR SUBCODE</b> ( <a href="#">NJAC 5:23-12</a> ) <a href="#">American Society of Mechanical Engineers</a> (ASME)	Sept. 21, 2015
<p>To purchase, please contact:</p> <ul style="list-style-type: none"> <li>• International Codes - <a href="#">International Code Council</a> [888] 422-7233</li> <li>• National Standard Plumbing Code - <a href="#">National Assoc. of Plumbing-Heating-Cooling Contractors</a> [800] 533-7694 or in NJ at [800] 652-7422 or [609] 987-0500</li> <li>• National Electrical Code - <a href="#">National Fire Protection Assoc.</a> [617] 770-3000 <ul style="list-style-type: none"> <li>• ASHRAE 90.1 - <a href="#">American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.</a> [800] 527-4723</li> </ul> </li> <li>• Rehabilitation Subcode - <a href="#">State of NJ, Department of Community Affairs, Division of Codes and Standards</a> [609] 984-0040</li> <li>• Barrier Free Subcode - <a href="#">State of NJ, Department of Community Affairs, Division of Codes and Standards</a> [609] 984-0040 <ul style="list-style-type: none"> <li>• ICC/ANSI A117.1 - <a href="#">International Code Council</a> [888] 422-7233</li> </ul> </li> <li>• Elevator Subcode - <a href="#">State of NJ, Department of Community Affairs, Division of Codes and Standards</a> [609] 984-0040</li> <li>• ASME - <a href="#">American Society of Mechanical Engineers</a> [800] 843-2763</li> </ul>	

## Team Roles and the Design Process

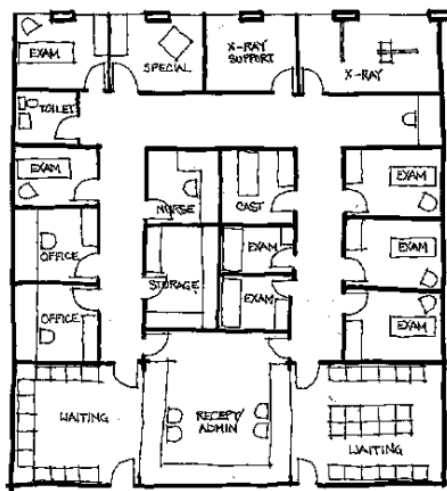
To create high quality interior environments requires that the user, installation maintenance staff, commands, programmers, designers, engineers, construction workers, and suppliers work together toward clearly defined statements of design excellence.

**Programming** is the first step in this process. Programming involves defining the project requirements and providing the financial resources to support them. This is where the user first forms a concept of what is needed.

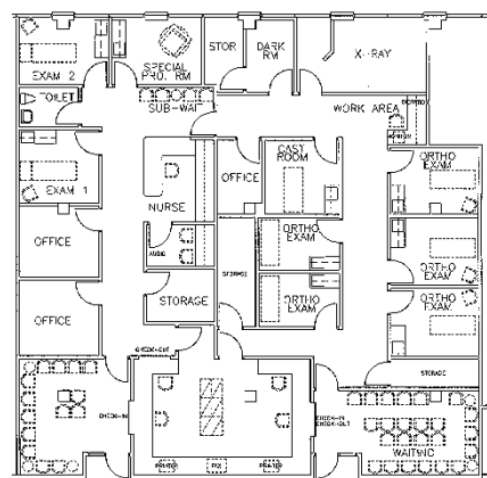
At **concept development** designers become fully involved in translating the user's operational and maintenance concepts into a built form. Designers work with the user to understand the reasons behind requirements and to give them form in terms of size, shape, and space layout.

### Conceptual Plan Working Drawings

As the design is developed into **contract documents** and procurement information, the designer works with the user to specify requirements for construction, furniture, finishes, and furnishings. The documents created are the master plan for bringing the project to reality. They give the building, its interior spaces, furniture, and furnishings a coordinated form and aesthetic expression.



Conceptual Plan



Working Drawings

**Execution** involves guiding the work of those who construct the building and providing the furniture and furnishings. Attention to detail during building construction, as well as during procurement and installation of furnishings, is critical to the achievement of excellence.

Creating stimulating, comfortable, and appropriate environments for living and working is an achievable goal when the user and the design and construction team work together as partners.

- Programming involves defining the project requirements and providing the financial resources to support them.
- At concept development designers become fully involved in translating the user's operational and maintenance concepts into a built form.
- As the design is developed into contract documents and procurement information, the designer works with the user to specify requirements for construction, furniture, finishes, and furnishings.
- Execution involves guiding the work of those who construct the building and providing the furniture and furnishings.
- Furniture-related interior design applies to facility types where the selection and arrangement of furniture and furnishings determines the functionality of the building.
- Building-related interior design applies to all facilities and requires the design and selection of interior surface materials and items permanently attached to the structure.
- Concept development, within the scope of design engineering, concept ideation is about looking at the requirements of a problem and coming up with a short description of the general class of product that can satisfy the requirements.
- Programming, we define architectural programming as the research and decision-making process that identifies the scope of work to be designed.
- Contract documents, Construction “Contract Documents” are the written documents that define the roles, responsibilities, and “Work” under the construction Contract, and are legally-binding on the parties (Owner and Contractor).

#### **Codes and Standards**

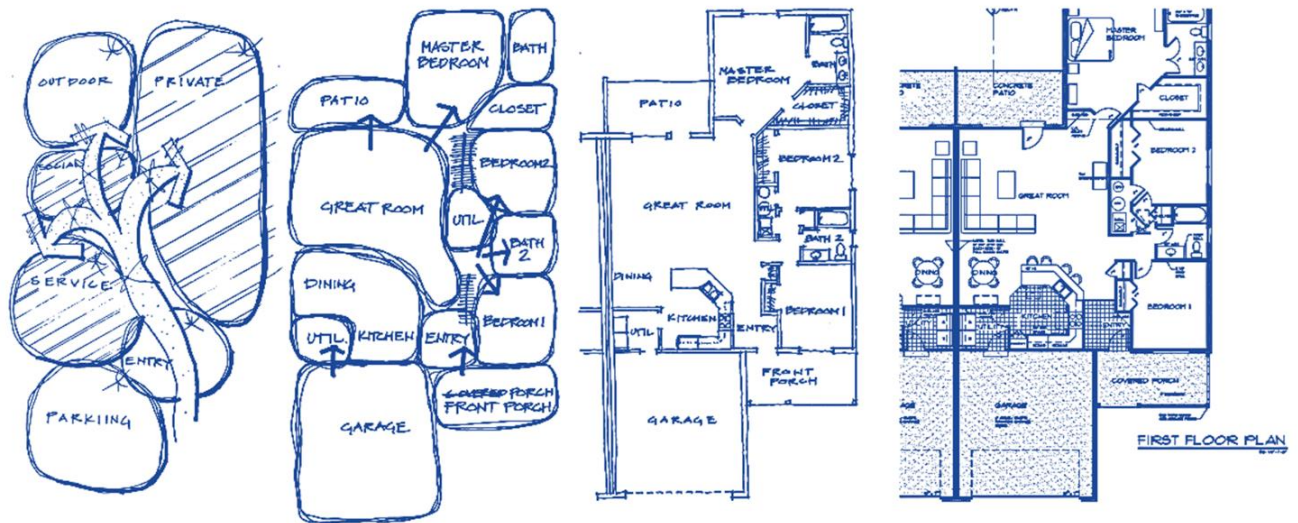
IRC, International Residential Code

IBC, International Building Code

NEC, National Electrical Code

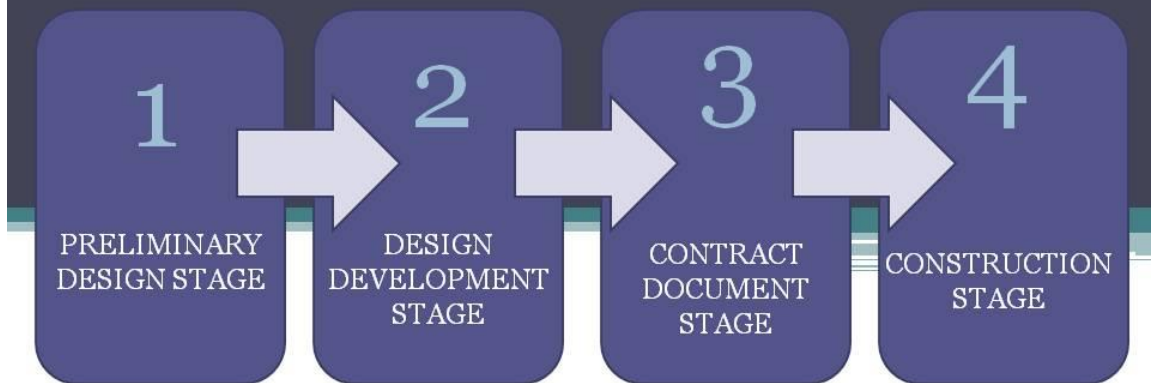
ADA, American Disabilities Act

NKBA Design Standards<sup>9</sup> (National Kitchen and Bath Association)



Concept sketches and drawings are part of a sequence of design steps known as the design process.

# THE PROCESS



# SPACE PLANNING WITH THE IRC (International Residential Code)

## LIGHT, VENTILATION AND HEATING

### Habitable rooms

All habitable rooms shall be provided with aggregate glazing area of not less than 8 percent of the floor area of such rooms. Natural ventilation shall be through windows, doors, louvers or other approved openings to the outdoor air. Such openings shall be provided with ready access or shall otherwise be readily controllable by the building occupants. The minimum openable area to the Outdoors shall be 4 percent of the floor area being ventilated.

**Bathrooms.** Bathrooms, water closet compartments and other similar rooms shall be provided with aggregate glazing area in windows of not less than 3 square feet (0.279 m<sup>2</sup>), one-half of which must be openable.

*Exception: The glazed areas shall not be required where artificial light and a mechanical ventilation system are provided. The minimum ventilation rates shall be 50 cfm (23.6 L/s) for intermittent ventilation or 20 cfm (9.4 L/s) for continuous ventilation. Ventilation air from the space shall be exhausted directly to the outside.*

**Stairway illumination.** All interior and exterior stairways shall be provided with a means to illuminate the stairs, including the landings and treads. Interior stairways shall be provided with an artificial light source located in the immediate vicinity of each landing of the stairway. For interior stairs the artificial light sources shall be capable of illuminating treads and landings to levels not less than 1 foot-candles (11 lux) measured at the center of treads and landings. Exterior stairways shall be provided with an artificial light source located in the immediate vicinity of the top landing of the stairway. Exterior stairways providing access to a basement from the outside grade level shall be provided with an artificial light source located in the immediate vicinity of the bottom landing of the stairway.

**Required glazed openings.** Required glazed openings shall open directly onto a street or public alley, or a yard or court located on the same lot as the building.

## **MINIMUM ROOM AREAS**

**Minimum area.** Every dwelling unit shall have at least one habitable room that shall have not less than 120 square feet (11.2 m<sup>2</sup>) of gross floor area.

**Other rooms.** Other habitable rooms shall have a floor area of not less than 70 square feet (6.5 m<sup>2</sup>).

*Exception: Kitchens.*

**Minimum dimensions.** Habitable rooms shall not be less than 7 feet (2134 mm) in any horizontal dimension.

*Exception: Kitchens.*

**Height effect on room area.** Portions of a room with a sloping ceiling measuring less than 5 feet (1524 mm) or a furred ceiling measuring less than 7 feet (2134 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required habitable area for that room.

## **CEILING HEIGHT**

**Minimum height.** Habitable rooms, hallways, corridors, bathrooms, toilet rooms, laundry rooms and basements shall have a ceiling height of not less than 7 feet (2134 mm).

The required height shall be measured from the finish floor to the lowest projection from the ceiling.

4. *Bathrooms shall have a minimum ceiling height of 6 feet 8 inches (2036 mm) over the fixture and at the front clearance area for fixtures as shown in Figure R307.2. A shower or tub equipped with a showerhead shall have a minimum ceiling height of 6 feet 8 inches (2036 mm) above a minimum area 30 inches (762 mm) by 30 inches (762 mm) at the showerhead.*



**FIGURE R307.2**  
**MINIMUM FIXTURE CLEARANCES**

## **GARAGES AND CARPORTS**

**Opening protection.** Openings from a private garage directly into a room used for sleeping purposes shall not be permitted. Other openings between the garage and residence shall be equipped with solid wood doors not less than 13/8 inches (35mm) in thickness, solid or honeycomb core steel doors not less than 13/8 inches (35 mm) thick, or 20-minute fire-rated doors.

**Duct penetration.** Ducts in the garage and ducts penetrating the walls or ceilings separating the dwelling from the garage shall be constructed of a minimum No. 26 gage (0.48 mm) sheet steel or other approved material and shall have no openings into the garage.

**Separation required.** The garage shall be separated from the residence and its attic area by not less than 1/2-inch (12.7 mm) gypsum board applied to the garage side. Garages beneath habitable rooms shall be separated from all habitable rooms above by not less than 5/8-inch (15.9 mm) Type X gypsum board or equivalent. Where the separation is a floor-ceiling assembly, the structure supporting the separation shall also be protected by not less than 1/2-inch (12.7 mm) gypsum board or equivalent.

**Floor surface.** Garage floor surfaces shall be of approved noncombustible material. The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

## **EMERGENCY ESCAPE AND RESCUE OPENINGS**

**Emergency escape and rescue required.** Basements with habitable space and every sleeping room shall have at least one openable emergency escape and rescue opening. Where basements contain one or more sleeping rooms, emergency egress and rescue openings shall be required in each sleeping room, but shall not be required in adjoining areas of the basement. Where emergency escape and rescue openings are provided they shall have a sill height of not more than **44 inches (1118 mm) above the floor**. Where a door opening having a threshold below the



adjacent ground elevation serves as an emergency escape and rescue opening and is provided with a bulkhead enclosure, the bulkhead enclosure shall comply with Section 310.3. The net clear opening dimensions required by this section shall be obtained by the normal operation of the emergency escape and rescue opening from the inside. Emergency escape and rescue openings with a finished sill height below the adjacent ground elevation shall be provided with a window well in accordance with Section R310.2.

**Minimum opening area.** All emergency escape and rescue openings shall have a minimum net clear opening of **5.7 square feet** (0.530 m<sup>2</sup>).

***Exception:** Grade floor openings shall have a minimum net clear opening of 5 square feet (0.465 m<sup>2</sup>).*

**Minimum opening height.** The minimum net clear opening height shall be **24 inches** (610 mm).

**Minimum opening width.** The minimum net clear opening width shall be **20 inches** (508 mm).

**Operational constraints.** Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools.

## MEANS OF EGRESS

**General.** Stairways, ramps, exterior exit balconies, hallways and doors shall comply with this section.

### Construction

**Attachment.** Required exterior exit balconies, stairs and similar exit facilities shall be positively anchored to the primary structure to resist both vertical and lateral forces. Such attachment shall not be accomplished by use of toenails or nails subject to withdrawal.

**Hallways.** The minimum width of a hallway shall be not less than 3 feet (914 mm).

### Doors

**Exit door required.** Not less than one exit door conforming to this section shall be provided for each dwelling unit. The required exit door shall provide for direct access from the habitable portions of the dwelling to the exterior without requiring travel through a garage. Access to

habitable levels not having an exit in accordance with this section shall be by a ramp in accordance with Section R311.6 or a stairway in accordance with Section R311.5.

**Door type and size.** The required exit door shall be a side-hinged door not less than 3 feet (914 mm) in width and 6 feet 8 inches (2032 mm) in height. Other doors shall not be required to comply with these minimum dimensions.

**Landings at doors.** There shall be a floor or landing on each side of each exterior door.

***Exception:** Where a stairway of two or fewer risers is located on the exterior side of a door, other than the required exit door, a landing is not required for the exterior side of the door. The floor or landing at the exit door required by Section R311.4.1 shall not be more than 1.5 inches (38 mm) lower than the top of the threshold. The floor or landing at exterior doors other than the exit door required by Section R311.4.1 shall not be required to comply with this requirement but shall have a rise no greater than that permitted in Section R311.5.3.*

***Exception:** The landing at an exterior doorway shall not be more than 73/4 inches (196 mm) below the top of the threshold, provided the door, other than an exterior storm or screen door does not swing over the landing. The width of each landing shall not be less than the door served. Every landing shall have a minimum dimension of 36 inches (914 mm) measured in the direction of travel.*

## **Stairways**

**Width.** Stairways shall not be less than 36 inches (914 mm) in clear width at all points above the permitted handrail height and below the required headroom height. Handrails shall not project more than 4.5 inches (114 mm) on either side of the stairway and the minimum clear width of the stairway at and below the handrail height, including treads and landings, shall not be less than 31.5 inches (787 mm) where a handrail is installed on one side and 27 inches (698 mm) where handrails are provided on both sides.

**Exception:** The width of spiral stairways shall be in accordance with Section R311.5.8.

**Headroom.** The minimum headroom in all parts of the stairway shall not be less than 6 feet 8 inches (2036 mm) measured vertically from the sloped plane adjoining the tread nosing or from the floor surface of the landing or platform.

### **Stair treads and risers.**

**Riser height.** The maximum riser height shall be 7<sup>3</sup>/<sub>4</sub> inches (196 mm). The riser shall be measured vertically between leading edges of the adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than 3/8 inch (9.5 mm).

**Tread depth.** The minimum tread depth shall be 10 inches (254 mm). The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than 3/8 inch (9.5 mm). Winder treads shall have a minimum tread depth of 10 inches (254 mm) measured as above at a point 12 inches (305) mm from the side where the treads are narrower. Winder treads shall have a minimum tread depth of 6 inches (152 mm) at any point. Within any flight of stairs, the greatest winder tread depth at the 12 inch (305 mm) walk line shall not exceed the smallest by more than 3/8 inch (9.5 mm).

**Landings for stairways.** There shall be a floor or landing at the top and bottom of each stairway.

**Exception:** A floor or landing is not required at the top of an interior flight of stairs, provided a door does not swing over the stairs. A flight of stairs shall not have a vertical rise greater than 12 feet (3658 mm) between floor levels or landings. The width of each landing shall not be less than the stairway served. Every landing shall have a minimum dimension of 36 inches (914 mm) measured in the direction of travel.

**Handrails.** Handrails shall be provided on at least one side of each continuous run of treads or flight with four or more risers.

**Height.** Handrail height, measured vertically from the sloped plane adjoining the tread nosing, or finish surface of ramp slope, shall be not less than 34 inches (864 mm) and not more than 38 inches (965 mm).

**Continuity.** Handrails for stairways shall be continuous for the full length of the flight, from a point directly above the top riser of the flight to a point directly above lowest riser of the flight. Handrail ends shall be returned or shall terminate in newel posts or safety terminals.

Handrails adjacent to a wall shall have a space of not less than 1 1/2 inch (38 mm) between the wall and the handrails.

**Handrail grip size.** All required handrails shall be of one of the following types or provide equivalent grasp ability.

1. Type I. Handrails with a circular cross section shall have an outside diameter of at least 1 1/4 inches (32 mm) and not greater than 2 inches (51 mm). If the handrail is not circular it shall have a perimeter dimension of at least 4 inches (102 mm) and not greater than 6 1/4 inches (160 mm) with a maximum cross section of dimension of 2 1/4 inches (57 mm).

## **GUARDS**

**Guards required.** Porches, balconies or raised floor surfaces located more than 30 inches (762 mm) above the floor or grade below shall have guards not less than 36 inches (914 mm) in height. Open sides of stairs with a total rise of more than 30 inches (762 mm) above the floor or grade below shall have guards not less than 34 inches (864 mm) in height measured vertically from the nosing of the treads. Porches and decks which are enclosed with insect screening shall be provided with guards where the walking surface is located more than 30 inches (762 mm) above the floor or grade below.

**Guard opening limitations.** Required guards on open sides of stairways, raised floor areas, balconies and porches shall have intermediate rails or ornamental closures which do not allow passage of a sphere 4 inches (102mm) or more in diameter.

## **SMOKE ALARMS**

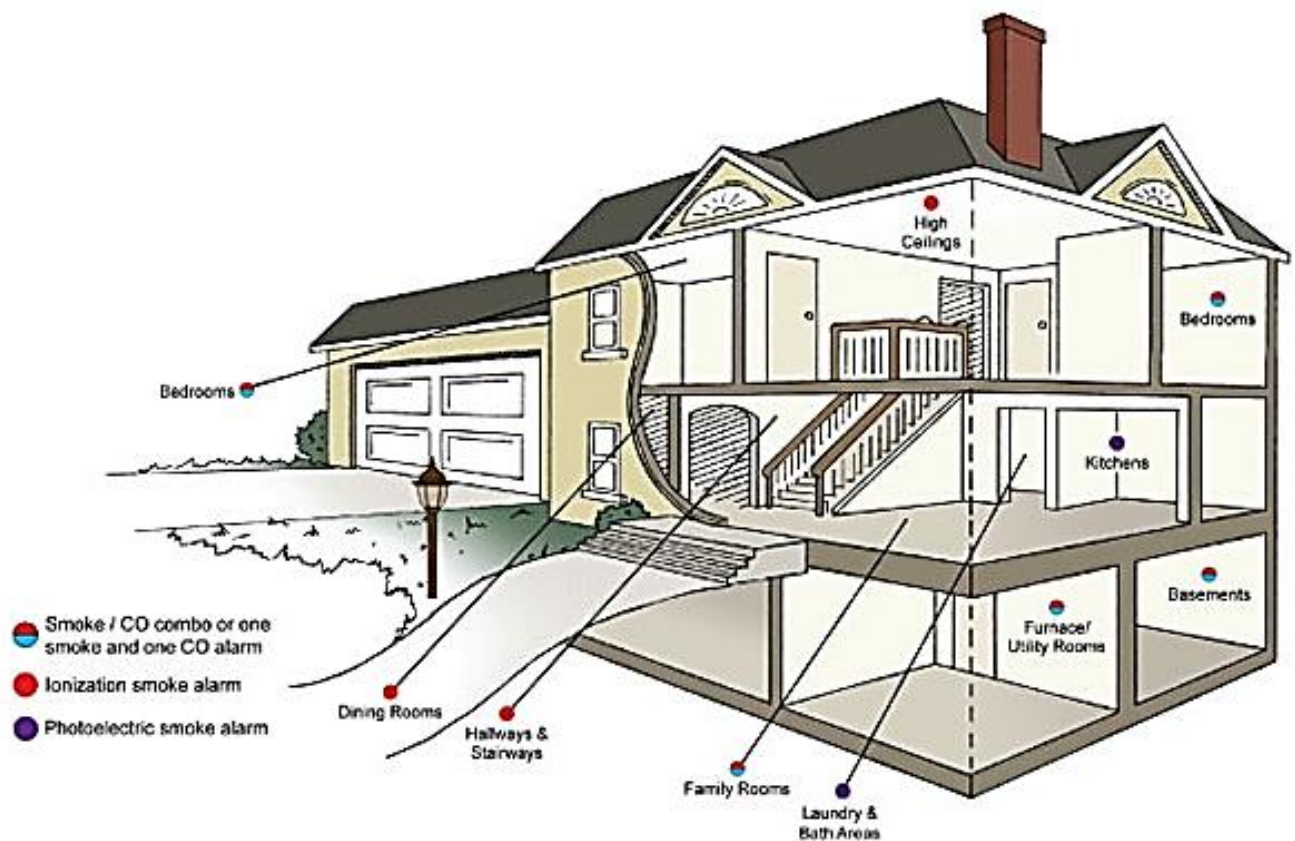
**[F] R313.1 Smoke alarms.** Smoke alarms shall be installed in the following locations:

1. In each sleeping room.
2. Outside each separate sleeping area in the immediate vicinity of the bedrooms.
3. On each additional story of the dwelling, including basements but not including crawl spaces and uninhabitable attics. In dwellings or dwelling units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall

suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

When more than one smoke alarm is required to be installed within an individual dwelling unit the alarm devices shall be interconnected in such a manner that the actuation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

All smoke alarms shall be listed and installed in accordance with the provisions of this code and the household fire warning equipment provisions of NFPA 72.



## MEANS OF EGRESS

A means of egress is a continuous path of travel from any point in a building or structure to the open air outside at ground level (public way). It consists of three separate and distinct parts:

1. Exit access
2. The exit
3. The exit discharge

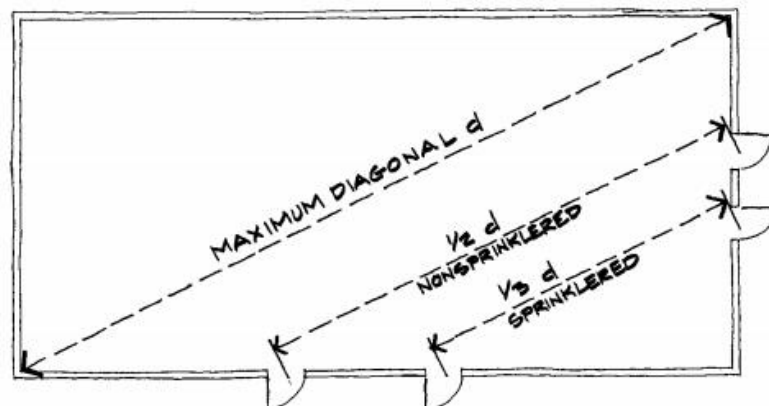
The *exit* is that portion of a means of egress that is separated from the area of the building from which escape is made, by walls, floors, doors, or other means that provide the protected path necessary for the occupants to proceed with safety to a public space. The most common form the exit takes is an enclosed stairway. In a single-story building the exit is the door opening to the outside.

After determining occupant load (Table A, p. 113) for spaces, rooms, floors, etc., use the following guidelines:

- 1. In some cases one exit can be used (see above), but often buildings need two exits (see Table K, p. 128). In more than one story, stairs become part of an exit. Elevators are not exits.

*(The NFPA code usually requires two exits. It requires three when the occupant load is 501 to 1000 and four when over 1000.)*

- 2. In buildings 4 stories and higher and in types I and II-B construction, the exit stairs are required to have 2-hour enclosure; otherwise, 1 hour is acceptable.
- 3. When two exits are required (for unsprinklered buildings), they have to be separated by a distance equal to half the diagonal dimension of the floor and/or room the exits are serving (measured in straight lines). See sketch below. If the building is sprinklered, the minimum separation is  $\frac{1}{3}$  rd.
- 4. Where more than two exits are required, two of them need to be separated by at least





half the diagonal dimension. The others are spaced to provide good access from any direction.

- 5. May exit from room through adjoining rooms (except rooms that are accessory or high-hazard occupancy), provided adjoining rooms (other than DUs) are not kitchens, storerooms, toilets, closets, etc. Foyers, lobbies, and reception rooms are not considered adjoining rooms and can always be exited through.
- 6. The total exit width required (in inches) is determined by multiplying the occupant load by the factors shown in Table J (p. 131). This width should be divided equally among the required number of exits.  
(For NFPA requirements, see Table I-I on p. 143.)
- 7. Total occupant load for calculating exit stair width is defined as the sum of the occupant load on the floor in question. The maximum exit stair width calculated is maintained for the entire exit. See sketch on p. 108.
- 8. Minimum exit door width is 36" with 32" clear opening. Maximum door width is 48".
- 9. The width of exit stairs, and the width of landings between flights of stairs, must all be the same and must meet the minimum exit stair width requirements as calculated or:  
44" min. width for an occupant load of 51 or more  
36" min. width for 50 or less
- 10. Doors must swing in the direction of travel when serving a hazardous area or when serving an occupant load of 50 or more.

A *horizontal exit* is a way of passage through a 2-hour fire wall into another area of the same building or into a different building that will provide refuge from smoke and fire. Horizontal exits cannot provide more than half of the required exit capacity, and any such exit must discharge into an area capable of holding the occupant capacity of the exit. The area is calculated at 3 SF/occupant. In institutional occupancies the area needed is 15 SF/ambulatory person and 30 SF/nonambulatory person.

# TABLE K 34

TABLE 1005.2.1  
MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

OCCUPANT LOAD	MINIMUM NUMBER OF EXITS
1-500	2
501-1,000	3
More than 1,000	4

# TABLE A 34

TABLE 1003.2.2.2  
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

OCCUPANCY	FLOOR AREA IN SQ. FT. PER OCCUPANT
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Concourse	100 gross
Waiting areas	15 gross
Baggage claim	20 gross
Baggage handling	300 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Assembly with fixed seats	See 1003.2.2.9
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	100 gross
Courtrooms—other than fixed seating areas	40 net
Dormitories	50 gross

(continued)

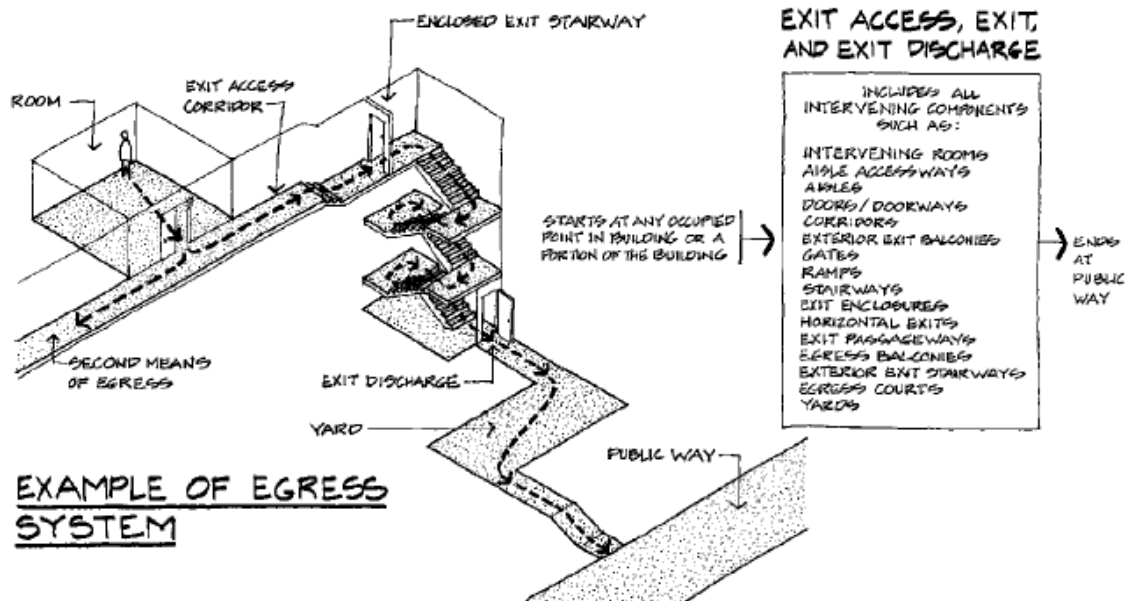
TABLE 1003.2.2.2—continued  
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

OCCUPANCY	FLOOR AREA IN SQ. FT. PER OCCUPANT
Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
H-5 Fabrication and manufacturing areas	200 gross
Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mercantile	
Basement and grade floor areas	30 gross
Areas on other floors	60 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross
Residential	200 gross
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net
Accessory storage areas, mechanical equipment room	300 gross
Warehouses	500 gross

For SI: 1 square foot = 0.0929 m<sup>2</sup>.



- \_\_\_ k. Exiting and Stairs: At the conceptual stage of architectural design, the most important aspects of the building code requirements are the number and distribution of exits.



A *means of egress* is a continuous path of travel from any point in a building or structure to the open air outside at ground level (public way). It consists of three separate and distinct parts:

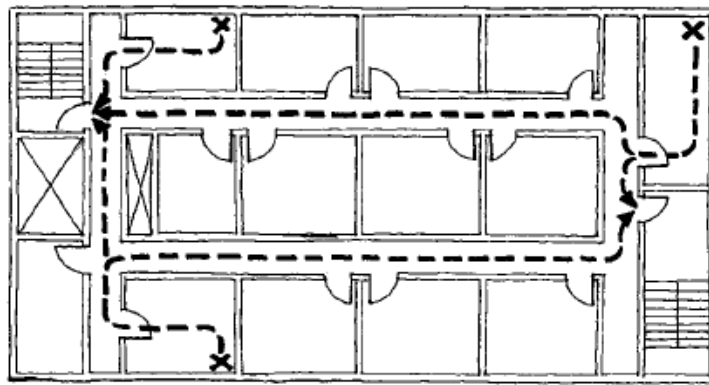
- \_\_\_ 1. Exit access
- \_\_\_ 2. The exit
- \_\_\_ 3. The exit discharge

The *exit access* leads to an exit. See Tables M and N, where only one is required; otherwise a minimum of two exits are almost always required. (As a general rule, plan on the NFPA code requiring two exits.) Other general requirements:

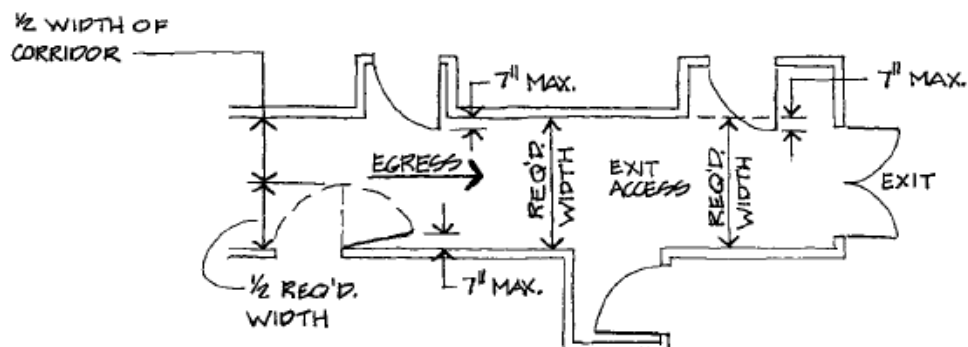
- \_\_\_ 1. Exit width determined by Table J, p. 131 (Table I-1 for the NFPA code), but corridor

width is usually no less than 44". It can be 36" for fewer than 51 people. School corridors must be 6' wide. Hospitals 8' wide. Large residential care homes, 5' wide.

- \_\_\_ 2. Dead-end corridors are usually limited to 20' long (in some cases 50').
- \_\_\_ 3. When more than one exit is required, the occupant should be able to go toward either exit from any point in the corridor system.
- \_\_\_ 4. Corridors used for exit access usually require 1-hour construction.
- \_\_\_ 5. Maximum travel distance from any point to an exit is per Table L on p. 132. (*The NFPA code is the same except: educational is 150' [200' with sprinklers], a day care home is 100' [150' with sprinklers], hotels are 100' [200' with sprinklers], apartments are 100' [200' with sprinklers], and mercantile is 150' [250' with sprinklers].*)
- \_\_\_ 6. Handrails or fully open doors cannot extend more than 7" into the corridor.
- \_\_\_ 7. Doors at their worst extension into the corridor cannot obstruct the required width by more than half.

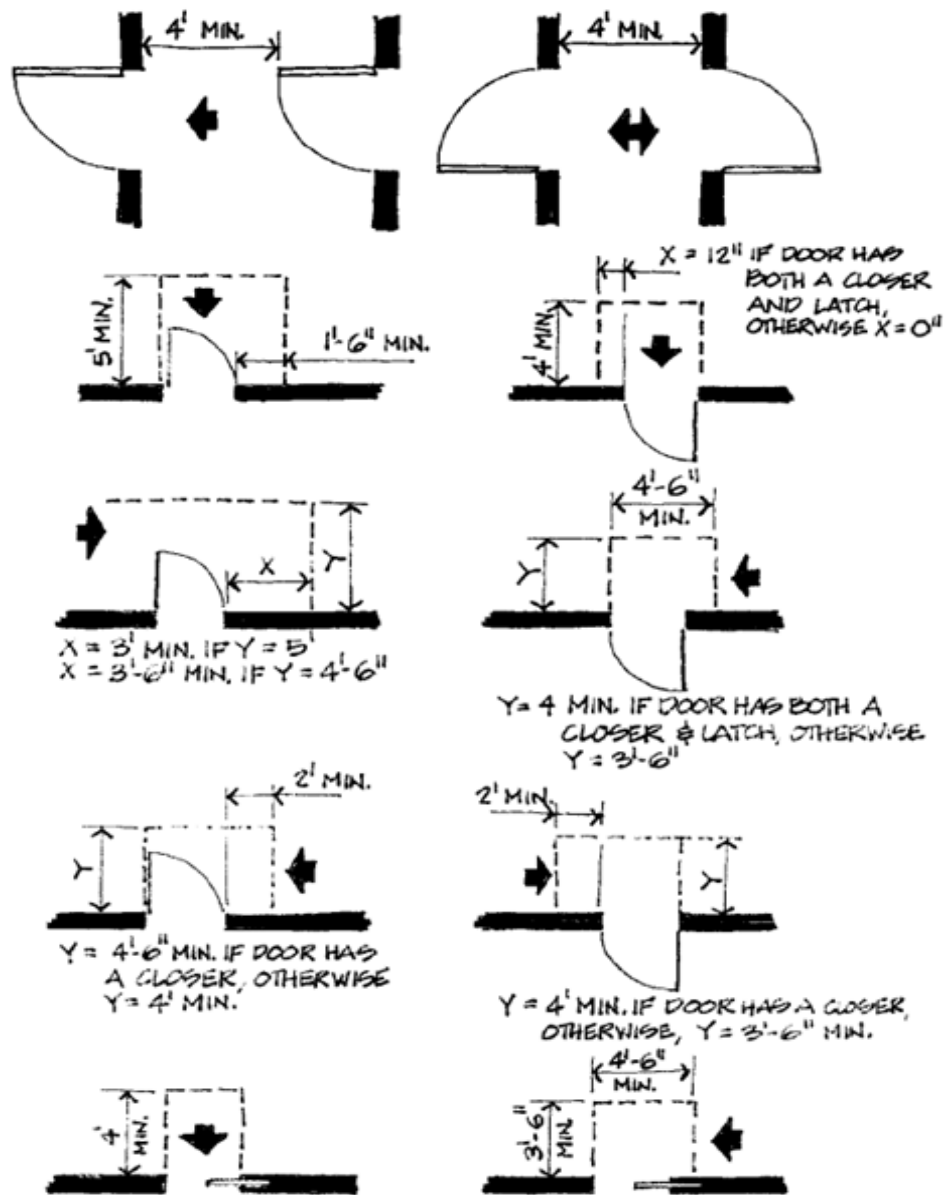


EXIT ACCESS ON UPPER OFFICE FLOOR - - - - -



## DOORS

## 1. Accessible Door Approach (ADA) (20)



## SLIDING &amp; FOLDING DOORS



NOTE: ALL DOORS IN ALCOVES SHALL COMPLY W/ FRONT APPROACHES.

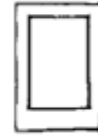
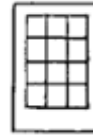
## General

### \_\_\_ a. Types by operation

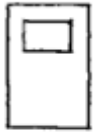
- \_\_\_ (1) Swinging
- \_\_\_ (2) Bypass sliding
- \_\_\_ (3) Surface sliding
- \_\_\_ (4) Pocket sliding
- \_\_\_ (5) Folding

### \_\_\_ b. Physical types

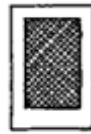
- (1) Flush    (2) Panelled    (3) French    (4) Glass



- (5) Sash    (6) Jalousie    (7) Louver



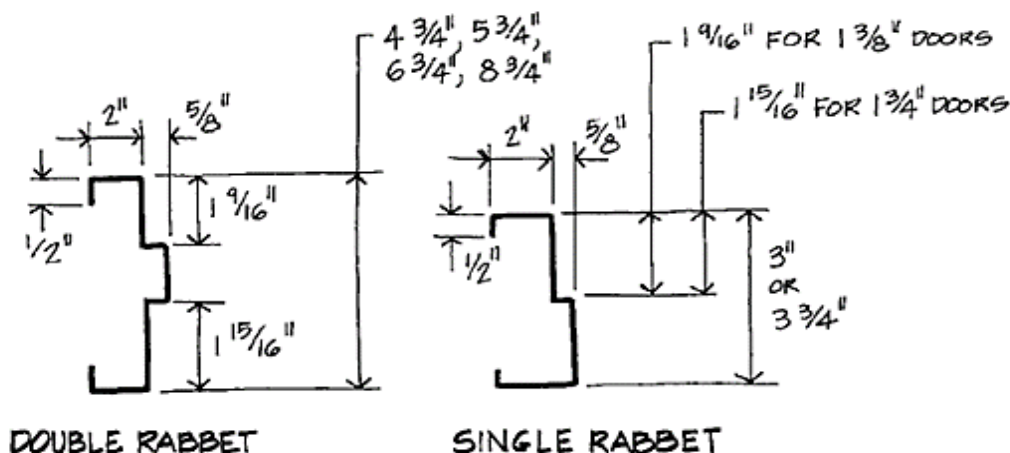
- (8) Shutter    (9) Screen    (10) Dutch



**Residential** doors thickness:  $1\frac{3}{8}$ ", height: 7'-0", width varies

**Commercial** doors thickness:  $1\frac{3}{4}$ ", height 6'-8", width varies

## Hollow Metal Doors and Frames



- a. Material (for gauges, see p. 329). Typical gauges of doors (16, 18, 20) and frames (12, 14, 16, 18)

Use	Frame	Door face
Heavy (entries, stairs public toilets, mech. rms.)	12, 14	16
Medium to low (rooms, closets, etc.)	14, 16, 20	18

- b. Doors (total door construction of 16 to 22 GA)

Thickness	1 3/4" and 1 7/8"
Widths	2' to 4' in 2" increments
Heights	6'8", 7', 7'2", 7'10", 8', 10'

**Costs: Frames: 3' x 7', 18 GA \$6.75/SF (of opening) or 16 GA at \$7.65/SF (60% M and 40% L), can vary  $\pm 40\%$ .**

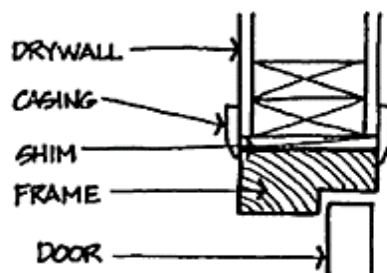
**Doors: 3' x 7', 20 GA, 1 3/4": \$14.60/SF (85% M and 3' x 6'8", 20 GA, 1 7/8": \$14.00/SF 15% L).**

**Add: lead lining: \$660/ea., 8' x 8" glass, \$120/ea., soundproofing \$30/ea., 3-hour \$120/ea., 1/2-hour \$25/ea.**

### — 4. Wood Doors

- a. Types

- (1) Flush
- (2) Hollow core
- (3) Solid core
- (4) Panel (rail and stile)



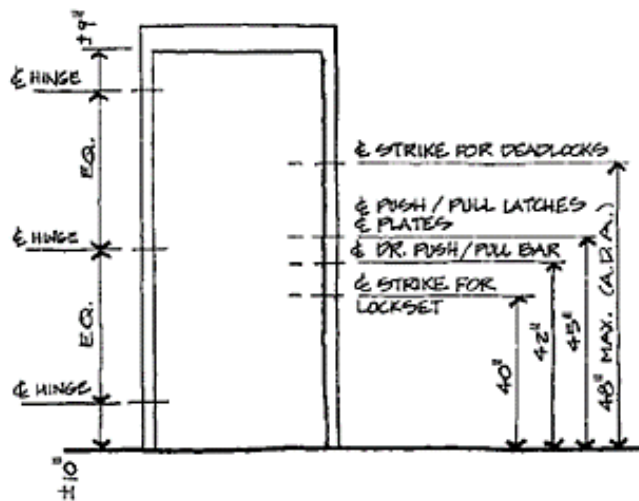
# HARDWARE

## \_\_\_ 1. General Considerations: How to ...

- \_\_\_ a. Hang the door
- \_\_\_ b. Lock the door
- \_\_\_ c. Close the door
- \_\_\_ d. Protect the door
- \_\_\_ e. Stop the door
- \_\_\_ f. Seal the door
- \_\_\_ g. Misc. the door
- \_\_\_ h. Electrify the door

## \_\_\_ 2. Recommended Locations

## \_\_\_ 3. Door Hand Conventions



LEFT HAND



RIGHT HAND



LEFT HAND  
REVERSE

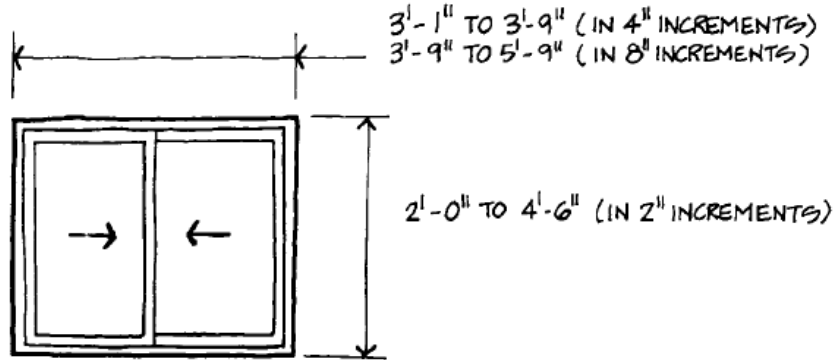


RIGHT HAND  
REVERSE

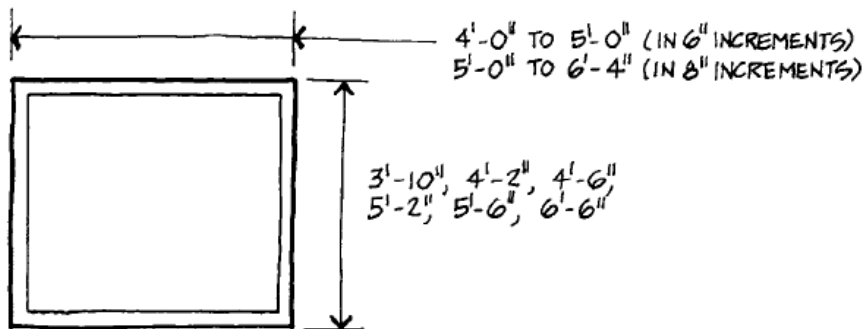


DIRECTION OF TRAVEL ASSUMED TO BE FROM OUTSIDE IN OR FROM KEYED SIDE FOR INTERIOR DOORS.

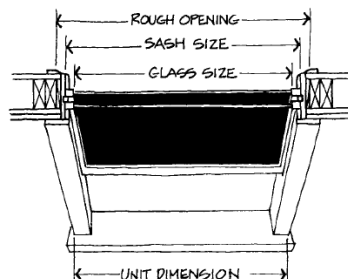
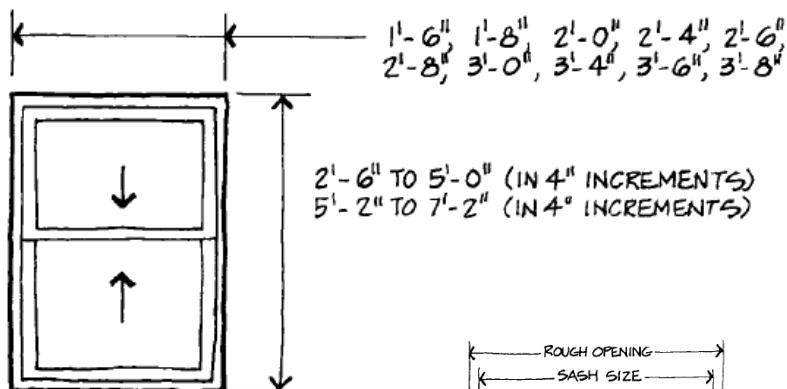
## TYPICAL WOOD WINDOW SASH SIZES



HORIZONTAL SLIDING WINDOWS



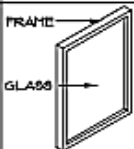
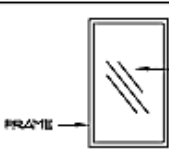

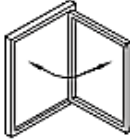
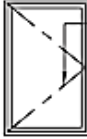
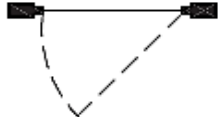
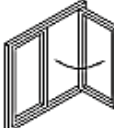
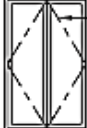

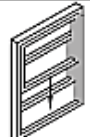
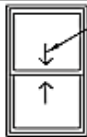


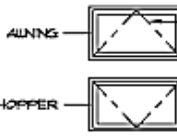
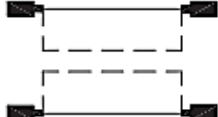
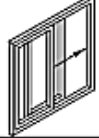


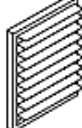


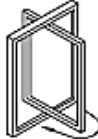

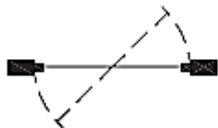
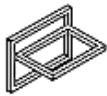
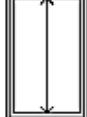
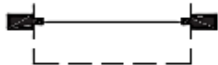


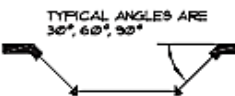


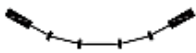
PICTURE WINDOWS



**Openings**  
 Where emergency escape and rescue openings are provided they shall have a sill height of not more than **44 inches (1118 mm) above the floor.**

All emergency escape and rescue openings shall have a minimum net clear opening of **5.7 square feet (0.530 m2).**

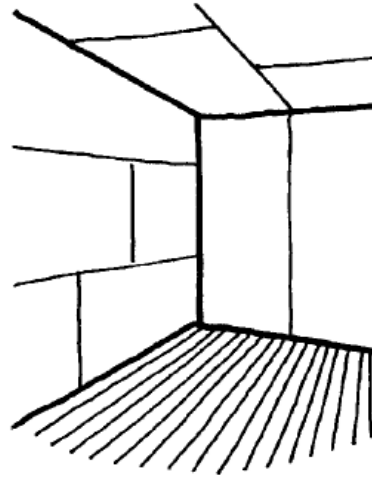






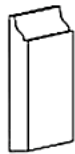

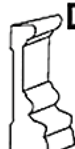













WINDOWS - TYPES AS DEFINED BY OPERATION			
TYPE	SKETCH	ELEVATION	PLAN
FIXED	 <p>MADE IN VARIETY OF SIZES &amp; SHAPES.</p>		
CASEMENT	 <p>HINGED AT SIDE AND SWINGS OUTWARD.</p>	 <p>INDICATES HINGE ACTION</p>	
DOUBLE CASEMENT	 <p>HINGED AT SIDES AND SWINGS OUTWARD.</p>	 <p>INDICATES HINGE ACTION</p>	
SINGLE AND DOUBLE HUNG	 <p>CONTAINS TWO SASH WHICH SLIDE. IF ONE IS FIXED, UNIT IS A "SINGLE-HUNG".</p>	 <p>INDICATES SLIDING SECTION</p>	
AWNING AND HOPPER	 <p>AWNINGS ARE HINGED AT TOP - OFTEN SWINGS OUT TO KEEP RAIN OUT. HOPPERS ARE BOTTOM HINGED - OFTEN SWING IN TO KEEP RAIN OUT.</p>	 <p>INDICATES HINGE ACTION</p>	
SLIDING	 <p>CAN BE MADE WITH ONE OR BOTH SASH AS SLIDING UNITS. ALSO MADE AS ONE CENTER FIXED UNIT AND SLIDING UNITS EACH SIDE.</p>	 <p>INDICATES SLIDING SECTION</p>	
JALOUSIE	 <p>SERIES OF SMALL, HINGED (AWNING) GLASS SECTIONS ALL OPERATED TOGETHER OR IN SECTIONS.</p>		
PIVOT	 <p>PIVOTS ON 2 POINTS AT CENTER OF TOP AND BOTTOM OF WINDOW. USED FOR EASE OF CLEANING.</p>		
PROJECTED	 <p>SWINGS OPEN AND SLIDES AT SAME TIME THROUGH SPECIAL LINKAGE. CAN BE TYPED AS HOPPER CASEMENT, OR AWNING.</p>		
BAY	 <p>ANGLE VARIES</p>		 <p>TYPICAL ANGLES ARE 30°, 60°, 90°</p>
BOW			



## GYPSUM WALLBOARD (DRYWALL)

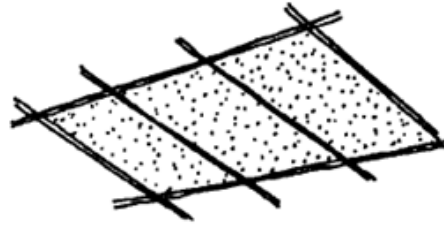
- 1. Usually in 4' x 8' (or 12') sheets from 1/4" to 1" thick in about 1/8" increments.
- 2. Attach (nail or screw) against wood or metal framing—usually at 16" (fire rating) to 24" oc.
- 3. Type "X", 5/8" will give 1 hr. fire rating. Roughly each additional 1/2" layer will give 1 hr. rating up to 4 hours, depending on backing and application.
- 4. Water-resistant (green) available for wet areas or exterior.



 <p><b>725 Base</b> Size: 1 1/16" x 7 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>366 Base</b> Size: 9/16" x 3 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>5180 Base</b> Size: 9/16" x 5 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>218 Base</b> Size: 9/16" x 5 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>618 Base</b> Size: 9/16" x 5 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>
 <p><b>OG Base</b> Size: 9/16" x 3 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>Delta Howe</b> Size: 1 1/16" x 3 1/2" x 16" Material: PFI Linear Foot Per Stick: 17</p>	 <p><b>356 Casing</b> Size: 1 1/16" x 2 1/4" x 17" Material: PFI Linear Foot Per Stick: 17</p>	 <p><b>Victorian Casing</b> Size: 1 1/16" x 3 1/4" x 17" Material: PFI Linear Foot Per Stick: 17</p>	 <p><b>366 Casing</b> Size: 1 1/16" x 2 1/4" x 17" Material: PFI Linear Foot Per Stick: 17</p>
 <p><b>48 Crown</b> Size: 9/16" x 4 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>714 Crown</b> Size: 9/16" x 7 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>45 Crown</b> Size: 9/16" x 5 1/4" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>281 Back Band</b> Size: 1 1/16" x 1 1/8" x 17" Material: PFI Linear Foot Per Stick: 17</p>	 <p><b>163 Base Cap</b> Size: 1 1/16" x 1 3/8" x 16" Material: PFI Linear Foot Per Stick: 16</p>
 <p><b>75 Bed Mold</b> Size: 9/16" x 1 5/8" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>180 Brick Mold</b> Size: 1 1/4" x 2" x 17" Material: PVC Linear Foot Per Stick: 17</p>	 <p><b>129 Shoe Mold</b> Size: 7/16" x 1 1/16" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>106 Quarter Round</b> Size: 1 1/16" x 1 1/16" x 16" Material: PFI Linear Foot Per Stick: 16</p>	 <p><b>390 Chair</b> Size: 1 1/16" x 2 5/8" x 16" Material: PFI Linear Foot Per Stick: 16</p>

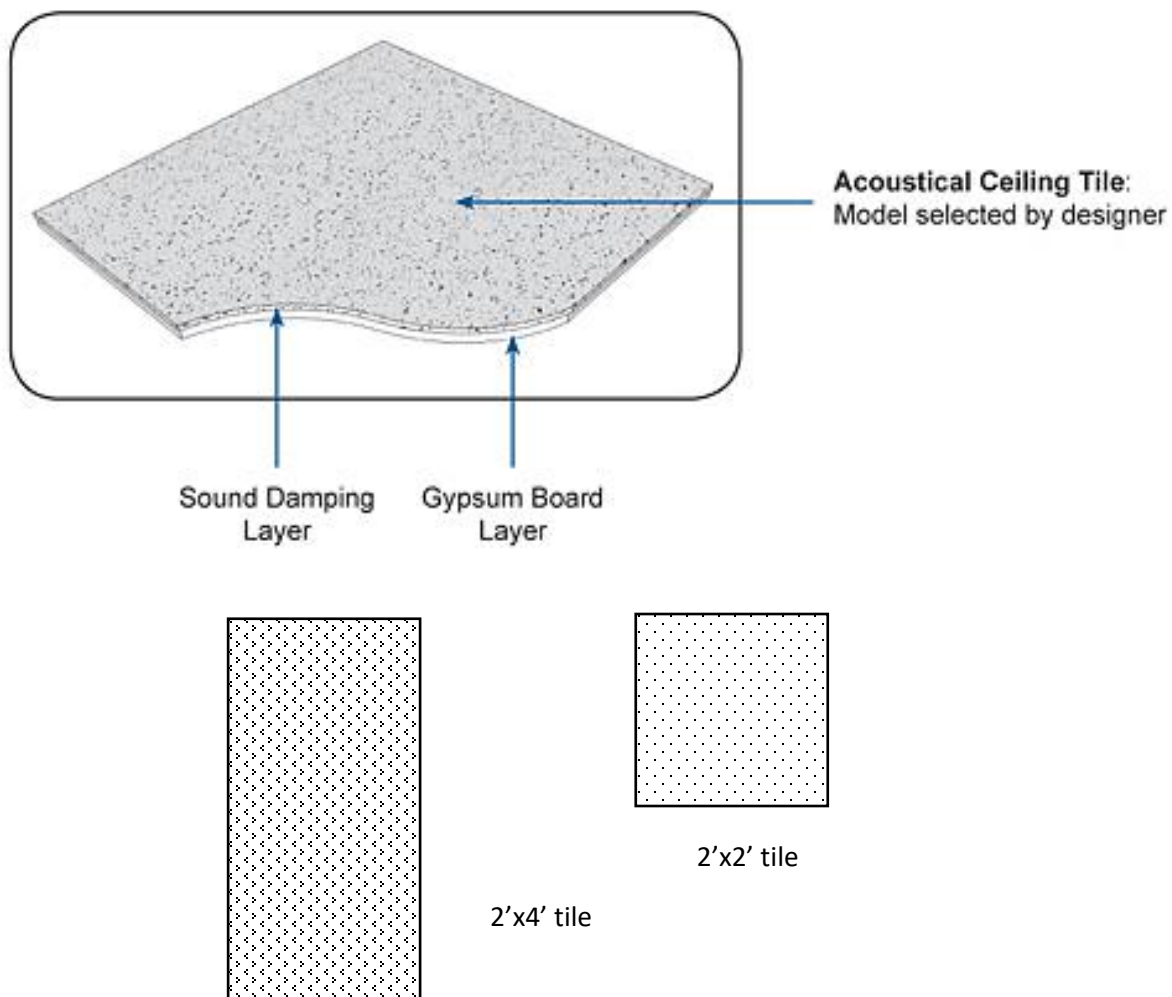
## ACOUSTICAL TREATMENT

- \_\_\_ 1. **Acoustical Ceilings:** Can consist of small ( $\frac{3}{4}$ " thick  $\times$  1' SQ) mineral fiber tiles attached to wallboard or concrete (usually glued). Also, acoustical mineral fibers with a binder can be shot on gypsum board or concrete.



**Costs: Small tiles \$1.10 to \$1.50/SF (40% M and 60% L)**

- \_\_\_ 2. **Suspended Acoustical Tile Ceilings:** Can be used to create a plenum space to conceal mechanical and electrical functions. Typical applications are 2' SQ or 2'  $\times$  4' tiles in exposed or concealed metal grids that are wire-suspended as in plaster ceilings. The finishes can vary widely.



# WOOD MATERIALS

\_\_\_ 1. **General** (Note: See p. 362 for species table. See pp. 337–341 for nails and connectors.)

\_\_\_ a. *Two general types of wood* are used in buildings:

\_\_\_ (1) Softwood (from evergreen trees) for general construction

\_\_\_ (2) Hardwood (from deciduous trees) for furnishings and finishes

\_\_\_ b. *Moisture and shrinkage:* The amount of water in wood is expressed as a percentage of its oven-dry (dry as possible) weight. As wood dries, it first loses moisture from within the cells without shrinking; after reaching the fiber saturation point (dry cell), further drying results in shrinkage. Eventually wood comes to dynamic equilibrium with the relative humidity of the surrounding air. Interior wood typically shrinks in winter and swells in summer. Average equilibrium moisture content ranges from 6% to 11%, but wood is considered dry enough for use at 12% to 15%. The loss of moisture during seasoning causes wood to become harder, stronger, stiffer, and lighter in weight. Wood is most decay-resistant when moisture content is under 20%.

\_\_\_ 2. **Lumber**

\_\_\_ a. *Sizes*

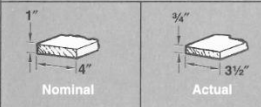
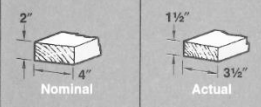
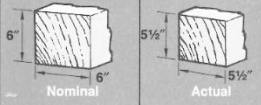
\_\_\_ (1) Sectional

Nominal sizes	To get actual sizes
2×'s up to 8×'s	deduct $\frac{1}{2}$ "
8×'s and larger	deduct $\frac{3}{4}$ "

\_\_\_ (2) Lengths

\_\_\_ (a) Softwoods: cut to lengths of 6' to 24', in 2' increments

\_\_\_ (b) Hardwoods: cut to 1'-long increments

STANDARD LUMBER SIZES				
Type	Nominal Size*		Actual Size*	
	Thickness	Width	Thickness	Width
<b>Common Boards</b>				
 Nominal Actual	1	2	$\frac{3}{4}$	$1\frac{1}{2}$
	1	4	$\frac{3}{4}$	$3\frac{1}{2}$
	1	6	$\frac{3}{4}$	$5\frac{1}{2}$
	1	8	$\frac{3}{4}$	$7\frac{1}{2}$
	1	10	$\frac{3}{4}$	$9\frac{1}{2}$
	1	12	$\frac{3}{4}$	$11\frac{1}{2}$
<b>Dimension</b>				
 Nominal Actual	2	2	$1\frac{1}{2}$	$1\frac{1}{2}$
	2	4	$1\frac{1}{2}$	$3\frac{1}{2}$
	2	6	$1\frac{1}{2}$	$5\frac{1}{2}$
	2	8	$1\frac{1}{2}$	$7\frac{1}{2}$
	2	10	$1\frac{1}{2}$	$9\frac{1}{2}$
	2	12	$1\frac{1}{2}$	$11\frac{1}{2}$
<b>Timbers</b>				
 Nominal Actual	5	5	$4\frac{1}{2}$	$4\frac{1}{2}$
	6	6	$5\frac{1}{2}$	$5\frac{1}{2}$
	6	8	$5\frac{1}{2}$	$7\frac{1}{2}$
	6	10	$5\frac{1}{2}$	$9\frac{1}{2}$
	8	8	$7\frac{1}{2}$	$7\frac{1}{2}$
	8	10	$7\frac{1}{2}$	$9\frac{1}{2}$

\* in in.

## CARPETING

- \_\_\_ 1. **Most wall-to-wall carpeting** is produced by looping yarns through a coarse-fiber backing, binding the backs of the loops with latex, then applying a second backing for strength and dimensional stability. Finally the loops may be left uncut for a rough, nubby surface or cut for a soft, plush surface.
- \_\_\_ 2. **The quality of carpeting** is often determined by its *face weight* (ounces of yarn or pile per square yard), not its total weight. Weights run:
  - \_\_\_ a. Low traffic: 20–24 oz/SY
  - \_\_\_ b. Medium traffic: 24–32 oz/SY
  - \_\_\_ c. High-end carpet: 26–70 oz/SY
- \_\_\_ 3. **A better measure of comparison:**

$$\text{weight density factor} = \frac{\text{face weight} \times 36}{\text{pile height}} = \text{oz/CY}$$

Ideally, this should be as follows:

- \_\_\_ a. Residential: 3000 to 3600 oz/CY
- \_\_\_ b. Commercial: 4200 to 7000 oz/CY
- \_\_\_ 4. **Flame spread:** see p. 458.
- \_\_\_ 5. **There are two basic carpet installation methods:**
  - \_\_\_ a. *Padded and stitched* carpeting: Stretched over a separate pad and mechanically fastened at joints and the perimeter. Soft foam pads are inexpensive and give the carpet a soft, luxurious feel. The more expensive jute and felt pads give better support and dimensional stability. Padding adds to foot comfort, helps dampen noise, and some say, adds to the life of the carpet.
  - \_\_\_ b. *Glued-down* carpets: Usually used in commercial areas subject to heavily loaded wheel traffic. They are usually glued down with carpet adhesive with a pad. This minimizes destructive flexing of the backing and prevents rippling.
- \_\_\_ 6. **Maintenance Factors**
  - \_\_\_ a. **Color:** Carpets in the midvalue range show less soiling than very dark or very light colors. Consider the typical regional soil color. Specify patterned or multicolored carpets for heavy traffic areas in hotels, hospitals, theaters, and restaurants.
  - \_\_\_ b. **Traffic:** The heavier the traffic, the heavier the density of carpet construction. If rolling traffic is a factor, carpet may be of maximum density for minimum resistance to rollers. Select only level-loop or dense, low-cut pile.



## CARPET TYPES

### TYPE OF WEAVE

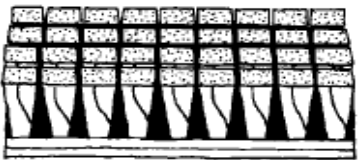
### CHARACTERISTICS AND BEST USES



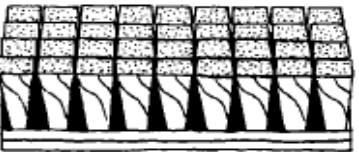
**LEVEL LOOP** : EVEN HEIGHT, TIGHTLY SPACED UNCUT LOOPS. TEXTURE IS HARD AND PEBBLY. HARD WEARING AND EASY TO CLEAN. IDEAL FOR OFFICES AND HIGH TRAFFIC AREAS.



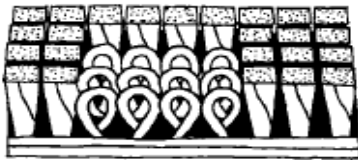
**MULTI-LEVEL LOOP** : UNEVEN HEIGHT IN PATTERNS, TIGHTLY SPACED UNCUT LOOPS. TEXTURE IS HARD & PEBBLY. HARD-WEARING & EASY TO CLEAN. IDEAL FOR OFFICES AND HIGH TRAFFIC AREAS.



**PLUSH 'CUT' PILE** : EVENLY CUT YARNS WITH MINIMAL TWIST. EXTREMELY SOFT, VELVET TEXTURE. VACUUMING AND FOOTPRINTS APPEAR AS DIFFERENT COLORS, DEPENDING ON LIGHT CONDITIONS. IDEAL FOR FORMAL ROOMS W/ LIGHT TRAFFIC.



**FRIEZE 'CUT' PILE** : EVENLY CUT YARNS WITH TIGHT TWIST. EXTREMELY SOFT, VELVET TEXTURE. VACUUMING AND FOOTPRINTS APPEAR AS DIFFERENT COLORS, DEPENDING ON LIGHT CONDITIONS. IDEAL FOR FORMAL RM'S WITH LIGHT TRAFFIC.



**CUT AND LOOP** : COMBINATION OF BOTH PLUSH AND LEVEL-LOOP. HIDES DIRT FAIRLY WELL. IDEAL FOR RESIDENTIAL APPLICATIONS.



**INDOOR-OUTDOOR** : CUT, TIGHTLY TWISTED YARNS THAT TWIST UPON THEMSELVES. TEXTURE IS ROUGH. HIDES DIRT EXTREMELY WELL AND IS NEARLY AS TOUGH AS LEVEL-LOOP. IDEAL FOR RESIDENTIAL APPLICATIONS.

- **Fiber** is the carpet material itself. Single fibers are spun together to create two-, three- or four-ply yarn, which is then attached to a woven backing.
- **Pile** refers to the height of the fiber. Pile is also referred to as "face" or "nap."
- **Density** is the measure of how closely packed the strands of fiber are to one another. The higher the density, the stronger the carpet.
- **Weight** is measured in ounces per square yard. Face weight refers to the amount of fiber on the surface of the carpet, while total weight includes the backing and latex as well. High face weight is a good indication of quality.
- **Texture** comes from the style in which fibers are looped, twisted or cut. This determines the look and feel of the carpet, and plays a large role in its durability.
- **Twist** refers to the number of time fibers turn in a 1-inch length. Higher twist counts are typically more resilient and better resist traffic and crushing.
- **PAR rating** is a 1-5 rating scale for Performance, Appearance and Retention; the higher the number, the more easily it retains its appearance.

## Basic Paints

### PRIMERS / SEALERS:

These coatings are designed to provide the surface for the finish coats of paint or clear finishes.

Primers seal the surface off and provide a "tooth" for the finish paint, they are used on bare wood and metal, previously painted surfaces that have been repaired or are in poor condition, ( flaking, peeling), or if the existing surface is to be painted with a new color that is much darker or lighter than the existing. Primers/Sealers are also used block out stains like water stains, crayon, smoke, soot, ink and on woods that will bleed through a paint coating, e.g., cedar or redwood.

Primers/Sealers insure longer lasting paint work as the resins in the finish paints stay on the surface creating the "wear layer" as they are designed to do. Peeling and premature failure is eliminated and this is by far the most important part in getting a long lasting, durable finish.

### FINISH PAINTS:

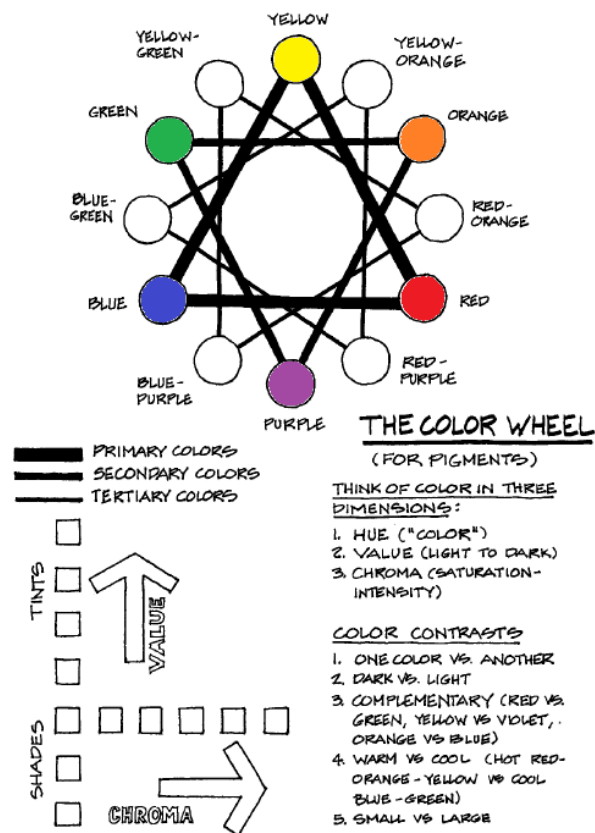
There are two types of paints used today, latex and alkyd. Alkyd paint is also known as oil-based paint. Latex provides an excellent finish, while being an easier paint to use. Latex paint cleans up with soap and water, dries quickly, has less odor, is non-flammable, easy to touch up, they remain more flexible and allow moisture to evaporate through the film thus reducing blistering, cracking and peeling.

Inexpensive latex paints use softer vinyl resins (binders) and more water in the formulation while the more durable of the latex paints use 100% acrylic resins and less water, (you only get what you pay for). The term "Enamel" is normally associated with paints that have some gloss to the finish. Enamels are formulated with higher concentrations of resin as they are intended to be subjected to more wear and tear

### LEVELS of GLOSS:

The sheen of a paint is the amount of light reflected by the surface of a paint finish. There are four basic sheens: flat, satin, semi-gloss and gloss.

### COLOR



**Flat Paints** exhibit non-reflective properties providing a matte finish. This finish helps hide surface imperfections, and is normally used for ceilings and walls in areas not subjected to a lot of wear and tear, dining rooms, living rooms and bedrooms not used by small children.

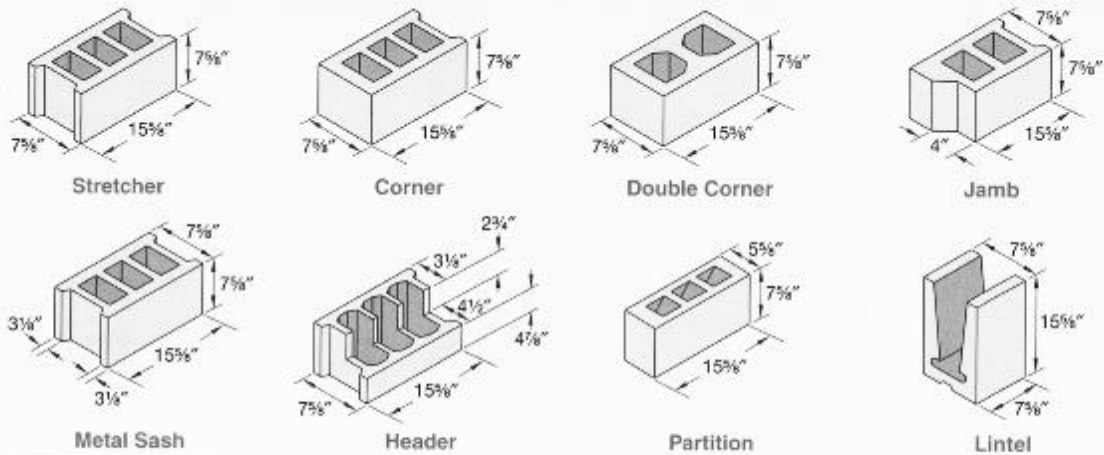
**Satin Finish** also known as eggshell finish, provides a soft luster sheen similar to that of an eggshell. A satin finish provides a harder surface finish which is more durable and more stain resistant than a flat finish. This durability makes satin paint a good choice for walls in children's rooms, hallways, stairways and family rooms.

**Semi-gloss Paints** are very durable, they are easier to clean, and are more stain resistant than satin finish paints. Semi-gloss paints are most often used on heavy wear surfaces or areas that are frequently cleaned such as kitchens and bathrooms. Semi-gloss paint is also used on wood trim and cabinets.

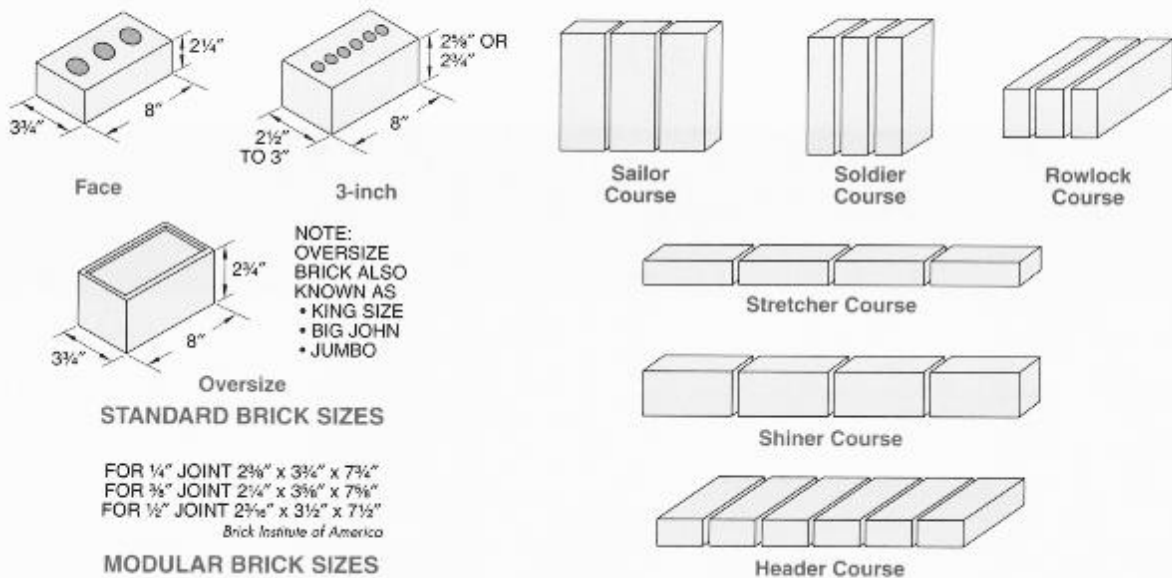
**Gloss Paint** is a harder, more durable, more stain resistant paint finish. It is easier to clean than all the other paint finishes. Gloss finishes generally make surface imperfections more noticeable. Gloss finishes are the best choice for heavy wear areas like kitchens, bathrooms, furniture and cabinets, floors, stairs, handrails, high traffic doors and trim.

## CONCRETE MASONRY UNITS AND BRICK

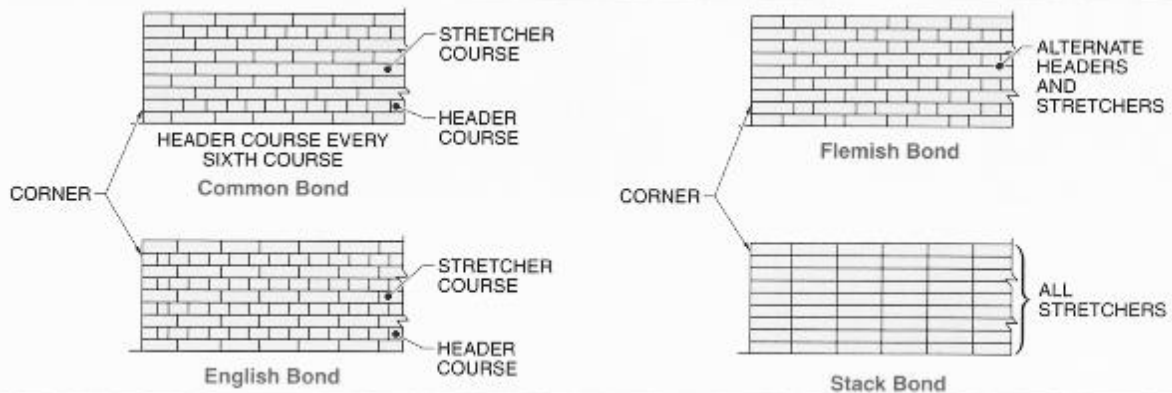
### Concrete Masonry Units



### Brick



### Bonds





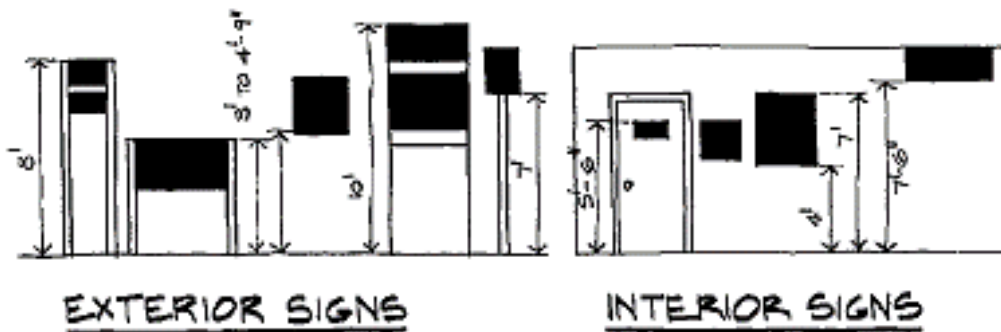
# GRAPHICS

\_\_\_ 1. **General:** Visual identification and direction by signage is very important for “wayfinding” to, between, around, in, and through buildings. Signage is enhanced by:

- \_\_\_ a. Size
- \_\_\_ b. Contrast
- \_\_\_ c. Design of letter character and graphics.



\_\_\_ g. Mounting heights



## RESIDENTIAL KITCHENS

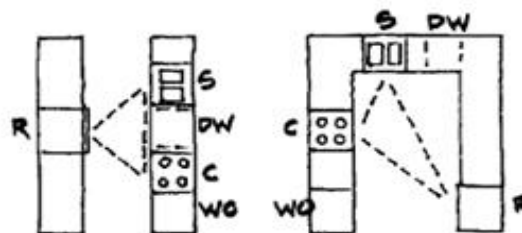
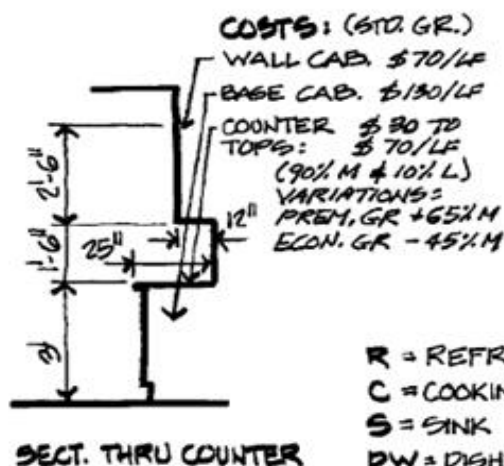
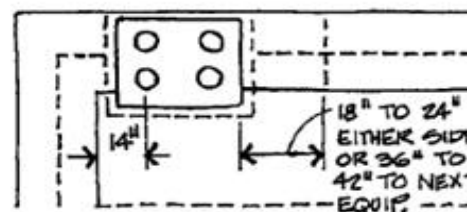
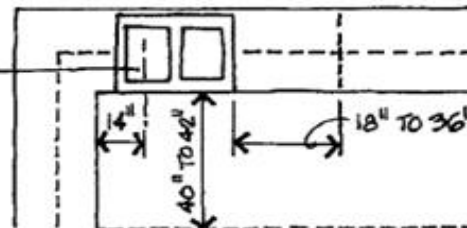
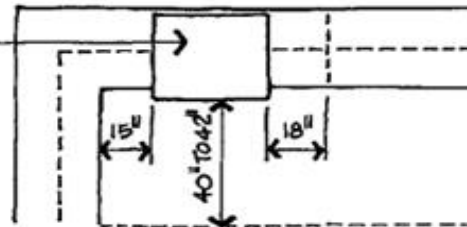
— A. REFRIGERATOR  
33" W x 32" D x 66" H  
\$700 TO \$2200

— B. DISHWASHER  
23" W x 24" D x 33" H  
\$500 TO \$825

— C. SINK  
\$400 TO \$660

— D. RANGE/OVEN  
36" W x 27" D x 36" H  
\$1000 TO \$2750

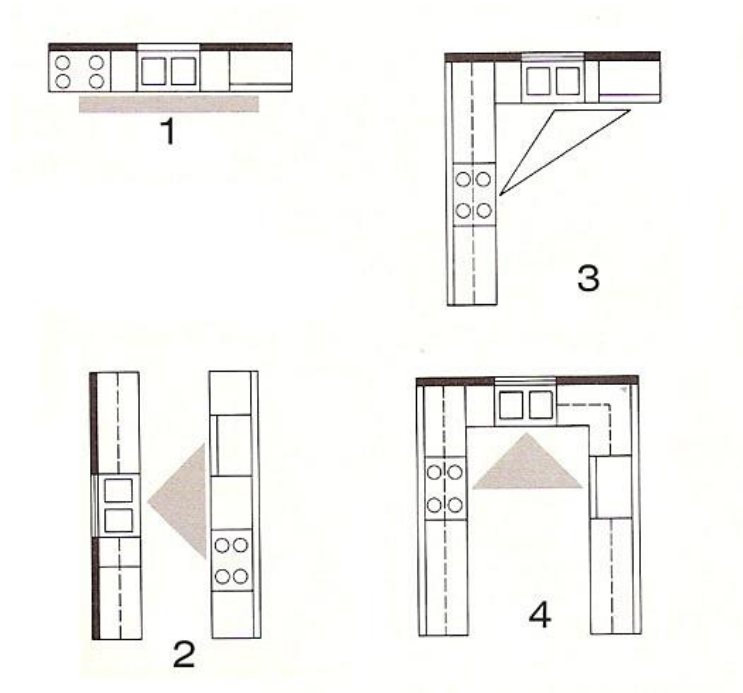
— E. WALL OVEN (MICROWAVE)  
25" W x 22" D x 18" H  
(CUPBOARDS USUALLY ABOVE & BELOW)  
\$320 TO \$680



### NOTES:

1. TOTAL LENGTH OF WORK TRIANGLE  
23 TO 26 LF.
2. SMALL KITCHENS:  
10 TO 20 LF COUNTER / EQ.
3. MIN. 18 SF OF STOR.  
SPACE + 6 SF / PERSON  
SERVED.

R = REFRIGERATOR  
C = COOKING (RANGE/OVEN)  
S = SINK  
DW = DISHWASHER  
WO = WALL OVEN



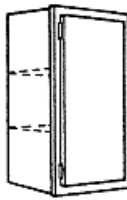
1. **One-wall or Single-line kitchen** is most satisfactory for small open-plan houses and apartments. The work pattern is difficult and tiring in this type of kitchen. Place the sink in the center with the refrigerator and stove at the opposite ends. At least 10' of wall space is needed.
2. **Corridor or Galley kitchen** is efficient in terms of space utilization where you can place the maximum counter space in the smallest space. These kitchens are best for long narrow rooms and typical of many apartments. Allow a minimum of 4' between facing units for access.
3. **L-shaped kitchen** is adaptable to any interior. It can form an efficient work triangle and diverts traffic to some extent. The sequence of centers should be planned: from storage to clean-up to cooking to service. The open end is used as an eating area.
4. **U-shaped kitchen** is the most efficient and functional of the kitchens plans. It is compact, reduces the number of wasted steps. The center may include any work center.

## Residential Spaces

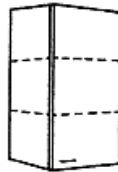
### KITCHENS

#### Cabinet Sizes

FRAMED



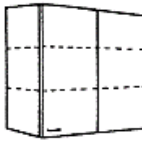
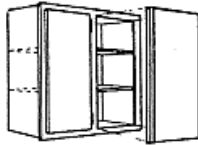
FRAMELESS



#### WALL CABINETS

Wall cabinets are available in heights of 42", 30", 24", 18", 15", and 12". Most cabinets are available in widths ranging from 9" to 48", in 3" increments. Framed wall cabinets are 12"

deep, not including doors. Frameless wall cabinets are 12 $\frac{3}{4}$ " deep, including doors.

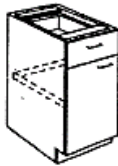
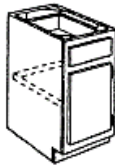


#### WALL BLIND CORNER CABINETS

Wall blind corner cabinets are available in heights of 42", 30", and 24". Most wall blind corner cabinets are available in widths of 24", 27", 30", 33", 36", 42", and 48".

#### DOUBLE-FACE WALL CABINETS

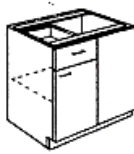
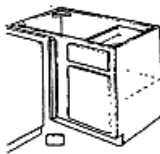
Double-face wall cabinets are available in heights of 30", 24", and 18". Most are available in widths of 18", 24", 30", 36", 42", and 48". Framed cabinets are 13 $\frac{1}{4}$ " deep with doors. Frameless are 13 $\frac{1}{2}$ " deep with doors.



#### BASE CABINETS

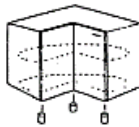
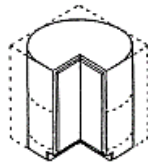
All base cabinets are 34 $\frac{1}{2}$ " tall. Most are available in widths ranging from 9" to 48", in 3" increments. Framed base cabinets are 24" deep, not including doors. Frameless base cabinets are 24 $\frac{3}{4}$ " deep, including doors.

Four-drawer base cabinets are available in widths ranging from 12" to 24", in 3" increments. Frameless base cabinets are also available in a three-drawer style in widths of 30" and 36".



#### BASE BLIND CORNER CABINETS

All base blind corner cabinets are 34 $\frac{1}{2}$ " high. Most are available in widths of 24", 30", 36", 39", 42", and 48".



#### SPECIALTY CABINETS

Lazy Susans:

36"-Wide

Range Hoods: (framed only)

36" & 30"-Wide

Wall What-Not Shelves: (framed only)

30"-High

Base Open Shelves: (framed only)

34 $\frac{1}{2}$ "-High

Pantries: (framed only)

36" x 66"

Utility Cabinets: (framed)

24" x 66"

18" x 66"

In 12" and 24" Depths

Utility Cabinets: (frameless)

24" x 65 $\frac{1}{2}$ "

18" x 65 $\frac{1}{2}$ "

In 12 $\frac{3}{4}$ " and 24 $\frac{3}{4}$ " Depths

Tilt-Out Range Hoods: (frameless only)

30" x 24"

Glass Door Wall Cabinets: (frameless only)

30" & 36"-Wide

Microwave Cabinets: (framed only)

30" x 21"

Microwave Shelves:

30" x 22 $\frac{3}{4}$ " (framed)

30" x 18" (frameless)

Oven Cabinets: (framed)

27" x 66"

30" x 66"

33" x 66"

Oven Cabinets: (frameless)

27" x 65 $\frac{1}{2}$ "

30" x 65 $\frac{1}{2}$ "

33" x 65 $\frac{1}{2}$ "

Up to six 6" drawers can be added to frameless oven cabinets.

### Ventilation

- Provide natural ventilation by means of openable exterior openings with an area not less than  $\frac{1}{20}$  of the floor area with a minimum of 5 s.f. (0.46 m<sup>2</sup>).
- A mechanical ventilating system providing a minimum of two air changes per hour may be employed in lieu of natural ventilation.
- Range center may be ventilated by a hood with an exhaust fan:
  - Vertically through roof
  - Directly through exterior wall
  - Horizontally to outside through soffit above wall cabinets.
- Self-venting cooktops may exhaust directly to outside or, if in an interior location, through a duct in the floor system.

### Countertop Surfaces

- The countertop surface may be plastic laminate, butcher block, ceramic tile, marble or granite, synthetic stone, concrete, or stainless steel.
- Provide a heat-resistant surface next to the range.

### Lighting

- Provide natural light by means of exterior glazed openings with an area not less than  $\frac{1}{10}$  of the floor area or a minimum of 10 s.f. (0.93 m<sup>2</sup>).
- The building code typically allows residential kitchens to be illuminated solely with artificial lighting.
- In addition to general area lighting, task lighting is required over each of the work centers and over countertops.

### Electrical

- A minimum of two circuits for small appliances should be provided with outlets spaced 4' (1220) o.c. and about 6" (150) above the countertop. These circuits should be protected by a ground fault interrupter (GFI).
- Special, single-outlet circuits are required for permanently installed appliances such as electric ranges and ovens.
- Separate circuits are also required for appliances such as the refrigerator, dishwasher, garbage disposal unit, and microwave oven.

### Gas

- Gas appliances require separate fuel supply lines.

### Plumbing

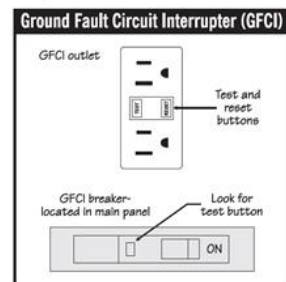
- Water supply lines for the sink and dishwasher are required.
- Waste lines for the sink, waste disposal unit, and dishwasher are required.
- See 11.22–11.26.

### Heating

- Supply registers are usually located under base cabinets.

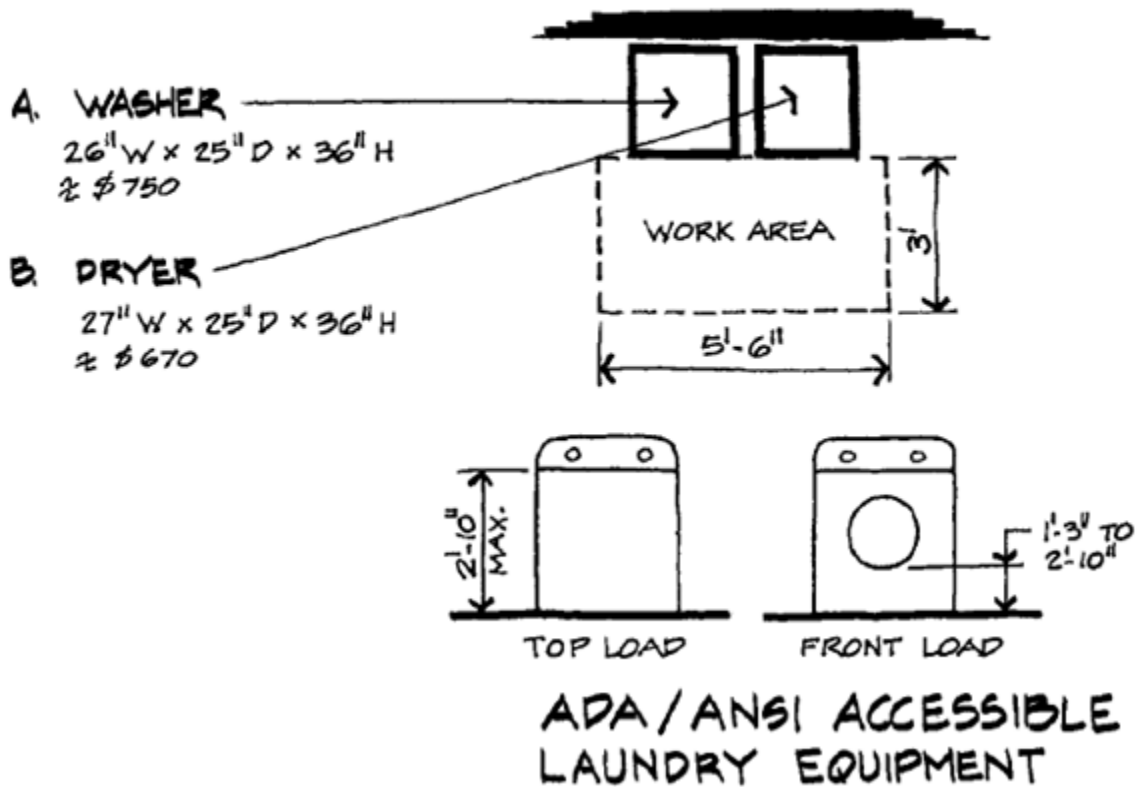
### Flooring

- Flooring should be slip-resistant, durable, easy to maintain, and resistant to water and grease.





# RESIDENTIAL LAUNDRIES



## BASIC DESIGN REQUIREMENTS:

HOT/COLD WATER SUPPLY

\*GAS SUPPLY IF GAS DRYER

\*30AMP ELECTRIC OUTLET IF ELECTRIC

20 AMP DUPLEX OUTLET

WATER DRAIN OUTLET

HOT AIR VENT TO EXTERIOR

— CW —

— HW —

I  
G

⊕  
D DUPLEX POWER RECEPTACLE  
ON DEDICATED CIRCUIT

⊕ DUPLEX POWER RECEPTACLE

○ D

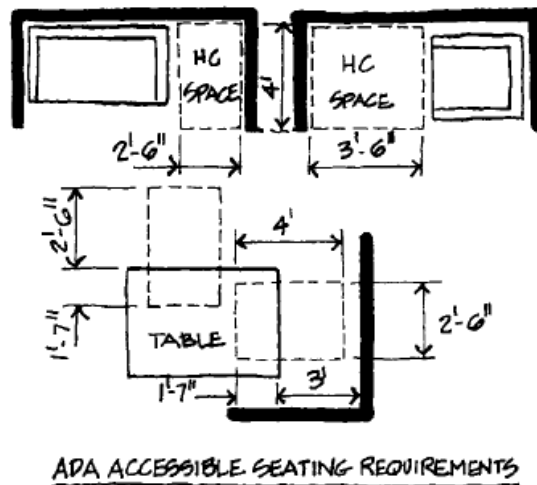
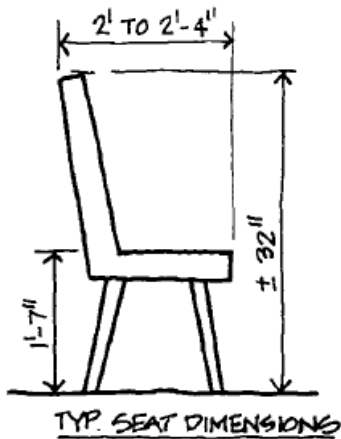
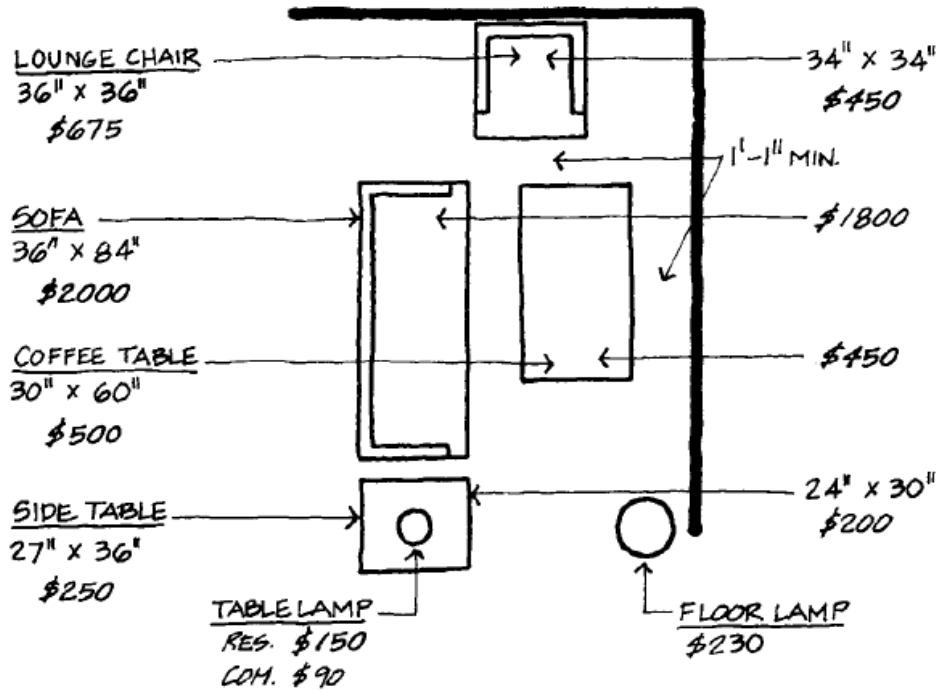
## LIVING/DINING/BEDROOMS

### 2. Living/Waiting

Note: Desirable conversation area is a 10' diameter.

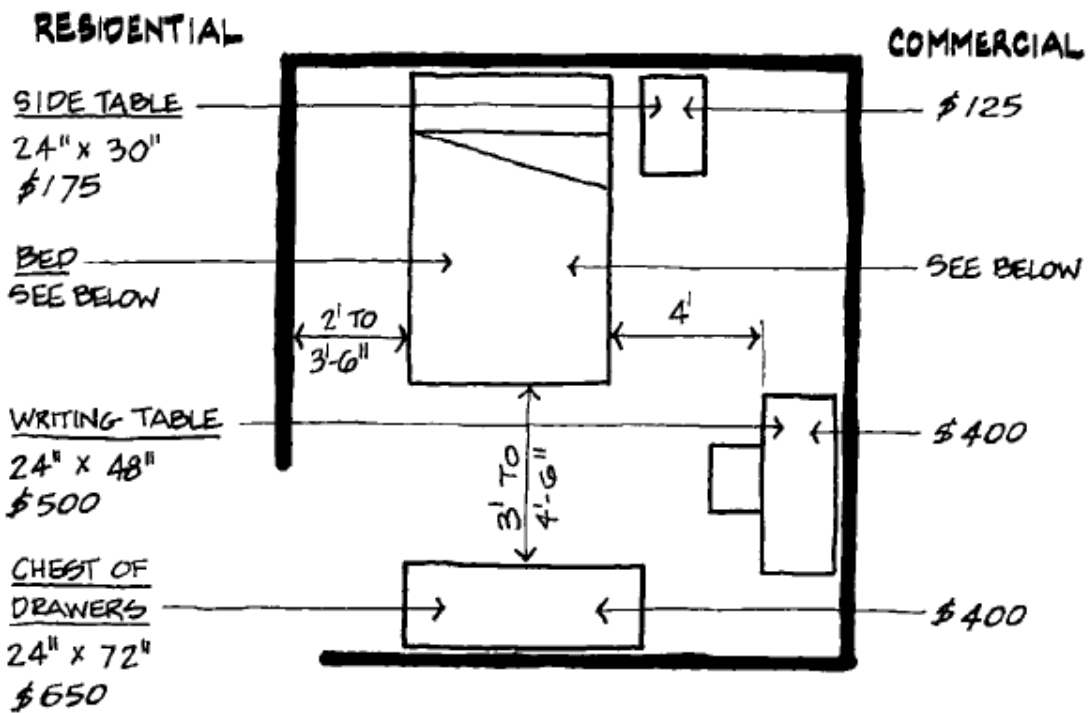
#### RESIDENTIAL

#### COMMERCIAL





### 3. Bedroom/Guestroom



#### BED SIZES

	W	L
KING	72	84
QUEEN	60	82
DOUBLE	54	82
SINGLE	39	82
DAY BED	30	75
CRIB	30	53

**COST: BEDS: \$500 TO \$1000/EA**

(mattress cost additional  
\$90 to \$2000+ per set)

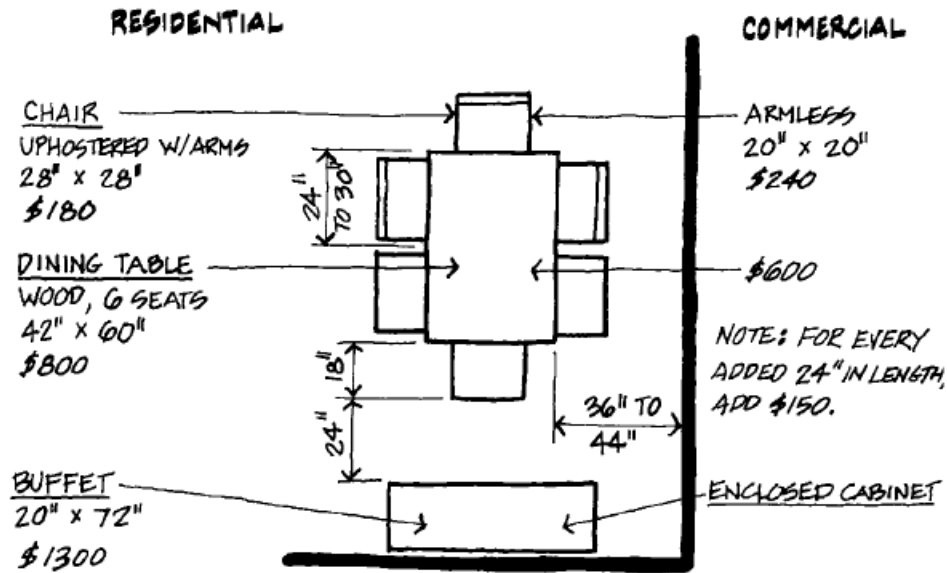
#### **BASIC DESIGN REQUIREMENTS:**

SEE PLAN OF OUTLETS IN A TYPICAL ROOM ELECTRICAL SECTION

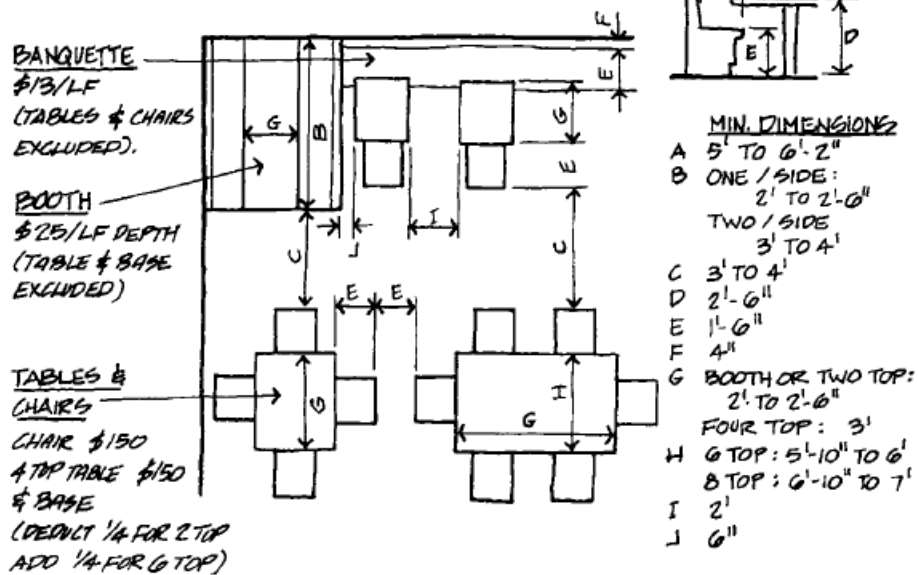
ONE OUTLET SHOULD BE WIRED TO LIGHT SWITCH

SEE HABITABLE ROOM REQUIREMENTS

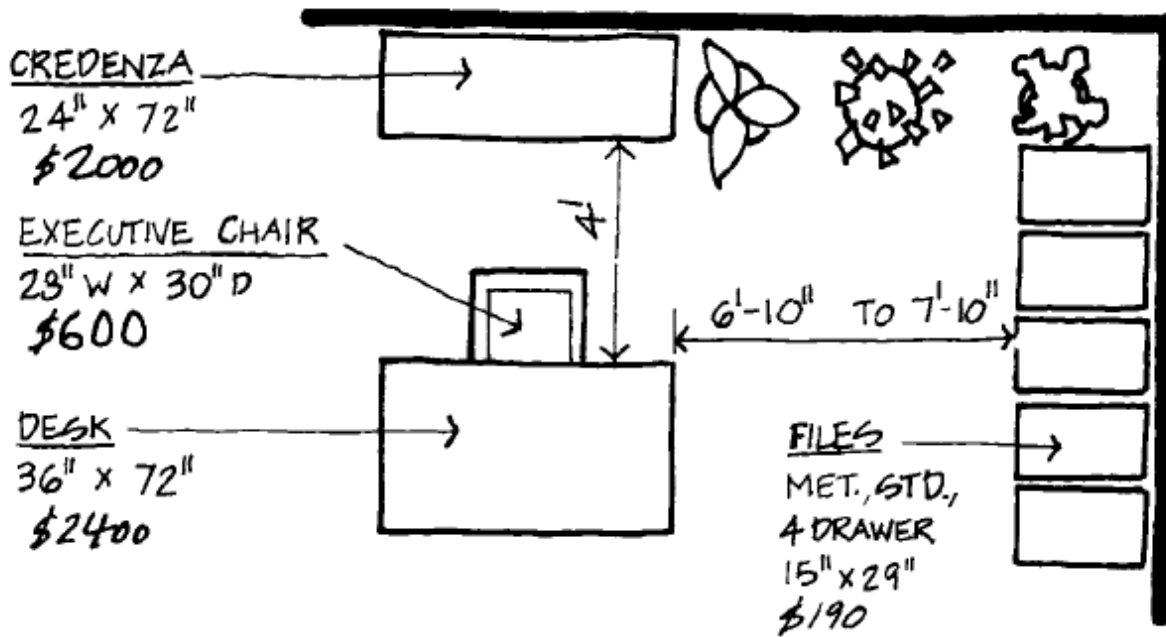
#### 4. Dining/Conference



#### 5. Restaurant Seating

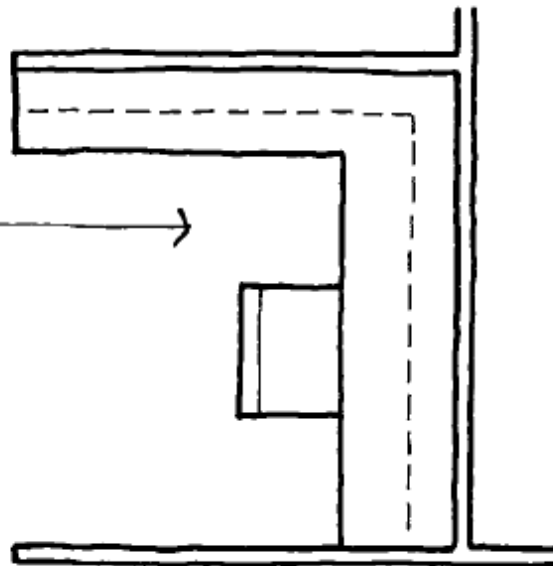


## \_\_\_ 6. Office



OPEN OFFICE MODULE  
4' TO 8'-6" SQ

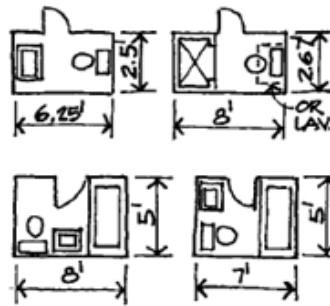
COSTS:  
\$475 TO \$4370 / PERSON



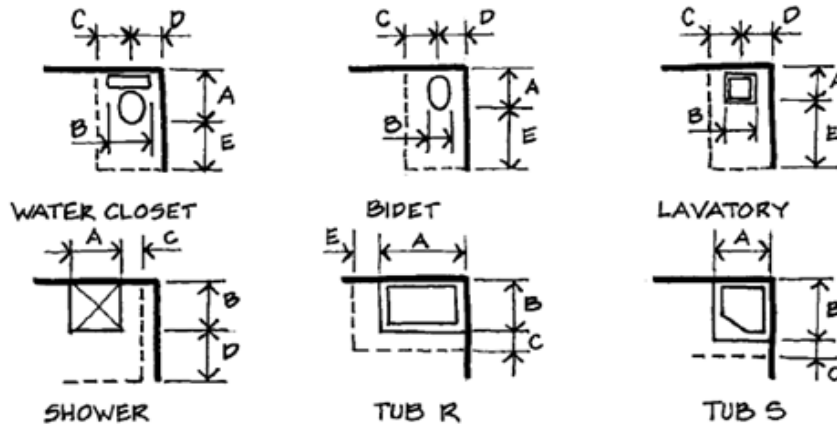
# BATHROOMS

The following systems need to be considered:

- 1. Fixture count by code
- 2. Water supply (p. 528)
- 3. Plumbing fixtures (p. 529)
- 4. Sanitary sewer (p. 530)
- 5. Rain water/storm sewer (p. 531)
- 6. Fire protection (p. 533)
- 7. Landscape irrigation (p. 537)
- 8. Gas (p. 537)
- 9. Other specialties (process, etc.)

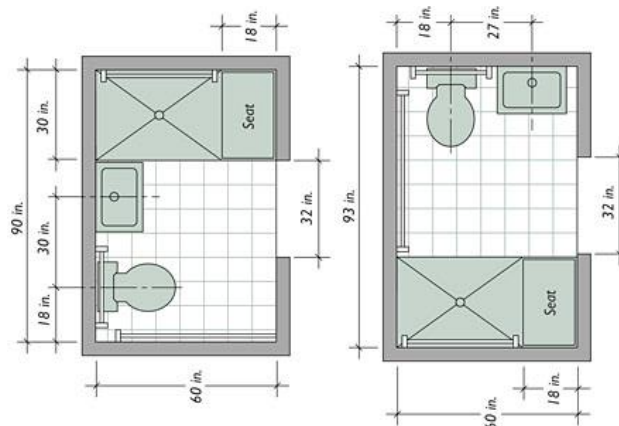


## RESIDENTIAL BATHROOMS



FIXTURE SIZES AND CLEARANCES (INCHES)

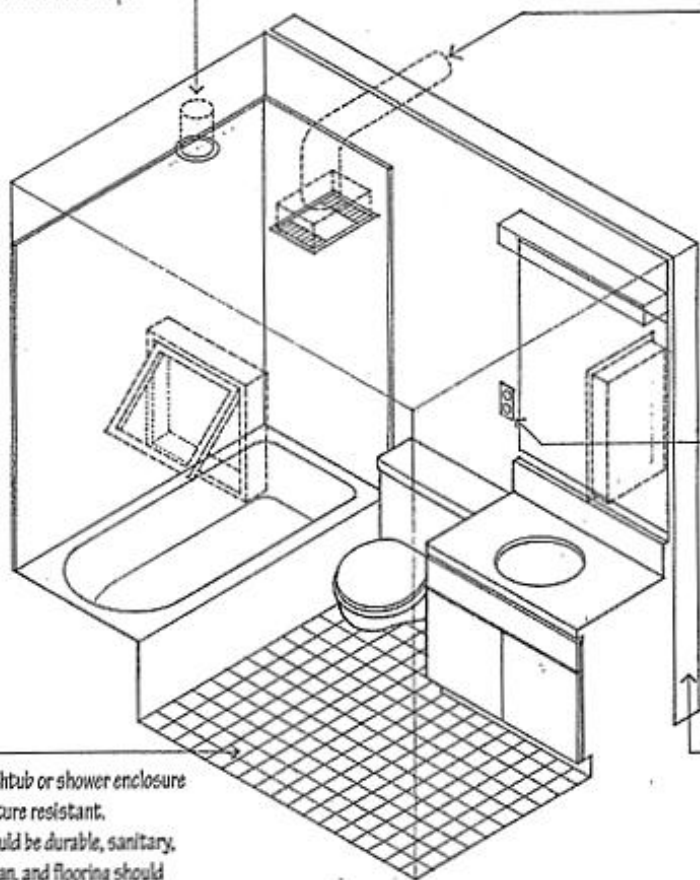
FIXTURE	A		B		C		D		E	
	MIN.	LIB.	MIN.	LIB.	MIN.	LIB.	MIN.	LIB.	MIN.	LIB.
WATER C.	27	31	19	21	12	18	15	22	18	34 - 36
BIDET	25	27	14	14	12	18	15	22	18	34 - 36
LAVATORY	16	21	18	30	2	6	14	22	18	30
SHOWER	32	36	34	36	2	8	18	34		
TUB R	60 STD	72	30 STD	42	2	8	18 - 20	30 - 34	2	8
TUB S	38		39		2	4				



## 9.30 THE BATHROOM SPACE

### Lighting

- Natural lighting by means of exterior glazed openings is always desirable.
- A single overhead light fixture is usually not acceptable; auxiliary lighting is required over the tub or shower, over the lavatory and vanity counter, and over any compartmentalized toilet spaces.
- The light fixture over the tub or shower should be resistant to water vapor.



### Finishes

- Backing for bathtub or shower enclosure should be moisture resistant.
- All finishes should be durable, sanitary, and easy to clean, and flooring should have a nonslip surface.

### Heating

- Heating may be supplied in the conventional manner through warm-air registers in the floor, hydronic or electric baseboard units, or electric resistance heaters in the wall.

### Ventilation

- Bathrooms require either natural or mechanical ventilation in order to remove stale air and supply fresh air.
- Provide natural ventilation by means of openable exterior openings with an area not less than  $\frac{1}{20}$  of the floor area or a minimum of  $1\frac{1}{2}$  s.f. (0.14 m<sup>2</sup>).
- A mechanical ventilating system may be employed in lieu of natural ventilation. The ventilating fan should be located close to the shower and high on an exterior wall opposite the bathroom door. It should be connected directly to the outside and be capable of providing five air changes per hour. The point of discharge should be at least 3' (915) away from any opening that allows outside air to enter the building.
- Residential exhaust fans are often combined with a light fixture, a fan-forced heater, or a radiant heat lamp.

### Electrical

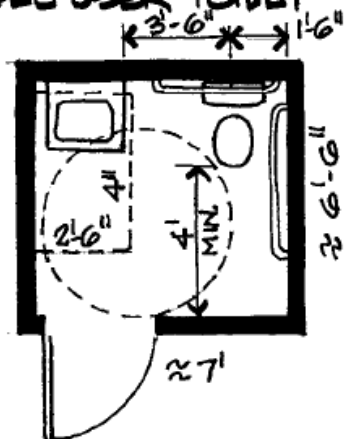
- Electrical switches and convenience outlets should be located where they are needed but away from water or wet areas. They should not be accessible from a bathtub or shower.
- All convenience outlets should be protected by a ground fault interrupter (GFI); see 11.30.

### Plumbing

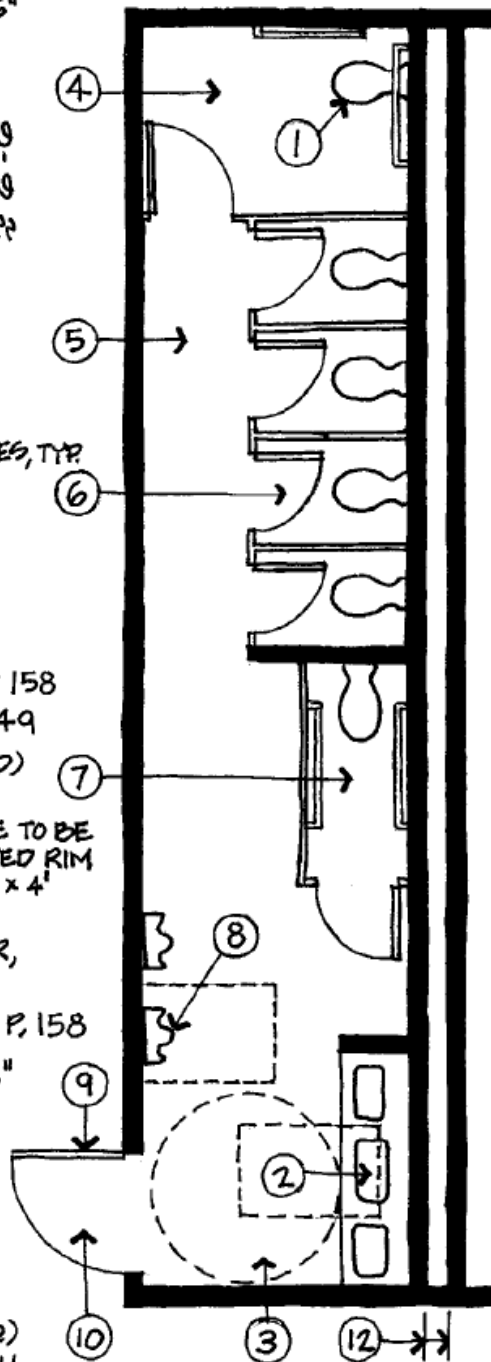
- Plumbing walls should have sufficient depth to accommodate the required water supply and waste lines and vents.
- See 11.22–11.26.
- Space is required for accessories such as a medicine cabinet, mirror, towel bars, toilet paper holder, and soap dish.
- Storage space is required for towels, linen, and cleaning supplies.

## TOILET ROOMS

### SINGLE USER TOILET



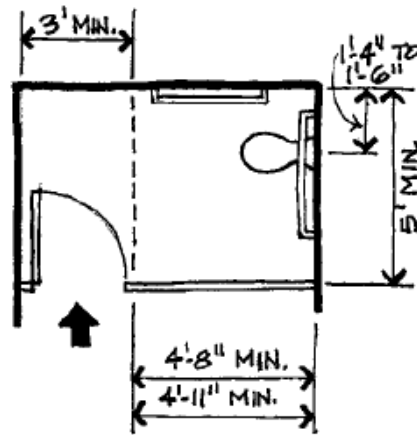
### PUBLIC TOILET



- ① HC WC, SEE FOLLOWING PAGES, TYP
- ② ACCESSIBLE LAVATORY
- ③ 5' DIA. TURNING CIRCLE, SOMEWHERE IN ROOM
- ④ STANDARD HC STALL (AT LEAST ONE)
- ⑤ ACCESSIBLE PATH, SEE P. 158
- ⑥ REGULAR STALLS, SEE P. 449
- ⑦ SIXTH STALL (IF REQUIRED) TO BE HC ALTERNATIVE
- ⑧ IF URINALS, AT LEAST ONE TO BE ACCESSIBLE W/ ELONGATED RIM AT 1'-5" AFF MAX. & 2'-6" x 4' SPACE IN FRONT.
- ⑨ ACCESSIBLE ENTRY DOOR, SEE P. 401
- ⑩ ACCESSIBLE, ROUTE, SEE P. 158
- ⑪ PLUMBING WALL, 6" TO 8"
- ⑫ PLUMBING CHASE:  
 4" FOR SINGLE LAV., URINAL OR WC (FLOOR MT'D.)  
 6"-8" FOR BATTERY OF WC (FLOOR MT'D.) OR BACK TO BACK WC (FLOOR MT'D.)  
 12" FOR BATTERY OF WC (WALL MT'D.) OR BACK TO BACK UR (WALL MT'D.)



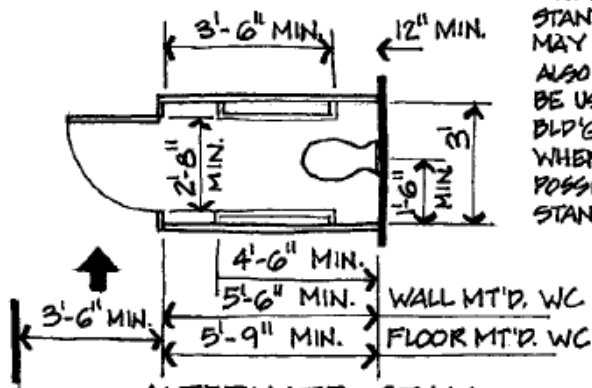
(ADA  
ANSI)



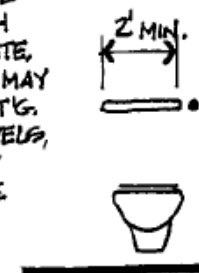
### STANDARD STALL

**STANDARD STALL**  
**(END OF ROW)**

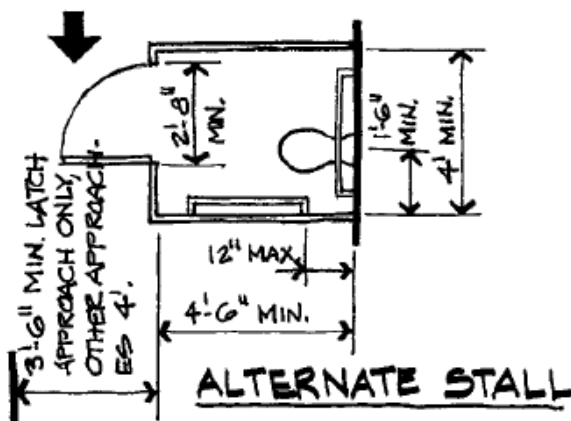
FIRST STALL TO BE STANDARD. SIXTH MAY BE ALTERNATE, ALSO ALTERNATE MAY BE USED IN EXIST'G. BLD'GS & REMODELS, WHERE IT IS NOT POSSIBLE TO USE STANDARD.



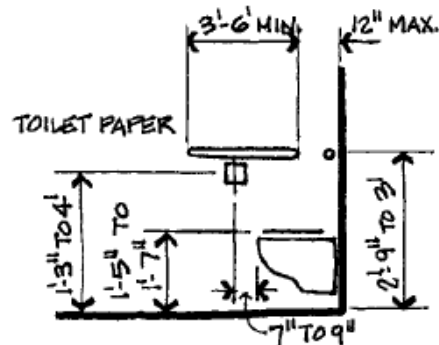
## ALTERNATE STALL



## REAR WALL



### ALTERNATE STALL

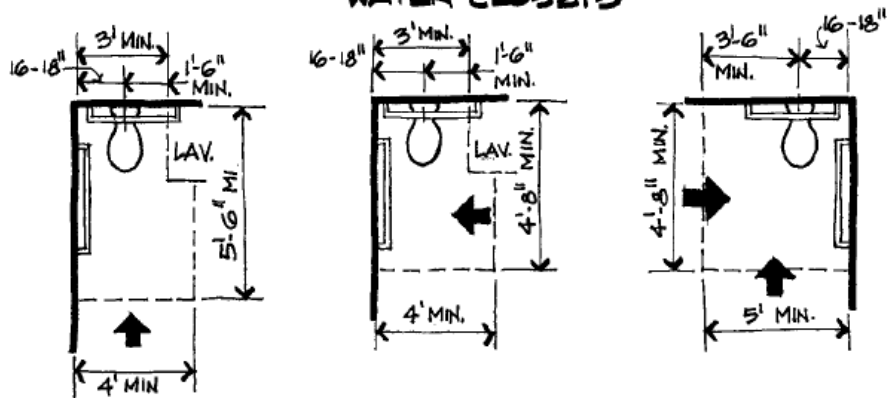


SIDE WALL

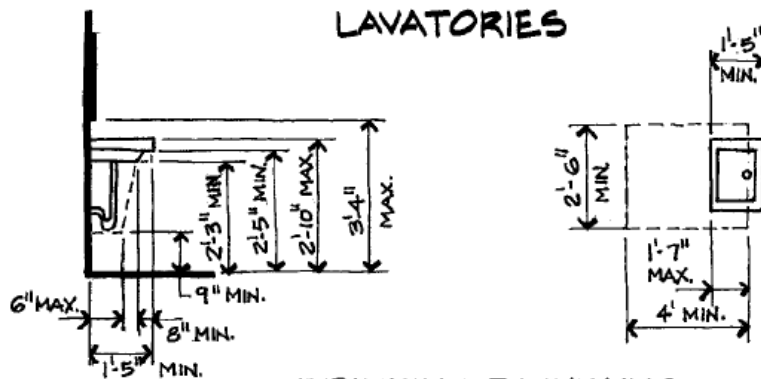


# ACCESSIBLE FIXTURES (ADA)

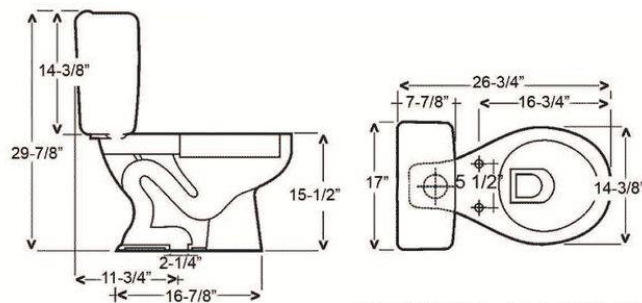
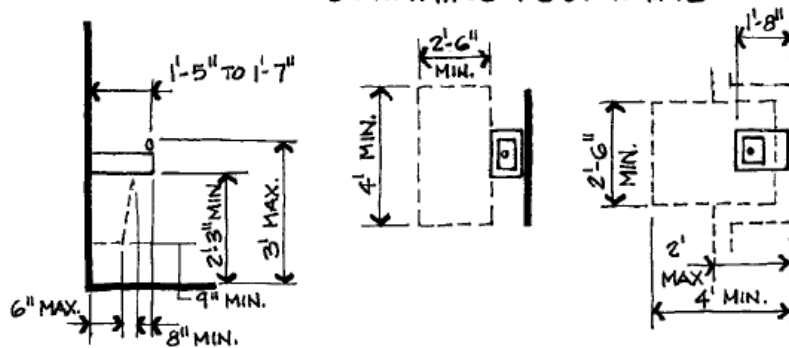
## WATER CLOSETS



## LAVATORIES

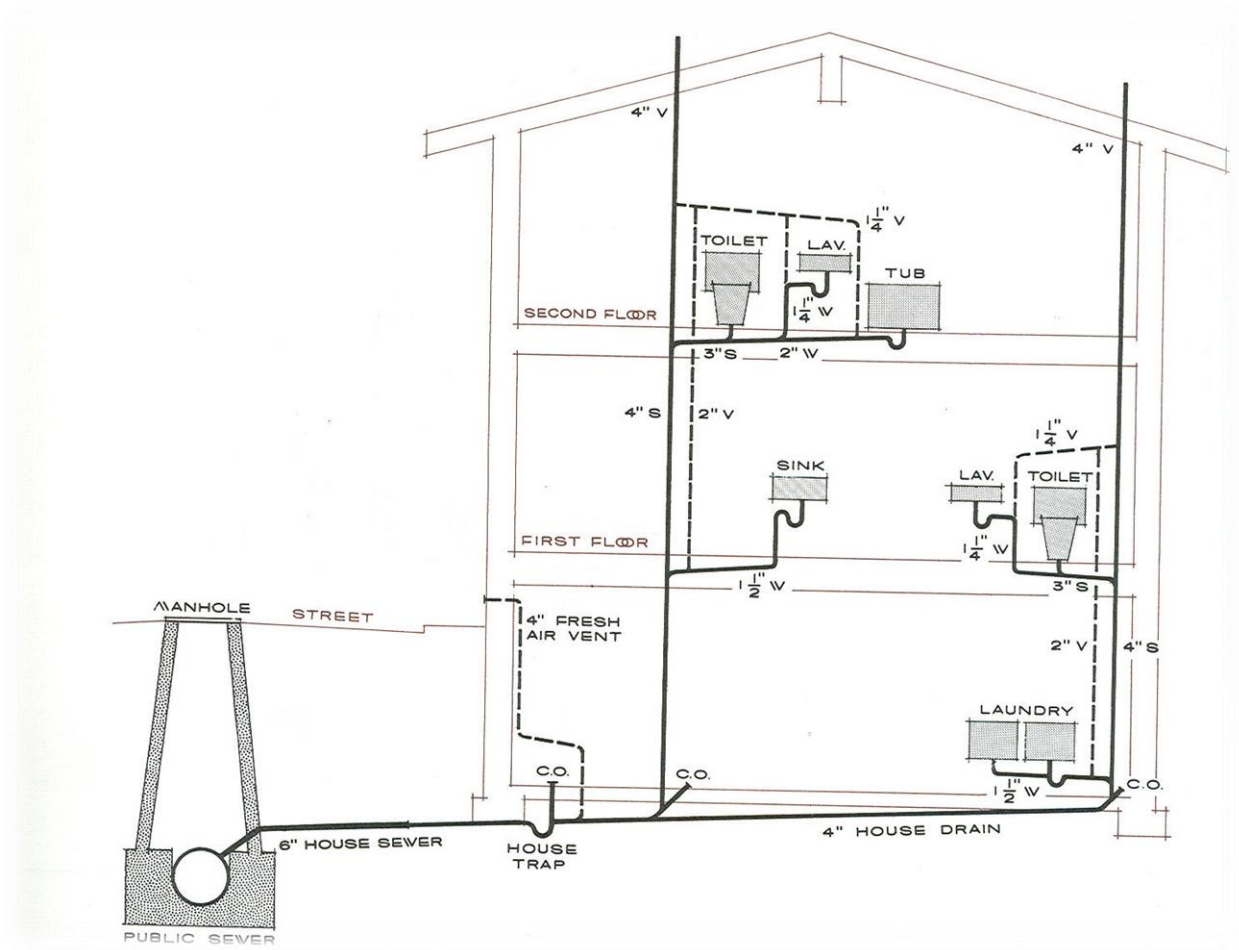


## DRINKING FOUNTAINS

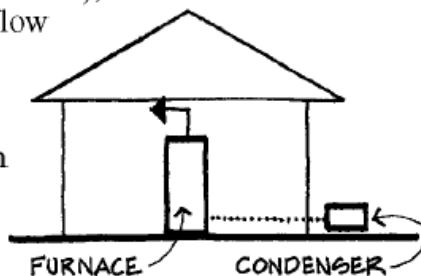


► 12" Rough ► Footprint: 9 3/4" x 16 7/8"

Dimensions of fixture are nominal and may vary within the range of tolerances established by ASME Standard A112.19.2-2008. Dimensions and specifications subject to change without notice.

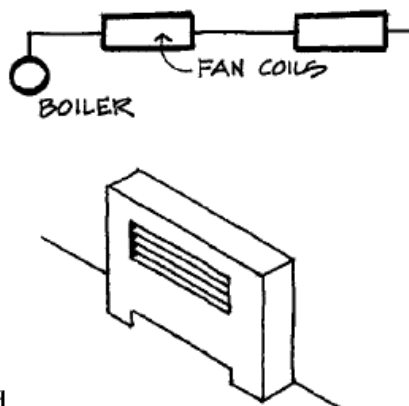


- b. Forced-air central heating is typically used for residential and light commercial buildings. It heats air with gas, oil flame, or elect. resistance at a furnace. A fan blows air through a duct system. The furnace can be upflow (for basements), side flow, or down flow (for attic). The furnace must be vented. Furnace sizes range between  $2'W \times 2.5'D \times 7'H$  to  $4'W \times 7'D \times 7'H$ . Main ducts are typically  $1' \times 2'$  horizontal and  $1' \times .33'$  vertical.

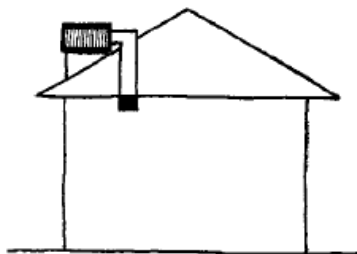


Can add cooling with a “split system” by adding evaporator coils in the duct and an exterior condenser. Typical condensers range from  $2'W \times 2'D \times 2'H$  to  $3.5'W \times 4'D \times 3'H$ .

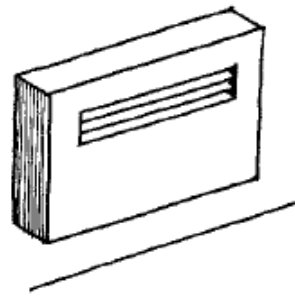
- c. Forced hot water heating is typically used for residential buildings and commercial offices. A burner or electric resistance heats water to fin tube convectors (or fan coil unit with blowers). The fueled boiler must be vented and provided with combustible air. Boiler sizes range from  $2'W \times 2'D \times 7'H$  to  $3'W \times 5'D \times 7'H$ . Fin tube convectors are typically  $3''D \times 8''H$ . Fan coils are  $2'W \times 2.5'H$ . There is *no* cooling.



- d. Evaporative cooling is typically used for residential buildings. It works only in hot, dry climates. A fan draws exterior air across wet pads and into the duct system. There is *no* heating. Cooler size typically is  $3'W \times 3'D \times 3'H$ . Main duct is typically  $1.5'W \times 1.5'D$ .



- e. Through-wall units and package terminal units are typically used for motels/hotels as well as small offices. They are self-contained at an exterior wall and are intended for small spaces. These are usually electric (or *heat pump* in mild climates), which are used for *both* heating and cooling. Interior air is recirculated and outside air is added. Typical sizes:



Package Terminal Units	3.5'W × 1.5'D × 1.3'H
Through-Wall Units	2'W × 2'D × 1.5'H

- f. Electric baseboard convectors are typically used for residential buildings and commercial offices. They heat by electrical resistance

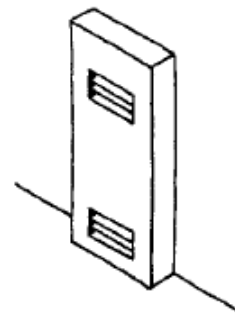


in 3"D × 8"H baseboards around the perimeter of the room. There is *no cooling*.

- g. Electric fan-forced unit heaters are much like item f above, but are larger because of internal fans recirculating the air. There is *no cooling*. Typical sizes range from 1.5'W × 8"D × 8"H to 2'W × 1'D × 1.8'H.

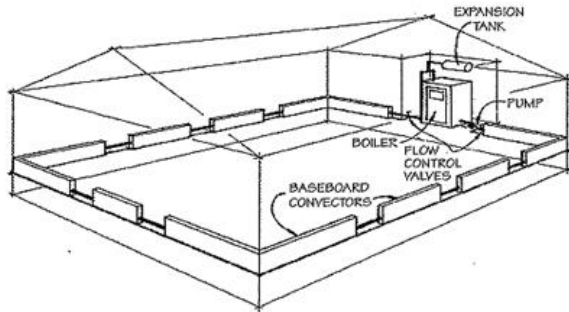
- h. Radiant heating: Electrical resistance wires are embedded in floor or ceiling. There is *no cooling*. An alternative is to have recessed radiant panels, typically 2' × 2' or 2' × 4'. For alternative cooling and heating use water piping. These are typically residential applications.

- i. Wall furnaces are small furnaces for small spaces (usually residential). They must be vented. There is *no cooling*. They may be either gas or electric. The typical size is 14"W × 12"D × 84"H.

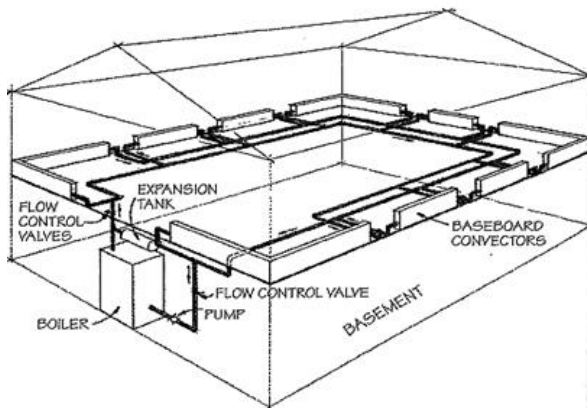


- j. Other miscellaneous small systems (typically residential):  
 — Passive solar heating (see p. 555)

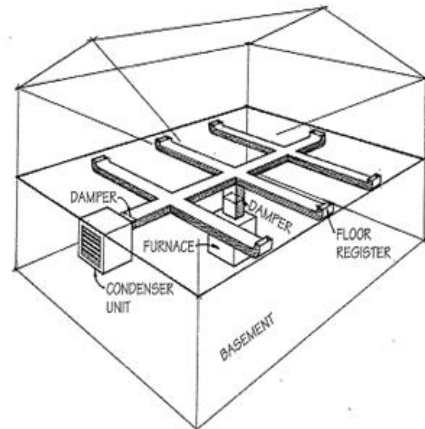
## HEATING COOLING SYSTEM BASIC LAYOUTS



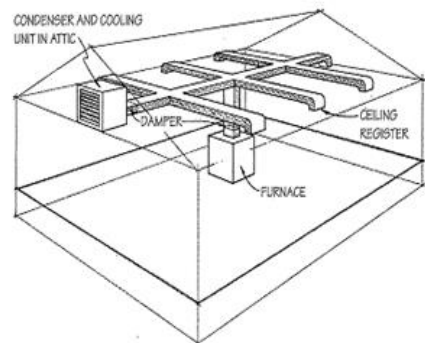
**FIGURE 19-12** One-pipe hot-water heating system with baseboard convectors in the rooms.



**FIGURE 19-13** Two-pipe, reverse-return hot-water heating system with baseboard convectors. The boiler is installed in the basement.



**FIGURE 19-9** Forced-air heating-cooling distribution system using rectangular ducts. The furnace and the cooling unit are placed in the basement.



**FIGURE 19-10** Forced-air heating-cooling distribution system using rectangular ducts to ceiling registers. The furnace is placed on the first floor, and the cooling unit is placed in the attic. Forced-warm-air furnaces can also be placed in the attic, and cooling units are available for placement outside.



## Basic Types of Lighting

There are three basic types of lighting that work together in your home:

1. **Ambient (general lighting)**
2. **Task**
3. **Accent**

A good lighting plan combines all three types to light an area according to function and style.



**Ambient lighting** provides an area with overall illumination. Also known as general lighting, it radiates a comfortable level of brightness without glare and allows you to see and walk about safely. In some spaces such as laundry rooms, the ambient lighting also serves as the primary source of task lighting.

It can be accomplished with chandeliers, ceiling or wall-mounted fixtures, recessed or track lights and with lanterns mounted on the outside of the home. Having a central source of ambient light in all rooms is fundamental to a good lighting plan.



**Task lighting** helps you perform specific tasks, such as reading, grooming, preparing and cooking food, doing homework, working on hobbies, playing games and balancing your checkbook. It can be provided by recessed and track lighting, pendant lighting and under cabinet lighting, as well as by portable floor and desk lamps.

Task lighting should be free of distracting glare and shadows and should be bright enough to prevent eye strain.



**Accent lighting** adds drama to a room by creating visual interest. As part of an interior design scheme, it is used to draw the eye to houseplants, paintings, sculptures and other prized possessions. It can also be used to highlight the texture of a brick or stone wall, window treatments or outdoor landscaping.

To be effective, accent lighting requires at least three times as much light on the focal point as the general lighting surrounding it.

Accent lighting is usually provided by recessed and track lighting or wall-mounted picture lights.

## Lighting Measurement Terminology

Wattage: *The amount of electricity consumed by a light source*

Lumens: *The amount of light that a light source produces*

Efficacy: *Lumens per watt*

Foot-candles: *The amount of light reaching a subject*

## Types of Bulbs

### INCANDESCENT

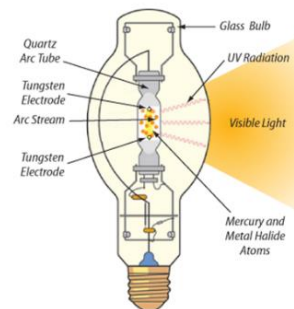


### FLUORESCENT

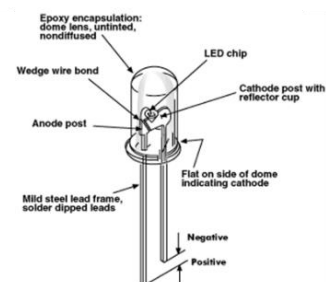


### HIGH-INTENSITY DISCHARGE

#### High-Intensity Discharge



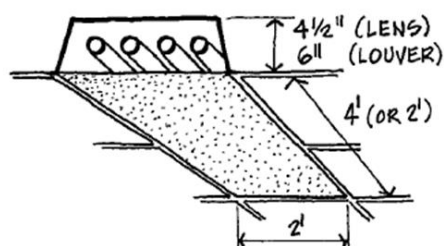
### LED





Wide-beam diffuse lighting is often fluorescent lights for normal ceiling heights (8' to 12'). The fixtures will produce a repetitive two-dimensional pattern that becomes the most prominent feature of the ceiling plane. Typical S/MH = 1.5.

Typical recessed fluorescent fixture:

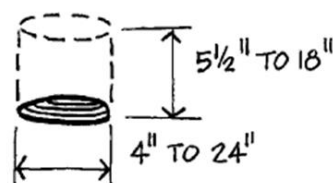


Medium-beam downlighting is produced with a fixture located in or on the ceiling that creates a beam of light directed downward. In the circulation and lobby areas of a building, *incandescent lamps* are often used. For large areas, *HID lamps* are often selected. In both cases the light is in the form of a *conical*

*beam*, and *scallops* of light will be produced on wall surfaces.

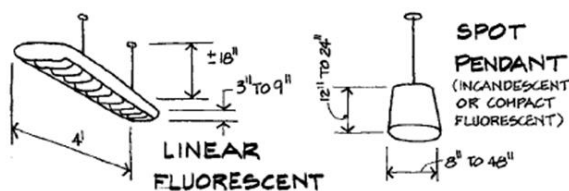
S/MH is usually about 0.7 to 1.3.

fixture:



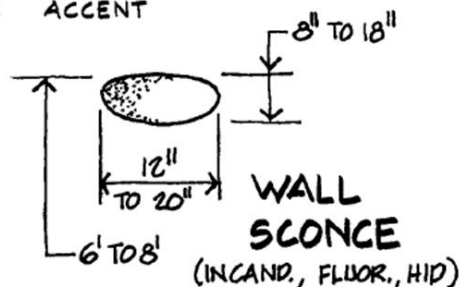
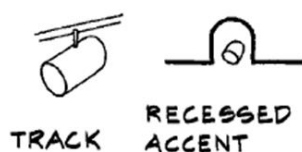
All systems other than direct ones necessarily imply that the lighting fixtures are in the space, whether pendant-mounted, surface-mounted, or portable. A semidirect system will provide good illumination on horizontal surfaces, with moderate general brightness.

Typical fixtures:



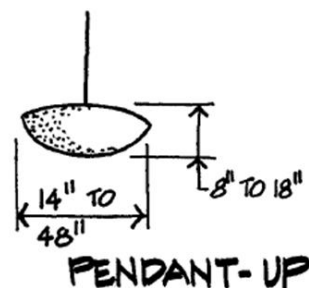
Used for special effects or spot lighting, such as lighting art objects or products on display.

Typical fixtures:



A semi-indirect system will place the emphasis on the ceiling, with some downward or outward-directed light.

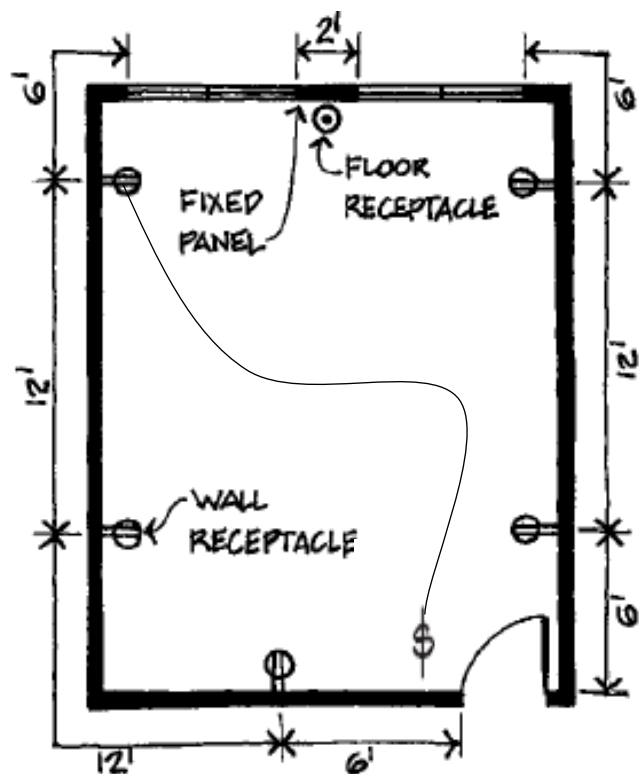
Typical fixture:



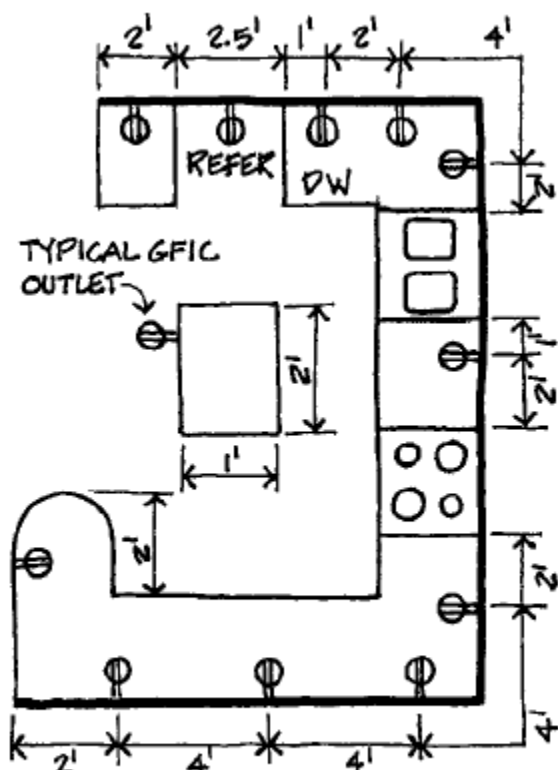
## ELECTRICAL DESIGN FOR RESIDENCES

Residential electrical requirements are set by **NFPA 70A**, *Electrical Code for One & Two Family Dwellings*, which sets the distances for electrical outlets and mandates the use of GFCIs in wet locations. Electrical outlets are not permitted directly above baseboard heating units in newer buildings. Ranges and ovens, open-top gas broiler units, clothes dryers, and water heaters have their own specific code requirements or standards. Electrical codes require that every room, hallway, stairway, attached garage, and outdoor entrance must have a minimum of one lighting outlet controlled by a wall switch. In rooms other than the kitchen and bathroom, the wall switch can control one or more receptacles for plugging in lamps rather than actual lighting outlets for ceiling- or wall-mounted lights. One lighting outlet of any type is required in each utility room, attic, basement, or underfloor space that is used for storage or that contains equipment that may require service. The number of branch circuits required for a residence, including an allowance for expansion, is estimated by allotting one 15-A circuit per 37 to 45 square meters (400–480 square ft), or one 20-A circuit per 49 to 60 square meters (530–640 square ft) plus an allowance for expansion, with more provided as needed.

The NEC requires a minimum of one 20-A appliance circuit exclusively for laundry outlets. In addition, an individual 30-A, 120/240V major appliance circuit, separate from the laundry circuit and rated for an electric dryer, must be supplied along with a heavy duty receptacle, unless it is certain that a gas dryer will be used. Places that are often used for workshop-type activities, like garages, utility rooms, and basements, should have receptacles in appliance-type circuits, with a maximum of four receptacles per circuit. Basements are required to have a minimum of one receptacle. Receptacles in garages, sheds, crawl spaces, below grade finished or unfinished basements, or outdoors must be GFCI types. GFCI-protected and weatherproofed receptacles must be located on the front and on the rear of the house, with a switch controlling them inside the house.

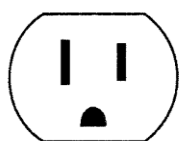


**PLAN OF OUTLETS IN A TYP. ROOM**

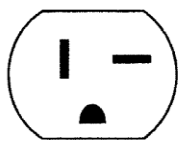


**PLAN OF OUTLETS IN KITCHEN**

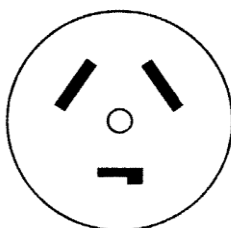
### Types of Outlets



110 volts  
15 amp

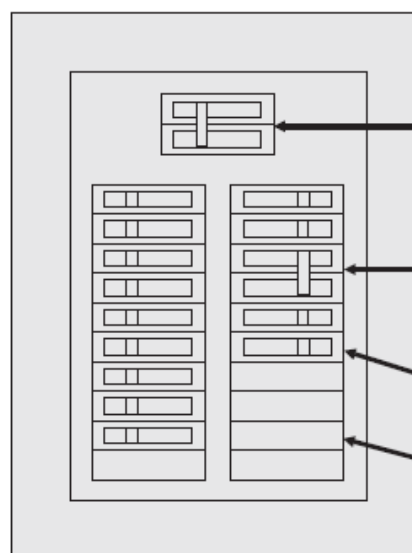


220 volts  
20 amp



220 volts  
30 amp

### Electrical Main Circuit Breaker Panel



Main breaker  
(turns off  
all power)

Double breaker  
(220V)

Single breaker  
(110V)

Blanks

## ELECTRICAL LAYOUT FOR COMMERCIAL SPACES

The electrical code establishes requirements for convenience receptacles in commercial spaces. The code seeks to ensure that there are enough outlets to prevent a spaghetti like tangle of extension cords, while respecting the total energy use in the space. An office of less than 37 square meters (400 square ft) is required to have one convenience receptacle per 3.7 square meters (40 square ft) or one per 3 meters (10 linear ft) of wall, whichever is greater. Larger offices need 10 outlets for the initial 37 square meters, with one outlet per 9.3 to 11.6 square meters (100–125 square ft) of additional space. Provide a minimum of one 20-A duplex receptacle for a computer terminal on an adjacent wall, power pole, or floor near each desk, with a maximum of six per 20-A branch circuit. Office corridors require one 20-A, 120V receptacle for each 15.3 meters (50 linear ft) for vacuuming and waxing machines. All office electrical equipment should be specification grade. Stores require one convenience outlet per 28 square meters (300 square ft) for lamps, show windows, and demonstration appliances. The type of store and the anticipated uses will determine locations and quantities.

Classrooms in schools need 20-A outlets wired two per circuit at the front and back of each classroom for opaque, slide, and video projectors. Side walls also need similar outlets, wired six to eight per circuit. Computer areas in schools need to be laid out in detail, with two-section surface mounted or recessed raceways on the wall behind a row of computers, and two duplex 20-A receptacles at each computer station wired on alternate circuits. Another section of raceway for network cabling and wiring into peripherals helps contain all these frequently changed wires. Special equipment in school laboratories, shops, and cooking rooms require adequate outlets.

Poke-through fittings (Fig. 31-2) are often used in existing commercial spaces to meet expanded desktop power and data wiring needs. They are fed through the floor from within a hung ceiling below. Poke-through fittings allow wiring relocations in rental office spaces.

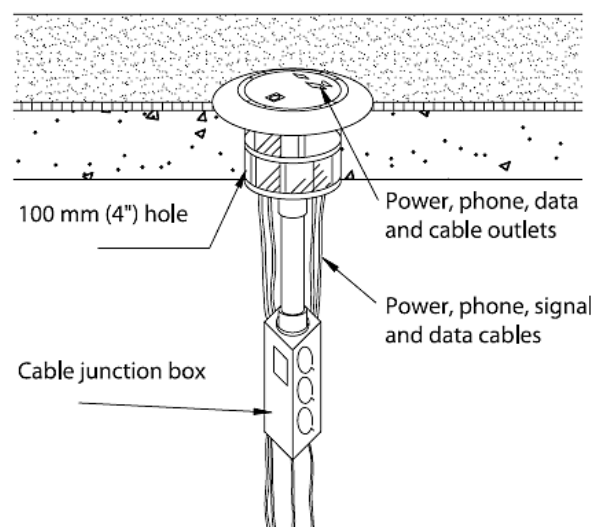
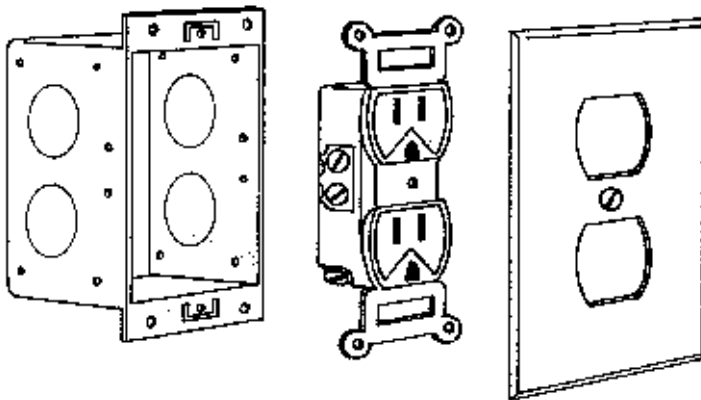
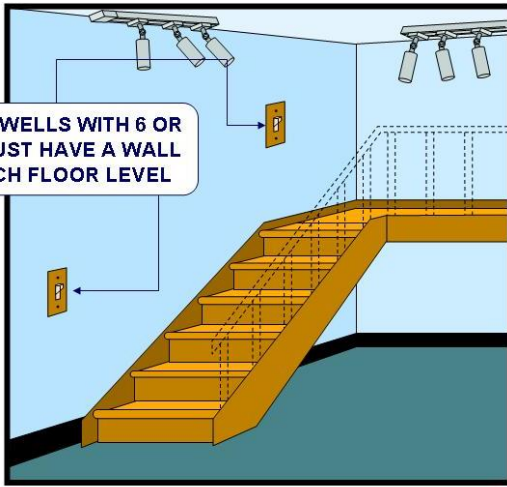


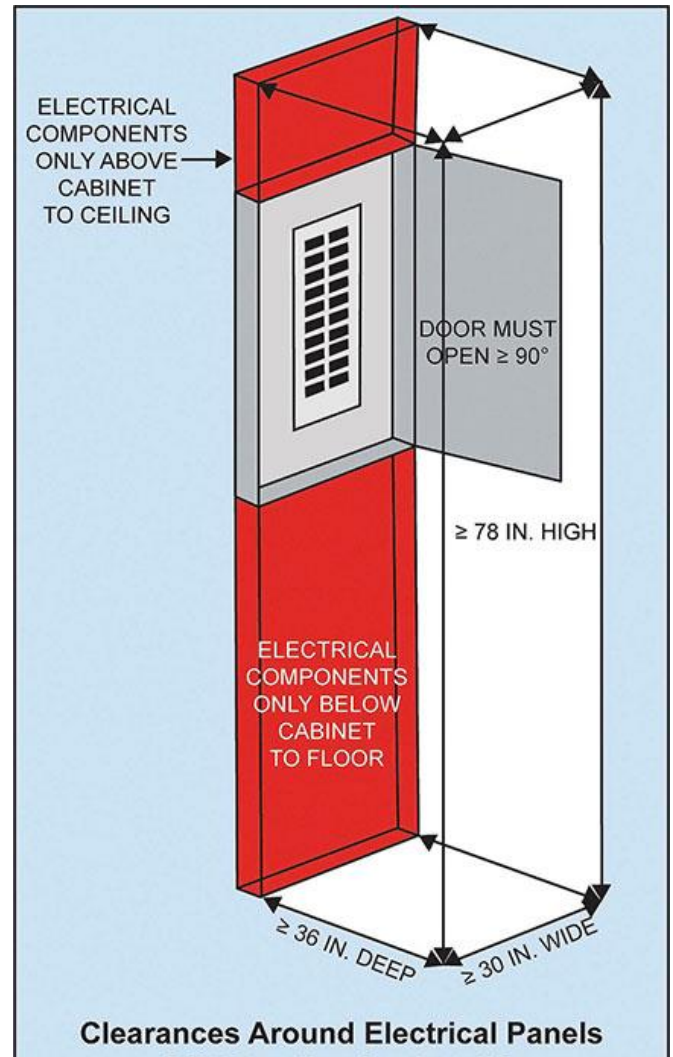
Figure 31-2 Poke-through electrical fitting.

### Hallway & Stairway Lighting

INTERIOR STAIRWELLS WITH 6 OR MORE STEPS MUST HAVE A WALL SWITCH AT EACH FLOOR LEVEL

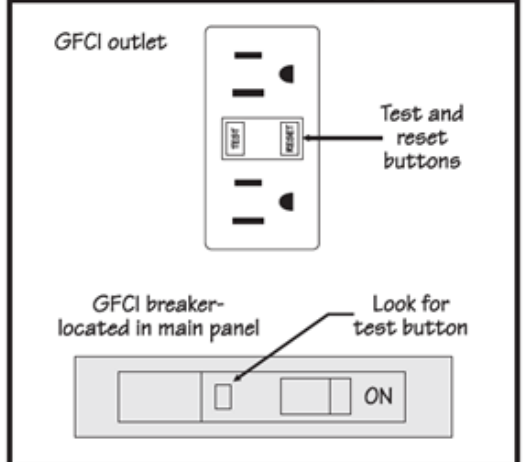


DUPLEX RECEPTACLE



Clearances Around Electrical Panels

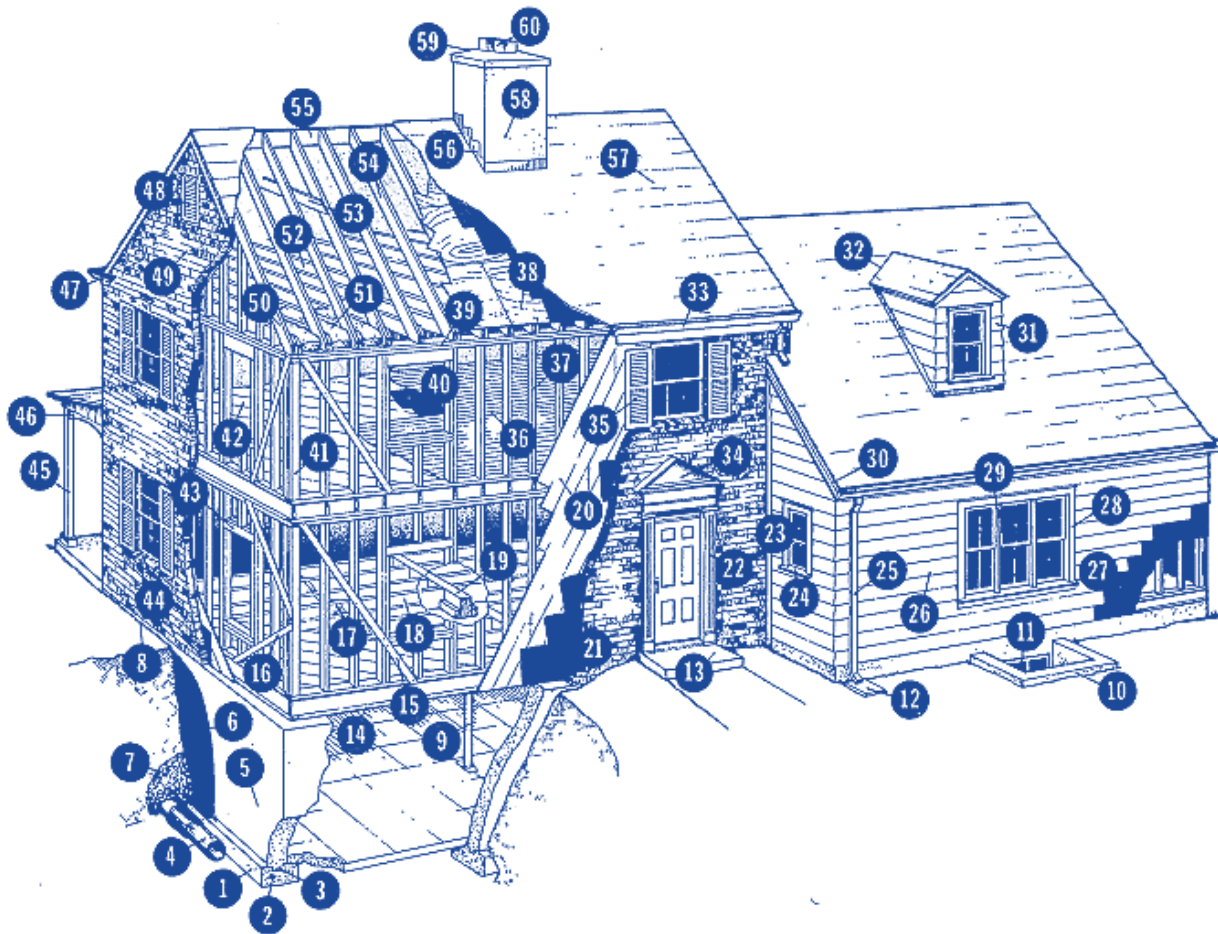
### Ground Fault Circuit Interrupter (GFCI)



TO BE USED IN WATER AREAS, BATH, KITCHEN, GARAGE



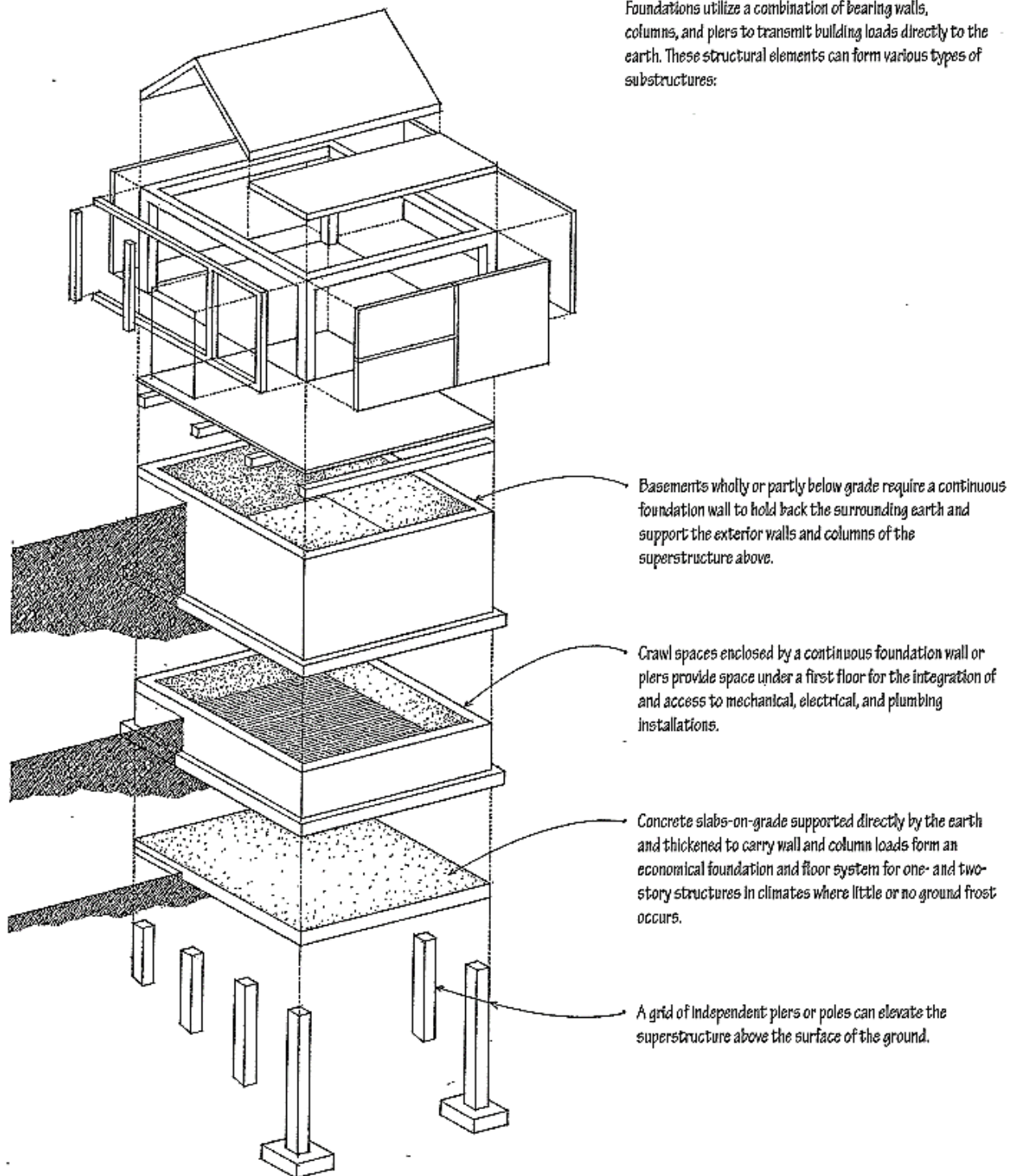
# RESIDENTIAL & COMMERCIAL BUILDING COMPONENTS



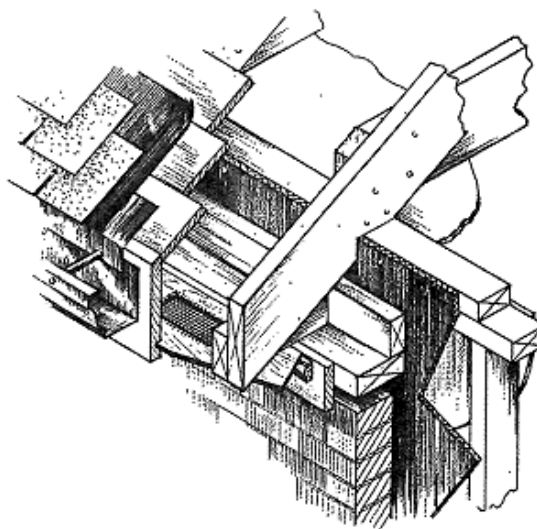
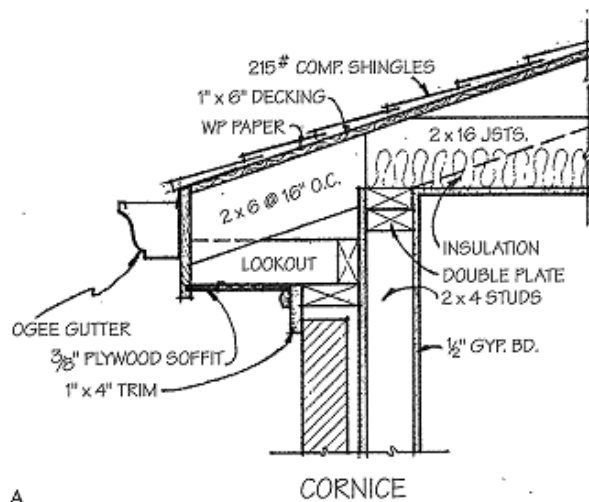
- |                     |                          |                         |
|---------------------|--------------------------|-------------------------|
| 1. Footing          | 21. Building paper       | 41. Corner post         |
| 2. Reinforcing rod  | 22. Trim pilaster        | 42. Subfloor            |
| 3. Keyway           | 23. Double-hung window   | 43. Lintel; header      |
| 4. Drain tile       | 24. Window sill          | 44. Brick sill          |
| 5. Foundation wall  | 25. Downspout; leader    | 45. Porch post          |
| 6. Waterproofing    | 26. Bevel siding         | 46. Porch frieze board  |
| 7. Gravel fill      | 27. Fiberboard sheathing | 47. Return cornice      |
| 8. Grade line       | 28. Window trim          | 48. Louver              |
| 9. Metal column     | 29. Mullion              | 49. Brick veneer; gable |
| 10. Areaway wall    | 30. Rake mold            | 50. End rafter          |
| 11. Basement window | 31. Dormer               | 51. Insulation          |
| 12. Splash block    | 32. Valley               | 52. Ceiling joist       |
| 13. Stoop           | 33. Gutter               | 53. Collar beam         |
| 14. Sill plate      | 34. Pediment door trim   | 54. Common rafter       |
| 15. Corner brace    | 35. Shutter              | 55. Ridge board         |
| 16. Knee brace      | 36. Finish flooring      | 56. Flashing            |
| 17. Bridging        | 37. Stud                 | 57. Shingles            |
| 18. Floor joist     | 38. Roof decking         | 58. Chimney             |
| 19. Beam; girder    | 39. Double top plate     | 59. Cement wash; cap    |
| 20. Sheathing       | 40. Flooring paper       | 60. Chimney flues; pots |

## TYPES OF FOUNDATION SYSTEMS

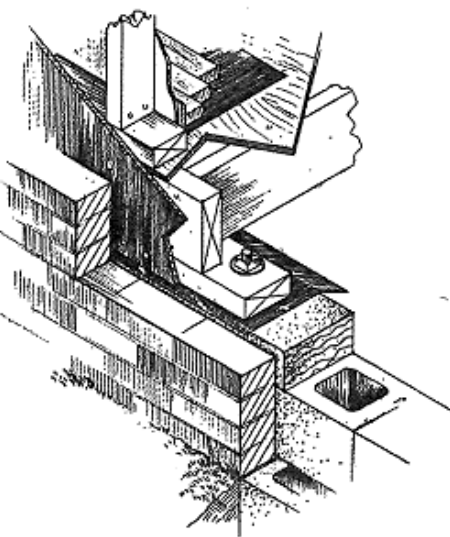
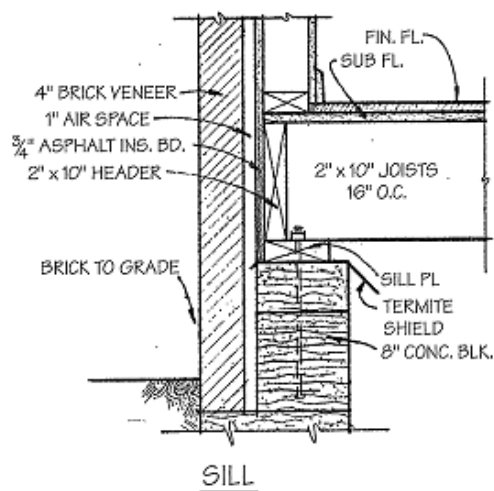
Foundations utilize a combination of bearing walls, columns, and piers to transmit building loads directly to the earth. These structural elements can form various types of substructures:



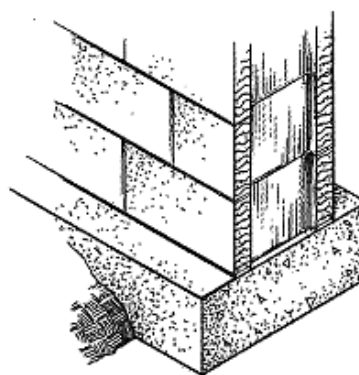
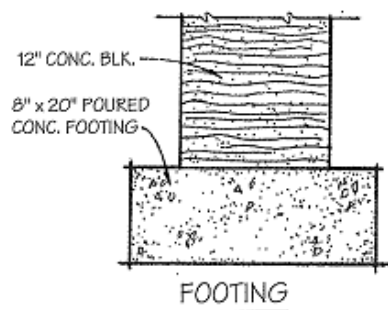




A



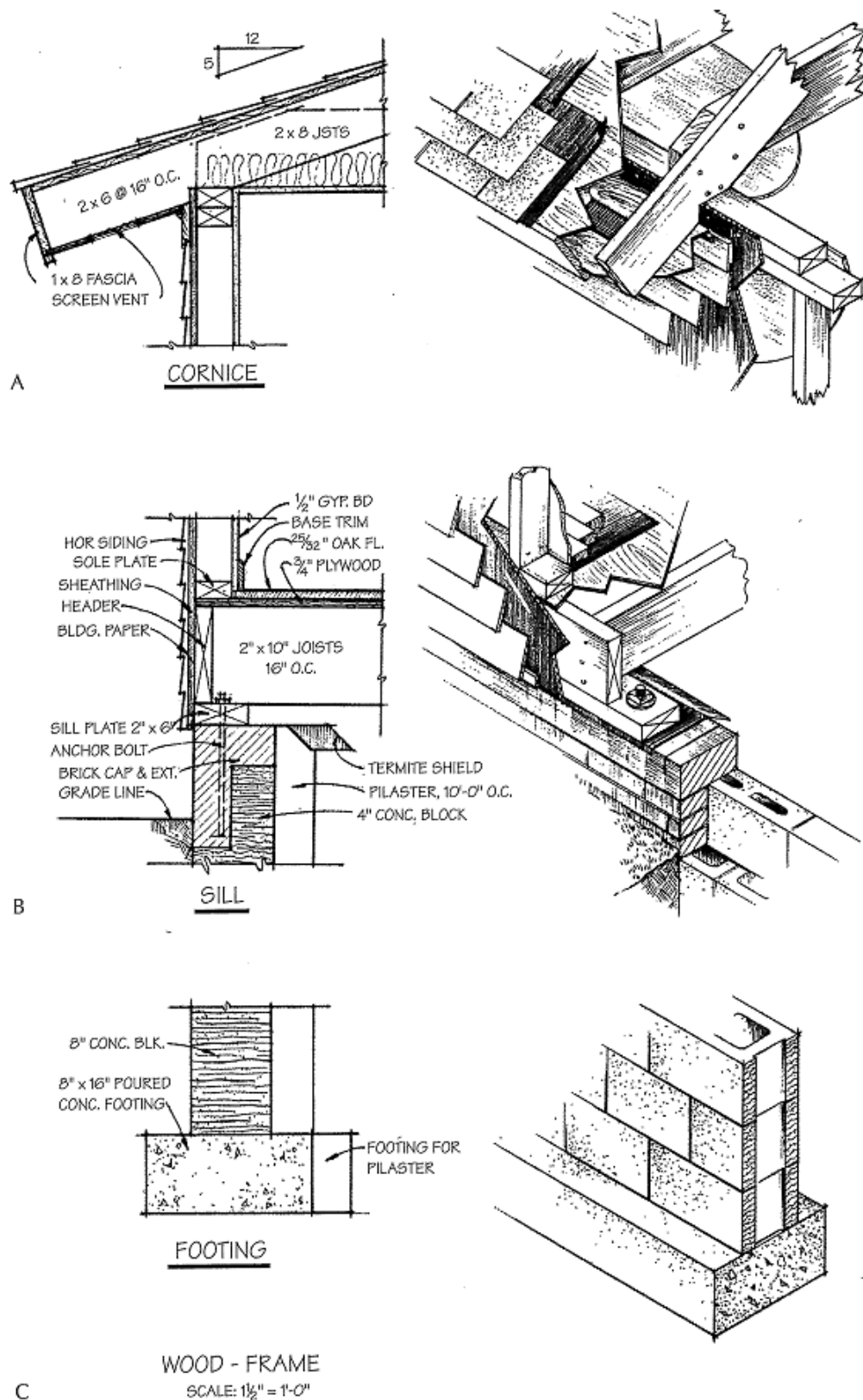
B



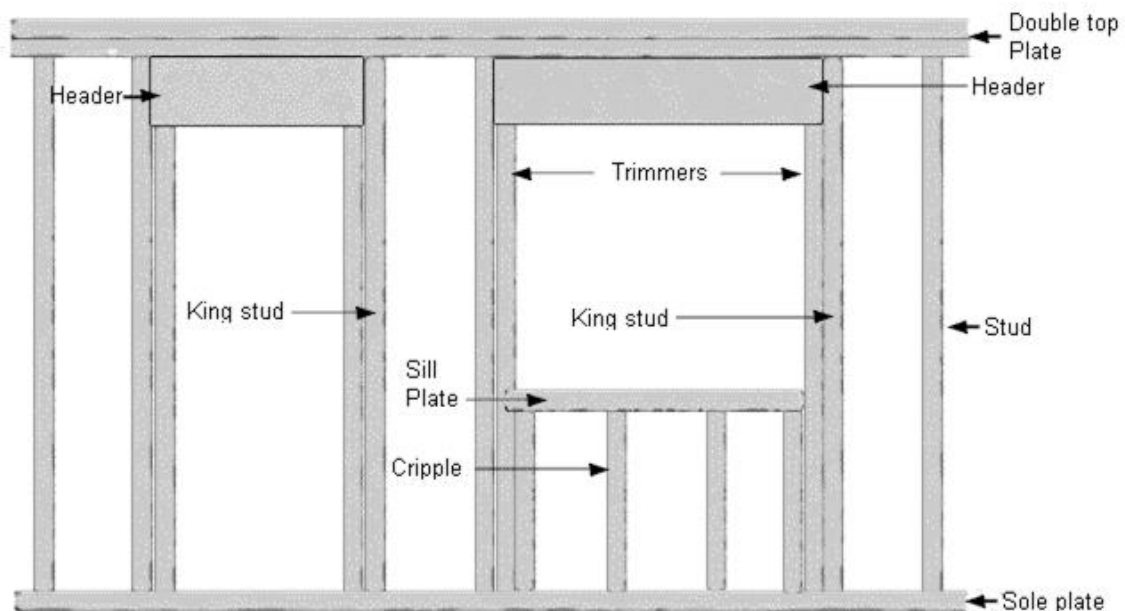
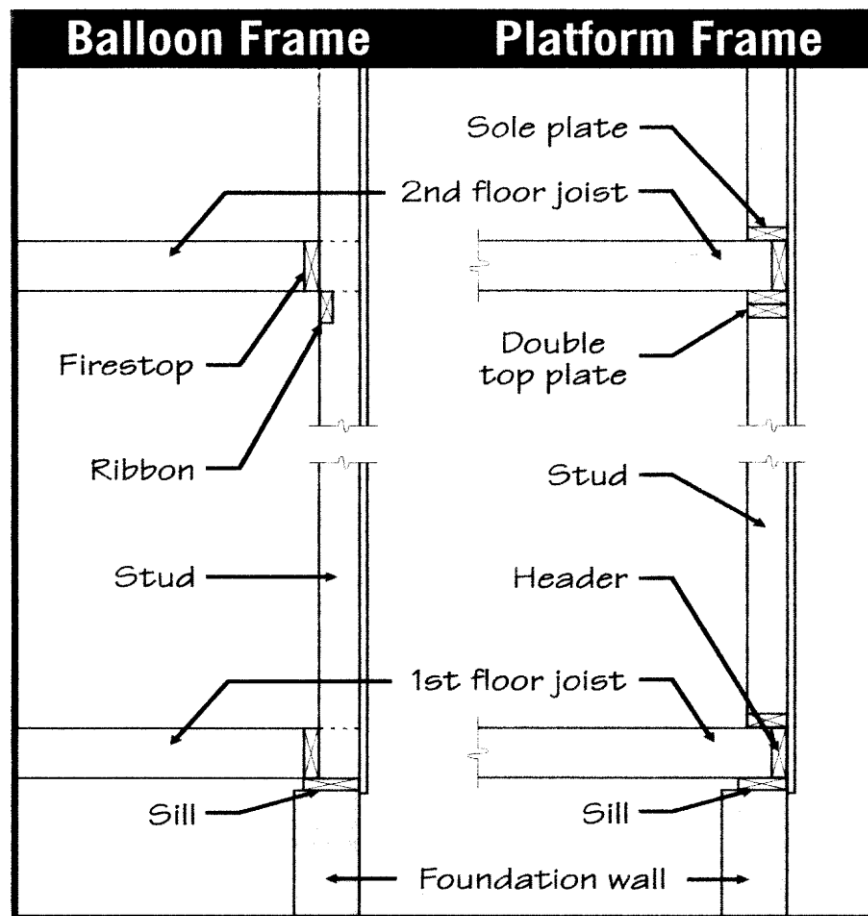
C

BRICK - VENEER  
SCALE: 1 1/2" = 1'-0"

FIGURE 14-2 Typical wall details (the isometric views help the reader visualize the construction).

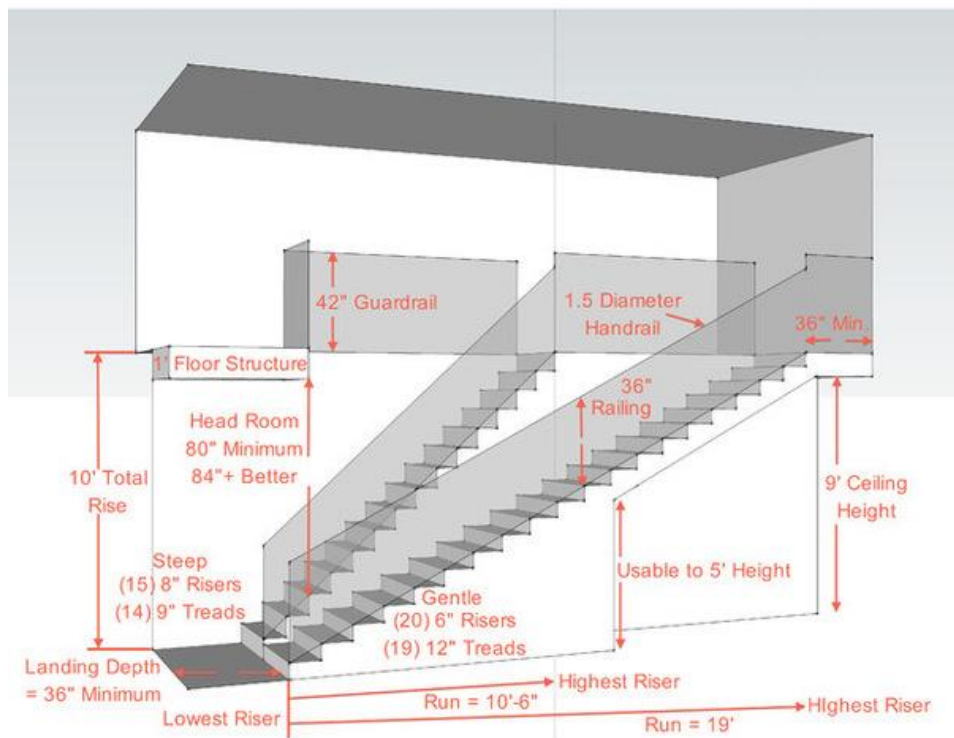
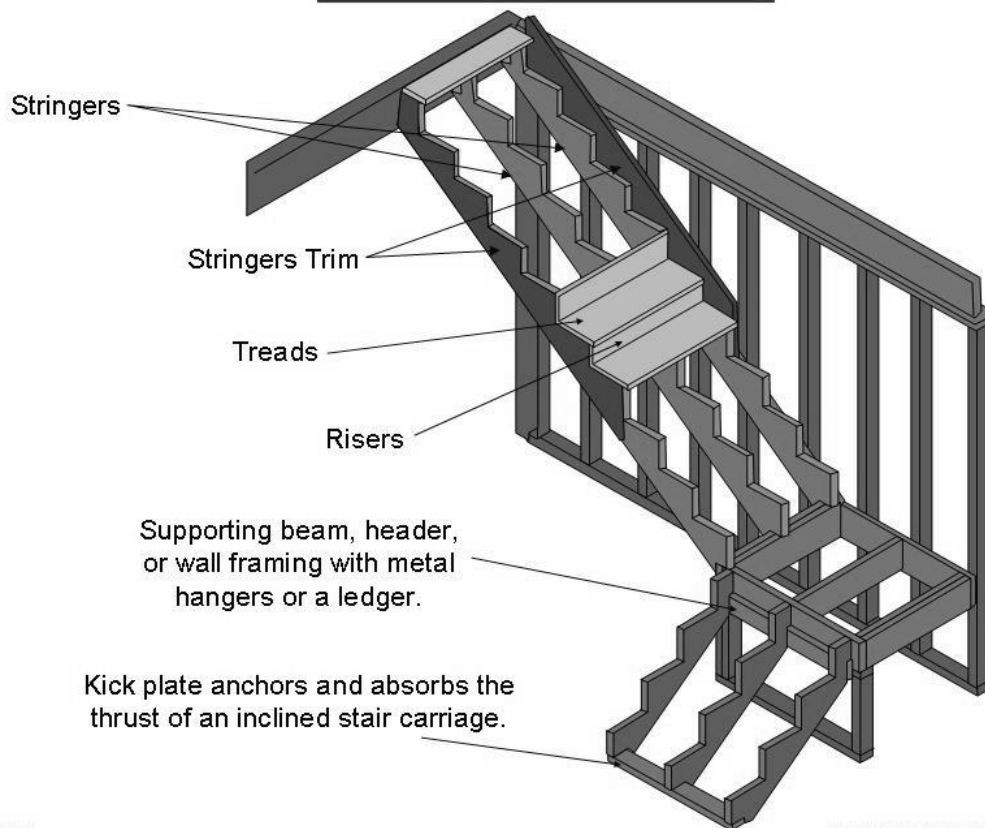


**FIGURE 14-1** Typical wall details (the isometric views help the reader visualize the construction).



Components of a framed wall

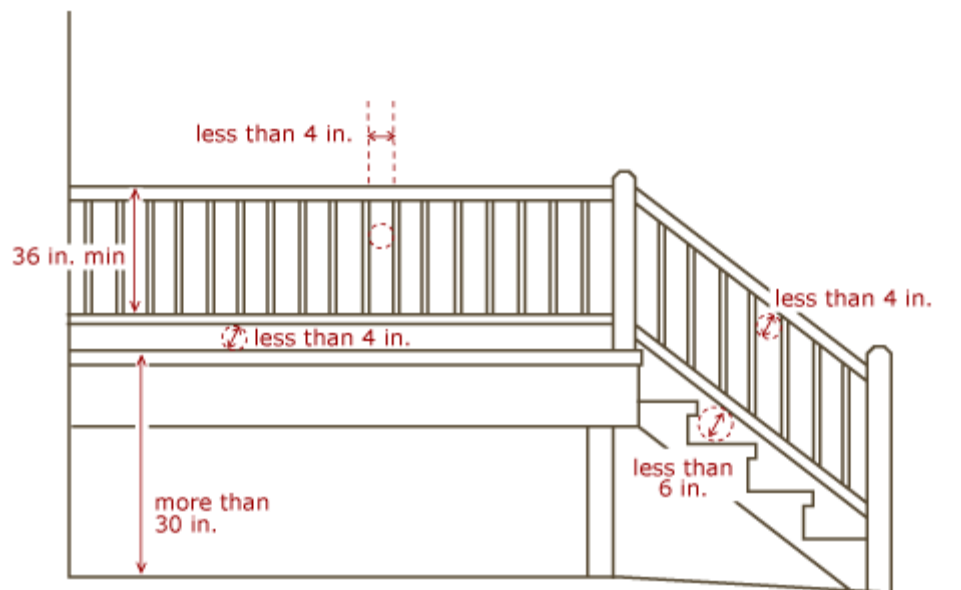
## Wood Stair Construction



# Handrails and guards

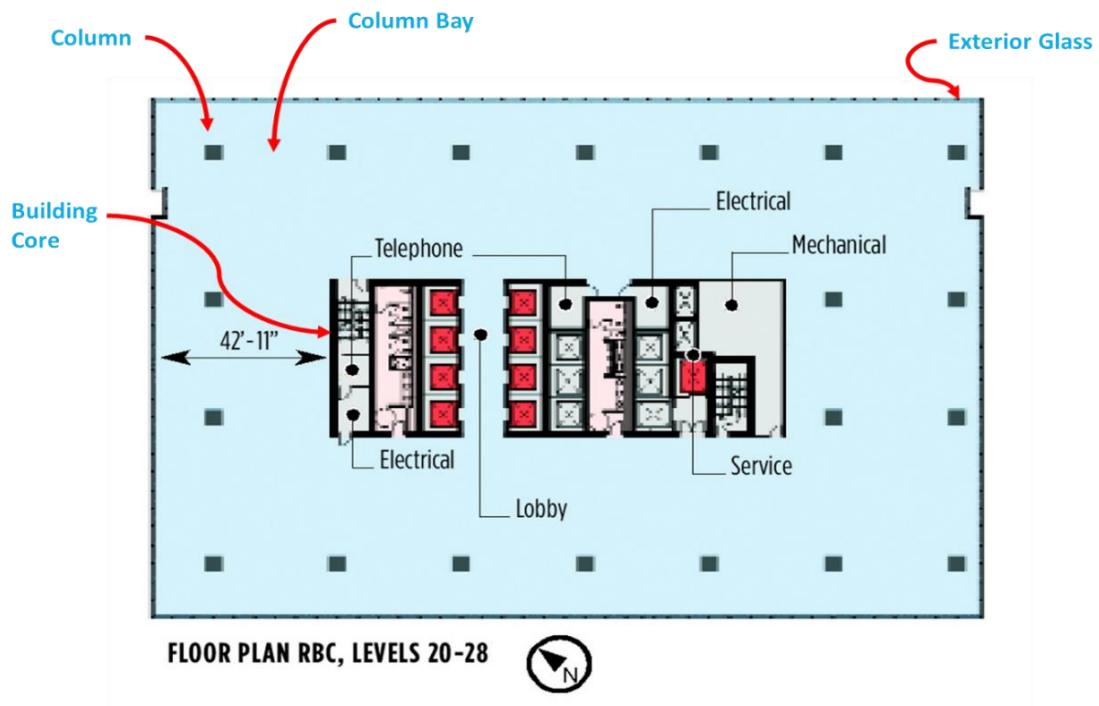
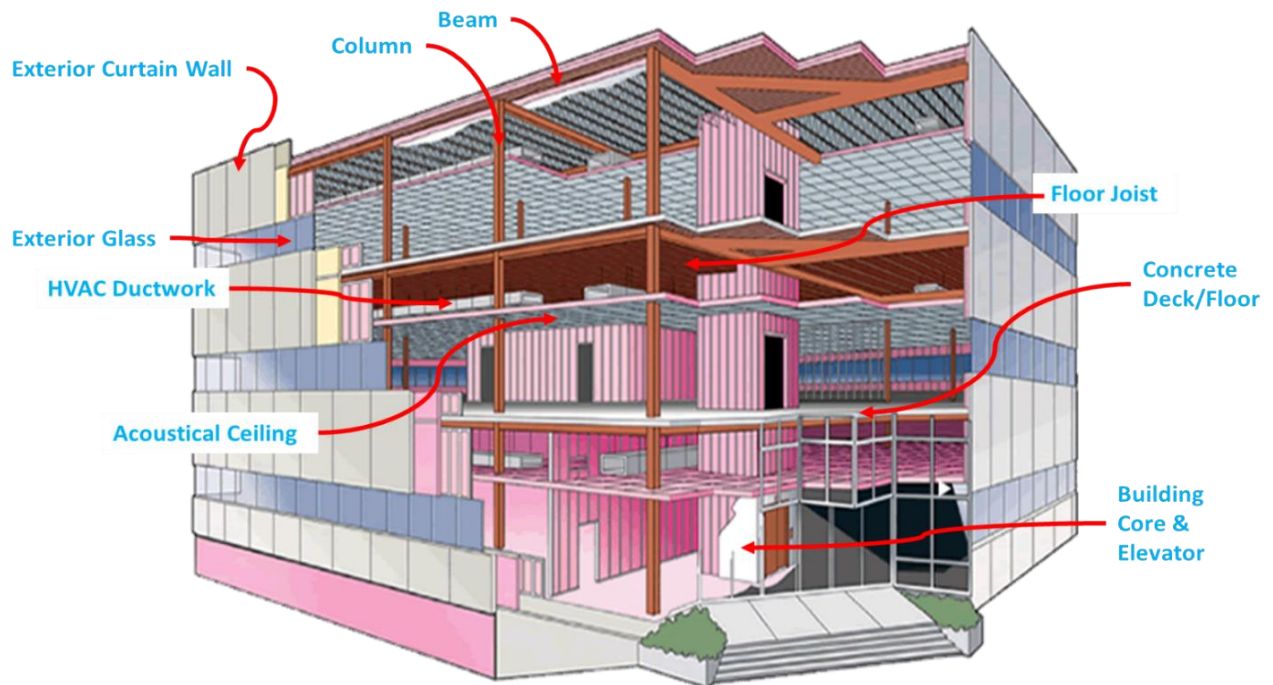
		handrail height (H)
U.S.	stairs against walls	30" to 38"
	open stairs	34" to 38"
Canada		32" to 36"

line through nosing

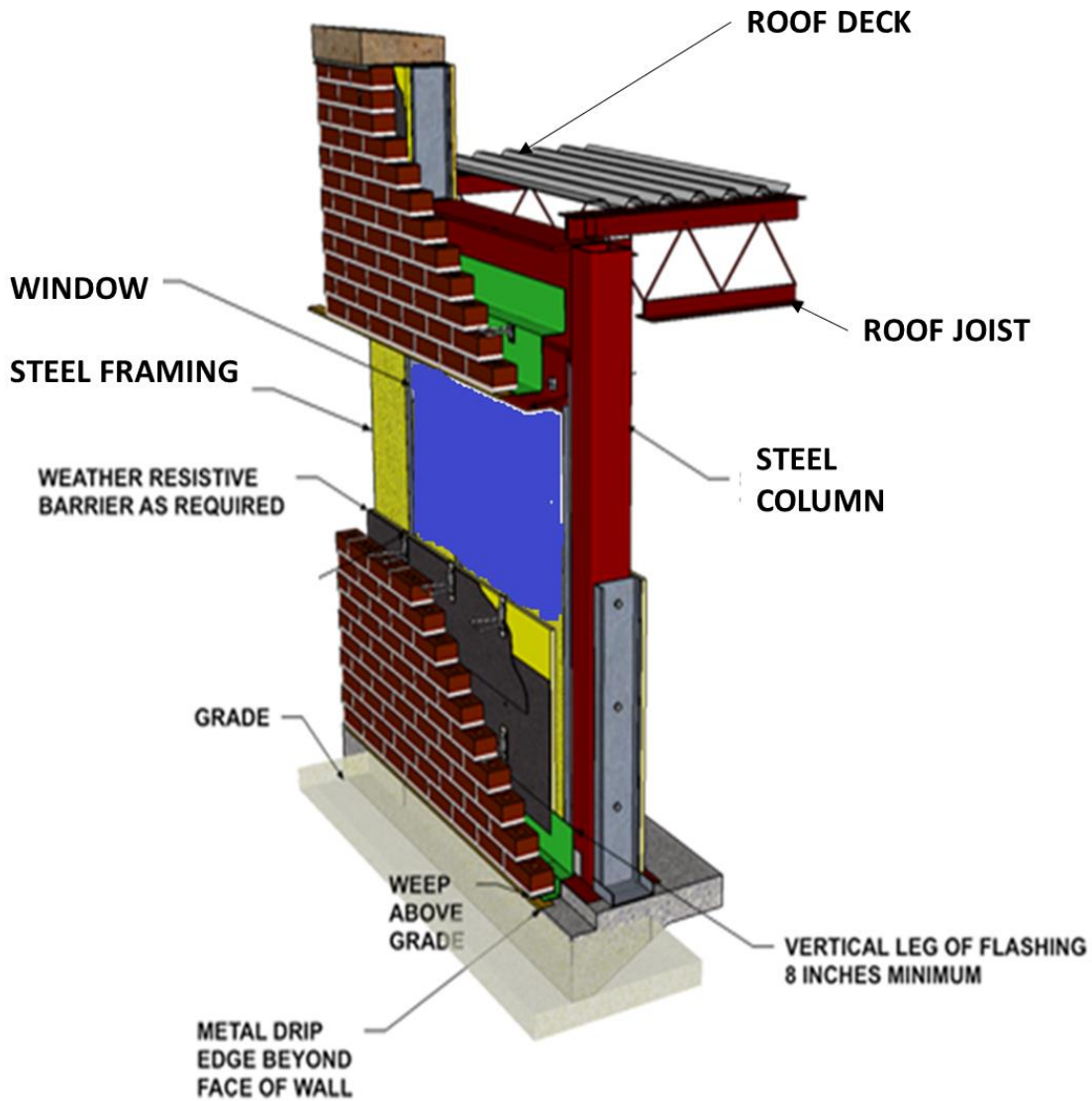




## Basic Commercial Building Structure Components

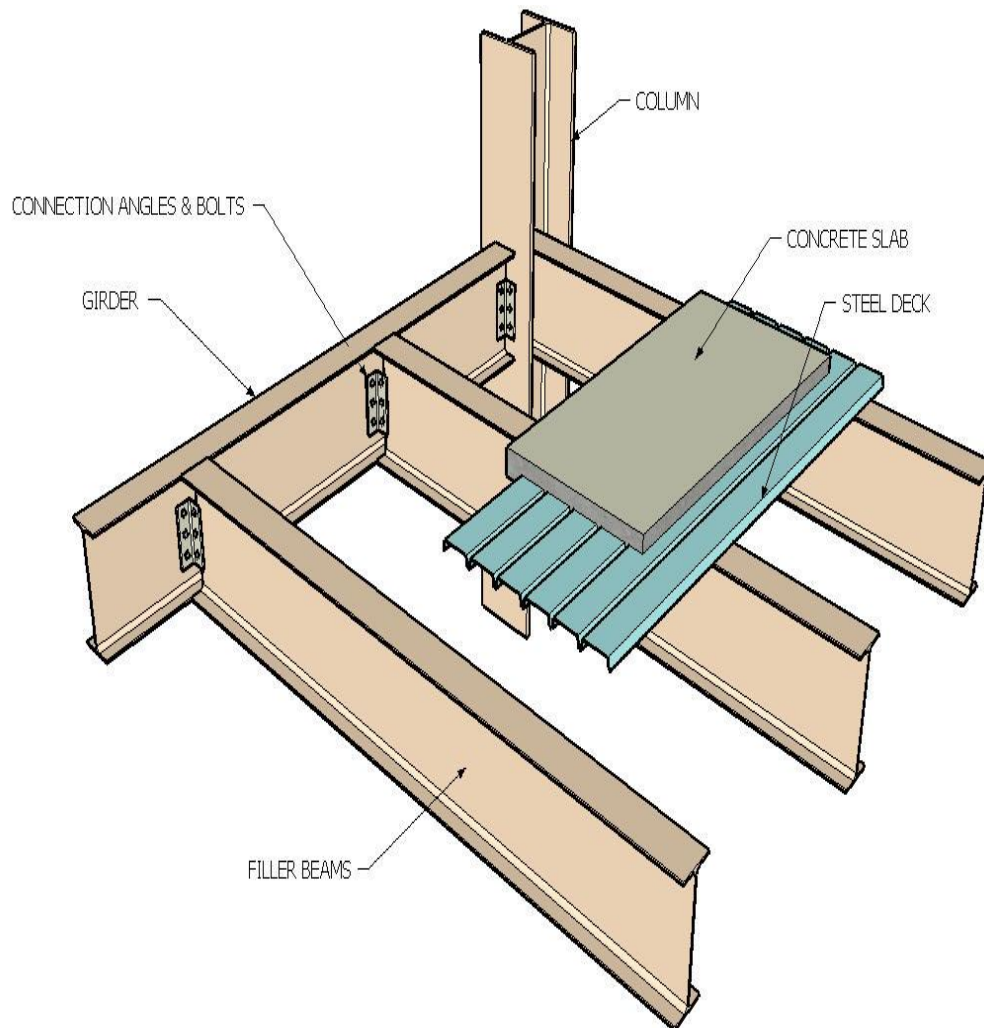




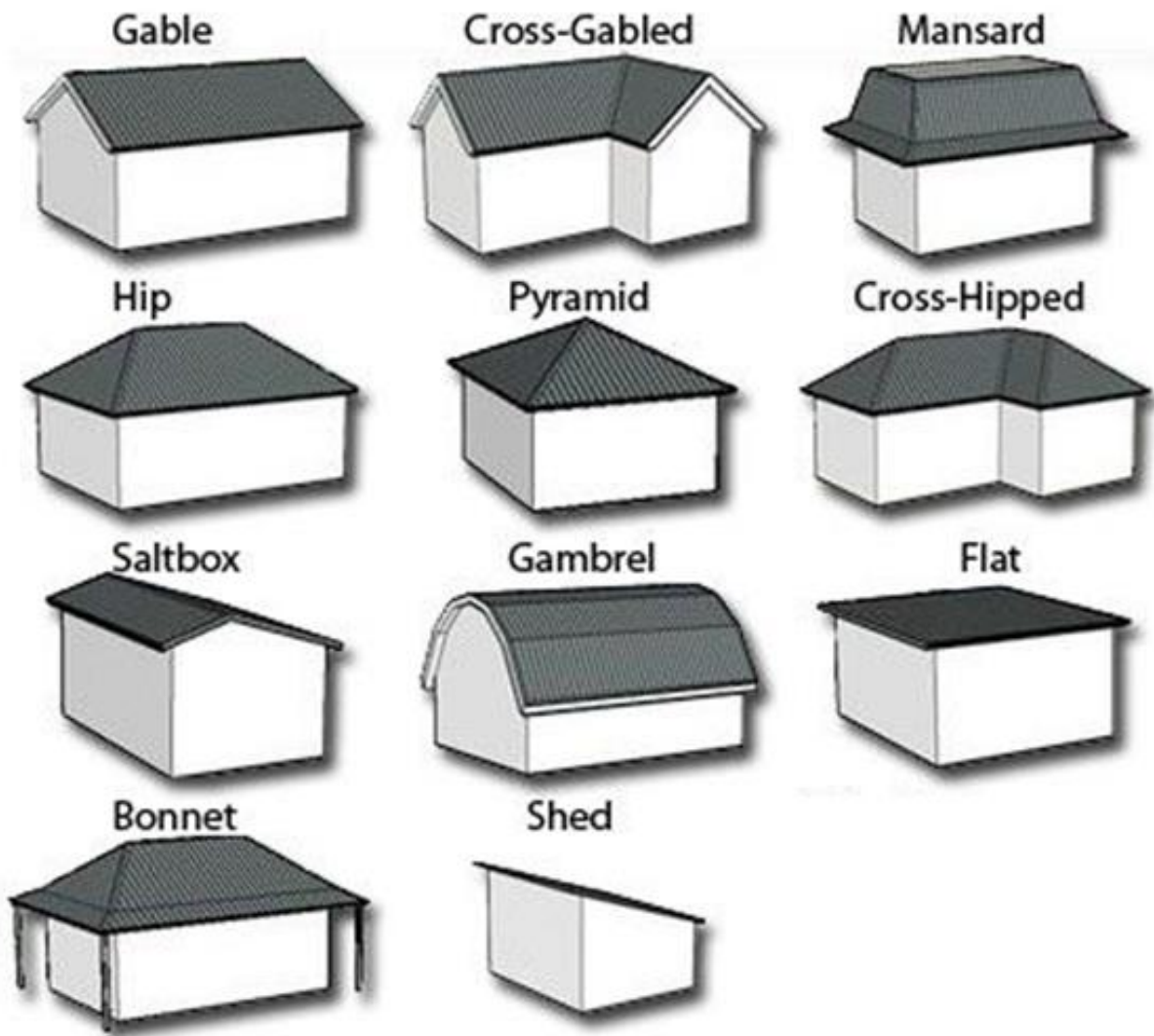


## COMMERCIAL BUILDING WALL DETAIL

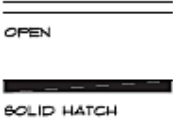
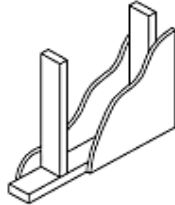
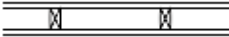
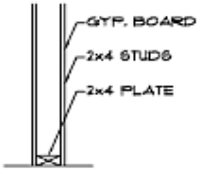



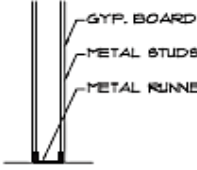
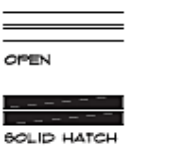
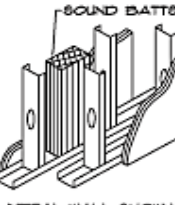
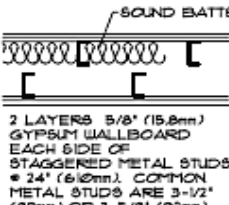
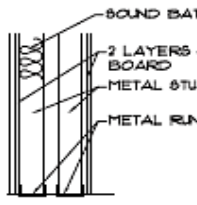

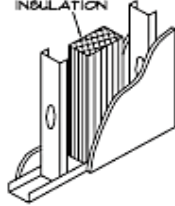
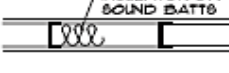
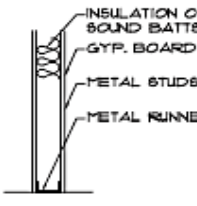
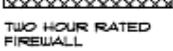
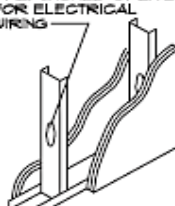


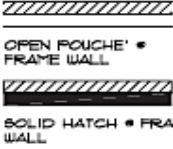
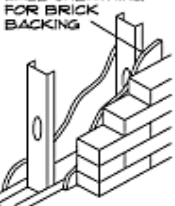
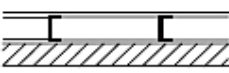
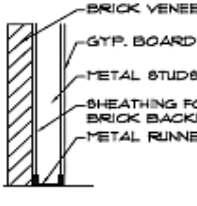
# POST AND BEAM COMMERCIAL CONSTRUCTION



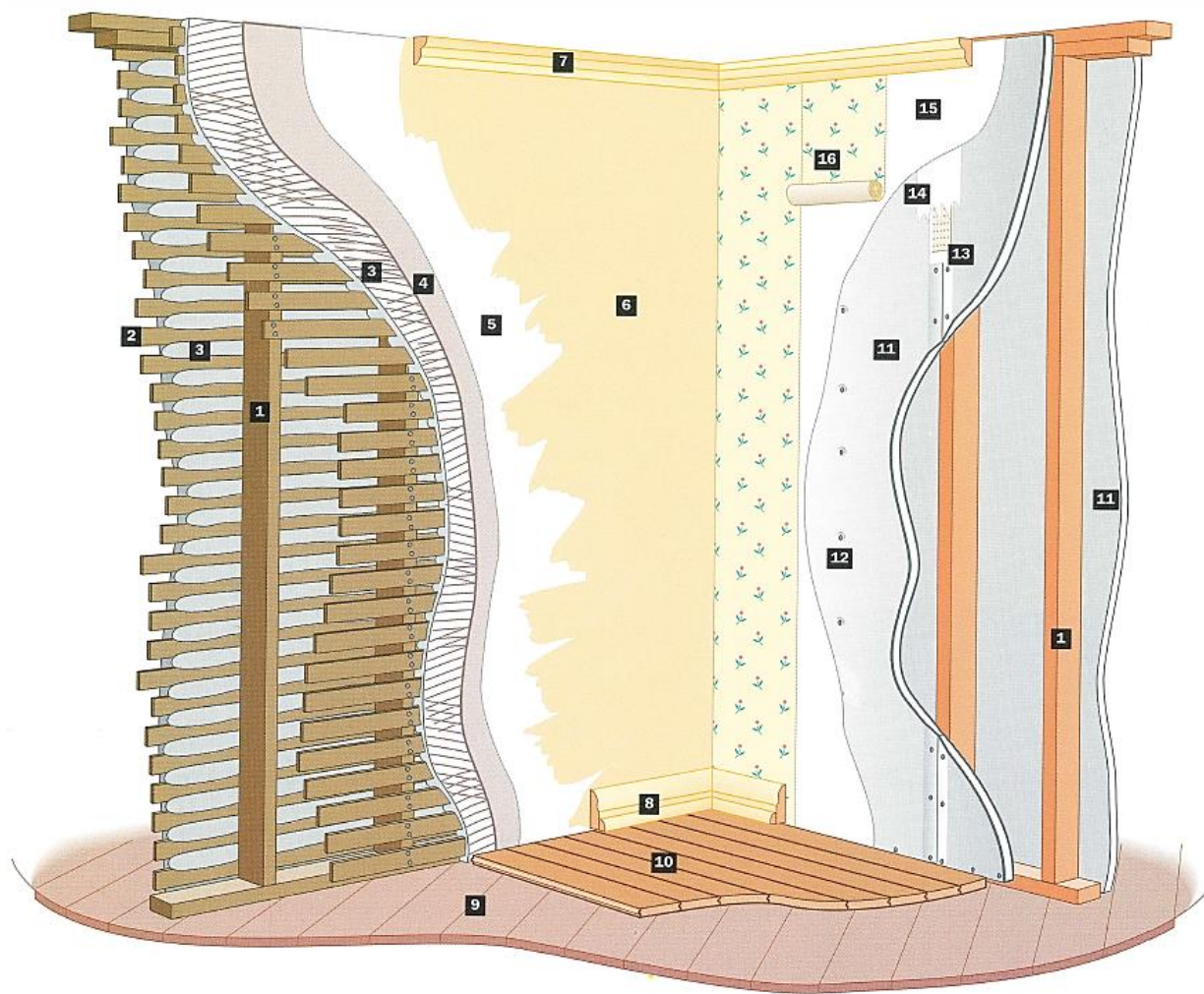
## RESIDENTIAL ROOF TYPES



# EXTERIOR/INTERIOR PARTITIONS

PLAN VIEW DESIGNATION	SKETCH	WALL CONSTRUCTION PLAN VIEW	SECTION VIEW
 <p>OPEN</p> <p>SOLID HATCH</p>		 <p>1/2" (12.7mm) OR 5/8" (15.8mm) GYPSUM WALLBOARD EACH SIDE OF 2x4 STUDS • 16" (406mm)</p>	 <p>GYP. BOARD</p> <p>2x4 STUDS</p> <p>2x4 PLATE</p>
 <p>OPEN</p> <p>SOLID HATCH</p>	 <p>PREPUNCHED OPENINGS FOR ELECTRICAL WIRING</p>	 <p>1/2" (12.7mm) OR 5/8" (15.8mm) GYPSUM WALLBOARD EACH SIDE OF METAL STUDS • 24" (610mm). COMMON METAL STUDS ARE 3-1/2" (89mm) OR 3-5/8" (92mm).</p>	 <p>GYP. BOARD</p> <p>METAL STUDS</p> <p>METAL RUNNER</p>
 <p>OPEN</p> <p>SOLID HATCH</p>	 <p>SOUND BATTS</p> <p>METAL WALL SHOWN</p>	 <p>SOUND BATTS</p> <p>2 LAYERS 5/8" (15.8mm) GYPSUM WALLBOARD EACH SIDE OF STAGGERED METAL STUDS • 24" (610mm). COMMON METAL STUDS ARE 3-1/2" (89mm) OR 3-5/8" (92mm).</p>	 <p>SOUND BATTS</p> <p>2 LAYERS GYP. BOARD</p> <p>METAL STUDS</p> <p>METAL RUNNERS</p>
 <p>INSULATED OR ACOUSTICAL WALL</p> <p>WALL CONSTRUCTION CAN BE WITH WOOD OR METAL STUDS</p>	 <p>INSULATION</p> <p>METAL WALL SHOWN</p>	 <p>INSULATION OR SOUND BATTS</p> <p>1/2" (12.7mm) OR 5/8" (15.8mm) GYPSUM WALLBOARD EACH SIDE OF METAL STUDS • 24" (610mm). COMMON METAL STUDS ARE 3-1/2" (89mm) OR 3-5/8" (92mm).</p> <p>METAL WALL SHOWN</p>	 <p>INSULATION OR SOUND BATTS</p> <p>GYP. BOARD</p> <p>METAL STUDS</p> <p>METAL RUNNER</p> <p>METAL WALL SHOWN</p>
 <p>TWO HOUR RATED FIREWALL</p>	 <p>PREPUNCHED OPENINGS FOR ELECTRICAL WIRING</p>	 <p>TWO LAYERS OF 5/8" (15.8mm) GYPSUM WALLBOARD EACH SIDE OF METAL STUDS • 24" (610mm). COMMON METAL STUDS ARE 3-1/2" (89mm) OR 3-5/8" (92mm).</p>	 <p>TWO LAYERS OF GYP. BOARD</p> <p>METAL STUDS</p> <p>METAL RUNNER</p>
 <p>OPEN POUCHÉ • FRAME WALL</p> <p>SOLID HATCH • FRAME WALL</p>	 <p>WALL SHEATHING FOR BRICK BACKING</p>	 <p>BRICK VENEER (WITH WALL TIES) OVER 1/2" (12.7mm) OR 5/8" (15.8mm) GYPSUM WALLBOARD EACH SIDE OF METAL STUDS • 24" (610mm). COMMON METAL STUDS ARE 3-1/2" (89mm) OR 3-5/8" (92mm).</p>	 <p>BRICK VENEER</p> <p>GYP. BOARD</p> <p>METAL STUDS</p> <p>SHEATHING FOR BRICK BACKING</p> <p>METAL RUNNER</p>



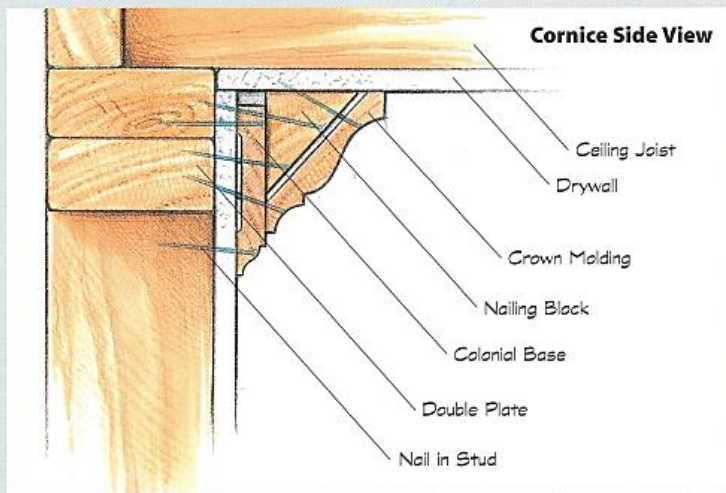


### Interior Walls

- |  |   |                              |
|--|---|------------------------------|
| 1 Studwall, sill plate and header                    | 6 Sealer and paint                      | 11 Drywall board             |
| 2 Wooden lath  | 7 Crown molding                         | 12 Drywall fasteners         |
| 3 Plaster scratch coat and "keys" holding it to lath | 8 Baseboard molding                     | 13 Joint or seam tape        |
| 4 Plaster brown coat                                 | 9 Diagonally laid subfloor              | 14 joint compound            |
| 5 Plaster top coat                                   | 10 Tongue and groove solid oak flooring | 15 Skim or "Cal" coat        |
|  |   | 16 Wallpaper or wallcovering |

## Installing Crown Molding

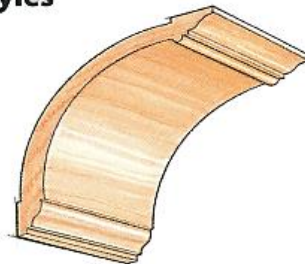
Installing crown molding often requires more than one method. Along walls that are perpendicular to the ceiling joists, nail the crown to the wall studs and ceiling joists. On walls parallel with the joists, there's usually no joist where you need it. One solution is to install triangular nailing blocks before running the molding—fasten the blocks to the studs or top plates; then fasten the molding to the blocks.



## Crown & Cornice Styles

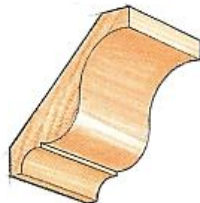
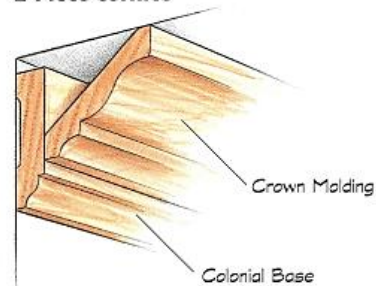


4 1/2" Cornice with Dentil



5" Cornice with Cove

### 2-Piece Cornice

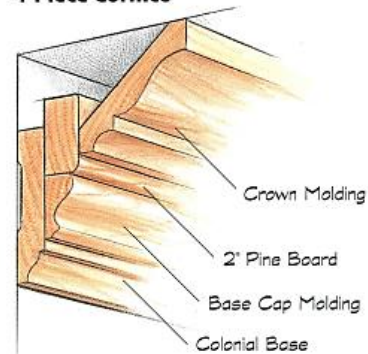


3 1/2" Crown Molding



2" Crown Molding

### 4-Piece Cornice



Cove Molding



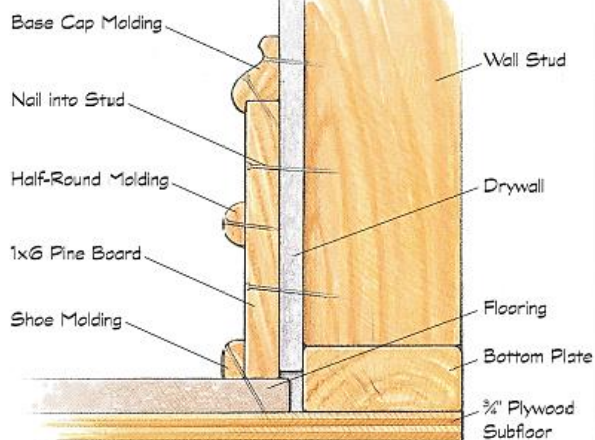
Bed Molding



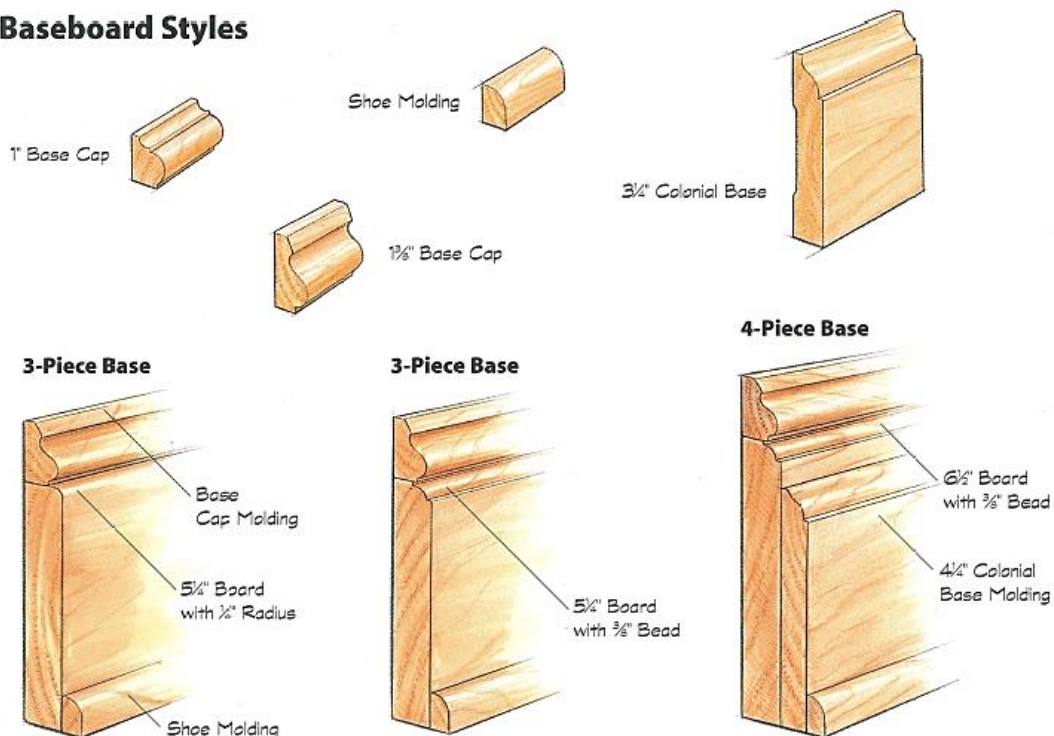
## Installing Baseboard

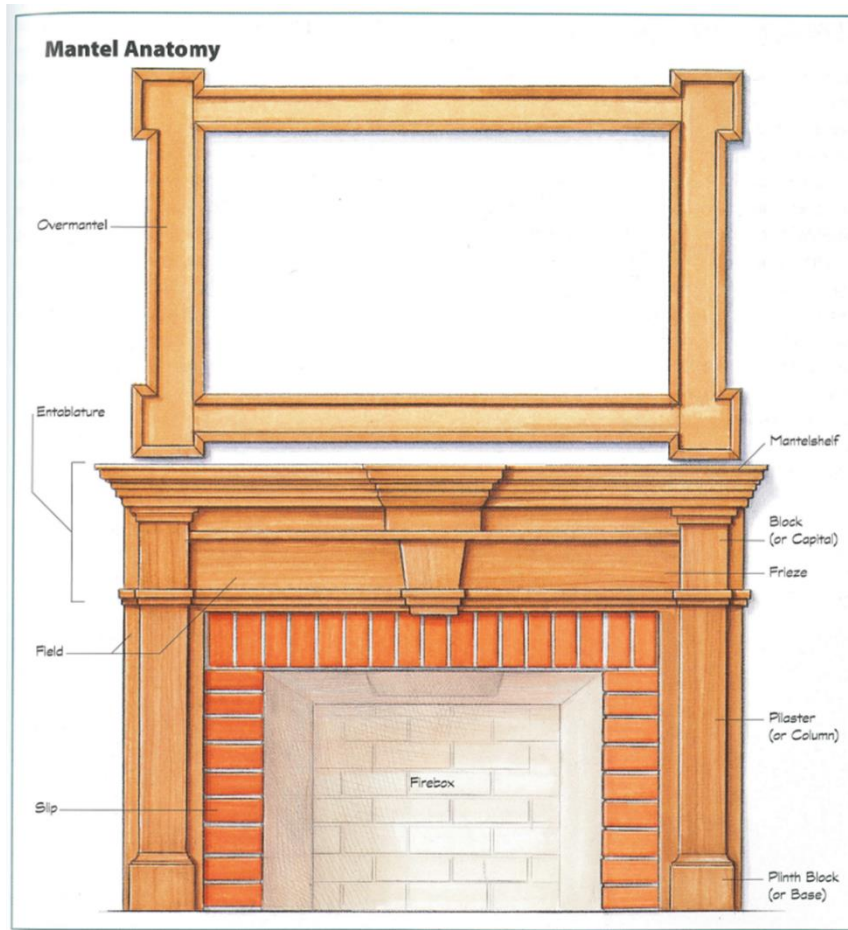
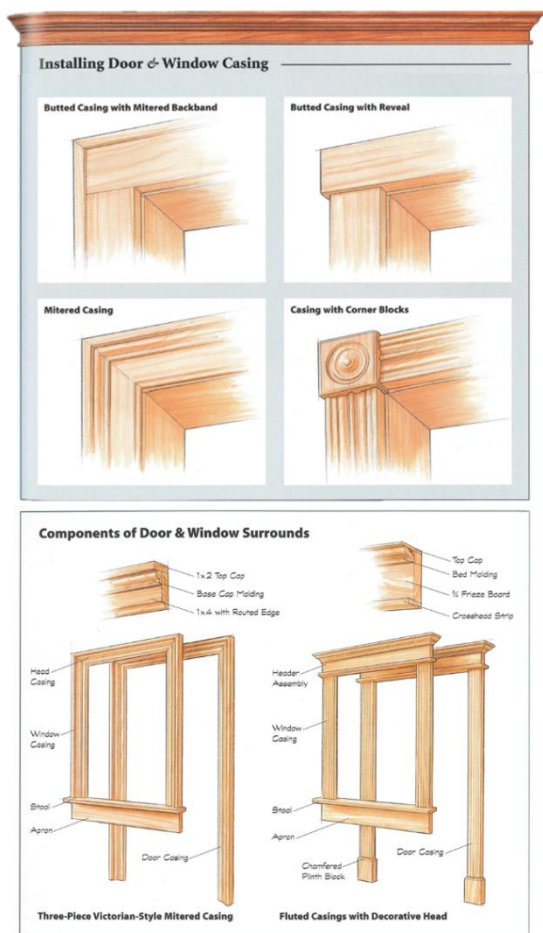
Most baseboards require two nails at each stud location. You can also drive nails into the bottom plate. For built-up baseboards, install the main board first, then add the cap and other accent moldings, nailing them into the main board or wall studs. Nail the base shoe to the floor only so that it can move independently of the baseboard and prevent gapping. For outside corners, make miter cuts to connect the molding; for inside corners, make coped cuts. (See chapter 13.) These types of cuts help keep the molding from showing gaps.

### Baseboard Side View

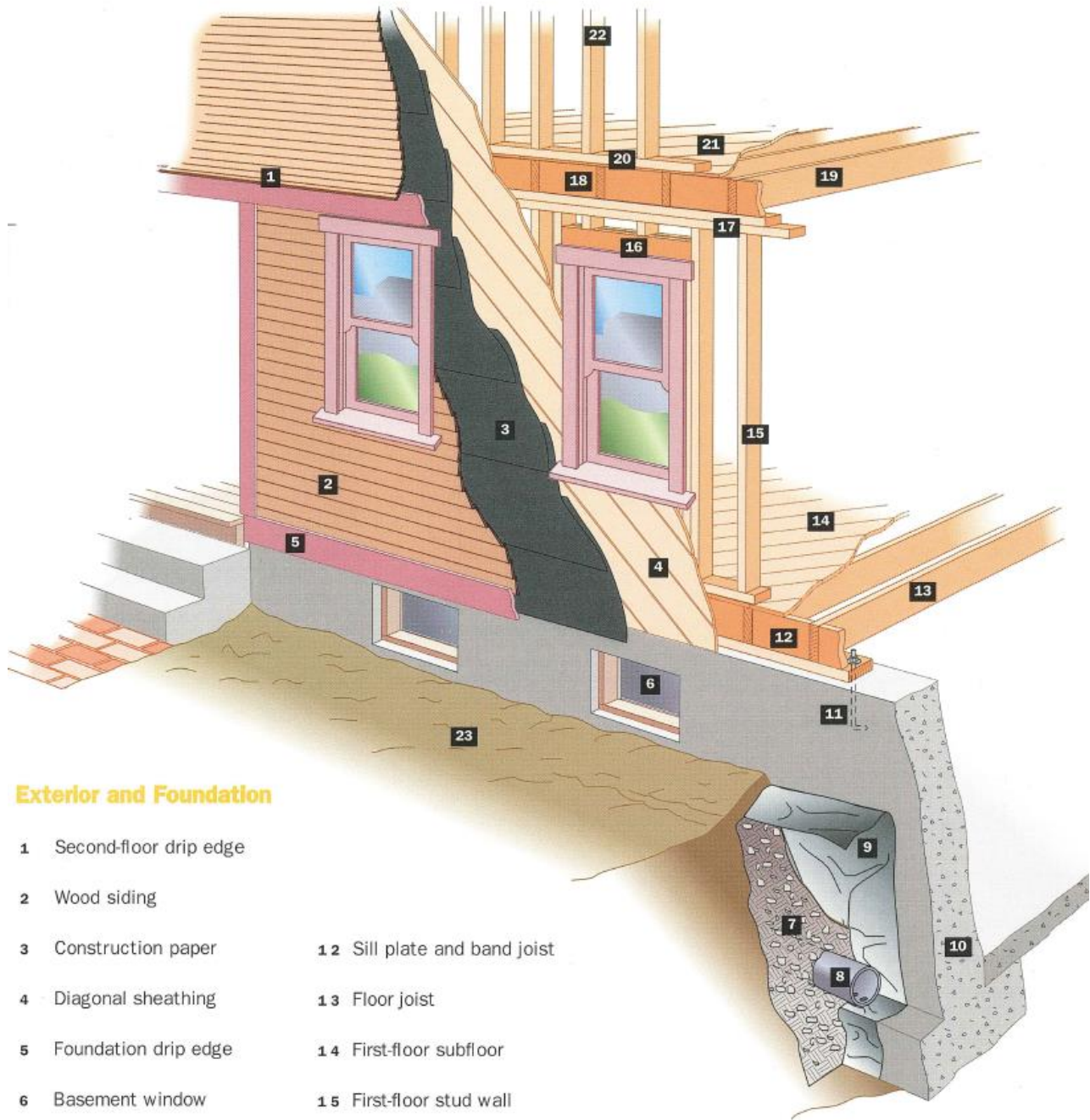


## Baseboard Styles



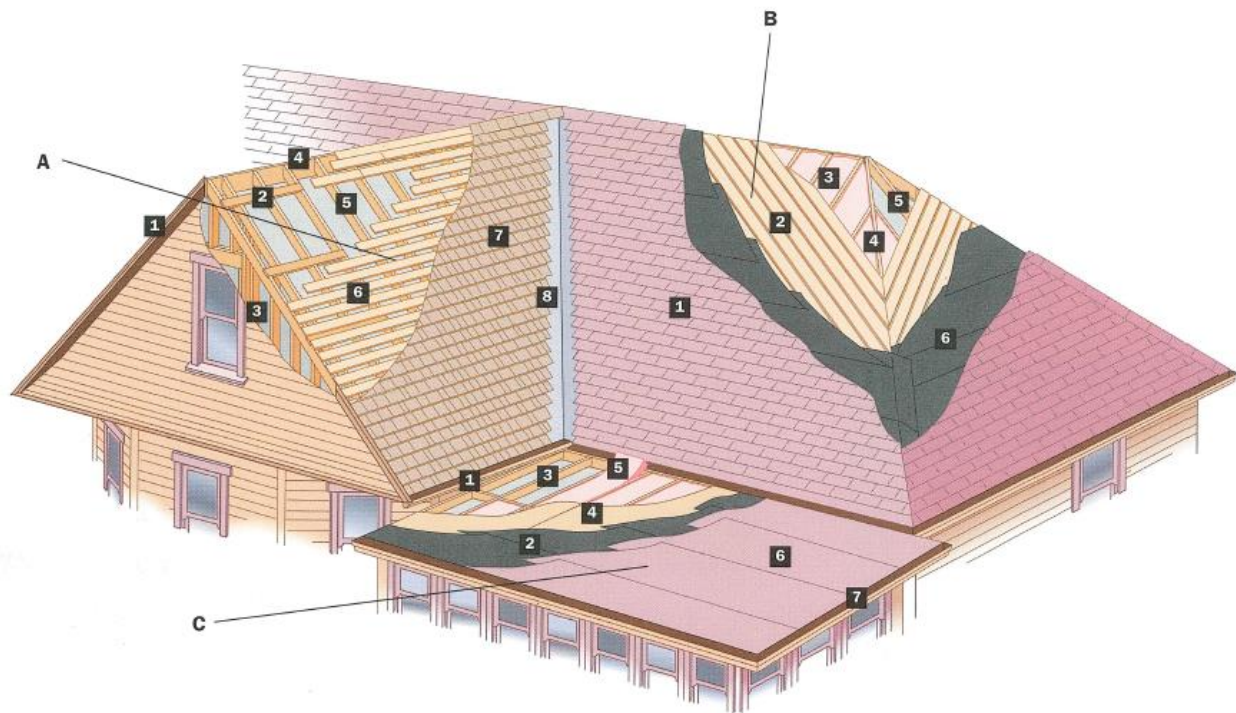






### Exterior and Foundation

- |                           |                              |   |
|---------------------------|------------------------------|---|
| 1 Second-floor drip edge  | 12 Sill plate and band joist | 21 Second-floor subfloor                      |
| 2 Wood siding             | 13 Floor joist               | 22 Second-floor stud wall                     |
| 3 Construction paper      | 14 First-floor subfloor      | 23 Slope drains run-off water from foundation |
| 4 Diagonal sheathing      | 15 First-floor stud wall     |   |
| 5 Foundation drip edge    | 16 Window header             |   |
| 6 Basement window         | 17 First-floor cap           |   |
| 7 Drain gravel            | 18 Second-floor band joist   |   |
| 8 Perforated drainpipe    | 19 Second-floor floor joist  |   |
| 9 Waterproof membrane     | 20 Second-floor sill plate   |   |
| 10 Foundation and footing |                              |   |
| 11 Foundation anchor bolt |                              |   |



#### **A Cedar Shingle on a Gable Roof**

- 1 Drip edge on cornice
- 2 Lookout rafter supporting cornice and eaves
- 3 Exterior wall stud
- 4 Ridge board
- 5 Rafter
- 6 Spaced sheathing
- 7 Layered cedar shingles
- 8 Valley rafter with open metal flashing

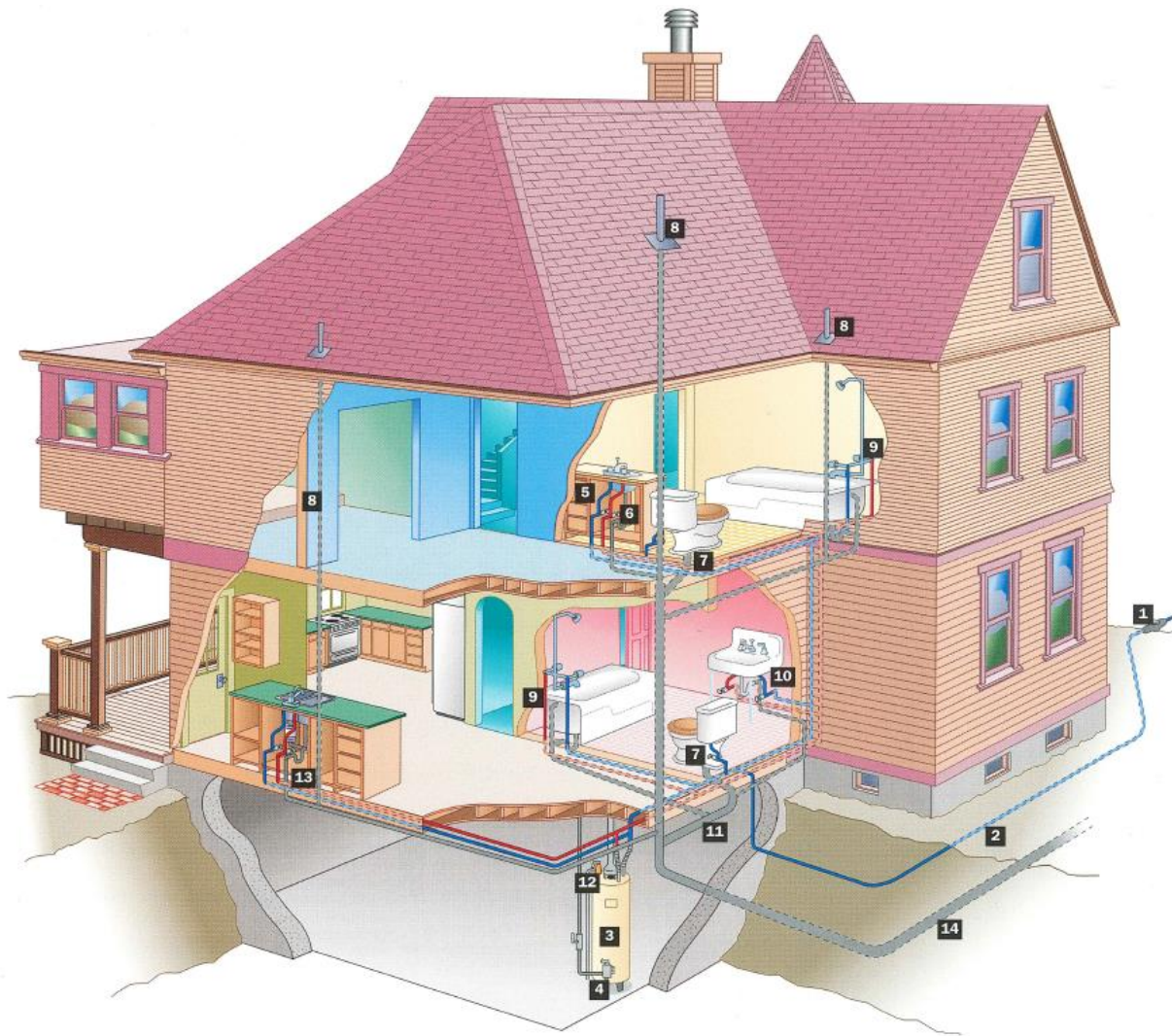
#### **B Original Composition Shingle on a Hip Roof**

- 1 Composition shingle
- 2 Diagonally applied solid sheathing (also applied horizontally, or as plywood and composition panels)
- 3 Roll fiberglass insulation
- 4 Hip rafter
- 5 Jack rafter
- 6 Roofing felt construction paper

#### **C Flat or Built-up Roof**

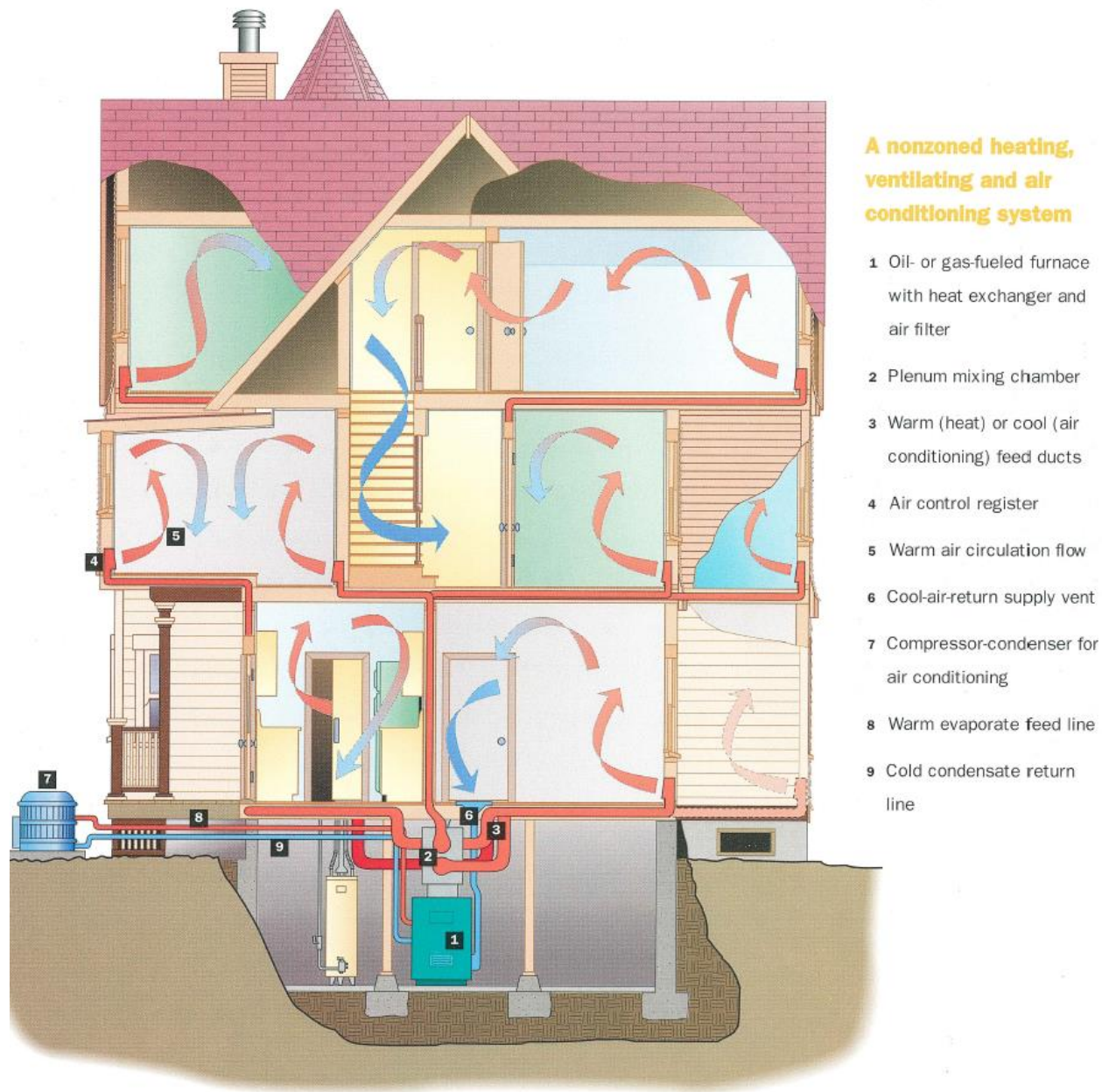
- 1 Slope for water runoff to gutter system
- 2 Roofing felt construction paper
- 3 Roof joist
- 4 Solid composition or plywood board sheathing
- 5 Roll fiberglass insulation
- 6 Asphalt composition roll roofing
- 7 Gutter system



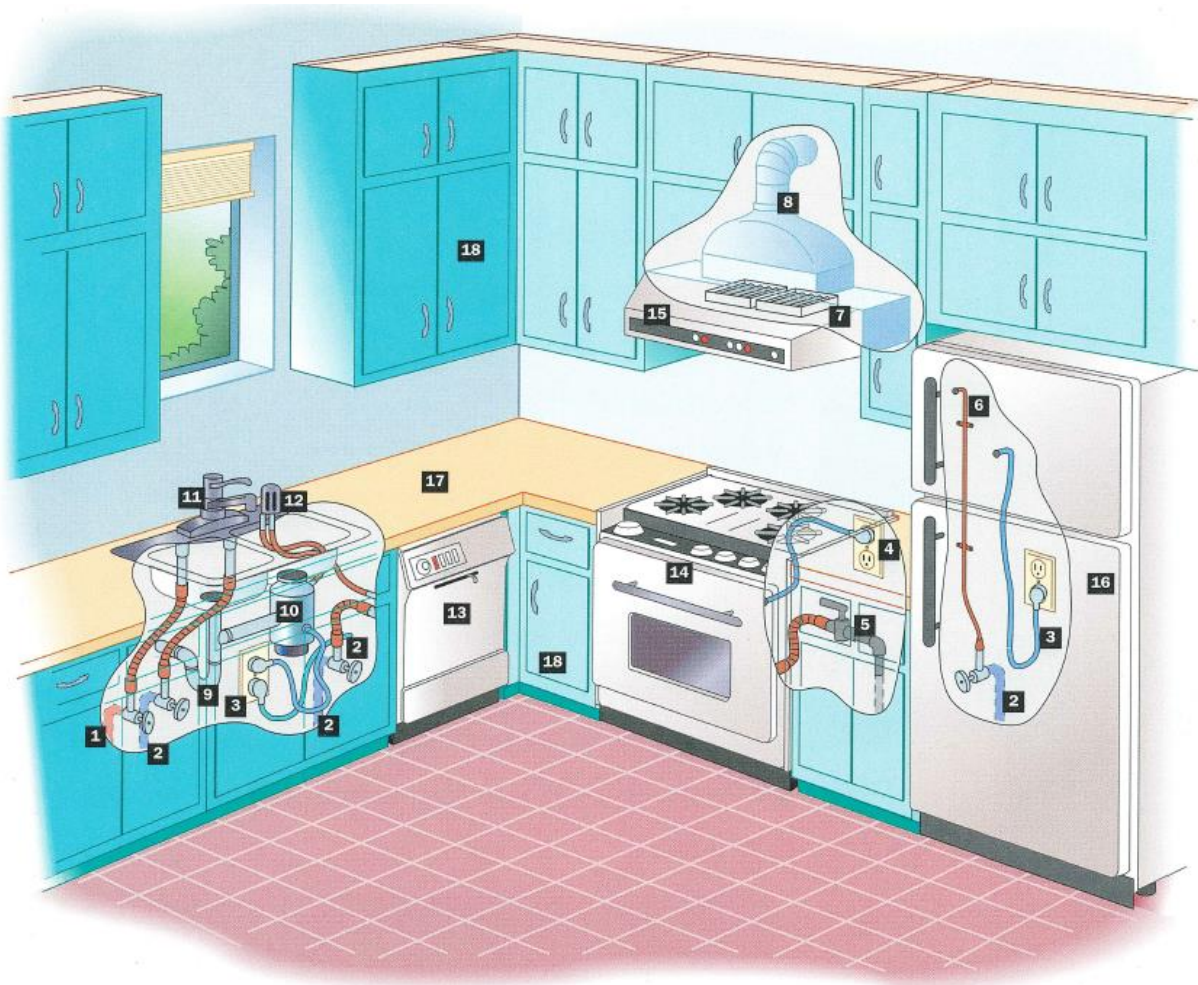


### Plumbing Systems

- |                           |                            |
|---------------------------|----------------------------|
| 1 Water service meter     | 8 Wastewater vent stack    |
| 2 Water service line      | 9 Tub and shower service   |
| 3 Water heater            | 10 Sink service            |
| 4 Gas or electric igniter | 11 Sewer waste junction    |
| 5 Cold water supply line  | 12 Pressure relief valve   |
| 6 Hot water supply line   | 13 Garbage disposal        |
| 7 Toilet                  | 14 Main sewer outflow line |

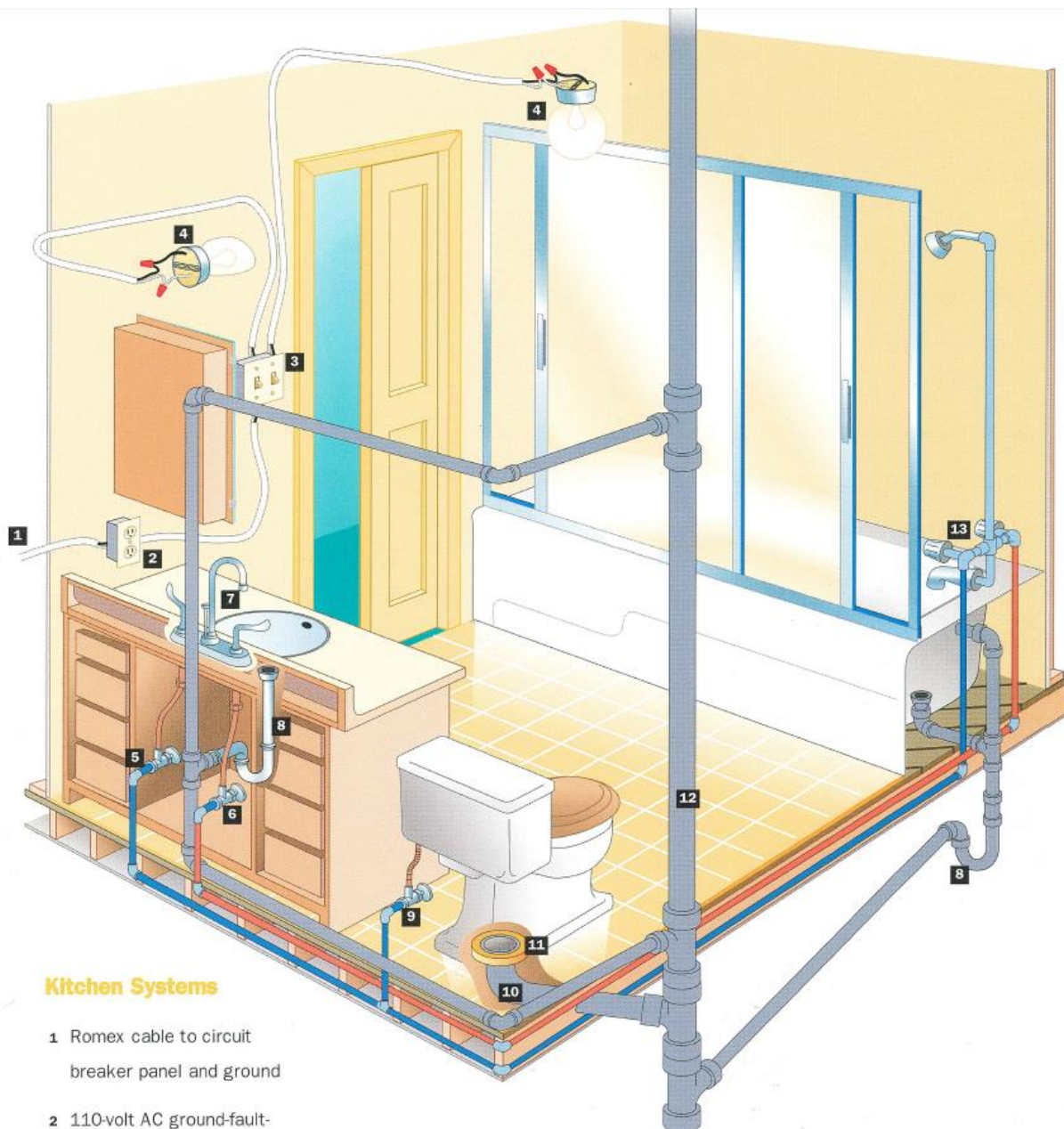






### Kitchen Systems

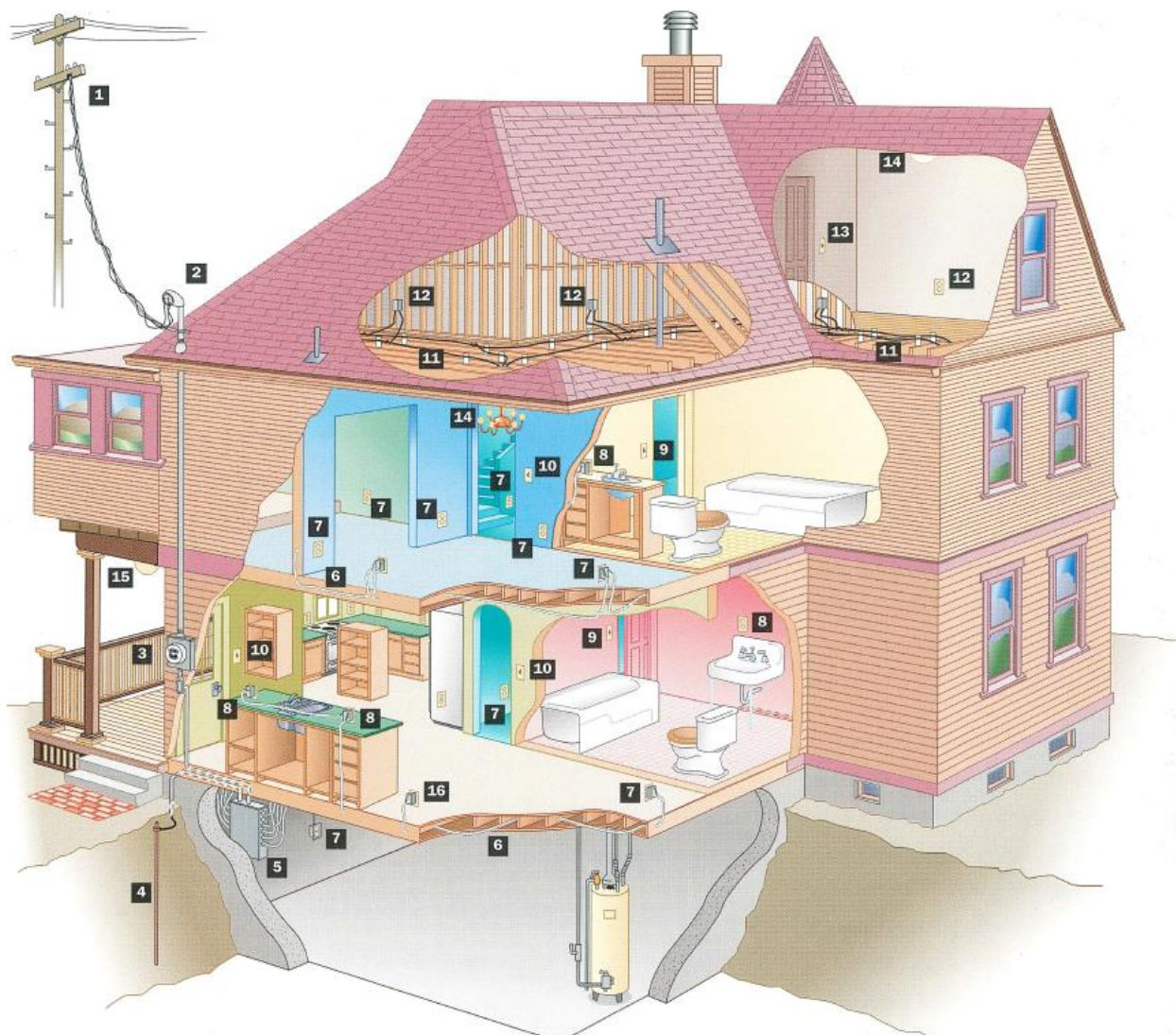
- |  |  |  |
|--|--|--|
| 1 Hot water supply and shut-off valve                | 6 Ice maker water line                                 | 12 Dishwasher air breather               |
| 2 Cold water supply and shutoff valve                | 7 Hood fans  | 13 Dishwasher                            |
| 3 110-volt AC ground-fault-protected electric outlet | 8 Hood vent to outdoors                                | 14 Gas range combined with electric oven |
| 4 220-volt AC grounded electric outlet               | 9 P trap to prevent sewer gasses from entering kitchen | 15 Range hood and light                  |
| 5 Natural gas supply and shutoff valve               | 10 Garbage disposal                                    | 16 Refrigerator-freezer                  |
|  | 11 Single-lever-cartridge faucet assembly              | 17 Countertop                            |
|  |  | 18 Cabinets                              |



### Kitchen Systems

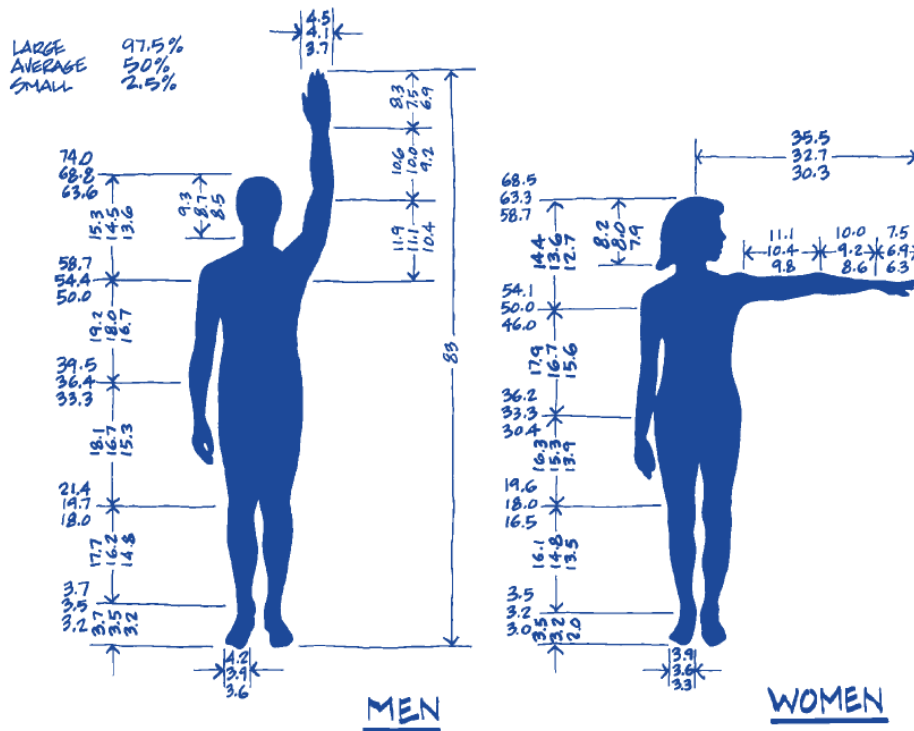
- |  |                                    |   |
|--|------------------------------------|---|
| 1 Romex cable to circuit breaker panel and ground    | 6 Hot water shutoff valve          | 10 Toilet sewer drain flange                |
| 2 110-volt AC ground-fault-protected electric outlet | 7 Faucet assembly                  | 11 Wax seal joining drain to toilet fixture |
| 3 110-volt AC ground-fault-protected switch          | 8 P-trap for wastewater drain line | 12 Air vent for sewer line                  |
| 4 Lighting fixtures                                  | 9 Toilet shutoff valve             | 13 Tap and Shower valve                     |
| 5 Cold water shutoff valve                           |                                    |   |



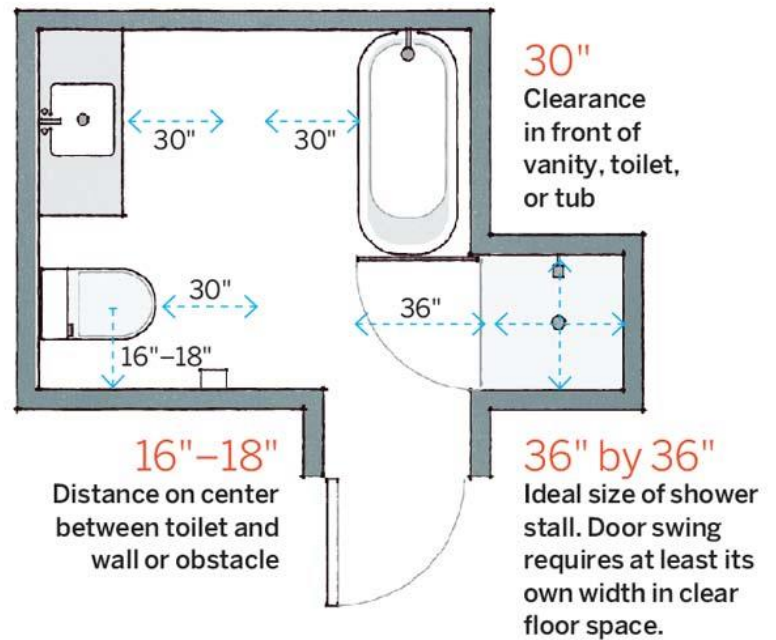
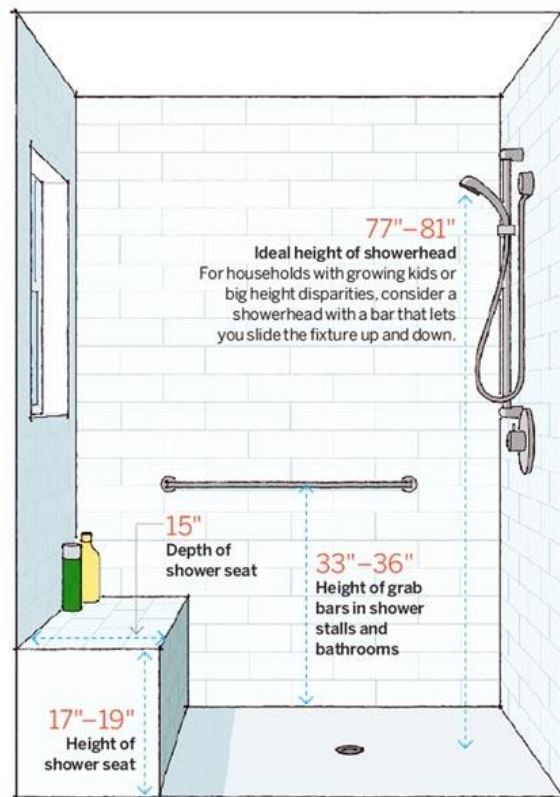
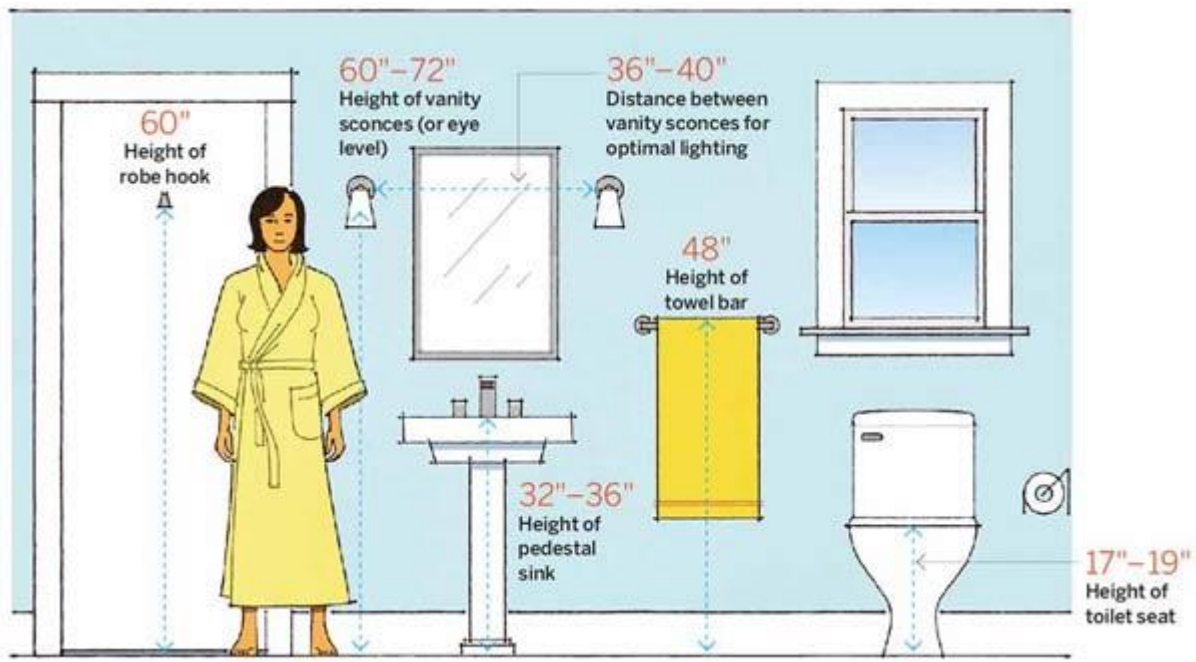


### Electrical System

- |   |   |  |
|---|---|--|
| 1 Utility Power Connection  | 6 110 Volt Romex® Cable Wiring Circuit  | 11 Obsolete Knob & Tube Wiring Circuit     |
| 2 House 220 Volt Electric Service Entrance                        | 7 Grounded Outlets                      | 12 Ungrounded Outlets                      |
| 3 Utility Electric Meter  | 8 Ground Fault Protected Outlets        | 13 Ungrounded Switches                     |
| 4 Primary Grounding Stake   | 9 Ground Fault Protected Light Switches | 14 Interior Lighting Fixtures              |
| 5 Electrical Main Box with Circuit Breakers and Multiple Circuits | 10 Grounded Light Switches              | 15 Weatherproof Exterior Lighting Fixtures |
|   |   | 16 220 Volt Outlet                         |

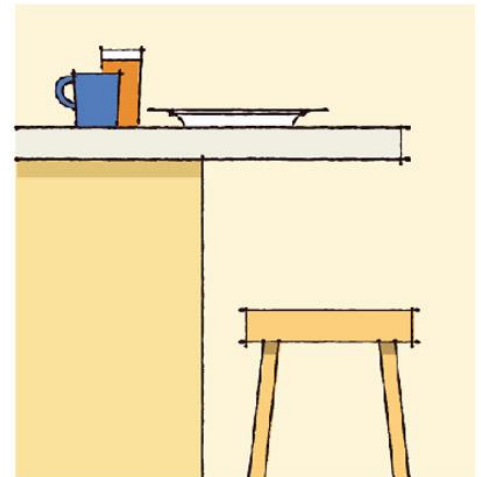
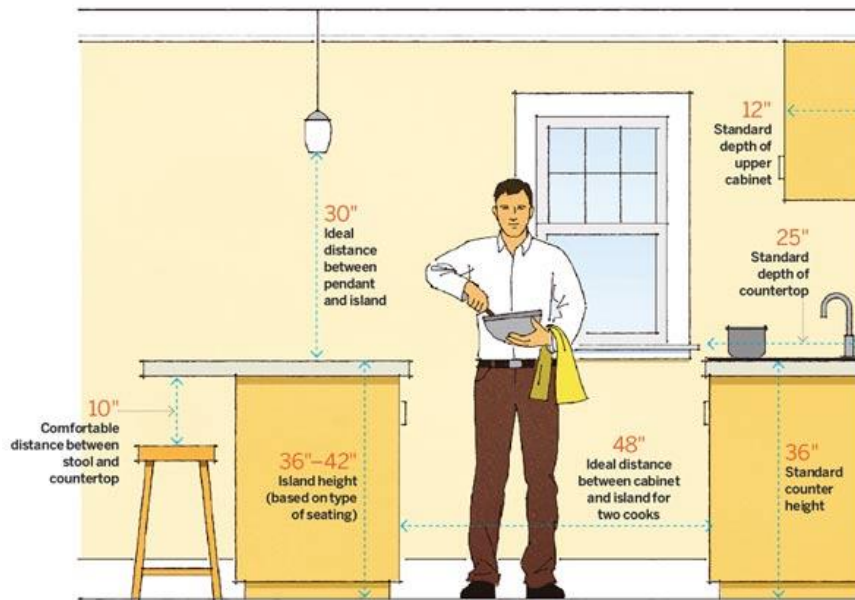


## COMMON BATHROOM DESIGN QUESTIONS

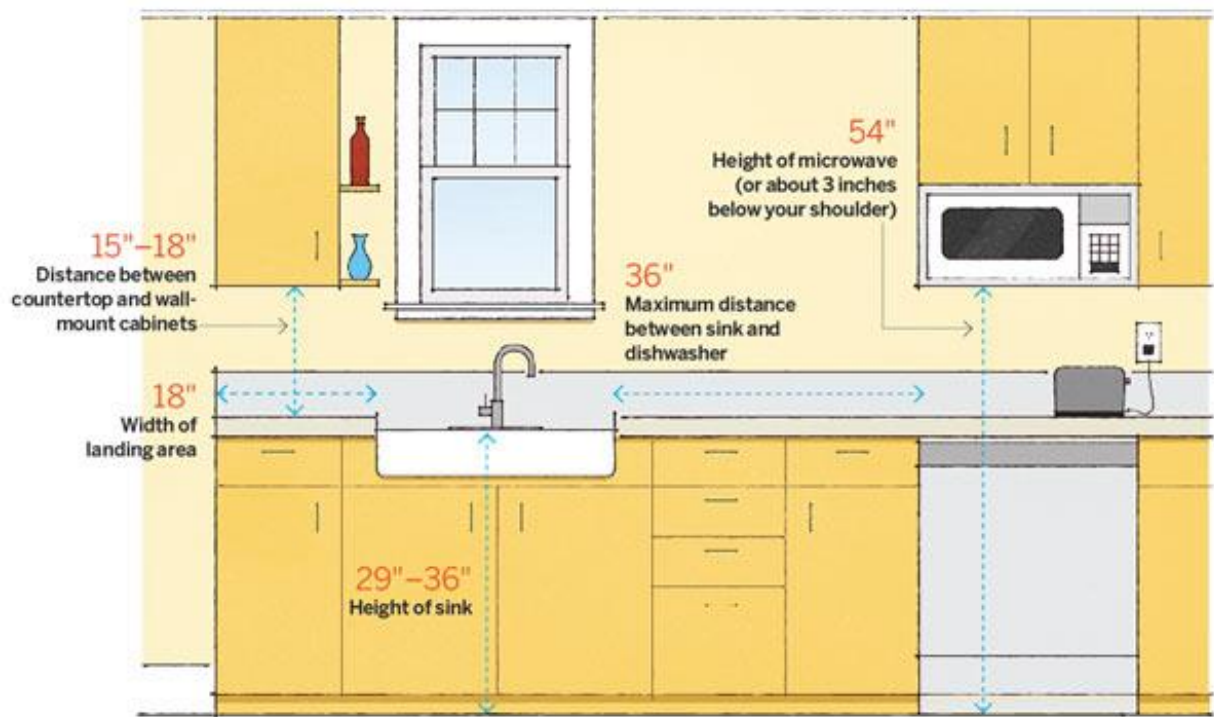


## COMMON KITCHEN DESIGN QUESTIONS



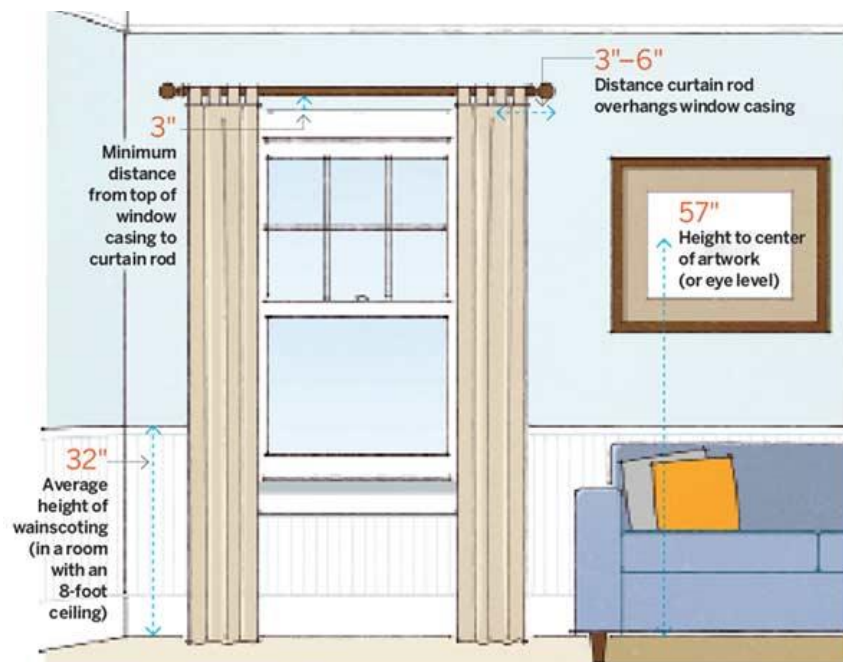
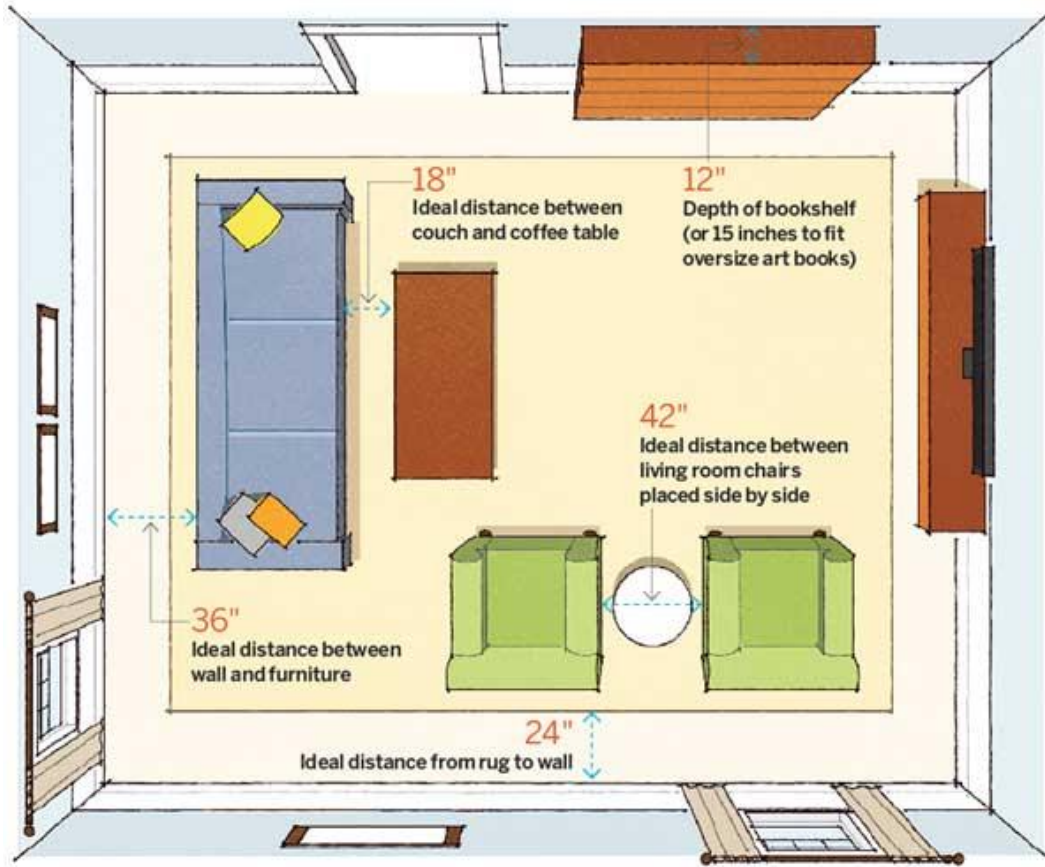


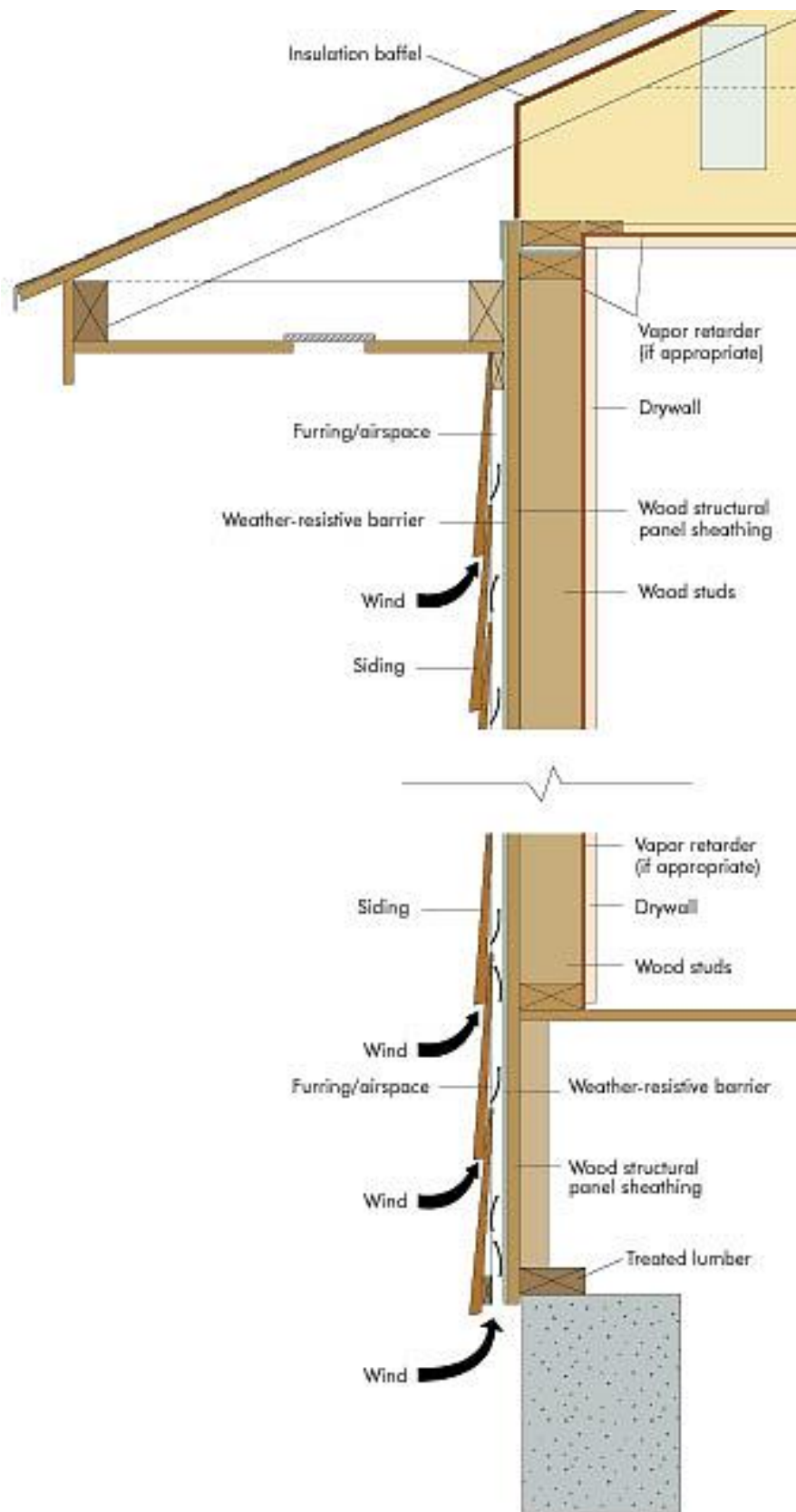
HEIGHT OF ISLAND	OVERHANG
42 inches	12 inches
36 inches	15 inches
30 inches	18 inches



## COMMON CLEARANCE QUESTIONS

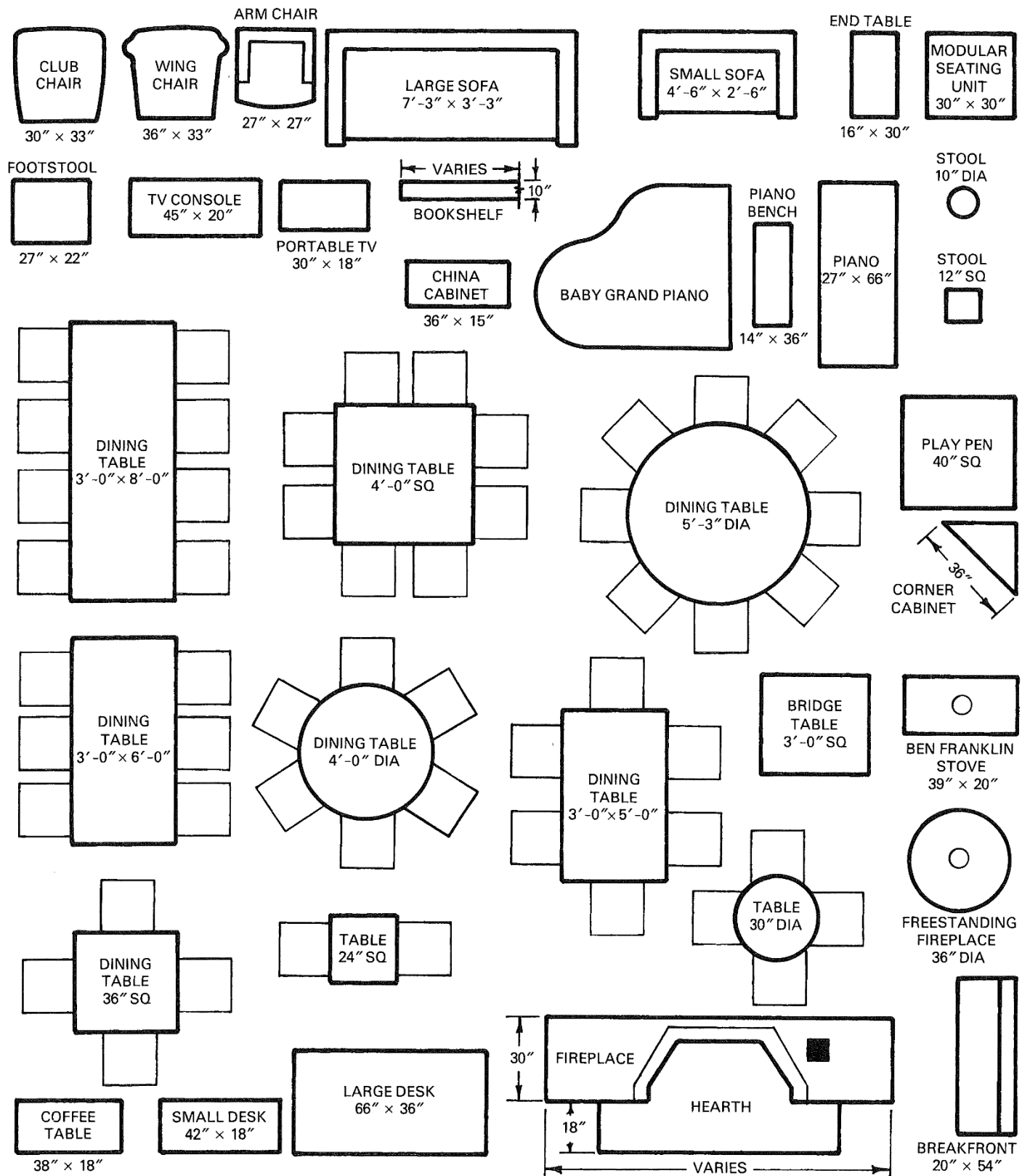






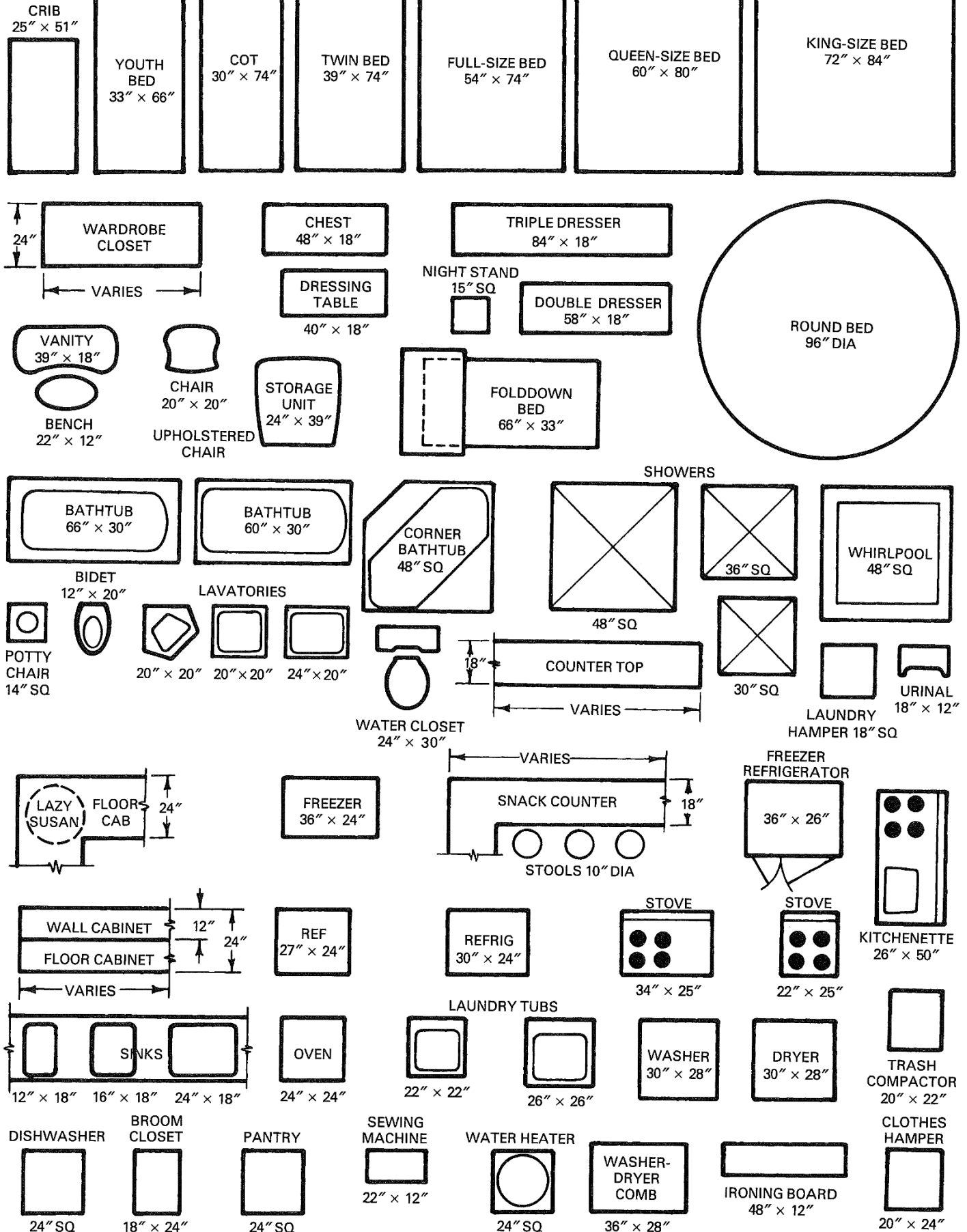
## T-2: Living Area

Scale:  $\frac{1}{4}" = 1'-0"$



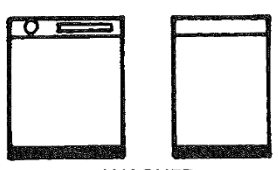
# T-3: Floor Plan Rooms

Scale:  $\frac{1}{4}" = 1'-0"$

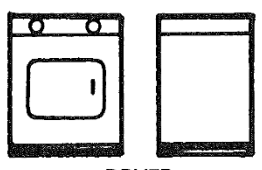


T-5: Service Area—Elevations

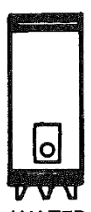
Scale: 1/4" = 1'-0"



WASHER



DRYER



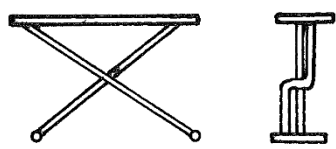
WATER  
HEATER



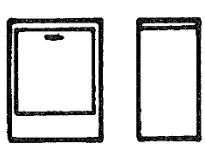
FREEZER



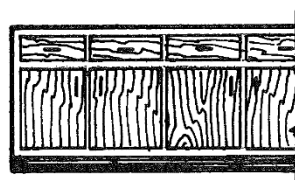
LAUNDRY TRAY



IRONING BOARD



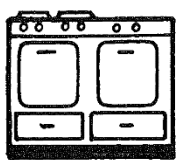
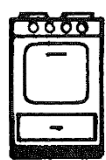
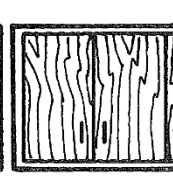
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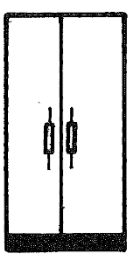
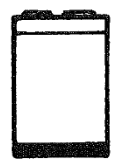
FLOOR CABINET



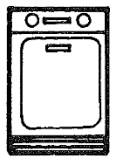
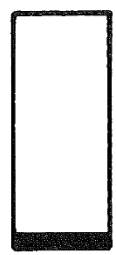
WALL CABINET



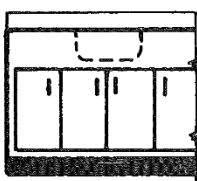
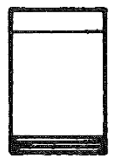
RANGES



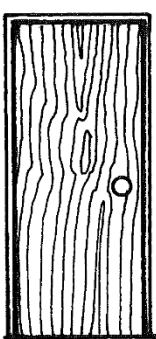
REFRIGERATOR/FREEZER



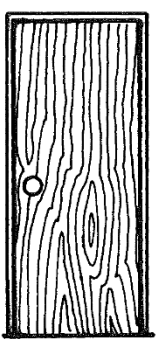
DISHWASHER



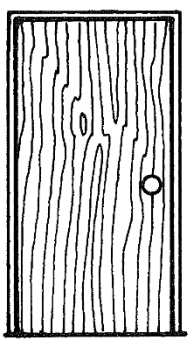
COUNTER AND  
SINK



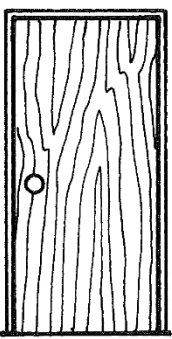
2'-9"



2'-6"

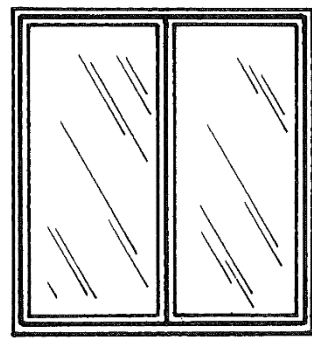


3'-3"

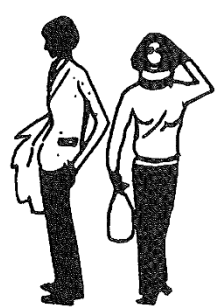


3'-0"

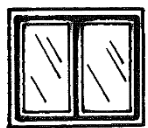
DOORS



6' SLIDING GLASS DOOR

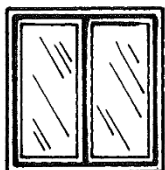


PEOPLE

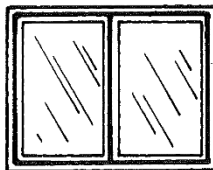


2'-6" x 2'-0"

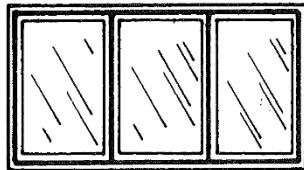
WINDOWS



3'-0" x 3'-0"

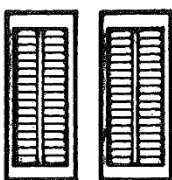
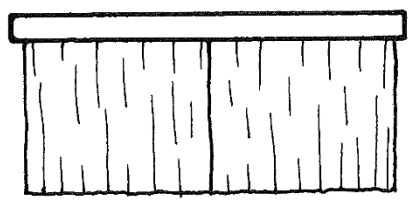


4'-0" x 3'-0"

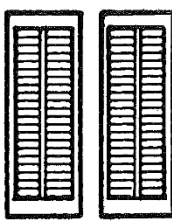


6'-0" x 3'-0"

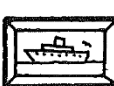
CURTAIN



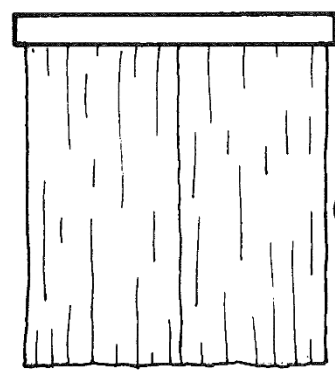
SHUTTERS



PICTURES



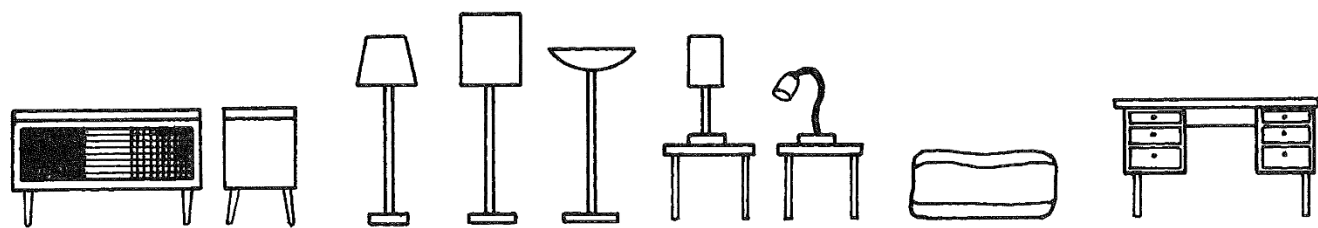
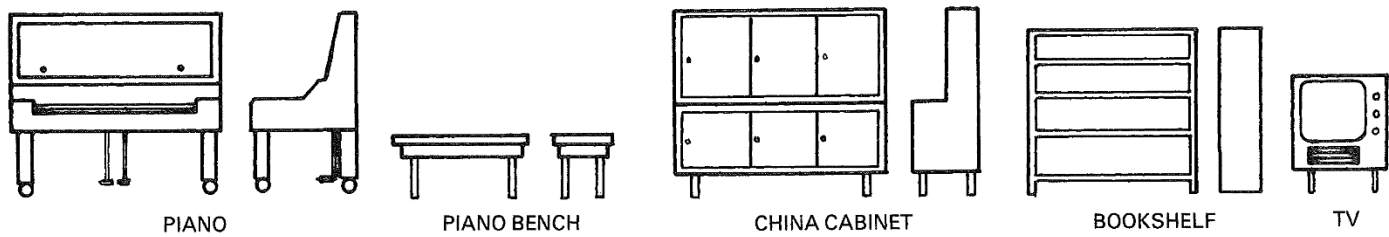
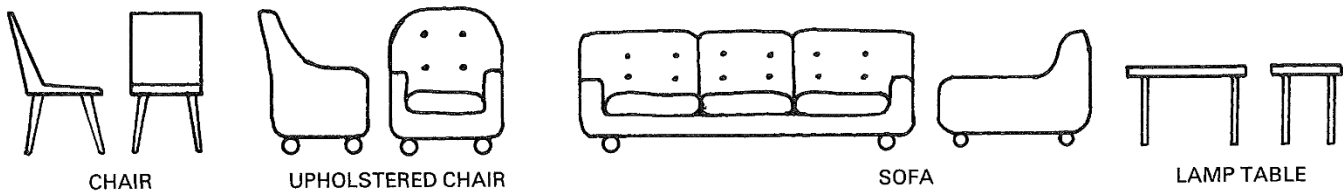
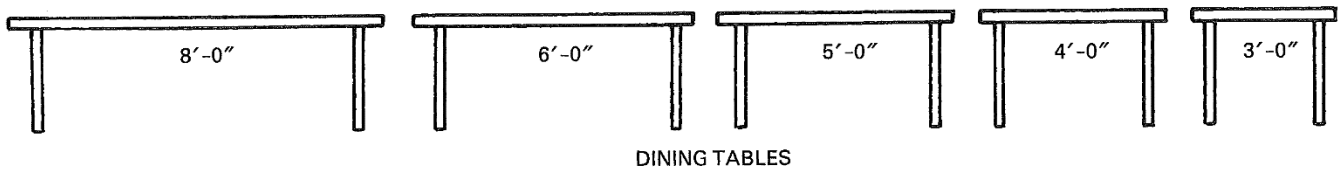
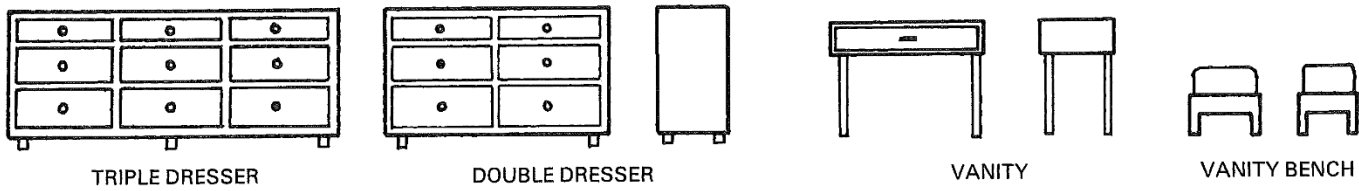
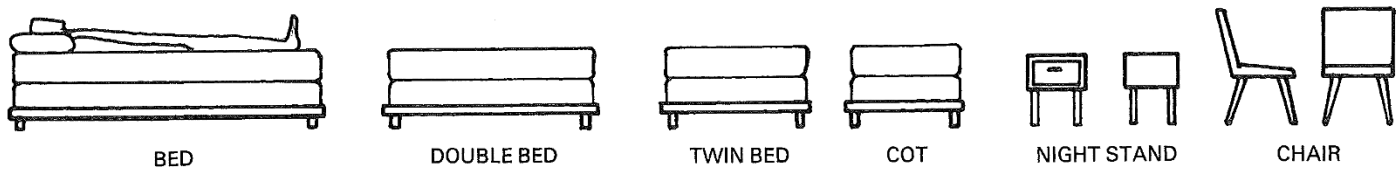
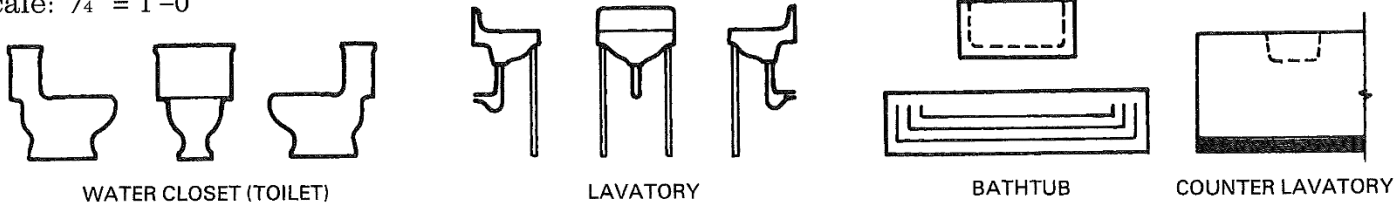
DRAPERIES



ELECTRIC SWITCHES AND  
OUTLETS

# T-4: Living and Sleeping Areas—Elevations

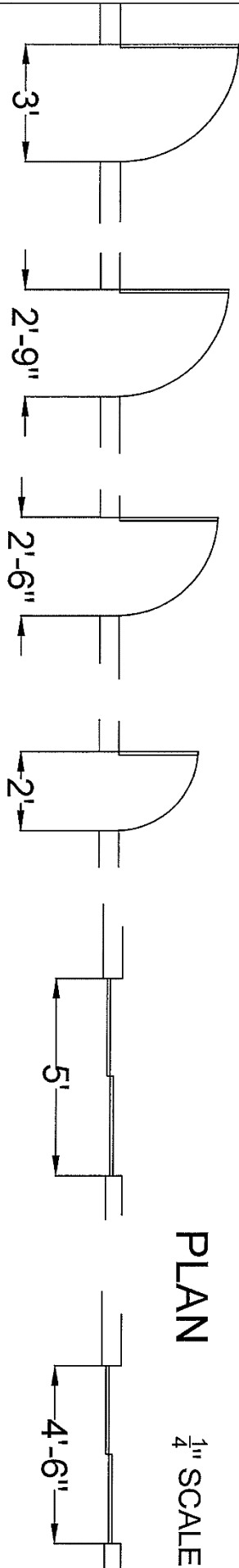
Scale: 1/4" = 1'-0"





# RESIDENTIAL DOORS

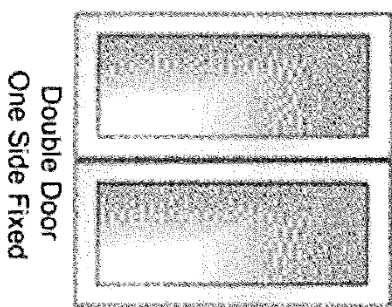
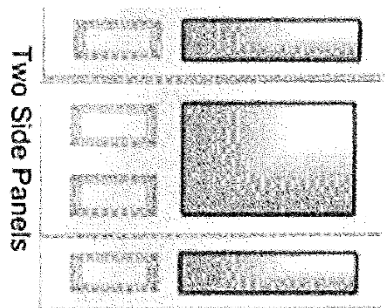
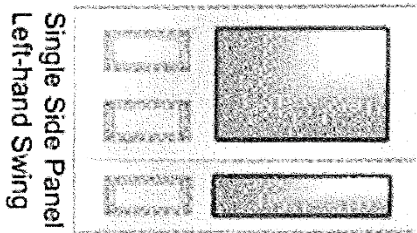
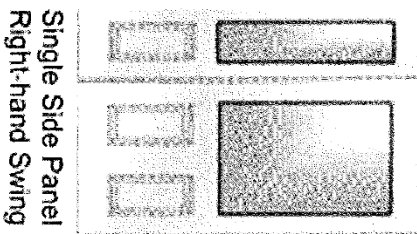
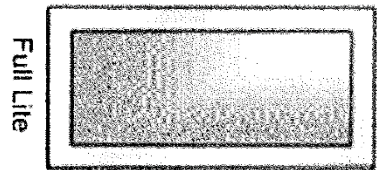
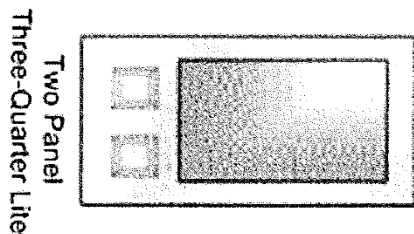
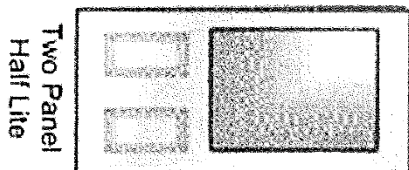
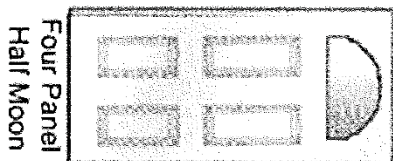
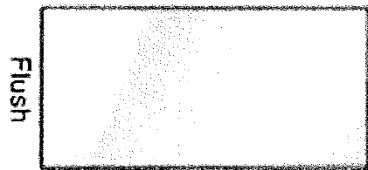
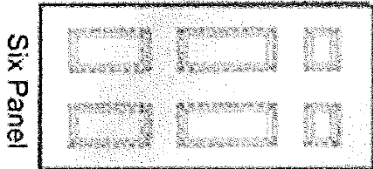
PLAN 1/4" SCALE



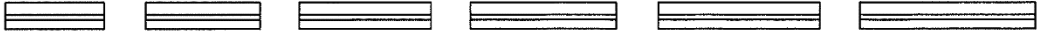
## Door Configurations

ELEVATION

6'-8"



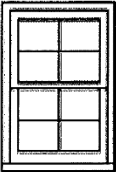
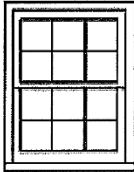
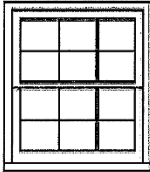
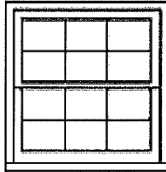
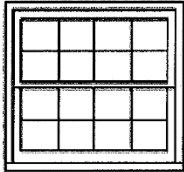
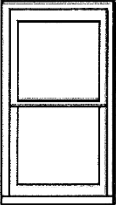
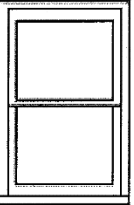
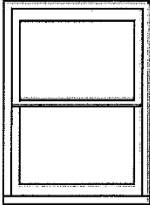
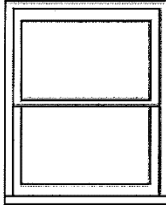
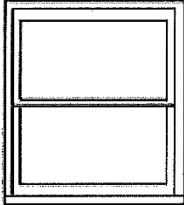
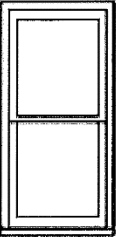
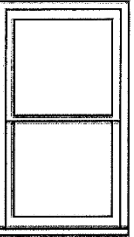
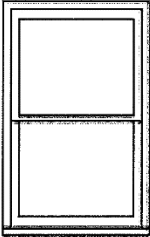
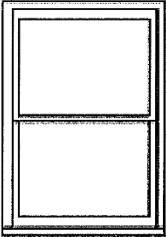
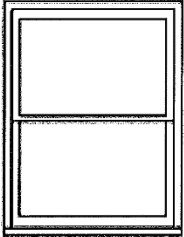
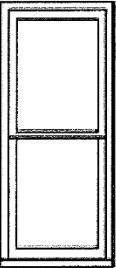
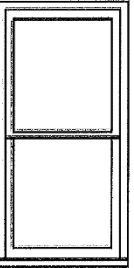
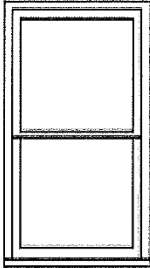
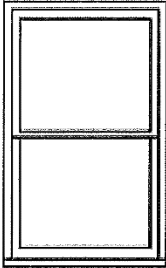
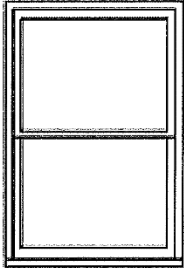
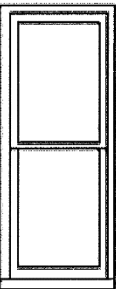
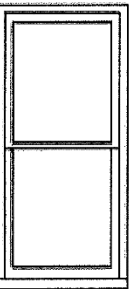
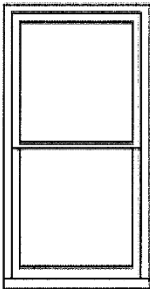
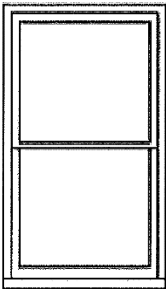
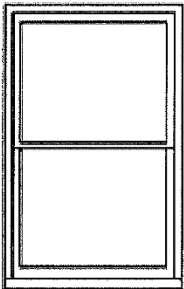
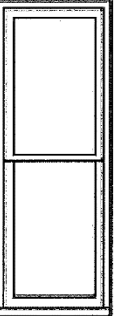
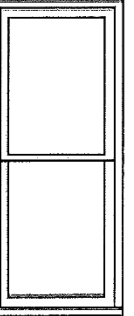
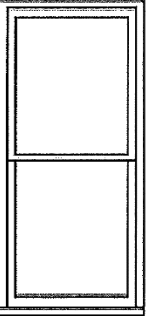
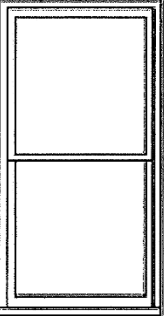
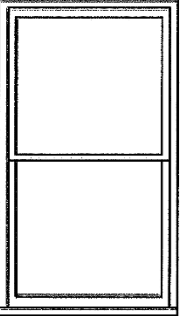
PLAN VIEW



$\frac{1}{4}$ " SCALE

ELEVATION

OUTSIDE CSS  
RCH OPENING  
SASH OPENING

24"	28"	32"	36"	40"	44"
22"	26"	30"	34"	38"	42"
1'8"	2'0"	2'4"	2'8"	3'0"	3'4"
42 $\frac{1}{4}$ " 41 $\frac{3}{4}$ " 3'2"					
50 $\frac{1}{4}$ " 49 $\frac{3}{4}$ " 3'10"					
58 $\frac{1}{4}$ " 57 $\frac{3}{4}$ " 4'6"					
66 $\frac{1}{4}$ " 65 $\frac{3}{4}$ " 5'2"					
70 $\frac{1}{4}$ " 69 $\frac{3}{4}$ " 5'6"					
78 $\frac{1}{4}$ " 77 $\frac{3}{4}$ " 6'2"					

DOUBLE HUNG WINDOWS