

# Grids & Datums

## ISLAMIC REPUBLIC OF IRAN

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“Archaeologists suggest that during Neolithic times small numbers of hunters lived in caves in the Zagros and Alborz Mountains and in the southeast of the country. Iran’s first organized settlements were established in Elam, the lowland region in what is now Khuzestan province, as far back as the middle of the 3rd millennium BC. Elam was close enough to Mesopotamia and the great Sumerian civilization to feel its influence, and records suggest the two were regular opponents on the battlefield. The Elamites established their capital at Shush and derived their strength through a remarkably enlightened federal system of government that allowed the various states to exchange the natural resources unique to each region. The Elamites’ system of inheritance and power distribution was also quite sophisticated for the time, ensuring power was shared by and passed through various family lines. By the 12<sup>th</sup> century BC the Elamites are thought to have controlled most of what is now western Iran, the Tigris Valley and the coast of the Persian Gulf. They even managed to defeat the Assyrians, carrying off in triumph the famous stone inscribed with the Code of Hammurabi. Having rapidly built a mighty military force, Cyrus the Great (as he came to be known) ended the Median Empire in 550 BC when he defeated his own grandfather – the hated king Astyages – in battle at Pasargadae. The Achaemenids introduced the world’s first postal service, and it was said the network of relay horses could deliver mail to the furthest corner of the empire within 15 days. The end of the First Persian Empire finally came at the hands of Alexander the Great, king of Macedonia. The Parthians had settled the area between the Caspian and Aral Seas many centuries before. Under their great king Mithridates (171–138 BC), they swallowed most of Persia and then everywhere between the Euphrates in the west and Afghanistan in the east, more or less re-creating the old Achaemenid Empire. A crucial chapter in Persian history started when the Arabs defeated the Sassanians at Qadisiyya in AD 637, following up with a victory at Nehavand near Hamadan that effectively ended Sassanian rule. By the time of Mohammed’s death in 632 the Arabs were firm adherents of Islam. The Persians found plenty to like in Islamic culture and religion, and happily forsook Zoroaster for the teachings of Mohammed without much need of persuasion.

“During WWI both Britain and Russia occupied parts of Iran while the Turks ravaged the partly Christian northwest. Inspired by the new regime in Russia, Gilan (the west Caspian area) broke away in 1920 to form a Soviet republic under Kuchuk Khan. The weak Qajar shah seemed unable to respond, so Britain backed charismatic army officer Reza Khan, who swiftly retook Gilan before ousting Shah Ahmad. Reza Shah, as he became known, set himself an enormous task: to drag Iran into the 20<sup>th</sup> century in the same way his neighbor Mustafa Kemal Atatürk was modernizing Turkey. Literacy, transport infrastructure, the health system, industry and agriculture had all been neglected and were pathetically underdeveloped. Like Atatürk,

Reza Shah aimed to improve the status of women and to that end he made wearing the chador (black cloak) illegal. Like Atatürk, too, he insisted on the wearing of Western dress and moved to crush the power of the religious establishment. However, Reza had little of the subtlety of Atatürk and his edicts made him many enemies. Some women embraced his new dress regulations, but others found them impossible to accept.

“On his return to Iran on 1 February 1979, Khomeini told the exultant masses of his vision for a new Iran, free of foreign influence and true to Islam: ‘From now on it is I who will name the government’. Ayatollah Khomeini soon set about proving the adage that ‘after the revolution comes the revolution’. His intention was to set up a clergy-dominated Islamic Republic, and he achieved this with brutal efficiency” (*Lonely Planet, 2013*).

Slightly smaller than Alaska, Iran is bordered by Afghanistan (936 km) (*PE&RS, January 2004*), Armenia (35 km), Azerbaijan (611 km) (*PE&RS, September 2010*), Iraq (1,458 km), Pakistan (909 km) (*PE&RS, July 2009*), Turkey (499 km) (*PE&RS, September 2005*), and Turkmenistan (992 km) (*PE&RS, December 2012*). The lowest point is the Caspian Sea (-28 m), and the highest point is Kāh-e Damūvand (5,671 m) (*World Factbook and NGA GeoNames Server, 2013*).

Prior to WWI, the Tiflis Datum of 1914 was established by the Russians and later was transformed to the Pulkovo 1931 Datum referenced to the Bessel 1841 ellipsoid. No parameters are currently available on this ancient system in Iran (*Army Map Service Geodetic Memorandum 1302*).

The British Survey of India surveyed the Trans-Iranian Arc from Iran to India. According to John W. Hager, “Reading the diary of that operation is fascinating. They ran out of spare tires for their vehicles and took to cutting out the good portions of the tires (or tyres) and putting them back together with nuts and bolts. I would guess that was Nahrwan Datum. Nahrwan was also used by the Iranian Oil Exploration and Producing Company (I.O.E.P.C.), the successor (1954) to the Anglo-Persian Oil Company. It mainly covers the area from Iraq in the area Ahvāz-Abādan east to Shīraz-Būshehr. The connection to Nahrwan was tenuous at best. Nahrwan, code NAH, located at Nahrwan S.E. Base,  $\Phi_0 = 33^\circ 19' 10.87'' N \pm 0.20''$ ,  $\Lambda_0 = 44^\circ 43' 25.54'' E \pm 0.69''$ ,  $\alpha_0 = 10^\circ 55' 51.8''$  to North End Base, Clarke 1880 (*where  $a = 6,378,249.145$  meters, and  $1/f = 293.465 - Ed.$* ).

“The next was Būshehr Datum, code BUS, at camp 279,  $\Phi_0 = 28^\circ 29' 26'' N$ ,  $\Lambda_0 = 51^\circ 05' 49'' E$ , Clarke 1880. The area of coverage was east of Shīraz – Būshehr to Kermān – Mināb. This was a temporary datum until Final Datum 58 was adopted.

“And then there was Final Datum 58, code FIN, at 49/87 Manyur (*Ahwaz - Ed*),  $\Phi_0 = 31^\circ 23' 59.190'' N$ ,  $\Lambda_0 = 48^\circ 32' 31.380'' E$ , Clarke 1880. Adopted in 1958 covering the combined area of Nahrwan and Būshehr datums. The station designation (49/87) looks suspiciously

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like a Survey of India designation. In actuality, Final Datum 58 was derived from Nahrwan. There were several 1<sup>st</sup> and 2<sup>nd</sup> order nets that ran the full east – west extent and went north to intersect with the trans-Iranian arc (Nahrwan and European 1950). Tellurometer and Geodimeter (*Electronic Distance Measuring equipment brands – Ed.*) were coming into their own and results from those instruments may have been included in the Final Datum 58 adjustment. Tellurometer traverses were being used more and more by the I.O.E.P.C. In 1955, 1956, and 1957, the country was photographed using SHORAN controlled photography. The SHORAN control network, Trans-Iranian Arc, selected arcs in the I.O.E.P.C. area, and new 2<sup>nd</sup> order triangulation, base lines and astros were all combined and adjusted to produce a network on European 1950 Datum.”

The U.S. Army Map Service let a contract in 1963 for 1<sup>st</sup> order surveying in Iran. The work included establishment of 3,750 km of precise electronic traverse, determination of 1<sup>st</sup> order astronomic positions and Laplace azimuths, 4,400 km of 3<sup>rd</sup> order traversing, and the location of 250 horizontal picture points for photogrammetric mapping (*Surveying in Iran by A. V. Cocking, Surveying and Mapping, December 1969, pp.655-660.*)

A curious variety of datums and coordinate systems have been used in Iran over the years, some by official government interests, most by the oil exploration and development industry. European Datum 1950 (*some offer the ED77 designation, albeit more by wishful thinking than by fact – Ed.*) in which the origin is at Helmersturm, Potsdam, Germany where:  $\Phi_0 = 52^\circ 22' 53.9540''$  N,  $\Lambda_0 = 13^\circ 04' 01.1527''$  East of Greenwich. The defining azimuth to station Golmberg is:  $\alpha_0 = 154^\circ 47' 32.19''$ , and the ellipsoid is the International 1924 (Hayford 1909) where  $a = 6,378,388$  m, and  $1/f = 297$ .

The Iran-Iraq Zone Lambert Conformal Conic is on the Final Datum 58, where the Central Meridian,  $\lambda_0 = 45^\circ$  E, latitude of origin,  $\phi_0 = 32^\circ 30'$  N, scale factor at origin,  $m_0 = 0.9987864078$ , False Easting = 1,500 km, False Northing = 1,166,200 m.

The “RassadIran” Datum is referenced to the International 1924 ellipsoid, and is derived from a chain originating at Kangan, near Täheri and is likely just a local snippet of ED50. For a tiny area of coastal Iran, someone cooked up a Hotine Rectified Skew Orthomorphic projection where:  $\phi_0 = 27^\circ 31' 07.7837''$  N,  $\lambda_0 = 52^\circ 36' 12.7410''$  E, False Easting = 658,377.437 m, False Northing = 3,044,969.194 m,  $\gamma_0 = +0^\circ 34' 17.9803''$ , and  $m_0 = 0.999895934$ . This origin point represents the location of “TOTAL 1,” an on-site ITRF96 point, such that the 3-parameter shift **from** RassadIran **to** the ITRF96 is:

$\Delta X = -133.688$  m,  $\Delta Y = -157.575$  m, and  $\Delta Z = -158.643$  m. The ITRF96 coordinates of TOTAL 1 are:  $\phi = 27^\circ 31' 03.8822''$  N,  $\lambda = 52^\circ 36' 13.1239''$  E, and  $H_0 = h_0 = 84.81$  m.

The 3-parameter transformation for all of Iran from ED50 to WGS84 is:

$\Delta X = -192.359$  m  $\pm 0.3162$  m,  $\Delta Y = +263.787$  m  $\pm 0.3162$  m, and  $\Delta Z = -24.450$  m  $\pm 0.3162$  m (*Strategy for Computation of Transformation Parameters from Local Datums to Regional Datum, F. Tavakoli, National Cartographic Center of IRAN, PCGIAP, July 1999.*)



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