



# ***Geospatial and GNSS CORS Infrastructure Forum***

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## **Geodetic Network in Cambodia**

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# ***Content***

***1. Introduction***

***2- Cambodia Geography***

***3- National Survey Organization***

***4-The Status of National Geodetic Network***

***5- The Challenges***

***6. Future Plan***

## 1- Introduction

- ❑ *The prolong civil war caused lots of difficulties not just the lack of human resources but the awareness among decision makers was also concerned.*
- ❑ *The Geospatial technology and applications was recently introduced in Cambodia increasingly, but slowly develop from time to time.*



### **3- National Survey Organization**

*The **General Department of Cadastre and Geography (GDCG)** under the Ministry of Land Management Urban Planning and Construction (MLMUPC) is responsible for mapping, surveying and cadastral works in Cambodia. This has six departments:*

- *Department of Land Administration*
- *Department of Land Dispute Affairs*
- *Department of Technique*
- *Department of Land Registration*
- *Department of Geography*
- *Department of Cadastre Information Technology*

*The **Department of Geography** is among others responsible for **national geodetic framework**. It will be supervisor of the Project. The department is supported by Technical Assistance provided by Land Administration Sub Sector Program (LASSP) .*

## 4-The Status of National Geodetic Network

### a)- The Role of Control Network

*Recommendations of Dr. Andrew Dyson Geodetic Consultant :*

- *As a matter of urgency, an accessible 1st order Geodetic Network be established through the whole Cambodia.*
- *The Cambodian Horizontal Datum should be defined based on the results of the Asia Pacific Regional Geodetic Project of 1998*
- *A precise vertical control network is established throughout Cambodia*
- *A common database is prepared for control points on any of the datum used in Cambodia and that a field search be made for any of these old control points so that they can be incorporated into the geodetic serving plan to enable the development of new transformation parameters relating the various datum*
- *The GPS specialist ensure quality control of the GPS operations, processing and adjustment in addition to providing the necessary on the job training.*

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## 4-The Status of National Geodetic Network

### **b)- Horizontal Datum**

- 1902-1950 : Indochina geodetic network based on Hanoi system was conducted from Tonkin delta to Pursat, but, almost all control points were lost.
- 1993-1994 : IGN installed 4 GPS control points in Phnom Penh and Siem Reap, and the points were linked to Taiwan. On the basis of this result, forty 1st-order and 2nd-order control points were installed around Phnom Penh, and fifteen control points (IGN93) were installed around Siem Reap.
- 1995-1997 : FINNMAP carried out UHA project using GPS. GPS survey was done in Mekong River, Tonle Sap Lake, and Bassac River.
- 1997 : With support of EU, GDCG established twenty two 1st-order control points referenced from IGN93 in each province. Also, it conducted 2nd survey of control points (EC97) in some provinces.
- 1998 : The result of EC97 was verified by PCGIAP1998 project which surveyed PCGIAP with five GPS stations .
- 2003 : CGD03(Cambodia Geodetic Datum 2003) was determined by reference to ITRF96 and GRS 80.
- 2009 : CGD09(Cambodia Geodetic Datum 2009) was determined by reference to ITRF2005 and GRS 80.(KOICA project) .

## 4-The Status of National Geodetic Network

### **b)- Horizontal Datum (...)**

*Horizontal Geodetic Datum of Cambodia used by LMAP / LASSP is defined as follows :*

Horizontal Datum Name : **CGD03 (Cambodian Geodetic Datum 2003)**  
Reference Frame : **ITRF2000 (International Terrestrial Reference Frame 2000)**  
Epoch : **1998.90**  
Reference Ellipsoid : **GRS80 (Geodetic Reference System 1980)**  
Semi-major Axis : **6,378,137.000 meters**  
Inverse Flattening : **298.257222101**

*The Cambodian Geodetic Datum 2003 is realized by the coordinates of the following high precision fundamental 0-order geodetic stations referred to the GRS80 ellipsoid determined within the International Earth Rotation Service Terrestrial Reference Frame 2000. Geodetic coordinates released in July 2003 were projected back to epoch 1998.90 .*

<b>Station</b>	<b>ITRF2000 Latitude</b>	<b>ITRF2000 Longitude</b>	<b>Ellipsoidal Height</b>	<b>Epoch Date</b>
PENH	11° 34' 25.7213"	104° 55' 03.2810"	15.2397 m	24 Nov 1998
SIEM	13° 24' 33.3967"	103° 48' 55.5972"	- 2.2294 m	24 Nov 1998
SIHA	10° 36' 38.5483"	103° 31' 24.6294"	- 3.6596 m	24 Nov 1998
STUE	13° 31' 49.8900"	105° 58' 15.5307"	37.5055 m	24 Nov 1998
SVAY	11° 05' 31.3986"	105° 47' 24.8193"	- 3.5451 m	24 Nov 1998

## 4-The Status of National Geodetic Network

### **b)- Horizontal Datum (...)**

<b>Map Projection:</b>	<b>UTM (Universal Transverse Mercator)</b>
<b>Projection Zone:</b>	<b>International UTM Zone 48, northern hemisphere</b>
<b>Central Meridian:</b>	<b>105° 00' 00" E</b>
<b>Latitude of Origin:</b>	<b>0° 00' 00" N</b>
<b>False Easting :</b>	<b>500,000.000 m</b>
<b>False Northing:</b>	<b>0.000 m</b>
<b>Scale Factor at Central Meridian</b>	<b>0.9996</b>

<b>Station</b>	<b>UTM Northing</b>	<b>UTM Easting</b>	<b>Ellipsoidal Height</b>	<b>Epoch Date</b>
PENH	1279428.548	491013.771	15.240	24 Nov 1998
SIEM	1482704.306	371750.641	-2.229	24 Nov 1998
SIHA	1173319.046	338477.632	-3.660	24 Nov 1998
STUE	1496014.009	605070.840	37.506	24 Nov 1998
SVAY	1226272.551	586303.151	-3.545	24 Nov 1998

*All further densification surveys have to be derived from the above fundamental 0-order stations and the epoch 1998.90 coordinates have to be used as fixed coordinates in 1st order horizontal geodetic network computations and adjustment in Cambodia*

## 4-The Status of National Geodetic Network

### **b)- Horizontal Datum (...)**

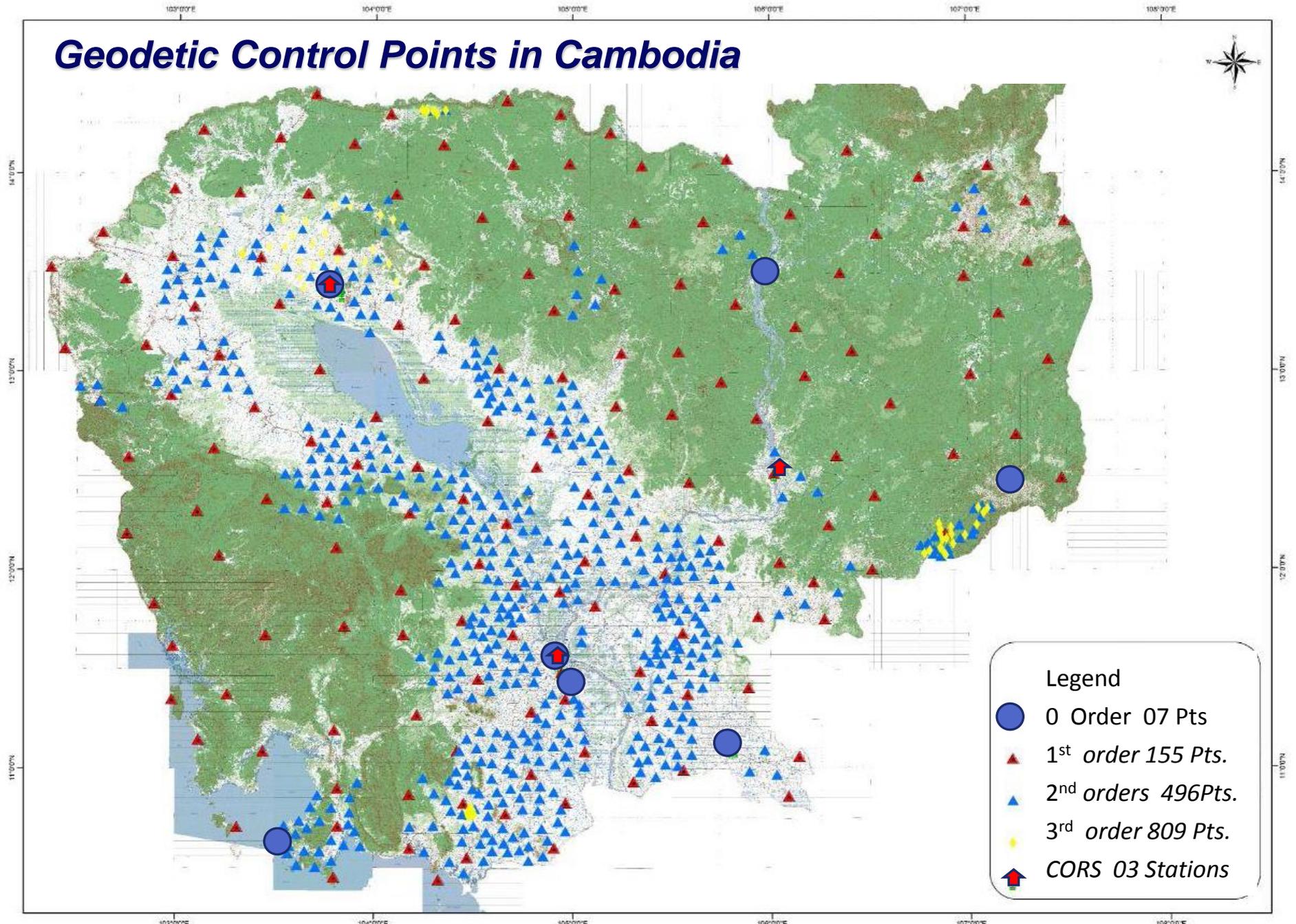
<b>Horizontal Datum Name:</b>	<b>CGD09 (Cambodian Geodetic Datum 2009)</b>
<b>Reference Frame:</b>	<b>ITRF2000 (International Terrestrial Reference Frame 2005)</b>
<b>Epoch:</b>	<b>2009.56</b>
<b>Reference Ellipsoid:</b>	<b>GRS80 (Geodetic Reference System 1980)</b>
<b>Semi-major Axis:</b>	<b>6,378,137.000 meters</b>
<b>Inverse Flattening:</b>	<b>298.257222101</b>

**Establishment of CGD09 :** In 2008-2009 KOICA project completed 1-order densification surveys of all Cambodia and incorporated previous 1-order GPS surveys by LMAP and KOICA in one homogenous countrywide network adjustment. The final network adjustment in 2009 includes seven Zero order stations, 155 1st order stations and three CORS stations.

Fundamental Zero order stations for **CGD09** were established and observed at **Phnom Penh , Siem Reap, Sihanoukville, Stueng Treng , Svay Rieng , Kandal , and Mondul Kiri.** These points were connected to IGS stations in Philippines, Singapore and Thailand at ITRF 2005 epoch 2009.56. Additionally three continuous operating reference stations (CORS) were established to **Kandal, Kratie and Siem Reap.**

The final network adjustment in 2009 includes seven **Zero order** stations, 155 **1st order** Stations and three **CORS** stations.

# Geodetic Control Points in Cambodia



Legend

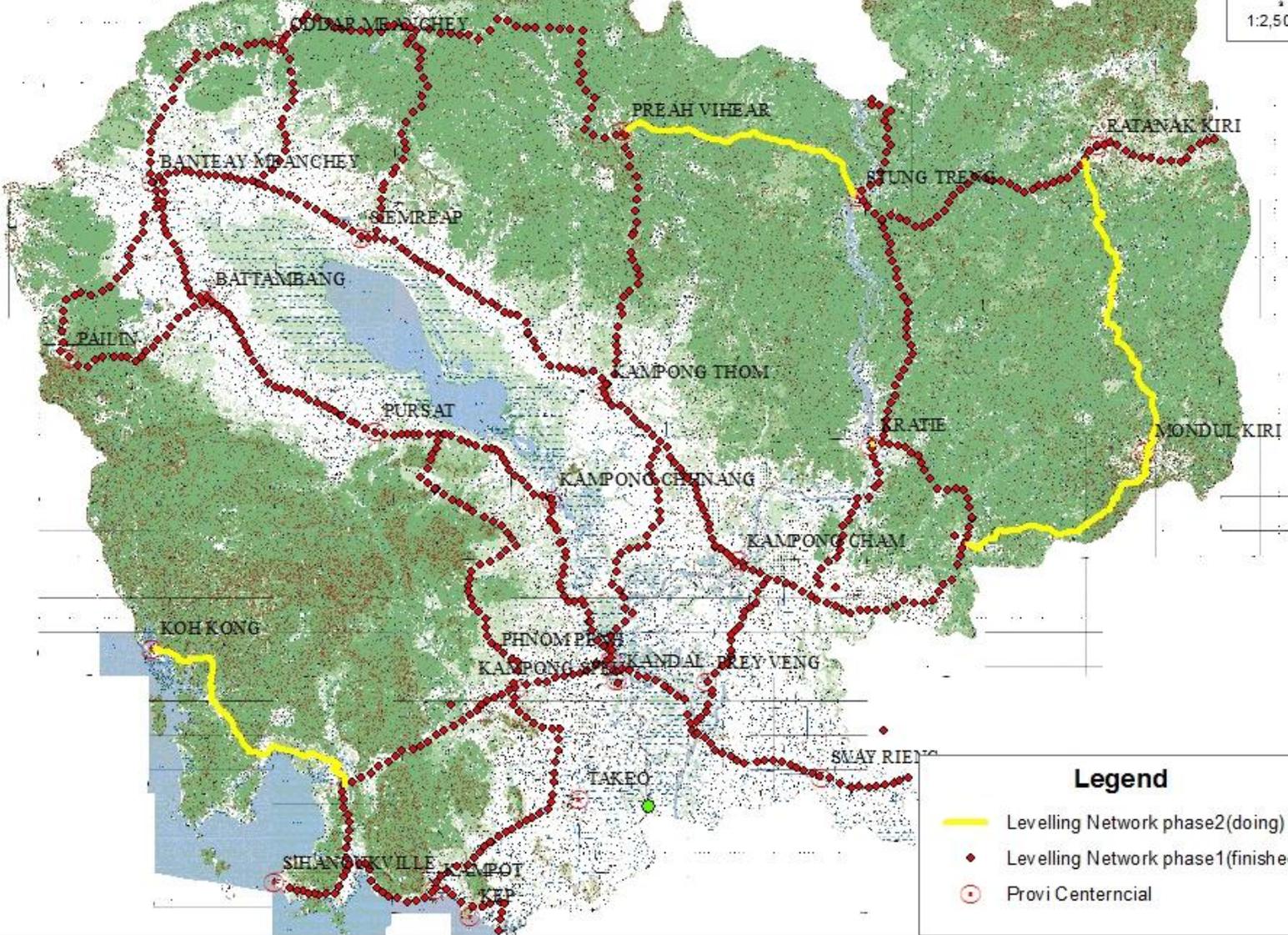
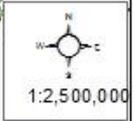
- 0 Order 07 Pts
- ▲ 1<sup>st</sup> order 155 Pts.
- ▲ 2<sup>nd</sup> orders 496 Pts.
- ▲ 3<sup>rd</sup> order 809 Pts.
- ▲ CORS 03 Stations

## 4-The Status of National Geodetic Network

### c)- Vertical Datum

- *In 1938-1954, Nivellement General built precise leveling network in south Indochina peninsula, and its purpose was to install 1st-order, 2nd-order, and 3rd-order benchmarks.*
- *Cambodia leveling network has not been completed yet, and Ponley of north Phnom Penh, Pursat Swai Dan Keo and Kampong Thom area was included in the network.*
- *IGN of France executed GPS survey and leveling in Phnom Penh area in 1944, and in Siem Reap in 1955. In 1996, leveling was conducted along the Mekong River, Tonle Sap Lake, and Bassac River to study agricultural development in Mekong River overflowing area. Also, leveling of 60 km and elevation point survey of 400km were carried out along the river bank.*
- *The latest 2nd-order benchmark survey was executed from Vietnam boundary to Prek Dam area by FINNMAP in 2001-2002. MRC extended the leveling to Tonle Sap Lake in Kampong Luong area.*
- *Benchmarks which installed by France (1938-1954) and Hunting Surveys (1959-1960) were destroyed by war and flooding. In 1996, some unstable benchmarks were eliminated, and some benchmarks were restored.*
- *2008-2009 Cambodia leveling network phase 1 has been completed ,*
- *2016 Cambodia leveling network phase 2 just started ,*

# VERTICAL NETWORK IN CAMBODIA



**Legend**

- Levelling Network phase2 (doing)
- Levelling Network phase1 (finished)
- Provi Centencial

## 5- The Challenges

### ❑ **Human resources**

- *Lack of qualified personnel, For example: In the local branches of Geodesy and Cartography created positions of officer in charge of geodesy are not enough and capacity still limited*
- *Lack of research scientific work,*
- *The unity quality of university education does not catch up latest technology*
- *Absence of strategic plan for systematic development of human resources,*

### ❑ **Technology**

- *No regular re-measurement /updates/ of national geodetic control network,*
- *We don't have an unified control points: one control point can not carry variety of information, such as latitude, longitude, height, gravity.*
- *GNSS permanent station operations do not meet international standards as inadequate use of the station.*
- *Gravimetric measurement is neglected last few decades,*

### ❑ **Budget**

- *Budget available still limited for huge Geodetic network work .*

## 6. Future Plan

### ❑ **Capacity building**

- *Training program on Geodesy professional and Continuous Development program*
- *Universities' geodesy teaching staff's training \professional development\ in developed countries,*
- *To increase the number of bachelor, master and doctoral students in Geodesy and Cartography studying in developed countries*
- *Short and long-term training of governmental, non-governmental organizations and the private sector professionals concerned.*

### ❑ **Technologies Improvement**

- *To establish a origin point by regular participation in International GNSS observation campaign, which will be used for 3 type of geodetic network (for horizontal, for vertical and for gravity),*
- *The horizontal network transformation into the unified coordinate system, have to continue,*
- *Establishment and computation of First Order Height network, have to complete,*
- *Welcome Asia Pacific and request for the best practice experts to support this professional in Cambodia*

### ❑ **Planned Activities**

- *Build an experimental research center for advanced technology implementation-*
- *To establish a ground station to receive and send satellite data.*
- *To involve into foreign scientific research and implement projects and program*

***Thank You for your attention !***

