BIJLAGEN BIJ RAPPORT R73/7/D

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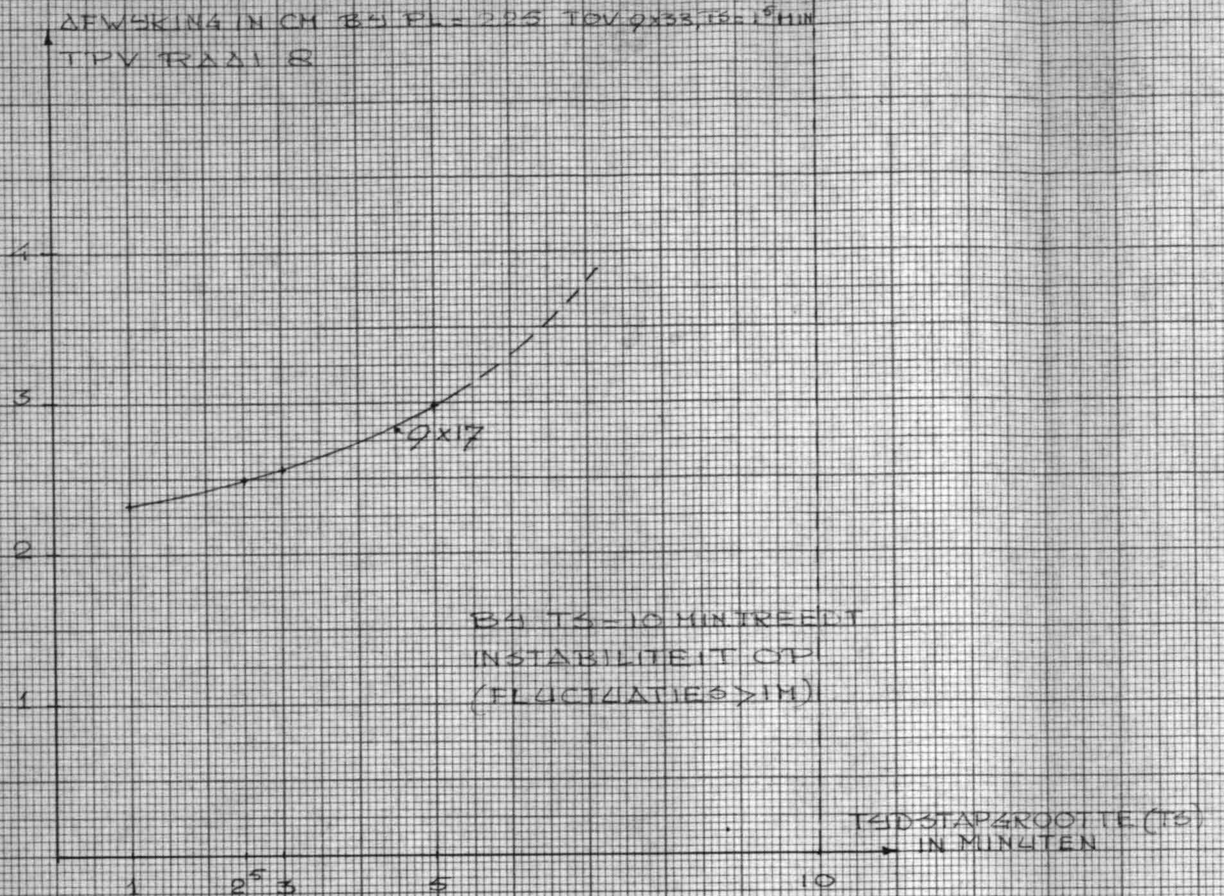
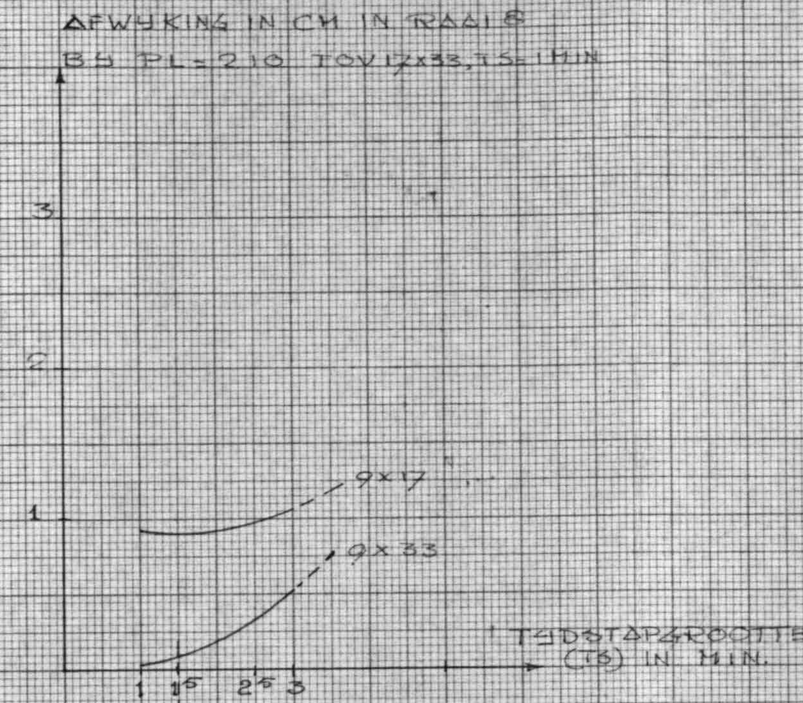
Vloeistofmechanica
Afd. Weg- en Waterbouwkunde
Technische Hogeschool Delft

OVERZICHT VAN DE BIJLAGEN

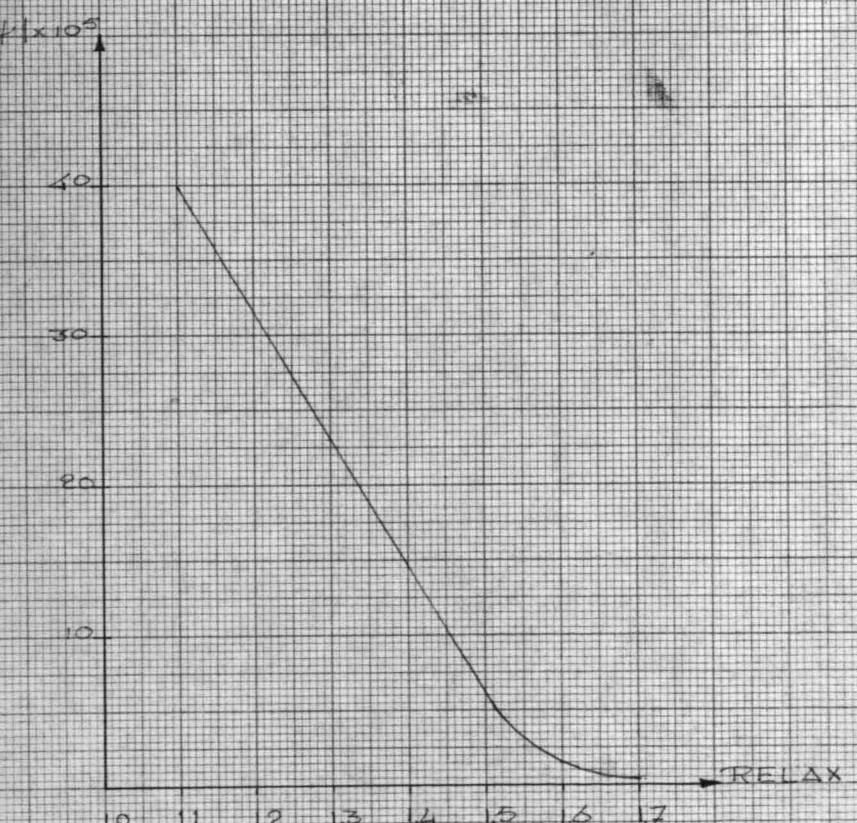
V.1.	Diverse figuren betreffende de nauwkeurigheid in verband met tijdstap grootte, onderverdeling en rekentijd.	
VI.1.	Stroomschema voor de programma's LM6A en LM6B (LM6).	
VI.2.	Computer programma LM6	(7 pagina's)
VI.3.	Computer programma LM6A	(8 pagina's)
VI.4.	Computer programma LM6B	(8 pagina's)
VIII.1A.	Detail van zandblok bij lineaire stijging gedurende 15 minuten.	
VIII.1B.	Detail van zandblok bij lineaire stijging bij time = 15 minuten.	
VIII.2.	Vergelijking van de hoogte van het freatisch vlak in de tijd gedurende 1 uur.	
VIII.3.	Vergelijking van de hoogte van het freatisch vlak in de tijd gedurende 15 minuten.	
VIII.4.	Resultaten van het vrije oppervlak in het zandblok bij lineaire stijging.	
VIII.5.	Resultaten van het vrije oppervlak per raai in de tijd bij lineaire stijging.	
VIII.6.	Resultaten van het vrije oppervlak in het zandblok bij periodieke randvoorwaarde.	
VIII.7.	Resultaten van het vrije oppervlak per raai in de tijd bij periodieke randvoorwaarde.	



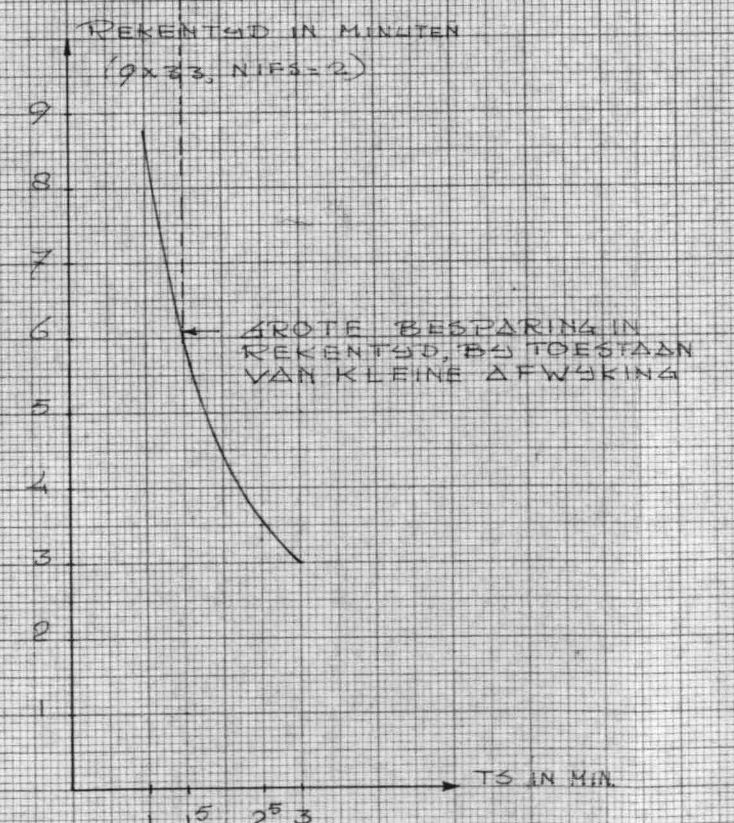
FIGUUR V.5



FIGUUR V.6



FIGUUR V.7 GEBASEERD OP
GEGEVENS ONTLEEND AAN
9x17, TS = 3 MIN, TIME = 0,1 (PL=210)



FIGUUR V.8

BYLAGE V.1

```
            C      FINITE ELEMENT METHOD IN PLANE GROUNDWATER FLOW
            C      PROGRAM 6, A.VERRUIJT, DELFT, HOLLAND, AUGUST 1971
            C
            C      **************************
            C      *                        *
            C      * NON-STEADY FLOW IN DAM *
            C      *      PROGRAM  LM6      *
            C      *                        *
            C      **************************
            C
            C      THIS PROGRAM CALCULATES THE TRANSIENT POSITION OF THE
            C      FREE SURFACE IN A DAM. THE DAM IS BASED UPON A HORIZONTAL
            C      IMPERMEABLE LAYER. ITS LEFT AND RIGHT SIDE SLOPES ARE
            C      STRAIGHT. THE WATER LEVEL AT THE RIGHT SIDE IS CONSTANT,
            C      AND THE WATER LEVEL AT THE LEFT SIDE FLUCTUATES. THE DAM
            C      IS COMPOSED OF A HOMOGENEOUS AND ISOTROPIC POROUS
            C      MATERIAL.
0001               REAL LA
0002               INTEGER CT,ST,TY,TB,TT,TL,TR
0003               DIMENSION CO(400,2),ST(800,3),TY(400),PE(800)
0004               DIMENSION CT(400,12),P(400,12),LA(400)
0005               DIMENSION PHI(400),PSI(400),Q(20),H(20)
0006               DIMENSION NO(3),X(3),Y(3),B(3),C(3),AA(3,3)
0007               DIMENSION BAS(20,2),TOP(20,2),TB(20),TT(20),PB(20),PT(20)
0008               DIMENSION POS(20),SLOPE(20)
0009               READ(5,1) AL,AR
0010             1 FORMAT(2F6.2)
            C      AL IS ANGLE OF LEFT SIDE SLOPE, IN DEGREES.
            C      AR IS ANGLE OF RIGHT SIDE SLOPE, IN DEGREES.
            C      BOTH ANGLES TAKEN WITH RESPECT TO THE HORIZONTAL
            C      BASE, IN COUNTERCLOCKWISE DIRECTION FROM THE
            C      ZERO DIRECTION WHICH POINTS TOWARD THE RIGHT.
0011               READ(5,2) NR,NC
0012             2 FORMAT(2I3)
            C      NR IS NUMBER OF ROWS OF NODES.
            C      NC IS NUMBER OF COLUMNS OF NODES.
0013               READ(5,3) W,PERM,BETA,HH
0014             3 FORMAT(4F12.6)
            C      W IS LENGTH OF HORIZONTAL BASE OF DAM.
            C      PERM IS COEFFICIENT OF PERMEABILITY.
            C      BETA IS EFFECTIVE POROSITY.
            C      HH IS ORIGINAL HEIGHT OF WATER TABLE.
0015               READ(5,4) MAXIT,NTS,NIFS,RELAX,TS
0016             4 FORMAT(3I6,2F12.6)
            C      MAXIT IS NUMBER OF ITERATIONS IN NUMERICAL SOLUTION
            C      (FOR INSTANCE MAXIT=NR+NC).
            C      NTS IS NUMBER OF TIME STEPS.
            C      NIFS IS NUMBER OF ITERATIONS IN CALCULATION OF NEW
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           C      POSITION OF FREE SURFACE (FOR INSTANCE NIFS=2).
           C      RELAX IS OVER-RELAXATION FACTOR (FOR INSTANCE RELAX=1.1).
           C      TS IS TIME STEP.
           C      TO ENSURE STABILITY TS MUST BE SMALL ENOUGH. A POSSIBLE
           C      UPPER BOUND IS BETA*(DELTAX**2)/(2*PERM*HH), WHERE
           C      DELTAX IS THE SMALLEST ELEMENT SIZE NEAR THE FREE
           C      SURFACE.
0017              KLM=0
0018              ITS=0
0019              TIME=0.0
0020              PI=3.141592654
0021              AL=AL*PI/180
0022              AR=AR*PI/180
0023              DW=W/(NC-1)
0024              DO 5 I=1,NC
0025              BAS(I,1)=(I-1)*DW
0026              BAS(I,2)=0.0
0027              TB(I)=1
0028            5 PB(I)=HH
0029              TB(1)=2
0030              TB(NC)=2
0031              A1=HH*COS(AL)/SIN(AL)
0032              A2=W+HH*COS(AR)/SIN(AR)
0033              DW=(A2-A1)/(NC-1)
0034              DO 6 I=1,NC
0035              TOP(I,1)=A1+(I-1)*DW
0036              TOP(I,2)=HH
0037              TT(I)=2
0038            6 PT(I)=HH
0039              TL=2
0040              TR=2
0041              PL=HH
0042              PR=HH
0043              NOD=NR*NC
0044              NEL=2*(NR-1)*(NC-1)
           C      CALCULATION OF STRUCTURE OF ELEMENTS,ST.
0045              L=NC-1
0046              LL=NR-1
0047              DO 30 I=1,L
0048              II=(I-1)*NR+1
0049              DO 30 J=1,LL
0050              JJ=2*(I-1)*LL+2*J-1
0051              JJJ=JJ+1
0052              III=II+J
0053              ST(JJ,1)=III-1
0054              ST(JJ,2)=III+NR-1
0055              ST(JJ,3)=III+NR
0056              ST(JJJ,1)=III-1
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0057              ST(JJJ,2)=III+NR
0058              ST(JJJ,3)=III
0059           30 CONTINUE
            C     END CALCULATION ST.
            C     CALCULATION OF INCLINATION OF COLUMNS.
0060              DO 31 I=1,NC
0061              A1=TOP(I,2)-BAS(I,2)
0062              A2=TOP(I,1)-BAS(I,1)
0063              SLOPE(I)=A2/A1
0064           31 CONTINUE
            C     END CALCULATION INCLINATION OF COLUMNS.
            C     CALCULATION OF TY AND PE.
0065              DO 50 I=1,NOD
0066           50 TY(I)=0
0067              DO 51 I=1,NR
0068              TY(I)=TL
0069           51 TY(NOD+1-I)=TR
0070              DO 52 I=1,NC
0071              J=(I-1)*NR
0072              TY(J+1)=TB(I)
0073           52 TY(J+NR)=TT(I)
0074              DO 53 I=1,NEL
0075           53 PE(I)=PERM
            C     END CALCULATION TY AND PE.
            C     CALCULATION OF NODAL CONTACTS,CT.
            C     CT(I,1)=I, CT(I,J), I=1,...,NOD, J=2,...,CT(I,12) ARE
            C     THE NODAL NUMBERS OF THE NODES THAT ARE IN ONE
            C     ELEMENT WITH NODE I.
0076              DO 280 I=1,NOD
0077              CT(I,1)=I
0078              CT(I,12)=1
0079              K=1
0080              J=1
0081          281 IF(J.GT.NEL) GOTO 280
0082              DO 282 II=1,3
0083              IF(ST(J,II).EQ.I) GOTO 283
0084          282 CONTINUE
0085              GOTO 284
0086          283 DO 285 II=1,3
0087              JJ=ST(J,II)
0088              DO 286 L=1,K
0089              IF(CT(I,L).EQ.JJ) GOTO 285
0090          286 CONTINUE
0091              K=K+1
0092              CT(I,K)=JJ
0093              CT(I,12)=K
0094          285 CONTINUE
0095          284 J=J+1
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```
0096             GOTO 281
0097         280 CONTINUE
          C      END CALCULATION CT.
          C      CALCULATION OF COORDINATES OF NODES,CO.
0098          41 DO 40 I=1,NC
0099             A1=BAS(I,1)
0100             A2=BAS(I,2)
0101             B1=TOP(I,1)-A1
0102             B2=TOP(I,2)-A2
0103             II=(I-1)*NR
0104             DO 40 J=1,NR
0105             III=II+J
0106             AJ=J-1
0107             AN=NR-1
0108             AJN=AJ/AN
0109             CO(III,1)=A1+AJN*B1
0110             CO(III,2)=A2+AJN*B2
0111          40 CONTINUE
          C      END CALCULATION CO.
          C      CALCULATION OF PHI IN FIRST ESTIMATION.
0112             DO 54 I=1,NC
0113             A1=TOP(I,2)
0114             II=(I-1)*NR
0115             DO 54 J=1,NR
0116          54 PHI(II+J)=A1
0117             DO 55 J=1,NR
0118          55 PHI(J)=PL
0119             PHI(NR)=CO(NR,2)
          C      END CALCULATION PHI.
          C      CALCULATION OF INITIAL VALUES OF MATRIX AND LOAD VECTOR.
0120             DO 290 I=1,NOD
0121             LA(I)=0.0
0122             DO 290 J=1,12
0123         290 P(I,J)=0.0
          C      END CALCULATION INITIAL VALUES.
          C      CALCULATION OF MATRIX COEFFICIENTS.
0124             DO 320 I=1,NEL
0125             DO 330 J=1,3
0126         330 NO(J)=ST(I,J)
0127             DO 340 K=1,3
0128             J=NO(K)
0129             X(K)=CO(J,1)
0130         340 Y(K)=CO(J,2)
0131             B(1)=Y(2)-Y(3)
0132             B(2)=Y(3)-Y(1)
0133             B(3)=Y(1)-Y(2)
0134             C(1)=X(3)-X(2)
0135             C(2)=X(1)-X(3)
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          C(3)=X(2)-X(1)
          D=X(1)*B(1)+X(2)*B(2)+X(3)*B(3)
          DDD=2*ABS(D)
          D=PE(I)/DDD
          DO 350 J=1,3
          DO 350 K=1,3
      350 AA(J,K)=(B(J)*B(K)+C(J)*C(K))*D
          DO 360 J=1,3
          JJ=NO(J)
          II=CT(JJ,12)
          DO 370 K=1,II
          DO 380 L=1,3
          IF(NO(L).EQ.CT(JJ,K)) GOTO 390
          GOTO 380
      390 P(JJ,K)=P(JJ,K)+AA(J,L)
          GOTO 370
      380 CONTINUE
      370 CONTINUE
      360 CONTINUE
      320 CONTINUE
C         END CALCULATION MATRIX COEFFICIENTS.
C         GAUSS-SEIDEL ITERATION.
          IT=0
      510 DO 520 I=1,NOD
          IF(TY(I).GT.1) GOTO 520
          CC=LA(I)
          II=CT(I,12)
          DO 530 J=2,II
      530 CC=CC-P(I,J)*PHI(CT(I,J))
          CC=CC/P(I,1)
          CC=PHI(I)-CC
          PHI(I)=PHI(I)-RELAX*CC
      520 CONTINUE
          IT=IT+1
          IF(MAXIT-IT) 540,550,510
      550 CONTINUE
          GOTO 510
      540 CONTINUE
C         END GAUSS-SEIDEL ITERATION.
C         CALCULATION OF NODAL FLOWS.
          DO 401 I=1,NC
          K=I*NR
          Q(I)=0.0
          L=CT(K,12)
          DO 401 J=1,L
      401 Q(I)=Q(I)-P(K,J)*PHI(CT(K,J))
C         END CALCULATION NODAL FLOWS.
C         CALCULATION OF APPARENT EVAPORATION.
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0178          DW=(TOP(2,1)-TOP(1,1))/2
0179          H(1)=Q(1)/DW
0180          L=NC-1
0181          DO 402 I=2,L
0182          DW=(TOP(I+1,1)-TOP(I-1,1))/2
0183      402 H(I)=Q(I)/DW
0184          DW=(TOP(NC,1)-TOP(L,1))/2
0185          H(NC)=Q(NC)/DW
0186          DO 403 J=1,10
0187          A1=(TOP(2,1)-TOP(1,1))/6
0188          H(1)=(Q(1)/A1-H(2))/2
0189          DO 404 I=2,L
0190          A1=(TOP(I+1,1)-TOP(I,1))/6
0191          A2=(TOP(I,1)-TOP(I-1,1))/6
0192          A3=A1+A2
0193      404 H(I)=(Q(I)-A1*H(I+1)-A2*H(I-1))/(2*A3)
0194          A1=(TOP(NC,1)-TOP(L,1))/6
0195      403 H(NC)=(Q(NC)/A1-H(L))/2
        C     END CALCULATION H.
        C     ITERATION OF POSITION OF FREE SURFACE.
0196          II=NC-1
0197          KLM=KLM+1
0198          IF(KLM.GT.1) GOTO 406
0199          DO 405 I=1,NC
0200      405 POS(I)=TOP(I,2)
0201      406 IF(KLM.EQ.NIFS) GOTO 408
0202          DO 407 I=2,II
0203      407 TOP(I,2)=POS(I)+TS*H(I)/(2*BETA)
0204          TOP(1,2)=(POS(1)+PL)/2
0205          GOTO 410
0206      408 CONTINUE
0207          DO 409 I=2,II
0208      409 TOP(I,2)=POS(I)+TS*H(I)/BETA
0209          TOP(1,2)=PL
0210          KLM=0
0211      410 CONTINUE
0212          DO 411 I=1,NC
0213      411 TOP(I,1)=BAS(I,1)+(TOP(I,2)-BAS(I,2))*SLOPE(I)
        C     END ITERATION POSITION FREE SURFACE.
0214          IF(KLM.GT.0) GOTO 41
        C     OUTPUT FREE SURFACE.
0215          IF(ITS.GT.0) GOTO 610
0216          WRITE(6,601)
0217      601 FORMAT(1H1,' FINITE ELEMENT METHOD')
0218          WRITE(6,602)
0219      602 FORMAT(1H ,' PROGRAM LM6')
0220      610 WRITE(6,603) TIME
0221      603 FORMAT(1H1,' TIME =',F12.6)
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0222          WRITE(6,604)
0223      604 FORMAT(1H ,' POSITION OF FREE SURFACE')
0224          DO 605 I=1,NC
0225          WRITE(6,606) TOP(I,1),TOP(I,2)
0226      606 FORMAT(1H ,2F12.6)
0227      605 CONTINUE
        C     END OUTPUT.
        C     TIME STEP.
        C     IN THIS PROGRAM THE WATER LEVEL AT THE LEFT SIDE SLOPE
        C     OF THE DAM, WHICH IS DENOTED BY PL, DECREASES BY HH/20
        C     IN EACH TIME STEP.  FOR OTHER TYPES OF FLUCTUATIONS THIS
        C     PART OF THE PROGRAM MUST BE ADJUSTED.
0228          PL=PL-HH/20
0229          TIME=TIME+TS
0230          ITS=ITS+1
0231          IF(ITS.LT.NTS) GOTO 41
0232          STOP
0233          END
```

```
      C     FINITE ELEMENT METHOD IN PLANE GROUNDWATER FLOW
      C     PROGRAM 6, A. VERRUIJT, DELFT, HOLLAND, AUGUST 1971
      C
      C     ****************************
      C     *                          *
      C     * NON-STEADY FLOW IN DAM   *
      C     *      PROGRAM  LM6 A      *
      C     *                          *
      C     ****************************
      C
      C     THIS PROGRAM CALCULATES THE TRANSIENT POSITION OF THE
      C     FREE SURFACE IN A DAM. THE DAM IS BASED UPON A HORIZONTAL
      C     IMPERMEABLE LAYER. ITS LEFT AND RIGHT SIDE SLOPES ARE
      C     STRAIGHT. THE WATER LEVEL AT THE RIGHT SIDE IS CONSTANT,
      C     AND THE WATER LEVEL AT THE LEFT SIDE FLUCTUATES. THE DAM
      C     IS COMPOSED OF A HOMOGENEOUS AND ISOTROPIC POROUS
      C     MATERIAL
      C     IN THIS PROGRAM LM6 A SOME ADDITIONS ARE MADE TO THE
      C     PROGRAM LM6 BY G.J. VAN EIJK
0001        REAL LA
0002        INTEGER CT,ST,TY,TB,TT,TL,TR
0003        DIMENSION CO(297,2),ST(512,3),TY(297),PE(512)
0004        DIMENSION CT(297,8),P(297,8),LA(297)
0005        DIMENSION PHI(297),PSI(297),Q(33),H(33)
0006        DIMENSION NO(3),X(3),Y(3),B(3),C(3),AA(3,3)
0007        DIMENSION BAS(33,2),TOP(33,2),TB(33),TT(33),PB(33),PT(33)
0008        DIMENSION POS(33),SLOPE(33),FS1(33),FS2(33),Q1(33),Q2(33)
0009        DIMENSION H1(33),H2(33)
0010        READ(5,1) AL,AR
0011      1 FORMAT(2F6.2)
      C     AL IS ANGLE OF LEFT SIDE SLOPE, IN DEGREES.
      C     AR IS ANGLE OF RIGHT SIDE SLOPE, IN DEGREES,
      C     BOTH ANGLES TAKEN WITH RESPECT TO THE HORIZONTAL
      C     BASE, IN COUNTERCLOCKWISE DIRECTION FROM THE
      C     ZERO DIRECTION WHICH POINTS TOWARD THE RIGHT.
0012        READ(5,2) NR,NC
0013      2 FORMAT(2I3)
      C     NR IS NUMBER OF ROWS OF NODES.
      C     NC IS NUMBER OF COLUMNS OF NODES
0014        READ(5,3) W,PERM,BETA,HH
0015      3 FORMAT(4F12.6)
      C     W IS LENGTH OF HORIZONTAL BASE OF DAM
      C     PERM IS COEFFICIENT OF PERMEABILITY
      C     BETA IS EFFECTIVE POROSITY.
      C     HH IS ORIGINAL HEIGHT OF WATER TABLE
0016        READ(5,4) MAXIT,NTS,NIFS,RELAX,TS,EIS
0017      4 FORMAT(3I6,2F12.6,F12.8)
      C     MAXIT IS NUMBER OF ITERATIONS IN NUMERICAL SOLUTION
```

N.B.

| = TOEVOEGING T.O.V. LM6

| = WYZIGING

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      C       (FOR INSTANCE MAXIT=NR+NC).
      C       NTS IS NUMBER OF TIME STEPS
      C       NIFS IS NUMBER OF ITERATIONS IN CALCULATION OF NEW
      C       POSITION OF FREE SURFACE (FOR INSTANCE NIFS=2).
      C       RELAX IS OVER-RELAXATION FACTOR (FOR INSTANCE RELAX=1.1)
      C       TS IS TIME STEP.
      C       EIS IS ALLOWABLE VALUE OF THE DIFFERENCE BETWEEN THE VALUES
      C       PSI AND PHI
      C       TO ENSURE STABILITY TS MUST BE SMALL ENOUGH. A POSSIBLE.
      C       UPPER BOUND IS BETA*(DELTAX**2)/(2*PERM*HH), WHERE
      C       DELTAX IS THE SMALLEST ELEMENT SIZE NEAR THE FREE
      C       SURFACE
0018          KLM=0
0019          ITS=0
0020          TIME=0.0
0021          PI=3.141592654
0022          AL=AL*PI/180
0023          AR=AR*PI/180
0024          DW=W/(NC-1)
0025          DO 5 I=1,NC
0026          BAS(I,1)=(I-1)*DW
0027          BAS(I,2)=0.0
0028          TB(1)=1
0029        5 PB(I)=HH
0030          TB(I)=2
0031          TB(NC)=2
0032          A1=HH*COS(AL)/SIN(AL)
0033          A2=W+HH*COS(AR)/SIN(AR)
0034          DW=(A2-A1)/(NC-1)
0035          DO 6 I=1,NC
0036          TOP(I,1)=A1+(I-1)*DW
0037          TOP(I,2)=HH
0038          TT(I)=2
0039        6 PT(I)=HH
0040          TL=2
0041          TR=2
0042          PL=HH
0043          PR=HH
0044          NOD=NR*NC
0045          NEL=2*(NR-1)*(NC-1)
      C       CALCULATION OF STRUCTURE OF ELEMENTS,ST.
0046          L=NC-1
0047          LL=NR-1
0048          DO 30 I=1,L
0049          II=(I-1)*NR+1
0050          DO 30 J=1,LL
0051          JJ=2*(I-1)*LL+2*J-1
0052          JJJ=JJ+1
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      III=II+J
      ST(JJ,1)=III-1
      ST(JJ,2)=III+NR-1
      ST(JJ,3)=III+NR
      ST(JJJ,1)=III-1
      ST(JJJ,2)=III+NR
      ST(JJJ,3)=III
   30 CONTINUE
C     END CALCULATION ST
C     CALCULATION OF INCLINATION OF COLUMNS
      DO 31 I=1,NC
      A1=TOP(I,2)-BAS(I,2)
      A2=TOP(I,1)-BAS(I,1)
      SLOPE(I)=A2/A1
   31 CONTINUE
C     END CALCULATION INCLINATION OF COLUMNS
C     CALCULATION OF TY AND PE.
      DO 50 I=1,NOD
   50 TY(I)=0
      DO 51 I=1,NR
      TY(I)=TL
   51 TY(NOD+1-I)=TR
      DO 52 I=1,NC
      J=(I-1)*NR
      TY(J+1)=TB(I)
   52 TY(J+NR)=TT(I)
      DO 53 I=1,NEL
   53 PE(I)=PERM
C     END CALCULATION TY AND PE
C     CALCULATION OF NODAL CONTACTS,CT.
C     CT(I,1)=I, CT(I,J), I=1,.  ,NOD, J=2,   ,CT(I,8)  ARE
C     THE NODAL NUMBERS OF THE NODES THAT ARE IN ONE
C     ELEMENT WITH NODE I
      DO 280 I=1,NOD
      CT(I,1)=I
      CT(I,8)=1
      K=1
      J=1
  281 IF(J.GT.NEL) GOTO 280
      DO 282 II=1,3
      IF(ST(J,II).EQ.I) GOTO 283
  282 CONTINUE
      GOTO 284
  283 DO 285 II=1,3
      JJ=ST(J,II)
      DO 286 L=1,K
      IF(CT(I,L).EQ.JJ) GOTO 285
  286 CONTINUE
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      K=K+1
      CT(I,K)=JJ
      CT(I,8)=K
  285 CONTINUE
  284 J=J+1
      GOTO 281
  280 CONTINUE
C     END CALCULATION CT.
C     CALCULATION OF COORDINATES OF NODES,CO
   41 DO 40 I=1,NC
      A1=BAS(I,1)
      A2=BAS(I,2)
      B1=TOP(I,1)-A1
      B2=TOP(I,2)-A2
      II=(I-1)*NR
      DO 40 J=1,NR
      III=II+J
      AJ=J-1
      AN=NR-1
      AJN=AJ/AN
      CO(III,1)=A1+AJN*B1
      CO(III,2)=A2+AJN*B2
   40 CONTINUE
C     END CALCULATION CO.
C     CALCULATION OF PHI IN FIRST ESTIMATION
      DO 54 I=1,NC
      A1=TOP(I,2)
      II=(I-1)*NR
      DO 54 J=1,NR
   54 PHI(II+J)=A1
      DO 55 J=1,NR
   55 PHI(J)=PL
      PHI(NR)=CO(NR,2)
C     END CALCULATION PHI.
C     CALCULATION OF INITIAL VALUES OF MATRIX AND LOAD VECTOR
      DO 290 I=1,NOD
      LA(I)=0.0
      DO 290 J=1,8
  290 P(I,J)=0.0
C     END CALCULATION INITIAL VALUES
C     CALCULATION OF MATRIX COEFFICIENTS
      DO 320 I=1,NEL
      DO 330 J=1,3
  330 NJ(J)=ST(I,J)
      DO 340 K=1,3
      J=NJ(K)
      X(K)=CO(J,1)
  340 Y(K)=CO(J,2)
```

```
      B(1)=Y(2)-Y(3)
      B(2)=Y(3)-Y(1)
      B(3)=Y(1)-Y(2)
      C(1)=X(3)-X(2)
      C(2)=X(1)-X(3)
      C(3)=X(2)-X(1)
      D=X(1)*B(1)+X(2)*B(2)+X(3)*B(3)
      DDD=2*ABS(D)
      D=PE(I)/DDD
      DO 350 J=1,3
      DO 350 K=1,3
  350 AA(J,K)=(B(J)*B(K)+C(J)*C(K))*D
      DO 360 J=1,3
      JJ=NO(J)
      II=CT(JJ,8)
      DO 370 K=1,II
      DO 380 L=1,3
      IF(NO(L).EQ.CT(JJ,K)) GOTO 390
      GOTO 380
  390 P(JJ,K)=P(JJ,K)+AA(J,L)
      GOTO 370
  380 CONTINUE
  370 CONTINUE
  360 CONTINUE
  320 CONTINUE
C     END CALCULATION MATRIX COEFFICIENTS.
C     GAUSS-SEIDEL ITERATION.
      IT=0
      RELAX=1.7
      K=1
  510 DO 520 I=1,NOD
      IF(TY(I).GT.1) GOTO 520
      CC=LA(I)
      II=CT(I,8)
      DO 530 J=2,II
  530 CC=CC-P(I,J)*PHI(CT(I,J))
      CC=CC/P(I,1)
      CC=PHI(I)-CC
      PHI(I)=PHI(I)-RELAX*CC
  520 CONTINUE
      IT=IT+1
      IF (IT.EQ.20 ) RELAX=1.0
      L=5*K
      M=L+1
      IF(IT.EQ.M) GOTO 540
      IF(IT.EQ.L) GOTO 550
      GOTO 510
  550 DO 551 I=1,NOD
```

```
          PSI(I)=PHI(I)
      551 CONTINUE
          GOTO 510
      540 DIG=0.0
          DO 552 I=1,NOD
          DI=ABS(PHI(I)-PSI(I))
          IF(DI.GT.DIG)DIG=DI
      552 CONTINUE
          IF(DIG.LT.EPS) GOTO 553
          IF(IT.GT.MAXIT) GOTO 553
          K=K+1
          GOTO 510
      553 IF(KLM.EQ.0) DIG1=DIG
          IF(KLM.EQ.1) DIG2=DIG
C         END GAUSS-SEIDEL ITERATION
C         CALCULATION OF NODAL FLOWS.
          DO 401 I=1,NC
          K=I*NR
          Q(I)=0.0
          L=CT(K,8)
          DO 401 J=1,L
          Q(I)=Q(I)-P(K,J)*PHI(CT(K,J))
      401 CONTINUE
          DO 415 I=1,NC
          IF(KLM.EQ.0) Q1(I)=Q(I)
          IF(KLM.EQ.1) Q2(I)=Q(I)
      415 CONTINUE
C         END CALCULATION NODAL FLOWS
C         CALCULATION OF APPARENT EVAPORATION.
          DW=(TOP(2,1)-TOP(1,1))/2
          H(1)=Q(1)/DW
          L=NC-1
          DO 402 I=2,L
          DW=(TOP(I+1,1)-TOP(I-1,1))/2
      402 H(I)=Q(I)/DW
          DW=(TOP(NC,1)-TOP(L,1))/2
          H(NC)=Q(NC)/DW
          DO 403 J=1,10
          A1=(TOP(2,1)-TOP(1,1))/6
          H(1)=(Q(1)/A1-H(2))/2
          DO 404 I=2,L
          A1=(TOP(I+1,1)-TOP(I,1))/6
          A2=(TOP(I,1)-TOP(I-1,1))/6
          A3=A1+A2
      404 H(I)=(Q(I)-A1*H(I+1)-A2*H(I-1))/(2*A3)
          A1=(TOP(NC,1)-TOP(L,1))/6
          H(NC)=(Q(NC)/A1-H(L))/2
      403 CONTINUE
```

```
      DO 416 I=1,NC
      IF(KLM.EQ.0) H1(I)=H(I)
      IF(KLM.EQ.1) H2(I)=H(I)
  416 CONTINUE
C     END CALCULATION Ho
C     ITERATION OF POSITION OF FREE SURFACE
      II=NC-1
      KLM=KLM+1
      IF(KLM.GT.1) GOTO 406
      DO 405 I=1,NC
  405 POS(I)=TOP(I,2)
  406 IF(KLM.EQ.NIFS) GOTO 408
      DO 407 I=2,II
  407 TOP(I,2)=POS(I)+TS*H(I)/(2*BETA)
      TOP(1,2)=(POS(1)+PL)/2
      DO 414 I=1,NC
      GOTO (412,413),KLM
  412 FS1(I)=TOP(I,2)
  413 FS2(I)=TOP(I,2)
  414 CONTINUE
      GOTO 410
  408 CONTINUE
      DO 409 I=2,II
  409 TOP(I,2)=POS(I)+TS*H(I)/BETA
      TOP(1,2)=PL
      KLM=0
  410 CONTINUE
      DO 411 I=1,NC
  411 TOP(I,1)=BAS(I,1)+(TOP(I,2)-BAS(I,2))*SLOPE(I)
C     END ITERATION POSITION FREE SURFACE.
      IF(KLM.GT.0) GOTO 41
C     OUTPUT FREE SURFACE.
      IF(ITS.GT.0) GOTO 610
      WRITE(6,601)
  601 FORMAT(1H1,' FINITE ELEMENT METHOD')
      WRITE(6,602)
  602 FORMAT(1H ,' PROGRAM LM6')
  610 WRITE(6,603) TIME
  603 FORMAT(1H1,' TIME =',F12.6)
      WRITE(6,604)
  604 FORMAT(1H ,'NODAL FLOWS AND APPARENT EVAPORATION Q1 Q2 Q
                                                       H1 H2 H
      DO 605 I=1,NC
      WRITE (6,606) Q1(I),Q2(I),Q(I),H1(I),H2(I),H(I)
  606 FORMAT(1H ,6F12.6)
  605 CONTINUE
      WRITE(6,611)
  611 FORMAT(1H1,'FIRST SECOND AND DEFINITE POSITION OF FREE
      DO 613 I=1,NC                                     SURFACE
```

```
      WRITE(6,612) FS1(I),FS2(I),TOP(I,1),TOP(I,2)
  612 FORMAT(1H ,4F12.6)
  613 CONTINUE
      WRITE (6,607) IT
  607 FORMAT(1H0,'AFTER',I5 ,' ITERATIONS THE DIFFERENCE IN THE'
                                                          VALUES
      WRITE (6,608)
  608 FORMAT(1H , 'OF PHI IS APPROXIMATELY')
      WRITE (6,609) DIG1 ,DIG2 ,DIG
  609 FORMAT(1H , 3F12.8)
C     END OUTPUT.
C     TIME STEP
C     IN THIS PROGRAM THE WATER LEVEL AT THE LEFT SIDE SLOPE
C     OF THE DAM, WHICH IS DENOTED BY PL, INCREASES BY HH/120
C     IN EACH TIME STEP,  FOR OTHER TYPES OF FLUCTUATIONS THIS
C     PART OF THE PROGRAM MUST BE ADJUSTED.
      PL=PL+HH/120
      TIME=TIME+TS
      ITS=ITS+1
      IF(ITS.LT.NTS) GOTO 41
      STOP
      END
```

```
      C     FINITE ELEMENT METHOD IN PLANE GROUNDWATER FLOW
      C     PROGRAM 6, A.VERRUIJT, DELFT, HOLLAND, AUGUST 1971
      C
      C     ***************************
      C     *                         *
      C     * NON-STEADY FLOW IN DAM  *
      C     *      PROGRAM  LM6 B     *
      C     *                         *
      C     ***************************
      C
      C     THIS PROGRAM CALCULATES THE TRANSIENT POSITION OF THE
      C     FREE SURFACE IN A DAM. THE DAM IS BASED UPON A HORIZONTAL
      C     IMPERMEABLE LAYER. ITS LEFT AND RIGHT SIDE SLOPES ARE
      C     STRAIGHT. THE WATER LEVEL AT THE RIGHT SIDE IS CONSTANT,
      C     AND THE WATER LEVEL AT THE LEFT SIDE FLUCTUATES. THE DAM
      C     IS COMPOSED OF A HOMOGENEOUS AND ISOTROPIC POROUS
      C     MATERIAL.
      C     IN THIS PROGRAM LM6 B SOME ADDITIONS ARE MADE TO THE
      C     PROGRAM LM6 BY G.J.VAN EIJK
      C     THE DIFFERENCE WITH THE PROGRAM LM6A IS THE POSSIBILITY
      C     TO START FROM A PERMANENT CONDITION,WHILE THE POSITION  OF
      C     THE FREE SURFACE IS GIVEN BY FOR EXAMPLE A DUPUIT PARABOLA
0001        REAL LA
0002        INTEGER CT,ST,TY,TB,TT,TL,TR
0003        DIMENSION CO(297,2),ST(512,3),TY(297),PE(512)
0004        DIMENSION CT(297,8),P(297,8),LA(297)
0005        DIMENSION PHI(297),PSI(297),Q(33),H(33)
0006        DIMENSION NO(3),X(3),Y(3),B(3),C(3),AA(3,3)
0007        DIMENSION BAS(33,2),TOP(33,2),TB(33),TT(33),PB(33),PT(33)
0008        DIMENSION POS(33),SLOPE(33),FS1(33),Q1(33),H1(33)
0009        DIMENSION FSP(33)
0010        READ(5,1) AL,AR
0011      1 FORMAT(2F6.2)
      C     AL IS ANGLE OF LEFT SIDE SLOPE, IN DEGREES.
      C     AR IS ANGLE OF RIGHT SIDE SLOPE, IN DEGREES.
      C     BOTH ANGLES TAKEN WITH RESPECT TO THE HORIZONTAL
      C     BASE, IN COUNTERCLOCKWISE DIRECTION FROM THE
      C     ZERO DIRECTION WHICH POINTS TOWARD THE RIGHT.
0012        READ(5,2) NR,NC
0013      2 FORMAT(2I3)
      C     NR IS NUMBER OF ROWS OF NODES.
      C     NC IS NUMBER OF COLUMNS OF NODES.
0014        READ(5,3) W,PERM,BETA,HH
0015      3 FORMAT(4F12.6)
      C     W IS LENGTH OF HORIZONTAL BASE OF DAM.
      C     PERM IS COEFFICIENT OF PERMEABILITY.
      C     BETA IS EFFECTIVE POROSITY.
      C     HH IS ORIGINAL HEIGHT OF WATER TABLE.
```

N.B.

| = TOEVOEGING T.O.V. LM6

| = WYZIGING

BYLAGE VI.4

```
      READ(5,4) MAXIT,NTS,NIFS,RELAX,TS,EIS
    4 FORMAT(3I6,2F12.6,F12.8)
C     MAXIT IS NUMBER OF ITERATIONS IN NUMERICAL SOLUTION
C     (FOR INSTANCE MAXIT=NR+NC).
C     NTS IS NUMBER OF TIME STEPS.
C     NIFS IS NUMBER OF ITERATIONS IN CALCULATION OF NEW
C     POSITION OF FREE SURFACE (FOR INSTANCE NIFS=2).
C     RELAX IS OVER-RELAXATION FACTOR (FOR INSTANCE RELAX=1.1).
C     TS IS TIME STEP.
C     EIS IS ALLOWABLE VALUE OF THE DIFFERENCE BETWEEN THE VALUES
C     PSI AND PHI
C     TO ENSURE STABILITY TS MUST BE SMALL ENOUGH. A POSSIBLE
C     UPPER BOUND IS BETA*(DELTAX**2)/(2*PERM*HH), WHERE
C     DELTAX IS THE SMALLEST ELEMENT SIZE NEAR THE FREE
C     SURFACE.
      READ(5,7) (FSP(I) ,I=1,NC)
    7 FORMAT(9F8.6)
C     FSP(I)= FREE SURFACE BY THE START FROM A PERMANENT CONDITION
C     WHILE THE PROGRAM LM6 NORMALLY STARTS FROM A HORIZONTAL LEVE
      KLM=0
      ITS=0
      TIME=0.0
      PI=3.141592654
      AL=AL*PI/180
      AR=AR*PI/180
      DW=W/(NC-1)
      DO 5 I=1,NC
      BAS(I,1)=(I-1)*DW
      BAS(I,2)=0.0
      TB(I)=1
    5 PB(I)=FSP(I)
      TB(1)=2
      TB(NC)=2
      A1=FSP(1)*COS(AL)/SIN(AL)
      A2=W+HH*COS(AR)/SIN(AR)
      DW=(A2-A1)/(NC-1)
      DO 6 I=1,NC
      TOP(I,1)=A1+(I-1)*DW
      TOP(I,2)=FSP(I)
      TT(I)=2
    6 PT(I)=FSP(I)
      TL=2
      TR=2
      PL=FSP(1)
      PR=HH
      NOD=NR*NC
      NEL=2*(NR-1)*(NC-1)
C     CALCULATION OF STRUCTURE OF ELEMENTS,ST.
```

```
              L=NC-1
              LL=NR-1
              DO 30 I=1,L
              II=(I-1)*NR+1
              DO 30 J=1,LL
              JJ=2*(I-1)*LL+2*J-1
              JJJ=JJ+1
              III=II+J
              ST(JJ,1)=III-1
              ST(JJ,2)=III+NR-1
              ST(JJ,3)=III+NR
              ST(JJJ,1)=III-1
              ST(JJJ,2)=III+NR
              ST(JJJ,3)=III
           30 CONTINUE
C             END CALCULATION ST.
C             CALCULATION OF INCLINATION OF COLUMNS.
              DO 31 I=1,NC
              A1=TOP(I,2)-BAS(I,2)
              A2=TOP(I,1)-BAS(I,1)
              SLOPE(I)=A2/A1
           31 CONTINUE
C             END CALCULATION INCLINATION OF COLUMNS.
C             CALCULATION OF TY AND PE.
              DO 50 I=1,NOD
           50 TY(I)=0
              DO 51 I=1,NR
              TY(I)=TL
           51 TY(NOD+1-I)=TR
              DO 52 I=1,NC
              J=(I-1)*NR
              TY(J+1)=TB(I)
           52 TY(J+NR)=TT(I)
              DO 53 I=1,NEL
           53 PE(I)=PERM
C             END CALCULATION TY AND PE.
C             CALCULATION OF NODAL CONTACTS,CT.
C             CT(I,1)=I, CT(I,J), I=1,...,NOD, J=2,...,CT(I,8)  ARE
C             THE NODAL NUMBERS OF THE NODES THAT ARE IN ONE
C             ELEMENT WITH NODE I.
              DO 230 I=1,NOD
              CT(I,1)=I
              CT(I,8)=1
              K=1
              J=1
          281 IF(J.GT.NEL) GOTO 280
              DO 282 II=1,3
              IF(ST(J,II).EQ.I) GOTO 283
```

```
0087          282 CONTINUE
0088              GOTO 284
0089          283 DO 285 II=1,3
0090              JJ=ST(J,II)
0091              DO 286 L=1,K
0092              IF(CT(I,L).EQ.JJ) GOTO 285
0093          286 CONTINUE
0094              K=K+1
0095              CT(I,K)=JJ
0096              CT(I,8)=K
0097          285 CONTINUE
0098          284 J=J+1
0099              GOTO 281
0100          280 CONTINUE
            C     END CALCULATION CT.
            C     CALCULATION OF COORDINATES OF NODES,CO.
0101           41 DO 40 I=1,NC
0102              A1=BAS(I,1)
0103              A2=BAS(I,2)
0104              B1=TOP(I,1)-A1
0105              B2=TOP(I,2)-A2
0106              II=(I-1)*NR
0107              DO 40 J=1,NR
0108              III=II+J
0109              AJ=J-1
0110              AN=NR-1
0111              AJN=AJ/AN
0112              CO(III,1)=A1+AJN*B1
0113              CO(III,2)=A2+AJN*B2
0114           40 CONTINUE
            C     END CALCULATION CO.
            C     CALCULATION OF PHI IN FIRST ESTIMATION.
0115              DO 54 I=1,NC
0116              A1=TOP(I,2)
0117              II=(I-1)*NR
0118              DO 54 J=1,NR
0119           54 PHI(II+J)=A1
0120              DO 55 J=1,NR
0121           55 PHI(J)=PL
0122              PHI(NR)=CO(NR,2)
            C     END CALCULATION PHI. .
            C     CALCULATION OF INITIAL VALUES OF MATRIX AND LOAD VECTOR.
0123              DO 290 I=1,NOD
0124              LA(I)=0.0
0125              DO 290 J=1,8
0126          290 P(I,J)=0.0
            C     END CALCULATION INITIAL VALUES.
            C     CALCULATION OF MATRIX COEFFICIENTS.
```

```
      DO 320 I=1,NEL
      DO 330 J=1,3
  330 NO(J)=ST(I,J)
      DO 340 K=1,3
      J=NO(K)
      X(K)=CO(J,1)
  340 Y(K)=CO(J,2)
      B(1)=Y(2)-Y(3)
      B(2)=Y(3)-Y(1)
      B(3)=Y(1)-Y(2)
      C(1)=X(3)-X(2)
      C(2)=X(1)-X(3)
      C(3)=X(2)-X(1)
      D=X(1)*B(1)+X(2)*B(2)+X(3)*B(3)
      DDD=2*ABS(D)
      D=PE(I)/DDD
      DO 350 J=1,3
      DO 350 K=1,3
  350 AA(J,K)=(B(J)*B(K)+C(J)*C(K))*D
      DO 360 J=1,3
      JJ=NO(J)
      II=CT(JJ,8)
      DO 370 K=1,II
      DO 380 L=1,3
      IF(NO(L).EQ.CT(JJ,K)) GOTO 390
      GOTO 380
  390 P(JJ,K)=P(JJ,K)+AA(J,L)
      GOTO 370
  380 CONTINUE
  370 CONTINUE
  360 CONTINUE
  320 CONTINUE
C     END CALCULATION MATRIX COEFFICIENTS.
C     GAUSS-SEIDEL ITERATION.
      IT=0
      RELAX=1.7
      K=2
  510 DO 520 I=1,NOD
      IF(TY(I).GT.1) GOTO 520
      CC=LA(I)
      II=CT(I,8)
      DO 530 J=2,II
  530 CC=CC-P(I,J)*PHI(CT(I,J))
      CC=CC/P(I,1)
      CC=PHI(I)-CC
      PHI(I)=PHI(I)-RELAX*CC
  520 CONTINUE
      IT=IT+1
```

```
          IF (IT.EQ.20 ) RELAX=1.0
          L=5*K
          M=L+1
          IF(IT.EQ.M) GOTO 540
          IF(IT.EQ.L) GOTO 550
          GOTO 510
      550 DO 551 I=1,NOD
          PSI(I)=PHI(I)
      551 CONTINUE
          GOTO 510
      540 DIG=0.0
          DO 552 I=1,NOD
          DI=ABS(PHI(I)-PSI(I))
          IF(DI.GT.DIG)DIG=DI
      552 CONTINUE
          IF(DIG.LT.EIS) GOTO 553
          IF(IT.GT.MAXIT) GOTO 553
          K=K+1
          GOTO 510
      553 IF(KLM.EQ.0) DIG1=DIG
C         END GAUSS-SEIDEL ITERATION.
C         CALCULATION OF NODAL FLOWS.
          DO 401 I=1,NC
          K=I*NR
          Q(I)=0.0
          L=CT(K,8)
          DO 401 J=1,L
          Q(I)=Q(I)-P(K,J)*PHI(CT(K,J))
      401 CONTINUE
          DO 415 I=1,NC
          IF(KLM.EQ.0) Q1(I)=Q(I)
      415 CONTINUE
C         END CALCULATION NODAL FLOWS.
C         CALCULATION OF APPARENT EVAPORATION.
          DW=(TOP(2,1)-TOP(1,1))/2
          H(1)=Q(1)/DW
          L=NC-1
          DO 402 I=2,L
          DW=(TOP(I+1,1)-TOP(I-1,1))/2
      402 H(I)=Q(I)/DW
          DW=(TOP(NC,1)-TOP(L,1))/2
          H(NC)=Q(NC)/DW
          DO 403 J=1,10
          A1=(TOP(2,1)-TOP(1,1))/6
          H(1)=(Q(1)/A1-H(2))/2
          DO 404 I=2,L
          A1=(TOP(I+1,1)-TOP(I,1))/6
          A2=(TOP(I,1)-TOP(I-1,1))/6
```

```
          A3=A1+A2
      404 H(I)=(Q(I)-A1*H(I+1)-A2*H(I-1))/(2*A3)
          A1=(TOP(NC,1)-TOP(L,1))/6
          H(NC)=(Q(NC)/A1-H(L))/2
      403 CONTINUE
          DO 416 I=1,NC
          IF(KLM.EQ.0) H1(I)=H(I)
      416 CONTINUE
C         END CALCULATION H.
C         ITERATION OF POSITION OF FREE SURFACE.
          II=NC-1
          KLM=KLM+1
          IF(KLM.GT.1) GOTO 406
          DO 405 I=1,NC
      405 POS(I)=TOP(I,2)
      406 IF(KLM.EQ.NIFS) GOTO 408
          DO 407 I=2,II
      407 TOP(I,2)=POS(I)+TS*H(I)/(2*BETA)
          TOP(1,2)=(POS(1)+PL)/2
          DO 414 I=1,NC
          IF(KLM.EQ.1) FS1(I)=TOP(I,2)
      414 CONTINUE
          GOTO 410
      408 CONTINUE
          DO 409 I=2,II
      409 TOP(I,2)=POS(I)+TS*H(I)/BETA
          TOP(1,2)=PL
          KLM=0
      410 CONTINUE
          DO 411 I=1,NC
      411 TOP(I,1)=BAS(I,1)+(TOP(I,2)-BAS(I,2))*SLOPE(I)
C         END ITERATION POSITION FREE SURFACE.
          IF(KLM.GT.0) GOTO 41
C         OUTPUT FREE SURFACE.
          IF(ITS.GT.0) GOTO 610
          WRITE(6,601)
      601 FORMAT(1H1,' FINITE ELEMENT METHOD')
          WRITE(6,602)
      602 FORMAT(1H ,' PROGRAM LM6')
      610 WRITE(6,603) TIME
      603 FORMAT(1H1,' TIME =',F12.6)
          WRITE(6,604)
      604 FORMAT(1H ,'NODAL FLOWS AND APPARENT EVAPORATION Q1 Q H1 H
          DO 605 I=1,NC
          WRITE (6,606) Q1(I),Q(I),H1(I),H(I)
      606 FORMAT(1H ,4F12.6)
      605 CONTINUE
          WRITE(6,611)
```

```
      611 FORMAT(1H1,'FIRST AND DEFINITE POSITION OF FREE SURFACE')
          DO 613 I=1,NC
          WRITE(6,612) FS1(I),TOP(I,1),TOP(I,2)
      612 FORMAT(1H ,3F12.6)
      613 CONTINUE
          WRITE (6,607) IT
      607 FORMAT(1H0,'AFTER',I5 ,' ITERATIONS THE DIFFERENCE IN THE VALUES')
          WRITE (6,608)
      608 FORMAT(1H , 'OF PHI IS APPROXIMATELY')
          WRITE (6,609) DIG1 ,DIG
      609 FORMAT(1H , 2F12.8)
C         END OUTPUT.
C         TIME STEP.
C         IN THIS PROGRAM THE WATER LEVEL AT THE LEFT SIDE SLOPE
C         OF THE DAM, WHICH IS DENOTED BY PL, INCREASES BY A COSINUS
C         IN EACH TIME STEP.  FOR OTHER TYPES OF FLUCTUATIONS THIS
C         PART OF THE PROGRAM MUST BE ADJUSTED.
          TIME=TIME+TS
          PL=HH-HH/3*COS(TIME*PI/6)
          ITS=ITS+1
          IF(ITS.LT.NTS) GOTO 41
          STOP
          END
```

GRONDWATERSTROMING DOOR EEN DAM MET EEN LINEAIR (LM6A) OF PERIODIEK (LM6B) BEWEGENDE RANDVOORWAARDE

STROOMSCHEMA VAN HET PROGRAMMA LM6A

VOOR HET PROGRAMMA LM6B DIENEN EEN AANTAL STATEMENTS VERVANGEN TE WORDEN DOOR TUSSEN HAAKJES BYGEPLAATSTE STATEMENTS, TERWYL DOOR GEBROKEN LYNEN OMGRENSDE STATEMENTS KOMEN TE VERVALLEN

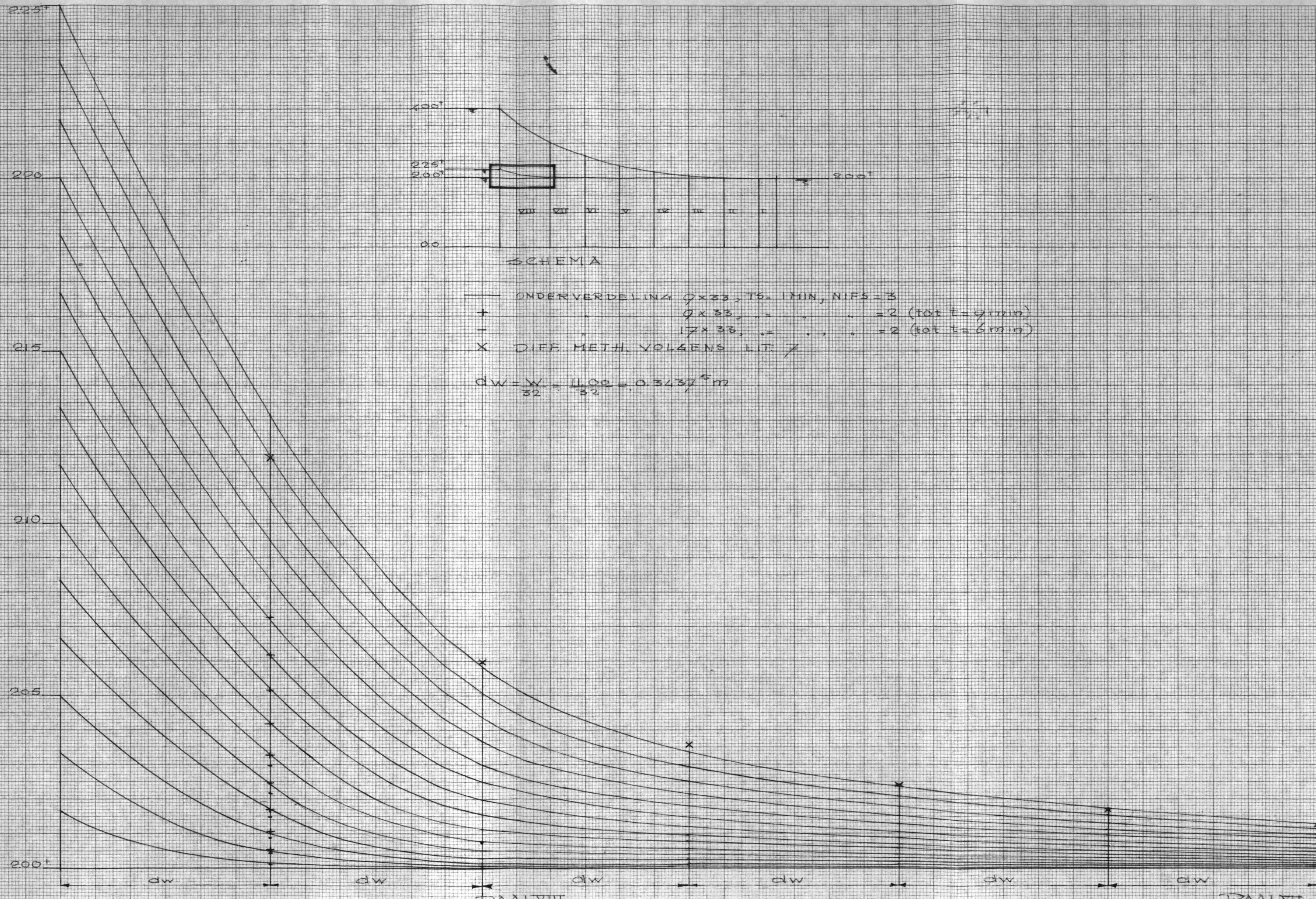
BYLAGE VI.1

GET. DOOR G.J. VAN ESK

T. b. v.

lab. bibl.

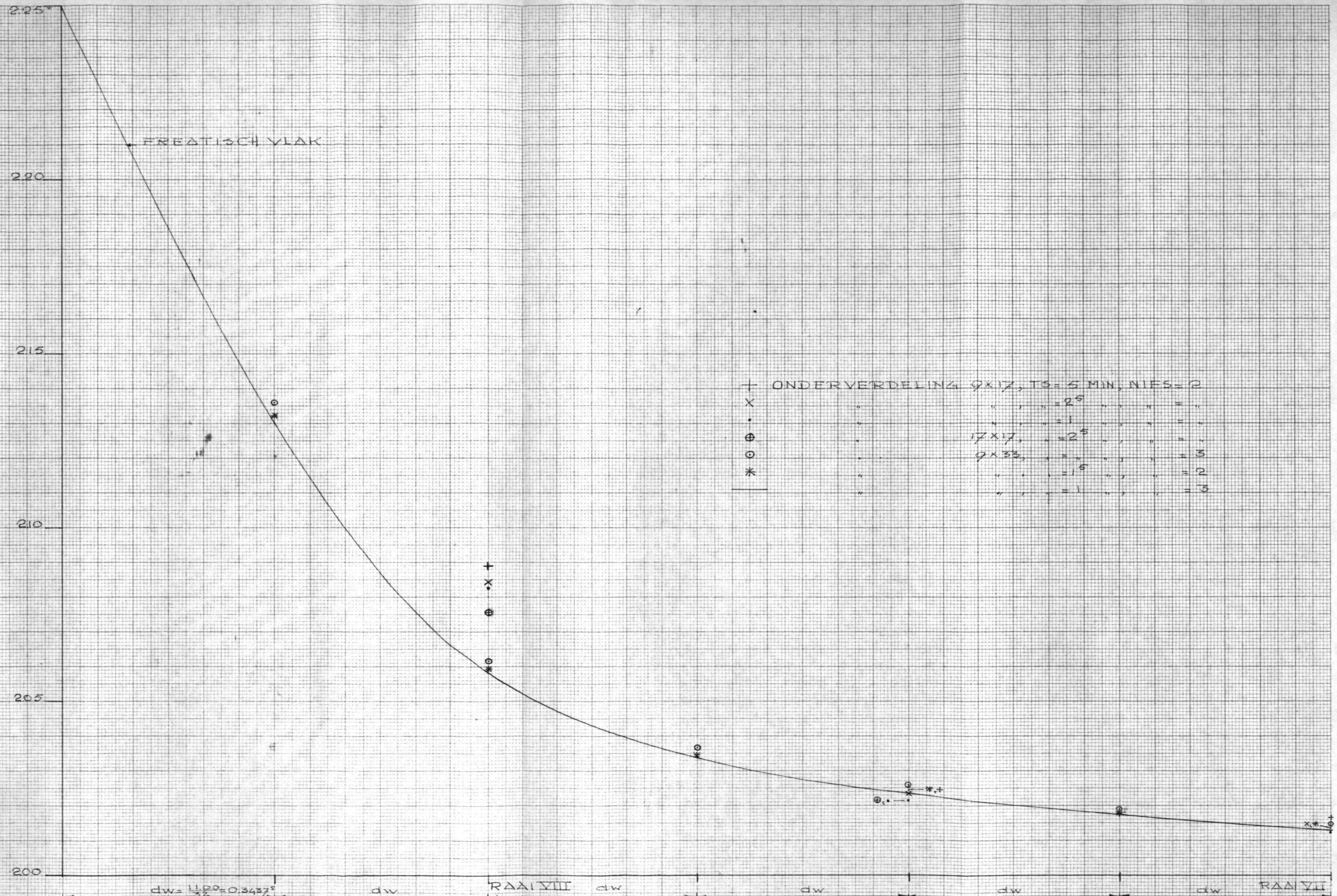
Kees Verspuy



VERLOOP FREATISCH VLAK IN OHLYSTE GEDEELTE VAN HET ZANDBLOK GEDURENDE HET EERSTE KWARTIER

BIJ LINEAIR STIJGENDE RANDVOORWAARDE

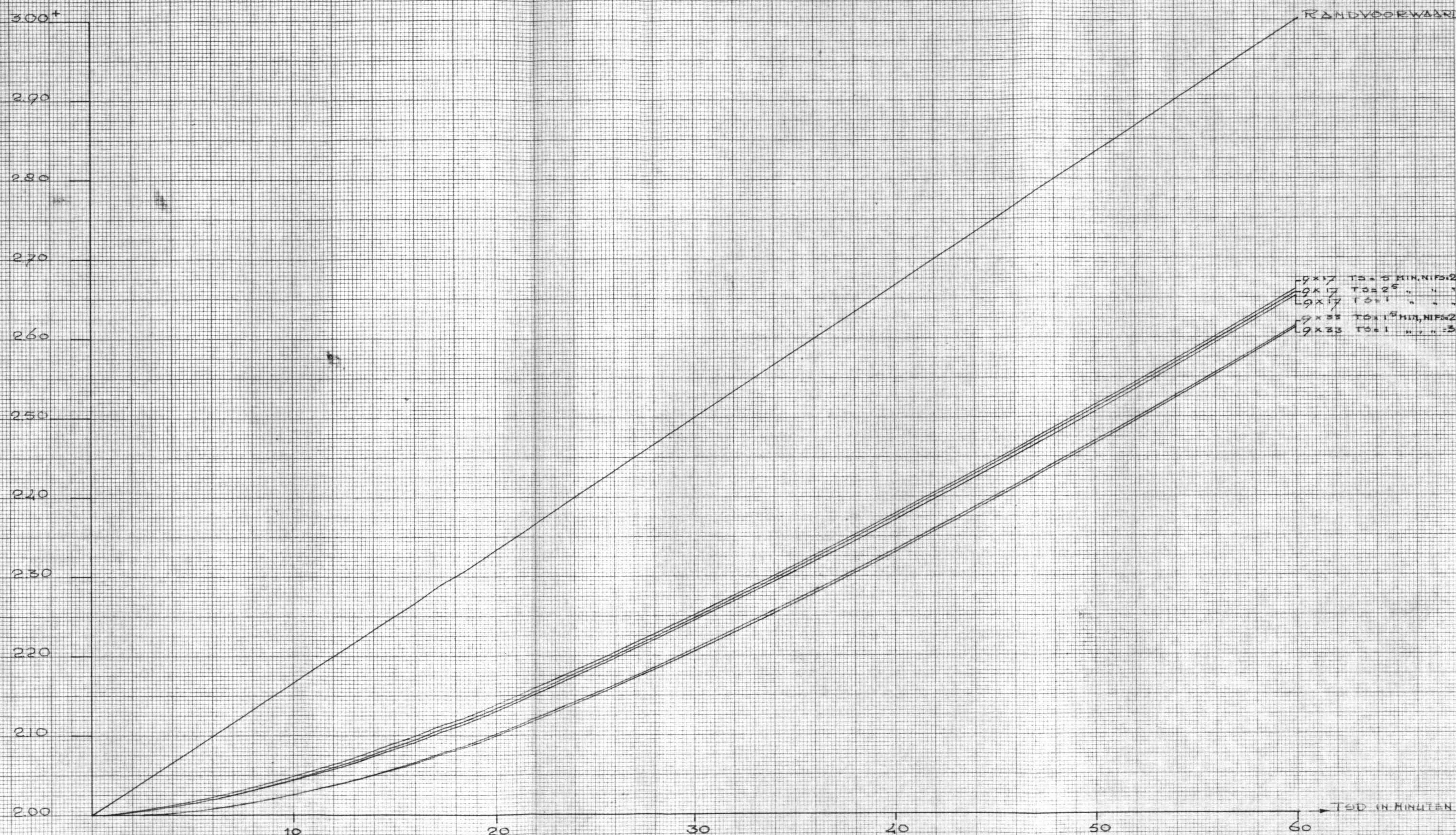
BIJLAGE VIII.1A



HET RESULTAAT VAN VERSCHILLENDE ONDERVERDELINGEN VERGELEKEN MET 9×33, TS= 1MIN, NIES=3 OP TIJDSTIP t= 15 MIN

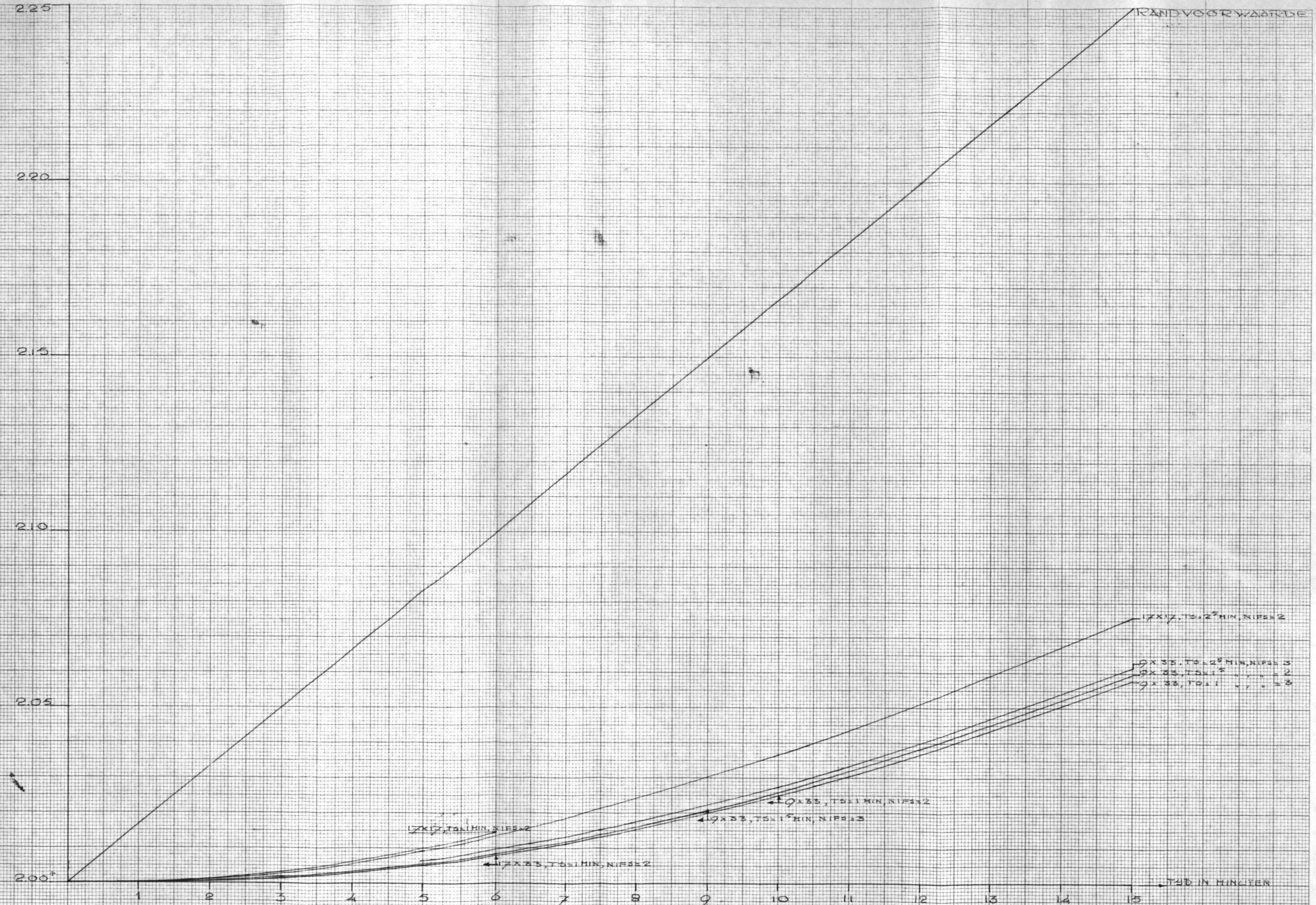
BIJ LINEAIR STIJGENDE RANDVOORWAARDE

BIJLAGE VIII.1B



VERLOOP VAN DE HOOGTE VAN HET FREATISCH VLAK IN RAAI VIII BIJ LINEAIR STIJGENDE RANDVOORWAARDE BIJ VARIATIE VAN ONDERVERDELING, TIJDSTAPGROOTTE EN NIFS

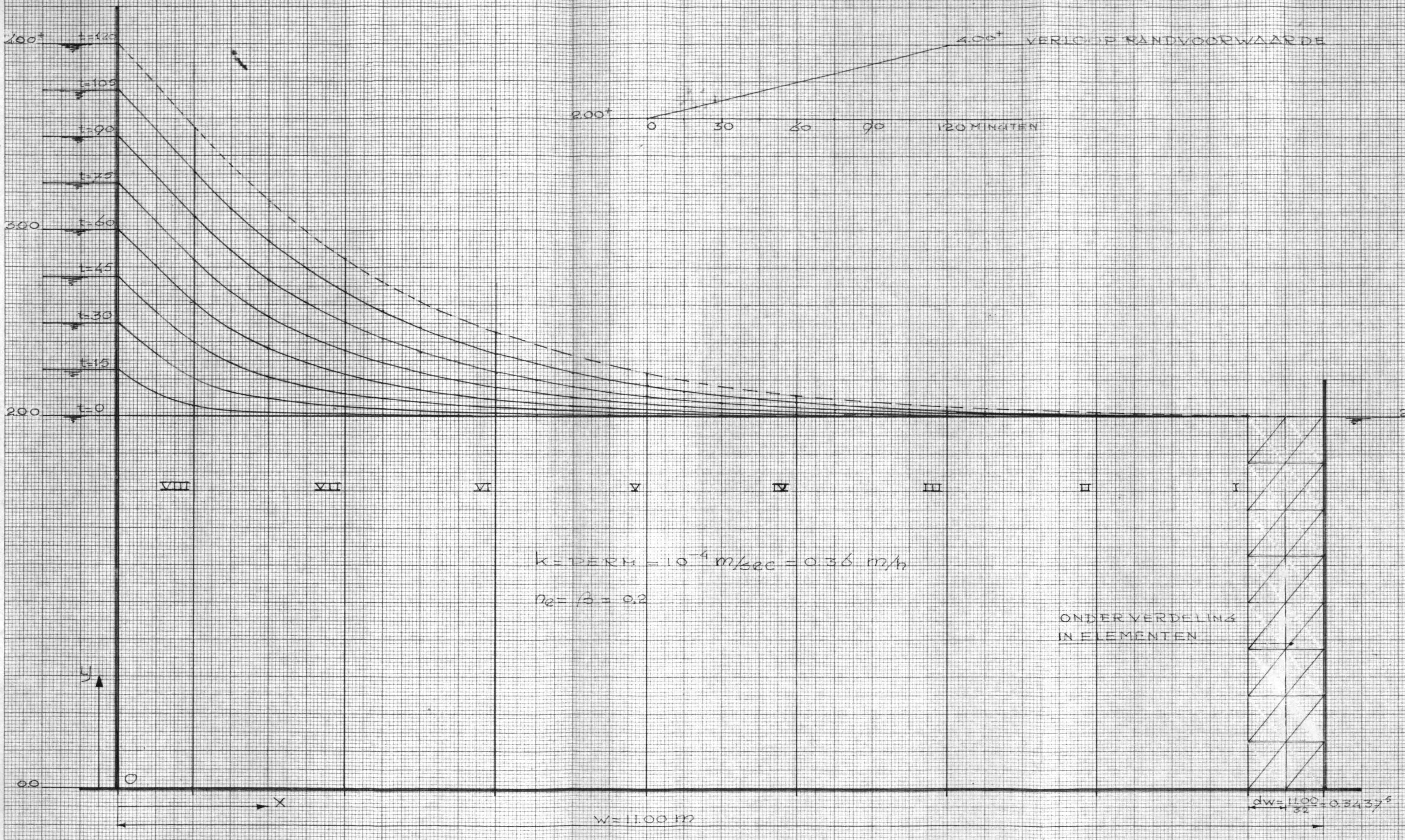
BIJLAGE VIII.2



VERLOOP VAN DE HOOGTE VAN HET FREATISCH VLAK IN RAAI VIII BIJ LINEAIR STIJGENDE RANDVOORWAARDE

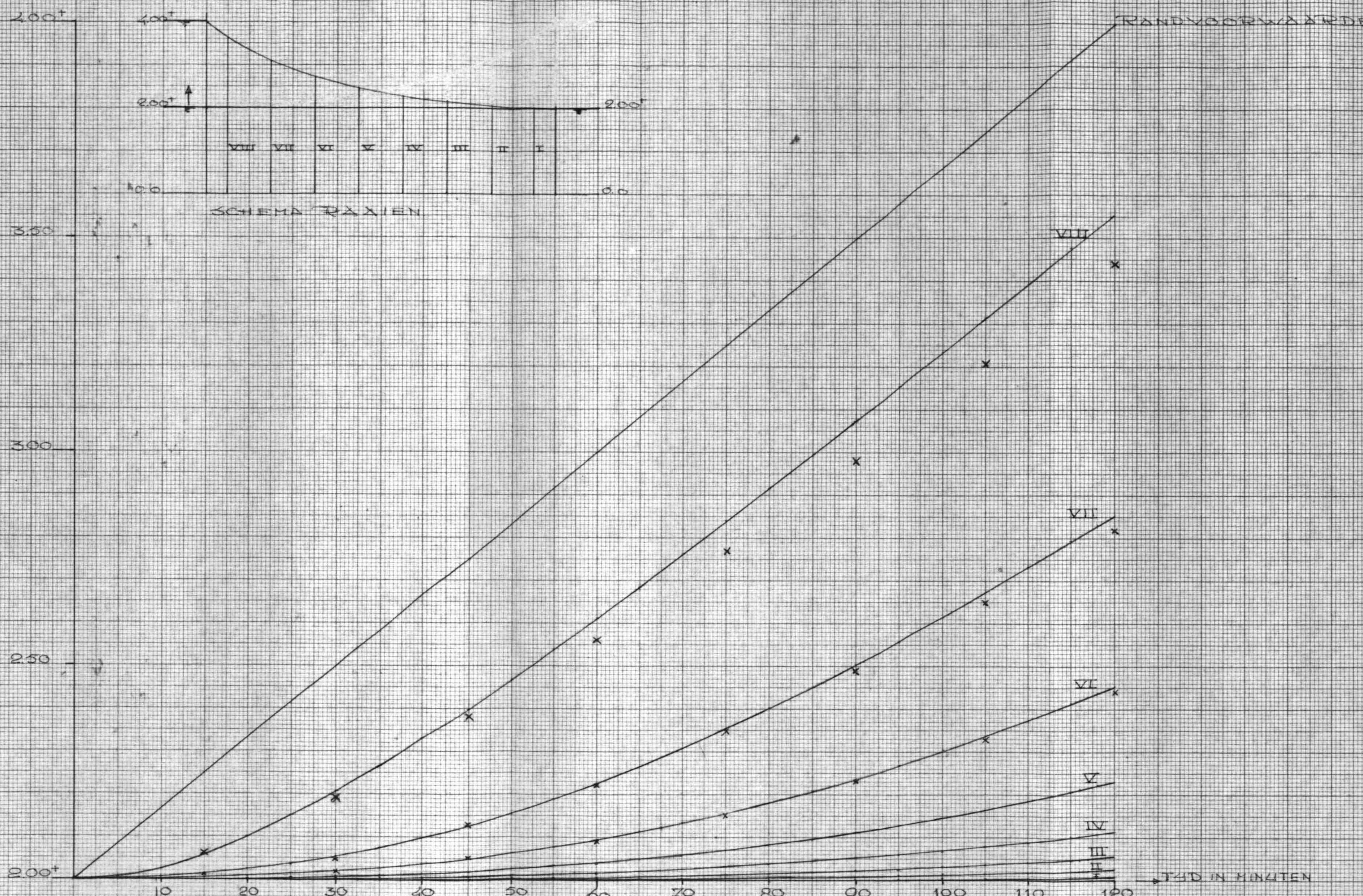
BIJ VARIATIE VAN ONDERVERDELING, TIJDSTAPGROOTTE EN NIFS GEDURENDE HET EERSTE KWARTIER

BIJLAGE VIII.3



VERLOOP FREATISCH VLAK IN ZANDBLOK BY LINEAIR STYGENDE RANDVOORWAARDE

BYLAGE VIII.4

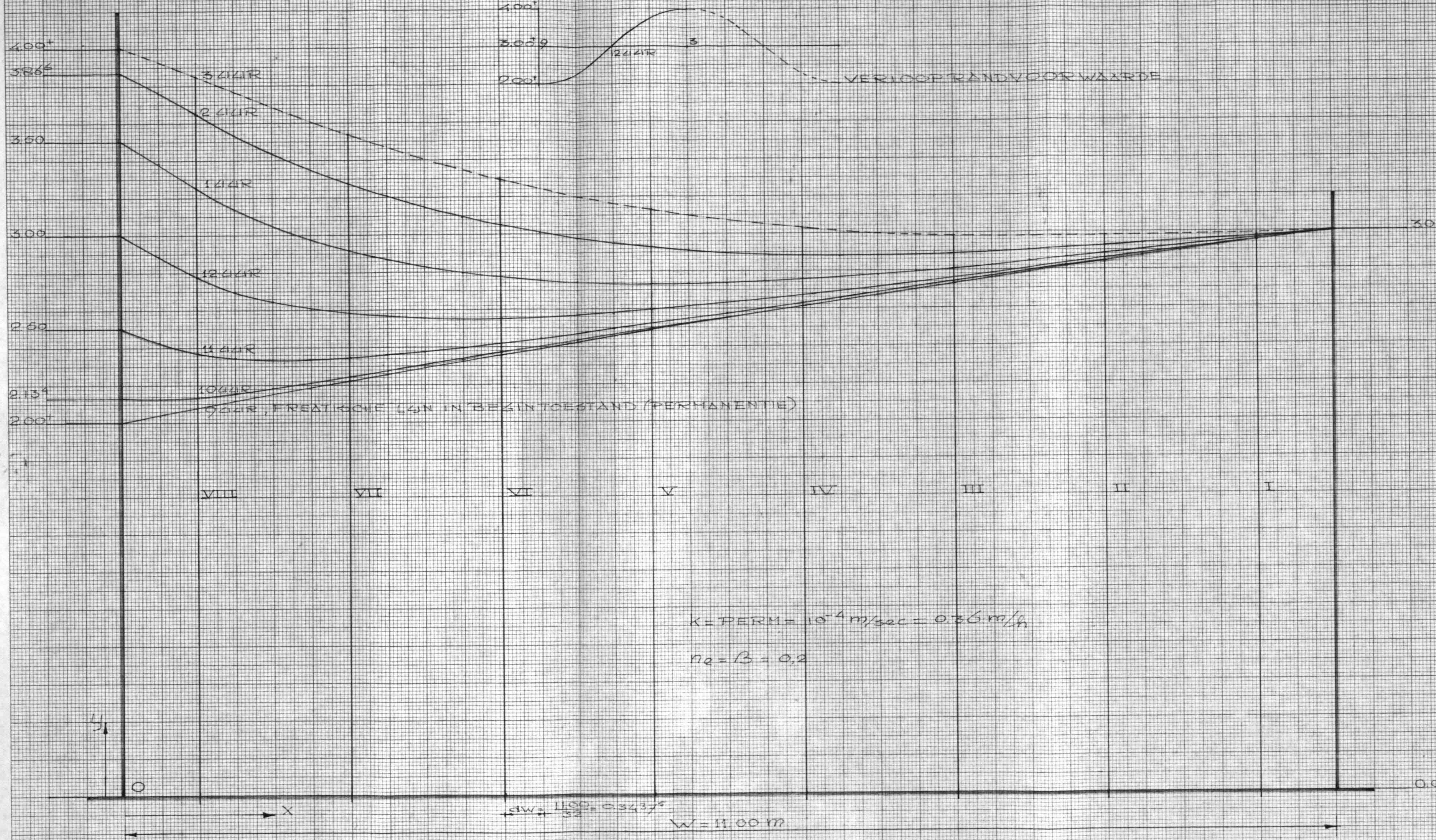


VERLOOP VAN DE HOOGTE VAN HET VRYE OPPERVLAK IN DE TYD BY LINEAIR STYGENDE RANDVOORWAARDE

—— BEPAALT MBV ONDERVERDELING 9x33, TS = 1 MIN, NIES = 3

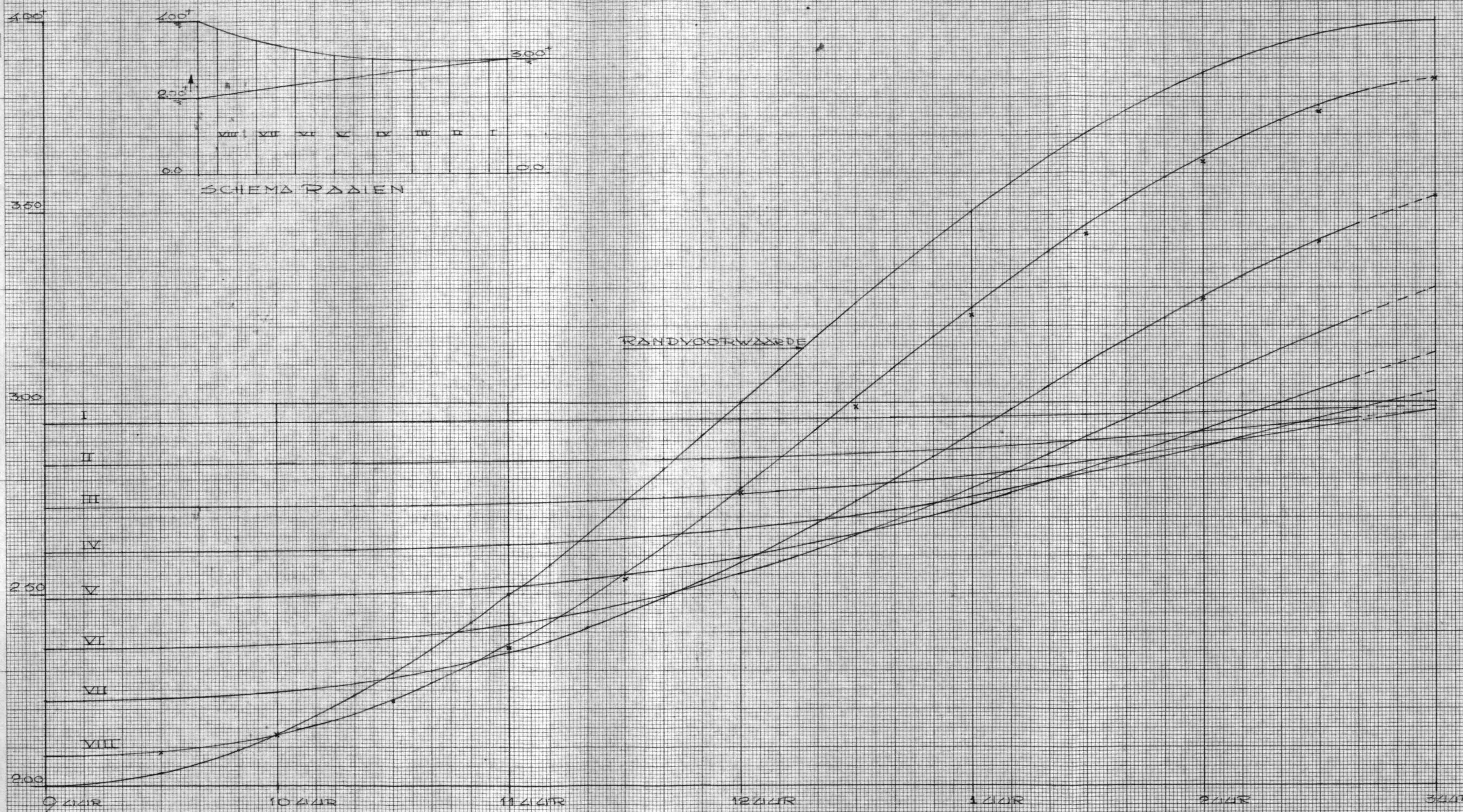
x WAARDEN VERKREGEN BY TOEPASSING VAN DIFF METH. VOLGENS LIT. 7

BYLAGE VIII.5



VERLOOP FREATISCH VLAK IN ZANDBLOK BY PERIODIEK VERLOPENDE RANDVOORWAARDE

BYLAGE VIII.6



VERLOOP VAN DE HOOGTE VAN HET VRIJE OPPERVLAK IN DE TIJD BIJ PERIODIEK VERLOPENDE RANDVOORWAARDE

—— WAARDEN VERKREGEN MBV ONDERVERDELING 9x33, T=2½ MIN, NIFS=2

× DIFF. METHODE VOLGENS LIT. 7

BIJLAGE VIII.7