Precise Digital Leveling

DAY 2

Presented by Daniel Determan:
Northwest Regional Geodetic Advisor (WA, OR, ID)

Overview:

Leveling Unit/Crew

Safety

Equipment, Use and Setup

Collimation Check

Review Terminology

Observation Guides and Field Notes

Important Information

Equipment & Field Technique Videos

Tips

NGS's 3rd Order Reset Document

Typical Level Unit

- One Observer (Instrument Person)*
- Two Rod People*
- One or Two Vehicles
  - One capable of transporting equipment – rods*
  - Drop one vehicle at end of day's work
- Safety People if Necessary
  - Warning Person to drive behind crew
- One Pacer to Help with Setups
- Computer to Download and Process Data*

* Required

Level Unit

One Observer

Two Rod Persons

+ Support Personnel

Safety is Paramount!

Please be Safe!

Please be Safe!

"Motorized" Leveling

Photo courtesy of Coleman Engineering Co.

"Motorized" Leveling

Photo courtesy of Coleman Engineering Co.

Call Before You Dig!

Call Before You Dig!

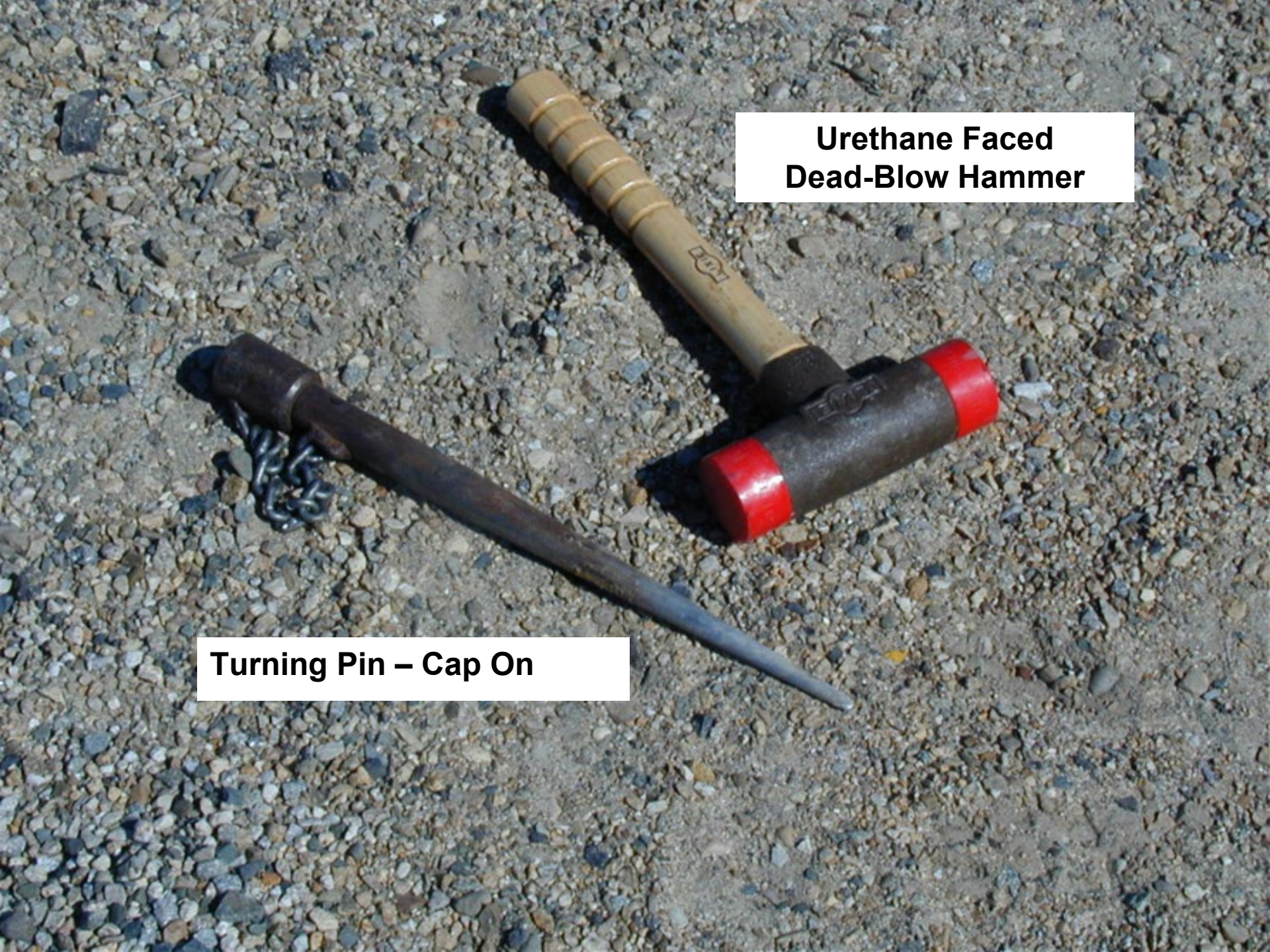
Precise Digital Leveling

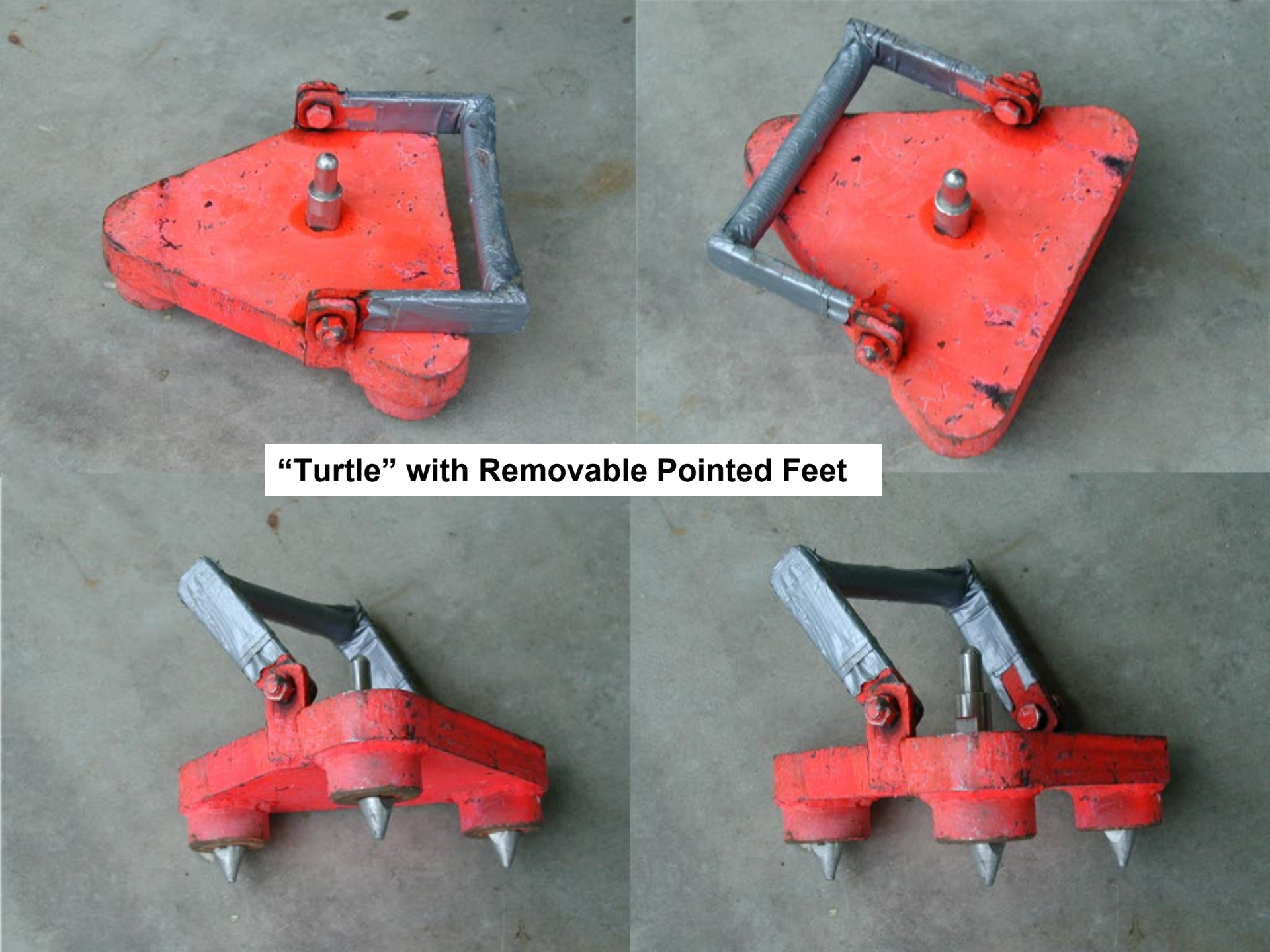
Section 2

Leveling Equipment and Setup


Turning Pin – Cap Off


Turning Pin – Cap On


Urethane Faced
Dead-Blow Hammer
Turning Pin – Cap On



“Turtle” with Removable Pointed Feet

Single-Piece, Bar-Coded Invar, Calibrated Rod with Brace Poles

Carrying Level Rod and Hammer and Turning Pin

Do Not Place Hand
Directly on Invar

Setting Rod Brace Poles – One and Then the Other

Always Protect Bottom of Rod

Do Not Place Rod on Ground!

Place Rod on Shoe When Idly Holding or Temporarily Showing Rod


Using Dead Blow Hammer to
Drive Turning Pin – Cap On

Turtle Setup on Asphalt

Rod/Turtle Setup on


Special Case Only
Turtle Being Prepared for
Setup on Asphalt
Points Removed


Special Case Only
Turtle on Asphalt
Points Removed
Location Swept
Turtle Stomped

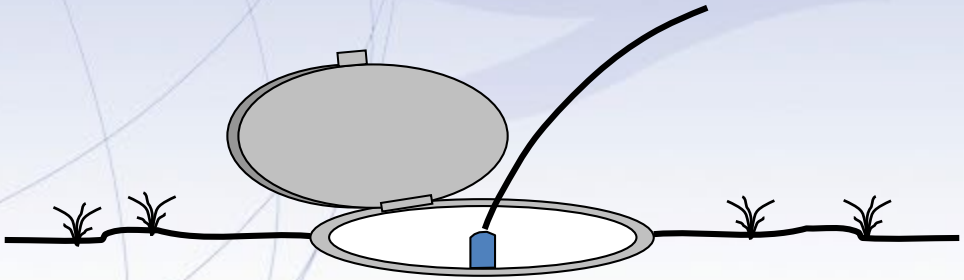

Rod on Turning Pin
Using Centering Guide


OOPS!!!
Guide on Turning Pin
Not Base of Rod!

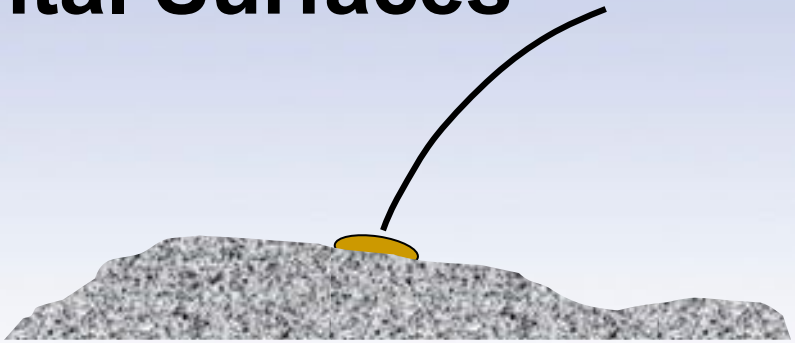
Rod on Turning Pin
Without Centering Guide

Spacer Set on High Point of Disk
Adding Height of Spacer

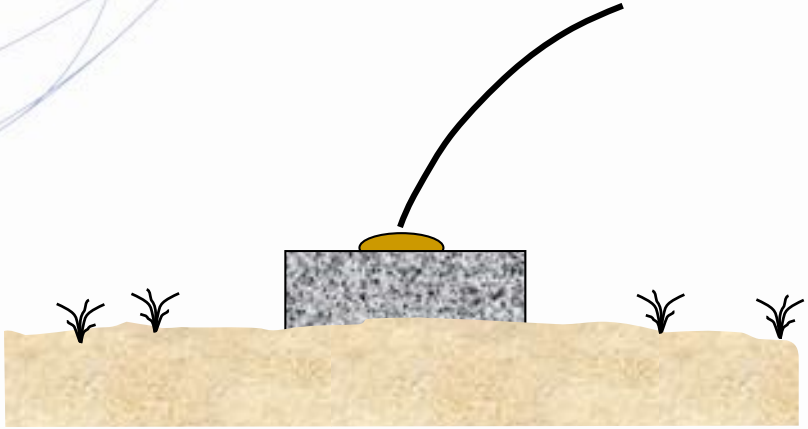
Control on Horizontal Surfaces



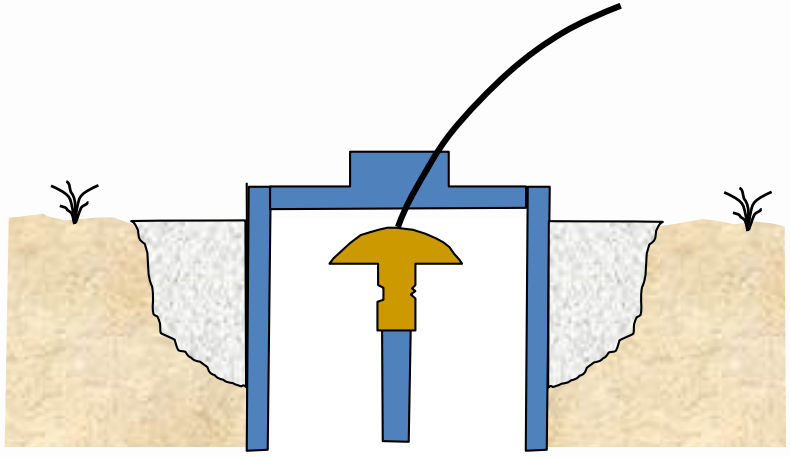
Class A and B Rod Mark



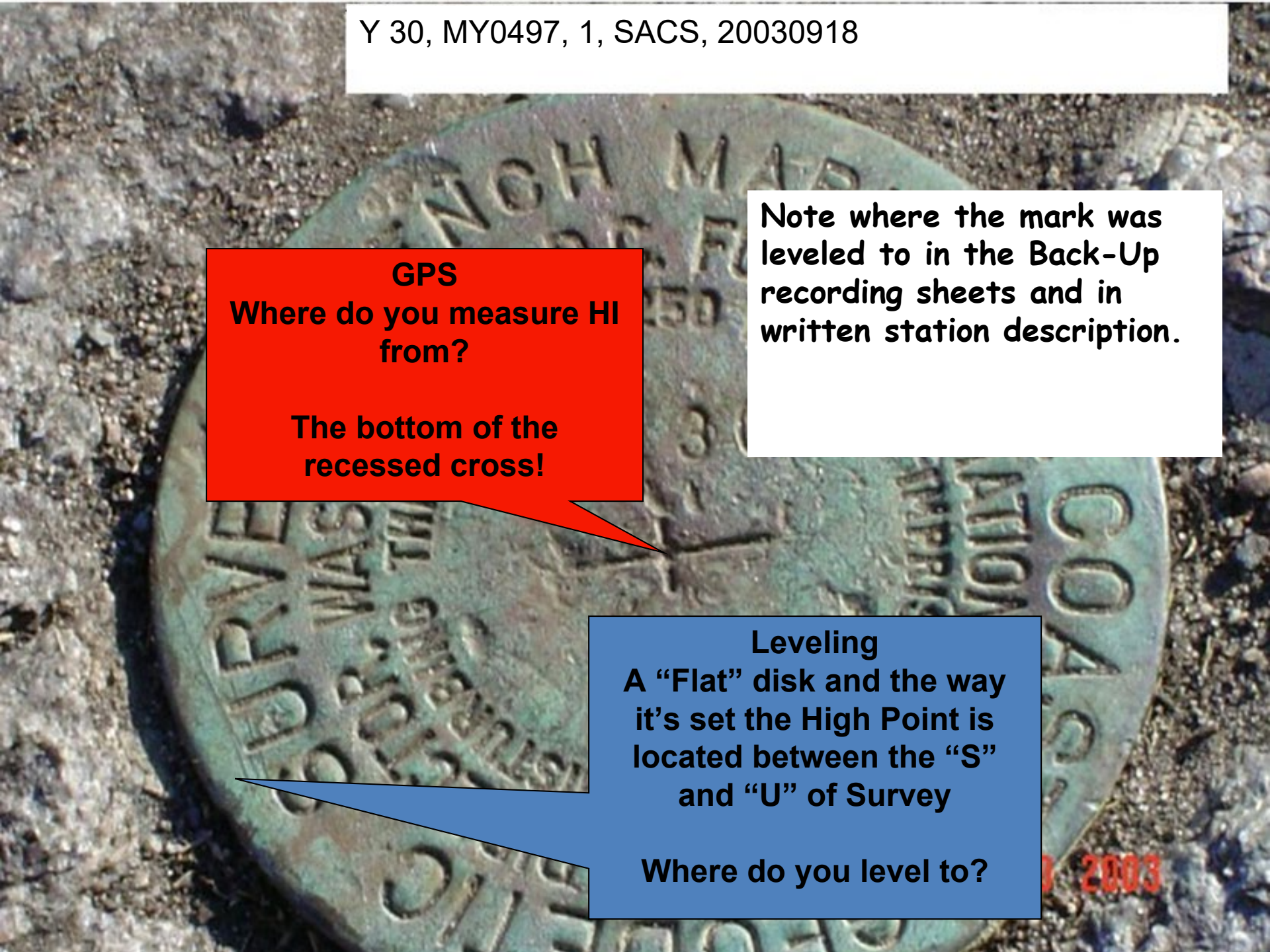
Disk in Bedrock



Concrete Post



Rod Mark With Disk


Y 30, MY0497, 1, SACS, 20030918
GPS
Where do you measure HI from?
The bottom of the recessed cross!
Note where the mark was leveled to in the Back-Up recording sheets and in written station description.
Leveling
A "Flat" disk and the way it's set the High Point is located between the "S" and "U" of Survey
Where do you level to?


NH0303, Q 102, 3W, 20061016


VERTICAL CONTROL

"Dappled Light"

Instrument may not be able to read rod

Rigid Leg Tripod With Thermister Equipment

Temperature Data Logger for Geodetic Leveling

Temperature Data Logger for Geodetic Leveling

The intent of this document is to describe how to build a data logger suitable for geodetic leveling that complies with NGS and FGCS requirements. While the equipment configuration designed by NGS approximately 20 years ago has served very well, temperature sensing technology has advanced greatly and utilization of off-the-shelf components is now possible.

Figure 1 - Complete Thermocouple Data Logger System

A significant departure from the earlier design used by NGS is that the temperature data are logged internally by a data logger during field operations, not entered into the level at each set-up. The temperature data are combined with the observation data post-mission by NGS program TRANSLEV. Therefore, it is vital that the leveling data file(s) include time of measurement(s) and that the clocks of the level and temperature logger are precisely synchronized. Note the data unit does display both probe temperatures so the data can be manually entered into the instrument if desired.

The design described in this document is not meant to be the only solution to acquiring temperature data during a leveling operation. It is, however, a design that meets the temperature data criteria, is composed of parts easily obtained, and can be assembled with simple hand tools by a person with average mechanical skills.

The parts list provided does not constitute an endorsement by NGS of any particular brand, model, or vendor of an item. Rather, inclusion of an item in the parts list indicates that it was the first item discovered that met the needs of the project at an acceptable price.

This system meets the requirements for temperature logging:

- The temperature difference between the two sensors is accurate to 0.1˚ C
- Temperatures at heights of 0.3 m and 1.3 m are obtained and probe heights are adjustable dependent on tripod set-up height

Approximate material cost for this device was $750.

Additional information can be obtained from Dave Minkel, NGS Geodetic Advisor to Arizona, dave.minkel@noaa.gov.

l for system):

- 1 – ≈ 6" section of ¾" plumber's strap
- 1 - #10 X 24 X ½ stainless pan head machine screw with nylon lock nut
- 1 - #8 X 32 X 2 stainless pan head machine screw with washer, lock washer, and wing nut
- 1 – Section of Shower Door Bottom Seal
- 1 - ¼" Mono Right-Angle Audio Plug, Radio Shack # 274-254

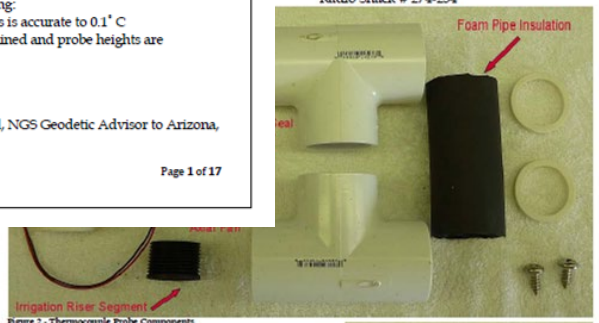


Figure 2 - Thermocouple Probe Components

The housing is constructed from two PVC tees joined by a short section of PVC pipe. The fan, used to draw air past the thermocouple bulb, is housed in the section of pipe. The shower door seal is used to wrap the fan to increase its diameter so it fits snugly into the pipe and does not rattle about. The end segments of the riser are cut off and used to retain the fan within the pipe; each segment is shortened with sandpaper until both segments can be completely (with the exception of the segment shoulders) inserted into the pipe without compressing the fan; the purpose of these segments is to retain the fan without restricting airflow.

Figure 3 - Fan Housing Assembled

To allow later disassembly of the unit, no glue is used. The riser "plugs", the tees, and the pipe

PLAY VIDEOS
Using a Turning Plate (Turtle)
Using a Centering Guide
Using a Spacer
Dappled Light
Thermisters

Vertically Set Bench Mark


FOR INFORMATION OR
VERTICAL
ORT DAMAGE
OL MARK
2007
THE DIRE
NATIONAL GEOD
WASHINGT

VIDEO
Setting Up on a Vertical Mark

Rules – Short List

- Never Setup on Asphalt
- Double Run Everything
- Never Read Below 0.5 Meter on Rod
- All Three Crosshairs Must be on Invar
- Same Rod on Starting and Ending BM
- Use Turtles and Turning Pins for Turning Points
- Always Keep a Hand on Rod when Setup
- Keep Setup Imbalance at a Minimum

http://www.topcon.co.jp/eng/survey/tripod.html

Model	TP-110	TP-110C	TP-110D	TP-100	TP-100D	DW-1	CW-1	SW-1
Center Pin Size	5/8"	35mm	5/8"	5/8"	5/8"	5/8"	35mm	5/8"
Shape of Tripod Head	Flat	Flat	Dome	Flat	Dome	Flat	Flat	Flat
Expanded Length (mm)	1,710	1,710	1,725	1,650	1,660	1,754	1,754	1,550
Retracted Length (mm)	1,010	1,010	1,025	1,000	1,010	1,090	1,090	-
Mass (kg)	4.0	4.0	4.1	3.7	3.7	6.7	6.7	5.0

http://www.leica-geosystems.com/corporate/en/ndef/lgs_6161.htm

GST20 RANGE OF WOODEN TRIPODS

These Tripods are well regarded by the market for being extremely stable and long lasting. The GST20 range consists of the GST20, GST20-9, GST120-9 and GST40 wooden tripods. Being highly rigid and with good vibration characteristics, these tripods are recommended by Leica Geosystems to be used with TPS for surveying and engineering applications.

The GST120-9 model provides a unique, patented self-closing feature for quick set-up and stowing.

The GST40 model is recommended for the DNA digital levels providing extremely high stability and fast set-ups due to the rigid legs.

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Tripod Ref.-No. 200 511

Features	Suitable for
■ Fixed tripod legs ■ Tripod legs plastic coated ■ Snap Cap	■ Digital levels ■ Theodolites ■ Tachymeters ■ Heavy-duty rotating lasers

Tripod Ref.-No. 200 511

Min. effective height	approx. 1.53 m
Max. effective height	approx. 1.61 m
Weight	approx. 6.70 kg
Tripod head	**flat**, ø 167 mm

Back

SuperTripod.com

Rigid leg tripod, available in four models: 68" and 72" inches in height, with fixed center head or slide head. Made of hardwood ash, grown and made in Europe.

NOAA commissioned.

http://www.hixonmfg.com/

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NGS Leveling Kit

QTY	PART #	DESCRIPTION
1	Y23089	DNA03, 0.3mm, precision digital level, magnetically damped compensator, with user manual and container
1	Y29422	Tripod GST40, with rigid legs, with accessories
2	Y80271	GPCL3 Invar Bar Code Leveling Rod, 3m, with circular level
1	Y55642	Wooden Shipping Case for GPLE3N/GPCL3
2	Y55635	GSL3 Pair of struts for GPCL3/GPLE3N staff
1	Y55642	Wooden Shipping Case for GPLE3N/GPCL3
1	Y83733	GWCL60 Invar Bar Code Scale, 60 cm
1	Y36977	GSS5 Sunshade for digital level
2	L20082	"Turtle"
2	L20083	NGS Turning Pins
2	L20081	20 mm Spacers
1	MISC	Urethane Face Dead Blow Hammer
1	W4000	Kestrel 4000 Pocket Weather Tracker (with carrying case)

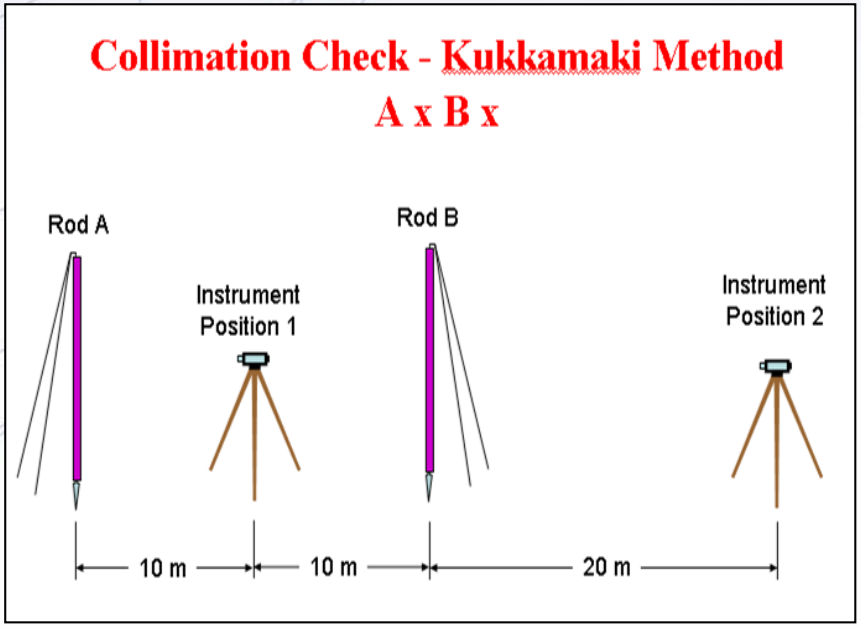
VIDEOS
Tri Pod Care and Maintenance
Tri Pod Set Up

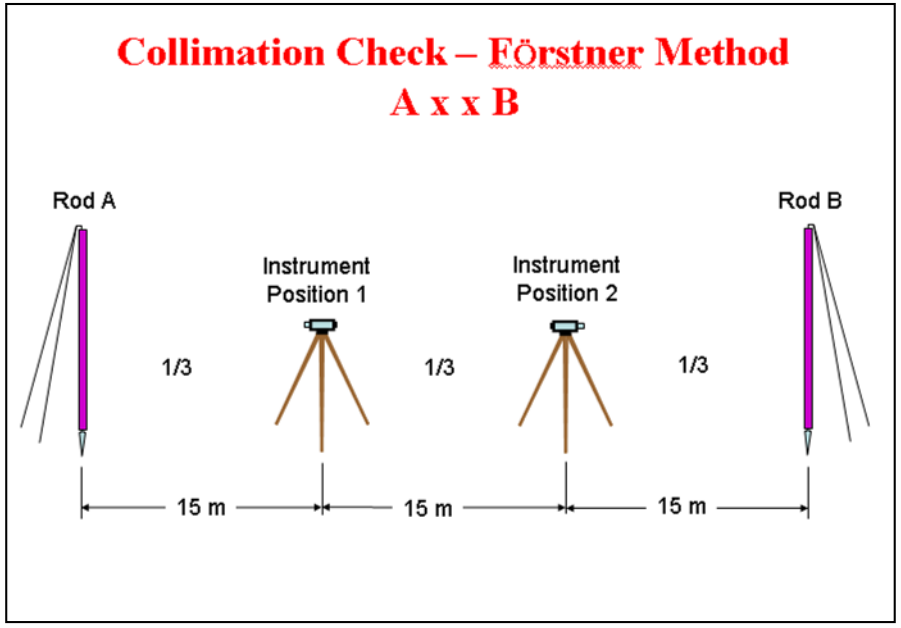
Precise Digital Leveling

Section 3

Collimation Check and Field Notes

Collimation Check
C-Check
Peg Test





Collimation Check

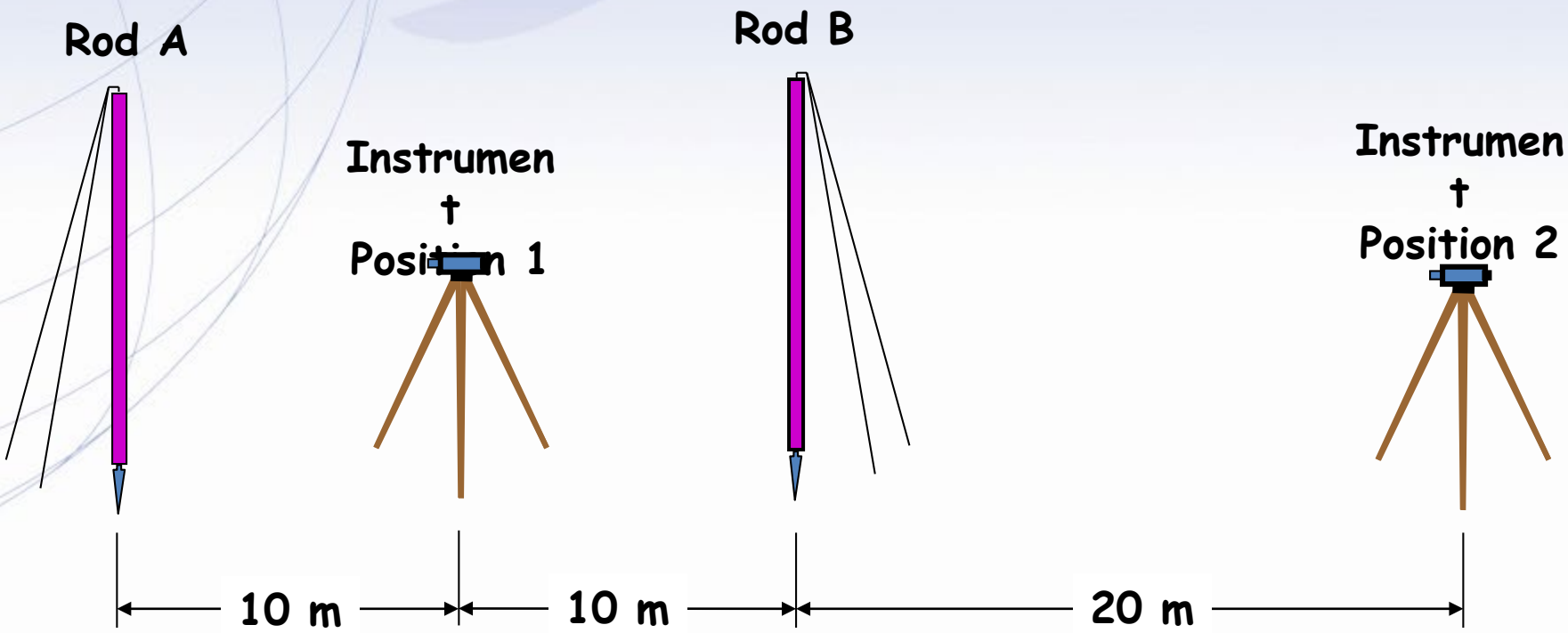
- Allow instrument and rods to acclimate prior to performing the collimation and/or leveling (allow equipment to adjust to the working environment for 10 minutes or more)
- Perform Collimation Check on level ground at the work site in the work environment
- Perform a Collimation Check at the beginning of every day that geodetic leveling is performed or when the level is jarred or any time there is a question about the instrument

Collimation Check (continued)

- Perform a Collimation Check whenever the ambient temperature changes more than 10 degrees Celsius during the course of leveling during the day
- Remove parallax and sharply focus the instrument and ensure all circular levels are in adjustment
- Apply collimation to all future measurements (also note in digital data files that this correction has been applied to all measurements)
- Record collimation (arc-seconds) on Backup Recording Sheet

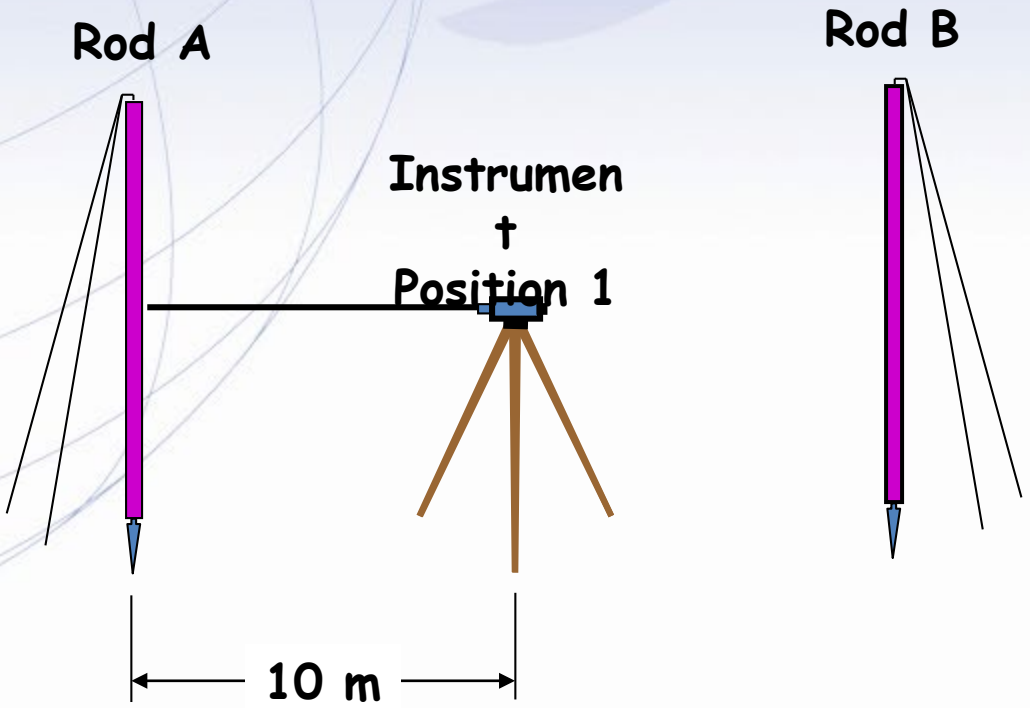
Collimation Check - Kukkamaki Method

A x B x

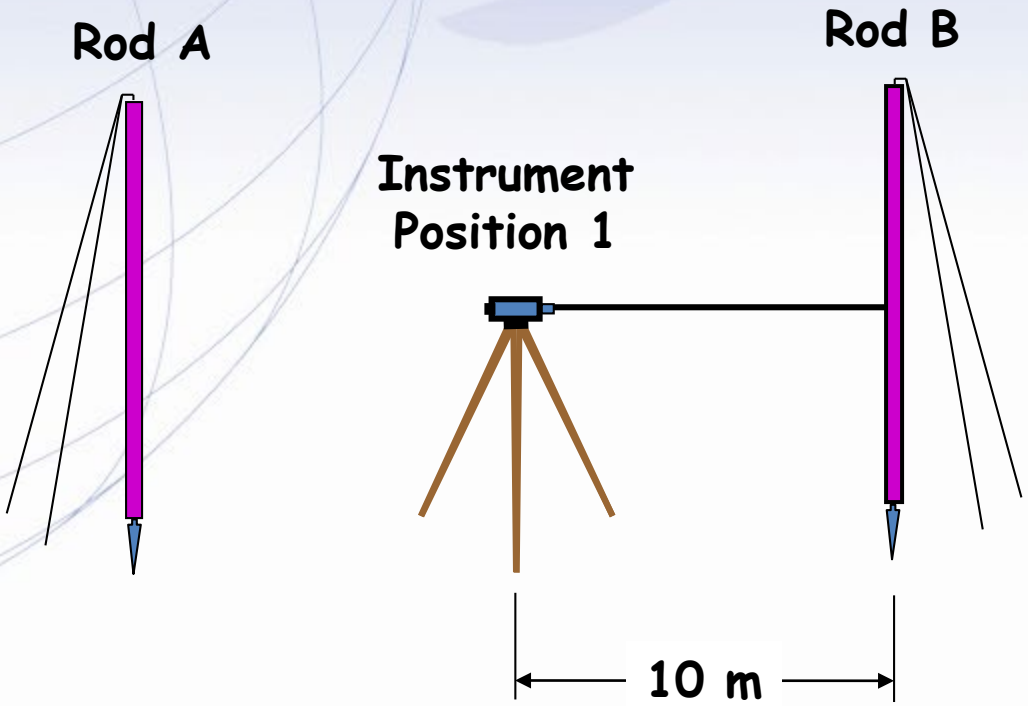


Collimation Check - Kukkamaki Method

A x B x

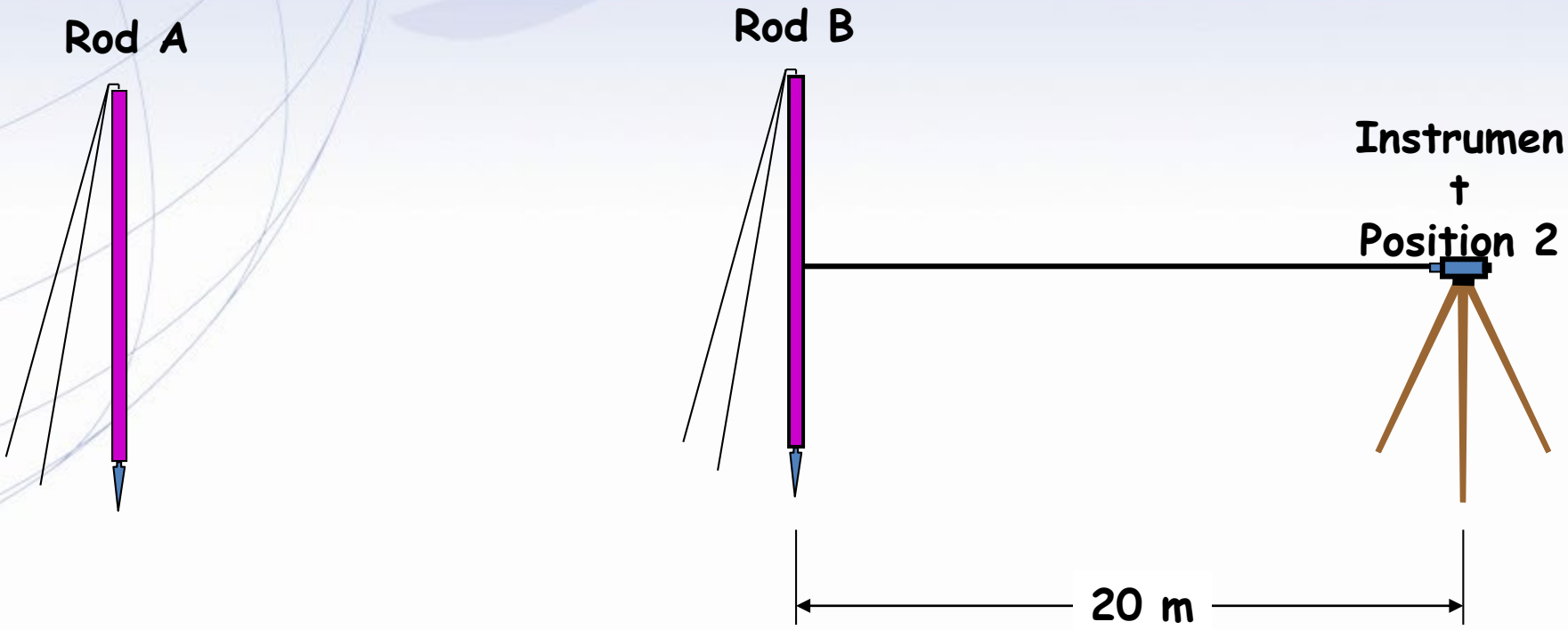


Collimation Check - Kukkamaki Method
A x B x

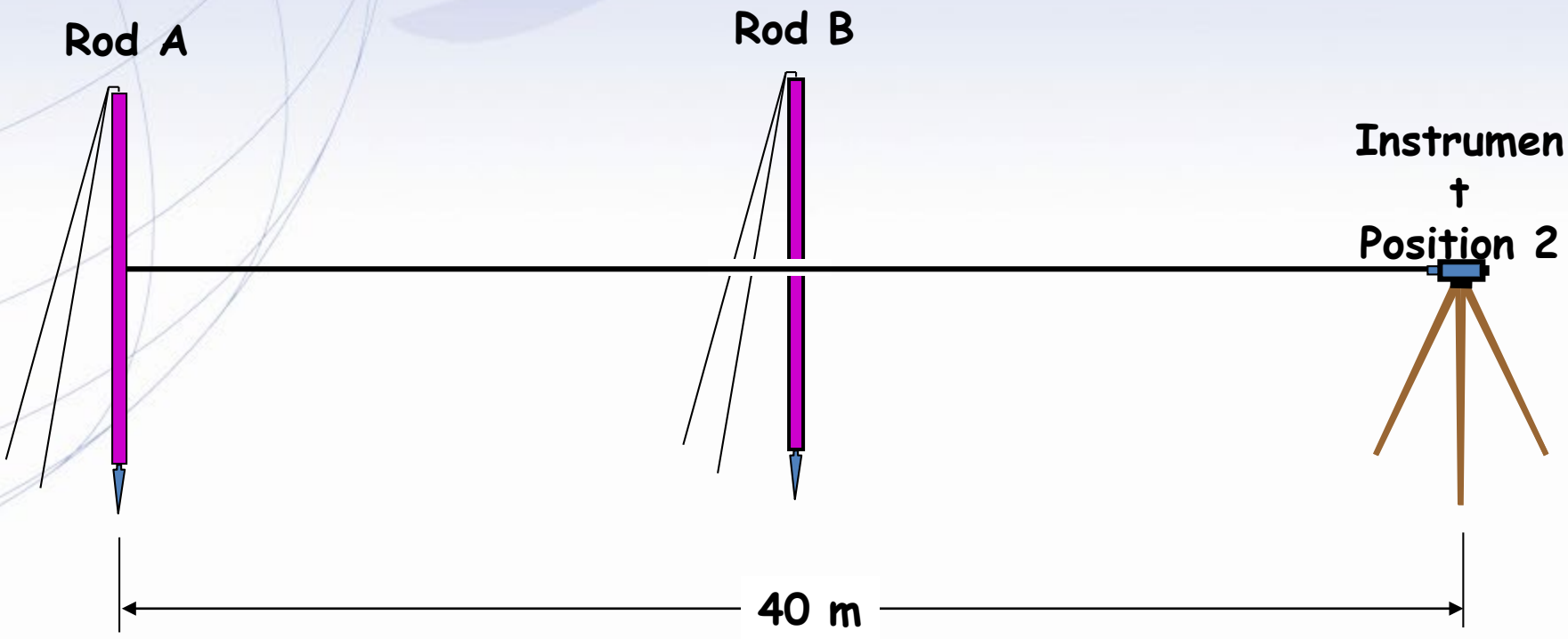


Collimation Check - Kukkamaki Method

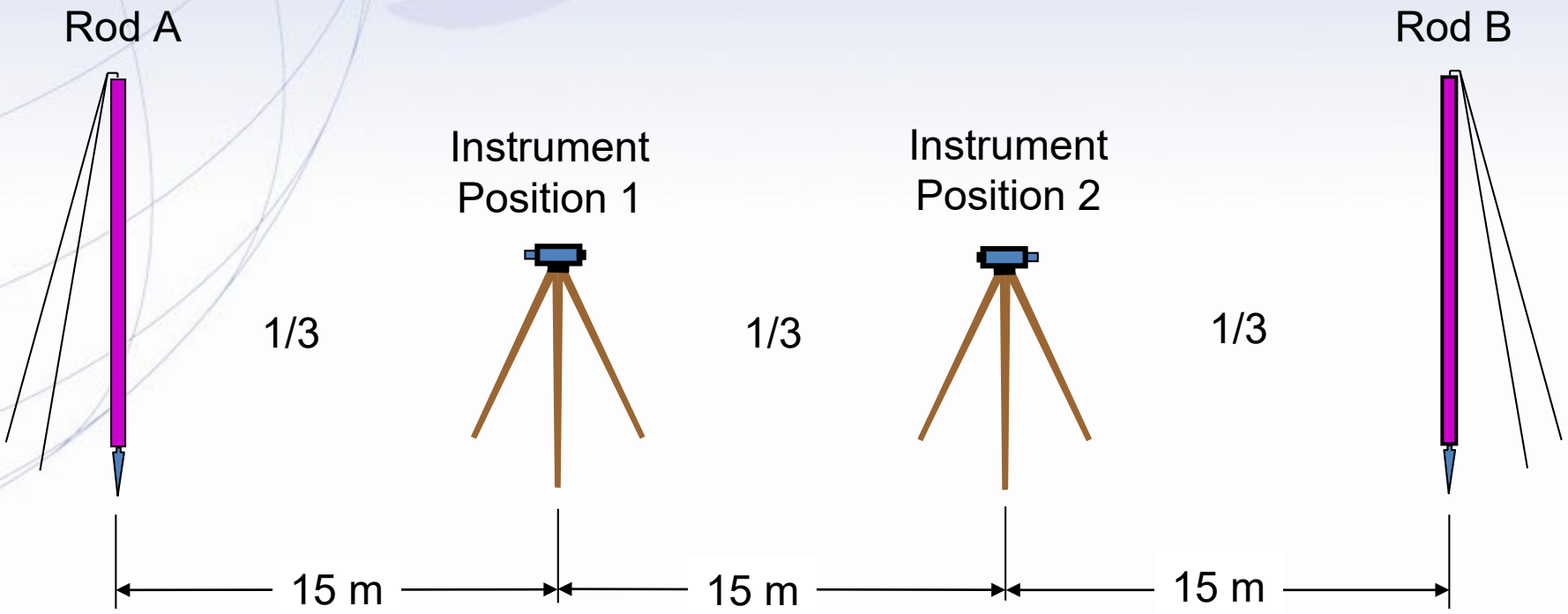
A x B x



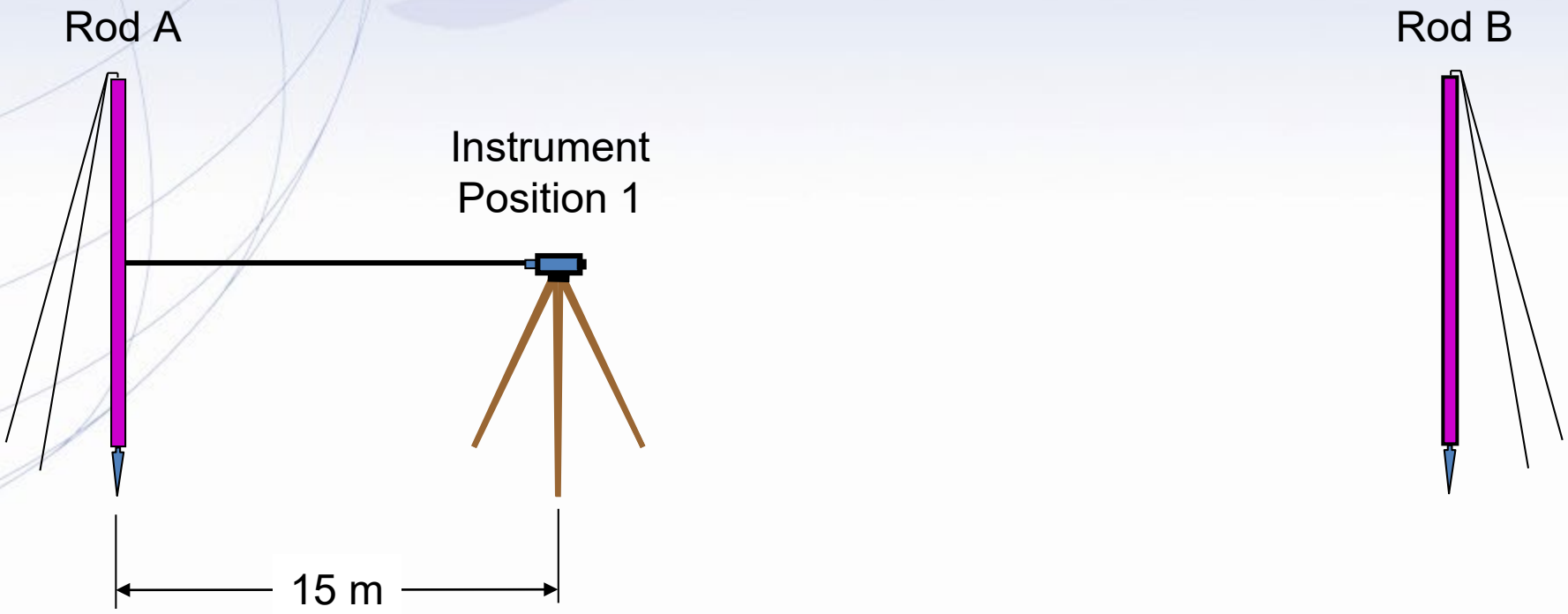
Collimation Check - Kukkamaki Method
A x B x



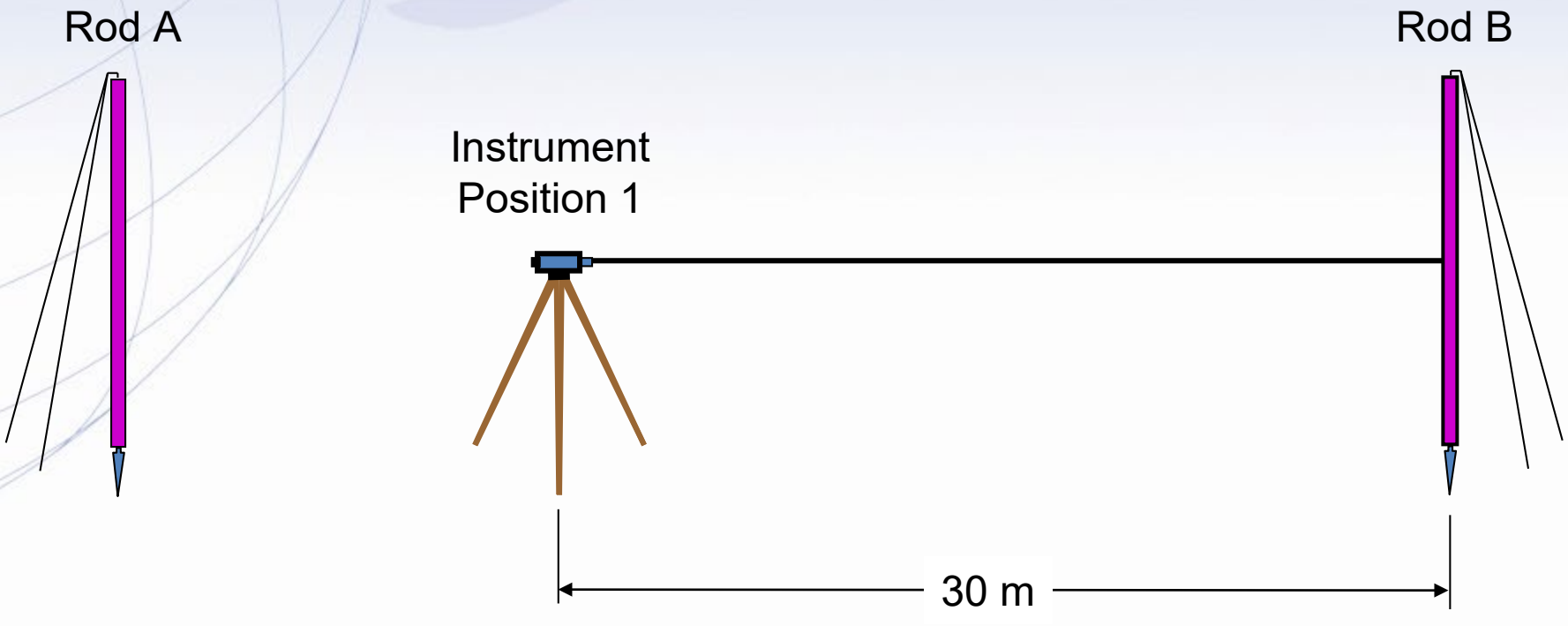
Collimation Check – Förstner Method
A x x B



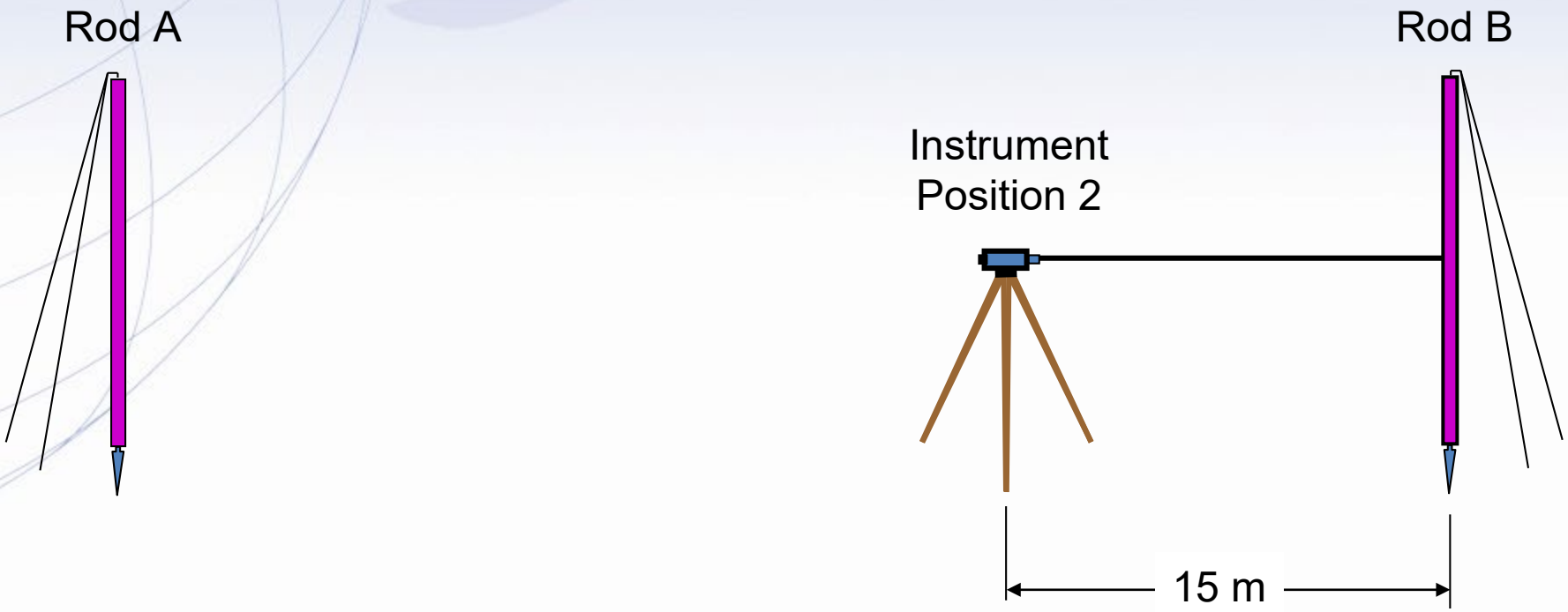
Collimation Check – Förstner Method
A x x B



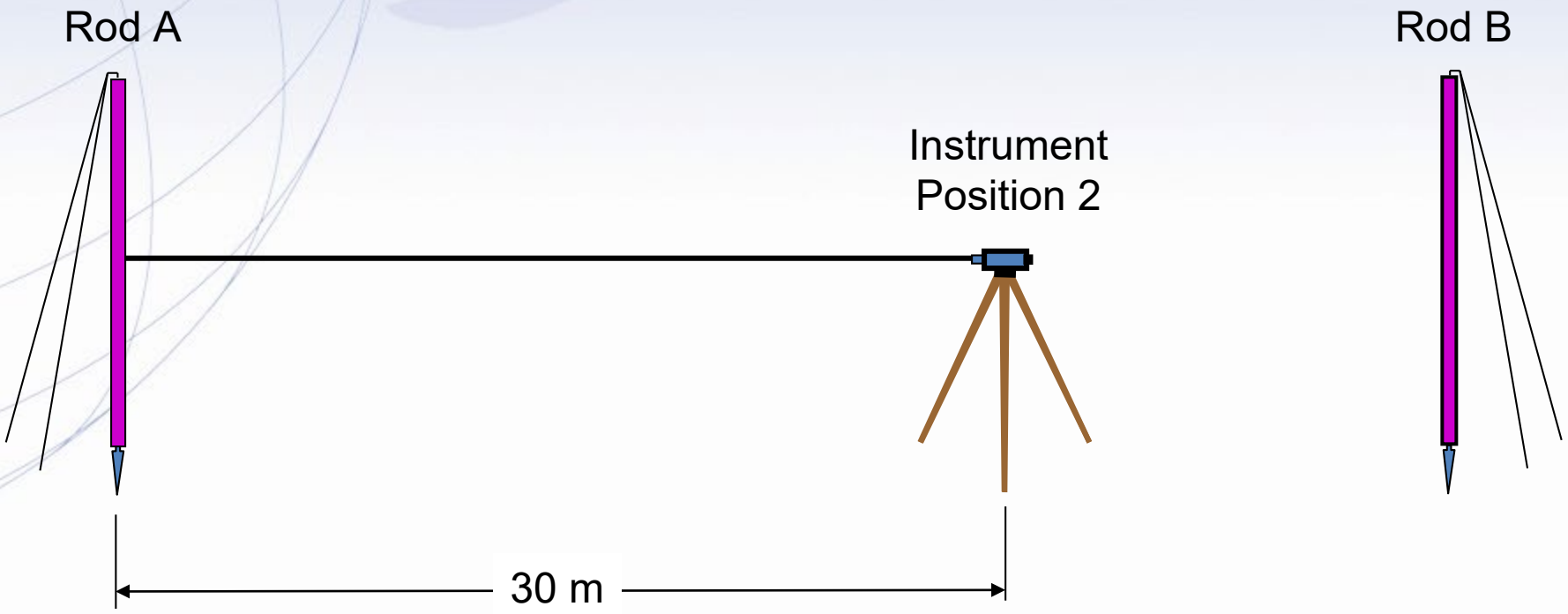
Collimation Check – Förstner Method
A x x B



Collimation Check – Förstner Method
A x x B

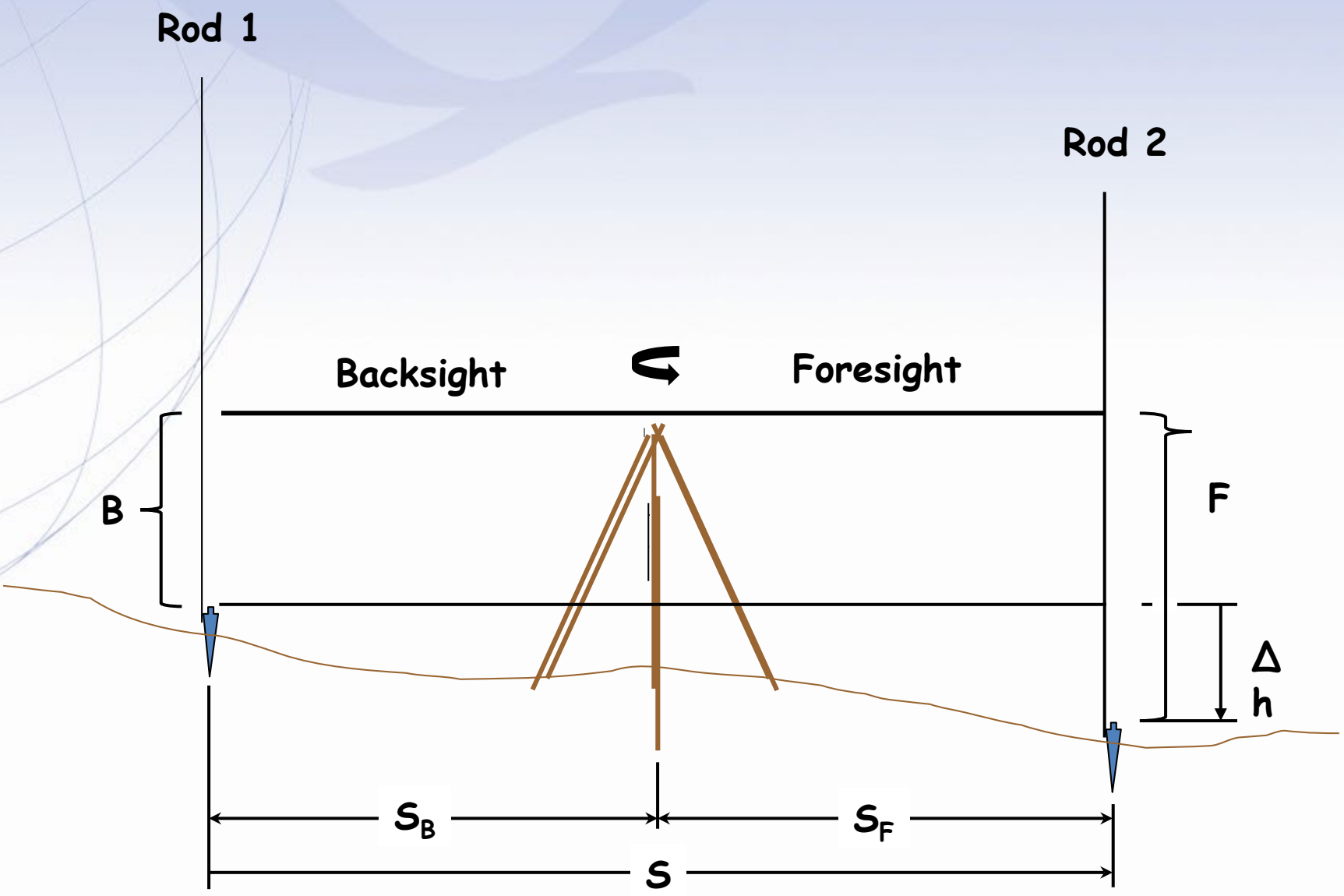


Collimation Check – Förstner Method
A x x B



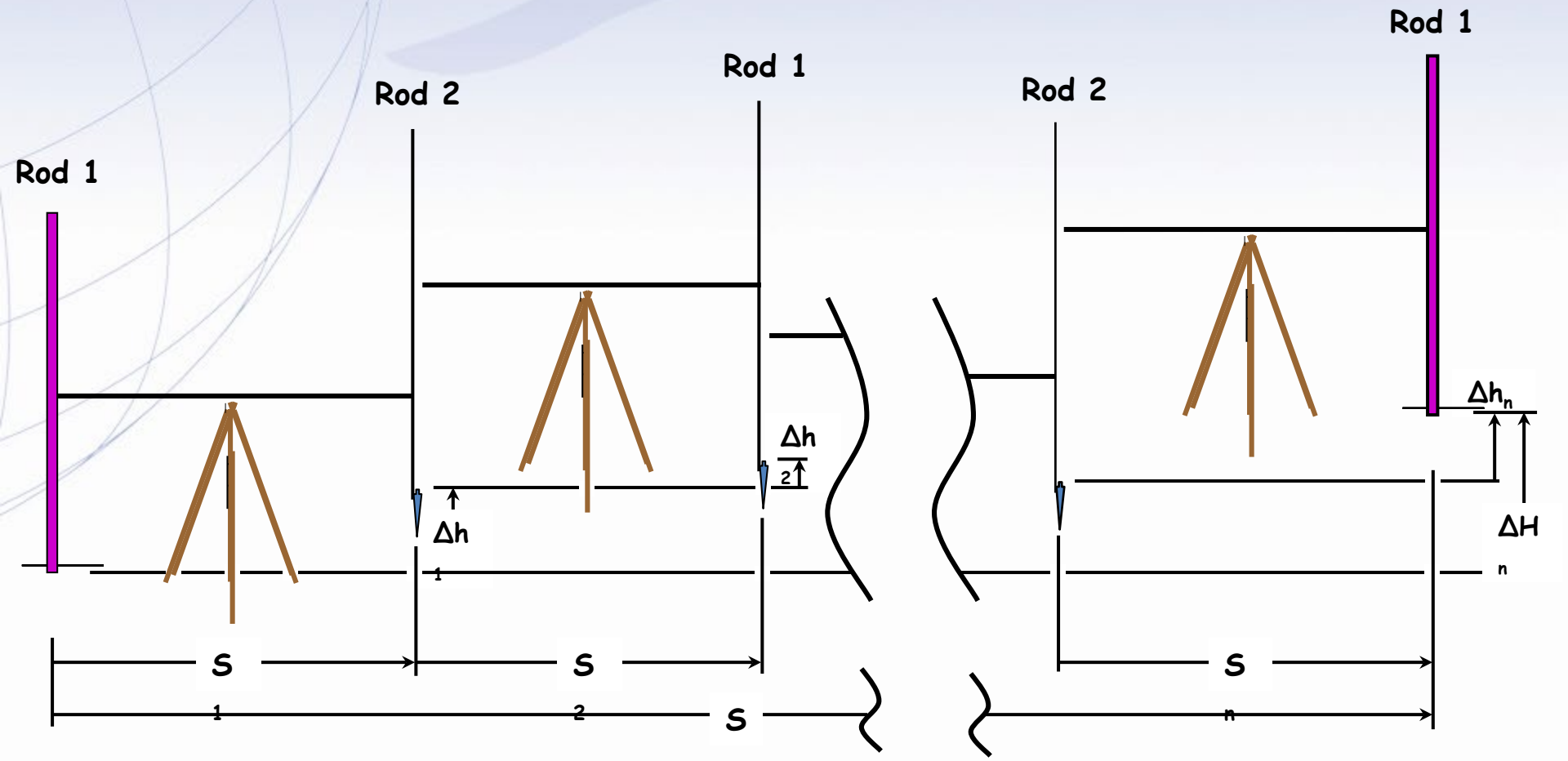
VIDEO
Taking a "C"-Shot (collimation check)

Setup of Leveling, $\Delta h = B - F$ and $S = S_B + S_F$

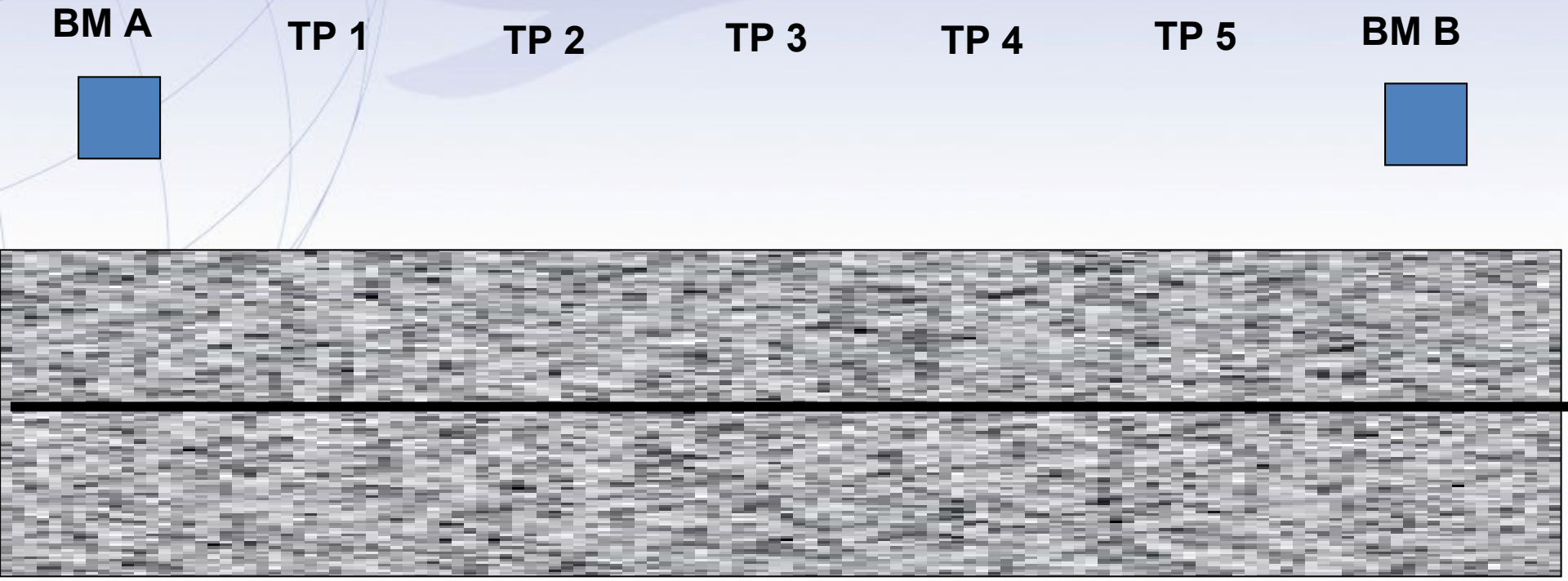


Section of Leveling

$$\Delta H = \Delta h_1 + \Delta h_2 + \ldots + \Delta h_n \text{ and } S = S_1 + S_2 + \ldots + S_n$$



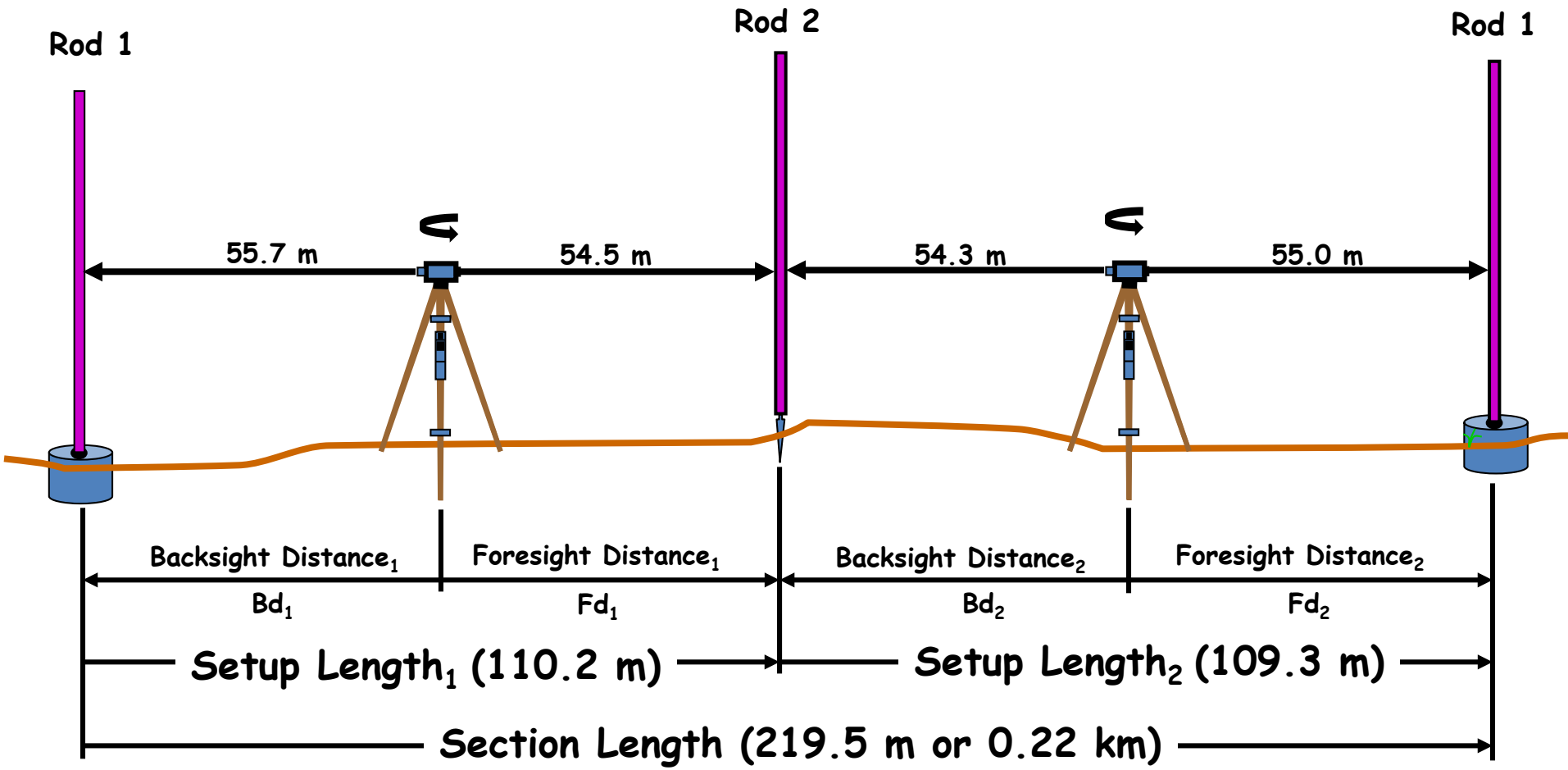
Section of Leveling



BM = Bench Mark
TP = Turning Point

Accumulated Distance Imbalance

$$Dbal = (Bd_1 + Bd_2 + \ldots + B_n) - (Fd_1 + Fd_2 + \ldots + F_n)$$



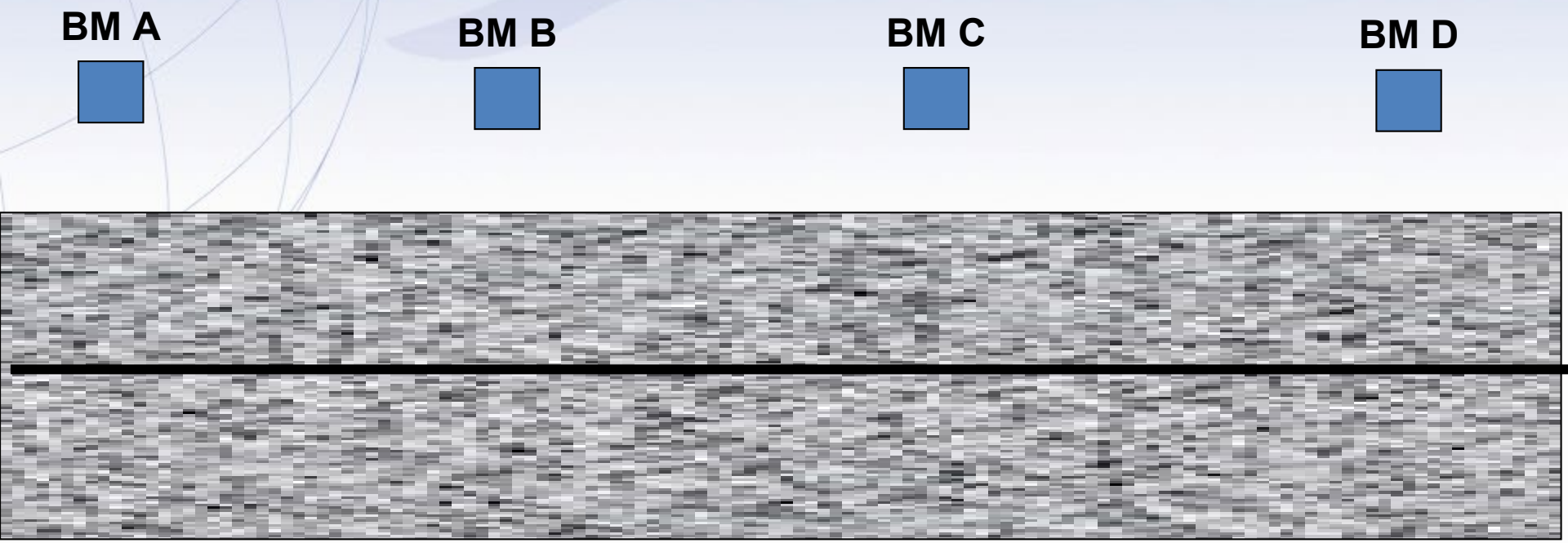
Example:

Bd_1 = 55.7 m; Fd_1 = 54.5 m Setup Imbalance = +1.2 m (short)

Bd_2 = 54.3 m; Fd_2 = 55.0 m Setup Imbalance = -0.7 m (long)

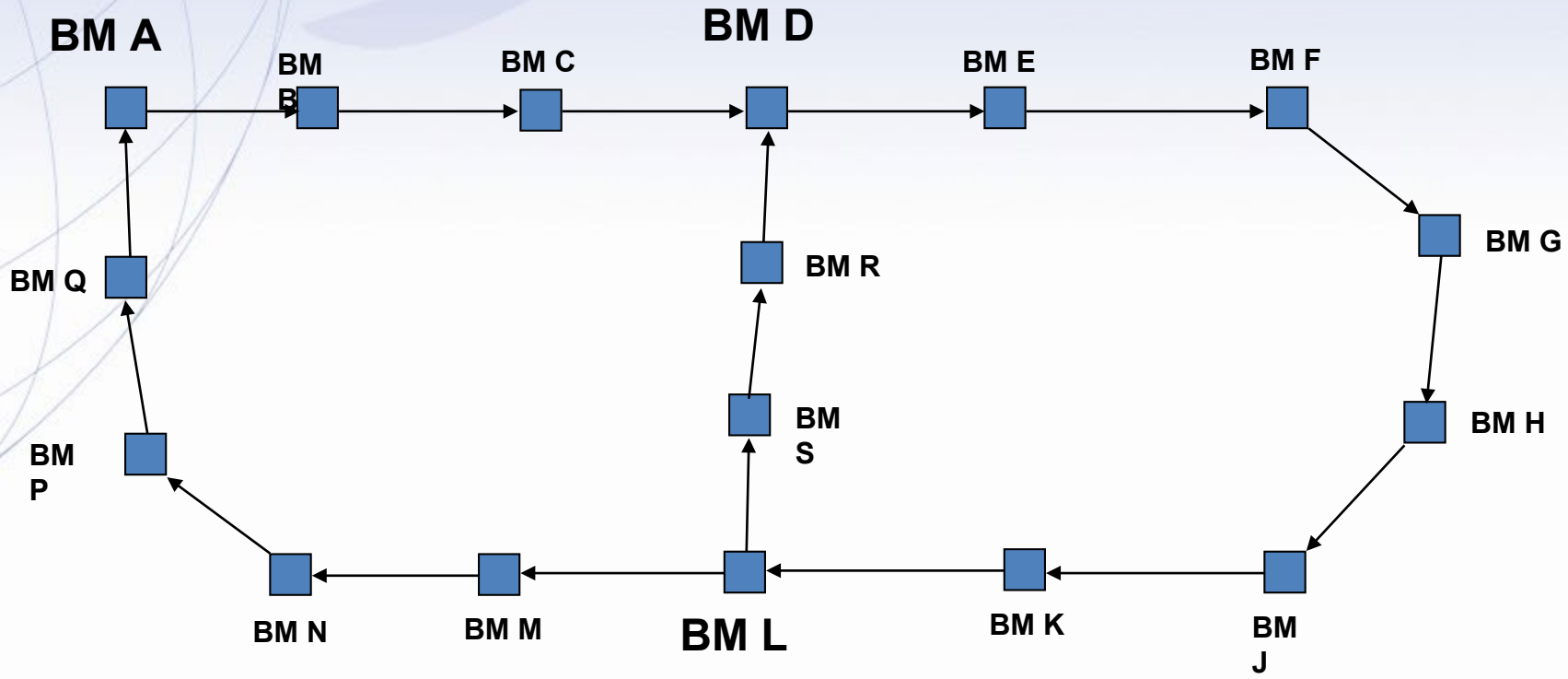
Section Accumulated Imbalance = +0.5 m (short)

Level Line



BM = Bench Mark

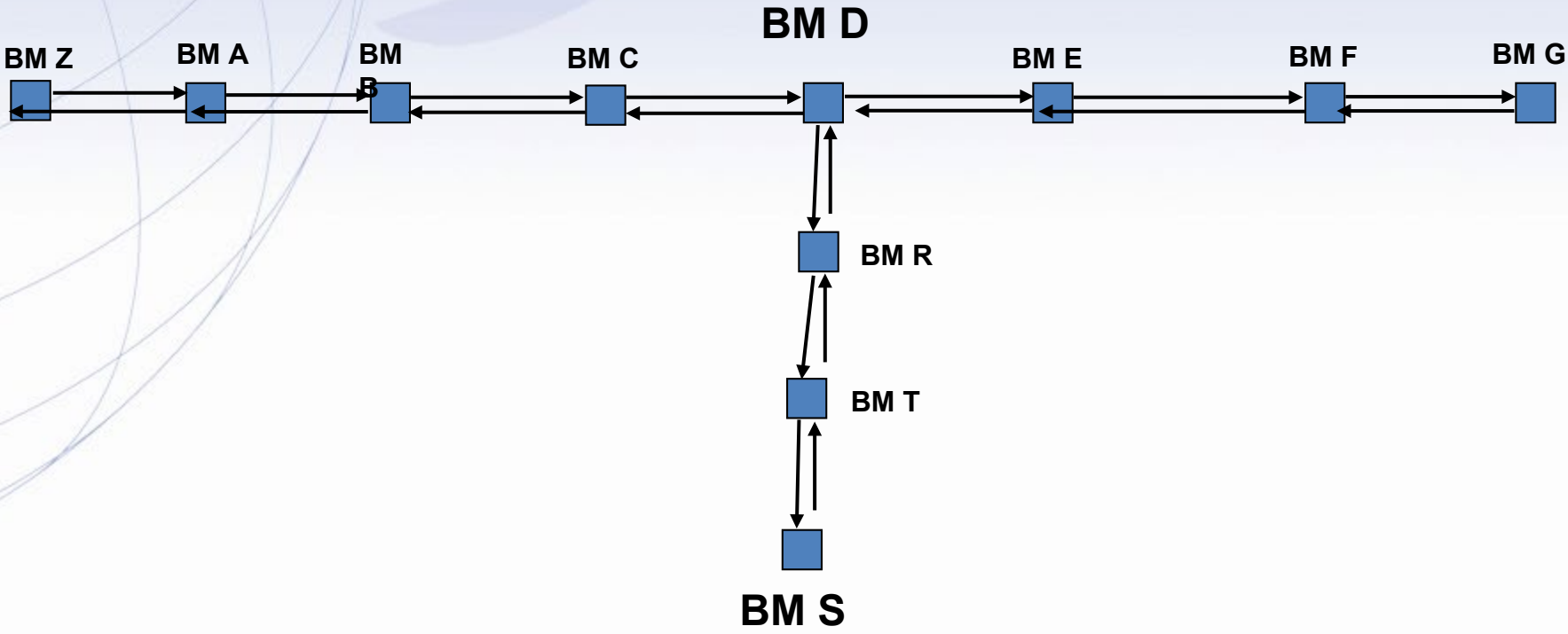
Level Loop(s)



BM = Bench Mark

= Forward Running

Level Spur



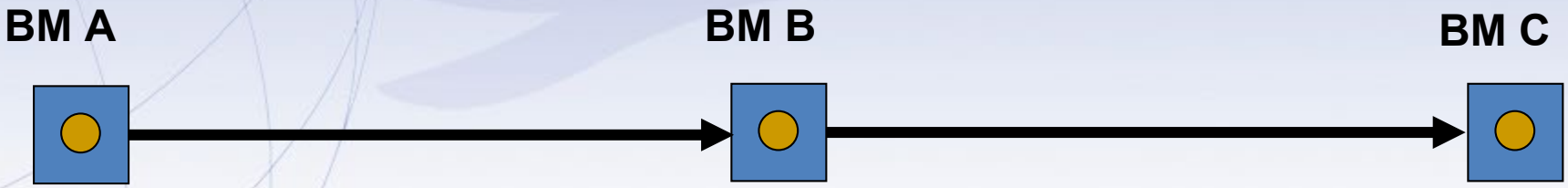
BM = Bench Mark

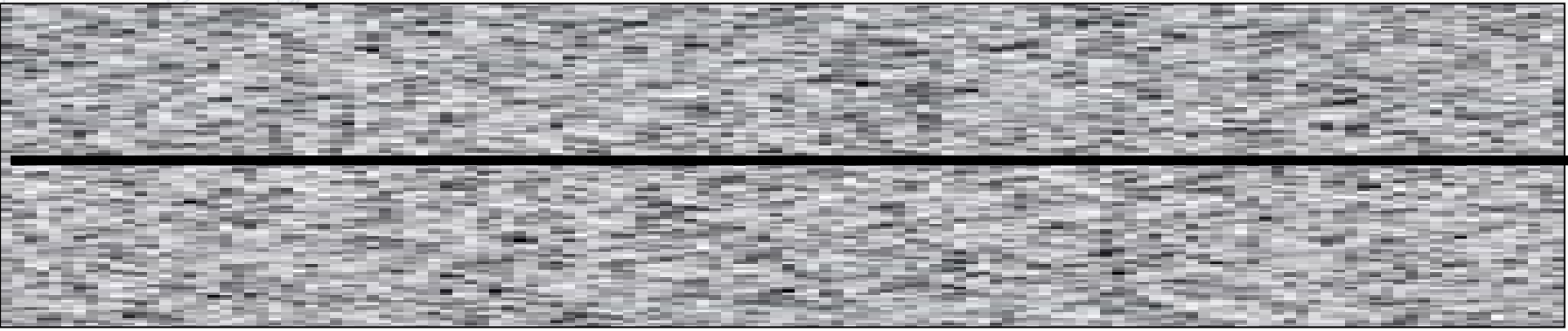
= Forward

Running

= Backward

Single Run

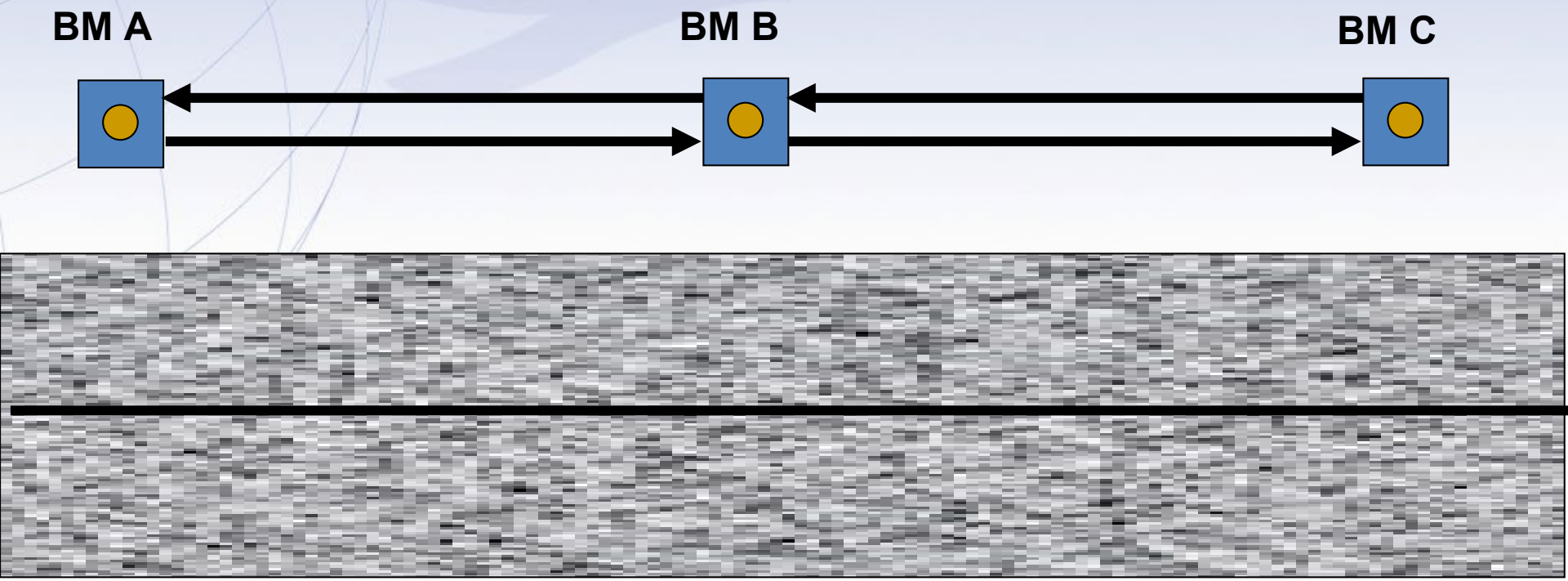




BM = Bench Mark

= One Way Leveling

Double Run



BM = Bench Mark

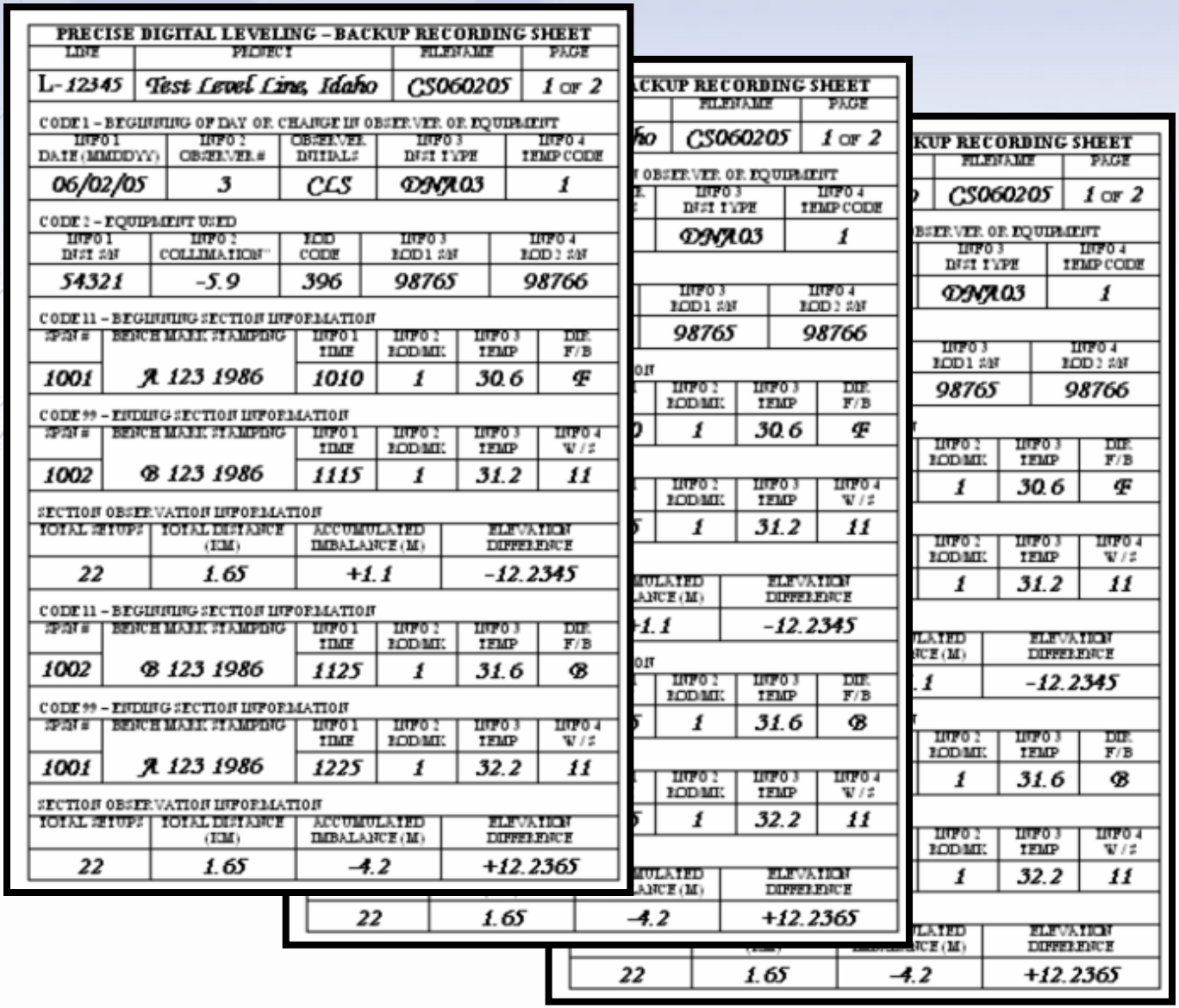
= Forward

= Backward

Running

VIDEO
Running a Section

Observing Guides and Field Notes



PRECISE DIGITAL LEVELING – BACKUP RECORDING SHEET

LINE	PROJECT	FILENAME	PAGE
L-12345	Test Level Line, Idaho	CS060205	1 OF 2

CODE 1 – BEGINNING OF DAY OR CHANGE IN OBSERVER OR EQUIPMENT

INFO 1 DATE (MMDDYY)	INFO 2 OBSERVER #	OBSERVER INITIAL #	INFO 3 INST TYPE	INFO 4 TEMP CODE
06/02/05	3	CLS	DNA03	1

CODE 2 – EQUIPMENT USED

INFO 1 INST SN	INFO 2 COLLIMATION"	ROD CODE	INFO 3 ROD 1 SN	INFO 4 ROD 2 SN
54321	-5.9	396	98765	98766

CODE 11 – BEGINNING SECTION INFORMATION

SPSN #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	DIR F/B
1001	A 123 1986	1010	1	30.6	F

CODE 99 – ENDING SECTION INFORMATION

SPSN #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	INFO 4 W / S
1002	B 123 1986	1115	1	31.2	11

SECTION OBSERVATION INFORMATION

TOTAL SETUPS	TOTAL DISTANCE (KM)	ACCUMULATED IMBALANCE (M)	ELEVATION DIFFERENCE
22	1.65	+1.1	-12.2345

CODE 11 – BEGINNING SECTION INFORMATION

SPSN #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	DIR F/B
1002	B 123 1986	1125	1	31.6	B

CODE 99 – ENDING SECTION INFORMATION

SPSN #	BENCH MARK STAMPING	INFO 1 TIME	INFO 2 ROD/MK	INFO 3 TEMP	INFO 4 W / S
1001	A 123 1986	1225	1	32.2	11

SECTION OBSERVATION INFORMATION

TOTAL SETUPS	TOTAL DISTANCE (KM)	ACCUMULATED IMBALANCE (M)	ELEVATION DIFFERENCE
22	1.65	-4.2	+12.2365

Leica Digital Leveling – Backup Recording Sheet

Line	Project	Filename	Page
L-			of

Code 1 – Beginning of Day or Change in Observer or Equipment

Info 1 Date (mmddyy)	Info 2 Observer #	Observer Initials	Info 3 Inst. Type	Info 4 Temp. Code

Code 2 – Equipment Used

Info 1 Inst. S/N	Info 2 Collimation "	Info 3 Rod 1 S/N	Info 4 Rod 2 S/N	Time Zone

Code 11 – Beginning Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Dir. F / B

Code 99 – Ending Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Info 4 W / S

Section Observation Information

Setups (#Stations)	Elevation Difference (dH T) M	Total Distance (DTot) KM	Accumulated Imbalance (TBal) M

Code 11 – Beginning Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Dir. F / B

Code 99 – Ending Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Info 4 W / S

Section Observation Information

Setups (#Stations)	Elevation Difference (dH T) M	Total Distance (DTot) KM	Accumulated Imbalance (TBal) M

Code 11 – Beginning Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Dir. F / B

Code 99 – Ending Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Info 4 W / S

Section Observation Information

Setups (#Stations)	Elevation Difference (dH T) M	Total Distance (DTot) KM	Accumulated Imbalance (TBal) M

Code 11 – Beginning Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Dir. F / B

Code 99 – Ending Section Information CM Plug Used on BM? Yes No

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Info 4 W / S

Section Observation Information

Setups (#Stations)	Elevation Difference (dH T) M	Total Distance (DTot) KM	Accumulated Imbalance (TBal) M

Closures And Remarks

Wind: 0 = Calm; 1 = Breezy; 2 = Windy
Sun: 0 = Cloudy; 1 = Partly Cloudy; 2 = Sunny

Dir.	Elevation Difference	SSN to SSN	Remarks
F			
B			
Diff.			
F			
B			
Diff.			

Required Leveling Notes

Entered at the beginning of the day
Or for change in observer, or instrumentation

Entered at the beginning of a section

Temperature readings inserted after each set-up
For recording gradient temperatures

Entered at the end of a section

9999 Entered at the end of day
Or for change of observer or equipment

Required LEVEL NOTES

Beginning of Day or Change in Observer/Instrument Type

Date (mmddyy)
Observer's Number (1, 2, 3, etc – observer specific for project)
Instrument Type (DNA03, DL101C, DINI12, etc)
Temperature Code (0 for Celsius or 1 for Fahrenheit)

Equipment Used

Instrument Serial Number (like 90810)
Collimation Check Error in Arc Seconds
Rod 1 Serial Number (like 25458)
Rod 2 Serial Number (like 25534)

Required Notes Entered Per Section

Start of Leveling Section

Start Time	(hhmm, 24 hour local)
Rod on Mark	(1 or 2)
Starting Temperature at Instrument	
Wind and Sun Code	

Temperature Gradient

(Recorded in instrument only - after each complete BF setup)

Info 1	Lower Probe	(decimal or no decimal by instrument type)
Info 2	Upper Probe	(decimal or no decimal by instrument type)

Required Notes at End of Leveling Section

Ending Time	(hhmm, 24 hour local)
Rod on Mark	(1 or 2 – should be the same as starting)
Ending Temperature at Instrument	
Wind & Sun Code	(00 = Calm/Cloudy; 02 = Calm/Sunny, etc.)

Wind Code:

0 – Calm	Wind speed averaged less than 6 mph during section
1 – Breezy	Wind speed averaged 6 to 15 mph during section
2 – Windy	Wind speed averaged greater than 15 mph during section

Sun Code:

0 – Cloudy	Less than 25% of setups are performed in sunny conditions
1 – Partly Cloudy	25 to 75% of setups are performed in sunny conditions
2 – Sunny	More than 75 % of setups are performed in sunny conditions

9999 End of Day or Change of Observer or Change of Equipment

Workshop - Leica Digital Leveling – Backup Recording Sheet

Line	Project	Filename	Page
L- 12345	Leveling Workshop, New Mexico 2009	051109A	1 of 2

Code 1 – Beginning of Day or Change in Observer or Equipment

Info 1 Date (mmddyy)	**Info 2** Observer #	Observer Name (First - Middle Initial - Last)	**Info 3** Inst. Type	**Info 4** Temp. Code
051109	1	Curt L. Smith	DNA03	0

Code 2 – Equipment Used

Info 1 Instrument S/N	**Info 2** Collimation"	**Info 3** Rod 1 S/N	**Info 4** Rod 2 S/N	Time Zone
332296	+2.0	26685	26686	MDT

Code 11 – Beginning Section Information **Spacer Plug Used on BM?** Yes (No)

SSN	Bench Mark Stamping	**Info 1** Time	**Info 2** Rod/Mk.	**Info 3** Temp.	**Dir.** F / B
1000	A 123 1952	0945	1	17.8	F

Code 99 – Ending Section Information **Spacer Plug Used on BM?** Yes (No)

SSN	Bench Mark Stamping	**Info 1** Time	**Info 2** Rod/Mk.	**Info 3** Temp.	**Info 4** W / S
1001	B 123 1952	1115	1	19.2	11

Section Observation Information

Setups (#Stations)	Elevation Difference (dH T) M	Total Distance (DTot) KM	Accumulated Imbalance (TBal) M
26	-13.23456	1.47782	+0.56

Sample Backup Recording Sheet

Code 11 – Beginning Section Information Spacer Plug Used on BM? Yes (No)

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Dir. F / B
1001	B 123 1952	1405	1	20.3	B

Code 99 – Ending Section Information Spacer Plug Used on BM? Yes (No)

SSN	Bench Mark Stamping	Info 1 Time	Info 2 Rod/Mk.	Info 3 Temp.	Info 4 W / S
1000	A 123 1952	1535	1	21.2	20

Section Observation Information

Setups (#Stations)	Elevation Difference (dH T) M	Total Distance (DTot) KM	Accumulated Imbalance (TBal) M
26	+13.23750	1.49872	-3.47

Remarks and Closure:

Wind: 0 = Calm; 1 = Breezy; 2 = Windy
Sun: 0 = Cloudy; 1 = Partly Cloudy; 2 = Sunny

Strong gusty winds and heavy road traffic.

Dir.	SSN to SSN	Elevation Difference (M)	Distance (KM)	Allowable: 4*√KM
F	1000 - 1001	-13.23456	1.47782	
B	1001 - 1000	+13.23750	1.49872	
Difference (F+B) =		+0.00294	1.47782	4.86262

F = -13.23456 m

B = +13.23750 m

+ 0.00294 m Allowable Section Closure

1st Order, Class II

$4\sqrt{1.47782} = 4.86262$ mm

2nd Order, Class I

$6\sqrt{1.47782} = 7.29393$ mm

Precise Digital Leveling

Section 7

Wrap-up and Bench Mark Resets

Leveling Tips

- Follow safety protocols - Watch for moving vehicles!
- Slow or no readings? Reduce sight lengths for:
  - Heat shimmer (scintillation)
  - Instrument vibration due to wind
  - Standard deviation won't come down
  - Dappled light on rod(s)
- Carry instrument upright between setups
- Check rods' and instrument's circular levels weekly or after receiving abnormal bump or shock
- Minimize latency between backsight and foresight
- Do not leave the instrument setup unattended
- Do not let thermistors or level get wet

Leveling Tips (continued)

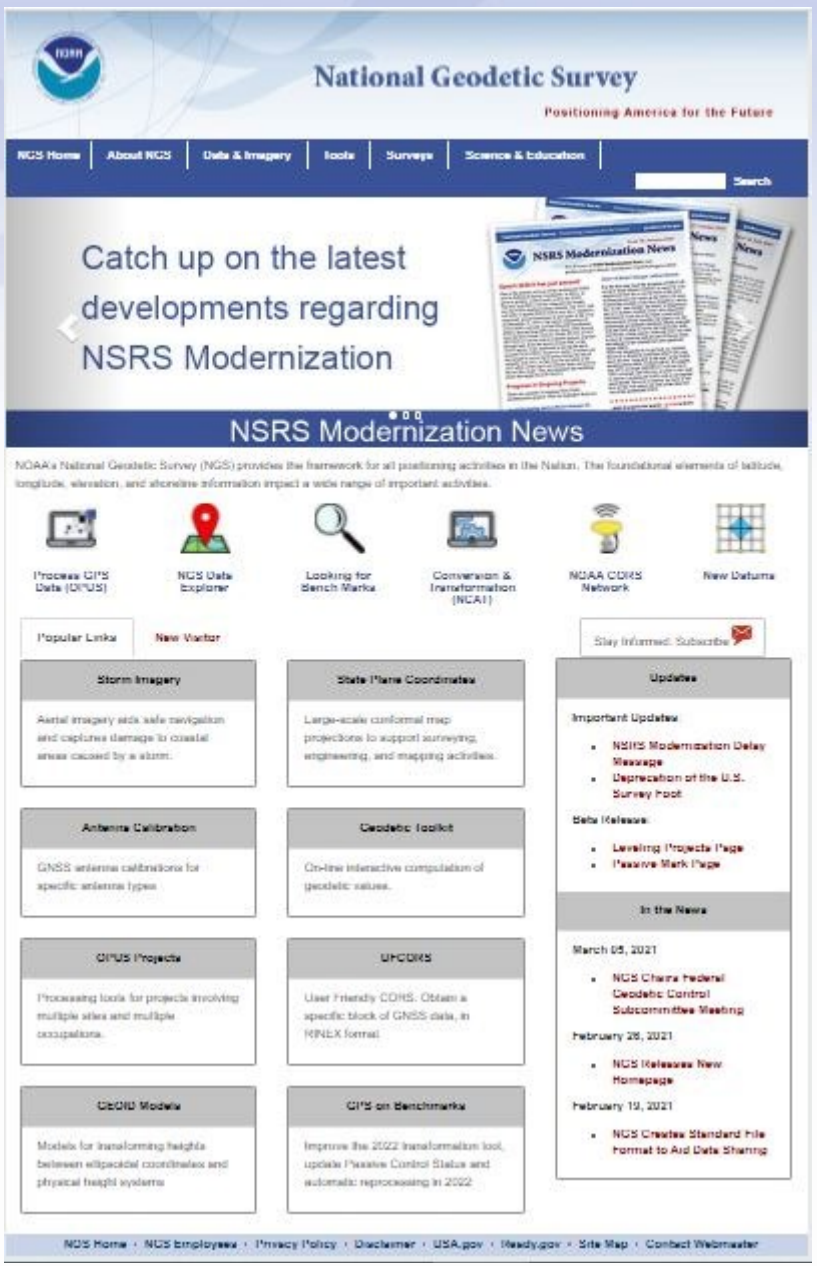
- Cross pavement (roadway) at right angles to minimize uneven sight conditions
- Clearly focus level instrument before measurement
- Stabilize both turning points and tripod every setup
- Never read below 0.5 meters on rod
- Ensure upper stadia crosshair is not above Invar when reading near the top of the rod
- Maintain tight setup imbalances
- Don't point the instrument into the sun
- Orchestrate setups so instrument is not pointing into low sun angle

Leveling Tips (continued)

- DO NOT DROP RODS!!
- Keep one hand on rod at all times
- Keep rod faces clean – do not touch Invar
- Always protect base of rod – keep off ground
- Never setup rod or instrument on asphalt
- Turn rod to change shadows if measurement fails
- Rod person calls out BM designation for check
- Start and end with the same rod on mark
- Backsight rod person does not move until foresight has been recorded and observer directs

Leveling Tips (continued)

- Make sure base of rod is directly on the turning point or BM, not on centering guide
- Be aware of your surroundings carrying rod
- Spacer must have a backsight and a foresight
- Do not forget to retrieve spacer after setup
- Double run all required sections
- Plan reverse leveling during a different time of day from the first level run
- Place visible mark on rod to indicate 0.5 m


National Geodetic Survey
Positioning America for the Future
NGS Home
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Catch up on the latest developments regarding NSRS Modernization
NSRS Modernization News
NSRS Modernization News
NOAA's National Geodetic Survey (NGS) provides the framework for all positioning activities in the Nation. The foundational elements of latitude, longitude, elevation, and shoreline information impact a wide range of important activities.
Process GPS Data (OPUS)
NGS Data Explorer
Looking for Bench Marks
Conversion & Transformation (NCAT)
NOAA CORS Network
New Datums
Popular Links
New Visitor
Stay Informed: Subscribe
Storm Imagery
Aerial imagery aids safe navigation and captures damage to coastal areas caused by a storm.
State Plane Coordinates
Large-scale conformal map projections to support surveying, engineering, and mapping activities.
Antenna Calibration
GNSS antenna calibrations for specific antenna types
Geodetic Toolkit
On-line interactive computation of geodetic values.
OPUS Projects
Processing tools for projects involving multiple sites and multiple occupations.
UFCORS
User Friendly CORS. Obtain a specific block of GNSS data, in RINEX format
GEOID Models
Models for transforming heights between ellipsoidal coordinates and physical height systems
GPS on Benchmarks
Improve the 2022 transformation tool, update Passive Control Status and automatic reprocessing in 2022
Updates
Important Updates
NSRS Modernization Delay Message
Deprecation of the U.S. Survey Foot
Beta Release:
Leveling Projects Page
Passive Mark Page
In the News
March 05, 2021
NGS Chairs Federal Geodetic Control Subcommittee Meeting
February 26, 2021
NGS Releases New Homepage
February 19, 2021
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National Geodetic Survey

Positioning America for the Future

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benchmark reset Search

Catch up on the latest developments regarding NSRS Modernization

NSRS Modernization News

NOAA's National Geodetic Survey (NGS) provides the framework for all positioning activities in the Nation. The foundational elements of latitude, longitude, elevation, and shoreline information impact a wide range of important activities.

Process GPS Data (OPUS) | NGS Data Explorer | Looking for Bench Marks | Conversion & Transformation (NCAT) | NOAA CORS Network | New Datums

Popular Links | New Visitor

Stay Informed: Subscribe

Storm Imagery

Aerial imagery aids safe navigation and captures damage to coastal areas caused by a storm.

State Plane Coordinates

Large-scale conformal map projections to support surveying, engineering, and mapping activities.

Updates

Important Updates:

- NSRS Modernization Delay Message
- Deprecation of the U.S. Survey Foot

National Geodetic Survey

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Everything Storm Imagery News More

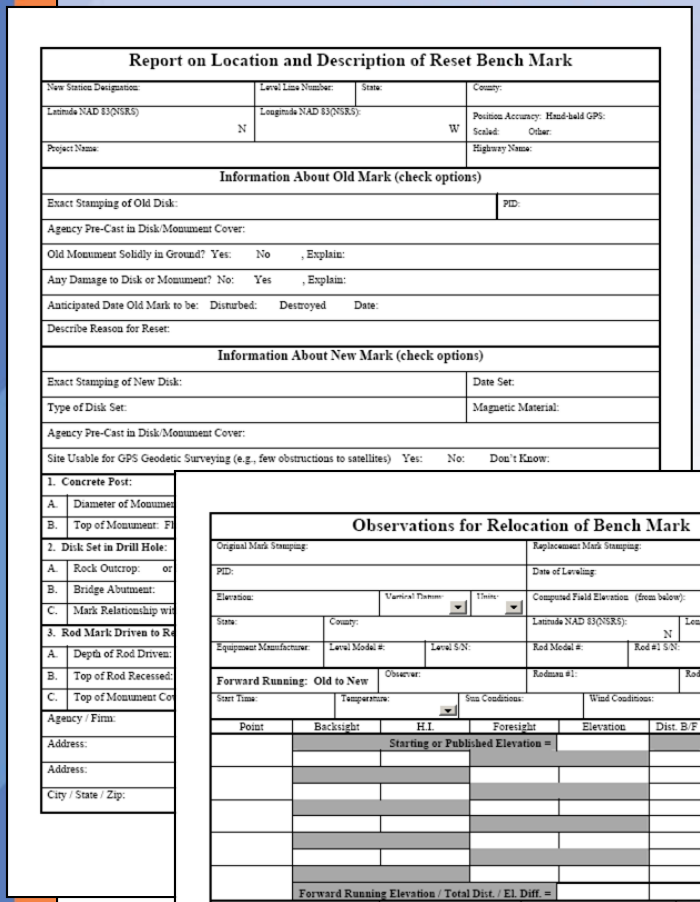
benchmark reset

[PDF] **Bench Mark Reset Procedures**
www.ngs.noaa.gov/PUBS_LIB/Benchmark_4_1_2011.pdf
with the word **RESET** and the year of the **reset**; for example, a **bench mark** designated M 123 **reset** in the year 2006, would be stamped M 123 **RESET** 2006 ...

Survey Mark Recovery | **Mark Descriptions Help**
www.ngs.noaa.gov/surveys/mark-recovery/mark-descriptions-help.shtml
Stamping is the unique ID, if any, that the original marksetter struck into the tablet.. Example: "MEADES RANCH 1891" as shown at right.. Do not ...

National Geodetic Survey - Survey Marks and Datasheets
www.ngs.noaa.gov/datasheets/
NGS_Description. Skip to main content. Toggle navigation NGS Home

Survey Mark Recovery
www.ngs.noaa.gov/surveys/mark-recovery/index.shtml
In the first field under the Marker ID section, enter the recovered mark's Permanent Identifier (PID) to auto-populate existing mark descriptive ...



Report on Location and Description of Reset Bench Mark

New Station Designation: | Level Line Number: | State: | County:

Latitude NAD 83(NSRS): N | Longitude NAD 83(NSRS): W | Position Accuracy: Hand-held GPS: Scaled: Other:

Project Name: | Highway Name:

Information About Old Mark (check options)

Exact Stamping of Old Disk: | PID:

Agency Pre-Cast in Disk/Monument Cover:

Old Monument Solidly in Ground? Yes: No , Explain:

Any Damage to Disk or Monument? No: Yes , Explain:

Anticipated Date Old Mark to be: Disturbed: Destroyed Date:

Describe Reason for Reset:

Information About New Mark (check options)

Exact Stamping of New Disk: | Date Set:

Type of Disk Set: | Magnetic Material:

Agency Pre-Cast in Disk/Monument Cover:

Site Usable for GPS Geodetic Surveying (e.g., few obstructions to satellites) Yes: No: Don't Know:

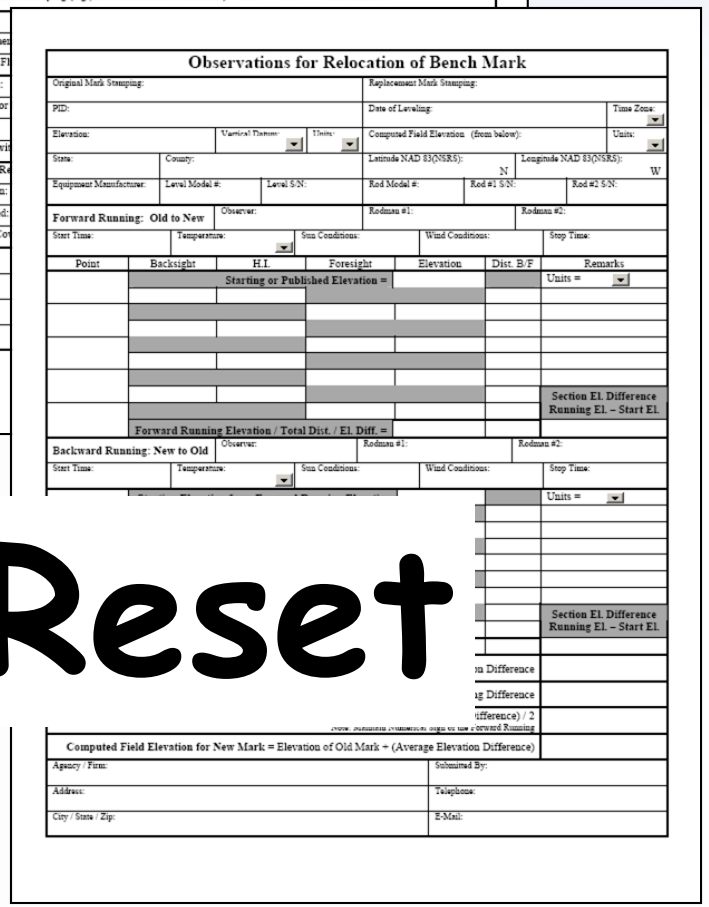
1. Concrete Post:
A. Diameter of Monume
B. Top of Monument: Fl
2. Disk Set in Drill Hole:
A. Rock Outcrop: or
B. Bridge Abutment:
C. Mark Relationship wi
3. Rod Mark Driven to Re
A. Depth of Rod Driven:
B. Top of Rod Recessed:
C. Top of Monument Co

Agency / Firm:

Address:

Address:

City / State / Zip:



Observations for Relocation of Bench Mark

Original Mark Stamping: | Replacement Mark Stamping:

PID: | Date of Leveling: | Time Zone:

Elevation: | Vertical Datum: | Units: | Computed Field Elevation (from below): | Units:

State: | County: | Latitude NAD 83(NSRS): N | Longitude NAD 83(NSRS): W

Equipment Manufacturer: | Level Model #: | Level S/N: | Rod Model #: | Rod #1 S/N: | Rod #2 S/N:

Forward Running: Old to New | Observer: | Rodman #1: | Rodman #2:

Start Time: | Temperature: | Sun Conditions: | Wind Conditions: | Stop Time:

Point	Backsight	H.I.	Foresight	Elevation	Dist. B/F	Remarks
	Starting or Published Elevation =					Units =
						Section El. Difference Running El. – Start El.
	Forward Running Elevation / Total Dist. / El. Diff. =					

Backward Running: New to Old | Observer: | Rodman #1: | Rodman #2:

Start Time: | Temperature: | Sun Conditions: | Wind Conditions: | Stop Time:

Units =

Section El. Difference Running El. – Start El.

Computed Field Elevation for New Mark = Elevation of Old Mark + (Average Elevation Difference)

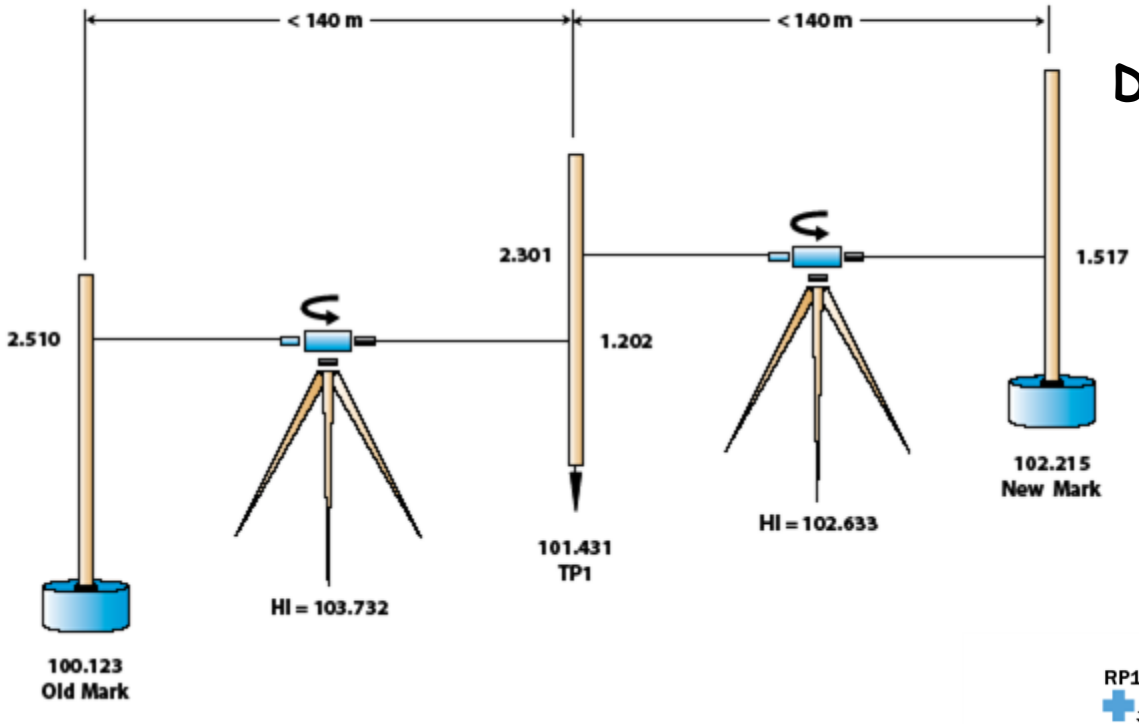
Agency / Firm: | Submitted By:

Address: | Telephone:

City / State / Zip: | E-Mail:

3rd Order Reset

Figure 3. Old mark to new mark level tie for distances for 140 meters. Accumulated backsight - foresight setup imbalance must be less thatn 10 meters.



Method 1
Direct Old to New Mark Elevation Transfer

Method 2
Reference Points to "Hold" Elevation Prior to Transfer

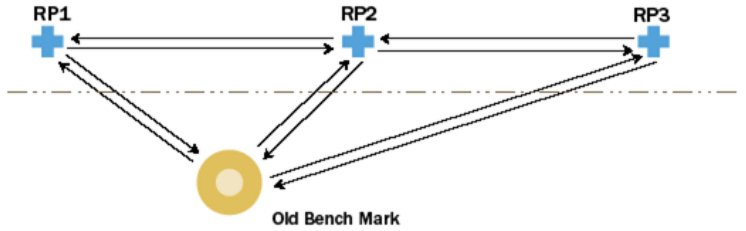


Figure 4. Old bench mark ties to three reference points.

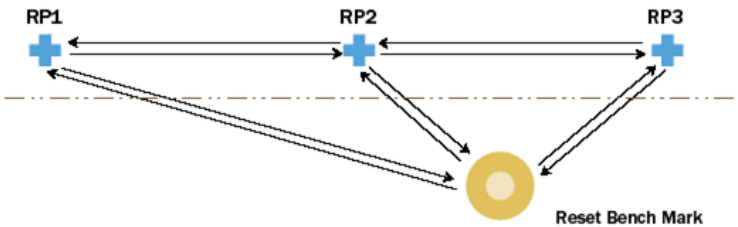


Figure 5. Three reference points tie to new reset bench mark.

Tolerances

Agreement of Observed Elevation Differences, Observed Backward and Forward During:

Condition	1st Order, Class II	2nd Order, Class I	2nd Order, Class II	3rd Order
One-setup section	+/- 0.50 mm	+/- 1.00 mm	+/- 1.50 mm	+/- 2.00 mm
2-runnings of section < 0.10 km in length	+/- 1.26 mm	+/- 1.90 mm	+/- 2.53 mm	+/- 3.79 mm
2-runnings of section of one-way length D: T*√D mm, T =	+/- 4.00	+/- 6.00	+/- 8.00	+/- 12.00

Table 1. Tolerances for Geodetic Leveling