ELASTRON

STEEL SERVICE CENTERS

SYMDECK – DESIGN TABLES

COMPOSITE PROFILE STEEL SHEETING

The composite decks consist of profiled steel sheeting and reinforced concrete. The composite method of deck construction was first introduced in North America and is increasingly being used in Europe and in Greece.

During the last years the use of composite decks in civil engineering structures has been increased due to the advantages that it offers with respect to more traditional solutions. The benefits from the usage of composite decks can be summarized in the following:

- Less construction time is required.
- The usage of wooden formwork is avoided.
- They can be used to bridge larger spans.

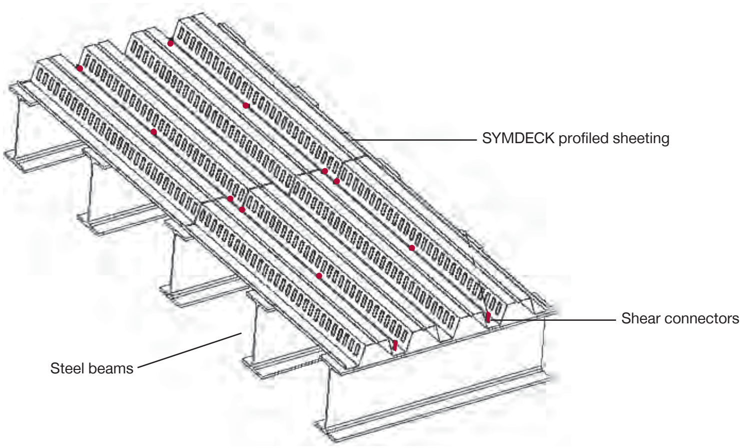


Figure 1: Typical configuration of a composite deck.

The main component of the composite decks is the profiled steel sheeting which during the construction phase, functions as formwork supporting the wet concrete (Figure 1). After the hardening of the concrete, the composite decks undertake the additional imposed loads. Usually, a light reinforcement is applied to the upper surface of the composite deck (Figure 2) which protects the concrete from cracking. In the case that a continuous beam structural system is adopted; this reinforcement also gives to the composite deck the ability to undertake hogging bending moments at the positions of the supports.

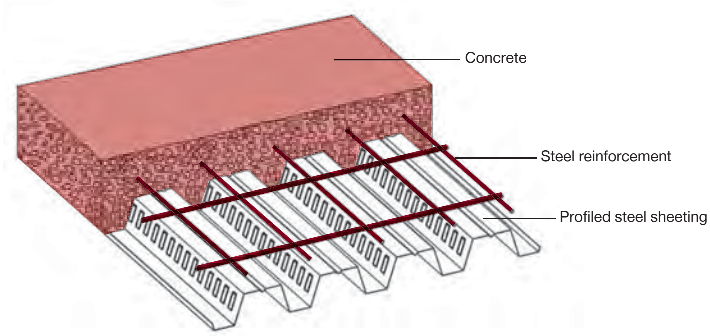


Figure 2: Typical composite deck.

SYMDECK 73

The SYMDECK 73 profiled steel sheeting is a galvanized trapezoidal profile which is being used in the construction of large spanning composite decks. Moreover it can be used alone (i.e. without concrete) as the main structural element for light floors.

The upper surface of the steel sheeting is stiffened against local buckling with an intermediate stiffener in its middle. Within the web of the cross-section there are embossments which offer the extra bond required between the steel sheeting and the concrete in order to transmit the longitudinal shear forces which develop at the interface of the two materials. It should be mentioned that the pure bond between the steel sheeting and the concrete is not considered as effective for the composite action.

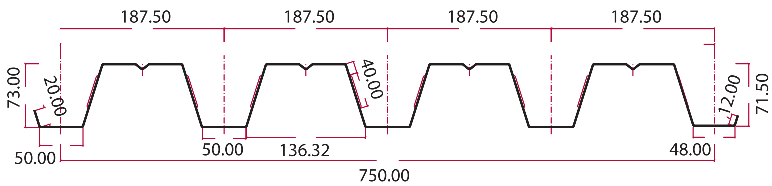
Steel sheetings are always manufactured according to the high standards of the factory, with a thickness that varies from 0.75 mm to 1.25 mm. The steel being used is of high quality S320G in accordance to Eurocode 3 - Part 1.3, galvanized and can be painted in various colours. The geometrical and inertial properties of the SYMDECK 73 profiled steel sheeting for each thickness are presented in Figure 3 and in the following tables.

Thickness	t (mm)	0.75	0.80	1.00	1.25
Weight	G (kg/m)	7.36	7.85	9.81	12.27
Cross section area	A (cm^2)	9.57	10.15	12.72	15.98
Second moment of inertia	I_y (cm^4)	82.51	88.00	110.42	138.32
Section modulus	W_y (cm^3)	20.68	22.11	27.74	34.67

Table 1: Geometrical and inertial properties of the SYMDECK 73 trapezoidal steel sheeting.

Thickness	t (mm)	0.75	0.80	1.00	1.25
Weight	G (kg/m^2)	9.81	10.47	13.08	16.36
Cross section area	A (cm^2/m)	12.76	13.533	16.96	21.31
Second moment of inertia	I_y (cm^4/m)	110.01	117.33	147.22	184.43
Section modulus	W_y (cm^3/m)	27.57	29.48	36.99	42.23

Table 2: Geometrical and inertial properties of the SYMDECK 73 trapezoidal steel sheeting per meter of width of cross section.



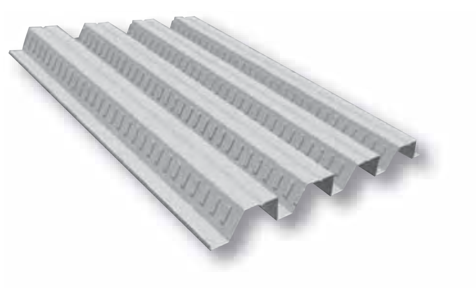


Figure 3: Geometry of the SYMDECK 73 trapezoidal steel sheeting.

DESIGN OF COMPOSITE DECKS

The design of composite decks according to Eurocode 4 includes two phases, the "construction phase" and the "phase of the composite action". During the construction phase, i.e. before the hardening of the concrete, the structural system should have the ability to receive the load of the wet concrete and the extra loads that occur due to the construction. In this case the profiled steel sheeting acts as formwork. After the hardening of the concrete the steel sheeting and the concrete work together as unified cross section. In this phase of the composite action, the extra loads applied on the deck during the construction lifetime, are undertaken by the composite action of the two materials.

CONSTRUCTION PHASE

In this phase the design is based on the serviceability and ultimate limit states. In the serviceability state, it is checked that the deflections caused by the design loads are within the limits set in Eurocode 4. In the ultimate limit state, the ability of the steel sheeting to undertake the bending moments caused by the design loads is checked. The ultimate limit state is checked using the provisions of the Part 1.3 of Eurocode 3 that refers to the cold formed thin gauge members and sheeting. In case that the required checks are not fulfilled, there is the possibility to place additional intermediate supports and repeat the required checks. These additional supports are removed after the hardening of the concrete.

PHASE OF THE COMPOSITE ACTION

In this phase the checks concern the ability of the deck to undertake bending moments (sagging and hogging), vertical shear and longitudinal shear. Also the deflections of the composite deck should comply with the limits set in Eurocode 4. The design against the ultimate limit state aims to the prevent of the failure modes described in the following.

FAILURE MODES OF COMPOSITE DECKS

The composites decks may fail under one of the failure modes described below:

- Bending failure (critical cross-section I)
- Longitudinal shear failure (critical cross-section II)
- Vertical shear failure (critical cross-section III)

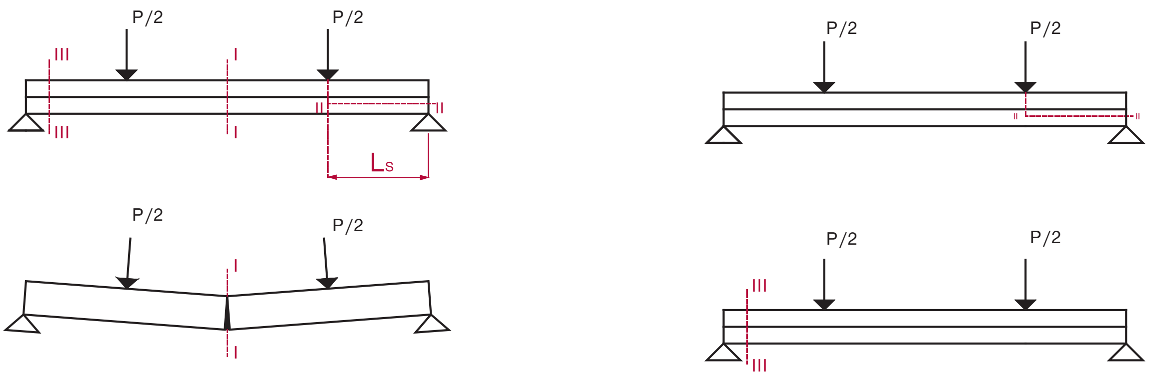


Figure 4: Failure modes of composite decks.

Bending failure

The bending failure is achieved only when the full shear connection between the steel sheeting and the concrete is attained. In this case, critical is the cross-section in the middle of the span (cross-section I) where vertical cracking appears.

Longitudinal shear failure

When the longitudinal shear forces that develop in the interface between the steel and the concrete cannot be fully undertaken, the bending strength of the cross section cannot be attained. On the contrary, critical is the horizontal cross-section along the shear length L_s in one of the two supports (cross-section II) in which slippage occurs between the steel sheeting and the concrete. Obviously, the failure in this case occurs for a load smaller than the one for which the bending failure is produced.

Vertical shear failure

The vertical shear failure is critical in composite decks having rather small span lengths, significant cross section height and relatively high loads. Critical is the cross-section III.

The steel sheeting plays an important role to the behavior and to the failure modes of composite decks because it is the factor that determines the type of the shear connection between the steel and the concrete. According to Eurocode 4, the resistance of the composite deck against longitudinal shear depends on the characteristic stresses which are defined through appropriate experimental testing.

The experimental procedure is specified and described in detail in Eurocode 4. The specimens are simply supported composite decks as presented in Figure 5.

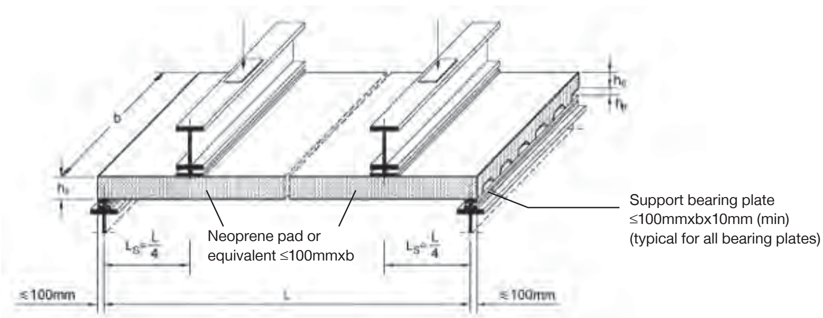


Figure 5: Experimental configuration for the determination of m, k.

The simply supported composite deck is loaded with two concentrated loads in an equal distance from the supports so that the shear span of the deck is equal to L_s=L/4. Two groups of three tests are conducted. In group A the specimens have a large shear span while in group B they have a small one. The diagram in Figure 6 defines the way that the factors m and k, are determined from the results of the conducted experiments.

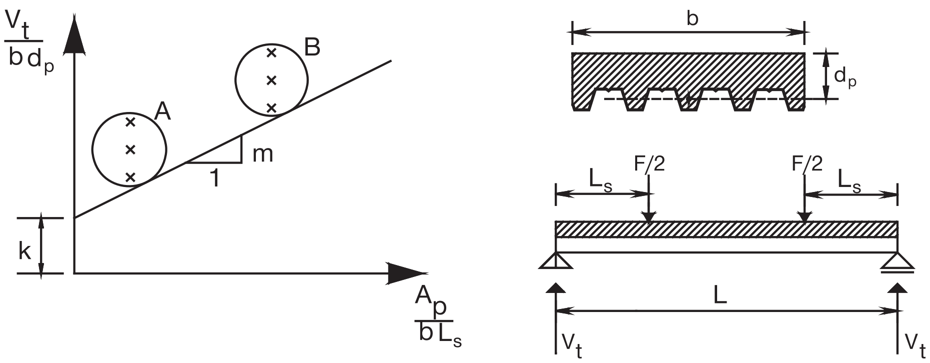


Figure 6: Determination of the factors m, k.

The values of the factors for the SYMDECK 73 profiled steel sheeting were determined after a set of experiments on composite decks. The tests were conducted in the Laboratory of Reinforced Concrete Technology and Structures of the Department of Civil Engineering at the University of Thessaly, Greece, within the framework of a relevant research program. The values were calculated by means of the diagram of Figure 7.

The factors m, k are effective for:

1. Deck thickness equal or smaller than the one used in tests (d ≤ 20cm).
2. Steel sheeting thickness equal or bigger than the one used in tests (t ≥ 0.75mm).
3. Concrete with characteristic compressive strength $f_{ck} \geq 20$ Mpa (C20/25 and above).
4. Profile steel sheeting with yield stress $f_y \geq 293$ Mpa (practically Fe320G and above).

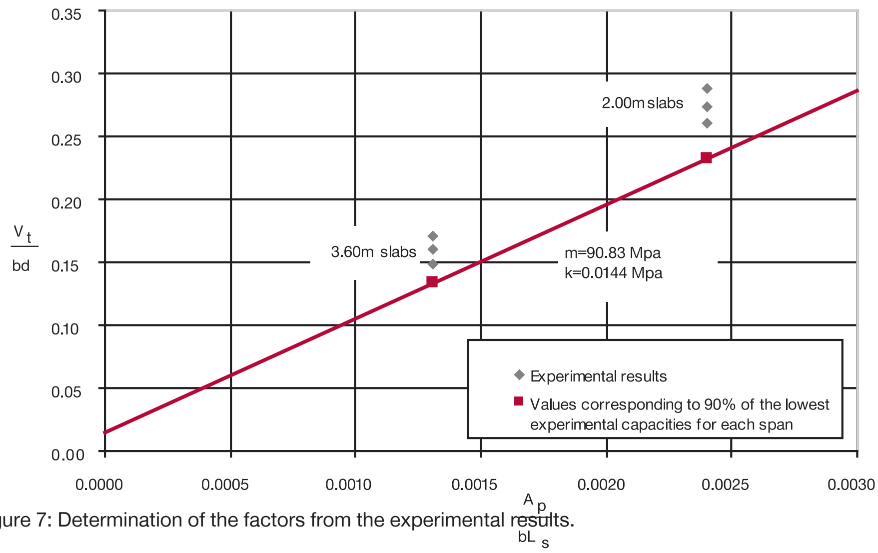


Figure 7: Determination of the factors from the experimental results.

DESIGNING TABLES OF COMPOSITES DECKS WITH SYMDECK 73 TRAPEZOIDAL STEEL SHEETING

The tables which have been created for various SYMDECK 73 steel sheeting thickness, concrete qualities and structural systems give the following abilities:

- Determination of the deck thickness required for a certain span length and a certain ultimate load.
- Determination of the maximum span length for a certain value of the deck thickness and a certain ultimate load.
- Determination of the maximum ultimate load for a certain deck thickness and a certain span length.

Also the tables indicate the need for temporary intermediate supports of the steel sheeting during the construction phase and the number of the required supports.

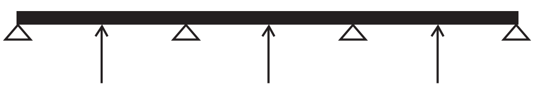


Figure 8: Model of a composite deck with intermediate supports.

The ultimate loads defined in the design tables were calculated with the help of the “SYMDECK Designer” software.

In the construction phase, the bending strengths were calculated according to the Part 1.3 of Eurocode 3, taking into account only the effective areas of the steel sheeting in the places where compressive stresses develop. It is noted that during the calculation of the bending strengths, the areas of the embossments of the steel sheeting are neglected (it is considered that an opening replaces the embossment).

During the construction phase, the steel sheeting supports its self weight, the weight of the wet concrete and the extra construction loads. A temporary support is essential when the design bending moments due to the above loads are greater than the bending moment resistance of the steel sheeting.

For the determination of the design bending moments, the envelope of the moments produced by the various load situations is used. For the determination of the envelope of the bending moments, the following loads are applied:

- Self weight of the steel sheeting G_p (permanent load).
- Self weight of the concrete (permanent load). Two cases are taken into account in order to consider the self weight of the concrete:

a) The case of a span-by-span casting (first a span is casted with the prescribed concrete thickness, and the casting continues in another span)

b) Progressive casting (the deck is casted in layers until the prescribed deck thickness is attained).

- Construction load (variable load)

The construction load is a uniformly distributed load of 1.5 kN/m² applied on a 3mx3m area (or on the entire span length, if it less than 3m) and a uniformly distributed load of 0.75 kN/m² applied on the remaining area. The loads are suitably arranged depending on whether the ultimate hogging design moment or the sagging design moment is calculated.

For the above mentioned loads the most unfavourable arrangement is considered as presented in Figures 9 and 10.

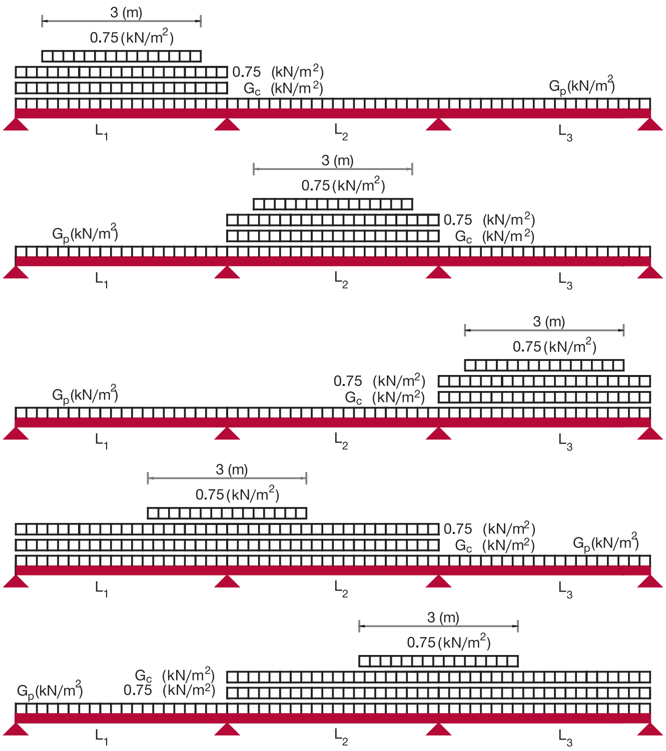


Figure 9: Load combinations for the “span-by-span” casting.

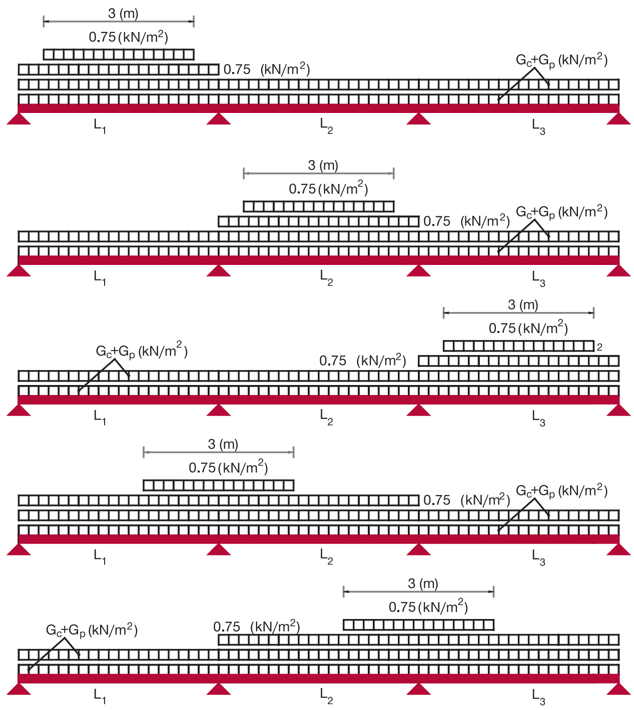


Figure 10: Load combinations for the “progressive” casting.

For the serviceability limit state, a load safety factor equal to 1.00 is considered.

In the case that the design bending moment is greater than the bending strength of the steel sheeting, the calculations are repeated with a structural system having intermediate supports. In the tables that follow, the span lengths requiring one intermediate support are indicated with yellow colour, while the span lengths requiring two intermediate supports are indicated with orange colour.

In the "composite action" phase the structural system of the composite deck is the initial one, i.e. the one resulting after the removal of the intermediate supports. In this phase, the applied loads in the composite deck are the self weight G, and the variable load Q. For the determination of the internal forces of the composite deck due to the above mentioned loads it is assumed that the variable load Q is applied on the entire area of the deck.

Two states are considered:

- **Ultimate limit state**

It is based on the loading combination 1.35G + 1.50Q from which the internal forces E_{Sd} are obtained (resistance against sagging moments M^{+}_{Sd}, resistance against hogging moments M^{-}_{Sd}, resistance against vertical shear $V_{Sd,v}$ and resistance against longitudinal shear $V_{Sd,l}$).

- **Serviceability limit state**

It is based on the load combination 1.00G + 1.00Q. For the calculation of the displacements, an average value of stiffness of the cracked and the uncracked cross section is used.

The definition of the ultimate variable load Q which is present in the above relations is determined such that:

- None of the design forces exceeds the respective resistances, and
- The displacements of the composite deck are in every span smaller than L/250, where L is the span length.

In the following tables the ultimate variable loads Q of the composite decks were calculated for three different structural systems and for span lengths varying between 1.00m and 5.50m.

The design tables were developed in the Department of Civil Engineering of the University of Thessaly, Greece (UTH) within the framework of the research project "DESIGN LOADS FOR COMPOSITE DECKS WITH PROFILED STEEL SHEETING" which was funded by ELASTRON S.A.

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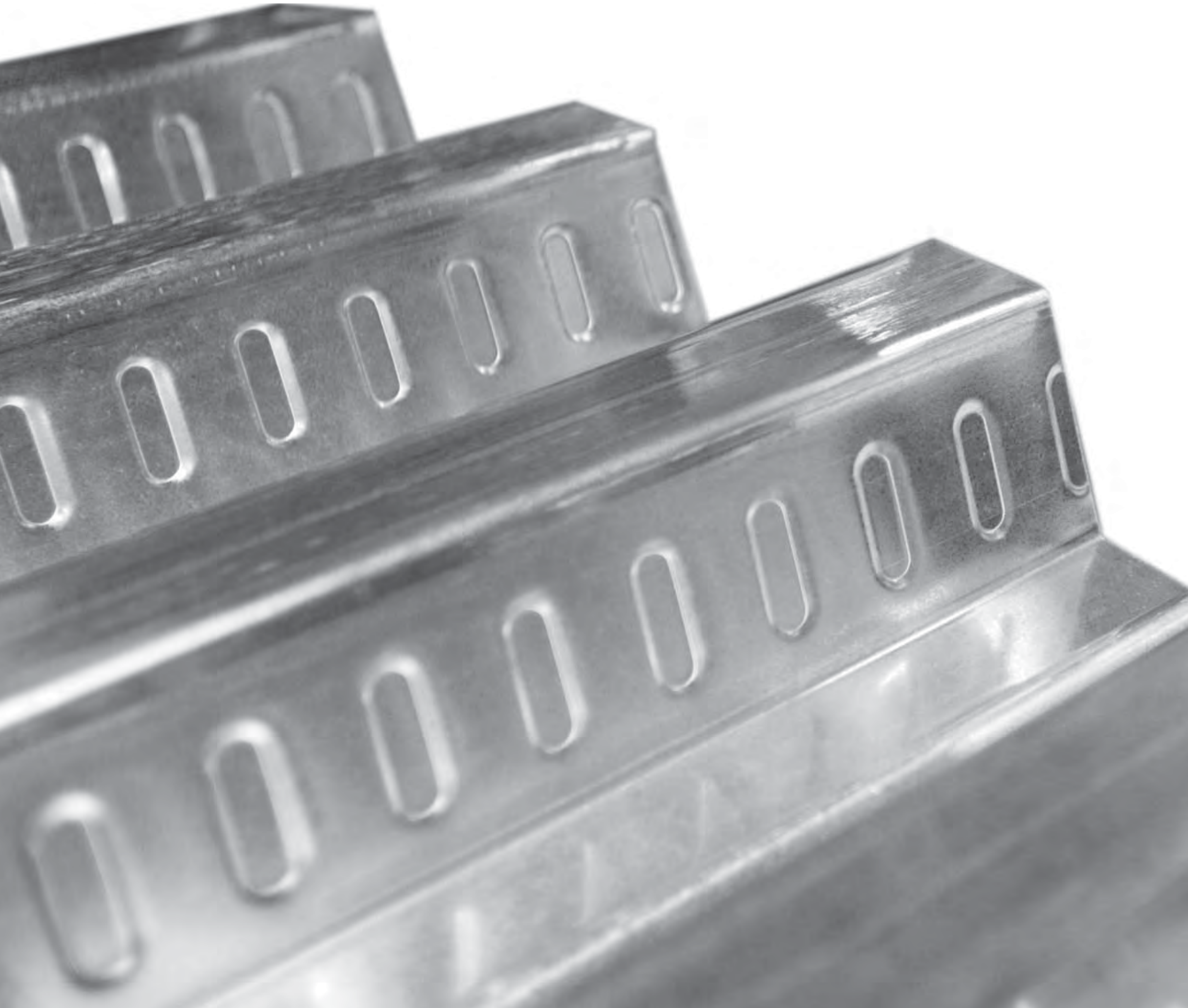


Steel sheeting thickness: **t=0.75 mm**
Concrete: C20/25
Steel reinforcement: S500

Thick-ness	Span L(m)																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	26.22	20.58	16.82	12.06	8.85	6.64	5.06	3.88	2.98	2.28	1.72	1.26	0.89	0.58					
0.14	28.14	22.07	18.02	13.44	9.87	7.40	5.64	4.32	3.32	2.54	1.91	1.41	0.99	0.65					
0.15	30.00	23.54	19.21	14.82	10.88	8.17	6.22	4.77	3.66	2.80	2.11	1.55	1.10	0.71					
0.16	31.89	24.98	20.37	16.02	11.89	8.93	6.80	5.21	4.00	3.06	2.31	1.70	1.20	0.78					
0.17	33.72	26.40	21.52	17.58	12.90	9.69	7.37	5.66	4.35	3.32	2.51	1.85	1.30	0.85					
0.18	35.52	27.79	22.64	18.96	13.93	10.45	7.95	6.10	4.69	3.58	2.70	1.99	1.41	0.92	0.51				
0.19	37.28	29.16	23.74	19.87	14.93	11.21	8.53	6.55	5.03	3.85	2.90	2.14	1.51	0.99	0.55				
0.20	39.02	30.50	24.82	20.77	15.94	11.97	9.11	6.99	5.37	4.11	3.10	2.28	1.61	1.06	0.59				

Maximum values of the variable load Q (kN/m²)

Steel sheeting thickness: **t=0.80 mm**
Concrete: C20/25
Steel reinforcement: S500

Thick-ness	Span L(m)																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	26.75	21.00	17.17	12.85	9.46	7.12	5.442	4.20	3.25	2.50	1.91	1.43	1.04	0.71					
0.14	28.67	22.49	18.37	14.32	10.54	7.93	6.066	4.68	3.62	2.79	2.13	1.60	1.16	0.80					
0.15	30.55	23.95	19.55	15.79	11.62	8.75	6.689	5.16	3.99	3.08	2.35	1.76	1.28	0.88	0.54				
0.16	32.41	25.39	20.72	17.26	12.70	9.56	7.313	5.64	4.36	3.37	2.57	1.93	1.40	0.96	0.59				
0.17	34.23	26.81	21.86	18.32	13.78	10.38	7.936	6.12	4.74	3.66	2.79	2.10	1.52	1.05	0.64				
0.18	36.02	28.20	22.98	19.25	14.86	11.19	8.56	6.60	5.11	3.94	3.01	2.26	1.64	1.13	0.70				
0.19	37.79	29.59	24.08	20.16	15.94	12.01	9.183	7.08	5.48	4.23	3.23	2.43	1.76	1.21	0.75				
0.20	39.52	30.90	25.16	21.05	17.03	12.82	9.807	7.57	5.86	4.52	3.45	2.59	1.89	1.30	0.80				

Maximum values of the variable load Q (kN/m²)

One intermediate support is required
Two intermediate supports are required

Steel sheeting thickness: **t=1.00 mm**
Concrete: C20/25
Steel reinforcement: S500

Thickness h_t (m)	Span L(m) 1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50
0.13	28.77	22.62	18.51	15.58	12.20	9.31	7.21	5.66	4.47	3.54	2.81	2.21	1.72	1.31	0.97	0.68			
0.14	30.68	24.09	19.71	16.57	13.60	10.38	8.04	6.31	4.98	3.95	3.13	2.47	1.92	1.47	1.09	0.76			
0.15	32.55	25.55	20.88	17.55	15.03	11.44	8.87	6.96	5.50	4.36	3.46	2.72	2.12	1.62	1.20	0.84	0.54		
0.16	34.39	26.98	22.03	18.50	15.90	12.51	9.69	7.61	6.01	4.77	3.78	2.98	2.32	1.77	1.32	0.93	0.59		
0.17	36.20	28.38	23.16	19.44	16.60	13.58	10.52	8.26	6.53	5.18	4.10	3.24	2.52	1.93	1.43	1.01	0.65		
0.18	37.98	29.76	24.28	20.36	17.40	14.64	11.35	8.91	7.04	5.59	4.43	3.49	2.72	2.08	1.55	1.09	0.70		
0.19	39.73	31.11	25.37	21.26	18.20	15.71	12.18	9.56	7.56	6.00	4.75	3.75	2.92	2.24	1.66	1.17	0.75		
0.20	41.45	32.44	26.44	25.15	18.90	16.43	13.01	10.20	8.07	6.40	5.08	4.00	3.12	2.39	1.78	1.25	0.81		

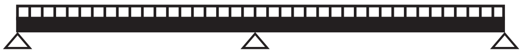
Maximum values of the variable load Q (kN/m^2)

Steel sheeting thickness: **t=1.25 mm**
Concrete: C20/25
Steel reinforcement: S500

Thickness h_t (m)	Span L(m) 1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50
0.13	31.31	24.65	20.20	17.02	14.64	11.94	9.34	7.41	5.94	4.80	3.88	3.14	2.54	2.04	1.61	1.25	0.95	0.68	
0.14	33.20	26.11	21.38	18.01	15.47	13.32	10.42	8.27	6.63	5.35	4.33	3.51	2.84	2.28	1.80	1.40	1.06	0.77	0.51
0.15	35.06	27.55	22.55	18.97	16.29	14.20	11.49	9.12	7.32	5.91	4.78	3.88	3.13	2.52	2.00	1.56	1.18	0.85	0.57
0.16	36.88	28.97	23.69	19.92	17.09	14.89	12.57	9.98	8.00	6.46	5.24	4.24	3.43	2.76	2.19	1.71	1.29	0.94	0.63
0.17	38.68	30.36	24.81	20.85	17.87	15.56	13.65	10.83	8.69	7.02	5.69	4.61	3.73	3.00	2.38	1.86	1.41	1.02	0.69
0.18	40.44	31.72	25.91	21.76	18.64	16.22	14.28	11.70	9.38	7.57	6.14	4.98	4.03	3.23	2.57	2.01	1.53	1.11	0.75
0.19	42.17	33.06	26.99	22.65	19.40	16.86	14.84	12.50	10.10	8.13	6.59	5.34	4.32	3.47	2.76	2.16	1.64	1.19	0.81
0.20	43.87	34.38	28.05	23.52	20.13	17.50	15.39	13.40	10.7	8.68	7.04	5.71	4.62	3.71	2.95	2.31	1.76	1.28	0.87

Maximum values of the variable load Q (kN/m^2)

One intermediate support is required

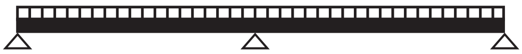


Steel sheeting thickness: **t=0.75 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thick-ness	Span L(m)																	
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	20.58	16.07	13.06	10.44	7.59	5.24	4.23	3.19	2.39	1.77	1.27	0.87	0.54						
0.14	22.08	17.22	13.98	11.63	8.46	6.28	4.72	3.55	2.67	1.97	1.42	0.97	0.61						
0.15	23.54	18.35	14.88	12.41	9.33	6.93	5.20	3.92	2.94	2.18	1.57	1.08	0.67						
0.16	24.99	19.46	15.77	13.14	10.20	7.57	5.68	4.28	3.22	2.38	1.72	1.18	0.73						
0.17	26.40	20.54	16.64	13.85	11.07	8.22	6.17	4.65	3.49	2.58	1.86	1.28	0.80						
0.18	27.79	21.61	17.49	14.55	11.93	8.86	6.65	5.01	3.76	2.79	2.01	1.38	0.86						
0.19	29.16	22.66	18.33	15.23	12.80	9.51	7.14	3.38	4.04	2.99	2.16	1.48	0.93						
0.20	30.50	23.69	19.15	15.91	13.47	10.15	7.62	5.75	4.31	3.19	2.31	1.58	0.99	0.50					

Maximum values of the variable load (kN/m²)



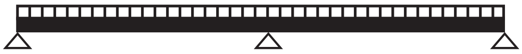
Steel sheeting thickness: **t=0.80 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thick-ness	Span L(m)																	
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	21.00	16.40	13.34	11.13	8.12	6.05	4.57	3.47	2.62	1.97	1.44	1.02	0.67						
0.14	22.49	17.55	14.25	11.90	9.05	6.75	5.09	3.86	2.93	2.19	1.61	1.14	0.75						
0.15	23.95	18.68	15.16	12.64	9.98	7.44	5.62	4.26	3.23	2.42	1.78	1.26	0.83						
0.16	25.39	19.78	16.04	13.37	10.91	8.13	6.10	4.66	3.53	2.65	1.95	1.38	0.91	0.52					
0.17	26.81	20.87	16.91	14.08	11.84	8.83	6.66	5.06	3.83	2.87	2.11	1.50	0.99	0.57					
0.18	28.20	21.93	17.76	14.78	12.54	9.52	7.19	5.46	4.13	3.10	2.28	1.61	1.07	0.61					
0.19	29.56	22.98	18.59	15.46	13.11	10.21	7.71	5.85	4.44	3.33	2.45	1.73	1.15	0.66					
0.20	30.90	24.01	19.41	16.13	13.67	10.90	8.24	6.25	4.74	3.55	2.61	1.85	1.23	0.71					

Maximum values of the variable load (kN/m²)

One intermediate support is required
Two intermediate supports are required

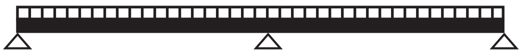


Steel sheeting thickness: **t=1.00 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thickness	Span L(m)																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	22.62	17.69	14.41	12.06	10.08	7.55	5.73	4.39	3.37	2.57	1.94	1.43	1.01	0.67					
0.14	24.09	18.83	15.32	12.81	10.93	8.47	6.44	4.93	3.79	2.90	2.19	1.62	1.15	0.77					
0.15	25.55	19.95	16.21	13.54	11.54	9.83	7.55	5.86	4.56	3.56	2.76	2.11	1.58	1.13	0.76				
0.16	26.98	21.04	17.09	14.26	12.15	10.50	8.26	6.40	4.99	3.89	3.02	2.31	1.73	1.24	0.84				
0.17	28.38	22.12	17.95	14.97	12.74	11.00	8.96	6.95	5.42	4.23	3.28	2.51	1.88	1.35	0.91	0.54			
0.18	29.76	23.18	18.79	15.66	13.31	11.48	9.67	7.50	5.85	4.56	3.53	2.71	2.02	1.46	0.98	0.58			
0.19	31.11	24.22	19.62	16.34	13.88	11.96	10.37	8.05	6.28	4.89	3.79	2.90	2.17	1.57	1.06	0.63			
0.20	32.44	25.24	20.43	17.00	14.43	12.43	10.83	5.60	6.70	5.23	4.05	3.10	2.32	1.68	1.13	0.67			

Maximum values of the variable load (kN/m²)



Steel sheeting thickness: **t=1.25 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thickness	Span L(m)																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	24.65	19.31	15.75	13.21	10.02	7.49	5.68	4.35	3.33	2.53	1.91	1.40	0.98	0.64					
0.14	26.11	20.44	16.66	13.95	11.26	8.42	6.39	4.89	3.75	2.86	2.16	1.59	1.12	0.74					
0.15	27.55	21.54	17.54	14.68	12.54	10.87	9.53	7.60	5.99	4.74	3.74	2.94	2.28	1.74	1.28	0.90	0.57		
0.16	28.97	22.63	18.41	15.39	13.13	11.37	9.76	8.40	6.63	5.25	4.15	3.27	2.54	1.94	1.44	1.11	0.65		
0.17	30.36	23.70	19.26	16.09	13.71	11.86	10.38	9.17	7.34	5.86	4.68	3.73	2.94	2.30	1.75	1.29	0.89	0.55	
0.18	31.72	24.75	20.10	16.77	14.29	12.35	10.80	9.53	7.92	6.32	5.05	4.02	3.18	2.48	1.89	1.39	0.97	0.60	
0.19	33.06	25.77	20.91	17.44	14.84	12.82	11.20	9.87	8.50	6.79	5.42	4.32	3.42	2.67	2.04	1.50	1.04	0.65	
0.20	34.38	26.78	21.72	18.10	15.39	13.28	11.59	10.21	9.06	7.25	5.80	4.62	3.65	2.85	2.18	1.61	1.12	0.70	

Maximum values of the variable load (kN/m²)

One intermediate support is required (grey shading)

Steel sheeting thickness: **t=0.75 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thick-ness	**Span L(m)**																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	21.53	16.82	13.69	10.96	7.99	5.95	4.49	3.40	2.57	1.93	1.41	0.99	0.65						
0.14	23.09	18.03	14.66	12.21	8.91	6.64	5.00	3.79	2.87	2.15	1.57	1.11	0.72						
0.15	24.63	19.21	15.61	13.03	9.82	7.32	5.52	4.18	3.16	2.37	1.73	1.22	0.80						
0.16	26.14	20.38	16.54	13.80	10.73	8.00	6.03	4.57	3.46	2.59	1.90	1.34	0.88						
0.17	27.62	21.52	17.45	14.55	11.65	8.68	6.55	4.96	3.76	2.81	2.06	1.45	0.95	0.54					
0.18	29.08	22.64	18.35	15.29	12.56	9.36	7.06	5.35	4.05	3.03	2.22	1.57	1.03	0.58					
0.19	30.52	23.75	19.23	16.01	13.48	10.04	7.57	5.74	4.35	3.25	2.38	1.68	1.10	0.62					
0.20	31.92	24.83	20.10	16.72	14.18	10.72	8.09	6.13	4.60	3.48	2.55	1.80	1.18	0.67					

Maximum values of the variable load (kN/m²)

Steel sheeting thickness: **t=0.80 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thick-ness	**Span L(m)**																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	21.96	17.17	13.98	11.68	8.55	6.39	4.84	3.69	2.82	2.13	1.59	1.15	0.78						
0.14	23.52	18.37	14.94	12.49	9.52	7.12	5.40	4.12	3.14	2.38	1.77	1.28	0.88	0.54					
0.15	25.05	19.55	15.89	13.27	10.50	7.85	5.95	4.54	3.46	2.62	1.95	1.41	0.97	0.60					
0.16	26.56	20.72	16.82	14.04	11.48	8.58	6.51	4.96	3.79	2.87	2.14	1.55	1.06	0.65					
0.17	28.04	21.86	17.73	14.79	12.46	9.32	7.06	5.39	4.11	3.11	2.32	1.68	1.15	0.71					
0.18	29.50	22.98	18.63	15.52	13.19	10.05	7.62	5.81	4.44	3.36	2.50	1.81	1.24	0.77					
0.19	30.93	24.08	19.51	16.24	13.80	10.78	8.17	6.24	4.76	3.61	2.69	1.94	1.33	0.83					
0.20	32.34	25.16	20.37	16.95	14.39	11.51	8.73	6.66	5.08	3.85	2.87	2.08	1.43	0.88					

Maximum values of the variable load (kN/m²)

One intermediate support is required
Two intermediate supports are required

Steel sheeting thickness: **t=1.00 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thick-ness	**Span L(m)**																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	23.65	18.51	15.09	12.65	10.82	8.41	6.48	5.04	3.95	3.09	2.41	1.86	1.41	1.04	0.72				
0.14	25.19	19.71	16.05	13.44	11.48	9.38	7.22	5.62	4.40	3.45	2.69	2.08	1.58	1.16	0.81	0.51			
0.15	26.71	20.88	16.99	14.21	12.13	10.34	7.97	6.20	4.86	3.81	2.97	2.30	1.74	1.28	0.90	0.57			
0.16	28.21	22.03	17.91	14.97	12.76	11.05	8.71	6.78	5.31	4.17	3.25	2.51	1.91	1.41	0.98	0.62			
0.17	29.68	23.16	18.82	15.72	13.39	11.58	9.46	7.36	5.77	4.52	3.53	2.73	2.07	1.53	1.07	0.68			
0.18	31.13	24.28	19.71	16.44	14.00	12.09	10.20	7.94	6.22	4.88	3.81	2.95	2.24	1.65	1.16	0.74			
0.19	32.55	25.37	20.58	17.16	14.59	16.60	10.94	8.52	6.68	5.24	4.09	3.17	2.41	1.77	1.24	0.79			
0.20	33.94	26.44	21.43	17.86	15.18	13.09	11.43	9.10	7.13	5.60	4.37	3.38	2.57	1.90	1.33	0.85			

Maximum values of the variable load (kN/m^2)

Steel sheeting thickness: **t=1.25 mm**
Concrete: C20/25
Steel reinforcement: S500

Reinforcement at the positions of hogging moments								
h_t (m)	**0.13**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.20**
Reinforcement	Φ8/20	Φ8/20	Φ8/15	Φ8/15	Φ10/20	Φ10/20	Φ10/15	Φ10/15

Thick-ness	**Span L(m)**																		
h_t (m)	**1.00**	**1.25**	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**	**3.75**	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**	**5.25**	**5.50**
0.13	25.76	20.20	16.49	13.85	11.86	9.88	7.61	5.94	4.67	3.68	2.89	2.26	1.74	1.31	0.95	0.64			
0.14	27.29	21.38	17.44	14.63	12.52	10.88	8.55	6.68	5.25	4.14	3.26	2.55	1.97	1.48	1.08	0.74			
0.15	28.80	22.55	18.37	15.40	13.16	11.42	10.03	8.21	6.54	5.24	4.20	3.37	2.68	2.11	1.63	1.22	0.88	0.58	
0.16	30.28	23.69	19.29	16.15	13.79	11.96	10.49	8.98	7.15	5.73	4.60	3.68	2.93	2.31	1.79	1.34	0.96	0.64	
0.17	31.74	24.81	20.18	16.88	14.41	12.48	10.94	9.68	7.77	6.22	5.00	4.00	3.19	2.51	1.95	1.46	1.05	0.70	
0.18	33.17	25.91	21.06	17.60	15.01	12.99	11.38	10.06	8.38	6.72	5.39	4.32	3.44	2.72	2.10	1.58	1.14	0.76	
0.19	34.76	26.99	21.93	18.31	15.56	13.49	11.80	10.42	9.00	7.21	5.79	4.64	3.70	2.92	2.26	1.70	1.23	0.82	
0.20	35.96	28.05	22.77	19.00	16.18	13.98	12.22	10.78	9.58	7.70	6.16	4.96	3.96	3.12	2.42	1.82	1.31	0.88	

Maximum values of the variable load (kN/m^2)

One intermediate support is required

DESIGN TABLES FOR LIGHT FLOORS MADE OF SYMDECK 73 STEEL SHEETING (COLD FORMED THIN SHEETING SECTION)

The ultimate loads for light floors made of SYMDECK 73 steel sheeting are given in the following (i.e. without the consideration of the composite action). The tables can be used for the design of light floors (e.g. steel sheeting & laminate wood & coverage) or in the case of covering the steel sheeting with light weight concrete where the composite action is neglected.

The floor loads are divided in two categories: permanent load G and variable load Q. The design for the two states considered is described below:

Service ability limit state – SLS

For the serviceability limit state, the ultimate load is given for two displacement limits, L/200 and L/300, where L is the span length. This ultimate load refers to the load combination G + Q (safety factors equal to 1.00). These loads are presented in the tables as $q_{Rd - SLS - L/200}$ και $q_{Rd - SLS - L/300}$.

Ultimate limit state – ULS

In the ultimate limit state, the ultimate load is calculated taking into account the bending moment resistance of the most critical cross-section. The calculated ultimate loads correspond to the load combination 1.35G + 1.50Q and denoted in the tables as $q_{Rd - ULS}$.

Use of tables

Depending on the rate between permanent and variable loads, the critical check may correspond either to the serviceability or to the ultimate limit state.

Example:

Consider a floor in which the following loads are applied permanent load G=1.0 kN/m^2 and variable load Q=5.0 kN/m^2. The design of the floor is required (steel thickness, span lengths) for three equal spans continuous beam structural system. The serviceability limit state check should be performed with an acceptable displacement equal to L/300.

1. Calculation of design load for the serviceability limit state
$q_{Sd - SLS} = G + Q = 1.0 + 5.0 = 6.0$ kN/m^2

2. Calculation of design load for the ultimate limit state
$q_{Sd - ULS} = 1.35G + 1.5Q = 1.35 \times 1.0 + 1.5 \times 5.0 = 8.85$ kN/m^2

3. From the design tables for a continuous beam of three equal spans, the following combinations are obtained that satisfy both the SLS check ($q_{Sd - SLS} < q_{Rd - SLS - L/300}$) and the ULS check ($q_{Sd - ULS} < q_{Rd - ULS}$).

t=0.75mm, L=2.25m
t=0.80mm, L=2.25m
t=1.00mm, L=2.75m
t=1.25mm, L=3.00m

t=0.75 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd\text{-}SLS\text{-}L/200}$	26.28	16.55	11.09	7.79	5.68	4.27	3.29	2.58	2.07	1.68	1.39	1.16	0.97	0.83	0.71	0.61	0.53	0.47	0.41
$q_{Rd\text{-}SLS\text{-}L/300}$	17.52	11.03	7.39	5.19	3.78	2.84	2.19	1.72	1.38	1.12	0.92	0.77	0.65	0.55	0.47	0.41	0.36	0.31	0.27
$q_{Rd\text{-}ULS}$	22.97	16.88	12.92	10.21	8.27	6.83	5.74	4.89	4.22	3.68	3.23	2.86	2.55	2.29	2.07	1.88	1.71	1.56	1.44

t=0.80 mm

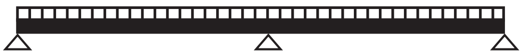
L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd\text{-}SLS\text{-}L/200}$	28.03	17.65	11.83	8.31	6.06	4.55	3.50	2.76	2.21	1.79	1.48	1.23	1.04	0.88	0.76	0.65	0.57	0.50	0.44
$q_{Rd\text{-}SLS\text{-}L/300}$	18.69	11.77	7.88	5.54	4.04	3.03	2.34	1.84	1.47	1.20	0.99	0.82	0.69	0.59	0.50	0.44	0.38	0.33	0.29
$q_{Rd\text{-}ULS}$	24.57	18.05	13.82	10.92	8.84	7.31	6.14	5.23	4.51	3.93	3.46	3.06	2.73	2.45	2.21	2.00	1.83	1.67	1.54

t=1.00 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd\text{-}SLS\text{-}L/200}$	35.18	22.15	14.84	10.42	7.60	5.71	4.40	3.46	2.77	2.25	1.86	1.55	1.30	1.11	0.95	0.82	0.71	0.62	0.55
$q_{Rd\text{-}SLS\text{-}L/300}$	23.45	14.77	9.89	6.95	5.07	3.81	2.93	2.31	1.85	1.50	1.24	1.03	0.87	0.74	0.63	0.55	0.48	0.42	0.37
$q_{Rd\text{-}ULS}$	30.86	22.67	17.36	13.72	11.11	9.18	7.72	6.57	5.67	4.94	4.34	3.84	3.43	3.08	2.78	2.52	2.30	2.10	1.93

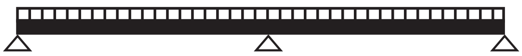
t=1.25 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd\text{-}SLS\text{-}L/200}$	44.07	27.75	18.59	13.06	9.52	7.15	5.51	4.33	3.47	2.82	2.32	1.94	1.63	1.39	1.19	1.03	0.89	0.78	0.69
$q_{Rd\text{-}SLS\text{-}L/300}$	29.38	18.50	12.39	8.70	6.35	4.77	3.67	2.89	2.31	1.88	1.55	1.29	1.09	0.93	0.79	0.69	0.60	0.52	0.46
$q_{Rd\text{-}ULS}$	38.72	28.45	21.78	17.21	13.94	11.52	9.68	8.25	7.11	6.20	5.44	4.82	4.30	3.86	3.48	3.16	2.88	2.64	2.42



t=0.75 mm

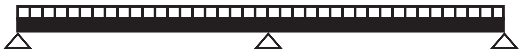
L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd\text{-}SLS\text{-}L/200}$	63.03	39.77	26.67	18.72	13.65	10.26	7.89	6.20	4.97	4.03	3.33	2.78	2.34	2.00	1.70	1.47	1.28	1.12	0.99
$q_{Rd\text{-}SLS\text{-}L/300}$	42.02	26.52	17.78	12.48	9.10	6.84	5.26	4.13	3.31	2.69	2.22	1.85	1.56	1.33	1.13	0.98	0.85	0.75	0.66
$q_{Rd\text{-}ULS}$	17.44	12.86	9.88	7.84	6.36	5.28	4.44	3.79	3.27	2.85	2.51	2.22	1.99	1.78	1.61	1.46	1.33	1.22	1.12



t=0.80 mm

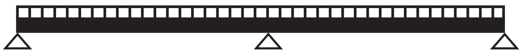
L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd\text{-}SLS\text{-}L/200}$	67.57	42.48	28.41	19.98	14.55	10.91	8.43	6.63	5.30	4.31	3.55	2.96	2.50	2.12	1.82	1.57	1.37	1.20	1.05
$q_{Rd\text{-}SLS\text{-}L/300}$	45.05	28.32	18.94	13.32	9.70	7.28	5.62	4.42	3.54	2.87	2.37	1.98	1.66	1.41	1.22	1.05	0.91	0.80	0.70
$q_{Rd\text{-}ULS}$	19.05	14.05	10.80	8.57	6.96	5.77	4.85	4.14	3.57	3.12	2.74	2.43	2.17	1.95	1.76	1.60	1.45	1.33	1.22

Ultimate loads in kN/m² for the ultimate and serviceability limit states.



t=1.00 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd-SLS-L/200}$	84.55	53.35	35.71	25.06	18.27	13.75	10.56	8.33	6.65	5.42	4.46	3.72	3.13	2.66	2.27	1.97	1.72	1.50	1.32
$q_{Rd-SLS-L/300}$	56.37	35.57	23.81	16.70	12.18	9.17	7.04	5.56	4.44	3.61	2.98	2.48	2.09	1.78	1.52	1.32	1.15	1.00	0.88
q_{Rd-ULS}	25.91	19.11	14.69	11.65	9.47	7.84	6.60	5.64	4.87	4.24	3.73	3.31	2.95	2.65	2.40	2.17	1.98	1.81	1.66



t=1.25 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd-SLS-L/200}$	105.9	66.79	44.64	31.42	22.89	17.19	13.27	10.42	8.33	6.77	5.59	4.66	3.93	3.34	2.86	2.48	2.15	1.88	1.66
$q_{Rd-SLS-L/300}$	70.62	44.53	29.76	20.95	15.26	11.46	8.85	6.94	5.56	4.51	3.72	3.11	2.62	2.22	1.91	1.65	1.43	1.25	1.10
q_{Rd-ULS}	35.09	25.89	19.90	15.79	12.83	10.63	8.95	7.64	6.60	5.75	5.06	4.48	4.00	3.60	3.25	2.94	2.68	2.45	2.25

t=0.75 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd-SLS-L/200}$	49.67	31.36	20.96	14.73	10.78	8.09	6.22	4.90	3.92	3.18	2.62	2.19	1.84	1.56	1.34	1.16	1.01	0.88	0.78
$q_{Rd-SLS-L/300}$	33.11	20.91	13.98	9.82	7.18	5.39	4.15	3.26	2.61	2.12	1.75	1.46	1.23	1.04	0.90	0.77	0.67	0.59	0.52
q_{Rd-ULS}	21.80	16.07	12.35	9.80	7.95	6.60	5.55	4.73	4.08	3.56	3.14	2.78	2.48	2.23	2.01	1.82	1.66	1.52	1.40

t=0.80 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd-SLS-L/200}$	53.19	33.40	22.37	15.71	11.47	8.59	6.64	5.21	4.18	3.40	2.80	2.33	1.96	1.67	1.43	1.24	1.07	0.94	0.83
$q_{Rd-SLS-L/300}$	35.46	22.26	14.91	10.47	7.65	5.73	4.43	3.47	2.78	2.26	1.87	1.55	1.30	1.12	0.95	0.83	0.72	0.63	0.55
q_{Rd-ULS}	23.82	17.56	13.50	10.71	8.70	7.21	6.07	5.18	4.47	3.90	3.43	3.04	2.71	2.44	2.20	2.00	1.82	1.66	1.53

t=1.00 mm

L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd-SLS-L/200}$	66.37	41.87	28.09	19.70	14.37	10.83	8.33	6.55	5.24	4.26	3.51	2.93	2.46	2.10	1.80	1.55	1.35	1.18	1.04
$q_{Rd-SLS-L/300}$	44.25	27.91	18.73	13.13	9.58	7.22	5.56	4.37	3.49	2.84	2.34	1.95	1.64	1.40	1.20	1.04	0.90	0.79	0.69
q_{Rd-ULS}	32.40	23.89	18.36	14.57	11.84	9.81	8.25	7.05	6.08	5.30	4.67	4.14	3.69	3.32	3.00	2.71	2.47	2.26	2.08

t=1.25 mm

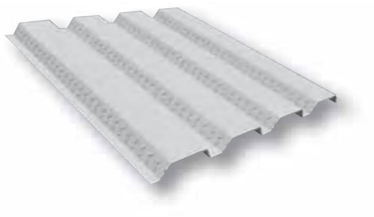
L (m)	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
$q_{Rd-SLS-L/200}$	83.33	52.40	35.21	24.67	18.01	13.48	10.42	8.21	6.55	5.34	4.40	3.66	3.07	2.62	2.25	1.94	1.69	1.48	1.30
$q_{Rd-SLS-L/300}$	55.56	34.93	23.47	16.45	12.01	8.99	6.94	5.47	4.37	3.56	2.93	2.44	2.06	1.75	1.50	1.30	1.13	0.99	0.87
q_{Rd-ULS}	43.87	32.35	24.87	19.74	16.04	13.29	11.18	9.55	8.24	7.19	6.33	5.61	5.00	4.49	4.06	3.68	3.35	3.07	2.82

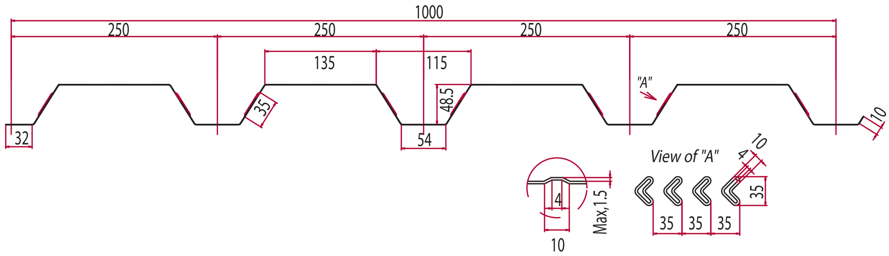
Ultimate loads in kN/m² for the ultimate and serviceability limit states.

COMPOSITE PROFILE

SYMDECK 50

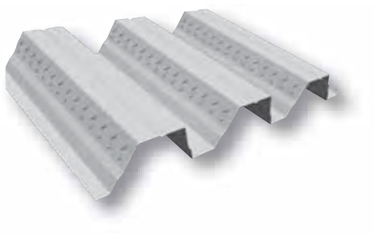
Coil Width: 1250mm
Coil Thickness: 0.75mm ~ 1.25mm (±0.02)
Covering Width: 1000 ±5.0mm
Depth of Wave: 48.5 ±1.0mm
Pitch: 250 ±2mm

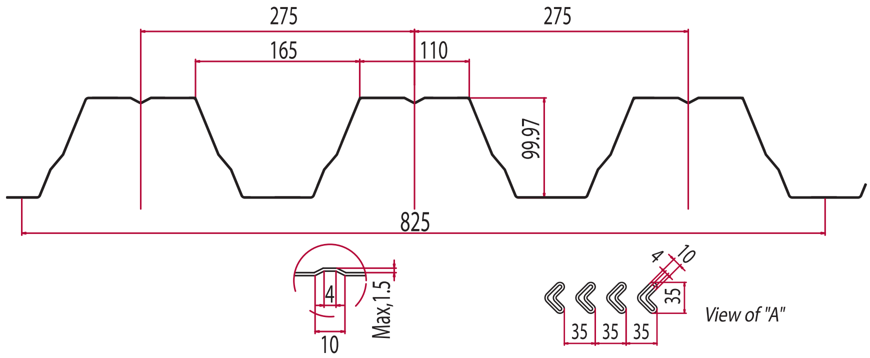




SYMDECK 100

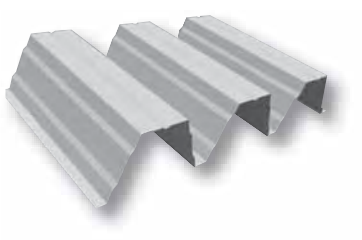
Coil Width: 1250mm
Coil Thickness: 0.75mm ~ 1.5mm (±0.02)
Covering Width: 825 ±5.0mm
Depth of Wave: 100 ±1.5mm
Pitch: 275 ±2mm

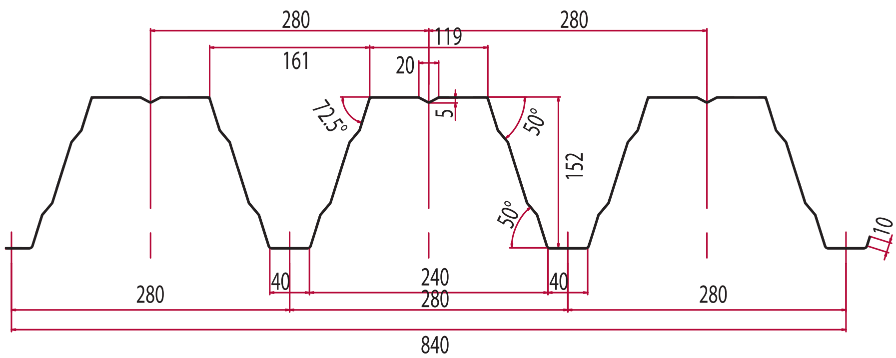




SYMDECK 150

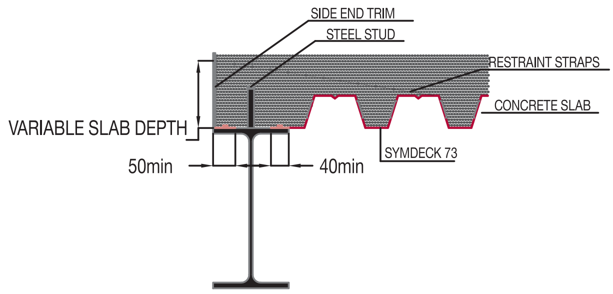
Coil Width: 1500mm
Coil Thickness: 0.75mm ~ 1.5mm (±0.02)
Covering Width: 840 ±5.0mm
Depth of Wave: 152±1.5mm
Pitch: 280 ±2mm



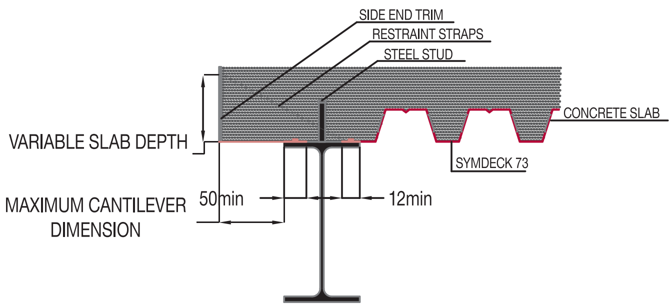


COMPOSITE FLOOR DECKS CONSTRUCTION DETAILS

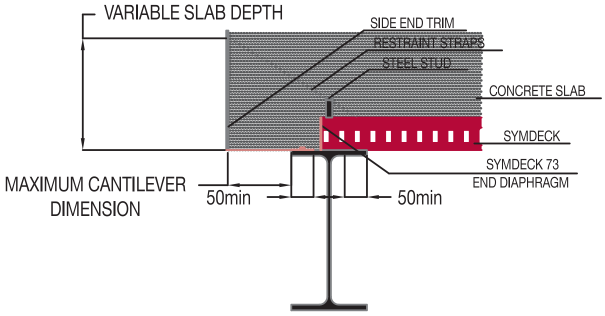
SIDE END DETAIL



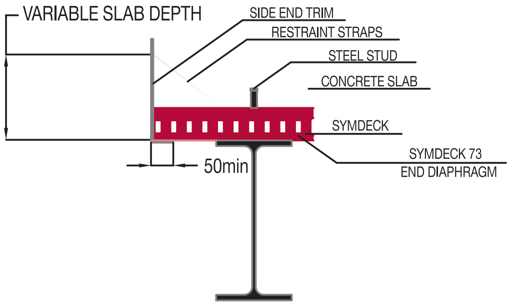
CANTILEVER SIDE END DETAIL

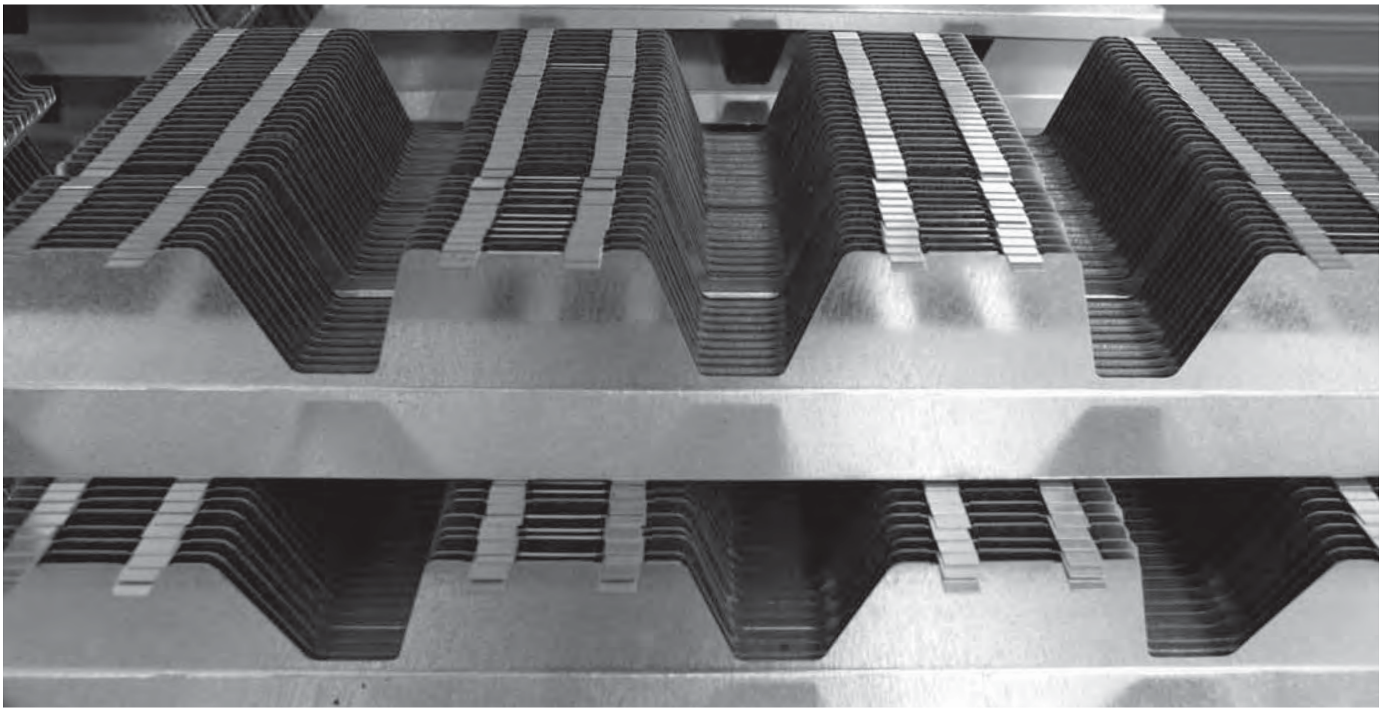


END DETAIL

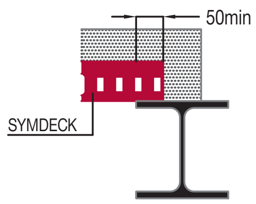


CANTILEVER END DETAIL

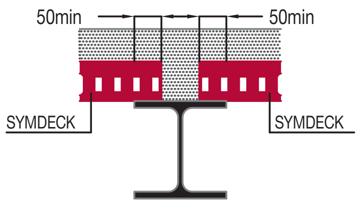




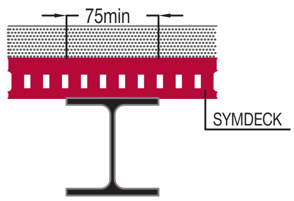
STEEL OR CONCRETE BEAM AND SUPPORT



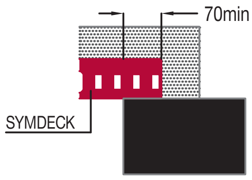
DOUBLE SUPPORT ON STEEL OR CONCRETE BEAM



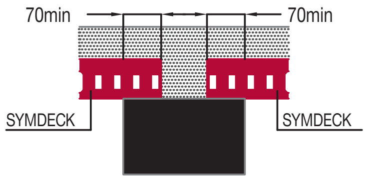
CONTINUOUS SUPPORT ON STEEL OR CONCRETE BEAM



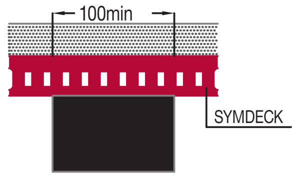
END DETAIL SUPPORT ON WALL



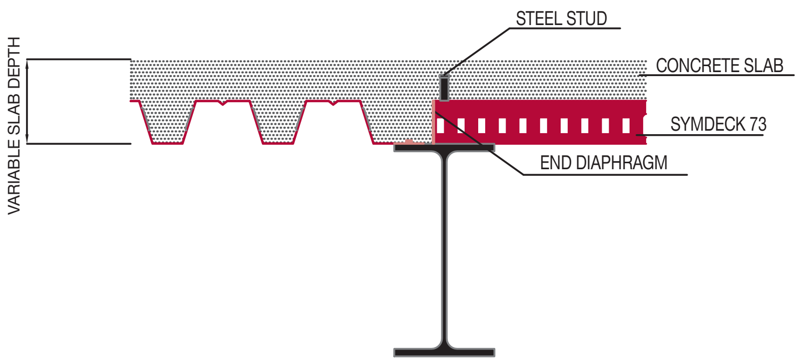
DOUBLE SUPPORT ON WALL

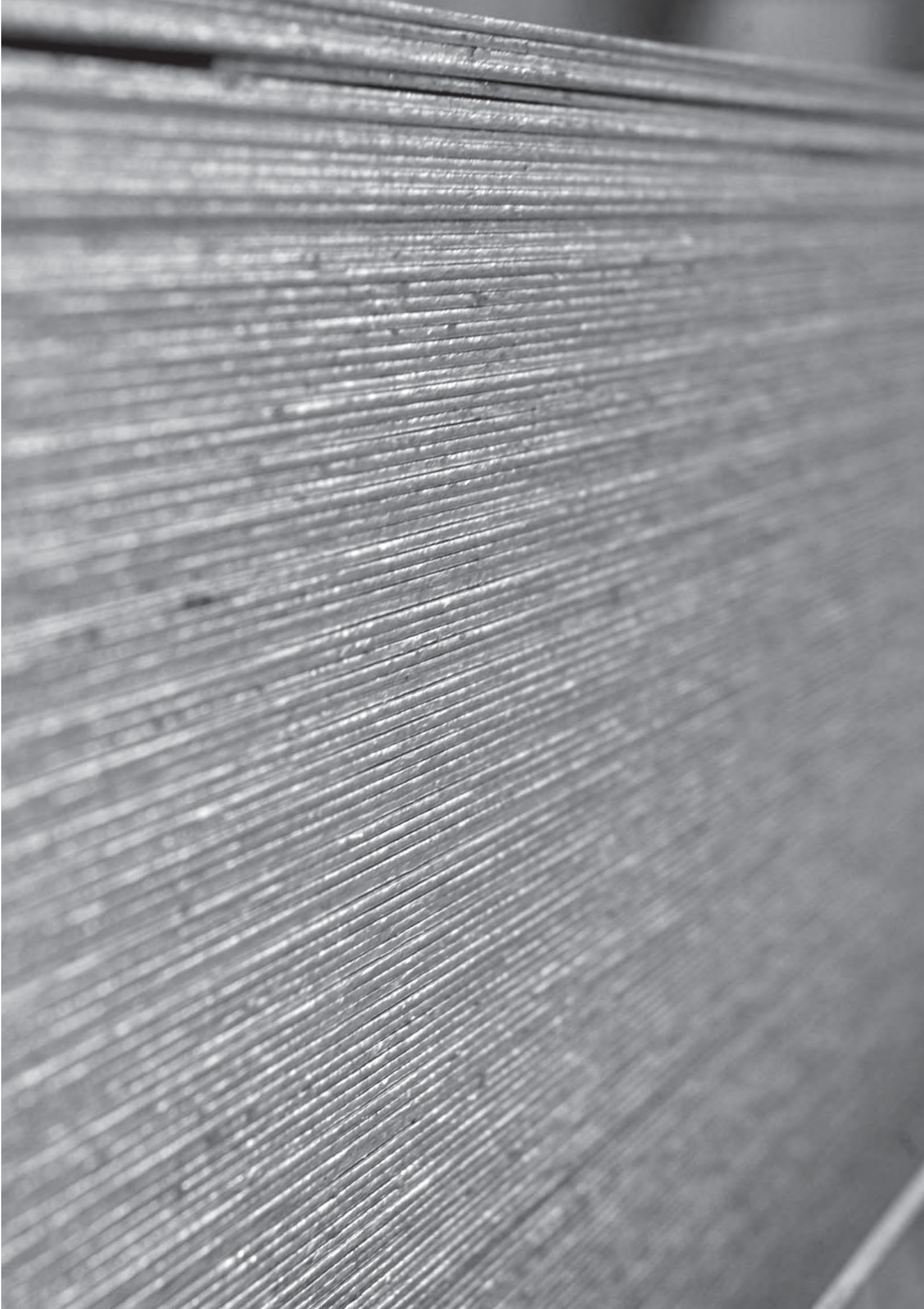


CONTINUOUS SUPPORT ON WALL



DETAIL OF COMPOSITE FLOOR (CHANGE DIRECTION)





TÜV HELLAS
Member of TÜV NORD Group

CERTIFICATE

Management system as per
EN ISO 9001 : 2008
Quality Management Systems - Requirements

In accordance with TÜV HELLAS (TÜV NORD) S.A procedures, it is hereby certified that

ELASTRON S.A.
Head Offices and Aspropyrgos Manufacturing Plant:
Diylistirion Ave. Ag. Ioannis
19 300 Aspropyrgos

Skaramaga Manufacturing Plant:
1, Palaska Str.
124 62 Skaramagas
Greece

applies a Management System in line with the above standard for the following scope

Trade and Processing of Steel Products

Certificate Registration No.041050100
Audit Report No. E-0405/2011

Initial certification 2005

TÜV HELLAS (TÜV NORD) S.A. Certification Body

Athens, 2011-06-05

This certification was conducted in accordance with the TÜV HELLAS S.A. auditing and certification procedures and is subject to regular surveillance audits.

ESYD
Πιστοποίηση ΣΔ
Αρ. Πιστ. 185-2

TÜV NORD
TÜV HELLAS
SYSTEM CERTIFICATION

TÜV HELLAS S.A. El. Venizelou 24, 15341 Ag. Paraskevi, Athens, Greece

INTERNATIONAL COMPARISON OF STANDARDS

EN					GERMANY	FRANCE	U.K.	SPAIN	ITALY	BELGIUM	SWEDEN	PORTUGAL	AUSTRIA	NORWAY
EN 1005-2:2004		**EN 10025:1990 +A1:1993**		**EN 10025:1990**	**DIN 17100**	**NF A 35-501**	**BS 4360**	**UNE 36-080**	**UNI 7070**	**NBN A 21-101**	**SS 14**	**NP 1729**	**N 3116**	
S185	1.0035	S185	1.0035	Fe 310-0	St 33	A 33		A 310-0	Fe 320	A 320	13 00-00	Fe 310-0	St 320	
		S235JR	1.0037	Fe 360 B	St 37 – 2	E24-2			Fe 360 B	AE 235-B	13 11-00	Fe 360-B		NS 12 120
		S235JRG1	1.0036	Fe 360 BFU	Ust 37 -2			AE 235 B-FU					Ust 360 B	NS 12 122
S235JR	1.0038	S235JRG2	1.0038	Fe 360 BFN	RSt 37 -2		40B	AE 235 B- FN			13 12-00		Rst 360 B	NS 12 123
S235JO	1.0114	S235JO	1.0114	Fe 360 C	St 37- 3 U	E24-3	40C	AE 235 C	Fe 360 C	AE 235-C		Fe 360-C	St 360 C	NS 12 124
												Fe 360-CE		
		S235J2G3	1.0116	Fe 360 D1	St 37-3 N	E24-4	40D	AE 235 D	Fe 360 D	AE 235-D		Fe 360-D	St 360 D	NS 12 124
S235J2	1.0117	S235J2G4	1.0117	Fe 360 D2										
S275JR	1.0044	S275JR	1.0044	Fe 430 B	St 44-2	E 28-2	43B	AE 275 B	Fe 430 B	AE 255-B	14 12-00	Fe 430-B	St 430 B	NS 12 142
S275JO	1.0043	S275JO	1.0143	Fe 430 C	St 44-3 U	E 28-3	43C	AE 275 C	Fe 430 C	AE 255-C		Fe 430-C	St 430 C	NS 12 143
													St 430 CE	
		S275JOG3	1.0144	Fe 430 D1	St 44-3 N	E 28-4	43D	AE 275 D	Fe 430 D	AE 255-D	14 14-00	Fe 430-D	St 430 D	NS 12 143
S275J2	1.0145	S275JOG4	1.0145	Fe 430 D2										
S355JR	1.0045	S355JR	1.0045	Fe 510 B		E 36-2	50B	AE 355 B	Fe 510 B	AE 355-B		Fe 510-B		
S355JO	1.0553	S355JO	1.0553	Fe 510 C	St 52-3 U	E 36-3	50C	AE 355 C	Fe 510 C	AE 355-C		Fe 510-C	St 51C	NS 12 153
		S355J2G3	1.0570	Fe 510 D1	St 52-3N		50D	AE 355D	Fe 510 D	AE 355-D		Fe 510-D	St 51 D	NS 12 153
S355J2	1.0577	S355J2G4	1.0577	Fe 510 D2										
		S355K2G3	1.0595	Fe 510 DD1		E 36-4	50DD			AE 355-DD		Fe 510-DD		
S355K2	1.0596	S355K2G4	1.0596	Fe 510 DD2										
S450JO	1.0590						55C							
E295	1.0050	E295	1.0050	Fe 490 – 2	St 50-2	A 50-2		A 490	Fe 490	A 490-2	15 50-00	Fe 490-2	St 490	
											15 50-01			
E335	1.0060	E335	1.0060	Fe 590 – 2	St 60-2	A 60-2		A 590	Fe 590	A 590-2	16 50 00	Fe 590-2	St 590	
											16 50 01			
E360	1.0070	E360	1.0070	Fe 690 - 2	St 70-2	A 70-2		A 690	Fe 690	A 690-2	16 55 00	Fe 690-2	St 690	
											16 55 01			

CHEMICAL COMPOSITION OF THE PRODUCT ANALYSIS

Designation		Method of deoxidation [b]	C in % max. for nominal product thickness in mm			Si % max.	Mn % max.	P % max. [d]	S % max. [d, e]	N % max. [f]	Cu % max. [g]	Other % max. [h]
According EN 10027-01 and CR 10260	According EN 10027-2		≤ 16	> 16 ≤ 40	> 40[c]							
S235JR	1.0038	FN	0,19	0,19	0,23	-	1,50	0,045	0,045	0,014	0,60	-
S235J0	1.0114	FN	0,19	0,19	0,19	-	1,50	0,040	0,040	0,014	0,60	-
S235J2	1.0117	FF	0,19	0,19	0,19	-	1,50	0,035	0,035	-	0,60	-
S275JR	1.0044	FN	0,24	0,24	0,25	-	1,60	0,045	0,045	0,014	0,60	-
S275J0	1.0143	FN	0,21	0,21	0,23[i]	-	1,60	0,040	0,040	0,014	0,60	-
S275J2	1.0145	FF	0,21	0,21	0,23[i]	-	1,60	0,035	0,035	-	0,60	-
S355JR	1.0045	FN	0,27	0,27	0,27	0,60	1,70	0,045	0,045	0,014	0,60	-
S355J0	1.0553	FN	0,23[j]	0,23[k]	0,24	0,60	1,70	0,040	0,040	0,014	0,60	-
S355J2	1.0577	FF	0,23[j]	0,23[k]	0,24	0,60	1,70	0,035	0,035	-	0,60	-
S355K2	1.0596	FF	0,23[j]	0,23[k]	0,24	0,60	1,70	0,035	0,035	-	0,60	-
S450J0[l]	1.0590	FF	0,23	0,23k	0,24	0,60	1,80	0,040	0,040	0,027	0,60	[m]

[b] FN = rimming steels not permitted; FF = fully killed steel
[c] For sections with nominal thickness > 100 mm the C content by agreement.
[d] For long products the P and S content can be 0,005% higher.
[e] For long products the max. S content can be increased for improved mach inability by 0,015% by agreement if the steel is treated to modify the sulphide morphology and the chemical composition shows min. 0,0020% Ca.
[f] The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,015% or alternatively min. 0,013% acid soluble Al or if sufficient other N binding elements are present. In this case the N binding elements shall be mentioned in the inspection document.
[g] Cu content above 0,45% may cause hot shortness during hot forming.
[h] If other elements are added, they shall be mentioned on the inspection document.
[i] For nominal thickness > 150 mm: C = 0,22% max.
[j] For grades suitable for cold roll forming C = 0,24% max.
[k] For nominal thickness > 30 mm: C = 0,24% max.
[l] Applicable for long products only.
[m] The steel may show a Nb content of max. 0,06%, a V content of max. 0,15% and a Ti content of max. 0,06%.
(according to EN10025)

MECHANICAL PROPERTIES AT AMBIENT TEMPERATURE FOR FLAT AND LONG PRODUCTS OF STEEL GRADES AND QUALITIES WITH VALUES FOR THE IMPACT STRENGTH

Designatio n		Minimum yield strength R_{eH}[a] MPa[b] Nominal thickness mm									Tensile strength R_m[a] MPa[b] Nominal thick-ness mm				
According EN 10027-1 and CR 10260	Accord-ing EN 10027-2	≤ 16	> 16 ≤ 40	> 40 ≤ 63	> 63 ≤ 80	> 80 ≤ 100	> 100 ≤ 150	> 150 ≤ 200	> 200 ≤ 250	> 250 ≤ 400[c]	> 3	≥ 3 ≤ 100	> 100 ≤ 150	> 150 ≤ 250	> 250 ≤ 400[c]
S235JR	1.0038	235	225	215	215	215	195	185	175	-	360 to 510	360 to 510	350 to 500	340 to 490	-
S235J0	1.0114	235	225	215	215	215	195	185	175	-	360 to 510	360 to 510	350 to 500	340 to 490	-
S235J2	1.0117	235	225	215	215	215	195	185	175	165	360 to 510	360 to 510	350 to 500	340 to 490	330 to 480
S275JR	1.0044	275	265	255	245	235	225	215	205	-	430 to 580	410 to 560	400 to 540	380 to 540	-
S275J0	1.0143	275	265	255	245	235	225	215	205	-	430 to 580	410 to 560	400 to 540	380 to 540	-
S275J2	1.0145	275	265	255	245	235	225	215	205	195	430 to 580	410 to 560	400 to 540	380 to 540	380 to 540
S355JR	1.0045	355	345	355	325	315	295	285	275	-	510 to 680	470 to 630	450 to 600	450 to 600	-
S355J0	1.0553	355	345	355	325	315	295	285	275	-	510 to 680	470 to 630	450 to 600	450 to 600	-
S355J2	1.0577	355	345	355	325	315	295	285	275	265	510 to 680	470 to 630	450 to 600	450 to 600	450 to 600
S355K2	1.0596	355	345	355	325	315	295	285	275	265	510 to 680	470 to 630	450 to 600	450 to 600	450 to 600
S450J0[d]	1.0590	450	430	410	390	380	380	-	-	-	-	550 to 720	530 to 700	-	-

[a] For plate and wide flats with widths ≥ 600 mm the direction transverse (t) to the rolling applies. For all other products the values apply for the direction parallel (l) to the rolling direction.
[b] 1 MPa = 1 N/mm2.
[c] The values apply to flat products.
[d] Applicable for long products only.
(according to EN10025)

MECHANICAL PROPERTIES AT AMBIENT TEMPERATURE FOR FLAT AND LONG PRODUCT OF STEEL GRADES AND QUALITIES WITH VALUES FOR THE IMPACT STRENGTH (CONCLUDED)

Designation		Position of test pieces [a]	Minimum percentage elongation after fracture [a] %										
			L_o = 80 mm Nominal thickness mm					$L_o = 5,65 \sqrt{S_o}$ Nominal thickness mm					
According EN 10027-1 and CR 10260	According EN 10027-2		≤ 1	> 1 ≤ 1,5	> 1,5 ≤ 2	> 2 ≤ 2,5	>2,5 < 3	≥ 3 ≤ 40	> 40 ≤ 63	> 63 ≤ 100	> 100 ≤ 150	> 150 ≤ 250	> 250[c] ≤ 400 only for J2 and K2
S235JR	1.0038	l	17	18	19	20	21	26	25	24	22	21	-
S235J0	1.0114												-
S235J2	1.0117	t	15	16	17	18	19	24	23	22	22	21	21 (l and t)
S275JR	1.0044	l	15	16	17	18	19	23	22	21	19	18	-
S275J0	1.0143												-
S275J2	1.0145	t	13	14	15	16	17	21	20	19	19	18	18 (l and t)
S355JR	1.0045	l	14	15	16	17	18	22	21	20	18	17	-
S355J0	1.0553												-
S355J2	1.0577												17 (l and t)
S355K2	1.0596	t	12	13	14	15	16	20	19	18	18	17	17 (l and t)
S450J0[d]	1.0590	l	-	-	-	-	-	17	17	17	17	-	-

[a] For plate, strip and wide flats with widths ≥600 mm the direction transverse (t) to the rolling direction applies. For all other products the values apply for the direction parallel (l) to the rolling direction.
[c] The values apply to flat products.
[d] Applicable for long product only.
(according to EN10025)