7. CONCLUSIONS

Certain objectives were mentioned when the dissertation started and from all the chapters the following conclusions can be extracted:

7.1. Theoretical background

The calculations of the stressed skin may seem long a tedious, as many parameters have to be introduced. But with a simple excel sheet, and the introduction of not many parameters it can be easily computerized. So what could have been a problem with so many manual calculations can be easily solved. Besides, if the same metal sheets are used, the longest calculation process is avoided. In order to calculate reference values with a short calculation the important values are the following:

	Direct Every	Direct Alternate	Indirect Every	Direct Alternate
Flexibility	$c_{11}+c_{22}$	$c_{11}+\mathit{c_{22}}$	$c_{23}+\mathit{c_{11}}+\mathit{c_{22}}$	$c_{11}+c_{22}$
Strength (V)	Seam	Seam	Purlin/rafter connection	End sheet connection

Table 7.1: Main factors for to check the flexibility and strength of a diaphragm.

The values in cursive mean that they play a role, but not as much as the other values.

7.2. Factors that modify the flexibility and strength

Resume of the factors that intervene in the strength and flexibility of the shear cell. A detailed explanation and graphics can be found in the Chapter IV. Part 5.3

Parameter			Flexibility c	Ultimate strength S
Shear cell dimensions	a	↑a	Higher flexibility: modification from 0 to 0.05 mm/KN per meter	Higher strength: modification from 0-5 KN per meter
	b	↑b	Lower flexibility: less noticeable from 30 meters on.	Higher strength: less noticeable for values lower than 30 m
Seam fasteners	Spacing	↑e_s	Higher flexibility: 0.01 mm/KN per 100 mm	Lower strength if the seam is the limiter factor (mainly direct connection)
	Type	↑d_N	None	Higher strength: 1-2 KN
Sheet/purlin fasteners	Type	↑d_N	None	Higher strength: 0-4 KN
Sheet/shear connector fasteners	Spacing	↑e_{sc}	Higher:0.01 mm/KN per 500 mm	None, unless the end sheet is the limiting factor (low distribution of fasteners)
	Type	↑d_N	None	Higher strength: 1-2 KN
Purlins	Spacing	↑e_p	Higher flexibility: modification from 0.05 to 0.2 mm/KN per meter	Lower strength: modification of 5 KN per meter

Metal sheet selected			Generally not a big change, depends much on the fastening pattern	None
Fastening pattern	Alternate to every		Reduction of flexibility: 0.05 to 0.5 mm/KN depends on the case and sheet	Increase of the ultimate stress. From 2 to 10 KN
Cleats connection	Flexible to rigid		Reduction on the flexibility 0.1-0.2 mm/KN	No modification
Connection to the frame	From indirect to direct		Reduction of flexibility :0.3 to 0.1 mm/KN	Increase of strength: 0 to 40 KN

Table 7.2: Influence of the different factors in shear strength and flexibility

7.3. Range of stresses and flexibilities of the shear cells

The statistical values plotted look like this:

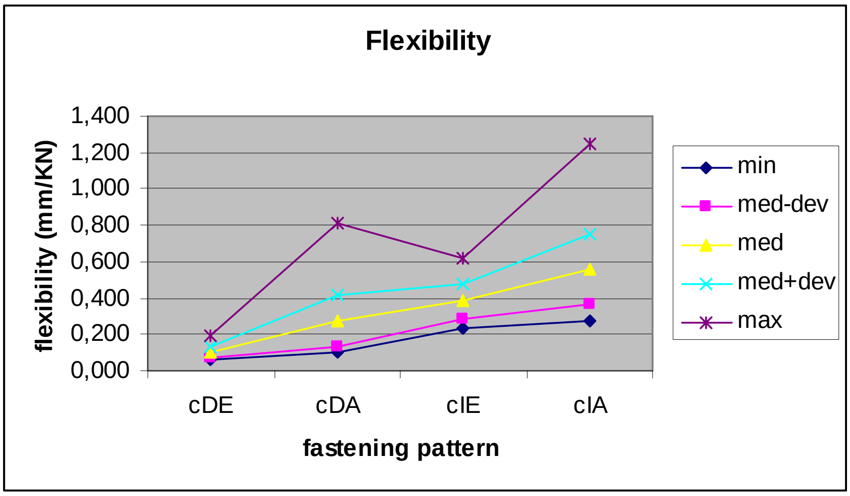

Fig 7.1: Statistical values of flexibilities of values in annex II

It can be seen that in direct fastening and in every though the values tend to be focused in the 0-0,2 mm/KN. With alternate pattern the medium lays between 0,1 and 0,4 mm/KN, some values that can be punctually higher, due to some fastening patterns of deep rib metal sheets. On the indirect, the same patterns are repeated but with a bit more of spacing due to c_{23} which has a significant value for alternate fastening.

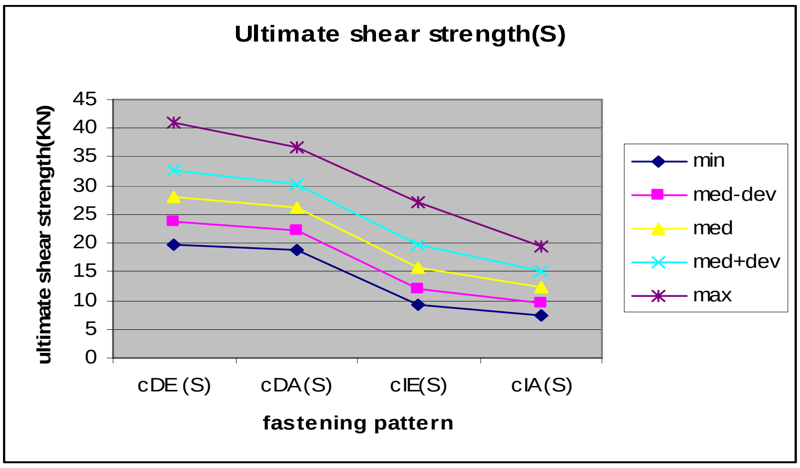

Fig 7.2: Statistical values of ultimate shear strength of values in annex II

It can be seen that the values concentrate, as the fastening pattern gets less stiff. There is a jump between the values reached with direct or indirect fastening, due to the change in where the weakest part is, in the seam or in the connection with the rafters.

7.4. Interaction stressed skin - building

The building and the diaphragm interact between them, and this interaction is regulated by the parameter r=c/k, which relates the flexibility of the two elements. The diaphragm is effective and possible when the following limits are respected:

Number of bays	Maximum r	Maximum H per frame (KN)
3	1,5	>60
4	0,6	>60
5	0,4	60
6	0,2	50
7	0,2	50
8	0,1	35
9	0,1	30
10	0,08	25
11	0,08	25
12	0,08	25

Table 7.3: Limitations for a symmetric building

Number of bays	Maximum r	Maximum H per frame (KN)
3	0,4	55
4	0,2	35
5	0,1	30
6	0,08	25
7	0,06	20
8	0,04	15

Table 7.4: Limitations for a non-symmetric building

7.5. Cases for which the stressed skin effect is a viable stiffen method

The buildings for which the stressed skin is a viable stiffen method is:

- Symmetric and five or less than bays: all kind of frames, flexible (k > 1mm/KN) and rigid ones (k < 1 mm/KN) can be stiffened, for wind forces up to 1.25 KN/m^2 or even more in certain cases
- Symmetric buildings with 6 or more bays: just the combination with flexible frames and wind forces up to 0.75 KN/m^2 can be expected
- Non-symmetric buildings fall in the second classification. The length of the non-symmetric building is difficult to be higher than 8 bays

	c							
r	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8
1,5	0,07	0,13	0,20	0,27	0,33	0,40	0,47	0,53
0,6	0,17	0,33	0,50	0,67	0,83	1,00	1,17	1,33
0,4	0,25	0,50	0,75	1,00	1,25	1,50	1,75	2,00
0,2	0,50	1,00	1,50	2,00	2,50	3,00	3,50	4,00
0,1	1,00	2,00	3,00	4,00	5,00	6,00	7,00	8,00
0,08	1,25	2,50	3,75	5,00	6,25	7,50	8,75	10,00
0,04	2,50	5,00	7,50	10,00	12,50	15,00	17,50	20,00

Table 7.5: values of k given r and c