

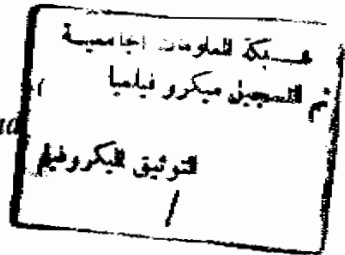
**AIN SHAMS UNIVERSITY  
FACULTY OF ENGINEERING  
PUBLIC WORKS DEPARTMENT**

**"STUDIES TOWARDS THE RIGOROUS ADJUSTMENT AND ANALYSIS  
OF THE EGYPTIAN PRIMARY GEODETIC NETWORKS  
USING PERSONAL COMPUTER"**

by

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a thesis

Submitted in partial fulfillment for the requirements of the  
Degree Of Doctor of Philosophy  
(Public Works- Surveying)

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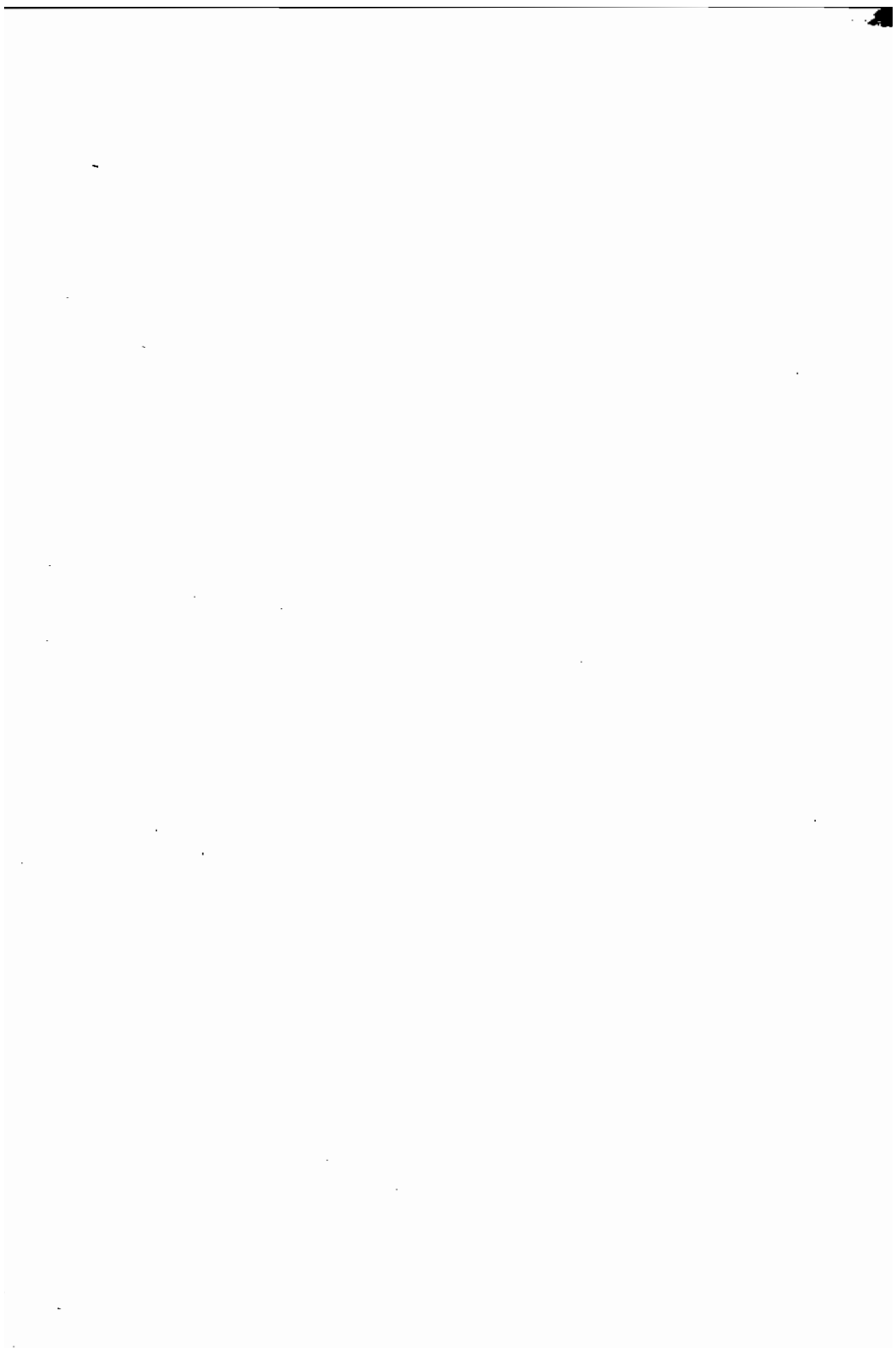
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Cairo, 1997





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Approval sheet

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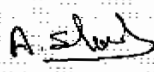
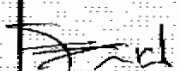

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### STATEMENT

This thesis is submitted to Ain Shams University for the degree of Ph.D. in Civil Engineering (Public Works - Surveying).

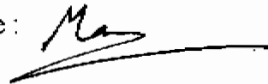
The work included in this thesis was carried out by the author in the Department of Public Works, Ain Shams University, from May, 1993 to November, 1997.

No part of this thesis has been submitted for a degree or qualification to any other University or institution.

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### Abstract

The economic development of any country requires comprehensive and modern geodetic control networks. The geodetic control networks, in classical geodesy, provide a basis for mapping, cadastral applications and large engineering projects. The recent applications of geodetic control networks require a very high accuracy for the network coordinates. The first order geodetic horizontal control networks of Egypt consists of two main networks; network 1 and network 2. Network 1 has been adjusted by ESA, using a non-rigorous adjustment. However, no final adjustment has been done by ESA for network 2, where its provisional coordinates are only available.

During the past few decades, several previous solutions for the Egyptian horizontal geodetic networks have been performed, either in two or three dimensions. However, these adjustments neglected, totally or partially, the role of the geoid on the adjusted coordinates. Also, no simultaneous adjustment for both networks 1 and 2 on the Egyptian Datum (EGD30) has been performed before. Consequently, it can be seen that, the accuracy of the existing coordinates of the Egyptian geodetic networks, will not be sufficient for precise geodetic applications. Therefore, the rigorous adjustment for the Egyptian horizontal control networks 1 and 2, is essential for recent scientific and precise purposes. In addition, the choice of the geodetic datum will cause corresponding changes in the resulting geodetic coordinates, which are computed relative to it. On the other hand, GPS measurements require existing regional control networks to be adjusted on the GPS datum, which is known as WGS84.

The main goal of this thesis is to perform different simultaneous rigorous adjustment solutions for the Egyptian horizontal geodetic control networks, with the geoid effects on the reduced observations to the reference ellipsoid being taken into account, referring to different geodetic datums, using the currently available personal computers. The first geodetic datum is the Egyptian geodetic datum (EGD30), which is based on Helmert ellipsoid (1906). The second datum is the WGS84, which is the datum of the GPS observations. For this purpose, a software package



was developed by the author, using FORTRAN 77 language, with Microsoft FORTRAN compiler version 5.1. This program was designed to perform the rigorous simultaneous least squares adjustment of large horizontal control networks, using the parametric approach, in terms of the two dimensional geodetic latitude and longitude. The main programming consideration was stipulated, such that the storage requirements for all consecutive different steps of the solution, are kept to a minimum in the memory of the used personal computer. By using the developed version of the software, which runs under Windows, and using any AT-IBM personal computers or their compatibles with extended memory over 8 Meager Ram., the software is capable of adjusting a horizontal network with more than 450 unknown stations.

The obtained results indicated that the non rigorous adjustment in sections, and the neglect of geoid effects in reducing observations to the ellipsoid, as used by ESA, cause undesirable distortions in the network point positions, as well as distortions in both scale and orientations of network sides, that exceed the allowable limits specified for first order geodetic work, and can not be neglected in precise geodetic applications. In addition, including both networks 1 and 2 into the same simultaneous combined adjustments, relative to EGD30 or WGS84, improves the positional accuracy of network 1 stations more than that of network 2 stations, when compared to the cases of adjusting networks 1 and 2 individually by itself. On the other hand, the simultaneous adjustment of network 1 alone, network 2 alone, and both networks 1 and 2 combined together, relative to WGS84 datum, possesses a higher point positional accuracy, than the corresponding adjusted coordinates relative to the Egyptian regional geodetic datum EGD30. This can be attributed to the higher reliability of both the used geoid model and datum initial fixed point in case of WGS84. Consequently, the rigorous simultaneous adjustment of the entire Egyptian networks, with the geoid information being taken into account, is recommended to be performed, relative to WGS84 global datum, with station O1 at Helwan taken as the initial fixed point.

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