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Mrs. Shoukletovich

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Name and home country:

Mr. W. MICHNOWICZ, Poland

Field of study:

Application of photogrammetric methods
in designing of transport routes

Country(ies) of study:

Sweden

Date of award:

17.1.74 - 12.4.74

FINAL REPORT

on studies to be made under fellowship in Sweden under the supervision of the Swedish Institute in Stockholm.

Fellow	Wacław Michnowicz
Home country	Poland
Name of supervisor	Ministry of Transport
Subject of study	Application of photogrammetric methods in designing of transport routes
Host country	Sweden
Place of study	The National Swedish Road Administration Stockholm
Supervising Agency	Swedish Institute

The fellowship has been arranged by UNO - TAO of the Economic Commission for Europe - Geneva for a period of three months from 17 January to 12 April 1974.

THE STATEMENT OF MY RESPONSIBILITY IN MY HOME COUNTRY WITH THE INDICATION OF MY TRAINING AND THE SPECIFIC NATURE OF THE WORK I HAVE BEEN DOING.

At the outset I kindly inform that I am at present being employed in the Polish Railways Design Office - "Centralne Biuro Studiów i Projektów Budownictwa Kolejowego - Kolprojekt" in Warsaw, Poland. The Polish Railways Design Office is under the Polish Ministry of Transport. Our "Kolprojekt" office specializes in planning and designing new railway projects, supervises their realization and acts as a technical consultant.

"Kolprojekt" also designs modernization for existing network structures and buildings.

I have been employed in the office in question for a period of 20 years. Initially I was engaged as assistant, then as designer, and finally as senior designer.

I graduated at the Technical University of Warsaw where I received my M.Sc. (Eng.) degree.

Immediately before leaving for scholarship in Sweden, I occupied the post of senior designer and chief of a design team in Railway Lines Section. My responsibilities include the planning and designing of: new railway lines and stations, modernization of existing network structures, railway crossing (single and double level crossings), by-roads and cross-roads, sidings and yards. I was also in charge of the whole of design team work which was under my control. In addition I was main designer of a double track railway line built a few years ago.

THE STATEMENT OF THE PROBLEM IN THE POLISH RAILWAYS DESIGN OFFICE WHICH LED OUR GOVERNMENT TO NOMINATE ME FOR A UNITED NATIONS FELLOWSHIP.

The railway and road network in Poland is to be modernized and developed. A number of circular lines is also planned to by pass the principal urban- and-industrial agglomerations.

The Central Railways Design Office (of which I am an employee) which executes technical documentation for the country's investments in principal railways, in order to cope with the continually increasing responsibilities, has begun to introduce new techniques of designing. The Office sees the need for an extensive use of photogrammetric methods in conjunction with electronic data processing.

It is expected that the knowledges and experiences which I am to acquire in Sweden will be helpful in the introduction in our Office of the new modern methods in designing of transport routes.

A STATEMENT COVERING THE PROGRAMME OF OBSERVATION AND STUDY DEvised BY THE UNITED NATIONS AND THE HOST GOVERNMENT.

Detailed programme of study has been arranged by the National Swedish Road Administration in Stockholm.

It has been prepared according to proposed field of study comprised in "Fellowship Nomination Form" i.e. application of photogrammetric methods in designing of transport routes and use of modern surveying instruments. In addition, fellow also has had the opportunity to obtain a lot of information concerning the organization of the National Swedish Road Administration and other offices. I have studied in Section for photogrammetry, geodesy and data processing for a greater part of my staying at the National Swedish Road Administration. This Section executes operational and development work within photogrammetry, geodesy and data processing (development and production).

The following will give a description of the basic topics I have studied in my stay in Sweden.

1. Photogrammetry

1.1 The use of photogrammetry in the design process

The use of photogrammetry in designing of transport routes normally means the use of aerial photography. For some special applications even terrestrial photography is useful e.g. for producing road or bridge perspectives superimposed on terrestrial photos.

The most significant advantage of using a photogrammetric technique as part of the design system compared to a design system entirely relying on ground survey methods is that the aerial photographs contain a large amount of qualitative and quantitative information that is readily available for use. Moreover, the photogrammetric technique makes it easy to adapt a proper and economical survey or evaluation method to various requirements on accuracy in different design stages. This is done simply by varying the scale of the aerial photography. The system of application of photogrammetry in highway design in Sweden is one part of the whole design system and it is very important that the combination of photogrammetry, ground survey, data processing and automatic plotting is organized in a

practical and logical way. The methods are so built up that in particular a combination of the use of photogrammetry and electronic computation is received, forming an integrated unit. The aerial photographs are the source from which the information is picked up and registered and the computer transforms the data into a form that is accepted by the designing and constructing engineer.

The methods are very useful mainly because they are established in such a way that the engineers in the field can use them without being specialists of more than the road-questions.

Photogrammetric techniques are related to the different stages of designing. The system that has been developed has been built up around a dividing of the designing procedure in three different stages, namely: route location, preliminary design and final design.

In route location, the evaluation of the photographs are often made with rather simple and cheap photogrammetric instruments (e.g. mirror stereoscope). The result of topographic analysis of the area are often presented in a more simple way than on a complete map. In the route location stage is often used instrument with optical projection (Balplex Plotter).

In the preliminary design, feasible routes are determined within the terrain corridor delimited in the route location stage. Among the different alternatives the most suitable one is selected. The Swedish Road Administration produces maps in scale 1:2000 for preliminary design.

In the final design, the use of photogrammetry concerns either preparing of large-scale map (1:500 - 1:1000) for design of interchanges, bridges etc. or numerical measurements of profiles, cross sections or digital terrain model. The photography scale is generally 1:3000 - 1:6000. Longitudinal profiles and cross sections are made by using the same stereo plotter as for the mapping (Wild A8, Wild A10). Wild A10 is supplied with a device for automatic recording of model coordinates on paper tape (Wild EK8). The road center line and necessary cross sections are drawn (often in automatic coordinatographs) at scale 1:500 or 1:1000 and adjusted on to the plotting table of the plotter. Programs used for the transformation between coordinates and cross section data for later calculation of cut and fill have built-in checks of the input data. The choice between terrestrial and photogrammetric measurements of cross sections depends mainly on ground vegetation, topography and size of the project.

1.2 The photogrammetric instruments

During my staying at the NSRA I also have had possibility to use in practice the theoretical news I have studied.

I was introduced to following photogrammetric instruments disposed by the Road Administration: stereoautograph Wild A10 with EK8, stereoautograph Wild A8 with EK5, stereo Balplex-Plotter and different kind of mirror stereoscopes.

In particular I have been interested in using an instrument with optical projection e.g. Balplex-Plotter which is classified as a "direct projection" instrument. The input material consists of reduced glass transparencies of the aerial negatives, the output product is a map manuscript. By introducing the Balplex-Plotter at the localization and at the preliminary design stage it is possible to spread out photogrammetry in relatively advanced form on the local level. Three or four engineers can work simultaneously in the instrument and they can by aid of the photogrammetric models discuss the problems, that the different alternative road or railway lines form and they always rapidly and accurately enough get answers of the questions at hand. In the Balplex-model all the possible routes are evaluated and their preliminary length-profiles and cross-sections are measured.

1.3 Photo interpretation

Photo interpretation technique as an aid for obtaining geological-geotechnical information is very important in designing of transport routes. The interpretation is usually made from panchromatic film diapositives or paper prints in the picture scale 1:10000 - 1:30000 giving as a result information about different types of soil, soil boundaries and an estimation of soil depths. The results are primarily used in the route location stage. Very useful for the interpretation of aerial photographs is zoom stereoscope.

1.4 Terrestrial photogrammetry

The use of photogrammetry is generally equal to the use of aerial photography. However, the terrestrial photogrammetry is occasionally used for determination of volumes of excavations, for presenting route and bridge perspectives. Thus it is possible to have the proposed route or bridge shown directly as a part of the landscape. Stereo perspectives are also possible to produce.

1.5 Digital terrain model (DTM)

In point of fact, photogrammetric techniques is the only reasonable method for the measurement of the large number of points that are involved in a digital terrain model. At the Road Administration DTM is used according to program VV 220 (interpolation of elevations in a cross section from surrounding points with known elevations) which is connected with big EDP-programme VV 202 applied generally at the NSRA. VV 202 is among other things calculating road cross sections.

2. Modern length-measuring devices

The modern length-measuring devices, especially electronic, is very suitable for many purposes in designing of transport routes. They are also suitable for the introduction of photogrammetry in planning. Without these instruments it would be much more difficult to solve the measuring problems for the long and narrow areas which are of interest when designing roads and railway lines. Some of these instruments are used to measure long distances, other are used for measuring the detailed traverses and for the staking of the route etc.

In all three design stages and in road construction work electronic distancers are used. Apart from ordinary geodetic instruments the following I could use in practice.

The Wild Distomat DI-10 infra-red distancer is very efficient as well for measuring the detailed traverses as for staking out. The control unit contains the electronics, the display and the internal battery. Operating controls have been kept to a minimum. The AGA Geodimeter mod. 6 (transmits a lightbeam) is used as well for longer as for shorter distances, but now is produced the AGA Geodimeter 700 for direct measurement of angles and distances. The light source is a 1mW HeNe laser. In a short time also will be used a mini infra-red distancer, the new DI3 Distomat for short-range survey work.

3. Data processing

The electronic data processing (EDP) at the NSRA is achieved by the computer SAAB D22. It has a high speed memory of 96 K words (1 word = 3 bytes), six magnetic tape memories, four disc memories, two line printers, optical paper-tape reader, card reader, paper-tape puncher etc. The main programming language is Algol-Genius. Some of the output from the computer is produced on paper-tape to be used for drawing in an off-line automatic plotter. The plotter is used for drawing road centerlines, interchanges, perspectives, cross sections, control for photogrammetric mapping etc.

The program system for calculating cut and fill etc. is improved. Road and bridge perspectives can be drawn related to almost any selected position of the eye-point and direction of sight beam.

The electronic computation is a great help as well for photogrammetric techniques as for geodesy.

VIEWS AND COMMENTS AS TO THE CONTRIBUTION WHICH MY TRAINING ABROAD CAN MAKE TO THE ADVANCEMENT IN MY PARTICULAR FIELD OF STUDY IN MY COUNTRY

The country's development, and in particular the advancements in its industry, the rapid processes of urbanization and the progressing development of urban and industrial agglomerations, involve the construction of new communication systems and the modernization of those already existing.

Arising from the general directives of the country's economic development, the modern requirements of railway and transit traffic, coupled with the need for taking into account a series of current and objective factors of economy and of the problems of environment protection, are placing increasing demands on the design offices in the charge of the Polish Ministry of Transport and Communication. In the nearest foreseeable future, a series of large-scale investments is envisaged and planned. The railway and road network in Poland is to be modernized and developed, and there is to occur an effective increase of the transportation capacities on the heavily used transportation lines. A series of circular lines is also planned to by pass the principal urban-and-industrial agglomerations and to relieve the crowded and heavily stressed communication junctions.

In this particular situation, designers of transport routes are confronted with increased requirements. The designing of transport routes of today puts much higher demands as well on the quality as on the effectivity of the result than before. When designing it must also be expected that the necessity of taking into account an increasing number of technical parameters, as well as such factors as the environment protection, the increase of traffic safety, etc., should require the elaboration of appropriate projects.

Our Office has elaborated a preliminary plan for the application of photogrammetric methods in the designing for the forthcoming years. The realization of this programme will require engineers possessing the knowledge and experiences in the photogrammetric field.

My knowledge and experience which I have acquired in Sweden can make advancement and can be helpful in our Office to some extent in the application of photogrammetric methods, especially in designing of transport routes. By using the modern methods connected with photogrammetry the routine-work of the designing is taken over by the new aids. The engineer will be able to have more and better information rapidly served as he needs it and he also will be able to get more time available for engineering judgements and thinking. The application of photogrammetric methods can make possible as well as the shortening of the time of designing, reduction of the costs of investments and technical documentation itself and the selection of the most optimal design solution.

Finally the fellow wishes to express his thanks to the National Swedish Road Administration for the interesting programme of study and the invaluable help during the whole time of his fellowship study.

He is indebted to the United Nations and Swedish Institute which have arranged the studies in Sweden, that have permitted him to obtain a lot of interesting information within his field of work.