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"CIVIL ENGINEERING"
FOR THE HP-41

SC-2

CIVIL ENGINEERING

02248C Media Manufactured in U.S.A. Software, Product of U.S.A.

PROGRAM DESCRIPTION I

Program Title BEAM DESIGN

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Program Description, Equations, Variables

THIS PROGRAM HELPS TO FIND THE BEAM REQ'D TO SUPPORT GIVEN LOADS IMPISED FOR ANY OF THESE THREE CONDITIONS: SIMPLY SUPPORTED BEAMS, BEAMS FIXED AT ONE END SUPPORTED AT OTHER, AND BEAMS FIXED AT BOTH ENDS. TO ACHIEVE THIS, THE PROGRAM CALCULATES THE SUPPORT REACTIONS AND STATIC FUNCTIONS (SHEAR, MOMENT, SLOPE, AND DEFLECTION) FOR THE ENTIRE BEAM. LOADINGS MAY BE DISTRIBUTED LOADS, POINT LOADS, AND/OR MOMENTS. STATIC FUNCTIONS ARE CALCULATED BASED ON THE SMALLEST DISTANCE BETWEEN TWO SUCCESSIVE POINTS EITHER d.MAX (IMPOSED BY USER) OR di (DISTANCE BETWEEN TWO LOADS). LOCATION OF AND MAGNITUDE OF MAXIMUM MOMENT 'M' AND MAXIMUM DEFLECTION 'Y' ARE CALCULATED BASED ON d.MAX. THEREFORE THE SMALLER d.MAX USED THE MORE ACCURATE THE CALCULATION. BASED ON MAX 'Y' A REQ'D MOMENT OF INERTIA 'I' AND SECTION MODULOUS 'S' ARE CALCULATED TO SATISFY DESIGN LIMITATIONS. AFTER CHOOSING AN 'I' AND 'S' BASED UPON PREVIOUS CALCULATIONS, USER INSERTS BEAM SPECIFICATIONS AS REQ'D TO FINALIZE BEAM DESIGN. THE FINAL CALCULATIONS ARE USED FOR FINDING DEFLECTIONS, MOMENTS, SECTION MODULOUS, UNSUPPORTED LENGTHS, AND ADDITIONAL DEFL. OF BEAM DUE TO APPLIED LIVE LOADS. FROM THIS THE BEAMS ARE EITHER APPROVED OR DISAPPROVED.

Necessary Accessories 41CV OR 41C W/QUAD MODULE, CARD READER, & PRINTER (OPTIONAL)

Operating Limits and Warnings SEE PAGE 2

Reference(s) AISC STEEL CONSTRUCTION MANUAL EIGHTH EDITION

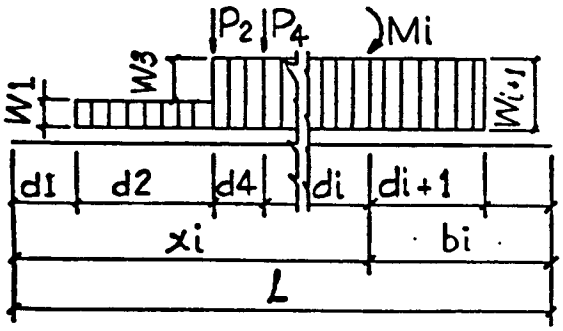
OPERATING LIMITS AND WARNINGS:

WHEN DISTRIBUTED LOADS EXIST, THE COMPUTED DEFLECTION Yi WILL DIFFER SLIGHTLY FROM THE ACTUAL VALUES DUE TO THE INTREGAL VALUES BEING APPROXIMATED. SO FOR d.MAX = L/4 THE MAXIMUM ERROR IS ABOUT Y.MAX / 1.0024 AND FOR SAY d.MAX = 1.0 THE MAXIMUM ERROR IS ABOUT Y.MAX / 1.00007. THEREFORE FOR d.MAX < L/4 THE ACCURACY WILL BE INCREASED. THE VALUE OF d.MAX MUST BE LIMITED IN SIZE TO 3 DECIMAL PLACES SINCE THE 4TH PLACE IS USED TO IDENTIFY THE LOAD TYPE.

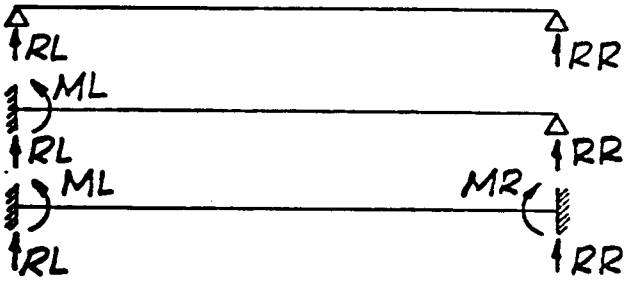
THIS PROGRAM IS LIMITED TO ONLY 9 SEPARATE LOADINGS AND DISTANCES SIMPLY DUE TO THE LACK OF STORAGE.

THE SMALLER THE d.MAX, THE LONGER IT TAKES FOR THE PROGRAM TO RUN.

LOADING SCHEME AND NOTATION

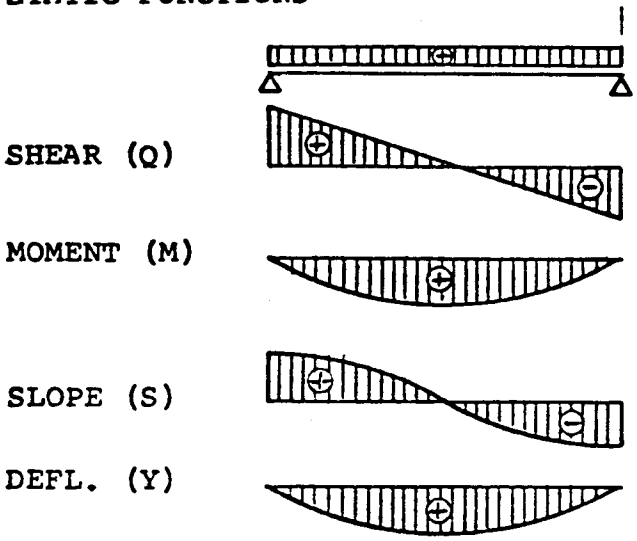


BEAM TYPES AND SUPPORT REACTIONS



SIGN CONVENTIONS FOR LOADS AND SUPPORT REACTIONS

SIGN CONVENTIONS FOR STATIC FUNCTIONS



SUPPORT REACTIONS:

$$RL = -\Sigma Wi\ bi^2/2L - Pi\ bi/L + \Sigma Mi/L - (ML+MR)/L$$

$$RR = -\Sigma Wi\ bi - \Sigma Pi - RL$$

FOR BEAMS FIXED AT ONE END:

$$ML = -3KL/L$$

FOR BEAMS FIXED AT BOTH ENDS:

$$ML = -2(2KL+KR)/L$$

$$MR = -2(2KR+KL)/L$$

SLOPE LEFT FOR SIMPLY SUPPORTED BEAMS:

$$SL = KL/EI$$

$$KL = \Sigma Wi\ bi^2\ (2L^2-bi^2)/24L + \Sigma Pi\ bi(L^2-bi^2)/6L + \Sigma Mi\ L(L^2-3bi^2)/6$$

$$KR = \Sigma Wi\ bi^2(bi-2L)^2/24L + \Sigma Pi\ xi(xi^2-L^2)/6L + \Sigma Mi\ L(L^2-3xi^2)/6$$

STATIC FUNCTIONS WILL BE COMPUTED BY NUMERICAL INTEGRATION USING SIMPSON'S RULE. THE SPACING BETWEEN TWO SUCCESSIV POINTS, di IS SUBDIVIDED INTO TWO PARTS.

THE INTERMEDIARY VALUES OF FUNCTIONS WILL BE NOTED WITH m.

STATIC FUNCTIONS TO THE LEFT OF COMPUTATION POINTS:

$W_{i,L} = W_{i-1,R} = W_m$ (BETWEEN 2 SUCCESSIVE POINTS W = CONSTANT)

SHEAR: $Q_{i,L} = -Q_{i-1,R} - (W_{i-1,R} + 4W_m + W_{i,L})di/6$

$Q_m = -Q_{i-1,R} - (W_{i-1,R} + W_m)di/4$

MOMENT: $M_{i,L} = M_{i-1,R} + (Q_{i-1,R} + 4Q_m + Q_{i,L})di/6$

$M_m = M_{i-1,R} + (Q_{i-1,R} + Q_m)di/4$

SLOPE: $S_{i,L} = S_{i-1,R} - (M_{i-1,R} + 4M_m + M_{i,L})di/6EI$

$S_m = S_{i-1,R} - (M_{i-1,R} + M_m)di/6EI$

DEFL: $Y_{i,L} = Y_{i-1,R} + (S_{i-1,R} + 4S_m + S_{i,L})di/6$

STATIC FUNCTIONS TO THE RIGHT OF COMPUTATION POINT:

$W_{i,R} = W_{i,L} + W_i$

$Q_{i,R} = Q_{i,L} - P_i$

$M_{i,R} = M_{i,L} + M_i$

$S_{i,R} = S_{i,L}$

$Y_{i,R} = Y_{i,L}$

HOW TO FIGURE MAXIMUM LOADING ON A BEAM:

FORMULAS TO CALCULATE LC AND LU:

$L \leq 12.7\ BF$ SMALLER NUMBER IS LC

$L \leq 556/\ D/AF$ LARGER NUMBER IS LU

FORMULAS FOR FINDING Fb:

$Fb = 24$ WHEN

$BF/2TF \leq 10.8$ AND

$BF/TF \leq 31.7$ OR

$Fb = 36(.79-.012(BF/2TF))$ WHEN (1.5-5)

$10.8 < BF/2TF < 15.8$

$Fb = 22$ WHEN

$L/RT \leq 53$ OR

$Fb = 24-(L/RT)^2/1181$ UNLESS (1.5-6a)

$L/RT \geq 119$ THEN

$Fb = 12X10^3/L\ D/AF$ FOR CHANNELS USE THIS FORMULA WITHOUT CONSIDERING ANY OTHER SINCE RT=0. (1.5-7)

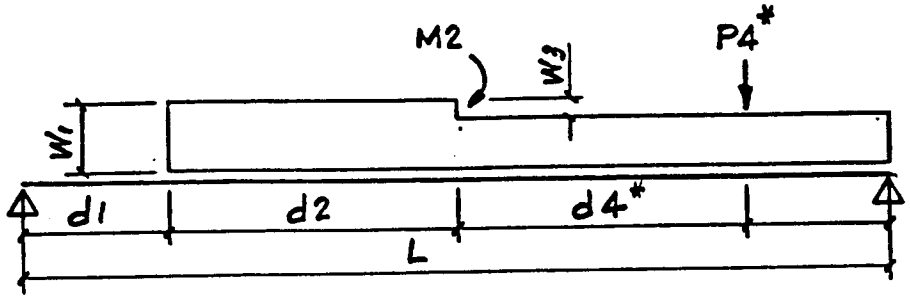
$I = 20\ Y.MAX/L$

$S = 12\ M.MAX/Fb$

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

EXAMPLE: 1
BEAM SIMPLY SUPPORTED



L = 12'-0
d1 = 2'-0 W1 = 10 K/FT d3 = 0 W3 = -2K/FT
d2 = 4'-0 M2 = 8 FT-K *d4 = 4'-0 P4 = 3K

SOLUTION: * ASSUME THAT P4 IS A LIVE LOAD

Input	Function	Display	Comments
	XEQ A	L=?	BEAM LENGTH
12	R/S	d1=?	DISTANCE 1
2	R/S	LOAD?(:W::P::M:)	TYPE LOAD 1
10	[C]	d2=?	DISTANCE 2
4	R/S	LOAD?(:W::P::M:)	TYPE LOAD 2
8	[E]	d3=?	DISTANCE 3
0	R/S	LOAD?(:W::P::M:)	TYPE LOAD 3
-2	[C]	d4=?	DISTANCE 4
-	R/S	BEAM?(0,1,2)	TYPE OF CONNECTION
0	R/S	)---(L=12.000	
		X=2.000 W1=10.000	
		X=6.000 M2=8.000	
		X=6.000 W3=-2.000	
		RL=-38.000	
		ML=0.000	
		RR=-50.000	
		MR=0.000	
		d.MAX=3.000?	
1	R/S	ST.FN.?(XEQ Q,M,S,Y)	
-	XEQ Q	X=0.000 Q=38.000	SHEAR EXCLUDING LIVE LOAD
		X=1.000 Q=38.000	
		X=2.000 Q=38.000	
		X=3.000 Q=28.000	
		X=4.000 Q=18.000	
		X=5.000 Q=8.000	
		X=6.000 Q=-2.000	
		X=7.000 Q=-10.000	
		X=8.000 Q=-18.000	
		X=9.000 Q=-26.000	
		X=10.000 Q=-34.000	
		X=11.000 Q=-42.000	
		X=12.000 Q=-50.000	

(CONTINUATION PAGE)

Input	Function	Display	Comments
-	XEQ M	X=0.000 M=0.000	MOMENT EXCLUDING LIVE LOAD
		X=1.000 M=38.000	
		X=2.000 M=76.000	
		X=3.000 M=109.000	
		X=4.000 M=132.000	
		X=5.000 M=145.000	
		X=6.000 M=148.000	
		X=6.000 M=156.000	
		X=7.000 M=150.000	
		X=8.000 M=136.000	
		X=9.000 M=114.000	
		X=10.000 M=84.000	
		X=11.000 M=46.000	
		X=12.000 M=0.000	
		MAXIMUM M	
		156.000 AT X=6.000	
			SLOPE EXCLUDING LIVE LOAD
-	XEQ S	X=0.000 S=585.778	
		X=1.000 S=566.778	
		X=2.000 S=509.778	
		X=3.000 S=416.444	
		X=4.000 S=295.111	
		X=5.000 S=155.778	
		X=6.000 S=8.444	
		X=7.000 S=-145.222	
		X=8.000 S=-288.889	
		X=9.000 S=-414.556	
		X=10.000 S=-514.222	
		X=11.000 S=-579.889	
		X=12.000 S=-603.556	
-	XEQ Y	E=29000.000	
		I=1.000	
			DEFLECTIONS EXCLUDING LIVE LOADS
		X=0.000 Y=0.000	
		X=1.000 Y=34.527	
		X=2.000 Y=66.790	
		X=3.000 Y=94.553	
		X=4.000 Y=115.870	
		X=5.000 Y=129.372	
		X=6.000 Y=134.284	
		X=7.000 Y=130.183	
		X=8.000 Y=117.183	
		X=9.000 Y=96.119	
		X=10.000 Y=68.382	
		X=11.000 Y=35.520	
		X=12.000 Y=0.036	
		MAXIMUM Y	
		134.284/I AT X=6.000	

(NOW RERUNPROGRAM INCLUDING ALL LIVE LOADS)

(CONTINUATION PAGE)

Input	Function	Display	Comments
***	XEQ -a	L=?	IGNORE SINCE LENGTH DOES NOT CHANGE, THIS STEP WAS TO SF04 ONLY.
4	XEQ B	d4=?	DISTANCE 4
4	R/S	LOAD?(:W::P::M:)	TYPE LOAD 4
3	[D]	d5=?	DISTANCE 5
-	R/S	BEAM?(0,1,2)	TYPE OF CONNECTIONS
0	R/S	)---(L=12.000 X=2.000 W1=10.000 X=6.000 M2=8.000 X=6.000 W3=-2.000 X=10.000 P4=3.000 RL=-38.500 ML=0.000 RR=-52.500 MR=0.000	
		d.MAX=3.000?	
1	R/S	ST.FN.?(XEQ Q,M,S,Y)	
-	XEQ Q	X=0.000 Q=38.500 X=1.000 Q=38.500 X=2.000 Q=38.500 X=3.000 Q=28.500 X=4.000 Q=18.500 X=5.000 Q=8.500 X=6.000 Q=-1.500 X=7.000 Q=-9.500 X=8.000 Q=-17.500 X=9.000 Q=-25.500 X=10.000 Q=-33.500 X=10.000 Q=-36.500 X=11.000 Q=-44.500 X=12.000 Q=-52.500	SHEAR INCLUDING LIVE LOAD
-	XEQ M	X=0.000 M=0.000 X=1.000 M=38.500 X=2.000 M=77.000 X=3.000 M=110.500 X=4.000 M=134.000 X=5.000 M=147.500 X=6.000 M=151.000 X=6.000 M=159.000 X=7.000 M=153.500 X=8.000 M=140.000 X=9.000 M=118.500 X=10.000 M=89.000 X=11.000 M=48.500 X=12.000 M=0.000 MAXIMUM M 159.000 AT X=6.000	MOMENT INCLUDING LIVE LOAD

*** NOTE: EITHER SF04, XEQ B OR XEQ -A TO RERUN PROGRAM TO INCLUDE LIVE LOADS. IF VERYFEW LIVE LOADS ARE ADDED SF04, XEQ B IS QUICKER THAN XEQ - BE SURE dn NUMBER IS INPUTED PRIOR TO XEQ B.

(CONTINUATION PAGE)

Input	Function	Display	Comments
-	XEQ S	X=0.000 S=597.444	SHEAR INCLUDING LIVE LOADS
		X=1.000 S=578.194	
		X=2.000 S=520.444	
		X=3.000 S=425.861	
		X=4.000 S=302.778	
		X=5.000 S=161.194	
		X=6.000 S=11.111	
		X=7.000 S=-145.806	
		X=8.000 S=-293.222	
		X=9.000 S=-423.139	
		X=10.000 S=-527.556	
		X=11.000 S=-596.972	
		X=12.000 S=-621.889	
-	XEQ Y	E=29000.000	
		I=1.000	
		X=0.000 Y=0.000	DEFLECTIONS INCLUDING
		X=1.000 Y=35.217	LIVE LOADS
		X=2.000 Y=68.140	
		X=3.000 Y=96.504	
		X=4.000 Y=118.333	
		X=5.000 Y=132.228	
		X=6.000 Y=137.383	
		X=7.000 Y=133.346	
		X=8.000 Y=120.202	
		X=9.000 Y=98.756	
		X=10.000 Y=70.289	
		X=11.000 Y=36.588	
		X=12.000 Y=0.036	
		MAXIMUM Y	
		137.383/I AT X=6.000	
		TRY I>228.971	BEAM MINIMUM REQUIREMENTS
		TRY S>79.500	WHEN LIVE LOADS APPLIED
	XEQ H	BEAM?	
W21 X	R/S	WT?	
44	R/S	I?	
843	R/S	S?	
81.6	R/S	D/AF?	
7.050	R/S	BF?	
6.5	R/S	TF?	
.451	R/S	RT?	
1.59	R/S	BEAM	
		W21 X 44	
		E=29000.000	
		I=843.000	
		S=81.600	
		D/AF=7.050	
		BF=6.500	
		TF=0.451	
		RT=1.590	

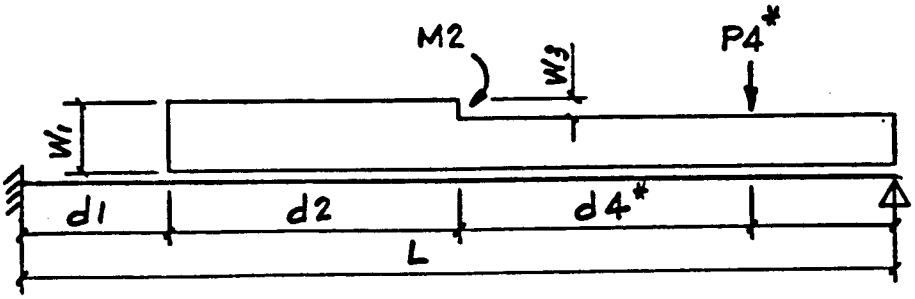
(CONTINUATION PAGE)

Input	Function	Display	Comments
		YBa=0.600 YB=0.163 AT 6.000 YLa=0.400 YL=0.004 AT 6.000 MMB=159.000 AT 6.000	
		L=12.000 Fb=17.055 MMA=115.973 MMB EXCEEDS ALLOWABLE SX = 111.874 SX EXCEEDS ALLOWABLE TRY S>111.874	SPAN IS TOGREAT TO BE UNSUPPORTED
		LU=6.863 Fb=22.000 MMA=149.600 MMB EXCEEDS ALLOWABLE SX = 86.727 SX EXCEEDS ALLOWABLE TRY S>86.727	SPAN IS TO GREAT TO BE SUPPORTED AT LU
		LC=6.572 Fb=24.000 MMA=163.200 SX = 79.500	SPAN IS OK TO BE SUPPORTED AT LC

PROGRAM DESCRIPTION II

ample Problem (Sketch if Desired)

EXAMPLE: 2
FIXED AT ONE END
SUPPORTED AT OTHER
***SF03



L = 12'-0
d1 = 2'-0 W1 = 10 K/FT d3 = 0 W3 = -2K/FT
d2 = 4'-0 M2 = 8 FT-K *d4 = 4'-0 P4 = 3K

LUTION: * ASSUME THAT P4 IS A LIVE LOAD

Input	Function	Display	Comments
	XEQ A	L=?	BEAM LENGTH
12	R/S	d1=?	DISTANCE 1
2	R/S	LOAD? (:W::P::M:)	TYPE LOAD 1
10	[C]	d2=?	DISTANCE 2
4	R/S	LOAD? (:W::P::M:)	TYPE LOAD 2
8	[E]	d3=?	DISTANCE 3
0	R/S	LOAD? (:W::P::M:)	TYPE LOAD 3
-2	[C]	d4=?	DISTANCE 4
-	R/S	BEAM? (0,1,2)	TYPE OF CONNECTION
1	R/S	1---(L=12.000	
		X=2.000 W1=10.000	
		X=6.000 M2=8.000	
		X=6.000 W3=-2.000	
		RL=-58.204	
		ML=-146.444	
		RR=-37.796	
		MR=0.000	
		d.MAX=3.000?	
1	R/S	ST.FN.?(XEQ Q,M,S,Y)	
-	XEQ Q		SHEAR EXCLUDING LIVE LOAD
-	XEQ M		MOMENT " " "
		MAXIMUM M	MAX M
		146.444 AT X=0.000	
-	XEQ S		SLOPE " " "
-	XEQ Y		DEFL " " "
		E=29000.000	
		I=1.000	
		MAXIMUM Y	MAX Y
		58.071/I AT X=7.000	

(NOW RERUN PROGRAM INCLUDING ALL LIVE LOADS)

(CONTINUATION PAGE)

Input	Function	Display	Comments
		YBa=6.600 YB=0.071 AT 7.000 YLa=6.400 YL=0.002 AT 7.000 MMB=149.361 AT 0.000	
		L=12.000 Fb=17.055 MMA=115.973 MMB EXCEEDS ALLOWABLE SX = 105.092 SX EXCEEDS ALLOWABLE TRY S>105.092	SPAN IS TO GREAT TO BE UNSUPPORTED
		LU=6.863 Fb=22.000 MMA=149.600 SX = 81.470	SPAN IS OK TO BE SUPPORTED AT LU
		LC=6.572 Fb=24.000 MMA=163.200 SX = 74.681	SPAN IS OK TO BE SUPPROTED AT LC

(CONTINUATION PAGE)

Input	Function	Display	Comments
***	XEQ -a	L=?	IGNORE SINCE LENGTH DOES NOT CHANGE, THIS STEP WAS TO SF04 ONLY.
4	XEQ B	d4=?	DISTANCE 4
4	R/S	LOAD? (:W::P::M:)	TYPE LOAD 4
3	[D]	d5=?	DISTANCE 5
-	R/S	BEAM? (0,1,2)	TYPE OF CONNECTIONS
/		I---(L=12.000 X=2.000 W1=10.000 X=6.000 M2=8.000 X=6.000 W3=-2.000 X=10.000 P4=3.000 RL=-50.947 ML=-149.361 RR=-40.053 MR=0.000	
		d.MAX=3.000?	
1	R/S	ST.FN.? (XEQ Q,M,S,Y)	
-	XEQ Q		SHEAR INCLUDING LIVE LOAD
-	XEQ M		MOMENT " " "
		MAXIMUM M 149.361 AT X=0.000	MAX M
-	XEQ S		SLOPE " " "
-	XEQ Y		DEFL " " "
		E=29000.000 I=1.000	
		MAXIMUM Y 59.798/1 AT X=7.000 TRY I>99.664 TRY S>74.681	MAX Y MIN I AND S REQ'D FOR CALCULATIONS
	XEQ H	BEAM?	
W21 X	R/S	WT?	
44	R/S	I?	
843	R/S	S?	
81.6	R/S	D/AF?	
7.050	R/S	BF?	
6.5	R/S	TF?	
.451	R/S	RT?	
1.59	R/S	BEAM W21 X 44 E=29000.000 I=843.000 S=81.600 D/AF=7.050 BF=6.500 TF=0.451 RT=1.590	

*** NOTE: EITHER SF04, XEQ B OR XEQ -A TO RERUN PROGRAM TO INCLUDE LIVE LOADS. IF VERYFEW LIVE LOADS ARE ADDED SF04, XEQ B IS QUICKER THAN XEQ -A. BE SURE dn NUMBER IS INPUTED PRIOR TO XEQ B.

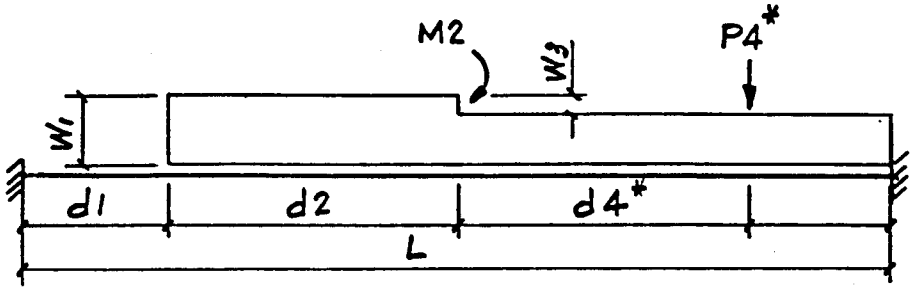
PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

EXAMPLE: 3

BEAM FIXED AT BOTH ENDS

***SF03



L = 12'-0

d1 = 2'-0 W1 = 10 K/FT d3 = 0 W3 = -2K/FT

d2 = 4'-0 M2 = 8 FT-K *d4 = 4'-0 P4 = 3K

SOLUTION: * ASSUME THAT P4 IS A LIVE LOAD

Input	Function	Display	Comments
	XEQ A	L=?	BEAM LENGTH
12	R/S	d1=?	DISTANCE 1
2	R/S	LOAD?(:W::P::M:)	TYPE LOAD 1
10	[C]	d2=?	DISTANCE 2
4	R/S	LOAD?(:W::P::M:)	TYPE LOAD 2
8	[E]	d3=?	DISTANCE 3
0	R/S	LOAD?(:W::P::M:)	TYPE LOAD 3
-2	[C]	d4=?	DISTANCE 4
-	R/S	BEAM?(0,1,2)	TYPE OF CONNECTION
2	R/S	I---I L=12.000	
		X=2.000 W1=10.000	
		X=6.000 M2=8.000	
		X=6.000 W3=-2.000	
		RL=-37.259	
		ML=-94.667	
		RR=-50.741	
		MR=103.556	
		d.MAX=3.000?	
1	R/S	ST.FN.?(XEQ Q,M,S,Y)	
-	XEQ Q		SHEAR EXCLUDING LIVE LOAD
-	XEQ M		MOMENT " " "
		MAXIMUM M	MAX M
		103.556 AT X=12.000	
-	XEQ S		SLOPE " " "
-	XEQ Y		DEFL " " "
		E=29000.000	
		I=1.000	
		MAXIMUM Y	MAX Y
		27.932/I AT X=6.000	

(NOW RERUN PROGRAM INCLUDING ALL LIVE LOADS)

(CONTINUATION PAGE)

Input	Function	Display	Comments
***	XEQ a	L=?	IGNORE SINCE LENGTH DOES NOT CHANGE, THIS STEP WAS TO SF04 ONLY.
		d4=?	DISTANCE 4
4	XEQ B	LOAD? (:W::P::M:)	TYPE LOAD 4
4	R/S	d5=?	DISTANCE 5
3	[D]	BEAM? (0,1,2)	TYPE OF CONNECTIONS
-	R/S	I---I L=12.000	
2		X=2.000 W1=10.000	
		X=6.000 M2=8.000	
		X=6.000 W3=-2.000	
		X=10.000 P4=3.000	
		RL=-37.481	
		ML=-95.500	
		RR=-53.519	
		MR=107.722	
		d.MAX=3.000?	
1	R/S	ST.FN.? (XEQ Q,M,S,Y)	SHEAR INCLUDING LIVE LOAD
-	XEQ Q		MOMENT " " "
-	XEQ M	MAXIMUM M	MAX M
		107.722 AT X=12.000	
-	XEQ S		SLOPE " " "
-	XEQ Y		DEFL " " "
		E=29000.000	
		I=1.000	
		MAXIMUM Y	MAX Y
		26.399/I AT X=6.000	
		TRY I>47.332	MIN I AND S REQ'D FOR CALCULATIONS
		TRY S>53.861	
	XEQ H	BEAM?	
W18 X	R/S	WT?	
35	R/S	I?	
510	R/S	S?	
57.6	R/S	D/AF?	
6.94	R/S	BF?	
6.0	R/S	TF?	
.425	R/S	RT?	
1.49	R/S	BEAM	
		W18 X 35	
		E=29000.000	
		I=516.000	
		S=57.600	
		D/AF=6.940	
		BF=6.000	
		TF=0.425	
		RT=1.490	

*** NOTE: EITHER SF04, XEQ B OR XEQ - A TO RERUN PROGRAM TO INCLUDE LIVE LOADS. IF VERYFEW LIVE LOADS ARE ADDED SF04, XEQ B IS QUICKER THAN XEQ - A BE SURE dn NUMBER IS INPUTED PRIOR TO XEQ B.

(CONTINUATION PAGE)

Input	Function	Display	Comments
		YBa=0.600	
		YB=0.056 AT 6.000	
		YLa=0.400	
		YL=0.001 AT 6.000	
		MMB=107.722 AT 12.000	
		L=12.000	
		Fb=16.091	
		MMA=77.238	
		MMB EXCEEDS ALLOWABLE	
		SX = 80.333	
		SX EXCEEDS ALLOWABLE	SPAN IS TOGREAT TO BE UNSUPPORTED
		TRY S>80.333	
		LU=6.676	
		Fb=21.552	
		MMA=103.450	
		MMB EXCEEDS ALLOWABLE	
		SX = 59.979	
		SX EXCEEDS ALLOWABLE	SPAN IS TO GREAT TO BE SUPPORTED AT LU
		TRY S>59.979	
		LC=6.335	
		Fb=24.000	
		MMA=115.200	
		SX = 53.861	SPAN IS OK TO BE SUPPORTED AT LC

GLOSSARY OF TERMS

W - UNIFORMALLY DISTRIBUTED LOAD, K/FT
P - CONCENTRATED LOAD, KIPS
M - IMPLIED MOMENT, K-FT
dn - DISTANCE FROM END OF BEAM OR LOAD TO NEXT LOAD, FT
Xi - DISTANCE FROM LEFT END TO POINT OF EXECUTION, FT
bi - DISTANCE FROM POINT OF EXECUTION TO RIGHT END, FT
L - LENGTH OF BEAM, FT
RL - REACTION AT LEFT SUPPORT, KIPS
ML - MOMENT AT LEFT SUPPORT, K-FT
RR - REACTION AT RIGHT SUPPORT, KIPS
MR - MOMENT AT RIGHT SUPPORT, K-FT
Q - SHEAR
M - MOMENT
S - SLOPE
Y - DEFLECTION
SL - SLOPE AT LEFT SUPPORT, IN
KL - CONSTANT AT LEFT SUPPORT
KR - CONSTANT AT RIGHT SUPPORT
BEAM - SHAPE AND DEPTH OF BEAM, EX. W21_X
WT - WEIGHT OF BEAM EX. 44
E - MODULUS OF ELASTICITY, 29,000 KSI
I - MOMENT OF INERTIA
S - SECTION MODULOUS
D/AF - DEPTH OF BEAM/AREA OF THE FLANGE
BF - FLANGE WIDTH
TF - FLANGE THICKNESS
RT - RADIUS OF GYRATION, (FOR CHANNEL RT = 0)
YBa - DEFLECTION OF BEAM ALLOWABLE DUE TO 1/240 OF SPAN
YB - MAX. DEFLECTION OF BEAM
YLa - DEFLECTION OF BEAM ALLOWABLE W/LIVE LOAD DUE TO 1/360 OF SPAN
YL - MAX. DEFLECTION OF BEAM DUE TO LIVE LOAD
MMB - MAX. MOMENT OF BEAM AT X
MMA - MAX. MOMENT OF BEAM ALLOWABLE
Fb - ALLOWABLE BENDING STRESS
SX - MIN. SECTION MODULOUS REQUIRED
LU - MAX UNBRACED LENGTH OF COMPRESSION FLANGE @ Fb = 22 KSI
LC - MAX UNBRACED LENGTH OF COMPRESSION FLANGE @ Fb = 24 KSI
LIVE LOADS - LOADS APPLIED TO THE BEAM THAT ARE NOT PERMANENT

02248 USER INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	SIZE: (HP-41C) DISPLAY
1	INITIALIZE PROGRAM		XEQ BEAM	A? OR ▬A?
2a	BEAM WITH LIVE LOAD EXCLUDED		XEQ A	L=?
2b	BEAM WITH LIVE LOAD INCLUDED		XEQ ▬a	L=?
3	BEAM LENGTH	L	R/S	d1=?
4	SPACING BETWEEN LOADS	d1	R/S	LOAD?(:W::P::M
5	LOADS W,P, OR M	LOAD 1	C,D, OR E	d2=?
6	REPEAT STEPS 4 AND 5 UNTIL ALL			
	DISTANCES AND LOADS ARE ENTERED			dn+1=?
6a	THEN TO CLOSE OUT DATA INPUT	-	R/S	BEAM?(0,1,2)
7	TO DISPLAY LOADINGS, REACTIONS, AND			
	END MOMENTS FOR BEAM	0,1,2*	R/S	d.MAX=L/4?
8	INTERVALS OF COMPUTATION (a OR b)			
8a	FOR d.MAX L/4	-		
8b	FOR INCREASED PRECISION d.MAX L/4	d.MAX	R/S	ST.FN.?(XEQ Q,M
9	STATIC FUNCTION CALCULATION **			
9a	SHEAR	-	XEQ Q	Xi=_Qi=_
9b	MOMENT	-	XEQ M	Xi=_Mi=_ MAX M AT X=_
9c	SHEAR	-	XEQ S	Xi=_Si=_
9d	DEFLECTION	-	XEQ Y	E=29,000 I=1
	(DISPLAY STOPS HERE IF STEP 2a WAS			Xi=_Yi=_
	EXECUTED. CONTINUE WITH STEP 11)			MAX Y AT X=_
	(DISPLAY STOPS HERE IF STEP 2b WAS			TRY I > ___
	EXECUTED. CONTINUE WITH STEP 11)			TRY S > ___
10	REPEAT STEPS 2 THRU 9 STARTING WITH			
	STEP 2b			
11	INPUT BEAM DATA AS REQ'D BY			
	I AND S CALCULATES STEP 11a			

				SIZE: (HP-41C)
TEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
	OR IF DATA PREVIOUSLY ENTERED IS STILL GOOD THEN GOTO STEP 11b			
11a	DATA INPUT AND BEAM CALCULATIONS	-	XEQ H	BEAM?
1)	BEAM	LNN_X	R/S	WT?
2)	BEAM WEIGHT	NN	R/S	I?
3)	MOMENT OF INERTIA	Ix-x	R/S	S?
4)	SECTION MODULOUS	Sx-x	R/S	D/AF?
5)	DEPTH/AREA OF FLANGE	d/Af	R/S	BF?
6)	FLANGE WIDTH	bf	R/S	TF?
7)	FLANGE THICKNESS	tf	R/S	RT?
8)	RADIUS OF GYRATION	rT	R/S	VARIES
	(IF GOOD: NO FURTHER OPERATIONS REQ'D)			
	(IF BAD: PROGRAM SUGGESTS CHANGES,			TRY I > ___
	USER MUST REPEAT STEP 11a)			TRY S > ___
11b	BEAM CALCULATIONS		XEQ F	VARIES
	(IF GOOD: NO FURTHER OPERATIONS REQ'D)			TRY I > ___
	(IF BAD: PROGRAM SUGGESTS CHANGES,			TRY S > ___
	USER MUST REPEAT STEP 11a)			
	* THESE FIGURES REPRESENT THE TOTAL NUMBER OF FIXED ENDS OF THE BEAM. (IF THERE IS ONE FIXED END, IT MUST BE PLACED ON THE LEFT END.)			
	** NOTE: Q, M, S, & Y MAY BE EXECUTED IN ANY ORDER BUT FOR THIS PROGRAM TO BE USED TO ITS MAXIMUM XEQ Q THEN M AND XEQ S THEN Y, BUT ALL FOUR MUST BE DONE BEFORE CONTINUING TO STEP 10.			
	***SF03 TO OMIT DISPLAY OR PRINTING OF Xi AND STATIC FUNCTION.			

PROGRAM LISTING

☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	◆LBL "BEA M"		
02	"A? OR a ?"		
03	AVIEW		
04	STOP		
05	◆LBL a		
06	SF 04		
07	GTO 00		
08	◆LBL A		
09	CF 04		
10	◆LBL 00		
11	CF 29		
12	"L=?"		
13	PROMPT		
14	STO 10		
15	4		
16	/		
17	STO 12		
18	1		
19	STO 08		
20	STO 09		
21	◆LBL 06		DATA INPUT
22	FIX 0		
23	RCL 08		
24	2		
25	*		
26	38		
27	+		
28	STO 06		
29	"d"		
30	ARCL 08		
31	"⊢=?"		
32	CF 22		
33	PROMPT		
34	FC? 22		
35	GTO 07		
36	"LOAD?<: W::P::M:"		
37	"⊢>"		
38	PROMPT		
39	◆LBL C		DISTRIBUTED
40	1		LOAD
41	GTO 06		
42	◆LBL D		CONCENTRAITED
43	2		LOAD
44	GTO 06		IMPLIED MOMENT
45	◆LBL E		
46	3		
47	◆LBL 06		LOAD IDENTIFIER
48	1 E4		
49	/		
50	RCL Z		
51	FIX 3		
52	RND		
53	+		
54	STO IND 06		
55	ISG 06		
56	STOP		
57	X<>Y		
58	STO IND 06		
59	RCL 09		
60	RCL 08		
61	X<=Y?		
62	ISG 08		
63	CLA		
64	X=Y?		
65	ISG 09		
66	CLA		
67	1		
68	−		
69	X=Y?		
70	ISG 09		
71	CLA		
72	X<=Y?		
73	GTO 06		
74	0		
75	1/X		
76	◆LBL B		CORRECTION
77	STO 08		
78	GTO 06		
79	◆LBL 07		
80	"BEAM?<0,1,2>"		
81	PROMPT		
82	◆LBL I		
83	STO 18		
84	ADV		
85	ΣREG 11		
86	CLΣ		
87	GTO IND 18		
88	◆LBL 00		
89	">---<"		SIMPLE BEAM

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix F in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

67 □97 ■41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
90	GTO 07		
91	◆LBL 01		
92	"I---<"		FIXED ONE END
93	GTO 07		
94	◆LBL 02		
95	"I---I"		FIXED BOTH ENDS
96	◆LBL 07		
97	RCL 10		
98	"⊢ L="		
99	FIX 3		
100	ARCL X		
101	AVIEW		
102	ADV		
103	STO 00		
104	RCL 09		
105	2		
106	*		
107	37		
108	+		
109	1 E3		
110	/		
111	40		
112	+		
113	STO 19		
114	.3		
115	STO 08		
116	◆LBL 16		
117	ISG 08		
118	RCL IND 19		
119	ENTER↑		
120	FIX 3		LOAD TYPE IDENTIFIER
121	RND		
122	ST- 00		
123	ST+ 11		
124	MOD		
125	1 E4		
126	*		
127	2		
128	+		
129	STO 07		
130	ISG 19		
131	"X="		
132	ARCL 11		
133	"⊢ "		
134	GTO IND 07		
135	◆LBL 03		
136	"⊢W"		DISPLAY OF DATA
137	GTO 07		
138	◆LBL 04		
139	"⊢P"		
140	GTO 07		
141	◆LBL 05		
142	"⊢M"		
143	◆LBL 07		COMPUTES SUPPORT REACTIONS AND SLOPE AT LEFT END
144	.5		
145	STO 03		
146	1		
147	STO 04		
148	3		
149	STO 05		
150	FIX 0		
151	ARCL 08		
152	"⊢="		
153	RCL 00		
154	2		
155	/		
156	RCL 00		
157	RCL IND 19		
158	FIX 3		
159	ARCL X		
160	AVIEW		
161	GTO IND 07		
162	◆LBL 03		
163	*		
164	◆LBL 04		
165	ST- 15		RR
166	*		
167	CHS		
168	◆LBL 05		
169	RCL 10		
170	/		
171	ST+ 12		RL
172	6		
173	/		
174	RCL 00		
175	X↑2		
176	RCL IND 07		
177	*		
178	RCL 10		
179	X↑2		
180	−		

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☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
181	*		
182	STO 01		
183	GTO IND 18		
184	◆LBL 00		SIMPLE SUPPORTS
185	ST+ 14		SL
186	GTO 07		
187	◆LBL 01		FIXED ONE END
188	3		
189	*		
190	RCL 10		
191	/		
192	ST- 13		ML
193	GTO 07		
194	◆LBL 02		FIXED BOTH ENDS
195	1		
196	STO 03		
197	RCL 10		
198	X↑2		
199	RCL 11		
200	X↑2		
201	-		
202	4		
203	/		
204	RCL 11		
205	RCL IND 19		
206	GTO IND 07		
207	◆LBL 03		
208	X<>Y		
209	RDN		
210	◆LBL 04		
211	*		
212	◆LBL 05		
213	CHS		
214	RCL 10		
215	/		
216	6		
217	/		
218	RCL 11		
219	X↑2		
220	RCL IND 07		
221	*		
222	RCL 10		
223	X↑2		
224	-		
225	*		
226	STO 02		KR
227	RCL 01		
228	2		
229	*		
230	-		
231	2		
232	*		
233	RCL 10		
234	/		
235	ST+ 13		ML
236	RCL 01		
237	RCL 02		
238	2		
239	*		
240	-		
241	2		
242	*		
243	RCL 10		
244	/		
245	ST- 16		MR
246	◆LBL 07		
247	ISG 19		
248	GTO 16		
249	RCL 12		
250	RCL 16		
251	RCL 13		
252	+		
253	RCL 10		
254	/		
255	+		
256	STO 12		
257	ST- 15		
258	ADV		
259	"RL"		DISPLAY OF
260	RCL 12		SUPPORT REACTIO
261	XEQ 15		AND MOMENTS
262	"ML"		
263	RCL 13		
264	XEQ 15		
265	"RR"		
266	RCL 15		
267	XEQ 15		
268	"MR"		
269	RCL 16		
270	XEQ 15		
271	RCL 10		
272	4		

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
273	/		
274	"d.MAX="		
275	ARCL X		
276	"⊢?"		
277	PROMPT		
278◆	LBL J		
279	STO 21		
280	"ST.FN.?		
	<XEQ Q,M"		
281	"⊢,S,Y>"		
282	PROMPT		
283◆	LBL "Q"		SHEAR FUNCTION
284	1		
285	SF 05		
286	SF 08		
287	CF 07		
288	CF 06		
289	GTO 07		
290◆	LBL "M"		MOMENT FUNCTION
291	2		
292	SF 05		
293	CF 08		
294	GTO 07		
295◆	LBL "S"		SLOPE FUNCTION
296	3		
297	CF 05		
298	SF 08		
299	CF 06		
300	CF 07		
301	GTO 07		
302◆	LBL "Y"		DEFLECTION
303	4		FUNCTION
304	CF 05		
305	CF 08		
306◆	LBL 07		INITIALIZES FOR
307	STO 18		COMPITATION OF
308	CF 00		STATIC FUNCTIONS
309	CF 02		
310	4		
311	X≠Y?		
312	GTO 07		
313	SF 00		FOR DEFL.
314	29 E03		
315	STO 22		
316◆	LBL 07		
317	ADV		
318	0		
319	STO 00		
320	STO 01		
321	ΣREG 02		
322	CLΣ		
323	ΣREG 11		
324	STO 02		
325	0		
326	STO 11		
327	RCL 19		
328	FRC		
329	40		
330	+		
331	STO 19		
332	RCL 12		
333	CHS		
334	STO 04		
335	RCL 13		
336	STO 05		
337	RCL 14		
338	STO 06		
339	FC? 00		
340	GTO 08		
341	"E"		
342	RCL 22		
343	XEQ 15		
344	"I"		
345	1		
346	XEQ 15		
347	ADV		
348◆	LBL 08		
349	FC? 03		
350	XEQ 13		
351	RCL IND		
	19		
352	RND		
353◆	LBL 19		
354	X=0?		
355	GTO 11		
356	STO 20		
357	RCL 21		
358	X>Y?		
359	X<>Y		
360	ST- 20		
361	ST+ 11		
362	RCL 03		
363	STO 15		
364	STO 16		
365	3.1		
366	STO 17		

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☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
367	RCL 18		
368	STO 08		
369	R↑		
370	XEQ 17		
371	◆LBL 10		NUMERICAL
372	CHS		INTEGRATION
373	RCL 15		
374	4		
375	*		
376	RCL 16		
377	RCL IND 17		
378	+		
379	+		
380	*		
381	6		
382	/		
383	ISG 17		
384	X<> IND 17		
385	ST+ IND 17		STATIC FUNCTION LEFT
386	X<> 16		
387	RCL 15		
388	+		
389	X<>Y		
390	4		
391	/		
392	*		
393	RCL 16		
394	+		
395	STO 15		
396	RDN		
397	DSE 08		
398	GTO 10		
399	XEQ 07		
400	FS? 03		
401	GTO 22		
402	RCL 11		
403	FRC		
404	X≠0?		
405	GTO 22		
406	XEQ 13		
407	◆LBL 22		
408	RCL 20		
409	GTO 19		
410	◆LBL 11		
411	FS?C 02		
412	GTO 14		
413	RCL IND 19		
414	ISG 19		
415	ENTER↑		
416	FIX 3		
417	RND		
418	MOD		
419	1 E4		
420	*		
421	2		
422	+		
423	STO 17		
424	4		
425	X=Y?		
426	SF 01		
427	RCL IND 19		
428	FS?C 01		
429	CHS		
430	XEQ 17		
431	ST+ IND 17		STATIC FUNCTION RIGHT
432	XEQ 07		
433	ISG 19		
434	GTO 11		
435	SF 02		
436	FC? 03		
437	XEQ 12		
438	RCL 10		
439	RCL 11		
440	-		
441	X=0?		
442	GTO 14		
443	GTO 19		
444	◆LBL 17		
445	RCL 18		
446	3		
447	+		
448	RCL IND X		
449	STO 23		
450	R↑		
451	R↑		
452	RTN		
453	◆LBL 07		
454	FS? 06		
455	GTO 00		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
456	FS? 07		FINDS EITHER
457	GTO 01		M MAX OR Y MAX
458	FC? 08		AND THEIR LOC.
459	RTN		DEPENDING ON
460	RCL 18		ACCURACY INPUTED
461	3		AS .d.MAX
462	+		
463	RCL IND X		
464	RCL 23		
465	*		
466	X≠0?		
467	X>0?		
468	RTN		
469	SF 07		
470	XEQ 21		
471	RCL 11		
472	STO IND Y		
473	RTN		
474	◆LBL 01		
475	FS? 08		
476	RTN		
477	XEQ 21		
478	RCL 11		
479	RCL IND Y		
480	X≠Y?		
481	RTN		
482	SF 06		
483	RCL 18		
484	3		
485	+		
486	RCL IND X		
487	RCL 23		
488	X>Y?		
489	XEQ 23		
490	X<>Y		
491	XEQ 22		
492	RTN		
493	◆LBL 00		
494	XEQ 21		
495	RCL 11		
496	RCL IND Y		
497	X≠Y?		
498	RTN		
499	RCL 23		
500	RCL IND 17		
501	X<=Y?		
502	RTN		
503	XEQ 22		
504	RTN		
505	◆LBL 23		
506	X<>Y		
507	XEQ 21		
508	1		
509	ST- IND Y		
510	R↑		
511	R↑		
512	RTN		
513	◆LBL 22		
514	FS? 05		
515	GTO 01		
516	1728		
517	*		
518	RCL 22		
519	/		
520	STO 27		
521	RTN		
522	◆LBL 01		
523	STO 25		
524	RTN		
525	◆LBL 21		
526	24		
527	2		
528	FS? 05		
529	CLX		
530	+		
531	RTN		
532	◆LBL 11		
533	RCL IND 19		
534	FS? 03		
535	GTO 01		
536	X≠0?		
537	XEQ 12		
538	◆LBL 01		
539	RCL IND 19		
540	RND		
541	GTO 19		
542	◆LBL 12		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
543	RCL 17		
544	RCL 18		
545	3		
546	+		
547	X≠Y?		
548	RTN		
549	◆LBL 13		DISPLAYS Xi AND
550	"X="		STATIC FUNCTION
551	ARCL 11		
552	"⊢ "		
553	RCL 18		
554	3		
555	+		
556	RCL IND X		
557	FC? 00		
558	GTO IND 18		
559	RCL 22		
560	/		
561	1728		
562	*		
563	GTO IND 18		
564	◆LBL 01		
565	"⊢0"		
566	GTO 05		
567	◆LBL 02		
568	"⊢M"		
569	GTO 05		
570	◆LBL 03		
571	"⊢S"		
572	GTO 05		
573	◆LBL 04		
574	"⊢Y"		
575	◆LBL 05		
576	FC? 21		
577	TONE 6		
578	"⊢="		
579	RND		
580	ARCL X		
581	AVIEW		
582	RTN		
583	◆LBL 14		
584	CF 02		
585	FC?C 06		
586	STOP		
587	CF 07		
588	SF 12		DISPLAYS
589	"MAXIMUM "		M MAX OR Y MAX
590	FS? 05		
591	GTO 01		
592	"⊢ Y"		
593	AVIEW		
594	CF 12		
595	CLA		
596	RCL 27		
597	ARCL X		
598	"⊢/I AT X="		
599	ARCL 26		
600	AVIEW		
601	GTO 00		
602	◆LBL 01		
603	RCL 25		
604	RCL 13		
605	ABS		
606	X<=Y?		
607	GTO 02		
608	STO 25		
609	0		
610	STO 24		
611	◆LBL 02		
612	RCL 25		
613	RCL 05		
614	ABS		
615	X<=Y?		
616	GTO 02		
617	STO 25		
618	RCL 10		
619	STO 24		
620	◆LBL 02		
621	"⊢ M"		
622	AVIEW		
623	CF 12		
624	CLA		
625	ARCL 25		
626	"⊢ AT X="		
627	ARCL 24		
628	AVIEW		
629	◆LBL 00		
630	FS? 05		
631	STOP		
632	RCL 27		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
633	FC? 04		
634	GTO 04		
635	ST+ 28		
636	CF 00		
637	RCL 10		
638	20		
639	/		
640	XEQ 21		
641	PSE		
642	RCL 25		
643	2		
644	/		
645	"TRY S>"		DISPLAYS S MIN
646	ARCL X		AND I MIN REQ'D
647	AVIEW		
648	STOP		
649◆	LBL 04		
650	CHS		
651	STO 28		
652	STOP		
653◆	LBL 15		
654	"⊢="		
655	ARCL X		
656	AVIEW		
657	RTN		
658◆	LBL H		STORES BEAM
659	"BEAM?"		DATA INPUTED
660	AON		
661	PROMPT		
662	ASTO 31		
663	"WT?"		
664	PROMPT		
665	ASTO 32		
666	AOFF		
667	"I?"		
668	PROMPT		
669	STO 33		
670	"S?"		
671	PROMPT		
672	STO 34		
673	"D/AF?"		
674	PROMPT		
675	STO 35		
676	"BF?"		
677	PROMPT		
678	STO 36		
679	"TF?"		
680	PROMPT		
681	STO 37		
682	"RT?"		
683	PROMPT		
684	STO 38		
685◆	LBL F		TESTES BEAM
686	SF 00		AGAINST LOADING
687	SF 01		CONDITIONS
688	XEQ 18		
689	CLA		
690	ADV		
691	SF 12		
692	"BEAM"		DISPLAYS DATA
693	AVIEW		OF BEAM TESTED
694	CLA		
695	ARCL 31		
696	"⊢ "		
697	ARCL 32		
698	AVIEW		
699	CF 12		
700	ADV		
701	"E="		
702	ARCL 22		
703	AVIEW		
704	"I="		
705	ARCL 33		
706	AVIEW		
707	"S="		
708	ARCL 34		
709	AVIEW		
710	"D/AF="		
711	ARCL 35		
712	AVIEW		
713	"BF="		
714	ARCL 36		
715	AVIEW		
716	"TF="		
717	ARCL 37		
718	AVIEW		
719	"RT="		
720	ARCL 38		
721	AVIEW		
722	ADV		
723	RCL 10		
724	20		
725	/		
726	"YBa="		
727	ARCL X		

00

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PROGRAM LISTING

☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
728	AVIEW		
729	RCL 27		
730	RCL 33		
731	/		
732	"YB="		
733	ARCL X		
734	"⊢ AT "		
735	ARCL 26		
736	AVIEW		
737	X<=Y?		
738	GTO 00		
739	"YB "		
740	XEQ 09		
741	LASTX		
742	*		
743	X<>Y		
744	XEQ 21		
745◆	LBL 00		
746	RCL 10		
747	30		
748	/		
749	"YLa="		
750	ARCL X		
751	AVIEW		
752	RCL 28		
753	ABS		
754	RCL 33		
755	/		
756	"YL="		
757	ARCL X		
758	"⊢ AT "		
759	ARCL 26		
760	AVIEW		
761	X<=Y?		
762	GTO 01		
763	"YL"		
764	XEQ 09		
765	AVIEW		
766	X<>Y		
767	RCL 28		
768	X<>Y		
769	/		
770	XEQ 21		
771◆	LBL 01		
772	"MMB="		
773	ARCL 25		
774	"⊢ AT "		
775	ARCL 24		
776	AVIEW		
777	GTO 00		
778◆	LBL 26		
779	XEQ 18		
780◆	LBL 00		
781	ADV		
782	CLA		
783	SF 12		
784	ARCL 29		
785	"⊢"		
786	ARCL 30		
787	AVIEW		
788	CF 12		
789	"Fb="		
790	ARCL 39		
791	AVIEW		
792	RCL 39		
793	RCL 34		
794	*		
795	12		
796	/		
797	"MMA="		
798	ARCL X		
799	AVIEW		
800	RCL 25		
801	X<=Y?		
802	GTO 02		
803	"MMB "		
804	XEQ 09		
805	AVIEW		
806◆	LBL 02		
807	RCL 39		
808	/		
809	12		
810	*		
811	"SX = "		
812	ARCL X		
813	AVIEW		
814	RCL 34		
815	X<>Y		
816	X<=Y?		
817	GTO 01		
818	"SX "		
819	XEQ 09		
820	AVIEW		
821	RCL 25		
822	12		
823	*		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

☐67 ☐97 ■41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
824	RCL 39		
825	/		
826	"TRY S>"		
827	ARCL X		
828	AVIEW		
829	◆LBL 01		
830	FC?C 01		
831	FS?C 00		
832	GTO 26		
833	STOP		
834	◆LBL 09		
835	"⊢EXCEED S "		
836	"⊢ALLOWABLE"		
837	RTN		
838	◆LBL 21		
839	/		
840	"TRY I>"		
841	ARCL X		
842	AVIEW		
843	RTN		
844	◆LBL 18		CALCULATES
845	RCL 36		UNSUPPORTED
846	12.67		LENGTHS
847	*		L,LU,& LC
848	12		
849	/		
850	556		
851	RCL 35		
852	/		
853	12		
854	/		
855	FC? 00		
856	GTO 00		
857	X<=Y?		
858	X<>Y		
859	STO 30		
860	FS? 01		
861	GTO 01		
862	"LU="		
863	ASTO 29		
864	GTO 03		
865	◆LBL 00		
866	X>Y?		
867	X<>Y		
868	STO 30		
869	"LC="		
870	ASTO 29		
871	31.7		
872	RCL 36		
873	RCL 37		
874	/		
875	X>Y?		
876	GTO 00		
877	2		
878	/		
879	10.8		
880	X<>Y		
881	X>Y?		
882	GTO 02		
883	24		
884	STO 39		
885	GTO 05		
886	◆LBL 00		
887	2		
888	/		
889	◆LBL 02		
890	-.432		
891	*		
892	28.44		
893	+		
894	STO 39		
895	GTO 05		
896	◆LBL 01		
897	RCL 30		
898	RCL 10		
899	X<=Y?		
900	X<>Y		
901	STO 30		
902	"L="		
903	ASTO 29		
904	◆LBL 03		
905	RCL 38		
906	X=0?		
907	GTO 02		
908	53.23		
909	RCL 30		
910	12		
911	*		
912	RCL 38		
913	/		
914	X<=Y?		
915	GTO 04		
916	119		
917	X<>Y		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E of 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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PROGRAM LISTING

☐ 67 ☐ 97 ■ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
918	X<=Y?		
919	GTO 03		
920	X↑2		
921	1.7 E05		
922	X<>Y		
923	/		
924	STO 39		
925	GTO 05		
926	◆LBL 03		
927	X↑2		
928	−1181		
929	/		
930	24		
931	+		
932	STO 39		
933	GTO 05		
934	◆LBL 02		
935	1 E03		
936	RCL 30		
937	/		
938	RCL 35		
939	/		
940	STO 39		
941	GTO 05		
942	◆LBL 04		
943	22		
944	STO 39		
945	◆LBL 05		
946	RCL 25		
947	X<>Y		
948	/		
949	END		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

02248C

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

00	bi	50	d6
01	KL	51	LOAD 6
02	KR	52	d7
03	Wi	53	LOAD 7
04	Qi		
05	Mi		
06	Si		
07	Yi		
08	COUNTER		
09	TOTAL LOADS		
10	L		
11	xi		
12	RL		
13	ML		
14	SL		
15	RR		
16	MR		
17	POINTER		
18	POINTER		
19	MEMORY COUNTER		
20	di		
21	d.MAX		
22	E 29,000 KSI		
23	PREVIOUS Q OR S		
24	LOC. WHEN Q=0		
25	M MAX		
26	LOC. WHEN S=0		
27	Y MAX		
28	ΔY (LL-NL)		
29	L, LC, OR LU		
30	VALUE OF R29		
31	BEAM		
32	WT. OF BEAM		
33	I		
34	S		
35	D/AF		
36	BF		
37	TF		
38	RT		
39	FB		
40	d1		
41	LOAD 1		
42	d2		
43	LOAD 2		
44	d3		
45	LOAD 3		
46	d4		
47	LOAD 4		
48	d5		
49	LOAD 5		

STATUS

SIZE 40+ TOT. REG. 25 USER MODE

ENG ____ FIX x SCI ____ ON x OFF ____

DEG x RAD ____ GRAD ____

* 2 REG. REQ'D FOR EACH LOAD

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES
00	C	FOR Y, L LC	LU
01	C	USED, L	LC LU
02	C	USED	
03	C	NO DISPLAY	
04	C	INCL. LIVE LOAD	NO LIVE LOAD
05	C	FOR Q OR M	FOR S OR Y
06	C	MAG. OF M OR Y	
07	C	LOC. OF Q OR S=0	
08	C	FOR Q OR S	FOR M OR Y

ASSIGNMENTS

FUNCTION	KEY	FUNCTION	KEY

PROGRAM REGISTERS NEEDED: 252

ROW 1 (1 : 2)

ROW 2 (2 : 8)

ROW 3 (8 : 15)

ROW 4 (16 : 26)

ROW 5 (27 : 33)

ROW 6 (34 : 36)

ROW 7 (36 : 39)

ROW 8 (40 : 48)

ROW 9 (48 : 55)

ROW 10 (56 : 65)

ROW 11 (66 : 76)

ROW 12 (76 : 80)

ROW 13 (80 : 85)

ROW 14 (86 : 91)

ROW 15 (92 : 95)

ROW 16 (95 : 100)

ROW 17 (101 : 110)

ROW 18 (111 : 118)

ROW 19 (118 : 125)

ROW 20 (126 : 133)

ROW 21 (133 : 139)

ROW 22 (140 : 148)

ROW 23 (149 : 157)

ROW 24 (157 : 165)

ROW 25 (166 : 176)

ROW 26 (177 : 186)

ROW 27 (187 : 197)

ROW 28 (198 : 208)

ROW 29 (209 : 220)

ROW 30 (221 : 233)

ROW 31 (234 : 245)

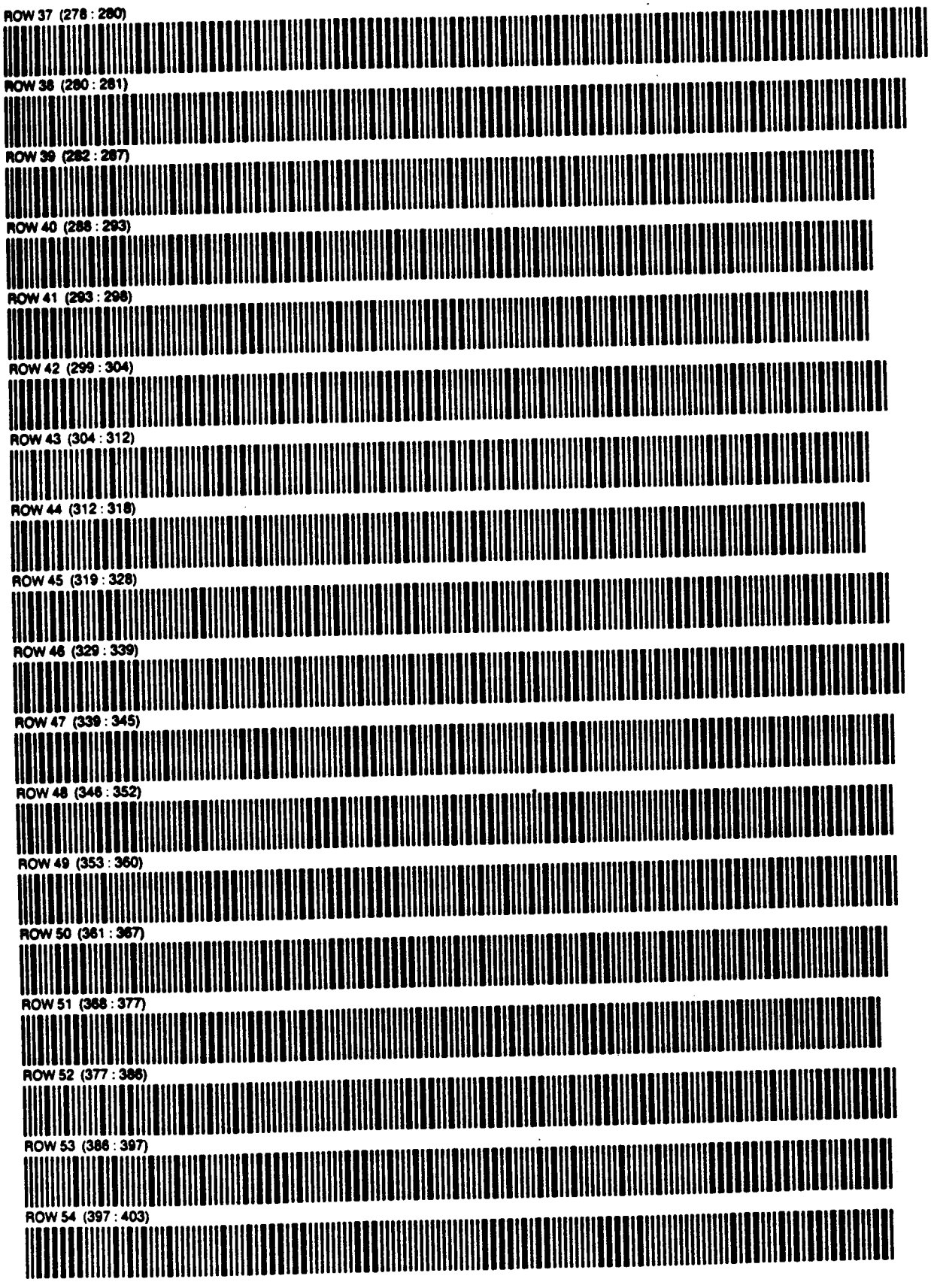
ROW 32 (245 : 253)

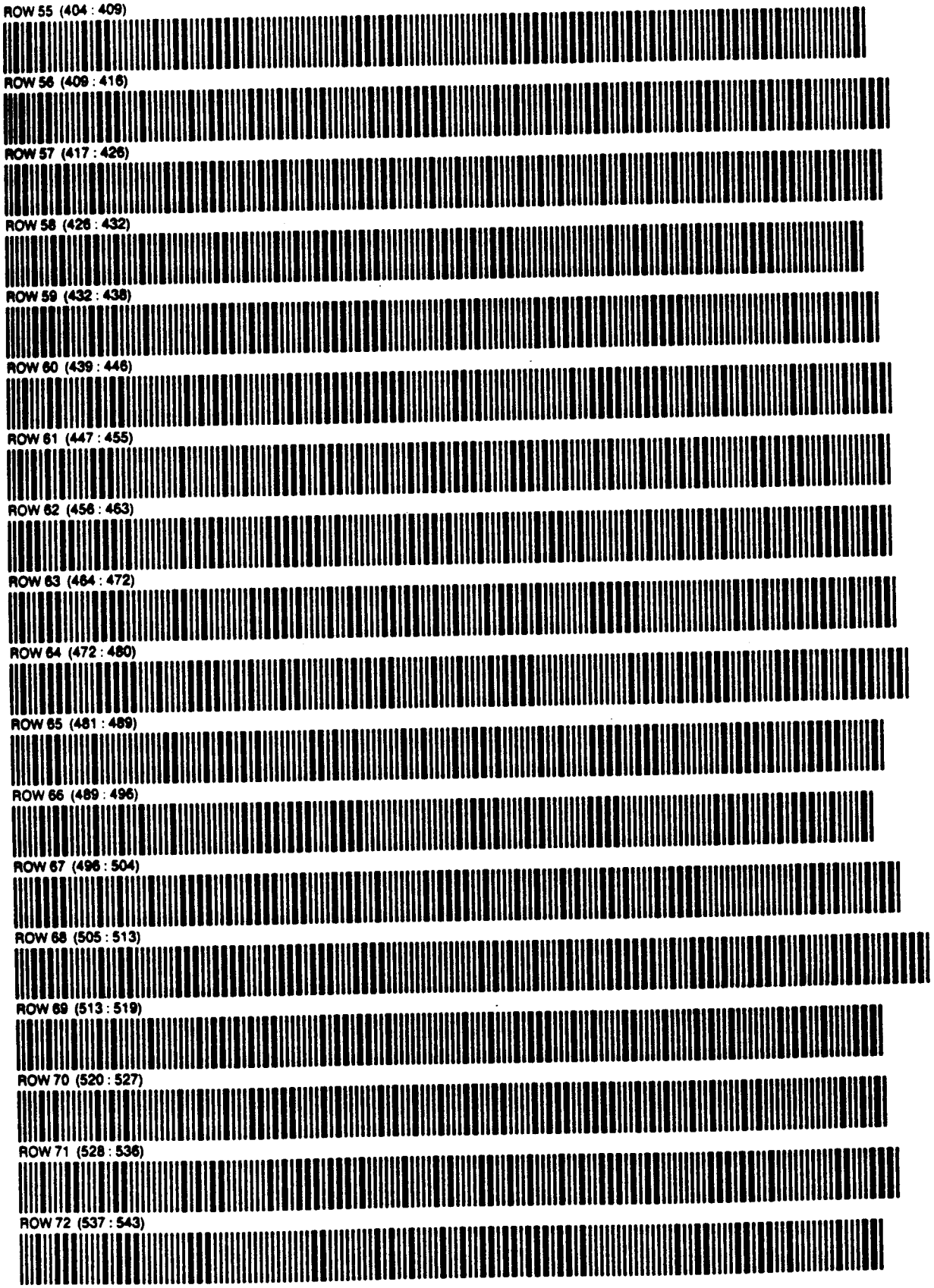
ROW 33 (254 : 261)

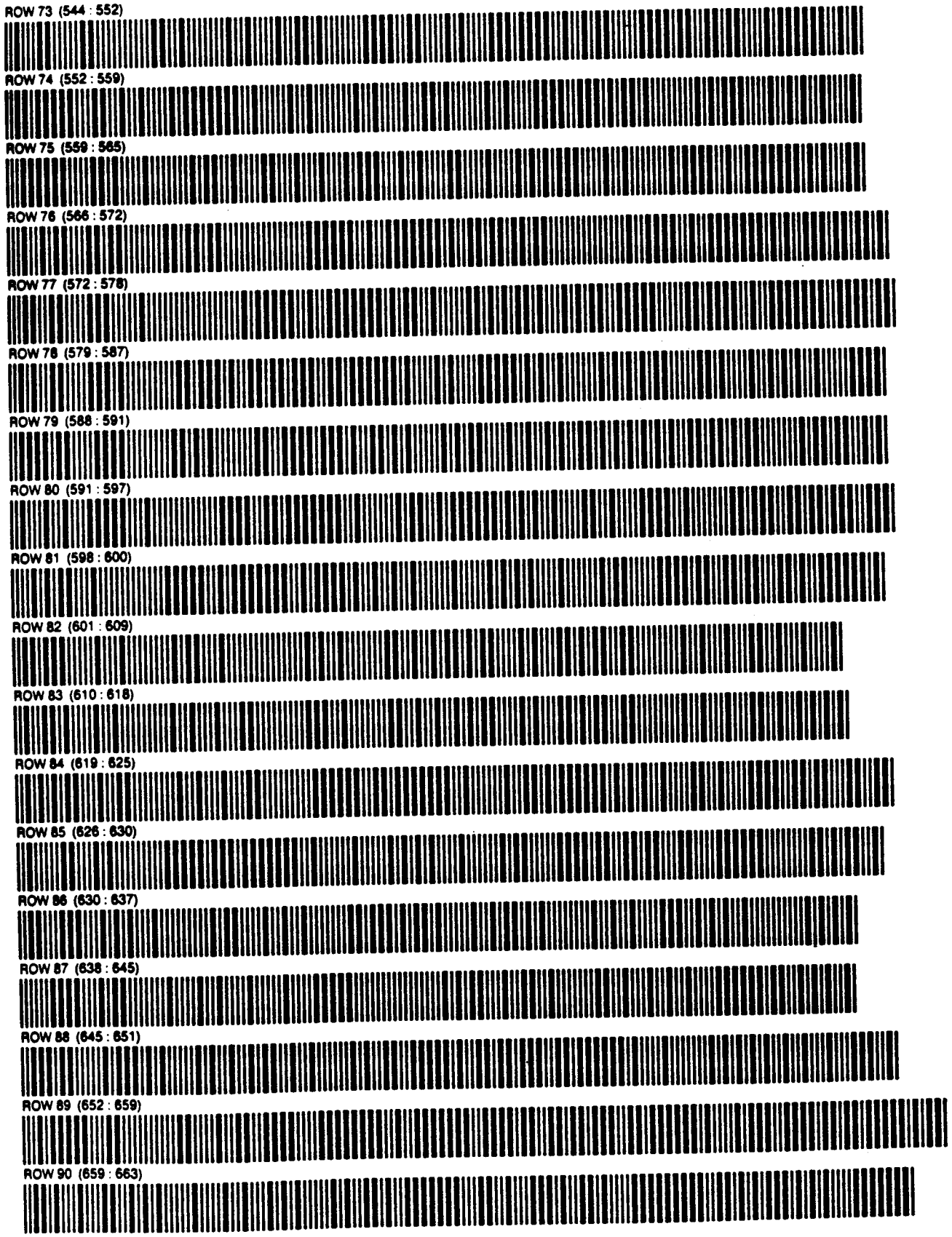
ROW 34 (262 : 267)

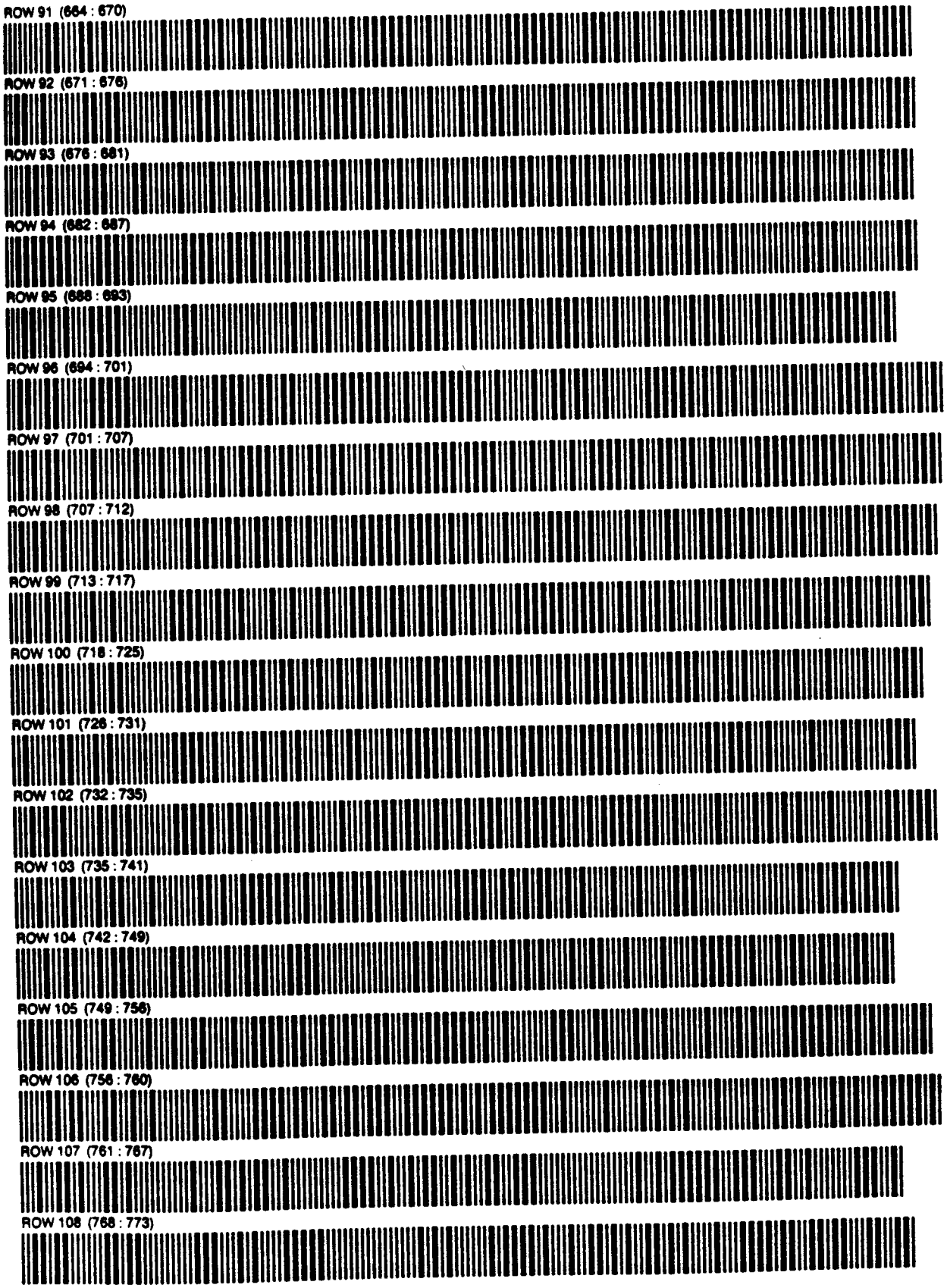
ROW 35 (267 : 274)

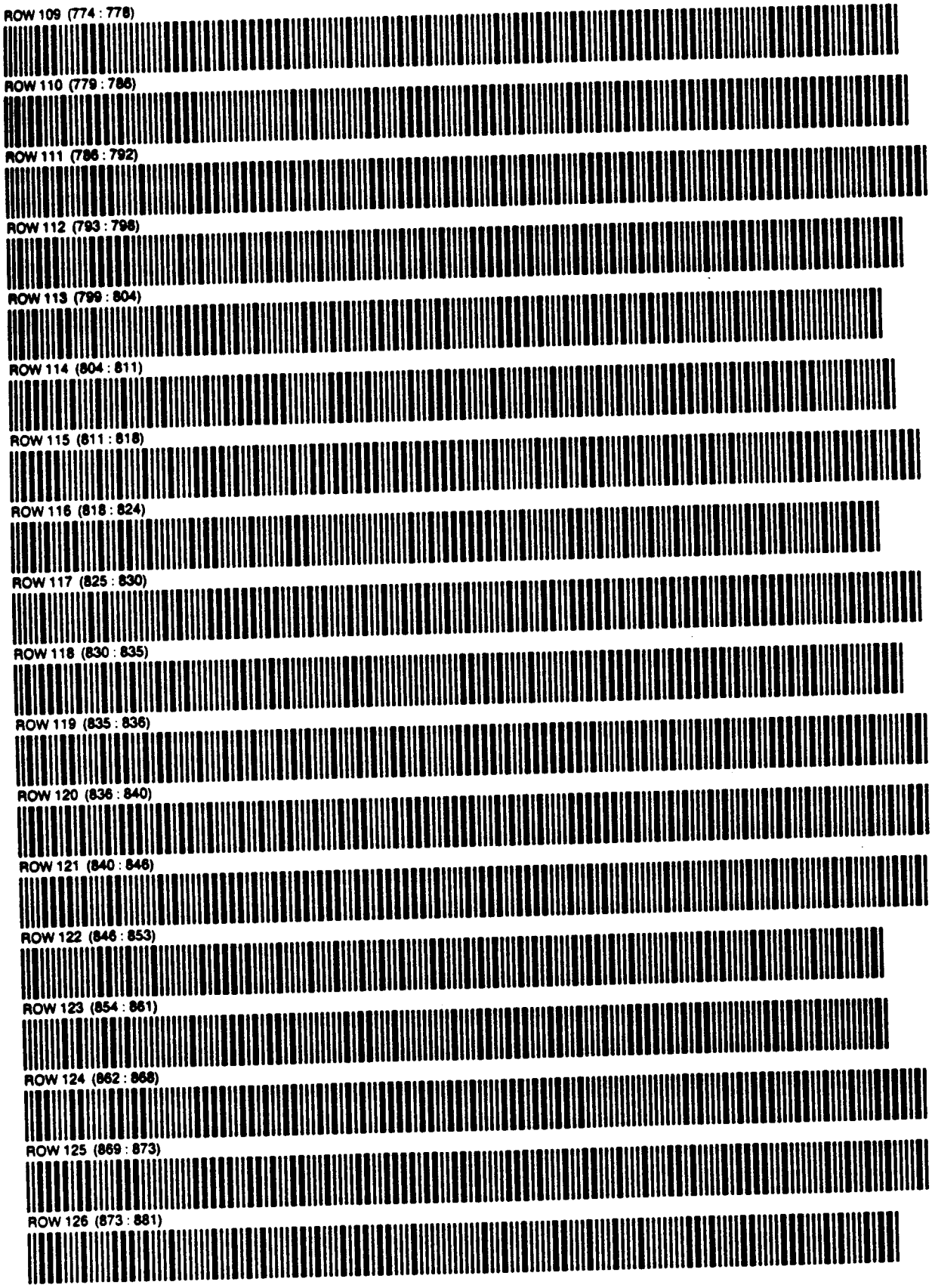
ROW 36 (274 : 278)


ROW 37 (278 : 280)
ROW 38 (280 : 281)
ROW 39 (282 : 287)
ROW 40 (288 : 293)
ROW 41 (293 : 298)
ROW 42 (299 : 304)
ROW 43 (304 : 312)
ROW 44 (312 : 318)
ROW 45 (319 : 328)
ROW 46 (329 : 339)
ROW 47 (339 : 345)
ROW 48 (346 : 352)
ROW 49 (353 : 360)
ROW 50 (361 : 367)
ROW 51 (368 : 377)
ROW 52 (377 : 386)
ROW 53 (386 : 397)
ROW 54 (397 : 403)


ROW 55 (404 : 409)
ROW 56 (409 : 416)
ROW 57 (417 : 426)
ROW 58 (426 : 432)
ROW 59 (432 : 438)
ROW 60 (439 : 446)
ROW 61 (447 : 455)
ROW 62 (456 : 463)
ROW 63 (464 : 472)
ROW 64 (472 : 480)
ROW 65 (481 : 489)
ROW 66 (489 : 496)
ROW 67 (496 : 504)
ROW 68 (505 : 513)
ROW 69 (513 : 519)
ROW 70 (520 : 527)
ROW 71 (528 : 536)
ROW 72 (537 : 543)


ROW 73 (544 : 552)
ROW 74 (552 : 559)
ROW 75 (559 : 565)
ROW 76 (566 : 572)
ROW 77 (572 : 578)
ROW 78 (579 : 587)
ROW 79 (588 : 591)
ROW 80 (591 : 597)
ROW 81 (598 : 600)
ROW 82 (601 : 609)
ROW 83 (610 : 618)
ROW 84 (619 : 625)
ROW 85 (626 : 630)
ROW 86 (630 : 637)
ROW 87 (638 : 645)
ROW 88 (645 : 651)
ROW 89 (652 : 659)
ROW 90 (659 : 663)


ROW 91 (664 : 670)
ROW 92 (671 : 676)
ROW 93 (676 : 681)
ROW 94 (682 : 687)
ROW 95 (688 : 693)
ROW 96 (694 : 701)
ROW 97 (701 : 707)
ROW 98 (707 : 712)
ROW 99 (713 : 717)
ROW 100 (718 : 725)
ROW 101 (726 : 731)
ROW 102 (732 : 735)
ROW 103 (735 : 741)
ROW 104 (742 : 749)
ROW 105 (749 : 756)
ROW 106 (756 : 760)
ROW 107 (761 : 767)
ROW 108 (768 : 773)


ROW 109 (774 : 778)
ROW 110 (779 : 786)
ROW 111 (786 : 792)
ROW 112 (793 : 798)
ROW 113 (799 : 804)
ROW 114 (804 : 811)
ROW 115 (811 : 818)
ROW 116 (818 : 824)
ROW 117 (825 : 830)
ROW 118 (830 : 835)
ROW 119 (835 : 836)
ROW 120 (836 : 840)
ROW 121 (840 : 846)
ROW 122 (846 : 853)
ROW 123 (854 : 861)
ROW 124 (862 : 868)
ROW 125 (869 : 873)
ROW 126 (873 : 881)

ROW 127 (882 : 890)

ROW 128 (890 : 894)

ROW 129 (895 : 902)

ROW 130 (903 : 908)

ROW 131 (909 : 916)

ROW 132 (916 : 922)

ROW 133 (923 : 929)

ROW 134 (930 : 936)

ROW 135 (936 : 944)

ROW 136 (944 : 949)

PROGRAM DESCRIPTION I

Program Title RETAINING WALL LOADS

Media Manufactured in USA
Software, Product of USA

Contributor's Name LAWRENCE BUSACK

Address 1925 HILL ROAD

City MONACA State/Country PA Zip Code 15061

Program Description, Equations, Variables PROGRAM CALCULATES THE RESULTANT FORCE AGAINST A WALL CAUSED BY BOTH THE SOIL ITSELF AND A UNIFORM SURCHARGE LOAD. THE SURCHARGE CAN BE OF ANY WIDTH AND CAN BE APPLIED AT ANY DISTANCE FROM THE WALL. EITHER ACTIVE OR PASSIVE SOIL PRESSURE CAN BE SPECIFIED. ADDITIONALLY AFTER THE WALL IS EVALUATED, THE PRESSURE AT ANY DEPTH CAN BE CALCULATED. NO PRINTER IS USED.

Necessary Accessories

Operating Limits and Warnings THE SOIL BACKFILL IS ASSUMED TO BE FREE DRAINING

Reference(s) JARQUIO, RAMON TOTAL LATERAL SURCHARGE PRESSURE DUE TO STRIP LOAD, JOURNAL OF THE GEOTECHNICAL ENGINEERING DIVISION, AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK, NEW YORK OCTOBER 1981

NOTE TO USER

Program is intentionally written to exclude the printer.

PROGRAM DESCRIPTION I

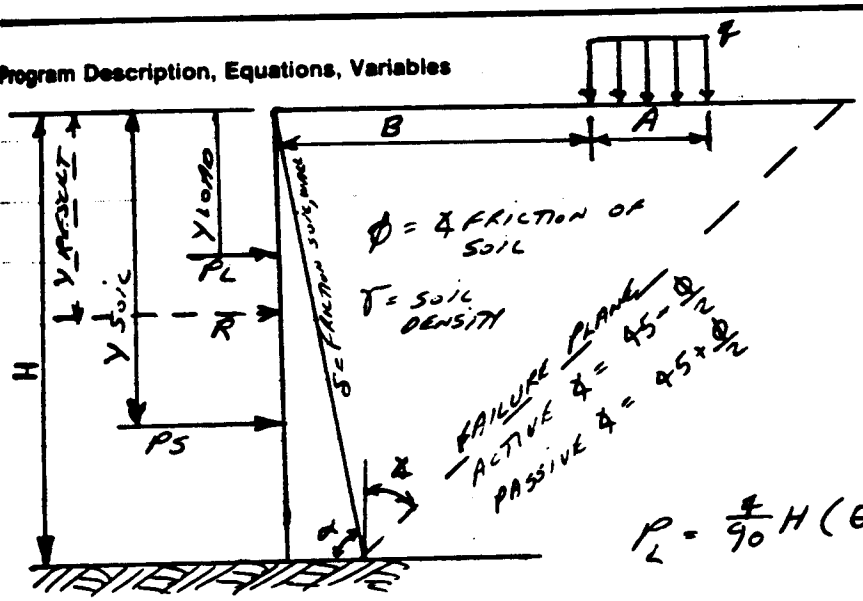
Program Title

Contributor's Name

Address

City **State/Country** **Zip Code**

Program Description, Equations, Variables



ϕ = ∠ FRICTION OF SOIL

γ = SOIL DENSITY

FAILURE PLANE W/ ACTIVE ∠ = $45° - \phi/2$

PASSIVE ∠ = $45° + \phi/2$

$$\theta_1 = \tan^{-1}\left(\frac{b}{h}\right)$$

$$\theta_2 = \tan^{-1}\left(\frac{a+b}{h}\right)$$

$$P_L = \frac{q}{90} H (\theta_2 - \theta_1)$$

$$Y_L = \frac{H^2(\theta_2 - \theta_1) + (a+b)^2(90 - \theta_2) - b^2(90 - \theta_1) - 57.3\,ah}{2h\,(\theta_2 - \theta_1)}$$

Necessary Accessories

Operating Limits and Warnings

Reference(s) PROGRAM HP 3095D RETAINING WALL - SOIL PRESSURES

(CONTINUATION PAGE)

FOR ACTIVE SOIL PRESSURE

$$M = \left[\frac{\sin(\phi+\delta)\sin\phi}{\sin(\alpha-\delta)\sin\alpha}\right]^{1/2} \qquad P_s = \tfrac{1}{2}\gamma H^2 K_a$$

$$Y_s = \frac{2H}{3}$$

$$K_a = \frac{\sin^2(\alpha+\phi)}{\sin^2\alpha\,\sin(\alpha-\delta)\,[1+M]^2}$$

FOR PASSIVE SOIL PRESSURE

$$N = \left[\frac{\sin(\phi+\delta)\sin\phi}{\sin(\alpha+\delta)\sin\alpha}\right]^{1/2} \qquad P_s = \tfrac{1}{2}\gamma H^2 K_p$$

$$Y_s = \frac{2H}{3}$$

$$K_p = \frac{\sin^2(\alpha-\phi)}{\sin^2\alpha\,\sin(\alpha+\delta)\,(1-N)^2}$$

RESULTANT PRESSURE $R = P_L + P_S$

RESULTANT LOCATION = $Y_R = \dfrac{P_L Y_L + P_S Y_S}{P_L + P_S}$

✱ ERROR CONDITIONS

IF A EXTENDS BEYOND THE FAILURE PLANE
DISPLAY "BEYOND ACTIVE/PASSIVE ZONE"

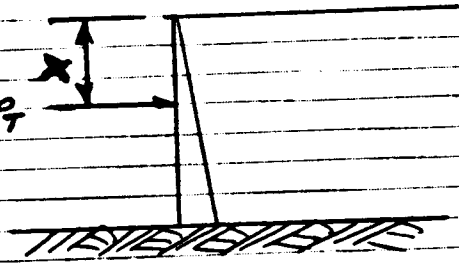
IF A EXTENDS BEYOND THE FAILURE PLANE,
REDUCE A TO BE WITHIN FAILURE PLANE AND
DISPLAY "PARTIALLY BEYOND ACTIVE/PASSIVE ZONE"

A CORRECTED = $H \tan\left(45-\frac{\phi}{2}\right) - b$ FOR ACTIVE ZONE

A CORRECTED = $H \tan\left(45+\frac{\phi}{2}\right) - b$ FOR PASSIVE ZONE

(CONTINUATION PAGE)

PRESSURE AT ANY DEPTH



X = DISTANCE FROM TOP OF WALL TO PRESSURE

P_T = TOTAL PRESSURE ON WALL AT DISTANCE X

P_{XS} = PRESSURE CAUSED BY SOIL

P_{XL} = PRESSURE CAUSED BY SURCHARGE LOAD

$$P_T = P_{XS} + P_{XL}$$

$$P_{XS} = \delta H K$$

$$P_{XL} = \frac{2q}{\pi}\left\{\frac{1}{57.3}\left[\tan^{-1}\left(\frac{a+b}{x}\right) - \tan^{-1}\left(\frac{b}{x}\right)\right] - \frac{(a+b)x}{(a+b)^2+x^2} + \frac{bx}{b^2+x^2}\right\}$$

ERROR MESSAGES

IF $X > H$ DISPLAY "DISTANCE BELOW WALL"

VARIABLES:

H = HEIGHT OF WALL

ϕ = INTERNAL FRICTION OF SOIL, DEGREES

δ = FRICTION BETWEEN SOIL AND WALL, DEGREES

α = ANGLE OF BACKSIDE OF RETAINING WALL, DEGREES

γ = DENSITY OF SOIL, lbs/ft^3

q = UNIFORM SURCHARGE LOAD, lbs/ft^2

A = WIDTH OF SURCHARGE LOAD, ft

B = DISTANCE FROM BACK OF WALL TO THE SURCHARGE LOAD, ft

P_L = LOAD ON WALL CAUSED BY SURCHARGE LOAD, lbs

Y_L = DISTANCE FROM TOP OF WALL TO APPLICATION OF LOAD, ft

P_S = LOAD ON WALL CAUSED BY SOIL, lbs

Y_S = DISTANCE FROM TOP OF WALL TO APPLICATION OF SOIL LOAD, ft

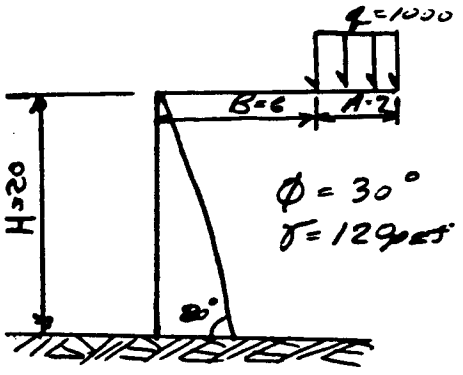
R = RESULTANT LOAD, lbs

Y_R = DISTANCE FROM TOP OF WALL TO APPLICATION OF RESULTANT LOAD, ft.

01154C

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)



A WALL IS 20 FEET HIGH WITH A BACKSLOPE OF 80°. THE WALL IS BACKFILLED WITH SOIL AT A UNIT WEIGHT OF 120 pcf. THE FRICTION ANGLE IS 30°. THE FRICTION BETWEEN SOIL AND WALL IS 20°. A LOAD OF 1000 psf IS APPLIED OVER A 7 FOOT WIDE AREA 6 FEET BEHIND THE WALL. FIND THE LOADS FOR BOTH ACTIVE AND PASSIVE SOIL PRESSURE. ALSO FIND THE PRESSURE AT 5 AND 10 FEET BELOW THE TOP OF WALL

SOLUTION:

Input	Function	Display	Comments
	XEQ "WALL"	WALL LOAD	
		HEIGHT? 0.00	
HEIGHT = 20	20 R/S	LSOIL? 0.00	
∠SOIL = 30	30 R/S	L WALL? 0.00	
∠ WALL = 20	20 R/S	L WALSL? 0.00	
∠ WALSL = 80	80 R/S	DENSE? 0.00	
DENSITY = 120	120 R/S	LOAD? 0.00	
LOAD = 1000	1000 R/S	WALDIS? 0.00	
WALDIST = 6	6 R/S	LOADWID? 0.00	
LOADWIDTH = 7	7 R/S	DATA OK Y/N	IF DATA HAS BEEN CORRECTLY ENTERED ENTER Y - PROGRAM WILL CONTINUE IF DATA HAS BEEN INCORRECTLY ENTERED ENTER N - PROGRAM WILL GO BACK TO HEIGHT? IF INPUT IS CORRECT ENTER R/S, IF INCORRECT ENTER NEW INPUT

(CONTINUATION PAGE)

INPUT	FUNCTION	DISPLAY	
	R/S	DENSE? 120.00	NO CHANGE, ENTER R/S
	R/S	LOAD? 1,000.00	NO CHANGE, ENTER R/S
	R/S	WALDIS? 6.00	NO CHANGE, ENTER R/S
	R/S	LOADWID? 7.00	NO CHANGE ENTER R/S
		DATA OK Y/N	DATA IS OK, ENTER Y
	Y R/S	ACT/PASS?	FOR PASSIVE SOIL PRESSURES ENTER PASS
	PASS R/S	R = 110,433.72	} OVERALL RESULTANT
	R/S	Y RESULT = 13.17	
	R/S	PL = 3627.69	} PORTION OF RESULTANT CREATED BY SURCHARGE
	R/S	YLOAD = 8.42	
	R/S	PS = 106,806.02	} PORTION OF RESULTANT CREATED BY SOIL
	R/S	Y SOIL = 13.33	
	R/S	K = 4.45	COEFFICIENT OF PASSIVE SOIL PRESSURE
		WALPRES Y/N	
	Y R/S	DISTANCE?	
DISTANCE = 5	5 R/S	PRES = 2,978.46	WALL PRESSURE AT 5 FEET
		NUPRES Y/N	
	Y R/S	DISTANCE?	
DISTANCE = 10	10 R/S	PRES = 5,552.01	WALL PRESSURE AT 10 FEET
	R/S	NUPRES Y/N	
	N R/S	NUWALL Y/N	

AS A SECOND PROBLEM ASSUME THE SAME WALL WITH NO SURCHARGE LOAD. THEREFORE ENTER Y

(CONTINUATION PAGE)

INPUT	FUNCTION	DISPLAY	
	Y R/S	ACT/PASS?	CHOOSE BETWEEN ACTIVE OR PASSIVE SOIL PRESSURE
	ACT R/S	PARTIALLY BEYOND ACTIVE ZONE	
		R=12,001.36	} OVERALL RESULTANT
	R/S	YRESULT = 12.05	}
	R/S	PL = 2,955.72	} PORTION OF RESULTANT CAUSED BY SURCHARGE LOAD
	R/S	YLOAD = 8.13	}
	R/S	PS = 9,045.64	} PORTION OF RESULTANT CAUSED BY SOIL
	R/S	Y SOIL = 13.33	}
	R/S	K = 0.38	COEFFICIENT OF ACTIVE SOIL PRESSU
	R/S	WALPRES Y/N	ENTER Y TO CALCULATE PRESSURES AT 5 & 10' BELOW TOP OF WALL
	Y R/S	DISTANCE?	DISTANCE BELOW WALL IS 5'
	5 R/S	PRES = 489.22 lbs/ft²	PRESSURE AT 5 FEET
	R/S	NUPRES Y/N	ENTER Y TO CALCULATE PRESSURE AT 10 FEET BELOW WALL
	Y R/S	DISTANCE?	
DISTANCE = 10	10 R/S	PRES = 619.67 lbs/ft²	AT 10 FEET BELOW WALL
	R/S	NUPRES Y/N	ENTER N TO CONTINUE PROGRAM
	N R/S	NUWALL Y/N	SINCE PASSIVE SOIL PRESSURE RESULTS ARE ALSO DESIRED ENTER Y TO RETURN TO INPUT SECTION OF PROGRAM.
	Y R/S	HEIGHT? 20.00	HEIGHT IS THE SAME, THEREFORE NO CHANGE IS REQUIRED, ENTER R/S
	R/S	L SOIL? 30.00	NO CHANGE, ENTER R/S
	R/S	L WALL? 20.00	NO CHANGE, ENTER R/S
	R/S	L WALSL? 80.00	NO CHANGE, ENTER R/S

(CONTINUATION PAGE)

INPUT	FUNCTION	DISPLAY	
	Y R/S	HEIGHT? 20.00	OK, ENTER R/S
	R/S	L SOIL? 30.00	
	R/S	L WALL? 20.00	
	R/S	L WALSU? 80.00	
	R/S	DENSE? 120.00	
	R/S	LOAD? 1,000.00	LOAD IS NOW 0
	0 R/S	DATA OK Y/N	DATA IS OK, ENTER Y
	Y R/S	ACT/PASS?	EVALUATE ONLY THE ACTIVE CASE
	ACT R/S	PS = 9,045.64	} SINCE NO SURCHARGE IS APPLIED ONLY SOIL RESULTS ARE SHOWN
	R/S	Y SOIL = 13.33	
	R/S	K = 0.38	
	R/S	WALPRES Y/N	
	Y R/S	DISTANCE?	
DISTANCE = 5.5	R/S	PRES = 226.14	PRESSURE FROM SOIL PRESSURE ONLY
	R/S	NUPRES Y/N	
	Y R/S	DISTANCE?	
DISTANCE = 10	10 R/S	PRES = 452.28	
	R/S	NUPRES Y/N	
	N R/S	NUNALL Y/N	ALL CALCULATIONS ARE COMPLETE, ENTER N R/S
	N R/S	WALL LOAD HEIGHT? 0.00	

USER INSTRUCTIONS

SIZE: (HP-41C)

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	LOAD PROGRAM			
2			XEQ "WALL"	WALL LOAD
2A				HEIGHT? 0.00*
3	ENTER HEIGHT, ft		R/S	L SOIL? 0.00*
4	ENTER SOIL FRICTION ϕ, DEG.		R/S	L WALL? 0.00*
5	ENTER WALL FRICTION δ, DEG.		R/S	L WALSL? 0.00*
6	ENTER BACKSLOPE OF WALL α, DEG		R/S	DENSE? 0.00*
7	ENTER SOIL DENSITY γ, lbs/ft^3		R/S	LOAD? 0.00*
8	ENTER APPLIED SURCHARGE, q, lbs/ft^2		R/S	
	IF SURCHARGE IS ZERO	(SKIP TO STEP 9)	R/S	DATA OK Y/N
	IF SURCHARGE IS NOT ZERO.		R/S	WALDIS? 0.00
8A	ENTER DISTANCE FROM LOAD TO POINT OF APPLICATION, ft		R/S	LOADWID? 0.00
8B	ENTER WIDTH OF LOAD, ft		R/S	DATA OK Y/N
9	IF DATA IS OK ENTER "Y" PROGRAM GOES TO STEP 10		R/S	ACT/PASS?
	IF DATA IS NOT OK, ENTER "N", PROGRAM RETURNS TO STEP 2A			

* AFTER FIRST USE OF PROGRAM, 0.00 IS REPLACED BY CURRENT VALUE OF DATA

USER INSTRUCTIONS

SIZE: (HP-41C)

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
10	IF ACTIVE SOIL PRESSURE IS TO BE USED		"ACT" R/S	*
	IF PASSIVE SOIL PRESSURE IS TO BE USED		"PASS" R/S	*
	* IF ERROR MESSAGES ARE NEEDED THEY WILL BE DISPLAYED FIRST THEN PROGRAM GOES TO STEP 11			
	MESSAGES:			
	① PARTIALLY BEYOND ACTIVE ZONE			
	② BEYOND ACTIVE ZONE			
	③ PARTIALLY BEYOND PASSIVE ZONE			
	④ BEYOND PASSIVE ZONE			
	* IF NO SURCHARGE LOAD HAS BEEN ENTERED NO ERROR MESSAGES WILL BE DISPLAYED. PROGRAM SKIPS TO STEP 15			
11				R= ⊛
12			R/S	YRESULT=⊛
13			R/S	PL = ⊛
14			R/S	YLOAD = ⊛
15			R/S	PS = ⊛

USER INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	SIZE: (HP-41C) DISPLAY
16			R/S	Y SOIC = ⊛
17			R/S	K = ⊛
	⊛ CURRENT VALUE IS DISPLAYED			
18			R/S	WALPRES Y/N
	IF WALL PRESSURES ARE DESIRED ENTER "Y"			
	PROGRAM GOES TO STEP 19		Y R/S	DISTANCE?
	IF NO WALL PRESSURES ARE DESIRED ENTER "N"			
	PROGRAM GOES TO STEP 21		N R/S	NUWALL Y/N
19	ENTER DISTANCE, X, BELOW WALL			DISTANCE?
			R/S	PRES = ⊛
	⊛ CURRENT VALUE IS DISPLAYED			
20			R/S	NUPRES Y/N
	IF ADDITIONAL WALL PRESSURES ARE DESIRED ENTER "Y" PROGRAM RETURNS TO STEP 19		Y R/S	DISTANCE?

USER INSTRUCTIONS

			SIZE: (HP-41C)
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
	IF NO ADDITIONAL WALL PRESSURES ARE DESIRED ENTER "N" PROGRAM GOES TO STEP 21		N R/S	NU WALL Y/N
21	IF ADDITIONAL PROBLEMS ARE TO BE RUN ENTER "Y" PROGRAM GOES TO STEP 2A		Y R/S	HEIGHT? ⊛
	⊛ DISPLAYS CURRENT VALUE			
	IF NO ADDITIONAL PROBLEMS ARE TO BE RUN ENTER "N" PROGRAM GOES TO STEP 2		N R/S	WALL LOAD HEIGHT? 0.00

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PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
✱01	LBL WALL		INITIALIZE
✱	LBL 00		PROGRAM
	CF 21		AND DISPLAY
	CL RG		TITLE
	WALL		
	AVIEW		TURN OFF
	PSE		PRINTER
	LOAD		
	AVIEW		
10	PSE		
✱	LBL 01		CLEAR FLAGS
✱	LBL IN		FOR NEW
	CF 01		RUN
	CF 02		
	CF 03		
	CF 04		
	0		
	STO 20		
	HEIGHT?		
20	XEQ 12		
	1		
	STO 20		
	L SOIL?		
	XEQ 12		
	2		
	STO 20		
	L WALL?		
	XEQ 12		
	3		
30	STO 20		
	L WALSL?		
	XEQ 12		
	4		
	STO 20		
	DENSE?		
	XEQ 12		
	5		
	STO 20		
	LOAD?		
40	XEQ 12		
	XL=0?		
	SF 04		
	FS?04		
	GTO 07		
	6		
	STO 20		
	WALDIS?		
	XEQ 12		
	7		
50	STO 20		

ENTER INPUT DATA AND STORE ON DATA REVIEW, RECALL BOTH NAME AND VALUE ⇒ CHANGE ONLY VALUES WHICH ARE IN ERROR, BYPASS CORRECT VALUES WITH R/S

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
51	LOADWIO?		
	XEQ 12		
	GTO 07		
✱	LBL 12		GENERALIZED
	ARCL IND 20		INPUT
	AVIEW		PROGRAM
	RCL IND 20		
	STOP		
	STO IND 20		
60	RTN		
✱	LBL 07		ASK IF DATA
	DATA OK Y/N •		IS OK OR
	AON		DOES IT NEED
	PROMPT		TO BE CHANGED
	AOFF		
	ASTO X		
	N		
	ASTO Y		
	X=Y?		
70	GTO 01		
	ACT/PASS?		CHOOSE BETWEEN
	AON		EITHER THE
	PROMPT		ACTIVE OR
	AOFF		
	ASTO X		PASSIVE SOIL
	PASS		STATE
	ASTO Y		
	X=Y?		
	SF 03		
80	FS?04		IF NO LOAD BYPASS
	GTO 08		LOAD SURCHARGE
	45		
	RCL 01		
	2		
	/		
	FS?03		
	CHS		
	—		
	TAN		
90	RCL 00		
	✱		
	RCL 06		
	—		
	RCL 07		
	X?Y?		
	SF 01		
	FS?01		
	XL?Y		
	XL0?		
100	SF 02		

IF $A \geq H \tan(45-\frac{\phi}{2})-b$ ALL LOAD IS WITHIN ACTIVE ZONE

IF $A \geq H \tan(45+\frac{\phi}{2})-b$ ALL LOAD IS WITHIN PASSIVE ZONE

IF NOT TOTALLY WITHIN ZONE REDUCE TO BE WITHIN ZONE

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
001	F5? 02		IF BEYOND ZONE
	GTO 08		SKIP LOADS CAL
	STO 10		ONLY SOIL LOAD
	RCL 06		
	+		$\theta_2 = TAN^{-1}\left(\frac{a+b}{h}\right)$
	RCL 00		
	/		
	ATAN		
	STO 09		
010	RCL 06		$\theta_1 = TAN^{-1}\left(\frac{b}{h}\right)$
	RCL 00		
	/		
	ATAN		
	STO 08		
	−		$P_L = \frac{\gamma}{90} h (\theta_2 - \theta_1)$
	RCL 00		
	X		
	RCL 05		
	X		
020	90		
	/		
	STO 11		$\gamma_L = \frac{k^2(\theta_2-\theta_1)+(a+b)^2(90-\theta_2)-b^2(90-\theta_1)-57.3h}{2h\,(\theta_2-\theta_1)}$
	RCL 09		
	RCL 08		
	−		
	RCL 00		
	X^2		
	X		
	RCL 10		
030	RCL 06		
	+		
	X^2		
	90		
	RCL 09		
	−		
	X		
	+		
	90		
	RCL 08		
040	−		
	RCL 06		
	X^2		
	X		
	−		
	RCL 10		
	RCL 00		
	X		
	57.3		
	X		
050	−		

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
151	RCL 09		
	RCL 08		
	−		
	RCL 00		
	X		
	2		
	X		
	/		
	STO 12		
*060	LBL 08		
	RCL 01		
	RCL 02		
	+		
	SIN		
	RCL 01		
	SIN		
	X		
	RCL 03		
	RCL 02		
170	F5? 03		
	CHS		
	−		
	SIN		
	/		
	RCL 03		
	SIN		
	/		
	$\sqrt{X}$		
	F5? 03		
180	CHS		
	1		
	+		
	X^2		
	RCL 03		
	RCL 02		
	F5? 03		
	CHS		
	−		
	SIN		
190	X		
	RCL 03		
	SIN		
	X^2		
	X		
	RCL 03		
	RCL 01		
	F5? 03		
	CHS		
200	+		

$M = \left[\frac{\sin(\phi+\delta)\sin\phi}{\sin(\alpha-\delta)\sin\alpha}\right]^{1/2}$ ACTIVE ZONE

$N = \left[\frac{\sin(\phi+\delta)\sin\phi}{\sin(\alpha+\delta)\sin\alpha}\right]^{1/2}$ PASSIVE ZONE

$K_\alpha = \frac{\sin^2(\alpha+\phi)}{\left[\sin^2\alpha\sin(\alpha-\delta)\right]\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\beta)}{\sin(\alpha-\delta)\sin(\alpha+\beta)}}\right]^2}$

$K_p = \frac{\sin^2(\alpha-\phi)}{\left[\sin^2\alpha\sin(\alpha+\delta)\right]\left[1-\sqrt{\frac{\sin(\phi+\delta)\sin(\phi+\beta)}{\sin(\alpha+\delta)\sin(\alpha+\beta)}}\right]^2}$

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
201	SIN		
	X²		
	X		
	STO 13		
	RCL 00		
	STO 15		$P_S = \frac{1}{2} T H^2 K$
	X²		
	X		
	RCL 04		$Y_S = \frac{2K}{3}$
210	X		
	2		
	ST X 15		
	/		
	STO 14		
	3		
	STO / 15		
	FS? 04		IF NO LOAD, SHOW ONLY SOIL RESULTS
	GTO 10		
	FS? 02		IF BEYOND ZONE SHOW ONLY SOIL AND DISPLAY ERROR
220	GTO 09		
	RCL 11		
	STO 16		
	RCL 12		
	X		
	RCL 14		
	ST+ 16		
	RCL 15		
	X		
	+		
230	RCL 16		
	/		
	STO 17		$R = P_L + P_S$ $\quad Y_R = \frac{P_L Y_L + P_S Y_S}{P_L + P_S}$
	FS? 01		IF ONLY PARTIALLY BEYOND ZONE SHOW ALL RESULTS
	XEQ 05		
*	LBL 09		
	FS? 02		IF BEYOND ZONE SHOW ONLY SOIL AND DISPLAY ERROR
	XEQ 03		
	FS? 02		
	GTO 10		
240	R=		DISPLAY RESULTANT INFORMATION
	RCL 16		
	AVIEW		
	STOP		
	YRESULT=		
	RCL 17		
	AVIEW		
	STOP		
	PL=		DISPLAY SURCHARGE
	RCL 11		
250	AVIEW		

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
251	STOP		
	YLOAD=		INFO
	RCL 12		
	AVIEW		
	STOP		
*	LBL 10		
	PS=		DISPLAY
	RCL 14		SOIL
	AVIEW		
260	STOP		RESULTS
	Y SOIL=		
	RCL 15		
	AVIEW		
	STOP		
	K=		
	RCL 13		
	AVIEW		
	STOP		
	WALPRES Y/N		PROVIDE OPTION
270	AON		OF CALCULATIN
	PROMPT		WALL PRESSURE
	AOFF		
	ASTO X		AT DEPTH
	N		
	ASTO Y		
	X=Y?		
	GTO 04		
*	LBL 06		ENTER DEPTH
	DISTANCE?		BELOW WALL
280	PROMPT		
	STO 18		
	RCL 00		IF BELOW WALL
	XLO?		DISPLAY MESSAGE
	GTO 02		
	FS? 02		IF BEYOND ZONE
	0		BYPASS
	FS? 02		SURCHARGE
	STO 19		PRESSURES
	FS? 02		
290	GTO 11		
	FS? 04		IF NO LOAD
	0		BYPASS
	FS? 04		SURCHARGE
	STO 19		PRESSURES
	FS? 04		
	GTO 11		
	RCL 10		
	RCL 06		
	+		
300	STO 19		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
301	RCL 18		
	/		
	ATAN		
	RCL 06		
	RCL 18		
	/		
	ATAN		
	−		
	57.3		
310	/		
	RCL 19		
	RCL 18		
	X		
	RCL 19		
	X^2		
	RCL 18		
	X^2		
	+		
	/		
320	−		
	RCL 06		
	RCL 18		
	X		
	RCL 06		
	X^2		
	RCL 18		
	X^2		
	+		
	/		
330	+		
	RCL 05		
	X		
	PI		
	/		
	2		
	X		
	STO 19		
*	LBL 11		
	RCL 18		
340	RCL 04		
	X		
	RCL 13		
	X		
	ST+ 19		
	PRES=		
	ARCL 19		
	AVIEW		
	STOP		
	NUPRES Y/N		
350	AON		

$$P_{XL} = \frac{2\pi}{\pi}\left\{\frac{1}{57.3}\left[\tan^{-1}\left(\frac{a+b}{x}\right) - \tan^{-1}\left(\frac{b}{x}\right)\right] - \frac{(a+b)x}{(a+b)^2+x^2} + \frac{bx}{b^2+x^2}\right\}$$

$P_{XS} = SHK$

$P_T = P_{XS} + P_{XL}$

DISPLAY PRESSURE AT DEPTH

ASK IF OTHER WALL PRESSURES

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
351	PROMPT		ARE DESIRED
	AOFF		
	ASTO X		
	Y		
	ASTO Y		
	X=Y?		
	GTO 06		
*	LBL 04		ASK IF
	NUWALL Y/N		PROGRAM IS
360	AON		TO BE REPEATED
	PROMPT		
	AOFF		IF YES GO TO INPUT
	ASTO X		
	Y		IF NO GO TO START
	ASTO Y		
	X=Y?		
	GTO 01		
	GTO 00		
*	LBL 05		
370	PARTIALLY		DISPLAY MESSAGES FOR WALL PROGRAM = (PARTIALLY) BEYOND ACTIVE/ PASSIVE ZONE"
	AVIEW		
	PSE		
*	LBL 03		
	BEYOND		
	AVIEW		
	PSE		
	ACTIVE		
	FS?03		
	CLA		
380	FS?03		
	PASSIVE		
	AVIEW		
	PSE		
	ZONE		
	AVIEW		
	PSE		
	RTN		
*	LBL 02		DISPLAY MESSAGE FOR PRESSURES = "DISTANCE BELOW WALL"
	DISTANCE		
390	AVIEW		
	PSE		
	BELOW		
	AVIEW		
	PSE		
	WALL		
	AVIEW		
	PSE		
	GTO 06		
399	END		
00			

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E.
67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes

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REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

INPUT	OUTPUT
00 H = HEIGHT	08 θ_1
01 ϕ = ∠ SOIL	09 θ_2
02 δ = ∠ WALL	10 A CORRECTED
03 α = ∠ WALL SL	11 PL
04 γ = DENSE	12 Y LOAD
05 q = LOAD	13 K
06 B = WALL IS	14 PS
07 A = LOAD WID	15 Y SOIL
	16 R
	17 Y RESULT
	18 X = DISTANCE
	19 Φ = PRES
	20 DATA LOADER

STATUS

SIZE 21	TOT. REG.		USER MODE		
ENG	FIX 2	SCI	ON	OFF	
DEG X	RAD	GRAD			

FLAGS

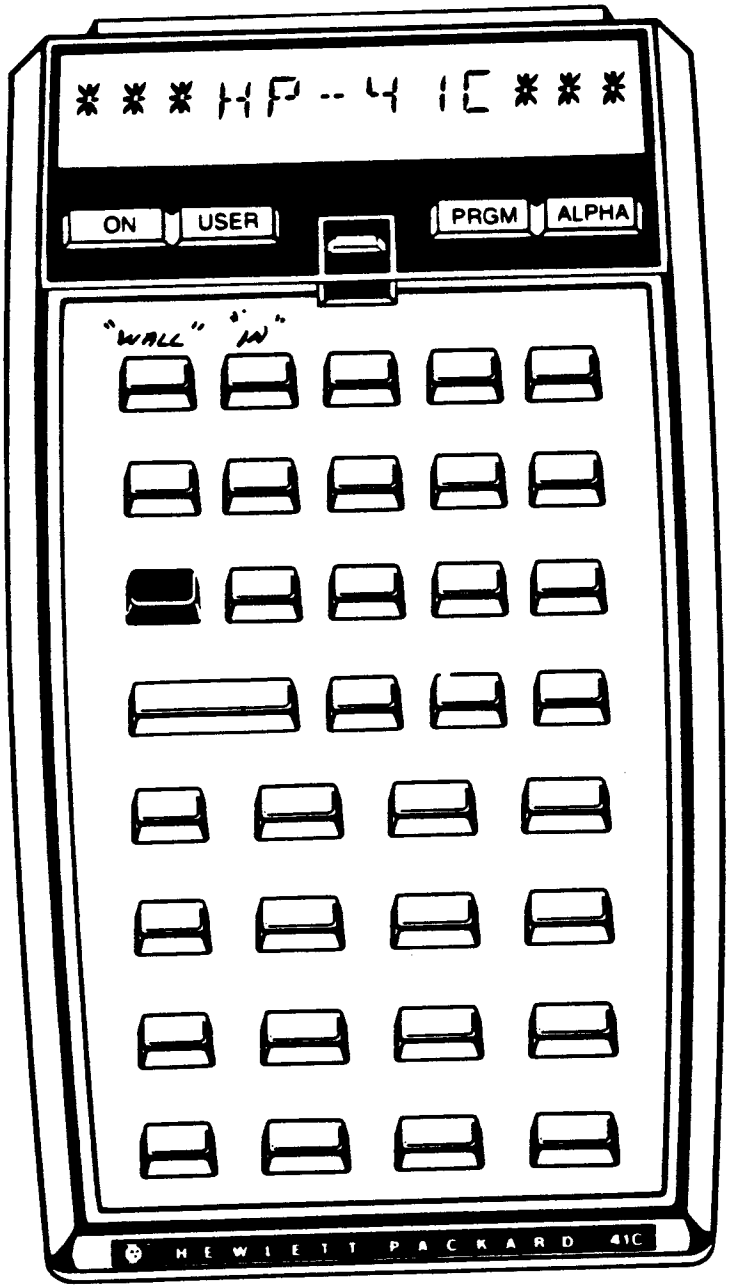
#	INIT S/C	SET INDICATES	CLEAR INDICATES
01	C	PARTIALLY BEYOND ZONE	WITHIN ZONE
02	C	BEYOND ZONE	WITHIN ZONE
03	C	PASSIVE ZONE	ACTIVE ZONE
04	C	NO LOAD	LOAD

ASSIGNMENTS

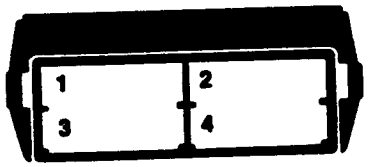
FUNCTION	KEY	FUNCTION	KEY
"WALL"	LBL00		
"IN"	LBL01	NO LOAD-WALL PASS	LBL
		DATA OK	LBL
ERROR-BEYOND TIE	LBL02	SOIL ROAD	LBL
ERROR-BEYOND ZONE	LBL03	NO RESULTANT	LBL
ERROR-PARTIALLY BEYOND ZONE	LBL05	NO RESULTANT	LBL
		DATA INPUT	LBL
NEW WALL	LBL04		
WALL PRESSURE	LBL06		

KEYBOARD CARD LABELING

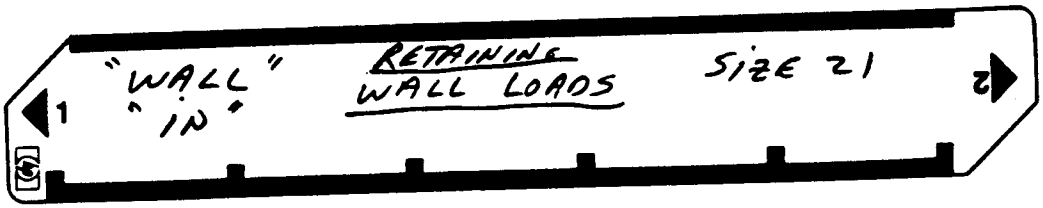
KEYBOARD



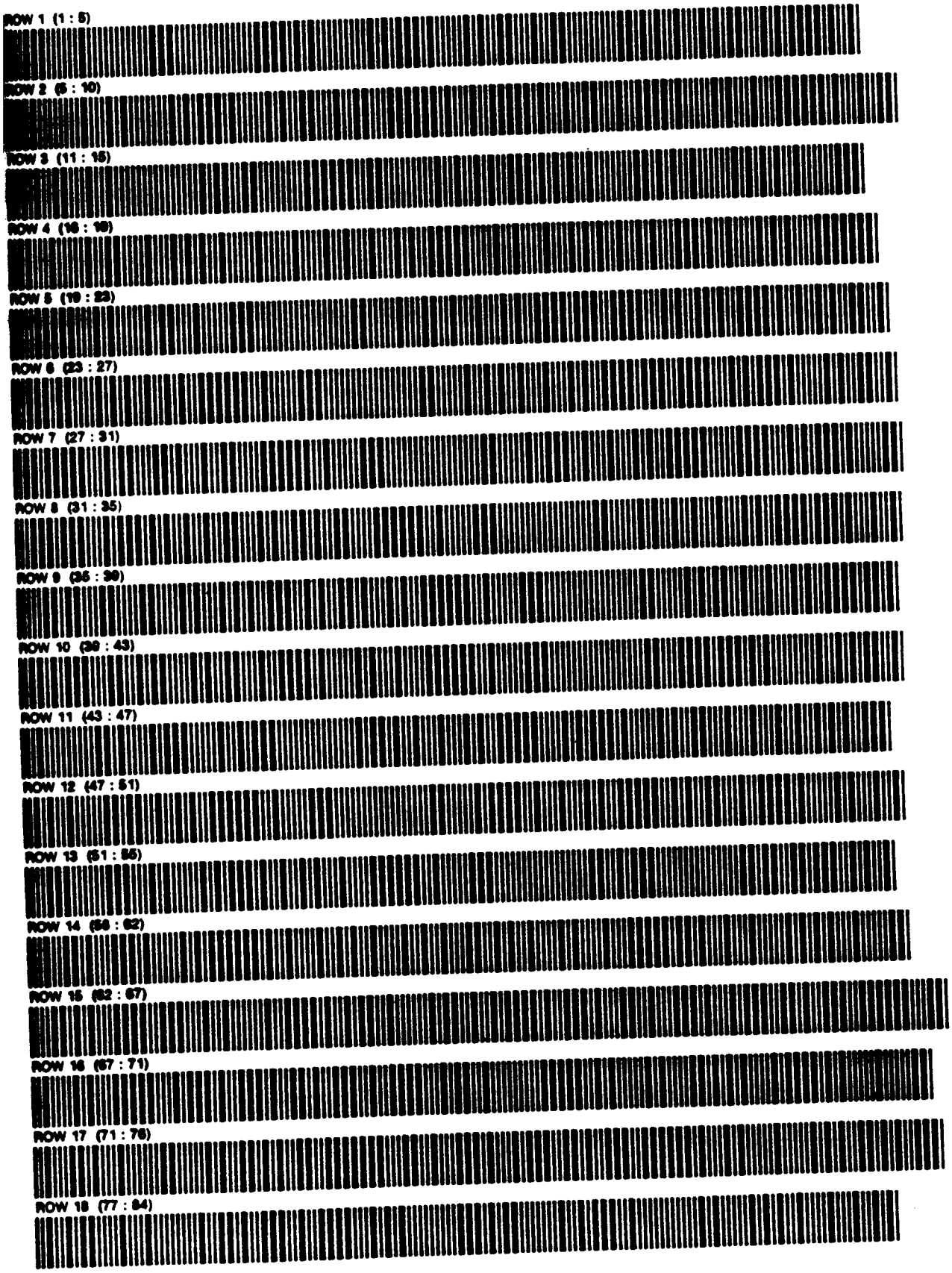
SYSTEM CONFIGURATION

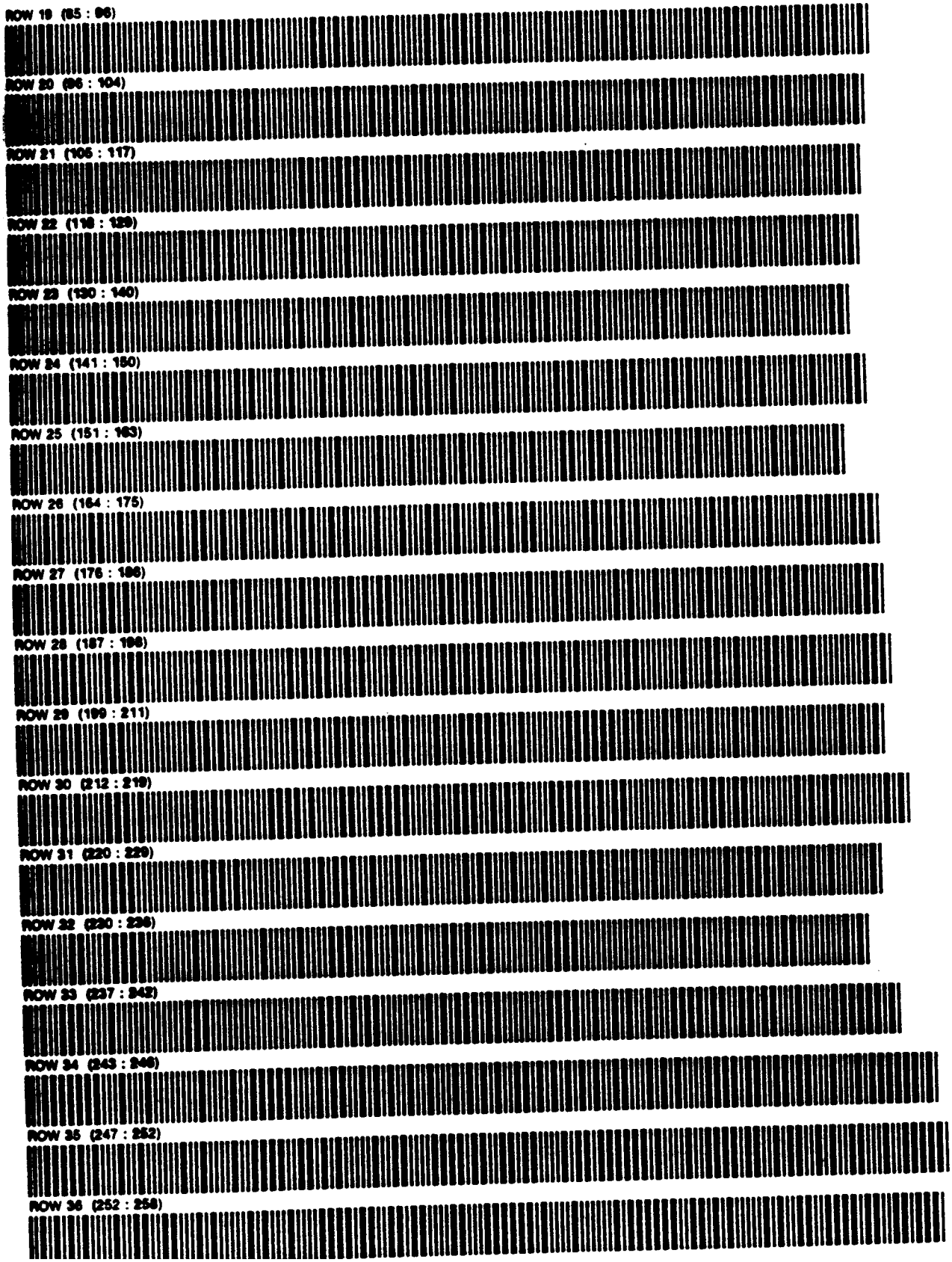


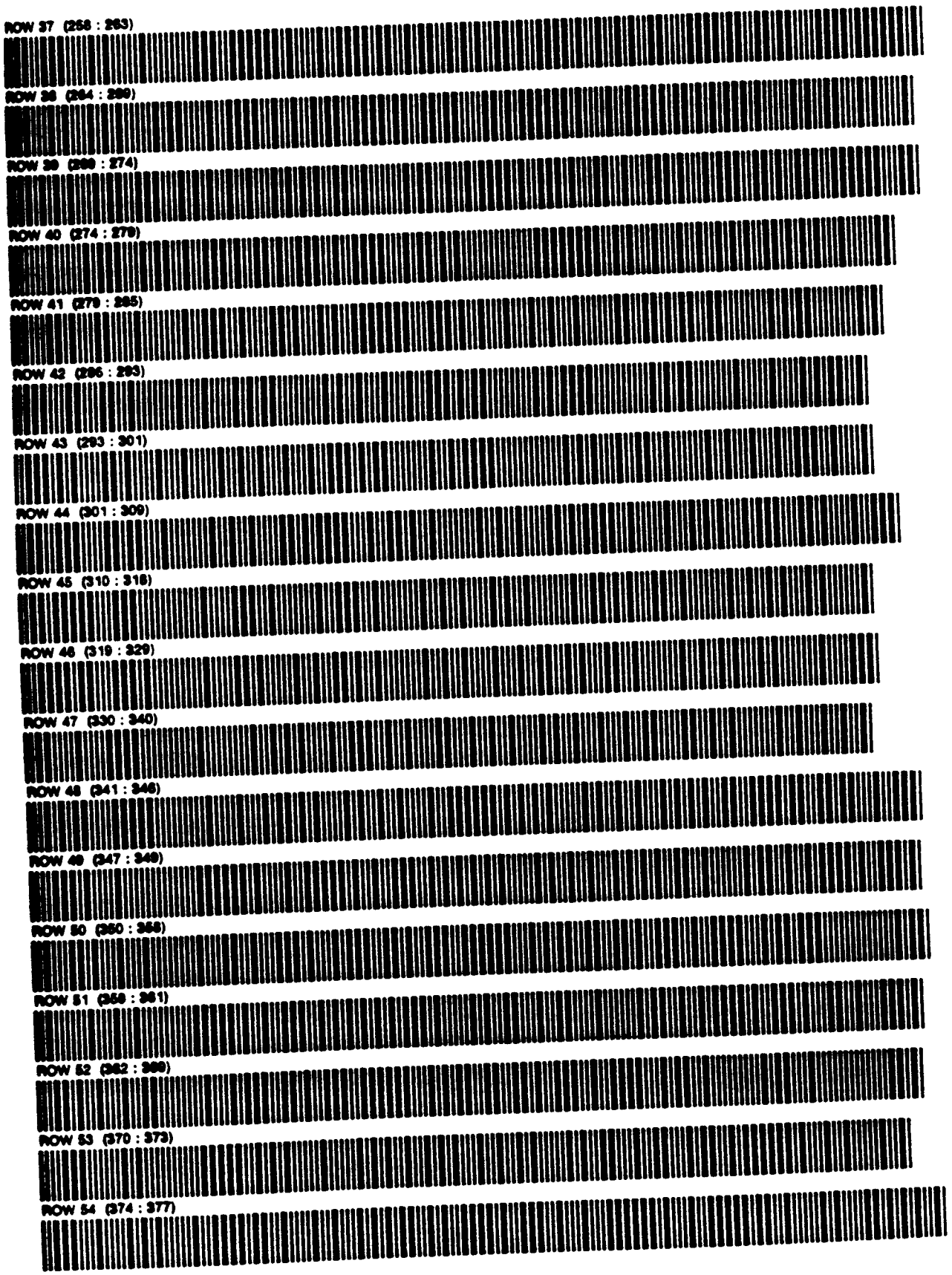
CARD

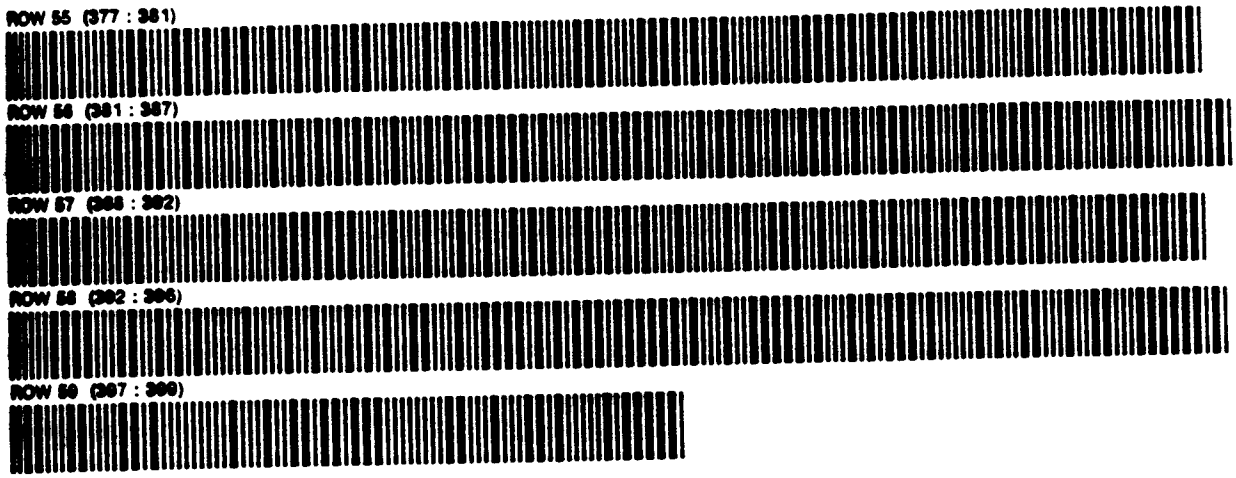


OGRAM REGISTERS NEEDED: 109




ROW 19 (85 : 96)
ROW 20 (96 : 104)
ROW 21 (105 : 117)
ROW 22 (118 : 129)
ROW 23 (130 : 140)
ROW 24 (141 : 150)
ROW 25 (151 : 163)
ROW 26 (164 : 175)
ROW 27 (176 : 186)
ROW 28 (187 : 198)
ROW 29 (199 : 211)
ROW 30 (212 : 219)
ROW 31 (220 : 229)
ROW 32 (230 : 236)
ROW 33 (237 : 242)
ROW 34 (243 : 246)
ROW 35 (247 : 252)
ROW 36 (252 : 258)


ROW 37 (258 : 263)
ROW 38 (264 : 269)
ROW 39 (269 : 274)
ROW 40 (274 : 279)
ROW 41 (279 : 285)
ROW 42 (285 : 293)
ROW 43 (293 : 301)
ROW 44 (301 : 309)
ROW 45 (310 : 318)
ROW 46 (319 : 329)
ROW 47 (330 : 340)
ROW 48 (341 : 346)
ROW 49 (347 : 349)
ROW 50 (350 : 356)
ROW 51 (358 : 361)
ROW 52 (362 : 369)
ROW 53 (370 : 373)
ROW 54 (374 : 377)


ROW 55 (377 : 381)
ROW 56 (381 : 387)
ROW 57 (388 : 392)
ROW 58 (392 : 396)
ROW 59 (397 : 399)

Media Manufactured in U.S.A.
Software, Product of U.S.A.

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PROGRAM DESCRIPTION I

Program Title SLOPE STABILITY ANALYSIS

Media Manufactured in USA
Software, Product of USA

Distributor's Name D. Holmes

Address 827 15th Street

City Bettendorf State/Country Iowa Zip Code 52722

Program Description, Equations, Variables

1. This program computes the safety factor, F, for slope stability analyses using the ordinary method of slices (OMS) and Bishop's modified F (submerged slopes).

2. The user must draw the shape of the slide mass and divide into vertical slices. See table below for number of slices vs. number of memory modules

Necessary Accessories

Operating Limits and Warnings None

No. of Slices	No. of Mem. Mod
3	0
19	1
35	2
51	3
66	4

Reference(s) 1/ "Stability of Earth Slopes by Method of Slices," Evans, Leonard T., program #A3993D

2/ Bishop, A.W., "The Use of the Slip Circle in the Stability Analysis of Slopes," Geotechnique, Vol V, 1955, pp. 7-17

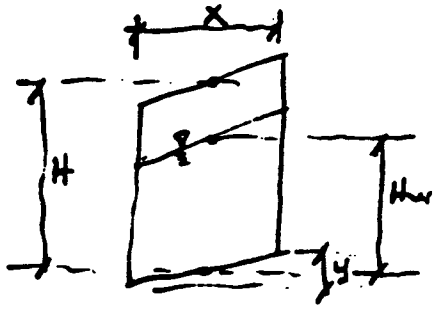
3/ Terzaghi, Karl and Peck, Ralph B., Soil Mechanics in Engineering Practice, John Wiley & Sons, N.Y., 1967, pp. 242-247

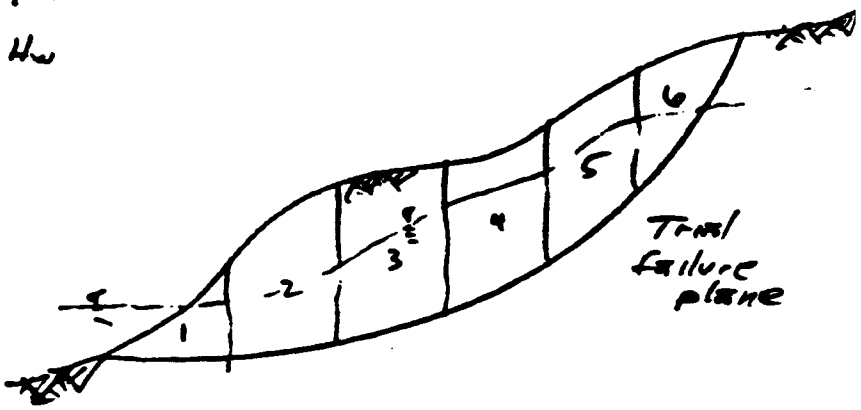
3. The following equation is used for both the OMS F and BSHP F.

$$F = \frac{\sum_{i=1}^{n} c x_i + (W_i \beta - u_i x_i) \tan\phi}{\cos\alpha \left[1 + \frac{\tan\alpha_i \tan\phi}{F}\right]} \Bigg/ \sum_{i=1}^{n} W_i \sin\alpha \qquad (1)$$ Ref 1

where,

γ = Soil unit weight "w"
c = cohesion
ϕ = friction angle of soil
x = slice width
y = rise of slice base
H = height of slice at center
H_w = height of static water table
α = TAN^{-1} Y/X
γ_w = unit weight of water (62.4 lb/ft^3)
W_i = $\gamma H_i x_i$
u = $\gamma_w H_w$





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4. Ordinary Method of Slices (OMS)-

a. Program solves equation (1) with the the following:

$\beta = \cos^2\alpha$

$\delta = 0$

b. Equation (1) is based on the following: (non submerged slopes)

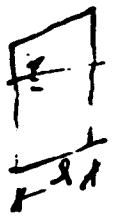
$$F = \frac{1}{\sum W_i \sin\alpha} \sum \left[c'l + \tan\phi' (W_i \cos\alpha - u l) \right]$$

(2)

Equation 9 Ref 2/ and Equation 35.22 Ref 3/ with $m_\alpha = 1$

where,

$$l = \frac{x}{\cos\alpha}$$



5. Bishop's F (submerged slopes)

a Program solves (1) with the OMS F as the initial F and iterates until $|F_{now} - F_{old}| \leq .001$. The following conditions are set:

$\beta = \delta = 1$

b. Equation (1) as modified by β and δ is based on:

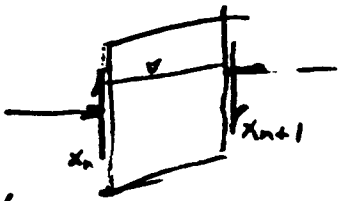
$$F = \frac{1}{\sum (W_1 + W_2) \sin\alpha} \sum \left[\left\{ c'b + \frac{\tan\phi' (W_1 + W_2 - bu_s + (X_n - X_{n+1}))}{\cos\alpha \left(1 + \frac{\tan\phi' \tan\alpha}{F}\right)} \right\} \right]$$ (3

Equation 22 Ref 2/ and Equation 35.22 Ref 3/

where,

$x = b$

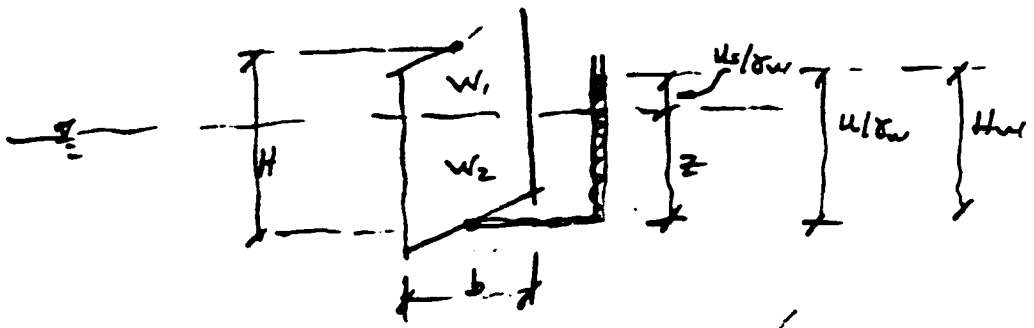
$(X_n^{\Delta X_n} - X_{n+1}) = 0$



The exclusion of ΔX_n does not significantly affect accuracy on circular arcs. Consideration should be given to ΔX_n if significant deviation from a circular failure arc.

c. Equation verification.

(1) Submerged slope, excess pore pressures



$W_1 = (H - z)b\gamma = Hb\gamma - zb\gamma$

$W_2 = z\gamma_b b = zb(\gamma - \gamma_w) = zb\gamma - zb\gamma_w$

$bu_s = b\gamma_w(H_w - z) = b\gamma_w H_w - b\gamma_w z$

$W_1 + W_2 - bu_s = Hb\gamma - b\gamma_w H_w = W_i - u_i x_i$

(2) Non-submerged slopes, $H_w \geq 0$.

$z = 0$

$W_1 = Hb\gamma$

$W_2 = 0$

$bu_s = b\gamma_w H_w$

$W_1 + W_2 - bu_s = Hb\gamma - b\gamma_w H_w = W_i - u_i x_i$

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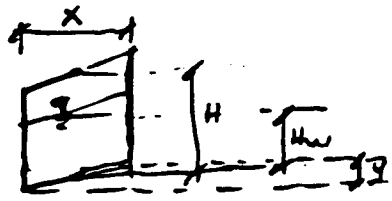
PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

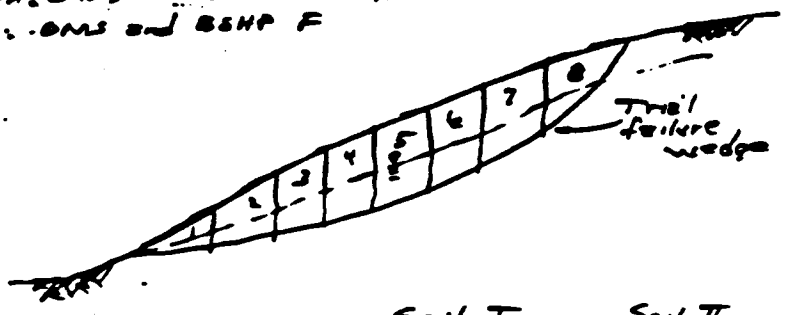
Slice Data

Slice No.	X	Y	H	Hw
1	5	-1.0	3	1
2	5	0	7	3
3	6	0.9	12	4
4	5	6.8	13	5
5	4	2	12	5
6	4	2.6	10	4
7	4	3.8	7	2
8	4	6	3	0



Problem 1
Given: 8 slices in Soil type I
Find: OMS and BSHP F

Problem 2
Given: Slices #1-#6 in Soil type I and #7 & #8 in Soil II
Find: OMS and BSHP F



Soil I	Soil II
ϕ = 25°	ϕ = 37°
C = 200 psf	C = 50 psf
$\gamma = W_t$ = 125 pcf	$\gamma = W_t$ = 130 pcf

SOLUTION:

Input	Function	Display	Comments
Problem 1	[USER]		
	[XEQ] SIZE 88		See User instruction #6
	[XEQ] CLRG		Clears all Flags for new data
	[XEQ] ■ 2		
	[XEQ] SLOPE	I XL = ?	
5	[R/S]	I YL = ?	
-1.0	[R/S]	I HL = ?	
3	[R/S]	I HWL = ?	
1	[R/S]	I XR = ?	
5 ....etc	:	:	
:	:	I XB = ?	
4	[R/S]	I YB = ?	
6	[R/S]	I HB = ?	
3	[R/S]	I HWB = ?	
6	[R/S]	I X9 = ?	
	[R/S]	I PHI? (Φ)	
25	[R/S]	I C = ?	
200	[R/S]	I W = ? (δ)	
125	[R/S]	II X9 = ?	
	[R/S]	II PHI?	
	[R/S]	VER I: A - II: B (Soil I verify)	Verify Soil I data, LBL A, etc. Program verifies Soil I data
	[A]	VER II: B	Verify Soil II, LBL B
	[B]	OMS-BSHP: C	For OMS F and Bishop F, LBL C
	[C]	OMS F = 1.7003	
	[R/S]	1.7946	
		1.8039	
		BSHP F = 1.8048	

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Program Description II

(CONTINUATION PAGE)

Input	Function	Display	Comments
Problem 2			
	[XEQ] CLRG		
	[XEQ] ΣΣ		
	[XEQ] SLOPE	I X1. = ?	
5 etc	[R/S]	etc	
⋮		!	
		I NW6. = ?	
4	[R/S]	I X7. = ?	
	[R/S]	I PHI? (Φ)	
25	[R/S]	I C = ?	
200	[R/S]	I W = ? (E)	
125	[R/S]	II X7. = ?	
4	[R/S]	II Y7. = ? etc	
!	!	!	
		II X9. = ?	
	[R/S]	II PHI = ?	
	[R/S]	II C = ?	
37	[R/S]	II W = ?	
50	[R/S]	YER I: A - II: B	Verify Soil I data, LOL A, etc.
180	[R/S]	(Soil I data)	
	[A]	(Soil II data)	
	[B]	OMS - BSHP: C	
	[C]	OMS F = 1.6008	
		1.7360	
		1.7520	
		1.7537	
		BSHP F = 1.7639	

See output for Problem #2 on next page.

Program Description II (continued)

Problem #2 Output

```
XEQ "SLOPE"

I X1.=?
5.  RUN
I Y1.=?
-1.  RUN
I N1.=?
3.  RUN
I NW1.=?
1.  RUN
I X2.=?
5.  RUN
I Y2.=?
0.  RUN
I N2.=?
7.  RUN
I NW2.=?
3.  RUN
I X3.=?
6.  RUN
I Y3.=?
.9  RUN
I N3.=?
12.  RUN
I NW3.=?
4.  RUN
I X4.=?
5.  RUN
I Y4.=?
1.8  RUN
I N4.=?
13.  RUN
I NW4.=?
5.  RUN
I X5.=?
4.  RUN
I Y5.=?
2.  RUN
I N5.=?
12.  RUN
I NW5.=?
5.  RUN
I X6.=?
4.  RUN
I Y6.=?
2.6  RUN
I N6.=?
10.  RUN
I NW6.=?
4.  RUN
I X7.=?
  RUN
I PHI?
25.  RUN
I C=?
200.  RUN
I W=?
125.  RUN
II X7.=?
4.  RUN
II Y7.=?
3.8  RUN
II N7.=?
7.  RUN
II NW7.=?
2.  RUN
II X8.=?
4.  RUN
II Y8.=?
6.  RUN
II N8.=?
3.  RUN
II NW8.=?
0.  RUN
II X9.=?
  RUN
II PHI=?
37.  RUN
II C=?
50.  RUN
II W=?
130.  RUN
VER I:A-II:B
XEQ A

I X1.=5.0
I Y1.=-1.0
I N1.=3.0
I NW1.=1.0
I X2.=5.0
I Y2.=0.0
I N2.=7.0
I NW2.=3.0
I X3.=6.6
I Y3.=0.9
I N3.=12.0
I NW3.=4.0
I X4.=5.6
I Y4.=1.8
I N4.=13.0
I NW4.=5.0
I X5.=4.6
I Y5.=2.0
I N5.=12.0
I NW5.=5.0
I X6.=4.0
I Y6.=2.6
I N6.=10.0
I NW6.=4.0
I PHI=25.0
I C=200.0
I W=125.0
END SOIL I
VER II:B
XEQ B

II X7.=4.0
II Y7.=3.8
II N7.=7.0
II NW7.=2.0
II X8.=4.0
II Y8.=6.0
II N8.=3.0
II NW8.=0.0
II PHI=37.0
II C=50.0
II W=130.0
END SOIL II
OMS-BSHP: C
XEQ C

OMS F=1.6006
1.7360
1.7520
1.7537
1.7539
BSHP F=1.7539
```

USER INSTRUCTIONS

SIZE: See Step 6 (HP-41C)

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Enter program, set USER,			
2.	For new data entry,		[XEQ] CLRG	
			[XEQ] Σ+	
3.	Begin program, enter data		[XEQ] SLOPE	
	as prompted. Must have at			
	least two slices.			
4.	If input error discovered during			
	Set I data verification ([A]),			
	[RLS], [RCL] 26 for direct			
	register address (integer portion			
	of address only) of incorrect			
	entry. [RCL] direct address and			
	verify that entry displayed is			
	incorrect entry. If the entry			
	recalled is not the one desired,			
	manually recall one or two			
	registers before the above			
	direct address. Once incorrect			
	entry is verified, enter			
	new value, [STO] correct			
	direct address. [A] for			
	reverification			
5	If input error discovered			
	during Set II data verification			
	([B]), [RLS], [RCL] 27 for			
	direct address of incorrect			
	entry and follow remaining			

User Instructions
(Continuation)

instructions as per paragraph #4.

6.

Number of Memory Modules	No. of Slices	SIZE
0	3	062
1	19	126
2	35	190
3	51	254
4	66	317

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PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL "SLOPE"		
02	FIX 1		
03	CF 22		
04	CF 10		
05	0.10001		
06	STO 20		
07	1.00401		
08	STO 14		
09	50.30001		
10	STO 28		
11	1.10001		
12	STO 13		
13	"I X"		Data input
14	ASTO IND 20		
15	ISG 20		
16	"I Y"		
17	ASTO IND 20		
18	ISG 20		
19	"I H"		
20	ASTO IND 20		
21	ISG 20		
22	"I HW"		
23	ASTO IND 20		
24	ISG 20		
25	"II X"		
26	ASTO IND 20		
27	ISG 20		
28	"II Y"		
29	ASTO IND 20		
30	ISG 20		
31	"II H"		
32	ASTO IND 20		
33	ISG 20		
34	"II HW"		
35	ASTO IND 20		
36	ISG 20		
37	"=?"		
38	ASTO 12		
39	0.10001		
40	STO 20		
41	LBL 01		
42	CLA		
43	LBL 05		
44	CLA		
45	ARCL IND 20		
46	ISG 20		
47	FIX 0		
48	ARCL 13		
49	ARCL 12		
50	CF 22		
51	PROMPT		
52	FS?C 22		
53	GTO 02		
54	GTO 03		
55	LBL 02		
56	FIX 1		
57	STO IND 28		
58	FS? 04		Data input
59	GTO 18		
60	RCL 28		
61	STO 11		
62	SF 04		
63	LBL 18		
64	ISG 28		
65	ISG 14		
66	GTO 01		
67	LBL 00		
68	ISG 13		
69	FS? 01		
70	GTO 04		
71	GTO 06		
72	LBL 06		
73	0.10001		
74	STO 20		
75	1.00401		
76	STO 14		
77	GTO 01		
78	LBL 03		
79	FS? 05		
80	GTO 19		
81	RCL 28		
82	STO 18		
83	SF 05		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix of 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for alpha keystrokes.

PROGRAM LISTING

☐67 ☐97 ☒41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
84	LBL 19		
85	FS? 01		
86	GTO 08		
87	SF 01		
88	RCL 13		
89	STO 29		
90	"I PHI?"		
91	PROMPT		
92	STO 15		
93	"I C=?"		
94	PROMPT		
95	STO 16		
96	"I W=?"		
97	PROMPT		
98	STO 17		
99	GTO 04		
100	LBL 04		
101	FS? 02		
102	GTO 07		Data input
103	SF 02		
104	4.10001		
105	STO 20		
106	CLA		
107	1.00401		
108	STO 14		
109	GTO 05		
110	LBL 07		
111	4.10001		
112	STO 20		
113	1.00401		
114	STO 14		
115	GTO 05		
116	LBL 08		
117	FS? 03		
118	GTO 13		
119	RCL 28		
120	STO 23		
121	SF 03		
122	LBL 13		
123	FS? 06		
124	GTO 09		
125	SF 06		
126	"II PHI=?"		
127	PROMPT		
128	FS?C 22		
129	GTO 17		
130	SF 10		
131	GTO 09		
132	LBL 17		
133	STO 08		
134	"II C=?"		
135	PROMPT		
136	STO 09		
137	"II W=?"		Data input
138	PROMPT		
139	STO 10		
140	LBL 09		
141	"VER I:A -II:B"		
142	AVIEW		
143	STOP		
144	LBL A		
145	1.10001		
146	STO 22		
147	"="		
148	ASTO 19		
149	1.00401		
150	STO 21		
151	RCL 11		
152	STO 26		
153	LBL 11		
154	0.10001		
155	STO 20		
156	LBL 10		LBL A verifies I/O data
157	CLA		
158	ARCL IND 20		
159	ISG 20		
160	FIX 0		
161	ARCL 22		
162	FIX 1		
163	ARCL 19		
164	ARCL IND 26		
165	AVIEW		
166	PSE		
167	ISG 26		
168	ISG 21		
169	GTO 10		
170	RCL 18		
171	INT		
172	RCL 26		
173	INT		
174	X=Y?		
175	GTO 12		
176	ISG 22		
177	1.00401		
178	STO 21		
179	GTO 11		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific informat
67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

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of the Handbook. Refer to Appendix E in

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PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
180	◆LBL 12		
181	"I PHI="		
182	ARCL 15		
183	AVIEW		
184	PSE		
185	"I C="		
186	ARCL 16		LBL A (con'd)
187	AVIEW		
188	PSE		
189	"I W="		
190	ARCL 17		
191	AVIEW		
192	PSE		
193	"END SOI L I"		
194	AVIEW		
195	PSE		
196	"VER II: B"		
197	AVIEW		
198	STOP		
199	◆LBL B		
200	RCL 18		
201	STO 27		
202	RCL 23		
203	INT		
204	RCL 27		
205	INT		
206	X=Y?		
207	GTO 20		
208	RCL 29		
209	STO 24		LBL B verifies Soil II data
210	1.00401		
211	STO 25		
212	◆LBL 16		
213	4.10001		
214	STO 20		
215	◆LBL 14		
216	CLA		
217	ARCL IND 20		
218	ISG 20		
219	FIX 0		
220	ARCL 24		
221	FIX 1		
222	ARCL 19		
223	ARCL IND 27		
224	ISG 27		
225	AVIEW		
226	PSE		
227	ISG 25		
228	GTO 14		
229	RCL 23		
230	INT		
231	RCL 27		
232	INT		
233	X=Y?		
234	GTO 15		
235	ISG 24		
236	1.00401		
237	STO 25		
238	GTO 16		
239	◆LBL 15		LBL B (con'd)
240	"II PHI="		
241	ARCL 08		
242	AVIEW		
243	PSE		
244	"II C="		
245	ARCL 09		
246	AVIEW		
247	PSE		
248	"II W="		
249	ARCL 10		
250	AVIEW		
251	PSE		
252	◆LBL 20		
253	"END SOI L II"		
254	AVIEW		
255	PSE		
256	"OMS-BSH P: C"		
257	AVIEW		
258	STOP		
259	◆LBL a		
260	CF 00		
261	CF 01		
262	CF 02		clears all used program flags
263	CF 03		
264	CF 04		
265	CF 05		
266	CF 06		
267	CF 07		
268	CF 08		
269	CF 09		
270	CF 10		
271	STOP		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appl 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

1168C

PROGRAM LISTING

☐67 ☐97 ☒41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
272	◆LBL C		
273	0		
274	STO 41		
275	STO 42		
276	CF 00		
277	CF 07		
278	CF 08		
279	CF 09		
280	◆LBL 30		
281	FS? 04		
282	GTO 27		
283	GTO 09		
284	◆LBL 27		
285	FS? 08		
286	GTO 28		
287	RCL 11		
288	STO 28		
289	SF 08		
290	◆LBL 28		
291	RCL IND 28		
292	STO 30		
293	ISG 28		
294	RCL IND 28		
295	STO 31		
296	ISG 28		
297	RCL IND 28		
298	STO 32		
299	ISG 28		
300	RCL IND 28		
301	STO 33		
302	ISG 28		
303	RCL 23		
304	RCL 28		
305	X=Y?		
306	GTO 29		
307	◆LBL 34		
308	RCL 28		
309	RCL 18		
310	X<=Y?		
311	GTO 21		
312	GTO 22		
313	◆LBL 21		
314	FS? 00		
315	GTO 24		
316	SF 00		
317	◆LBL 22		
318	RCL 15		
319	STO 34		
320	RCL 16		
321	STO 35		
322	RCL 17		
323	STO 36		
324	GTO 23		
325	◆LBL 29		
326	SF 09		
327	FS? 10		
328	GTO 34		
329	◆LBL 24		
330	RCL 08		
331	STO 34		
332	RCL 09		
333	STO 35		
334	RCL 10		
335	STO 36		
336	GTO 23		
337	◆LBL 23		
338	FS? 07		
339	GTO 26		
340	1		
341	STO 37		
342	RCL 31		
343	RCL 30		
344	/		
345	ATAN		
346	STO 38		
347	COS		
348	X↑2		
349	STO 39		
350	0		
351	STO 40		
352	GTO 25		

LBL C computes OMS F, then BSHP's F using equation #1

LBL C (con't)

00

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

0.168C

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
353	LBL 26		
354	1		
355	STO 39		
356	STO 40		
357	RCL 31		
358	RCL 30		
359	/		
360	ATAN		
361	STO 38		
362	GTO 25		
363	LBL 25		
364	RCL 36		
365	RCL 32		
366	*		
367	RCL 30		
368	*		
369	RCL 39		
370	*		
371	62.4		
372	RCL 33		
373	*		LBL C (con't)
374	RCL 30		
375	*		
376	-		
377	RCL 34		
378	TAN		
379	*		
380	RCL 35		
381	RCL 30		
382	*		
383	+		
384	RCL 40		
385	RCL 34		
386	TAN		
387	*		
388	RCL 38		
389	TAN		
390	*		
391	RCL 37		
392	/		
393	1		
394	+		
395	RCL 38		
396	COS		
397	*		
398	/		
399	ST+ 41		
400	RCL 36		
401	RCL 32		
402	*		
403	RCL 30		
404	*		
405	RCL 38		
406	SIN		
407	*		
408	ST+ 42		
409	FS? 09		
410	GTO 31		
411	GTO 30		
412	LBL 31		
413	RCL 41		
414	RCL 42		
415	/		
416	STO 37		
417	FS? 07		
418	GTO 32		
419	SF 07		
420	RCL 37		
421	STO 43		LBL C (con't)
422	FIX 4		
423	"OMS F="		
424	ARCL 37		
425	AVIEW		
426	PSE		
427	0		
428	STO 41		
429	STO 42		
430	CF 00		
431	CF 08		
432	CF 09		
433	GTO 30		
434	LBL 32		
435	1 E-3		
436	CLA		
437	ARCL 37		
438	AVIEW		
439	PSE		
440	RCL 37		
441	RCL 44		
442	-		
443	ABS		
444	X<=Y?		
445	GTO 33		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

□97 ☑41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
446	RCL 37		
447	STO 44		
448	0		
449	STO 41		
450	STO 42		
451	CF 00		
452	CF 08		
453	CF 09		
454	GTO 30		
455	◆LBL 33		LBL C (con't)
456	"BSHP F= "		
457	ARCL 37		
458	AVIEW		
459	STOP		
460	END		

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

00	"I X"	50	X_i for Soil I
01	"I Y"	51	Y_i "
02	"I H"	52	H_i "
03	"I HW"	53	HW_i "
04	"II X"		= L_c
05	"II Y"		
06	"II H"		
07	"II HW"		
08	ϕ_2 storage		
09	C_2 storage		
10	γ_2 storage		
11	USED		
12	"= ?"		
13	USED		
14	USED		
15	ϕ_1 storage		
16	C_1 storage		
17	γ_1 storage		
18	USED "="		
19			
20	USED		
21	USED		
22	USED		
23	USED		
24	USED		
25	USED		
26	USED		
27	USED		
28	USED		
29	USED		
30	USED X_i		
31	USED Y_i		
32	USED H_i		
33	USED HW_i		
34	USED ϕ_i		
35	USED C_i		
36	USED γ_i		
37	OMS F & RSHP F		
38	α_i		
39	β		
40	δ		
41	USED		
42	USED		
43	OMS F_i		
44	USED		
45	open		
46	open		
47	open		
48	open		
49	open		

STATUS

see step #6

SIZE 1 TOT. REG. 152 USER MODE

ENG ____ FIX 4 SCI ____ ON X OFF ____

DEG X RAD ____ GRAD ____

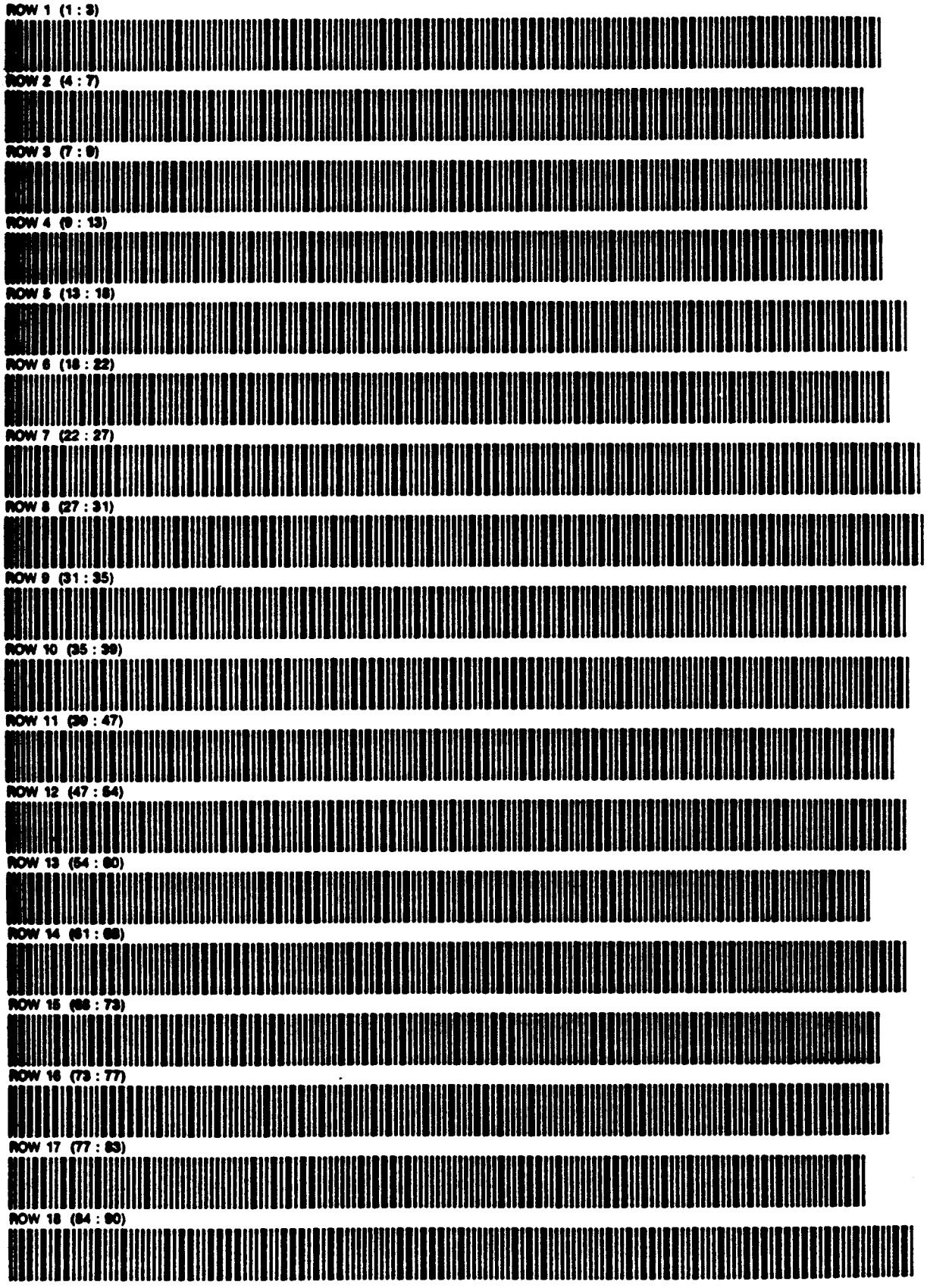
FLAGS

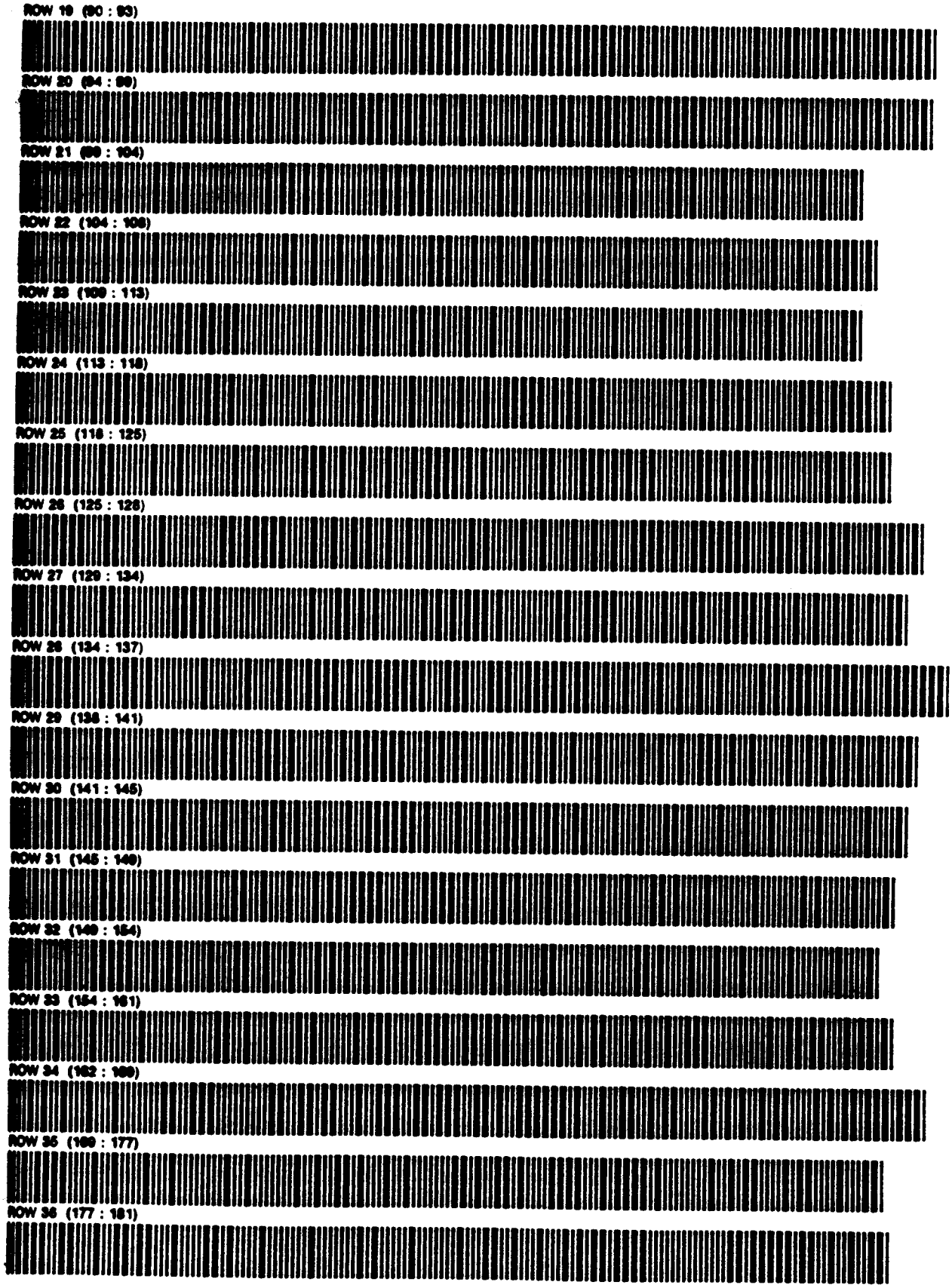
#	INIT S/C	SET INDICATES	CLEAR INDICATES
00	C	All Soil I data used	All Soil I data not used
01	C	Soil II digit entered	No soil II data
02	C	Soil II data used	Soil II data not used
03	C	Soil II data end reg. stored	Soil II data end reg. "0" stored
04	C	Soil I data reg. stored	Soil I init. reg. not stored
05	C	Soil II init. reg. stored	Soil II init. reg. not stored
06	C	Soil II data was prompted	Soil II data not prompted
07	C	OMS was calculated	OMS not calculated
08	C	Soil I data used	No soil I data used
09	C	All Soil II data used	All Soil II data not used
10	C	No Soil II data	Soil II data entry
22	C	Digit entered	no digit entered

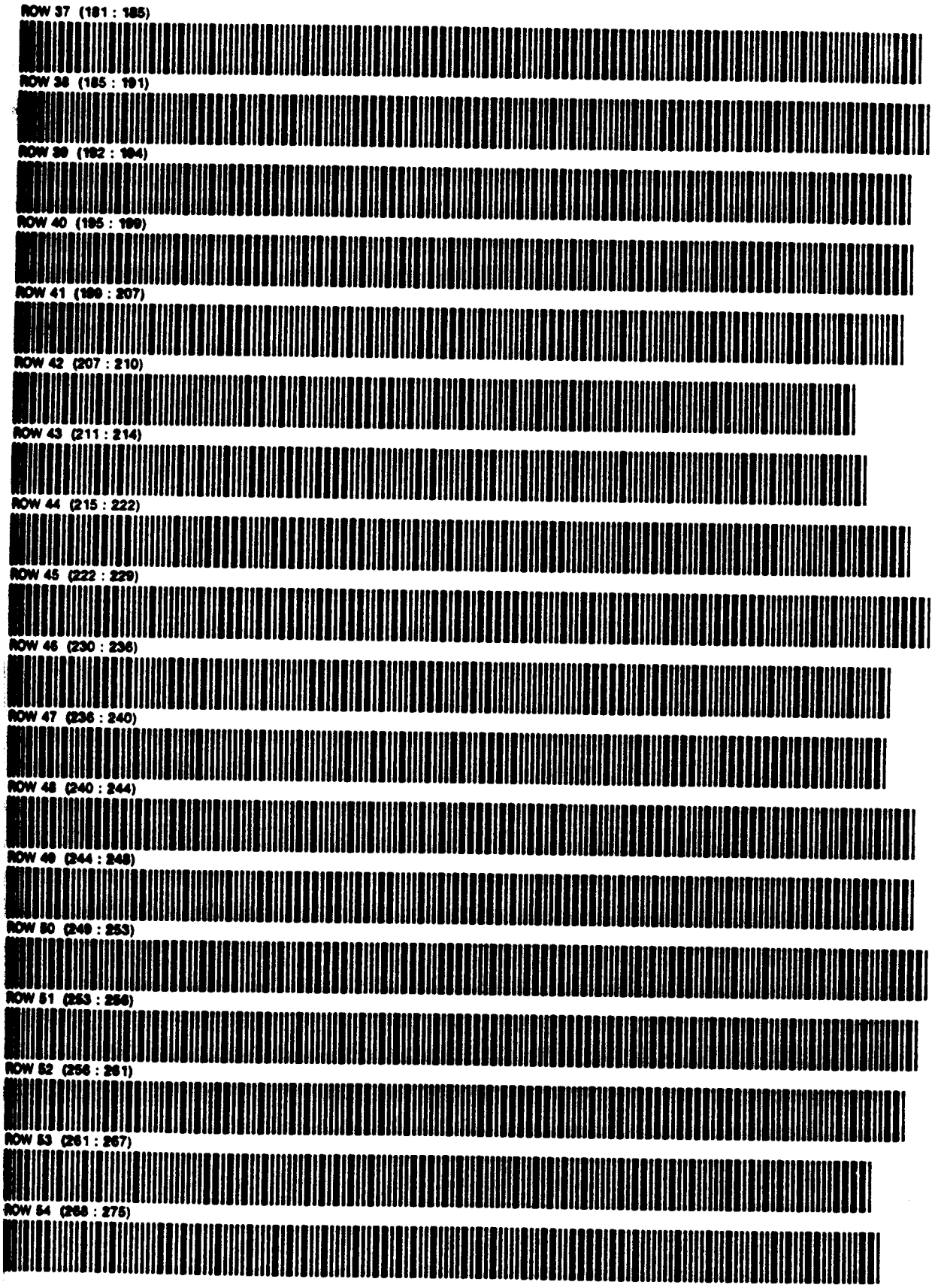
ASSIGNMENTS

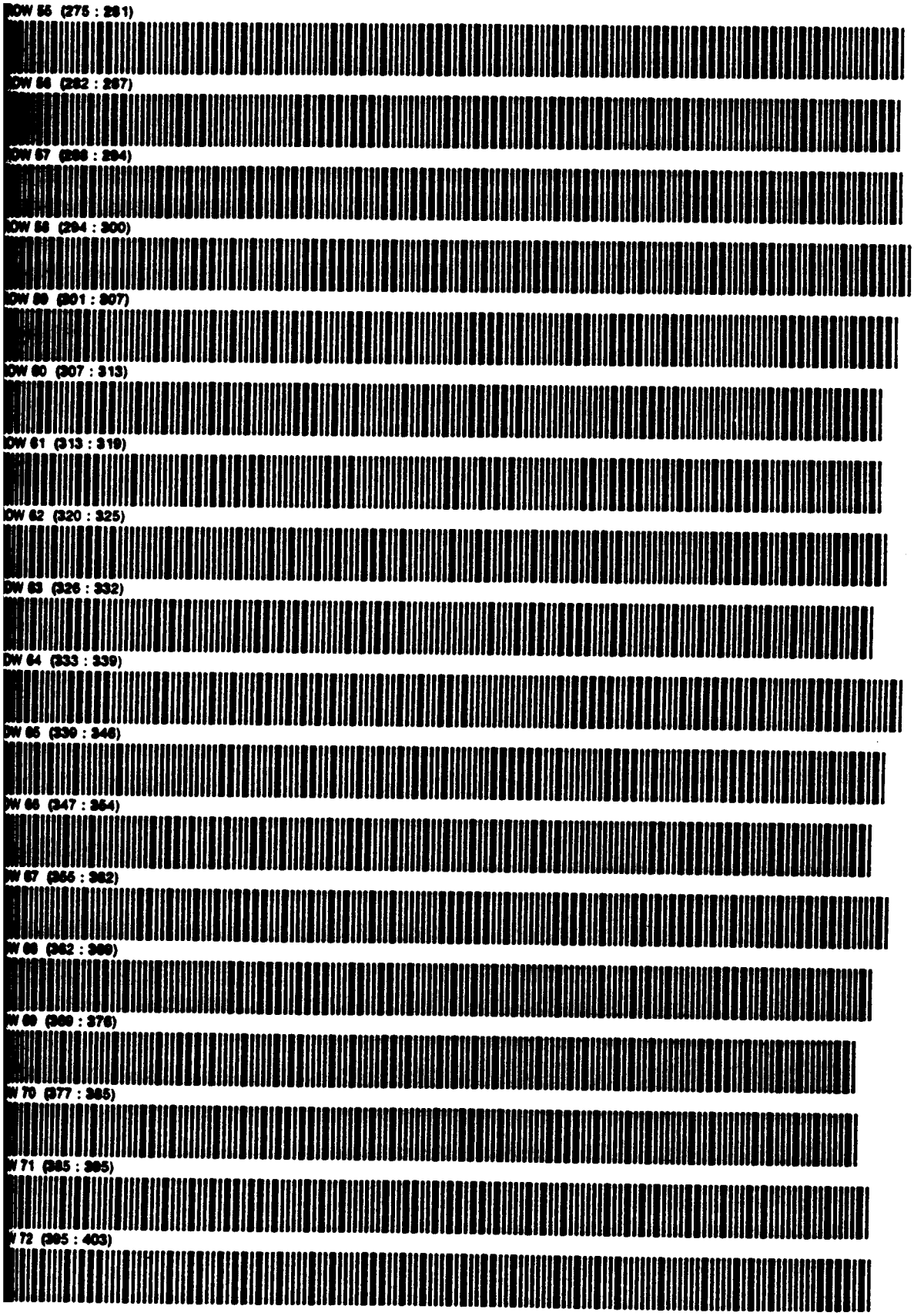
FUNCTION	KEY	FUNCTION	KEY
None			

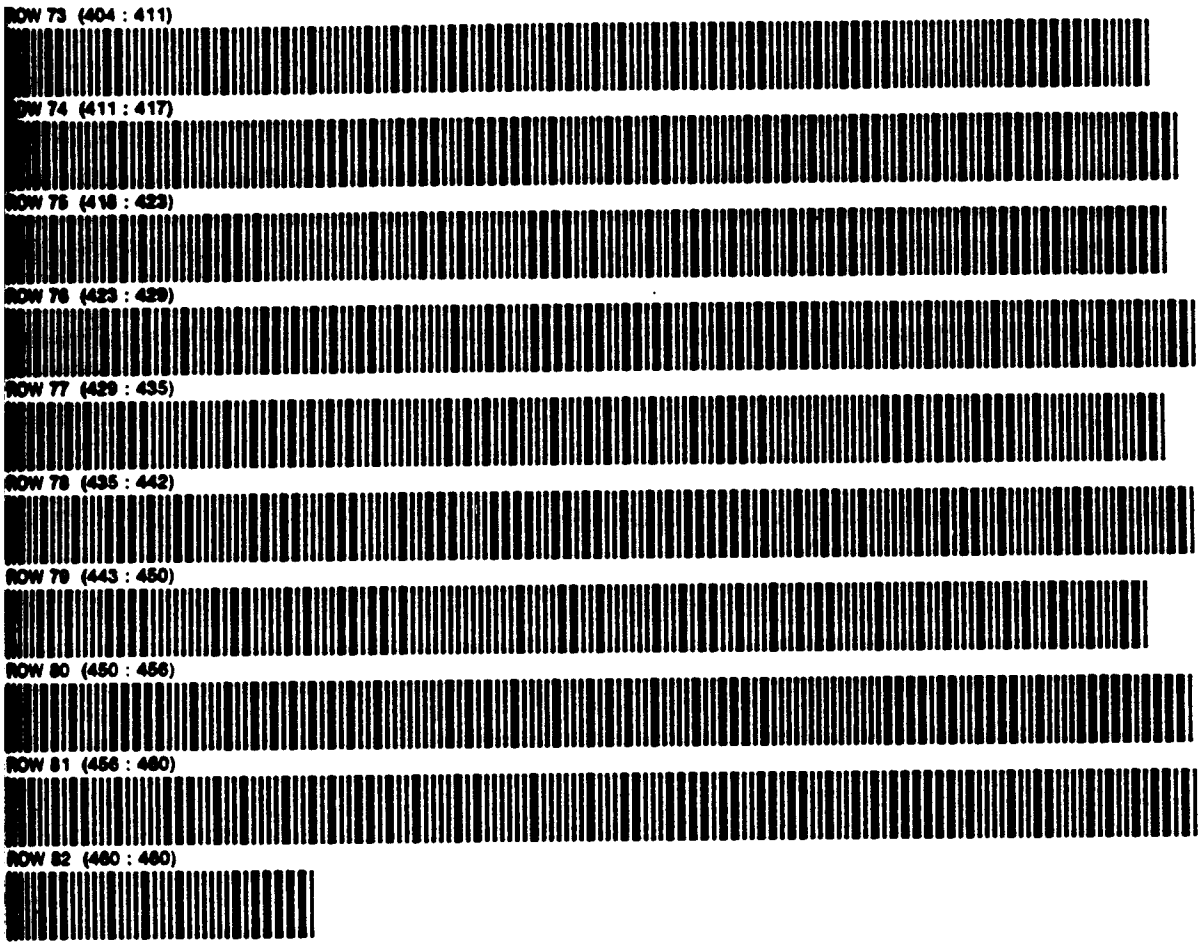
PROGRAM REGISTERS NEEDED: 151




ROW 19 (90 : 93)
ROW 20 (94 : 99)
ROW 21 (99 : 104)
ROW 22 (104 : 108)
ROW 23 (109 : 113)
ROW 24 (113 : 118)
ROW 25 (118 : 125)
ROW 26 (125 : 128)
ROW 27 (129 : 134)
ROW 28 (134 : 137)
ROW 29 (138 : 141)
ROW 30 (141 : 145)
ROW 31 (145 : 149)
ROW 32 (149 : 154)
ROW 33 (154 : 161)
ROW 34 (162 : 169)
ROW 35 (169 : 177)
ROW 36 (177 : 181)


ROW 37 (181 : 185)
ROW 38 (185 : 191)
ROW 39 (192 : 194)
ROW 40 (195 : 199)
ROW 41 (199 : 207)
ROW 42 (207 : 210)
ROW 43 (211 : 214)
ROW 44 (215 : 222)
ROW 45 (222 : 229)
ROW 46 (230 : 236)
ROW 47 (236 : 240)
ROW 48 (240 : 244)
ROW 49 (244 : 248)
ROW 50 (249 : 253)
ROW 51 (253 : 256)
ROW 52 (256 : 261)
ROW 53 (261 : 267)
ROW 54 (268 : 275)


ROW 55 (275 : 281)
ROW 56 (282 : 287)
ROW 57 (288 : 294)
ROW 58 (294 : 300)
ROW 59 (301 : 307)
ROW 60 (307 : 313)
ROW 61 (313 : 319)
ROW 62 (320 : 325)
ROW 63 (326 : 332)
ROW 64 (333 : 339)
ROW 65 (339 : 346)
ROW 66 (347 : 354)
ROW 67 (355 : 362)
ROW 68 (362 : 369)
ROW 69 (369 : 376)
ROW 70 (377 : 385)
ROW 71 (385 : 395)
ROW 72 (395 : 403)


ROW 73 (404 : 411)
ROW 74 (411 : 417)
ROW 75 (418 : 423)
ROW 76 (423 : 429)
ROW 77 (429 : 435)
ROW 78 (435 : 442)
ROW 79 (443 : 450)
ROW 80 (450 : 456)
ROW 81 (456 : 460)
ROW 82 (460 : 460)

PROGRAM DESCRIPTION I

Program Title: MASONRY WALL ANALYSIS

Contributor's Name: MARTIN N. POHLL

Address: 567 W. Shaw Avenue

City: FRESNO State/Country: CALIF. Zip Code: 93704

Program Description, Equations, Variables:

ANALYZES A SOLID GROUTED CONCRETE MASONRY WALL FOR COMBINED AXIAL AND BENDING LOADS IN ACCORDANCE WITH UNIFORM BUILDING CODE CRITERIA. PRINTER OUTPUT HIGHLY ANNODATED FOR USE AS FINAL STRUCTURAL CALCULATIONS.

EQUATIONS:

$NP = AsN/bd$

$K = \sqrt{(NP)^2 + 2NP} - NP$

$J = 1 - K/3$

$R = 1 - (H/40T)^3$

$fv = V/bJd$

$fa = P/bT$, $Fa = 0.2\ F'cR$

$fb = 2M/(d^2bjK)$, $Fb = F'm/3$

$COMBINED = fa/Fa + fb/Fb$

VARIABLES:

P = AXIAL LOAD

M = BENDING MOMENT

V = SHEAR

T = THICKNESS

d = DEPTH

H = HEIGHT

F'c = ALLOW. COMPRESSION

N = MODULAR RATIO

BAR SIZE & BAR SPACING

Necessary Accessories: PRINTER, MEMORY MODULE

Operating Limits and Warnings: DO NOT USE FOR REINFORCING BAR SIZE GREATER THAN #8. DOES NOT CONSIDER COMPRESSIVE REINFORCEMENT.

Reference(s): INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS, "UNIFORM BUILDING CODE", 1979 EDITION.

Sample Problem (Sketch if Desired)

CANTILEVER RETAINING WALL

P = 1500 lbs/ft (includes wall weight)

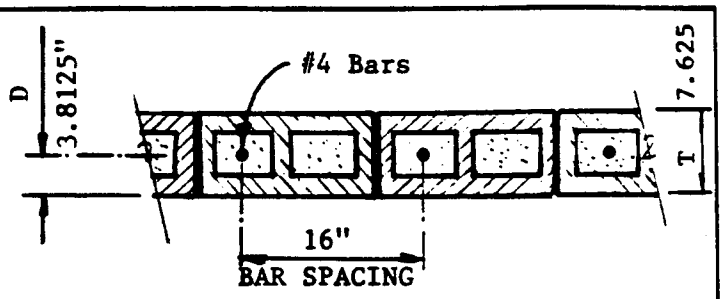
$M = \frac{15(48)^2}{6} = 5760$ in. lb/ft

$V = \frac{15(48)}{2} = 360$ lb/ft

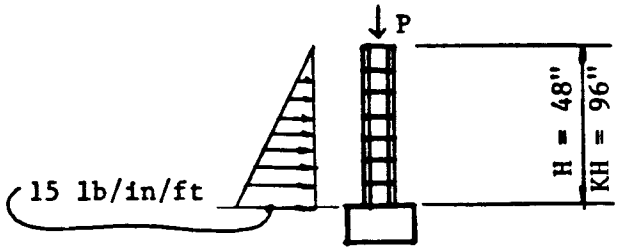
ASSUME NO INSPECTION:

F'c = 750 psi

N = 40



WALL SECTION



WALL ELEVATION

SOLUTION:

Input	Function	Display	Comments
	XEQ MAS2	UNITS: IN-LBS	
	R/S	PER FT. BASIS	(Assuming
	R/S	P = 0.0	All registers were cleared prior
1500	R/S	M = 0.0	to execution)
5760	R/S	V = 0.0	
360	R/S	T = 0.0	
7.625	R/S	d = 0.0	
3.8125	R/S	H = 0.0	
96	R/S	BAR SIZE = 0.0	
4	R/S	BAR SPACING 0.0	
16	R/S	F↑c = 0.0	
750	R/S	N = 0.0	
40	R/S		
		SEE NEXT PAGE	PRINTER OUTPUT GIVEN ON NEXT PAGE
			TRY REVISED DATA
	LBL B	P=1500.000	
	R/S	M=5760.000	
	R/S	V=360.000	
	R/S	T=7.625	
	R/S	d=3.813	Revise d
5.375	R/S	H=96.000	
	R/S	BAR SIZE=4.000	
	R/S	BAR SPACING=16.000	Revise Bar spacing
32	R/S	F↑c=750.000	
	R/S	N=40.000	
		SEE NEXT PAGE	Printer output on next page

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

$$As = \frac{\left(\frac{\text{BAR SIZE}}{8}\right)^2 \pi}{4\left(\frac{\text{BAR SPACE}}{12}\right)}$$

$$NP = \frac{As\ N}{bd}$$

WHERE b = 12"

$$K = \sqrt{(NP)^2 + 2NP} - NP$$

$$J = 1 - K/3$$

$$R = 1 - \left(\frac{H}{40T}\right)^3$$

ACTUAL SHEAR STRESS

$$fv = \frac{V}{bJd}$$

ACTUAL COMPRESSIVE STRESS

$$fa = \frac{P}{bT}$$

ALLOWABLE COMPRESSIVE STRESS

$$Fa = 0.2\ F'c\ R$$

ACTUAL BENDING STRESS

$$fb = \frac{2M}{d^2bjk} \quad \frac{2M}{d^2bJK}$$

ALLOWABLE BENDING STRESS

$$Fb = \frac{F'm}{3}$$

COMBINED STRESSES

$$\text{COMBINED} = \frac{fa}{Fa} + \frac{fb}{Fb}$$

ACTUAL STEEL TENSILE STRESS

$$fs = \frac{M}{AsJd}$$

ACTUAL BOND STRESS

$$\Sigma o = \frac{(\text{BAR SIZE})\ \pi}{8\ (\text{BAR SPACING}/12)}$$

$$fu = \frac{V}{\Sigma o\ JD}$$

SOLUTION:

PRINTER OUTPUT FROM INITIAL DATA

```
MASONRY WALL
units:in-lbs
per ft basis
solid grout
P = 1500
M = 5760
V = 360
T = 7.625
d = 3.813
H = 96.000
H/T= 12.590
R = 0.969
F'c= 750.0
N = 40.0
NP= 0.1288
K = 0.3948
J = 0.8684

MAS STRESS
fv = 9.06
fa = 16.39
Fa = 145.32
fb = 192.65
Fb = 250.00
COMBINED
axial = 0.11
bend  = 0.77
total = 0.88

STEEL STRESS
NO 4at 16
As =  0.15
fs = 11814
Σo = 1.178
fu = 92.3
```

PRINTER OUTPUT FROM REVISED DATA

```
MASONRY WALL
units:in-lbs
per ft basis
solid grout
P = 1500
M = 5760
V = 360
T = 7.625
d = 5.375
H = 96.000
H/T= 12.590
R = 0.969
F'c= 750.0
N = 40.0
NP= 0.0457
K = 0.2600
J = 0.9133

MAS STRESS
fv = 6.11
fa = 16.39
Fa = 145.32
fb = 139.95
Fb = 250.00
COMBINED
axial = 0.11
bend  = 0.56
total = 0.67

STEEL STRESS
NO 4at 32
As =  0.07
fs = 15935
Σo = 0.589
fu = 124.5
```

0242[illegible] USER INSTRUCTIONS

Instructions assume all registers initially cleared

SIZE: (HP-41C) 021

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	ENTER THE PROGRAM		XEQ MAS2	P = 0.0
2.	INPUT VARIABLE DATA AS REQUESTED BY			
	CALCULATOR (BASED ON ONE FOOT LENGTH			
	OF WALL):			
	P = AXIAL LOAD	lbs/ft	R/S	M = 0.0
	M = BENDING MOMENT	in-lbs/ft	R/S	V = 0.0
	V = SHEAR	lbs/ft	R/S	T = 0.0
	T = WALL THICKNESS	inches	R/S	d = 0.0
	d = EFFECTIVE DEPTH (COMPRESSIVE FACE TO REBAR CENTROID)	inches	R/S	H = 0.0
	H = UNSUPPORTED HEIGHT OR LENGTH OF WALL (USE KH FOR OTHER THAN PINNED END CONDITIONS)	inches	R/S	BAR SIZE = 0.0
	BAR SIZE = DIAMETER ÷ 8	inches	R/S	BAR SPACING =0.0
	BAR SPACING	inches	R/S	F'c = 0.0
	F'c = ALLOWABLE MASONRY COMPRESSIVE STRESS	psi	R/S	N = 0.0
	N = MODULAR RATIO	none	R/S	See Program Description for Output
3	IF YOU WANT TO RERUN WITH REVISED DATA,		LBL B	P-(current value
				⋮
	Revise only those variables you want	new value	R/S	Same as above
	to change or		R/S	

02-20-C

PROGRAM LISTING

☐ 67 ☐ 97 ☐ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL "MAS 2"		
02	SF 12		
03	SF 21		
04	SF 27		
05	"UNITS:I N-LBS"		
06	AVIEW		
07	"PER FT BASIS"		
08	AVIEW		
09	LBL B		
10	1		
11	STO 00		
12	FIX 3		
13	"P= "		
14	XEQ 01		
15	"M= "		
16	XEQ 01		INPUT VARIABLES
17	"V= "		
18	XEQ 01		
19	"T= "		
20	XEQ 01		
21	"d= "		
22	XEQ 01		
23	"H= "		
24	XEQ 01		
25	"BAR SIZE= "		
26	XEQ 01		
27	"BAR SPACING= "		
28	XEQ 01		
29	"F'c = "		
30	XEQ 01		
31	"N= "		
32	XEQ 01		
33	RCL 07		
34	8		
35	/		
36	X↑2		$A_s = \frac{\left(\frac{\text{BAR SIZE}}{8}\right)^2 \pi}{4\left(\frac{\text{BAR SPACE}}{12}\right)}$
37	PI		
38	*		
39	4		
40	/		
41	RCL 08		
42	/		
43	12		
44	*		
45	STO 11		
46	RCL 10		$NP = \frac{A_s N}{bd}$
47	*		
48	RCL 05		WHERE b = 12"
49	/		
50	12		
51	/		
52	STO 12		
53	X↑2		
54	RCL 12		
55	2		
56	*		
57	+		
58	SQRT		
59	RCL 12		
60	-		
61	STO 13		$K = \sqrt{(NP)^2 + 2NP} - NP$
62	3		
63	/		
64	1		$J = 1 - K/3$
65	-		
66	CHS		
67	STO 14		
68	RCL 06		
69	RCL 04		
70	/		
71	40		
72	/		
73	3		
74	Y↑X		
75	1		$R = 1 - \left(\frac{H}{40T}\right)^3$
76	-		
77	CHS		
78	STO 15		
79	ADV		
80	ADV		
81	FIX 0		
82	"MASONRY WALL"		
83	AVIEW		
84	SF 13		
85	"UNITS:I N-LBS"		
86	AVIEW		
87	"PER FT BASIS"		

02420C

PROGRAM LISTING

☐ 67 ☐ 97 ☐ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
88	AVIEW		
89	"SOLID G ROUT"		
90	AVIEW		
91	CF 13		
92	"P = "		
93	RCL 01		
94	ARCL X		
95	AVIEW		
96	"M = "		
97	RCL 02		
98	ARCL X		
99	AVIEW		
100	"V = "		
101	RCL 03		
102	ARCL X		
103	AVIEW		PRINT INPUT DATA
104	"T = "		
105	FIX 3		
106	RCL 04		
107	ARCL X		
108	AVIEW		
109	"d = "		
110	RCL 05		
111	ARCL X		
112	AVIEW		
113	"H = "		
114	RCL 06		
115	ARCL X		
116	AVIEW		
117	"H/T= "		
118	RCL 04		
119	/		
120	ARCL X		
121	AVIEW		
122	"R = "		
123	RCL 15		
124	ARCL X		
125	AVIEW		
126	"F↑c= "		
127	FIX 1		
128	RCL 09		
129	ARCL X		
130	AVIEW		
131	"N = "		
132	RCL 10		
133	ARCL X		
134	AVIEW		
135	"NP= "		
136	FIX 4		
137	RCL 12		
138	ARCL X		
139	AVIEW		
140	"K = "		
141	RCL 13		
142	ARCL X		
143	AVIEW		
144	"J = "		
145	RCL 14		
146	ARCL X		
147	AVIEW		
148	FIX 2		
149	ADV		
150	"MAS STR ESS"		
151	AVIEW		
152	SF 13		
153	"FV = "		MASONRY STRESSES
154	RCL 03		ACTUAL SHEAR STRESS
155	RCL 05		$fv = \frac{V}{bJd}$
156	/		
157	12		WHERE b = 12"
158	/		
159	RCL 14		
160	/		
161	ARCL X		
162	AVIEW		
163	"FA = "		
164	RCL 01		ACTUAL COMPRESSIVE STRESS
165	RCL 04		$fa = \frac{P}{bT}$
166	/		
167	12		WHERE b = 12"
168	/		
169	STO 16		
170	ARCL X		
171	AVIEW		
172	CF 13		
173	"Fa = "		
174	RCL 09		
175	RCL 15		
176	*		
177	.2		ALLOWABLE COMPRESSIVE STRESS
178	*		$Fa = 0.2\ F'c\ R$
179	STO 17		
180	ARCL X		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E of 67 or 97 OWNER'S HANDBOOK AND PROGRAMMING GUIDE for exact keystrokes.

02420C

PROGRAM LISTING

☐ 67 ☐ 97 ☐ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
181	AVIEW		
182	SF 13		
183	"FB = "		
184	RCL 02		
185	2		
186	*		
187	RCL 05		
188	X↑2		
189	/		
190	12		
191	/		
192	RCL 13		
193	/		
194	RCL 14		
195	/		
196	STO 18		
197	ARCL X		
198	AVIEW		
199	CF 13		
200	"Fb = "		
201	RCL 09		
202	3		
203	/		
204	STO 19		
205	ARCL X		
206	AVIEW		
207	"COMBINE D"		
208	AVIEW		
209	SF 13		
210	"AXIAL = "		
211	RCL 16		
212	RCL 17		
213	/		
214	ARCL X		
215	AVIEW		
216	"BEND = "		
217	RCL 18		
218	RCL 19		
219	/		
220	ARCL X		
221	AVIEW		
222	"TOTAL = "		
223	+		
224	ARCL X		
225	AVIEW		
226	ADV		
227	CF 13		
228	"STEEL STRESS"		
229	AVIEW		
230	FIX 0		
231	"NO"		
232	ACA		
233	RCL 07		
234	ACX		
235	SF 13		
236	"AT"		
237	ACA		
238	RCL 08		
239	ACX		
240	PRBUF		
241	CF 13		
242	FIX 2		
243	"A"		
244	ACA		
245	SF 13		
246	"S = "		
247	ACA		
248	RCL 11		
249	ACX		
250	PRBUF		
251	SF 13		
252	FIX 0		
253	"FS = "		
254	RCL 02		
255	RCL 11		
256	/		
257	RCL 14		
258	/		
259	RCL 05		
260	/		
261	ARCL X		
262	AVIEW		
263	"ΣO = "		
264	RCL 07		
265	RCL 08		
266	/		
267	12		
268	*		
269	8		
270	/		
271	PI		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

02420C

PROGRAM LISTING

☐ 67 ☐ 97 ☐ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
272	*		
273	STO 20		
274	FIX 3		
275	ARCL X		
276	AVIEW		
277	"FU = "		
278	RCL 03		
279	RCL 14		
280	/		
281	RCL 05		
282	/		ACTUAL BOND STRESS
283	RCL 20		
284	/		$\Sigma o = \frac{(\text{BAR SIZE})\ \pi}{8\ (\text{BAR SPACING}/12)}$
285	FIX 1		
286	ARCL X		
287	AVIEW		$fu = \frac{V}{\Sigma o\ JD}$
288	CF 13		
289	RTN		
290	◆LBL 01		
291	CF 22		
292	ARCL IND 00		
293	PROMPT		
294	FS? 22		
295	STO IND 00		
296	1		
297	ST+ 00		
298	RTN		
299	.END.		

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
51			
60			
70			
80			
90			
00			

40

50

Note: Refer to HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E of 67 or 97 OWNER'S HANDBOOK AND PROGRAMMING GUIDE for exact keystrokes.

02420C

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

00			
01	P		
02	M		
03	T V		
04	T		
05	d		
06	H		
07	BAR SIZE		
08	BAR SPACING		
09	F'c		
10	N		
11	As		
12	NP		
13	K		
14	J		
15	R		
16	fa		
17	Fa		
18	fb		
19	Fb		
20	Σ_o		

STATUS

SIZE 021 TOT. REG. 120 USER MODE

ENG ____ FIX Varies SCI ____ ON X OFF ____

DEG ____ RAD ____ GRAD ____

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES
12	S	DOUBLE WIDE	NORMAL PRINT
13	C	LOWER CASE	UPPER CASE
21	S	Printer enable	
22		Numeric input	
27	S	User mode on	

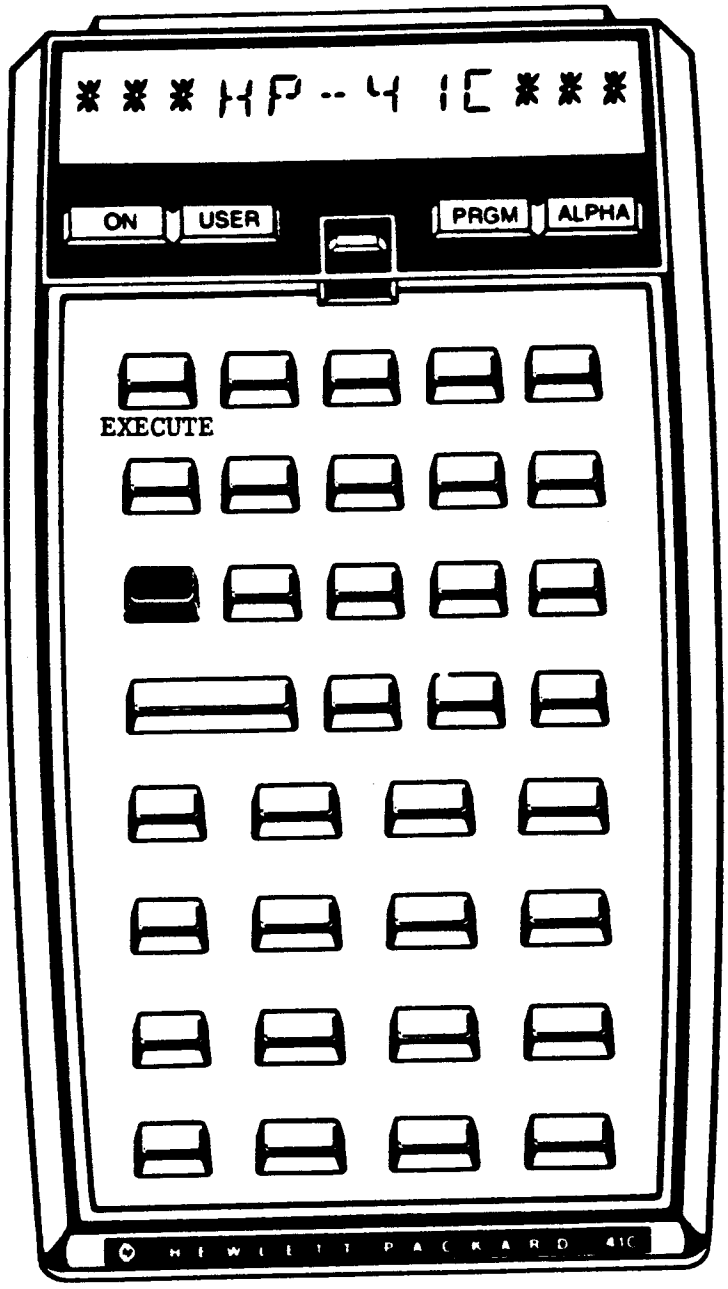
ASSIGNMENTS

FUNCTION	KEY	FUNCTION	KEY

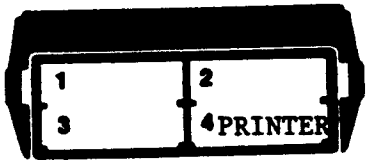
NONE USED

KEYBOARD CARD LABELING

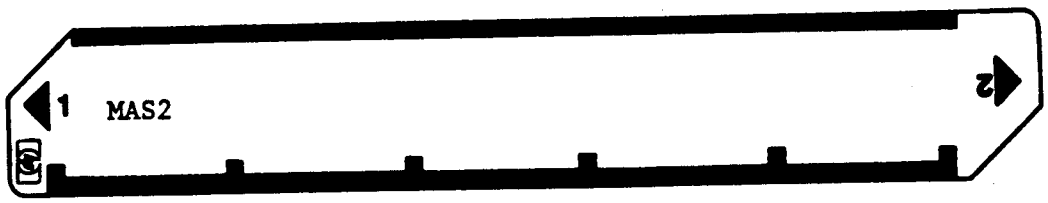
KEYBOARD



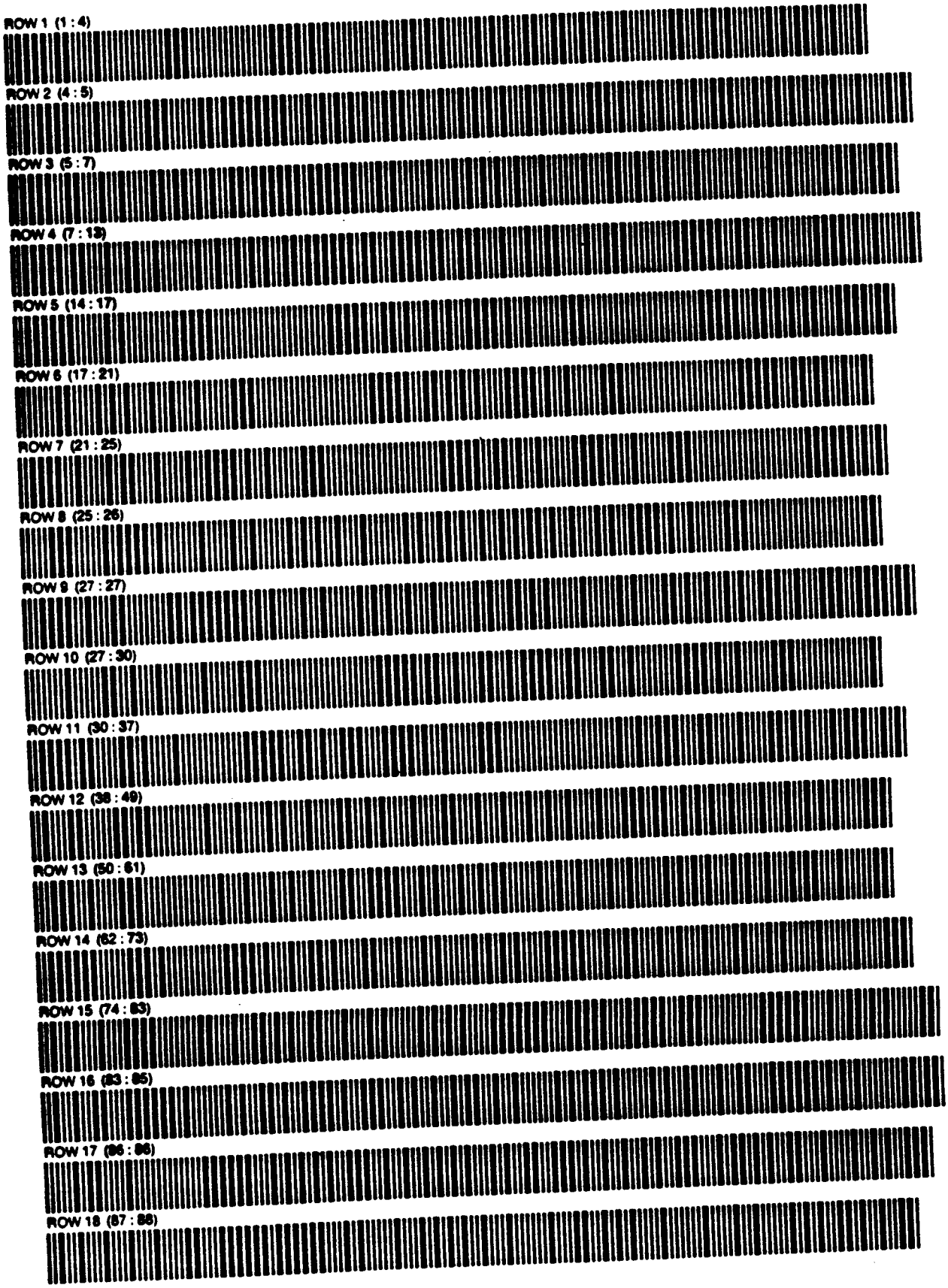
SYSTEM CONFIGURATION

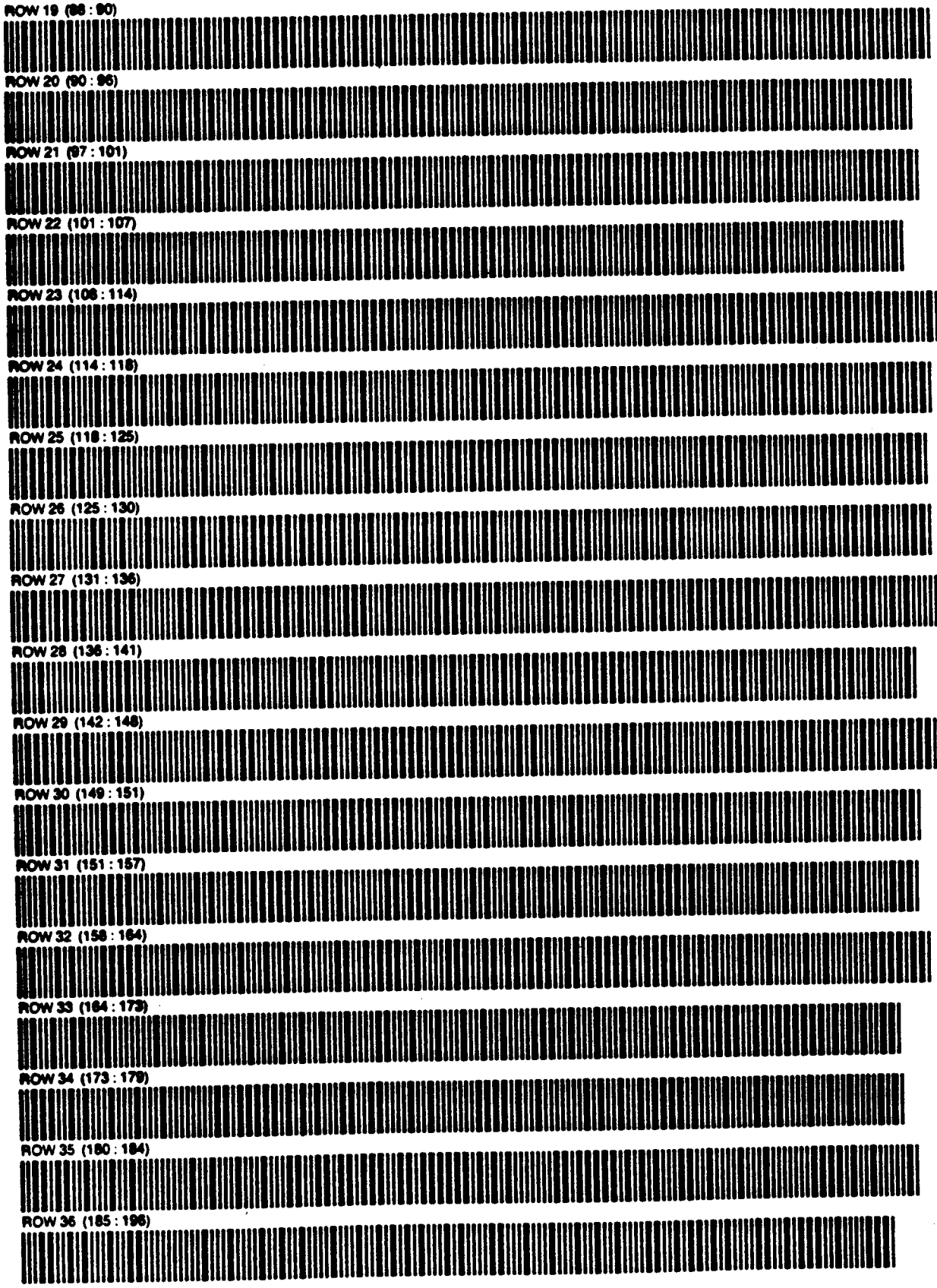


CARD



PROGRAM REGISTERS NEEDED: 99




ROW 19 (88 : 90)
ROW 20 (90 : 96)
ROW 21 (97 : 101)
ROW 22 (101 : 107)
ROW 23 (108 : 114)
ROW 24 (114 : 118)
ROW 25 (118 : 125)
ROW 26 (125 : 130)
ROW 27 (131 : 136)
ROW 28 (136 : 141)
ROW 29 (142 : 148)
ROW 30 (149 : 151)
ROW 31 (151 : 157)
ROW 32 (158 : 164)
ROW 33 (164 : 173)
ROW 34 (173 : 179)
ROW 35 (180 : 184)
ROW 36 (185 : 196)

ROW 37 (197 : 201)

ROW 38 (202 : 208)

ROW 39 (208 : 211)

ROW 40 (211 : 217)

ROW 41 (217 : 221)

ROW 42 (221 : 225)

ROW 43 (225 : 229)

ROW 44 (229 : 233)

ROW 45 (234 : 240)

ROW 46 (241 : 247)

ROW 47 (247 : 252)

ROW 48 (253 : 259)

ROW 49 (260 : 266)

ROW 50 (267 : 276)

ROW 51 (276 : 283)

ROW 52 (284 : 292)

ROW 53 (292 : 300)

ROW 54 (300 : 300)

Media Manufactured in USA
Software. Product of CANADA

07820 PROGRAM DESCRIPTION I

Program Title: 36 BEAMS

Contributor's Name: Michel Walsh

Address: 824 rue principale

City: St-Léonard de Portneuf State/Country: Québec Zip Code: G0A-4A0

Program Description, Equations, Variables: Can resolve any one span strait beam, without axial force, elastically.

V Shear

M Flexural Moment

EIT Slope of deformed beam time "EI"

EIY Deflection of deformed beam, time "EI"

See reference for equations.

For a discontinuity of a function (like a concentrated load for shear), evaluation of it at discontinuity give the value of the function at the left.

Necessary Accessories: Cases with many loads need memory module.

Operating Limits and Warnings: "EI" (Young modulus time Inertia) must be constant.

Reference(s): ROARK and YOUNG, "Formulas for Stress and Strain", 5° ed.,McGraw Hill.

PROGRAM DESCRIPTION I

Program Title

Contributor's Name

Address

City **State/Country** **Zip Code**

Program Description, Equations, Variables

The "codes" for the end restrain are as follow:

EE

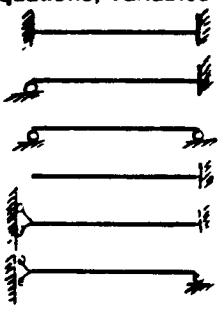
SE

SS

NE

GE

GS

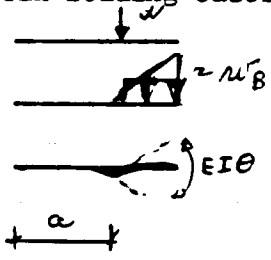


and for the six loading-cases: (they are written for EE)

CO

WB

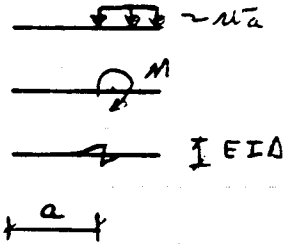
TC



WA

M

DC



Program use superposition to resolve the non-"EE" case (i.e.: SE is simply EE with an appropriate moment added to SE, obtaining so EE).

Necessary Accessories

Operating Limits and Warnings WB can't be zero. Subroutine SE must don't be erase if you use SS or NE. Subroutine GE must don't be erase if you use GS. Round-off errors can give such as a 10 as "EIY" instead of a zero theoric. Don't forgot: it's EI time Y and not Y itself...

Reference(s)

007820 USER INSTRUCTIONS

SIZE: Variable. (HP-41C)

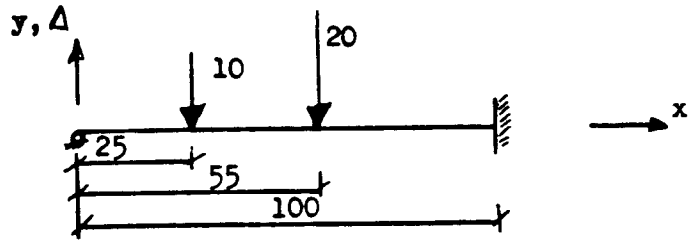
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Enter subprog. that you need. "BEAM" and "Q" must be enter. Also, "CO","WA", "WB","L","TC","DC" if it's a load acting on the beam. You can clear of memory the loads-prog. ("CO","WA",...) you don't need. Also you can clear end-restrain-code ("SE","SS",...) if it's not your case (see "warning" of PROG. DESC. I)			
2.	SIZE. If you want register 08 (R08) for your own use, write 9 in line 03 of "BEAM" and il line 11 of "FF". If you want also R09, write 10 in line 03 of "BEAM" (the same number must appear in line 11 of "FF"), and so on... If you want, say, i registers for your own, and you have j loads, size must be: $8+i+3j=n$ (Your registers are R08 to R(7+i) if i is greater than zero).		SIZE n	
3.	INITIALISATION for a (new) case:		XEQ'BEAM	L:
4.	Input length	L	R/S	END: alpha
5.	Input "END RESTRAIN CODE"	code	R/S	a
6.	Input "a"-length (Write negative number for out, going then to 10.)	a	R/S	C-CH: alpha
7.	Input "LOADING-CODE" for load at (or beginning at) the "a"-distance	code	R/S	VALUE
8.	Input numerical value of the "load"	value	R/S	a
9.	Repeat 5. to 8. as you want.			

STEP	INSTRUCTIONS	INPUT	FUNCTION	SIZE: (HP-41C) DISPLAY
10	You can, here, clear all programs			
	and then, enter "FF".	(No ".END." statement are		written on
	Now, if you want EIY(x),EIT(x),M(x),	magnetics cards, so, change "RTN" by		
	or V(x), you execute "FF":	"END" if you want "CLP".		)
			XEQ'FF	C-FCT:
11	0 for EIY; 1 for EIT; 2 for M;3 for V	code	R/S	X:
12	Input X value to obtain fct(X)	x-value	R/S	result
				X:
13	For a new X (same fct) repeat 12.			
	For a new fct, goto step 10.			
	Note that if you want "FF" in a prog of your mind (i.e.: to find max.) without interruption: Put X in R05 Set flag 00 Put 0,-1,-2 or -3 in R06 to obtain, respectively EIY,EIT,M or V Use XEQ'GG instead of XEQ'FF and then, the result isn't "pause" and is return in the X-STACK. (Stack is perturbed) Remember, the same number must appear in line 03 of "BEA'" and in line 11 of "FF" .	(No END statement on mag.card, so number of line is different if loaded from mag. cards.)		

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

#1



Find EIΔ at $x = \frac{1}{2}l = 50$ and at $x = 40$

EIθ at $x = 0$

and $V(X = 0)$.

SOLUTION:

Input	Function	Display	Comments
			Since we have two loads, and no need of own-reg., size must be 8 + 2⁵ = 9 ⇒ 14
~~8~~ : 14	XEQ'SIZE'		
	XEQ'BEAM'	L:	I supposeenough space. Input length
100	R/S	END alpha	It's SE
SE	R/S	a	The first CO is at 25
25	R/S	C-CH alpha	It's COncentrated load
CO	R/S	W	It's intensity is 10 units
10	R/S	a	We have effectively another load.
55	R/S	C-CH alpha	COncentrated, again
CO	R/S	W	
20	R/S	a	No more loads, put negative one.
1 chs	R/S		Input are finished. Goto computation.
	XEQ'FF'	C-FCT	Deflection, first, say...
0	R/S	X	at 50
50	R/S	-240846	so, downard (-)
		X	(if the PAUSE isn't suff. to read the answer, press chs twice)
40	R/S	-246420	
		X	No more value for deflection.
	XEQ'FF	C-FCT	For rotation, say
1	R/S	X	at simple support
0	R/S	-9084.375	(i.e.:clockwise (-))
		X	no more for rotation...
	XEQ'FF	C-FCT	For shear, it's 3
3	R/S	X	at simple support
0	R/S	11.4919	
Nb: Evaluated shear at x = 25.0001, it's		x = 25 will give 1.4919	11.4919 and at (See page 1)

00782C

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

00 EIYleft-support.
01 EITleft-support
02 M lest-support
03 V left-support
04 M right-support; also, indice
05 lenght; also, X in fct(X)
06 addresse of "a"-value; also,order of the derivative of EIY(x) to obtain wanted fct.

07 First register wich is free (addresse of the -)
08 Used or reserved register
Each register used by 36BEAMS, following reserved by user, are grouped by 3 (one group by load):
- "a"-value
- "exponent"-value
- intensity of the load.
time a cte (appearing in EI Y)

The exponent-value is owned by the "load" (CO WA WB M ....) and tell to the program what kind of "constant" is store in the "group-register", and so, more meaningfull than a simple arbitrairely code when computation (see listing and comments of "FF") occur.

SIZE You must determine yourself the size before running accordingly to : n = 7 + i + 3*j

where i number of register for your own use; j number of loads

Your "i" registers reserved are R08 to R(7 + i). Don't forget modification in line 03 of BEAMS and 11 of FF if i is not zero.

Erroneous result appear if you forget this modification with i different of zero.

STATUS

SIZE	var.	TOT. REG.		USER MODE	
ENG		FIX	SCI	ON	OFF
DEG		RAD	GRAD		

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES
00		No pause in 'FF'	Pause in 'FF'

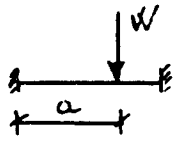
ASSIGNMENTS

FUNCTION	KEY	FUNCTION	KEY

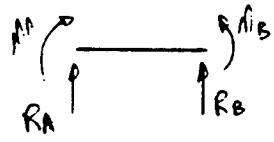
00782C PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL'CO		Concentrated load
	RCL IND 07		first disp. reg.
	1		
	ST+ 07		
	*		
	'W		
	PROMPT		
	CHS		
	STO IND 07		
10	RCL 05		
	X≠2		
	/		
	RCL 05		
	RCL Z		
	-		
	*		
	LAST x		
	X<>Z		
	X↑2		
20	*		
	ST+ 04		
	RCL T		
	/		
	*		
	ST+ 02		
	X<>Y		
	/		
	RCL 05		
	/		
30	RCL 05		
	RCL T		
	2		
	*		
	+		
	*		
	CHS		
	ST+ 03		
	RCL 07		
	1		
40	+		
	3		
	STO IND Y		
	2		
	ST+ 07		
	RTN		
	END	(1)	
50			



$a \neq 0$



$$R_A = \frac{W(l-a)^2(l+2a)}{l^3}$$

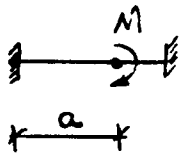
$$M_A = \frac{-Wa(l-a)^2}{l^2}$$

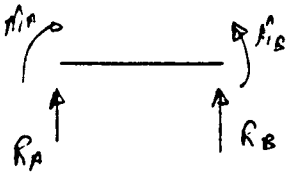
$$M_B = \frac{Wa^2(3l-2a)}{l^3}$$

$$EIy_A = EI\theta_A = 0$$

same code is written for TEE

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
51	LBL'M		Moment load
	RCL 05		
	RCL IND 07		first disp. reg.
	3		
	*		
	-		
	LAST x		
	RCL 05		
	2		
60	*		
	-		
	RCL 05		
	RCL IND 07		
	ST* Z		
	-		
	ST* Z		
	RCL IND 07		
	*		
	RCL 05		
70	/		
	RCL 05		
	X↑2		
	ST/ T		
	ST/ Z		
	/		
	6		
	*		
	1		
	ST+ 07		
80	RDN		
	'M		
	PROMPT		
	ST* Z		
	ST* T		
	ST+ IND 07		
	*		
	ST- 03		
	RDN		
	ST+ 04		
90	RDN		
	ST- 02		
	1		
	ST+ 07		
	2		
	STO IND 07		
	X<>Y		
	ST+ 07		
	RTN		
	END	(1)	
00			





$$R_A = \frac{-6Ma(l-a)}{l^3}$$

$$M_A = \frac{-M}{l^2}(l-a)(l-3a)$$

$$M_B = \frac{M}{l^2}a(3l-2l)$$

$$EIy_A = EI\theta_A = 0$$

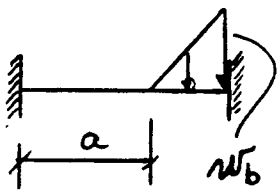
(1) No end statement on mag. card.

Notes: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

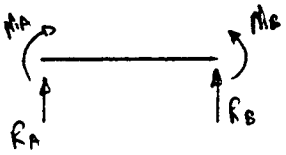
00782C PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	Lbl'WB		
	RCL 05		
	RCL IND 07		
	-		
	STO 06		
	X ↑ 2		
	Last x		
	*		
	RCL IND 07		
10	3		
	*		
	RCL 05		
	2		
	*		
	+		
	X < > Y		
	*		
	Last X		
	3		
20	ST / Z		
	RDN		
	RCL 05		
	3		
	*		
	RCL IND 07		
	+		
	RCL IND 07		
	+		
	*		
30	20		
	ST / Z		
	/		
	RCL 05		
	/		
	RCL 05		
	X ↑ 2		
	ST / Z		
	/		
	RCL 06		
40	X ↑ 2		
	6		
	/		
	'WB		
	PROMPT		
	ST * T		
	ST * Z		
	ST * Y		
	ST/ 06		
	X < > T		
50	ST- 02		



$w_b \neq 0$



$$R_A = \frac{w_b (l-a)^3 (3l+2a)}{20 l^3}$$

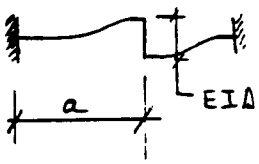
$$M_A = \frac{-w_b (l-a)^3 (2l+3a)}{60 l^2}$$

$$M_B = R_A l + M_A - \frac{w_b (l-a)^2}{6}$$

$EI\theta_A = EIy_A = 0$

since code is written for EE case.

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
51	RCL Z		
	ST + 03		
	RCL 05		
	*		
	-		
	+		
	ST - 04		
	1		
	ST + 07		
60	RCL 06		
	1/x		
	ST- IND 07		
	1		
	ST + 07		
	5		
	STO IND 07		
	1		
	ST + 07		
	RTN		
70	END		
01	LBL'DC		
	1		
	ST + 07		
	RCL 05		
	1/X		
	ENTER ↑		
	X ↑ 2		
	*		
	LAST X		
80	6		
	ST * Y		
	ST * Z		
	RDN		
	2		
	ST * Z		
	RDN		
	'EIY		
	PROMPT		
	STO IND 07		
20 90	STO * Z		
	*		
	ST + 04		
	ST- 02		
	RDN		
	ST + 03		
	2		
	ST + 07		
	RTN		
29	END		
00			



$$R_A = \frac{12 EI\Delta}{l^3}$$

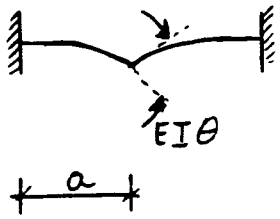
$$M_A = \frac{-6 EI\Delta}{l^2} = -M_B$$

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL'TC		
	RCL 05		
	RCL IND 07		
	3		
	*		
	-		
	LAST X		
	RCL 05		
	2		
10	*		
	-		
	RCL IND 07		
	2		
	*		
	RCL 05		
	*		
	RCL 05		
	/		
	RCL 05		
20	X ↑ 2		
	ST/ T		
	ST/ Z		
	/		
	2		
	ST * Z		
	ST * T		
	*		
	3		
	*		
30	1		
	ST + 07		
	*		
	'EIT		
	PROMPT		
	ST * Z		
	ST * T		
	STO IND 07		
	*		
	ST- 03		
40	RDN		
	ST + 02		
	RDN		
	ST + 04		
	1		
	ST + 07		
	STO IND 07		
	ST + 07		
	RTN		
	END		
00	LBL'EE		



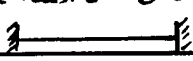
Externaly created rotation

$R_A = \frac{6EI\theta}{\ell^2}(\ell - 2a)$

$M_A = \frac{2EI\theta}{\ell^2}(3a - 2\ell)$

$M_B = \frac{2EI\theta}{\ell^2}(\ell - 3a)$

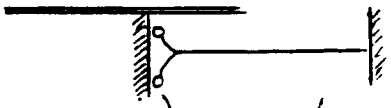
"Encastré" Beam



STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
02	XEQ'Q		
	RTN		
04	END		
01	LBL'Q		
	'a =		
	PROMPT		
	X < 0?		
	RTN		
	STO IND 07		
07	'C-CH:		
	AON		
	PROMPT		
	ASTO X		
	AOFF		
	XEQ IND X		
	GTO'Q		
14	END		
01	LBL'GE		
	XEQ'Q		
03	RCL 03		
	RCL 05		
	*		
	2		
	/		
	ST + 02		
	ST- 04		
	6		
	/		
	RCL 05		
13	X ↑ 2		
	*		
	ST- 00		
	0		
	STO 03		
	RTN		
19	END		
01	LBL'GS		
	XEQ'GE		
	RCL 04		
04	ST- 02		
	RCL 05		
	X ↑ 2		
	*		
	2		
	/		
	ST + 00		
	CL X		
	STO 04		
	RTN		
14	END		

— General command input exit if $a < 0$

— XEQ T Loading code



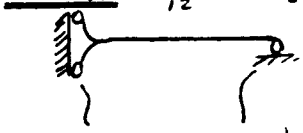
Translation can occur, but no rotation "Guidé"

Elimination of R_A:

$M_A = M_A + \frac{R_A \ell}{2}$

$EIG_A = 0$ $M_B \; M_B - \frac{R_A \ell}{2}$

$EI\gamma_A = -\frac{R_A \ell^3}{12}$



Guidé Simply supported

Elimination of M_B

$R_A = 0$ $EIG_A = 0$

$M_A = M_A - M_B$

$EI\gamma_A = EI\gamma_A + \frac{M_B \ell^2}{2}$

Note: No "End" statement on magnetic cards. Replaced by "RTN" statement.

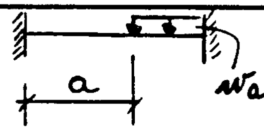
Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS

```
LBL'WA
RCL 05
RCL IND 07
-
X↑2
LAST X
*
RCL IND 07
3
*
RCL 05
+
X<>Y
*
LAST X
6
ST/ Z
RDN
RCL 05
RCL IND 07
+
*
2
ST/ Z
/
RCL 05
X↑2
ST/ Z
/
RCL 05
/
RCL 05
RCL IND 07
-
X↑2
2
/
[illegible]
PROMPT
ST* Y
ST* Z
ST* T
STO L
CL X
1
ST+ 07
X<>T
ST- 02
LAST X
ST-IND 07
X<>T
ST+ 03
RCL 05
*
-
+
CHS
ST+ 04
1
RCL 07
+
4
STO IND Y
2
ST+ 07
END
```



$R_A = \frac{w_a}{2l^3}(l-a)^3(l+a)$

$M_A = \frac{-w_a}{12l^2}(l-a)^3(l+3a)$

$M_B = R_A l + M_A - \frac{w_a}{2}(l-a)^2$

```
LBL'SS
XEQ'SE
RCL 04
RCL 05
/
ST- 03
RCL 05
X↑2
*
6
/
ST+ 01
CL X
STO 04
RTN
END
```

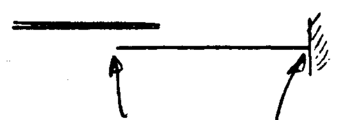
"S"imply supported
Elimination of M_B from 'SE:

$R_A = R_A$ [illegible] M_B / l

$M_A = 0 \quad EIy_A = 0$

$EI\theta_A = EI\theta_A - \frac{M_B l}{6}$

```
LBL'NE
XEQ' SE
RCL 03
RCL 05
X↑2
*
2
/
ST+ 01
1.5
/
RCL 05
*
ST- 00
CL X
STO 03
RTN
END
```



"N"othing "E"ncastre
Elimination of R_A from 'SE

$R_A = 0 \quad M_A = 0$

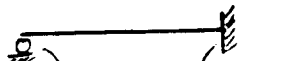
$EIy_A = -R_A l^3/3EI$

$EI\theta_A = EI\theta_A + \frac{R_A l^2}{2EI}$

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

00782C PROGRAM LISTING

67 ☐ 97 ☐ 41C

STEP/LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL'BEAM		Initialization for a new case
	CLRG		
	8		
	STO 07		
	'L:		
	PROMPT		
	STO 05		
	'END:		
	AON		
10	PROMPT		
	ASTO X		
	Aoff		
	XEQ IND X		
	LBL 00		
	STOP		
	'XEQ ?		
	AVIEW		
	GTO 00		
	END		
20			
01	LBL'SE		 "S"imply "E"nclosed supported
	XEQ'Q		
	RCL 02		
	2		
	/		
	ST+ 04		Elimination of M_B from TEE
	2		
	/		
	RCL 05		$R_A = R_A + \frac{3M_A}{2l}$
80	*		
	ST+ 01		$EI\theta_A = \frac{M_A l'}{4}$
	RCL 02		
	1.5		$M_B = M_B + \frac{M_A}{2}$
	*		
	RCL 05		$M_A = 0$
	/		
	ST+ 03		
	CL X		
	STO 02		
10	RTN		
	END		
50			

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 OWNER'S HANDBOOK AND PROGRAMMING GUIDE for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
LBL'FF		Compute EIY(x) if δ=0
'C-FCT:		EIθ(x) δ=-1
PROMPT	= |δ|	M(x) δ=-2
CHS	= δ	V(x) δ=-3
STO 06		
LBL 08		Manually: XEQ "FF" and enter |δ| corresponding to fct you want.
'X=		
PROMPT		In subroutine: set flag 00, put δ in R06, put x in R05, XEQ "GG"
STO 05		
LBL'GG		
8		
STO 04		
RCL 05		
X < 0?		
RTN		
2		
RCL 06		
ABS		
X > Y?		
GTO 09		
1 E 3		
/		
3		
+		
0		
LBL 04		
RCL 06		
RCL Z		
+		
INT		
FACT		
1/X		
RCL IND T		
*		
+		
RCL 05		
*		
DSE Y		
GTO 04		
RCL IND Y		
+		
LBL 05		
RCL 05		
RCL IND 04		
X<=0?		
GTO 02		
2		
ST + 04		
CL X		
RCL IND 04		$\sum_i \text{Coef}_i * \frac{\langle x-a_i\rangle^{\langle exp_i+\delta\rangle}}{\langle exp_i+\delta\rangle!}$
RCL 06		
+		
X < 0?		since $V = \frac{d}{dx}(M) = \frac{d}{dx}(EI\theta) = \frac{d}{dx}(y)$
GTO 06		
Y↑X		So, δ = order of derivative (0 for EIy) which is the equation shown. "exp_i" is simply the exponent of "co", "m", "wo"... when we compute EIy.
LAST X		
FACT		
/		
1		
ST- 04		
*		
RCL IND 04		
*		
+		
2		
LBL 03		
ST + 04		
RCL 04		
RCL 07		
X > Y?		
GTO 00		
R↑		
FS ? 00		if in subroutine RETURN,
RTN		
PSE		if manually, PSE
GTO 08		
LBL 09		
3		
X = Y?		
GTO 01		
0		
GTO 05		
CL x		LBL 02 — $\langle x-a_i\rangle = 0$ if $x < a_i$
3		
GTO 03		
LBL 06		
RCL T		
1		
GTO 03		
LBL 00		
R↑		
GTO 05		
LBL 01		
RCL 03		
GTO 05		
END		

$V(x) = R_A + \ldots$

$M(x) = M_A + R_A x + \ldots$

$EI\theta(x) = EI\theta_A + M_A x + R_A \frac{x^2}{2} + \ldots$

$EI\Delta(x) = EI\Delta_A + EI\theta_A x + M_A \frac{x^2}{2} + R_A \frac{x^3}{6} + \ldots$

Note: $\langle K\rangle^0 = 1$ if $K > 0$

$\qquad = 0$ if $K \le 0$

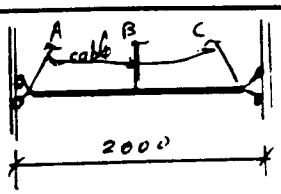
$\langle K\rangle^m = \langle K\rangle^0 K^m$

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

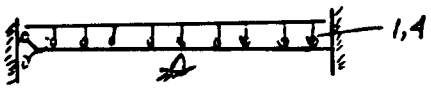
PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

#2. A guided on rails platform is normally suspended by 3 cables. Suppose cable A is now loose or broken, we want know deflection at this end if a uniform load of 1.4 is apply. Suppose, for demonstration, inextensible cables.

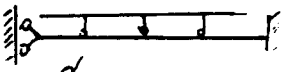


Since end C is guided + translation restrained, it's become an encastred end. So, our model is then:



It's a two spans beam.

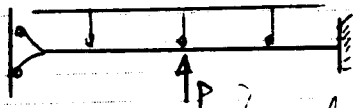
Let us consider middle support as redondant. Central reaction is then temporaly remove, and we have



causing a deflection at center, Δ_0. But central support act as a concentrated force, upward. If reaction is 1 (one), we have an upward deflection Δ_1. It's well know, then, that true

SOLUTION:

reaction, P_1 is central reaction, we obtain :

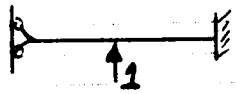
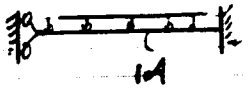


2 loads

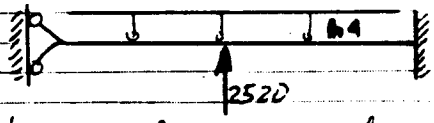
so size 14 is the minimum
$14 = 8 + 2*3$

Since P is upward.

so, upward deflection.

Input	Function	Display	Comments
1- Compute Δ_1			
XEQT BEAM	R/S	L:	
2000	R/S	END:	
GE	R/S	α =	
1000	R/S	C-CH:	
CO	R/S	W:	
1 CHS	R/S	α =	
1 CHS	R/S		
	XEQT FF	C-FCT:	
0	R/S	X =	
1000	R/S	20833333-3	
		X =	
2- Compute Δ_0			
	XEQT BEAM	L:	
2000	R/S	END:	
AE	R/S	α =	
0	R/S	C-CH:	
WA	R/S	WA:	
1.4	R/S	α =	
1 CHS	R/S		
	XEQT FF	C-FCT:	
0	R/S	X =	
1000	R/S	-5,25 E11	
		X =	

So, P = 2520 = true reaction at unfixed support
(inextensible cable)

3- We now compute 

("Hard-user" only: Since almost loads are already entered we will ask: "Is there a way to add loads without beginning at zero, as nothing was already worked in?" Answer is yes:
- Restore length in R05; Put 0 in R04
- Give the first register disponible for new loads in R07
(8 + i + 3 + already entered loads since last XEQT BCAM)
↑ # of registers reserved to you
- XEQT Code of restrain.

no need, correct number is always there

Here: 2000 STO 05 0 STO 04
~~XEQT GE STO 07~~
XEQT GE)

For the next trace of all INPUT option: (Re-begin at zero)

XEQT BCAM	L:	2000
R/S	CND	GE
R/S	a=	0
R/S	C-CH:	WA
R/S	WA:	1.4
R/S	a=	1000
here, hard-user rejoins us →	C-CH:	CO
R/S	W:	2520 CHS (upward)
R/S	a=	1 CHS

XEQT FF	C-FCT	0
R/S	X=	

Let us verify at X=1000

		1000
R/S	-60	
since it's about zero	(-40 for hard-user, don't ask me why!)	(EIy = -60
(Round-off errors don't give exactly 0)		y = 0)

and now, at X=0

	X:	0
R/S	-9,333 E10	

Evidently, since EIy at X=0 is always in R00:
RCL 00 -9,333 E10 is also good.

PROGRAM REGISTERS NEEDED: 21

ROW 1 (1 : 2)

ROW 2 (3 : 10)

ROW 3 (10 : 20)

ROW 4 (21 : 30)

ROW 5 (31 : 40)

ROW 6 (40 : 49)

ROW 7 (50 : 60)

ROW 8 (61 : 70)

ROW 9 (71 : 80)

ROW 10 (81 : 89)

ROW 11 (90 : 98)

ROW 12 (98 : 98)

PROGRAM REGISTERS NEEDED: 95

ROW 1 (1 : 7)

ROW 2 (8 : 18)

ROW 3 (19 : 28)

ROW 4 (29 : 38)

ROW 5 (39 : 46)

ROW 6 (47 : 54)

ROW 7 (55 : 65)

ROW 8 (65 : 69)

ROW 9 (70 : 80)

ROW 10 (81 : 85)

ROW 11 (86 : 95)

ROW 12 (95 : 101)

ROW 13 (102 : 113)

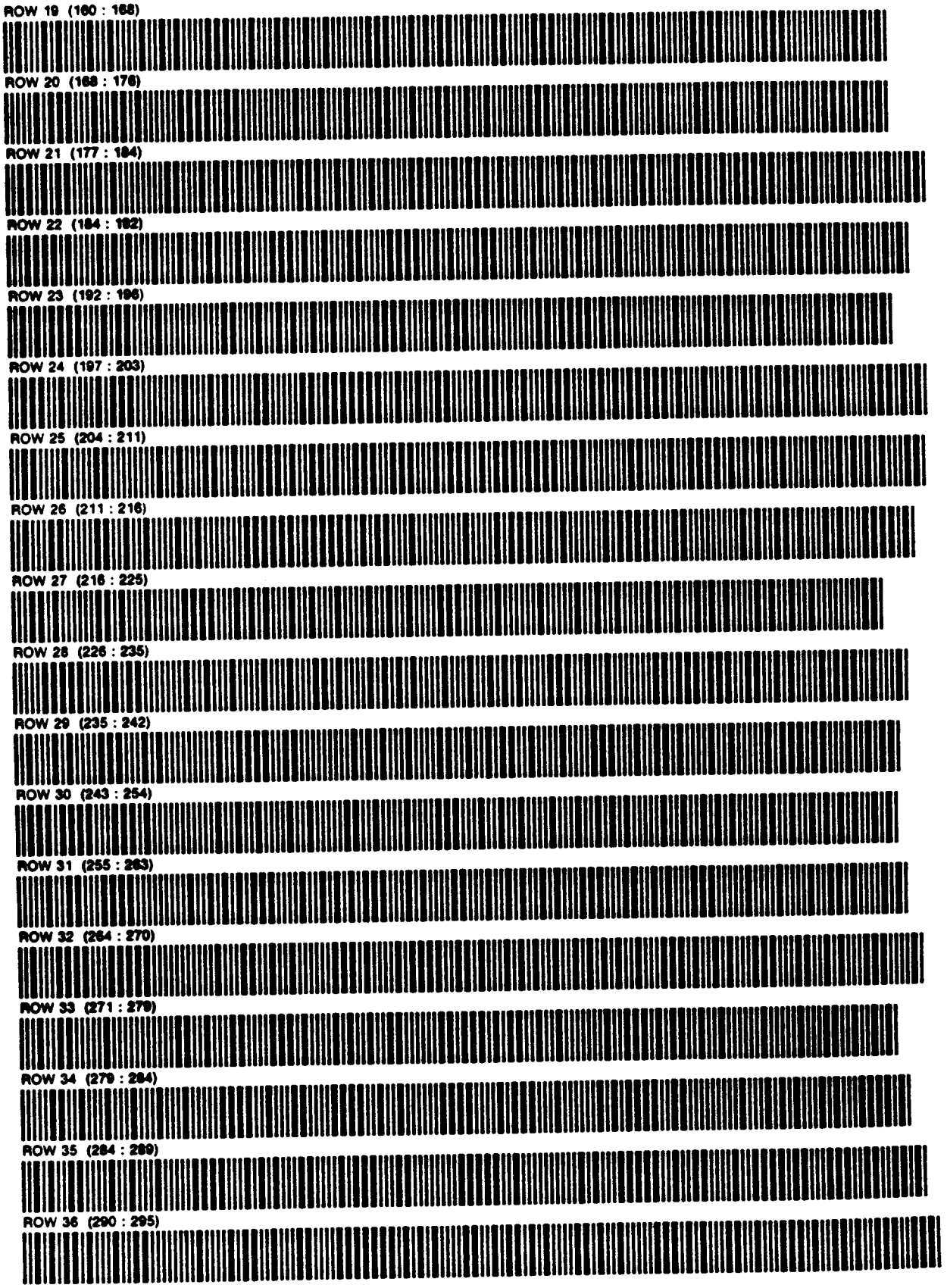
ROW 14 (114 : 124)

ROW 15 (125 : 134)

ROW 16 (135 : 143)

ROW 17 (144 : 150)

ROW 18 (150 : 160)


ROW 19 (160 : 168)
ROW 20 (168 : 176)
ROW 21 (177 : 184)
ROW 22 (184 : 192)
ROW 23 (192 : 196)
ROW 24 (197 : 203)
ROW 25 (204 : 211)
ROW 26 (211 : 216)
ROW 27 (216 : 225)
ROW 28 (226 : 235)
ROW 29 (235 : 242)
ROW 30 (243 : 254)
ROW 31 (255 : 263)
ROW 32 (264 : 270)
ROW 33 (271 : 279)
ROW 34 (279 : 284)
ROW 35 (284 : 289)
ROW 36 (290 : 295)

ROW 37 (296 : 300)

ROW 38 (301 : 309)

ROW 39 (310 : 315)

ROW 40 (316 : 325)

ROW 41 (326 : 332)

ROW 42 (332 : 341)

ROW 43 (342 : 351)

ROW 44 (352 : 361)

ROW 45 (362 : 372)

ROW 46 (373 : 379)

ROW 47 (380 : 390)

ROW 48 (391 : 399)

ROW 49 (400 : 409)

ROW 50 (409 : 417)

ROW 51 (418 : 424)

023086 Media Manufactured in U.S.A. Software, Product of Brasil

PROGRAM DESCRIPTION I

Program Title TRUSS DEFORMATION

Contributor's Name Paulo de Salles Mourão

Address Rua Eng. Amaro Lanari 110/201

City Belo Horizonte State/Country MG, BRASIL Zip Code 30000

Program Description, Equations, Variables 1) For a loaded truss , it is of interest to get the elastic line for both superior and inferior polygonals of the structure , that is , respective joints' strains under elastic deformation , which is the program's goal , restrictive to the more important vertical displacements .
As everybody knows , there are classical types of trusses that received particular names , such as Warren , Pratt , Howe . Notwithstanding the standardization , they can vary to a certain extent , and non typical designs can vary widely . For this reason, it is difficulty to combine a vast range of application with a high degree of program's automation . So we decided to sacrifice some on the last one , in order to maintain an wide applicability , that includes all standard trusses and great number of non typical ones , without redundant members .

2) The sacrifice doesn't go as far as requiring reentering of data as such . However , references to data are provided in such a way that the user will furnish them to the 41C , as oriented by the display,opportunely .

3) Now , let us present the chief variables of the program

(see continuation page 2)

Necessary Accessories 2 memory modules

Operating Limits and Warnings 30 angles and 20 sides limit the size of the structure for one straightforward run , but since subsequent runs can always be done , there is no total limitation .

Reference(s) Theory of Structures , by Timoshenko and Young
Ed. McGraw-Hill Book Company , Inc .

ELTRUSS

3-1) Angle , as symboled by the 41C sign : ∠ . Refers to the angle between two concurrent bars , not to the angle of the bar about X axis , which will also play a role , and will be referred to as angle (∠) about X . For practical reasons only the angle unit is the degree with decimal fractions .

3-2) Unitary stress acting on a bar , positive if tension , negativ if compression . Will be called 'S' , from sigma .

3-3) Fictitious loads symboled 'FP' are the main findings from the program , they come from the sum of adjacent angles variation in each desired joint . So , they have no physical dimension.

3-4) The vertical strains , symboled 'ST',being final outputs .

4) Consider now a triangle , whose ver--tices were numbered 1,2,3, meaning that such numbers became references for respective angles. (Such refe--rences match the registers that contain the angles). The sides were numbered 42, 43, 44 , but instead of standing for lenghts of the sides , such references apply to 'S' varia--bles (3-2, above.)

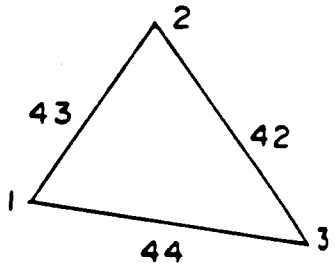


Fig 1

4-1) If we prefix the symbol of a variable with the letter 'R' , we symbolize the reference to such variable . In this way, 'RS' stands for a reference to the variable sigma , and 'R∠ signifies a reference to the variable angle . As stated before , such references are numbers that match registers where the variables are stored .

4-2) Figure 2 shows a joint 'J' where 3 triangles concur . As this joint is being treated in program's running, the user will be invited to make entries , and besides what will appear in the display to orient him, her, the following simple rules must be obeyed :

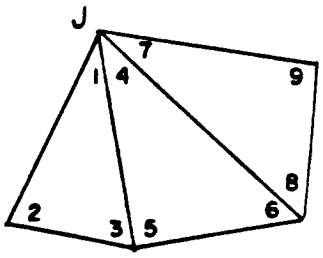


Fig 2

4-2-1) Couples of angle and sigma refe--rences will be called for , fre--quently, respective to the ele--ments of a triangle .
First rule :Entered an angle reference ,its counterpart is always the opposite side sigma reference .

see continuation page 3

Example : In fig 1 the couples are :
1-42 2-44 3-43

4-2-2) A joint (knot) J is being considered (fig 2). In the case illustrated three triangles are to be computed (may be one to several). The order of triangle treatment is not relevant , but of course it is easier to follow a sequence , as :
1-2-3 , 4-5-6 , 7-8-9 ,
or the reverse , but not either beginning or finishing with the middle triangle .
On the other hand , it is mandatory to begin each triangle with the angle contiguous to the joint in question (for fig 2 , 1 in the first , 4 in the second , 7 in the third triangle.)
For the other 2 couples in each triangle the order is irrelevant , but again it helps to adopt a rule ; for example , counter-clockwise , we'd get the sequences cited above .
After the n triangles have been processed , and the program asks for elements of the n+1 triangle (nonexistent), enters zero and run - the next joint will be ready .

5) The searched vertical strains are due mainly to the variation of the angles between bars , but if inclined bars are present, there is part due to variation of respective lenghts. See in next item 6 how to consider this . Referring again to fig 1 , variation of angle 1 is a function of angles 2 and 3 , and the unitary variation of each side ; if we call DL the variation of a lenght L , we can write :

$$DL/L = S/E$$

, being E the module of elasticity , supposed constant . The second member will be used .
Now, the formula for angle variation . According to the reference , we can write for the variation $D\angle$ of angle 1 in fig 1 :

$$E(D\angle 1) = (S42-S44)\cot an(2) + (S42-S43)\cot an(3)$$

It is not necessary to write similar equations for the other 2 angles , because only 1 angle in each triangle will be considered at a time .
For each joint , respective $D\angle$ will be treated as the fictitious load (FP) there applied, and after all of them have been computed , they are input in the last part for desired strains gathering .

6) In case of inclined bars , besides the effects described in (5) , there will be strains due to variation in the lenght of the bars , and we can apply the same fictitious loads concept , considering at bars' ends two equal FP with opposite signs .

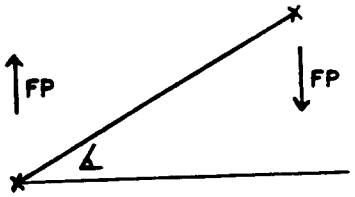


Fig 3

see continuation page 4

In each inclined bar , the intensity of FP is :

FP = (S/E)tan(∠) ∠ =angle about X

If ∠ is positive , as in fig 3 , the sign of FP depends on the sign of S . For a compressed bar , S is negative , and so is FP . It is necessary to state to which FP applies this negative sign :it is to the left FP , so the right FP is positive . A positive FP leads to a positive strain , that is , a strain going down , for this is the natural tendency of a joint in a load structure .
Lbl S (reminding of slope) takes care of these calculations , and for clarity to the user the FP value displayed is preceded by the reminder "TO RIGHT", meaning that the FP sign applies to the right element . Summarizing : If FP is displayed with positive sign , the situation matches fig 3 ; and if negative sign , invert fig 3 .

7) After determining all FP , we consider them as concentrated loads applied on a simply supported beam that matches the truss , as long as abscissas are concerned. The bending moment that results at each joint abscissa , equals respective strain. Related computations are performed in Lbl T , that asks as inputs each FP and respective abscissa . Then , strains are output currently from left to right , at each R/S command .

8) How to reference an entire truss ? Very simply :
Number angles "ad libitum" from 1 to 30 (if more angles , see 9)
Equal angles must receive same number .
Then , number sides in same way, from 31 to 50 (if more , see 9)
Such numbers will stand for sigma (S) in the bars , not lenght.
The program will prompt for angles , first , which must be en--tered according to the numeration. No more angles , enters 0 , run , and the program prompts for 'S', that will be entered in similar way , and so for the conclusion .

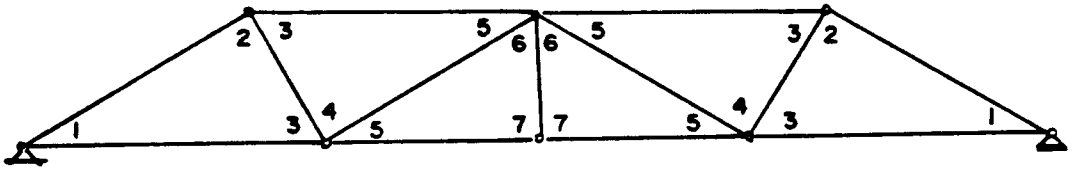
9) If the truss exceeds program's capacity , run in first part how many joints as possible , then renumber the remainder of the truss, and make another independent run for determining lacking FP . The last part , Lbl T ,can take simultaneously 20 FP and abscissas . If 2 or more runs are necessary , the results must be superposed (in this last part).

10) Vertical bars at ends - If in pg 5 truss ref.30 and ref.42 bars were vertical ones , at Lbl S 90 could not be angle entry , but with adequate precision we'd entry with ATAN H, being H the height (1645). This ensure to be 1 mm the X of FP near left support , and similarly for right support . Another option is introducing a fictitious moment equal to vertical bar's strain at respective end but this doesn't make use of program's facilities .

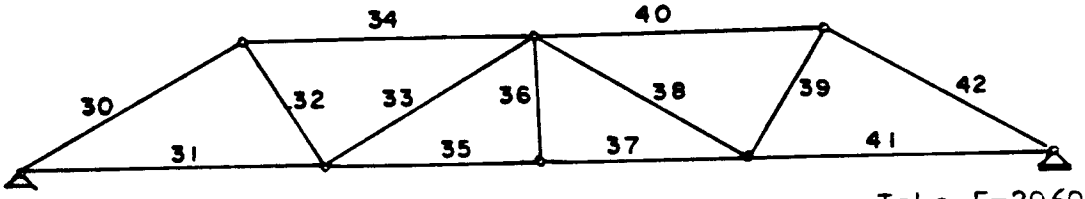
PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

The truss below was numbered for angles and 'S' values . Respective values are given in page 6 table . Find the elastic lines of both su--perior and inferior polygonals of the truss .



Angles



S

Take E=206000 N/mm^2

SOLUTION: We assume the program loaded in the 41C , and SIZE 060 covered

Input	Function	Display	Comments
	XEQ ELTRUSS	E	Call the program
206000	R/S	END ENTRIES	Enter E and run
		WITH ZERO	Advice about going on
		ANGLE ENTRY	What will be entered now
		∠ 1	Angle ref. 1 enter. , run.
31	R/S	∠ 2	Angle ref. 2 enter , run.
88	R/S	∠ 3	Similarly ...
61	R/S	∠ 4	Similarly ...
88	R/S	∠ 5	Similarly ...
30	R/S	∠ 6	Similarly ...
60	R/S	∠ 7	Similarly ...
90	R/S	∠ 8	No 8th angle, enter 0,run
0	R/S	SIGMA ENTRY	Next variable entry , the
		S 30	1st is referenced by '30'.
53.22	CHS R/S	S 31	As each reference appears
45.62	R/S	S 32	in display ,respective
10.76	R/S	S 33	value is keyed in and runs
18.82	CHS R/S	S 34	(See S table , pg 6)
50.84	CHS R/S	S 35	
67.13	R/S	S 36	
FFX CHS 20	R/S	S 37	As a zero value would ter-
67.13	R/S	S 38	-minate the entry , enter
5.18	CHS R/S	S 39	in its place a tiny value.
13.25	R/S	S 40	
62.65	CHS R/S	S 41	
55.90	R/S	S 42	
65.22	CHS R/S	S 43	Nonexistent ,enter 0 ,run
0	R/S	ABOVE JOINT?	Asks situation of joint ,
		Y OR N	Y=ABOVE , N=BELOW
Y	R/S	KNOT N 1	First , above
		TRIANGLE N 1	Knot, triangle, and refe-
		R& RS 1	-rence entries are given
			User must review 4-2 item
			See continuation pg 7

'S' table Unit : N/mm^2

R	S
30	-53.22
31	45.62
32	10.76
33	-18.82

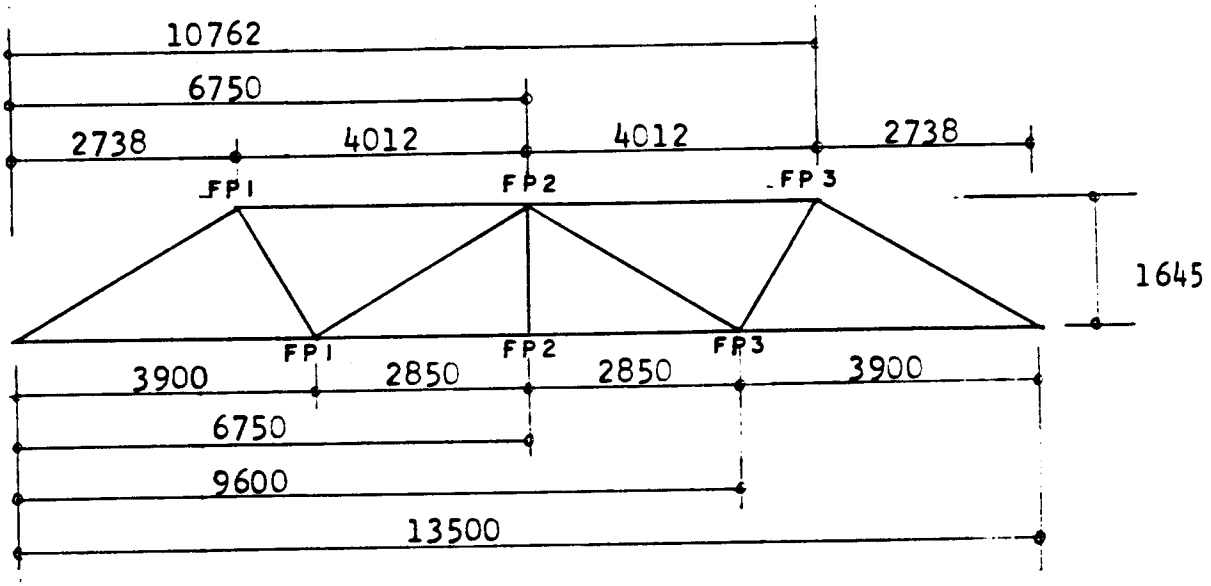
R	S
34	-50.84
35	67.13
36	0.00
37	67.13

R	S
38	-5.18
39	13.25
40	-62.65
41	55.90
42	-65.22

Angle table
Unit : deg.

R	∠
1	31
2	88
3	61
4	89

R	∠
5	30
6	60
7	90



TRUSS measurements - abscissas of the knots
Unit : mm

Determined FP table

	principal	additional	sum
FP1	0.001159	0.000155	0.001314
FP2	0.001705	-	0.001705
FP3	0.001575	0.000190	0.001765

S U P E R I O R

	principal
FP1	0.001192
FP2	0.001398
FP3	0.001665

INFERIOR

Input	Function	Display	Comments
2 31 1	ENTER R/S ENTER	2 R∠ RS 2	Enter couple of ∠ and S references, according to 4-2 item , thrice for each triangle. This comment will repeat as comment 1 .
32 3 30	R/S ENTER R/S	R∠ RS 3 TRIANGLE N 2	Second triangle of same knot will be considered
3 33	ENTER R/S	R∠ RS 1 R∠ RS 2	Comment 1
4 34 5	ENTER R/S ENTER	R∠ RS 3	
32 0	R/S R/S	TRIANGLE N 3 R∠ RS 1 FP1=0.001159	Third triangle is referenced As nonexistent , enter 0 ,... First FP1 is displayed , and second knot is announced
	R/S	KNOT N 2 TRIANGLE N 1 R∠ RS 1	Comment 1
5 32 3	ENTER R/S ENTER	R∠ RS 2	
33 4 34	R/S ENTER R/S	R∠ RS 3 TRIANGLE N 2	Second triangle of this joint
6 35	ENTER R/S	R∠ RS 1 R∠ RS 2	Comment 1
5 36 7	ENTER R/S ENTER	R∠ RS 3	
33 6	R/S ENTER	TRIANGLE N 3 R∠ RS 1	Third triangle , joint 2
37 7 38	R/S ENTER R/S	R∠ RS 2 R∠ RS 3	Comment 1
5 36	ENTER R/S	TRIANGLE N 4 R∠ RS 1	Fourth triangle , knot 2
5 39 4	ENTER R/S ENTER	R∠ RS 2	Comment 1
40 3 38	R/S ENTER R/S	R∠ RS 3 TRIANGLE N 5	Fifth triangle is required
0	R/S R/S	R∠ RS 1 FP2=0.001705 KNOT N 3	As nonexistent , enter 0 , run , and FP2 is shown . Third joint will be treated
		TRIANGLE N 1 R∠ RS 1	Comment 1
			see continuation pg 8

ELT 7055

Input	Function	Display	Comments
3	ENTER	3	Entering elements of knot
38	R/S	R∠RS 2	N 3 , TRIANGLE N 1
5	ENTER	5	
39	R/S	R∠RS 3	Comment 1
4	ENTER	4	
40	R/S	TRIANGLE N 2	Second triangle
		R∠RS 1	
2	ENTER	2	
41	R/S	R∠RS 2	
3	ENTER	3	Comment 1
42	R/S	R∠RS 3	
1	ENTER	1	
39	R/S	TRIANGLE N 3	Third triangle , nonexistent
		R∠RS 1	Now are complete FP due to
0	R/S	FP3=0.001575	angle variation for superior
			polygonal,and for the other
	XEQ S	S	effect (item 6), call Lbl S.
	RCL 30	-53.220000	For 1st inclined bar , enter
	R/S	ANGLE ABOUT X	S and run . Now, asks angle
	RCL 01	31.000000	Call it and run
	R/S	TO RIGHT	Position of FP for sign
		FP=1.5523E-4	
			Now, run for the other bar
	XEQ S	S	
	RCL 42	-6.5220 01	Call the stress, and run
	R/S	ANGLE ABOUT X	The angle is 180-∠1
180	RCL 01	3,1000 01	
	-	1,4900 02	
	R/S	TO RIGHT	
		FP=-1.9023E-4	FP is positive, since the
			point is to the left of bar.
			Now we can return to Lbl 04
	XEQ 04	ABOUT JOINT?	for the inferior polygonal
		Y OR N	Of course , N
N	R/S	KNOT N 1	First knot will be treated
		TRIANGLE N 1	
		R∠RS 1	Comment 1
3	ENTER	3	
30	R/S	R∠RS 2	
2	ENTER	2	
31	R/S	R∠RS 3	
1	ENTER	1	
32	R/S	TRIANGLE N 2	Passes to 2nd triangle
		R∠RS 1	
4	ENTER	4	Comment 1
34	R/S	R∠RS 2	
5	ENTER	5	
32	R/S	R∠RS 3	
3	ENTER	3	
33	R/S	TRIANGLE N 3	Passes to 3rd triangle
		R∠RS 1	
5	ENTER	5	Comment 1
36	R/S	R∠RS 2	
7	ENTER	7	
33	R/S	R∠RS 3	

see continuation pg 9

Input	Function	Display	Comments
6 35	ENTER R/S	6 TRIANGLE N 4 R RS 1	Nonexistent Enter 0 , run
0	R/S R/S	FP1=0.001192 KNOT N 2 TRIANGLE N 1	FP1 output . Run again , Announces 2nd joint
7 33	ENTER R/S	R∠RS 1 7 R∠RS 2	Comment 1
6 35 5	ENTER R/S ENTER	6 R∠RS 3 5	
36 7	R/S ENTER	TRIANGLE N 2 R∠RS 1 7	Second triangle of 2nd KNOT
38 5 36	R/S ENTER R/S	R∠RS 2 5 R∠RS 3	Comment 1
6 37	ENTER R/S	6 TRIANGLE N 3 R∠RS 1	Nonexistent Enter 0 , run
0	R/S R/S	FP2=0.001398 KNOT N 3 TRIANGLE N 1	FP2 output. Run for 3rd knot This is the last joint of inferior polygonal
5 36	ENTER R/S	R∠RS 1 5 R∠RS 2	
6 37 7	ENTER R/S ENTER	6 R∠RS 3 7	
38 4	R/S ENTER	TRIANGLE N 2 R∠RS 1 4	Passes to 2nd triangle
40 3 38	R/S ENTER R/S	R∠RS 2 3 R∠RS 3	Comment 1
5 39	ENTER R/S	5 TRIANGLE N 3 R∠RS 1	Last triangle of last knot
3 42 1	ENTER R/S ENTER	3 R∠RS 2 1	Comment 1
39 2 41	R/S ENTER R/S	R∠RS 3 2 TRIANGLE N 4	Nonexistent Enter 0 , run
0	R/S	R∠RS 1 FP3=0.001665	FP3 output Since no inclined bars are present, Lbl S doesn't apply

For table of determined FP , see page 6

See continuation page 10

Input	Function	Display	Comments
	XEQ T	L TOTAL	For getting strains , XEQ T
13500	R/S	X FP 1	Enter Truss lenght and run
2738	ENTER	2738	First superior polygonal
.001314	R/S	X FP 2	Page 6 helps data entry
6750	ENTER	6750	Entering 2nd abscissa ,and FP
.001705	R/S	X FP 3	
10762	ENTER	10762	Third and last X and FP
.001765	R/S	X FP 4	Nonexistent, enter 0 and run
0	R/S	STRAINS	Advice that strains will follo
		ST1=6.18232	Strain related to X1. Run agai
	R/S	ST2=9.96953	Strain in the middle. Run
	R/S	ST3=6.91627	Strain related to X3 .
	XEQ T	L TOTAL	Return to T for inferior pol.
13500	R/S	X FP 1	Make similar entries
3900	ENTER	3900	
.001192	R/S	X FP 2	Asks 2nd X and FP
6750	ENTER	6750	
.001398	R/S	X FP 3	Third X and FP
9600	ENTER	9600	
.001665	R/S	X FP 4	Nonexistent, enter 0 and run
0	R/S	STRAINS	Results will be shown
		ST1=7.90781	First one , run
	R/S	ST2=10.28940	Again
	R/S	ST3=8.68669	Completing the output .

In practice , of course , the precision of five decimal digits is illusory ,and additional strains will be produced by other factors. . So , rounding off the values, the results are :

Vertical strains ,superior polygonal : 6.2 , 10.0 , 6.9 mm
inferior 7.9 , 10.3 , 8.7 mm

Comments regarding program's effectiveness

It cannot be denied that this program's execution requires substantial amount of user's guidance . However, as stated in page 1 this is the price to pay for assuring vast range of application . As truss configurations vary widely, it is not possible ,keeping the generalization , to avoid instructions necessary to face distinct truss arrangements , even if mass storage were to be employed . On the other hand , the execution is far from cumbersome , very easy to grasp , thoroughly signaled , and he or she who has ever calcu-lated truss strains using a Williot-Mohr diagram or equivalent process , will consider using this program a very convenient way .

USER INSTRUCTIONS

SIZE: 060 (HP-41C)

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter the program , check status		XEQ ELTRUSS	E
2	Call the program	E	R/S	END ENTRIES WITH ZERO ANGLE ENTRY
3	Enter the module of elasticity			∠ 1
4	Enter angle numbered 1	∠ 1	R/S	∠ 2
	enter angle numbered 2	∠ 2	R/S	∠ 3
	enter angle numbered 3	∠ 3	R/S	∠ 4
5	when a nonexistent angle is asked enter zero , run	0	R/S	SIGMA ENTRY S 30
6	Enter sigma numbered 30	S 30	R/S	S 31
	enter sigma numbered 31	S 31	R/S	S 32
	enter sigma numbered 32	S 32	R/S	S 33
7	when a nonexistent S is asked enter zero and run	0	R/S	ABOVE JOINT? Y OR N
8	Enter Y if it is superior joint	Y	R/S	KNOT N 1 TRIANGLE N 1 R∠ RS 1
9	Enter 1st pair R∠, RS (Review 4-2) (page 2)	R∠	ENTER	R∠
		RS	R/S	R∠ RS 2
	enter 2nd pair	R∠	ENTER	R∠
		RS	R/S	R∠ RS 3
	enter 3rd pair	R∠	ENTER	R∠
		RS	R/S	TRIANGLE N 2 R∠ RS 1
10	Repeat step 9 for triangle n 2			TRIANGLE N X
11	When a nonexistent triangle is announced			R∠ RS 1
12	Enter zero and run , FP1 is shown	0	R/S	FP1=( )
	run again		R/S	KNOT N 2
13	Next joint will be considered			TRIANGLE N 1 R∠ RS 1
14	Repeat step 9 for this triangle			KNOT N Y
	Repeat step 9 for subsequent triangles , then step 11 to 13			TRIANGLE N 1 R∠ RS 1
15	After treating all joints , XEQ S for inclined bars, if present .		XEQ S	S
16	Enter stress in the bar	S	R/S	∠ ABOUT X
17	Enter angle about X Gives FP value (review item 6)	∠	R/S	TO RIGHT FP=( )
18	Repeat 15 to 17 for all inclined bars .			
19	Holding FP values , final compu--tations will follow in Lbl T		XEQ T	L TOTAL
20	Enter Truss lenght and run	L	R/S	X FP 1
21	Of 1st FP , abscissa and value	X	ENTER	X
		FP	R/S	X FP 2
22	Repeat 21 for subsequent pairs			
23	When nonexistent one , enter 0, run At each run, next strain is shown	0	R/S	STRAINS ST 1=( )

02808C

PROGRAM LISTING

☐ 67 ☐ 97 ☐ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL ELTRUSS		
	CLRG		
	"E"		Elasticity
	PROMPT		module
	STO 59		
	"END ENTRIES"		How to leave
	" WITH ZERO"		entry loops
	XEQ 06		
	1		
10	STO 00		
	"ANGLE ENTRY"		Angle entry
	XEQ 06		loop
	FIX 0		
	LBL 11		
	"∠ "		
	ARCL 00		
	PROMPT		
	X=0?		
	GTO 12		
20	STO IND 00		Storage
	1		
	ST+00		
	GTO 11		
	LBL 12		
	"SIGMA ENTRY"		Sigma entry
	XEQ 06		loop
	30		
	STO 00		
	LBL 13		
30	"S"		
	ARCL 00		
	PROMPT		
	X=0?		
	GTO 04		
	STO IND 00		Storage
	1		
	ST+00		
	GTO 13		
	LBL 04		
40	CF 00		
	FIX 0		Preparation
	0		
	STO 00		
	"ABOVE JOINT?"		Asks position
	" Y OR N"		of joint
	AON		
	PROMPT		
	ASTO X		
	"Y"		
50	ASTO Y		If above ...

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
51	X=Y?		
	SF 00		Flag 00 is set
	AOFF		
	LBL 05		
	1		
	ST+00		Preparation
	0		
	STO 58		
	"KNOT N "		Knot(joint) ,
60	ARCL 00		is referred
	XEQ 06		by number
	0		
	STO 51		
	LBL 07		
	1		
	ST+51		Triangle is
	"TRIANGLE N "		also control-
	ARCL 51		-led by num-
	XEQ 06		-ber
70	1.003		Reg. 52 will
	STO 52		control verti-
	LBL 08		-ces of trian-
	"R∠ RS "		-gle loop
	ARCL 52		References for
	PROMPT		angles and
	X=0?		Stresses are
	GTO 15		asked.
	XEQ IND 52		Calls subrou-
	ISG 52		-tines (see
80	GTO 08		01 - 02 - 03)
	XEQ 10		
	GTO 07		
	LBL 15		
	"="		
	ASTO X		Will display
	RCL 58		calculated
	FC?00		"FP" matched
	CHS		to knot's
	RCL 59		number
90	/		
	"FP"		
	ARCL 00		
	ARCL Y		
	FIX 6		
	ARCL X		
	PROMPT		
	FIX 0		
	GTO 05		
	LBL 06		Display
00	AVIEW		subroutine

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
101	PSE		
	RTN		
	LBL 01		The three subroutines 01 , 02 , 03 position adequately angles and sigmas for each triangle being processed
	STO 53		
	RTN		
	LBL 02		
	STO 55		
	RDN		
	STO 54		
10	RTN		
	LBL 03		
	STO 57		
	RDN		
	STO 56		
	RTN		
	LBL 10		This subroutine calculates angle variation as function of other angles and sigmas
	RCL IND	56	
	XEQ 14		
	RCL IND	53	
20	RCL IND	55	
	-		
	*		
	RCL IND	54	
	XEQ 14		
	RCL IND	53	
	RCL IND	57	
	-		
	*		
	+		
30	ST+58		
	RTN		
	LBL 14		Figures cotangent of angle
	TAN		
	1/X		
	RTN		
	LBL S		
	"S "		For an incli--ned member , calculates respective "FP"
	PROMPT		
	"∠ ABOUT X"		
40	PROMPT		
	TAN		
	*		
	RCL 59		
	/		
	CHS		
	"TO RIGHT"		Position of FP matched by its sign
	XEQ 06		
	"FP="		
	SCI 4		
50	ARCL X		

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
51	PROMPT		
	LBL T		
	"L TOTAL"		To enter whole truss lenght
	PROMPT		
	STO 51		
	LBL 21		
	1		
	STO 53		Preparation
	31		
60	STO 54		
	0		
	STO 52		
	STO 55		
	FIX 0		
	LBL 22		
	"X FP "		Loop : abscissas and fictitious loads entry
	ARCL 53		
	PROMPT		
	X=0?		
70	GTO 23		
	STO IND 54		
	X≷Y		
	STO IND 53		
	CHS		
	RCL 51		Left reaction is figured
	+		
	*		
	RCL 51		
	/		and accumulated
80	ST+52		
	1		
	ST+53		
	ST+54		
	GTO 22		
	LBL 23		
	"STRAINS"		Advice that strains will follow , cal--culated as moments of fictitious loads "FP"
	XEQ 06		
	1.1		
	STO 00		
90	RCL 52		
	STO 30		
	RCL 01		
	*		
	STO 55		
	XEQ 30		
	31		
	STO 54		
	LBL 24		
	RCL IND	54	
200	ST-30		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

ELTRUSS

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
201	RCL IND	00	
	CHS		Difference of abscissas from contiguous knots are taken ,thence by mul- -tiplying by resultant of fictitious for- -ces to the left , new mo- -ment is cal- -culated.
	ISG 00		
	RCL IND	00	
	+		
	RCL 30		
	*		
	ST+55		
	XEQ 30		
10	1		
	ST+54		
	GTO 24		
	LBL 30		
	FIX 0		
	"="		
	ASTO X		Displays strain relative to designated knot
	"ST "		
	ARCL 00		
	ARCL X		
20	FIX 5		
	ARCL 55		
	PROMPT		
	END		
30			
40			
50			
51			
60			
70			
80			
90			
00			

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

ELTRUSS

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

Registers		Contents
00		Counter at input labels
51		Triangle number control
52		Triangle vertice number control
53	53-55-57	Current reference numbers for sigmas
54		
55	54-56	Current reference numbers for angles
56		
57		(as asked in lbl 08, and stored in lbls. 01 to 03)
58	Σ D ∠	
59	E	

STATUS

SIZE	060	TOT. REG.	134	USER MODE	
ENG		FIX	0-6	SCI 4	ON OFF
DEG	x (mainly DEG)	RAD	x	GRAD x	any

FLAGS

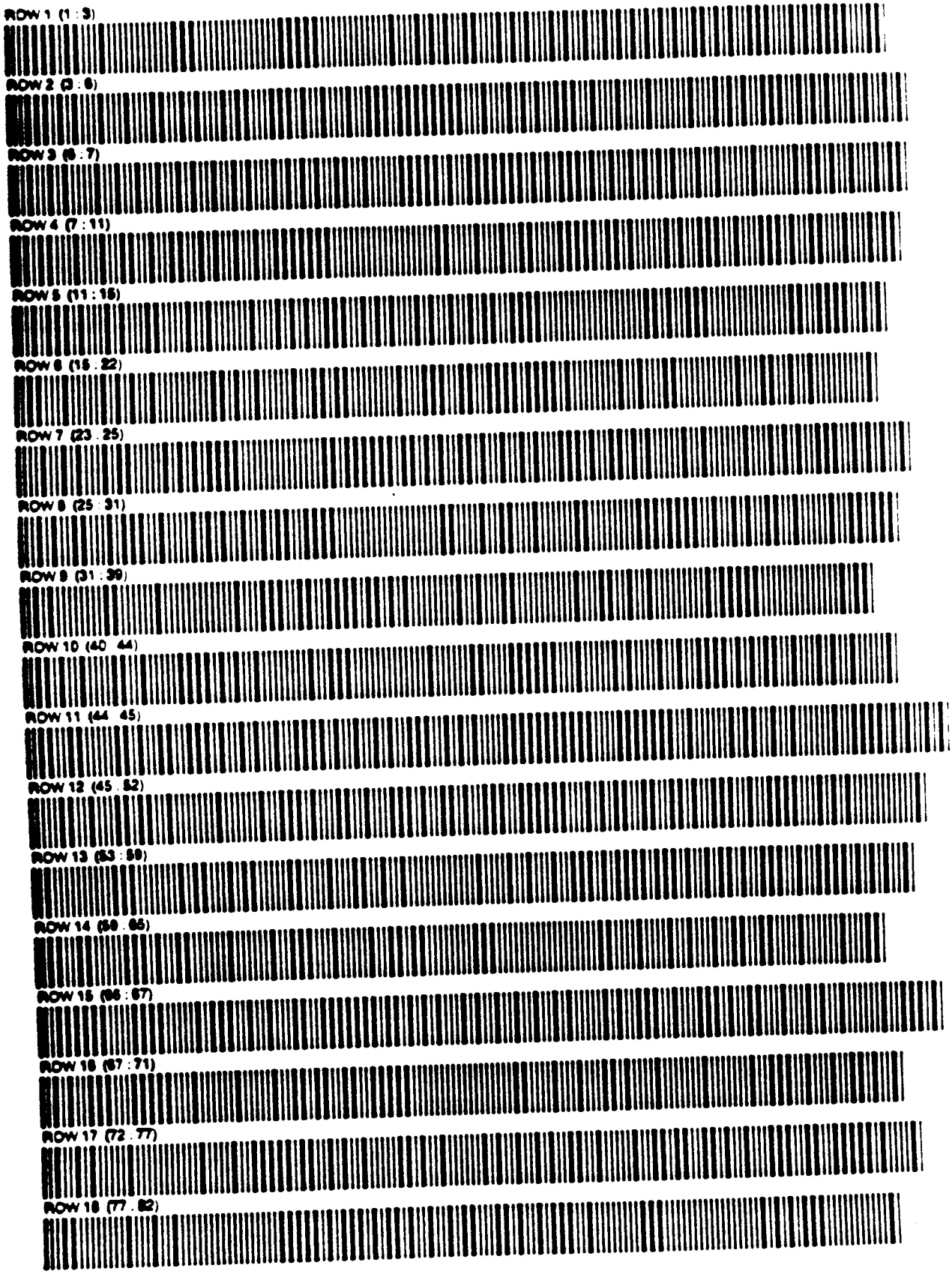
#	INIT S/C	SET INDICATES	CLEAR INDICATES
00	C	Above joint	Below joint

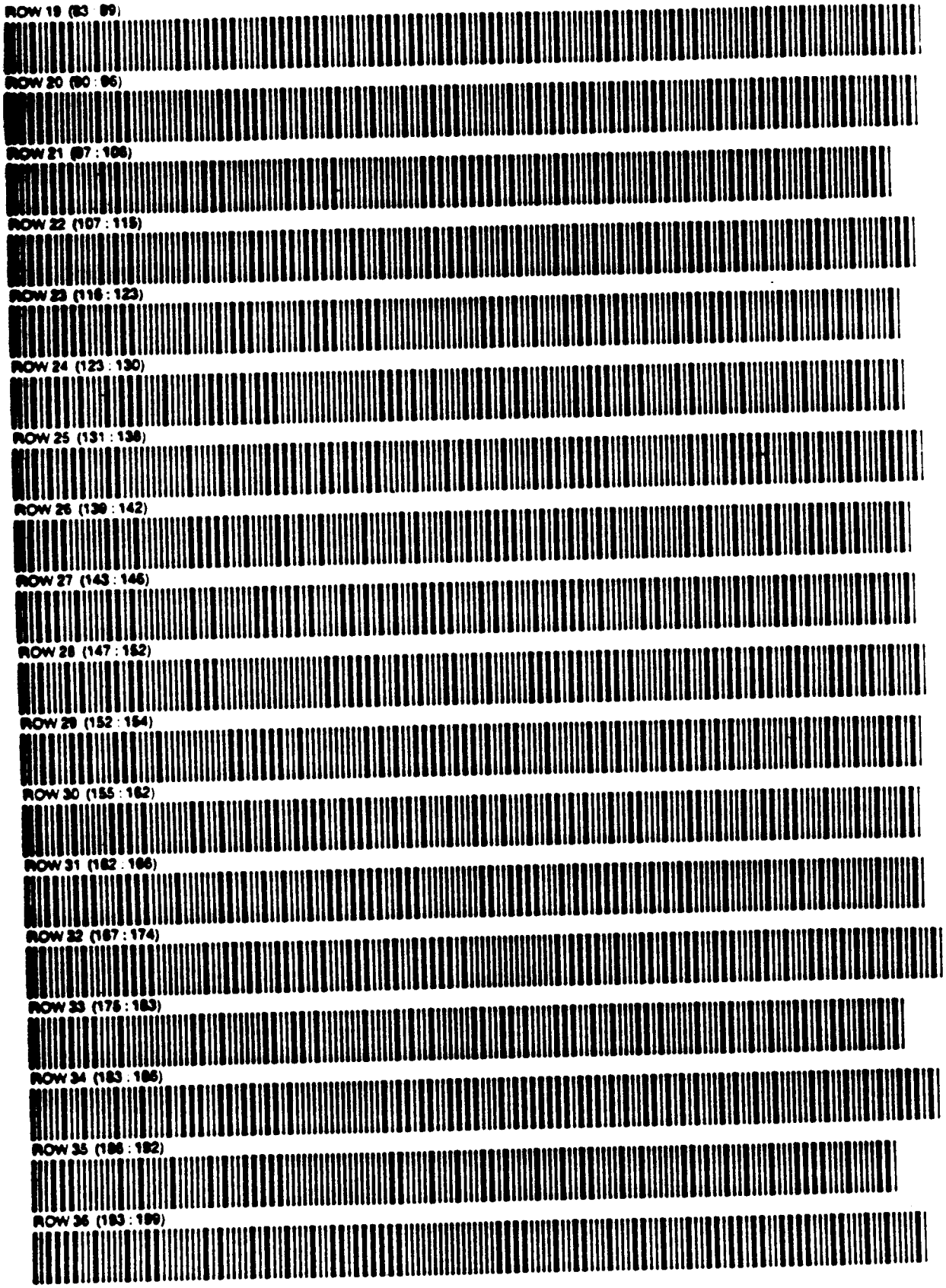
ASSIGNMENTS

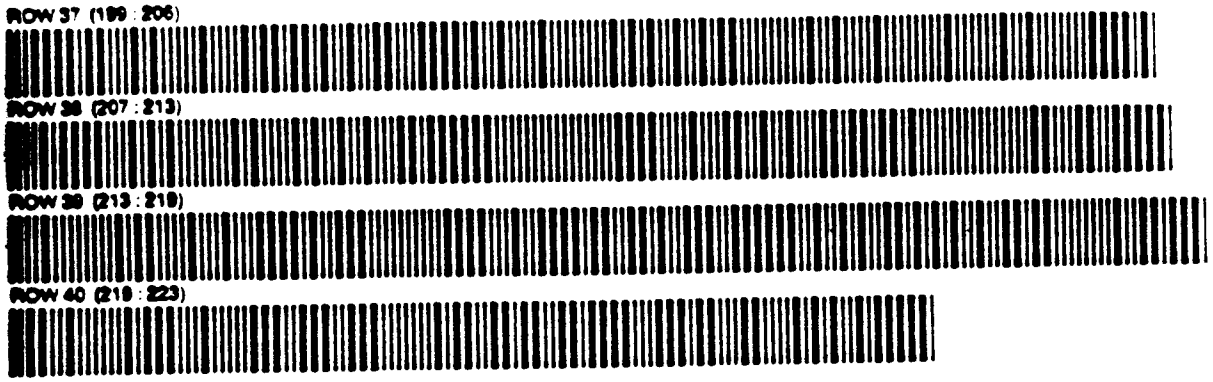
No

FUNCTION	KEY	FUNCTION	KEY

PROGRAM REGISTERS NEEDED: 74




ROW 19 (83 : 89)
ROW 20 (90 : 96)
ROW 21 (97 : 106)
ROW 22 (107 : 115)
ROW 23 (116 : 123)
ROW 24 (123 : 130)
ROW 25 (131 : 138)
ROW 26 (139 : 142)
ROW 27 (143 : 146)
ROW 28 (147 : 152)
ROW 29 (152 : 154)
ROW 30 (155 : 162)
ROW 31 (162 : 166)
ROW 32 (167 : 174)
ROW 33 (175 : 183)
ROW 34 (183 : 186)
ROW 35 (186 : 192)
ROW 36 (193 : 199)


ROW 37 (199 : 206)
ROW 38 (207 : 213)
ROW 39 (213 : 219)
ROW 40 (219 : 223)