

and last but not least, what one of my contemporaries called "Madki." When presenting the Resident Engineer an itemized bill for some extra work ordered by the engineer, the engineer objected to the percentage added to the itemized cost. This was 20%, The Resident Engineer told him he thought 10% was ample. The contractor replied that 10% would only cover the "Madki." "What in the hell is 'Madki?'" asked the engineer. "Mental anguish, don't know, and indifference on the part of the engineer" was the reply. So the new type of plans and measurements are just one more factor that the contractor must evaluate and take into account.

It will undoubtedly be sometime after a highway department decides to adopt the method before it will be put into actual use. It may decide to equip and staff its own organization so that it can do the work in its entirety. Or the decision may be to contract this work to engineering companies already doing this kind of work. In either case the delay in getting the first plans ready for bidding will be quite lengthy. In my opinion the delay in the first instance would be at least a year. It could possibly be that long or longer if attempt is made to do the work by contract, due to prior commitments on the part of the engineering firms.

Under these conditions, the highway departments would have ample time to promote the "education" of the construction contractors in the use of the new methods. This could be done in several ways. A panel discussion could be set up at some highway letting at which the engineers could make talks to the contractors on the various phases of the work. Most states have a contractors' association and they could invite the engineers, and the photogrammetric and electronic

instrument manufacturing company representatives to discuss the matter at their yearly conventions. No doubt highway construction specifications will have to be rewritten around these new methods. This should be done and put in the hands of the construction contractors far enough in advance of letting the first projects to give the contractors time to clear up anything they did not understand or were uncertain about. I feel that it is a matter of educating the contractors as well as the engineers. Once the engineer is sold on the accuracy of the method for meeting his requirements, then the contractors should have no hesitancy in following suit. But since their profit and livelihood depend on an understanding of the method, it behooves the highway engineer to make clear how it works and how the construction contractor will be expected to operate under it.

I think the instrument manufacturers and engineering firms sponsoring these new methods could very well direct some of their educational and advertising effort in the direction of the highway construction contractors. They could point out the benefits and advantages to the contractors as a result of the adoption of these new methods. If the new method materially reduced the time now consumed by the Highway Departments in getting out the final estimates, this quicker action would be a strong point in talking to the contractors. I think I can safely say for the majority of the highway construction contractors that once they understand the operational limitations as well as the advantages and accuracies of the proposed methods, they will have no hesitancy in accepting them and cooperating with the engineers in carrying out the construction work under the plans and specifications prepared by and for their use.

DISCUSSION*

MR. GOODALE: (Caracas, Venezuela) I'm particularly interested in photographic interpretation. Could you, Mr. McLerran, give me the names of text books recently published on photographic interpretation?

MR. MCLERRAN: Probably the best source

of information are recent papers published by the Highway Research Board. There is a text book, not illustrated, put out by the Civil Engineering Department of Purdue University. I believe the title is "A Manual on the Airphoto Interpretation of Soils and Rocks for Engineering Purposes." Others

* This section is incomplete. Omissions were made necessary by the wording of some questions or answers and some questions and answers being confusing, obscure or incorrectly stated—
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are Technical Development Reports Number 52 and Number 85. In addition there are many recent papers published in PHOTOGRAMMETRIC ENGINEERING.

MR. GOODALE: Mr. Pryor made a statement at the beginning of the session which he may like to discuss. I believe he said the stereoscope gives a true concept of relief.

MR. PRYOR: If I remember my words correctly, I said the stereoscope gives a better concept of relief than the average topographic map for the average user of a map.

MR. GOODALE: It's quite important to bear in mind not only the phases of stereo-plotting instruments and their accuracy, but also the fallacies of our apparatus. I think that we should also remember that the stereoscopic view is not a true concept of relief as it is on the ground, but contains distortions.

MR. PRYOR: With the mirror stereoscopes most of us use, our eyes are farther from the pair of photographs than the lens was at the time the photographs were taken. Therefore, we get an exaggeration, or, shall we say, an amplification of the sense of vertical demension.

As an example: If we are stereoscopically examining photographs that were taken with a six-inch focal-length camera at a distance of 12 inches from the photographs, the vertical dimension will have an appearance twice as large as it really is.

On the other hand, if we examined them from a six inch position, the vertical dimension will appear the same as if you were examining a true-scale relief model of the ground.

I am not so sure that I understand Mr. Goodale's question about distortions. I do not construe the illusion of magnification of relief as a distortion. Furthermore, with most photogrammetric instruments, if I understand them correctly, the Multiplex and Kelsh are examples, if the focal-lengths of the projection and of the taking camera are the same, the stereoscopic model is vertically and horizontally at the same scale.

The concept of relief, of course, doesn't necessarily mean that you couldn't have a visual exaggeration vertically and still not understand properly the concept of relief topographically.

As another example: In highway engineering, excepting for bridge sites and

cross sections plotted to natural scale for computing volumes of earth work, we always exaggerate the vertical in the profile. The reason is that an exaggeration, usually ten to one, makes possible getting a better concept of the relief existing in the profile than if plotted in a natural one-to-one scale, horizontally and vertically. An exaggeration in the vertical dimension gives the viewer and user a "better" concept of topographic relief, stereoscopically as well as graphically.

MR. PETER ESCHWEILER. (Cornell University) Mr. Meyer, in your presentation at the public hearings do you make any use of the stereomosaic?

MR. MEYER: No. We don't use a stereomosaic.

MR. MAX GLEISSNER, (U. S. Geological Survey at Rolla): Mr. Meyer, A couple of years ago you were experimenting with vectographs. Did you have any success?

MR. MEYER: We are still trying. We haven't had any apparent success in employing them for any particular use.

MR. L. J. BRUNZIE (Robinson Aerial Surveys): Mr. Herd, with regard to grading quantities, how do the contractors' figures compare with those of Ohio, for cut and fill? What are the percentages of error?

MR. HERD: We've only been measuring final sections photogrammetrically for a year or so. One contractor was pleasantly surprised with the results; the way he could check detail shown on the plans. For actual figures, five or six projects varied between two and five per cent from the original estimates. This is also typical and similar to the way projects work out when surveyed in the field.

MR. BRUNZIE: I also understand you have measured profile elevations at break points and at 50 foot intervals, and have used them in computing cut and fill quantities.

MR. HERD: The profiles are surveyed on the ground. We use such elevations for setting up stereo-models.

MR. SANDERS (Aeroflex Company): Mr. Wood, are the specifications so written as to require calibrated equipment?

MR. WOOD: My thesis is that it's not the equipment but the management in a tech-

nical firm that determines its quality, its workmanship. An engineer who purports to practice photogrammetry and who builds a good record of experience will have equipment to do the job. On the other hand because a company has certain equipment doesn't fully qualify it. It's the men who are doing the work that qualify the company. Qualified people have the equipment necessary to do the work, or they won't try to sell the services.

MR. VERN CARTWRIGHT (Aerial photography contractor, Sacramento, California): Assuming a contractor has the necessary experience and type of cameras, to what extent can aerial color photography be used?

MR. PRYOR: Aerial color photography could be used for photographic interpretation, assuming, of course, that you could find the ideal day for such photography; you have many more problems to cope with in taking acceptable color photography than for acceptable panchromatic photography.

Aside from the color transparency as developed after being taken out of the camera, difficult and time consuming reproduction problems decrease usefulness of color photography to most highway engineers or engineering organizations serving highway engineers. It is a fertile field for research and further study for application.

On the other hand, color tone, as it's called in black and white photographs, gets its name because of the sensitivity of film to the color of the ground and the things that are on it. So, if you get the color direct, color tone would really mean something; particularly for photographic interpretation. Not only for determination of soils conditions and location and classification of materials that go into the highway as it is constructed, but for interpretation, classification, and evaluation of land uses which are equally important.

In most of our discussions we seemed to have overlooked land uses and this is unfortunate because land use in many places has more of a controlling effect on highway location than any other consideration. For most highways in developed areas, especially urban, land use controls the location instead of soils, or topography. And, finally, of course, dimensions do enter into nearly every phase of highway location

and design, regardless of the importance of qualitative considerations.

MR. SANDERS: In the construction of the mosaics referred to by Mr. Meyer and Mr. Harwood, is any attempt made to reconstitute the photographs? Correct for tilt? Or do you just assemble contact prints?

MR. MEYER: We make an ordinary stapled mosaic. In my paper I mentioned that we don't have the time to make scale and tilt corrected prints of any kind.

MR. PRYOR: In highway engineering, mosaics are used to show the relationship of one route alternative to another and to the engineering problems encountered. Contact prints assembled and stapled together to make mosaics contain all the displacements caused by tilt and relief, but together they enable engineers to show the position of highway routes across photographic patterns seen on the photographs; the objects or features causing these patterns can be identified when you are on the ground. Therefore, the true relationship between route location proposals and ground positions can be obtained by using the most unprecise mosaics.

MR. LOREN ADKINS: (U. S. Forest Service): Does the Bureau of Public Roads intend to use photogrammetry for the location and design of all forest highways from now on?

MR. PRYOR: I can't answer with a direct yes or no. The Bureau of Public Roads is encouraging its regional offices to make every possible use of photogrammetry.

We have conducted a number of schools and have one underway right now to give location and design engineers a little know-how in the use of photographs for reconnaissance purposes, and the application of photogrammetry in large-scale mapping for preliminary surveys and design. Thus, we are working toward the objective of having all surveys, wherever and whenever practicable, made by photogrammetric methods. Moreover we are encouraging the States and our Regional offices, to negotiate contracts with qualified photogrammetric engineering firms for the photogrammetric services they can perform in supplying what is needed in highway engineering work.