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ОБЗОР ГЕОДЕЗИЧЕСКИХ ИЗЫСКАНИЙ В НЕПАЛЕ

GEODETIC SURVEY IN NEPAL

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Аннотация. В статье описаны особенности выполнения геодезических измерений в Непале. Акцентировано внимание на основных факторах, влияющих на создание высокоточной сети для определения движения земной коры во времени [1].

Ключевые слова: Геодезический обзор, топографическое отображение, WGS 84 / зона UTM 45 N, данная величина Непал 1981.

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Annotation. The article describes the features of performing geodetic measurements in Nepal. Attention is focused on the main factors affecting the creation of a high-precision network for determining the movement of the earth's crust in time [1].

Keywords: Geodetic survey, topographic mapping, WGS 84 / UTM zone 45N, Datum Nepal 1981.

Nepal is a South Asian landlocked country located between China and India in the coordinates 28.3949° N, 84.1240° E. Survey department of Nepal is actively engaged on establishment of a national network of control points throughout the country. It studies the crustal movement to help to predict natural disaster and the geoidal surface of Nepal and help to find the parameters in establishing the location of Nepal in the Earth's surface. It prepares and updates the cadastral plans of all the districts of the kingdom and land database and provides land rights to individuals and when land transactions take place. It prepares topographical base maps and takes aerial photography for various developmental, planning and mapping works. Preparation of Administrative and Land resource maps, establishment of National Topographical Database, as well as multi-resolution topographical database, carrying out international boundary survey works and to fulfill other international commitments of Nepal regarding surveying and mapping, coordination of surveying, mapping and GIS activities in Nepal with other agencies, updating the various maps and data prepared by the department are some of other works of department. In addition to it, it also provides maps, aerial photographs, geodetic data, and other related data required for planning developmental, educational, administrative and research works by other agencies in Nepal. The main branches of Survey Department are Topographical Survey, Geodetic Survey, Cadastral Survey and Survey Training Centre. Geodetic survey Branch firstly named as Trigonometrical survey Branch was established in Nepal in 25 September 1970 to help in establishing a network of trigonometrically points or control stations for cadastral mapping works. It then started establishing triangulation network throughout the country for precise leveling, astronomy, gravity and other geodetic survey works. Geodetic Survey Branch is now actively engaged in producing geodetic, gravimetric and altimetric (height) data required for the preparation of maps and geo-information products including cadastral information of the country.

Objectives of Geodetic survey Branch

- To establish and maintain higher order (first, second and third order) geodetic ground control network throughout the country.
- To establish lower order ground control points and provide map sheets with ground control to prepare large-scale cadastral map of the country.
- To establish and maintain leveling network in the country.
- To establish and maintain gravity network and determine gravity anomaly of the country.
- To promote the research works in the field of geodesy and astronomy in the country.
- To archive the different types of ground control points data as well as other geodetic information products and provide services for Development Projects.

Activities

Geodetic Survey Branch has already completed the following works:

- Establishment of 7 Laplace points and 14 azimuth points distributed all over the country for the azimuth control of the Geodetic Network.
- Establishment of high precision geodetic net of first order with 16 Doppler stations and 68 trigonometric points.
- Establishment of the precise leveling bench marks of 3200 points along the high ways / roads (6430 km).
- Establishment of 9 absolute and 1193 relative gravity points all over the country.
- Extension of trigonometrical control in the remaining areas.
- Fourth order horizontal control densification for cadastral survey (47 districts completed and work is in progress to complete the remaining districts of the country).
- Establishment of a geodetic observatory at Nagarkot with Tower, astronomical observatory, base station for triangulation network, meteorological station and continuous GPS observation.
- GPS observations of the geodetic stations for regional/local transformation parameter (WGS 84 to Everest 1830 and vice-versa).
- Precise leveling at Swayambhu, Gorkha Durbar and other places of historical importance to study the level displacements of those regions.

Available Maps and Data

- Geodetic Control Data.
- Aerial Photographs.
- Topographical Base Maps:
  - Terai and Middle Mountain at the scale of 1 : 25000;
  - High hills and Himalayas at the scale of 1 : 50000.
- Land Resources Maps.
- Administrative and Physiological Maps.
- Maps of VDC/Municipalities, District, Zone & Development region.
- Digital Topographic Data.
- Cadastral Plans.
- Ortho photo Maps.
- Soil Data.

Progress of last Five Decades

Napigoswara was established in 1964 and started preparation of cadastral maps/documents in national level. It completed series of cadastral maps of cultivated areas for all the seventy-five districts of Nepal. Geodetic survey Branch was established in 1970. It established higher and lower order national geodetic control network and lower orders national leveling network, observatory tower, base stations, gravity station and Laplace station. Survey Training Centre was established in 1969. It helped in production of different level of survey technicians (Basic, Junior and Supervisory level). And updated knowledge on surveying and mapping techniques for working surveyors by refresher courses on various subjects. Topographical survey was established in 1976 and established aerial survey lab, installation of photogrammetry, cartography and printing equipment. Preparation of aerial photos of whole kingdom of Nepal at 1 : 50,000 scales were taken in 1979 and 1992. Preparation of land use maps (at 1 : 50,000 scale) and subsequent report of whole kingdom of Nepal was done in 1980 and also was conducted of topographic base maps (1 : 25,000 and 1 : 50,000 scale) of whole kingdom of Nepal except some portion of northwestern region of Nepal. The preparation of Nepal China International boundary maps was on1979 and there was preparation of large-scale maps of specific regions of the country.

With advancements in technology, new surveying equipment and techniques are developing. Current advancements are making the science of surveying more valuable, accurate, and comprehensive than ever. For example, the use of GPS in modern surveying methods is one of the radical changes influencing land measurements. GPS is a breakthrough technology in surveying because it is extremely precise, fast, and reliable. Furthermore, the role of the surveyor is changing as technology expands and geospatial data becomes availa-

ble to anyone through programs such as Google Earth. A surveyor is no longer necessary for many basic data acquisition tasks … because the data already exists. Instead, the modern surveyor needs skills in geospatial data management and analysis. The technical boundaries of the surveying in history are no longer applicable.

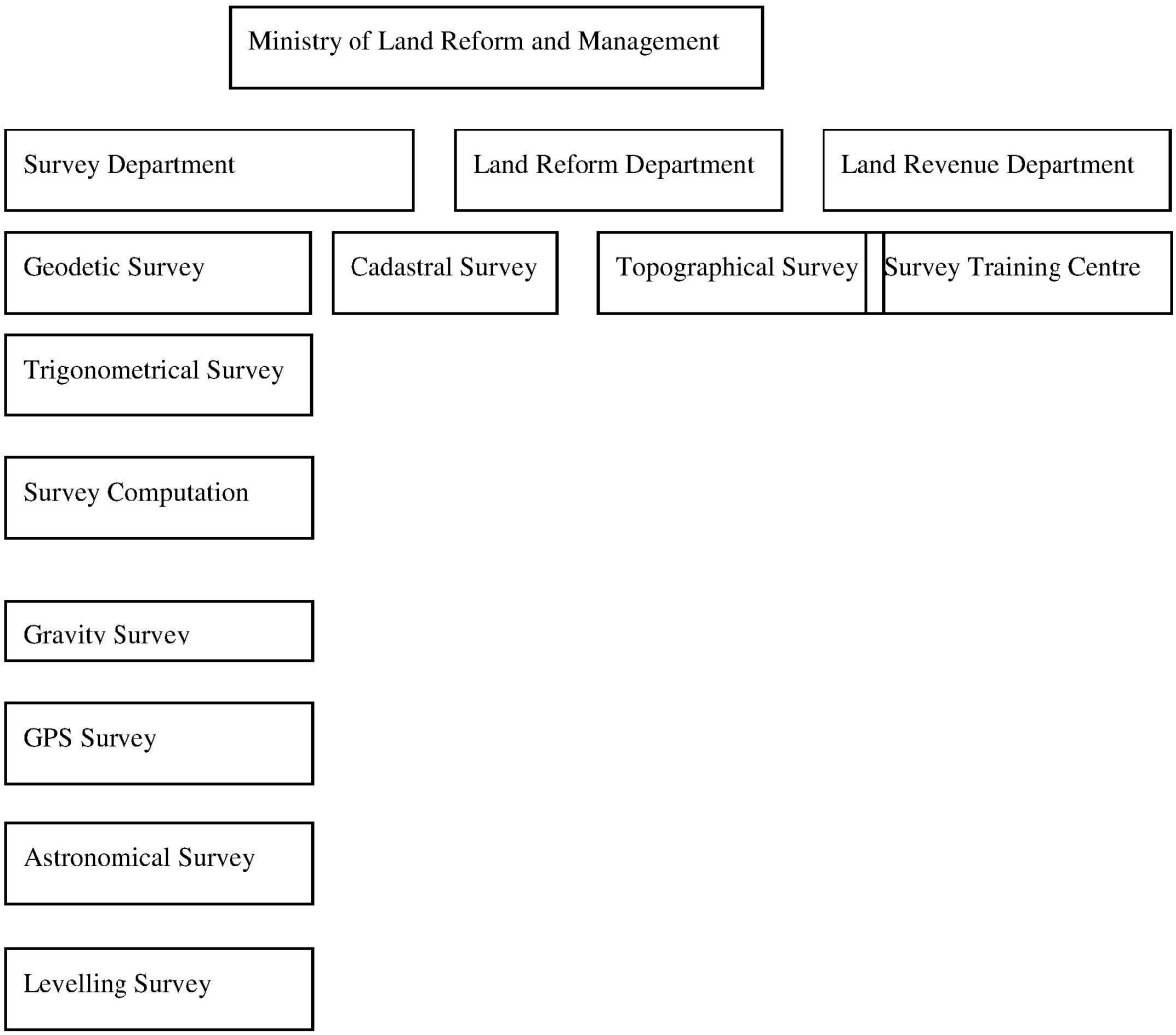

Figure – Structure of Ministry of Land Reform and Management

With current technologies, measurements and estimation have become easy. Subjects of rising significance are the formation and managing of data and, subsequently, data application. The contemporary surveyor's challenges include the induction of modern dominant technologies such as airborne scanning, terrestrial scanning, satellites that create high-resolution images, and an increasing number of satellites. As surveyors continue to work, they work with an increasingly diverse collection of professionals. The state and private sector is recognizing the economic significance of this discipline and that it has huge future growth prospects. It is an exciting time for the discipline, and surveyors have to adapt themselves rapidly to the latest technologies if they wish to remain valuable in the field of surveying [2]. Today surveyors are familiar with a new generation of surveying equipment and techniques. Traditional system of surveying and mapping has been replaced by semi-modern or modern techniques that can be characterized as 'black box technology', giving results in real time and in digital form. Many of the surveying activities including field operation have been using 'Push of Bottom' System with limited use of knowledge and experiences of the survey professionals. This technical evolution has influenced the instrumentation and techniques used in surveying and mapping. The investigations are carried out in order to identify tachometers with unacceptable systematic errors or to take into account these errors in order to increase measurement precision. And additional theories are being made continuously [3, 4].

In Nepal, plane table surveying for cadastral survey is still popular. More than 2000 surveyors are still working on this technology. However, topographical surveying is carried out using aerial photos with photogrammetric analogue plotter and geodetic surveying is still using triangulation traversing by theodolite and distance meter. Precise theodolite and levels carry out higher order geodetic controls and precision leveling works. Attempts to automate and make the surveying and mapping process more efficient have also been going on for considerable time. Global Positioning System (GPS) was used in the production of topographical base map for Eastern Nepal, Topographical base maps were at 1 : 25,000 scale in the plane and 1 : 50,000 scale at the mountain. The aerial photography was taken with the help of kinematics GPS techniques in order to have the minimum control for the aerial triangulation singular on an unaccusable Himalayan part of the country. Similarly, the same method was used for the Western Nepal Topographical Mapping Project. The extension of ground control for large-scale cadastral maps is also carried out by GPS methods. The utilisation of digital geographic information has been growing fast in all sectors of the society of the world. Also, in Nepal, this has given a great influence to different organisations and in some of the sectors of society. Recently, Survey Department has already prepared the specifications for geographic information service and national topographic database to ensure homogeneous quality and availability of needed geographic information with this national database standard.

Survey Department runs digital mapping applications on environment. It is utilising cadcore/Tracer software for on-screen vectorising and ARC/Info as their editing and map use software. ARC/Info database is used as data storage format. Digital geographic information is also used in producing graphic maps. The objective of the product specification is to ensure the sufficient information content for the user and the specification for topographic maps at the scale 1 : 25, 000 and 1 : 50, 000 are aiming to fulfil the needs of users, as most updated maps of most of the regions of the country are easily available [5, 8].

Affliated Professional Organizations

SAARC Networking Arrangement on Cartography

For sharing the advancement in cartography technology in the SAARC region, for the environment protection and alleviation of poverty, a committee, SAARC Networking Arrangement on Cartography (SAARC) was created by the coordination of the Department. At present, it is working on producing a Mapping Education Directory and a Mapping Inventory for the SAARC region.

Asia-Pacific Regional Space Agency Forum (APRSAF)

Survey Department became member of APRSAF on January 2004. The membership was awarded during APRSAF-10 which was held in Chiang Mai, Thailand.

Group of Earth Observation (GEO)

Survey Department became member of GEO on April 2004. The Membership was awarded during Earth Observation Summit II which was held in Tokyo, Japan.

Global Spatial Data Infrastructure Association (GSDIA)

National Geographic Information Infrastructure Programme of Survey Department has been active as Founding Full Member of GSDI Association since 2004.

International Steering Committee for Global Mapping (ISCGM)

On the 28th November, 2000 AD Nepal entered its 1 : 1 000 000 map on the global map in the web site http://www.iscgm.org in conformation with the global mapping concept of which Nepal is a member.

Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)

Nepal is a member and active participant of the Permanent Committee on GIS Infrastructure for Asia and the Pacific.

Asian Association on Remote Sensing (AARS)

Nepal is a member and active participant of this association. Survey Department successfully conducted the 23rd Asian Conference on Remote Sensing which was scheduled for November 25-29,2002. This conference is an annual event of Asian Association on Remote Sensing.

International Federation of Surveyors (FIG)

Survey Department became member of FIG from April 2002. This membership was awarded during XXII FIG International Congress.

JPT member of Sentinel Asia

Survey Department became the JPT member of Sentinel Asia. The membership was awarded by JAXA [6, 7].

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