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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 12897-2006

Replacing GB 12897-1991

Specifications for first and second order levelling

国家一、二等水准测量规范

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m) or scale stand (mass not less than 5 kg) based on the soil materials of the line, the number of turning-point pins shall be not less than

4. It may use cloud nails as the turning-point pin for special sections.

1 Scope

China's national specification for first and second order levelling - the highest precision height measurement carried out anywhere, and the work that establishes and maintains the national height datum on which every elevation in the country ultimately rests. It specifies the layout principles, the levelling methods and the accuracy requirements for the establishment of the first and second order levelling networks. First order levelling is an extraordinary undertaking: an instrument is set up between two staves, the height difference is read, and the process is repeated over distances of thousands of kilometres, with an accumulated error that must stay within a few millimetres over a hundred kilometres. Nothing in surveying demands more of the procedure, because at that accuracy every physical effect that can be ignored elsewhere becomes a systematic error - the refraction of the line of sight through air of varying temperature near the ground, the settlement of the instrument and of the staves during a set-up, the expansion of the staff with temperature, the residual collimation of the instrument, the magnetic effect on a compensator, and the deflection of the vertical, since a levelling network measures geopotential rather than geometric height. The standard exists to eliminate or bound each of them. It sets the design of the network and the monumentation of the benchmarks, which must be stable for decades; the instruments and staves and their calibration; the observing procedure - the sight lengths, the height of the line of sight above ground, the order of readings, the balancing of forward and backward sights, and the times of day when observing is prohibited; the repetition and the closure tolerances; the corrections applied; and the adjustment of the network. Issued on 24 May 2006 and in force since 1 October 2006, it replaces GB 12897-1991.

This standard specifies the layout principles, leveling methods, and accuracy indicators for the establishment of the first and second order leveling networks throughout the country. This standard applies to the layout and survey of the state first and second order leveling network. Regional precise leveling networks can also make reference to it.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions

of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 3161 Optical theodolite GB/T 10156 Level

GB/T 16818 Specifications for short to medium ranges electro-optical distance measurements

GB/T 18314 Specifications for global positioning system (GPS) surveys

GB 50007-2002 Code for design of building foundation CH 1001 General rules for drafting technical summaries of surveying and mapping CH 1002 Specifications for inspection and acceptance of surveying and mapping products CH 1003 Standard for quality assessment of surveying and mapping products

3 Terms and definitions

The following terms and definitions apply to this standard. The following terms and definitions apply to this standard.

3.1 Node The benchmark in the leveling network that connects at least three leveling lines.

3.2 Leveling line Leveling line between two adjacent nodes in the same order leveling network.

3.3 Section Leveling line between two adjacent basic benchmarks in a leveling line.

3.4 Leveling section Leveling line between two adjacent benchmarks.

3.5 Connect leveling The observation of including a benchmark or other elevation point in a leveling line.

3.6 Branch leveling Observation from any benchmark in a leveling line to any other fixed point.

4 Leveling network

4.1 Elevation system and elevation reference The elevation of the benchmark point is a normal height system, which is calculated starting from the 1985 national elevation reference. Qingdao national origin elevation is

4.2 Leveling accuracy The accident mean square error $M\Delta$ per kilometer leveling and the complete mean square error MW per kilometer leveling shall not exceed the values as specified in Table 1.

4.3 Layout principles

4.3.1 The first order leveling line shall be laid along the road as far as possible, the leveling

line shall be closed into a loop and form a mesh. The perimeter of the first order leveling loop shall not be greater than 1600 km in the eastern region and not greater than 2000 km in the western region, such perimeter can be appropriately widened in mountain and difficult areas.

4.4 Benchmark layout density Along the leveling line, it shall lay benchmarks at certain interval. The benchmarks are divided into three types. bedrock benchmarks, basic benchmarks, and ordinary benchmarks. The requirements for the spacing and layout of various benchmarks shall be implemented in accordance with Table 2.

4.6 Connect leveling of new line and surveyed line

4.6.1 The starting point and the end point of the newly established first and second order leveling lines shall be the bedrock benchmark or basic benchmark of the surveyed higher and same order lines. When the end point cannot be subject to connect leveling with the surveyed line, it shall predict the future connect leveling line.

4.6.2 When the newly established leveling line will pass or be close to the surveyed first and second order benchmarks within 4 km, within 1 km from the surveyed third or fourth order benchmarks, in case of new line surveying, it shall include the surveyed benchmarks into the plan for connect leveling or adjoining leveling. In case of connect leveling, it shall check the surveyed benchmarks in accordance with the provisions of 7.10.

4.7 Gravity survey on leveling lines

4.7.1 Gravity shall be measured at each benchmark on the first order leveling line. For the second order leveling line with an elevation greater than 4000 m or an average height difference between the benchmarks of 150 m ~ 250 m, gravity shall also be determined for each benchmark. In the first and second order leveling observation where the height difference is greater than 250 m, gravity shall be measured at the ground inclination change.

4.8 Technical design of leveling network

4.8.1 Prior to the deployment of the first and second order leveling network, it shall make surveys to collect the leveling, geological, hydrological, meteorological, and road data.

5.1.1 Selection of leveling line

5.1.2 Selection of benchmark position The benchmark points shall be selected to be at location with stable ground and representative ground elevation, be conducive to the long-term preservation and elevation connect leveling, facilitate the satellite positioning technology to determine the coordinates.

5.1.3 Selection of bedrock benchmark The bedrock benchmarks should be selected on the