Certificate in Building Information Modelling (BIM) - Asset Management for EMSD Projects

9 Interfacing/ Integrating BIM-AM System with Other Systems 1

CONTENT

9.1 Laser scanning for BIM model construction to existing buildings

Laser Scanning

- Laser scanning is a method of high-accuracy mapping or reality capture that uses laser beams to quickly capture complete detail of the entire building construction project - much like a camera taking a 360-degree photo, but with an accurate position for every pixel.
- Point Cloud - The detailed 3D representation of the building project.
- Originally applied in the construction and maintenance of industrial plant facilities, laser scanning has since been adopted for many other uses, including building construction and **building information modeling (BIM)**.

Building Construction Applications:

- Many modern building construction projects are renovations or redevelopments that lack current construction or maintenance documents on the existing facility.
- In these situations, the rich, complete data captured with a laser scanner can provide the required information on existing building conditions with the accuracy needed for construction planning.
- As construction progresses, laser scanning data can be used to compare the newly constructed work against the as-designed model or drawings for quality assurance.
- If laser scanning is used throughout the entire construction project, the new facility will have as-built documentation from all the major milestones in the project, creating a record of what is behind the walls, above the ceilings and under the floor slabs for owners to utilize throughout the lifecycle of the building.

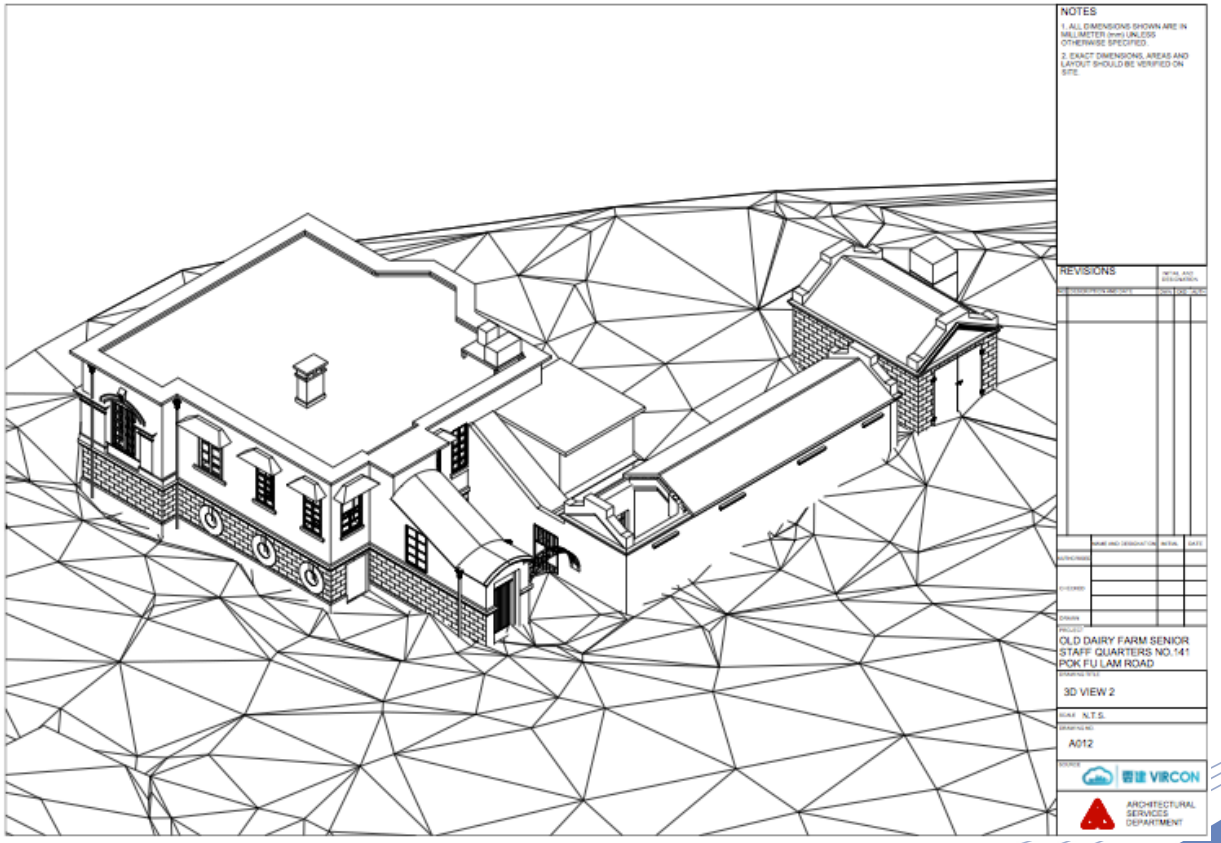
Example 1 –

The Pokfulam Farm Project:

- Built in 1887, Grade I.
- The project presents the history of the Old Dairy Farm and introduces the culture of Pokfulam village and the surrounding area through exhibitions, guided tours and workshops

BIM Model:

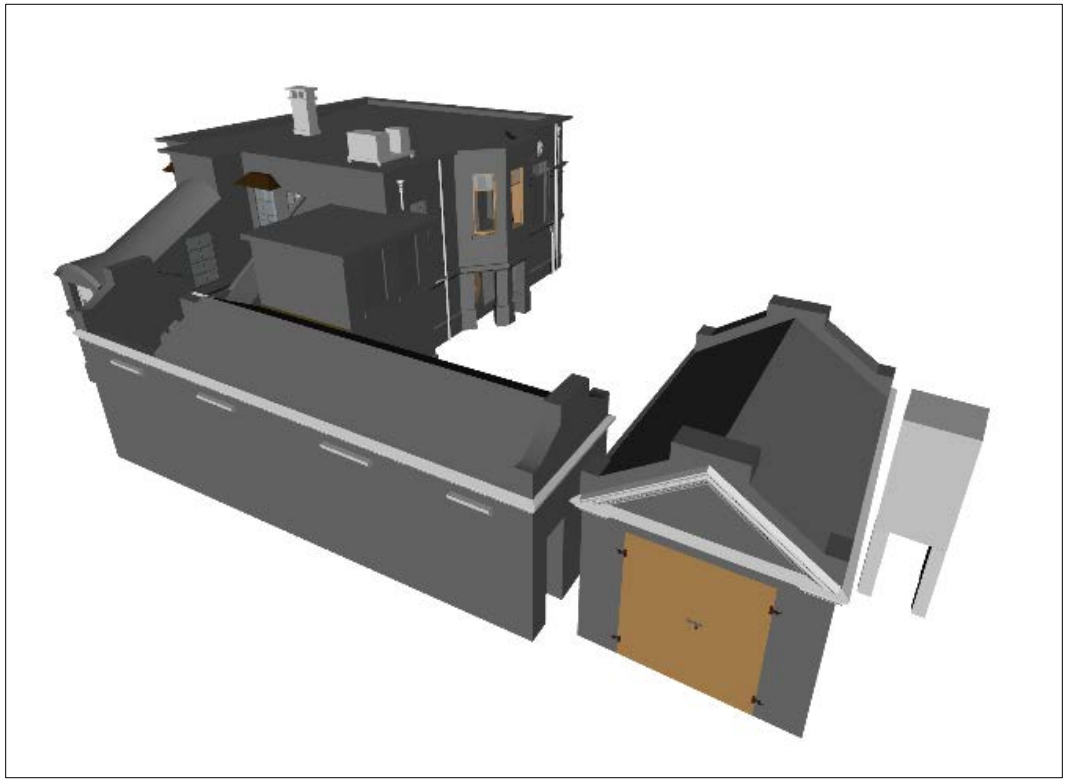
3D scanning data turned into BIM for heritage record and further design.



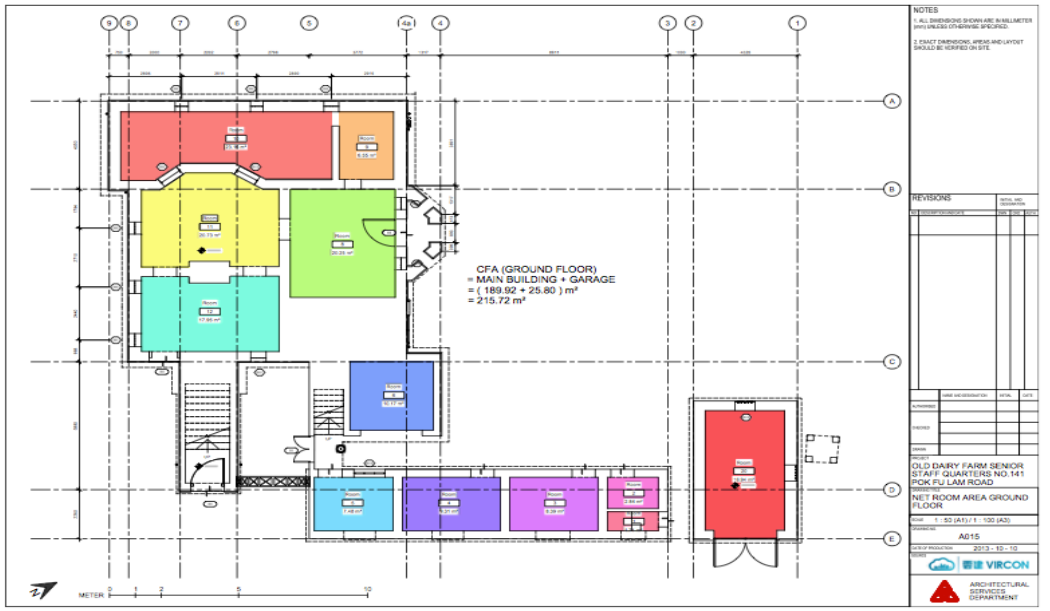
3D Scanning:

Point Cloud Data:

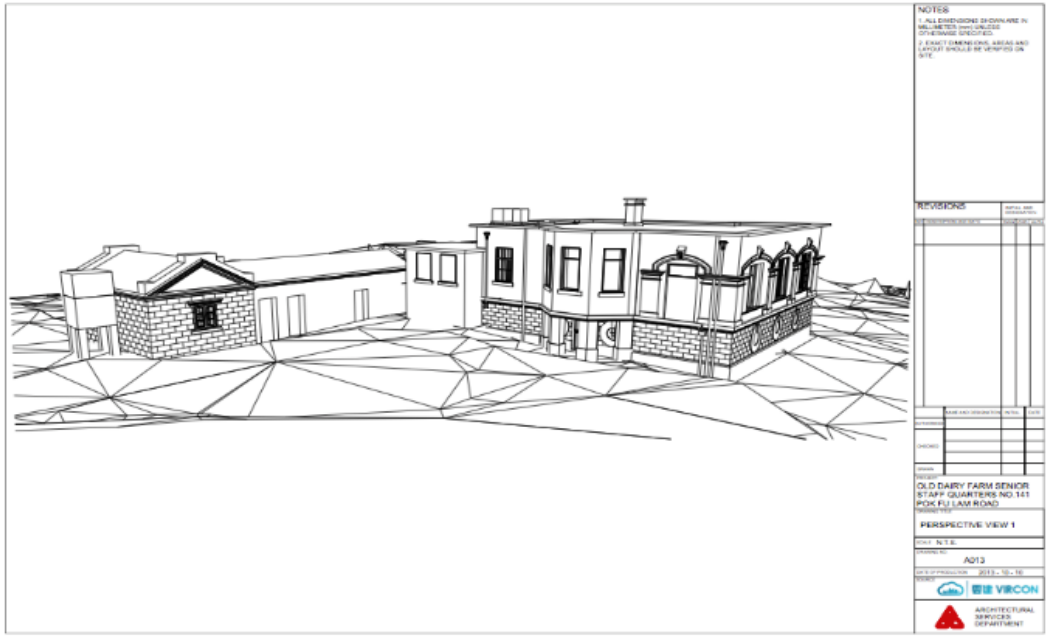
BIM Model:



Drawing Production and Quantity Take-off:



Room Schedule	
Name	Area
Room 01	10.37 m²
Room 02	6.65 m²
Room 03	24.67 m²
Room 04	24.61 m²
Room 05	4.53 m²
Room 06	21.89 m²
Room 07	24.25 m²
Room 08	23.20 m²
Room 09	10.55 m²
Room 10	7.48 m²
Room 11	25.21 m²
Room 12	24.35 m²
Room 13	21.31 m²
Room 14	9.55 m²
Room 15	4.30 m²
Room 16	9.73 m²
Room 17	7.48 m²
Room 18	1.84 m²



Example 2

- Ruins of St. Paul's, Macau:

- A long term monitoring project.
- A 6-months interval monitoring exercise

Setting Up:

- Two scanners are set-up at the selected positions and pointed to the direction of the required scans.

(Source: GLand Surveying, Planning & GIS Co Ltd)

Targets Located:

- Targets are positioned within the region of Field of View (FOV) of scanner.

- Targets fixed on wall

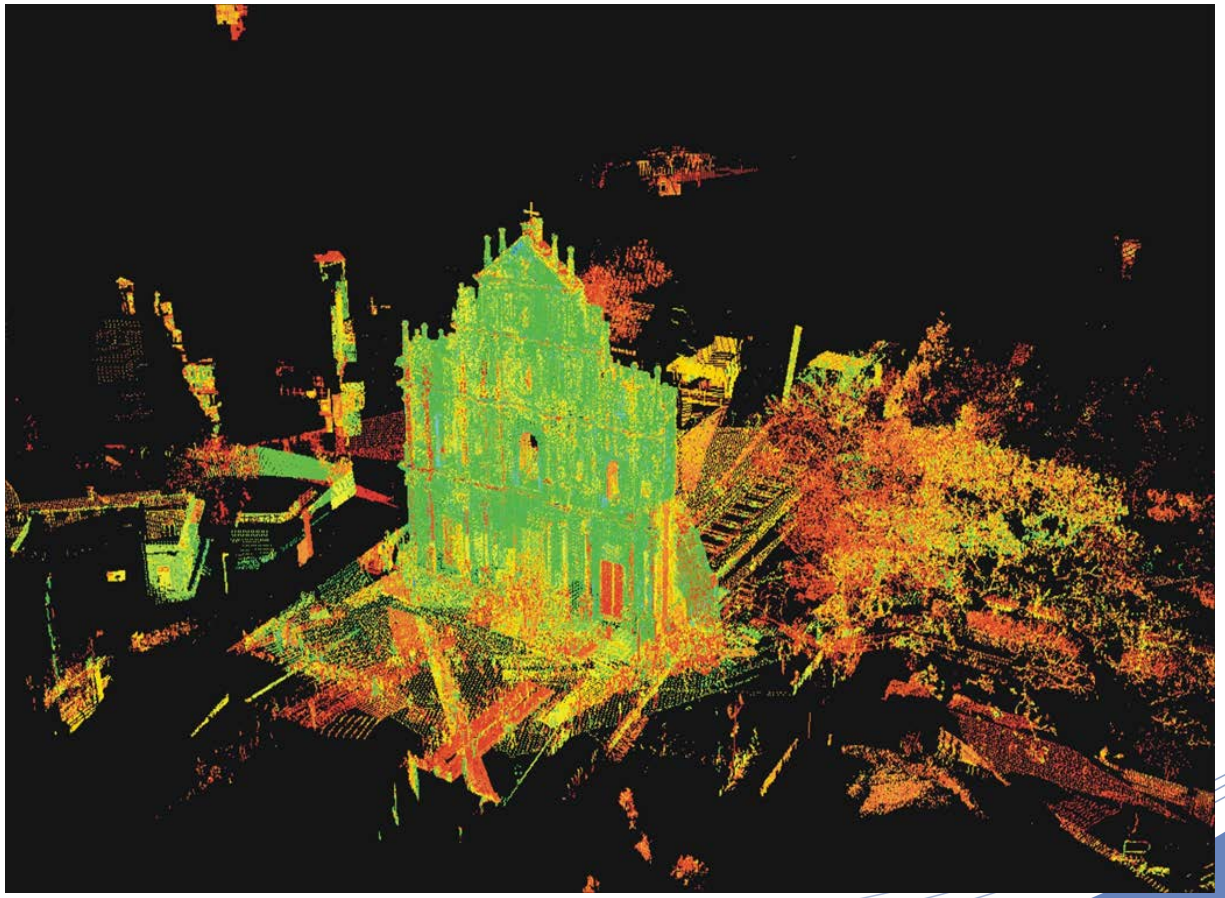
(Source: GLand Surveying, Planning & GIS Co Ltd)

Field Scanning:
The field scanning is started after the setting up of scanner and targets located.

(Source: GLand Surveying, Planning & GIS Co Ltd)

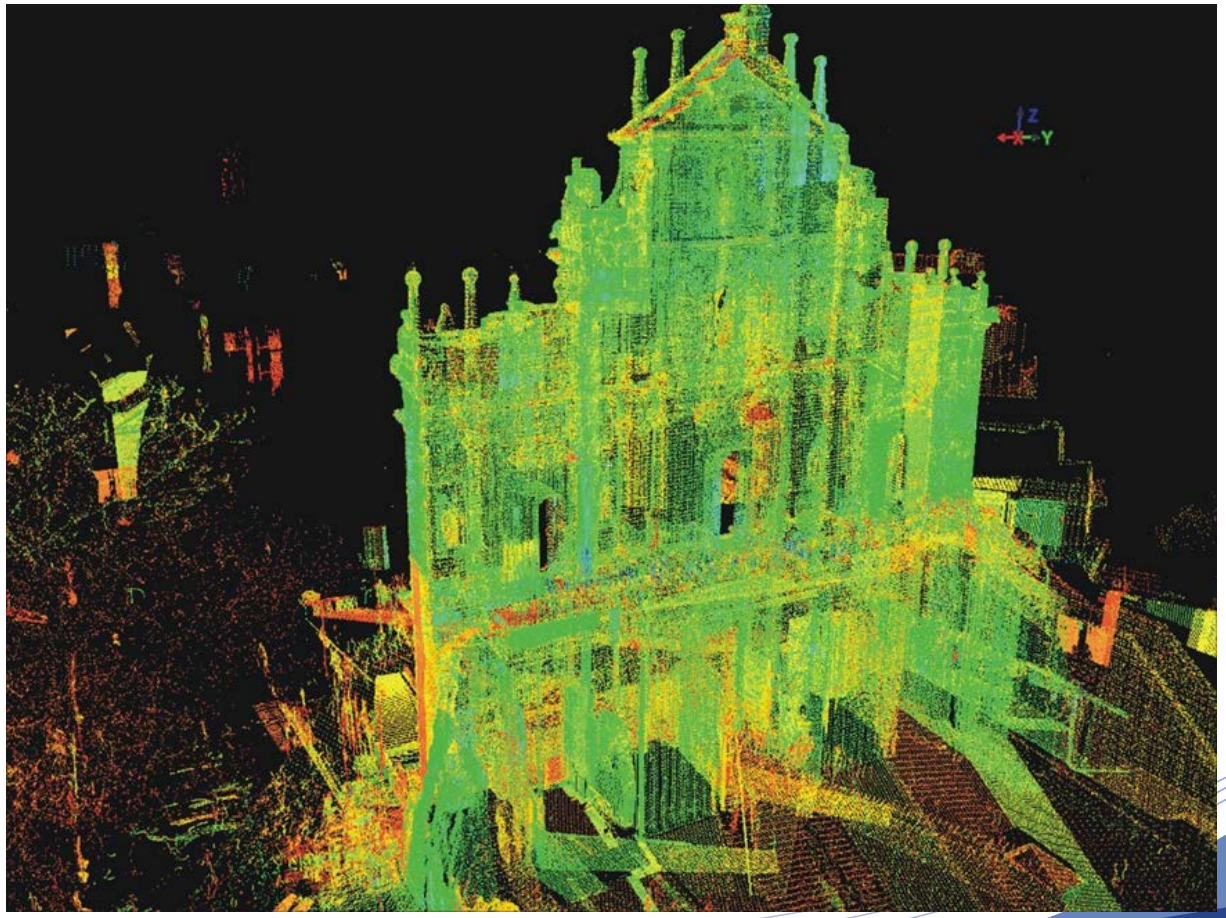
Scanning:

- Scanned point clouds (before noise removal)



(Source: GLand Surveying, Planning & GIS Co Ltd)

- Scanned point clouds (before noise removal)

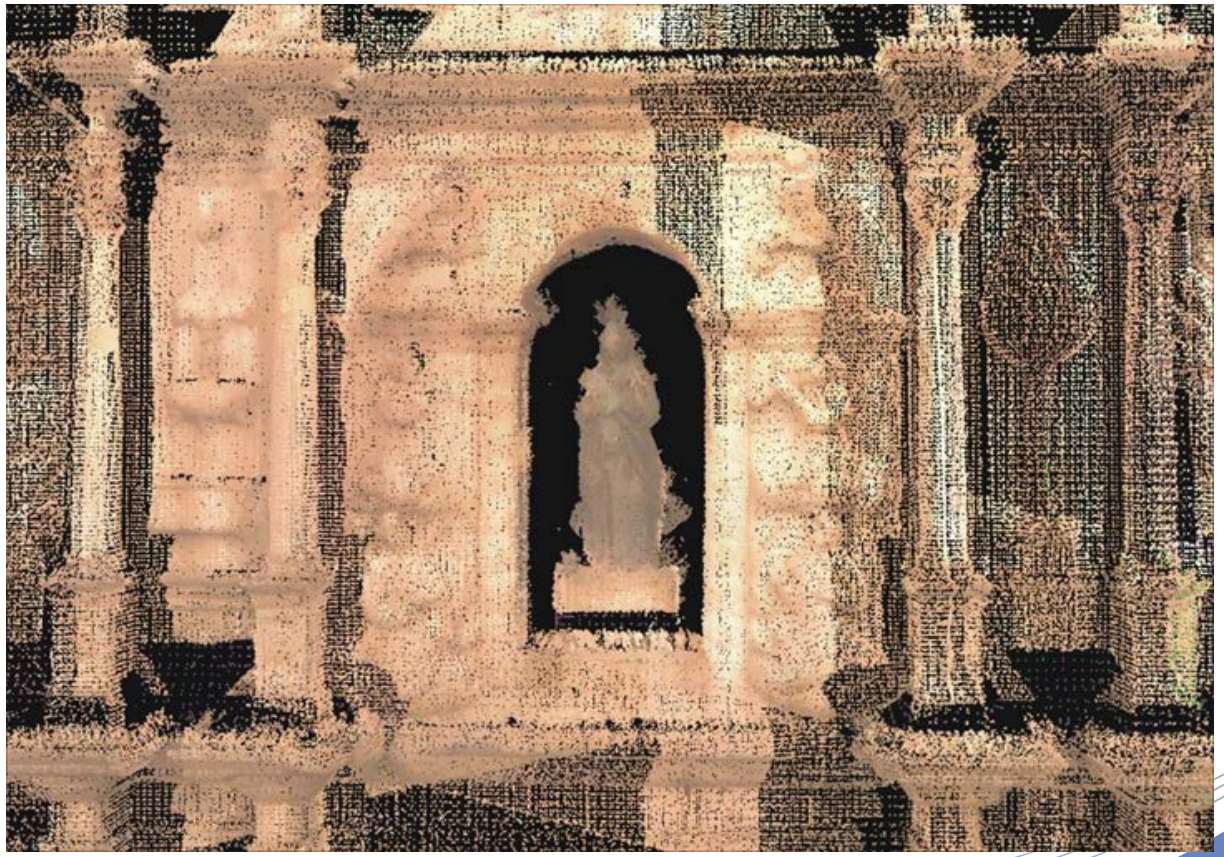


(Source: GLand Surveying, Planning & GIS Co Ltd)

- Scanned point clouds in true colour (after noise removal)

(Source: GLand Surveying, Planning & GIS Co Ltd)

- Scanned point clouds in true colour (after noise removal)



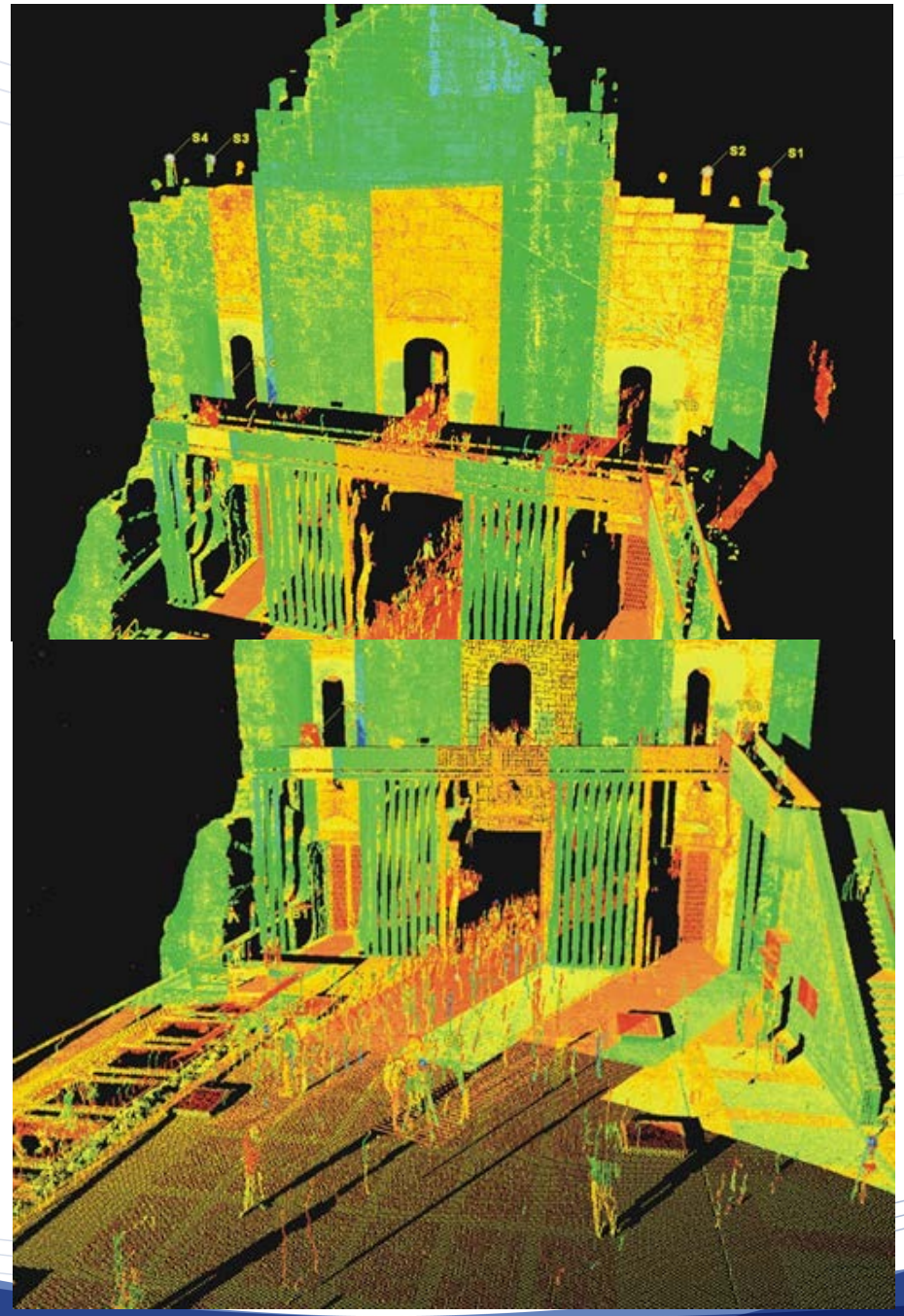
(Source: GLand Surveying, Planning & GIS Co Ltd)

- Scanned point clouds in true colour (after noise removal)

(Source: GLand Surveying, Planning & GIS Co Ltd)

Target Registration:

- Scanning of Targets located at known positions.
- Spherical objects were also used as target purposes.



(Source: GLand Surveying, Planning & GIS Co Ltd)

Constraint ID	ScanWorld	ScanWorld	Type	Status	Weight	Error	Error Vector
TargetID: B31	ScanWorld 4 (8Jul Outside2)	ScanWorld 3 (8Jul Outside2)	Coincident: Vertex-Vertex	On	1.0000	0.001 m	(0.000, 0.001, 0.000) m
TargetID: B33	ScanWorld 4 (8Jul Outside2)	ScanWorld 3 (8Jul Outside2)	Coincident: Vertex-Vertex	On	1.0000	0.000 m	(0.000, 0.000, 0.000) m
TargetID: B36	ScanWorld 4 (8Jul Outside2)	ScanWorld 5 (8Jul Outside2)	Coincident: Vertex-Vertex	On	1.0000	0.001 m	(0.000, 0.000, -0.001) m
TargetID: B35	ScanWorld 4 (8Jul Outside2)	ScanWorld 5 (8Jul Outside2)	Coincident: Vertex-Vertex	On	1.0000	0.001 m	(-0.001, 0.000, 0.000) m
TargetID: B30	ScanWorld 4 (8Jul Outside2)	ScanWorld 3 (8Jul Outside2)	Coincident: Vertex-Vertex	On	1.0000	0.001 m	(0.000, -0.001, 0.000) m
Cloud/Mesh 1	ScanWorld 4 (8Jul Outside2)	ScanWorld 5 (8Jul Outside2)	Cloud: Cloud/Mesh-Cloud/Mesh	On	1.0000	0.001 m	aligned [0.005 m]

- To join all scans together to form a TRUE 3D representation.
- Basically matching up the names of the scanned targets.
- A least square adjustment calculates the X, Y, Z shift and rotation for each scan.

Registration Media:

- Cyrax targets
- Point Cloud constraints

(Source: GLand Surveying, Planning & GIS Co Ltd)

3D Laser Scanner A:

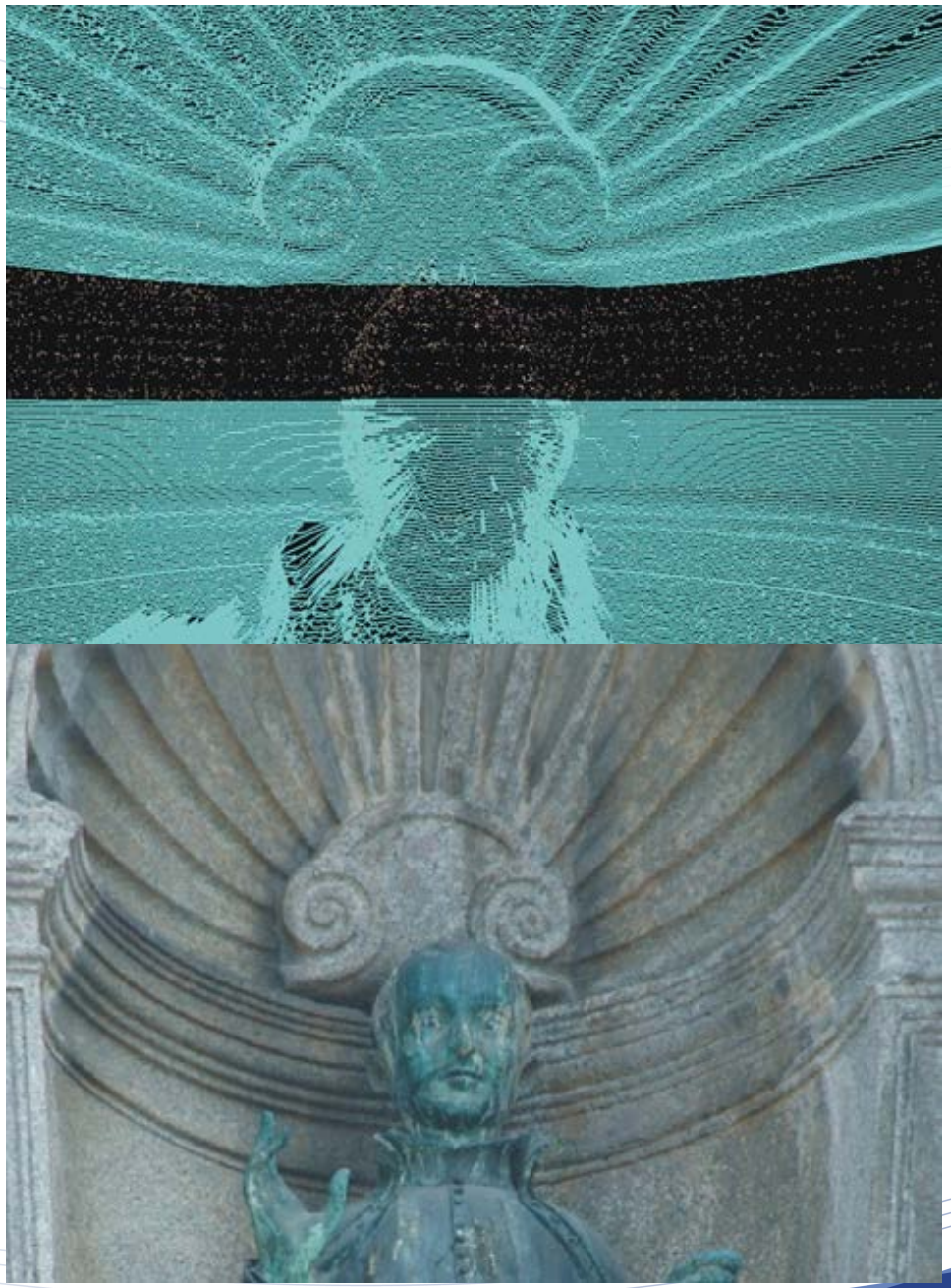
- Number of Scan Worlds: 14
- Total no. of points: about 4.7 B
- Days of Scanning: 7 Days
- Post-Processing Time: 30 Days

3D Laser Scanner B:

- Number of Scan Worlds: 12
- Total no. of points: about 10 B
- Days of Scanning: 2 Days
- Post-Processing Time: 10 Days

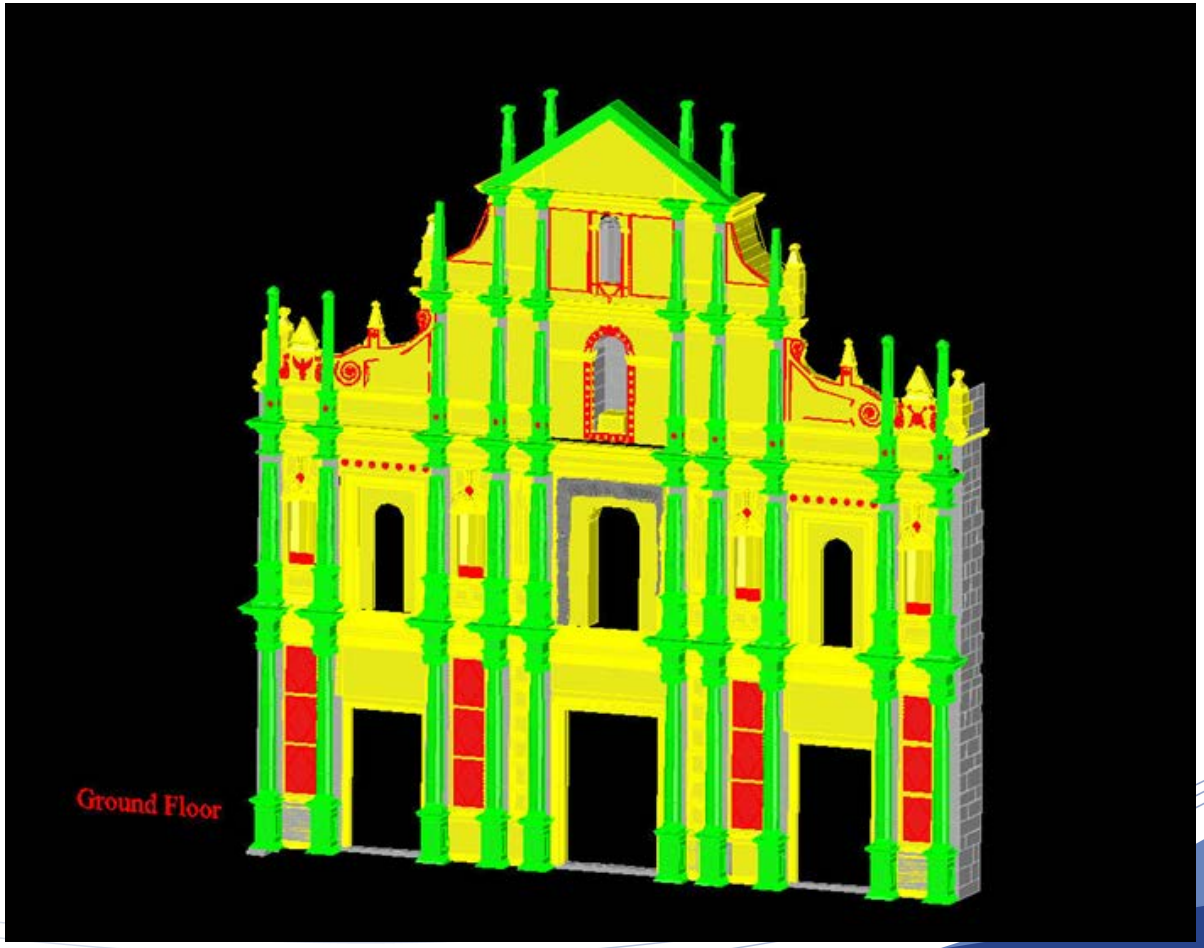
(Source: GLand Surveying, Planning & GIS Co Ltd)

3D Modelling:
Forming of Horizontal and Vertical Sectional line in 3 millimetre (i.e. 0.003 metre) separation with the sectional alignment parallel to wall face.



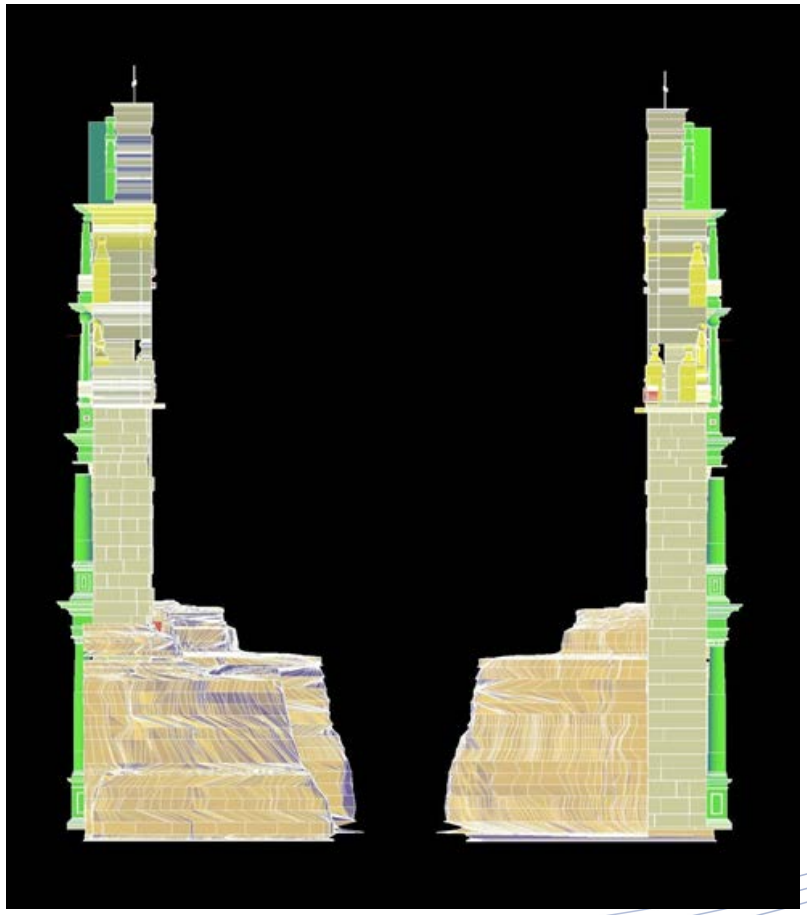
(Source: GLand Surveying, Planning & GIS Co Ltd)

- Building the model.



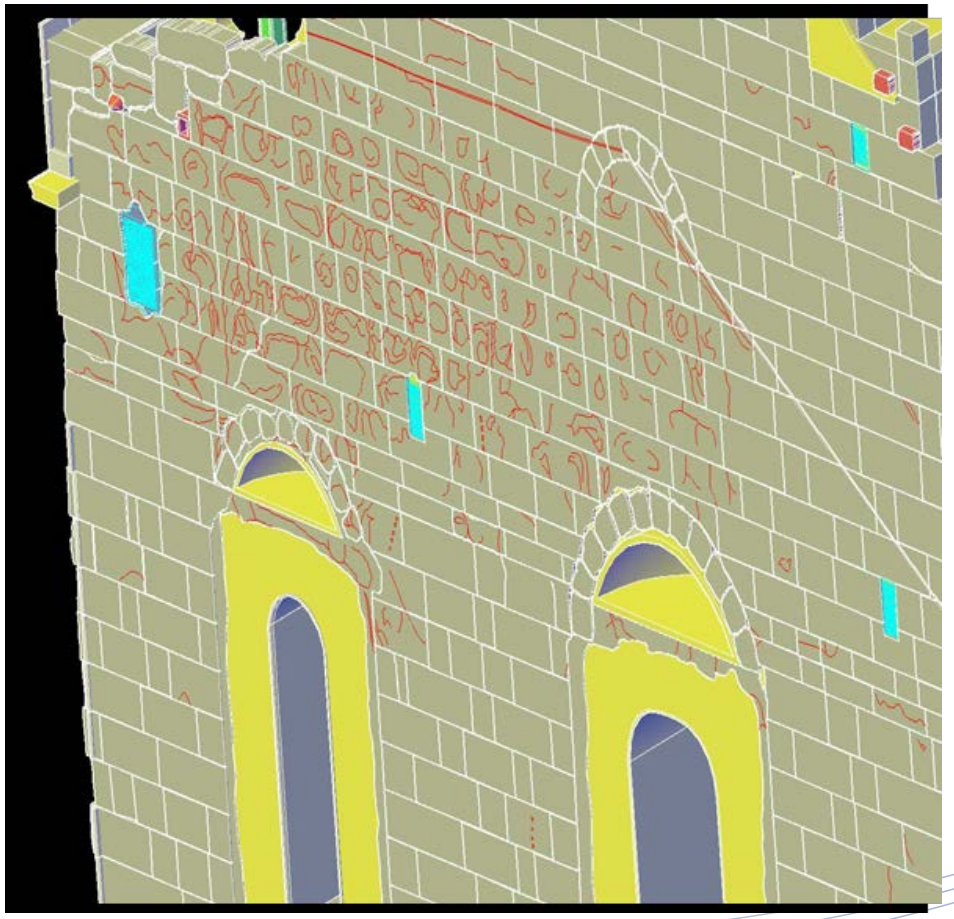
(Source: GLand Surveying, Planning & GIS Co Ltd)

- 3D modelling (Wire- frame presentation)
- Front Elevation (Conceptual presentation)
- Rear Elevation (Conceptual presentation)
- Side Elevations (Conceptual presentation)



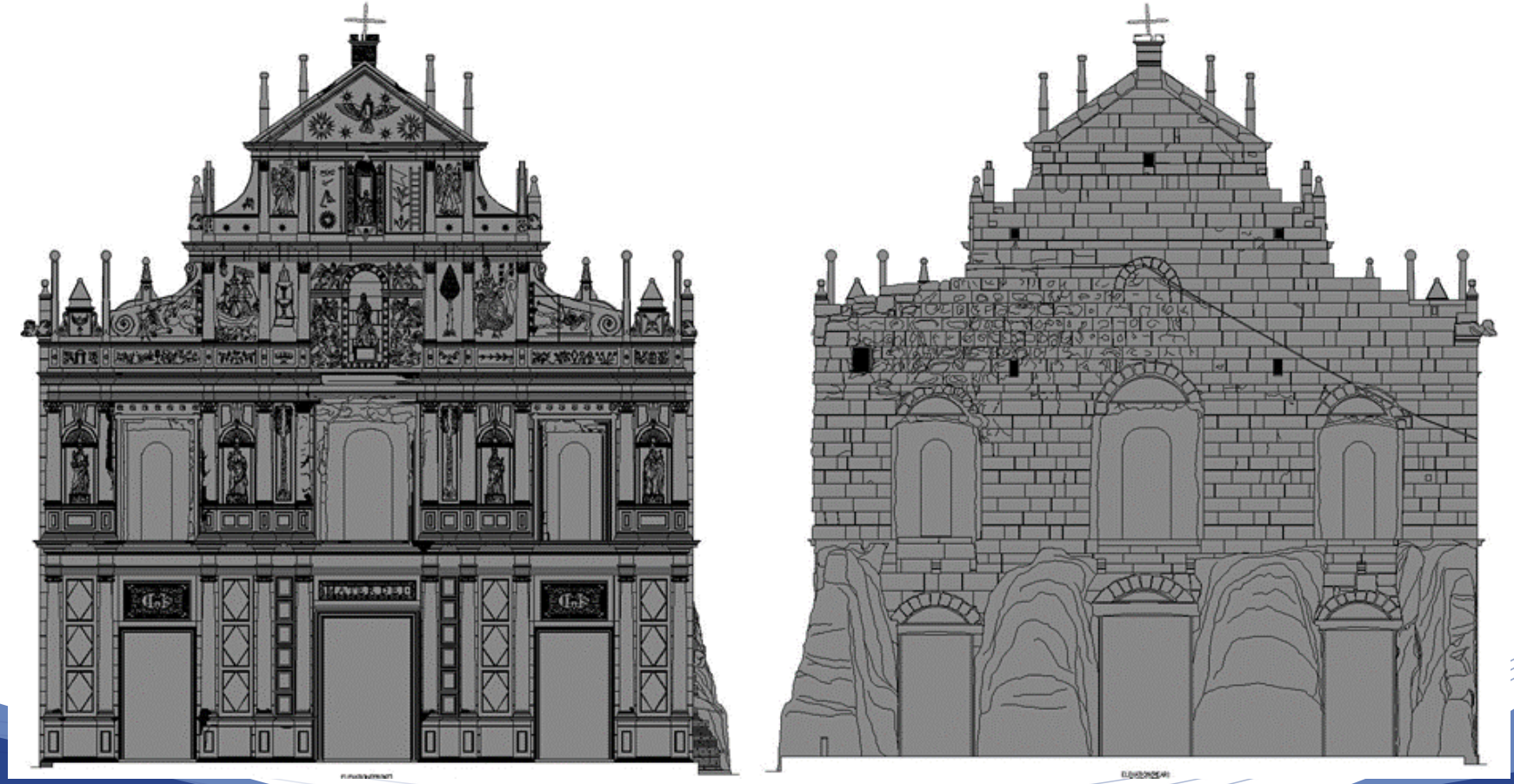
(Source: GLand Surveying, Planning & GIS Co Ltd)

- 3D modelling of columns, wall face and defects (Conceptual presentation)



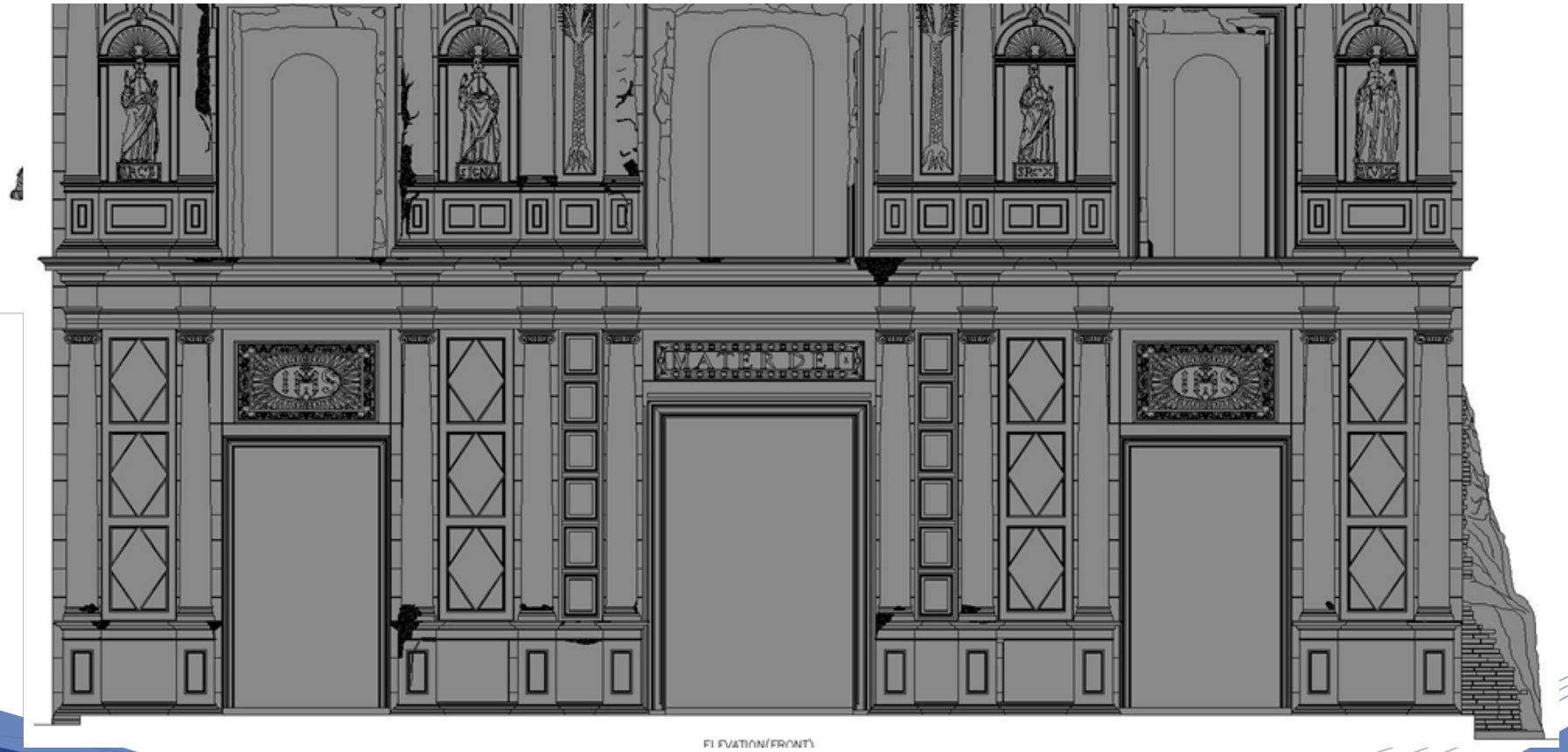
(Source: GLand Surveying, Planning & GIS Co Ltd)

- Elevation drawings.



(Source: GLand Surveying, Planning & GIS Co Ltd)

- Front Elevation- Details.



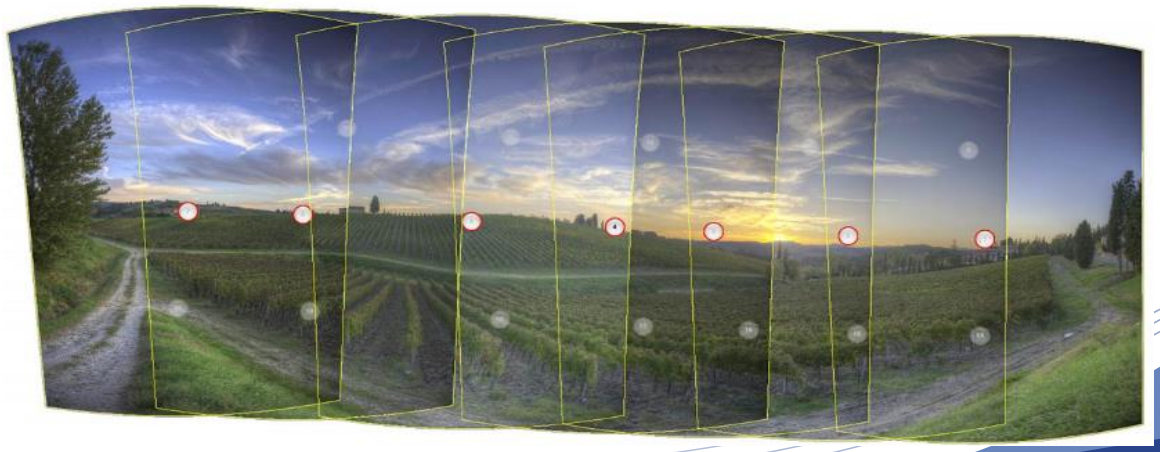
(Source: GLand Surveying, Planning & GIS Co Ltd)

12.2 Verification of BIM Model by 360 spherical photos

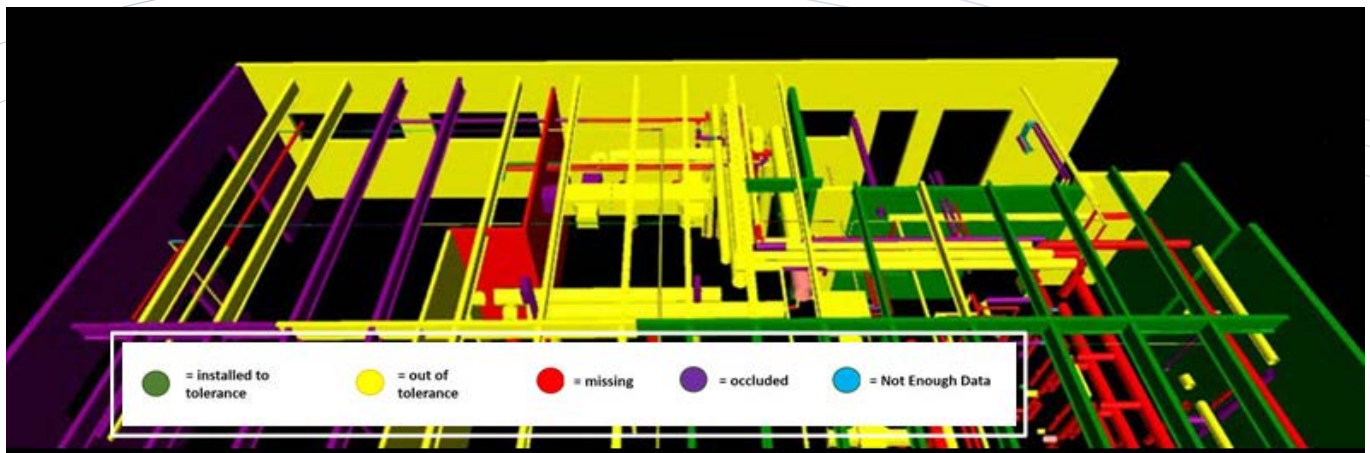
Mobile Scanner

UAV Devices

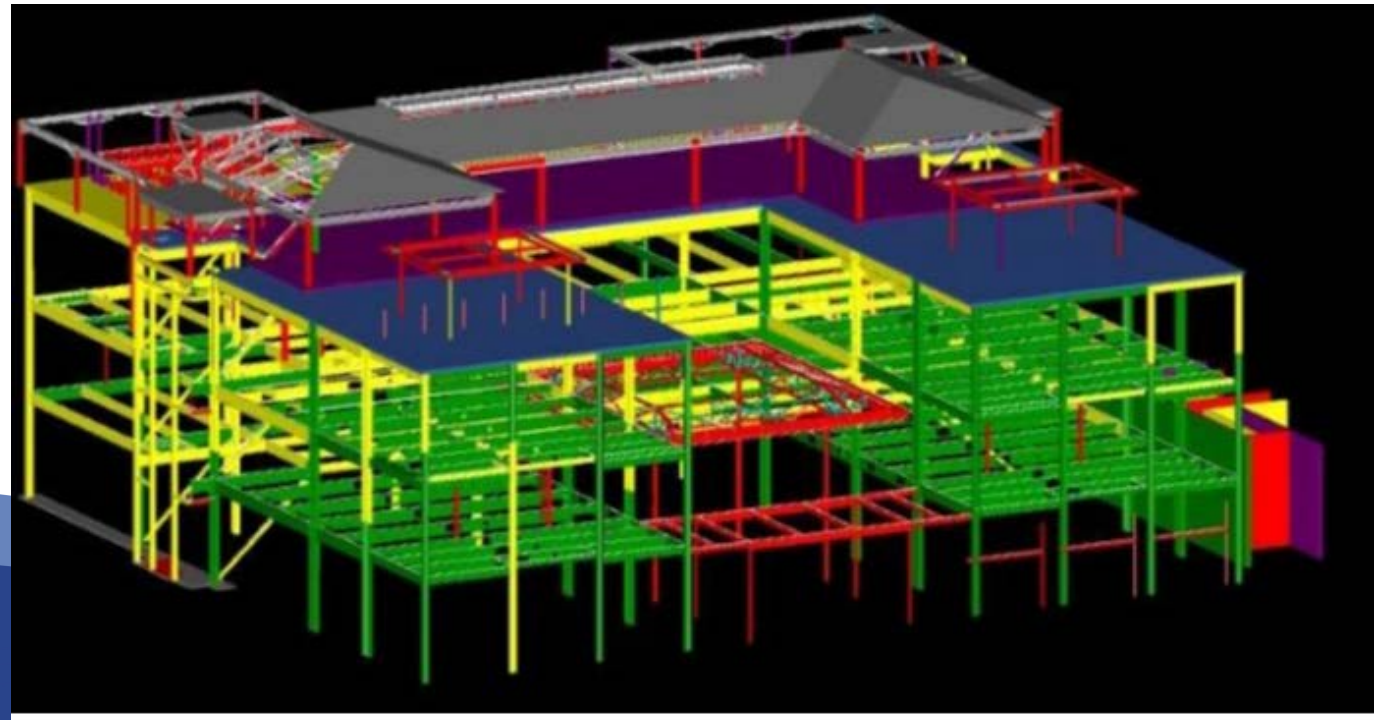
Point Cloud



Verification



Verity's "stop light" variance classification gives you a quick overview of construction quality.



Demonstration

BIM Model Construction

for

Existing Buildings