

C o m m i s s i o n VII

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INTERPRETATION OF COLOR AERIAL PHOTOGRAPHS FOR UPDATING
LAND REGISTER MAPS IN CZECHOSLOVAKIA

Abstract: Technology of updating land register maps by means of visual interpretation and photogrammetric processing of color aerial photographs made on the FOMACHROM D-20 color reversible film of Czechoslovak production.

The maintenance of real estate, and the land use registration in particular, pertain to main assignments of the surveying and mapping branch in Czechoslovakia. The current scope and labor consumption of this assignment may be demonstrated by the following data: in the Czech Socialist Republic alone, which covers 62 per cent of the Czechoslovak territory, there is 11.5 million of parcels which are registered, each of average acreage equivalent to 0.68 hectares. 13 per cent of these, i.e. 1.5 million of parcels, are subject to annual changes. The changes are approximately of the following type: 15 - 25 per cent go for housing and capital construction, while land use and boundaries of parcels allow for 75 - 85 per cent of changes.

Prior to 1976, the investigation of the majority of changes was accomplished directly in the field, the changes being measured by traditional geodetical methods in five-year cycles. Used for this purpose in some enterprises were also black-and-white photographs, nonetheless they often failed to provide the results expected. The inadequate accuracy and completeness of change identification ensued particularly from the fact that, though structures and land boundaries were quite identifiable on the black-and-white photographs, this was not true for the completeness and accuracy of separately registered categories of land use. The check-out included both time-consuming field inspection and classification alike of the purpose of some lines plotted from aerial photographs in analogue instruments.

However effective it may appear, the technology of using aerial photographs, primarily designed for other users and other

purposes, suffers from certain disadvantages that cannot be counterbalanced by low cost of their lending. The photographs are mostly of too large scale and the layout differing from that of the land register maps highly enhance the non-productive time in photogrammetric restitution causing difficulties in identifying a sufficient amount of identical points both on the photograph and in the map alike. These are necessary for absolute orientation of stereopairs and graphical restitution of planimetry from aerial photographs to the map. Much of aerial photographs for large-scale and medium-scale mapping are taken out of cereal growing season /i.e. March-May, September-October/, which allows for the difficulties in using black-and-white photographs for identifying some agricultural categories of land use.

Thus, a priority has been set to develop a new technology of identifying changes in land use and their air survey in rural areas. The Research Institute of Geodesy, Topography and Cartography in Prague was assigned with this task. Information on real estate changes in urban areas are acquired in another way, e.g. from municipal and state authorities empowered to grant permits for housing and capital construction. Two ways have been accepted of enhancing the interpretability of aerial photographs for updating the land register maps in Czechoslovakia, namely:

- the use of color reversible film in aerial photography
- the exercise of aerial photography in the season of cereal ripeness and harvesting, or at the beginning of autumnal agricultural work.

Color slides in true colors are quite easily readable even for an untrained user. No additional prints or enlargements are needed, since the interpretation and photogrammetric restitution of changes in land use are made directly on original images on transparent film base. For this purpose the FOMACHROM D-20 color reversible film of Czechoslovak production is used, designed for acquiring aerial photographs 23 x 23 cm in size, of color fidelity as well as contrast required for the flight height of up to 2,000 m.

Getting an optimum coverage of the land register map at the scale of 1:2,880 requires that aerial photographs must be acquired

- at the scale of 1:20,500 with a 9/23 super wide angle camera; one strip of photographs covers simultaneously two map sheet series
- at the scale of 1:13,000 with a 15/23 wide angle camera; one strip of photographs covers one map sheet series.

Larger scale of photographs is used when graphical transformation of individual photographs into the map is conducted /4.5x enlargement/, or when numerical photogrammetric processing is executed of a great many changes in boundaries of parcels or some structures /e.g. weekend houses in forest areas/.

The interpretation of the changes in land use and in land boundaries is made in county centres of geodesy by technicians who passed a short training. Included in the program are specimens of typical categories of land use as well as more sophisticated cases in which a mere color does not help and the process of recognition requires the analysis of image texture and pattern, or the knowledge of relevant interaction between phenomena. The procedure is based on a visual interpretation of original color slides, their content being compared with the existing land register map in the projector, interpretoscope or stereoscope. The interpreters, though without any special photogrammetric training, are quite familiar with the situation and conditions in their county. They can quite safely identify the following categories of land use:

- arable land
- hop fields
- vineyards
- gardens and orchards
- meadows and pastures
- woods and forests
- ponds
- other water bodies and streams
- urban areas

- other areas /e.g. infertile and devastated land/.

Less manifested changes in the run of boundaries of parcels, e.g. agricultural land cultivated with machinery or growing forests, can be recognized in the subsequent photogrammetric restitution of the photographs. The identifications of types and age of woods goes beyond the real estate register; it is subject to a special register of forest use and planning.

The technology of the graphical restitution in analogue instruments for updating the land register maps at the scale of 1:2,880 exhibits some particular features stemming from the way of the original compilation and later updating of these maps. The origin of the maps covering rural areas mostly dates as far back as the 1st half of the 19th century during which, in the former Austrian-Hungarian empire, cadastral surveys were undertaken and cadastral maps graphically compiled by the survey-table method separately for each cadastral unit. In the 1880s they were updated by the same method. In the course of the next 80 years changes, new structures and boundaries were surveyed and plotted in the map separately, first by graphical and thereafter by numerical methods of detailed geodetical measurements. The damaged map manuscripts had to be gradually replaced by reproductions. In the early 1960s the maps covering individual cadastral units were connected into one continuous representation. All these transformations accounted for a lower accuracy and homogeneity of the map content and draft.

A special procedure of identifying the content of a photograph /stereo model/ with the map is applied, so that the correct map skeleton of the original surveys may be distinguished from the later local systematic and random errors in representation. It is not the point but the line evaluated along the whole run that makes the fundamental element of the ground control. The operator should follow the lines with which there is little probability their position might have changed through the reunion of parcels, reconstruction of roads and capital reconstruction. The admissible deviation accounts for a mean value of 0.5 mm, with the possibility of reaching as much as 1 mm on the 1:2,880 map.

The internal accuracy of photogrammetric plotting of color aerial photographs at the scales of 1:13,000 and/or 1:20,500 is much higher: in accordance with the quality of identification of points and lines in the photographs a mean position error may be achieved ranging from 0.15 to 0.25 mm, or from 0.20 to 0.35 mm in the 1:2,580 map, respectively. The break points of boundary lines are neither subject to commissional search nor signaled prior to aerial photography. Consequently, the changes in the ownership to parcels are not surveyed by this method.

Color aerial photography for updating land register maps in Czechoslovakia has been developing at a rather high rate:

- prior to 1978 experimental photographs were taken covering the area of 90,000 hectares,
- in 1979 they covered the area of 400,000 hectares,
- in 1980 more than 25 per cent of large-scale and medium-scale photographs are required on color reversible film.

The interpretation and photogrammetric restitution of color aerial photographs for updating land register maps in Czechoslovakia are both time-saving during necessary field surveys and cost-saving alike insofar as transportation and fuels are concerned. The aerial photographs in true colors present an objective as well as commonly accessible documentation on the actual state of land use for users, owners, and governmental authorities.