

Duke Energy

3-Phase Padmount Transformer Concrete Foundation Specifications

July 2009

Flat Pad and Pit Pad Application and Construction

The information contained in this document has been prepared to assist both Duke Energy personnel and Duke Energy customers in the application and construction of foundations for all 3-phase padmount transformers. This information is intended to provide clear distinctions between the responsibilities of Duke Energy and of the customer. However, in all cases, it is critical to maintain an open dialog between Duke Energy and the customer regarding conductor quantities, conduit sizes and locations, connections, and electrical load requirements. This will ensure that the proper dimensions are used for the concrete transformer foundation.

The "Pit Pad" is preferred for all 3-phase padmount installations. In cases where there are 3 secondary conductors per phase or fewer AND the conductors are less than or equal to 400 MCM, a "flat pad" may be considered. The Duke Energy project coordinator will make the final decision whether it is permissible to use a "flat pad."

A separate secondary bus enclosure is required whenever the customer is installing more than ten (10) 600 MCM or smaller conductors per phase, or more than eight (8) conductors per phase that are larger than 600 MCM.

Generally, the "SMALL" pad is used for transformers rated 300 KVA and below, and the "LARGE" pad is used for transformers rated 500 KVA and above. Consider a "LARGE" pad in applications where the number of customer conduits/conductors exceeds the window opening restrictions of the "SMALL" pad, and when load growth and/or a transformer change-out to a larger size is anticipated. In most cases, regardless of the KVA rating, the air compartment of all currently purchased transformers should cover the entire window opening of either pad. (There may be some rare exceptions.)

Customer Responsibilities

The customer may choose to construct the transformer pad on site or purchase a prefabricated unit from a manufacturer. In either case, the customer is responsible for assuring the pad is manufactured to the requirements provided in this specification.

Listed below are instructions for building a transformer pad on site.

1. Customer is to contact Duke Energy to inspect pad forms and dimensions prior to concrete being poured
2. Customer shall supply the concrete mix (as shown in the concrete mix specifications), welded wire fabric, #4 reinforcing bars, and shall pour the "flat pad" or "pit pad".
3. The dimensions shall be in accordance with the specifications based on the transformer KVA size. The thickness of all walls on the "pit pad" shall be a minimum of 5 - 1/2" thick. The transformer KVA Size is to be specified by Duke Energy.

Customer Responsibilities (continued)

4. Refer to the Padmount Building Clearance Standard for the minimum allowable distance between transformer pads and buildings, building openings and equipment. There shall be a minimum clearance of 10' from the front of the concrete pad to any walls, machinery, or other obstacles. If there are multiple transformers or secondary bus enclosures involved in the installation, there shall be a minimum clearance of 3 feet between all padmount equipment.
5. When a transformer is installed in a vault, the customer shall install a 1" metering conduit from the secondary compartment of the pit pad to the metering location as specified by Duke Energy.
6. Customer shall install the conduit for the primary conductors (as specified for "pit" pad installations only) as close to the center of the "primary" area as practical. The "primary" conduit(s) and the customer's "secondary" conduits shall be cut to meet the dimensions as shown.

Note: The preferred method for installing customer's "secondary" conduits is shown. An alternative method is for the customer's conduit to be installed in the side of the pit. If the customer's switchgear is at a level below the padmount transformer location, special arrangements must be made to prevent water from entering the customer's switchgear through the customer's conduits.

7. Customer shall inform Duke Energy of the number, size, and type of secondary conductors that will be installed. (Example: 500 MCM Copper, 600 volt insulated, four (4) conductors per phase.)
8. Customer must be specific regarding 4-wire (grounded-wye) and 3-wire ("floating-wye") deliveries. Special metering and grounding considerations may need to be considered for each of these deliveries. For 3-wire deliveries, a single grounding conductor (maximum size 1/0) from the customer shall be connected to the copper grounding ring in the transformer compartment, and the ground strap must be completely disconnected from the X0 bushing.

Note: 4-wire deliveries and 3-wire deliveries **SHALL NOT** be provided from the same transformer. A 4-wire delivery requires the X0 bushing to be grounded, and a 3-wire delivery requires that the X0 bushing be completely disconnected from ground. (These two conditions cannot be met using a single transformer.)

9. It is the responsibility of the customer to provide room for excess secondary cables when conductors are in parallel. All parallel conductors shall be grouped and marked by the electrician. There must be no more than 1.5 feet difference between the shortest and the longest of any parallel cables on any one phase.

Duke Energy Responsibilities

1. Duke Energy will supply and install the 10' ground rod prior to the installation of the padmount transformer.
2. Duke Energy will install lugs on the secondary conductors and will make the connections of the secondary conductors to the low voltage spade terminals. Excess secondary conductor length is the responsibility of the customer as there will be very little space in the secondary compartment of the transformer to accommodate excess cable.

Concrete Mix Specifications

1. Concrete mix used for Transformer Pads shall meet the following requirements:
 - Minimum 28 day compressive strength of 3,000 psi
 - Maximum water / cement ratio of 0.50
 - Maximum slump of 4 inches
 - Air-entrainment content between 4 and 8 percent
2. Concrete shall be afforded adequate cure for a minimum of :
 - **five (5) days** if the ambient temperature is **over 70° F**, or
 - **seven (7) days** if the ambient average temperature is **below 70° F**.
3. Adequate cure can be performed by any of the following methods:
 - Waterproof membranes
 - Sprinkling or Soaking
 - Curing Compounds
4. Pad shall be supported on a sub-base of sand, gravel, or crushed stone. The granular sub-base is to be a minimum of four (4) inches thick and shall be compacted with a vibratory compactor.
5. Dampen the sub-base prior to concrete placement. At the time of placement, the sub-base shall not contain standing water.

6. The top of the concrete pad must be steel troweled and completely smooth to prevent “gaps” between the transformer and the surface of the concrete pad.

Installing Conduit in Pit Pads

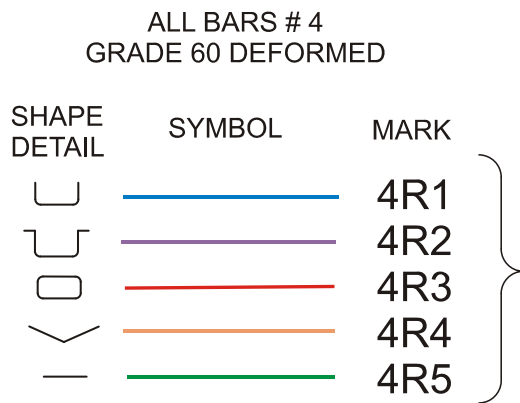
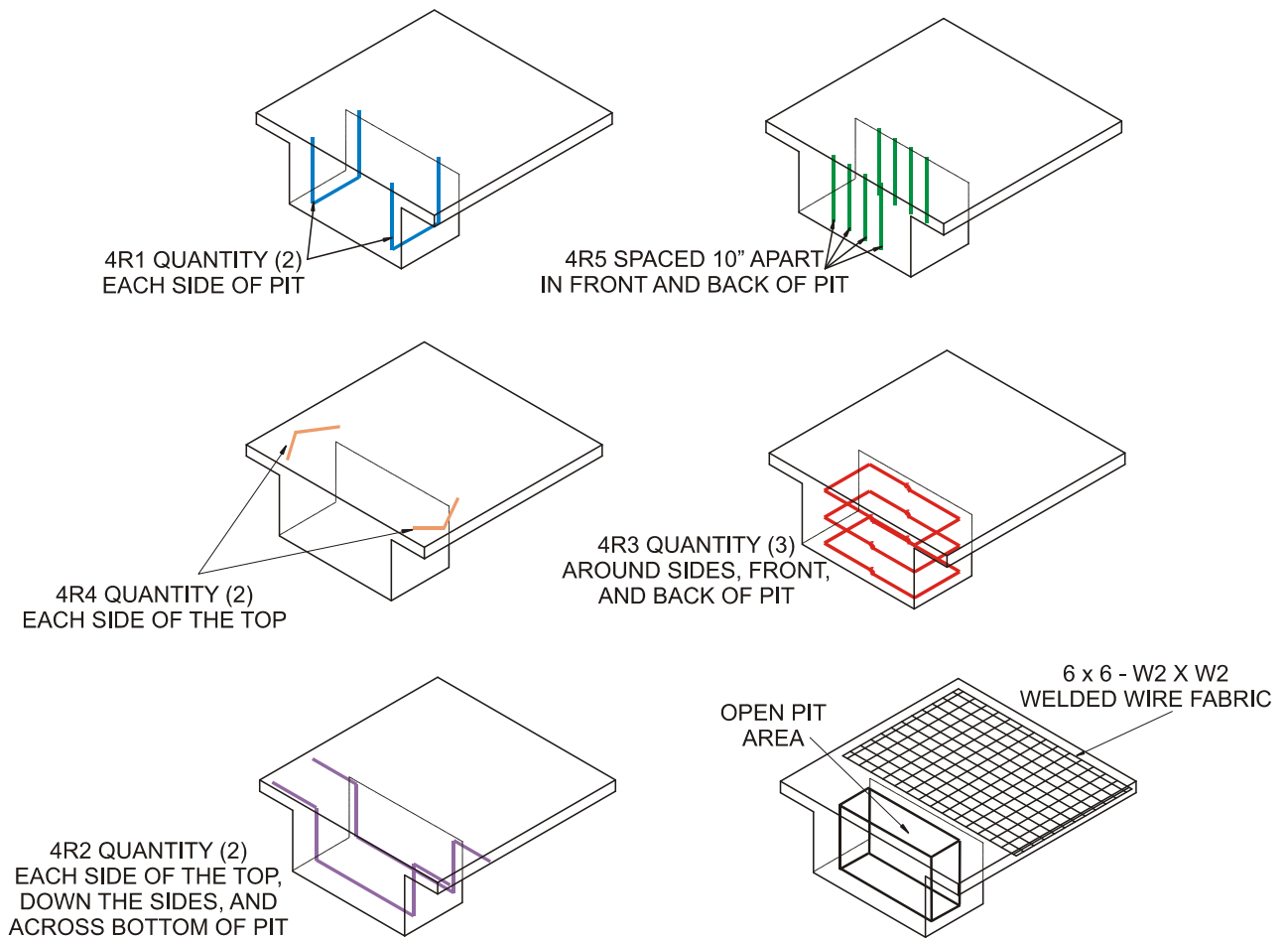
Conduit for Duke Energy Primary Cables shall be specified by Duke Energy and installed by the customer when pouring the pad. Conduit shall be Schedule 40 and shall adhere to the following specifications:

Conduit Size	Elbow Radius
4”	36”
5”	36”
6”	36”

All conduits shall be installed so the belled end is “up” in the transformer compartment to minimize damage to the cables during installation.

Customer’s secondary conduits shall not cross or interfere with the primary conduits. (The customer’s conduit can exit the secondary side either coming out the front, the right side, or the back.)

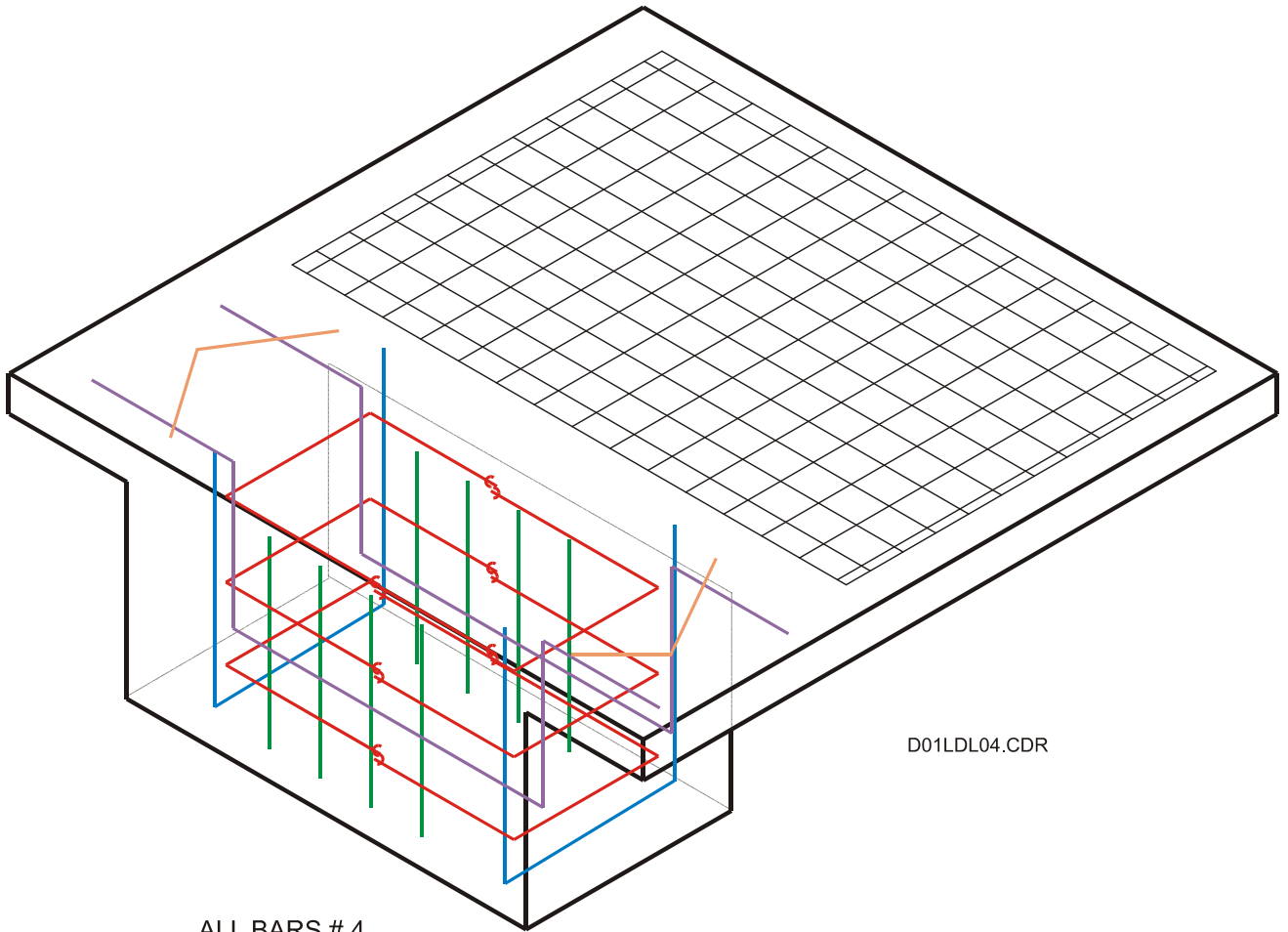
The customer’s conduits shall not extend outside the designated “secondary” area of the window.













4R1	2	Center bars in "pit box" side walls. Provide 3" clearance from wall bottom and 2" clearance from top surface of pad.
4R2	2	Center bars in "pit box" end walls. Provide 3" clearance from wall bottom and 2" clearance from top surface of pad. Terminate bar ends 2" from pad edges.
4R3	4	Center bars in "pit box" end and side walls. Place bottom bar 3" from pit bottom, Place top bar 2" from top surface. Maximum bar spacing is 12".
4R4	2	Place bars in approximate locations shown to provide corner crack control. Provide 2" clearance from top surface and any concrete edge.
4R5	8	Center in end walls of "pit box." Terminate bars 3" from bottom surface and 2" from top surface. Maximum bar spacing is 12".
WWF	-	Provide 2" clearance from top surface. Terminate 2" from pad edges.

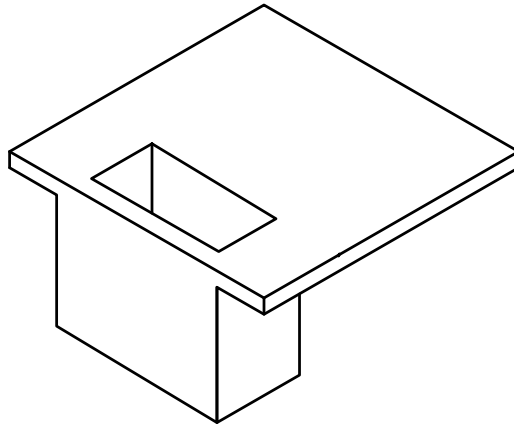
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CONCRETE PIT PAD - COMPLETE CONSTRUCTION



ALL BARS # 4
GRADE 60 DEFORMED

SHAPE DETAIL	SYMBOL	MARK
		4R1
		4R2
		4R3
		4R4
		4R5

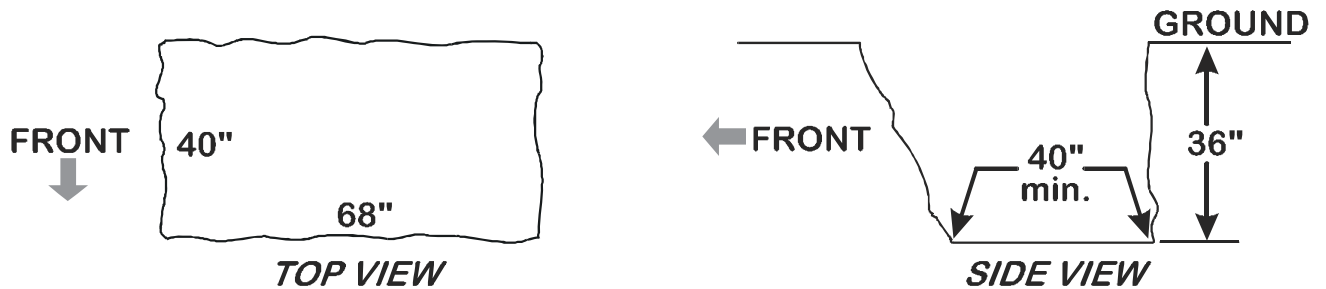


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Instructions for Building 3-Phase Padmounted Transformer “Pit Pads”

- Step 1 Dig a rectangular shaped hole approximately 40" x 68" and 36" deep. (The 68" side should be to the front.)

Note: The hole indicates the front of the transformer. The pad should be located so that a minimum of 10' of clearance can be maintained in front of the transformer and a minimum of 3' of clearance on all other sides.

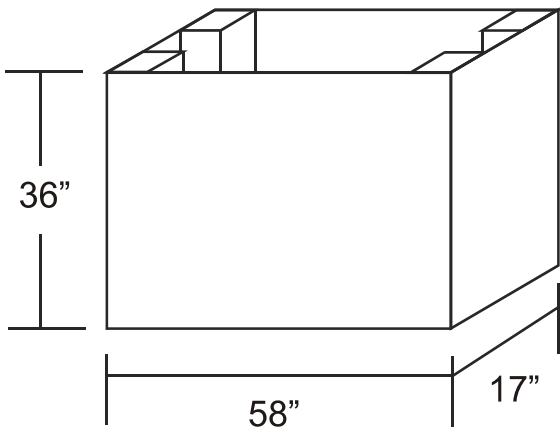


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Dig The Hole

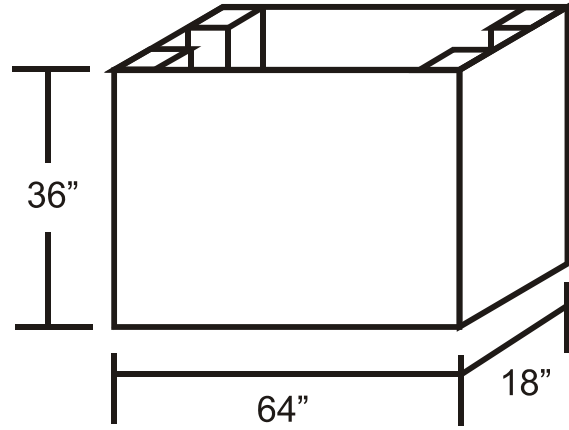
- Step 2 Build a rectangular shaped box, open at the top and bottom, from 2x4's and plywood. The plywood sides of the box should be 36" tall.

Window Opening for the
Small 82" x 84" "Pit" Pad



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Window Opening for the
Large 94" x 94" "Pit" Pad

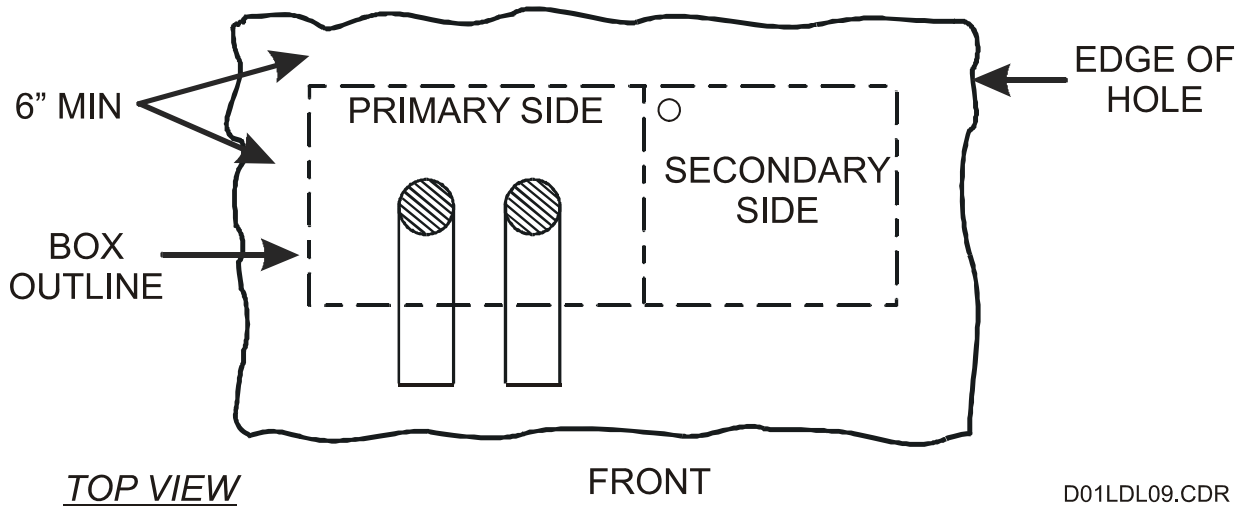


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Window Box

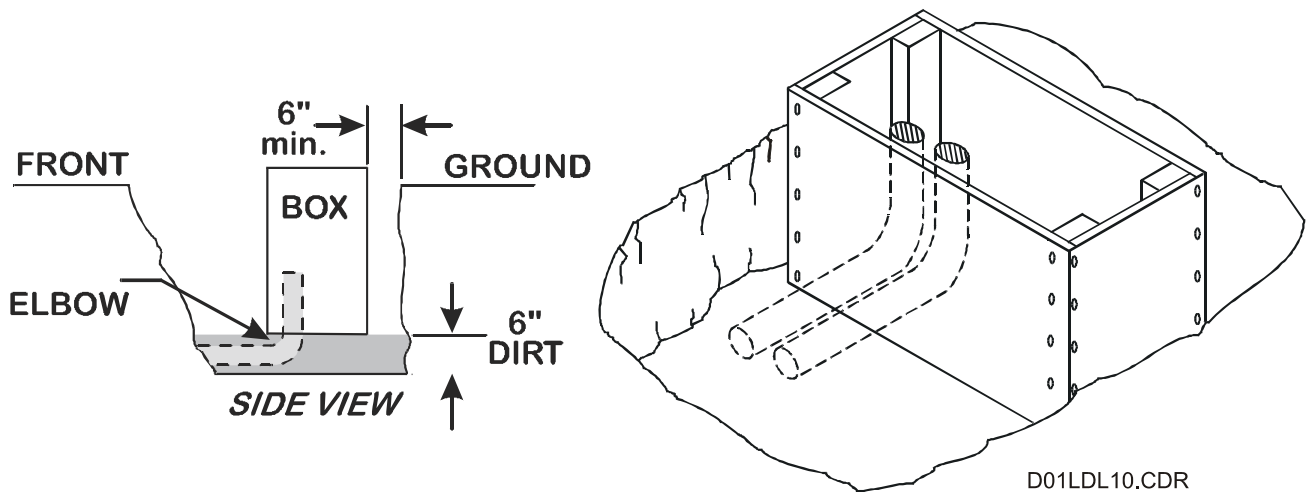
- Step 3 Set the box in the hole and position it so that a minimum of 6" of space exists between the sides and back of box and the edge of the hole. (The space between box and front edge of hole will probably be 10" to 12".) Trace a line around the bottom outside edge of box in dirt and then remove the box. Install two (2) conduit elbows in bottom of hole for the primary conductors as specified by Duke Energy (belled end up) entering from the front of hole and placed so they will come up within outline of box. TAPE BOTH ENDS OF CONDUITS COMPLETELY CLOSED.

Note: The customer's secondary conduits should be installed at this time. If the customer is providing the service conductors to the transformer, they may elect to enter the secondary side of the box from the front, back or right side. If Duke Energy is providing the service conductors, all conduits must enter from the front of the box. The 1" metering conduit should also be installed at this time. Make sure it is in the designated "secondary" area.



Window Box Placement

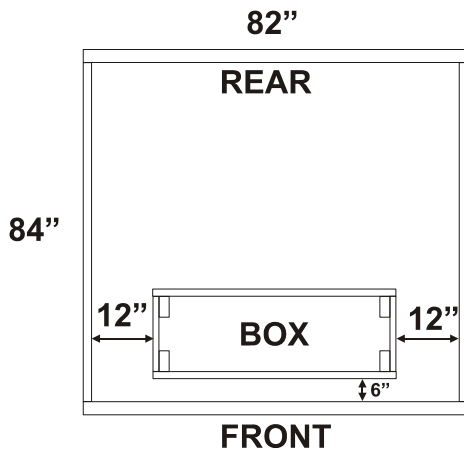
Step 4 Fill approximately 6" of dirt in the hole to support elbows. Place the box back in the hole over conduits, positioning box again so a minimum of 6" of space exists between the back and sides of the hole and box. The box should stick out from the top of the hole approximately 6" (or the width of a standard 2x6 board). Make sure conduits enter correctly in primary and secondary side of box.



Primary Conduit Installation

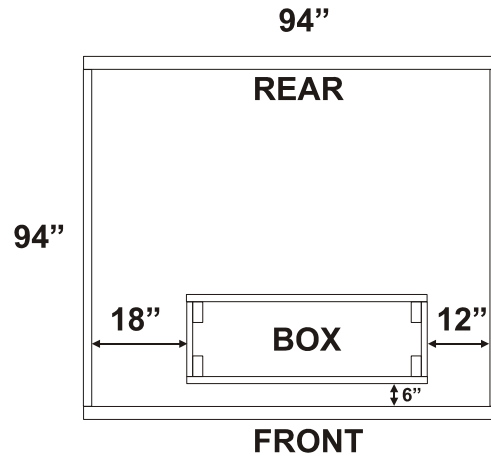
Step 5 Form the top part of the pad using 2x6 boards using the dimensions as indicated below.

Note: It may be easier to "level" box with the sides if you lay two 2x4 boards on the top of the side boards so that they cross over top of box as shown in Figure 6. Tack these boards onto top of box to ensure sides are the same height as the box.



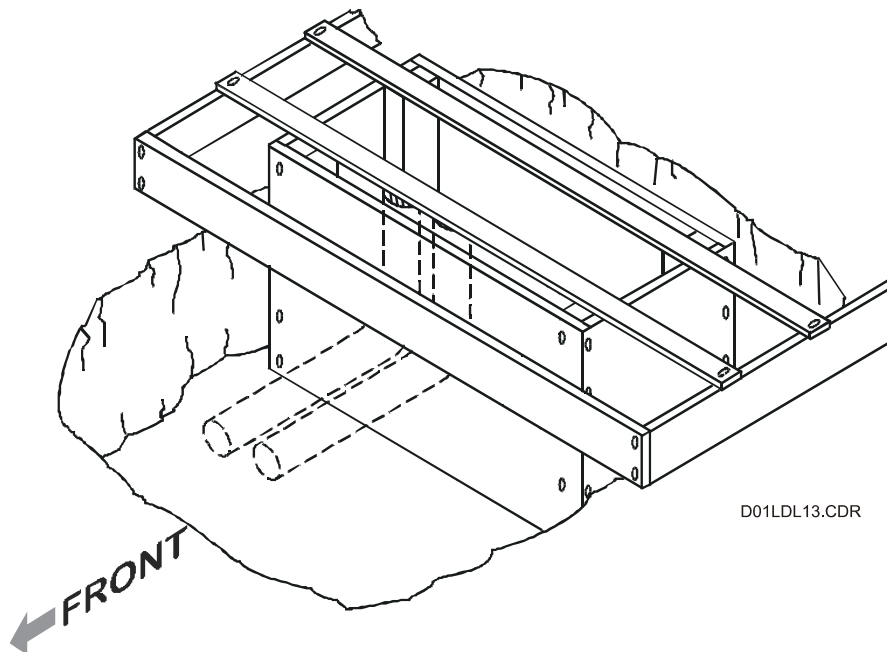
Small 82" x 84" Pad

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Large 94" x 94" Pad

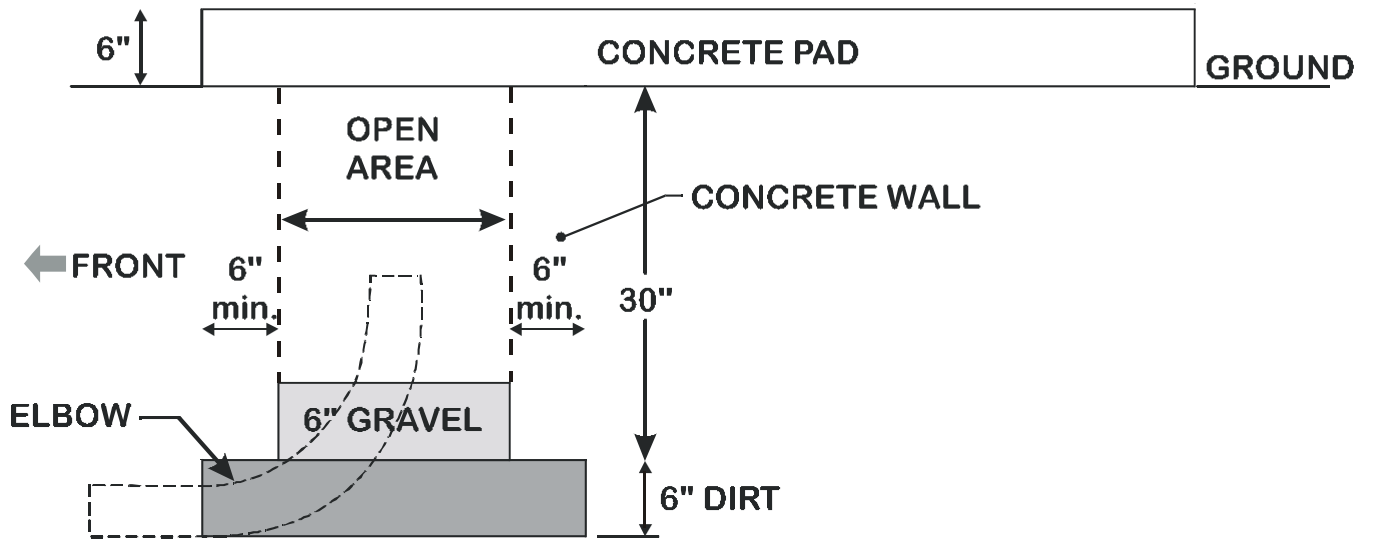
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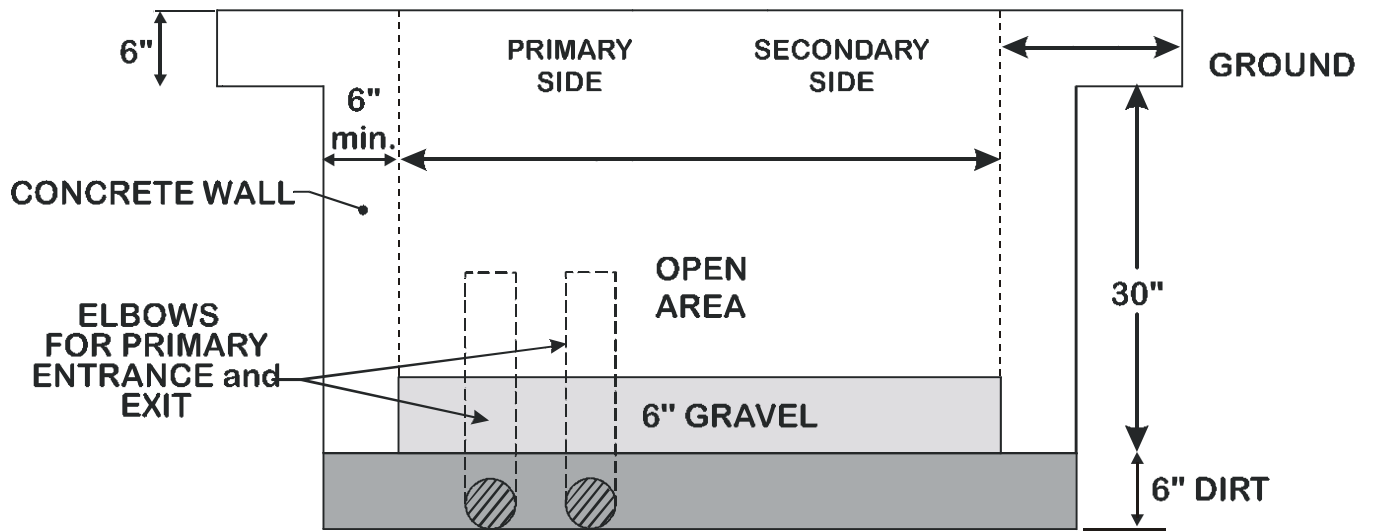
Figure 6

Note: CUT OFF ALL ELBOWS 6" ABOVE GRAVEL.



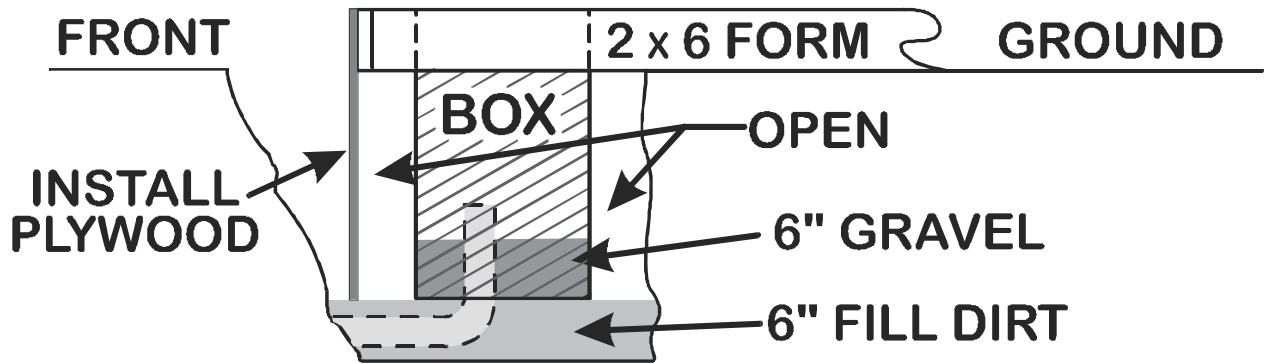
SIDE VIEW

Depth Dimensions – Front View



FRONT VIEW

Depth Dimensions – Front View



SIDE VIEW

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Plywood Installation

- Step 6 Install a piece of plywood inside the hole long enough to reach from one side of the hole to the other and wide enough to reach from the top of the front 2x6 form to the bottom of the hole. (These dimensions should be approximately 68" x 36".) Tack the plywood to the front of the 2x6 and let the bottom of the board rest on the ground. Plywood must be thick enough so it won't give at bottom of hole when the concrete is poured.
- Step 7 Fill in the area between plywood and the front of the hole with dirt. Be careful that plywood doesn't "push in" at bottom. Fill box with 6" of gravel.
- Step 8 Install reinforcing bars around box in "pit area" and welded wire fabric in "pad area" to reinforce entire pit pad. (See pages 7 & 8 for more complete details.)
- Step 9 Pour concrete "around" the box and "within" the 2x6 forms. (See page 3 for concrete mix specifications.)
- Step 10 Allow concrete to set up, then remove 2x6 forms and box.