

Application of 3D Laser Scanning for Deformation Measurement on Industrial Objects



Luka BABIĆ, Boško PRIBIČEVIĆ, Almin ĐAPO, Croatia
University of Zagreb, Faculty of Geodesy

INTRODUCTION

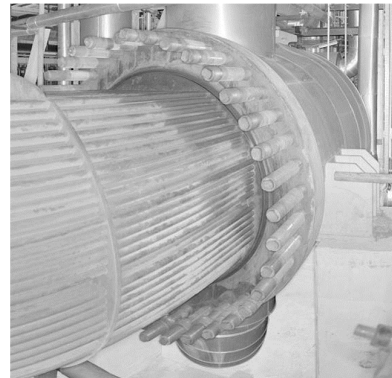
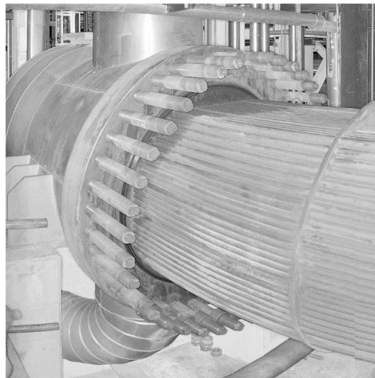


- ❖ Heat exchanger in the Oil refinery Rijeka
 - Problems occurred during the removal of its envelope while conducting regular maintenance
 - Requested by construction engineers
 - High accuracy demands
- ❖ Of the many facets of laser scanning application, the most prominent and effective one is, without a doubt, the one for deformation analysis purposes



THE PROBLEM

- ❖ The envelope couldn't be removed easily but instead had to be shifted vertically using cranes to allow extraction without scraping the assembly residing within
- ❖ Subsidence of the tracks carrying the envelope or a vertical divergence of the heat exchangers envelopes base, i.e. the flange, were judged to be at fault

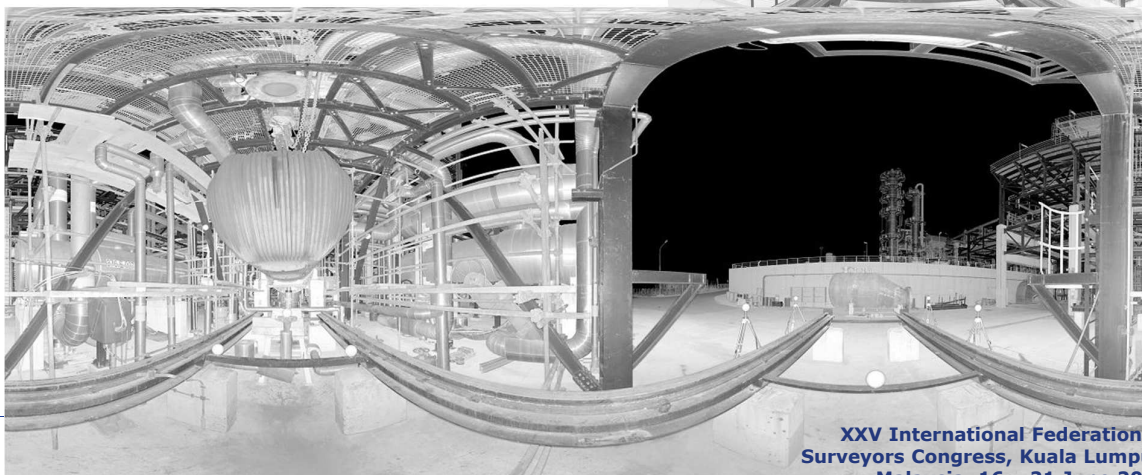
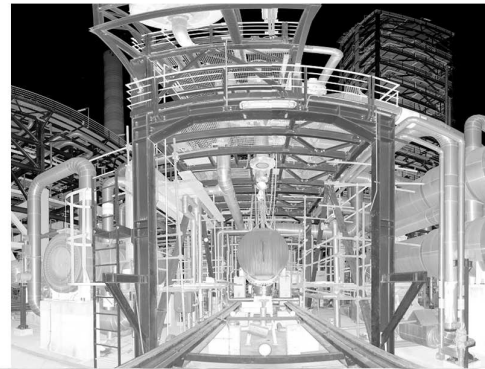


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SURVEY

- ❖ Obstructions of the flange made it difficult to approach
- ❖ Ingenuity was required to survey the whole flange

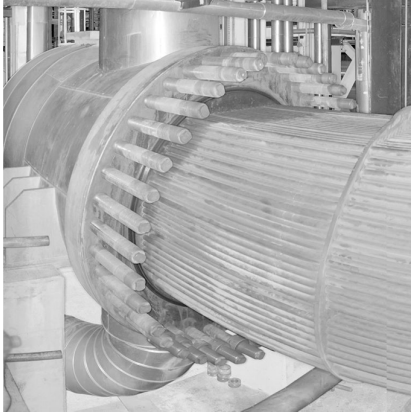


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SURVEY

- ❖ Scanning from left, right and bottom
- ❖ Sphere target registration
- ❖ One scan captured all the spheres
- ❖ Scanner to sphere distance < 5 m
- ❖ Precise leveling of the tracks
- ❖ Survey using a total station (georeferencing)

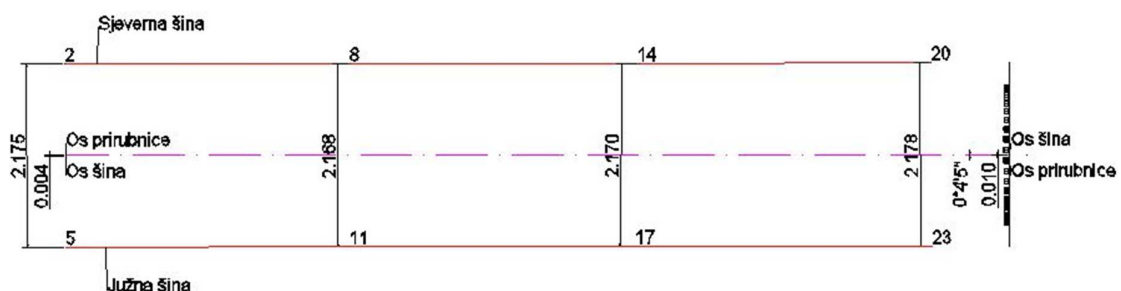


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ANALYSIS - TRACKS

- ❖ Comparison of track axis with that of the flange
- ❖ Determining track axis and flange axis
- ❖ Alignment of the track axes in line with the flange axis

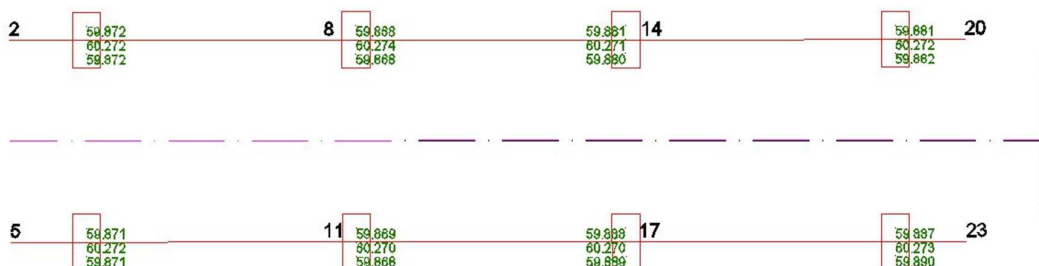


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RESULTS - TRACKS

- ❖ Precise leveling
- ❖ Beginning to end showed minimal discrepancies
- ❖ Tracks horizontal



ANALYSIS - FLANGE

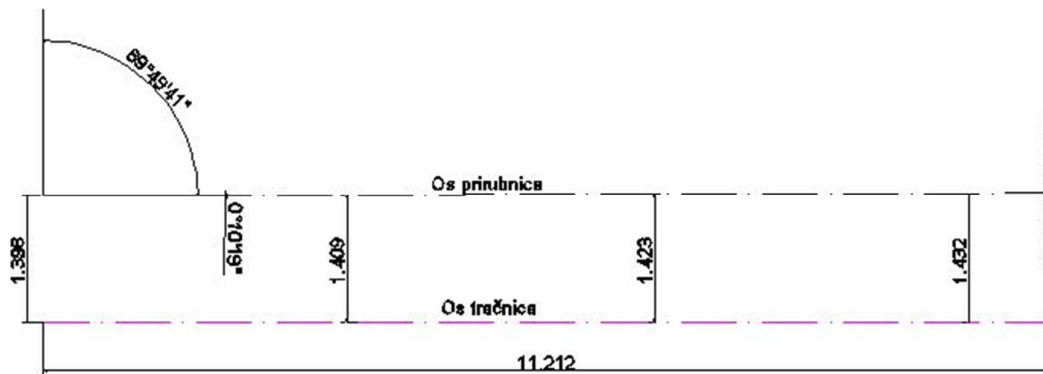
- ❖ Fitting a cylinder to extracted points of the flange for determining the flange axis
- ❖ Fitting a plane to extracted points of the flange contact surface for determining verticality
- ❖ Numerical values

	Number of points	Coordinates of the center (m)	Normal vector (m)	Standard deviation (mm)
Flange envelope Radius (1.7335)	141 957	5463269.63847; 5015873.37341; 61.70562	-0.84699; 0.53160; -0.00303	0.49
Flange surface	269 743	5463269.54456; 5015873.43279; 61.70459	-0.84699; 0.53160; -0.00303	1.19



RESULTS - FLANGE

- ❖ Graphical representation
- ❖ Propagation of offset between track and flange axis with distance
- ❖ Angular value between z and flange axis



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RESULTS – SUMMARY

- ❖ There is no (significant) deformation or subsidence of the tracks
- ❖ Horizontal alignment of the flange axis with the track axis is in order, i.e. there are no significant discrepancies between the two
- ❖ Vertical divergence of the flange amounts to 3,03 mm or roughly 3 cm for every 10 meters
- ❖ This findings are actually in line with the problem as reported from the personnel that worked on envelope removal
- ❖ Amounts derived represent numerical values of discrepancies

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CONCLUSION

- ❖ Terrestrial laser 3D scanning is one of the most promising contactless measurement technologies
- ❖ It allows acquisition of a large amount of precisely measured points in a very short period of time
- ❖ In this specific project it proved as a valuable asset without which it would have been very hard if not impossible to obtain data of adequate value for deriving sound conclusions
- ❖ Whether it be for documentation of complex facilities or deformation analysis, the basic requirement is the same: to have the ability to collect comprehensive, detailed and accurate data that can ensure deriving relevant conclusions and produce valuable information

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Thank you!

Questions?

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