TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PASHCHIMANCHAL CAMPUS
DEPARTMENT OF GEOMATICS ENGINEERING
LAMACHAUR-16, POKHARA, NEPAL

A REPORT ON

FIELD SURVEY 2080

COURSE: GE654 (FIELD SURVEY II)

SUBMITTED TO:

DEPARTMENT OF GEOMATICS ENGINEERING
WESTERN REGIONAL CAMPUS, POKHARA-16

SUBMITTED BY:

GROUP "A"

AADARSHA ACHARYA	(PAS077BGE001)
BARSHA BASNET	(PAS077BGE008)
RABINDRA BHUSAL	(PAS077BGE030)
SACHIN RAYAMAJHI	(PAS077BGE036)
SHRADAYA RAJ POUDEL	(PAS077BGE044)
SACHIN ARYAL	(PAS076BGE034)

DATE: 2024-05-02

ACKNOWLEDGEMENT

We extend our heartfelt gratitude to everyone who contributed to the success of our survey campaign, "BGE Survey Camp II - 2080." This endeavour required immense effort, research, and dedication, and we are immensely grateful for the support we received.

We would like to express our deepest gratitude to the Department of Geomatics Engineering, for conducting survey camp. In order to accomplish the aim, this survey camp provided us opportunity to incorporate amazing experiences and task-oriented work. A special acknowledgment goes to Er. Netra Bahadur Katuwal, the coordinator of the survey camp, for his invaluable assistance, motivating suggestions, encouragement, and continuous supervision throughout the fieldwork and the completion of the report. His guidance played a pivotal role in the success of our campaign.

We would like to express our sincere appreciation to our esteemed teachers, Er. Umesh Bhurtyal, Dr. Er. Niraj K.C, Er. Saurav Gautam, and Er. Pradip Aryal, for their sincere help and encouragement. Their support was crucial in navigating the challenges and ensuring the quality of our work. Special thanks to survey officer from District Survey Office, Kaski Mrs. Sandhya Dhakal for assisting us during cadastral survey.

Our heartfelt thanks also goes to Er. Nirmal Baral, Campus Chief of Pashchimanchal Campus, all the undergraduate and postgraduate colleges located within our survey area, and everyone who indirectly contributed to our success. Your support did not go unnoticed, and we are truly grateful for your assistance.

Finally, we extend our sincere gratitude to all our colleagues for their unwavering support and insightful comments. Your collaboration was instrumental in the accomplishment of our goals.

Once again, thank you to everyone involved in making the BGE Survey Camp II - 2080 a resounding success. Your contributions have left a lasting impact on our journey, and we are truly grateful.

ABSTRACT

This report presents the comprehensive findings and outcomes derived from the collaborative efforts of Group "A" students during the "Survey Camp-2080." The camp focused on executing a GPS Survey in a selected study area within Pokhara, Kaski, encompassing Cadastral Survey, Hydropower Survey, DGPS, and Drone Survey of Armala, Pokhara. Furthermore, the camp provided a platform for practicing Global Navigation Satellite System (GNSS) surveying, specifically Differential GPS (DGPS), to attain precise coordinates for locations. Additionally, participants explored the utilization of Drone Survey techniques for flight planning and post-processing of images, coupled with known Ground Control Points (GCP). The primary objectives included familiarizing ourselves with surveying instruments, understanding their functionalities, and honing the skills required for efficient field surveys. The broad aim was to demonstrate a seamless integration of theoretical and practical knowledge in Engineering Surveying. The report details the systematic methodology employed, the observations made, calculations performed, error adjustment methods applied, and the results obtained during the survey. Challenges encountered in the fieldwork are addressed along with concise solutions. The culmination of our efforts is manifested in the obtained results, meticulously presented within the report. A significant aspect of the survey involved the creation of a cadastral map for the designated area, fulfilling to technical requirements. Our group undertook fieldwork to make informed decisions regarding the planning and execution of thematic maps, utilizing GPS, cadastral maps, and hydropower components' maps in GIS. Through this process, we gained a profound understanding of GIS, enhancing our confidence in executing precision engineering surveys in GPS, hydropower, and cadastral surveying. Furthermore, the camp provided a platform for practicing GNSS (DGPS) surveying to attain precise coordinates for locations. Additionally, the utilization of Drone Survey techniques for flight planning and post-processing of images, coupled with known Ground Control Points (GCP), was explored. In addition to the core objectives, the report also encompasses miscellaneous tasks completed during the camp, including the calculation of parcel area using both automatic and manual processes. Furthermore, participants conducted height measurements of towers using Total Stations (TS) and utilized TS features to measure missing line segments accurately. In a nutshell, the report culminates with the presentation of the survey area map, accompanied by attribute data, encapsulating the comprehensive insights gained from the Survey Camp-2080. This experience has not only enriched our understanding of various surveying techniques but has also equipped us with practical skills essential for future endeavours in the field of Engineering Surveying.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATION

BM = Bench Mark

CP = Control Station

DoS = Department of Survey

GIS = Geographical Information System

GNSS = Global Navigation Satellite System

GPS = Global Positioning System

DGPS= Differential Global Positioning System

LIS = Land Information System

OSM = Open Street Map

QGIS = Quantum Information System

SD = Survey Department

TS = Total Station

DoD = Department of Defence

KEYWORDS

1. Global Positioning System (GPS)
2. Navigation System with Timing and Ranging (NAVSTAR)
3. Satellite-based navigation
4. Total Station
5. Triangulation
6. Cadastral surveying
7. Digital cadastre system
8. Thematic mapping
9. Hydropower components
10. GPS positioning
11. Adjudication
12. Boundary demarcation
13. Map verification

CHAPTER 1 GPS SURVEY

1.1 INTRODUCTION

1.1.1 BACKGROUND

The Global Positioning System (GPS) is a satellite-based radio-based navigation system that was developed by the U.S. Department of Defence (DoD) in the early 1970s. The United States Navy conducted satellite navigation experiments in the mid 1960's to track US submarines carrying nuclear missiles. In the early 1970's, the Department of Defence (DoD) wanted to ensure a robust, stable satellite navigation system, consequently launched its first Navigation System with Timing and Ranging (NAVSTAR) satellite in 1978. The 24-satellite system became fully operational in 1993. Today, GPS is a multi-use, space-based radio navigation system owned by the US Government and operated by the United States Air Force (NASA, 2017). GPS satellites are powered by solar energy. They have backup batteries on-board to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path. Each satellite weighs about 2,000 pounds and is built to last about ten years.

1.1.2 GPS

The Global Positioning System consists of 24 satellites, that circle the globe once every 12 hours, to provide worldwide position, time and velocity information. GPS makes it possible to precisely identify locations on the earth by measuring distance from the satellites. GPS allows us to record or create locations from places on the earth and help us navigate to and from those places. Originally the System was designed only for military applications and it wasn't until the 1980's that it was made available for civilian use also. GPS provides continuous positioning and timing information, anywhere in the world under any weather conditions. Because it serves an unlimited number of users as well as being used for security reasons, GPS is a one-way-ranging (passive) system. That is, users can only receive the satellite signals (What-When-How, p. 2008). GPS currently provides two levels of service:

- Standard Positioning Service (SPS) which uses 2 the coarse acquisition (C/A) code on the L1 frequency.
- Precise Positioning Service (PPS) which uses the P(Y) code on both the L1 and L2 frequencies.

There are three types of segments in GPS surveying.

- ✓ Space Segment: The space segment consists of a group of 24 satellites orbiting the Earth to help determine locations on the ground. Each satellite sends out signals containing carrier frequencies, digital codes, and a navigation message. By receiving signals from at least four satellites, GPS devices can calculate their exact position using timing and satellite positions. This allows users to find their location accurately anywhere on Earth.

- ✓ Control Segment: The control segment of the GPS system has tracking stations worldwide, with a main control station in Colorado Springs, USA. It tracks GPS satellites to predict their locations, check system integrity, monitor satellite clocks, gather atmospheric data, and maintain the satellite almanac. Monitor stations receive satellite signals, calculate pseudo ranges, and send data to the main control station. The main control station uses this data to compute satellite orbits, monitor clock behaviour, and generate navigation messages. These messages are sent to ground antennas and then transmitted to satellites. With global antennas, the control segment communicates with each satellite at least three times daily.
- ✓ User Segment: The user segment includes military and civilian users alike. By connecting a GPS receiver to a GPS antenna, users can receive GPS signals, enabling them to pinpoint their location anywhere worldwide. Importantly, GPS services are accessible to all users globally without any direct charges.

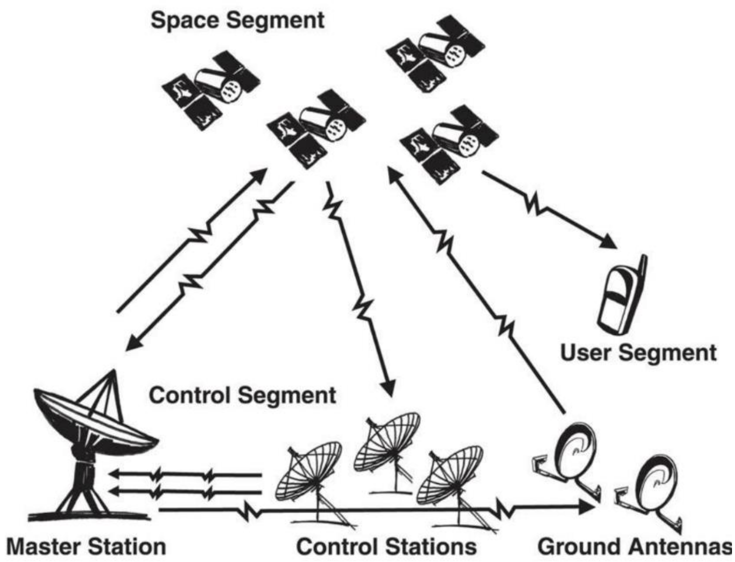


Figure 1: Segments of GPS
Source: General Technical Information (wordpress.com)

1.1.3 WORKING PRINCIPLE

GPS positioning relies on the triangulation principle, estimating the distance between the receiver and visible satellites. This distance is determined by calculating the time it takes for a signal to travel from the satellite to the receiver, considering the signal's speed as the speed of light. Users must know the GPS time used by the satellites to calculate their position accurately.

The GPS measurement process involves calculating four variables:

- ✓ The receiver's three-dimensional position.
- ✓ The time difference between the receiver's clock and the satellite's on-board clock.

For a GPS measurement, a minimum of four satellites is required to determine these four variables. However, if the time difference between the satellite constellation's time reference and the receiver's time reference is known, only three satellites are needed to deduce the user's position. In theory, three spheres intersect at two points, but one point can be disregarded if it results in an implausible position or velocity (e.g., not located on Earth's surface).

The mathematical representation of the triangulation principle for GPS involves solving a system of equations. Given the positions of satellites (S_1, S_2, S_3, and S_4) and the distances (d_1, d_2, d_3, d_4) to the receiver (R), the receiver's position (x, y, and z) and time offset (Δt) can be found.

The system of equations incorporates the known positions of satellites, signal transmission times, and the speed of light (c).

$$(x - x_1)^2 + (y - y_1)^2 + (z - z_1)^2 = (c \cdot (t_1 + \Delta t))^2$$

$$(x - x_2)^2 + (y - y_2)^2 + (z - z_2)^2 = (c \cdot (t_2 + \Delta t))^2$$

$$(x - x_3)^2 + (y - y_3)^2 + (z - z_3)^2 = (c \cdot (t_3 + \Delta t))^2$$

$$(x - x_4)^2 + (y - y_4)^2 + (z - z_4)^2 = (c \cdot (t_4 + \Delta t))^2$$

This mathematical model allows the receiver to accurately calculate its position and time offset, ensuring precise navigation.

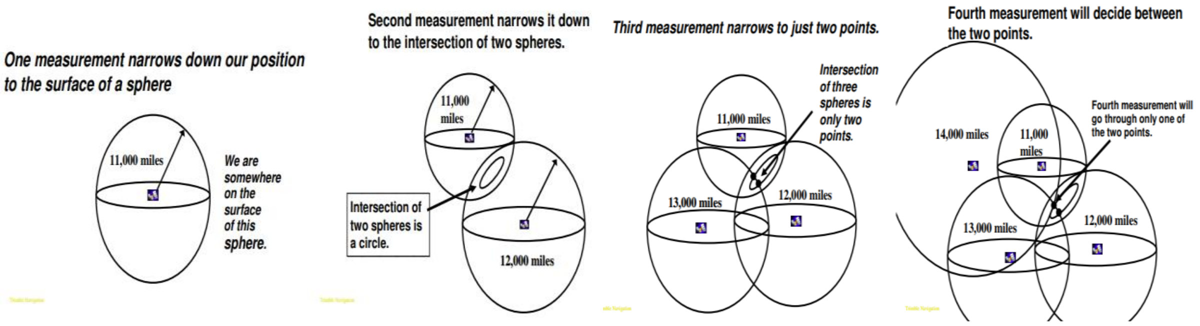


Figure 2: Working Procedure of GPS

Source: New Hampshire (nh.gov)

1.1.4 THEMATIC MAPPING

Thematic maps are single-topic maps that focus on specific themes or phenomena, such as population density, rainfall and precipitation levels, vegetation distribution, and poverty. This differs from reference maps which include a number of different elements like roads, topography, and political boundaries. A thematic map is a type of map that portrays the geographic pattern of a particular subject matter (theme) in a geographic area. This usually involves the use of map symbols to visualize selected properties of geographic features that are not naturally visible, such as temperature, language, or population. Thematic maps have attributes that make spatial patterns clearer, shedding new light on the theme in questions and allowing for further insights (Maptive, 2020).

A thematic map mainly contains primary contents, secondary contents, and supportive contents. The primary content is the main theme, secondary content is a topographic base map and supportive content is marginal information. There are so many varieties of the thematic maps such as a chorochromatic map, choropleth maps, isoline map, isopleth map, prism map, dot maps, proportional symbol maps, flow line maps cartograms. For point data, dot and proportional symbol map is preferred, for line data isoline or isopleth map are preferred and for area data choropleth chorochromatic etc. may be preferred.

1.2 OBJECTIVES

1.2.1 Main Objective

1. To prepare a map showing all the undergraduate and postgraduate colleges recorded at area of interest.

1.2.2 General Objective

1. To know about handling Handheld GPS device.
2. To use GPS as the techniques of data collection for GIS.

1.3 STUDY AREA

Country	Nepal
Province	Gandaki
District	Kaski
Metropolitan	Pokhara
Places	DownTown Area (Bagar – Mahendrapool – Naya Bazar – Mustang chowk – Rastra Bank Chowk – Shrijana chowk – Bindyabasini chowk)

Table 1: Description of Study Area of Thematic Mapping

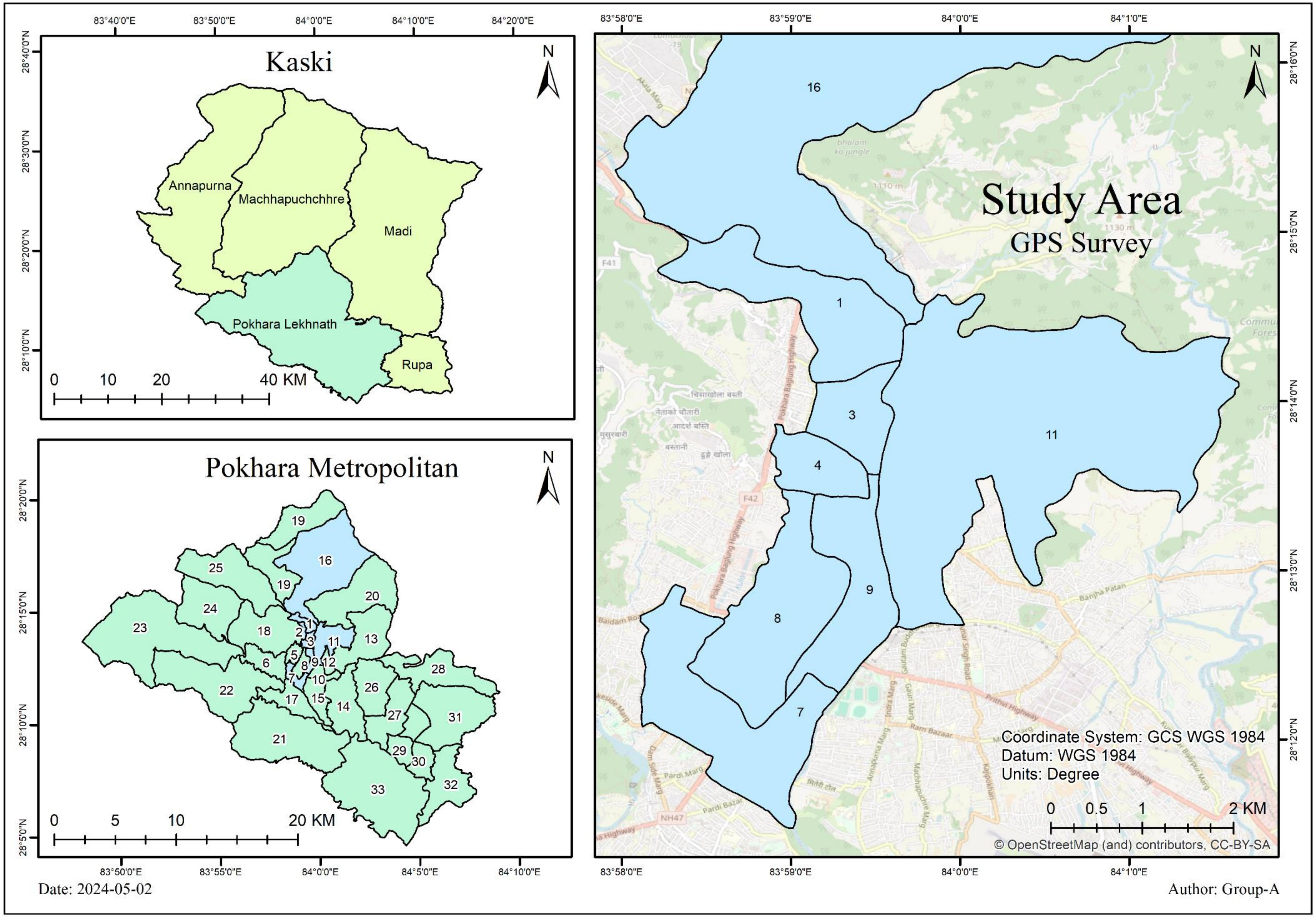


Figure 3: Map of Study Area of GPS Survey

1.4 METHODOLOGY

1.4.1 DATA COLLECTION

1.4.1.1 GPS POINT DATA COLLECTION

The different undergraduate and post graduate colleges' location were collected using Hand GPS (Kobo Toolbox) and different attribute data were taken manually by collector.

1.4.1.2 ATTRIBUTE DATA COLLECTION

In the section of attribute data, questionnaires were made which includes the Name of college, Spatial Location of the college, Number of the course available, the Number of the seats available, Number of Total students, Number of males and females students admitted in both bachelors and masters, and the Photo of the college as possible.

Example:

Name of College: Pokhara College of Management

Coordinate: 28.2295697, 83.9904635, and 840.7000122070312

Preferred to: Bachelor

No. of course available in bachelor: 2

No of Seat Available: 144

Total no. of students in Bachelor: 460

Total no. of male students in Bachelor: 228

Total no. of female students in Bachelor: 237

Figure 4: Photo of Pokhara College of Management

1.4.1.3 DIGITIZATION AND SECONDARY DATA COLLECTION

Secondary data such as road network, existing data of colleges were taken from the OpenStreetMap. OSM is the open-source platform where everyone can add and edit the map and place attribute there.

1.4.2 DATA ACQUITION

- ✓ Data collected from Kobo collect mobile application was uploaded to the Kobo toolbox server.
- ✓ Data in the Kobo toolbox server was downloaded in .csv format.
- ✓ Local Unit map of Pokhara Metropolitan City was downloaded through internet.

1.4.3 DATA CLEANING

Data cleaning involves fixing errors and inconsistencies in data. This includes correcting spelling mistakes, removing duplicates, and ensuring data is accurate and consistent. It's like tidying up messy information to make it reliable for analysis. This process helps improve data quality and ensures that results from analysis are trustworthy.

1.4.4 DATA VISUALIZATION

Displaying different kinds of maps to show data visually. Choropleth maps use colors to highlight data differences in regions. Proportional maps use symbols to represent data amounts in specific places. And web maps are also used, which are interactive maps online, to make it easier for people to explore and understand the data.

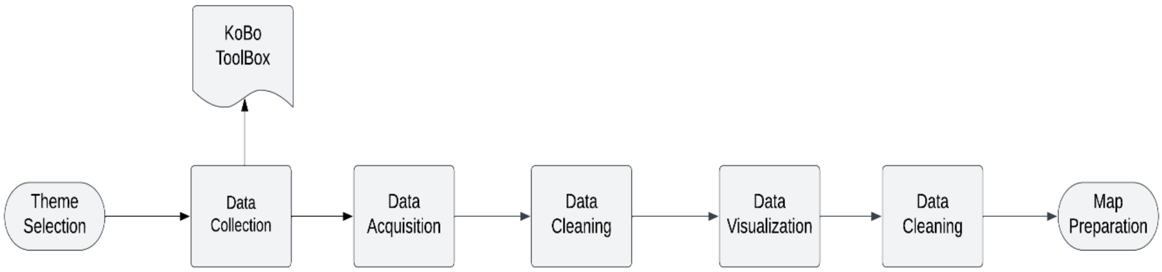


Figure 5: Methodology of GPS Survey

1.5 INSTRUMENT AND SOFTWARE USED

- Mobile application KOBO Collect were used for obtaining data.
- KOBO Toolbox was used for downloading data obtained from KOBO Collect.
- OpenStreetMap overpass turbo tool is used to download the secondary data for map visualization.
- ArcMap was used for preparing maps according to the theme.
- Visual Studio Code is used for preparing WebGIS using JS, HTML, CSS and other language in Leaflet map tiles.

1.6 RESULT AND DISCUSSION

Using the data collected in the field, thematic maps representing existing undergraduate and postgraduate colleges of wards 1, 3, 4, 7, 8, 9, 11, 16, 17 of Pokhara Metropolitan City has been prepared. The map is intended to provide locations of the colleges during the admission of the student according to their desire and the route to get into colleges. The maps are based on the no. of the students available in colleges, the ration of males and females admitted in colleges, and the distributions of the colleges among various wards in Pokhara. The map can be utilized by students, locals, parents of the students, and so on.

Along with this web map we analysed the point college data by using Leaflet tiles which helps to visualize the map interactively and after hover and clicking any point data it will show the Name of College and photo of the colleges and all attributes of that college. Similarly, we can see the different features of the college associated with their spatial locations by on click options in right side of the screen. The link to this web map is: College (wonderful-dolphin-f59ff0.netlify.app)

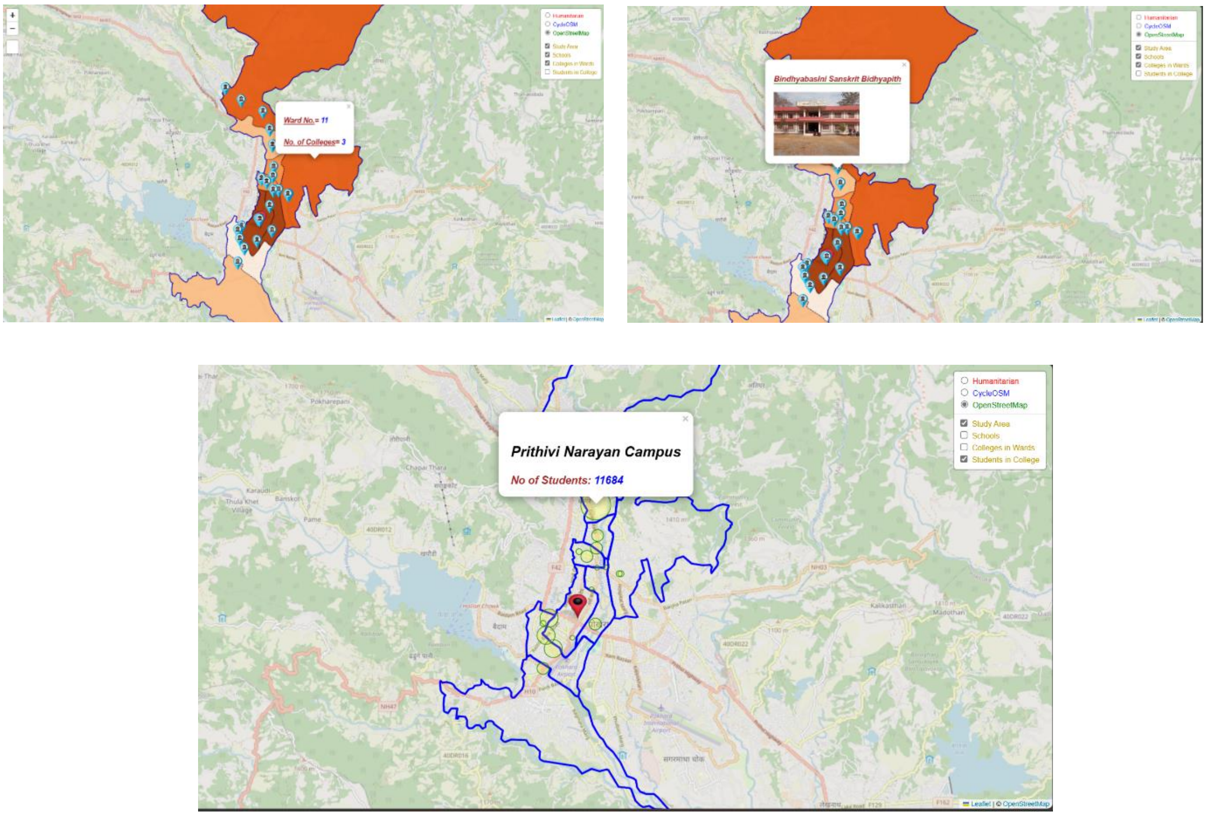


Figure 6: Interactive Map Using LeafletJS

1.7 CONCLUSION AND RECOMMENDATION

After the proper manipulation, processing and analysis of the data obtained from the field, it can be concluded that ward no. 14 contains highest number of the students while ward no. 8 has highest number of undergraduate and postgraduate college. Such services are not evenly distributed among the wards and some of the ward also has null number of colleges, thus in the coming days, it would be better for the local authorities to lay out plan to increase the number of Colleges as required. Similarly, the result is obtained as the lowest number of students is enrolled in Gandaki College of Hotel Management and the highest number of students is enrolled in Prithivi Narayan Campus.

CHAPTER 2 DIGITAL CADASTRAL SURVEY AND MAPPING

2.1 BACKGROUND

The cadastral system and cadastral surveying have a fascinating history, with Egypt being among the pioneers in their development. Similarly, the history of cadastral surveying in Nepal dates back to ancient times, with mentions of land administration systems since the Lichhabi era. During the Malla era, significant improvements were made, including land classification, standardization of measurement units, and the introduction of professional land surveyors known as Dangols. Cadastral mapping became essential, with the chain survey method being introduced. The formal cadastral survey began after the land reform program in 2021 B.S., initially focusing on fiscal purposes to generate land tax revenue. Over time, the system evolved to provide greater land tenure security to owners, culminating in the development of legal cadastres. Today, Nepal is transitioning towards a multi-purpose cadastre system, incorporating digital technologies for efficient mapping and land management.

2.2 INTRODUCTION

2.2.1 CADASTRAL SURVEY

Cadastral surveying is a branch of surveying that is concerned with the survey and demarcation of land parcel for the purpose of defining parcels of land for land registry. Cadastral survey is a survey of the boundaries of land parcels. The primary objective of cadastral survey is to determine concerned with the location of the land parcel and its extent. The extent of its boundaries and surface area is to indicate its separate identity both graphically on a map or record and physically on the ground. A secondary objective is to provide information for a multipurpose cadastre to satisfy the overall information requirements of land administration. [Dale 1976]. The cadastral survey is the first step in any form of land management.

According to FIG “Cadastral surveying is the definition, identification, demarcation, measuring, and mapping of new or changed legal parcel boundaries. It is usually the process of re-establishing lost boundaries and sometimes resolving disputes over boundaries or other interests in real property."

2.2.2 TYPES OF CADASTRAL SYSTEM

2.2.2.1 GRAPHICAL CADASTRAL SYSTEM

It is a traditional method of mapping parcel. Hard copy maps and registers are two separately prepared document. Records are analysed, stored, maintained, and disseminated manually. Example: Cadastral Survey by Plane Table Method.

2.2.2.2 DIGITAL CADASTRAL SYSTEM

In this method, cadastral mapping is conducted using modern, highly accurate instruments, and the entire mapping, recording, and archiving process is carried out using computers. Additionally, transaction and maintenance procedures are also computerized.

A digital cadastre system involves recording the coordinates of every corner of a parcel, which is then managed by a computer. Furthermore, a system is considered a digital cadastre when data are captured and processed in digital environments. Mostly, Total station is used for recording coordinate of every corner of parcel. Data, both graphical and attribute, are captured, stored, processed and managed in a digital environment.

2.2.3 PROCEDURE OF DIGITAL CADASTRAL SURVEY

2.2.3.1 PLANNING:

Initial phase in which meeting among authorities and various stake holders takes place for deciding the area to be surveyed. After an area is decided, old existing records are collected from survey office and land revenue office. Decisions about method of surveying, man power to be needed on the survey team, time frame, materials needed, etc. are made during the planning phase.

2.2.3.2 NOTICE PUBLISHED IN GAZETTE

The intention of publishing government decision in gazette is to make those decision legal and official. After the decision is published in gazette, the respective organizations and people would cooperate to carry out cadastral survey successfully.

2.2.3.3 NOTIFICATION AND AWARENESS WITH LOCAL COMMUNITY:

It is a legal procedure in which the information about areas to be surveyed is notified to public and stakeholders through newspapers, television, radio, notice boards, etc. A 15 days' notice according to Niyamabali 2058 Anusuchi 1, is given before entering into the plot official letters are also given to district and local administrative units.

2.2.3.4 ESTABLISHMENT OF CONTROL POINTS:

The geodetic survey branch of Survey Department design the sheets (of scale 1:500, 1:1250, 1:2500) for an area of which cadastral surveying is intended. The sheet generally contains 3-4 control points. The control points which are plotted on sheet is found out in the actual field with the help of D-card details. Based on trigonometrical point (control point) which are already in sheet, further additional control points (temporary) are established in area to be surveyed. The additional control points make cadastral survey easy and fast.

2.2.3.5 ADJUDICATION:

Adjudication is the process of legally recognizing the ownership over a particular unit of land. The ownership is then formally documented in the land register, and will be the legal evidence of that owner owns that tract of land. In adjudication process, the landowner, tenants, notary, adjacent parcel owners, representative from local government unit and aged and experienced people and the survey team formalized the ownership over the property land based on their mutual understanding. The agreement between adjoining parcel neighbours with their signature is recorded on paper, termed as *muchulka*.

2.2.3.6 BOUNDARY DEMARCATION:

Before carrying out survey, the boundary of a parcel is identified and marked by looking existing maps and records. It is the defining corners of parcel boundary are identified and those corners are monumented using wooden peg, iron pipe etc.

2.2.3.7 BOUNDARY DELINEATION, MONUMENTATION AND SURVEYING:

The coordinate of each parcel is now recorded using total station. Other attribute information about land like – land type, use of land, ownership/tenants name, etc. and the details on the land –like buildings, trees, etc. are also taken. Sketches are also prepared. The parcel boundary is surveyed using PT or TS.

2.2.3.8 CADASTRAL MAP AND DATABASE PREPARATION:

The data obtained through survey are downloaded cadastral maps are prepared by using parcel editor, an extension of ArcGIS 9.3. Attribute data associated with each parcel of the map are also entered. All these data are integrated together to form a database system which can be retrieved, edited and updated easily.

2.2.3.9 MAP VERIFICATION:

Verifies the land owners of each parcel.

2.2.3.10 7 DAYS NOTIFICATION AND REGISTRATION:

After completion of cadastral map and field book preparation 7 days' notice is published. Within this 7 days, if there are any corrections to be made on land records published by survey team or survey office, respective parcel owner can file complaints. The corrections should be done within next 7 days after the 7 days notification deadline.

From the 8th day of 7days notification, the first registration process is commenced for those parcels without complaints. Registration being started (land owner come to signature in field book and confirm each and every entity (information about his parcel) of parcel. Registration provides legal basis for parcel transferring.

2.2.3.11 DISTRIBUTION OF LAND OWNERSHIP CERTIFICATES:

After all map records are verified and all legal process are completed, the survey offices prepare and distribute land ownership certificate to concerned owner.

2.2.3.12 DATABASE UPDATING:

The digital database is updated when changes on information related to parcel occurs.

2.3 OBJECTIVES

2.3.1 GENERAL OBJECTIVES:

The main objective of this project is to produce the Cadastral map of Armala Village of Pokhara Metropolitan City.

2.3.2 SPECIFIC OBJECTIVES:

- ✓ To become familiar with all the GIS tools necessary for making cadastral maps.
- ✓ To become able to present an attribute data with maps.
- ✓ To collect information about land use and land type.
- ✓ To take details of the area like trees, buildings, roads, etc.
- ✓ To calculate area of some parcels using total station.

2.4 INSTRUMENT AND SOFTWARE USED

2.4.1 INSTRUMENTS:

- Total Station
- Pegs
- Tape
- Marker, paper, pen.
- Reflector, stand, clamp etc.

2.4.2 SOFTWARE:

- ArcMap
- Ms-Excel
- Ms-Word

2.5 STUDY AREA

Country	Nepal
Province	Gandaki
District	Kaski
Metropolitan	Pokhara
Place	Throughout the targeted area of Armalakot

Table 2: Description of Study Area of Cadastral Survey

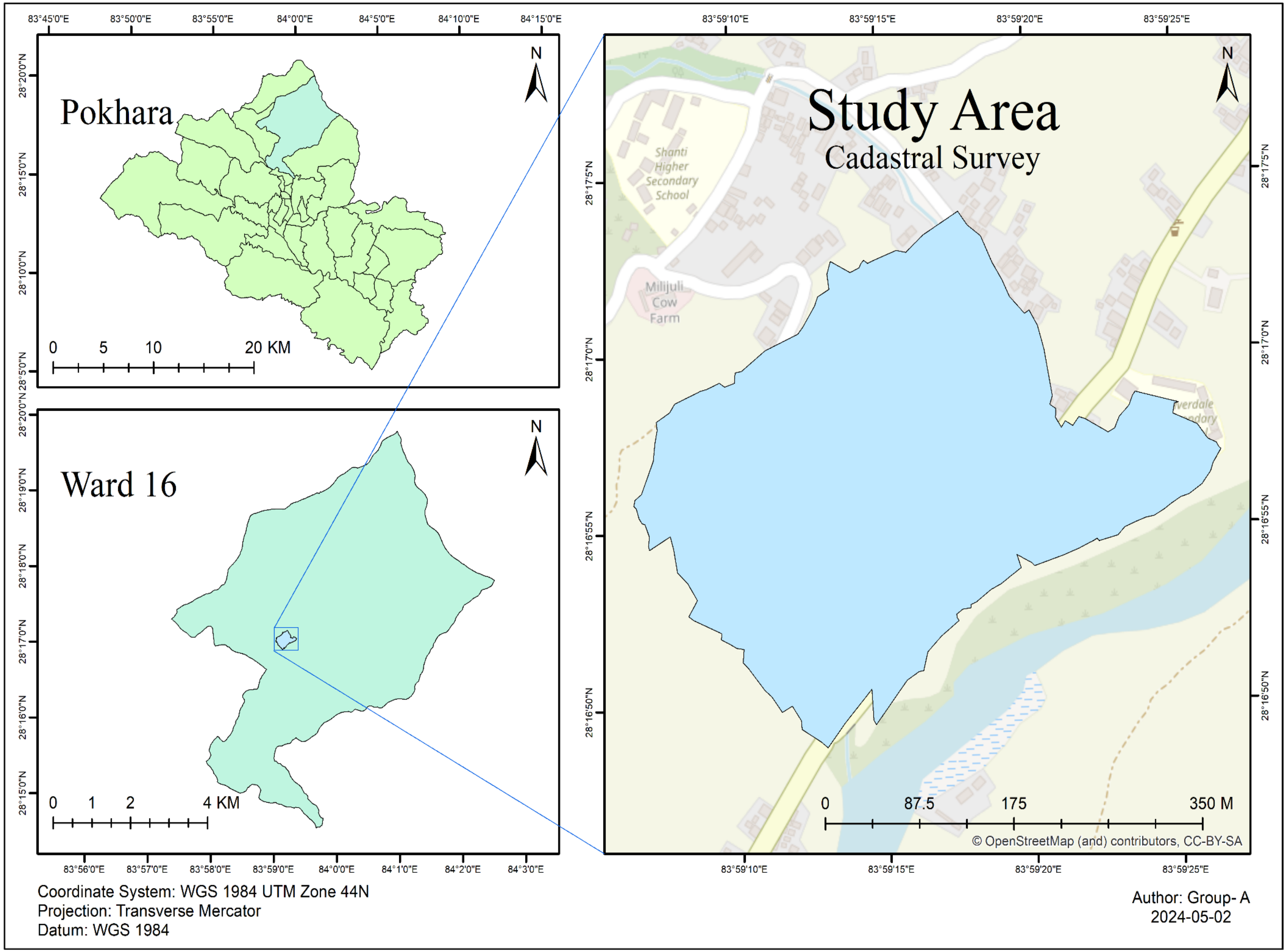


Figure 7: Map of Study Area of Cadastral Survey

2.6 METHODOLOGY

The methodology includes the primary data collected from total station survey. The obtained data were filtered and combined through MS-Excel. These data were loaded in the ArcMap. Database preparation and report extraction is smooth in windows.

2.6.1 SITE SELECTION:

Armalakot located at Kaski district of Gandaki province had been selected as a project work for the cadastral surveying and mapping.

2.6.2 RECONNAISSANCE:

Initial inspection of the area to be surveyed was carried out and appropriate location for establishing the control stations were determined checking indivisibility between two stations.

2.6.3 MARKING CONTROL POINTS AND MAKING CLOSED TRAVERSE:

After Reconnaissance, control stations were marked and peg was fixed. After that Total Station is established at each successive stations and angular measurements were made and traverse is closed. We also make Description Card (D-Card) on each major and minor station for the assurance of control point if we lost the point it can be reconstructed by applying all the measurement taken for D-Card.

2.6.3.1 SAMPLE OF D-CARD:

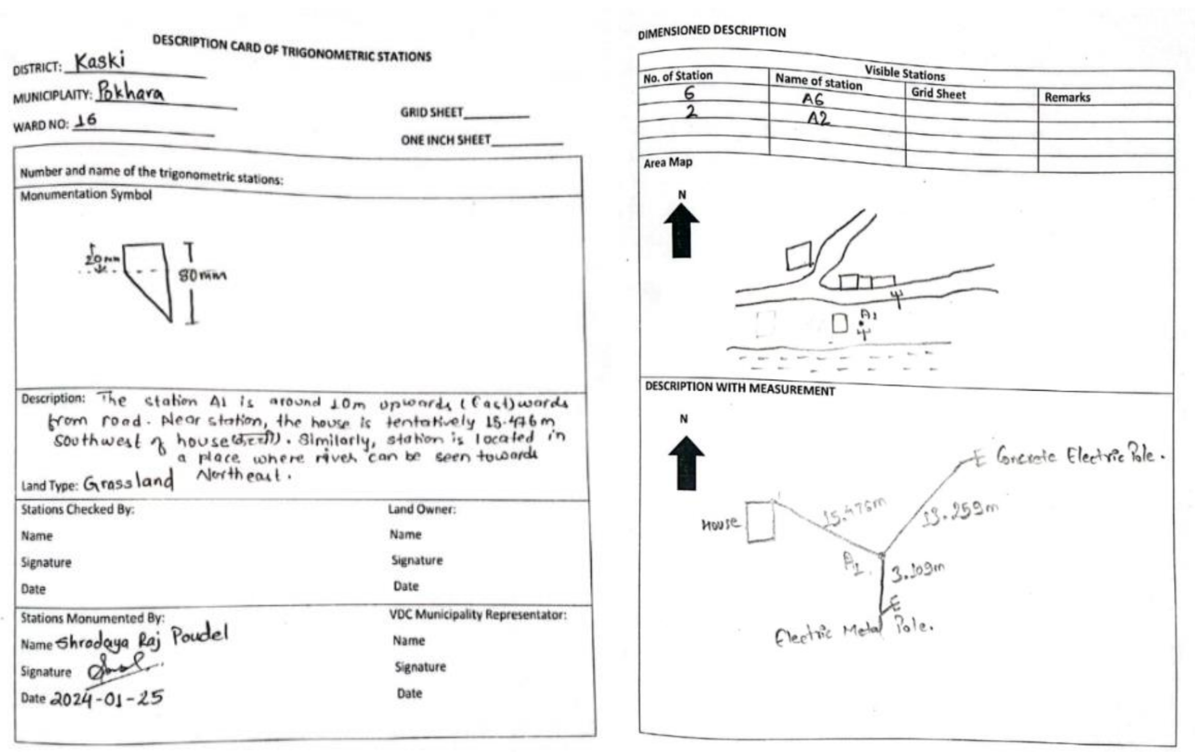


Figure 8: Sample of D-card of Station-A1

2.6.4 BALANCING OF TRAVERSE:

Coordinates of each station were calculated along with Bowditch's Rule and closing errors were adjusted.

Station/Object		Face	Horizontal Readings/Angles				Mean of Sets	Distance(m)	Mean Distance(m)
			SET I	Horizontal Angle	SET II	Horizontal Angle			
From	To		d-m-s	d-m-s	d-m-s	d-m-s	d-m-s		
A	F	L	0°0'0"	134°09'58"	0°0'0"	134°10'04"	134°09'59.5"	151.927	151.927
		R	179°59'47"	134°09'53"	179°59'58"	134°10'03"		151.927	
	B	L	134°09'58"	134°09'55"	134°10'04"	134°10'3.5"		215.323	215.3235
		R	314°09'40"		314°10'01"			215.324	
B	A	L	0°0'0"	98°49'32"	0°0'0"	98°49'32"	98°49'32"	215.3247	215.323
		R	179°59'59"	98°49'33"	180°0'08"	98°49'31"		215.3226	
	C	L	98°49'32"	98°49'32.5"	98°49'32"	98°49'31.5"		214.4175	214.414
		R	278°49'32"		278°49'39"			214.4121	
C	B	L	0°0'0"	116°46'11"	0°0'0"	116°46'19"	116°46'13.25"	214.4236	214.4235
		R	119°59'54"	116°46'10"	180°0'06"	116°46'13"		214.4234	
	D	L	116°46'11"	116°46'10.5"	116°46'19"	116°46'16"		140.3722	140.3722
		R	296°46'04"		296°46'19"			140.3722	
D	C	L	0°0'0"	140°32'58"	0°0'0"	140°32'54"	140°32'52.52"	140.384	140.3842
		R	179°59'59"	140°32'47"	179°59'58"	140°32'50"		140.3844	
	E	L	140°32"58"	140°32'52.5"	140°32'54"	140°32'52"		185.9864	185.98625
		R	320°32'46"		320°32'48"			185.9861	
E	D	L	0°0'0"	111°23'01"	0°0'0"	111°23'00"	111°23'1.75"	186.0069	186.0033
		R	180°00'02"	111°23'02"	180'00'04"	111°23'04"		185.9997	
	F	L	111°23'01"	111°23'31.5"	111°23'00"	111°23'02"		180.4387	180.4391
		R	291°23'04"		291°23'8"			180.4396	
F	E	L	0°0'0"	118°19'0"	0°0'0"	118°18'56"	118°19'0.5"	180.46	180.459
		R	179°59'58"	118°19'0"	179°59'57"	118°19'06"		180.4589	
	A	L	118°19'00"	118°19'0"	118°18'56"	118°19'01"		151.9038	151.9037
		R	298°18'58"		298°19'03"			151.9036	

Table 3: Traverse of Cadastral Survey

2.6.5 DETAILING:

The coordinates of each corner of the parcel were observed using Total Station at each successive stations and coordinates were noted for future references.

2.6.6 DATA EXTRACTION AND DIGITIZING:

The data recorded in the Total Station was extracted to another device and those in-situ data were further processed and manipulated using ArcMap.

2.6.7 DATABASE AND CADASTRAL MAP PREPARATION:

Database were prepared using ArcGIS and respective attributes to spatial data were fed and ultimately, cadastral map of the proposed location was prepared along with different reports.

2.6.8 DOCUMENTATION:

Finally, documentation of the cadastral maps attached with other important documents and reports were made ready.

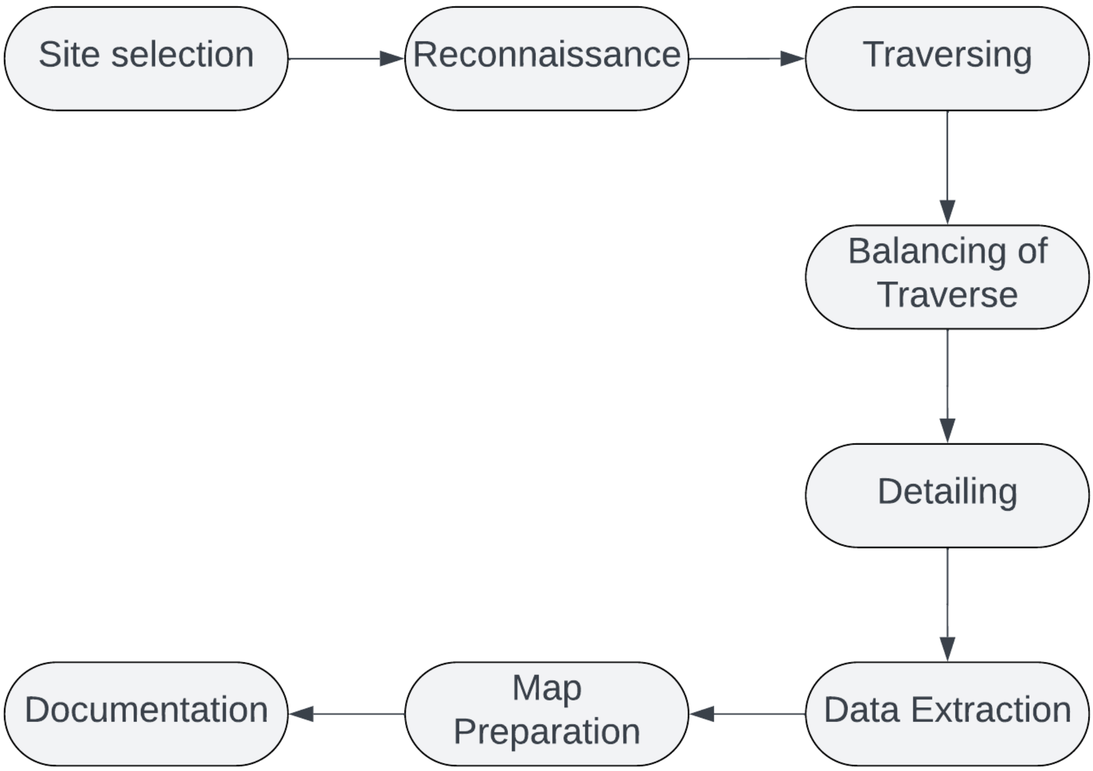


Figure 9: Methodology of Cadastral Survey

2.7 SAMPLE OF DATA

Owner	District	Municipality	Ward No.	Parcel No.	Sheet No	Tenant	Usability	Land Type	Area(m^2)	Shape Length
Karan Karki	Kaski	Pokhara Metropolitan	16	4	094-1325	-	House	Commercial	635.124	108.344
Barsa Sharma	Kaski	Pokhara Metropolitan	16	5	094-1325	Shan Chhetri	House	Build-up	453.403	99.104
Pran Khadka	Kaski	Pokhara Metropolitan	16	6	094-1325	-	Agriculture	Agriculture	300.245	72.442
Saugat Malla	Kaski	Pokhara Metropolitan	16	7	094-1325	Bir Tamang	Agriculture	Agriculture	695.480	110.993
Aryan Sigdel	Kaski	Pokhara Metropolitan	16	8	094-1325	-	Agriculture	Agriculture	423.208	84.472
Nikhil Shah	Kaski	Pokhara Metropolitan	16	9	094-1325	-	Agriculture	Agriculture	728.040	109.095
Anu Pandey	Kaski	Pokhara Metropolitan	16	10	094-1325	-	Agriculture	Agriculture	400.551	85.030
Gagan Thapa	Kaski	Pokhara Metropolitan	16	11	094-1325	Sai Sampang	Agriculture	Agriculture	489.882	93.912
Dikshya Rai	Kaski	Pokhara Metropolitan	16	12	094-1325	-	Agriculture	Agriculture	536.867	94.735
Bipin Rai	Kaski	Pokhara Metropolitan	16	13	094-1325	-	Agriculture	Agriculture	669.576	105.282

Table 4: Sample Data of Cadastral Survey

2.8 AREA CALCULATION

For comparing the accuracy of manual and automatic calculation we tried a small parcel area of Armalakot. Firstly, the land is carefully selected for measurement, followed by a thorough reconnaissance of the area. Reflectors are strategically positioned at key points for measurement. The Total Station is then set up on suitable ground and activated. Through menu navigation, the "Area Calculation" function is selected, and the Total Station focuses on the reflectors to read their coordinates. Once all required points are recorded, the device computes the area, displaying the result on its screen. Total Station gives the area of any polygonal shape automatically with its inbuilt area calculation function.

Conversely, the manual method required dividing the parcel into triangles, monumenting pegs at crucial points, measuring distances between pegs, and summing up the areas of each triangle. Through our comparative analysis, we aimed to assess the accuracy and efficiency of both approaches.

Figure 10: Procedure of Area Calculation

2.8.1 AREA CALCULATED

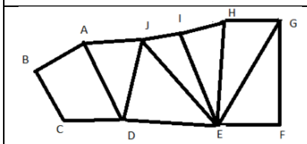
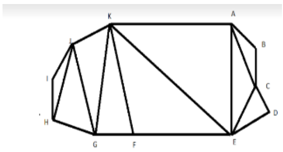
Sketch	Area: Surveyor-1	Area: Surveyor-2	Area: Surveyor-3	Area by TS	Difference
	428.772	428.579	430.082	429.1687	S1-A: 0.396 S2-A: 0.589 S3-A: 0.913
	476.984	476.134	477.012	478.078	S1-A: 1.094 S2-A: 1.994 S3-A: 1.066

Table 5: Area of a Parcel

2.9 RESULT AND DISCUSSION

The output of our work includes:

- Cadastral map sheets.
- Area of a single parcel.
- Non-spatial attribute of the parcel.

The computerized cadastral survey offers more accurate three-dimensional data for each corner of each land. This technology helps to lessen land disagreement and conflict between nearby land parcel owners since it generates a digital map using precise field data. Hence, we were able to create the cadastral map of targeted area of Armalakot which is prepared with the help of ArcGIS.

2.10 CONCLUSION AND RECOMMENDATION

In conclusion, the results of our cadastral surveying project underscore the efficiency and accuracy of digital survey methods in gathering field data for cadastral mapping and maintaining land records. The adoption of digital cadastral surveys offers numerous benefits, including improved service delivery in a digital environment, trustworthy land information, enhanced security, and accessibility. Moreover, it proves to be a highly effective and efficient approach for land management and administration. Therefore, upon the completion of this project, we strongly recommend the widespread implementation of digital cadastral surveys as the most suitable, precise, and practical method for cadastral mapping in the Nepalese context. Additionally, considering the challenges associated with gathering non-spatial data, efforts should be directed towards enhancing the manipulability and usability of the cadastral system for better national land management in the future. Given the pivotal role of cadastral surveys in governmental use concerning land rights and ownership, the transition to digital systems not only ensures ease and speed but also minimizes errors compared to traditional analogue methods, making it the preferred choice for high-precision work.

CHAPTER 3 HYDROPOWER SURVEY

3.1 BACKGROUND

Hydropower, the conversion of energy from flowing water into electricity, has long been recognized as a crucial component of the global energy mix. Its utilization offers several advantages, including renewable and clean energy generation, grid stability, and reduced greenhouse gas emissions compared to fossil fuel-based power generation.

According to the International Hydropower Association (IHA), hydropower accounts for approximately 16% of the world's electricity production, making it the largest source of renewable energy globally. Hydropower represents an important source of energy, accounting for one fifth of the world's electricity supply. The technical and economically feasible hydropower potential of Nepal has been estimated at 83,000 and 42,000 megawatts, respectively. Though hydropower development started in 1911, it progressed slowly. By 2005, Nepal had developed only 557 MW due to the absence of private-sector engagement, political considerations, and overwhelming dependency on external financing. Around this time, Nepal went through an acute power crisis that lasted nearly a decade. Much of its hydropower capacity was reliant on run-of-river hydropower plants, and with fluctuating seasonal river discharges and increasing energy demand from rapid urbanization, the nation was forced to ration energy (Balanced Hydropower Development in Nepal, 2016). This crisis made it evident that the construction and commissioning of hydropower projects was the call of the hour, and a more measured approach was needed to carefully plan and develop both projects and policy to benefit the Nepali citizens. Distribution was another key challenge. The last decade has witnessed rapid development under the stewardship of the private sector. The generation capacity has surpassed 2,000 MW and is expected to reach 7,300 MW by 2025.

3.2 INTRODUCTION

The electricity produced by the movement of fresh water from rivers and lakes is called hydropower, it is a renewable energy source dependent upon the hydrologic cycle of water, which involves evaporation, precipitation and the flow of water due to gravity. Gravity causes water to flow downwards and this downward motion of water contains kinetic energy that can be converted into mechanical energy, and then from mechanical energy into electrical energy. At a good site, hydropower can generate very cost-effective electricity.

Thus, hydropower survey is the study and design of the hydropower components like dam, canal, settling basin, penstock pipe, fore bay, powerhouse, tailrace, etc. While surveying we need to find the suitable location for each and every component so that it will help to finish work in great manner with great efficiency without any obstruction.

3.2.1 TYPES OF HYDROPOWER

Hydropower is a versatile, flexible technology that at its smallest can power a single home, and at its largest can supply industry and the public with renewable electricity on a national and even on a regional scale. There are four broad hydropower typologies:

3.2.1.1 RUN-OF-RIVER HYDROPOWER

A run-of-river project will have little or no storage facility. It has a facility that channels flowing water from a river through a canal or penstock to spin a turbine. Run-of-river provides a continuous supply of electricity (baseload), with some flexibility of operation for daily fluctuations in demand through water flow that is regulated by the facility.

3.2.1.2 STORAGE HYDROPOWER

It is typically a large system that uses a dam to store water in a reservoir. Electricity is produced by releasing water from the reservoir through a turbine, which activates a generator. Storage hydropower provides base load as well as the ability to be shut down and started up at short notice according to the demands of the system (peak load). It can offer enough storage capacity to operate independently of the hydrological inflow for many weeks or even months.

3.2.1.3 PUMPED-STORAGE HYDROPOWER

The hydropower system supplies peak-load energy by cycling water between lower and upper reservoirs, using surplus energy to pump water during low-demand periods and generating electricity by releasing water through turbines during high-demand periods.

3.2.1.4 OFFSHORE HYDROPOWER

A less established but growing group of technologies that use tidal currents or the power of waves to generate electricity from seawater. These technologies can often overlap. For example, storage projects can often involve an element of pumping to supplement the water that flows into the reservoir naturally, and run of-river projects may provide some storage capability.

3.2.2 BASIC COMPONENTS OF HYDROPOWER

Basic components of hydropower are listed below.

3.2.2.1 INTAKE

Intake is the structure between river and canal. It consists of a gate to open/close the water feed. An intake prevents major debris from entering the system. The intake is located preferably on an outside of a river bend in a way that silt and debris is not “automatically” streamed in. Due to its location in/on the river it is to be designed to withstand floods.

3.2.2.2 CATCHMENT AREA

The catchment area of a hydro plant is the whole area behind the dam, draining into a stream or river across which the dam has been built at a suitable place.

3.2.2.3 DAMS AND RESERVOIR

A hydroelectric dam is one of the major components of a hydroelectric facility. A dam is a large, manmade structure built to contain some body of water. Dams are also useful to control river flow and regulate flooding. It is the structure built across a stream, a river, to retain water. It acts as a barrier that stops or restricts the flow of water or underground streams.

3.2.2.4 CANAL

The canal transports the water towards the point where it drops steeply. To gain as much height difference as possible, it is aligned with as little slope as possible. Canals usually lay on valley slopes. It is to be secured that no waters cross the canal uncontrolled (flushing above or under) from its side. 1 - 1⁄2 meter path between hillside and canal allows its comfortable maintenance and prevents slides blocking the flow.

3.2.2.5 FOREBAY

A fore bay is a basin area of a hydropower plant where water is temporarily stored before going into the intake chamber. The storage of water in fore bay is decided based on required water demand in that area. This is also used when the load requirement in intake is less.

3.2.2.6 PENSTOCK

Penstocks are like large pipes laid with some slope which carries water from the intake structure or reservoir to the turbines. These are designed to resist the water hammer effect. Apart from this, penstock is similar to normal pipe. To overcome this pressure, a heavy wall is provided for short length penstock and surge tank is provided in case of long length penstocks.

3.2.2.7 POWERHOUSE

A power house is a building provided to protect the hydraulic and electrical equipment. Generally, the whole equipment is supported by the foundation or substructure laid for the power house.

3.2.2.8 TAILRACE

Tailrace is the flow of water from turbines to the stream. It is good if the power house is located nearer to the stream. But if it is located far away from the stream then it is necessary to build a channel for carrying water into the stream.

3.3 OBJECTIVE

3.3.1 GENERAL OBJECTIVE

- To make a detailed study of the hydropower site through surveying.

3.3.2 SECONDARY OBJECTIVE

- To allocate each of the hydropower components by analysing the appropriate location for them using survey data.
- To prepare a contour map of the surveyed area and the area of each components.

3.4 STUDY AREA

Country	Nepal
Province	Gandaki
District	Kaski
Metropolitan	Pokhara
Place	Throughout the targeted area of Armalakot

Table 6: Description of Study Area of Component of Hydropower Survey

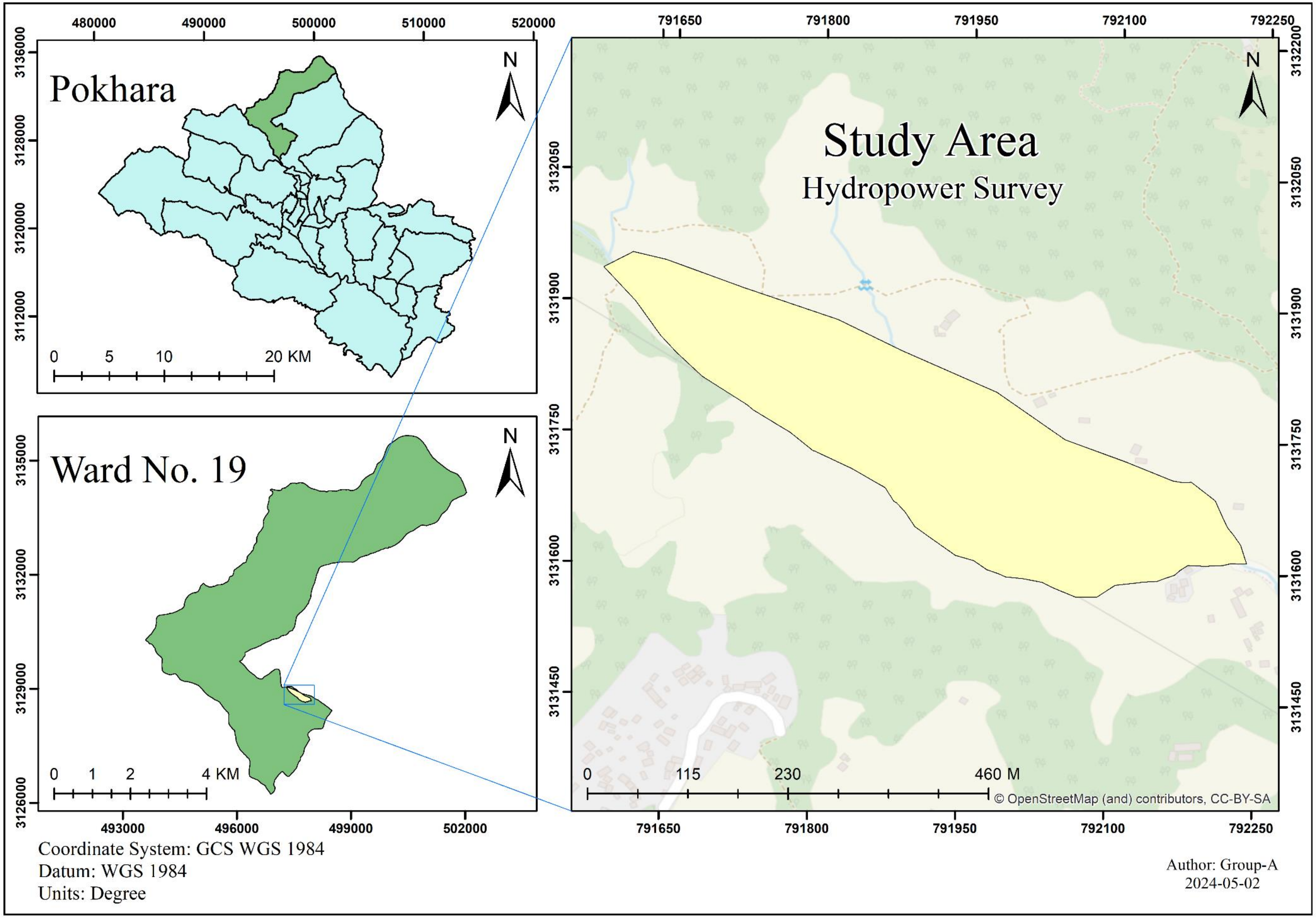


Figure 11: Map of Study Area of Component of Hydropower Survey

3.5 INSTRUMENT AND SOFTWARE USED

3.5.1 INSTRUMENT USED

- ✓ Total Station
- ✓ Reflector
- ✓ DGPS
- ✓ Hammer
- ✓ Pegs
- ✓ Marker
- ✓ Measuring Tapes

3.5.2 SOFTWARES USED

- ✓ ARCGIS
- ✓ MS WORD
- ✓ MS EXCEL

3.6 METHODOLOGY

The methodology includes the collection of data of the survey site after reconnaissance and detailing the coordinate of topographical features. After finishing the survey at site these point data was loaded in the ArcMap for the post processing to acquire the final Topographic map of that area for the proposed Hydropower.

3.6.1 WORKFLOW OF HYDROPOWER SURVEY

3.6.1.1 SITE SELECTION AND PLANNING:

Area of the place was surveyed. The site should be visible from all station.

3.6.1.2 RECONNAISSANCE:

After the process of reconnaissance, we were able to make an analysis of the topographical structure of the site. It was the examination of all or part of the area accomplished in sufficient detail to make generalizations of the area to be covered.

3.6.1.3 MAKING MAJOR TRAVERSE AND COMPUTING COORDINATE:

After the process of reconnaissance, we were able to make an analysis of the topographical structure of the site. It was the examination of all or part of the area accomplished in sufficient detail to make generalizations of the area to be covered.

Station/Object		Face	Horizontal Readings/Angles				Mean of Sets
			SET I	Horizontal Angle	SET II	Horizontal Angle	
From	To		d-m-s	d-m-s	d-m-s	d-m-s	d-m-s
A	E	L	0°0'0"	47°32'59"	0°0'0"	47°32'43"	47°32'39.5"
		R	180°00'08"	47°32'44"	179°59'59"	47°32'13"	
	B	L	47°32'59"	47°32'51"	47°32'43"	47°32'28"	
		R	227°32'44"		227°32'12"		
B	A	L	0°0'0"	145°27'55"	0°0'0"	145°27'46"	145°27'48"
		R	179°59'55"	145°27'49"	179°59' 56"	145°27'42"	
	C	L	145°27'55"	145°27'52"	145°27'46"	145°27'44"	
		R	325°27'44"		325°27'38"		
C	B	L	0°0'0"	118°39'27"	0°0'0"	118°39'28"	118°39'27.75"
		R	180°00'06"	118°39'27"	180°0'01"	118°39'29"	
	D	L	118°39'27"	118°39'27"	118°39'28"	118°39'28.5"	
		R	298°39'33"		298°39'30"		
D	C	L	0°0'0"	55°24'53"	0°0'0"	55°24'54"	55°24'48.5"
		R	180°00'10"	55°24'36"	179°59'54"	55°24'41"	
	E	L	55°24"53"	55°24'49.5"	55°24'54"	55°24'47.5"	
		R	235°24'46"		235°24'41"		
E	D	L	0°0'0"	172°55'27"	00°0'0"	172°55'15"	172°55'20.75"
		R	180°00'09"	172°55'26"	179°59'59"	172°55'16"	
	A	L	172°55'27"	172°55'26.5"	172°55'15"	172°55'15.5"	
		R	352°55'26"		352°55'15"		

Table 7: Traverse of Hydropower Survey

3.6.1.4 DETAILING:

The details of land structure /land use, tree, house, water, dam, fore bay, canal, reservoir etc. were observed in the field of survey.

3.6.1.4.1 DAM:

Axis making perpendicular to water flow was surveyed and upstream of the river from the dam axis of 50m-70m and downstream of 150m was surveyed with cross-section and high flood level, low flood level were also measured.

3.6.1.4.2 SETTLING BASIN:

An area of about 50m * 50m was surveyed which was performed to find the topographical structure.

3.6.1.4.3 CANAL:

Maintaining the equal gradient, canal alignment was fixed where the survey was performed for the area of 30m-40m at chainage of about 5m.

3.6.1.4.4 FORE BAY:

Detailing of 40m-60m radius was performed at a chainage of about 5m.

3.6.1.4.5 PENSTOCK:

Maintaining the proper gradient required it was surveyed at a chainage of about 2m with a cross section of 30m-40m.

3.6.1.4.6 POWERHOUSE AND TAILRACE:

Detailed survey was done for powerhouse in an area of about 60m * 60m and for the tailrace, it is surveyed at an interval of 5m and upstream of 50m was surveyed with cross-section and high flood level, low flood level were also measured.

3.6.1.5 DATA DOWNLOAD AND CLEANING:

Field data was analysed and collected by using TS survey. Finally, the data was downloaded and data cleaning was done through MS- Excel.

3.6.1.6 PREPARING TOPO MAP:

Finally topographic map was prepared from these downloaded data by using ArcMap software.

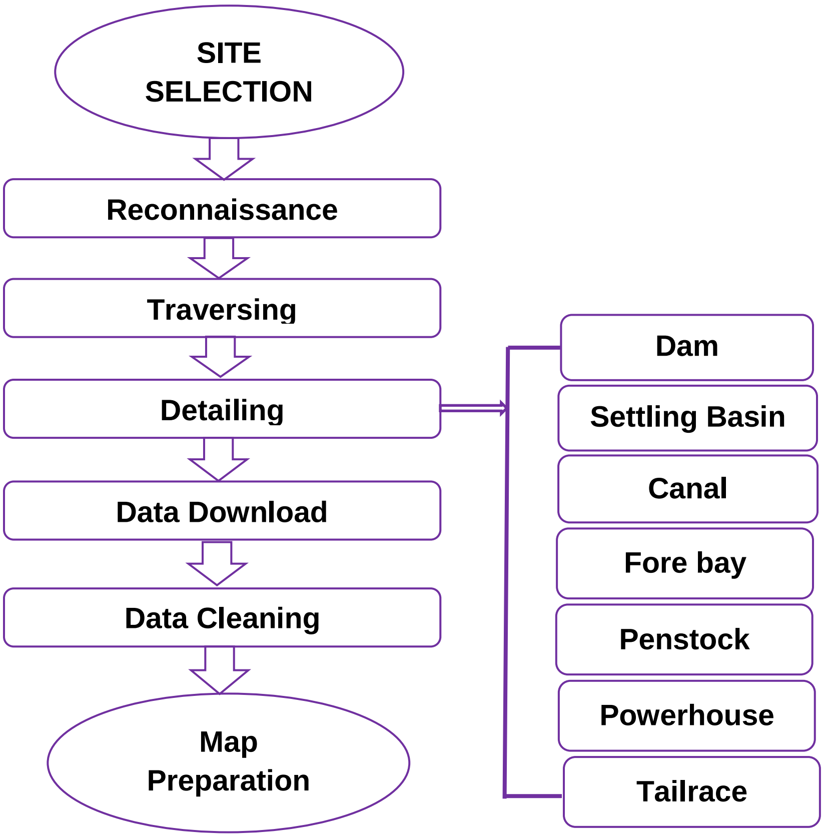


Figure 12: Methodology of Survey of Hydropower Components

3.7 Sample Dataset:

Object ID	Northing	Easting	Zenith	Code
1	3131854	791828.4	1030.248	A
2	3131795	791844.4	1029.184	AX
3	3131852	791828.8	1029.568	SH
4	3131850	791828.9	1028.958	SH
5	3131848	791829.4	1028.665	SH
6	3131842	791830.7	1027.561	SH
1234	3131735	791864.6	1036.756	SB
1235	3131734	791860	1038.142	SB
1237	3131765	791861.7	1031.365	SPL
1238	3131775	791870.8	1027.845	SPL
2071	3131644	791928.9	1036.819	STC
2076	3131667	791954.3	1029.064	FSH

Table 5: Sample Data of Component of Hydropower Survey

3.8 RESULT AND DISCUSSION

A hydropower study was undertaken for the intended area. A map was created to indicate the proper location of the important hydropower structures, including the river, dam, penstock, tailrace, canal, fore bay, and powerhouse. A topographic map was created to show existing features with contour.

The outputs of our hydropower survey as follow:

- Topographic map of hydropower survey site
- Topographic map of canal area
- Topographic map of penstock area
- Topographic map of fore bay area
- Topographic map of powerhouse area
- Topographic map of tailrace area.

And, for the proposed location, a hydropower study was conducted. The precise locations of the significant hydroelectric structures were marked on a map.

3.9 CONCLUSION AND RECOMMENDATION

Hydropower survey for the purposed area was conducted and thus a map was prepared showing proper location for prominent structure of hydropower showing river, dam, settling basin, canal, fore bay, powerhouse etc. There are few buildings inside the hydropower component and proper measures can be taken to compensate the civilians. Following the project's completion, we advised that a hydropower survey be prepared in an efficient manner with the help of the right instructions and in-depth understanding of the hydropower's components.

CHAPTER 4 D.G.P.S SURVEY

4.1 BACKGROUND

Differential Global Positioning System (DGPS) surveys encapsulates a transformative evolution in positioning technology, revolutionizing various industries reliant on precise spatial data. Originating as an enhancement to standard GPS systems, DGPS mitigates inherent inaccuracies by correcting for factors like atmospheric disturbances and satellite clock drift. Since its inception, DGPS has rapidly gained prominence across diverse sectors including maritime navigation, precision agriculture, and infrastructure development. By augmenting accuracy and reliability, DGPS surveys enable unprecedented levels of precision in mapping, navigation, and asset management, fostering efficiency and safety in critical operations. Despite its widespread adoption, challenges such as signal obstruction and multipath interference persist, underscoring the importance of continual innovation in DGPS technology.

4.2 INTRODUCTION

To establish a precise position, GNSS (Global Navigation Satellite System) receivers rely on timing signals from a minimum of four satellites. However, various errors and delays can occur during the transit of these signals to Earth, leading to inaccuracies in positioning. Differential Global Positioning System (DGPS), now referred to as Differential Global Navigation Satellite System (DGNSS), represents an enhancement to GNSS designed specifically to address these errors and inaccuracies. By providing correction information, DGPS significantly improves the accuracy of GNSS receivers, surpassing the capabilities of standard receivers. With these errors mitigated, GNSS receivers equipped with DGPS have the potential to achieve accuracies as fine as 10 centimetres, enabling precise positioning across a range of applications. This introduction sets the stage for exploring the principles, applications, and benefits of DGPS in greater detail within the report.

4.2.1 METHODS OF DGPS SURVEY

4.2.1.1 RTK (REAL TIME KINEMATIC):

The Real Time Kinematic (RTK) method represents an advanced iteration of DGPS, utilizing the carrier wave of GPS signals to achieve unparalleled positional accuracy. By comparing observations from multiple receivers within the system, RTK fine-tunes satellite and receiver clock errors, enabling precise positioning in real-time. This methodology ensures accuracies ranging from 20 cm to sub-centimetre levels, making RTK indispensable in various applications such as construction, farming, vehicle testing, and surveying across land, marine, hydrographic, and aerial domains. While RTK entails higher costs compared to standard DGPS receivers, its ability to deliver highly accurate positioning in real-time underscores its significance in industries demanding precision and reliability. RTK corrections can be sourced from local base stations or private correction providers such as OmniSTAR, Leica, and Trimble, further expanding its versatility and applicability across diverse sectors.

4.2.1.2 PPK (POST PROCESSED KINEMATIC):

Static DGPS, a traditional form of differential GPS, operates on a post-observation correction method to enhance the accuracy of GPS signals. The process begins with a base station, equipped with precisely known coordinates, observing GPS signals and calculating corrections. Simultaneously, a rover records its GPS measurements during data collection. Post-processing occurs after data collection, wherein the rover's measurements are compared to the base station's known position, and corrections are applied to refine accuracy. Despite requiring additional time for processing compared to real-time methods, static DGPS yields higher accuracy by leveraging data from multiple GPS systems and reference stations. It typically achieves meter-level accuracy, making it well-suited for applications like navigation and mapping.

4.2.2 WORKING PRINCIPLES

The principle of Differential Global Positioning System (DGPS) builds upon the foundational workings of the Global Positioning System (GPS). GPS relies on signals transmitted from a minimum of four satellites to determine a receiver's position. The distance between the receiver and each satellite is calculated based on the time it takes for the signals to travel from the satellite to the receiver's antenna. This information allows the GPS receiver to triangulate its position. However, inherent errors in the GPS signals can affect the accuracy of this positioning data. DGPS addresses this by employing a base station with known coordinates to calculate the difference between its specified location and the coordinates indicated by the satellites. This differential correction is continuously broadcasted to DGPS receivers or rovers by the base station. By applying this correction, DGPS receivers are able to accurately determine their location, compensating for errors in the GPS signals and significantly improving positional accuracy. Understanding this principle lays the groundwork for delving into the operational mechanisms and applications of DGPS technology.

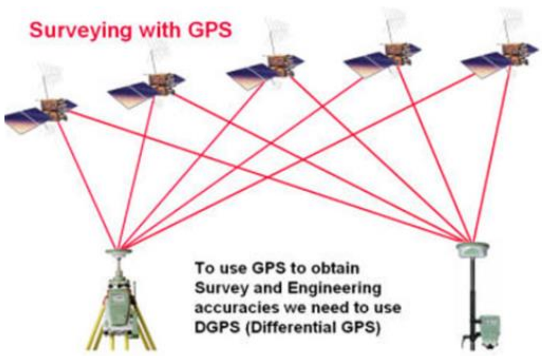


Figure 13: Principle of DGPS Survey

Source: gisgeography

4.3 OBJECTIVES

4.3.1 GENERAL OBJECTIVE

- To conduct a comprehensive survey using DGPS technology to assess and analyse a designated site for its suitability for various applications.

4.3.2 SECONDARY OBJECTIVES

- To precisely allocate each component of interest within the surveyed area by leveraging DGPS data to determine optimal locations.

4.4 INSTRUMENT AND SOFTWARE USED

4.4.1 INSTRUMENTS:

- DGPS Receiver
- Marker, paper, pen.
- Stand, clamp etc.

4.4.2 SOFTWARE:

- EMLID Flow

4.5 STUDY AREA

Country	Nepal
Province	Gandaki
District	Kaski
Metropolitan	Pokhara
Place	Throughout the targeted area of Armalakot

Table 8: Description of Study Area of DGPS Survey

4.6 METHODOLOGY

- Set Up GNSS Receiver:
  Begin by setting up the GNSS receiver at the designated station location.
- Launch Emlid Flow App:
  Open the Emlid Flow mobile application on the device connected to the GNSS receiver.
- Configure Settings:
  Adjust any necessary settings within the Emlid Flow app, such as data recording interval or desired coordinate format.

- Start Data Recording:

  Initiate the data recording process within the Emlid Flow app. Ensure that the GNSS receiver is properly connected and receiving signals.
- Record Data for 10 Minutes:
  Allow the GNSS receiver and Emlid Flow app to record data continuously for a predetermined duration of 10 minutes.
- Stop Data Recording:
  End the data recording process within the Emlid Flow app after the 10-minute interval has elapsed.
- Save Data:
  Save the recorded data within the Emlid Flow app or export it to a designated storage location for further processing.
- Data Processing:
  Utilize the recorded data for further processing and analysis as needed, such as post-processing for differential corrections or generating reports.

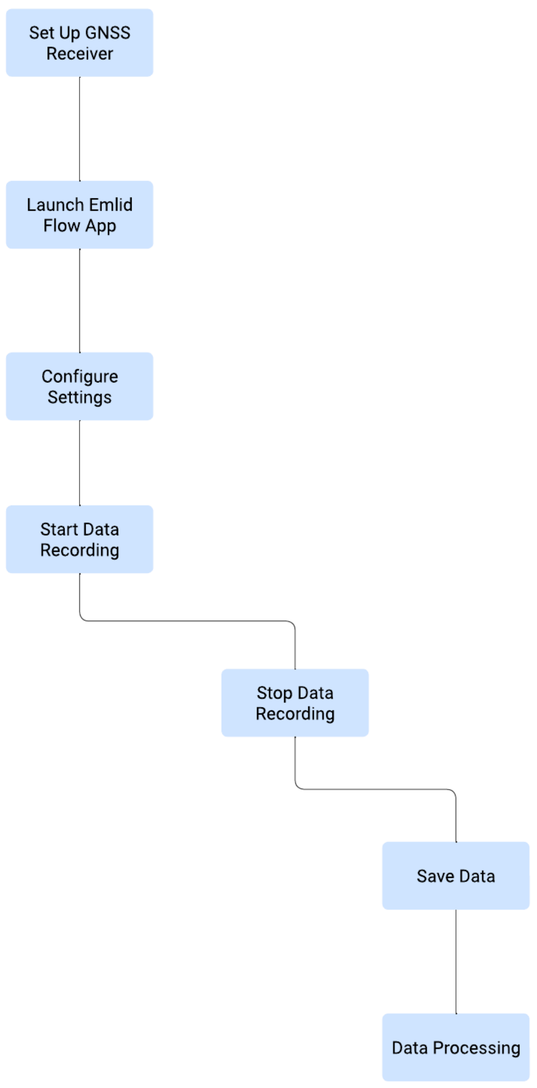


Figure 14 Methodology of DGPS Survey

4.7 RESULT AND DISCUSSION

A DGPS survey was conducted to assess the study area with precision and accuracy. The survey aimed to determine the coordinates of various key points within the area of interest. Through meticulous data collection and analysis, the coordinates of significant locations were pinpointed and recorded. The outputs of our DGPS survey is the coordinate data for the study area.

4.8 CONCLUSION AND RECOMMENDATION

In conclusion, the DGPS survey conducted for the study area has yielded valuable coordinate data and topographic information essential for various applications. The precise determination of coordinates facilitates accurate mapping, planning, and analysis. Moving forward, it is recommended to utilize these survey results efficiently in further research, planning, and development projects related to the study area.

CHAPTER 5 DRONE SURVEY

5.1 BACKGROUND

A drone survey is an aerial survey conducted using an unmanned aerial vehicle (UAV) or drone. Unlike traditional ground-based surveying methods, drones capture data from above, providing a bird's-eye view of the landscape. Equipped with high-resolution cameras, GPS, and advanced mapping software, drones produce precise measurements and detailed aerial imagery. Drone mapping has been around for a while now and even the history of it dates back to the late 1970's. However, the earliest examples of drone mapping can be traced back to 1957 as a way for people to scout places that would be difficult or impossible for humans to reach. In recent years drone mapping has exploded in popularity as drones continue making our lives easier and are often used by government agencies and military forces. These capabilities make them a cost-effective and efficient alternative for various surveying tasks.

5.2 INTRODUCTION

It is designed to full fill requirements for a low cost platform, with long endurance, moderate payload capacity and capability to operate without runway. Drone includes equipment of photography, infrared detection, radar observation and TV surveillance. Drone was developed in Britain during World War-II, is the short sky spy which was originally conceived as a military reconnaissance. Introduction using these points. The advent of unmanned aerial vehicles (UAVs), commonly known as drones, has revolutionized the field of aviation and reshaped the way we perceive aerial operations. Originating as miniature remotely piloted aircraft, drones have emerged as versatile and indispensable tools with a myriad of applications across various sectors.

The genesis of drones can be traced back to Britain during World War II, where they were initially developed as military reconnaissance platforms. Termed "sky spies," these early drones were conceived to provide aerial intelligence gathering without risking human lives. Since then, drones have undergone significant advancements, expanding their roles beyond military applications to encompass civilian, commercial, and scientific endeavours.

5.3 OBJECTIVES

5.3.1 GENERAL OBJECTIVE

- ✓ To utilize drone technology to conduct a comprehensive aerial survey aimed at assessing and analysing a designated site for its suitability across diverse applications.

5.3.2 SECONDARY OBJECTIVES

- ✓ To obtain high-resolution imagery and elevation data of the surveyed area using drone technology, facilitating precise allocation of key components of interest.
- ✓ To generate accurate Digital Elevation Models (DEM) of the surveyed terrain, enabling detailed analysis and planning for various projects and applications.

5.4 INSTRUMENT AND SOFTWARE USED

5.4.1 INSTRUMENTS:

- DJI Phantom Drone
- Tablet for TV surveillance
- Marker, paper, pen.

5.4.2 SOFTWARE:

- Pix4d Mappers
- ArcMap

5.5 STUDY AREA

Country	Nepal
Province	Gandaki
District	Kaski
Metropolitan	Pokhara
Place	Throughout the targeted area of Pashchimanchal Campus, Lamachaur

Table 9: Description of Study Area of Drone Survey

5.6 METHODOLOGY

5.6.1 SITE SELECTION:

The area selected for the survey was the premises of Pashchimanchal Campus, located in Lamachaur. Prior to the survey, careful consideration was given to safety protocols, regulatory requirements, and obtaining necessary permissions for drone operation in the designated airspace.

5.6.2 INSTRUMENT SETUP:

For the survey, a DJI Phantom drone was chosen based on its suitability for the task, considering factors such as payload capacity, flight time, and camera quality. Before deployment, the drone's camera was calibrated to ensure accurate imagery.

5.6.3 FLIGHT PLANNING:

Specialized mission planning software was utilized to plan the survey area, defining parameters such as altitude, overlap, and flight speed. Waypoints were carefully defined to optimize the drone's path for comprehensive coverage of the premises.

5.6.4 DATA ACQUISITION:

Prior to take-off, a comprehensive pre-flight checklist was completed to verify the operational readiness of all systems. The drone was then launched, and the planned mission was executed in an automated manner. High-resolution aerial images were captured systematically, ensuring complete coverage of the survey area. Each image was geotagged to ensure accurate location data for post-processing.

5.6.5 POST-PROCESSING:

Following the survey, the captured images were transferred to a computer for post-processing using Pix4D Mapper software. The images were stitched together to create orthomosaic and digital surface model (DSM) representations of the survey area. Additionally, aspect and slope analyses of the terrain were refined and generated using ArcMap software, providing valuable insights into the topographic characteristics of the premises.

5.6.6 DOCUMENTATION:

By preparing maps and necessary documents, the report served as a valuable reference for communicating the findings to relevant stakeholders.

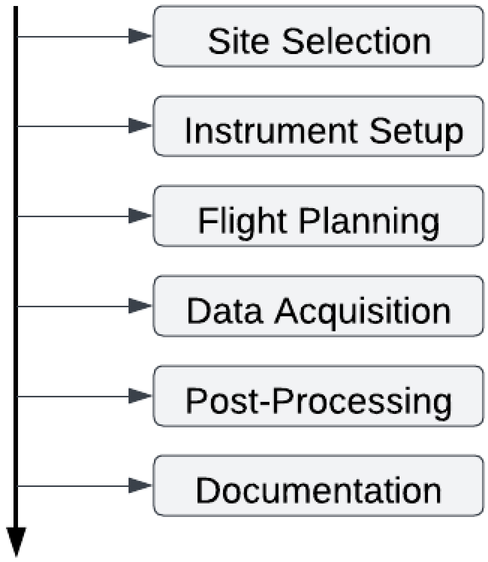


Figure 15: Methodology of Drone Survey

5.7 RESULT AND DISCUSSION

The drone survey conducted for the study area aimed to provide precise and accurate aerial data for analysis and assessment. The outputs of our drone survey include detailed orthomosaic maps, digital surface models (DSMs), and 3D models of the study area. These datasets provide valuable insights into the terrain characteristics, elevation profiles, and spatial distribution of features within the surveyed premises. By leveraging drone technology, we were able to gather rich and detailed information that can be utilized for various applications, such as urban planning, environmental monitoring, and infrastructure development.

5.8 CONCLUSION AND RECOMMENDATION

In conclusion, the drone survey conducted for the study area has yielded invaluable aerial data essential for comprehensive analysis and decision-making. The precise imagery and elevation information captured during the survey facilitate accurate mapping, planning, and assessment of the area. Moving forward, it is recommended to utilize these survey results efficiently in further research, planning, and development projects related to the study area. Furthermore, ongoing monitoring and evaluation of the study area using drone technology can provide valuable insights into changes over time, allowing for proactive management and decision-making.

CHAPTER 6 MISCELLANEOUS SURVEY

6.1 MEASUREMENT OF HEIGHT OF TOWER

6.1.1 INTRODUCTION:

The precise measurement of tower height is fundamental in surveying for construction and infrastructure projects, where accuracy is paramount for engineering and planning purposes.

Total Station (TS), a sophisticated surveying instrument, emerges as a pivotal tool in this task, offering precise measurements of angles and distances with exceptional accuracy. With its advanced capabilities, TS enables surveyors to obtain detailed and reliable data essential for assessing the height of towers and other structures.

The process of finding the height of objects without actually going to the top of the object is known as Remote Elevation Measuring (REM) i.e., a total station placed remotely (faraway) from the object is used to measure the heights. Remote Elevation Measuring (REM) revolutionizes height measurement by utilizing Total Stations placed remotely from objects of interest. This innovative technique eliminates the need for physical access to measure heights, enhancing safety and efficiency.

6.1.2 WORKING PRINCIPLE:

Remote Elevation Measuring (REM) operates on the principle of trigonometry to determine the height of a target from a distance using Total Stations (TS) or similar surveying instruments. The method involves measuring the slope distance (S) and the horizontal and vertical angles ($\theta z1$ and $\theta z2$) from the instrument to the target.

The height of the target is calculated using the following formula.

$Ht = h1 + h2$

$h2 = S*\sin\theta z1*\cot\theta z2 – S*\cos\theta z$

Where:

- h1 is the known height of the instrument or reference point.
- h2 is the calculated height of the target.
- S is the slope distance measured by the instrument.
- $\theta z1$ is the horizontal angle from the instrument to the target.
- $\theta z2$ is the vertical angle from the instrument to the target.

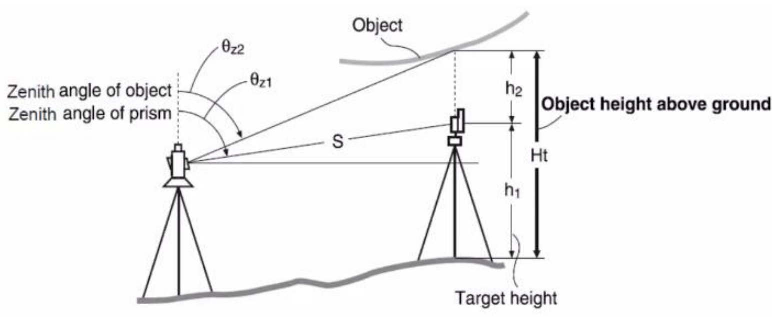


Figure 16 Remote Elevation Measurement

6.1.3 METHODOLOGY:

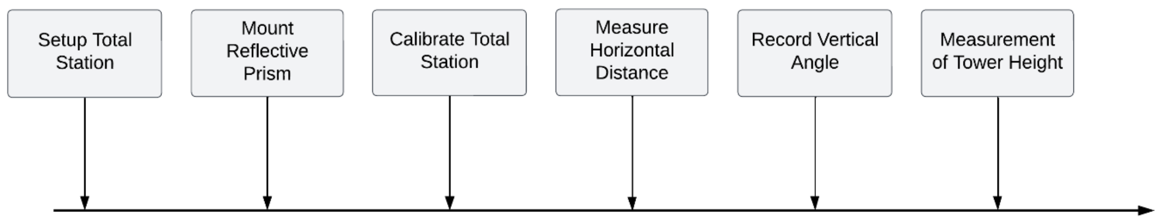


Figure 17: Methodology of Remote Elevation Measurement

6.1.4 RESULTS AND DISCUSSION

Using Remote Elevation Measuring (REM) with Total Station (TS), the height of the tower was accurately determined. REM facilitated precise height measurement without the need for direct access to the tower's top. The obtained height data provided valuable insights for engineering and planning purposes. The results demonstrate the effectiveness of REM in obtaining accurate height measurements remotely, underscoring its significance in modern surveying practices.

The obtained heights are as follows:

S.N	1	2	3	4	Average height
T1	30.105	30.003	29.993	29.995	30.0240
T2	29.378	29.298	29.357	29.301	29.3335
T3	34.928	34.934	35.078	35.126	35.0165
T4	26.117	26.199	26.119	26.137	26.1430
T5	37.081	37.005	36.99	37.105	37.0452

Table 10: Height of Towers

6.1.5 CONCLUSION

Through collaborative efforts, we effectively utilized Total Station for tower height measurement, highlighting its accuracy and efficiency in surveying tasks. Additionally, we gained valuable insights into using Total Station for traverse, enhancing our surveying capabilities and increasing measurement accuracy. This experience underscores the importance of Total Station as a versatile tool in surveying and engineering applications. Moving forward, it is recommended to continue exploring and expanding the use of Total Station while investing in continuous training and skill development to maximize its potential benefits in future projects.

6.2 MISSING LINE MEASUREMENT

6.2.1 INTRODUCTION:

The Missing Line Measurement (MLM) method, commonly utilized in surveying and geomatics, represents a sophisticated technique for determining various parameters between two target prisms using Total Stations (TS). In surveying, MLM offers a practical solution for measuring slope distance, horizontal distance, and horizontal angle to a target from a reference point without necessitating the relocation of the instrument. This method is particularly advantageous for capturing accurate measurements in situations where terrain or obstacles may impede direct access to the target. Moreover, MLM provides flexibility by allowing the last measured point to be adjusted as the next starting position, facilitating seamless data collection and analysis. With MLM, measurement results can be conveniently displayed as gradients between two points, offering valuable insights for engineering, construction, and land management projects. In this report, we delve into the principles, applications, and advantages of the Missing Line Measurement method, exploring its significance in modern surveying practices and its potential to enhance efficiency and accuracy in various fieldwork scenarios.

6.2.2 WORKING PRINCIPLE:

The working principle of Missing Line Measurement (MLM) revolves around utilizing Total Station (TS) to measure distances and angles from a known point (usually the instrument setup location) to a first point, and then to a second point. Trigonometric calculations are applied to determine the missing line, enabling accurate measurement even in situations where obstacles or inaccessible terrain obstruct direct line-of-sight.

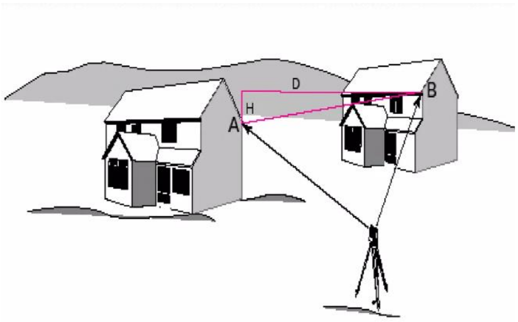


Figure 18: Working Process of MLM

6.2.3 METHODOLOGY

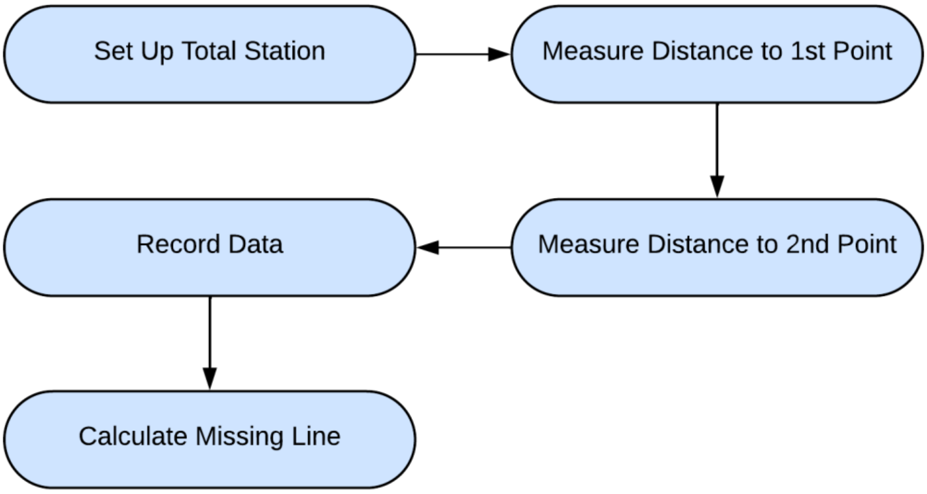


Figure 19: Methodology of MLM

6.2.4 RESULTS AND DISCUSSION

The application of Missing Line Measurement (MLM) utilizing Total Station (TS) technology proved highly effective in accurately measuring distances and elevations between points in our surveying project. Despite challenges such as obstacles or inaccessible terrain, MLM enabled precise determination of the missing line through trigonometric calculations, providing valuable data on slope distances and vertical and horizontal angles between reference and target points. These results were instrumental in various engineering, construction, and land management projects, supporting informed decision-making and planning processes.

The obtained measurements are as follows:

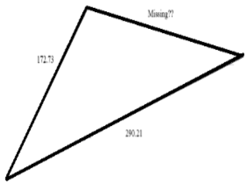
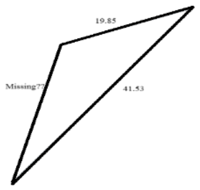
Sketch	Missing Line Measurement by TS	MLM by Tape	Error
	290.380	290.362	0.018
	196.312	195.210	1.102
	26.712	26.523	0.189

Table 11 Results of MLM

6.2.5 CONCLUSION AND RECOMMENDATION:

Through collaborative efforts, we demonstrated the effectiveness of Total Station in missing line measurement, affirming its accuracy and efficiency in surveying tasks. This newfound expertise opens up opportunities for more comprehensive and precise surveying endeavours in the future. The successful utilization of Total Station underscores its importance as a versatile and indispensable tool in surveying and engineering applications. Moving forward, it is recommended to continue exploring and expanding the use of Total Station in various surveying tasks, while also investing in continuous training and skill development to maximize its potential benefits.

REFERENCE

Kelusberg, A., “Comparing GPS and GLONASS”, GPS World, Vol. 1, No 6, November/December, 1990, pp, 52-54

W. Schofield, M. Breach, “Engineering Surveying”, Library of Congress Publication, 2007.

Anderson, J., & Mikhail, E. (1998). Surveying: Theory and Practice. (7th ed, p. 1011) McGraw Hill.

SD, 2011. Annual Report of 2067-68, Programme of Cadastral Survey Branch, Survey Department (SD), Government of Nepal.

SHRESTHA, B.L: Land Records, Registration and Cadastral Surveying, Nepal

SIGDEL, M.P; SHARMA, A.; 2005 March; Cadastral Resurvey and Updating Land Records, Survey Department, Nepal

PAUDYAL, D.R.: 2005; Evaluation of Alternatives- District Versus Central Updating of Cadastral Information (M.Sc. Thesis), ITC, the Netherlands.

Dr. B. Umashankar and Dr. R. Satish, Providing and executing safety works to mitigate hazard for the approach road adjacent to Bio-diversity park @ TSIIC Cyberabad in the State of Telangana, India

Y. Gao, X. Shen & M. Abdel-Salam (2002) Global Differential GPS Positioning without Using a Base Station, Geographic Information Sciences, 8:1, 9-15.

Wikipedia

LucidChart