COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Record No. 1969 / 49

Computer Programs for Turam Ratios and Data Reductions

by

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ILLUSTRATIONS

SUMMARY

Programs TURAMTAB and TURAMBUK were designed to improve the field techniques and data reductions of the Turam electromagnetic method. Both programs have proved successful.

1. INTRODUCTION

In the past, Turam surveys have used only a portion of the area excited by the primary field. Thus, for a primary source loop 4000 feet long, only traverses normal to the central 2400 feet would be used. This was because the theoretical ratios required for the data reductions near the corners of the loop were too difficult to determine. It should be noted that for a given distance from the loop, the field is weaker near the ends of the loop. BMR model tests have shown that reading to the end of a loop is justified (Williams, in preparation). Grounded cables were often used instead of loops because computation of the theoretical fields and ratios was much easier.

Accordingly FORTRAN program TURAMTAB was written to calculate the theoretical ratios for any traverse for a given loop and coil spacing.

Theoretical ratios produced by this program allowed more efficient use of the primary loop and increased the field efficiency, but reduction of the data remained as tedious as ever. FORTRAN program TURAMBUK was then written to facilitate the computation of the data reductions.

The present work is concerned only with ratio measurements. Phase measurements are not treated by these programs.

2. PROGRAM TURAMTAB

This program calculates ratios of theoretical field amplitudes for a specific loop and coil spacing (see Figure 1). The results are printed as reciprocals of the ratios; a sample table is shown in Appendix 1.

One punched card contains the length and width of the loop and the coil spacing, under format 3F10, and supplies data for one set of tables. Additional cards may be inserted if more than one set of tables is required.

The program calculates and prints out the reciprocals of the ratios for traverses commencing at the end of the loop and extending to the centre. The traverse interval is 100 feet if the length of the loop is equal to or less than 5000 feet, and 200 feet if it is greater. (In actual fact the program does not treat dimensions so that the only requirement is that all data units be the same). This limitation of traverse spacing is simply a function of printout limit, i.e. one cannot fit more than 26 columns of this size on a page.

Station spacing in all cases is 25 feet. The length of the traverse is governed by the coil spacing and statement 17 (Appendix 1). The first coil is always at 150 feet from the loop, hence the first station for 50-ft coil spacing is 175 feet and so on. The last position of the first coil is always 2250 feet, hence for 50-ft coil spacing the last station is 2275 feet.

The flow chart and program listing in Appendix 1 should make the operation of the program quite clear.

3. SUBROUTINE SUM

This subroutine calculates the relative field intensity (Z) for a loop XX feet long and YY feet wide at a point DΓ feet from the near side of the loop on a traverse SS feet from the end of the loop (see Figure 1).

Using the parameters defined in Figure 2, the field at a point P due to a line segment AB is

$$Zp = 0.1 \; \frac{\sin\alpha + \sin\beta}{d} \; \text{gauss/amp} \quad \ldots\ldots\ldots\ldots \; (1)$$

where d is in centimetres and α and β are as illustrated in Figure 2.

Figure 3 shows the more general case where

$$Zp = 0.1 \; \frac{\sin\beta - \sin\alpha}{d} \; \text{gauss/amp} \quad \ldots\ldots\ldots\ldots \; (2)$$

To obtain a value for the total field intensity due to a rectangular loop, it is necessary to combine the effects of the four sides of the loop. Figure 4 shows the angles and dimensions that are necessary for these calculations. The sides are numbered 1 to 4, and the fields Z1, Z2, etc., refer to the fields due to these sides at a point P.

<u>Side 1</u>

$$\text{At P, } Z1 = 0.1 \; \frac{\sin\hat{A} + \sin\hat{B}}{DD}$$

$$\text{let } SA = \sin\hat{A} = \frac{SS}{\sqrt{SS^2 + DD^2}}$$

$$\text{let } SB = \sin\hat{B} = \frac{XX - SS}{\sqrt{(XX - SS)^2 + DD^2}}$$

$$\text{If} \quad A = \sqrt{SS^2 + DD^2}$$

$$\text{and} \quad B = XX - SS$$

$$\text{and} \quad C = \sqrt{B^2 + DD^2}$$

where A and B and C are not angles but FORTRAN variables, then the FORTRAN statements to obtain Z1 are as follows:

(To face page 2)

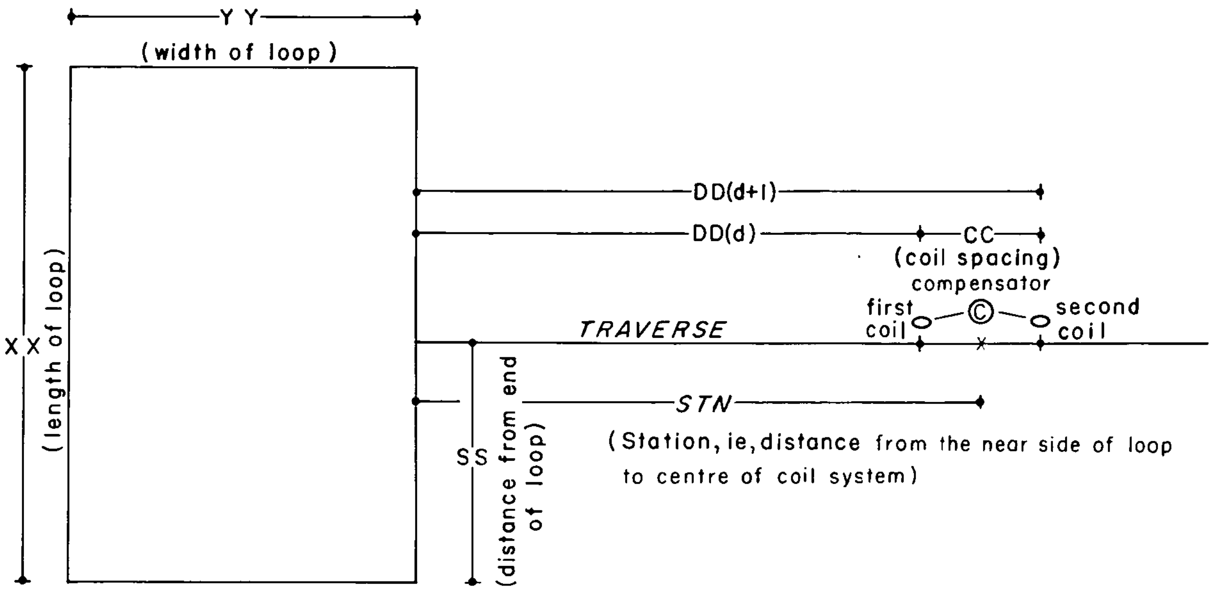


Fig 1 Sketch of Turam system showing the main parameters required for reductions

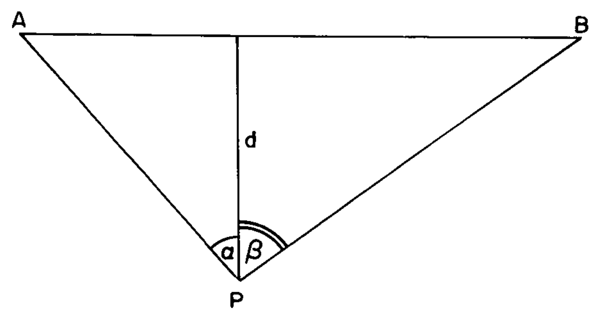


Fig 2 Geometry for equation 1

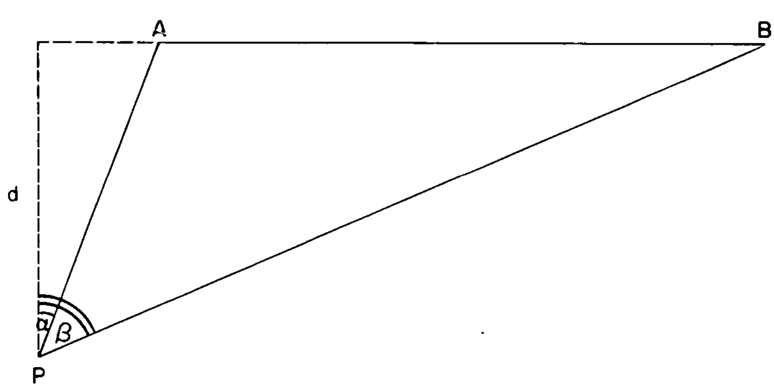


Fig 3 Geometry for equation 2

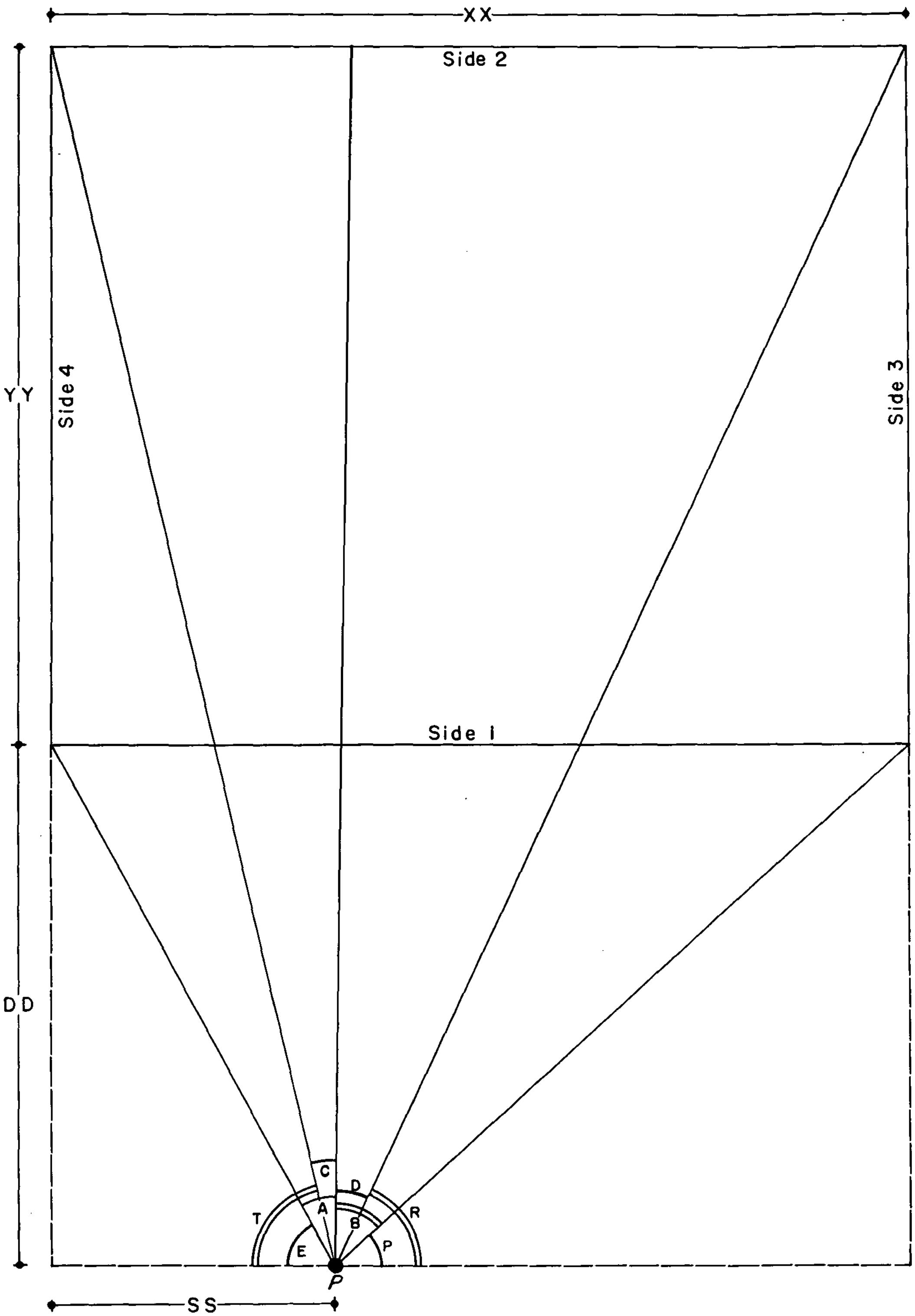


Fig 4 Geometric parameters required to calculate the field intensity at P by SUM

```
A  = SQRT (DD * DD + SS * SS)
B  = XX - SS
C  = SQRT (B * B + DD * DD)
SA = SS/A
SB = B/C
Z1 = (SA + SB) / DD * .1
```

Side 2

$$\text{Now } Z2 = 0.1 \; \frac{\sin \hat{C} + \sin \hat{D}}{YY + DD}$$

$$\text{let } SC = \sin \hat{C} = \frac{SS}{\sqrt{(YY + DD)^2 + SS^2}}$$

$$= SS/F, \text{ for } E = YY + DD \text{ and } F = \sqrt{E^2 + SS^2}$$

$$\text{let } SD = \sin \hat{D} = \frac{XX - SS}{\sqrt{(XX - SS)^2 + (YY + DD)^2}}$$

$$= B/G, \text{ where } G = \sqrt{B^2 + E^2}$$

The additional FORTRAN statements are

```
E  = YY + DD
F  = SQRT (E * E + SS * SS)
G  = SQRT (B * B + E * E)
SC = SS/F
SD = B/G
Z2 = (SC + SD) / DD * .1
```

Side 3

$$\text{Now } Z3 = 0.1 \; \frac{\sin \hat{R} - \sin \hat{P}}{XX - SS}$$

$$\text{let } SR = \sin \hat{R} = \frac{YY + DD}{\sqrt{(YY + DD)^2 + (XX - SS)^2}} = \frac{E}{\sqrt{E^2 + B^2}} = \frac{E}{G}$$

$$SP = \sin \hat{P} = \frac{DD}{\sqrt{(XX - SS)^2 + DD^2}} = \frac{DD}{\sqrt{B^2 + DD^2}} = \frac{DD}{C}$$

The additional FORTRAN statements are

```
SR = E/G
SP = DD/C
Z3 = (SR - SP) / B * .1
```

Side 4

$$\text{Now } Z4 = 0.1 \; \frac{\sin \hat{T} - \sin \hat{E}}{SS}$$

$$\text{let } ST = \sin \hat{T} = \frac{YY + DD}{\sqrt{(YY + DD)^2 + SS^2}} = \frac{E}{\sqrt{E^2 + SS^2}} = \frac{E}{F}$$

$$\text{and } SE = \sin \hat{E} = \frac{DD}{\sqrt{DD^2 + SS^2}} = \frac{DD}{A}$$

The FORTRAN statements are

```
ST = E/F
SE = DD/A
Z4 = (ST - SE) / SS * .1
```

Rectangular loop

The total intensity at P is

Z = Z1 - Z2 - Z3 - Z4

because the direction of the field due to the nearest side is opposite to the directions of the fields due to the other sides (Figure 5).

This derivation requires two further comments. Take the case of Z4 when SS = 0; then we have ST = SE = 1 and Z4 becomes

$$Z4 = \frac{1 - 1}{0} * .1$$

which is meaningless. It can easily be shown that in this case Z4 = 0 and this fact is included in the program to avoid the confusion of 0/0.

Secondly, this program has no mention of units. If XX, YY, and SS are in feet we should have

Z = (Z1 - Z2 - Z3 - Z4) / 30.46 gauss/amp.

However, this is unimportant for ratio calculations and is left out in case the routine is required for calculating the field in other units (e.g. MKS).

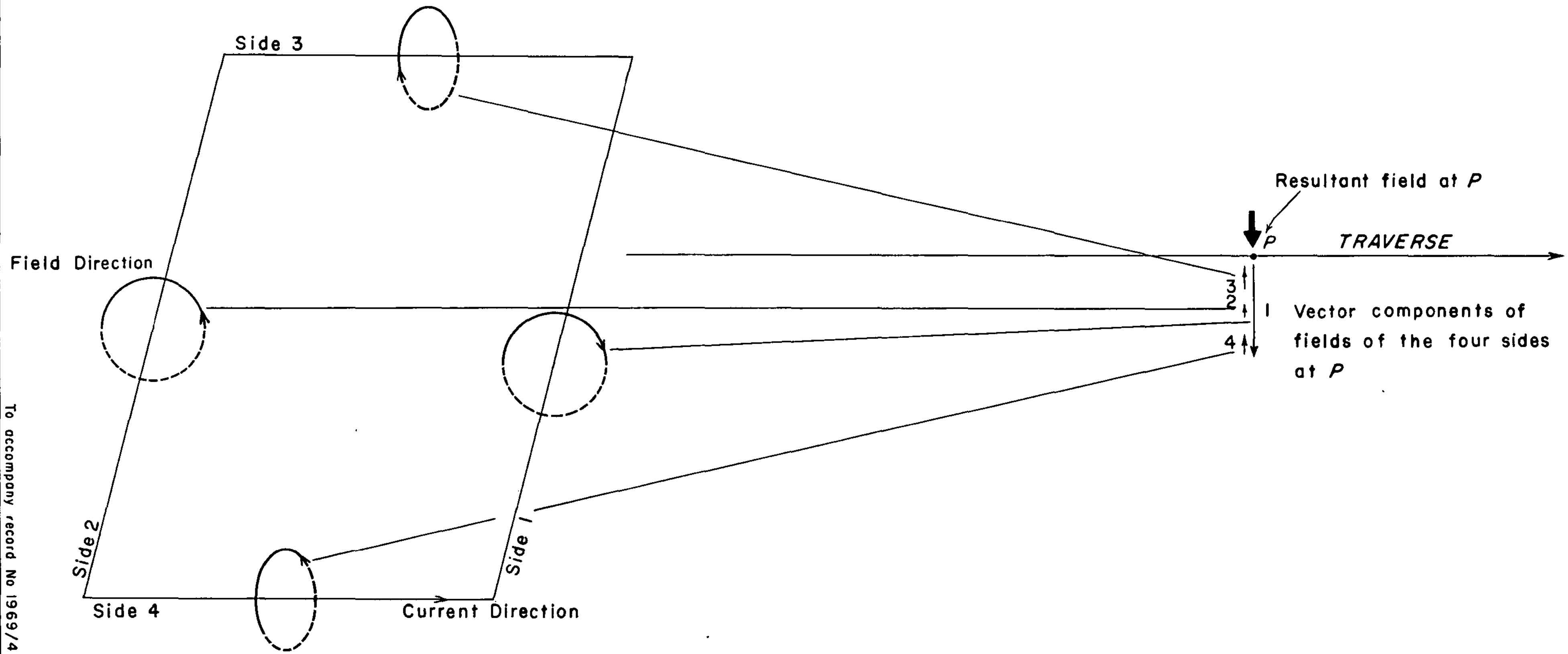


Fig. 5 Schematic illustration of primary field magnetic components from a rectangular loop

(To face page 4)

To accompany record No 1969/49

G29-99

4. PROGRAM TURAMBUK

This program (see Appendix 2) produces a reduction book for a specific traverse, loop, and coil spacing. Each page of the book refers to a particular station on the traverse.

One data card per book is required. This card contains the following information: length of loop, width of loop, coil spacing, and distance of traverse from the end of loop (see Figure 1) under format 4F10.

The station system is the same as in TURAMTAB. The program first calculates the theoretical or normal ratio (RN) for the particular station using SUM, and prints this information and titles at the top of every page. It then produces a table that will give the reduced ratio corresponding to the field ratio measured at the particular station. The series of tables covers a range of reduced ratios from 0.4 (approx.) to 1.4 (approx.). However, in certain cases a reduced ratio of 1.4 would require a field ratio greater than 2.0, which is the upper limit of most field instruments, and in such cases the tables cease at reduced ratio values corresponding to a field ratio of 2.0. A table of differences is given at the bottom of each page (Appendix 2).

The book is used in the following way. The page referring to the appropriate station (i.e. distance from the cable) is selected. The first column gives the unreduced ratio to one significant place. One then moves across the columns at this value to the column containing the value of the second decimal digit. This value plus the difference appropriate to the third decimal digit is the reduced ratio. Thus for a field reading of 1.944 at a station 200 feet from the loop we have (see Appendix 2):

Reduced ratio to one significant place	1.064
Reduced ratio to two significant places	1.087
Reduced ratio to three significant places	1.089

The flow chart of the program is given in Appendix 2.

5. DISCUSSION

The Turam tables (i.e. TURAMTAB output) have improved field efficiency by enabling a greater area to be surveyed with one particular loop. Model test measurements of undisturbed fields have confirmed the computed ratios. The model tests have also shown that Turam measurements on traverses near the end of a loop may be interpreted in the same way as measurements on traverses near the centre of the loop.

Thus, with the aid of these tables, it has been possible to improve field efficiency without detracting from the accuracy of the method. The tables are quite cheap to produce (less than $1 per loop).

When using the Turam reduction tables the author estimates that, with a little practice, reduction time can be reduced to about one quarter of that required to reduce the results with a slide rule.

Computing cost for one Turam book is about $3 (October 1968). The books must be bound in a form suitable for field use. Since at least eight books would be required for a particular loop their production is only recommended for the standard-sized loops.

6. REFERENCE

WILLIAMS, J.P. BMR Turam Model Tests, 1967-8. Bur. Min. Resour. Aust. Rec. (in preparation).

Appendix I

Listing of program TURAMTAB and subroutine SUM

```
      PROGRAM TURAMTAB
      DIMENSION RN(26)
      INTEGER RN,D
    9 READ 1,XX YY,CC
    1 FORMAT(3F10)
      IF(EOF,60)11,10
   10 KK=XX 200+1
      M=1
      KKK=XX 2
      IF(KK.GT 2 )M=2
      JJ=M*100
      PRINT 3,XX YY,CC,(K K=JJ,KKK JJ)
    3 FORMAT( / ,56X,*TURAM  REDUCTION  TABLES*./ ,20X.  *LENGTH  OF  L
     100P  = * F4,* FT* 5X,*WIDTH  OF  LOOP  = *,F4 * FT*,5X,  *COIL  SP
     . 2ACING  = *,F4,* FT*, ,50X,*DISTANCE  FROM  END  OF  LOOP*, ,
     32X, STN*,4X,1H0,2515)
   17 CO 4 D=6 90
      DO 5 L=1 KK,M
      DD=D*25
      SS=(L 1)*J
      CALL SUM (Z,XX YY,DD,SS)
      ZP=Z
      DD=DD+CC
      CALL SUM (Z,XX,.Y DD,SS)
    5 RN(L)=Z.ZP*1000
      STN=DD-CC 2
    4 PRINT 6,STN (RN(L),L=1,KK M)
    6 FORMAT(X,F4 2615)
    7 GO TO 9
   11 END
```

```
      SUBROUTINE SUM (Z XX,YY,CD,SS)
      A=SQRT(CD*DD+SS*SS)
      B=XX SS
      C=SQRT(B*B+DD*DD)
      E=CD-Y
      F=SQRT(E*E+SS*SS)
      G=SQRT(B*B+E*E)
      SA=SS A
      SB=B C
      SC=SS/F
      SD=B G
      SR=E G
      SP=DD.C
      ST=E F
      SE=CD A
      Z1=(SA+SB) D * 1
      Z2=(SC+SD),E* 1
      Z3=(SR-SP) B*.1
      IF(SS.EQ 0)23,24
   23 Z4=0
      GO TO 25
   24 Z4=(ST SE) SS*.1
   25 Z=Z1 Z2 Z3-Z4
      RETURN
      END
```

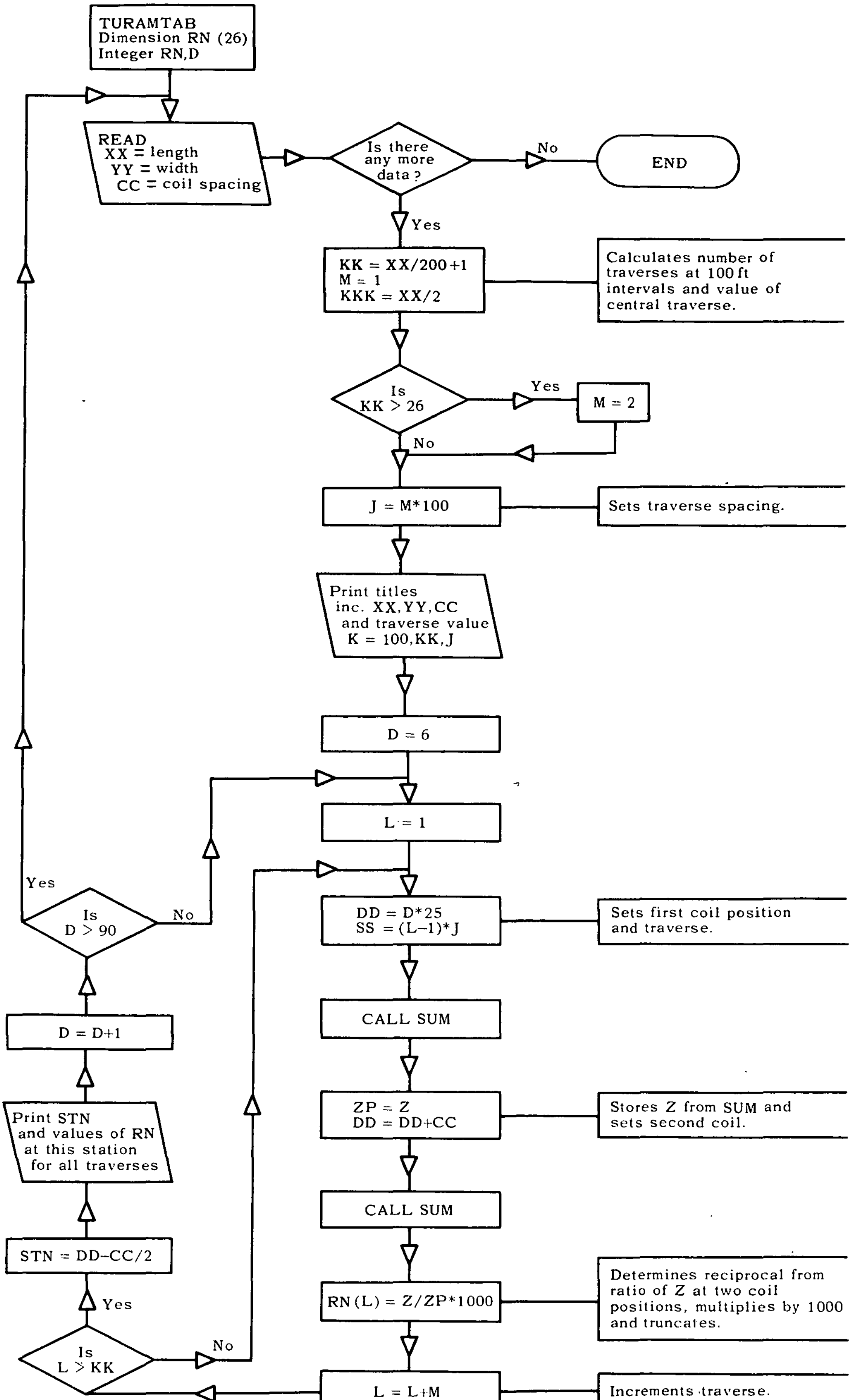
Sample output of TURAMTAB

TURAM REDUCTION TABLES

LENGTH OF LOOP = 4000 FT   WIDTH OF LOOP = 2000 FT   COIL SPACING = 100 FT

DISTANCE FROM END OF LOOP

STN	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
200	569	522	515	521	528	535	540	544	547	550	552	554	555	556	557	558	559	559	559	560	560
225	604	562	553	557	563	569	574	578	581	584	586	588	589	590	591	592	593	593	593	594	594
250	633	595	585	587	592	597	602	606	609	612	614	616	617	619	620	620	621	622	622	622	622
275	657	624	613	613	617	622	626	630	633	636	638	640	641	643	644	645	645	646	646	646	646
300	678	649	637	636	639	643	647	651	654	657	659	661	662	663	664	665	666	666	667	667	667
325	697	670	659	657	659	662	666	669	672	675	677	678	680	681	682	683	684	684	685	685	685
350	713	689	677	675	676	679	682	685	688	690	692	694	696	697	698	699	700	700	700	701	701
375	727	705	694	691	691	694	697	700	702	704	706	708	710	711	712	713	713	714	714	714	715
400	740	720	709	705	705	707	710	712	715	717	719	721	722	723	724	725	726	726	727	727	727
425	751	733	723	719	718	720	722	724	726	728	730	732	733	734	735	736	737	737	738	738	738
450	761	745	735	731	730	731	733	735	737	739	740	742	743	745	746	746	747	747	748	748	748
475	771	755	746	741	740	741	742	744	746	748	750	751	753	754	755	755	756	757	757	757	757
500	779	765	756	751	750	750	752	753	755	757	758	760	761	762	763	764	764	765	765	765	765
525	787	774	765	761	759	759	760	761	763	765	766	767	769	770	771	771	772	772	773	773	773
550	794	782	774	769	767	767	768	769	770	772	773	775	776	777	778	778	779	779	780	780	780
575	801	789	782	777	775	774	775	776	777	779	780	781	782	783	784	785	785	786	786	786	786
600	807	796	789	784	782	781	782	783	784	785	786	787	788	789	790	791	791	792	792	792	792
625	812	802	795	791	789	788	788	789	790	791	792	793	794	795	796	796	797	797	798	798	798
650	818	808	802	797	795	794	794	794	795	796	797	798	799	800	801	802	802	803	803	803	803
675	822	814	807	803	801	800	799	800	801	802	803	803	804	805	806	806	807	807	808	808	808
700	827	819	813	809	806	805	805	805	806	806	807	808	809	810	810	811	812	812	812	812	812
725	831	824	818	814	811	810	810	810	810	811	812	813	813	814	815	815	816	816	816	817	817
750	835	828	822	818	816	815	814	814	815	815	816	817	818	818	819	819	820	820	820	821	821
775	839	832	827	823	821	819	819	819	819	819	820	821	821	822	823	823	824	824	824	824	824
800	843	836	831	827	825	823	823	823	823	823	824	825	825	826	826	827	827	827	828	828	828
825	846	840	835	831	829	827	827	826	827	827	827	828	829	829	830	830	831	831	831	831	831
850	849	843	839	835	833	831	830	830	830	830	831	831	832	833	833	833	834	834	834	834	834
875	853	847	842	839	836	835	834	834	834	834	834	835	835	836	836	837	837	837	837	837	837
900	855	850	846	842	840	838	837	837	837	837	837	838	838	839	839	839	840	840	840	840	840
925	858	853	849	845	843	841	841	840	840	840	840	841	841	842	842	842	843	843	843	843	843
950	861	856	852	849	846	845	844	843	843	843	843	844	844	844	845	845	845	845	846	846	846
975	863	859	855	851	849	848	847	846	846	846	846	846	847	847	847	848	848	848	848	848	848
1000	866	861	857	854	852	850	849	849	848	848	849	849	849	849	850	850	850	850	851	851	851
1025	868	864	860	857	855	853	852	851	851	851	851	851	851	852	852	852	853	853	853	853	853
1050	870	866	862	860	857	856	855	854	854	853	853	854	854	854	854	855	855	855	855	855	855
1075	872	868	865	862	860	858	857	856	856	856	856	856	856	856	857	857	857	857	857	857	857
1100	874	870	867	864	862	861	859	859	858	858	858	858	858	858	859	859	859	859	859	859	859
1125	876	872	869	867	864	863	862	861	861	860	860	860	860	861	861	861	861	861	861	861	861
1150	878	874	871	869	867	865	864	863	863	862	862	862	862	862	863	863	863	863	863	863	863
1175	880	876	873	871	869	867	866	865	865	864	864	864	864	864	865	869	865	865	865	865	865
1200	882	878	875	873	871	869	868	867	867	866	866	866	866	866	866	866	867	867	867	867	867
1225	883	880	877	875	873	871	870	869	869	868	868	868	868	868	868	868	868	868	869	869	869
1250	885	882	879	877	875	873	872	871	870	870	870	870	870	870	870	870	870	870	870	870	870
1275	886	883	881	878	876	875	874	873	872	872	872	871	871	871	872	872	872	872	872	872	872
1300	888	885	882	880	878	877	876	875	874	874	873	873	873	873	873	873	873	873	873	873	873
1325	889	886	884	882	880	878	877	876	876	875	875	875	875	875	875	875	875	875	875	875	875
1350	891	888	885	883	881	880	879	878	877	877	877	876	876	876	876	876	876	876	876	876	876
1375	892	889	887	885	883	882	880	880	879	878	878	878	878	878	878	878	878	878	878	878	878
1400	893	891	888	886	885	883	882	881	880	880	880	879	879	879	879	879	879	879	879	879	879
1425	895	892	890	888	886	885	883	883	882	881	881	881	881	881	880	880	880	880	880	880	880
1450	896	893	891	889	887	886	885	884	883	883	882	882	882	882	882	882	882	882	882	882	882
1475	897	895	892	890	889	887	886	885	885	884	884	884	883	883	883	883	883	883	883	883	883
1500	898	896	894	892	890	889	888	887	886	886	885	885	885	884	884	884	884	884	884	884	884
1525	899	897	895	893	891	890	889	888	887	887	886	886	886	886	886	886	886	886	886	886	886
1550	900	898	896	894	893	891	890	889	889	888	888	887	887	887	887	887	887	887	887	887	887
1575	902	899	897	895	894	893	892	891	890	889	889	889	888	888	888	888	888	888	888	888	888
1600	903	900	898	897	895	894	893	892	891	891	890	890	889	889	889	889	889	889	889	889	889
1625	904	901	899	898	896	895	894	893	892	892	891	891	891	890	890	890	890	890	890	890	890
1650	905	902	901	899	897	896	895	894	893	893	892	892	892	892	891	891	891	891	891	891	891
1675	905	903	902	900	899	897	896	895	895	894	894	893	893	893	892	892	892	892	892	892	892
1700	906	904	903	901	900	898	897	896	896	895	895	894	894	894	894	893	893	893	893	893	893
1725	907	905	904	902	901	899	898	897	897	896	896	895	895	895	895	894	894	894	894	894	894
1750	908	906	905	903	902	900	899	898	898	897	897	896	896	896	896	895	895	895	895	895	895
1775	909	907	905	904	903	901	900	900	899	898	898	897	897	897	897	896	896	896	896	896	896
1800	910	908	906	905	904	902	901	900	900	899	899	898	898	898	897	897	897	897	897	897	897
1825	911	909	907	906	904	903	902	901	901	900	900	899	899	899	898	898	898	898	898	898	898
1850	911	910	908	907	905	904	903	902	902	901	901	900	900	900	899	899	899	899	899	899	899
1875	912	911	909	908	906	905	904	903	903	902	901	901	901	900	900	900	900	900	900	900	900
1900	913	911	910	908	907	906	905	904	903	903	902	902	902	901	901	901	901	901	901	901	901
1925	914	912	911	909	908	907	906	905	904	904	903	903	902	902	902	902	902	902	901	901	901
1950	914	913	911	910	909	908	907	906	905	905	904	904	903	903	903	903	902	902	902	902	902
1975	915	914	912	911	910	909	908	907	906	905	905	905	904	904	904	903	903	903	903	903	903
2000	916	914	913	912	910	909	908	908	907	906	906	905	905	905	904	904	904	904	904	904	904
2025	917	915	914	912	911	910	909	908	908	907	907	906	906	905	905	905	905	905	905	905	905
2050	917	916	914	913	912	911	910	909	908	908	907	907	907	906	906	906	906	906	905	905	905
2075	918	916	915	914	913	912	911	910	909	909	908	908	907	907	907	907	906	906	906	906	906
2100	919	917	916	915	913	912	912	911	910	909	909	908	908	908	908	907	907	907	907	907	907
2125	919	918	916	915	914	913	912	911	911	910	910	909	909	909	908	908	908	908	908	908	908
2150	920	918	917	916	915	914	913	912	912	911	910	910	910	909	909	909	909	909	908	908	908
2175	920	919	918	917	915	915	914	913	912	912	911	911	910	910	910	910	909	909	909	909	909
2200	921	920	918	917	916	915	914	914	913	912	912	911	911	911	910	910	910	910	910	910	910
2225	922	920	919	918	917	916	915	914	914	913	913	912	912	911	911	911	911	911	911	910	910
2250	922	921	920	918	917	917	916	915	914	914	913	913	912	912	912	912	911	911	911	911	911
2275	923	921	920	919	918	917	916	916	915	914	914	913	913	913	912	912	912	912	912	912	912
2300	923	922	921	920	919	918	917	916	916	915	915	914	914	913	913	913	913	913	913	912	912



Appendix 1 cont. TURAMTAB Program Flow Chart

Appendix 2

Listing of program TURAMBUK

```
      PROGRAM TURAMBUK
      DIMENSION T(10),RR(10),DIFF(9),DS(9)
      INTEGER T,DS,D
   17 READ 1,XX,YY,CC,SS
    1 FORMAT(4F10)
      IF(EOF,60)11,10
   10 DO 2,D=6,90
      DD=D*25
      CALL SUM (Z,XX,YY,DD,SS)
      ZP=Z
      DD=DD+CC
      CALL SUM (Z,XX,YY,DD,SS)
      RN=ZP,Z
      STN=DD-CC.2
      PRINT 3,XX,YY,CC SS,RN,STN
    3 FORMAT(1H1  ,/ 18X,*LENGTH  = *,F5,* FT*.3X,*WIDTH  = *,F5,* FT*,
     1/,30X,*COIL  SPACING  = * F4,*FT *.,,18X,*DISTANCE  FROM  END  OF
     2 LOOP  = * F5,* FT* , ,6X,*RN*,F10.3,44X,*STN* F5, ..)
      DO 4  L=1,10
    4 T(L)=L-1
      PRINT 5,(T(L),L=1 10)
    5 FORMAT(8X,10I6, /)
      IFR=RN*5.
      FRSTART=IFR/10.
    9 FS=FRSTART
      I=1
    7 RR(I)=FRSTART*1000/RN
      I=I+1
      FRSTART=FRSTART+0.01
      IF(I.EQ.11)6,7
    6 PRINT 8,FS (RR(I),I=1,10)
    8 FORMAT(6X,F3.1,10F6)
      IF(FS.GT 1.995.AND.FS.LT.2.005)12,18
   18 IF(RR(10).GE 1400)12,9
   12 DO 13 M=1,9
      DIFF(M)=M RN
   13 DS(M)=M
    2 PRINT 14 (DS(M),M=1,9),(DIFF(M),M=1,9)
   14 FORMAT(/ , ,36X,*DIFFERENCES*,./,16X,9I4, /,16X,9F4)
   16 GO TO 17
   11 END
```

Sample output of TURAMBUK

LENGTH = 4000 FT WIDTH = 2000 FT
COIL SPACING = 100FT
DISTANCE FROM END OF LOOP = 2000 FT

RN 1.785 STN 200

	0	1	2	3	4	5	6	7	8	9
0.8	448	454	459	465	471	476	482	487	493	499
0.9	504	510	515	521	527	532	538	543	549	555
1.0	560	566	571	577	583	588	594	599	605	611
1.1	616	622	627	633	639	644	650	655	661	667
1.2	672	678	683	689	695	700	706	711	717	723
1.3	728	734	739	745	751	756	762	767	773	779
1.4	784	790	795	801	807	812	818	823	829	835
1.5	840	846	851	857	863	868	874	879	885	891
1.6	896	902	907	913	919	924	930	935	941	947
1.7	952	958	963	969	975	980	986	991	997	1003
1.8	1008	1014	1019	1025	1031	1036	1042	1047	1053	1059
1.9	1064	1070	1075	1081	1087	1092	1098	1103	1109	1115
2.0	1120	1126	1131	1137	1143	1148	1154	1159	1165	1171

DIFFERENCES

1	2	3	4	5	6	7	8	9
1	1	2	2	3	3	4	4	5

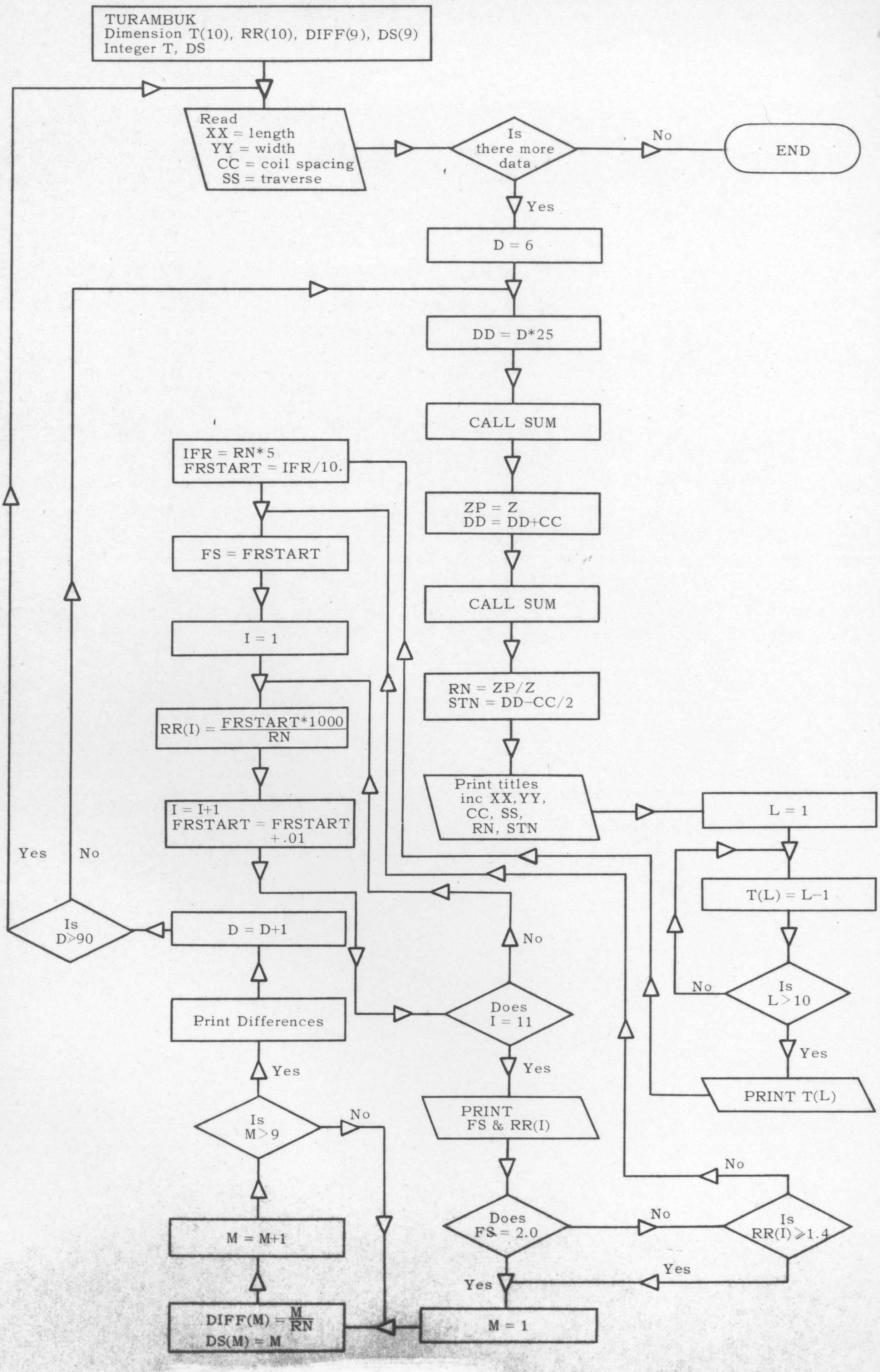
LENGTH = 4000 FT WIDTH = 2000 FT
COIL SPACING = 100FT
DISTANCE FROM END OF LOOP = 2000 FT

RN 1.114 STN 1800

	0	1	2	3	4	5	6	7	8	9
0.5	449	458	467	476	485	494	503	512	521	530
0.6	539	547	556	565	574	583	592	601	610	619
0.7	628	637	646	655	664	673	682	691	700	709
0.8	718	727	736	745	754	763	772	781	790	799
0.9	808	817	826	835	844	853	862	871	880	889
1.0	898	907	915	924	933	942	951	960	969	978
1.1	987	996	1005	1014	1023	1032	1041	1050	1059	1068
1.2	1077	1086	1095	1104	1113	1122	1131	1140	1149	1158
1.3	1167	1176	1185	1194	1203	1212	1221	1230	1239	1248
1.4	1257	1266	1274	1283	1292	1301	1310	1319	1328	1337
1.5	1346	1355	1364	1373	1382	1391	1400	1409	1418	1427

DIFFERENCES

1	2	3	4	5	6	7	8	9
1	2	3	4	4	5	6	7	8



Appendix 2 cont. TURAMBUK Program Flow Chart