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The home owner needs to sit with the electrical installer over a cup of coffee to be assured their new home will be capable of supplying enough circuits.

After reading this introduction with all the newer appliances do you want to live in a new house that was the "low bid?" Eliminate the #14 wire, it shouldn't be allowed in the home. Eliminate cords. Do you only want two circuits in the kitchen?

The low-bid minimum from the National Electrical Code (NEC):

NEC 90.1 Purpose.

(B) Adequacy. This Code contains provisions that are considered for safety. Compliance therewith and proper maintenance result in an installation that is essentially free from hazard ***but not necessarily efficient, convenient***, **or *adequate* for good service *or future expansion* of electrical use.**

Definitions

Efficient: **Not necessarily** doing something in a good, careful and complete way with no waste of time, money or energy.

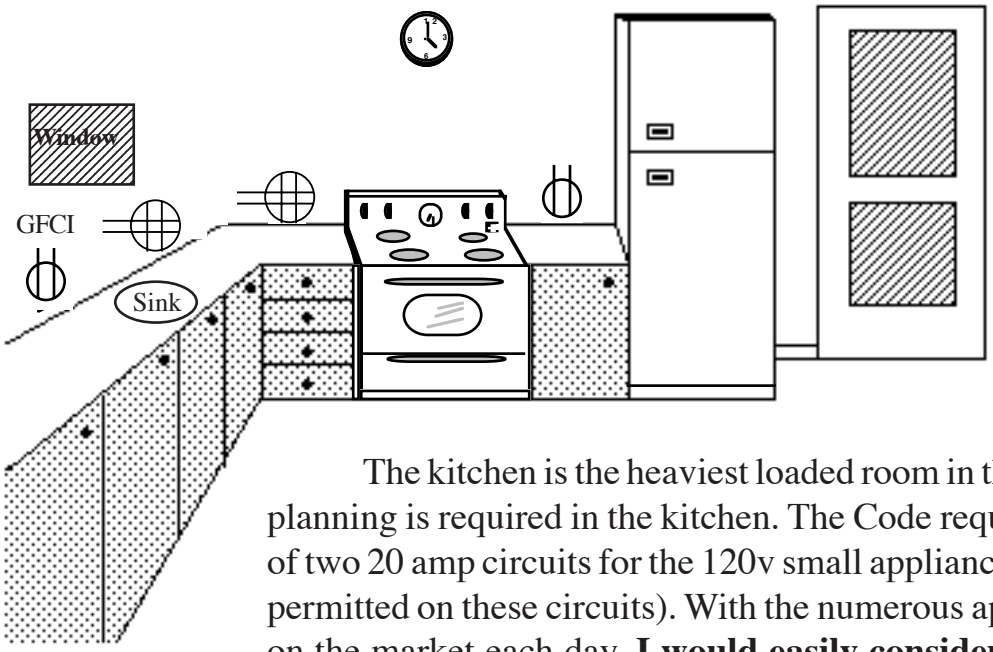
Convenient: **Not necessarily** suitable or agreeable to the needs or purpose; well-suited with respect to facility or ease in use; favorable, easy, or comfortable for use.

Adequate: **Not necessarily** sufficient for a specific need or requirement. Enough or good enough for what is required or needed.

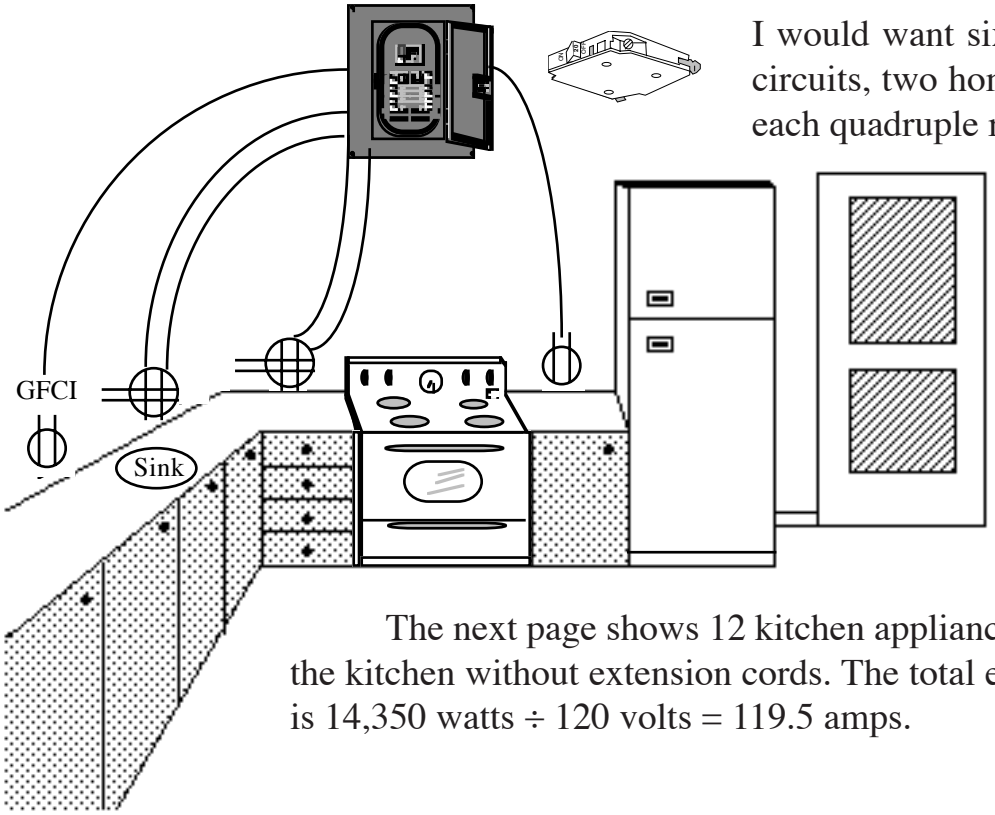
Good service *or future expansion* of electrical use, but not necessarily. Good service takes the time needed to understand the needs of their customer base.

But, **not necessarily,** an expansion plan outlines an approach to **growing** operations it details the steps it will take to expand to **new develop new products** or services, or invest in new technologies. Think ahead. The future is always unpredictable.

This Code contains provisions that are considered for **safety**.



The kitchen is the heaviest loaded room in the house. Careful planning is required in the kitchen. The Code requires a **minimum** of two 20 amp circuits for the 120v small appliances (lighting is not permitted on these circuits). With the numerous appliances coming on the market each day, **I would easily consider more than two receptacle circuits in the kitchen and quadruple receptacles.**



I would want six 20 amp branch circuits, two home run circuits at each quadruple receptacle.

The next page shows 12 kitchen appliances try cooking in the kitchen without extension cords. The total electricity needed is 14,350 watts ÷ 120 volts = 119.5 amps.

Microwave -
1000-1200 Watts

Pressure Cooker -
1000 Watts

Stand Mixer -
500 Watts

Toaster -
1500 Watts

Air Fryer -
1550 Watts

Griddle -
1500 Watts

Coffee Maker -
750 to 1200 watts.

Electric Skillet -
1200 Watts

Deep Fryer -
1500 Watts

Rice Cooker -
500 Watts

Indoor Smoker -
1500 Watts

Pizza Oven -
1200 Watts

On Thankgiving try using these kitchen appliances without triping the breaker.

The electrician has made service calls where the home owner ran a cord from the kitchen to the receptacle in the living room to get power to cook with.

LIVING ROOM

TV

The Living room shows two **quadruple receptacles** much needed for TV, modem, DVD player, and cable box.

TheBath room shows two **quadruple receptacles** much needed for shaver, tooth brush, clock, and phone charger.

Modem

Smart Digital TV

Cable Receiver Box

DVD Player

BATHROOM

Hair Dryer - 1875 Watts

Rechargeable Shaver

Bathroom Clock

Rechargeable Toothbrush

Phone and Watch Charger

GARAGE

It's typically advisable to have at least a 200-amp service to ensure the electrical system can handle the power requirements of an EV charging station. You'll want a dedicated 240-volt circuit for charging your car.

Why does the 20 amp circuit breaker trip when the coffee pot is on and I turn on the microwave oven?

A microwave pulls between 12 and 15 amps and the average coffee maker is 12.5 amps. 12 + 12.5 = **24.5 amps**.

This problem becomes even more prominent if the breaker is shared.

Microwave - 700 to 1200 watts 10 amperes.

Microwave wattages can typically range from 600 to 1,700 and above. In general, most recipes call for 1,000 watts, although microwave power levels, settings and features may vary by model.

Microwaves with 700 watts or less **are slower and may not cook evenly**. In general, the higher the wattage, the faster the cooking time.

Generally, microwave wattages range from 700 watts to 1200 watts.

Coffee Maker - 750 to 1500 watts 10 amperes.

When it comes to the **first usage**, this is the one that draws the most electricity.

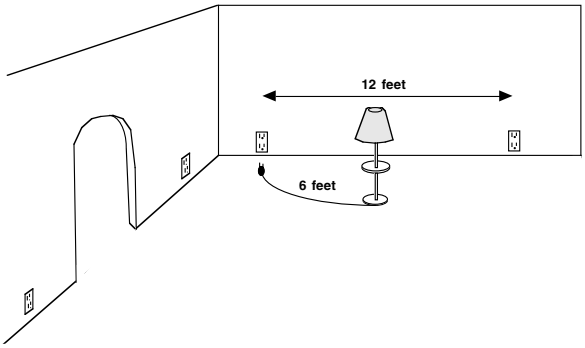
Your machine can use almost 1700 watts (14.1 amperes) to make your first cup of coffee.

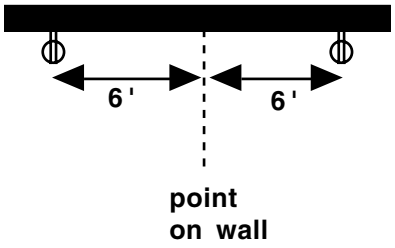
The average Coffee Maker uses 1500 watts. Your devices wattage may be different depending on the brand, size, or other factors.

Microwaves draw a significant amount of power when operating, and if the circuit is already handling a heavy load, it may not be able to handle the additional demand.

Breaker design allows for 80% of the max amp rating for an extended period. A microwave pulls between 12 and 15 amps and can trip the breaker, even though it should be on a 20 amp breaker.

I've had students in class that were wiring multi-million dollar lake side homes with the code minimum receptacles and #14 Romex wire.



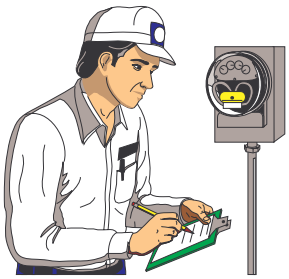


The new home owner will have decisions to make in the beginning and feel like they are in the middle of a fence.

Do you want to live in a new house that was the "low bid?"

If a person lived in the house say for **20 years** as some do, the cost of voltage drop on **ONE CIRCUIT** in the house, if the utility company didn't raise the rate in 20 years and the resistance of the receptacle circuit didn't increase over the 20 years, the cost would be $41.85 x 20 years = **$837**!! For only **ONE circuit** in the house!

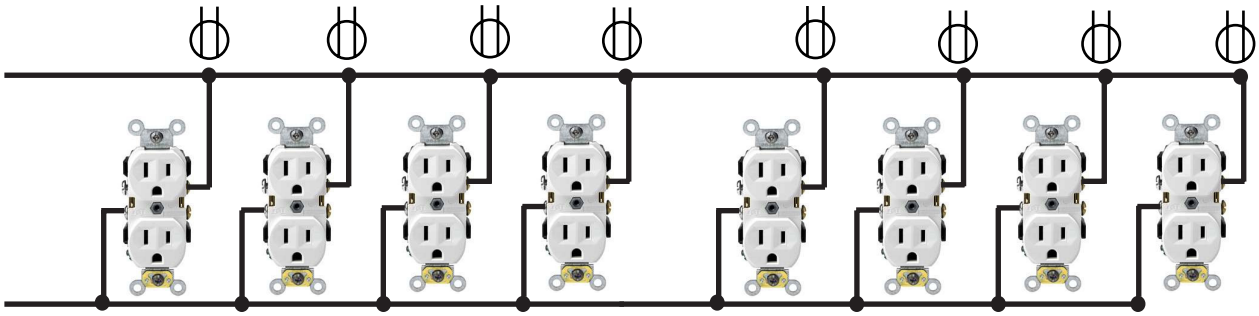
But the advertisements you receive on saving energy are on insulating your home better, installing new efficient windows, energy efficient appliances, etc. **Have you ever received an advertisement on lowering voltage drop by having your home load tested to see how much electricity ALL your circuits are wasting not just the one circuit example. Does anyone other than me really care?**



This is a very neglected area in the electrical industry. **These kinds of savings need to be explained to the customer**. By upsizing wire, the contractor can demonstrate the real savings to the customer as well as ensurance against future needs. By using a conductor only one size larger than the Code required minimum can provide a quick payback in savings.

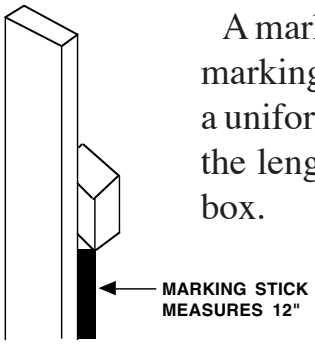
RECEPTACLES

There is **no limit** to the number of receptacles connected on one circuit. In a dwelling these are called **convenience** receptacles and can replace the extenson cords.

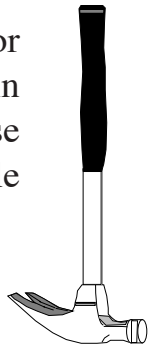


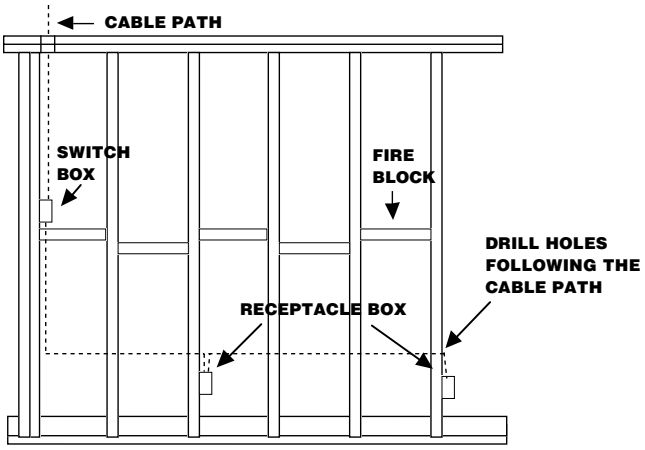
Quadruple receptacles is an excellent inexpensive way to eliminate cords. Replace a single-gang box with a double-gang box and add another duplex receptacle, you already have the wiring to jumper power so the only expense is the cost of a double-gang box. Great investment for the new home.

It's best to go over the electrical plans **and install a new home wired for the future.** Once the walls are up and painted its gets very expensive to add new circuits.



A marking stick cut from a scrap piece of lumber is handy for marking each receptacle box location as it will keep them all in a uniformed height from the floor. Often the electrician will use the length of a hammer to mark the height of each receptacle box.

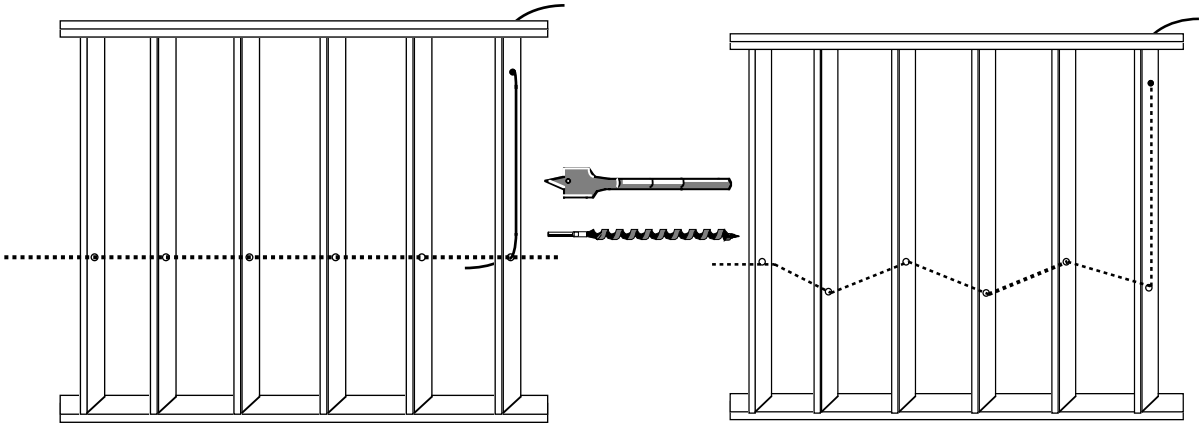




Once the boxes are installed, drill the holes for the NM cable to be routed to each box and the home run for each circuit must be routed from the service panel to the first outlet that each circuit is supplying.

When drilling the holes for the cable to be pulled into, drill the holes in a straight line when possible. Holes drilled in a straight line makes pulling the cable from box to box much easier.

When drilling holes around corners, drill at a sloping angle instead of drilling holes with abrupt turns. This makes pulling the wire much easier than trying to pull the wire through a sharp turn. Bending cable at a sharp angle can damage the conductor.



CORRECT WAY TO BORE HOLES CABLE IS EASIER TO PULL IN A STRAIGHT LINE.

INCORRECT WAY TO BORE HOLES CABLE IS HARD TO PULL AND IT TAKES MORE CABLE

BOX FILL CALCULATIONS - CUBIC INCHES

Proper calculations in box fill will result in conductors not being jammed into the box causing nicks or damage to the conductor insulation resulting in possible grounds or short circuits.

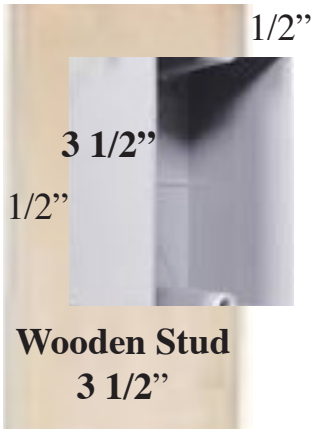
Based on AWG sizes, not insulation sizes.

When determining the maximum number of conductors permitted in a box, **Table 314.16(A)** would apply for conductor sizes #18 through #6. Table 314.16(A) shows the number of conductors **all the same size** permitted in a box. But, the number of conductors permitted as shown in Table 314.16(A) represents an **empty** box. If the box contains internal clamps, fixture studs, hickeys, switches or receptacles, the number of conductors shown in **Table 314.16(A)** would have to be **reduced**.

•Note: Box fill requirements don't apply to terminal housings supplied with motors.

Table 314.16(A). Metal Boxes

Box Dimension, Inches Trade Size or Type	Min. Cu. In. Cap.	Maximum Number of Conductors* No. 18	No. 16	No. 14	No. 12	No. 10	No. 8	No. 6
4 x 1-1/4 Round or Octagonal	12.5	8	7	6	5	5	5	2
4 x 1-1/2 Round or Octagonal	15.5	10	8	7	6	6	5	3
4 x 2-1/8 Round or Octagonal	21.5	14	12	10	9	8	7	4
4 x 1-1/4 Square	18.0	12	10	9	8	7	6	3
4 x 1-1/2 Square	21.0	14	12	10	9	8	7	4
4 x 2-1/8 Square	30.3	20	17	15	13	12	10	6
4-11/16 x 1-1/4 Square	25.5	17	14	12	11	10	8	5
4-11/16 x 1-1/2 Square	29.5	19	16	14	13	11	9	5
4-11/16 x 2-1/8 Square	42.0	28	24	21	18	16	14	8
3 x 2 x 1-1/2 Device	7.5	5	4	3	3	3	2	1
3 x 2 x 2 Device	10.0	6	5	5	4	4	3	2
3 x 2 x 2-1/4 Device	10.5	7	6	5	4	4	3	2
3 x 2 x 2-1/2 Device	12.5	8	7	6	5	5	4	2
3 x 2 x 2-3/4 Device	14.0	9	8	7	6	5	4	2
3 x 2 x 3-1/2 Device	18.0	12	10	9	8	7	6	3



Box is 3 x 2 x 3 1/2”
18 Cubic Inches

The 18 cubic inch box is a very popular size to feed in and out with #12 conductors. You can look at the box mounted on the stud, when you leave 1/2” out for the drywall, the box is 1/2” from the end of the stud.

Daisy chaining is the practice of running wires from receptacle to receptacle.

Plastic or fiberglass electrical boxes aren't designed to be used with MC cable.

A pigtail is not counted in box fill.

Table 314.16(A)

A standard single-gang box has 18 cubic inches of space. That equates to enough room to hold 8 - #12 gauge wires.

3" x 2' x 3 1/2"

BOXES

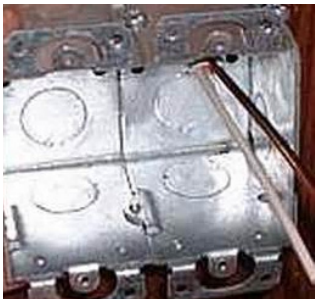
1 1/2”
Box Extension

• Install electrical box extensions - using a "side car" screw-on box extender or, if the box is deep-set into the wall, a box depth extender, it is possible to add several cubic inches of space to an existing electrical box without necessarily opening the wall itself.

•To add an electrical box extension, you must have access to the ***top or bottom screw*** on the open side of the box to remove the side plate - that's where you'd add on a second gangable box as an extension or a side-car hidden box extension.

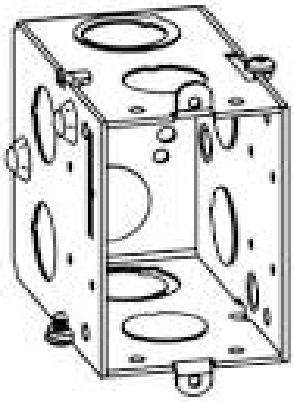
• Install a larger cubic-inch electrical box - this step is most disruptive as it means opening the wall cavity at each location where space inside the existing electrical box is inadequate for aluminum wire repairs.

Some electrical boxes installed as original work are stamped out of a single piece of steel and ***cannot be expanded***.



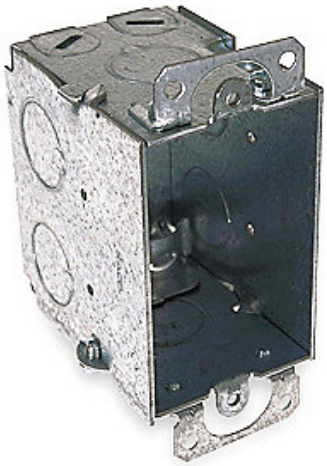
Others called "***gangable***" metallic boxes installed as original work included side plates that could be removed to install a sidecar extension.

Gangable electrical boxes can be expanded by adding another box along the open (away from the stud or joist) side of the existing box (***requiring a larger wall opening***), or by adding a "side car" extension that hides behind the wall surface.



3 x 2 x 3 1/2”
18 cubic inch

1 1/2”
Box Extension



3 x 2 x 2 3/4”
14.6 cubic inch

3 1/4 x 1 1/2”
Octagonal Box
10.9 cubic inch

4 x 1 1/2” Square
22.6 cubic inch

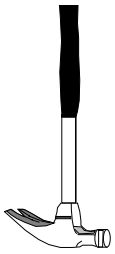
1 1/2”
Box Extension

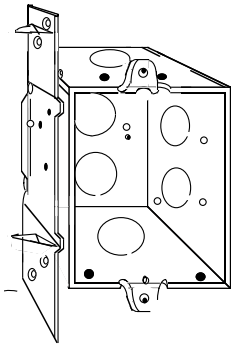
1/2” Deep
Pancake Box

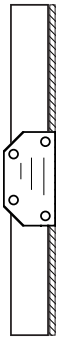
Gangable
Device Box

Several Shapes
and Sizes

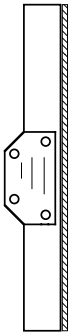
Outlet boxes are nailed to the vertical studs of the wall using 16 penny nails placed through the mounting holes in the box. Most nonmetallic boxes have the mounting nails fitted to the box ready to mount. There is no Code rule on the mounting height of the box from the floor. The type and thickness of the wall board should be known before mounting the boxes so that the boxes will be flush with the finished surface.





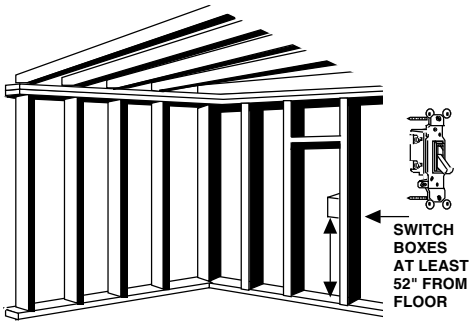


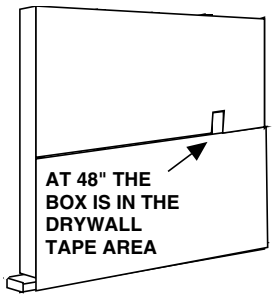
IF THE WALL SURFACE IS MADE OF A COMBUSTIBLE MATERIAL THE BOX MUST BE MOUNTED FLUSH WITH THE SURFACE

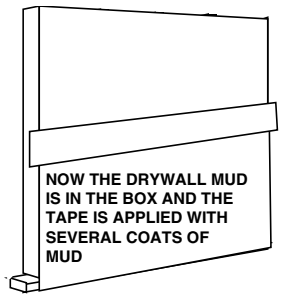


IF THE WALL SURFACE IS MADE OF A NONCOMBUSTIBLE MATERIAL THE BOX MAY BE MOUNTED NO MORE THAN 1/4" BACK FROM THE SURFACE

If the surface of the wall is to be of a combustible material such as wood, the boxes for outlets must be mounted flush with the finished surface. If the surface of the wall is to be of a non-combustible material such as dry wall, the boxes for outlets may be recessed in the wall not more than 1/4".

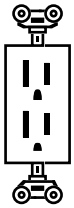




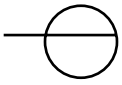


Some drawings show switch box mounting heights at 48" from the floor. Being an electrician over the years has caused me to disagree with this 48" measurement in some cases. When drywall is installed at 48" in height and 12 feet horizontally, the box will be located in the taped joint at 48". Same condition exists with the wall that has 4' x 8' paneling laid horizontally as a wainscot for protection of the lower half of the wall, the top trim moulding will cover the box at 48". The bottom of the box should be at least 52" from the floor to stay clear of the 48" of the material being installed, otherwise the joint will fall at the box location. **Prior planning before installing boxes is very important in the layout.**

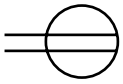
ELECTRICAL SYMBOLS



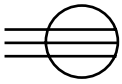
CONVENIENCE RECEPTACLES



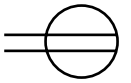
single receptacle



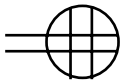
duplex receptacle



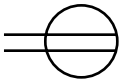
triplex receptacle



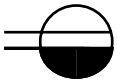
triplex receptacle



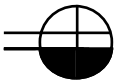
quadruplex receptacle



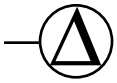
ungrounded duplex receptacle



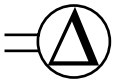
split-wired duplex



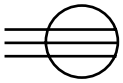
split-wired triplex



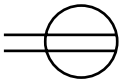
single special-purpose receptacle



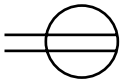
duplex special-purpose receptacle



range receptacle



weatherproof receptacle



switch and receptacle

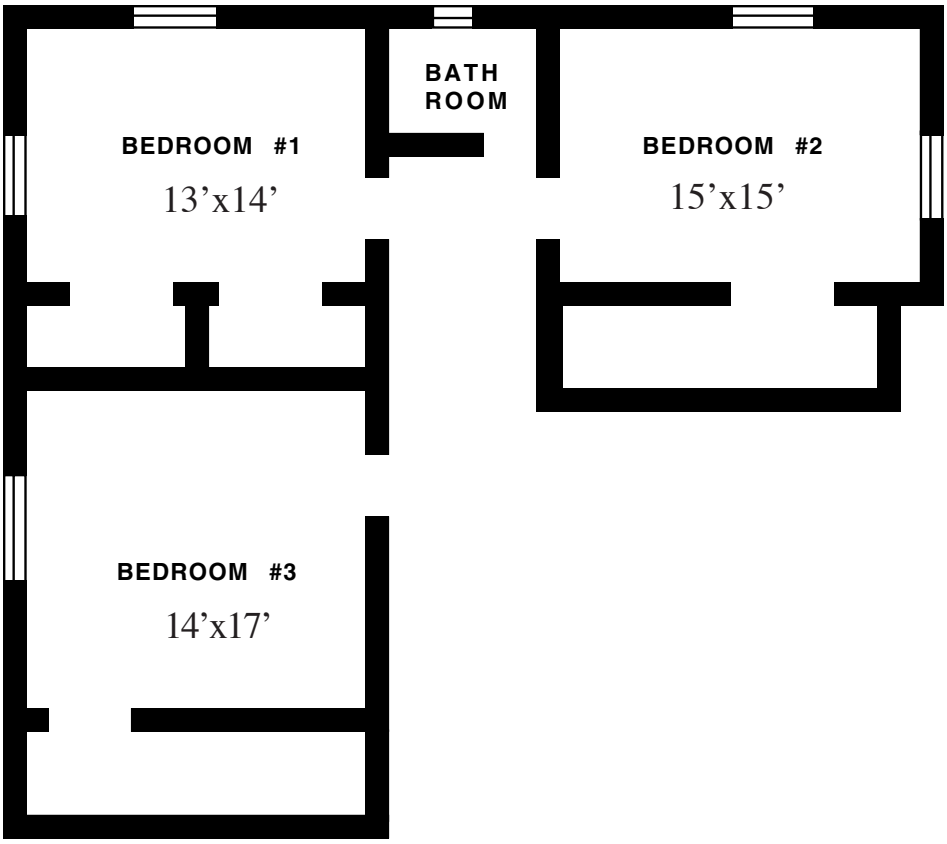
floor receptacle

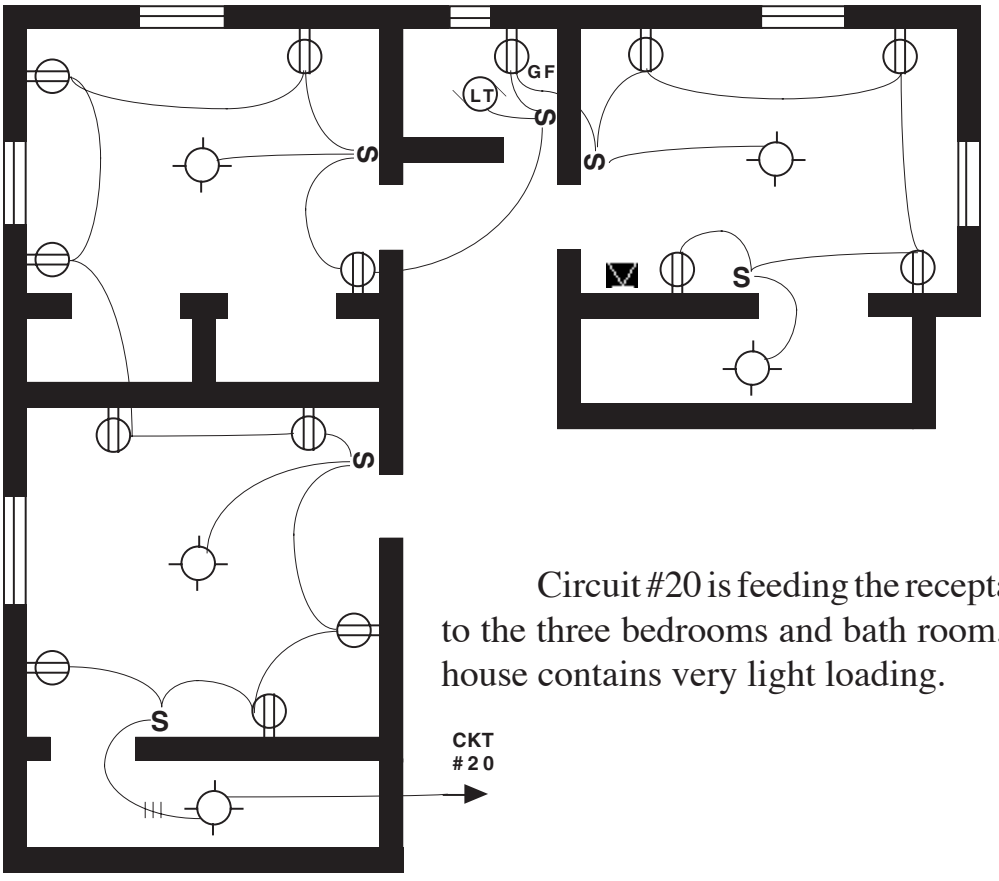
special-purpose dishwasher

special-purpose heat pump

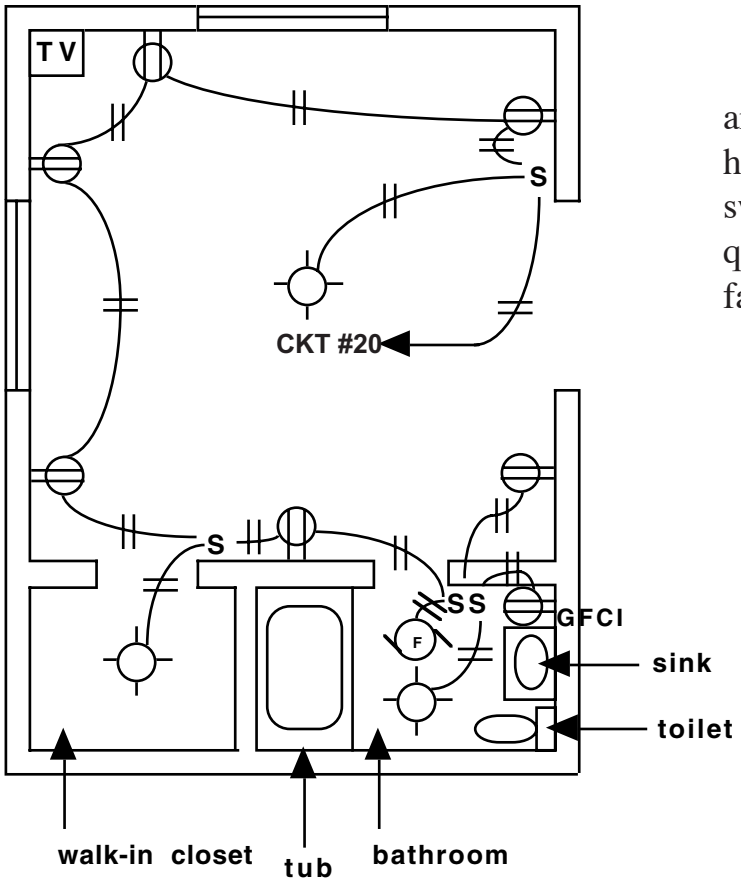
special-purpose clothes dryer

special-purpose air conditioner





Circuit #20 is feeding the receptacles and lighting to the three bedrooms and bath room. This area of the house contains very light loading.



A walk-in closet and bathroom are added to the floor plan. Each room has a ceiling light controlled by a wall switch. The bathroom also has a required GFCI receptacle and a ceiling fan controlled by a wall switch.

A schedule is a very handy working tool for the electrician as an electrical item can be fully described using a minimum of text. This allows the electrician to see a clear picture of the circuit components.

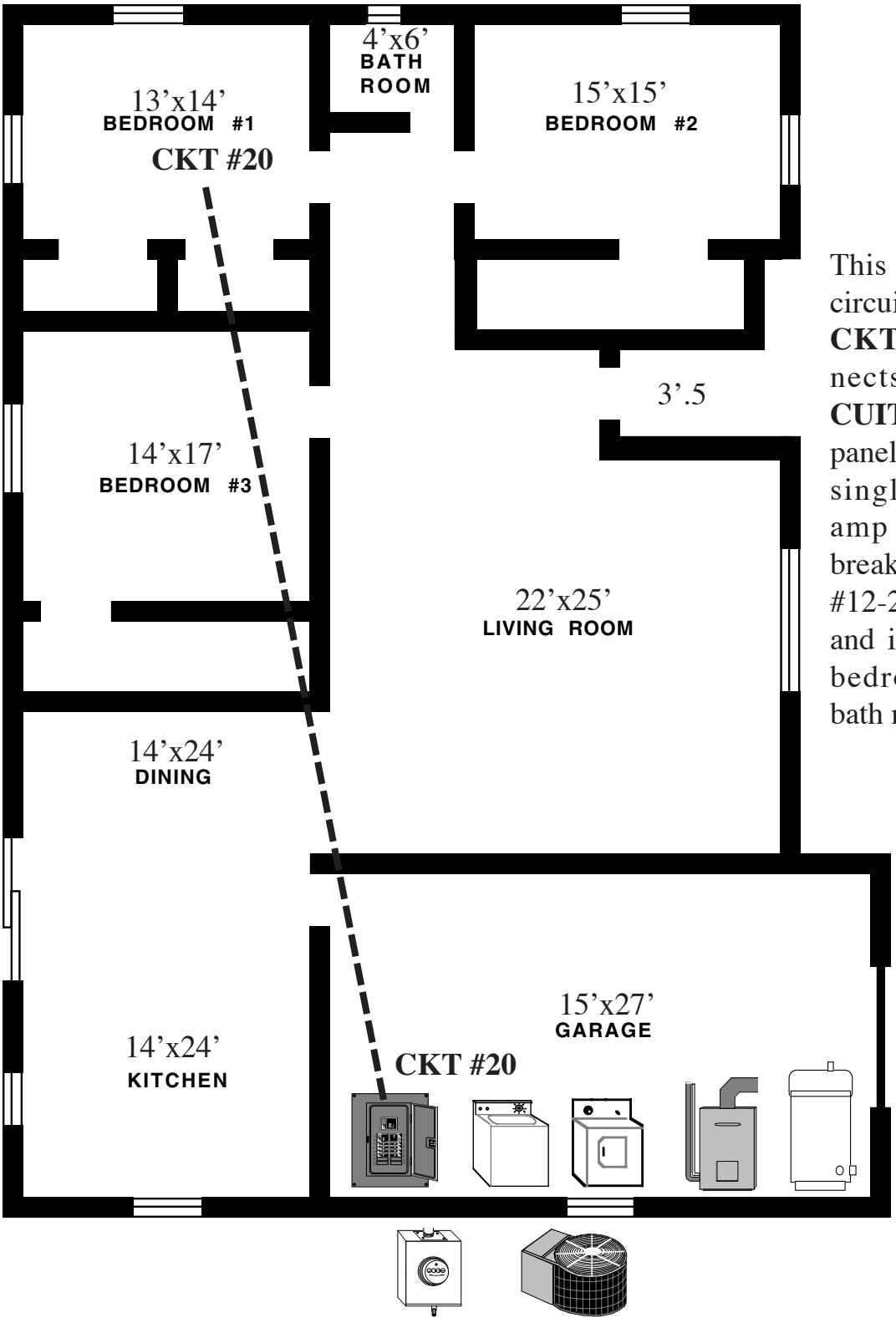
Shown below is one type of a panelboard schedule. There are many different versions.

PANELBOARD SCHEDULE H - 6677

MAINS 150 **PHASE** 1 **VOLTS** 240/120 **AMPERE** 150

Circuit Number	Circuit Breaker		Conductor		Serves
	Poles	Amps	Number of	Size	
1	2	35	2	#8	Air Conditioner
2	2	30	2	#10	Water Heater
3	—	—	—	—	Air Conditioner
4	—	—	—	—	Water Heater
5	2	50	3	#6	Range
6	2	30	3	#10	Dryer
7	—	—	—	—	Range
8	—	—	—	—	Dryer
9	1	20	2	#12	Dining Room
10	1	20	2	#12	Kitchen - SW
11	1	20	2	#12	Garbage Disposal
12	1	20	2	#12	Kitchen - SE
13	1	20	2	#12	Dishwasher
14	1	20	2	#12	Kitchen Lights-Fan
15	1	20	2	#12	Washer
16	1	20	2	#12	Furnace
17	1	20	2	#12	Garage Recpts.
18	1	20	2	#12	Garage Lights, etc
19	1	20	2	#12	Living Room
20	1	20	2	#12	Bedrooms-Bath

Example: This panelboard circuit shows that **CKT #20** connects to **CIRCUIT 20** in the panelboard, it is a single-pole 20 amp circuit breaker, using a #12-2 conductor, and it serves the bedrooms and bath rooms.

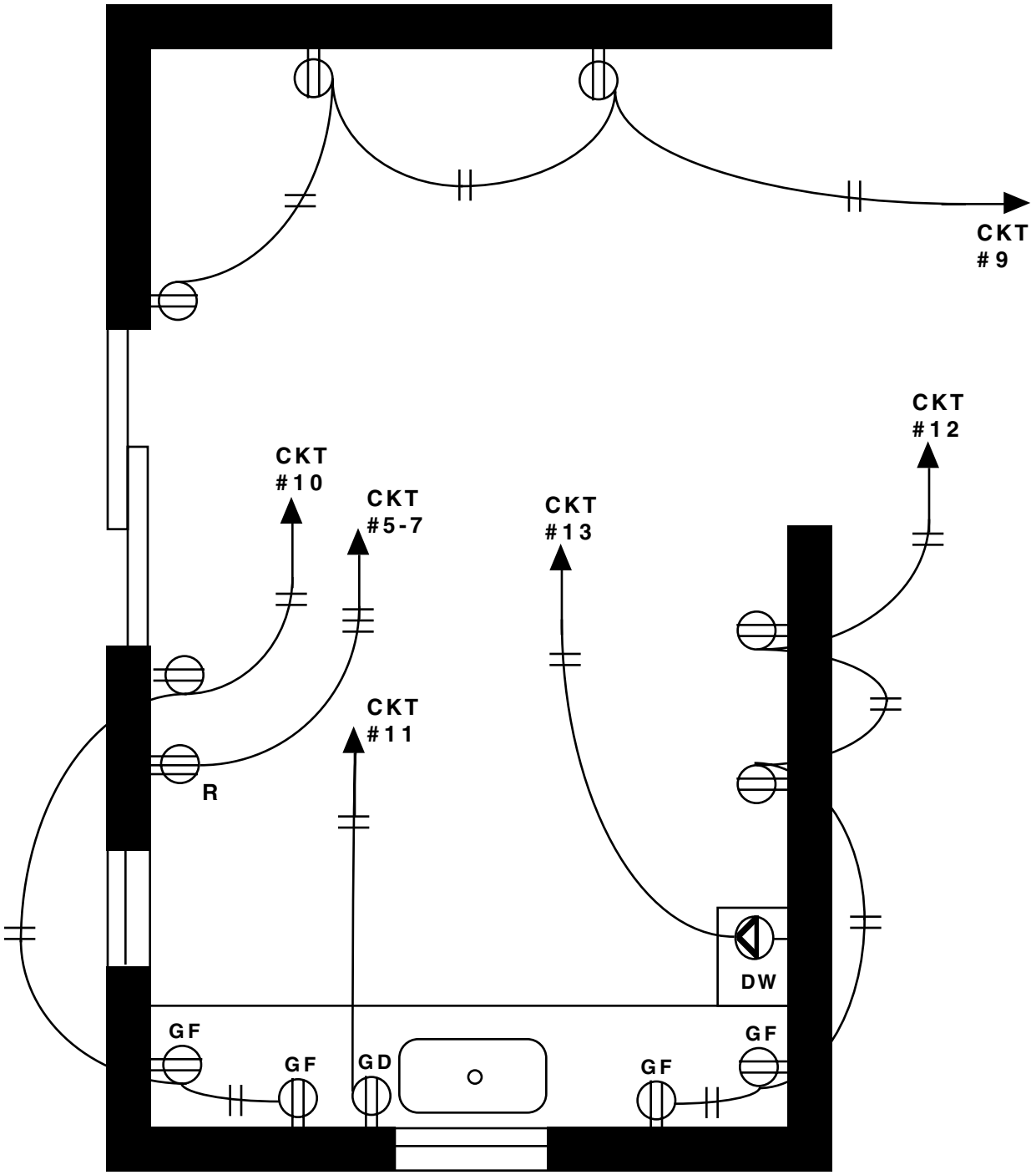


This panelboard circuit shows that **CKT #20** connects to **CIRCUIT 20** in the panelboard, it is a single-pole 20 amp circuit breaker, using a #12-2 conductor, and it serves the bedrooms and bath rooms.

The service panelboard is located in the garage which is close to the major appliances.
The garage is used as the laundry room with the installation of the washer and dryer.
The furnace is also located in the garage along with the water heater.
The central air conditioning unit is located just outside the garage wall.

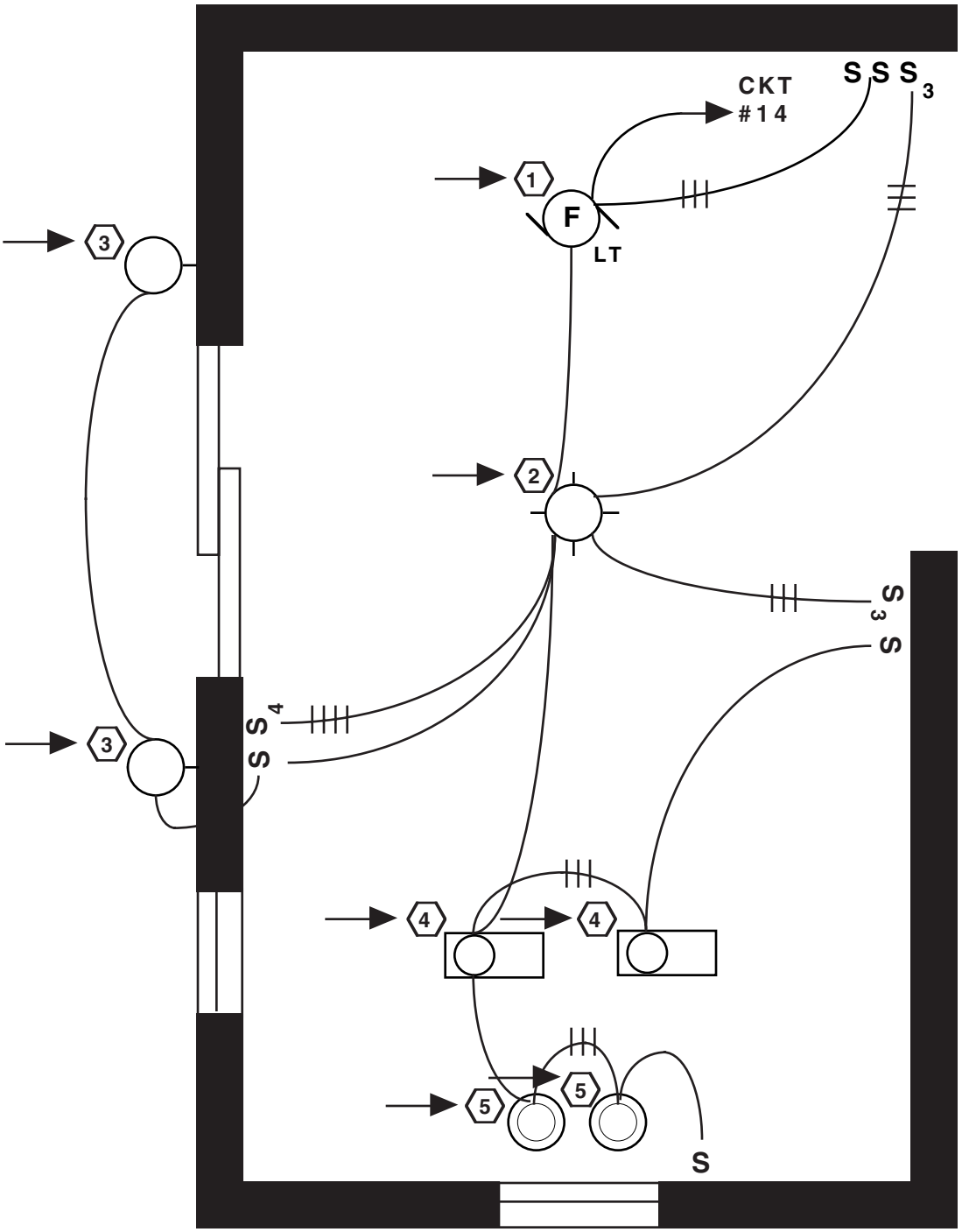
This floor plan shows six circuits (homeruns). Three for the small appliance outlets, one for the dishwasher, one for the disposal and one for the range. The two slash marks indicate a two-wire circuit, the three slash marks on the range cable indicates a three-wire cable.

Often designers will omit the two slash marks from the drawing, after adding the switches and lighting outlets, the drawing can become cluttered with several lines. To avoid confusion, the cable with NO slash marks is a two-wire cable, any cable with MORE than two-wires will be noted with slash marks.

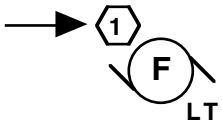


The kitchen lights are not allowed on the 20 amp small appliance circuits, so a separate circuit #10 is run for the lights.

The ceiling fan-light combo has two single-pole switches (one for fan and one for light) with a 3-wire cable to the fixture. The ceiling light is controlled from three locations by using two 3-way switches and one 4-way switch. The other lights are controlled by single-pole switches. •NO slash marks indicates 2-wire cable.

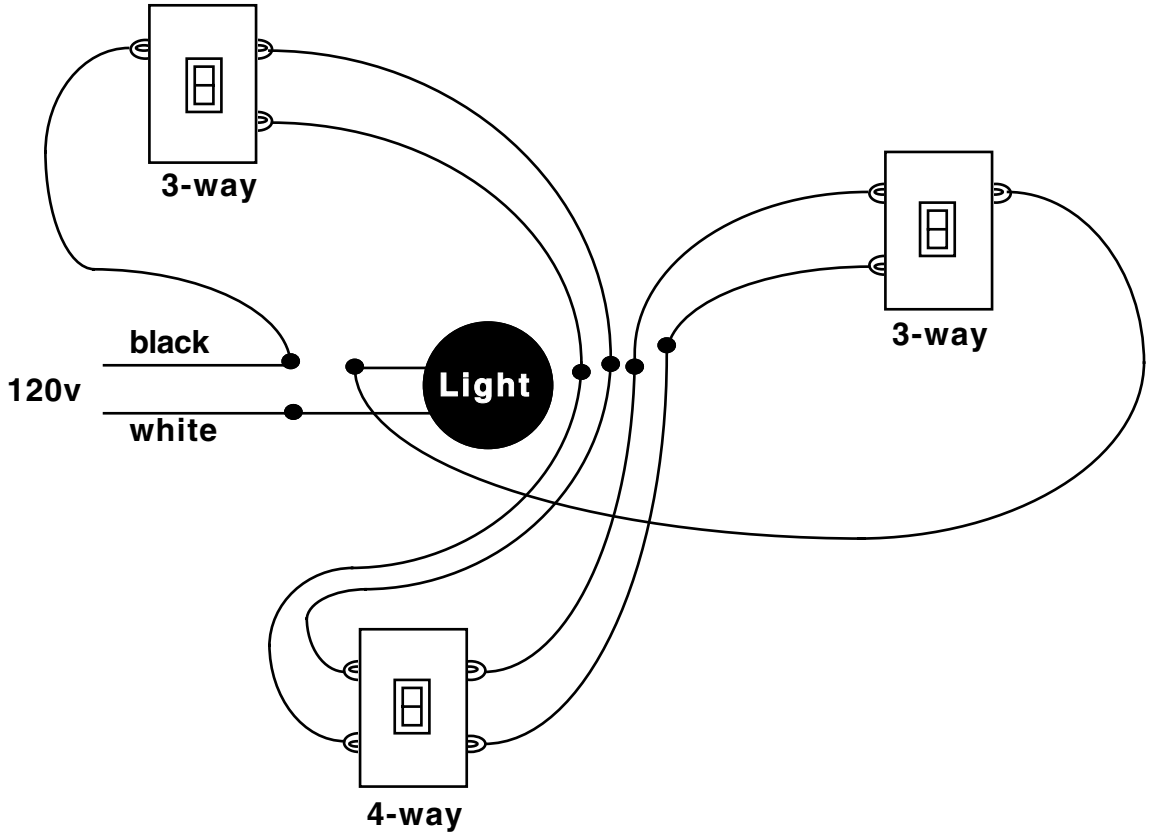


A lighting fixture schedule is a very helpful part of the electrical drawing. It shows the type by an indicator box. The fixture schedule lists the quantity, manufacturer and item number, type of mounting and even the lamp required for the fixture.

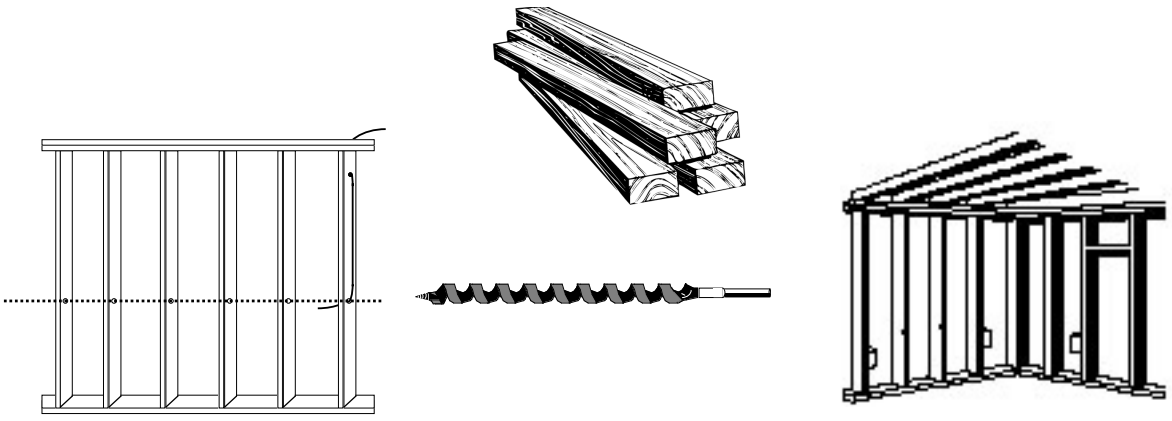


LIGHTING FIXTURE SCHEDULE H - 6677					
Symbol	**Type**	**Quantity**	**Manufacturer #**	**Mounting**	**Lamps**
F LT	1	1	Blowtime Inc. f-47338	surface	4-60w
	2	1	Brightlite Co. L-s 23975	surface	100w
	3	2	Outdoor Lumens R-72w	wall	60w
	4	2	Quicklite Inc. F-5649	surface	2-40w WW
	5	2	Intense Lighting R-1275	recessed	60w

Shown below is the ceiling light which is controlled from three locations, which requires four wires from the 4-way switch to the ceiling outlet box, three wires from each 3-way switch to the ceiling outlet box, and a 2-wire cable which is the 120 volt source wire.

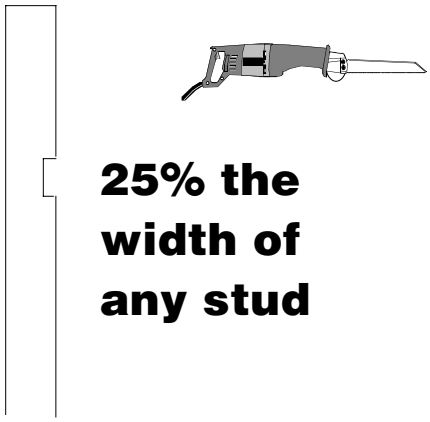


DRILLING & NOTCHING VERTICAL FRAMING MEMBERS (STUDS)

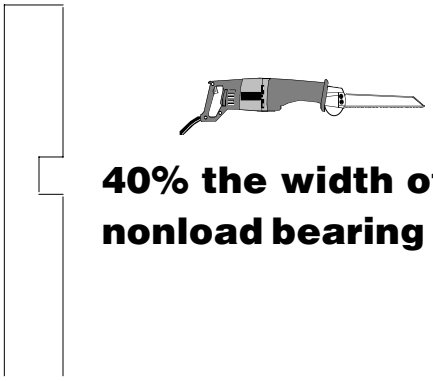


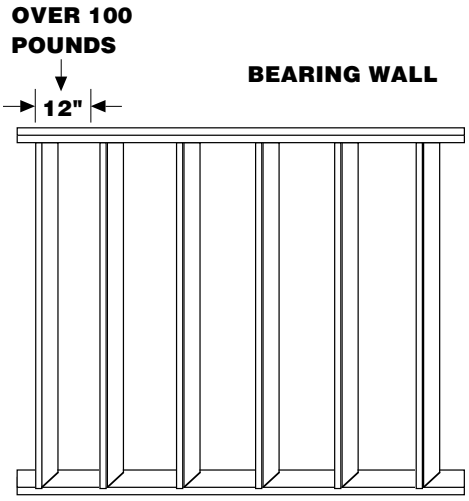
NOTCHING OF STUDS

The Building Code permits the notching of any stud up to 25% of its width. A standard 2x4 stud has a width of 3 1/2" x 25% = 7/8" notch is permitted in any vertical 2 x 4 stud.



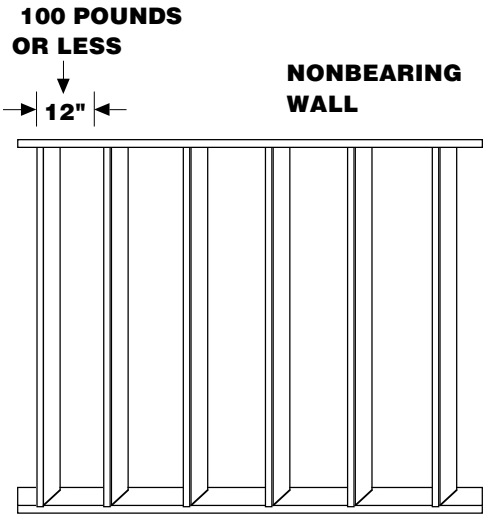
The notch size can be increased to 40% the depth of a width on a *nonload* bearing wall. 3 1/2" x 40% = 1 3/8" notch.





A *load bearing* wood stud wall is a wall which supports more than 100 pounds per lineal foot of superimposed load.

One building code defines a *bearing* wall as a wall supporting any vertical load in addition to its own weight.



A *nonload bearing* wood stud wall is a wall which supports 100 pounds or less per lineal foot of superimposed load. (It would NOT support any weight of a ceiling).

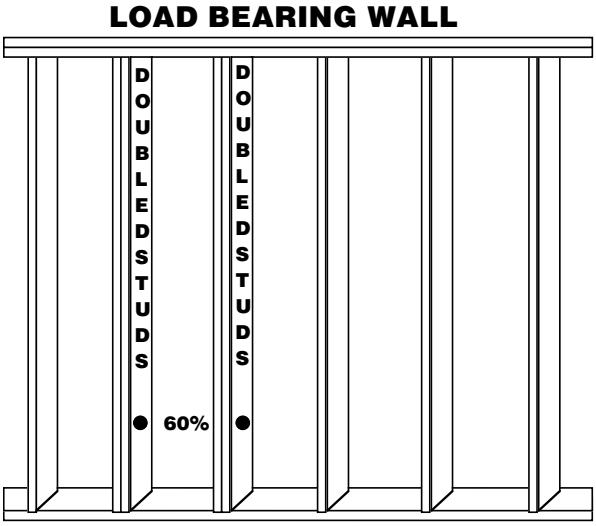
One building code defines a *nonbearing* wall as a wall which supports no vertical load other than its own weight.

DRILLING OF WOOD STUDS

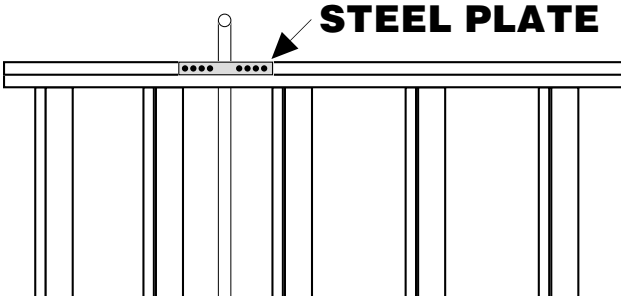
The Building Code permits a hole not greater than 40% of the stud width in any wood stud (load bearing or nonload bearing). However, the hole is not permitted within 5/8" to the edge of the stud. Holes and notches are NOT permitted at the same location in a stud. A hole closer than 5/8" to the edge of a stud will be considered a notch.

A hole of up to 1 3/8" is permitted in any 2x4 stud

A hole of up to 2 1/16" is permitted in a 2x4 stud in a nonload bearing wall



A 60% of the width hole can be drilled in a *load bearing* wall if each drilled stud is *doubled*, provided NOT more than *two* successive doubled studs are drilled.

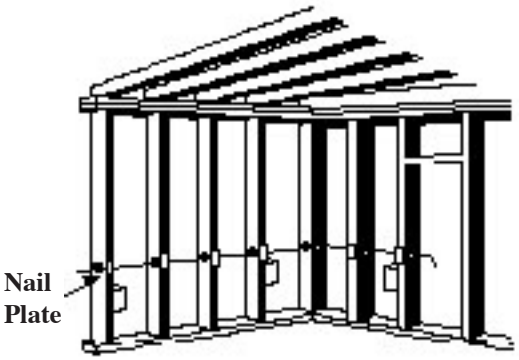


When drilling or cutting into the top plate is required, a steel plate measuring at least 1/8" in thickness and 1 1/2" in width shall be fastened across the opening with not less than four 16 penny nails.

NAIL PLATES

The National Electrical Code in section 300.4(A)(2) permits cable or raceway to be laid in these notches if protected by a steel plate at least 1/16" to protect the cable or raceway from the penetration of nails or screws.

When holes are bored in the framing members, the holes must be kept 1 1/4 inches from the nearest edge. This is to prevent nails or screws from being driven into the cable when the paneling or drywall material is being installed. If this clearance of 1 1/4 inches isn't possible, then metal nail plates must be placed on the outer edge to protect the cable.



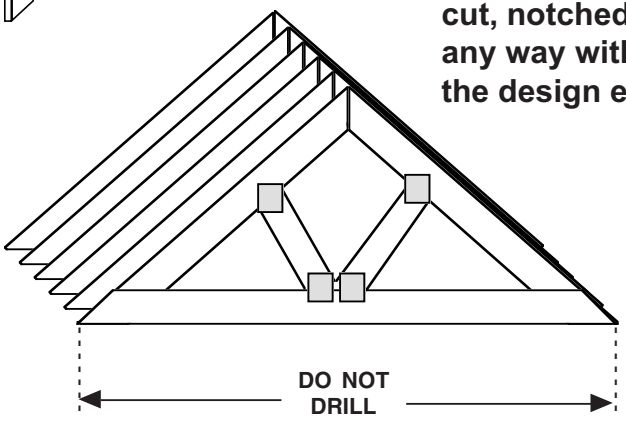
A standard 2" x 4" stud measures 3 1/2" on the 4" side, if the hole is drilled in the center of the stud, nail plates may not be necessary. Closer to either outer edge will require nail plates.

When metal studs are used, bushings or grommets are installed in the holes to protect the cable from the sharp edges.

A 2x4 stud is 3 1/2" in width. The code requires a 1 1/4" clearance from the nearest edge. From each edge in 1 1/4" would permit a maximum 1" diameter hole in the center of a 2x4 stud.

A hole larger than 1" diameter would require a metal nail plate for protection.

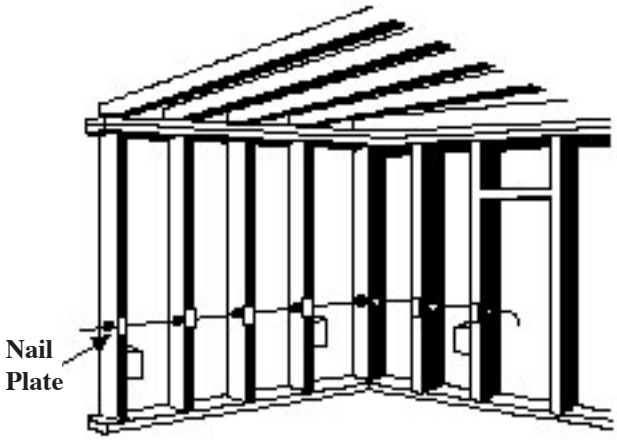
Truss members and components shall not be cut, notched or drilled, spliced or otherwise altered in any way without written concurrence and approval of the design engineer.

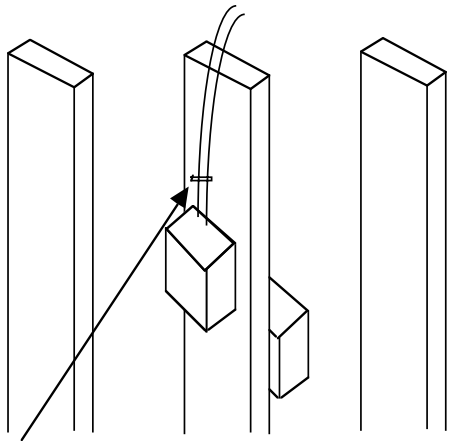


No additional loading of any member, such as HVAC equipment, water heater, shall be permitted without such additional load being incorporated in the **engineering design**.

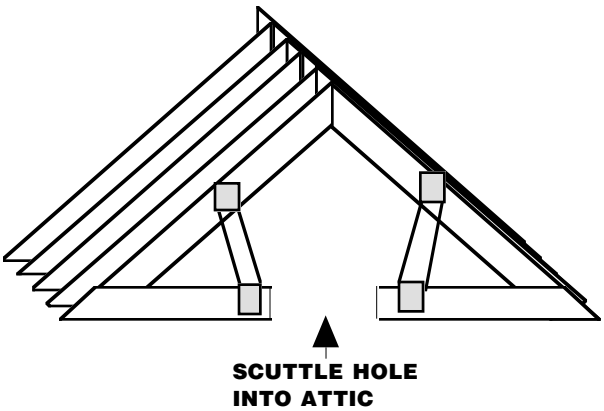
DRILLING AND NOTCHING OF *HORIZONTAL* LUMBER

When holes are bored in the framing members, the holes must be kept 1 1/4 inches from the nearest edge. This is to prevent nails or screws from being driven into the cable when the paneling or drywall material is being installed. If this clearance of 1 1/4 inches isn't possible, then metal nail plates must be placed on the outer edge to protect the cable. A standard 2" x 4" stud measures 3 1/2" on the 4" side, if the hole is drilled in the center of the stud, nail plates may not be necessary. Closer to either outer edge will require nail plates.



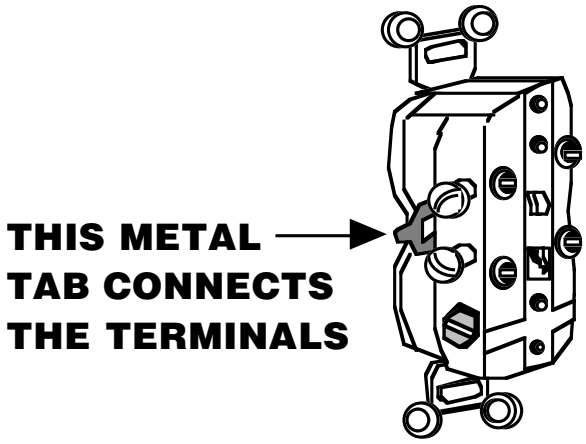


The cable must be stapled within 8" of the box if it is not clamped to the box or within 12" if it is clamped to the box, and must be stapled at no more than 4 1/2 feet of cable run. To avoid damage to the cable, the staples should not be driven too tightly against the cable. If the cable is run through holes such as through the studs from box to box, it is considered supported and stapling is not necessary.



If romex is run in an attic across the joists or within 7 feet of an entrance accessible by a permanent stairway or door, the cable must be protected by guard strips at least as high as the cable. If the opening is not accessible by permanent stairs or ladders the protection is required within 6 feet of the scuttle hole.

The larger circuits for an electric range, clothes dryer and electric heat must be installed. These circuits require larger wire than the general purpose receptacles and lights. This larger wire is more difficult to route to the location and larger holes may be required to be drilled.

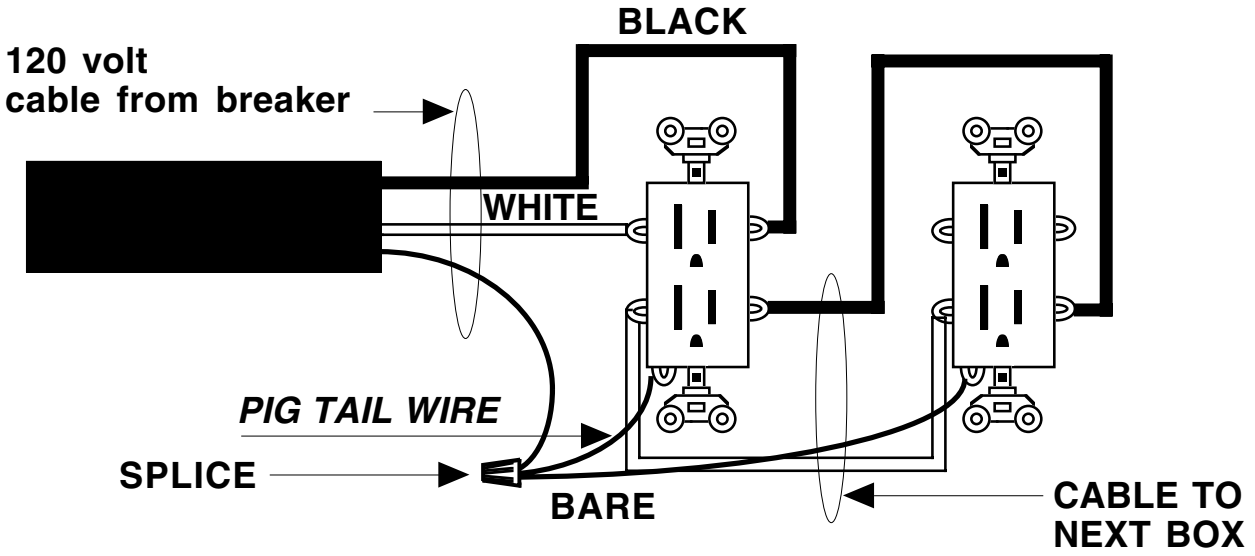


A metal tab on each side connects the terminals so that both the top and bottom receptacles have 120 volts even though the black and white wires are only connected to the top terminals. The voltage to the bottom terminals is fed through the metal tabs.

The bottom screw terminals are used to feed the circuit voltage to another receptacle located down the wall.

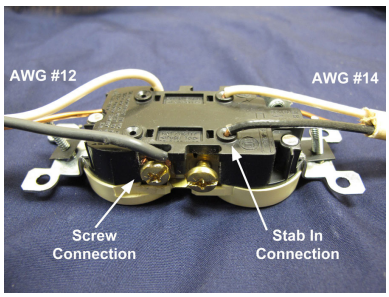
The Code prohibits more than one wire on a terminal screw unless the terminal is identified for more than one wire. Connectors marked Al/Cu are suitable for use with aluminum, copper or copper-clad aluminum.

A duplex receptacle has only one screw terminal for the grounding wire and generally are listed only for *one* wire. To feed the grounding wire to the next receptacle, a splice is made connecting a "pigtail" from the first receptacle.



CONNECT ONLY *ONE* WIRE TO A TERMINAL- UNLESS THE TERMINAL IS IDENTIFIED FOR MORE THAN ONE WIRE

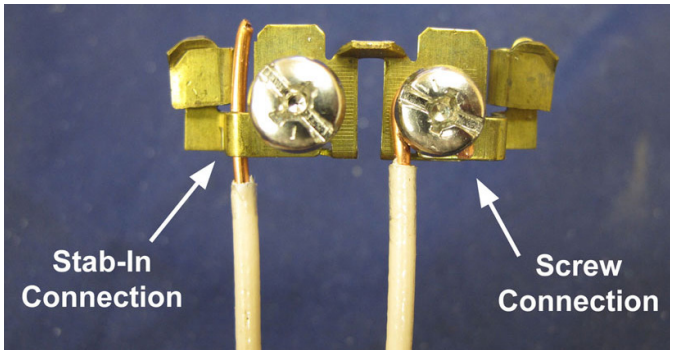
It’s hard to believe the real world today permits these connections, a torque is required on the screw connection but allows a stab-in connection.

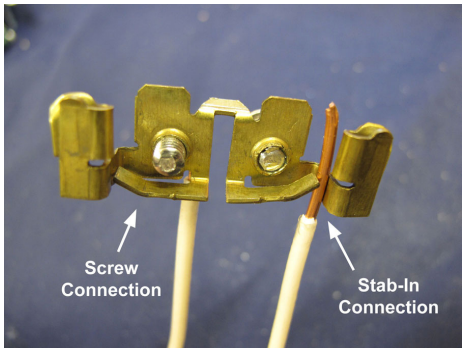


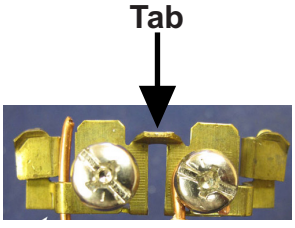
Back-stabbed

It is not necessary for a receptacle to have something plugged into it for it to cause a fire. The reason that there are two screw terminals on each bus is so that power can be supply to another receptacle or device. Hence, electrical current may be passing through the receptacle even though it has nothing plugged into it.

Stab-in / Push-in connections were common in the 1970's and 1980's. In 1996, UL Standard 498 was revised to only permit stab-in (push-in) connections with solid copper conductors that were size AWG #14. The manufactures reduced the size of the holes so that AWG #12 wire would **not** fit. AWG #12 wire is thicker and more stiff than AWG #14 wire. When the receptacle was pushed into the outlet box, too much pressure was being inserted on the spring metal gripper, and this was causing loose connections.

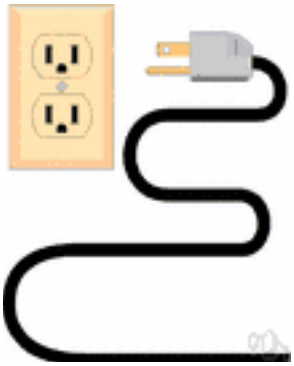






On duplex receptacles, there is a break tap between the screws terminals on both the "hot" and "grounded" buses. This allows the duplex receptacle to be spilt into two receptacles. A common use for this is to control one of the receptacles from a wall switch that turns on a table lamp.

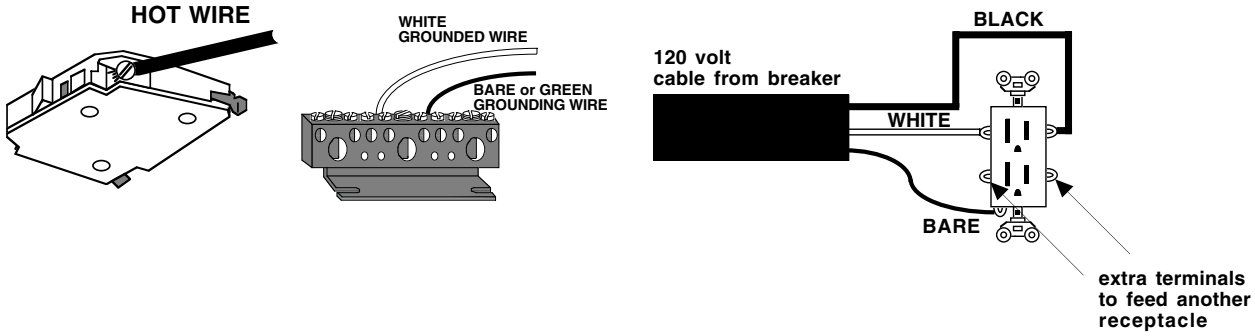
Receptacles

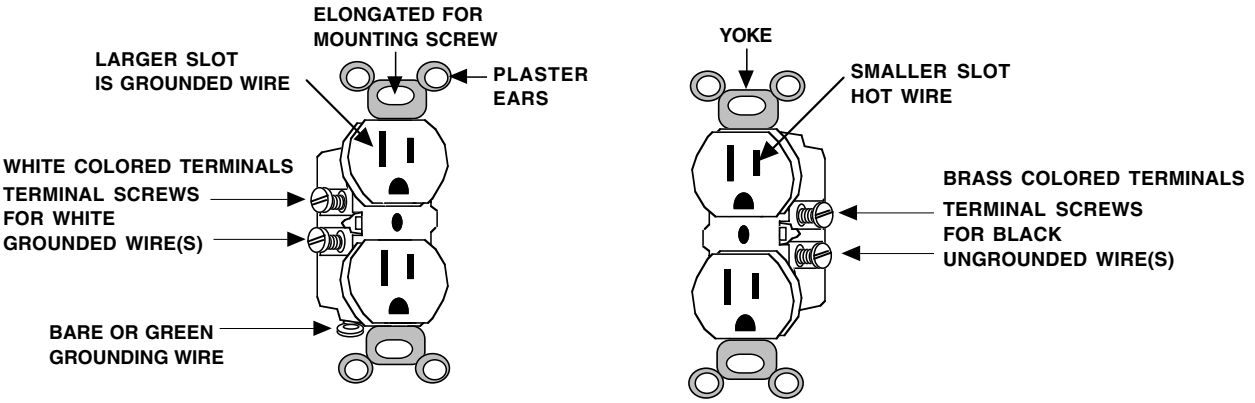


The National Electrical Code doesn't limit the number of receptacles you can place on a 20-amp circuit, but you'll overload the breaker if you run appliances that draw more current than the breaker can handle. The NEC does specify that a circuit breaker shouldn't handle more than **80 percent** of the load for which it is rated unless the breaker is labeled otherwise. By this standard, the total current draw on a 20-amp circuit shouldn't exceed 16 amps. A 15-amp circuit should not exceed 12 amps.

The Duplex Receptacle

The 120 volt source originates at the panelboard. The ungrounded (hot) wire is connected to the single-pole circuit breaker. The white grounded wire connects to the neutral bus terminal as does the bare or green colored equipment grounding wire. The cable is then run from the panelboard to the first receptacle and the wires connected to supply the receptacle.





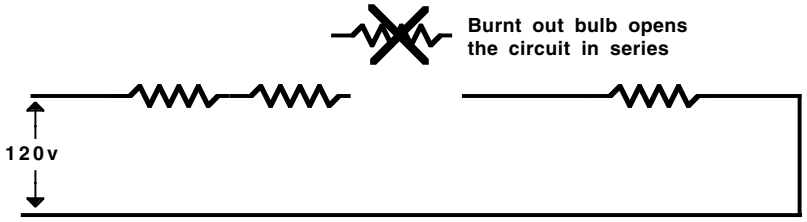
Daisy chain - Feed Thru wiring of receptacle outlets

Definition.

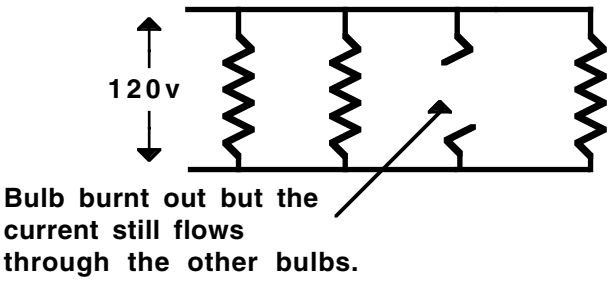
Daisy chain. Is a wiring scheme in which multiple devices are wired together in sequence or in a ring.

Electric receptacle. A receptacle outlet is providing a place in a wiring system where current can be taken to run electrical devices.

Series Circuit. If one connection is opened, the **entire** circuit is opened.

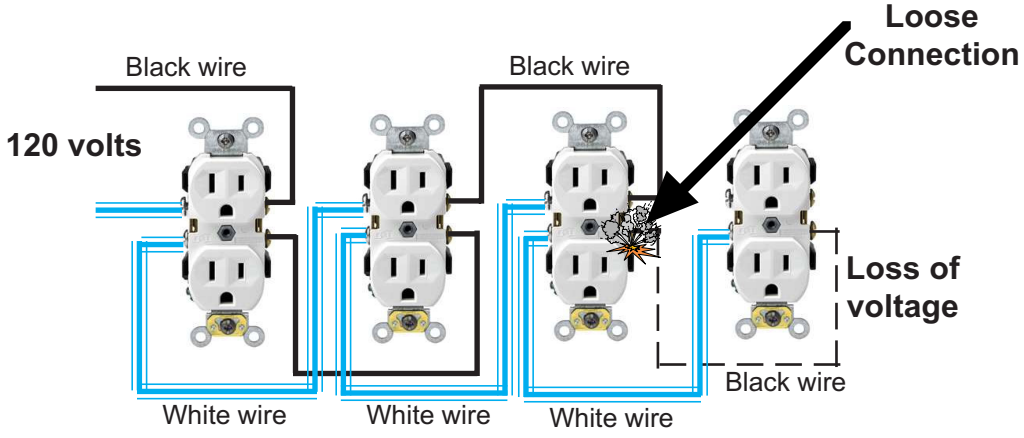


Parallel Circuit. Parallel loads are connected directly across the voltage source.

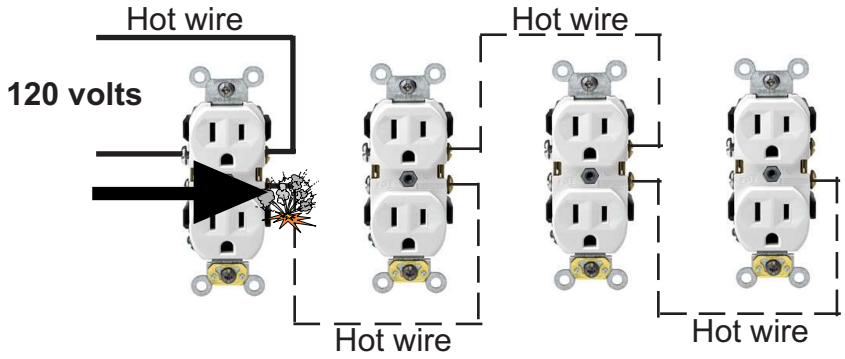


The sketch below shows a bad connection at bottom of receptacle #3 losing voltage to receptacle #4. The first two duplex receptacles have 120 volts as does the top of receptacle #3.

This circuit is **NOT** connected in series or all the receptacles would lose voltage. But, are the duplex receptacles connected in parallel?

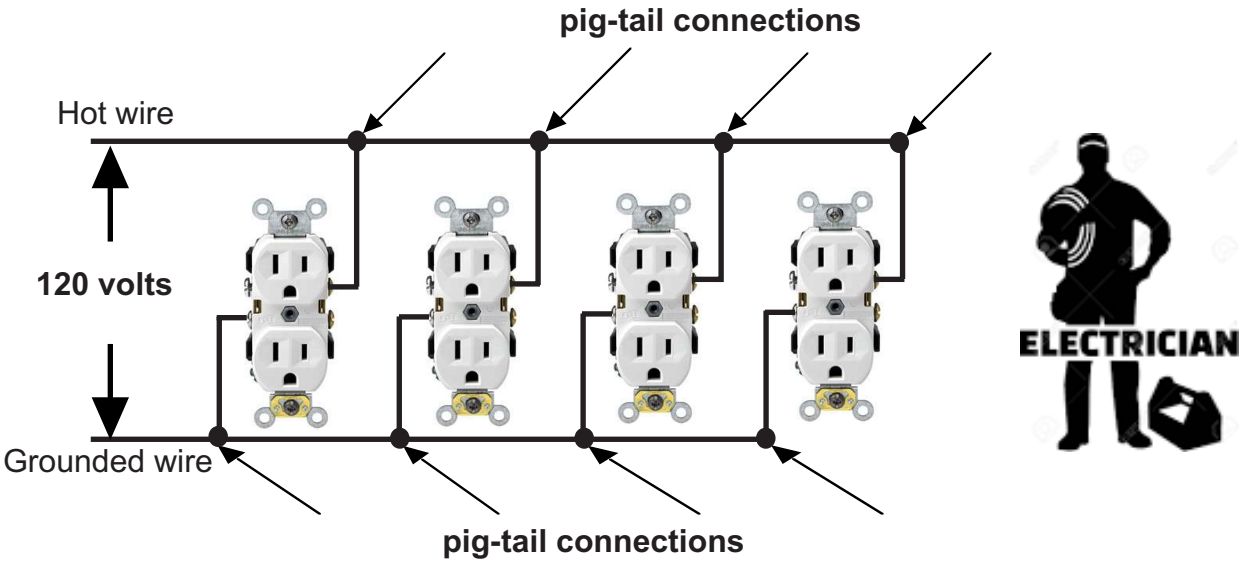


The sketch below shows on a **feed-thru** connection the hot wire at the bottom tab connection on receptacle #1 came off so the voltage drop would be in all the receptacles as this open connection is supplying the voltage to the other three receptacles. **NOT** a parallel connected circuit! It's **NOT** a series circuit either, as the top of receptacle #1 is hot.



What one must remember, a voltage of 120 at only receptacle #1. Shown below in a feed-thru circuit are four loads connected in parallel and each load receives 120 volts **if the connections at the feed-thru tabs are tightened correctly**.

PARALLEL CONNECTED



Terminals on devices are listed for *#10 size wire and smaller*.