Grids & Datums

BOZNIA AND HERZEGOVINA

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"The region's ancient inhabitants were Illyrians, followed by the Romans who settled around the mineral springs at Ilidža near Sarajevo in 9 *AD*. When the Roman Empire was divided in 395 *AD*, the Drina River, today the border with Serbia, became the line dividing the Western Roman Empire from Byzantium. The Slavs arrived in the late 6th and early 7th centuries. In 960 the region became independent of Serbia, only to pass through the hands of other conquerors: Croatia (*PE&RS*, July 2012), Byzantium, Duklja (modern-day Montenegro) and Hungary (*PE&RS*, April 1999). Bosnia's medieval history is a much-debated subject, mainly because different groups have tried to claim authenticity and territorial rights on the basis of their interpretation of the country's religious make-up before the arrival of the Turks. During this period (1180–1463) Bosnia and Herzegovina became one of the most powerful states in the Western Balkans. The most significant event was the expansion of the Bosnian state under Stephen Kotromanić who conquered large parts of the Dalmatian coast and in 1326 annexed the southern province of Herzegovina. The country thus became Bosnia and Herzegovina for the first time. The first Turkish raids came in 1383

Austria-Hungarians pushed Bosnia and Herzegovina into the modern age with industrialization, the development of coal mining and the building of railways and infrastructure. Ivo Andrić's *Bridge over the Drina* succinctly describes these changes in the town of Višegrad. But political unrest was on the rise. Previously, Bosnian Muslims, Catholics and Orthodox Christians had only differentiated themselves from each other in terms of religion. But with the rise of nationalism in the mid-19th century, Bosnia's Catholic and Orthodox population started to identify themselves with neighboring Croatia or Serbia respectively. At the same time, resentment against foreign occupation intensified and young people across the sectarian divide started cooperating with each other and working against the Austria-Hungarians, thus giving birth to the idea of 'Yugoslavism' (land of the southern Slavs). Resentment against occupation intensified in 1908 when Austria annexed Bosnia and Herzegovina outright. The assassination of the Habsburg heir Archduke Franz Ferdinand by a Bosnian Serb, Gavrilo Princip, in Sarajevo on 28 June 1914 led Austria to declare war on Serbia. Russia and France (*PE&RS*, January 2001) supported Serbia, and Germany

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and by 1463 Bosnia was a Turkish province with Sarajevo as its capital. Herzegovina is named after Herceg (Duke) Stjepan Vukčić, who ruled the southern part of the present republic from his mountain-top castle at Blagaj, near Mostar, until the Turkish conquest in 1482.

"Bosnia and Herzegovina was assimilated into the Ottoman Empire during the 400 years of Turkish rule. Conversion to Islam largely took place during the initial 150 years of Turkish rule and it's generally held that people converted voluntarily. Orthodox and Catholic Christians continued to practice their religions although under certain constraints. As the Ottoman Empire declined elsewhere in the 16th and 17th centuries, the Turks strengthened their hold on Bosnia and Herzegovina as a bulwark against attack. Sparked by the newly born idea of nationhood, the South Slavs rose against their Turkish occupiers in 1875-6. In 1878 Russia inflicted a crushing defeat on Turkey (*PE&RS*, September 2005) in a war over Bulgaria (*PE&RS*, January 2002) and at the subsequent Congress of Berlin it was determined that Austria (*PE&RS*, March 2004)-Hungary would occupy Bosnia and Herzegovina despite the population's wish for autonomy. The

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"The Military Geographic Institute started the survey of the occupied territory (*of Bosnia and Herzegovina – Ed.*) in 1879 with a first order chain which extends between the 35° and 36° meridian through the central part of the province and includes the base line at Sarajevo measured in 1882. In the North the first order chain was attached to these stations of the first order net in Slavonia: 356 Kučerina (of Dublca base extension net); 360 Maksimov Hrast; 362 Kasonja; 363 Lipovica, and in the South to the following stations of the Dalmatian first order chain: 341 Tmor; 343 Rogo; 345 Ostra Glavica; 348 Sniježnica; 350 Orjen. For all these stations the geographic positions referring to the Vienna University can be found in part II of *Positions Rechnungen (Protocol 290B), 1889*. In 1883-1885, the first order net was extended from Sarajevo east and south east to the Serbian and Montenegro boundary" (*Mapping of the Countries in Danubian and Adriatic Basins, Andrew M. Glusic, AMS TR No. 25, June 1959*).

The third topographic survey of the Austro-Hungarian Empire (Neue Aufnahme) was conducted from 1869 to 1896 and was mainly based on the Vienna University Datum and the Bessel 1841 ellipsoid (actually adopted in 1863) where $a = 6,377,397.15$ m. The Vienna Datum of 1806 was established based on the origin of St. Stephan Turm (St. Stephan's Tower) where $\Phi_o = 48° 12' 31.5277"$ North, $\Lambda_o = 16° 22' 27.3275"$ East of Greenwich. (These longitudes were originally referenced to Ferro, in the Canary Islands which is $17° 39' 46.02"$ West of Greenwich.) The defining azimuth of the Datum was from St. Stephan Turm to Leopoldsberg: $\alpha_o = 345° 55' 22.0"$.

"Bosnia and Herzegovina prior to that time had no survey and no reliable maps; therefore it was planned to start with the cadastral survey as early as 1880. The occupied province still was in a stage of resistance and since survey parties needed the protection of small combat units the K.u.k. Military Geographic Institute was charged with the execution of the cadastral survey; consequently the cadastral survey was planned and executed in such a manner that its complete utilization in the topographical survey was assured in advance.

"In order to provide the cadastral and topographical survey with a sufficient density of trig points (1 trig point on each 25 square kilometers) the 2nd, 3rd and 4th order triangulation started in 1879, i.e. before the completion of the first order net. This triangulation, usually covering a region which during the next year has to be surveyed by the cadastral survey, started individually from the first order stations belonging to the already mentioned first order chains which surround Bosnia and Herzegovina from the North, West and South. In each region the triangulation was adjusted preliminarily and immediately used in the detail survey.

"For the first and second order stations, which formed the so called 'main net,' the geographic positions of the Vienna System were computed from different starting points in different regions. These geographic positions are the basis for the 'uniform graticule system' in Bosnia and Herzegovina. Triangulation of Bosnia and Herzegovina comprise: Base line Dubica, Base line Sarajevo, 30 First order stations, 136 Second order stations, 2,094 Third and Fourth order trig points, totaling 2,260 trig points; of them 54 churches, mosques and monuments.

"The cadastral survey of Bosnia and Herzegovina is unique for the entire Monarchy, since it is in position completely identical with the topographical survey. The cadastral sections are cut in the 'uniform graticule system.' The polyhedric (identical to the photogrammetric Local Space Rectangular coordinate system – Ed.) sheet of 15'×30' at 1:75,000 scale is divided into 16 cadastral sections at 1:12,500 scale, 64 cadastral sections at 1:6,250 scale and 256 sections at 1:3,125 scale which were used only in the survey of closed settlements. In order to meet the cadastral requirement the spheroidal Soldner (Cassini-Soldner – Ed.) coordinates with the origin at center of each 1:75,000 sheet for all lower order stations of Military triangulation were computed. The cadastral survey was completed in 1885. Reduced by pantograph to 1:25,000 scale, it served as base for the topographical survey.

"In 1944, the Germans transformed the Soldner coordinates with the origin at the center of each 1:75,000 sheet, into Yugoslavian Reduced Gauss-Krüger coordinates (where the scale factor at origin (m_o = 0.9999), the central meridians of the belts (C.M. = λ_o = 15°, 18°, 21° East of Greenwich) and the False Easting at C.M. = 500 kilometers – Ed.). It should be remembered that the sheets were positioned on geographic positions of Vienna University System computed from preliminary adjusted regional nets with different starting points used in computation; meanwhile the Yugoslav triangulation represents a homogeneous, final adjusted net oriented on Hermannskogel (1871 – Ed.) datum. Linear conformal transformation was made by the sheets where, because of lack of a sufficient number of identical trig points, the transformation elements were derived from the differences between the Soldner and Yugo Reduced Gauss-Krüger coordinates of 2 sheet corners and the central point of each sheet. In order to furnish the Yugo Reduced G.K. coordinates needed in the comparison of the geographic positions of sheet corners and centers in Vienna University system were transferred into the system of the Yugoslav Triangulation by the application of corrections derived by Dr. Ledersteger for the purpose of the recasting of sheets. These corrected geographic coordinates were then converted into reduced Gauss-Krüger coordinates.

"The comparisons of the reduced Gauss-Krüger coordinates of the Military triangulation of Bosnia and Herzegovina, obtained from this transformation, with the Yugo Red. Gauss-Krüger coordinates show at identical stations disparities up to 18 meters. The average values of disparities on each sheet were taken as blanket corrections which have to be applied to the transformed coordinates of stations belonging to the corresponding sheet. By application of these corrections the transformed coordinates should be in sympathy with Yugoslav Triangulation in limit of ±5 meters and would meet only artillery and cartographic requirements.

"The corrections run as follows:

dN from +7.00 m to – 6.51 m

dE from +9.95 m to −13.70 m.

"Since the plane table sections are positioned upon geographic positions of the Vienna University system computed from preliminary adjusted regional nets the sheet corners are not in sympathy with the adjusted K. un k. M.T. first order net but have displacements within limits of the above mentioned corrections" (op.cit., A.M.Glusic, 1959).

In 2007, funding was received to implement a number of EUREF permanent stations in Bosnia and Herzegovina. Thirty-four permanent stations were installed, (17 in the Federation of BiH and 17 in Republika Srpska). The Geodetic Society of Bosnia-Herzegovina became a Member Association of FIG in 2010, and invited a member of the FIG Council to attend the Congress 2011, held 28-30 September 2011 in Hidza near Sarajevo. Reconstruction of the cadaster began in 2007 and is reported to be making good progress.

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