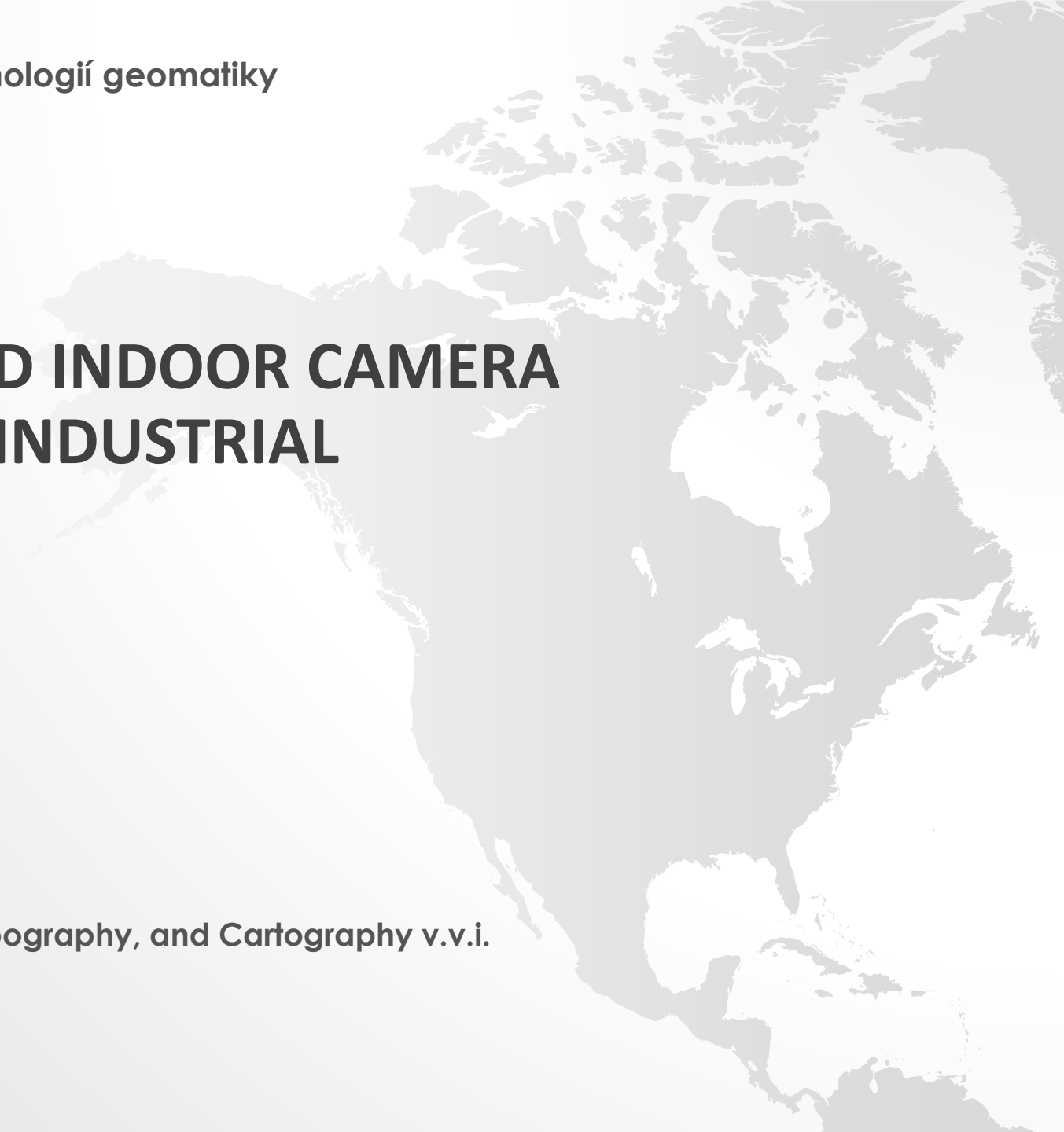


**SVK – workshop moderních technologií geomatiky  
TELČ 2021**

# **A CAPABILITY OF 3D INDOOR CAMERA APPLICATION FOR INDUSTRIAL ARCHAEOLOGY**

**SHULTS ROMAN**

**Research Institute of Geodesy, Topography, and Cartography v.v.i.**

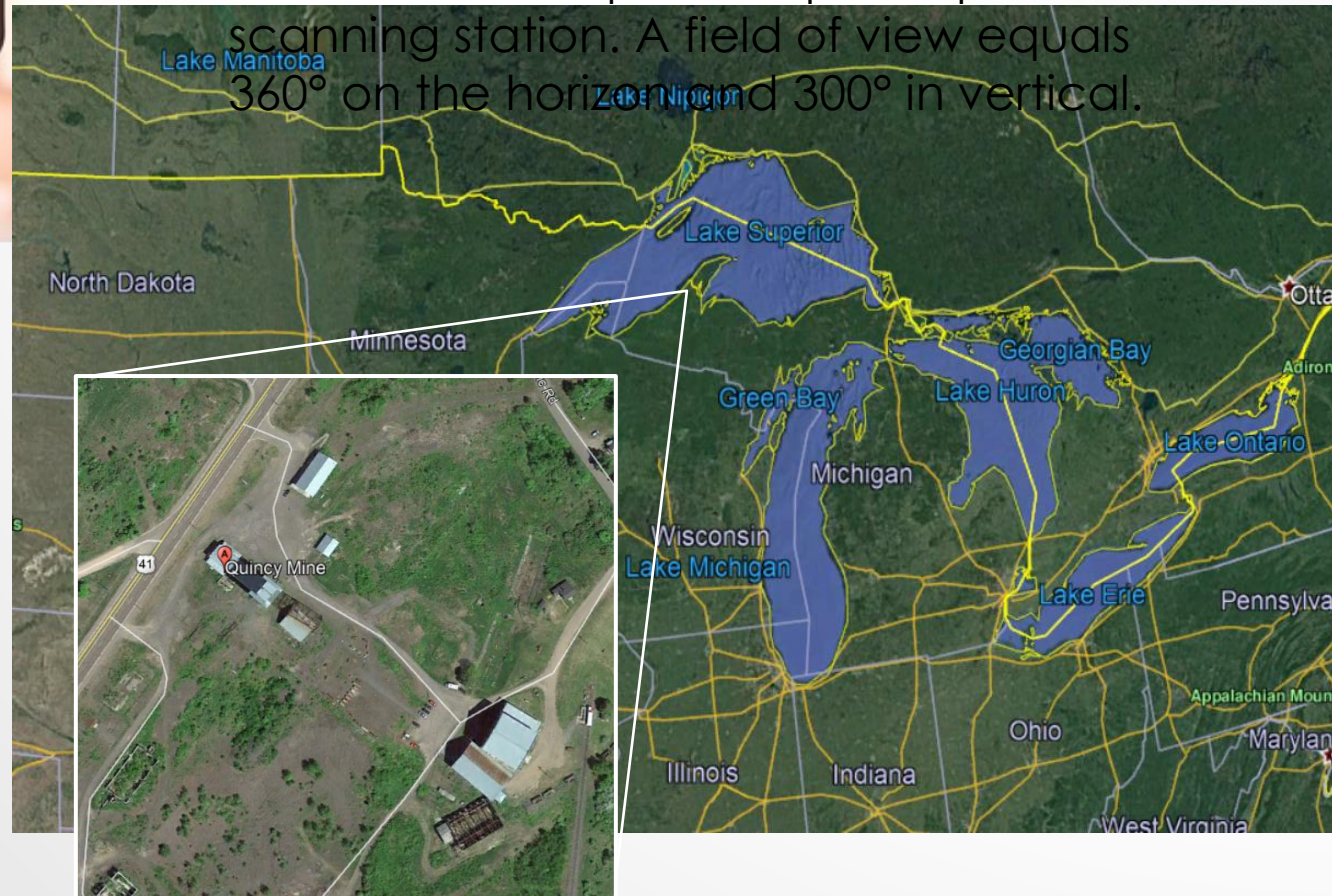


- Materials and Equipment
- Camera accuracy check and calibration
- Data acquisition and modeling
- Conclusions

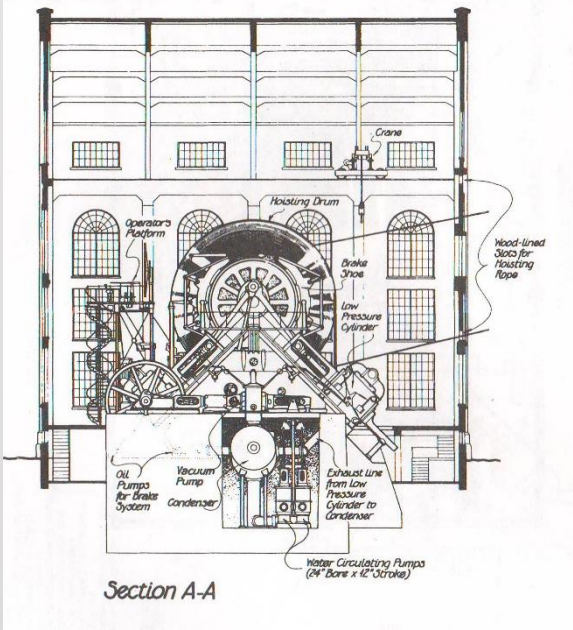
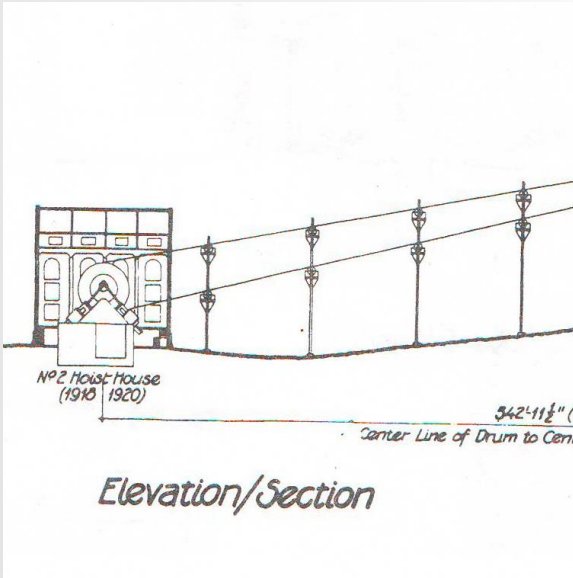
# Materials and Equipment



The maximum operating distance is 4.5 m according to camera specification. The camera resolution equals 10 points per degree or 3600 points in a horizontal plane, 1800 points in a vertical plane, which in total equals 4M points per one scanning station. A field of view equals 360° on the horizon and 300° in vertical.

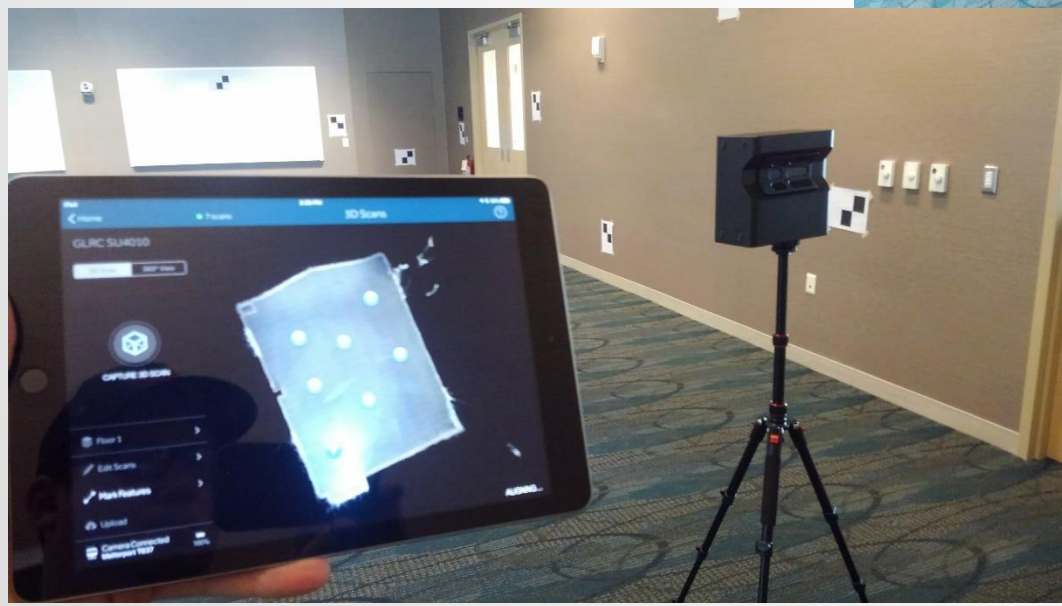




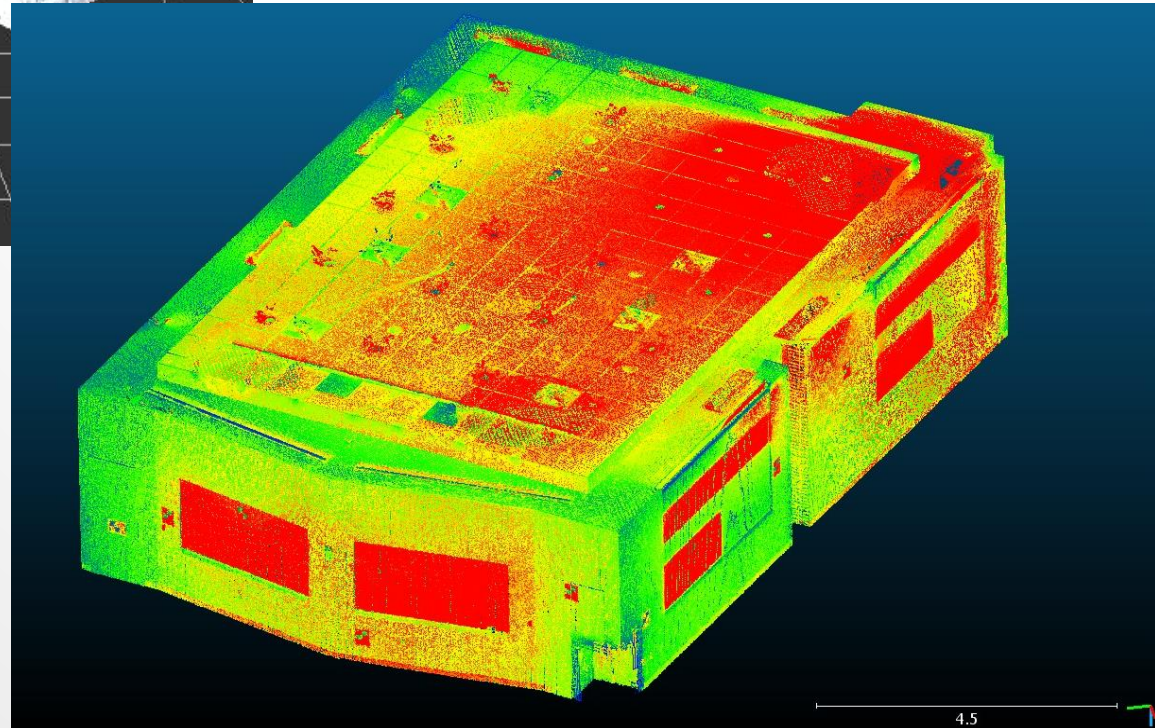
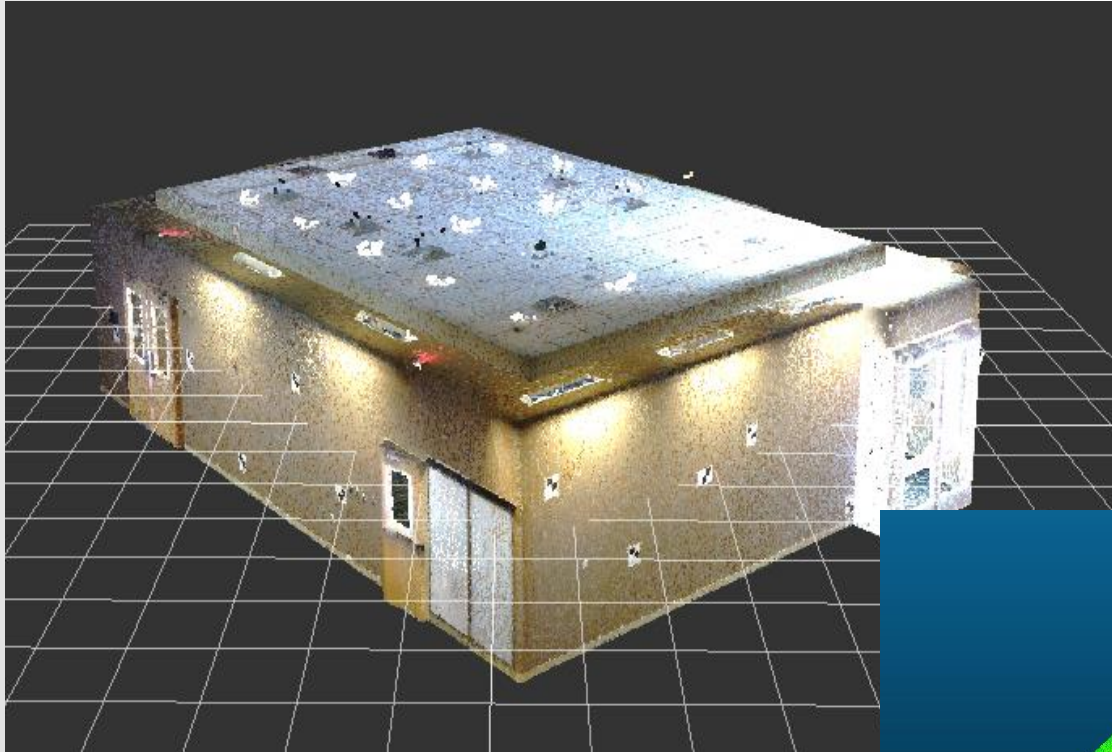




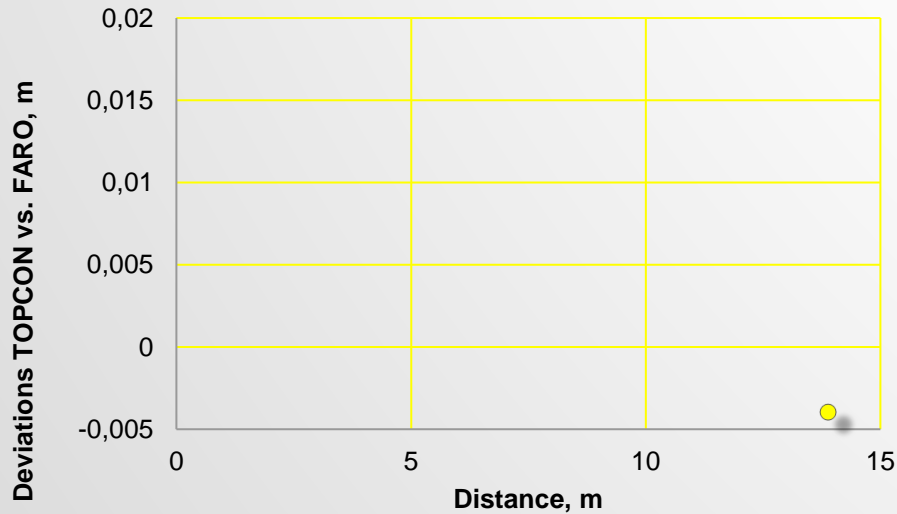
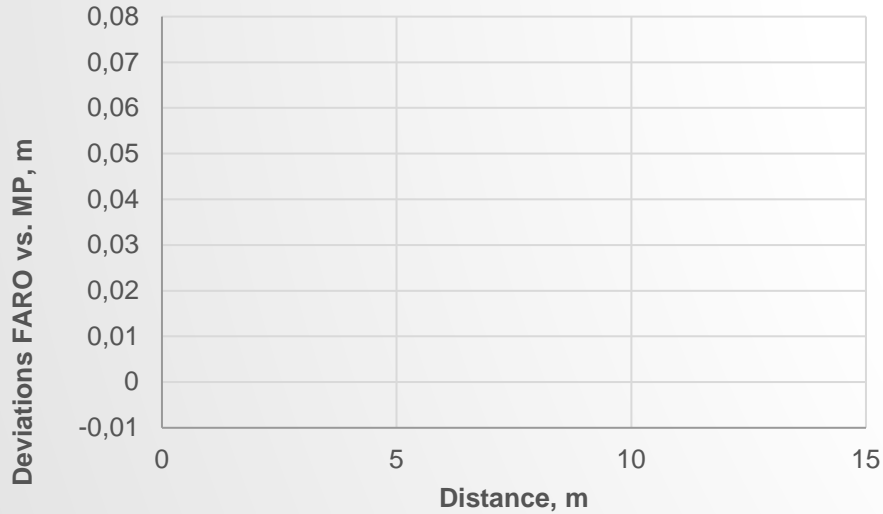
# Camera accuracy check and calibration



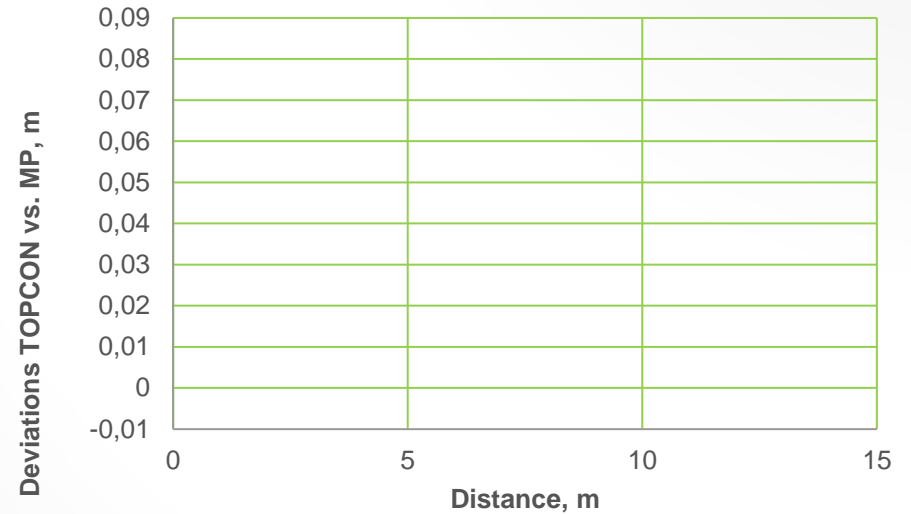
## Data Collection



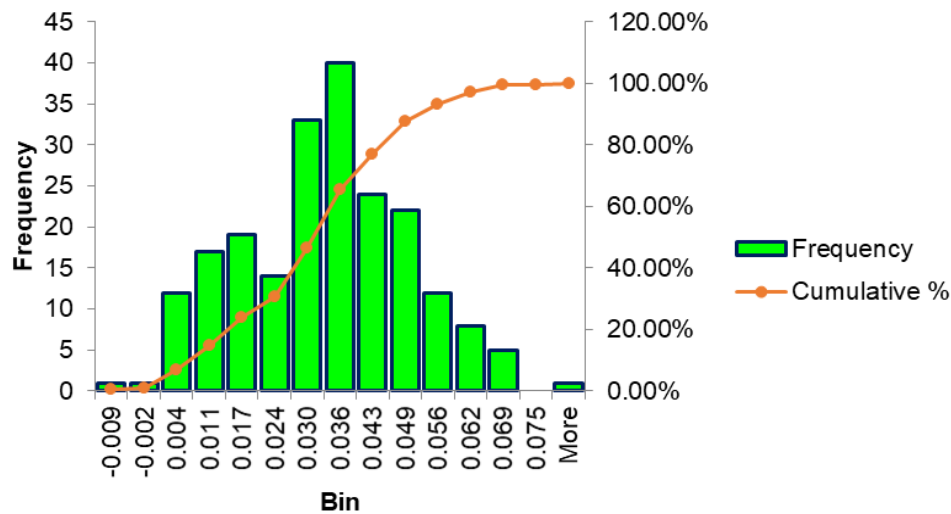




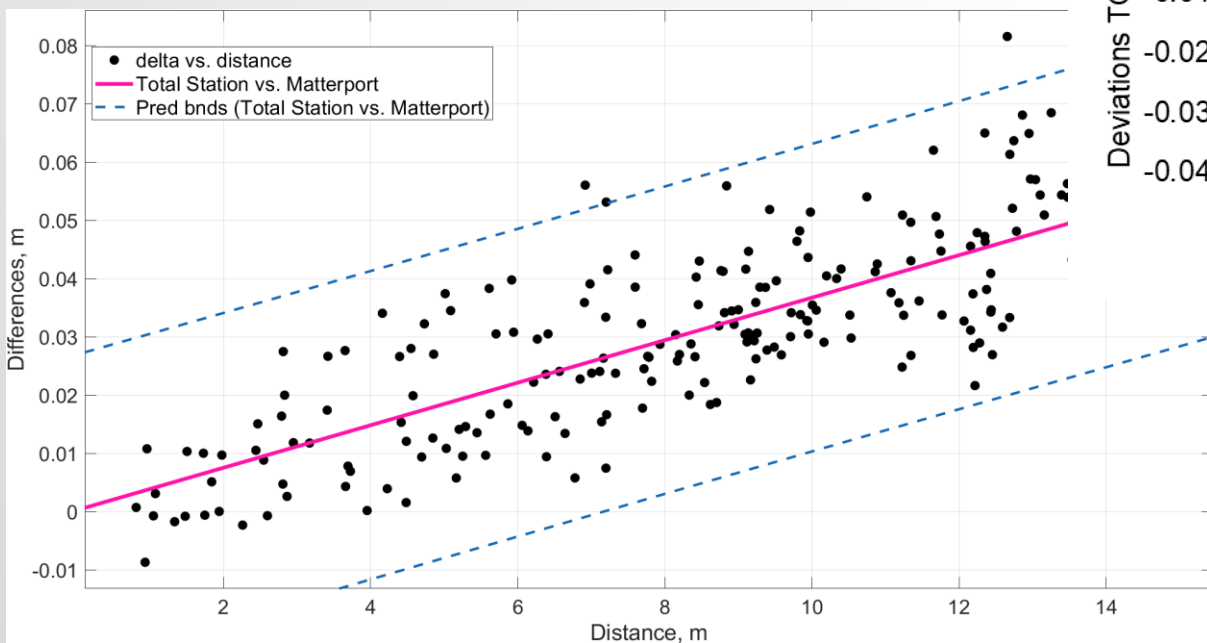
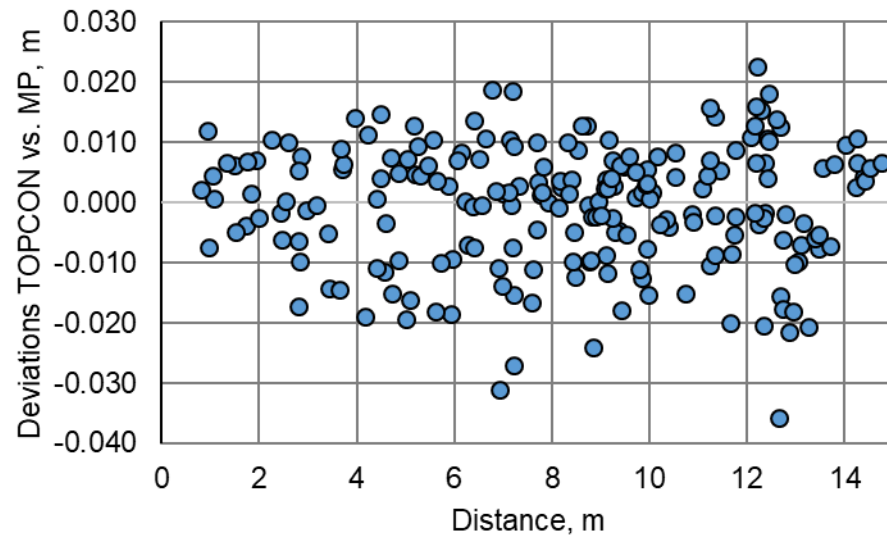
## Accuracy Check – Distances Comparison



	FARO Scanner vs. Matterport	Total station vs. Matterport	Total station vs. FARO Scanner
<b>Mean</b>	0.0216	0.0305	0.0088
<b>Median</b>	0.0224	0.0306	0.0093
<b>Standard Deviation</b>	0.0141	0.0166	0.0044
<b>Range</b>	0.0782	0.0903	0.0224
<b>Minimum</b>	-0.0077	-0.0086	-0.0025
<b>Maximum</b>	0.0705	0.0816	0.0199
<b>Count</b>	210	210	210



## Accuracy Check – Distances Comparison

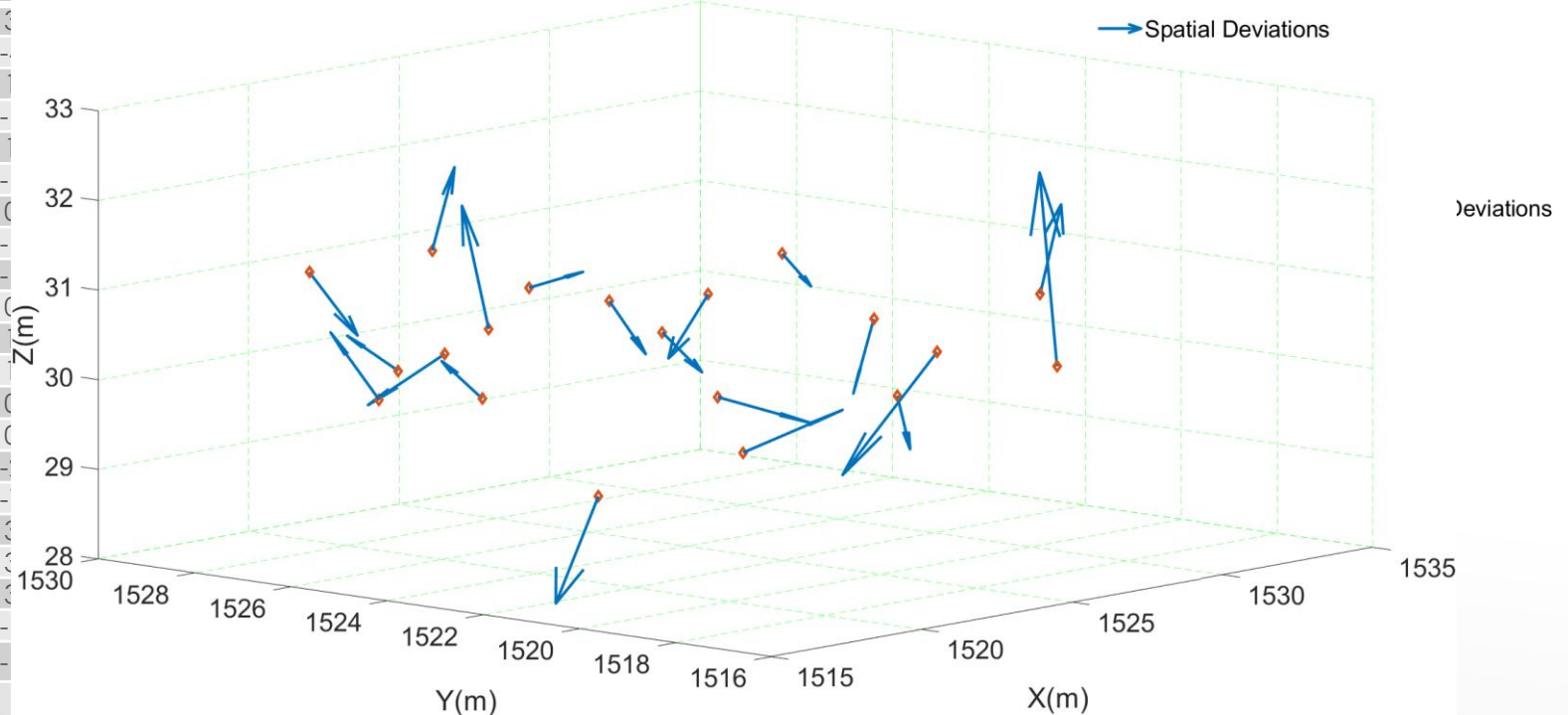


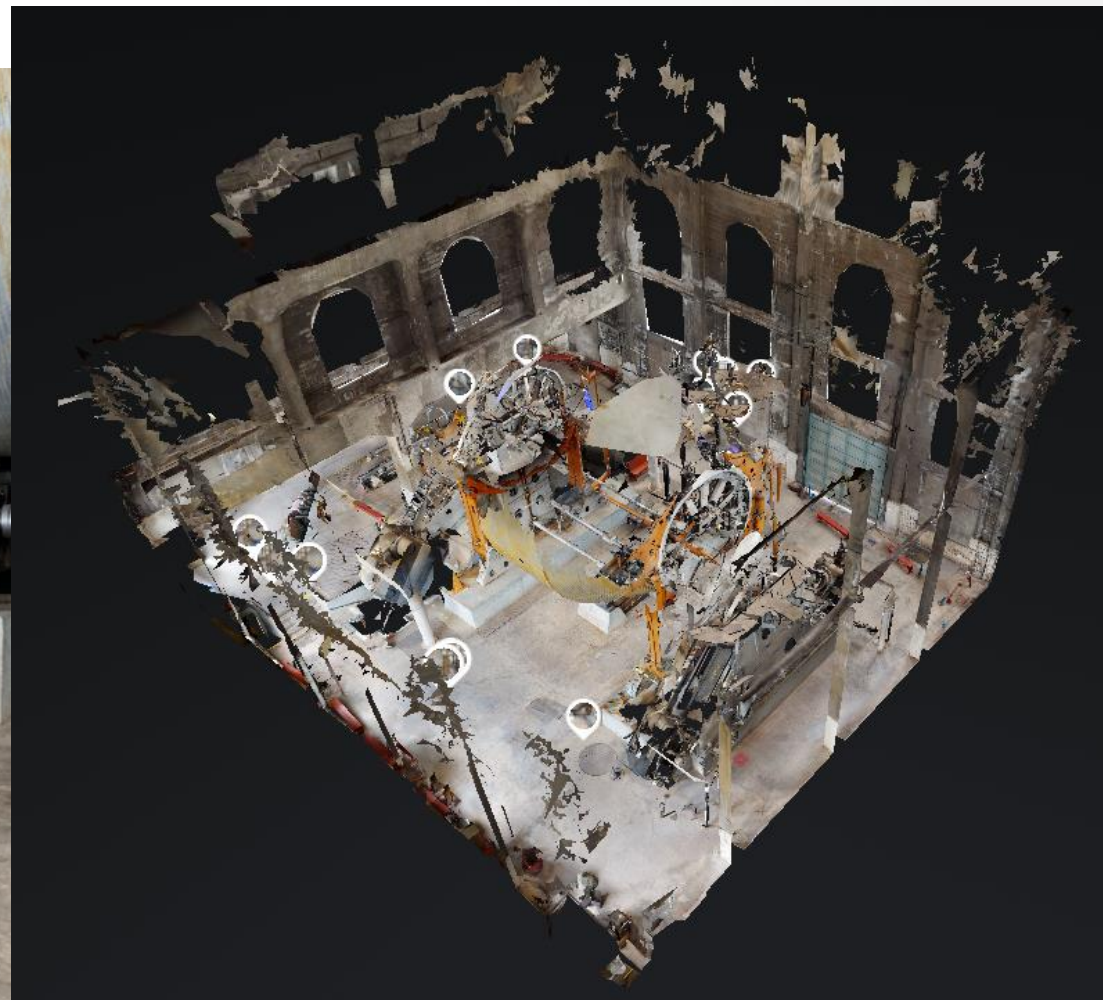
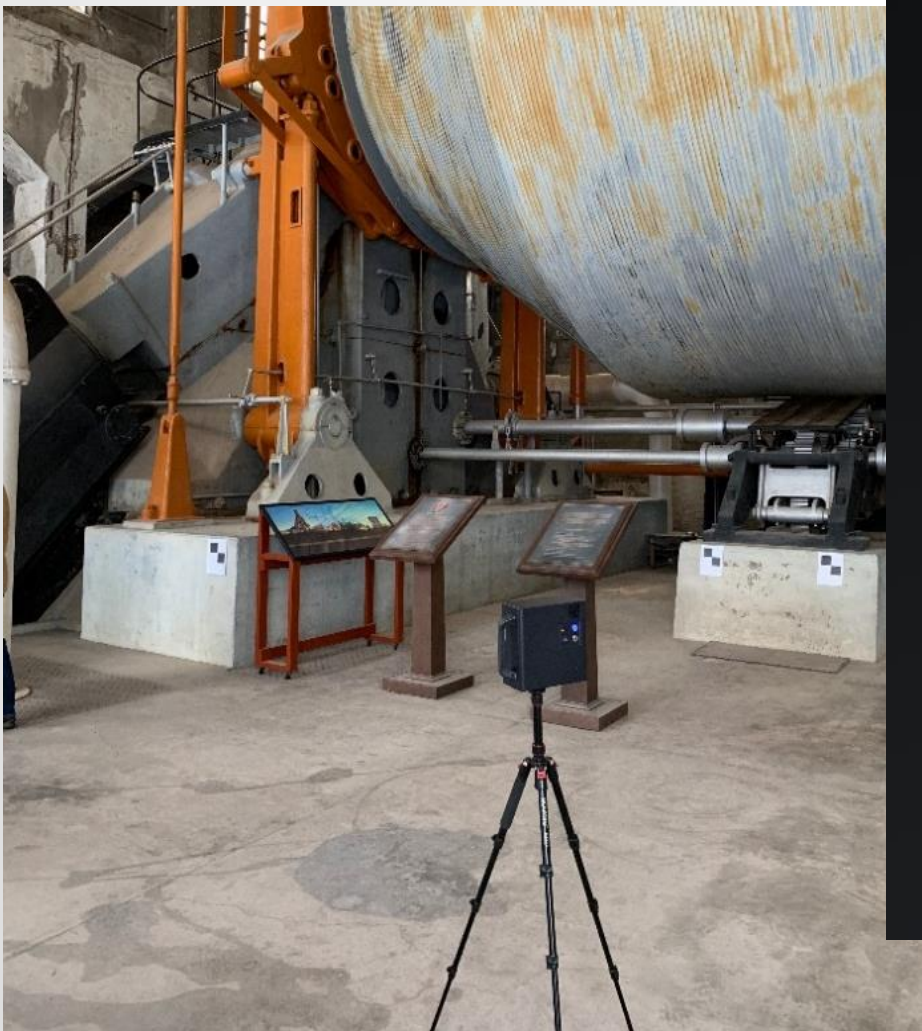


Parameter	Value	$\sigma_{Par}$	Test
Tx	-5.8489 m	1.7 mm	X
Ty	4.5493 m	1.7 mm	X
Tz	1.6798 m	1.9 mm	X
M	-2636.7 mm/km	236.8 mm/km	X
Rx	199.16791 gon	25.01 mgon	X
Ry	0.10794 gon	19.00 mgon	X
Rz	56.21379 gon	15.18 mgon	X

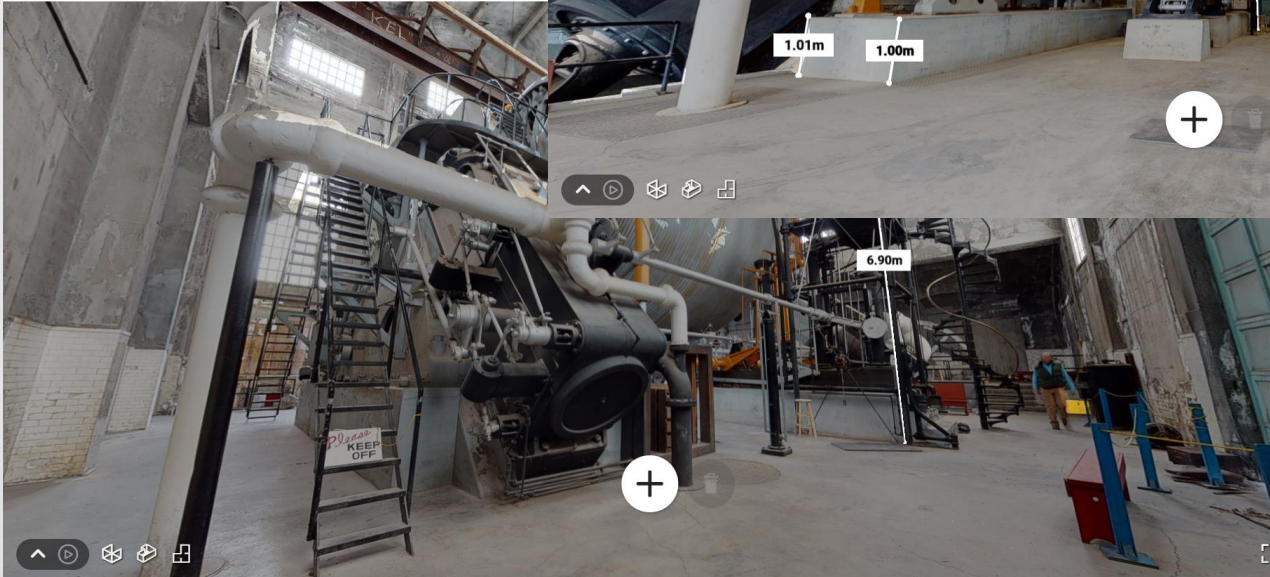
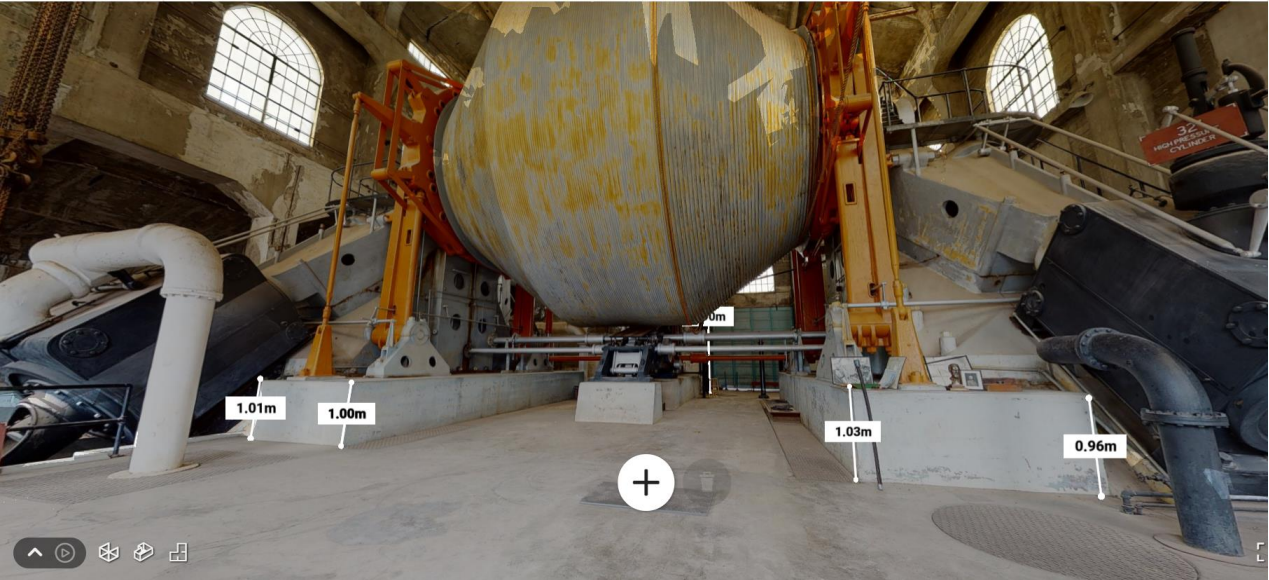
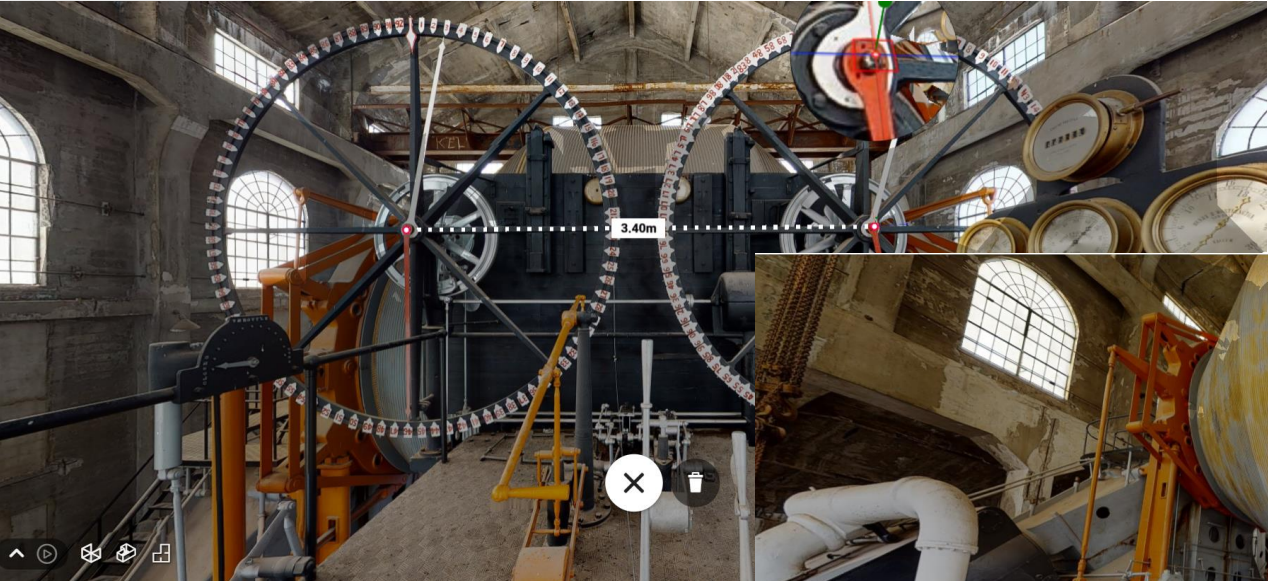
Point	$\epsilon_x$ (mm)	$\epsilon_y$ (mm)	$\epsilon_z$ (mm)	$\sigma_x$ (mm)	$\sigma_y$ (mm)	$\sigma_z$ (mm)
A01	-5.7	-4.2	-	-	-	-
A02	4.4	-1.1	-	-	-	-
A03	3.9	-1.5	-	-	-	-
A04	1.4	-2.0	-	-	-	-
A05	2.8	3.5	-	-	-	-
A06	2.7	1.1	-	-	-	-
A07	-2.5	0.6	0	-	-	-
A08	2.2	-1.9	-	-	-	-
A09	-1.5	2.1	-	-	-	-
A10	-4.2	-0.4	-	-	-	-
A11	-3.8	0.6	-	-	-	-
A12	-2.6	-5.6	-	-	-	-
A13	-2.6	-0.3	0	-	-	-
A14	10.9	5.4	0	-	-	-
A15	1.1	1.7	-	-	-	-
A16	4.2	0.2	-	-	-	-
A17	-4.6	-5.8	-	-	-	-
A18	-2.3	-0.2	-	-	-	-
A19	-0.7	-0.3	-	-	-	-
A20	-1.9	4.1	-	-	-	-
A21	-1.2	4.0	-	-	-	-

## Calibration

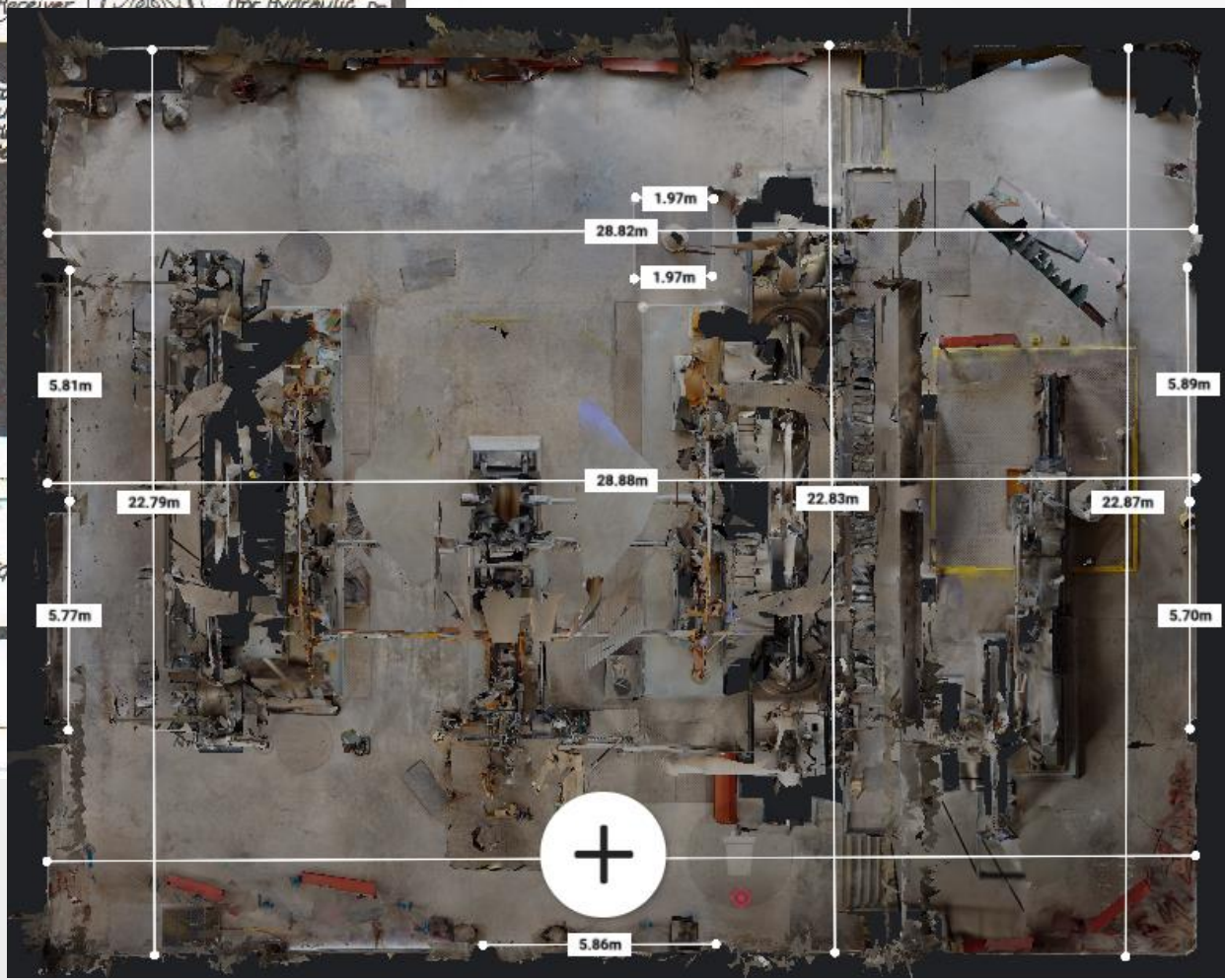
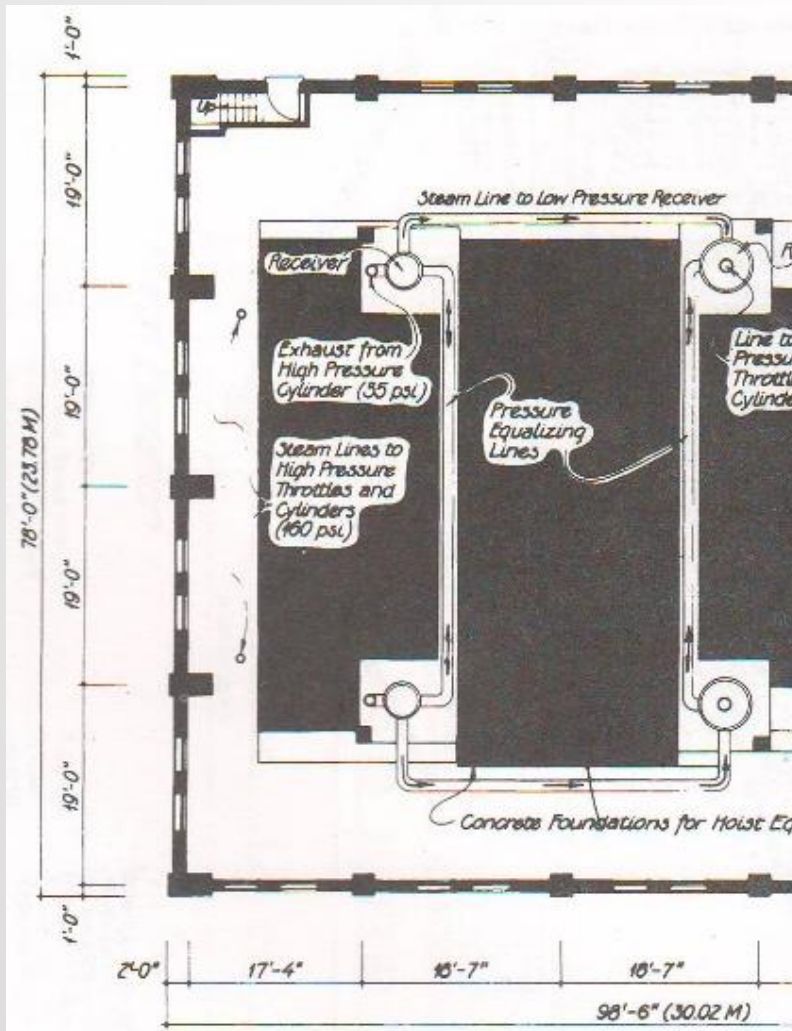






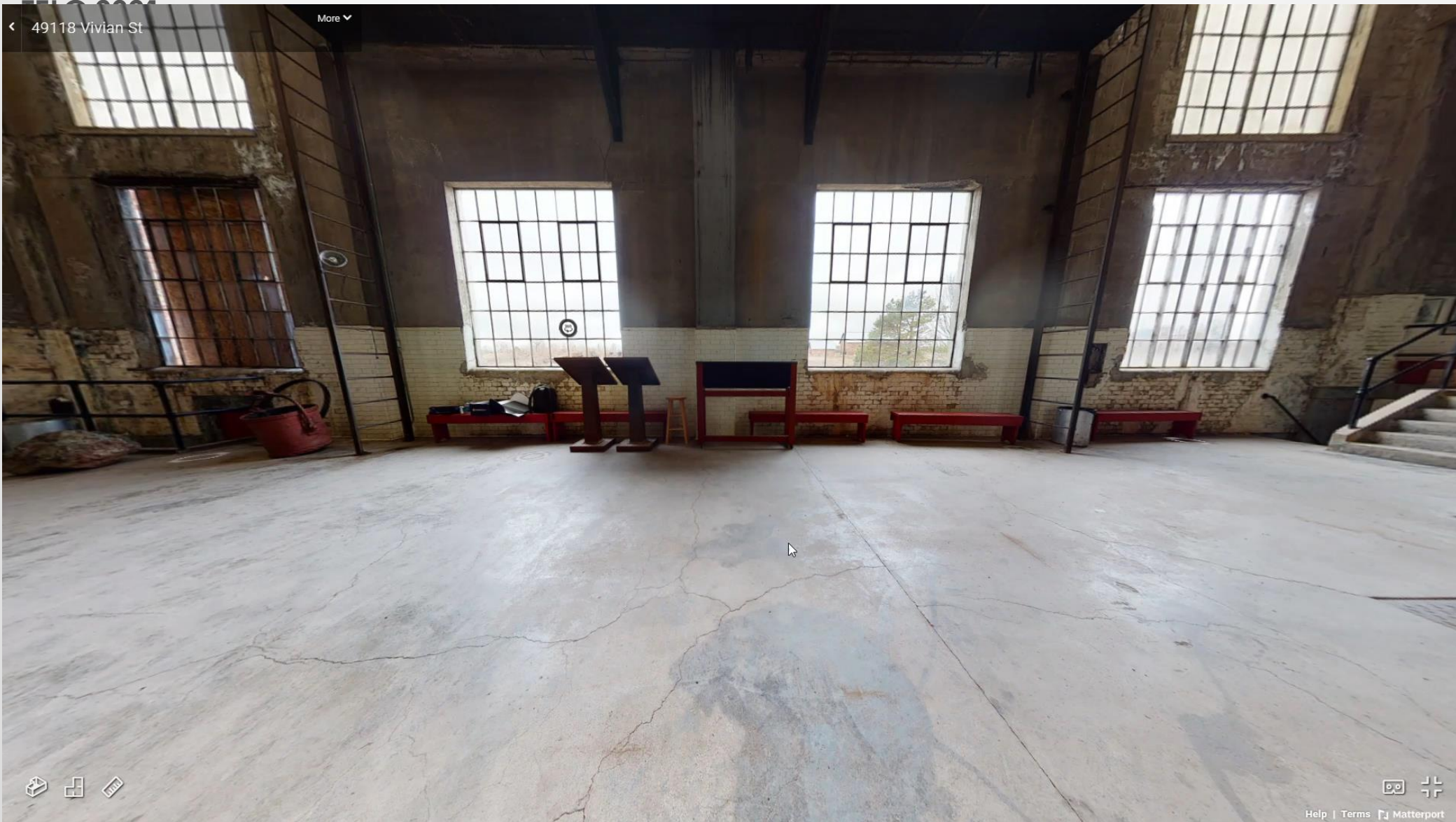












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Distances	Control Distances from Map, m	Matterport Distances, m	Differences, m	Corrected Matterport distances, m	Corrected differences, m
1	5.81	5.79	-0.02	5.81	0
2	5.81	5.77	-0.04	5.79	-0.02
3	5.81	5.7	-0.11	5.72	-0.09
4	5.81	5.83	0.02	5.85	0.04
5	5.73	5.66	-0.07	5.68	-0.05
6	2	1.97	-0.03	1.98	-0.02
7	2	1.97	-0.03	1.98	-0.02
8	2	1.97	-0.03	1.98	-0.02
9	23.16	22.87	-0.29	22.95	-0.21
10	23.16	22.83	-0.33	22.91	-0.25
11	23.16	22.79	-0.37	22.87	-0.29
12	29	28.82	-0.18	28.92	-0.08
13	29	28.88	-0.12	28.98	-0.02
14	29	28.89	-0.11	28.99	-0.01
15	28.4	28.24	-0.16	28.34	-0.06
<b>Mean</b>	14.66		-0.125	14.58	-0.073
<b>RMS</b>			0.120		0.098
<b>Relative</b>			1:122 (0.0082%)		1:150 (0.0067%)

The general picture emerging from the study is that the calibration procedure for the 3D camera is an inevitable stage.

The accomplished accuracy check has shown significant systematic errors in the camera results. A positive correlation was obtained between distances and systematic deviations.

The calibration procedure was suggested and accomplished. That step allowed us to get the scale coefficients that are considered as calibration parameters. These calibration parameters were applied for the real surveying results of the Quincy Mine Hoist Engine.

The results provide convincing evidence showing that for the 3D camera, accuracy improvement is possible. The accuracy enhancement of up to 19% was achieved.

However, our findings are not generalizable beyond the study sample since the size of the calibration test field was considerably smaller than the surveyed object.

Future studies will have to consider the design of the calibration test field and the development of the new calibration model.

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**Thank you for attention**

