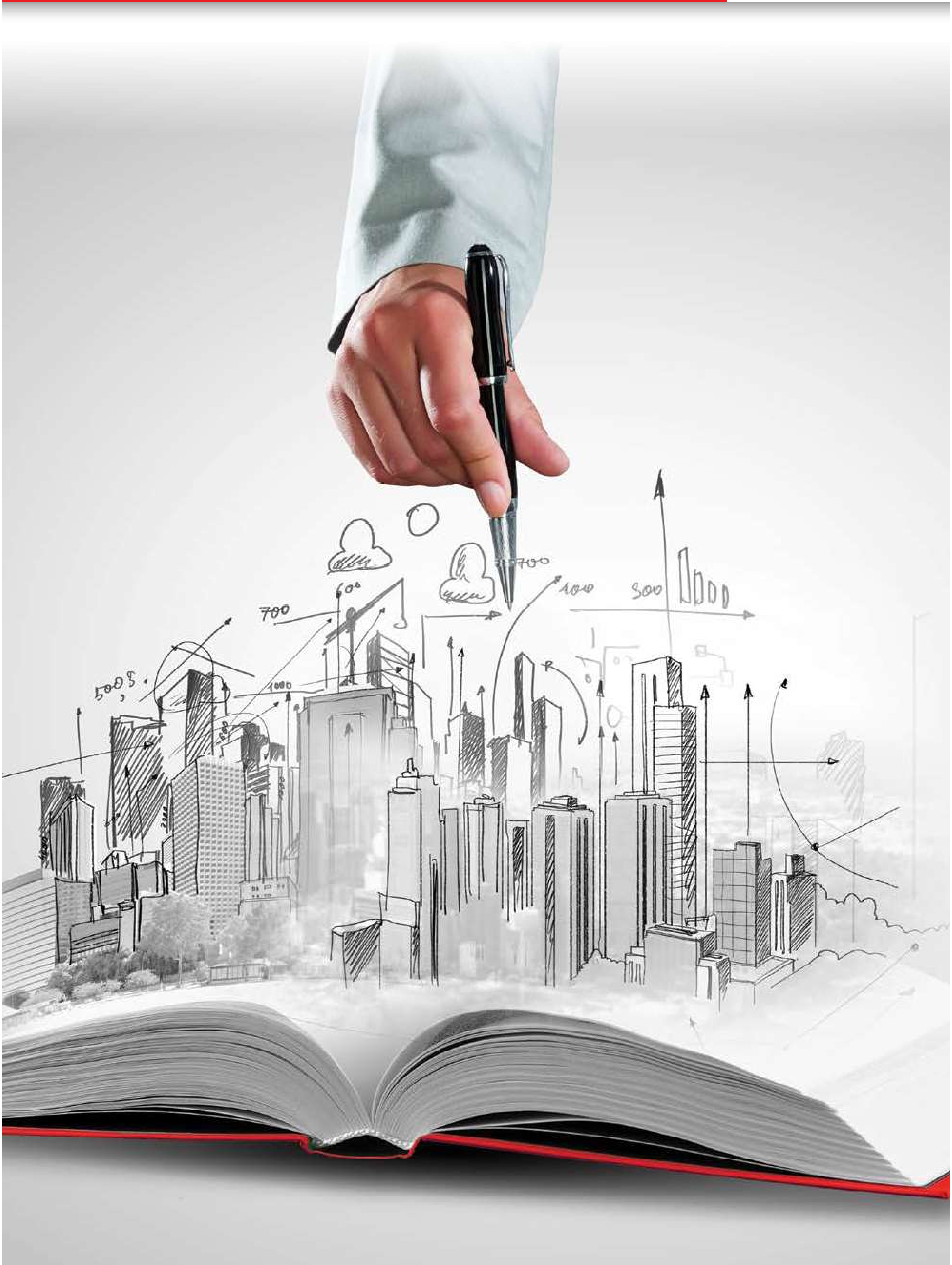
ANNEXURE - fischer Basic Information



Building Material – Concrete

The substrate's quality is crucial when selecting the correct fixing: A differentiation is made between concrete, masonry and panel building materials. Concrete is made from a mixture of cement, aggregates and water.

Concrete's main properties are:

- High level of compressive strength,but only low tensile strength(≈ 10 % of the compressive strength).
- Inserting individual rebars andor mats will increase tensile strength(steel + concrete = reinforced concrete).
- Structure easily reproducible as it isregulated by standards, therefore it isan ideal anchor base.

Concrete is mainly split into two categories:

Standard concrete and lightweight concrete. While standard concrete contains gravel; lightweight concrete contains additives such as pumice, expanded clay or polystyrene® usually with a lower compressive strength or bulk density. This leads to unfavourable conditions for anchor fixings.

The load bearing capacity of heavy duty fi xings depends on the concrete's compressive and tensile strength. This is indicated by the numbers in the abbreviations: e.g. the most commonly used concrete compressive strength is C20/25 with a cube compressive strength of 25 N/mm².

EXPERT TIP

- **Standard concrete qualities:**
  C12/15 to C50/60, even higher grades are also available for special applications. The majority of anchors approved for concrete may only be used from concrete quality from C20/25 up to a max. of C50/60. In the past, designations from DIN 1045 were used in Germany: B25 (≃ C20/25) to B55 (≃ C45/55).
- **C20/25 means:**
  C = concrete
  20 = compressive strength f_{ck} or $f_{ck, cyl}$ of a concrete test cylinder (Ø 150 mm, height 300 mm) in N/mm²
  25 = compressive strength $f_{ck, cube}$ of a concrete test cube (edge length 150 mm) in N/mm²
- **Normal concrete** without accelerating additives reaches its nominal strength after 28 days. Only then can the fixing be installed in compliance with the approval /assessment.
- **Fresh concrete:** still workable up to approx. one hour after pouring.
- **Green concrete:**.elbakrow regnol on ,sruoh ruof retfa nedrah ot strats
- **New concrete:** is hardened after 28 days, however minimum compressive strength not yet reached.
- **Hard concrete:** more than 28 days old, nominal strength reached.

Compressive strength classes in different countries

Country	Specimen	Dimensions [1] [cm]	Concrete strength class	Unit	Standard
China	Cube	15x15x15	C15,C20, C25, C30, C35, C40, C45 C50, C55,C60	N/mm²	GB50010-2010
Denmark	Cube	15x15x15	C12/15, C16/20, C20/25, C25/30, C30/37, C40/50, C45/55, C50/60	N/mm²	DS/EN 206
Germany	Cube	15x15x15	C12/15, C16/20, C20/25, C25/30, C30/37, C40/50, C45/55, C50/60	N/mm²	EN 206
France	Cylinder	16x32	B20,B25,B30, B35, B40, B45, B50	N/mm²	BAEL 91
Great Britain	Cube	15x15x15	C20, C25, C30, C37, C40, C45, C55, C60	N/mm²	BS EN 12390-3:2009
Italy	Cube	15x15c15	C 8/10, C12/15, C16/20, C20/25, C25/30, C28/35, C30/37, C32/40, C35/45, C40/50, C45/55, C50/60	N/mm²	UNI EN 206
Japan	Cylinder	10x20	≥ 15	N/mm²	JIS A 1108
Korea	Cylinder	10x20, 15x30	18, 21, 24, 27, 30	N/mm²	KS F 2405
The Netherlands	Cylinder	15x30	C 8/10, C12/15, C16/20, C20/25, C25/30, C30/37, C35/45, C40/50, C45/55, C50/60	N/mm²	NEN-EN 206-1
Austria	Cube	15x15x15	C 8/10, C12/15, C16/20, C20/25, C25/30, C30/37, C35/45, C40/50, C45/55, C50/60	N/mm²	ÖNORM B 4710-1
Sweden	Cube	15x15x15	C12/15, C16/20, C20/25, C25/30, C30/37, C40/50, C45/55, C50/60	N/mm²	SS-EN206
Switzerland	Cube	15x15x15	C12/15, C16/20, C20/25, C25/30, C30/37, C40/50, C45/55, C50/60	N/mm²	SIA 262
Spain	Cylinder	15x30	Unreinforced concrete: HM-20, HM-25, HM-30, HM-35, HM-40, HM-45, HM-50 Reinforced concrete: HA-25, HA-30, HA-35, HA-40, HA-45, HA-50 Pre-stressed concrete: HP-25, HP-30, HP-35, HP-40, HP-45, HP-50	N/mm²	EHE-08
USA	Cylinder	15x30	2000, 2500, 3000, 3500, 4000, 5000, 6000, 7000, 8000	Psi	ACI 318

(1) Conversion: $f_{Cylinder} = 0.85 \times f_{Cube,\ 20x20x20}$; $f_{Cube,\ 15x15x15} = 1.05 \times f_{Cube,\ 20x20x20}$

EXPERT TIP

- **Anchors** used in **new concrete** must be **suitable** for this purpose, or may only bear loads after reaching the minimum compressive strength.
- **Concrete** always shows **cracks** (shrinkage during hardening, loading).
- **In cracked concrete,** anchors which are tested in cracked concrete must be used. These **anchors** must be able to **expand** when concrete starts to crack e. g. expansion anchors (e. g. FAZ II), form locking anchors or undercut anchors (e. g. FZA), or bonded anchors (e. g. FIS SB).
- **Cutting** through **reinforcement steel** while making **drill holes** is **not permitted.** In special cases, non load-bearing steels can be cut after consultation with the responsible engineer.
- The load bearing capacity of the concrete along the entire drill hole must be guaranteed (no honeycombing in the concrete, no voids and pockets).
- **Pre-stressed concrete:** A certain drilling distance must be maintained from the tensioning strands as stated in the approval/assessment (e. g. FHY, FBS II 6 or EA II).

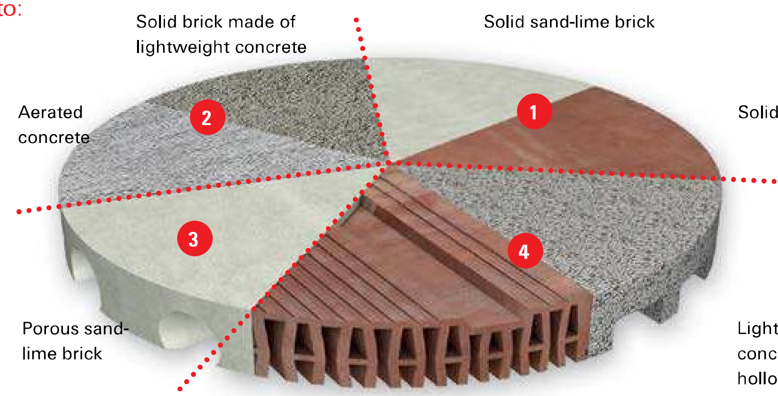
NOTE

Building Material – Masonry

Compared to concrete, there is a larger variety
of masonry building materials.

Masonry can be classified according to:

- Brick type used (e. g. natural stone, lime stone or aerated concrete).
- Wall type (e. g. single or double layer).
- Brick strength class and gross density.



Generally, masonry is classifi ed into four groups:

1 **Solid bricks with a dense structure** are a highly compres-sion resistant building material, without cavities or low hole surface percentage (up to a max. 15 % e. g. as grip holes). This type is very well suited for anchor fi xings.

3 **Perforated bricks with a compact structure** (perforated and hollow bricks) are mostly manufactured from the same compressive strength materials as solid blocks but with cavities. If higher loads are introduced into these building materials, special fi xings should be used (e. g. bonded anchors, FIS V), which bridge or fi ll the cavities.

2 **Solid bricks with porous structure** usually have a very large number of pores and low compressive strength. Therefore, special fixings should be used, e. g. fixings with a longer expansion zone or bonded anchors.

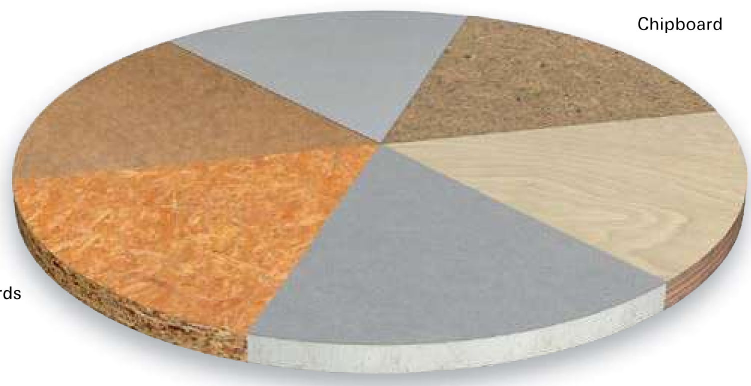
4 **Perforated bricks with porous structure** have many cavities and pores and thus generally a low compressive strength. In this case, special care is required when selecting the fi xing. Suitable fi xings include those with a long expansion zone or form locking injection anchors.

EXPERT TIP

- Before **fixing in masonry,** determine which brick type (designation, size, compressive strength) and mortar type (mortar category) has been used.
- For **safety anchoring** in unknown or old masonry, pull out tests must be carried out on-site to determine the anchor load bearing capacity.
- For **fixings close to the edge,** it is important to know if the wall is a load bearing wall as this prevents the risk of brick pull out.
- Even **solid brick** can have holes (e. g. MZ, KS). The holes are mostly larger grip-holes in the centre of the brick (up to max. 15 % cavity proportion per brick).
- Always drill without hammer function in **perforated and hollow bricks.** Here, special, sharply ground drills with hard metal tips are suitable.
- **Plaster or other non load-bearing layers** may not be added to the load-bearing base and are not to be used in calculating the anchorage depth.
- **Avoid anchoring into masonry joints** as much as possible due to joint inhomogeneity. If anchoring into a joint cannot be avoided (e. g. plaster on masonry) loads should be reduced.
- For **systems approved by building authorities, anchoring in joints** (vertical or horizontal joints) is regulated in the approval notices.
- For **anchoring high loads** in performated bricks, the anchorage depth should be increased.
- **Expansion fixings** (e. g. FAZ II or FBN II) are not suitable for use in masonry due to its high expansion forces which may lead to cracks in the brick. Frame fixings are suitable due to its longer expansion part.
- **Bonded anchors** achieve the highest possible loads in masonry.

Building Material – Drywall Panels

Panel building materials are thin-walled materials that often have limited strength – e. g. plasterboard like “Rigips”, “Knauf”, “LaGyp”, “Norgips”; Gypsum fi breboard like “Fermacell”, “Rigicell” or chip board, hard fibre boards, plywood and others.



The main characteristics of panel building materials are:

- Often thin-walled materials, mainly with limited strength.
- Easy-to-process materials for non load-bearing walls and also used as cladding material (e. g. walls, roofs or ceilings).
- A wide range of different building materials.

Special fixing elements must be used:

Cavity fixings are fixings made of plastic or metal, whichanchor by form locking into the material, e. g. by knotting or a snap on mechanism (e. g. toggles).

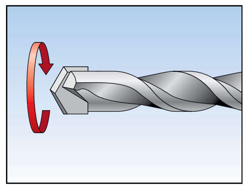
EXPERT TIP

- Only approved anchors should be used for **lightweight materials, prestressed hollow core slabs and panel materials.**
- Contact your **fischer consultant** on site before anchoring **heavy or safety-relevant loads** in the above-mentioned substrates.

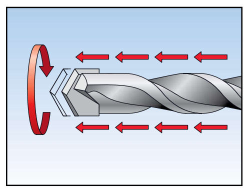
NOTE

Drilling

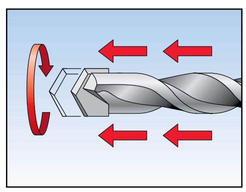
The building material determines the drilling method.
Five methods are possible:

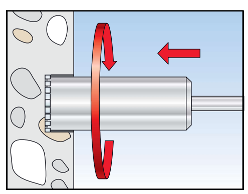
Rotary drilling
Rotary drilling without impact, uses a sharply ground carbide drill bit. When this method is used, the drill hole does not become too large and the perforated brick´s webs do not break.

Impact drilling (mechanical)
Impact drill with rotation and a high number of light strokes, is suitable for dense structured building materials.

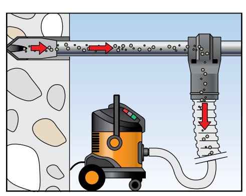



Hammer drilling (pneumatic)
Hammer drill uses rotation and a low number of light strokes with high impact energy, also suitable for dense structured solid building materials.

Diamond or core drilling process
Mainly used for larger drill hole diameters or for heavily reinforced components and/or if noise or vibration must be reduced.





Hollow drilling
Special drill with a hollow core, which is connected to a vacuum cleaner. Cleans the drilled hole during the drilling operation. No further brushing or blowing is required. Can be used in concrete and masonry with dense structure.

EXPERT TIP

- The drilling method for approved anchors is specifi ed in the **approval/ assessment.**
- Drill bits with **excessively worn cutting** edges should **not be used** (see approval/assessment).
- For certain fixings, **special drills** are required (e.g. a stop drill) as per approval /assessment.
- **Drill holes** must be **carefully cleaned** (blown out and brushed). See the respective approval/assessment or manufacturer's specifi cations.
- The **drill hole depth** is always exacly specified and relates to a given anchoring base thickness. For general applications without an approval/assessment the following applies: the drill hole depth + 30 mm should not exceed the anchoring base thickness.
- In case of **incorrect drilled** holes (hitting reinforcements or wrong location), the location for the new drill hole is regulated in the applicable fixing approval /assessment). Usually, the distance for the new drill hole must be twice the depth of the incorrect drill hole. The wrong drill hole must be fi lled with injection mortar (e. g. FIS V).
- **Diamond core drilling** is only permitted if stated in the approval/assessment or according to manufacturer's guidelines (e.g. RSB, FIS EM Plus, FAZ II, FBS II...).
- **The load bearing capacity is reduced** by water filled holes or wet substrates especially for chemical or plastic fixings.
- **Cutting** through a reinforcement is not permitted.
- **The drill hole** must be drilled perpendicular to the anchor base (an inclinement of up to 5° is permitted). Exceptional cases are regulated in the anchor approval /assessment and or according to manufacturer's guidelines.

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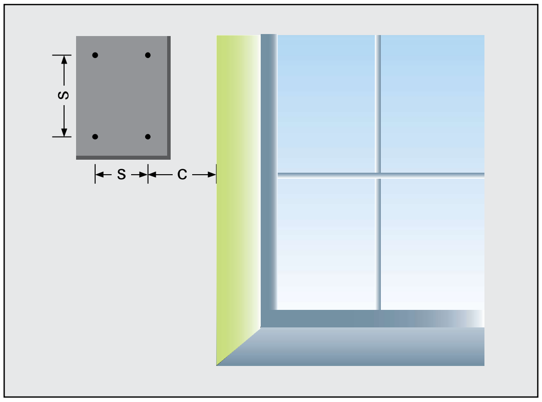
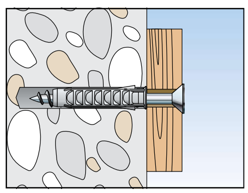
Installation

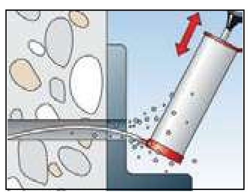
In general, the following aspects must be taken into consideration during installation:



The edge distance and centre distance, as well as the component thickness and width, must be carefully observed to ensure that the fixing can take the required load. Otherwise, it may lead to spalling of the construction material or cracks. For fixings without approval, e.g. nylon fixings, a minimum edge distance of c = 1 x h_{ef} (h_{ef} = anchorage depth) and a minimum spacing of s = 1 x h_{ef} must be adhered to for concrete. When using non approved metal anchors, a minimum edge distance of c = 1.5 x h_{ef} and a minimum spacing of s = 3 x h_{ef} must be adhered to. When using hammerset anchors, spacing and edge distance can increase due to higher expansion forces.



The drill hole depth must be larger than the anchorage depth (exception chemical anchor systems), to ensure that the screw has enough room at the end of the fixing element to penetrate at least one time the screw's diameter.



Drill hole cleaning after drilling, e.g. by blowing out, brushing or suction, is generally necessary. The load bearing capacity will be reduced, if the hole is not cleaned. (Exceptions: approved anchor systems where no hole cleaning is required, e.g. FHB II + PF - High speed capsule).

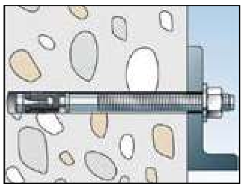
EXPERT TIP

- **Strictly adhere to specifications** for component geometry, edge and spacing distances. If this is not taken into account, the component will be damaged or the anchor capacity will be reduced.
- **Drill hole cleaning is essential.** The specifications in the approvals and the manufacturer's specifications must be observed.

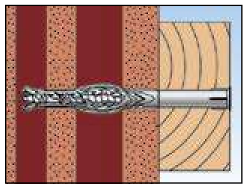
NOTE

Installation types

There are three different types of installation.



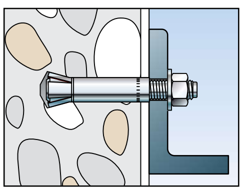
Anchor bolt FAZ II



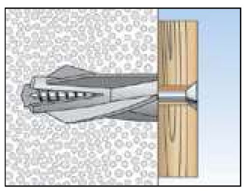
Frame fixing SXRL

Push-through installation
In particular for simplifying installation for series installations or for attachments with two or more fixing points:

- If the attachment's hole diameter is larger than the drill bit diameter, then the attachment can be used as a template. Please note: The drill bit tip is generally larger than the nominal diameter of the drill.
- In addition to facilitating a simple installation, an exact fit is also achieved.
- The fixing is inserted into the drill hole through the attachment and then tightened (e.g. FAZ II, FBN II, FH II).



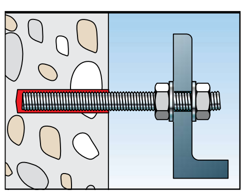
Zykon anchor FZA



Aircrete anchor GB

Pre-positioned installation
The anchor is installed before fastening the attachment. If drilling is not done precisely, then the holes in the attachment will not match up. This could mean that the anchors cannot be installed or could cause damage to the anchors. The installation sequence:

- Transfer the hole pattern of the fixture to the anchor base.
- Drill and clean the holes, install the attachment and then fix the attachment (e.g plastic fixings: S, SX, UX; metal fixings: FZA, EA II).



Threaded rod FIS A

Stand-off installation
This allows attachments to be compression and tension resistant at a certain distance from the anchor base. For this purpose, external threaded metal anchors (e.g. FAZ II, FBN II) or internal threaded anchors (e.g. EA II) with screws or threaded rods are clamped against the anchor base surface while using a bearing washer and nut. When using chemical systems with threaded rods (e.g. FIS SB, FIS V, FIS EM Plus, and FIS A), the installation can be done without using a bearing washer and nut.

EXPERT TIP

- **Clearance holes in the attachment** are specified for the respective anchor size in the approvals/assessments and manufacturer's guidelines.
- **For stand - off** installations with shear loads on the anchor, additional bending moment occurs and this must be considered.
- **The attachment must lie** fully flush on the surface base or it must have either a compression resistant levelling layer of max. 3 mm or half the anchor's diameter, otherwise the anchor must be checked for bending.
- **The attachment shall be in contact with the anchor** over its entire thickness, otherwise the anchor must be checked for bending.
- **Usable length is the maximum fixing height** t_{fix} which takes into account the attachment's thickness plus additional non-bearing layers (e.g. plaster, air, insulation etc.).
- Post-installed anchors must be tightened with a specific torque. A calibrated torque wrench must be used to ensure the correct pre-stressing force and the correct installation of the anchor. For **chemical anchors, the prescribed hardening time must be adhered to** before tightening torque or service load can be applied.
- Anchors must be mounted as a standard unit as delivered. The exchange or removal of parts is not permitted.

Loads

When selecting an anchor, it is necessary to know the load on the total construction and the resulting action forces.

Action forces can differ based on:

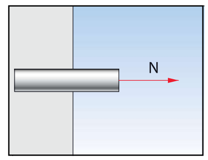
Dimension ▪ Direction ▪ Type of load ▪ Point of application

There are various types of loads:

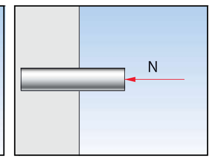
Approvals generally give characteristic resistance. In the manufacturer´s guidelines, **"permissible loads"** are specified for products with approvals. For anchors without an approval, **"recommended loads"** are given by the manufacturer.

- **Determine the size,** direction and point of application of the load. These parameters determine which anchor should be used.
- **Characteristic resistance** (N_{RK} or V_{RK}) describes the 5 % fractile of resistance. (Value with a 95 % probability of being exceeded, with a confidence level of 90 %).
- **Permissible loads** are working loads that already include an appropriate safety factor. These only apply if the approval conditions are complied with (N_{zul} or V_{zul}).
- **Recommended loads or maximum working loads** include an adequate safety factor. These only apply if the manufacturer´s specifications are complied with (F_{rec} – valid for all load directions, N_{rec} - for compressive or tensile load or V_{rec} for shear load).
- **The calculation** is carried out by dividing the respective failure load or characteristic loads by a safety factor.
  Recommended safety factors compared to the average failure load:
  Steel and bonded anchors $\gamma \geq 4$
  Plastic anchors $\gamma \geq 7$
  Hammerfix anchors N $\gamma \geq 4$
- **Recommended safety factors compared to the characteristic failure loads:**
  Steel and bonded anchors $\gamma \geq 3$
  Plastic anchors $\gamma \geq 5$
  For deviations to the regulation, see load tables. For certain products, the safety factors may deviate. In general, the global safety factor is calculated using the scatter of the faillure load, the failure probability and the reliability index of a product.
- **The specified loads** apply to individual anchors that are installed away from the edge, i.e. there is no influence from edges or other anchors.
- **The characteristic spacing and edge distances,** marked with $c_{cr,N}$ and $c_{cr,V}$, give the distances at which an anchor achieves its max. characteristic load.

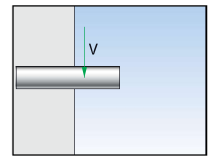
Load directions



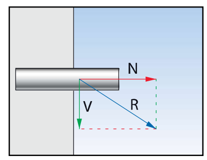
Tensile load



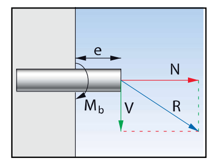
Compression load



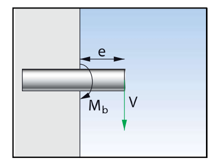
Shear load



Oblique load (tension and shear load)

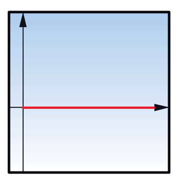


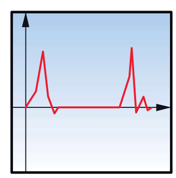
Oblique load at distance e (Bend + tension + shear load)

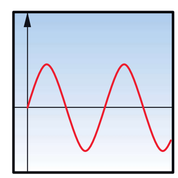


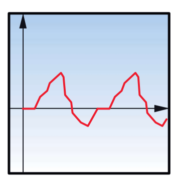
Shear load and bending moment

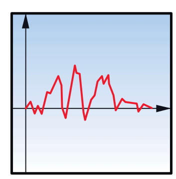
Types of loads


statically dormant


dynamically rising


dynamically changing

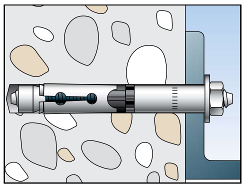

shock

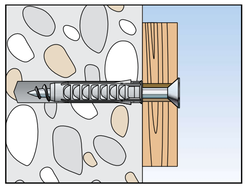

seismic activity

- **The specified minimum spacing and edge distance,** marked with s_{min} and c_{min}, indicates the distance at which no failure of the building material will occur when installing the anchor (cracks). These distances are mandatory and must be complied with. The characteristic spacing and edge distances may be shorter but not less than the minimum values but at the same time the load bearing capacity must be reduced. When combined loads occur, loads are determined separately for tensile and shear load and the overall utilization is determined by means of an interaction equation. As a rule, the sum of the ratio values from tensile and shear loads is less than 1.2.

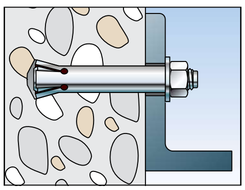
Working Principles

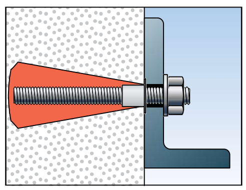
There are different load transfer mechanisms which induce forces acting on the anchor in a building material.


Sleeve anchor (e.g. FH II)

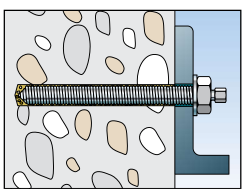

Plastic anchor (e.g. SX)

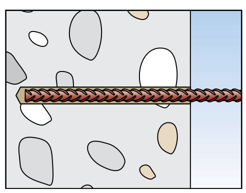
For frictional locking, the expanding part of the anchor is pressed against the drill hole wall.


Undercut anchor (e.g. FZA)


Injection anchor (e.g. FISV with cone drill PBB)

For form locking, the anchor geometry adapts to the subtrate's form or drill hole shape (e.g. conical drill hole).


Resin anchor
(e.g. Superbond RSB)


Subsequent reinforcement connector with concrete reinforcing bars

For adhesive bonding, the load will be transferred by a combination of adhesion and micro-keying (e.g. using resin / injection mortar).

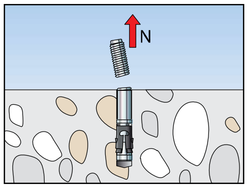
EXPERT TIP

For many fixings, a combination of working principles occurs (e.g. in soft base material a combination of friction and form locking takes place).

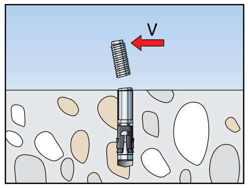
NOTE

Failure modes

If there is excessive stress, incorrect installation or a substrate with inadequate load bearing capacity, the following types of failure can occur.

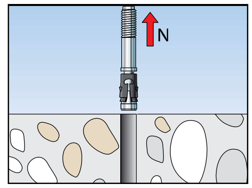


Steel failure tension

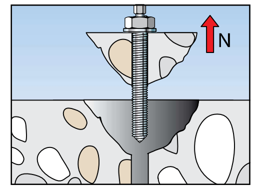


Steel failure shear

Steel failure:
- Insufficient steel stength for the applied load



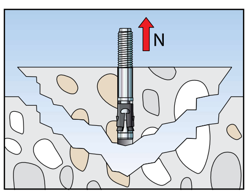
Pull out



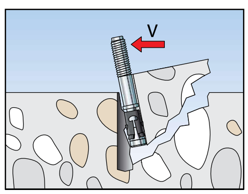
Combined failure

Pull out failure:
- Friction failure and or adhesion failure due to high load or incorrect installation

Combined failure:
- Pull out
- Concrete failure near the surface

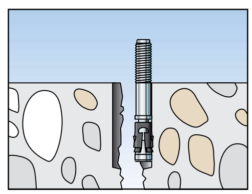


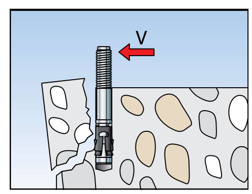
Concrete cone failure



Pry-out failure

Anchor base failure:
- Tensile load "N" or shear load "V" too high
- Inadequate strength of anchor base
- Insufficient embedment depth


Concrete splitting failure



Concrete edge failure

Anchor base splitting:
- Insufficient component dimensions
- Deviation from the spacing and edge distances
- Excessive expansion pressure

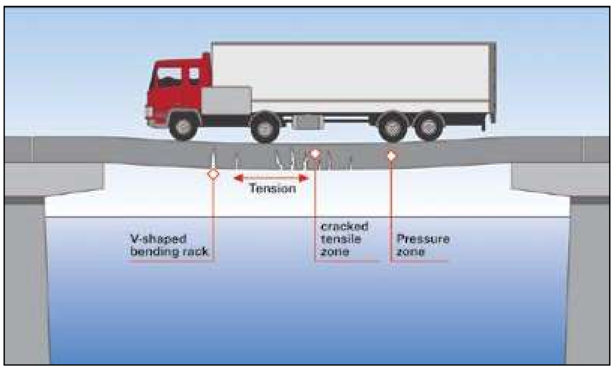
EXPERT TIP

- In most anchor approvals/assessments, the anchoring of **predominately static loads** is regulated. However, there are also approvals which regulate non-static loads (fatigue loads, e.g. FHB dyn).
- Seismic loads for post-installed anchors are regulated in Europe according to ETAG 001 Appendix E. The assessment is to be carried out in accordance with EOTA TR045 until the Eurocode 1992-4 is introduced. The seismic performance of an anchor system is categorised by performance categories C1 and C2. The classification of the seismic performance categories C1 and C2 for seismicity level and the evaluation category is the responsibility of the respective Member State (in Germany, an approval in accordance with ETAG 001 is sufficient. Classification in accordance with C1 and C2 is not necessary). The performance category and the characteristic values are found in the respective ETA (e.g. FAZ II, FH II, FIS SB, FIS EM Plus...).
- **The main causes for anchor failure are overloading, incorrect installation or an insufficient load bearing anchoring base.**

NOTE

Cracks in concrete components

Cracks can occur anywhere in concrete at any time:
Factors involved in this are loads such as dead loads,
traffi c or windloads, concrete shrinkage and creeping or
external infl uences such as seismic activity or ground motion
result in stresses and deformations thus leading to cracks.



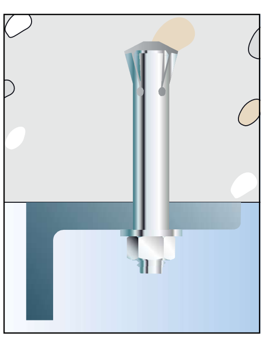
Example:
If a bridge designed as a single-span element is loaded, the bridge will buckle. Due to this buckling, cracks could occur in the element's tensile area.

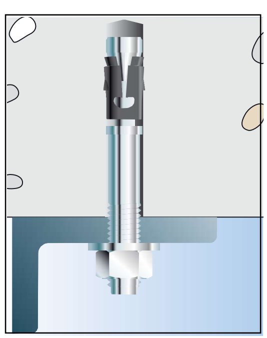
Concrete is not able to support tensile loads, therefore, reinforce-ments are placed in the element to take the tensile load area numerous cracks are formed that are barely visible to the naked eye. This is called the cracked tensile zone.

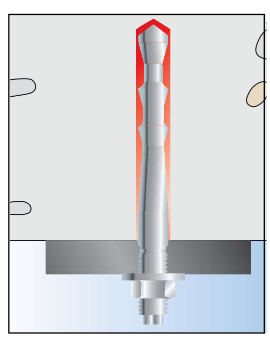
Suitable anchor systems for cracked concrete

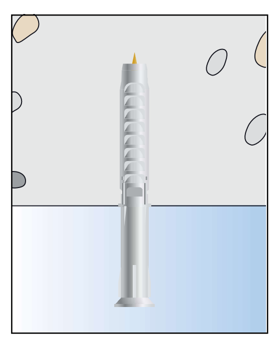
When fixing in concrete, **cracks** are always **expected in the anchoring area which will have an impact on the load bearing capacity** of the anchor system. However, it is very complicated, if not impossible, to prove whether the concrete is cracked or not cracked.

For safety reasons, designers and craftsmen should **always use anchor bolts which are suitable for cracked concrete.** Fixings with an approval/assessment according to ETAG 001 for cracked concrete have proven their suitability in cracks, therefore they can be used without any restrictions in tensile and compres-sion zones of a concrete member.


Undercut anchor FZA


Bolt anchor FAZ II


Threaded rod FHB II


Frame fixing SXS

Due to safety reasons, always use crack-suitable anchor systems such as FAZ II,
FH II, FHB II, FIS SB, FIS EM plus or FIS V.

Fire protection – Fundamentals

General requirements of building structures
for fire protection.

Structural installations

Structural installations are to be ordered, erected, changed and brought into commission in such a way that:

- the emergence of a fire is prevented from breaking out.
- the spread of fire and smoke (spread of fire) is prevented
- in the event of a fire, the rescue of people and animals is possible.
- eff ective fi re-fi ghting operations are possible.

German regulation

In Germany, the procedure for construction and operational fi re protection are specified by the fi re protection standard DIN 4102, the Model Building Ordinance (MBO), Regional Construction Ordinances (LBO) and various trade-specifi c regulations from professional associations.

The following applies as per Section 1 and 2 of DIN 4102:

Building materials such as **concrete, wood, stone, metal** etc., are classified according to their behaviour **into fl ammable or non-flammable building material classes.**

However, **components composed** of different **flammable and non- flammable materials** are not classified into fire classes in building construction but they are evaluated as a complete system according to their fi re resistance duration. The fire resistance duration R is indicated in minutes and classified according to two categories:

- **Components with a fire resistance duration** of R30 and R60 are fire inhibiting.
- **Fire-resistant,** are all components with a fire resistance duration of R90, R120 and R180.

Tested systems such as cable, ventilation or duct systems are not only tested for fire resistance, but also for functional capability in the event of fire (e.g. supply lines to sprinkler systems). The fire resistance duration of these systems is e.g. E30 to E120 for electrical cable systems or L30 to L120 for specifi ed ventilation ducts. The anchors that are used to fasten these systems must have at least the same fire resistance duration.

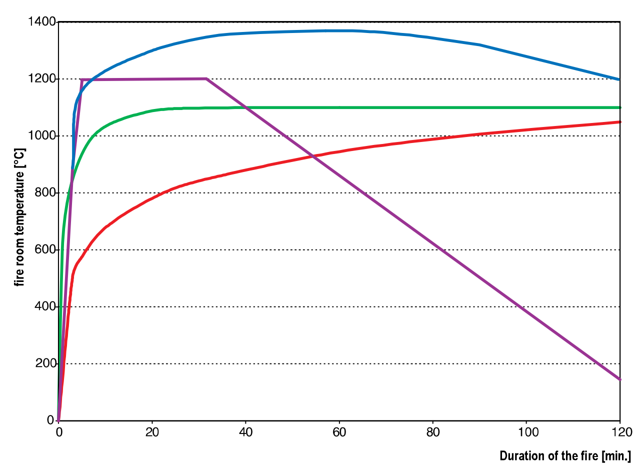
European standardisation

In accordance with the European Norm DIN EN 13501-1, the classifi cation of fi re behaviour of building materials / products is similar to that of DIN 4102. The classifications are, however, much more precise.

In addition to, the main classification criteria concerning flammability, flame spread and heat released, e.g. smoke development and dropping behaviour is tested.

Fire resistance of components has been tested in Germany in accordance with the European Norm DIN EN 1363 or DIN EN 1365 since 2000. The fire resistance duration is then labelled with the letter R for "Resistance".

The standard temperature-time curve (ETK) of DIN 4102 and ISO 834 is based on a simulation of real fire conditions and forms the evaluation basis that is used worldwide to determine the fire resistance duration. In addition, there are other temperature curves for special fire exposures, e.g. the hydrocarbon curve for destructive fi res caused by flammable liquids or the RAB / ZTV tunnel curve (Germany) or the Rijkswaterstaat tunnel curve (the Netherlands), which describe tunnel fires.



Temperature curves: — (ETC), — Hydrocarbon curve,
— RABT/ZTV tunnel curve — Rijkswaterstaat tunnel curve

Fire protection in fastening technology

The fastening technology has a vital importance in fire protection.
To ensure the functional capability and stability of railings, pipe systems,
fire safety doors or ceiling elements.

Assessing fixings for fire is carried out in accordance with the technical regulation EOTA TR020 or in accordance with fire protection reports.

The labelling and classifi cation of anchors and fixings is classified in:

1 Fire behaviour (e.g. non-flammable)
2 Fire resistance duration (e.g. R90)

For this purpose, the legal regulations set down in the fi nal draft of the Delegated Act "Fire Behaviour" must be observed.

EOTA TR020 only states anchor performance ratings that have an **ETA for cracked concrete!** Meanwhile, a new evaluation document issued by the German Institute for Construction Engineering (DIBt) is used to determine the characteristic load values and the corresponding fi re resistance duration.

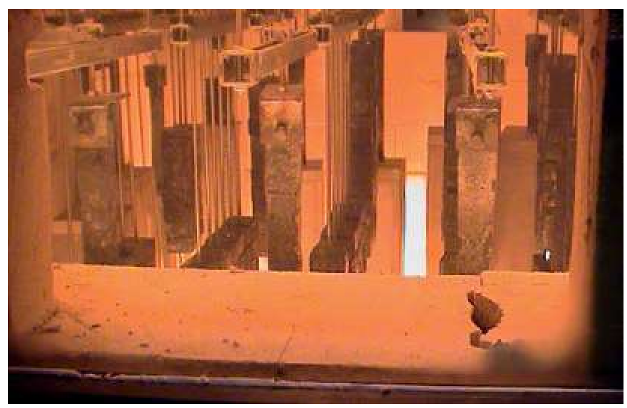
A partial safety factor of γ_M = 1.0 on the load side is used in the event of fire.

The fire values only refer to anchor bolts that are directly exposed to flames.

Alternatively, anchors can be protected from direct exposure to fire by using fire protection panels or fire protecting coatings.

For fixing cladding systems, it is assumed that the load bearing capacity of specified plastic screw anchors in concrete with an external diameter of 10 mm and a metal screw diameter of 7 mm and an anchoring depth of h_{ef} = 50 mm with a polyam-ide PA6 plastic sleeve has a suffi cient fi re resistance of at least 90 minutes (R90), if the permissible load (no permanent centric tensile load) is ≤ 0.8 kN.

Before the fire test



During the fire test

After the fire test

Corrosion – Fundamentals

Corrosion is a chemical reaction which degrades metal.

The less noble the metal ("electrochemical potential"), the more severe the material damage is, resulting in metal loss or corrosion flakes. For this reason, different appearance patterns have been determined. **The most common types of corrosion in fixings and anchors are:**

Surface corrosion: In this case, the metal corrodes relatively uniformly over the entire surface or over a part of the surface. An example of this is the invisible rusting of a screw in the transition area from anchor plate to hole due to condensation. The result: A connection that appears completely intact from the outside, but suddenly fails.

Contact corrosion: If metals with a different nobility are in contact with each other in a conductive medium, the less noble metal always corrodes (the anode). Whereas stainless is not aff ected. A decisive factor is the surface ratios of the two types of metal: The greater the surface area of the most noble metal in comparison with the less noble, the greater the corrosion. For example, if larger stainless steel sheets are screwed with galvanised screws, the screws will be agressively attacked within a very short time. Whereas using stainless screws in galvinised sheets poses no problems.

Stress corrosion cracking: Permanent internal or external tensile stresses lead to metal strain or corrosion. In this process, a crack develops due to mechanical stresses, which grows under increasing loads and thus creates a path for progressive corrosion. For example, this occurs with stainless steel of corrosion resistance Class III e.g. A4, in an atmosphere containing chlorine (swimming pools). Generally, stress corrosion cracking is not visible with fixings and usually leads to sudden failure of the anchoring.

In 1985, the suspended concrete ceiling of an indoor swimming pool collapsed in Uster, Switzerland. The stainless steel ceiling attachments exhibited no external defects, but were completely destroyed internally in some cases due to stress corrosion cracking.

Example of trans-crystalline stress corro-sion cracking on stainless steel 1.4401 with high chloride concentra-tion

Corrosion protection

There are different ways to protect fastenings from corrosion. The most important are:

Galvinised zinc coating (or also electrolytic zinc coating) followed by passivation is the most common corrosion protection used in metal finishing. A zinc coating thickness of 3 – 10 µm off ers excellent corrosion protection for damp rooms and outdoor use.

Hot-dip galvanising is the application of a metal zinc coating by dipping it in molten zinc (at approx. 450 °C). Zinc layer thickness's of 45 – 80 µm offer an excellent corrosion protec-tion for moist rooms and outdoor use.

Stainless steel fi xings of corrosion resistance class III e. g. A4, material no. 1.4401, 1.4404 and 1.4571 as well as two phased duplex steel (austenitic and ferritic structure / magnetic) are suitable for anchoring in damp rooms, in open air, in industrial atmospheres or near the sea (but not directly in sea water).

Stainless steel anchors made from high corrosion-re-sist-ant steel of the corrosion resistance class V e.g. material no. 1.4529 are used in especially aggressive environ-ments e.g. in atmospheres containing chlorine (swimming pools), in road tunnels or with direct sea water contact. Due to their high molybdenum content they are risistant is such aggressive enviroments. That means that steel type 1.4529 – containing chrome, molybdenum and nicklel – has an alloy content of 58 %. The rest consists of iron and carbon. Due to this very high alloy content, the production for this steel type is very expensive, but on the other hand the conection is safe and maintenance – free in terms of corrosion.

Dynamics

For predominantly non-static loads.

The general building approvals issued by the **German Institute of Construction Engineering (DiBt) and the European Technical Approvals / Assessments (ETA)** are mainly valid for predominately static loads. However, there are certain applications e. g. swinging cranes, crane rails, jib cranes, elevator guide rails, machines, industrial robots and blast fans in tunnels including antenna and masts which are subjeted to dynamic eff ects

In general, the anchoring of components with more than > 1000 load cycles must be carried out using fastening elements that have been checked and approved for this purpose. Until recently, the design for post-installed anchors for such dynamically loaded applications was nearly impossible. Time consuming and costly expert reports and or approvals for individual applications were required.

The bonded anchors: fi scher Highbond anchor FHB dyn and fi scher UMV multicone dyn and FDA **have a German DiBt approval for dynamic loads.** In the approval, only fatigue loads are considered as dynamic loads and not loads from shock or seismic activity.

The approvals apply to the anchoring of dynamic loads with unlimited numbers of load cycles, for tension and for shear loads.

In addition, the FHB dyn is manufactured in anchor size M12 and M16 from highly corrosion-resistant steel (e. g. corrosion resistant Class V - 1.4529).

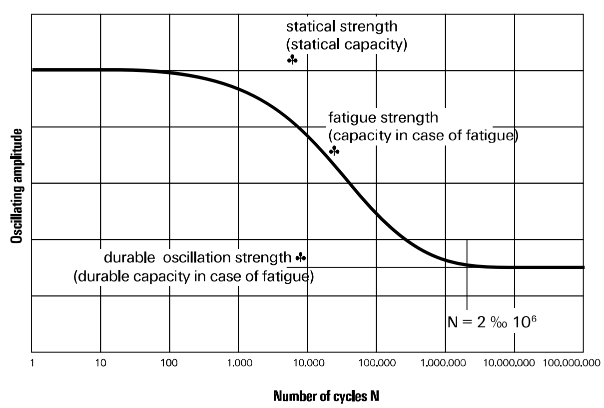
Dynamic load tests have shown - compared to normal stainless steel grades of corrosion resistant class III (e. g. 1.4401 also known as 316) – that this material is not only highly suitable for indoor and outdoor humid environments, as well as other agres-sive conditions, it is also highly suitable for dynamic loadings.

Elevator guide rails

Industrial robots

Blast fans

Antenna and masts



Wöhler curve

Action	Run of the oscillation		Possible cause
harmonic	period T	sinusoidal	Unbalances, tumbling machines
periodic	period T_0	optional, periodical	Regularly abutting parts (e.g. punching machines) , rail- and road traffic
transient		optional, nonperiodical	Earthquakes
impulsive		optional, with very short time of influence	Impact, explosion

Legal basis

The European Union (EU) determines the legal foundation for the assessment, CE labelling and bringing building products into the European Economic Area (EEA).

The aim is to reduce trade barriers by harmonising the requirements of building products.

REGULATION (EU) No 305/2011 (Construction Products Regulations) OF THE EUROPEAN PARLIAMENT AND COUNCIL fully came into force on 1st July 2013. The Construction Products Regulation is law in all EU countries. However, the Construction Product Directive 89/106 / EEC is not law in all EU countries.

Construction products are products, or parts which are permanently incorporated into buildings. Their performance infl uences the structure´s basic requirements (e.g. mechanical strength). Therefore, construction products and materials for safetly relevant applications are affected.

Important building requirements include:
1 Mechanical strength and stability
2 Fire protection
3 Hygiene, health and environmental protection
4 Safety and accessibility during use
5 Sound protection
6 Energy saving and heat protection
7 Sustainable use of natural resources

When a construction product is covered by a harmonised standard (hEN), or a European Technical Assessment or Approval (ETA) has been issued for this product, the manufacturer is obligated to draw up a Declaration of Performance (DoP) for this product and affi x the CE marking on the product. The application for an ETA for a construction product by the manufacturer is voluntary. National approvals may only be issued if a construction product is not marked with a CE label.

Existing European Technical Approvals (ETA) are valid until the end of the validity date and will be amended with the Declaration of Performance (DoP) by the manufacturer from the due date. The reference number of the DoP is part of the CE marking and must be determined by the manufacturer. The Declarations of Performance (DoP) are available on the fi scher website under "Approvals/Assessments": http://www.fi scher.de/sdb.

The CE mark is the only means to certify whether the manufacturer has conformed to the applicable harmonised requirements of construction products. The CE label allows the construction product to be freely traded without trade barriers in the European Economic Area.

Each Member State determines the essential characteristics for use of the construction product and its performance in its territory. The unrestricted use of a construction product in a Member State depends on whether performance values exist in the DoP for the essential characteristics determined by the Member State. If one characteristic is declared with "NPD" (No Performance Determined), this can lead to a ban on use in a Member State. Therefore, each member State must establish Product Contact Points, which will provide information on these regulations. In Germany, this is the Federal Institute for Material Research and Testing (BAM: see www.pcp.bam.de).

Assessment procedure

Fasteners which are not covered by a harmonised standard (hEN) can apply for an ETA (European Technical Assessment) on the basis of a European Assessment Document (EAD).

Existing assessment documents, such as ETAGs (European Technical Approval Guidelines) for metal and plastic fixings are still valid and transferred into EADs in accordance with the EU Const-ruction Products Regulation (CRP). The ETAGs and the new EADs can be downloaded from the EOTA website: http://www.eota.eu

The assessment document for mechanical fasteners (ETAG 001- 1, -2, -3, -4 or in the future, EAD 33-0232) and the assessment document for bonded anchors (ETAG 001-5 or in the future, EAD 33-0499) divides possible approvals of metal fixings into 12 options.

Options 1-6 are for use in cracked and non-cracked concrete, options 7-12 are only for use in non-cracked concrete. Anchors of Option 1 off er the largest range of fl exibility for assessment, since performance values for concrete of the strength classes C20/25 to C50/60, as well as the minimum spacing and edge distances are available (see table below).

Section 6 of the ETAG 001 (in the future, EAD 33-0747) regula-tes the assessment of metal fixings in cracked and non-cracked concrete for multiple use for non-structural systems. Non-load bearing systems include components which do not contribute to the stability of the construction, they only transmit their dead or wind load. These are, for instance, simple suspend-ed ceilings and false ceilings, pipelines and façade claddings.

When using fixings for multiple use, it is assumed that if excessive slippage or failure of a fixing point occurs, that the load will be transferred to neighbouring fi xing point. A fixing point can be defi ned as a single anchor or a group of anchors.

This is known as a redundant system, where stability is not affected by an individual anchor failure.

Possible assessment options according to EAD

<table>
<tr><th>Options</th><th>Cracked concrete</th><th>Non-cracked concrete</th><th>One value for all concrete strengths</th><th>Different values for C20/25 to C50/60</th><th>One value for load direction</th><th>Separate values for tensile and shear capacity</th><th>c_{cr} / s_{cr}</th><th>$c_{min} < c_{cr}$ / $s_{min} < s_{cr}$</th><th>Design method as per EN 1992-4</th></tr>
<tr><td>1</td><td rowspan="6">✓</td><td rowspan="6">✗</td><td>✗</td><td>✓</td><td rowspan="2">✗</td><td rowspan="2">✓</td><td rowspan="4">✓</td><td rowspan="4">✓</td><td rowspan="2">A</td></tr>
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<tr><td>3</td><td>✗</td><td>✓</td><td rowspan="4">✓</td><td rowspan="4">✗</td><td rowspan="2">B</td></tr>
<tr><td>4</td><td>✓</td><td>✗</td></tr>
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<tr><td>6</td><td>✓</td><td>✗</td></tr>
<tr><td>7</td><td rowspan="6">✗</td><td rowspan="6">✓</td><td>✗</td><td>✓</td><td rowspan="2">✗</td><td rowspan="2">✓</td><td rowspan="4">✓</td><td rowspan="4">✓</td><td rowspan="2">A</td></tr>
<tr><td>8</td><td>✓</td><td>✗</td></tr>
<tr><td>9</td><td>✗</td><td>✓</td><td rowspan="4">✓</td><td rowspan="4">✗</td><td rowspan="2">B</td></tr>
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<tr><td>12</td><td>✓</td><td>✗</td></tr>
</table>

Design of fastenings

Two different anchor designs are differentiated.

Method with global safety factors

Permissible loads are determined from the average failure load or from the 5 % fractile load and compared with the action load.

The safety factor depends on the anchoring system, the type of installation and external infl uences such as temperature and or humidity. Global safety factors are generally = 3 for steel and bonded anchors and = 5 for plastic anchors.

Methods with partial safety factors

According to this method, it is shown that the value of the design actions S_d does not exceed the value of the design resistance R_d ($S_d \leq R_d$).

The action on fi xings are determined according to the same rules and used the same partial safety factors employed in reinforcred concrete design (see Eurocode 1990; national appendix must be observed).

The design resistance is determined by using the characteristic resistance and the partial safety factor of the material ($_M$), which takes into account the scatter of the material. The values can be taken directly form the ETA. Safety is national law. The design method as well as the related partial safety factors are determined by the Member State.

Only the product specific coefficient for installation is specified in the ETA, which is used to calculate the partial factor $_M$. The design standard EN 1992-4, which is expected to be ratified in 2018, contains the national determined partial safety factors (observe the respective national appendex).

The design method as set down according to ETAG 001, Annex C - design method for metal anchors and the design method according to TR029 - bonded anchor design in concrete, as well as CEN/TS 1992-4, Section 4 (mechanical anchors) and Section 5 (chemical anchors) are the current methods for anchor design based on a European Technical Approval or Assessment (ETA). Moreover, the ETAG 001 Annex C distinguishes between three different design methods (A, B and C), method A being the most important and the most economical method since anchors are considered separately for all load directions and failure modes. Methods B and C play a minor role and are hardly used.

Other important design provisions are:

EOTA TR020 Anchor design in concrete under fi re exposure, or CEN/TS 1992-4, Part 1, Appendix D

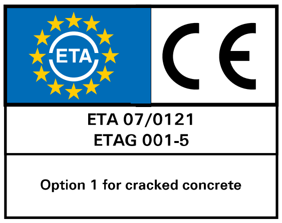
EOTA TR045
Anchor design in concrete for seismic actions
The applicable assessment design methods are generally indicated in the respective ETA. It is important that design methods are not commingled.

The design for metal anchor (under static and seismic loads as well as under fire exposure) is summarised in EN1992-4, i.e. in Section 4 of the Eurocode 2, but then must be ratified by each Member State and, if applicable, adapted for national annexes. As soon as EN1992-4 is published, all other design methods (ETAG 001 Annex C, TR045, TR020, TR029 and CEN/TS 1992-4) are no longer valid.

fischer has developed a simple yet powerful design software for daily use: the fischer - C-FIX. The software enables designers and users to carry out anchor designs according to different design methods. Complex anchor arrangements can be calculated quickly and easily. The feature “multple design” makes it possible to select the best technical and cost saving solution.

Approvals, markings and their importance

The most important symbols
are presented below.

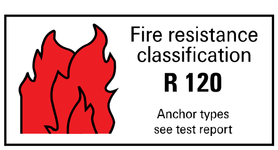


European Technical Approval / Assessment
Issued by a European approval authority (e. g. DIBt) on the basis ofthe guidelines for European technical approvals (ETAG). ETA (Eng-lish): European Technical Approval/Assessment. CE: The CE marks the conformity of the product to all applicable legal provisions in which their installation is intended. This means that the CE mark only certifies that the requirements determined in the relevant har-monisation legal provisions of the union have been complied with.Products with the CE mark can be freely traded in the European Economic Market.

ICC International Code Council
ICC Evaluation Service Inc. (ICC ES) issues reports, e. g. for subsequent anchoring on the basis of the International Building Code® and the related standards in the United States of America

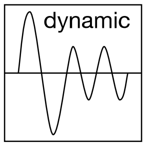
FM Certificate
Recognised for use in local water- based fire extinguisher systems (Factory Mutual Research Corporation for Property Conservation, American insurance company).

General building authority approval
German approval, issued by the DIBt, Berlin with the accompany-ing certificate of conformity for construction products with the general building authority approval. Confirmed by a material testing institute.

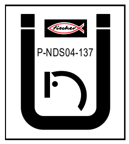


Fire-tested fixing
The anchor was subjected to a fire test. It is an "investigation report to test the anchor under fire exposure (fire behaviour) (with R-Class). Fire tests are not required when using the simplified verification method according to TR020 - then the values can be transferred directly to the ETA.

This product is made from **high corrosion resistant steel** of corrosion resistance class V, e. g. 1.4529.

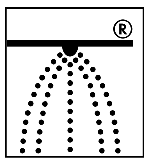


Dynamically loadable anchors
The anchor is suitable and approved for anchoring of "not predominantly static" (i.e. dynamic) loads.static" (i.e. dynamic) loads.static" (i.e. dynamic) loads.

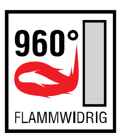


General construction-related test certificate

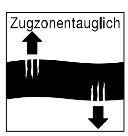
The fixing is suitable for anchoring under **seismic influence.** Please note: The ICC-ESRs also allow seismic stress (see Category C1 and C2 in accordance with the ETAG 001 Annex E).



Mark for labels that confirm compliance with the VDS-CEA guidelines for **sprinkler systems, planning and installation.** Fixings labelled as such may be used for fixing pipes for extinguishing systems.



Tested for **flammability** in accordance with VDE.



Fixings for tensile zones
The fixing is suitable and approved for anchoring in cracked concrete (tensile zone) and in uncracked concrete (compression zone).

Fixing made of high-quality, ageing-resistant **nylon** (polyamide).

Component test with window frame screws in accordance with ift guideline MO-01/1; Testing structural connections on windows.

The term "approvals" used in the catalogue consists of documents that are available and can be used as evidence of the usability of building products for which the documents were issued. These are (fire) reports, general construction-related approvals issued by the German Institute for Construction Technology Berlin (e.g. Z-21...) or European Technical Approvals or Assessments (ETA). In general, the usability of construction products in an EU Member State is given, if the performance of the significant characteristics required in each Member State has been clarified/ confirmed by the manu-facturer. Information on the significant necessary characteristics in a country can be found at the national Product Information Contact (Link: http://ec.europa.eu/Docs- Room/doc-uments/4170/attach-ments/1/translations/en/rendi-tions/native).

Fire prevention

Fire prevention is a critical consideration for those who are responsible for creating the design, specification and construction of new buildings, with consideration in the ongoing maintenance of occupied premises.

As the causes of fire vary and are often unpredictable, construction measures are being designed to influence the formation and spread of fire, smoke and toxic gases, by minimising the available factors needed to create a fire or to limit the spread of fire once it has started. Effective fire fighting within a building is generally achieved through a combination of active and passive FireStop systems and, when used in conjunction with each other, provide a balanced fire protection strategy.

Active FireStop systems

Active fire prevention systems are designed to react to the outbreak of a fire, which is then suppressed with the help of sprinkler systems, halogen installations, fire extinguishers or other proactive mechanical systems. The effects of the fire may also be lessened by the removal of smoke from the equation. By including alarms and emergency lighting, active systems also serve to provide escape paths for people inside the building.

Passive fire prevention systems

Passive fire prevention is an integral component, which is designed and built in to the fabric of the structure. It is also an essential element of the fire safety of a building. The risk of fire can be minimised by dividing the building into a series of compartment/cells bounded by fire rated walls and floors. To maintain the firestopping integrity of a compartment/cells, any gaps, openings, void or channels within the fire rated walls or floors must be sealed with an approved or certfied system to prevent the passage of fire, smoke and toxic gases.

Building codes and national regulations

Most model building codes have very clear requirements on passive fire protection. "Fire investigation reports have consist-ently shown that unprotected or improperly protected penetrations and joints cause millions in property damage and contrib-ute to the loss of life and injuries due to the uncontrolled migration of fire, smoke and toxic gases." In order to promote life safety and property protection, the national building codes include fire testing and performance requirements for penetration firestop and fire resistive joint systems. The following regulations are published as statutory instruments by Parliament with respect to life safety purposes:

ENGLAND AND WALES: 1991

Section 11.2 of Approved Document B3 states: "If a fire separating element is to be effective, then every joint, or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire stopping so that the fire resistance of the element is not impaired"
Section 11.12 adds, under the heading of 'Fire stopping', a requirement that: "Joints between fire separating elements should be fire stopped; and all openings for pipes, ducts, conduits or cables to pass through any part of a fire separa-ting element should be:
Kept as few in number as possible and kept as small as practical fire-stopped (which in the case of a pipe or duct, should allow for thermal movement)"

BS 7671: 2008: UNITED KINGDOM

The 17th edition of the IEE Wiring Regulations (BS 7671:2008) is the national standard in the United King-dom for all commercial, domestic and industrial wiring installations.
Section: 527-02-01 states "Where a wiring system passes through elements of building construction such as floors, walls, roofs, ceilings, partitions or cavity barriers the openings remaining after passage of the wiring systems shall be sealed according to the degree of fire resistance required of the element concerned."
Section: 527-02-02 states "where a wiring system such as conduit, cable ducting, cable trunking, busbar or busbar trunking penetrates an element of building construction ha-ving specified fire resistance it shall be internally sealed so as to maintain the degree of fire resistance of the respec-tive element as well as being externally sealed to maintain the required fire resistance."

GERMANY: FEDERAL STATE BUILDING ORDER

In Germany, the Federal State Building Order is regulated at the level of the federal states. Therefore, there are 16 regional state building codes with their own regulations and guidelines. The 2002 Directive Building Code and the 2005 Directive Guidelines for conduit and ventilation systems form the basis for further consideration. The list of the Technical Building Regulations – M-ETB, includes other codes, such as the MLAR and the German Ventilation Systems Directive – MLüAR. Once guidelines are adopted into the list at regional state level List of Technical Building Regulations–LTB, the guidelines become legally binding.

NFPA 101 LIFE SAFETY CODE: UNITED STATES

Life Safety Code addresses those construction, protection, and occupancy features necessary to minimise danger to life from the effects of fire, including smoke, heat, and toxic gases created during a fire. The Code establishes minimum criteria for the designs of egress facilities, so as to allow prompt escape of occupants from buildings or, where desirable, into safe areas within buildings. The Code also addresses protective features and systems, building services, operating features, maintenance activities, and other provisions in recognition of the fact that achieving an acceptable degree of life safety depends on additional safeguards to provide adequate egress time or protection for people exposed to fire. Relevant firestop requirements can be found in below mentioned references:
8.2.2 Compartmentation Continuity
8.2.3.2.4 Penetrations and Openings In Fire barriers
8.2.4.4 Penetrations and Openings In Smoke Partitions
8.3.2 Continuity of Smoke Barriers

NFPA 5000 BUILDING CONSTRUCTION AND SAFETY CODE

NFPA 5000 – Building Construction and Safety Code is a model building code developed by the National Fire Protection Association. For the most part, the requirements for fire stops are the same in NFPA 5000 as they are in the IBC. It also addresses joints between assemblies in a similar manner to the IBC. NFPA 5000 states openings must be protected by „a system or material capable of restricting the transfer of smoke". It addresses protection for through-penetrations and membrane penetrations in Section 8.8 using the same test methods as the IBC. The requirements for F and T ratings are also the same. Joint systems, including perimeter joints at curtain walls, are addressed in the same manner as the IBC.

IBC INTERNATIONAL BUILDING CODE: UNITED STATES

In the Past: The Regional Model codes developed by the Building Officials Code Administrators International (BOCA) were used on the East Coast and throughout the Midwest of the United States, while the codes from the Southern Building Code Congress International (SBCCI) were used in the Southeast and the codes published by the International Conference of Building Officials (ICBO) covered the West Coast and across to most of the Midwest. After three years of extensive research and development, the first edition of the International Building Code was published in 1997. The code was patterned on three legacy codes previously developed by the organizations (BOCA, SBCCI, ICBO) that constitute IBC. By the year 2000, ICC had completed the International Codes series. Relevant firestop requirements can be found in below mentioned references:
702 Definitions
704.9 Separation of Vertical Openings - Sprinkler Exception
708 Fire Partitions 1 Hour Rating
709 Smoke Barriers 1 Hour Rating
710 Horizontal Assemblies
711 Penetrations (General)
711.3.2 Sprinkler Heads Electrical Boxes
711.4.1.2 „F" & „T" Rating Requirements
712 Fire-Resistant Joint Systems
712.4 Curtain Wall to Edge of Slab

OTHER RELEVANT CODES FROM IBC:UNITED STATES

The International Building Code and International Residen-tial Code are just a few of the comprehensive I-Codes the Code Council has created. The publications of the codes allow for easier following from members and allow them to observe and study the model code. Some of these codes have specific practices, such as the International Fire Code and the International Green Construction Code, or the IGCC. Here is the current list of I-Codes developed and published by the Code Council:
International Building Code
International Residential Code
International Fire Code
International Plumbing Code
International Mechanical Code
International Fuel Gas Code
International Energy Conservation Code
IBC Performance Code
International Wildland Urban Interface Code
International Existing Building Code
International Property Maintenance Code
International Private Sewage Disposal Code
International Zoning Code
International Green Construction Code.

OTHER RELEVANT CODE

NFPA is responsible for 300 codes and standards that are designed to minimize the risk and effects of fire by establi-shing criteria for building, processing, design, service, and installation.
Some of the other widely used NFPA codes are:
NFPA 70 NEC – National Electrical Code
NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
NFPA 221 - Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls

Approvals, markings and their importance

British Standard
BS 476-20

BS 476-20:1987
Fire tests on building materials and structures. Method for deter-mination of the fire resistance of elements of construc-tion (general principles).

BS EN13501-1

EN13501-1:2007+A1:2009
Fire classification of construction products and building elements. Reaction to Fire.

BS EN13501-2

EN13501-2:2007+A1:2009
Fire classification of construction products and building elements. Resistance to Fire.

BS EN1366-3: 2004

EN1366-3:2004
Fire resistance tests for service installations - Penetration seals.

BS EN1366-4: 2006

EN1366-4:2006
Fire resistance tests for service installations - Linear joint seals.

DIN

DIN 4102:Part1
Fire behaviour of building materi-al and elements - Part 1: Building materials, concepts.

American Standard
ASTM E 84 (UL 723)

ASTM E 84
Test method for Surface Bur-ning Characteristics of Building materials. The test evaluates the spread of flame along the surface of the material. It is not a resistance test.

American Standard
ASTM E 1966
(UL 2079)

ASTM E 1966
Test method for Fire-Re-sistive Joint Systems. This test is used to evaluate the performance of a joint after a cyclic movement test and fire exposure test. UL 2079 - equivalent.

American Standard
ASTM E 814 (UL 1479)

ASTM E 814
Test method for Fire Tests of Through Penetrations Fire Stops. This test is used to evaluate the performance of a firestop system, following fire ex-posure a hose stream test is conducted. UL 1479 - equivalent.

BS EN ISO 10140

BS EN ISO 10140:2010
The laboratory measurement of airborne sound insulation of buildng elements.

BS EN 1026

BS EN 1026: 2000
Air permeability test method.

BS EN 1027

BS EN 1027: 2000
Water permeability test method.

ETA
ETA-XX/XXXX
ETAG XXX-X
XXX

CE marking is a declaration by the manufacturer (through verified testing) that the product meets all the appropriate provi-sions of the relevant legislations implementing certain European Directives. ETA - The European Technical Assess-ment provides information about the construction product to be declared in relation to its essential characteristics.

CLASSIFIED
C UL US

UL is an abbreviation for Under-writers Laboratories Inc. which is an independant, not for profit product safety testing and certifi-cation organisation.

UL
EU

UL-EU Mark is intended for use on products destined for the European marketplace.

FM
APPROVED

FM Approvals is an internatio-nal leader in third-party certifica-tion and approval of commercial and industrial products.

Warrington certifire Certification
APPROVED PRODUCT
CF xxxx

Certifire is an independant Third Party Certification organisation. The scheme under-takes require-ments such as the manufacturing of products under a Third Party Quality Management System, Independent Audit Testing, and a Comprehensive Field of Applica-tions document based on careful chosen test that helps to ensure the products and systems are used within their approval scope.

certifire

fischer

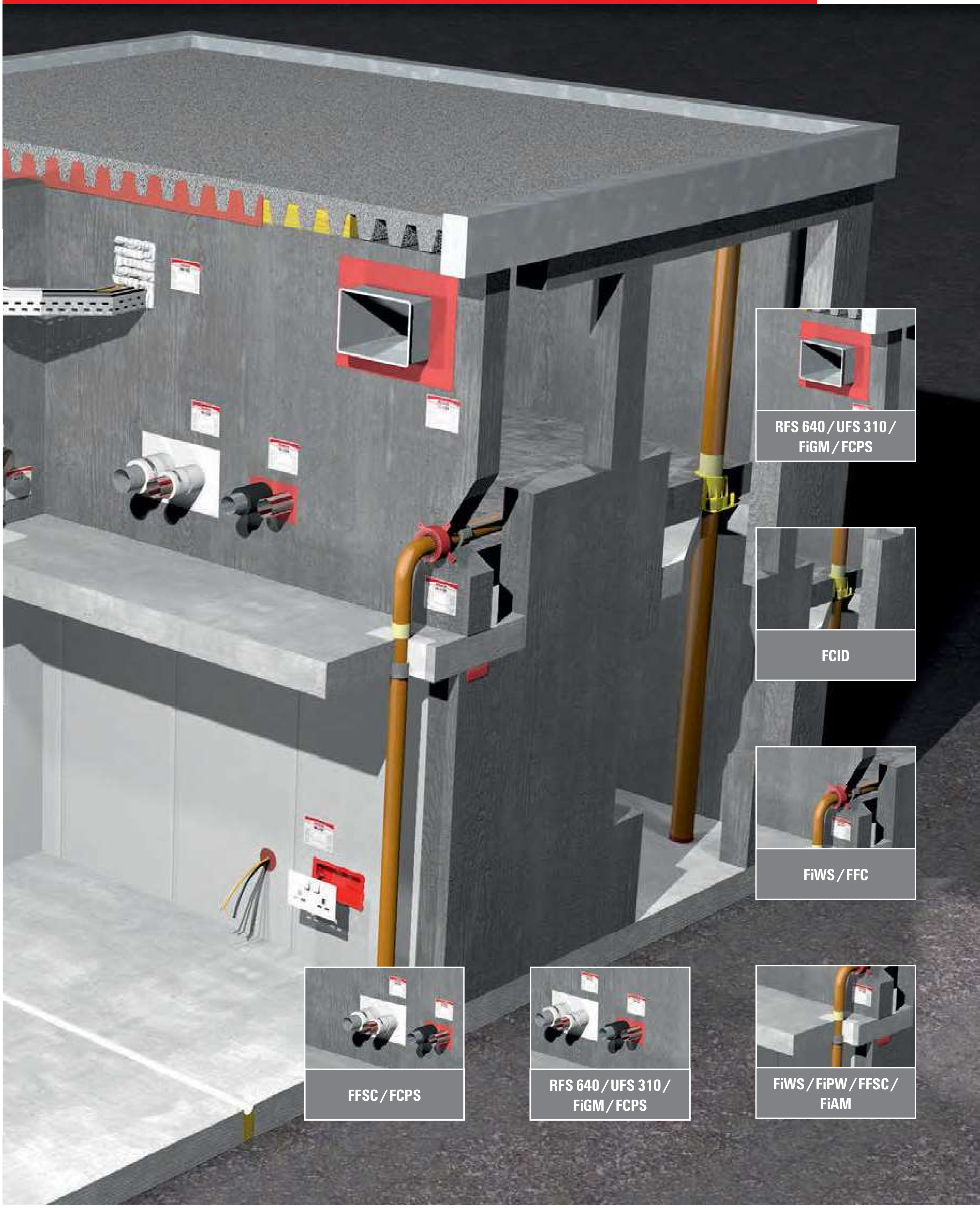
Advanced product selection guide

Product	Tested to ■								Approved to ■				Application ■								Page
	BS 476: Part 20	BS EN 1366-3	BS EN 1366-4	DIN 4102	AS 1530	ASTM E 814 (UL 1479)	ASTM E 1966 (UL 2079)	ASTM E84 (UL 723)	ETA/CE marking	UL approved	Certifire approved	FM approval	Construction joint	Perimeter joints	Metallic pipes	Insulated pipes	Non-metallic pipes	Cable and cable trays	Air ducts	Insulated air ducts	
Intumescent Acoustic Mastic FiAM	■	■	■				■	■	■	■	■		■		■			■	■		
Fire Rated Silicone Sealant FFRS	■		■						■		■		■								
Rapid Fire Seal RFS 640	■					■	■	■		■		■	■	■	■			■	■		
Fire | Barr ElastoSeal FBB-ES	■		■						■				■	■							
Universal FireStopping Sealant UFS 310	■					■	■	■		■		■	■		■	■	■	■	■	■	
Intumescent Graphite Mastic FiGM	■	■	■						■		■		■		■	■	■	■	■		
Intumescent Pipe Wrap FiPW	■	■							■		■					■	■				
Intumescent Wrap Strip FiWS						■		■		■		■			■	■	■				
Fire Collar FFC	■	■							■							■	■				
Cast in Device FCID	■				■												■				
Intumescent Pillows FiP	■	■							■		■				■			■	■		
Intumescent Putty Pad FiPP	■	■																■			
Coated Panel System FCPS	■	■							■		■				■	■	■	■	■		
FireStop Compound FFSC	■	■			■		■		■	■					■	■	■	■	■		
Fire | Barr Cavity Barriers	■		■										■	■							
FireStop Foam	■		■	■									■								
Thermal Defense Wrap DTW	■	■							■						■	■		■	■	■	

9

Annexure - B

FiAM	Intumescent Acoustic Mastic	Page 174	UFS 310	Universal FireStopping Sealant	Page 176
FFRS	Fire Rated Silicone Sealant	Page 186	FiGM	Intumescent Graphite Mastic	Page 184
RFS 640	Rapid Fire Seal	Page 180	FiPW	Intumescent Pipe Wrap	Page 190



FFC	Fire Collar	Page 192	FCPS	Coated Panel System	Page 194
FCID	Cast in Device	Page 209	FFSC	FireStop Compound	Page 196
FiP	Intumescent Pillows	Page 200			
FiPP	Intumescent Putty Pad	Page 209			

Engineering judgement request form

Project name: ______________________ Requested by: ______________________
Consultant: ______________________ Company: ______________________
Contactor: ______________________ Email: ______________________
Contact: ______________________ Phone: ______________________
Email: ______________________ Fax: ______________________
Phone: ______________________ Supplier: ______________________
Fax: ______________________ fischer engineer: ______________________

Fire rating requirements

Frating (hours): Trating (hours): Approval type:

Through penetration

Assembly details: ☐ Wall ☐ Floor

Base material: ☐ Concrete ☐ Blocks ☐ Drywall

Thickness: ______________________

Other please specify: ______________________

Opening details: ☐ Circular ☐ Rectangular — Sleeved ☐ Yes ☐ No — Size — Sleeve type ☐ PVC ☐ Steel

Annular Space: Min: __________ Max: __________

Penetration details:

☐ Pipe	☐ Duct	☐ Cables	☐ Cable trays/ladders	☐ Bus Bars
Size ________	Size ________	Size ________	Size ________	Size ________
Type	Type	Type	Type	Type
Insulation	Insulation	Insulation	Insulation	Insulation
Type ________	Type ________	Type ________	Type ________	Type ________
Thick ________	Thick ________	% fill ________	Nos ________	________

Joint

Joint type: ☐ Head of wall ☐ Bottom of wall ☐ Floor to floor ☐ Floor to wall ☐ Wall to wall ☐ Perimeter joint

Base material: ☐ Concrete ☐ Blocks ☐ Concrete ☐ Blocks ☐ Drywall ☐ Steeldeck ☐ Drywall ☐ Steeldeck

Joint details: ☐ Static ☐ Dynamic — Width ________

Movement required: ______________________

Curtain wall details: ______________________

Special conditions / comments / drawings / standards

____
____
____
____
____
____

Request form · Version 2 · 2017-06-22

Reference No.: ________

Calculation of Consumption Guide

CALCULATIONS FOR MASTIC / SEALANT

a = Hole diameter in mm
b = Depth of sealant in mm/wet fi lm thickness for spray material (see recommendations)
c = Pipe or bunched cables diameter in mm
d = Annular space in mm (see recommendations)
l = Length of square opening/joint
w = Width of square opening/joint
h = Cartridge or spray bucket size in ml
n = Number of holes
e = Area of hole in mm^2 = $\pi(a \div 2)^2$
f = area of pipe in mm^2 = π $(a \div 2)^2$
g = Amount of mastic needed per hole in ml = ((e-f) x b) ÷ 1,000

Round holes

No. of cartridges needed = n x ($\frac{g}{h}$)
Area of hole e = π x $(a \div 2)^2$ mm^2
Area of pipe f = π x $(c \div 2)^2$ mm^2
Mastic volume = g = ((e-f) x b) ÷ 1,000 ml

Example:
a = 90 mm
b = 40 mm
c = 50 mm
h = 310 ml
n = 20

e = 3.14 x 45^2 = 6,361.73 mm^2
f = 3.14 x 25^2 = 1,963.50 mm^2
g = ((6,361.73 - 1,963.50) x 40) ÷ 1,000 = 175.92 ml

No. of cartridges = 20 x ($\frac{175.92}{310}$)
= 11.35 cartridges

Square holes

No. of cartridges needed = n x ($\frac{g}{h}$)
Area of hole e = l x w mm^2
Area of pipe f = π x $(c \div 2)^2$ mm^2
Mastic volume = g = ((e-f) x b) ÷ 1,000 ml

Example:
l = 90 mm
w = 100 mm
b = 40 mm
c = 50 ml
h = 310 ml
n = 20

e = 90 x 100 = 9,000 mm^2
f = 3.14 x 25^2 = 1,963.50 mm^2
g = ((9,000 - 1,963.50) x 40) ÷ 1,000
= 281.46 ml

No. of cartridges = 20 x ($\frac{281.46}{310}$) = 18.1 cartridges

Linear joints

No. of cartridges/buckets = ($\frac{g}{h}$)
Area of joint = e = l x w mm^2
Mastic volume = ((e-f) x b) ÷ 1000 ml
= g

Example for mastic/sealant:
w = 20 mm
l = 30m = 30,000 mm
b = 10 mm
h = 310 ml
e = 20 x 30,000 = 60,000 mm^2
g = (60,000 x 10) ÷ 1,000 = 6,000 ml
No. of cartridges = ($\frac{6,000}{310}$)
= 19.4 cartridges

Example of joint Spray:
w = 100 mm, w1 = 125 mm (with overspray)
l = 300 m = 300,000 mm
b = 1.5 mm
h = 19 litres = 19,000 ml
e = 125 x 300,000 = 37,500,000 mm^2
g = (37,500,000 x 1.5) ÷ 1,000 = 56,250 ml
No. of buckets = ($\frac{56,250}{19,000}$) = 2.96 buckets

Calculation of Consumption Guide

CALCULATIONS FOR COMPOUND

l = length of the opening b = width of the opening
d = depth as per required fi re rating C = penetrant area or cross sectional area of services
Y = coverage/yield of 1 bag in litres
Volume of compound required = volume of opening - volume of services
= [(lxbxd) - (Cxd)] m3
= [(lxbxd) - (Cxd)] x 1,000 litres
= V

No. of bags = $\frac{V}{Y}$

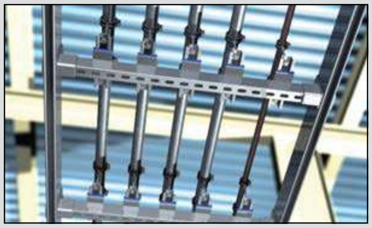
Example
l = 1,000 mm = 1 m b = 500 mm = 0.5 m
d = 100 mm = 0.1 m C = 20 % of opening = l x b x 20 % = 1 x 0.5 x 0.2 = 0.1
Y = 24 litres per 22 kg bag
Volume of compound required = [(1 x 0.5 x 0.1) - (0.1 x 0.1)] x 1,000 litres
V = 40 litres
Numbers of bags required = $\frac{40}{24}$
= 1.67 bags

CALCULATIONS FOR PILLOWS FIP

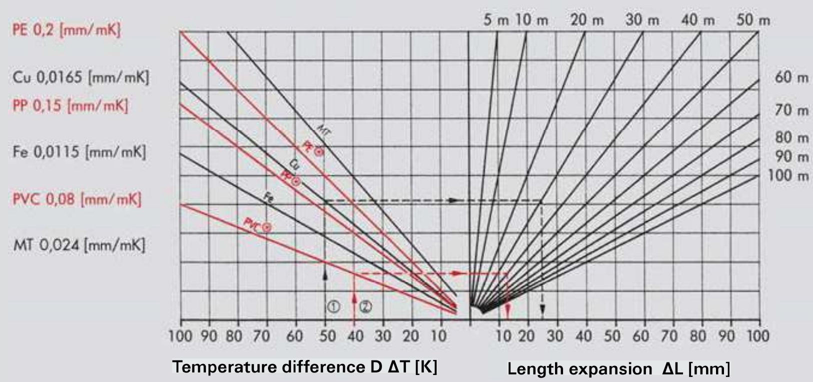
Estimation of large and medium size pillows in walls and floors openings of size up to 1 sq. meter.

Width [mm]	Size / Seal type	Length [mm] 100 Large	100 Medium	300 Large	300 Medium	500 Large	500 Medium	700 Large	700 Medium	900 Large	900 Medium	1,000 Large	1,000 Medium
200	Wall	3	5	7	13	12	22	17	31	21	39	24	47
	Floor	2	3	4	7	6	12	9	17	11	22	12	27
400	Wall	5	9	14	26	24	44	33	61	42	78	47	95
	Floor	3	5	7	15	12	24	17	34	22	43	24	52
600	Wall	7	13	21	39	35	65	49	91	63	117	70	143
	Floor	4	7	11	22	18	36	25	51	33	65	36	79
800	Wall	9	18	28	52	47	87	66	122	84	157	94	192
	Floor	5	10	15	29	24	48	34	67	33	87	48	107
1,000	Wall	10	22	35	65	59	109	82	152	105	196	117	217
	Floor	6	12	18	36	30	60	42	84	54	108	60	120

Elongation



Materials expand with heat. For long components, the change in length is mainly con-sidered. So it is not always a matter of expansion. Shrinkage upon cooling is to also be included in the calculation. This is important when installing pipes. Within piping, the change in length is to be specifi cally steered. Not doing this during installation results not only in pipe defects, but also in serious damage to components. It is therefore essential to determine how great the change in the length of a pipe can be. For this pur-pose, the pipe length and the expansion coeffi cient of the pipe material, as well as the expected temperature diff erence, must be known. This is to be determined such that not only the normal operating temperatures, but also the maximum temperatures that can arise in a case of malfunction, are taken into account. The range is therefore from around 10 °C assembly temperature up to 95°C service temperature for water fi lled systems.



Note:
For plastic pipes (PE, PP, PVC), the length expansionread from the diagram is to be multiplied by a factor of 10.

Example:

① Copper pipe, Cu – Length of pipe span 30 m
Temperature difference △T = 50 K
Length expansion △ L= 24,75 mm

② PVC pipe – Length of pipe span L = 40 m
Temperature difference △ T = 40 K
Length expansion △ L = 128 mm (table value x10)

Length expansion calculation formula

△ L =	L · △ T · α	
[mm]	[m] [K] [mm/m K]	

△ L = Change in length
L = Length of the pipe span/section
△ T = Temperature difference
α = Length expansion coefficient

Soundproofing

As defined in the appropriate standards, the goal of soundproofing is to reduce the transmission to other apartments or usage areas to a given noise range. The upper limits for permissible residual noise levels are defined in the standards.

Soundproofing - VDI 4100
In principle, the VDI 4100 values are, among other things, protection against noise from building systems that are mounted in the neighbouring area. According to VDI 4100, living areas are rooms that are in need of protection; in apartments, these are all rooms with a floor space of > 8m2. This includes kitchens, bathrooms, toilets, hallways and ancillary rooms. VDI 4100 further recommends agreeing with the contracted companies the sound insulation values SSt EB I = 35 dB or SSt EB II = 30 dB for noise emerging from one's own area. Exceptions to this are all sounds that are influenced by the residents, i.e. self-installed air conditioners in the apartment or noises from flushing toilets, etc.

Soundproofing - DIN 4109
The DIN 4109 from 2016-07 still supplemented by A1 (2001-01), in which the permissible sound pressure level in living and sleeping areas for noise from building installations was reduced from 35 to 30 dB(A). The standard is not applicable to the protection against noise from building installations in one's own living area, but only to sounds coming from "external" areas as defined in VDI4100. For increased sound insulation, DIN 4109 Addendum 2 (from 1989) specifies a reduction in the permissible values by 5 dB(A) (to 25 dB(A)) as effective for noises from building installations.

Soundproofing - important influential factors for pipe mounting
Sound propagates in vibrations. These sound waves can propagate in solid, liquid and gaseous media, where the speed of this sound propagation differs greatly in the various media. So the sound in pipe installations is primarily forwarded through the pipeline itself and not through the carried medium. Transmission over the metal pipe is faster than in water, for example. In welded heating systems, for example, the individual sounds of striking a pipe can propagate throughout the entire building. The sound waves are transmitted in a medium in that the molecules constantly jolt one another, thereby transmitting the wave. Steel pipes or metallic mounting elements have an ordered metallic lattice, wherein forwarding is faster and with less loss than in amorphous materials, such as rubber (general elastomers). It can thus be determined that an inversely proportional relationship exists between the speed of sound [symbol; c] and the insulating behaviour of materials. That is, materials with a low sound speed always have better insulating properties than materials with a high sound speed (steel c = 5100 m/s). Rubber (c ~40 m/s) is therefore eminently suitable for sound insulation.
In rubber, the sound waves stop dead, so to speak, wherein the energy is converted into heat.

Therefore, the sound isolation must in principle occur between the pipes and the structure. Here, we recommend the installation of a sound insulating element as close to the sound source as possible; in the simplest case, with an insulating insert in the pipe clamp itself. Sound tested pipe clamps by fischer FRS Plus pipe clamp, FRS pipe clamp and FRS-L Universal pipe clamp.

Corrosion protection

In most cases , pipes and supply lines are installed in dry rooms. Therefore, in addition to corrosion resistant materials, such as plastics or stainless steel and copper, the steel products used for installation systems are galvanised. A zinc coating thickness of 5-8 µm by means of electrolytic process (galvanising) is standard.

For mounting rails, Sendzimir galvanised material is mainly used. Sendzimir galvanising is a method in which the material is drawn through a molten zinc bath, thereby achie-ving a zinc layer thickness of 12-20 µm. This method is used when there is no more welding for the subsequent processing. This is the case for mounting rails because they are cold-formed after galvanising. By cutting and stamping the holes, the surface in this area is not completely covered by a protective layer. Punched mounting rails are therefore only recommended for the dry interior rooms.

For cantilever brackets, non-galvanised channel pieces are used which are welded to the base plate. Following completion, the entire component is galvanised, creating a zinc coating thickness of 5-8 µm.

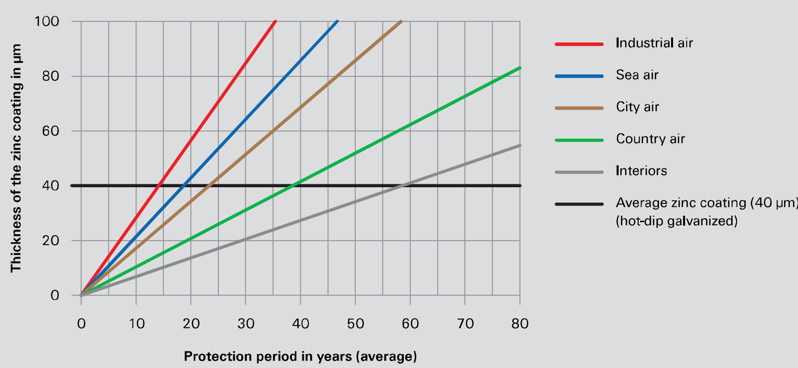
Threaded parts are either galvanised or made of stainless steel. Hot dip galvanising is less suitable for this because the large zinc layer thickness of 40-150 µm severely impairs the thread engagement

.If installation systems are installed outdoors or in wet interior rooms, they must be made of either hot dip galvanised steel or stainless steel.

Hot dip galvanising is very well suited to the protection of steel. The corrosion process is thus 10 times slower than with galvanising. The zinc loss depends on the surrounding atmoshpere and humidity. An annual zinc reduction of 1 - 10 µm can, however, be assumed. The layer thickness is therefore crucial to the durability of the material.

Crucial here are the environmental infl uences under which the systems are installed. An overview of the expected impact on the protective action can be seen in the following diagram and tables.

hot-dip galvanized steel:



Stainless steel

Steel Grade				Designation of the Steel Group with	Corrosion	
Material No.	Short Name	AISI	UNS		Resistance Class	Exposure and Typical Applications
1.4305	X8CrNiS18-9	303	S 30300	A1	I / light	Indoor climate except damp location.
1.4301	X5CrNi18-10	304	S 30400	A2	II / moderate	Accessible constructions without nameable content of chlorides or sulfur dioxide, except industrial atmosphere.
1.4307	X2CrNi 18-9	304L	S 30403	A2L		
1.4362	X2CrNiN23-4	324	S32304	A4	III / medium	Constructions with moderate chlo-ride and sulfur dioxide exposure and inaccessible constructions.
1.4401	X5Cr-NiMo17-12-2	316	S 31600			
1.4404	X2Cr-NiMo17-12-2	316 L	S 31603	A4L		
1.4571	X6CrNi-MoTi17-12-2	316 Ti	S 31635	A5		
1.4529	X1NiCrMo-CuN25-20-7	–	N 08926	1.4529	IV / strong	High corrosion exposure due to chlorine, chloride and/or sulfur dioxide, high humidity as well as accumulation of hazardous substances.

Fire protection

Fire protection in pipe installations according to the latest standards.

- Fire-proof installations for individual pipes and pipe routes from R30 - R120 or F30 to F120.
- Proof of compliance with the criteria of MLAR (German standard pipe system directive) for installation in escape and rescue routes

Fire protection - protection goals

Firstly, fi re protection serves to protect people, and is regulated by the building laws in the respective countries (or regional states). Secondly, fi re protection serves to protect property and this is regulated by the insurance associations, such as VdS and FM. These requirements partially go beyond the building legislation. This is particularly evident in the installation of fi re protection systems, such as sprinklers, etc., as approved or recogni-sed components must be used here. (See the following section for further details on this)

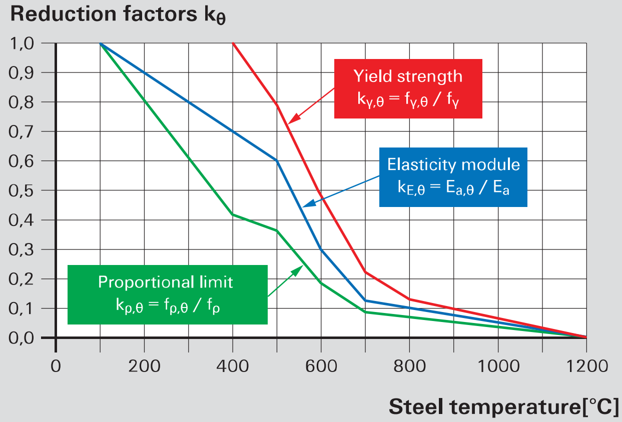
Fire inspection reports for the mounting of pipe clamps and mounting rails

Fire safety inspection reports meet the requirements for fi re protection according to the building regulations of the countries and, especially for Germany, according to the nati-onwide homonymic German pipe systems directive (LAR), based on the standard pipe systems directive of 2005 (MLAR 2005).

Personal protection is defi ned in the MLAR Directive through clear rules for escape routes, such as corridors, stairwells and hallways between stairwells and the exit.

The key message is to ensure the safety of the escape route by ensuring the functioning of the fi re-proof sub-ceiling. To this end, compliance with the minimum distance of min a ≤ 50 mm according to MLAR is required between installations and underlying suspen-ded fi re-proof F30 sub-ceilings (fi re resistance of 30 minutes). Based on the fi re inspec-tions, load information for a fi re resistance of 30 minutes in relation to the maximum

Permissible deformation of mounting rails or pipe clamps, for example, was determined. The necessity for these considerations arises from the properties of the steel, which at 30 minutes is subjected to a temperature of > 800° C according to the standard temperature curve (ISO curve).



Dependency of the yield strength, proportional limit and elasticity module on the temperatutre (basis: EN1993-1-2:2012-12 Eurocode 3).

Additionally, the same information is documented in the inspection reports for a fire resistance rating of R30, R60, R90 and R120 according to EN1363-1 and DIN4102-2. (see following load tables)

Product overview with proof in inspection reports and supplementary sheets.

Product	Document no.	MLAR	R30 – R120	F30 – F120
FRS	MFPA Leipzig - GS 3.2/14-175-2	•	•	
FUS / FCA	MFPA Leipzig - GS 3.2/14-175-4	•	•	
FRS-L Universal	MFPA Leipzig - GS 3.2/15-141-3	•	•	
FLS / ALK	MFPA Leipzig - GS 3.2/15-141-4	•	•	
SB	MPA-NRW - 210005109-7			•
SBS	MPA-NRW - 210005109-4	•		•
PDH-K	MPA-NRW - 210005109-6	•		•

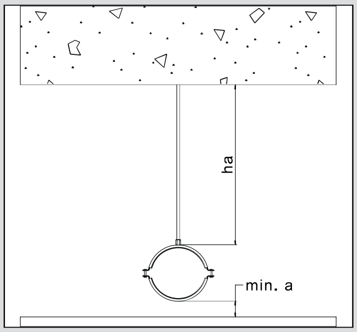
Annexure - C

9

Load tables based on fire protection inspection reports.

Pipe clamp FRS - Load table based on the Adivisory Opinion No. GS 3.2/14-175-2

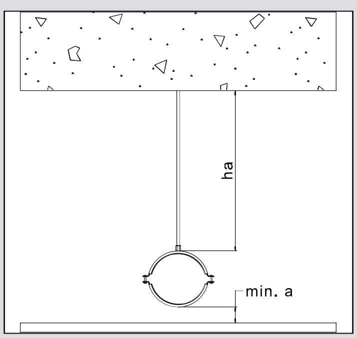
The following figures are valid for all FRS-L universal pipe clamps, galvanized, hdg and stainless steel.



FRS M8/M10		MLAR-loads		Max. Loads				
Threaded rods ≥ 4.8		Strain	F-resistance	Max. strain	Fire resistance time [minute]			
Clamping range	h_a	min a	30	min a	30	60	90	120
[mm]	[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
12 - 67	≤ 250	≤ 50	0.56	51	0.56	0.29	0.20	0.15
	≤ 500	≤ 50	0.56	54				
	≤ 750	≤ 50	0.56	57				
	≤ 1000	≤ 50	5.51	60				
72 - 92	≤ 250	≤ 50	0.65	50	0.79	0.49	0.36	0.29
	≤ 500	≤ 50	0.62	53				
	≤ 750	≤ 50	0.59	56				
	≤ 1000	≤ 50	0.57	59				
108 - 116	≤ 250	≤ 50	0.48	61	0.63	0.39	0.29	0.23
	≤ 500	≤ 50	0.43	64				
	≤ 750	≤ 50	0.39	66				
	≤ 1000	≤ 50	0.35	69				
121 - 168	≤ 250	≤ 50	0.96	61	1.00	0.51	0.34	0.25
	≤ 500	≤ 50	0.89	63				
	≤ 750	≤ 50	0.82	66				
	≤ 1000	≤ 50	0.85	69				

Pipe clamp FRS-L universal load table based on the Adivisory Opinion No. GS 3.2/15-141-3

The following figures are valid for all FRS-L universal pipe clamps, galvanized, hdg and stainless steel.



FRS-L universal M8/M10		MLAR-loads		Max. loads				
Threaded rods ≥ 4.8		Strain	F-resistance	Max. strain	Fire resistance time [minute]			
Clamping range	h_a	min a	30	min a	30	60	90	120
[mm]	[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
8 - 37	≤ 250	≤ 50	0.27	54	0.27	0.14	0.09	0.07
	≤ 500	≤ 50	0.26	57				
	≤ 750	≤ 50	0.24	60				
	≤ 1000	≤ 50	0.22	62				
38 - 66	≤ 250	≤ 50	0.17	72	0.29	0.14	0.09	0.06
	≤ 500	≤ 50	0.16	75				
	≤ 750	≤ 50	0.15	78				
	≤ 1000	≤ 50	0.13	80				
67 - 119	≤ 250	≤ 50	0.53	75	0.53	0.35	0.27	0.22
	≤ 500	≤ 50	0.53	78				
	≤ 750	≤ 50	0.53	81				
	≤ 1000	≤ 50	0.53	83				

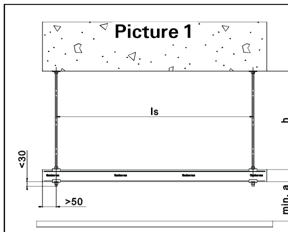
FUS-Channel/FCA-Cantilever arm - Load table based on the Adivisory Opinion No. GS 3.2/14-175-4

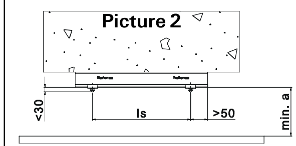
The following figures are valid for FUS channels and FCA cantilever arms, galvanized, hdg and stainless steel

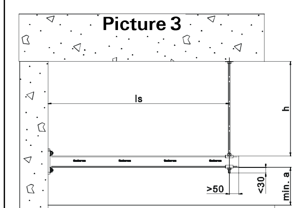
FUS / FCA 41/2,5 (picture 1-3)		MLAR -loads		Max. Loads				
Threaded rods ≥ 4.8		strain	F-resistance	Max. strain	Fire resistance time [minute]			
Load case	l_s	min a [1]	30	min a [2]	30	60	90	120
	[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
Point load	≤ 400	≤ 50	0,90	278	2,40	1,33	0,92	0,72
	≤ 700	≤ 50	-	320	1,61	1,04	0,80	0,67
Multiple load [3]	≤ 400	≤ 50	0,90	278	2,40	1,33	0,92	0,72
	≤ 700	≤ 50	-	320	1,61	1,04	0,80	0,67
Uniformly distributed load	≤ 400	≤ 50	1,50	258	3,00	2,10	1,41	1,06
	≤ 700	≤ 50	0,60	299	2,44	1,57	1,21	1,00
	≤ 1250	≤ 50	-	468	3,29	1,81	1,27	0,98
FUS / FCA 62/2,5 (picture 1-3)		**MLAR -loads**		**Max. Loads**				
Threaded rods ≥ 4.8		strain	F-resistance	Max. strain	Fire resistance time [minute]			
Load Case	l_s	min a [1]	30	min a [2]	30	60	90	120
	[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
Point load	≤ 400	≤ 50	1,76	25	1,76	1,06	0,78	0,62
	≤ 1000	≤ 50	-	460	2,27	1,31	0,93	0,72
Multiple load [3]	≤ 400	≤ 50	1,76	25	1,76	1,06	0,78	0,62
	≤ 960 [4]	≤ 50	4,30	550	4,30	2,14	1,39	1,01
	≤ 1000	≤ 50	0,55	661	2,52	1,60	1,21	0,99
Uniformly distributed load	≤ 400	≤ 50	1,76	25	1,76	1,06	0,78	0,62
	≤ 960 [4]	≤ 50	4,30	550	4,30	2,14	1,39	1,01
	≤ 1000	≤ 50	0,55	661	2,52	1,60	1,21	0,99
	≤ 1250	≤ 50	0,50	592	2,41	1,65	1,31	1,11
FUS 62/2,5 (picture 4)		**MLAR -loads**		**Max. Loads**				
Vertical FUS 41/2,5		strain	F-resistance	Max. strain	Fire resistance time [minute]			
Load case	l_s	min a [1]	30	min a [2]	30	60	90	120
	[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
Point load	≤ 1000	≤ 50	0,57	369	1,33	0,87	0,68	0,57
Multiple load [3]	≤ 1000	≤ 50	0,62	649	1,92	1,34	1,08	0,92
Uniformly distributed load	≤ 1000	≤ 50	0,62	649	1,92	1,34	1,08	0,92

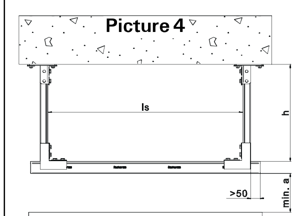
[1] Valid for a suspension height ha ≤ 500 mm
[2] Based on suspension height ha = 250mm, Expansion length of threaded rods in case of fire ~ 10mm/m
[3] Given load values apply for multiple loads as summated point loads symmetrical allocated
[4] This values are valid for FCA 62/2,5 with additional support by threaded rod

Picture 1 - 3 are valid for FUS/FCA and FLS/ALK load tables







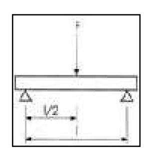


FLS-Channel/ALK-Cantilever arm - Load table based on the Adivisory Opinion No. GS 3.2/14-175-?

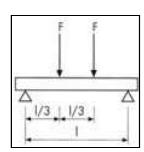
The following figures are valid for FLS channels and ALK cantilever arms, galvanized, hdg and stainless steel

FUS / FCA 41/2,5 (picture 1-3)		MLAR -loads		Max. Loads				
Threaded rods ≥ 4.8		strain	F-resistance	Max. strain	Fire resistance time [minute]			
Load case	l_s	min a	30	min a	30	60	90	120
	[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
Point load	≤ 400 [1]	≤ 50	0,24	93	0,24	0,13	0,10	0,09
	≤ 400 [2]	≤ 50	0,09	289	0,47	0,38	0,33	0,30
	≤ 400 [4]	≤ 50	0,32	226	1,33	0,78	0,53	0,40
Multiple load [3]	≤ 400 [1]	≤ 50	0,72	93	0,72	0,38	0,30	0,27
	≤ 400 [2]	≤ 50	0,26	289	1,42	1,13	0,99	0,90
	≤ 400 [4]	≤ 50	0,81	226	1,33	0,78	0,53	0,40
Uniformly distributed load	≤ 400 [1]	≤ 50	0,72	93	0,72	0,38	0,30	0,27
	≤ 400 [2]	≤ 50	0,35	308	1,37	1,19	1,06	0,95
	≤ 400 [4]	≤ 50	0,81	226	1,33	0,78	0,53	0,40

[1] Valid for a suspension height ha = 0 mm, s. picture 2
[2] Valid for a suspension height ha = 500mm, s. picture 1 (Expansion length of threaded rods in case of fire ~ 10mm/m)
[3] Given load values apply for multiple loads as summated point loads symmetrical allocated
[4] This values are valid for ALK 37-450 with additional support by threaded rod, s picture 3 (ha = 500 mm)



Single load
Spot load, e.g. a pipe clamp on the rail.



Multiple load
More than one load point on the rail, e.g. several pipe clamps.

Uniform load
Uniform distribution of load on the rails, e.g. bend-proof ventilation duct.

Mounting sprinkler systems

Sprinkler systems are usually created according to diff erent standards. For example, according to the VdS standard (VdS CEA 4001), the American FM standard 1951 (Factory Mutual Insurance Company" (FM Global)), UL 203 (Underwriters Laboratories (UL)), NFPA 13 regulations (National Fire Protection Association (NFPA)) or EN 12845.

The European Directive CEA 4001 was created in 1995 by the insurance industry in coo-peration with the manufacturers' association EUROFEU, and VdS CEA 4001 was created in Germany in 2003 by the "Association of Property Insurers" (VdS).

EN 12845 was developed on the basis of CEA 4001 from 1995 and the VdS CEA 4001 from 2003, creating a standard that was practically the same word for word. National practices, such as those for Germany, are to be included in a revised DIN 14489 as a national annex to EN 12845.

The American rules correspond to the requirements for mounting pipe installations, but they must be checked in detail in each case.

For mounting sprinkler pipes, the diff erent load values, mounting distances and connec-tion sizes for pipe loops and pipe clamps, which are listed in the following table for the most common directives, are applicable.

	FM1951				NFPA13				VdS CEA 4001			
Pipe sizes	Test load	Max. distance	Min rod size		Test load calcula-ted	Max. distance	Min rod size		Loading capacity	Max. distance	Min rod size	
DN	[kN]	[m]	[metric]	[inch]	[kN]	[m]	[metric]	[inch]	[kN]	[m]	[metric]	[inch]
15	no data	no data	no data	no data	1.4	3.60	9.5	3/8	2.0	4.00	M8	no data
20	1.512	3.6	M10	3/8	1.5	3.60	9.5	3/8	2.0	4.00	M8	no data
25	1.824	3.6	M10	3/8	1.7	3.66	9.5	3/8	2.0	4.00	M8	no data
32	1.913	3.6	M10	3/8	1.9	3.66	9.5	3/8	2.0	4.00	M8	no data
40	2.313	4.6	M10	3/8	2.4	4.57	9.5	3/8	2.0	4.00	M8	no data
50	2.825	4.6	M10	3/8	2.9	4.57	9.5	3/8	3.5	4.00	M10	no data
65	4.181	4.6	M10	3/8	3.8	4.57	9.5	3/8	3.5	6.00	M10	no data
80	4.715	4.6	M10	3/8	4.8	4.57	9.5	3/8	3.5	6.00	M10	no data
90	5.583	4.6	M10	3/8	5.7	4.57	9.5	3/8	3.5	6.00	M10	no data
100	6.561	4.6	M10	3/8	6.7	4.57	9.5	3/8	5.0	6.00	M10	no data
125	8.896	4.6	M12	1/2	9.0	4.57	12.7	1/2	5.0	6.00	M12	no data
150	11.632	4.6	M12	1/2	11.8	4.57	12.7	1/2	8.5	6.00	M12	no data
200	16.903	4.6	M12	1/2	18.2	4.57	12.7	1/2	8.5	6.00	M16	no data
250	26.044	4.6	M16	5/8	26.7	4.60	15.9	5/8	no data	6.00	no data	no data

	FM1951				NFPA13				VdS CEA 4001			
Pipe sizes	Test load	Max. distance	Min rod size		Test load calcula-ted	Max. distance	Min rod size		Loading capacity	Max. distance	Min rod size	
DN	[kN]	[m]	[metric]	[inch]	[kN]	[m]	[metric]	[inch]	[kN]	[m]	[metric]	[inch]
300	35.141	4.6	M16	5/8	36.0	4.60	15.9	5/8	no data	6.00	no data	no data
350	no data	no data	no data	no data	42.9	4.60	no data	no data	no data	6.00	no data	no data
400	no data	no data	no data	no data	55.7	4.60	no data	no data	no data	6.00	no data	no data
450	no data	no data	no data	no data	70.1	4.60	no data	no data	no data	6.00	no data	no data
500	no data	no data	no data	no data	84.4	4.60	no data	no data	no data	6.00	no data	no data

Dimensions and weights of pipes, ventilation ducts and ventilation pipes

Schedule 40 pipe table

S.no.	Nom. Pipe Size	Out Diameter	Inner Diameter	Out Diameter	Inner Diameter	Weight of pipe	Weight of water in pipe	Total pipe weight filled with
		in	in	mm	mm	kg/M`	kg/M`	kg/M`
1.	1/8"	0.405	0.269	10.3	6.8	0.4	0.04	0.4
2.	1/4"	0.540	0.364	13.7	9.2	0.6	0.1	0.7
3.	3/8"	0.675	0.493	17.1	12.5	0.8	0.1	1.0
4.	1/2"	0.840	0.622	21.3	15.8	1.3	0.2	1.5
5.	3/4"	1.050	0.824	26.7	20.9	1.7	0.3	2.0
6.	1"	1.315	1.049	33.4	26.6	2.5	0.6	3.1
7.	11/4"	1.660	1.380	42.2	35.1	3.4	1.0	4.3
8.	11/2"	1.900	1.610	48.3	40.9	4.0	1.3	5.4
9.	2"	2.375	2.067	60.3	52.5	5.4	2.2	7.6
10.	21/2"	2.875	2.469	73.0	62.7	8.6	3.1	11.7
11.	3"	3.500	3.068	88.9	77.9	11.3	4.8	16.0
12.	31/2"	4.000	3.548	101.6	90.1	13.6	6.4	19.9
13.	4"	4.500	4.026	114.3	102.3	16.1	8.2	24.3
14.	5"	5.563	5.047	141.3	128.2	21.8	12.9	34.6
15.	6"	6.625	6.065	168.3	154.1	28.2	18.6	46.8
16.	8"	8.625	7.981	219.1	202.7	42.5	32.1	74.6
17.	10"	10.750	10.020	273.1	254.5	60.2	50.7	111.0
18.	12"	12.750	11.938	323.9	303.2	79.7	72.2	151.8
19.	14"	14.000	13.000	355.6	330.2	94.3	87.0	181.3
20.	16"	16.000	15.000	406.4	381.0	123.2	113.8	237.0
21.	18"	18.000	16.874	457.2	428.6	155.9	144.6	300.5
22.	20"	20.000	18.814	508.0	477.9	182.9	179.2	362.0
23.	24"	24.000	22.626	609.6	574.7	254.7	259.2	513.9

9

Annexure - C

Weights of galvanized ventilation ducts in kg/m without insulation

Sheet metal 0.75			Sheet metal 0.88						Sheet metal 1.0						Sheet metal 1.13						Sheet metal 1.25				
200	224	250	280	315	355	400	450	500	560	630	710	800	900	1000	1120	1250	1400	1600	1800	2000	2240	2500	2800	3150	◄ B ▼ H
6.6	7.0	7.4	9.3	10.0	10.7	11.6	12.6	13.6	16.7	18.3	20.0	22.0	24.2	26.4	32.8	36.0	39.8	44.7	49.7	54.7	70.2	77.6	86.3	96.3	200
	7.4	7.8	9.8	10.4	11.2	12.1	13.0	14.0	17.2	18.8	20.5	22.5	24.7	26.9	33.4	36.6	40.4	45.3	50.3	55.3	70.8	78.3	86.9	97.0	224
		8.3	10.3	10.9	11.7	12.6	13.6	14.5	17.8	19.4	21.1	23.1	25.3	27.5	34.1	37.3	41.0	46.0	51.0	55.9	71.6	79.1	87.7	97.8	250
			10.8	11.5	12.3	13.2	14.1	15.1	18.5	20.0	21.8	23.8	26.0	28.2	34.8	38.0	41.8	46.7	51.7	56.7	72.5	79.9	88.6	98.6	280
				12.2	13.0	13.8	14.8	15.8	19.3	20.8	22.6	24.5	26.7	28.9	35.7	38.9	42.6	47.6	52.6	57.6	73.5	80.9	89.6	99.6	315
					13.7	14.6	15.6	16.6	20.1	21.7	23.4	25.4	27.6	29.8	36.7	39.9	43.6	48.6	53.6	58.5	74.6	82.1	90.7	100.8	355
						15.5	16.5	17.4	21.1	22.7	24.4	26.4	28.6	30.8	37.8	41.0	44.7	49.7	54.7	59.7	75.9	83.4	92.0	102.1	400
							17.4	18.4	22.2	23.8	25.5	27.5	29.7	31.9	39.0	42.3	46.0	51.0	55.9	60.9	77.3	84.8	93.4	103.5	450
								19.4	23.3	24.9	26.6	28.6	30.8	33.0	40.3	43.5	47.2	52.2	57.2	62.2	78.8	86.3	94.9	104.9	500
									24.6	26.2	27.9	29.9	32.1	34.3	41.8	45.0	48.7	53.7	58.7	63.6	80.5	88.0	96.6	106.7	560
										27.6	29.5	31.5	33.7	35.9	43.5	46.7	50.5	55.4	60.4	65.4	82.5	90.0	98.6	108.7	630
											31.2	33.2	35.4	37.6	45.5	48.7	52.5	57.4	62.4	67.4	84.4	92.3	100.9	111.0	710
												35.2	37.4	39.6	47.7	51.0	54.7	59.7	64.6	69.6	87.4	94.9	103.5	113.6	800
													39.6	41.8	50.2	53.4	57.2	62.2	67.1	72.1	90.3	97.8	106.4	116.4	900
														44.0	52.7	55.9	59.7	64.6	69.6	74.6	93.2	100.6	109.3	119.3	1000
															55.7	58.9	62.6	67.6	72.6	77.6	96.6	104.1	112.7	122.8	1120
																62.2	65.9	70.9	75.8	80.8	100.3	107.8	116.4	126.5	1250
																	69.6	74.6	79.6	84.5	104.7	112.1	120.8	130.8	1400
																		79.6	84.5	89.5	110.4	117.9	126.5	136.6	1600
																			89.5	94.5	116.2	123.6	132.3	142.3	1800
																				99.4	121.9	129.4	138.0	148.1	2000
																					128.8	136.3	144.9	155.0	2240
																						143.8	152.4	162.4	2500
																							161.0	171.1	2800
																								181.5	3150

The weights in kg/m are reference values. The weights can deviate, depending on the sheet metal thickness and the type of flange used. The flange weight is included flat-rate. The loads based on a mineral wool weight of 80 kg/m2 and a thickness of 5 cm.

Weights of galvanized ventilation ducts in kg/m with (80 kg/m³ , 5 cm thickness)

Sheet metal 0.75			Sheet metal 0.88						Sheet metal 1.00						Sheet metal 1.13						Sheet metal 1.25				
200	224	250	280	315	355	400	450	500	560	630	710	800	900	1000	1120	1250	1400	1600	1800	2000	2240	2500	2800	3150	◄ B ▼ H
9.1	9.6	10.2	12.1	13.0	14.0	15.2	16.4	17.7	21.0	22.9	25.1	27.6	30.4	33.2	39.8	43.8	48.3	54.3	60.4	66.4	79.4	87.8	97.6	109.0	200
	10.2	10.8	13.8	13.6	14.6	15.8	17.0	18.3	21.7	23.6	25.8	28.3	31.1	33.8	40.6	44.5	49.0	55.0	61.1	67.1	80.2	88.6	98.4	109.8	224
		11.4	14.5	14.3	15.3	16.4	17.7	19.0	22.4	24.3	26.5	29.0	31.8	34.5	41.3	45.3	49.8	55.8	61.9	67.9	81.0	89.5	99.2	110.6	250
			15.3	15.0	16.0	17.2	18.4	19.7	23.2	25.1	27.3	29.8	32.6	35.4	42.2	46.2	50.7	56.7	62.8	68.8	82.0	90.4	100.2	111.6	280
				15.9	16.9	18.1	19.3	20.6	24.2	26.1	28.3	30.8	33.6	36.3	43.3	47.2	51.8	57.8	63.8	69.9	83.1	91.6	101.3	112.7	315
					17.9	19.1	20.3	21.6	25.3	27.2	29.4	31.9	34.7	37.4	44.5	48.4	53.0	59.0	65.0	71.1	84.4	92.9	102.6	114.0	355
						20.2	21.5	22.7	26.5	28.5	30.7	33.2	35.9	38.7	45.9	49.8	54.3	60.4	66.4	72.4	85.9	94.3	104.1	115.5	400
							22.7	24.0	27.9	29.8	32.0	34.5	37.3	40.1	47.4	51.3	55.8	61.9	67.9	73.9	87.5	96.0	105.7	117.1	450
								25.3	29.3	31.2	33.4	35.9	38.7	41.4	48.9	52.8	57.3	63.4	69.4	75.4	89.1	97.6	107.4	118.7	500
									30.9	32.9	35.1	37.6	40.3	43.1	50.7	54.6	59.1	65.2	71.2	77.3	91.1	99.5	109.3	120.7	560
										34.8	37.0	39.5	42.3	45.0	52.8	56.7	61.3	67.3	73.3	79.4	93.4	101.8	111.6	123.0	630
											39.2	41.7	44.5	47.2	55.2	59.1	63.7	69.7	75.7	81.8	96.0	104.4	114.2	125.6	710
												44.2	47.0	49.7	57.9	61.9	66.4	72.4	78.5	84.5	98.9	107.4	117.1	128.5	800
													49.7	52.5	61.0	64.9	69.4	75.4	81.5	87.5	102.1	110.6	120.4	131.8	900
														55.3	64.0	67.9	72.4	78.5	84.5	90.5	105.4	113.9	123.6	135.0	1000
															67.6	71.5	76.0	82.1	88.1	94.1	109.3	117.8	127.5	138.9	1120
																75.4	80.0	86.0	92.0	98.1	113.5	122.0	131.8	143.1	1250
																	84.5	90.5	96.6	102.6	118.4	126.9	136.6	148.0	1400
																		96.6	102.6	108.6	124.9	133.4	143.1	154.5	1600
																			108.6	114.7	131.4	139.9	149.6	161.0	1800
																				120.7	137.9	146.4	156.2	167.5	2000
																					145.7	154.2	164.0	175.3	2240
																						162.7	172.4	183.8	2500
																							182.2	193.6	2800
																								204.9	3150

Important dimensions, variables and units

Material

S 250 GD

	Material No.	Tensile strength Rm N/mm² min.	Yield strength ReH N/mm² min.	Elongation at break A80% min.
S 250 GD	1.0242	≥ 330	≥ 250	≥ 19

DX 51 D

DX 51 D	1.0226	270 – 500	- *	≥ 22

*For fischer profiles defined 240 N/mm²

DC 01

DC 01	1.0330	270 – 410	≤ 280	≥ 28

S 235 JR

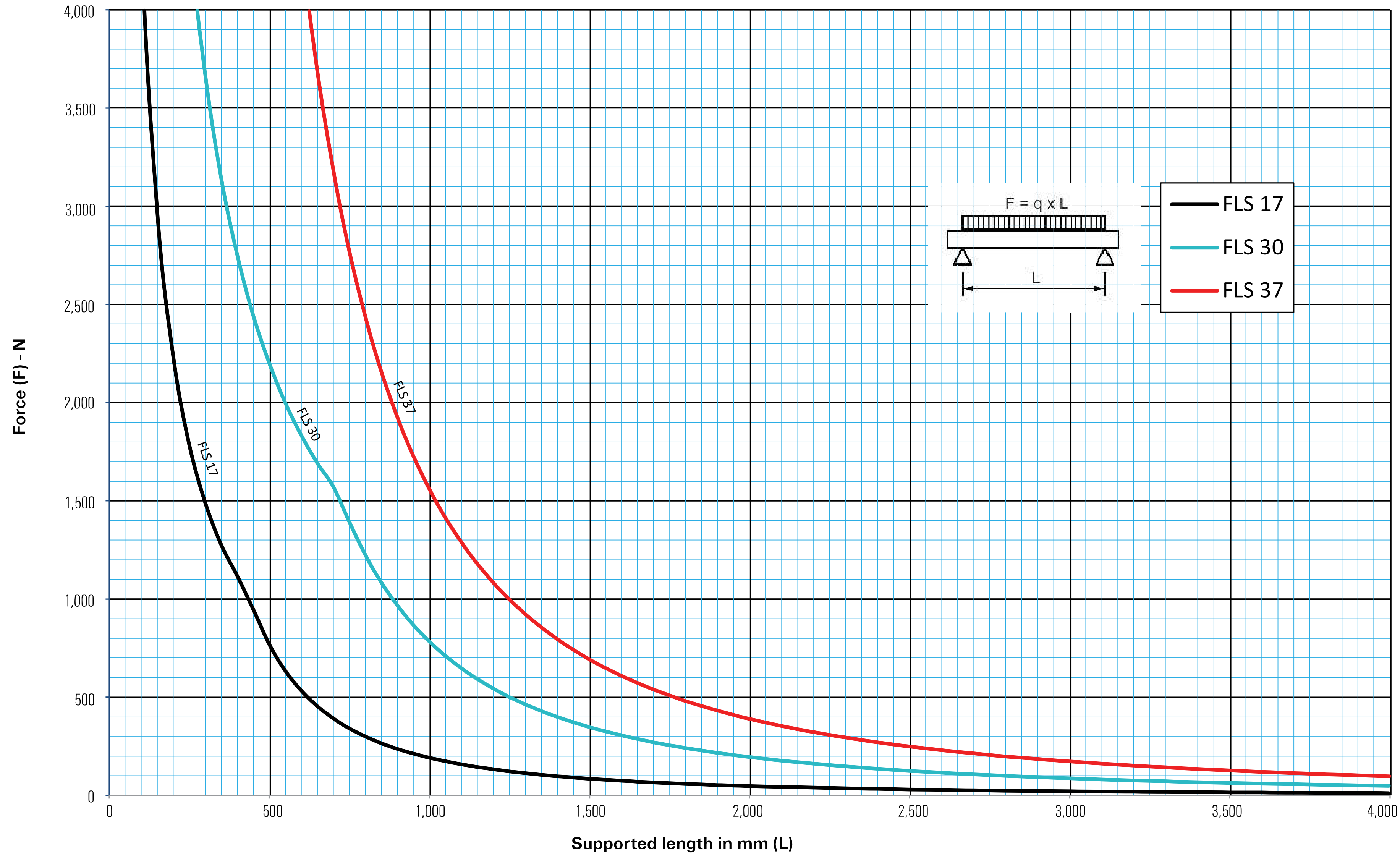
S 235 JR	1.0037	360 - 510	≥ 235	19/17

DD 11

				LO = 80mm		LO = 5,65√SO
DD 11	1.0332	440	170 - 360	23	24	28

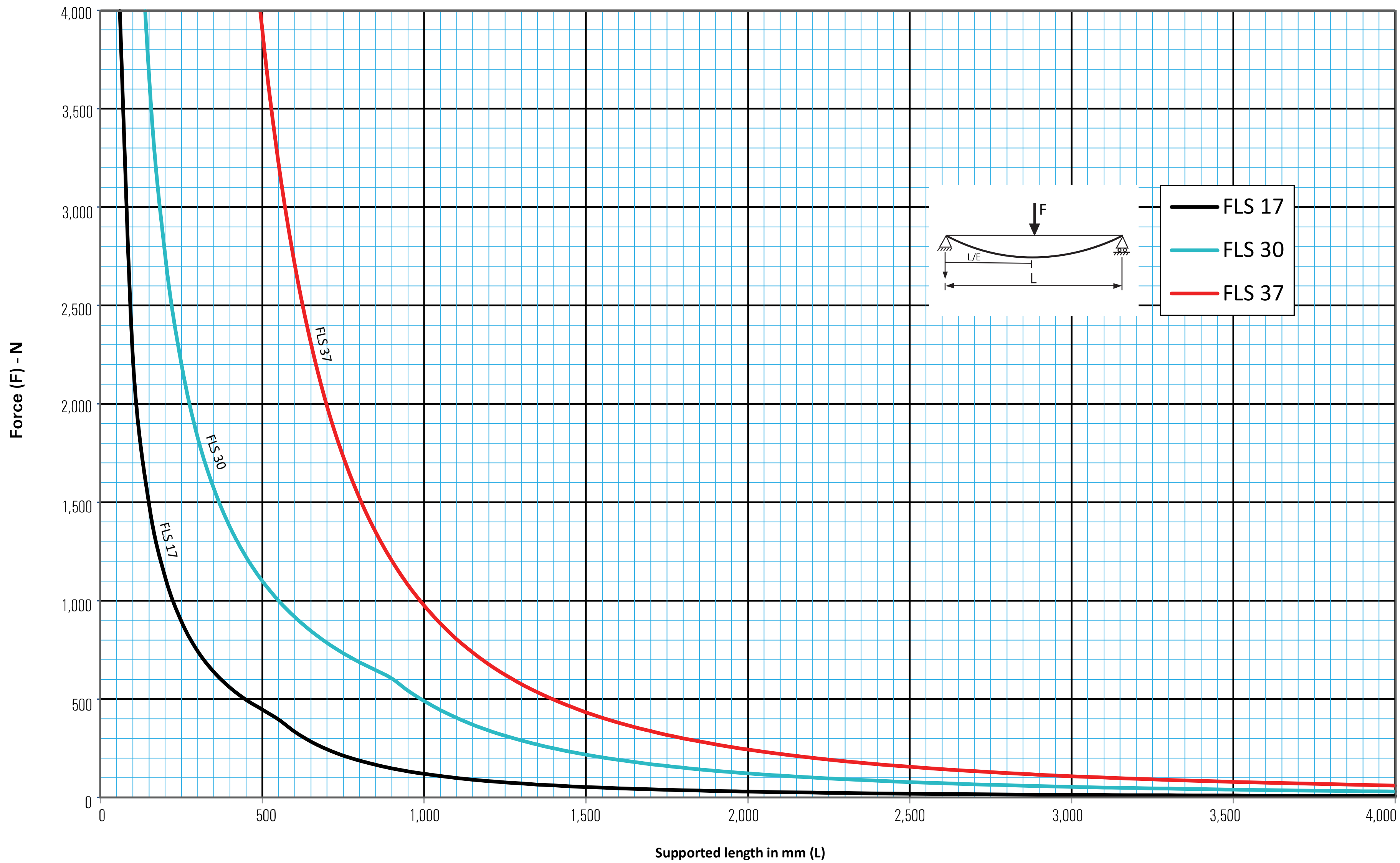
equivalents of carbon steel qualities			
DIN EN ISO			ASTM
Description	Material-no.		
S 250 GD+Z	1.0242	DIN EN 10346	A 569
DD11	1.0332	DIN EN 10111	A 569
DC01	1.0330	DIN EN 10130	A 366
St 22	1.0320	DIN 1614-1	n/a
DX51D+Z 275 NA-C	1.0226+Z	DIN EN 10327	A 653
S235JR	1.0037	DIN EN 10025	A 283
S 355 MC	1.0976	DIN EN 10149	Gr. 50
4.6; 4.8, 5.8, 8.8	DIN EN ISO 898-1		F 568M

fischer FLS (Light Duty) - Design Curve 1



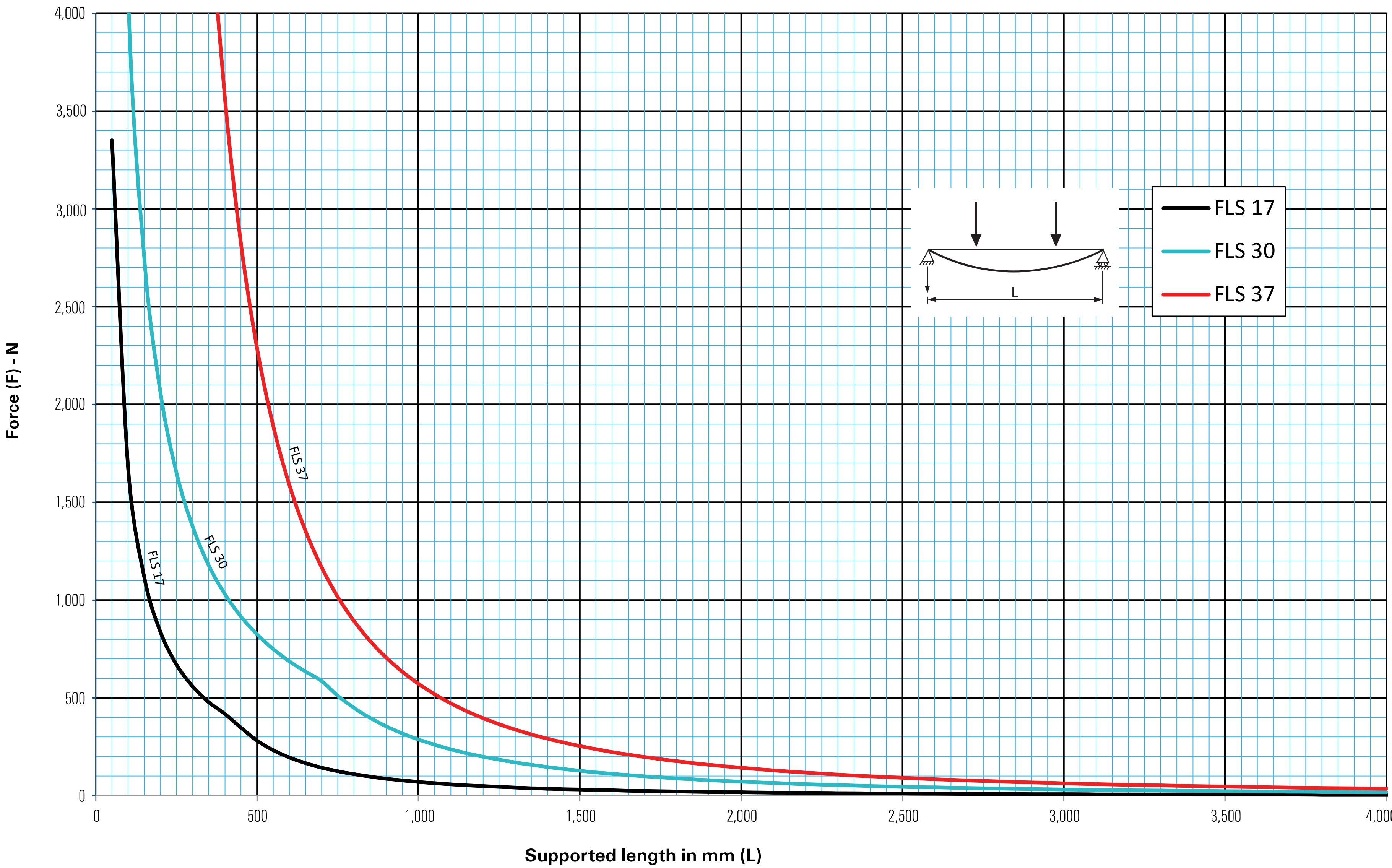
Design load under **Uniformly distributed load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FLS (Light Duty) - Design Curve 2



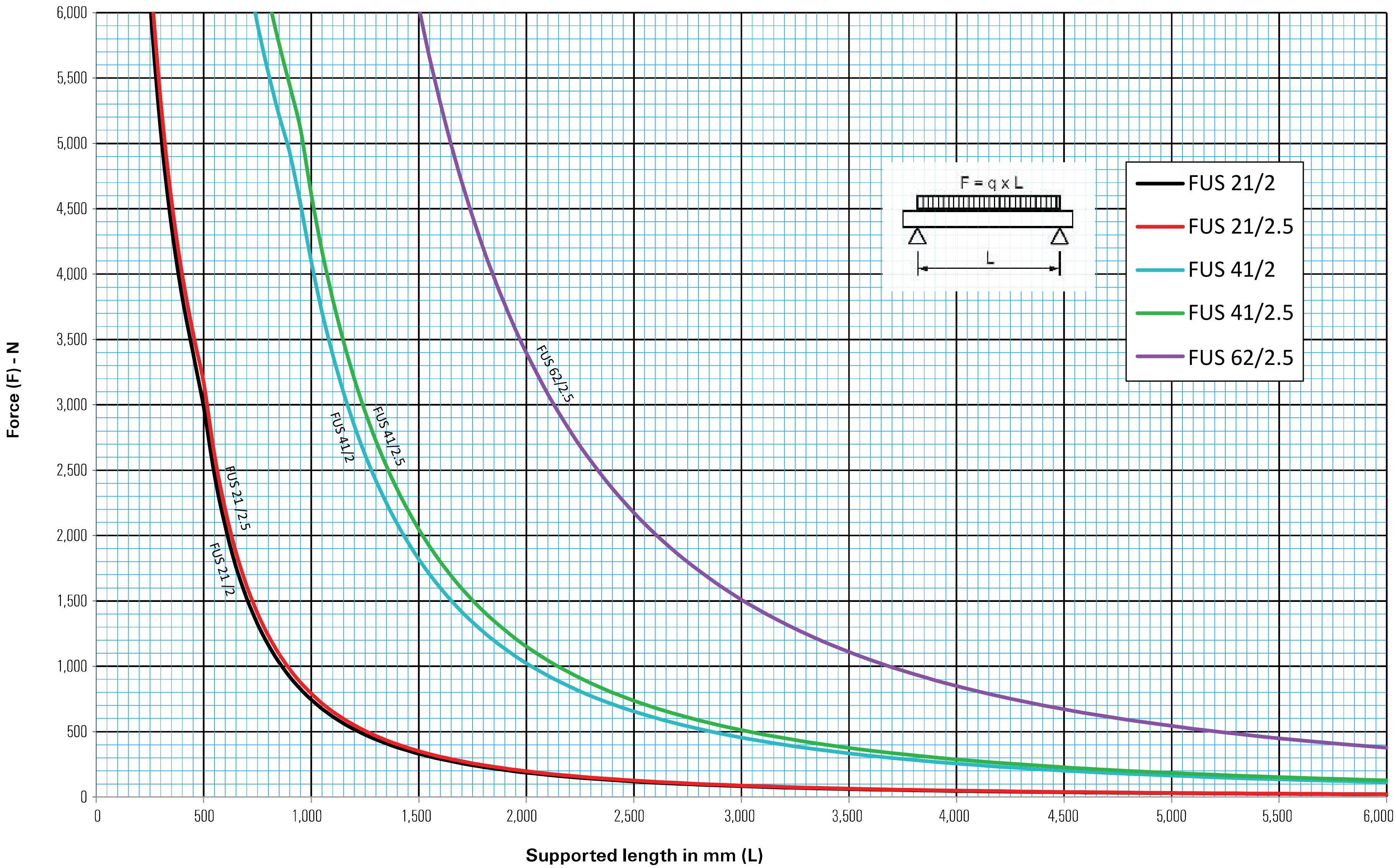
Design load under **Single concentrated load in the center** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not

fischer FLS (Light Duty) - Design Curve 3



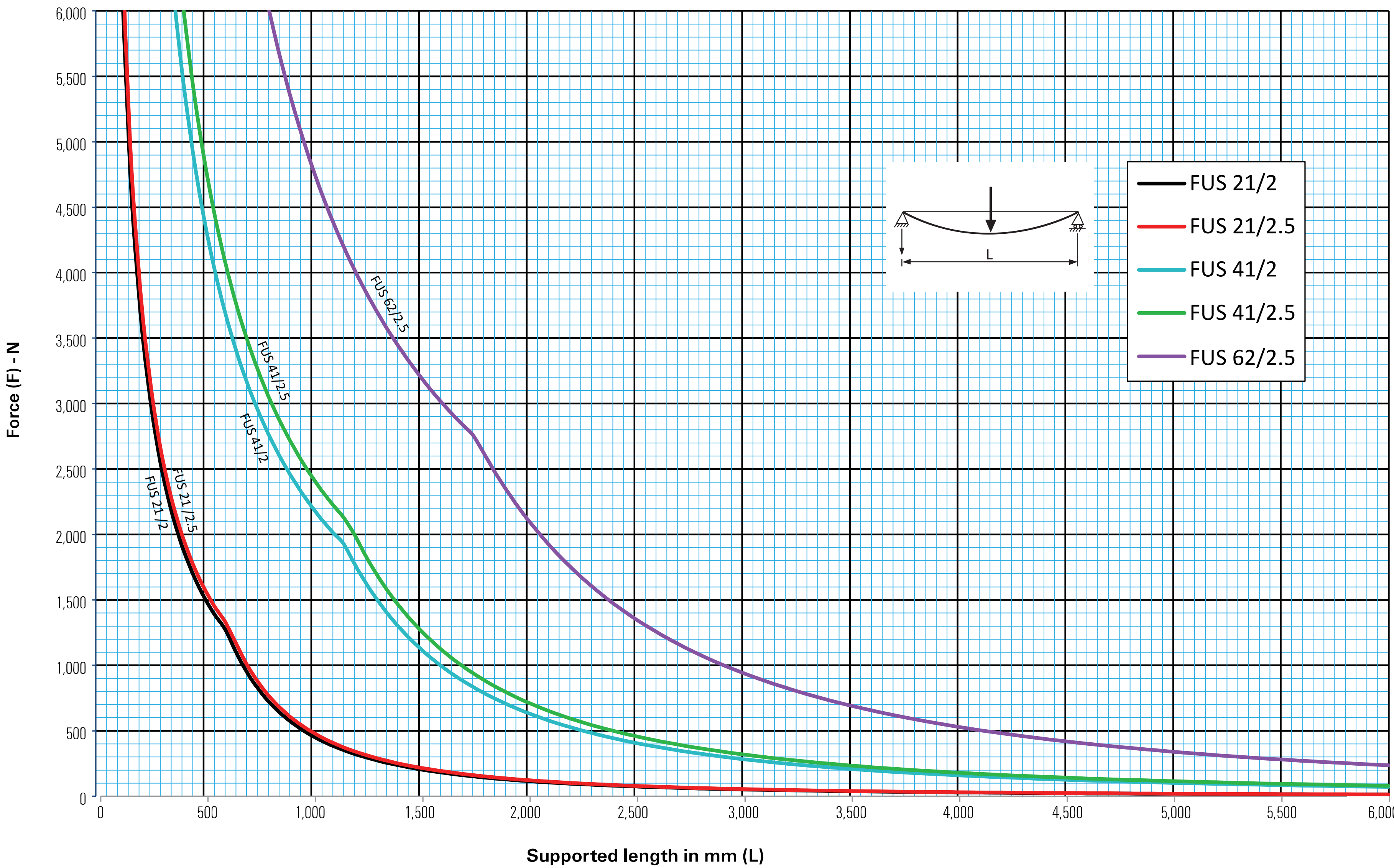
Design load under **Double concentrated load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FUS (Medium Duty) - Design Curve 1



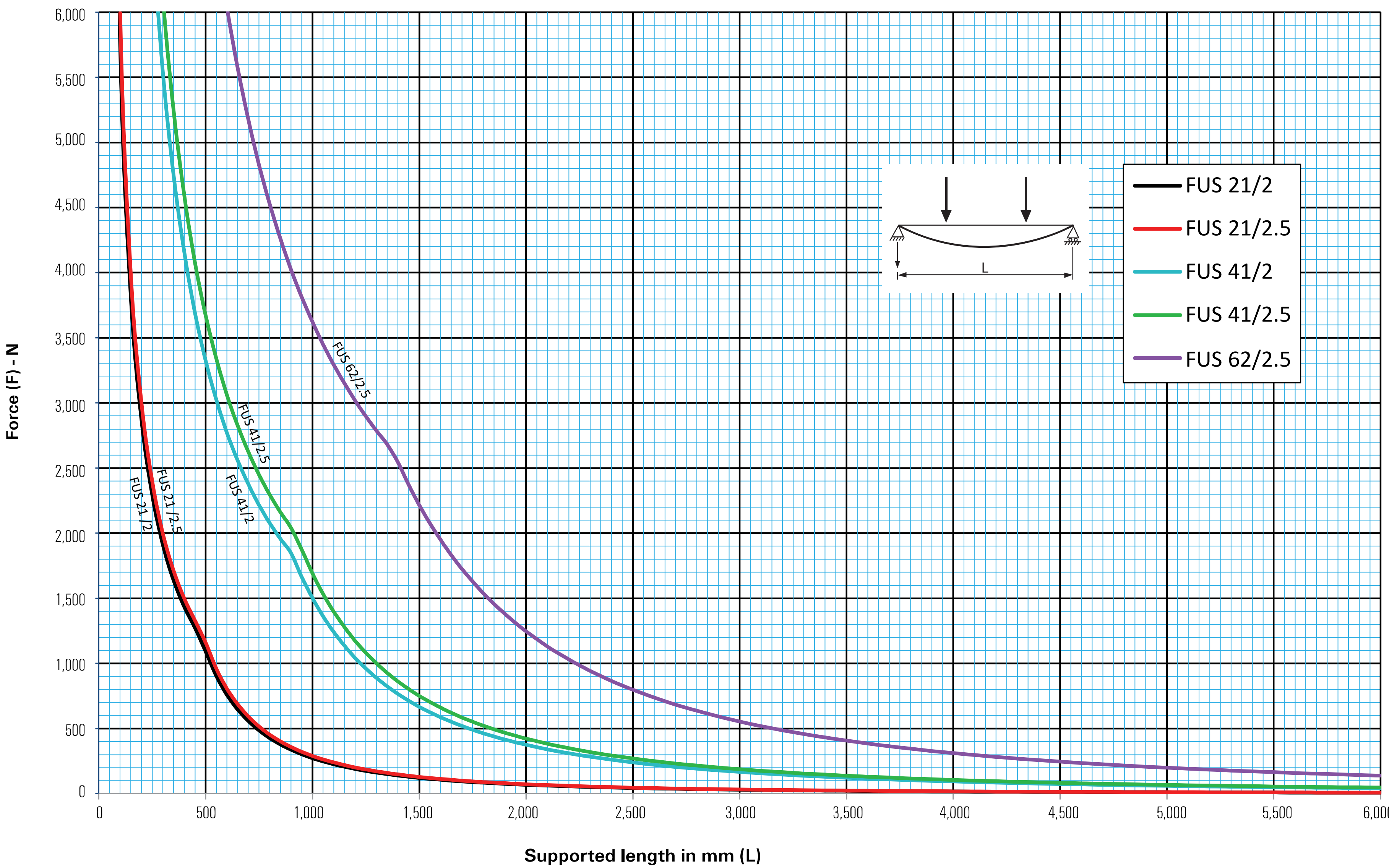
Design load under **Uniformly distributed load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FUS (Medium Duty) - Design Curve 2



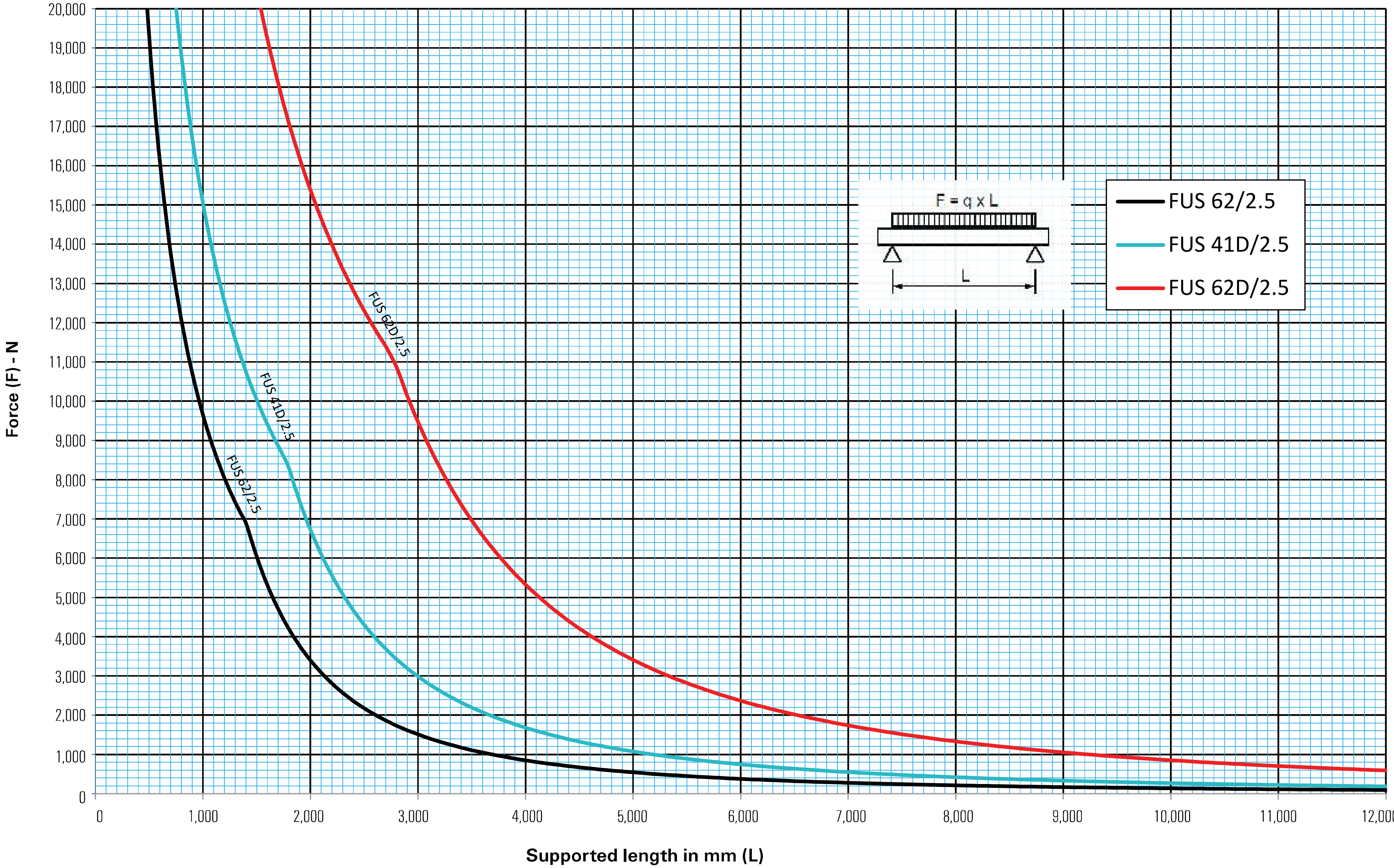
Design load under **Single concentrated load in the center** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FUS (Medium Duty) - Design Curve 3



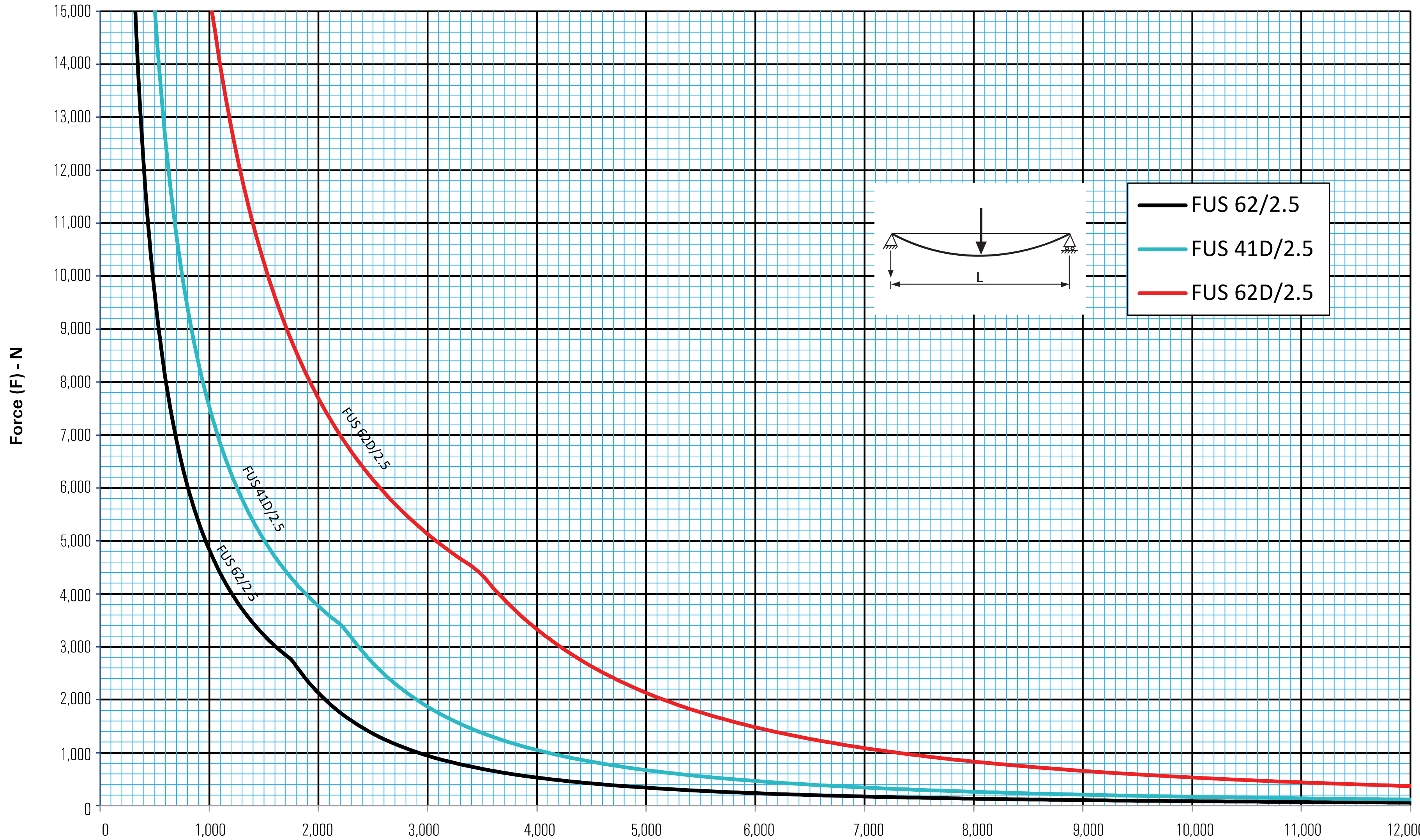
Design load under **Double concentrated load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FUS (Heavy Duty) - Design Curve 1



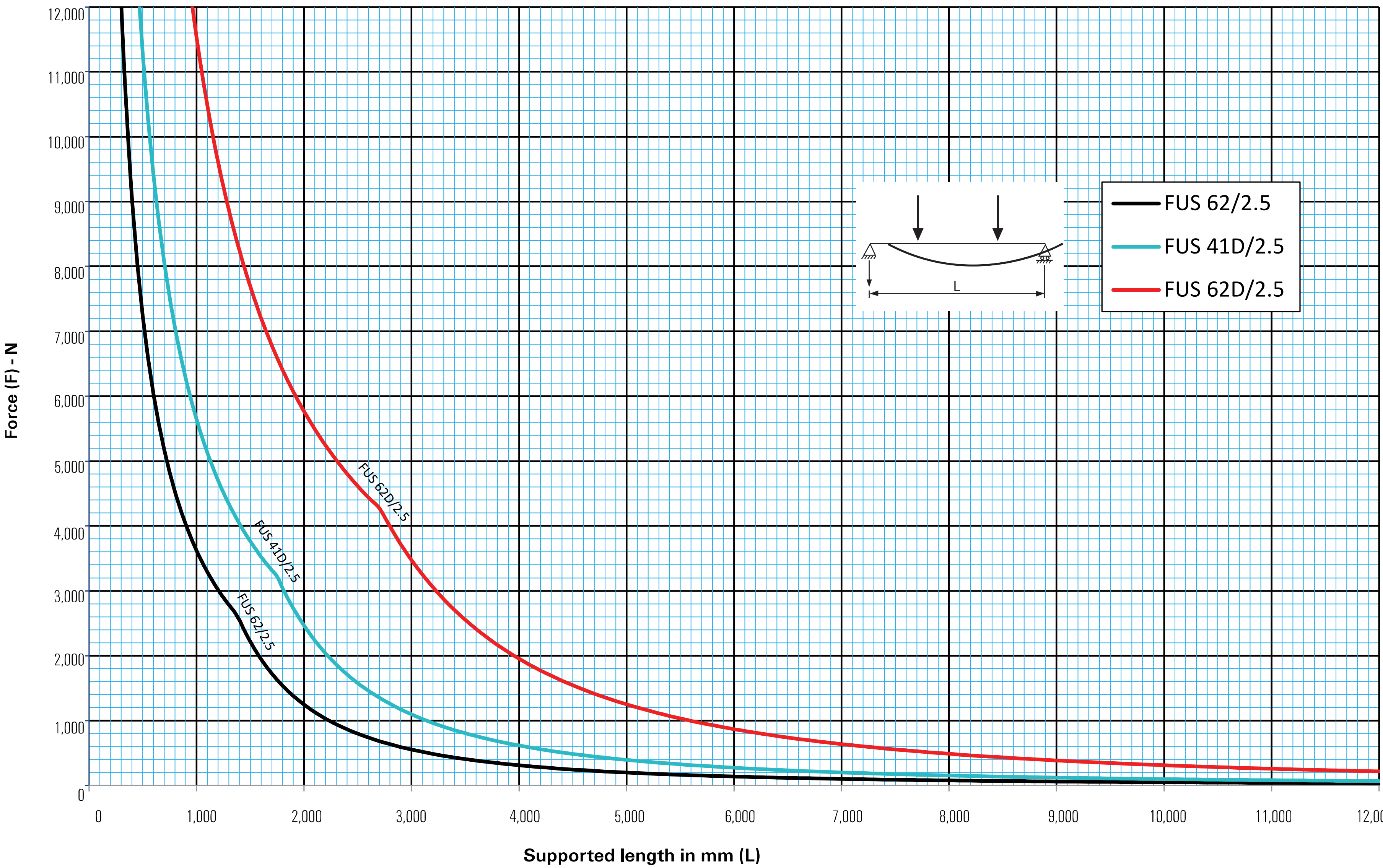
Design load under **Uniformly distributed load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FUS (Heavy Duty) - Design Curve 2



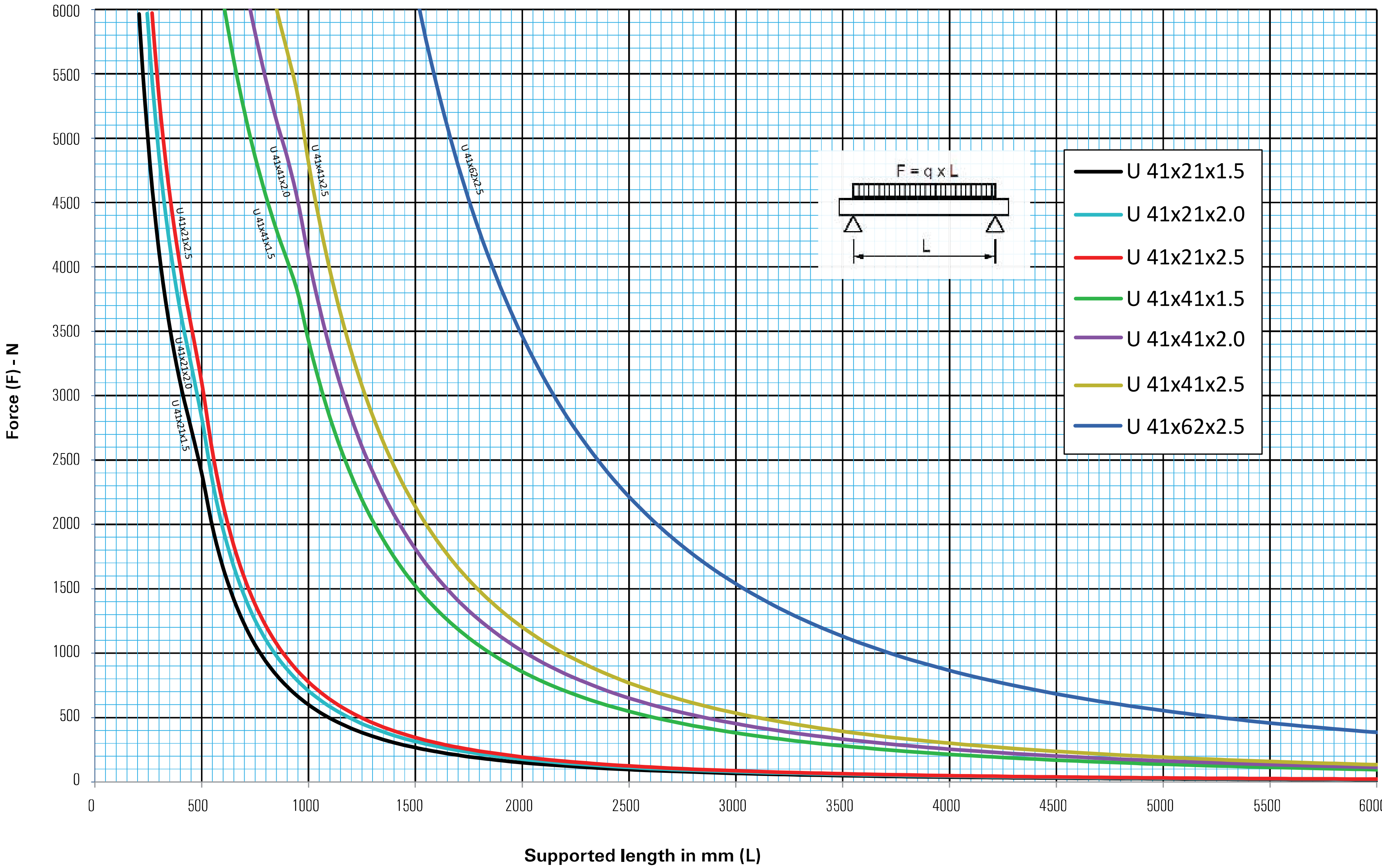
Design load under **Single concentrated load in the center** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer FUS (Heavy Duty) - Design Curve 3



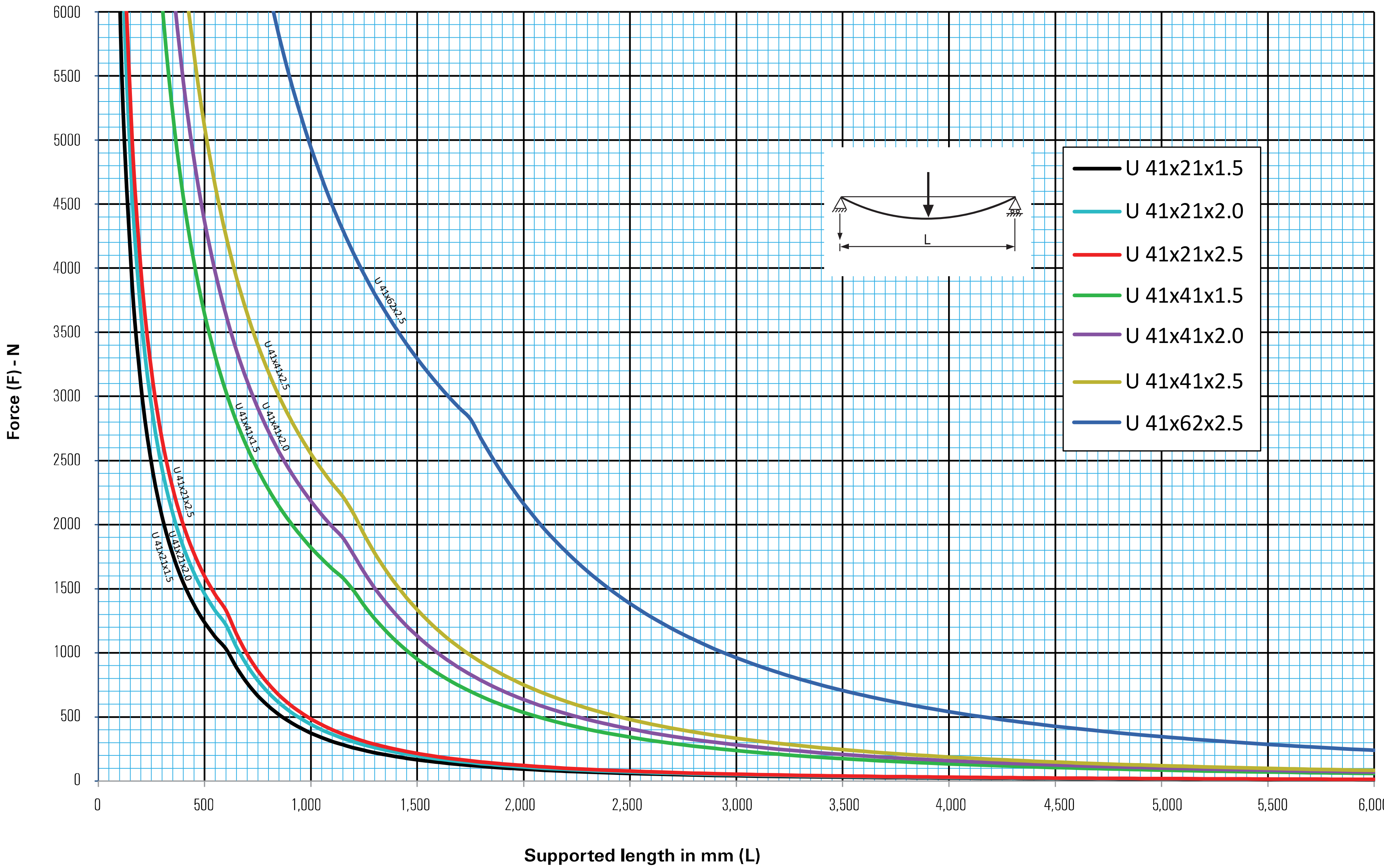
Design load under **Double concentrated load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer U Channel - Design Curve 1



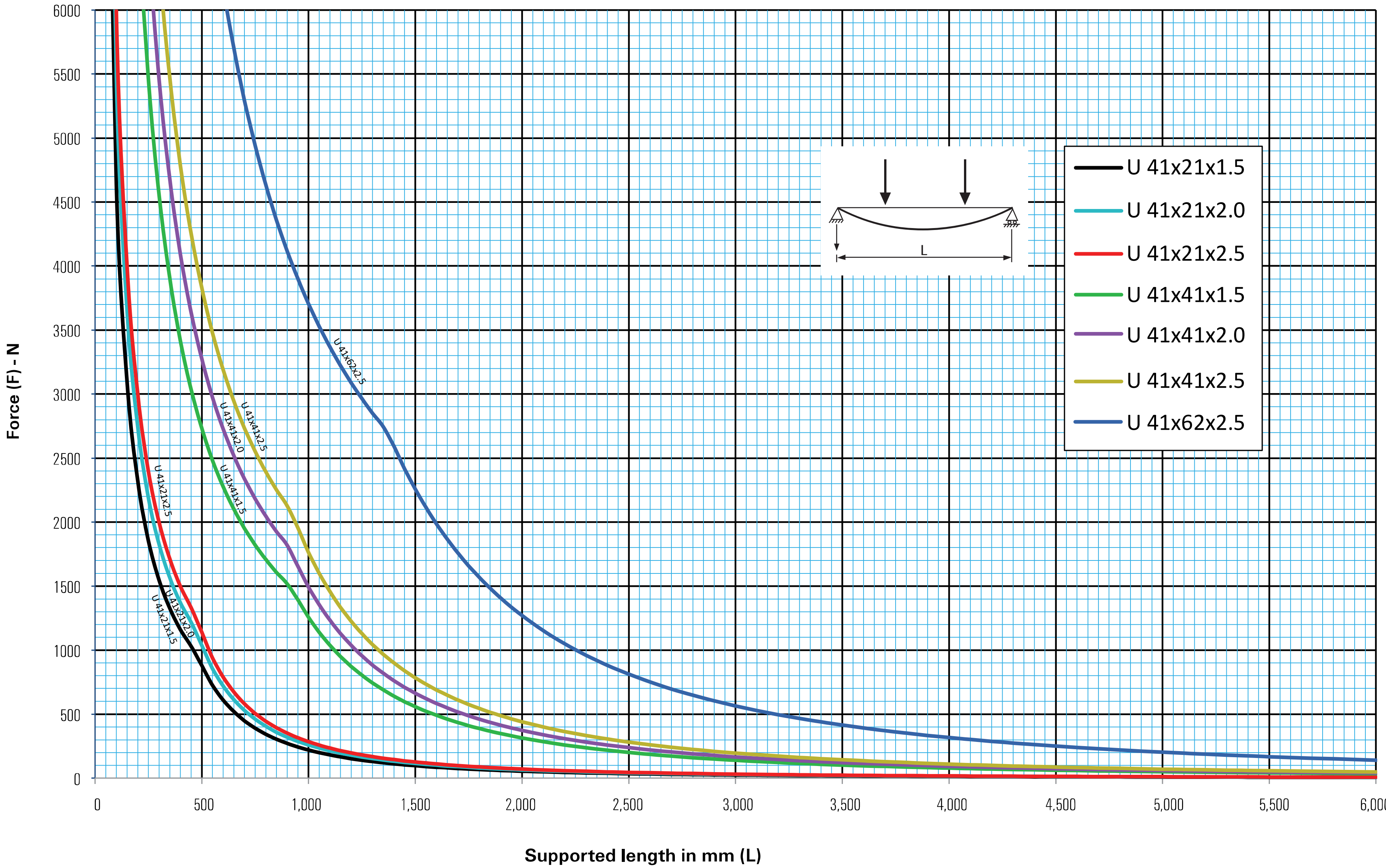
Design load under **Uniformly distributed load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer U Channel - Design Curve 2



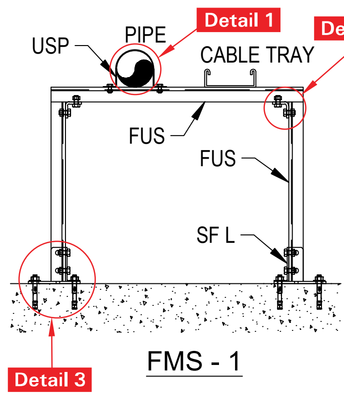
Design load under **Single concentrated load in the center** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

fischer U Channel - Design Curve 3

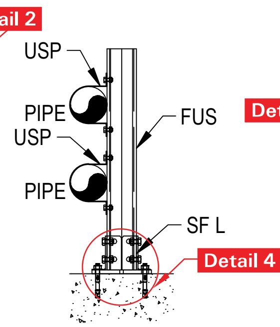


Design load under **Double concentrated load** - For the load curves, the Design steel Stress = 217 N/mm and the maximum deflection under load L/200 are not exceeded. Fixings and screw fastenings must be calculated accordingly. The increased yield strength is calcuated according DIN EN 1993-1-3:2010-12, sec. 3.2.2.

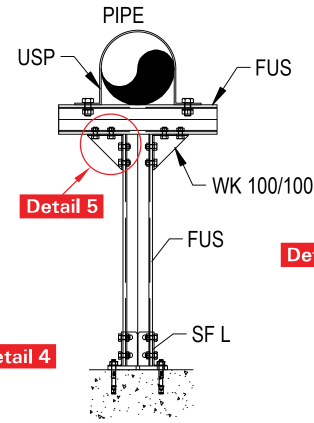
Floor Mounted Supports



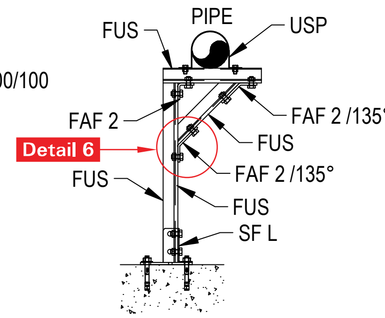
FMS - 1



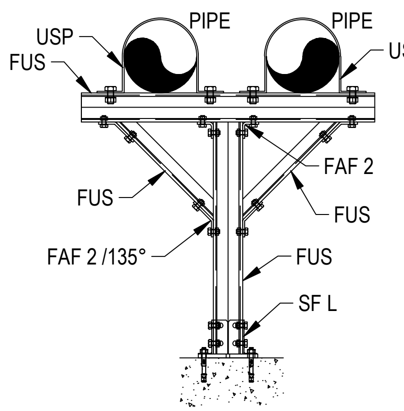
FMS - 2



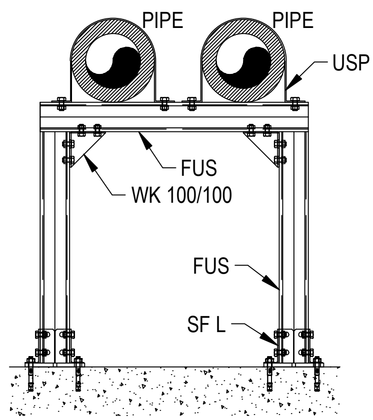
FMS - 3



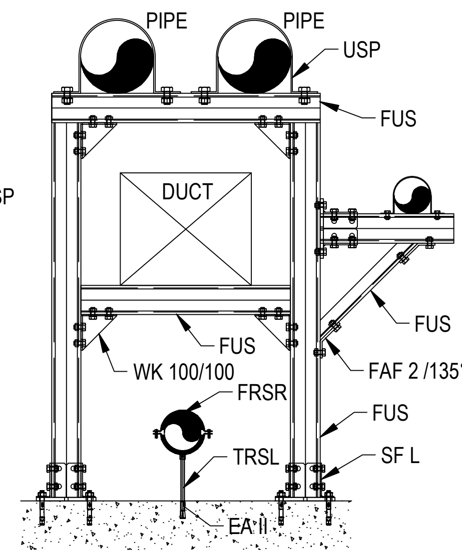
FMS - 4



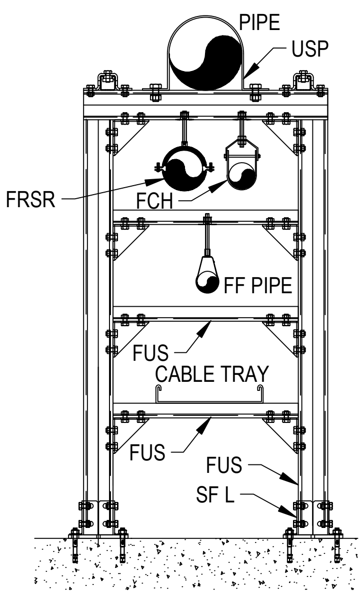
FMS - 5



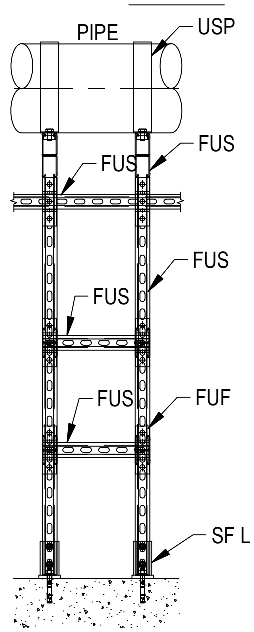
FMS - 6



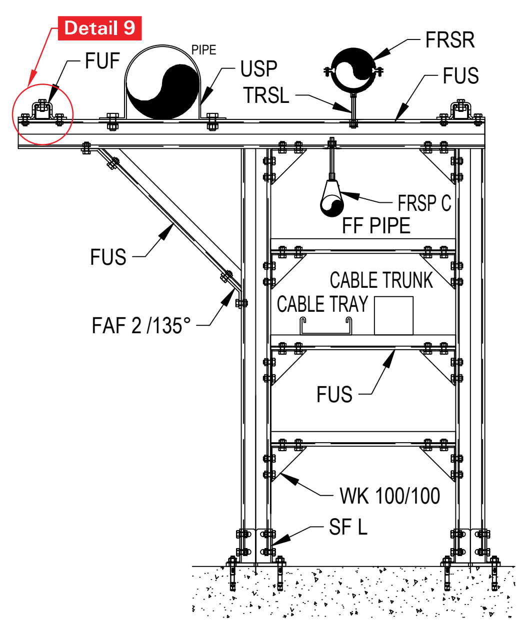
FMS - 7



FMS - 8

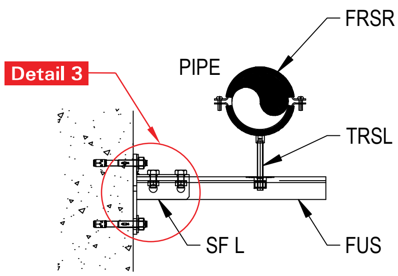


FMS - 9

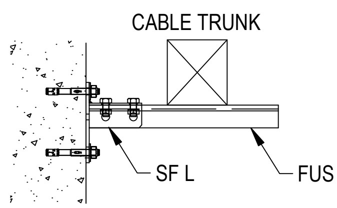


FMS - 10

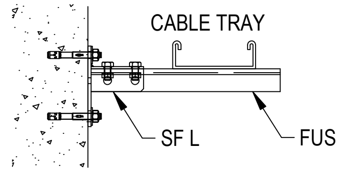
Wall Mounted / Cantilever Supports



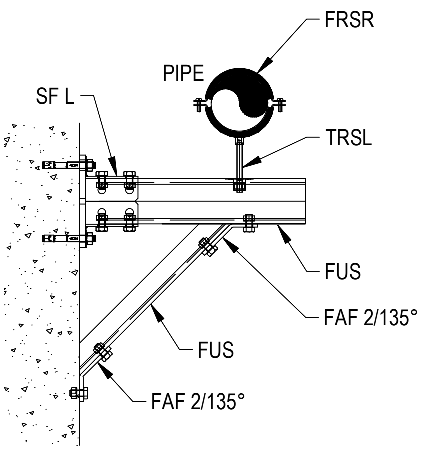
WMS - 1



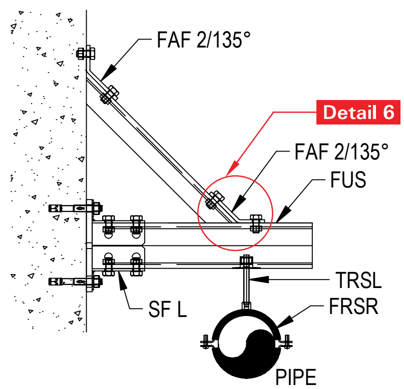
WMS - 2



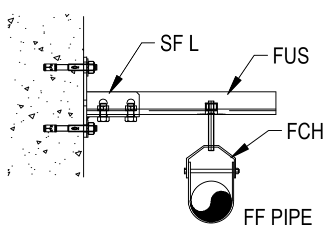
WMS - 3



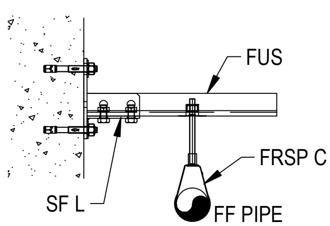
WMS - 4



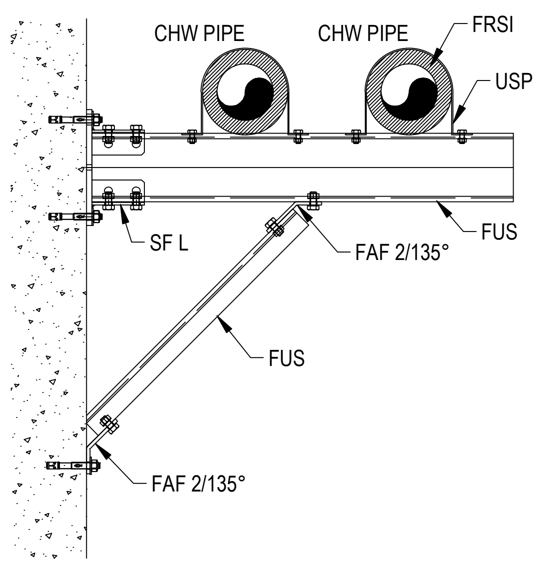
WMS - 5



WMS - 6

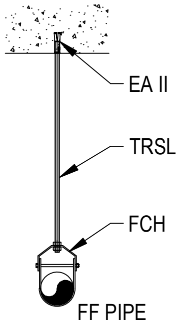


WMS - 7

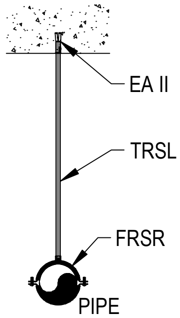


WMS - 8

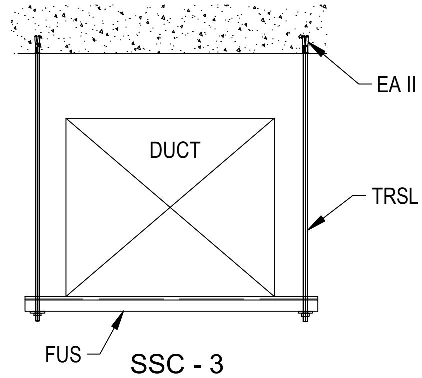
Suspended Supports (Ceiling)



SSC - 1



SSC - 2



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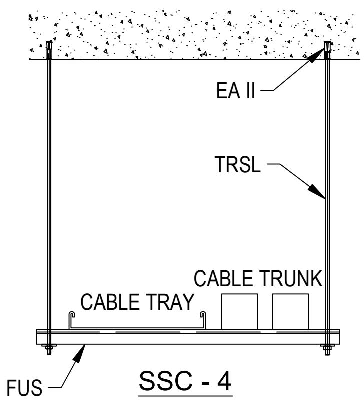
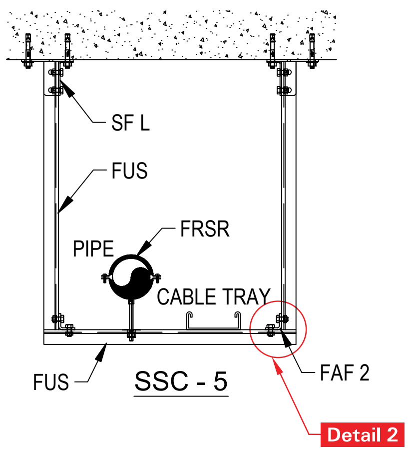
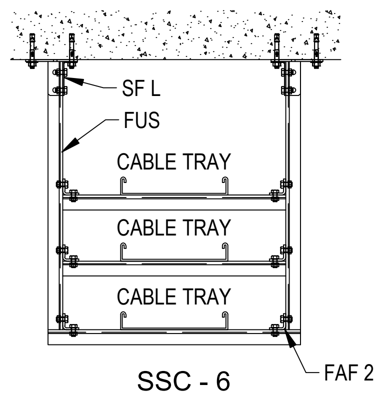


SSC - 4



SSC - 5



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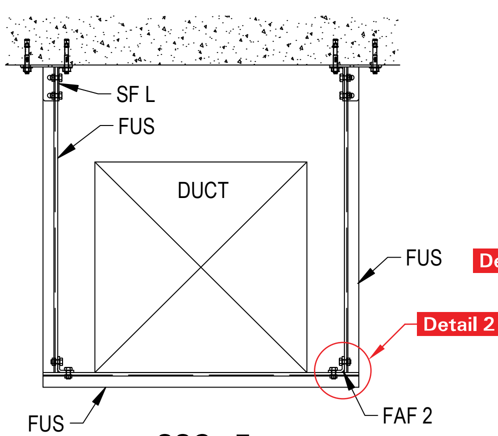
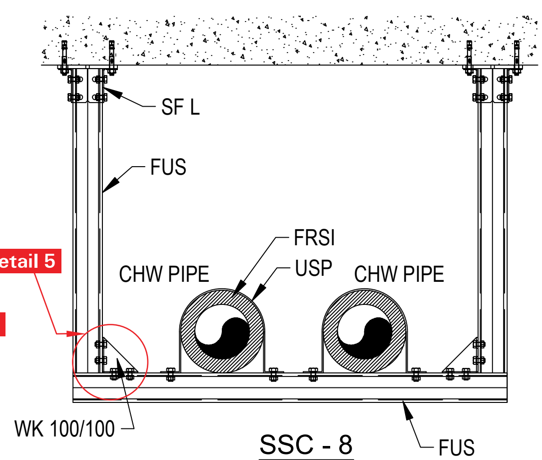


SSC - 7

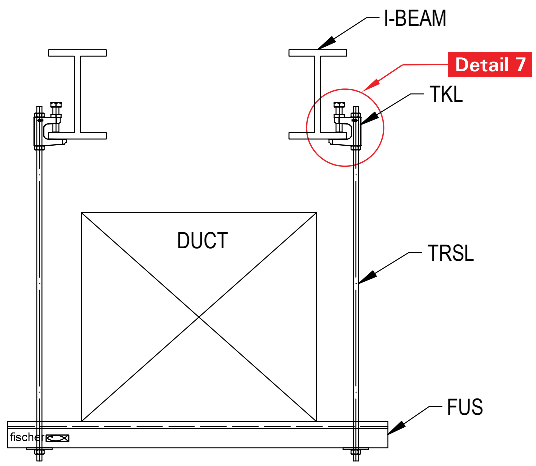


SSC - 8

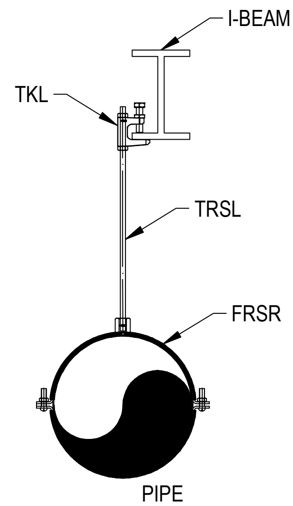
9

Annexure - C

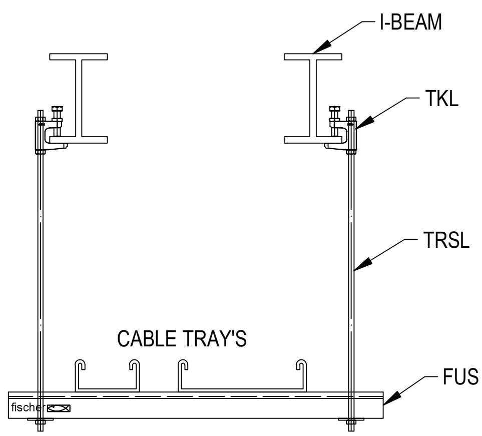
Suspended Supports (Structure)



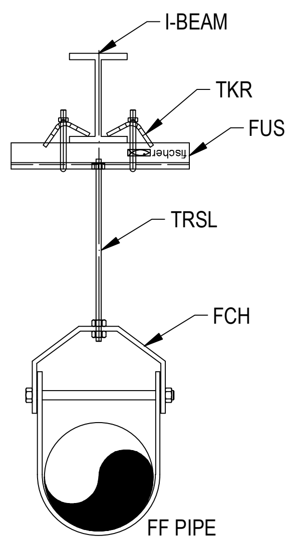
SSS-1



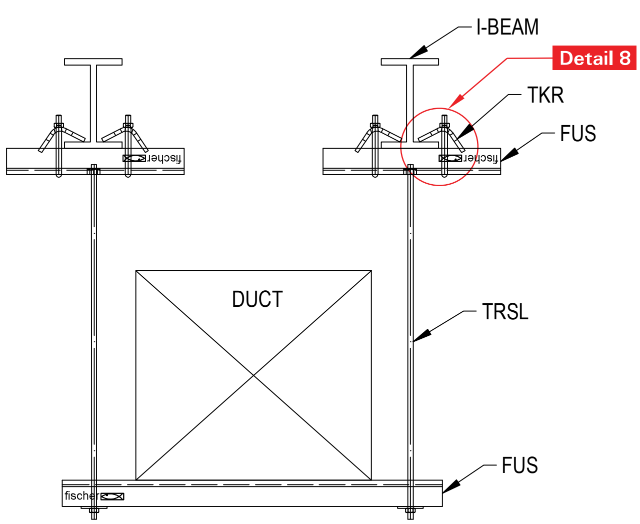
SSS-2



SSS-3

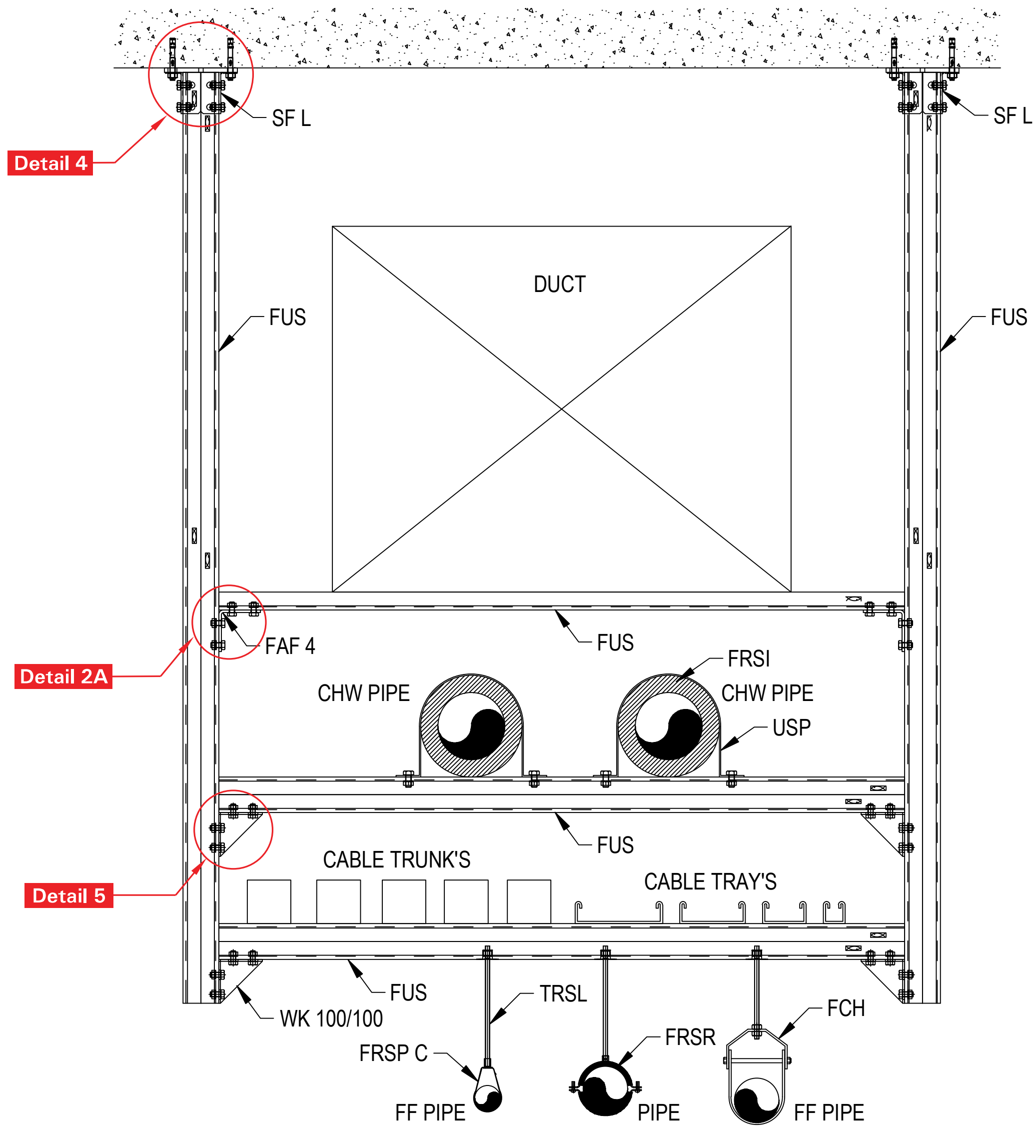


SSS-4

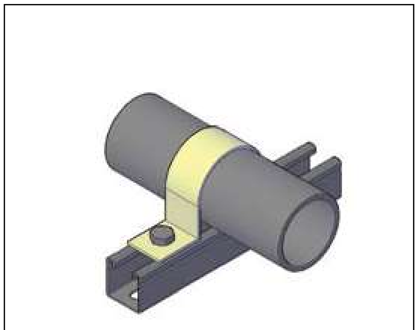


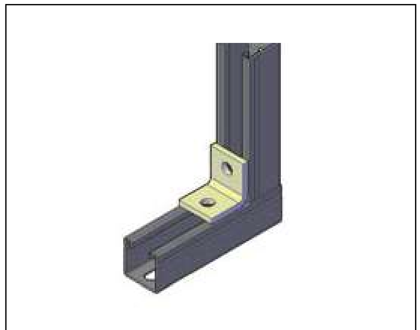
SSS-5

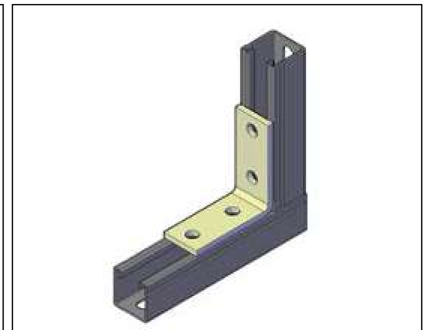
Combined Support for MEP Systems

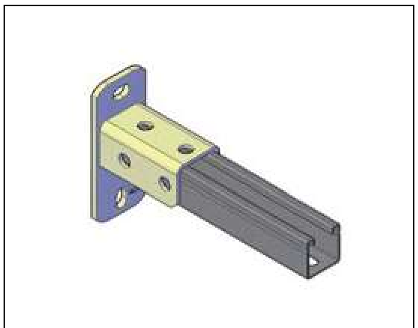


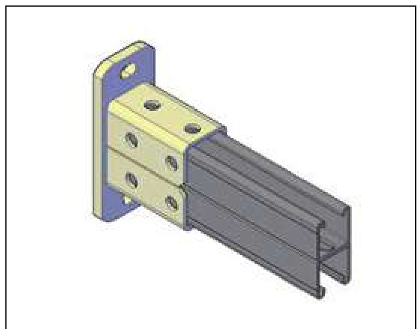
Details

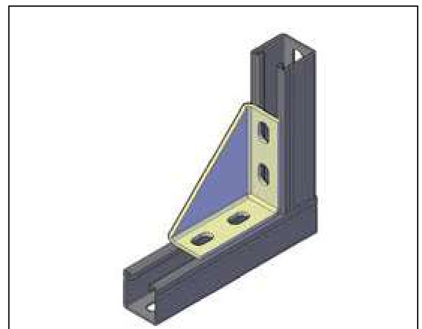

Detail 1 (U-STRAP)

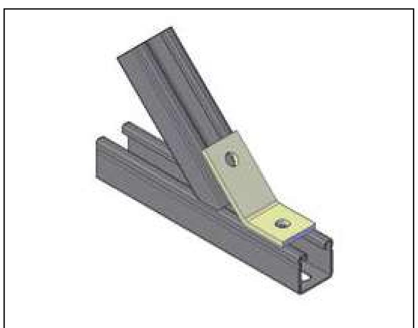

Detail 2 (FAF 2)

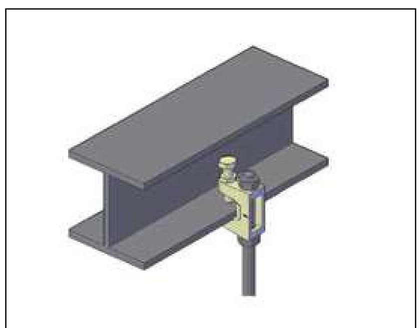

Detail 2A (FAF 4)

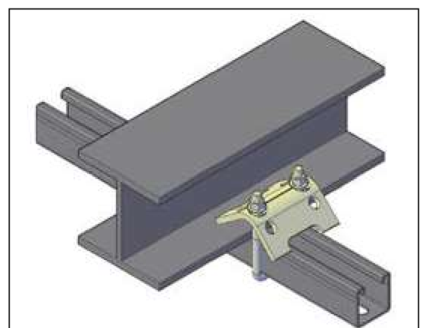

Detail 3 (SF L41)

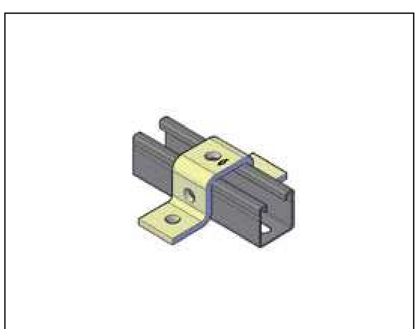

Detail 4 (SF L82)


Detail 5 (WK100/100)

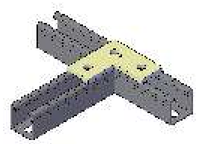

Detail 6 (FAF 2/135°)

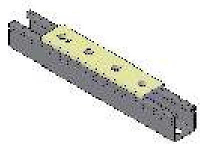

Detail 7 (TKL)


Detail 8 (TKR)


Detail 9 (FUF 41)

Typical Connection Details


FFF 3L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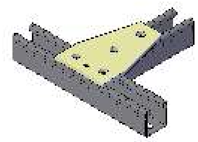
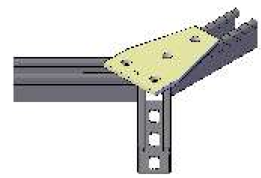
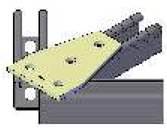
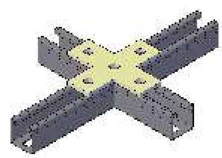

FFF 4D - Linear Arrangement


FFF 4D - Angular Arrangement 1


FFF 4D - Angular Arrangement 2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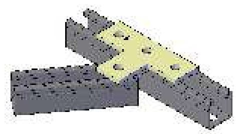
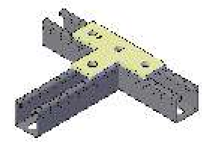
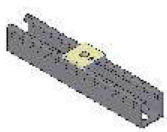

FFF 4T - Angular Arrangement


FFF 4T - Linear Arrangement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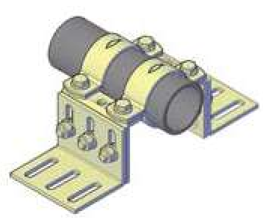
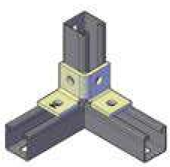
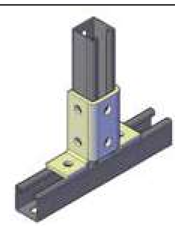

FFPK FFFS

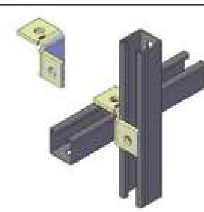

FRSR

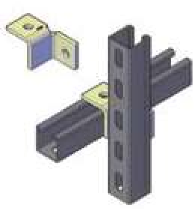

FSB 45°


FUF 4Y

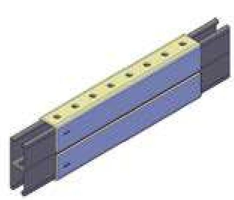

FUF 8T

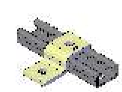

FUF 21


FUF 180° L

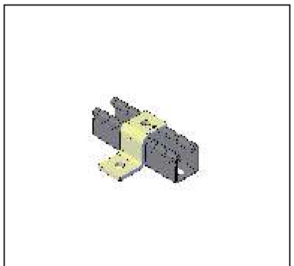

FUF 180° R

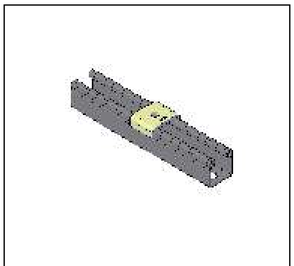

FUF OC 41


FUF OC 62


FZF 21

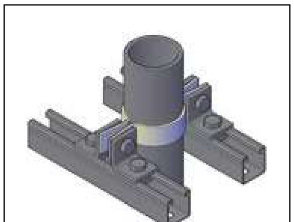
Typical Connection Details

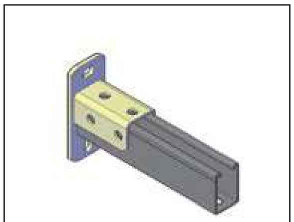

FZF 41

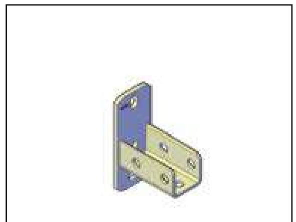

HK 41

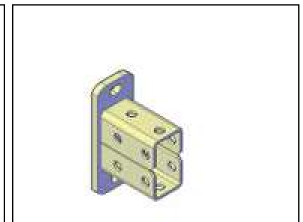

PSAE

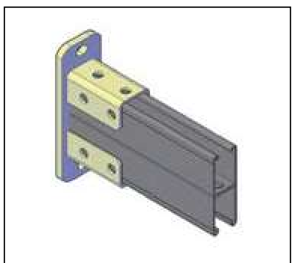

PVB

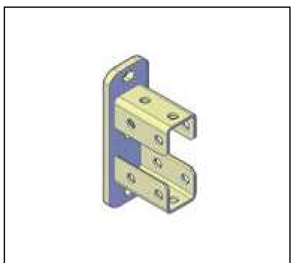

RCWR


SF L41 with FUS 62

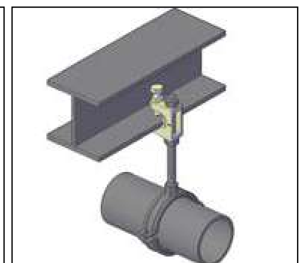

SF L41

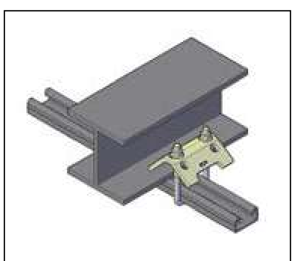

SF L82

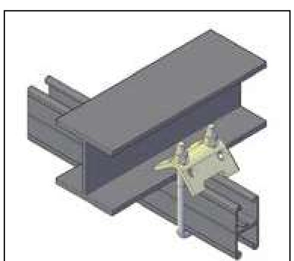

SF L124 with FUS 62D

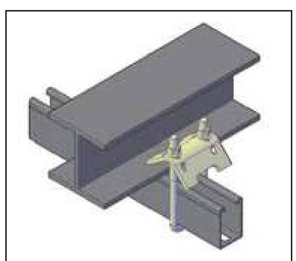

SF L124

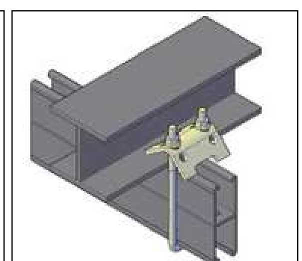

SKSL & FCN Clix Arrangement


TKL

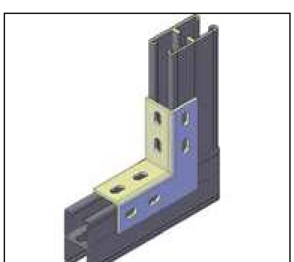

TKR 41 with FUS 21


TKR 82 with FUS 41D


TKR 82 with FUS 62

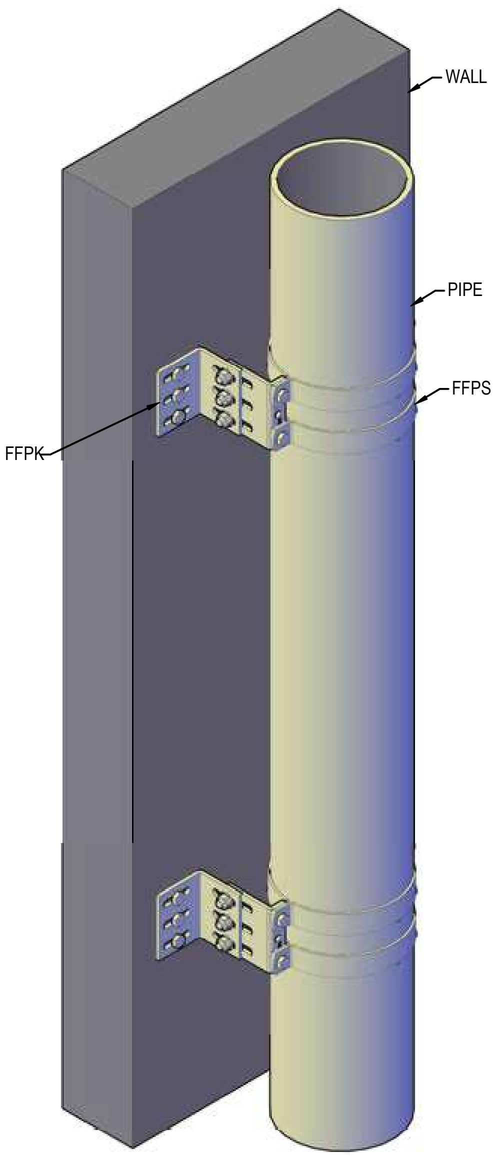

TKR 124 with FUS 62D


U-Bolt ETR

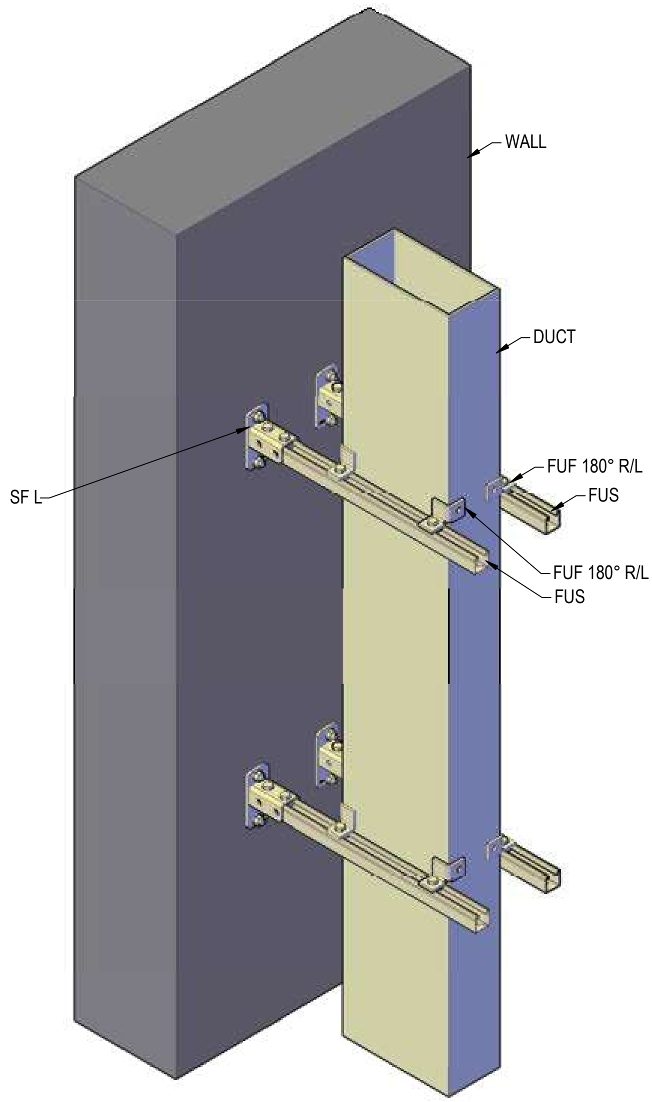

UW S

fischer

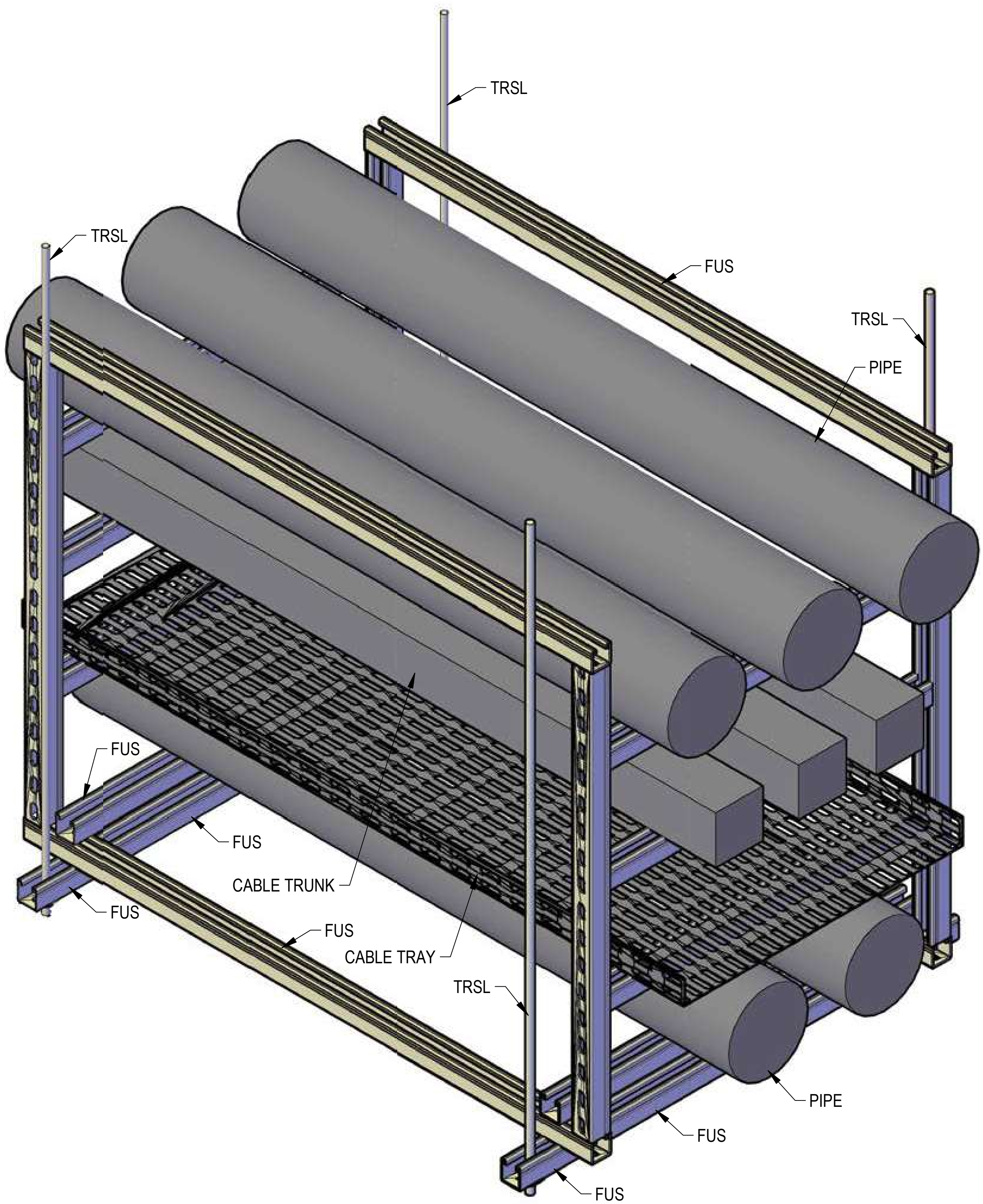
Riser Support for Pipe



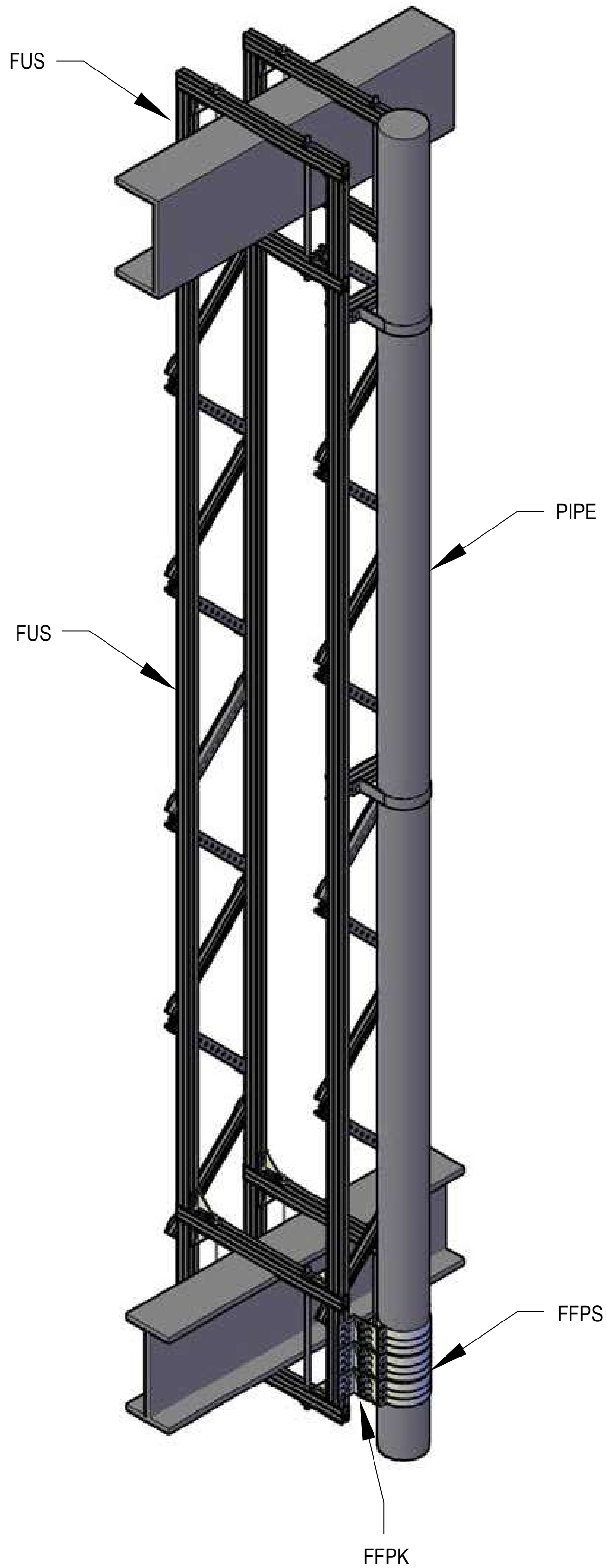
Riser Support for Duct



Modular Support for MEP Systems

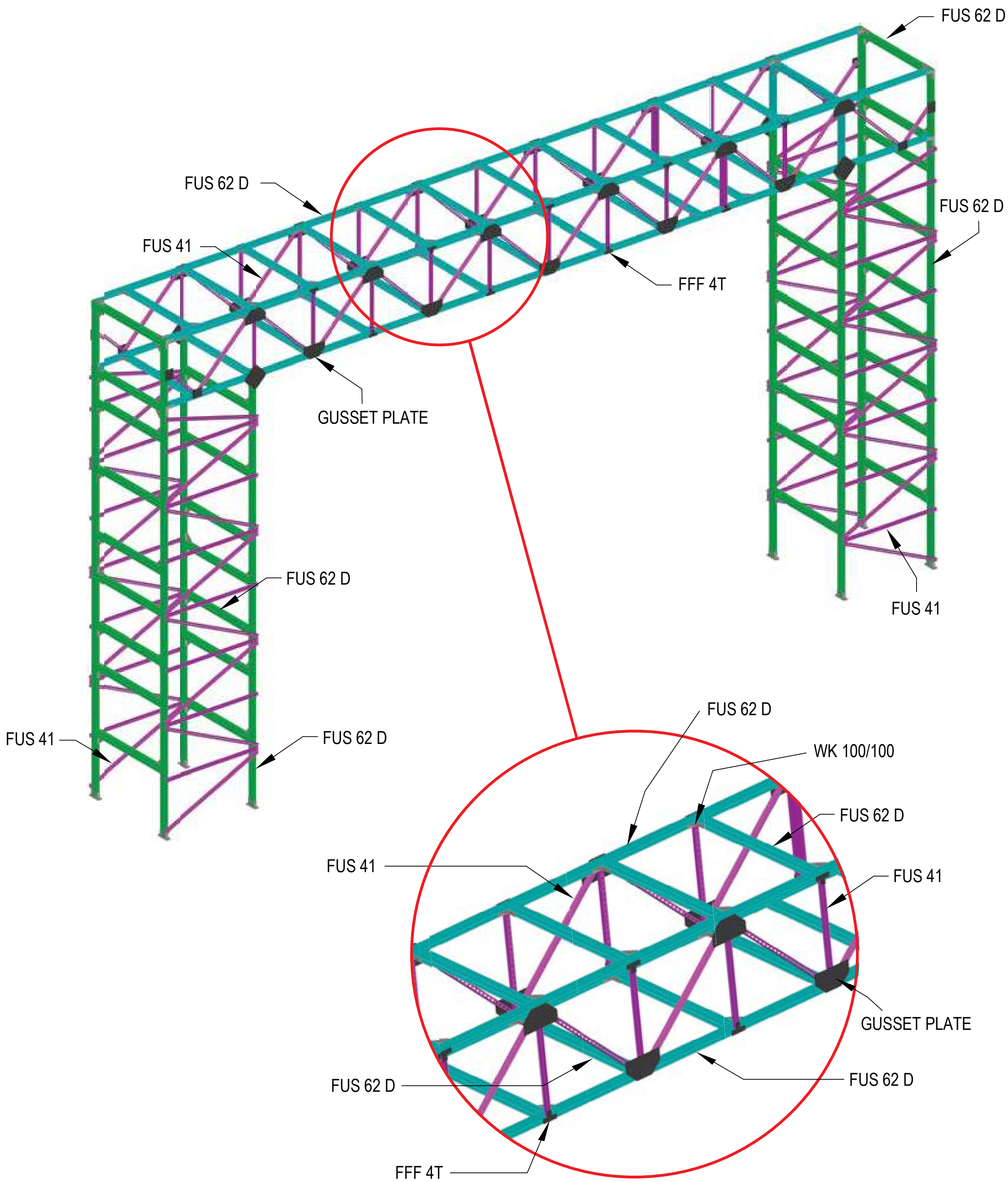


SaMontec Application - 3D Model



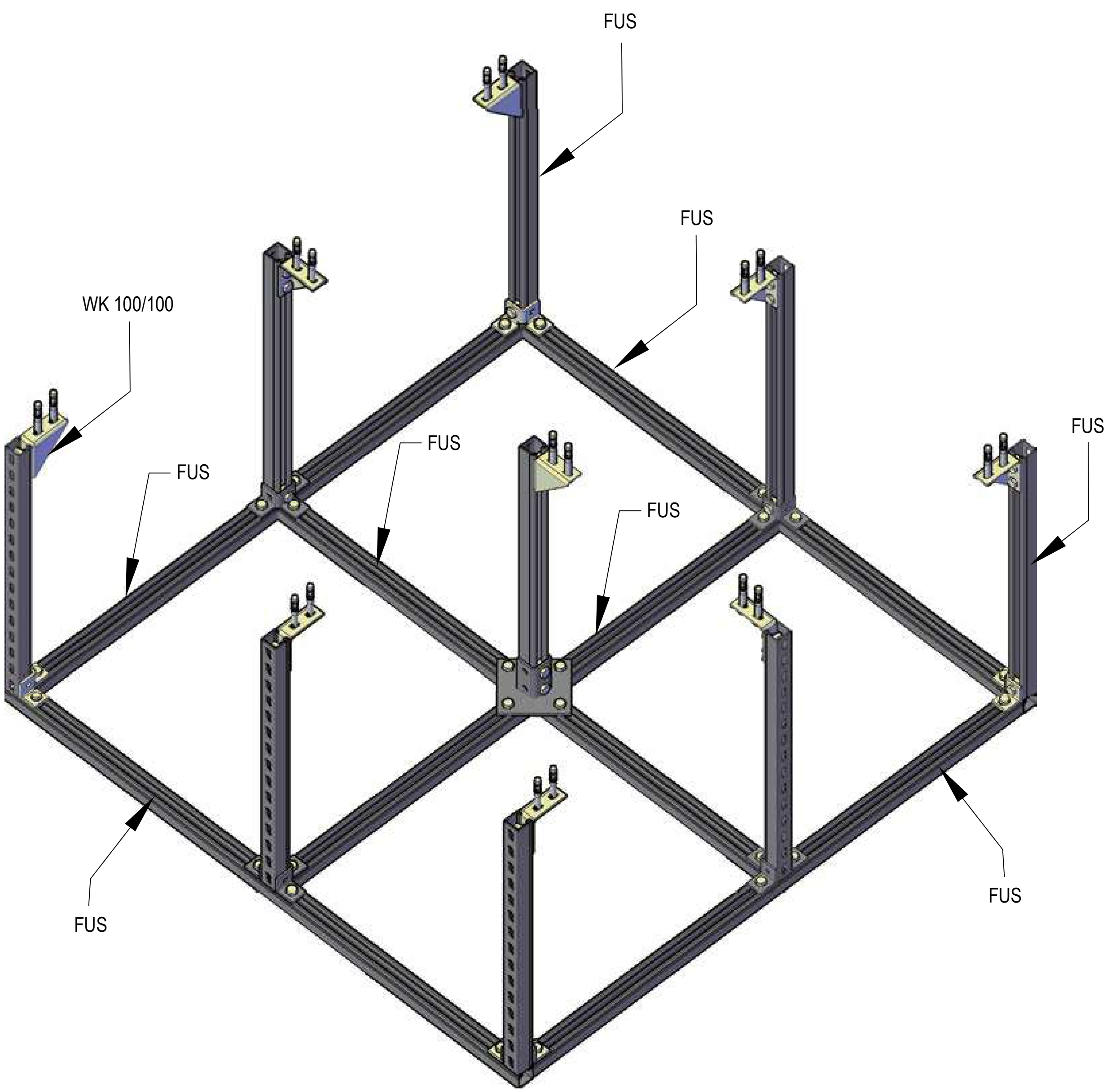
Riser Support for Pipe

SaMontec Application - 3D Model

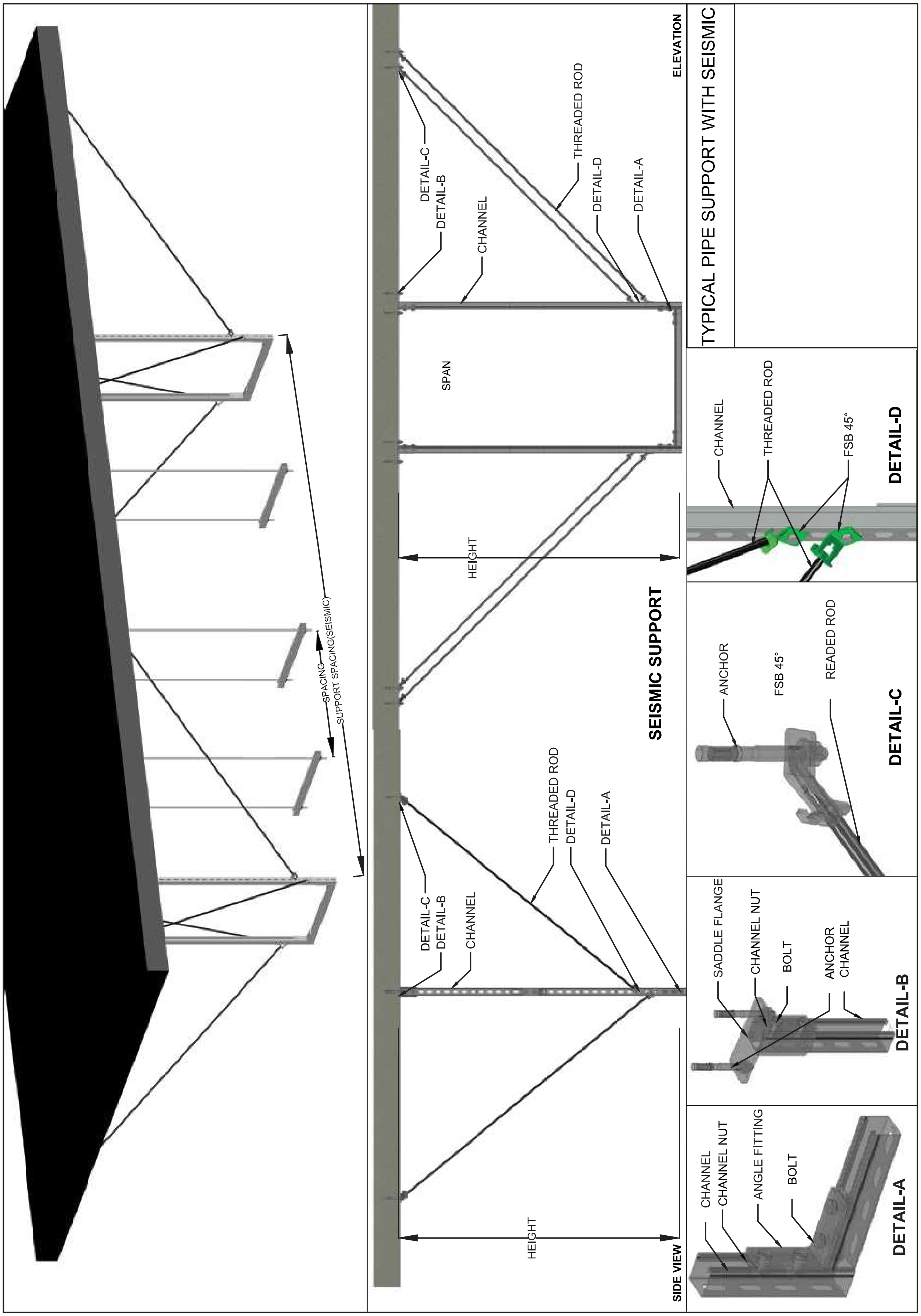


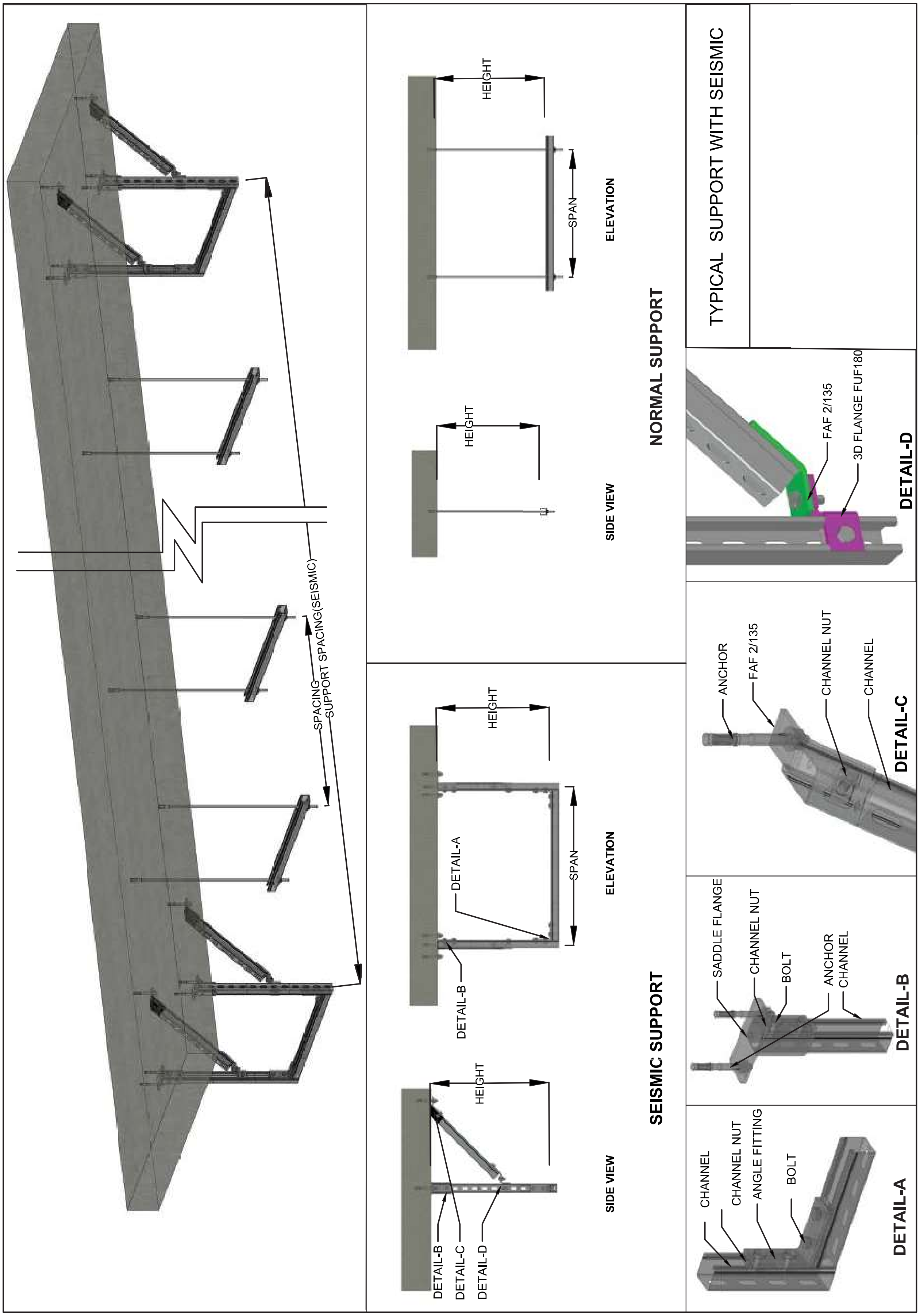
Pipe Rack / Bridge For Pipes & MEP Systems

SaMontec Application - 3D Model



Ceiling Grid System


SUPPORT SPACING(SEISMIC)
SPACING
ELEVATION
DETAIL-C
DETAIL-B
CHANNEL
THREADED ROD
DETAIL-D
DETAIL-A
SPAN
HEIGHT
SEISMIC SUPPORT
SIDE VIEW
DETAIL-C
DETAIL-B
CHANNEL
THREADED ROD
DETAIL-D
DETAIL-A
HEIGHT
TYPICAL PIPE SUPPORT WITH SEISMIC
CHANNEL
THREADED ROD
FSB 45°
DETAIL-D
ANCHOR
FSB 45°
READED ROD
DETAIL-C
SADDLE FLANGE
CHANNEL NUT
BOLT
ANCHOR CHANNEL
DETAIL-B
CHANNEL
CHANNEL NUT
ANGLE FITTING
BOLT
DETAIL-A


TYPICAL SUPPORT WITH SEISMIC
SPACING
SUPPORT SPACING(SEISMIC)
NORMAL SUPPORT
SIDE VIEW
HEIGHT
ELEVATION
HEIGHT
SPAN
SEISMIC SUPPORT
SIDE VIEW
HEIGHT
DETAIL-B
DETAIL-C
DETAIL-D
ELEVATION
HEIGHT
SPAN
DETAIL-A
DETAIL-B
DETAIL-A
CHANNEL
CHANNEL NUT
ANGLE FITTING
BOLT
DETAIL-B
SADDLE FLANGE
CHANNEL NUT
BOLT
ANCHOR CHANNEL
DETAIL-C
ANCHOR
FAF 2/135
CHANNEL NUT
CHANNEL
DETAIL-D
FAF 2/135
3D FLANGE FUF180