

# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

ABSTRACT:



REFERENCES:

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48						
49	0	PVo	Wo 03-Feb-2021	First Issue		
50						
51	REV	BY	DATE	DESCRIPTION	CHECKED	PROJECT APPROVAL
52						THIRD PARTY APPROVAL
53						
54	STATUS CODE			DOCUMENT NUMBER	REVISION	STATUS
55						
56	A Preliminary for information only			<b>SP121000</b>	<b>0</b>	<b>A</b>
57	B For review					
58	C Authorized for construction					
59						
60						
61						

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FATIGUE STMW REV 1.0  
ORDER 16696      Za 05-Sep-1992      18:16:05  
PROJ Voorbeeld

PAGE 0

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*****      **      *****      ****      ****      ***      **      *****
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**  *      **  **      **      **      **      **   **      **   **      **
*****      **  **      **      **      **      **      **      **      ****
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**      **  **  **      **      **      **      **   **      **   **      ** *
****      **  **      ****      ****      *****      ****      *****
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PIPE - STRESS - PROGRAMME - FATIGUE

DEVELOPED AND MAINTAINED BY

P.W.H. VOORHAAR  
LIJNBAAAN 27  
3421JG OUDEWATER

THIS PROGRAMME CALCULATES THE FATIGUE LIFE OF A PIPING SYSTEM  
USING THE PALMGREN-MINER'S ACCUMULATION RULE ACCORDING TO :

STOOMWEZEN D1200V PAR. 7.3.8

DNV "RULES FOR SUBMARINE PIPELINE SYSTEMS" PAR 4.2.4

ASME BOILER AND PRESSURE CODE VIII DIVISION 2 APPENDIX 5

PLACE - OUDEWATER      DATE - Za 05-Sep-1992

COMPANY -

NAME - P.W.H. VOORHAAR

SIGNATURE -

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THIS CALCULATION FORMS AN INTEGRAL PART OF A SET OF 5 CALCULATIONS  
MADE WITH THE P10 PROGRAMME.  
THESE 5 CALCULATIONS REPRESENT THE CYCLIC EVENTS CREATED BY  
ENVIRONMENTAL OR OPERATIONAL CONDITIONS.



NUMBER OF EVENTS :	5	Sa_limit
Occurances of event 1 :	10 in 40 YEARS.	3351.42 N/mm <sup>2</sup>
Occurances of event 2 :	10 in 40 YEARS.	3351.42 N/mm <sup>2</sup>
Occurances of event 3 :	10 in 40 YEARS.	3351.42 N/mm <sup>2</sup>
Occurances of event 4 :	1000 in 40 YEARS.	557.89 N/mm <sup>2</sup>
Occurances of event 5 :	10000 in 40 YEARS.	343.23 N/mm <sup>2</sup>

$R(f; \text{Infinite}) = 0.45 \cdot R_m$  ( $0.45 \cdot 550.00 \text{ N/mm}^2 = 247.50 \text{ N/mm}^2$ )  $Z=60\%$   
 $R_e(50.00) = 415.00 \text{ N/mm}^2$   
 $E\text{-modulus} = 191625.00 \text{ N/mm}^2$

THE ALLOWABLE NUMBER OF CYCLES AT MAXIMUM OCCURRING STRESS AMPLITUDE  
IS DETERMINED ACCORDING TO STOOMWEZEN D0105 PAR. 3.2.

THE FATIGUE LIMIT (ENDURANCE LIMIT FOR  $>2E+6$  CYCLES) =  $69.26 \text{ N/mm}^2$

STRESS AMPLITUDE ( $S_a$ ) TO BE USED ACCORDING STOOMWEZEN D0105 PAR. 3.0

THIS APPROACH HAS BEEN DISCUSSED WITH ING. E.P.W. BOON OF  
STOOMWEZEN'S TWD IN THE HAGUE ON 23 JANUARY 1992.

# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

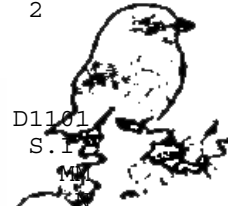
Date: Wo 03-Feb-2021

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1  FATIGUE STMW REV 1.0
2  ORDER 16696   Za 05-Sep-1992   18:16:05
3  PROJ Voorbeeld
4
5  K- AND I- FACTORS ACCORDING TO           = STOOMWEZEN D1101
6  INPUT UNITS                             = S.I.
7  PIPE DIMENSION UNITS                   =
8  FORCE UNITS                             =
9  OUTPUT UNITS                           = S.I.
10 INSTALLATION TEMPERATURE                = 7 CELSIUS
11 ALLOWED NUMBER OF ITERATIONS PER LOAD-COMPONENT = 40
12 TOLERANCE FOR FRICTION FORCES, ABSOLUTE = 1.000 N
13 TOLERANCE FOR FRICTION FORCES, RELATIVE = 1.000 PERCENT
14 EQUIVALENT STRESSES CALCULATED ACCORDING TO = HUBER HENCKY
15 DIRECTION OF GRAVITY                    = -Y
16 ACCELERATION OF GRAVITY                 = 9.80665 M/S2
17 MULTIPLICATION FACTOR FOR PRIMARY STRESSES = 0.750
18 BASE CASE (SPRING DESIGN)               = 1
19 FATIGUE FACTOR                         = 1.000
    
```

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21 *****
22 * . = NOT RESTRAINED *
23 * A = RESTRAINED *
24 * F = RESTRAINED BY FRICTION FORCE *
25 * RESTRAINT-CODE N = ONLY NEGATIVE REACTION POSSIBLE *
26 * DESCRIPTION P = ONLY POSITIVE REACTION POSSIBLE *
27 * S = CONVENTIONAL SPRING TO BE DESIGNED *
28 * C = CONSTANT-LOAD-HANGER TO BE DESIGNED *
29 * I = INVERSE SPRING TO BE DESIGNED *
30 *****
    
```

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31
32 NOD =====GLOBAL COORDINATES===== =====RESTRAINTS===== PAIR PENDULUM ==TEXT=
33 NR          X          Y          Z  RX  RY  RZ  TX  TY  TZ  NODE  LENGTH
34           MM          MM          MM
35
36 10    18300    4481    37650    .  .  .  .  .  .  .  Boun_Pt
37 20    18300    6700    37650    .  .  .  .  F  F  .  Wall_gu
38 30    18300    11600   37650    .  .  .  .  F  .  .  Stab_in
39 40    18300    15900   22150    .  .  .  .  .  F  .  Roof_gu
40 50    18300    15900   16803    .  .  .  .  .  F  .  Roof_gu
41 60    22500    15900    9555    .  .  .  .  .  F  .  Roof_gu
42 70    27555    15900    4501    .  .  .  .  F  .  Roof_gu
43 80    31485    15900    571    .  .  .  .  F  F  .  Roof_gu
44 90    36000    19700   -3944    .  .  .  .  F  .  Shaft_g
45 100   36000    26600   -3944    .  .  .  .  F  .  Shaft_g
46 110   36000    33250   -3944    .  .  .  .  F  .  Shaft_g
47 120   36000    38250   -3944    .  .  .  .  F  .  Shaft_g
48 130   36000    44250   -3944    .  .  .  .  F  .  Shaft_g
49 140   36000    48250   -3944    .  .  .  .  F  .  Shaft_g
50 150   36000    54750   -3944    .  .  .  .  F  .  Shaft_g
51 160   36000    57415   -3944    A  A  A  A  A  A  .  Anc_flg
52 170   25904    61900   -6462    .  .  .  .  .  .  .  Pig_rec
53 500   18300     820    40698    .  .  .  A  P  A  .  Sea_bed
54 502   18300     820    43098    .  .  .  A  P  A  .  Sea_bed
55 504   18300     820    45498    .  .  .  A  P  A  .  Sea_bed
56 506   18300     820    47898    .  .  .  A  P  A  .  Sea_bed
    
```

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NOD =====GLOBAL COORDINATES===== =====RESTRAINTS===== PAIR PENDULUM ==TEXT=											
NR	X	Y	Z	RX	RY	RZ	TX	TY	TZ	NODE	LENGTH
	MM	MM	MM								MM
510	18300	820	49898	.	.	.	A	A	A		Sea_bed
520	18300	820	54898	.	.	.	A	A	A		Sea_bed
530	18300	820	59898	.	.	.	A	A	A		Sea_bed
540	18300	820	64898	.	.	.	A	A	A		Sea_bed
550	18300	820	69898	.	.	.	A	A	A		Sea_bed
560	18300	820	78898	.	.	.	A	A	A		Sea_bed
564	18300	820	88898	.	.	.	A	A	A		Sea_bed
566	18300	820	91298	.	.	.	A	A	A		Sea_bed
568	18300	820	93698	.	.	.	A	A	A		Sea_bed
570	15356	820	98439	.	.	.	A	A	A		Sea_bed
580	10573	820	99721	.	.	.	A	A	A		Sea_bed
590	5743	820	101015	.	.	.	A	A	A		Sea_bed
600	913	820	102309	.	.	.	A	A	A		Sea_bed
610	-3916	820	103603	.	.	.	A	A	A		Sea_bed
620	-8746	820	104897	.	.	.	A	A	A		Sea_bed
630	-13575	820	106191	.	.	.	A	A	A		Sea_bed
644	-20337	820	108003	A	A	A	A	A	A		Vrt_Anc
900	18300	15900	32525	.	.	.	.	.	.		Open_ba
901	18300	15900	30745	.	.	.	.	.	.		Open_ba

NOD ==FRICTION RATES= =====LOCAL X-AXIS===== ==SPRING DATA===== ==TEXT=											
NR	FR-X	FR-Y	FR-Z	X	Y	Z	PS	FIX	RES	T	VAR
				MM	MM	MM	MAX	%	%		%
20	0.300										Wall_gu
30	0.300		0.300								Stab_in
40	0.300	0.300									Roof_gu
50	0.300	0.300									Roof_gu
60	0.300	0.300		1.0000		1.0000					Roof_gu
70	0.300		0.300	1.0000		1.0000					Roof_gu
80	0.300			1.0000		1.0000					Roof_gu
90	0.300		0.300								Shaft_g
100	0.300		0.300								Shaft_g
110	0.300		0.300								Shaft_g
120	0.300		0.300								Shaft_g
130	0.300		0.300								Shaft_g
140	0.300		0.300								Shaft_g
150	0.300		0.300								Shaft_g
570				4					-1		Sea_bed
580				4					-1		Sea_bed
590				4					-1		Sea_bed
600				4					-1		Sea_bed
610				4					-1		Sea_bed
620				4					-1		Sea_bed
630				4					-1		Sea_bed
644				4					-1		Vrt_Anc

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NOD =====SUPPORT SPRING RATES ===== ==TEXT=

NR	SRX NM/MRAD	SRY NM/MRAD	SRZ NM/MRAD	STX N/MM	STY N/MM	STZ N/MM	
500				414.5	2074.3	4465.3	Sea_bed
502				326.4	1633.3	3516.0	Sea_bed
504				326.4	1633.3	3516.0	Sea_bed
506				326.4	1633.3	3516.0	Sea_bed
510				11540.0	222645.0	7325.0	Sea_bed
520				11540.0	222645.0	7325.0	Sea_bed
530				11540.0	222645.0	7325.0	Sea_bed
540				11540.0	222645.0	7325.0	Sea_bed
550				11540.0	222645.0	7325.0	Sea_bed
560				11540.0	222645.0	7325.0	Sea_bed
564				5539.2	106870.0	3516.0	Sea_bed
566				5539.2	106870.0	3516.0	Sea_bed
568				7034.8	135772.0	7034.8	Sea_bed
570				7325.0	222645.0	11540.0	Sea_bed
580				7325.0	222645.0	11540.0	Sea_bed
590				7325.0	222645.0	11540.0	Sea_bed
600				7325.0	222645.0	11540.0	Sea_bed
610				7325.0	222645.0	11540.0	Sea_bed
620				7325.0	222645.0	11540.0	Sea_bed
630				7325.0	222645.0	11540.0	Sea_bed

NOD =====DISPLACEMENT LIMITS ===== ==TEXT=

NR	DXMIN MM	DYMIN MM	DZMIN MM	DXMAX MM	DYMAX MM	DZMAX MM	
20	-3.00			3.00			Wall_gu
30	-3.00		-3.00	3.00		3.00	Stab_in
40	-3.00	-3.00		3.00	3.00		Roof_gu
50	-3.00	-3.00		3.00	3.00		Roof_gu
60	-3.00	-3.00		3.00	3.00		Roof_gu
70	-3.00		-3.00	3.00		3.00	Roof_gu
80	-3.00			3.00			Roof_gu
90	-3.00		-3.00	3.00		3.00	Shaft_g
100	-3.00		-3.00	3.00		3.00	Shaft_g
110	-3.00		-3.00	3.00		3.00	Shaft_g
120	-3.00		-3.00	3.00		3.00	Shaft_g
130	-3.00		-3.00	3.00		3.00	Shaft_g
140	-3.00		-3.00	3.00		3.00	Shaft_g
150	-3.00		-3.00	3.00		3.00	Shaft_g
901	-12.00	-12.00		12.00	12.00		Open_ba

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NOD =====REACTION LIMITS ===== --TEXT=

NR	RXMIN	RYMIN	RZMIN	RXMAX	RYMAX	RZMAX	TEXT
	N	N	N	N	N	N	
500	-5182		-8931	5182	67208	8931	Sea_bed
502	-4080		-7032	4080	52920	7032	Sea_bed
504	-4080		-7032	4080	52920	7032	Sea_bed
506	-4080		-7032	4080	52920	7032	Sea_bed
510	-115400		-14650	115400	2449100	14650	Sea_bed
520	-115400		-14650	115400	2449100	14650	Sea_bed
530	-115400		-14650	115400	2449100	14650	Sea_bed
540	-115400		-14650	115400	2449100	14650	Sea_bed
550	-115400		-14650	115400	2449100	14650	Sea_bed
560	-115400		-14650	115400	2449100	14650	Sea_bed
564	-55392		-7032	55392	1175570	7032	Sea_bed
566	-55392		-7032	55392	1175570	7032	Sea_bed
568	-70347		-70347	70348	1492970	70348	Sea_bed
570	-14650		-115400	14650	2449100	115400	Sea_bed
580	-14650		-115400	14650	2449100	115400	Sea_bed
590	-14650		-115400	14650	2449100	115400	Sea_bed
600	-14650		-115400	14650	2449100	115400	Sea_bed
610	-14650		-115400	14650	2449100	115400	Sea_bed
620	-14650		-115400	14650	2449100	115400	Sea_bed
630	-14650		-115400	14650	2449100	115400	Sea_bed

=====TUBULAR PIPE DATA=====

PN	TEXT	ODIAM	SCHEDULE	DIAMETER	WALLTH	TOL	CORR	EFACTOR
		MM		MM	MM	PERCENT	MM	
1	24airST	631.61		631.61	24.11	5.00	1.00	1.00
2	24airBD	631.61		631.61	22.11		1.00	1.00
3	24subST	631.61		631.61	24.11	5.00	1.00	1.00
4	24subBD	631.61		631.61	22.11		1.00	1.00
5	18subST	619.40		619.40	18.00	5.00	1.00	1.00
6	18subBD	619.40		619.40	16.00		1.00	1.00
7	18conST	619.40		619.40	18.00	5.00	1.00	1.00
8	18conBD	619.40		619.40	16.00		1.00	1.00
10	24" vlv	631.61		631.61	24.11	5.00	1.00	10.00

=====CONTINUATION TUBULAR PIPE DATA=====

PN	TEXT	MASS	INSUL.	WIDTH	SHAPE-M
		KG	KG/M	MM	
1	24airST			631.60	0.70
2	24airBD			631.60	0.70
3	24subST			731.60	1.00
4	24subBD			731.60	1.00
5	18subST			719.40	1.00
6	18subBD			719.40	1.00
7	18conST			719.40	1.00
8	18conBD			719.40	1.00
10	24" vlv	4000.00		631.60	0.70

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FATIGUE STMW REV 1.0 PAGE 7  
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==MEMBER==		===PIPE===		===LOAD===		=====CENTERLINE=====			===BEND===		JACK		
FR	TO	NR	PN	TEXT	LN	TEXT	X	Y	Z	RAD.FL	MI	PI	LE
							MM	MM	MM	MM			
10	20	1	5	18subST	1	mg 18mm		500					
-	-	2	-		-			500					
-	-	3	-		2	mg 18mm		500					
-	-	4	-		-			500					
-	-	5	-		3	mg 18mm		219					
20	30	1	-		-			500					
-	-	2	-		4	mg 18mm		500					
-	-	3	-		-			500					
-	-	4	-		5	mg 18mm		500					
-	-	5	-		-			500					
-	-	6	-		6	mg 18mm		500					
-	-	7	-		-			500					
-	-	8	-		7	mg 18mm		500					
-	-	9	-		-			500					
-	-	10	-		8	mg 18mm		400					
30	900	1	-		-			500					
-	-	2	-		9	mg 18mm		500					
-	-	3	-		-			252					
-	-	5	6	18subBD	10	mg 18mm	3048						
-	-	-	-		-					3048			
-	-	-	-		-					-3048			
-	-	7	5	18subST	11	mg 18mm		-500					
-	-	8	-		-			-500					
-	-	9	-		13	mg 18mm		-500					
-	-	10	-		-			-500					
-	-	11	-		-			-77					
900	901	1	-		14	mg 18mm		-280					
-	-	2	-		-			-500					
-	-	3	-		-			-500					
-	-	4	-		15	mg 18mm		-500					
901	40	1	-		-			-245					
-	-	2	-		-			-500					
-	-	3	-		16	mg 18mm		-500					
-	-	4	-		-			-500					
-	-	5	-		-			-500					
-	-	6	3	24subST	17	mg 24mm		-500					
-	-	7	-		-			-500					
-	-	8	-		-			-500					
-	-	9	-		18	mg 24mm		-500					
-	-	10	-		-			-500					
-	-	11	-		-			-500					
-	-	12	-		19	mg 24mm		-500					
-	-	13	-		-			-500					
-	-	14	-		-			-500					
-	-	15	-		20	mg 24mm		-500					
-	-	16	-		-			-500					
-	-	17	-		-			-500					
-	-	18	-		-			-350					
40	50	1	-		21	mg 24mm		-150					
-	-	2	-		-			-500					

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ORDER 16696 Za 05-Sep-1992 18:16:05  
PROJ Voorbeeld



==MEMBER==		===PIPE===		===LOAD===		=====CENTERLINE=====			===BEND===		JACK		
FR	TO	NR	PN	TEXT	LN	TEXT	X	Y	Z	RAD.	FL MI	PI	LE
							MM	MM	MM	MM			
9	40	50	3	3	24subST	21 mg 24mm				-500			
10	-	-	4	-		22 mg 24mm				-500			
11	-	-	5	-		-				-500			
12	-	-	6	-		-				-500			
13	-	-	7	-		23 mg 24mm				-500			
14	-	-	8	-		-				-500			
15	-	-	9	-		-				-500			
16	-	-	10	-		24 mg 24mm				-500			
17	-	-	11	-		-				-500			
18	-	-	12	-		-				-197			
19	50	60	1	4	24subBD	25 mg 24mm				-1785			
20	-	-	2	-		-				-1263			
21													
22											3048		
23	-	-	3	-		-	893			-893			
24	-	-	4	3	24subST	26 mg 24mm	1262			-1262			
25	-	-	5	-		-	354			-354			
26	-	-	6	-		-	354			-354			
27	-	-	7	-		27 mg 24mm	354			-354			
28	-	-	8	-		-	354			-354			
29	-	-	9	-		-	354			-354			
30	60	70	1	-		28 mg 24mm	277			-277			
31	-	-	2	-		-	354			-354			
32	-	-	3	-		-	354			-354			
33	-	-	4	-		29 mg 24mm	354			-354			
34	-	-	5	-		-	354			-354			
35	-	-	6	-		-	354			-354			
36	-	-	7	-		30 mg 24mm	354			-354			
37	-	-	8	-		-	354			-354			
38	-	-	9	-		-	354			-354			
39	-	-	10	-		31 mg 24mm	354			-354			
40	-	-	11	-		-	354			-354			
41	-	-	12	-		-	354			-354			
42	-	-	13	-		32 mg 24mm	354			-354			
43	-	-	14	-		-	354			-354			
44	-	-	15	-		-	104			-104			
45	70	80	1	-		33 mg 24mm	354			-354			
46	-	-	2	-		-	354			-354			
47	-	-	3	-		-	354			-354			
48	-	-	4	-		34 mg 24mm	354			-354			
49	-	-	5	-		-	354			-354			
50	-	-	6	-		-	354			-354			
51	-	-	7	-		35 mg 24mm	354			-354			
52	-	-	8	-		-	354			-354			
53	-	-	9	-		36 mg 24mm	354			-354			
54	-	-	10	-		-	354			-354			
55	-	-	11	-		37 mg 24mm	354			-354			
56	-	-	12	-		-	40			-40			
57	80	90	1	-		38 mg 24mm	354			-354			
58	-	-	2	-		-	354			-354			

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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FATIGUE STMW REV 1.0

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ORDER 16696 Za 05-Sep-1992 18:16:05

PROJ Voorbeeld

==MEMBER== ===PIPE=== ===LOAD=== =====CENTERLINE===== ===BEND=== JACK

FR TO NR PN TEXT LN TEXT X Y Z RAD.FL MI PI E

MM MM MM MM

80 90 3 3 24subST 39 mg 24mm 354 -354

- - 4 - - 354 -354

- - 5 - 40 mg 24mm 354 -354

- - 6 - - 354 -354

- - 7 - 41 mg 24mm 238 -238

- - 9 4 24subBD 42 mg 24mm 2155 -2155

- - - - - - 3048 3048

- - 11 3 24subST 43 mg 24mm 500

- - 12 - - 252

90 100 1 - 44 mg 24mm 500

- - 2 - - 500

- - 3 - 45 mg 24mm 500

- - 4 - - 500

- - 5 - 46 mg 24mm 500

- - 6 - - 500

- - 7 - 47 mg 24mm 500

- - 8 - - 500

- - 9 - - 500

- - 10 - 48 mg 24mm 500

- - 11 - - 500

- - 12 - - 500

- - 13 - 49 mg 24mm 500

- - 14 - - 400

100 110 1 - - 500

- - 2 - 50 mg 24mm 500

- - 3 - - 500

- - 4 - - 500

- - 5 - 51 mg 24mm 500

- - 6 - - 500

- - 7 - - 500

- - 8 - 52 mg 24mm 500

- - 9 - - 500

- - 10 - - 500

- - 11 - 53 mg 24mm 500

- - 12 - - 500

- - 13 - - 500

- - 14 - - 150

110 120 1 - 54 mg 24mm 500

- - 2 - - 500

- - 3 - - 500

- - 4 - 55 mg 24mm 500

- - 5 - - 500

- - 6 - - 500

- - 7 - 56 mg 24mm 500

- - 8 - - 500

- - 9 - - 500

- - 10 - 57 mg 24mm 500

120 130 1 - - 500

- - 2 - - 500

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

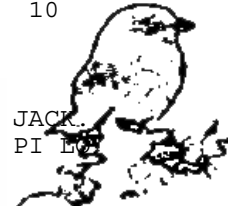
Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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FATIGUE STMW REV 1.0 PAGE 10  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld



==MEMBER== ===PIPE=== ===LOAD=== =====CENTERLINE===== ===BEND=== JACK  
 FR TO NR PN TEXT LN TEXT X Y Z RAD.FL MI PI L  
 MM MM MM MM

120	130	3	3	24subST	58	mg 24mm			500				
-	-	4	-	-	-	-			500				
-	-	5	-	-	-	-			500				
-	-	6	-	59	mg	24mm			500				
-	-	7	-	-	-	-			500				
-	-	8	1	24airST	-	-			500				
-	-	9	-	60	50C120B	-			500				
-	-	10	-	-	-	-			500				
-	-	11	-	-	-	-			500				
-	-	12	-	61	50C120B	-			500				
130	140	1	-	-	-	-			500				
-	-	2	-	-	-	-			500				
-	-	3	-	62	50C120B	-			500				
-	-	4	-	-	-	-			500				
-	-	5	-	-	-	-			500				
-	-	6	-	63	50C120B	-			500				
-	-	7	-	-	-	-			500				
-	-	8	-	-	-	-			500				
140	150	1	-	64	50C120B	-			500				
-	-	2	-	-	-	-			500				
-	-	3	-	-	-	-			500				
-	-	4	-	65	50C120B	-			500				
-	-	5	-	-	-	-			500				
-	-	6	-	-	-	-			500				
-	-	7	-	66	50C120B	-			500				
-	-	8	-	-	-	-			500				
-	-	9	-	-	-	-			500				
-	-	10	-	67	50C120B	-			500				
-	-	11	-	-	-	-			500				
-	-	12	-	-	-	-			500				
-	-	13	-	68	50C120B	-			500				
150	160	1	-	-	-	-			500				
-	-	2	-	-	-	-			500				
-	-	3	-	69	50C120B	-			500				
-	-	4	-	-	-	-			500				
-	-	5	-	-	-	-			500				
-	-	6	-	-	-	-			165				
160	170	1	-	70	50C120B	-			500				
-	-	2	-	-	-	-			500				
-	-	3	2	24airBD	71	50C120B			437				
-	-	4	-	-	-	-			3048				
-	-	-	-	-	-	-							
-	-	-	-	-	-	-							
-	-	6	1	24airST	72	50C120B			-2957				-737
-	-	7	10	24" vlv	-	-			-1317				-328
-	-	8	1	24airST	-	-			-1552				-387
-	-	9	-	-	-	-			-485				-121
-	-	9	-	-	-	-			-485				-121
-	-	10	-	-	-	-			-485				-121
-	-	11	-	-	-	-			-485				-121
-	-	12	-	-	-	-			-485				-121

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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FATIGUE STMW REV 1.0 PAGE 11  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld



==MEMBER==		===PIPE===		===LOAD===		=====CENTERLINE=====			===BEND===		JACK
FR	TO	NR	PN	TEXT	LN	TEXT	X	Y	Z	RAD.	FL MI PI
							MM	MM	MM	MM	
160	170	13	1	24airST	72	50C120B	-485		-121		
-	-	14	-		-		-485		-121		
-	-	15	-		-		-485		-121		
-	-	16	-		-		-388		-97		
10	500	1	7	18conST	73	conc 18		-500			
-	-	2	-		-			-113			
-	-	4	8	18conBD	74	conc 18		-3048			
										3048	
500	502	1	7	18conST	75	conc 18			1200		
-	-	2	-		-				1200		
502	504	1	-		76	conc 18			1200		
-	-	2	-		-				1200		
504	506	1	-		77	conc 18			1200		
-	-	2	-		-				1200		
506	508	1	-		-				1000		
508	510	1	-		-				1000		
510	512	1	-		-				1000		
512	514	1	-		-				1000		
514	516	1	-		-				1000		
516	518	1	-		-				1000		
518	520	1	-		-				1000		
520	522	1	-		-				1000		
522	524	1	-		-				1000		
524	526	1	-		-				1000		
526	528	1	-		-				1000		
528	530	1	-		-				1000		
530	532	1	-		-				1000		
532	534	1	-		-				1000		
534	536	1	-		-				1000		
536	538	1	-		-				1000		
538	540	1	-		-				1000		
540	542	1	-		-				1000		
542	544	1	-		-				1000		
544	546	1	-		-				1000		
546	548	1	-		-				1000		
548	550	1	-		-				1000		
550	552	1	-		-				1000		
552	554	1	-		-				1000		
554	556	1	-		-				1000		
556	558	1	-		-				1000		
558	560	1	-		-				5000		
560	562	1	-		-				5000		
562	564	1	-		-				5000		
564	566	1	-		-				1200		
-	-	2	-		-				1200		
566	568	1	-		-				1200		
-	-	2	-		-				1200		
568	570	1	8	18conBD	-				1613		
-	-	2	-		-				2339		

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## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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FATIGUE STMW REV 1.0  
ORDER 16696    Za 05-Sep-1992    18:16:05  
PROJ Voorbeeld



==MEMBER==		===PIPE===		===LOAD===		=====CENTERLINE=====			===BEND===		JACK		
FR	TO	NR	PN	TEXT	LN	TEXT	X	Y	Z	RAD.	FL MI	PI	LE
							MM	MM	MM	MM			
568	570	2	8	18conBD	77	conc 18				3048			
			-		-		-2259		605				
568	570	3	8	18conBD	77	conc 18	-685		184				
570	572	1	7	18conST	-		-920		246				
572	574	1	-		-		-966		259				
574	576	1	-		-		-966		259				
576	578	1	-		-		-966		259				
578	580	1	-		-		-966		259				
580	582	1	-		-		-966		259				
582	584	1	-		-		-966		259				
584	586	1	-		-		-966		259				
586	588	1	-		-		-966		259				
588	590	1	-		-		-966		259				
590	592	1	-		-		-966		259				
592	594	1	-		-		-966		259				
594	596	1	-		-		-966		259				
596	598	1	-		-		-966		259				
598	600	1	-		-		-966		259				
600	602	1	-		-		-966		259				
602	604	1	-		-		-966		259				
604	606	1	-		-		-966		259				
606	608	1	-		-		-966		259				
608	610	1	-		-		-966		259				
610	612	1	-		-		-966		259				
612	614	1	-		-		-966		259				
614	616	1	-		-		-966		259				
616	618	1	-		-		-966		259				
618	620	1	-		-		-966		259				
620	622	1	-		-		-966		259				
622	624	1	-		-		-966		259				
624	626	1	-		-		-966		259				
626	628	1	-		-		-966		259				
628	630	1	-		-		-966		259				
630	632	1	-		-		-966		259				
632	634	1	-		-		-966		259				
634	636	1	-		-		-966		259				
636	638	1	-		-		-966		259				
638	640	1	-		-		-966		259				
640	642	1	-		-		-966		259				
642	644	1	-		-		-966		259				

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

FATIGUE STMW REV 1.0  
ORDER 16696 Za 05-Sep-1992 18:16:05  
PROJ Voorbeeld

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```
==MEMBER== ==K AND I FACTOR== ==COLD==  
FR TO NR =SPRING=  
K I MM  
30 900 5 3.080 1.364  
50 60 2 2.274 1.115  
80 90 9 2.274 1.115  
160 170 4 2.274 1.115  
10 500 4 3.080 1.364  
568 570 2 3.080 1.364
```

# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0 PAGE 14  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld

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=====GENERAL DATA=====
NEW      REROUN-   BOUR-   YOUNGS   COLD     ===ITERATED SITUATIONS===
MATRIX   DING        DON     MODULUS  SPRING   CO CO CO CO CO  FRICTIO
          YES          NO      E-HOT    100%    WE          NO
          WE PR          WE PR TE  YES
          WE PR TE WI  YES
    
```

```

NOD COMP =====NODAL MOVEMENTS===== ==TEXT==
NR          RX          RY          RZ          DX          DY          DZ
          MRAD        MRAD        MRAD        MM          MM          MM
644  WE          140.00          Vrt_Anc
644  TE          140.00          Vrt_Anc
    
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

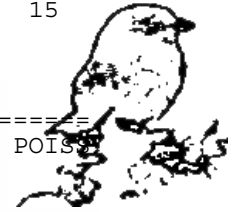
Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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FATIGUE STMW REV 1.0  
ORDER 16696 Za 05-Sep-1992 18:16:05  
PROJ Voorbeeld



=====MATERIAL DATA=====

LN	TEXT	NR	=====DESCRIPTION=====	E-MOD N/MM2	L.E.C. E-6/C	D-PIPE KG/M3	POIS
1	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
2	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
3	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
4	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
5	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
6	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
7	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
8	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
9	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
10	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
11	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
12	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
13	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
14	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
15	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
16	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
17	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
18	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
19	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
20	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
21	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
22	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
23	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
24	mg 18mm	31	STE 415.7 TM DIN17172	191625	11.028	0.0	0.303
25	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
26	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
27	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
28	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
29	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
30	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
31	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
32	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
33	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
34	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
35	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
36	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
37	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
38	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
39	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
40	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
41	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
42	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
43	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
44	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
45	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
46	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
47	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
48	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
49	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
50	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
51	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
52	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
53	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
54	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
55	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
56	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
57	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
58	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
59	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
60	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303
61	mg 24mm	31	STE 415.7 TM DIN17172	191625	11.028	1567.6	0.303

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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FATIGUE STMW REV 1.0  
ORDER 16696      Za 05-Sep-1992      18:16:05  
PROJ Voorbeeld

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=====MATERIAL DATA=====										
LN	TEXT	NR	=====DESCRIPTION=====				E-MOD	L.E.C.	D-PIPE	POISS
						N/MM2	E-6/C	KG/M3		
51	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
52	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
53	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
54	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
55	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
56	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
57	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
58	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
59	mg 24mm	31	STE	415.7	TM	DIN17172	191625	11.028	1567.6	0.303
60	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
61	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
62	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
63	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
64	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
65	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
66	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
67	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
68	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
69	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
70	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
71	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
72	50C120B	31	STE	415.7	TM	DIN17172	191625	11.028	7849.0	0.303
73	conc 18	36	STE	415.7	TM	with 50mm concr	191625	11.028	2373.4	0.303
74	conc 18	36	STE	415.7	TM	with 50mm concr	191625	11.028	2373.4	0.303
75	conc 18	36	STE	415.7	TM	with 50mm concr	191625	11.028	2373.4	0.303
76	conc 18	36	STE	415.7	TM	with 50mm concr	191625	11.028	2373.4	0.303
77	conc 18	36	STE	415.7	TM	with 50mm concr	191625	11.028	2373.4	0.303

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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=====MATERIAL DATA=====											
LN	TEXT	NR	=====DESCRIPTION=====				FE	F1	F2		
						N/MM2	N/MM2	N/MM2			
1	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
2	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
3	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
4	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
5	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
6	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
7	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
8	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
9	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
10	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
11	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
12	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
13	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
14	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
15	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
16	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
17	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
18	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
19	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
20	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
21	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
22	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
23	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
24	mg	18mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
25	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
26	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
27	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
28	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
29	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
30	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
31	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
32	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
33	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
34	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
35	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
36	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
37	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
38	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
39	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
40	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
41	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
42	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
43	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
44	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
45	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
46	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
47	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
48	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
49	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
50	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
51	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
52	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
53	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
54	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
55	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
56	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
57	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
58	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
59	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
60	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000
61	mg	24mm	31	STE	415.7	TM	DIN17172	386.0	242.0	290.4	1.000



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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

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=====MATERIAL DATA=====

LN	TEXT	NR	=====DESCRIPTION=====	FE N/MM2	F1 N/MM2	F2 N/MM2	
51	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
52	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
53	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
54	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
55	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
56	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
57	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
58	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
59	mg 24mm	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
60	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
61	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
62	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
63	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
64	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
65	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
66	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
67	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
68	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
69	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
70	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
71	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
72	50C120B	31	STE 415.7 TM DIN17172	386.0	242.0	290.4	1.000
73	conc 18	36	STE 415.7 TM with 50mm concr	386.0	242.0	290.4	1.000
74	conc 18	36	STE 415.7 TM with 50mm concr	386.0	242.0	290.4	1.000
75	conc 18	36	STE 415.7 TM with 50mm concr	386.0	242.0	290.4	1.000
76	conc 18	36	STE 415.7 TM with 50mm concr	386.0	242.0	290.4	1.000
77	conc 18	36	STE 415.7 TM with 50mm concr	386.0	242.0	290.4	1.000



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## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

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*****
* ABBREVIATION * EXPLANATION OF THE ABBREVIATIONS *
* ===== * =====
*
* FR-TO * NODE-NUMBERS AT BOTH ENDS OF THE BRANCH *
* NR * MEMBER-NUMBER WITHIN THE BRANCH. *
* * ( T = TEE AT ONE OR BOTH ENDS OF THE MEMBER ) *
* * ( B = MEMBER IS A BEND ) *
*
* P-TEXT * SHORT DISCRIPTION OF PIPE USED FOR MEMBER. *
*
* U-FACT * USAGE FACTOR ACCORDING TO DNV. *
*
* CFD * CUMMULATIVE FATIGUE DAMAGE. *
* * IF CFD GREATER OR EQUAL TO U-FACT THAN A *
* * FATIGUE FAILURE CAN OCCUR. *
*
* Sa-1,Sa-2 etc. * MAXIMUM OCCURRING STRESS AMPLITUDE IN MEMBER *
* * WITH EVENT NUMBER IN N/MM^2 *
*
* N-1,N-2 etc. * ALLOWABLE NUMBER OF CYCLES AT MAXIMUM *
* * OCCURING STRESS WITH EVENT NUMBER. *
* * "INFINITE" MEANS THAT STRESS LEVEL IS SUCH *
* * THAT IT FORMS NO LIMITATION TO FATIGUE LIFE. *
*
* FD-1,FD-2 etc. * FATIGUE DAMAGE DUE TO STRESS AMPLITUDE Sa-1 *
* * AND NUMBER OF CYCLES N-1 WITH EVENT NUMBER. *
*****
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# Voorhaar Stress Engineering

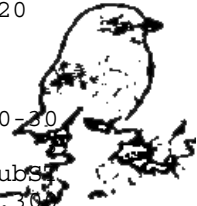
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

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Project: Fatigue Example

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FR-TO	10-20	10-20	10-20	10-20	10-20	20-30	20-30	20-30
NR	1	2	3	4	5	1	2	
P-TEXT	18subST	18subST	18subST	18subST	18subST	18subST	18subST	18subST
U-FACT	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
CFD	3.4E-02	5.6E-02	7.9E-02	1.0E-01	1.1E-01	1.1E-01	9.5E-02	7.8E-02

===== Maximum occuring stress amplitude =====

Sa- 1	234.54	248.31	263.55	280.28	288.09	288.09	264.85	248.93
Sa- 2	213.01	230.95	250.37	271.27	280.90	280.90	261.95	247.31
Sa- 3	142.27	137.26	132.25	127.24	122.24	120.06	115.33	120.00
Sa- 4	120.18	118.74	117.30	115.86	114.42	113.79	113.94	115.38
Sa- 5	94.28	113.66	134.51	156.86	167.11	167.11	149.40	133.37

===== Allowable number of cycles =====

N- 1	3.9E+04	3.1E+04	2.5E+04	2.0E+04	1.8E+04	1.8E+04	2.4E+04	3.1E+04
N- 2	6.0E+04	4.2E+04	3.0E+04	2.2E+04	2.0E+04	2.0E+04	2.5E+04	3.2E+04
N- 3	1.2E+05	1.3E+05	1.4E+05	1.5E+05	1.7E+05	1.8E+05	1.9E+05	1.8E+05
N- 4	1.8E+05	1.8E+05	1.9E+05	1.9E+05	2.0E+05	2.0E+05	2.0E+05	1.9E+05
N- 5	3.6E+05	2.0E+05	1.4E+05	1.0E+05	9.3E+04	9.3E+04	1.1E+05	1.4E+05

===== Fatigue damage =====

FD- 1	2.5E-04	3.2E-04	4.1E-04	5.1E-04	5.6E-04	5.6E-04	4.1E-04	3.3E-04
FD- 2	1.7E-04	2.4E-04	3.3E-04	4.5E-04	5.1E-04	5.1E-04	4.0E-04	3.2E-04
FD- 3	8.2E-05	7.6E-05	7.1E-05	6.5E-05	5.9E-05	5.7E-05	5.1E-05	5.7E-05
FD- 4	5.7E-03	5.5E-03	5.4E-03	5.2E-03	5.0E-03	5.0E-03	5.0E-03	5.1E-03
FD- 5	2.8E-02	4.9E-02	7.3E-02	9.7E-02	1.1E-01	1.1E-01	9.0E-02	7.2E-02

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# Voorhaar Stress Engineering

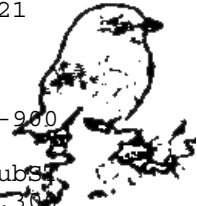
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STWM REV 1.0
ORDER 16696 Za 05-Sep-1992 18:16:05
PROJ Voorbeeld

FR-TO 20-30 20-30 20-30 20-30 20-30 20-30 20-30 20-30 30-900
NR 4 5 6 7 8 9 10
P-TEXT 18subST 18subST 18subST 18subST 18subST 18subST 18subST 18subST 18subST
U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300
CFD 6.2E-02 4.8E-02 3.7E-02 2.9E-02 2.4E-02 2.2E-02 2.4E-02 2.4E-02 2.4E-02
    
```

===== Maximum occuring stress amplitude =====

Sa- 1	240.06	233.40	228.95	226.90	227.45	230.69	236.54	242.97
Sa- 2	234.53	223.73	215.11	208.89	205.26	204.31	209.07	209.07
Sa- 3	124.98	129.98	134.99	140.00	145.02	150.03	154.05	154.72
Sa- 4	116.82	118.26	119.70	121.14	122.58	124.02	125.17	125.18
Sa- 5	119.15	106.92	96.85	89.19	84.12	81.97	83.90	83.90

===== Allowable number of cycles =====

N- 1	3.6E+04	4.0E+04	4.4E+04	4.5E+04	4.5E+04	4.2E+04	3.8E+04	3.4E+04
N- 2	3.9E+04	4.8E+04	5.8E+04	6.6E+04	7.0E+04	7.0E+04	6.6E+04	6.6E+04
N- 3	1.6E+05	1.5E+05	1.4E+05	1.3E+05	1.2E+05	1.1E+05	1.1E+05	1.1E+05
N- 4	1.9E+05	1.8E+05	1.8E+05	1.7E+05	1.7E+05	1.6E+05	1.6E+05	1.6E+05
N- 5	1.8E+05	2.4E+05	3.3E+05	4.5E+05	5.8E+05	6.6E+05	5.9E+05	5.9E+05

===== Fatigue damage =====

FD- 1	2.8E-04	2.5E-04	2.3E-04	2.2E-04	2.2E-04	2.4E-04	2.6E-04	3.0E-04
FD- 2	2.5E-04	2.1E-04	1.7E-04	1.5E-04	1.4E-04	1.4E-04	1.5E-04	1.5E-04
FD- 3	6.2E-05	6.8E-05	7.4E-05	7.9E-05	8.5E-05	9.0E-05	9.4E-05	9.5E-05
FD- 4	5.3E-03	5.5E-03	5.6E-03	5.8E-03	6.0E-03	6.1E-03	6.3E-03	6.3E-03
FD- 5	5.6E-02	4.2E-02	3.0E-02	2.2E-02	1.7E-02	1.5E-02	1.7E-02	1.7E-02

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# Voorhaar Stress Engineering

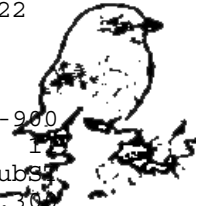
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0                                PAGE 22
ORDER 16696      Za 05-Sep-1992    18:16:05
PROJ Voorbeeld

FR-TO  30-900  30-900  30-900  30-900  30-900  30-900  30-900  30-900
NR      2        3      B 5      7        8        9        10
P-TEXT 18subST 18subST 18subBD 18subST 18subST 18subST 18subST 18subST
U-FACT  0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
CFD     6.7E-03 6.6E-03 7.7E-03 6.1E-03 6.0E-03 5.9E-03 5.8E-03 5.8E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1  227.88  214.68  200.74  165.52  159.16  152.26  145.80  146.16
Sa- 2  193.25  179.33  187.26  142.86  139.37  132.64  134.57  135.37
Sa- 3  155.40  155.74  180.02  139.71  136.41  133.11  129.82  126.54
Sa- 4  125.19  125.20  134.87  121.40  120.77  120.14  119.51  118.87
Sa- 5   68.06   54.13   52.39   21.46   18.60   13.14   15.70   16.59
```

===== Allowable number of cycles =====

```
N- 1  4.4E+04  5.8E+04  7.2E+04  9.4E+04  1.0E+05  1.1E+05  1.2E+05  1.2E+05
N- 2  7.5E+04  8.3E+04  7.8E+04  1.2E+05  1.3E+05  1.4E+05  1.4E+05  1.3E+05
N- 3  1.0E+05  1.0E+05  8.3E+04  1.3E+05  1.3E+05  1.4E+05  1.5E+05  1.6E+05
N- 4  1.6E+05  1.6E+05  1.4E+05  1.7E+05  1.7E+05  1.8E+05  1.8E+05  1.8E+05
N- 5  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit
```

===== Fatigue damage =====

```
FD- 1  2.3E-04  1.7E-04  1.4E-04  1.1E-04  1.0E-04  9.3E-05  8.6E-05  8.6E-05
FD- 2  1.3E-04  1.2E-04  1.3E-04  8.2E-05  7.9E-05  7.1E-05  7.3E-05  7.4E-05
FD- 3  9.6E-05  9.6E-05  1.2E-04  7.9E-05  7.5E-05  7.2E-05  6.8E-05  6.4E-05
FD- 4  6.3E-03  6.3E-03  7.4E-03  5.8E-03  5.8E-03  5.7E-03  5.6E-03  5.5E-03
FD- 5  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0
ORDER 16696 Za 05-Sep-1992 18:16:05
PROJ Voorbeeld

FR-TO 900-901 900-901 900-901 900-901 901-40 901-40 901-40 901-40
NR 1 2 3 4 1 2 3
P-TEXT 18subST 18subST 18subST 18subST 18subST 18subST 18subST 18subST
U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300
CFD 5.8E-03 5.7E-03 5.7E-03 5.6E-03 5.6E-03 5.5E-03 5.4E-03 5.3E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1 148.42 155.30 165.52 181.05 181.05 173.79 160.51 149.49
Sa- 2 139.20 148.81 161.03 175.41 175.41 168.04 154.56 143.33
Sa- 3 126.04 124.22 121.06 118.62 119.34 119.23 118.77 118.54
Sa- 4 118.78 118.42 117.79 117.16 116.53 116.22 115.58 114.95
Sa- 5 20.77 31.02 43.88 58.88 58.88 51.83 38.98 28.38
```

===== Allowable number of cycles =====

```
N- 1 1.1E+05 1.0E+05 9.4E+04 8.2E+04 8.2E+04 8.7E+04 9.9E+04 1.1E+05
N- 2 1.3E+05 1.1E+05 9.8E+04 8.6E+04 8.6E+04 9.2E+04 1.1E+05 1.2E+05
N- 3 1.6E+05 1.6E+05 1.7E+05 1.8E+05 1.8E+05 1.8E+05 1.8E+05 1.8E+05
N- 4 1.8E+05 1.8E+05 1.8E+05 1.9E+05 1.9E+05 1.9E+05 1.9E+05 2.0E+05
N- 5 Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

===== Fatigue damage =====

```
FD- 1 8.8E-05 9.6E-05 1.1E-04 1.2E-04 1.2E-04 1.1E-04 1.0E-04 9.0E-05
FD- 2 7.8E-05 8.9E-05 1.0E-04 1.2E-04 1.2E-04 1.1E-04 9.5E-05 8.3E-05
FD- 3 6.4E-05 6.1E-05 5.8E-05 5.5E-05 5.6E-05 5.6E-05 5.5E-05 5.5E-05
FD- 4 5.5E-03 5.5E-03 5.4E-03 5.3E-03 5.3E-03 5.2E-03 5.2E-03 5.1E-03
FD- 5 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

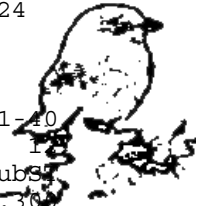
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0 PAGE 24
ORDER 16696 Za 05-Sep-1992 18:16:05
PROJ Voorbeeld
FR-TO 901-40 901-40 901-40 901-40 901-40 901-40 901-40 901-40
NR 5 6 7 8 9 10 11
P-TEXT 18subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300
CFD 5.2E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.9E-03 1.9E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1 141.14 100.55 99.39 100.24 100.39 100.39 99.93 99.60
Sa- 2 134.77 95.81 94.49 94.67 96.22 96.24 96.06 94.53
Sa- 3 118.32 87.62 87.54 88.07 88.72 89.35 89.95 90.53
Sa- 4 114.32 84.42 83.98 83.84 84.19 84.52 84.83 85.10
Sa- 5 20.45 11.39 10.51 11.06 11.79 12.02 11.53 9.43
```

===== Allowable number of cycles =====

```
N- 1 1.2E+05 2.9E+05 3.0E+05 2.9E+05 2.9E+05 2.9E+05 3.0E+05 3.0E+05
N- 2 1.4E+05 3.4E+05 3.6E+05 3.6E+05 3.4E+05 3.4E+05 3.4E+05 3.6E+05
N- 3 1.8E+05 4.8E+05 4.8E+05 4.7E+05 4.6E+05 4.4E+05 4.3E+05 4.2E+05
N- 4 2.0E+05 5.7E+05 5.8E+05 5.9E+05 5.8E+05 5.7E+05 5.6E+05 5.5E+05
N- 5 Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

===== Fatigue damage =====

```
FD- 1 8.1E-05 3.5E-05 3.3E-05 3.4E-05 3.4E-05 3.4E-05 3.4E-05 3.3E-05
FD- 2 7.3E-05 2.9E-05 2.8E-05 2.8E-05 3.0E-05 3.0E-05 3.0E-05 2.8E-05
FD- 3 5.5E-05 2.1E-05 2.1E-05 2.1E-05 2.2E-05 2.2E-05 2.3E-05 2.4E-05
FD- 4 5.0E-03 1.8E-03 1.7E-03 1.7E-03 1.7E-03 1.8E-03 1.8E-03 1.8E-03
FD- 5 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

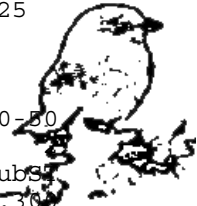
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 25



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1  FATIGUE STMW REV 1.0
2  ORDER 16696      Za 05-Sep-1992      18:16:05
3  PROJ Voorbeeld
4
5  FR-TO  901-40  901-40  901-40  901-40  901-40  901-40  40-50  40-50
6  NR      13      14      15      16      17      18      1
7  P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
8  U-FACT 0.300   0.300   0.300   0.300   0.300   0.300   0.300   0.300
9  CFD     1.9E-03 2.0E-03 2.0E-03 2.0E-03 2.1E-03 2.1E-03 2.1E-03 2.1E-03
    
```

===== Maximum occuring stress amplitude =====

```

13 Sa- 1  100.73  104.60  111.06  119.48  129.53  137.44  137.44  133.94
14 Sa- 2   95.22   98.66  104.68  112.66  122.26  129.86  129.86  126.46
15 Sa- 3   91.08   91.60   92.10   92.56   93.00   93.29   93.29   93.18
16 Sa- 4   85.35   85.57   85.76   85.92   86.06   86.14   86.17   86.25
17 Sa- 5    9.87   13.09   18.92   26.73   36.20   43.72   43.72   40.29
    
```

===== Allowable number of cycles =====

```

28 N- 1  2.9E+05 2.6E+05 2.2E+05 1.8E+05 1.5E+05 1.3E+05 1.3E+05 1.4E+05
29 N- 2  3.5E+05 3.1E+05 2.6E+05 2.1E+05 1.7E+05 1.5E+05 1.5E+05 1.6E+05
30 N- 3  4.1E+05 4.0E+05 3.9E+05 3.9E+05 3.8E+05 3.8E+05 3.8E+05 3.8E+05
31 N- 4  5.4E+05 5.4E+05 5.3E+05 5.3E+05 5.2E+05 5.2E+05 5.2E+05 5.2E+05
32 N- 5  Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
    
```

===== Fatigue damage =====

```

33 FD- 1  3.5E-05 3.9E-05 4.6E-05 5.6E-05 6.8E-05 7.6E-05 7.6E-05 7.3E-05
34 FD- 2  2.9E-05 3.2E-05 3.9E-05 4.8E-05 5.9E-05 6.8E-05 6.8E-05 6.4E-05
35 FD- 3  2.4E-05 2.5E-05 2.5E-05 2.6E-05 2.6E-05 2.7E-05 2.7E-05 2.6E-05
36 FD- 4  1.8E-03 1.9E-03 1.9E-03 1.9E-03 1.9E-03 1.9E-03 1.9E-03 1.9E-03
37 FD- 5  0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
    
```

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# Voorhaar Stress Engineering

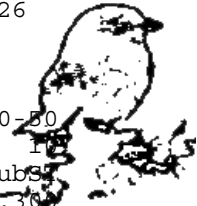
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0                                     PAGE 26
ORDER 16696      Za 05-Sep-1992      18:16:05
PROJ Voorbeeld

FR-TO   40-50   40-50   40-50   40-50   40-50   40-50   40-50   40-50
NR           3     4     5     6     7     8     9
P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
U-FACT  0.300   0.300   0.300   0.300   0.300   0.300   0.300   0.300
CFD     2.1E-03 2.1E-03 2.0E-03 2.0E-03 2.0E-03 2.0E-03 2.0E-03 2.0E-03
```

```
===== Maximum occuring stress amplitude =====
Sa- 1   123.24  114.13  106.94  102.48  101.52  104.12  104.84  104.83
Sa- 2   116.08  107.28  100.40   96.23   95.54   98.63   99.55   99.60
Sa- 3    92.80   92.40   91.98   91.55   91.10   90.65   90.19   89.74
Sa- 4    86.31   86.33   86.33   86.33   86.30   86.24   86.16   86.05
Sa- 5    29.83   20.97   14.07    9.90    9.24   12.47   13.50   13.66
```

```
===== Allowable number of cycles =====
N- 1    1.7E+05  2.0E+05  2.4E+05  2.7E+05  2.8E+05  2.6E+05  2.5E+05  2.5E+05
N- 2    1.9E+05  2.4E+05  2.9E+05  3.4E+05  3.4E+05  3.1E+05  3.0E+05  3.0E+05
N- 3    3.8E+05  3.9E+05  4.0E+05  4.0E+05  4.1E+05  4.2E+05  4.3E+05  4.4E+05
N- 4    5.2E+05  5.2E+05  5.2E+05  5.2E+05  5.2E+05  5.2E+05  5.2E+05  5.2E+05
N- 5    Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit
```

```
===== Fatigue damage =====
FD- 1    6.0E-05  5.0E-05  4.2E-05  3.7E-05  3.6E-05  3.9E-05  3.9E-05  3.9E-05
FD- 2    5.2E-05  4.2E-05  3.4E-05  3.0E-05  2.9E-05  3.2E-05  3.3E-05  3.3E-05
FD- 3    2.6E-05  2.6E-05  2.5E-05  2.5E-05  2.4E-05  2.4E-05  2.3E-05  2.3E-05
FD- 4    1.9E-03  1.9E-03  1.9E-03  1.9E-03  1.9E-03  1.9E-03  1.9E-03  1.9E-03
FD- 5    0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00
```

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# Voorhaar Stress Engineering

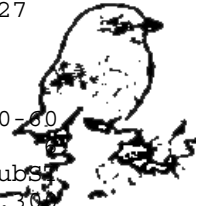
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STWM REV 1.0 PAGE 27  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld  
 FR-TO 40-50 40-50 50-60 50-60 50-60 50-60 50-60 50-60  
 NR 11 12 1 2 3 4 5  
 P-TEXT 24subST 24subST 24subBD 24subBD 24subBD 24subST 24subST 24subST  
 U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300  
 CFD 2.0E-03 2.0E-03 2.3E-03 2.2E-03 2.3E-03 2.0E-03 2.1E-03 2.1E-03

===== Maximum occuring stress amplitude =====  
 Sa- 1 104.62 103.43 106.29 101.85 105.77 103.33 105.68 109.19  
 Sa- 2 99.47 98.38 102.63 100.49 98.57 95.71 97.37 100.18  
 Sa- 3 89.31 88.90 92.19 92.10 94.53 91.93 92.89 93.88  
 Sa- 4 85.91 85.74 89.00 88.13 89.01 86.18 86.71 87.27  
 Sa- 5 13.56 12.64 14.02 12.37 9.56 9.53 10.66 12.90

===== Allowable number of cycles =====  
 N- 1 2.6E+05 2.6E+05 2.4E+05 2.8E+05 2.5E+05 2.7E+05 2.5E+05 2.3E+05  
 N- 2 3.0E+05 3.1E+05 2.7E+05 2.9E+05 3.1E+05 3.4E+05 3.2E+05 2.9E+05  
 N- 3 4.5E+05 4.5E+05 3.9E+05 3.9E+05 3.6E+05 4.0E+05 3.8E+05 3.7E+05  
 N- 4 5.3E+05 5.3E+05 4.5E+05 4.7E+05 4.5E+05 5.2E+05 5.1E+05 4.9E+05  
 N- 5 Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit

===== Fatigue damage =====  
 FD- 1 3.9E-05 3.8E-05 4.1E-05 3.6E-05 4.0E-05 3.8E-05 4.0E-05 4.4E-05  
 FD- 2 3.3E-05 3.2E-05 3.7E-05 3.4E-05 3.2E-05 2.9E-05 3.1E-05 3.4E-05  
 FD- 3 2.2E-05 2.2E-05 2.5E-05 2.5E-05 2.8E-05 2.5E-05 2.6E-05 2.7E-05  
 FD- 4 1.9E-03 1.9E-03 2.2E-03 2.1E-03 2.2E-03 1.9E-03 2.0E-03 2.0E-03  
 FD- 5 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00

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# Voorhaar Stress Engineering

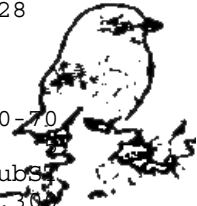
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0                                PAGE 28
ORDER 16696      Za 05-Sep-1992      18:16:05
PROJ Voorbeeld

FR-TO   50-60   50-60   50-60   60-70   60-70   60-70   60-70   60-70
NR       7       8       9       1       2       3       4
P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
U-FACT  0.300   0.300   0.300   0.300   0.300   0.300   0.300   0.300
CFD     2.2E-03 2.3E-03 2.4E-03 2.4E-03 2.3E-03 2.2E-03 2.1E-03 2.0E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1   113.89  119.70  124.94  124.94  116.46  109.03  103.30  102.29
Sa- 2   104.17  109.25  113.93  113.93  106.10  99.32   94.23   94.50
Sa- 3    94.92   96.00   96.86   96.86   95.68   94.53   93.41   92.33
Sa- 4    87.86   88.48   88.99   88.99   88.32   87.69   87.08   86.50
Sa- 5    16.31   20.77   24.94   24.94   17.78   11.63    7.15    8.55
```

===== Allowable number of cycles =====

```
N- 1    2.0E+05  1.8E+05  1.6E+05  1.6E+05  1.9E+05  2.3E+05  2.7E+05  2.7E+05
N- 2    2.6E+05  2.3E+05  2.0E+05  2.0E+05  2.5E+05  3.0E+05  3.6E+05  3.6E+05
N- 3    3.5E+05  3.4E+05  3.3E+05  3.3E+05  3.4E+05  3.6E+05  3.7E+05  3.9E+05
N- 4    4.8E+05  4.6E+05  4.5E+05  4.5E+05  4.7E+05  4.8E+05  5.0E+05  5.1E+05
N- 5    Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit
```

===== Fatigue damage =====

```
FD- 1    5.0E-05  5.6E-05  6.2E-05  6.2E-05  5.3E-05  4.4E-05  3.8E-05  3.6E-05
FD- 2    3.9E-05  4.4E-05  5.0E-05  5.0E-05  4.1E-05  3.3E-05  2.8E-05  2.8E-05
FD- 3    2.8E-05  3.0E-05  3.0E-05  3.0E-05  2.9E-05  2.8E-05  2.7E-05  2.6E-05
FD- 4    2.1E-03  2.2E-03  2.2E-03  2.2E-03  2.1E-03  2.1E-03  2.0E-03  2.0E-03
FD- 5    0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

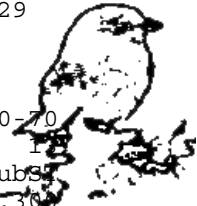
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 29



```

1  FATIGUE STMW REV 1.0
2  ORDER 16696      Za 05-Sep-1992    18:16:05
3  PROJ Voorbeeld
4
5  FR-TO   60-70   60-70   60-70   60-70   60-70   60-70   60-70   60-70
6  NR      6       7       8       9       10      11      12
7  P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
8  U-FACT  0.300   0.300   0.300   0.300   0.300   0.300   0.300   0.300
9  CFD     2.0E-03 2.0E-03 1.9E-03 1.9E-03 1.8E-03 1.8E-03 1.8E-03 1.9E-03
10

```

===== Maximum occuring stress amplitude =====

```

13  Sa- 1   104.32  106.18  107.63  108.65  109.30  109.71  110.10  110.77
14  Sa- 2    97.17   99.65  101.72  103.37  104.74  106.16  107.61  109.18
15  Sa- 3    91.27   90.26   89.28   88.34   87.48   86.78   86.49   86.43
16  Sa- 4    85.95   85.43   84.94   84.49   84.09   83.95   84.25   84.56
17  Sa- 5    11.74   14.71   17.23   19.28   20.90   22.20   23.36   24.62

```

===== Allowable number of cycles =====

```

28
29
30  N- 1   2.6E+05  2.4E+05  2.4E+05  2.3E+05  2.3E+05  2.2E+05  2.2E+05  2.2E+05
31  N- 2   3.2E+05  3.0E+05  2.8E+05  2.7E+05  2.5E+05  2.4E+05  2.4E+05  2.3E+05
32  N- 3   4.1E+05  4.3E+05  4.5E+05  4.7E+05  4.9E+05  5.0E+05  5.1E+05  5.1E+05
33  N- 4   5.3E+05  5.4E+05  5.5E+05  5.7E+05  5.8E+05  5.9E+05  5.8E+05  5.7E+05
34  N- 5   Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit

```

===== Fatigue damage =====

```

45
46
47  FD- 1   3.9E-05  4.1E-05  4.3E-05  4.4E-05  4.4E-05  4.5E-05  4.5E-05  4.6E-05
48  FD- 2   3.1E-05  3.4E-05  3.6E-05  3.8E-05  3.9E-05  4.1E-05  4.2E-05  4.4E-05
49  FD- 3   2.4E-05  2.3E-05  2.2E-05  2.1E-05  2.1E-05  2.0E-05  2.0E-05  2.0E-05
50  FD- 4   1.9E-03  1.9E-03  1.8E-03  1.8E-03  1.7E-03  1.7E-03  1.7E-03  1.8E-03
51  FD- 5   0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00

```

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# Voorhaar Stress Engineering

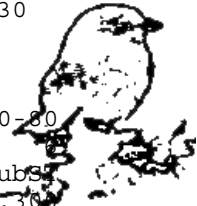
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0                                PAGE 30
ORDER 16696      Za 05-Sep-1992      18:16:05
PROJ Voorbeeld

FR-TO   60-70   60-70   70-80   70-80   70-80   70-80   70-80   70-80
NR       14     15      1       2       3       4       5
P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
U-FACT  0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
CFD     1.9E-03 1.9E-03 1.9E-03 2.0E-03 2.0E-03 2.0E-03 2.0E-03 2.1E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1   112.17  112.78  112.78  113.18  113.78  115.66  117.35  119.96
Sa- 2   111.10  111.79  111.79  112.19  112.55  113.54  114.69  116.72
Sa- 3    86.61   86.67   86.98   87.42   87.93   88.49   89.07   89.65
Sa- 4    84.85   84.94   85.20   85.44   85.65   85.83   85.99   86.12
Sa- 5    26.25   26.85   26.85   27.11   27.28   27.71   28.70   30.60
```

===== Allowable number of cycles =====

```
N- 1   2.1E+05  2.1E+05  2.1E+05  2.0E+05  2.0E+05  1.9E+05  1.9E+05  1.8E+05
N- 2   2.2E+05  2.1E+05  2.1E+05  2.1E+05  2.1E+05  2.0E+05  2.0E+05  1.9E+05
N- 3   5.1E+05  5.1E+05  5.0E+05  4.9E+05  4.8E+05  4.6E+05  4.5E+05  4.4E+05
N- 4   5.6E+05  5.5E+05  5.5E+05  5.4E+05  5.3E+05  5.3E+05  5.2E+05  5.2E+05
N- 5   Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit
```

===== Fatigue damage =====

```
FD- 1   4.8E-05  4.8E-05  4.8E-05  4.9E-05  5.0E-05  5.2E-05  5.4E-05  5.7E-05
FD- 2   4.6E-05  4.7E-05  4.7E-05  4.8E-05  4.8E-05  4.9E-05  5.1E-05  5.3E-05
FD- 3   2.0E-05  2.0E-05  2.0E-05  2.1E-05  2.1E-05  2.2E-05  2.2E-05  2.3E-05
FD- 4   1.8E-03  1.8E-03  1.8E-03  1.9E-03  1.9E-03  1.9E-03  1.9E-03  1.9E-03
FD- 5   0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

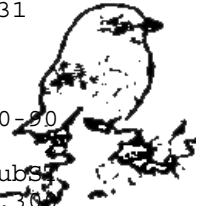
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 31



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1  FATIGUE STMW REV 1.0
2  ORDER 16696      Za 05-Sep-1992    18:16:05
3  PROJ Voorbeeld
4
5  FR-TO   70-80   70-80   70-80   70-80   70-80   70-80   80-90   80-90
6  NR      7       8       9       10      11      12       1
7  P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
8  U-FACT  0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
9  CFD     2.1E-03 2.1E-03 2.1E-03 2.1E-03 2.2E-03 2.2E-03 2.2E-03 2.1E-03
    
```

===== Maximum occuring stress amplitude =====

Sa- 1	123.81	129.13	136.03	144.53	154.61	155.85	155.85	137.65
Sa- 2	119.97	124.68	130.96	138.82	148.26	149.43	149.43	130.59
Sa- 3	90.22	90.78	91.32	91.84	92.34	92.40	92.87	93.32
Sa- 4	86.22	86.29	86.34	86.36	86.36	86.35	86.35	86.31
Sa- 5	33.75	38.39	44.62	52.46	61.91	63.08	63.08	44.28

===== Allowable number of cycles =====

N- 1	1.6E+05	1.5E+05	1.3E+05	1.2E+05	1.1E+05	1.0E+05	1.0E+05	1.3E+05
N- 2	1.8E+05	1.6E+05	1.4E+05	1.3E+05	1.1E+05	1.1E+05	1.1E+05	1.5E+05
N- 3	4.3E+05	4.2E+05	4.1E+05	4.0E+05	3.9E+05	3.9E+05	3.8E+05	3.8E+05
N- 4	5.2E+05	5.2E+05	5.1E+05	5.1E+05	5.1E+05	5.1E+05	5.1E+05	5.2E+05
N- 5	Infinitt	Infinitt	Infinitt	Infinitt	Infinitt	Infinitt	Infinitt	Infinitt

===== Fatigue damage =====

FD- 1	6.1E-05	6.7E-05	7.5E-05	8.4E-05	9.5E-05	9.6E-05	9.6E-05	7.7E-05
FD- 2	5.7E-05	6.2E-05	6.9E-05	7.8E-05	8.8E-05	9.0E-05	9.0E-05	6.9E-05
FD- 3	2.3E-05	2.4E-05	2.5E-05	2.5E-05	2.6E-05	2.6E-05	2.6E-05	2.7E-05
FD- 4	1.9E-03	1.9E-03	1.9E-03	1.9E-03	1.9E-03	1.9E-03	1.9E-03	1.9E-03
FD- 5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

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# Voorhaar Stress Engineering

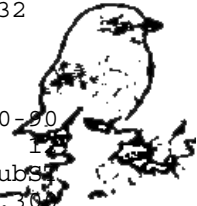
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0 PAGE 32  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld  
 FR-TO 80-90 80-90 80-90 80-90 80-90 80-90 80-90 80-90  
 NR 3 4 5 6 7 B 9 11  
 P-TEXT 24subST 24subST 24subST 24subST 24subST 24subBD 24subST 24subST  
 U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300  
 CFD 2.1E-03 2.0E-03 2.0E-03 2.0E-03 2.0E-03 2.4E-03 2.2E-02 3.8E-02

===== Maximum occuring stress amplitude =====

Sa- 1	121.02	106.70	112.11	122.30	128.46	146.95	175.13	191.13
Sa- 2	113.31	98.35	102.44	111.98	117.70	149.09	170.86	185.92
Sa- 3	93.74	94.13	94.51	94.85	95.07	100.03	86.45	87.40
Sa- 4	86.25	86.15	86.03	85.89	85.71	88.91	83.85	83.85
Sa- 5	27.06	12.19	6.96	26.27	32.12	61.96	87.01	102.07

===== Allowable number of cycles =====

N- 1	1.7E+05	2.4E+05	2.1E+05	1.7E+05	1.5E+05	1.2E+05	8.6E+04	7.6E+04
N- 2	2.0E+05	3.1E+05	2.7E+05	2.1E+05	1.9E+05	1.1E+05	8.9E+04	7.9E+04
N- 3	3.7E+05	3.6E+05	3.6E+05	3.5E+05	3.5E+05	2.9E+05	5.1E+05	4.9E+05
N- 4	5.2E+05	5.2E+05	5.2E+05	5.3E+05	5.3E+05	4.5E+05	5.9E+05	5.9E+05
N- 5	Infinitt	Infinitt	Infinitt	Infinitt	Infinitt	Infinitt	5.0E+05	2.8E+05

===== Fatigue damage =====

FD- 1	5.8E-05	4.1E-05	4.8E-05	5.9E-05	6.6E-05	8.7E-05	1.2E-04	1.3E-04
FD- 2	4.9E-05	3.2E-05	3.7E-05	4.7E-05	5.4E-05	8.9E-05	1.1E-04	1.3E-04
FD- 3	2.7E-05	2.8E-05	2.8E-05	2.8E-05	2.9E-05	3.4E-05	2.0E-05	2.0E-05
FD- 4	1.9E-03	1.9E-03	1.9E-03	1.9E-03	1.9E-03	2.2E-03	1.7E-03	1.7E-03
FD- 5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-02	3.6E-02

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

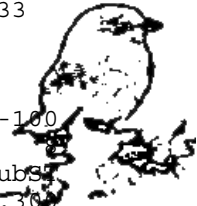
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 33



```

1  FATIGUE STMW REV 1.0
2  ORDER 16696      Za 05-Sep-1992    18:16:05
3  PROJ Voorbeeld
4
5  FR-TO  90-100  90-100  90-100  90-100  90-100  90-100  90-100  90-100
6  NR      1      2      3      4      5      6      7
7  P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
8  U-FACT 0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
9  CFD    3.8E-02 1.4E-02 1.9E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
10

```

===== Maximum occuring stress amplitude =====

```

13  Sa- 1   191.13  167.86  147.17  129.14  113.80  101.30  92.18  95.73
14  Sa- 2   185.92  162.76  142.19  124.26  109.04  96.66  87.64  91.42
15  Sa- 3    87.40   87.33   87.25   87.18   87.10   87.03  86.95  86.87
16  Sa- 4    83.84   83.83   83.83   83.82   83.81   83.80  83.80  83.79
17  Sa- 5   102.07   78.92   58.36   40.44   25.22   12.84   3.84   7.63

```

===== Allowable number of cycles =====

```

28
29
30  N- 1   7.6E+04  9.2E+04  1.1E+05  1.5E+05  2.0E+05  2.8E+05  3.9E+05  3.4E+05
31  N- 2   7.9E+04  9.7E+04  1.2E+05  1.6E+05  2.3E+05  3.3E+05  4.8E+05  4.1E+05
32  N- 3   4.9E+05  4.9E+05  4.9E+05  4.9E+05  5.0E+05  5.0E+05  5.0E+05  5.0E+05
33  N- 4   5.9E+05  5.9E+05  5.9E+05  5.9E+05  5.9E+05  5.9E+05  5.9E+05  5.9E+05
34  N- 5   2.8E+05  8.0E+05  Infinit  Infinit  Infinit  Infinit  Infinit  Infinit

```

===== Fatigue damage =====

```

45
46
47  FD- 1   1.3E-04  1.1E-04  8.7E-05  6.7E-05  5.0E-05  3.5E-05  2.5E-05  2.9E-05
48  FD- 2   1.3E-04  1.0E-04  8.2E-05  6.2E-05  4.4E-05  3.0E-05  2.1E-05  2.5E-05
49  FD- 3   2.0E-05  2.0E-05  2.0E-05  2.0E-05  2.0E-05  2.0E-05  2.0E-05  2.0E-05
50  FD- 4   1.7E-03  1.7E-03  1.7E-03  1.7E-03  1.7E-03  1.7E-03  1.7E-03  1.7E-03
51  FD- 5   3.6E-02  1.2E-02  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00  0.0E+00

```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

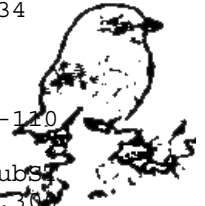
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 34



```

1  FATIGUE STMW REV 1.0
2  ORDER 16696   Za 05-Sep-1992   18:16:05
3  PROJ Voorbeeld
4
5  FR-TO  90-100  90-100  90-100  90-100  90-100  90-100  100-110  100-110
6  NR      9      10      11      12      13      14      1
7  P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
8  U-FACT 0.300   0.300   0.300   0.300   0.300   0.300   0.300   0.300
9  CFD    1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
10

```

===== Maximum occuring stress amplitude =====

```

13 Sa- 1   96.30  96.11  90.00  97.69 109.84 121.94 121.94 102.65
14 Sa- 2   92.07  91.91  86.03  93.83 106.09 118.29 118.29  99.11
15 Sa- 3   86.80  86.72  86.65  86.58  86.50  86.43  86.37  86.29
16 Sa- 4   83.78  83.78  83.77  83.77  83.76  83.76  83.75  83.75
17 Sa- 5    8.29   8.13   5.64  10.07  22.33  34.53  34.53  15.36

```

===== Allowable number of cycles =====

```

28
29
30 N- 1   3.3E+05 3.4E+05 4.3E+05 3.2E+05 2.2E+05 1.7E+05 1.7E+05 2.7E+05
31 N- 2   4.0E+05 4.0E+05 5.2E+05 3.7E+05 2.5E+05 1.8E+05 1.8E+05 3.0E+05
32 N- 3   5.0E+05 5.0E+05 5.1E+05 5.1E+05 5.1E+05 5.1E+05 5.1E+05 5.2E+05
33 N- 4   5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05
34 N- 5   Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit

```

===== Fatigue damage =====

```

45
46
47 FD- 1   3.0E-05 3.0E-05 2.3E-05 3.1E-05 4.5E-05 5.9E-05 5.9E-05 3.7E-05
48 FD- 2   2.5E-05 2.5E-05 1.9E-05 2.7E-05 4.1E-05 5.5E-05 5.5E-05 3.3E-05
49 FD- 3   2.0E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05 2.0E-05 1.9E-05 1.9E-05
50 FD- 4   1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
51 FD- 5   0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00

```

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# Voorhaar Stress Engineering

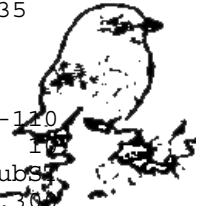
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STWM REV 1.0                                PAGE 35
ORDER 16696      Za 05-Sep-1992    18:16:05
PROJ Voorbeeld

FR-TO 100-110 100-110 100-110 100-110 100-110 100-110 100-110 100-110
NR      3      4      5      6      7      8      9
P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
U-FACT 0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
CFD     1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
```

```
===== Maximum occuring stress amplitude =====
Sa- 1  100.84 110.35 116.72 119.89 120.27 119.86 116.63 110.18
Sa- 2   97.53 107.16 113.63 116.92 117.37 117.01 113.89 107.56
Sa- 3   86.22  86.15  86.08  86.00  85.93  85.86  85.79  85.72
Sa- 4   83.74  83.74  83.74  83.73  83.73  83.73  83.72  83.72
Sa- 5   13.79  23.42  29.90  33.19  33.63  33.28  30.17  23.84
```

```
===== Allowable number of cycles =====
N- 1  2.9E+05 2.2E+05 1.9E+05 1.8E+05 1.8E+05 1.8E+05 1.9E+05 2.2E+05
N- 2  3.2E+05 2.4E+05 2.0E+05 1.9E+05 1.9E+05 1.9E+05 2.0E+05 2.4E+05
N- 3  5.2E+05 5.2E+05 5.2E+05 5.2E+05 5.3E+05 5.3E+05 5.3E+05 5.3E+05
N- 4  5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05
N- 5  Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

```
===== Fatigue damage =====
FD- 1  3.5E-05 4.6E-05 5.3E-05 5.7E-05 5.7E-05 5.7E-05 5.3E-05 4.5E-05
FD- 2  3.1E-05 4.2E-05 4.9E-05 5.3E-05 5.4E-05 5.3E-05 5.0E-05 4.2E-05
FD- 3  1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05
FD- 4  1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
FD- 5  0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

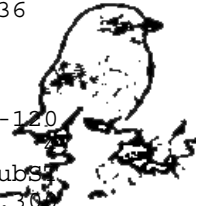
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0                                     PAGE 36
ORDER 16696      Za 05-Sep-1992      18:16:05
PROJ Voorbeeld

FR-TO  100-110 100-110 100-110 100-110 110-120 110-120 110-120 110-120
NR      11      12      13      14      1      2      3
P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
U-FACT  0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
CFD     1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.7E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1   100.53  100.81  120.12  126.57  126.57  110.20  97.31  88.06
Sa- 2    98.03   98.54  117.97  124.45  124.45  108.20  95.42  86.28
Sa- 3    85.65   85.58   85.51   85.44   85.42   85.35  85.29  85.22
Sa- 4    83.72   83.72   83.72   83.72   83.72   83.72  83.72  83.73
Sa- 5    14.30   14.82   34.25   40.73   40.73   24.48  11.70   3.76
```

===== Allowable number of cycles =====

```
N- 1   2.9E+05 2.9E+05 1.8E+05 1.6E+05 1.6E+05 2.2E+05 3.2E+05 4.7E+05
N- 2   3.1E+05 3.1E+05 1.8E+05 1.6E+05 1.6E+05 2.3E+05 3.5E+05 5.2E+05
N- 3   5.3E+05 5.4E+05 5.4E+05 5.4E+05 5.4E+05 5.4E+05 5.4E+05 5.5E+05
N- 4   5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05
N- 5   Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

===== Fatigue damage =====

```
FD- 1   3.5E-05 3.5E-05 5.7E-05 6.4E-05 6.4E-05 4.5E-05 3.1E-05 2.1E-05
FD- 2   3.2E-05 3.2E-05 5.4E-05 6.2E-05 6.2E-05 4.3E-05 2.9E-05 1.9E-05
FD- 3   1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 1.8E-05 1.8E-05 1.8E-05
FD- 4   1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
FD- 5   0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

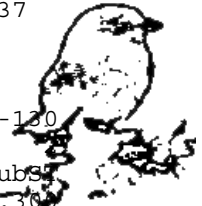
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 37



```

1  FATIGUE STMW REV 1.0
2  ORDER 16696   Za 05-Sep-1992   18:16:05
3  PROJ Voorbeeld
4
5  FR-TO 110-120 110-120 110-120 110-120 110-120 110-120 120-130 120-130
6  NR      5      6      7      8      9      10     1
7  P-TEXT 24subST 24subST 24subST 24subST 24subST 24subST 24subST 24subST
8  U-FACT 0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
9  CFD    1.8E-03 1.8E-03 1.7E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
10

```

===== Maximum occuring stress amplitude =====

```

13 Sa- 1   91.23  91.25  89.83  94.11 106.39 122.49 122.49 101.35
14 Sa- 2   89.69  89.71  88.40  92.89 105.28 121.46 121.46 100.41
15 Sa- 3   85.15  85.09  85.02  84.95  84.89  84.82  84.76  84.70
16 Sa- 4   83.73  83.73  83.73  83.74  83.74  83.74  83.75  83.75
17 Sa- 5    5.96   5.99   4.67   9.16  21.54  37.72  37.72  16.66

```

===== Allowable number of cycles =====

```

28
29
30 N- 1   4.1E+05 4.1E+05 4.4E+05 3.6E+05 2.4E+05 1.7E+05 1.7E+05 2.8E+05
31 N- 2   4.4E+05 4.4E+05 4.7E+05 3.8E+05 2.5E+05 1.7E+05 1.7E+05 2.9E+05
32 N- 3   5.5E+05 5.5E+05 5.5E+05 5.5E+05 5.6E+05 5.6E+05 5.6E+05 5.6E+05
33 N- 4   5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05
34 N- 5   Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit

```

===== Fatigue damage =====

```

45
46
47 FD- 1   2.4E-05 2.4E-05 2.3E-05 2.7E-05 4.1E-05 6.0E-05 6.0E-05 3.5E-05
48 FD- 2   2.3E-05 2.3E-05 2.2E-05 2.6E-05 4.0E-05 5.8E-05 5.8E-05 3.4E-05
49 FD- 3   1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
50 FD- 4   1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
51 FD- 5   0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00

```

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# Voorhaar Stress Engineering

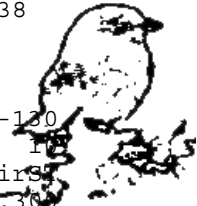
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0                                PAGE 38
ORDER 16696      Za 05-Sep-1992    18:16:05
PROJ Voorbeeld

FR-TO 120-130 120-130 120-130 120-130 120-130 120-130 120-130 120-130
NR      3      4      5      6      7      8      9
P-TEXT 24subST 24subST 24subST 24subST 24subST 24airST 24airST 24airST
U-FACT 0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
CFD     1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1   98.56  107.98  113.50  115.10  115.08  112.64  106.99  98.89
Sa- 2   97.76  107.23  112.80  114.43  114.41  112.01  106.40  98.32
Sa- 3   84.63   84.57   84.51   84.44   84.38   84.32   84.26   84.20
Sa- 4   83.76   83.76   83.77   83.78   83.78   83.79   83.79   83.80
Sa- 5   14.00   23.47   29.03   30.66   30.64   28.23   22.61   14.53
```

===== Allowable number of cycles =====

```
N- 1   3.1E+05 2.3E+05 2.0E+05 2.0E+05 2.0E+05 2.1E+05 2.4E+05 3.1E+05
N- 2   3.2E+05 2.4E+05 2.1E+05 2.0E+05 2.0E+05 2.1E+05 2.4E+05 3.1E+05
N- 3   5.6E+05 5.7E+05 5.7E+05 5.7E+05 5.7E+05 5.7E+05 5.8E+05 5.8E+05
N- 4   5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05
N- 5   Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

===== Fatigue damage =====

```
FD- 1   3.2E-05 4.3E-05 4.9E-05 5.1E-05 5.1E-05 4.8E-05 4.2E-05 3.3E-05
FD- 2   3.1E-05 4.2E-05 4.8E-05 5.0E-05 5.0E-05 4.8E-05 4.1E-05 3.2E-05
FD- 3   1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05
FD- 4   1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
FD- 5   0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

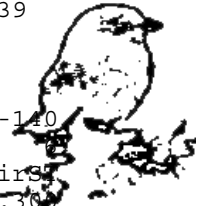
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0 PAGE 39  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld  
 FR-TO 120-130 120-130 130-140 130-140 130-140 130-140 130-140 130-140  
 NR 11 12 1 2 3 4 5  
 P-TEXT 24airST 24airST 24airST 24airST 24airST 24airST 24airST 24airST  
 U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300  
 CFD 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03

===== Maximum occuring stress amplitude =====  
 Sa- 1 93.46 109.02 109.02 101.79 97.13 95.75 99.05 105.03  
 Sa- 2 92.95 108.54 108.54 101.33 96.69 95.21 98.41 104.28  
 Sa- 3 84.14 84.08 84.02 83.97 83.92 83.91 83.96 84.09  
 Sa- 4 83.81 83.82 83.82 83.83 83.84 83.85 83.85 83.86  
 Sa- 5 9.14 24.73 24.73 17.51 12.86 11.36 14.56 20.41

===== Allowable number of cycles =====  
 N- 1 3.7E+05 2.3E+05 2.3E+05 2.8E+05 3.3E+05 3.4E+05 3.0E+05 2.5E+05  
 N- 2 3.8E+05 2.3E+05 2.3E+05 2.8E+05 3.3E+05 3.5E+05 3.1E+05 2.6E+05  
 N- 3 5.8E+05 5.8E+05 5.8E+05 5.8E+05 5.9E+05 5.9E+05 5.9E+05 5.8E+05  
 N- 4 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05  
 N- 5 Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit

===== Fatigue damage =====  
 FD- 1 2.7E-05 4.4E-05 4.4E-05 3.6E-05 3.1E-05 2.9E-05 3.3E-05 4.0E-05  
 FD- 2 2.6E-05 4.4E-05 4.4E-05 3.5E-05 3.0E-05 2.9E-05 3.2E-05 3.9E-05  
 FD- 3 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05 1.7E-05  
 FD- 4 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03  
 FD- 5 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00

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# Voorhaar Stress Engineering

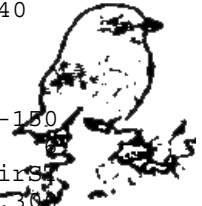
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STWM REV 1.0 PAGE 40
ORDER 16696 Za 05-Sep-1992 18:16:05
PROJ Voorbeeld
FR-TO 130-140 130-140 140-150 140-150 140-150 140-150 140-150 140-150
NR 7 8 1 2 3 4 5
P-TEXT 24airST 24airST 24airST 24airST 24airST 24airST 24airST 24airST
U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300
CFD 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1 113.70 125.08 125.08 105.03 97.20 109.15 118.25 124.52
Sa- 2 112.84 124.11 124.11 103.95 95.91 107.74 116.74 122.90
Sa- 3 84.17 84.24 84.32 84.39 84.47 84.55 84.62 84.70
Sa- 4 83.87 83.88 83.89 83.89 83.90 83.91 83.92 83.93
Sa- 5 28.97 40.23 40.23 20.07 12.01 23.83 32.82 38.97
```

===== Allowable number of cycles =====

```
N- 1 2.0E+05 1.6E+05 1.6E+05 2.5E+05 3.2E+05 2.3E+05 1.8E+05 1.6E+05
N- 2 2.1E+05 1.6E+05 1.6E+05 2.6E+05 3.4E+05 2.3E+05 1.9E+05 1.7E+05
N- 3 5.8E+05 5.8E+05 5.7E+05 5.7E+05 5.7E+05 5.7E+05 5.6E+05 5.6E+05
N- 4 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.9E+05
N- 5 Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

===== Fatigue damage =====

```
FD- 1 4.9E-05 6.2E-05 6.2E-05 4.0E-05 3.1E-05 4.4E-05 5.5E-05 6.2E-05
FD- 2 4.8E-05 6.1E-05 6.1E-05 3.8E-05 2.9E-05 4.3E-05 5.3E-05 6.0E-05
FD- 3 1.7E-05 1.7E-05 1.7E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
FD- 4 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
FD- 5 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

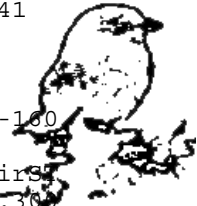
Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 41



```

1  FATIGUE STMW REV 1.0
2  ORDER 16696   Za 05-Sep-1992   18:16:05
3  PROJ Voorbeeld
4
5  FR-TO 140-150 140-150 140-150 140-150 140-150 140-150 140-150 150-150
6  NR      7      8      9      10     11     12     13
7  P-TEXT 24airST 24airST 24airST 24airST 24airST 24airST 24airST 24airST
8  U-FACT 0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
9  CFD    1.9E-03 1.9E-03 1.9E-03 1.9E-03 1.8E-03 1.8E-03 1.8E-03 1.8E-03
10
11  ===== Maximum occuring stress amplitude =====
12
13  Sa- 1   127.91  128.55  128.39  125.96  120.59  112.24  100.92  95.50
14  Sa- 2   126.18  126.75  126.55  124.01  118.52  110.06  98.63   92.99
15  Sa- 3    84.78   84.85   84.93   85.01   85.08   85.16   85.24   85.32
16  Sa- 4    83.94   83.94   83.95   83.96   83.97   83.98   83.99   84.00
17  Sa- 5    42.24   42.81   42.60   40.05   34.56   26.09   14.65    9.00
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28  ===== Allowable number of cycles =====
29
30  N- 1   1.5E+05 1.5E+05 1.5E+05 1.6E+05 1.7E+05 2.1E+05 2.9E+05 3.4E+05
31  N- 2   1.6E+05 1.6E+05 1.6E+05 1.6E+05 1.8E+05 2.2E+05 3.1E+05 3.8E+05
32  N- 3   5.6E+05 5.6E+05 5.5E+05 5.5E+05 5.5E+05 5.5E+05 5.5E+05 5.4E+05
33  N- 4   5.9E+05 5.9E+05 5.9E+05 5.9E+05 5.8E+05 5.8E+05 5.8E+05 5.8E+05
34  N- 5   Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
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45  ===== Fatigue damage =====
46
47  FD- 1   6.6E-05 6.6E-05 6.6E-05 6.3E-05 5.7E-05 4.8E-05 3.5E-05 2.9E-05
48  FD- 2   6.4E-05 6.4E-05 6.4E-05 6.1E-05 5.5E-05 4.5E-05 3.2E-05 2.6E-05
49  FD- 3   1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05 1.8E-05
50  FD- 4   1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03
51  FD- 5   0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
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```

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# Voorhaar Stress Engineering

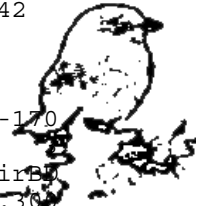
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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1  FATIGUE STMW REV 1.0                                PAGE 42
2  ORDER 16696      Za 05-Sep-1992      18:16:05
3  PROJ Voorbeeld
4
5  FR-TO 150-160 150-160 150-160 150-160 150-160 160-170 160-170 160-170
6  NR      2      3      4      5      6      1      2
7  P-TEXT 24airST 24airST 24airST 24airST 24airST 24airST 24airST 24airST
8  U-FACT 0.300  0.300  0.300  0.300  0.300  0.300  0.300  0.300
9  CFD     1.8E-03 1.9E-03 1.9E-03 1.2E-02 1.9E-02 8.3E-03 8.3E-03 8.9E-03
10

```

===== Maximum occuring stress amplitude =====

```

13  Sa- 1   107.67  122.97  141.40  162.97  170.78  149.69  148.38  152.83
14  Sa- 2   105.06  120.24  138.57  160.03  167.80  149.69  148.38  152.83
15  Sa- 3    85.39   85.47   85.55   85.63   85.65  140.93  140.93  146.19
16  Sa- 4    84.01   84.02   84.03   84.03   84.04  140.93  140.93  146.19
17  Sa- 5    21.05   36.23   54.54   75.99   83.76   10.20    8.76    7.71

```

===== Allowable number of cycles =====

```

28
29
30  N- 1   2.3E+05 1.7E+05 1.2E+05 9.6E+04 9.0E+04 1.1E+05 1.1E+05 1.1E+05
31  N- 2   2.5E+05 1.8E+05 1.3E+05 9.9E+04 9.2E+04 1.1E+05 1.1E+05 1.1E+05
32  N- 3   5.4E+05 5.4E+05 5.4E+05 5.3E+05 5.3E+05 1.2E+05 1.2E+05 1.2E+05
33  N- 4   5.8E+05 5.8E+05 5.8E+05 5.8E+05 5.8E+05 1.2E+05 1.2E+05 1.2E+05
34  N- 5   Infinit Infinit Infinit 1.0E+06 5.9E+05 Infinit Infinit Infinit

```

===== Fatigue damage =====

```

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46
47  FD- 1   4.3E-05 6.0E-05 8.1E-05 1.0E-04 1.1E-04 9.0E-05 8.8E-05 9.3E-05
48  FD- 2   4.0E-05 5.7E-05 7.8E-05 1.0E-04 1.1E-04 9.0E-05 8.8E-05 9.3E-05
49  FD- 3   1.8E-05 1.9E-05 1.9E-05 1.9E-05 1.9E-05 8.0E-05 8.0E-05 8.6E-05
50  FD- 4   1.7E-03 1.7E-03 1.7E-03 1.7E-03 1.7E-03 8.0E-03 8.0E-03 8.6E-03
51  FD- 5   0.0E+00 0.0E+00 0.0E+00 9.9E-03 1.7E-02 0.0E+00 0.0E+00 0.0E+00

```

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# Voorhaar Stress Engineering

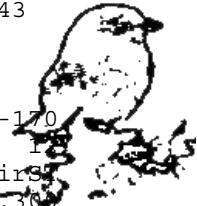
## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



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FATIGUE STMW REV 1.0 PAGE 43
ORDER 16696 Za 05-Sep-1992 18:16:05
PROJ Voorbeeld
FR-TO 160-170 160-170 160-170 160-170 160-170 160-170 160-170 160-170
NR B 4 6 7 8 9 10 11
P-TEXT 24airBD 24airST 24" vlv 24airST 24airST 24airST 24airST 24airST
U-FACT 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300 0.300
CFD 8.9E-03 4.6E-03 0.0E+00 2.3E-03 2.1E-03 2.0E-03 1.9E-03 1.9E-03
```

===== Maximum occuring stress amplitude =====

```
Sa- 1 151.28 110.57 0.00 89.14 87.93 86.87 85.95 85.18
Sa- 2 151.28 110.57 0.00 89.14 87.93 86.87 85.95 85.18
Sa- 3 146.19 109.81 0.00 88.87 87.72 86.71 85.83 85.10
Sa- 4 146.19 109.81 0.00 88.87 87.72 86.71 85.83 85.10
Sa- 5 6.64 0.76 0.00 0.27 0.21 0.16 0.12 0.08
```

===== Allowable number of cycles =====

```
N- 1 1.1E+05 2.2E+05 Infinit 4.5E+05 4.8E+05 5.0E+05 5.3E+05 5.5E+05
N- 2 1.1E+05 2.2E+05 Infinit 4.5E+05 4.8E+05 5.0E+05 5.3E+05 5.5E+05
N- 3 1.2E+05 2.2E+05 Infinit 4.5E+05 4.8E+05 5.1E+05 5.3E+05 5.5E+05
N- 4 1.2E+05 2.2E+05 Infinit 4.5E+05 4.8E+05 5.1E+05 5.3E+05 5.5E+05
N- 5 Infinit Infinit Infinit Infinit Infinit Infinit Infinit Infinit
```

===== Fatigue damage =====

```
FD- 1 9.2E-05 4.6E-05 0.0E+00 2.2E-05 2.1E-05 2.0E-05 1.9E-05 1.8E-05
FD- 2 9.2E-05 4.6E-05 0.0E+00 2.2E-05 2.1E-05 2.0E-05 1.9E-05 1.8E-05
FD- 3 8.6E-05 4.5E-05 0.0E+00 2.2E-05 2.1E-05 2.0E-05 1.9E-05 1.8E-05
FD- 4 8.6E-03 4.5E-03 0.0E+00 2.2E-03 2.1E-03 2.0E-03 1.9E-03 1.8E-03
FD- 5 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
```

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002



PAGE 44

FATIGUE STMW REV 1.0  
 ORDER 16696 Za 05-Sep-1992 18:16:05  
 PROJ Voorbeeld  
 FR-TO 160-170 160-170 160-170 160-170 10-500 10-500 10-500 500-502  
 NR 13 14 15 16 1 2 B 4  
 P-TEXT 24airST 24airST 24airST 24airST 18conST 18conST 18conBD 18conS  
 U-FACT 0.300 0.300 0.300 0.300  
 CFD 1.8E-03 1.8E-03 1.7E-03 1.7E-03

===== Maximum occuring stress amplitude =====

Sa- 1	84.55	84.07	83.74	83.55
Sa- 2	84.55	84.07	83.74	83.55
Sa- 3	84.50	84.05	83.73	83.55
Sa- 4	84.50	84.05	83.73	83.55
Sa- 5	0.05	0.03	0.01	0.00

===== Allowable number of cycles =====

N- 1	5.7E+05	5.8E+05	5.9E+05	6.0E+05
N- 2	5.7E+05	5.8E+05	5.9E+05	6.0E+05
N- 3	5.7E+05	5.8E+05	5.9E+05	6.0E+05
N- 4	5.7E+05	5.8E+05	5.9E+05	6.0E+05
N- 5	Infinitt	Infinitt	Infinitt	Infinitt

===== Fatigue damage =====

FD- 1	1.8E-05	1.7E-05	1.7E-05	1.7E-05
FD- 2	1.8E-05	1.7E-05	1.7E-05	1.7E-05
FD- 3	1.8E-05	1.7E-05	1.7E-05	1.7E-05
FD- 4	1.8E-03	1.7E-03	1.7E-03	1.7E-03
FD- 5	0.0E+00	0.0E+00	0.0E+00	0.0E+00

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# Voorhaar Stress Engineering

## EXAMPLE FATIGUE CALCULATION BASED ON P10 OUTPUT AND STOOMWEZEN RULES

Date: Wo 03-Feb-2021

Time: 09:57:50

Project: Fatigue Example

Jobnr: PV2002

PAGE 45

FATIGUE STMW REV 1.0  
ORDER 16696 Za 05-Sep-1992 18:16:05  
PROJ Voorbeeld

```
===== MAXIMUM CUMULATIVE DAMAGE FACTORS IN THIS OUTPUT =====  
*****  
*      FR-TO      *      MEMBER      *      CFD      *  
*****  
* 10-20          * 5          * 1.1E-01      *  
* 20-30          * 1          * 1.1E-01      *  
* 10-20          * 4          * 1.0E-01      *  
* 20-30          * 2          * 9.5E-02      *  
* 10-20          * 3          * 7.9E-02      *  
*****
```

EXPECTED LIFETIME OF PIPING SYSTEM : 105 YEARS  
=====

