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НЕКОТОРЫЕ РЕКОМЕНДАЦИИ ПО СОВЕРШЕНСТВОВАНИЮ ДЕЙСТВУЮЩИХ НОРМАТИВНЫХ ТРЕБОВАНИЙ ПО КРУПНОМАСШТАБНЫМ ТОПОГРАФИЧЕСКИМ СЪЁМКАМ

SOME RECOMMENDATIONS FOR IMPROVING THE CURRENT REGULATORY REQUIREMENTS FOR LARGE-SCALE TOPOGRAPHICAL SURVEYING

Көп жылдык өндүрүштүк тажрыйба көрсөткөндөй,турак курулган аймактардынири масштабдагы топографиялык тасмаларын жасоодо тахеометрикалык тартууларды пайдалануу максатка ылайык. Бирок аларды жөнгө салган нормалар 30 жыл мурда иштелип чыккан жана ошондон улам 30" теодолиттер колдонулат, ал эми аралыктар болсо жиптен жасалган чен өлчөгүчтөр жана болот орогуч чен өлчөгүчтөр (рулетка) менен ченелет. Ушуга байланыштуу азыркы колдонулуп жаткан усулду өркүндөтүү максатында бир катар теориялык жана эксперименттик изилдөөлөрдү жүргүзүү зарылдыгы туулат. Ошону менен катар эле электрондук приборлорду пайдалануу менен ири масштабдагы топографиялык тартууларды жүргүзгөндөгү тактык менен нормага ылайык четтөөлөрдү негиздөө талапка ылайык.

Ачкыч сөздөр: *ири масштабдагы топографиялык карта, геодезиялык өлчөөлөр, электрондук тахеометр, тактык, нормалар жана эрежелер.*

Многолетний производственный опыт показал, что для производства крупномасштабных топографических съёмок застроенных территорий целесообразно использования тахеометрических съёмок. Однако нормы, регламентирующие её, были разработаны 30 лет назад, исходя из того, что для работы будут применяться 30" теодолиты, а расстояния измеряться при помощи нитяного дальномера и стальной рулетки. Поэтому они не учитывают многих возможностей современных приборов и методик. В связи с вышеизложенными возникает необходимость проведения некоторых теоретических и экспериментальных исследований для совершенствования существующей методики, обоснования точности и нормативных допусков съемочного обоснования крупномасштабных топографических съемок с использованием электронных приборов.

Ключевые слова: *крупномасштабная топографическая съёмка, геодезическая измерения, электронный тахеометр, точность, нормы и правила.*

A long period experience determined that for large-scale topographic surveying built-up areas would be best to use the tacheometrical surveying. However, the rules governing it were developed 30 years ago, based on the fact that, the work will be used 30" theodolites, and the distance measured by the EDM textile and steel tape. Therefore, they do not take into account the many possibilities of modern instruments and techniques.

In connection with the above, there is a need for some of the theoretical and experimental research for the improvement of existing methods, substantiate the accuracy and regulatory tolerances surveying justify large-scale topographic surveys using electronic devices.

Keywords: *large-scale topographic survey, geodetic measurements, total station, accuracy, regulations.*

Introduction

Practical experience has shown that, it is advisable to use of tacheometric surveying for the large-scale topographic production of built-up areas.

It should be noted that, indicators which are given in the regulatory and technical documentation /2, 3/, are designed for the use of traditional optical surveying instruments and does not take into account the capabilities of modern geodetic instruments, namely: methods and measurement accuracy of production, as well as computer processing of measurement results. For example, modern devices has the ability to quickly and accurately producing angular, linear and altitude measurements, as well as their lower cost process results using software.

Main part

Over the past 15 years in topographic and geodetic sphere, there is are extensive use of modern surveying instruments including total stations to significantly improve the quality, accuracy and performance instead of traditional one in Uzbekistan. At the same, there is no one scientific-proved technique and conduction of accuracy of large-scale topographic surveys using modern instruments for our conditions. In addition, tolerances on the parameters of set datum creation and production of surveying are the same that have been taken for traditional methods and instruments. In connection with the above, there is a need for some of the theoretical and experimental research for the improvement of existing methods, substantiate the accuracy and regulatory tolerances surveying justify large-scale topographic surveys using electronic devices.

Studying of content of developed in our recent papers /2/ have shown that, listed technical standards and indicators mostly duplicate the source /1/. It should be stated that, the methodology, tools and precision currently performed topographic and geodetic works shall be governed by these sources, although they are performed with modern appliances throughout.

The huge technological improvement over the last decades has led not only to the development of new instrumentation and data processing technology, obtained by means of these devices, but, what is more important - to increase the accuracy of measurements made by them.

A fundamentally new geodetic instruments and methods of geodetic measurements, such as GPS and 3D laser scanners geodetic receivers, which are actively used in large-scale topographic survey were made. Since these devices have appeared later than the introduction of the manual operation /1/, the rules and methods for working with these instruments are not reflected in it.

It is also important that modern instruments such as total stations and laser digital levels are not only more precisely its founders, but largely immune from error removing samples observer.

Currently, manufacturers of surveying equipment, as well as a number of independent developers offer software for processing the results of measurements made by these devices. Typically, these programs allow you to perform calculations to control the presence of gross and systematic measurement errors, which increases their accuracy and reliability.

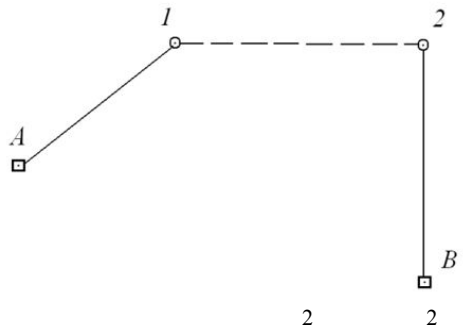
Below we consider the analysis of some of the provisions of the Regulations /2/ on topographic surveying on a scale of 1: 5000, 1: 2000, 1: 1000 and 1: 500.

1. In section 21, it is written that, "in exceptional cases, topographic survey may be carried out only on the survey justification, if in the area or near at a distance of 5 km there are no points the state geodetic network."

Today, while using of geodetic GPS receiver in a differential mode, you can get coordinates of points with high accuracy at a distance of 20 km and more. Obviously, this requirement becomes meaningless.

In section 427 for the scale of 1:500 and section height of 0,5 m maximum distance from the unit to the rack for surveying solid contour point may be 60 m.

To be calculated the maximum distance between the device and a contour point of capture in the scale of 1:500 with Total Station (Trimble M3).



Assume that the pickets 1 and 2 (see. Fig.) survey produced an average total station precision points surveying justification for which $m_S = 5$ mm, $m_\beta = 5'$, $m_\nu = 5'$.

According to the drawings can be written:

$$m_{\text{r.p.1,2}}^2 = m_{\text{r.p.A,B}}^2 + m_{\text{r.p.A,1}}^2 + m_{\text{в.п.B,2}}^2, \quad (1)$$

where $m_{\text{r.p.}}$ - mean square error of the relative position of points 1 and 2; A and B ; A and 1; B and 2.

Taking in general the principle of equal influence of errors, $m_{\text{r.p.A,1}} = m_{\text{r.p.B,2}} = m_{\text{pic}}$; $m_{\text{r.p.A,B}} = \frac{1}{2} m_{\text{pic}}$, from the formula (1), obtained

$$m_{\text{r.p.1,2}} = m_{\text{pic}} \sqrt{2{,}25} . \quad (2$$

From (2), there are errors in determining the position of the planned picket points for the mean square

$$m_{\text{pic}} = \frac{m_{\text{r.p.1,2}}}{\sqrt{2{,}25}} . \quad (3)$$

Taking into account section 16.1 Regulations for the surveying of scale 1:500 in urban areas and industrial sites will be: the mean square error in the mutual position on the plan for the coordinated points and permanent buildings corners (constructions) located from one another at a distance up to 50 m, should not exceed $0{,}4$ mm : $3 \cdot 500 = 67$ mm. In this case accuracy of the mutual position of the planned permanent buildings and structures of the corners (3) is 45 mm.

To determine the accuracy of the plan point position picket way of polar coordinates have

$$m_{\text{pic}}^2 = m_S^2 + \frac{m_\beta^2}{\rho^2} \cdot S^2 . \quad (4)$$

It can be written

$$S = \frac{\rho}{m_\beta} \sqrt{m_{\text{pic}}^2 - m_S^2} . \quad (5)$$

Substituting in (5) values, $m_{\text{pic}} = 45$ mm , $m_S = 5$ mm , $m_\beta = 5'$ we obtain the maximum distance from the unit to the contour point $S = 1845$ m.

Next step is calculating the allowable distance to picket point at altitude capture, believing that high-altitude survey is conducted as an electronic total station with the measurement at each point of the vertical angle ν with an accuracy of $(m_\nu = 5')$.

According to the formula (1), can be written:

$$m_{h\ 1,2}^2 = m_{h\ \text{A,B}}^2 + 2m_{h\ \text{pic}}^2 . \quad (6)$$

If the height of the surveying justification points defines the technical leveling, as required by the Regulation [2], the accuracy will be

$\Delta h = 50\sqrt{L} = 50\sqrt{0,2} = 22,4$ mm; $m_{h\ \text{A,B}} = \frac{1}{3}\Delta h = 7,5$ mm.

In section 459 Regulations states that the difference between the heights of the points obtained from different stations, shall not exceed 20 mm. Then the mean square error in determining the excess between the points 1 and 2 (see. Fig.), The height of which is determined from the stations A and B will be equal to

$$m_{h\ 1,2} = (20\text{mm} \cdot 1,25)/2 = 12,5\ \text{mm}.$$

The mean square error of exceeding defined as the difference between the set point marks base and rally can get from

$$m_{h\ \text{pic}} = \sqrt{\frac{m^2_{h\ 1,2} - m^2_{h\ \text{A,B}}}{2}} = 7,1\text{mm}. \quad (7)$$

According to the formula $h = S\sin\nu$ mean square error in determining the excess of the solution of a right triangle is [4],

$$m^2_{h\ \text{pic}} = (\sin\nu)^2 \cdot m^2_S + (S\cos\nu)^2 \cdot \frac{m^2_\nu}{\rho^2}. \quad (8)$$

For urban areas taking $\nu = 2^0$ with the known value of errors in determining the height of the picket points $m_{h\ \text{pic}}$ for finding the maximum distance to it from the formula (8) can be written:

$$S = \frac{\sqrt{m^2_S\left(\frac{m^2_{h\ \text{pic}}}{m^2_S} - \sin^2\nu\right)\rho^2}}{\cos\nu \cdot m_\nu}. \quad (9)$$

In $m_S = 5$ mm, $\nu = 2^0$ from (9), can be obtained $S = 293$ m.

Conclusion

Obviously, the need to rethink the current provisions and requirements for topographical surveying regulations, in accordance with the requirements of the time.

Based on the results obtained by the above calculation, and taking into account that today's devices not only allow more accurate measurement of distances and angles, but more importantly - remember the measurement results in the internal memory electronic devices (and it is precisely at the stage of removing the reference and record the measurement results in field journal comes the largest number of gross errors), the maximum distance from the device to the station, you can offer up to 300 m.

References

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