

# **CE 673A INSTRUMENTATION LABORATORY AND FIELD PRACTICES**

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# AGENDA

Introduction

Control Network Setup

- Reconnaissance
- GNSS Traversing
- Levelling
- Feature mapping

Deliverables

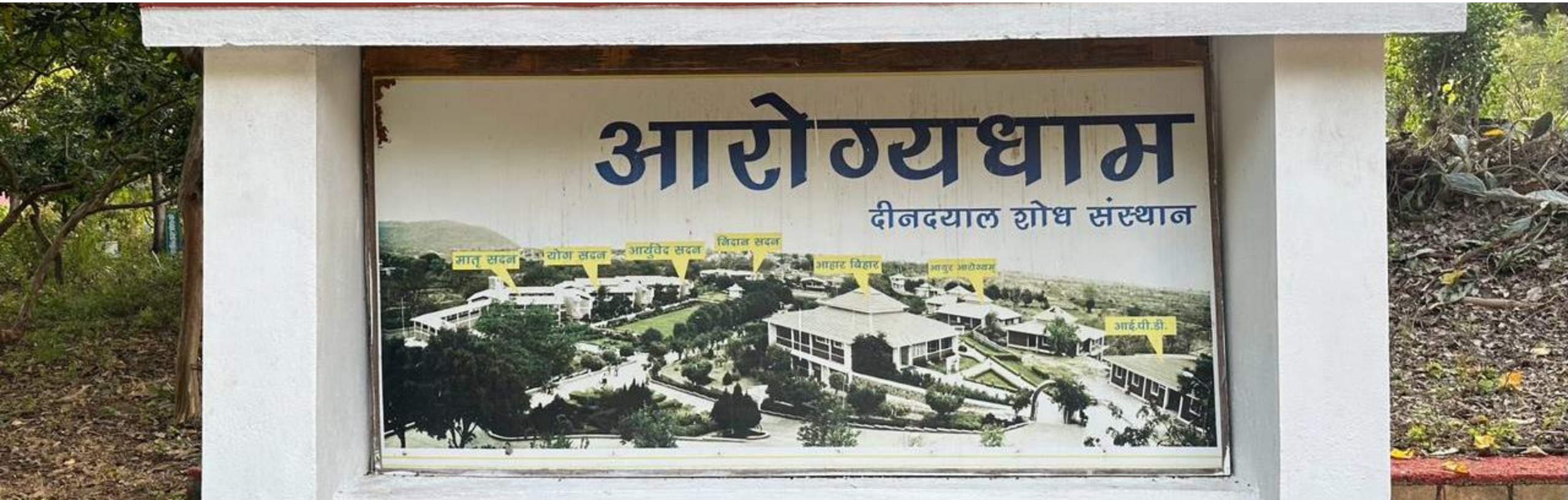
Lab work

- Chain and Compass survey
- EDM Calibration
- TS Traversing



# INTRODUCTION

The CE673A Instrumentation Laboratory and field practices in Geoinformatics project encapsulated an immersive one-week expedition into the heart of Aarogydham Chitrakoot area, Madhya Pradesh, commencing on November 28th, 2023. This endeavor aimed at learning practical skills in Geoinformatics, instrumental surveying techniques





# RECONNAISSANCE SURVEY

Criteria for CP selection:

1. Intervisibility between two CP
2. Open to sky
3. Maximum area coverage
4. Point should not be in busy location

Number of CP: 7

Control Network:



fig: CPs displayed in ArcGis Pro

## GNSS TRAVERSING

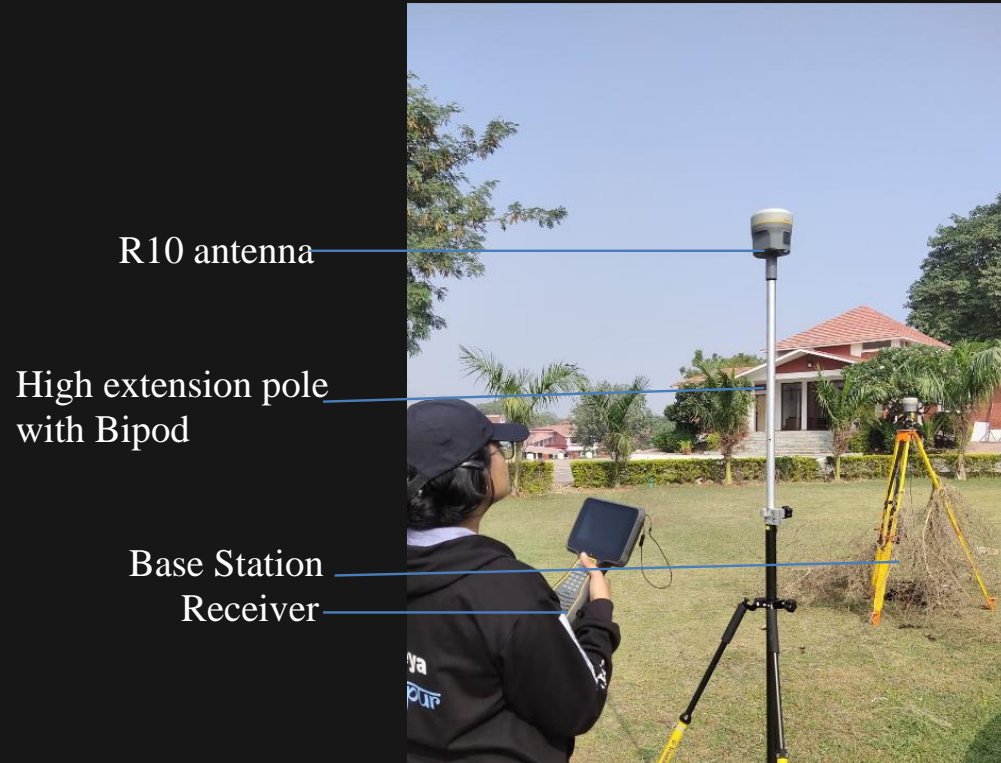


Fig: R10 GNSS receiver in rover and base mode

Transit rule:

Northing adjustment for each point =

$$\left( \frac{\Delta N \text{ for traverse line to point}}{\sum \Delta N} \right) * \text{Northing closure error}$$

Easting adjustment for each point =

$$\left( \frac{\Delta E \text{ for traverse line to point}}{\sum \Delta E} \right) * \text{Easting closure error}$$

Readings: Static mode by R10 GNSS receiver

Post processing: TBC processing

Accuracy

Preprocessing:

Postprocessing:

e/p ratio: *1:203563 (first order class of 1:25000)*



LEVELLING BY AUTO LEVEL



Fig: Surveyor using Auto level and holding staff

BS	FS	HI	RL	Remark
0.975		100.975	100	BM
0.54	1.335	100.18	99.64	CP1
0.76	2.875	98.065	97.305	
1.22	2.16	97.125	95.905	CP2
0.81	1.39	96.545	95.735	
2.83	1.65	97.725	94.895	CP3
1.71	1.085	98.35	96.64	CP4
3.765	4.38	97.735	93.97	CP5
2.665	0.955	99.445	96.78	
1.325	0.365	100.405	99.08	CP6
1.285	1.385	100.305	99.02	CP7
1.305	0.88	100.73	99.45	
	0.725		100.00	

Table : reduced level of CPs

Method of levelling: HI method  
Closing error: 0.005 m  
Classification: Precision levelling (C: 2.639)

Purpose: Determine Orthometric height of CP

Correction: loop closure as function of distance

## FEATURE MAPPING BY TOTAL STATION



Fig: TS reading by target staff for contour data

Point	Easting (m)	Northing (m)	Elevation (m)
p1	486246.8	2781781	90.214
p2	486195	2781799	86.332
p3	486157	2781820	85.1
p4	486174.5	2781842	87.198
p5	486237.1	2781901	84.555
p6	486271.4	2781871	89.658
p7	486247.6	2781820	89.999

Oriented by back-sighting the previous CP  
N, E are added for CP, while orthometric height  
obtained by Auto level is added in elevation

Purpose: Determine co-ordinates for feature mapping



Fig: Data points in Arc GIS



# TOPOGRAPHIC MAP

Topographical map of Aarogyadham digitized on Arc GIS

Scale : 1: 1500 (Large scale map), 1 cm on map is 15 m on ground

Plottable error: 37.5 cm

Contour interval: 1m (rolling terrain)

CRS: WGS 84, UTM zone 44

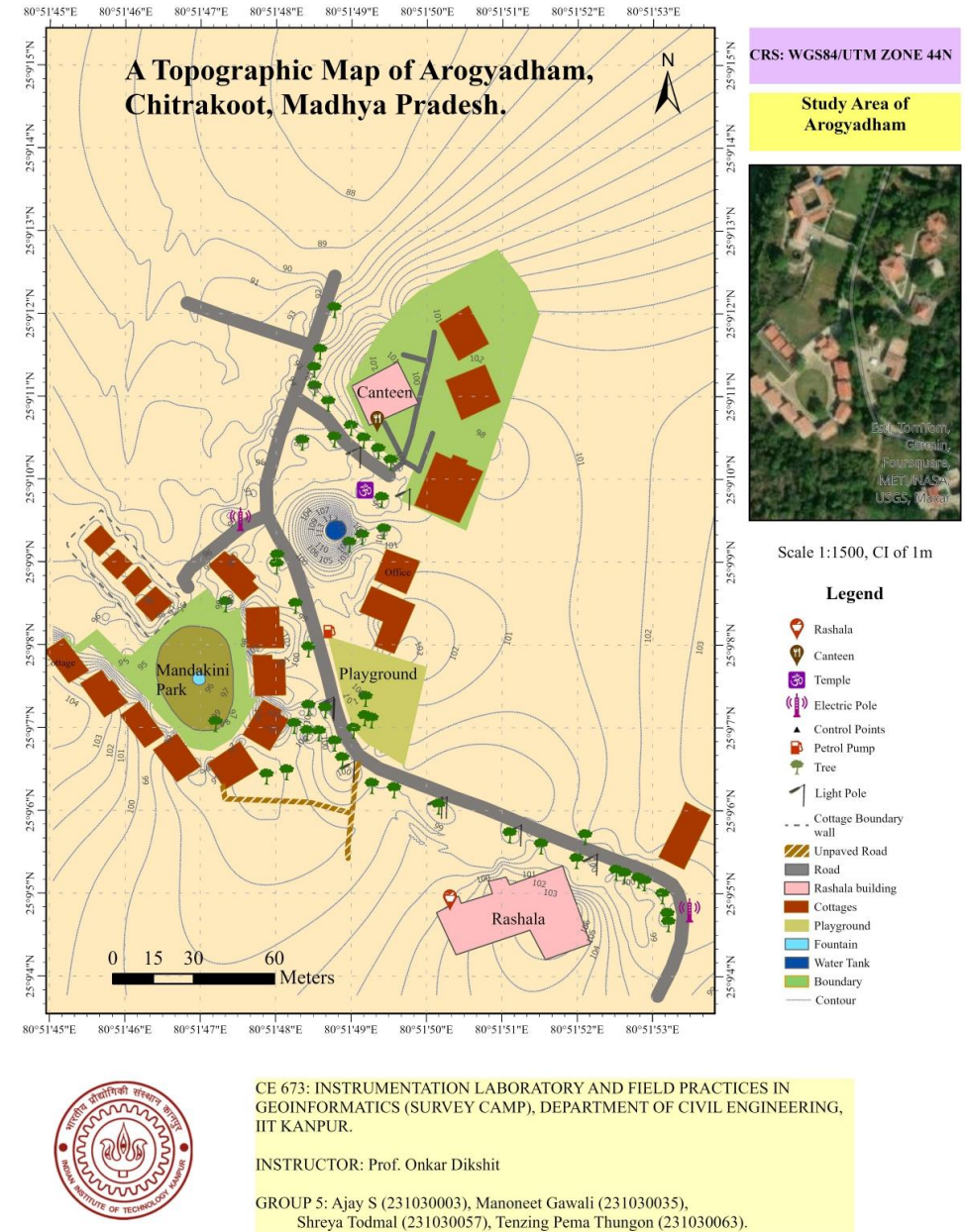


Fig: Topo map of Aarogyadham digitized on Arc GIS



## ROAD PROFILE

Ground preparations:

- Section at 20 m interval
- Divide each section in 5 parts, 0.9m each, width of road is 3.6m

Purpose: Insight about the change in elevation w.r.t. length of the road

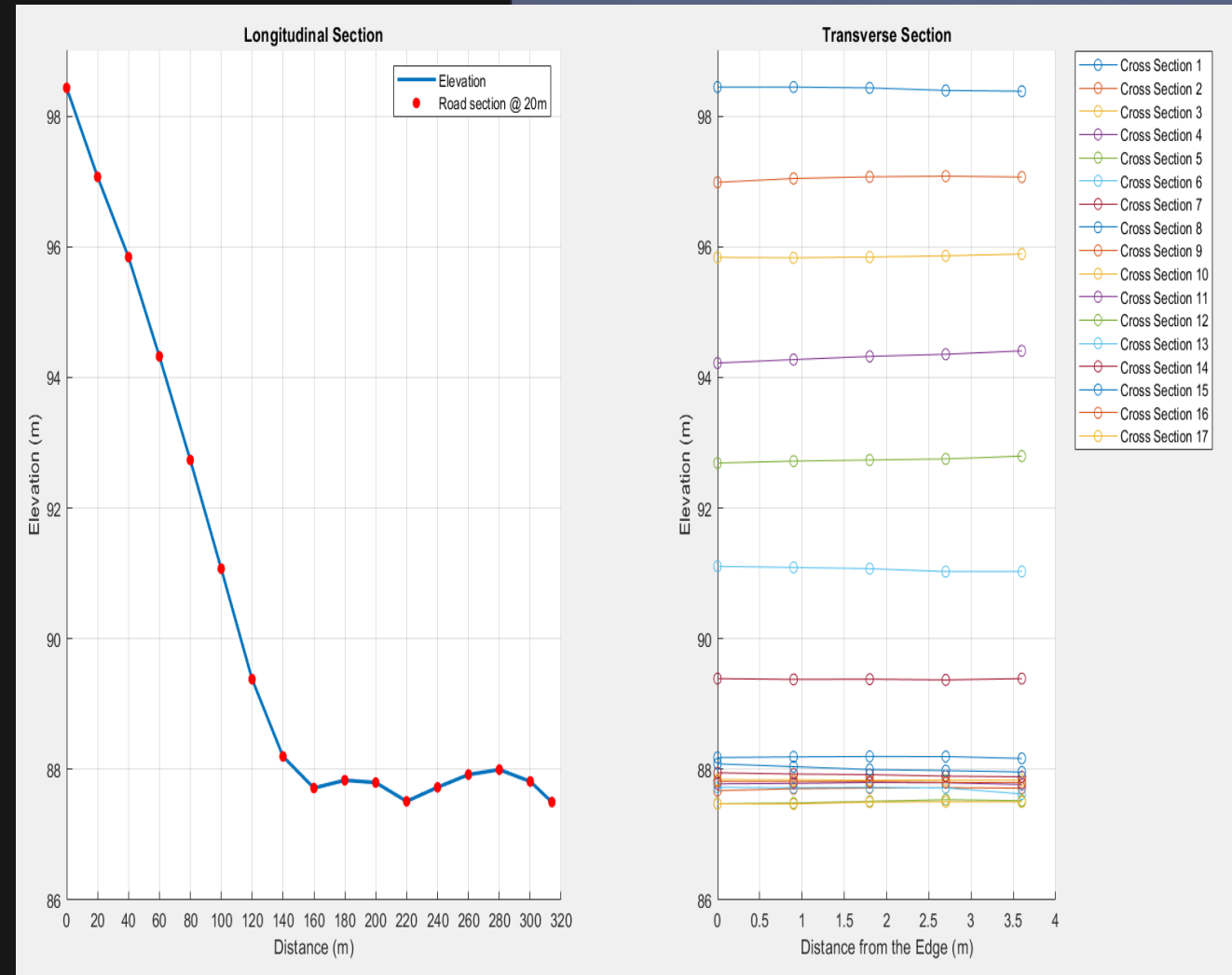


Fig: Road profile

## JUNO SURVEY



Fig: Surveyor using Juno 3B

Scale : 1: 15000 (Large scale map), 1 cm on map is 150 m on ground

Plottable error: 3750 cm

CRS: WGS 84, UTM zone 44

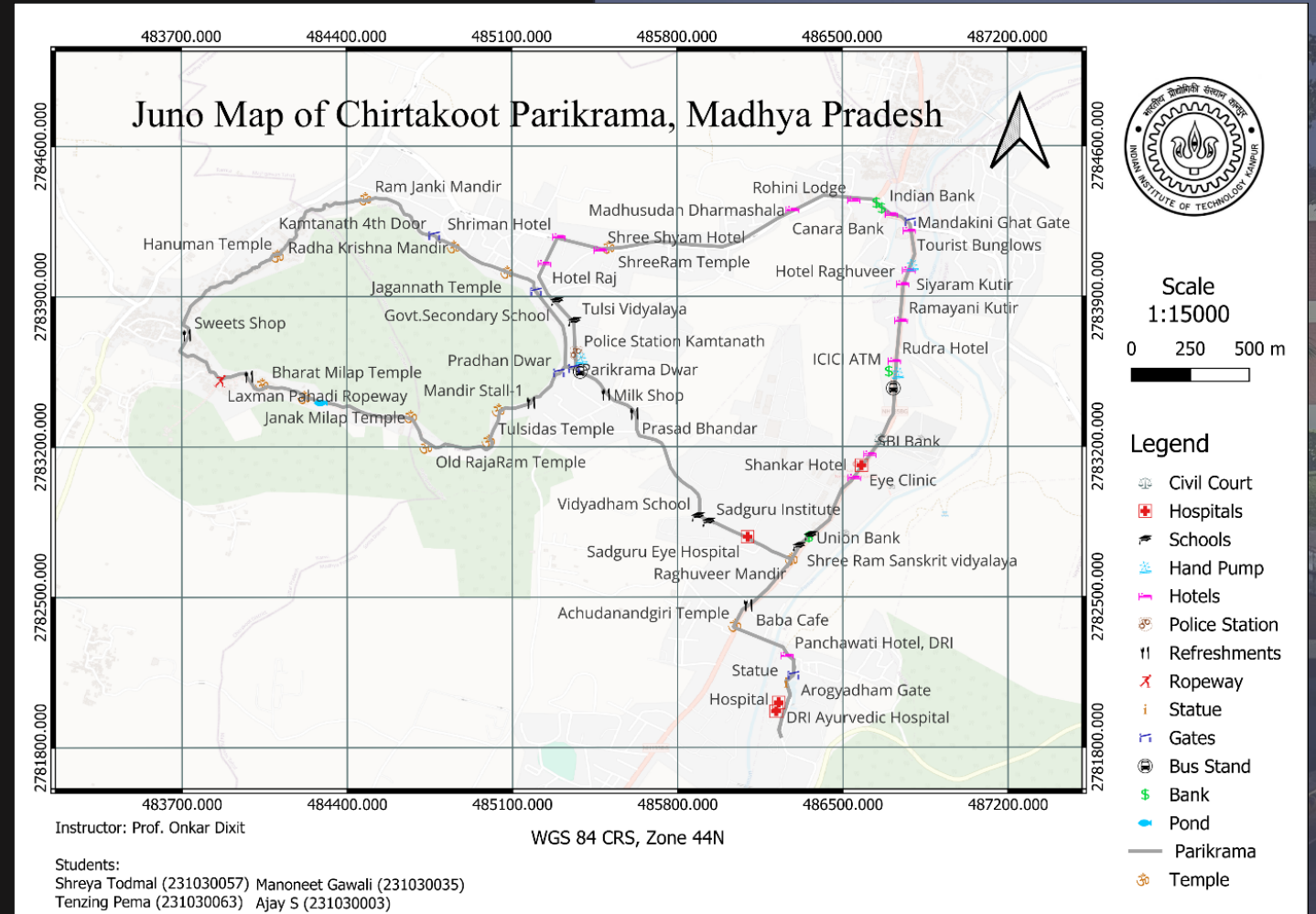


Fig: Navigational map of Chitrakoot Parikrama digitized on Q GIS



## CHAIN AND COMPASS SURVEY



Fig: Main station setup and prismatic compass

Close traverse plotted by both linear and angle measurements

Graphical method is used for correction

Three main stations are set up A, B,C

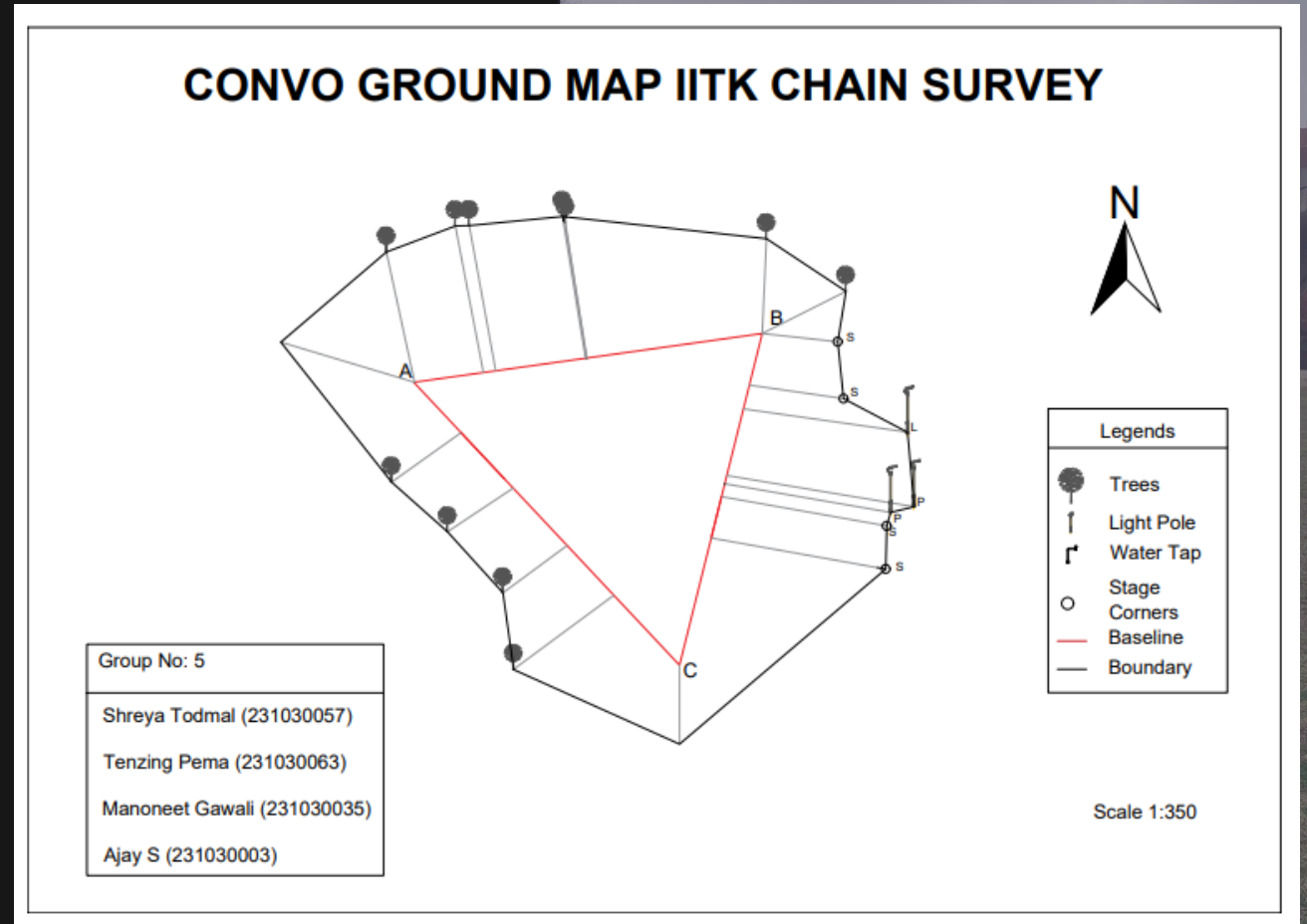


Fig: Convo ground map by chain and compass surveying

## EDMI CALIBRATION

Taped dist di( m)	taped distance	EDMI dist, Di (m)	Do + Sd (m)	Di- (D0+sum (d)) (m)	Correction (m) Cyclic error	Corrected distance
20	0	19.995	20	-0.005	0.0045	19.77905
21	1	20.997	21	-0.003	0.0042	20.77023
22	2	21.993	22	-0.007	0.0035	21.75548
23	3	22.996	23	-0.004	0.0035	22.74764
24	4	23.991	24	-0.009	0.0026	23.7319
25	5	24.989	25	-0.011	0.0024	24.71912
26	6	25.988	26	-0.012	0.0023	25.70733
27	7	26.988	27	-0.012	0.0023	26.69653
28	8	27.994	28	-0.006	0.0017	27.69166
29	9	27.994	29	-1.006	-0.0083	27.69166
30	10	29.993	30	-0.007	0.0016	29.66908

Table : EDM corrected distance by cycle error and scale error

Distance by EDM:

$$2D = m\lambda + \frac{\phi}{2\pi}\lambda + k$$

Purpose:

- Determine cyclic error
- Reflector instrument constant
- Scale error

Scale error : 10.18 ppm

Corrected distance:

$$\text{corrected distance} = \text{scale error(ppm)} \frac{\text{Measured distance}}{1000}$$



TOTAL STATION TRAVERSING

Station Observed	Face L/R	Horizontal Angle				Successive difference	Adjusted angle
		Reading (Degrees)	Mean of interior angle	Multiples of average corrections	Correction rounded		
A	L	0	144.086235	0.012	0.0125	0.0125	144 5' 55"
D		144.1572					
A'		0.0025					
Error		-0.0025					
A	R	180	94.177625	0.249	0.025	0.0125	94 11' 24"
D		324.01527					
A'		179.9991					
Error		0.0009					
B	L	0	72.479995	0.0374	0.0375	0.0125	72 29' 33"
A		94.17805					
B'		0.0011					
Error		-0.0011					
B	R	180	49.206385	0.0499	0.05	0.0125	49 13' 8"
A		274.1772					
B'		180.01694					
Error		-0.01694					
C	L	0	57.862	0.0374	0.0375	0.0125	57 29' 33"
B		72.47777					
C'		0.0025					
Error		-0.0025					
C	R	180	49.206385	0.0499	0.05	0.0125	49 13' 8"
B		252.48222					
C'		180.00111					
Error		0.00111					
C	L	0	49.206385	0.0499	0.05	0.0125	49 13' 8"
D		49.16694					
C'		0.003888					
Error		0.003888					
C	R	180	49.206385	0.0499	0.05	0.0125	49 13' 8"
D		229.24583					
C'		180.03888					
Error		0.03888					
						0.05	360 0' 0"

Table : TS traverse corrections

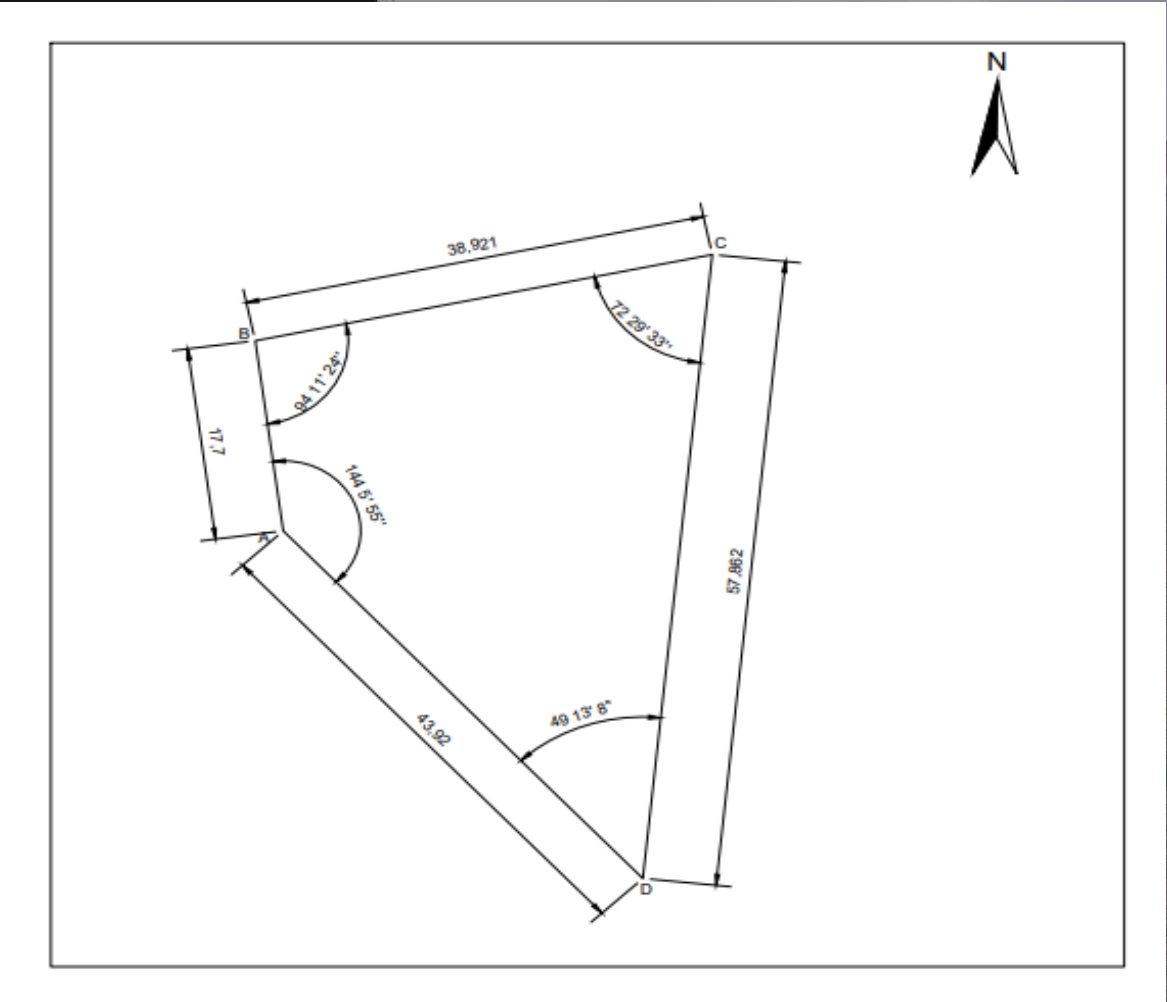


Fig : Traversing of convo ground by TS



# THANK YOU

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TAs