

9.2 Use of CETRIS® Boards in Engineering and Transport Constructions

Use of CETRIS® boards

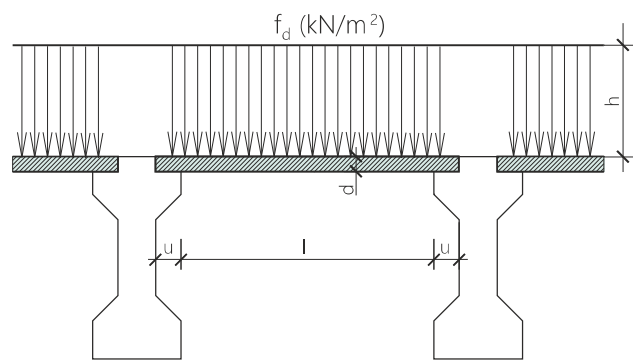
In the construction or reconstruction of transport structures system of permanent shuttering in the joints on bridge supporting structures (between beams or between the beam prefa ledge) is mainly applied. The CETRIS® board creates a flat bottom (or side) shuttering surface of the planned element (column, beam, bridge construction, etc.). During concreting, the concrete mixture and shuttering CETRIS® boards are connected, after concreting, CETRIS® board remains an integral part of the whole structure. This application does not require any treatment of the inner side and edges of CETRIS® boards before concreting. The outer (visible) side of CETRIS® board can be provided with surface treatment after concreting, which besides of aesthetic effect increases the resistance of the board against weathering, frost and especially

extends its lifetime. The thickness of CETRIS® board does not lessen covering of reinforcement, it is also not counted into the anchorage depth of additionally inserted (drilled) anchors. If CETRIS® boards are designed for areas with high stress (alternating exposure to water, frost and defrosting chemicals), is the suitability of cement bonded particle boards CETRIS® verified by test of appropriate technical-qualitative conditions for the road constructions This test is based on ČSN 73 1326 (Determination of surface resistance of cement concrete against water and chemical defrosting chemicals). The cement bonded particle board CETRIS® complied with 115 frost cycles.

Determination of thickness "d" of CETRIS® boards

According to the magnitude of the load transferred by the board, the correct thickness of CETRIS® board is determined. The decisive load is called Mounting load during the concreting of the construction. CETRIS® board transfers the pressure (weight) of the concrete mix, and the weight of the workers via its surface to the bearing supports. After solidification and hardening the concrete with reinforcement bears the entire load, CETRIS® board fulfils only the function of the external cladding. To determine the thickness of boards, dimensioning tables are processed based on the following assumptions:

1. The vertical uniform load represents the self-weight of the concreted ceiling panel and the weight of the board itself. In case of application of CETRIS® boards where movement of people on the surface (called Walkable boards) is assumed, the boards must be able to transfer also concentrated load of normative value 1.50 kN working on the area of 100 × 100 mm directly on the surface boards in the middle of its range. Instances where boards do not meet these requirements, are shown in red boxes in the tables. The tables show the worst static condition – simple beam; if the board operates as continuous beam its load-bearing capacity is higher.
2. The calculation was done assuming the elastic behaviour of the material while respecting the following mechanical and physical characteristics of the CETRIS® boards determined by the following tests:
Under the loads shown in given tables, the maximum normal stress in marginal fibres of the boards from standard load does not exceed 3.60 N/mm² for boards of thickness up to 32 mm, and 3.00 N/mm² for boards of thickness 34 – 40 mm (2.5 times the safety of boards of thickness up to 32 mm, respectively, 3 times the safety of the boards of thickness 34 up to 40 mm is achieved).
3. The maximum elastic deflection of the CETRIS® board from the operating load including dead weight must not exceed 1/300 of the span. The effect of the final shaping of the boards during long-term action of loads was not considered because the boards shall be used only as shuttering in this case.



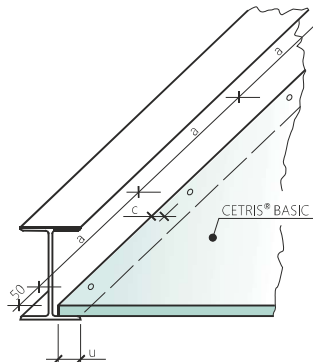
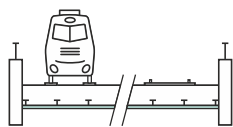
Case 1 - horizontal action (the CETRIS boards forms the lower shuttering of the bridges, beams, etc.)

Modulus of elasticity	4500 Nmm ⁻²
Bending tensile strength	9 Nmm ⁻²
Modulus of shear perpendicular to the board plane	2500 Nmm ⁻²
Shear strength	2 Nmm ⁻²
Volume mass	1 400 kgm ⁻³
Transverse contraction coefficient	$\nu = 0,15$

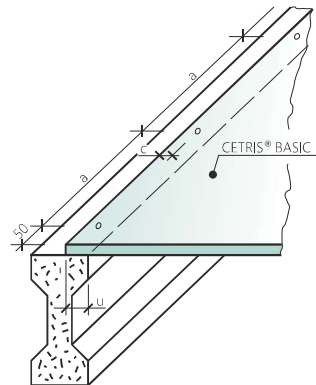
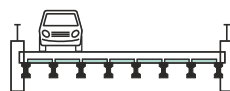
4. The length of the mounting of the CETRIS® boards on the “u” profile supports must be at least 40 mm. This value is set with regard to the eventual anchoring of the boards in the support – the recommended distance of the screw from the board edge is 25 mm – see the table and figures:

Board thickness d (mm)	a (mm)	c (mm)	u (mm)
18, 20	300	25	min. 40
22,24,26,28,30	400		
32,34,36,38,40	500		

Railway bridge



Road bridge



The result of the calculation is a table showing the maximum standard vertical load of the boards in kN/m²

Span V m	Maximum vertical load in kN/m ² - for these board thicknesses:											
	18 mm	20 mm	22 mm	24 mm	26 mm	28 mm	30 mm	32 mm	34 mm	36 mm	8 mm	40 mm
0,200	38,63	47,72	57,77	68,78	80,76	93,69	107,58	101,95	115,12	129,10	143,87	159,44
0,250	24,63	30,44	36,86	43,90	51,55	59,82	68,70	65,09	73,51	82,44	91,88	101,84
0,300	17,03	21,05	25,51	30,38	35,69	41,42	47,58	45,06	50,90	57,10	63,65	70,55
0,350	12,44	15,39	18,66	22,23	26,12	30,33	34,85	32,99	37,27	41,81	46,62	51,68
0,400	8,50	11,72	14,21	16,94	19,92	23,13	26,58	25,15	28,42	31,90	35,57	39,44
0,450	5,89	8,15	10,91	13,32	15,66	18,19	20,91	19,78	22,36	25,10	27,99	31,04
0,500	4,23	5,86	7,87	10,28	12,62	14,66	16,86	15,94	18,02	20,23	22,57	25,04
0,550	3,11	4,34	5,84	7,64	9,78	12,05	13,86	13,09	14,81	16,63	18,56	20,60
0,600	2,34	3,28	4,42	5,81	7,45	9,36	11,58	10,93	12,37	13,90	15,51	17,22
0,650	1,79	2,52	3,41	4,50	5,78	7,28	9,02	9,25	10,47	11,77	13,14	14,59
0,700	1,38	1,96	2,67	3,53	4,56	5,75	7,14	7,91	8,96	10,08	11,26	12,50
0,750	1,08	1,54	2,12	2,81	3,64	4,60	5,72	6,83	7,74	8,71	9,74	10,82
0,800	0,84	1,22	1,69	2,26	2,93	3,72	4,64	5,70	6,75	7,60	8,49	9,44
0,850	0,66	0,97	1,36	1,82	2,38	3,04	3,80	4,67	5,67	6,67	7,46	8,30
0,900	0,52	0,77	1,09	1,48	1,95	2,50	3,14	3,87	4,70	5,64	6,60	7,34
0,950	0,40	0,62	0,88	1,21	1,60	2,07	2,60	3,22	3,92	4,72	5,61	6,53
1,000	0,31	0,49	0,71	0,99	1,32	1,72	2,17	2,70	3,30	3,97	4,74	5,58
1,050	0,23	0,38	0,58	0,81	1,09	1,43	1,82	2,27	2,78	3,37	4,02	4,75
1,100	0,17	0,30	0,46	0,66	0,90	1,19	1,53	1,92	2,36	2,86	3,43	4,06
1,150	0,12	0,22	0,36	0,54	0,75	0,99	1,28	1,62	2,00	2,44	2,93	3,48
1,200	0,07	0,16	0,28	0,43	0,61	0,83	1,08	1,37	1,71	2,09	2,52	3,00
1,250	0,03	0,11	0,22	0,34	0,50	0,69	0,91	1,16	1,46	1,79	2,17	2,59

These values were also converted to the maximum permissible thickness of the concrete layer on the horizontal shuttering and maximum permissible height of the vertical shuttering. The considered volume mass of the concrete was 2,500 kg/m³.



Span V m	Maximum thickness of the concrete layer in m - for these board thicknesses:											
	18 mm	20 mm	22 mm	24 mm	26 mm	28 mm	30 mm	32 mm	34 mm	36 mm	38 mm	40 mm
0,200	1,55	1,91	2,31	2,75	3,23	3,75	4,30	4,08	4,60	5,16	5,75	6,38
0,250	0,99	1,22	1,47	1,76	2,06	2,39	2,75	2,60	2,94	3,30	3,68	4,07
0,300	0,68	0,84	1,02	1,22	1,43	1,66	1,90	1,80	2,04	2,28	2,55	2,82
0,350	0,50	0,62	0,75	0,89	1,04	1,21	1,39	1,32	1,49	1,67	1,86	2,07
0,400	0,34	0,47	0,57	0,68	0,80	0,93	1,06	1,01	1,14	1,28	1,42	1,58
0,450	0,24	0,33	0,44	0,53	0,63	0,73	0,84	0,79	0,89	1,00	1,12	1,24
0,500	0,17	0,23	0,31	0,41	0,50	0,59	0,67	0,64	0,72	0,81	0,90	1,00
0,550	0,12	0,17	0,23	0,31	0,39	0,48	0,55	0,52	0,59	0,67	0,74	0,82
0,600	0,09	0,13	0,18	0,23	0,30	0,37	0,46	0,44	0,49	0,56	0,62	0,69
0,650	0,07	0,10	0,14	0,18	0,23	0,29	0,36	0,37	0,42	0,47	0,53	0,58
0,700	0,06	0,08	0,11	0,14	0,18	0,23	0,29	0,32	0,36	0,40	0,45	0,50
0,750	0,05	0,06	0,08	0,11	0,15	0,18	0,23	0,27	0,31	0,35	0,39	0,43
0,800		0,05	0,07	0,09	0,12	0,15	0,19	0,23	0,27	0,30	0,34	0,38
0,850			0,05	0,07	0,10	0,12	0,15	0,19	0,23	0,27	0,30	0,33
0,900				0,06	0,08	0,10	0,13	0,15	0,19	0,23	0,26	0,29
0,950				0,05	0,06	0,08	0,10	0,13	0,16	0,19	0,22	0,26
1,000					0,05	0,07	0,09	0,11	0,13	0,16	0,19	0,22
1,050						0,06	0,07	0,09	0,11	0,13	0,16	0,19
1,100						0,05	0,06	0,08	0,09	0,11	0,14	0,16
1,150							0,05	0,06	0,08	0,10	0,12	0,14
1,200								0,05	0,07	0,08	0,10	0,12
1,250								0,05	0,06	0,07	0,09	0,10

of such a marked value – board not freely walkable!

