

WORKINGGROUP IV/

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LOW COST ROAD MAPPING FOR ROAD MANAGEMENT

ABSTRACT: Road maintenance, repair, improvements and accident studies as well as various dealings with other authorities and the general public would be facilitated by an easy availability of detailed maps in a suitable intermediate scale (e g 1:5000 - 1:20 000) of the roads and their immediate surroundings. The area of interest in this context is extremely narrow but its length will be tenths of kilometers even in a small country. Hence the kilometer-cost and the production-time for a regular photogrammetric mapping - not to talk about a ground survey - would mostly become prohibitive. The paper describes a simple approach based on a combination of an approximately scaled enlarged airphoto-ribbon (from mostly existing photocoverage in 1:20 000 - 1:50 000) with photointerpretation and TripMaster-positioned field reconnaissance of relevant details not visible in the airphotos. It is a development study within the Swedish Road Authorities

Road management includes maintenance and repair, recording of accidents, minor and major improvements etc etc and a lot of dealings with the general public, the industry, other authorities and other sectors of the road authorities itself. All this must be referred to indentifiable positions. In several countries this is achieved with km-posts possibly also with 100-mtr stones along the roadside. Through a graphical presentation the use thereof is facilitated. If that presentation also informs about (shows) the horizontal alignment as well as what is close to the road on each side as buildings, accessroads to fields and meadows, fences, drainage, communication and power lines etc, it becomes still more useful. It becomes a road map but not of the type and scale the motorists are using. Anyhow, the road management map must have a size and a scale so that it can be handled in the road supervisor's car or outside it, even in bad weather. As to the scale it should be as ladies skirts - "short enough to be interesting but long enough to cover the subject". In more technical wording - the scale should be optimized with a presentation detailed enough and convenient for a positioning accurate enough (e g within 5-10 mtrs) on one hand and on the other hand a reasonable portion of the road in a small handy sheet (e g DinA4 209x296mm). That boils down to something between 1:5000 and 1:20 000 depending on the class of the road, the type and use of the landscape and how much of details shall be presented.

A road and its immediate neighbourhood - e.g. 50-100 mtrs from each side - can be mapped in a number of ways as e.g. classical ground survey based on a transit traverse or aerial stereomapping or by automatic recording of the forces attacking an "inertia platform" in an instrument mounted in a car driven along the road.

The various methods have their advantages and disadvantages. For most of them it is either a matter of high costs or to sparse an information on the thousands of details along the road which give a good picture of all the interactions between the road and the activities by man and nature along it. Such details also facilitate the direct position identification when observing, reporting or issuing orders about something regarding the road.

Stereophotogrammetrically plotted maps can include much of detailed information in a more or less digested form, ortophotos the same but in undigested form, but those methods become fairly expensive as only a very narrow strip of each stereomodel is used when plotting the map or producing the height data needed for the ortophoto-production.

In road management operations it is normally more important and helpful to know the relative positions of those points or road portions which are involved than to know their coordinates in the coordinate system of the country or to know the exact distance from a certain reference point which may be a road crossing several kilometers away.

An airphoto is excellent in presenting innumerable pieces of information and their relative positions. But an ordinary airphoto on which a portion of the road is depicted together with millions of pieces of information outside the immediate road neighbourhood and thus irrelevant to the road activities is not practical in an unprocessed form. One reason of several is that the road in an airphoto, if not taken particularly for road purposes, may cut askew over a corner of the airphoto, a second that it is difficult to keep a fair number of airphotos in order, a third is that there are numerous pieces of important information about the road which are not or hardly visible in the airphoto and thus must be marked and a fourth reason is e.g. that it is almost impossible to make clearly understood notations with the airphoto texture as the writing surface.

In some countries, the ground area occupied by the road as well as its drainage system etc. are from legal point of view a kind of land holding and therefor boundary-marked and surveyed with high precision. In other countries, as in Sweden, the public interest is secured by "the right of way" and then it is not a matter of a formal title registration. Anyhow, maps produced for title registration or for right-of-way formalities are normally of such a type and in such an impractical large scale that they are not suitable for a regular routine road management.

The same applies commonly to the large scale maps (1:500 - 1:2 000) prepared for the construction of a new road or for a major improvement of an old one. It is also to be noted that such road construction maps are normally only available for those pieces of the road system which have been subject to construction work during the last few decades. Hence such maps - anyhow they are plotted in a far too large scale - only exist spotwise in the road net.

It is also to be noted that the total length of a road net is very high in an industrialized country which makes it necessary to keep the km-cost as well as the km-production-time as low as possible. In the developing nations the road net is far more open and consequently the total road length far lower. But the available resources possible to direct to the road mapping is still lower.

Aerial photography is - compared with the area and the immense number of details recorded in each photo - a fairly cheap method of recording details of the landscape, cheap as to cost per sqkm or hectare. But, again, we are

in road mapping only interested in a very very narrow strip of the photographed area. Therefore it is, from economy point of view, most essential to use existing photographs whenever possible, e.g. such taken for a regular topographic mapping, commonly in a scale between 1:20 000 and 1:60 000. If no reasonably late photocoverage in medium or small scale exists, or none at all - which may be the case in several developing nations - a special photo-mission has to be undertaken. But in such a case there are certainly several other parties interested in fresh aerial photos over such areas where the few roads cut through. Public and private activities are certainly most intense there. In such cases a fairly small photoscale for the single photo-strip, which need not - as otherwise normal in aerial photography - follow straight lines, might be of a common interest e.g. 1:30 000 - 1:60 000. With the road normally in the middle part of the strip, the photos will reach 3 - 6 kms on each side out into the landscape

The main principles of the production procedure for the very simple and low cost ROAD MANAGEMENT MAP described in this paper are as follows:

1. Carefully planned narrow strips of the negatives (with the road centrally in the strip) are enlarged but neither rectified nor orthophotocorrected. Enlargement only to an approximate scale and only scaled along the road. The minor errors in the scale across the road are insignificant. Scaling to be based on existing maps. If no acceptable maps exist one has to drive along the road with a car equipped with a precise trip-meter and identify and record distances for dominant sharp road side features, crossroads etc. If special photography shall be carried out the km-posts, if existing, shall be photosignalled by spreading lime around them. If there are no km-posts, signalled km-pegs should be set out according to tripmeter readings.
2. The standard length of road in each sheet shall be some 40-50 mm shorter than the length of the sheet. For DinA4-size (296mm) that means about 250 mm craw-flight length of road in each sheet and if the scale is 1:10 000 that means 2.5 km of road per sheet. The sheets shall be planned accordingly and preferably before the planning of the enlargements. If possible it is preferred if each 2.5 km piece of road is enlarged from only one negative. When using existing photographs this may occasionally not be possible. Then the joints may either be glued together or separated with a clear gap with some duplication of ground, clearly marked on the photos. There should, if possible, be a minor overlap of 5-10 mm between the 2.5km-pieces.
3. The narrow strip of land on each side of the road, being of interest for the road management and valuable for orientation, shall be delineated with polygons of straight lines and so the outside limits of the narrow overlap zone at the ends of the 2.5km pieces. A rough tracing of the polygon and the road is made and placed on a sheet (e.g. A4) of heavy weight map drawing paper with the road located centrally. The polygon is pin-transferred to the paper and a window cut out. The airphoto is taped behind the window and the package properly numbered.
4. The field reconnaissance is carried out by car equipped with a precise tripmeter. There are several makes - a simple and fairly cheap one is the Swedish "Halda TripMaster" with digital display of each 10th meter. One can estimate to about 3 meters. The field reconnaissance may be carried out before the base maps are available but is facilitated by their availability.

5. The reconnaissance is made during slow driving (and sometimes stopping) first in one direction and thereafter in the opposite one. The road shall be divided into legs of some 5-15 kms length between major roadcrossings, villages etc. It is advisable to complete one or a few legs at a time. Recordings are preferably made with a taperecorder, with additional pencilrecordings of belowmentioned connectionpoints.
6. When driving in the forward direction the following shall be recorded:
 - Connection points preferably also identifyable in the airphotos for every 500-1000 mtrs
 - All important road features and other influencing features on or immedeately outside the right road bank
 - Drainage drums and bridges with measures and other main characteristics
 - Crossing power transmission and telephone lines etc.
7. On the return drive the trip meter shall in each endpoint of a leg, be set to the same value as recorded in the forward drive and geared for reverse counting. The features on or outside the other roadbank as well as connection points are recorded and so are details about the road surface, traffic paintings on it etc.
8. The tape recordings are plotted on special transparent forms with the road as a straight ribbon some 30 mm wide and with the same lengthwise scale as the one the photos have been enlarged to (e.g. 1:10 000)
9. With the help of the special connection points and other recorded features also visible in the photo the transparent plot is consecutively adjusted to fit to the air photo road. To achieve this it is necessary to rotate and move the plot along the road minor distances. The recorded and plotted details are continously pin-transferred from the plot to the photo.
10. From the pinmarks sharp and parallell pencillines (indicator lines) are drawn out into the white map area. At the ends of the lines the feature is described with a symbol (rubbing down technique is practical) or abbreviation or with full text. All must be done neatly and clearly as the white surface must not be overburdened but useful for later annotations when the maps are used for their purpose.
11. Cadastral information from available maps or a special reconnaissance may be included as follows. In the photo crosses are marked on the road where boundaries cross or touch the road. Indicatorlines are drawn out to (almost) the edge of the sheet where small arrows indicate the directions to the different holding-numbers.
12. North-arrows, sheet-indexes, relevant other information and some place-names are also introduced on the white map surface.
13. The sheets are grouped in sets technically and administratively suitable and numbered accordingly.
14. The sheets are now reproduced in a considerable number of copies. As they shall be used as a work-material it is most essential to use a cheap procedure e.g office offset printing or xerox. It doesn't matter very much if the sharpness goes down quite a bit, the important point is that the sheets can be consumed without any hesitation. If a few sharp copies are needed

Titlepage for a set of some 20 mapsheets joined in the upper edge with a spiral.



STATENS VÄGVERK

VÄGDRIFTSKARTA 282C + 282B

(ROAD MANAGEMENT MAP)

UPPSALA — EDSBRO

282C+B



THE PURPOSE OF THE MAP : This simple type of map is intended to cover all public roads and it may also be used for major private roads. It is meant to be a detailed complement to the ROAD DATA BANK used for general studies of the Govt road net, its management and improvement.

This detailed map is intended as a basis for various planning, reporting, ordering etc. within the local road management, as well as a basis for accumulating various information of interest.

Further it is intended for use as reference map when dealing with other authorities and the general public.

SUBDIVISION AND NUMBERING: A road with a certain official number may pass parts of several provinces, in connection with this map that part of a road falling within one province constitutes a separate road, given the number of the road with the province littera added. In this case 282C. If there is a short piece only falling within the next province it may be included in the map-set. In this case a short part is falling within province B and is thus included in the province C set, therefor called 282C+B.

The road is subdivided into legs with major settlements or natural features as dividing points. Those legs are given littera A, B etc. from the starting point of the road. Each leg is further subdivided into mapsheets (size e.g. DIN A4 with 250 mm of road on each) numbered in consecutive order and named after a dominant geographical name close to the road.

When information density is very high parts of the road within one sheet may be blown up. Such specials are given the number of the standard sheet with the addition of A, B etc.

SCALE AND ACCURACY : The standard scale is 1:10 000 with minor parts blown up twice or four times where the information density is too high for the scale 1:10 000.

The aerial photostrip is just an enlargement and not a rectification. Its scale may vary slightly and differ from the 1:10 000. All positions are to be counted or measured relative to nearby photo-details or identified features specially marked. The relative position accuracy may be expected to be better than 0.5 mm (=5 mtrs).

LEGEND : See overleaf (not here!)

(The symbols will adhere whenever possible to the official road sign symbols. Additional symbols are used for several other features like access roads, drainage culverts, telephone lines, sign posts, boundary points and title registration numbers etc.etc.)

282C + 282 B

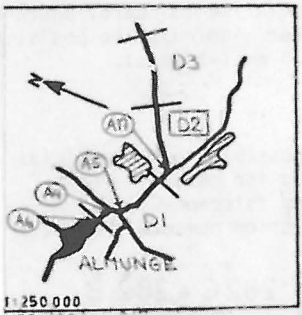
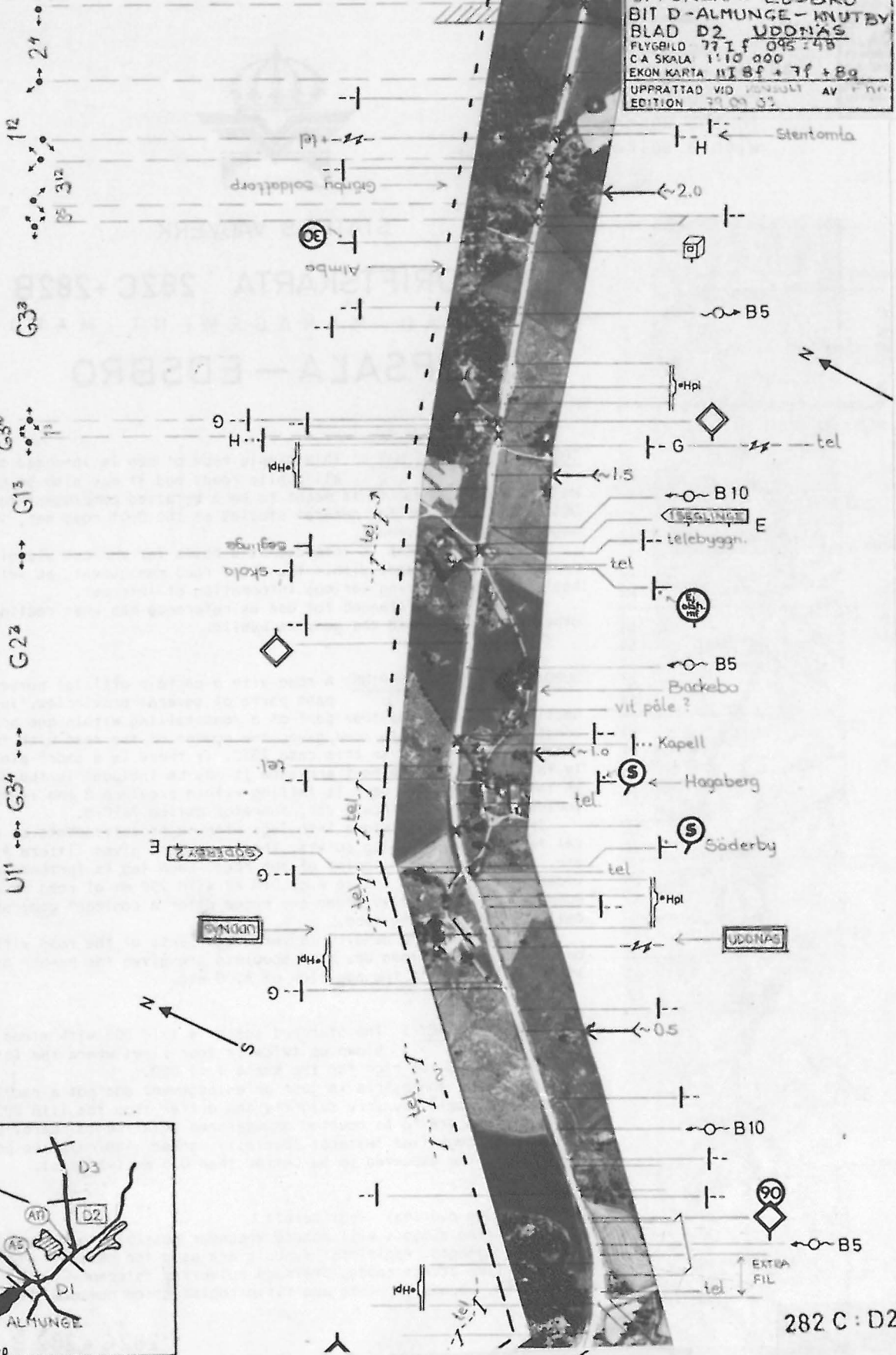
282C : D2

EDSBRO (282C : D3)

DRIFTKARTA VAG 282 C
 UPPSALA - EDSBRO
 BIT D - ALMUNGE - KNUTBY
 BLAD D2 UDDNÄS
 FLYGBILD 771 f 095:48
 CA SKALA 1:10 000
 EKON KARTA III Bf + 7f + 8g
 UPPRÄTTAD VID UDDNÄS AV ...
 EDITION 1953

GRÄNBY

UDDNÄS



UPPSALA (282C : D1)

282 C : D2

244.