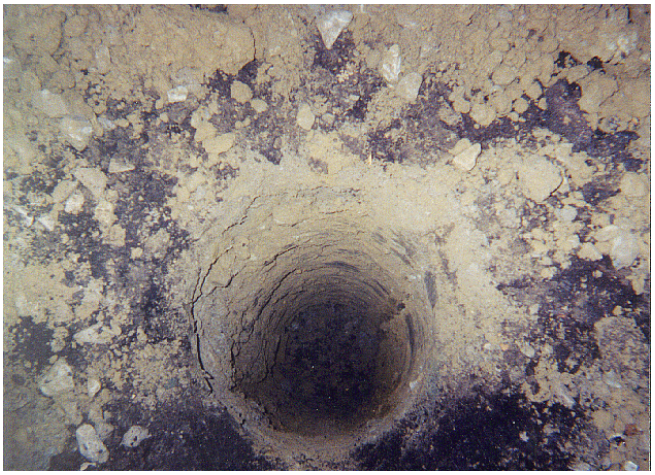
Appendix B: Construction of a Weatherproof PEPP Vault

Introduction

The following document presents a complete description of the construction of a weatherproof vault in which to place your PEPP seismometer. Included is a list potential location considerations, a list of necessary materials, and several photographs from the installation of David Burch's vault at Eastern Greene High School. There are several important factors to consider before undertaking the construction of an outdoor vault. First, since your vault will be located out of doors, the security of the instrumentation and electronics will be of concern. Second, it is imperative that the vault provide adequate protection from the elements. In particular, the seismometers are susceptible to temperature variations which may have a noticeable impact on the quality of the recordings, and the processor box, which must reside together with the seismometer, must be protected from moisture. A final consideration is the ability to install the vault in a sufficiently quiet area. Noise from passing foot traffic, air conditioning or heating units and other machinery are conspicuous sources of seismic noise which may lead to severely degraded measurements. Should you be interested in constructing such a vault at your school please feel free to contact us by phone, email, or otherwise. We would also like to acknowledge Terry Stigall and David Burch for the preparation of the text and photographs which appear on this page. You can find instructions on the construction of a similar vault at the IRIS-PASSCAL home page.

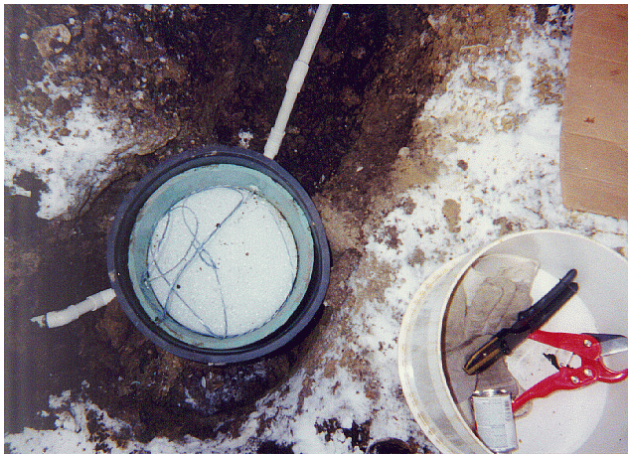
Description of Vault Construction

Getting the hole dug. Ask the local utility company to auger your hole. They should have a 16" auger and can go up to 12' down and can do it in little time. If you tell them about this science project they may do it free of charge (Fig. 1). If you have no luck with that, you can rent an auger or shovel the hole by hand. Dig the hole until you either hit a hard surface or to the depth the auger or your strength will allow (Fig 2). When digging the hole, you may want to collect the dirt on a tarp, to keep the damage to the landscape to a minimum and aid in clean up. If it is wet, lay some cardboard down to stand on to get out of the mud.

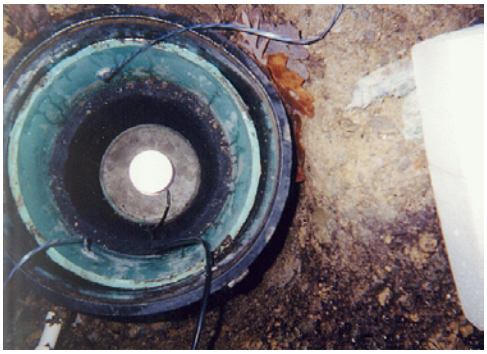


Setting the pipes. Measure the hole depth. Fill the hole with Sakrete to 1' less than the PVC pipe length. For example, if you have a 12' deep hole and your pipes are 6' long, you will need to fill the hole 7' deep with Sakrete before setting your pipes in place. Keep in mind the top of the 12" pipe must extend about 6 to 12 inches above the ground surface. Cut the 12" and 6" pipes to length making the 6" pipe two feet shorter than the 12" pipe. Cut the length of the rebar so that it will run from the bottom of the hole to below the top edge of where the 6" pipe will be. Cut it longer if you think you can pound it down deeper into the hole. This will add stability to the pedestal. If its too long, and can't be driven further down, the rebar can be cut with a hand-held disk grinder. Once the rebar rod is in place in the center of the hole, fill the hole with Sakrete to the desired depth. If the PVC pipe will rest on the bottom of the hole, nest the rebar in the center of the 6" pipe and nest the 6" pipe inside the 12" pipe. They can be off center, just maintain several inches between the two pipes for an air gap and to add insulation. Embed them deep and securely into the Sakrete to help seal out moisture (Fig. 3). Fill the 6" pipe with Sakrete and level off the top flush with the pipe edge. Let it set up (this should take approximately 24 hours).

Adding insulation and cabling Add insulation to aid in thermal stability. Cut the 1" thick pipe insulation to fit the inside diameter of the 12" PVC pipe and line the PVC with the insulation from the bottom to the top until it extends 12" above the top of the 6" pipe. The top edge of this insulation will provide the ledge to support the Styrofoam circles that the processor box will rest on (Fig. 4). If you use a different type of insulation try to ensure that it does not touch the 6" pipe. You will want to maintain the air gap between the two pipes to help isolate surface vibrations from the sensor. Stack the two Styrofoam circles together and place them flat inside the pipe This becomes the shelf on which the processor box will rest. You can use other materials for this shelf if you wish and if you use a different type of insulation that will not support the processor box, you may have to attach some shelf supports to the 12" side wall either by gluing or screwing a couple of supports in place (Fig. 5). Drill the access holes for the cables, fitting and gluing the pipe fittings into place. Attach the wiring conduit, adding a cable pull (cord) through the conduit as you install it and trench it



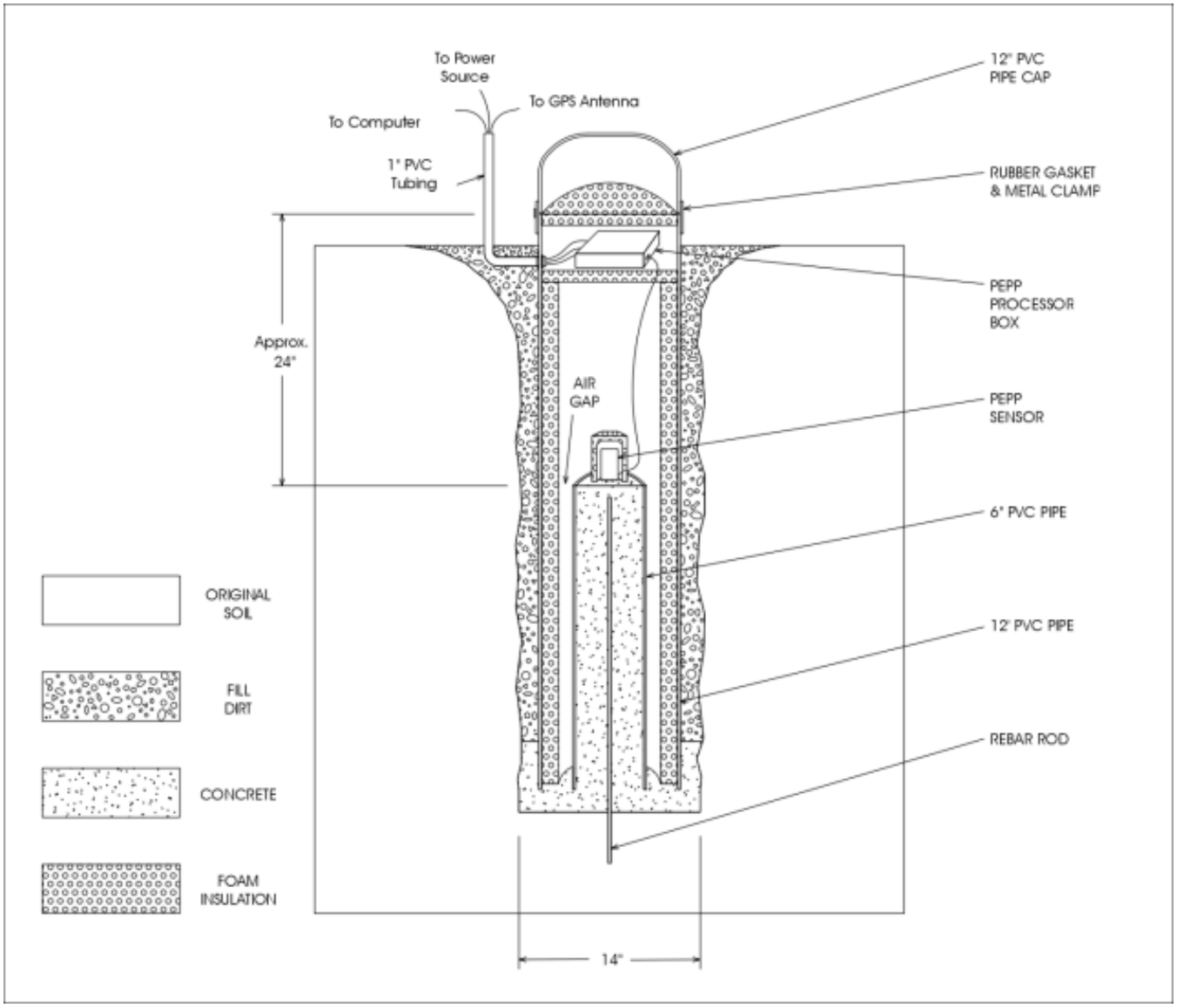
into place (Fig. 6). Run the GPS, data and power cables to their desired locations (Fig. 7). If you drill into a wall or window casing use silicone caulk to seal around the cables. You may have to cut off the connectors from the cables to run them through the conduit. Make an access hole in the shelf to be able to run the seismometer cable up from the pedestal to the processor box. Feed the GPS, power, and data cable into the vault. leave a few extra feet on the cables length for convenience. Solder the connectors back onto the cables observing the exact wiring connection for each (the wiring diagram for each connection is in the PEPP manual).



Installing equpiment

Remove the shelf and place the seismometer on the pedestal. Place a small insulating cover over it. A Styrofoam shipping container for chemical bottles works well - it is the perfect sizer. Ask the science deptartment if they can spare one. Run the cable up, place the Styrofoam shelf into place, attach the sensor, GPS data cable, and power connectors to the processor box and coil the excess cable lengths on the shelf and place the processor box on them. Turn on the power, check that the processor box is operating by observing the proper light blinking pattern on the box, and run QUAKES on the PC and look for a signal. If something appears to be wrong, recheck your wiring and connections. If all is working, insulate the cap cover, and secure it into place using the rubber gasket and screw clamp bands. Back fill around the vault if you have not already done so, clean up the area. Your vault is now complete. Over the next few weeks adjust the threshold settings and trigger parameters until you settle on values suitable for your site. Inspect your vault periodically for damage or flooding.

[Final schematic of the new vault]



List of Necessary Materials

Equipment List

- Tarp or plastic to put dirt on
- Wheelbarrow or tub for mixing Sakrete
- 1 or 2 shovels
- Garden hoe (to mix Sakrete)
- Trowel
- Power drill (extension cord if not cordless)
- Paddle bit - to drill fittings for conduit
- Sledge hammer
- Hacksaw to cut rebar
- Saw to cut PVC pipe
- 5 gal. water container and/or garden hose
- Pull cord to feed wire through pipes
- Utility Knife
- Screw Driver (to tighten band)
- Hammer

To Attach Cable Connnectors:

- Soldering iron (extension cord if not cordless)
- Solder
- Small screw driver
- Wire cutter/strippers
- Connectors and covers

Supplies

- Sakrete # of bags depends on hole depth
- 1 Rebar rod 4' - 8' long
- 4" or 6" PVC pipe thickwall (length depends on hole depth)
- 12" PVC pipe thickwall
- 12" PVC pipe cap
- 12" Metal clamp
- 12" Rubber gasket
- 1" PVC tubing elbows and fittings glue. Length depends on distance between vault and building (a good weather rated garden hose may work well for this.)
- 2 12" rigid styrofoam circles 1" thick (to make shelf that processor box sits on)
- 1" black foam pipe wrap insulation (this is what David Burch used to insulate his vault. I haven't found this stuff available and am working on a source or substitute.
- 1 Silicone sealant

Call around for supplies--many companies will donate needed items to the school

Location Considerations

- A power source (external outlet on building or inside a nearby wall where a small hole can be drilled through the wall or window casings.

- GPS clock placement such as on the school's roof
- Computer cables to be run into the building.
- Pick a spot away from air handlers, air compressors and machinery.
- If possible locate vault away from parking areas.
- Look for an area free of foot traffic such as a flower bed or near landscape shrubbery.
- Also consider accessability for the utility truck that will auger the hole.

The vault can be placed near the building. Just make sure there are no pipes conduit or buried drain tiles around.

The material in this page is courtesy of Terry Stigall (Indiana University) and David Burch (Eastern Greene HS, Bloomfield, IN).