

# Top 10+ Mistakes of DWV plumbing design

Listed below are the some of the most frequently missed items, noticed by our inspectors, at plumbing rough-in when non-plumbers attempt plumbing design. Most of the problems arise from the differences between plumbing codes. Self-help plumbing books are great but they may not be derived from the code adopted by Washington State. This handout is based on the **2006 Uniform Plumbing Code**. Many of the errors are related to venting as these rules vary between codes.

A brief explanation is included with the “item”. The applicable code section for each “item” is also provided beginning on page 3 of this handout. More comprehensive Uniform Plumbing Code handouts are available at the Building Dept. for all codes that govern sizing water lines, drainage piping, venting, location of cleanouts, etc.

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## **1. Not considering upper floor plumbing when designing under slab plumbing** {UPC 908.1, 311.2}

*Vents from basement fixtures need to extend dry to roof but can be combined – see below where you can combine vents. UPC allows bathroom wet venting for combinations of fixtures within one or two bathrooms located on the same floor in dwelling units. See UPC 908.4 for details.*

## **2. Not providing a vent for every trap** {UPC 901.0, 902.0}

*Every trap needs a vent, most are dry (see UPC 908.4 where wet venting allowed) to roof originating from fixture trap arm – see below where you can combine vents – also grading of combination vents.*

## **3. Installing a sanitary Tee instead of wye or long sweep for drainage connection or back to back fittings (sinks) not directional** {UPC 701.2.3} {UPC 704.1,704.2, 706.0}

*Sanitary tees may only be used on drainage piping when transitioning from horizontal (1/4” per foot) to vertical. All others must sweep in direction of flow with proper drainage fittings.*

## **4. Trap arm too long for size of pipe** {UPC1002.2}{UPC Table 10-1}

*Horizontal distance from trap weir to inner edge of vent shall be within distance in Table 10-1, but not closer than 2 times the diameter of the trap arm.*

## **5. Clothes washer trap not within prescribed distance** {UPC 804.1}

*Standpipe not more than 30” or less than 18” above trap- no trap installed below floor –trap installed 6” to 18” above floor.*

## **6. Drain piping** {UPC 708.0} **and vent pipe** {UPC 905.1} **not to grade**

*Drain piping can be horizontal (1/4” per foot), vertical, or 450- vent piping shall be free of sags and be graded and connected to drip back by gravity to drain pipe it serves.*

## **7. Not having cross section of vent equal to the sewer size** {UPC 904.1}

*The size of required sewer pipe is equal to the size of the vent through the roof, separate vent areas may be combined to equal sewer pipe area.*

**8. Connecting vents below flood height of highest fixture** {UPC 905.3}

*Vents should be 6" above flood-level rim of fixture before offsetting horizontally, or need to use drainage fittings and grade to drain. Vents shall rise to 6" above flood-level rim of fixture served before being connected to any other vent.*

**9. Combining too many fixtures on vent pipe** {UPC Table 7-3, Table 7-5}

*Use Table 7-3 and determine # of fixture units for each type fixture, add all fixtures on common vent, not to exceed max. # of fixtures for size of vent. Most common error is more than 24 fixture units on 2" vent pipe.*

**10. Vents connected "flat" rather than above horizontal centerline of sewer** {UPC 905.2}

*Vents connecting to horizontal drainage shall connect above horizontal centerline of the downstream drain pipe.*

**11. Cutting too large a hole for piping in bearing wall or joist** {IRC 502.8 602.6}

*See chart – Bearing Wall 40% of depth – Interior non-bearing 60% - 5/8" minimum to edge.*

**12. Pipe protection nail plates too small** {UPC 313.9}

*When piping penetrating framing member that are closer than 1" to edge a steel nail plate that extends a min. 1 1/2" beyond the outside diameter of the pipe that needs protection.*

**13. Installing Dishwasher w/o air gap fitting** {UPC 807.4}

*No domestic dishwasher shall be directly connected to drainage system or food disposer without the use of an approved dishwasher airgap fitting on the discharge side of the dishwasher. Airgaps shall be installed above the flood level of sink or drainboard which ever is higher.*

**14. Tapping DWV pipe for condensate or HWH pressure relief valve discharge piping**

{UPC 311.2}

*No drainage or vent piping shall be drilled and tapped for the purpose of making connections thereto, and no cast-iron soil pipe shall be threaded. Pipe to terminate at approved drain with air-gap or exterior of building.*

**UPC 311.2** No drainage or vent piping shall be drilled and tapped for the purpose of making connections thereto, and no cast-iron soil pipe shall be threaded.

**UPC 313.9** Plastic and copper piping penetrating a framing members to within one (1) inch of the exposed framing shall be protected by steel nail plates not less than 0.0478 inches (18 gauge) in thickness. The steel nail plate shall extend along the framing member a minimum of 1-1/2 inches beyond the outside diameter of the pipe or tubing.

**UPC 701.2.3** Fittings used for drainage shall be of the drainage type, have a smooth interior waterway, and be constructed so as to allow one fourth (1/4) inch per foot grade.

**UPC 704.1** Drainage piping shall be provided with approved inlet fittings for fixture connections, correctly located according to the size and type of fixture proposed to be connected.

**UPC 704.2** Two fixtures set back-to back, or side-by-side within distance allowed between a trap and its vent may be served by a single vertical drainage pipe provided that each fixture wastes separately into an approved double-fixture fitting having inlet opening at the same level.

### **UPC 706.0 Changes in Direction of Drainage Flow**

**UPC 706.1 Changes in direction of drainage piping** shall be made by the appropriate use of approved fittings and shall be of the angles presented by a one-sixteenth (1/16) bend, one-eighth (1/8) bend, or one-sixth (1/6) bend, or other approved fittings of equivalent sweep.

**UPC 706.2 Horizontal drainage lines, connecting with a vertical stack**, shall enter through forty-five (45) degree wye branches, sixty (60) degree wye branches, combination wye and 1/8 bend branches, sanitary tee or sanitary tapped tee branches, or other approved fittings of equivalent sweep. No fitting having more than one (1) inlet at the same level shall be used unless such fitting is constructed so that the discharge from one (1) inlet cannot readily enter any other inlet. Double sanitary tees may be used when the barrel of the fitting is at least two (2) pipe sizes larger than the largest inlet. (pipe sizes recognized for this purpose are 2 in., 2-1/2 in., 3 in., 3-1/2 in., 4 in., 4-1/2 in., 5 in., 6 in., etc.)

**UPC 706.3 Horizontal drainage lines connecting with other horizontal drainage lines** shall enter through forty-five (45) degree wye branches, combination wye and one-eight (1/8) bend branches, or other approved fittings of equivalent sweep.

**UPC 706.4 Vertical drainage lines connection with horizontal drainage lines** shall enter through forty-five (45) degree wye branches, combination wye and one-eight (1/8) bend branches, or other approved fittings of equivalent sweep. Sixty (60) degree branches or offsets may be used only when in a true vertical position.

### **UPC 708.0 Grade of Horizontal Drainage Piping**

Horizontal drainage piping shall be run in practical alignment and a uniform slope of not less than one-fourth (1/4) inch per foot or two percent toward the point of disposal provided that, where it is impractical due to the depth of the street sewer or to the structural features or to the arrangement of any building or structure to obtain a slope of one-fourth (1/4) of an inch per foot or two (2) percent, any such pipe or piping four (4) inches or larger in diameter may have a slope of not less than one-eighth (1/8) of an inch per foot or one (1) percent, when first approved by the Authority Having Jurisdiction.

## **UPC 804.0 Indirect Waste Receptors**

**UPC 804.1** All plumbing fixtures or other receptors receiving the discharge of indirect waste pipes shall be approved for the use proposed and shall be of such shape and capacity as to prevent splashing or flooding and shall be located where they are readily accessible for inspection and cleaning. **No standpipe receptor for any clothes washer shall extend more than thirty (30) inches, nor less than eighteen (18) inches above its trap. No trap for any clothes washer standpipe receptor shall be installed below the floor, but shall be roughed in not less than six (6) inches and not more than eighteen (18) inches above the floor.** No indirect waste receptor shall be installed in any toilet room, closet, cupboard, or storeroom, nor in any other portion of a building not in general use by the occupants thereof; except standpipes for clothes washer may be installed in toilet and bathroom areas when the clothes washer is installed in the same room.

**UPC 804.2** Where water service connections are installed for a clothes washer, an approved method of waste disposal shall be provided.

**UPC 807.4** No domestic dishwashing machine shall be directly connected to a drainage system or food waste disposer without the use of an approved dishwasher airgap fitting on the discharge side of the side of the dishwashing machine. Listed airgaps shall be installed with the flood-level (FL) marking at or above the flood level of the sink or drainboard, whichever is higher.

### **UPC 901.0 – Vents Required**

Each plumbing fixture trap, except as otherwise provided in this code, shall be protected against siphonage and back-pressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vent pipes installed in accordance with the requirements of this chapter and as otherwise required by this code.

### **UPC 902.0 – Vents Not Required**

902.1 Vent piping may be omitted on an interceptor when such interceptor acts as a primary settling tank and discharges through a horizontal indirect waste pipe into a secondary interceptor. The second interceptor shall be properly trapped and vented.

902.2 Traps serving sinks that are part of the equipment of bars, soda fountains, and counters need not be vented when the location and construction of such bars, soda fountains, and counters is such as to make it impossible to do so. When such conditions exist, said sinks shall discharge by means of approved indirect waste pipes into a floor sink or other approved type of receptor.

### **UPC 904.0 – Size of Vents**

**UPC 904.1** The size of vent piping shall be determined from its length and the total number of fixture units connected thereto, as set forth in Table 7-5. the diameter of an individual vent shall not be less than one and one-fourth (1-1/4) inches nor less than one-half (1/2) the diameter of the drain to which it is connected. In addition, the drainage piping of each building and each connection to a public sewer or a private sewage system shall be vented by means of one or more vent pipes, the aggregate cross-section area of which shall not be less than that of the largest required building sewer, as determined from Table 7-5. Vent pipes from fixtures located upstream from pumps, ejectors, backwater valves, or other devices that in any way obstruct the free flow of air and other gases between the building sewer and the outside atmosphere shall not be used for meeting the cross-sectional area venting requirements of this section.

**UPC 904.2** No more than one-third (1/3) of the total permitted length, per Table 7-5, of any minimum-sized vent shall be installed in a horizontal position.

Exception: When a minimum-sized vent is increased one (1) pipe size for its entire length, the maximum length limitation does not apply.

### **UPC 905.0 Vent Pipe Grades and Connections**

**UPC 905.1** All vent and branch vent pipes shall be free from drops or sags, and each such vent shall be level or shall be so graded and connected as to drip back by gravity to the drainage pipe it serves.

**UPC 905.2** Where vents connect to a horizontal drainage pipe, each vent pipe shall have its invert taken off above the drainage centerline of such pipe downstream of the trap being served.

**UPC 905.3** Unless prohibited by structural conditions, each vent shall rise vertically to a point not less than six (6) inches above the flood-level rim of the fixture served before offsetting horizontally, and whenever two or more vent pipes converge, each such vent pipe shall rise to a point at least six (6) inches in height above the flood-level rim of the plumbing fixture it serves before being connected to any other vent. Vents less than six (6) inches above the flood-level rim of the fixture shall be installed with approved drainage fittings, material, and grade to drain.

**UPC 905.4** All vent pipes shall extend undiminished in size above the roof, or shall be reconnected with a soil or waste vent of proper size.

**UPC 905.5** The vent pipe opening from a soil or waste pipe, except for water closets and similar fixtures, shall not be below the weir of the trap.

**UPC 905.6** Two (2) fixtures may be served by a common vertical pipe when each such fixture wastes separately into an approved double fitting having inlet openings at the same level.

**UPC 908.1** Wet venting is limited to vertical drainage piping receiving the discharge from the trap arm of one (1) and two (2) fixture unit fixtures that also serves as a vent for not to exceed four (4) fixtures. All wet-vented fixtures shall be within the same story; provided, further, that fixtures with a continuous vent discharging into a wet vent shall be within the same story as the wet-vented fixtures. No wet vent shall exceed six (6) feet in developed length.

**UPC 908.2** The vertical piping between any two (2) consecutive inlet levels shall be considered a wet-vented section. Each wet-vented section shall be a minimum of one (1) pipe size larger than the required minimum waste pipe size of the upper fixture or shall be one (1) pipe size larger than the sum of the fixture units served by such wet-vented section, whichever is larger, but in no case less than two (2) inches.

**UPC 908.3** Common vent sizing shall be the sum of the fixture units served but, in no case, smaller than the minimum vent pipe size required for any fixture served, or by Section 904.0

#### **UPC 908.4.1{Wash State Amendments to 2006 UPC}**

Where permitted. Any combination of fixtures within one (1) or two (2) bathrooms located on the same floor level and serving **dwelling units** or **sleeping units** shall be permitted to be vented by a wet vent. The wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent along the direction of the flow in the drain pipe to the most downstream fixture drain connection to the horizontal branch drain. Only the fixtures within the bathroom(s) shall connect to the

wet vented horizontal branch drain. Any additional fixtures shall discharge downstream of the wet vent system and be conventionally vented.

**UPC 1002.2** Each fixture trap shall have a protecting vent so located that the developed length of the trap arm from the trap weir to the inner edge of the vent shall be within the distance given in Table 10-1, but in no case less than two (2) times the diameter of the trap arm.

**TABLE 7-3  
Drainage Fixture Unit Values (DFU)**

Inch	mm
1-1/4	32
1-1/2	40
2	50
2-1/2	65
3	80

Plumbing Appliance, Appurtenance, or Fixture	Min. Size Trap and Trap Arm <sup>7</sup>	Private	Public	Assembly <sup>8</sup>
Bathtub or Combination Bath/Shower .....	1-1/2"	2.0	2.0	
Bidet.....	1-1/4"	1.0		
Bidet.....	1-1/2"	2.0		
Clothes Washer, domestic, standpipe <sup>5</sup> .....	2"	3.0	3.0	3.0
Dental Unit, cuspidor .....	1-1/4"		1.0	1.0
Dishwasher, domestic, with independent drain .....	1-1/2" <sup>2</sup>	2.0	2.0	2.0
Drinking Fountain or Watercooler (per head) .....	1-1/4"	0.5	0.5	1.0
Food-Waste-Grinder, commercial.....	2"		3.0	3.0
Floor Drain, emergency .....	2"		0.0	0.0
Floor Drain (for additional sizes see Section 702) .....	2"	2.0	2.0	2.0
Shower, single-head trap.....	2"	2.0	2.0	2.0
Multi-head, each additional .....	2"	1.0	1.0	1.0
Lavatory, single.....	1-1/4"	1.0	1.0	1.0
Lavatory, in sets of two or three.....	1-1/2"	2.0	2.0	2.0
Washfountain.....	1-1/2"		2.0	2.0
Washfountain.....	2"		3.0	3.0
Mobile Home, trap .....	3"	12.0		
Receptor, indirect waste <sup>13</sup> .....	1-1/2"			See footnote <sup>13</sup>
Receptor, indirect waste <sup>14</sup> .....	2"			See footnote <sup>14</sup>
Receptor, indirect waste <sup>1</sup> .....	3"			See footnote <sup>1</sup>
<b>Sinks</b>				
Bar .....	1-1/2"	1.0		
Bar .....	1-1/2" <sup>2</sup>		2.0	2.0
Clinical .....	3"		6.0	6.0
Commercial with food waste.....	1-1/2" <sup>2</sup>		3.0	3.0
Special Purpose.....	1-1/2"	2.0	3.0	3.0
Special Purpose.....	2"	3.0	4.0	4.0
Special Purpose.....	3"		6.0	6.0
Kitchen, domestic .....	1-1/2" <sup>2</sup>	2.0	2.0	
(with or without food-waste grinder and/or dishwasher)				
Laundry.....	1-1/2"	2.0	2.0	2.0
(with or without discharge from a clothes washer)				
Service or Mop Basin.....	2"		3.0	3.0
Service or Mop Basin.....	3"		3.0	3.0
Service, flushing rim .....	3"		6.0	6.0
Wash, each set of faucets .....			2.0	2.0
Urinal, integral trap 1.0 GPF <sup>2</sup> .....	2"	2.0	2.0	5.0
Urinal, integral trap greater than 1.0 GPF.....	2"	2.0	2.0	6.0
Urinal, exposed trap.....	1-1/2" <sup>2</sup>	2.0	2.0	5.0
Water Closet, 1.6 GPF Gravity Tank <sup>6</sup> .....	3"	3.0	4.0	6.0
Water Closet, 1.6 GPF Flushometer Tank <sup>6</sup> .....	3"	3.0	4.0	6.0
Water Closet, 1.6 GPF Flushometer Valve <sup>6</sup> .....	3"	3.0	4.0	6.0
Water Closet, greater than 1.6 GPF Gravity Tank <sup>6</sup> .....	3"	4.0	6.0	8.0
Water Closet, greater than 1.6 GPF Flushometer Valve <sup>6</sup> .....	3"	4.0	6.0	8.0

<sup>1</sup> Indirect waste receptors shall be sized based on the total drainage capacity of the fixtures that drain therein to, in accordance with Table 7-4.

<sup>2</sup> Provide a 2" (51 mm) minimum drain.

<sup>3</sup> For refrigerators, coffee urns, water stations, and similar low demands.

<sup>4</sup> For commercial sinks, dishwashers, and similar moderate or heavy demands.

<sup>5</sup> Buildings having a clothes-washing area with clothes washers in a battery of three (3) or more clothes washers shall be rated at six (6) fixture units each for purposes of sizing common horizontal and vertical drainage piping.

<sup>6</sup> Water closets shall be computed as six (6) fixture units when determining septic tank sizes based on Appendix K of this code.

<sup>7</sup> Trap sizes shall not be increased to the point where the fixture discharge may be inadequate to maintain their self-scouring properties.

<sup>8</sup> Assembly [Public Use (See Table 4-1)].

**TABLE 7-5**  
Maximum Unit Loading and Maximum Length of Drainage and Vent Piping

Size of Pipe, inches (mm)	1-1/4 (32)	1-1/2 (40)	2 (50)	2-1/2 (65)	3 (80)	4 (100)	5 (125)	6 (150)	8 (200)	10 (250)	12 (300)
<b>Maximum Units</b>											
Drainage Piping <sup>1</sup>											
Vertical	1	2 <sup>2</sup>	16 <sup>3</sup>	32 <sup>3</sup>	48 <sup>4</sup>	256	600	1,380	3,600	5,600	8,400
Horizontal	1	1	8 <sup>3</sup>	14 <sup>3</sup>	35 <sup>4</sup>	216 <sup>5</sup>	428 <sup>5</sup>	720 <sup>5</sup>	2,640 <sup>5</sup>	4,680 <sup>5</sup>	8,200 <sup>5</sup>
<b>Maximum Length</b>											
Drainage Piping											
Vertical, feet (m)	45 (14)	65 (20)	85 (26)	148 (45)	212 (65)	300 (91)	390 (119)	510 (155)	750 (228)		
Horizontal (unlimited)											
<b>Vent Piping (See note)</b>											
Horizontal and Vertical											
Maximum Units	1	8 <sup>3</sup>	24	48	84	256	600	1,380	3,600		
Maximum Lengths, feet (m)	45 (14)	60 (18)	120 (37)	180 (55)	212 (65)	300 (91)	390 (119)	510 (155)	750 (228)		

<sup>1</sup> Excluding trap arm.

<sup>2</sup> Except sinks, urinals, and dishwashers.

<sup>3</sup> Except six-unit traps or water closets.

<sup>4</sup> Only four (4) water closets or six-unit traps allowed on any vertical pipe or stack; and not to exceed three (3) water closets or six-unit traps on any horizontal branch or drain.

<sup>5</sup> Based on one-fourth (1/4) inch per foot (20.9 mm/m) slope. For one-eighth (1/8) inch per foot (10.4 mm/m) slope, multiply horizontal fixture units by a factor of 0.8.

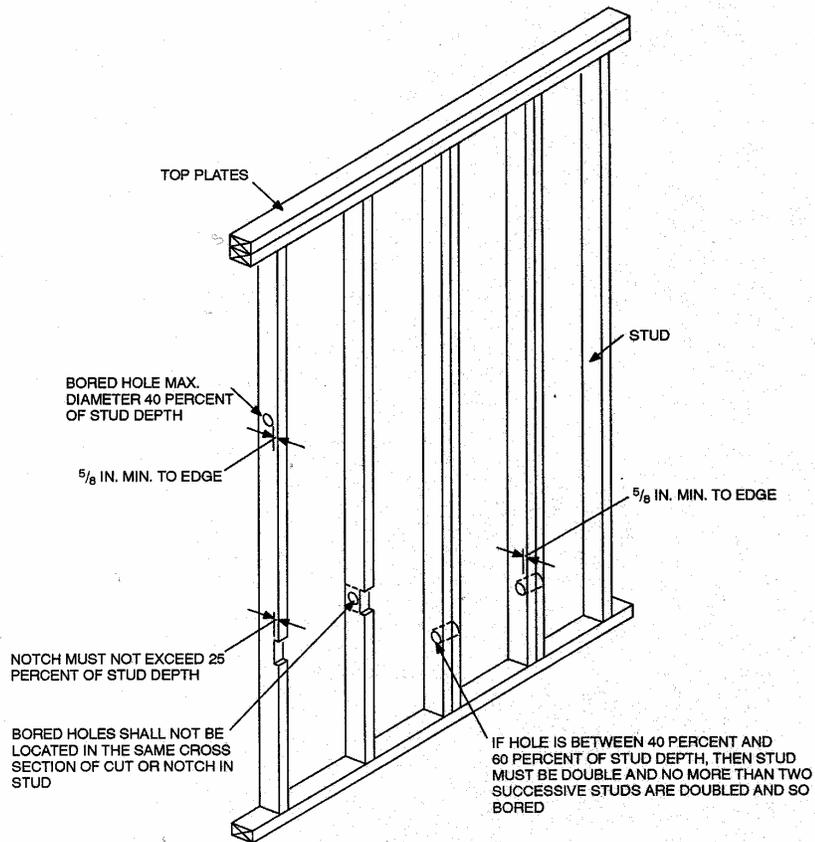
**Note:** The diameter of an individual vent shall not be less than one and one-fourth (1-1/4) inches (31.8 mm) nor less than one-half (1/2) the diameter of the drain to which it is connected. Fixture unit load values for drainage and vent piping shall be computed from Tables 7-3 and 7-4. Not to exceed one-third (1/3) of the total permitted length of any vent may be installed in a horizontal position. When vents are increased one (1) pipe size for their entire length, the maximum length limitations specified in this table do not apply.

**TABLE 10-1**  
Horizontal Distance of Trap Arms  
(Except for water closets and similar fixtures)\*

Trap Arm Inches	Distance Trap to Vent		Trap Arm mm	Distance Trap to Vent mm
	Feet	Inches		
1-1/4	2	6	32	762
1-1/2	3	6	40	1067
2	5	0	50	1524
3	6	0	80	1829
4 & larger	10	0	100 & larger	3048

Slope one-fourth (1/4) inch per foot

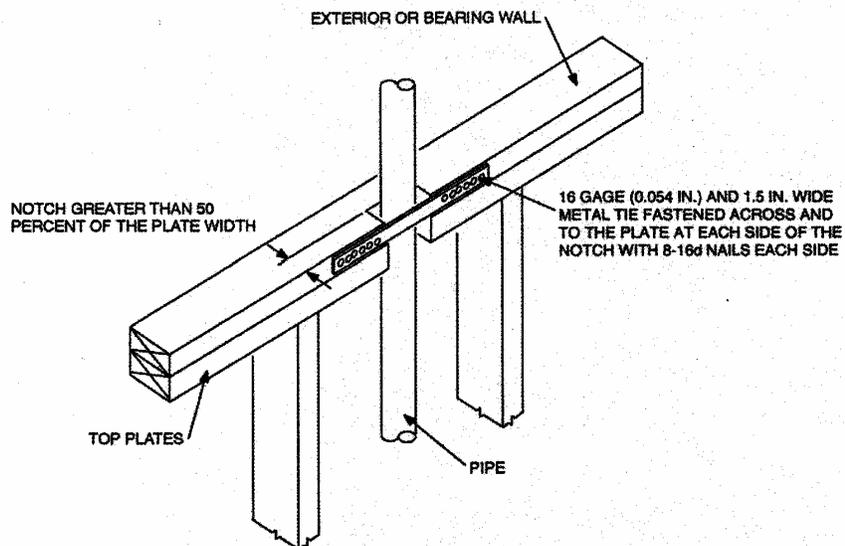
\*The developed length between the trap of a water closet or similar fixture (measured from the top of the closet ring [closet flange] to the inner edge of the vent) and its vent shall not exceed six (6) feet.



For SI: 1 inch = 25.4 mm.

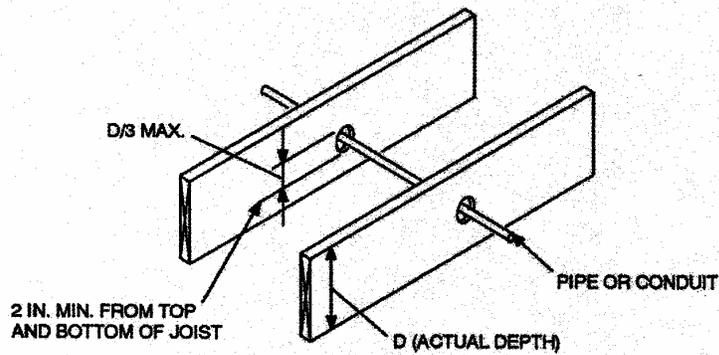
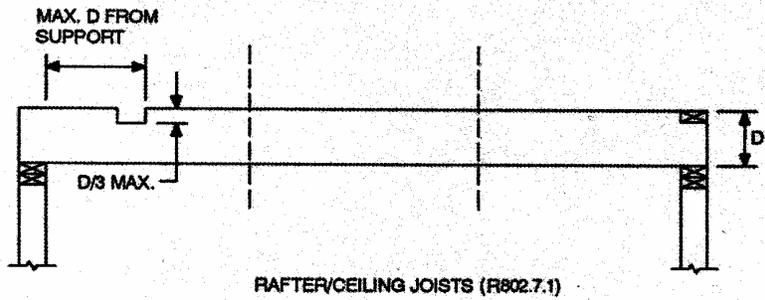
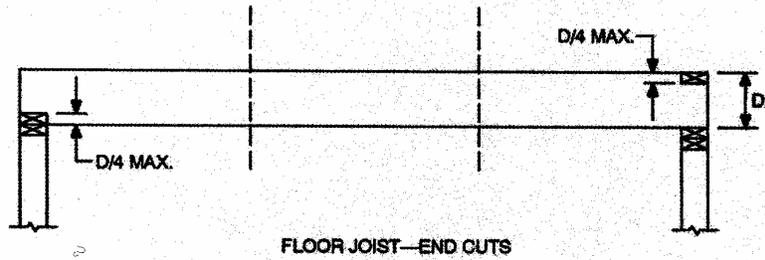
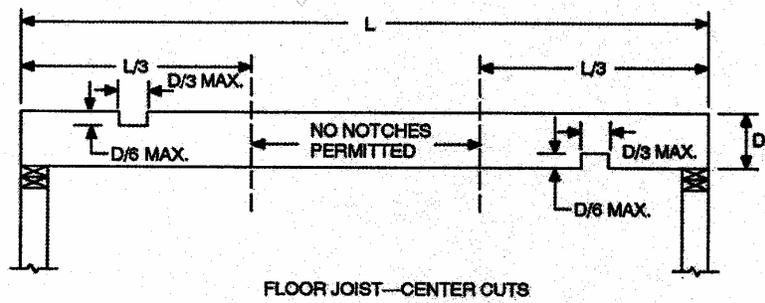
NOTE: Condition for exterior and bearing walls.

FIGURE R602.6(1)  
NOTCHING AND BORED HOLE LIMITATIONS FOR EXTERIOR WALLS AND BEARING WALLS



For SI: 1 inch = 25.4 mm.

FIGURE R602.6.1  
TOP PLATE FRAMING TO ACCOMMODATE PIPING



For SI: 1 inch = 25.4 mm.

FIGURE R502.8  
CUTTING, NOTCHING AND DRILLING