

ACBA4017

*DIGITAL
SURVEYING
AND
HIGHWAY
DESIGN*



REGISTER



AIM

- *To provide learners with the digital skills in building surveys and highway design.*

COURSE CONTENT



Fundamentals of Surveying



Digital Surveying Tools and Techniques



Innovation and Automation in Construction



Highway Design Principles

FUNDAMENTALS OF SURVEYING



WHAT IS SURVEYING?

- *Surveying is the process of measuring and mapping physical features.*
- *It is an essential tool for construction, infrastructure development, and mapping.*

WHAT IS SURVEYING?

Land Surveying

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Building Surveying

- *Building surveying focusses on inspecting and assessing buildings and structures, both during construction and for existing structures.*



- *Production of maps and plans of natural and man-made feature.*
- *Height information can be added as either spot heights or as contours.*

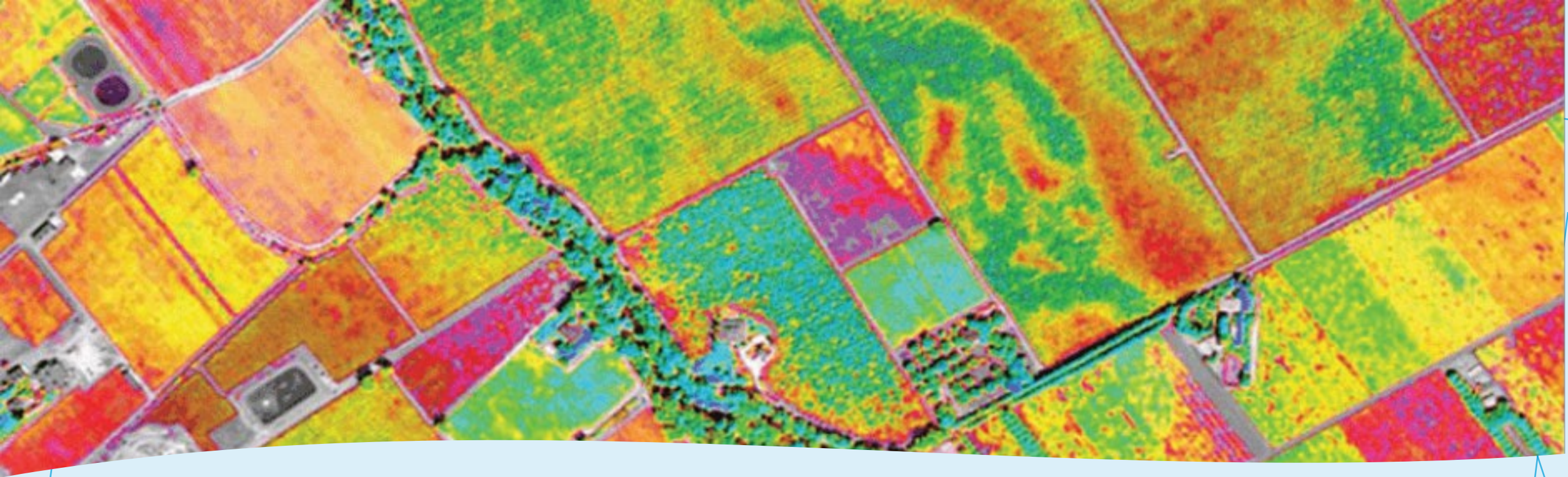
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SURVEYING APPLICATIONS

Land Survey - Cadastral

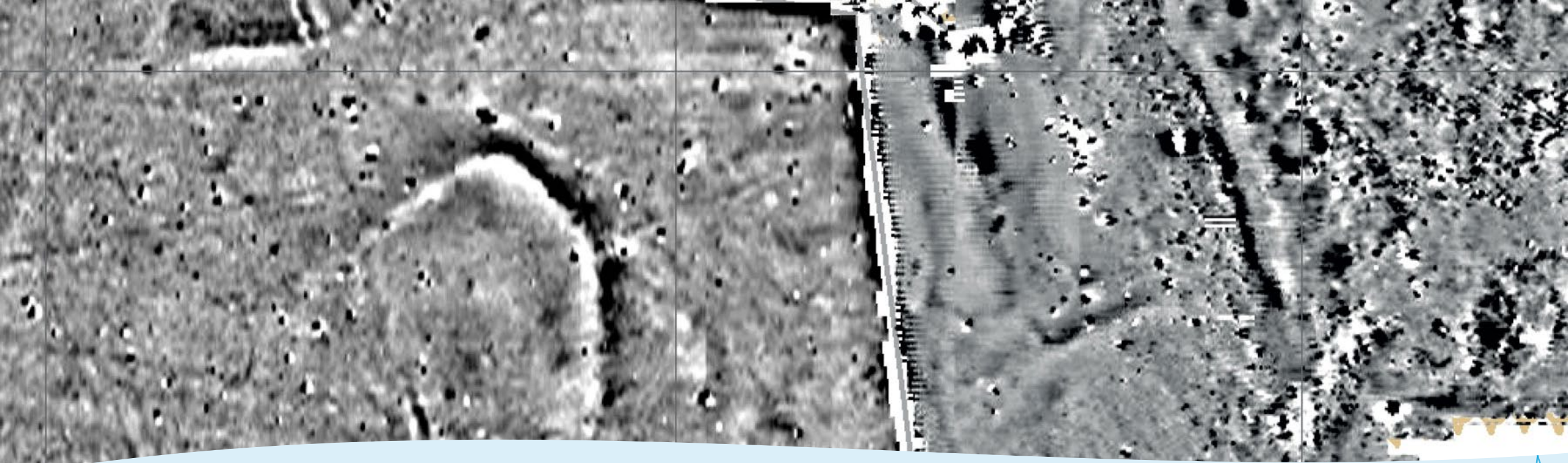
- *Plan to show property boundaries for legal purposes.*
- *Registration of ownership of land is based on such plans.*



SURVEYING APPLICATIONS

Land Survey - Remote Sensing

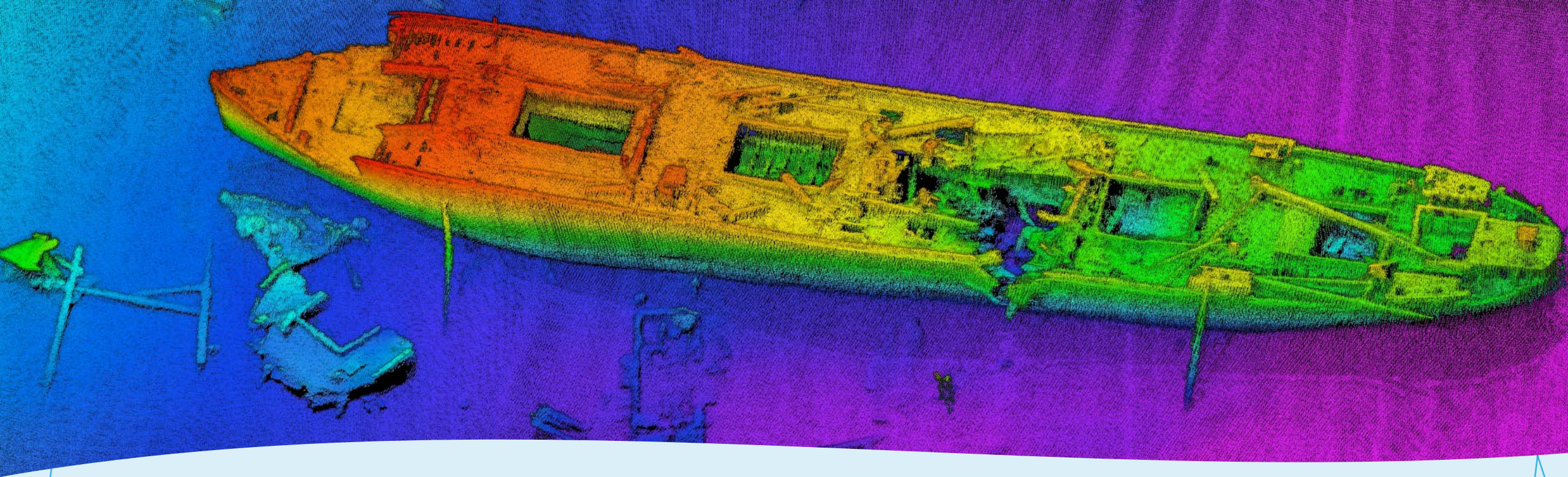
Remote sensing is the process of collecting and analysing information about the Earth's surface without direct physical contact.



SURVEYING APPLICATIONS

Land Survey - Archaeological

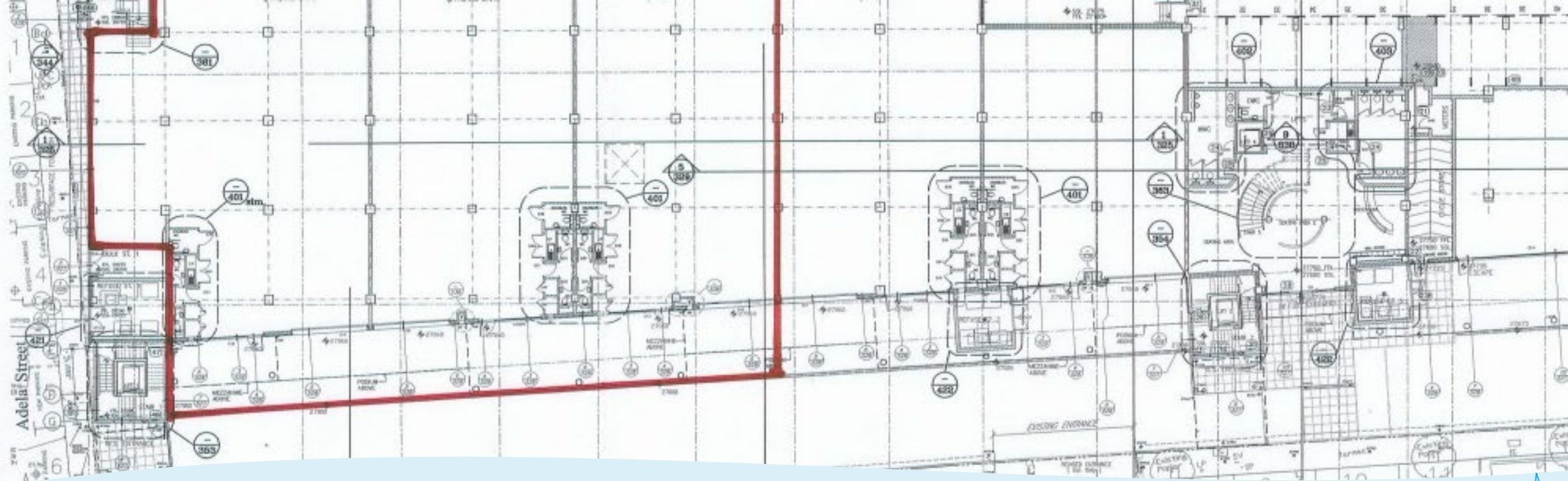
Helps locate, map, and document archaeological sites.



SURVEYING APPLICATIONS

Land Survey - Hydrographic

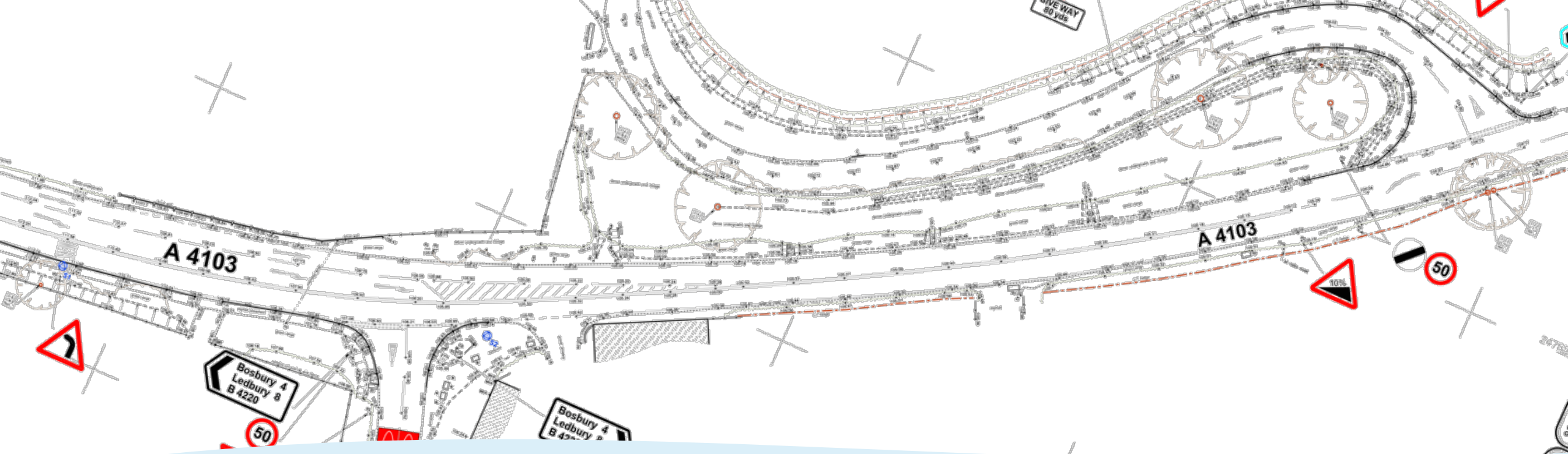
Focuses on mapping bodies of water, including oceans, rivers, lakes, and harbours.



Engineering Surveys - Construction

SURVEYING APPLICATIONS

- *Ensures that construction projects like buildings, roads, bridges, and tunnels are built in the correct location and according to design specifications.*



SURVEYING APPLICATIONS

Engineering Surveys - Route

- *Used in the planning and construction of linear projects such as roads, railways, pipelines, and canals.*



SURVEYING APPLICATIONS

Engineering Surveys - Mining

- *Specifically related to mining operations, this type involves surveying surface and underground mine workings to guide tunnelling and extraction*



SURVEYING APPLICATIONS

Building Survey

- *Assessing the condition, structure, and design of buildings.*
- *It covers both new construction and existing structures, ensuring that they meet regulatory standards and are safe for use.*

ACTIVITY

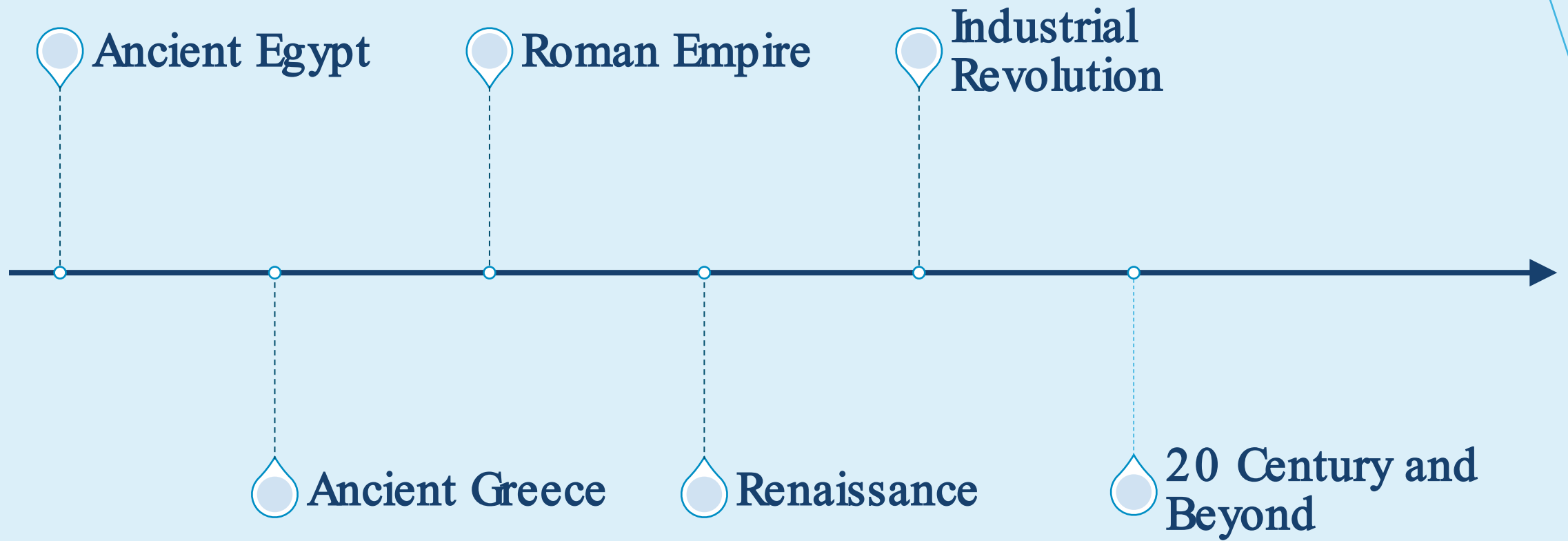


Task: Measure the dimensions of the room.



Instructions: Estimate the length, width, and height of the room.

HISTORY OF SURVEYING





ANCIENT EGYPT

One of the earliest uses of surveying was in ancient Egypt, where surveyors known as "rope stretchers" used simple geometry to re-establish land boundaries after the annual flooding of the Nile River.



ANCIENT GREECE

Greek scholars such as Thales and Pythagoras further developed geometric principles, laying the groundwork for more precise surveying techniques.

The Greeks also invented the "dioptra," an early surveying instrument used for measuring angles.

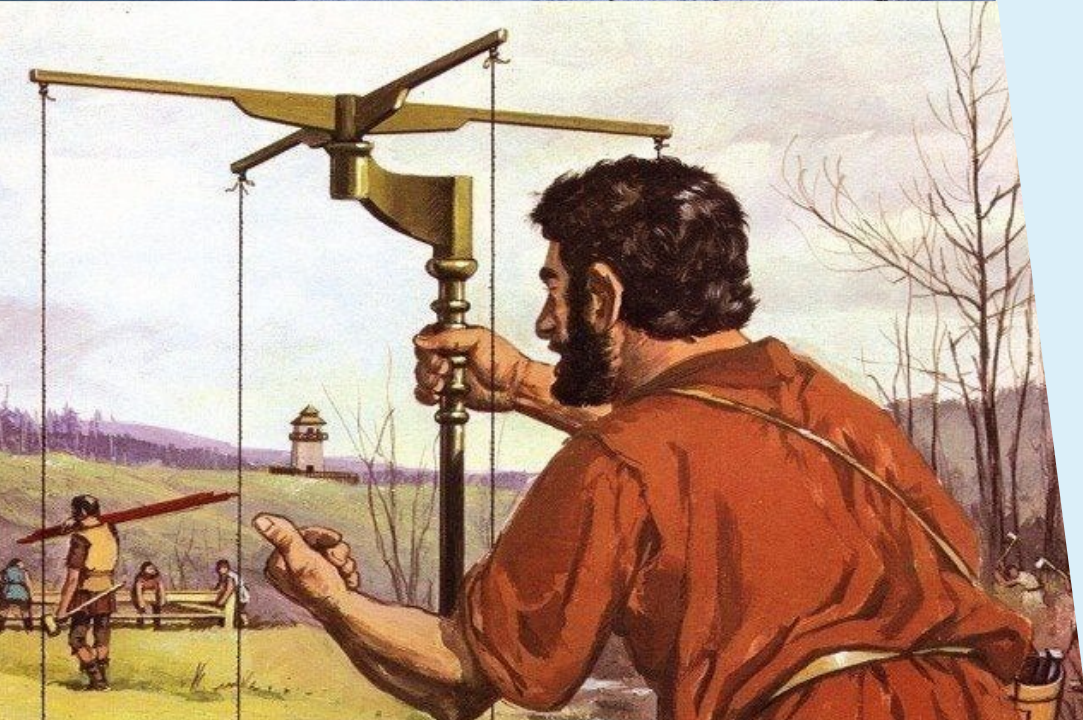




ROMAN EMPIRE

The Romans made significant advancements in surveying for the construction of their extensive road networks, aqueducts, and cities.

They used tools like the "groma" for establishing straight lines and right angles.





RENAISSANCE

During the Middle Ages, surveying techniques stagnated somewhat in Europe.

The Renaissance brought a renewed interest in science and mathematics, leading to the refinement of surveying instruments such as the theodolite.





INDUSTRIAL REVOLUTION

This period saw significant advancements in surveying tools and techniques.

In the 18th century, the development of triangulation allowed surveyors to map large areas accurately.

The establishment of national mapping agencies, such as the Ordnance Survey in the UK, led to the creation of detailed and standardised maps





20TH CENTURY AND BEYOND

*The 20th century brought technological
innovations*

*These advancements make it possible to
measure and map structures with
unprecedented speed and precision.*

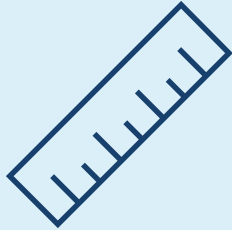


SURVEYING EQUIPMENT

SURVEYING EQUIPMENT

DISTANCE

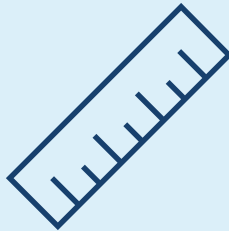
- The horizontal distance between two points.



SURVEYING EQUIPMENT

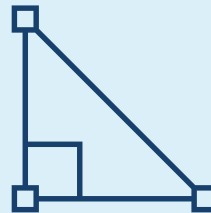
DISTANCE

- The horizontal distance between two points.



ANGLE

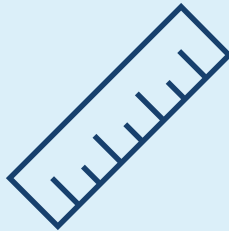
- The horizontal and vertical angles between points.



SURVEYING EQUIPMENT

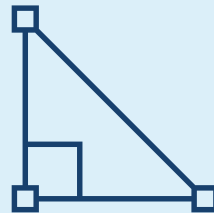
DISTANCE

- The horizontal distance between two points.



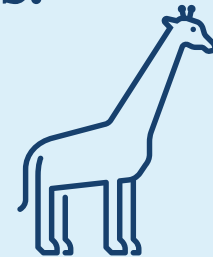
ANGLE

- The horizontal and vertical angles between points.



ELEVATION

- The height difference between points.



SURVEYING EQUIPMENT

Survey Tape

- Flexible, graduated measuring tool used to measure distances.





SURVEYING EQUIPMENT

Pacing

- **Method used to estimate distances by counting the number of steps, or paces, taken while walking over a distance.**



SURVEYING EQUIPMENT

Measuring Wheel

- A tool used in surveying to measure distances by rolling it along the ground.
- The wheel's circumference is known, and as it rolls, it counts the number of revolutions to determine the distance travelled.



SURVEYING EQUIPMENT

Surveyor's Chain

- A traditional measuring tool used in land surveying to measure distances.
- It consists of a series of metal links connected, typically 100 or 66 feet long, depending on the type of chain.

SURVEYING EQUIPMENT

Electronic Distance Measurement

- A technology used in surveying to accurately measure distances between points using electromagnetic waves, typically laser or infrared light.



SURVEYING EQUIPMENT

Dumpy Level

- **An optical surveying instrument used to establish or check horizontal levels and transfer elevations over long distances.**
- **It is commonly used in construction and civil engineering to ensure structures are level and aligned.**



SURVEYING EQUIPMENT

Automatic Level

- Like a dumpy level but with a built-in compensating device, usually based on a pendulum system to correct for residual misalignment.

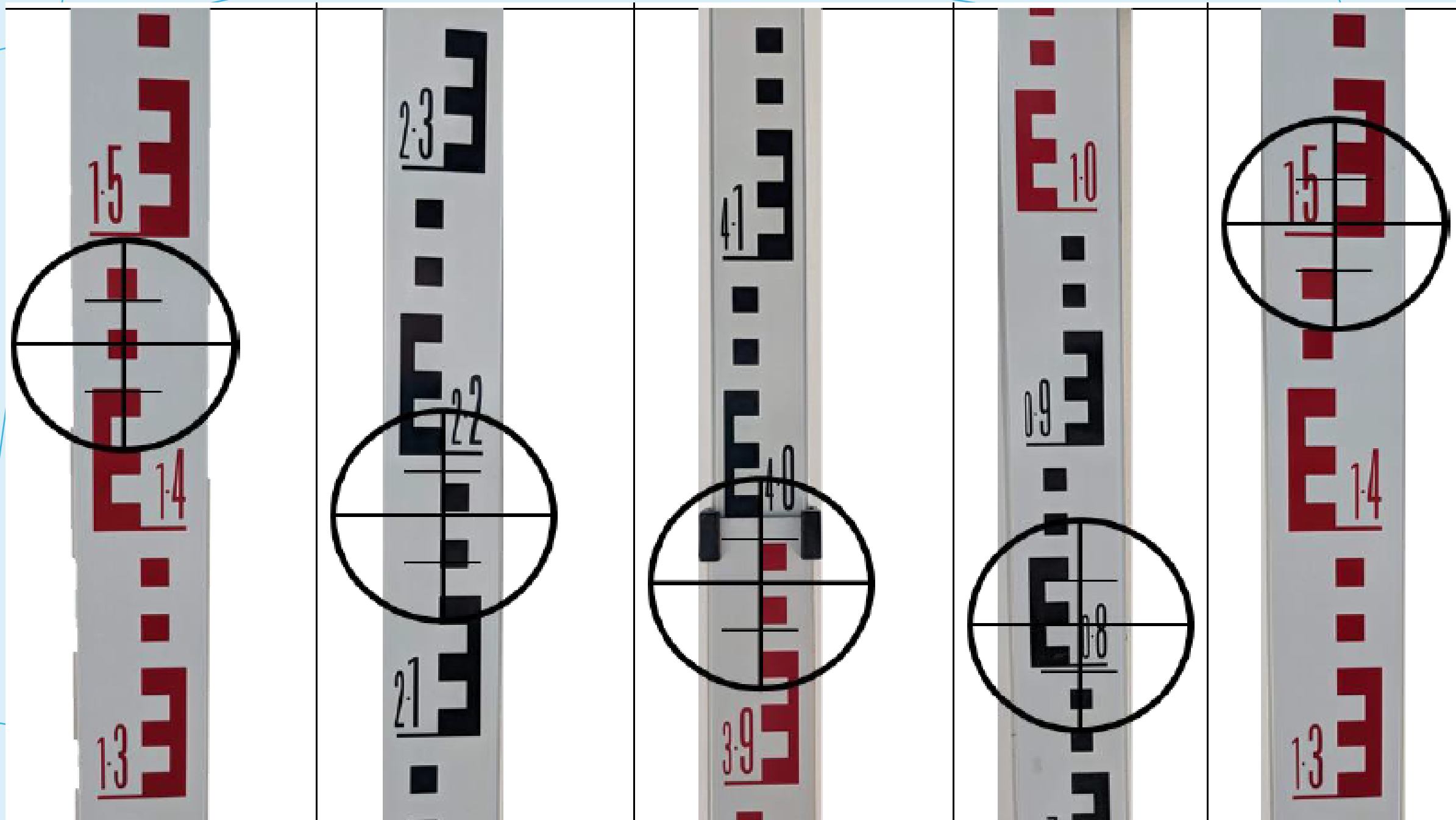


SURVEYING EQUIPMENT

Levelling Staff

- A graduated rod used in conjunction with levelling instruments like a dumpy level or an automatic level to measure vertical distances (elevations) during surveying





SURVEYING EQUIPMENT

Laser Level

- An instrument that uses a laser beam to project a perfectly horizontal (or sometimes vertical) reference line or plane over a long distance.



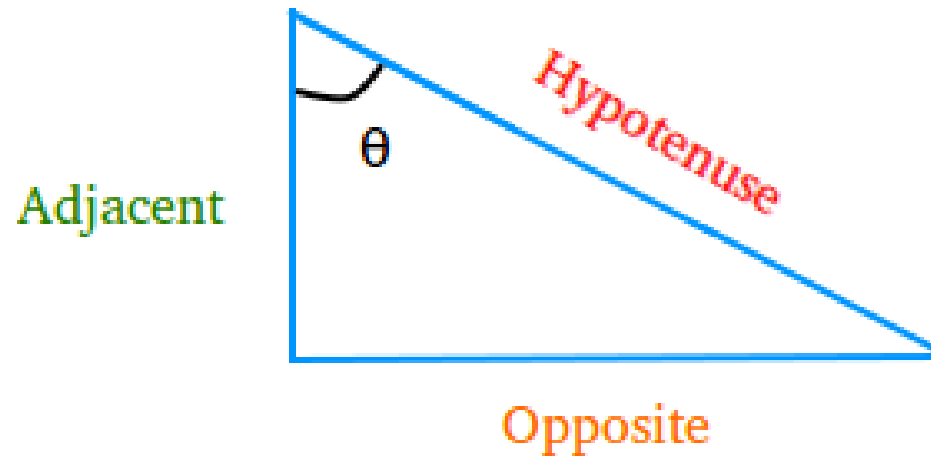


SURVEYING EQUIPMENT

Theodolite

- A theodolite is a precision instrument used in surveying to measure both horizontal and vertical angles between points on the Earth's surface.

TRIGONOMETRY



$$\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \quad \cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$$

$$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}}$$



SURVEYING EQUIPMENT

Total Station

- A total station is a surveying instrument that combines a theodolite and an electronic distance measuring device to provide precise measurements of distances and angles

A red surveying prism with yellow reflective markings is mounted on a green and blue surveying instrument, which is placed on a blue and yellow tripod. The background is a blurred green field.

SURVEYING EQUIPMENT

Surveying Prism

- A reflective device used in conjunction with total stations and other surveying instruments to accurately measure angles and distances.
- The prism reflects light (often from a laser) back to the instrument, allowing for precise positioning and measurement.

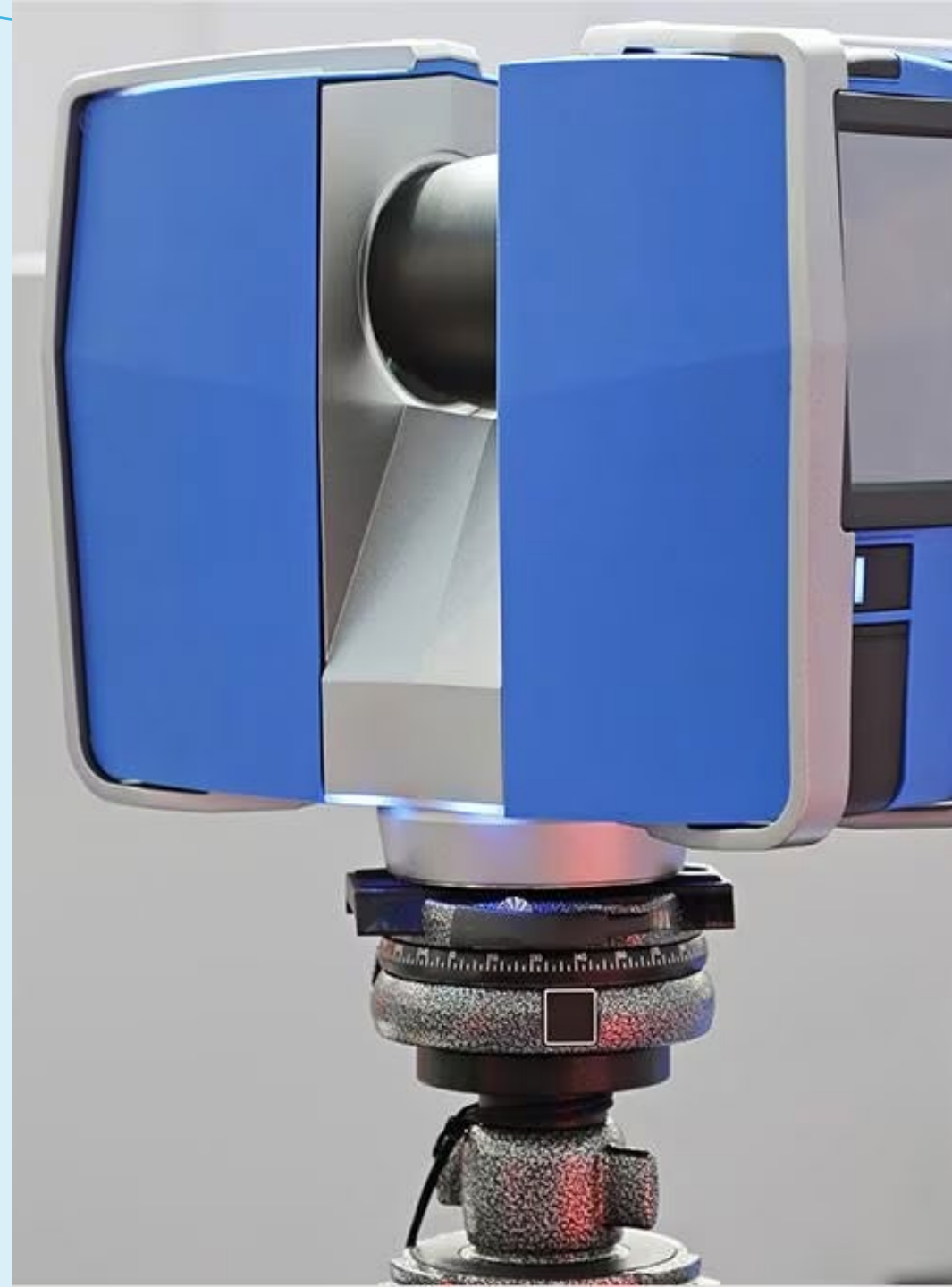
SURVEYING EQUIPMENT

GNSS



SURVEYING EQUIPMENT

Terrestrial Laser Scanner



SURVEYING EQUIPMENT

Thermography



SURVEYING EQUIPMENT

Drones



SURVEYING EQUIPMENT

Robotics

