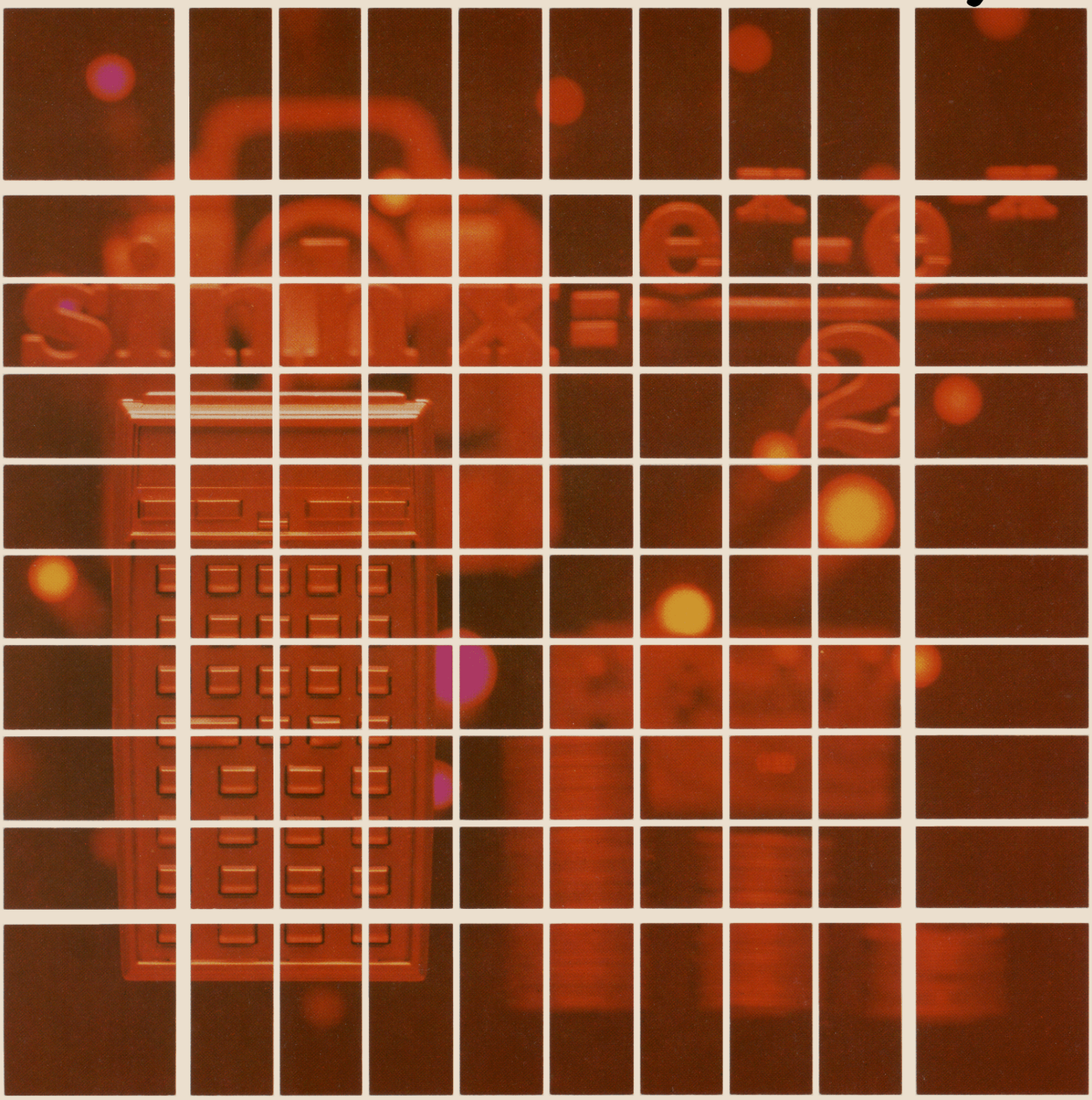
HEWLETT-PACKARD

HP-41C

USERS' LIBRARY SOLUTIONS

Structural Analysis



NOTICE

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INTRODUCTION

This HP-41C Solutions book was written to help you get the most from your calculator. The programs were chosen to provide useful calculations for many of the common problems encountered.

They will provide you with immediate capabilities in your everyday calculations and you will find them useful as guides to programming techniques for writing your own customized software. The comments on each program listing describe the approach used to reach the solution and help you follow the programmer's logic as you become and expert on your HP calculator.

KEYING A PROGRAM INTO THE HP-41C

There are several things that you should keep in mind while you are keying in programs from the program listings provided in this book. The output from the HP 82143A printer provides a convenient way of listing and an easily understood method of keying in programs without showing every keystroke. This type of output is what appears in this handbook. Once you understand the procedure for keying programs in from the printed listings, you will find this method simple and fast. Here is the procedure:

1. At the end of each program listing is a listing of status information required to properly execute that program. Included is the SIZE allocation required. Before you begin keying in the program, press [XEQ] [ALPHA] SIZE [ALPHA] and specify the allocation (three digits; e.g., 10 should be specified as 010).

   Also included in the status information is the display format and status of flags important to the program. To ensure proper execution, check to see that the display status of the HP-41C is set as specified and check to see that all applicable flags are set or clear as specified.

2. Set the HP-41C to PRGM mode (press the [PRGM] key) and press [■] [GTO] [.] [.] to prepare the calculator for the new program.

3. Begin keying in the program. Following is a list of hints that will help you when you key in your programs from the program listings in this handbook.

   a. When you see " (quote marks) around a character or group of characters in the program listing, those characters are ALPHA. To key them in, simply press [ALPHA], key in the characters, then press [ALPHA] again. So "SAMPLE" would be keyed in as [ALPHA] "SAMPLE" [ALPHA].

   b. The diamond in front of each LBL instruction is only a visual aid to help you locate labels in the program listings. When you key in a program, ignore the diamond.

   c. The printer indication of divide sign is /. When you see / in the program listing, press [÷].

   d. The printer indication of the multiply sign is ⁜. When you see ⁜ in the program listing, press [×].

   e. The ⊢ character in the program listing is an indication of the [APPEND] function. When you see ⊢, press [■] [APPEND] in ALPHA mode (press [■] and the K key).

   f. All operations requiring register addresses accept those addresses in these forms:

      nn (a two-digit number)
      IND nn (INDIRECT: [■], followed fy a two-digit number)
      X, Y, Z, T, or L (a STACK address: [.] followed by X, Y, Z, T, or L)
      IND X, Y, Z, T or L (INDIRECT stack: [■] [.] followed by X, Y, Z, T, or L)

      Indirect addresses are specified by pressing [■] and then the indirect address. Stack addresses are specified by pressing [.] followed by X, Y, Z, T, or L. Indirect stack addresses are specified by pressing [■] [.] and X, Y, Z, T, or L.

Printer Listing	Keystrokes	Display
01◆LBL "SAMPLE"	[■] [LBL] [ALPHA] SAMPLE [ALPHA]	*01 LBL"SAMPLE*
02 "THIS IS A "	[ALPHA] *THIS IS A* [ALPHA]	*02"THIS IS A*
03 "⊢SAMPLE"	[ALPHA] [■] [APPEND] SAMPLE	*03" ⊢ SAMPLE*
04 AVIEW	[■] AVIEW [ALPHA]	*04 AVIEW*
05 6	6	*05 6*
06 ENTER↑	[ENTER↑]	*06 ENTER ↑*
07 -2	2 [CHS]	*07 -2*
08 /	[÷]	*08 /*
09 ABS	[XEQ] [ALPHA] ABS [ALPHA]	*09 ABS*
10 STO IND L	[STO] [■] [.] L	*10 STO IND L*
11 "R3="	[ALPHA] R3= [■] [ARCL] 03	*11"R3=*
12 ARCL 03	[■] [AVIEW]	*12 ARCL 03*
13 AVIEW	[ALPHA]	*13 AVIEW*
14 RTN	[■] [RTN]	*14 RTN*

S T R U C T U R A L A N A L Y S I S I

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T A B L E O F C O N T E N T S

B E A M C A L C U L A T I O N

(Requires an additional memory module)

This program calculates for a supported beam of uniform section; charged with n concentrated loads P_i (i = 1%n), a uniform distributed load q and support moments M_L and M_R :

- The required moment of Inertia I_m for a given deflection coefficient m = F/l.
- The support reactions L and R.
- The location X of the maximum field moment.
- The maximum field moment max.M or in the case : $M_S = (M_R \text{ or } M_L) >$ max.M. the greatest support moment M_S.
- The required section moduli SM_i (i = 1/3) for three admissible tensions σi (i = 1%3) of three kinds of steel.
- The bending moments M_i and the shearing forces Q_i at the position of the concentrated loads P_i and at each desired location a_i (input : a_i ; P_i=0).

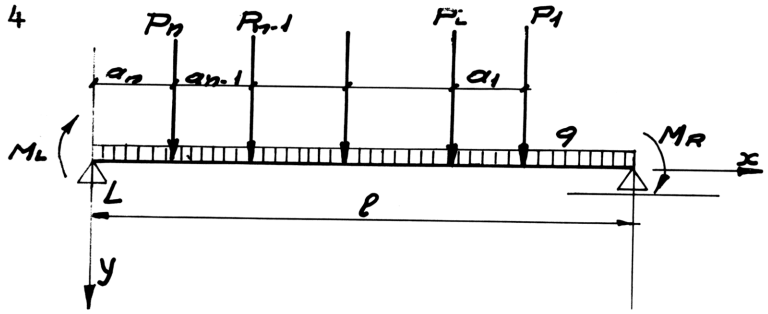
Operating limits and warnings.

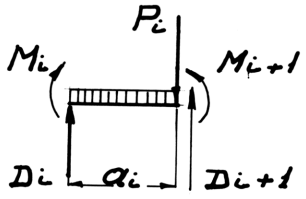
- To prevent the division by zero : $q \neq 0$
- In the case that the shearing force Q does not change of sign : max.M does not exist and M_S (M_L or M_R) is displayed and the section moduli are calculated accordingly.
- Mathematically it can be proved that for isostatic girders the maximum deflection and the deflection in the middle of the girder do not differ more than 2,5 % from each other.

When however the support moments M_L and M_R are important in comparison with the other loads and when those moments are working furthermore in opposite sense, it may occur that the elastica shows a deflection point, about in the middle of the span so that in this special case the calculated deflection is not a maximum.

For normal calculations the 41 C calculator works autonomicly.

In the event that the moments and shear force line are to be calculated, the printer is required.





P_i ; L ; R	: kN
M_L ; M_R ; M	: kNm
q	: kN/m
ℓ ; a_i	: m
I	: cm^4
SM	: cm^3
$E = 21000$	: kN/cm^2

SUPPORT REACTIONS

$$R = \frac{q\ell}{2} + \frac{1}{\ell}\Sigma Px + \frac{M_L + M_R}{\ell}$$

$$L = q\ell + \Sigma P - R$$

Deflection $F = y_{o,s\ell}$

$$y_{o,s\ell} = F = \Sigma\left(\frac{P_i x}{6EI}\frac{1}{2}\left(\ell^2 - \frac{\ell^2}{4} - x_i^2\right)\right) + \frac{5}{384}\frac{q\ell^4}{EI} + \frac{(M_L - M_R)\ell^2}{6EI}\cdot\frac{3}{8} = \frac{\ell}{m}$$

$$F = \frac{1}{EI}\left[\frac{\ell^3}{12}\Sigma P_i a_i(0{,}75 - \alpha_i^2) + \frac{q\ell^2}{76{,}8} + \frac{(M_L - M_R)\ell^2}{16}\right] = \frac{\ell}{m}$$

$$I = \frac{m\ell^2}{E}\left[\frac{1}{12}\Sigma P_i a_i(0{,}75 - \alpha_i^2) + \frac{q\ell}{76{,}8} + \frac{(M_L - M_R)}{16\ell}\right]$$

$$I = \frac{m\ell^2}{C}\left[\frac{1}{3}\left(\Sigma P_i a_i(0{,}75 - \alpha_i^2) + \frac{q\ell}{19{,}2} + \frac{M_L - M_R}{4\ell}\right]\right. \quad cm^4$$

$C = 8{,}4\ kN/cm^2$

$\frac{x}{\ell}$ $\begin{cases} \leq 0{,}5 \Rightarrow \alpha = x/\ell \\ > 0{,}5 \Rightarrow \alpha = 1 - x/\ell \end{cases}$

Bending moments and shearing forces

$$M_{i+1} = M_i + (D_i - q\frac{a_i}{2})a_i$$

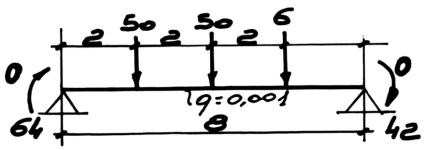
$$D_{i+1} = D_i - qa_i - P_i$$

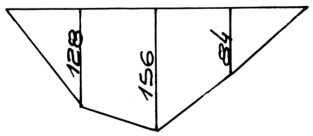
$D \geq 0$ $\quad sing(D) = 1$ $\quad\}$ $sing(D_i) + sing(D_{i+1}) = 2 \Leftrightarrow$ No sing change

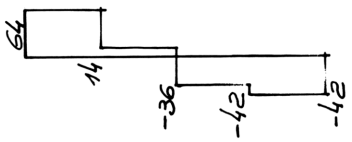
$D < 0$ $\quad sing(D) = -1$ $\quad\}$ " " $= 0 \Leftrightarrow$ sing change

EXAMPLE 1

Case I $a' > a$



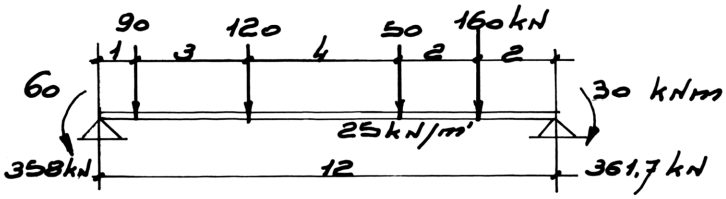


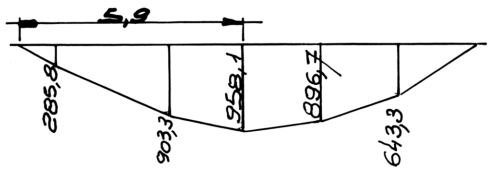


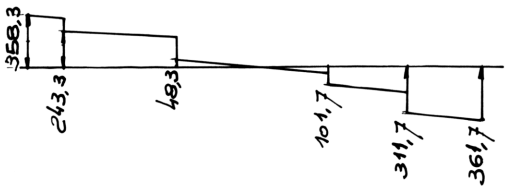

```
XEQ BEAM  SIGMA1,=16,00
          SIGMA2,=18,00
          SIGMA3,=24,00
A         F:L=300,00
B         MOM.L=0,00
          MOM.R=0,00
          SPAN=8,00
          U.L.=1,00E-3
          N.P=3,00
          DIST.3,=2,00
          P3,=50,00
          DIST.2,=2,00
          P2,=50,00
          DIST.1,=2,00
          P1,=6,00
          I300,=16.858,
          SP:L=64,0R=42,0
          X=4,0
          MAX.M=156,0
          SM.16,0=975,1
          SM.18,0=866,7
          SM.24,0=650,0
```

EXAMPLE 2

Case III $a'_3 < a_3$





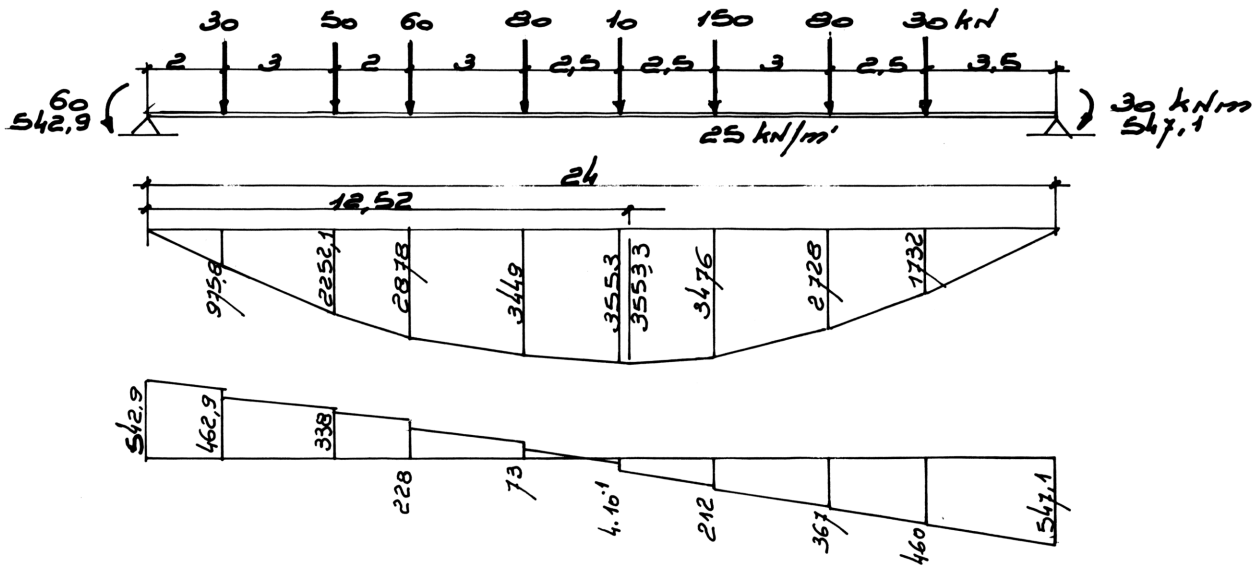



```
A         F:L=300,0
B         MOM.L=-60,0
          MOM.R=30,0
          SPAN=12,0
          U.L.=25,0
          N.P=4,0
          DIST.4,=1,00
          P4,=90,00
          DIST.3,=3,00
          P3,=120,00
          DIST.2,=4,00
          P2,=50,00
          DIST.1,=2,00
          P1,=160,00
          I300,=175.347,
          SP:L=358,3R=361,7
          X=5,9
          MAX.M=950,1
          SM.16,0=5.937,5
          SM.18,0=5.272,1
          SM.24,0=3.958,6

F         M 4, 286,   Q 4, 243,
          M 3, 903,   Q 3, 48,
          M 2, 897,   Q 2,-102,
          M 1, 643,   Q 1,-312,
```

EXAMPLE 3

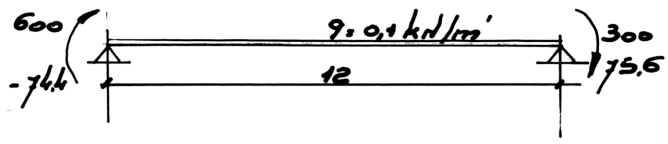
Case III $a'_6 < a_6$

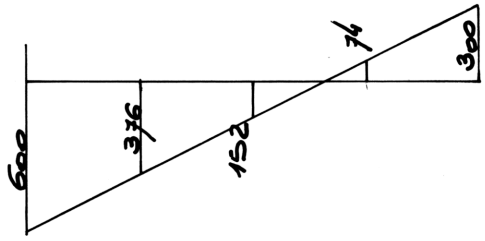



```
B   MOM.L=-60,
    MOM.R=30,
    SPAN=24,
    U.L.=25,
    N.P=8,
    DIST.8,=2,00
    P8,=30,00
    DIST.7,=3,00
    P7,=50,00
    DIST.6,=2,00
    P6,=60,00
    DIST.5,=3,00
    P5,=80,00
    DIST.4,=2,50
    P4,=10,00
    DIST.3,=2,50
    P3,=150,00
    DIST.2,=3,00
    P2,=80,00
    DIST.1,=2,50
    P1,=30,00
    I300,=1.266.610,
    SP:L=542,9R=547,1
    X=12,5
    MAX.M=3.553,3
    SM.16,0=22.208,4
    SM.18,0=19.740,8
    SM.24,0=14.805,6
F   M 8, 976,    Q 8, 463,
    M 7, 2.252,   Q 7, 338,
    M 6, 2.878,   Q 6, 228,
    M 5, 3.449,   Q 5, 73,
    M 4, 3.553,   Q 4, 4,-01
    M 3, 3.476,   Q 3,-212,
    M 2, 2.728,   Q 2,-367,
    M 1, 1.732,   Q 1,-460,
```

EXAMPLE 4

Case II $a' > L$

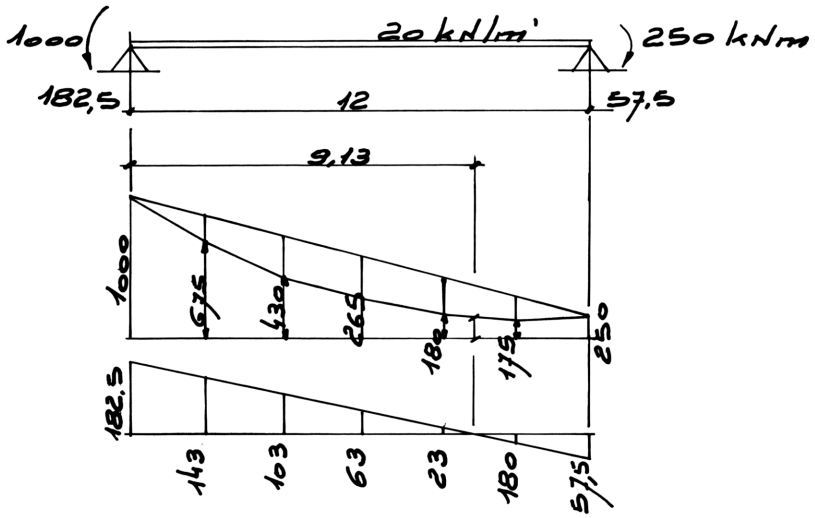





```
XEQ BEAM SIGMA1,=16,00
         SIGMA2,=18,00
         SIGMA3,=24,00
A        F:L=300,00
B        MOM.L=600,00
         MOM.R=300,00
         SPAN=12,00
         U.L.=0,10
         N.P=3,00
         DIST.3,=3,00
         P3,=0,00
         DIST.2,=3,00
         P2,=0,00
         DIST.1,=3,00
         P1,=0,00
         I300,=32.464,
         SP:L=-74,4R=75,6
         MS=600,0
         SM.16,0=3.750,0
         SM.18,0=3.333,3
         SM.24,0=2.500,0
F        M 3, 376,    Q 3,-75,
         M 2, 152,    Q 2,-75,
         M 1,-74,     Q 1,-75,
```

The display will show NONEXISTENT

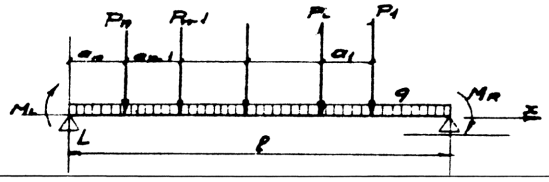
Case III : a' < L




```
XEQ BEAM SIGMA1,=16,00
         SIGMA2,=18,00
         SIGMA3,=24,00
A        F:L=300,00
B        MOM.L=-1.000,00
         MOM.R=250,00
         SPAN=12,00
         U.L.=20,00
         N.P=5,00
         DIST.5,=2,00
         P5,=0,00
         DIST.4,=2,00
         P4,=0,00
         DIST.3,=2,00
         P3,=0,00
         DIST.2,=2,00
         P2,=0,00
         DIST.1,=2,00
         P1,=0,00
         I300,=-69.643,
         SP:L=182,5R=57,5
         MS=1.000,0
         SM.16,0=6.250,0
         SM.18,0=5.555,6
         SM.24,0=4.166,7
F        M 5,-675,   Q 5, 143,
         M 4,-430,   Q 4, 103,
         M 3,-265,   Q 3, 63,
         M 2,-180,   Q 2, 23,
         M 1,-175,   Q 1,-18,
```

USER INSTRUCTIONS

PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	**Instructions** Operation Instructions Istruzioni	**Variables** Dateneingabe Données Dati	**Function(s)** Taste(n) Touche(s) Tasti	**Result** Resultat Résultat Risultato
1	Load Program (user mode)		user	
2	Beginning execution and input data:		XEQ BEAM	SIGMA 1 =
3	Input : admissible tensions	$\sigma 1$ kN/cm^2	R/S	SIGMA 1 = $\sigma 1$
				SIGMA 2 =
4		$\sigma 2$ "	R/S	SIGMA 2 = $\sigma 2$
				SIGMA 3 =
5		$\sigma 3$ "	R/S	SIGMA 3 = $\sigma 3$
6			A	F:L =
7	Desired deflection coefficient :	m = F/L	R/S	F:L = m
8			B	MOM.L =
9	Left end moment	M_L kN m	R/S	MOM.L = M_L
				MOM.R =
10	Right end moment	M_R kN m	R/S	MOM.R = M_R
				SPAN =
11	Beam span	L m	R/S	SPAN = L
				U.L =
12	Uniform distributed load	q kN/m	R/S	U.L = q
				N.P =
13	Number of concentrated loads	n	R/S	N.P = n
				DIST.n =
14	Distance	A_n m	R/S	DIST.n = A_n
				P_n =
15	Applied concentrated load	P_n kN	R/S	$P_n = P_n$
				DIST.n-1
16	Repeat step 14 and 16 for	A_{n-1} m	R/S	DIST.n-1=A_{n-1}
				P_{n-1} =
17	Each A_i and P_i ; i = 1 n	P_{n-1} kN	R/S	$P_{n-1} = P_{n-1}$
18	Required moment of inertia	cm^4		Im = Ir
19	Support reactions	kN		SP.L=L. R=R
20	Position of the max.field moment	m		X = x
21	Max.bending moment in the field	kNm		MAX.M = M
	Or			
22	The max. support moment	kNm		MS = M
23	Required section modul	cm^3		SM.$\sigma 1$ = SM1
24		"		SM.$\sigma 2$ = SM2
25		"		SM.$\sigma 3$ = SM3
26	Return to step 6			F:L =
27	If you want to print the bending moments and the shearing forces under each local load P_i		MA N mode	
	Push	kNm ; kN	F	$M_{n,m...}$ $Q_{n,q...}$
28	Return to step 6			MOM.L
29	For a new case go to step	2 ; 6 or 8	[XEQ BEAM][A]or[B]	

PROGRAM LISTING
PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line / Zeile / Ligne / Linea	Keystrokes / Tastenfolge / Touches / Tasti		Comments / Kommentar / Commentaires / Commenti
01	LBL "BEAM"	XEQ	BEAM
02	1.00301		
03	STO 00		
04	LBL 00		
05	RCL 00		
06	FIX 0		
07	"SIGMA"		
08	ARCL X		
09	XEQ 21		$\sqrt{1}$; $\sqrt{2}$; $\sqrt{3}$
10	STO IND 00		
11	ISG 00		
12	GTO 00		
13	LBL A	A	
14	"F:L="		$m = F/\ell$
15	PROMPT		
16	XEQ 22		
17	STO 04		
18	LBL B	B	
19	0		
20	STO 10		
21	STO 12		
22	STO 13		
23	STO 15		
24	CF 01		
25	CF 02		
26	"MOM.L="		
27	ASTO 05		
28	"MOM.R="		
29	ASTO 06		
30	"SPAN="		
31	ASTO 07		
32	"U.L.="		
33	ASTO 08		
34	"N.P="		
35	ASTO 09		
36	5.00901		
37	STO 00		
38	LBL 01		
39	CLA		
40	ARCL IND 00		
41	PROMPT		M_L; M_R; ℓ; q; n
42	XEQ 22		
43	STO IND 00		
44	ISG 00		
45	GTO 01		

Line / Zeile / Ligne / Linea	Key pressed / Tastenfolge / Touches / Tasti	Comments / Kommentar / Commentaires / Commenti
46	X=0?	
47	GTO 04	
48	XEQ 05	$n+19 \rightarrow$ REG.18 $2n+19 \rightarrow$ REG.19
49	LBL 02	
50	FIX 0	
51	"DIST."	
52	ARCL 00	
53	XEQ 21	a_i $(i = 1 \div n)$
54	STO IND 18	
55	ST+ 10	
56	RCL 10	
57	RCL 07	
58	/	
59	STO 11	
60	FIX 0	
61	"P"	
62	ARCL 00	
63	XEQ 21	P_i $(i = 1 \div n)$
64	STO IND 19	
65	ST+ 12	
66	RCL 11	
67	*	
68	ST+ 13	
69	.5	
70	RCL 11	
71	X<=Y?	
72	GTO 03	$\frac{x}{\ell} \leq 0.5 \Rightarrow \alpha = \frac{x}{\ell}$
73	1	
74	-	
75	CHS	
76	LBL 03	$\frac{x}{\ell} > 0.5 \Rightarrow \alpha = 1 - \frac{x}{\ell}$
77	STO 14	
78	X↑2	
79	.75	
80	-	
81	CHS	
82	RCL 14	
83	*	
84	RCL IND 19	
85	*	
86	ST+ 15	$\Sigma P\alpha\left(\frac{3}{4} - \alpha^2\right)$
87	DSE 18	
88	DSE 19	
89	DSE 00	
90	GTO 02	
91	FIX 2	
92	RCL 15	
93	3	
94	/	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
95	◆LBL 04	
96	RCL 08	
97	RCL 07	
98	*	
99	19.2	
100	/	
101	+	
102	RCL 05	
103	RCL 06	
104	-	
105	4	
106	/	
107	RCL 07	
108	/	
109	+	
110	RCL 07	
111	X↑2	
112	*	
113	8.4	
114	/	
115	RCL 04	
116	*	
117	FIX 0	
118	"I"	
119	ARCL 04	
120	"⊢="	
121	ARCL X	
122	XEQ 23	Im
123	RCL 08	
124	RCL 07	
125	*	
126	2	
127	/	
128	RCL 05	
129	RCL 06	
130	+	
131	RCL 07	
132	/	
133	+	
134	RCL 13	
135	+	
136	ENTER↑	
137	ENTER↑	
138	RCL 08	
139	RCL 07	
140	*	
141	-	
142	ST- 12	
143	FIX 1	
144	"SP:L="	
145	ARCL 12	
146	"⊢R="	
147	RCL Y	

Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
148	XEQ 22	R:4
149	XEQ 05	
150	RCL 05	
151	STO 13	
152	0	
153	STO 10	
154	STO 16	
155	RCL 09	
156	X=0?	
157	GTO 06	
158	◆LBL 07	
159	RCL IND 19	
160	STO 15	
161	RCL IND 18	
162	STO 14	
163	GTO 08	
164	◆LBL 17	
165	RCL 16	
166	ST+ 13	
167	RCL 13	
168	STO IND 18	
169	RCL 12	
170	STO IND 19	
171	RCL 14	
172	ST+ 10	
173	DSE 18	
174	DSE 19	
175	DSE 00	
176	GTO 07	
177	FS? 01	
178	GTO A	CASE I a'>a;
179	XEQ 09	
180	GTO A	CASE II a'>b
181	◆LBL 06	
182	SF 02	
183	RCL 07	
184	STO 14	
185	◆LBL 08	
186	FS? 01	
187	GTO 13	
188	RCL 14	
189	RCL 12	
190	RCL 08	
191	/	
192	ABS	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
193	X<=Y?	$\left\|\frac{D}{9}\right\| = a' \leq a_i$
194	GTO 12	
195	GTO 13	
196	LBL 12	
197	STO 11	
198	XEQ 14	
199	XEQ 09	
200	FS? 02	
201	GTO A	
		END OF CALCULATION
202	LBL 13	
203	FS? 02	CASE III $a' < a_i$
204	GTO 20	CASE IV
205	RCL 14	
206	STO 11	
207	XEQ 14	
208	RCL 12	
209	SIGN	SIGN (D_i)
210	RCL 11	
211	RCL 08	
212	*	
213	RCL 15	
214	+	
215	ST- 12	$D_{i+1} = D_i - (a_i q + P_i)$
216	FS? 01	
217	GTO 17	
218	X<>Y	
219	RCL 12	
220	SIGN	
221	+	SIGN (D_{i+1})
222	X≠0?	
223	GTO 17	
224	RCL 16	CASE II
225	XEQ 09	
226	GTO 17	CASE I
227	LBL 09	
228	RCL 05	
229	ABS	
230	RCL 06	
231	ABS	
232	X>Y?	
233	GTO 19	
234	X<>Y	
235	LBL 19	$\|M_R\| > \|M_L\|$?
236	RCL 13	
237	RCL 16	
238	+	
239	STO 17	
240	ABS	
241	X<=Y?	

Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
242	XEQ 15	$\|M_{FIELD}\| \leq \|M_S\|$?
243	RCL 11	
244	RCL 10	
245	+	
246	"X="	
247	ARCL X	
248	XEQ 23	
249	"MAX.M="	
250	RCL 17	
251	XEQ 22	
252	LBL 10	
253	1.00301	
254	STO 11	
255	FIX 1	
256	LBL 16	
257	RCL 11	
258	RCL 17	
259	RCL IND 11	
260	/	
261	100	
262	*	
263	"SM."	
264	ARCL IND 11	
265	"⊢="	
266	XEQ 22	
267	ISG 11	
268	GTO 16	
269	SF 01	
270	RTN	
271	LBL 14	
272	RCL 12	
273	RCL 11	
274	RCL 08	
275	*	
276	2	
277	/	
278	-	
279	RCL 11	
280	*	
281	STO 16	
282	RTN	$\Delta M_i = a_i \left(D_i - \frac{a_i q}{2}\right)$
283	LBL 05	
284	RCL 09	
285	STO 00	
286	19	
287	+	
288	STO 18	$n+19 \rightarrow$ REG. 18

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
289	RCL 00	
290	+	
291	STO 19	2N+19 → REG. 19
292	RTN	
293	◆LBL 20	
294	0	
295	STO 13	
296	XEQ 09	
297	GTO A	
298	◆LBL 15	
299	RCL Y	
300	STO 17	
301	"MS="	
302	RCL 17	
303	XEQ 22	
304	XEQ 10	
305	FS? 02	
306	GTO A	
307	GTO 13	
308	◆LBL 21	
309	"⊢="	
310	PROMPT	
311	FIX 2	
312	◆LBL 22	
313	ARCL X	
314	◆LBL 23	
315	AVIEW	
316	PSE	
317	RTN	
318	◆LBL F	F
319	XEQ 05	PRINT: MAN. MODE
320	FIX 0	
321	◆LBL 18	
322	"M"	
323	ACA	
324	RCL 00	
325	ACX	
326	RCL IND 18	
327	ACX	
328	" Q"	
329	ACA	
330	RCL 00	
331	ACX	
332	RCL IND 19	
333	ACX	
334	PRBUF	
335	DSE 18	
336	DSE 19	
337	DSE 00	
338	GTO 18	
339	GTO A	
340	.END.	END OF PRINTING

REGISTERS, STATUS, FLAGS

REGISTERBELEGUNG, FLAGS, BETRIEBSARTEN
REGISTRES, INDICATEURS, MODES OPÉRATOIRES
REGISTRI, MODI OPERATIVI, FLAGS

Registers
Datenspeicher
Registres de données
Registri

00	counter	
	σ_1	
	σ_2	
	σ_3	
	m	
05	M_L	
	M_R	
	L	
	q	
	n	
10	Σa_i	$\Sigma\ a_i$
	X/L	a_i
	ΣP	D_i
	$\Sigma P_{X/L}$	M_{i+1}
	α	a_i
15	$\Sigma P_\alpha(0{,}75-\alpha^2)$	P_i
		$a(D - \frac{aq}{2})$
		M_S or Max
	a-counter	
	P-counter	
20	a_n	M_n
	n + 19	
25	a_1	M_1
	P_n	D_n
30	2n + 19	
35	P_1	D_1
40		
45		

Status
Betriebsart
Modes opératoires
Modi operativi

Size 91	Total Reg. 110+2n	User Mode
Eng ☐	Fix ☒ Sci ☐	On ☒
Deg ☐	Rad ☐ Grad ☐	Off ☐

Purpose (Bedeutung / Signification / Scopo)		Flags SET	Flags CLEAR
00	max.M calculated		
01	n = 0		
02			
03			
04			
05			
06			
07			
08			
09			
10			
11	Audio execute		
12			
13			
14			
15			
16			
17			
18			
19			
20			
21	Printer Enable		
22	Number Input		
23	Alpha Input		
24	Range Ignore		
25	Error Ignore		
26	Audio Enable		
27	User Mode		
28	Decimal Point		
29	Digit Grouping		

Assignments
Tastenbelegung / Assignations / Assegnamenti

Function (Funktion / Fonction / Funzione)	Key (Taste / Touche / Tasto)	Function (Funktion / Fonction / Funzione)	Key (Taste / Touche / Tasto)
Start of input		Print M. and Q	F
" m = F/L	A	(Man. mode)	
MOM.L	B		

C O N T I N U O U S B E A M

(Requires an additional memory module)

This program calculates the support of a continuous beam with max. 5 unequal fields.

Each field i with a moment of inertia I_i and a span L_i is loaded with :

- an uniformly distributed load q_i
- any given number of local loads P_i
- external support moments M_L and M_R
- any given number of load factors R' and L'.

These factors may be calculated and inserted manually or by means of magnetic cards.

Note : The external support moments may be used as a random condition for the computation of continuous beams combined with cantilever beams (type GERBER).

Equation of three moments $\Longrightarrow$ reduced by elemination

$$\begin{bmatrix} a_{11} & a_{12} & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 \\ 0 & a_{32} & a_{33} & a_{34} \\ 0 & 0 & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} M_B \\ M_C \\ M_D \\ M_E \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix} \Longrightarrow \begin{bmatrix} a_{11} & a_{12} & 0 & 0 \\ 0 & b_{22} & a_{23} & 0 \\ 0 & 0 & b_{33} & a_{34} \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} M_B \\ M_C \\ M_D \\ M_E \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix}$$

$a_{11} = 2(L_1' + L_2')$ | $a_1 = R_1 L_1' + L_2 L_2'$

$a_{22} = 2(L_2' + L_3')$ | $a_2 = R_2 L_2' + L_3 L_3'$

$a_{33} = 2(L_3' + L_4')$ | $a_3 = R_3 L_3' + L_4 L_4'$

$a_{44} = 2(L_4' + L_5')$ | $a_4 = R_4 L_4' + L_5 L_5'$

$a_{12} = a_{21} = L_2'$ | $L_i' = L_i : I_i \quad ; \alpha_i = (P_a(L-a) : L^2)_i$

$a_{23} = a_{32} = L_3'$ | $R_i = qL_i^2/4 + \sum_i \alpha_i (2L_i - a_i) + \sum R' + M_L$

$a_{34} = a_{43} = L_4'$ | $L_i = qL_i^2/4 + \sum_i \alpha_i (L_i + a_i) + \sum L' + M_R$

$$b_{22} = a_{22} - \frac{a_{12}^2}{a_{11}} \qquad M_E = -b_4 : b_{44}$$

$$b_{33} = a_{33} - \frac{a_{22}^2}{b_{22}} \qquad M_D = -(b_3 - a_{34}M_E) : b_{33}$$

$$b_{44} = a_{44} - \frac{a_{34}^2}{b_{33}} \qquad M_C = -(b_2 - a_{23}M_D) : b_{22}$$

$$b_2 = a_2 - a_1\frac{a_{12}}{a_{11}} \qquad M_B = -(a_1 - a_{12}M_C) : a_{11}$$

$$b_3 = a_3 - b_2\frac{a_{33}}{b_{22}}$$

$$b_4 = a_4 - b_3\frac{a_{43}}{b_{33}}$$

$$\begin{bmatrix} a_{11} & a_{12} & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 \\ 0 & a_{32} & a_{33} & a_{34} \\ 0 & 0 & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix} \qquad a_{ij} = a_{ji}$$

1) $a_{11}a_{21}X_1 + a_{12}a_{21}X_2 = a_1a_{21}$

2) $a_{21}a_{11}X_1 + a_{22}a_{11}X_2 + a_{23}a_{11}X_3 = a_2a_{11}$

$-$

$$(a_{12}^2 - a_{22}a_{11})X_2 - a_{23}a_{11}X_3 = a_1a_{21} - a_2a_{11}$$

$$\underbrace{\left(a_{22} - \frac{a_{12}^2}{a_{11}}\right)}_{b_{22}''}X_2 + a_{23}X_3 = \underbrace{a_2 - a_1\frac{a_{12}}{a_{11}}}_{b_2''}$$

---

2) $b_{22}X_2 + a_{23}X_3 = b_2$

3) $a_{32}X_2 + a_{33}X_3 + a_{34}X_4 = a_3$

$$2)\ b_{22}a_{32}X_2 + a_{23}a_{32}X_3 = b_2a_{32}$$

$$3)\ a_{32}b_{22}X_2 + a_{33}b_{22}X_3 + a_{34}b_{22}X_4 = a_3b_{22}$$

$$(a_{23}^2 - a_{33}b_{22})X_3 - a_{34}b_{22}X_4 = b_2a_{32} - a_3b_{22}$$

$$\underbrace{\left(a_{33} - \frac{a_{23}^2}{b_{22}}\right)}_{\parallel\, b_{33}}X_3 + a_{34}X_4 = \underbrace{a_3 - b_2\frac{a_{32}}{b_{22}}}_{\parallel\, b_3}$$

$$3)\ b_{33}X_3 + a_{34}X_4 = b_3$$

$$4)\ a_{43}X_3 + a_{44}X_4 = a_4$$

$$3)\ b_{33}a_{43}X_3 + a_{34}a_{43}X_4 = b_3a_{43}$$

$$4)\ a_{43}b_{33}X_3 + a_{44}b_{33}X_4 = a_4b_{33}$$

$$(a_{34}^2 - a_{44}b_{33})X_4 = b_3a_{43} - a_4b_{33}$$

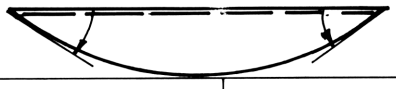
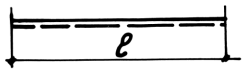
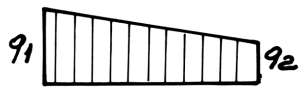
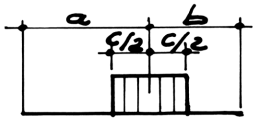
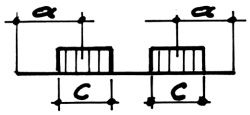
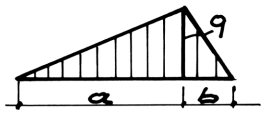
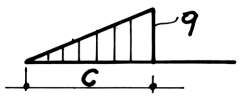
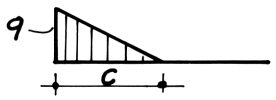
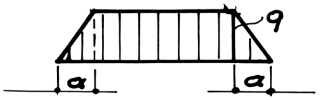
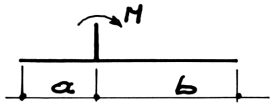
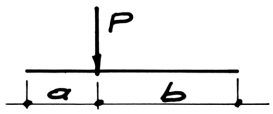
$$\underbrace{\left(a_{44} - \frac{a_{34}^2}{b_{33}}\right)}_{\parallel\, b_{44}}X_4 = \underbrace{a_4 - b_3\frac{a_{43}}{b_{33}}}_{\parallel\, b_4}$$

$$\begin{matrix}1)\\2)\\3)\\4)\end{matrix}\begin{bmatrix} a_{11} & a_{12} & 0 & 0 \\ 0 & b_{22} & a_{33} & 0 \\ 0 & 0 & b_{33} & a_{34} \\ 0 & 0 & 0 & b_{44} \end{bmatrix}\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{bmatrix} = \begin{bmatrix} a_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix}$$

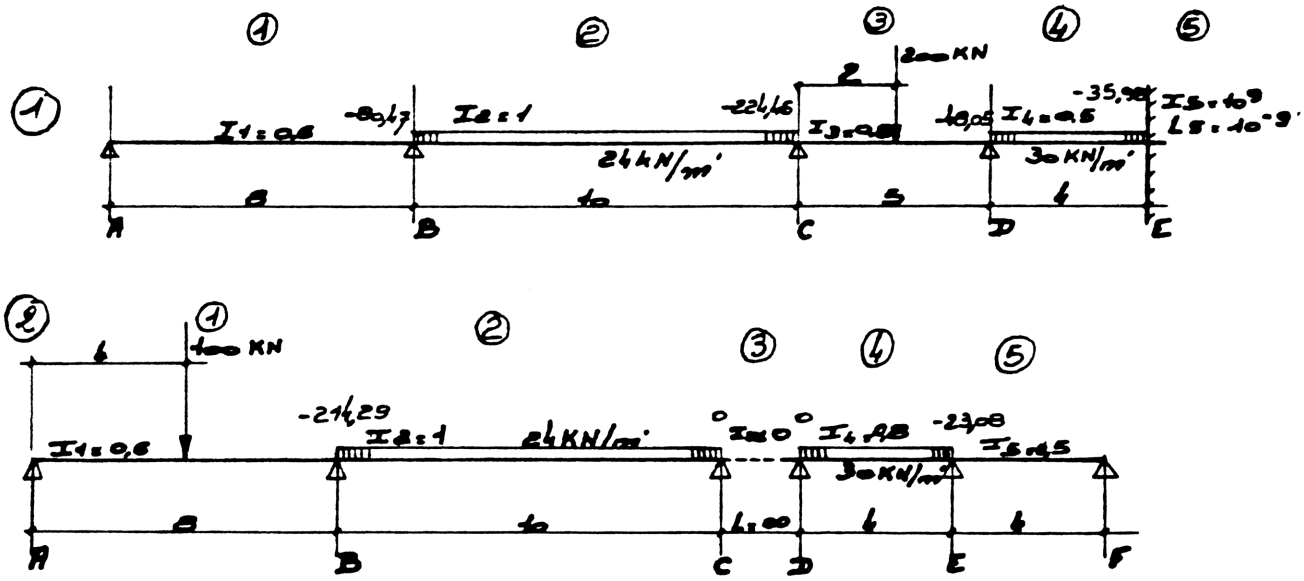
$$b_{rr} = a_{rr} - a_{r-1,r}^2 : b_{r-1,r-1}$$

$$b_r = a_r - b_{r-1} \cdot \frac{a_{r,r-1}}{b_{r-1,r-1}}$$

$\alpha = \frac{a}{l}$ $\beta = \frac{b}{l}$ $\gamma = \frac{c}{l}$

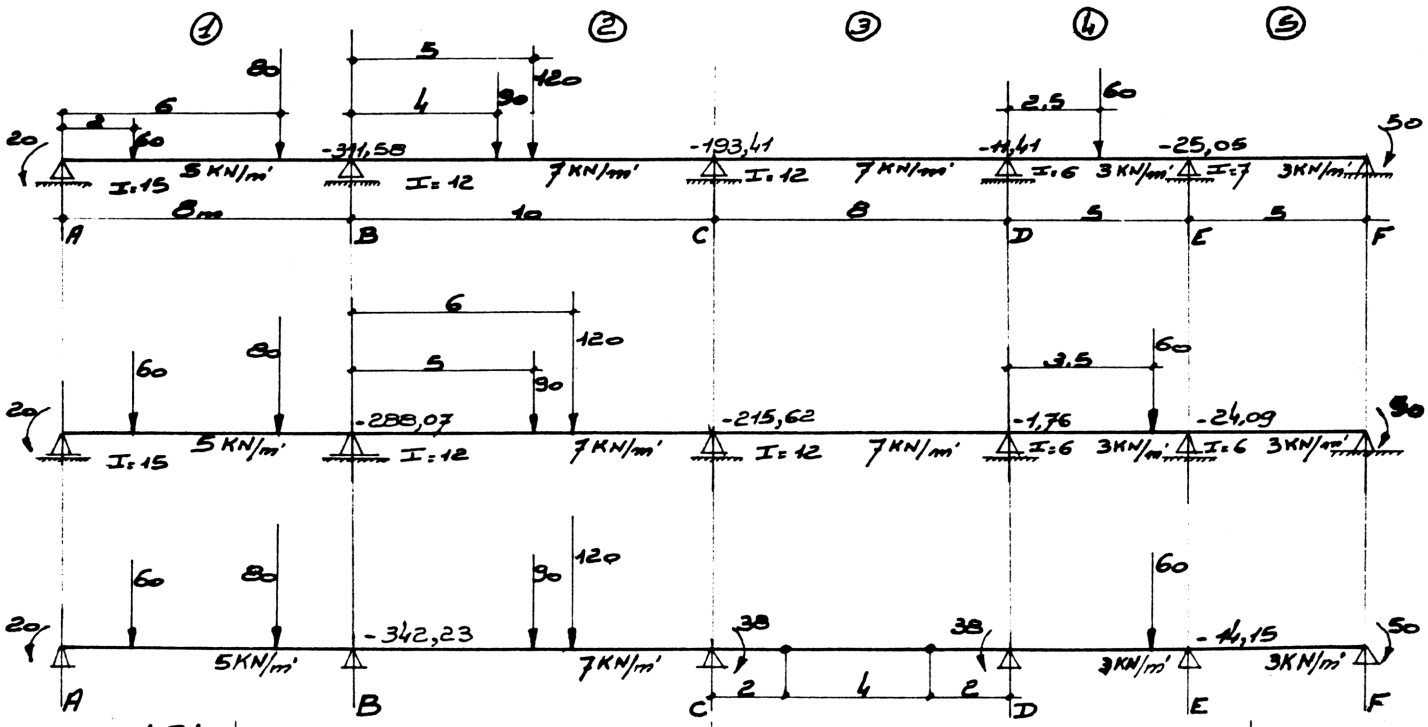
		$\frac{1}{6EI} \cdot L = \varphi_A$  $\varphi_B = -\frac{1}{6EI} \cdot R$
		L R
1		$\frac{l^2}{60}(8q_1 + 7q_2)$ $\quad \frac{l^2}{60}(7q_1 + 8q_2)$
2		$qbc(1-\beta^2-0{,}25\gamma^2)$ $\quad q \cdot a \cdot c(1-\alpha^2-0{,}25\gamma^2)$
3		$qlc[3\alpha(1-\alpha)-0{,}25\gamma^2]$ $\quad qlc[3\alpha(1-\alpha)-0{,}25\gamma^2]$
4		$\frac{ql^2}{60}(1+\beta)(7-3\beta^2)$ $\quad \frac{ql^2}{60}(1+\alpha)(7-3\alpha^2)$
5		$\frac{qc^2}{3}(2-2{,}25\gamma+0{,}6\gamma^2)$ $\quad \frac{qc^2}{3}(1-0{,}6\gamma^2)$
6		$\frac{qc^2}{3}(1-0{,}75\gamma+0{,}15\gamma^2)$ $\quad \frac{qc^2}{6}(1-0{,}3\gamma^2)$
7		$\frac{ql^2}{4}[1-\alpha^2(2-\alpha)]$ $\quad \frac{ql^2}{4}[1-\alpha^2(2-\alpha)]$
8		$-M(1-3\beta^2)$ $\quad M(1-3\alpha^2)$
9		$\frac{Pab}{l}(1+\beta)$ $\quad \frac{Pal}{l}(1+\alpha)$
10		$\frac{6EI}{l^2}(\Delta_B - \Delta_A)$ $\quad -\frac{6EI}{l^2}(\Delta_B - \Delta_A)$

EXAMPLE 1



LBL	Case 1	LBL	Case 2
XEQ cB	F.N? =1.00 I? =0.60 L? =8.00	A	F.N? =1.00 I? =0.60 L? =8.00 UL? =0.00 X? =4.00 P? =100.00
B	F.N? =2.00 I? =1.00 L? =10.00 UL? =24.00	B	F.N? =2.00 I? =1.00 L? =10.00 UL? =24.00
B	F.N? =3.00 I? =0.80 L? =5.00	B	F.N? =4.00 I? =0.80 L? =4.00 UL? =30.00
(c)	X? =2.00 P? =200.00	B	F.N? =5.00 I? =0.50 L? =4.00
B	F.N? =4.00 I? =0.50 L? =4.00 UL? =30.00	E	ME=-23.08 MD=1.07E-7 MC=-2.68E-7 MB=-214.29
B	F.N? =5.00 I? =1000000000. L? =1.00E-9		
E	ME=-35.98 MD=-48.05 MC=-224.46 MB=-80.47		

EXAMPLE 2



LBL

XEQ CB

F.N? =1,00
I? =15,00
L? =8,00
UL? =5,00
X? =2,00
P? =60,00
X? =6,00
P? =80,00

D
ML,R? =-20,00
MR,L? =0,00

B
F.N? =2,00
I? =12,00
L? =10,00
UL? =7,00
X? =4,00
P? =90,00
X? =5,00
P? =120,00

B
F.N? =3,00
I? =12,00
L? =8,00
UL? =7,00

B
F.N? =4,00
I? =6,00
L? =5,00
UL? =3,00
X? =2,50
P? =60,00

B
F.N? =5,00
I? =7,00
L? =5,00
UL? =3,00

D
ML,R? =0,00
MR,L? =-50,00

E
ME=-25,05
MD=-11,41
MC=-193,41
MB=-311,58

LBL

B
F.N? =2,00
I? =12,00
L? =10,00
UL? =7,00
X? =5,00
P? =90,00
X? =6,00
P? =120,00

B
F.N? =4,00
I? =6,00
L? =5,00
UL? =3,00
X? =3,50
P? =60,00

B
F.N? =5,00
I? =6,00
L? =5,00

E
ME=-24,09
MD=1,76
MC=-215,62
MB=-288,07

B
F.N? =2,00

D
ML,R? =0,00
MR,L? =-38,00

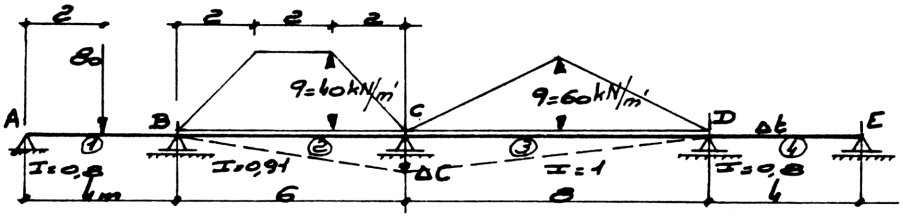
B
F.N? =3,00
I? =0,10
L? =1.000.000.000,
UL? =0,00

B
F.N? =4,00

D
ML,R? =-38,00
MR,L? =0,00

E
ME=-14,15
MD=1,27E-8
MC=-3,27E-8
MB=-342,23

EXAMPLE 3



1) Loads P and q:

$$\begin{cases} R_2 = L_2 = \frac{q\ell^2}{4}(1-d^2(2-d)) = 60 \times \frac{6^2}{4}\left(1-\left(\frac{2}{6}\right)^2\left(2-\frac{2}{6}\right)\right) = 293{,}3 \text{ KN} \\ R_3 = L_3 = \frac{5}{32}q\ell^2 = 5 \times 60 \times 8^2 : 32 = 600 \text{ KN} \end{cases}$$

2) Temperature difference in field 4 of $\Delta t = t_o - t_u = 30$ grd.

$EI = 24 \cdot 10^4$ kNm²
$\alpha_T = 10^{-5}$
$h = 60$ cm

$R_4 = L_4 = \frac{3EI\alpha_T \Delta t}{h} = 3 \times 24\,10^4 \times 10^{-5} \times 30 : 0{,}6 = 360$

3) Displacement of support C: $\Delta C = 1$ cm

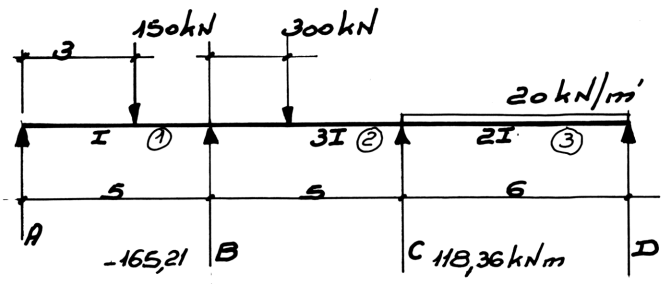
$EI_2 = 0{,}91 \times 15 \times 10^4$ kNm²
$EI_1 = 1$ " "

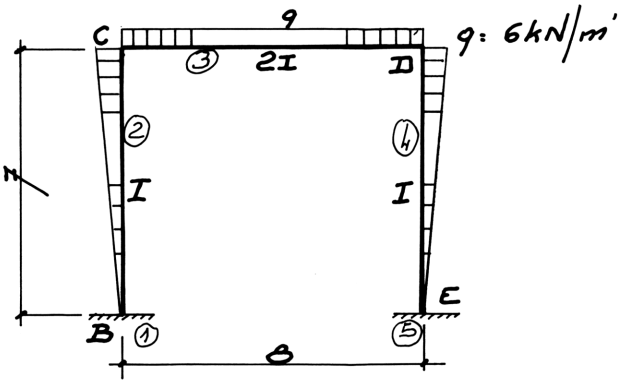
$R = -6EI(\Delta_R - \Delta_L) : \ell^2$
$L = -R$

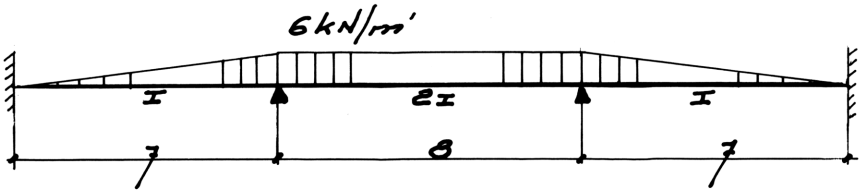
$\begin{cases} R_2 = -6 \times 0{,}91 \times 15\,10^4 \times 0{,}01 : 6^2 = -227{,}5 & L_2 = 227{,}5 \\ R_3 = +6 \times 1 \times 15\,10^4 \times 0{,}01 : 8^2 = +140{,}6 & L_3 = -140{,}6 \end{cases}$

LBL	Case 1	LBL	Case 2	LBL	case 3
XEQCB	F.N? =1,00				
	I? =0,80				
	L? =4,00				
	UL? =0,00			B	F.N? =2,00
	X? =2,00				I? =0,91
	P? =80,00				L? =6,00
B	F.N? =2,00	A	F.N? =1,00		UL? =0,00
	I? =0,91		I? =0,80	D	ML,R? =-227,50
	L? =6,00		L? =4,00		MR,L? =227,50
D	ML,R? =293,33		UL? =0,00	B	F.N? =3,00
	MR,L? =293,33	B	F.N? =2,00		I? =1,00
B	F.N? =3,00		I? =0,91		L? =8,00
	I? =1,00		L? =6,00		UL? =0,00
	L? =8,00		UL? =0,00	D	ML,R? =140,63
D	ML,R? =600,00	B	F.N? =3,00		MR,L? =-140,63
	MR,L? =600,00		I? =1,00	B	F.N? =4,00
B	F.N? =4,00		L? =8,00		I? =0,80
	I? =0,80		UL? =0,00		L? =4,00
	L? =4,00	B	F.N? =4,00		UL? =0,00
E	ME=3,57E-8		I? =0,80	E	ME=2,37E-8
	MD=-128,44		L? =4,00		MD=-85,34
	MC=-182,55		UL? =0,00		MC=136,73
	MB=-57,38	D	ML,R? =360,00		MB=-103,57
			MR,L? =360,00		
		E	ME=-7,89E-8		
			MD=-76,09		
			MC=22,29		
			MB=-6,34		

EXAMPLE 4

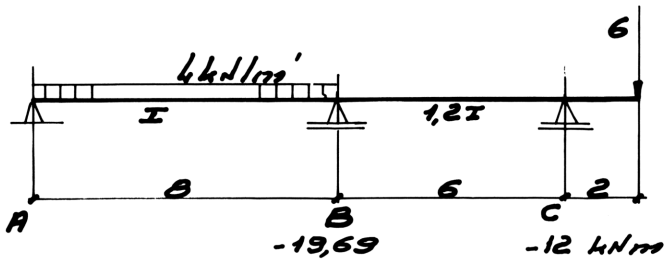






$L2 = \frac{7}{60} \cdot 6 \cdot 7^2 = 34,30\ kNm$ $\quad L4 = R2 = 39,20$

$R2 = \frac{2}{15} \cdot 6 \cdot 7^2 = 39,20\ kNm$ $\quad R4 = L2 = 34,30$




```
LBL
case a  XEQ CB  F.N? =1.00
                I? =1.00
                L? =5.00
                UL? =0.00
                X? =3.00
                P? =150.00
           B    F.N? =2.00
                I? =3.00
                L? =5.00
                UL? =0.00
                X? =2.00
                P? =300.00
           B    F.N? =3.00
                I? =2.00
                L? =6.00
                UL? =20.00
           E    ME=2.94E-9
                MD=-1.17E-8
                MC=-118.36
                MB=-165.21
case b     A    F.N? =1.00
                I? =1000000000.
                L? =1.00E-9
           B    F.N? =2.00
                I? =1.00
                L? =7.00
           D    ML,R? =39.20
                MR,L? =34.30
           B    F.N? =3.00
                I? =2.00
                L? =8.00
                UL? =6.00
           B    F.N? =4.00
                I? =1.00
                L? =7.00
           D    ML,R? =34.30
                MR,L? =39.20
           B    F.N? =5.00
                I? =1000000000.
                L? =1.00E-9
           E    ME=-5.19
                MD=-23.93
                MC=-23.93
                MB=-5.19
case c     A    F.N? =1.00
                I? =1.00
                L? =8.00
                UL? =4.00
           B    F.N? =2.00
                I? =1.20
                L? =6.00
           D    ML,R? =-12.00
           E    ME=4.21E-10
                MD=-1.68E-9
                MC=6.31E-9
                MB=-19.69
```

Example 5 Extented program

REMARK : Optionaly the program can be extented for direct calculation of the most occuring load factors (L : R).

In this example the program as been extented with the steps 235 : 309 to compute directly the load factors numbers : 1, 2 and 9 of the tabel.

$$L_a = 50 \times 8{,}5 \times 3 \left(1 - \left(\frac{8{,}5}{10}\right)^2 - 0{,}25\left(\frac{3}{10}\right)^2\right) = 325{,}13 \quad R\ 16$$

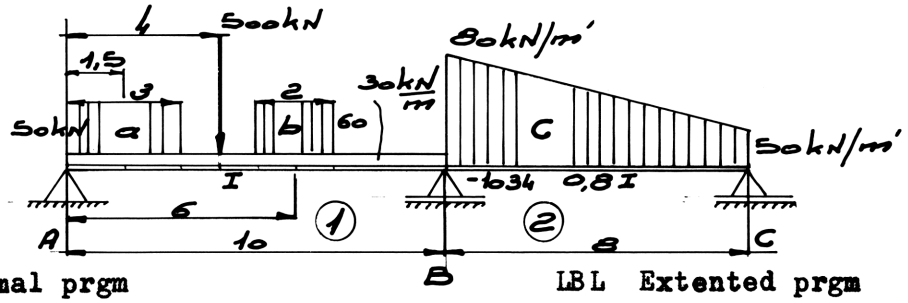
$$R_a = 50 \times 1{,}5 \times 3 \left(1 - \left(\frac{1{,}5}{10}\right)^2 - 0{,}25\left(\frac{3}{10}\right)^2\right) = 214{,}88 \quad R\ 11$$

$$L_b = 60 \times 4 \times 2 \left(1 - \left(\frac{4}{10}\right)^2 - 0{,}25\left(\frac{3}{10}\right)^2\right) = 398{,}40 \quad R\ 16$$

$$R_b = 60 \times 6 \times 2 \left(1 - \left(\frac{6}{10}\right)^2 - 0{,}25\left(\frac{2}{10}\right)^2\right) = 435{,}60 \quad R\ 11$$

$$L_c = \frac{8^2}{60}\left(8 \times 80 + 7 \times 50\right) = 1056 \quad R\ 17$$

$$R_c = \frac{8^2}{60}\left(7 \times 80 + 8 \times 50\right) = 1056 \quad R\ 12$$



LBL Normal prgm

```
A F.N? =1,00
  I? =1,00
  L? =10,00
  UL? =30,00
  X? =4,00
  P? =500,00
D ML,R? =214,88
  MR,L? =325,13
  ML,R? =435,60
  MR,L? =398,40
B F.N? =2,00
  I? =0,80
  L? =8,00
D ML,R? =1.024,00
  MR,L? =1.056,00
E ME=4,32E-10
  MD=-1,73E-9
  MC=6,49E-9
  MB=-1.034,12
```

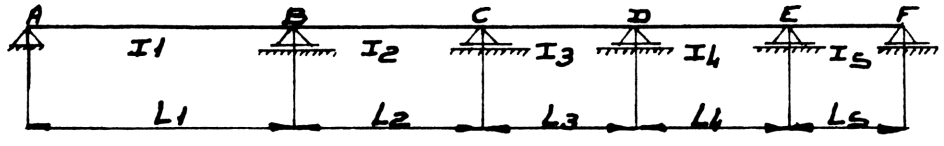
LBL Extented prgm

```
A F.N? =1,00
  I? =1,00
  L? =10,00
  UL? =30,00
  X? =4,00
  P? =500,00
F X? =1,50
  C? =3,00
  Q? =50,00
  X? =6,00
  C? =2,00
  Q? =60,00
B F.N? =2,00
  I? =0,80
  L? =8,00
  UL? =0,00
G QL? =80,00
  QR? =50,00
E ME=6,25E-10
  MD=-2,50E-9
  MC=9,37E-9
  MB=-1.038,62
```

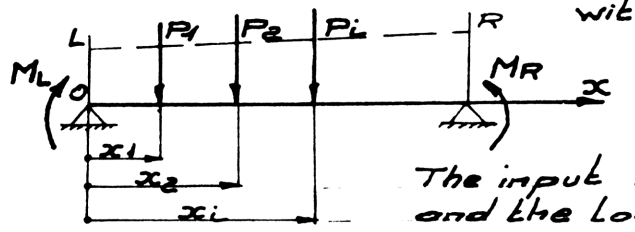
USER INSTRUCTIONS

PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	Instructions Operation Instructions Istruzioni	Variables Dateneingabe Données Dati	Function(s) Taste(n) Touche(s) Tasti	Result Resultat Résultat Risultato
	CONTINUOUS BEAM CARDS	DISPLAY		PRINTER and DISPLAY
1	Enter program		size	
2	Printer : used at option		MAN.mode	
3	To start the execution or a new data input of another beam	print	A or XEQCB	CLRG
4	For each other field		B	
5	Input of the field number i = 1+5	F.N. ? i	R/S	F.N.? = i
6	Moment of inertia	I. ? I_i	R/S	I.? = I_i
7	Span	L. ? l_i	R/S	L.? = L_i
8	The uniformly distributed load	U.L.? q_i	R/S	UL.? = q_i
9	Input concentrated loads i = 1+n		C	
10	Local coordinate	X.? x_i	R/S	X.? = x_i
11	The applied concentrated load	P.? P_i	R/S	P.? = P_i
12	Repeat step 10 and 11 for each concentrated load P_i applied in this field			
13	When the considered field i is loaded with external support moments or load factor	print	D	
14	Input of the left support moment and/or the load factor	ML,R ? ml_i	R/S	ML,R?=ml_i r
15	Input of the right support moment and/or the left load factor	MR,L ? mr_i	R/S	MR,L?=mr_i
16	Repeat step 14 and 15 for each applied moment and/or load factor in this field	ML,R ?		
17	For each other field go to step 4			
18	Compute support moments		E	M_E = --- M_D = ---
19	Step 18 can be repeated; for a new case go to step 3			M_C = --- M_B = ---



Indications of applied loads with positive sign convention



The input sequence of the field numbers i and the local loads in these fields is of option

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti	Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
01	◆LBL "CB"	A OR XEQ CB	47	/	
02	CLRG		48	RCL 23	
03	9.001		49	*	
04	STO 10		50	"P"	
			51	XEQ 10	Pi
05	◆LBL 00		52	*	
06	9 E9		53	STO 22	
07	STO IND 10		54	RCL 24	
08	DSE 10		55	2	
09	GTO 00		56	*	
			57	RCL 23	
10	◆LBL B	B	58	−	
11	SF 12		59	*	
12	"F.N"	FIELD NUMBER: i=1÷5	60	RCL 22	
13	XEQ 10		61	RCL 24	
14	CF 12		62	RCL 23	
15	STO 10		63	+	
16	10		64	*	
17	+		65	XEQ 01	
18	STO 00		66	GTO C	
19	"I"	MOM. OF INERTIA: Ii			D
20	XEQ 10		67	◆LBL D	SUPPORT MOM. OR
21	"L"	SPAN : Li	68	"ML,R"	LOAD FACTORS.
22	XEQ 10		69	XEQ 10	ML OR R'
23	STO 24		70	ENTER↑	
24	X<>Y		71	"MR,L"	MR OR L'
25	/		72	XEQ 10	
26	STO IND 10		73	X<>Y	
27	RCL 24		74	XEQ 01	
28	X↑2		75	GTO D	
29	"UL"	UNIF. DISTR. LOAD: qi			
30	XEQ 10		76	◆LBL E	E
31	*		77	SF 00	COMPUTATION OF M
32	4		78	SF 12	
33	/		79	5	
34	ENTER↑		80	STO 10	
35	STO IND 00		81	◆LBL 02	
36	XEQ 04		82	RCL IND 10	L'5 ÷ L'2
37	STO IND 10		83	DSE 10	
38	XEQ 09		84	GTO 19	
			85	GTO 03	
39	◆LBL C	C			
40	RCL 24	CONCENTRATED LOADS	86	◆LBL 19	
41	"X"		87	RCL IND 10	L'4 ÷ L'1
42	XEQ 10	Xi [i=1÷n]	88	+	
43	STO 23		89	2	
44	−		90	*	
45	RCL 24		91	5	
46	X↑2		92	ST+ 10	
			93	RDN	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti	Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
94	STO IND 10	$a_{44}; a_{33}; a_{22}; a_{11}$	137	ENTER↑	
95	5		138	XEQ 07	
96	ST- 10		139	STO 08	b_{33}
97	GTO 02		140	RCL 09	
			141	RCL 08	
98	*LBL 03		142	RCL 04	
99	5		143	ENTER↑	
100	STO 10		144	XEQ 07	
101	10		145	STO 09	b_{44}
102	+		146	RCL 22	
103	STO 00		147	RCL 06	
			148	RCL 21	
104	*LBL 05		149	RCL 02	
105	RCL IND 10	L'_i $(i=5\div1)$	150	XEQ 07	
106	XEQ 04		151	STO 22	
107	RCL IND 10	L_i $(i=5\div1)$	152	RCL 23	
108	*		153	RCL 07	
109	XEQ 09		154	RCL 22	
110	RDN		155	RCL 03	
111	DSE 00		156	XEQ 07	
112	DSE 10		157	STO 23	b_3
113	GTO 18		158	RCL 24	
114	GTO 06		159	RCL 08	
			160	RCL 23	
115	*LBL 18		161	RCL 04	
116	RCL IND 10		162	XEQ 07	b_4
117	RCL IND 00		163	RCL 09	
118	*		164	/	
119	+		165	CHS	
120	20		166	STO 24	
121	ST+ 10		167	"ME"	$M_E \Rightarrow$ REG. 24
122	RDN		168	XEQ 11	
123	STO IND 10		169	RCL 08	
124	20		170	RCL 23	
125	ST- 10		171	RCL 04	
126	GTO 05	$a_1 \div a_4$	172	RCL 24	
			173	XEQ 08	
127	*LBL 06		174	STO 23	
128	RCL 07		175	"MD"	$M_D \Rightarrow$ REG 23
129	RCL 06		176	XEQ 11	
130	RCL 02		177	RCL 07	
131	ENTER↑		178	RCL 22	
132	XEQ 07		179	RCL 03	
133	STO 07	b_{22}	180	RCL 23	
134	RCL 08		181	XEQ 08	
135	RCL 07		182	STO 22	
136	RCL 03		183	"MC"	$M_C \Rightarrow$ REG 22
			184	XEQ 11	
			185	RCL 06	
			186	RCL 21	
			187	RCL 02	
			188	RCL 22	
			189	XEQ 08	

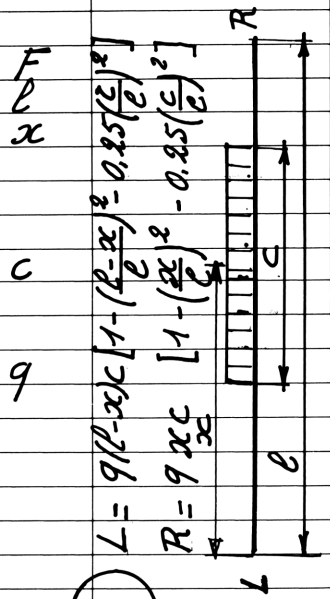
PROGRAM LISTING

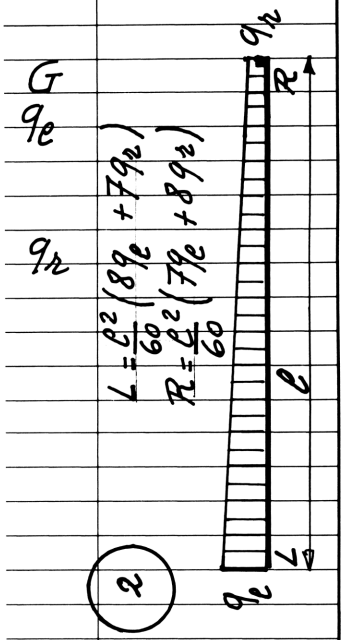
PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti	Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
190	STO 21	MB ⇒ REG.21	234	PSE	
191	"MB"		235	.END.	
192	XEQ 11				
193	CF 12				
194	CF 00		55		
195	RTN				
196	◆LBL 01				
197	ST+ IND 00				
198	XEQ 04		60		
199	RDN				
200	ST+ IND 10				
201	XEQ 09				
202	RTN		65		
203	◆LBL 04				
204	15				
205	ST+ 10				
206	RDN		70		
207	RTN				
208	◆LBL 07				
209	*				
210	X<>Y				
211	/		75		
212	-				
213	RTN				
214	◆LBL 08				
215	*		80		
216	+				
217	X<>Y				
218	/				
219	CHS				
220	RTN		85		
221	◆LBL 09				
222	15				
223	ST- 10				
224	RTN		90		
225	◆LBL 10				
226	"⊢? "				
227	PROMPT				
228	◆LBL 11		95		
229	FIX 2				
230	"⊢="				
231	ARCL X				
232	·AVIEW				
233	FS? 00		00		

PROGRAM LISTING
PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line / Zeile / Ligne / Linea	Keystrokes / Tastenfolge / Touches / Tasti	Comments / Kommentar / Commentaires / Commenti
228	*LBL 11	
229	FIX 2	
230	"⊢="	
231	ARCL X	
232	AVIEW	
233	FS? 00	
234	PSE	EXTENTED PROGRAM
235	RTN	
236	*LBL F	
237	RCL 24	
238	"X"	
239	XEQ 10	
240	STO 23	
241	−	
242	"C"	
243	XEQ 10	
244	STO 21	
245	*	
246	"Q"	
247	XEQ 10	
248	STO 22	
249	*	
250	XEQ 12	
251	RCL 24	
252	RCL 23	
253	−	
254	RCL 24	
255	/	
256	X↑2	
257	−	
258	*	
259	XEQ 12	
260	RCL 23	
261	RCL 24	
262	/	
263	X↑2	
264	−	
265	RCL 22	
266	*	
267	RCL 23	
268	*	
269	RCL 21	
270	*	
271	XEQ 01	
272	GTO F	
273	*LBL 12	
274	1	
275	RCL 21	
276	RCL 24	
277	/	
278	X↑2	
279	4	
280	/	
281	−	
282	RTN	
283	*LBL G	
284	"QL"	
285	XEQ 10	
286	STO 23	
287	8	
288	*	
289	"QR"	
290	XEQ 10	
291	STO 22	
292	XEQ 13	
293	RCL 22	
294	8	
295	*	
296	RCL 23	
297	XEQ 13	
298	XEQ 01	
299	GTO G	
300	*LBL 13	
301	7	
302	*	
303	+	
304	RCL 24	
305	X↑2	
306	*	
307	60	
308	/	
309	END	





$1 - 0,25\left(\frac{c}{\ell}\right)^2$

85 90 95 00

REGISTERS, STATUS, FLAGS

REGISTERBELEGUNG, FLAGS, BETRIEBSARTEN
REGISTRES, INDICATEURS, MODES OPÉRATOIRES
REGISTRI, MODI OPERATIVI, FLAGS

Registers
Datenspeicher
Registres de données
Registri

00		i+10		
	9E9	L'_1		
	"	L'_2		
	"	L'_3		
	"	L'_4		
05	"	L'_5		
	"	a_{11}		
	"	a_{22}	b_2	
	"	a_{33}	b_{33}	
	"	a_{44}	b_{44}	
10	9,001	i	5	15
	R_1			
	R_2			
	R_3			
	R_4			
15	R_5			
	L_1			
	L_2			
	L_3			
	L_4			
20	L_5			
				M_B
	P_i	b_2		M_C
	x_i	b_3		M_D
	L_i			M_E
25				
30				
35				
40				
45				

Status
Betriebsart
Modes opératoires
Modi operativi

Size 25 Total Reg. 61 **User Mode**

Eng ☐	Fix ☒	Sci ☐		On ☒
Deg ☐	Rad ☐	Grad ☐		Off ☐

Purpose
Bedeutung
Signification
Scopo

Flags

	Purpose	SET	CLEAR
00		X	X
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11	Audio execute		
12		X	X
13			
14			
15			
16			
17			
18			
19			
20			
21	Printer Enable		
22	Number Input		
23	Alpha Input		
24	Range Ignore		
25	Error Ignore		
26	Audio Enable		
27	User Mode		
28	Decimal Point		
29	Digit Grouping		

Assignments
Tastenbelegung / Assignations / Assegnamenti

Function Funktion Fonction Funzione	Key Taste Touche Tasto	Function Funktion Fonction Funzione	Key Taste Touche Tasto
Start = CLRG	A	Computation	E
Start input for		support moments	
each other field	B		
Input concentrated			
loads	C		
Input external			
moment and factors	D		

M A X I M U M M A X I M O R U M B E N D I N G M O M E N T

(Requires an additional memory module)

This program calculates for a load train with n local loads P_i with a dynamic coefficient γ and an uniformly distributed load q :

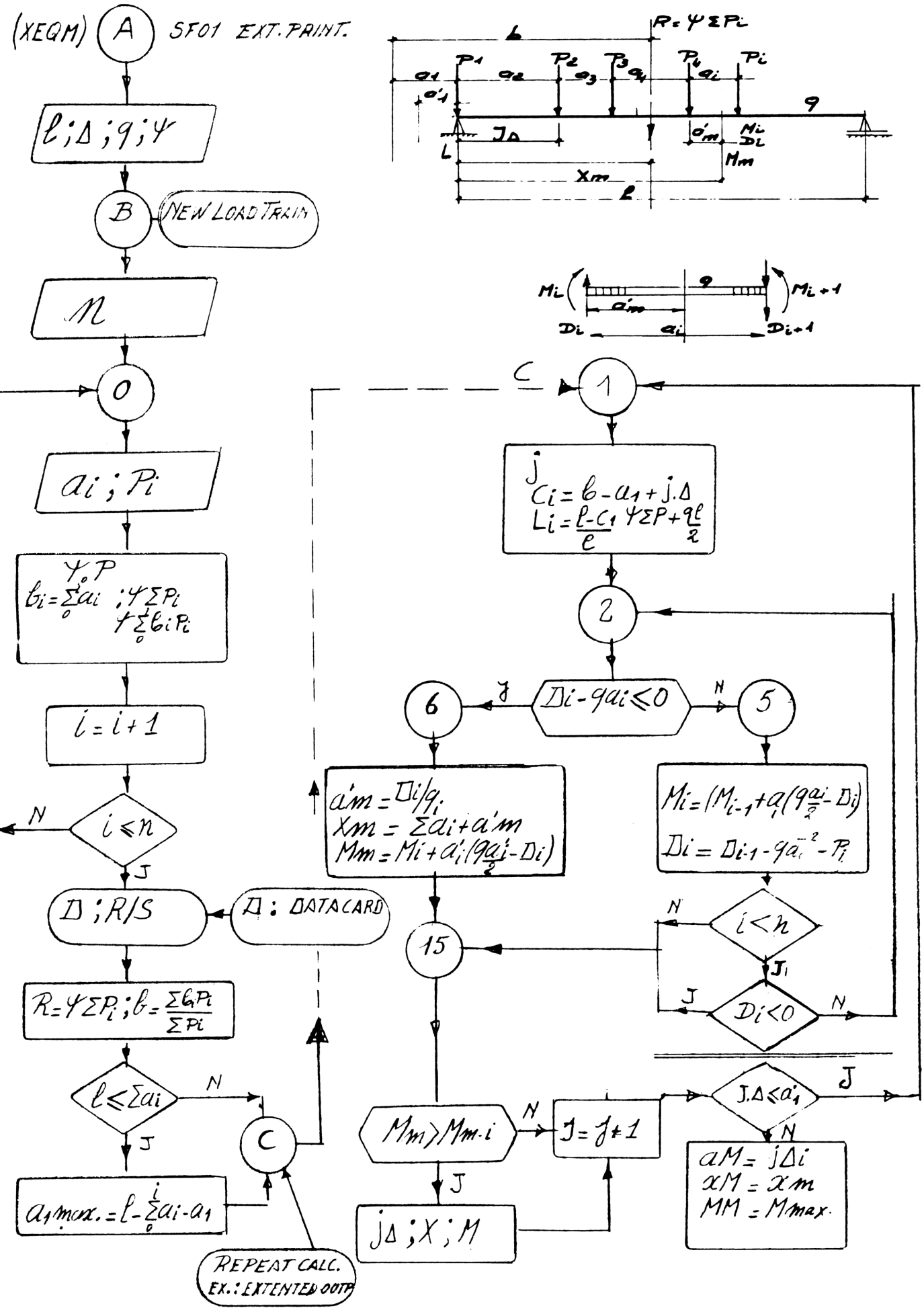
- the left support reaction L
- the bending moment at any local load P_i
- the shear force just after any local load P_i
- the max. bending moment at each step Δ
- the max. bending moment and its location

After the complete run (of n-steps) of the load train, this program gives the position $J\Delta$ of the train ; the max. maximorum moment and its location.

Note :

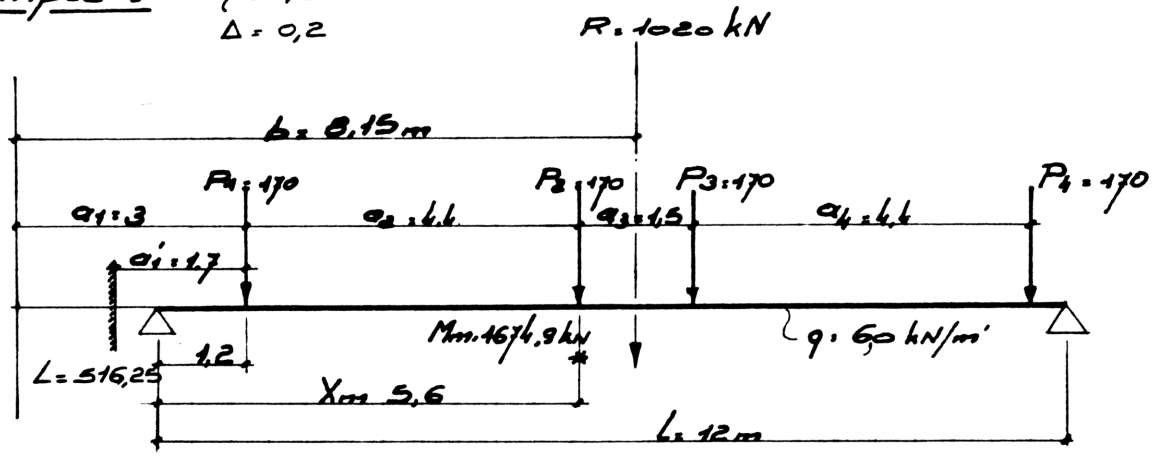
In this program it is possible to store data onto cards (for example : the load train) for later use.

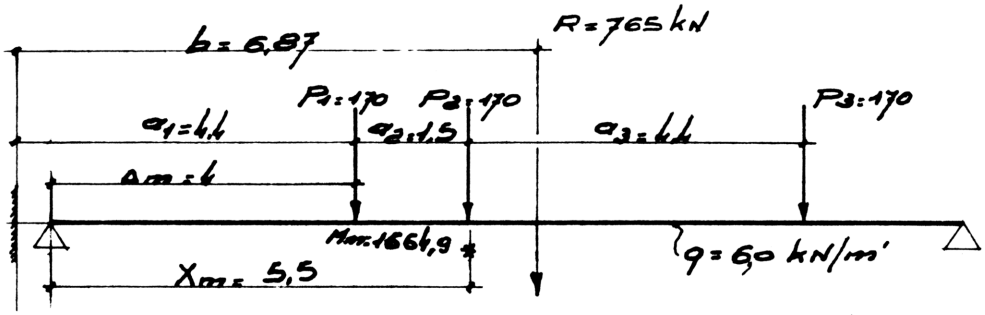
CALCULATION OF THE MAXIMUM MAXIMORUM BENDING MOMENT



Example 1

$\psi = 1,5$
$\Delta = 0,2$





LBL
XEQ M (CF01)

```
L?=12,00
INC?=0,20
UL?=6,00
d?=1,50
```

(B)

```
N?=4,00
a?=3,00
P?=170,00
d.P=255,00
a?=4,40
P?=170,00
d.P=255,00
a?=1,50
P?=170,00
d.P=255,00
a?=4,40
P?=170,00
d.P=255,00
```

*(D)

```
R=1.020,00
b=8,15
a1=1,70
aM=1,20
XM=5,60
MM=1.674,92
N=0,00
```

SF01 C

```
MOMENT    SHEAR
0,00    618,25
0,00    363,25
1.540,22    81,85
1.656,25    -182,15
N=0,20
MOMENT    SHEAR
0,00    601,25
120,13    345,05
1.580,27    63,65
1.669,00    -200,35
N=0,40
MOMENT    SHEAR
0,00    584,25
233,22    326,85
1.613,28    45,45
1.674,71    -218,55
N=0,60
MOMENT    SHEAR
0,00    567,25
339,27    308,65
1.639,25    27,25
1.673,38    -236,75
N=0,80
MOMENT    SHEAR
0,00    550,25
438,28    290,45
1.658,18    9,05
1.665,01    -254,95
N=1,00
MOMENT    SHEAR
0,00    533,25
530,25    272,25
1.670,07    -9,15
N=1,20
MOMENT    SHEAR
0,00    516,25
615,18    254,05
1.674,92    -27,35
N=1,40
MOMENT    SHEAR
0,00    499,25
693,07    235,85
1.672,73    -45,55
N=1,60
MOMENT    SHEAR
0,00    482,25
763,92    217,65
1.663,50    -63,75
aM=1,20
XM=5,60
MM=1.674,92
```

CF01 B

```
N?=3,00
a?=4,40
P?=170,00
d.P=255,00
a?=1,50
P?=170,00
d.P=255,00
a?=4,40
P?=170,00
d.P=255,00
```

*(D)

```
R=765,00
b=6,87
X=5,29  M=1.282,51
aM=4,00
XM=5,50
MM=1.664,87
```

*NOTE : D? IS DISPLAYED IF NO DATA CARD IS USED : PUSH R/S.

Example 2

A
L?=24,00
INC?=1,00
UL?=50,00
d?=1,50

(B)
N?=5,00
a?=8,00
P?=200,00
d.P=300,00
a?=3,00
P?=250,00
d.P=375,00
a?=6,00
P?=300,00
d.P=450,00
a?=6,00
P?=350,00
d.P=525,00
a?=3,00
P?=400,00
d.P=600,00

*(D)
R=2.250,00
b=18,60
a1=6,00
X=14,63 M=10.522,27
X=12,75 M=10.364,06
X=12,38 M=9.003,52
aM=0,00
XM=14,63
MM=10.522,27
N=0,00

SF01 L
MOMENT SHEAR
0,00 1.856,25
0,00 1.556,25
4.443,75 1.031,25
9.731,25 281,25
X=14,63 M=10.522,27
N=1,00
MOMENT SHEAR
0,00 1.762,50
1.737,50 1.412,50
5.750,00 887,50
10.175,00 137,50
X=12,75 M=10.364,06
N=2,00
MOMENT SHEAR
0,00 1.668,75
3.237,50 1.268,75
6.818,75 743,75
10.381,25 -6,25
N=3,00
MOMENT SHEAR
0,00 1.575,00
4.500,00 1.125,00
7.650,00 600,00
10.350,00 -150,00
N=4,00
MOMENT SHEAR
0,00 1.481,25
5.525,00 981,25
8.243,75 456,25
10.881,25 -293,75
N=5,00
MOMENT SHEAR
0,00 1.387,50
6.312,50 837,50
8.600,00 312,50
9.575,00 -437,50
N=6,00
MOMENT SHEAR
0,00 1.293,75
6.862,50 693,75
8.718,75 168,75
X=12,38 M=9.003,52
aM=0,00
XM=14,63
MM=10.522,27

B
N?=5,00
a?=3,00
P?=0,00
d.P=0,00
a?=6,00
P?=200,00
d.P=300,00
a?=3,00
P?=250,00
d.P=375,00
a?=6,00
P?=300,00
d.P=450,00
a?=6,00
P?=350,00
d.P=525,00

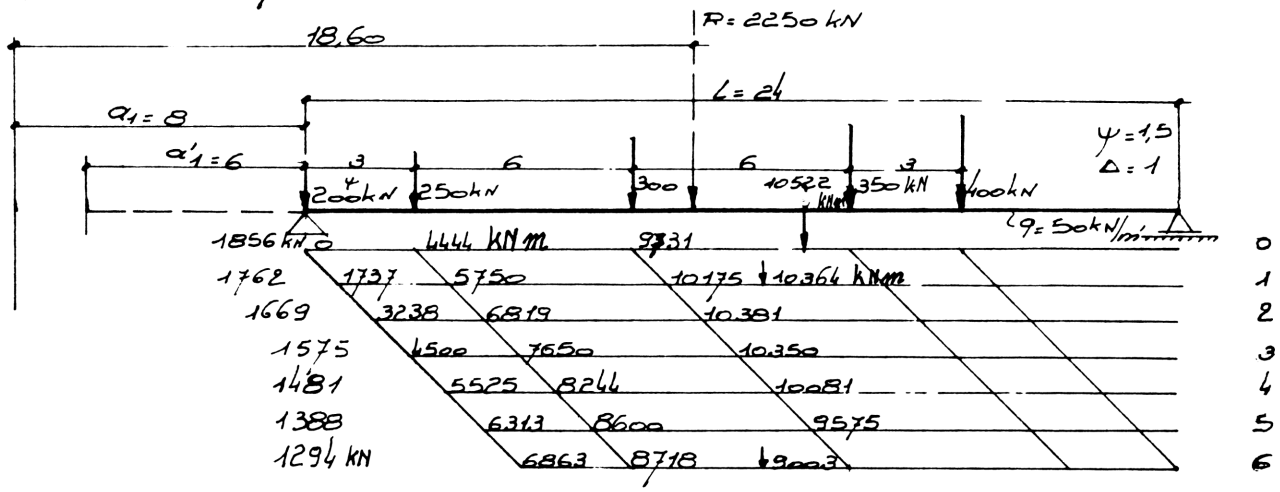
D? R/S
R=1.650,00
b=16,91
a1=3,00
N=0,00
MOMENT SHEAR
0,00 1.293,75
0,00 1.293,75
6.862,50 693,75
8.718,75 168,75
X=12,38 M=9.003,52
N=1,00
MOMENT SHEAR
0,00 1.225,00
1.200,00 1.175,00
7.350,00 575,00
8.850,00 50,00
X=11,00 M=8.875,00
N=2,00
MOMENT SHEAR
0,00 1.156,25
2.212,50 1.056,25
7.650,00 456,25
8.793,75 -68,75
N=3,00
MOMENT SHEAR
0,00 1.087,50
3.937,50 937,50
7.762,50 337,50
8.550,00 -187,50
aM=0,00
XM=12,38
MM=9.003,52

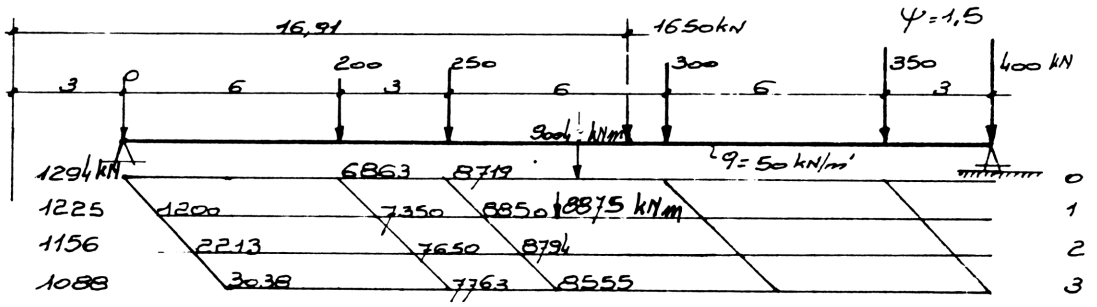
B
N?=4,00
a?=6,00
P?=0,00
d.P=0,00
a?=9,00
P?=200,00
d.P=300,00
a?=3,00
P?=250,00
d.P=375,00
a?=6,00
P?=300,00
d.P=450,00

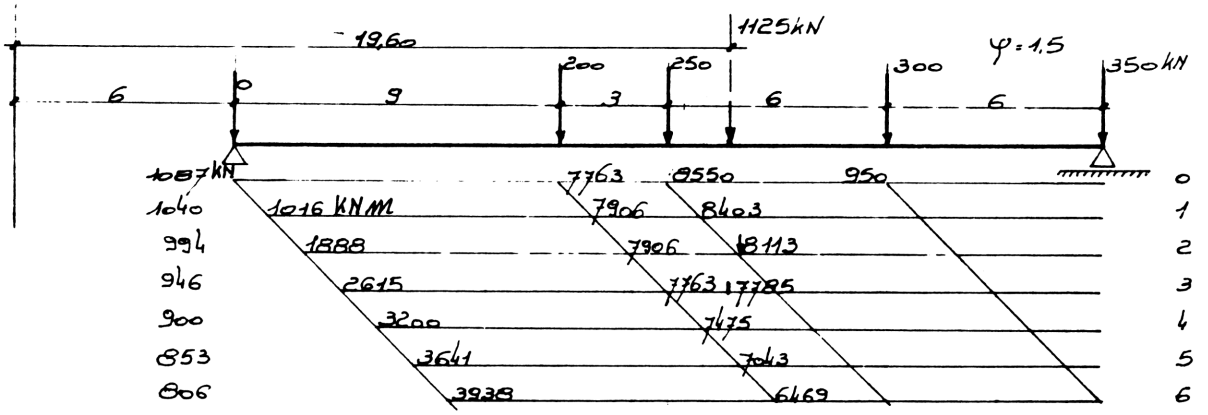
D? R/S
R=1.125,00
b=19,60
a1=6,00
N=0,00
MOMENT SHEAR
0,00 1.987,50
0,00 1.987,50
7.762,50 337,50
8.550,00 -187,50
N=1,00
MOMENT SHEAR
0,00 1.040,63
1.015,63 990,63
7.906,25 240,63
8.403,13 -284,38
N=2,00
MOMENT SHEAR
0,00 993,75
1.987,50 893,75
7.906,25 143,75
X=13,88 M=8.112,89
N=3,00
MOMENT SHEAR
0,00 946,88
2.615,63 796,88
7.762,50 46,88
X=12,94 M=7.784,47
N=4,00
MOMENT SHEAR
0,00 900,00
3.200,00 700,00
7.475,00 -50,00
N=5,00
MOMENT SHEAR
0,00 853,13
3.640,63 603,13
7.043,75 -146,88
N=6,00
MOMENT SHEAR
0,00 806,25
3.937,50 506,25
6.468,75 -243,75
aM=0,00
XM=12,00
MM=8.550,00

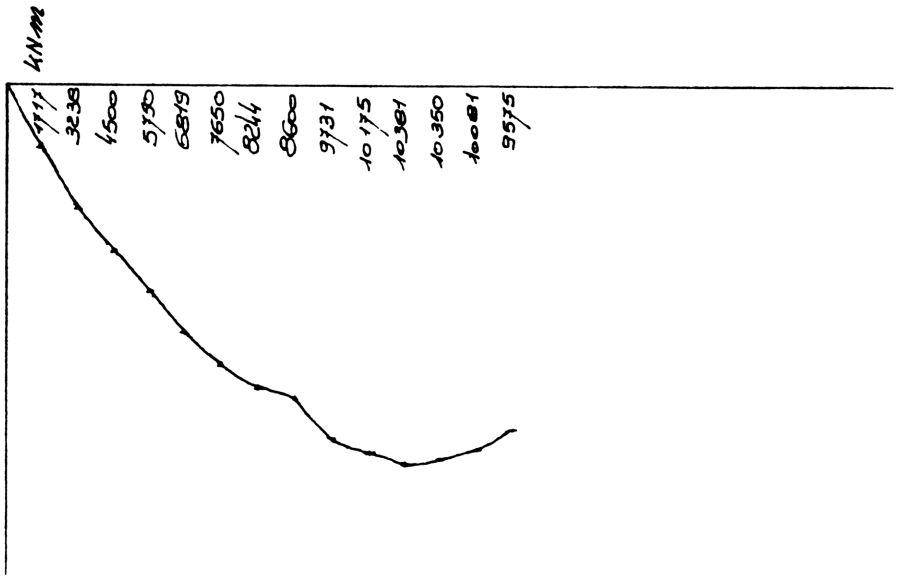
*NOTE:
STORE THE LOAD TRAIN FOR LATER USE IN EXAMPLE 3
- ENTER 0,020 IN X-REGISTER
- XEQ WDTAX
- INSERT DATA CARD SIDES 1 AND 2
- PUSH R/S

Sketch example 2

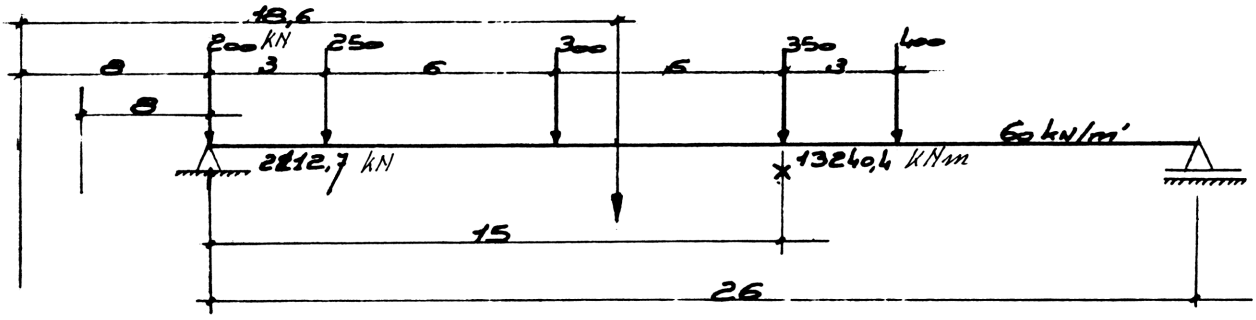








Example 3



CALCULATE THE MAXIMUM MAXIMORUM BENDING MOMENT FOR:
- L 26 24 22 m
- q 60 50 50 kN/m'
- LOAD TRAIN OF EXAMPLE 2 : USING DATA CARD

PUSH D D? DISPLAYED: INSERT DATA CARD SIDE 1 AND 2

LBL	
CF01 A	L?=26,00
	INC?=1,00
	UL?=60,00
D (D?) R/S	R=2.250,00
	b=18,60
	a1=8,00
	X=15,02 M=13.067,32
	X=13,58 M=12.954,99
	X=12,13 M=12.967,47
	X=13,87 M=11.617,47
	X=12,42 M=11.154,99
	aM=0,00
	XM=15,00
	MM=13.240,38

LBL	
A	L?=24,00
	INC?=1,00
	UL?=50,00
D(D?) R/S	R=2.250,00
	b=18,60
	X=14,63 M=10.522,27
	X=12,75 M=10.364,06
	X=12,38 M=9.003,52
	X=10,50 M=8.606,25
	aM=0,00
	XM=14,63
	MM=10.522,27

LBL	
A	L?=22,00
	INC?=1,00
D(D?) R/S	R=2.250,00
	b=18,60
	X=11,82 M=8.666,74
	X=12,64 M=7.816,94
	X=10,59 M=7.304,18
	aM=1,00
	XM=10,00
	MM=8.686,36

USER INSTRUCTIONS

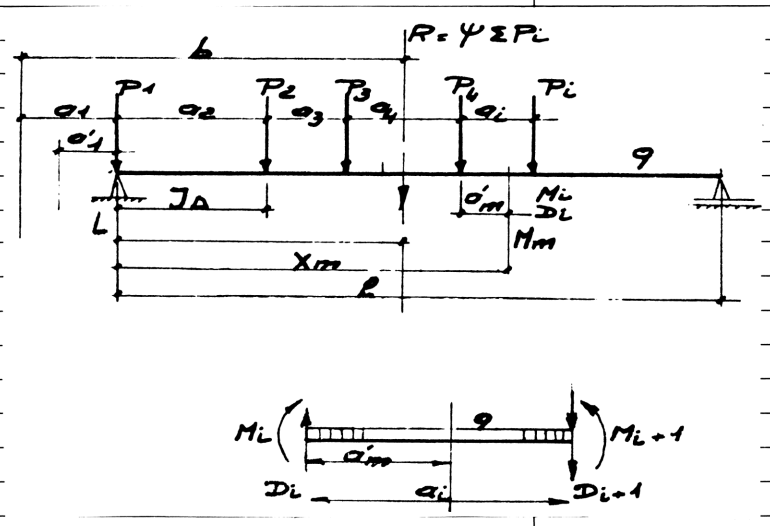
PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	Instructions Operation Instructions Istruzioni	Variables Dateneingabe Données Dati	Function(s) Taste(n) Touche(s) Tasti	Result Resultat Résultat Risultato
	MAXIMUM MAXIMORUM BENDING MOMENT		CF 28; SF 29	
		DISPLAY		PRINTER and DISPLAY
1	Enter program 2 cards		size 16+n CF 01	
2	Printer : used at option		MAN. mode	
3	If you want to print L ; M_i ; Q_i under each local load P_i at each step J		SF 01	
4	To start the execution		A or XEQMM	
5	The span	L ? l	R/S	L? = l
6	The step	INC ? Δ	R/S	INC? = Δ
7	The uniformly distributed load	UL ? q	R/S	UL? = q
8	The dynamic coefficient	d ? ψ	R/S	d ? = ψ
9	Start of input of the load train		B	
10	The number of concentrated loads	N ? n	R/S	N ? = n
11	The distance	a ? a_i	R/S	a ? = a_i
12	The applied concentrated load	P ? P_i	R/S	P ? = P_i
13	Repeat step 11 and 12 for each input of a_i and P_i			
14	Insert data card sides 1 and 2	D ?	XEQ WDTA	
	[Data card used at option]			
15	If no data card is used		R/S	R = P_i
	Location of the resultant R			b = b
	The maximum admissible distance a_1			$a_1 = a_{1max.}$
	a_1 is only displayed in the case that $a_1 \geqslant a_{max.}$			
	Step number			N = j
	L : left support reaction			Moment shear 0,00 L
	M_i : the bending moment under P_i			M_1 Q_1
	Q_i : the shear force just after P_i			⋮ ⋮
	X : the coordinate of the location of the max. moment			M_i Q_i
	M : the maximum moment			
	X and M are only displayed in the case that the location of the maximum moment does not correspond with a local load			X =... M =...
	The coordinate of the load P_1 in number of steps			aM = ... RG.9
	The coordinate of the maximum moment			xM = ... RG.8
	The max. maximorum bending moment			MM = ... RG.7
16	For a new load train go to step 9		B	
17	For repetition of the calculation after a complete run push		C	

USER INSTRUCTIONS

PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	**Instructions** Operation Instructions Istruzioni	**Variables** Dateneingabe Données Dati	**Function(s)** Taste(n) Touche(s) Tasti	**Result** Resultat Résultat Risultato
18	Input with data card push		D	
19	Insert data card sides 1 and 2	DC ?	R/S	
20	Possible modification of : l	l	STO 10	
	(only with data card) Δ	Δ	STO 11	
	q	q	STO 12	
	γ	γ	STO 13	



PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
01	◆LBL "M"	XEQ M OR ASN A
02	"L"	L?= l
03	XEQ 10	
04	STO 10	
05	"INC"	INC?= Δ
06	XEQ 10	
07	STO 11	
08	"UL"	UL?= q
09	XEQ 10	
10	STO 12	
11	"d"	d?= Y
12	XEQ 10	
13	STO 13	
14	◆LBL B	B
15	"N"	N?= n
16	XEQ 10	
17	16015	
18	+	
19	1 E3	
20	/	
21	STO 14	16,015+n.10³ → 14
22	STO 15	" " " → 15
23	0	
24	STO 00	
25	STO 01	
26	STO 02	CLRG 0÷2
27	◆LBL 00	
28	"a"	a?= aᵢ (i=1÷n)
29	XEQ 10	
30	ST+ 00	
31	E2	
32	*	
33	"P"	P?= Pᵢ (i=1÷n)
34	XEQ 10	
35	RCL 13	
36	*	
37	"d.P"	d.P= YPᵢ
38	XEQ 11	
39	ST+ 01	
40	E4	
41	/	
42	+	
43	STO IND 15	
44	XEQ 09	
45	RCL 00	
46	*	
47	ST+ 02	
48	ISG 15	
49	GTO 00	
50	◆LBL D	D
51	"D?"	D?= DATA CARD
52	PROMPT	R/S: CONTINUE
53	SF 02	
54	RCL 00	
55	RCL 02	
56	RCL 01	R= YΣPᵢ
57	"R"	
58	XEQ 11	
59	/	
60	"b"	
61	XEQ 11	
62	STO 00	
63	RDN	
64	RCL 10	
65	X<=Y?	
66	XEQ 08	
67	◆LBL C	C
68	0	REPETITION
69	STO 03	CALCULATION
70	STO 07	
71	◆LBL 01	
72	0	
73	STO 06	
74	STO 05	
75	RCL 03	
76	RCL 00	
77	+	
78	XEQ 03	
79	−	
80	RCL 10	
81	−	
82	CHS	
83	RCL 10	
84	/	
85	RCL 01	
86	*	
87	RCL 10	
88	RCL 12	
89	*	
90	2	
91	/	
92	+	
93	STO 04	
94	RCL 14	
95	STO 15	
96	FS? 01	
97	XEQ 13	
98	SF 00	
99	◆LBL 02	
100	XEQ 12	
101	ST+ 06	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
102	RCL 12	
103	*	
104	RCL 04	
105	X<=Y?	
106	GTO 06	
107	XEQ 12	
108	XEQ 05	
109	XEQ 12	
110	RCL 12	
111	*	
112	RCL 04	
113	-	
114	CHS	
115	RCL IND 15	
116	XEQ 09	
117	-	
118	STO 04	
119	ISG 15	$D_i < 0$
120	X<0?	
121	GTO 15	
122	CF 00	
123	GTO 02	
124	*LBL 06	
125	XEQ 12	
126	ST- 06	
127	RCL 04	
128	RCL 12	
129	/	
130	ST+ 06	
131	XEQ 05	$X = \sum a_i - a_i + J\Delta$
132	"X="	
133	ARCL 06	$M = M_i + a'(qa' - D_i)$
134	"⊢ M="	
135	ARCL 05	
136	AVIEW	$D_i < 0$ PRINT
137	GTO 17	
138	*LBL 15	
139	FS? 01	
140	XEQ 14	
141	*LBL 17	
142	RCL 05	
143	RCL 07	
144	X<=Y?	
145	XEQ 04	
146	RCL 11	
147	ST+ 03	
148	XEQ 03	
149	RCL 03	
150	X<=Y?	
151	GTO 01	

Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
152	SF 12	
153	RCL 09	
154	"aM"	$aM = J.\Delta \rightarrow 9$
155	XEQ 11	
156	RCL 08	
157	"XM"	
158	XEQ 11	$XM = x_m \rightarrow 8$
159	RCL 07	
160	"MM"	
161	XEQ 11	$MM = max.M \rightarrow 7$
162	CF 12	
163	CF 02	
164	RTN	
165	*LBL 03	
166	RCL 16	
167	XEQ 07	
168	RTN	
169	*LBL 04	
170	RCL 05	
171	STO 07	
172	RCL 06	
173	STO 08	
174	RCL 03	
175	STO 09	
176	RTN	
177	*LBL 09	
178	FRC	
179	E4	
180	*	
181	RTN	
182	*LBL 08	
183	-	
184	CHS	
185	ST+ 00	
186	XEQ 03	
187	+	
188	"a1"	
189	XEQ 11	$a'_i = a_i$ max.
190	E2	
191	*	
192	RCL 16	
193	FRC	
194	+	
195	STO 16	
196	RTN	
197	*LBL 07	
198	INT	
199	E2	
200	/	

PROGRAM LISTING
PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
201	RTN	
202	◆LBL 05	PRINTER ON SF01
203	FS? 01	
204	XEQ 14	
205	ENTER↑	Mi ; Qi
206	ENTER↑	
207	RCL 04	
208	*	
209	RCL 05	
210	+	
211	X<>Y	
212	X↑2	
213	RCL 12	
214	*	
215	2	
216	/	
217	-	
218	STO 05	
219	RTN	
220	◆LBL 12	
221	RCL IND 15	
222	XEQ 07	
223	FS? 00	
224	RCL 03	
225	RTN	
226	◆LBL 10	
227	"⊢?"	
228	PROMPT	
229	◆LBL 11	
230	FIX 2	
231	"⊢="	
232	ARCL X	
233	AVIEW	
234	FS? 02	
235	PSE	
236	RTN	
237	◆LBL 13	
238	CLA	
239	SF 12	
240	"N="	N=J
241	ARCL 03	
242	ACA	
243	CF 12	
244	PRBUF	
245	"MOMENT SHEAR"	MOMENT SHEAR
246	PRA	
247	RTN	
248	◆LBL 14	
249	CLA	
250	ARCL 05	
251	"⊢ "	
252	ARCL 04	
253	ACA	
254	PRBUF	Mi ; Qi
255	.END.	

Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
60		
65		
70		
75		
80		
85		
90		
95		
00		

REGISTERS, STATUS, FLAGS

REGISTERBELEGUNG, FLAGS, BETRIEBSARTEN
REGISTRES, INDICATEURS, MODES OPÉRATOIRES
REGISTRI, MODI OPERATIVI, FLAGS

Registers
Datenspeicher
Registres de données
Registri

00	0	Σa_i	b
	0	$\gamma\Sigma p^i$	
	0	$\gamma\Sigma b_i p_i$	
	0		$L_i : D_i$
05	0		
	0	Σa_i	$\sum_{MM^i}^{n} a_i - a_1$
	0		xM
			aM
10	1		
	Δ		
	q		
	γ		
	16,015		
15	16,015		
	(a,P)1		
	" " 2		
	" " 3		
	" " 4		
20	" " 5		
	" " 6		
25			
30			
40			
45			

Status
Betriebsart
Modes opératoires
Modi operativi

Size 16+n	Total Reg. 80+n	User Mode
Eng ☐	Fix ☐ Sci ☐	On ☒
Deg ☐	Rad ☐ Grad ☐	Off ☐

Purpose / **Flags**
Bedeutung
Signification
Scopo

	Purpose	SET	CLEAR	
00		X	X	No
01	Extented output	X	X	Extented output
02		X		print
03				
04				
05				
06				
07				
08				
09				
10				
11	Audio execute			
12		X		
13				
14				
15				
16				
17				
18				
19				
20				
21	Printer Enable			
22	Number Input			
23	Alpha Input			
24	Range Ignore			
25	Error Ignore			
26	Audio Enable			
27	User Mode			
28	Decimal Point		X	
29	Digit Grouping	X		

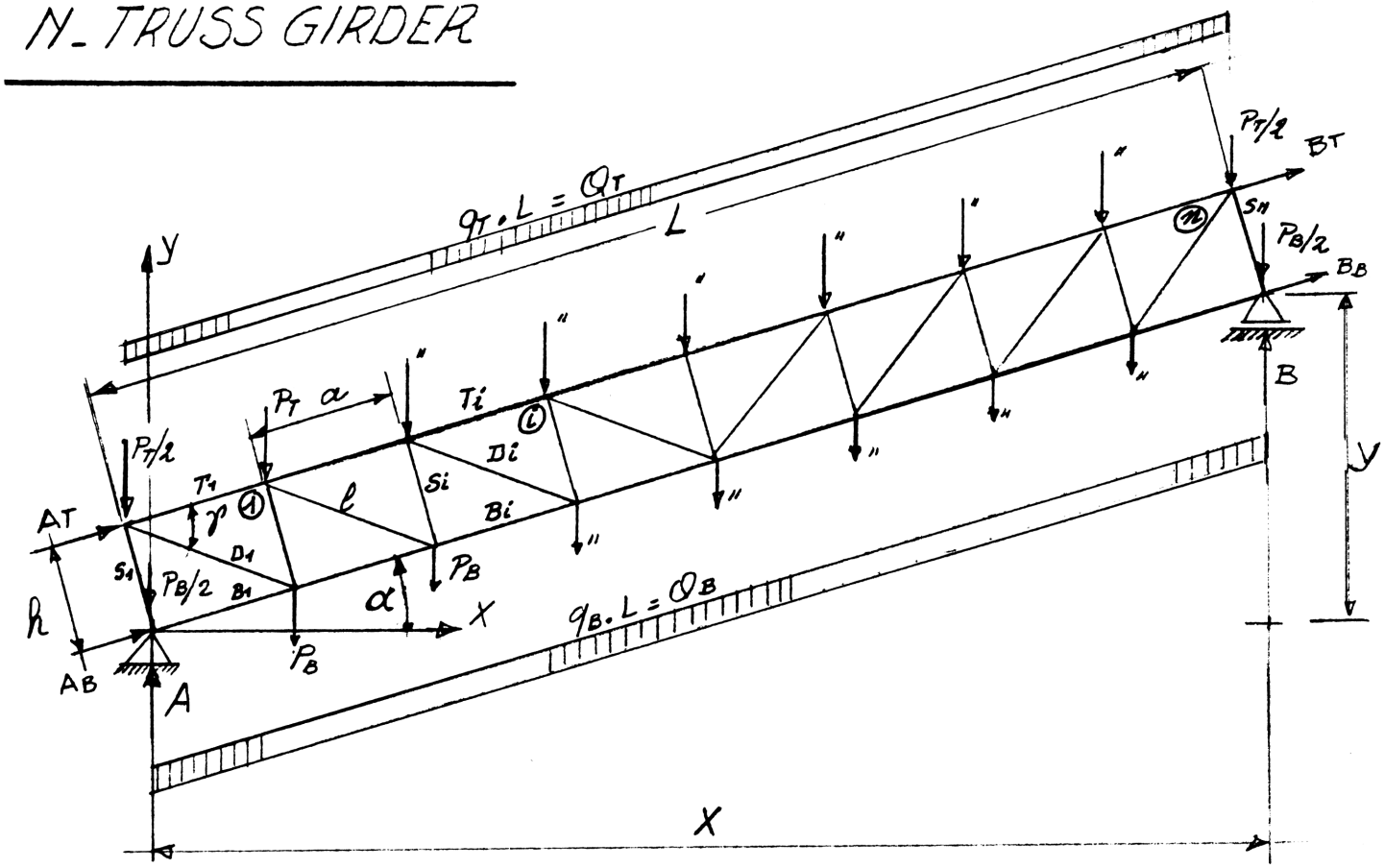
Assignments
Tastenbelegung/Assignations/Assegnamenti

Function (Funktion / Fonction / Funzione)	Key (Taste / Touche / Tasto)	Function (Funktion / Fonction / Funzione)	Key (Taste / Touche / Tasto)
Start XEQ M	A		
Input new load	B		
train			
Repetition	C		
Data card	D		

N - T R U S S G I R D E R

(Requires an additional memory module)

N_TRUSS GIRDER



Loads with positive sign convention

<u>Requirements</u> : n equal panels

$$\vec{A}_T + \vec{A}_B + \vec{B}_T + \vec{B}_B = 0$$

<u>Input</u> : Dimensions : Coordinates X and Y (m)

Number of panels n

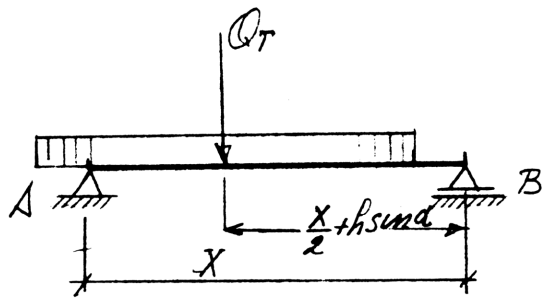
Theoretical height h (m)

Loads : Uniformly distributed loads :

U.L.TOP = q_T and U.L.BOT. = q_B (kN/m)

Longitudinal loads : $\overrightarrow{A}_B$; $\overrightarrow{A}_T$; $\overrightarrow{B}_T$ (kN)

Output :	Length :	L (m)	Total load :	Q_T ; Q_B	(kN)
	Slope angle :	α ° (°)	Local load :	P_T ; P_B	(kN)
	Node distance :	a (m)	Support reaction :	A ; B	(kN)
	Diagonal length :	l (m)	Member loads :	T_i ; B_i ; D_i ; S_i	(kN)



$$L = (X^2 + Y^2)^{1/2}$$

$$\alpha = \tan^{-}(Y/X)$$

$$a = L/n$$

$$l = (a^2 + h^2)^{1/2}$$

$$\gamma = \tan(h/a)$$

$$Q_T = q_T.L \qquad P_T = Q_T/n$$

$$Q_B = q_B.L \qquad P_B = Q_B/n$$

$$A = \frac{Q_T}{X}\left(\frac{X}{2} + h\sin\alpha\right) + \frac{Q_B}{2} - \frac{h}{X}(A_T + B_T)$$

$$A = \frac{Q_T + Q_B}{2} - \frac{h}{X}(A_T + B_T - Q_T\sin\alpha)$$

$$B = Q_T + Q_B - A$$

PANEL 1

$$T\begin{cases} -\frac{P_T}{2}\cos\alpha - D_1\sin\gamma - S_1 = 0 \\ -\frac{P_T}{2}\sin\alpha - D_1\cos\gamma - T_1 + A_T = 0 \end{cases}$$

$$B\begin{cases} (-\frac{P_B}{2} + A)\cos\alpha + S_1 = 0 \\ (-\frac{P_B}{2} + A)\sin\alpha + A_B + B_1 = 0 \end{cases}$$

$$S_1 = (\frac{P_B}{2} - A)\cos\alpha$$

$$B_1 = (\frac{P_B}{2} - A)\sin\alpha - A_B$$

$$D_1 = -\frac{1}{\sin}\left(\frac{P_T}{2}\cos\alpha + S_1\right) < 0 \rightarrow \text{GToi}$$

$$T_1 = \frac{P_T}{2}\sin\alpha - D_1\cos\gamma - A_T$$

PANEL 2 : (i - 1)

$$T\begin{cases} -P_T\cos\alpha - D_n\sin\gamma - S_n = 0 \\ -P_T\sin\alpha - D_n\cos\gamma + T_n - T_{n-1} = 0 \end{cases}$$

$$B\begin{cases} -P_B\cos\alpha - D_{n-1}\sin\gamma + S_n = 0 \\ -P_B\sin\alpha - D_{n-1}\cos\gamma - B_{n-1} + B_n = 0 \end{cases}$$

$$S_n = P_B\cos\alpha - D_{n-1}\sin\gamma$$

$$B_n = P_B\sin\alpha + D_{n-1}\cos\gamma + B_{n-1}$$

$$D_n = -\frac{1}{\sin\gamma}(P_T\cos + S_n) < 0 \rightarrow \text{GToi}$$

$$T_n = P_T\sin\alpha - D_n\cos\gamma + T_{n-1}$$

PANEL i

$$T\begin{cases} -P_T\cos\alpha - S_i = 0 \\ -P_T\sin\alpha - T_{i-1} + T_i = 0 \end{cases}$$

$$B\begin{cases} -P_B\cos\alpha + (D_{i-1}+D_i)\sin\gamma + S_i = 0 \\ -P_B\sin\alpha - (D_{i-1}-D_i)\cos\gamma - B_{i-1} + B_i = 0 \end{cases}$$

$$S_i = -P_T\cos\alpha$$

$$T_i = P_T\sin\alpha + T_{i-1}$$

$$D_i = \frac{1}{\sin\gamma}(P_B\cos\alpha - S_i) - D_{i-1}$$

$$B_i = P_B\sin\alpha - (D_{i-1}-D_i)\cos\gamma + B_{i-1}$$

PANEL i + 1 + n = m

$$T\begin{cases} -P_T\cos\alpha - S_m - D_{m-1}\sin\gamma = 0 \\ -P_T\sin\alpha - D_{m-1}\cos\gamma - T_{m-1} + T_m = 0 \end{cases}$$

$$B\begin{cases} -P_B\cos\alpha + S_m + D_m\sin\gamma = 0 \\ -P_B\sin\alpha + D_m\cos - B_{m-1} + B_m = 0 \end{cases}$$

$$S_m = -P_T\cos\alpha - D_{m-1}\sin\gamma$$

$$B_m = P_B\sin\alpha - D_m\cos\gamma + B_{m-1}$$

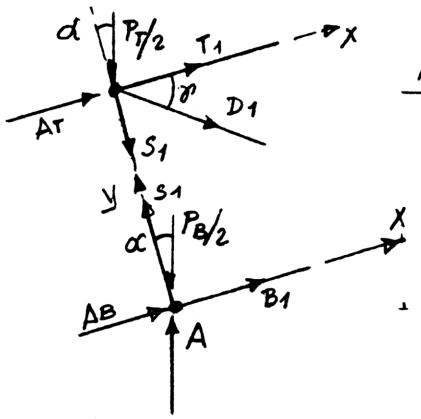
$$T_m = P_T\sin\alpha + D_{m-1}\cos\gamma + T_{m-1}$$

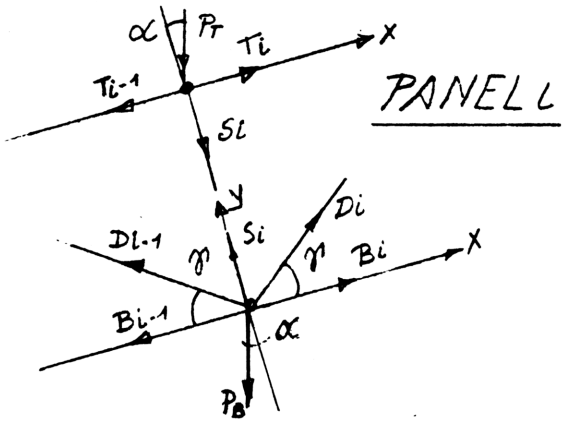
$$D_m = \frac{1}{\sin\gamma}(P_B\cos\alpha\ S_m)$$

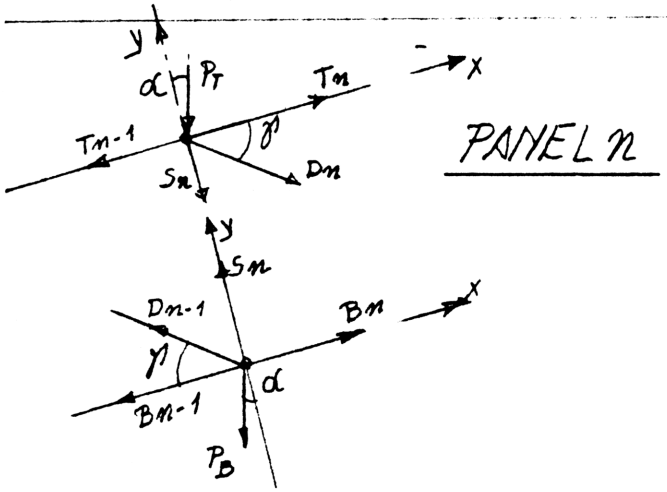
PANEL n + 1 = 1

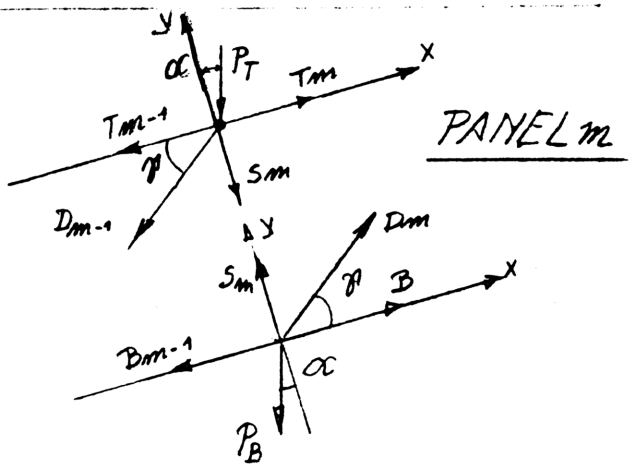
$$T \quad -\frac{P_T}{2}\cos\alpha - S_m - D_m\sin\gamma = 0$$

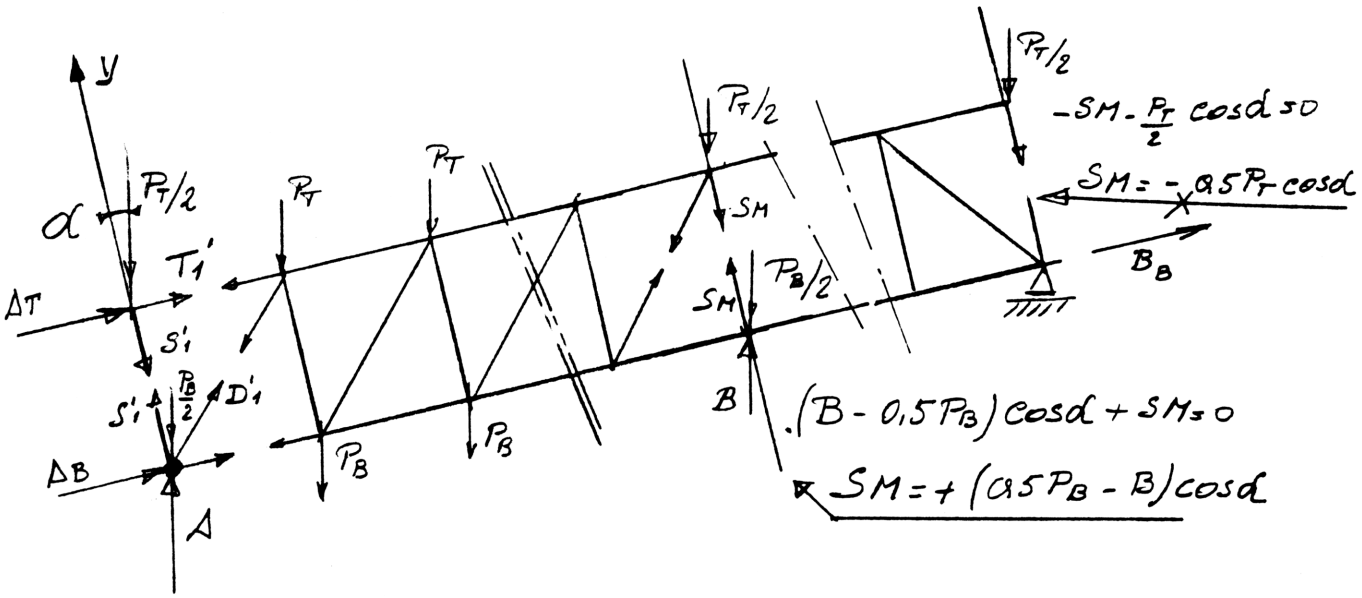
$$S_m = -(\frac{P_T}{2}\cos\alpha + D_m\sin\gamma)$$











$$T\begin{cases} -\frac{P_T}{2}\cos\alpha - S_1' = 0 \\ -\frac{P_T}{2}\sin\alpha - A_T + T_1' = 0 \end{cases}$$

$$S_1' = -\frac{P_T}{2}\cos\alpha$$

$$T_1' = \frac{P_T}{2}\sin\alpha - A_T$$

$$B\begin{cases} (-\frac{P_B}{2} + A)\cos\alpha + D_1'\sin\gamma + S_1' \\ (-\frac{P_B}{2} + A)\sin\alpha + D_1'\cos\gamma + B_1' + A_B = 0 \end{cases}$$

$$D_1' = ((\frac{P_B}{2} - A)\cos\alpha - S_1')\frac{1}{\sin\gamma}$$

$$B_1' = (\frac{P_B}{2} - A)\sin\alpha - D_1'\cos\gamma - A_B$$

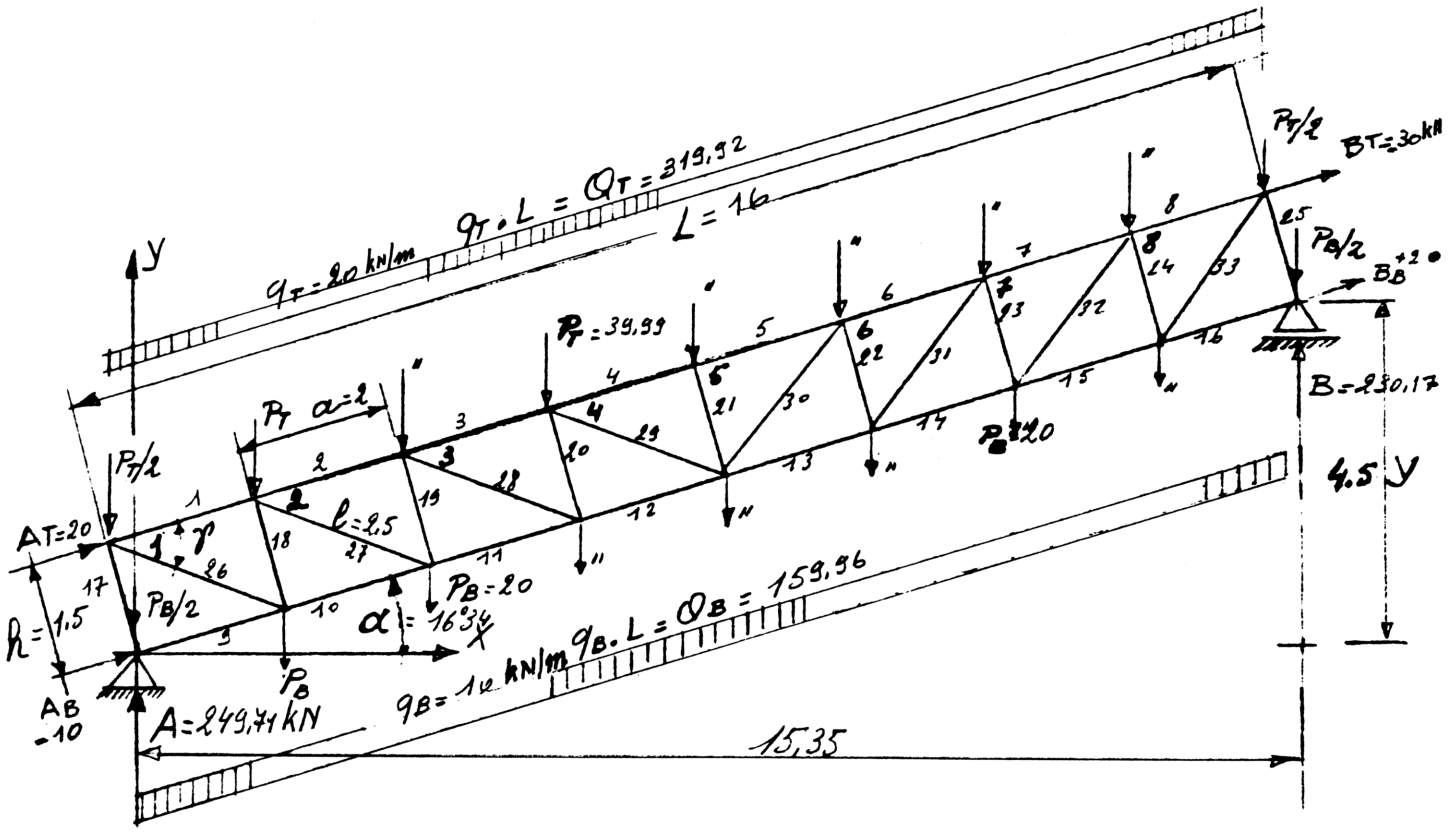
When the indication " DIAG.CH.OF INCL. " is printed before the first series (i = 1) this means that the first diagonal was compressed and tipped by the program.

However to have tensioned diagonals in that case the girder should be turned over (see e.g. 3 and 4)

In the case that a girder with equally directed diagonals should be calculated, this characteristic may be useful (see e.g. 3 and 4).

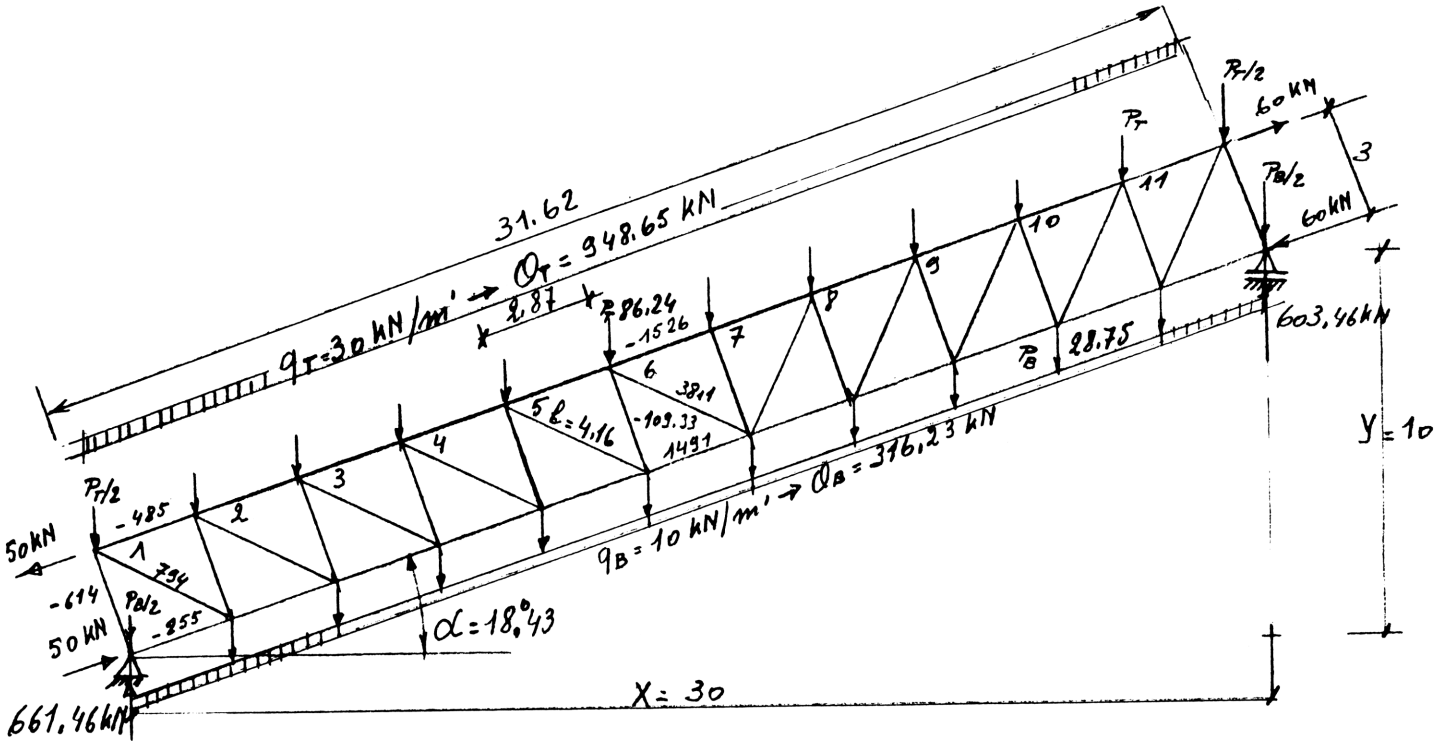
This program can also be applied to girders with different serial section lengths (see e.g. 5).

Example 1




```
Y ? 4.50 X ? 15.35Y ? 4.
50 X ? 15.35
LENGTH = 16.00
SLOPE = 16.34
NUB. ? 8.00
TH. HEIGHT ? 1.50
CHORD. L = 2.00
 DIAG. L = 2.50
 U.L.TOP ? 20.00
QT = 319.92 PT = 39.99
U.L.BOT. ? 10.00
QB  = 159.96 PB = 20.00
AB ?-10.00 AT ? 20.00
BT ?-30.00
```

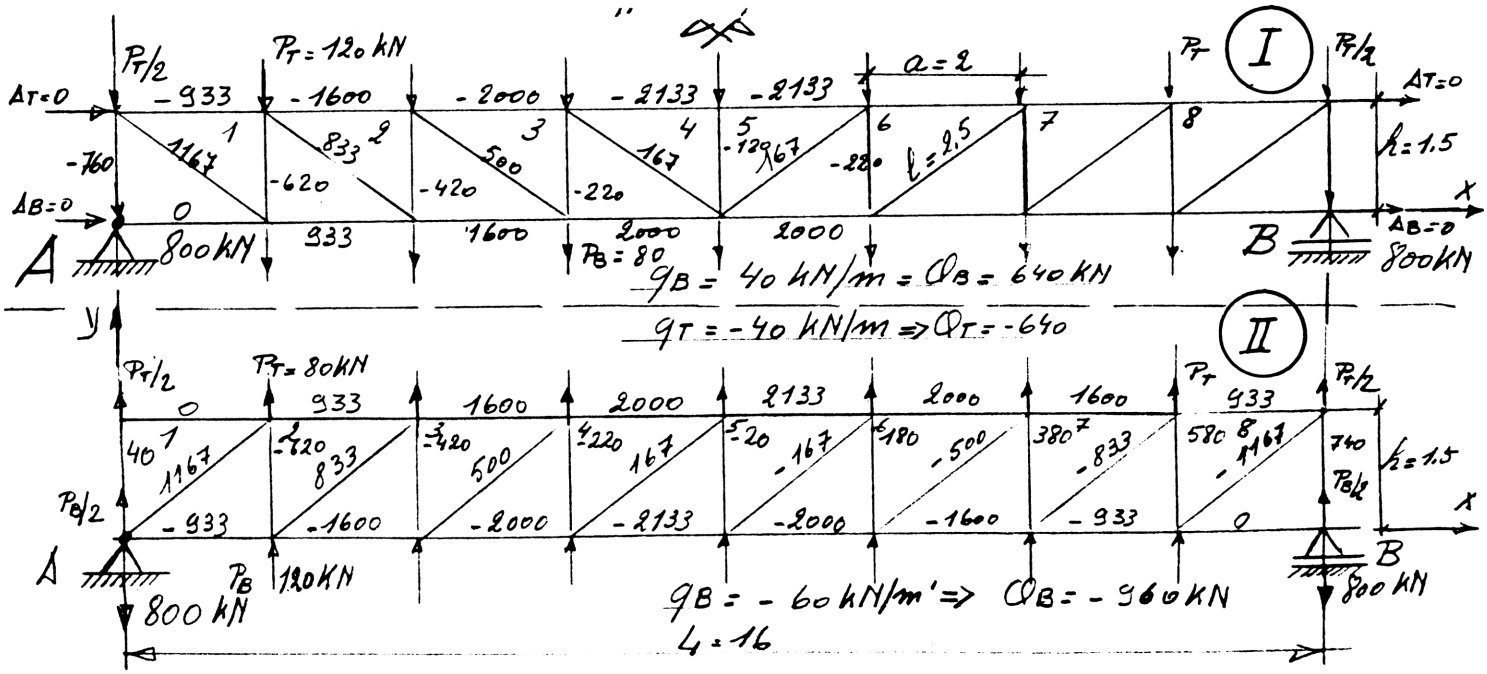
```
SUP. REACT:
A  =  249,71
B  =  230,17
N TOPCH. BOTT. CH.
            DIAG. STAN.
-----------------------
 1, -295,43 -57,44
         351,35 -230,03
 2, -488,51 229,25
         255,43 -191,66
 3, -604,86 439,20
         159,51 -134,10
 4, -644,47 572,42
          63,59 -76,53
DIAG. CH. OF INCL.
 5, -633,22 603,05
          32,33 -38,38
 6, -596,11 506,07
         128,26 -57,78
 7, -482,26 332,37
         224,18 -115,34
 8, -291,68 81,94
         320,10 -172,90
           SM =-211,28
```




```
Y ? 10,00 X ? 30,00
LENGTH = 31,62
SLOPE = 18,43
NUB. ? 11,00
TH. HEIGHT ? 3,00
CHORD. L = 2,87
 DIAG. L = 4,16
 U.L.TOP ? 30,00
QT = 948,68 PT = 86,24
U.L.BOT. ? 10,00
QB  = 316,23 PB = 28,75
AB ? 50,00 AT ?-50,00
BT ? 60,00
SUP. REACT:
A  =  661,46
B  =  603,46
```

```
N TOPCH. BOTT. CH.
            DIAG. STAN.
------------------------
 1, -485,42 -254,63
         793,57 -613,88
 2, -902,66 303,52
         642,48 -545,69
 3, -1.215,37 757,13
         491,38 -436,60
 4, -1.423,53 1.106,20
         340,29 -327,51
 5, -1.527,16 1.350,73
         189,20 -218,42
 6, -1.526,25 1.490,72
          38,10 -109,33
DIAG. CH. OF INCL.
 7, -1.498,98 1.448,00
         112,99 -81,82
 8, -1.393,53 1.274,38
         264,08 -163,40
 9, -1.183,55 996,22
         415,17 -272,49
 10, -869,02 613,52
         566,27 -381,58
 11, -449,96 126,28
         717,36 -490,67
            SM =-558,85
```

Example 3

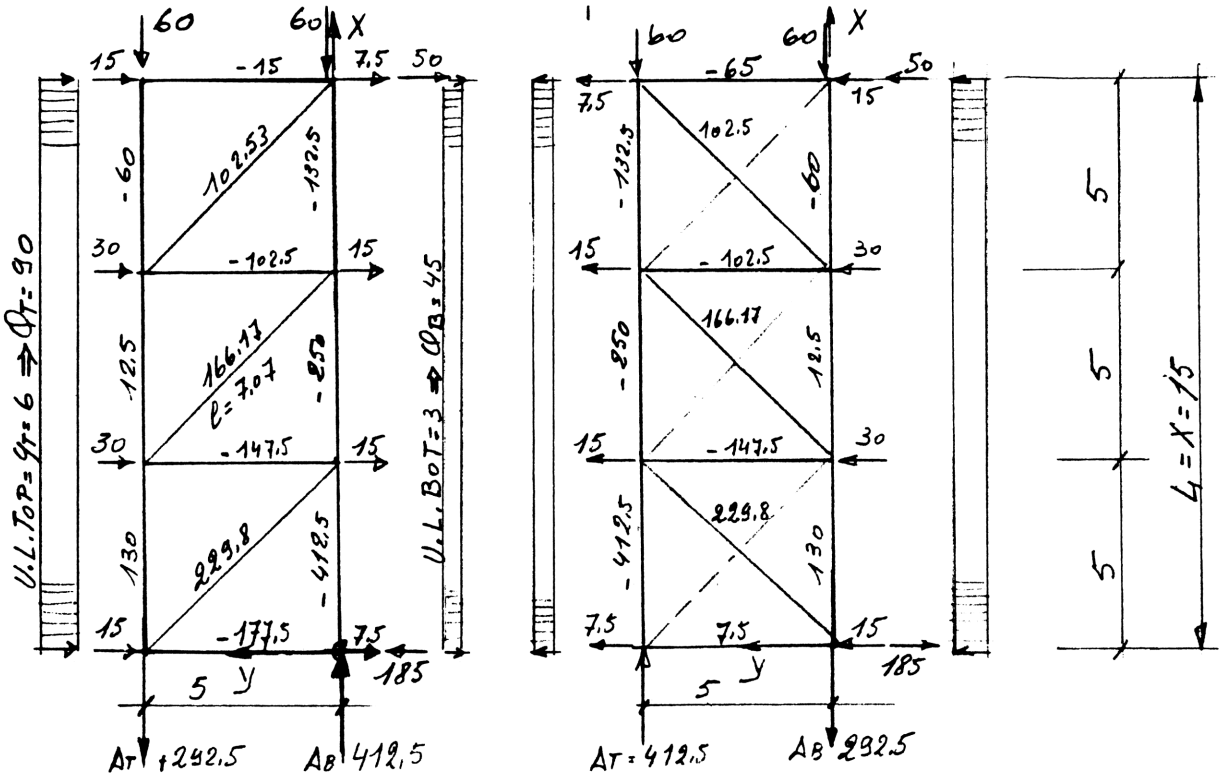


I

```
Y ? 0,00 X ? 16,00
LENGTH = 16,00
SLOPE = 0,00
NUB. ? 8,00
TH. HEIGHT ? 1,50
CHORD. L = 2,00
 DIAG. L = 2,50
 U.L.TOP ? 60,00
QT = 960,00 PT = 120,00
U.L.BOT. ? 40,00
QB  = 640,00 PB = 80,00
AB ? 0,00 AT ? 0,00
BT ? 0,00
SUP. REACT:
A  =  800,00
B  =  800,00
N TOPCH. BOTT. CH.
              DIAG. STAN.
------------------------
 1, -933,33 0,00
        1.166,67 -760,00
 2, -1.600,00 933,33
          833,33 -620,00
 3, -2.000,00 1.600,00
          500,00 -420,00
 4, -2.133,33 2.000,00
          166,67 -220,00
DIAG. CH. OF INCL.
 5, -2.133,33 2.000,00
          166,67 -120,00
 6, -2.000,00 1.600,00
          500,00 -220,00
 7, -1.600,00 933,33
          833,33 -420,00
 8, -933,33 -2,60E-6
        1.166,67 -620,00
             SM =-760,00
```

II

```
Y ? 0,00 X ? 16,00
LENGTH = 16,00
SLOPE = 0,00
NUB. ? 8,00
TH. HEIGHT ? 1,50
CHORD. L = 2,00
 DIAG. L = 2,50
 U.L.TOP ?-40,00
QT =-640,00 PT =-80,00
U.L.BOT. ?-60,00
QB  =-960,00 PB =-120,00
AB ? 0,00 AT ? 0,00
BT ? 0,00
SUP. REACT:
A  =-800,00
B  =-800,00
N TOPCH. BOTT. CH.
              DIAG. STAN.
------------------------
DIAG. CH. OF INCL.
 1, 0,00 -933,33
        1.166,67 40,00
 2, 933,33 -1.600,00
          833,33 -620,00
 3, 1.600,00 -2.000,00
          500,00 -420,00
 4, 2.000,00 -2.133,33
          166,67 -220,00
 5, 2.133,33 -2.000,00
          -166,67 -20,00
 6, 2.000,00 -1.600,00
          -500,00 180,00
 7, 1.600,00 -933,33
          -833,33 380,00
 8, 933,33 2,60E-6
        -1.166,67 580,00
             SM = 740,00
```



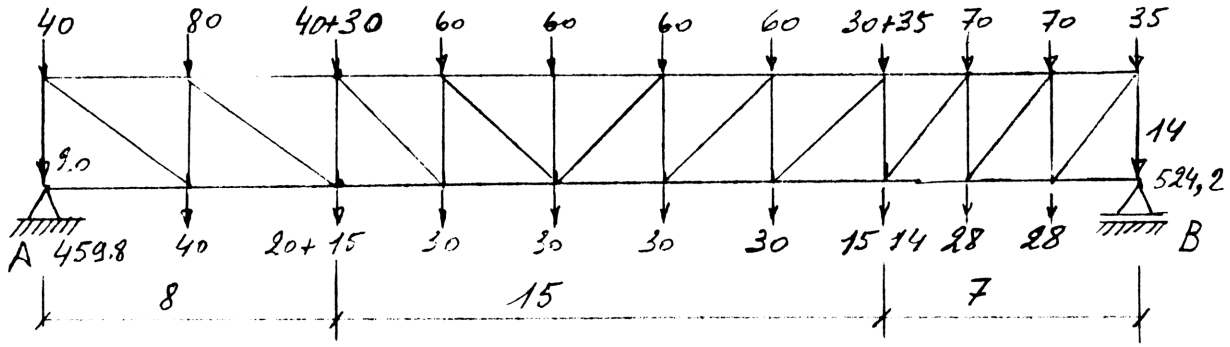
$$A_B = (90+45)\frac{15}{2\times5} + 50\times\frac{15}{5} + 60 = 412.5$$

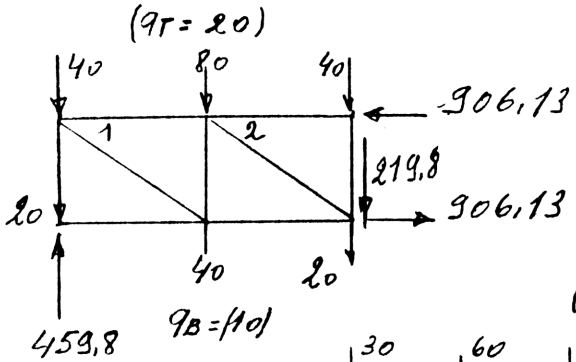
$$A_T = - \quad - \quad + \quad = -292.5$$

```
Y ? 0,00 X ? 15,00
LENGTH = 15,00
SLOPE = 0,00
NUB. ? 3,00
TH. HEIGHT ? 5,00
CHORD. L = 5,00
 DIAG. L = 7,07
 U.L.TOP ? 6,00
QT = 90,00 PT = 30,00
U.L.BOT. ? 3,00
QB  = 45,00 PB = 15,00
AB ? 412,50 AT ?-292,50
BT ?-60,00
SUP. REACT:
A  =  185,00
B  =-50,00
N TOPCH. BOTT. CH.
                DIAG. STAN.
-------------------------
 1, 130,00 -412,50
          229,81 -177,50
 2, 12,50 -250,00
          166,17 -147,50
 3, -60,00 -132,50
          102,53 -102,50
              SM =-15,00
```

```
Y ? 0,00 X ? 15,00
LENGTH = 15,00
SLOPE = 0,00
NUB. ? 3,00
TH. HEIGHT ? 5,00
CHORD. L = 5,00
 DIAG. L = 7,07
 U.L.TOP ?-3,00
QT =-45,00 PT =-15,00
U.L.BOT. ?-6,00
QB  =-90,00 PB =-30,00
AB ?-292,50 AT ? 412,50
BT ?-60,00
SUP. REACT:
A  =-185,00
B  =  50,00
N TOPCH. BOTT. CH.
                DIAG. STAN.
-------------------------
DIAG. CH. OF INCL.
 1, -412,50 130,00
          229,81 7,50
 2, -250,00 12,50
          166,17 -147,50
 3, -132,50 -60,00
          102,53 -102,50
              SM =-65,00
```

Example 5

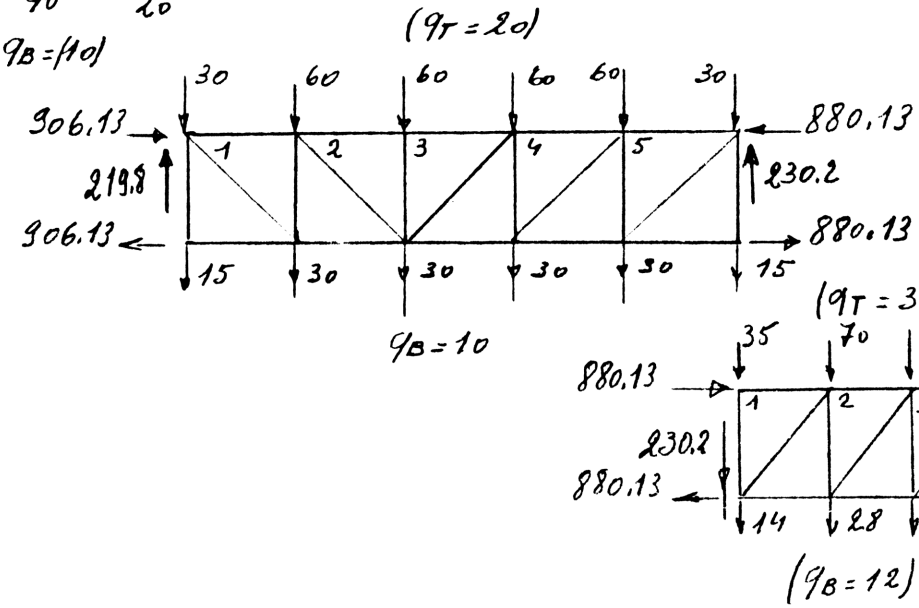




$$A = \frac{1}{30}(240\times26+450\times14.5+294\times3.5) = 459.8$$

$$B = 240+450+294-459.8 = 524.2$$

$$B_T = -\frac{459.8\times8-240\times4}{3} = -906.13$$



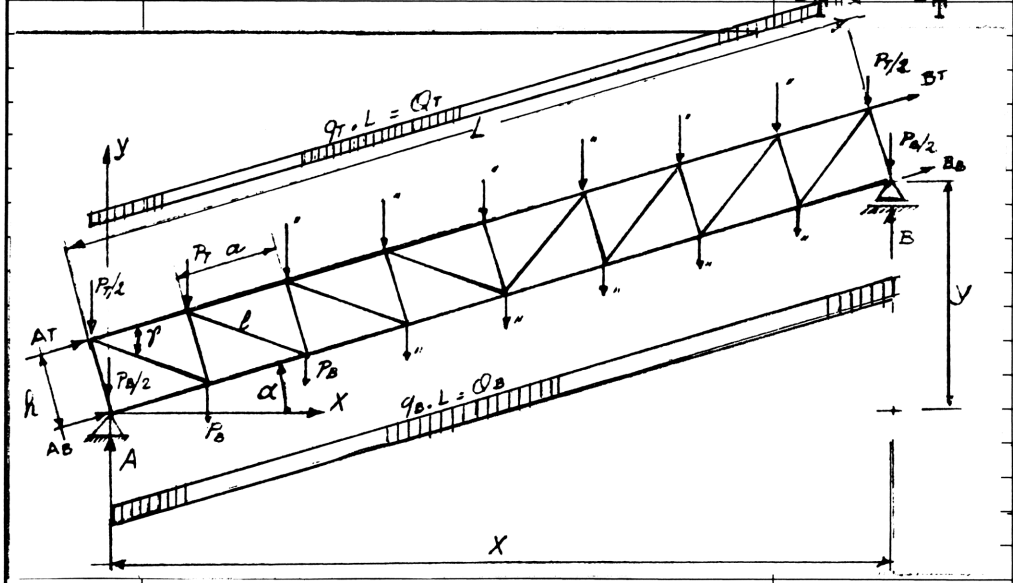

```
Y ? 0,00 X ? 8,00
LENGTH = 8,00
SLOPE = 0,00
NUB. ? 2,00
TH. HEIGHT ? 3,00
CHORD. L = 4,00
 DIAG. L = 5,00
 U.L.TOP ? 20,00
QT = 160,00 PT = 80,00
U.L.BOT. ? 10,00
QB  = 80,00 PB = 40,00
AB ? 0,00 AT ? 0,00
BT ?-906,13
SUP. REACT:
A =  459,80
B =-219,80
N TOPCH. BOTT. CH.
            DIAG. STAN.
------------------------
 1, -533,06 0,00
         666,33 -439,80
 2, -906,13 533,06
         466,33 -359,80
            SM =-40,00
```

```
Y ? 0,00 X ? 15,00
LENGTH = 15,00
SLOPE = 0,00
NUB. ? 5,00
TH. HEIGHT ? 3,00
CHORD. L = 3,00
 DIAG. L = 4,24
 U.L.TOP ? 20,00
QT = 300,00 PT = 60,00
U.L.BOT. ? 10,00
QB  = 150,00 PB = 30,00
AB ?-906,13 AT ? 906,13
BT ?-880,13
SUP. REACT:
A =  219,80
B =  230,20
N TOPCH. BOTT. CH.
            DIAG. STAN.
------------------------
 1, -1.080,93 906,13
         247,20 -204,80
 2, -1.165,73 1.080,93
         119,93 -144,80
DIAG. CH. OF INCL.
 3, -1.165,73 1.160,53
           7,35 -60,00
 4, -1.160,53 1.065,33
         134,63 -65,20
 5, -1.065,33 880,13
         261,91 -155,20
            SM =-215,20
Y ? 0,00 X ? 7,00
LENGTH = 7,00
SLOPE = 0,00
NUB. ? 3,00
TH. HEIGHT ? 3,00
CHORD. L = 2,33
 DIAG. L = 3,80
 U.L.TOP ? 30,00
QT = 210,00 PT = 70,00
U.L.BOT. ? 12,00
QB  = 84,00 PB = 28,00
AB ?-880,13 AT ? 880,13
BT ? 0,00
SUP. REACT:
A =-230,20
B =  524,20
N TOPCH. BOTT. CH.
            DIAG. STAN.
------------------------
DIAG. CH. OF INCL.
 1, -880,13 662,98
         353,71 -35,00
 2, -662,98 369,60
         477,86 -349,20
 3, -369,60 2,00E-7
         602,01 -447,20
            SM =-510,20
```

USER INSTRUCTIONS

PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	Instructions Operation Instructions Istruzioni	Variables Dateneingabe Données Dati	Function(s) Taste(n) Touche(s) Tasti	Result Resultat Résultat Risultato
1	Load program N-Truss Girder 3 cards		XEQNG	
			size 17	
2	Printer		MAN.mode	
	Beginning execution and data input	DISPLAY		PRINTER
3	Coordinates of B :	Y ? y	R/S	
4		X ? x	R/S	Y? y X? x m
				length =L m
				slope $=\alpha$ deg
5	Number of panels :	NUB ? n	R/S	
6	Theoretical height:	TH.HEIGHT?h	R/S	th.height? h m
	Chord length			chord.L = a m
	Diagonal length			diag.L = l m
	Uniformly distributed loads :			
7	- on the top-chord	U.L.TOP ? q_T	R/S	U.L.TOP? q_T kNm
				Q_T $= q_T L$ kN
				P_T $= Q_T/n$ kN
8	- on the bottom-chord	U.L.BOT ? q_B	R/S	U.L.BOT ? q_B kNm
				Q_B $= q_B L$ kN
				P_B $= Q_B/n$ kN
	Longitudinal loads :			
9		A_B ? A_B	R/S	
10		A_T ? A_T	R/S	A_B? A_B? A_T? A_T kN
11		B_T ? B_T	R/S	B_T? B_T kN
				Sup.react.:
				A = R_A kN
				B = R_B kN
			N	TOPCH. BOTT.CH. DIAG. STAN
			1	T_1 B_1 D_1 S_1
			2	T_2 B_2 D_2 S_2
			n	T_n B_n D_n S_n
	When the diagonal is compressed, it is tipped in the other direction and the machine automatically continues the computation after printing		DIAG.CH.OF INCL.	
			i	T_i B_i D_i S_i
			m	T_m B_m D_n S_n
	Member load in last stanchion SM			



SM

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
01	*LBL "NG"	XEQ NG
02	SF 00	
03	CLRG	
04	CLA	
05	"Y ?"	y-COORDINATE ?
06	XEQ 99	
07	ENTER↑	
08	" X ?"	x-COORDINATE ?
09	XEQ 99	
10	STO 00	
11	PRBUF	
12	"LENGTH"	L
13	R-P	
14	STO 01	
15	XEQ 98	
16	PRBUF	
17	RDN	
18	"SLOPE"	α
19	XEQ 98	
20	STO 03	
21	PRBUF	
22	RCL 01	
23	"NUB. ?"	n ?
24	XEQ 99	
25	STO 04	
26	PRBUF	
27	/	
28	STO 05	
29	"TH. HEIGHT ?"	h ?
30	XEQ 99	
31	STO 14	
32	PRBUF	
33	RCL 05	
34	"CHORD. L"	$a = L/n$
35	XEQ 98	
36	PRBUF	
37	R-P	
38	" DIAG. L"	$l = (a^2+h^2)^{1/2}$
39	XEQ 98	
40	PRBUF	
41	RDN	
42	SIN	
43	STO 07	
44	LASTX	
45	COS	
46	STO 08	
47	" U.L.TOP ?"	q_{TOP} ?
48	XEQ 99	
49	STO 09	
50	PRBUF	
51	RCL 01	
52	*	
53	STO 10	$Q_T = q_T L$
54	"QT"	
55	XEQ 98	
56	RCL 04	
57	/	
58	STO 13	
59	STO 11	
60	" PT"	$P_T = Q_T/n$
61	XEQ 98	
62	PRBUF	
63	"U.L.BOT. ?"	q_{BOT} ?
64	XEQ 99	
65	STO 09	
66	PRBUF	
67	RCL 01	
68	*	
69	STO 12	
70	"QB "	
71	XEQ 98	$Q_B = q_B L$
72	RCL 04	
73	/	
74	STO 16	
75	STO 15	
76	" PB"	$P_B = Q_B : n$
77	XEQ 98	
78	PRBUF	
79	RCL 03	
80	1	
81	P-R	
82	STO 03	
83	ST* 13	
84	ST* 16	
85	RDN	
86	STO 02	
87	ST* 11	
88	ST* 15	
89	"AB ?"	$\vec{A}_B$?
90	XEQ 99	
91	STO 06	
92	RCL 12	
93	RCL 10	
94	+	
95	STO 01	
96	2	
97	/	
98	" AT ?"	$\vec{A}_T$?
99	XEQ 99	
100	STO 05	
101	PRBUF	
102	"BT ?"	$\vec{B}_T$?

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
103	XEQ 99	
104	+	
105	RCL 10	
106	RCL 02	
107	*	
108	-	
109	RCL 14	
110	*	
111	RCL 00	
112	/	
113	-	
114	STO 09	
115	"SUP. RE ACT:"	
116	PRA	
117	SF 12	
118	"A"	A
119	XEQ 98	
120	PRBUF	
121	RCL 01	
122	-	
123	CHS	
124	"B"	B
125	XEQ 98	
126	PRBUF	
127	CF 12	
128	"N TOPCH . BOTT. "	
129	"┣CH."	
130	PRA	
131	"DIAG. S TAN."	
132	ACA	
133	ADV	
134	"-------- --------"	
135	"┣------- ---"	
136	PRA	
137	1000	
138	ST/ 04	
139	1	
140	ST+ 04	
141	RCL 16	
142	2	
143	/	
144	RCL 09	
145	RCL 03	
146	*	
147	-	
148	STO 00	S_1
149	RCL 13	
150	2	
151	/	
152	+	
153	RCL 07	
154	/	
155	CHS	
156	X<0?	$D_1<0$
157	GTO 03	
158	STO 01	
159	RCL 08	
160	*	
161	CHS	
162	RCL 11	
163	2	
164	/	
165	+	
166	RCL 05	
167	-	
168	STO 05	T_1
169	RCL 15	
170	2	
171	/	
172	RCL 09	
173	RCL 02	
174	*	
175	-	
176	RCL 06	
177	-	
178	STO 06	B_1
179	XEQ 97	
180	◆LBL 00	
181	RCL 16	
182	RCL 01	
183	RCL 07	
184	*	
185	-	S_n
186	STO 00	
187	RCL 15	
188	RCL 01	
189	RCL 08	
190	*	
191	+	
192	RCL 06	
193	+	
194	STO 09	B_n
195	RCL 13	
196	RCL 00	
197	+	
198	RCL 07	
199	/	
200	CHS	
201	X<0?	$D_n<0$
202	GTO 04	
203	STO 01	
204	RCL 09	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line / Zeile / Ligne / Linea	Keystrokes / Tastenfolge / Touches / Tasti	Comments / Kommentar / Commentaires / Commenti
205	STO 06	
206	RCL 11	
207	RCL 01	
208	RCL 08	
209	*	
210	-	
211	ST+ 05	T_m
212	XEQ 97	
213	GTO 00	
214	◆LBL 03	
215	XEQ 01	
216	RCL 13	
217	-2	
218	/	
219	STO 00	
220	RCL 11	S_1
221	2	
222	/	
223	RCL 05	
224	-	
225	STO 05	
226	RCL 16	T_1
227	2	
228	/	
229	RCL 09	
230	RCL 03	
231	*	
232	-	
233	STO 10	
234	RCL 00	
235	-	
236	RCL 07	
237	/	
238	STO 01	D_1
239	RCL 08	
240	*	
241	CHS	
242	RCL 10	
243	RCL 02	
244	*	
245	RCL 03	
246	/	
247	+	
248	RCL 06	
249	-	
250	STO 06	B_1
251	XEQ 97	
252	GTO 02	
253	◆LBL 04	
254	XEQ 01	
255	RCL 01	
256	STO 02	
257	0	
258	STO 01	
259	◆LBL 02	
260	RCL 13	
261	RCL 01	
262	RCL 07	
263	*	
264	+	
265	CHS	
266	STO 00	$S_i ; S_m$
267	RCL 11	
268	RCL 01	
269	RCL 08	
270	*	
271	+	
272	ST+ 05	$T_i ; T_m$
273	RCL 16	
274	RCL 00	
275	-	
276	RCL 07	
277	/	
278	RCL 02	
279	-	
280	STO 01	
281	RCL 15	
282	RCL 01	
283	RCL 02	
284	-	
285	RCL 08	
286	*	
287	-	
288	ST+ 06	$B_i ; B_m$
289	XEQ 97	
290	0	
291	STO 02	
292	GTO 02	
293	◆LBL 01	
294	CF 00	
295	"DIAG. C H. OF "	
296	"⊢INCL."	
297	PRA	
298	RTN	
299	◆LBL 99	
300	ACA	
301	PROMPT	
302	FIX 2	
303	ACX	
304	RTN	

PROGRAM LISTING
PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti	Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
305	◆LBL 98.		51		
306	ACA				
307	" ="				
308	ACA				
309	ACX		55		
310	FIX 2				
311	RTN				
312	◆LBL 97				
313	RCL 04				
314	FIX 0		60		
315	ACX				
316	FIX 2				
317	" "				
318	ARCL 05				
319	ACA		65		
320	" "				
321	ARCL 06				
322	ACA				
323	PRBUF				
324	CLA		70		
325	ARCL 01				
326	ACA				
327	" "				
328	ARCL 00				
329	ACA				
330	ADV		75		
331	ISG 04				
332	RTN				
333	RCL 01				
334	RCL 07				
335	*		80		
336	RCL 13				
337	2				
338	/				
339	FC?C 00				
340	+		85		
341	CHS				
342	"SM"				
343	XEQ 98				
344	ADV				
345	GTO "NG"				
346	.END.		90		
45			95		
50			00		

REGISTERS, STATUS, FLAGS

REGISTERBELEGUNG, FLAGS, BETRIEBSARTEN
REGISTRES, INDICATEURS, MODES OPÉRATOIRES
REGISTRI, MODI OPERATIVI, FLAGS

Registers
Datenspeicher
Registres de données
Registri

00	X		S
	L	Q_B+Q_T	D
		sin α	X
	α	cos α	
	n		1,00 n
05	a	A_T	T
		A_B	B
	sin γ		
	cos γ		
	q_T	A	
10	Q_T		X
	P_T	$P_T \sin \alpha$	
	Q_B		
	P_T	$P_T \cos \alpha$	
	h		
15	P_B	$P_B \sin \alpha$	
	P_B	$P_B \cos \alpha$	

Status
Betriebsart
Modes opératoires
Modi operativi

Size 17 Total Reg. 95 + 16 =111 **User Mode**

Eng ☐ Fix ☐ Sci ☐ On ☒

Deg ☒ Rad ☐ Grad ☐ Off ☐

	Purpose Bedeutung Signification Scopo	Flags SET	Flags CLEAR
00		X	
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11	Audio execute		
12		X	
13			
14			
15			
16			
17			
18			
19			
20			
21	Printer Enable		
22	Number Input		
23	Alpha Input		
24	Range Ignore		
25	Error Ignore		
26	Audio Enable		
27	User Mode		
28	Decimal Point		
29	Digit Grouping		

Assignments
Tastenbelegung/Assignations/Assegnamenti

Function Funktion Fonction Funzione	Key Taste Touche Tasto	Function Funktion Fonction Funzione	Key Taste Touche Tasto
Start input and calculation	XEQNG		

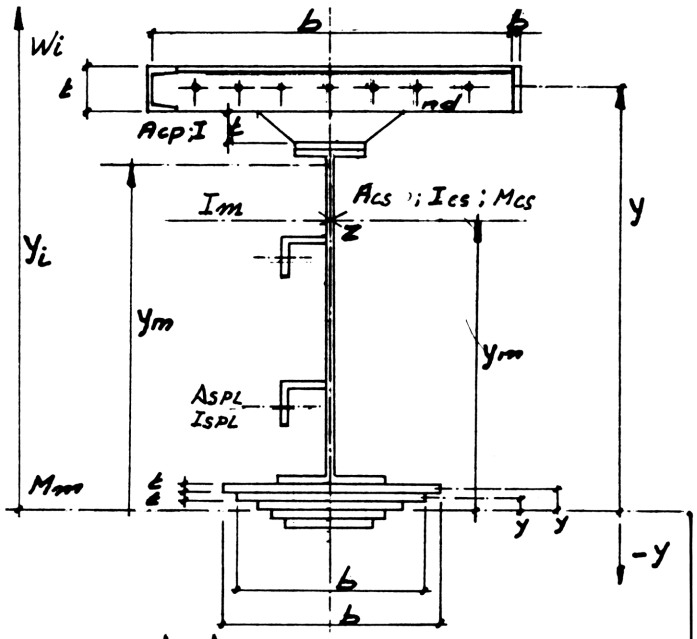
CHARACTERISTICS OF COMPOSITE CROSS-SECTIONS

(Requires an additional memory module)

This program calculates the characteristics of a transformed ($m = E_S/E_C$) composite steel-concrete cross section :

- the area of the cross-section
- the statical moment
- the coordinate of the neutral axis
- the moment of inertia
- the radius of gyration
- the section modulus referred to a given coordinate

After computation of the characteristics the cross-section may be modified by cancelling, substitution or adding members without necessity to recommence the complete input.



$$A_m = \frac{A_c - A_{cs}}{m} + A_{cs} + A_s$$

$$M_m = \frac{M_c + M_{cs}}{m} + M_{cs} + M_s$$

$$h_m = M_m : A_m$$

$$I_m = h_m^2 A_m - I_{cs} - I_s - \frac{I_c - I_{cs}}{m}$$

$$r_m = (I_m / A_m)^{1/2}$$

$$W_m = I_m / h - h_m < 0 \Longrightarrow h_i > h_m$$

indication

Concrete { CR = Rectangular section
CT = Triangular section

Steel in concrete { SCR = Steel reinforcement
SCP = Steel plates
CP = Steel profils

Steel { SPL = Rectangular section
SPR = Profils

Aerea of cross sections

$$A_c = \sum_{CR} bt + \sum_{CT} bt/2$$

$$A_{cs} = \sum_{SCR} n\pi d^2/4 + \sum A_{CP} + \sum_{SCP} bt$$

$$A_s = \sum_{SPL} bt + \sum A_{SPR}$$

Statical moments

$$M_c = \sum_{CR} ybt + \sum_{CT} ybt/2$$

$$M_{cs} = \sum_{SCR} yA_{SCR} + \sum_{SCP} ybt + \sum_{CP} yA_{CP}$$

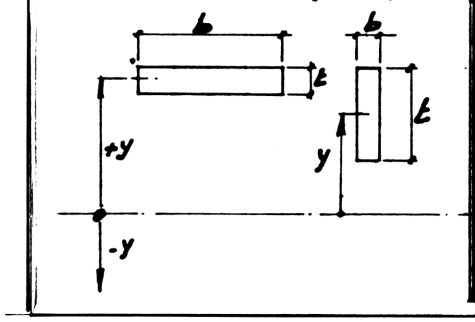
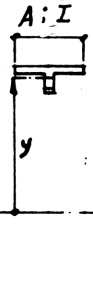
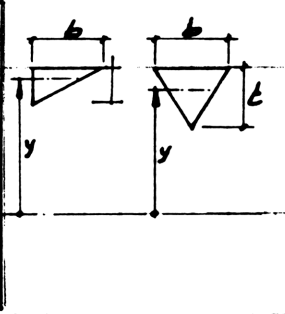
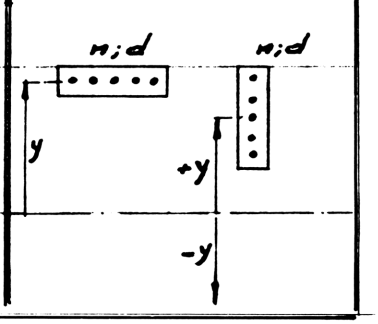
$$M_s = \sum_{SPL} ybt + \sum_{SPR} yA_{SPR}$$

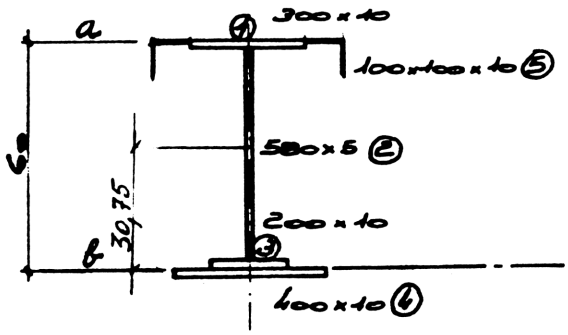
Moments of inertia

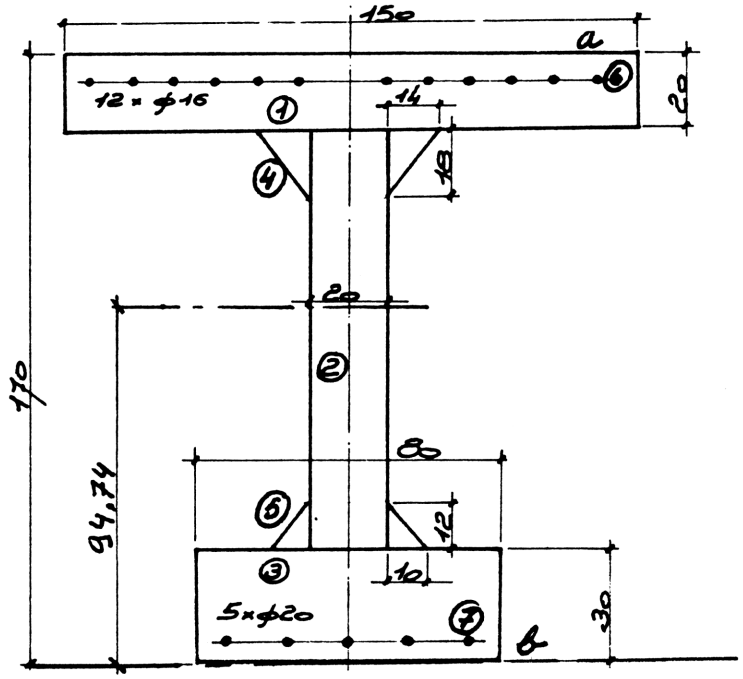
$$I_{cs} = \sum_{SCR} (y^2 \frac{\pi d^2}{4} + \frac{\pi d^4}{64})n + \sum_{CR} (y^2 bt + \frac{bt^3}{12}) + \sum_{CP} (h^2 A_{CP} + I_{CP})$$

$$I_s = \sum_{SPL} (y^2 bt + \frac{bt^3}{12}) + \sum_{SPR} (y^2 A_{SP} + I_{SP})$$

$$I_c = \sum_{CR} (y^2 bt + \frac{bt^3}{12}) + \sum_{CT} (\frac{h^2 bt}{2} + \frac{bt^3}{36})$$

CASE	SPL	CR	SCP	SPR	SCP	CT		SCR	
LBL	A	C	F	B	G	D		E	
									





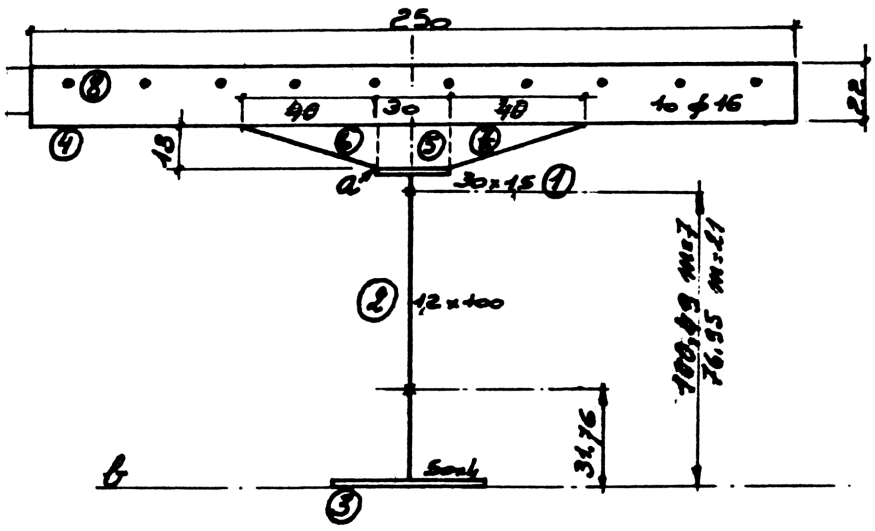
1

LBL	SECTION	
J	1	SPL.B ?=30,00
		T ?=1,00
		Y ?=59,50
	2	SPL.B ?=0,50
		T ?=58,00
		Y ?=30,00
	3	SPL.B ?=20,00
		T ?=1,00
		Y ?=0,50
H		A=79,00
		M=2.665,00
		Y=33,73
		I=50.544,75
		R=25,29
	a	YX ?=60,00
		SX=-1.924,35
	b	YX ?=0,00
		SX=1.498,32
A		SPL.B ?=40,00
		T ?=1,00
		Y ?=-0,50
B	5	SPR.A ?=38,40
		Y ?=57,18
		I ?=354,00
H		A=157,40
		M=4.840,71
		Y=30,75
		I=117.492,23
		R=27,32
	a	YX ?=60,00
		SX=-4.017,41
	b	YX ?=0,00
		SX=3.820,36

2

LBL	SECTION	
J-C	1	CR.B ?=150,00
		T ?=20,00
		Y ?=160,00
	2	CR.B ?=20,00
		T ?=120,00
		Y ?=90,00
	3	CR.B ?=80,00
		T ?=30,00
		Y ?=15,00
D	4	CT.B ?=28,00
		T ?=18,00
		Y ?=144,00
	5	CT.B ?=20,00
		T ?=12,00
		Y ?=34,00
E	6	SCR.N ?=12,00
		D ?=1,60
		Y ?=167,00
	7	SCR.N ?=5,00
		D ?=2,00
		Y ?=3,00
I		MOD. ?=7,00
		A=1.201,57
		M=113.832,35
		Y=94,74
		I=4.837.100,26
		R=63,45
	a	YX ?=170,00
		SX=-64.268,52
	b	YX ?=0,00
		SX=51.058,69

Example 3



LBL	SECTION	
J	1	SPL.B ?=30,00 T ?=1,50 Y ?=104,75
	2	SPL.B ?=1,20 T ?=100,00 Y ?=54,00
	3	SPL.B ?=50,00 T ?=4,00 Y ?=2,00
H		A=365,00 M=11.593,75 Y=31,76 I=576.500,04 R=39,74
	a	YX ?=105,50 SX=-7.818,40
	b	YX ?=0,00 SX=18.149,65
C	4	CR.B ?=250,00 T ?=22,00 Y ?=129,50
	5	CR.B ?=30,00 T ?=13,00 Y ?=112,00
D	6	CT.B ?=40,00 T ?=13,00 Y ?=114,17
	7	CT.B ?=40,00 T ?=13,00 Y ?=114,17

LBL	SECTION	
I		MOD. ?=7,00 A=1.280,71 M=128.064,95 Y=99,99 I=3.015.889,44 R=48,53
	c	YX ?=140,50 SX=-74.457,11
	a	YX ?=105,50 SX=-547.839,66
E	8	SCR.N ?=10,00 D ?=1,60 Y ?=137,50
I		MOD. ?=7,00 A=1.297,95 M=130.434,61 Y=100,49 I=3.039.812,01 R=48,39
	c	YX ?=140,50 SX=-75.981,86
	a	YX ?=105,50 SX=-607.103,42
I		MOD. ?=21,00 A=689,39 M=53.050,44 Y=76,95 I=2.183.392,49 R=56,28
	c	YX ?=140,50 SX=-34.358,74
	b	YX ?=0,00 SX=28.373,04

USER INSTRUCTIONS

PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	Instructions Operation Instructions Istruzioni	Variables Dateneingabe Données Dati	Function(s) Taste(n) Touche(s) Tasti	Result Resultat Résultat Risultato
	Properties of composite sections 2 cards	DISPLAY		PRINTER and DISPLAY
1	Enter program		size 14	
2	Printer : used at option		MAN.mode	
3	For beginning the execution or a new data input of another section push		J or XEQ CS	CLRG
	STEEL SECTIONS			
4	PLATES		A	
5	Input : Width	SPL.B ? b	R/S	SPL.R? = b
6	Input : Tickness	T ? t	R/S	T? = t
7	Input : Y-coordinate of the centroid	Y ? y	R/S	Y? = y
8	For next case Then go to step 5	SPL.B ?		
9	PROFILES		B	
10	Input: area of the cross section	SPR.A ? A_s	R/S	SPR.A? = A_s
11	Input: y-coordinate of the centroid	Y ? y	R/S	Y? = y
12	Input: the moment of inertia	I ? I_s	R/S	I? = I_s
13	For next case SPR Then go to step 10	SPR.A?		
	CONCRETE			
14	RECTANGULAR SECTION		C	
15	Input : Width	CR.B ? b	R/S	CR.B? = b
16	Input : Tickness	T ? t	R/S	T? = t
17	Input: Y-coordinate of the centroid	Y ? y	R/S	Y? = y
18	For next case CR Then go to step 15	CR.B ?		
19	TRIANGULAR SECTION		D	
20	Input: the side of triangular section	CT.B ? b	R/S	CT.B? = b
21	Input: the height	T ? t	R/S	T? = t
22	Input: the Y-coordinate of the centroid	Y ? y	R/S	Y? = y
23	For next case CT Then go to step 20	CT.B ?		
	STEEL IN CONCRETE			
24	STEEL REINFORCEMENT		E	
25	Input: the number of bars	SCR.N ? n	R/S	SCR.N? = n
26	Input: the diameter of the bars	D ? d	R/S	D? = d
27	Input: the coordinate of the centroid	Y ? y	R/S	Y? = y
28	For next case SCR. Then go to step	SCR.N?		
25	STEEL PLATES		F	
26	Input : Width	SCP.B ? b	R/S	SCP.B? = b
27	Input : Tickness	T ? t	R/S	T? = t
28	Input: Y-coordinate of the centroid	Y ? y	R/S	Y? = y
29	For next case SCP. Then go to step 26	SCP.B?		

USER INSTRUCTIONS

PROGRAMMABLAUF
INSTRUCTIONS D'EMPLOI
NORME OPERATIVE

Step Schritt Pas Passo	Instructions Operation Instructions Istruzioni	Variables Dateneingabe Données Dati	Function(s) Taste(n) Touche(s) Tasti	Result Resultat Résultat Risultato
30	STEEL PROFILES		G	
31	Input: the cross section	SCP.A ? A_c	R/S	SCP.A? = A_c
32	Input: the Y-coordinate of the centroid	Y ? y_c	R/S	Y? = y_c
33	Input: the moment of inertia	I ? I_c	R/S	I? = I_c
34	For next case SCP. Then go to step	SCP.A ?		
35	RESULTS STEEL SECTION		H	
	Aerea of cross-section			A = A_s
	Statical moment			M = M_s
	Y-coordinate of the neutral axis			Y = y
	Moment of inertia			I = I_s
	Radius of gyration			R = r_s
36	Input: y-coordinate	YX ? y	R/S	YX? = y
	Output: section modulus of the steel section referred to the given y-coordinate			SX = W_s
37	For a new y-coordinate go to step 36			
38	RESULTS COMPOSITE SECTION		I	
39	Input: modular ratio = E_s/E_c	MOD ? m	R/S	MOD? = m
	Output:			
	Aerea of transformed composite cross section			A = A_{cs}
	Statical moment " " " "			M = M_{cs}
	Y-coordinate of the neutral axis " "			Y = y_{cs}
	Moment of inertia			I = I_{cs}
	Radius of gyration			R = r_{cs}
40	Input: Y-coordinate	YX ? y	R/S	YX? = y
	Output: the section modulus of the transformed composite cross section			SX = W_{cs}
41	For a new y-coordinate go to step 40	YX ?		
42	For cancelling, substitution or adding new sections			
	SPL go to step 4		A	
	SPR " " " 9		B	
	CR " " " 14		C	
	CT " " " 19		D	
	SCR " " " 24		E	
	SCP.B " " 25		F	
	SCP.A " " 30		G	
43	For each new case go to step 3		J	CLRG

PROGRAM LISTING
PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
01	◆LBL "CS"	XEQ CS OR J
02	CLRG	STEEL
		A STEEL PLATE
03	◆LBL A	
04	"SPL"	SPL.B ? b
05	XEQ 07	
06	RCL 10	
07	ST+ 01	
08	RCL 00	
09	ST+ 02	
10	RCL 13	
11	ST+ 03	
12	GTO A	
13	◆LBL B	B PROFILES
14	"SPR"	SPR.A ? As
15	XEQ 08	
16	RCL 10	
17	ST+ 01	
18	RCL 12	
19	ST+ 02	
20	RCL 11	
21	ST+ 03	
22	GTO B	
		CONCRETE
23	◆LBL C	C RECTANGULAR
24	"CR"	CR.B ? b
25	XEQ 07	
26	RCL 10	
27	ST+ 04	
28	RCL 00	
29	ST+ 05	
30	RCL 13	
31	ST+ 06	
32	GTO C	
33	◆LBL D	D TRIANGULAR
34	"CT"	CT.B ? b
35	XEQ 07	
36	RCL 10	
37	2	
38	/	
39	ST+ 04	
40	RCL 00	
41	2	
42	/	
43	ST+ 05	
44	RCL 11	
45	3	
46	/	
47	ST+ 06	
48	RCL 13	
49	RCL 11	
50	−	

Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
51	2	
52	/	
53	ST+ 06	
54	GTO D	
55	◆LBL E	STEEL IN CONCRETE
56	"SCR.N"	E STEEL REINF.
57	XEQ 02	SCR.N ? n
58	"D"	D ? d
59	XEQ 02	
60	X↑2	
61	STO 10	
62	*	
63	PI	
64	*	
65	4	
66	/	
67	STO 11	
68	ST+ 07	y ? y
69	"Y"	
70	XEQ 02	
71	STO 12	
72	*	
73	ST+ 08	
74	RCL 12	
75	*	
76	RCL 11	
77	RCL 10	
78	*	
79	16	
80	/	
81	+	
82	ST+ 09	
83	GTO E	
84	◆LBL F	F STEEL PLATES
85	"SCP"	SCP.B ? b
86	XEQ 07	
87	RCL 10	
88	ST+ 07	
89	RCL 00	
90	ST+ 08	
91	RCL 13	
92	ST+ 09	
93	GTO F	
94	◆LBL G	G STEEL PROFILES
95	"SCP"	SCP.A ? Acs
96	XEQ 08	
97	RCL 10	
98	ST+ 07	
99	RCL 12	
100	ST+ 08	
101	RCL 11	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
102	ST+ 09	
103	GTO G	
104	◆LBL 07	
105	"⊢.B"	--- B? = b
106	XEQ 02	
107	"T"	T? = t
108	XEQ 02	
109	STO 11	
110	*	
111	STO 10	
112	"Y"	y? = y
113	XEQ 02	
114	STO 13	
115	*	
116	STO 00	
117	RCL 13	
118	*	
119	STO 13	
120	RCL 10	
121	RCL 11	
122	X↑2	
123	*	
124	12	
125	/	
126	STO 11	
127	ST+ 13	
128	RTN	
129	◆LBL 08	
130	"⊢.A"	--- A? = A
131	XEQ 02	
132	STO 10	
133	"Y"	
134	XEQ 02	
135	STO 11	
136	*	
137	STO 12	
138	RCL 11	
139	*	
140	"I"	I? = I_o
141	XEQ 02	
142	+	
143	STO 11	
144	RTN	
145	◆LBL I	I RES. COMPOSITE
146	"MOD."	MOD.? = m
147	XEQ 02	
148	STO 10	
149	◆LBL H	H RES. STEEL OR CONCRETE
150	SF 00	
151	SF 12	

Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
152	RCL 04	
153	RCL 07	
154	−	
155	RCL 10	
156	/	
157	RCL 07	
158	+	
159	RCL 01	
160	+	
161	"A"	A = $A_{COMPOSITE}$
162	XEQ 00	
163	STO 13	
164	RCL 05	
165	RCL 08	
166	−	
167	RCL 10	
168	/	
169	RCL 08	
170	+	
171	RCL 02	
172	+	
173	"M"	M = $M_{COMPOSITE}$
174	XEQ 00	
175	X<>Y	
176	/	
177	"Y"	y = $y_{COMPOSITE}$
178	XEQ 00	
179	STO 12	
180	X↑2	
181	RCL 13	
182	*	
183	RCL 09	
184	−	
185	RCL 03	
186	−	
187	RCL 06	
188	RCL 09	
189	−	
190	RCL 10	
191	/	
192	−	
193	CHS	I = $I_{COMPOSITE}$
194	"I"	
195	XEQ 00	
196	STO 11	
197	ENTER↑	
198	ENTER↑	
199	ENTER↑	
200	RCL 13	
201	/	
202	SQRT	
203	"R"	R = $R_{COMPOSITE}$
204	XEQ 00	
205	CF 12	

PROGRAM LISTING

PROGRAMMAUFLISTUNG
LISTAGE DU PROGRAMME
LISTATO DI PROGRAMMA

Line Zeile Ligne Linea	Keystrokes Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti	Line Zeile Ligne Linea	Key pressed Tastenfolge Touches Tasti	Comments Kommentar Commentaires Commenti
			51		
	206◆LBL 03				
	207 CLX				
	208 RCL 12	YX ? y			
	209 "YX ?"		55		
	210 PROMPT				
	211 XEQ 00				
	212 SF 00				
	213 −				
	214 /				
	215 "SX"	SX = S	60		
	216 XEQ 00				
	217 GTO 03				
	218◆LBL 02				
	219 CF 00		65		
	220 "⊢ ?"				
	221 PROMPT				
	222◆LBL 00				
	223 FIX 2		70		
	224 "⊢="				
	225 ARCL X				
	226 AVIEW				
	227 FS? 00				
	228 PSE				
	229 RTN		75		
	230 .END.				
30			80		
35			85		
40			90		
45			95		
50			00		

REGISTERS, STATUS, FLAGS

REGISTERBELEGUNG, FLAGS, BETRIEBSARTEN
REGISTRES, INDICATEURS, MODES OPÉRATOIRES
REGISTRI, MODI OPERATIVI, FLAGS

Registers
Datenspeicher
Registres de données
Registri

00	tby		
	Σ tb = A	Σ A	
	Σ tby = M	Σ Ay = M	
	$\Sigma t^3b/12 + tby^2$	Σ I	
	A_c		
05	M_c		
	I_c		
	A_{cs}		
	M_{cs}		
	I_{cs}		
10	tb	A	d^2
	$I : t^3b/12$	$n\pi d^2/4$	t
	Ay	y	
	$t^3b/12 + tby^2 = I_s$	I_c	y
15			

Status
Betriebsart
Modes opératoires
Modi operativi

Size 14 Total Reg. 78 **User Mode**

Eng ☐ Fix ☒ Sci ☐ On ☒

Deg ☐ Rad ☐ Grad ☐ Off ☐

	Purpose (Bedeutung / Signification / Scopo)	Flags SET	Flags CLEAR
00		X	X
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11	Audio execute		
12		X	X
13			
14			
15			
16			
17			
18			
19			
20			
21	Printer Enable		
22	Number Input		
23	Alpha Input		
24	Range Ignore		
25	Error Ignore		
26	Audio Enable		
27	User Mode		
28	Decimal Point		
29	Digit Grouping		

Assignments
Tastenbelegung / Assignations / Assegnamenti

Function (Funktion / Fonction / Funzione)	Key (Taste / Touche / Tasto)	Function (Funktion / Fonction / Funzione)	Key (Taste / Touche / Tasto)
Steel plates	A	Res.steel or beton	H
Profiles	B	Res. composite	I
Rect. section	C	New section = XEQCS	J
Triang. section	D		
Steel reinf.	E		
Steel plates	F		
Profiles	G		

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Mechanical Engineering
Solar Engineering
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Chemistry
Games
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Optometry II (Contact Lens)
Physics
Surveying

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STRUCTURAL ANALYSIS

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MAXIMUM MAXIMORUM BENDING MOMENT
N-TRUSS GIRDER
CHARACTERISTICS OF COMPOSITE CROSS-SECTIONS

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