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FACULTY OF ENGINEERING

Study of geodetic and other techniques for determination of deformations of tall buildings in Egypt"

By

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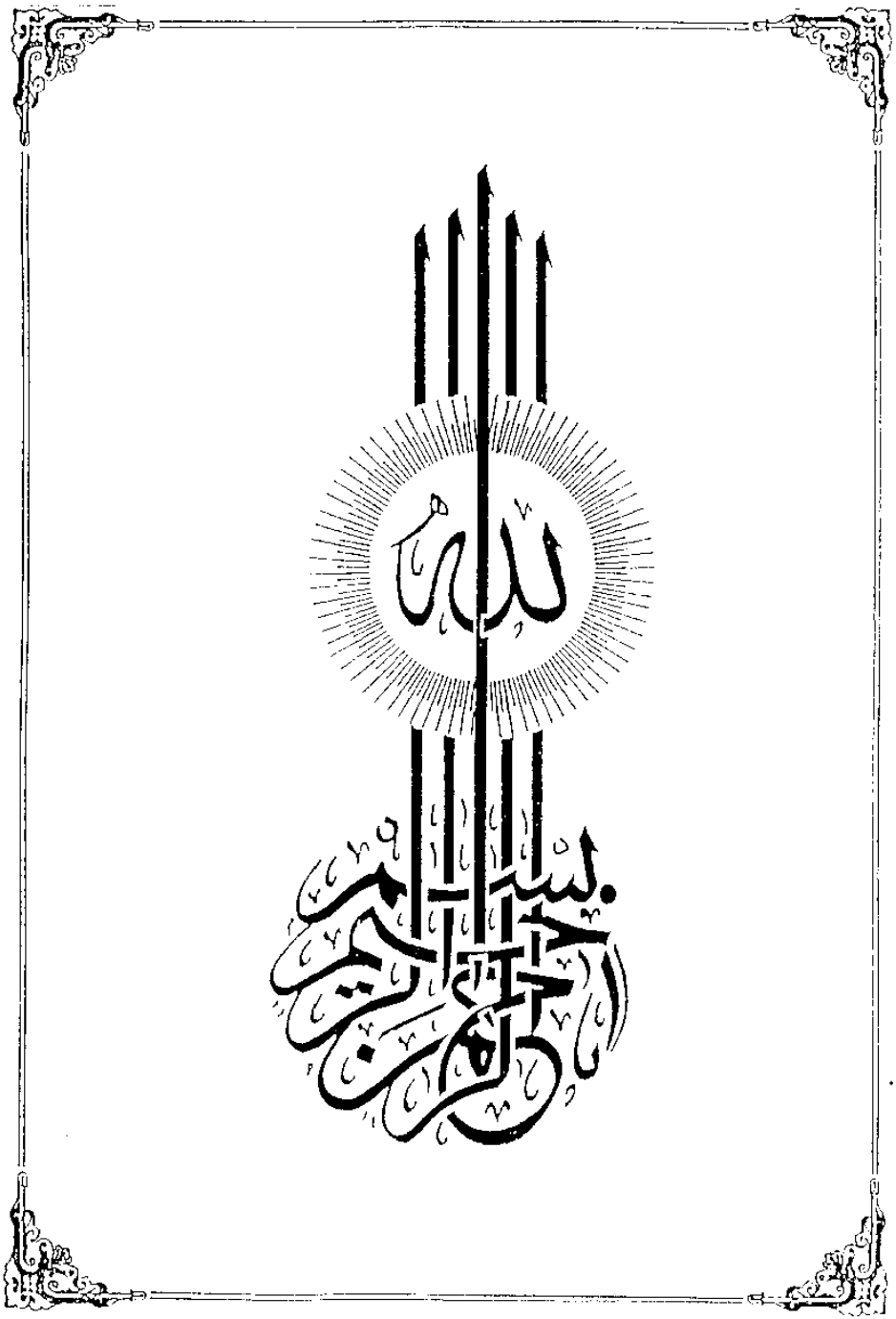

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the Department of Public works, Ain Shams University, from 10 /12 / 1980 to 29 / 10 / 1988.

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ABSTRACT

Many high rise or tall buildings have been constructed in Egypt during the recent years. These tall buildings are considered as very sensitive and valuable structures. Of course, any distortion or deformation in any element of a tall building greater than the allowable tolerances may cause a dangerous damage to the building. Thus, there is an increasing need for monitoring and determining their deformations for the human safety as well as economical considerations. Such deformations must be measured and monitored during and after construction by using the most precise available techniques.

There are several methods that can be used in practice for monitoring structural deformations, which include geodetic and other techniques. Thus the main objective of this thesis is to study some of these methods from the obtainable accuracy point of view to decide upon their suitability as applied to the special case of tall buildings.

In this context geodetic and other techniques for determining tall building deformations are discussed, analysed and compared for determining both horizontal and vertical deformations. Geodetic techniques have been proved to be the most accurate methods for deformation measurements. Besides they are familiar to most of the practicing surveyors. Therefore special emphasis has been but on some of the common geodetic techniques in our investigation herein.

For the above mentioned reasons some experimental field tests on geodetic techniques were done by the author to determine their accuracy when applying them in the case of tall buildings. Three field tests were done on the intersection method to determine the effect of intersecting angles, the direction of deformation and the value of the vertical angle on the intersection accuracy. The best accuracy

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obtained from this method using 40m base line in the X direction (parallel to the base line) is 0.1243 mm ,where both the intersecting angles are 45° and 0.0832 mm in Y direction (perpendicular to the base), where both the intersecting angles are 25°. It is also found that there is a serious effect of large vertical angles (more than 50°) on the obtainable accuracy.

Two field tests on the precise levelling (using a mm steel scale) and trigonometric levelling methods were done. The first test showed that a high accuracy (0.04 mm) can be achieved for distances up to 10 m. The accuracy obtained from the trigonometric levelling method is approximately the same as that obtained from precise levelling in case of short distances up to 10 m and small vertical angles up to + or - 5°.

The above obtained results indicate that the tested geodetic techniques can be safely used for monitoring horizontal and vertical deformations of tall buildings having small magnitudes especially those resulting from settlement and external loading. On the other hand, methods can be combined with geodetic techniques for measuring deformations resulting from construction mistakes, which generally occur with relatively significant magnitudes.

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