

CORS Installation Procedures



What It Takes to Install a CORS

Our Goals in this session:

- Identify the components that make up a CORS SYSTEM
- Relate a professional procedure for installing a reliable high performance CORS
- Demonstrate this procedure in use during a recent CORS installation

We want to prevent you from making mistakes that will impact your system's performance

CORS = Continuously Operating *24/7*
Reference Station *Data you can depend upon*

What are the components of a CORS *installation*?

- Planning and Preparation
 - Hardware
 - Monumentation
 - Software
 - Communications
 - Toolkit
 - Knowledge
- System Installation
- Installation Report

CORS Hardware

- **Electronics Component**
 - GPS Receiver
 - Network Router
 - Device Server
 - Uninterruptible Power Supply (UPS)
 - Electrical Surge protection
 - Equipment Location
 - Enclosure
 - Shelf
 - Computer?
 - Internet power switch
- **GPS Antenna Component**
 - GPS Antenna
 - Location
 - Monumentation - Mounting
- **GPS Antenna Cable Component**
 - Routing
 - Lightning protection
 - Grounding
- **Radio Component (optional)**



Which components don't come from Trimble?

■ Electronics:

- **UPS** - Uninterruptible Power Supply – Size for load and duration
 - Source: Any Computer Store
 - Brands: APC, Belkin, Tripp Lite, ...
- **Router** – Interface between GPS receiver and computer network
 - Source: Any Computer Store
 - Brands: Linksys, D-Link, Belkin, Netgear, Cisco, ...
- **Device Server** – Converts from serial communications to Internet Protocol network comms.
 - Source: Online Computer Stores (CDW.com, Amazon.com)
 - Brands: Lantronix, Control, Moxa, ...
- **Electrical Surge Protection** – AC Power, Ethernet, Serial
 - Source: Online Computer or Comms Stores (CDW.com, Tessco.com)
 - Brands: APC, Tripp Lite, Polyphaser...

Which components don't come from Trimble?

- **Electronics:**
 - **Grounding System** – Ground rod and wire to fully engineered system
 - Source: Communications Retailers, Grounding Specialty Shops (Tessco.com)
 - Brands: Polyphasor, Harger, Wireless Solutions
 - **Custom Coaxial Cables** – Very long or very short lengths
 - Source: Communications Retailers (Tessco.com, DavisRF)
 - Brands: Times Microwave, Amphenol, RFS Cablewave, Belden, Andrew
 - **Lightning Protection** – Surge suppressors to engineered systems
 - Source: Communications Retailers, Lightning Protection Specialty Shops (Tessco.com)
 - Brands: Polyphaser, Harger, Huber+Suhner
 - **Mechanical Components** – Hardware, Brackets, Metal Parts, Consumables
 - Source: McMaster-Carr (mcmaster.com), Grainger (grainger.com), Allied Electronics(allied.com), Newark Elec., Corner Hardware Store, Fabrication Shop
 - Brands: Various

Monumentation

- General Requirements
 - Clear sky view
 - 100 meters (328') unobstructed view to the horizon 360 degrees
 - No nearby Signal reflectors
 - 1.5 meters (5') above horizontal surfaces
 - No nearby signal transmitters
 - 300 meters (984')
 - Stability
 - Thermal Expansion
 - Wind Loading
 - Soil Expansion/Contraction
 - Conditions must not change with time



Monumentation

- Pillar Mount
 - Concrete
 - Metal



Monumentation

- Drilled-Braced Monument
 - Extremely Stable



Monumentation

- Building Mount
 - Rooftop attachment
 - Wall side attachment



-Which components don't come from Trimble?

- GPS Antenna Monumentation:

- Building Mount – Custom fabrication or standard parts

- Source: McMaster-Carr (mcmaster.com), Grainger (grainger.com), Corner Hardware Store, Fabrication Shop
- Brands: Various

- Ground Pillar – Custom fabrication and/or concrete

- Source: McMaster-Carr (mcmaster.com), Grainger (grainger.com), Corner Hardware Store, Fabrication Shop, Local Concrete Contractor
- Brands: Various

- Drilled-Braced Monument – See SCIGN site (www.scign.org)

- Web Search: SCIGN Drilled-Braced Monument

Recon the Site

- How do we get access?
 - Arrangements for keys before arrival
 - Access to roofing
 - Security passes issued
 - Building tenants notified
 - Scheduling constraints

- Consider this in your long-term service plan

Recon the Site

- What are the major considerations?
 - Determine the GPS electronics location
 - Determine GPS antenna location
 - Determine the GPS antenna cable route
- Is the site a suitable location for a CORS?

Recon the Site – GPS Antenna Installation

- Make notes! Take Pictures!
 - Dimensions
- How will you mount the Antenna?
 - Bracket fabrication
 - Stability
 - Clear sky view
 - Installation practicality
 - Safety, long-term maintenance
 - Attachment
 - Fasteners, Welding
 - Offsite fabrication required?
 - Tradesmen – welder, mason, carpenter, roofer
 - Building penetration for mechanical bracket
 - Concrete forms?
- Tools required?
 - Lift truck
 - Tall ladder



Recon the Site – Electronic Components Installation

- Make notes! Take pictures!
- How could the electronic parts be installed?
 - Enclosure or table top?
 - How to mount the equipment box?
 - Wall, studs, fasteners, cable runs, access
 - Structural modifications required?
 - Offsite fabrication required? Shelves, brackets
 - Network and power outlets
 - Is there commercial power at the site?
 - Do I need a new network connection?
 - Personnel – Will we need utility representatives on site during the installation?



Recon the Site – GPS Antenna Cable Route

- Make notes! Take pictures!
 - Lengths
 - Actually measure along the proposed route
 - Holes needed through interior walls?
- Building penetration for the antenna cable to get to the GPS
 - Where? Wall? Roof? Existing penetration?
 - Leaks are bad
- 30m of cable is supplied – Times Microwave LMR400
 - Is this enough? Consider bends, turns, bulkheads, need for securing
 - Need longer cable?
 - Goal – no preamps
 - Commercial cables are available that will enable up to 300' lengths
 - Times Microwave LMR600
 - Sources: Tessco, DavisRF

Plan the Installation

- The pieces of the puzzle have to fit
 - Revise your plan while on site
 - Revise your plan off site after reviewing pictures and sketches
 - Revise you plan based on available components
 - Go back and measure again with new plan
- Check List:
 - Antenna can connect to the GPS receiver
 - GPS receiver can connect to power and a network
 - GPS antenna will be stable
 - Installation will be pleasing to the landlord and safe for you

Plan the Installation

- Order the parts
 - Have parts fabricated
 - Arrange the contractors
 - Arrange site access
 - Get Permits
-
- Spend the majority of the installation time planning and preparing. The actual installation should take 24 man hours or less on site.

CORS Installation

- Install the CORS
 - Take components to the site
 - Install the components according to your plan

Site Reports

- Installation reports (site reports) are not optional. They are a part of your deliverable to the customer.
- Installation reports will be used for troubleshooting when necessary.
- Document all serial numbers.
- Include photos and diagrams of the site.
- Document site contacts.

Put Theory Into Practice:

A Real CORS Installation

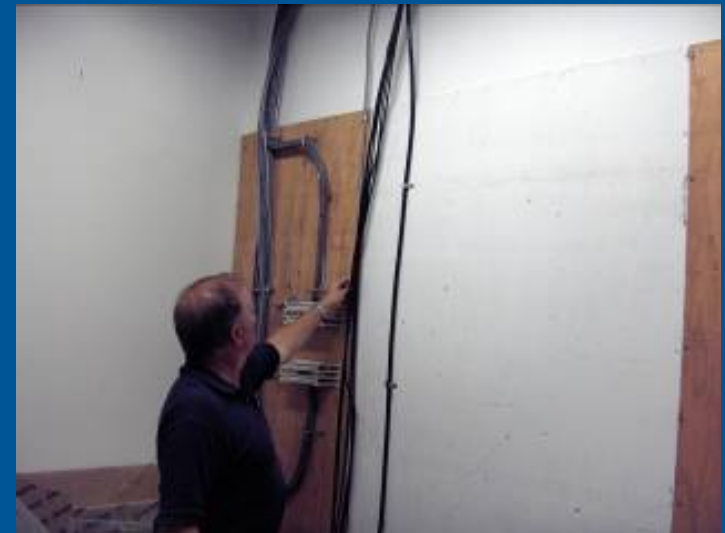
A Real CORS Installation

- A survey company wants to install a CORS at their building in Norfolk, Virginia
- This CORS will stream data to RTKNet software



Site Recon

- Determine the GPS electronics location
 - Shared space designated "Electrical Room"
 - Excellent security
 - Good environmentals – temperature controlled
 - Easy physical access
 - Reliable electrical power
 - Large plywood mounting plates on wall
 - Located close to the roof
 - Room's unfinished ceiling is roof decking
 - 30m Antenna cable is sufficient
 - Network connection already within the room
 - Ground bar located in the room



Site Recon

- Determine the GPS Antenna Location
 - Rooftop mount was the general plan
 - Building is 2.5 stories with a steel frame and brick siding
 - Easy access via internal ladder
 - Secure location



Site Recon

- Determine the GPS Antenna Location
 - 360 degree clear sky view
 - No nearby signal reflectors
 - No nearby transmitters



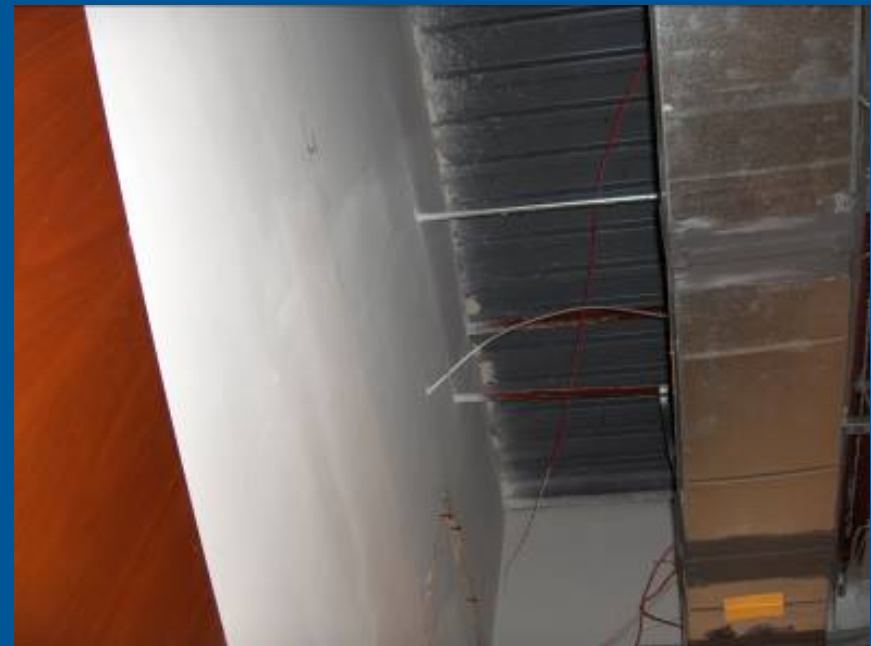
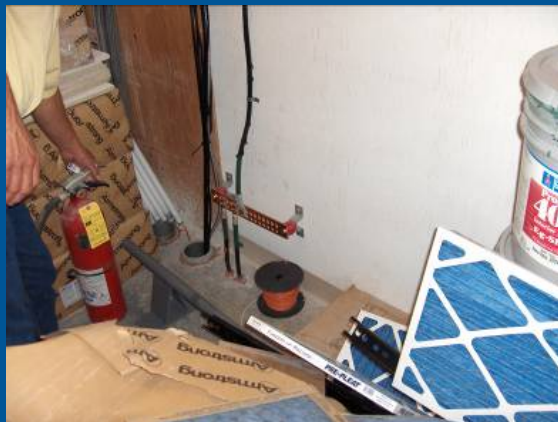
Site Recon

- Determine the GPS Antenna Location
 - Vertical structural steel available for attaching mount
 - Very stable
 - Can be drilled
 - Minimal multipath
 - Mount 3m above HVAC air handlers
 - Roof can be penetrated
 - Rubber membrane
 - 4" thick foam board
 - Corrugated steel decking



Site Recon

- Determine the GPS antenna cable route
 - Cable can be attached to superstructure on rooftop
 - Can run through conduit over walkway
 - Cable can follow other cables in the electrical room
 - Roof will need a penetration
 - Easy inside access for drilling
 - Grounding point is available!
 - A 30m cable will work well



Preparation for Installation

- Plan the installation based on site inspection
- Order all required components
- Design any custom parts
- Have custom parts fabricated
- Schedule contractors
- Schedule with property owner

Preparation for Installation

- Site was inspected and found to be good for a CORS
 - The antenna must have minimal visual impact
- The installation was planned
- A NetRS with Zephyr Geodetic antenna was ordered
- A custom GPS antenna mount was fabricated
- Various components and supplies were ordered
- Permission was granted to work on the site and to access the roof
- A temporary electronic access card and key were acquired
- Contractors were scheduled
- Tools were gathered

CORS Installation

You have a good idea where everything will go....now start humping it inside!

Tip: add luggage wheels to your tool kit

Tip: get an intern to help



Installation Procedure

We chose to install in this order

- Electronics cabinet
- GPS antenna cable
- GPS antenna

.....We did it this way so that we could be on the roof during the hottest part of the day.

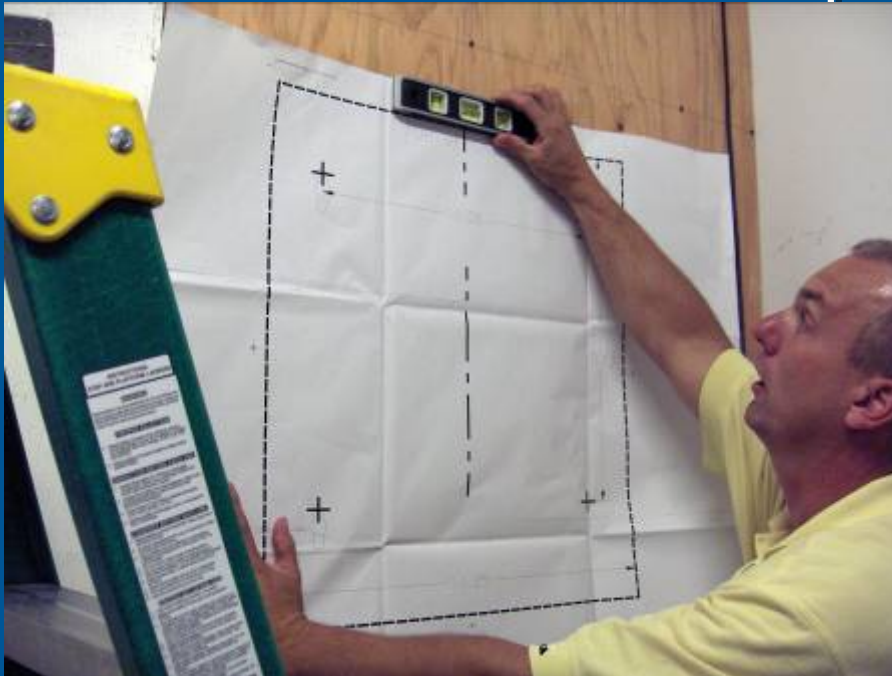
-Install the Equipment cabinet

- This cabinet came from Tescos
 - Large size allows for additional equipment
 - Clear hinged front – troubleshooting by the untrained
 - Lockable – no meddling by the untrained
 - 19" rack – don't forget to buy shelves
 - Landlord friendly - neat
 - Easy to order



-Install the Equipment cabinet

- Start mounting – based upon your Recon
 - Pick suitable fasteners – we used butterfly mollys
 - Drill using the supplied template
 - Be sure to level the template



-Install the Equipment cabinet

- Drill as needed



-Install the Equipment cabinet

- Mount the enclosure
 - 2-man lift!



Review

Completed so far:

Site recon and installation planning

Transportation of equipment to the CORS site

Installation of the equipment cabinet

Still needed:

Install the GPS antenna cable and accessories

- Which means a building penetration

Install the electronic components in the cabinet

Install the antenna mount and GPS antenna

A Word About Cutting Holes in Buildings

- Always check with the landlord
- When waterproofing systems are in place such as a rubber roof, hire a contractor
- If you don't know how to make a hole through the material, hire a contractor
- Time the drilling so that you are not doing the job on a bad day or there is potential of rain if you need to leave a hole. Always temporarily patch the holes if you must leave the site.
- Check to see "what's on the other side" – BEFORE DRILLING
- TIP – *Leaks are Bad*

Let's Drill Through the Roof

- Contact a roofing specialist – you can't buy this stuff at Home Depot.
- Measure twice *or more* – drill once



Roof Penetration

- “Claudio the roofing guy”



Roof Penetration

- The hole was drilled and the Antenna Cable has been roughed into place.
 - TIP - Protect the factory "N" or "TNC" connector with tape or a dummy plug to prevent damage. We used a dummy plug (add to your toolbox)



Roof Penetration

- Claudio works his magic...
 - Prep the area
 - Seal the cable
 - Use an off-the-shelf seal or make one – we made one
 - Use the correct glue
 - Seal edges with the correct sealer



Roof Penetration

- Claudio works his magic...
 - Caution: Flammable



Roof Penetration

- TIP- Secure the cable while curing



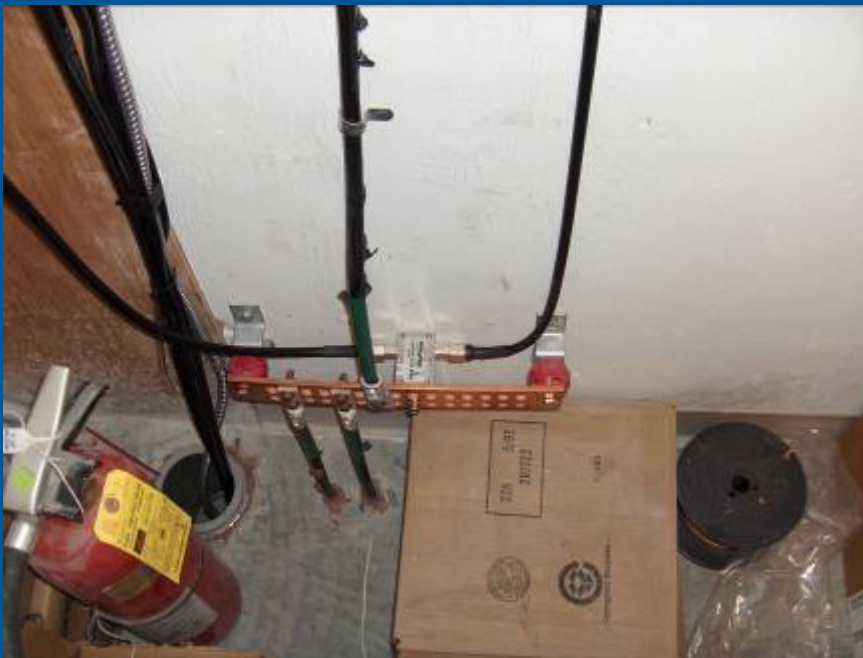
While The Roof Seal Is Curing – Move Inside

- Prep the cable ends – we recommend you buy patch cables and avoid terminating cables in the field.
- Connect the cables with the lightning arrester In-Line



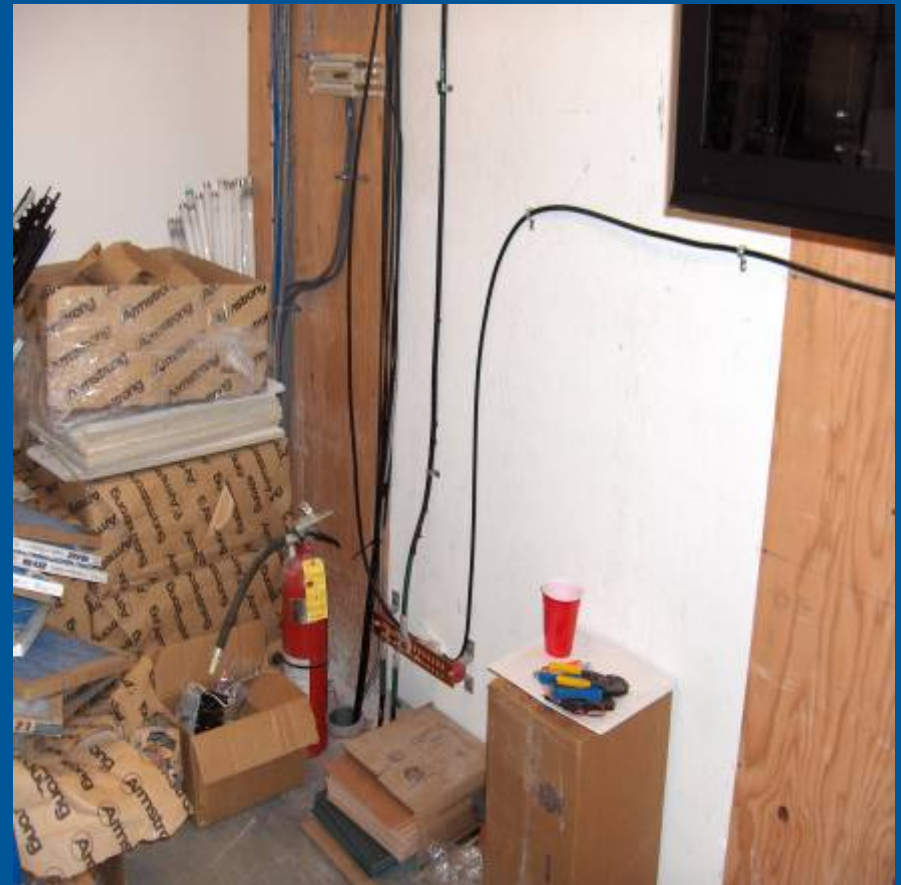
Cabling the GPS Antenna – Lightning protector

- Lightning protector *must* be grounded
- DO NOT mount the unit to the back of the NetRS
- Check www.polyphaser.com for tips



Secure the Cabling

- Landlord wants it neat
- Use clips to secure all wiring
- This room may be used by unknowing maintenance people. Secure your installation out of their way. Otherwise it is guaranteed to be damaged.



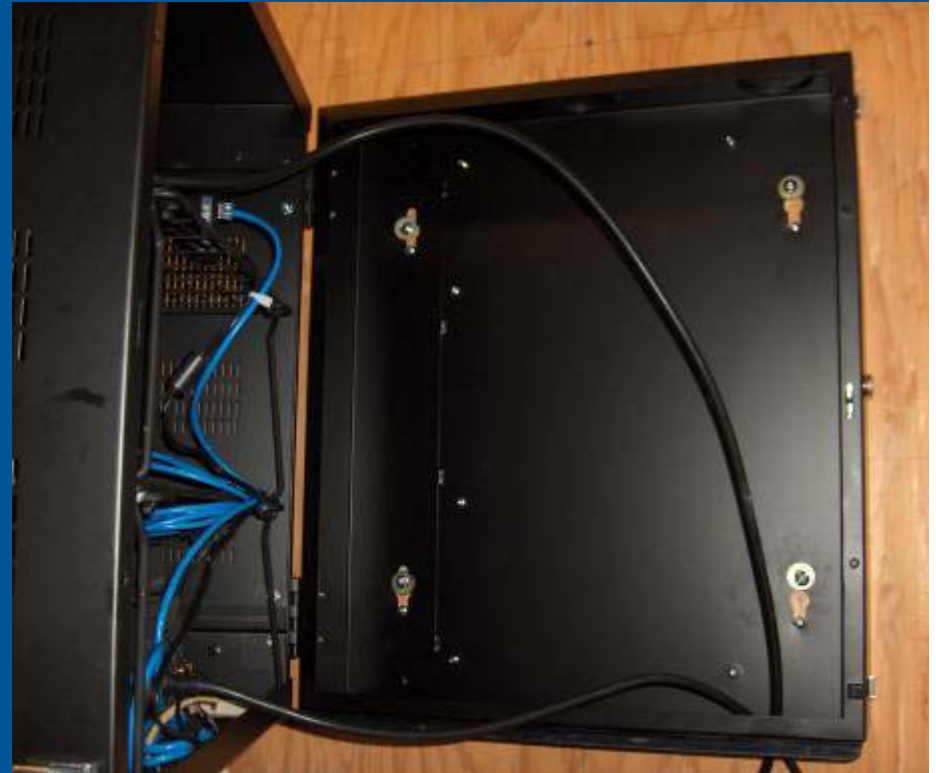
Populate the Equipment Cabinet

- Planning ahead means you have shelves for all gear
- We improvised shelves from HomeDepot
 - NetRS
 - Router
 - UPS



Populate the Equipment Cabinet

- Orderly wiring
 - Tie Wraps
 - Hook and Loop ties



Populate the cabinet

- *TIP* – Leave the NetRS serial cable in the cabinet for service



Review

So far we have finished:

Site recon and installation planning

Transportation of equipment to the CORS site

Installation of the equipment cabinet

Routing the GPS antenna cable

Installing the electronic components

We still need to:

Install the antenna mount and GPS antenna

GPS Antenna Mount Installation

- The mount was fabricated before CORS installation
 - Welded Steel
- Problem – We realized the mount was too short which would lead to multipath. We contacted a speed shop for pipe and welding services (after hours). (The 1.5 meter rule)
- After modifications, the mount was professionally painted



-GPS Antenna Mount Installation

Holes were marked and drilled using ½" drill

- Have sharp bits
- Use cutting oil



GPS Antenna Mount Installation

We used self-tapping screws to fasten the mount to the structure



GPS Antenna Mount Installation

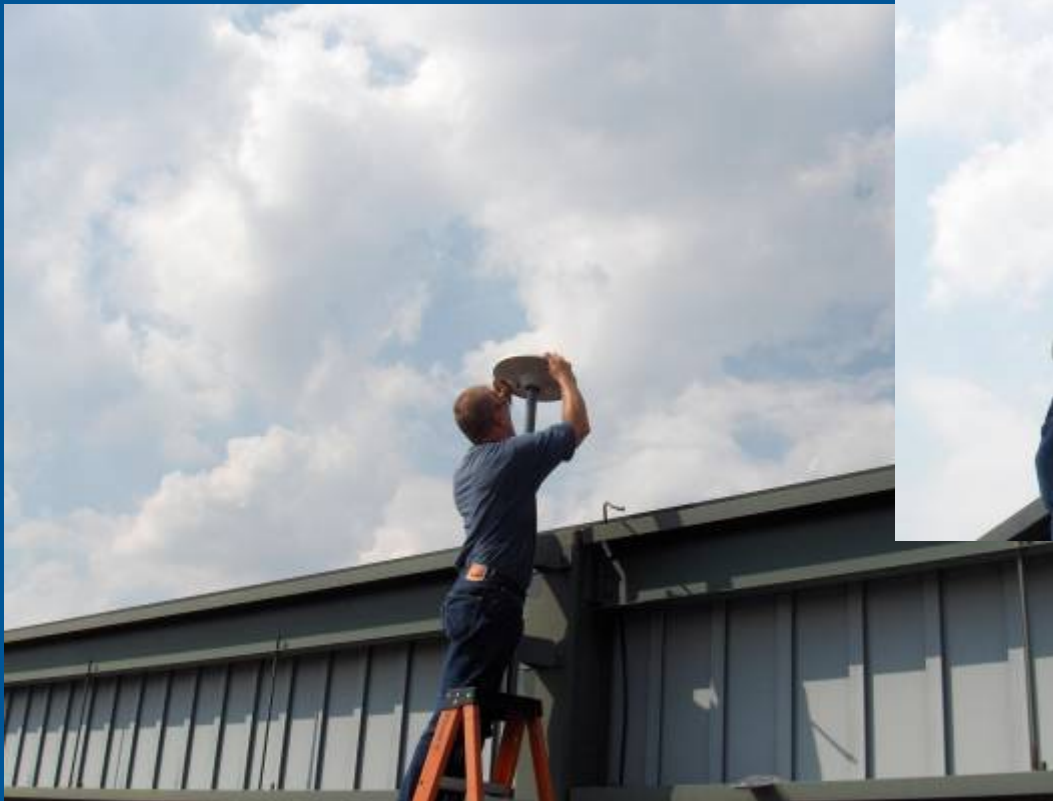
Attach the Mount



GPS Antenna Mount Installation

Finally, Install the antenna and secure the cable

- *Tip* – tape the cable to protect from UV



GPS Antenna Mount Installation

A Beautiful Moment



GPS Antenna Mount Installation

- The landlord did not want the antenna to attract attention.



Completion of Installation

- Electronic components had to be configured
 - NetRS
 - Router



Thank you

Resources – Supplies and Information

- www.tessco.com
- www.davisrf.com
- www.mcmaster.com
- www.alliedelec.com
- www.newark.com
- www.ngs.noaa.gov/CORS/Articles/Cors_guidelines.pdf
- www.polyphaser.com
- www.harger.com