VOIDCON

INNOVATIVE PERMANENT FORMWORK

TECHNICAL

CATALOGUE

CLOTAN STEEL

Ora et Labora

016 986 8000
clotansteel.co.za

Applications

Conventional brick & mortar

Residential Structures

Concrete frame structures [Columns & beams]

Shopping Centres; Schools; Multi-storey Residential; Commercial etc.

Steel structures

Composite – Non Composite;
Propped – Un-propped

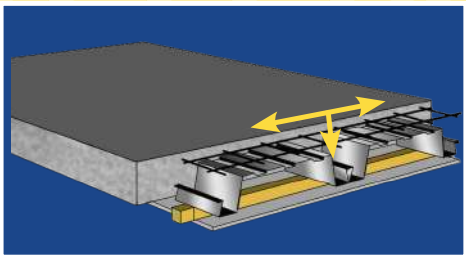
Light steel frame structures

Surface slabs & raft Foundations

Product Features

Permanent Decking

Composite Action



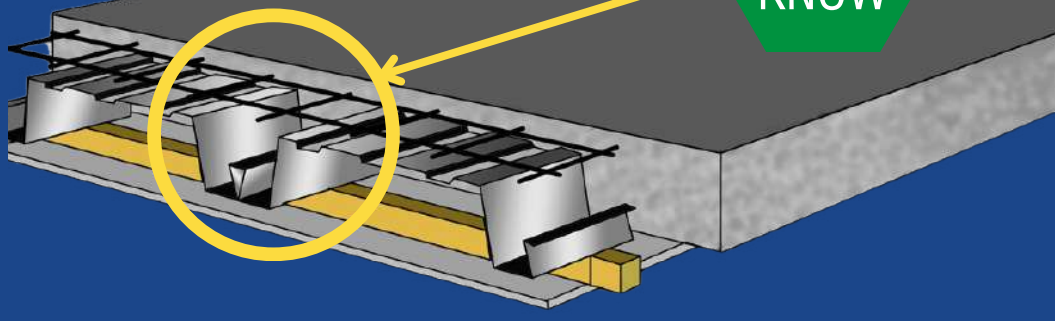
T-Beam Design

Not only acts as permanent shuttering but also serves as tensile reinforcement, resulting in a composite action with the concrete.

T-BEAM DESIGN

a UNIQUE interlocking mechanism that offers structural support and reinforcement.

DID YOU KNOW



Product Benefits

BENEFITS

- Up to 60% concrete savings.
- Highly cost-effective.
- Minimal propping requirement.
- Comprehensive engineering and technical support.
- Ideal for complicated-shaped slabs.
- Ample space in voids for services(Electrical & Plumbing).
- Improved sound and temperature insulation.
- Easy installation of conventional ceiling systems.
- Lightweight nature of Voidcon leads to major savings on superstructures.

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Contents

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What is Voidcon?

The Voidcon Permanent Formwork System, launched in 2004, is a composite suspended slab system proudly manufactured by Clotan Steel.

Voidcon is a 100% patented South African product, and is designed, manufactured, and distributed nationwide in South Africa and boasts a variety of structural projects across the African continent.

Voidcon keeps building innovation on top of mind; offering a lighter, more cost-effective, and environmentally friendly building system compared to conventional concrete slab building methods.

How does the Voidcon Permanent Formwork System work?

The Voidcon Permanent Formwork System is manufactured utilising galvanised steel profiles, laid in position as panels. These panels, once laid into position, act as formwork for wet concrete to be poured over the profiled galvanised panels. The concrete provides strength, and together with the steel provides higher stability.

The Voidcon Permanent Formwork System can be used on any design– curved or straight. It has been used in design applications for factories, warehouses, shopping malls, office blocks and blocks of flats.

Why choose Voidcon for a floor/slab project?

- The Voidcon Permanent Formwork System uses less concrete than conventional decking systems, resulting in substantial project cost savings.
- Installing a Voidcon Permanent Formwork System is more economical and practical, featuring a quicker installation method in high-quality soffit finishes.
- The Voidcon Permanent Formwork System utilises the patented T-Beam design. In return the system uses less concrete and steel, making it substantially less harmful to the environment.
- The concrete and steel combination provides strength and stability – while the concrete is strong in compression, steel is strong in tension. The result is the profile and concrete forming an indestructible bond, providing exceptional composite action.
- Clotan Steel can, through its more than 30 years of export experience, deliver the Voidcon system across the African continent and further afield.
- The Voidcon system requires minimal propping and is ideal for the use of complicated shaped slab design requirements. Voidcon is designed to carry uniformly distributed loads.
- The Voidcon system offers sound and temperature insulation.

DID YOU KNOW?

The Voidcon system offers:

- **Design flexibility for designers, developers and architects.**
- **Cost efficiency, and lightweight product features.**

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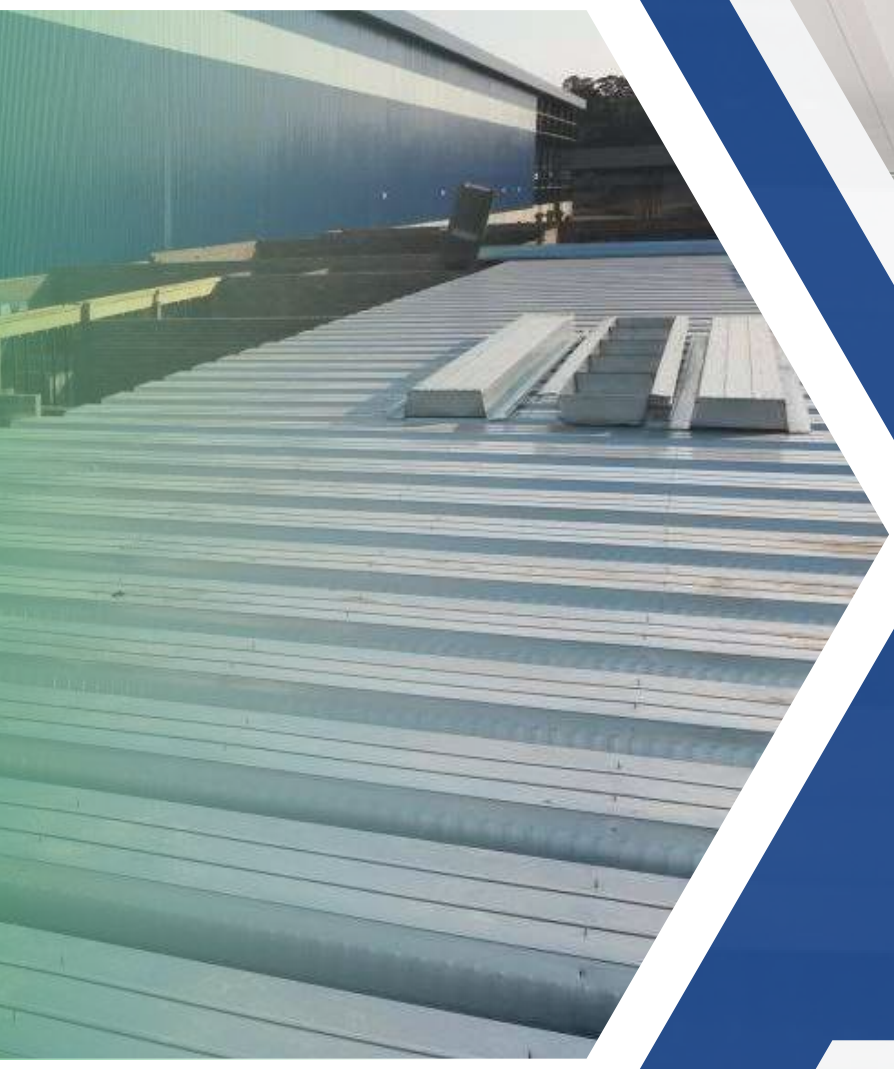
Design Parameters



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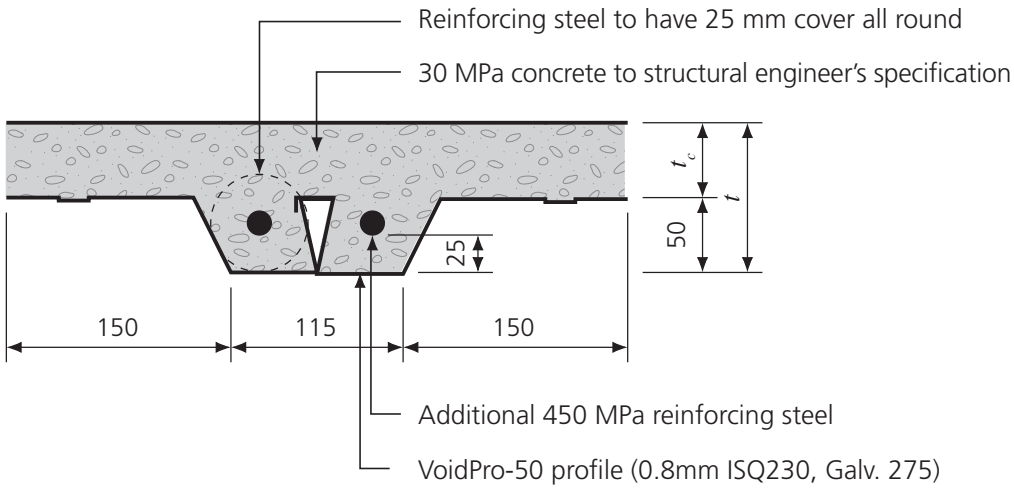
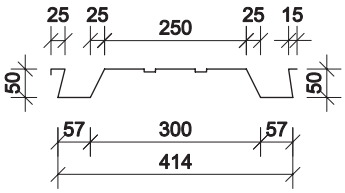
VP-50

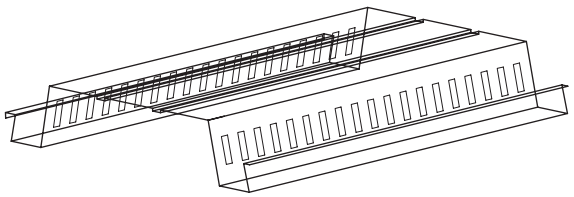
The VoidPro-50 profile displaces 0.0344 m^3 concrete per m^2 floor area. When calculating additional reinforcing requirements, it was assumed that the VoidPro-50 profile has an effective tension steel area of 292 mm^2 and that the centroid of the deck tension steel area is located 20.55 mm from the bottom of the deck.

Cross section through a typical VoidPro-50 T-beam



VoidPro-50: Front elevation and 3D view





Voidpro-50 Load-Span Table

Additional reinforcing steel in [mm²] per beam at 415 mm spacing, for the VoidPro-50 system used in a single span simply supported configuration. Calculations are based on a characteristic concrete cube strength of 30 MPa and a characteristic deck steel yield strength of 230 MPa. Additional reinforcing should be high strength steel with a yield stress of 450 MPa. Additional reinforcing steel is limited to a maximum diameter of 20 mm. Cover of 25 mm above the deck soffit should be provided in all cases. Where values are listed as zero, no additional reinforcing is required as the VoidPro-50 profile provides sufficient tensile reinforcing. Where no value is listed, the span length is governed by either deflection considerations or the depth of the concrete compression block exceeds the limits imposed to prevent failure by concrete crushing. Underlined-values are for cases where serviceability considerations govern, but the allowable span can be increased by providing the indicated amount of reinforcing steel.

Reinforcing requirements for ultimate and serviceability limit states

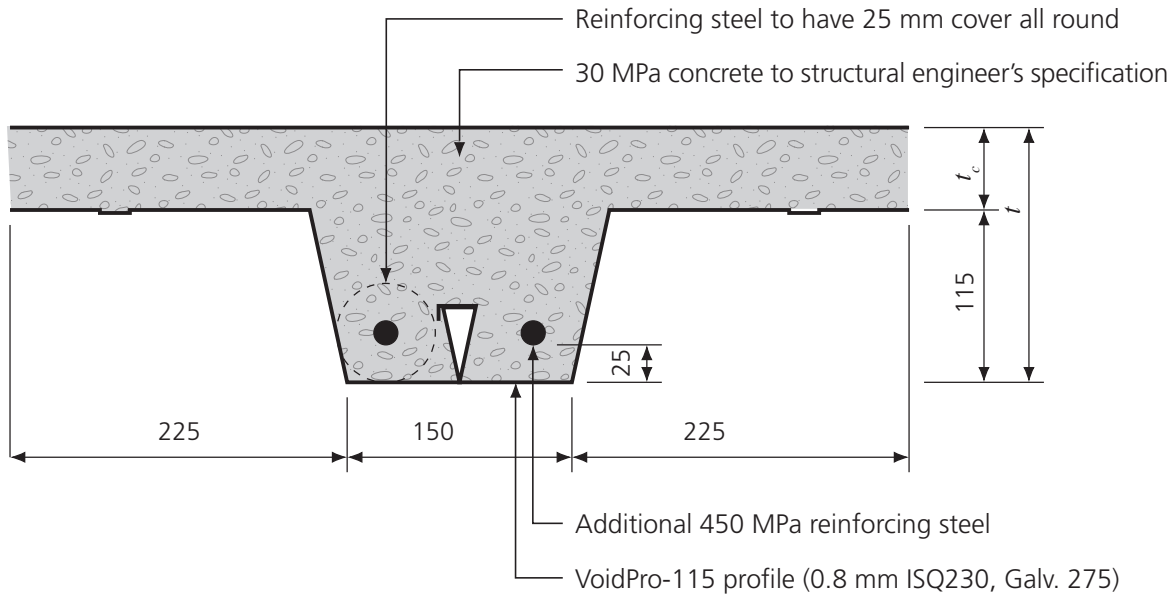
Q_n[a]	G_n[b]	TL_f[c]	t[d]	Floor span in [m]									
[kPa]	[kPa]	[kPa]	[mm]	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75
				Additional reinforcing steel in [mm²] per beam 415 mm $^{c}/_{c}$									
1.50	2.065	5.96	120	0	0	0	0	0	0				
2.00	2.065	6.76	120	0	0	0	0	0					
2.50	2.065	7.56	120	0	0	0	0	0					
3.00	2.065	8.36	120	0	0	0	0	0					
4.00	2.065	9.96	120	0	0	0	0						
5.00	2.065	11.56	120	0	0	0							
7.50	2.065	15.56	120	0	20								
1.50	2.411	6.37	135	0	0	0	0	0	0	0	0		
2.00	2.411	7.17	135	0	0	0	0	0	0	0			
2.50	2.411	7.97	135	0	0	0	0	0	0	10			
3.00	2.411	8.77	135	0	0	0	0	0	0				
4.00	2.411	10.37	135	0	0	0	0	10	30				
5.00	2.411	11.97	135	0	0	0	10	30					
7.50	2.411	15.97	135	0	0	30	70						
1.50	2.756	6.79	150	0	0	0	0	0	0	0	0	0	410
2.00	2.756	7.59	150	0	0	0	0	0	0	0	0	20	
2.50	2.756	8.39	150	0	0	0	0	0	0	0	20	440	
3.00	2.756	9.19	150	0	0	0	0	0	0	10	30		
4.00	2.756	10.79	150	0	0	0	0	0	20	40			
5.00	2.756	12.39	150	0	0	0	0	20	40	210			
7.50	2.756	16.39	150	0	0	10	40	80	440				
1.50	2.987	7.06	160	0	0	0	0	0	0	0	0	0	10
2.00	2.987	7.86	160	0	0	0	0	0	0	0	0	10	30
2.50	2.987	8.66	160	0	0	0	0	0	0	0	10	30	240
3.00	2.987	9.46	160	0	0	0	0	0	0	0	20	50	
4.00	2.987	11.06	160	0	0	0	0	0	10	30	50	450	
5.00	2.987	12.66	160	0	0	0	0	10	30	60	150		
7.50	2.987	16.66	160	0	0	0	30	60	90	390			

[a] Unfactored imposed (live) load.
[b] Unfactored own-weight of the slab and the VoidPro-50 profile.
[c] Total factored load using the SANS10160-1 STR load combination of $1.2Gn + 1.6Qn$ where Gn is the total nominal permanent (dead) load and Qn is the total imposed (live) load. Note that in calculating the total factored load, an allowance was made for the additional permanent load of 0.9 kPa accounting for services and finishes. Concrete own weight was calculated based on a mass of 2350 kg/m³.
[d] Total thickness of the slab.

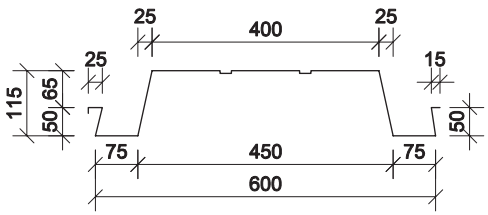
VP-115

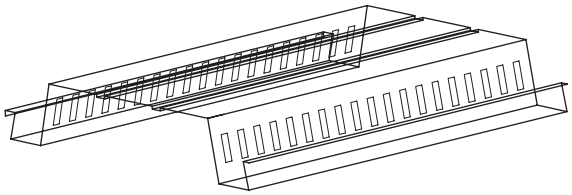
The VoidPro-115 profile displaces 0.0815 m^3 concrete per m^2 floor area. When calculating additional reinforcing requirements, it was assumed that the VoidPro-115 profile has an effective tension steel area of 320 mm^2 and that the centroid of the deck tension steel area is located 18.75 mm from the bottom of the deck.

Cross section through a typical VoidPro-115 T-beam



VoidPro-115: Front elevation and 3D view





Voidpro-115 Load-Span Table

Additional reinforcing steel in [mm²] per beam at 600 mm spacing, for the VoidPro-115 system used in a single span simply supported configuration. Calculations are based on a characteristic concrete cube strength of 30 MPa and a characteristic deck steel yield strength of 230 MPa. Additional reinforcing should be high strength steel with a yield stress of 450 MPa. Additional reinforcing steel is limited to a maximum diameter of 20 mm. Cover of 25 mm above the deck soffit should be provided in all cases. Where values are listed as zero, no additional reinforcing is required as the VoidPro-115 profile provides sufficient tensile reinforcing. Where no value is listed, the span length is governed by either deflection considerations or the depth of the concrete compression block exceeds the limits imposed to prevent failure by concrete crushing. Underlined-values are for cases where serviceability considerations govern, but the allowable span can be increased by providing the indicated amount of reinforcing steel.

Reinforcing requirements for ultimate and serviceability limit states

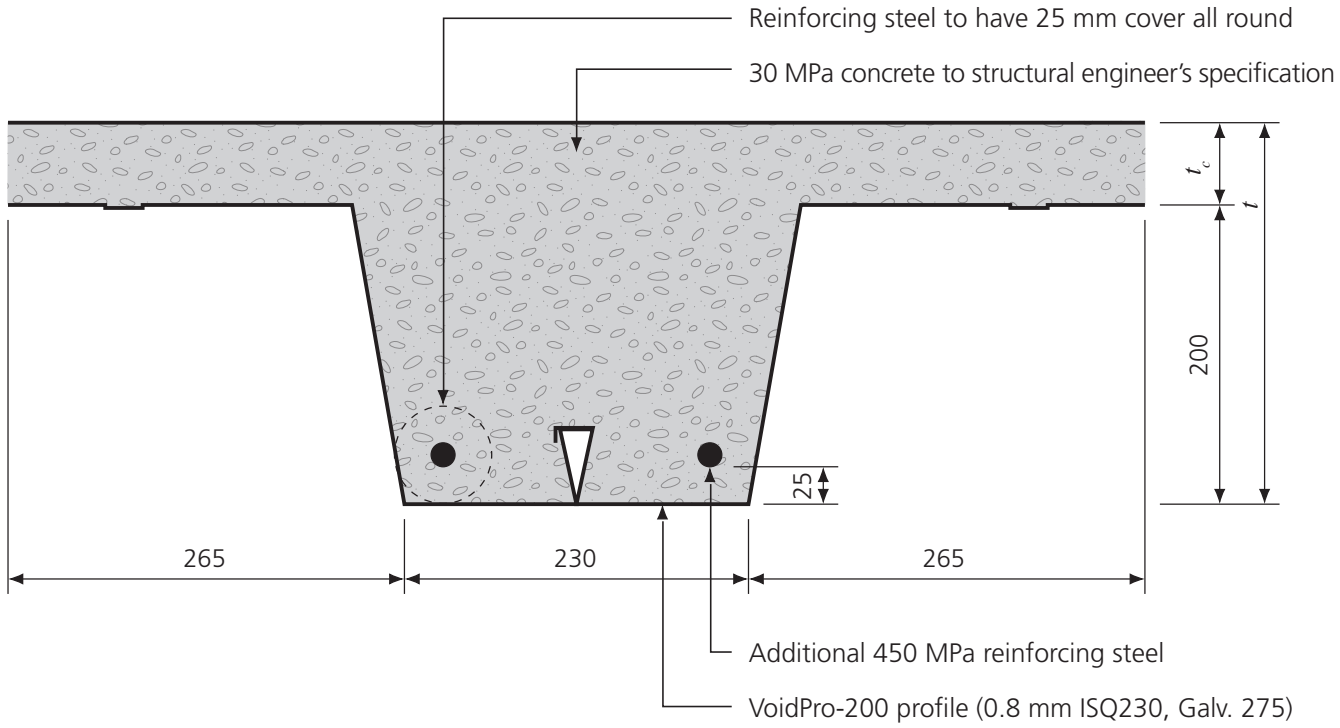
Q_n[a]	G_n[b]	TL_f[c]	t[d]	Floor span in [m]												
[kPa]	[kPa]	[kPa]	[mm]	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50
				Additional reinforcing steel in [mm²] per beam 600 mm $^{c}/_{c}$												
1.50	2.150	6.06	170	0	20	40	60	270								
2.00	2.150	6.86	170	20	50	70	100	860								
2.50	2.150	7.66	170	50	70	100	510									
3.00	2.150	8.46	170	70	100	240										
4.00	2.150	10.06	170	120	230											
5.00	2.150	11.66	170	170	790											
7.50	2.150	15.66	170													
1.50	2.611	6.61	190	0	10	30	50	80	100	220	720					
2.00	2.611	7.41	190	10	40	60	80	110	130	560						
2.50	2.611	8.21	190	30	60	80	110	140	400	1090						
3.00	2.611	9.01	190	50	80	110	140	230	730							
4.00	2.611	10.61	190	100	130	160	250	750								
5.00	2.611	12.21	190	140	170	210	650									
7.50	2.611	16.21	190	240	470	1200										
1.50	2.842	6.89	200	0	10	30	50	70	100	120	220	630				
2.00	2.842	7.69	200	10	30	50	80	100	130	150	520	1230				
2.50	2.842	8.49	200	30	50	80	100	130	160	380	930					
3.00	2.842	9.29	200	50	70	100	130	160	250	670						
4.00	2.842	10.89	200	90	120	150	180	270	700							
5.00	2.842	12.49	200	130	160	200	240	630								
7.50	2.842	16.49	200	220	270	500	1140									
1.50	3.418	7.58	225	0	0	20	40	60	90	110	130	160	180	400	770	1520
2.00	3.418	8.38	225	0	20	40	70	90	110	140	170	190	350	680	1310	
2.50	3.418	9.18	225	20	40	60	90	110	140	170	200	270	570	1070		
3.00	3.418	9.98	225	40	60	80	110	140	170	200	230	450	850			
4.00	3.418	11.58	225	70	100	130	160	190	220	260	490	920				
5.00	3.418	13.18	225	100	130	170	200	240	280	470	890					
7.50	3.418	17.18	225	190	230	270	320	430	810	1550						
1.50	3.995	8.27	250	0	0	20	40	60	80	100	120	150	170	200	230	340
2.00	3.995	9.07	250	0	20	40	60	80	100	130	150	180	210	240	300	530
2.50	3.995	9.87	250	10	30	50	80	100	130	150	180	210	240	270	460	770
3.00	3.995	10.67	250	30	50	70	100	120	150	180	210	240	280	390	650	1080
4.00	3.995	12.27	250	60	80	110	140	170	200	230	270	310	430	710	1170	
5.00	3.995	13.87	250	90	110	150	180	210	250	290	330	430	710	1170		
7.50	3.995	17.87	250	160	200	240	280	330	380	430	710	1160				

[a] Unfactored imposed (live) load.
[b] Unfactored own-weight of the slab and the VoidPro-115 profile.
[c] Total factored load using the SANS10160-1 STR load combination of $1.2Gn + 1.6Qn$ where Gn is the total nominal permanent (dead) load and Qn is the total imposed (live) load. Note that in calculating the total factored load, an allowance was made for the additional permanent load of 0.9 kPa accounting for services and finishes. Concrete own weight was calculated based on a mass of 2350 kg/m³ .
[d] Total thickness of the slab.

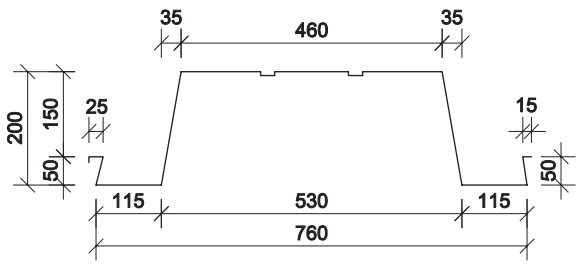
VP-200

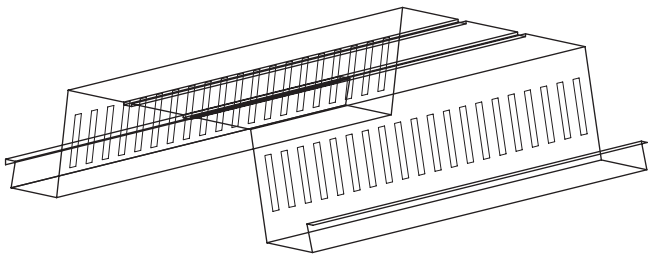
The VoidPro-200 profile displaces 0.130 m^3 concrete per m^2 floor area. When calculating additional reinforcing requirements, it was assumed that the VoidPro-200 profile has an effective tension steel area of 384 mm^2 and that the centroid of the deck tension steel area is located 15.20 mm from the bottom of the deck.

Cross section through a typical VoidPro-200 T-beam



VoidPro-200: Front elevation and 3D view





Voidpro-200 Load-Span Table

Additional reinforcing steel in [mm²] per beam at 760 mm spacing, for the VoidPro-200 system used in a single span simply supported configuration. Calculations are based on a characteristic concrete cube strength of 30 MPa and a characteristic deck steel yield strength of 230 MPa. Additional reinforcing should be high strength steel with a yield stress of 450 MPa. Additional reinforcing steel is limited to a maximum diameter of 20 mm. Cover of 25 mm above the deck soffit should be provided in all cases. Where values are listed as zero, no additional reinforcing is required as the VoidPro-200 profile provides sufficient tensile reinforcing. Where no value is listed, the span length is governed by either deflection considerations or the depth of the concrete compression block exceeds the limits imposed to prevent failure by concrete crushing. Underlined-values are for cases where serviceability considerations govern, but the allowable span can be increased by providing the indicated amount of reinforcing steel.

Reinforcing requirements for ultimate and serviceability limit states

Q_n [a]	G_n [b]	TL_f [c]	t [d]	Floor span in [m]											
[kPa]	[kPa]	[kPa]	[mm]	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50
				Additional reinforcing steel in [mm²] per beam 760 mm $^{c}/_{c}$											
1.50	2.962	7.03	255	0	0	0	30	80	130	180	240	400	1080		
2.00	2.962	7.83	255	0	0	10	60	110	170	230	290	670			
2.50	2.962	8.63	255	0	0	40	90	140	200	270	370	1030			
3.00	2.962	9.43	255	0	10	60	110	180	240	320	580				
4.00	2.962	11.03	255	0	40	100	170	240	320	420	1130				
5.00	2.962	12.63	255	20	80	150	220	310	400	760					
7.50	2.962	16.63	255	90	170	260	360	480	860						
1.50	3.423	7.59	275	0	0	0	30	80	130	180	240	300	490	1110	
2.00	3.423	8.39	275	0	0	10	60	110	160	220	280	350	740	1690	
2.50	3.423	9.19	275	0	0	30	80	140	200	260	330	470	1070		
3.00	3.423	9.99	275	0	0	50	110	170	230	300	380	660	1500		
4.00	3.423	11.59	275	0	40	90	160	230	300	380	520	1180			
5.00	3.423	13.19	275	10	70	130	210	290	370	470	860				
7.50	3.423	17.19	275	80	150	240	330	440	560	990					
1.50	3.999	8.28	300	0	0	0	30	70	120	180	230	290	360	510	1000
2.00	3.999	9.08	300	0	0	10	50	100	160	210	280	340	410	720	1420
2.50	3.999	9.88	300	0	0	30	80	130	190	250	320	390	490	980	1980
3.00	3.999	10.68	300	0	0	50	100	160	220	290	360	440	660	1290	
4.00	3.999	12.28	300	0	30	80	140	210	280	360	450	540	1080	2200	
5.00	3.999	13.88	300	0	60	120	190	270	350	440	540	840	1650		
7.50	3.999	17.88	300	60	130	220	300	400	510	630	980	1940			
1.50	4.460	8.83	320	0	0	0	30	70	120	170	230	290	360	420	610
2.00	4.460	9.63	320	0	0	10	50	100	150	210	270	340	410	480	820
2.50	4.460	10.43	320	0	0	20	70	120	180	240	310	380	460	590	1080
3.00	4.460	11.23	320	0	0	40	90	150	210	280	350	430	510	760	1380
4.00	4.460	12.83	320	0	20	80	130	200	270	350	430	520	650	1180	2230
5.00	4.460	14.43	320	0	50	110	180	250	330	420	510	610	950	1740	
7.50	4.460	18.43	320	50	120	200	280	380	480	590	720	1120	2070		
1.50	4.921	9.39	340	0	0	0	30	70	120	170	230	290	350	420	490
2.00	4.921	10.19	340	0	0	0	50	100	150	210	270	330	400	480	550
2.50	4.921	10.99	340	0	0	20	70	120	180	240	300	370	450	530	700
3.00	4.921	11.79	340	0	0	40	90	140	200	270	340	420	500	580	880
4.00	4.921	13.39	340	0	20	70	130	190	260	340	420	500	590	770	1300
5.00	4.921	14.99	340	0	40	100	170	240	320	400	490	590	700	1080	1860
7.50	4.921	18.99	340	40	110	180	270	360	460	560	680	810	1270	2220	

[a] Unfactored imposed (live) load.
[b] Unfactored own-weight of the slab and the VoidPro-200 profile.
[c] Total factored load using the SANS10160-1 STR load combination of $1.2Gn + 1.6Qn$ where Gn is the total nominal permanent (dead) load and Qn is the total imposed (live) load. Note that in calculating the total factored load, an allowance was made for the additional permanent load of 0.9 kPa accounting for services and finishes. Concrete own weight was calculated based on a mass of 2350 kg/m³ .
[d] Total thickness of the slab.

SANS 10144

Tables of the area and mass of reinforcing bars

1	2	3	4	5	6	7	8	9	10	11	12	13
Bar diameter mm	**Area of steel per metre** mm^2											
	Bar spacing mm											
	75	100	125	150	175	200	250	300	350	400	450	500
8	672	503	402	336	288	251	201	168	144	126	112	101
10	1 048	785	628	524	488	393	314	262	244	196	175	157
12	1 508	1 131	908	754	646	565	452	377	323	283	251	226
16	2 680	2 011	1 608	1 340	1 148	1 005	804	670	574	503	447	402
20	4 188	3 142	2 514	2 094	1 796	1 571	1 257	1 047	898	785	698	628
25	6 344	4 909	3 926	3 272	2 804	2 454	1 963	1 636	1 402	1 227	1 091	982
32	10 724	8 042	6 434	5 362	4 596	4 021	3 217	2 681	2 298	2 011	1 787	1 608
8 & 10	860	644	516	430	368	322	258	215	184	161	143	129
10 & 12	1 276	958	766	638	548	479	383	319	274	240	213	192
12 & 16	2 096	1 571	1 256	1 048	898	785	628	524	449	393	349	314
16 & 20	3 436	2 576	2 060	1 718	1 472	1 288	1 030	859	736	644	572	515
20 & 25	5 368	4 025	3 220	2 684	2 300	2 013	1 610	1 342	1 150	1 006	894	805
25 & 32	8 636	6 476	5 180	4 318	3 700	3 238	2 590	2 159	1 850	1 619	1 439	1 295

Mass and area

1	2	3	4	5	6	7	8	9	10
Bar diameter mm	**Mass per unit length** kg/m	**Area** mm^2							
		Number of bars							
		1	2	3	4	5	6	7	8
8	0,395	50	101	151	201	251	302	352	402
10	0,617	79	157	236	314	393	471	550	628
12	0,888	113	226	339	452	565	679	792	905
16	1,58	201	402	603	804	1 005	1 206	1 407	1 608
20	2,47	314	628	942	1 257	1 571	1 885	2 199	2 513
25	3,85	491	982	1 473	1 963	2 454	2 945	3 436	3 927
32	6,31	804	1 608	2 413	3 217	4 021	4 825	5 630	6 434
49	9,86	1 257	2 513	3 770	5 027	6 283	7 540	8 796	10 052
50	15,40	1 963	3 927	5 890	7 854	9 817	11 781	13 744	15 708

VOIDCON

INNOVATIVE PERMANENT FORMWORK

Fire Design/Rating

VOIDCON

A PROUD PRODUCT OF CLOTAN STEEL

CLOTAN STEEL

Ora et Labora

Design Steps for Simplified Design of Voidpro Slabs in Fire

For a 30 minute fire resistance rating no additional reinforcement is required (based on EN 1994-1-2 guidelines). For 60 minute and higher resistances the capacity of floor slabs in sagging is calculated according to the 500°C Isotherm Method of EN 2-1-2 (BSI 2005), or Buchanan (2001). The basis for this simplified method is that all concrete with a temperature greater than 500°C is to be ignored, while all concrete with a temperature less than 500°C is to be assumed to have its full strength. Reinforcement is designed with a reduced strength based on its temperature. Slabs are designed as simply-supported T-beams, even for continuous slabs.

The process to be followed is:

1. Ensure that the minimum slab thickness specified in Table 1 is satisfied. Note that if a structural screed/grout is placed on the concrete its thickness may be included when satisfying minimum thickness requirements. However, its thickness must not be included when carrying out the structural design calculations outlined in this document. For example, a 170mm thick VoidPro 115 slab with a 20mm thick screed on top (minimum thickness) will be equivalent to a 190mm slab for insulation resistance, but for structural resistance the slab must be designed as 170mm thick. However, it must be ensured that the screed is securely bonded to the slab, will not delaminate during a fire, and does not have a waterproofing layer, insulation layer or other such layer in between the concrete and screed.
2. Calculate the fire limit bending moments, based on the load combinations provided in Equation 1 and Table 2. The load combination to be checked is at the fire limit state (FLS) and is based upon the accidental load combination (ACC) of SANS 10160-1:

$Fire\ limit\ state\ load = 1.0 \times Permanent\ Load + \psi \times Imposed\ Load$	*Eq. 1*

   The combination factor, ψ, is taken according to SANS 10160 as specified in Table 2.
3. Determine the depth of the 500°C temperature isotherm for the standard fire. See Table 3 and Figure 2 for more details.
4. Determine the temperature of reinforcing steel at the centre of bars and calculate the reduced strength of reinforcing steelwork $(f_{yT} = k_{yT} f_y)$. This is provided in Table 4.
5. Calculate the resistance of the section according to normal concrete design methods (SANS 10100-1, SANS 51992-1-1 / EN 1992-1-1, or to Buchanan (2001)) but using the reduced rebar strength, f_{yT}. Ignore the contribution of the permanent formwork. The following equations are suggested as a simple approach:

   (a) Depth of concrete compression block:

$a_f = \frac{A_s f_{y,T}}{0.67 f_{cu} b}$	*Eq. 2*

   (b) Sagging moment capacity in fire:

$M_f = A_s f_{y,T}(d - a_f/2)$	*Eq. 3*

Where:

a_f	Depth of compression block
A_s	Area of reinforcing steel in tension (per rib)
b	Width of the rib
d	Effective depth to centre of reinforcement
f_{cu}	Characteristic strength of the concrete
$f_{y,T}$	Yield strength of reinforcing steel at temperature T, where $f_{y,T} = k_{y,T} f_y$

6. Ensure that the neutral axis (referred to as x in SANS 10100-1) of the section falls within the upper section of the beam which is cooler than 500°C. This is calculated as $\frac{a_f}{0.9}$, and is measured from the top of the slab.

Profile	Min. slab thickness for 60min fire rating	Min. thickness above flute (mm)
VoidPro 50	120	70
VoidPro 115	190	75
VoidPro 200	275	75

Table 1: Minimum thickness of VoidPro systems to satisfy a 60 minute insulation fire resistance rating

Category	Specific use	ψ – Combination factor
A	Domestic and residential areas	0.3
B	Public areas not susceptible to crowding	0.3
C	Public areas where people may congregate	0.3
D	Shopping areas	0.3
E1	Light industrial use	0.5
E2	Industrial use	0.6
E3	Storage areas	0.8
H	Inaccessible roofs	0.0
J	Accessible flat roofs, excluding occupancy categories A to D	0.3
K	Accessible flat roofs with occupancies A to D	In accordance with Categories A to D

Table 2: Combination factor for the fire limit state (FLS)

Fire time (min)	a_{500} - 500°C Isotherm Depth (mm)
60 min	23
90 min	32
120 min	40

Table 3: Depth of 500°C isotherm for the design of slabs in sagging according to EN 1994-1-2 Table D5.

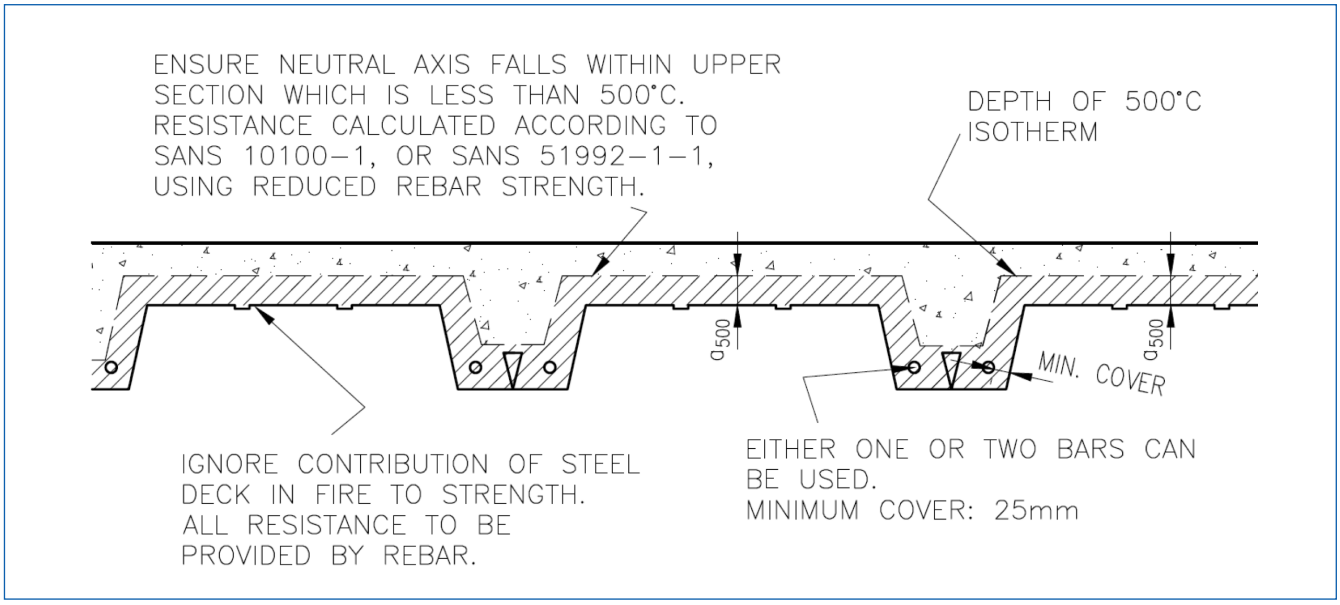


Figure 2: Fire limit state (FLS) design considerations and layout

Fire resistance time (min)	T - Steel temp (°C):	k_{yT} - Reduction factor
60 min	460	0.78
90 min	610	0.37
120 min	720	0.19

Table 4: Temperature and reduction factors for reinforcing steel at different standard fire times assuming 20mm

Design Assumptions

The following assumptions have been made to calculate fire resistance ratings of the VoidPro panels:

Concrete strength:	C25/30 (i.e. 30MPa cube strength)
Rebar properties:	Yield strength – 450 MPa. Young's modulus – 200 GPa.
Cover:	25mm
Top steel / mesh:	If required minimum top reinforcement as per EN 1994-1-1 should be added to reduce cracking for continuous beams.

The entire steel formwork profile is neglected for calculations as it rapidly loses strength in fire. Rebar detailing specifications must comply with applicable SANS requirements.

Notes

For composite steel-concrete floors in fire specialist literature should be consulted such as that of the MACS+ design software or Slab Panel Method (SPM) for designing slabs in fire. This can lead to reductions in required reinforcement and reduced passive protection requirements for steel beams. Detailing requirements associated with the aforementioned methods must be adhered to, to ensure that cracking in slabs does not occur.
The Eurocode EN documents permit using a lower partial material factor for the ACC limit state. Hence, partial material factors for concrete and steelwork may be been taken as 1.0. For continuous slabs a savings in sagging reinforcement can be made using continuity, but the literature listed above should be consulted for the calculation of hogging moment capacity.

VP-50
Reinforcing Requirements for a 60 minute Fire Rating

Additional reinforcing steel in [mm²] per beam at 415 mm spacing, for the VoidPro-50 system used in a single span simply supported configuration. The minimum slab thickness required to attain a 60 minute fire rating is 120 mm. Those values with * next to them are governed by fire requirements, whilst the remainder are governed by serviceability or ultimate limit state requirements. The steel decking has been assumed to lose all its strength in fire. Additional reinforcing steel is limited to a maximum diameter of 20 mm. Cover of 25 mm above the deck soffit should be provided in all cases. Refer to Table 1.1 for additional design assumptions. The reinforcement is suitable for the following occupancies according to SANS 10160-1: (A) Domestic and residential areas, (B) Public areas not susceptible to crowding, (C) Public areas where people may congregate, (D) Shopping areas, and (J/K) Accessible flat roofs. For other occupancy categories (industrial usage, storage etc.) refer to the Voidcon fire design guideline document.

Reinforcing requirements for a 60 minute fire rating

Q_n[a]	G_n[b]	TL_f[c]	t[d]	Floor span in [m]									
[kPa]	[kPa]	[kPa]	[mm]	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75
				Additional reinforcing steel in [mm²] per beam 415 mm $^{c}/_{c}$									
1.50	2.065	3.42	120	*37	*44	*53	*62	*72	*83				
2.00	2.065	3.57	120	*38	*46	*55	*65	*75					
2.50	2.065	3.72	120	*40	*48	*58	*68	*79					
3.00	2.065	3.87	120	*41	*50	*60	*70	*82					
4.00	2.065	4.17	120	*45	*54	*65	*76						
5.00	2.065	4.47	120	*48	*58	*69							
7.50	2.065	5.22	120	*56	*68								
1.50	2.411	3.76	135	*34	*42	*50	*58	*68	*78	*89	*100		
2.00	2.411	3.91	135	*36	*43	*52	*61	*70	*81	*92			
2.50	2.411	4.06	135	*37	*45	*54	*63	*73	*84	*96			
3.00	2.411	4.21	135	*38	*47	*56	*65	*76	*87				
4.00	2.411	4.51	135	*41	*50	*60	*70	*81	*94				
5.00	2.411	4.81	135	*44	*53	*64	*75	*87					
7.50	2.411	5.56	135	*51	*62	*74	*87						
1.50	2.756	4.11	150	*33	*39	*47	*55	*64	*74	*84	*95	*107	410
2.00	2.756	4.26	150	*34	*41	*49	*57	*67	*77	*87	*99	*111	
2.50	2.756	4.41	150	*35	*42	*51	*59	*69	*79	*90	*102	440	
3.00	2.756	4.56	150	*36	*44	*52	*61	*71	*82	*94	*106		
4.00	2.756	4.86	150	*39	*47	*56	*66	*76	*88	*100			
5.00	2.756	5.16	150	*41	*50	*59	*70	*81	*93	210			
7.50	2.756	5.91	150	*47	*57	*68	*80	*93	440				
1.50	2.987	4.34	160	*32	*38	*46	*54	*62	*72	*82	*93	*104	*116
2.00	2.987	4.49	160	*33	*40	*47	*56	*65	*74	*85	*96	*108	*120
2.50	2.987	4.64	160	*34	*41	*49	*58	*67	*77	*88	*99	*111	240
3.00	2.987	4.79	160	*35	*42	*51	*59	*69	*79	*90	*102	*115	
4.00	2.987	5.09	160	*37	*45	*54	*63	*73	*84	*96	*109	450	
5.00	2.987	5.39	160	*39	*48	*57	*67	*78	*89	*102	150		
7.50	2.987	6.14	160	*45	*54	*65	*76	*89	*102	390			

[a] Unfactored imposed (live) load.
[b] Unfactored own-weight of the slab and the VoidPro-50 profile.
[c] Total factored load using the SANS10160-1 ACC load combination of $1.0Gn + 0.3Qn$ where Gn is the total nominal permanent (dead) load and Qn is the total imposed (live) load. Note that in calculating the total factored load, an allowance was made for the additional permanent load of 0.9 kPa accounting for services and finishes.
[d] Total thickness of the slab.

VP-115
Reinforcing Requirements for a 60 minute Fire Rating

Additional reinforcing steel in [mm²] per beam at 600 mm spacing, for the VoidPro-115 system used in a single span simply supported configuration. The minimum slab thickness required to attain a 60 minute fire rating is 190 mm. Those values with * next to them are governed by fire requirements, whilst the remainder are governed by serviceability or ultimate limit state requirements. The steel decking has been assumed to lose all its strength in fire. Additional reinforcing steel is limited to a maximum diameter of 20 mm. Cover of 25 mm above the deck soffit should be provided in all cases. Refer to Table 2.1 for additional design assumptions. The reinforcement is suitable for the following occupancies according to SANS 10160-1: (A) Domestic and residential areas, (B) Public areas not susceptible to crowding, (C) Public areas where people may congregate, (D) Shopping areas, and (J/K) Accessible flat roofs. For other occupancy categories (industrial usage, storage etc.) refer to the Voidcon fire design guideline document.

Reinforcing requirements for a 60 minute fire rating

Q_n [a]	G_n [b]	TL_f [c]	t [d]	Floor span in [m]												
[kPa]	[kPa]	[kPa]	[mm]	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50
				Additional reinforcing steel in [mm²] per beam 600 mm $^{c}/_{c}$												
1.50	2.15	3.50	(170)	*112	*125	*138	*153	270								
2.00	2.15	3.65	(170)	*117	*130	*144	*159	860								
2.50	2.15	3.80	(170)	*122	*136	*150	510									
3.00	2.15	3.95	(170)	*126	*141	240										
4.00	2.15	4.25	(170)	*136	230											
5.00	2.15	4.55	(170)	170	790											
7.50	2.15	5.30	(170)													
NOTE: (170) – Structural screed of 20 mm minimum thickness required on top of 170 mm thick slab to obtain 60 minute fire rating. No insulation/waterproofing layer may be installed between screed and concrete.																
1.50	2.611	3.96	190	*110	*123	*136	*151	*165	*181	220	720					
2.00	2.611	4.11	190	*114	*128	*142	*156	*172	*188	560						
2.50	2.611	4.26	190	*119	*132	*147	*162	*178	400	1090						
3.00	2.611	4.41	190	*123	*137	*152	*168	230	730							
4.00	2.611	4.71	190	*131	*147	*163	250	750								
5.00	2.611	5.01	190	140	170	210	650									
7.50	2.611	5.76	190	240	470	1200										
1.50	2.842	4.19	200	*110	*122	*136	*150	*164	*180	*196	220	630				
2.00	2.842	4.34	200	*114	*127	*141	*155	*170	*187	*203	520	1230				
2.50	2.842	4.49	200	*118	*131	*145	*161	*176	*193	380	930					
3.00	2.842	4.64	200	*121	*136	*150	*166	*182	250	670						
4.00	2.842	4.94	200	*129	*144	*160	180	270	700							
5.00	2.842	5.24	200	*137	160	200	240	630								
7.50	2.842	5.99	200	220	270	500	1140									
1.50	3.418	4.77	225	*108	*121	*134	*148	*162	*178	*194	*210	*228	*246	400	770	1520
2.00	3.418	4.92	225	*112	*125	*138	*153	*168	*183	*200	*217	*235	350	680	1310	
2.50	3.418	5.07	225	*115	*128	*142	*157	*173	*189	*206	*224	270	570	1070		
3.00	3.418	5.22	225	*119	*132	*147	*162	*178	*195	*212	*231	450	850			
4.00	3.418	5.52	225	*125	*140	*155	*171	190	220	260	490	920				
5.00	3.418	5.82	225	*132	*148	170	200	240	280	470	890					
7.50	3.418	6.57	225	190	230	270	320	430	810	1550						
1.50	3.995	5.35	250	*107	*120	*133	*146	*161	*176	*192	*208	*226	*244	*262	*282	340
2.00	3.995	5.50	250	*110	*123	*136	*151	*165	*181	*197	*214	*232	*251	*270	300	530
2.50	3.995	5.65	250	*113	*126	*140	*155	*170	*186	*203	*220	*238	*257	*277	460	770
3.00	3.995	5.80	250	*116	*130	*144	*159	*175	*191	*208	*226	*245	280	390	650	1080
4.00	3.995	6.10	250	*122	*137	*151	*167	*184	*201	230	270	310	430	710	1170	
5.00	3.995	6.40	250	*129	*143	*159	180	210	250	290	330	430	710	1170		
7.50	3.995	7.15	250	160	200	240	280	330	380	430	710	1160				

[a] Unfactored imposed (live) load.
[b] Unfactored own-weight of the slab and the VoidPro-115 profile.
[c] Total factored load using the SANS10160-1 ACC load combination of $1.0Gn + 0.3Qn$ where Gn is the total nominal permanent (dead) load and Qn is the total imposed (live) load. Note that in calculating the total factored load, an allowance was made for the additional permanent load of 0.9 kPa accounting for services and finishes.
[d] Total thickness of the slab.

VP-200
Reinforcing Requirements for a 60 minute Fire Rating

Additional reinforcing steel in [mm²] per beam at 760 mm spacing, for the VoidPro-200 system used in a single span simply supported configuration. The minimum slab thickness required to attain a 60 minute fire rating is 275 mm. Those values with * next to them are governed by fire requirements, whilst the remainder are governed by serviceability or ultimate limit state requirements. The steel decking has been assumed to lose all its strength in fire. Additional reinforcing steel is limited to a maximum diameter of 20 mm. Cover of 25 mm above the deck soffit should be provided in all cases. Refer to Table 3.1 for additional design assumptions. The reinforcement is suitable for the following occupancies according to SANS 10160-1: (A) Domestic and residential areas, (B) Public areas not susceptible to crowding, (C) Public areas where people may congregate, (D) Shopping areas, and (J/K) Accessible flat roofs. For other occupancy categories (industrial usage, storage etc.) refer to the Voidcon fire design guideline document.

Reinforcing requirements for a 60 minute fire rating

Q_n [a]	G_n [b]	TL_f [c]	t [d]	Floor span in [m]											
[kPa]	[kPa]	[kPa]	[mm]	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50
				Additional reinforcing steel in [mm²] per beam 760 mm $^{c}/_{c}$											
1.50	2.962	4.31	(255)	*84	*107	*132	*160	*191	*225	*261	*300	400	1080		
2.00	2.962	4.46	(255)	*87	*111	*137	*166	*198	*232	*270	*311	670			
2.50	2.962	4.61	(255)	*90	*115	*142	*172	*204	*240	*279	370	1030			
3.00	2.962	4.76	(255)	*93	*118	*146	*177	*211	*248	320	580				
4.00	2.962	5.06	(255)	*99	*126	*155	*188	240	320	420	1130				
5.00	2.962	5.36	(255)	*105	*133	*165	220	310	400	760					
7.50	2.962	6.11	(255)	*120	170	260	360	480	860						
NOTE: (255) – Structural screed of 20 mm minimum thickness required on top of 255 mm thick slab to obtain 60 minute fire rating. No insulation/waterproofing layer may be installed between screed and concrete.															
1.50	3.423	4.77	275	*86	*109	*134	*163	*194	*228	*265	*304	*347	490	1110	
2.00	3.423	4.92	275	*88	*112	*139	*168	*200	*235	*273	*314	*358	740	1690	
2.50	3.423	5.07	275	*91	*115	*143	*173	*206	*242	*282	330	470	1070		
3.00	3.423	5.22	275	*94	*119	*147	*178	*212	*250	300	380	660	1500		
4.00	3.423	5.52	275	*99	*126	*156	*188	230	300	380	520	1180			
5.00	3.423	5.82	275	*105	*133	*164	210	290	370	470	860				
7.50	3.423	6.57	275	*118	150	240	330	440	560	990					
1.50	3.999	5.35	300	*87	*110	*136	*165	*197	*231	*269	*309	*352	*398	510	1000
2.00	3.999	5.50	300	*90	*113	*140	*170	*202	*238	*276	*318	*362	410	720	1420
2.50	3.999	5.65	300	*92	*117	*144	*174	*208	*244	*284	*326	390	490	980	1980
3.00	3.999	5.80	300	*94	*120	*148	*179	*213	*251	*291	360	440	660	1290	
4.00	3.999	6.10	300	*99	*126	*156	*188	*225	280	360	450	540	1080	2200	
5.00	3.999	6.40	300	*104	*132	*163	*198	270	350	440	540	840	1650		
7.50	3.999	7.15	300	*117	*148	220	300	400	510	630	980	1940			
1.50	4.460	5.81	320	*88	*111	*138	*167	*199	*234	*271	*312	*355	*402	*452	610
2.00	4.460	5.96	320	*90	*114	*141	*171	*204	*240	*278	*320	*365	*413	480	820
2.50	4.460	6.11	320	*93	*117	*145	*175	*209	*246	*285	*328	380	460	590	1080
3.00	4.460	6.26	320	*95	*120	*148	*180	*214	*252	*293	350	430	510	760	1380
4.00	4.460	6.56	320	*99	*126	*156	*188	*225	270	350	430	520	650	1180	2230
5.00	4.460	6.86	320	*104	*132	*163	*197	250	330	420	510	610	950	1740	
7.50	4.460	7.61	320	*115	*146	200	280	380	480	590	720	1120	2070		
1.50	4.921	6.27	340	*89	*112	*139	*168	*200	*236	*274	*314	*358	*405	*455	*508
2.00	4.921	6.42	340	*91	*115	*142	*172	*205	*241	*280	*322	*367	*415	480	550
2.50	4.921	6.57	340	*93	*118	*146	*176	*210	*247	*287	*330	*376	450	530	700
3.00	4.921	6.72	340	*95	*121	*149	*180	*215	*253	*293	340	420	500	580	880
4.00	4.921	7.02	340	*99	*126	*156	*188	*225	*264	340	420	500	590	770	1300
5.00	4.921	7.32	340	*104	*131	*162	*197	240	320	400	490	590	700	1080	1860
7.50	4.921	8.07	340	*114	*145	180	270	360	460	560	680	810	1270	2220	

[a] Unfactored imposed (live) load.
[b] Unfactored own-weight of the slab and the VoidPro-200 profile.
[c] Total factored load using the SANS10160-1 ACC load combination of $1.0Gn + 0.3Qn$ where Gn is the total nominal permanent (dead) load and Qn is the total imposed (live) load. Note that in calculating the total factored load, an allowance was made for the additional permanent load of 0.9 kPa accounting for services and finishes.
[d] Total thickness of the slab.

Stability of structural elements or components

1	2	3	4	5	6	7
Type of occupancy	**Class of occupancy**	**Stability** min				
		Single-storey building	**Double-storey building**	**3 to 10 storey building**	**11 storeys and more**	**Basement in any building**
Entertainment and public assembly	A1	30	60	120	120	120
Theatrical and indoor sport	A2	30	60	120	120	120
Place of instruction	A3	30	30	90	120	120
Worship	A4	30	60	90	120	120
Outdoor sport	A5	30	30	60	90	120
High risk commercial service	B1	60	60	120	180	120
Moderate risk commercial service	B2	30	60	120	120	120
Low risk commercial service	B3	30	30	90	120	120
Exhibition hall	C1	90	90	120	120	120
Museum	C2	60	60	90	120	120
High risk industrial	D1	60	90	120	180	240
Moderate risk industrial	D2	30	60	90	120	180
Low risk industrial	D3	30	30	60	120	120
Plant room	D4	30	30	60	90	120
Place of detention	E1	60	60	90	120	120
Hospital	E2	60	90	120	180	120
Other institutional (residential)	E3	60	60	120	180	120
Medical facilities	E4	30	30	Not applicable	Not applicable	120
Large shop	F1	60	90	120	180	120
Small shop	F2	30	60	120	180	120
Wholesalers' store	F3	60	90	120	120	120
Office	G1	30	30	60	120	120
Hotel	H1	30	60	90	120	120
Dormitory	H2	30	30	60	120	120
Domestic residence	H3	30	30	60	120	120
Detached dwelling house	H4	30	30	60	Not applicable	120
Hospitality	H5	30	30	Not applicable	Not applicable	120
High risk storage	J1	60	90	120	180	240
Moderate risk storage	J2	30	60	90	120	180
Low risk storage	J3	30	30	90	90	120
Parking garage	J4	30	30	30	90	120

NOTE 1 Unprotected steel may be used in the structural system of all single-storey and certain double-storey buildings in spite of the fact that in many cases such structural members would not comply with the requirements of this table. The practice is regarded as safe for all practical cases that are likely to occur in single-storey construction, but the possible consequences of early distortion or collapse should be considered in the design of double-storey buildings in order to be certain that escape routes will be able to serve their purpose for the required period. Particular care should be exercised where thin sections are used or in "space-frame" type structures.

NOTE 2 A further problem arises in the application of the requirement of 4.2. Distortion or collapse of any structural member should not cause loss of integrity or stability in any external wall facing a site boundary or another building as this might lead to non-compliance with the safety distance requirement. Where such a situation occurs, it would be necessary either to protect the steel to the extent required to attain the stability given in this table or to regard such wall as being of type N for the purposes of 4.2.

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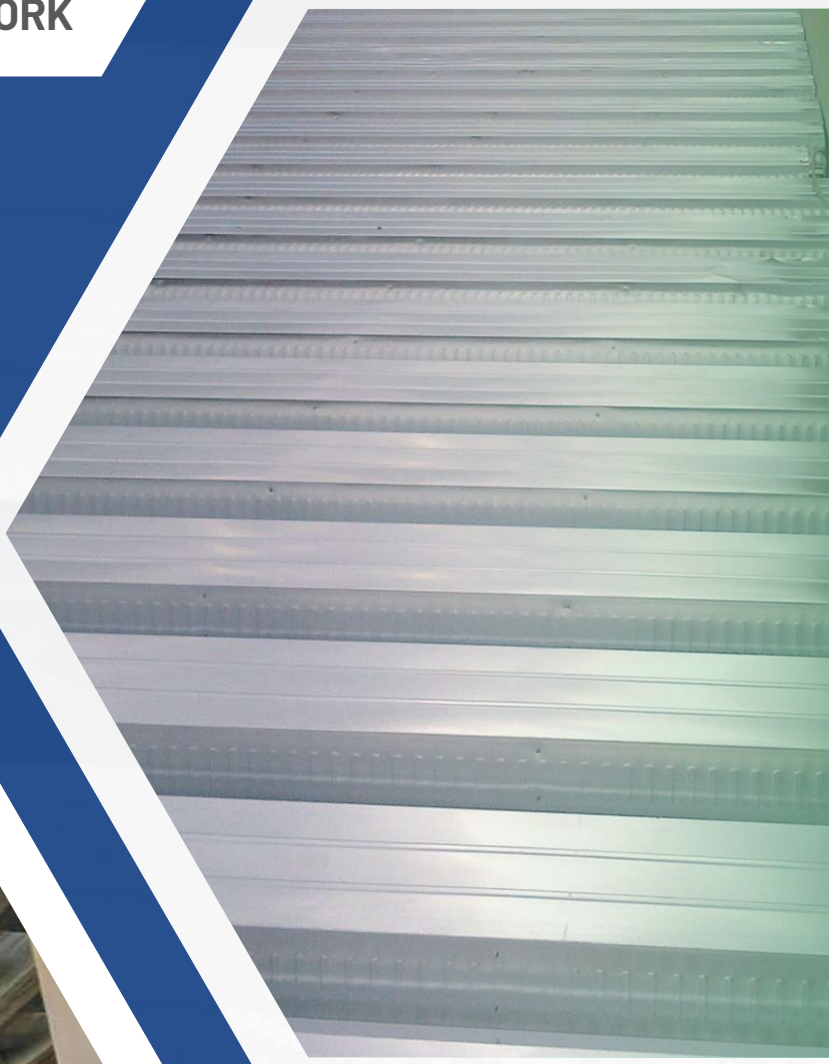
Product List



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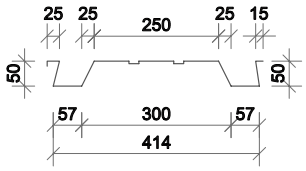
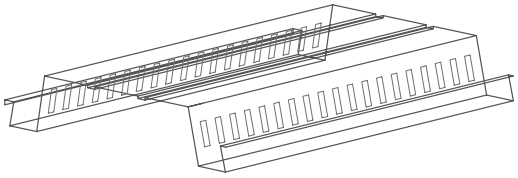
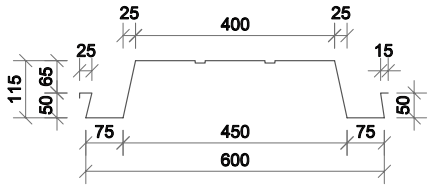
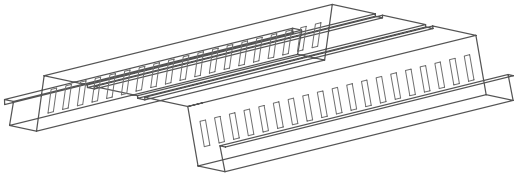
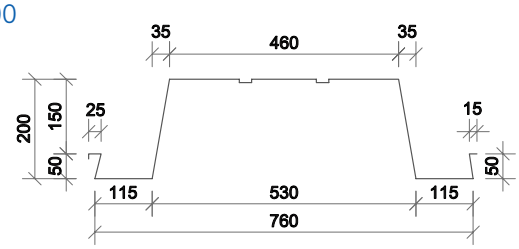
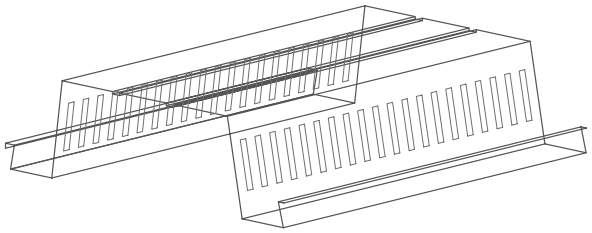
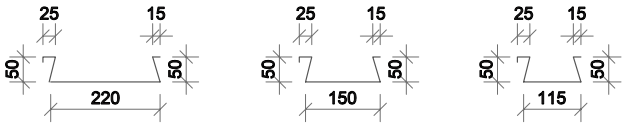
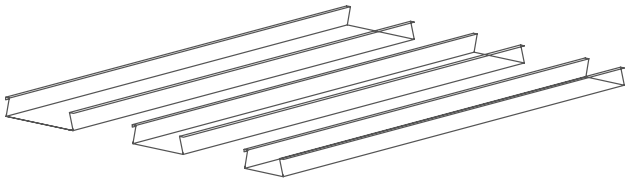
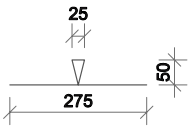
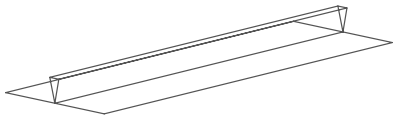
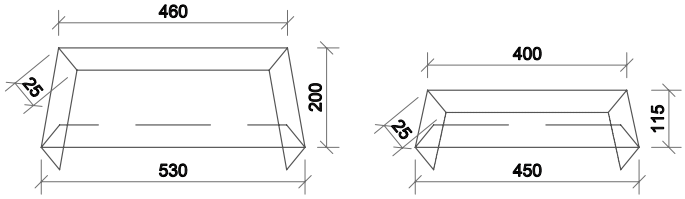
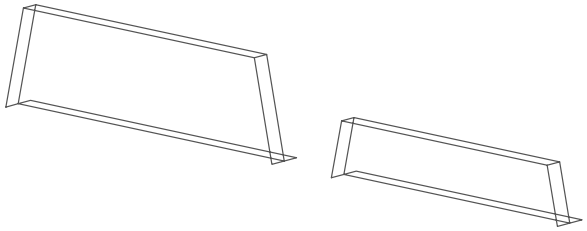
Product List

Product Dimensions	3D View
VP-50 	
VP-115 	
VP-200 	
VP Beam 	
VP Cross Beam 	
Closures/Stiffeners 	

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