# Cohoe Radio Observatory, Alaska ~ Part 5, Observatory Infrastructure and Building

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## 1. Introduction

This article series describes construction of a new radio observatory in Cohoe, Alaska. The current part, Part 5, describes the construction work undertaken during summer 2014. The previous four parts in this series are

- Part 1, Radio Frequency Interference Survey [Reeve1]
- Part 2, Guyed Tower Foundation Construction [Reeve2]
- Part 3, Guyed Tower Installation [Reeve3]
- Part 4, Callisto Antenna System [Reeve4]

Note: References in brackets [ ] are provided in **section 7**.

The latest work consisted of construction of a driveway and the installation of water, sewer and electric lines, building foundation and the building itself. The building exterior is finished but the interior is not. The activities are individually described in the following sections. My original plan was to have this entire project completed by end of summer but demands for radio equipment that I manufacture took away from my time at Cohoe. However, as described in more detail in the following sections, the building is in-place and ready for interior work and, thus, the major construction activities are done.

## 2. Driveway

I contracted a local company to build a 100 ft driveway from the existing built-up area to the new building location adjacent to the tower described in Parts 2 and 3. The soil at the site consists of about 6 in of peat on 2 to 3 ft of red sandy clay (top soil) and hard, compacted sand and gravel to a depth of 15 ft, the latter being very good road foundation material. For the driveway, the top soils were removed and replaced with imported sand and gravel.

Starting at the built-up area, the excavator removed the roots and top soil and placed them aside (figure 1). A dump truck then emptied a load of sand and gravel material into the excavated area. The dump truck stayed in-place while the previously excavated top soil and root masses were loaded into the empty dump (figure 2). When full the dump truck left to dispose of the material and pick up a new load of sand and gravel. Meanwhile, the new material was spread by a small tracked front-end loader. This process was repeated for the full length of the 10 ft wide driveway (figure 3). The job required about 12 dump truck loads and, including the utilities described in the next section, 1.5 d work time.


Figure 1 ~ An excavator with a wide bucket removes the top soils from the hard-pan sand and gravel mixture while the contractor’s helper looks on. (Image © 2014 W. Reeve)


Figure 2 ~ Left: After dumping a load of sand and gravel backfill, the dump truck is loaded with the roots and top soils to be disposed of. Right: A small tracked front-end loader spreads, compacts and levels the backfill in the driveway. (Images © 2014 W. Reeve)

Figure 3 ~ The completed driveway is 100 ft long and 10 ft wide. The tower can be seen in the back at the right. (Image © 2014 W. Reeve)

## 3. Utilities

A water well, recreational septic system and electrical distribution were built in 2011 for one of the existing cabins and a camping trailer on the Cohoe site. The well is to be reused but I built a new, larger septic system to serve the new observatory and existing and future cabins. A new 1 in diameter HDPE water line and 2 AWG aluminum underground residential distribution (URD) electric cable were trench laid on one side of the new driveway from the new building location to an existing cabin, where the new lines are to be connected to existing. A joint trench for these lines was dug by the excavator with a narrow bucket after the driveway was completed. This method kept the structural soils from being mixed with the unusable top soils.

The URD cable consists of three (triplex) conductors, each with an extremely tough cross-linked polyethylene (XLPE) insulation designed for direct-buried applications. The cable is identical to that used by electric utilities and carries the necessary UL listing for my application. I installed a metal junction box at an existing cabin and rerouted the existing electric distribution line in flexible conduit to it. I tapped the new electric line into the existing at this location. At the observatory end, the electric line was installed in a flexible conduit to a load center, which I installed inside. The new observatory building has no metallic paths to other grounding systems at the Cohoe site, so National Electrical Code allows the grounded circuit conductor (neutral) in the feeder and the electrical equipment to be bonded to a local earth grounding electrode system. Using a 10 lb sledge hammer (the arm-strong method), I drove an 8 ft x 5/8 in ground rod outside and below the load center. In addition to the load center I bonded this rod to the tower ground rod about 10 ft away at the tower base. The observatory electrical system will include circuits for lighting, convenience receptacles, radio equipment, water heater and ventilation.

The septic system consists of a 2-chamber septic tank and associated drain (or leach) field. Two 4 in sewage lines were laid in separate trenches from a Y-connection, one to the new observatory building and the other to the cabin where the water and electric lines are tapped (figure 4). The septic system includes clean-outs, vents, inspection ports and other features required by State of Alaska regulations.

Figure 4 ~ Left: The 4 in sewer line is laid in a trench from the new building location. The vertical pipe in the middle of the picture is a cleanout near the new building. The tower foundation is seen at upper-right. Right: The septic tank is almost completely buried in this picture. The two vertical black pipes are vents and inspection ports. Part of the (turquoise) line to the drain field and a monitor tube can be seen in the background. (Images © 2014 W. Reeve)

## 4. Foundation

I looked at two alternative foundation types, one using buried *Sonotube* concrete forms and another using a driven metal helix post system. By now I was tired of mixing concrete so I contracted with Techno Metal Post Alaska to install helix posts. A special diesel-powered, wheeled vehicle is used to hydraulically screw the posts into the ground (figure 5). Each post is driven until a predetermined torque limit is reached. The torque is related to the load rating of the post as determined from engineer certified load charts and tables. The post layout is simple (figure 6).

The helix posts are 3.5 in diameter x 8 ft long. If a longer length is needed to achieve the desired driving torque, a 7 ft pipe section is welded to the first, with a coupling for alignment, and driving continues. This process is repeated as necessary until the needed torque is reached. Any excess lengths are simply sawed off. In my installation, because of the extremely hard ground underneath the top soils, only a few posts needed an extension of a few feet. The posts varied from 5 to 10 ft depth with compression load ratings of 13 000 to 20 000 lb. TMP Alaska used two hydraulic motor heads, one for initial driving of the ten posts and a second with a different gearing arrangement and more torque that turned slower for the final driving. Changing the motor required only a few minutes. Upon completion of the post driving operation, the posts were marked with a laser level and cut with a portable band saw. TMP Alaska's trailer included a self-powered arc welder, and the final operation consisted of welding U-brackets to the top of each post for the beams (figure 7). The complete job required a total of 6 h from the time TMP Alaska arrived at Cohoe to their departure.

Figure 5 ~ The self-powered post driver (called R2D) was brought to the site in an enclosed trailer hauled behind TMP Alaska's pickup truck. The machine has local and wireless controls and uses a diesel engine with hydraulic pump. An 8 ft post with helix at the bottom can be seen hanging from the geared hydraulic motor ready for installation. The posts are galvanized steel and covered with green plastic sleeves. The sleeve eliminates frost heaving due to adfreeze of the steel posts and the ground during winter. (Image © 2014 W. Reeve)

## 5. Observatory Building

The observatory building will house all radio and electronic equipment and living quarters. The building uses conventional 2x4 wood-frame construction and is 24 ft long x 12 ft wide plus a 4 ft porch (figure 8). It was prebuilt to order by a company called Sterling Supply in the town of Sterling about 35 road miles away. When I ordered the building, I specified window sizes and locations and door location and with finished exterior but unfinished interior. My order also included exterior sheathing below the floor joists and foam insulation in the joist cavities.

After I completed the foundation, Sterling Supply delivered the building to Cohoe on a special trailer. The trailer was maneuvered into position and the building lowered onto the foundation beams. The delivery truck and trailer were on-site < 30 min. I was unable to be on-site during delivery so have no pictures of the process.

The main source of heat will be a small air-tight wood stove, which will be installed when the interior is finished in summer 2015. The stove will be used only when the observatory is occupied and the inside temperature is uncomfortably low. The observatory radio equipment will be installed in a cabinet and self-heated.

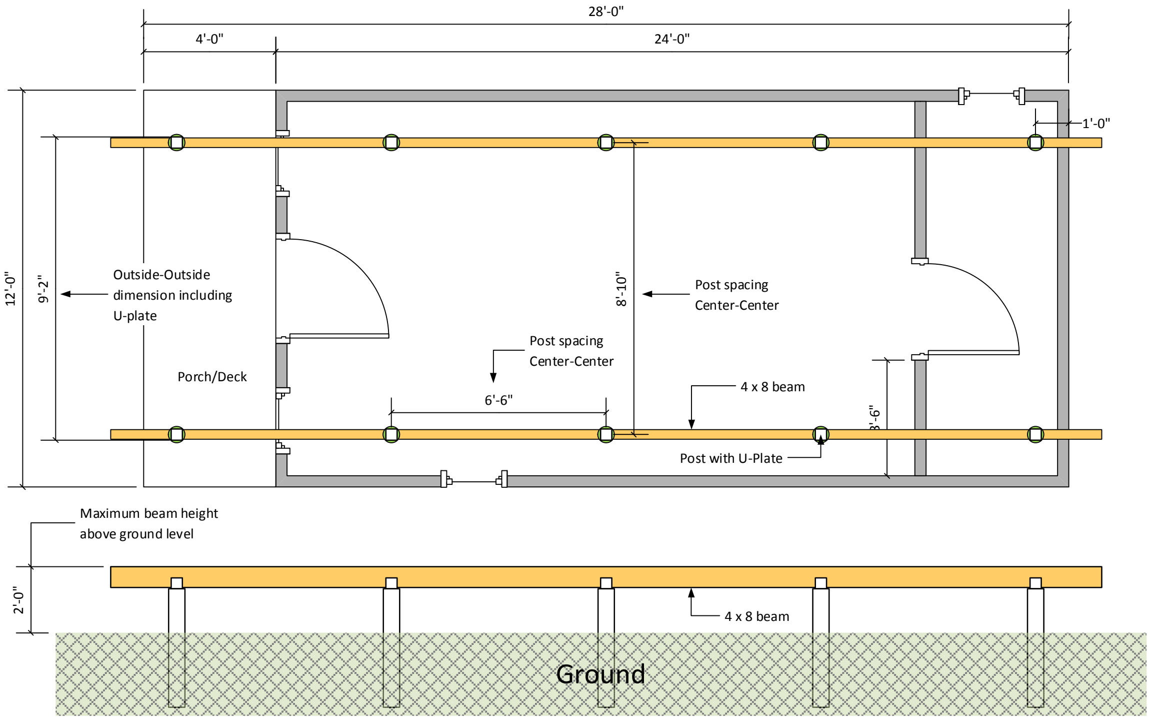


Figure 6 ~ Plan view of the foundation showing the post and beam structure and building walls. Additional strength is provided by beams in the building floor structure (not shown). (Image © 2014 W. Reeve)

Figure 7 ~ Left: This view looking down the driveway was taken shortly after the ten helix posts were installed. Right: The next day I installed pressure-treated outdoor wood beams for the building to rest on. This view is looking up the driveway toward the original Cohoe cabin. The foundation was lined up with the driveway so the building could be delivered on a trailer. (Images © 2014 W. Reeve)

Figure 8 ~ Upper: Observatory building resting on its foundation the day after delivery. The stairs have not yet been built but all other exterior work is completed. The green metal roofing sheds snow very easily, so an ice bridge will be built between the tower and building cable entrance to protect the coaxial and rotor control cables to the tower. Lower-left: View of the observatory building from the end of the driveway. The tower can be seen on the right. Lower-right: Inside view of unfinished building looking toward the front. The roof is made from built-up trusses and the cavities between floor joists are sealed and insulated. The usable interior floor space is approximately 250 $ft^2$ and walls are 8 ft high (Images © 2014 W. Reeve)

## 6. Next Step

The next step consists of indoor work including bathroom construction and installation of associated plumbing, electrical wiring and wall and ceiling insulation, and wall, floor and ceiling finishing.

## 7. References:


[Reeve1] Reeve, W., Radio Frequency Interference Survey at Cohoe Radio Observatory, Alaska, *Radio Astronomy*, Society of Amateur Radio Astronomers, September-October 2013

[Reeve2] Reeve, W., Cohoe Radio Observatory, Alaska ~ Part 2, Guyed Tower Foundation Construction, *Radio Astronomy*, Society of Amateur Radio Astronomers, November-December 2013

[Reeve3] Reeve, W., Cohoe Radio Observatory, Alaska ~ Part 3, Guyed Tower Installation, *Radio Astronomy*, Society of Amateur Radio Astronomers, January-February 2014

[Reeve4] Reeve, W., Cohoe Radio Observatory, Alaska ~ Part 4, Callisto Antenna System, Radio Astronomy, Society of Amateur Radio Astronomers, May-June 2014


## 8. Units of Measure Conversion

Many unit converters can be found online: http://www.digitaldutch.com/unitconverter/volume.htm, but for convenience conversions of the non-metric units used in this article are shown below.

| **Convert from** | **To** | **Multiply by** |
|---|---|---|
| acre | square kilometer ($km^2$) | 0.004 |
| inches (in) | millimeter (mm) | 25.4 |
| feet (ft) | meter (m) | 0.305 |
| mile (mi) | kilometer (km) | 1.6 |
| pound (lb) | kilogram (kg) | 0.454 |

**Document Information**

Author: Whitham D. Reeve



Revisions: 0.0 (Original draft started, 22 Sep 2014)
0.1 (Work on 1st draft, 23 Sep 2014)
0.2 (Add'l work on 1st draft, 1 Oct 2014)
0.3 (Final edits, 6 Oct 2014)
1.0 (Distribution, 7 Oct 2014)

Word count: 2075

File size (bytes): 6265344