OBO Typicals

Detailed mounting drawings

of mounting, cable tray, mesh cable tray, cable ladder and wide span systems

OBO BETTERMANN

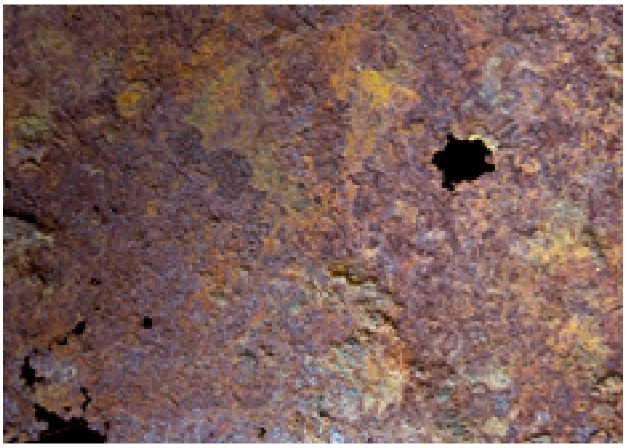
Notes

OBO Typicals – detailed mounting drawings of mounting, cable tray, mesh cable tray, cable ladder and wide span systems

Only examples are shown on the following pages, please consult us before using these drawings.
Project-specific typicals can be drawn separately in consultation and as required.

More Typicals on
www.obo-bettermann.com

Metal: corrosion and corrosion protection



Corrosion
(from the Latin corrodere, “to eat or gnaw to pieces”) in a technical context is a reaction between a material (generally a metal) and its surroundings, leading to a measurable change in the material and potentially impairing the functionality of a component or system.

A large number of products used in industrial installations are made of metal. Metals are much tougher than many other materials and are less sensitive to mechanical loading. The OBO metal products are made of aluminium, die-cast zinc, stainless steel or steel.

Steel (St), the most commonly used material, is very strong and has good elasticity and chemical resistance. However, steel is susceptible to corrosion and must therefore be protected accordingly.

Stainless steels consist mainly of alloyed, very hard and rustproof steels. Stainless steels are divided into quality classes according to the percentage of alloys. These are indicated by the material number according to DIN EN 10027.

Aluminium (Al), as a light metal, has comparatively low strength but good electrical conductivity and high corrosion resistance.

Die-cast zinc components (Zn) are very strong and hard. The manufacturing process enables the production of very precise components with good corrosion resistance.

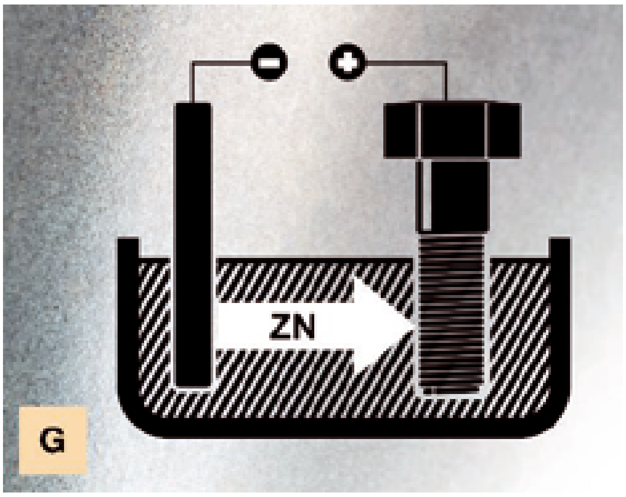
Corrosion protection

Corrosion protection means all steps taken to prevent corrosion damage to metallic components. It is impossible to prevent corrosion permanently, so corrosion protection measures generally aim to reduce the speed of corrosion so that the component is not damaged by corrosion for the duration of its service life.
The term “passive corrosion protection” refers to all measures designed to shield products from corrosive media. Coatings are one way of achieving passive corrosion protection. At OBO, most steel products are protected from corrosion by a layer of zinc. Zinc coatings can be applied to components using a variety of methods.

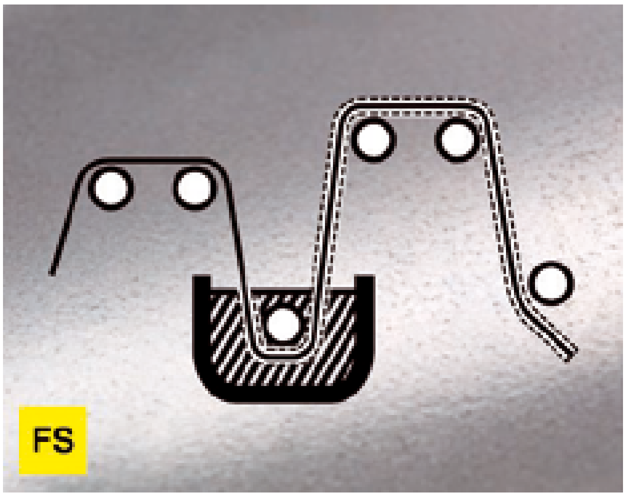
Zinc slat covering

Zinc slat coverings are coatings applied in a non-electrolytic manner. They offer a cathodic protection and thus have excellent corrosion protection, while at the same time, there is no risk of hydrogen-induced breakage. Due to these properties, this coating type is used for connection components with a high strength classification or structural parts with high tensile strength. The low layer thickness of the zinc slat covering allows a thin, homogeneous coating, which is particularly important for maintaining the accuracy of threads. This coating achieves a resistance of 480 hrs in the salt spray test for the connection elements.

Galvanisation types



Electrogalvanisation – electrolytic galvanisation in accordance with DIN EN 12329
In electrogalvanisation, the component is coated by dipping it not in molten zinc, but in a zinc electrolyte, through which a direct electric current is passed.



Strip galvanising – hot galvanised according to the strip-galvanising method in accordance with DIN EN 10327 (formerly DIN EN 10147 and DIN EN 10142)
Strip galvanisation or Sendzimir galvanisation is where a continuous ribbon of steel is galvanised in a continuous line.

Hot-dip galvanisation – hot galvanisation using the dipping method according to DIN EN ISO 1461
Batch galvanisation is mainly used for galvanising prefabricated steel parts, by dipping them in molten zinc at a temperature of around 450 °C.

Hot-dip coating – zinc-aluminium coating in accordance with DIN EN 10346
In contrast to conventional coating systems, the material being galvanised in the double-dip process passes through two baths in succession: the first contains pure zinc, the second a zinc-aluminium alloy.

Surface testing and corrosion categories

Classification of corrosion resistance
All the system components must show sufficient resistance against corrosion in agreement with the standard DIN EN 61537. The minimum zinc layer thicknesses are determined through a measurement. The grouping into the appropriate class is detailed in the table "Classification of corrosion resistance". The table "Corrosion categories according to DIN EN ISO 12944" shows the area of application and the zinc loss to be expected.

Classification of corrosion resistance
All components, depending on the environment, must show sufficient resistance against corrosion in agreement with the standard DIN EN 61537.This is how corrosion categories are determined, e.g. with a salt spray test. In this procedure, components are sprayed with salt for a certain time period. The resulting level of red rust is the basis for allocation to a corrosion category, i.e. in which environment the component is resistant to corrosion.

Classification of corrosion resistance according to EN 61537

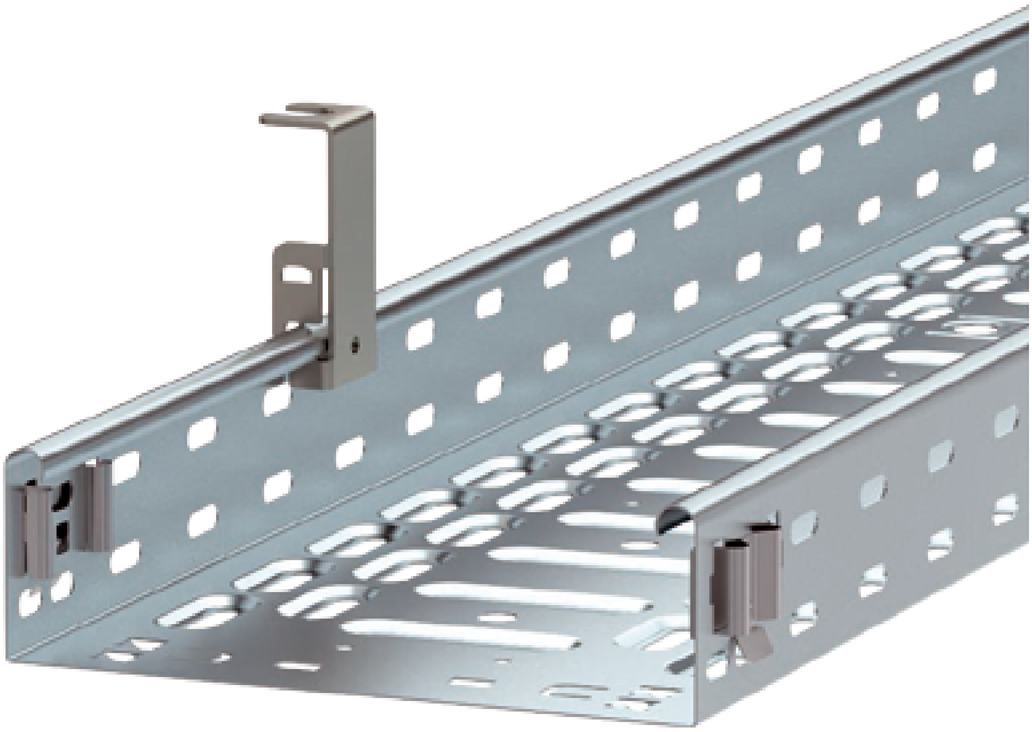
Class	Reference material and surface treatment
0*	None
1	Electroplated to a minimum thickness of 5 µm
2	Electroplated to a minimum thickness of 12 µm
3	Pre-galvanised to grade 275 to EN 10327 and EN 10326
4	Pre-galvanised to grade 350 to EN 10327 and EN 10326
5	Post-galvanised to a zinc mean coating thickness (minimum) of 45 µm according to ISO 1461
6	Post-galvanised to a zinc mean coating thickness (minimum) of 55 µm according to ISO 1461
7	Post-galvanised to a zinc mean coating thickness (minimum) of 70 µm according to ISO 1461
8	Post-galvanised to a zinc mean coating thickness (minimum) of 85 µm according to ISO 1461 (usually high silicon steel)
9A	Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S30400 or EN 10088 grade 1-4301 without a post-treatment *
9B	Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S31603 or EN 10088 grade 1-4404 without a post-treatment *
9C	Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S30400 or EN 10088 grade 1-4301 with a post-treatment **
9D	Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S31603 or EN 10088 grade 1-4404 with a post-treatment **

* For materials which do not have a declared corrosion resistance classification
** The end treatment process is used to improve the protection against crack corrosion and the contamination of other steels

Corrosion categories to DIN EN ISO 12944

Corrosion category	Typical environment, inside	Typical environment, outside	Corrosion load	Average zinc removal
C 1	Heated buildings with neutral atmospheres, e.g. offices, shops, schools, hotels	-	Insignificant	<0.1 µm/a
C 2	Unheated buildings in which condensation can occur, e.g. warehouse, sports halls	Atmosphere with low level of impurities. Often rural areas	Low	0.1 to 0.7 µm/a
C 3	Production facilities with a high level of humidity and some air impurities, e.g. plants for food production, laundries, breweries, dairies	City and industrial atmosphere, considerable impurities through sulphur dioxide, coastal areas with low salt load	Medium	0.7 to 2.1 µm/a
C 4	Chemical plants, swimming pools, boat sheds over seawater	Industrial areas and coastal areas with low salt load	Strong	2.1 to 4.2 µm/a
C 5-I	Buildings or areas with almost constant condensation and with high levels of impurities	Industrial areas with high levels of humidity and aggressive atmosphere	Very strong (industry)	4.2 to 8.4 µm/a
C 5-M	Buildings or areas with almost continuous condensation and with high levels of impurities	Coastal or offshore areas with salt load	Very strong (sea)	>4.2 to 8.4 µm/a

Contact corrosion



If two different metals are conductively connected with each other, contact corrosion can occur. This poses a considerable risk to the load capacity and lifespan of the components used.

The level of contact corrosion is determined primarily by the level of the potential difference between the contact partners. Contact corrosion occurs at potential differences of 100 mV or greater and the anodic (electrically negative) partner is at risk of corrosion. Therefore, strongly non-precious metals should never be brought into contact with precious metals.

Additional contact corrosion criteria:

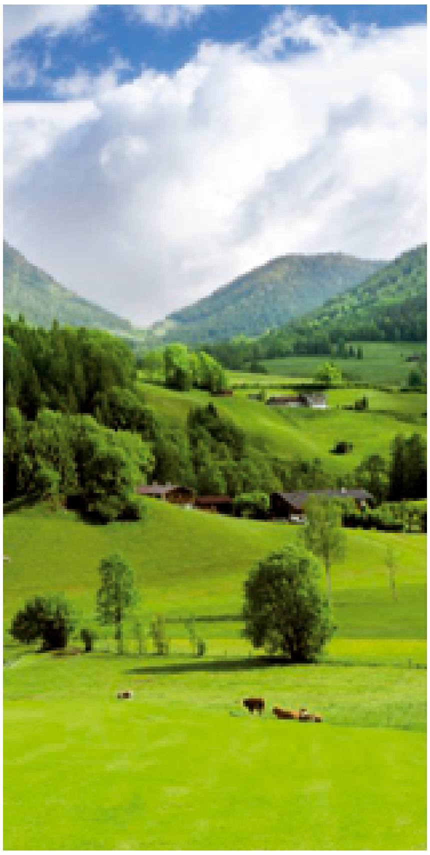
- Level of electrical resistance between the contact partners. The higher the resistance, the lower the contact corrosion. Positive on Al and Ti.
- Occurrence of an electrolyte. An electrolyte, such as perspiration or condensation, attacks the protective layers, increasing conductivity. Dirt increases this effect through released ions.
- Length of the impact of the electrolyte. The longer the electrolyte is active, the greater the corrosion will be.
- The surface ratios of the contact partners influence the current density. The best thing to have is a small surface ratio of the "precious" to the "less precious" contact partner.
- Different environments or atmospheres can increase or influence the risk of contact corrosion to varying degrees.

Installation locations

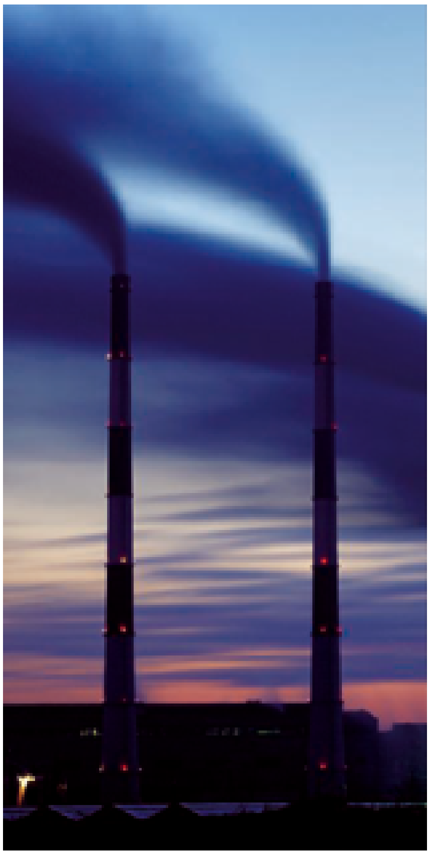
Whether indoors or outdoors, in aggressive atmospheres or under special hygienic conditions, OBO can offer the perfect surface and materials for your installation, no matter what the requirements may be. OBO metal products are machined from high-quality sheet steel or steel wire and are available with various surfaces. Different hardening and coating methods ensure tailor-made corrosion protection, specially tailored to the appropriate application:

Application	Material	Surface protection
Indoors	St Steel	L Painted/powder-coated
	St Steel	FS Strip-galvanised DIN EN 10346
	St Steel	G Electrogalvanised DIN EN 12329
Outdoors	St Steel	FT Hot galvanised DIN EN ISO 1461
	St Steel	DD Hot galvanised DIN EN ISO 1461
	VA Stainless steel A2	
	VA Stainless steel A4	
Especially corrosive areas	VA Stainless steel A2	
	VA Stainless steel A4	

Contact corrosion in different environments



Land climate



Industrial atmosphere

Sea climate

Small/large	ZN	FT	Al	Cu	VA	CuZn
Zn		✓	○	✗	✗	○
FT	✓		○	✗	✗	○
Al	✓	✓		✗	✗	○
Cu	✓	✓	✓		✓	✓
VA	✓	✓	✓	✓		✓
CuZn	✓	✓	✓	✓	✓	

✓	No to low corrosion
○	Low risk of contact corrosion
✗	Heavy corrosion

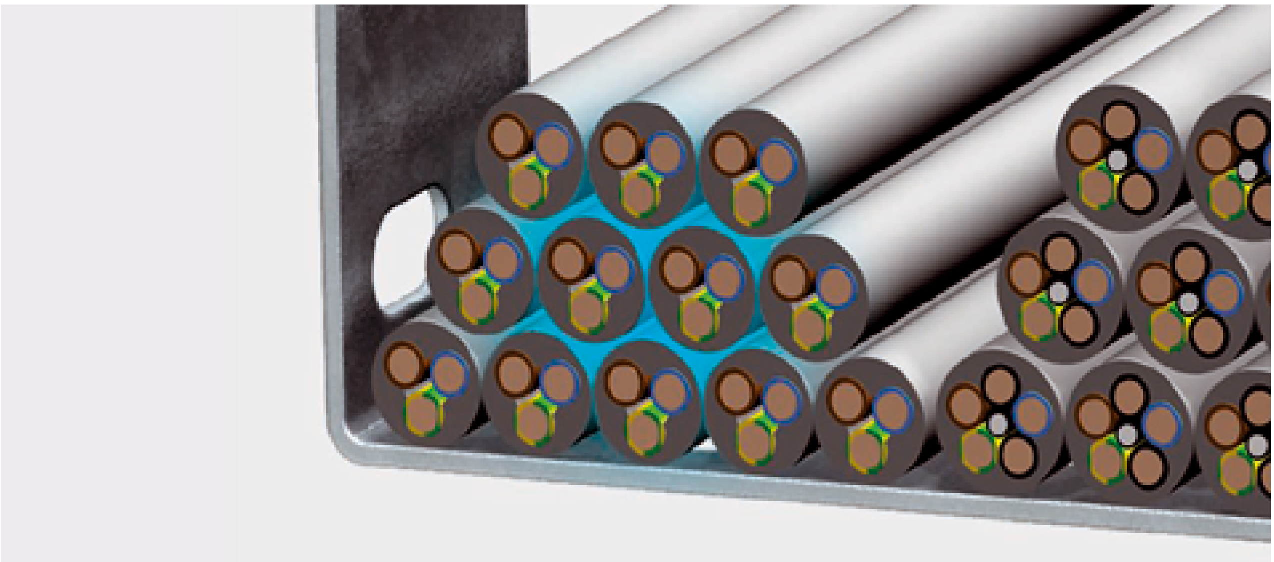
Surfaces for special visual requirements or special environmental loads

Applications with specific optical requirements or special environmental conditions
Colour-coated products are becoming ever more popular. The coating may be required for optical reasons or for reasons of corrosion protection.

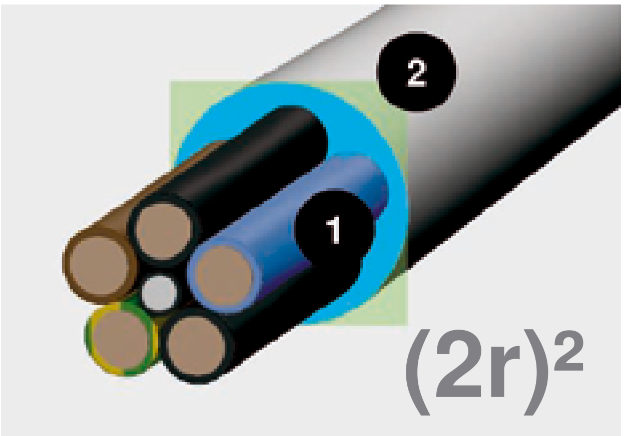
Colour coatings for reasons of corrosion protection
- Products in FT (hot-dip galvanised version)
- All RAL colours available
- Coating of the visible surfaces or the complete system
- Suitable for the colour of the structure when routed openly
- Separation of different voltages/functions (e.g. blue 230/400 V power supply; red weak current such as telephone cables and IT)

Colour-coated systems are not indicated specially in this catalogue. You can obtain details of these systems by contacting our telephone hotline on +49 (0)2373 89-1238.

Cable sizes

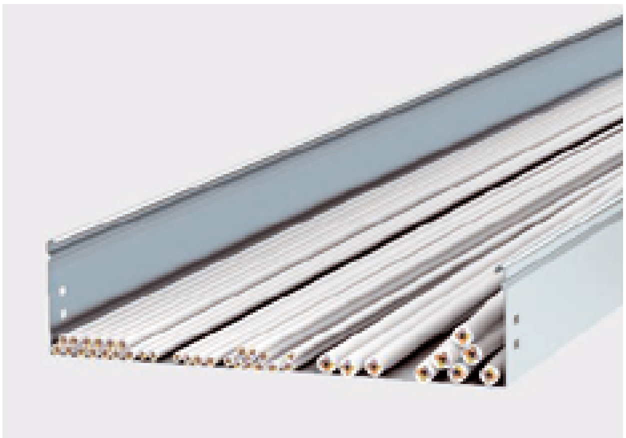


The term “cable” means a jacketed electrical cable for the transmission of electrical energy and data. Cables are given according to their nominal cross-section. The external diameter and usable cross-section depend on their nominal cross-section and the number of individual wires contained in the cable. When fastening clips or cable support systems are used, it is important to know the actual space requirements of the individual cables. It is not sufficient to take only the diameter as a basis for the calculation of the cable volume.



Circular area (1) and space required (2)

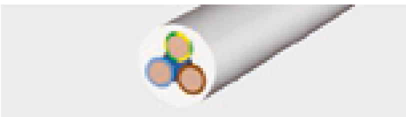
Calculation with the formula (2r)²
The diameter says little about the actual space required by a cable. Calculate: $(2r)^2$. This value reflects the realistic space requirements, including the compartments.



To save you work, we have listed the diameter and usable cross-section of the most important cable types below.

Important:
These values are average values, which may vary from manufacturer to manufacturer. Please refer to the manufacturer's specifications for the exact values.

Basic values for calculation of the cable volume



Insulated power cables

Type	Diameter mm	Usable cross-section cm²
1 x 4	6.5	0.42
1 x 6	7	0.49
1 x 10	8	0.64
1 x 16	9.5	0.9
1 x 25	12.5	1.56
3 x 1.5	8.5	0.72
3 x 2.5	9.5	0.9
3 x 4	11	1.21
4 x 1.5	9	0.81
4 x 2.5	10.5	1.1
4 x 4	12.5	1.56
4 x 6	13.5	1.82
4 x 10	16.5	2.72
4 x 16	19	3.61
4 x 25	23.5	5.52
4 x 35	26	6.76
5 x 1.5	9.5	0.9
5 x 2.5	11	1.21
5 x 4	13.5	1.82
5 x 6	14.5	2.1
5 x 10	18	3.24
5 x 16	21.5	4.62
5 x 25	26	6.76
7 x 1.5	10.5	1.1
7 x 2.5	13	1.69

Insulated power cables

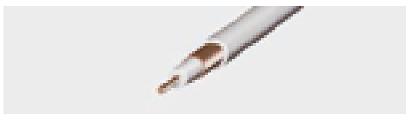
Type	Diameter mm	Usable cross-section cm²
1 x 10	10.5	1.1
1 x 16	11.5	1.32
1 x 25	12.5	1.56
1 x 35	13.5	1.82
1 x 50	15.5	2.4
1 x 70	16.5	2.72
1 x 95	18.5	3.42
1 x 120	20.5	4.2
1 x 150	22.5	5.06
1 x 185	25	6.25
1 x 240	28	7.84
1 x 300	30	9
3 x 1.5	11.5	1.32
3 x 2.5	12.5	1.56
3 x 10	17.5	3.06
3 x 16	19.5	3.8
3 x 50	26	6.76
3 x 70	30	9
3 x 120	36	12.96
4 x 1.5	12.5	1.56
4 x 2.5	13.5	1.82
4 x 6	16.5	2.72
4 x 10	18.5	3.42
4 x 16	21.5	4.62
4 x 25	25.5	6.5
4 x 35	28	7.84
4 x 50	30	9
4 x 70	34	11.56
4 x 95	39	15.21
4 x 120	42	17.64
4 x 150	47	22
4 x 185	52	27
4 x 240	58	33.6
5 x 1.5	13.5	1.82
5 x 2.5	14.5	2.1
5 x 6	18.5	3.42
5 x 10	20.5	4.2
5 x 16	22.5	5.06
5 x 25	27.5	7.56
5 x 35	34	11.56
5 x 50	40	16

Telecommunications cables

Type	Diameter mm	Usable cross-section cm²
2 x 2 x 0.6	5	0.25
4 x 2 x 0.6	5.5	0.3
6 x 2 x 0.6	6.5	0.42
10 x 2 x 0.6	7.5	0.56
20 x 2 x 0.6	9	0.81
40 x 2 x 0.6	11	1.12
60 x 2 x 0.6	13	1.69
100 x 2 x 0.6	17	2.89
200 x 2 x 0.6	23	5.29
2 x 2 x 0.8	6	0.36
4 x 2 x 0.8	7	0.49
6 x 2 x 0.8	8.5	0.72
10 x 2 x 0.8	9.5	0.9
20 x 2 x 0.8	13	1.69
40 x 2 x 0.8	16.5	2.72
60 x 2 x 0.8	20	4
100 x 2 x 0.8	25.5	6.5
200 x 2 x 0.8	32	10.24

IT cables type Cat...

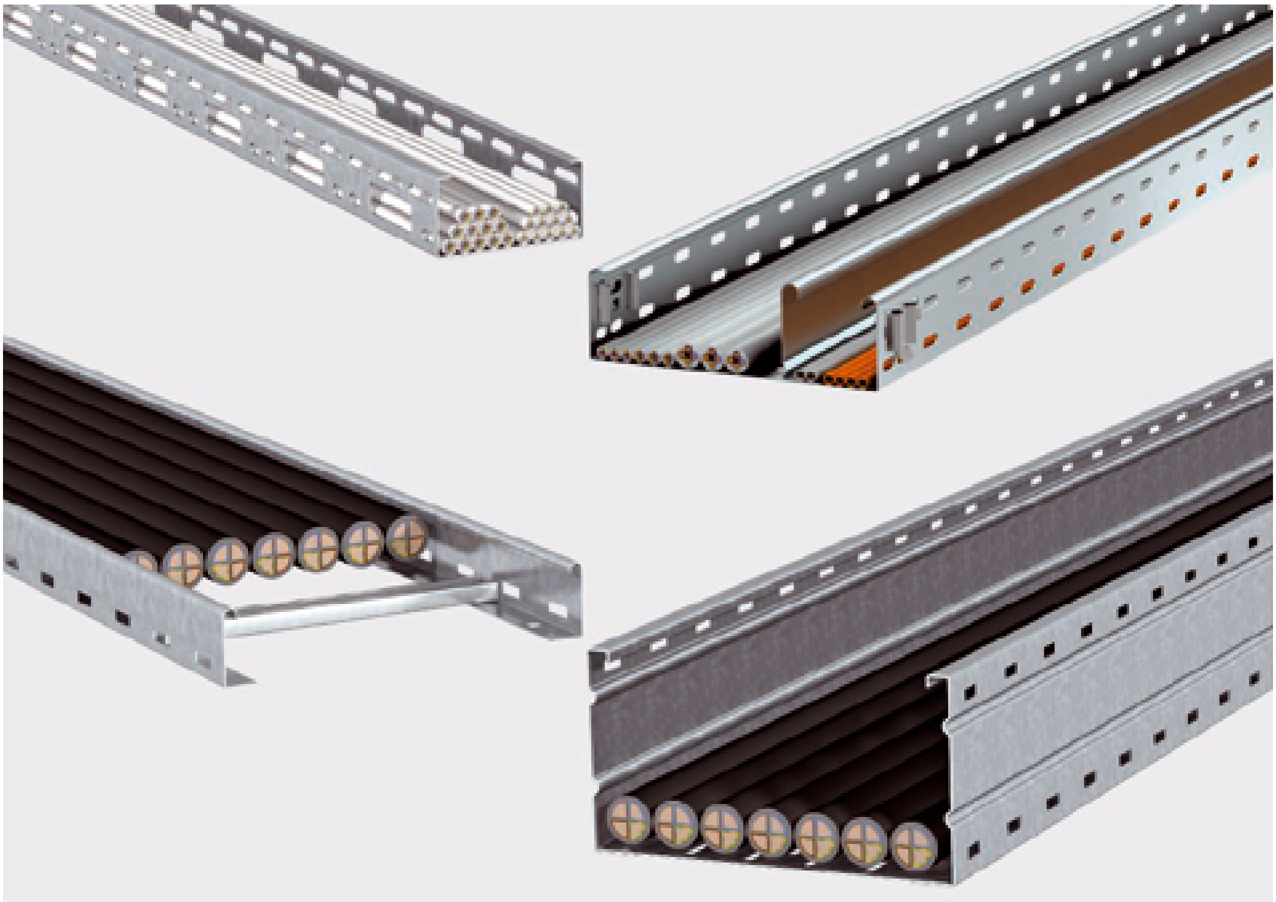
Type	Diameter mm	Usable cross-section cm²
Cat. 5	8	0.64
Cat. 6	8	0.64



Coax cable (Standard)

Type	Diameter mm	Usable cross-section cm²
SAT/BK cable	6.8	0.48

Selection of the correct cable support system

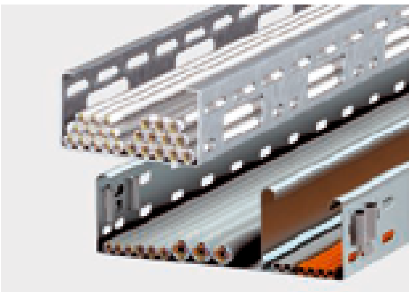


When selecting the right cable support system, the cable volume is not the only decisive factor. The type of cabling, method of laying and cable weight all play an important role. The most important aspects are explained on the following pages.

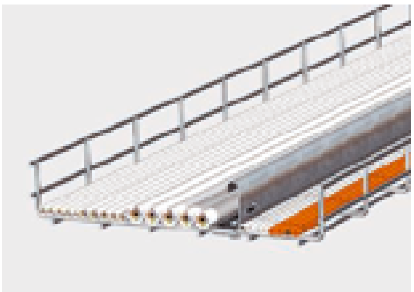
Cable types

Not all cables are the same. To select the perfect cable support system, you need to know which type of cables are to be laid: Are they sensitive data cables, which must be laid at a certain distance from each other on account of the necessary shielding? Or power cables, for which a not inconsiderable heat build-up must be taken into account? For all these applications OBO can offer tailor-made system solutions.

System types

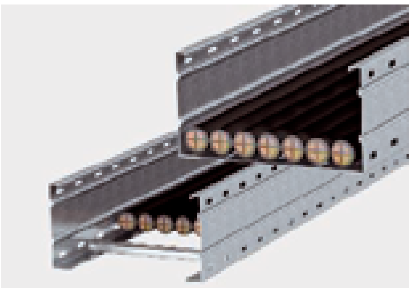


Universal cable trays
Areas of application: From low-voltage cabling to power supply.

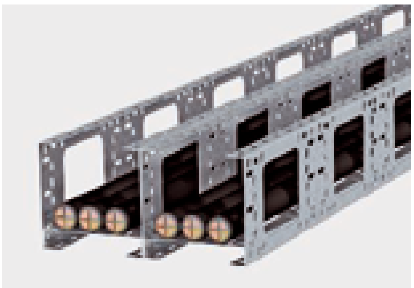


Mesh cable trays for the installation of light cables
Areas of application: IT cabling, telephone cabling and control cables. Also suitable for use in false ceilings and cavity floors.

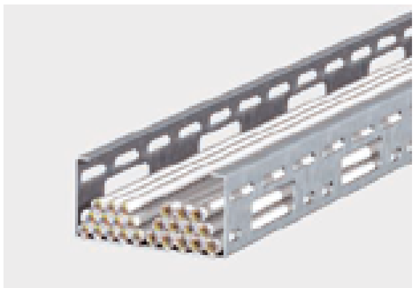
Cable ladders for power cables with a large cross-section
Areas of application: Cables and power conductors with large cross-sections. These can be fastened to the rungs using clamp clips. The high load capacity and good ventilation ensure perfect cable laying.



Wide span cable trays and ladders for large support distances
Areas of application: For installations in which the support distances are more than three metres, on account of the construction conditions.



Modular system for special tasks
The product range that knows no bounds. The range of individually combinable products is particularly suited to complex installation tasks.

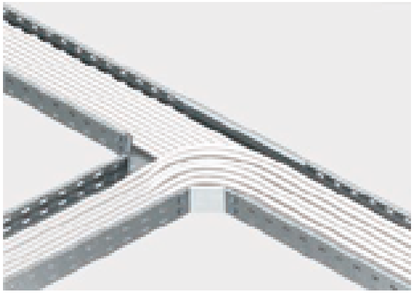


AZ small duct for universal use
Areas of application: for luminaire support systems through to low-voltage cabling and power supply.

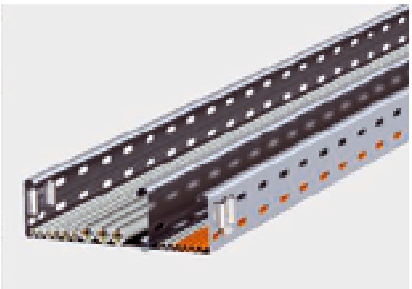
Finding the appropriate system for the planned cable volume

Cable height
The cable height may not exceed the edge height of the cable tray.

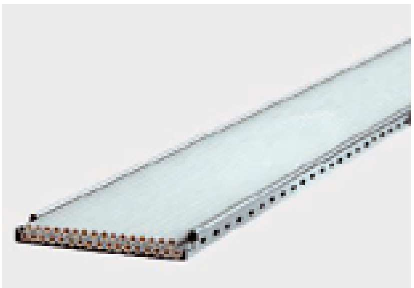
Volume reserve
When selecting the system, a volume reserve of at least 30% should be planned for possible later installations.



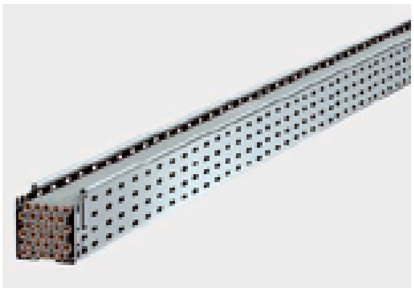
Branches
When dimensioning branches, the bending radii of the cables must be taken into account.



Separation of system levels
When selecting the volume, pay attention to the different conductors. To separate different voltage levels, you must take the required spacings into account.



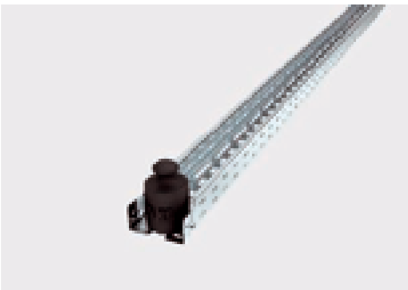
Same usable cross-section, different requirements
There are different requirements for laying data and power cables. Even if the usable cross-section or cable volume is the same, data cables tend to have a narrow, high tray, whereas power cables require a wide, flat version, to avoid heat build-up.



Examples
Flat, wide variant:
- E.g. for power cables
- Cable tray width: 300 mm
- Side rail height: 35 mm
- Usable cross-section: 103 cm²

Narrow, high variant:
- E.g. for data cables
- Cable tray width: 100 mm
- Side height: 110 mm
- Usable cross-section: 108 cm²

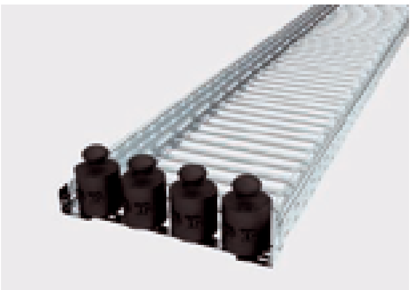
Calculating the cable load



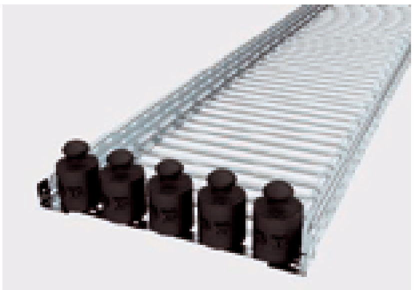
100 mm = 15 kg/m

200 mm = 30 kg/m

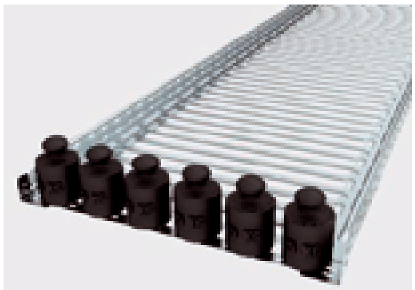
300 mm = 45 kg/m



400 mm = 60 kg/m



500 mm = 75 kg/m



600 mm = 90 kg/m

Of equal significance for the selection of the most suitable cable support system is the load capacity. This must be matched with the expected cable weight (including the reserve for later installation). There are three variants for determining the cable weight:

Variant 1: Orientation to experience values

The average load capacity of a cable tray can be calculated roughly using experience values. For a system with a strut height of 60 mm, a value of 15 kg per 100 mm width is valid for each metre of cable tray or cable ladder. However, more accurate than orientation to experience values is to calculate the cable load using the formula from DIN VDE 0639 Part 1 (Variant 2) or the manufacturer's specifications (Variant 3).

The graphics show the load capacities, based on experience values, of cable trays with a rail height of 60 mm, relative to cable tray widths of 100 to 600 mm.

Variant 2: Calculation formula according to VDE 0639 T1

DIN VDE 0639 Part 1 (cable support systems) offers a formula for calculating the maximum permitted cable load. In the example calculation below, the maximum approved cable load for a cable tray is worked out using the dimension 60 x 300 mm and a usable cross-section of 178 cm².

Variant 3: Exact calculation according to manufacturer's specifications

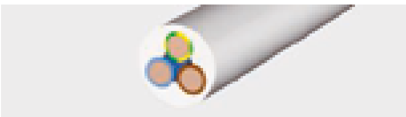
Most cable manufacturers offer a very accurate method of calculating cable weights, and appropriate lists or tables can be obtained from them. Important: The following tables only provide a rough overview. They are average values, which may vary from manufacturer to manufacturer. Please refer to the manufacturer's specifications for the exact values.

	0.028 N	
Cable load (F) =	–––––	x Usable cross-section
	m x mm²	

	0.028 N	
1. Cable load (F) =	–––––	x 17,800 mm² = 500 N/m
	m x mm²	

2. Conversion from Newtons (N) to kilogrammes (kg) 10 N ~ 1 kg – in our example, this means: 500 N/m = 50 kg/m

Actual cable load of different cable types



Insulated power cables

Type	Cable load kg/m
1 x 4	0.08
1 x 6	0.105
1 x 10	0.155
1 x 16	0.23
1 x 25	0.33
3 x 1.5	0.135
3 x 2.5	0.19
3 x 4	0.265
4 x 1.5	0.16
4 x 2.5	0.23
4 x 4	0.33
4 x 6	0.46
4 x 10	0.69
4 x 16	1.09
4 x 25	1.64
4 x 35	2.09
5 x 1.5	0.19
5 x 2.5	0.27
5 x 4	0.41
5 x 6	0.54
5 x 10	0.85
5 x 16	1.35
5 x 25	1.99
7 x 1.5	0.235
7 x 2.5	0.35

Insulated power cables

Type	Cable load kg/m
1 x 10	0.18
1 x 16	0.24
1 x 25	0.35
1 x 35	0.46
1 x 50	0.6
1 x 70	0.8
1 x 95	1.1
1 x 120	1.35
1 x 150	1.65
1 x 185	2
1 x 240	2.6
1 x 300	3.2
3 x 1.5	0.19
3 x 2.5	0.24
3 x 10	0.58
3 x 16	0.81
3 x 50	1.8
3 x 70	2.4
3 x 120	4
4 x 1.5	0.22
4 x 2.5	0.29
4 x 6	0.4
4 x 16	1.05
4 x 25	1.6
4 x 35	1.75
4 x 50	2.3
4 x 70	3.1
4 x 95	4.2
4 x 120	5.2
4 x 150	6.4
4 x 185	8.05
4 x 240	11
5 x 1.5	0.27
5 x 2.5	0.35
5 x 6	0.61
5 x 10	0.88
5 x 16	1.25
5 x 25	1.95
5 x 35	2.4
5 x 50	3.5

Telecommunications cables

Type	Cable load kg/m
2 x 2 x 0.6	0.03
4 x 2 x 0.6	0.035
6 x 2 x 0.6	0.05
10 x 2 x 0.6	0.065
20 x 2 x 0.6	0.11
40 x 2 x 0.6	0.2
60 x 2 x 0.6	0.275
100 x 2 x 0.6	0.445
200 x 2 x 0.6	0.87
2 x 2 x 0.8	0.04
4 x 2 x 0.8	0.055
6 x 2 x 0.8	0.08
10 x 2 x 0.8	0.115
20 x 2 x 0.8	0.205
40 x 2 x 0.8	0.38
60 x 2 x 0.8	0.54
100 x 2 x 0.8	0.875
200 x 2 x 0.8	1.79

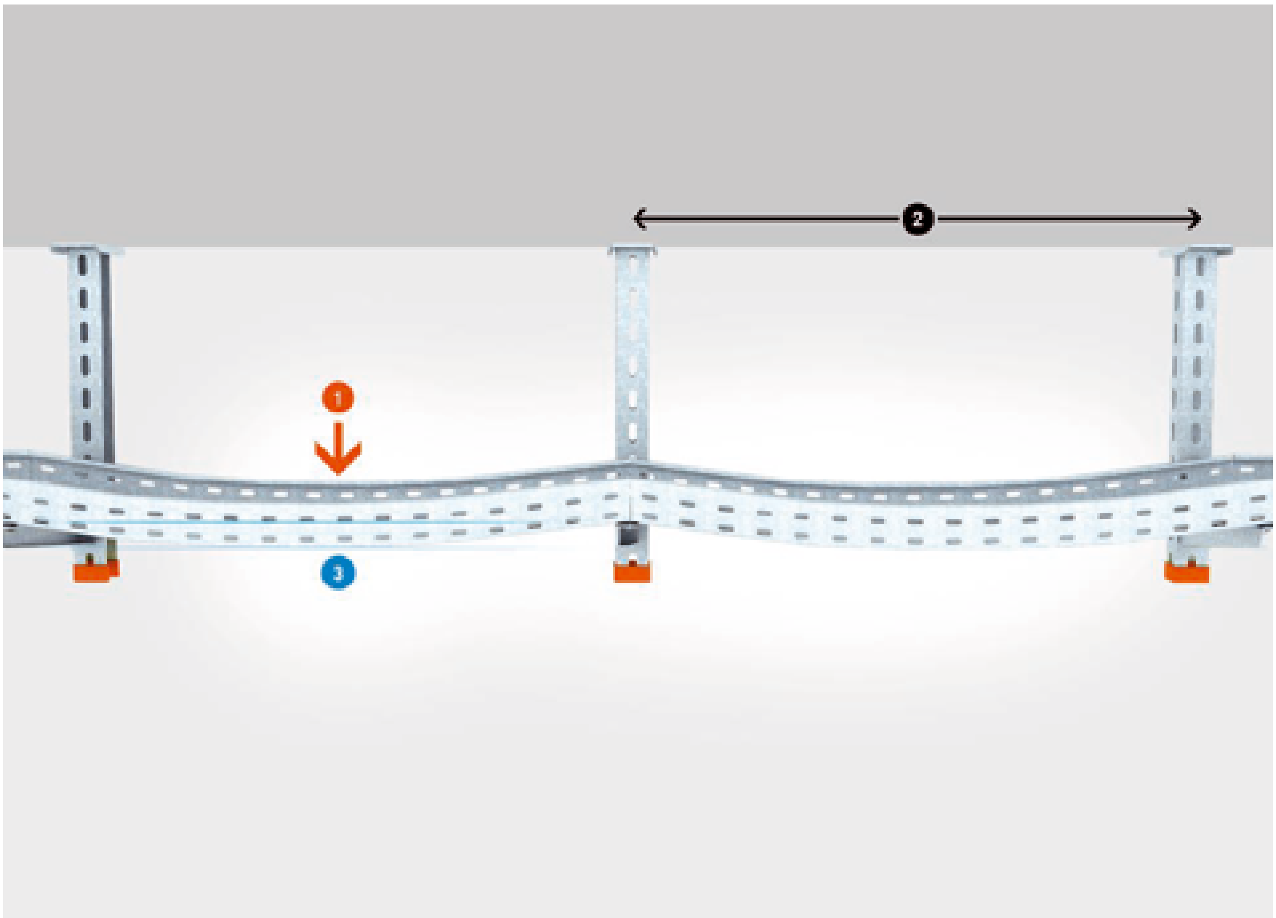
Coax cable (standard)

Type	Cable load kg/m
SAT/BK cable	0.06

IT cables type Cat...

Type	Cable load kg/m
Cat. 5	0.06
Cat. 6	0.06

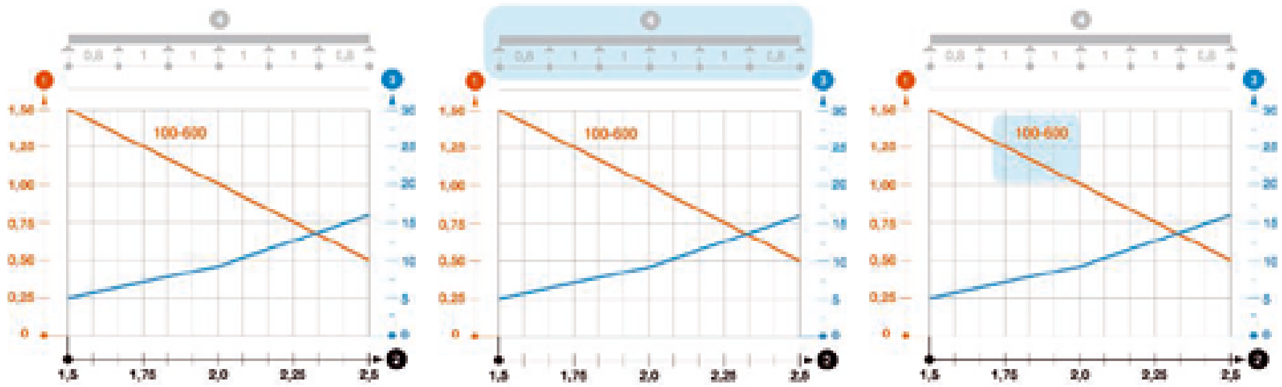
Finding the appropriate system for the cable load



Explanation of the pictograms: 1 = load in kN without man load, 2 = support width in m, 3 = strut bend in mm

Load tests for cable support systems
All OBO products and systems are subjected to practical load testing. The basic principles for the tests of OBO cable support systems are DIN EN 61537 and DIN VDE 0639. After the load test, the maximum load capacity can be determined for each component, depending on the support distances and specific article parameters, such as component dimensions. This is all shown in a chart, included with each component.
You can find additional information on the load tests for cable trays, brackets and suspended supports on the following pages. The values given do not take resistance against environmental forces such as snow, wind and other outside influences into account.

Finding the appropriate system for the cable load

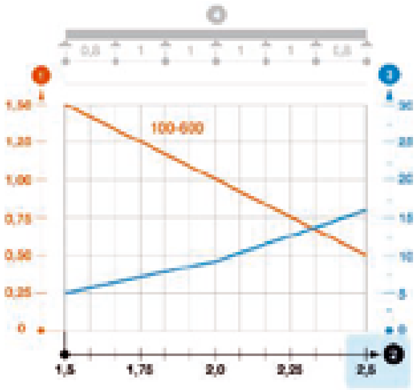


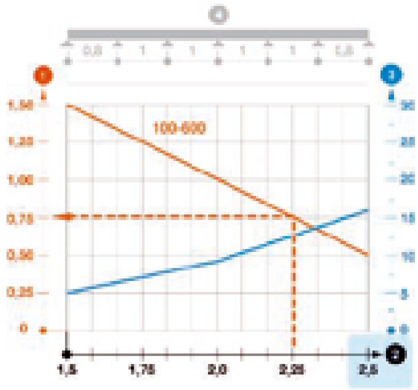
Load diagram, legend
1 = Load in kN/m
without human load
2 = Support width in m
3 = Strut bending in mm
4 = Schematic diagram
of the support widths during
the testing process
– = Approved load according to the support widths for the different tray widths
– = Rail bending according to support width

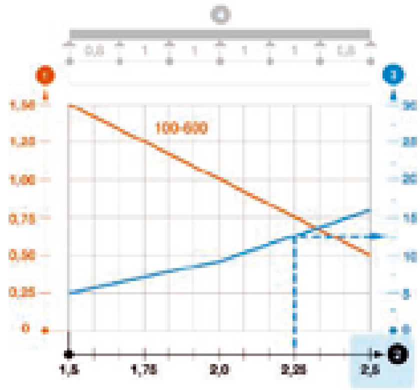
Information 1: The testing process
The basic principles of the tests of OBO cable support systems is VDE 0639 Part 1 and DIN EN 61537. The purpose of the tests is to determine the maximum load capacities for each component, depending on parameters such as component width, support spacing, etc., and to present this in a diagram to be included with each component. The area highlighted in blue in the above example schematises the experiment set-up with a variable support spacing (L) in the central area and a factor of 0.8 x L at the front and rear ends of the cable tray.

Information 2: Load curves for selected cable tray or cable ladder widths
The load capacity of the cable trays according to the support width can be read off in the diagram using the load curves – this is an example for a cable tray for the tray widths 100 to 600 mm. It may occur that in the load curves, width differences must be made, allowing multiple curves to be visible simultaneously in the diagram. A key factor for the load capacity of the cable trays is (in addotion to the support spacing and side height) the material thickness, which varies according to type.

Finding the appropriate system for the cable load







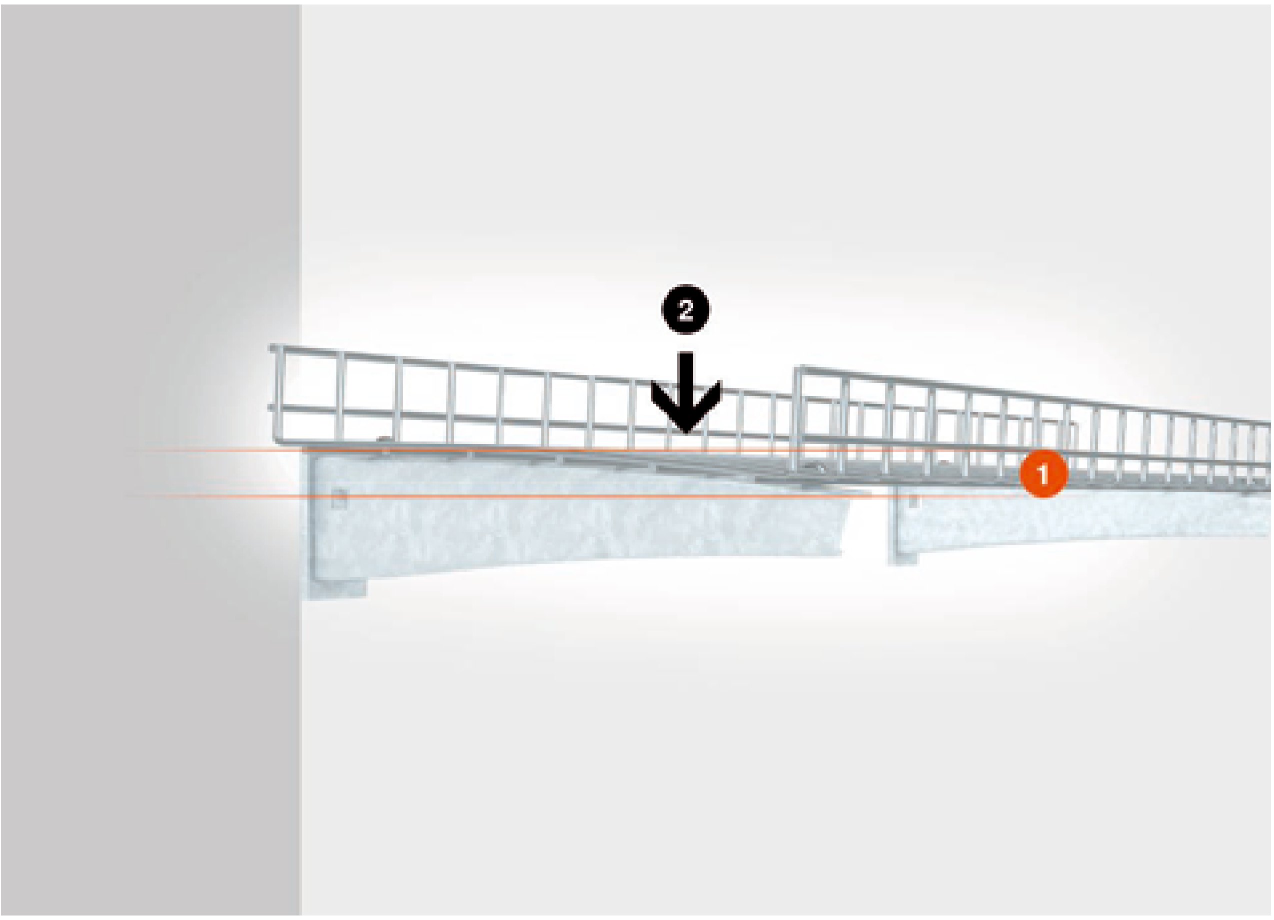
Information 3: Possible support spacings
The theoretically possible spans for the cable tray can be read off on the axis at the foot of the table. Using the load curves, it is easy to read off to what extent the load capacity of the system falls as the support spacing grows. On all OBO cable support systems (with the exception of the wide span trays), we recommend not exceeding a support spacing of 1.5 m, if possible.

Information 4: Ratio: load/span
Which load is possible at which support spacing? With the diagram, you can find the appropriate information at a glance. In our example (with the blue background), a span of 2.25 m for the tray produces a maximum load capacity of 0.75 kN for each running metre of cable tray. Please note that in this example, the volume of the cable tray may exceed the permitted load. Therefore if at all possible, do not exceed the support spacing of 1.5 m, as recommended by OBO.

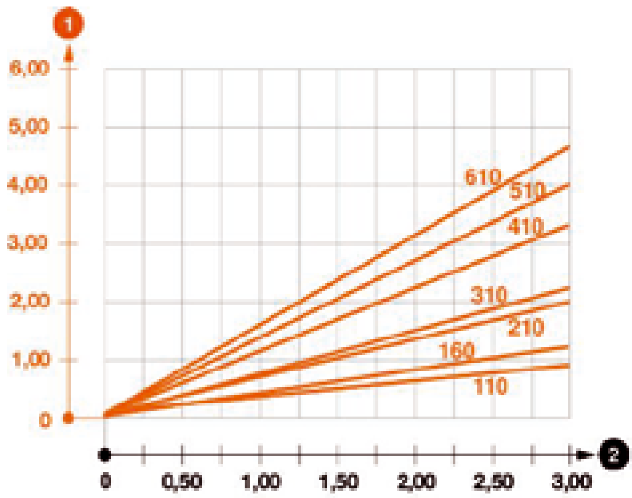
Information 5: W = Rail bending
To what extent does the load on a cable tray cause the rail to bend? This information is supplied by the blue curve (w) in millimetres (orientation values on the axis on the right-hand side of the diagram).

The course of the blue curve clearly shows how quickly the cable tray will sag as the support spacing increases. In our example, the bend at a support spacing of 2.25 m is shown, here approximately 12 mm.

Finding the appropriate bracket for the cable load

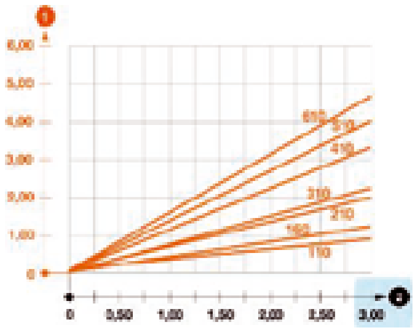


Key components of the OBO cable support systems are the parts for mounting, in particular the brackets and suspended supports. They connect the cable trays and ladders to the wall and to the ceiling, and are thus an important construction element of the overall system. When calculating the load capacity of a cable support system, the brackets and suspended supports must not be forgotten. The test diagram is also useful in selecting the right products.

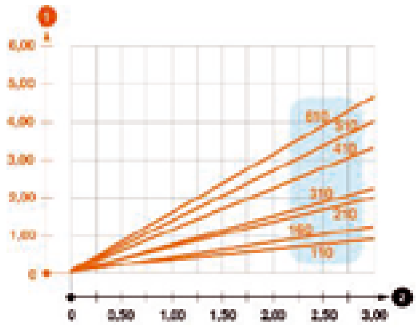


Load diagram, legend
1 = Bend in mm at the bracket tip
2 = Load without man load in kN/m
-- = Load curves for the different bracket lengths

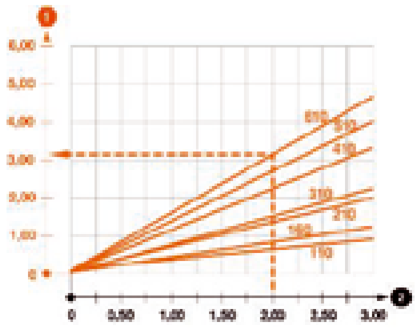
Finding the appropriate bracket for the cable load



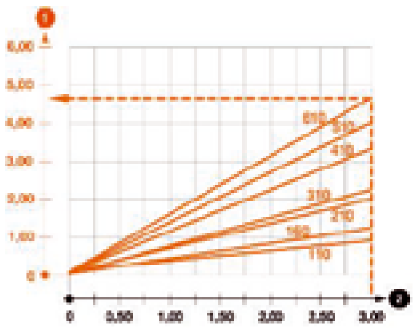
Information 1: Recommended maximum load of the brackets
The bracket is the part of the installation system upon which the cable tray or mesh cable tray is located. It is either directly connected to the wall or is connected to the ceiling using supports. The grey bar on the right edge of the diagram provides information on the maximum load capacity of the bracket.



Information 2: Load curves for all bracket widths
The bending of the bracket is dependent on its width, which in our example, can range from 110 mm to 610 mm. The load curves are assigned to the appropriate bracket type.

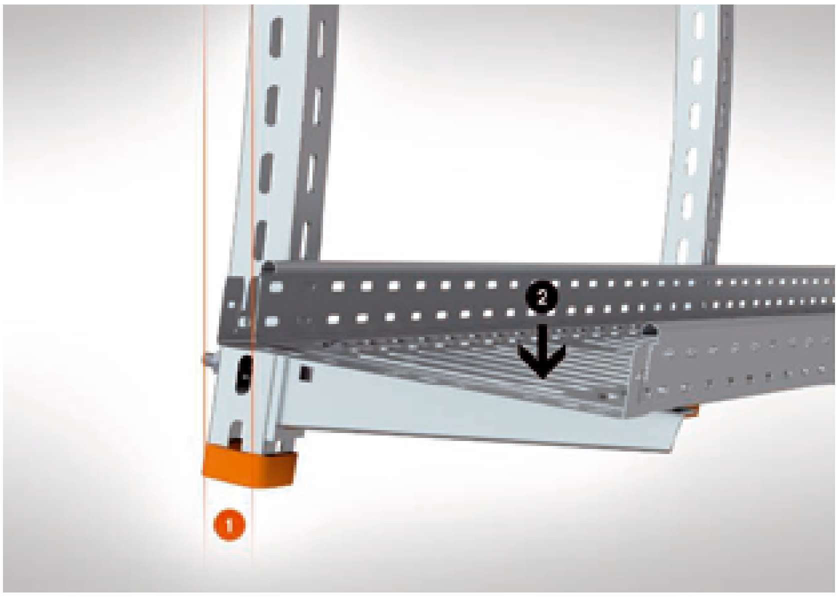


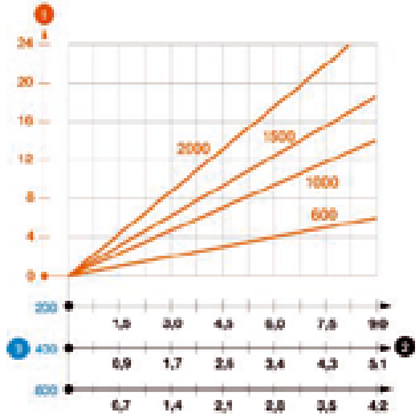
Information 3: Bending of the bracket tip at a specific load
The load curve in the diagram provides information on the bending of the boom tip at a specific load. In our example (dotted orange line), a 610 mm-wide bracket with a load of 2 kN bends by approx. 3.1 mm. A basic rule of thumb is: The shorter the bracket, the less the bend will be.



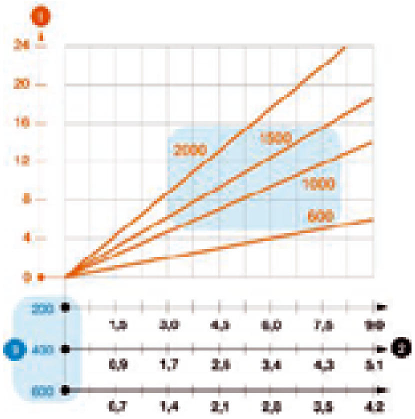
Information 4: Bending of the bracket tip at maximum load
The bending factor of the bracket at maximum load can also be seen in the diagram. In our example (shown in orange), the bend value for a 610 mm-wide bracket at a maximum load of approx. 3.0 kN is approximately 4.5 mm. To minimise the bend, the centre of gravity of the cable load should be as close as possible to the wall or the support fastening.

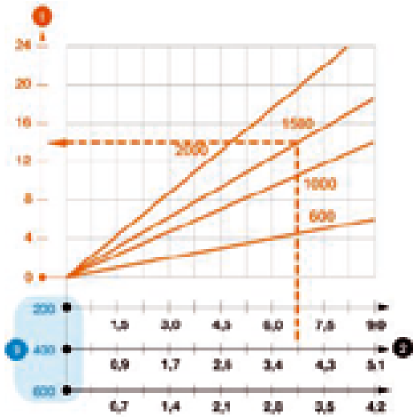
Finding the appropriate support for the cable load

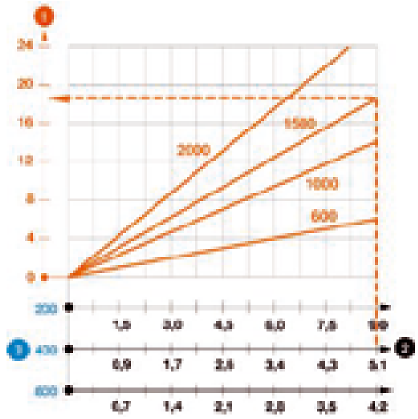




Load diagram, legend
1 = Bend in mm at the bracket tip
2 = Load without man loadin kN/m
-- = Load curves for the different bracket lengths





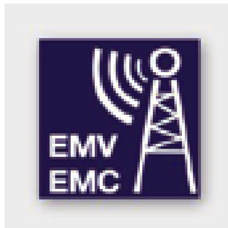


Information 1: Various support lengths and bracket widths
The load capacity of a cable support system is not just dependent on the width of a bracket, but also on the length of a suspended support. The load curves in the diagram provide information on the load capacity of a suspended support of length 600, 1,000, 1,500 or 2,000 mm, taking the bracket width into account.

Information 2: Calculation of the deflection for the example
The weight of the total suspended support/bracket/cable tray system causes an excursion of the suspended support from the vertical. The excursion value can be read off from the axis on the left edge of the diagram. In our example (blue background), a 1,500 mm-long suspended support, together with a 400 mm-wide bracket and a weight load of 4 kN at the end of the support, will produce an excursion of approximately 14 mm.

Information 3: Calculation of the excursion at maximum load for the example
The excursion of the suspended support at a maximum load can also be read off on the diagram. Our blue example shows an excursion of roughly 18 mm at the end of the support for a 1,500 mm-long suspended support, in combination with a 400 mm-wide bracket at a maximum cable load of approximately 5 kN.

Definition of electromagnetic compatibility (EMC)



Recent years have seen the use of electronic circuits increase continually. Whether in industrial systems, medicine, households, telecommunications systems, vehicles or electrical building installations – we find powerful electrical equipment and systems everywhere, and these switch ever greater currents, achieve greater radio ranges and transport ever more power in smaller spaces.

However, the use of state-of-the-art technology means that the complexity of applications also increases. The consequence of this is that ever more opposing influences (electromagnetic interferences) can occur from system parts and cables, causing damage and economic losses.

Here, we talk of electromagnetic compatibility. Electromagnetic compatibility (EMC) is the ability of an electrical unit to function satisfactorily in its electromagnetic environment, without inappropriately influencing this environment, to which other units also belong (VDE 0870-1). In terms of standardisation, electromagnetic compatibility is dealt with by the EMC Directive 2004/108/EC. This means that electrical resources emit electromagnetic interferences (emissions), which are picked up by other devices or units (immission) that act as receivers (interference sink). This in turn means that the function of an interference sink can be severely reduced and, in the worst-case scenario, total failure and economic losses. The interferences can then spread along cables or in the form of electromagnetic waves.

Path of faults

Fault source (transmitting emissions)	Coupling of interference variables (spreading of interference)	Fault sink (receiving emissions)
For example - Mobile telephones - Switching components - Ignition systems - Frequency converters	- Galvanic - Inductive - Capacitive - Electromagnetic	- Process computer - Radio receiver systems - Controllers - Converters

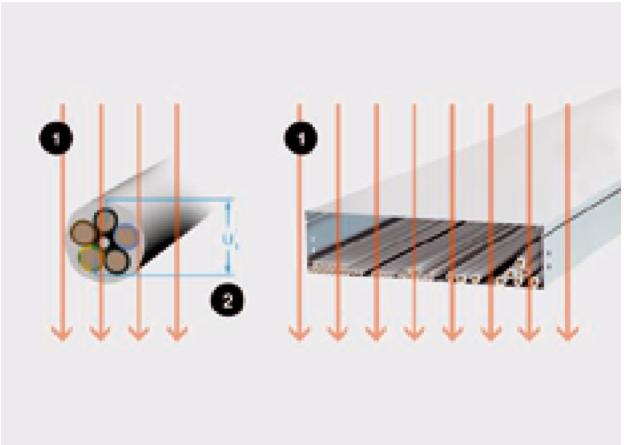
Guarantee of EMC

Guaranteeing EMC
A systematic planning process is necessary to guarantee EMC. The interference sources must be identified and quantified. The coupling describes the spread of the interference from the interference source up to the device being influenced, the interference sink. The task of EMC planning is to ensure the compatibility at the source, coupling path and sink using suitable measures. During their daily work, planners and installation engineers are confronted with this subject on an increasingly regular basis. This means that EMC is a basic factor to be taken into consideration during the planning of installations and cabling systems.
Due to the high complexity of electromagnetic compatibility, the problems of EMC must be analysed and solved using simplifying hypotheses and models, as well as experiments and measurements.

Cable support systems and their contribution to EMC
Cable support systems can make an important contribution to the improvement of EMC. They are passive and can thus make a safe, long-lasting contribution to EMC through the fact that cables are run within cable support systems or are shielded by them. Routing cables inside cable support systems greatly reduces the galvanic decoupling and coupling due to electrical and magnetic fields in the cables. Thus cable support systems can make a contribution to the reduction of coupling from the source to the sink. The shielding action of cable support systems can be quantified by the coupling resistance and the shield attenuation. This gives the planner important engineering parameters for cable support systems for EMC engineering.

Lightning discharge
From the analysis of the effectiveness of EMC in buildings (EN 62305-4), we know that lightning discharge is one of the greatest sources of interference to be expected. This causes a direct current feed into the entire equipotential bonding system in the building and/or to magnetic decoupling of interference currents in electrical cables. With regard to these couplings, cable support systems can offer an effective contribution to the reduction of interference voltages.

Magnetic shield insulation of cable support systems



The magnetic field (H) of strength 3 kA/m in a defined experimental set-up: without cable support system on the left, with cable support system on the right. 1 = Field H, 2 = V1 L_{zuPE}

The magnetic shield insulation of cable support systems is the ratio in decibels (dB) of an induced voltage into an unprotected cable to the induced voltage into the same cable, when this is in a cable support system.

Experimental structure to determine the magnetic shield insulation of cable support systems:
An unshielded cable (NYM-J 5x6 mm²) is subjected to an 8/20 magnetic field with a strength of 3 kA/m. Here, the induced voltage V1 is measured in the unshielded cable. The same cable is then positioned in the centre of a cable support system (once with a cover, once without) and subjected to the same magnetic field of 3 kA/m. Here, the induced voltage V2 is measured in the unshielded cable. The magnetic shield insulation is calculated from the measured values according to the formula:

$\alpha_S = 20 \log (V1/V2)$ dB

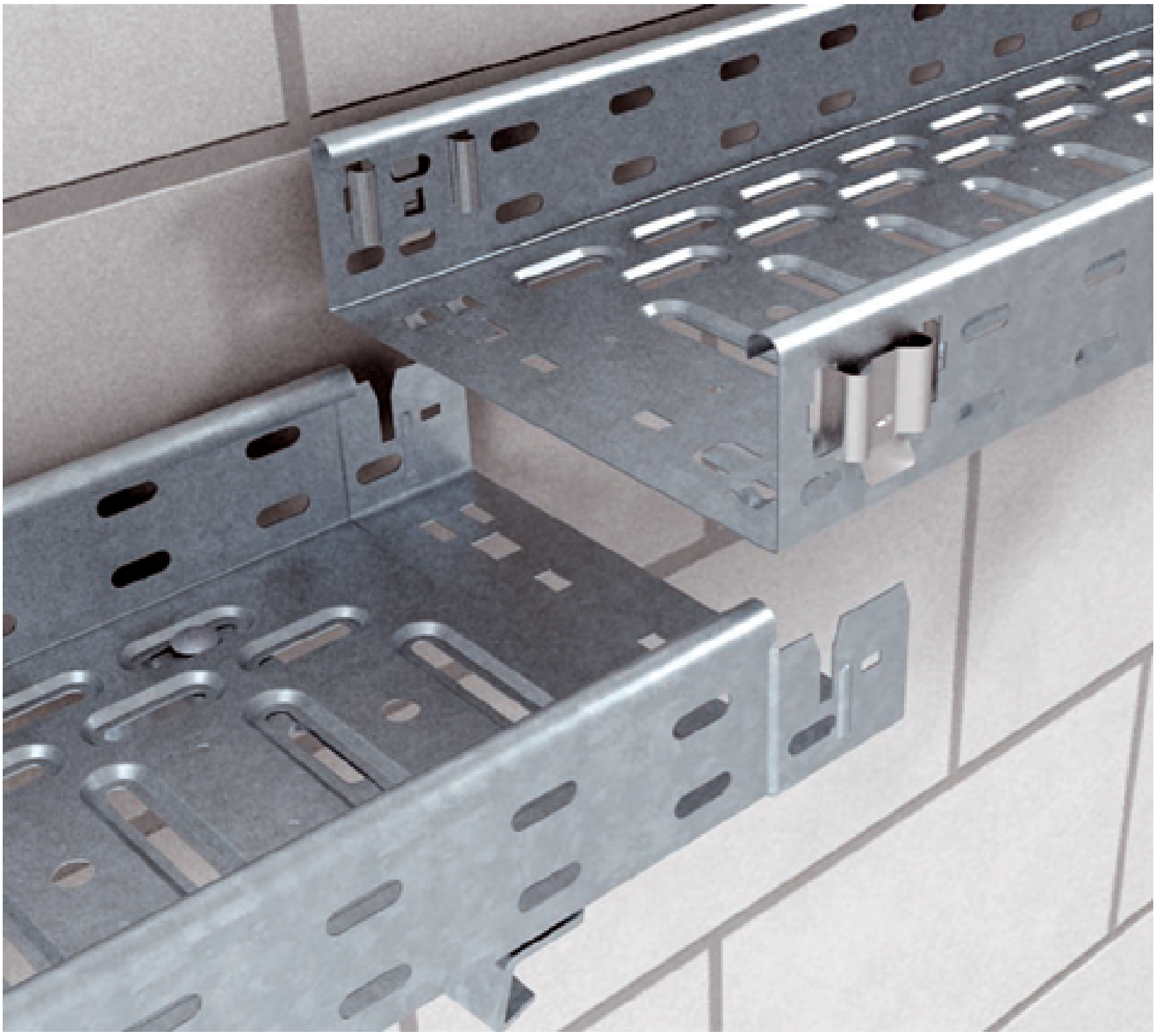
Experiment result:
The magnetic shield effect αS of a cable support system could be clearly proved by the experiments and the simulation with an FEM program.
The best result of around 50 dB was achieved with cable support systems (cable trays) with covers.

Note:
The shield insulation against electrical fields is almost perfect, as it is with a Faraday cage.

Magnetic shield insulation 8/20 dB

Type, cable tray/cable ladder	Without cover	With cover
RKSM 630 FS	20	50
MKS 630 FS	20	50
MKS 630 FT	20	50
MKSU 630 FS	20	50
MKSU 630 FT	20	50
MKSU 630 VA	20	50

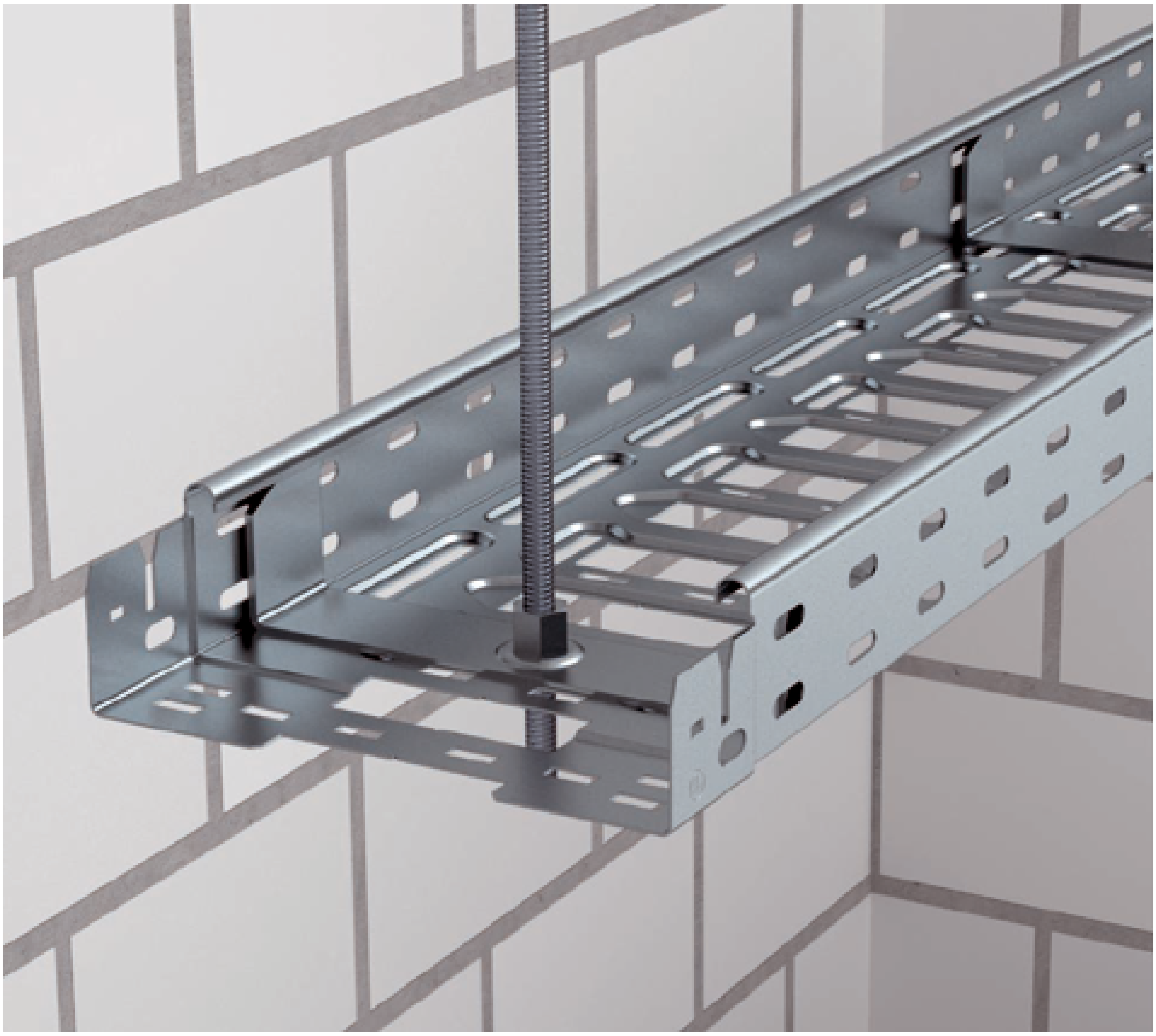
System description



The RKS-Magic® cable tray system permits particularly fast straight connection of the cable trays. The innovative, screwless straight connector can be mounted in the blink of an eye. Just connect the ends of the cable tray, lock them in place – and you‘re done! The long-lasting, static straight connectors can be permanently stabilised by bending the connection flaps. The RKS-Magic® cable tray is available with the side heights 35 and 60 mm. A comprehensive range of fittings with bends (45° and 90°), T branch pieces, add-on tees and cross-overs completes the system. Also 90° bends and adjustable bends (rising/falling) are available for vertical changes of direction.

When mounting fittings, always plan additional supports. Besides the various fittings, the system also includes all types of connectors (straight, angle and adjustable connectors) and additional accessories such as barrier strips, joint plates, mounting plates and covers.
You can find detailed mounting examples and article descriptions on the following pages. The RKS-Magic® cable tray is tested for routing with the maintenance of electrical function. You can find comprehensive information on this in our new Safety and protective installations product catalogue.

System description

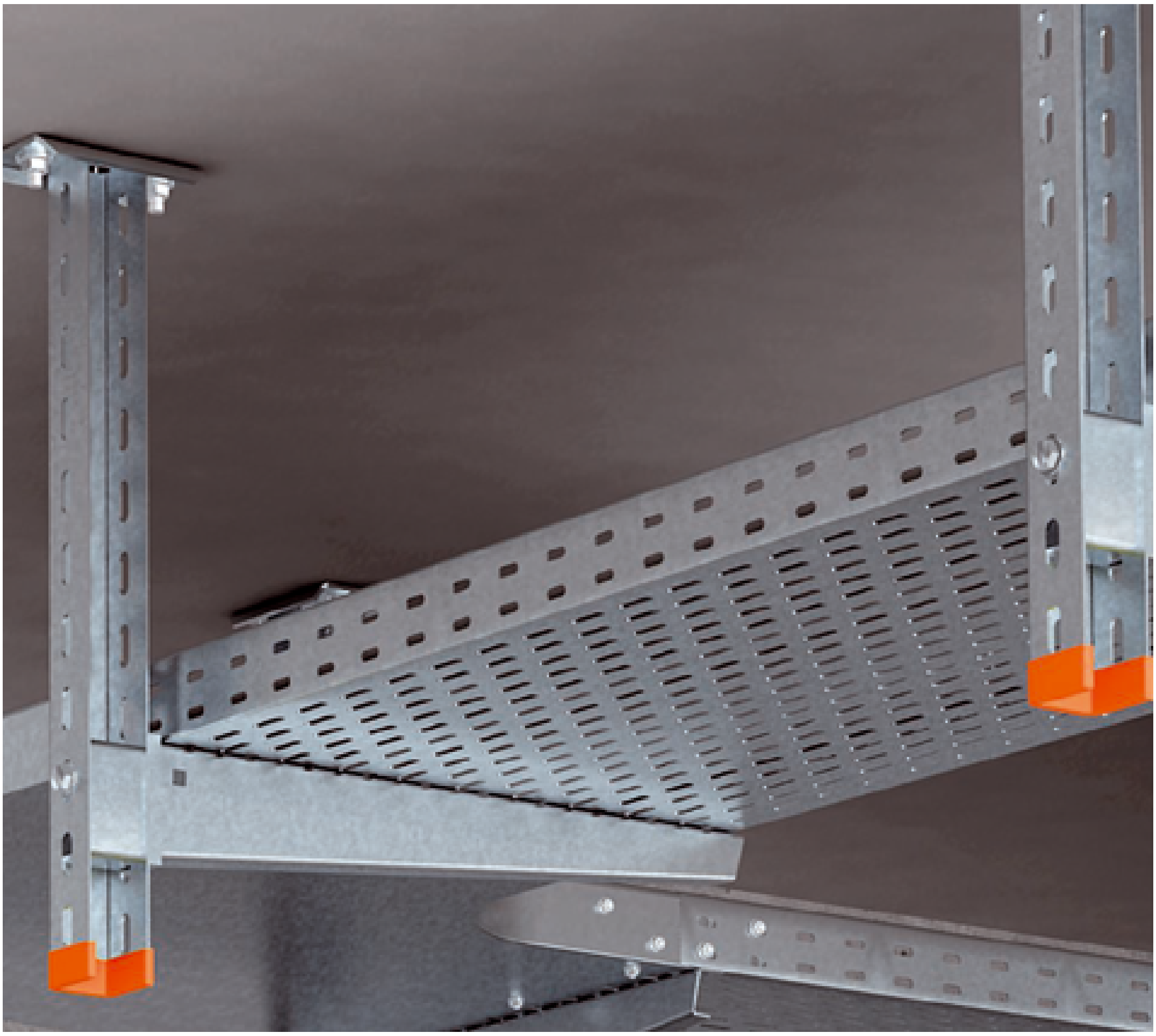


The cable tray is suitable for universal cable routing. From low-voltage cabling to power supplies, from data cables to telecommunications networks. A full product range, with suitable system components, can create perfect solutions for any task. No matter whether used in dry inner areas or in aggressive atmospheres: Different surface versions and materials ensure safe corrosion protection. Side heights of 60, 85 and 110 mm are available. Due to the high hole proportion of 30% and more, the perforated cable trays MKSM and SKSM of widths of 200 mm or greater are ideally suited for use beneath sprinkler systems. The IKSM cable tray also has large openings in the side rail, which can be used for cable entries or exits.

The complete system is supplemented by connectable, screwless fittings with Magic connection. The system also includes all types of connectors and additional accessories such as barrier strips, joint plates, mounting plates and covers.

You can find detailed mounting examples and article descriptions on the following pages.

System description

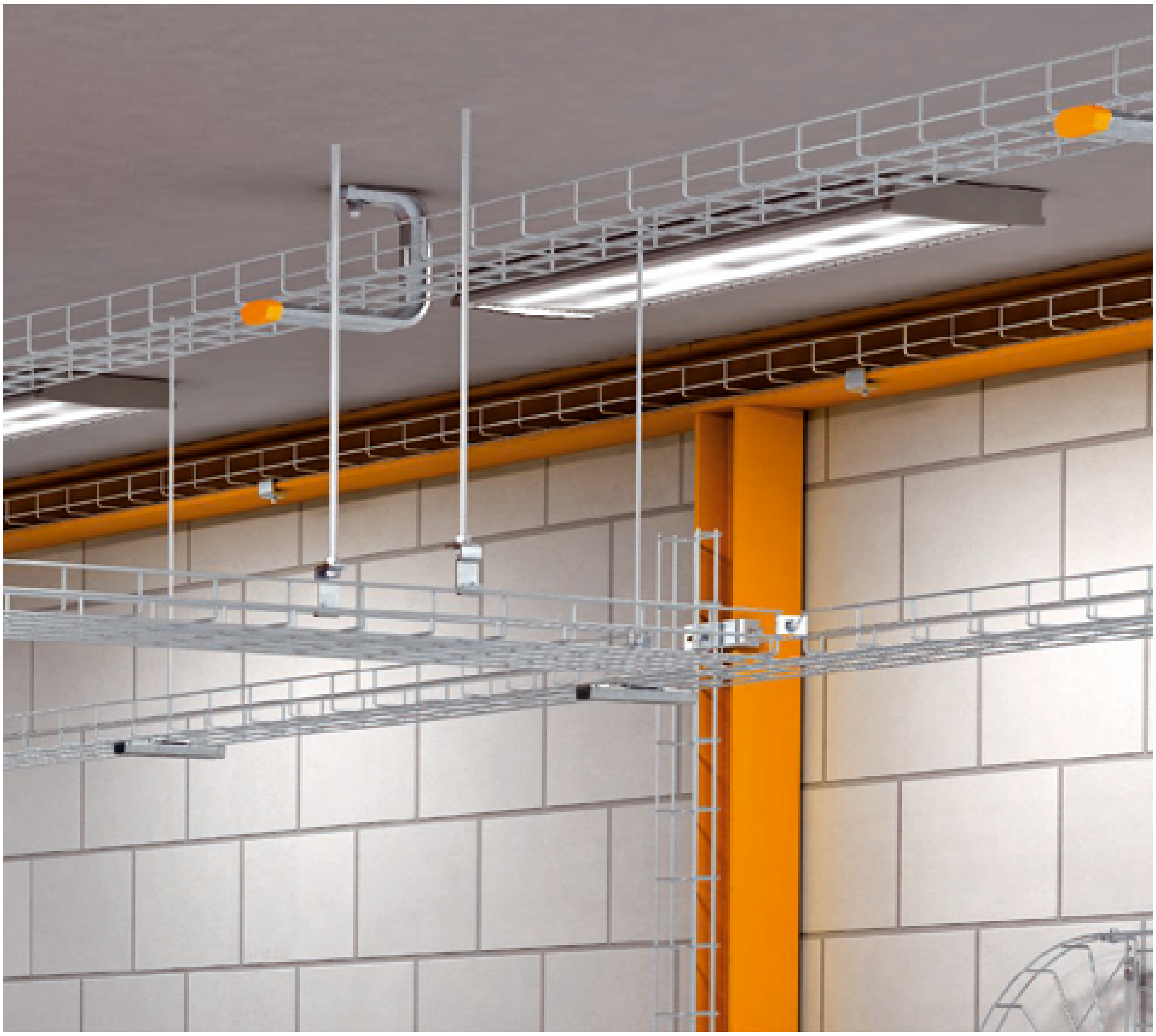


The cable tray is suitable for universal cable routing. From low-voltage cabling to power supplies, from data cables to telecommunications networks. A full product range, with suitable system components, can create perfect solutions for any task. No matter whether used in dry inner areas or in aggressive atmospheres: Different surface versions and materials ensure safe corrosion protection. Side heights of 35, 60, 85 and 110 mm up to the special cable tray systems DKS and IKS with 30% perforations and large entries and exits are available.
When mounting fittings, always plan additional supports.
Besides the various fittings, the system also includes all types of connectors and additional accessories such as barrier strips, joint plates, mounting plates and covers.
You can find detailed mounting examples and article descriptions on the following pages.

System description

When you need to bridge wide spans and support high cable loads, the OBO wide span cable trays are the perfect solution. The product range comprises cable trays with widths of between 200 and 600 mm and side heights of 110 to 160 mm. Comprehensive system accessories, such as fittings and all the fastening materials for concrete and steel mounting, round off this product range perfectly. OBO wide span cable trays have proven their worth in many areas of industrial and systems engineering. These systems are becoming ever-more popular in buildings with a steel framework. OBO wide span cable trays are the complete product range for all applications and requirements and, with their large load capacity combined with large spans, provide efficient and optimised power supply.

System description



OBO Bettermann's mesh cable tray systems are the ideal basis for quick, safe and economical cable routing in all areas of professional electrical installations. The GR-Magic mesh cable tray system with shaped connector for screwless quick mounting guarantees the shortest possible installation times, even for complex mounting operations. The mesh cable trays are available with side heights of 35, 55 and 105 mm in the versions electro-galvanised, hot-dip galvanised and rustproof stainless steel. The comprehensive range of practical accessories, such as mesh cable tray bends, hold-down clamps, quick connectors, barrier strips, suspension profiles, brackets, etc., ensures that the product range is complete down to the smallest detail.

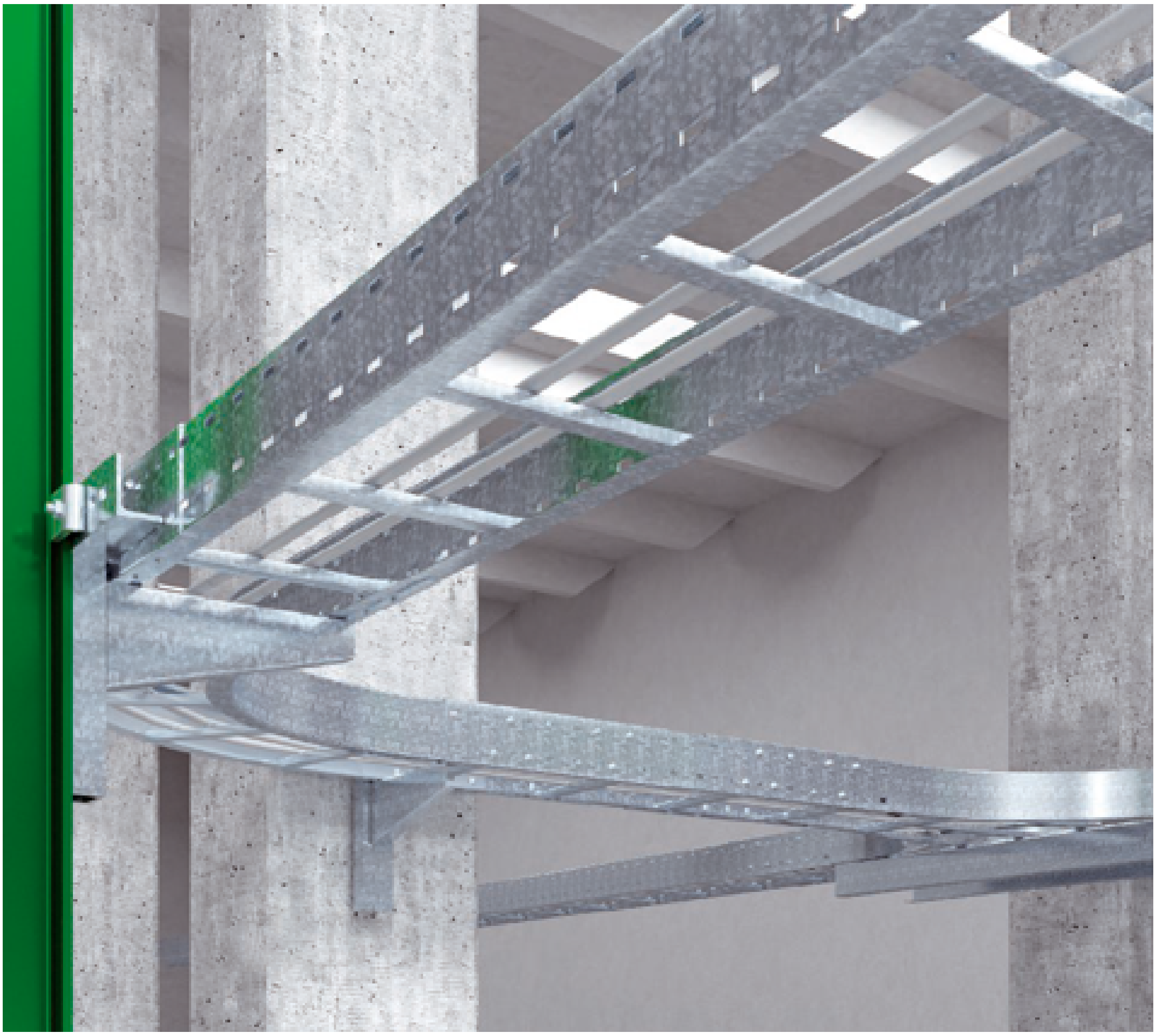
System description

The high load capacity and good ventilation of the OBO cable ladder systems can offer tangible benefits, in particular during the installation of power cables. OBO Bettermann's cable ladder systems can be used universally and, due to the continuous rail and rung perforation, offer countless installation benefits. A factor guaranteeing easy mounting is the option of the integrated fastening of cables using OBO clamp clips on the rungs, which are available in various different versions. OBO cable ladder systems are shipped partly folded up, thus saving space during transport and storage. OBO cable ladder systems can be supplied in lengths of 3 and 6 m, in all standard widths from 200 to 600 mm and with rail heights of 45, 60 and 110 mm. On the following pages, you can select your preferred mounting variant from the installation diagrams shown and combine the corresponding articles in the order section.

System description

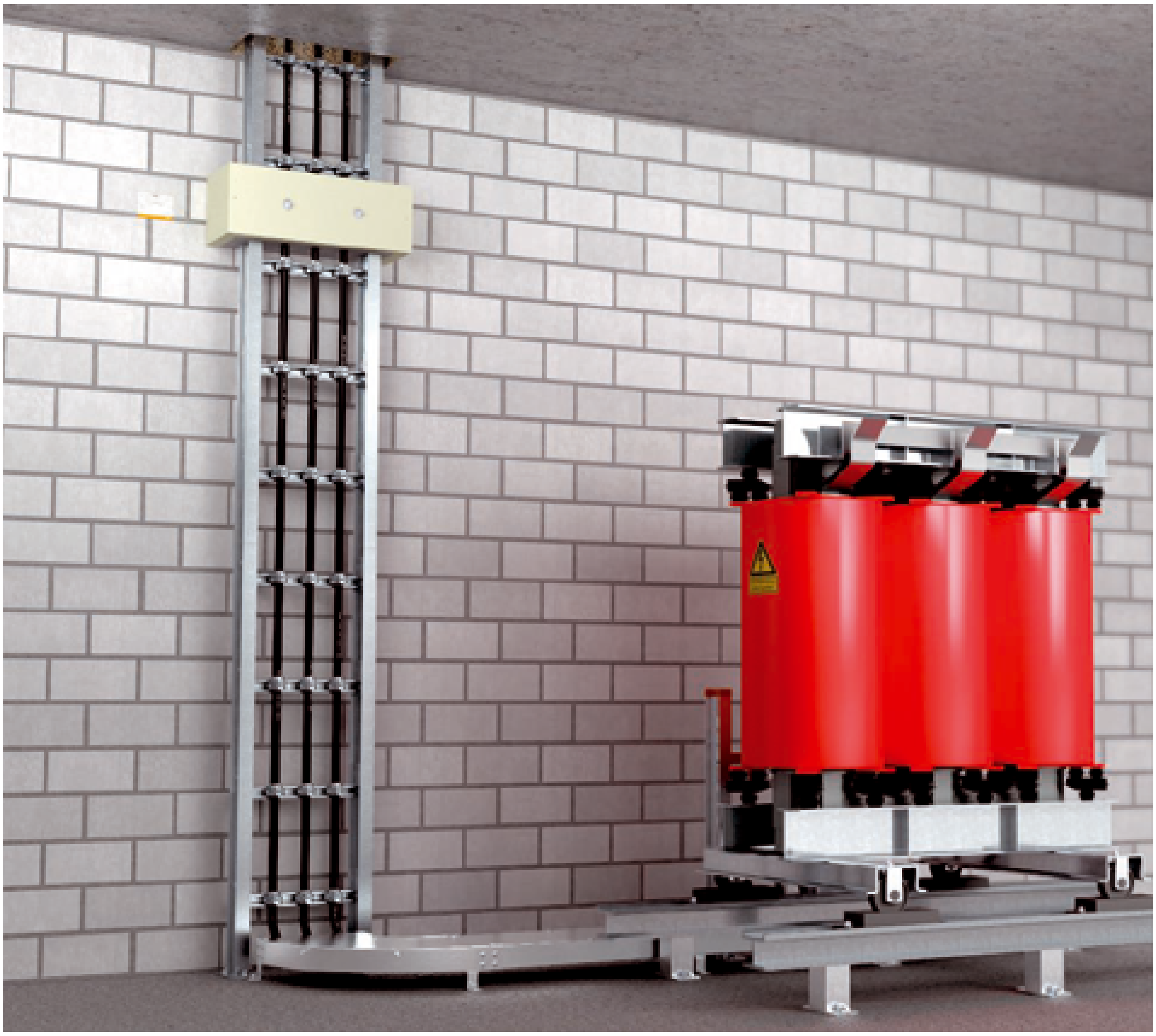
The high load capacity and good ventilation of the OBO cable ladder systems can offer tangible benefits, in particular during the installation of power cables. OBO Bettermann's cable ladder systems can be used universally and, due to the continuous rail and rung perforation, offer countless installation benefits. A factor guaranteeing easy mounting is the option of the integrated fastening of cables using OBO clamp clips on the rungs, which are available in various different versions. OBO cable ladder systems are shipped partly folded up, thus saving space during transport and storage. OBO cable ladder systems can be supplied in lengths of 3 and 6 m, in all standard widths from 200 to 600 mm and with rail heights of 45, 60 and 110 mm. On the following pages, you can select your preferred mounting variant from the installation diagrams shown and combine the corresponding articles in the order section.

System description



When you need to bridge wide spans and support high cable loads, the OBO wide span cable ladders are the perfect solution. The product range comprises wide span cable ladders with widths of between 200 and 600 mm and side heights of 110 to 160 mm. Comprehensive system accessories, such as fittings and all the fastening materials for concrete and steel mounting, round off this product range perfectly. OBO wide span cable ladders have proven their worth in many areas of industrial and systems engineering. These systems are becoming evermore popular in buildings with a steel framework. OBO wide span cable ladders offer a complete product range for all applications and requirements and, with their large load capacity combined with large spans, provide efficient and optimised power supply.

System description



OBO vertical ladder systems for vertical routing of all kinds of cables. Available as light-duty vertical ladders with a side height of 45 mm, as a heavy-duty vertical ladder with U profiles and as industrial vertical ladders with I profiles. Both the heavy-duty and industrial vertical ladders can be assembled in variable lengths. The side rails are standard profiles of type US 5 and IS 8, which are connected using the appropriate rungs. The continuous rail perforation of the system and the comprehensive accessories simplify and accelerate installation, which can take place either directly on the wall, clamped to a steel construction or also as a free-standing construction. The system is perfectly complemented with OBO clamp clips.

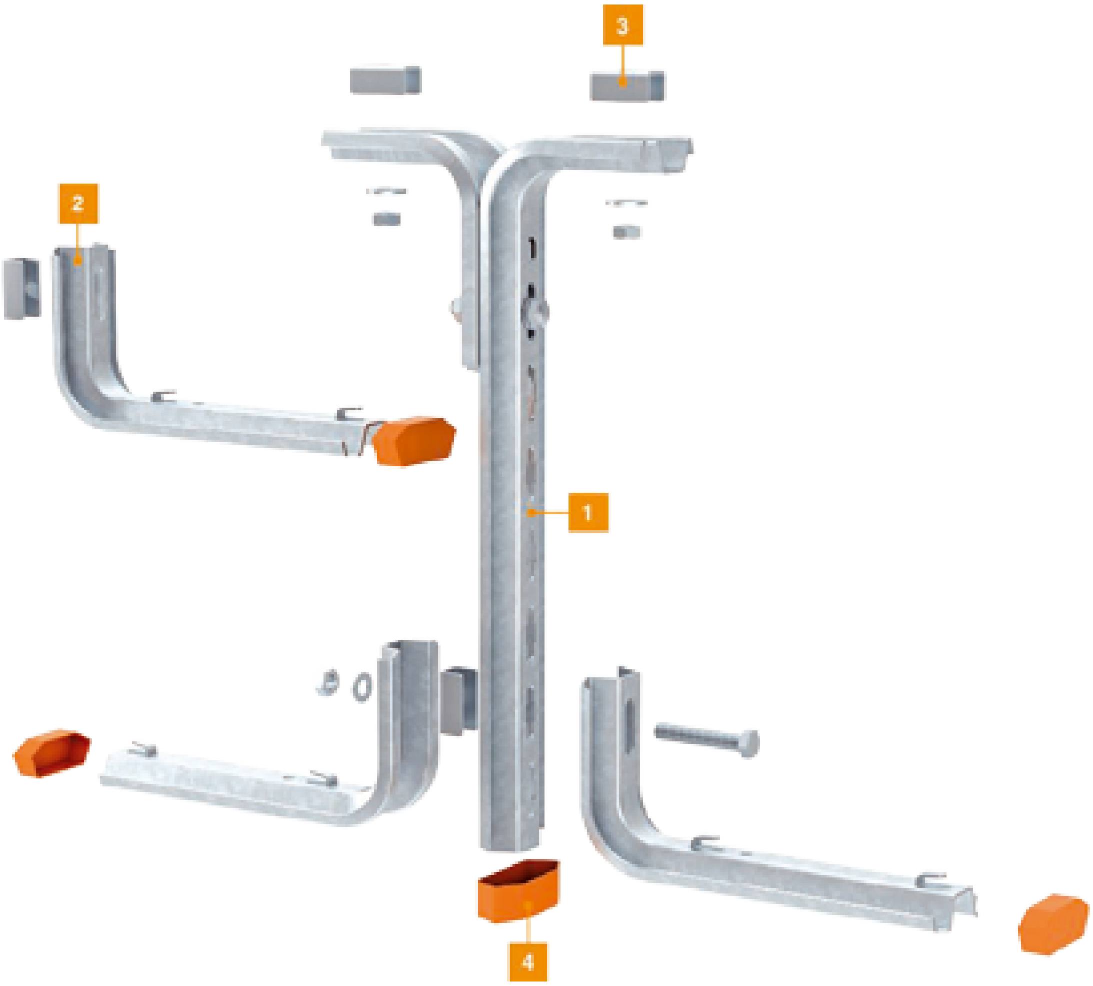
System description

TP supports and brackets

The TP system is a range of light supports and brackets. This product range, which consists of TP suspended supports and brackets, can be used universally as ceiling and wall mounting.

Installation principle

TP supports and brackets



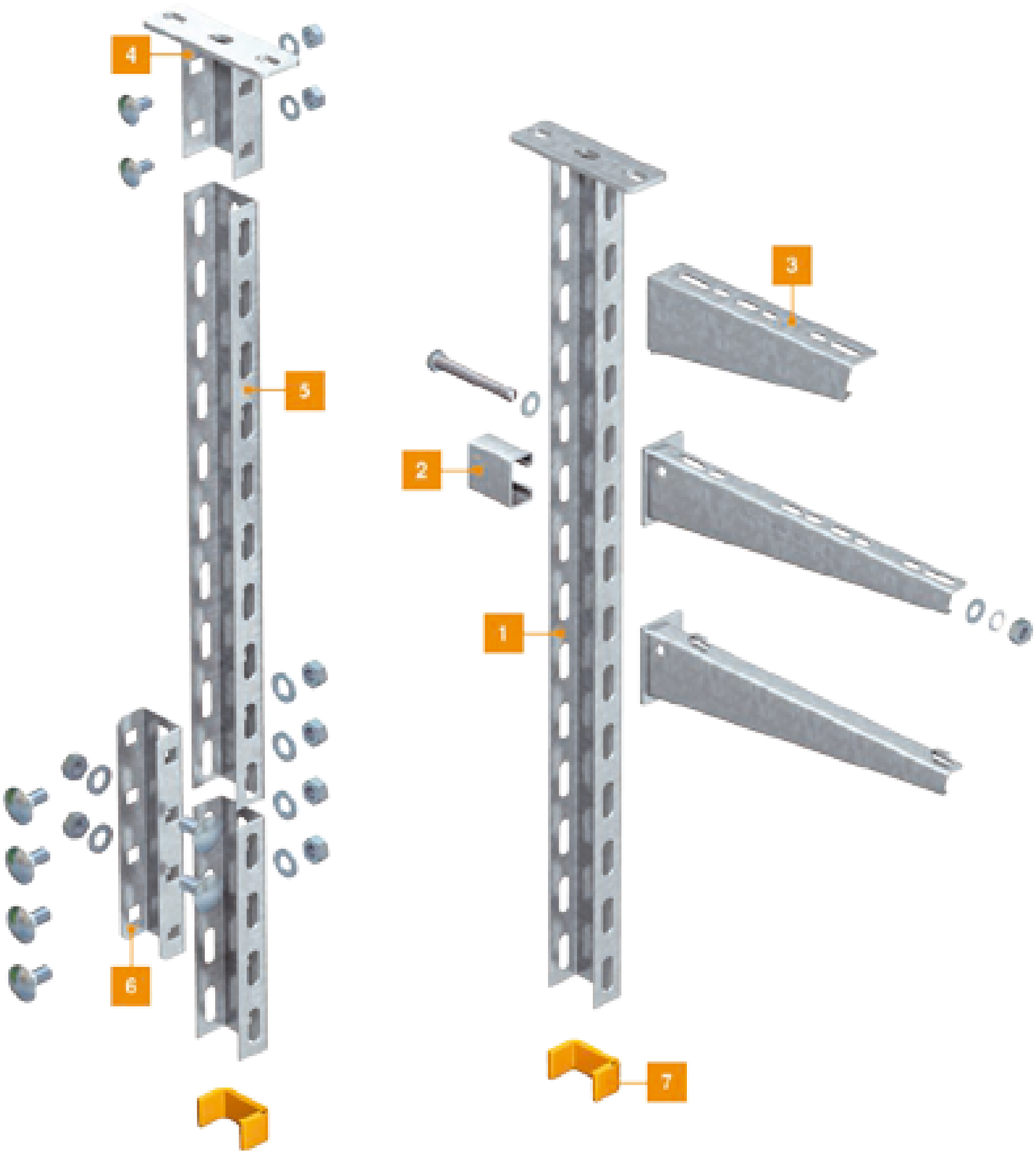
1	TP suspended support
2	TP support/wall and support brackets
3	Spacer
4	End cap

System description

U supports and brackets

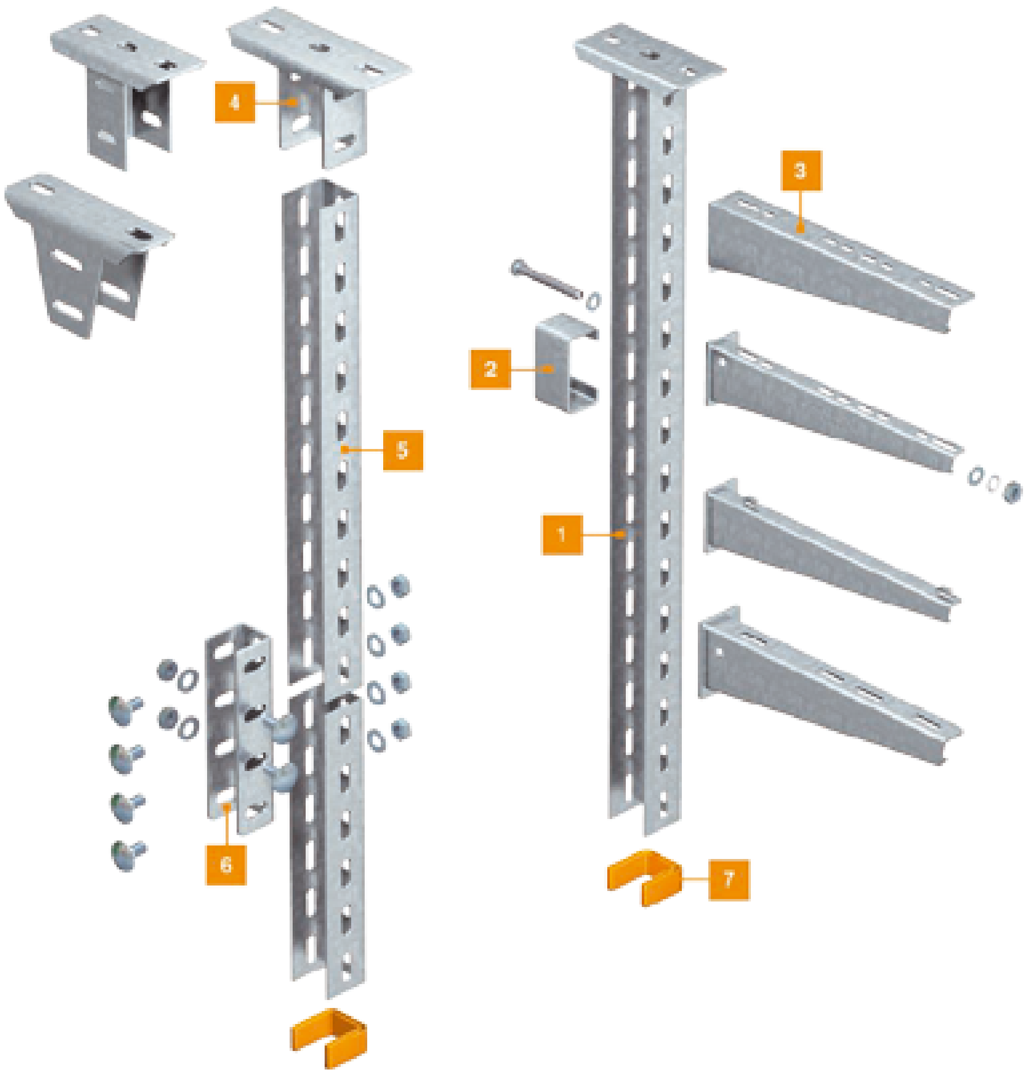
The perfectly matched U support family consists of US 3 (light-duty system), US 5 (medium-duty system) and US 7 (heavy-duty system). The U support range is particularly noted for its versatility. The U supports can be used as ceiling suspension, floor stand-off or as construction profiles.

Installation principle
US 3 U support



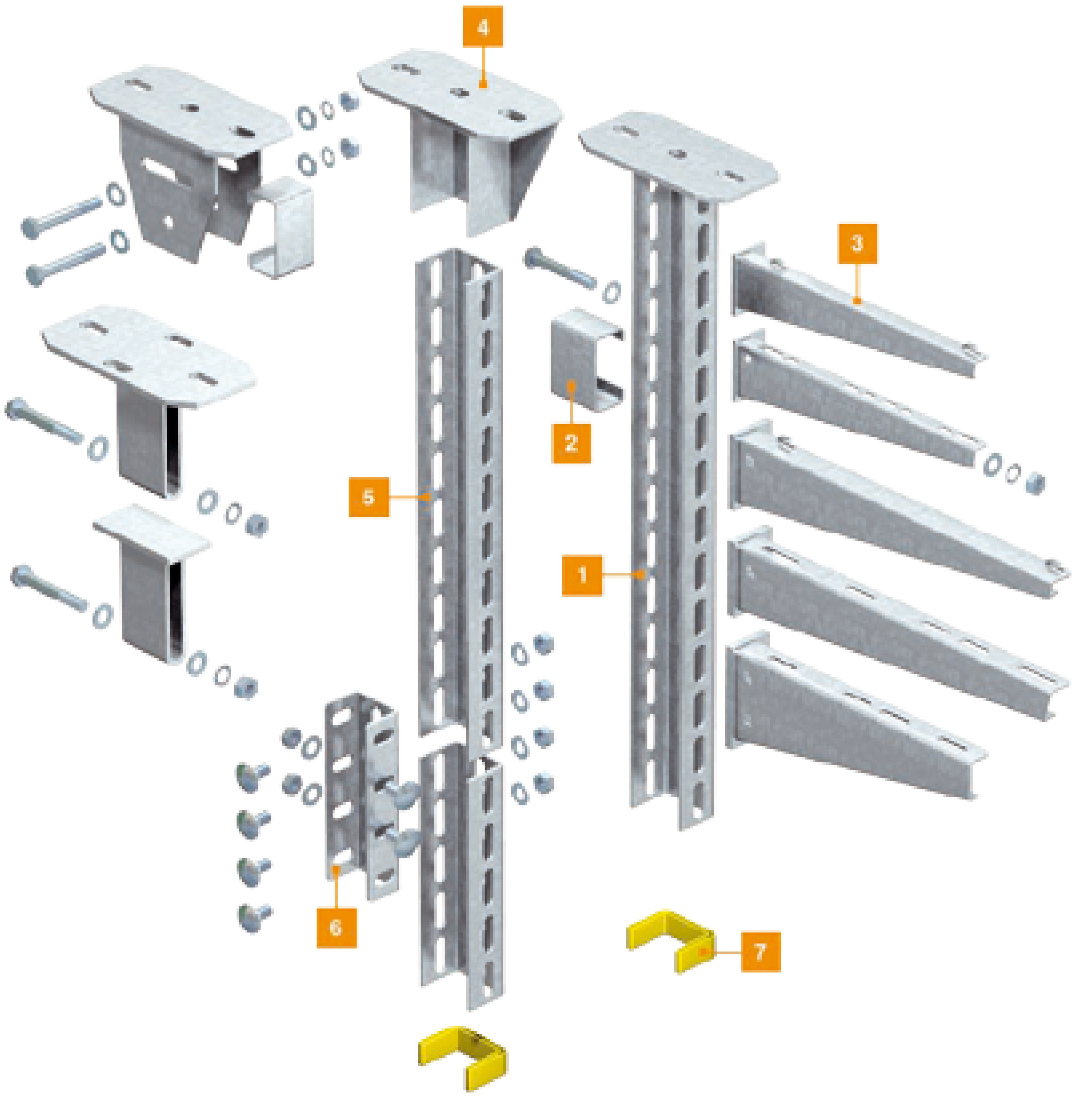
1	US 3 suspended support
2	Spacer
3	Wall and support bracket
4	Head plate
5	US 3 support
6	U support connector
7	End cap

Installation principle
US 5 U support



1	US 5 hanging support
2	Spacer
3	Wall and support bracket
4	Head plate
5	US 5 support
6	U support connector
7	End cap

Installation principle
US 7 U support



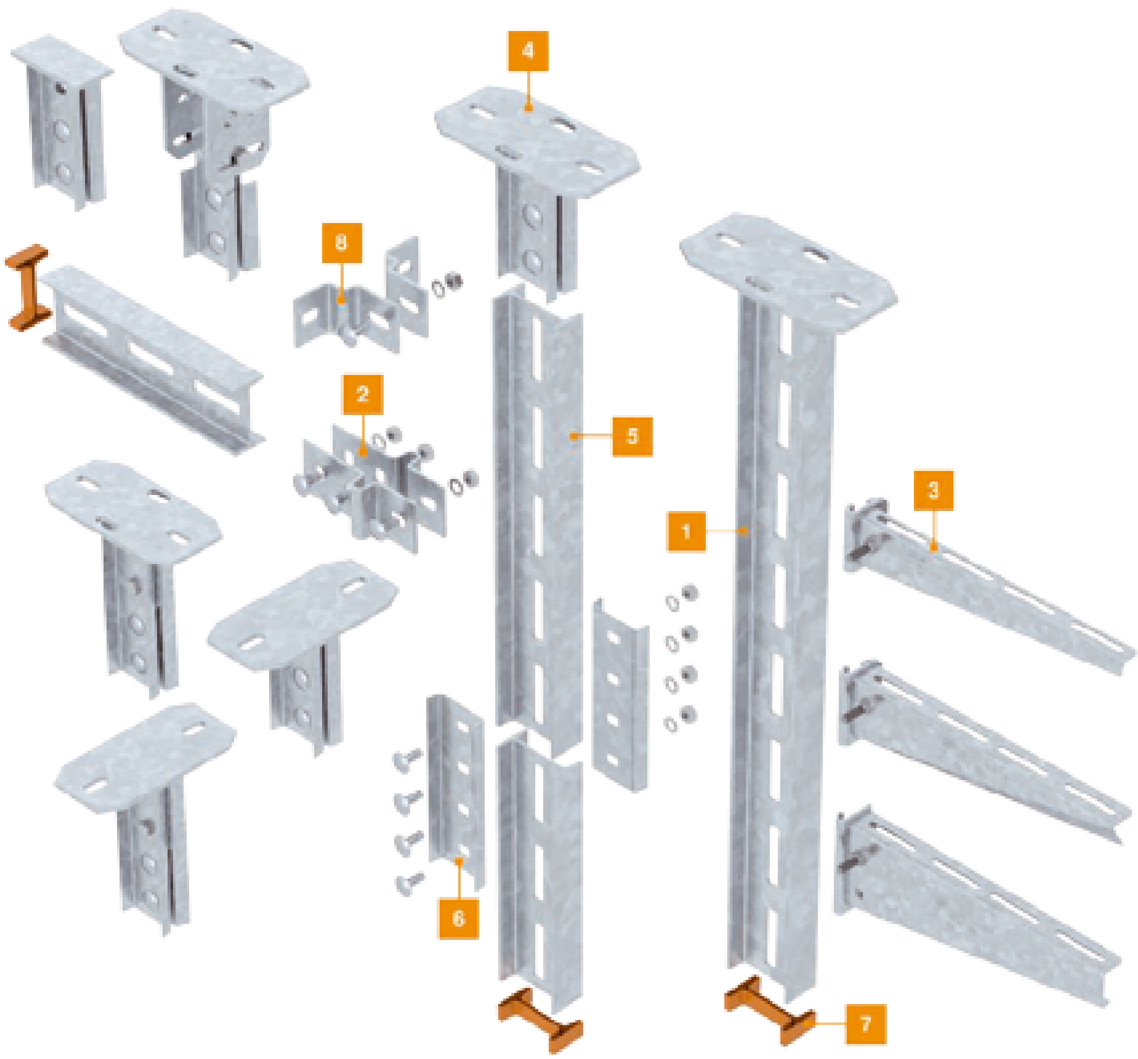
1	US 7 hanging support
2	Spacer
3	Wall and support bracket
4	Head plate
5	US 7 support
6	U support connector
7	End cap

System description

I supports and brackets

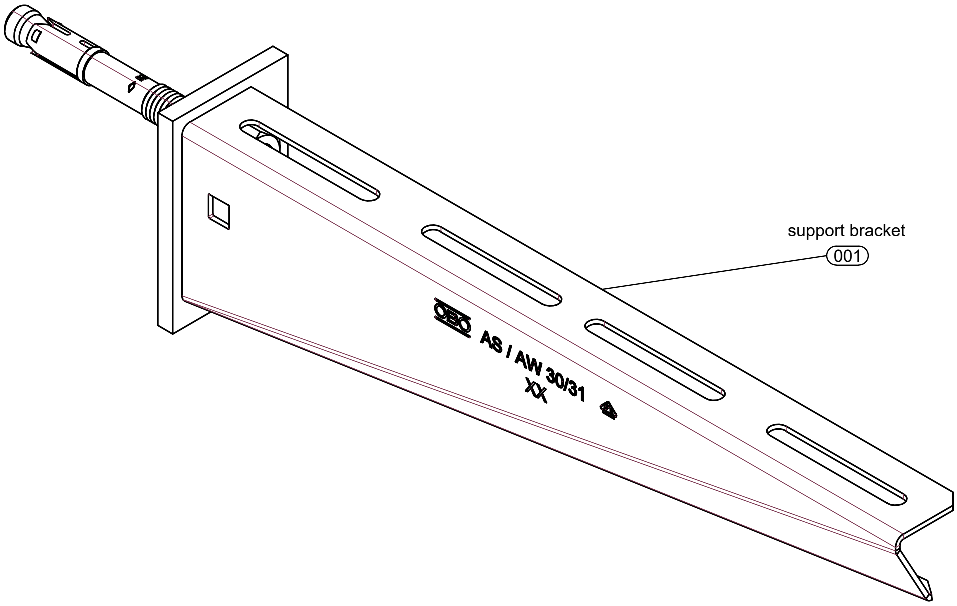
The I support system from OBO Bettermann really comes into its own in situations where high loads must be carried, large distances must be bridged and difficult routes must be implemented. The I support system fulfils all the requirements of a heavy-duty cable mounting system. The high load capacities of all the system components permit the mounting of complex structures. The comprehensive range of head plates allows the implementation of all conceivable solutions. This heavy-duty system is used with large support spacings of wide span systems or for multilayer set-ups of standard cable trays and cable ladder systems. The combination of I supports and support brackets of type AS 15, AS 30 and AS 55 form a perfectly matched product range, the height of which can be infinitely adjusted.

Installation principle
I supports and brackets



1	Luminaire support tray
2	Luminaire support rail
3	90° bend
4	Cover with turn buckle
5	Edge protection ring
6	Suspension bracket
7	Suspension chain
8	Centre suspension
9	Threaded rod
10	Trapezoidal fastening

Notes



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6419747	AW 30 31 FT	support bracket
2			
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 019	PE 04	PF 150	Typical-No.: OBO-KTS-150-019	Project No.:	

	Date:	Name:	Description: Product drawing
Creator:			
Editor:			Comment: Article display of the bracket AS/AW 30/XX
Status:			

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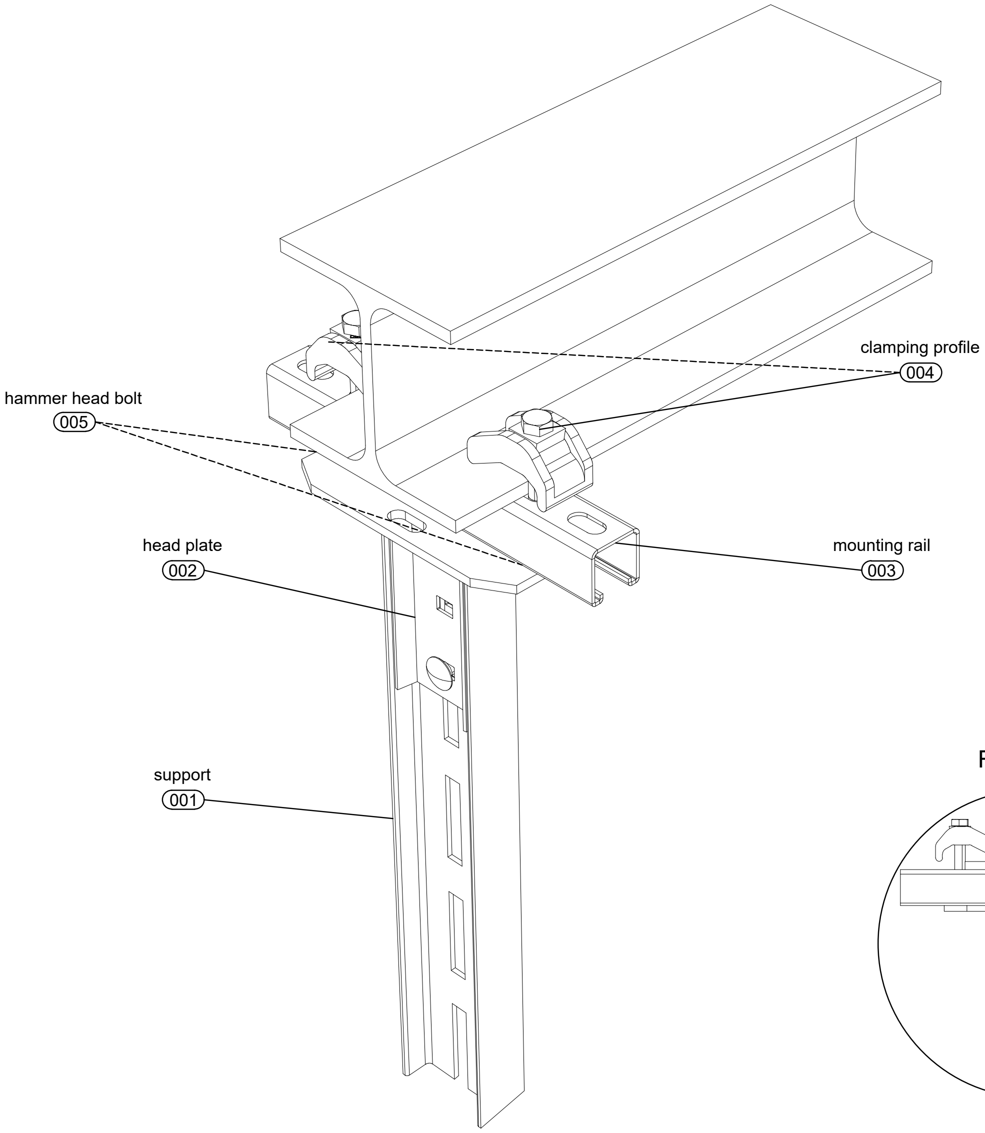
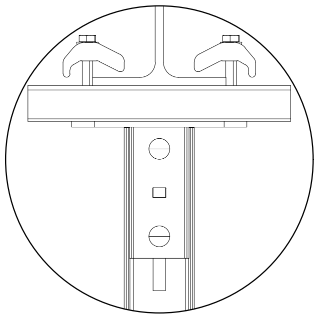
Ind.	Amendment typical	Date:	Name:			



Front view



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6337139	IS 8 120 FT	support
2	6347053	KI 8 FT	Head plate (including appropriate fastening material)
3	1122517	MS4141P0300FT	mounting rail
4	6355800	TKS-S-30 FT	clamping profile
5	1148334	MS41HB M12x30 ZL	hammer head bolt
6			
7			
8			
9			
10			

Drawing-No.: 028	PE 04	PF 150	Typical-No.: OBO-KTS-150-028	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Cable support structures on steel beams provided by the customer

Comment: The clamp fastening of I-supports Supports on steel beams provided by the customer

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

Scale:	Sheet size:
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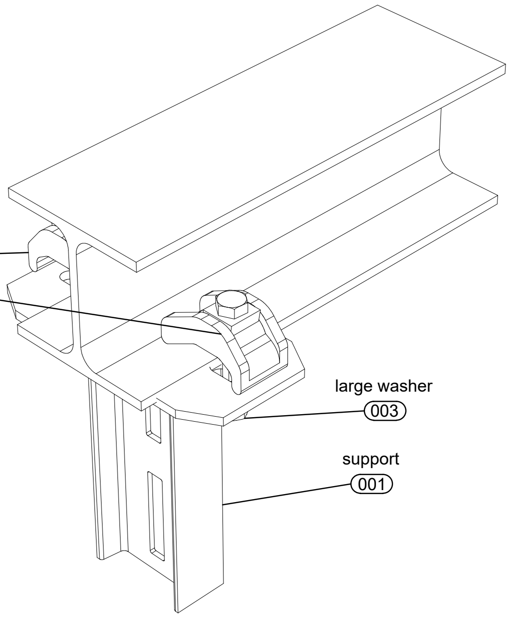


These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6361021	IS K 8 20 FT	support
2	6355800	TKS-S-30 FT	clamping angle
3	6408737	DIN440 14 F	large washer
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 061 | PE 04 | PF 150 | Typical-No.: OBO-KTS-150-061 | Project No.:

	Date:	Name:
Creator:		
Editor:		

Status:

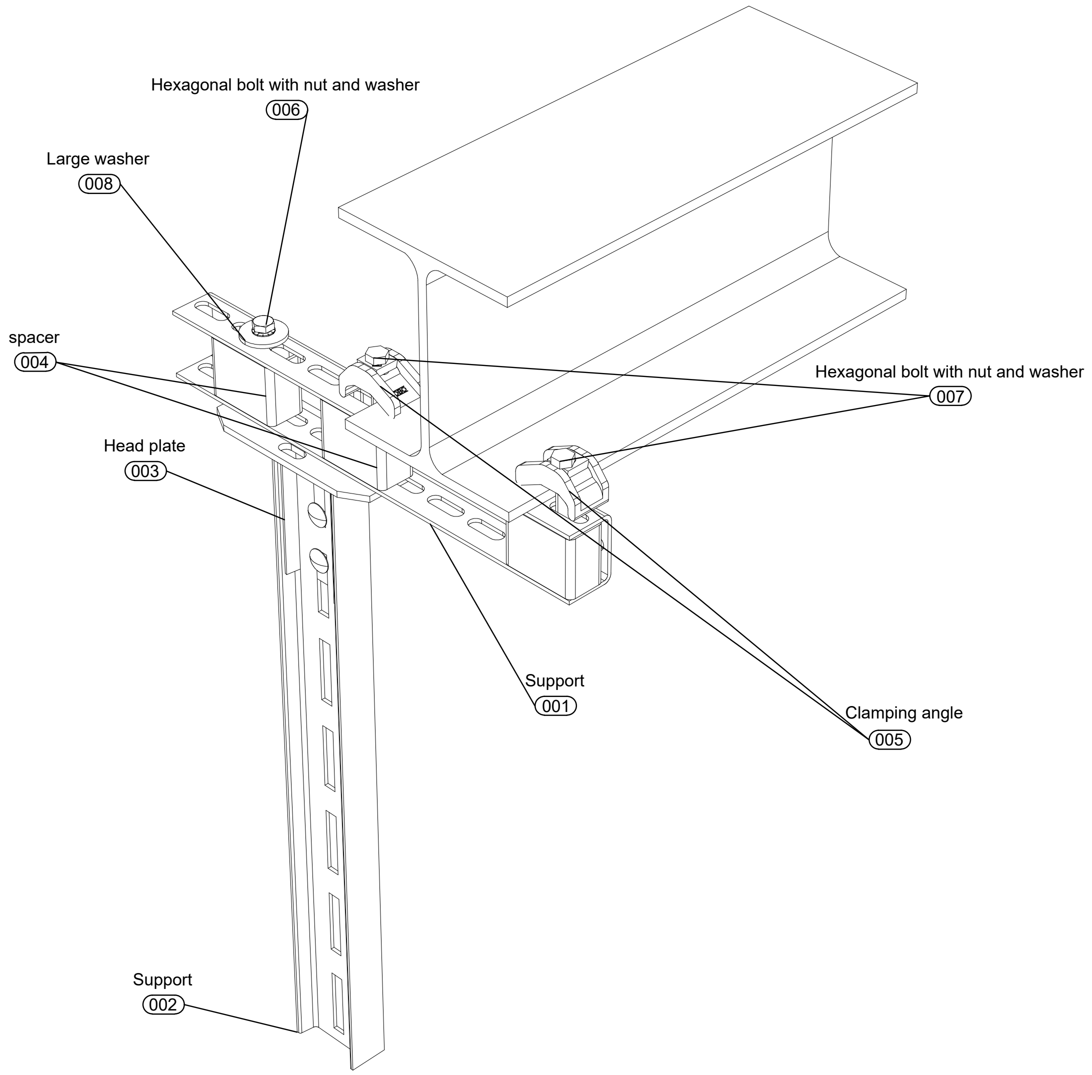
Description: Product drawing

Comment: Clamp fastening on the H-beam

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

Scale: | Sheet size: | Sheet: | of:



Remark:
The length of the U-support depends on the beam width.
(length = beam width + 300mm)

The length of the I-support must also be taken into account due to its load (structural engineer's calculation necessary).

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6340075	US 7 50 FT	Support
2	6337082	IS 8 70 FT	Support
3	6347053	KI 8 FT	Head plate (including appropriate fastening material)
4	6416519	DSK 61 FT	spacer
5	6355800	TKS-S-30 FT	Clamping angle
6	6418317	SKS 12X110 F	Hexagonal bolt with nut and washer
7	6408478	SKS 12X130 F	Hexagonal bolt with nut and washer
8	6408737	DIN440 14 F	Large washer
9			
10			

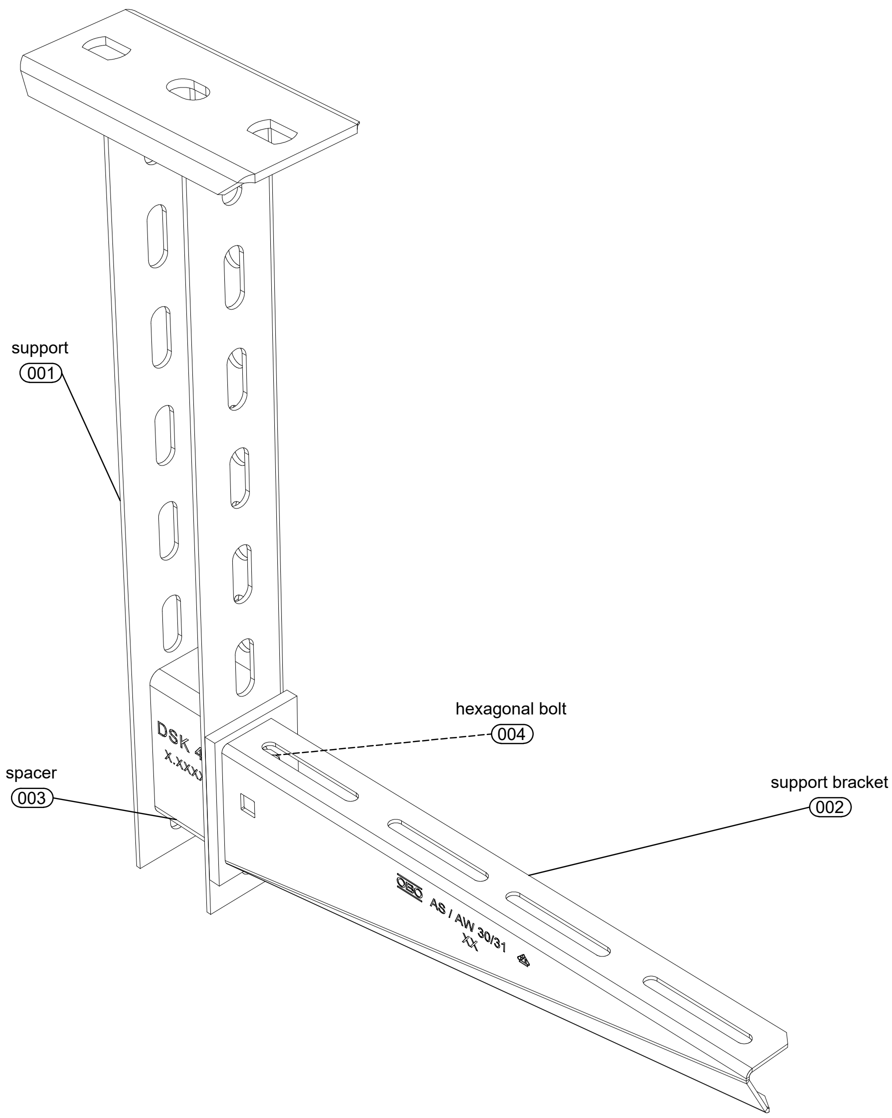
Drawing-No.: 064	PE 04	PF 150	Typical-No.: OBO-KTS-150-064	Project No.:

Date: Name:
Creator:
Editor:
Status:

Description: Cable support structures on steel beams provided by the customer

Comment: Special solution: Suspension from steel beam with I-post at a distance

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
					Sheet:	of:



Remark
Attachment of the bracket to the support from a width of 400mm with a hexagonal bolt through both bars of the support.

- up to 310mm width without spacer
- from 410mm width with spacerk

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6341543	US 5 K 40 FT	support
2	6419747	AW 30 31 FT	support bracket
3	6416500	DSK 45 FT	spacer
4	6418250	SKS 10x80 F	hexagonal bolt with nut and washer
5			
6			
7			
8			
9			
10			

Drawing-No.: 141	PE 04	PF 150	Typical-No.: OBO-KTS-150-141	Project No.:

	Date:	Name:	Description: Product drawing
Creator:			
Editor:			Comment: support and bracket
Status:			

				OBO BETTERMANN	Scale:	Sheet size:
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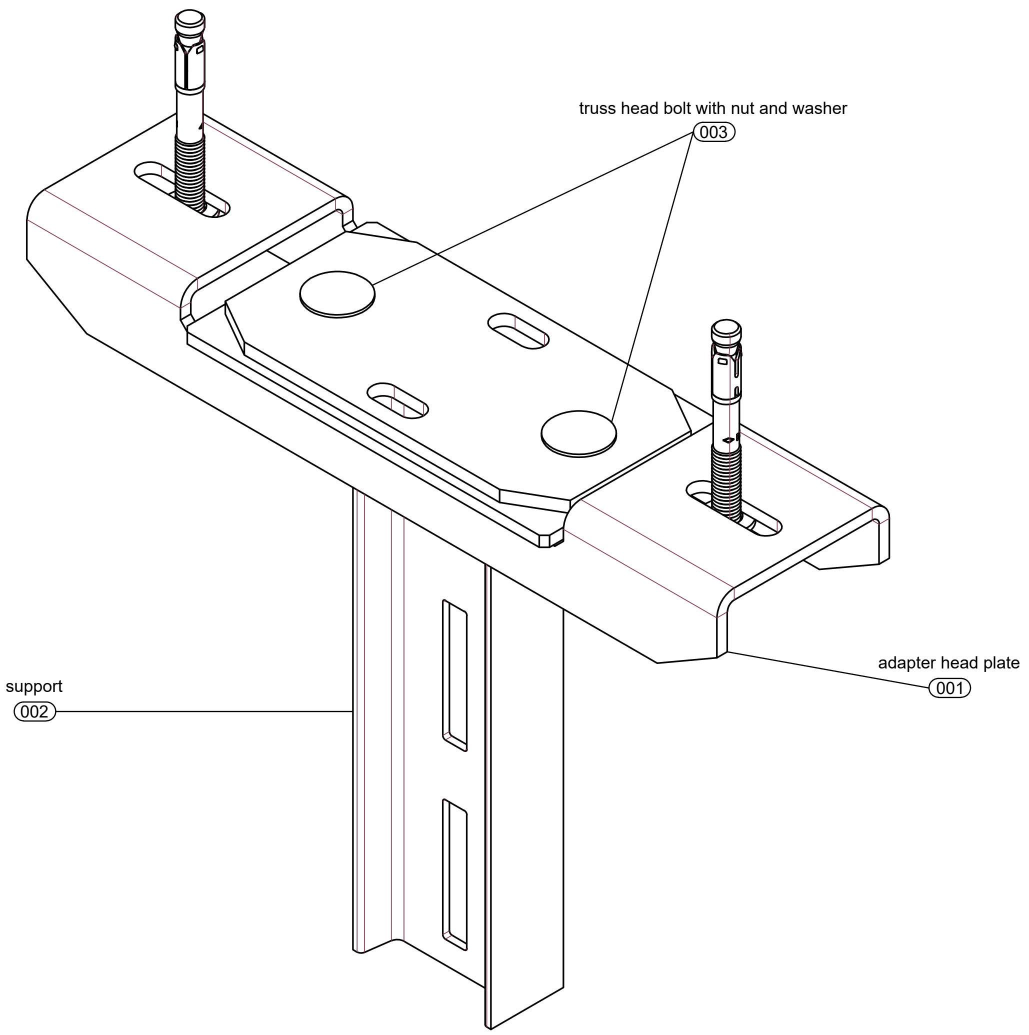
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6346804	KA-SY FT	adapter head plate
2	6361072	IS 8 K 40 FT	support
3	6406270	FRS 12x30 F	truss head bolt with nut and washer
4			
5			
6			
7			
8			
9			
10			

Drawing-No.:	PE	PF	Typical-No.:	Project No.:
162	04	150	OBO-KTS-150-162	

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Ceiling fixing

Comment: Adapter head plate in symmetrical design to increase the load capacity

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

Scale:	Sheet size:
Sheet:	of:

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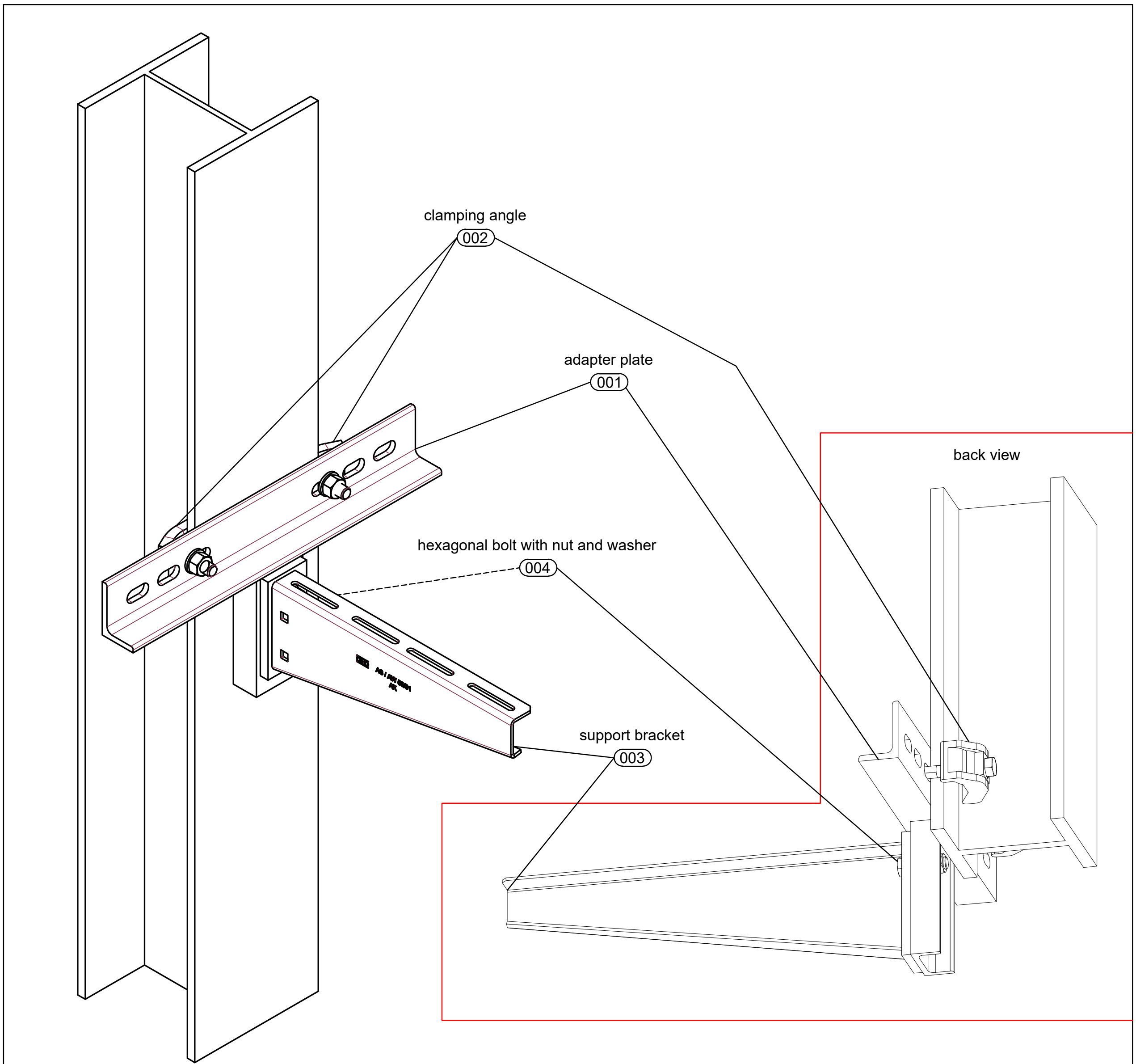

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6346715	KA-AW 30 FT	adapter plate
2	6355800	TKS-S-30 FT	clamping angle
3	6418597	AW 55 41 FT	support bracket
4	3163113	SKS 12x40 F	hexagonal bolt with nut and washer
5			
6			
7			
8			
9			
10			

Drawing-No.: 166	PE 04	PF 150	Typical-No.: OBO-KTS-150-166	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Adapter plate on steel beam for bracket

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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Sheet size:

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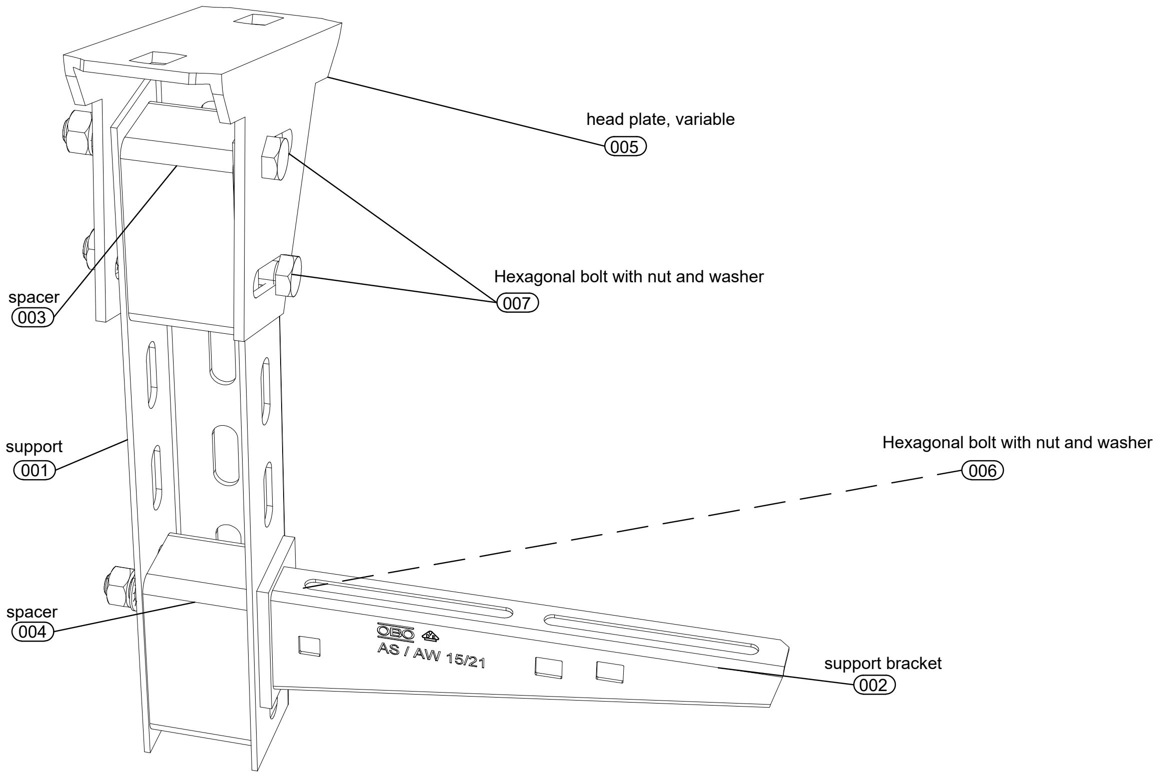
of:



These are examples only, please consult us before use.

	Item No.	Dimension	Description
1	6340903	US 5 30 FT	support
2	6420680	AW 15 21 FT	support bracket
3	6416504	DSK 47 FT	spacer
4	6416500	DSK 45 FT	spacer
5	6348920	KU 5 V FT	head plate, variable
6	6418250	SKS 10X80 F	Hexagonal bolt with nut and washer
7	6418252	SKS 10X90 F	Hexagonal bolt with nut and washer
8			
9			
10			

Drawing-No.: 320	PE 04	PF 150	Typical-No.: OBO-KTS-150-320	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Ceiling fixing

Comment: Variable head plate with support and bracket

Ind.	Amendment typical	Date:	Name:
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OBO BETTERMANN

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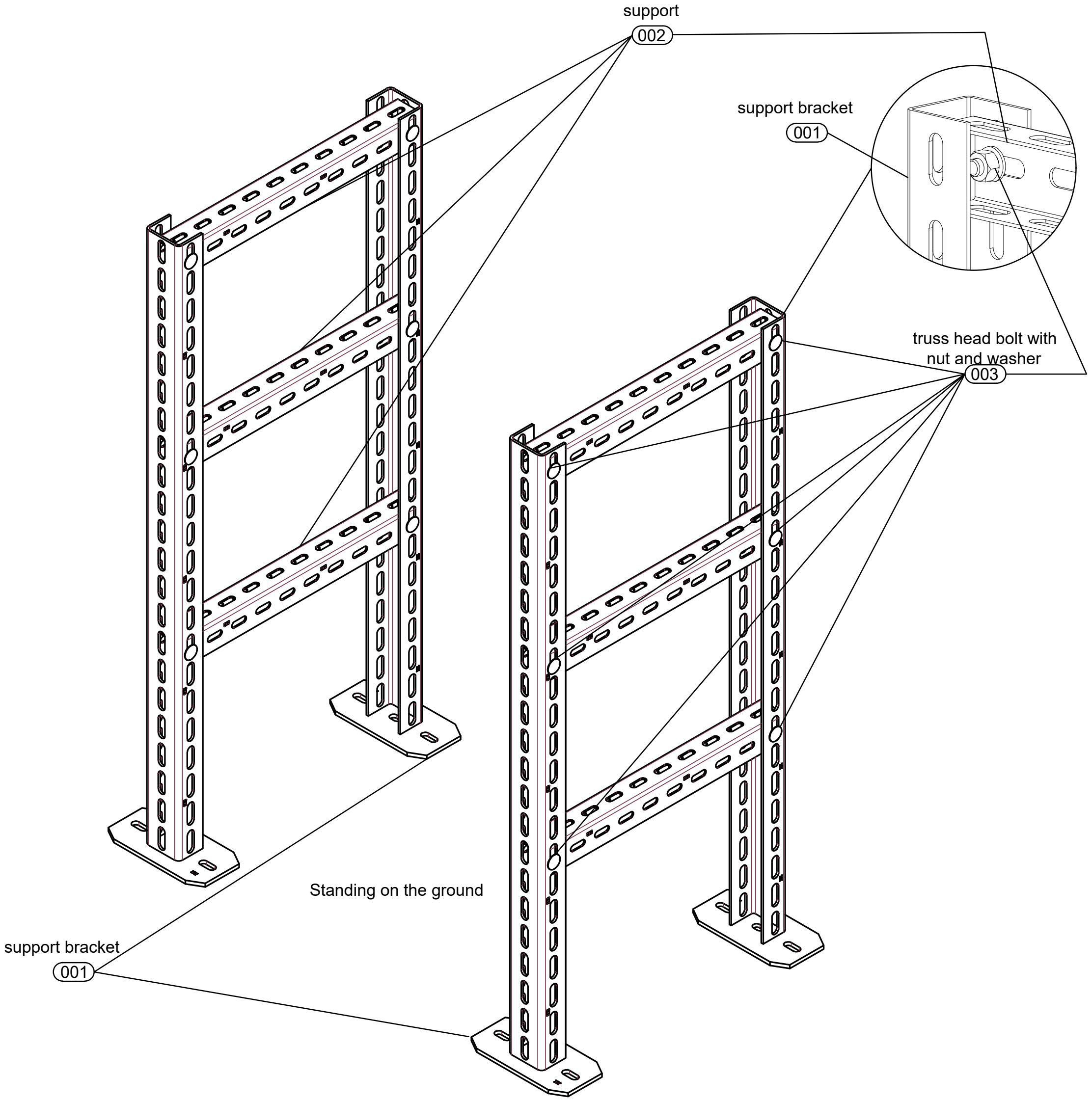

These are examples only, please consult us before use.

Remark
the US3 is mounted with the opening to the rear

	Item No.	Designation	Description
1	6341578	US 5 K	support
2	6342306	US 3	support (opening to the back)
3	6407579	FRS 10x30	truss head bolt with nut and washer
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 416	PE 04	PF 150	Typical-No.: OBO-KTS-150-416	Project No.:	

	Date:	Name:	Description: elevated stand
Creator:			
Editor:			Comment: elevation bridge with 3 floors
Status:			

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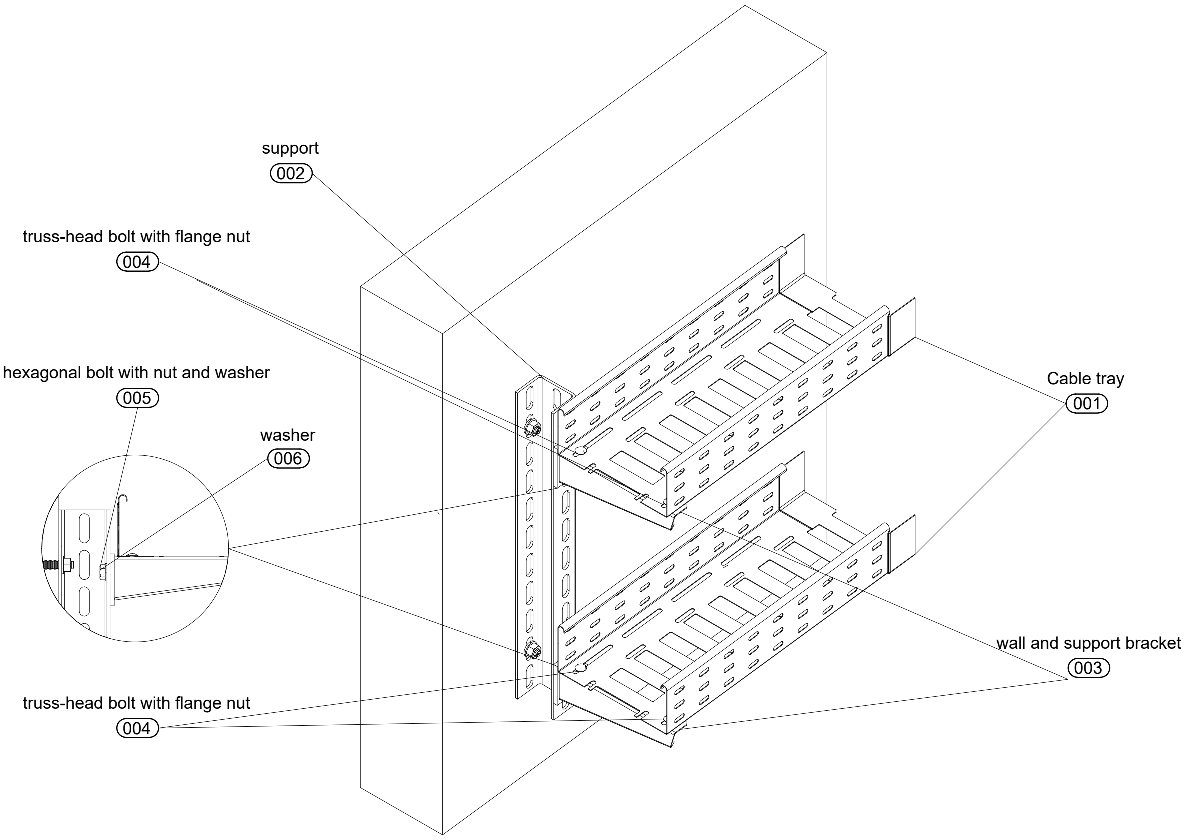
Ind.	Amendment typical	Date:	Name:			

Notes

Fixing Variant 1, installed
cable tray parallel to concrete structures



Remark
Construction is only designed for max. widths up to 300mm

These are examples only, please consult us before use.

	Item No.	Dimension	Description
1	6059101	MKSM 820 FT	cable tray
2	6340075	US 7 50 FT	support
3	6419720	AW 30 21 FT	wall and support bracket
4	6406122	FRSB 6x12 F	truss-head bolt with flange nut
5	3163091	SKS 12x30 F	hexagonal bolt with nut and washer
6	3402479	966 M12 F	washer
7			
8			
9			
10			

Drawing-No.:	004
PE	04
PF	200
Typical-No.:	OBO-KTS-200-004
Project No.:	
Date:	
Name:	
Creator:	
Editor:	
Status:	
Description:	Wall mounting at distance with U-profile
Comment:	two cable trays mounted horizontally on profile and bracket at a distance from the wall
Ind.	----------- / -----------
Amendment typical	
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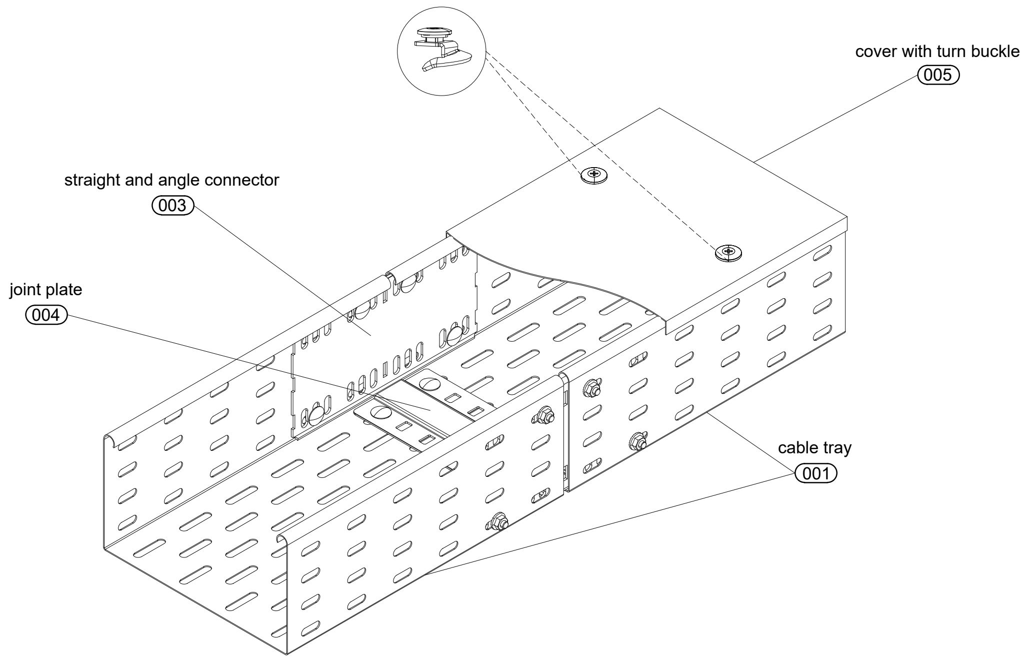
OBO BETTERMANN



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6060196	MKS 120 FS	cable tray
2	6061206	SKS 120 FS	cable tray
3	6067131	RLVL 110 FS	straight and angle connector
4	7070213	SSLB 200 FS	joint plate
5	6052207	DRL 200 FS	cover with turn buckle
6			
7			
8			
9			
10			

Drawing-No.: 030	PE 04	PF 200	Typical-No.: OBO-KTS-200-030	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Cable tray MKS/SKS butt connector with cover and lock

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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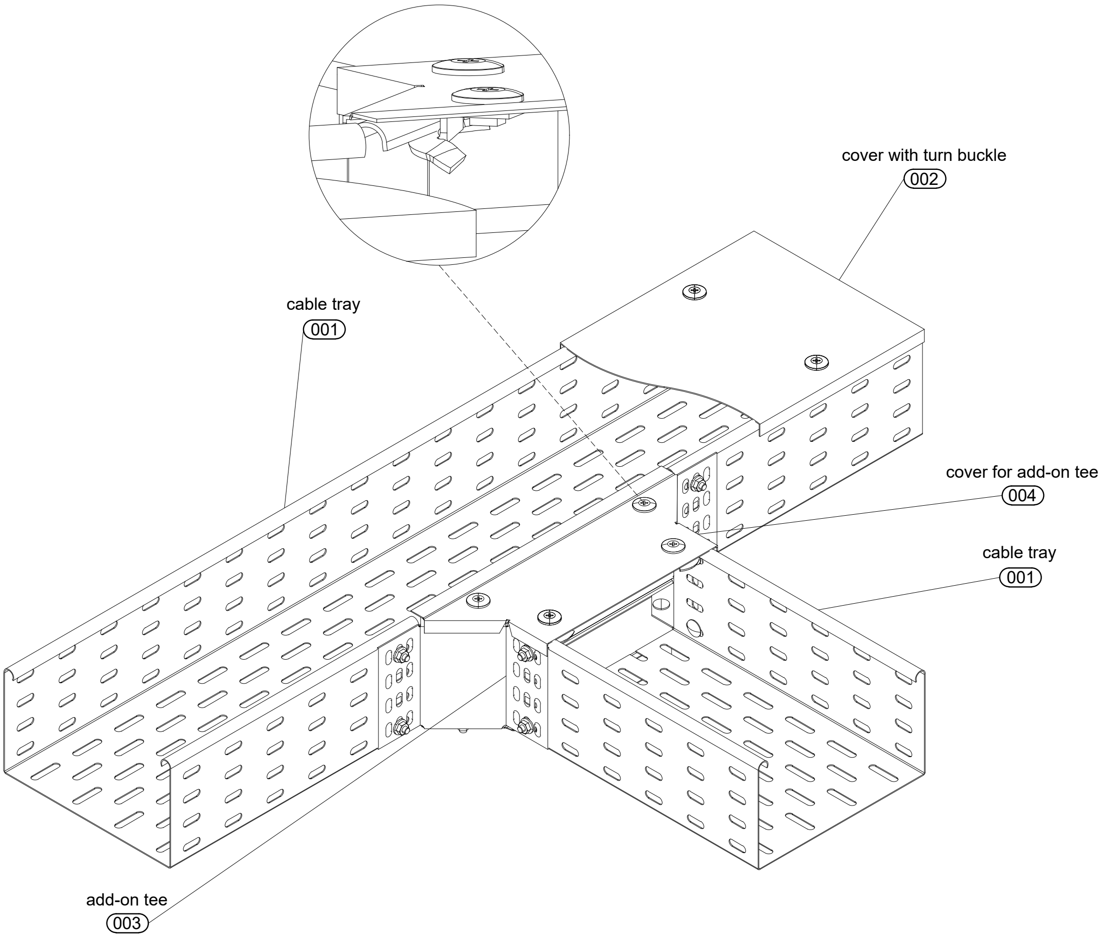

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6060196	MKS 120 FS	cable tray
2	6052207	DRL 200 FS	cover with turn buckle
3	7002653	RAA 120 FS	add-on tee
4	7128444	DFAA 200 FS	cover for add-on tee
5			
6			
7			
8			
9			
10			

Drawing-No.: 039	PE 04	PF 200	Typical-No.: OBO-KTS-200-039	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Cable tray MKS with cover and lock

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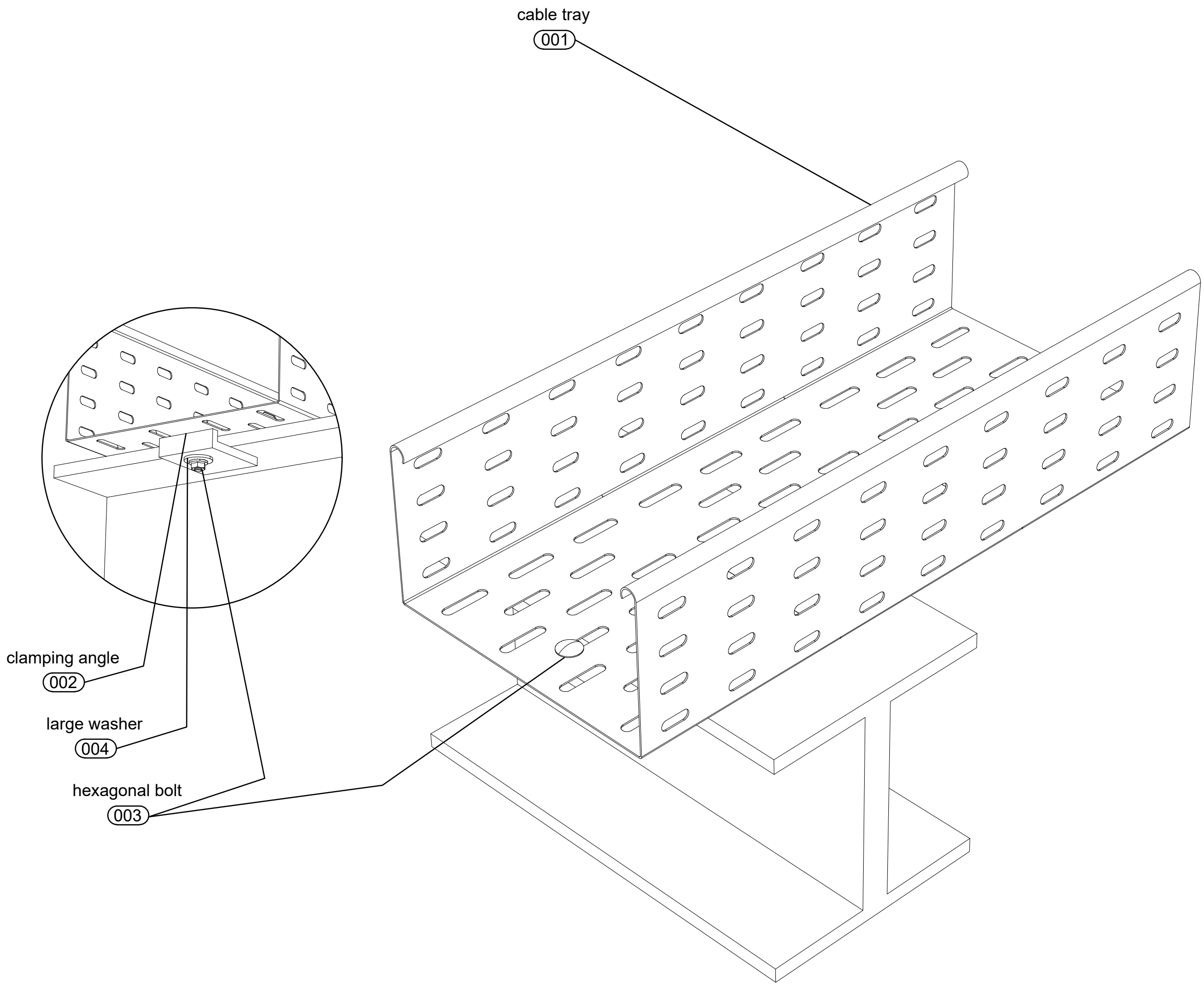
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6061621	SKS 120 FT	cable tray
2	6354114	KL1 15 S FT	clamping angle
3	6406907	FRSB 6x30 F	hexagonal bolt
4	6408702	DIN440 7 F	large washer
5			
6			
7			
8			
9			
10			

Drawing-No.: 116	PE 04	PF 200	Typical-No.: OBO-KTS-200-116	Project No.:

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			
Status:			Comment: Cable tray mounted directly on H-beam

Ind.	Amendment typical	Date:	Name:		Scale:	Sheet size:
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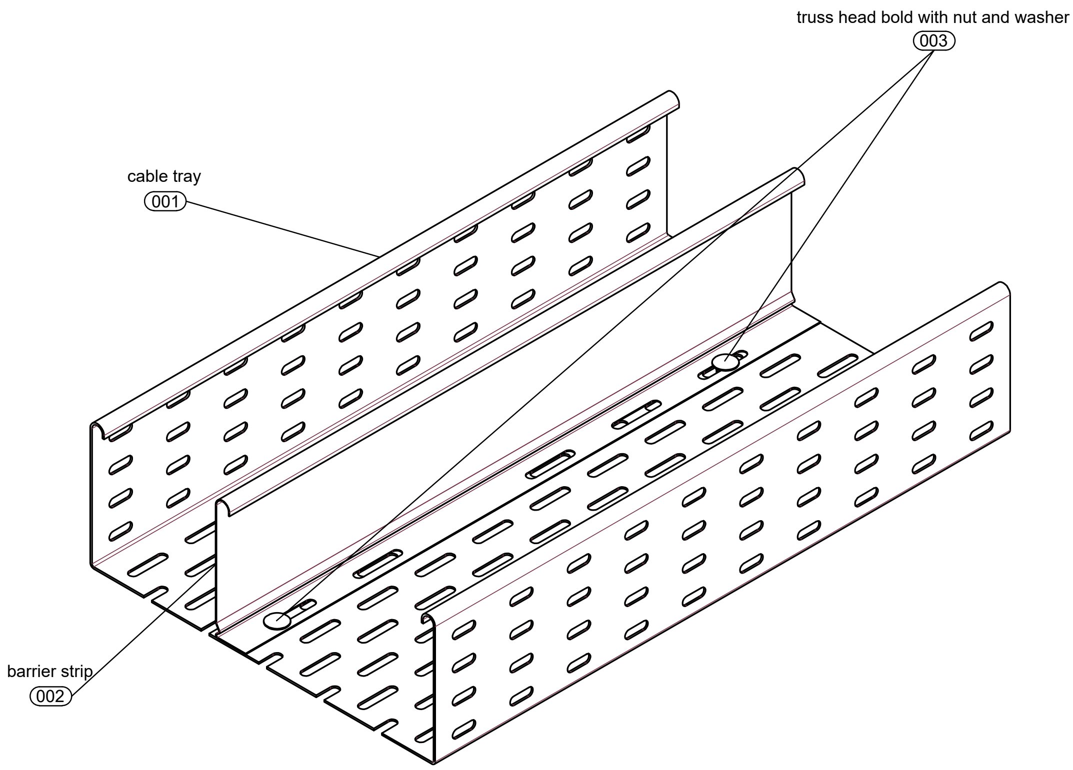

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6061621	SKS 120 FT	cable tray
2	6062335	TSG 110 DD	barrier strip
3	6406122	FRSB 6x12 F	truss head bolt with nut and washer
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 186	PE 04	PF 200	Typical-No.: OBO-KTS-200-186	Project No.:

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			Comment: Cable tray with separating strip
Status:			

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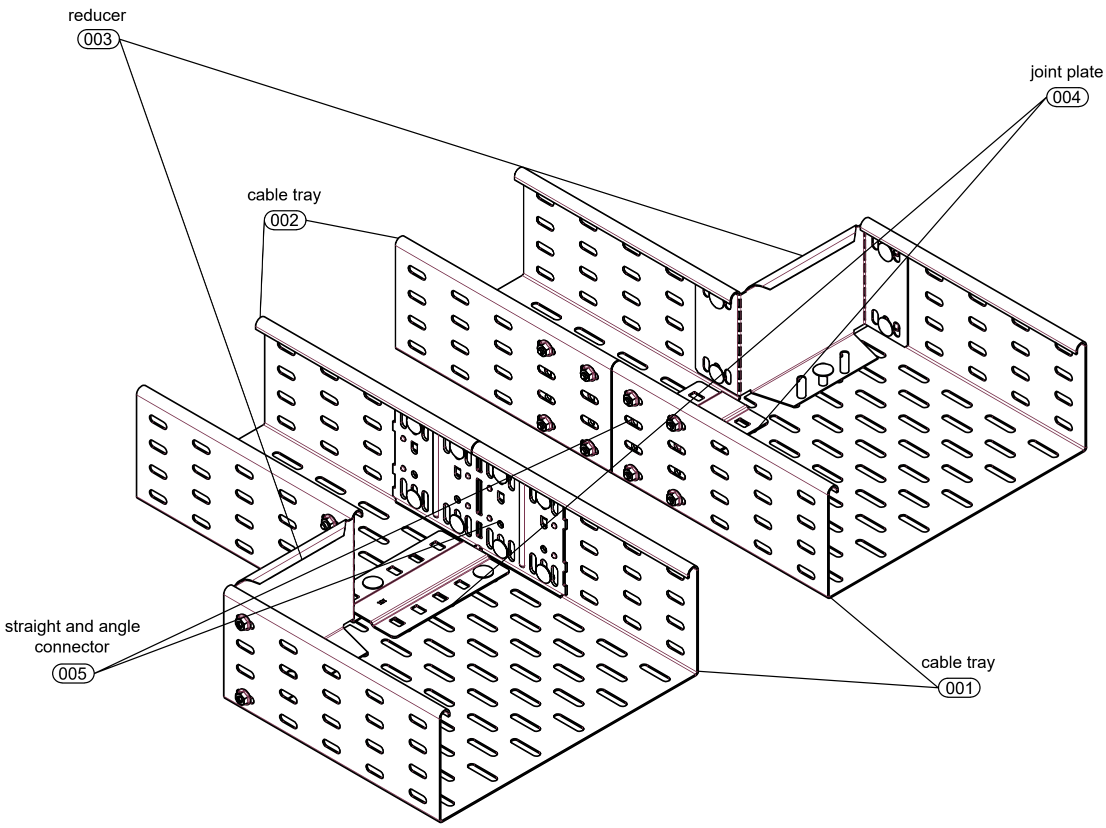
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6061621	SKS120 FT	cable tray
2	6061605	SKS 110 FT	cable tray
3	7107471	RWEB 120 DD	reducer
4	7070314	SSLB 200 DD	joint plate
5	6067913	RLVL 110 FT	straight and angle connector
6			
7			
8			
9			
10			

Drawing-No.: 217		PE 04	PF 200	Typical-No.: OBO-KTS-200-217	Project No.:
	Date:	Name:	Description: Product drawing		
Creator:					
Editor:			Comment: Cable tray with reduction		
Status:					

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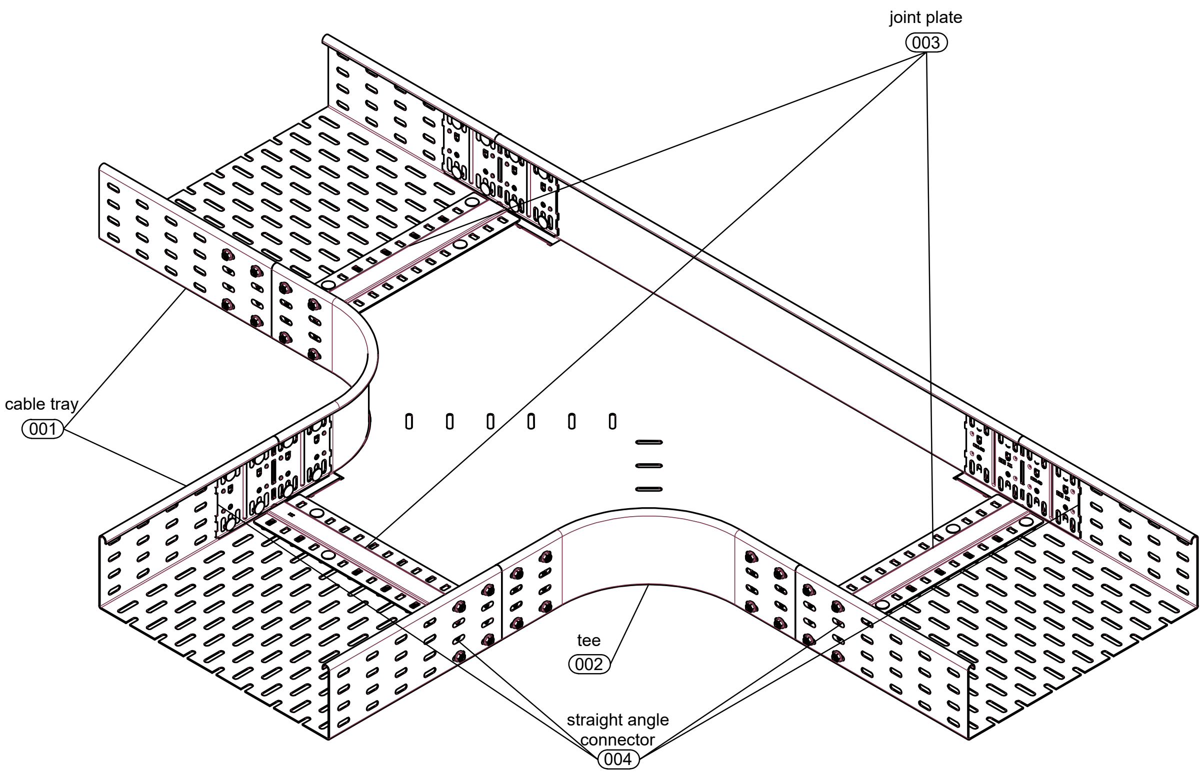
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6061565	SKS 130 FS	cable tray
2	7003684	RT 130 FS	tee
3	7070217	SSLB 300 FS	joint plate
4	6067131	RLVL 110 FS	straight angle connector
5			
6			
7			
8			
9			
10			

Drawing-No.: 223	PE 04	PF 200	Typical-No.: OBO-KTS-200-223	Project No.:

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			
Status:			Comment: Cable tray T-piece

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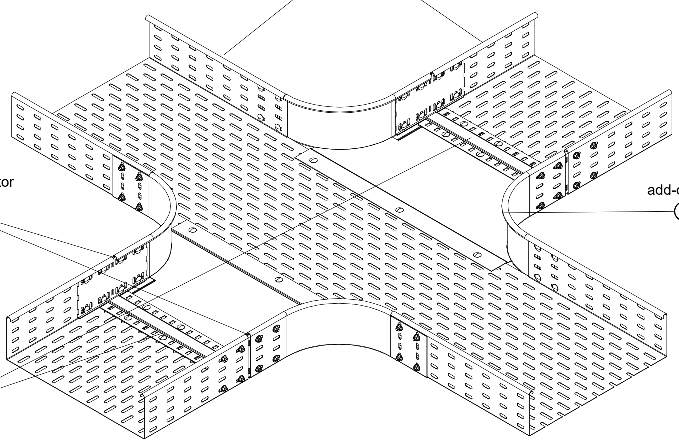
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6061400	SKS 140 FS	cable tray
2	6067131	RLVL 110 FS	straight and angle connector
3	7002696	RAA 140 FS	add-on tee
4	7070221	SSLB 400 FS	joint plate
5			
6			
7			
8			
9			
10			

Drawing-No.: 224	PE 04	PF 200	Typical-No.: OBO-KTS-200-224	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Cable tray T-branch pieces

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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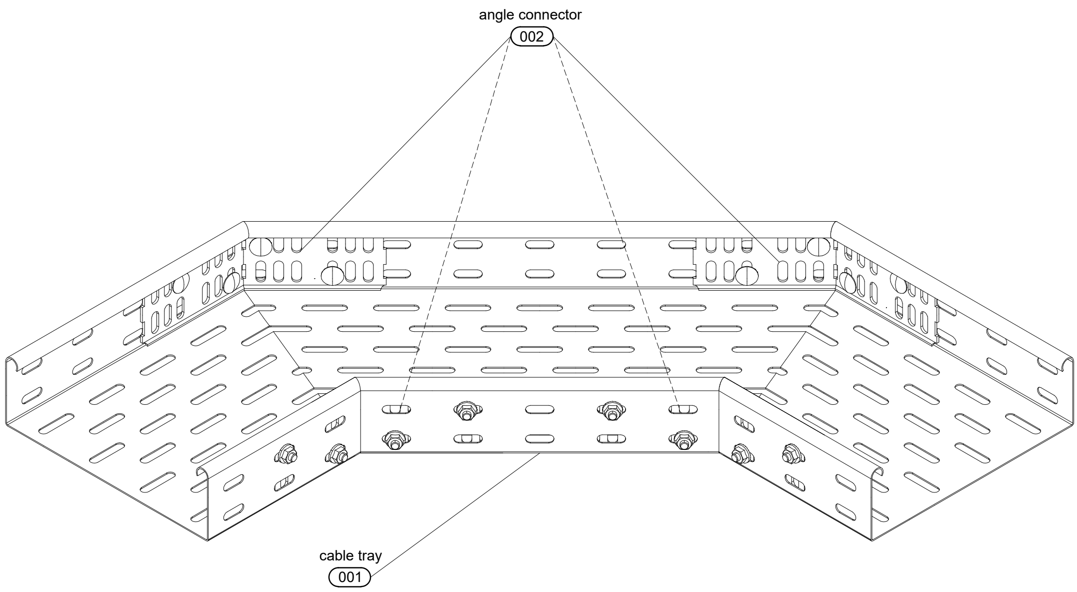

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6056652	SKS 620 FT	cable tray
2	6067611	RWVL 60 FT	angle connector
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 253	PE 04	PF 200	Typical-No.: OBO-KTS-200-253	Project No.:

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			Comment: Cable tray with angle connector
Status:			

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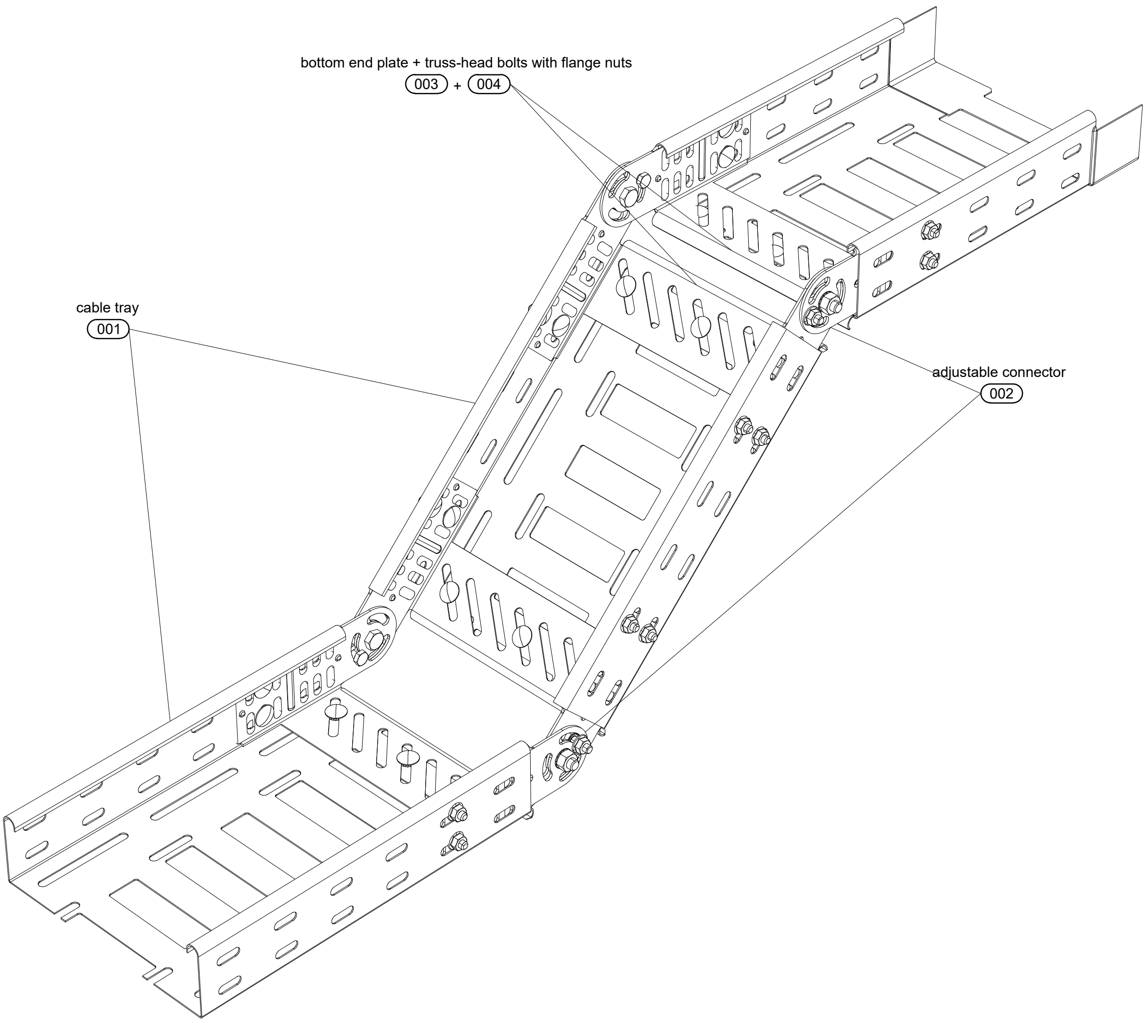
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6059008	MKSM 640 FS	cable tray
2	7082010	RGV 60 FS	adjustable connector
3	7083408	BEB 400 FS	bottom end plate
4	6406122	FRSB 6x12 F	truss-head bolt with flange nut
5			
6			
7			
8			
9			
10			

Drawing-No.: 541	PE	PF 200	Typical-No.: OBO-KTS-200-541	Project No.:	

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			
Status:			Comment: Cable ladder with articulated elbow elements

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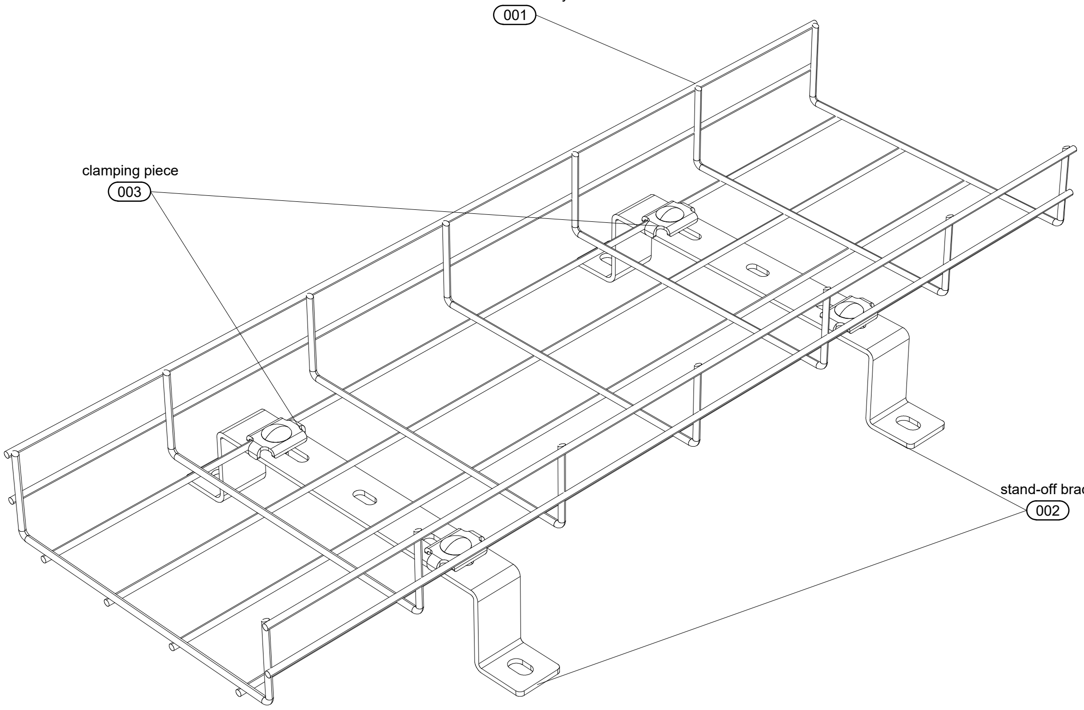
Ind.	Amendment typical	Date:	Name:			

Notes

Notes



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6001420	GRM 55 200 FT	mesh cable tray
2	6015581	DBL 50 200 FT	stand-off bracket
3	6016820	GKS 34 FT	clamping piece
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 522	PE 04	PF 250	Typical-No.: OBO-KTS-250-522	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Wall mounting

Comment: mesh cable tray mounted vertically on the wall on spacers

	-----------		

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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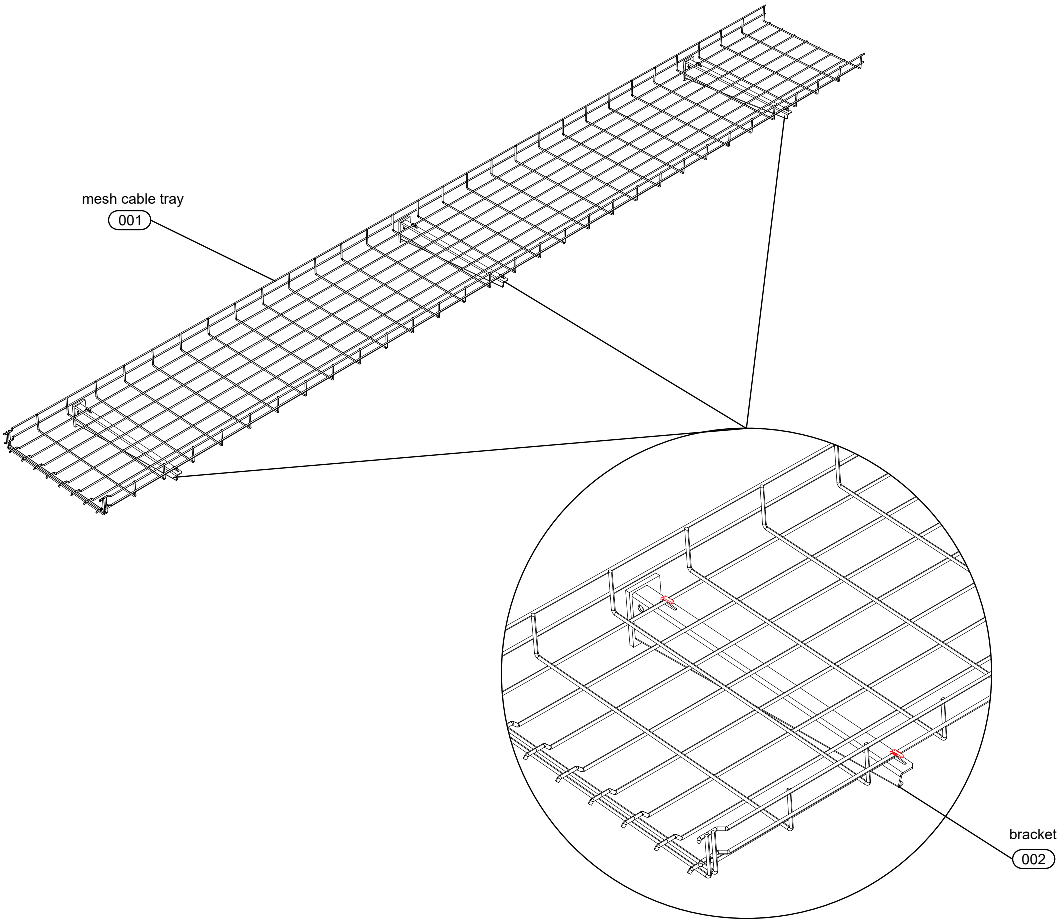

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6001428	GRM 55 400 FT	mesh cable tray
2	6420612	AW G 15 41 FT	mesh cable tray bracket
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 1001	PE 04	PF 250	Typical-No.: OBO-KTS-250-1001	Project No.:

	Date:	Name:	Description: Wall mounting
Creator:			
Editor:			Comment:
Status:			

Ind.	Amendment typical	Date:	Name:		Scale:	Sheet size:
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Notes

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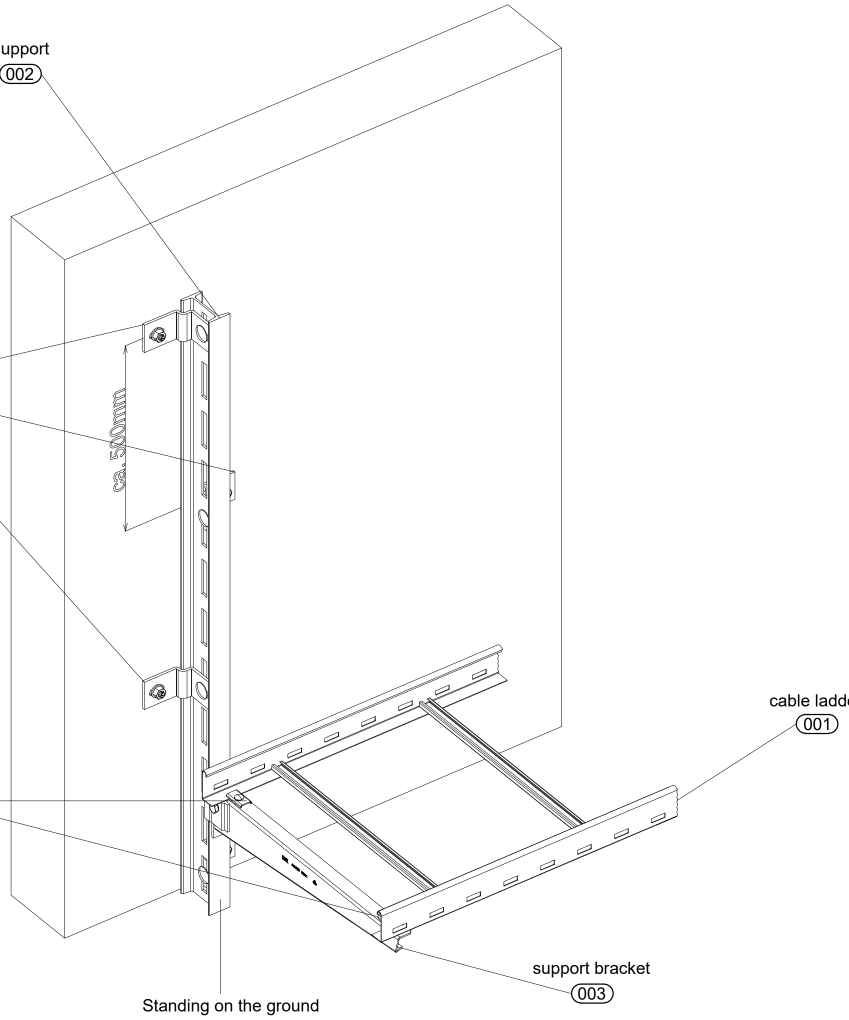
Fixing Variante 1, installed
cable ladder parallel to concrete structures



Remark
IS 8 120 FT (length 1200mm) => 4BW 80 55 FT
IS 8 200 FT (length 2000mm) => 6BW 80 55 FT

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6208659	LG 650 VS 6 FT	cable ladder
2	6337139	IS 8 120 FT	support
3	6419400	AS 30 51 FT	support bracket
4	6019528	BW 80 55 FT	fastening bracket
5	6221084	LKS 40 FT	clamping piece
6			
7			
8			
9			
10			

Drawing-No.: 006	PE 04	PF 300	Typical-No.: OBO-KTS-300-006	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Wall mounting at distance with U-profile

Comment: Cable ladder mounted horizontally with distance to the wall on profile and bracket

Ind.	Amendment typical	Date:	Name:

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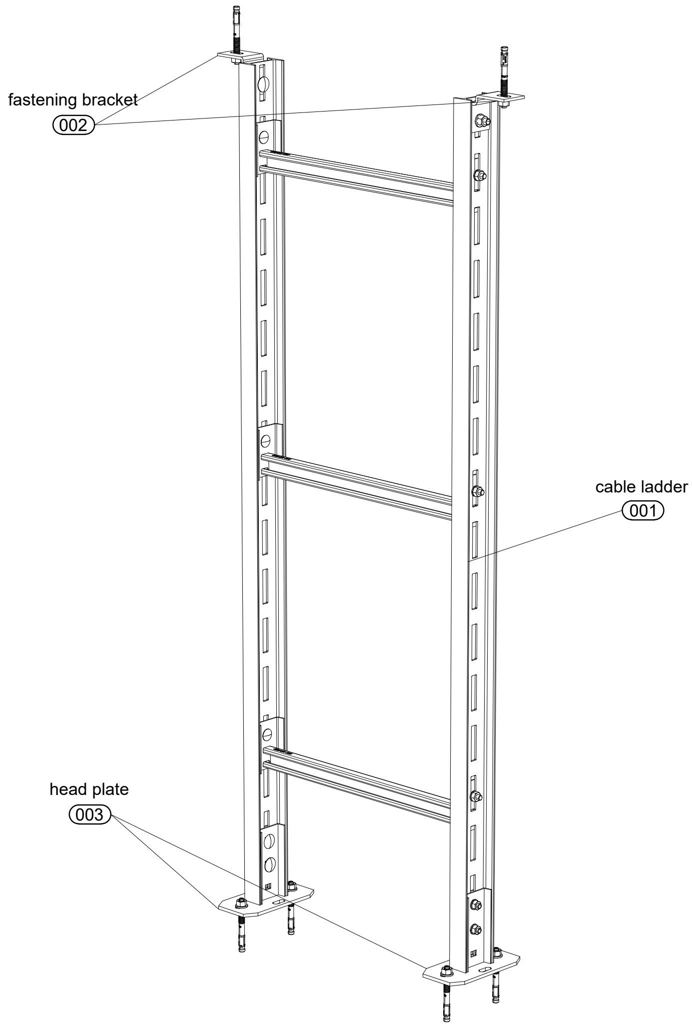

This free-standing cable ladder is suitable for single-sided cable clamp installation.

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6013422	SLS 80 C40 6 FT	industrial vertical cable ladder C40
2	6019528	BW 80 55 FT	fastening bracket
3	6347053	KI 8 FT	head plate
4			
5			
6			
7			
8			
9			
10			

Drawing-No.:	PE	PF	Typical-No.:	Project No.:
008	04	300	OBO-KTS-300-008	

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Freestanding fixed ladder

Comment: Fixed ladder with floor and ceiling mounting

Ind.	Amendment typical	Date:	Name:

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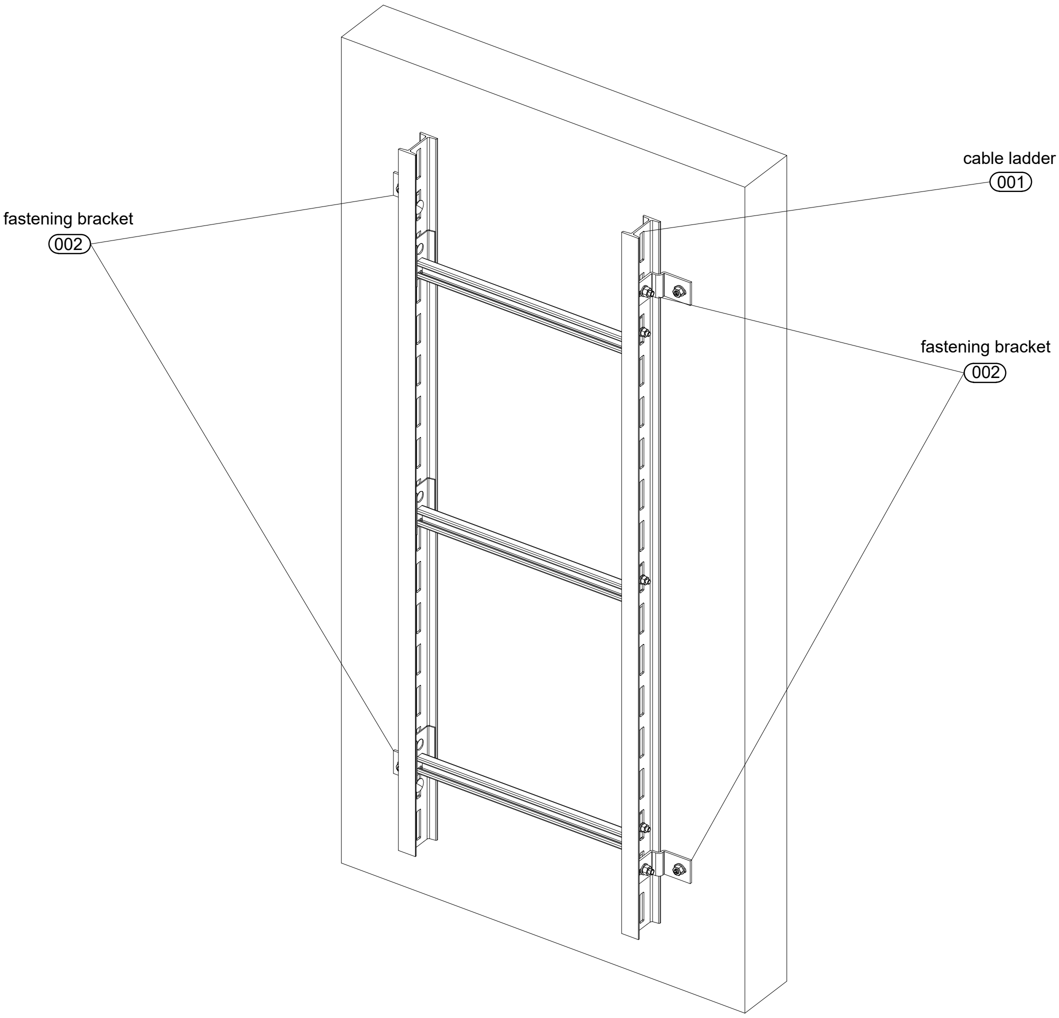

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6013422	SLS 80 C40 6 FT	industrial vertical cable ladder C40
2	6019528	BW 80 55 FT	fastening bracket
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 024	PE 04	PF 300	Typical-No.: OBO-KTS-300-024	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Wall mounting of a fixed ladder

Comment: Vertical wall mounting of the SLSxx fixed ladder with BWxx mounting bracket

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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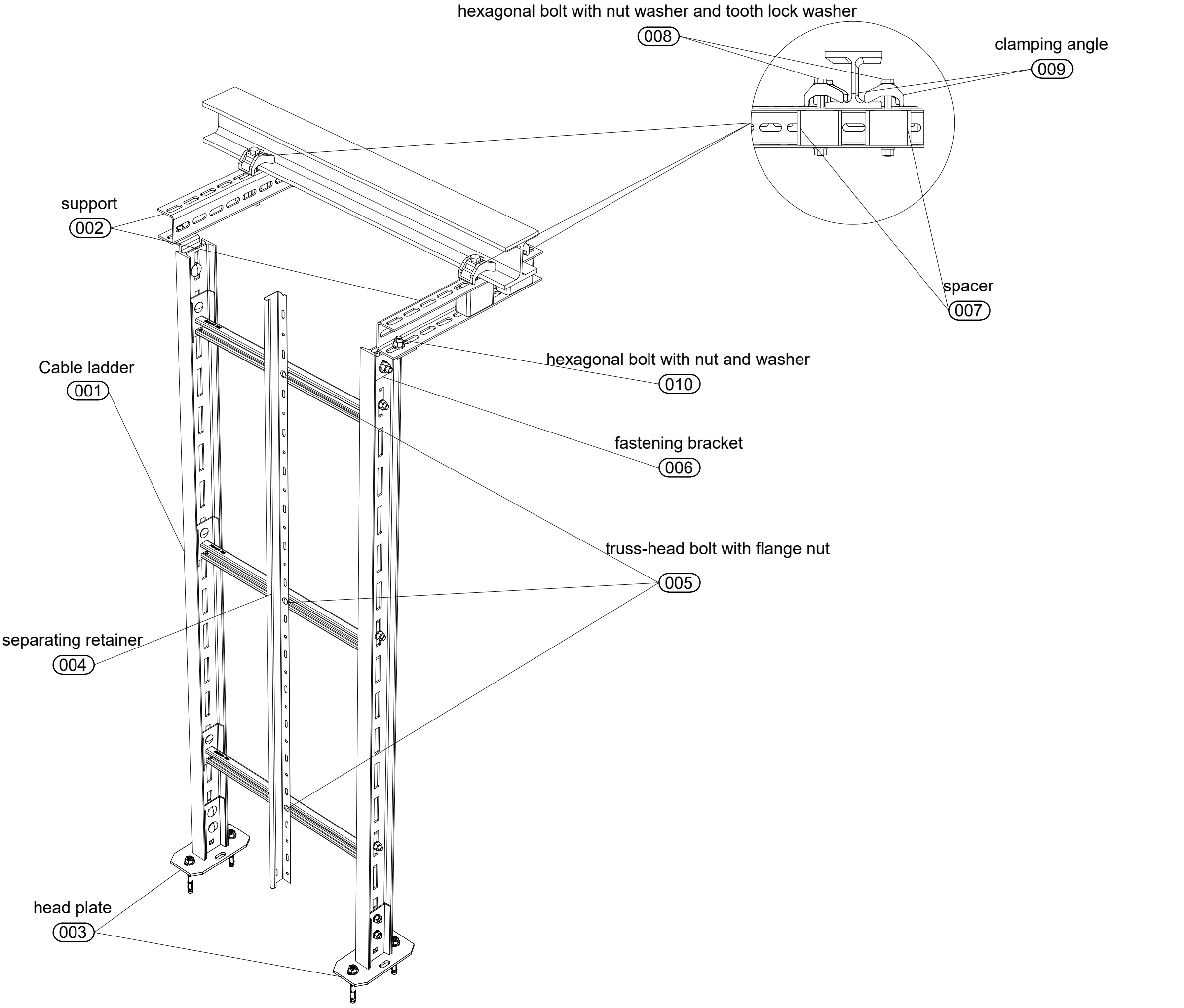

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6013422	SLS 80 C40 6 FT	industrial vertical cable ladder C40
2	6340202	US 7 120 FT	support
3	6347053	KI 8 FT	head plate
4	6062025	TSG 45 A2	separating retainer
5	6406907	FRSB 6x30 F	truss-head bolt with flange nut
6	6019528	BW 80 55 FT	fastening bracket
7	6416519	DSK 61 FT	spacer
8	6418478	SKS 12x130 F	hexagonal bolt with nut washer and tooth lock washer
9	6355808	TKS-L-25 FT	clamping angle
10	3163091	SKS 12x30 F	hexagonal bolt with nut and washer

Drawing-No.: 082	PE 04	PF 300	Typical-No.: OBO-KTS-300-082	Project No.:	

	Date:	Name:	
Creator:			Description: Cable support structures on steel beams provided by the customer
Editor:			
Status:			Comment: Vertical ladder attached to H-beam and anchored to the ground-level

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
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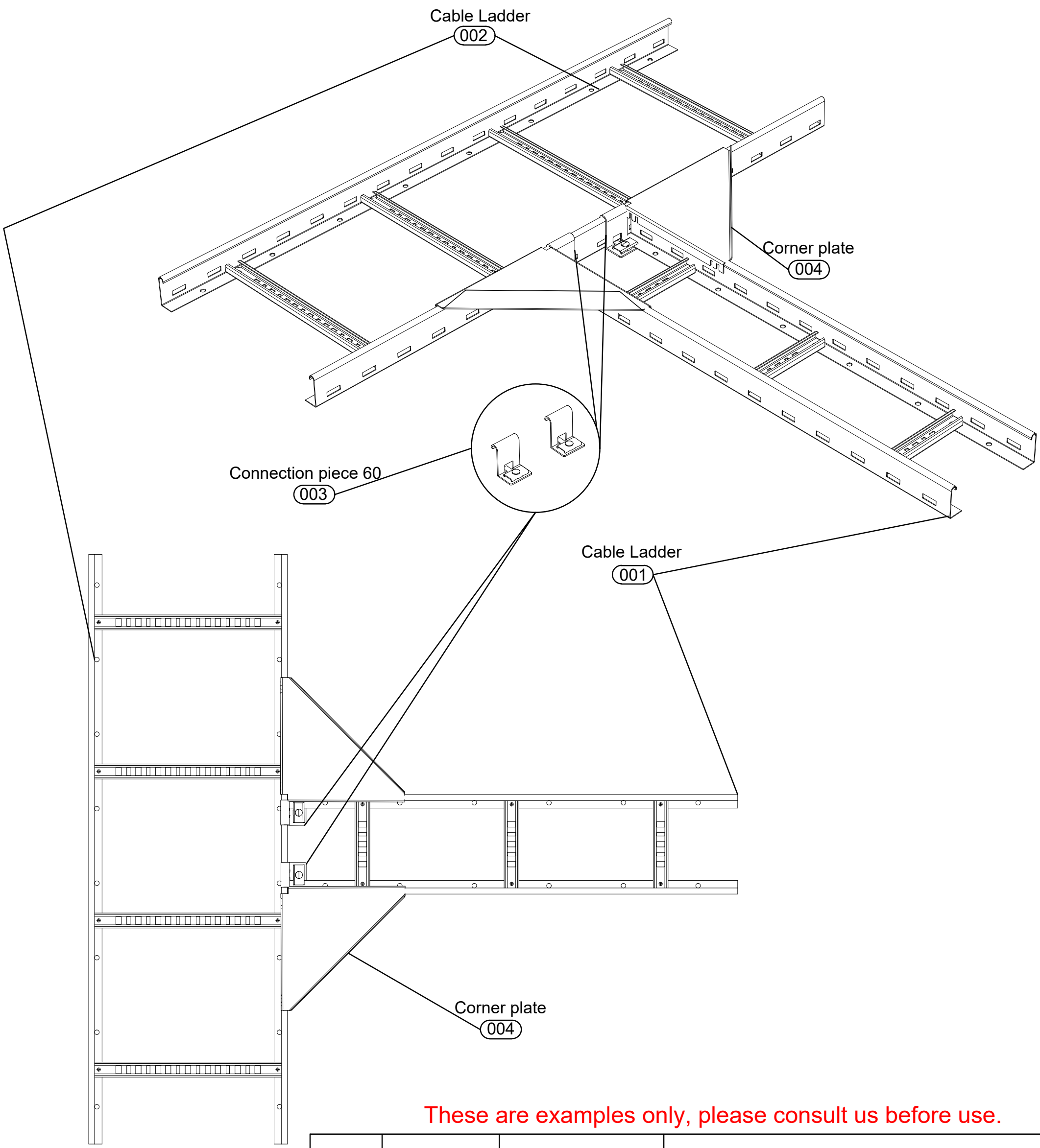

These are examples only, please consult us before use.

	Item No.	Dimension	Description
1	6208562	LG 620 VS 3 FT	Cable Ladder
2	6208570	LG 640 VS 3 FT	Cable Ladder
3	6221378	LAS 60 FT	Connection piece 60
4	6221216	LEB 25 DD	Corner plate
5			
6			
7			
8			
9			
10			

Drawing-No.: 143-01	PE 04	PF 300	Typical-No.: OBO-KTS-300-143-1	Project No.:

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			
Status:			Comment: Cable ladder T-branch with corner plate

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
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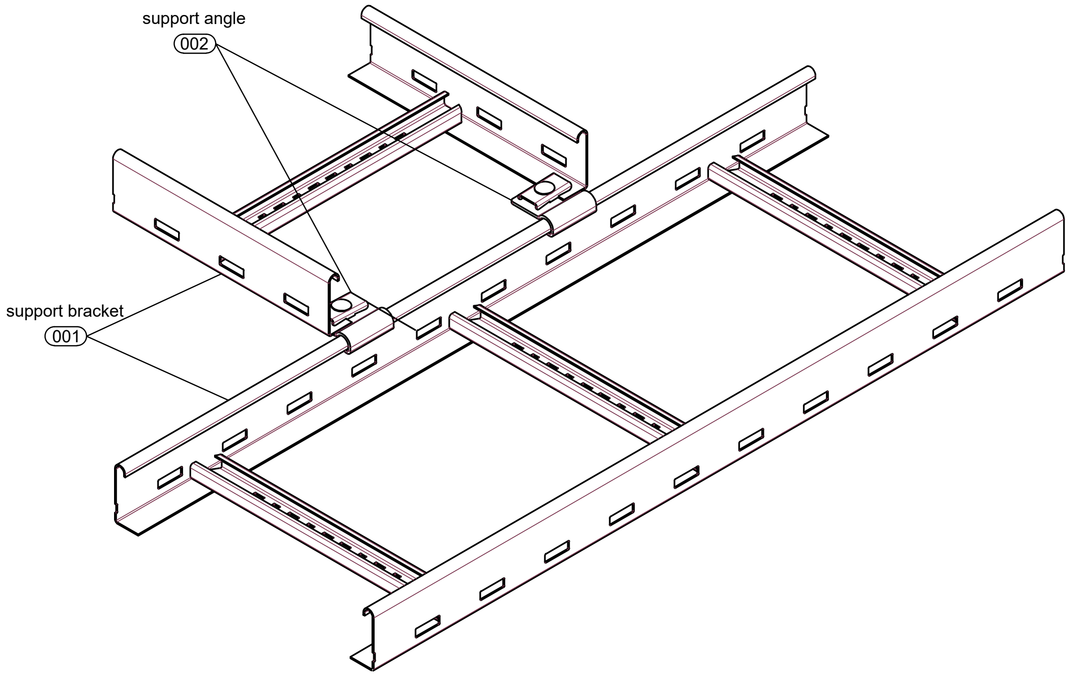

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6208659	LG 650 VS 6 FT	cable ladder
2	6221513	LAW FT	support angle
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 144	PE 04	PF 300	Typical-No.: OBO-KTS-300-144	Project No.:	
	Date:	Name:	Description: Product drawing		
Creator:					
Editor:			Comment: Cable ladder T-branch only with terminals		
Status:					

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
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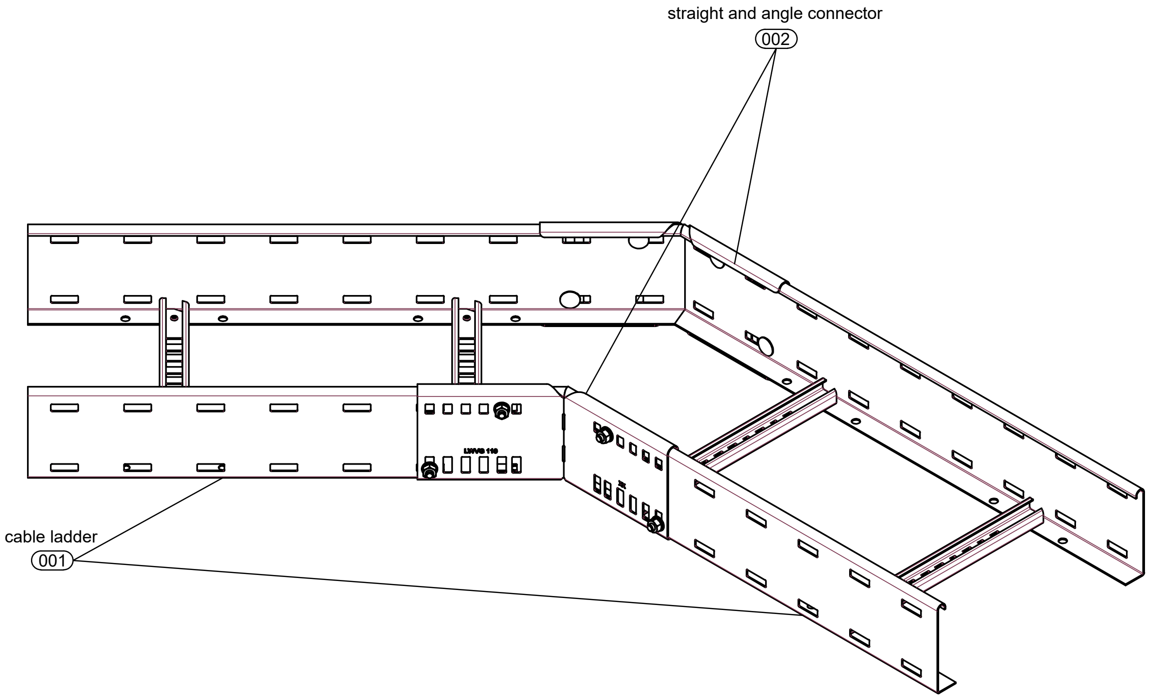

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6216426	LG 113 VS 3 FT	cable ladder
2	6216587	LWVG 110	straight and angle connector
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 209	PE 04	PF 300	Typical-No.: OBO-KTS-300-209	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Cable ladder with angle connector

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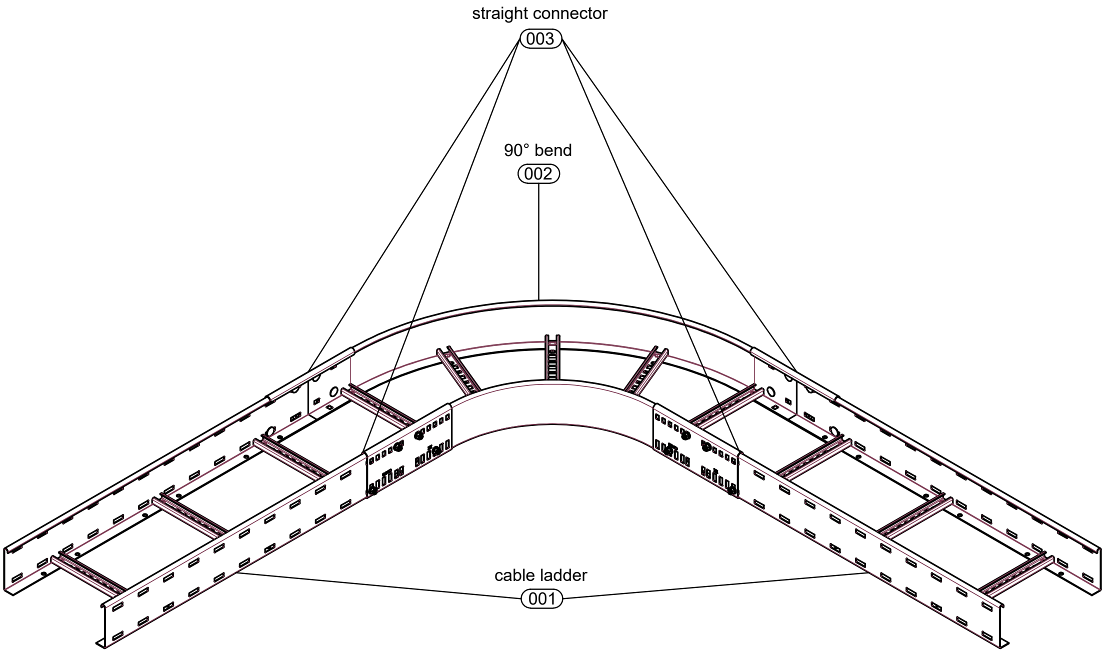
Ind.	Amendment typical	Date:	Name:			



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6216426	LG113 VS 3 FT	cable ladder
2	6225144	LB 90 1130 R3 FT	90° bend
3	6216548	LVG 110 FT	straight connector
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 216	PE 04	PF 300	Typical-No.: OBO-KTS-300-216	Project No.:	
	Date:	Name:	Description: Product drawing		
Creator:					
Editor:					
Status:			Comment: Cable conductor with 90° bend		
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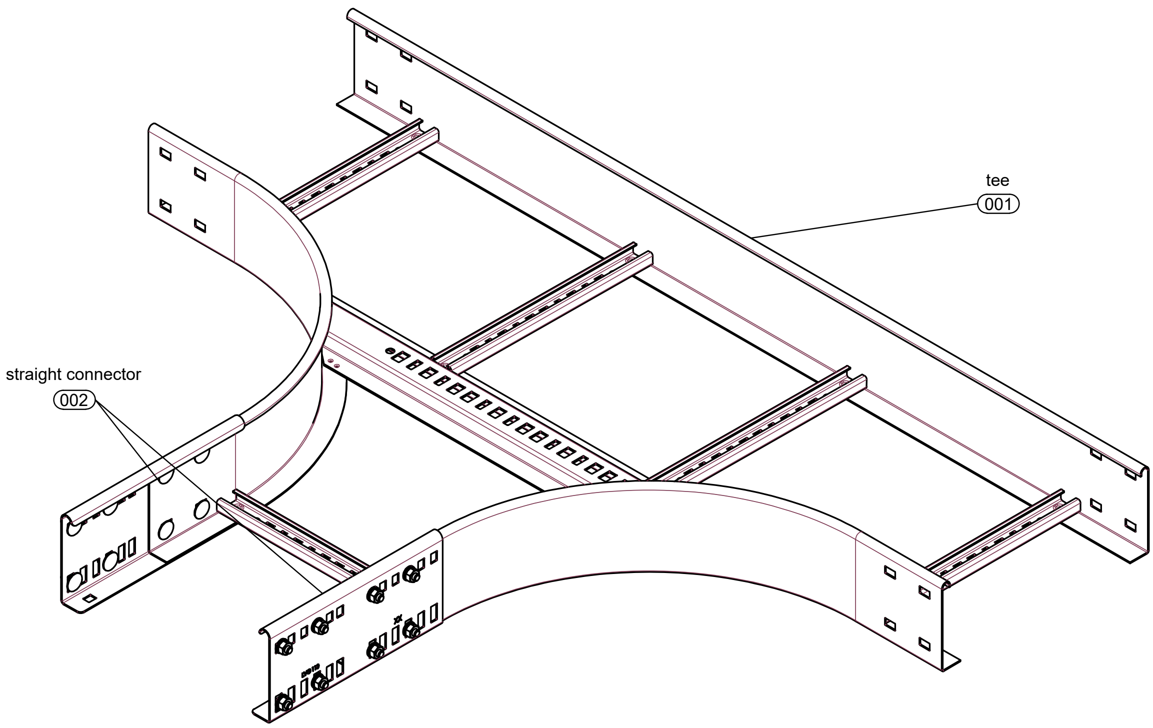
Ind.	Amendment typical	Date:	Name:		



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6225312	LT 1130 R3 FT	tee
2	6216548	LVG 110 FT	straight connector
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 220	PE 04	PF 300	Typical-No.: OBO-KTS-300-220	Project No.:

	Date:	Name:	
Creator:			Description: Product drawing
Editor:			
Status:			Comment: Cable ladder 90° bend with connector

Ind.	Amendment typical	Date:	Name:		
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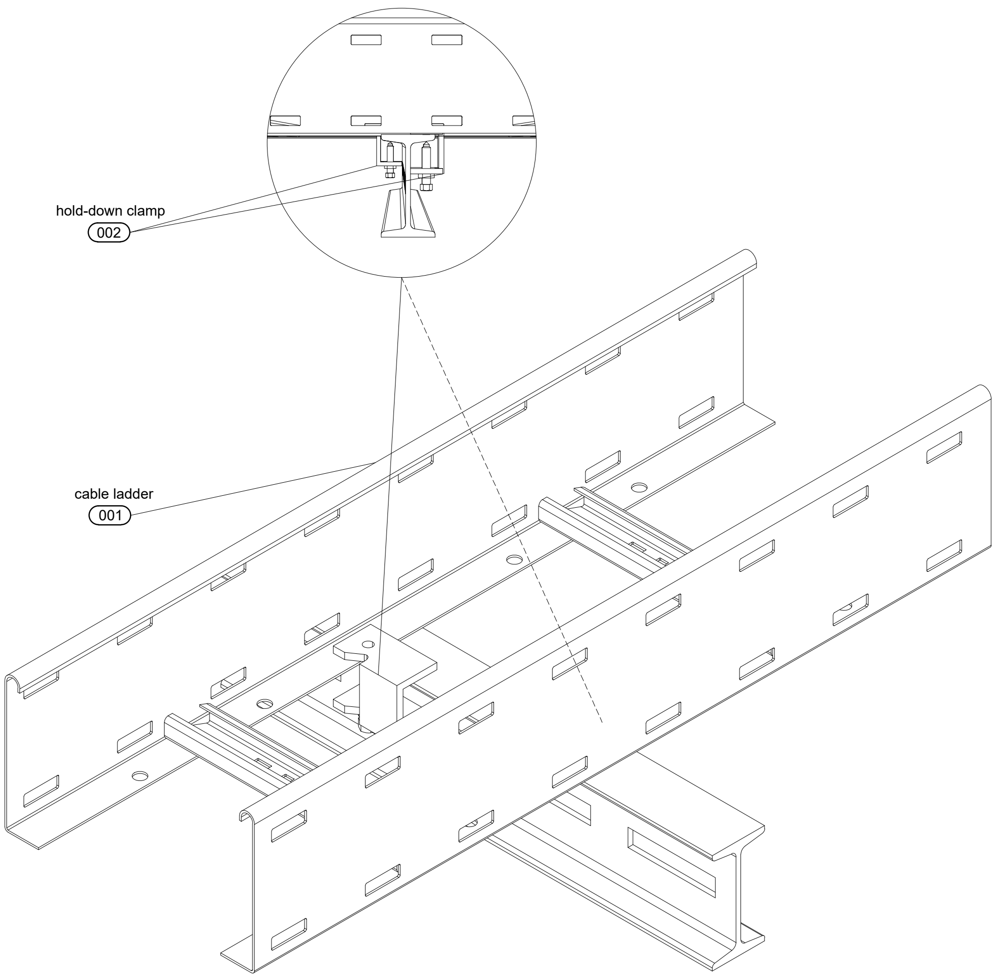

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6216429	LG 114 VS 3 FT	cable ladder
2	6221061	KLL 32 FT	hold-down clamp
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 282	PE 04	PF 300
Typical-No.: OBO-KTS-300-282	Project No.:	

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Cable support structures on steel beams provided by the customer

Comment: Cable ladder directly attached to an H-profile

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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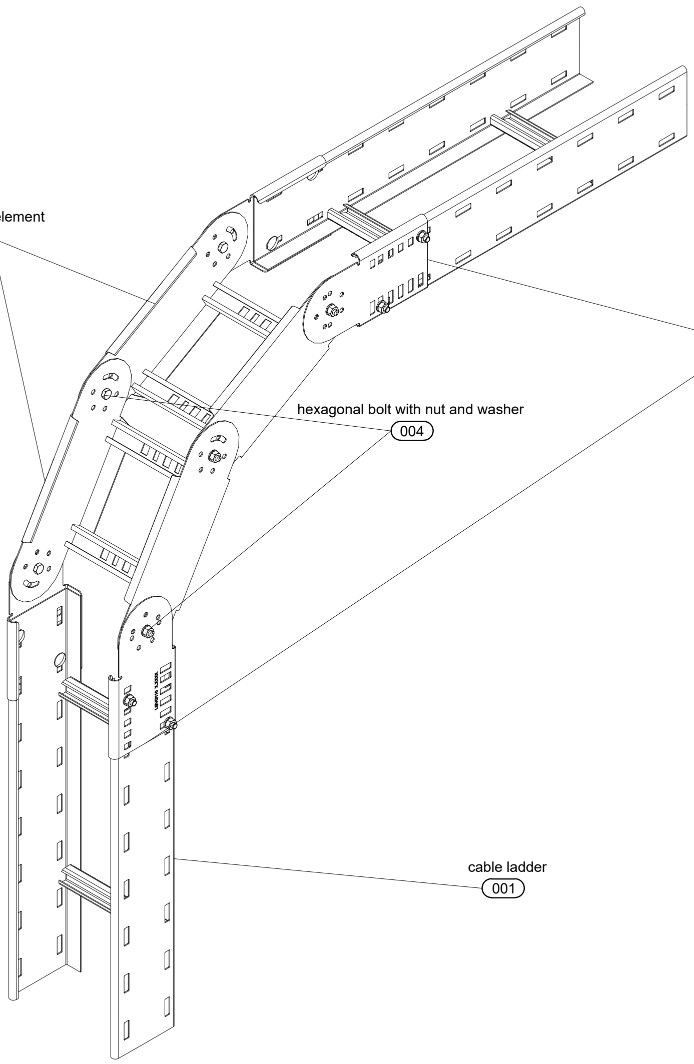

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6216429	LG 114 VS 3 FT	cable ladder
2	6225514	LGBE 1140 FT	articulated bend element
3	6216653	LGVG 110 FT	adjustable connector
4	3158624	SKS 8x16 F	hexagonal bolt with nut and washer
5			
6			
7			
8			
9			
10			

Drawing-No.: 304	PE 04	PF 300	Typical-No.: OBO-KTS-300-304	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Cable ladder with articulated elbow elements as drop sections

Ind.	Amendment typical	Date:	Name:

OBO BETTERMANN

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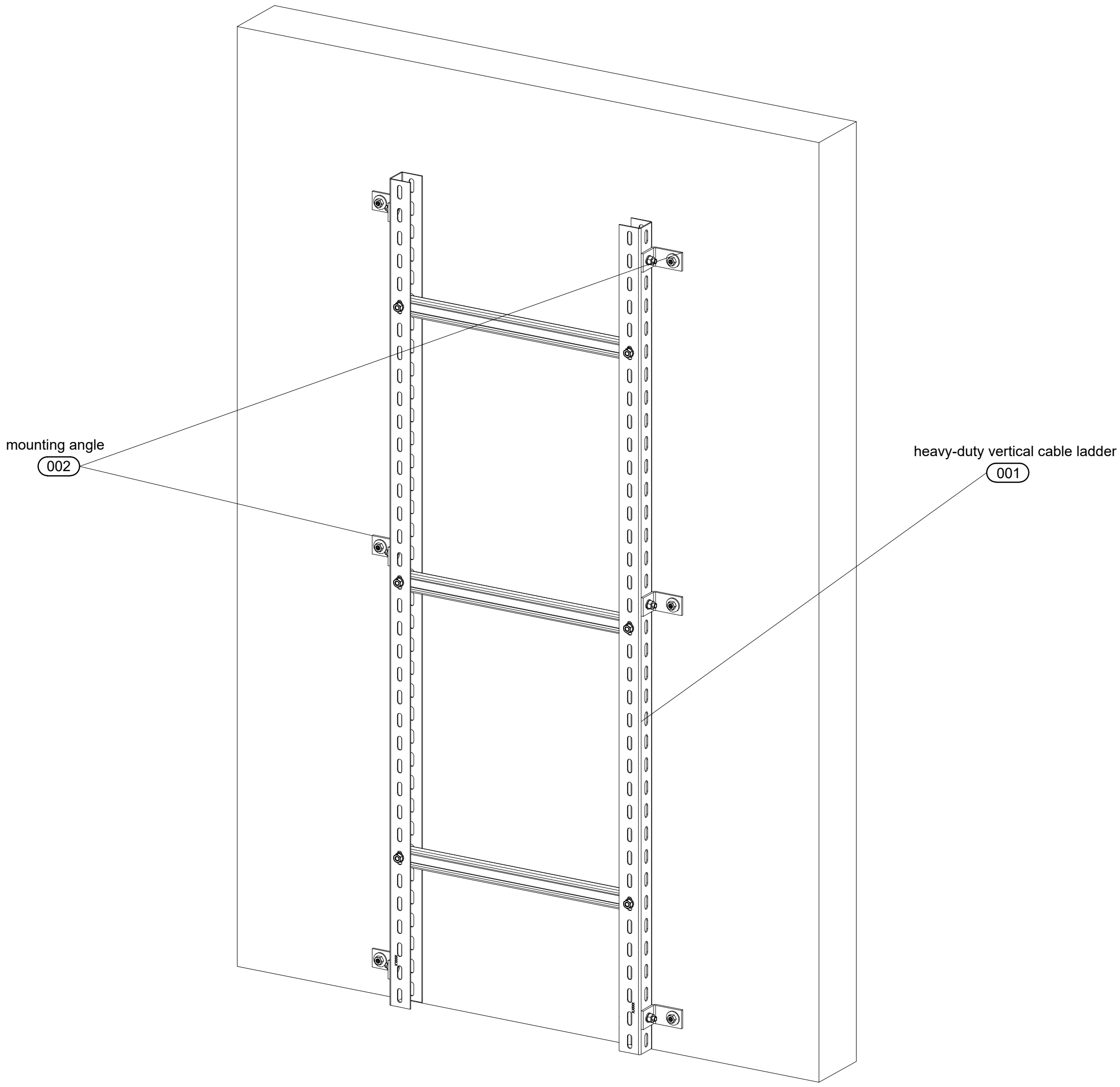

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6010490	SLM 50 C40 5 FT	heavy-duty vertical cable ladder
2	6019706	BW 70 40 FT	mounting angle
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 401	PE 04	PF 300	Typical-No.: OBO-KTS-300-401	Project No.:

	Date:	Name:
Creator:		
Editor:		
Status:		

Description: Product drawing

Comment: Vertical ladder Mounting on the wall

Ind.	Amendment typical	Date:	Name:

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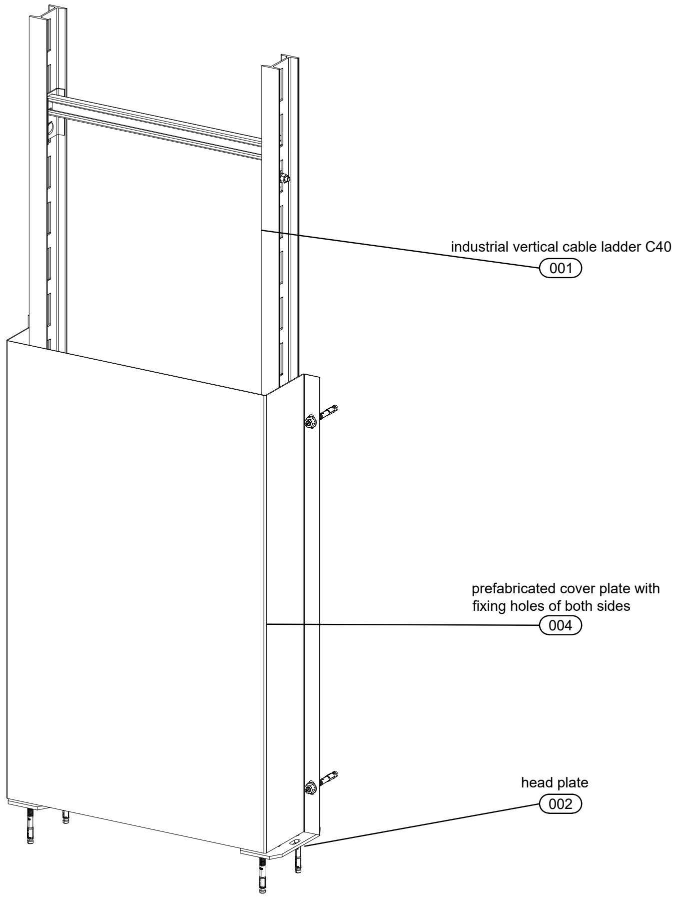

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6013430	SLS 80 C40 7 FT	industrial vertical cable ladder C40
2	6347053	KI 8 FT	head plate
3			
4		prefabricated cover plate with fixing holes of both sides (special solution request)	
5			
6			
7			
8			
9			
10			

Drawing-No.: 531	PE 04	PF 300	Typical-No.: OBO-KTS-300-531	Project No.:	
Date:	Name:	Description: Wall mounting			
Creator:					
Editor:		Comment: vertical ladder to the wall with prefabricated cover as cable protection			
Status:					
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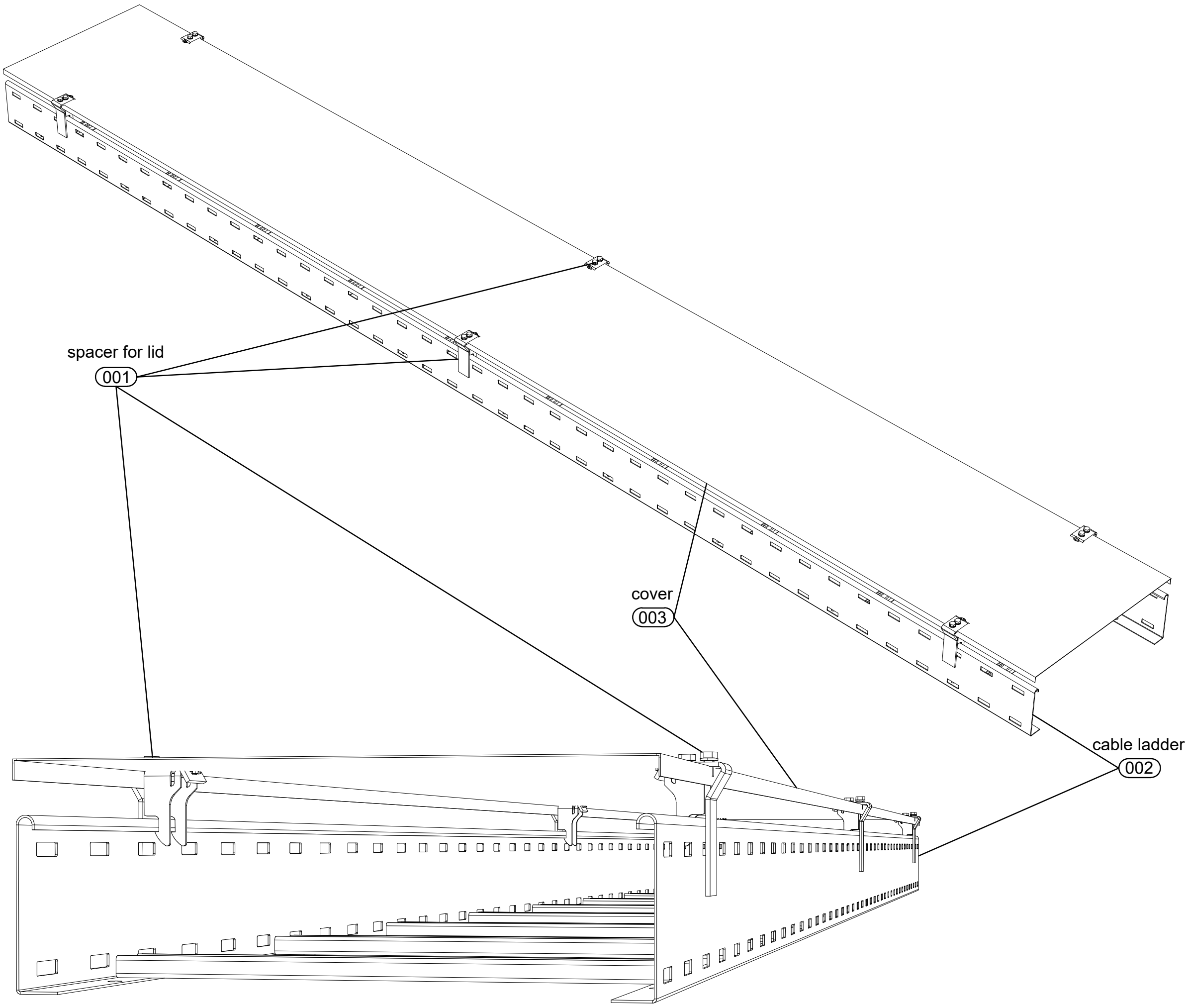
Ind.	Amendment typical	Date:	Name:		



These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6065475	AH 35 A2	spacer for lid
2	6216429	LG 114 VS 3 FT	cable ladder
3	6052715	DRL 400 DD	cover
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 1000	PE 04	PF 300	Typical-No.: OBO-KTS-300-1000	Project No.:

	Date:	Name:	Description: Mounting the cover at a distance
Creator:			
Editor:			Comment:
Status:			

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
					Sheet:	of:

Notes

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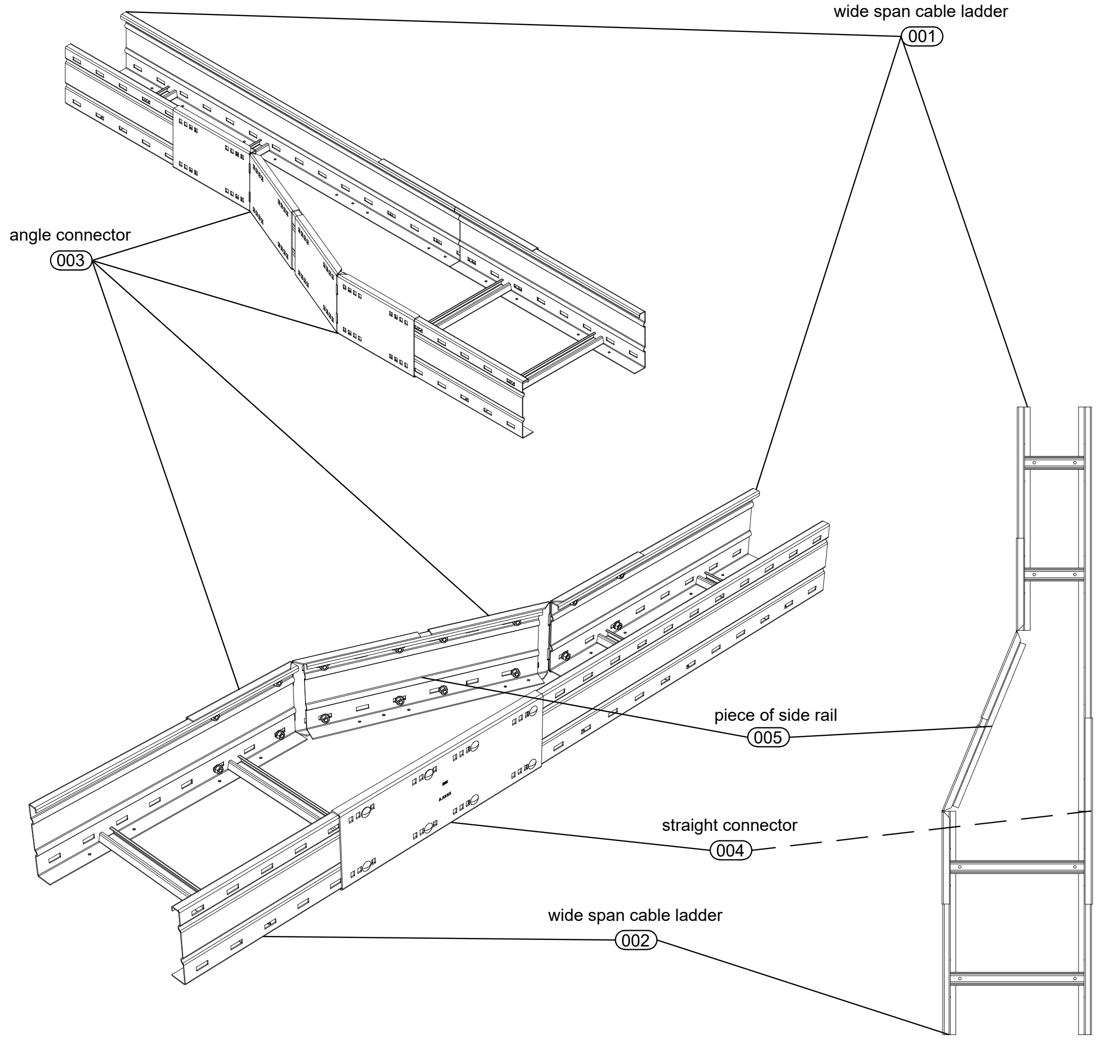

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6227120	WKLG 1620 FT	wide span cable ladder
2	6227147	WKLG 1640 FT	wide span cable ladder
3	6227836	WRWVK 160 A2	angle connector
4	6227716	WRVL 160 FT	straight connector
5			Piece of side rail fitted on customer side
6			
7			
8			
9			
10			

Drawing-No.: 1002	PE 04	PF 320	Typical-No.: OBO-KTS-320-1002	Project No.:

	Date:	Name:	Description: Product drawing
Creator:			
Editor:			Comment: Reducer, straight, Ladder
Status:			

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
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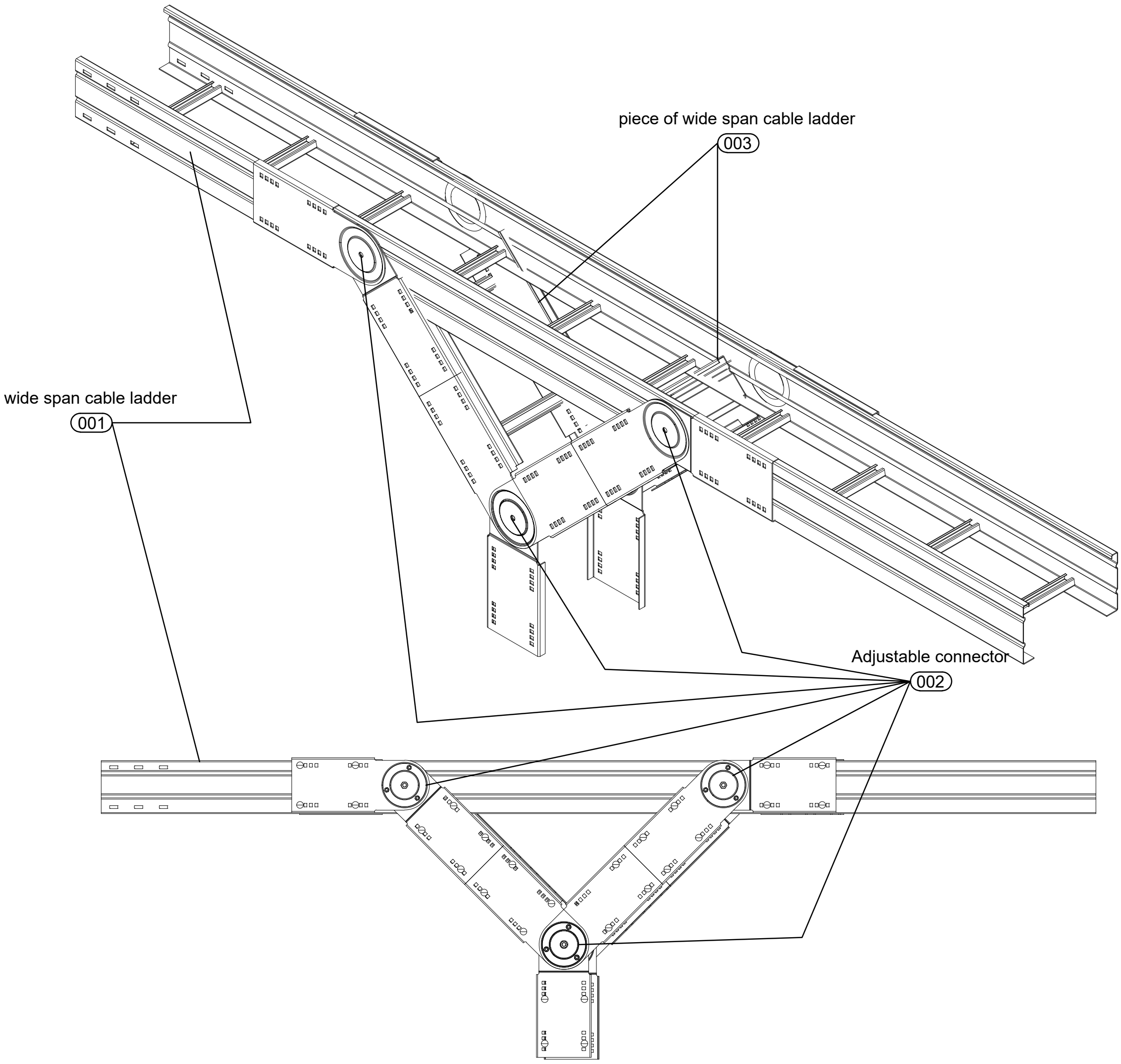

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6227147	WKLG 1640 FT	wide span cable ladder
2	6227961	WRGV 160 FT	Adjustable connector
3			Piece of wide span cable ladder on customer side
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 1003		PE 04	PF 320	Typical-No.: OBO-KTS-320-1003	Project No.:
	Date:	Name:	Description: Product drawing		
Creator:					
Editor:			Comment: Tee, vertical down, Ladder		
Status:					

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
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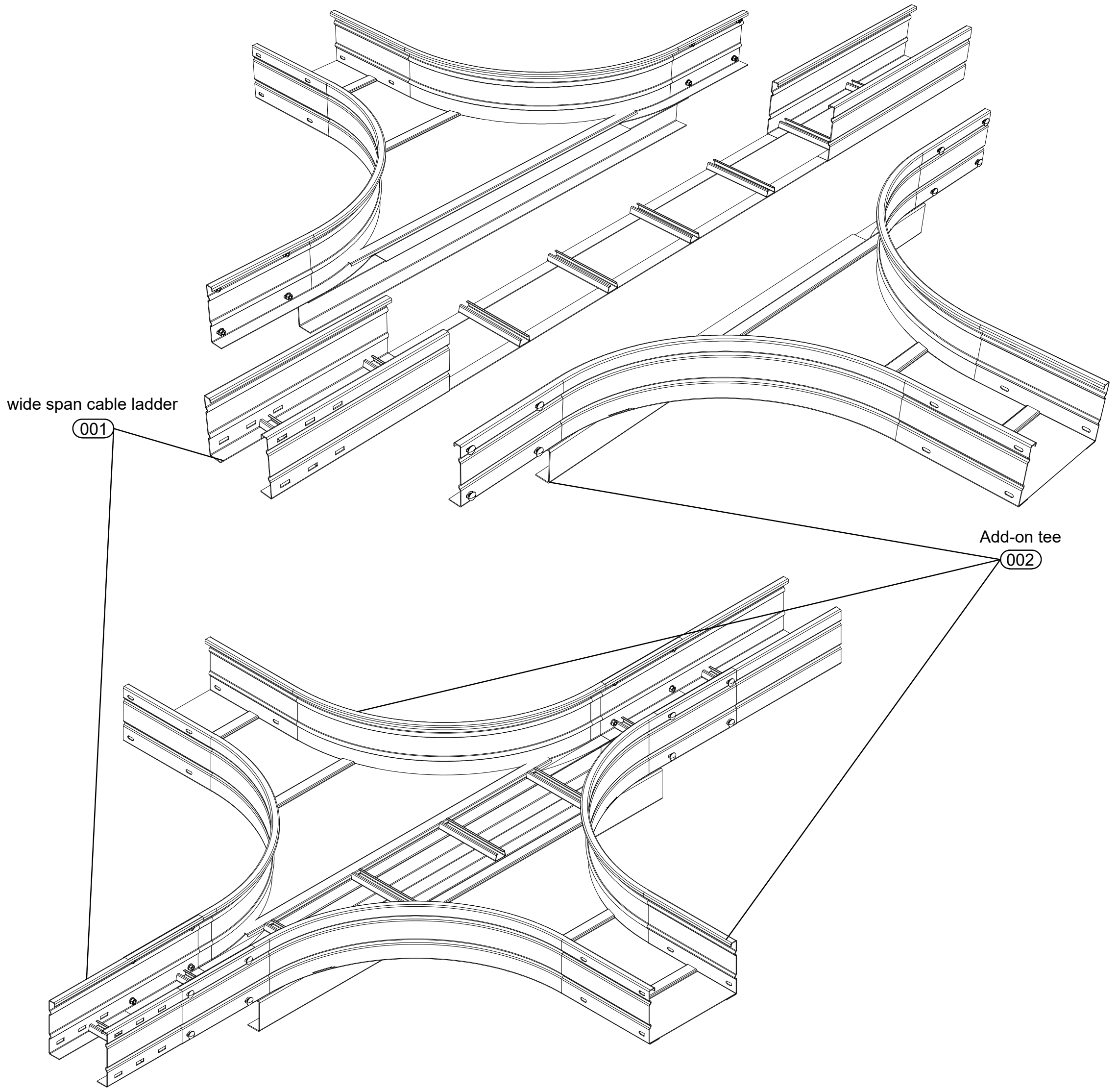

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6227139	WKLG 1630 FT	wide span cable ladder
2	6098835	WRAA 164 FT	Add-on tee
3			
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 1004
PE 04
PF 320
Typical-No.: OBO-KTS-320-1004
Project No.:

Date: Name:
Creator:
Editor:
Status:

Description: **Product drawing**

Comment: Cross element with 2 Add-on tee

Ind. Amendment typical Date: Name:

OBO BETTERMANN

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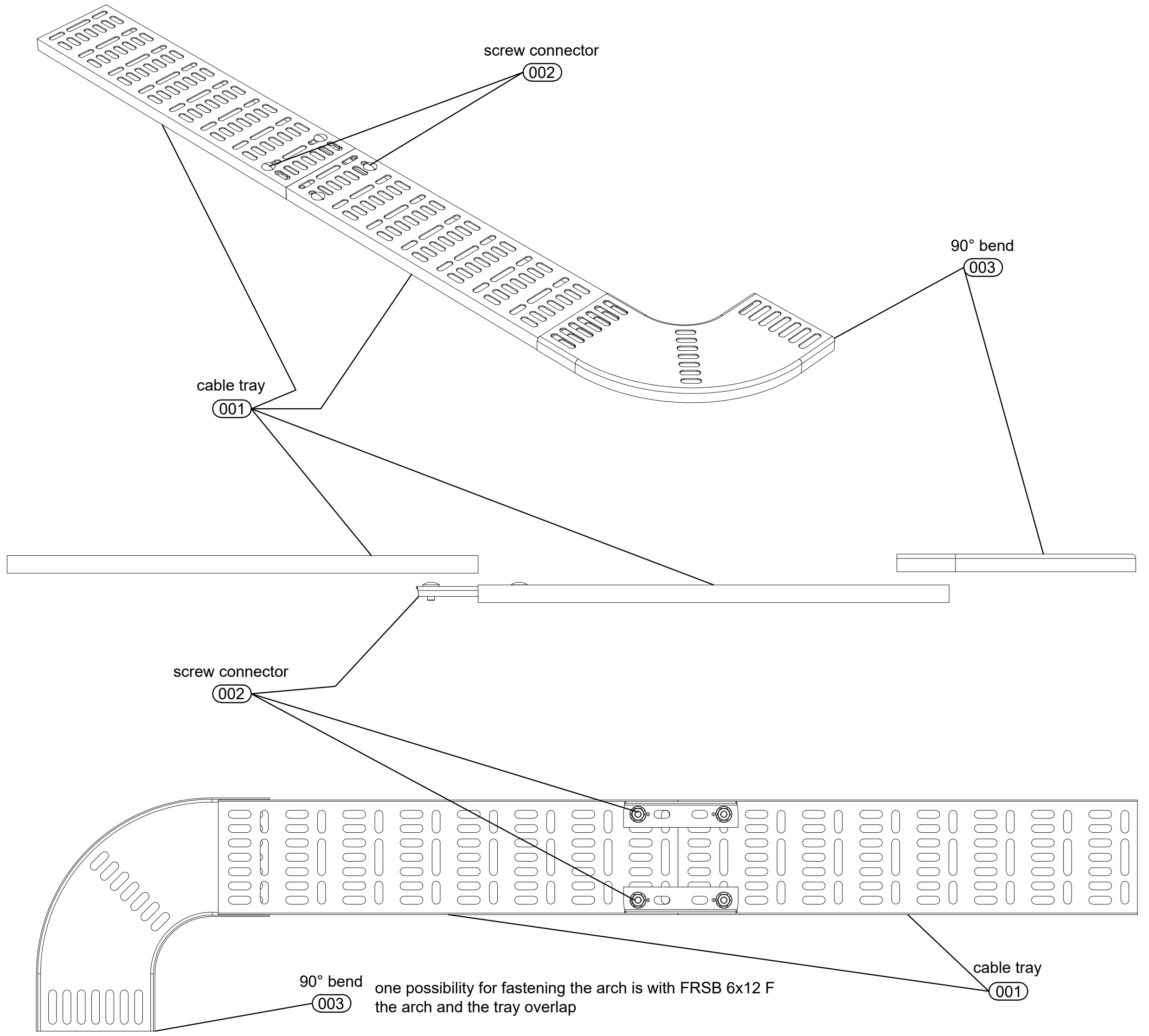

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	6045103	MKR 15 100 FT	cable tray marine standard
2	6066240	MKR SV FT	screw connector
3	7061242	MKRB 90 15 100 FT	90° bend marine standard
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 1000	PE 04	PF 600	Typical-No.: OBO-KTS-600-1000	Project No.:

	Date:	Name:	Description: Product drawing
Creator:			
Editor:			
Status:			Comment:

Ind.	Amendment typical	Date:	Name:	OBO BETTERMANN	Scale:	Sheet size:
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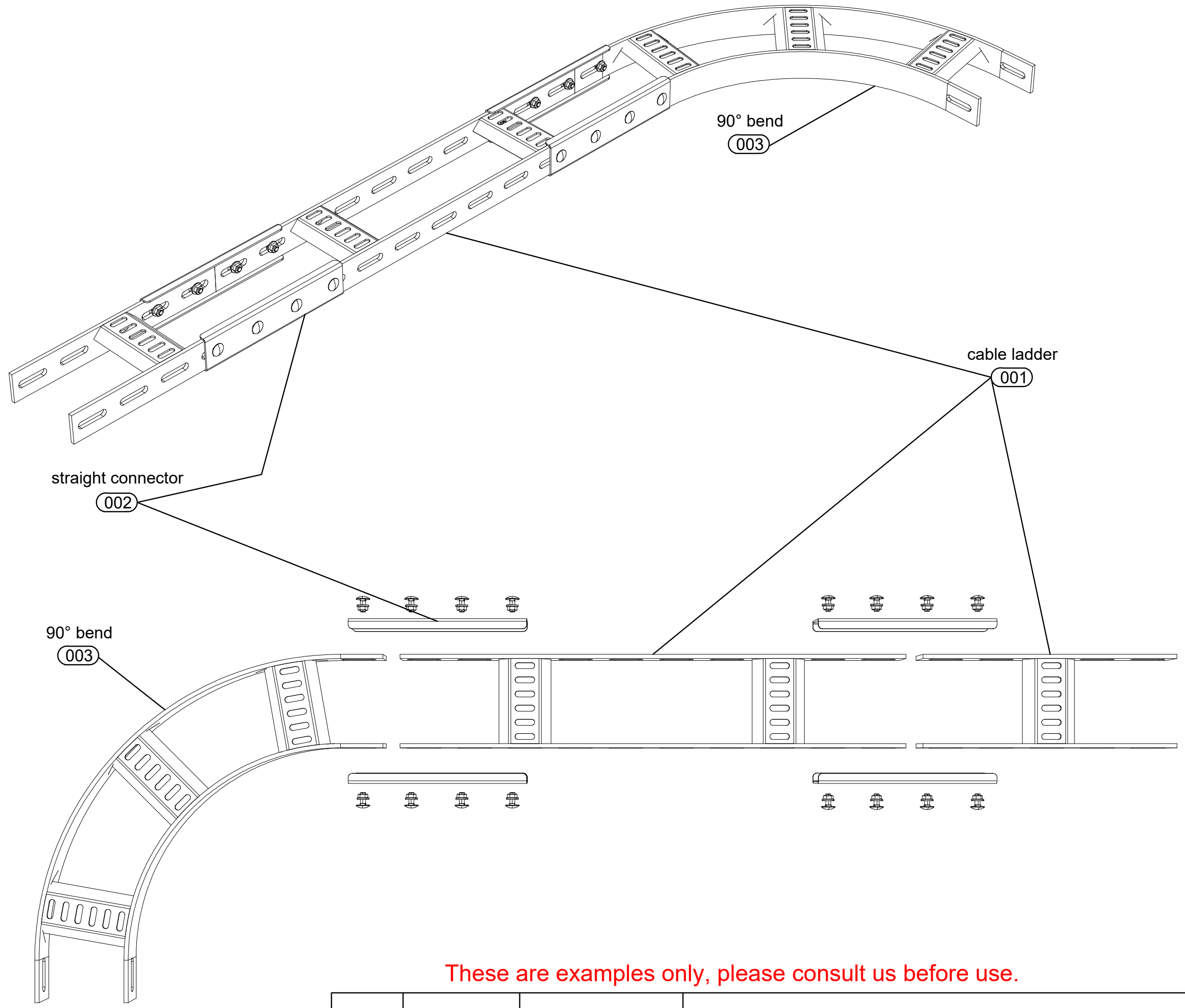

These are examples only, please consult us before use.

	Item No.	Designation	Description
1	7097433	SL 62 300 FT	cable ladder, shipbuilding with trapezoidal rung
2	7103548	SLV 62 FT	Straight connector with bolts
3	7098898	SLB 90 62 300 FT	90° bend with trapezoidal rung
4			
5			
6			
7			
8			
9			
10			

Drawing-No.: 1001	PE 04	PF 600	Typical-No.: OBO-KTS-600-1001	Project No.:

	Date:	Name:	Description: Product drawing
Creator:			
Editor:			Comment:
Status:			

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Building Connections