DIGITAL THEODOLITE

Leonard Digges invented the theodolite in 1551.
The electronic digital theodolite first introduced in the late 1960s
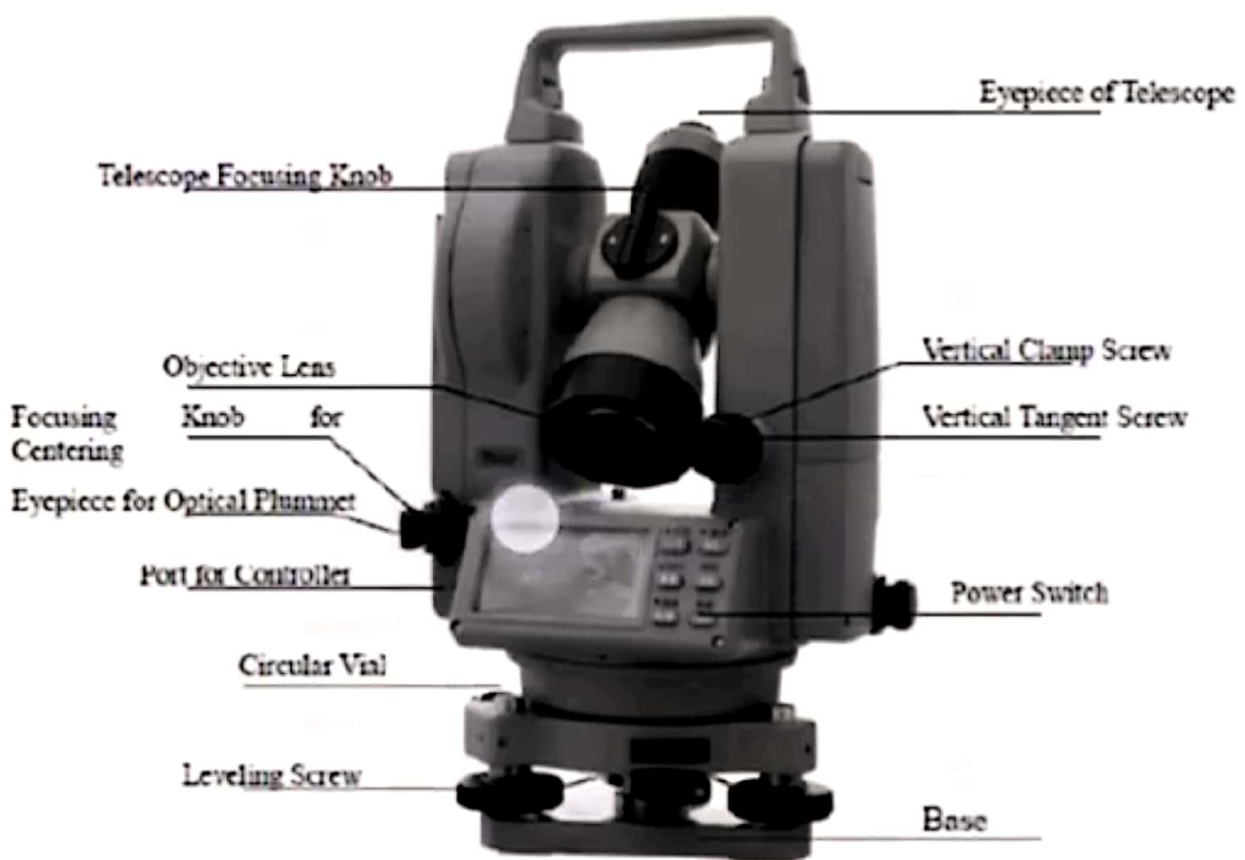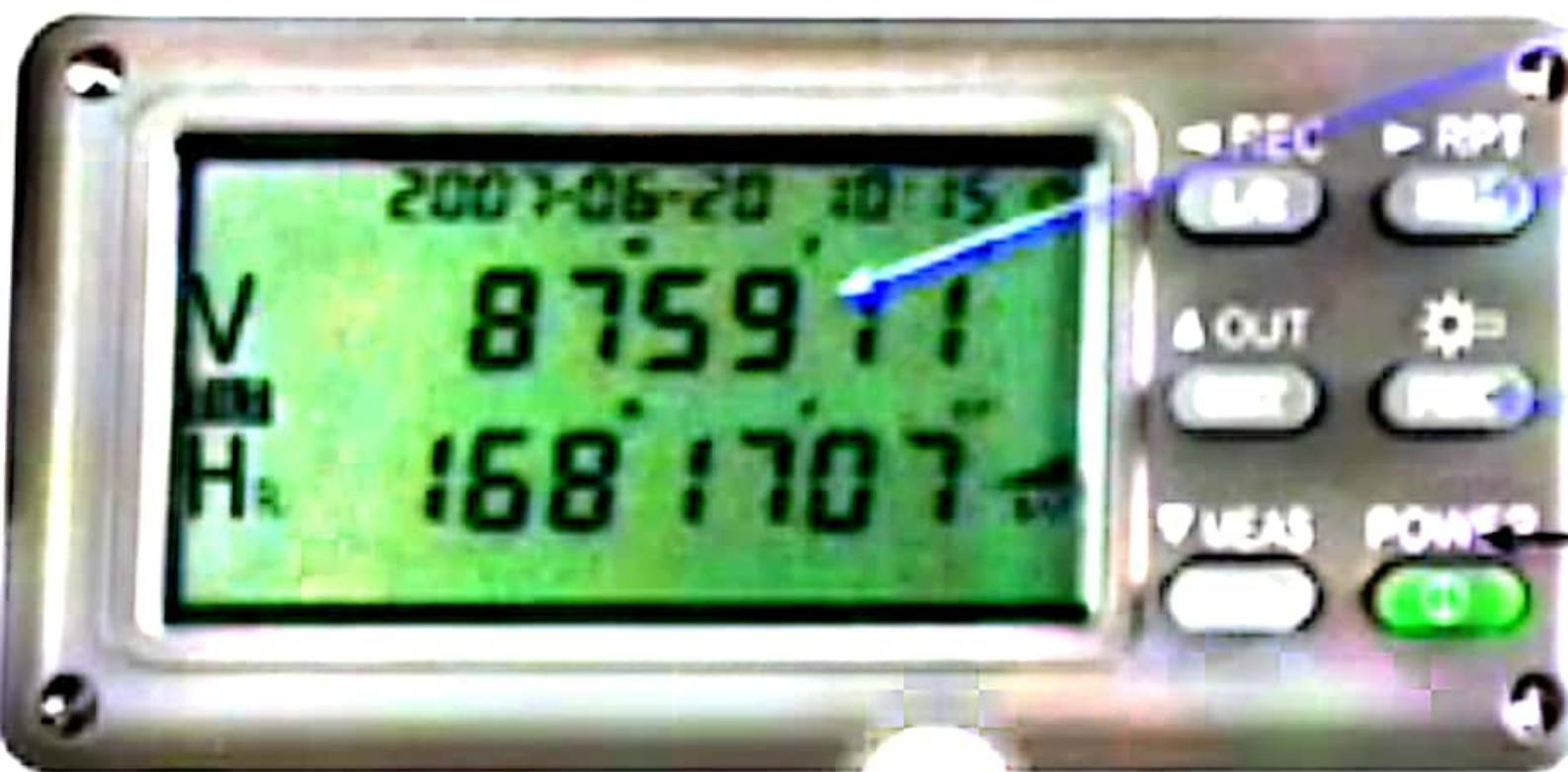
DIGITAL THEODOLITE ▌▌▌ 2

There are two different kinds of theodolites: digital and non digital. Non digital theodolites are rarely used anymore. Digital theodolites consist of a telescope that is mounted on a base, as well as an electronic readout screen that is used to display horizontal and vertical angles. Digital theodolites are convenient because the digital readouts take the place of traditional graduated circles and this creates more accurate

PARTS OF THEODOLITE

Eyepiece of Telescope

Telescope Focusing Knob

Objective Lens

Focusing Knob for Centering

Eyepiece for Optical Plummet

Port for Controller

Vertical Clamp Screw

Vertical Tangent Screw

Power Switch

Circular Vial

Leveling Screw

Base

1

Save key: Press it under shift mode and then it is saved in memory.

Press it to move cursor **LEFT** under special function mode

Select the key for right or left Horizontal angle Press key alternately

2

Repeated measure key: Press it to enter repeated state under shift mode

Press it to move cursor **RIGHT** under special function mode.

Horizontal angle Locking key: Press the key twice to lock horizontal angle. Press key again to return unlock mode.

3

4

Export key: Press it under shift mode export current angle to serial port and to record with electronic controller

Decreasing key: Press it under special function mode to cursor up or decreasing number.

Horizontal angle "0" setting key. Press it twice to set horizontal angle

Crosshair and LCD illuminating key: Press it for 3 sec to turn on light and than press it for 3 sec to turn off light

Mode shift key: Press it continuously to enter different mode alternatively performing functions mark on keys or penal respectively.

5
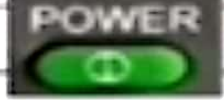
Distance measuring key: Press it under shift to make tracking measure once per second precision is 0.01m. Press it continuously to display slope distance, horizontal , vertical angle and alternatively.

Decreasing key. Press it under special function mode to cursor down or increasing number.

The Shift Key between Vertical angle and Slope percentage.

6

POWER SWITCH:
Press the key to turn on and press the key for over 2 sec to turn off.

Press-key	Function 1	Function 2
◄ REC L/R	Increment of right and left horizontal angle.	Save measured data
► RPT HOLD	Hold horizontal angle	measure angle repeatedly
▲ OUT OSET	Reset horizontal angle	Export measured data through serial-port
FUNC	Select the second function	Illumination for LCD and graduation board
▼ MEAS V/%	Vertical angle/slope angle percentage	Measure slope /horizontal/vertical distance
POWER	Power switch	

Setting items

1) Unit of angle measurement in degree (360°)

2) Automatic power off :10 min or 30 min " (factory setting 10 min)

3) Minimum angle of display 1" or 5" (factory setting 1")

4) The vertical angle reading passes through the quadrant of 0°, 90°, 180°, 270°, 360° with beep or no beep" (factory setting: beep)

5) Compatible with different kind EDMs

6) Current time setting: (yyyy-mm-dd)

Horizontal Angle Measurement

1) Turn the instrument clockwise to sight at the object A exactly, **press O SET(OUT)** twice to set horizontal angle to 0° 0' 00" as the initial zero direction.

V 705040

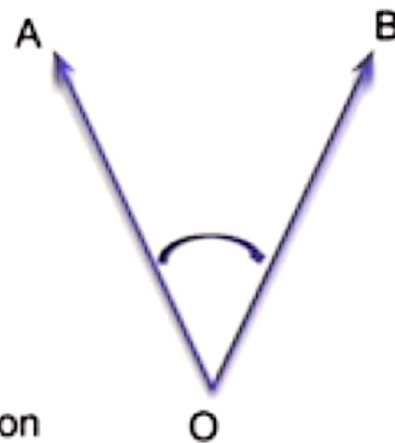H 00000   →   Horizontal angle is set to zero in A direction

Turn the instrument clockwise and sight at object B, Suppose that:

V 72 49 30   ← Vertical Angle

H 46 39 10   ←

horizontal angle in AB direction

A   B

O

Slope Percentage

The vertical angle can be converted into slope percentage in angle measurement mode. Press V/% and the display shows vertical angle or grade percentage alternately.
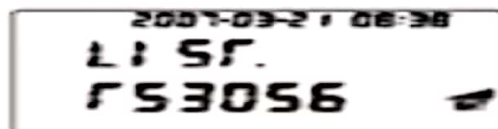
```
V%:  -45.491 %        ■■■
HA:   286°52´20"
```

Another depression of the [%/VA] key restores the vertical angle display.

```
VA:    114°27´40"     ■■■
HA:    286°52´20"
```

Review Angle Data in Memo

Press FUNC key and **'POWER'** key **to** turn on. After beeping three times. it enters memory Review interface.

```
2007-03-21 06:38
LIST.
rS3056          ✎
```

Press V/ % key to display angle data in memory mode. N. 000 means there is no angle data in memory.

```
2007-03-21 08:38
n. 000
0000000 ✎
```
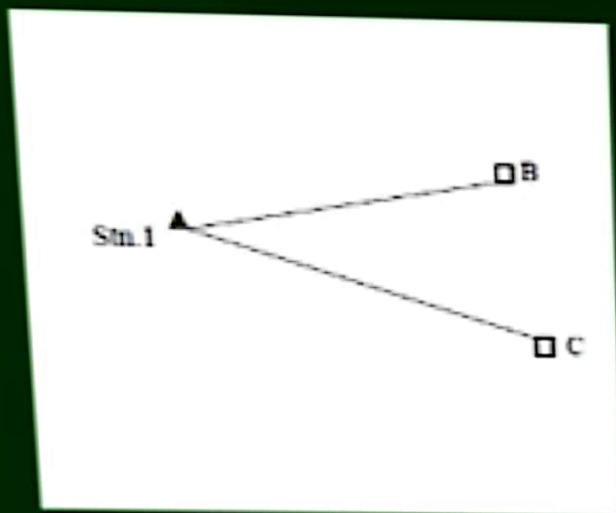
N. 001means there are angle data in memory. so we can use (▶) and (◀) to select angle in memory to look over. Use ▲ or ▼ to select vertical angle and horizontal angle displayed in the second line.

```
2007-03-21 08:38
∨   n. 004
10000000 ✎
```

press **FUNC**: to quit and return to review instrument serial number. Press again to quit memory mode and return to angle measure mode

An angle is define as a different in direction between two convergent lines.

A horizontal angle is formed by the direction to two objects in a horizontal plane.

A Vertical angle is formed by two intersecting lines in a vertical plane, one of this line horizontal.

A(Reference Object) B C
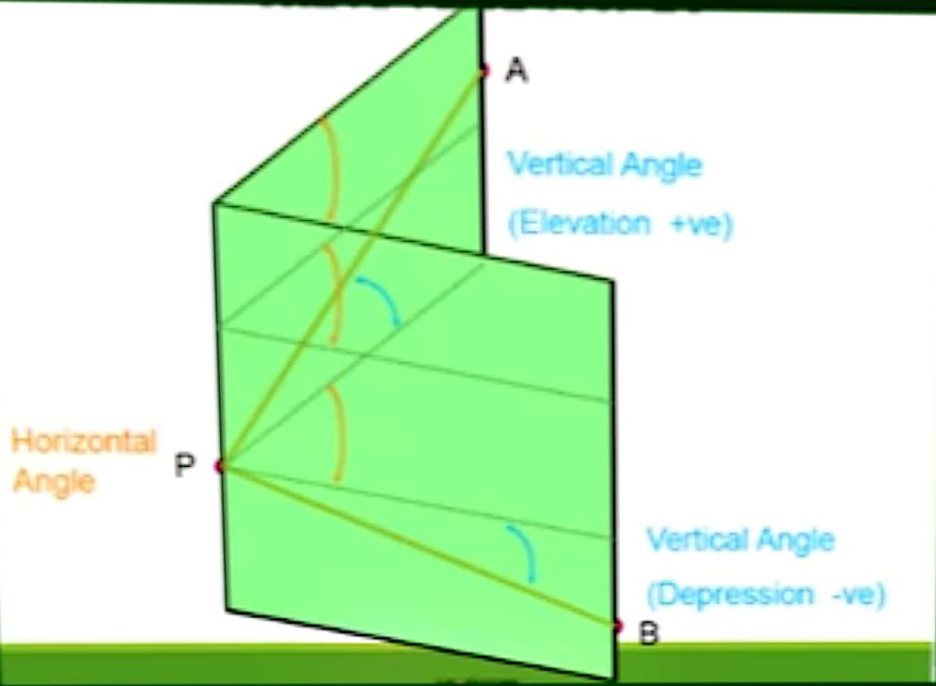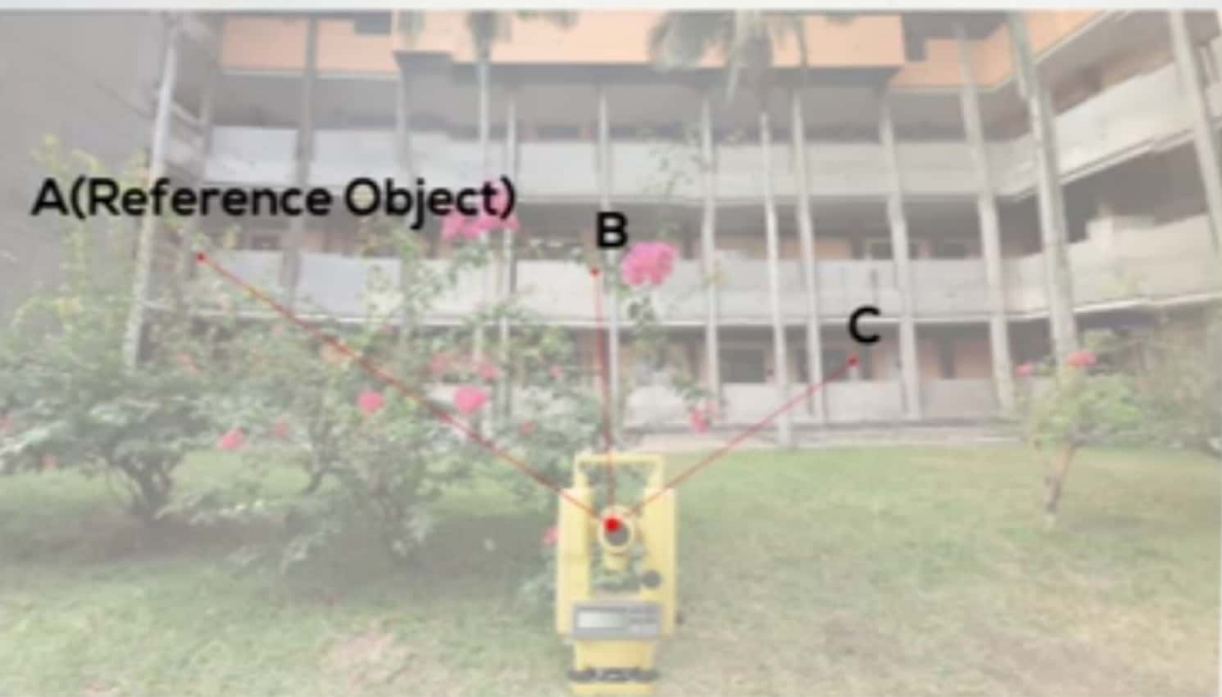
We had been given three points
which is A (as a reference
object), B, and C with different
quadrant.

REFERENCE OBJECT (RO)

A survey point that is used as an initial sight for orientation when measuring horizontal angle and direction

REDUCED ★ ANGLE

DEFINED BY THE ACUTE ANGLE WHICH IS THE LINE MAKES WITH THE MERIDIAN

What is Face left and Face right?

face right is when the vertical circle of an instrument is in the right side of the observer and face left is when vertical circle of an instrument is in left side of the observer while taking the readings during survey

If Face right is ‹180°, so face right need to +180° while if ›180°, face right need to -180°.

STATION 1

HORIZONTAL CIRCLE

POINT	FACE LEFT (FL)	FACE RIGHT (FR)	MEAN
R.O₁	0°00'00"	180°00'04"	00°00'02"
TARGET 2	36°00'47"	216°00'54"	36°00'51"
TARGET 3	252°40'41"	72°40'41"	72°40'41"
TARGET 4	235°33'19"	55°33'24"	235°33'22"
R.O₂	90°00'00"	270°00'10"	90°00'05"
TARGET 2	126°00'53"	306°01'00"	126°00'57"
TARGET 3	162°40'47"	342°40'41"	162°40'44"
TARGET 4	325°33'27"	145°33'32"	325°33'30"
R.O₃	180°00'00"	00°00'07"	180°00'04"
TARGET 2	216°00'57"	36°01'03"	46°01'00"
TARGET 3	252°40'47"	72°40'47"	252°40'47"
TARGET 4	55°33'25"	235°33'27"	55°33'26"
R.O₄	270°00'00"	90°00'00"	270°00'00"
TARGET 2	306°00'47"	126°00'57"	306°00'52"
TARGET 3	342°40'45"	162°40'41"	342°40'43"
TARGET 4	145°33'21"	325°33'21"	145°33'21"

TO FIND MEAN

FACE RIGHT -/+ 180° = A
216°00'54" -/+ 180° = 36°00'54"

A + FACE LEFT = B
36°00'54"+36°00'47" = 72°01'41"

B / 2 = MEAN TARGET 2
72°01'41"/ 2 = 36°00'51"

HOW TO CALCULATE THE REDUCED ANGLE ?

THE WAY TO CALCULATE REDUCED ANGLE
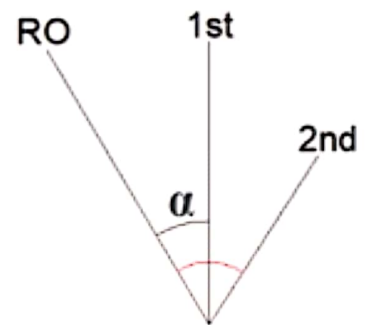
REDUCED ANGLE = MEAN-R.O MEAN

So,

31°55'18"-0°00'00"
=31°55'18"

Horizontal circle

Target	Face left	Face right	Mean	Reduced direction
1	0	180	$\frac{0°00'00"+(180°00'00"-180)}{2} = 0°00'00"$	0
2	31° 55' 15"	211° 55' 20"	$\frac{31°55'18"+(211°55'20"-180)}{2} = 31°55'18"$	31° 55' 18"
3	61° 40' 20"	241° 40' 05"	$\frac{61°40'13"+(241°40'40"-180)}{2} = 61°40'35"$	61° 40' 13"

TO FIND REDUCE DIRECTION

MEAN TARGET 2 - MEAN R.O
=36°00'51" - 00°00'02"
=36°00'49"

STATION 1

HORIZONTAL CIRCLE

POINT	FACE LEFT (FL)	FACE RIGHT (FR)	MEAN	REDUCED DIRECTION
R.O₁	0°00'00"	180°00'04"	00°00'02"	00°00'00"
TARGET 2	36°00'47"	216°00'54"	36°00'51"	36°00'49"
TARGET 3	252°40'41"	72°40'41"	72°40'41"	72°40'39"
TARGET 4	235°33'19"	55°33'24"	235°33'22"	235°52'41"
R.O₂	90°00'00"	270°00'10"	90°00'05"	90°00'00"
TARGET 2	126°00'53"	306°01'00"	126°00'57"	36°00'52"
TARGET 3	162°40'47"	342°40'41"	162°40'44"	72°40'39"
TARGET 4	325°33'27"	145°33'32"	325°33'30"	235°33'25"
R.O₃	180°00'00"	00°00'07"	180°00'04"	180°00'00"
TARGET 2	216°00'57"	36°01'03"	46°01'00"	36°00'56"
TARGET 3	252°40'47"	72°40'47"	252°40'47"	72°40'43"
TARGET 4	55°33'25"	235°33'27"	55°33'26"	124°26'38"
R.O₄	270°00'00"	90°00'00"	270°00'00"	270°00'00"
TARGET 2	306°00'47"	126°00'57"	306°00'52"	36°00'52"
TARGET 3	342°40'45"	162°40'41"	342°40'43"	72°40'43"
TARGET 4	145°33'21"	325°33'21"	145°33'21"	124°26'39"

FINAL ANGLE

STATION 1					
HORIZONTAL CIRCLE					
POINT	FACE LEFT (FL)	FACE RIGHT (FR)	MEAN	REDUCED DIRECTION	FINAL ANGLE
R.O₁	0°00'00"	180°00'04"	00°00'02"	00°00'00"	00°00'00"
TARGET 2	36°00'47"	216°00'54"	36°00'51"	36°00'49"	36°00'52"
TARGET 3	252°40'41"	72°40'41"	72°40'41"	72°40'39"	
TARGET 4	235°33'19"	55°33'24"	235°33'22"	235°52'41"	
R.O₂	90°00'00"	270°00'10"	90°00'05"	90°00'00"	
TARGET 2	126°00'53"	306°01'00"	126°00'57"	36°00'52"	
TARGET 3	162°40'47"	342°40'41"	162°40'44"	72°40'39"	72°40'41"
TARGET 4	325°33'27"	145°33'32"	325°33'30"	235°33'25"	
R.O₃	180°00'00"	00°00'07"	180°00'04"	180°00'00"	
TARGET 2	216°00'57"	36°01'03"	46°01'00"	36°00'56"	
TARGET 3	252°40'47"	72°40'47"	252°40'47"	72°40'43"	
TARGET 4	55°33'25"	235°33'27"	55°33'26"	124°26'38"	180°04'51"
R.O₄	270°00'00"	90°00'00"	270°00'00"	270°00'00"	
TARGET 2	306°00'47"	126°00'57"	306°00'52"	36°00'52"	
TARGET 3	342°40'45"	162°40'41"	342°40'43"	72°40'43"	
TARGET 4	145°33'21"	325°33'21"	145°33'21"	124°26'39"	

144°03'29"/4
=36°00'52"

36°00'49"+36°00'52" + 36°00'56"+ 36°00'52"+ =144°03'29"

RESULT OF FINAL
BEARINGS

R.O

36°00'52"

TARGET 2

72°40'41"

TARGET 3

180°04'51"

TARGET 4

Scanned with Car
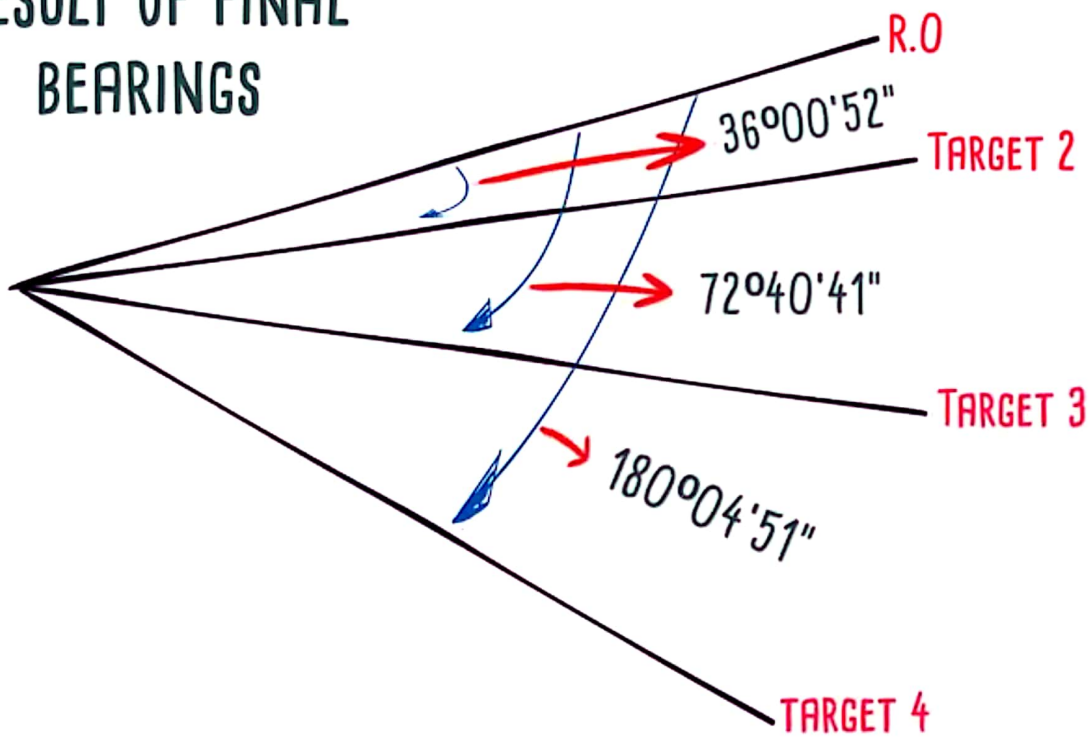
How to find reduced direction for (FL) & (FR).

FACE LEFT +/- 90º=RD (FL)

78º28'13" +/-90º=11º31'47"

FACE RIGHT +/- 90º = RD(FR)

281º31'52" +/-90º=11º31'52"

STATION R. O				
VERTICAL CIRCLE				
POINT	FACE LEFT (FL)	FACE RIGHT (FR)	REDUCED DIRECTION (FL)	REDUCED DIRECTION (FR)
R.O	78º 28' 13"	281º 31' 52"	11º 31' 47"	11º 31' 52"
TARGET 2	72º 34' 42"	287º 25' 09"	17º 25' 18"	17º 25' 09"
TARGET 3	89º 45' 09"	270º 14' 47"	00º 14' 51"	00º 14' 47"
TARGET 4	77º 50' 16"	282º 09' 58"	12º 09' 44"	12º 09' 58"

Vertical Angle

In vertical calculation, the result in vertical are not similar with horizontal angle which the formula using in both calculations actually different. However, method for calculate face left and face right is same either in vertical or horizontal which is

Face right − face left = +/-180°

270°00' 00" - 90°00'00" = +/-180°

While, reduced direction in vertical angle can be calculate by the quadrant. For example:

Quadrant 4	Quadrant 1
360° - answer	90° - answer
270° - answer	180° - answer
Quadrant 3	Quadrant 2

Vertical Angle

Point	VERTICAL		REDUCED DIRECTION	
	Face left	Face right	Face left	Face right
A (ro)	78° 44' 52"	281° 15' 07"	78° 44' 52"	79° 15' 07"
B	90° 21' 12"	269 38' 53"	90° 21' 12"	91° 38' 53"

Based on the point A,

Face right: Quadrant 4 – answer

       : 360° 00' 00" - 281° 15' 07"

       : 79° 15' 07"

Face left: 78° 44' 52"

Besides, our final angle in vertical calculation measure by:-

= $\dfrac{\text{Reduced direction (FL) + Reduced direction (FR)}}{2}$

= $\dfrac{79° 15' 07" + 78° 44' 52"}{2}$ = 78° 59' 60"

How to Find Height By Theodolite.

215°

Tan ∅ = 215° − 180° = 35°

28'

35°

Abrar rahi

180°

$$\text{Tan } 35° = \frac{P}{B}$$

No To find the Total Height

Total Height = 15' + 28'

P = Tan 35° × 40'

P = 28'

Total Height = 43'

15'

40'