

The Socialist Republic of Vietnam

Inhabited since Paleolithic times, the beginning of Vietnamese civilization dates back to the late Neolithic or early Bronze Age. Vietnam is tropical in the south and subject to monsoons in the north. The country is low, comprised of the Mekong Delta in the south, the Red River Delta in the north, central highlands, hilly, mountainous in the far north and northwest. The lowest point in Vietnam is the South China Sea; the highest is Ngoc Linh at 3,143 meters. The area of Vietnam is slightly larger than New Mexico; with a 3,260-km coastline, its maritime boundary had been established according to the "Straight Baseline" principle. Vietnam is a poor, densely populated communist state that has had to recover from the ravages of war, the loss of financial support from the old Soviet Bloc, and the rigidities of a centrally planned economy. Independence Day is 02 September (1945).

France had occupied all of Vietnam by 1884 and remained for the most part until 1954. Longitude was determined in Haiphong by Héraud and Bouillet, hydrographic engineers, in 1874. The longitude was deduced from the time transfer from Saigon; two chronometers were used for the first traverse and five chronometers were used between the observatory at Haiphong and the observatory of Saigon. It is interesting to note that by 1883, Hong Kong and Haiphong were connected by submarine cable. The longitude of Hong Kong had been determined in 1881 by telegraph, so it was deduced that the longitude of Haiphong was now determined to a better precision than was determined by the use of chronometers. In 1886, Héraud measured the baseline in Haiphong between Grand Mirador and Petit Mirador to be 4,312.8 meters. "The observatory in Haiphong was established to observe the longitude difference. It was essentially comprised of a masonry pillar constructed on a solid foundation, and a grass hut was constructed of bamboo." The position observed in 1874 was $\phi_0 = 20^\circ 51' 43.5''$ N and $\lambda_0 = 104^\circ 20' 30''$ East of Paris or $106^\circ 40' 43.95''$ East of Greenwich. These observations were the initial determinations that later would provide the defining datum for the northern part of Vietnam. Grand Mirador was defined as

the position of the geodetic net (Position du réseau géodésique indo-chinois) where $\Phi_0 = 21^\circ 01' 58.415''$ N and $\Lambda_0 = 109^\circ 00' 57.90''$ East of Greenwich. The azimuth from Grand Mirador to Nui Deo is $\alpha_0 = 334^\circ 29' 49.8''$. The ellipsoid of reference is the Clarke 1880 where $a = 6,378,249$ m and $1/f = 293.46$. The subsequent transferred origin of the grid for Signal Grand Mirador was $\phi_0 = 20^\circ 42' 24.337''$ N and $\lambda_0 = 106^\circ 46' 29.282''$ East of Greenwich. The False Easting and False Northing for this Hatt Azimuthal Projection were each equal to zero. There were four bases measured in the 1880s by the French; they were near Sontay, at Than-Hoa, south of Haiphong, and near Baria.

Grand Mirador de Do-Son was observed in April, 1887, and was a local datum such that $\Phi_0 = 20^\circ 42' 24.9''$ N and $\Lambda_0 = 106^\circ 46' 36.15''$ East of Greenwich. The defining azimuth was $\alpha_0 = 191^\circ 33' 22''$. In 1929, the coordinates were updated to $\Phi_0 = 20^\circ 42' 24.34''$ N and $\Lambda_0 = 106^\circ 46' 29.28''$ E, and in 1932 A. Gougenheim finally changed the coordinates of Doson to $\Phi_0 = 20^\circ 42' 24.337''$ N and $\Lambda_0 = 106^\circ 46' 29.2282''$ E.

Another grid was defined as Haiphong, the west gable of the observatory pagoda: $\Phi_0 = 20^\circ 51' 44.3''$ N and $\Lambda_0 = 106^\circ 40' 43.95''$ E. Nearby, the derivative Hanoi system at the "tour de la citadelle," the tower of the standard, had coordinates of $\phi_0 = 21^\circ 01' 58''$ N and $\lambda_0 = 103^\circ 29' 52.2''$ E, and was used for some French surveys, but it was based on the Haiphong System because its coordinates are $x = 99,618.0$ m W. and $y = 34,531.0$ m N. Furthermore, the derivative Tour de la citadelle de Nam Dinh had coordinates of $\phi_0 = 20^\circ 25' 30.4''$ N and $\lambda_0 = 103^\circ 49' 50.0''$ E, and was used for some French surveys, but was based on the Haiphong System because its coordinates are $x = 65,292.8$ m W. and $y = 32,917.5$ m S. Note that all the azimuthal grids used by the French in Vietnam were quadrant-based; no false origins were used.

The Hon-Matt Grid based on the Hatt Azimuthal projection was established in 1877, and is near Vinh on the Ca River. The coordinates of the origin are $\phi_0 = 18^\circ 47' 40''$ N and $\lambda_0 = 105^\circ 55' 58.95''$ E. In 1924, the

Hon-Nieu Grid was used where $\phi_0 = 18^\circ 48' 10.183''$ N and $\lambda_0 = 105^\circ 46' 33.799''$ E. It was also used in 1932 for additional French hydrographic surveys. The old Cape Saint-Jacques Lighthouse (phare) hydrographic survey was based on $\phi_0 = 10^\circ 19' 33.220''$ N and $\lambda_0 = 104^\circ 44' 32.663''$ E.

The Bay of Tourane (now Da Nang) Grid was established in 1907 by Cot, where $\phi_0 = 16^\circ 11' 01.44''$ N and $\lambda_0 = 108^\circ 06' 17.61''$ E; the pillar was listed at Nui-Hoi. The defining azimuth from Nui-Hoi to Tien-Cha is $\alpha_0 = 110^\circ 33' 32.2''$.

In 1913, a number of new hydrographic survey grids were established, including the Cathedral of Saigon, where: $\phi_0 = 10^\circ 46' 44.180''$ N and $\lambda_0 = 104^\circ 21' 25.803''$ East of Paris, as compared with the Old Observatory of Saigon where $\phi_0 = 10^\circ 46' 42.78''$ N and $\lambda_0 = 104^\circ 21' 31.29''$ East of Paris. (Note that Paris is $2^\circ 20' 13.95''$ East of Greenwich.) The Bay of Natrang was surveyed with a Hatt Grid in 1913, and the origin of the coordinates was at Signal Honheo where $\phi_0 = 12^\circ 24' 13.11''$ N and $\lambda_0 = 106^\circ 56' 00.14''$ East of Paris.

By 1914, a Hatt Azimuthal Grid was observed and established at Cana, where $\phi_0 = 11^\circ 22' 35.067''$ N and $\lambda_0 = 108^\circ 50' 20.137''$ E (1929 up-dated coordinates are listed). After the First World War in Europe, the Cana Grid was also used for the Isles Catwick in 1924. In 1923, a local survey was run from the lighthouse at Baikan where $\phi_0 = 8^\circ 39' 59.17''$ N and $\lambda_0 = 104^\circ 21' 48.31''$ East of Paris; X_0 and Y_0 were equal to zero. A datum and cadastral grid system were established at Long Vinh where $\Phi_0 = 9^\circ 35' 59.79''$ N and $\Lambda_0 = 106^\circ 18' 58.07''$ East of Greenwich. The baseline was run from Lich Hoi Binch to Long Vinh, and measured 17,805.73 m. The defining azimuth of that baseline was $\alpha_0 = 230^\circ 56' 07.426''$. That same year, the Îles Poulo-Condore Datum of 1923 (now Con Son) was established where $\Phi_0 = 8^\circ 41' 35.86''$ N, $\Lambda_0 = 104^\circ 14' 27.28''$ East of Paris, the azimuth of West Base to East Base was defined as $\alpha_0 = 191^\circ 33' 22''$, and its length was measured to be 1,411.83 m. By 1923, the coordinates for "Mirador d' Hanoi"

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were published as $\phi_o = 21^\circ 01' 58.415''$ N and $\lambda_o = 103^\circ 29' 52.120''$ East of Paris.

In the annual report of A. Gougenheim for his hydrographic mission to French Indochina of June 1930 to June 1931, he listed a projection summary that enumerated all of the Hatt Azimuthal Equidistant projections he used that year in his mission, including the calculating machine coefficients for both the direct and the inverse for Origine Grand Mirador de Doson, Origine Hon Nieu, Origine Cana, and Origine Nui Chauvien. Each pair of formulae for direct and inverse also included a version for units of sexagesimal seconds (degrees) as well as centesimal seconds (grads). Of course, everything was truncated at the cubic! Gougenheim later presented his own machine calculation for the ellipsoidal geodesic that was recast and presented by Paul D. Thomas of the U.S. Naval Hydrographic Office during the 1970s.

After the Second World War, three Hatt Azimuthal Grids were devised by the French in Vietnam. The Signal HaiPhuc (1933) origin was at $\phi_o = 13^\circ 26' 04.693''$ N and $\lambda_o = 109^\circ 17' 44.322''$ East of Greenwich. The Borne (monument) de Bac Lieu (1933) origin was at $\phi_o = 9^\circ 15' 42.02''$ N and $\lambda_o = 105^\circ 43' 14.48''$ East of Greenwich. The last grid established by the French was at Cam Ranh Bay in 1949 where the origin was published as $\phi_o = 11^\circ 55' 55.85''$ N and $\lambda_o = 100^\circ 49' 58.60''$ East of Paris rather than East of Greenwich!

John W. Hager tells me that "in 1954, the triangulation of Thailand was adjusted to Indian 1916 [Datum] based on 10 stations on the Burma border. In 1960, the triangulation of Cambodia and Vietnam

was adjusted holding fixed two Cambodian stations connected to the Thailand adjustment of stations from the Cambodian-Vietnam adjustment. North Vietnam was also adjusted to this system but with lower standards. The details are that of the Indian Datum as defined in 1900 and labeled as Indian 1916: origin at Kalianpur Hill Station, $\Phi_o = 24^\circ 07' 11.26''$ N, $\Lambda_o = 77^\circ 39' 17.57''$ East of Greenwich, the initial azimuth to Surantal from south is: $\alpha_o = 190^\circ 27' 05.10''$. The ellipsoid of reference is the Everest 1830 where $a = 6,377,276.345$ m, and $1/f = 300.8017$."

I was assigned to Army Map Service (later TOPOCOM) during the Vietnam War, and for a short period was a Company Commander. Some of "my" personnel were at a SECOR satellite tracking station in Thailand while establishing a precise location for a SHORAN transmitter for navigation control of airplanes. The South Asia Datum was used for that application, and was referenced to the Modified Fisher 1960 ellipsoid where $a = 6,378,155$ m and $1/f = 298.3$. I do not think that that Datum was ever used (at that time) for unclassified applications. NIMA lists two transformations for Vietnam. For Vietnam near 16° N, from the Indian 1960 Datum to the WGS 84 Datum: $\Delta X = +198\text{m} \pm 25\text{m}$, $\Delta Y = +881\text{m} \pm 25\text{m}$, and $\Delta Z = +317\text{m} \pm 25\text{m}$, and the solution is based on two stations. For Con Son Island from the Indian 1960 Datum to the WGS 84 Datum: $\Delta X = +182\text{m} \pm 25\text{m}$, $\Delta Y = +915\text{m} \pm 25\text{m}$, and $\Delta Z = +344\text{m} \pm 25\text{m}$, and the solution is based on one station.

Mal Jones of Perth, Australia tells me that from the WGS 84 Datum to the Hanoi 1972 Datum, the ellipsoid of reference is

the Krassovsky 1940 where $a = 6,378,245$ m and $1/f = 298.3$, and the parameters are $\Delta X = -21\text{m}$, $\Delta Y = +124\text{m}$, $\Delta Z = +68\text{m}$, rX axis rotation = $+0''$, rY axis rotation = $+0''$, rZ axis rotation = $+0.814''$, and dS scale change = $+0.38$ ppm. From the WGS 84 Datum to the Indian (Vietnam) Datum, $\Delta X = -199\text{m}$, $\Delta Y = -931\text{m}$, and $\Delta Z = -321\text{m}$. According to "Vietsovpetro," further details and accuracy are unknown. However, this is suspiciously close to the VT78 parameters for the WGS 72 Datum that I received from Robert Holloway of Mt. Lawley, West Australia back in 1998. The current geodetic and mapping authority is the General Department of Land Administration in Hanoi. Vietnam continues to be an enigma, and I believe that it is due to its history of the last couple of centuries.



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