PROJECT TITLE:

DEFORMATION MONITORING OF AN OIL STORAGE TANK BY GEODETIC METHODS. CASE STUDY: OIL LIBYA NAIROBI TERMINAL

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NAME: GITHUMBII W.J

SUPERVISOR: DR. Ing- S.M MUSYOKA

joywanja23@yahoo.com
Outline

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Background

• Definition
• Why deformation monitoring?
• Application
Statement of Problem

• There is need to monitor oil tanks periodically to determine their health.
General Objective:

- To assess whether the tank under study has deformed horizontally; and in so doing develop MATLAB programs that can be used for the analysis of the tank deformation and other deformation monitoring data.
Specific Objectives

- To develop MATLAB programs for the deformation analysis.
- To adjust the reference network around the tank.
- To compute the object coordinates of tank surface points for each of the epochs.
- To carry out a 2 epoch analysis between epochs 1 & 2, and epochs 1 & 3.
- To determine the amounts of deformation between epochs 1 & 2, and epochs 1 & 3, if any.
Study Area

• Tank No 17 under study is at the Oil Libya Nairobi terminal, along Nanyuki road off Lunga Lunga road, South east of Nairobi CBD. The yard is bounded approximately by the coordinates 263976m E to 264186m E and 9855958m N to 9856256m N, with an area coverage of 0.0487 km².

• Project considers horizontal deformation only.

joywanja23@yahoo.com
Area of study
Geometry of the tank and surrounding reference points
Methodology

1. Adjustment of reference network (free network)
2. Computation of tank point coordinates for epochs 1, 2 & 3 (fixed network, individually)
3. Combined Analysis
   - Epochs 1 & 2: Congruency test, single point diagnosis
   - Epochs 1 & 3: Congruency test, single point diagnosis
4. Deformation results

joywanja23@yahoo.com
Tank position in relation to the reference network
Tank distortion tolerances

\[ \Delta L = \alpha L_0 \Delta T \]

For Steel tanks, the coefficient of linear expansion \( \alpha \) is given by:

\[ \alpha = 13 \times 10^{-6} \text{ m/m K} \]

From the oil terminal operations temperatures, the average operating range is:

Max = 28°C (301K)  
Min = 13°C (286K)

\[ \Delta L = \alpha L_0 \Delta T \]

For the x-axis

\[ L_{x_0} = \text{circumference of the tank} = 23.95 \text{m} \]
\[ \alpha = 13 \times 10^{-6} \text{ m/m K} \]
\[ \Delta T = 301-286 = 15^\circ \text{C} \]

\[ \Delta x_{17} = 13 \times 10^{-6} \text{ m/m K} \times 15 \times 23.95 \]
\[ \Delta x_{17} = 0.004670 \text{ m} \]
\[ = 0.004670 \text{ mm} \]

\[ \Delta h_{d_{17}} = (\Delta x^2 + \Delta y^2)^{1/2} \]
\[ = (4.67^2 + 0.00002^2)^{1/2} \]
\[ = 4.67 \text{ mm} \]

joywanja23@yahoo.com
The null hypothesis of the congruency test, that “all points are stable” was accepted.

Thus, there was no deformation.

Single Point diagnosis was not carried out.
Conclusion

Objectives of the study were achieved:

1. Development of MATLAB deformation programs
2. Adjustment of reference network
3. Determination of tank point coordinates
4. Combined analysis and calculation of deformations

MATLAB program proved to be effective.

Analysis showed that there was no deformation.

joywanja23@yahoo.com
Recommendations

- Further studies should be carried out on the tank in order to assess other types of deformations e.g. foundation settlements, vertical deformations, and the tank’s out of roundness etc.

- MATLAB software is appropriate for use in deformation studies. Use of other survey software e.g. Starnet, Microsurvey for comparison purposes.

joywanja23@yahoo.com
THANK YOU.