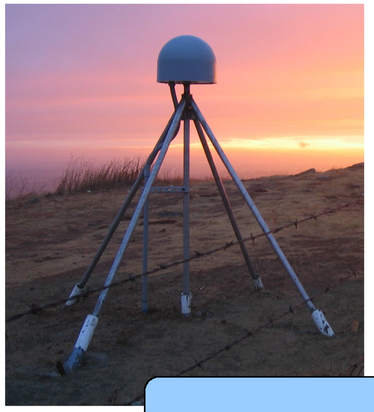

GPS antenna monuments and mounts supported by UNAVCO: Options and Effectiveness

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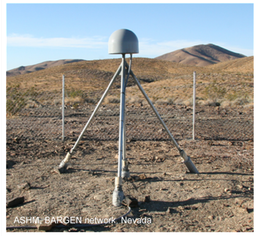
Many different monumentation types and antenna mounts have been used in UNAVCO-supported projects for campaign, semi-permanent and long-term continuous GPS sites. We summarize nine monuments and mounts currently in popular use in UNAVCO-supported projects as options to the greater scientific community. The designs range in height from 0 to 3 meters; substrates into which they are installed include soil, bedrock, and concrete; and costs range from approximately $30 to $15000. In many places outside the US, logistical, economical, and material restraints make installation of deep- and shallow-drilled braced monuments at best difficult and at worst impossible. Simpler single-mast or concrete monuments offer less expensive, more portable installation options.

Monuments

Deep drilled braced

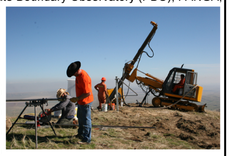


- 4-5 stainless steel legs in a tripod configuration cemented into the substrate up to depths of about 40 feet. Welded together at the top.

Pros:
- Highest stability
- Installable in any substrate

Cons:
- Expensive
- Labor-, equipment- and materials-intensive
- Requires a drill rig and crew
- Requires AC power to install (e.g. generator)
- Large footprint, high-profile

- Used throughout the Plate Boundary Observatory (PBO), PANGA, BARGEN, and Costa Rica



Mount commonly used: SCIGN mount

Cost: $7,500-15,000

Labor: 2-3 people

Installation time: 2-4 days

Concrete pillar

- Of variable design, but typically consisting of reinforced concrete set within a tubular concrete form. The leveling mount and GPS antenna are secured to a stainless steel pin which is anchored within the top of the pillar.

Pros:
- Readily available materials; can be constructed almost anywhere
- Installable in any substrate

Cons:
- Labor- and materials-intensive

- Used extensively throughout the world including for many GGN sites

Labor: 2-3 people

Installation time: 1-3 days

Cost: $500-2000

Mounts commonly used: SCIGN mount, SECO 2072

Polar mast

- Variable-height aluminum mast bolted onto bedrock. Mast shown here is 1 meter tall.

Pros:
- Materials and equipment for installation are lightweight and highly portable.
- Can be installed with a battery-powered drill
- Small footprint
- Short installation time

Cons:
- Installable only in bedrock or cement

- Used throughout the TAMDEF network and the POLENET network in Greenland and Antarctica.

Labor: 1-2 people

Installation time: 1 hour

Cost: $500

Mount commonly used: included in monument

Shallow drilled braced

- 4-5 1" diameter stainless steel legs in a tripod configuration epoxied into the substrate up to depths of about 5-6 feet. Welded together at the top.

Pros:
- High stability

Cons:
- Labor-, equipment- and materials-intensive
- Requires AC power to install (e.g. generator)
- Requires heavy duty hammer drill
- Large footprint, high-profile
- Installable only in bedrock

- Used throughout the Plate Boundary Observatory (PBO), BARGEN, PANGA, Iceland, Saudi Arabia, etc.

Mount commonly used: SCIGN mount

Labor: 2-3 people

Installation time: 1-3 days

Cost: $800

Shallow foundation mast

- 1.25" diameter threaded stainless steel mast cemented into bedrock. Throughout the Rio Grande network, masts used are ~5' long set into holes 16-24" deep.

Pros:
- Inexpensive
- Small footprint
- Readily available materials

Cons:
- Installable only in bedrock or cement
- Requires heavy duty hammer drill

- Used in the Rio Grande network and for GGN sites in the Faulkland Islands (FALK) and Madagascar (ABPO)

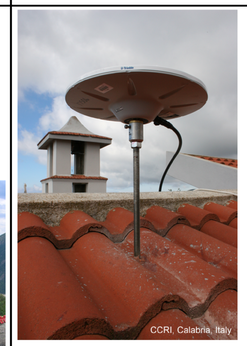
Labor: 1-2 people

Installation time: 1-2 days

Cost: $150

Mount commonly used: SCIGN mount

5/8"all-thread



- 5/8" stainless steel all-thread cut to custom height, cemented or epoxied into bedrock or cement.

Pros:
- Inexpensive
- Can be installed with a battery-powered drill
- Small footprint, low-profile
- Short installation time
- Materials readily available; no custom machining of monument needed

Cons:
- Installable only in bedrock or cement

- Used in Calabria, Italy; Bangladesh; the Caribbean; and Santorini

Labor: 1-2 people

Installation time: 1 hour

Cost: $30

Mount commonly used: cup with brass adapter

Shallow braced (non-drilled)

- 4-5 1" diameter stainless steel legs in a tripod configuration pounded into the substrate up to depths of about 5-6 feet. Welded together at the top.

Pros:
- Installable in unconsolidated substrate

Cons:
- Labor-, equipment- and materials-intensive
- Requires AC power to install (e.g. generator)
- Requires heavy duty hammer drill
- Large footprint, high-profile

- Used in the Plate Boundary Observatory (PBO) network and South America

Labor: 2-3 people

Installation time: 1 day

Cost: $800

Mount commonly used: SCIGN mount

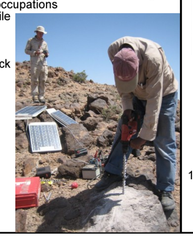
Stainless steel mast

- Designs vary but consist generally of a two-part system: A threaded pin cemented or epoxied into the ground with a removable mast screwed onto this pin. Throughout the Afar network, monuments are a 1" diameter, 0.5m-long stainless steel mast screwed onto a 10"-long threaded pin which is cemented into bedrock.

Pros:
- Inexpensive
- Can be installed with a battery-powered drill
- Above-ground portion can be removed and remaining pin used for campaign occupations
- Small footprint, low-profile
- Short installation time

Cons:
- Installable only in bedrock or cement

- Used in Afar, Ethiopia; RETREAT, Italy; and Iceland



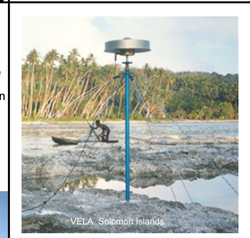
Labor: 1-2 people

Installation time: 1 hour

Cost: $130

Mount commonly used: cup with brass adapter

Tech 2000 (for campaign use)



- A single, segmented aluminum mast with a spike on the end which fits into a typical dimpled survey marker in bedrock. The mast is stabilized and leveled by four tension chains with turnbuckles attached to a mount at the top of the mast and anchored to bolts in the bedrock.

Pros:
- Fixed height.
- Can be installed with a battery-powered drill
- Higher long-term stability than a tripod or spike mount
- Compact and lightweight

Cons:
- Installable only in bedrock or cement
- Many small parts

- Used in campaigns throughout the Pacific, including Hawaii and the South Pacific islands, and also in Antarctica.

Labor: 1-2 people

Installation time: 1 hour

Cost: $600

Mount commonly used: included

Antenna Mounts

SCIGN mount

- Expensive but precise. Only needed if using a SCIGN dome. $600, available through John McRaney of SCEC/University of Southern California.

SECO 2072-series stainless steel adapter

- Less expensive and also precise. Used in the US National Geodetic Survey's CORS network. $225, available from www.surveying.com.

Cup and brass adapter

- Inexpensive but no leveling ability. Allows for antenna to be aligned to north. $50, custom machined.

Custom monumentation and mounts

UNAVCO works with scientists to design custom monumentation when needed. Solutions are often simple and cost-effective.

Things to consider

When choosing a monument and mount, consider:

- Stability needed (precision needed)
- Funds available
- Time available for installation
- Site security
- Materials available (esp. international work)
- Site accessibility
- Site substrate

Requesting support from UNAVCO

UNAVCO is a non-profit, membership-governed consortium that supports and promotes Earth science by advancing high-precision techniques for the measurement and understanding of deformation.

UNAVCO can provide assistance with design, purchasing, and construction of geodetic monumentation to NSF- and NASA-funded scientists.

To request support from UNAVCO, fill out a support request form at http://www.unavco.org. For questions, contact support@unavco.org.