



## **Geodetic ground control in Al-Baha region of the KSA**

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Current technology of Global Navigation Satellite Systems (GNSS) is the best choice to establish ground control for photogrammetric mapping. In this project, a network that covers a highly mountainous area of 16,000 km<sup>2</sup> western the Kingdom of Saudi Arabia (KSA) has been established using GNSS within the MOMRA Terrestrial Reference Frame for the year 2000 (MTRF2000) Epoch 2004.0, where MOMRA stands for the Ministry of Municipal and Rural Affairs. The network that defines MTRF2000 is called Saudi Geodetic Network (SGN) and twelve points of this network were used as reference stations for high level (HL), medium level (ML) and low level (LL) photogrammetric Ground Control Points (GCPs). The scales of captured aerial photographs were as follows: HL = 1/45,000, ML = 1/22,500, and LL = 1/5,500. For the sake of project execution, the network was divided into two categories: primary network and secondary network. Primary network is composed of SGN as reference points and both HL & ML GCPs as target points, while secondary network is composed of SGN, HL & ML as reference points and LL GCPs as target points. The total number of new HL, ML & LL GCPs that were constructed and observed according to industry standards is 205 points: 38 HL, 30 ML and 137 LL. While monumentation lasted for 11 business days, GNSS data collection operations lasted for 20 business days. The whole newly-established network was first processed using Ashtech Solutions software package to ensure integrity, then precise ephemeris was acquired and GEONAP software package was used for final processing. After that, least squares adjustment was carried out using GEONET and NGS ADJUST software packages by constraining the GCPs of SGN in the primary network and SGN & Primary stations in the secondary network. The achieved accuracy was better than 1 ppm in both cases.