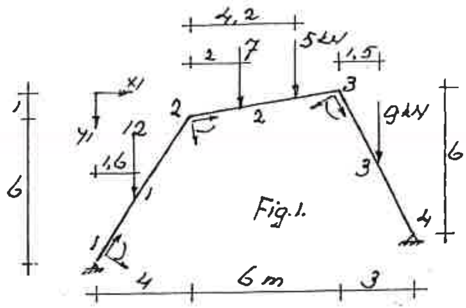
Part 16

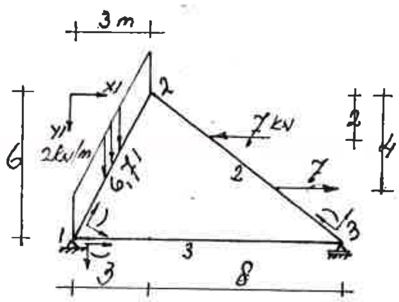
Program **FRAMEPROGRAM222** 1 -21

Constructions with sloping members loaded
with vertical and horizontal member loads.

Examples EX1 to EX10 to click on.
Vertical and/or horizontal member loads are
given, their components are determinated
by clicking OKF2F5. The subroutines applied
are ADDF2FVV etc.
The code explained and written. 7 -14

Example EX1 to EX6 with frame data and
member loads given.
These data, before the main calculation,
can also be stored with STORE NR= GET.





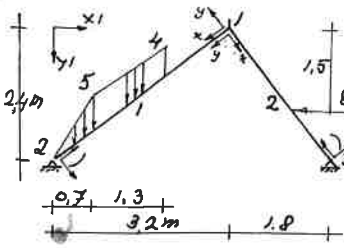
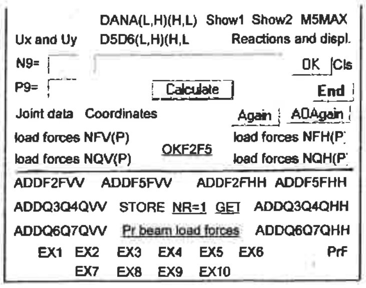


Fig.1.



With a click on Pr beam load forces the
components determinated with OKF2F5 are
shown, with right mouse button the original
horizontal and vertical member load forces.

(If data are stored before clicking OKF2F5, then click it
after getting back these data, if data are stored after
clicking OKF2F5 then don't click it again after getting
back those data.)

DANA(L,H)(H,L) Show1 Show2 M5MAX
Ux and Uy D5D6(L,H)(H,L Reactions and displ.
N9= OK Cls
P9= Calculate End
Joint data Coordinates Again AOAgain
load forces NFV(P) OKF2F5 load forces NFH(P)
load forces NQV(P) load forces NQH(P)
ADDF2FVV ADDF5FVV ADDF2FHH ADDF5FHH
ADDQ3Q4QVV STORE NR= ? GET ADDQ3Q4QHH
ADDQ6Q7QVV Pr beam load forces ADDQ6Q7QHH
EX1 EX2 EX3 EX4 EX5 EX6 PrF
EX7 EX8 EX9 EX10

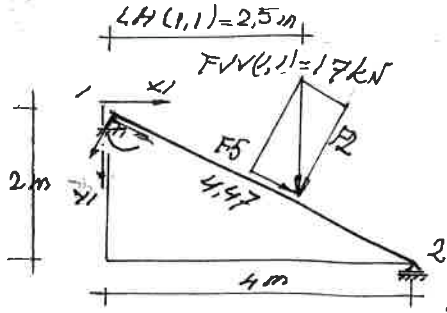


Fig. 1.

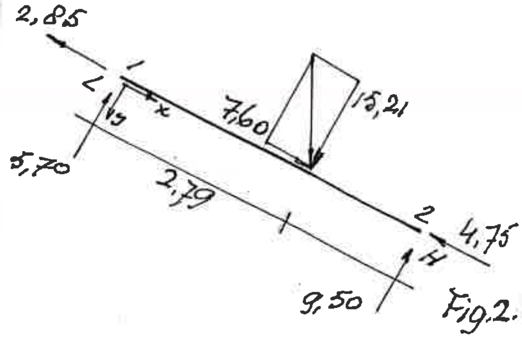


Fig.2.

```
N9= 2
I   FY    PV UV SV X1     MZ   PR UR SR
1   0     1  0  0  0,00   0    0  0  0
2   0     1  0  0  4,00   0    0  0  0
I   FX    PH UH SH Y1
1   0     1  0  0  0,00
2   0     0  0  0  2,00
P9= 1
P   LL HH  NL NH  BA  EI  EA    L1
1   1  2   1  1   1   1   1     4,47

NFB(1)=1  I     F2      L2
          1  15,21    2,80
NFA(1)=1  I     F5      L5
          1   7,60    2,80

UV(1)=     0,00 /EI  UH(1)=     0,00 /EI
UV(2)=     0,00 /EI  UH(2)=     0,00 /EI

HE(1,2)=  16,334 /EI
HE(2,1)= -19,304 /EI

RH(1)=     0,00 kN   RV(1)=     6,38 kNm
                     RV(2)=    10,63 kNm
```

FRAMEPROGRAM222

Sloping members with vertical or horizontal member load forces.

Example. EX1 AOAgain

Fig.1.
N9=2 joints and P9=1 member. EA=500EI

Type 2 in TN9, Tab, cursor in TSTRING, click on Joint data and type in TSTRING

for support 1 PV(1)=1 Enter, PH(1) Enter,
for support 2 PV(2)=1 Enter.

The coordinates of the joints

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	0	0	2	4	2

Click Coordinates and type in TSTRING 1,0,0 Enter and 2,4,2 Enter.

The member data.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	1	1	1	1	500

Type 1 in TP9, Tab, cursor in TSTRING, type 1,1,2,1,1,1,1,500 Enter.

Click Show1 and Show2 to see the data put in.

Vertical member load force 17 kN, click load forces NFV(P),

P	NFV(P)	I	FVV(P,I)	LH(P,I)
1	1	1	17	2.5

The horizontal distance to the load force always from left member end, here member end 1. Click in TSTRING and type 1,1,1,17,2.5 Enter. (Or click EX1.)

Click **OKF2F5** to get the vertical force of 17 kN resolved into components F2 perpendicular to and F5 along the member.
Or click ADDF2FVV and ADDF5FVV, page 7 and 9.

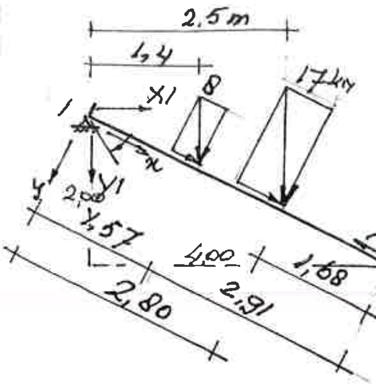
Next click Pr beam load forces to get the components printed. With right mouse button the force data put in appear, not shown here.
Fig.2.
Member length L1= Sqr(2^2+4^2)=Sqr(20)=4,47 m.

a/4,47= 2,5/4 a=(2,5/4)*4,47= 2,79 m

F2/17= 4/4,47 F2= 17*(4/4,47)= 15,21 kN, a positive value according to the beam axis system placed at member end 1.

F5/17= 2/4,47 F5= 17*(2/4,47)= 7,60 kN, a positive value according to the member axis system $\lfloor_y{}^x$ always placed at the lowest member end number.
Next Calculate and Reactions and displ.

NL(1)=1 and NH(1)=1, member end hinges, therefore separately calculated member end slope deflection HE(1,2) and HE(2,1).
With NL(1)=0, member end 'real joint', one will find UR(1) and HE(2,1).



1,57+2,91=4,48~4,47

Fig. 1.

NFB(1)=2	I	F2	L2		
	1	-15,21	1,68		
	2	-7,16	2,91		
NFA(1)=2	I	F5	L5		
	1	7,60	2,80		
	2	3,58	1,57		
NFV(1)=2	I	FV	LH		
	1	17,00	2,50		
	2	8,00	1,40		
UV(1)=		0,00 /EI		UH(1)=	0,00 /EI
UR(1)=		25,29 /EI			
UV(2)=		0,00 /EI		UH(2)=	0,00 /EI
UR(2)=		-26,63 /EI			
RH(1)=		0,00 kN		RV(1)=	11,58 kNm
				RV(2)=	13,43 kNm

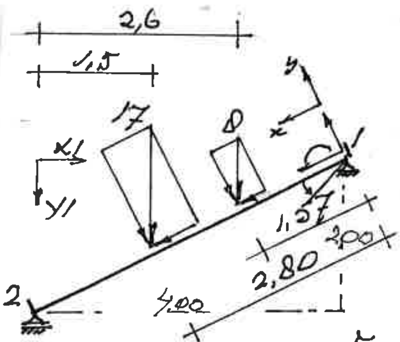


Fig. 2.

NFB(1)=2	I	F2	L2		
	1	-15,21	2,80		
	2	-7,16	1,57		
NFA(1)=2	I	F5	L5		
	1	7,60	2,80		
	2	3,58	1,57		
NFV(1)=2	I	FV	LH		
	1	17,00	1,50		
	2	8,00	2,60		
UV(1)=		0,00 /EI		UH(1)=	0,00 /EI
UR(1)=		-25,29 /EI			
UV(2)=		0,00 /EI		UH(2)=	0,00 /EI
UR(2)=		26,63 /EI			

Example. EX2 AOAgain

Fig.1..
N9=2 joints and P9=1 member. EA=500EI
The beam axis system is placed at member end 2, the member axis system member end 1.

Type 2 in TN9, Tab, cursor in TSTRING, click on Joint data and type in TSTRING

for support 1 PV(1)=1 Enter, PH(1) Enter,
for support 2 PV(2)=1 Enter.

The coordinates of the joints

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	0	0	2	4	2

Click Coordinates and type in TSTRING
1,0,0 Enter and 2,4,2 Enter.

The member data.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	0	0	2	1	500

Type 1 in TP9, Tab, cursor in TSTRING, type
1,1,2,0,0,**2**,1,500 Enter.

Two vertical member load forces 17 kN and 8 kN,

P	NFV(P)	I	FVV(P,I)	LH(P,I)
1	2	1	17	2.5
1	2	2	8	1.4

click load forces NFV(P) and type in TSTRING
1,2,1,17,2.5 Enter and 1,2,2,8,1.4 Enter.

Click **OKF2F5** to resolve 17 and 8 kN into components or click ADDF2FVV and ADDF5FVV page 7 and 9.

Click Pr beam load forces to print the components, with right mouse button the start forces are printed, see on the left.

Fig.2.
The same beam but 'mirrorred' with beam axis system placed at member end 1, BA(1)=1, and member axis system at member end 1.

Click AOAgain, type 2 in TN9, Tab, Joint data and in TSTRING
PV(1)=1 Enter, PV(2)=1 Enter, PH(2)=1 Enter,

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	4	0	2	0	2

click Coordinates and type in TSTRING
1,4,0 Enter and 2,0,2 Enter.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	0	0	1	1	500

Type 1 in TP9, Tab, cursor in TSTRING, type
1,1,2,0,0,**1**,1,500 Enter.

P	NFV(P)	I	FVV(P,I)	LH(P,I)
1	2	1	17	1.5
1	2	2	8	2.6

Click load forces NFV(P) and type in TSTRING
1,2,1,17,1.5 Enter and 1,2,2,8,2.6 Enter.

Fig.1. with UR(1)= 25,29/EI, positive answer, so as assumed to the right.
Fig.2. with UR(1)=-25,29/EI, negative answer, not to the right but to the left.

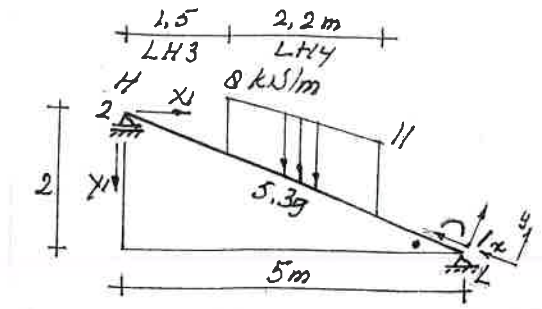


Fig.1.

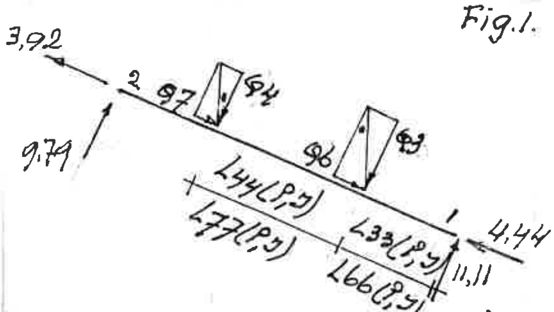


Fig.2.

```
N9= 2
I   FY     PV UV SV X1     MZ   PR UR SR
1   0      1  0  0  5,00   0    0  0  0
2   0      1  0  0  0,00   0    0  0  0
I   FX     PH UH SH Y1
1   0      1  0  0  2,00
2   0      0  0  0  0,00
P9= 1
P    LL HH   NL NH   BA   EI   EA    L1
1    1  2    1  1    1    1    500   5,39

NQB(1)=1   I      Q3       Q4      L3      L4
           1  -10,21    -7,43    1,40    2,37
NQA(1)=1   I      Q6       Q7      L6      L7
           1   -4,09    -2,97    1,40    2,37

NQV(1)=1   I     Q3V      Q4V     LH3     LH4
           1    8,00    11,00    1,50    2,20
```

```
D5(1,2)=     0,00 kN     D5(2,1)=     0,00 kN
D6(1,2)=   -11,97 kN     D6(2,1)=   -10,54 kN
MF(1,2)=     0,00 kNm    MF(2,1)=     0,00 kNm

UV(1)=       0,00 /EI    UH(1)=       0,00 /EI
UV(2)=       0,00 /EI    UH(2)=       0,00 /EI

HE(1,2)=  -35,969 /EI
HE(2,1)=   34,642 /EI

RH(1)=       0,00 kN     RV(1)=      11,97 kNm
                         RV(2)=      10,54 kNm

DA(1,2)=    11,11 kN     DA(2,1)=     9,79 kN
NA(1,2)=     4,44 kN     NA(2,1)=     3,92 kN
MF(1,2)=     0,00 kNm    MF(2,1)=     0,00 kNm
```

Example. EX3 AOAgain

Fig.1.
EA is 500*EI. N9=2.
X1(1)=5, Y1(1)=2, X1(2)=0 and Y1(2)=0. The beam axis system is placed at beam end 1, BA(P)=1.

Type in TN9 a 2, click on Joint data.
Click in TSTRING and type,
PV(1)=1 Enter, PH(1)=1 Enter, hinge support,
PV(2)=1 Enter, roller hinge support.
Click on Coordinates, click in TSTRING, type for
I, X1(I),Y1(I) 1,5,2 Enter, 2,0,0 Enter.

The member data.
P9=1

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	1	1	1	1	500

Click in TP9, type 1, click in TSTRING, type 1,1,2,1,1,1,1,500 Enter.
Click on Beam load forces NQV(P). The data are

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
1	1	1	8	11	1,5	2.2

Click in TSTRING and type
1,1,1,8,11,1.5,2.2 Enter. (Or click EX3.)

Then a click on ADDQ3Q4QVV and ADDQ6Q7QVV, and the components of the vertical distributed loads are calculated. Page 11 and 12.

A click on Pr beam load forces prints the member load forces NQB(1) and NQA(1). With right mouse button the start values NQV(1), see the print on the left. Next Calculate etc.

Fig.2.
Calculation of the components.
The beam axis system is placed at member end 1, seen from this point follows Q3 and not Q4, exchangement!, Q4 and not Q3.
The beam length is Sqr(2^2+5^2)= 5,39 m.

Q3/11=5/5,39 ⇒ Q3=11*(5/5,39)= 10,20 kN/m
Q4/8 =5/5,39 ⇒ Q4= 8*(5/5,39)= 7,42 kN/m

The printed values have a negative sign, that is correct because the forces are directed towards end 1 where the beam axis is placed, and that is against the made assumption.
The needed distances are measured from end 1 as well.

L3/5,39=1,3/5 ⇒ L3=5,39*(1,3/5)= 1,40 m
L4/5,39=2,2/5 ⇒ L4=5,39*(2,2/5)= 2,37 m

Q6/11=2/5,39 ⇒ Q6=11*(2/5,39)= 4,08 kN/m
Q7/8 =2/5,39 ⇒ Q7= 8*(2/5,39)= 2,97 kN/m

The printed values are negative, correct since the assumed directions of Q6 and Q7 is away from that lowest member end number.
Distances L6 and L7 are equal to L3 and L4.

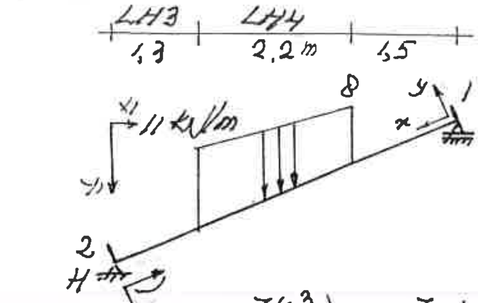


Fig.1.

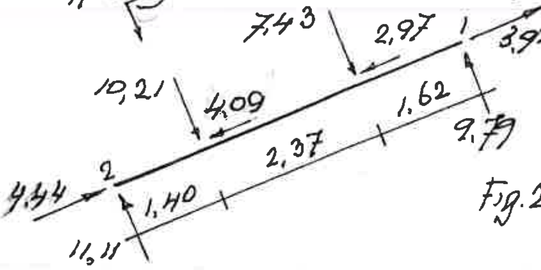


Fig.2.

NQB(1)=1	I	Q3	Q4	L3	L4	
	1	10,21	7,43	1,40	2,37	
NQA(1)=1	I	Q6	Q7	L6	L7	
	1	2,97	4,09	1,62	2,37	
DA(1,2)=	9,79 kN		DA(2,1)=	11,11 kN		
NA(1,2)=	-3,92 kN		NA(2,1)=	-4,44 kN		
MF(1,2)=	0,00 kNm		MF(2,1)=	0,00 kNm		
UV(1)=	0,00 /EI		UH(1)=	0,00 /EI		
UR(1)=	-34,64 /EI					
UV(2)=	0,00 /EI		UH(2)=	0,00 /EI		
UR(2)=	35,97 /EI					**A**
			RV(1)=	10,54 kNm		
RH(2)=	0,00 kN		RV(2)=	11,97 kNm		

NQB(1)=1	I	Q3	Q4	L3	L4	
	1	10,21	7,43	1,40	2,37	
UV(1)=	0,00 /EI		UH(1)=	0,05 /EI		
UR(1)=	-34,64 /EI					
UV(2)=	0,00 /EI		UH(2)=	0,00 /EI		
UR(2)=	35,97 /EI					**B**
ADDQ3Q4QVV						
			RV(1)=	10,54 kNm		
RH(2)=	-7,76 kN		RV(2)=	8,86 kNm		

NQA(1)=0	I	Q6	Q7	L6	L7	
	1	2,97	4,09	1,62	2,37	
UV(1)=	0,00 /EI		UH(1)=	-0,05 /EI		
UR(1)=	0,00 /EI					
UV(2)=	0,00 /EI		UH(2)=	0,00 /EI		
UR(2)=	0,00 /EI					**C**
ADDQ6Q7QVV						
			RV(1)=	0,00 kNm		
RH(2)=	7,76 kN		RV(2)=	3,10 kNm		

Example.   AOAgain   EX4

Fig.1.
Like on the preceding page, but mirrored.
A roller support at member end 1 and a hinge support at member end 2.
EA is 500*EI. N9=2.
X1(1)=5, Y1(1)=0, X1(2)=0 and Y1(2)=2.

Steps for input data, click Joint data.
PV(1)=1 Enter, a roller hinge support,
PV(2)=1 Enter, PH(2)=1 Enter, a hinge support.
Click Coordinates.
I, X1(I),Y1(I) 1,5,0 Enter, 2,0,2 Enter.

The beam axis system is placed at beam end 2, BA(P)=2. Both beam ends are assumed to be real joints, NL(1)=0 and NH(1)=0, then there are also two primery moments.

P9=1

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	0	0	2	1	500

1,1,2,0,0,2,1,500 Enter.

Click on Beam load forces NQV(P). The data are

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
1	1	1	11	8	1.3	2.2

Load forces and distances always seen from the left of the beam with order, Q3V and Q4V, LH3 and LH4.

1,1,1,11,8,1.3,2.2 Enter.   (Or click EX4.)

A Then a click on ADDQ3Q4QVV and ADDQ6Q7QVV, the components of the vertical distributed loads are calculated. Or click OKF2F5.
Next Calculate etc.
Comparing the results of the preceding page,
rotation UR(1)=-34,64 and HE(2,1)= 34,64,
rotation UR(2)= 35,97 and HE(1,2)=-35,97.

Fig.2.
Σ forces along the member axis = 0 ?
4,44 + 3,92 – 0,5*(2,97+4,09)*2,37=
8,36 – 8,37 =-0,01 ≈ 0

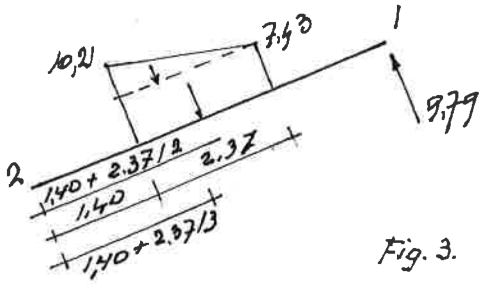


Fig. 3.

Σ mom. member end 2 = 0 ?
9,79*5,39-(7,43*2,37)*(1,40+0,5*2,37)
-(0,5*(10,21-7,43))*2,37*((1/3)*2,37+1,40))
52,77 – 45,52 – 7,21 = 0,04 ≈ 0

B Click only **ADDQ3Q4QVV**, Pr beam load forces Calculate, Reactions and displ
C Click only **ADDQ6Q7QVV**, etc.

Results A = results B + results C.

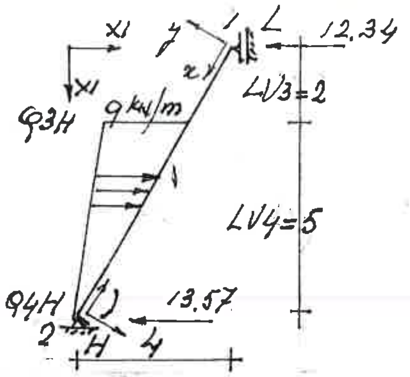


Fig.1.

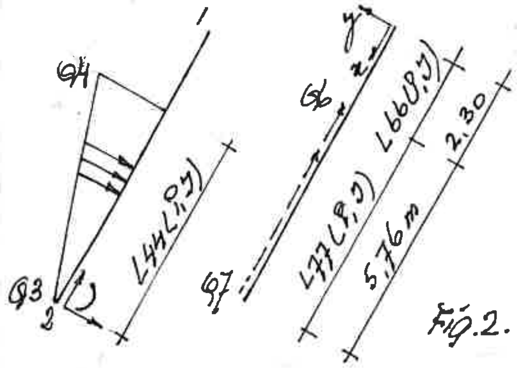


Fig.2.

NQB(1)=1	I	Q3	Q4	L3	L4
	1	0,00	7,81	0,00	5,76
NQA(1)=1	I	Q6	Q7	L6	L7
	1	-4,47	0,00	2,30	5,76

DA(1,2)=	10,71 kN	DA(2,1)=	11,79 kN
NA(1,2)=	6,12 kN	NA(2,1)=	6,73 kN
MF(1,2)=	0,00 kNm	MF(2,1)=	0,00 kNm
UV(1)=	0,00 /EI	UH(1)=	0,00 /EI
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UR(2)=	81,13 /EI		
HE(1,2)=	-80,539 /EI		BA(1)=**2**
RH(1)=	-12,34 kN		
RH(2)=	-13,57 kN	RV(2)=	0,00 kNm

NQB(1)=1	I	Q3	Q4	L3	L4
	1	-7,81	0,00	2,30	5,76
NQA(1)=1	I	Q6	Q7	L6	L7
	1	-4,47	0,00	2,30	5,76

DA(1,2)=	10,71 kN	DA(2,1)=	11,79 kN
NA(1,2)=	6,12 kN	NA(2,1)=	6,73 kN
MF(1,2)=	0,00 kNm	MF(2,1)=	0,00 kNm
UV(1)=	0,00 /EI	UH(1)=	0,00 /EI
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UR(2)=	81,13 /EI		
HE(1,2)=	-80,539 /EI		BA(1)=**1**
RH(1)=	-12,34 kN		
RH(2)=	-13,57 kN	RV(2)=	0,00 kNm

Example. AOAgain EX5

Fig.1.
Again N9=2, EA=500*EI. First click Joint data. A vertical roller support at the top, PH(1)=1, a hinge support below, PV(2)=1 and PH(2)=1. The coordinates are X1(1)=4, Y1(1)=0, X1(2)=0 and Y1(2)=7. After clicking Coordinates 1,4,0 Enter, 2,0,7 Enter. Further BA(1)=**1**.

Member end 2 is assumed to be a real joint, so NH(1)=0, a zero for the highest member end number.

P9=1

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	1	0	2	1	500

After a click on Beam load forces NQH(P) following data can be typed in TSTRING,

P	NQH(P)	I	Q3H(P,I)	Q4H(P,I)	LV3(P,I)	LV4(P,I)
1	1	1	9	0	2	5

Or click EX5.
With horizontal member loads didtances always starting from highest member end, Q3H with LV3 and Q4H with LV4.

Fig.2.
Then a click on ADDQ3Q4QHH and ADDQ6Q7QHH to calculate the components. See the results on the left.
Q3=0 because the beam axis system is placed at member end 2 where the load force is zero, the next load is Q4. The distances from member end 2 as well, L3=0 and L4=5,76 m.
Q6 has a negative value because the f orce is not directed from L to H. The two distances are measured from lowest member end number L, first L6= 2,30, then L7= 5,76 m.

Below results when clicking only ADDQ3Q4HH

UV(1)=	0,11 /EI	UH(1)=	0,00 /EI
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UR(2)=	81,14 /EI		
HE(1,2)=	-80,532 /EI		
RH(1)=	-12,34 kN		
RH(2)=	-7,20 kN	RV(2)=	11,16 kNm

Some results when clicking only on ADDQ6Q7QHH.

UV(1)=	-0,11 /EI	UH(1)=	0,00 /EI
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UR(2)=	-0,01 /EI		
HE(1,2)=	-0,007 /EI		
RH(1)=	0,00 kN		
RH(2)=	-6,38 kN	RV(2)=	-11,16 kNm

Due to forces along the member, the member is not bent, arises a slope of 0,01/EI to the left which, added to the slope due to the perpendicular loads gives the final values on the left.

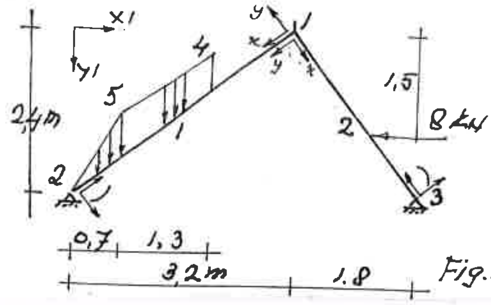


Fig.1.

NQB(1)=2	I	Q3	Q4	L3	L4
	1	0,00	4,00	0,00	0,88
	2	4,00	3,20	0,88	1,63
NQA(1)=2	I	Q6	Q7	L6	L7
	1	3,00	0,00	3,13	0,88
	2	2,40	3,00	1,50	1,63
NFB(2)=1	I	F2	L2		
	1	-6,40	1,13		
NFA(2)=1	I	F5	L5		
	1	-4,80	1,88		
NQV(1)=2	I	Q3V	Q4V	LH3	LH4
	1	0,00	5,00	0,00	0,70
	2	5,00	4,00	0,70	1,30
NFH(2)=1	I	FH	LV		
	1	-8,00	1,50		

D5(1,2)=	-5,10 kN	D5(2,1)=	5,10 kN
D6(1,2)=	-0,70 kN	D6(2,1)=	-8,80 kN
MF(1,2)=	3,78 kNm	MF(2,1)=	0,00 kNm
D5(1,3)=	5,10 kN	D5(3,1)=	2,90 kN
D6(1,3)=	0,70 kN	D6(3,1)=	-0,70 kN
MF(1,3)=	-3,78 kNm	MF(3,1)=	0,00 kNm

UV(1)=	0,06 /EI	UH(1)=	-0,05 /EI
UR(1)=	-0,71 /EI		
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UV(3)=	0,00 /EI	UH(3)=	0,00 /EI
HE(2,1)=	4,162 /EI		
HE(3,1)=	-1,794 /EI		
RH(2)=	5,10 kN	RV(2)=	8,80 kNm
RH(3)=	2,90 kN	RV(3)=	0,70 kNm

With PH(3)=0 and FX(3)=2.90 kN.

UV(1)=	0,07 /EI	UH(1)=	-0,04 /EI
UR(1)=	-0,71 /EI		
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UV(3)=	0,00 /EI	UH(3)=	0,01 /EI
HE(2,1)=	4,165 /EI		
HE(3,1)=	-1,799 /EI		
RH(2)=	5,10 kN	RV(2)=	8,80 kNm
		RV(3)=	0,70 kNm

Example. EX6

Fig.1.
N9=3 joints, P9=2 members, EI=1 and EA=300.
Type 3 in TN9 and Tab cursor in TSTRING.
After clicking Joint data input follows for both hinge supports, PV(2)=1 Enter, PH(2)=1 Enter, PV(3)=1 Enter and PH(3)=1 Enter.
After clicking Coordinates,
I, X1(I),Y1(I),
1,3.2,0 Enter, 2,0,2.4 Enter, 3,5,2.4 Enter.
Tab cursor in TP9, type 2 Tab cursor in TSTRING and type the two rows of member data followed by Enter.

P9=2

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	0	1	2	1	300
2	1	3	0	1	3	1	300

After input of the coordinates Tab, cursor in TP9, type 2 and Tab, cursor in TSTRING and type each row of member data followed by Enter.

Beam load forces of member 1.
Vertical beam load forces with distances always measured from the left beam end.

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
1	2	1	0	5	0	0.7
1	2	2	5	4	0.7	1.3

Click load forces NQV(P) and type in TSTRING each row of the given data here above followed by Enter.

Beam load force of member 2.
Horizontal beam load forces with distances always measured from the top end of the beam.

P	NFH(P)	I	FHH(P,I)	LV(P,I)
2	1	1	8	1.5

Click load forces NFH(P) and type in TSTRING the given row of data Enter.
(Or click EX6.)
Click OKF2F5, or ADDQ3Q4QVV and ADDQ6Q7QVV, and ADDF2FHH and ADDF5HH.

More on page 15.

Going on with this example.
Changing some data.
Support 3 becomes a horizontal roller support, so PH(3)=0 instead of PH(3)=1 and joint 3 is loaded with a horizontal load force of 2,90 kN to the right, 'replacing' the reaction RH(3)= 2,90 kN.

Then click Again to make all UH(I), UV(I) and UR(I) zero, next click Calculate and Reactions and displ.
Click M5MAX for maximum bending moments and bending moment zero points.

M5=	0,00	kNm	X=	0,00 m	P= 1
M5=	3,60	kNm	X=	1,46 m	
M5=	-0,01	kNm	X=	2,96 m	
M5=	-3,77	kNm	X=	4,00 m	
M5=	0,00	kNm	X=	0,00 m	P= 2
M5=	-3,07	kNm	X=	1,13 m	
M5=	0,01	kNm	X=	1,97 m	
M5=	3,77	kNm	X=	3,00 m	

Subroutines for sloping members with vertical and horizontal member load forces.

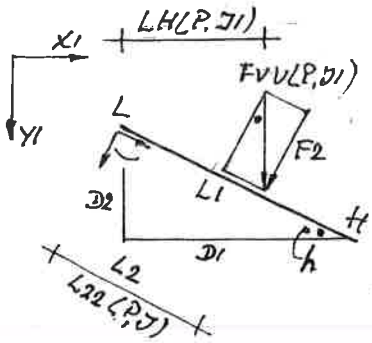


Fig. 1a.

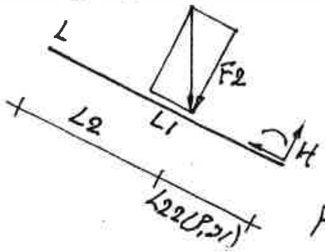


Fig. 1b.

```
Private Sub ADDF2FVV()
ForP=1 To P9
For I1=1 To NFV(P)

NFB(P)=NFB(P)+1 : I=NFB(P)
L=LL(P) : H=HH(P)
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
C=D1/L1

If C>0 Then
F2=FVV(P,I1)*C : L2=LH(P,I1)/C
If BA(P)=L Then
F22(P,I)=F2 : L22(P,I)=L2
ElseIf BA(P)=H Then
F22(P,I)=-F2 : L22(P,I)=L1-L2
End If

ElseIf C<0 Then
F2=-FVV(P,I1)*C: L2=-LH(P,I1)/C
If BA(P)=L Then
F22(P,I)=-F2 : L22(P,I)=L1-L2
ElseIf BA(P)=H Then
F22(P,I)=F2 : L22(P,I)=L2
End If
End If

Next I1
Next P
End Sub
```

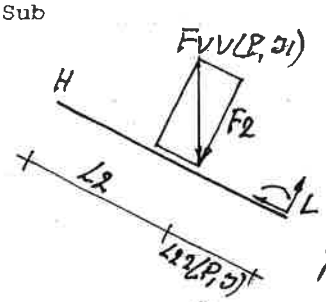


Fig. 2a.

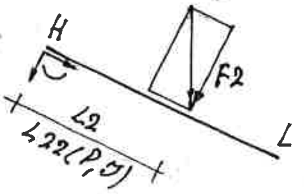


Fig. 2b.

Vertical beam loads and sloping beams, the beam loads are not perpendicular to the beam axis. Suppose there are NFV(P) vertical forces, then For I1=1 To NFV(P) load forces F22(P,I) have to be determined. Each time I1 the number of perpendicular beam load forces is increasing with 1, therefore
NFB(P)=NFB(P)+1 : I=NFB(P).

Fig.1a and 1b.
The beam with the assumptions belonging to the X1-Y1 axis system.
Cos(h)=C=D1/L1 and Cos(h)=F2/FVV(P,I1) so that

F2=FVV(P,I1)*C

Cos(h)=LH(P,I1)/L2 thus L2=LH(P,I1)/C

C>0, the values of F2 and L2 are positive.

Fig.1a.
The beam axis system is placed at beam end L, in that case F2 and L2 are correct values. So

If BA(P)=L Then
F22(P,I)=F2 : L22(P,I)=L2

Fig.1b.
Now the beam axis system at member end H. The picture shows that F2 must get a negative value and L2 must become L1-L2, a positive value, all according to the assumptions belonging to the beam axis system. Then follows

ElseIf BA(P)=H Then
F22(P,I)=-F2 : L22(P,I)=L1-L2
End If.

The second possibility.
Fig.2a and 2b.
Member end numbers L and H are exchanged.

Again F2=FVV(P,I1)*C and L2=LH(P,I1)/C

C<0, the values of F2 and L2 are negative.
Multiplied by - 'minus' makes them positive,

F2=-FVV(P,I1)*C and L2=-LH(P,I1)/C

Fig.2a.
The beam axis system at L. Now the figure shows that F2 must have a negative value, so -F2, and L2 must become L1-L2, both positive values.

If BA(P)=H Then
F22(P,I)=-F2 : L22(P,I)=L1-L2

Fig.2b.
Now the beam axis system at member end H. Now F2 must have a positive value, it has, and L2 must have a positive value, it has as well. So

ElseIf BA(P)=H Then
F22(P,I)=F2 : L22(P,I)=L2
End If

LH(P,I1) always measured from the left beam end! C cannot be zero, division by zero!

Subroutine ADDF2FHH

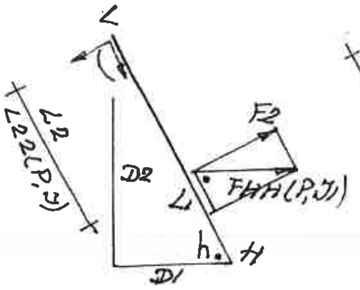


Fig.1a.

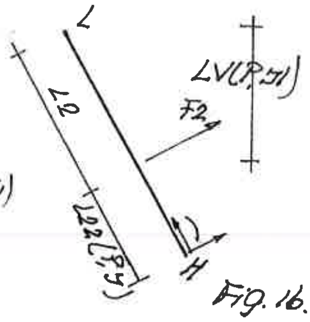


Fig.1b.

Horizontal beam loads and sloping beams, the beam loads are not perpendicular to the beam axis.
If there are NFH(P) horizontal forces, then For I1=1 To NFH(P) load forces F22(P,I) have to be determined. Each time I1 the number of perpendicular beam load forces is increasing with 1, therefore
NFB(P)=NFB(P)+1 : I=NFB(P).

Fig.1a and 1b.
The beam with the assumptions belonging to the X1-Y1 axis system.
Sin(h)=S=D2/L1 and Sin(h)=F2/FHH(P,I1) so that

F2=FHH(P,I1)*S

Sin(h)=LV(P,I1)/L2 thus L2=LV(P,I1)/S

S>0, the values of F2 and L2 are positive.

Fig.1a.
The beam axis system is placed at beam end L, in that case F2 must get a negative value, L2 has the correct value. So

If BA(P)=L Then
F22(P,I)=-F2 : L22(P,I)=L2

Fig.1b.
Now the beam axis system at member end H. The picture shows that F2 has the assumed direction, and L2 must become L1-L2. Then follows

ElseIf BA(P)=H Then
F22(P,I)=F2 : L22(P,I)=L1-L2
End If.

The second possibility.
Fig.2a and 2b.
Member end numbers L and H are exchanged.

Again F2=FHH(P,I1)*S and L2=LV(P,I1)/S

C<0, the values of F2 and L2 are negative.
Multiplied by - 'minus' makes them positive,

F2=-FVV(P,I1)*C and L2=-LH(P,I1)/C

Fig.2a.
The beam axis system at L. Now the figure shows that F2 has the correct direction, and L2 must become L1-L2, both positive values.

If BA(P)=L Then
F22(P,I)=F2 : L22(P,I)=L1-L2

Fig.2b.
Now the beam axis system at member end H. Now F2 must have a negative value, and L2 must have a positive value. So

ElseIf BA(P)=H Then
F22(P,I)=F2 : L22(P,I)=L2
End If
LV(P,I1) always measured from the top end of the beam. S cannot be zero, division by zero!

```
Private Sub  ADDF2FHH()

ForP=1 To P9

For I1=1 To NFH(P)
NFB(P)=NFB(P)+1 : I=NFB(P)

L=LL(P) : H=HH(P)
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
S=D2/L1

If S>0 Then
F2=FHH(P,I1)*S : L2=LV(P,I1)/S

If BA(P)=L Then
F22(P,I)=-F2 : L22(P,I)=L2
ElseIf BA(P)=H Then
F22(P,I)=F2 : L22(P,I)=L1-L2
End If

ElseIf S<0 Then
F2=-FHH(P,I1)*S : L2=-LV(P,I1)/S

If BA(P)=L Then
F22(P,I)=F2 : L22(P,I)=L1-L2
ElseIf BA(P)=H Then
F22(P,I)=-F2 : L22(P,I)=L2
End If

End If

Next I1
Next P
End Sub
```

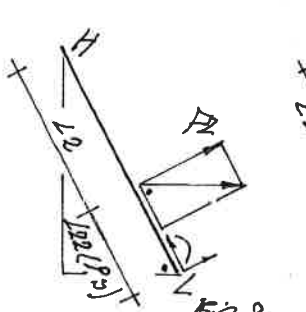


Fig.2a.

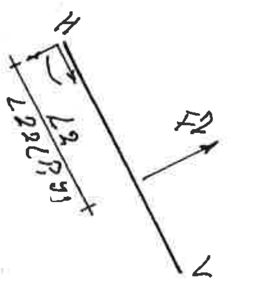


Fig.2b.

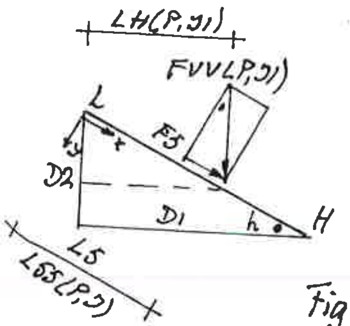


Fig.1.

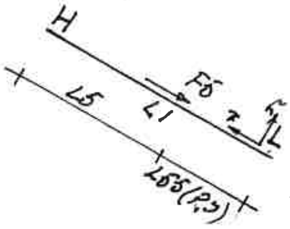


Fig.2.

```
Private Sub ADDF5FVV()
For P=1 To P9
For I1=1 To NFV(P)
NFA(P)=NFA(P)+1 : I=NFA(P)
L=LL(P) : H=HH(P)
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
C=D1/L1 : S=D2/L1
F5=FVV(P,I1)*S : L5=LH(P,I1)/C

If S>0 Or S<0 Then F55(P,I)=F5
If C>0 Then L55(P,I)=L5
If C<0 Then L55(P,I)=L1+L5

Next I1
Next P
End Sub
```

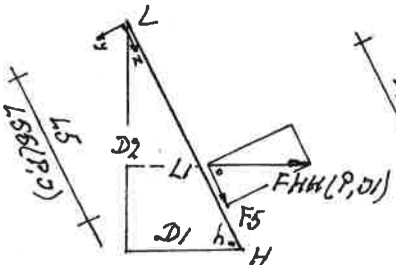


Fig.1.

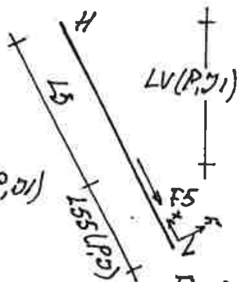


Fig.2.

```
Private Sub ADDF5FHH()
For P=1 To P9
For I1=1 To NFH(P)
NFA(P)=NFA(P)+1 : I=NFA(P)
L=LL(P) : H=HH(P)
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
C=D1/L1 : S=D2/L1
F5=FHH(P,I1)*C : L5=LH(P,I1)/S

If C>0 Or C<0 Then F55(P,I)=F5
If S>0 Then L55(P,I)=L5
If S<0 Then L55(P,I)=L1+L5

Next I1
Next P
End Sub
```

Subroutine ADDF5FVV

Fig.1.
The vertical beam load FVV(P,I1) has a component perpendicular to the beam axis, and also a component along the beam axis.
Then For I1=1 To NFV(P) vertical load forces F5(P,I) must be determined. Each time the number NFA(P) load forces along the member axis increases with 1,
NFA(P)=NFA(P)+1 : I=NFA(P).

Sin(h)=S=D2/L1 and Sin(h)=F5/FVV(P,I1) so that

F5=FVV(P,I1)*S

S is pos. so F5 is, as the figure shows F5 is indeed directwed as assumed from L to H.

Cos(h)=LH(P,I1)/L5, then L5=LH(P,I1)/C

C is pos. so L5 is, it is the L5 of the figure.

Fig.2.
The member end numbers L and H are exchanged, now S and C are negative.

Again are F5=FVV(P,I1)*S and L5=LH(P,I1)/C.

F5 has a negative value, so it is not directed as drawn, but opposite directed, that is as assumed from L to H, so correct.
L5 is negative, to get the correct L5 measured from L write L5=L1+L5 instead of L5=L1-L5.
Then the following code applies.

```
If S>0 Or S<0 Then F55(P,I)=F5
If C>0 Then L55(P,I)=L5
If C<0 Then L55(P,I)=L1+L5
```

Subroutine ADDF5FHH

Fog.1.
Now with FHH(P,I1) and LV(P,I1), like above, C becomes S and S becomes C.
Cos(h)=C=D1/L1 and Cos(h)=F5/FHH(P,I1) so that

F5=FHH(P,I1)*C

C is pos. then F5 is, F5 is indeed directed from L to H.

Sin(h)=LV(P,I1)/L5, then L5=LV(P,I1)/S

S is pos. so L5 is, as the figure shows.

Fig.2.
With member end numbers exchanged, cosinus C and sinus S are negative.

Again are F5=FHH(P,I1)*C and L5=LV(P,I1)/S.

F5 is negative, indeed directed from L to H
L5 is negative, and like above not L5=L1-L5 but L5=L1+L5. Then follows

```
If C>0 Or C<0 Then F55(P,I)=F5
If S>0 Then L55(P,I)=L5
If S<0 Then L55(P,I)=L1+L5
```

Example.

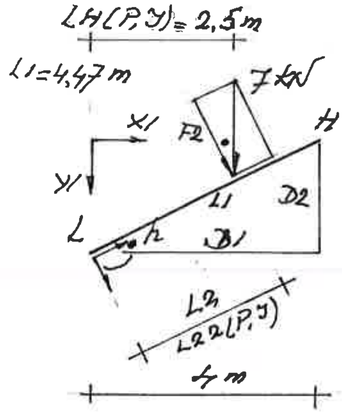


Fig.1a.

Fig.1a.
Calculation of F22(P,I).
There is one vertical force
FVV(P,I1)=FVV(P,1)= 7 kN, and a distance
LH(P,I1)=LH(P,1)= 2,5 m.
This distance is always measured from the left of the beam, whether its left member end number is L or H or not.
With construction axis system X1-Y1 given are
X1(L)=0, Y1(L)=2, X1(H)=4 and Y1(H)=0 m.
D1=X1(H)-X1(L)=4-0= 4 m
D2=Y1(H)-Y1(L)=0-2=-2 m
L1=Sqr(D1^2+D2^2)=Sqr(16+4)= 4,47 m
Cos(h)=C=D1/L1=4/4,47=0,895
C>0
F2=FVV(P,1)*C=7*0,895= 6,27 kN

L2=LH(P,1)/C=2,5/0,895= 2,79 m
BA(P)=L
F22(P,I)=F2= 6,27 kN
L22(P,I)=L2= 2,79 m, these values are correct.

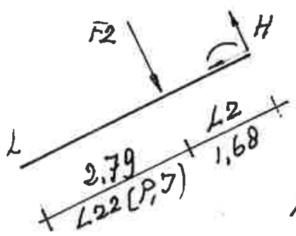


Fig.1b.

Fig.1b.
BA(P)=H
F22(P,I)=-F2=-6,27 kN, yes it must be negative.
L22(P,I)=L1-L2= 4,47-2,79= 1,68 m.

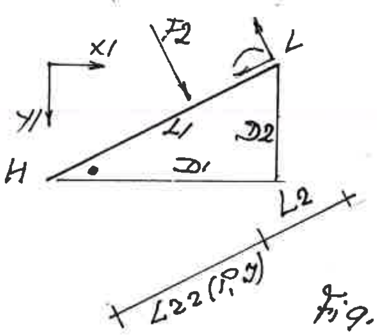


Fig.2a.

Fig.2a.
The member end numbers are exchanged.
X1(L)=4, Y1(L)0, X1(H)=0, Y1(H)=2.
D1=X1(H)=X1(L)=0-4=-4 m
D2=Y1(H)-X1(L)=2-0= 2 m
L1=Sqr(16+4)= 4,47 m
Cos(h)=C=D1/L1=-4/4,47=-0,895
C<0
With C<0 F2 and L2 would become negative, a minus sign is added to make them positive,
F2=-FVV(P,I)*C=-7*(-0,895)= 6,27 kN

L2=-LH(P,I)/C=2,5/(-0,895)= 2,79 m
BA(P)=L
F22(P,I)=-F2=-6,27 kN
L22(P,I)=L1-L2=4,47-2,79= 1,68

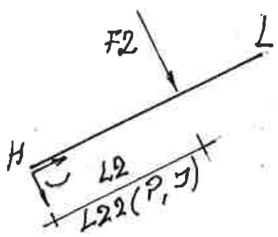


Fig.2b.

Fig.2b.
BA(P)=H
F22(P,I)=F2= 6,27 kN
L22(P,I)=L2= 2,79 m

Calculation of F55(P,I),

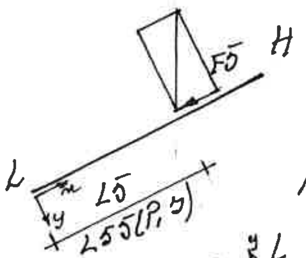


Fig. 3a.

Fig.3a.
Coordinates, L and H, like fig.1a.
Cos(h)=C=D1/L1= 4/4,47=0,895 C>0
Sin(h)=S=D2/L1=(-2)/4,47=-0,447 S<0
F5=FVV(P,I)*S= 7*(-0,447)=-3,13 kN
L5=LH(P,I)/C=2,5/0,895= 2,79 m
Correct values.

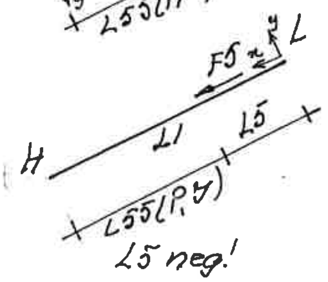
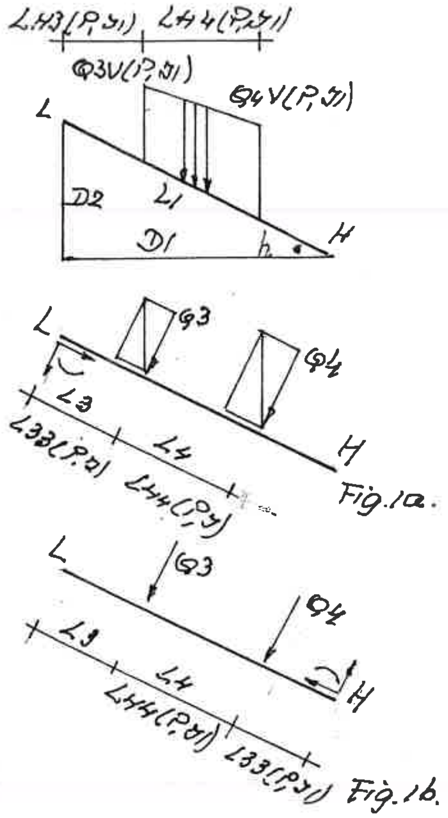


Fig.3b.

Fig.3b like fig.1b.
Cos(h)=C=-0.895 C<0
Sin(h)=S= 0,447 S>0
F5=FVV(P,I)*S= 7*0,447= 3,13
L5=LH(P,I)/C=2,5/(-0,895)=-2,79 m
F5 correct but L5 negative.
Then for both cases

S>0 Or S<0 Then F55(P,I)=F5, -3,13 Or 3,13.
C>0 Then L55(P,I)=L5= 2,79 m
C<0 Theb L55(P,I)=L1+L5= 4,47=(-2,79)= 1,68 m.

Subroutine ADDQ3Q4QVV



With this subroutine vertical distributed beam loads, e.g. own weight, on a sloping beam are divided into loads perpendicular to and along the beam axis.

NQV(P) is the number of these vertical loads. For each load I1 the number of loads NQB(P) perpendicular to the beam axis increases with 1, NQB(P)=NQB(P)+1, then that load has number I=NQB(P).
The distances measured from the left are

LH3(P,I1) and LH4(P,I1) and the load values are

Q3V(P,I1) and Q4V(P,I1).

Fig.1a and 1b.

Cos(h)=C=D1/L1 and Cos(h)=Q3/Q3V(P,I1) so that

Q3=Q3V(P,I1)*C, then also Q4=Q4V(P,I1)*C.

Cos(h)=LH3(P,I1)/L3 thus

L3=LH3(P,I1)/C, then also L4=LH4(P,I1)/C.

C>0, the values of Q3, Q4, L3 and L4 are positive.

Fig.1a.
The beam axis system is placed at beam end L, in that case Q3, Q4, L3 and L4 are correct values. So

```
If BA(P)=L Then
Q33(P,I)=Q3 : Q44(P,I)=Q4
L33(P,I)=L3 : L44(P,I)=L4
```

Fig.1b.
Now the beam axis system at member end H. The picture shows that Q3 and Q4 must get negative values and exchanged!, and L3 must become L1-L3-L4, L4 stays L4. Then follows

```
ElseIf BA(P)=H Then
Q33(P,I)=-Q4 : Q44(P,I)=-Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4
End If.
```

The second possibility.
Fig.2a and 2b, see next page.
Member end numbers L and H are exchanged.
And again are

Q3=Q3V(P,I1)*C, then also Q4=Q4V(P,I1)*C and

L3=LH3(P,I1)/C, then also L4=LH4(P,I1)/C.

C<0, the calculated values are negative, to make them positive a minus sign is added, so that they correspond with the figurues 2a and 2b. Thus

Q3=-Q3V(P,I1)*C and Q4=-Q4V(P,I1)*C,

L3=-LH3(P,I1)/C and L4=-LH4(P,I1)/C.

```
Private Sub  ADDQ3Q4QVV_Click()
For P=1 To P9
For I1=1 To NQV(P)

NQB(P)=NQB(P)+1 : I=NQB(P)
L=LL(P) : H=HH(P)
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
C=D1/L1

If C>0 Then

Q3=Q3V(P,I1)*C : Q4=Q4V(P,I1)*C
L3=LH3(P,I1)/C : L4=LH4(P,I1)/C

If BA(P)=L Then

Q33(P,I)=Q3 : Q44(P,I)=Q4
L33(P,I)=L3 : L44(P,I)=L4

ElseIf BA(P)=H Then

Q33(P,I)=-Q4 : Q44(P,I)=-Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4

End If

ElseIf C<0 Then
Q3=-Q3V(P,I1)*C : Q4=-Q4V(P,I1)*C

L3=-LH3(P,I1)/C : L4=-LH4(P,I1)/C
```

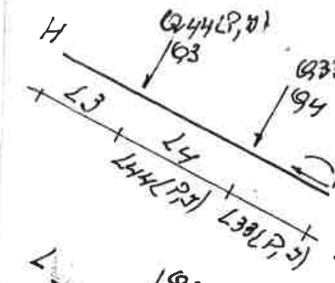


Fig.2a.

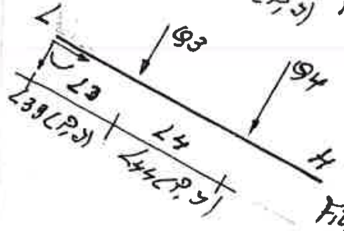


Fig.2b.

Fig.2a.
The beam axis system placed at member end L, Q3 and Q4 must have negative values, and must be exchanged!, L3 becomes L3=L1-L3-L4 and L4 stays the same. Then is
If BA(P)=L Then
Q33(P,I)=-Q4 : Q44(P,I)=-Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4
Fig.2b.
The beam axis system at member end H. The figure shows that Q3 and Q4, which got positive values, are directed as assumed. L3 and L4 are correct as well.
ElseIf BA(P)=H Then
Q33(P,I)=Q3 : Q44(P,I)=Q4
L33(P,I)=L3 : Q44(P,I)=L4
End If

```
If BA(P)=L Then
Q33(P,I)=-Q4 : Q44(P,I)=-Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4

ElseIf BA(P)=H Then
Q33(P,I)=Q3 : Q44(P,I)=Q4
L33(P,I)=L3 : L44(P,I)=L4

End If
End If
Next I1
Next P
End Sub
```

Subroutine ADDQ6Q7QVV

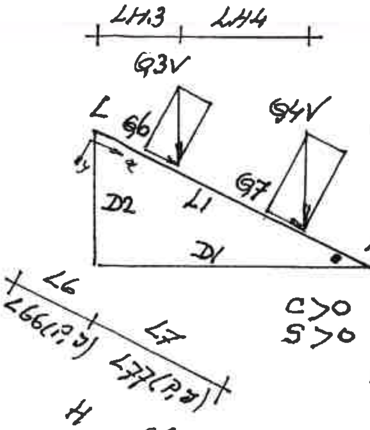


Fig.1a.

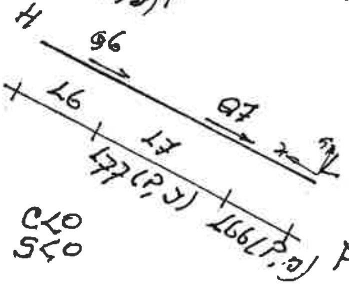


Fig.1b.

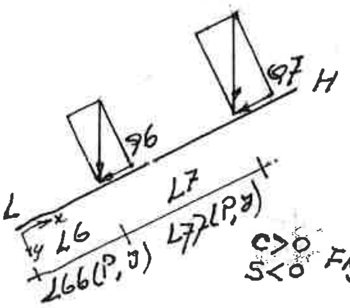


Fig.1C.

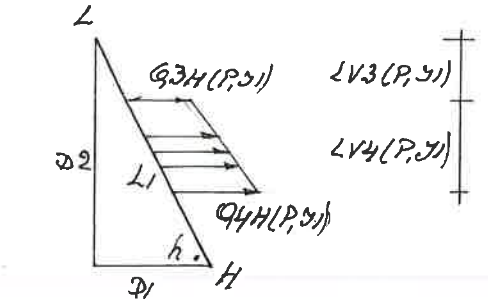
Next the components of the distributed loads along the member axis.
Fig.1a.
Sin(h)=S=D2/L1 and Sin(h)=Q6/Q3V(P,I1) so that Q6=Q3V(P,I1)*S, then also Q7=Q4V(P,I1)*S.
Cos(h)=LH3(P,I1)/L6 thus
L6=LH3(P,I1)/C, then also L7=LH4(P,I1)/C.

Fig.1a. See the code below.
S>0, Q6 and Q7 have correct directions.
C>0, L6 and L7 are correct.
Fig.1c.
S<0, Q6 and Q7 have negative values, correct because not directed from L to H.
C>0, L6 and L7, also correct, positive values.
Fig.1b.
S<0, Q6 and Q7 have negative values, correct, not directed from L to H. But, seen from L, the values have to be exchanged.
C<0, L6 and L7 have negative values, adding a minus sign makes them positive. Then follows,
L66(P,I)=L1-L6-L7 : L77(P,I)=L7.

Fourth possibility, not drawn, with S>0 and C<0, correct like fig.1b. The four cases can be distinguished with C>0 and C<0.

```
Private Sub ADDQ6Q7QVV()
For P=1 To P9
For I1=1 To NQV(P)
NQA(P)=NQA(P)+1 : I=NFA(P)
L=LL(P) : H=HH(P)
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
C=D1/L1 : S=D2/L1
Q6=Q3V(P,I1)*S : Q7=Q4V(P,I1)*S
L6=LH3(P,I1)/C : L7=LH4(P,I1)/C

If C>0 Then
Q66(P,I)=Q6 : Q77(P,I)=Q7
L66(P,I)=L6 : L77(P,I)=L7
ElseIf C<0 Then
Q66(P,I)=Q7 : Q77(P,I)=Q6
L6=-LH3(P,I1)/C : L7=-LH4(P,I1)/C
L66(P,I)=L1-L6-L7 : L77(P,I)=L7
End If
Next I1
Next P
End Sub
```



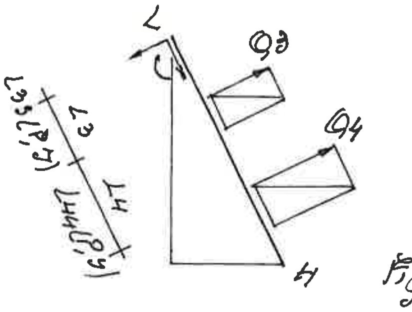


Fig. 1a.

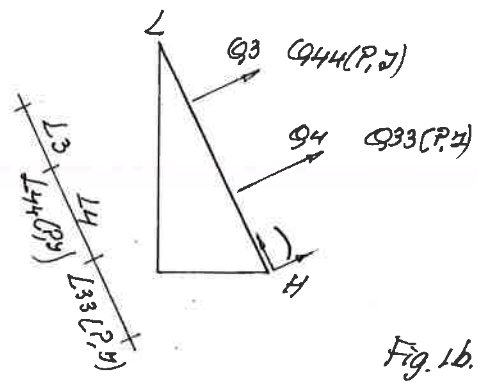


Fig. 1b.

```
Private Sub  ADDQ3Q4QHH()
For P=1 To P9
For I1=1 To NQH(P)

NQB(P)=NQB(P)+1  : I=NQB(P)
L=LL(P)  : H=HH(P)
D1=X1(H)-X1(L)  : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
S=D2/L1

If S>0 Then

Q3=Q3H(P,I1)*S  : Q4=Q4H(P,I1)*S
L3=LV3(P,I1)/S  : L4=LV4(P,I1)/S

If BA(P)=L Then
Q33(P,I)=-Q3  : Q44(P,I)=-Q4
L33(P,I)=L3  : L44(P,I)=L4

ElseIf BA(P)=H Then
Q33(P,I)=Q4: Q44(P,I)=Q3
L33(P,I)=L1-L3-L4  : L44(P,I)=L4
End If

ElseIf S<0 Then
Q3=-Q3H(P,I1)*S  : Q4=-Q4H(P,I1)*S
L3=-LV3(P,I1)/S  : L4=-LV4(P,I1)/S
```

Subroutine ADDQ3Q4QHH

In this case horizontal distributed beam loads and a sloping beam. They will be divided in components Q3 and Q4 perpendicular to the beam axis, and Q6 and Q7 along the beam axis on next page.

NQH(P) is the number of these horizontal loads. For each load I1 the number of loads NFB(P) perpendicular to the beam axis increases with 1, NQB(P)=NQB(P)+1, then that load has number I=NQB(P).
The distances measured from the top are

LV3(P,I1) and LV4(P,I1) and the load values are

Q3H(P,I1) and Q4H(P,I1).

Fig.1a and 1b.

Sin(h)=S=D2/L1 and Sin(h)=Q3/Q3H(P,I1) so that

Q3=Q3H(P,I1)*S, then also Q4=Q4H(P,I1)*S.

Sin(h)=LV3(P,I1)/L3 thus

L3=LV3(P,I1)/S, then also L4=LV4(P,I1)/S.

S>0, the values of Q3, Q4, L3 and L4 are positive.

Fig.1a.
The beam axis system   is placed at beam end L, in that case L3 and L4 have correct values, but Q3 and Q4 must be negative. So

If BA(P)=L Then
Q33(P,I)=-Q3 : Q44(P,I)=-Q4
L33(P,I)=L3 : L44(P,I)=L4

Fig.1b.
Now the beam axis system at member end H. The picture shows that Q3 and Q4 have correct values but have to be exchanged. The new L3 must become L1-L3-L4, L4 stays L4. Then follows

ElseIf BA(P)=H Then
Q33(P,I)=Q4 : Q44(P,I)=Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4
End If.

The second possibility.
Fig.2a and 2b, see next page.
Member end numbers L and H are exchanged.
And again are

Q3=Q3H(P,I1)*S, then also Q4=Q4V(P,I1)*S and

L3=LV3(P,I1)/S, then also L4=LV4(P,I1)/S.

S<0, the calculated values are negative, to make them positive a minus sign is added, so that they coorespond with the figurues 2a and 2b. Thus

Q3=-Q3H(P,I1)*S and Q4=-Q4H(P,I1)*S,

L3=-LV3(P,I1)/S and L4=-LV4(P,I1)/S.

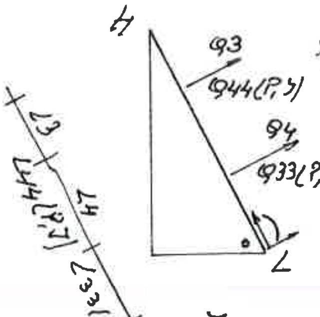


Fig.2a.

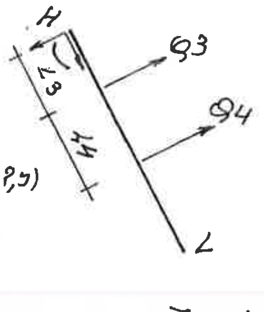


Fig.2b.

```
If BA(P)=L Then
Q33(P,I)=Q4 : Q44(P,I)=Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4

ElseIf BA(P)=H Then
Q33(P,I)=-Q3 : Q44(P,I)=-Q4
L33(P,I)=L3 : L44(P,I)=L4

End If
End If
Next I1
Next P
End Sub
```

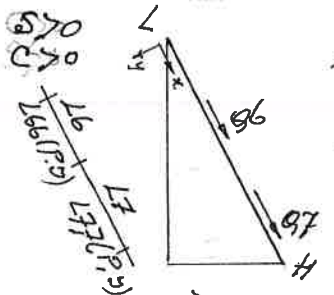


Fig.1a.

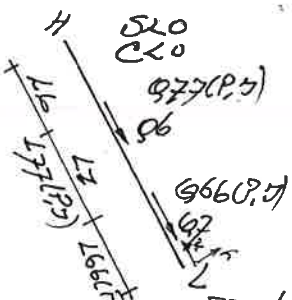
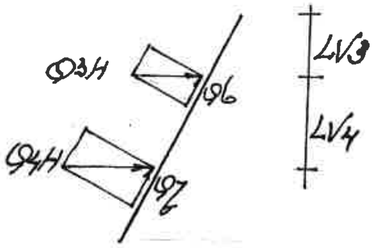


Fig.1b.



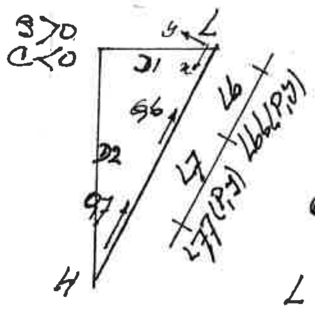


Fig.1c.

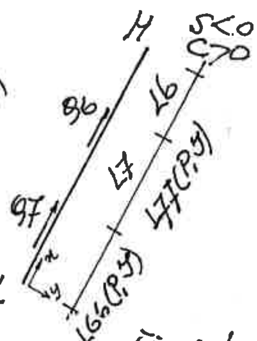


Fig.1d.

```
Private Sub ADDQ6Q7QHH()
For P=1 To P9
For I1=1 To NQH(P)
NQA(P)=NQA(P)+1 : I=NQA(P)
L=LL(P) : H=HH(P)
```

Fig.2a.
The beam axis system placed at member end L, Q3 and Q4 now have correct values, but must be exchanged. L3 becomes L3=L1-L3-L4 and L4 stays the same. Then is

```
If BA(P)=L Then
Q33(P,I)=Q4 : Q44(P,I)=Q3
L33(P,I)=L1-L3-L4 : L44(P,I)=L4
```

Fig.2b.
The beam axis system at member end H. The figure shows that Q3 and Q4, which got positive values, must become negative. L3 and L4 are have correct values.

```
ElseIf BA(P)=H Then
Q33(P,I)=-Q3 : Q44(P,I)=-Q4
L33(P,I)=L3 : Q44(P,I)=L4
End If
```

Subroutine ADDQ6Q7QHH

Now the components Q6 and Q7 of the distributed loads along the member axis.
Fig.1a.
Cos(h)=C=D1/L1 and Cos(h)=Q6/Q3H(P,I1) so that Q6=Q3H(P,I1)*C, then also Q7=Q4H(P,I1)*C.
Sin(h)=LV3(P,I1)/L6 thus
L6=LV3(P,I1)/S, then also L7=LV4(P,I1)/S.

Fig.1a.
C>0, Q6 and Q7 have correct directions, from L to H. And S>0, then L6 and L7 are correct.
Fig.1c.
C<0, Q6 qnd Q7 have negative values, correct, UnotU directed from L to H.
S>0, L6 and L7 have positive values, correct.
Fig.1b.
C<0, Q6 and Q7 are negative, correct, not directed from L to H. But seen from member end L, Q6 and Q7 must be exchanged.
S<0, L6 and L7 are negative, adding a minus sign makes them positive. And after that the correct distances, 'exchanged', become
L66(P,I)=L1-L6-L7 : L77(P,I)=L7.
Fig.d.
C>0, Q6 and Q7 positive, correct, but have to be exchanged.
S<0, L6 and L7 are negative, made positive and 'exchanged' like fig.1b.
The four cases can be distinguished with S>0 and S<0, see the code below.

```
D1=X1(H)-X1(L) : D2=Y1(H)-Y1(L)
L1=Sqr(D1^2+D2^2)
C=D1/L1 : S=D2/L1
Q6=Q3H(P,I1)*C : Q7=Q4H(P,I1)*C
L6=LV3(P,I1)/S : L7=LV4(P,I1)/S

If S>0 Then
Q66(P,I)=Q6 : Q77(P,I)=Q7
L66(P,I)=L6 : L77(P,I)=L7
ElseIf S<0 Then
Q66(P,I)=Q7 : Q77(P,I)=Q6
L6=-LV3(P,I1)/S : L7=-LV4(P,I1)/S
L66(P,I)=L1-L6-L7 : L77(P,I)=L7
End If
Next I1
Next P
End Sub
```

NQB(1)=2	I	Q3	Q4	L3	L4
	1	0,00	4,00	0,00	0,88
	2	4,00	3,20	0,88	1,63
NQA(1)=2	I	Q6	Q7	L6	L7
	1	3,00	0,00	3,13	0,88
	2	2,40	3,00	1,50	1,63
NFB(2)=1	I	F2	L2		
	1	-6,40	1,13		
NFA(2)=1	I	F5	L5		
	1	-4,80	1,88		

DA(1,2)=	3,62 kN	DA(2,1)=	3,98 kN
NA(1,2)=	3,66 kN	NA(2,1)=	-9,36 kN
MF(1,2)=	3,78 kNm	MF(2,1)=	0,00 kNm
DA(1,3)=	-3,66 kN	DA(3,1)=	-2,74 kN
NA(1,3)=	3,62 kN	NA(3,1)=	1,18 kN
MF(1,3)=	-3,78 kNm	MF(3,1)=	0,00 kNm

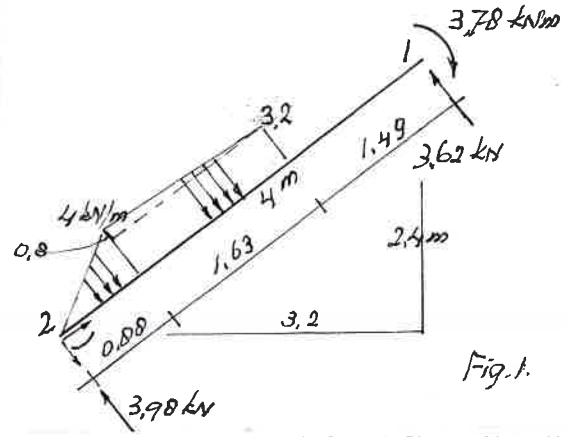
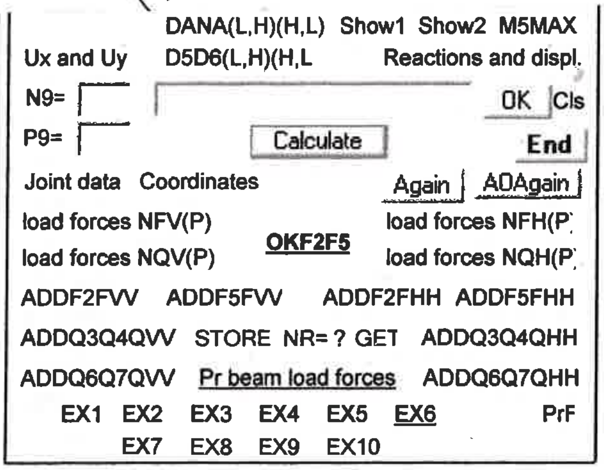


Fig.1.



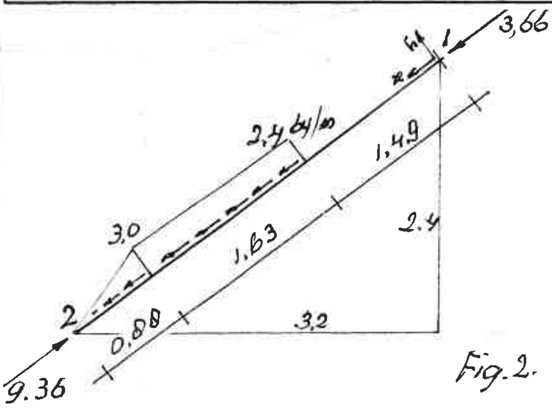


Fig.2.

Continuation of example EX6 of page 6.

Click EX6 and OKF2F5,
or ADDQ3Q4QVV and ADDQ6Q7QVV, next
Pr Beam load forces for the components of the vertical member loads, and

Calculate and DANA(L,H)(H,L).

Fig.1.
The member load components perpendicular to the member axis.

Member end forces and moments.
DA(1,2)= 3,62 kN DA(3,1)= 3,92 kN
MF(1,2)= 3,78 kN MF(2,10= 0 kN
Drawn with their real directions.

Equilibrium calculation. ∑ mom. joint 2=0 ?

((4*0,88)/2)*((2/3)*0,88)= 1,76*0,59= 1,04

(3,2*1,63)*(0,88+1,63/2)= 5,22*1,70= 8,85

4,0-3,2= 0,8 kN/m
(0,8*1,63/2)*(0,88+1,63/3)= 0,65*1,42= 0,92 kNm

MF(1,2)= 3,78 kNm
DA(1,2)= 3,62 kN
3,62*4= 14,48 kNm to the left

∑ mom. = 1,04+8,85+0,92+3,78 -14,48= 0,11 ok

Equilibrium perpendicural to the member axis?
(4*0,88)/2+((4,0+3,2)/2)*1,63 -3,98-3,62=

1,76 +5,87 -3,98 -3,62= 0,03 ok

Fig.2.
Member 1 with the load force components along the member axis.

The components of the vertically distributed member loads are calculated with
ADDQ6Q7QVV, or OKF2F5 with both subroutines.

Member end forces.
NA(1,2)= 3,66 kN and NA(2,1)= -9,36 kN

Equilibrium along the member?
3,66 +(3*0,88)/2 +((3,0+2,4)/2)*1,63 -9,36=
3,66 +1,32 +4,40 -9,36= 0,02 ok

```
Private Sub LOKF2F5_Click()

  ADDF2FVV          page  7
  ADDF5FVV          page  9
  ADDQ3Q$QVV        page 11
  ADDQ6Q&QCC        page 12

  ADDF2FHH          page  8
  ADDF5FHH          page  9
  ADDQ3Q4QHH        page 13
  ADDq6Q7QHH        page 14

End Sub
```

Example.   EX7

Fig.1.
N9=3 joints an P9=2 members.
Type 3 in TN9, Tab, cursor in TSTRING.
Click Joint data and type in TSTRING for the two hinge supports PV(1)=1 Enter, PH(1)=1 Enter, PV(3)=1 Enter, PH(3)=1 Enter.

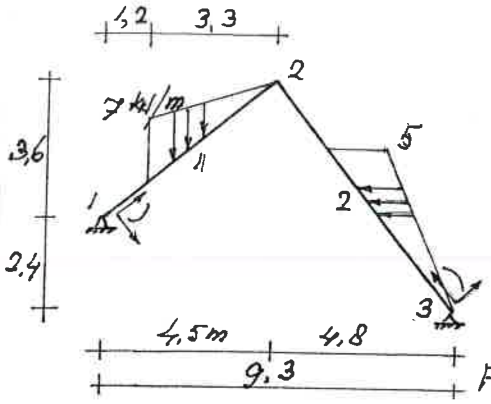


Fig.1.

N9=3 joints.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	0	3.6	2	4.5	0
3	9.3	6			

Click Coordinates and type in TSTRING
1,0,3.6 Enter, 2,4.5,0 Enter, 3,9.3,6 Enter.

P9=2 members.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	1	0	1	1	300
2	2	3	0	1	3	1	300

Type 2 in TP9, Tab, and type in TSTRING
1,1,2,1,0,1,1,300 Enter and
2,2,3,0,1,3,1,300 Enter.

N9= 3

I	FY	PV	UV	SV	X1	MZ	PR	UR	SR
1	0	1	0	0	0,00	0	0	0	0
2	0	0	0	0	4,50	0	0	0	0
3	0	1	0	0	9,30	0	0	0	0

I	FX	PH	UH	SH	Y1
1	0	1	0	0	3,60
2	0	0	0	0	0,00
3	0	1	0	0	6,00

P9= 2

P	LL	HH	NL	NH	BA	EI	EA	LL
1	1	2	1	0	2	1	300	5,76
P	LL	HH	NL	NH	BA	EI	EA	LL
2	2	3	0	1	2	1	300	7,68

NQV(1)=1 vertical distributed load forces.

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
1	1	1	7	0	1.2	3.3

Click load forces NQV(P) and type in TSTRING
1,1,1,7,0,1.2,3.3 Enter.

NQH(2)=1 horizontal distributed load forces.

P	NQH(P)	I	Q3H(P,I)	Q4H(P,I)	LV3(P,I)	LV4(P,I)
2	1	1	-5	0	1.8	4.2

Click load forces NQH(P),
2,1,1,-5,0,1.8,4.2 Enter.

Click **OKF2F5**, Show1, Show2 and with left button and right button resp. Pr beam load forces.

	I	Q3	Q4	L3	L4
NQB(1)=1	1	5,47	0,00	1,54	4,23
	I	Q6	Q7	L6	L7
NQA(1)=1	1	-4,37	0,00	1,54	4,23
	I	Q3	Q4	L3	L4
NQB(2)=1	1	0,00	-3,90	0,00	5,38
	I	Q6	Q7	L6	L7
NQA(2)=1	1	-3,12	0,00	2,31	5,38
	I	Q3V	Q4V	LH3	LH4
NQV(1)=1	1	7,00	0,00	1,20	3,30
	I	Q6	Q7	L6	L7
NQH(2)=1	1	-5,00	0,00	1,80	4,20

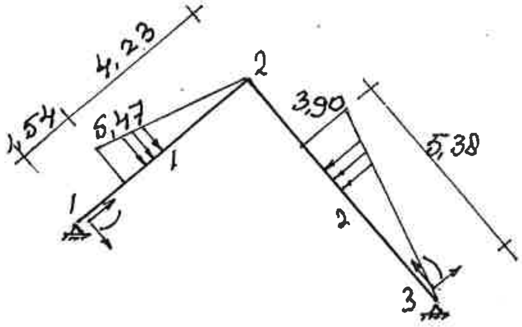


Fig.2a.

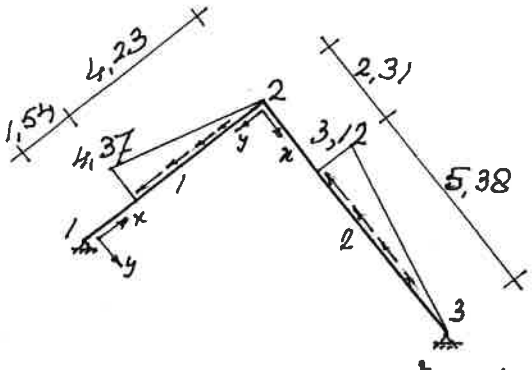


Fig.2b.

Fig.2a and 2b.
With the components of the member loads.
Click Calculate and Reactions and displ. for the results here below.

UV(1)=	0,00 /EI	UH(1)=	0,00 /EI
UV(2)=	0,22 /EI	UH(2)=	-0,10 /EI
UR(2)=	2,57 /EI		
UV(3)=	0,00 /EI	UH(3)=	0,00 /EI
HE(1,2)=	9,399 /EI		
HE(3,2)=	-18,977 /EI		
RH(1)=	10,09 kN	RV(1)=	12,58 kNm
RH(3)=	3,35 kN	RV(3)=	2,21 kNm

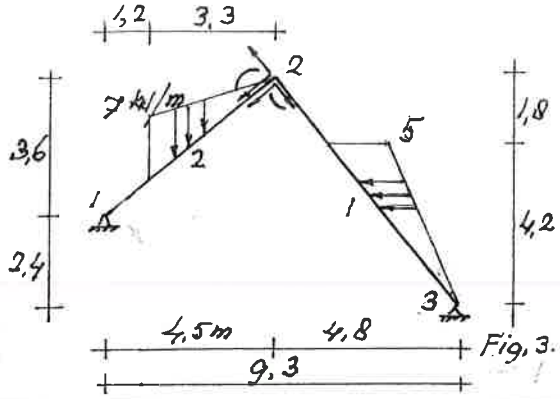


Fig.3.

Like preceding page with same joint numbering, but different member numbering and beam axis system at other member ends.

P9=2 members.

P	LL	HH	NL	NH	BA	EI	EA
1	2	3	0	1	2	1	300
2	1	2	1	0	2	1	300

NQV(2)=1 vertical distributed load forces.

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
2	1	1	7	0	1.2	3.3

NQH(1)=1 horizontal distributed load forces.

P	NQH(P)	I	Q3H(P,I)	Q4H(P,I)	LV3(P,I)	LV4(P,I)
1	1	1	-5	0	1.8	4.2

Click **OKF2F5**, Show1, Show2 and with left button and right button resp. Pr beam load forces. And Calculate, Reactions and displ. Final results are the same.

P9= 2

P	LL	HH	NL	NH	BA	EI	EA	L1
1	2	3	0	1	2	1	300	7,68
P	LL	HH	NL	NH	BA	EI	EA	L1
2	1	2	1	0	2	1	300	5,76

NQB(1)=1	I	Q3	Q4	L3	L4
	1	3,90	0,00	2,31	5,38
NQA(1)=1	I	Q6	Q7	L6	L7
	1	-3,12	0,00	2,31	5,38
NQB(2)=1	I	Q3	Q4	L3	L4
	1	0,00	-5,47	0,00	4,23
NQA(2)=1	I	Q6	Q7	L6	L7
	1	-4,37	0,00	1,54	4,23
NQH(1)=1	I	Q6	Q7	L6	L7
	1	-5,00	0,00	1,80	4,20
NQV(2)=1	I	Q3V	Q4V	LH3	LH4
	1	7,00	0,00	1,20	3,30

UV(1)=	0,00 /EI	UH(1)=	0,00 /EI
UV(2)=	0,22 /EI	UH(2)=	-0,10 /EI
UR(2)=	2,57 /EI		
UV(3)=	0,00 /EI	UH(3)=	0,00 /EI
HE(3,2)=	-18,977 /EI		
HE(1,2)=	9,399 /EI		
RH(1)=	10,09 kN	RV(1)=	12,58 kNm
RH(3)=	3,35 kN	RV(3)=	2,21 kNm

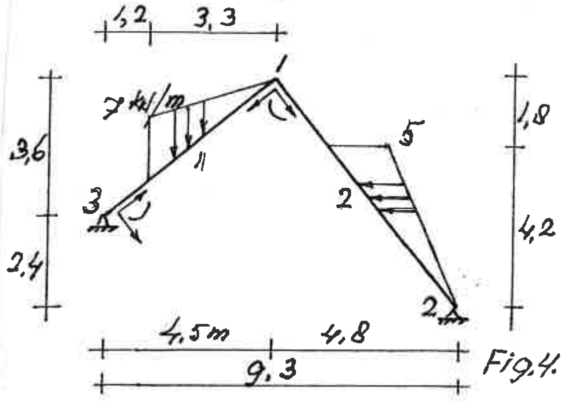


Fig.4.

Some other changes.

PV(2)=1, PH(2)=1, PV(3)=1 and PH(3)=1.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	4.5	0	2	9.3	6
3	0	3.6			

A change in member data!

P9=2 members.

P	LL	HH	NL	NH	BA	EI	EA
1	1	3	0	1	3	1	300
2	1	2	0	1	1	1	300

NQV(1)=1 horizontal distributed load forces.

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
1	1	1	7	0	1.2	3.3

NQH(2)=1 vertical distributed load forces.

P	NQH(P)	I	Q3H(P,I)	Q4H(P,I)	LV3(P,I)	LV4(P,I)
2	1	1	-5	0	1.8	4.2

NQB(1)=1	I	Q3	Q4	L3	L4
	1	5,47	0,00	1,54	4,23
NQA(1)=1	I	Q6	Q7	L6	L7
	1	0,00	4,37	0,00	4,23
NQB(2)=1	I	Q3	Q4	L3	L4
	1	3,90	0,00	2,31	5,38
NQA(2)=1	I	Q6	Q7	L6	L7
	1	-3,12	0,00	2,31	5,38
NQV(1)=1	I	Q3V	Q4V	LH3	LH4
	1	7,00	0,00	1,20	3,30
NQH(2)=1	I	Q6	Q7	L6	L7
	1	-5,00	0,00	1,80	4,20

UV(1)=	0,22 /EI	UH(1)=	-0,10 /EI
UR(1)=	2,57 /EI		
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UV(3)=	0,00 /EI	UH(3)=	0,00 /EI
HE(3,1)=	9,399 /EI		
HE(2,1)=	-18,977 /EI		
RH(2)=	3,35 kN	RV(2)=	2,21 kNm
RH(3)=	10,09 kN	RV(3)=	12,58 kNm

And see, final results the same!!

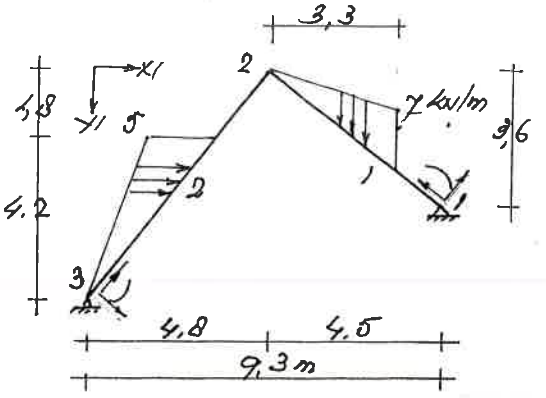


Fig. 1.

Example.

Fig.1.
The 'mirrorred' construction of page 16. Beam axis systems also now at member ends 1 and 3.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	9.3	3.6	2	4.8	0
3	0	6			

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	1	0	1	1	300
2	2	3	0	1	3	1	300

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
1	1	1	0	7	0	3.3
P	**NQH(P)**	**I**	**Q3H(P,I)**	**Q4H(P,I)**	**LV3(P,I)**	**LV4(P,I)**
2	1	1	5	0	1.8	4.2

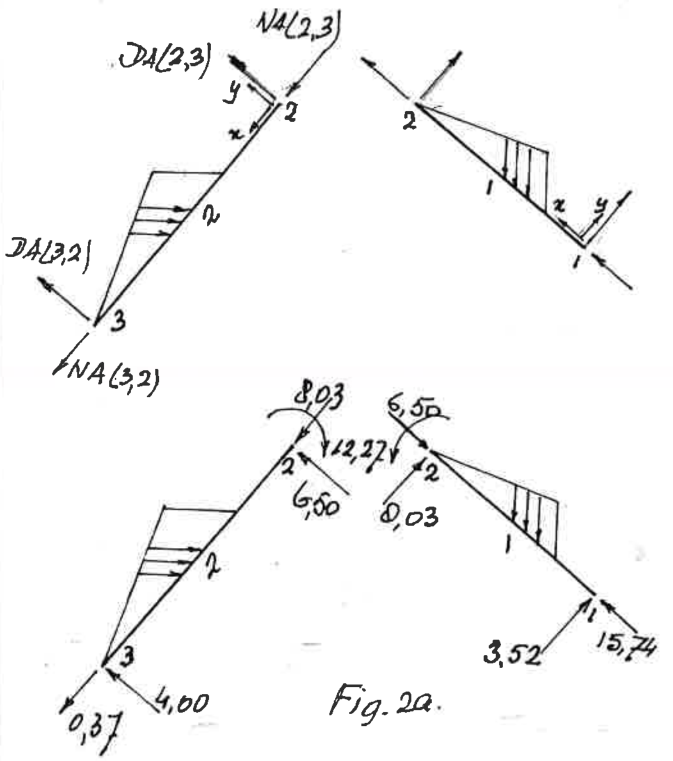


Fig. 2a.

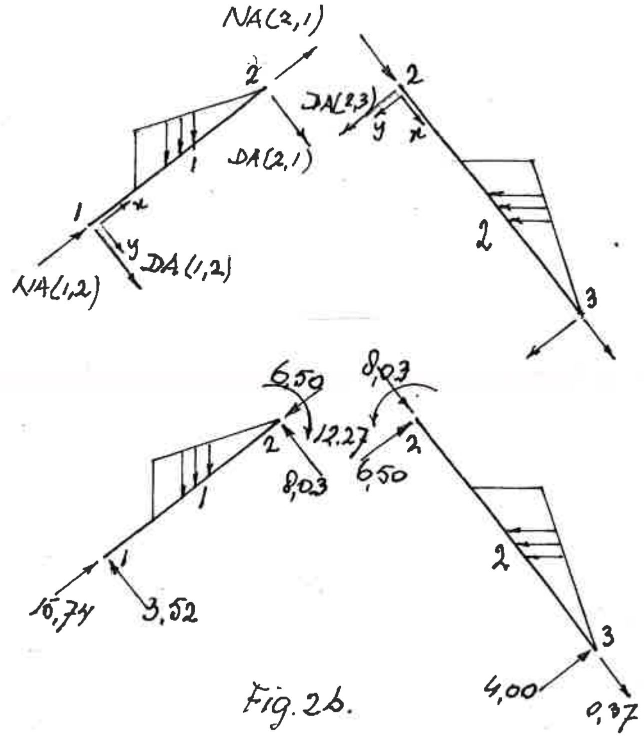


Fig. 2b.

DA(1,2)= 3,52 kN	DA(2,1)= 8,03 kN
NA(1,2)= 15,74 kN	NA(2,1)= -6,50 kN
MF(1,2)= 0,00 kNm	MF(2,1)= -12,27 kNm
DA(2,3)= 6,50 kN	DA(3,2)= 4,00 kN
NA(2,3)= 8,03 kN	NA(3,2)= 0,37 kN
MF(2,3)= 12,27 kNm	MF(3,2)= 0,00 kNm
UV(1)= 0,00 /EI	UH(1)= 0,00 /EI
UV(2)= 0,22 /EI	UH(2)= 0,10 /EI
UR(2)= -2,57 /EI	
UV(3)= 0,00 /EI	UH(3)= 0,00 /EI
HE(1,2)= -9,399 /EI	
HE(3,2)= 18,977 /EI	
RH(1)= -10,09 kN	RV(1)= 12,58 kNm
RH(3)= -3,35 kN	RV(3)= 2,21 kNm

Click **OKF2F5**, Show1, Show2 and with left button and right button resp. Pr beam load forces to check the data.
Next Calculate and DANA(L,H)(H,L) and Reactions and displ.

Fig.2a and 2b.
The member axis system $\underset{y}{\downarrow}\overset{x}{\rightarrow}$ is always placed at the lowest member end number. The direction of the member end forces DA(,) is assumed like the y axis, the direction of the member end forces NA(,) is assumed like the x axis. A negaive answer then opposite directed.
The direction of the member end moments MF(,) are assumed to the right.

Results fig.1 page 16
HE(1,2)= 9,399/EI and HE(3,2)= -18,977/EI,

and here the 'mirrorred' fig.1 with
HE(1,2)= -9,399/EI and HE((3,2)= 18,977/EI.

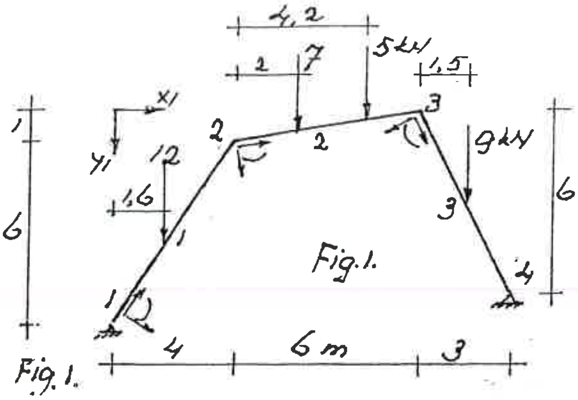


Fig.1.

NFB(1)=1	I	F2	L2
	1	6,66	2,88
NFA(1)=1	I	F5	L5
	1	-9,98	2,88
NFB(2)=2	I	F2	L2
	1	6,90	2,03
	2	4,93	4,26
NFA(2)=2	I	F5	L5
	1	-1,15	2,03
	2	-0,82	4,26
NFB(3)=1	I	F2	L2
	1	4,02	3,35
NFA(3)=1	I	F5	L5
	1	8,05	3,35
NFV(1)=1	I	FV	LH
	1	12,00	1,60
NFV(2)=2	I	FV	LH
	1	7,00	2,00
	2	5,00	4,20
NFV(3)=1	I	FV	LH
	1	9,00	1,50

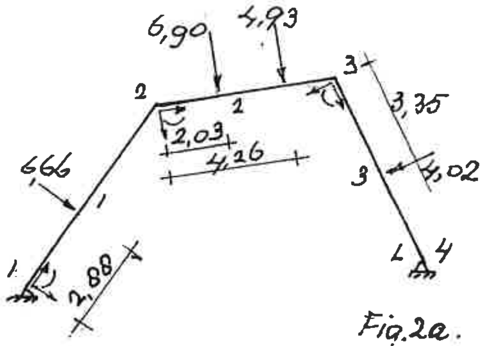


Fig.2a.

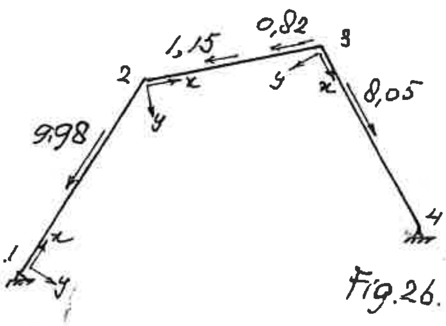


Fig.2b.

Example. EX8

Fig.1.

PV(1)=1 PH(1)=1 PV(4)=1 PH(4)=1

N9=4 joints.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	0	7	2	4	1
3	10	0	4	13	6

P9=3 members.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	1	0	1	1	100
2	2	3	0	0	2	1	100
3	3	4	0	1	3	1	100

Vertical member load forces.

P	NFV(P)	I	FVV(P,I)	LH(P,I)
1	1	I	12	1.6
2	2	1	7	2
2	2	2	5	4.2
3	1	1	9	1.5

DA(2,3)=	-4,45 kN	DA(3,2)=	-7,39 kN
NA(2,3)=	8,25 kN	NA(3,2)=	-6,27 kN
MF(2,3)=	-2,22 kNm	MF(3,2)=	12,15 kNm

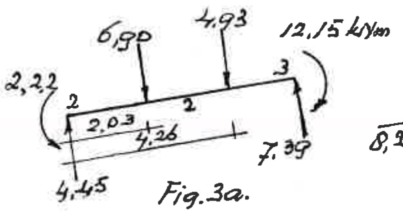


Fig.3a.

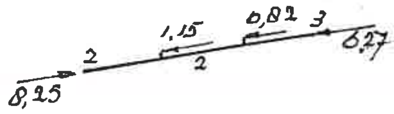


Fig.3b.

Fig.3a. Equilibrium check.
$\sum$'vert.' =0 4,45-6,90-4,93+7,39= 0,01 ok
$\sum$ mom. jt.2 =0
6,90*2,03 +4,93*4,26 +12,15 -2,22 -7,39*
14,00 +21,00 +9,93 -44,93= 0 ok

Fig.3b.
$\sum$ 'hor.' =0 8,25 -1,15 -0,82 -6,27= 0,01 ok

UV(1)=	0,00 /EI	UH(1)=	0,00 /EI
UV(2)=	41,97 /EI	UH(2)=	61,28 /EI
UR(2)=	-3,74 /EI		
UV(3)=	-23,95 /EI	UH(3)=	49,85 /EI
UR(3)=	-7,59 /EI		
UV(4)=	0,00 /EI	UH(4)=	0,00 /EI
HE(1,2)=	12,527 /EI		
HE(4,3)=	-0,218 /EI		
RH(1)=	7,40 kN	RV(1)=	17,75 kNm
RH(4)=	-7,40 kN	RV(4)=	15,25 kNm

Click M5MAX for bending maximum bending moments and moment zero points.

M5= -2,22	kNm	X= 0,00 m	P= 2
M5= 0,00	kNm	X= 0,50 m	
M5= 6,80	kNm	X= 2,03 m	
M5= -0,01	kNm	X= 4,44 m	
M5=-12,15	kNm	X= 6,08 m	

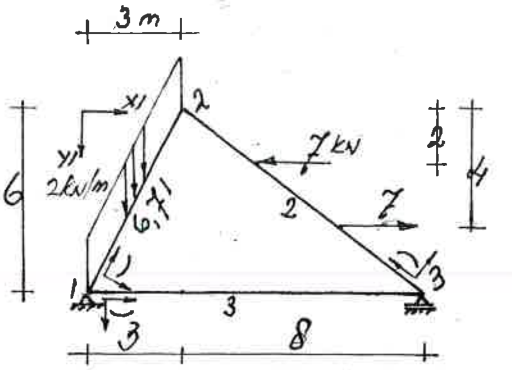


Fig.1a.

NQB(1)=1	I	Q3	Q4	L3	L4
	1	0,89	0,89	0,00	6,71
NQA(1)=1	I	Q6	Q7	L6	L7
	1	-1,79	-1,79	0,00	6,71
NFB(2)=2	I	F2	L2		
	1	-4,20	6,67		
	2	4,20	3,33		
NFA(2)=2	I	F5	L5		
	1	-5,60	3,33		
	2	5,60	6,67		
NQV(1)=1	I	Q3V	Q4V	LH3	LH4
	1	2,00	2,00	0,00	3,00
NFH(2)=2	I	FH	LV		
	1	-7,00	2,00		
	2	7,00	4,00		

Example. ` EX9

Fig.1a. PV(1)=1 PH(1)=1 PV(3)=1

N9=4 joints.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	0	6	2	3	0
3	11	6			

P9=3 members.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	0	0	1	1	300
2	2	3	0	0	3	1	300
3	1	3	0	0	1	1	300

NQV(1)=1 vertical distributed load.

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LV3(P,I)	L4V(P,I)
1	1	1	2	2	0	3

NFH(2)=2 horizontal loads

P	NFH(P)	I	FVV(P,I)	LH(P,I)
2	2	1	-7	2
2	2	2	7	4

UV(1)=	0,00 /EI	UH(1)=	0,00 /EI
UR(1)=	3,42 /EI		
UV(2)=	0,20 /EI	UH(2)=	0,02 /EI
UR(2)=	-2,02 /EI		
UV(3)=	0,00 /EI	UH(3)=	0,13 /EI
UR(3)=	3,77 /EI		
RH(1)=	0,00 kN	RV(1)=	12,86 kNm
		RV(3)=	0,56 kNm

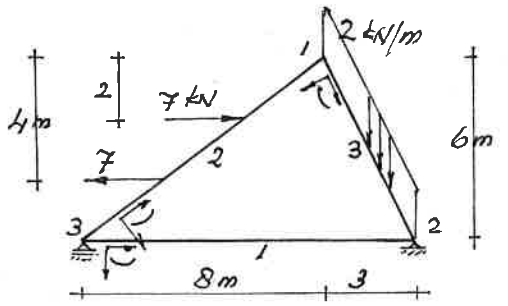


Fig.1b.

NFB(2)=2	I	F2	L2		
	1	-4,20	3,33		
	2	4,20	6,67		
NFA(2)=2	I	F5	L5		
	1	5,60	6,67		
	2	-5,60	3,33		
NQB(3)=1	I	Q3	Q4	L3	L4
	1	0,89	0,89	0,00	6,71
NQA(3)=1	I	Q6	Q7	L6	L7
	1	1,79	1,79	0,00	6,71
NFH(2)=2	I	FH	LV		
	1	-7,00	4,00		
	2	7,00	2,00		
NQV(3)=1	I	Q3V	Q4V	LH3	LH4
	1	2,00	2,00	0,00	3,00

Example. ` EX10

Fig.1b. PV(2)=1 PH(2)=1 PV(3)=1

N9=4 joints.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	8	0	2	11	6
3	0	6			

P9=3 members.

P	LL	HH	NL	NH	BA	EI	EA
1	2	3	0	0	3	1	300
2	1	3	0	0	3	1	300
3	1	2	0	0	1	1	300

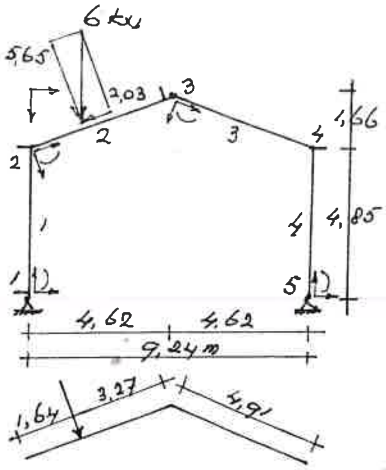
NQV(3)=1 vertical distributed load.

P	NQV(P)	I	Q3V(P,I)	Q4V(P,I)	LH3(P,I)	LH4(P,I)
3	1	1	2	2	0	3

NFH(2)=2 horizontal loads.

P	NFH(P)	I	FHH(P,I)	LV(P,I)
2	2	1	7	2
2	2	2	-7	4

UV(1)=	0,20 /EI	UH(1)=	-0,02 /EI
UR(1)=	2,02 /EI		
UV(2)=	0,00 /EI	UH(2)=	0,00 /EI
UR(2)=	-3,42 /EI		
UV(3)=	0,00 /EI	UH(3)=	-0,13 /EI
UR(3)=	-3,77 /EI		
RH(2)=	0,00 kN	RV(2)=	12,86 kNm
		RV(3)=	0,56 kNm



Example, see Part15 page 15.

First type 5 in TP9, Tab, cursor in TSTRING.
Click Joint data and type in TSTRING
PH(1)=1 Enter, PV(1)=1 Enter, PR(1)=1 Enter,
PH(5)=1 Enter, PV(5)=1 Enter, PR(5)=1 Enter.

N9=5 joints.

I	X1(I)	Y1(I)	I	X1(I)	Y1(I)
1	0	6.51	2	0	1.66
3	4.62	0	4	9.24	1.66
5	9.24	6.51			

Click Coordinates and type in TSTRING
1,0,6.51 Enter, 2,0,1.66 Enter,
3,4.62,0 Enter, 4,9.24,1.66 Enter and
5,9.24,6.51 Enter.

P9=4 members.

P	LL	HH	NL	NH	BA	EI	EA
1	1	2	0	0	1	1	300
2	2	3	0	0	2	1	300
3	3	4	0	0	3	1	300
4	4	5	0	0	5	1	300

Type 4 in TP9 Tab and type in TSTRING
1,1,2,0,0,1,1,300 Enter,
2,2,3,0,0,2,1,300 Enter etc.

Vertical load force on member 2.

P	NFV(P)	I	FVV(P,I)	LH(P,I)
2	1	1	6	1.54

Click load forces NFV(P) and type in TSTRING
2,1,1,6,1.54 Enter.

Next Calculate, D5D6(L,H)(H,L) and
Reactions and displ, see results on the left.

NFB(2)=1	I	F2	L2
	1	5,65	1,64
NFA(2)=1	I	F5	L5
	1	-2,03	1,64
NFV(2)=1	I	FV	LB
	1	6,00	1,54

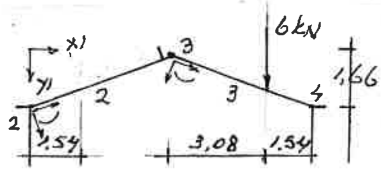
UV(1)=	0,00 /EI	UB(1)=	0,00 /EI
UR(1)=	0,00 /EI		
UV(2)=	0,08 /EI	UB(2)=	4,36 /EI
UR(2)=	5,35 /EI		
UV(3)=	9,12 /EI	UB(3)=	7,59 /EI
UR(3)=	-2,84 /EI		
UV(4)=	0,01 /EI	UB(4)=	10,84 /EI
UR(4)=	0,92 /EI		
UV(5)=	0,00 /EI	UB(5)=	0,00 /EI
UR(5)=	0,00 /EI		
RB(1)=	0,90 kN	RV(1)=	5,14 kNm
RM(1)=	1,09 kNm		
RB(5)=	-0,90 kN	RV(5)=	0,86 kNm
RM(5)=	-2,38 kNm		

Now with 6 kN on member 3, start all over again
or going on as follows, see left bottom.

Click load forces NFV(P) and type in TSTRING
2,1,1,-6,1.54 Enter to 'remove' 6 kN,
and ad 6 kN to member 3
3,1,1,6,3.08 Enter.

Click OKF2F5 and left and right button on
Pr beam load forces.

Possible problems of double values after
OKF2F5, to avoid them start all over again!



NFB(2)=2	I	F2	L2
	1	5,65	1,64
	2	-5,65	1,64
NFA(2)=2	I	F5	L5
	1	-2,03	1,64
	2	2,03	1,64
NFB(3)=1	I	F2	L2
	1	5,65	3,27
NFA(3)=1	I	F5	L5
	1	2,03	3,27
NFV(2)=1	I	FV	LB
	1	-6,00	1,54
NFV(3)=1	I	FV	LB
	1	6,00	3,08

Click Again!!
Next Calculate, and Reactions and displ.
And compare, see the 'symmetry' in results.

UV(1)=	0,00 /EI	UB(1)=	0,00 /EI
UR(1)=	0,00 /EI		
UV(2)=	0,01 /EI	UB(2)=	-10,84 /EI
UR(2)=	-0,92 /EI		
UV(3)=	9,12 /EI	UB(3)=	-7,59 /EI
UR(3)=	2,84 /EI		
UV(4)=	0,08 /EI	UB(4)=	-4,36 /EI
UR(4)=	-5,35 /EI		
UV(5)=	0,00 /EI	UB(5)=	0,00 /EI
UR(5)=	0,00 /EI		
RB(1)=	0,90 kN	RV(1)=	0,86 kNm
RM(1)=	2,38 kNm		
RB(5)=	-0,90 kN	RV(5)=	5,14 kNm
RM(5)=	-1,09 kNm		