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Precise determination of the orthometric corrections in the height network of Iran

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The orthometric height system, as the main height system in geodesy, practically is derived from spirit leveling measurements after the orthometric correction is applied. A rigorous definition of the orthometric height is due to the rigorous evaluation of mean gravity value along the plumb line from the earth surface to the geoid level. Usually, the Helmert (1890) method using Poincare-Pray vertical gradient of gravity is used in most countries for determination of the mean gravity. Here, we calculate the rigorous mean gravity by removing and restoring topographical masses above the geoid. For some 1^{st} order leveling network stations in Iran with maximum height of $2900m$, the corrections to the orthometric heights reaches up to $-18cm$ compared with the Helmert method. These corrections are due to the consideration of spherical bouguer shell, short and long wavelength of terrain roughness, lateral density variations and free-air gravity gradient in the real Earth. For validation of our method, a comparison was made with the mean gravity of real measurements taking place in steps inside a borehole into topography in Germany to the depth of $499.7m$. A difference of $0.481mGal$ is shown which is equivalent to the uncertainty of less than $0.1cm$ in orthometric height.