

# T3D

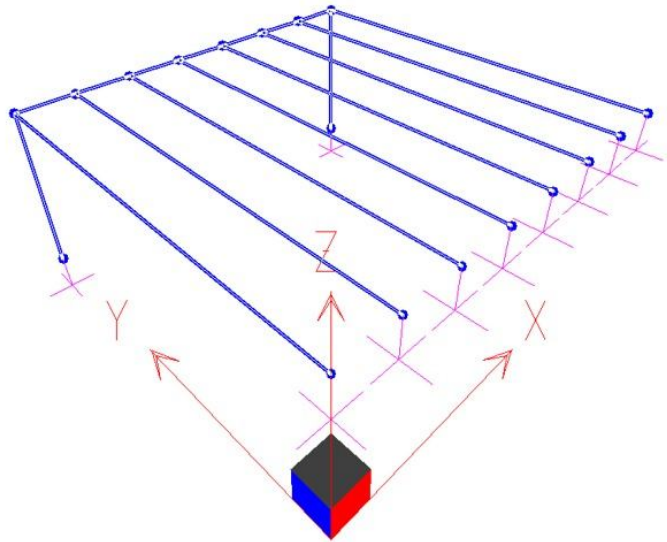
## TELAIO TRIDIMENSIONALE.

SYSTEM P=1

L=1 : metri, tonnellate

### JOINTS

1	X=7	Y=0	Z=3
2	X=7	Y=7	Z=3
3	X=6	Y=0	Z=3
4	X=6	Y=7	Z=3
5	X=5	Y=0	Z=3
6	X=5	Y=7	Z=3
7	X=4	Y=0	Z=3
8	X=4	Y=7	Z=3
9	X=3	Y=0	Z=3
10	X=3	Y=7	Z=3
11	X=2	Y=0	Z=3
12	X=2	Y=7	Z=3
13	X=1	Y=0	Z=3
14	X=1	Y=7	Z=3
15	X=0	Y=0	Z=3
16	X=0	Y=7	Z=3
17	X=7	Y=7	Z=0
18	X=0	Y=7	Z=0



:

### RESTRAINTS

1,15,2 R=1,1,1,1,1,1 :INCASTRI TRAVE CENTRALE  
 2,16,2 R=0,0,0,0,0,0 :VINCOLI TRAVE PERIMETRALE  
 17,18,1 R=1,1,1,1,1,1 :BASE PILASTRI

:

### FRAME

NM=4 NL=1

1	I=0.00220,0.01370	E=3000000	A=0.2560	J=0.0066	:TRAVE
2	I=0.00340,0.00340	E=3000000	A=0.2025	J=0.0059	:PILASTRI
3	I=0.00206,0.00862	E=3000000	A=0.1550	J=0.00046	:TRAVETTI SOLAIO

~~4 D=0.80 B=0.32 J=0.0066~~

1 WL=0,-0.97,0 :CARICO TOTALE

1,1,2	M=3	NSL=1	LP=3,0	:TRAVETTI
2,3,4	M=3	NSL=1	LP=3,0	
3,5,6	M=3	NSL=1	LP=3,0	
4,7,8	M=3	NSL=1	LP=3,0	
5,9,10	M=3	NSL=1	LP=3,0	
6,11,12	M=3	NSL=1	LP=3,0	
7,13,14	M=3	NSL=1	LP=3,0	
8,15,16	M=3	NSL=1	LP=3,0	
9,17,2	M=2	NSL=0	LP=3,0	:PILASTRI
10,18,16	M=2	NSL=0	LP=3,0	
11,2,4	M=1	NSL=0	LP=2,0	:TRAVE
12,4,6	M=1	NSL=0	LP=2,0	
13,6,8	M=1	NSL=0	LP=2,0	
14,8,10	M=1	NSL=0	LP=2,0	
15,10,12	M=1	NSL=0	LP=2,0	
16,12,14	M=1	NSL=0	LP=2,0	
17,14,16	M=1	NSL=0	LP=2,0	

:

## Torsion constant

The torsion constant is a geometrical property of a beam's cross-section which is involved in the relationship between angle of twist and applied torque along the axis of the bar, for a homogeneous linear-elastic bar. That is, the torsion constant describes a beam's torsional stiffness.

For a beam of uniform cross-section along its length:

$$\theta = TL/JG$$

where

$\theta$  is the angle of twist in radians

$T$  is the applied torque

$L$  is the beam length

$J$  is the torsion constant

$G$  is the Modulus of rigidity (shear modulus) of the material

## Rectangle

$$J = \beta ab^3$$

where

$a$  is the length of the long side

$b$  is the length of the short side

$\beta$  is found from the following table:

$a/b$	$\beta$
1.0	0.141
1.5	0.196
2.0	0.229
2.5	0.249
3.0	0.263
4.0	0.281
5.0	0.291
6.0	0.299
10.0	0.312
$\infty$	0.333

Table 1

### I-Shaped, Channel and Tee Section

As will be observed from a study of Table 1 the values of  $\beta$  become nearly constant for large ratios  $a/b$ . Thus the torsional constants for sections composed of thin rectangles may be computed as the sum of the values for the individual components. Such an approach will give an approximation, which neglects the contribution in the fillet region where the components are joined.

For most common structural shapes this approximation causes little error, thus

$$J \approx \sum \frac{1}{3} ab^3$$

Where  $a$  is the long dimension and  $b$  the thin dimension of the rectangular elements.

TELAIO TRIDIMENSIONALE.

J O I N T D I S P L A C E M E N T S

LOAD CONDITION 1 - DISPLACEMENTS "U" AND ROTATIONS "R"

JOINT	U(X)	U(Y)	U(Z)	R(X)	R(Y)	R(Z)
1	.000000	.000000	.000000	.000000	.000000	.000000
2	-.1888E-04	-.2127E-04	-.5286E-04	.3183E-03	-.6359E-03	-.1172E-04
3	.000000	.000000	.000000	.000000	.000000	.000000
4	-.000013	-.000009	-.001147	.000501	-.001361	-.000010
5	.000000	.000000	.000000	.000000	.000000	.000000
6	-.000008	-.000002	-.002471	.000509	-.001166	-.000004
7	.000000	.000000	.000000	.000000	.000000	.000000
8	-.000003	.000001	-.003306	.000479	-.000446	-.000001
9	.000000	.000000	.000000	.000000	.000000	.000000
10	.000003	.000001	-.003306	.000479	.000446	.000001
11	.000000	.000000	.000000	.000000	.000000	.000000
12	.000008	-.000002	-.002471	.000509	.001166	.000004
13	.000000	.000000	.000000	.000000	.000000	.000000
14	.000013	-.000009	-.001147	.000501	.001361	.000010
15	.000000	.000000	.000000	.000000	.000000	.000000
16	.1888E-04	-.2127E-04	-.5286E-04	.3183E-03	.6359E-03	.1172E-04
17	.000000	.000000	.000000	.000000	.000000	.000000
18	.000000	.000000	.000000	.000000	.000000	.000000

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PROGRAM: SAP90/FILE: t3d. SOL

TELAIO TRIDIMENSIONALE.

R E A C T I O N S A N D A P P L I E D F O R C E S

LOAD CONDITION 1 - FORCES "F" AND MOMENTS "M"

JOINT	F(X)	F(Y)	F(Z)	M(X)	M(Y)	M(Z)
1	.0542	1.4128	3.6473	4.5629	.0482	-.1463
2	.0000	.0000	.0000	.0000	.0000	.0000
3	.0440	.6013	4.0218	5.7126	.1032	-.1168
4	.0000	.0000	.0000	.0000	.0000	.0000
5	.0212	.1136	4.3143	6.7292	.0884	-.0581
6	.0000	.0000	.0000	.0000	.0000	.0000
7	.0057	-.0594	4.4719	7.3076	.0338	-.0161
8	.0000	.0000	.0000	.0000	.0000	.0000
9	-.0057	-.0594	4.4719	7.3076	-.0338	.0161
10	.0000	.0000	.0000	.0000	.0000	.0000
11	-.0212	.1136	4.3143	6.7292	-.0884	.0581
12	.0000	.0000	.0000	.0000	.0000	.0000
13	-.0440	.6013	4.0218	5.7126	-.1032	.1168
14	.0000	.0000	.0000	.0000	.0000	.0000
15	-.0542	1.4128	3.6473	4.5629	-.0482	.1463
16	.0000	.0000	.0000	.0000	.0000	.0000
17	-4.2384	-2.0683	10.7046	2.0201	-4.1956	.0266
18	4.2384	-2.0683	10.7046	2.0201	4.1956	-.0266
TOTAL	.8882E-15	.4441E-15	.5432E+02	.5266E+02	.9770E-14	-.3101E-13

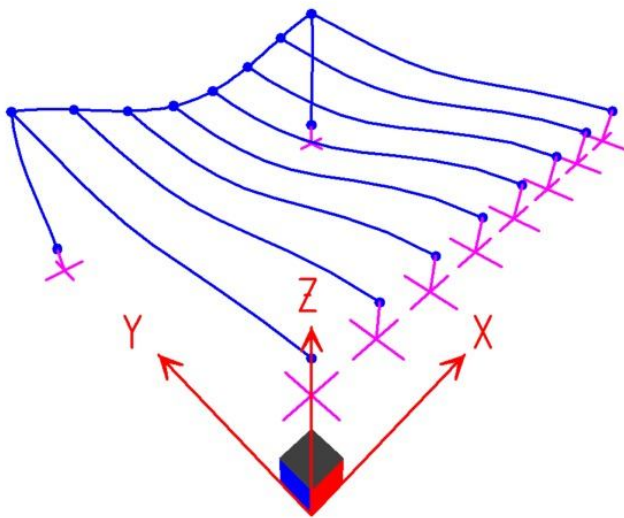
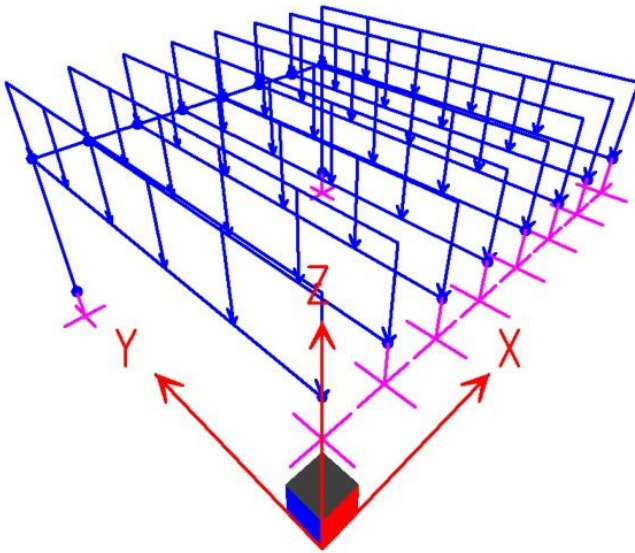
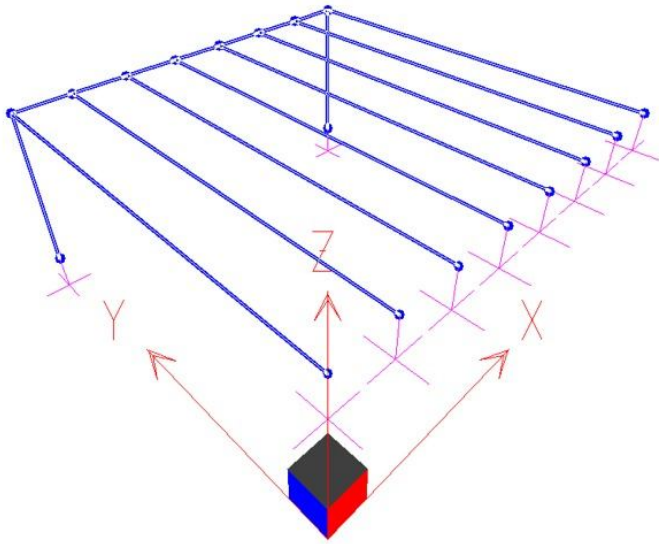
F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COND	AXIAL FORCE	DIST ENDI	1-2 PLANE		1-3 PLANE		AXIAL TORQ
				SHEAR	MOMENT	SHEAR	MOMENT	
1	1	-1.41						
			.0	3.65	-4.56	.05	-.15	-.05
			3.8	.00	2.29	.05	.06	
			7.0	-3.14	-2.80	.05	.23	
2	1	-.60						
			.0	4.02	-5.71	.04	-.12	-.10
			4.1	.00	2.62	.04	.07	
			7.0	-2.77	-1.33	.04	.19	
3	1	-.11						
			.0	4.31	-6.73	.02	-.06	-.09
			4.4	.00	2.87	.02	.04	
			7.0	-2.48	-.29	.02	.09	
4	1	.06						
			.0	4.47	-7.31	.01	-.02	-.03
			4.6	.00	3.00	.01	.01	
			7.0	-2.32	.23	.01	.02	
5	1	.06						
			.0	4.47	-7.31	-.01	.02	.03
			4.6	.00	3.00	-.01	-.01	
			7.0	-2.32	.23	-.01	-.02	
6	1	-.11						
			.0	4.31	-6.73	-.02	.06	.09
			4.4	.00	2.87	-.02	-.04	
			7.0	-2.48	-.29	-.02	-.09	
7	1	-.60						
			.0	4.02	-5.71	-.04	.12	.10
			4.1	.00	2.62	-.04	-.07	
			7.0	-2.77	-1.33	-.04	-.19	
8	1	-1.41						
			.0	3.65	-4.56	-.05	.15	.05
			3.8	.00	2.29	-.05	-.06	
			7.0	-3.14	-2.80	-.05	-.23	
9	1	-10.70						
			.0	2.07	-2.02	-4.24	4.20	-.03
			3.0	2.07	4.18	-4.24	-8.52	
10	1	-10.70						
			.0	2.07	-2.02	4.24	-4.20	.03
			3.0	2.07	4.18	4.24	8.52	
11	1	-4.18						
			.0	7.56	-8.57	-.66	.26	-1.39
			1.0	7.56	-1.01	-.66	-.40	

TELAIO TRIDIMENSIONALE.

FRAME ELEMENT FORCES

ELT ID	LOAD COND	AXIAL FORCE	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
12	1	-4.14	.0	4.79	-1.11	-.05	-.20	-.06
			1.0	4.79	3.68	-.05	-.26	
13	1	-4.12	.0	2.32	3.60	.06	-.17	.23
			1.0	2.32	5.91	.06	-.11	
14	1	-4.11	.0	.00	5.88	.00	-.09	.00
			1.0	.00	5.88	.00	-.09	
15	1	-4.12	.0	-2.32	5.91	-.06	-.11	-.23
			1.0	-2.32	3.60	-.06	-.17	
16	1	-4.14	.0	-4.79	3.68	.05	-.26	.06
			1.0	-4.79	-1.11	.05	-.20	
17	1	-4.18	.0	-7.56	-1.01	.66	-.40	1.39
			1.0	-7.56	-8.57	.66	.26	









TELAIO TRIDIMENSIONALE.

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
2	1	-1,888E-05	-2,127E-05	-5,286E-05	3,183E-04	-6,359E-04	-1,172E-05
3	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
4	1	-1,343E-05	-9,053E-06	-1,147E-03	5,006E-04	-1,361E-03	-1,006E-05
5	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
6	1	-8,041E-06	-1,709E-06	-2,471E-03	5,089E-04	-1,166E-03	-4,411E-06
7	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
8	1	-2,678E-06	0,0000	-3,306E-03	4,786E-04	-4,455E-04	-1,037E-06
9	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
10	1	2,678E-06	0,0000	-3,306E-03	4,786E-04	4,455E-04	1,037E-06
11	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
12	1	8,041E-06	-1,709E-06	-2,471E-03	5,089E-04	1,166E-03	4,411E-06
13	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
14	1	1,343E-05	-9,053E-06	-1,147E-03	5,006E-04	1,361E-03	1,006E-05
15	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
16	1	1,888E-05	-2,127E-05	-5,286E-05	3,183E-04	6,359E-04	1,172E-05
17	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
18	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000

TELAIO TRIDIMENSIONALE.

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	1	0,0542	1,4128	3,6473	4,5629	0,0482	-0,1463
3	1	0,0440	0,6013	4,0218	5,7126	0,1032	-0,1168
5	1	0,0212	0,1136	4,3143	6,7292	0,0884	-0,0581
7	1	5,705E-03	-0,0594	4,4719	7,3076	0,0338	-0,0161
9	1	-5,705E-03	-0,0594	4,4719	7,3076	-0,0338	0,0161
11	1	-0,0212	0,1136	4,3143	6,7292	-0,0884	0,0581
13	1	-0,0440	0,6013	4,0218	5,7126	-0,1032	0,1168
15	1	-0,0542	1,4128	3,6473	4,5629	-0,0482	0,1463
17	1	-4,2384	-2,0683	10,7046	2,0201	-4,1956	0,0266
18	1	4,2384	-2,0683	10,7046	2,0201	4,1956	-0,0266

TELAIO TRIDIMENSIONALE.

FRAME ELEMENT FORCES

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	1	0,00	-1,41	-3,65	-5,418E-02	-4,821E-02	-1,463E-01	-4,56
		1,75	-1,41	-1,95	-5,418E-02	-4,821E-02	-5,153E-02	3,346E-01
		3,50	-1,41	-2,523E-01	-5,418E-02	-4,821E-02	4,328E-02	2,26
		5,25	-1,41	1,45	-5,418E-02	-4,821E-02	1,381E-01	1,22
		7,00	-1,41	3,14	-5,418E-02	-4,821E-02	2,329E-01	-2,80
2	1	0,00	-6,013E-01	-4,02	-4,399E-02	-1,032E-01	-1,168E-01	-5,71
		1,75	-6,013E-01	-2,32	-4,399E-02	-1,032E-01	-3,984E-02	-1,598E-01
		3,50	-6,013E-01	-6,268E-01	-4,399E-02	-1,032E-01	3,715E-02	2,42
		5,25	-6,013E-01	1,07	-4,399E-02	-1,032E-01	1,141E-01	2,03
		7,00	-6,013E-01	2,77	-4,399E-02	-1,032E-01	1,911E-01	-1,33
3	1	0,00	-1,136E-01	-4,31	-2,124E-02	-8,841E-02	-5,806E-02	-6,73
		1,75	-1,136E-01	-2,62	-2,124E-02	-8,841E-02	-2,088E-02	-6,645E-01
		3,50	-1,136E-01	-9,193E-01	-2,124E-02	-8,841E-02	1,630E-02	2,43
		5,25	-1,136E-01	7,782E-01	-2,124E-02	-8,841E-02	5,347E-02	2,55
		7,00	-1,136E-01	2,48	-2,124E-02	-8,841E-02	9,065E-02	-2,939E-01
4	1	0,00	5,939E-02	-4,47	-5,705E-03	-3,378E-02	-1,614E-02	-7,31
		1,75	5,939E-02	-2,77	-5,705E-03	-3,378E-02	-6,155E-03	-9,670E-01
		3,50	5,939E-02	-1,08	-5,705E-03	-3,378E-02	3,829E-03	2,40
		5,25	5,939E-02	6,206E-01	-5,705E-03	-3,378E-02	1,381E-02	2,80
		7,00	5,939E-02	2,32	-5,705E-03	-3,378E-02	2,380E-02	2,309E-01
5	1	0,00	5,939E-02	-4,47	5,705E-03	3,378E-02	1,614E-02	-7,31
		1,75	5,939E-02	-2,77	5,705E-03	3,378E-02	6,155E-03	-9,670E-01
		3,50	5,939E-02	-1,08	5,705E-03	3,378E-02	-3,829E-03	2,40
		5,25	5,939E-02	6,206E-01	5,705E-03	3,378E-02	-1,381E-02	2,80
		7,00	5,939E-02	2,32	5,705E-03	3,378E-02	-2,380E-02	2,309E-01
6	1	0,00	-1,136E-01	-4,31	2,124E-02	8,841E-02	5,806E-02	-6,73
		1,75	-1,136E-01	-2,62	2,124E-02	8,841E-02	2,088E-02	-6,645E-01
		3,50	-1,136E-01	-9,193E-01	2,124E-02	8,841E-02	-1,630E-02	2,43
		5,25	-1,136E-01	7,782E-01	2,124E-02	8,841E-02	-5,347E-02	2,55
		7,00	-1,136E-01	2,48	2,124E-02	8,841E-02	-9,065E-02	-2,939E-01
7	1	0,00	-6,013E-01	-4,02	4,399E-02	1,032E-01	1,168E-01	-5,71
		1,75	-6,013E-01	-2,32	4,399E-02	1,032E-01	3,984E-02	-1,598E-01
		3,50	-6,013E-01	-6,268E-01	4,399E-02	1,032E-01	-3,715E-02	2,42
		5,25	-6,013E-01	1,07	4,399E-02	1,032E-01	-1,141E-01	2,03
		7,00	-6,013E-01	2,77	4,399E-02	1,032E-01	-1,911E-01	-1,33
8	1	0,00	-1,41	-3,65	5,418E-02	4,821E-02	1,463E-01	-4,56
		1,75	-1,41	-1,95	5,418E-02	4,821E-02	5,153E-02	3,346E-01
		3,50	-1,41	-2,523E-01	5,418E-02	4,821E-02	-4,328E-02	2,26
		5,25	-1,41	1,45	5,418E-02	4,821E-02	-1,381E-01	1,22
		7,00	-1,41	3,14	5,418E-02	4,821E-02	-2,329E-01	-2,80
9	1	0,00	-10,70	-2,07	4,24	-2,659E-02	4,20	-2,02
		7,5E-01	-10,70	-2,07	4,24	-2,659E-02	1,02	-4,689E-01
		1,50	-10,70	-2,07	4,24	-2,659E-02	-2,16	1,08
		2,25	-10,70	-2,07	4,24	-2,659E-02	-5,34	2,63
		3,00	-10,70	-2,07	4,24	-2,659E-02	-8,52	4,18
10	1	0,00	-10,70	-2,07	-4,24	2,659E-02	-4,20	-2,02
		7,5E-01	-10,70	-2,07	-4,24	2,659E-02	-1,02	-4,689E-01
		1,50	-10,70	-2,07	-4,24	2,659E-02	2,16	1,08
		2,25	-10,70	-2,07	-4,24	2,659E-02	5,34	2,63
		3,00	-10,70	-2,07	-4,24	2,659E-02	8,52	4,18
11	1	0,00	-4,18	-7,56	6,555E-01	-1,39	2,595E-01	-8,57
		2,5E-01	-4,18	-7,56	6,555E-01	-1,39	9,562E-02	-6,68
		5,0E-01	-4,18	-7,56	6,555E-01	-1,39	-6,825E-02	-4,79
		7,5E-01	-4,18	-7,56	6,555E-01	-1,39	-2,321E-01	-2,90
		1,00	-4,18	-7,56	6,555E-01	-1,39	-3,960E-01	-1,01
12	1	0,00	-4,14	-4,79	5,416E-02	-6,299E-02	-2,049E-01	-1,11
		2,5E-01	-4,14	-4,79	5,416E-02	-6,299E-02	-2,184E-01	8,944E-02
		5,0E-01	-4,14	-4,79	5,416E-02	-6,299E-02	-2,320E-01	1,29
		7,5E-01	-4,14	-4,79	5,416E-02	-6,299E-02	-2,455E-01	2,49
		1,00	-4,14	-4,79	5,416E-02	-6,299E-02	-2,590E-01	3,68
13	1	0,00	-4,12	-2,32	-5,939E-02	2,309E-01	-1,684E-01	3,60
		2,5E-01	-4,12	-2,32	-5,939E-02	2,309E-01	-1,536E-01	4,18
		5,0E-01	-4,12	-2,32	-5,939E-02	2,309E-01	-1,387E-01	4,76
		7,5E-01	-4,12	-2,32	-5,939E-02	2,309E-01	-1,239E-01	5,33
		1,00	-4,12	-2,32	-5,939E-02	2,309E-01	-1,090E-01	5,91
14	1	0,00	-4,11	0,00	0,00	0,00	-8,521E-02	5,88
		2,5E-01	-4,11	0,00	0,00	0,00	-8,521E-02	5,88
		5,0E-01	-4,11	0,00	0,00	0,00	-8,521E-02	5,88

	7,5E-01	-4,11	0,00	0,00	0,00	-8,521E-02	5,88
	1,00	-4,11	0,00	0,00	0,00	-8,521E-02	5,88
15	1						
	0,00	-4,12	2,32	5,939E-02	-2,309E-01	-1,090E-01	5,91
	2,5E-01	-4,12	2,32	5,939E-02	-2,309E-01	-1,239E-01	5,33
	5,0E-01	-4,12	2,32	5,939E-02	-2,309E-01	-1,387E-01	4,76
	7,5E-01	-4,12	2,32	5,939E-02	-2,309E-01	-1,536E-01	4,18
	1,00	-4,12	2,32	5,939E-02	-2,309E-01	-1,684E-01	3,60
16	1						
	0,00	-4,14	4,79	-5,416E-02	6,299E-02	-2,590E-01	3,68
	2,5E-01	-4,14	4,79	-5,416E-02	6,299E-02	-2,455E-01	2,49
	5,0E-01	-4,14	4,79	-5,416E-02	6,299E-02	-2,320E-01	1,29
	7,5E-01	-4,14	4,79	-5,416E-02	6,299E-02	-2,184E-01	8,944E-02
	1,00	-4,14	4,79	-5,416E-02	6,299E-02	-2,049E-01	-1,11
17	1						
	0,00	-4,18	7,56	-6,555E-01	1,39	-3,960E-01	-1,01
	2,5E-01	-4,18	7,56	-6,555E-01	1,39	-2,321E-01	-2,90
	5,0E-01	-4,18	7,56	-6,555E-01	1,39	-6,825E-02	-4,79
	7,5E-01	-4,18	7,56	-6,555E-01	1,39	9,562E-02	-6,68
	1,00	-4,18	7,56	-6,555E-01	1,39	2,595E-01	-8,57