GEOMATICS ENGINEERING DEPARTMENT

SECOND YEAR GEOMATICS

SUMMER TRAINING (2) - (GED200)

LECTURE NO: 1

CADASTRAL SURVEYING

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Overview Of Today's Lecture

- Subject
- Scope
- Syllabus
- Assessment
- Cadastral Surveying
- Field Work
- Office Work
- Choosing appropriate Scale
- Map Production

YOUR SUBJECT

- **Name: Summer Training (2)**
- **Subject Code: GED200**
- Prior to registering in second year, the student should have completed 4 weeks of summer training (GED200) on surveying works for 5 days per week. The daily training is for 6 hours (1 hr. Lecture + 1 hr. tutorial + 4 hrs. Field and Lab.), amounting to a total of 30 hours per week. A maximum grade of 20 marks is added to the 'semester work' grades of the Geodesy (1) (GED203) course of second year.
- The class is scheduled from **Sunday to Thursday**, with sessions running from **10 am to 4 pm**. All sessions are compulsory. All sessions are ***compulsory***.
- Oral examinations will be held between **July 07th and August 01st, 2024**.

YOUR SUBJECT

- **References**

1. Lecture notes of subject codes GED101, and GED103
2. "Surveying: Principles and Applications" by Barry Kavanagh and Tom Mastin (2016). This textbook covers the principles of traverse surveying using both theodolites and total stations, with a focus on practical applications. Link: https://www.amazon.com/Surveying-Principles-Applications-Barry-Kavanagh/dp/0137009402 ↗
3. "Surveying with Construction Applications" by Barry F. Kavanagh (2012). This comprehensive textbook covers many aspects of surveying, including traverse surveying using theodolite and total station, as well as other surveying methods. Link: https://www.amazon.com/Surveying-Construction-Applications-Barry-Kavanagh/dp/0135000517 ↗
4. "Surveying: Theory and Practice" by James M. Anderson and Edward M. Mikhail (2017). This textbook covers the fundamental concepts of surveying, including traverse surveying using theodolites and total stations. Link: https://www.amazon.com/Surveying-Theory-Practice-James-Anderson/dp/0073397904 ↗
5. "Surveying for Engineers" by J. Uren and W.F. Price (2013). This textbook covers the principles and methods of surveying, including traverse surveying using theodolites and total stations, with a focus on engineering applications. Link: https://www.amazon.com/Surveying-Engineers-J-Uren/dp/0230301457 ↗
6. "Manual of Surveying Instructions" by the Bureau of Land Management (BLM) (2009). This is the official manual used by BLM surveyors in the United States and covers the principles and methods of surveying, including traverse surveying using theodolites and total stations. Link: https://www.blm.gov/sites/blm.gov/files/documents/files/2009_manual_of_surveying_instructions.pdf ↗

SCOPE

The scope of this training course includes:

- **Leveling surveying:** which is a technique used to determine the elevations of different points on a site, and plane surveying using digital theodolite, which is a technique used to measure angles and distances on a site.
- **Cadastral surveying using total station**: which is a technique used to establish property boundaries and create land maps.
- **Map generation:** which includes a topics such as collecting and organizing field data, creating and editing maps, and using mapping software.
- **Identification of various map elements**: such as symbols, scales, and legends, which are commonly used in maps.
- **Creating digital maps:** using engineering software such as Autodesk, which is a software commonly used in the engineering industry.

SYLLABUS

- **Subject Code GED200 involves:**

A. Leveling Surveying

B. Traverse surveying using digital theodolite

C. Cadastral Surveying using Total station.

D. Map generation.

E. Identification of various map elements.

F. Digital maps using engineering software (e.g., Autodesk)

TUTORIALS

- Longitudinal Leveling
- Grid Leveling
- Cross Section Leveling
- Traverse observations using digital theodolite.
- Cadastral mapping using total station.
- Cadastral map generation according the ESA standards.
- Contour map generation at different contour intervals.

ASSESSMENT

Assessment Tool	Week	Weight
Field work follow-up	1, 2, 3	15 %
Assignments	1, 2, 3	30 %
Technical Report	3, 4	15 %
Showcase	4	20 %
Oral Exam	4	20 %
Total	**4**	**100** %

$A^+ \geq 85\%$, $A \geq 75\%$, $B^+ \geq 71\%$, $B \geq 65\%$, $C^+ \geq 58\%$, $C \geq 50\ \%$, $D^+ \geq 44\ \%$, $D \geq 38\ \%$, $F < 38\ \%$

Your Teacher

- **Name**
  - Dr. Eng. Reda Fekry
- **Research Interests**
  - Multi-modality 3D remote sensing.
  - Pattern recognition, and related environmental and industrial applications.
  - Sensor fusion for environmental informatics.
  - Deep learning for vision.
  - Object segmentation and classification
- **Teaching Areas**
  - Surveying and Geodesy.
  - Photogrammetry and Remote Sensing.
  - Geospatial computer vision and machine learning.
- **Room**
  - RCO-30
- **E-mail**
  - reda.abdelkawy@feng.bu.edu.eg
  - fekry.khaliel@connect.polyu.hk
  - rfekry@ecu.edu.eg

WHAT SPECIFIC SKILLS OR COMPETENCIES SHOULD WE PRIORITIZE?

INFORMATION SOCIETY AND SPATIAL INFORMATION

- We are living in a so-called information society, in which large percentage of the population works in information technology (related sectors and information becomes an important resource.
- Among all kinds of information 80 % are position related information, i.e., each piece of information has a position (or coordinates) attached to it. This position-related information is called geographic information (or in more general term geo-spatial information/data.

PART I – CADASTRAL SURVEYING

CADASTRAL SURVEYING

Research: research existing records and other sources of information about the property, such as deeds, maps, and previous surveys.

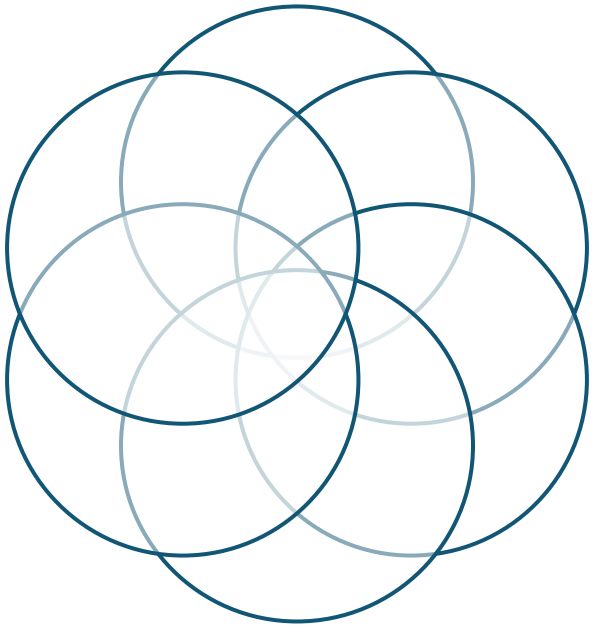
Fieldwork: using a total station.

Data analysis: analyzes the data collected and makes any necessary adjustments to ensure accuracy.

Drafting: create a draft of the cadastral map.

Review: draft map is reviewed by the surveyor and other stakeholders.

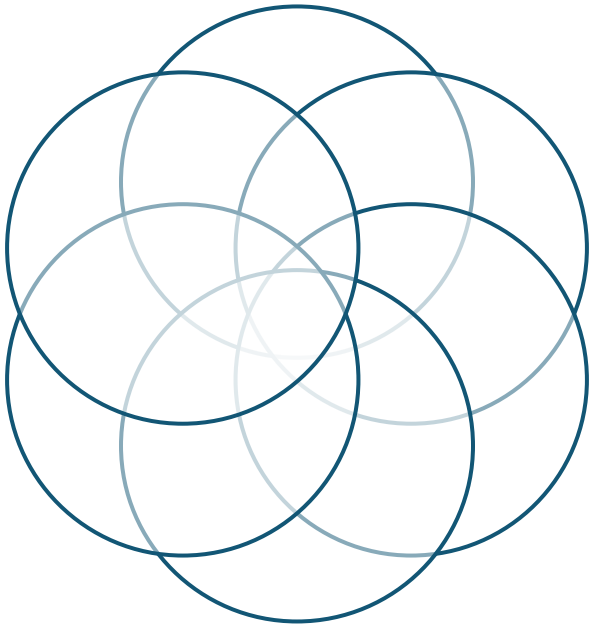
Final map: the final cadastral map is prepared and delivered to the client.



Cadastral Surveying

Research: research existing records and other sources of information about the property, such as deeds, maps, and previous surveys.

Final map: the final cadastral map is prepared and delivered to the client.



Fieldwork: using a total station.

Review: draft map is reviewed by the surveyor and other stakeholders.

Data analysis: analyzes the data collected and makes any necessary adjustments to ensure accuracy.

Drafting: create a draft of the cadastral map.

Cadastral Surveying – Field Work

1. Reconnaissance and sketching
2. Establish reference points
3. Traverse Observations
4. Feature mapping

CADASTRAL SURVEYING – FIELD WORK

1. Reconnaissance

An important first step in surveying and mapping projects, as it helps to ensure that the project is well-planned and that any potential issues are identified and addressed before the main survey or mapping work begins.

- **Some specific tasks that may be performed during reconnaissance include:**

1. Walking or driving around the site to observe the terrain and natural features.
2. Taking photographs or videos of the site to document its characteristics.
3. Reviewing existing maps, aerial photographs, or other data sources to gather additional information.
4. Meeting with stakeholders or landowners to discuss the project goals and any potential issues or concerns.

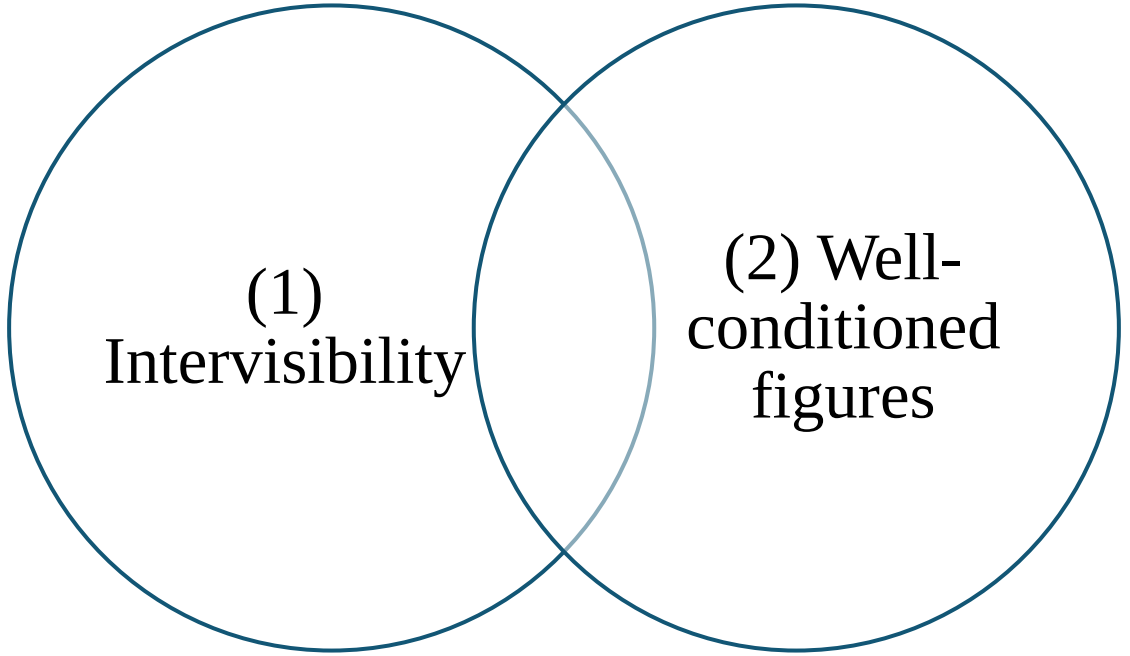
CADASTRAL SURVEYING – FIELD WORK

2. Establish reference points (Traverse)

1. **Choose stable and permanent points:** to ensure that they do not move or shift over time. Good examples of stable reference points include solid surfaces such as concrete or bedrock, or permanent structures such as buildings or bridges.
2. **Use multiple reference points:** It's important to establish multiple reference points on the site, to ensure that the survey is accurate and reliable. Three or more reference points are typically used to establish a network of coordinates for the site.
3. **Measure distances and angles accurately:** When measuring the distances and angles between reference points, it's important to use the total station accurately and carefully. The instrument should be leveled properly, and measurements should be taken multiple times to ensure accuracy.
4. **Check and adjust for errors:** After measuring the distances and angles between reference points, it's important to check for any errors or discrepancies. If there are errors, adjustments may need to be made to the measurements to ensure that the reference points are accurate.
5. **Use established benchmarks**: In some cases, it may be helpful to use established benchmarks as reference points. Benchmarks are fixed points with known elevations, such as survey markers or benchmarks established by the National Geodetic Survey.
6. **Document the reference points**: It's important to document the locations and elevations of the reference points, to ensure that they can be found and used in future surveys. This documentation may include descriptions, photos, or other data.

CADASTRAL SURVEYING – FIELD WORK

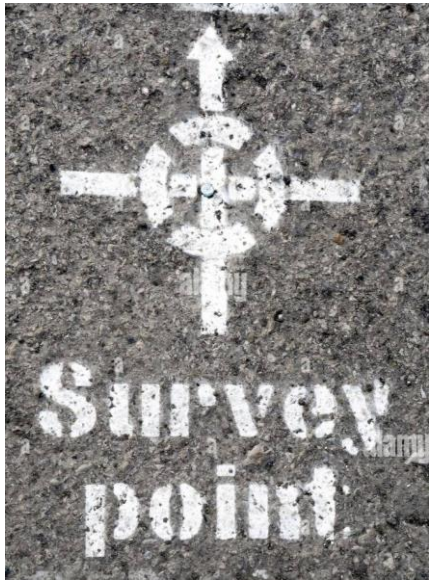
2. Establish reference points (Constraints)

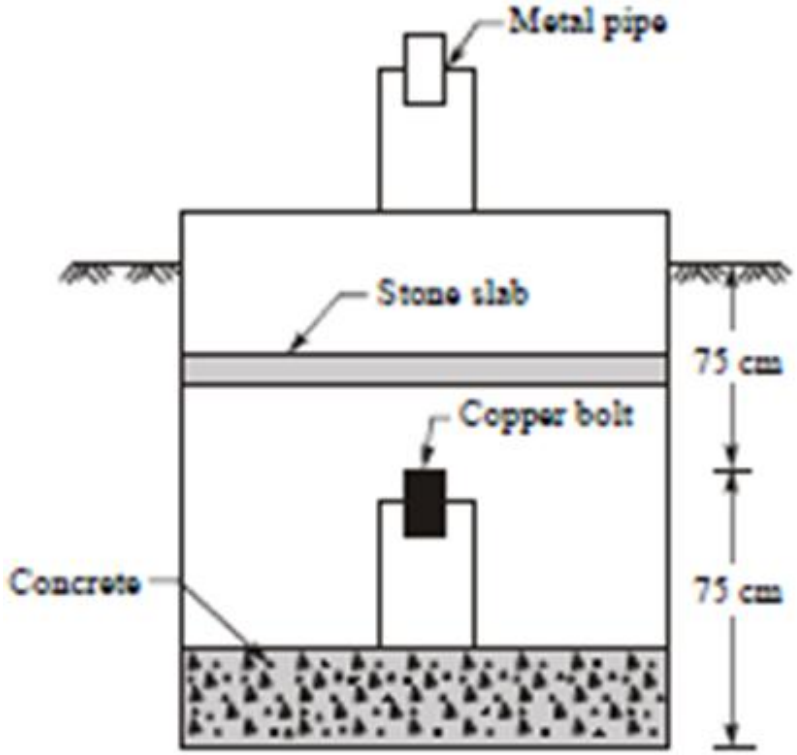


Why? 🤔

CADASTRAL SURVEYING – FIELD WORK

2. Establish reference points (Constraints)





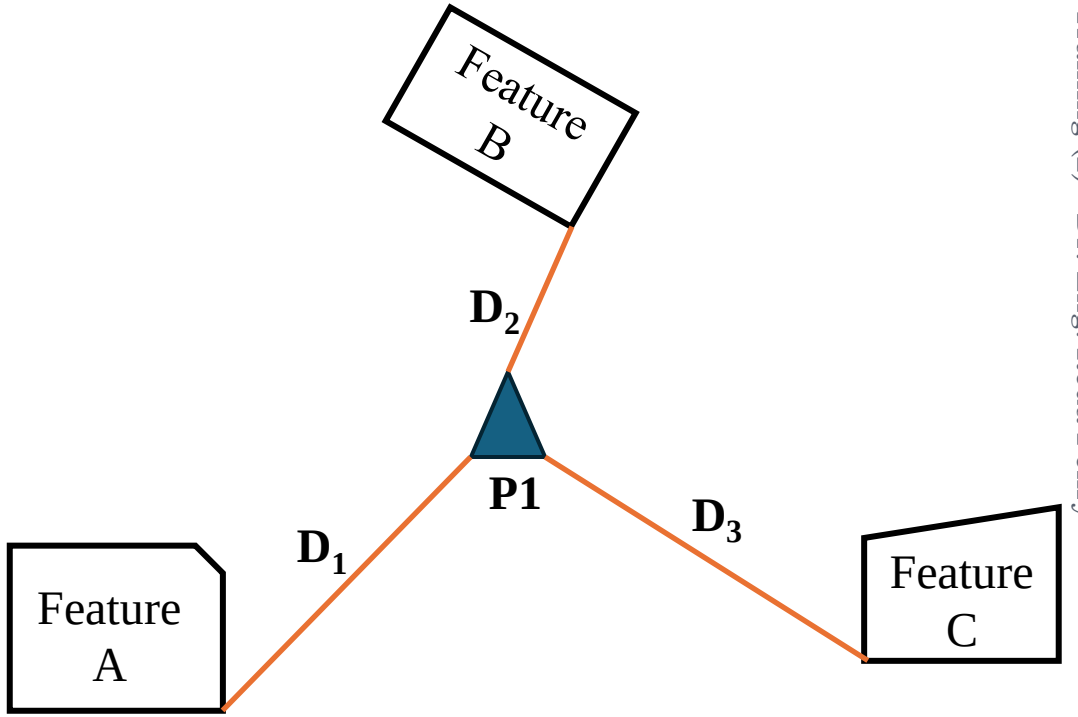
Images from internet

CADASTRAL SURVEYING – FIELD WORK

2. Establish reference points (Description Cards)

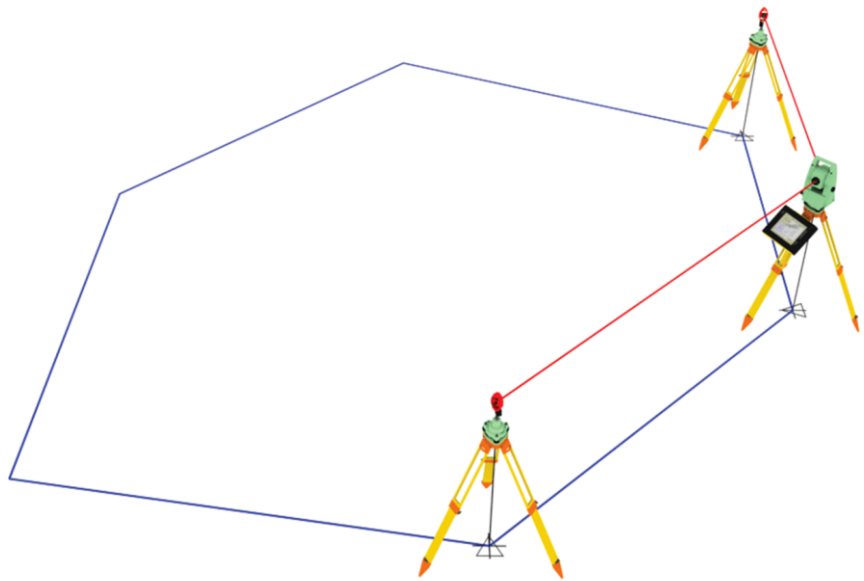
A description card for a reference point provides important information that is used to identify and locate the point in future surveys. By including accurate and detailed information about the point's location, appearance, and markers, surveyors can ensure that the reference point is easily recognizable and can be used reliably in future surveys.

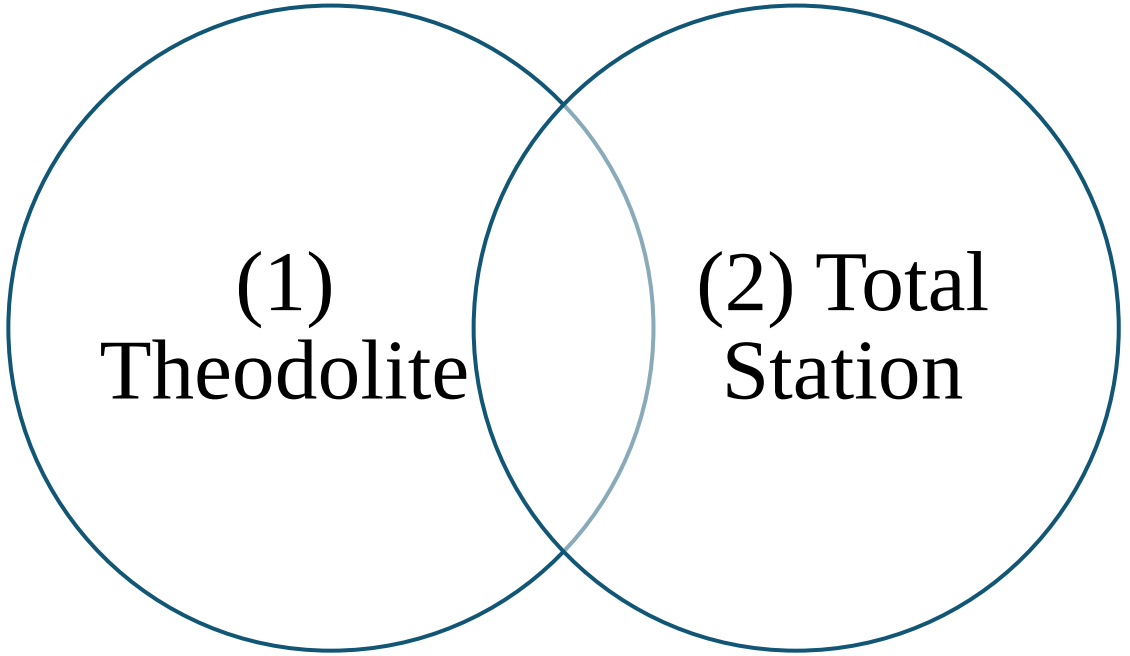
Station Name: ……		
Point number	……	……
Name or designation	……	……
Location:	……	……
Description	……	……
Elevation above MSL	……	……
Markers	……	……
Nearby features	……	……



CADASTRAL SURVEYING – FIELD WORK

3. Traverse Observations





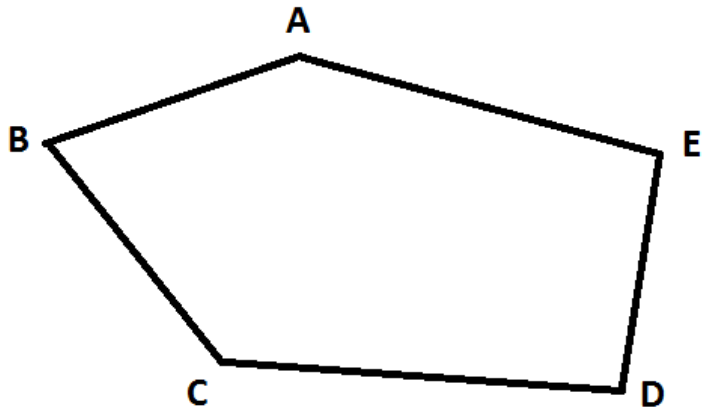
Does it make difference? 🤔

Images from internet

CADASTRAL SURVEYING – FIELD WORK

3. Traverse Observations (Theodolite Observation Sheet)

Occupied Station	To	Fore Bearing	Back Bearing	Vertical/Zenith Angle	Distance
A	B	.....	.....	.....	.....
	E	.....	.....	.....	.....
	B	.....	.....	.....	.....

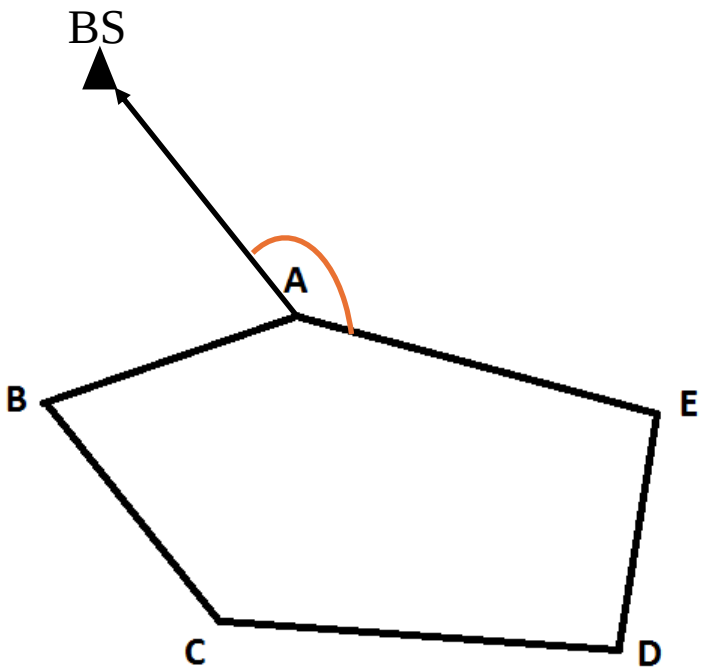


Closed Traverse

What will be computed using these observations? 🤔

CADASTRAL SURVEYING – FIELD WORK

3. Traverse Observations (Total Station)



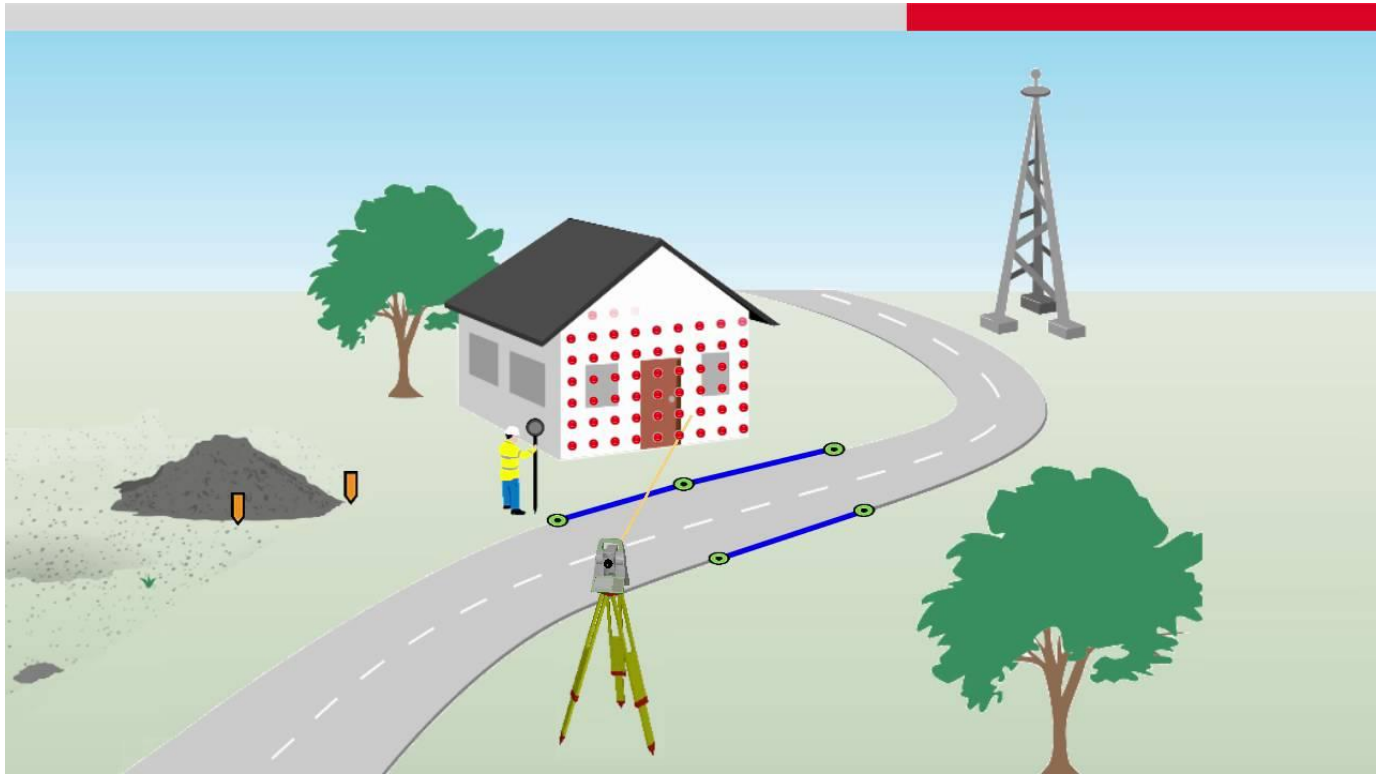
Closed Traverse

Occupied Station	To	E	N	Elevation	Remarks
A	BS	.....	.....	.....	.....
	B	.....	.....	.....	.....
B	A				
	C				

How much this differ from theodolite observations? 🤔

CADASTRAL SURVEYING – FIELD WORK

4. Feature Mapping



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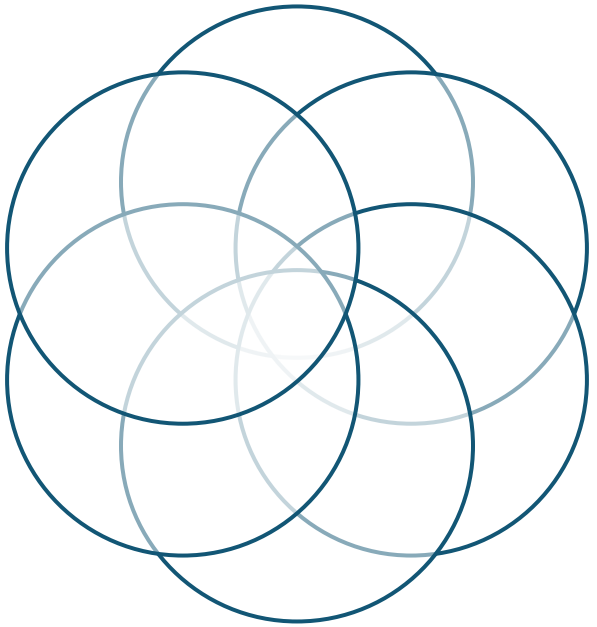


Cadastral Surveying – Office Work

1. Traverse Adjustment
2. Map Drafting
3. Map Review and Revision
4. Final Map

CADASTRAL SURVEYING – OFFICE WORK

1. Traverse Adjustment

A. Linear Error

$$d_s = \sqrt{(\sum \Delta x)^2 + (\sum \Delta y)^2}$$

B. Angular Error

$$d_\theta = \sum interior\ angles\ - \left((n-2) \times 180°\right)$$

CADASTRAL SURVEYING – OFFICE WORK

1. Traverse Adjustment

How can you know the traverse linear error is acceptable?

Before providing an answer, it is important to consider any relevant standards.

According to the Egyptian Survey Authority (ESA) , The following are the traverse standard errors:

1. **Horizontal traverse:** The maximum allowable error for a closed traverse is 1:10,000 of the traverse length, while the maximum allowable error for an open traverse is 1:5,000 of the traverse length.
2. **Vertical traverse:** The maximum allowable error for a closed traverse is 1:5,000 of the traverse length, while the maximum allowable error for an open traverse is 1:2,500 of the traverse length.
3. **Combined horizontal and vertical traverse:** The maximum allowable error for a closed traverse is the square root of the sum of the squares of the horizontal and vertical errors, divided by the traverse length. The maximum allowable error for an open traverse is the same as for the horizontal traverse.

CADASTRAL SURVEYING – OFFICE WORK

1. Traverse Adjustment

How can you know the traverse linear error is acceptable?

$$Relative\ accuracy\ of\ traverse = \frac{linear\ error\ ds}{perimeter\ of\ traverse}$$

How can you know the traverse angular error is acceptable?

$$allowable\ angular\ error = ls \times \sqrt{n}$$

Such that:

ls: is the theodolite least count.

n: is the number of stations of traverse.

CADASTRAL SURVEYING – OFFICE WORK

1. Traverse Adjustment

Which method should be used? Why?

1. **Bowditch's rule**
2. **Transit Rule**
3. **……**

N.B: For equations and procedures please refer to subject codes GED101 and GED103.

CADASTRAL SURVEYING – OFFICE WORK

- **Map Drafting**

The actual drafting of the map involves using manual or digital techniques to create the final product.

1. Scale Selection

2. Start plotting (using tools such as pens, pencils, and rulers to draw the map on paper, or digital drafting involves using software to create the map on a computer)

CADASTRAL SURVEYING – OFFICE WORK

- **Map Drafting (Selection of Scale)**

a. Based on project size w.r.t paper size

b. Based on smallest feature to be mapped

- **Large Scale**

1:250

1:500

…

…

1:5000

Typically used for cadastral and agricultural maps.

- **Small Scale**

1:25000

…

…

1:2000000

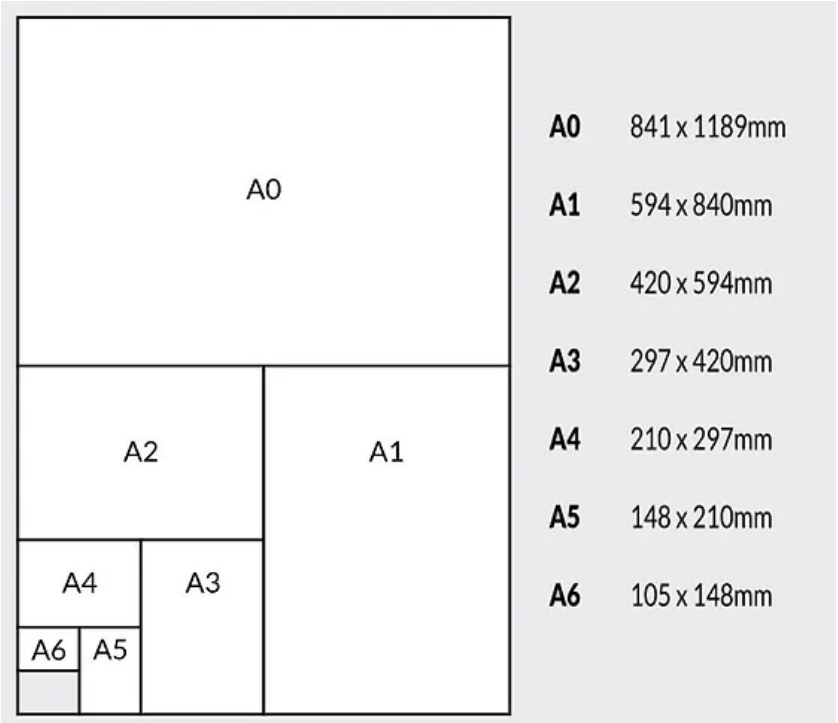
Typically used for topographic maps.

CADASTRAL SURVEYING – OFFICE WORK

- **Map Drafting (Selection of Scale)**

a. Based on project size w.r.t paper size

b. Based on smallest feature to be mapped



Cadastral Surveying – Office Work

- **Map Drafting (Selection of Scale)**

a. Based on project size w.r.t paper size

- **Map Size**

Width = paper width – 4 cm

Length = paper length – 4cm

- **Example**

Paper size is A_0 (84 cm * 120 cm)

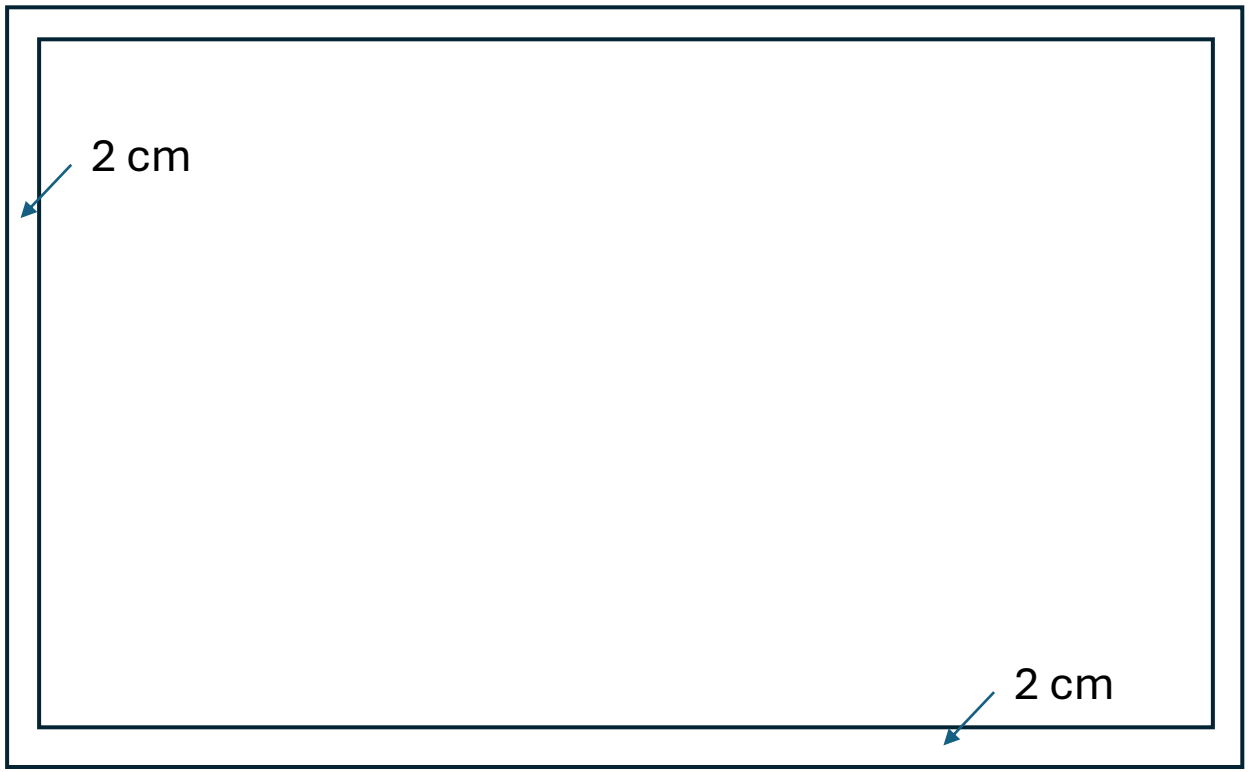
Actual length = 120 – 4 = 116 cm

Actual width = 84 – 4 = 80 cm.

Project dimensions (1250 m * 900 m)

Scale of width = $\frac{80\ cm}{900\ m} = \frac{80\ cm}{90000\ cm} = \frac{1}{1125}$

Scale of length = $\frac{116\ cm}{1250\ m} = \frac{116\ cm}{125000\ cm} = \frac{1}{1078}$



Cadastral Surveying – Office Work

Map Drafting (Selection of Scale)

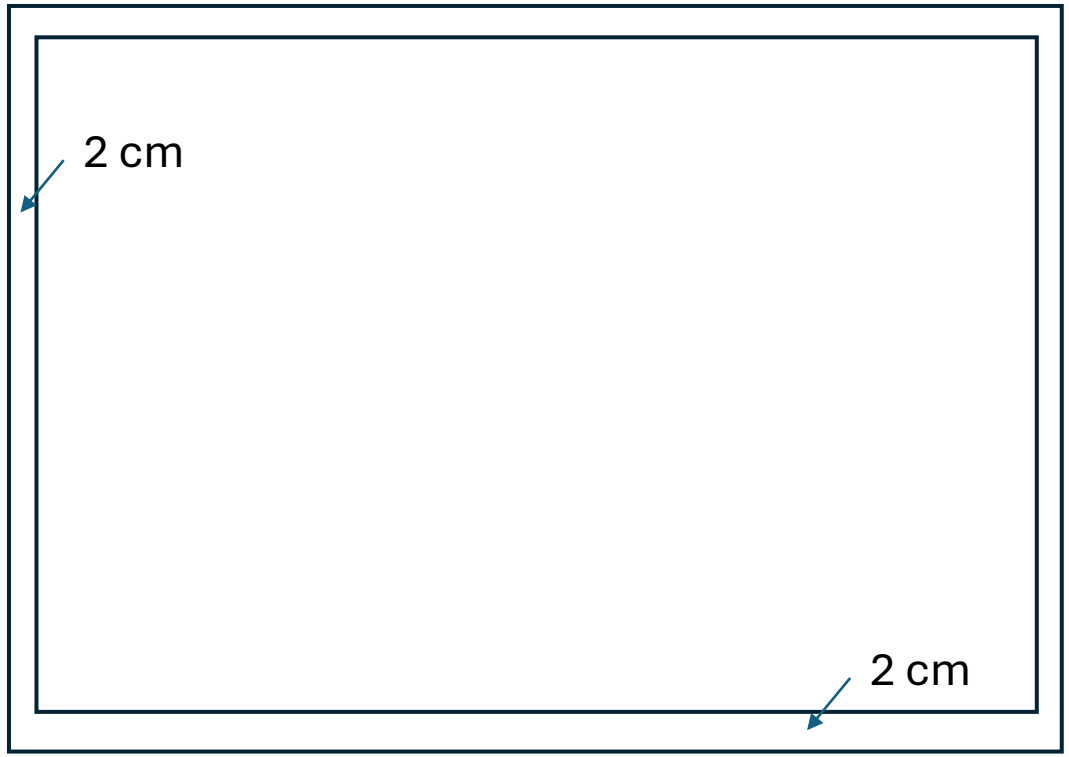
a. Based on project size w.r.t paper size

- Scale of width $= \frac{80\ cm}{900\ m} = \frac{80\ cm}{90000\ cm} = \frac{1}{1125}$
- Scale of length $= \frac{116\ cm}{1250\ m} = \frac{116\ cm}{125000\ cm} = \frac{1}{1078}$

Therefore, use the small scale which is $\frac{1}{1125}$.

But the conventional scales in surveying are:-

1:250, 1:500, 1:1000, 1:2500, 1:5000, etc.,



<u>The optimal scale of this project is 1:2500.</u>

CADASTRAL SURVEYING – OFFICE WORK

- **Map Drafting (Selection of Scale)**

b. Based on smallest feature to be mapped

Formula of smallest feature that appears on a map: -

$$smallest\ feature = 3\ mm\ \times \frac{1}{map\ scale}$$

Let our map scale is 1:100, then

$$smallest\ feature = 3\ mm\ \times 100 = 300\ mm = 30\ cm$$

Then at scale 1:100, map can show a feature of length 30 cm.

CADASTRAL SURVEYING – OFFICE WORK

- **Map Drafting (Selection of Scale)**

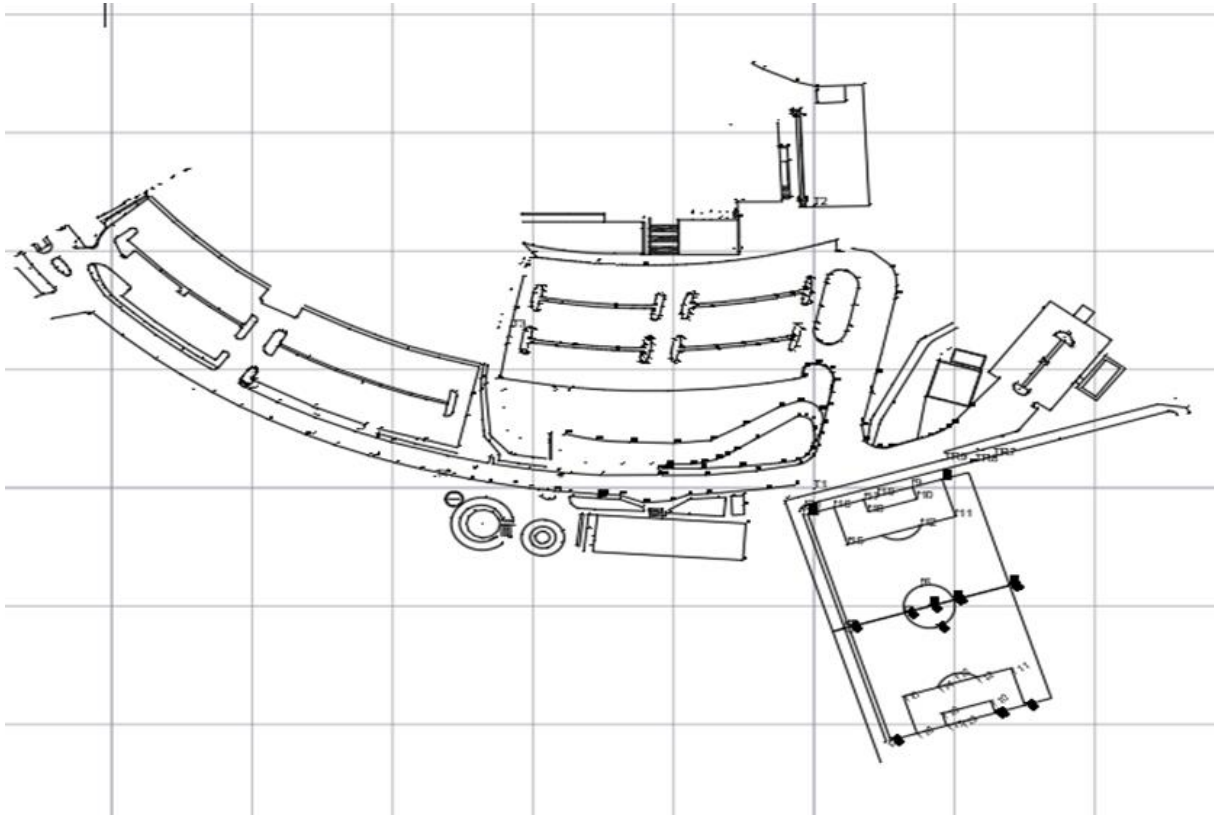
What should be done if the total project area cannot be plotted on a single map at scale 1:100?!!

Therefore, you need to divide your area into several maps:-

1	2
3	4

CADASTRAL SURVEYING – OFFICE WORK

- **Map Drafting (Drawing)**



S. No.	Object	Symbol	Colour
7.	Lake or pond		Prussian blue
8.	Open well		Prussian blue
9.	Tube well		Black
10.	Footpath		Black
11.	Metalled road		Burnt sienna
12.	Unmetalled road		Burnt sienna
13.	Railway line (single)		Black
14.	Railway line (double)		Black
15.	Road bridge or culvert		Black
16.	Railway bridge or culvert		Black
17.	Level-crossing		Black and burnt sienna
18.	Wall with gate		Black
19.	Boundary line		Black

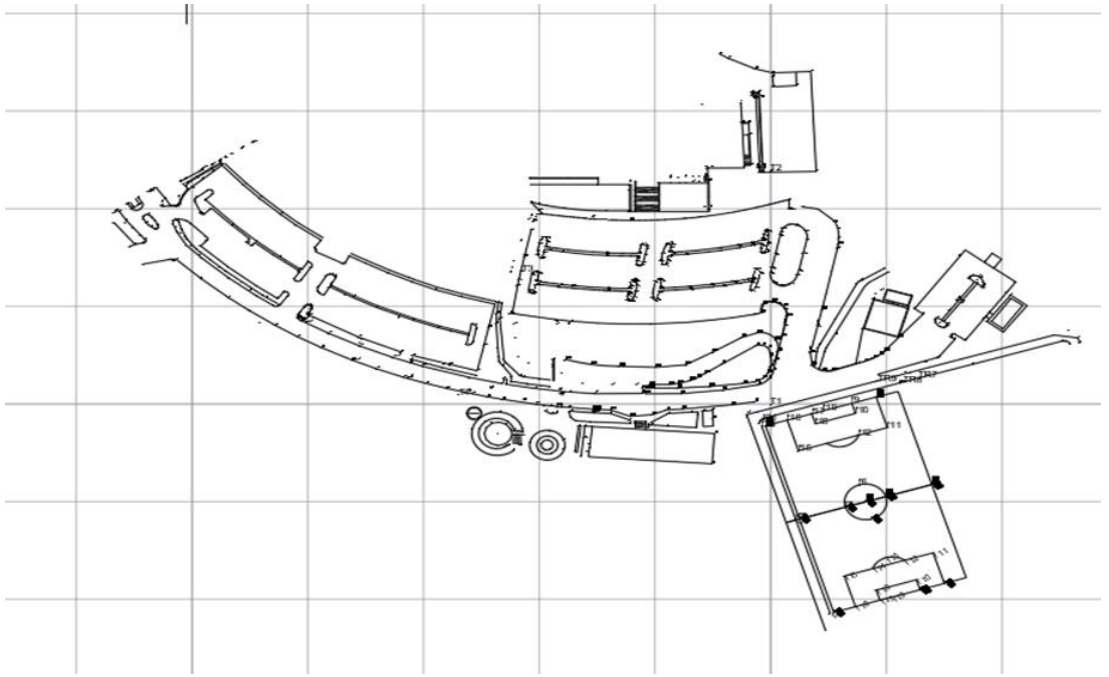
Conventional signs

CADASTRAL SURVEYING – OFFICE WORK

Map Drafting

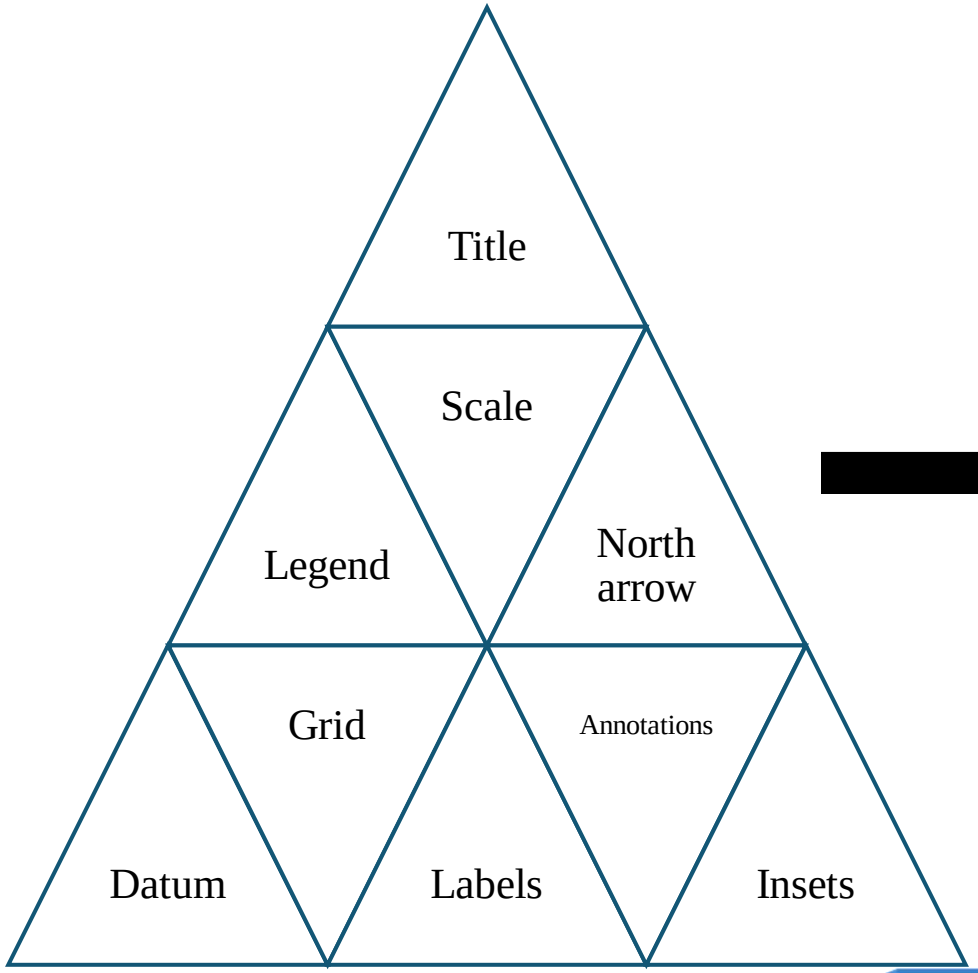
The actual drafting of the map involves using manual or digital techniques to create the final product.

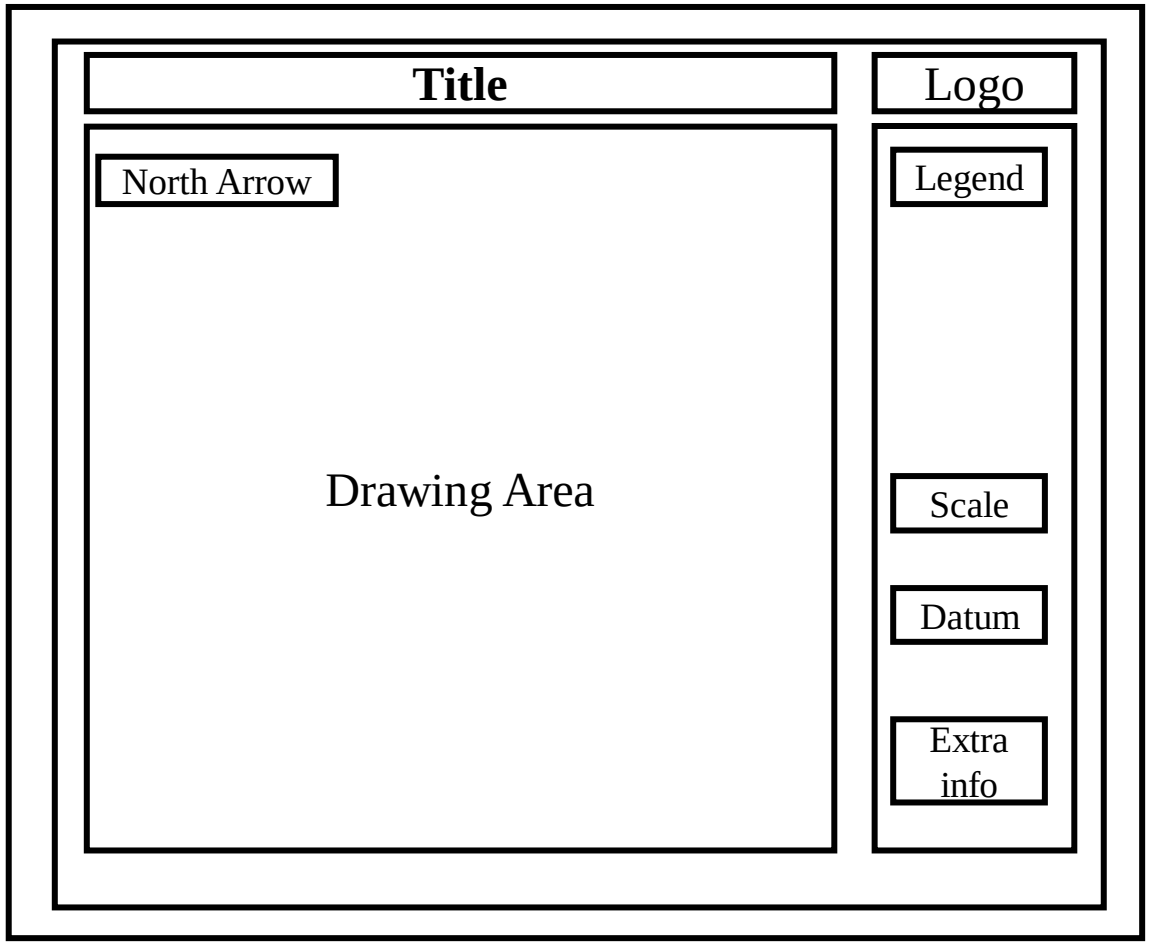
Manual drafting involves using tools such as pens, pencils, and rulers to draw the map on paper, while digital drafting involves using software to create the map on a computer.



CADASTRAL SURVEYING – OFFICE WORK

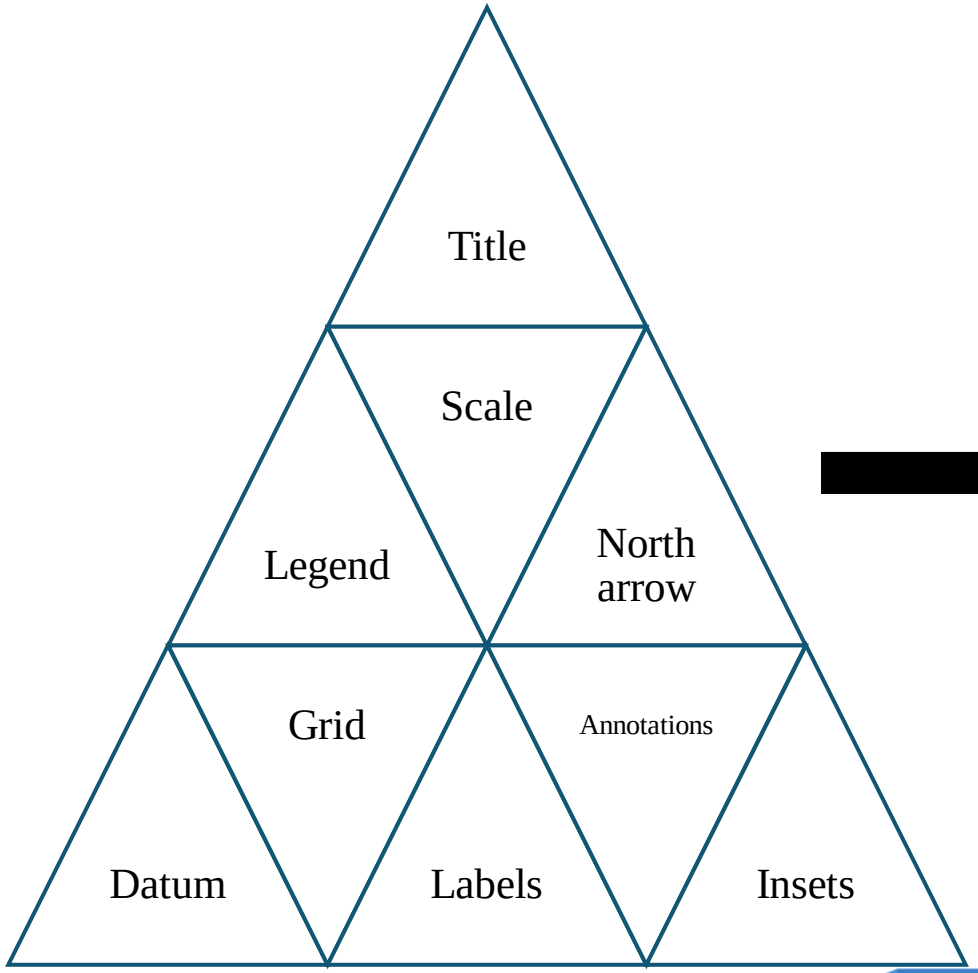
2. Map Drafting (Map Elements)

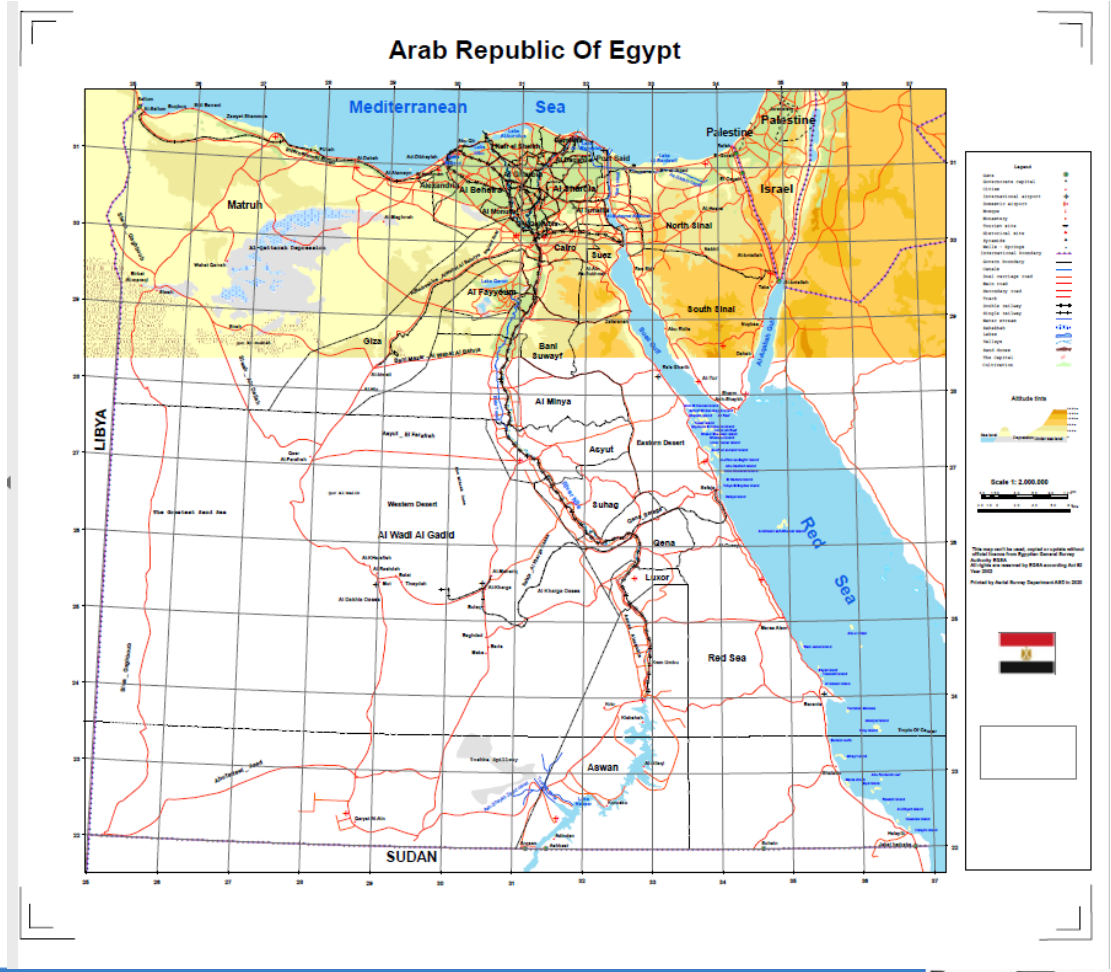


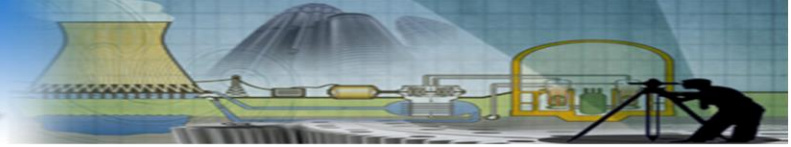


CADASTRAL SURVEYING – OFFICE WORK

2. Map Review and Revision







END OF PRESENTATION

THANK YOU FOR ATTENTION!