Investigation of the Use of the Ellipsoidal Normal to Model the Plumb Line in a Millimeter Cadastre

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ABSTRACT

It may soon become possible to routinely stake an absolute location of a geodetic coordinate repeatedly on the ground to millimeter accuracy using GPS. A cadastre could be developed using such coordinates as the definitive location of boundary corners. A boundary line would be a one-dimensional line connecting boundary corners. A boundary line extending into space or toward the center of the Earth would be a two-dimensional surface with length, height and no width. A cadastre using geodetic coordinates would most naturally use the ellipsoidal normal to define the vertical dimension, however historically (and in many jurisdictions, legally) the vertical dimension has been defined by the plumb line. Unlike the ellipsoidal normal, the plumb line is not a straight line but is rather a space curve with finite radius of curvature and torsion (Leick 1995). The deflection of the vertical is the angular difference at the Earth's surface between the ellipsoidal normal and the tangent to the plumb line. (For instance, a 2 second deflection of the vertical results in about 5 cm difference in a vertical distance of 3 km underground and 2 km above ground, distances over which an owner might reasonably be expected to have actual control). This paper will investigate the use of the ellipsoidal normal to model the plumb line with respect to the vertically extended boundary line in which it is proposed to be a 3-D surface that has length, height and enough width to include all variations caused by the space-curved plumb line.

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