

# Grids & Datums

## NEGARA BRUNEI DARUSSALAM

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East Borneo has been settled from *circa* 1st century *B.C.* by Hindu Pallavas from southeast India. Chinese and Arabic records indicate that this ancient trading kingdom existed at the mouth of the Brunei River as early as the seventh or eighth century *A.D.* This early kingdom was apparently conquered by the Sumatran Hindu Empire of Srivijaya in the early ninth century, which later controlled northern Borneo and the Philippines. It was subjugated briefly by the Java-based Majapahit Empire but soon regained its independence and once again rose to prominence. In the early 15th century, with the decline of the Majapahit kingdom and widespread conversion to Islam, Brunei became an independent sultanate. It was a powerful state from the 16th to the 19th century, ruling over the northern part of Borneo and adjacent island chains. But Brunei fell into decay and lost Sarawak in 1841, becoming a British protectorate in 1888 and a British dependency in 1905. Set up as the Union of Malaya in 1946, Brunei later formed the Federation of Malaya which became independent in 1957. Malaysia was formed in 1963 when the former British colonies of Singapore and the East Malaysian states of Sabah and Sarawak on the northern coast of Borneo joined the Federation (*Background Notes, U.S. Dept. of State, 2011*).

Bordered by Malaysia (381 km) (PE&RS, April 2009), Brunei is slightly smaller than Delaware. The lowest point is the South China Sea (0 m), and the highest point is Bukit Pagon (1,850 m) which is on the border with Sarawak, Malaysia.

The Borneo Triangulation network in Sabah and Sarawak consists of the Borneo West Coast Triangulation of Brunei and Sabah (1930-1942). "In 1934 it was decided to cooperate with the Survey of Brunei and to establish the second Sarawak base line near Marudi, some 330 miles from the Kuching baseline, and to rely on a future connection to the Jesselton (North Borneo) base to provide a check on the work north east of Marudi. The Marudi base line was measured jointly by Officers of the Sarawak and Brunei Surveys. The base net was observed and extended southwestwards towards Sibul by Sarawak, while Brunei carried it northeastwards to the North Borneo Border and established stations in the Fifth Division of Sarawak. *The Triangulation of Brunei*, published by the Surveyor General, Federated Malay States and Straits Settlements, explains how this section of the chain is based on astronomical observations at Labuan (*Island - Ed*), and is computed in terms of the Sarawak Eastern Meridian of Reference" (*The Primary Triangulation of Sarawak, W. Harnack, Empire Survey Review, no. 42, pp. 206-214*). The Eastern System is in terms of the Marudi Base (probable error  $\pm 1/1,000,000$ ), the latitude and longitude observed at Labuan and the azimuth observed at Timbali (Labuan). The azimuth observed at Miri agrees within 0.04" (*op. cit., Harnack*). In 1947, readjustment of this triangulation was undertaken by the Directorate of Overseas Surveys (DOS), United Kingdom to establish a local

geodetic reference system known as Borneo Triangulation 1948 and was established with the origin at Bukit Timbalai, Labuan Island where:  $\Phi_0 = 05^\circ 17' 03.55''$  North,  $\Lambda_0 = 115^\circ 10' 56.41''$  East of Greenwich. The reference ellipsoid used for the BT 1948 is the Modified Everest where  $a = 6,377,298.556$  m and  $1/f = 300.8017$ . The BT68 results from the readjustment of the primary control of East Malaysia (Sabah, Sarawak plus Brunei) made by DOS, and the old Borneo West Coast Triangulation of Brunei and Sabah (1930-1942), the Borneo East Coast Triangulation of Sarawak and extension of the West Coast Triangulation in Sabah (1955-1960), and some new points surveyed between 1961 and 1968. The Hotine Rectified Skew Orthomorphic (RSO) defining parameters for BT 1948 and for BT68 consist of: Conversion Factor (1 chain = 20.11676512 m, *from Sears, Jolly, & Johnson, 1927*), projection origin  $\phi_0 = 4^\circ 00' N$ ,  $\lambda_0 = 115^\circ 00' E$ , Scale Factor at Origin ( $m_0$ ) = 0.99984, basic or initial line of projection passes through the Skew Origin at an azimuth of ( $\gamma_0 = \text{Sin}^{-1}(0.8)$  or  $53^\circ 19' 56.9537''$ , False Easting = False Northing = zero. The new GDM2000 RSO for Borneo and the Geocentric Datum of Brunei Darussalam 2009 (Roel Nicolai, *Principal Geodesist, Shell Global Solutions International, The Hague, The Netherlands - personal communication, 1 November 2011*). (GDBD2009) for Brunei retains the exact same parameters as for BT 1948 and BT 68 except for the basic or initial line of projection that passes through the Skew Origin at an azimuth of ( $\gamma_0 = \text{Sin}^{-1}(-0.8)$  or  $53^\circ 18' 56.91582''$ , and the fact that the new ellipsoid of revolution is the GRS 80 where:  $a = 6,378,137$  m, and  $1/f = 298.2572221$ . According to *TR 8350.2*, the transformation parameters **from** "Timbalai 1948 Datum" **to** WGS 84 Datum (Sarawak, Sabah and Brunei) are:  $\Delta X = -679$  m  $\pm 10$  m,  $\Delta Y = +669$  m  $\pm 10$  m,  $\Delta Z = -48$  m  $\pm 12$  m, and the solution is based on eight satellite stations. According to the *EPSG Database, version 7.6*, **from** BT48 **to** GDBD2009, the Coordinate Frame Rotation Transformation is:  $\Delta X = -689.594$  m,  $\Delta Y = +623.840$  m,  $\Delta Z = -65.936$  m,  $R_x = +0.02331''$ ,  $R_y = -1.17094''$ ,  $R_z = +0.80054''$ ,  $\delta s = 5.88536$  ppm. Brunei Shell Petroleum (BSP) uses:  $\Delta X = -678$  m,  $\Delta Y = +670$  m,  $\Delta Z = -48$  m (*op. cit., Roel Nicolai*).



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