REPORT ON PRELIMINARY FIELD TESTING OF AIRBORNE SURVEY SYSTEM (ARTY CONCEPT) AT NUI DAT - SOUTH VIETNAM

ANNEX L — Report on Preliminary Field Testing of Airborne Survey System (Arty Concept) at Nui Dat

One of thirteen annexes (A–M) to “War in Vietnam: A Surveyor’s Story”, by Lieutenant Colonel Robert Francis Skitch (Retd), 1934–2026 — Officer Commanding, Detachment 1st Topographical Survey Troop, Nui Dat, 1966–67.

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ANNEX L

R723:1:3

A Sec 1 Topo Svy Tp
NUI DAT

May 67

HQ AFV SAIGON (3)

REPORT ON PRELIMINARY FIELD TESTING OF AIRBORNE SURVEY SYSTEM (ARTY CONCEPT) AT NUI DAT - SOUTH VIETNAM

(Scanned and transcribed from the original)

Refs A. DRA 542-I of I6 Feb 67.
B. Paper submitted by Lt Col D. Tier.

General

1. On receipt of reference A in February 1967 it was decided to carry out a field test of the principle expounded in reference B. The testing was intended to:-

a. Develop a field procedure which could be used in this and other observations of this nature.

b. Determine whether the inherent weaknesses of height measurement by altimetry would negate the resolution of such measurement into the horizontal plane.

c. Determine what modifications might be needed to develop the principle of simultaneous co-ordinated observations to an air station into a practical reality.

2. The testing carried out was limited in extent although sufficient to give some indication of the problems involved and the likely solutions. Observations were carried out on two separate days, the results of the first day being completely abortive and those of the second being sufficient to provide sensible computations.

Procedure

3. The procedure adopted is outlined in Annex A, and this was found to be very suitable and the only modifications necessary were:

a. After day one it became obvious that the helicopter would have to hover as steady as possible with no forward

movement.

b. The number of observations at each air station was reduced from 5 to 3 face left and face right pointings.

Modifications

4. In addition to the principle of fixing the unknown station from a single known station with observations to two air-stations, one on either side of the line between the known and the unknown station, a second known station was introduced into the observations of the first, air-station. This permitted the air-station position to be horizontally triangulated, requiring the altimetric vertical interval principle to be used only in carrying the position from the air-station to the unknown station.

Computations

5. All computations were carried out in plane trigonometrical figures. Separate computations were carried out for face left and face right readings and these meaned. Computations are attached as Annex B.*(omitted)*

Results

6. Co-ordinates of the assumed unknown station obtained, viz, the air-station fixed in the first instance by horizontal triangulation from the two known stations and in the second instance by vertical triangulation from the single known station, are shown in comparison with the known values of the assumed unknown station.

Results of Airborne System of Survey

7.	CO-ORDS	BEARING
Correct value	(E 749 052 (N 1162 131	100° 42′ 07″
Computed from 2 known stations and one air-station	(E 748 944 (N 1162 229	
Computed from one known station and two air-stations	(E 749 206 (N 1162 395	98° 31′ 43″

Analysis of Results

8. The large miscloses on the unknown station are due to:

a. To a greater extent, the imprecision of the principles of altimetry.

b. To a lesser extent the difficulties of intersecting the rotor mast of the helicopter from two or three directions simultaneously, over comparatively short distances.

c. The difficulty in holding the helicopter steady in both the horizontal and the vertical plane at the instant of intersection, without a point of reference on the ground. This aggravated the situation in (b.) above.

Altimetry Discussion

9. It is the opinion of the writer that the principle of altimetry does not offer sufficient precision to allow vertical intervals so measured to be resolved into a horizontal plane. The altimeters used were of WALLACE and TIERNAN (manufacturer) graduated to ten metres. It is possible to interpolate fairly precisely to two metres. The following factors, however, prevent vertical (interval) being measured to this degree of accuracy.

a. The vertical interval between the ground station and the air station is necessarily in the order of 300 - 500 metres, at the horizontal distance of 5000-6000 metres. The barometric datum plane is not likely to be truly horizontal over this range of altitude or distance.

b. Internal pressures within the helicopter make precise measurement of altitude by altimetry difficult. An attempt to calibrate the air station barometer against the ground station barometer was made, with the helicopter hovering with maximum power. This was not necessarily representative of the internal pressures at an altitude of 700 metres.

c. The combined effect of vapour pressure and an air temperature produces an altitude correction of 5% of the vertical interval. It was only possible to measure this with any degree of precision at the ground station, due to the internal influences of the helicopter.

d. Altimeters are affected by a condition known as 'lag' i.e., the altimeter requires time to ‘settle’ after movement, while the internal stresses in the mechanical components ‘take up’. This is especially true when large changes of altitude are effected. The error introduced by 'lag' could conceivably be 10 metres in the vertical interval of 700 metres.

e. The general assumptions applied to altimetry are acceptable only when the vertical interval is kept to a minimum. Generally, for accuracy to be within 5 metres, the maximum vertical interval should be no more than 100 metres.

Even if this interval was possible, error in resolution to horizontal distance would be magnified 50 times, so requiring a precision of better than one metre.

f. At an altitude of 700 metres, errors are magnified 8 times in resolving to the horizontal. To obtain an accuracy of 50 metres in horizontal position, an accuracy of +/-7 metres would be required in measuring the vertical interval. This is not likely to be achieved by altimetry under these conditions, regardless of the mechanical accuracy of the instruments.

Conclusion

10. Although the field testing carried out could not be considered to be exhaustive, when supported by the known facts of altimetry outlined above, it would indicate that sufficient precision to provide a horizontal fixation to an accuracy of +/-20 (metres) is unlikely to be attained. This would require a vertical interval to be measured to better than 2 ½ metres. Even under optimum conditions this accuracy would be difficult to achieve.

Recommendations

It is considered that further testing of the principle developed in reference B is not warranted.

RF Skitch (signed)
Capt· OC
A Sec 1 Topo Svy Tp

AIRBORNE SURVEY CONTROL SYSTEM
PROCEDURE

General

1. Simultaneous hor and vert observations are carried out from two known survey control stations to a hovering or slow moving helicopter (Air Station).

2. The vertical interval between the Air Station and all three ground stations (known and unknown) is measured at the instant of observation by altimetry.

3. At the known stations, the horizontal angle to the air station is read from a known azimuth line and at the unknown station, the horizontal angle to the air station is read from an unknown azimuth line.

4. Vertical observations from the known and unknown ground stations are carried out simultaneously with the horizontal observations to the air station.

5. Co-ordination is carried out by radio with control from the air station.

Procedure

6. All ground station personnel will be positioned and fully ready for observations 15 minutes before the helicopter moves to air station (1). RO lines will be proven during the setting up procedure.

7. Barometers/altimeters and psychrometers will be positioned in the shade.

8. A comparative altimeter reading between the air station altimeter and the unknown ground station altimeter will be carried out before the commencement of the 1st air station observations and after the completion of the 2nd air station observations. This will be effected by having the helicopter hover horizontal with the instrument position approx 100 metres out from the instrument position. The instrument observer will indicate whether the helicopter needs to rise or fall by:

   a. Extending left arm for fall.

   b. Extending right arm for rise.

   c. Extending both arms for 0K.

Altimeters will be read on the command READ given by the ground station.

9. Barometers/Altimeters on the ground stations will be read before and after each set of observations. Altimeter at the air station will be read on each observation. Barometers/Altimeters will be calibrated together at base before and after the task.

10. A set of observations will consist 5 face left and 5 face right observations with the horizontal being closed at the completion of each ½ set. Commands and responses will be as follows:

COMMAND	RESPONSE

a. To determine when station preparation is complete enroute to air station.

81. To all stations-	81A - READY OK OUT
STATION REPORT SIGNALS -	81B - READY OK OUT
OVER.	81C - READY OK OUT

COMMAND	RESPONSE

b. To determine whether helicopter can be sighted.

81. To all stations -	81A ROGER OUT
CAN YOU SEE ME OVER	81B ROGER OUT
	81C NEGATIVE OUT

c. Air station will then proceed towards 81C until 81C reports 'I CAN SEE YOU – OVER'. Other stations keep aligned during this process. Air station will then move back to 1st position.

81. To all stations-	81A ROGER OUT
CAN YOU SEE ME OVER	81B ROGER OUT
	81C ROGER OUT
81. To all stations -	All stations record hor and vert
RECORD HOR AND VERT	angle for recovery.

d. To commence observations. All stations align on RO.

81. To all stations -	81A READY OUT
PREPARE FOR OBSERVATIONS	81B READY OUT
OVER	81C READY OUT

e. 81. To all stations - READ BAROMETERS OVER
81A BAROMERER OUT
81B BAROMETER OUT
81C BAROMETER OUT

f. 81. To all Stations - FACE LEFT ON AIR STATION PREPARE TO READ
81A READY OUT
81B READY OUT
81C READY OUT

g. 81. To all stations - READING NO 1 - 'ONE TWO-THREE-FOUR-MARK' – All stations read and record hor and vert readings. Remember to check alidade bubble. Air station will read altimeter and record. On completion of readings all stations will report.
81A OUT
81B OUT
81C OUT
If any one station finds that a mistake or an accident has occurred he will report: 81A ABORT OVER

h. 81. To all stations - ABORT READING NO 1 READING NO 1 ALPHA 'ONE-TWO-THREE-FOUR-MARK'
81A OUT
81B OUT
81C OUT

i. 81. To all stations - READING NO 2 etc etc to reading No 5
etc etc

j. 81. To all stations - READING NO 5 'ONE-TWO THREE-FOUR-MARK'
81A OUT
81B OUT
81C OUT

k. 81. To all stations - CLOSE HORIZONS AND REPORT
All stations continue swing through 360^0 and re-read RO and report miscloses in seconds of arc

81 A 5 SECONDS OUT
81 B 2 SECONDS OUT
81 C 10 SECONDS OUT

l. If miscloses in excess of 20 seconds occur, set will be aborted and re-observed as follows:

To all stations - ABORT FIRST HALF SET - FACE LEFT ON AIR STATION PREPARE TO READ – OVER
81A READY OUT
81B READY OUT
81C READY OUT

m. Observation of 1st set will then continue. If misclose on 1st

set is satisfactory:

81.	To all stations -	81A OUT
	PLUNGE ON RO	81B OUT
		81C OUT

n. 2nd ½ set will continue in same manner.

81.	To all stations-	81A BAROMETER OUT
	READ BAROMETER OVER	81B BAROMETER OUT
		81C BAROMETER OUT

o.

81.	To all stations-	
	FACE RIGHT ON AIR	81A READY OUT
	STATION – PREPARE TO	81B READY OUT
	READ – OVER	81C READY OUT

p. Procedure will then continue as before. At completion of 2nd set, after miscloses have been verified and barometers read helicopter will proceed to 2nd air station and all observers will keep telescopes on the helicopter during movement. 2nd air station will proceed in same manner as first.

q. 81. To all stations -
PROCEEDING TO SECOND AIR STATION OUT

r. Should any ground station lose the helicopter in the movement the 2nd air station, this station should report immediately:

81B I CANNOT SEE YOU – OUT

s. At completion of 2nd air station comparative altimeter reading between air station and ground station 81C will be carried out as before. At completion of this:

81.	To all stations -	81A ROGER OUT
	END OF OBSERVATIONS	81B ROGER OUT
	RETURN TO BASE OUT	81C ROGER OUT