

# 1 Appendix 1: Detailed stress results

## 1.1 Critical cross section 1

### 1.1.1 Load case 1

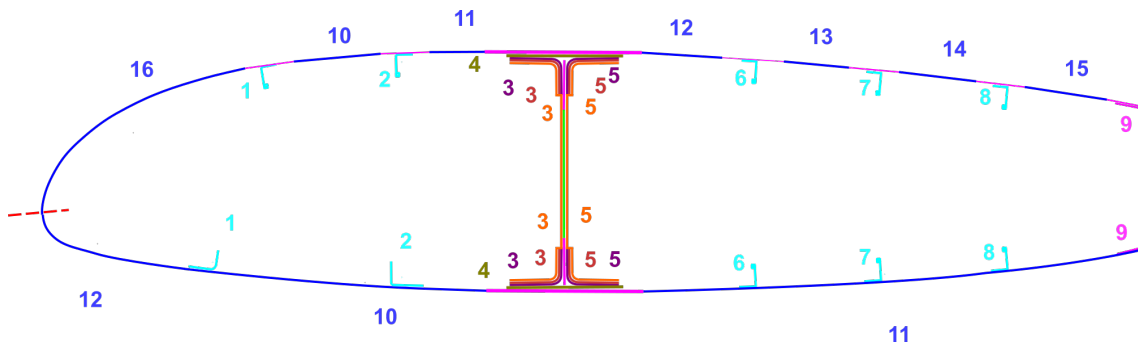


Figure 1.1: Cross section elements numbering

Table 1.1: Upper section stress analysis

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	RF <sub>LL</sub>
1	Stringer 1	232	-19	12.05
2	Stringer 2	217	-22	9.98
3	Flange 3	256	-22	11.85
4	Stiffening sheet 4	233	-26	9.07
5	Flange 5	260	-22	12.03
6	Stringer 6	252	-21	12.16
7	Stringer 7	252	-18	13.81
8	Stringer 8	252	-14	17.97
9	2nd Flange	265	-20	13.40
10	Skin 1	48	-25	1.91
11	Skin 2	43	-25	1.73
12	Skin 3	29	-26	1.15
13	Skin 4	42	-23	1.85
14	Skin 5	41	-20	2.08
15	Skin 6	33	-18	1.84
16	LE Skin	91	-7	12.25

*Table 1.2: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	RF <sub>LL</sub>
1	Stringer 1	430	22	19.49
2	Stringer 2	430	25	17.17
3	Flange 3	430	25	17.32
4	Stiffening sheet 4	430	28	15.36
5	Flange 5	430	25	17.32
6	Stringer 6	430	26	16.61
7	Stringer 7	430	26	16.77
8	Stringer 8	430	25	17.10
9	2nd Flange	430	24	17.95
10	Skin 1	430	27	16.18
11	Skin 2	430	25	17.19
12	LE skin	430	16	26.70

### 1.1.2 Load case 2

*Table 1.3: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	RF <sub>LL</sub>
1	Stringer 1	232	3.5	66.74
2	Stringer 2	217	3.9	55.23
3	Flange 3	256	3.9	65.60
4	Stiffening sheet 4	233	4.6	50.22
5	Flange 5	260	3.9	66.62
6	Stringer 6	252	3.7	67.32
7	Stringer 7	156	3.3	47.16
8	Stringer 8	252	2.5	99.53
9	2nd Flange	265	3.6	74.19
10	Skin 1	48	4.5	10.60
11	Skin 2	43	4.5	9.60
12	Skin 3	29	4.6	6.36
13	Skin 4	42	4.1	10.22
14	Skin 5	41	3.6	11.49
15	Skin 6	33	3.3	10.19
16	LE Skin	91	1.3	67.90

*Table 1.4: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$\mathbf{RF}_{LL}$
1	Stringer 1	430	-4.3	99.31
2	Stringer 2	430	-4.9	88.32
3	Flange 3	430	-5.0	85.55
4	Stiffening sheet 4	430	-5.1	84.42
5	Flange 5	430	-5.0	85.55
6	Stringer 6	430	-5.0	85.94
7	Stringer 7	430	-5.0	86.72
8	Stringer 8	430	-4.9	88.32
9	2nd Flange	430	-4.3	99.31
10	Skin 1	430	-5.1	84.42
11	Skin 2	430	-5.1	84.42
12	LE skin	430	-3.9	110.81

## 1.2 Critical cross section 2

### 1.2.1 Load case 1

*Table 1.5: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$\mathbf{RF}_{LL}$
1	Stringer 1	232	-14	16.89
2	Stringer 2	217	-16	13.97
3	Flange 3	256	-15	16.60
4	Stiffening sheet 4	233	-18	12.71
5	Flange 5	260	-15	16.86
6	Stringer 6	252	-15	17.03
7	Stringer 7	156	-13	11.93
8	Stringer 8	252	-10	25.18
9	2nd Flange	265	-14	18.77
10	Skin 1	273	-18	15.23
11	Skin 2	43	-18	2.43
12	Skin 3	29	-18	1.61
13	Skin 4	42	-16	2.59
14	Skin 5	41	-14	2.91
15	Skin 6	33	-13	2.58
16	LE Skin	91	-5	17.16

*Table 1.6: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	RF <sub>LL</sub>
1	Stringer 1	430	17	25.15
2	Stringer 2	430	19	22.36
3	Flange 3	430	20	21.66
4	Stiffening sheet 4	430	20	21.38
5	Flange 5	430	20	21.66
6	Stringer 6	430	20	21.76
7	Stringer 7	430	20	21.96
8	Stringer 8	430	19	22.36
9	2nd Flange	430	17	25.15
10	Skin 1	430	20	21.38
11	Skin 2	430	20	21.38
12	LE skin	430	15	28.06

### 1.2.2 Load case 2

*Table 1.7: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	RF <sub>LL</sub>
1	Stringer 1	232	2.5	91.57
2	Stringer 2	217	2.9	75.79
3	Flange 3	256	2.8	90.02
4	Stiffening sheet 4	233	3.4	68.91
5	Flange 5	260	2.8	91.41
6	Stringer 6	252	2.7	92.36
7	Stringer 7	156	2.4	64.70
8	Stringer 8	252	1.8	136.53
9	2nd Flange	265	2.6	101.79
10	Skin 1	273	3.3	82.58
11	Skin 2	43	3.3	13.18
12	Skin 3	29	3.4	8.73
13	Skin 4	42	3.0	14.03
14	Skin 5	41	2.6	15.77
15	Skin 6	33	2.4	13.99
16	LE Skin	91	1.0	93.08

*Table 1.8: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$\mathbf{RF}_{LL}$
1	Stringer 1	430	-3	136.39
2	Stringer 2	430	-4	121.29
3	Flange 3	430	-4	117.49
4	Stiffening sheet 4	430	-4	115.94
5	Flange 5	430	-4	117.49
6	Stringer 6	430	-4	118.02
7	Stringer 7	430	-4	119.09
8	Stringer 8	430	-4	121.29
9	2nd Flange	430	-3	136.39
10	Skin 1	430	-4	115.94
11	Skin 2	430	-4	115.94
12	LE skin	430	-3	152.19

### 1.3 Critical cross section 3

#### 1.3.1 Load case 1

*Table 1.9: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$\mathbf{RF}_{LL}$
1	Stringer 1	232	-16.1	14.43
2	Stringer 2	217	-18.0	12.04
3	Flange 3	229	-17.9	12.78
4	Stiffening sheet 4	221	-21.1	10.46
5	Flange 5	234	-17.9	13.07
6	Stringer 6	252	-17.2	14.63
7	Stringer 7	156	-15.3	10.15
8	Stringer 8	252	-12.0	20.93
9	2nd Flange	265	-16.5	16.07
10	Skin 1	273	-20.6	13.24
11	Skin 2	43	-20.4	2.11
12	Skin 3	29	-21.0	1.40
13	Skin 4	42	-18.9	2.24
14	Skin 5	41	-16.6	2.49
15	Skin 6	33	-15.3	2.19
16	LE Skin	91	-6.9	13.12

*Table 1.10: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$RF_{LL}$
1	Stringer 1	430	17.3	24.79
2	Stringer 2	430	19.7	21.88
3	Flange 3	430	20.3	21.15
4	Stiffening sheet 4	430	20.6	20.86
5	Flange 5	430	20.3	21.15
6	Stringer 6	430	20.2	21.25
7	Stringer 7	430	20.0	21.46
8	Stringer 8	430	19.7	21.88
9	2nd Flange	430	17.3	24.79
10	Skin 1	430	20.6	20.86
11	Skin 2	430	20.6	20.86
12	LE skin	430	15.4	27.88

### 1.3.2 Load case 2

*Table 1.11: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$RF_{LL}$
1	Stringer 1	232	2.6	87.67
2	Stringer 2	217	3.0	73.17
3	Flange 3	229	3.0	77.67
4	Stiffening sheet 4	221	3.5	63.58
5	Flange 5	234	3.0	79.41
6	Stringer 6	252	2.8	88.89
7	Stringer 7	156	2.5	61.70
8	Stringer 8	252	2.0	127.22
9	2nd Flange	265	2.7	97.65
10	Skin 1	273	3.4	80.44
11	Skin 2	43	3.4	12.83
12	Skin 3	29	3.5	8.51
13	Skin 4	42	3.1	13.58
14	Skin 5	41	2.7	15.13
15	Skin 6	33	2.5	13.33
16	LE Skin	91	1.1	79.70

*Table 1.12: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$RF_{LL}$
1	Stringer 1	430	-2.9	150.63
2	Stringer 2	430	-3.2	132.94
3	Flange 3	430	-3.3	128.53
4	Stiffening sheet 4	430	-3.4	126.74
5	Flange 5	430	-3.3	128.53
6	Stringer 6	430	-3.3	129.15
7	Stringer 7	430	-3.3	130.39
8	Stringer 8	430	-3.2	132.94
9	2nd Flange	430	-2.9	150.63
10	Skin 1	430	-3.4	126.74
11	Skin 2	430	-3.4	126.74
12	LE skin	430	-2.5	169.42

## 1.4 Critical cross section 4

### 1.4.1 Load case 1

*Table 1.13: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$RF_{LL}$
1	Stringer 1	232	-15.8	14.66
2	Stringer 2	217	-17.7	12.24
3	Flange 3	231	-17.6	13.07
4	Stiffening sheet 4	222	-20.7	10.71
5	Flange 5	236	-17.6	13.40
6	Stringer 6	252	-17.0	14.87
7	Stringer 7	156	-15.1	10.31
8	Stringer 8	252	-11.9	21.21
9	2nd Flange	265	-16.3	16.33
10	Skin 1	273	-20.3	13.47
11	Skin 2	43	-20.1	2.15
12	Skin 3	29	-20.6	1.43
13	Skin 4	42	-18.5	2.27
14	Skin 5	41	-16.3	2.53
15	Skin 6	33	-15.0	2.23
16	LE Skin	91	-6.9	13.17

*Table 1.14: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$RF_{LL}$
1	Stringer 1	430	16.8	25.61
2	Stringer 2	430	19.0	22.58
3	Flange 3	430	19.7	21.83
4	Stiffening sheet 4	430	20.0	21.52
5	Flange 5	430	19.7	21.83
6	Stringer 6	430	19.6	21.93
7	Stringer 7	430	19.4	22.15
8	Stringer 8	430	19.0	22.58
9	2nd Flange	430	16.8	25.61
10	Skin 1	430	20.0	21.52
11	Skin 2	430	20.0	21.52
12	LE skin	430	14.9	28.84

#### 1.4.2 Load case 2

*Table 1.15: Upper section stress analysis*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$RF_{LL}$
1	Stringer 1	232	3.0	77.63
2	Stringer 2	217	3.3	64.86
3	Flange 3	231	3.3	69.25
4	Stiffening sheet 4	222	3.9	56.74
5	Flange 5	236	3.3	70.96
6	Stringer 6	252	3.2	78.77
7	Stringer 7	156	2.8	54.61
8	Stringer 8	252	2.2	112.33
9	2nd Flange	265	3.1	86.49
10	Skin 1	273	3.8	71.38
11	Skin 2	43	3.8	11.38
12	Skin 3	29	3.9	7.56
13	Skin 4	42	3.5	12.04
14	Skin 5	41	3.1	13.40
15	Skin 6	33	2.8	11.80
16	LE Skin	91	1.3	69.77



*Table 1.16: Lower section stress results*

No.	Element	$\sigma_c$ [MPa]	$\sigma$ [MPa]	$R_{FLL}$
1	Stringer 1	430	-3.2	135.68
2	Stringer 2	430	-3.6	119.62
3	Flange 3	430	-3.7	115.63
4	Stiffening sheet 4	430	-3.8	114.00
5	Flange 5	430	-3.7	115.63
6	Stringer 6	430	-3.7	116.19
7	Stringer 7	430	-3.7	117.31
8	Stringer 8	430	-3.6	119.62
9	2nd Flange	430	-3.2	135.68
10	Skin 1	430	-3.8	114.00
11	Skin 2	430	-3.8	114.00
12	LE skin	430	-2.8	152.76

## 2 Appendix 2: SMG-92 spectra

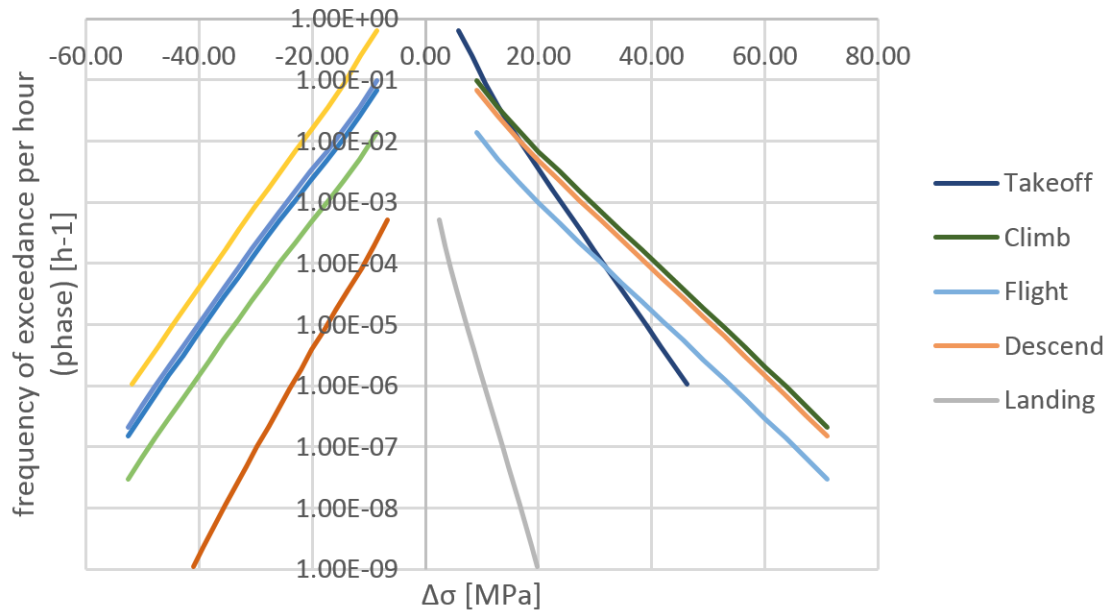


Figure 2.1: Manoeuvre spectra for SMG-92

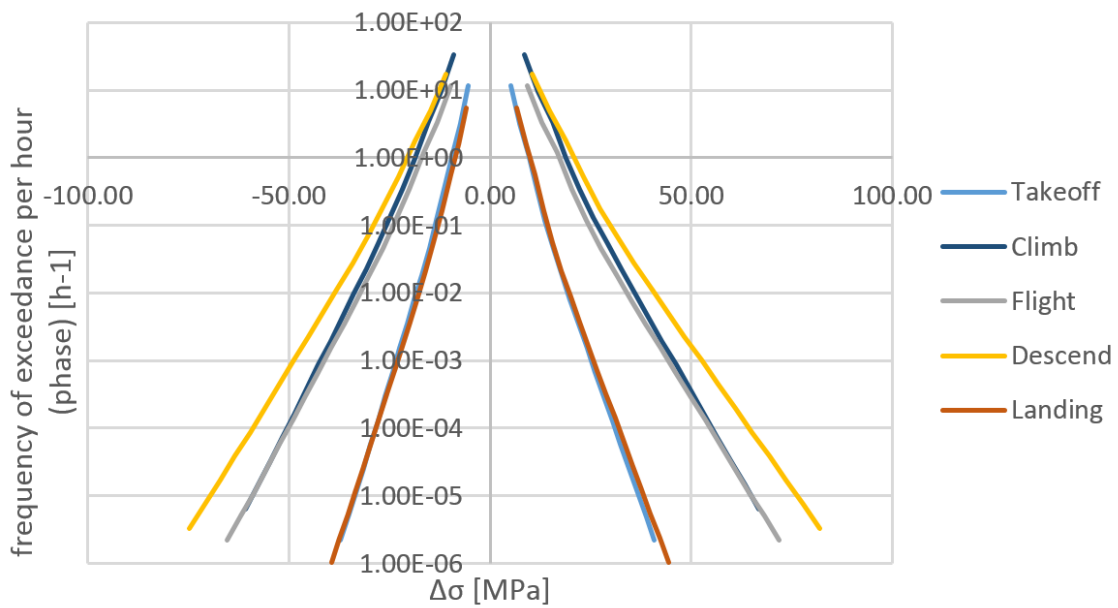


Figure 2.2: Gust spectra for SMG-92

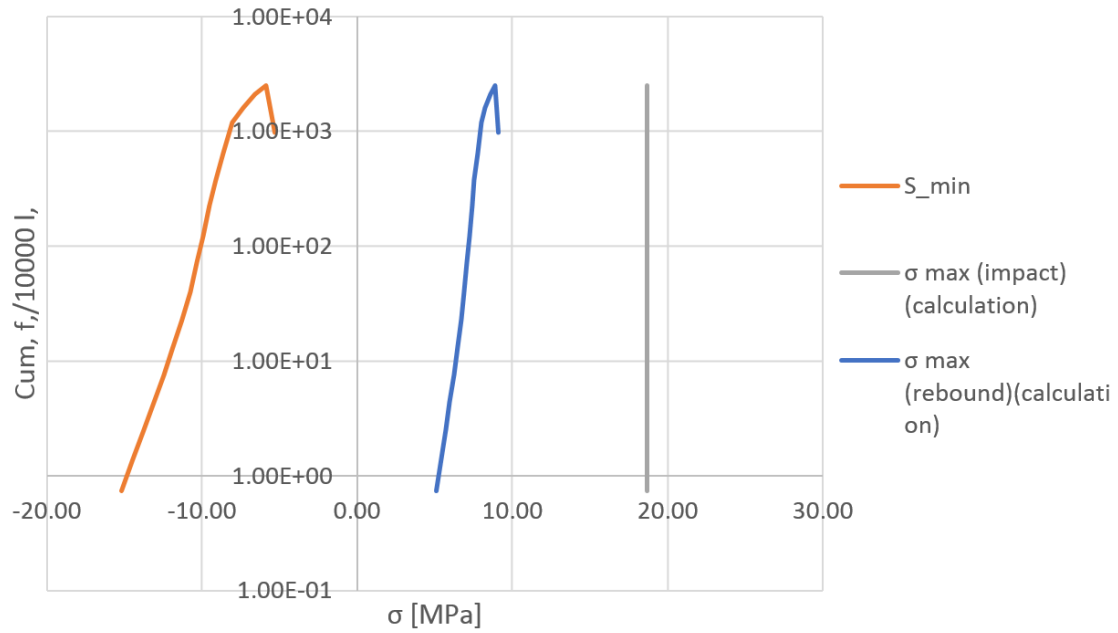


Figure 2.3: Impact and rebound spectra for SMG-92

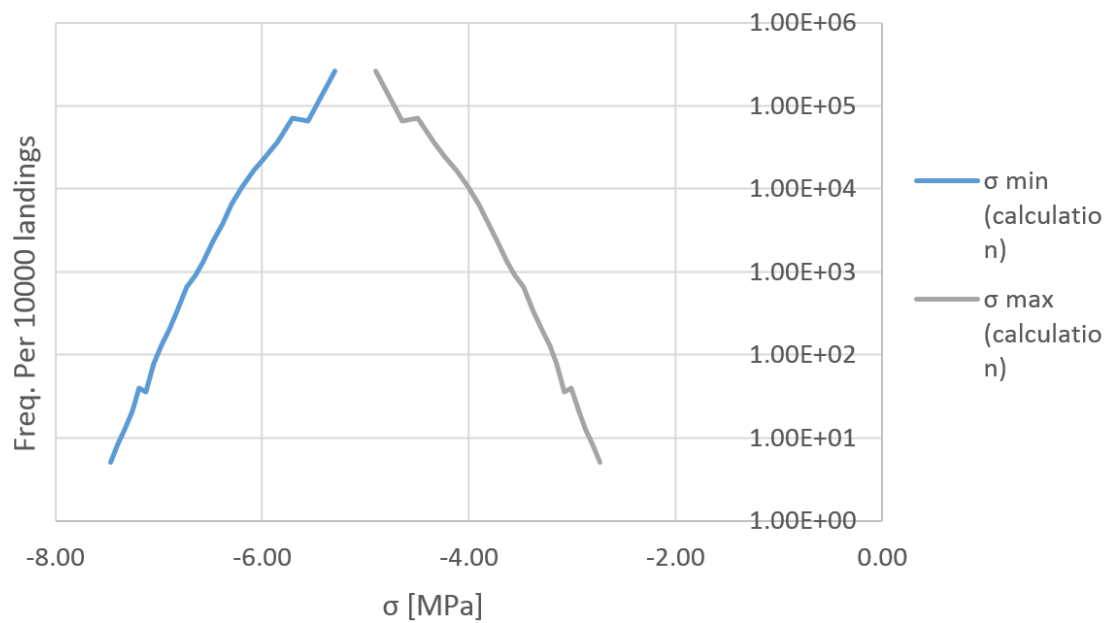


Figure 2.4: Taxi spectra for SMG-92