

AFRICOVER PROJECT- EAST AFRICA

An Overview of Geodetic Framework of Tanzania

Abstract.

This report outlines an overview of the present status of the “Geodetic network” in Tanzania, both horizontal and vertical. It gives a brief history of the establishment of geodetic control points as well as their consistency but framework analysis is not made

1.0 Introduction

Tanzania geodetic network, both horizontal and vertical control points, has been gradually established since the colonial period. Computations of horizontal and vertical control points were completed by the end of the second decade. As of now, quite a number of first and second order network monuments have been destroyed by human beings mostly because of ignorance of the purpose and significance of the pillars. The Surveys and Mapping Division replaces some of these points whenever opportunities arise usually in the course of carrying out topographic mapping programs.

Survey control points in Tanzania are in two groups. The first group comprises a set of interconnected and monumented survey markers that have been well defined in known spherical and plane survey datums. The points provide a reference for all other surveys by extending a uniform co-ordinate system, scale and accuracy throughout the country.

The second group is a set of auxiliary survey points established and defined to enable a transformation of survey data and other information such as aerial photographs and satellite images into the mapping projection. This group constitutes points densified down to the required accuracy for a specific purpose.

The mapping spheroid in Tanzania is the Clarke 1880 (modified) of which the parameters are semi major axis (a) = 637,8249.415 metres and flattening, $f= 1:293.5$. The projection is the Universal Transverse Mercator (UTM).

Tanzania is mapped at different scales using aerial photographs. The functional basic scales comprise of the medium scale at 1:50,000, that covers the whole country; scale at 1:10,000 for some districts, and large scales of 1:5,000 and 1:2,500 mostly for urban areas.

2.0 Geodetic Network

2.1 Horizontal Network

The horizontal network is based on the arc of 30th Meridian. The coordinates are based on the new 1950 arch Datum. The 1950 coordinates which were computed by the Directorate of Overseas Surveys (DOS) were based on the datum in Zimbabwe (then Southern Rhodesia). This datum was derived from another datum in Southern Africa. The datum was also used to establish control points in Democratic Republic of Congo (then the Belgian Congo) and Mozambique (then the Portuguese East Africa). The situation thus provided a uniform system from the Cape to the equator.

It was in Tanganyika among the East Africa territories that a geodetic network was computed first using this arc datum. The main purpose of the network was to provide control for topographical mapping. The control network was not up to primary standard, but since it was the only one available, it had to be used as such. The values of the geodetic network were later improved, by re-computing in 1960 and 1965. To date no more points have been established and no measurements carried out specifically for improving the existing network.

The horizontal geodetic control points in Tanzania were established using triangulation method, later new equipment such as electromagnetic distance measurement equipment, e.g tellurometer, distomat were deployed to establish baselines of which a total of 55 lines were completed and incorporated in the 1965 datum results of 532 points. The traverses added 42 points to the network.

Other control points have been established in the course of carrying out national mapping programs. Examples of these are the control points established during the mapping of the western block in 1974. These control points were established by Aerodist method. Another control establishment was during the mapping of the Mwanza Geita block, adjacent to the southern part of lake Victoria, in 1992/93. In the later case the points were established by Global Positioning System (GPS). The 604 points listed in table 2 constitute the geodetic framework of Tanzania.

Category	Number of Points	Spacing in Km	Period of Establishment	Remarks
Triangulation	532	25 – 40		Arc 1960 data of DOS
Tellurometer Traverses	42	25 – 40		In 44 lines known
Doppler by ADOS	9	Over 300		Redefined trig. Points
Aerodist	43	78 – 300	1973-1974	Including 13 redefined trigs.
GPS			1992-1993	Mapping, DCA, and village data
Mwanza – Geita block			1992-1993	Cities and Municipalities
DCA Campaign	8			
USEP Project –9 major towns			1993-1995	Some 35,000 points
TOTAL	604			

Table 1 showing methods and distribution of geodetic control points.

3.0 Vertical Network.

A program to establish a network of geodetically heightened benchmarks was begun in 1961 and by the end of 1964 completed a total of 1458 miles of leveling in Tanzania. The vertical network was established using spirit leveling and the country is well covered by primary, secondary and tertiary leveling network although some of the benchmarks have been destroyed. These points include the following: -

- The leveling Circuit referred as circuit A. This was connected to the Fundamental Bench Marks (FBM) at Hale to the Tanga Tide Gauge on the Indian ocean. Then from Fundamental Bench Mark at Ruvu to Dar Es Salaam Tide Gauge, again on the Indian ocean.
- The leveling line from Tanga along the main road to Mombasa to the Kenyan border.
- The level line from Kilosa to Mbeya, through Mikumi and Iringa
- The level line from Mikumi to Ifakara and later on one level line was established and completed.
- Leveling line from Kyaka through Bukoba, Biharamulo, Geita, Mwanza, Musoma to Sirari, bordering with Kenya.
- Leveling line from Tabora, through Shinyanga, Malya to Mwanza

- Leveling line from Malya through Luguru in Bariadi District to Mkuyuni Mwanza

Also a series of Benchmarks (BM) with Intermediate Fundamental BenchMark (IFBM) were constructed along Mbeya Tunduma road, but have not been heighted.

4.0 Transformation between WGS 84 and the Geodetic network system.

So far the National network has not been transformed to WGS 84 system. As part of International GPS campaign of setting up control points in WGS 84 for civil aviation, points were established at 8 Tanzania airports namely Kilimanjaro, Dar Es Salaam, Zanzibar Mwanza, Mbeya, Kigoma, Mtwara and Dodoma. This campaign was tied to a similar campaign in Uganda at Kasese and Entebe airports. There after the airport GPS network was linked to Zambia, Malawi, and Mozambique; respectively at Kasama, Karonga and Pemba airports. The results of this campaign in Tanzania is available.

To effectively utilize a three dimensional data of GPS network, transformation has to be made between the WGS 84 and the existing National geodetic network. The transformation between the WGS 84 and the existing network is relatively cheaper than before once a proper geoid is selected.

5.0 Conclusion

The facts, presented in this report leads to the following conclusions:

- In present form, the National geodetic network of Tanzania is consistent but not validated.
- The geodetic network of Tanzania is far from satisfying the density and coverage requirements particularly those points associated with surveys for settlement planning both in rural and urban areas.
- There is need to set up a new National Geodetic framework using the off the shelf GPS technology which is the only way to providing the requisite control frame in Tanzania.
- There is need to evaluate and validate the established geodetic control points in the country to satisfy the expected permissible error at plotting scale.