CONSIDERATIONS REGARDING THE ENGINEERING TOPOGRAPHY ROLE FOR QUALITY ASSURANCE IN THE DOMAIN OF CIVIL, INDUSTRIAL AND AGRICULTURAL CONSTRUCTIONS CONTEXT

CONSIDERAȚII PRIVIND ROLUL TOPOGRAFIEI INGINEREŞTI ÎN ASIGURAREA CALITĂȚII ÎN DOMENIUL CONSTRUCȚIILOR CIVILE, INDUSTRIALE ŞI AGRICOLE

FLOAREA-MARIA BREBU*, ALINA BĂLĂ, CARMEN-AURELIA PEPTAN***, GHEORGHIȚA PEPTAN*****

** U.S.A.M.V.B. of Timisoara,*
***Politehnical University of Timisoara,*
****C.N.C.F. "CFR" S.A of Timisoara, Romania*

Abstract: *The works of civil, industrial and agricultural constructions can't be achieved without single-handed the technique of geodesic measurements and of the special techniques from constructions, mainly by reason of erect finicality to the complicated geometry of buildings as much as their suppleness, in the sense of material saving. Taking into consideration that the engineering topography is involved in all the phases of accomplishing a construction, starting with phase of designing, during the execution of the building, up to the supervision of the construction in exploitation phase, this contributes substantially to the quality in the constructions domain.*

Rezumat: *Lucrările de construcţii civile, industriale şi agricole nu se pot realiza fără ajutorul tehnicii măsurătorilor geodezice şi a tehnicilor speciale din construcţii, în special datorită pretenţiilor ridicate de geometria complicată a construcţiilor, cât şi de supleţea lor, în sensul economiei de materiale. Având în vedere că topografia inginerească este implicata în toate fazele de realizare ale unei construcţii, începând cu faza de proiectare, în timpul realizării construcţiei, până la supravegherea construcţiei în faza de exploatare, aceasta contribuie substanţial la asigurarea calităţii în domeniul construcţiilor.*

Key words: *engineering topography, measurement, building*
Cuvinte cheie*: topografia inginerească, măsurători, construcţie*

INTODUCTION

The engineering topography (applied, special) deals with the study of the methods used to carry out, on the site of investment objectives in different activity branches.

The works of civil, industrial and agricultural constructions can't be achieved without single-handed the technique of geodesic measurements and of the special techniques from constructions, mainly by reason of erect finicality to the complicated geometry of buildings. Engineering topograpy studies and solves problems concerning the technical-economical studies that settle the basis of the designing, elaboration of execution project of the objective, its execution and exploitation, till the after-effects time behaviour of the erected construction.

It can be said that any design project of a construction or capitalization of a land is drawn up only on the base of a topographic plan in which are represented all the details concerning the configuration and the relief necessary to draw up a correct design construction project. Thus, any new construction appears first on the topographic plan and then is applied on the field.

In the construction domain, there have been transformed fundamentally the own measurement techniques towards the guidance, leading and control of the construction to be erect, that solicit precise measurement methods. This thing led at the creation of new specified technologies, which implicitly was felt aslo in the domain of tools and measurements means. The range of classical geodesic measurement means was comleted with higly precised tools, at which there are added measurement means from physic and machine constructions domain.

The usage of geodesic measuremnt methods, in the domain of Topographic Engineering reyuires along the assurance of precise requests the choice of corresponding devices and technologies. This choice is imposed by the precision calculus „apriori" (necessary or theoretical) starting from the given maximum admissible deviation, as for the knowledge at execution and mountling.

At every big civil, industrial construction objects, special constructions, taking into consideration the shape and the dimension of them, communication ways and underground works, the geodesic engineer, at figurative way, "appears the first on the site and leaves the last", from the following considerations:

- before starting the execution of a construction, it has to deliver the reference material necessary at the designing (the topographic base of the projects) and it has to programme its own specific works together with all the specialists from the constructions domain. This coopertion is important because from this aspect it depends the warranty of the final products;
- it has to coordinate the configuration of network supporting points or of the tracing network of the designed objectives. This objective is valid in all the constructions domain, including the machine constructions, instalations and industrial technological lines;
- it has to programme his own measurement development during the execution, starting from the precise requests of the constructions specialists- on technical and economical criteria- and to establish the performances of measurements means, to choose the measurement and techniques techologies, as wall as the labour force necessary to achieve the designed project;
- in the second phase, during the execution, appears tracind works and the control measurements that has to correspond with some highly precised requests, made in many cases in hard conditions, specific on constructions sites;
- the assembly view and the constructive details makes up at the ending of construction-mounting works together with topographic documentation and the other observations made by specialty design engineers, builders, that are component parts of technical construction book;
- extremly important for the construction and measurement specialists are the measurements of after-effects constructions behaviour during the expoitation period. Presently, the mesurements made on engineering constructions compared with the results of experiments made on models and apriori statistical computations is the most trustfull method to analyze the exploitation state and secureness of the construction.

PREPARATORY TOPOGRAPHIC WORKS AND THE APPLICATION ON FIELD OF CIVIL AND INDUSTRILA CONSTRUCTION PROJECTS

Before starting the execution of a aconstuction it is made the topographic preparation of the design project in order to be applied on the field.

The technical documentation that stays at the basis of tracing topographic works is conditioned by the soil nature and complexity and construction type.

Topographic preparations of tracing works represent the assembly of all the operations made in the office in order to apply on the field the designed constructions.

During this opertion there are several stages:

- choosing the tracing topographic network compound from points marked on the field by poles and landmarks, of X,Y,Z coordinates known or determined;
- designing the supporting network;
- choosing tracing methods done functioning of:
- the existing mesurement methods
- dimensions and plan shape of the constructions
- requested precision
- the way of accomplishing the tracing network
- device type
- choosing the topographical devices and and their accesories for the tracing depending on the endowment devices and customers requests;
- calculus of tracing elements of points from the project;
- calculus of the necessary precision tracing points;
- drawing up the systematisation project of the topographic works. This project foresees the execution order of tracing topographic works, way of marking and signalling on the site of control points for tracing works, deadlines and necessary documents of tracing deliverables.

From topographic preparations we obtain the invnetary points coordinates of supported tracing network, as well as the inventary of characteristic points of the construction, general tracing plan with the tracing schemes for each element of the objective and the topographic elements to be traced. With their help there are transposed on the field the characteristic points of the construction.

Laying out on the field of topographical projects is an operation that needs the performing of field and office topographic works. The office topographic works consists of:

- establishing the supporting network scheme for the tracing
- field mesurements of the network
- network compensation
- marking and signalling of network points
- drawing up the tracing schemes and bonding (coordinates establishment) the main axis of the construction to the base points of the tracing (topo-geodesic supporting network)
- preparing the tracing project on graphic, analytic or grapho-analytical way.

Determination of topographic elements of the project consist in transformation of geometrical numerical calculus elements to determine the coordinates, distances, angles, level differences and slopes.

Starting from construction dimensions and the figurative location on the topographic plan, by numerical computations there are determined the coordinates of construction corners, the top of communication ways routings, channels and pipeing routings, etc. Following up, there is accomplished the topographic bonding of these points to the topographic supporting network, determining the angles and the distances necessary to the tracing.

It follows the preparation of tracing schemes that comprises the tracing scheme of every point presented graphically as a drawing. On this scheme there are written:

- tracing elements (angles, distances, level differences, quotations, slopes) and the marking way on the field;
- tracing way and procedure, the points pf tracing base and its sides;
- foreseen measurements in order to assure the tracing precision, connected to environmental conditions, obstacles, etc.;
- tools and auxilliary equipment used for tracing;
- data of beginning and ending of the tracing;
- tracing control;
- reception and delivery of traced points;
- way of materialisation, signalling and protection of traced points.

The assurance of geometrical quality of a construction supposes the performing of a strict control for each phase described below.

If for obtainning the situation plans there are used topographical surveyings, for the quality control it has to be followed:

- the control of precision and surveying network form;
- checking by boring of surveying quality such as:
- comparison of vectorial data with the screening existent plans and with the field schetches;
- completion of all site collected data;
- correct interpretation of site schetches.

When the situation plan is obtained on the basis of an cartographical documentation, then:

- in the phase of scanning and geo-referentiation, quality control consists in the checking of:
- scanning quality;
- the value of square medium error in the process of geo-referentiation;
- relative spatial positionning of geor-referneciated plans.
- in the phase of vetorisation of an existing documentation, quality control is performed through manual ora automatic methods.

Site application of the constructions has the scope of assuaring the observance of designed shape and dimensions the constructions, recipocal position of the constructions as well as the absolute position in a coordinating system defined by the tracing network..

The ahievement of this desideratum belongs mainly, to the domain of"Engineering Topography", to the topographical measurements accomplished with the solicitated precision in the execution project.

Topo-engineering design notion has in this sense a very important component that includes the correct establishing of necessary precision at tracing, followed by the assignment of performances of measurement means, accesories, methods and technologies to be used at tracing. To establish these corelations, starting from values of the precision imposed by the general designer of the work, is very important, having a direct influence on the correct applications of constructions design projects. Un insuffiecient precision at tracing can lead to a defective execution, implicitly to a noncorresponding quality in accomplishing of the designed objective, but an extremely big precision of tracing works can lead to the prolongation of execution period, a great volume of time at the execution of topographic works, measurements means and accesories more performant that it should be.

THE PRECISION OF SITE APPLICATION OF THE PROJECTS AND CONSTRUCTIONS EXECUTION

The checking of tracing elements is performed according tor Romanian norm C *83-75 Guide for the execution of detailed tracing in constructions*. Tracing precision is determined by norms and tolerances on constructive reasons.

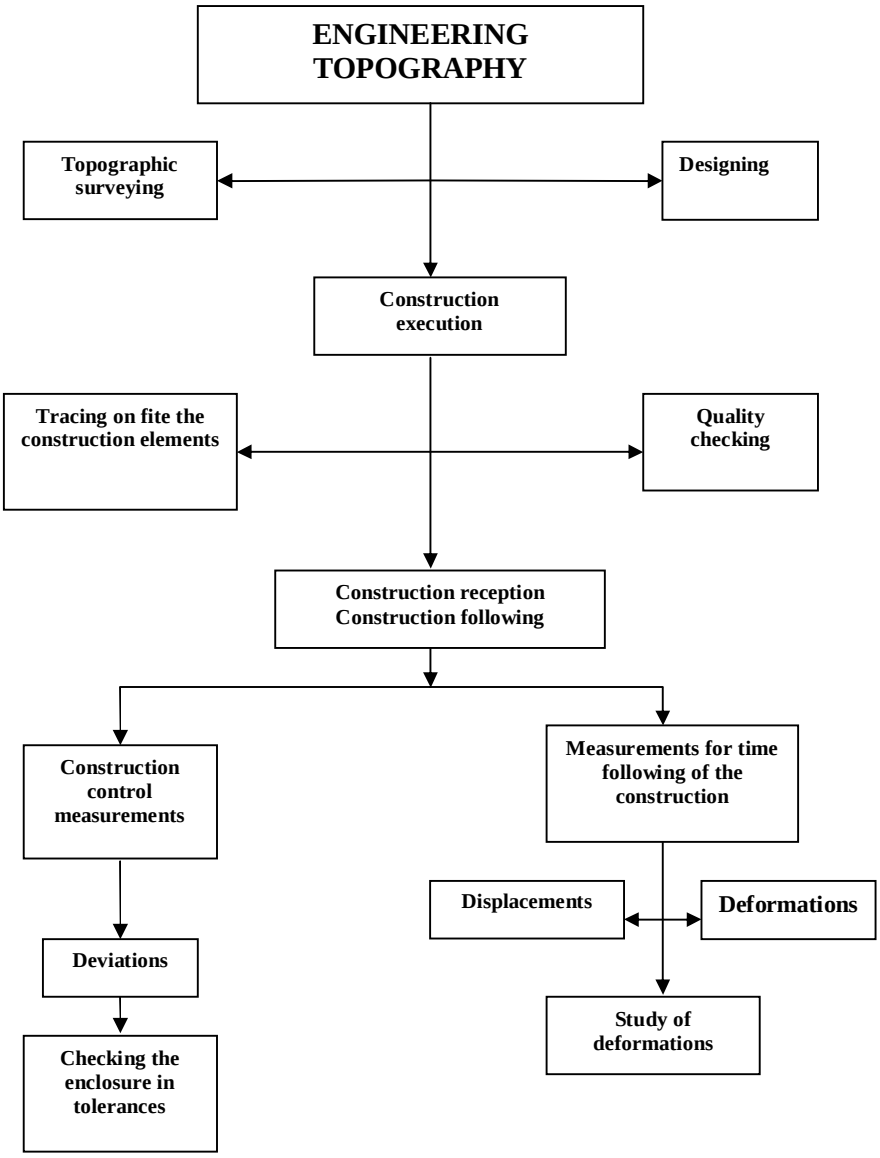

Figure 1.Engineering topography works

In the general case, the precision of aplication on site of the projects and the execution of the constructions is influenced by three factors that, theoretically, can interfere during the execution of a construction:

- precision of calculus made at projects preparation;
- precision of constructions elements at execution (prefabricated elements, modulation of metallic elelments of the construction, etc.), in which is enclosed the precision of execution at construction-mountling works;
- precision of topographic works performed.

These three components that inluence independently, can be grouped in the calue of maximum admissible deviation value (Δ) towards the designed dimensions, which can be considered as a tolerance, value prescibed in generally in construction design projects. This thing can be expressed by a general relationship under the form:

$\sigma 2 = \sigma C2 + \sigma pr2 + \sigma 2$ CM , unde

σC - represents standard positionning deviation of a designed pont of a construction rised from the influence of errors performed at the topographical measurements (angle tracing, distances, etc.);

σpr - represents the standard deviation caused by the influences of errors from the project preparation;

σ CM – represents the standard deviation resulted from the errors influence of construction-mountling works, inluding the errors at the execution of prefabricated elements and of the metallic structure components. Presenting in the constrution project of maximum admissible standard value Δ towards the designed dimensions supposes the determination of a correction between the importance of compound standard deviations below, such as their total influence don't have to exceed the maximum admissible deviation, taking into consideration the technical possibilty of the achievement the precision of three separated processes (designing-tracing-execution) , also the economic efficiencies at solving the problems concerning the construction execution.

CONCLUSIONS

Thus, the engineering topography contibutes at the achievement of constructions "quality", especially in the following domains:

- determination of quality requests and testing the procedures;
- observation supervision of geometrical requests;
- documentations for different phases or sates of the construction.

It can be conluded that this branch of topography antecedates, attendances and closes any construction process.

The reasons of the failures in constructions can be designing errors, non-observance of technical norms, errors that can appear at the execution of topographic measurements as well at the preparing of tracing topographic project as well as the deviations from the construction plan during the execution. Reducing these failures leads to the avoidance of some supplementary expenses.

LITERATURE

1. URSEA V., Topografie aplicată în construcţii, Ed. Didactică şi Pedagogică, Bucuresti, 1971.
2. COŞARCĂ C., Topografie inginerească, Ed.Mirton, Timişoara 2003.
3. GRECEA C., Geodezie, Ed.Mirton, Timişoara 2005.
4. GRECEA C., BACIU A., Lucrări topografice la trasarea în plan a construcţiilor, UPT Bulettin, Timişoara 2005
5. IRVINE W., Surveying for Construction, McGraw-Hill Book Companz Europe, London 1995