TVET CERTIFICATE V in Land Surveying

CADASTRAL MEASUREMENT

CSTLSV5001 Perform cadastral measurement

Competence

Credits: 8 Learning hours:80

Sector: Construction and Building Services

Sub-sector: Land Surveying

Module Note Issue date: November, 2020

Purpose statement

This module describes the skills, knowledge and attitudes required to perform cadastral measurements. At the end of this module, participants will be able to identify cadastral function, apply cadastral data collection, and perform land demarcation.

Table of Contents

Total Number of Pages: 100

Learning unit 1- Identify cadastral functions

1. Introduction on Cadastral survey

Meaning of Cadastral s==[[urveying

It is a branch of surveying dealing with the survey and demarcation of land for the purpose of defining land parcels and registering them in a land registry.This survey determines the ownership, boundaries and location of land parcels. It allows determining boundaries of individual land (public or private), but also national and international boundaries.

Cadastral survey and the land registry together constitute the cadastral system

- is the technique, profession, and science of determining the terrestrial or three-dimensional position of points, the distances and angles between them".

A land surveying professional is called "a land surveyor".

Lo 1.1 –Identification of different categories of cadastre.

Content/Topic 1 Differentiate The Categories of Cadastre

Types of cadastre

The type of cadastre one refers to will usually be determined by the extent of the boundaries recorded on the cadastral maps, which itself depends on its overall function (cadastres are normally classified according to purpose):

The types of cadastre are following:

Types of cadastre

1. Judicial / Legal cadastre – supports tenure security
2. Fiscal cadastre – supports land taxation
3. Multipurpose cadastre – supports all land administration processes

4. Register -) to establish and maintain the Register; and to administer the registration system established

1. **Judicial (or legal) Cadastre**: It records the proprietary (ownership) interest on land; it includes information on the ownership, area and location; it provides evidences for legal actions such as subdivision, boundary re-establishment and conflict resolution. It is a register of rights on land., It is based

on the area defined by the right., It may not have national coverage since not all citizens may choose to register their lands.

It is a register of rights on land

It is based on the area defined by the right.

It may not have national coverage since not all citizens may choose to register their lands.

2**. Fiscal Cadastre:** It is compiled for purposes of raising revenues (taxes), it relates to the usage and quality of land. Usage may be agricultural, residential, commercial, industrial, etc. and Quality may be the productivity of the land., It is a register with records on value of the land., It is based on the taxable area of land., It should maintain national coverage since it may be used for the purpose of land taxation

It is a register with records on value of the land

It is based on the taxable area of land

It should maintain national coverage since

it may be used for the purpose of land taxation

3. **Multipurpose Cadastre** is described as the one combining the judicial and fiscal cadastres, and links additional land attribute data to the parcels. It supports all land administration processes., It is a register of attributes of land parcel., It combines the judicial and fiscal cadastres., It links additional land attributes data to parcel that can serve for various purposes (planning, valuation, taxation, land development, environment management, etc.).

The term 'multi-purpose cadastre' means about the same as the term 'land information system' (LIS). Therefore, the main components of such a system are a spatial reference structure, a topographic map base, a cadastral map overlay showing land parcels with various land information linked with them.

It is a register of attributes of land parcel

It combines the judicial and fiscal cadastres

It links additional land attributes data to parcel that can serve for various purposes (planning, valuation, taxation, land development, environment management, etc)

4. Register

"Register" means the Land Register required to be maintained but does not include a record of customary land;

"registration" means the administrative process which, under this Act, affects, confers, confirms or terminates interests by means of entries in the Register but does not include record of customary land;

"Registrar" means the Registrar of Land appointed and includes any person designated as an Assistant Registrar of Land when acting within the scope of their delegated authority;

The functions of the Registrar are:

(a) to establish and maintain the Register; and

(b) to administer the registration system established by this Act and ensure that it operates efficiently, effectively, and economically; and

(c) to ensure that this Act is administered in a cost effective manner

Register

(1) The Registrar must create and maintain the currency of a land register to be known as the Register and which may comprise wholly or partly an electronic or computer system or such other form or forms as the Registrar from time to time considers appropriate for the purposes of this Act.

(2) A register, document, index, and all information, proceedings, and all acts made, created, collected, or originated under or in accordance with the Land Registration or any enactment repealed by that enactment, which subsist or are in force on the commencement day shall remain in force for all purposes, and where there is a corresponding provision in this Act, are taken to have been made, created, collected, or originated under or in accordance with that provision.

(3) The Land Register maintained under the Land Registration forms part of the Register created

(4) The Registrar:

(a) must record in the Register information required to be recorded by this Act or by other applicable law;

(b) may record in the Register information that is authorised to be recorded by this Act or by other applicable law; or

(c) subject to this Act or other applicable law, may record in the Register information which the Registrar is satisfied should be recorded in the Register.

(5) The Registrar must maintain such indexes in respect of the information recorded in the Register and in respect of documents and information otherwise held by the Registrar under this Act, a former Act, or other law as in the Registrar's opinion are necessary to ensure the information and the documents are reasonably accessible to the Registrar and to any person authorised by this Act or other law to have access to them.

(6) The Registrar must ensure that all information stored in an electronic or computerized form remains intact and preserved by means of an appropriate form of computer backup or other duplication.

Content/Topic 2. the different functions of Cadastre.

A. Purpose of registration

At its most basic level, a modern land registration system or cadastre can be considered strictly as an information or record keeping system. However, the greater purpose of such programmers is to:

Help secure land tenure,

Stimulate land markets and

Make better use of land and its resources.

A successful cadastre should:

- provide security of tenure,
- be simple and clear,
- be accessible,
- provide current and reliable information at low cost

A land register or cadastre in itself does not produce a land market or push economic development by itself. Land markets simply determine who has access to land and how land is used. Instead, the land registration or cadastre system can be considered as one of several crucial ‘tools’ that links the legal policies of land and property with the participants in the market and supports private land transactions.

A system for recording land ownership, land values, land use and other land-related data is an indispensable tool for a market economy to work properly, as well as for sustainable management of land resources. All industrialized nations with a market economy maintain some sort of land register system that fulfils the above requirements.

These Guidelines use the term “land” to refer to the objects to which mortgages and other data are to be connected. “Real estate” is an alternative term. In practice a land administration system can incorporate various basic objects or units, land parcels being the most common.

Real estate can consist of one or several land parcels. Many countries also allow buildings or parts of buildings to be registered as separate real estates, as well as structures under or above the surface. The latter are referred to as properties in strata. Defining the basic units is a major element in the design of any land information system.

A good land administration system will:

(i) Guarantee ownership and security of tenure;

(ii) Support land and property taxation;

(iii) Provide security for credit;

(iv) Develop and monitor land markets;

(v) Reduce land disputes;

(Vi) Support environmental management;

B.Function of Cadastre

1. Guarantee of ownership and security of tenure

The compilation of land records and the judicial processes that must be gone through in order to bring land information onto the registers should provide formal identification and, in some systems, legal proof of ownership. The public registers should contain all essential juridical information allowing anyone viewing the system to identify third party rights as well as the name of the landowner.

In some systems, such as the English registration of title to land, the State then guarantees the details recorded in the register, so that if a mistake were to occur, compensation would be paid. In others, the registers are treated as primary evidence rather than definitive proof. The Netherlands is an example of the latter, although any enquirer is protected against inaccurate or incomplete information either contained in deeds entered in the public registers or caused by errors, omissions, delays or other irregularities. Thus, although there is technically no guarantee of ownership per se, the integrity of the system is sufficiently high for landowners to have full confidence in their rights.

2. Support for land and property taxation

Good land records will improve efficiency and effectiveness in collecting land and property taxes by identifying landowners and providing better information on the performance of the land market, for example by identifying the current prices being paid for property and the volume of sales. Since the cadastre should provide full cover of the land, all properties can be included and none should be omitted.

While not all countries seek to impose taxes on land or property, such fiscal measures are regarded by many as fair and just since they are perceived in effect as taxes upon wealth. They are relatively easy to collect in contrast for example to personal income taxes where earnings can be hidden. It is not possible to hide a piece of land or building although it is possible to conceal the records of such a property.

3. Provide security for credit

Certainty of ownership and knowledge of all the rights that exist in the land should provide confidence for banks and financial organizations to provide funds so that landowners can invest in their land. Mortgaging land is one way to acquire capital for investing in improvements. Landowners can then construct or improve buildings and infrastructure or improve their methods and management of the land, for example by introducing new farming techniques and technologies.

4. Develop and monitor land markets

The introduction of a cheap and secure way of transferring land rights means that those who wish to deal in land can do so with speed and certainty. Those who do not wish to sell their land can be protected-no persons need be dispossessed of land unless they so wish since their rights should be guaranteed.

The registers should be public so that at any time a landowner can confirm his or her rights. Those who wish to buy land can do so with confidence, knowing that the person who is trying to sell the land is the legally guaranteed owner. Those whose properties are subject to compulsory purchase-for instance where a new highway is to be built across their land-can be treated with fairness since the registers should provide information on current land prices, thus allowing better estimates of the market value of land to be made.

5.Reduce land disputes

In many countries disputes over land and its boundaries give rise to expensive litigation and all too often lead to a breakdown in law and order. Much time is taken up by the courts in resolving these matters, leading to delays in other parts of the judicial system.

Land often cannot be put onto the market or put to better use without resolution of the disputes, since no potential investor is likely to wish to be committed to developing land where a lawsuit may be pending. The process of registering rights should prevent such disputes arising in the future, since at the time of first registration formal procedures should be followed that will resolve uncertainties.

6.Support environmental management

Multi-purpose cadastral records can be used to record conservation areas and give details of archaeological sites and other areas of scientific or cultural interest that may need to be protected. The cadastre can be used in the preparation of environmental impact assessments and in monitoring the consequences of development and construction projects. In the Netherlands, for example, there is a register of presently polluted sites and of formerly polluted sites that have been decontaminated.

The Cadastral Documents are used for

Land taxation:

Land taxes tax an economic rent, i.e. the excess amount earned by a factor over the cost of its supply.

Land taxes are in principle non-distortionary, and as they make it possible for governments to make less use of distortionary taxes like labor, capital, consumption or trade taxes, they tend to have a welfare improving effect. Land taxes not only provide a stable and efficient basis for government revenue, they can have a positive impact on the sustainability of land use and the distribution of wealth and income too: a land tax reduces the incentive to clear forest for agricultural development and it can be used to re-distribute land rents from large land owners to the poor.

We find that land taxes are interesting for developing countries for a number of reasons

1. Land taxes require a land registry or cadastre. While this is associated with substantial implementation and maintenance costs, improved land tenure security and formal land rights also enable and facilitate access to finance, investments, and sustainable land use management.

2. Tax evasion of conventional taxes like income, value added or a trade-related tax is particularly high due to a large informal economy where activities under taxation can be shifted to. Land taxes are more difficult to evade because of the visibility of land and property.

3. Many developing countries require substantial financial sources for financing basic infrastructure related to access to water, sanitation, education, and health. Land taxation can increase domestic revenues to help finance the SDGs without harming the economy.

4. Land taxes are best administered on a local level because acceptance by tax-payers is higher when the tax is used locally. Thus, land taxes can be part of a fiscal and political decentralization reform that may increase the quality of political institutions and governance.

5. Land taxation gives an additional incentive to put land under its most productive use. This is relevant for land which is hold for financial objectives rather than for production or usage.

6. Some developing countries are characterized by large deforestation and urban sprawl differential land taxes on agricultural land or housing land could provide additional incentives to mitigate deforestation and urban expansion.

B. Land transfer

Where land intended to be transferred, or any easement affecting land is intended to be created, the proprietor shall execute a transfer in the approved form

C. Construction permits:

By submitting complete and legible plans that clearly indicate and describe new development and any modification to existing buildings, you will help the City to issue your permit in a timely manner. All the documentation must be submitted in digital format are

Application Form

- Land Ownership Documents
- Proof of Payments (Fees)
- Location Maps
- Site Analysis
- Design Report
- Environmental Impact Assessment Report or Clearance except category 2 and 3
- Site Plan
- Landscape Plan
- Geotechnical Data except for category 2 and 3
- Architectural Data
- Structural Data

• Building Services:

- Plumbing, Drainage, Storm water and Waste water Data

- Electrical, Telecommunication and Mechanical Data

• Safety Measure Plan (Fire management, disaster prevention, etc.)

• Bill of Quantities

• Certifications

• Other Documentation

D. Land use planning:

Land use planning is a procedure for planning the sustainable use of the land considering its potentialities, limitations and the user needs. Land use planning is a procedure which leads to an optimal and sustainable use of the land and all its attributes.

STEP 1: Getting organized to work with the LUP and identifying stakeholders

STEP 2: Setting the vision for the LUP

STEP 3: Analyzing the situation

STEP 4: Setting the goals and objectives for the LUP

STEP 5: Establishing the development thrust and spatial strategies

STEP 6: Public consultations on LUP

STEP 7: Preparation the detail draft LUP

STEP 8: Reviewing, adopting and approving the LUP

STEP 9: Implementing the LUP

STEP 10: Monitoring, Reviewing & Evaluating the LUP.

E. Mortgage

Variation of mortgage A mortgage may be varied as regards:

(a) The amount secured by the mortgage; or

(b) The rate of interest; or

(c) The term or currency of the mortgage; or

(d) The covenants, conditions, and powers contained or implied in the mortgage, by a variation of mortgage in the approved form.

(2) A mortgage variation form must be registered and contain the following information:

(a) Reference to the mortgage and the relevant folio of the Register; and

(b) The nature of the variation.

(3) A mortgage variation instrument must be executed and be registered by:

(a) The mortgagor, except where the variation only operates to reduce the amount secured or rate of interest; and

(b) The mortgagee, except where the variation only operates to increase the amount secured or rate of interest.

(4) If the land is subject to another mortgage, the consent of the mortgagee under that mortgage must be obtained.

F. Financial institution/Bank:

To provide a good foundation for economic growth, all in the interests of all landowners Land is a capital and the title is used to get access to bank loan using land as collateral

G. Land management

H. Environmental planning

I. Land market

7. Support land Transfer

Definition :

Assign :to transfer property rights from one person to another, for example in a lease or mortgage certificate.

Land Tenure: the allocation and security of rights in lands; the legal surveys of boundaries; the transfer of property through sale or lease; and the management; adjudication of disputes regarding rights and boundaries.

Land Value: the assessment of the value of land and properties; the gathering of revenues through taxation; and the management and adjudication of land valuation and taxation disputes.

Land-Use: the control of land-use through adoption of planning policies and land-use regulations at various levels; the enforcement of land-use regulations; and the management and adjudication of land-use conflicts.

Land Development: the building of new infrastructure; the implementation of construction planning; and the change of land-use through planning permission and granting of permits.

Responsibilities of some professional

The notary is responsible for the correctness of the documents to be presented to the registrar;

The surveyor is responsible for a correct and workable identification of the real properties being object of the right;

The registrar is responsible for the land records, more precisely for their aim to contribute to a correct picture of the (legal) situation of the real properties;

The information technology manager covering all modern advanced technologies necessary for recording and supplying information

All transactions in this section on transfer of rights will include a transfer of the rights of a person (natural or non-natural) on a parcel to another person (by sale, inheritance/succession, donation, exchange, expropriation, ...); this will lead to a change in the non-spatial component of the database, namely a change of right holder on the parcel. However, these transactions will not affect either the right itself or the parcel itself; therefore no changes will appear in the spatial component of the LAIS database. New land titles will be delivered to new right holders.

Required documents for

***Voluntary Sale*:**

♣ Proof of identity of the Buyer (Transferee)

♣ Notarised sale agreement, signed by registered parties

♣ Land documents for the parcel to be sold

♣ Notarised Memorandum of Association indicating shares of every shareholder, in case among persons to be registered there are foreigners and Rwandans co-owning land or a company business company, an organisation or association with legal personality in which foreigners are shareholders

Transfer of rights on a parcel by court decision:

♣ Proof of identity of the applicant

♣ Court decision and a report of judgment execution, where necessary

♣ Extract of Marriage or certificate of celibacy of the applicant (Transferee)

♣ Land documents for the parcel to be transferred (If the losing party is not willing to return the land documents, the court bailiff indicates it in his/her report of judgment execution)

♣ Notarised Memorandum of Association indicating shares of every shareholder, in case among persons to be registered there are foreigners and Rwandans co-owning land or a company business company, an organisation or association with legal personality in which foreigners are shareholders.

- Content/Topic 3 .when cadastral survey is needed?

PURPOSE OF CADASTRAL SURVEY

The principal purpose of cadastral surveys is to give unambiguous spatial locations, sizes and shapes of land parcels specifically for land registration. Cadastral information is important in the assignment, processing and transfer of interests in land, levying land tax, supporting land markets, land development planning and so on. Efficient acquisition of such information is a critical issue for the achievement of timely urban land development.

Cadastral surveys determine the parcel boundaries, size and location. A parcel (or plot) of land is an area of land with a particular ownership, land use, or other characteristic. A parcel is frequently used as the basis for a cadastre or land registration system:

✓ The parcel is that to which title applies;

✓Title refers to legal rights in land, and includes freehold (fee simple), leasehold, easements, rights of use, and any combination thereof;

✓ Title may be public, private or communal;

✓ A boundary is a line (that has no width) that defines the spatial extent of the parcel;

✓ A cadastral surveyor marks boundary on the ground and draws boundaries on paper (or in digital files) but does not make boundaries;

✓ Land registration refers not to registering land per se, but to recording rights in land (parcels).

Cadastral surveying is also applied for the purposes of determination of boundaries between nations. International boundaries are determined and maintained in collaboration of national mapping agencies of bordering nations.

Boundaries are the main object of cadastral surveying. Normally other features, such as roads, watercourses, land-use boundaries, buildings, etc., are included, but the primary purpose is to define land unit on the ground and in the cadastre and land register. Cadastral surveying includes the determination of the boundaries on the ground, the survey of the boundaries, and the demarcation of the boundaries.

WHEN ARE CADASTRAL SURVEYS NEEDED?

Cadastral or property boundary surveys are needed when:

- New parcels of land are created i.e. a new estate or large land development
- You want to subdivide your block and get several new land titles
- Neighbours want to check their property boundaries prior to fencing or building on or near the boundary
- You want to create and grant an easement for access or use by another party

For existing properties where boundaries need to be redefined, these surveys are commonly known as repeg or re-establishment surveys.

LO 1.2 – Identify cadastral data types.

Content/Topic 1 .Description of cadastral data

What Are Cadastral Data?

Cadastral data are defined as the geographic extent of the pas t, current t, and future rights and interests in real property including the spatial information necessary to describe that Geographic extent .Rights and interests are the benefits or enjoyment in real property that can be conveyed , transferred , or otherwise allocated to another for economic Remuneration. Rights and interests are recorded in land record documents. The spatial Information necessary to describe rights and interests includes surveys and legal Description frameworks such as the Public Land Survey System , as well as parcel by - parcel surveys and description.

Additionally , cadastral data can include each of the following types of data :

• Location • Extent • Parcels

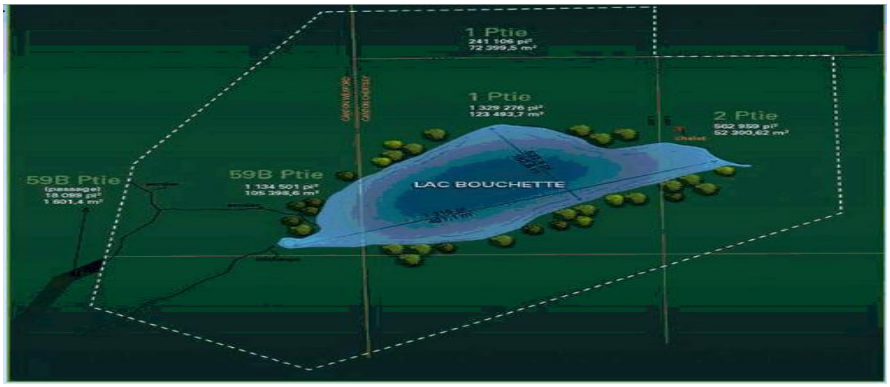
• Legal Descriptions

• Corners and Boundaries • Rights and Interests

• Restrictions • Transactions • Ag en t • Actions • Values

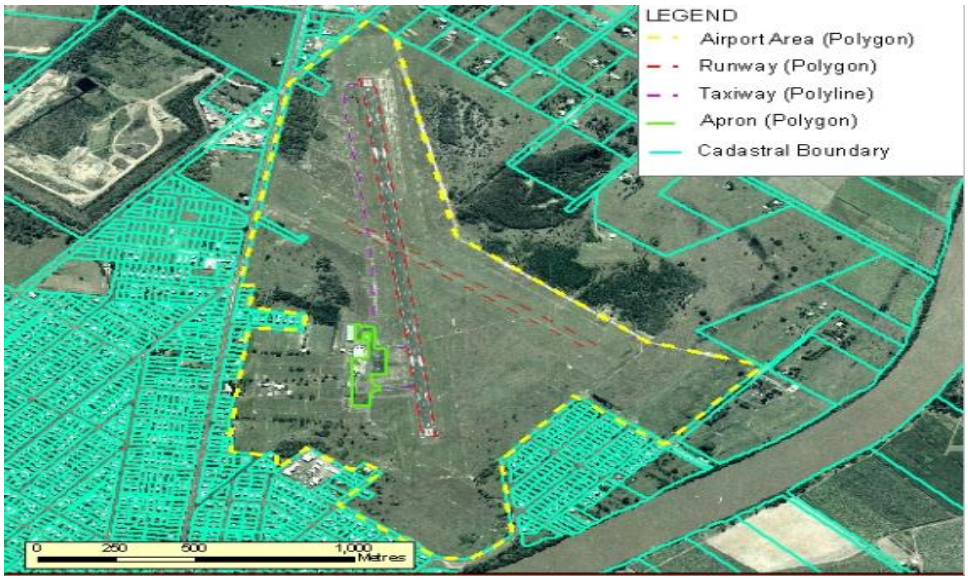
A. Location

Location Cadastral Data can be defined as any area and where it is in respect to other features , either re a l or man de fined. Location of an area relates directly to map projections, coordinate systems, and real and political boundary designations. In the map to the right you can see the location of the lake in relation to other reference data .



B. Extent

Extent Cadastral Data can be defined as any spatial area. It is typically a polygon feature that has defined boundaries and has an area that can be calculated. In the map to the right you can see the airport boundary in hashed yellow line.



C. Parcels

Parcels Cadastral Data are a very specific type of Cadastral Data that express real property boundaries (at a given point in time) and include information about the rights and interests associated with that piece of property. The map at the right is a screen capture of an Internet Mapping Application that show s parcels and specific information about them.

What is a land parcel?

“a unit of land over which homogeneous and unique interest (right) is established”

Stored data for each parcel are:

- Name, date of birth, address, shares of the land owner,
- Location of the parcel, like street-name, house number, center coordinates ,Extent of the parcel,Corners and the boundaries
- District and parcel-number,
- Area of the parcel,
- Type of land use,
- Results from official soil assessment,
- Internal information about year of creation of the parcel, year of maintenance, number of cadastral maps, number of survey plans,
- Number of folio and property in the land register,
- Additional details about the parcel, like parcel is part of a consolidation project, polluted soil, historical monuments, parcel is part of a nature reserve or a water reserve

D. Legal Descriptions

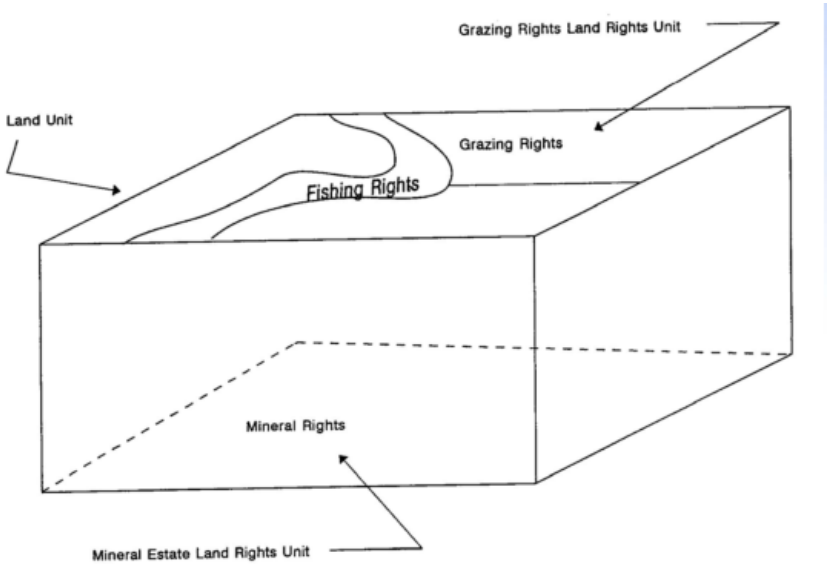
Legal Descriptions Cadastral Data are the deed description. It should include any encumbrances and appurtenances that run with the land. The legal description is the one used for conveyance and should be descriptive enough so that a particular parcel of land can be both located and identified. The legal description should be used in every deed of conveyance within the chain of title. The image at the right is an example of a legal description.

E. Corners and Boundaries

Corners and Boundaries Cadastral Data are simply the locations of Actual survey measurements and monument location; as well as legal description of that location. Oft en times corners and boundaries are marked with a simple or complex marker to be used for future survey work . The images at the right highlight a couple different examples of these monuments

F. Rights and Interests

Rights and Interests Cadastral Data essentially reflect the land usage a particular area can have . More specific ally it show s who , if anyone, can inhabit the land, and can develop and utilize resources (water , minerals, timber , wildlife, recreation , et c.) associated with the land.



G. Restrictions

Restrictions Cadastral Data show the limitations of use to a certain property . Normally these restrictions are placed to ensure that surrounding land value or use is maintained. For example most cities have ordinances prohibiting hog farming within city limits

H. Transactions, Agent, Action, Value

Transactions Cadastral Data show the rights within an area, most often proposed areas of sale or trade.

Agent Cadastral Data show an individual, organization, or public agency that holds rights, interests, or restrictions in land.

Actions Cadastral Data show proposed or current activities taking place on the land

Value Cadastral Data show the market worth or assessed value of an area of land.

LO 1.3 – **Identify cadastral documents.**

- Content/Topic 1 .Identification of different cadastral documents.

  1.DEED PLAN DOCUMENT

  . **What is a title/deed plan?**

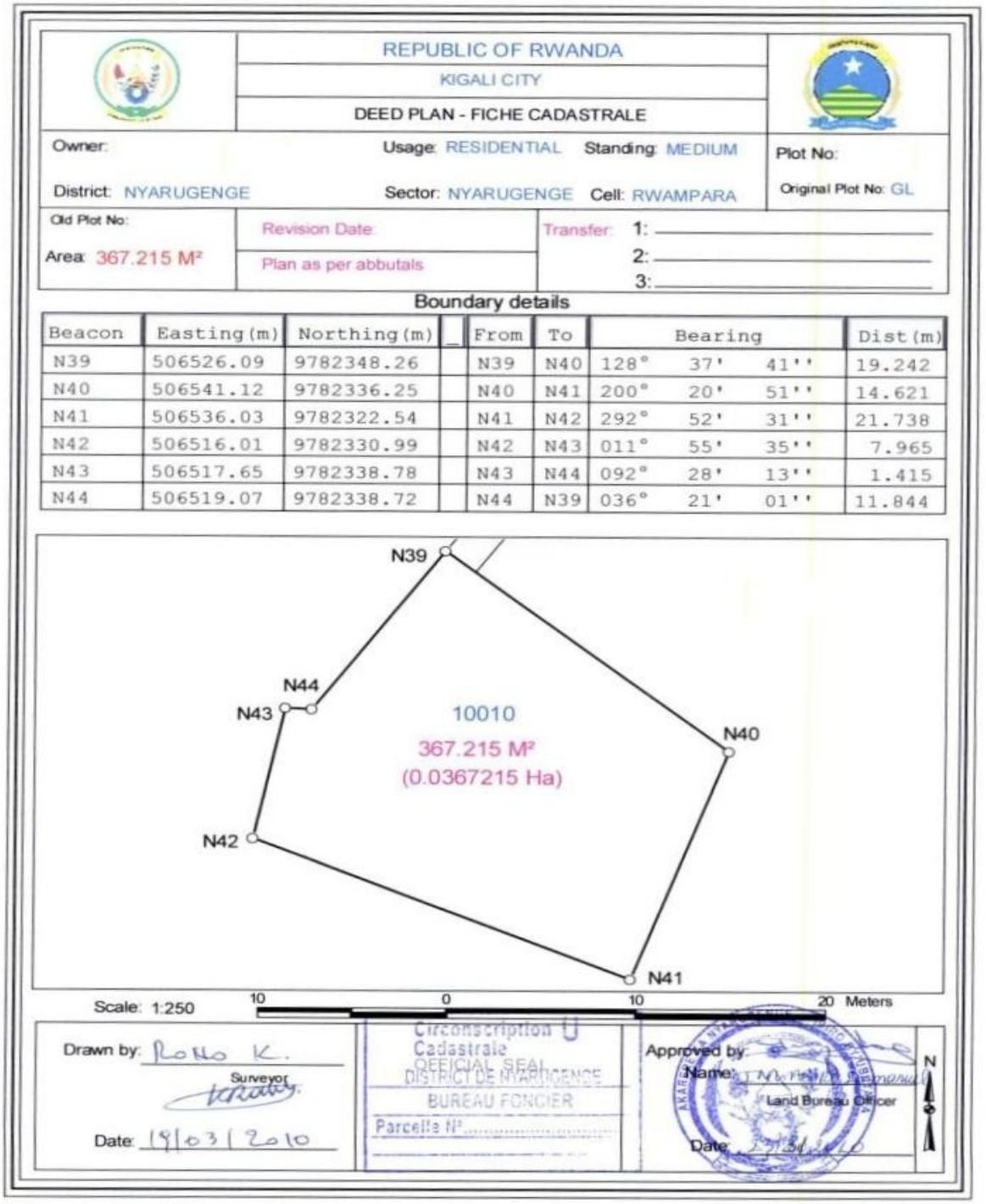
When registering a property, the land owner must submit his/her request to cadastral or land registry office in order to prepare for him/her a title register and a title/deed plan. The plan shows the land owned. Each title plan is stored in the computer system under a title number which is unique to that property. Title plans are prepared on the latest Cadastral Survey map available at the time of registration and are not updated as a matter of course.

What does your title plan show?

The title plan must include:

1. The title number of the land
2. The land included in the title which is normally edged in red. There may be other colors or markings on the plan. The significance of these is explained in the register
3. The scale at which the plan is drawn
4. The orientation of the plan mainly showing the north direction
5. The coordinates of each corner point
6. The length and bearing of each side
7. The name of the surveyor and the chief surveyor
8. The signatures and stamp

DEEDPLAN :Contains geometric spatial information that describes one parcel only and gives more detailed information on it. Each parcel from survey plan requires independent deed plan.



REPUBLIC OF RWANDA

KIGALI CITY

DEED PLAN - FICHE CADASTRALE

Owner:

Usage: RESIDENTIAL Standing: MEDIUM

Plot No:

District: NYARUGENGE Sector: NYARUGENGE Cell: RWAMPARA

Original Plot No: GL

Old Plot No:

Area: 367.215 M²

Revision Date:

Plan as per abbutals

Transfer: 1: _____

2: _____

3: _____

Boundary details

Beacon	Easting(m)	Northing(m)		From	To	Bearing			Dist(m)
N39	506526.09	9782348.26		N39	N40	128°	37'	41''	19.242
N40	506541.12	9782336.25		N40	N41	200°	20'	51''	14.621
N41	506536.03	9782322.54		N41	N42	292°	52'	31''	21.738
N42	506516.01	9782330.99		N42	N43	011°	55'	35''	7.965
N43	506517.65	9782338.78		N43	N44	092°	28'	13''	1.415
N44	506519.07	9782338.72		N44	N39	036°	21'	01''	11.844

Scale: 1:250 10 0 10 20 Meters

Drawn by: Rollo K.

Surveyor

Date: 19/03/2010

Circonscription Cadastrale

OFFICIAL SEAL

DISTRICT DE NYARUGENGE

BUREAU FONCIER

Parcelle N°

Approved by:

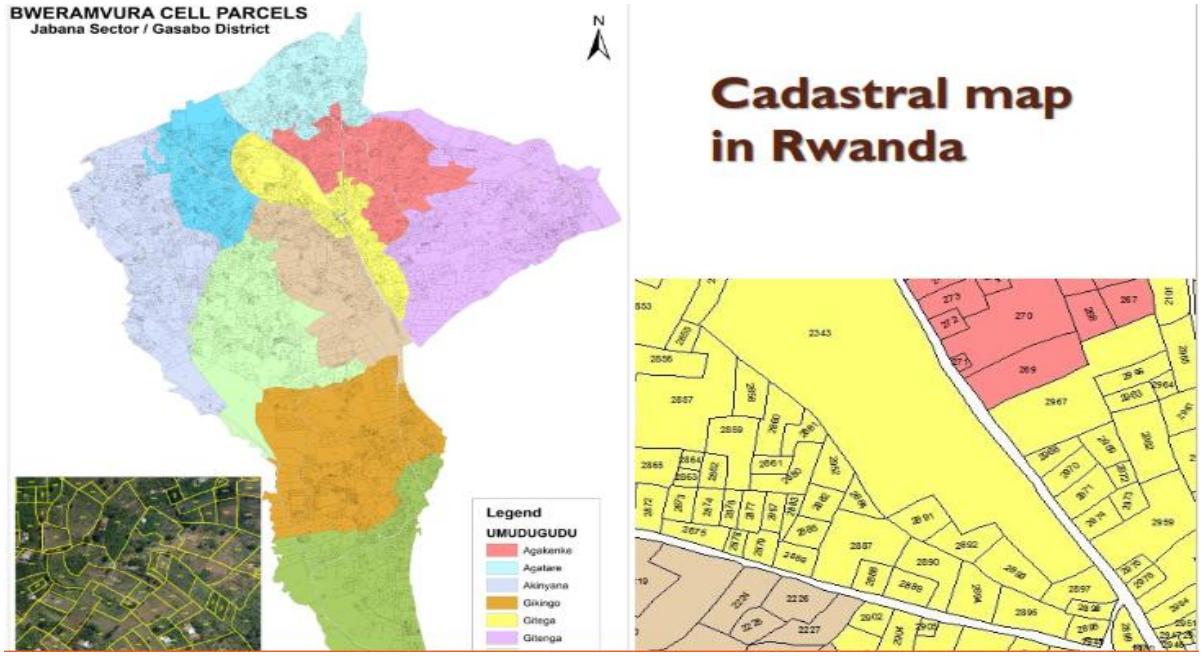
Name:

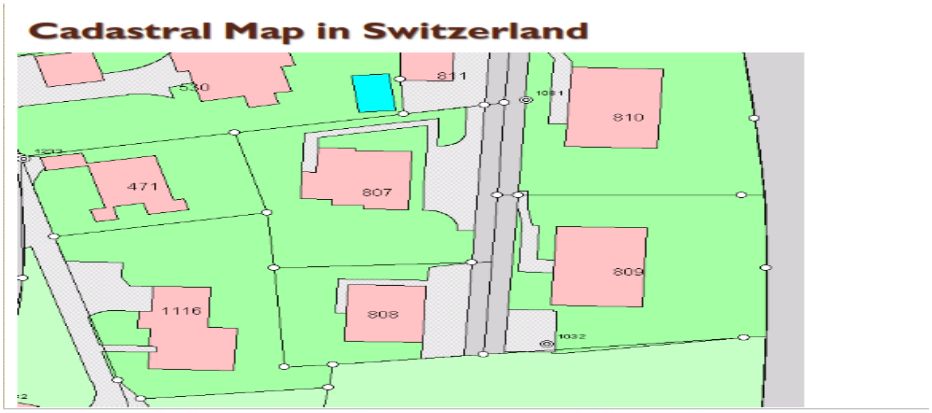
Land Bureau Officer

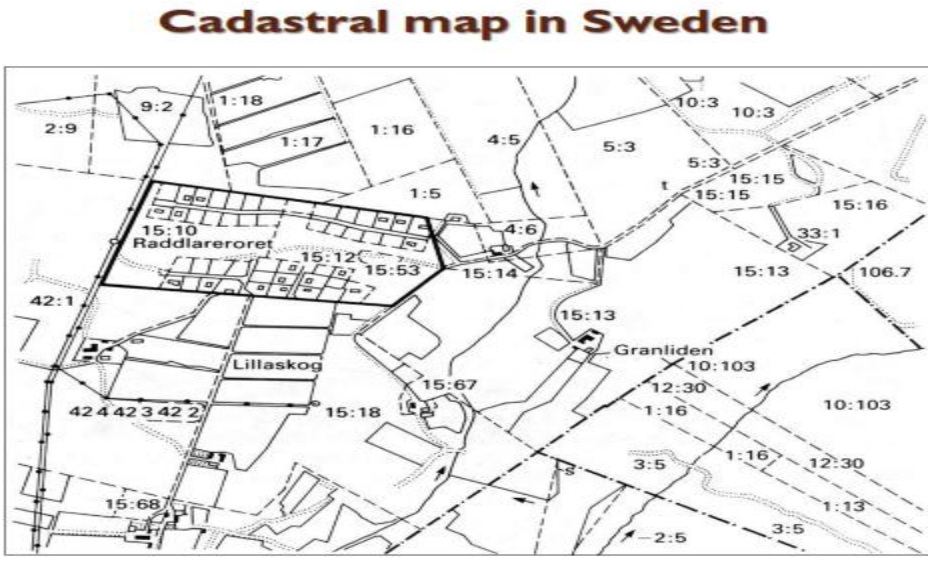
Date:

N

2. A Cadastral Map?







Cadastral map in Rwanda ,Switzerland and Sweden

Cadastral map

A cadastral map is a map that shows the boundaries and ownership of land parcels. Some cadastral maps show additional details, such as survey district names, unique identifying numbers for parcels, certificate of title numbers, positions of existing structures, section or lot numbers and their respective areas, adjoining and adjacent street names, selected boundary dimensions and references to prior maps.

A cadastral map is a map defining land ownership. The land register cadastral map is further defined by the Act as a map showing all registered geospatial data relating to registered plots. The cadastral map consists of cadastral units, each of which represents a single registered plot of land.

WHAT DOES A CADASTRAL MAP DEPICT?

A cadastral map will show the boundaries of land parcels but may also incorporate details of the resources associated with them, including the physical structures on or beneath them, their geology, soils, and vegetation and the manner in which the land is used.

A cadastral map can include a number of details, including information about tax rates, who owns the land, which kinds of structures are present, what the zoning is in the region, etc. All these data are anticipated to put in a context of the area of the map by providing the viewers with as much data as possible about the land.

The scale of cadastral maps is of great importance. Since the object of the map is to provide a precise description and identification of the land, the scale must be large enough for every separate plot of land which may be the subject of separate ownership (conveniently called a “survey plot” or “land parcel”) to appear as a recognizable unit on the map. When map data are stored in a computer, they may be drawn at almost any scale and this can give an impression of greater accuracy than the quality of the survey data may deserve.

Another essential prerequisite of cadastral maps is that they should show an ample number of points which can be precisely identified on the ground to facilitate any other point on the ground to be identified on the map (or vice versa) by eye or by simple and short measurements.

Properties are generally rectangular and often have dimensions measured in fractions or multiples of chains (unit of length).

A cadastral map will also emphasize specific landmarks which people can employ to orient themselves within the map, including buildings and natural features such as lakes and streams.

The map also supplies information to people about property rights, and a history of the rights in that area.

These maps are updated on a standard basis. It is a good idea to keep track of the cadastral survey, as information can change.

Most of analogue maps are now replaced by digital maps containing geographical information about:

• parcel boundaries and corner point markings,

• numbering of parcels,

• Boundaries of districts

• Survey control points,

• outlines of houses and buildings,

• House numbers,

• Street names,

• Results from official soil assessment,

• Type of land use,

• Topographical details like kerbs, cycle tracks, trees, embankments, walls etc.

CADASTRAL MAPS TYPES:

They are four mainly types of cadastral maps:

- Survey plan
- Deed plan
- Registry index maps (RIM)
- Preliminary index Diagram (PID)

SURVEY PLAN

It contains geometric (spatial) information on one or more parcels which arises from fixed boundary survey strictly. It is mostly exclude information on owners details since parcels may owned by different people. It is from where deed plan are generated. Survey plan describes many parcels but gives little information about those parcels.

REGISTRY INDEX MAP (RIM)

This is a cadastre map covering relatively large area (say a block/sell) that must arise from combination of several survey plans from a given area or mass land registration by general survey techniques. RIMs are especially used in rural areas.

PRELIMINARY INDEX DIAGRAM (PID)

This is a cadastral map resulting from aerial photography, on which parcels of land have been traced manually and numbered after verification from the ground.

It is the fastest survey technique often employed during adjudication and first registration of land parcels country wide.

CONTENTS OF CADASTRAL MAP.

What data are on a cadastral map?

Fig 2: Cadastral map – content

The content of cadastre maps varies with the type, but they mostly contain the following information:

Parcel boundary information and corner marking

Survey control points and Outlines of buildings

House number and Street number

Type of land use

Topographical details like

Parcel identifier (Unique Parcel Identification –UPI in Rwanda)

Location / Address (province, district, sector, cell, village)

Information on size, value and use of the land,

Information on development above or beneath land surface (buildings, pipelines for water, electricity, sewage…)

Purposes of the cadastral map

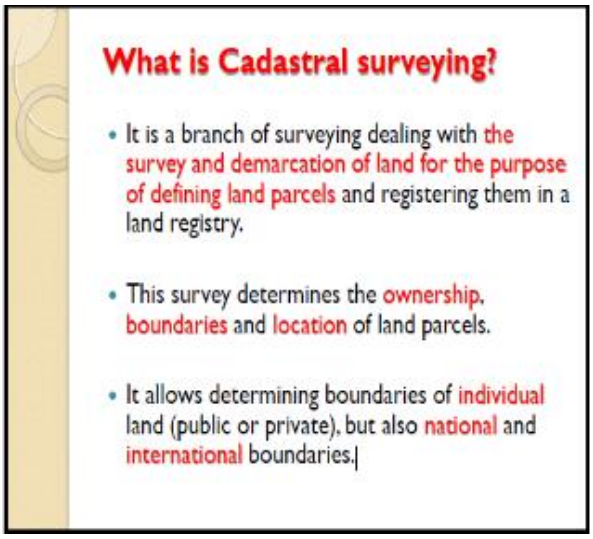
Provides a cartographic record of official and sometimes private land surveys and subdivisions.

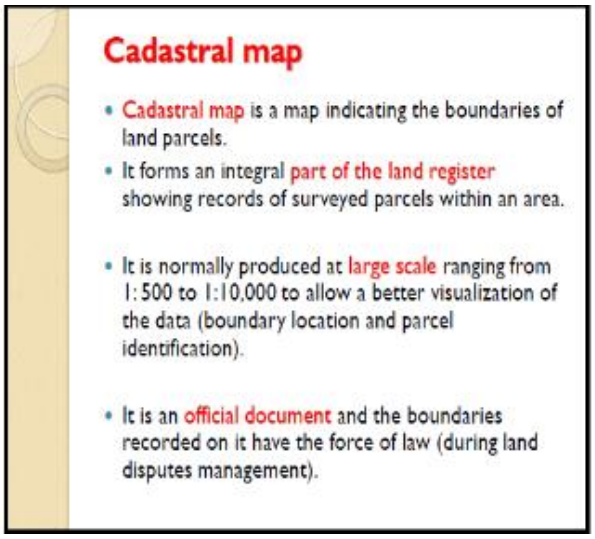
Facilitates the administration and transfer of land ownership.

Records land ownership.

Assists in the valuation and taxation of land.

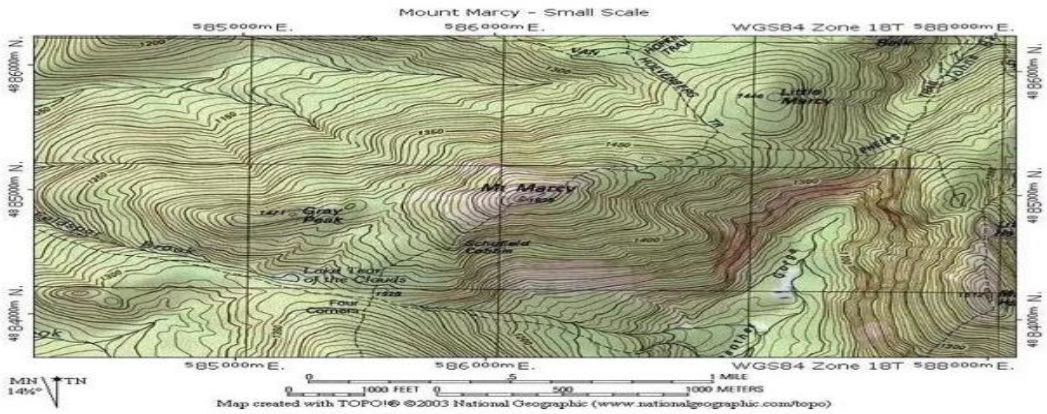
The difference between cadastral map and cadastral surveying.





3. Topographic map:

Topographic map: Topographic maps also display physical features, using contour lines instead of color to show changes in the landscape, such as elevation. The spacing of contour lines are even and help differentiate between steep and flat features; for example, a mountain may have many closely knit contour lines to show steepness and a high elevation, whereas flatlands may have spread apart contour lines to show flatness and a low elevation



4. Registration

(1) The Director of Surveys shall, in consultation with the Registrar, prepare a map or series of maps, to be called the registry map, for every registration district and the map or series of maps shall be maintained in the registry.

(2) For the purposes of the registry map, each registration section constituted under section 7 may be identified by a distinctive name and the registration section may be further divided into blocks which shall be given distinctive numbers or letters or combination of numbers and letters.

(3) The parcels in each registration section shall be numbered consecutively and the name of the registration section and the number or the letter of the block and the number of the parcel shall together be sufficient reference to a parcel.

(4) The Registrar may combine or divide registration sections or blocks or vary their boundaries.

(5) A plan approved by the Director of Surveys shall be noted in the folio of the land register appertaining to each parcel, and the land registrar shall file that plan

5. A construction permit

A building permit is an official approval issued by the local government agency that allows you or your contractor to proceed with a construction or remodelling project on your property. It is intended to ensure that the project plans to comply with local standards for land use, zoning, and construction

- Content /Topic2 .The Parts of certificate of registration

A.MINISTERIAL ORDER DETERMINING MODALITIES OF LAND LEGISTRATION

Cadastral surveying refers to the determination of the position of the boundaries of public or private land, including national and international boundaries, and the registration of those lands with relevant authorities. Cadastral surveying operations essentially include the determination of the boundaries on the ground, the survey of the boundaries, and the demarcation of boundaries.

Cadastral surveying is the definition, identification, demarcation, measuring and mapping of new or changed legal parcel boundaries. It usually includes the process of re-establishing lost boundaries and sometimes resolving disputes over boundaries or other interests in real property. There are always specific regulations regarding training and experience for surveyors wishing to carry out cadastral surveys because they have a professional responsibility to society.

Cadastral surveys are carried out by governmental officials and private surveyors or by a combination of both. This varies depending on the legal jurisdiction. Special certification is required and this can be administered either by the state or by a professional society.

Cadastral surveying is the sub-field of surveying that specializes in the establishment and re- establishment of real property boundaries. It is an important component of the legal creation of properties.

Cadastral surveying is the discipline of land surveying relating to the laws of land ownership and the definition of property boundaries.

Objectives of cadastral survey are 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.

Survey recording: this process includes the checking or examination of the result of the cadastral survey and the entry of the information in registration books and cadastral index map . A unique parcel identified is allocated to each parcel The Examination can check on

a) land policy matters

b) legal matters

c) technical matters

B.Parts of certificate of registration are:

- **The "parcel section"** in which is recorded the description of the immoveable property including its location ,description ,approximate surface area ,sketch map or graphic image of the parcel , giving the unique parcel identification number and reference to the registry index map of the land and any annotations concerning servitudes or other real right benefiting the property .the registered proprietor may choose to base the registration on the cadastral plan
- **The "proprietorship section** "in which is recorded full detail of the owner of the immoveable property including an address for service in Rwanda and if the proprietor is a legal person ,its registration number
- **The" charge section "** in which is recorded annotation of real charges on the immoveable property ,other than legal servitudes ,including servitudes burdening the land ,lease for more than nine years and mortgages . a certificate of registration may be rectified according to this order

Learning Unit 2 –: Apply **cadastral data collection**

LO 2.1 – **Identify cadastral data records instruments/tools**

Content/Topic 1 .identification of cadastral data record instruments/ tools

Following are the surveying instruments which are used for surveying data collection:

1. **Direct distance measurements (DDM)instruments**

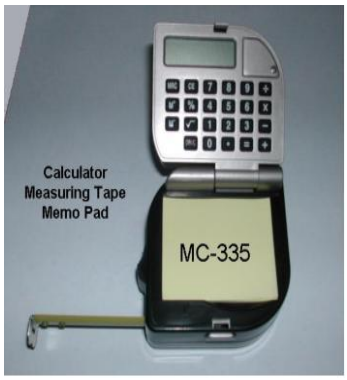
Tapes: Depending upon the materials used, they are classified as:

(*i*) cloth or linen tape

(*ii*) metallic tape

(*iii*) steel tape and

(*iv*) invar tape



(*i*) **Cloth or Linen Tape:** 12 to 15 mm wide cloth or linen is varnished and graduations are marked. They are provided with brass handle at the ends. They are available in length of 10 m, 20 m, 25 m and 30 m. These tapes are light and flexible. However because of the following disadvantages they are not popular:

-Due to moisture they shrink.

-Due to stretching they extend.

- They are not strong.

-They are likely to twist.

ii) **Metallic Tape:** They are made up of varnished strip of waterproof linen interwoven with small wires of brass, copper or bronze. End 100 mm length of tapes are provided with leather or suitable strong plastic materials. Tapes of length 10 m, 20 m, 30 m and 50 m are available in a case of leather or corrosion resistant metal fitted with a winding device. Red and black coloured markings are used for indicating full metres and its fractions in centimeters

(*iii*) **Steel Tape:** A steel tape consists of 6 to 10 mm wide strip with metal ring at free end and wound in a leather or corrosion resistant metal case. It is provided with a suitable winding device. Tapes are marked indicating 5 mm, centimetres, decimetres and metres. The end 10 cm length is marked with millimetres also. 10 m, 20 m, 30 m, or 50 m tapes are used in surveying Steel tapes are superior to metallic tapes as far as accuracy is concerned.

However they are delicate. Care should be taken to wipe clean before winding. They should be oiled regularly to prevent corrosion.

(*iv*) **Invar Tape:** Invar is an alloy of nickel (36%) and steel. It's coefficient of thermal expansion is low. Hence errors due to variation in temperature do not affect measurements much. The width of tape is 6 mm. It is available in length 30 m, 50 m and 100 m. It is accurate but expensive

2.Total Station

Total Station is a lightweight, compact and fully integrated electronic instrument combining the capability of an EDM and an angular measuring instrument such as wild theodolite.

Total Station can perform the following functions:

Distance measurement

Angular measurement

Data processing

Digital display of point details

Storing data is an electronic field book

The important features of total station are,

Keyboard control: all the functions are controlled by operating key board.

Digital panel: the panel displays the values of distance, angle, height and the coordinates of the observed point, where the reflector (target) is kept.

Remote height object: the heights of some inaccessible objects such as towers can be read directly. The microprocessor provided in the instrument applies the correction for earth's curvature and mean refraction, automatically.

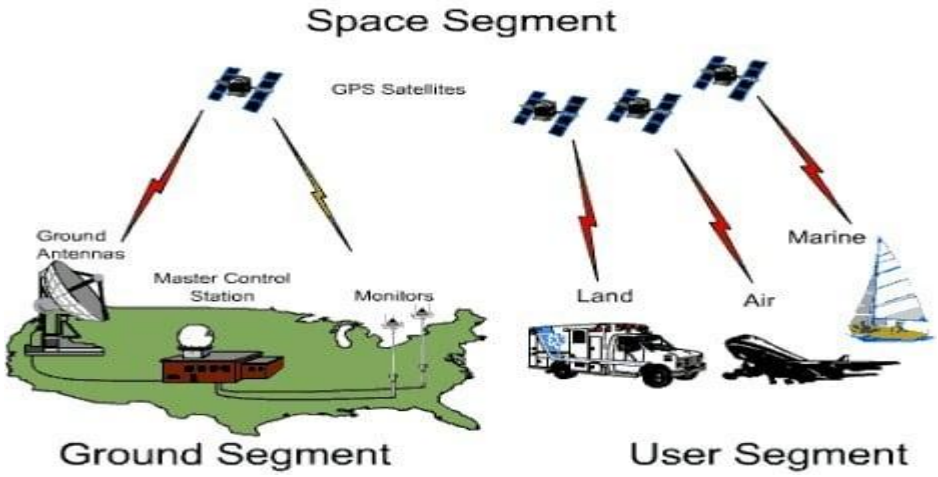
Traversing program: the coordinates of the reflector and the angle or bearing on the reflector can be stored and can be recalled for next set up of instrument.

Setting out for distance direction and height : whenever a particular direction and horizontal distance is to be entered for the purpose of locating the point on the ground using a target, then the instrument displays the angle through which the theodolite has to be turned and the distance by which the reflector should move.

3.Global Positioning System (GPS)

Global Positioning System (GPS) is developed by U.S. Defense department and is called Navigational System with Time and Ranging Global Positioning System (NAVSTAR GPS) or simply GPS

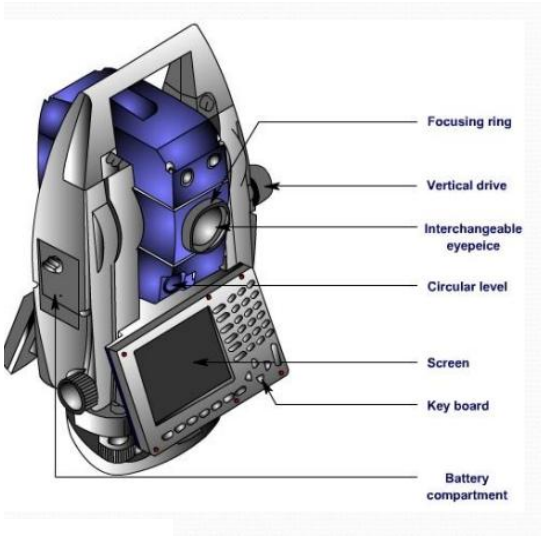
For this purpose U.S. Air Force has stationed 24 satellites at an altitude of 20200 km above the earth's surface. The satellites have been positioned in such a way, at least four satellites will be visible from any point on earth.



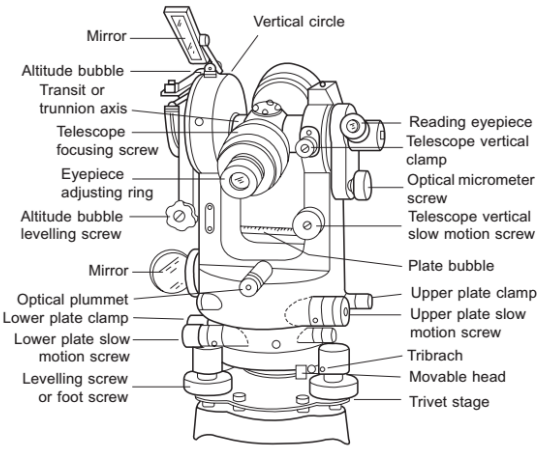
The user needs a GPS receiver to locate the position of any point on ground. The receive processes the signals received from the satellite and compute the position (latitude and longitude) and elevation of a point with reference to datum.

4.THEODOLITE :—

There are basically two types of theodolite, the optical micro optic type or the electronic digital type, both of which are capable of resolving angles to 1', 20”, 1” or 0.1” of arc, depending upon the accuracy requirements of the work in hand. The finesse of selecting an instrument specific to the survey tolerances is usually overridden by the commercial aspects of the company and a 1” instrument may be used for all work. When one considers that 1” of arc subtends 1 mm in 200 m, it is sufficiently accurate for practically all work carried out in engineering.



Distance measuring Instrument.



- Content/Topic 2 .The standards Requirements for cadastral.

A.What is the Cadastral Standard

Is One of the seven themes defined as Framework data that

•Establishes a baseline for Cadastral data collection and distribution regarding Rural and Urban Area

•Builds on the Framework Data Content Base Standard and Framework Cadastral Standard .

Only when a data set meets the requirements set forth in its thematic standard part and the Framework Base Standard can it be considered Framework data.

B.Purpose for the Cadastral Standard

The primary purpose of the standard is to provide a standard for the definition and structure for cadastral data which will facilitate data sharing at all levels of government and the private sector and will protect and enhance the investments in cadastral data at all levels of government and the private sector.

Furthermore the purpose is to ensure that cadastral data works in harmony with other data sets. For example , to determine whether there is parcel or cadastral information available in a specified city , users will need to navigate to that geography and then verify that the minimum core parcel information and its metadata have been made available for that area.

Finally , the standard provides the information necessary to identify the existence of parcel level cadastral information and the source of that information. The geospatial metadata provided in conformance to this part will include the contact , distribution, and access requirements for the cadastral data .

Additional information on the content of the full parcel or cadastral data sets, its accuracy , and its spatial projection, is also provided with the metadata .

The goal of the cadastral standard is to include only the minimum data necessary to facilitate locating the existence of parcel level information and identifying the source. These data , along with the appropriate metadata ,will provide the information describing how and where to get the data needed to support applications.

The development of this part of the Framework Data Content Standard , used in conjunction with the Cadastral Data Content Standard will greatly assist in mitigating the following issues:

•Duplication of data and application development

•Complications eexchanging cadastrall data and information

•Difficulties in integrating data

•Poor framework / support for analytic activities

•Difficulties managing multiple representations of features

The FGDC (Federal Geographic Data Committee)

is the responsible organization for coordinating work on all parts (urban and Rural) of the

Geographic Information Frame work Data Content Standard including the Cadastral Theme

C. The following is a list of the main components to the Cadastral Standard Application Schema including a brief description of each class:

Parcel class The Parcel class is the main class to convey cadastral information. It is stereotyped as a <<Feature>> and as such has identity and geometry properties.

Owner Type class - The Owner Type class is a code list of valid values that classify the owner type. This is not the ownership type, but rather is the classification of the owner.

Parcel Source class -The Parcel Source class groups elements regarding each parcel and its source information.

Parcel Geometry class -This class represents a choice between a centroid or polygon representation of the parcel.

Parcel Collection class - These features were introduced for conformance with the other Geographic Information Framework Data Content Standard parts and as such are not a part of the Cadastral part. These represent a super type of data collection with metadata. They are a set of features that occur within the context of a container object known as a "feature collection". This is a convention used to delimit a group of features of a given type and common schema

D.Accuracy standards.

At a minimum, all survey measurements must conform to the accuracy standards established by the laws and regulations of the appropriate State, or the accuracy standards established by the National Society of Professional Surveyors (NSPS), whichever is most restrictive. The NSPS standards referred to are the Model Standards of Practice, adopted "NSPS Classification and Accuracy Standards for Property Surveys," lists the following:

Classification of Survey	Acceptable Relative Positional Accuracy at the 95 Percent Confidence Level
Urban	0.07 feet (21 mm) plus 50 ppm
Suburban	0.13 feet (40 mm) plus 100 ppm
Rural	0.26 feet (79 mm) plus 200 ppm

As described in Section of the NSPS standards, "Positional Accuracy Definitions and Procedures," these acceptable accuracies are comparable to the results of a correctly weighted least-squares adjustment, or twice the calculated linear error of closure of a compass-rule adjustment

If not otherwise directed in the Project Instructions, you must assume the standards for "rural" surveying

LO 2.2 – **Identify methods of cadastral data records**

- Content/Topic 1 .Identification of different Methods for cadastral surveying

A.Introduction on methods of cadastral surveying

Parcel boundaries usually are defined by stable marks on the ground. In urban areas the boundaries may be identified as well by buildings. Physical demarcation on the ground is important because It provides actual notice of the boundaries to the landowners. In some countries the boundaries are defined by the surveyed and calculated coordinates. This way of defining boundaries is very useful in areas under construction because then very often the monuments are lost immediately after putting them into the ground.

The demarcation and delineation of the boundaries are part of a cadastral survey aimed at defining the parcels on the ground and securing evidence for the re-establishment of the boundary if the marks disappeared. The accuracy of thesecadastral surveys shouldbe related to the value of the land and being regulated by official instructions for the whole country. These accuracy instructions are indicating the necessary survey methods:

B.Methods for cadastral surveying

There are various methods for the determination of coordinates of corner points of parcel boundaries.

Methods used in cadastral surveying are not rigidly prescribed, although it is a requirement that all work be adequately and carefully checked.

All recognized methods, using modern accurate instruments, are acceptable.

Two main methods are to be described in this module:

a) Direct measurements (ground)
b) Photogrammetric (Aerial)

a). Direct measurement : Ground survey: it is done in the field using instruments

1.Global Positioning System (GPS)

Ground survey methods for cadastral surveys need control points measured from trigonometric points of the national land survey authorities. The measurements to create and maintain this grid of control points are very cost-intensive. These costs can be minimised by using Differential GPS (DGPS).

Cadastral surveys can be undertaken using low-cost or high sophisticated equipment. The method chosen will be influenced by the accuracy demanded. In rural areas even the plane tables may be the right equipment. This is only dependent to the budget that will be available. The most cost-efficient method is the Total station that calculates already the coordinates and guarantees a good data flow from the survey to the digital map. The major principle of surveying boundaries and buildings is controlling the work by an independent second measurement.

In areas with a high accurate cadastre and where the coordinates represent the legal boundaries it is possible to create new legal boundaries from existing plans by calculating without surveying in the field. Final result of this work will be coordinates for all surveyed boundaries respectively corner points of parcels and buildings and control points. These coordinates are stored in a point file indicating nature of point, status, accuracy and reliability.

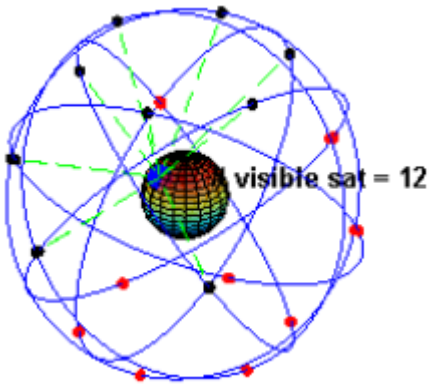
Established boundaries should be marked. The same applies to newly constructed parcel boundaries or boundaries settled by arrangement or judgment. Establishing and marking of boundaries' proceedings involve the hearing of concerned land owners, who are to be notified in due course about date and location of the procedure. A record of the proceedings is to be taken (Demarcation Record) a copy of which may be forwarded to the owners involved.

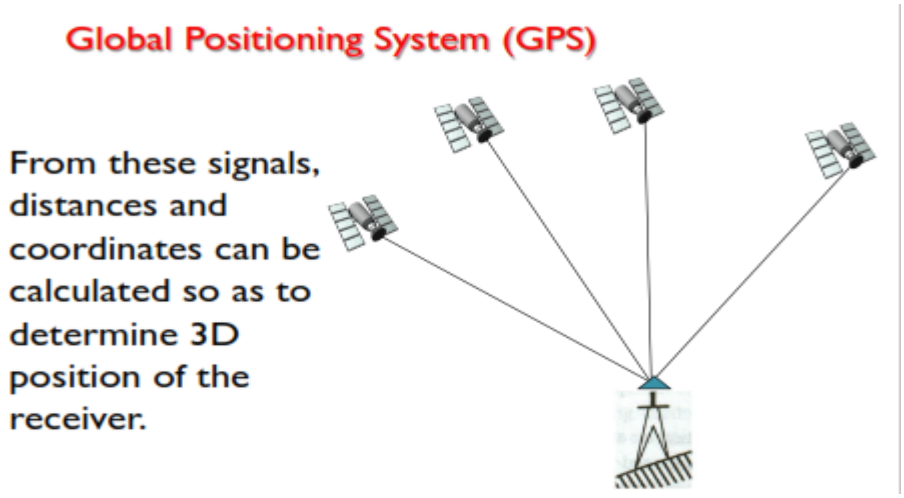
Land owners and long-term leaseholders are obliged to inform the competent authorities about relevant changes pertaining their land; this applies especially to the construction of new buildings or changes to the exterior plan of existing buildings. Any necessary surveying are at the expense of the owner.

Access to survey plans and point file should be allowed only to persons who guarantee a proper use of the data.

Total station or electronic theodolite (it measures angles and distances to provide the basis for calculating the coordinates of boundary points and house corners) Global Positioning System (GPS)

It is best known as a navigation system for cars, aircraft and ships,but it is also very effective for cadastral surveying. It uses special satellites which orbit the earth, continuously emitting signals which can bepicked up by GPS receivers.





Advantages

- It provides data with higher accuracy
- Suitable for sporadic land registration
- world-wide availability
- high accuracy DGPS
- no control points necessary
- easy data flow

Disadvantages

- It cannot work under trees or near buildings
- It requires special software to process the data,
- cannot work under trees or near buildings
- special software required
- expensive equipment
- GPS education necessary
- Expensive equipment,
- It is time consuming,
- It requires some expertise to manipulate the equipments.

It is best known as a navigation system for cars, aircraft and ships, but it is also very effective for cadastral surveying.

GPS is a world-wide operating system of satellites for navigation. In the field of surveying with high accuracy (some centimetres) GPS can be used as Differential Global Positioning System with a reference station on a surveyed control point. GPS is used for cadastral surveys especially in rural areas. Mostly, hybrid methods of using GPS where it is possible and using Total stations where GPS doesn't work (under trees or near buildings) are very cost-effective.

2. Methods for detailed surveys

The goal of cadastral survey is to establish a cadastral map which gives a total view of all the land units within the area in question. This may require the new and former surveys integrated into a general control grid. This then provide the possibility to compile plans from existing topographic maps, cadastral surveys, aerial pictures, ortho-photo maps etc.

New cadastral surveys can be made with either ground surveys methods or photogrammetric methods.

The main ground survey methods have been:

The plane table method

The orthogonal method

The polar method

a.The plane table method

Plane table surveying is a graphical method of surveying in which both the fieldwork and plotting are done simultaneously using a plane table. The main advantage of plane table surveying is that the topographic features to be mapped are in full view.

Plane Table Survey

Advantages of Plane Table Survey

The advantages of use of plane table in surveying are

It is the most used and suitable method for surveying and preparing small scale maps.

All possible human and machine errors can be eliminated as the surveying and plotting are done simultaneously in the field. Plane table surveying finds its importance in the places with high magnetic fluctuations where compass survey is not reliable.

As this type of survey does not use the machine, it is less costly than most of the type of surveying techniques.

It is one of the most rapid surveying techniques. Errors occurring due to mistakes in the field book entry are eliminated.Contours and other irregular objects may be accurately represented on the map since the tract is in view.

It does not require skilled personal to plot the map. The errors and mistakes in plotting can be checked by drawing check lines.

Disadvantages of Plane Table Survey

The disadvantages of use of plane table in surveying are:

The process of shifting and re-orienting the plane table from one place to another is very lengthy.

This type of surveying is not feasible in raining and windy areas as the plotting work are done in the field itself.

The plane table and its accessories are heavy and difficult to carry

The accuracy achieved in other types of surveying is higher than the accuracy achieved by plane table surveying.

If the survey is to be re-plotted to a different scale or quantities are to be computed, it is a great inconvenience in the absence of the field notes. It is not suitable for surveying large areas.

This method of surveying is not suitable in dense forest areas as the trees block the view of other important components of the field.

This method of surveying can only be done in the day time

Plane table was used extensively for cadastral surveys during the nineteenth century in Europe.

It allows map making in the open fields on the base of proportional triangles. All points are the points of intersection of the directions observed from the terminals of a base. The scale of themapresultsfrom the plotted lengths of the base. The maps produced were predominantly in scales of 1:1000, 1:2500 and 1:5000.

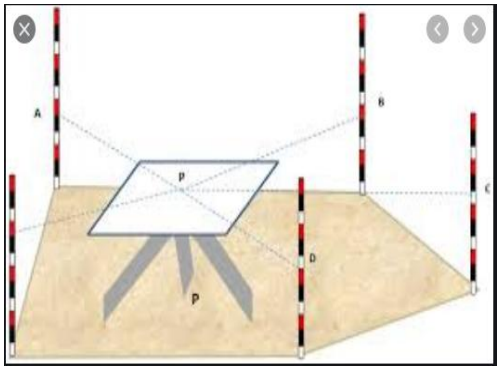


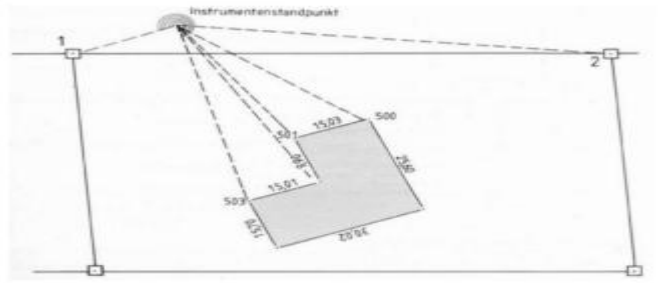
Fig a): Example of a plane table survey carried out to record a single building.

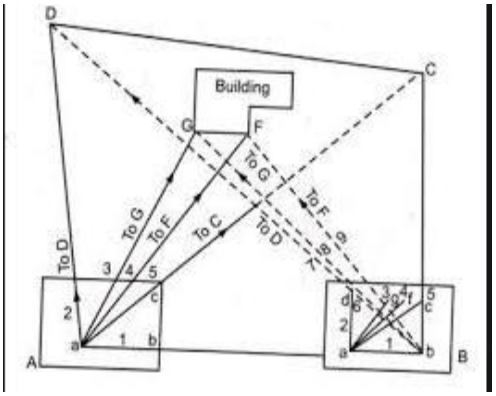
b.The orthogonal method

Orthogonal method along with polar method is classical for numerical cadastral surveying. Orthogonal method is based on perpendicular offsets. Cadastral survey is carried out using simple tools as the chain and the square. The square is a sighting device used for setting out right angles. The chain must be standardized. Chains have since been replaced by tapes. Orthogonal methods are today carried out as tape and offset surveying.

c.Polar Method

The polar method refers to surveying by bearing and distance. Polar methods have been enhanced by the development of electronic distance measuring devices and data-processing equipments. The emergences of self-recording electronic tacheometers and automatic plotters have developed the profession of surveying.





2. Photogrammetry

The terrain is photographed with fixed-wing aircraft or helicopters equipped with special cameras pointing vertically downwards taking a series of photographs to form strips in which each successive image overlaps the last by 60 to 80%.

Terrestrial works has to be done only by marking the boundaries and surveying the ground control points.

Air surveys can be used to produce maps from primary sources, that is by taking measurements from aerial photographs. Points identified on overlapping aerial photographs may be transformed into positions on maps either by mechanical analogue means or through the use of mathematical techniques. The processes, known as photogrammetry, require some ground measurements to be taken in order to establish the precise scale and orientation of any map in relation to the ground data.

Cadastral surveys may be undertaken by using aerial photographs. The accuracy of the surveyed coordinates of parcel boundaries, buildings and other topography depends on the scale of the photographs. High accuracy and efficiency can be obtained using analytical or digital photogrammetric methods. Terrestrial works has to be done only by marking the boundaries and surveying the ground control points. Using the Global Positioning System (GPS) for navigation of the aeroplane can minimise the costs for ground surveys drastically.

In urban areas the scale of the aerial photographs should range between 1:3000 and 1:8000. So the accuracy for each stereoscopic measured point can be about some centimetres. In regions not very populated even satellite images can be used.

The accuracy of the surveyed coordinates of parcel boundaries, buildings and features depends on the resolution of the photographs.

Advantages:

use of aerial photography is cost-effective way of mapping

photographs contain high content of information

photographs represent the actuality

very fast method of mapping

Disadvantages

Expensive equipment required

Photogrammetry education necessary

Clouds, visibility problem

In many circumstances the legal boundaries of holdings cannot be determined from the photographs without extensive checking on the ground. Generally more work will be required tosupplement the photographs in the case of cadastral maps than in the case of most topographical mapping.

Nevertheless the techniques can be as accurate as, and significantly cheaper than, undertaking a survey entirely by ground survey methods.

Methods utilizing photogrammetric techniques are generally suitable for systematic adjudication and large-scale projects and require a substantial financial commitment from the Government. It should be emphasized that all cadastral surveys which utilise photogrammetric require at least some field completion. The photogrammetric method can only be used where the physical boundary or some point indicating the boundary is clearly evident on the aerial photograph. In general areas with tree cover hedges or in villages and urban areas and a large proportion of ground survey completion is often required.

- Content/Topic 2.Professional requirement for cadastral data

A.MINIMUM QUALIFICATIONS:

Education: Bachelor's degree from a recognized college or university with a major study in land surveying, civil technologies, forestry, engineering, geography, or related field.

Associate's degree from a recognized college or university with a major study in land surveying, civil technologies, forestry, engineering, geography, or related field.

Experience: Four years of experience in land surveying, engineering, mapping, right-of-way research, or related field. Six years of experience in land surveying, engineering, mapping, right-of-way research, or related field.

License/Certification: Must possess a valid New Hampshire driver's license or have access to transportation. The applicant's Motor Vehicle Record must meet the minimum standards as established by the hiring agency. Must possess a Surveyor in Training Certificate

For promotion from Land Surveyor Technician I, labour grade to Land Surveyor Technician II, labor grade , employees must:

1. Meet the minimum qualification requirements of education and experience for the II level;

2. Obtain a Surveyor in Training Certificate;

3. Have obtained a satisfactory annual performance evaluation as a Land Surveyor Technician I.

B main categories of Land surveyors

B.1.Chief Land Surveyor. The Chief Land Surveyor oversees all land survey activities relevant to the Division of Realty land acquisition program and boundary management on Service lands. He or she is responsible for national policy interpretation and Service wide policy formulation, managerial leadership and technical guidance, program implementation and evaluation, and internal and external coordination necessary for the successful management of the survey program. As needed, he or she issues technical and procedural program guidance to ensure adequate technical support and proficiency, provides the final interpretation for the Service Manual regarding cadastral surveys, and assists the Office of the Solicitor and the Department of Justice in preparing the technical and legal portions of litigation involving cadastral surveys on Service lands. The Chief Land Surveyor also acts as the consulting specialist for the cadastral survey program on related activities between the Service and other Federal, State, tribal, and private entities, and represents the Service on the Interagency Cadastral Coordination Council

B.2 Regional Land Surveyor (RLS). The RLS is responsible for all cadastral surveys of Service lands within his/her Region, and for the development and administration of the Region's land survey program. He/she is responsible for Regional policy interpretation, managerial leadership and technical guidance, program implementation and evaluation, and internal and external coordination necessary for the successful management of the Region’s survey program. This includes supporting land acquisitions, realty management, water rights acquisition, construction, and boundary management. He/she plans the workload and program budget, estimates survey project time and cost, and performs Survey Tract Reviews, boundary surveys, and other land survey services. Other duties include Certified Department of the Interior Land Surveyor (CILS) responsibilities, acting as the Contracting Officer’s Representative (COR), and representing the Region and the Service as an expert witness on land survey matters in Federal court, the Federal Civilian Board of Contract Appeals, and the Interior Board of Land Appeals

C.Surveyors based on their skills

Survey assistants* or *chainmen are usually unskilled workers who help the surveyor. They place target reflectors, find old reference marks, and mark points on the ground. The term 'chainman' derives from past use of measuring chains. An assistant would move the far end of the chain under the surveyor's direction.

Survey technicians often operate survey instruments, run surveys in the field, do survey calculations, or draft plans. A technician usually has no legal authority and cannot certify his work. Not all technicians are qualified, but qualifications at the certificate or diploma level are available.

Licensed, registered, or chartered surveyors usually hold a degree or higher qualification. They are often required to pass further exams to join a professional association or to gain certifying status. Surveyors are responsible for planning and management of surveys. They have to ensure that their surveys, or surveys performed under their supervision, meet the legal standards. Many principals of surveying firms hold this status.

D.OTHERS SURVEYORS BASED ON SITUATION

PERSON	ROLE	INTERACTION/ROLE
Refuge Facilities/Asset Coordinator	Maintains the 5-year Refuge Deferred Maintenance and Construction plans.	Provides cost estimates, especially of required cadastral surveys
Hatcheries Facilities/ Asset Coordinator	Maintains the 5-year Hatchery Deferred Maintenance and Construction plans	Provides costs estimates, especially of required cadastral surveys
Division of Engineering (DEN), Regional Engineer and Staff	Serves as Project Manager for non-exempt and other Construction /maintenance projects, including the management of the Dam Safety Program	Conducts or contracts for cadastral surveys . or provides technical standards for design surveys. Researches land ownership and consults on survey issues
Refuge Roads Coordinator	Manages the Refuge roads and transportation program.	Provides boundary and control data and receives control and topographic data from road projects
Refuge Inventory & Monitoring Lead	Manages and funds controlled mapping and	Provides survey technical standards or carries out control and evaluation surveys. Receives

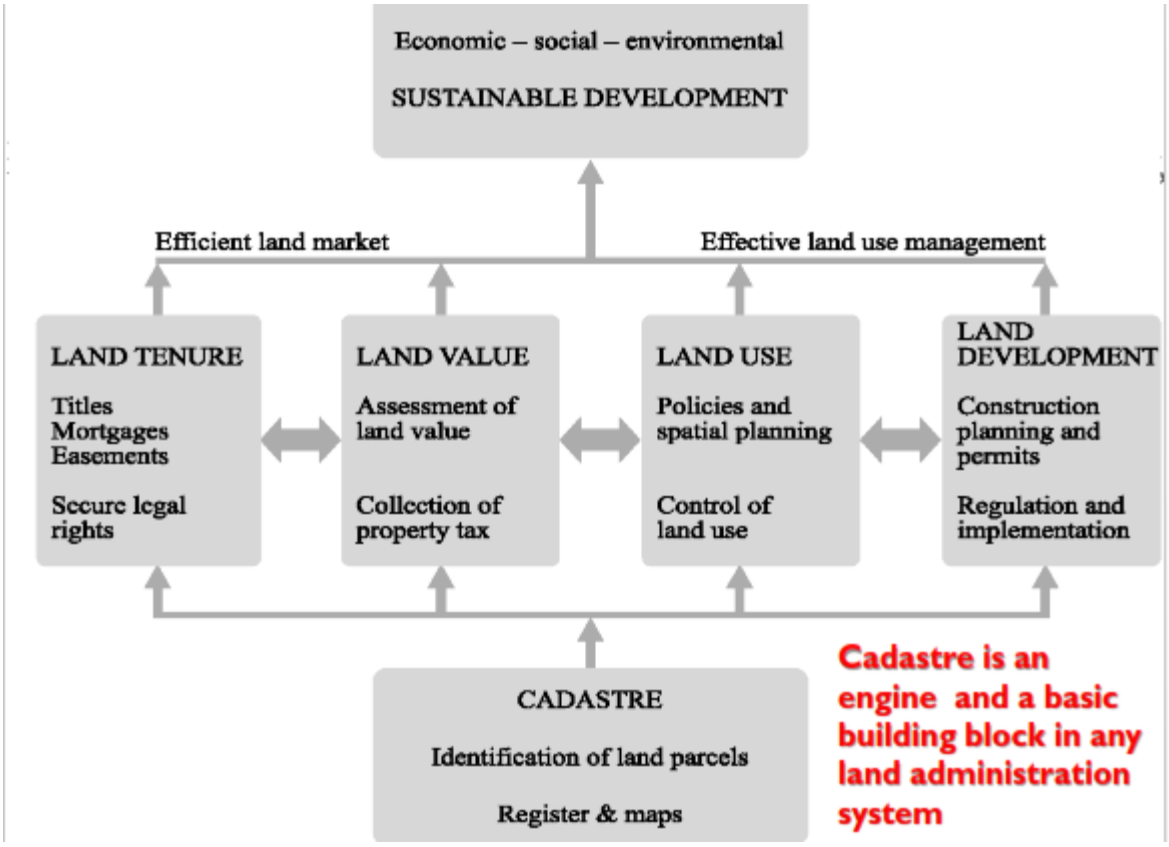
	other projects using survey instruments.	control and topographic data .Provides training and support for use of survey grade instruments
Regional Water Rights Manager	Acquires and manages water rights for Refuges,Hatcheries, and other programs.	Provides support, technical assistance, or professional services for measuring water and acquiring State water rights
Program Leads for - Partners for Fish & Wildlife - National Fish Passage Program - Coastal Program	Administer partnership programs that fund habitat improvement, mostly on non-Service lands	Provide technical standards,technical support and training, and control information

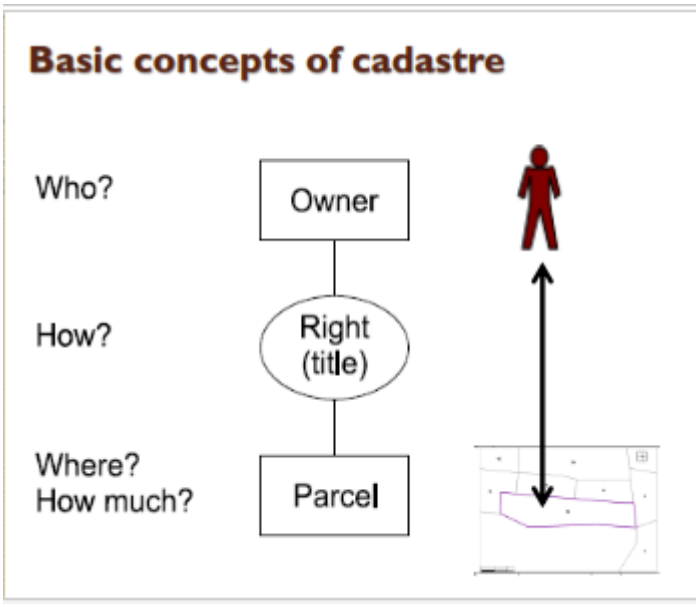
LO 2.3 – **Collect cadastral data used in land information system.**

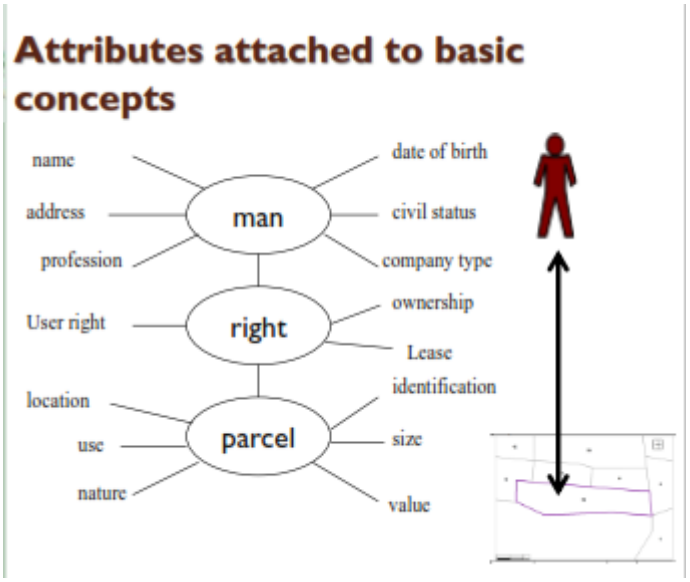
- Content/Topic 1 .classification of cadastral data

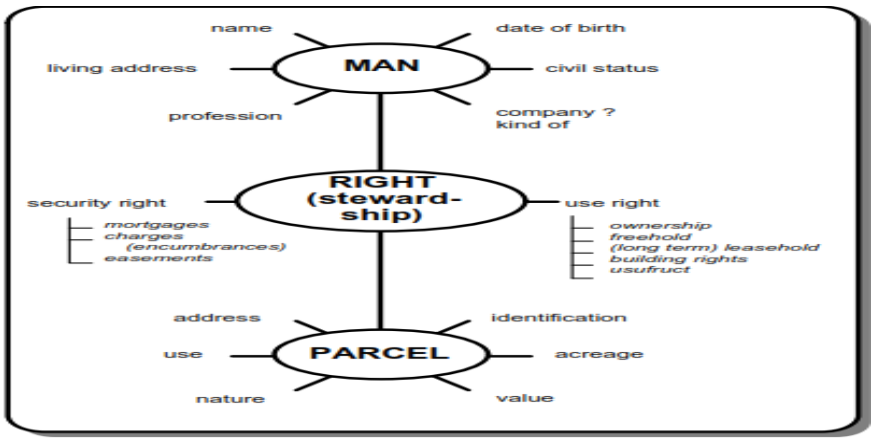
What is a Cadastre?

It is usually includes a Geometric description of land Parcels linked to other records describing the nature of the interests and ownership and often the value of the parcel and its improvement


Economic – social – environmental
SUSTAINABLE DEVELOPMENT
Efficient land market
Effective land use management
LAND TENURE
Titles
Mortgages
Easements
Secure legal rights
LAND VALUE
Assessment of land value
Collection of property tax
LAND USE
Policies and spatial planning
Control of land use
LAND DEVELOPMENT
Construction planning and permits
Regulation and implementation
CADASTRE
Identification of land parcels
Register & maps
Cadastre is an engine and a basic building block in any land administration system


Basic concepts of cadastre
Who?
Owner
How?
Right (title)
Where?
How much?
Parcel


Attributes attached to basic concepts
name
address
profession
man
date of birth
civil status
company type
User right
right
ownership
Lease
location
use
nature
parcel
identification
size
value


name
living address
profession
MAN
date of birth
civil status
company ?
kind of
security right
mortgages
charges
(encumbrances)
easements
RIGHT (steward-ship)
use right
ownership
freehold
(long term) leasehold
building rights
usufruct
address
use
nature
PARCEL
identification
acreage
value

“A Cadastre is normally defined as a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities), it usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements.’’

It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (it provides evidences for legal action), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection”

The outlines or boundaries of the property and the parcel identifier are normally shown on large scale maps which, together with registers, may show for each separate property the nature, size, value and legal rights associated with the parcel. It gives an answer to the questions "where" and "how much".

A cadastre is a record of areas and values of land and of landholders that originally was compiled for purposes of taxation.

It may be established for fiscal purposes (e.g. valuation and equitable taxation) referred to as fiscal cadastre, legal purposes (conveyancing) referred to as legal cadastre, to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection referred to as multipurpose cadastre.

A Cadastre is normally a parcel-based system, ie. Information is geographically referenced to unique, well-defined units of land. These units are defined by the formal or informal boundaries marking the extent of lands held for exclusive use by individuals and specific groups of individuals (e.g. families, corporations, and communal groups). Each parcel is given a unique code or parcel identifier.

Examples of these codes include addresses, co-ordinates, or plot numbers shown on a survey plan or map.

Graphical indices of these parcels, known as cadastral maps, show the relative location of all parcels in a given region. Cadastral maps commonly range from scales of 1:10,000 to 1:500. Large scale diagrams or maps showing more precise parcel dimensions and features (e.g. Buildings, irrigation units, etc.) can be compiled for each parcel based on ground surveys or remote sensing and aerial photography. Information in the textual or attribute files of the Cadastre, such as land value, ownership, or use, can be accessed by the unique parcel codes shown on the cadastral map, thus creating a complete Cadastre.

The data of general interest in a cadastre;

- land parcels (e.g. location, boundaries, co-ordinates)
- land tenure (e.g. property rights, ownership, leases)
- land value (e.g. quality, economic value, tax value, value of improvements)

A CADASTRE

is NOT synonymous with or results in individual ownership of land,
resulting in more productive farming

because
a cadastre is NOT a system of land tenure

but
a system of recording existing land tenure situations

A CADASTRE

is a TOOL to cure a lack of legal security

because
it creates CLEARNESS

the security itself must come from the LAND-LAW

A CADASTRE

does NOT convert customary tenure

if necessary, the LAND-LAW can change the tenure system

the cadastre ONLY registres according to existing land-law

over-enthousiastic claims may ENDANGER projects

because
a cadastre is NOT IN ITSELF result-producing,
it is always AUXILIARY to other measures,

but
complementary measures do NOT work without a cadastre

A CADASTRE

is NOT a magical specific which will automatically produce good land use and development

but

a NECESSARY DEVICE, part of government machinery

A CADASTRE

is a TOOL to preserve the results of a land reform

it is NOT a land reform itself

A CADASTRE

COMPLEMENTS measures or reforms and thus CONTRIBUTES to necessary changes

is does NOT change things itself

A CADASTRE

is a system of REGISTRATION of rights

it is NOT a system of rights on the land itself

LO 2.4 – **Identify duties of a cadastral surveyor**

- Content/Topic 1 .Identification of duties for a cadastral surveyors

1.Cadastral surveyor activities

a.Initiation

Initial request for cadastral survey may come from private land holders who want documents on the land for protection

. Family head

. A village

. An institutional chief

. State or Government Department/ cooperation

Licensed Surveyor act as a consultant for these groups

b. Planning and documentation

- Cadastral surveying involves thorough planning, costing and careful execution

- Planning involves studying and understanding of agreed technical specification to understand the complete time sequence of events the clients and establishing the purpose of the work

- Planning has two stages:

- gathering and examining relevant information needed for the work

- field visit and verification

- Preparation and planning

c.During the gathering and examination of relevant information, the surveyor should ensure the following, where appropriate:

-study accuracy specification

- collect letter from the appropriate agency commissioning you to the work

-obtain official letter from the appropriate office

-apply for a band number (regional number) from the appropriate Survey Office and the accompanying site plans when needed, especially for lands that does not belong to the government

- look for relevant documents on the property (old maps and points),site plans or knowledge of prior problems (litigation)

- enquire from appropriate planning agent to see if the land falls within the right place

- notify all the persons involved, in case of people who share boundaries with the land under consideration

-make inventory of the land

◦ acquire all the necessary information about the survey to be executed- topographic maps, all the persons who have certain interest in the land, etc

◦ look for the existence of control points

◦ make a work plan

◦ select appropriate equipment and measurement technique to be adopted

◦ estimate cost of work and have negotiation with the client

d. The following may be needed when planning for sub- division or layout surveys:

◦ check to see if land to be subdivided falls within the approved scheme

◦ search for controls and plot of layout scheme

◦ with the help of the controls, re-grid the layout, use controls to re-grid the sheet. This is necessary to avoid errors accumulation of error from the tracing ,printing and copying of the layout schemes

◦ plot any available detail other to check if it fits into the new temperate created

e. The following may be applied for sub-division surveys:

◦ scale coordinates of the points to be set out

◦ calculate bearing and distances

◦ compute included angles from bearings

◦ apply scale and sea level corrections to distances – because on the field we measure slant distances these corrections are added to the computed horizontal distances.

f. Field visit/field reconnaissance

Verify the information gathered during office preparation

Verify the position of the controls and to familiarize oneself with the topography

Contact land owners and other stakeholders

Make relevant field sketches – after the reconnaissance survey

Establish the position of pillars and detail lines

Demarcate boundaries in the presence of land owners or those who have interest in the land

g. Field measurements

Number the pillars -the technique used here is to use the number of adjoining plots as pillar numbers

Use a minimum of two identified controls on site as instrument and reference stations

Use the appropriate survey instrument and measuring technique to survey and detail boundary points

Other information in proximity to the working area must be surveyed – this is needed for people to orient the map

Connect the work to an approved reference system or the National grid

Measure of angles and distances or determine the coordinates of points directly in the field

Incorporate enough checks on the work

◦ angles must be measured on at least two zeros

◦ distances must be measured from two different directions

h.Computations

Adjust bearings from included angles

Compute latitudes and departures

Institute a lot of checks on the computations

Calculate angular, linear and fractional misclosures

Test this against the accuracy specification and adjust accordingly

i.Drawings

Plot the work according to the required scale

-1: 2500 or1:5000

- Compute area of the plot/site

- Indicate bearings and distances of the boundaries

- A good cadastral plan should have the following:

- title

- location

- size of plot – acreage

A good cadastral plan should have the following:

- other marginal information

- north direction,

-scale and well-spaced grids

- name of owner

- whom the land was acquired from

-date of execution of the surveys

- name of the Surveyor and stamp

Submission for approval

Submit field books, computations, drawings and report for approvals

Proper fling procedure must be adopted

Documents to be submitted for approval must include the following:

◦ Letter ushering the consultant to do the survey

◦ List of existing pillars and their coordinates

◦ Test of controls

◦ Site plan

Documents to be submitted for approval must include the following:

◦ History of survey and diagram of survey; direction of survey, traverse lines, azimuth, etc.

◦ Abstract of distances, included angles

◦ Astronomical computation or GPS computations

◦ Computation of convergence , Computation of forward bearings ,Computation of Latitude and departures

◦ Check computations

◦ Abstract of coordinates

◦ Computations of bearing and distances , Area computations from latitude and departures

◦ Area computation from coordinates ,Cost of survey

Examination and approval

Examination of submitted work involves:

◦ Field checks

◦ Computations and drawings - checked against the standards provided for such surveys

◦ Other checks include - accuracy of measurements, errors in angular and distance measurements, stability of controls used, etc.

◦ Checking of drawings– plotted against existing town Sheet

Approved work is certified by Surveyor General or his representative

Copies of map, possibly digital version are maintained in a cadastral database

Final delivery

Copies of the approved work are submitted to the client

The original copy must remain with the surveyor

2.Here there is a list of duties for a cadastral surveyor

1.Perform duties related to land surveying for identifying land ownership and property boundaries.

2.Conduct records management activities and perform historical and legal land ownership research.

3.Develop and inspect land surveying project contracts.

4.Support field measurement and layout.

5.Conduct standard calculations to identify areas, elevation and volumes of field survey notes.

6.Conduct basic calculations using field note data.

7.Read, utilize and interpret design drawings and topographic maps.

8.Study, learn and interpret CAD computer applications.

9.Perform as Senior Project Leader for survey at in-house and mapping projects.

10.Support Real Estate Product Line coordinator and in-house design group.

11.Provide consistent and superior quality documents for survey, design and building projects for all clients in region.

12.Perform as cadastral issue matter expert as team member.

13.Perform as Contracting Officer Technical Representative (COTR) for Architect-Engineer.

14.Involve in implementing mapping contracts and Indefinite Quality (IQ) surveying.

15.Provide vertical and horizontal control maps and government cost estimate for mapping and survey projects.

16. Marking of parcel corners and Advises / consultancy for the landowner

17.Validation - getting approval on cadastral plans from relevant authorities

18. Land price valuation and Registration of updated

19.Defining restrictions on land use

20. Preparation (correction) of territorial planning documents

Learning Unit 3 – Perform land demarcation

LO 3.1 – **Identify the types of boundaries**

- Content/Topic 1 .Introduction on baundaries

A.INTRODUCTION on HISTORY OF BOUNDARY.

In sedentary era, communities were staying in one place.

Limits were determined through occupation, fights among competing groups, mutual agreement or through customary rules.

The man took steps to become a food producer

Cultivation rights tended to have clearly defined limits.

It became necessary to define and delimit the areas => boundaries

Historically, the need for delimitation arose as soon as anyone – tribe, family or individuals – laid claim to a particular right in an area. Hunting, fishing and grazing rights were often not clearly demarcated, while cultivation rights tended to have clearly defined limits. These limits were determined in different ways such as by occupation, by fights among competing groups, by mutual agreement or by applying customary rules. With intensified use of land and stronger family and individual rights, it becomes necessary to define and delimit the areas concerned for both social and economic reasons.

It refers to either the physical objects that mark the limits of a parcel, property, or interest in land or an imaginary line or surface marking or defining the division between two legal interests in land.

In a legal sense, a boundary is a surface which defines where one landowner's property ends and the next begins.

The Great Wall of China, man-made boundary to protect against intrusion of nomadic group or warlike people or force

Boundaries are defined by laws and regulations, with many variations across countries and even states or provinces within a country. In many jurisdictions, fences, hedges, or walls may have legal standing in marking or identifying the boundary, while in others, they may have no legal status at all.

In still others, they may play some, though not a legally defining, role in boundary determination.

A land administration system requires a boundary system underpinned by law that defines, describes, and relates every boundary to the ground.

There are many options to create, describe, and mark boundaries on the ground.

A monument may indicate the boundary itself or the end or turning point of an artificial line describing the boundary.

Typically, boundaries are identified on the ground by monuments (any tangible landmark that indicates a boundary).

Monuments can be natural features or artificial marks that meet prescribed regulations for marking boundaries.

The precision with which a boundary has to be measured will depend on several factors:

accuracy required (often in relation to its value), land use, legal constraints and cost.

The two areas in the images may require different accuracy


Boundaries In a legal sense, a boundary is a surface which defines where one landowner's property ends and the next begins. Generally, this surface is vertical and suspended from the sky so that anyone passing through it from one side to the other passes from one set of property rights into another. The boundary surface inter-sects the ground along the legal boundary line. A legal boundary is an infinitesimally high surface extending from the centre of the Earth to the infinite in the sky and is essentially an abstract concept. In the case of strata titles, such as inhigh-rise buildings, the boundary surface may be horizontal. In practice, most people mark the limits of their property on the surface of the Earth either with linear features, such as fences or hedges, or with point features, such as wooden pegs, iron bars or concrete markers. These physical objects may also be referred to as the boundary, though they may not follow the same line in space as the legal limit.

- Content/Topic 2 .Identification of types boundaries ,advantages of each boundaries

A.TYPES OF BOUNDARY.

Fixed boundaries

General boundaries

These terms are ambiguous for there are at least three concepts of a fixed boundary and three of a general boundary.

1. Fixed boundaries

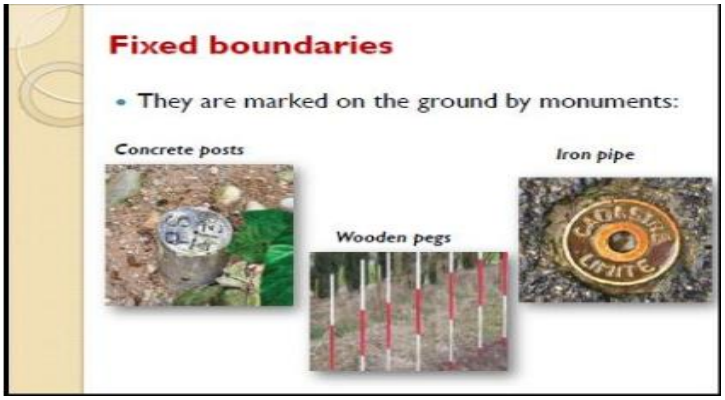
A boundary becomes "fixed" when agreement is reached between adjoining owners and a line of division is recorded as such in the register to represent what is on the ground.

The agreed boundary cannot be changed without proper documentation (or in some cases judicial decision).

Fixed boundary is where the precise line of the boundary is determined by legal surveys and expressed mathematically by bearings and distances, or by coordinates.

It is a boundary accurately surveyed for which a surveyor can accurately find or replace any corner monument from the recorded survey measurements.

They are marked on the ground by monuments:



Fixed boundaries are usually determined and marked by a land surveyor who is registered or licensed by the state to undertake cadastral surveys.

They are the most common form of boundary in the developed world and are found in most jurisdictions worldwide.

Three concepts of fixed boundaries:

To some, a fixed boundary (sometimes referred to as a specific boundary) is one which has been accurately surveyed so that any lost corner monument can be replaced precisely from the measurements.

To others, the term "fixed boundary" is used to describe a boundary corner point which becomes fixed in space when agreement is reached at the time of alienation of the land. The location of the legal boundary cannot then be changed without some document of transfer. The surveyor's measurements may provide useful evidence of the boundary's location but the boundary is fixed whether or not there has been a survey.

This is the principle which is adopted under the so-called Torrens system.

In some systems, however, a boundary is only fixed when agreement is reached between adjoining owners and the line of division between them is recorded as fixed in the register. From then on the evidence on the register normally overrides whatever is on the ground.

The exact line of a boundary under dispute is then determined by reference to the documentary evidence in preference to long-term occupation and possession of the

land or to the position of well established physical features, such as hedges, which may be inconsistent with any registered plan.

Advantage of fixed boundaries

Easier relocation and reestablishment, especially where physical markings are missing

Generally associated with fewer boundary disputes

Disadvantage of fixed boundaries

Fixed boundaries are the higher cost in their establishment

2. General boundaries:

They are represented by physical features, manmade or natural feature ridge, wall, ditch, road, or railway line):

Fence

Road

Hedge

Ditch

General boundaries are also sometimes referred to as “indefinite” or “approximate” boundaries.

In general boundaries, the precise line separating adjoining properties is left undetermined as to whether it is one side of a hedge or wall or ditch or fence or the other or down the middle of a bounding feature and the ownership of the land is guaranteed up to the bounding feature.

A general boundary may also be uncertain and variable such as the edge of a forest or a line of high tide as in coastal areas. Uncertain boundaries are deliberately kept vague to prevent argument between neighbours.

There is no need for a precise survey, although a reasonably accurate topographic plan is needed. General boundaries are most appropriate where the development of the landscape is mature, for example in urban areas and in rural areas that have been cultivated for a long time so that the pattern of land use is well established.

Provided that there is good monumentation, for instance in the form of fences or iron stakes driven into the ground, then the parcels define themselves and all that is a pointer to ensure that the correct parcel has been referred to. Inspection on the ground can reveal the precise alignment of the boundaries should that be needed and a surveyed plan is only necessary to identify the parcels.

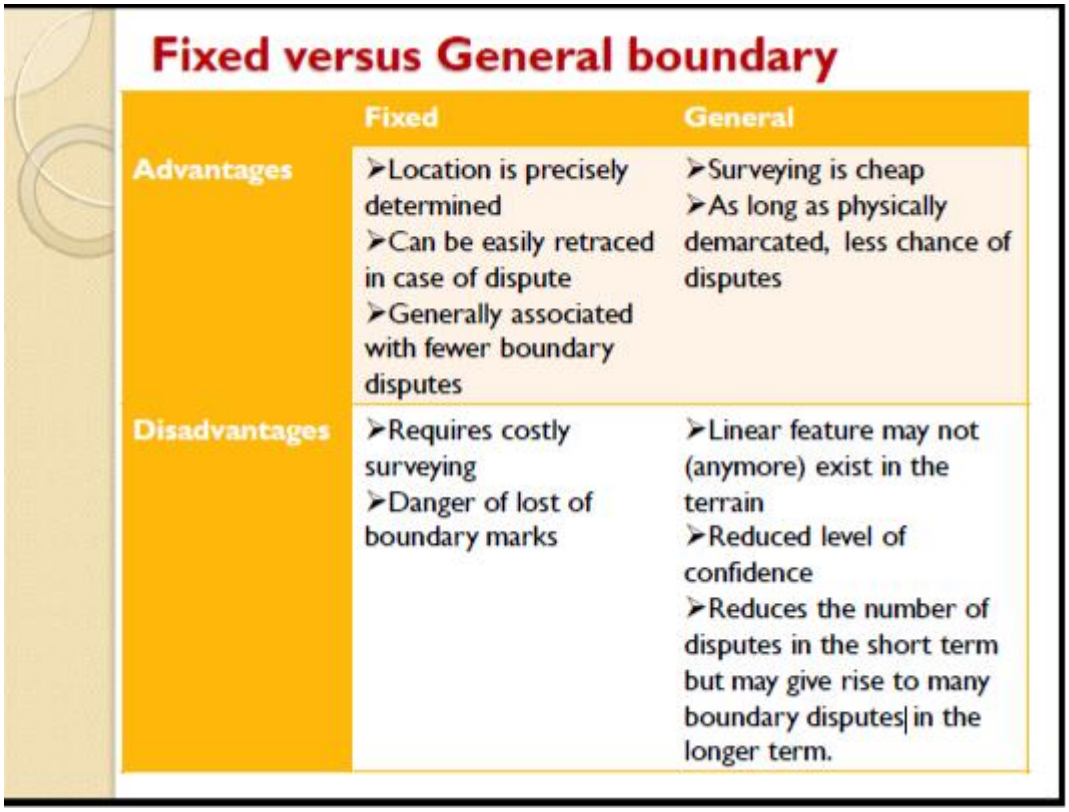
Advantage of general boundaries

Cheaper due to less demanding standards of surveys

Cadastral records may be compiled more cheaply and maintained using general boundaries

Disadvantage of general boundaries

Reduces the number of disputes in the short term but may give rise to many boundary disputes in the longer term.



LO 3.2 – **Identify the methods of land demarcation**

- Content/Topic 1. Description of Methods for Land Demarcation

A. Mets and bounds

It is one of the oldest methods for identifying a land parcel mostly used in England.

“Metes" refers to a boundary defined by the measurement of each straight distance.

“Bounds" refers to a more general boundary description (along a certain watercourse, a stone wall, an adjoining public road way, or an existing building, etc).

Metes and Bounds: Uses bearings and distances to measure the circumference of the property described **in the** legal description

B. Lot and Block Survey System

It is a method used in the United States and Canada to locate and identify land, particularly for lots in densely populated urban areas, and suburban areas.

The owners of a large tract of land would create a surveying plan and subdivide the tract into a series of smaller lots to be sold to buyers.

This subdivision survey plan would then be recorded with an official government record keeper.

Lot and Block: Descriptions must identify the individual lot, the block in which that lot is located as well as a reference to find the cited plat map in the public record.

Boundary Demarcation:

Boundary Demarcations defined as the process of placing the boundary on the ground.

It is a more mechanical process than delimitation, which involves setting up beacons or pillars or posts, numbering them, and recording them on maps.

The demarcation process is sometimes delayed for very long periods of time because of economical reasons, or countries avoid to enter into potential conflicts.

The logistical component of demarcation today is much easier than in the past because accessibility to rural areas is much better: development of modern transportation infrastructures; the use of field vehicles and helicopters, and improved communication throughout the world.

Allocation is a result of negotiation between the two parties representing the two bordering countries.

Other facilities include the revolution in surveying tools, including satellite surveying and high-resolution satellite imagery, high-quality mapping, precise measurements, and precise documentation of the demarcation

The demarcation of rights to land is likely one of the earliest activities undertaken by human societies. Primitive societies demarcated and defended territories to hunting and gathering sites in order to limit open access exploitation Early agricultural societies demarcated rights to much smaller plots of land for farming In modern societies rights are demarcated for residential and commercial use in dense urban areas, for farmland in highly mechanized large-scale fields, for huge landscapes allocated primarily as wildlife refuges or wilderness parks, and for such related resources as minerals and water. Yet, despite the somewhat obvious point that a system of demarcating rights to land will be important in determining the use of that land, the literature in economics and in law is completely absent. In this paper we examine the impact of two different – decentralized or unsystematic and centralized or systematic demarcations of property boundaries: metes and bounds (MB) and the rectangular survey (RS). Under the metes and bounds system, land claimants define property boundaries in order to capture valuable land and to minimize the individual costs of definition and enforcement. Individual surveys are not required to occur before settlement and they are not governed by a standardized method of measurement or parcel shape. Property is demarcated by natural features of the land (e.g., trees, streams, rocks) and relatively permanent human structures (e.g., walls, bridges). Under a centralized and systematic land survey regime a large area is governed by a common system of plot shapes, sizes and boundary descriptions

C.rectangular survey

We argue that the rectangular survey tends to lower the costs of land development and exchange through its measurement, enforcement, and incentive effects as compared to using metes and bounds to define land ownership boundaries. The latter are necessarily vague and imprecise (“four paces from the most northerly rock pile…”), temporary (trees disappear, stream beds change, so that boundary markers had to be periodically investigated to insure that they were still visible),The centralized rectangular survey defines land ownership in a manner that reduces the costs of measurement, enforcement, and exchange. By bearing upfront costs of systematic survey prior to occupancy the marginal costs of demarcating and establishing boundaries is low compared to metes and bounds. Individual plots are aligned north –south, boundaries are clear, precise, and uniformly positioned and the system of description is uniform across the country. The centralized system itself is public good (much like a library catalog system) so that the market for land is expanded

The land governed by the rectangular survey shows a uniform system of plots and roads, while the metes and bounds system shows a seemingly random array of plots and fewer roads

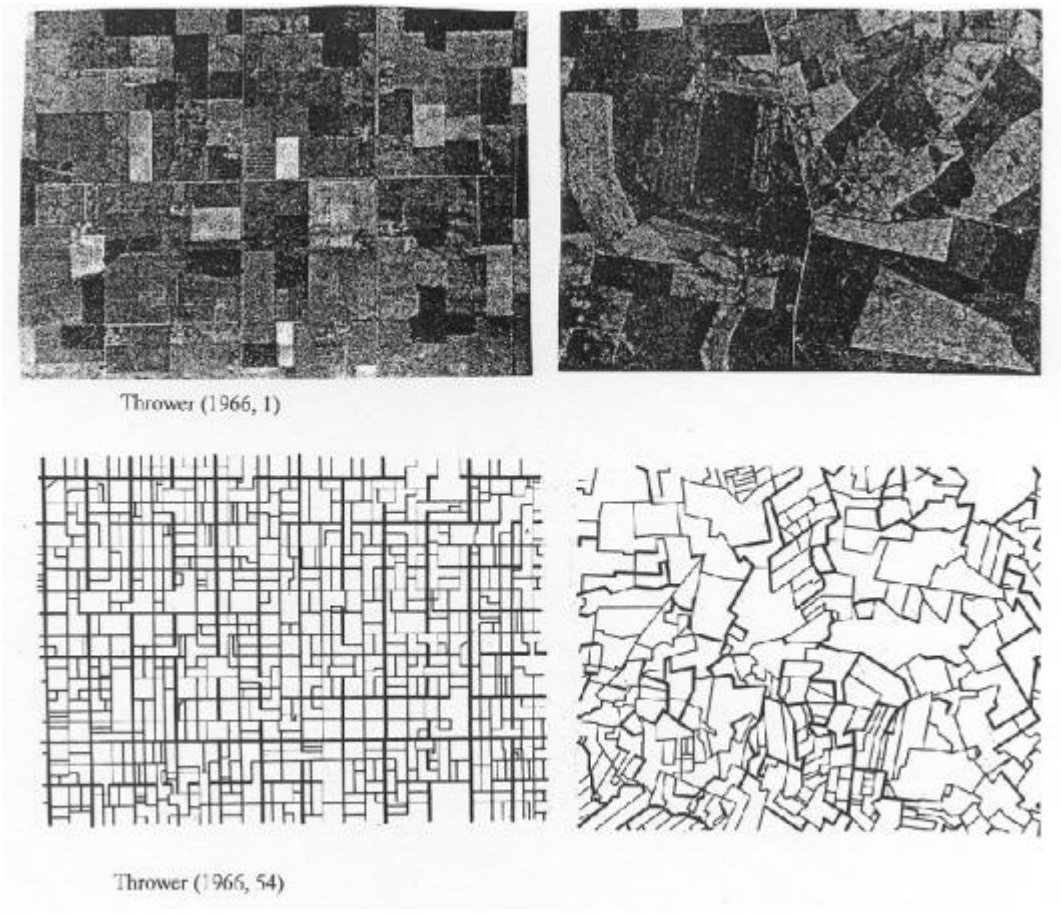


Figure 1: Comparison of Rectangular Survey with Metes and Bounds

Ideally every tract of land has a description on paper and a physical survey on the ground. When boundary disputes arise, all parties concerned must quickly learn the vocabulary and processes involved with real estate. Written for anyone dealing in real estate transactions, Subdividing the Land: Metes and Bounds and Rectangular Survey Systems provides this background. It defines key legal terms, examines key concepts of Metes and Bounds, the structure of the U.S. Land Survey System and offers many illustrations and tables that clearly explain the concepts.

Each state has its own property laws, but the book's material is generic enough to be applicable across the entire United States and even Canada. Taking into account that local laws may be influenced by many factors, the book also covers the roots of English property laws and effects of French, Spanish, and Mexican legacies. The author discusses topics such as water law, mining claims, and the Metes and Bounds and Torrens system of property registry. He provides a section of basic legal concepts applicable to land transactions and a glossary of special or semi-technical terms.

Unlike most other topics related to surveying, there is no math associated with the topics given; yet the subjects can be complex and tricky. This book is a resource of many interrelated topics, and thus presents a knowledge base for land surveyors and the background for handling many types of land transactions conducted by real estate agents, engineers, architects, and lawyers.

Metes and bounds are the limits or boundaries of a piece of property as identified by its natural landmarks. Examples of metes and bounds landmarks include rivers, roads, stakes, or other such natural or manmade markers

Metes and bounds is a system or method of describing land, real property or real estate. Newer systems include rectangular, lot and block and Torrens. The system has been used in England for many centuries, and is still used there in the definition of general boundaries

The **platted**, or short-form, description describes a parcel of land by reference to a recorded survey or **plat**. A **metes and bounds** description completely describes the boundary lines of the land. Each boundary line or "call" is described by a course and a distance.

D.Assessing Parcel Identifiers (number)

Various reference systems have been developed including:

a. The name of the grantor or grantee

b. A sequential title number

c. The volume and folio numbers on which the plot is registered

d. The name of a farm or locality with an individual plot number

e. The registration block and individual plot numbers

f. A post office address

g. A street index reference and parcel number

h. A grid coordinate or "geocode"

The reference chosen should be easy to understand and easy to remember by land owners; easy to use for the public and by computers; permanent so that it does not change with the sale of a property, but capable of being updated when there is for example a subdivision of the land; unique; accurate; and economic to introduce.

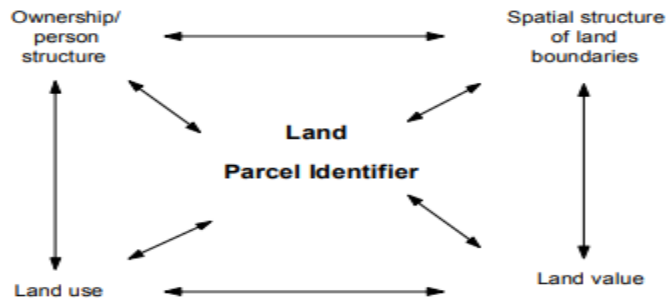
It is essential that when these numbers or names are drawn on a map that they do not obscure the details of the map itself. The cadastral map should show the boundaries of each land parcel and in some jurisdictions may also show its area and the actual length and bearing of each boundary line. These considerations may obviously demand a scale somewhat larger than that required merely to indicate each surveyed plot.

The smallest satisfactory scale depends primarily on the area of the smallest survey plot likely to be met with, and may thus vary greatly in different circumstances. A much larger scale will be necessary for cadastral maps of towns than for those of rural areas. Distances recorded on such plans are the horizontal distances between points and not the surface distances actually measured on the ground.

Thus the area recorded for a plot of land on a steep hillside will be the horizontal equivalent which may be significantly less than the actual surface area.

Cadastral maps should show a sufficient number of points which can be accurately identified on the ground to enable any other point on the ground to be identified on the map (or vice versa) by eye or by simple and short measurements. Professionally this requirement is satisfied by marks recording

The original triangulation stations, or the stations on supplementary theodolite traverses, but this is usually inadequate or inconvenient for practical purposes. In areas where there are permanent fences or fields surrounded by embankments, the fences and banks may provide an adequate means of detailed identification, but in unfenced open fields without any embankments, some means of indicating the land parcel boundaries on the ground will be done through ground marks.



- Content /Topic3 .Other documents used in cadastral

Other documents than Map

The statistical data can be represented graphically.

A graph

a.Definition

is the representation of data by using graphical symbols such as lines, bars, pie slices, dots etc. A graph does represent a numerical data in the form of a qualitative structure and provides important information.

Graphs are a good means of describing, exploring or summarizing The statistical data because the use of a visual image can simplify complex information and help to highlight patterns and trends in the data.

Graphs are a good means of describing, exploring or summarising numerical data because the use of a visual image can simplify complex information and help to highlight patterns and trends in the data. They are a particularly effective way of presenting a large amount of data but can also be used instead of a table to present smaller datasets. There are many different graph types to choose from and a critical issue is to ensure that the graph type selected is the most appropriate for the data. Having done this, it is then essential to ensure that the design and presentation of the graph help the reader or audience interpret the data.

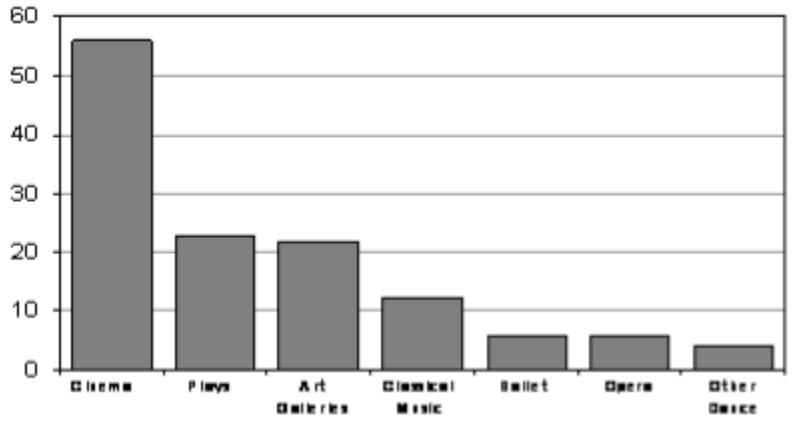
A summary of the types of data that can be presented in the most common types of graphs is provided below and this is followed by some general guidelines for designing readily understandable graphs. There is more detailed information on the uses and good design of particular types of graph in the companion study guides covering bar charts, histograms, pie charts, line graphs and scatter plots available from the Student Learning Centre.

b.TYPES OF GRAPH

1. Bar charts

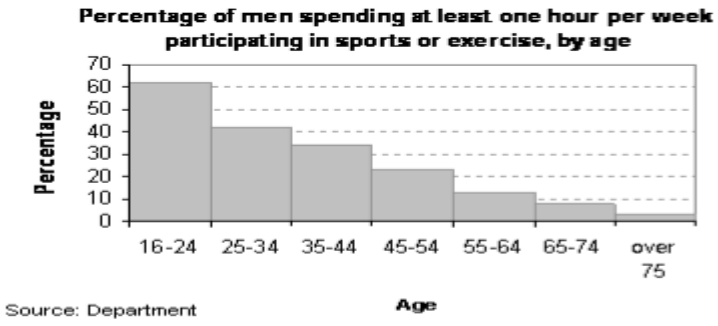
Bar charts are one of the most commonly used types of graph and are used to display and compare the number, frequency or other measure (e.g. mean) for different discrete categories or groups. The graph is constructed such that the heights or lengths of the different bars are proportional to the size of the category they represent. Since the x-axis (the horizontal axis) represents the different categories it has no scale. The y-axis (the vertical axis) does have a scale and this indicates the units of measurement. The bars can be drawn either vertically or horizontally depending upon the number of categories and length or complexity of the category labels. There are various ways in which bar charts can be constructed and this

makes them a very flexible chart type. For example, if there is more than one set of values for each category then grouped or component bar charts can be used to display the data. Further details about each of these different types of bar chart can be found in the associated study guide Bar Charts.



2. Histograms

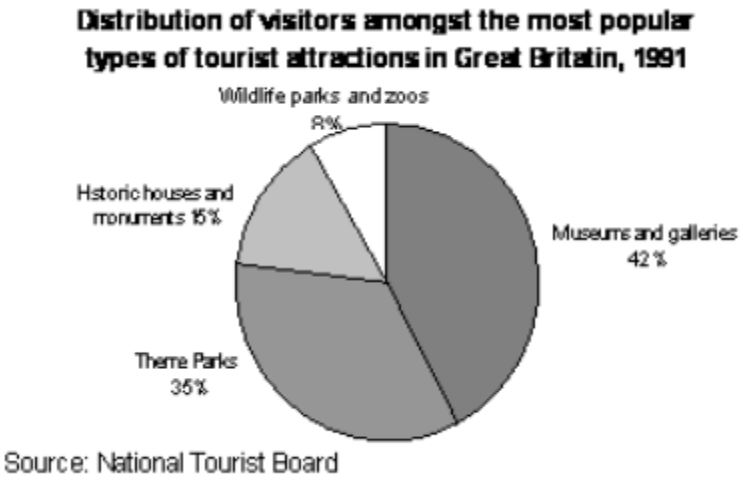
Histograms are a special form of bar chart where the data represent continuous rather than discrete categories. For example, a histogram could be used to present details of the average number of hours exercise carried out by people of different ages because age is a continuous rather than a discrete category. However, because a continuous category may have a large number of possible values the data are often grouped to reduce the number of data points. For example, instead of drawing a bar for each individual age between 0 and 65, the data could be grouped into a series of continuous age ranges such as 16-24, 25-34, 35-44 etc. Unlike a bar chart, in a histogram both the x- and y-axes have a scale. This means that it is the area of the bar that is proportional to the size of the category represented and not just its height Further information on constructing histograms is available in the associated study guide Histograms.



3. Pie charts

Pie charts are a visual way of displaying how the total data are distributed between different categories. The example here shows the proportional distribution of visitors between different types of tourist

attractions. Similar uses of a pie chart would be to show the percentage of the total votes received by each party in an election. Pie charts should only be used for displaying nominal data (i.e. data that are classed into different categories). They are generally best for showing information grouped into a small number of categories and are a graphical way of displaying data that might otherwise be presented as a simple table. The study guide Pie Charts gives more details about designing pie charts and using them to compare data.



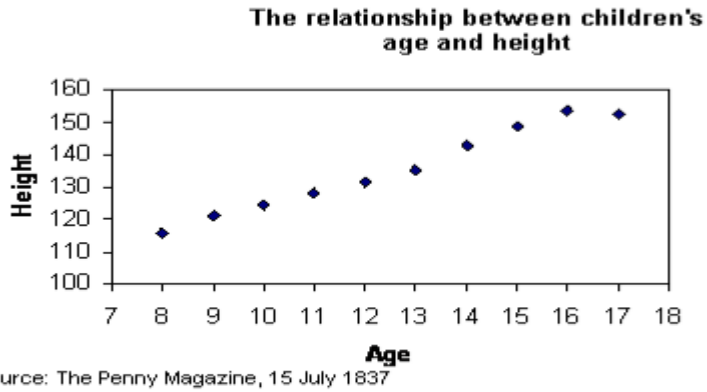
4. Line graphs

Line graphs are usually used to show time series data – that is how one or more variables vary over a continuous period of time. Typical examples of the types of data that can be presented using line graphs are monthly rainfall and annual unemployment rates. Line graphs are particularly useful for identifying patterns and trends in the data such as seasonal effects, large changes and turning points. As well as time series data, line graphs can also be appropriate for displaying data that are measured over other continuous variables such as distance. For example, a line graph could be used to show how pollution levels vary with increasing distance from a source, or how the level of a chemical varies with depth of soil. However, it is important to consider whether the data have been collected at sufficiently regular intervals so that estimates made for a point lying half-way along the line between two successive measurements would be reasonable. In a line graph the x-axis represents the continuous variable (for example year or distance from the initial measurement) whilst the y-axis has a scale and indicates the measurement. Several data series can be plotted on the same line chart and this is particularly useful for analysing and comparing the trends in different datasets.

Source: Office for National Statistics

5. Scatter plots

Scatter plots are used to show the relationship between pairs of quantitative measurements made for the same object or individual. For example, a scatter plot could be used to present information about the examination and coursework marks for each of the students in a class. In the example here, the paired measurements are the age and height of children in 1837. In a scatter plot a dot represents each individual or object (child in this case) and is located with reference to the x-axis and y-axis, each of which represent one of the two measurements. By analyzing the pattern of dots that make up a scatter plot it is possible to identify whether there is any systematic or causal relationship between the two measurements. For example, in this case it is clear from the upward trending pattern of dots that children's height increases with age. Regression lines can also be added to the graph and used to decide whether the relationship between the two sets of measurements can be explained or if it is due to chance.



Source: The Penny Magazine, 15 July 1837

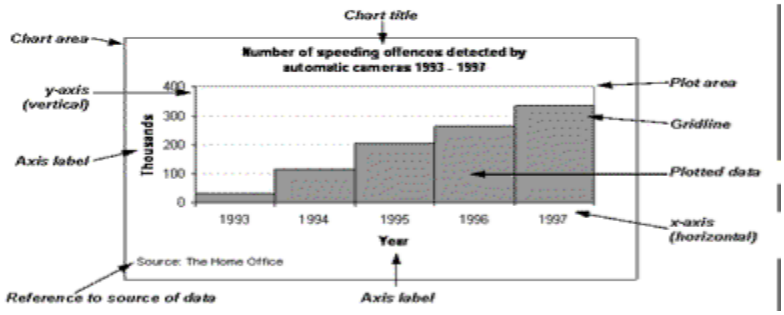
C.GOOD GRAPH DESIGN

Although there are many different types of graph, there are a number of elements that are common to the majority of them such as axes. This section provides some general guidelines to help you design your graph

and ensure that you apply these elements in a way that will help the reader or audience interpret the data you are presenting.

Components of a graph:

The different components of a graph are identified in the diagram on the next page and this is followed by a description that highlights some of the specific design and presentation issues related to each component.



1.Chart area

The chart area defines the boundary of all the elements related to the graph including the plot itself and any headings and explanatory text. It emphasises that these elements need to be considered together and that they are separate from the surrounding text. The boundary of the chart area can be imaginary rather than defined by a frame.

2. Plot area

The plot area is the region containing the data. It is bounded by the x- and y-axes to the bottom and left side. The frame can be completed by drawing around the top and right sides too, but this is not essential.

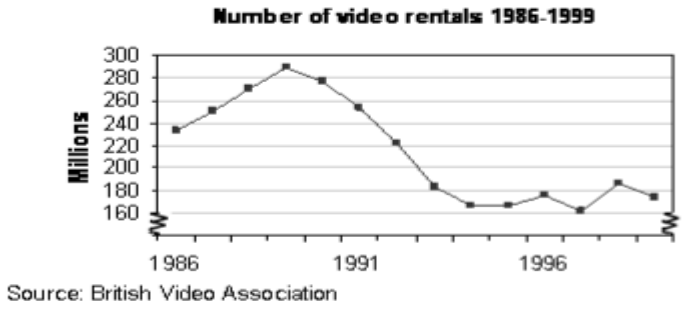
3. The x-axis

The x-axis is the horizontal line that defines the base of the plot area. Depending upon which type of graph is being considered different locations on the x -axis represent either different categories (such as years) or different positions along a numerical scale (such as temperature or income). Details are placed just below the x-axis and an axis label is usually provided to clarify the units of measurement. However, if the category details are mentioned somewhere else such as in the title of the graph, or are very obvious (such as years) then it is not necessary to include an axis label.

4. The y-axis

The y-axis is the vertical line that usually defines the left side of the plot area, but if more than one variable is being plotted on the graph then the vertical lines on both the left and right sides of the plot area may be used as y-axes. The y-axis always has a numerical scale and is used to show values such as counts, frequencies or percentages. Intervals on the scale are marked by numbers and tick marks, indicating the major divisions, to the left of the y-axis. Like the x-axis, the y-axis usually has a label that provides details of the units of measurement. The label is often written vertically to follow the line of the y-axis but can instead be placed just above the top of the y- axis.

In order to best highlight a trend in the data, it may be necessary to start the y-axis scale at a point other than zero. In such cases the starting value on the y-axis should be clearly labelled and the readers' attention drawn to the non-zero start by breaking the y-axis just below the first value as shown in the example opposite.



5. Gridlines

Gridlines are the vertical and horizontal lines placed within the plot area to help read values from the graph. The gridlines should be subtle and not detract from the data. In the case of simple graphs it is not always necessary to include them. Gridlines are usually drawn at regular intervals based on the major divisions of the y-axis scale.

6. Title

All graphs should include a title that summarises what the graph shows. The title should identify what is being described (e.g. speeding offences detected by automatic cameras) and the units of measurements (e.g. percentages, total number, frequency). The title may be placed within the chart area, as in the example above, or above or below the chart.

LO 3.3 – **Subdivide land.**

Content/Topic 1 .land law in Rwanda

Purpose of land law in Rwanda
Rwanda has been working on a Land Tenure Regularization (LTR) programme since 2005 (with trials till 2008 and full implementation since 2008) with the objective of all rightful landholders in Rwanda receiving legally valid land title documents and minimizing disputes preventing the issue of land titles.

The Land Tenure Regularizations (LTR) programme has been using general boundaries demarcation, marked on orthophotographies or enlarged satellite images, with claims being assessed in the field in a highly participatory system.

To support the program, two computer systems were developed to record and process the land claims information. The Land Tenure Regularization Support System (LTRSS) contains textual details of land parcels and the Geographic Information System (GIS) maintains the spatial details of land parcels.

The two systems are linked through a Unique Parcel Identifier (UPI).
Although the LTR has been a success, there is a need to maintain the system in terms of the information on parcels, rights and right owners that is regularly changing due to different types of transaction on land (sale, inheritance, sub-division/merge of parcels, servitudes, expropriation, corrections, etc.). Without a fully functioning maintenance system, with time the information collected by the LTR will becomes more and more out of date, until eventually it will become a not accurate and not useful record of land, rights and right owners.

- LAW N°43/2013 OF 16/06/2013 43/2013 GOVERNING LAND IN RWANDA
- LAW №05/2017 OF 03/02/2017 ESTABLISHING RWANDA LAND MANAGEMENT AND USE AUTHORITY AND DETERMINING ITS MISSION, ORGANISATION AND FUNCTIONING

LAND POLICY

Land Policy Framework Taking into account the current national development aspirations as reflected in the Vision 2050 and the National Strategy for Transformation, this chapter focuses on major land related issues that need attention for both policy development and strategic planning. This chapter also provides a set of policy actions proposed to address the identified issues. This policy is structured around the following eight thematic areas clustered under three main pillars of the land management as detailed below: Pillar 1. Land Use Planning, Surveying and Mapping: This pillar is a key component for efficient land management. It describes the hierarchy of land use planning process from the central to district levels. It provides a shift from a district boundary-based planning to a sectorial and land suitability-based planning. The main thematic areas under this pillar are: (i) the National land use and development master plans, (ii) Sector specific land use master plan, and (iii) District land use implementation plans. Pillar 2. Land Use Management: This pillar provides guidance on the efficient use and management of available land across sectors based on prescriptions of the national land use and development master plan and sector level land use master plans. Thematic areas under this pillar comprise: (i) land utilization by various sectors, (ii) efficient land use

management and (iii) land for strategic investment. Pillar 3. Land Administration: This pillar provides policy orientation on how to improve the current land administration system in Rwanda in terms of

(i) land registration,

(ii) administration of land lease fees and real property taxes,

(iii) management of land related disputes and

(iv) coordination of the land sub-sector

Content/Topic 2 .Distribution of land to be subdivided

Description of Land cover and Land use

A.Land Cover

Land cover corresponds to a physical description of Earth leading to a simple definition the observed physical cover of Earth's surface. This is what is overlaying or currently covering the ground. This description enables various physical categories to be distinguished basically, areas of vegetation (trees, bushes, fields, lawns), bare soil (even if this is a lack of cover), hard surfaces (rocks, buildings), and, according to the accepted concept of land, wet areas and bodies of water (sheets of water and watercourses, wetlands).

B.The types of land use: there are many types of land use like

Recreational - fun, non-essentials like parks.

Transport - roads, railways, and airports.

Agricultural - farmland.

Residential - housing.

Commercial - businesses and factories

b.1.Built-up land

It is defined as an area of human habitation developed due to non-agricultural lands which cover buildings, industrial structures, transportation network,

b.2.Agricultural lands

It is defined as the land primarily used for farming and for production of food, fibre, commercial and horticultural crops. It includes the land under crops (irrigated and rainfed), fallow, plantations

b.3.Forests

It is an area within notified forest boundary, predominantly with trees and other vegetation capable of producing timber and other forest produce. It occurs on uplands, coastal plains in association with forest trees and other vegetation

b.4.Wastelands

It is described as degraded land which can be brought under vegetative cover with reasonable effort, and which is currently under-utilised and deteriorates due to lack of appropriate water and soil management due to natural causes

b.5.Water bodies

It is a natural course of water distributed over land. It includes ponds, lakes, streams and rivers. It may be perennial or non-perennial. It appears in light blue to dark blue tone subject to shallow surface water spread, deep and more volume of water, turbidity,

b.6.Others

It can be treated as miscellaneous because of the nature of occurrence, physical appearance and other characteristics. Saltpans and roads/railways are brought under this category.

Area under various Land use Classes

Boundary disputes and judicial determination

Boundary disputes generally arise because of one landowner's lack of consideration for the owners of neighboring land. It is apparent that far more boundary disputes arise between the owners of urban residential properties than between commercial or agricultural neighbors. Disputes between residential neighbors are likely to involve access issues and the location and/or type of boundary separating the land parcels, potentially causing much angst (and considerable expense) for the aggrieved parties. where a dispute exists, a land surveyor is not the final arbiter of any boundaries under dispute: this role falls to the Courts. The surveyor's role in these matters is one of fact-finder and expert witness, providing the evidence of what has gone on before, upon which the Courts will make judgment

Land use Classes	
Level 1	**Level 2**
Built up land	**Urban**
	Rural
	Industrial
Agricultural lands	**Crop land**
	Commercial / Energy / Shelter Plantations
	Fallow land
Forests	**Scurb Forest**
	Forest blanks
Wasteland	**Land with scurb**
	Land without scurb
	Salt affected area
	Sandy area
	Swampy/Marshy
	Tidal Flat
	Reef area
Water bodies	**River/streams/tanks**
Others	**Salt pan**

Content/Topic 2 .Method of Land Subdivision

Cadastral surveying techniques and procedures

Cadastral surveying involves all kinds of surveys in relation to original surveys/ acquisition surveys ;

subdivision or layout surveys ;relocation and retracement surveys ;consolidation or resettlement surveys

a.Original/acquisition surveys

Applies to areas not yet surveyed, Involve processes require to establish new cadastral boundaries

Layout surveys

b.Subdivision/layout survey

New smaller parcels of land within larger previously surveyed tracts , Creates a new cadastral parcels

Establish new cadastral boundaries of the original cadastral parcel Surveys are usually based on approved planning schemes for the government or private individual

The purpose of subdivision is to provide land allotments of a size and location suitable for use and occupation .The Sub-division approaches are:

1) Sub-division of a parcel from a known point

2) Sub-division of an area by a line of known bearing

3) Sub-division of a parcel by a line passing through a known point inside the figure

b.1. Sub-division of a parcel from a known point

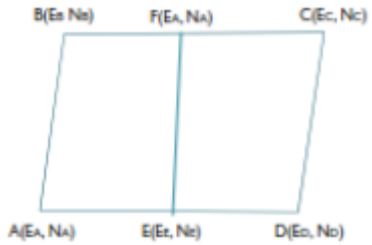
Dividing line is EF

Coordinate of E is known

Coordinate of F is unknown

Use method of computing areas to determine the coordinate of F

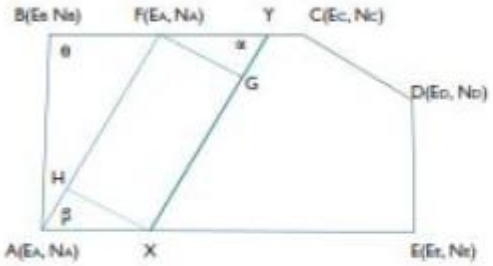
Area ABFEA = Area EFCDE



b.2.Sub-division of an area by a line of known bearing

Sub-division survey

Sub-division of a parcel from a known bearing



- Dividing line is XY
- Direction of AF given
- Known points ABFCDE
- Unknown points XY
- Assume XY is parallel to AF
- d = separation between AF and XY
- Using method of computing areas
- Area ABFYXA = ½ Area ABCDEA

Sub-division of a parcel from a known bearing

- Area ABFYXA = 0.5 Area ABCDEA
  = ABF+YFG+HFGXH+AHX

YG = d cot α;

AH = d cot β

ABF = ½AB.BFSin θ

FYG = ½ d^2 cot α

XHFG=d(AF- d cot β) = d.AF - d^2 cot β

AXH = 0.5 d^2 cot β

Sub-division of a parcel from a known bearing

Putting all together:

½ d^2 cot α + d.AF - d^2 cot β + ½ d^2 cot β = ½ ABCDE-ABF

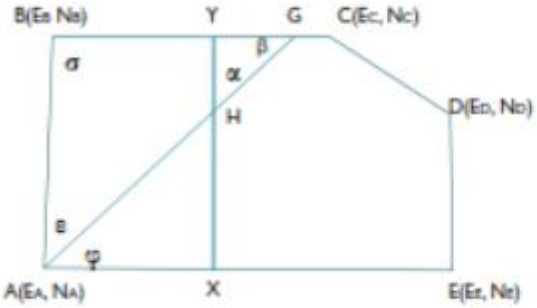
½ d^2 cot α - ½ d^2 cot β + d.AF = ½ ABCDE-ABF = A

d^2 cot α - d^2 cot β + 2d.AF = 2A

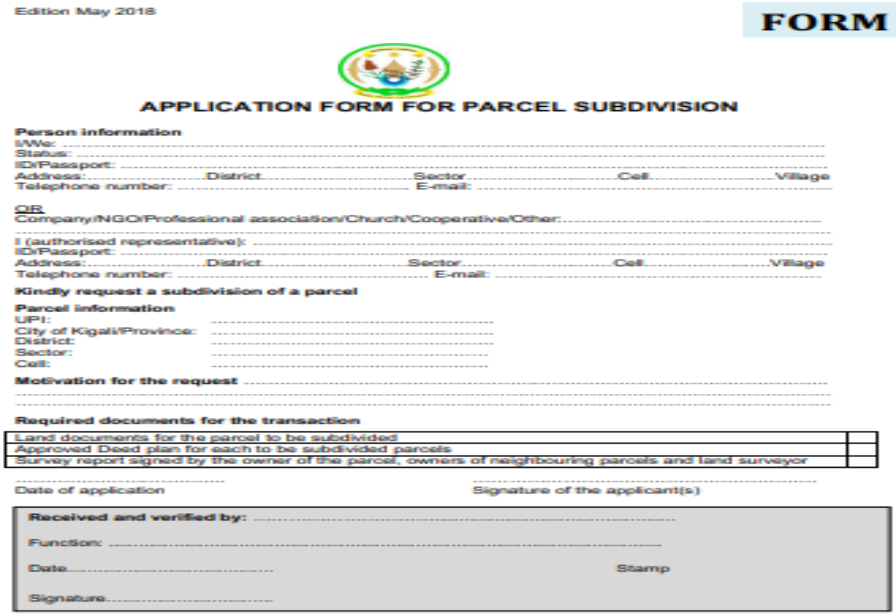
d^2 (cot α - cot β) + 2d.AF -2A = 0

b.3 Sub-division of a parcel by a line passing through a known point inside the figure

Sub-division of a parcel by a line passing through a known point inside the parcel



- Dividing line is XY
- Dividing line is located at H
- Using method of computing areas
- Area ABYX = YCDEX =
  = ½ Area ABCDEA



Edition May 2018

FORM 1

APPLICATION FORM FOR PARCEL SUBDIVISION

Person information
I/We: .....
Status: .....
ID/Passport: .....
Address: .....District..... Sector..... Cell..... Village
Telephone number: ..... E-mail: .....

OR
Company/NGO/Professional association/Church/Cooperative/Other: .....
I (authorised representative): .....
ID/Passport: .....
Address: .....District..... Sector..... Cell..... Village
Telephone number: ..... E-mail: .....

Kindly request a subdivision of a parcel

Parcel information
UPI: .....
City of Kigali/Province: .....
District: .....
Sector: .....
Cell: .....

Motivation for the request .....

Required documents for the transaction

Land documents for the parcel to be subdivided	
Approved Deed plan for each to be subdivided parcels	
Survey report signed by the owner of the parcel, owners of neighbouring parcels and land surveyor	

Date of application ..... Signature of the applicant(s) .....

Received and verified by: .....
Function: .....
Date..... Stamp
Signature.....

- Content/Topic 2 .Land Regulation ;parcel standard

A **residential** area is a **land** used in which **housing** predominates, as opposed to industrial and commercial areas. ... These include single-family **housing**, multi-family **residential**, or mobile homes. **Zoning** for **residential use** may permit some services or work opportunities or may totally exclude business and industry.

Land use planning definition Land use planning is a procedure for planning the sustainable use of the land considering its potentialities, limitations and the user needs. Land use planning is a procedure which leads to an optimal and sustainable use of the land and all its attributes.

Steps proposed to be adopted into the prescribed phases/tasks of the LUP Planning Process. When developing and preparing a LUP at national

STEP 1: Getting organized to work with the LUP and identifying stakeholders

STEP 2: Setting the vision for the LUP

STEP 3: Analysing the situation

STEP 4: Setting the goals and objectives for the LUP

STEP 5: Establishing the development thrust and spatial strategies

STEP 6: Public consultations on LUP

STEP 7: Preparation the detail draft LUP

STEP 8: Reviewing, adopting and approving the LUP

STEP 9: Implementing the LUP

STEP 10: Monitoring, Reviewing & Evaluating the LUP

Industrial Land Use The 1975 Plan set aside substantial land for industrial development for which there has been little demand since then. A 1987 inventory of vacant industrial-zoned land within the City revealed a substantial number of vacant parcels with services available. Highway 10 from Reserve Street to the Wye includes examples of both clustered and random industrial development. The Missoula Development Park was recently approved, creating lots for light industry, commercial, and research and development. Other development park proposals from that area of Missoula are proposed. It is unlikely that the Missoula environment can sustain heavy industrial development so the current development and land use designations meet the needs of the community. Given the forecast for little economic growth over the decade from 1975-1985, the 1975 Plan contains much more land than has been needed for industrial growth. Some of this land does not have adequate access or other services available at this time, such as that designated for light industrial use south of the airport.

A land use regulation lies within the police power if it is reasonably related to the public welfare.

The legal basis for all land use regulation is the police power of the city to protect the public health, safety, and welfare of its residents. Land is the platforrn of all human activities Therefore whatever is done in any sector of the economy has an impact on land. At present licenses,rights, and claims such as for mining , water rights, hunting rights/leases and timber harvesting licenses are issued without regard to existing land tenure rights. This creates land use conflicts and disputes between the allocates of land and other users. For example hunting rights in districts, mining in districts, timber harvesting licenses in regions, have caused serious land use conflicts.

Changes in crop distribution

Photo credit: REMA

Figure 1: Land Use in Rwanda 1990 and 2002

Besides the change in land use and cultivated area, there have been changes in terms of crop distribution by area occupied. The changes in cropping pattern have implications on the environment in the areas concerned. For instance, areas where bananas and coffee were replaced with tubers such as cassava are likely to become susceptible to soil erosion because of loss of cover. Figure 2 shows some of the changes in crop distribution. The area occupied by legumes and cereals remained fairly constant over the period 1990- 2002 (although there was some increase in absolute terms). However, the area under tubers increased significantly from 25 to 33 per cent of total farmland over the same period. Many areas have experienced gains of over 100 per cent in Irish potatoes, for instance Butare and Gikongoro provinces. The traditional epicenter of Irish potato production, Ruhengeri, lost about 50 per cent of its production during the same period. The increase in cassava production was dramatic in Gikongoro where it showed a ten-fold gain, while the eastern zone (Gitarama, and Kibuye) more than doubled their output. The area under bananas has dropped from 26 to 23 per cent of cultivated land between 1990 and 2002. Kibuye was the only part of the country with increased banana production. The reduction was most dramatic in the Kigali Rural province, where output fell by 91 per cent. The areas surrounding Kigali Rural also experienced substantial declines. Good rains and greater attention from farmers is having a positive effect on banana production in areas of decline. Upward trends in banana will likely continue as many farmers rely heavily on them as part of their cropping system

Some Policy Statements:

(i) Before user rights such as for mining, timber harvesting, hunting, etc. are considered, existing land tenure rights should be recognized.

(ii) An Interrninisterial Committee should be formed by the relevant ministries to ensure consultation between the issuing authorities and. the Ministry responsible for Lands.

(iii) The government will ensure that perrnits, licenses, claims: and rights for exploitation of natural resources are issued in line with land use policies, and environment conservation policies and programmes. uses as both human and animal populations increase. This has resulted in the encroachment of forest, woodland, wildlife and rangellands.

LO 3.4 – **Stakeout plot corners**

- Content/Topic 1 .Field Procedure in cadastral survey

Stakeout procedures
✓ Corners mark identification
✓ Accuracy requirement
✓ Instruments selection
✓ Stakeout of Coordinate
✓ Fix land marks
❖ Plots boundary features
✓ Roads
✓ Water courses/rivers

BOUNDARY SURVEY OPERATON

A complete surveying activity involves the following steps:

1. Reconnaissance of the area to be surveyed,
2. Planning of the survey management and decision-making,
3. Appropriate methods and instruments required are chosen,
4. Field measurement,
5. Data processing (boundary computations)
6. Survey plan production -Survey Record Plan, Land Boundary Plan, Dimension Plan & Site Plan

Generally, the above activities are grouped under field Work and office work

A. Reconnaissance of the area to be surveyed:

Reconnaissance involves the examination, collection and assemblage of all necessary and available information relating to the exercise.

It also involves visiting the site for familiarization with the existing conditions and topography of the area.

Before commencing a survey, it is a distinct advantage to make a thorough study of the title and survey information.

This provides the background to the survey and also gives the history of any particular boundary.

Apart from title searches the surveyor must be armed with all relevant survey information including the basic plan and nearby surveys.

To obtain this, he s/he searches mostly in the Registrar General/s office and/or Lands

Departments whichever maintains the relevant information.

B. Planning of the survey management and decision-making (pre-field work):

On the basis of the assessment done during reconnaissance, the surveyor is now well set to plan, organize and quickly undertake the survey work efficiently and with confidence.

This step assists in deciding where the points are to be located, the accessibility of the station, the equipment required, the number of personnel needed to carry out the field work.

A sketch map of the area should be drawn after the reconnaissance exercise.

C. Appropriate methods and instruments required are chosen:

To conceive the most appropriate techniques to execute the survey and thus derive reasonable cost estimates for the survey work. To work out a list of requirements:

Technical and non-technical personnel, Equipment , Transport,

Duration of the survey together with a time schedule and Any other relevant logistics

D. Field measurement

The work of a cadastral surveyor is about 1/3 in the field, 2/3 in the office.

It can only be done under the direction of a licensed cadastral surveyor.

Field Work involves:

1.Reconnaissance of the area to be surveyed.

2.Careful handling and adjustment of instrument.

3.Setting out in the field.

4.Performing measurements.

E.Recording of measured data.

Field work notes

The Surveyor's Field Note Book: Standard field notebooks should be prepared before the commencement of the fieldwork to record surveying fieldwork data so that other persons can readily retrieve them for use at any time.

Field notes should:

Be neat, clear, accurate and complete;

Include when, where, for what purpose and by whom the survey is done and the instrument identification;

All entries be clearly labeled;

Indicate the weather and any other conditions seen in the field;

Should indicate all field computations so that possible mistakes can be detected later.

Methods of Keeping Note

1.Written description of what has been done

2.Using sketch: Used where many angles and distances are measured from the same point.

3.Combination of the above: On extensive survey, combination of tabulation and sketch is used.

4.Digital methods: With the use of Total Station and GNSS equipment, field data can be recorded automatically and later downloaded into a computer and processed.

Arrangement of field work notes

1. Title page

A title page is the orientation, index, table of contents, and summary information for a set of field notes.

It should include information that will aid someone searching for specific survey information.

The title page should facilitate the information recovery process.

2. Header information

For example, coordinates, control stations, curve data, point descriptions, computed bearings, etc are all record information.

3. Observation and measurements

These values represent the heart of the survey. Record each required field value in its proper place

4. Descriptions

A survey point description is a (written, sketched, or written and sketched) recording of the general and exact horizontal (and vertical) location, datum, and the particular physical characteristics of a point which enable its recovery and the differentiation of that point from any other point.

There are several basic elements which, when included in the description, will aid in its identification. These elements are:

1. Name of point.
2. Physical description of monument, including size, appearance, materials, specific marks, and condition
3. Angles and/or distances to, and descriptions of, reference marks
4. General location and directions to its immediate vicinity
5. Citation of document or filed original field notes which first described point.

F. Data processing (boundary computations)

1. Scale selection

Consideration should be given to the choice of a suitable scale as it determines the amount of mapping space, and hence the amount of information which can be portrayed on the plan.

While choosing a scale, ensure that there will be enough space on the mapping plane for writing all the descriptive plot/marginal info.

2. Plan drawing/plotting

After choosing the suitable scale, a plan is plotted.

Most legal framework direct that all plans be plotted by rectangular coordinates.

Plotting is done either manually using conventional cartographic tools or digitally using spatial software which include GIS (e.g.ArcGIS) and CAD (e.g. AutoCAD Land Development) .

The original (drawn) cadastral survey plan rolled and dispatched separately to the relevant authorities for scrutiny and approval. Cadastral survey report

The cadastral survey work is usually compiled in the form of a plan known as

Cadastral Survey Plan, and Job File containing other survey data.

Both the cadastral survey plan and the Job File are dispatched to the relevant authorities for analysis and approval.

GUIDELINES TO FOLLOW WHEN RECORDING MEASUREMENTS

1. Always record the full raw values as called out by the instrument operator. Do not record only the sums or the differences or the mean of a series of raw values. also., do not record only "corrected" sums, differences or means.

2. Record significant figures only and clearly indicate the decimal portion of a measured value.

3. Do not erase any observation. If a blunder is made in recording a "call out", or if an observation is rejected, draw a slash through the entry without destroying the legibility of the erroneous entry. Erase diminish, and often destroy, the credibility of the field notes.

4. Do not discard a page with erroneous records.

5. Write clear and legible notes. A professional looking set of notes is likely to be of professional quality.

CONSIDERATIONS FOR SELECTION OF A SUITABLE SCALE

Size & shape of the plot(s) to be plotted;

Relative sizes of the shortest & longest boundary lines;

Density of information vs clarity & legibility/ readability;

Size of grid interval;

Size of drafting & reproduction material available (taking into consideration that the minimum size of a plan should not be less than 20cm x 30cm)

Size of reproduction equipment available e.g. Printer, plotter

Storage & handling convenience of the resulting plans and copies made from them

Summary Steps of a cadastral survey

A. Determine if a Survey is Needed

B. Request for Survey

C. Request Received

D. Project Instructions

E. Assignment Instructions

F. Additional Research

G. Control Survey

H. Field Survey

I. Monumentation

J. Prepare Survey Returns

K. Survey Review and Plat Signing

L. Filing

Content/Topic 2 . Plot boundaries Features

Boundary features

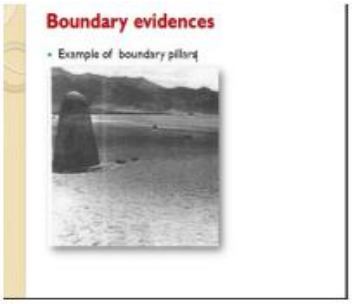
are structures that separate one property from another. This may include a fence, wall, hedge, ditch or some other **feature** such as a wire or even a change in the landscape such as the edge of paving.

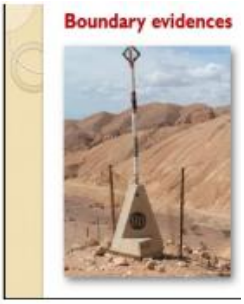
Fence

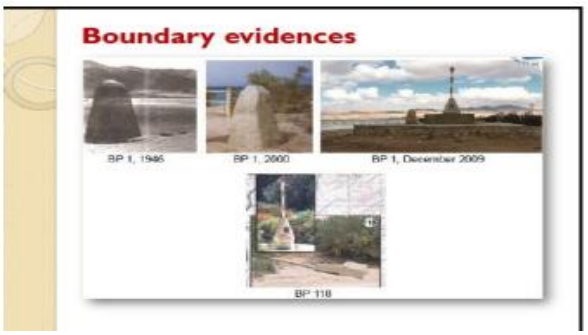
Road

Hedge

Ditch







The cadastral boundaries are derived based on roads, fences and edges of agricultural fields (crop types); adjacent vegetation ; roads, foot paths, water drainage, open areas and scrubs ; that Shows the case of a nonlinear irregular boundary shape

LO 3.5 – Beaconing

Content/Topic 1 .Identification of Boundaries Marks

A.Kinds of boundaries

Boundaries can be classified at many levels, they may be international (between countries), national (between states of a country), regional (between regions of a state), local (between localities of a region or local government area) or as in the context of this paper individual boundaries separating parcels of subdivided land.

Boundaries between countries and states are more commonly referred to as borders, and may be either natural (eg. seas, rivers, lakes) or artificial (eg defined by geographic lines of latitude and longitude). Borders serve political, legal and economic purposes in separation of the jurisdictions of abutting areas.

Other kinds of boundaries include maritime boundaries, which define the exclusive rights of a country or state over the resources of oceans adjoining the land of that country or state: In Australia, "a 3 nautical mile limit of coastal waters; a 12 nautical mile limit of the territorial sea, 24 nautical mile Contiguous Zone and a 200 nautical mile limit of the Australian *Exclusive Economic Zone*" (Geoscience Australia, 2011). Maritime boundaries may also exist for specific purposes, such as marine parks and fishing zones and 'administrative boundaries', which are based on cadastral maps and used for political and governmental administrative purposes (eg. electoral boundary divisions, censuses taken periodically for planning and development purposes at a national or regional level).

- Content/Topic 2. Types of boundaries Features for Land Parcel

1.Boundary lines (commonly called property lines) define the extent of the legal limits of ownership of any parcel of land. At common law, the rule of 'marks (monuments) before measurements' prevail in the definition of a boundary.

There is also a presumption at common law that where land is described as being bounded by a road, ownership extends to the middle of the road (the *ad medium filum viae* rule), unless there is a clearly defined intent to the contrary (which is usually the case).

If the description of a boundary is ambiguous, otherwise uncertain or in conflict with the occupations, Courts may settle the position of the disputed boundary. Courts have established precedents granting priorities of weight where any two or more of the following boundary features present conflicting evidence in the determination of a true boundary position, in order of priority:

“Natural boundaries (eg rivers, cliffs)

Monumented lines (boundaries marked by survey or other defining marks, natural or artificial)

Old occupations, long undisputed (for example an old wall or fence)

Abuttals (a described ‘bound’ of the property eg a natural or artificial feature such as a street or road)

Statements of length, bearing or direction (‘metes’ or measurements in a described direction)

This ranking order is not rigidly adhered to; special circumstances may lead a court at times to give greater weight than normal to a feature of lower rank” (Hallmann 1994, 13.13).

Fence

Hedge

Road

Ditch

Subject to any evidence to the contrary, Courts have consistently ruled in favour of long, acquiescent and undisturbed occupation dating to the time of survey as the most convincing evidence of a boundary between properties.

Further, it is a fact of law that where a property is described by ‘metes and bounds’, that is both measurements and a feature which describes the extent of ownership, the described bounds (abuttals) take priority over the stated measurements.

Strata title boundaries are specifically defined by the strata title plan and, commonly, are the centre of the walls, floor and ceilings enclosing a lot.

2.Monumentation (point)boundaries

(1) Placed monuments shall be classified as follows :

(a) "**boundary peg**" means a round iron or round steel post with a minimum diameter of 12 millimetres and a minimum length of 450 mm placed in the ground;

(b) "**boundary stone**"

(i) means a monument made of rock or concrete cement with a square flat surface having minimum dimension 100 mm x 100 mm and a maximum dimension of 200 mm x 200 mm and of a minimum length of 450 mm;

(ii) may be inscribed with relevant information such as the abbreviation of the boundary holder or a cut cross or an arrow;

(c) "**cut cross**" means a mark in the form of a cross cut into bedrock or **concrete**;

(d) "**reference marks**"

(i) means 2 survey markers placed at a minimum distance of 1 .00m from the boundary stone or corner, generally at right angles to each other and which are not visible to the public and are in a safe location.

(ii) shall be used by land surveyors to re-establish the referenced corner monument

Concrete posts

Iron pipe

Wooden pegs

- **Content/topic 3:The nature of boundaries and their characteristics**

1.natures of boundaries

Boundaries of land are generally fixed and do not move, although the interpretation of the location of the boundary can be difficult and professional judgments may vary in the interpretation of evidence of the location.

Where '**natural' boundaries** are formed by seas, lakes, rivers etc the situation is more complex: such boundaries are said to be 'ambulatory'. Ambulatory boundaries cannot be marked on the ground and are not fixed in one place, but can change position over time through slow and imperceptible accretion or erosion of the described feature.

Physical features (hedges, walls, streams, fences) may provide adequate means to identify general boundaries.

In an open field, boundary marks will be required in order to indicate the land parcel boundaries on the ground.

Marking Land parcel has two roles:

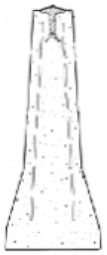
1. Define the parcel on the ground,
2. Evidence for reestablishment of boundaries at a later time.

2. A good mark must be:(characteristics of boundaries)

Durable in itself and not easy to remove either accidentally or wilfully (on will). Made in material that should not encourage theft.

Easily recognizable and fairly visible on the surface.

For important points (eg: used as control point), the surface marks are supplemented with marks that are set in concrete and buried beneath the surface On the surface Beneath the surface



On the surface

Beneath the surface

A good boundary mark should be

Visible

Durable

Not easy to remove

Easy to recognized

Remarks

1.When a survey is made, all angles and points of curvature of a boundary under survey, being either retraced or created, shall be defined by one of the monument classifications referred under paragraph

(2) Where evidence of a boundary mark no longer exists, all available information concerning its original position shall be considered in the re-establishment thereof.

(3) Where it is not possible or not advisable to monument a true angle or point of intersection, or where it is determined that the location of a monument will place it in immediate danger of destruction, one witness monument shall be placed at a suitable point as near as practicable to its intended location and on one of the boundaries under survey.

(4) Where a boundary line terminates at a natural boundary, as in the case of lots fronting the sea, a monument shall be placed on the boundary line far enough from the natural boundary as to be reasonably safe from destruction.

(5) An accurate record shall be made of the distance along the boundary line between the natural boundary and the monument.

Learning Outcome 3.5: Beaconing

- **Content /Topic 1: Boundary marks and Beaconing**

Boundaries marks
Linear features
Point features
Characteristics of boundary marks
Visible
Durable
Not easy to remove
Easy to recognized
Not encourage theft

Beacons Type
Wooden peg
Concrete marks
Iron bar
Stones

Boundary Beacons standard
Concrete or stone in cement
Underground portion =15cm diameter
Buried to a depth of 20cm
Upper portion =15cm above the ground
Diameter of 25cm

Layout beacons standard
10cm square in section
61cm long Buried depth below ground 53cm
7.6cm above ground

Ordinary property boundary beacons standard

18cm square in sections
77cm long
Buried depth above the ground 7.6cm
68.6cm below ground

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