





Measurement of Existing Buildings

- If plans of the existing buildings are not available a detailed survey will be necessary.

Measurement of Existing Buildings

- If plans of the existing buildings are not available a detailed survey will be necessary.
- The basic principle of measuring existing buildings is easy to learn, but accuracy is essential.

Measurement of Existing Buildings

- If plans of the existing buildings are not available a detailed survey will be necessary.
- The basic principle of measuring existing buildings is easy to learn, but accuracy is essential.
- A small error in the measurement of an existing building can cause a great deal of trouble when setting out, so care is necessary in taking and checking dimensions in order to give reliable results.

Sketching

- On arrival at the premises make a sketch of each of the floors of the building.

Sketching



Drawings are for illustrative purposes only.
Produced using Elmhurst Sketch 3.15.4w

Internal Measurements

- When sketches of all floors have been completed the measuring can begin.

Internal Measurements

- When sketches of all floors have been completed the measuring can begin.
- It is better to measure the building in a set pattern to avoid omitting important dimensions.

Internal Measurements

- Measure along walls and partitions on the plaster face including door and window openings and piers etc.

Internal Measurements

- Measure along walls and partitions on the plaster face including door and window openings and piers etc.
- 'Running' dimensions should be taken; it is more accurate and saves time.

Internal Measurements

- Measure along walls and partitions on the plaster face including door and window openings and piers etc.
- 'Running' dimensions should be taken; it is more accurate and saves time.
- For example, a wall of a room 5 m long containing a 1 m wide door opening in the centre would not be measured in three separate dimensions 2 m, 1 m and 2 m.

Internal Measurements

- Measure along walls and partitions on the plaster face including door and window openings and piers etc.
- 'Running' dimensions should be taken; it is more accurate and saves time.
- For example, a wall of a room 5 m long containing a 1 m wide door opening in the centre would not be measured in three separate dimensions 2 m, 1 m and 2 m.
- By using one length of tape the dimensions are booked 2 m, 3 m and 5 m.

Internal Measurements

- Measure along walls and partitions on the plaster face including door and window openings and piers etc.
- 'Running' dimensions should be taken; it is more accurate and saves time.
- For example, a wall of a room 5 m long containing a 1 m wide door opening in the centre would not be measured in three separate dimensions 2 m, 1 m and 2 m.
- By using one length of tape the dimensions are booked 2 m, 3 m and 5 m.
- When booking running dimensions each figure should be booked near the end of the length to which it refers.

Internal Measurements

- The thickness of walls and partitions should be obtained at door openings, making an allowance for any rendering or plaster.

Internal Measurements

- The thickness of walls and partitions should be obtained at door openings, making an allowance for any rendering or plaster.
- In old buildings plaster finishes are about 20 mm thick, but in modern buildings they are usually about 13 mm thick.

Internal Measurements

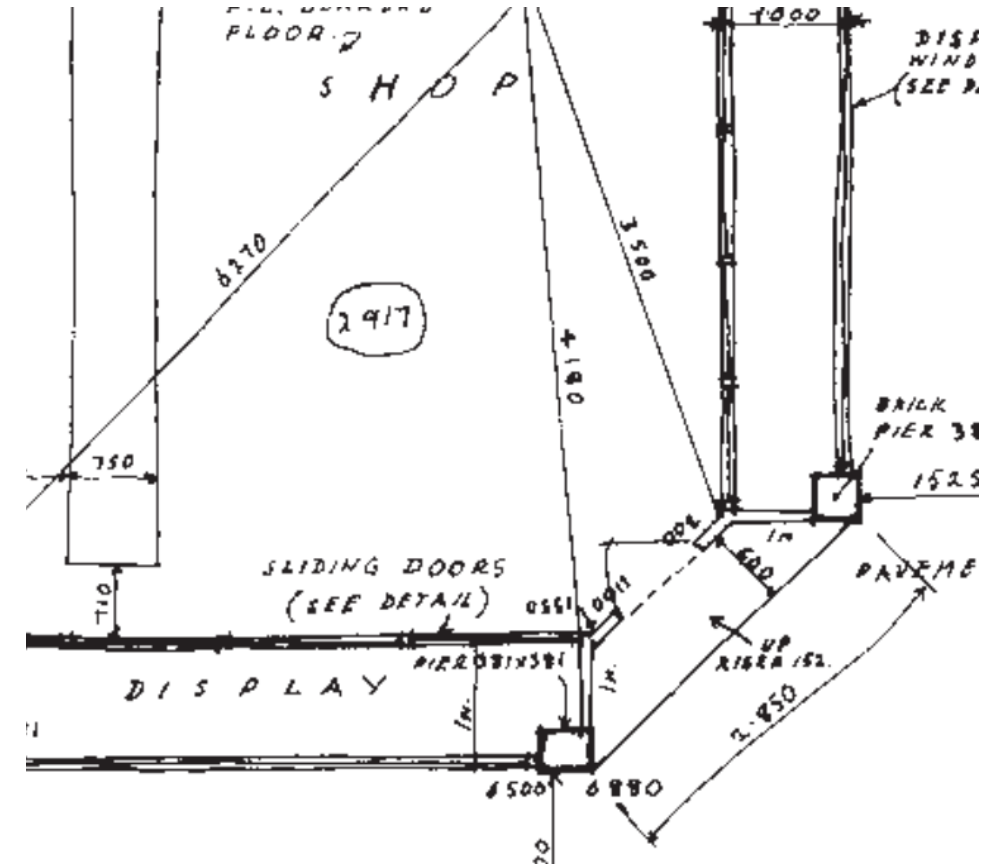
- The thickness of walls and partitions should be obtained at door openings, making an allowance for any rendering or plaster.
- In old buildings plaster finishes are about 20 mm thick, but in modern buildings they are usually about 13 mm thick.
- Where it is difficult to obtain the thickness of a partition by either of this method it will have to be calculated by deducting the sum of all the internal dimensions from the overall external dimensions

Internal Measurements

- The thickness of walls and partitions should be obtained at door openings, making an allowance for any rendering or plaster.
- In old buildings plaster finishes are about 20 mm thick, but in modern buildings they are usually about 13 mm thick.
- Where it is difficult to obtain the thickness of a partition by either of this method it will have to be calculated by deducting the sum of all the internal dimensions from the overall external dimensions
- The difference is the thickness of the partition required. However, if the thickness of two partitions is required, the difference will give the total thickness which will have to be divided between the two partitions.

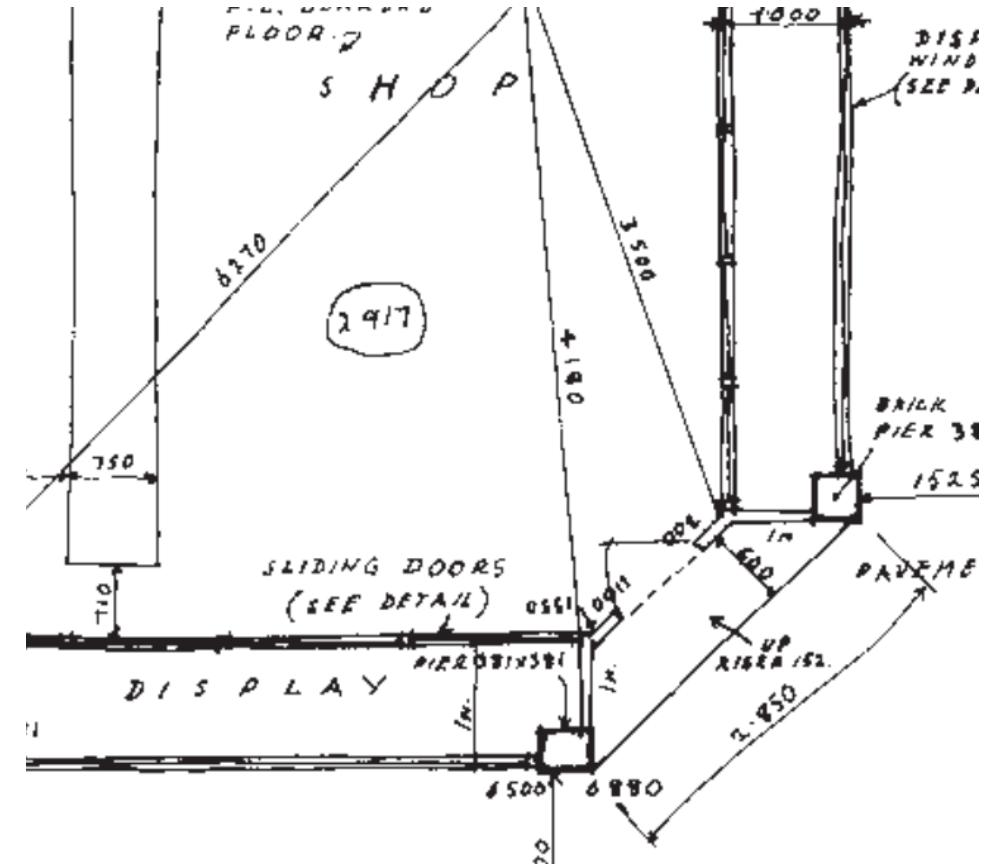
Internal Measurements

- In old buildings, floor to ceiling heights are often found to vary. The heights can be booked in the centre of the room and enclosed in a circle.



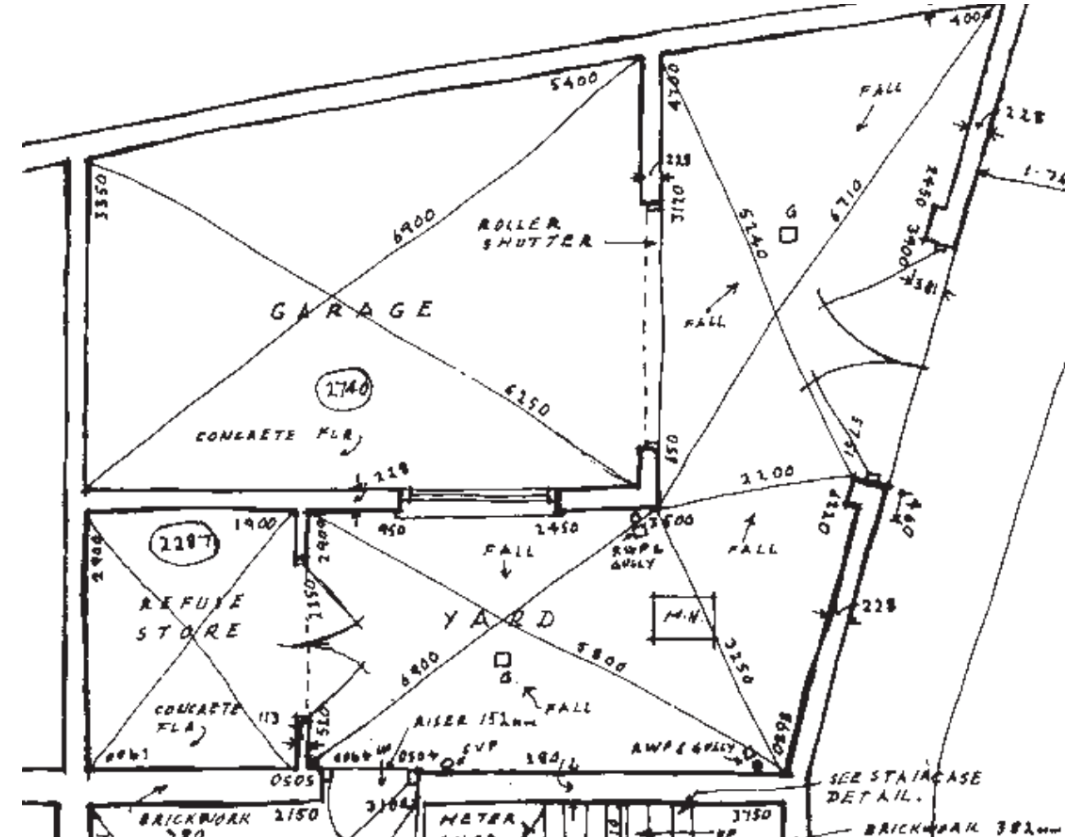
Internal Measurements

- In old buildings, floor to ceiling heights are often found to vary. The heights can be booked in the centre of the room and enclosed in a circle.
- It is often difficult to take the height of a room against the wall where there is a large moulded cornice



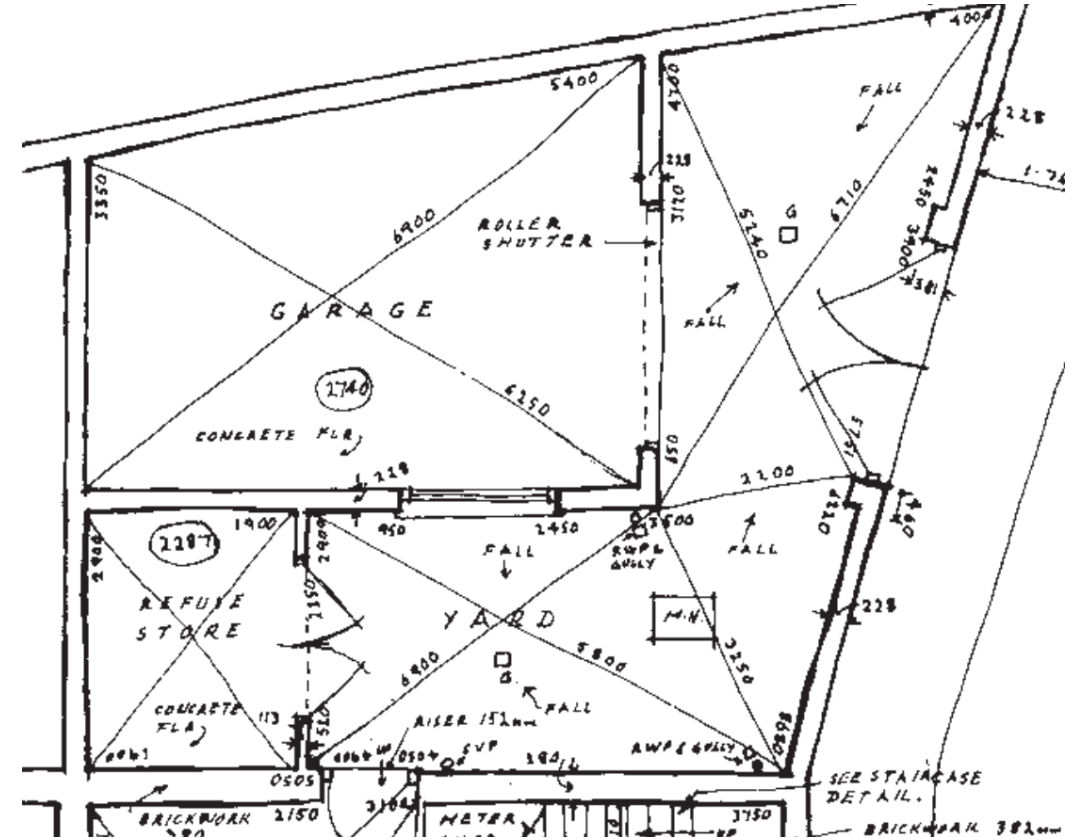
Internal Measurements

- It cannot be assumed that all rooms are rectangular especially in old buildings. If rooms are irregular in plan, they are measured by taking diagonals across the room.



Internal Measurements

- It cannot be assumed that all rooms are rectangular especially in old buildings. If rooms are irregular in plan, they are measured by taking diagonals across the room.
- It may appear that one diagonal is all that is necessary, but in practice it is wiser to take several as a check.



Internal Measurements

- The floor thickness can be measured at staircase openings or lift wells.

Internal Measurements

- The floor thickness can be measured at staircase openings or lift wells.
- Variations in floor thicknesses will be revealed by corresponding variations in floor to ceiling heights below.

Internal Measurements

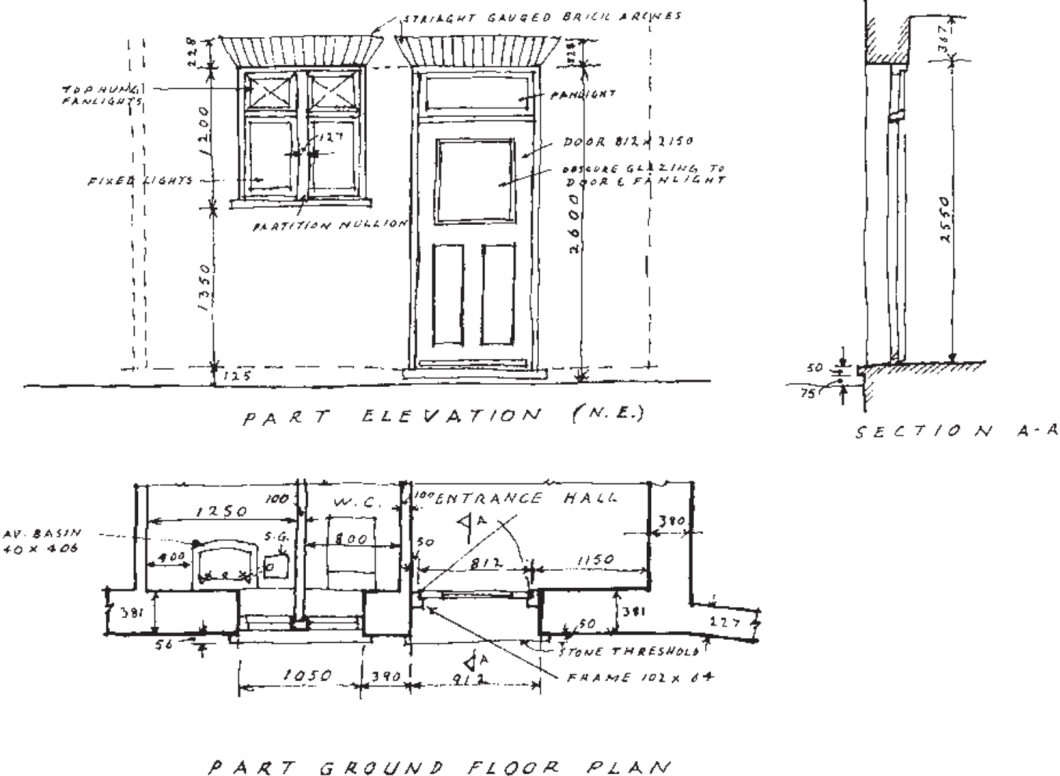
- The floor thickness can be measured at staircase openings or lift wells.
- Variations in floor thicknesses will be revealed by corresponding variations in floor to ceiling heights below.
- To obtain the exact size of floor joists and their condition, one or two boards should be removed.

Internal Measurements

- The heights of external door and window openings are not always required, but if alterations are contemplated they are essential if sections through the building are to be drawn.

Internal Measurements

- The heights of external door and window openings are not always required, but if alterations are contemplated they are essential if sections through the building are to be drawn.
- The survey sketches should show the plan and elevation of the window or door, and the dimensions must clearly indicate where they are taken; edge of frame, architrave or brickwork.

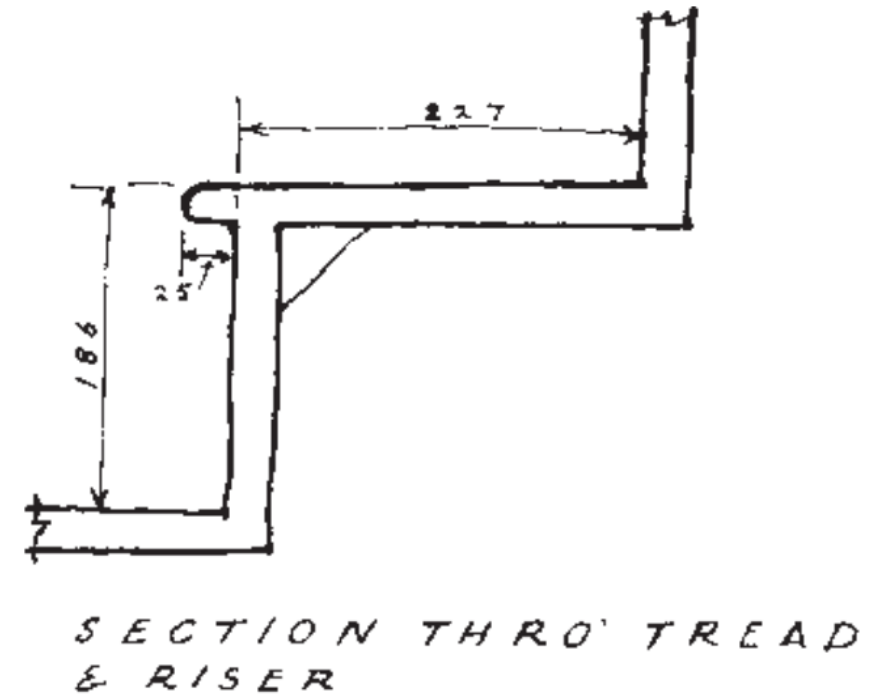


Internal Measurements

- Staircases are usually drawn on both floor plans, the foot being shown on the lower floor and the head on the upper.

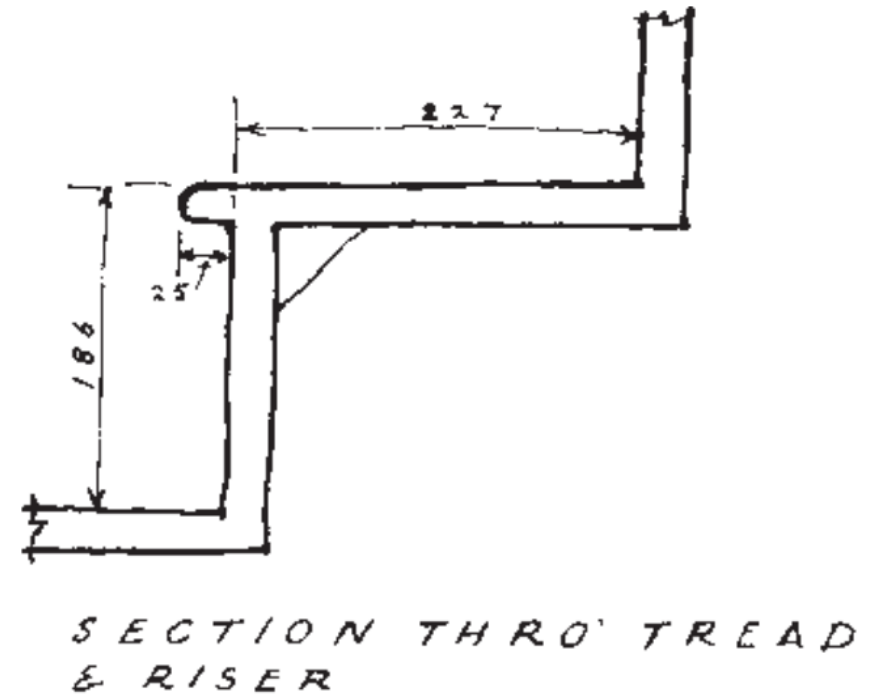
Internal Measurements

- Staircases are usually drawn on both floor plans, the foot being shown on the lower floor and the head on the upper.
- It is usual to measure the treads from the face of the lower riser to the face of the top riser. Enter this dimension with the number of treads on the survey sketch.



Internal Measurements

- Staircases are usually drawn on both floor plans, the foot being shown on the lower floor and the head on the upper.
- It is usual to measure the treads from the face of the lower riser to the face of the top riser. Enter this dimension with the number of treads on the survey sketch.
- The risers are similarly measured from tread to tread



Internal Measurements

- The survey of a pitched roof can be divided into two parts, the interior and the exterior. When measurements have been completed on the top floor it is logical to continue into the roof space by way of the loft hatch, not forgetting to mark the position of the loft hatch on the top floor plan.

Internal Measurements

- The survey of a pitched roof can be divided into two parts, the interior and the exterior. When measurements have been completed on the top floor it is logical to continue into the roof space by way of the loft hatch, not forgetting to mark the position of the loft hatch on the top floor plan.
- Measurements should be taken from ceiling joists to ridge together with sizes, position and direction of all the structural timbers.

Internal Measurements

- The survey of a pitched roof can be divided into two parts, the interior and the exterior. When measurements have been completed on the top floor it is logical to continue into the roof space by way of the loft hatch, not forgetting to mark the position of the loft hatch on the top floor plan.
- Measurements should be taken from ceiling joists to ridge together with sizes, position and direction of all the structural timbers.
- Whilst in the roof space ascertain the position and size of any water storage tanks or feed tanks.

External Measurements

- When all the internal measuring is completed, the external measurements can be taken. The horizontal dimensions can be booked on the floor plans.

External Measurements

- When all the internal measuring is completed, the external measurements can be taken. The horizontal dimensions can be booked on the floor plans.
- Carefully sketch all elevations and measure the widths and heights of all openings; note the position of rainwater and soil pipes, and their size and material.

External Measurements

- If difficulties are encountered when measuring external heights, this can be overcome in brick faced buildings by counting the brick courses.



External Measurements

- If difficulties are encountered when measuring external heights, this can be overcome in brick faced buildings by counting the brick courses.
- Alternatively, a photo could be taken of the building with an item of known scale and sizes can be calculated from this at a later stage.



External Measurements

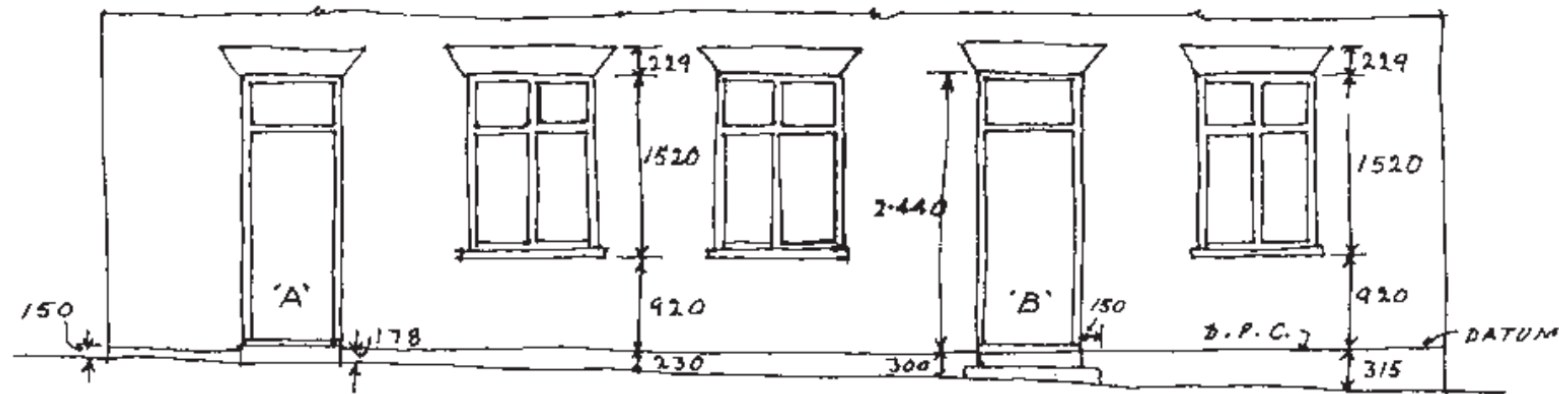
- If no levelling has been done along the face of each external wall, the ground line of each elevation should be taken from a constant datum, such as a damp course line or top of a plinth.

External Measurements

- If no levelling has been done along the face of each external wall, the ground line of each elevation should be taken from a constant datum, such as a damp course line or top of a plinth.
- Measurements can then be taken from this line down to the ground level at appropriate points along each elevation.

External Measurements

- Heights of window sills and heads can also be related to this line.



External Measurements

- If alterations or additions are proposed which involve alterations to the drainage system, it will be necessary to plot the positions, sizes and depths of inspection chambers, gullies and drain runs together with the positions of rainwater and waste pipes.

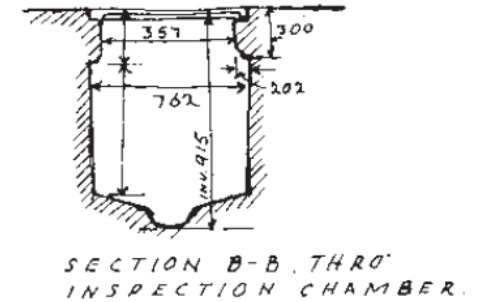
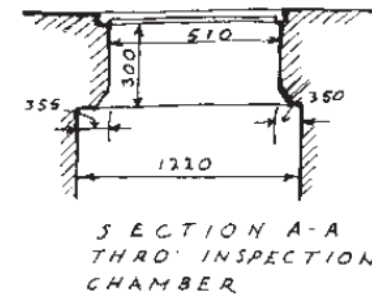
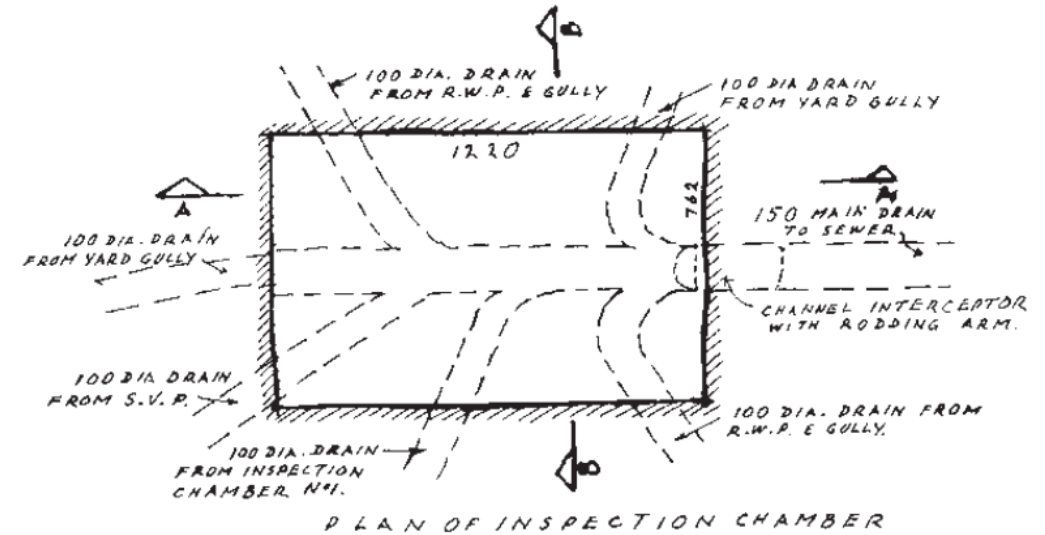
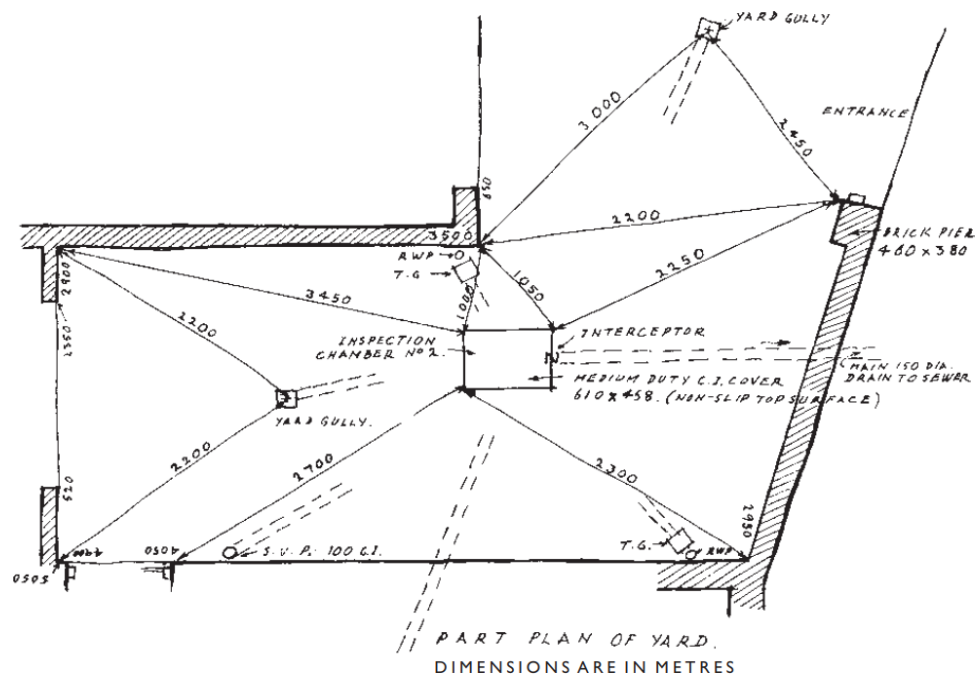
External Measurements

- If alterations or additions are proposed which involve alterations to the drainage system, it will be necessary to plot the positions, sizes and depths of inspection chambers, gullies and drain runs together with the positions of rainwater and waste pipes.
- Inspection chamber positions can be established by taking measurements to suitable points on the external or boundary walls of the building.

External Measurements

- If alterations or additions are proposed which involve alterations to the drainage system, it will be necessary to plot the positions, sizes and depths of inspection chambers, gullies and drain runs together with the positions of rainwater and waste pipes.
- Inspection chamber positions can be established by taking measurements to suitable points on the external or boundary walls of the building.
- The inspection chamber cover should be removed and the internal measurements of the chamber taken, together with the depth from cover to invert and the position and size of all pipe runs.

External Measurements



Sketching

- On arrival at the premises make a sketch of each of the floors of the building.
- Care should be taken not to overcrowd the sketch sheets

Gross External Area (GEA)

- Gross External Area is the area of a building measured externally at each floor level.

Gross Internal Area (GIA)

- Gross Internal Area is the area of a building measured to the internal face of the perimeter walls at each floor level.

Net Internal Area (NIA)

- Net Internal Area is the usable area within a building measured to the internal face of the perimeter walls at each floor level



Terrestrial Laser Scanning

Fundamentals of Terrestrial Laser Scanning



Basic Principles of Laser Scanning Technology

Laser Pulse Distance Measurement

Laser scanning measures distances by timing laser pulse reflections with high accuracy.

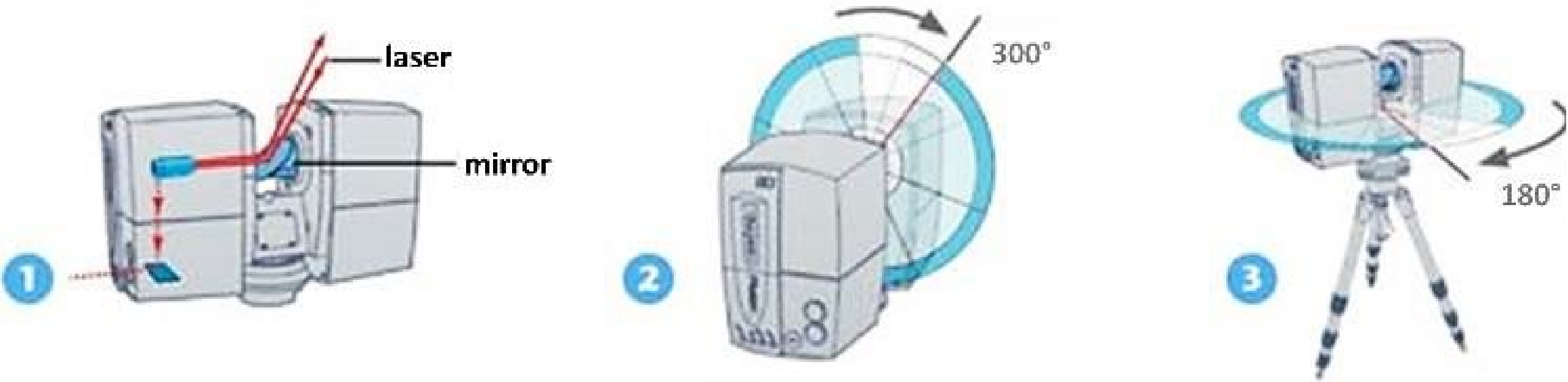


Basic Principles of Laser Scanning Technology

Laser Pulse Distance Measurement

Laser scanning measures distances by timing laser pulse reflections with high accuracy.

Components and Operation of Terrestrial Laser Scanners



Inertial Navigational System (INS)

- The solution for positioning and orientating the system whilst the laser scanner component is recording data is critical to the accuracy of the final output.
- The INS relies on blending information from Global Navigation Satellite Systems (GNSS) receivers and an Inertial Measurement Unit (IMU), to generate highly accurate positional and orientation estimates for the trajectory of the system, commonly referred to as SBET (Smoothed Best Estimate of Trajectory).
- This commonly involves the use of the latest GNSS base station technology to allow differential processing



Camera

- Most mobile LiDAR systems can be mounted with multiple cameras.
- These can collect imagery at various frame rates to ensure overlap and coverage of the area of interest.
- If cameras are used with systems that have an INS then the images can be precisely time-stamped using the onboard GNSS signal.



Types of Terrestrial Laser Scanners

Time-of-Flight Scanners

Measure distance by calculating the travel time of laser pulses, ideal for long-range scanning.

Phase-Shift Scanners

Use phase difference to determine distance, offering high accuracy in short to medium ranges.

Triangulation Scanners

Employ geometric triangulation for precise data in close-range and controlled environments.

Data Acquisition and Processing Workflow

Site Preparation and Scanner Setup

Optimal Scanner Location

Choose scanner locations that ensure clear line-of-sight and cover the entire target area effectively.



Site Preparation and Scanner Setup

Equipment Stability

Stabilise scanning equipment to prevent movement and ensure accurate data collection during operation.



Data Collection Techniques

Optimising Scanner Settings

Adjust scanner resolution and range to capture detailed and accurate data effectively.



Data Collection Techniques

Multiple Scan Positions

Use multiple scan angles to minimise obstructions and ensure comprehensive data coverage.

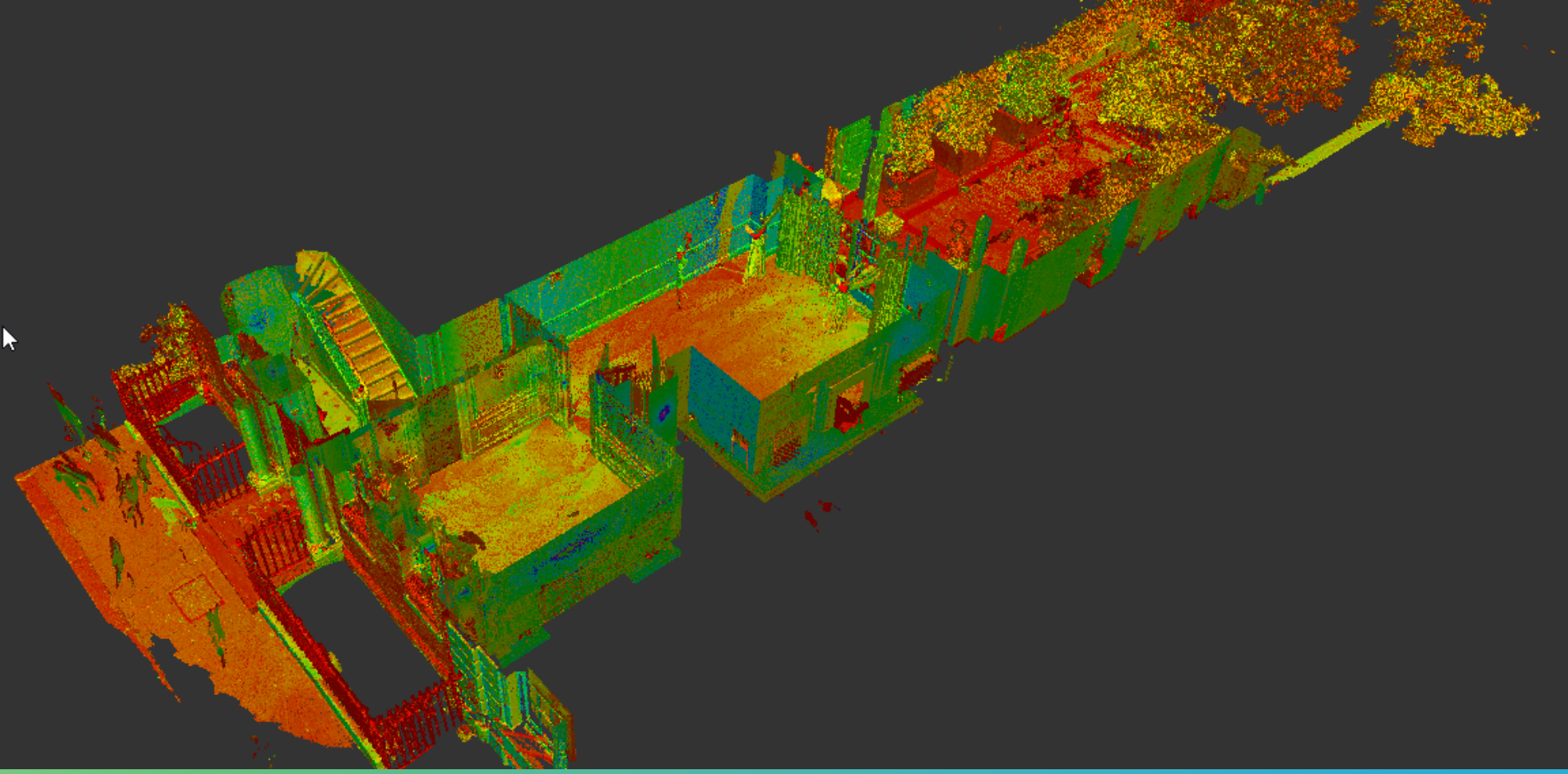


Data Collection Techniques

Multiple Scan Positions

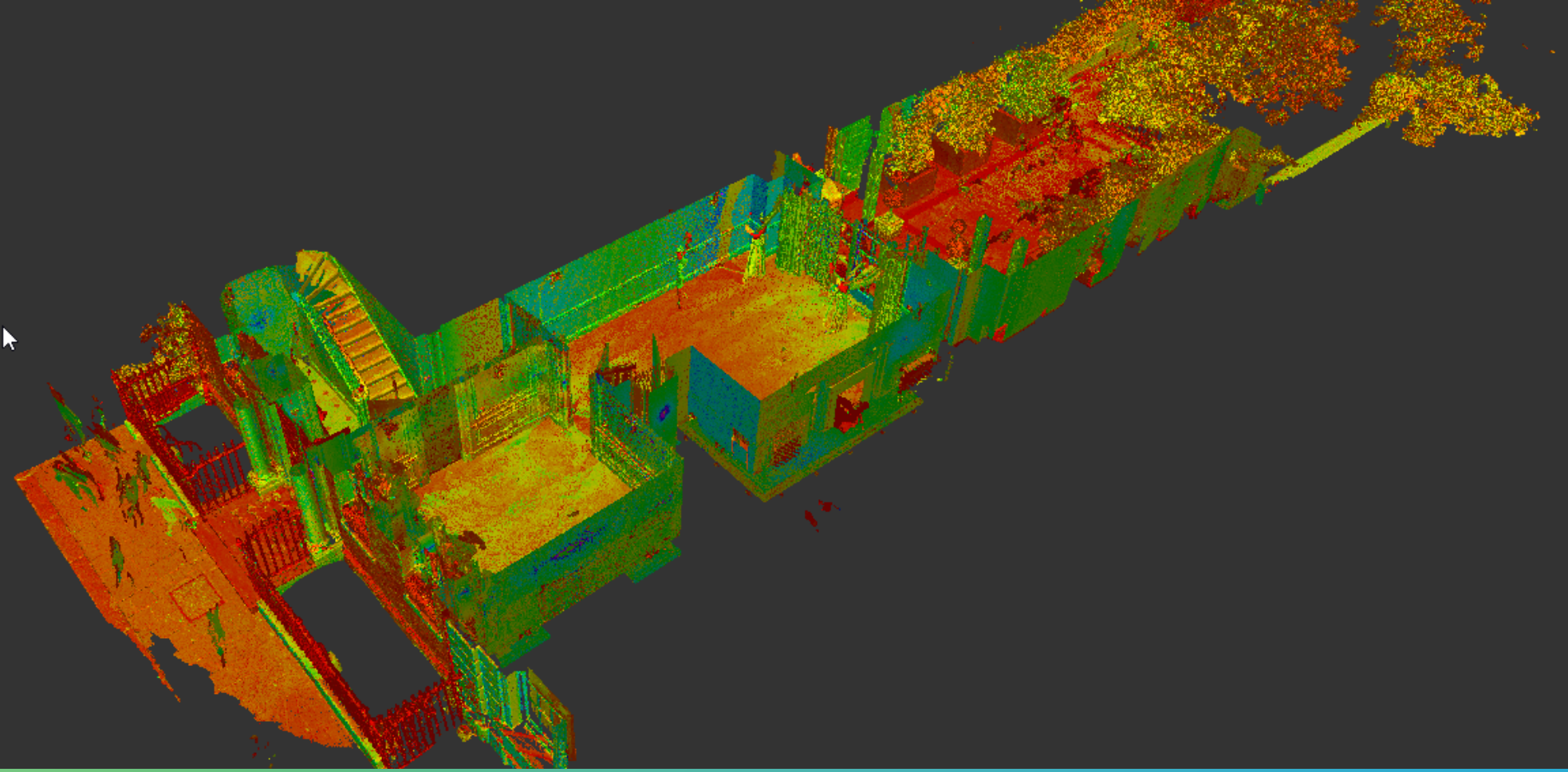
Use multiple scan angles to minimise obstructions and ensure comprehensive data coverage.





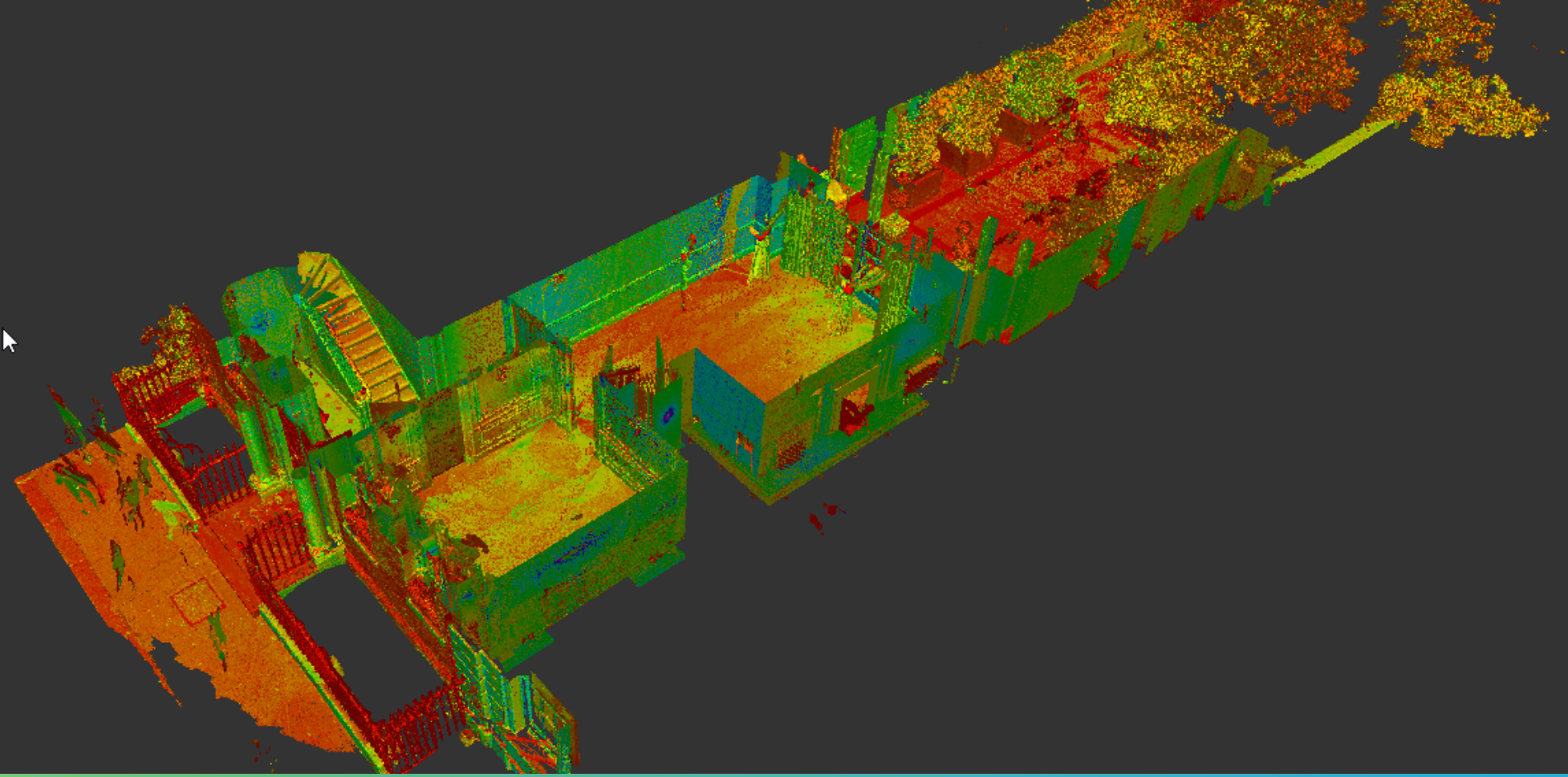
Point Cloud Generation

Raw scanned data is processed to generate a point cloud representing the surfaces of the scanned object or environment.



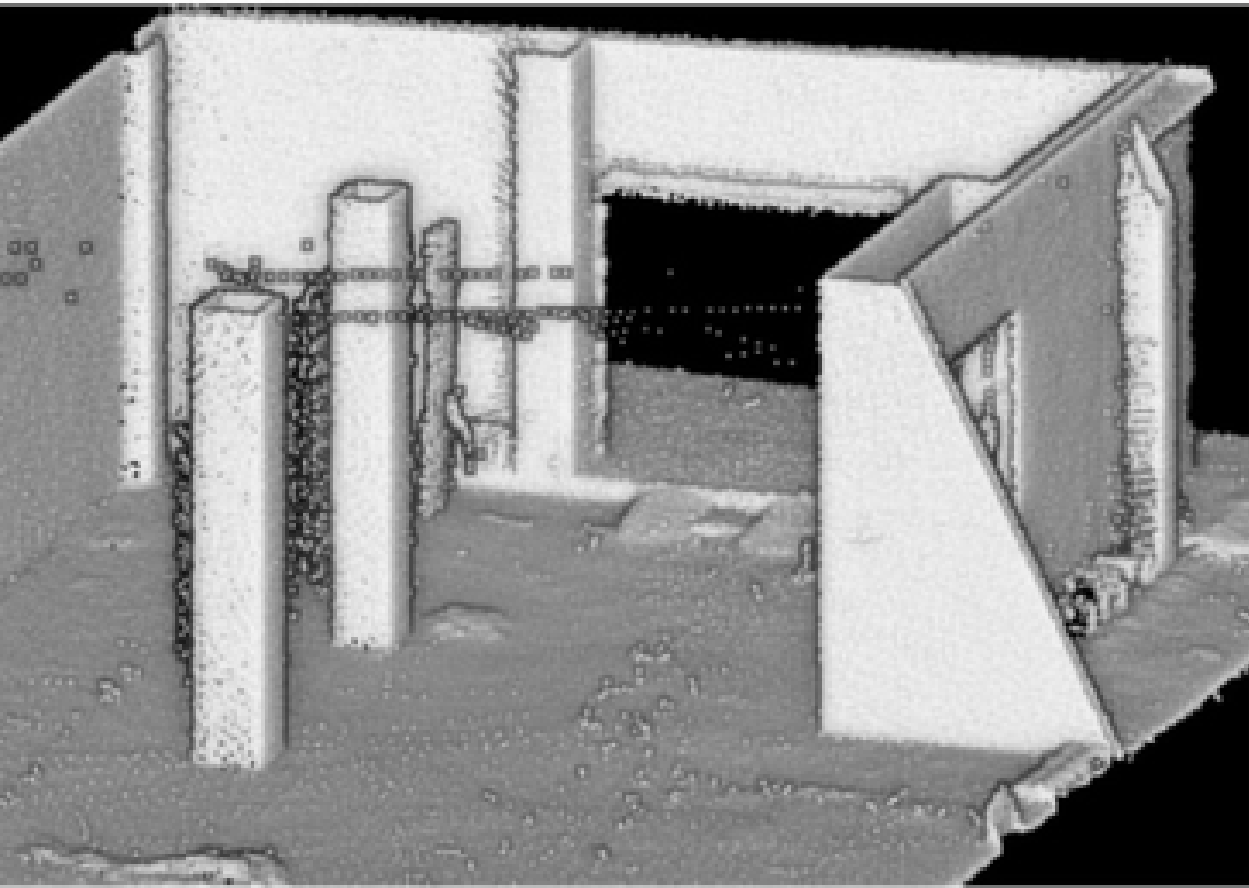
Point Cloud Generation

A point cloud is basically a big collection of tiny dots in 3D space, where each dot represents a specific point on the surface of an object or environment

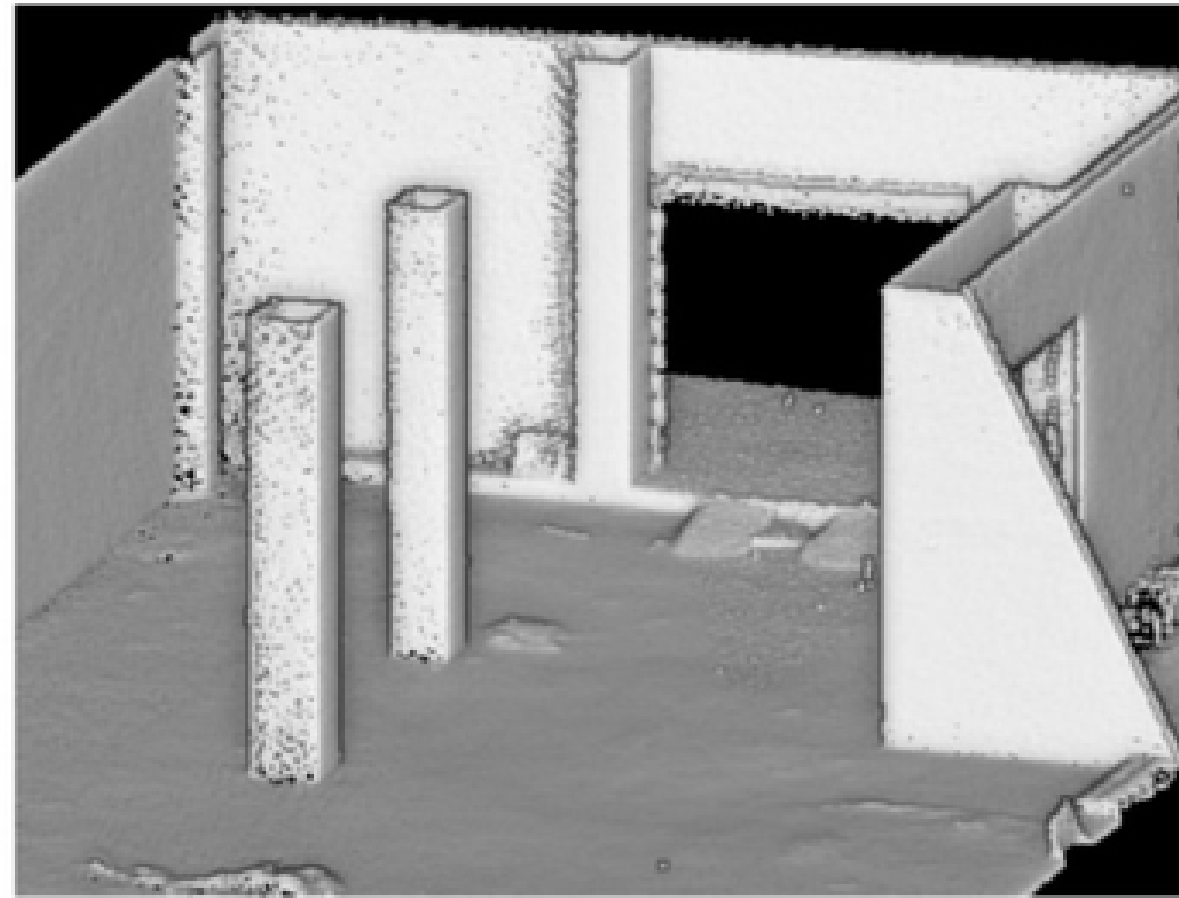


Point Cloud Generation

Each point comes with coordinates like (x, y, z)



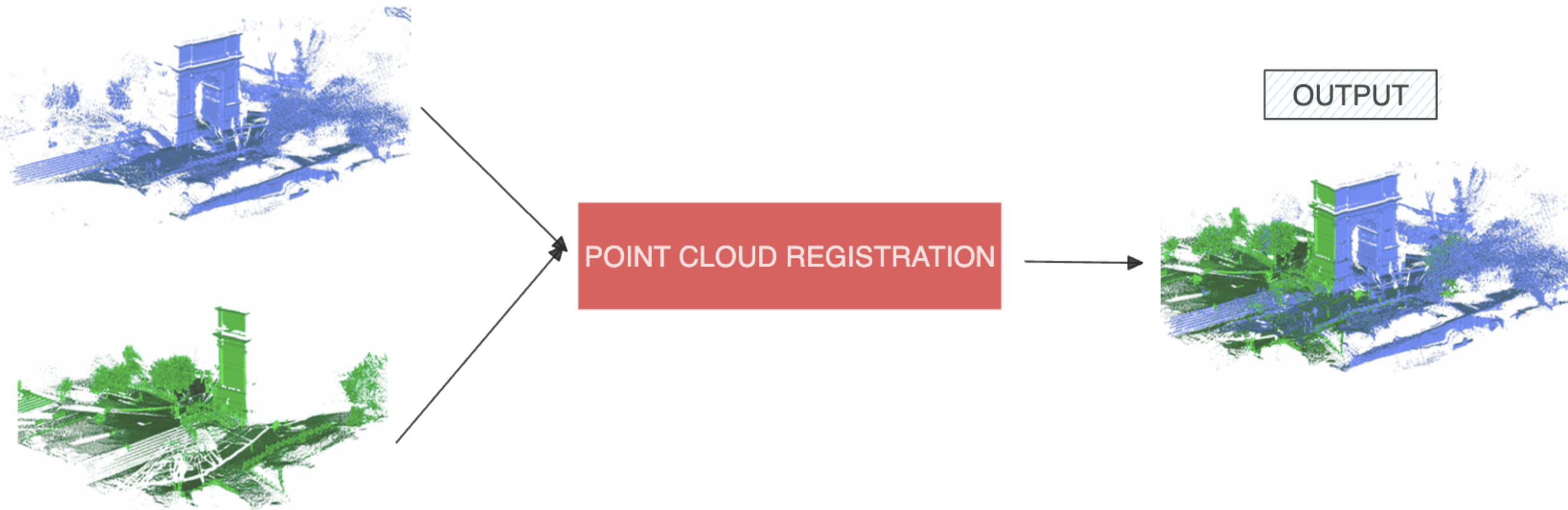
b)



Point Cloud Processing

Noise Filtering

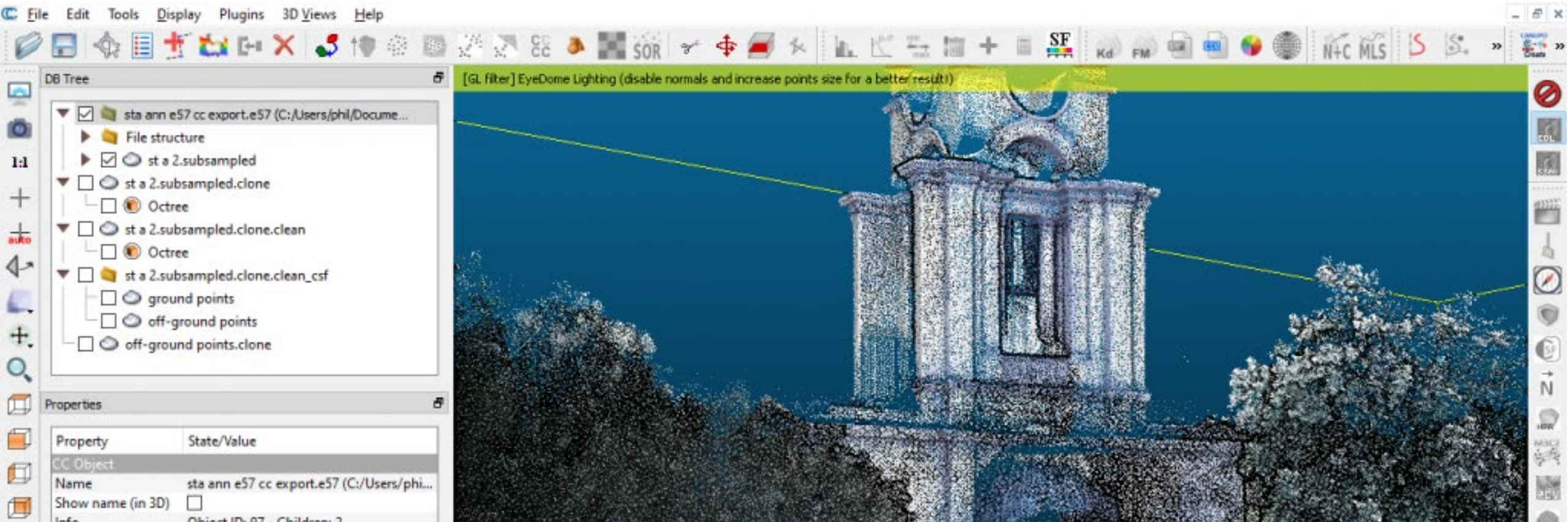
Noise is filtered from the raw data to enhance the accuracy and quality of the point cloud for better analysis.



Point Cloud Processing

Scan Alignment

Multiple scans are aligned and merged to create a comprehensive and continuous point cloud representation.

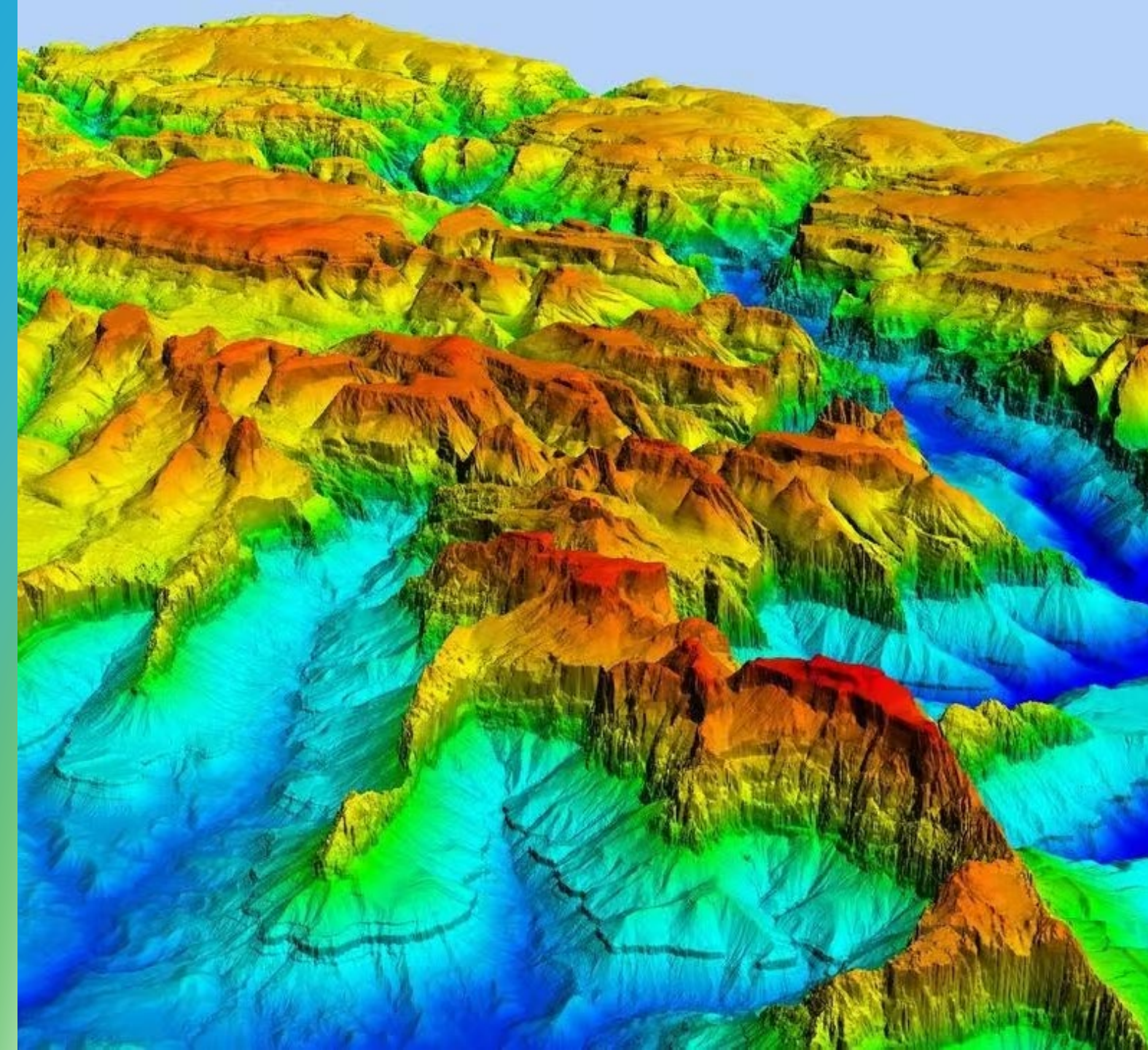


Point Cloud Processing

Data Conversion

Processed data is converted into usable formats compatible with analysis and visualisation tools.

Applications of Terrestrial Laser Scanning



Surveying and Topographic Mapping

- Rapid Topographic Mapping
- Accurate Land Surveying
- Detailed Terrain Models
- Environmental Change Monitoring

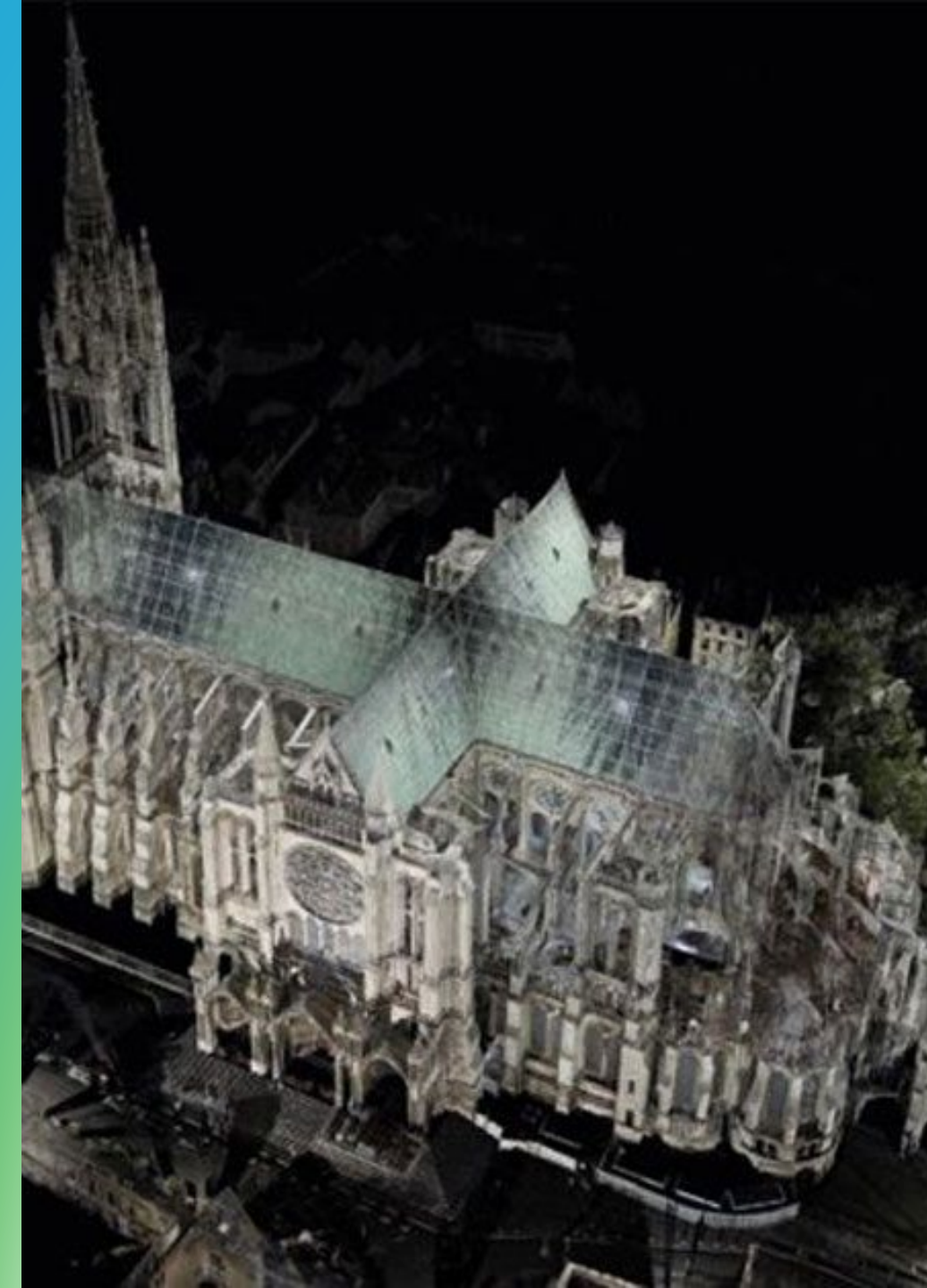


Architecture and Construction

- As-Built Documentation

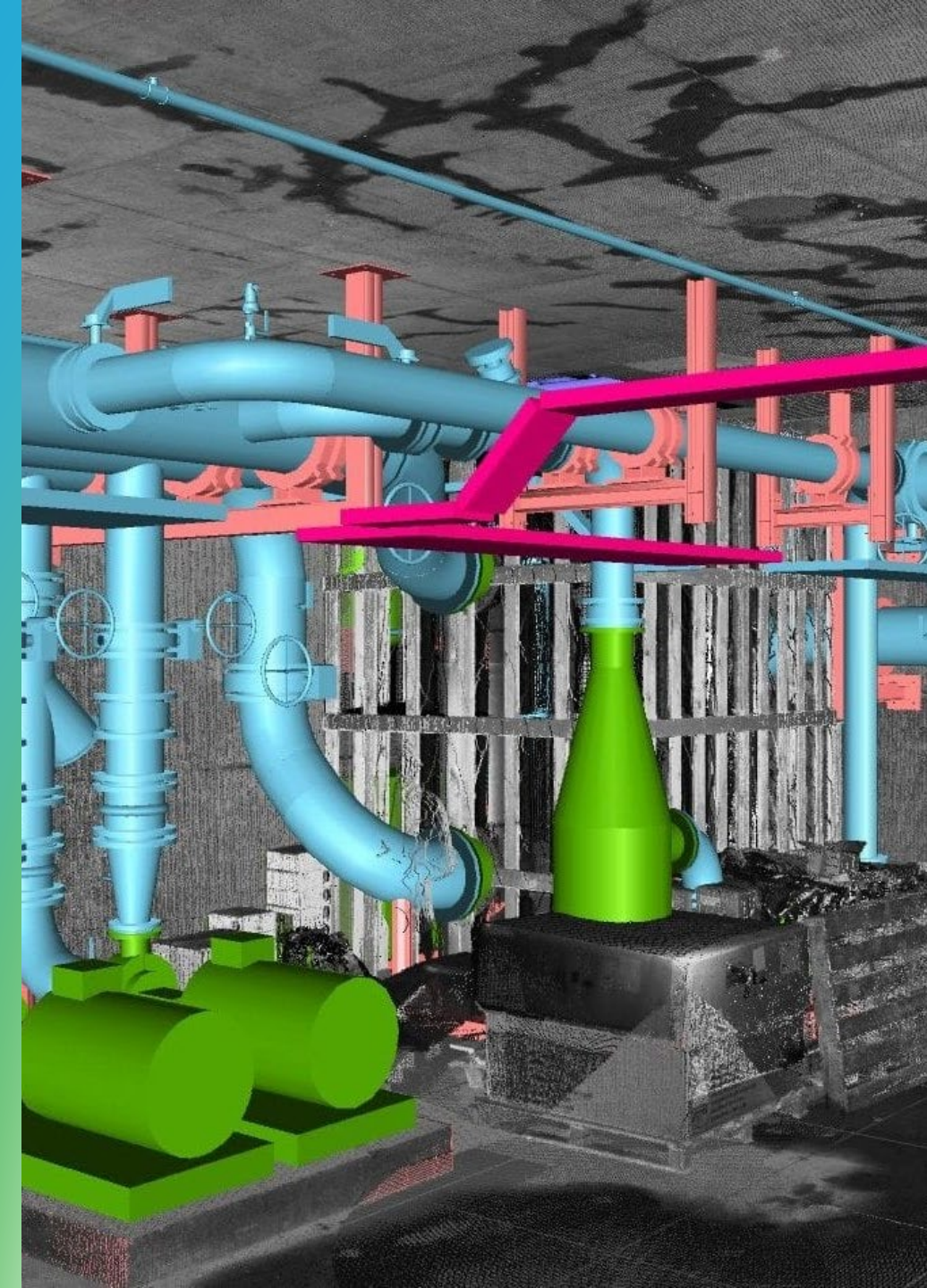
Architecture and Construction

- As-Built Documentation
- Heritage Preservation



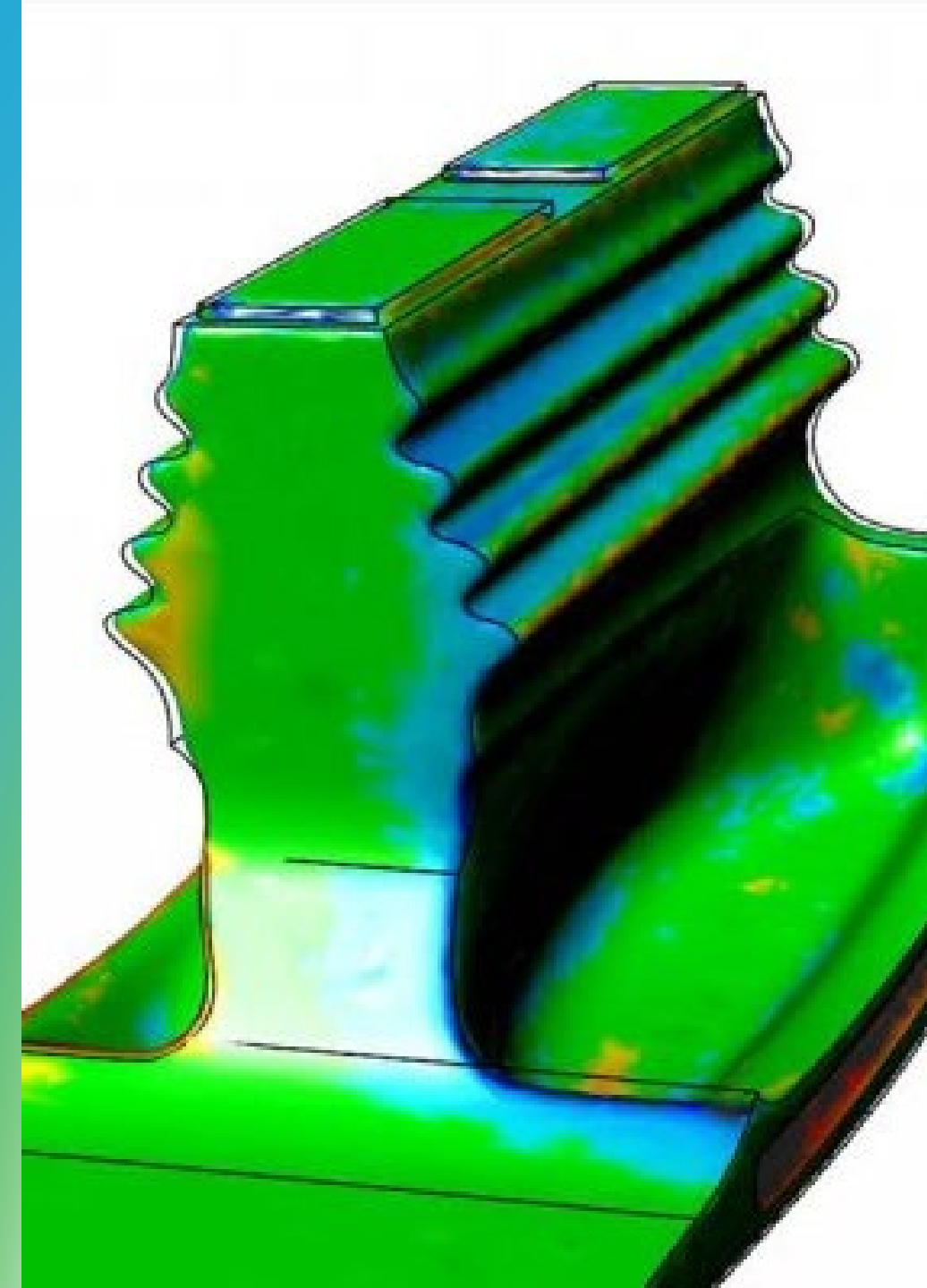
Architecture and Construction

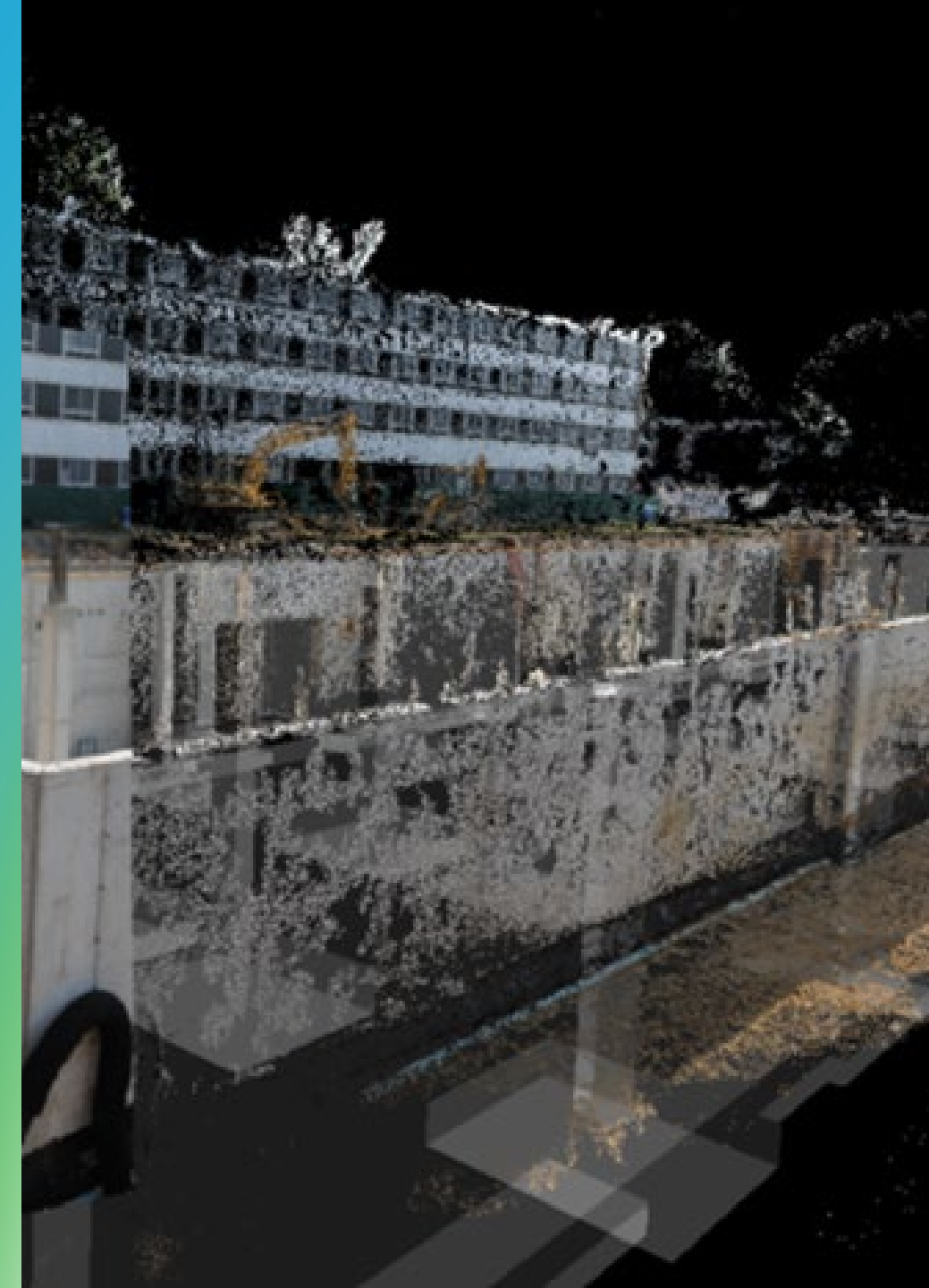
- As-Built Documentation
- Heritage Preservation
- Building Information Modelling



Architecture and Construction

- As-Built Documentation
- Heritage Preservation
- Building Information Modelling
- Quality Control & Deviation Checks





Architecture and Construction

- As-Built Documentation
- Heritage Preservation
- Building Information Modelling
- Quality Control & Deviation Checks
- Progress Monitoring



Architecture and Construction

- As-Built Documentation
- Heritage Preservation
- Building Information Modelling
- Quality Control & Deviation Checks
- Progress Monitoring
- Site planning & Logistics

Challenges and Limitations



Accuracy and Resolution

Scanner Resolution Impact

Higher scanner resolution improves accuracy by capturing finer details of the target surface.



Accuracy and Resolution

Distance to Target

Accuracy decreases as distance to the target increases due to signal dispersion and loss.



Accuracy and Resolution

Surface Properties

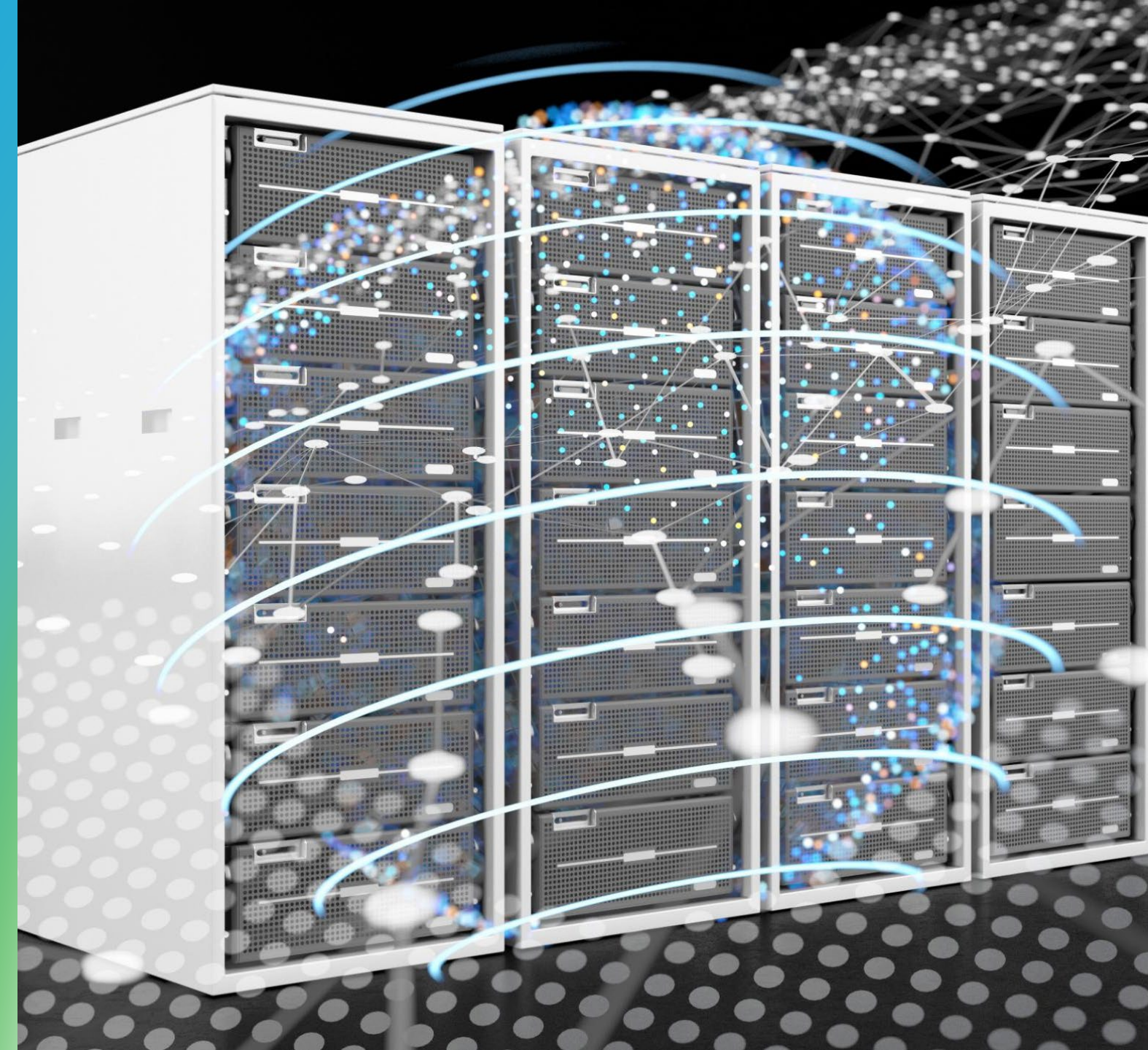
Reflectivity and texture of surfaces affect the scanner's ability to capture accurate data.



Accuracy and Resolution

Atmospheric Conditions

Weather and atmospheric particles can distort signals, impacting scan resolution and precision.



Data Storage & Processing Demands

- Massive Data Generation
- Storage Requirements
- Computational Resources