



DIGITAL CONSTRUCTION AND LASER SCANNING

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This development has become possible owing to digital technology implementation in our lives.

Digital Economics

The application of digitalization techniques has been one of the activities undertaken by us. Other related areas are digital society, the Internet, industry, ecology, digital psychology, digital construction, etc. We will focus on digital construction having direct relation to our topic.

Digital Construction

It means that all construction activities have to be digitized, such as document management, design, storage, data transmission and interpretation, construction management, documentation, accounting and control, geometry control, operating with digital data, as-built surveys, etc.

BIM and 3D modelling

BIM is a process of construction management (design, construction, management and utilization).

A BIM model consists of 3D project management and utilization model and the required descriptions. BIM is based on the 3D facility model. It is created in the facility coordinate system and includes its element-by-element model (at the design stage), all connections, interactions, dynamic calculations, processes, schedules, visualization, logistics, etc.

BIM and 3D modelling

The following concepts are appeared: BIM in the facility design, construction, operation and utilization stages.

BIM in the design stage. A facility design is created in BIM with all descriptions, relationships, and interactions that will determine the whole facility life cycle. However, it should be taken into account that the updated information concerns only the facility design. At the design stage, the estimated project costs of the construction stages can be determined.

BIM and 3D modelling

BIM in the construction stage. This process is a logical extension of BIM in design. By our definition, it is a **BIM** project, where the actual developments of project construction are made, including geometry and quality data of building materials, based on which the necessary actions and new opportunities are taken:

- ❖ Merging and the design and construction verification
- ❖ Changes in the project
- ❖ Determination of actual volumes and building costs at any stage
- ❖ Changes in structural analysis
- ❖ Documentation of all processes, etc.

At this stage, a lot of other tasks of construction can be solved, which were not even set before.

BIM and 3D modelling

- ▶ BIM in the operations stage. This process is a logical extension of BIM in design and construction. This is realized by BIM data in construction, being adopted for maintenance tasks. Maintenance tasks are formulated and they are a part of BIM. Handover of the constructed facility to the customer is made along with a BIM model. This is a completely new solution.

How 3D construction facility models are generated?

The actual 3D models are created by the corresponding measured data. There are following main methods by:

- Discrete measured data (a surveying measuring tape, a theodolite, a total station)
- Imagery data (cameras)
- Laser scanning data (the most modern 3D generation technique).

At present, laser scanners provide all stages of engineering surveying, design, construction and facilities operation by metrics.

What is the result of laser scanning?

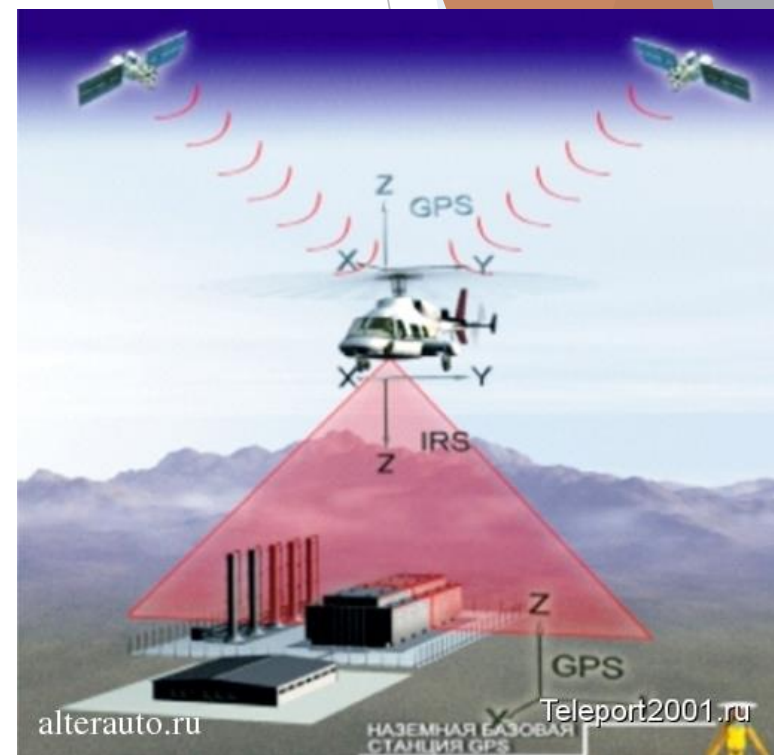
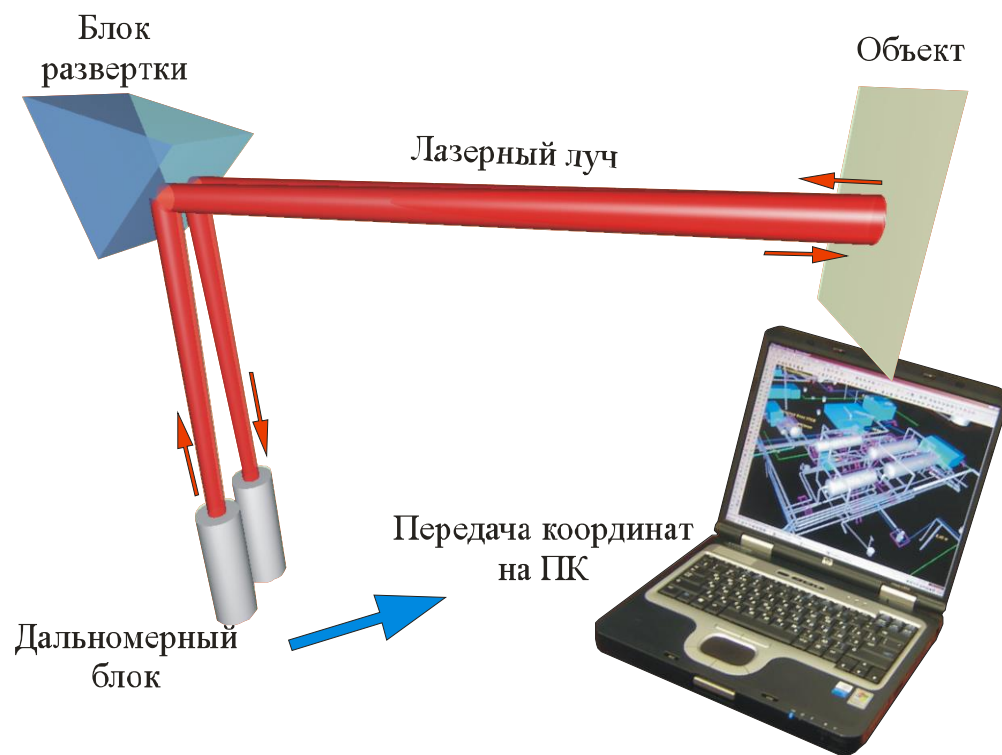
Laser scanning is the process of repeated measuring the coordinates of laser reflection points. The laser beam is controlled by the special scanning unit at a given speed. The number of laser pulses can reach hundreds of thousand per second. The result of the measurements is a facility model created by a set of points (a cloud). The point density may vary. While scanning the facility from different points, stitching scanned images is carried out, noises are removed, and the whole facility is created as a cloud of points presented in digital format as a file.

What is the result of laser scanning?

The facility model in the form of a point cloud has all metric properties necessary for assessment of facility geometry. The special software is used for this purpose. This cloud of points is formed in the given coordinate system and can be used for the problem-solution (design, geometry control parameters of construction, etc.). A cloud of points is used for geometrical measurements, generate sections, views, and types. The imagery can be imposed on a cloud of points. If necessary a cloud of points is also used for the creation of a vector facility with different designation and contents.



The principles of laser scanning



How can laser scanning be used in construction?



Very simple!

At any stage a facility under construction is scanned and its model is created in the form of a point cloud in the required coordinate system. Moreover, the process continues so fast that it does not require interrupting the construction and can be performed during the day and night.

The complete geometry control is now possible owing to the recent trends in construction:

The development of digital construction

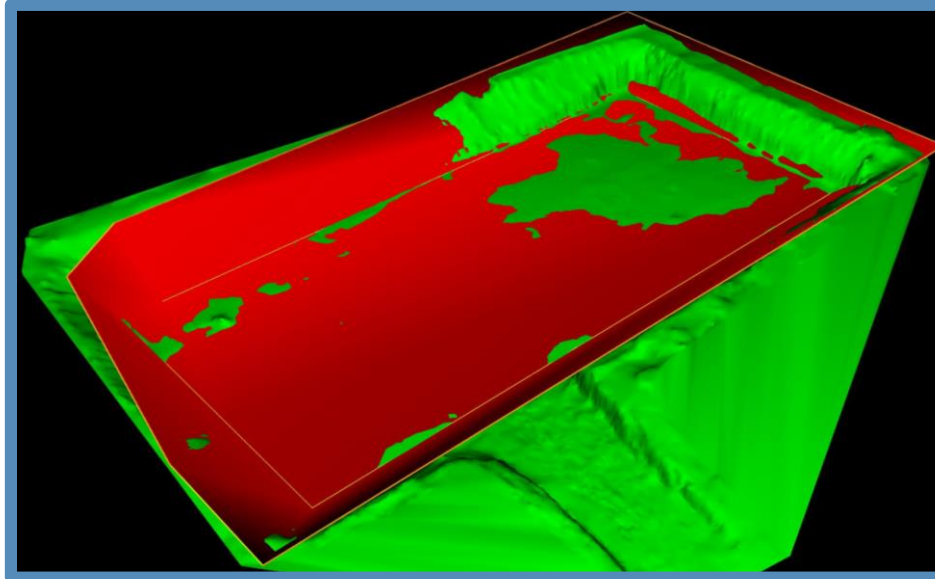
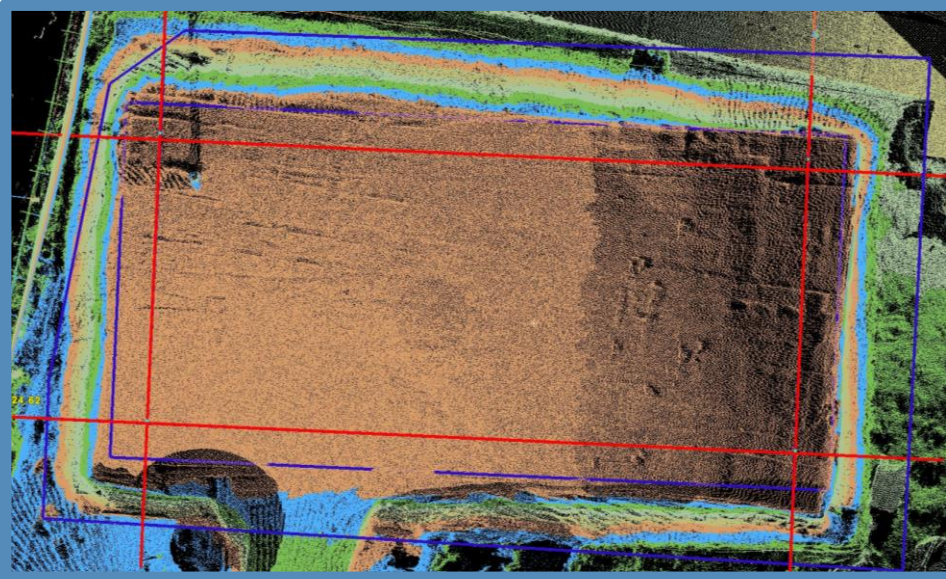
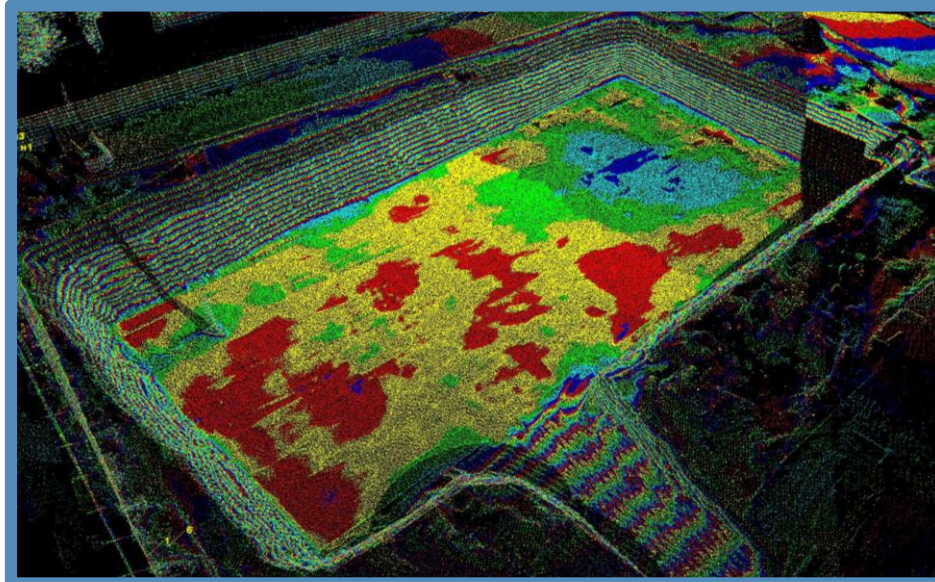
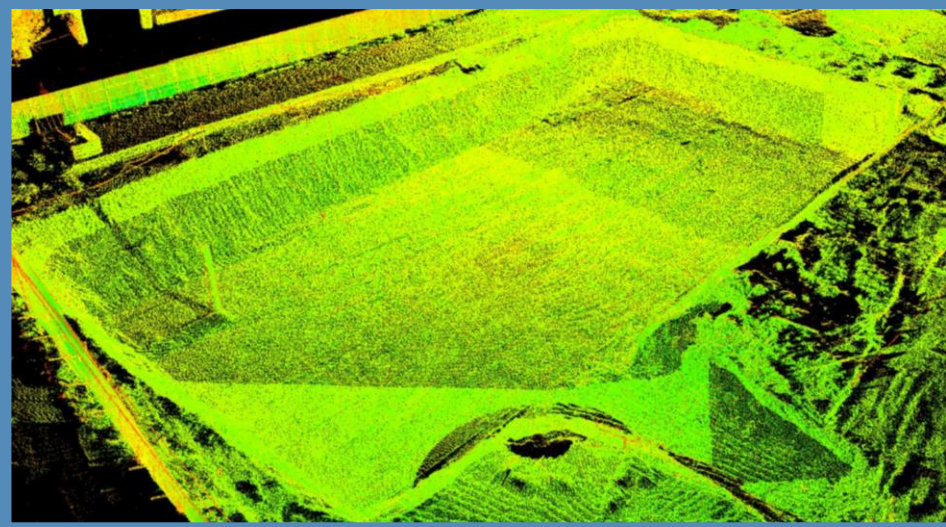
The implementation of BIM technologies

The development of available measuring means (laser scanning) the results of which are used for 3D facilities modelling

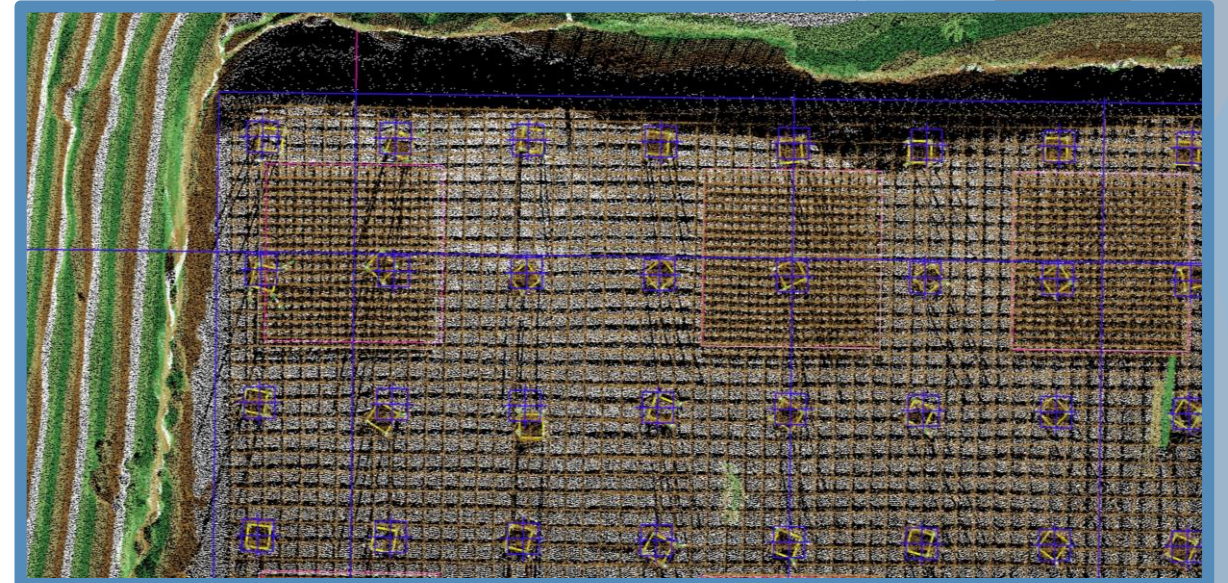
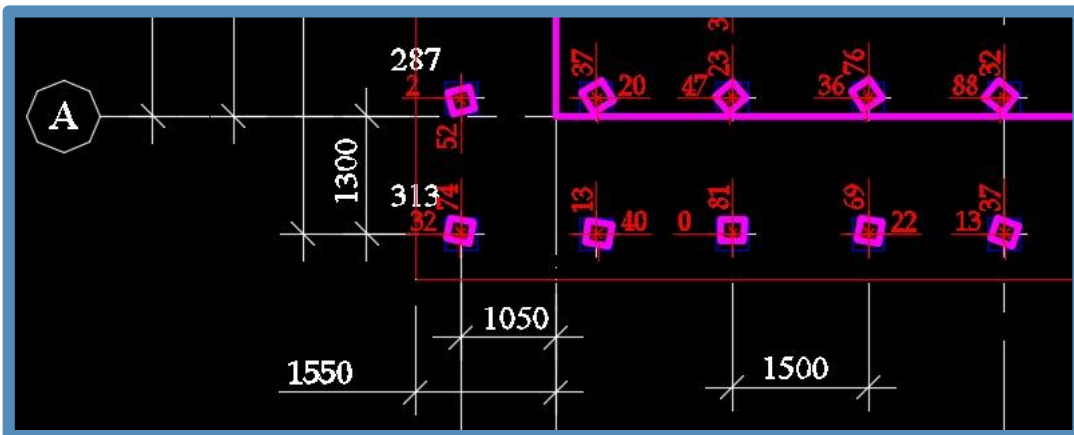
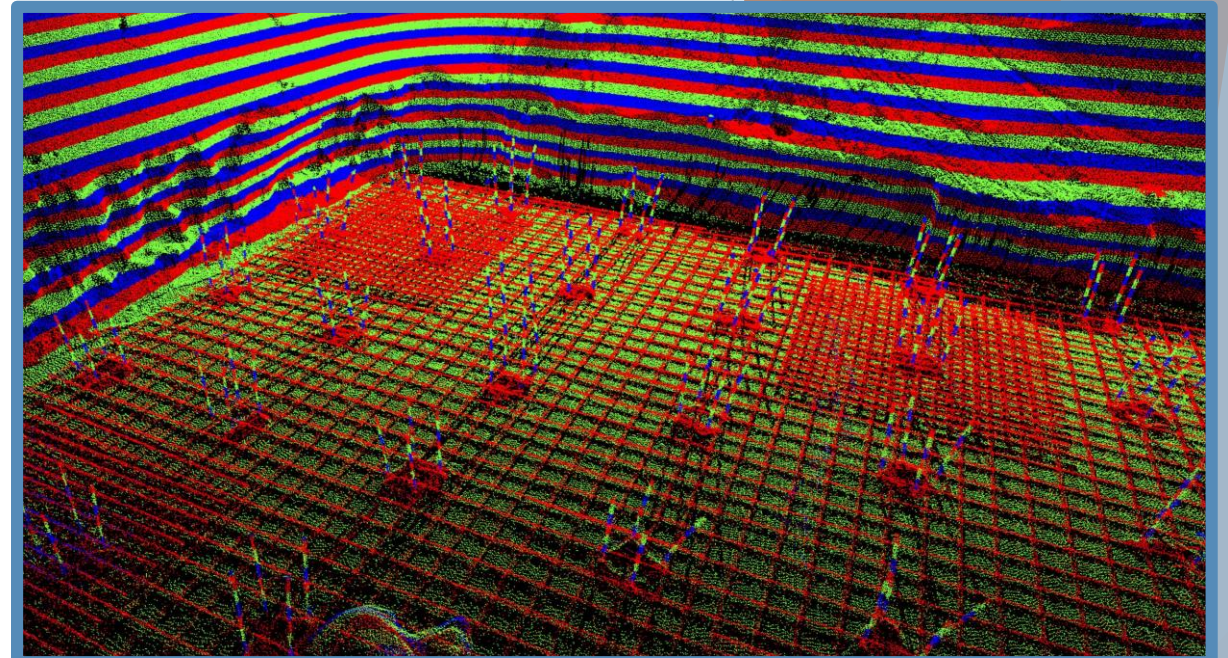
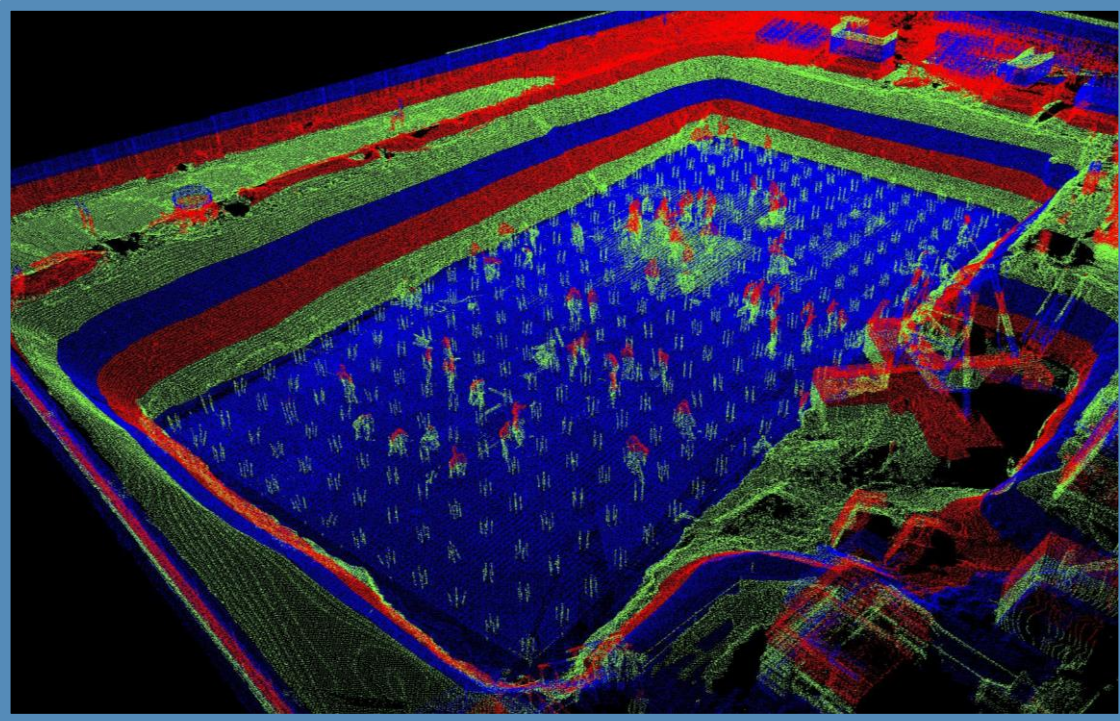
The availability of advanced software making possible to work with 3D models according to the results of measurements

We have developed technologies for the complete geometry control using laser scanning data and to solve a variety of related tasks.

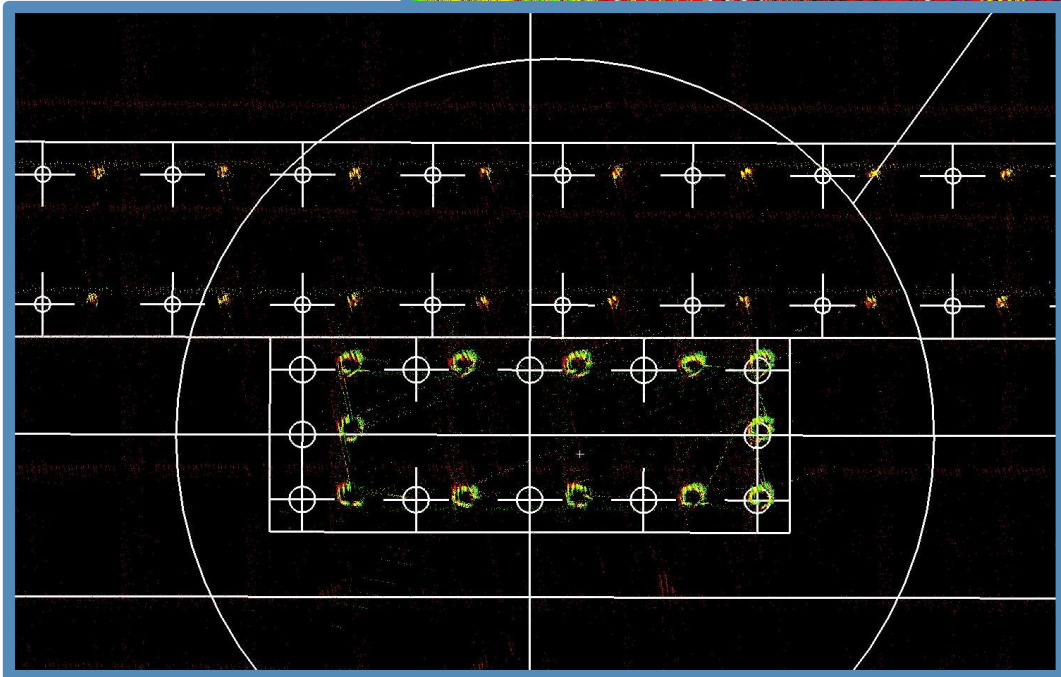
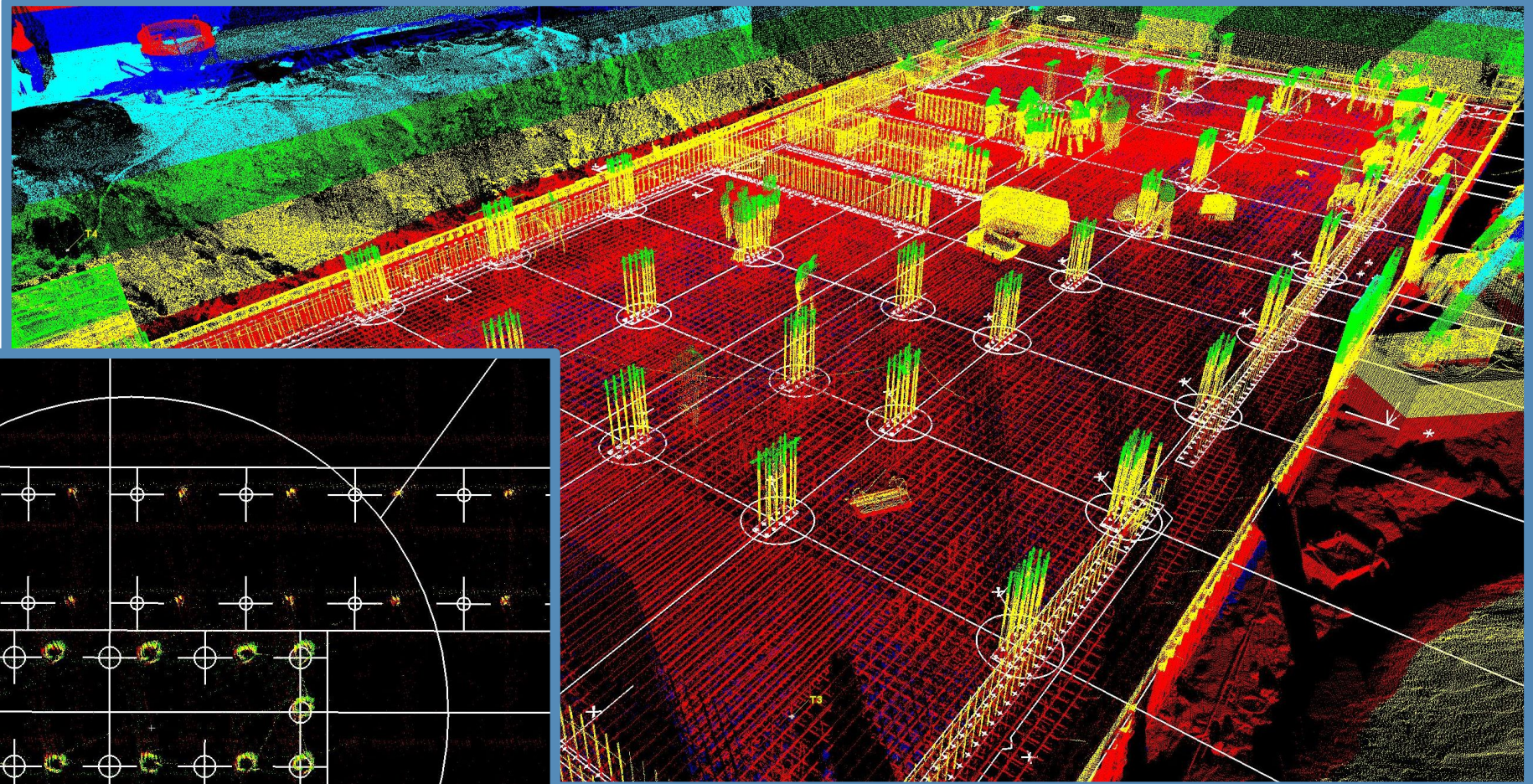
Examples ▶ Excavation pit



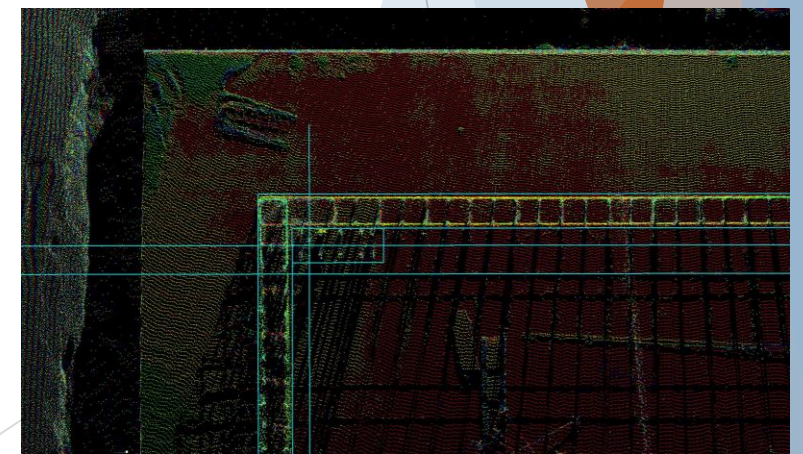
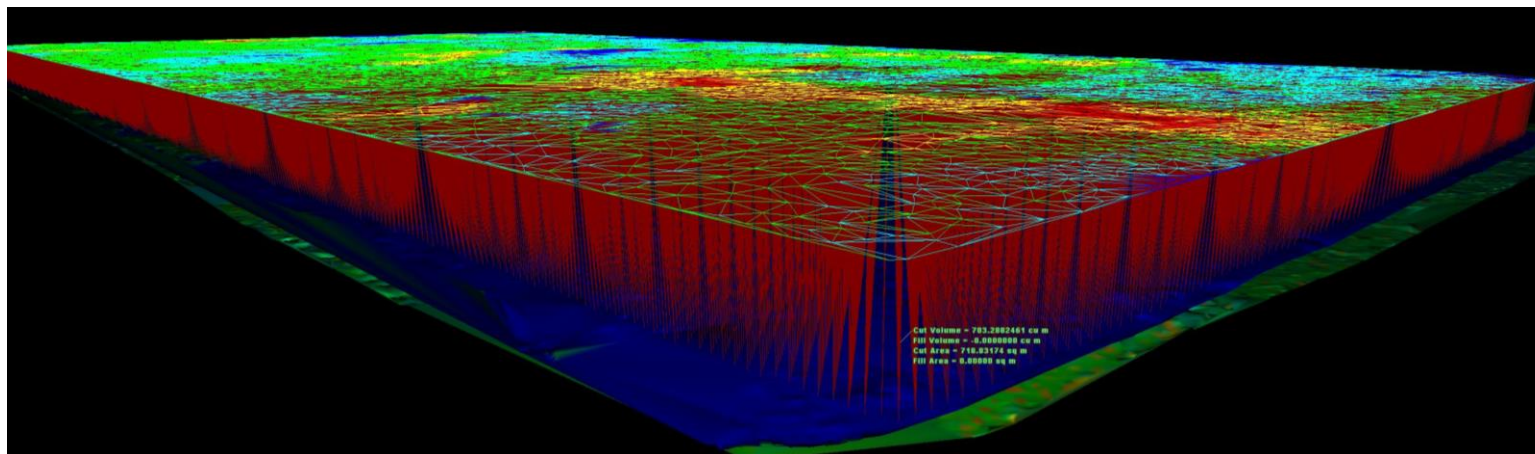
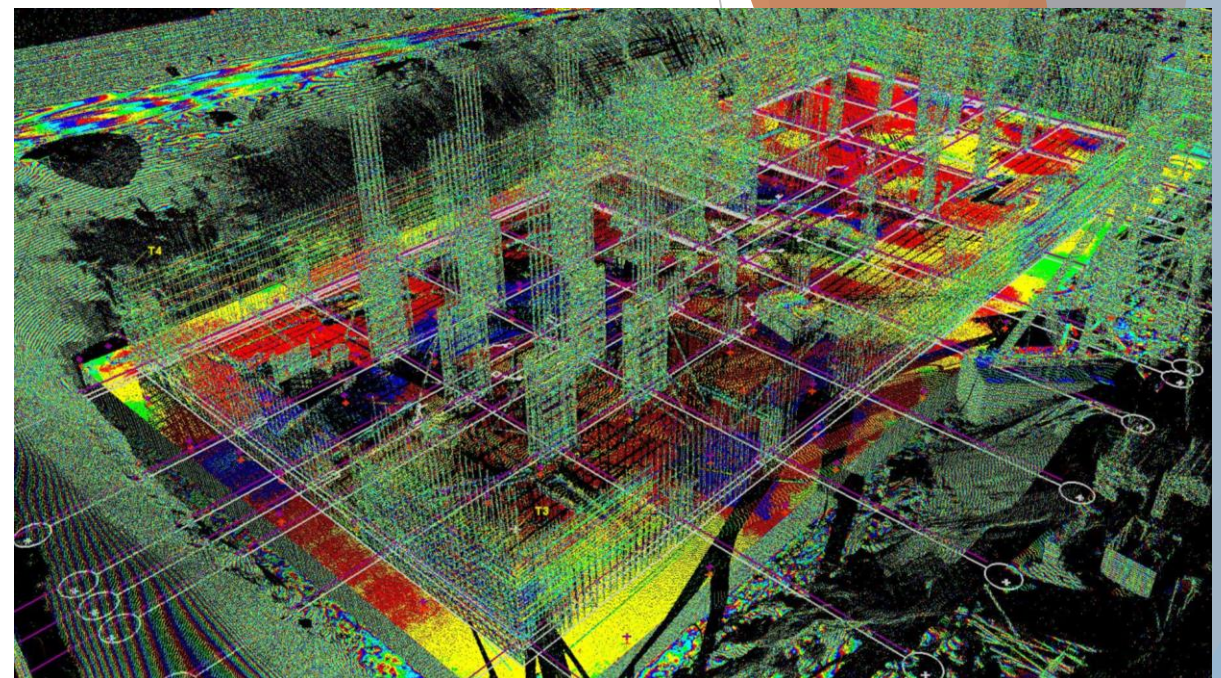
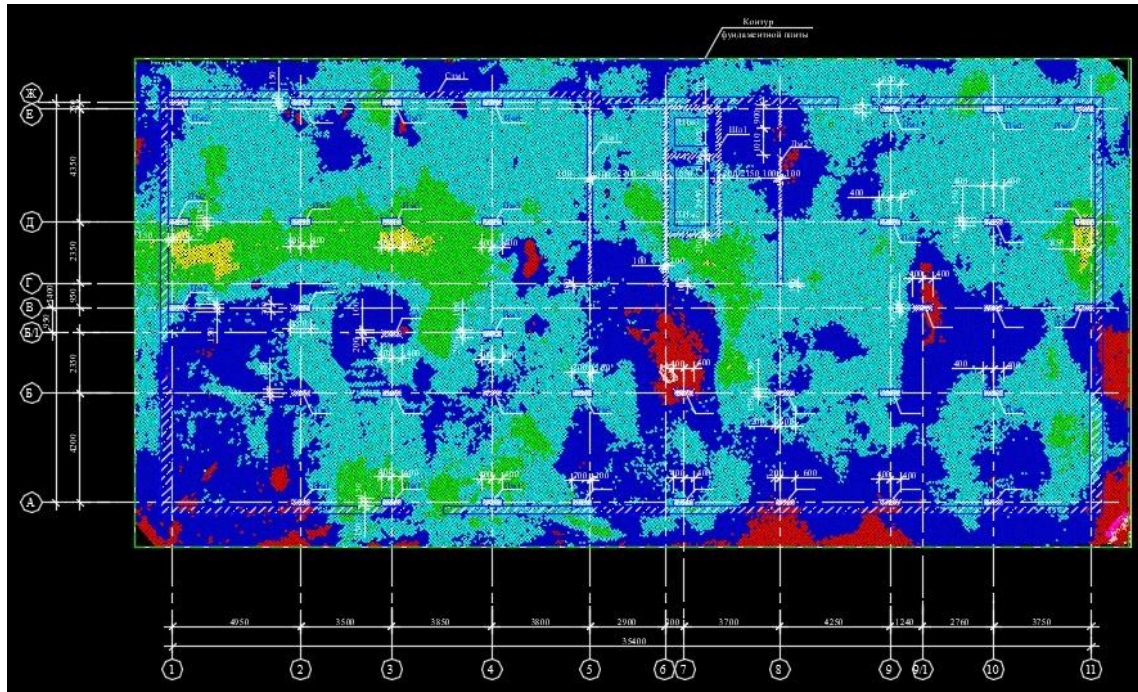
Examples ► Piles



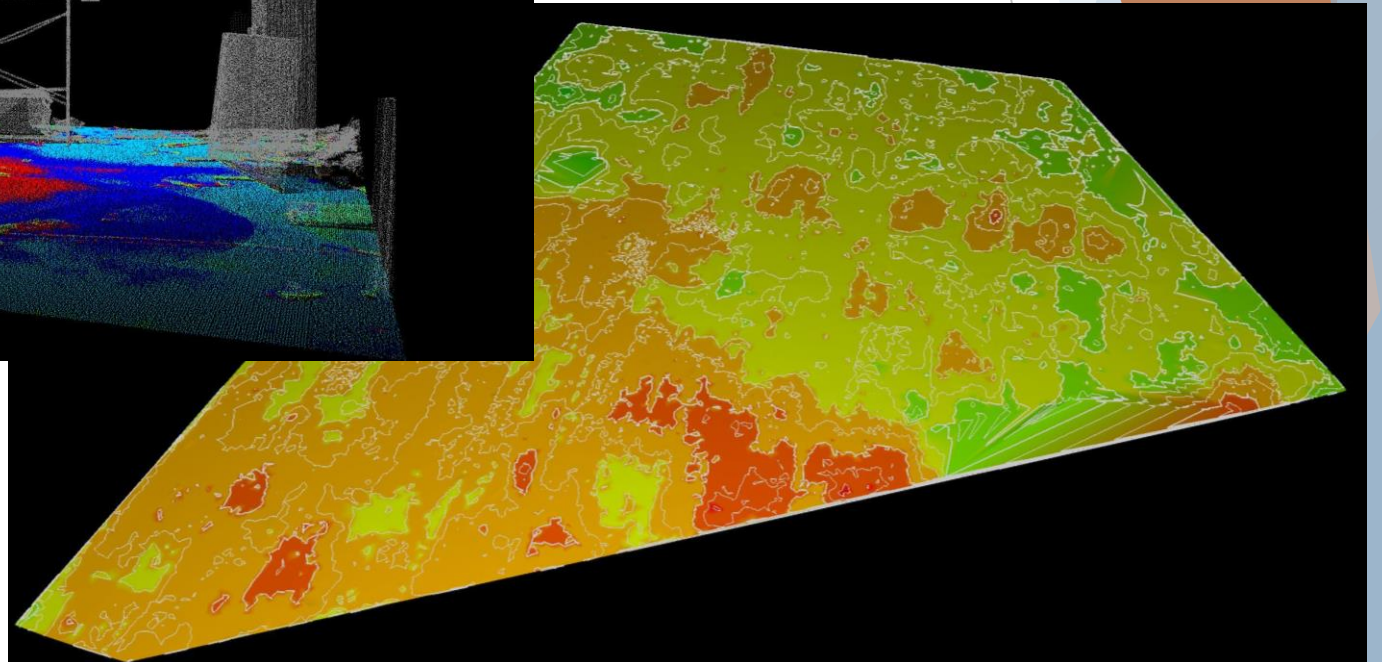
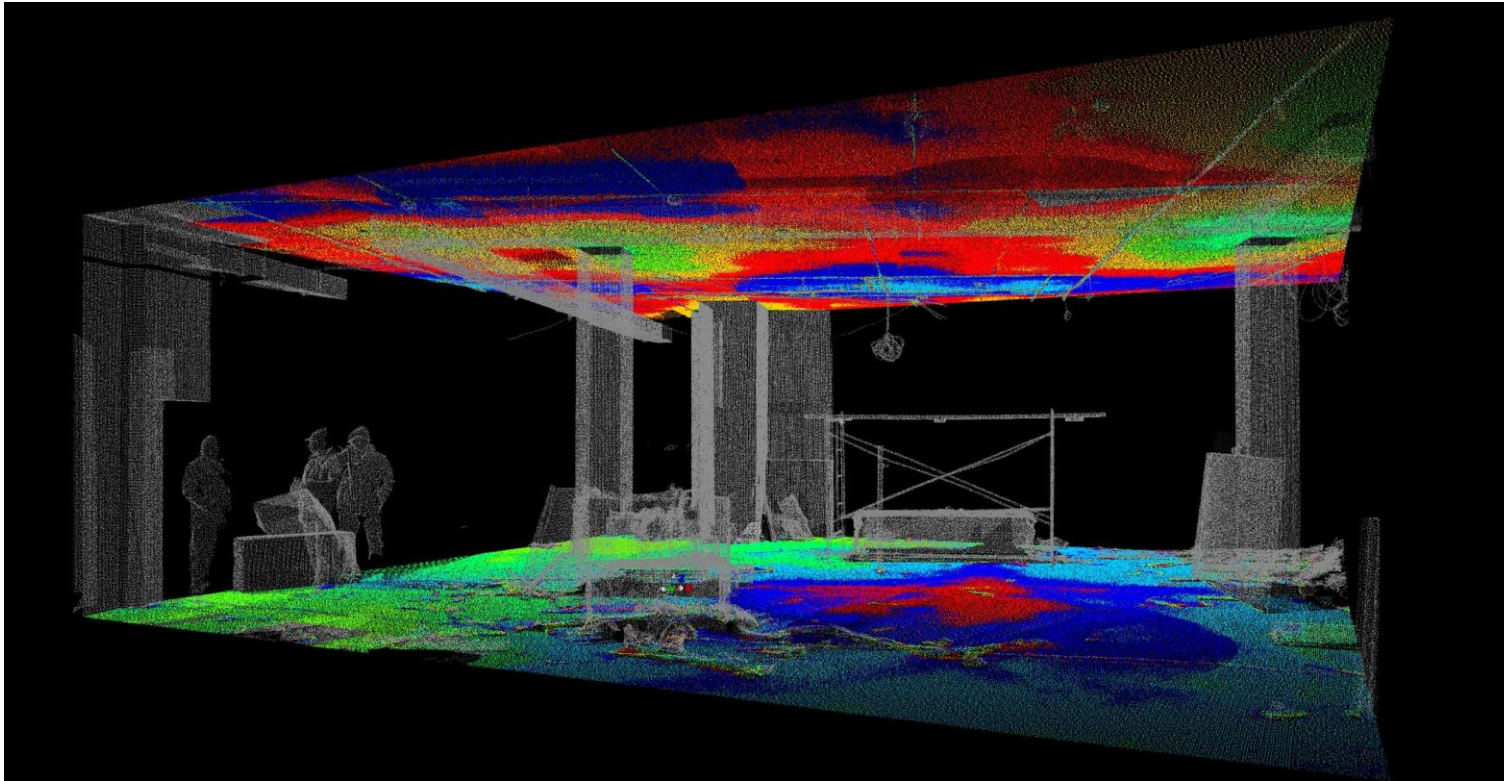
Examples ▶ Reinforcement



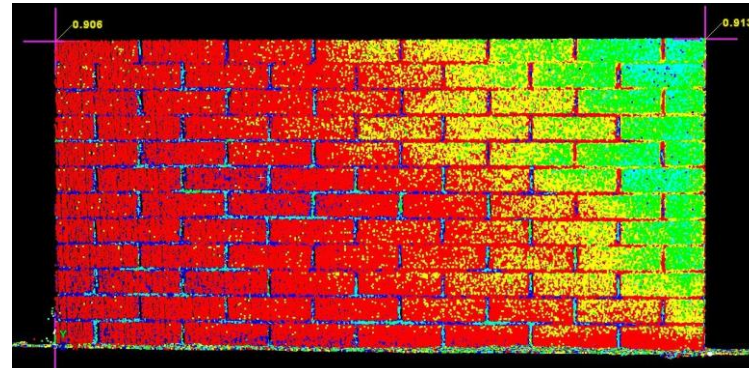
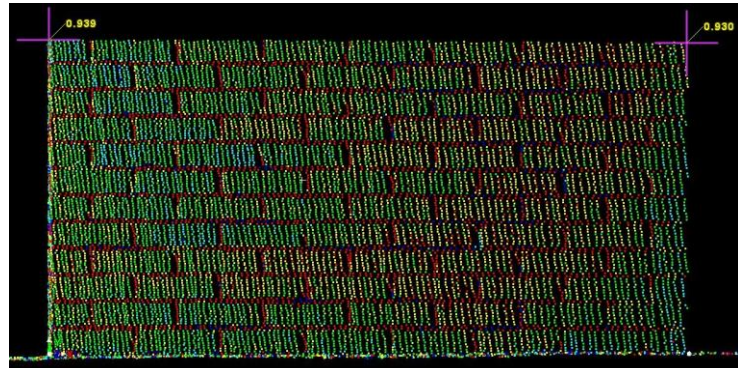
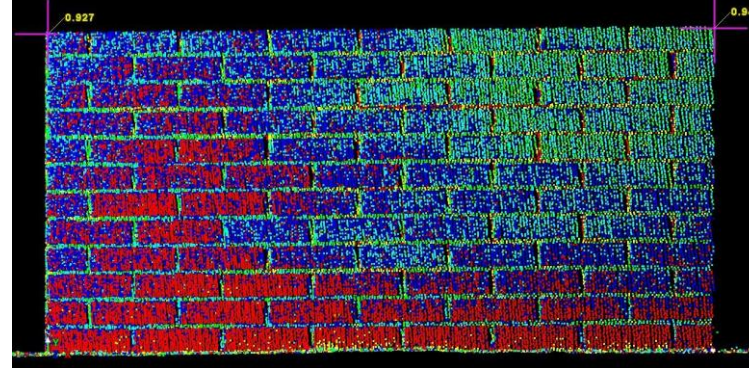
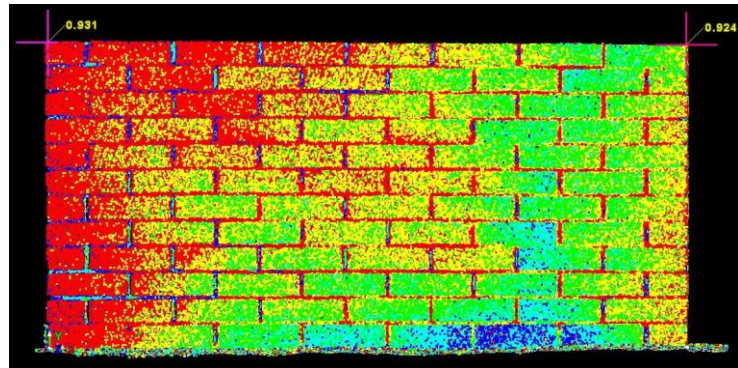
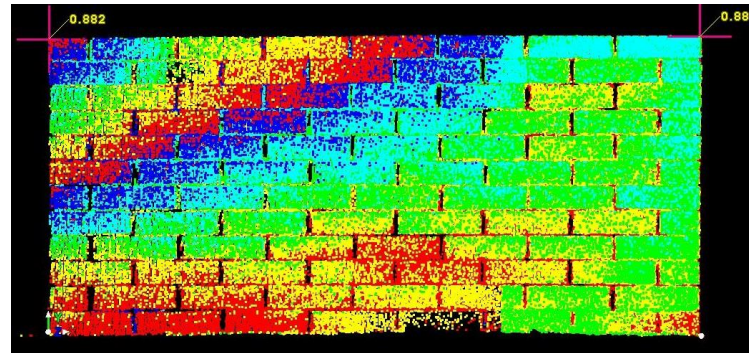
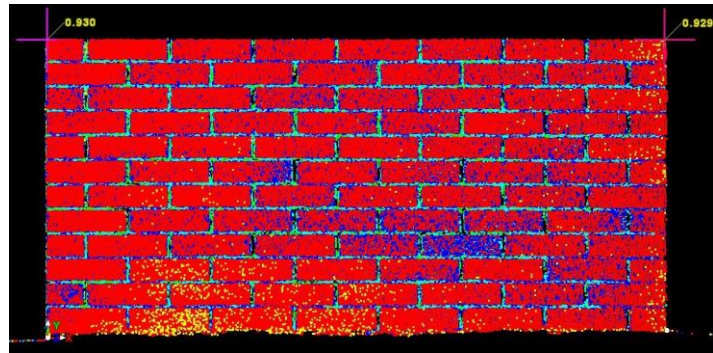
Examples ▶ Foundation plate



Examples ▶ Floor slabs, floors, ceilings

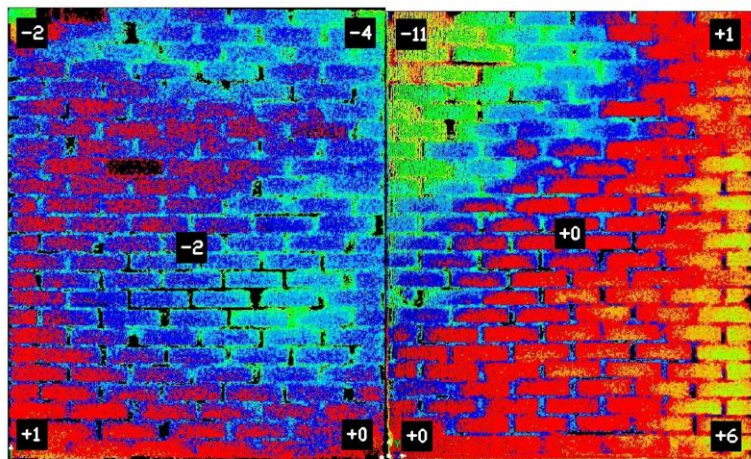


Examples ▶ Control of brick layout

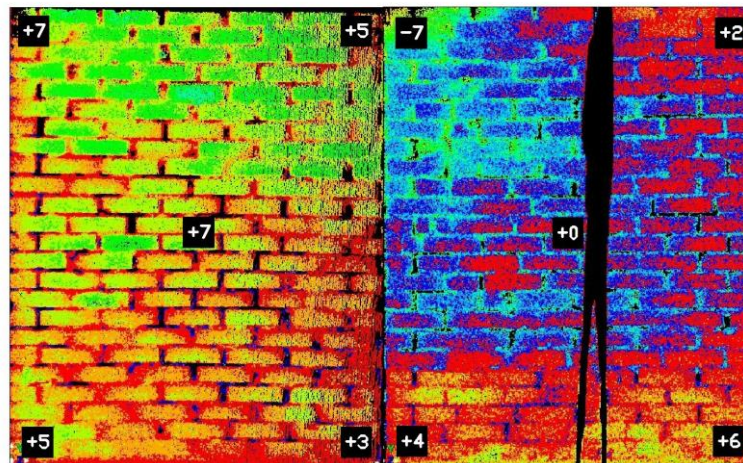


Examples ► Control of plastering (initial surface)

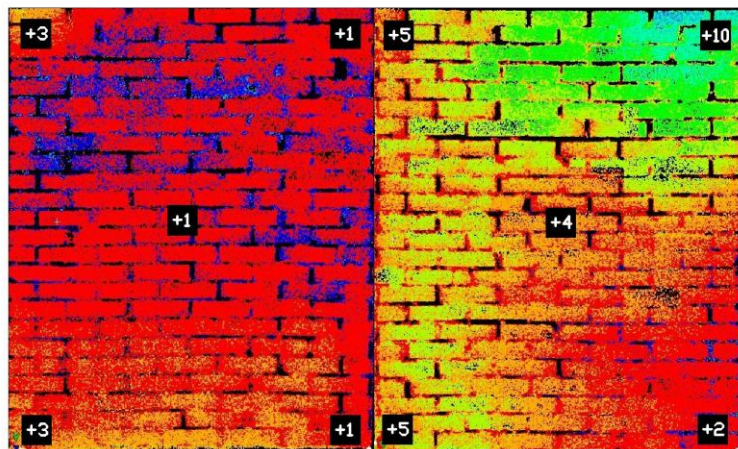
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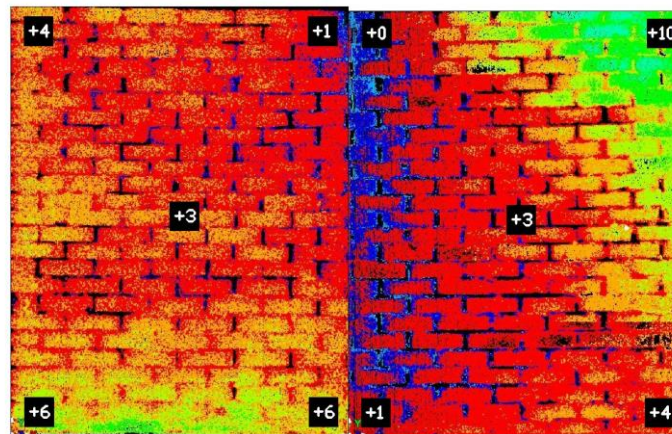
Номер 2



Номер 3

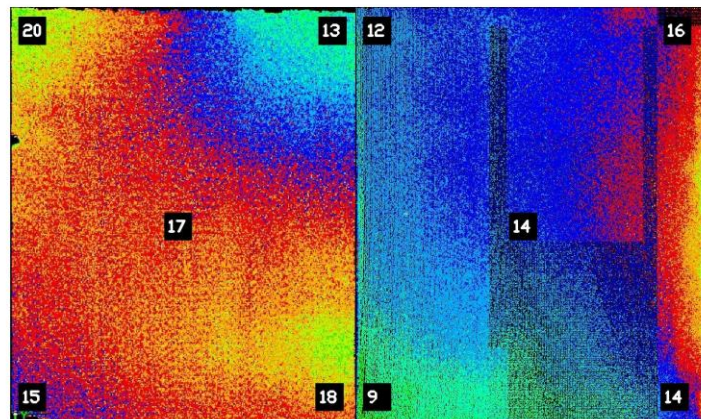


Номер 4

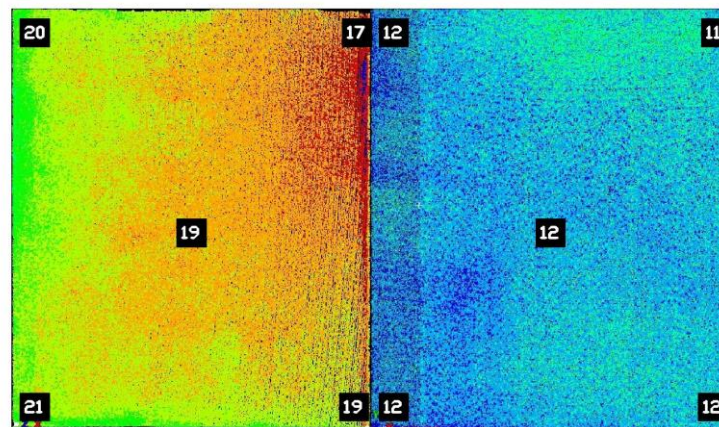


Examples ▶ Control of plastering (final surface)

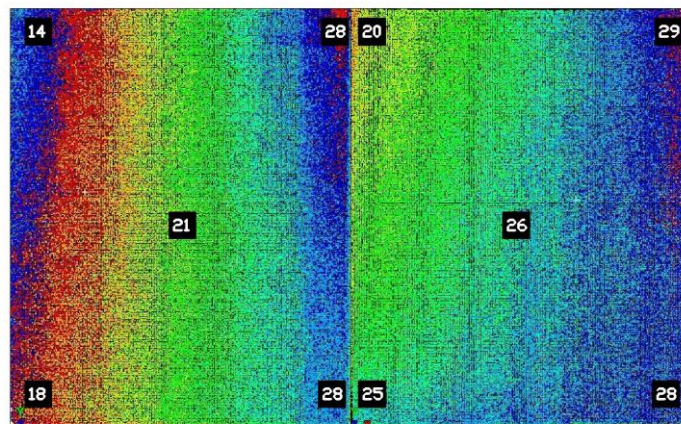
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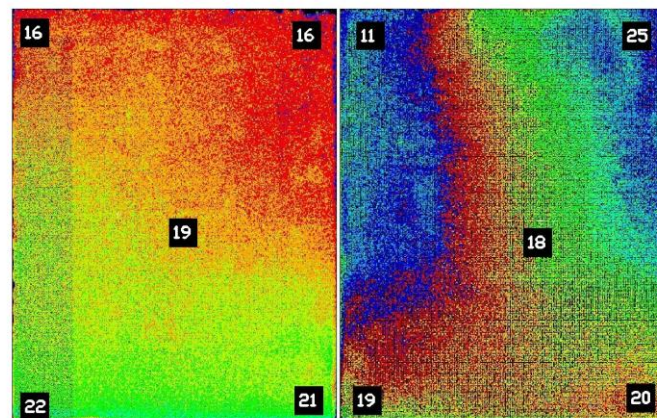
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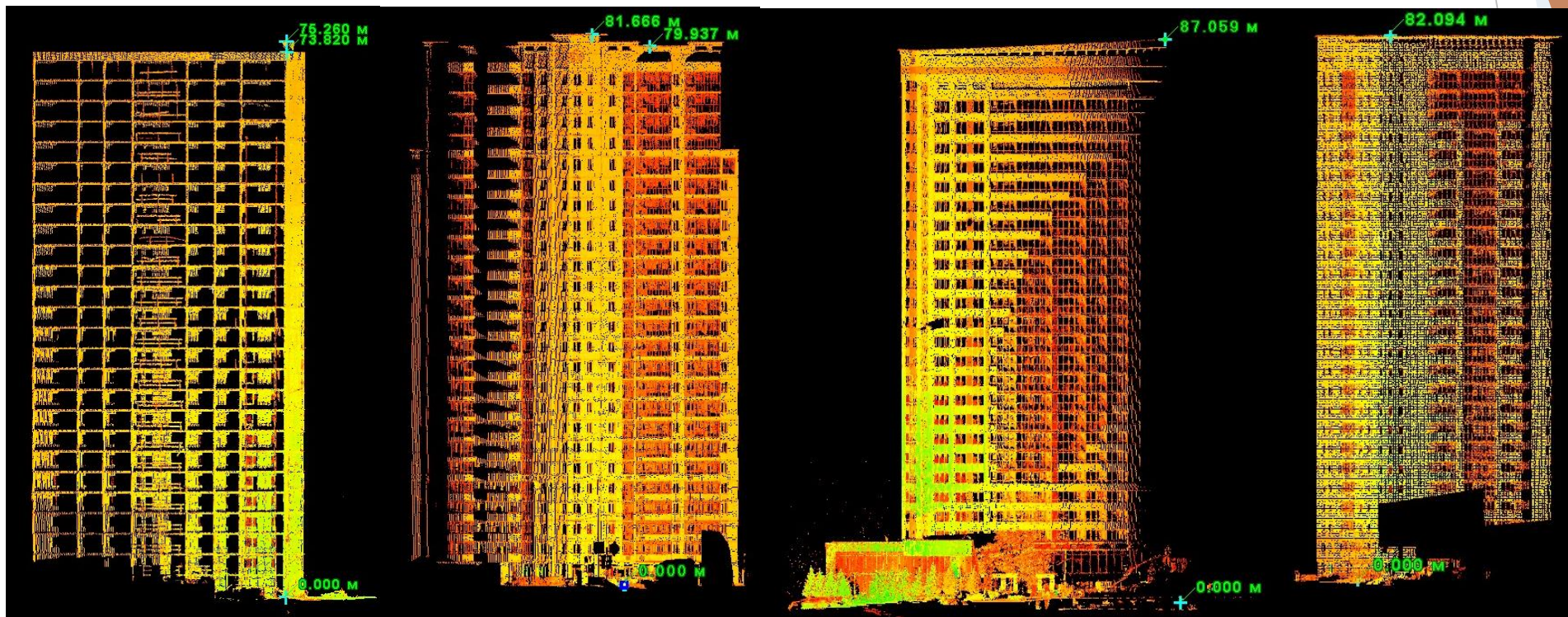
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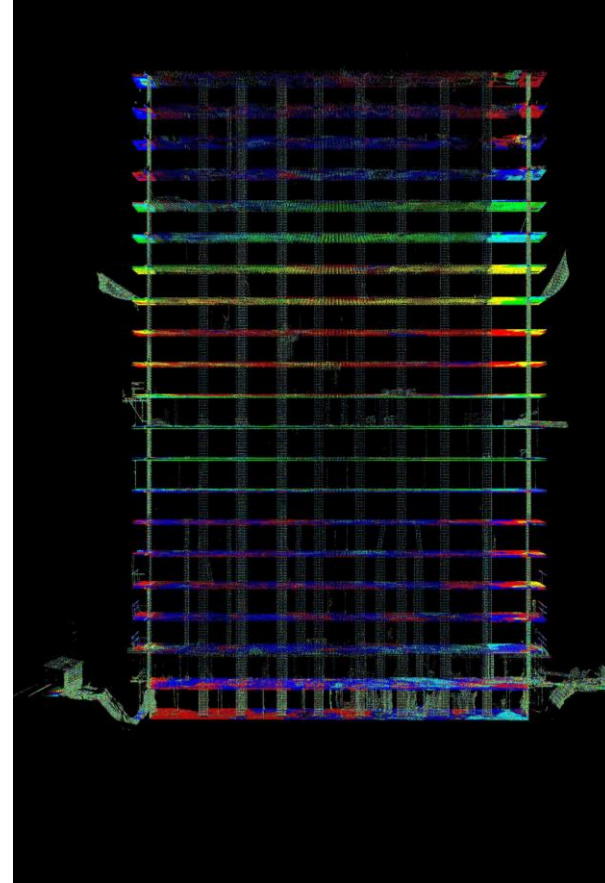
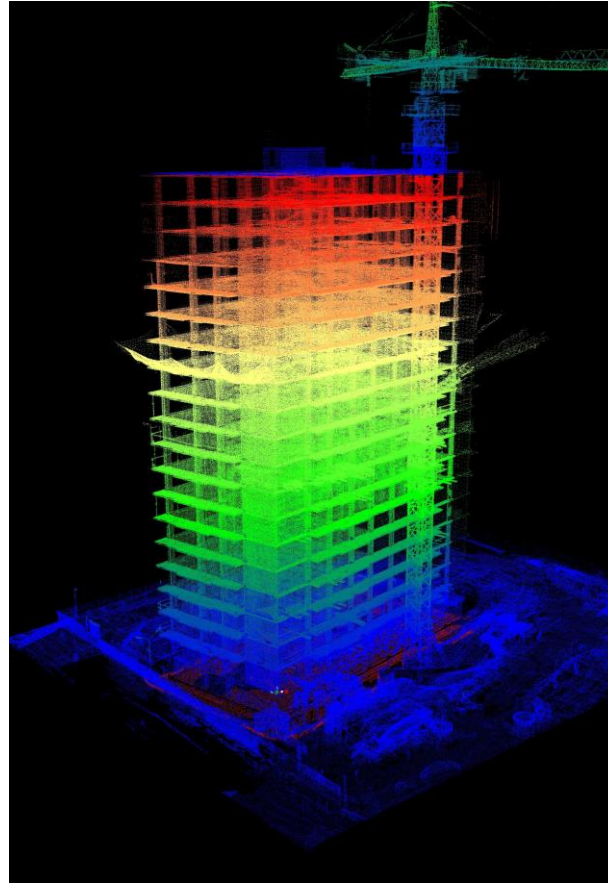
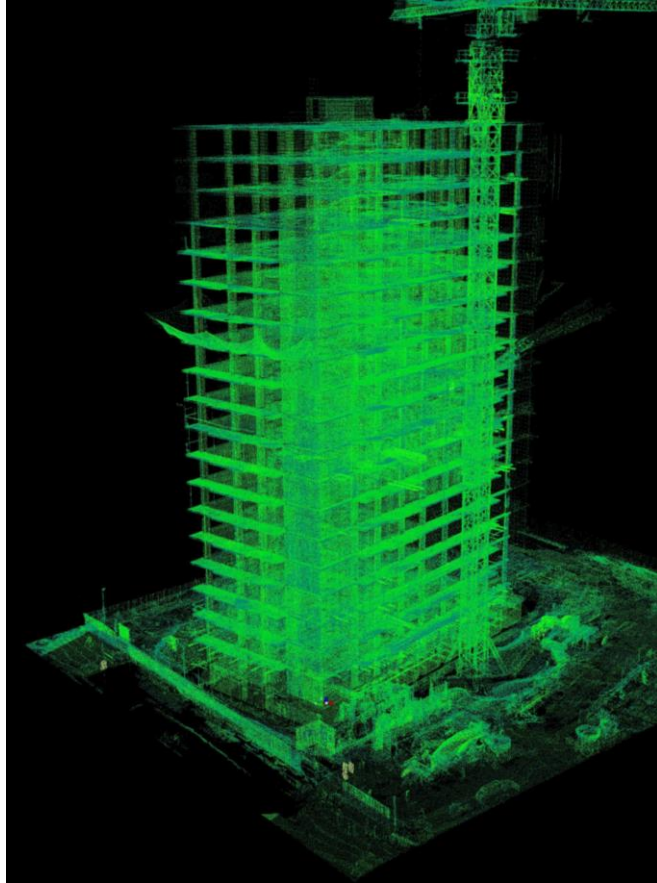
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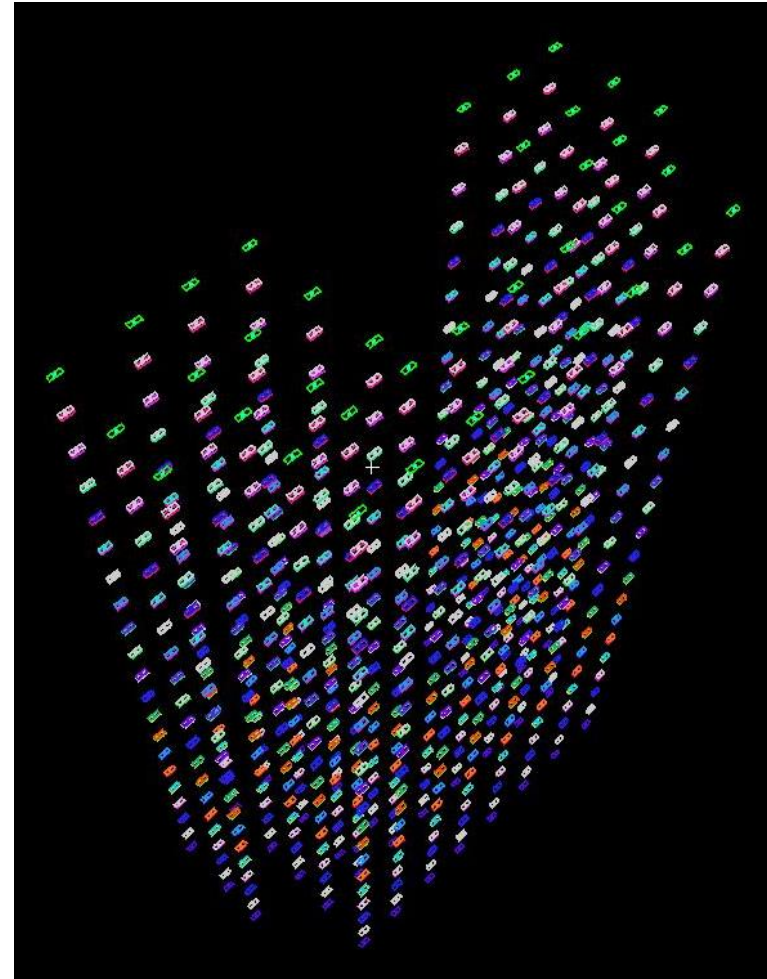
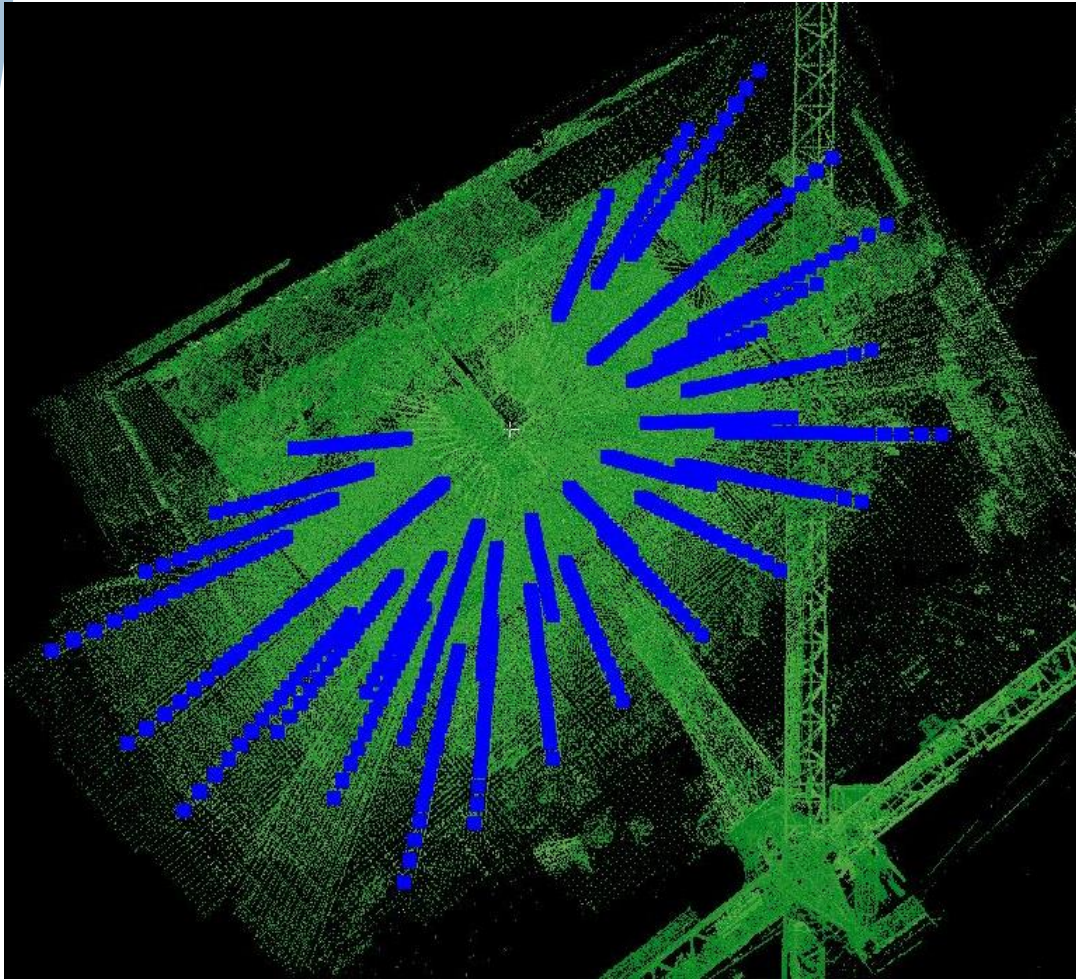
Examples ► Buildings



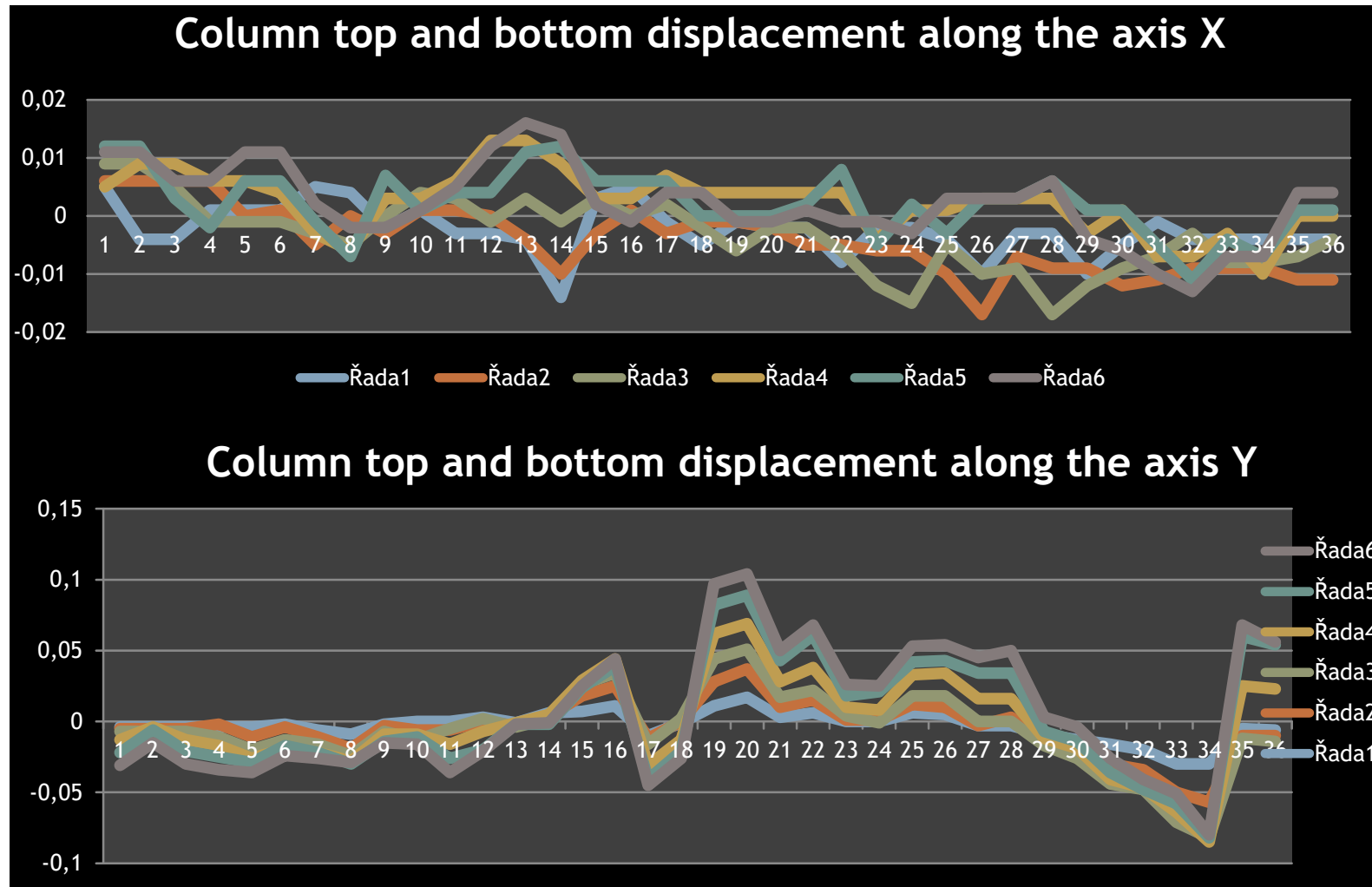
Examples ► A scanned building from different angles



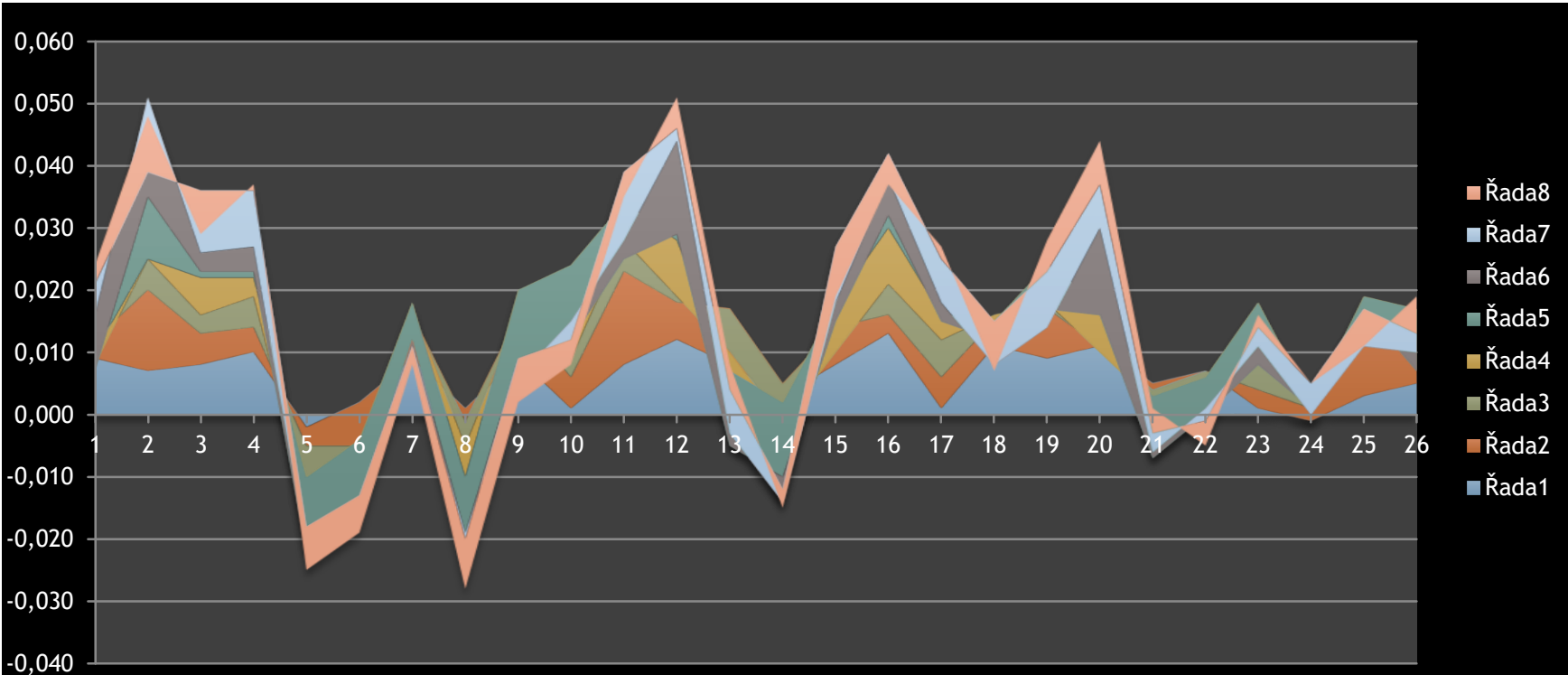
Examples A scanned building from different angles



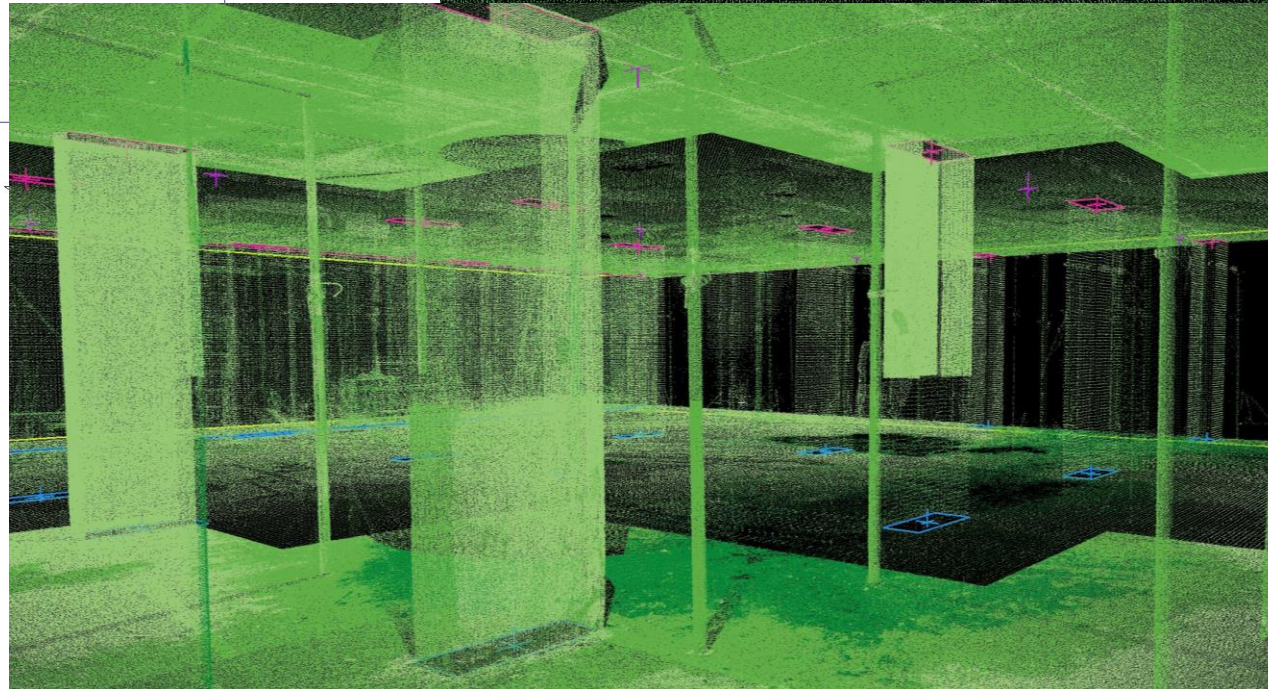
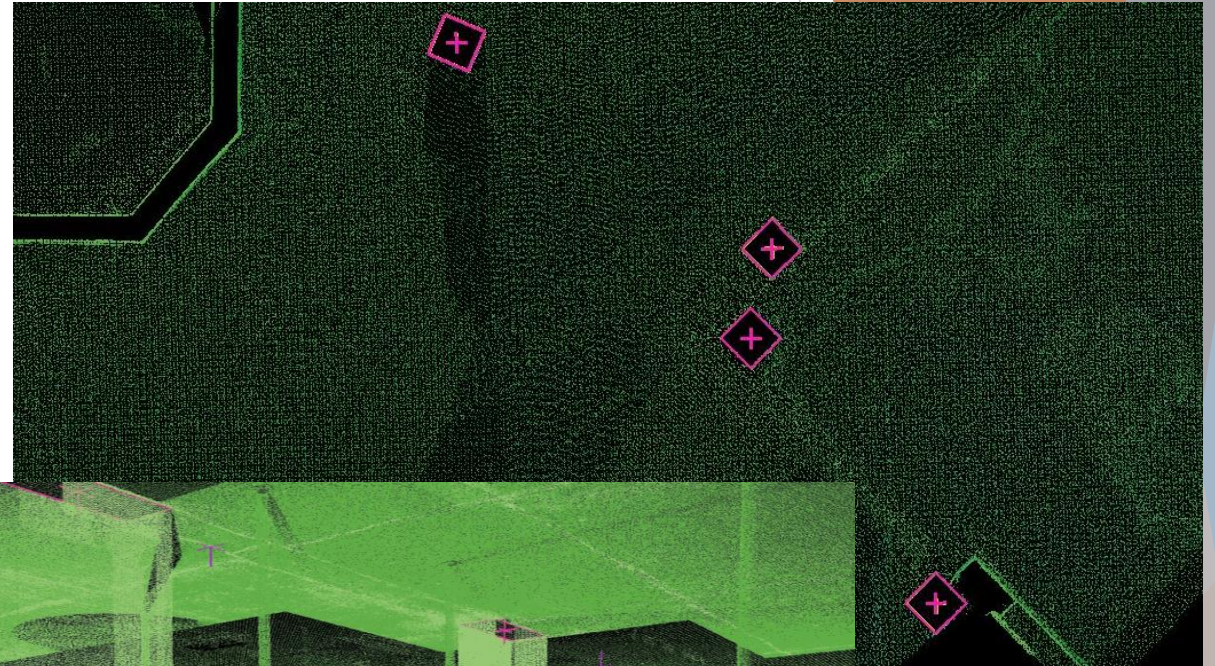
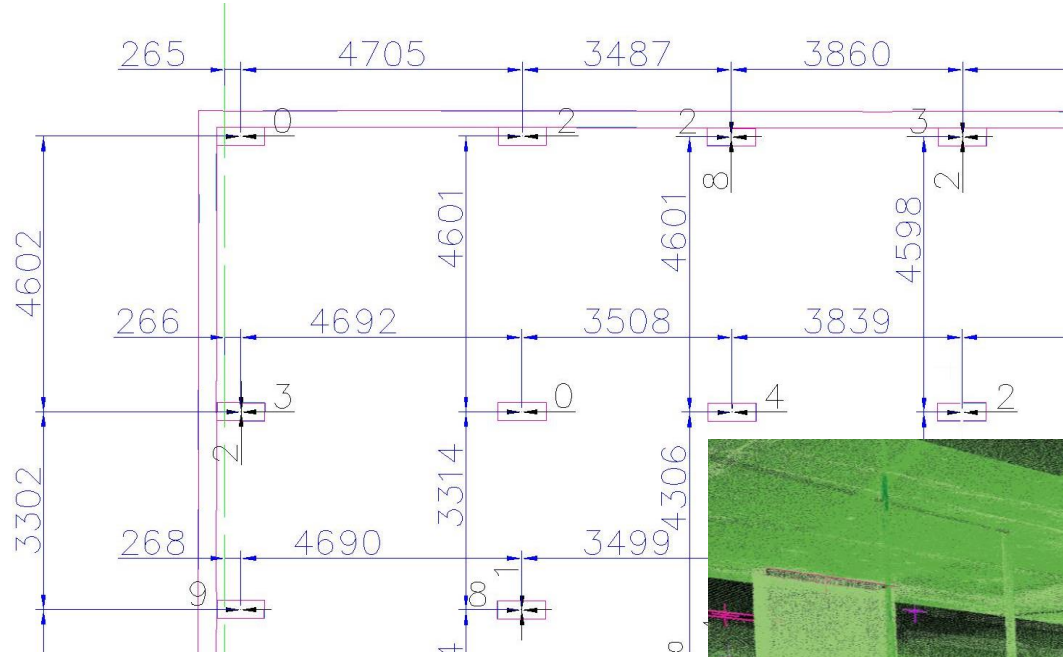
Examples ► A plot of floor thickness deviation



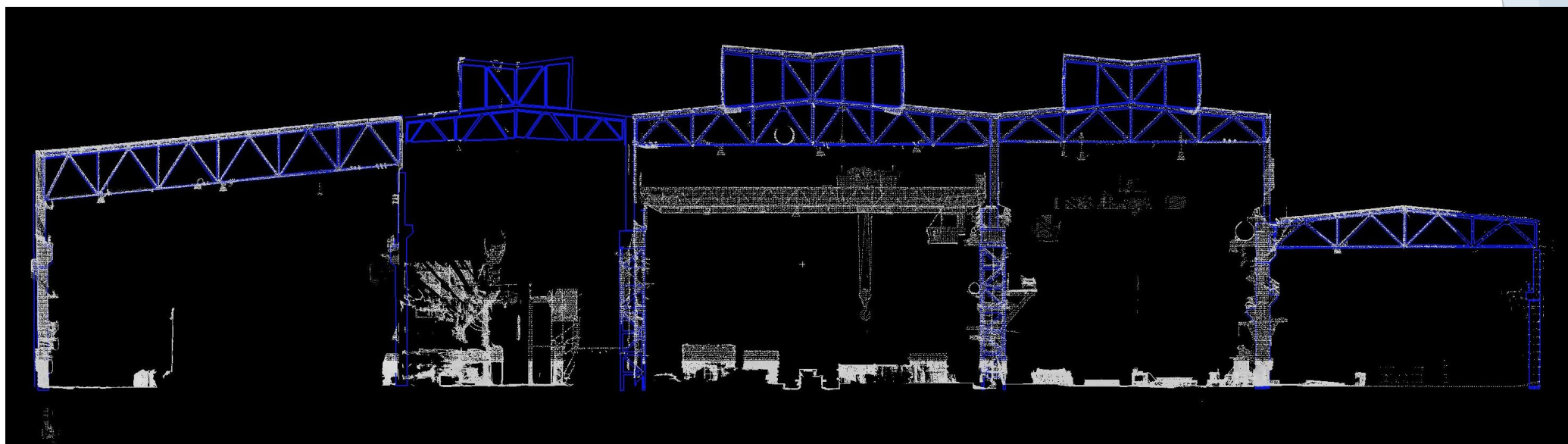
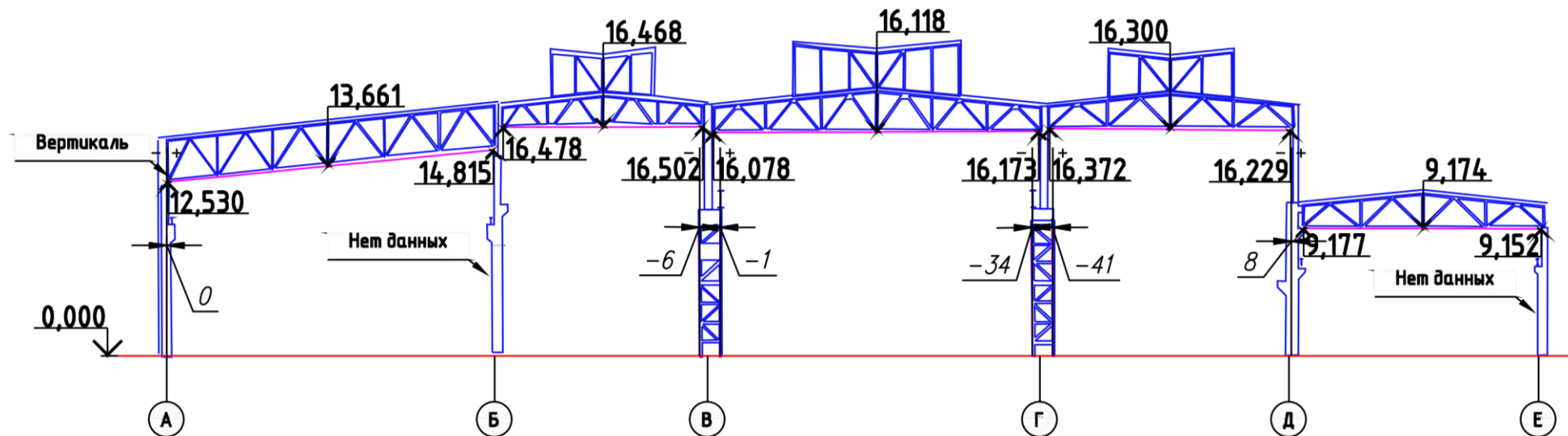
Examples ▶ A plot of floor thickness deviation



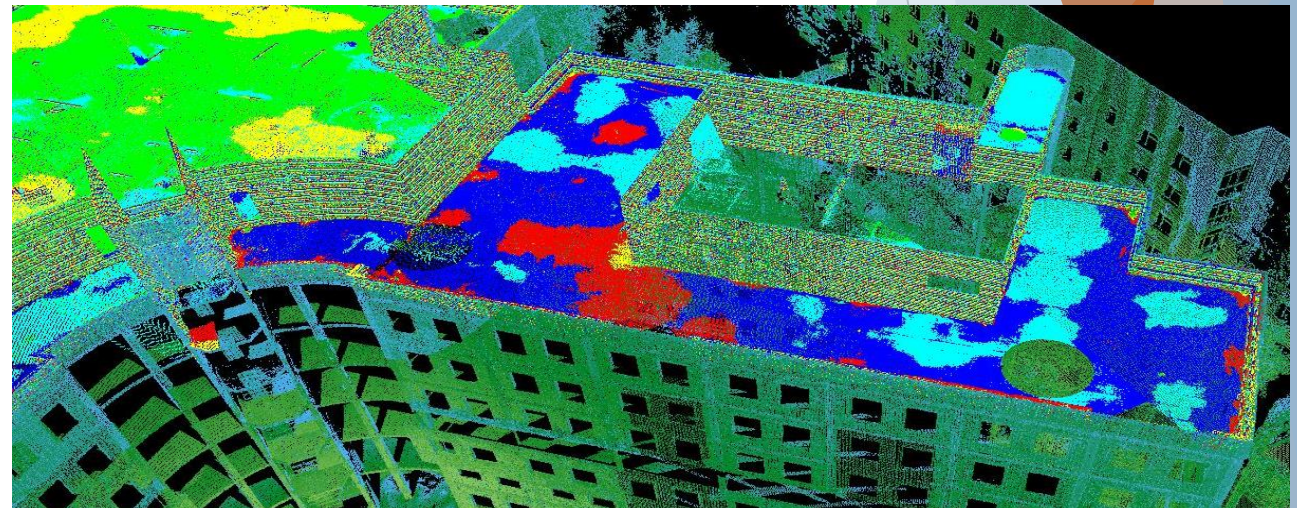
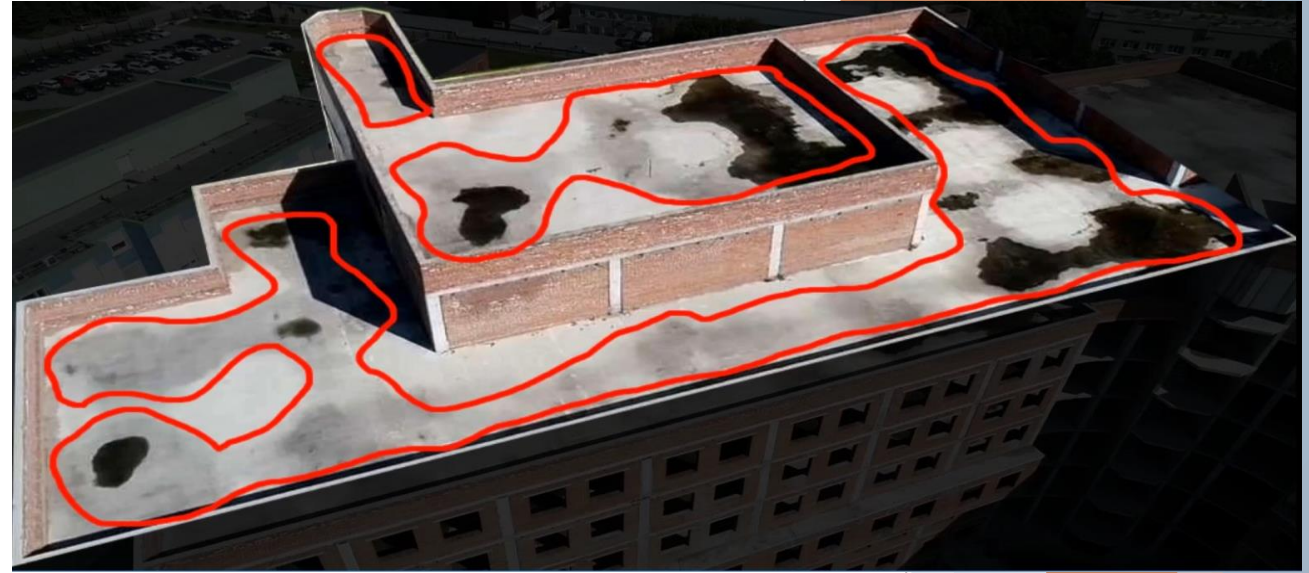
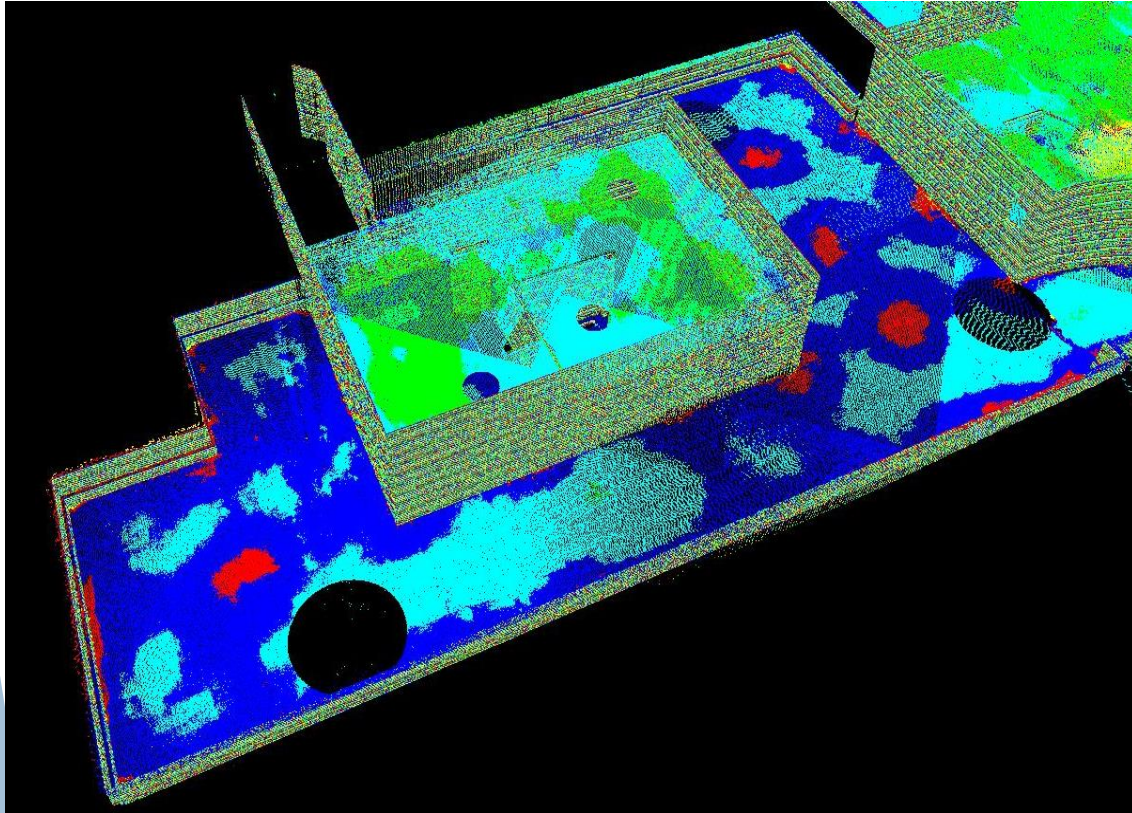
Examples ► Premises sizes



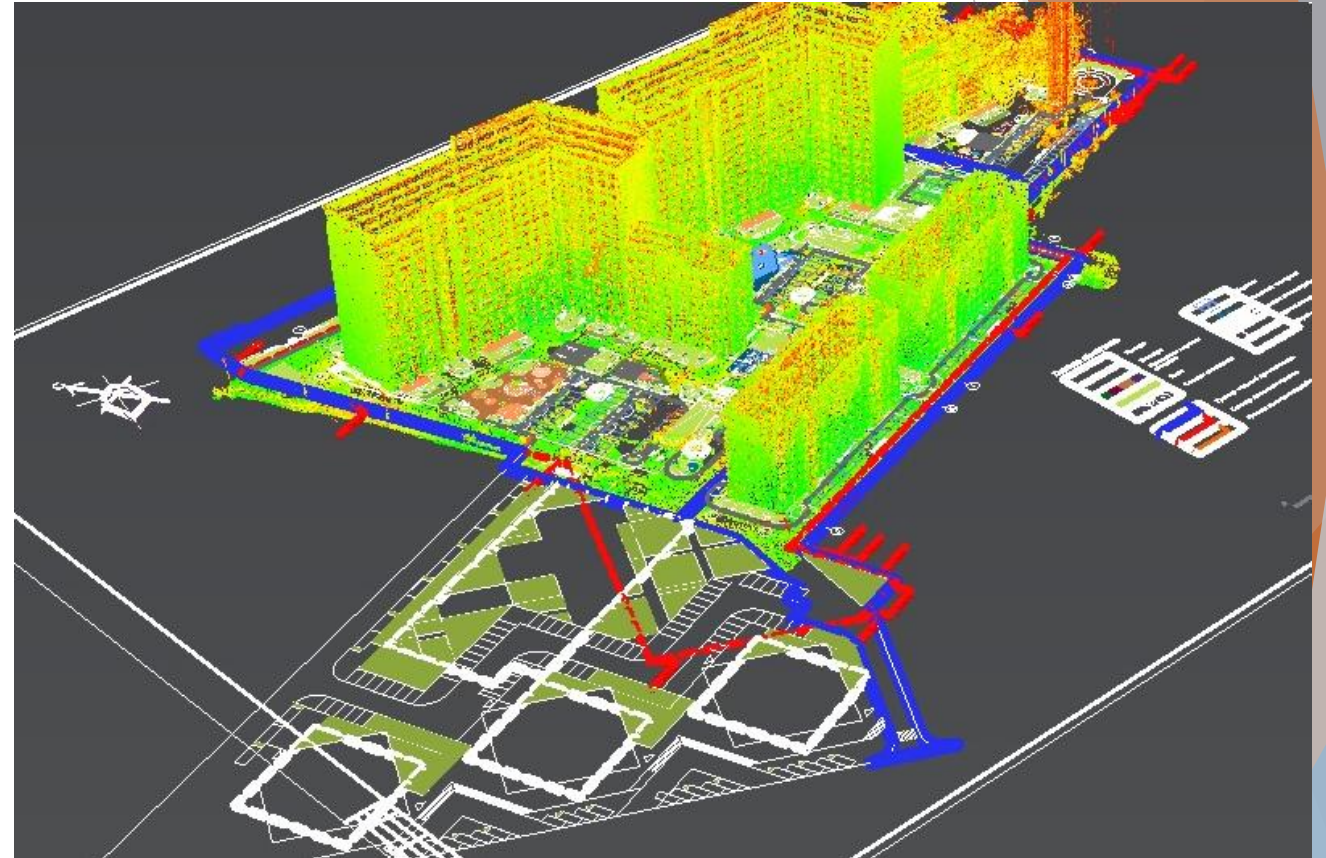
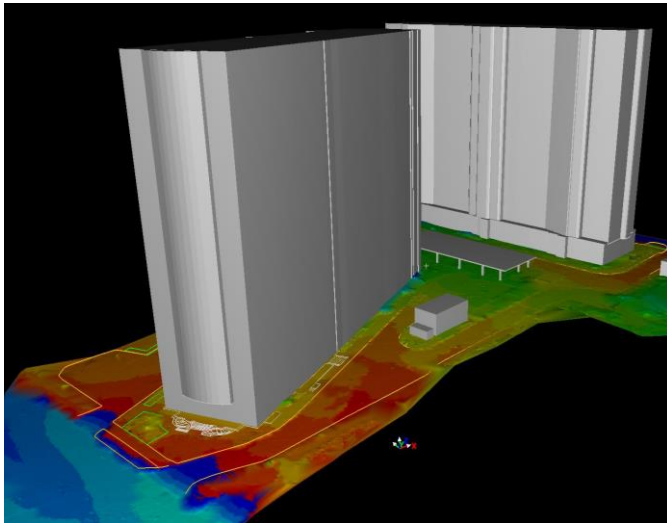
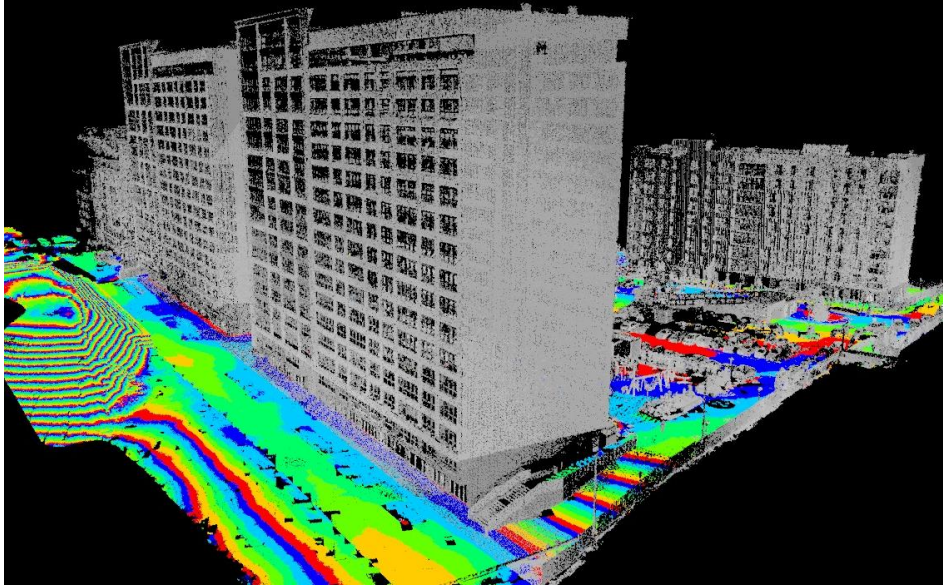
Examples ► Girders and beams



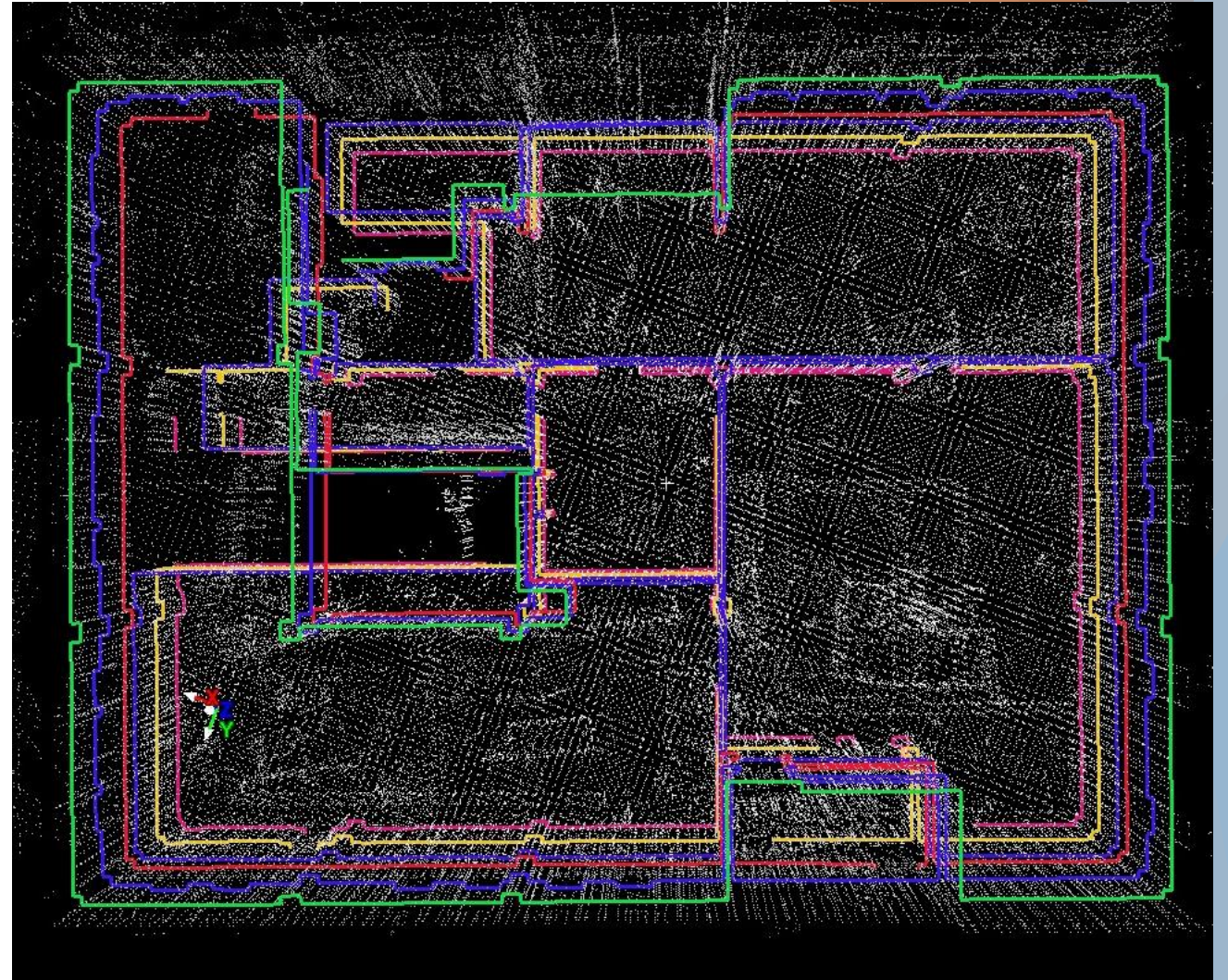
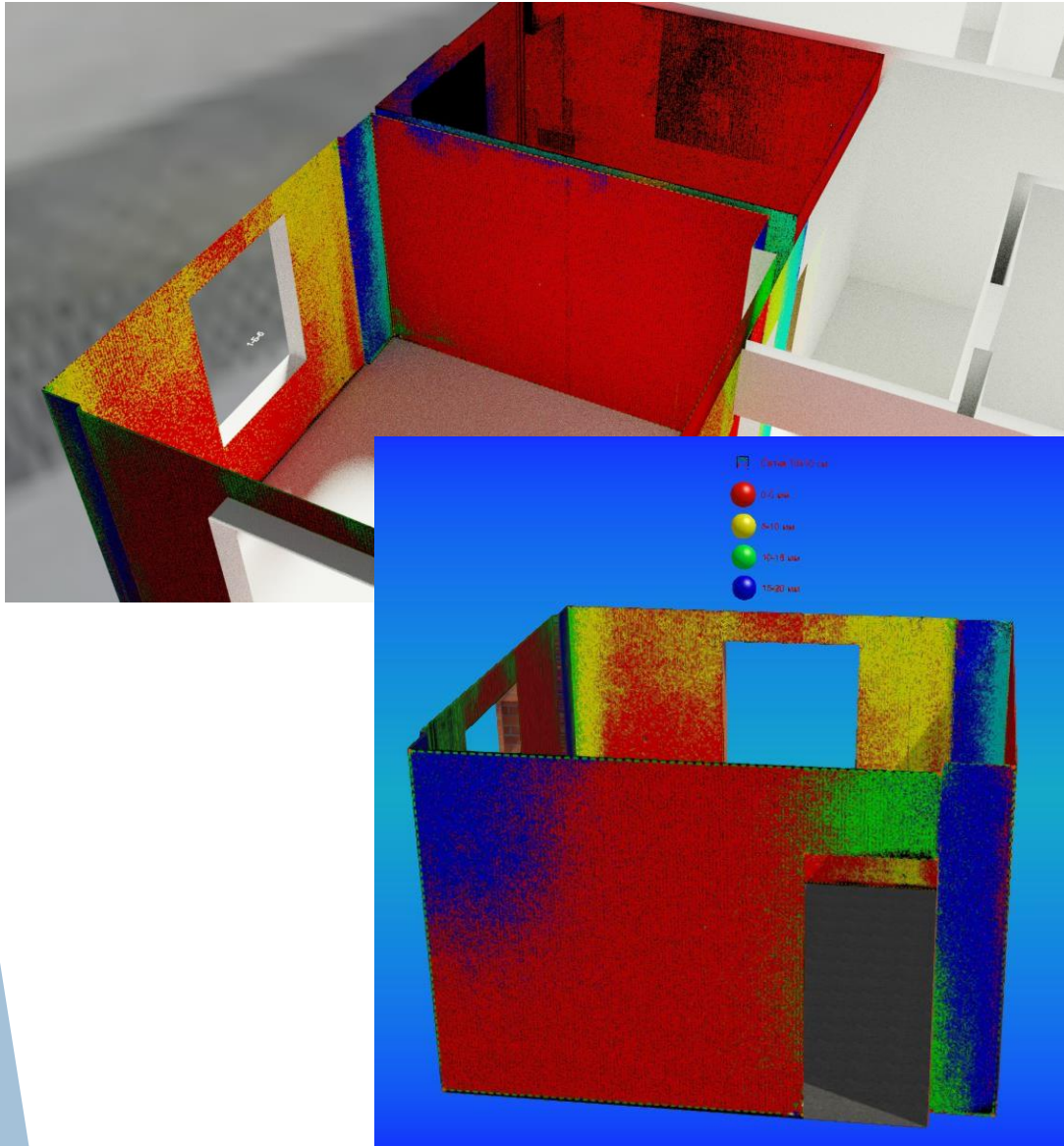
Examples ▶ Roof and roof coating



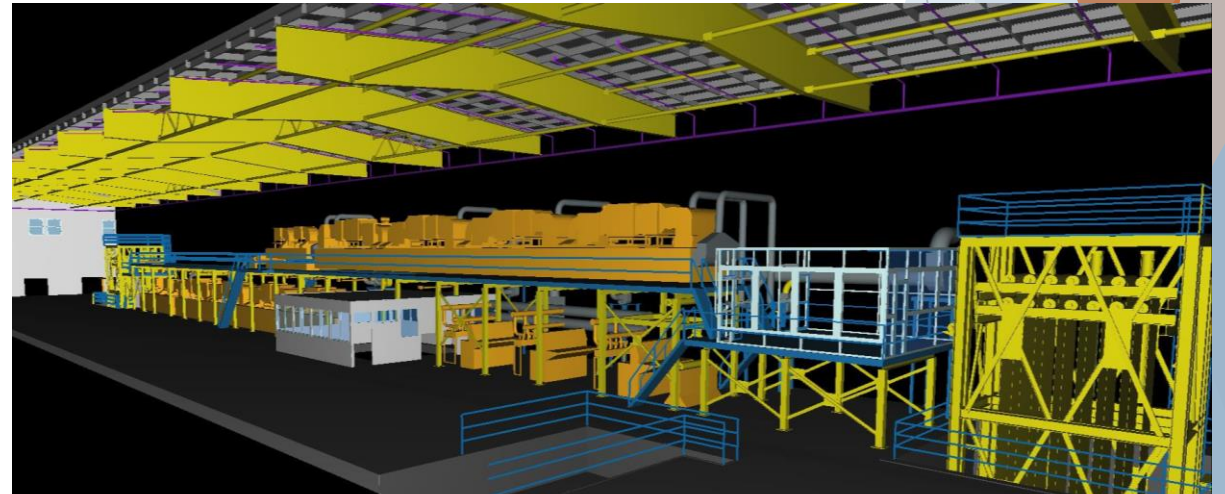
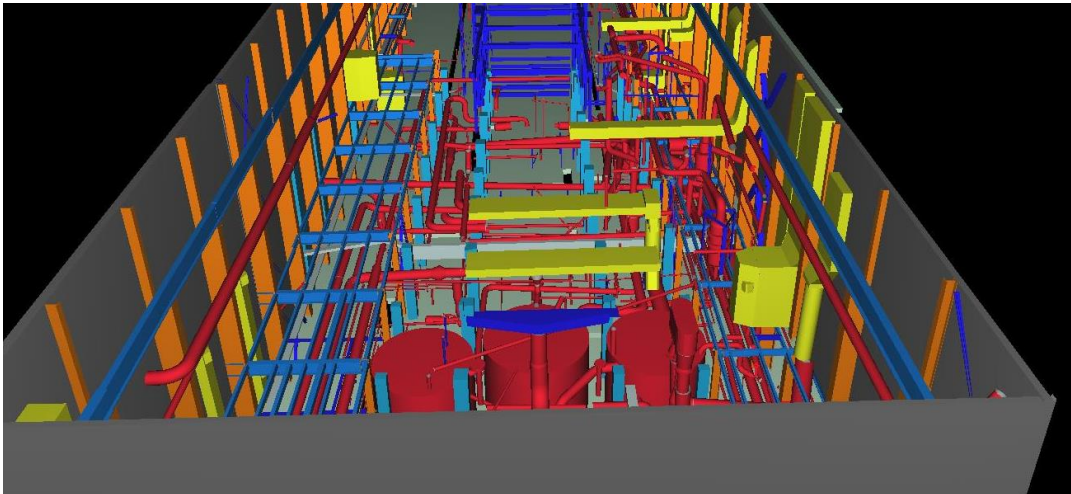
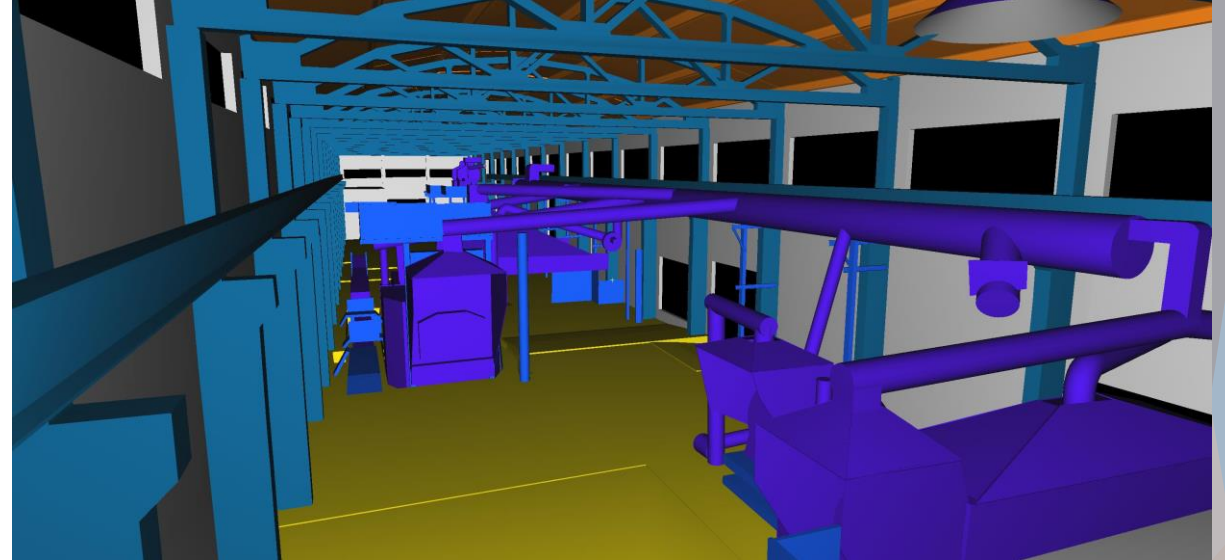
Examples Construction site



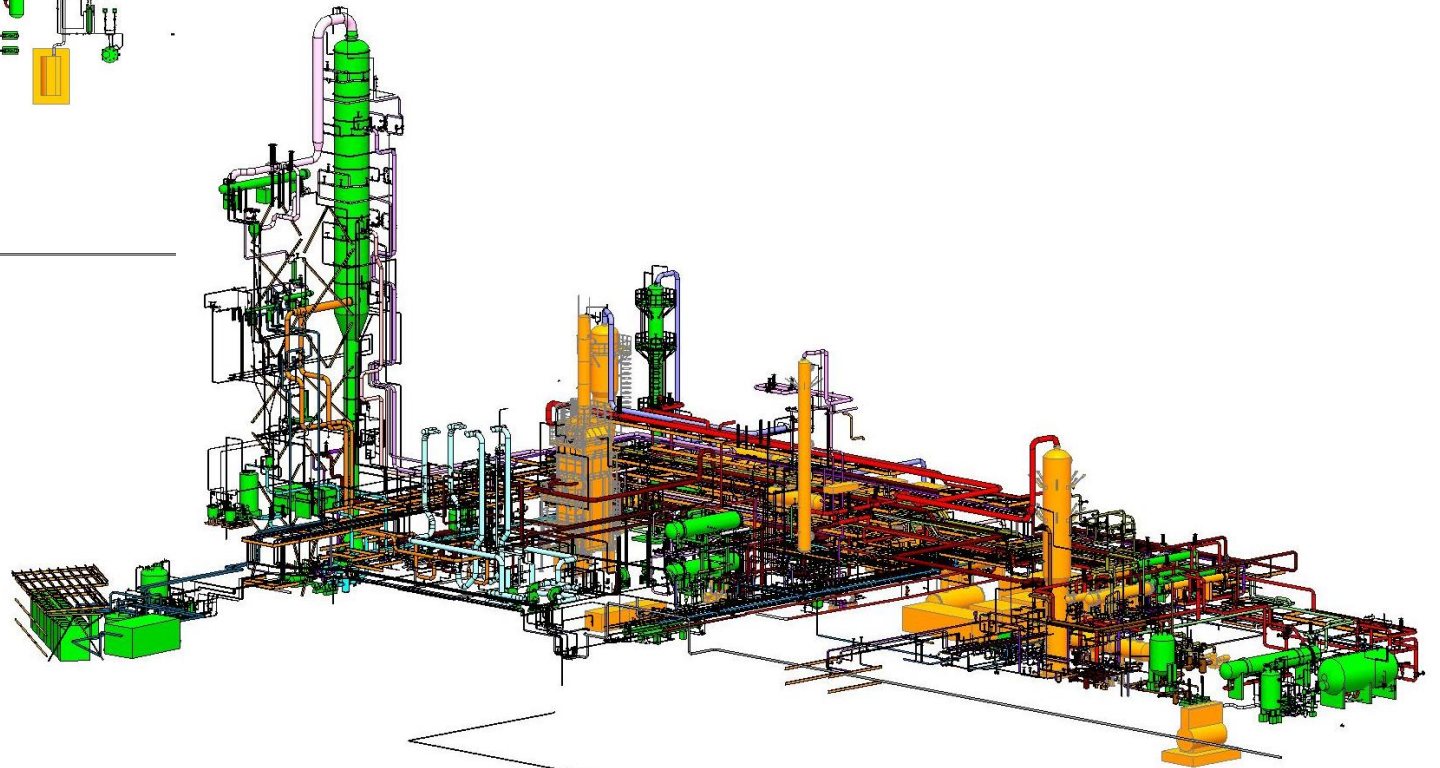
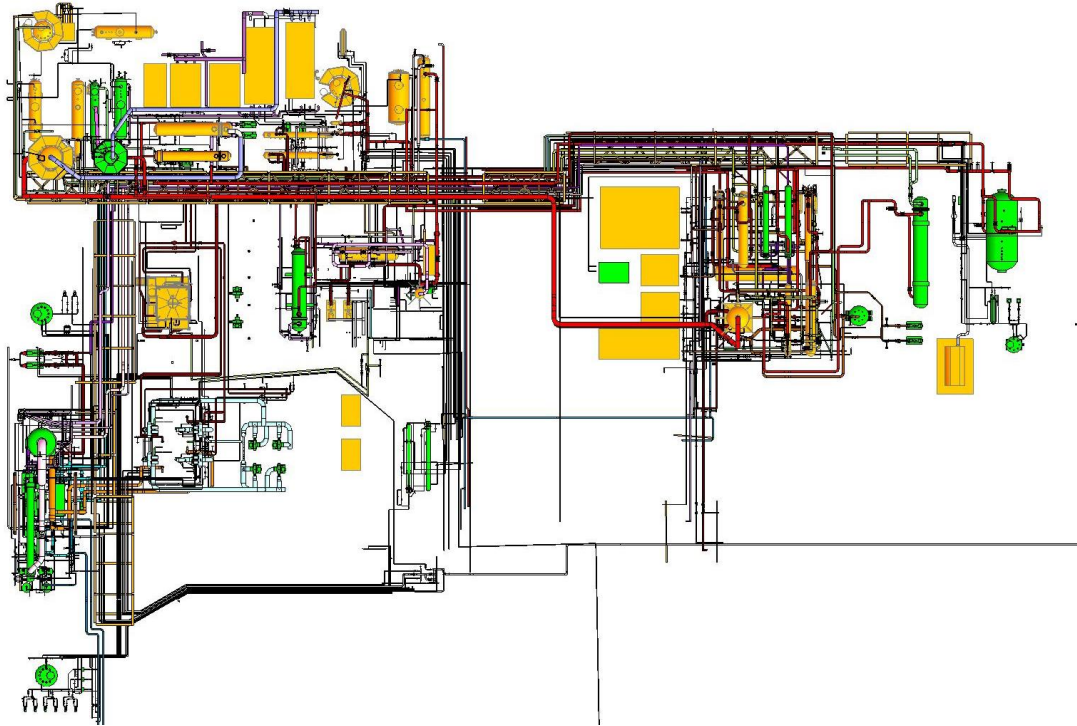
Examples ► Premises



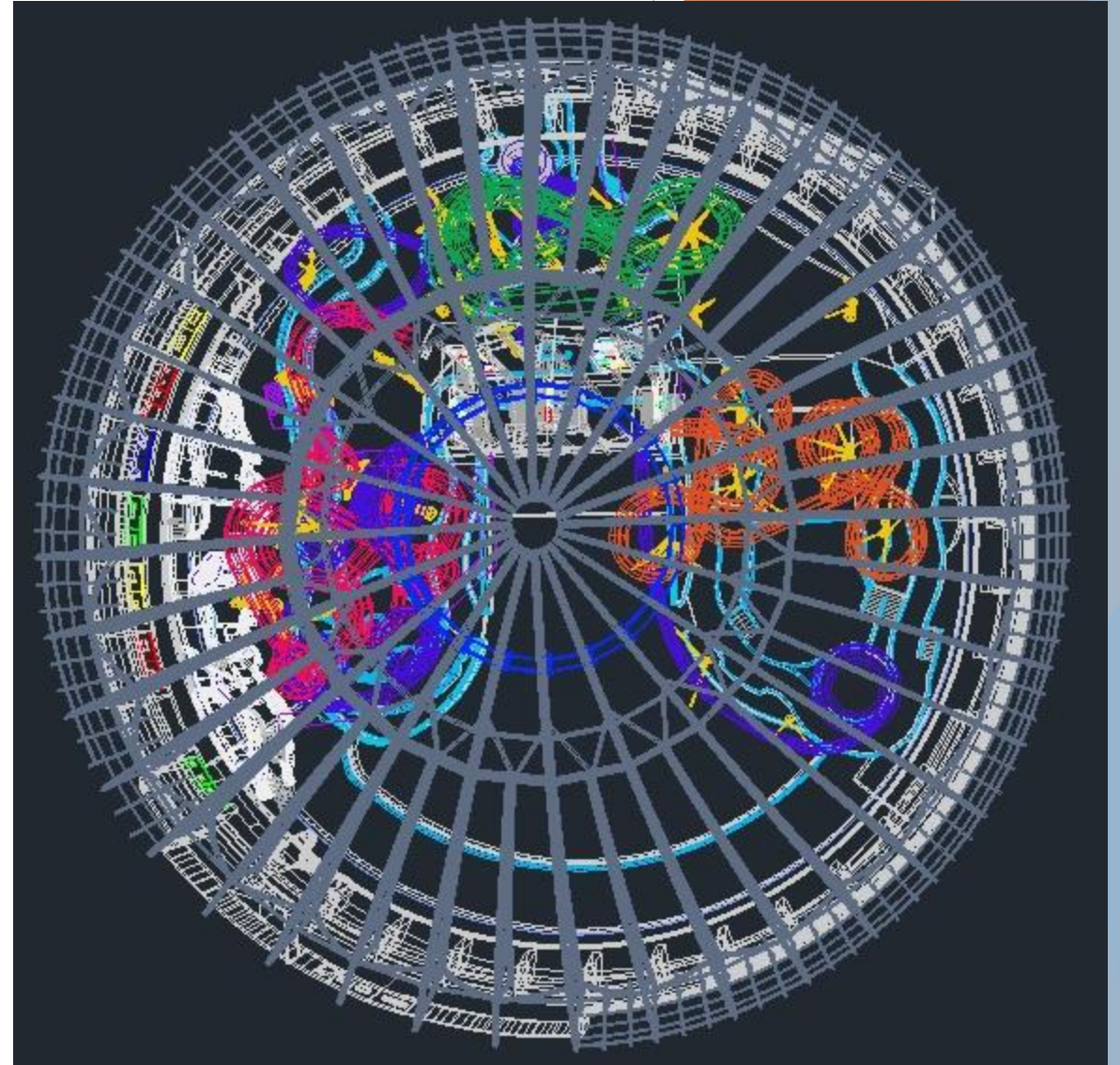
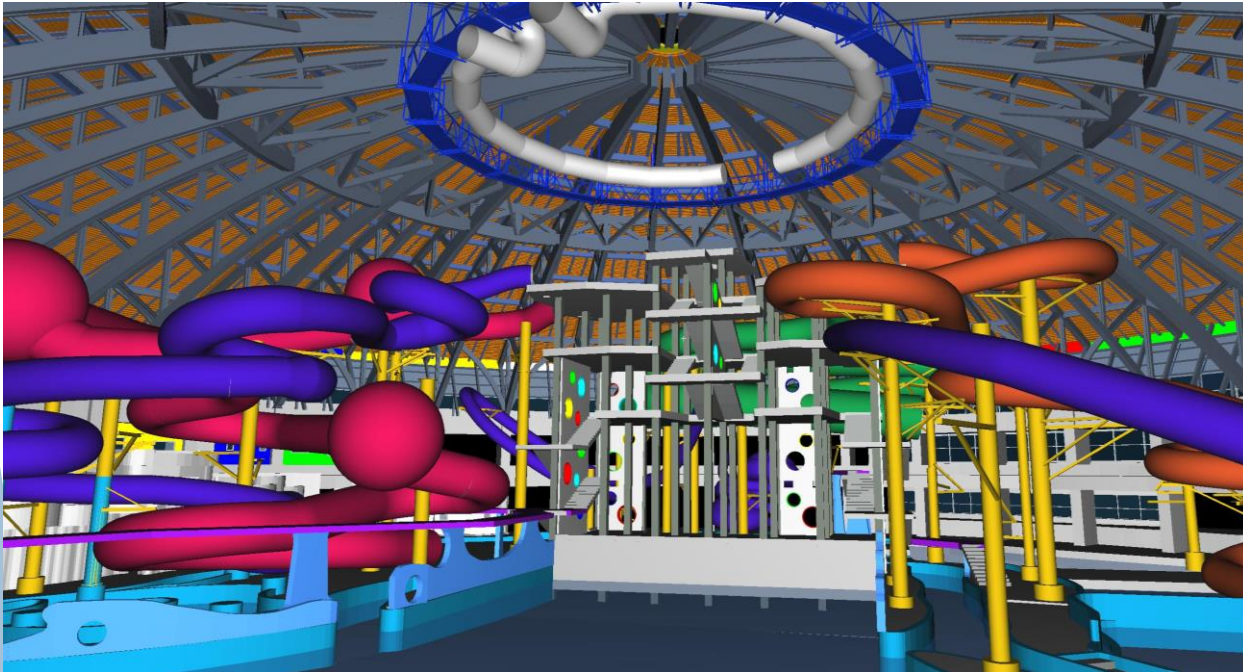
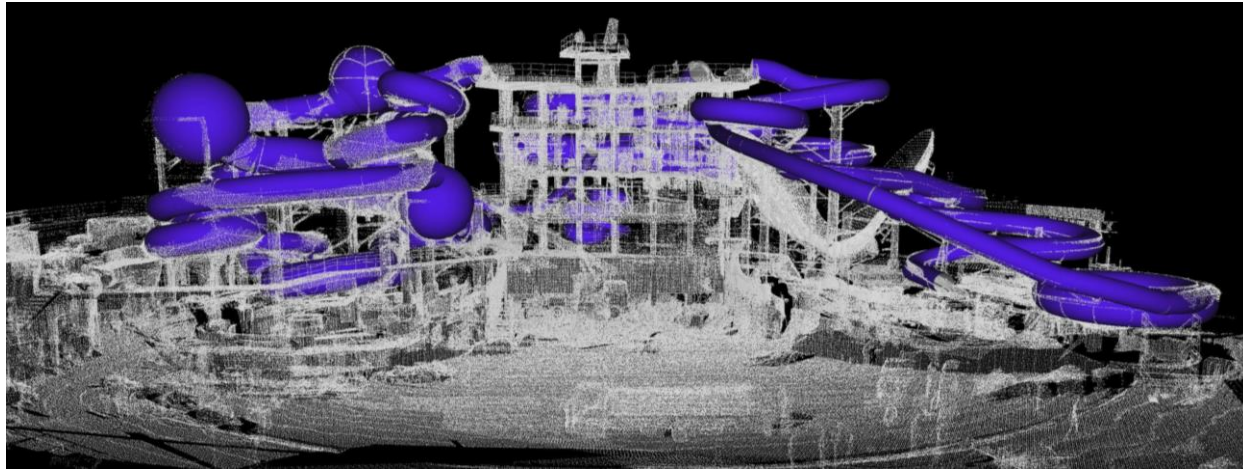
Examples ► Industrial facilities



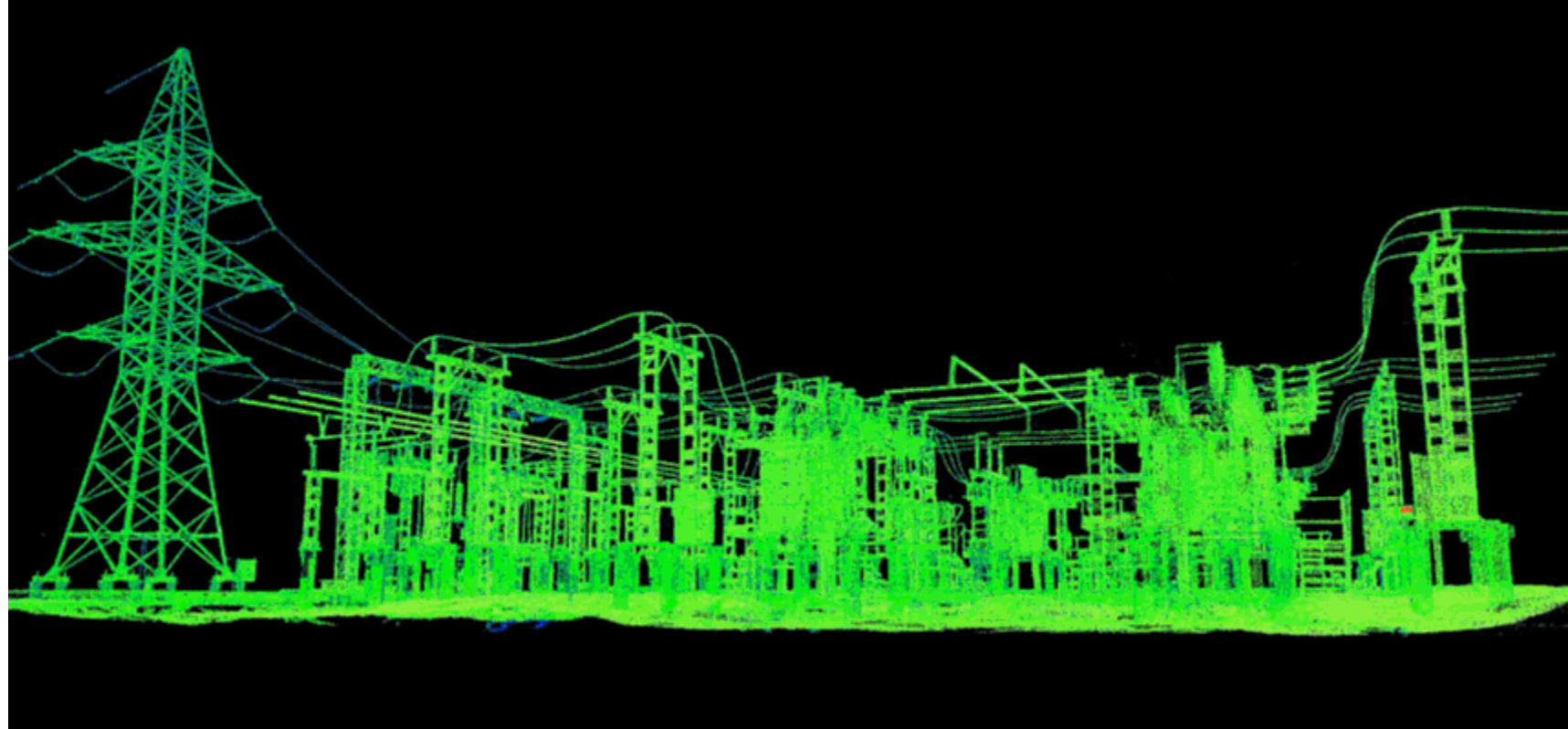
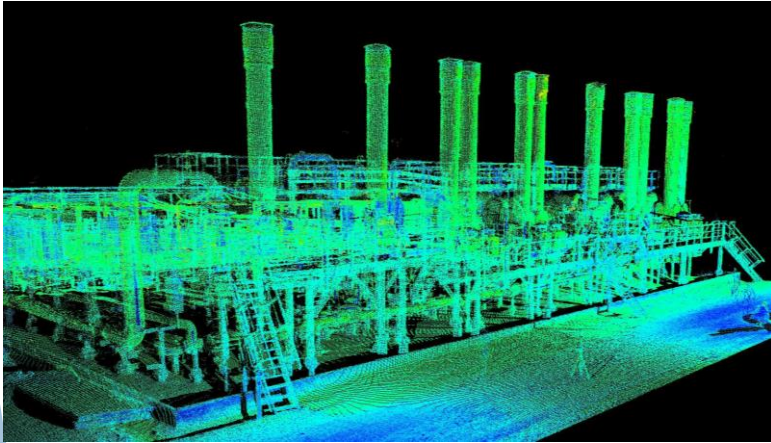
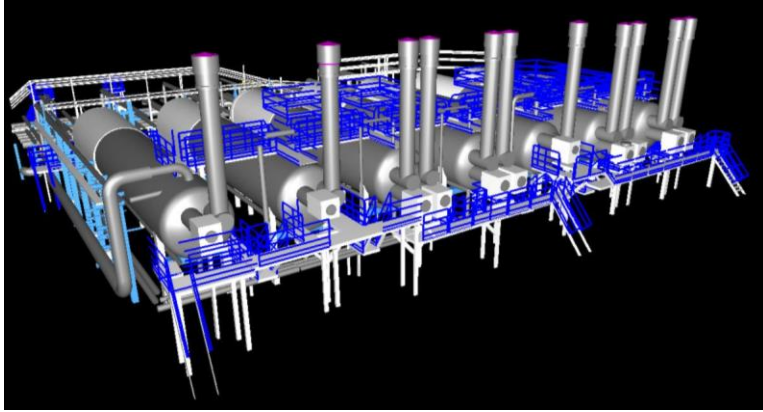
Examples ▶ Production facilities



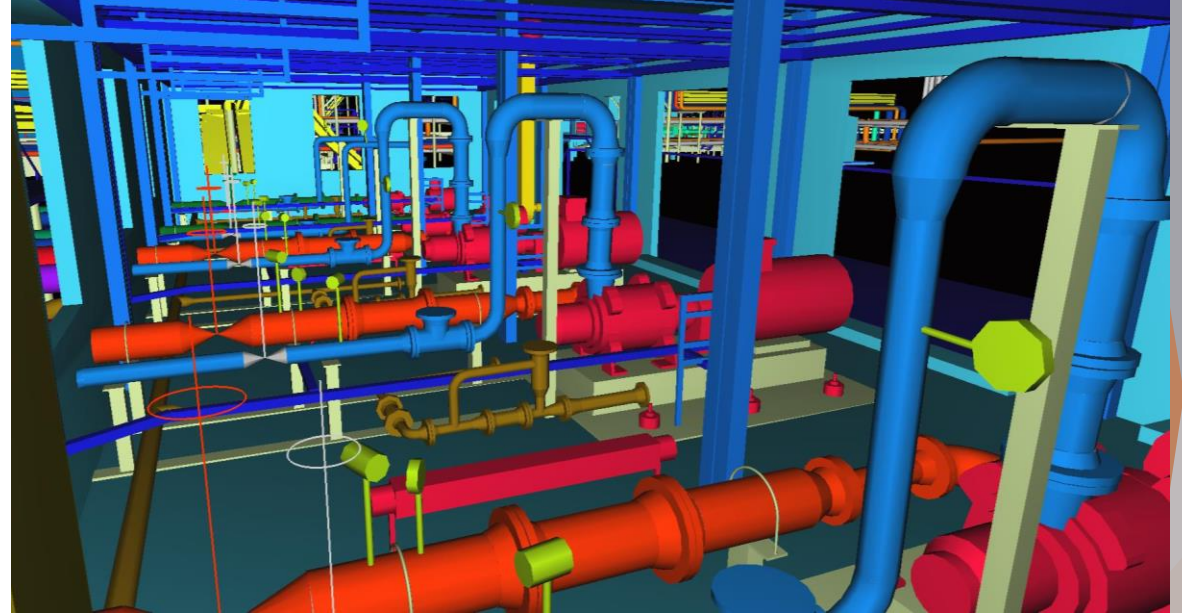
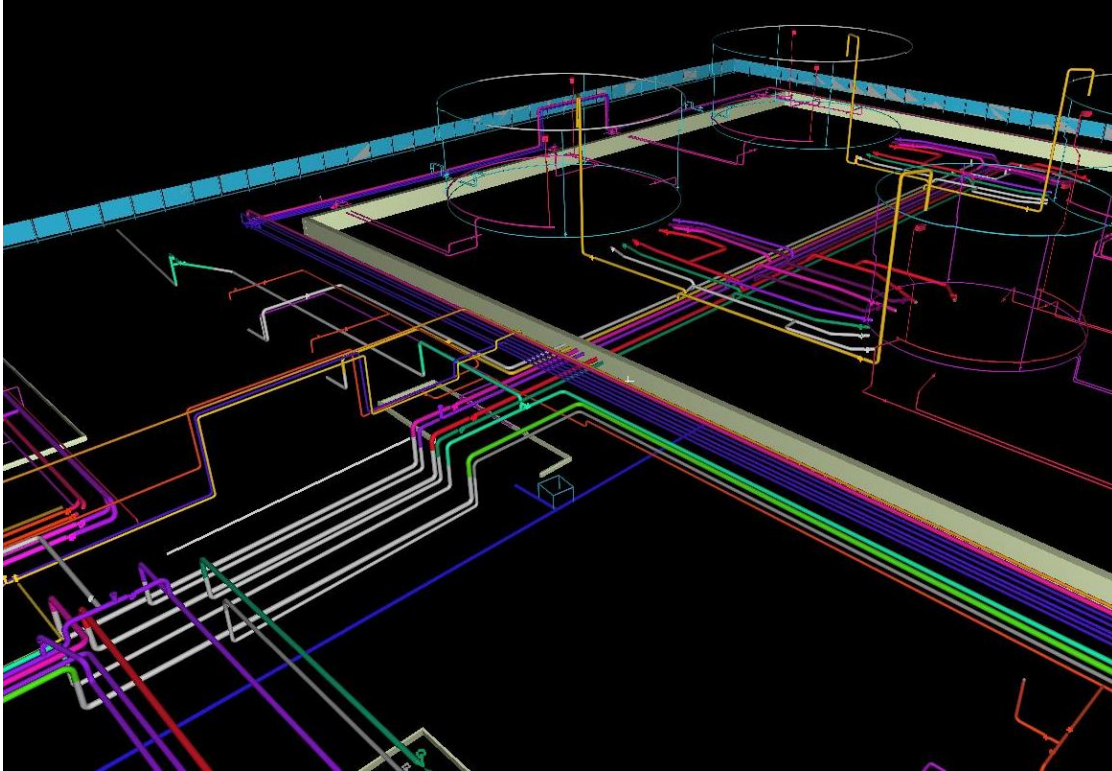
Examples ► Socially significant facilities



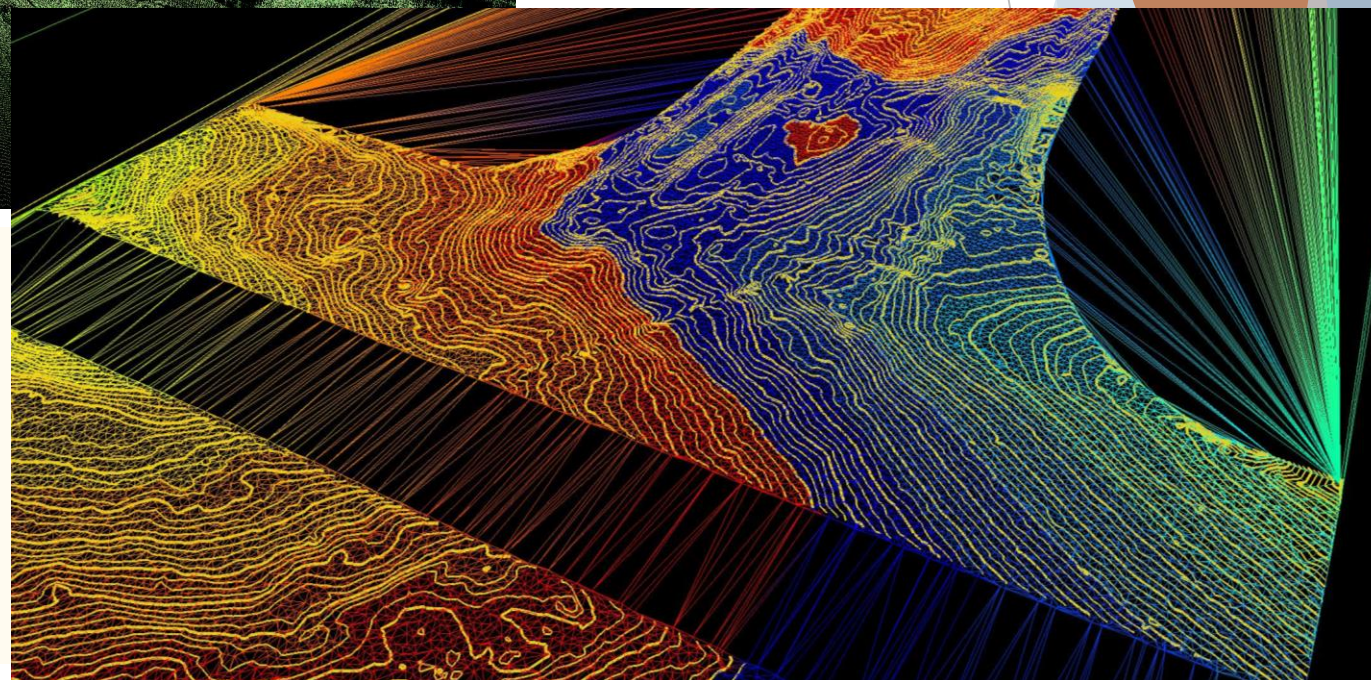
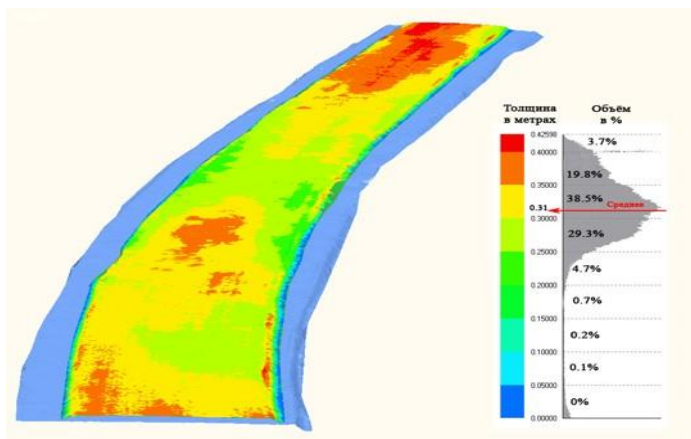
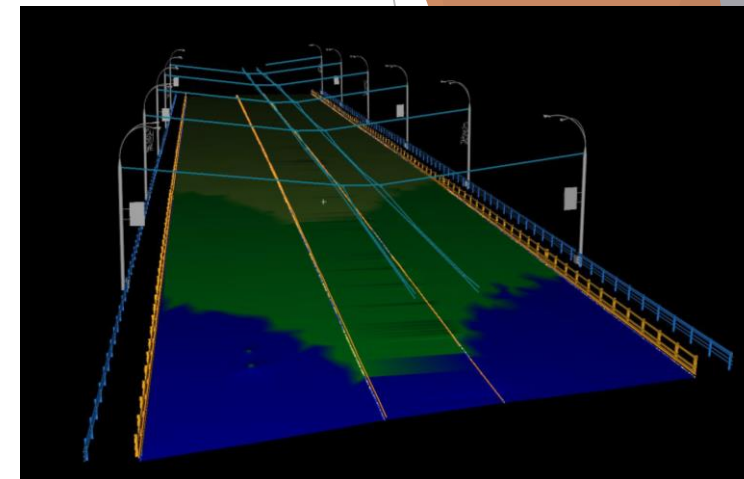
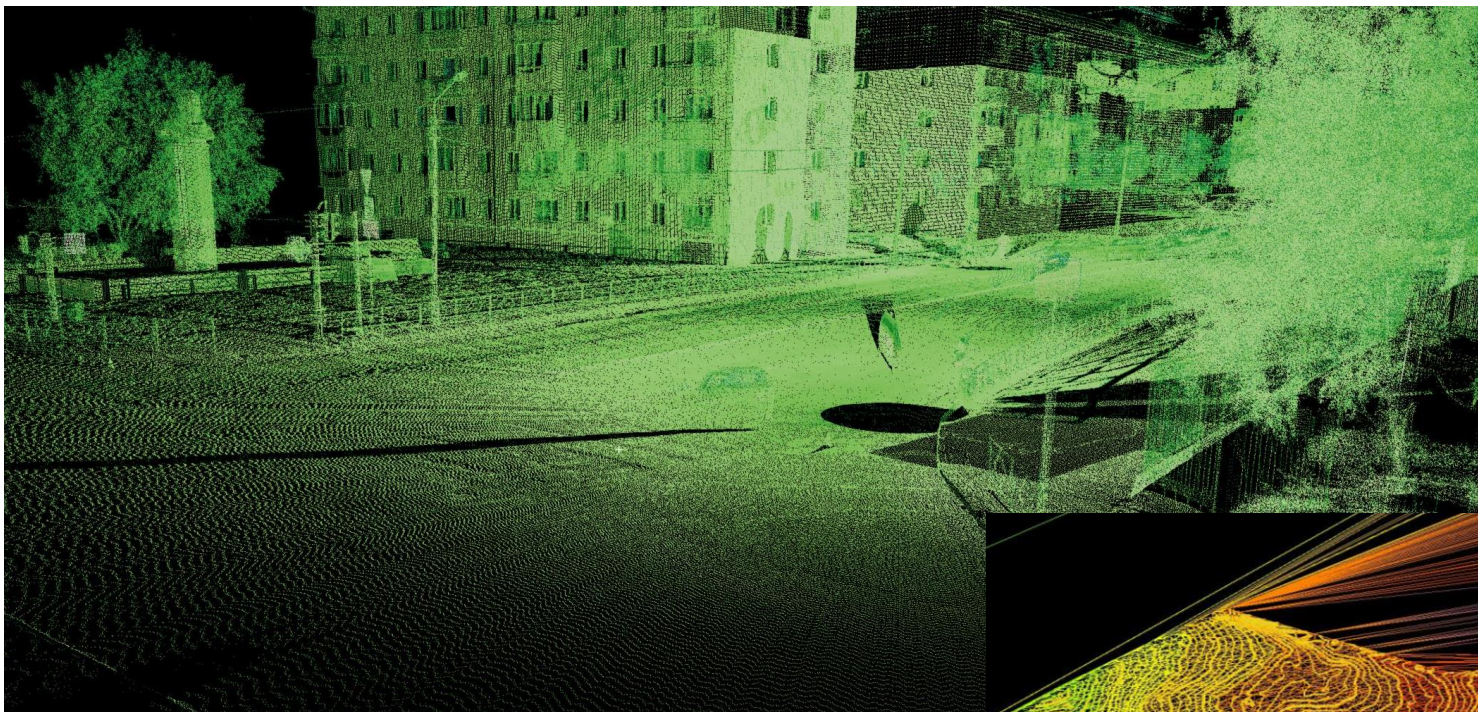
Examples ► Energy facilities



Examples ► Oil and gas facilities

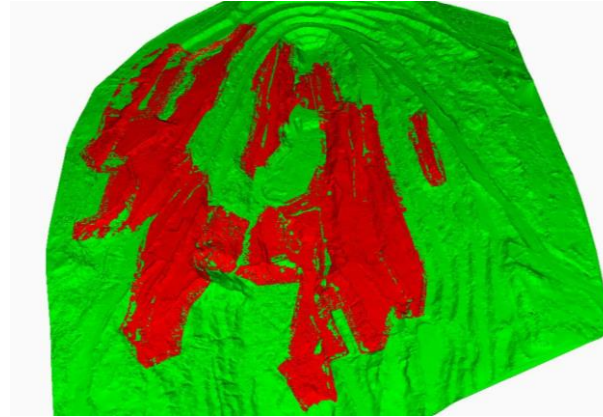
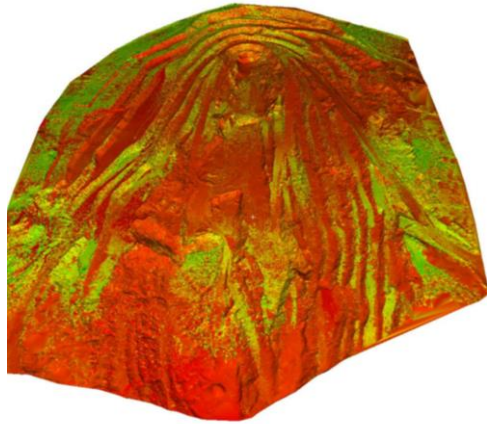


Examples ► Highways



Examples

- ▶ An open-pit coal mine
- ▶ This technology was fully implemented at an open-pit coal mine



We obtain similar results for other kinds of
work:

Façades

Measurements

etc.

Conclusion

Laser scanning in construction provides the following:

To provide the design process by the sufficient and even redundant geospatial data

To increase the design quality

To provide the design, construction and facility maintenance by BIM

To provide the overall compliance with the project

To provide the compliance with quality warranty

To provide the overall volume control and objectivity of as-built surveys

To calculate the quantity of work and the estimated costs at any stage of construction with complete certainty.

Conclusion

Laser scanning in construction provides the following:

- To provide the complete geometry control in construction
- To make construction and reconstruction processes more “transparent”
- To facilitate the implementation of precision construction (new technological level)
- To provide the risk reduction in reconstruction and construction (economic and technical)
- To increase the operational efficiency of the object (facility)
- To use laser scanning data as service data at any time and for different tasks
- To come over to the revolutionary changes. Construction industry is becoming spatio-temporally transparent, available for use and open.

Conclusion

Laser scanning in construction provides the following:

Two years of experience in the use of this technology will be a means of determining whether or not it is ready to be realized at any facility (buildings, structures, roads, transport, industry, etc.)



Thank you for your attention!

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