



"From the wisdom of the ages
to the challenges of modern world"

Application, specifics and technical implementation of the 3D terrestrial laser scanning
for measurement and analysis of the spatial geometry of a steel construction

Gintcho Kostov, Bulgaria
"GEO ZEMIA" Ltd.

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FIG WORKING WEEK 2015

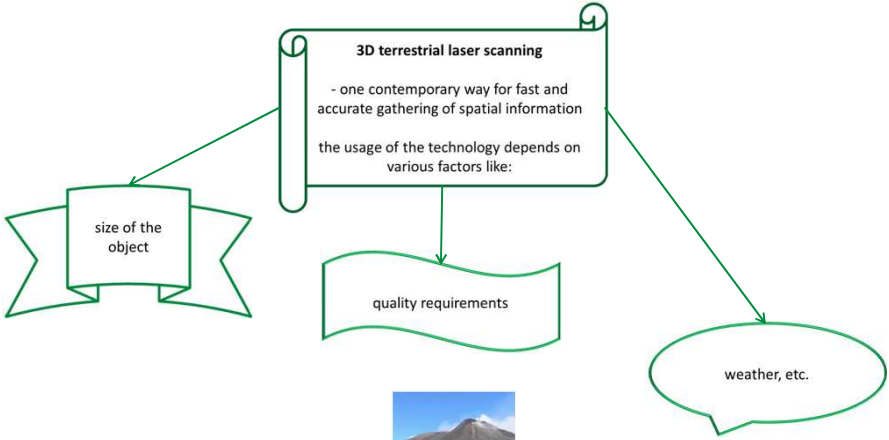
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Application, specifics and technical implementation of the 3D terrestrial laser scanning for
measurement and analysis of the spatial geometry of a steel construction

1. INTRODUCTION




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graph TD; A["3D terrestrial laser scanning  
- one contemporary way for fast and accurate gathering of spatial information  
the usage of the technology depends on various factors like:"] --> B["size of the object"]; A --> C["quality requirements"]; A --> D(["weather, etc."]);
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3D terrestrial laser scanning
- one contemporary way for fast and accurate gathering of spatial information
the usage of the technology depends on various factors like:

size of the object

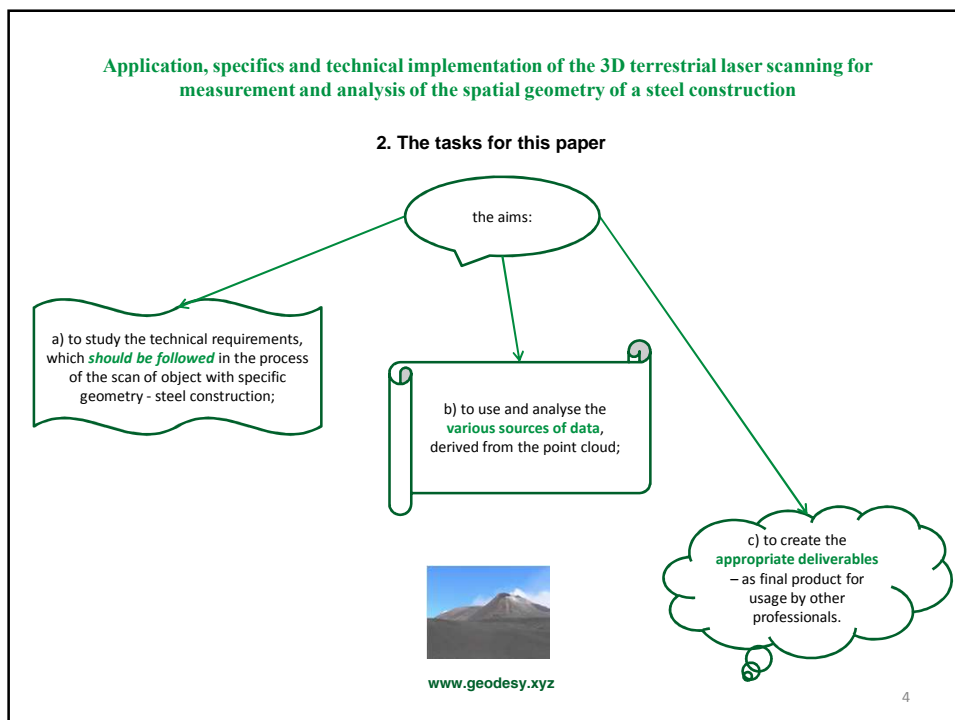
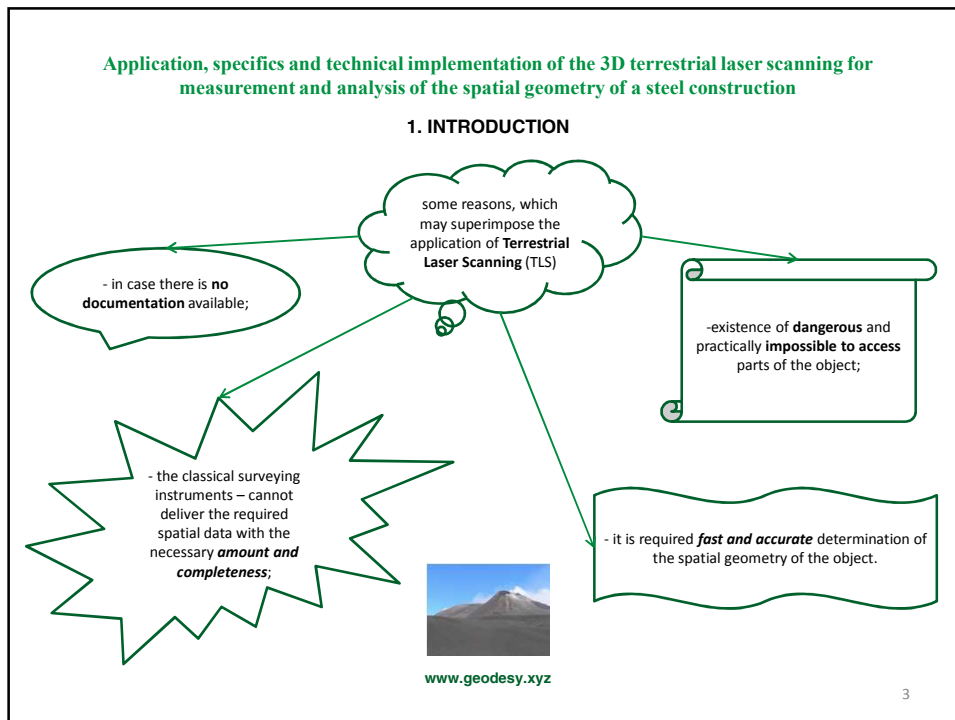
quality requirements

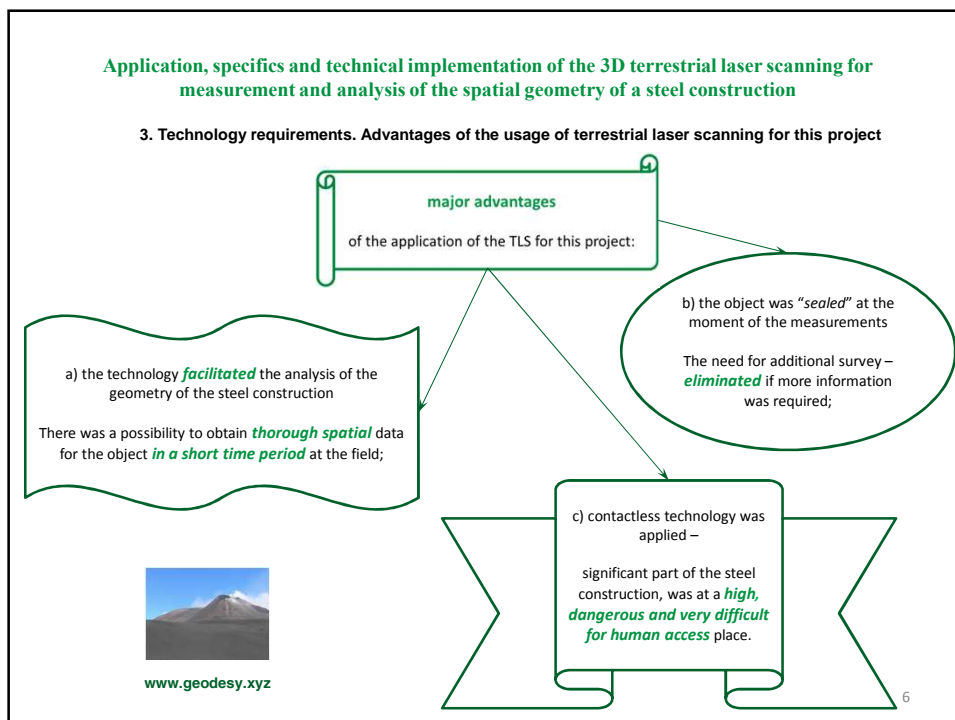
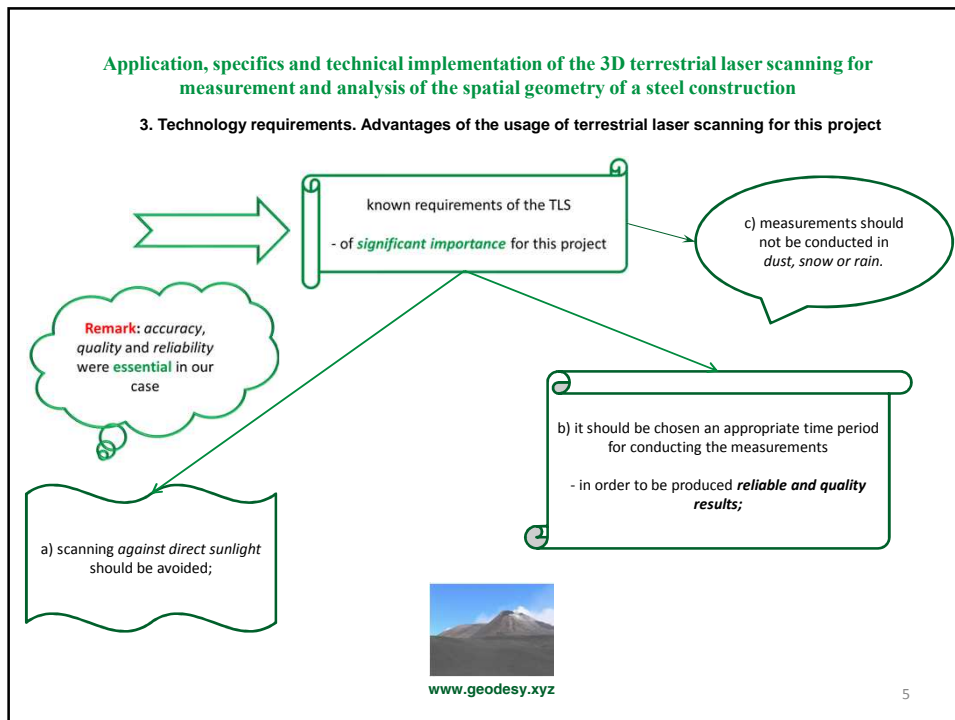
weather, etc.

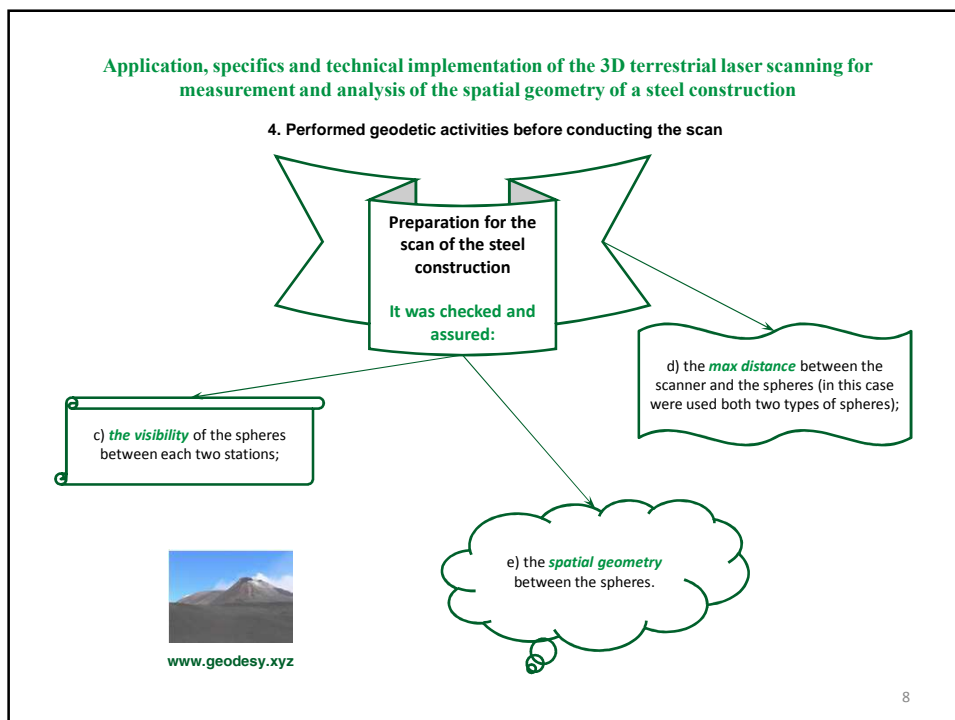
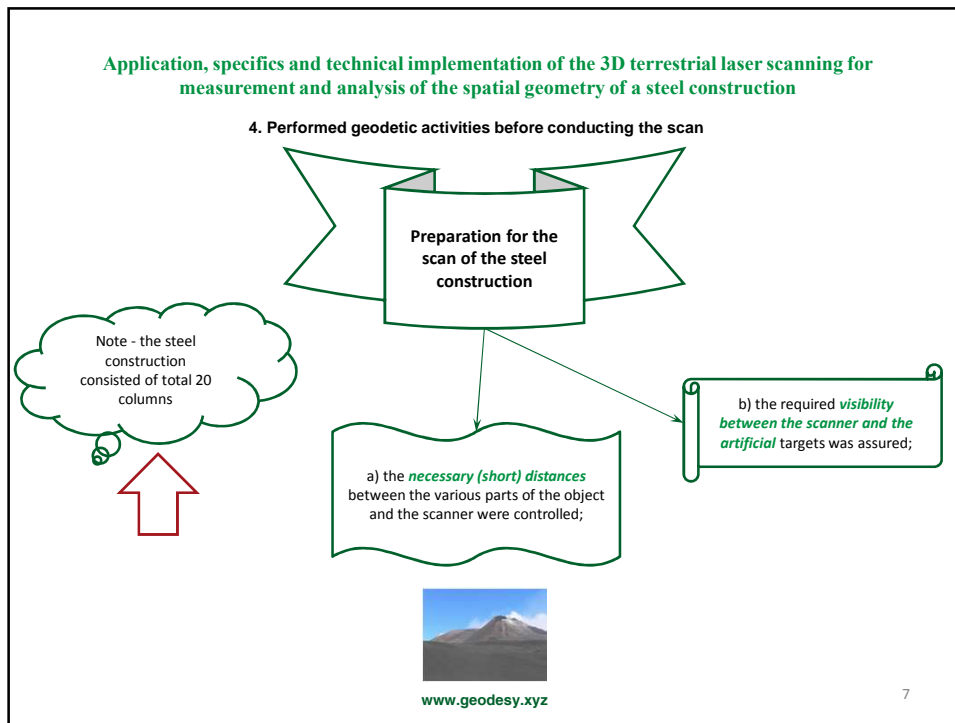


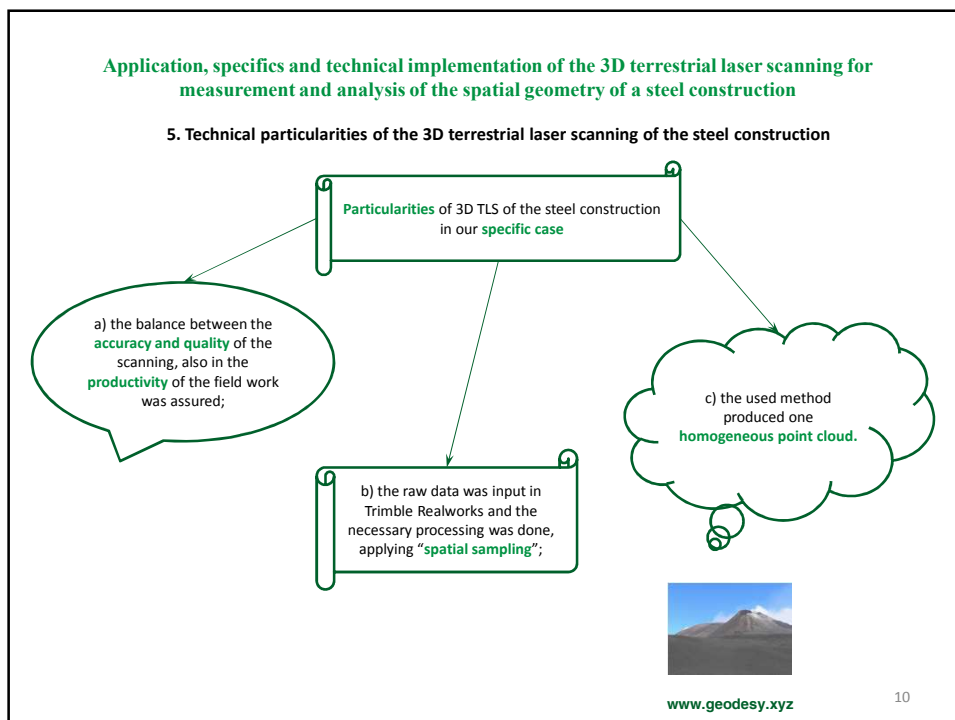
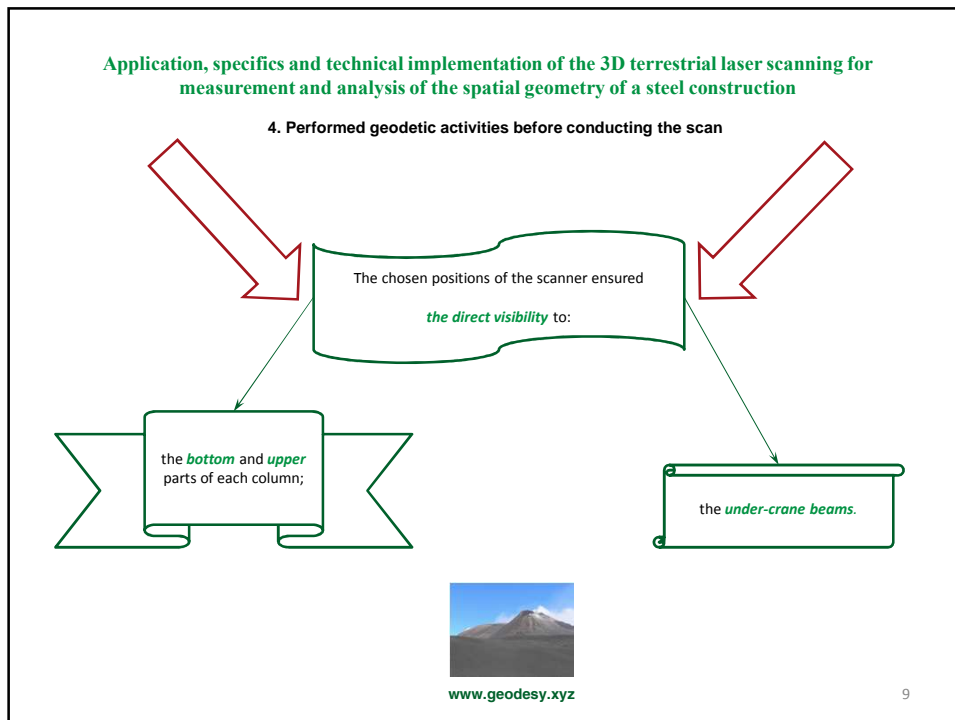
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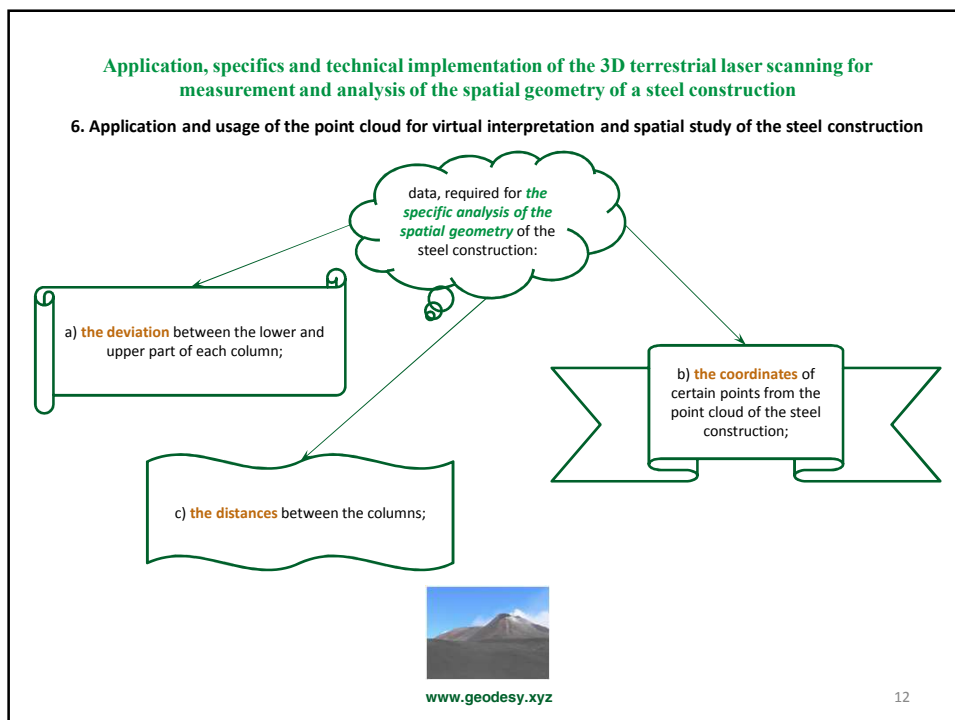
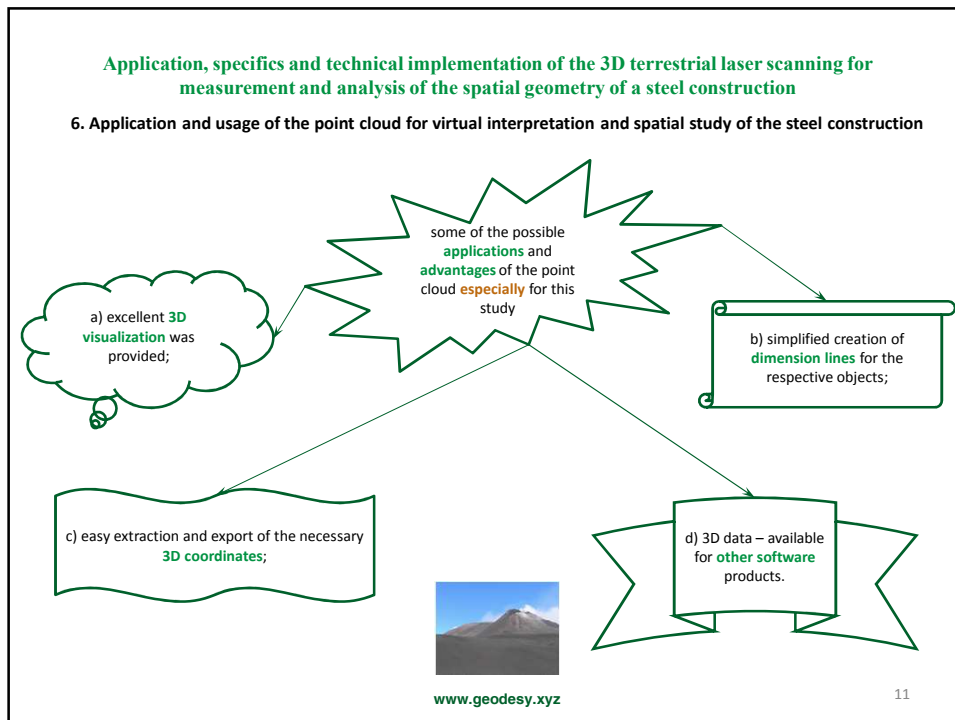
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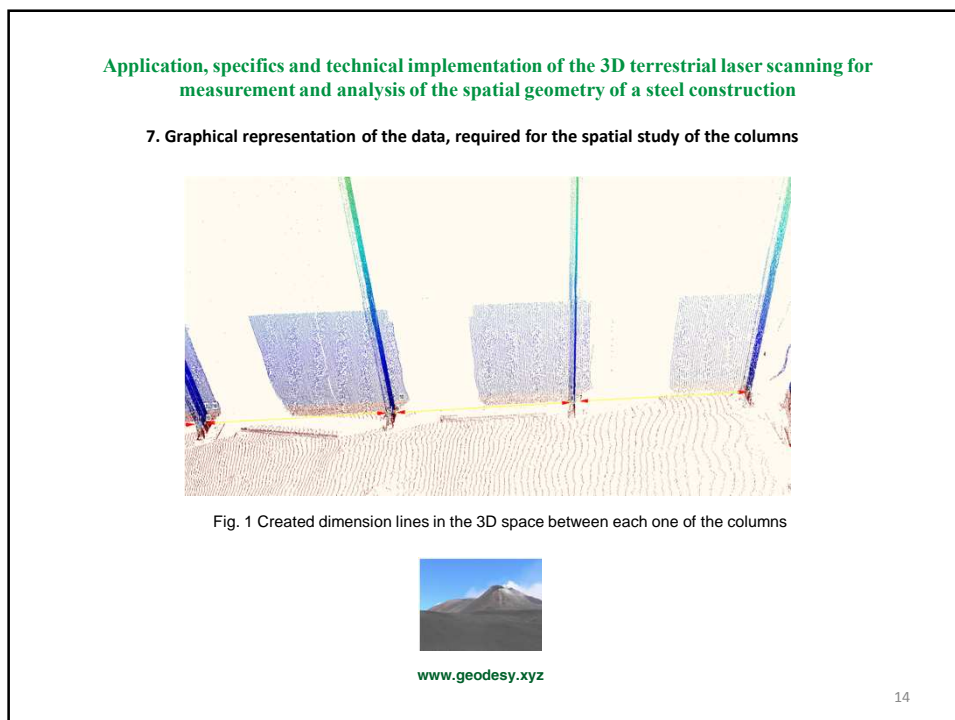
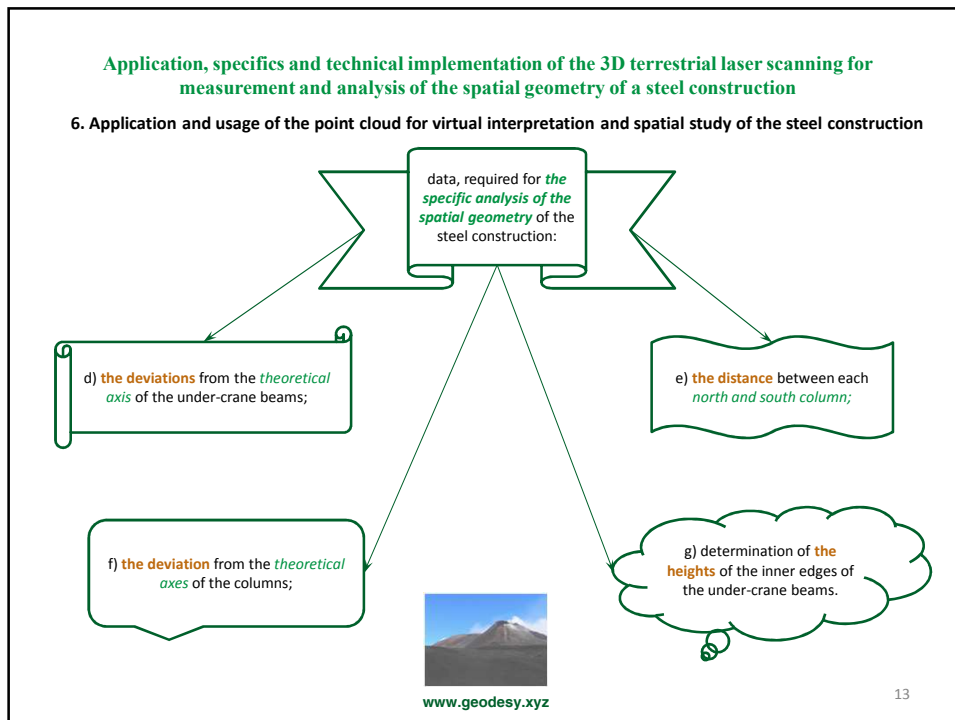












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7. Graphical representation of the data, required for the spatial study of the columns

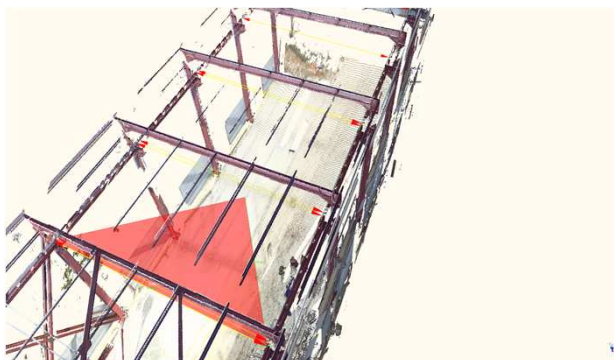


Fig. 2 Created dimension lines at the *upper part* of the construction, between the beams



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15

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7. Graphical representation of the data – advantages of TLS

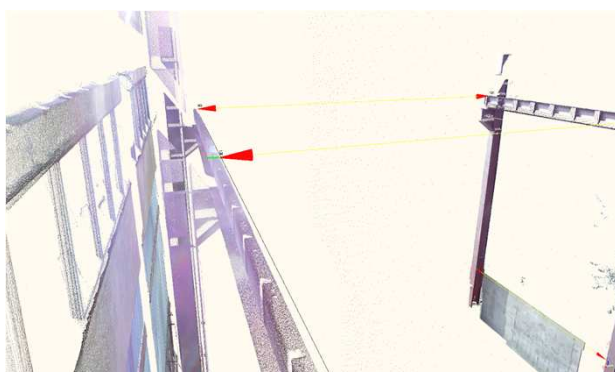


Fig. 3 One of the *advantages* of the point cloud – its ability to show from various points of view the *difficult or impossible for human access* parts of the object.



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16

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8. Results and analysis from the performed 3D terrestrial laser scanning

example for the application of "distance measurement"
- used for thorough spatial analysis of the condition of the steel construction.



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Fig. 4 The deviation in the position of the beam's axis, highlighted as triangle

17

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8. Results and analysis from the performed 3D terrestrial laser scanning

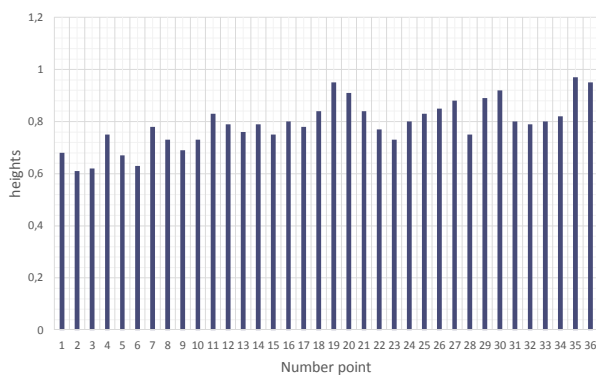


Fig.5 The variations of the heights of the inner edges of the under-crane beams



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18

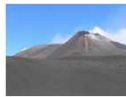
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8. Results and analysis from the performed 3D terrestrial laser scanning

- distances between the various parts of the steel construction

- the deviations from the relevant axes

- the directions of the deviations



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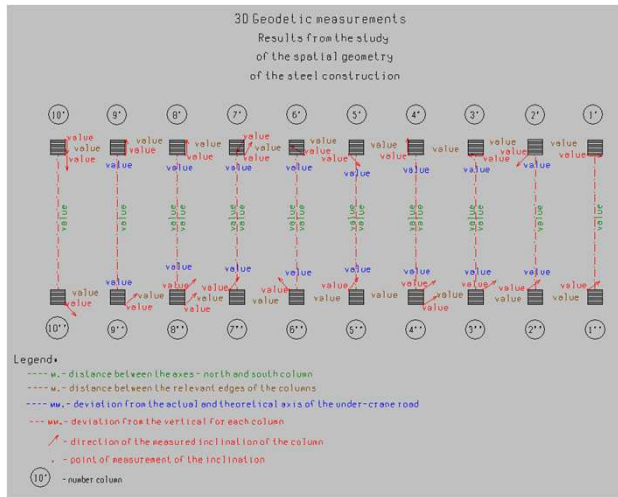
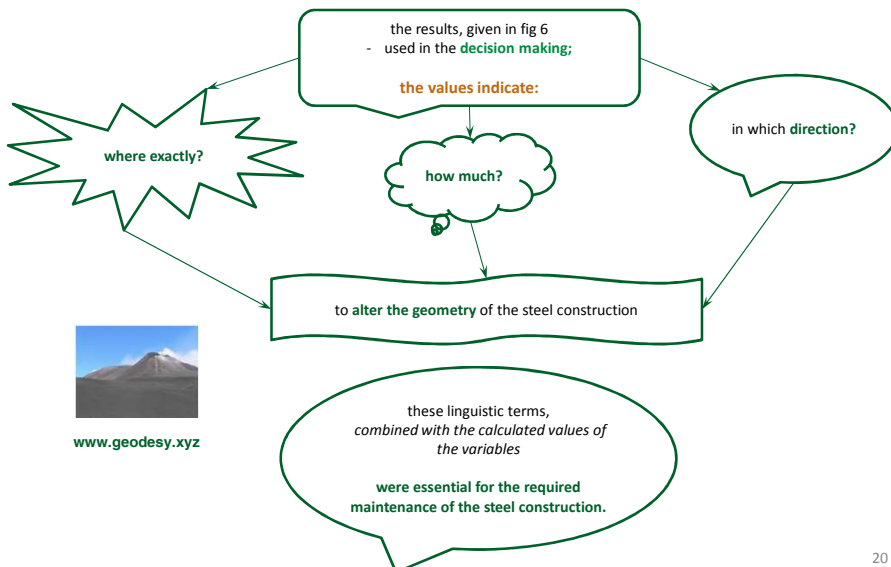


Fig.6 2D graphic with combined information for the current condition of the steel construction

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9. CONCLUSION. RECOMMENDATIONS. FUTURE WORK



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9. CONCLUSION. RECOMMENDATIONS. FUTURE WORK

One *contemporary, precise and productive* way for gathering of spatial information was used for geodetic measurements and analysis.

The usage of *other* survey method was *practically not applicable* in our case, due to: *time limitations*, requirements for *accuracy* and *productivity*, also the necessity for delivery of *large amount* of spatial information.



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The data in this project consisted of various sources of deliverables, *including and not limited to*:

- 3D coordinates;
- various dimension lines;
- drawings (in *.dwg, *.pdf, etc.);
- tables;
- screenshots, etc.

The created data *was successfully* implemented in the *urgent* decision-making for the maintenance of the steel construction.

21

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9. CONCLUSION. RECOMMENDATIONS. FUTURE WORK

Despite all the mentioned technological *requirements* and *limitations* of the terrestrial laser scanning, its usage could be **strongly recommended**, for study and analysis of objects with complexity like steel constructions.



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22

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Future work

this study raises the following questions:

1. Improvement of the possibilities for combined usage of Trimble RealWorks with the external software;
2. The necessity for maintenance of Trimble Realworks in order to be fully compatible with the third party software (i.e. IE);
3. Implementation of the possibility for usage of other browsers (e.g. Mozilla Firefox, Opera, etc.) for visualisation and management of the measured 3D data.



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23

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REFERENCES:

- H.-M. Zogg, H. Ingsand. Terrestrial Laser Scanning for Deformation Monitoring- Load Tests on the Felsenau Viaduct (CH). The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B5. Beijing 2008.
- H. S. Park, H. M. Lee, Hojjat Adeli I. Lee. A New Approach for Health Monitoring of Structures: Terrestrial Laser Scanning. Computer-Aided Civil and Infrastructure Engineering. Volume 22, Issue 1, pages 19–30, January 2007.
- Hao Yang, Xiangyang Xu and Ingo Neumann. The Benefit of 3D Laser Scanning Technology in the Generation and Calibration of FEM Models for Health Assessment of Concrete Structures, Sensors 2014. ISSN 1424-8220. www.mdpi.com/journal/sensors.
- Jian Wang, Lei Li, Yan Jiang. 3D Modelling of a Gold Mine Using Laser Scanning the Digital Mine. GIM International – The global magazine for geomatics www.gim-international.com, Geomares publishing. Issue 11, Volume 27, November 2013.
- Lijing Bu and Zhengpeng Zhang. Application of Point Clouds From Terrestrial 3D Laser Scanner for Deformation Measurements. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B5. Beijing 2008.
- M. Cabaleiro, B. Riveiro, P. Arias, J.C. Caamaño, J.A. Vilán. Automatic 3D modelling of metal frame connections from LIDAR data for structural engineering purposes. ISPRS Journal of Photogrammetry and Remote Sensing 96 (2014) 47–56.
- Milev, G. Laser and Radar Scanning. Magazine "GKZ" Issue 2012'5-6. (In Bulgarian)



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24

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REFERENCES:

Reha Metin ALKAN and Gokcen KARSIDAG. Analysis of The Accuracy of Terrestrial Laser Scanning Measurements. FIG Working Week 2012. Knowing to manage the territory, protect the environment, evaluate the cultural heritage. Rome, Italy, 6-10 May 2012.

Tomáš Křemen, Bronislav Koska, Jiří Pospíšil, Peter Kyrinovič, Jana Haličková and Alojz Kopáček. Checking of Crane Rails by Terrestrial Laser Scanning Technology. 13th FIG Symposium on Deformation Measurement and Analysis. 4th IAG Symposium on Geodesy for Geotechnical and Structural Engineering. LNEC, Lisbon 2008 May 12-15.

Zhang Guo-hui. Deformation Monitor Based on 3D Laser Scanner. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B4. Beijing 2008.

<http://mep.trimble.com/sites/mep.trimble.com/files/Trimble%20TX5%20User%20Guide.pdf>
http://trl.trimble.com/docushare/dsweb/Get/Document-628869/022504-122.Trimble_TX5_DS_1012_LR.pdf
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<http://www.buryassociates.co.uk/surveying-services/laser-scanning-surveys/what-is-laser-scanning.html>
http://www.dot.ca.gov/hq/row/landsurveys/SurveysManual/15_Surveys.pdf
http://www.gim-international.com/issues/articles/td2113-D_Modelling_of_Shukhov_Tower.html
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<http://www.trimble.com/global%2Fglobal%2Easp%3Fnav%3DCollection-31049>

Used Software:

1. Trimble Realworks;
2. Mkad.



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25

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Thank you for your attention!



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26