omparison of Accuracy in Cross-Sections etermined Photogrammetrically and y Ground Measurements

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This paper presents results obtained from (a) precise field cross-sections, (b) unadjusted photogrammetric cross-sections as taken with a Benson-Lehner terrain data translator on a Kelsh plotter, and (c) adjusted photogrammetric cross-sections.

THIS COMPARISON of results for different types of surveys is from earthwork mputations based on field measurements and photogrammetric measurements on yoming Interstate Project I-90-2(5). The test was made within a 2.5-mi section very rough terrain where in some instances right-of-way widths were in excess of 0 ft due to maximum vertical variations up to 250 ft across the sections.

Photography was taken, by a consultant, with a Fairchild cartographic camera with B and L Metrogon lens, and a 6-in. focal length, at a flight height of 6,000 ft for a gative scale of 1,000 ft = 1 in. Ground control was furnished by the highway de-rtment engineers. The area was then mapped, by the consultant, with a 5-ft contour terval at a horizontal scale of 200 ft = 1 in. The projected alignment was staked the field by personnel of both the consultant and the highway department, and a pre-se field profile obtained by highway department engineers on this alignment and rnished to the consultant. The consultant obtained the photogrammetric cross-sec-ons with a Benson-Lehner terrain data translator on a Kelsh plotter.

For checking the accuracy of the photogrammetric cross-sections, precise field oss-sections were obtained with a Zeiss self-leveling level at an interval of approxi-ately 1,000 ft. Right angles were turned off each station with a transit, and the stances to all cross-section breaks were measured with a steel chain.

For the earthwork computations of embankment and excavation, as given in Table it was assumed that the distance between each section was 100 ft in horizontal stance. End areas for embankment were computed for a four-lane section of inter-ate highway with a 40-ft median width and approximately a 15-ft average fill at cen-rline of the eastbound lanes. An approximate 10-ft cut at centerline of the eastbound nes was used for the excavation computations. This method gives a thorough check each one-half of the section that would be affected by cut and fill.

Earthwork quantities were computed for (a) the precise field sections, (b) for the adjusted photogrammetric sections, and (c) after each entire photogrammetric cross-ction was "adjusted" either up or down to reduce the centerline elevation difference tween photogrammetric and field to zero (0) (1). Table 1 shows that the larger per-ntages of "difference" between photogrammetric and field quantities and unadjusted otogrammetric quantities were in nearly all instances reduced by "adjusting" the otogrammetric cross-section. This adjustment procedure is easily handled in com-ter programs, and may be a standard procedure if desired.

CONCLUSIONS

The results of this study, as given in Table 1, support the conclusion of Funk (1) at adjustment of photogrammetric surveys by means of an accurate field profile ll materially reduce large localized errors in earthwork quantities.

TABLE I

COMPARISON OF EXCAVATION AND EMBANKMENT QUANTITIES IN CUBIC YARDS AND PERCENT DIFFERENCE

Station	CUBIC YARDS EXCAVATION			Percent Difference From Precise Field		CUBIC YARDS EMBANKMENT			Percent Difference From Precise Field	
	Precise	Photogrammetric		Photogrammetric		Precise	Photogrammetric		Photogrammetric	
	Field	Unadusted	Adjusted	Unadjusted	Adjusted	Field	Unadjusted	Adjusted	Unadjusted	Adjusted
1695										
	6661	7261	6743	+9.00	+1.23	7603	7050	7471	-7.27	-1.74
1703										
	6986	7495	7193	+7.28	+2.96	8144	7726	7967	-5.13	-2.17
1709										
	6264	6677	6470	+6.59	+3.29	7296	6970	7139	-4.52	-2.15
1720										
	7486	7609	7512	+1.64	+0.35	7273	7211	7282	-0.85	+0.12
1730										
	7768	7789	7637	+0.27	-1.69	7481	7539	7573	+0.76	+1.23
1740										
	7355	7135	7229	-2.99	-1.71	7039	7255	7138	+3.07	+1.41
1749										
	9388	8688	9221	-7.46	-1.71	7841	8516	8104	+8.61	+3.35
1760										
	8218	7697	8088	-6.34	-1.58	6244	6783	6437	+8.63	+3.09
1770										
	5953	5659	5804	-4.94	-2.50	4707	4917	4796	+4.46	+1.89
1780										
	7327	7303	7379	-0.33	+0.71	6816	6966	6906	+2.20	+1.32
1790										
	7138	7285	7292	+2.06	+2.16	6835	6895	6871	+0.87	-0.53
1800										
	6357	6580	6525	+3.50	+2.64	6581	6431	6426	-2.28	-2.36
1810										
	6690	6983	6807	+4.38	+1.75	7526	7273	7420	-3.36	-1.41
1820										
	7575	7669	7186	+1.24	-5.14	7449	7258	7663	-2.56	+2.87
1830										
TOTAL	101,166	101,830	101,086	+0.66	-0.08	98,835	98,790	99,193	-0.05	+0.36

NOTE: For earthwork computations the distance between each cross-section taken was assumed to be 100'

The fact that medium-scale photography has provided such relatively small "differences" between field and photogrammetric quantities is of particular interest, because it is not general practice to cross-section from this scale of photography. It is planned at this time to pay staked quantities on this project as based on the photogrammetric cross-sections. This study supports the theory that precise control and good workmanship will produce dependable aerial surveys.

REFERENCE

1. Funk, L. L., "Adjustment of Photogrammetric Surveys." HRB Bull. 228:21-27 (1959).