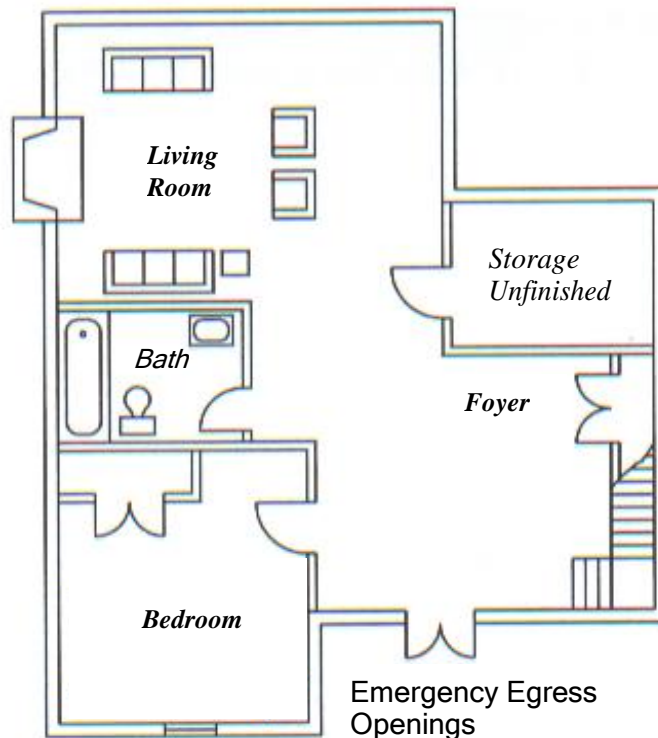




2012
CITY OF FREDERICKSBURG
GUIDE FOR FINISHING BASEMENTS



This pamphlet provides guidelines for homeowners finishing, remodeling or renovating their basements. Compliance with requirements is subject to verification and inspection.

Virginia Uniform Statewide Building Code

The State of Virginia requires that your finished basement comply with the Virginia Uniform Statewide Building Code (VUSBC) which incorporates the International Residential Code 2012 for One-and-two Family Dwellings. City of Fredericksburg is required to enforce the VUSBC. For additional information, the VUSBC & supplements can be obtained through the Virginia Department of Housing & Community development in Richmond. The International Residential Code 2012 can be purchased @ WWW.iccsafe.org.

Permits required to finish basements?

- A building permit is required when a basement is altered, added on to, or finished (partially or completely).
- An electrical permit is required if adding electrical wiring for outlets, fixtures, etc.
- A plumbing permit is required if adding plumbing pipes fixtures, etc.
- A mechanical permit is required if any ductwork, bath fans or heat are added.

Who should apply for permits?

- If a contractor/s is to perform work, the City of Fredericksburg strongly suggests that the contractor obtain the permit and be listed on the permit as the responsible party. In this way the City will be in a better position to assist you in gaining compliance with codes if the work is rejected. All contractors must be properly licensed in order to obtain a permit.

What do permits cost?

- Call the Permit Office at 540-372-1080 to obtain information regarding the fee structure for a building permit. The Permit Office is open Monday – Friday from 8:15 a.m. to 4:30 p.m. Fee schedule is also online @ www.fredericksburgva.gov

What is required for the permit application?

- A plan view of the basement must be provided (see typical plan view on cover of this guide) identifying each room i.e., study, family room, laundry room, and **bedroom**. Stairs and other egresses, as required by code must, be shown on the plan view.

What inspections are required?

- Inspections are required by the VUSBC to ensure code compliance for all permits. The number of inspections varies whether electrical, plumbing or mechanical installations are made see “*inspection timing checklist*” (pg.17-18) for required inspections and the stage of construction at which the project should be, prior to requesting the inspection.
- All inspection shall be made prior to concealment.

What is a “Habitable Space”?

- A habitable space is defined as a space for living, eating, sleeping, or cooking. Bathrooms, toilet rooms, closets, halls, storage or utility spaces are not considered habitable space.

GENERAL BUILDING CODE REQUIREMENTS

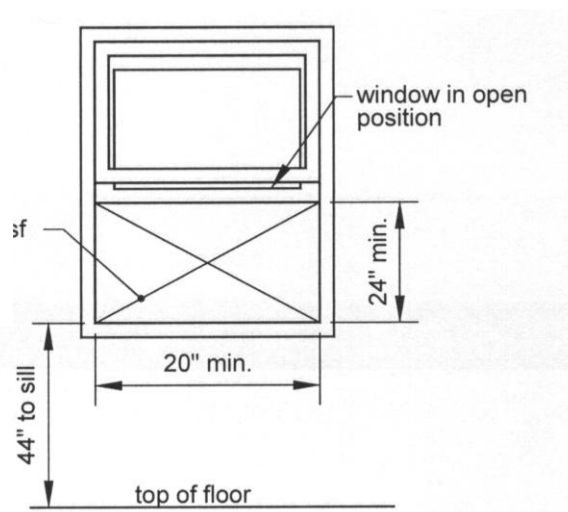
Bedrooms and habitable spaces require emergency egress

Emergency egress openings are required for each bedroom and for habitable spaces within basements. At least one openable window or exterior door, approved for emergency egress / rescue must be provided. A bedroom egress opening (window or door) can also serve as the egress for other habitable areas within the basement provided the bedroom door cannot be locked. Windows with tilting or removable sashes can be used to achieve the clear opening requirements. These window units must be operable from inside the basement without the use of keys or tools. Where windows are provided, they shall have a sill height of not more than **44 inches** from the floor; have a net clear opening of **5.0** square feet at grade level & **5.7 square feet** if above or below grade level; see definition of grade level below: have a net clear opening height of 24 **inches**, and have a net clear opening width of **20 inches**. Note that A window with net clear openings of **24”H x 20”W** will not meet the minimum square foot opening requirements.

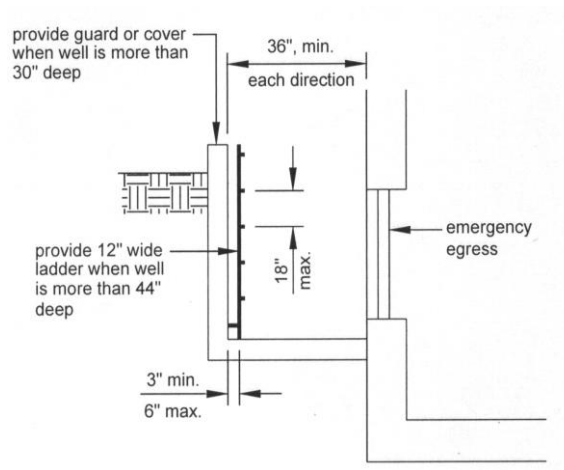
Window open able area:

- At grade level 5.0 sq. ft.
- Above or below grade 5.7 sq. ft.

GRADE LEVEL - within 44” above or below finished ground level.



Where the emergency egress windows exit to a window well, the minimum dimensions of the well shall not be less than **3 feet by 3 feet**. If the window well has a depth greater than **44 inches**, a permanently mounted ladder or stair is required. The ladder or stair may encroach a maximum of **6 inches** into the required dimensions. Depending where the window well is located, a cover or other means may be required for safety.



Ceiling Height

Habitable spaces in basements shall have a ceiling height of not less than **7 feet**. Beams & girders spaced not less than **4 feet** on center may project a maximum of **6 inches** below the required ceiling height. Hallways, bathrooms, toilet rooms and laundry rooms in the basement shall have a minimum ceiling height of **6 feet 8 inches**. Bathroom height is measured at the center of the front clearance area of fixture. A shower or tub equipped with a shower head shall have a minimum 6'8" ceiling height within the fixture at the place of its intended use.

Room Sizes

Habitable rooms shall have an area of not less than **70 square feet** and be not less than **7 feet** in any direction. Note that bathrooms, toilet rooms, closets, halls, storage or utility spaces are not considered habitable spaces

Toilet, bath and shower spaces--

Bathtubs, shower floors and walls above bathtubs installed with shower heads and in shower compartments shall be finished with a nonabsorbent surface to a height not less than 6 feet above the floor surface. Ceramic tile shall be installed on fiber-cement, fiber-mat reinforced cement, glass mat gypsum backers or fiber-reinforced gypsum backers in accordance with manufacturer's instructions. Bathrooms, water closet compartments and similar areas shall be provided with a window for ventilation purposes. The window must be a minimum of 3 square feet, half of which must be openable. In lieu of installing a window, mechanical ventilation can be provided by using a vent fan with a minimum capability of 50 cfm or 20 continuous and shall be vented directly to the outside.

Hallways

The minimum width of hallways shall not be less than **3 feet**.

Stairs

Enclosed, accessible space under stairways shall have walls & soffits protected on the enclosed side with ½ **inch** gypsum board. Means shall be provided to illuminate the stair including the landings and treads with artificial light located in the immediate vicinity of the landings and at the top and bottom of the stair. The control for the lighting shall be accessible at the top and bottom of the stair without traversing any steps.

Smoke Alarms

Smoke alarms are required for the basement, for each bedroom and outside of each bedroom (within **10 feet**). Alarms shall be powered from the 120-volt home wiring system with battery backup. The wiring shall be a permanent connection without any switches or disconnecting devices other than the normal branch circuit protective device. If the existing home has interconnected smoke alarms, and it is reasonably possible to interconnect new smoke alarms with the existing system, all smoke alarms shall be interconnected and so that activation of one alarm will activate all alarms.

Carbon Monoxide Alarms

Carbon monoxide alarms shall be installed outside of each sleeping area (within 10 feet) in dwelling units with fuel fired appliances or having an attached garage. Single station carbon monoxide alarms shall be plug-in, battery type or hard wired, listed as complying with UL 2075 or 2034.

Fire Extinguishers

Kitchen areas other than dwelling units equipped with an approved sprinkler system. A fire extinguisher having a rating of 2-A: 10-B: C or an approved equivalent type of fire extinguisher shall be installed in the kitchen area.

Insulation

A minimum of **R-10** (continuous roll type) or R-13 (batt type installed between the studs) Insulation shall be provided with a vapor barrier, installed from the top of the basement wall to a depth of **10 feet** below grade or to the top of the basement floor, whichever is less.

CODE REQUIREMENTS FOR WALL CONSTRUCTION

Studs

Studs may be steel or utility grade or better lumber. Spacing and fastening shall be in accordance with the TABLES 1 & 2.

TABLE 1 STUD SPACING

Wall type	Stud spacing on center
Drywall	16 " or 24"
Wood veneer / paneling	16"

TABLE 2 FASTENING SCHEDULE

Connection	Nailing
Top plate to stud	End nail, 2-16d or toe nail 2-16d or 3-8d
Stud to bottom plate	Toe nail, 2-16d or 3-8d*
Bottom plate to floor	Face nail (concrete nail) @ 24" o.c. *

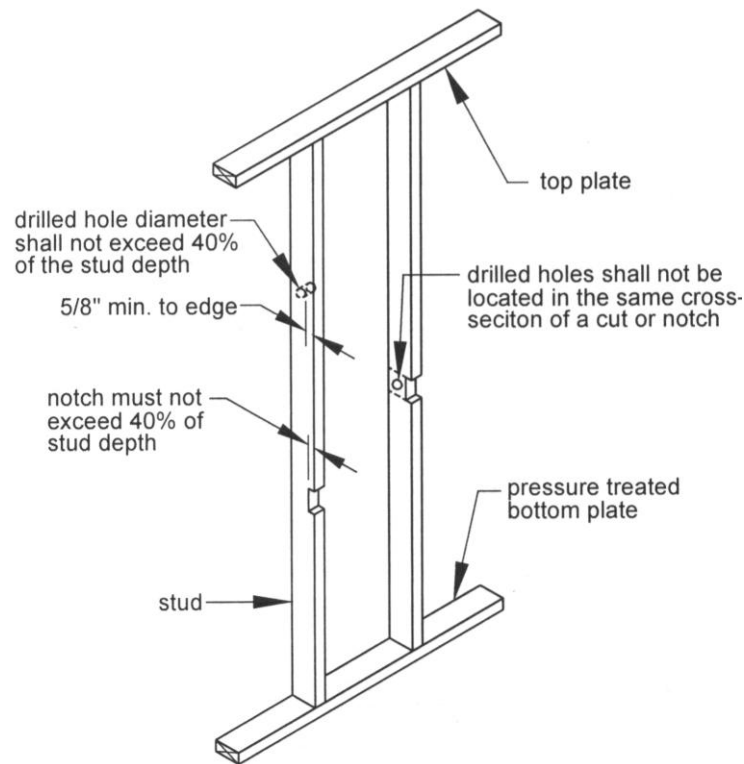
*Nails used for connection to pressure treated wood sill plate must be approved for use with specific type of pressure treated wood being used.

Headers

A single, flat 2X4 member may be used as a header in interior non-load bearing walls for openings up to **8 feet** in width if the wall above is not more than **24 inches**. If the opening does not meet the above conditions, the header shall be sized in accordance with TABLE 3.

TABLE 3
Header
Size

Header Size	Span Length (feet)
(2) 2x4	4
(2) 2x6	6
(2) 2x8	10
(2) 2x10	12
(2) 2x12	16



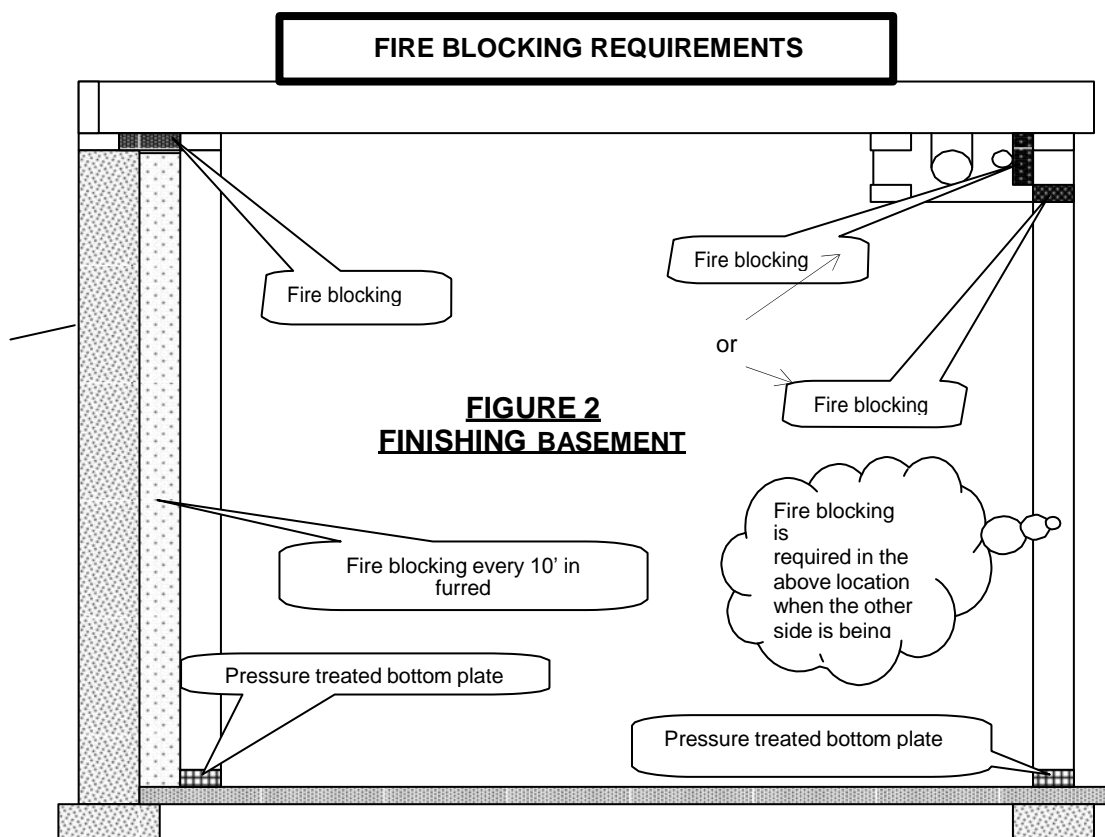
Drilling and notching studs

Studs in non-load bearing walls may be notched to a depth not to exceed **40%** of a single stud width. Studs may be bored or drilled, provided that the diameter of the resulting hole is no greater than **60%** of the stud width, the hole is no closer than **5/8**inch to the edge of the stud and the hole is not located in the same section as a cut or notch.

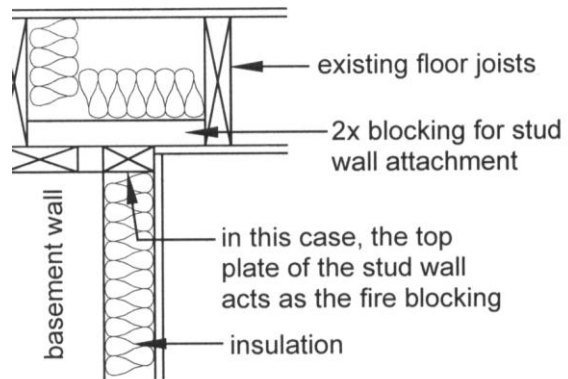
Fire blocking

Fire blocking shall be provided to cut off all concealed draft openings and to provide an effective fire barrier between stories. Fire blocking can consist of **2 inch** nominal lumber or two thickness of **1 inch** nominal lumber with broken lap joints, or one thickness of **23/32 inch** wood structural panel with joints backed by **23/32 inch** structural panels or one thickness of **3/4 inch** particle board with joints backed by **3/4 inch** particle board, **1/2 inch** gypsum board or **1/4 inch** cement based millboard. When piping, conduit or similar obstructions are encountered; insulation shall be packed tightly around the obstruction. The integrity of all fire blocking shall be maintained. Fire blocking shall be provided in the following locations:

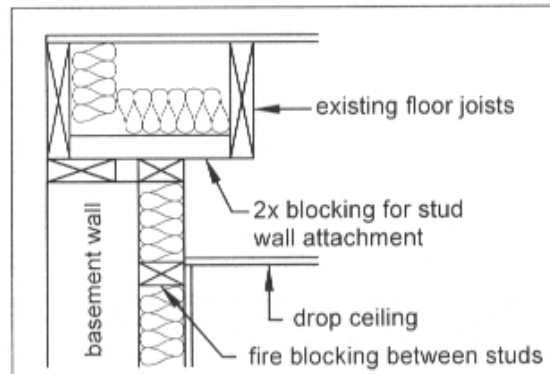
- a. In concealed spaces of stud walls and partitions, including furred spaces at the ceiling and floor level.
- b. At all interconnections between vertical and horizontal spaces such as occur at soffits, dropped ceilings, etc.
- c. In concealed spaces between stair stringers at the top and bottom of the run.
- d. Horizontal fire stopping is required in concealed spaces, every **10 feet** (this can be batts or blankets of mineral or glass fiber in walls constructed using parallel rows of studs).



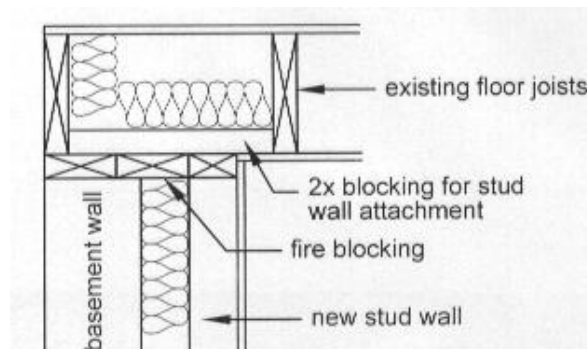
Typical Fire Blocking Detail



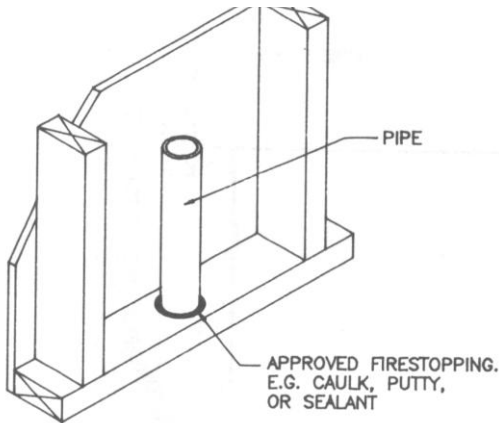
Fire Blocking at Dropped



Fire Blocking at Offset Stud Wall



Fire stopping Around Piping

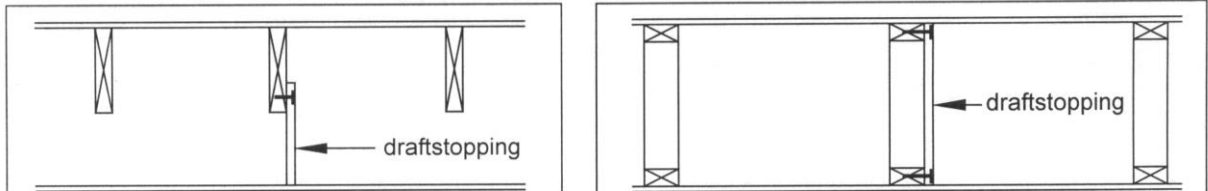


CODE REQUIREMENTS FOR FLOOR / CEILING CONSTRUCTION

Draft stopping

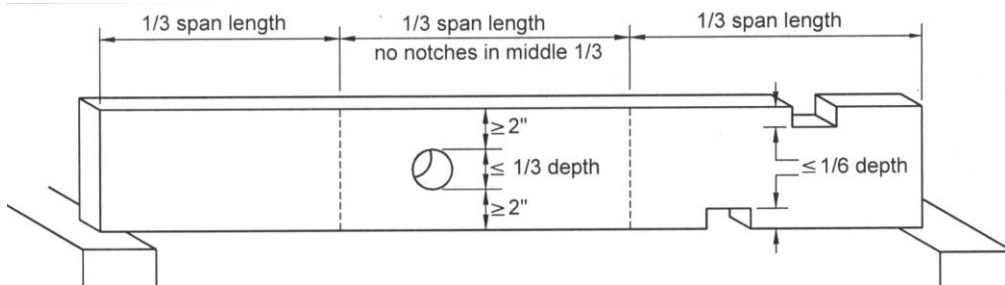
When the ceiling of a finished basement is not connected directly to the floor or when open web trusses are used, draft stopping must be provided. Draft stopping must be installed to sectionalize concealed spaces into approximately equal areas, not exceeding **1,000 sq.ft.**

Draft stopping must be installed parallel to the floor framing members. Draft stopping materials may be **1/2 inch** gypsum board or **3/8 inch** plywood.



Drilling and notching joists

Notches in the top and bottom of joists shall not exceed shall not exceed **1/6** the depth of the joist, shall not be longer than 1/3 of the depth of the member and shall not be located in the middle **1/3** of the span. Cantilevered joists shall not be notched. Holes drilled in joists shall not be within **2 inches** of the top or bottom of joists or to any other hole or notch and their diameter shall not exceed **1/3** the depth of the joist. Drilling and notching of manufactured wood products (TJI, LVL) must be done in accordance with specific manufacturer's instructions.



CODE REQUIREMENTS FOR MECHANICAL SYSTEMS

Appliance access

Furnaces, hot water heaters and other appliances must be listed & labeled, installed per specific manufacturer's instructions and must be removable without removing permanent construction. They shall also meet the following minimum requirements:

- **30 inch x 30 inch** clear floor space at front / control side.
- **6 inch** clearance at all other sides and top.
- Doors at furnace room shall be a minimum of **24 inches** and be of adequate size for removal of the largest appliance.
-

Combustion Air (see APPENDIX “A” fill in sheets; for additional details and requirements).

All **fuel** burning appliances must be provided with combustion air (electric appliances are not fuel fired and are exempt). Since a lot of homes in the City of Fredericksburg use gas fired appliances, only these will be covered in this guide. For fuel fired appliances other than gas, refer to the IRC Chapter 17 for specific requirements.

Note that combustion air cannot be obtained from a **bedroom, storage closet or, bath / toilet rooms.**

The following provides guidance and requirements for the following two methods:

The Standard Air Infiltration Rate Method assumes the house has an air infiltration rate of at least 0.4 Air Changes per Hour (ACH) and permits using air from inside the house as outlined in this policy. If you have any reservation that your house may have less than 0.4 ACH, requirements must be calculated using IRC chapter 24, section G2407.5.2. or all combustion air should be obtained from outside as outlined here.

To obtain all combustion air from inside and the air infiltration rate for the house is unknown (air infiltration rate assumed to be at least 0.4 ACH), combustion air requirements can be found by determining the total input Btu/h of all fuel fired appliances and verifying that a sufficient volume of combustion air is available.

Using the standard method, you must have at least 50 cubic feet per 1,000 input Btu/h for all fuel fired appliances. If necessary, combining spaces on the same level and on different levels can be used to achieve combustion air requirements. You must use the fill in sheets in Appendix “A” (attached) to determine combustion air requirements. These sheets must be on site along with the approved plan if combustion air is required. Not having the completed **“Appendix “A”** may result in the rejection of the mechanical rough-in inspections.

- **The All Combustion Air from Outside Method** does not rely on interior air for combustion and provides required air from outside the house through duct(s).

Where desired to obtain all combustion air from outside, the required volume of outside air can be supplied by a single duct to the utility room / unfinished area, providing appliances have a minimum of 1” clearance from the sides & back and 6” of clearance in front (or per specific manufacturers requirements). The single duct must be located within 12” from the top of the ceiling and sized for a minimum of 1in²/ 3000 Btu/h input rating of all appliances. The duct size shall in no case be smaller than the combined cross-sectional flow areas of all the flue collars or draft hood outlets of the appliances served by the openings. The area of multiple ducts can be added together. You must use the fill in sheets in Appendix “A” (attached) to determine combustion air requirements. These sheets must be on site along with the approved plan if combustion air is required. Not having the completed “Appendix “A” will result in a rejection of the # 400 inspection.

Bathroom Vent Fans

Bathroom ventilation must be provided. This may be accomplished using a window with a minimum of 3ft² of glazing; half of which must be operable. In lieu of a window a vent fan can be installed (minimum of 50 CFM) which discharges directly to the outside. Vent fan ducts in concealed areas, not readily accessible for maintenance, must be flexible or rigid metal. Where only a water closet (toilet) and sink are installed, such as in a “powder room”, the window or vent fan may be replaced with an un-vented, listed, fan-filtration unit; however, direct ventilation is recommended.

CODE REQUIREMENTS FOR PLUMBING

Bathtub / Showers

Shower compartments must have a minimum area of **900** square inches and a minimum of **30 inches** in any direction. Hinged doors shall open outward and have a minimum width of 22” and all glass, which encloses the shower, must be safety glazed. Showerheads shall have a maximum water consumption rate of **2.5 gallons** per minute. All shower control valves shall have a high limit stop and shall be set to limit water temperature to a maximum of 120°F. Bathtubs shall have outlets and overflows at least **1 ½ inch** diameter. The waste outlet shall be equipped with an approved stopper. If the bathtub is equipped with a shower it must have an anti-scald control valve with a hot water limit of **125F**.

Bathroom Sinks (Lavatories)

Sinks shall have waste outlets of not less than **1 ¼ inch** diameter. A strainer, pop up stopper, crossbar or other device shall be provided to restrict the opening of the waste outlet. Faucets shall have a maximum flow rate of **2.2 gallons** per minute @ **60psi**.

Sinks other than bathrooms & laundry tubs

Sinks shall have waste outlets of not less than **1 ½ inch**.

Toilets (water closets)

Toilets shall have a maximum flow rate of **1.6 gallons** per flush.

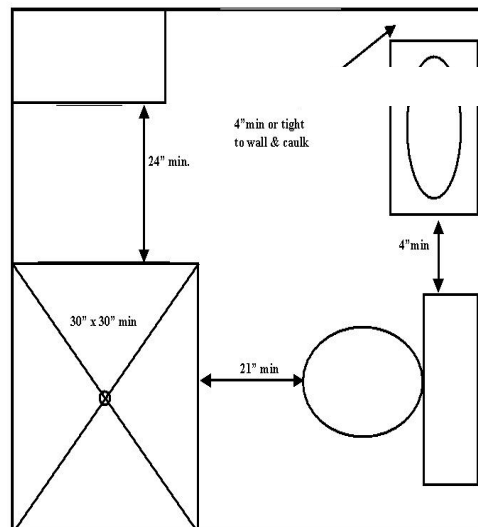
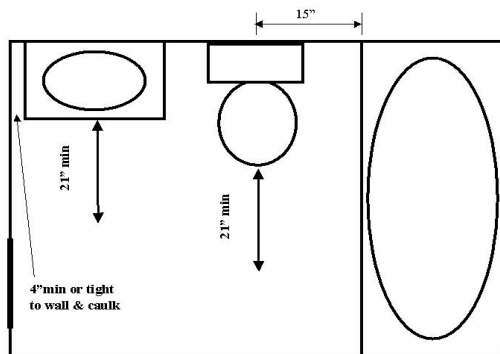
Clothes washer discharge

The discharge of a clothes washer shall be through an air break into an 18” minimum and 44” maximum standpipe or into a laundry sink. The trap and drain shall be a minimum of 2”.

Water Heaters

Where water heaters are installed in locations where leakage of the tank, fittings or condensation will cause damage, a galvanized steel pan or other type pan listed for this use must be installed. The pan shall be a minimum of **1.5 inches** deep and be equipped with a **¾-inch** minimum drain line (or at least as large as the tank relief valve). The drain shall extend, full size, and terminate over an indirect waste receptor or extend to the exterior of the basement, terminating not less than **6 inches** or more than **24 inches** above grade.

Bathroom Fixture Spacing



ELECTRICAL CODE REQUIREMENTS

Panel board (circuit breaker panel)

A flat workspace **30 inches** wide and **36 inches** deep from the floor to the ceiling with a minimum height of **6 feet 6 inches** shall be maintained in front of the circuit breaker panel. This space shall be maintained unobstructed at all times. Circuit breaker panels must not be located in toilet rooms, bathrooms or clothes closets. A light must be provided for the circuit breaker panel workspace.

Branch circuits

A **15** or **20**-ampere circuit can be used for supplying lighting and outlets. The rating of any single plugged in electrical device shall not exceed **80%** of the branch circuit ampere rating. Hardwired appliances or equipment may be included in the circuit provided that its rating does not exceed **50%** of the circuit rating.

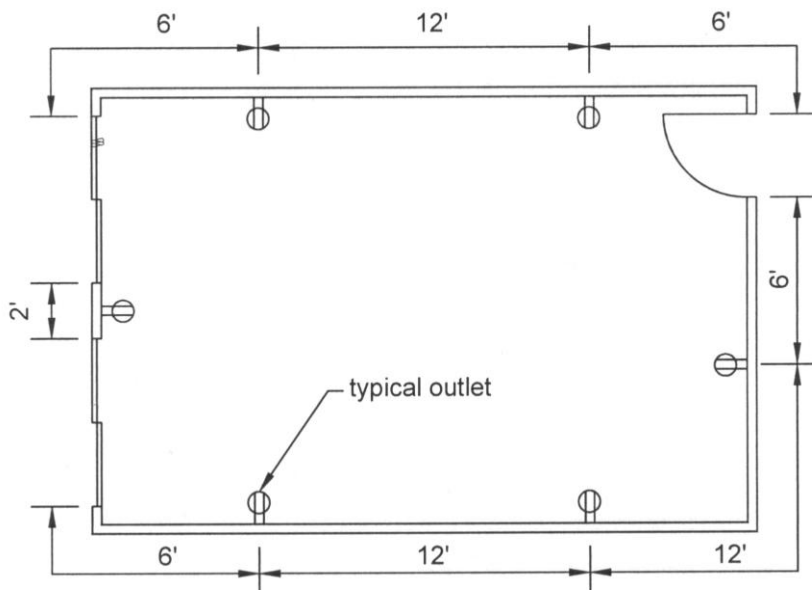
Conductor Size

	Circuit Rating		
	15 amp	20 amp	30 amp
Min. conductor size	14	12	10
Max. breaker size, ampere	15	20	30
Outlets rating, amperes	15 max.	15 or 20	30
Maximum load, amperes	15	20	30

Electrical Outlets

In every kitchen, family room, dining room, living room, parlor, den, recreation or similar room, convenience electrical outlets shall be installed. Spacing of the outlets shall be so that no point along the floor line in any wall space is more than **6 feet** (12' between outlets), measured horizontally, from an outlet in that space, (including any wall space **2 feet** or more in width and the wall space occupied by fixed panels in exterior walls but excluding sliding panels in exterior walls). Each wall space that is more than **2 feet** in width shall be treated separately from other wall spaces. The wall space occupied by fixed room dividers, such as freestanding bar type counters shall be included in the **6-foot** measurement. Hallways more than **10 feet** long must have a minimum of **1 outlet**.

Bathrooms must have a minimum of **1 20-ampere** circuit to power the outlet(s). Such circuit shall serve no other outlets outside the bathroom. A receptacle must be located on a wall adjacent and within **36 inches** of the sink. ***Ground fault*** circuit interrupters (GFCI) must protect all ***bathroom*** receptacles. Each unfinished portion of the basement shall have at least one receptacle outlet (GFCI). All 120-volt 15- and 20-ampere receptacles shall be tamper resistant receptacles. All 120-volt 15- and 20-ampere ***bedroom*** circuits (lighting, smoke alarm, receptacles, etc.) must be protected with ***Arc-Fault*** circuit interrupters.



Receptacle Requirements

Receptacles installed for the attachment of portable cords shall be rated not less than **20 amperes, 125 volts**, single phase and shall be of the grounding type. Faceplates for flush mounted receptacles shall completely cover the wall opening and seat flat against the wall surface. Metal faceplates must be grounded.

Lighting

A minimum of 50 percent of lamps in permanently installed fixtures shall be high-efficiency lamps. At least one wall switch controlled lighting outlet shall be installed in each habitable room and bathroom. In rooms other than bathrooms, one or more receptacle outlets controlled by a wall switch shall be considered equivalent to the required lighting outlets. At least one switch controlled (or pull chain light) must be provided in each room and hallway. Lighting fixtures must not be installed within **3 feet** horizontally and **8 feet** vertically of a bathtub rim or shower stall threshold. A light fixture can be installed above a shower if it constructed & installed so that water cannot enter or accumulate in wiring areas and the fixture is marked “suitable for wet locations”. Lighting fixtures must be installed so that combustible materials are not subject to temperatures greater than **90F**.

Lighting fixtures in clothes closets shall be limited to surface mounted or recessed incandescent fixtures with completely enclosed lamps, and surface mounted, recess mounted fluorescent or LED fixtures identified as suitable for installation within the storage area. Incandescent fixtures with open or partially enclosed lamps and pendant fixtures or lamp holders are prohibited. See following table for clearance requirements:

Closet Light Fixture Clearances to Storage Space (inches)		
Fixture Type	Bulb Type	
	Fluorescent	Incandescent ^a /LED ^a
Surface Mounted	6	12
Recessed	6	6
a. Bulb must be within completely enclosed lamp		

JFS

- *Effective Date July 14, 2014*

INSPECTION TIMING CHECKLIST FOR BASEMENTS

TYPE OF INSPECTION	WORK TO BE COMPLETED PRIOR TO INSPECTION REQUEST	INSPECTION PERFORMED BY	APPROVAL REQUIRED PRIOR TO PROCEEDING WITH
<p style="text-align: center;">Framing Electrical rough-in Mechanical rough-in Plumbing rough-in</p>	<p>All framing complete. Wall plates secured to floor. All concealed wall cavities separated from concealed ceiling cavities by approved fire blocking, / draft stopping to include penetrations by wiring and piping. All wiring runs complete and terminated in boxes, fixture boxes wired; fixtures not installed. Plumbing piping completed, fixtures not installed. All vents installed; all gas piping, sewer piping, water piping that will be enclosed in walls installed and pressure tested. All vent & heating ductwork installed. Appendix A fill in Sheets are required for Mechanical rough in inspection, if combustion air is required.</p>	<p>City of Fredericksburg Inspector.</p>	<p style="text-align: center;">Insulation / Energy</p>

Insulation / Energy	All new insulation completely installed. All gaps at sill plates around windows and penetrations must be properly sealed. If existing basement walls are already insulated, in may be possible to schedule these inspections at the same time that the framing and trade rough-in inspections are made.	City of Fredericksburg Inspector.	Final
Final	All appliances, fixtures, outlets, panels' switches, etc., must be installed and operational. All electrical wiring must be completed. Electrical panel index must be completed / updated for new electrical circuits. All walls must be completed (gypsum board installed & taped); painting is not required. All doors installed. Concrete floors are adequate (no floor coverings required). All plumbing fixtures installed and operational. All roughed-in plumbing capped, All work on approved plan completed.		

APPENDIX A

Basement Combustion Air Calculation Fill In Sheets

Sheets to be picked up by inspector during Mechanical (# 400) inspection

If combustion air is required, not having these completed sheets available for the #400 (Mechanical) inspection will result in a failed inspection.

There are two different methods provided in this Appendix for calculating combustion air requirements: 1). The “Standard air infiltration rate method” and 2). The “All combustion air from outside method”.

The **standard method** assumes that the structure has at least 0.4 air changes per hour. If you know your structure *will not* meet this requirement you cannot use this method and you may supply all combustion air from outside using the **All Combustion Air from Outside Method** or calculate requirements using other methods outlined in the International Residential Code (not covered in this guide). If using other methods not covered here, you must have calculation sheets (in a similar format as this Appendix) available for review & pick up by your inspector.

STANDARD AIR INFILTRATION METHOD

STEP 1 FIND TOTAL Btu’s OF ALL APPLIANCES LOCATED IN UTILITY ROOM/S

List all fuel fired appliances located in the utility room/s (furnace, water heater, etc.) and obtain the input Btu’s from the label located on / within the appliance. Insert in table below and add all input Btu’s to obtain “A”.

	Appliance Type	Input Btu’s
1		
2		
3		
4		

STEP 2 FIND VOLUME OF UTILITY ROOM/S

Fill in dimensions of utility rooms (feet) in table below and multiply to obtain “B” (cubic feet)

Length	Width	Height	Volume LxWxH

STEP 3 FIND MINIMUM VOLUME TO MEET COMBUSTION AIR REQUIREMENTS “C”.

You need 50 cubic feet per 1,000 input Btu’s to meet combustion air requirements

$\frac{\text{A}}{1,000} = \text{C} \quad \text{x } 50 = \text{B}$

STEP 4 DETERMINE IF UTILITY ROOM MEETS COMBUSTION AIR REQUIREMENTS.

IF B IS EQUAL OR GREATER

THAN REQUIREMENTS HAVE BEEN MET

IF NOT: COMMUNICATION WITH OTHER ARE AS IS REQUIRED... PROCEED TO STEP 5.

STEP 5 DETERMINE SIZE OF LOUVERED GRILLS “D” OR LOUVERED DOOR “E” FOR UTILITY ROOM TO COMMUNICATE WITH OTHER AREAS IN BASEMENT

Required unrestricted area of each opening is = _____ / 1,000 = _____ square inches Utility Room
 or 100 in² each whichever is greater.

Louvered Grills (2) required:

For sizing metal grills multiply grill length x width x 0.75 to determine unrestricted area.

For sizing wooden grills multiply grill length x width x 0.25 to determine unrestricted area.

Indicate size of both grills to be installed here _____ square inches

(see basement guide for grill placement)

Louvered door:

Required area of opening in louvered door is _____ / 1,000 x 2 = _____ square inches

For sizing wooden louvered opening in door multiply louvered area length x width x 0.25 to determine openable area

For sizing metal louvered opening in door multiply louvered area length x width x 0.75 to determine openable area.

Indicate size of louvered opening in door here _____ = _____ square inches

STEP 6 FIND USABLE ROOM VOLUMES OF OTHER AREAS IN BASEMENT.

List and identify all rooms & hallways in basement. Note that rooms with doors and other prohibited sources of combustion air (bedrooms, Bath’s, toilet rooms and closets) cannot be used in the Usable Room Volume calculations and their volumes must not be included in the Usable Volume column of the table below. Add all usable room volumes to obtain “F”.

	Basement Room Designation (Type)	Length (feet)	Width (feet)	Height (feet)	Total Volume LxWxH	Usable Volume
1						
2						
3						
4						
5						
6						
7						

STEP 7 DETERMINE IF BASEMENT TOTAL USABLE VOLUME MEETS COMBUSTION AIR REQUIREMENTS

IF B + _____ = NEW COMBINED TOTAL VOLUME: **NCCIW1** IS EQUAL OR GREATER THAN _____ REQUIREMENTS HAVE BEEN MET.

IF NOT COMMUNICATION WITH OTHER AREAS OUTSIDE OF THE BASEMENT IS REQUIRED...PROCEED TO STEP 8 TO FIND USABLE VOLUME AVAILABLE FROM FIRST FLOOR.

STEP 8 FIND USABLE ROOM VOLUMES OF FIRST FLOOR

List and identify all rooms & hallways on first floor. Note that rooms with doors and other prohibited sources of combustion air (bed-rooms, Bath's, toilet rooms and closets) cannot be used in the Usable Room Volume calculations and their volumes must not be included in the Usable Volume column of the table below. Add all usable room volumes to obtain "G". For non standard room sizes (cathedral ceilings etc.) provide separate room volume calculation sheet.

	Room Designation (Type)	Length (feet)	Width (feet)	Height (feet)	Total Volume LxWxH	Usable Volume
1						
2						
3						
4						
5						
6						
7						
						=

STEPS 9 DETERMINE IF BASEMENT PLUS FIRST FLOOR USABLE VOLUMES MEET COMBUSTION AIR REQUIREMENTS.

IF _____ + _____ = _____ = **NEW COMBINED TOTAL VOLUME₂**

IF THE FIRST FLOOR HAS ADDITIONAL GAS FIRED APPLIANCES (WHICH REQUIRE INTERIOR AIR FOR COMBUSTION) THE BTU'S MUST BE ADDED, AS IN STEP 1, CALCULATED IN STEP 3 AND BECOMING A NEW COMBINED VOLUME REQUIREMENT.

_____ / 1,000 = _____ x 50 = _____

FIND NEW COMBINED VOLUME REQUIREMEN _____ + _____ = _____

IF IT IS MORE THEN REQUIREMENTS HAVE BEEN MET.

THE NORMAL WAY OF PROVIDING COMMUNICATION BETWEEN THE BASEMENT AND THE FIRST FLOOR IS TO INSTALL A LOUVERED DOOR, HOWEVER UPPER AND LOWER GRILLS ARE ALSO ACCEPTABLE; THE LOUVERED DOOR OR GRILLS MUST BE THE SAME SIZE AS THAT DETERMINED IN STEP 5.

IN THE UNLIKELY EVENT THAT COMBINING USABLE AREAS IN THE BASEMENT AND FIRST FLOORS STILL DOES NOT MEET COMBUSTION AIR REQUIREMENTS, THE SAME PROCEDURE CAN BE USED TO COMBINE A THIRD FLOOR. IF THIS IS REQUIRED, YOU MUST PROVIDE ADDITIONAL SEPARATE SHEETS (USING SAME PROCEDURE) SHOWING HOW COMBUSTION AIR REQUIREMENTS WILL BE MET.

**ALL COMBUSTION AIR FROM OUTSIDE METHOD
(SINGLE HORIZONTAL DUCT*)**

STEP 1 FIND TOTAL Btu's

List all fuel burning appliances (furnace, water heater, etc.) Obtain input Btu's from appliance labels. Add all BTU's to obtain "B".

	Appliance Type	Input Btu's
1		
2		
3		
4		
		=

**STEP 2 FIND AREA OF ALL CONNECTORS
(Square inches)**

List all fuel fired appliances and their vent connector areas (see **chart A** below for information on determining areas of connectors).

	Appliance Type	Vent Connector Area
1		
2		
3		
4		
		=

**STEP 3 FIND COMBUSTION AIR DUCT SIZE
(square inches)**

**You need 1 square inch per 3,000
Input Btu's to meet Combustion
Air requirements.**

_____ / 3,000 = _____

**STEP 4 DETERMINE REQUIRED DUCT
SIZE (square inches)**

**DUCT SIZE MUST USE GREATER OF
OR**

CHART A	
CIRCULAR DUCT DIAMETER(d) (inches)	AREA (square inches)
3	7
4	13
5	20
6	28
7	38
8	50

Area of circular duct = $3.14 \times d^2 / 4$

* you may use 1 or more horizontal ducts to achieve the required minimum duct area; for example if the required area is 65 square inches you could combine an 8" and 5" duct (50 sq in +20 sq in= 70 sq in) to meet requirements.

