

El Salvador

# The use of GNSS systems in the Geodesy management of the National Registry Center

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## History of Geodesy in El Salvador



Throughout the history of El Salvador, various works have been carried out aimed at determining the shape and dimensions of the national territory. These works gave rise to different networks materialized as points on the ground with higher or lower coverage densities and acceptable preci-

sion values. Achieving that in the decade of the 50's and 60's the first geodesic networks were established with an approximate of 1500 points or vertices throughout the country.

It is in the 90's when the first measurement works with GPS equipment began in the country and the handling of raw data and its post-processing in special programs for the handling of satellite information.

The vertices SOLEDAD, SCORPIÓN, and SAN DIEGO

NORTH, were the first points measured over 72 hours continuous (absolute measurement) and post-processed by the National Imagery Mapping Agency (NIMA).

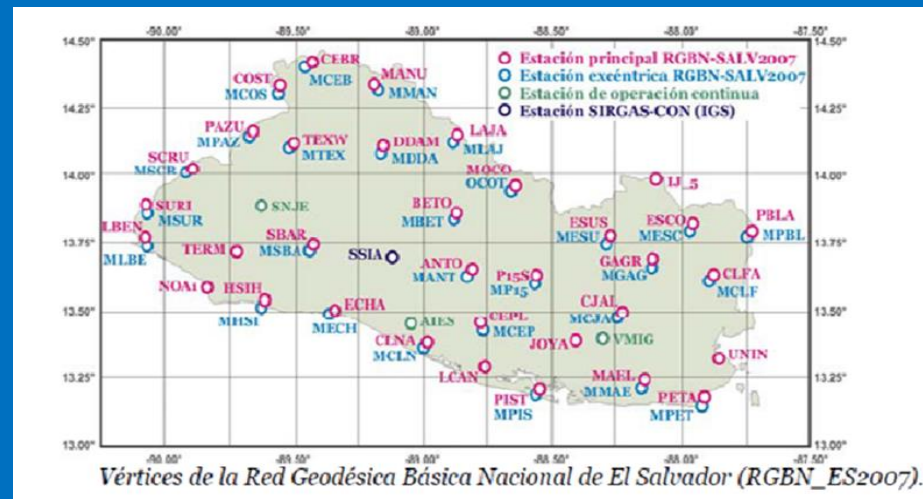
## NATIONAL GEODESIC NETWORK

The coordinates on the surface of the Earth vary as a function of time as a consequence of the movements of tectonic plates, the abrupt movements caused by earthquakes that change the coordinates sporadically and randomly. That is why the position of the geodesic vertices in El Salvador can vary from 1 to 3 cm per year. Due to this, maintenance and updating of the departmental geodetic networks is necessary. The National Basic Geodesic Network of El Salvador (RGNB\_ES2007) is made up of 38 stations distributed homogeneously over the national territory. The main objective of RGNB\_ES2007 is to provide a modern, accurate and

reliable reference platform to producers and users of georeferenced information in the country.

## NATIONAL BASIC GEODESIC NETWORK

Next, the National Basic Geodetic Network is presented, which serves as a reference for adjusting the networks and thus obtaining geodetic positions directly referred to the current ITRF.

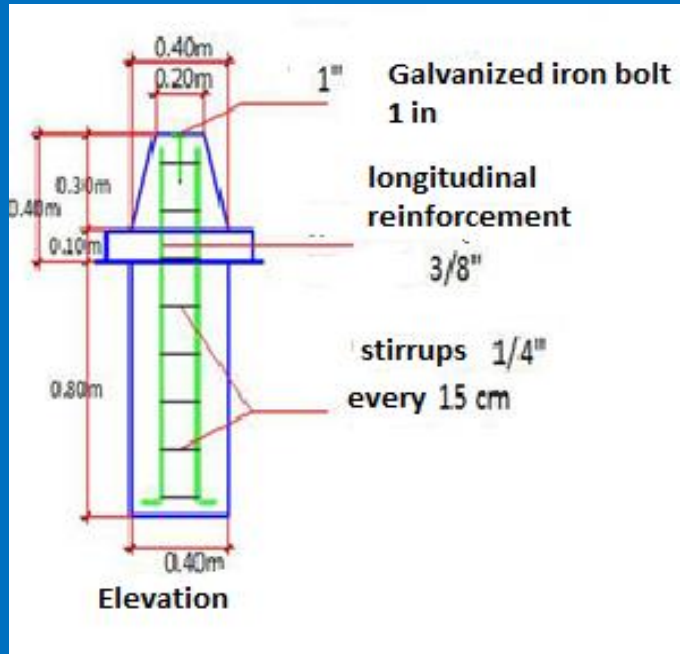


ITRF: International Terrestrial Reference System

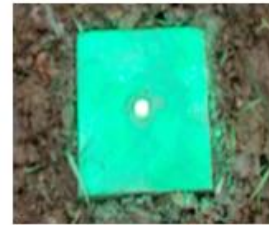
## VERTICE GEODESIC AND MARKS OF AZIMUT

Geodetic vertices and Azimuth Marks (MKZ) or vertex of back view, are points whose horizontal and vertical position have been obtained from high-precision geodetic surveys with the use of differential GPS, physically materialized on the ground by means of a cairn or Truncated pyramidal concrete monument with a central plate or pin with a mark embedded in concrete.

## GEODETC VERTICE MATERIALIALIZATION



Detail of reinforcement monument  
"Modified Type III" Cairn  
(truncated pyramid)



Measurement stage with GNSS equipment







## DESCRIPTION OF RTK BASES

Technical description with diagram, allows the user to reach the site where the urban pair is located without any difficulty. They include: Outline of the municipality, description of how to get there and the graphic location scheme with its references.

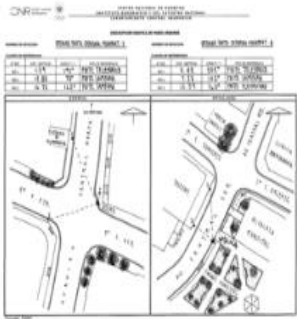
Municipality scheme



Description of urban pairs



Urban pairs location scheme



## CALCULATION AND PROCESSING

The Calculation and Processing Unit of the Geodesy Management is responsible for calculating and processing all measurements and works concerning vertices and level lines (First and Second Order); This in order to keep the geodetic information of all our national territory updated in order to have accurate and reliable data at all times. The Calculation Unit is made up of four technicians in charge of processing and updating geodesic networks nationwide.



## DOWNLOAD PROCESS AND CALCULATION OF HORIZONTAL NETWORKS

The raw data collected during the week by each Field Brigade is downloaded by the Calculation technicians directly from the Trimble Teams.



Raw data download by calculation technician

## PROCESSING OF VERTICES AND AZIMUT MARKS

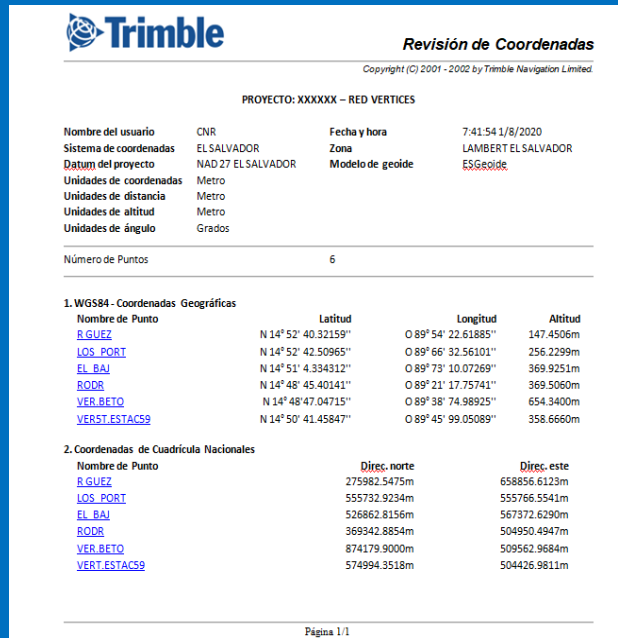
For the processing of the data they are downloaded with \* .DAT and \* .T02 extension of GNSS observations are used TRIMBLE TOTAL CONTROL (TTC) software or TRIMBLE BUSINESS CENTER (TBC).

Starting the processing with the height check, antenna type, GPS receiver model and time of

observation; information that is verified with the Reports field (Fig. 3), which the technicians present, and thus do the measurement processing in the software Below is an image of a geodetic network in which the data loading process and the configuration of the parameters of each of these have already been carried out in the software and is ready for processing.

After analysis, processing and adjustment, it is generated a report of the results, which presents the Geographic coordinates SIRGAS-ES2007 and

these in turn, its transformation to the LAMBERT SIRGAS-ES2007 projection



**Trimble** **Revisión de Coordenadas**

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**PROYECTO: XXXXXX - RED VERTICES**

Nombre del usuario	CNR	Fecha y hora	7:41:54.1/8/2020
Sistema de coordenadas	EL SALVADOR	Zona	LAMBERT EL SALVADOR
Datum del proyecto	NAD 27 EL SALVADOR	Modelo de geolide	ESGeoid
Unidades de coordenadas	Metro		
Unidades de distancia	Metro		
Unidades de altitud	Metro		
Unidades de ángulo	Grados		

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**1. WGS84 - Coordenadas Geográficas**

Nombre de Punto	Latitud	Longitud	Altitud
<a href="#">R.GUEZ</a>	N 14° 52' 40.32159"	O 89° 54' 22.61885"	147.4506m
<a href="#">LOS_PORT</a>	N 14° 52' 42.50965"	O 89° 66' 32.56101"	256.2299m
<a href="#">EL_BAJ</a>	N 14° 51' 4.334312"	O 89° 73' 10.07269"	369.9251m
<a href="#">RODR</a>	N 14° 48' 45.40141"	O 89° 21' 17.75741"	369.5060m
<a href="#">VER.BETO</a>	N 14° 48' 47.04715"	O 89° 38' 74.98925"	654.3400m
<a href="#">VERT.ESTACS9</a>	N 14° 50' 41.45847"	O 89° 45' 99.05089"	358.6660m

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**2. Coordenadas de Cuadrícula Nacionales**

Nombre de Punto	Direc. norte	Direc. este
<a href="#">R.GUEZ</a>	275982.5475m	658856.6123m
<a href="#">LOS_PORT</a>	555732.9234m	555766.5541m
<a href="#">EL_BAJ</a>	526862.8156m	567372.6290m
<a href="#">RODR</a>	369342.8854m	504950.4947m
<a href="#">VER.BETO</a>	874179.9000m	509562.9684m
<a href="#">VERT.ESTACS9</a>	574994.3518m	504426.9811m

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Image Report of the results

## PRECISIONS OF GEODETIC VERTICES AND MARKS OF AZIMUT.

The precision of the vertex coordinates will be better than the following:

- Accuracy Planimetry :+/- 0.15 mts.
- Accuracy Altimetry:+/- 0.33 mts.

## RTK BASE AND URBAN POINT

The maximum distance from the urban pair to the point that you want to position, depends on the level of visibility you have and the equipment that will be used:

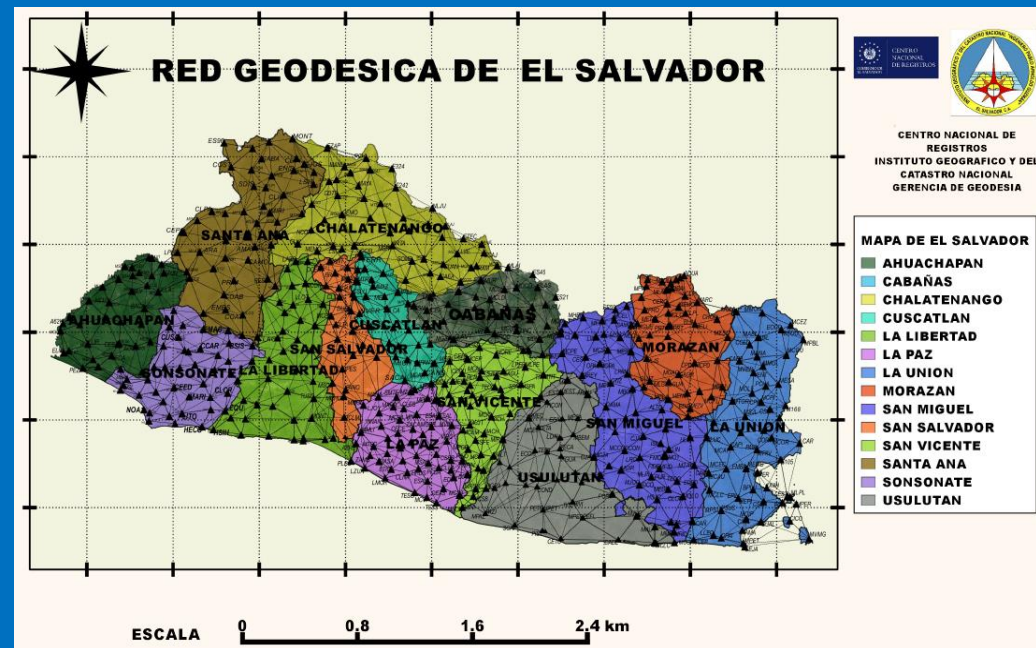
- 1.Total station distance of 100mt max
- 2.GPS receiver max 20km distance

## GEODEMIC NETWORKS DATA TO DELIVER:

WGS84 and Lambert coordinates. Accuracy + - 7mm

Technical description

## NATIONAL GEODEMIC NETWORK



**THANKS FOR YOUR ATTENTION**