MECHANICAL CLADDING FIXATION

www.unitech-ikk.com
www.sfsp-ikk.com
www.ikkgroup.com

UNITECH
For Building and Construction Materials

MECHANICAL CLADDING FIXATION (STANGLE)

PRODUCED BY

SPECIALIZED FACTORY FOR STEEL PRODUCTS
SIGMA FACTORY FOR STEEL PRODUCTS

Mechanical Cladding Fixation (Stangle)

Index

ABOUT UNITECH

Unitech Introduction

Unitech is a Saudi based Multinational Company providing building and construction solutions that is empowering the region's construction industry for the past 40+ years. We have been successfully providing solutions through mastering our main business activities: Design, Manufacture and Trade.

Design:
Provide Design & Engineering Solution to the construction sector, complying with international & local standards.

Manufacture:
Operating with Global Standards, we are widely recognized for our advanced light steel solutions and Hot-Dip Galvanization Facility.

Trade:
We are one of the region's largest Importer/Exporter of Building & Construction Materials.

Unitech is an **ISO QMS 9001:2015** certified company and is a member of the US Green Building Council. Our experienced teams and operations are present across the Middle-East North Africa regions (MENA) and Pakistan, giving us an extensive regional network that benefits our clients and partners. We are also present in Europe via our design and engineering office in Stuttgart.

For more information, please visit: www.unitech-ikk.com

Mission & Vision

Mission

UNITECH is committed to transforming the construction and building sector by equipping engineers with advanced solutions and expert support at every project stage. As a leading industry provider, we empower our team to deliver exceptional service that consistently exceeds expectations. By fostering a cohesive and forward-focused culture, we attract and retain top talent, driving our mission forward. Our innovative, customer-centric products set new industry benchmarks and pave the way for future progress.

Vision

To be the Customer's First Choice...

Our Strategy

Unitech's strategy continues to focus on accelerating its business throughout the region, to service the construction sector via superior products & solutions, backed up by a group of highly experienced people in the field. Unitech also aims to enhance its geographical presence in its areas of interest and where opportunities exist.

We combine a deep understanding of building and construction materials markets with a successful history of upgrading our products and developing our processes.

We have the qualified employees, the know-how and the products to service major construction projects, medium sized to mega projects taking in care our positive contribution to our societies.

We thrive towards excellence by acknowledging:

Customer Satisfaction

Partner and Supplier Relations

Employee Retention

Positive Influence on Society and Environment

Our Employees

We are a company that prides itself on its 'family' culture and we seek out high-caliber people. We are a company that has, at its core, a team philosophy that is clearly apparent each and every day - there is a real sense of being there for one another.

We believe in nurturing the skills of our team members and providing growing levels of responsibility. Our people bring unique skills, energy, expertise, experience and perspectives to our workforce.

Unitech›s family of employees consists of experienced, well-motivated and dedicated team of engineers, technicians, sales executives and management staff. This team is committed to serve our customers, with the best solutions available in the market.

Our Journey
40+ Years of Excellence

Since 1979, having been set to become an independent company under the framework developed by Sheikh Isam Kabbani, Unitech started its journey of success with confidence and enthusiasm, hard work and care to detail and a commitment to become the best within its industry.

Its dedicated people could only imagine what the future could bring to this newly established entity. Unitech's journey of success has been marked with outstanding achievements and superior accomplishments. Year by year, Unitech has been acknowledged as the "First Choice for Building & Construction Material" by major construction consultants in the region, governmental authorities, well-known contracting and project development corporations.

We have obtained invaluable knowledge about the construction industry in general, providing specialized solutions to construction projects throughout MENA region. From a couple of outlets in Saudi Arabia, Unitech today is present all over the Kingdom and in several countries throughout the region providing its products and
solution to various locations worldwide.

Est. 1979

THE BEGINNING
Unitech was established in the Western Region of KSA as a Sales Company selling basic construction material.

During the same year, another branch was established in the heart of the kingdoms capital, Riyadh.

1980 to 1989

AGE OF GREAT RISK
Unitech Dammam was open for business in the oil-rich eastern coast of Saudi Arabia.

Within these 10 years the idea of in-house manufacturing facility was born and Specialized Factory for Steel Products (SFSP) was established in Riyadh.

1990 to 1999

AGE OF GROWTH
Branches of Unitech were established in Makkah, Madina, Khamis Mushayt and Jubail.

The need to increase its range of products and the necessity to have production lines for mass production lead to the decision to move the SFSP Factory from Riyadh to Jeddah.

Pioneering Construction
Since 1979

We are constantly evolving in order to become more flexible in our operations, more sustainable in our societies, and more innovative in conducting our business.

By delivering superior products tailored to the specific construction needs, ambitious solutions, and an outstanding customer service, we serve today's needs through developing tomorrow's markets.

Helping construction projects experience success is what fueled its days. Unitech is keen to continue offering superior products, a wide spectrum of solutions, governed by our top-notch management style.

Such aspirations require trust in our responsibilities. Our Responsibilities for the future and with this in mind we continue to target excellence with committed efforts.

2000 to 2015

AGE OF CONSTRUCTION BOOM

Qassim, Hofuf and Yanbu Branches were inaugurated in KSA and branches outside KSA were established in UAE, Egypt, Lebanon, Oman, Jordan and Germany in order to facilitate the construction boom in the Middle East.

During this period SFSP state of the art facilities were launched in DIC UAE and Unitech thrived, marking some of the best years in business.

2016 to 2019

AGE OF GREAT CHANGE

This period, marked the age of great change in order to align with the economic shift in the GCC and the world in general.

Company wide right sizing initiatives were taken especially in KSA to align with the kingdoms ambitious vision 2030 and during this period the upgraded SFSP state of the art facilities were launched in JIC 3 KSA.

2020 & Beyond

NEW FRONTIER

This period marks the expansion of Unitech into the South and Central Asian territories. We aim to cater these markets and play an active role in these countries development.

During 2020, Unitech Pakistan was officially inaugurated and marked the entrance of Unitech into Asian Market.

Our Manufacturing Arm SFSP

SFSP is a leading manufacturer and fabricator of light steel construction products in the region, servicing the construction sector through its state of the art facilities which are spread all over the MENA region. Products of SFSP are manufactured from quality raw material according to the relevant international standards to meet all kinds of construction projects requirements, such as MEP, façade, blockwork & waste management systems.

Commitment to Quality

Our commitment to quality is clearly revealed in the way we do our business; our processes, our close interaction with our clients as well as the strict product inspection procedures. To achieve this, we have implemented quality systems & processes that are continually being improved to satisfy our customer's needs.

Product Development

Product development process is substantial to the success of our business. We leverage all resources to provide up-to-date reliable products, environmentally friendly, durable to withstand the toughest weather conditions. Our engineers are constantly testing the products, seeking to present a combination of performance and quality across all our product ranges.

For more information, please visit:
www.sfsp-ikk.com

Value Chain

Our value chain starts up with the quality of the raw materials and ends up in client satisfaction. Our business practices backed up by all technologically essential business elements are supported by an efficient logistics, warehousing and delivery system that maintains a valuable supply chain for products.

The value chain is integrated in our business module, giving us strength and preserving our good reputation gained through the past 4 decades.

Engineering
Specialty

Our products development engineers integrate their vast knowledge to provide the perfect solution to projects within the required specifications and time-frame.

The products development department maintains highly skilled calibers with a dedication towards efficient and reliable solutions even in the most complicated cases where delicacy and skillful approaches are indispensable.

Design and Product Safety

Our design and engineering office in Stuttgart ensures our products comply with relevant European and international standards of fabrication, taking into attention the safety factors which govern the public safety of projects.

Sustainability and Responsibility

We are constantly working hard to reduce our environmental footprints while maintaining the high quality and safety standards. We have set our targets to become three times more efficient in the next 10 years. Our responsibility towards our stakeholders is valued through our positive contributions towards our colleagues, our business partners and our communities as well.

Our Design Office

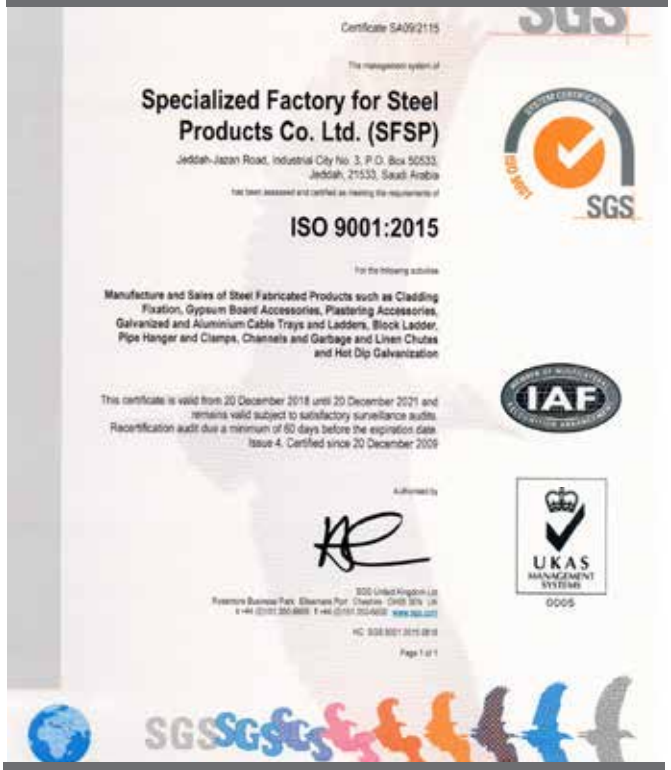
UNITECH DEUTSCHLAND is a “Design & Engineering” Office. Unitech Germany support Unitech & SFSP operations through well-informed cadre of engineers. They help our customers from conception to the completion by delivering design, engineering and project management services.

Thanks to our multidisciplinary team in Unitech Germany and their expertise, we assist you in your ambition to develop your innovation, your engineering and your organization. Our goal is to serve our clients through these elements:

- Excellent in engineering ideas and solutions
- High quality in performance
- Firmness on meeting deadlines

SFSP Certifications

ISO 9001 : 2015
(Quality Management Systems)



Certificate SA09/2115

Specialized Factory for Steel Products Co. Ltd. (SFSP)

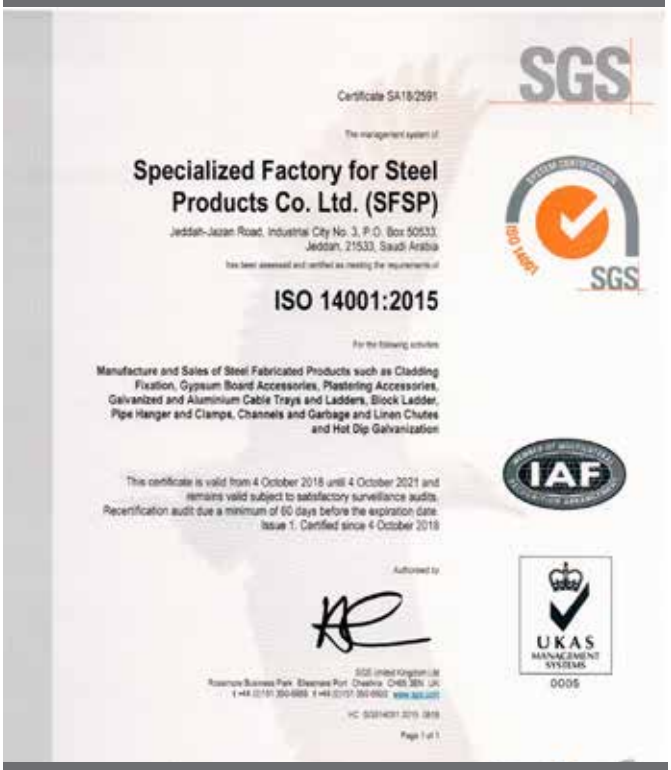
Jeddah-Jazan Road, Industrial City No. 3, P.O. Box 50533, Jeddah, 21533, Saudi Arabia

ISO 9001:2015

Manufacture and Sales of Steel Fabricated Products such as Cladding Fixation, Gypsum Board Accessories, Plastering Accessories, Galvanized and Aluminium Cable Trays and Ladders, Block Ladder, Pipe Hanger and Clamps, Channels and Garbage and Linen Chutes and Hot Dip Galvanization

This certificate is valid from 20 December 2018 until 20 December 2021 and remains valid subject to satisfactory surveillance audits. Recertification audit due a minimum of 60 days before the expiration date. Issue 4. Certified since 20 December 2009

14001 : 2015
(Environmental Management System)



Certificate SA18/2591

Specialized Factory for Steel Products Co. Ltd. (SFSP)

Jeddah-Jazan Road, Industrial City No. 3, P.O. Box 50533, Jeddah, 21533, Saudi Arabia

ISO 14001:2015

Manufacture and Sales of Steel Fabricated Products such as Cladding Fixation, Gypsum Board Accessories, Plastering Accessories, Galvanized and Aluminium Cable Trays and Ladders, Block Ladder, Pipe Hanger and Clamps, Channels and Garbage and Linen Chutes and Hot Dip Galvanization

This certificate is valid from 4 October 2018 until 4 October 2021 and remains valid subject to satisfactory surveillance audits. Recertification audit due a minimum of 60 days before the expiration date. Issue 1. Certified since 4 October 2018

ISO 45001 : 2018
(Occupational Health & Safety)

Certificate SA19/10111

Specialized Factory for Steel Products Co. Ltd.(SFSP)

Jeddah-Jazan Road, Industrial City No. 3, P.O. Box 50533, Jeddah, 21533, Saudi Arabia

ISO 45001:2018

Manufacture and Sales of Steel Fabricated Products such as Cladding Fixation, Gypsum Board Accessories, Plastering Accessories, Galvanized and Aluminium Cable Trays and Ladders, Block Ladder, Pipe Hanger and Clamps, Channels and Garbage and Linen Chutes and Hot Dip Galvanization

This certificate is valid from 19 February 2019 until 19 February 2022 and remains valid subject to satisfactory surveillance audits. Recertification audit due a minimum of 60 days before the expiration date. Issue 1. Certified since 19 February 2019

STD 096
(Q-Mark Certificate)

CERTIFICATE OF REGISTRATION

This is to certify that

Sigma Factory for Steel Products
P.O. Box 37991
Dubai Industrial City
Dubai
United Arab Emirates

Meets the requirements of the Exova BM TRADA **Q-Mark International Fire Door Manufacture** scheme to **STD 096 - Issue 3 - 01/12/2015** which only operates in Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Oman, Qatar, Saudi Arabia and The United Arab Emirates for the products on the attached schedule

Certificate Number
476

Date of Initial Certification
16 June 2014

Date of last issue
13 October 2017

Date of Expiry
15 June 2020

Karen Prendergast
Sector Director - Certification
Exova BM TRADA

Exova (UK) Ltd, (T/A Exova BM TRADA), Chiltern House, Stocking Lane, High Wycombe, Buckinghamshire, HP14 4ND, UK
Registered Office: Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian EH28 8PL United Kingdom. Reg No. SC070429.

This certificate remains the property of Exova (UK) Ltd. This certificate and all copies or reproductions of the certificate shall be returned to Exova (UK) Ltd or destroyed if requested. Further clarification regarding the scope of this certificate and verification of the certificate is available through Exova BM TRADA or at the above address or at www.exovabmtrada.com

The use of the UKAS accreditation mark indicates accreditation in respect of those activities covered by the accreditation certification 012

Multisite clients - The scope of certification shown above includes the participating sites shown on the registration schedule

Page 1 of 2

ISO 9001 : 2015
(Quality Management System)

Certificate of Registration

This is to certify that the Management System of:

Sigma Factory for Steel Products

P.O. Box 37991, Saih Suhaib - 3, 4 Round About, Dubai Industrial City, Dubai, United Arab Emirates.

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 9001:2015

Certificate Number:	**22244-Q15-001**
Initial Registration Date:	23 February 2015
Previous Expiry Date:	22 February 2024
Recertification Date:	14 November 2023
Re-issue Date:	30 November 2023
Current Expiry Date:	22 February 2027

Scope of Registration:

Trading and Manufacturing of all kinds of Steel Related Construction Materials.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

ISO 14001 : 2015
(Environmental Management System)

Certificate of Registration

This is to certify that the Management System of:

Sigma Factory for Steel Products

P.O. Box 37991, Saih Suhaib - 3, 4 Round About, Dubai Industrial City Dubai, United Arab Emirates.

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 14001:2015

Certificate Number:	**22244-EMS-001**
Initial Registration Date:	22 September 2015
Previous Expiry Date:	21 September 2024
Recertification Date:	04 June 2024
Re-issue Date:	04 July 2024
Current Expiry Date:	21 September 2027

Scope of Registration:

Trading and Manufacturing of all kinds of Steel Related Construction Materials.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR.

OHSAS 45001 : 2018
(Health & Safety Management System)

Certificate of Registration

This is to certify that the Management System of:

Sigma Factory for Steel Products

P.O. Box 37991, Saih Suhaib - 3, 4 Round About, Dubai Industrial City Dubai, United Arab Emirates.

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 45001:2018

Certificate Number:	**22244-OHS-001**
Initial Registration Date:	22 September 2015
Previous Expiry Date:	21 September 2024
Recertification Date:	10 June 2024
Re-issue Date:	20 June 2024
Current Expiry Date:	21 September 2027

Scope of Registration:

Trading and Manufacturing of all kinds of Steel Related Construction Materials.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR.

Registered in United Arab Emirates as BM TRADA VENTURES LLC (TRADING AS BMTV)
Unit 904, Business Avenue Building, PO Box 30945, Dubai, UAE

Alcumus ISOQAR Limited, Alcumus Certification, Cobra Court, 1 Blackmore Road, Stretford, Manchester M32 0QY.
T: 0161 865 3699 **F:** 0161 865 3685 **E:** isoqarenquiries@alcumusgroup.com **W:** www.alcumusgroup.com/isoqar

BS EN 61537:2007 (KEMA - KEUR Certified For Cable Management Products)

CERTIFICATE

DEKRA

Issued to:
Applicant:
Isam Kabbani Trading Est. (Unitech)
Rashidiya
Dubai, United Arab Emirates

Manufacturer/Licensee:
Sigma Factory for Steel Products (SFSP)
Saih Shuaib 3, 4R/A, Dubai Industrial City,
Dubai, United Arab Emirates

Product : Cable management system
Trade name : SFSP
Types : IE-CT-X-10, IE-CT-X-12, IE-CT-X-15, IE-CT-X-20

The product and any acceptable variation thereto is specified in the Annex to this certificate and the documents therein referred to.

DEKRA hereby declares that the above-mentioned product has been certified on the basis of:
- a type test according to the standard IEC 61537:2006 and EN 61537:2007
- an inspection of the production location according to CENELEC Operational Document CIG 021
- a certification agreement with the number 2156954

DEKRA hereby grants the right to use the KEMA-KEUR certification mark.

The KEMA-KEUR certification mark may be applied to the product as specified in this certificate for the duration of the KEMA-KEUR certification agreement and under the conditions of the KEMA-KEUR certification agreement.

This certificate is issued on: 20 January, 2014 and expires upon withdrawal of one of the above mentioned standards.

Certificate number: 2156954.01

DEKRA Certification B.V.

drs. G.J. Zoetbrood
Managing Director

H.R.M. Barends
Certification Manager

ACCREDITED BY THE DUTCH ACCREDITATION COUNCIL

PRODUCTCERTIFICATIE NVKL 0001

KEMA KEUR

DEKRA Certification B.V. Meander 1051, 6825 MJ Arnhem P.O. Box 5185, 6802 ED Arnhem The Netherlands
T +31 88 96 83000 F +31 88 96 83100 www.dekra-certification.com Registered Arnhem 09085396

SFSP Certifications

UL Certification*
(Cable Trays)

CERTIFICATE OF COMPLIANCE

Certificate Number 20160816-E483358
Report Reference E483358-20160816
Issue Date 2016-AUGUST-16

Issued to: Sigma Factory for Steel Products
Saih Shuaib 3, 4 R/A Dubai Industrial City
Opposite DEWA Substation
Dubai UNITED ARAB EMIRATES

This is to certify that representative samples of CABLE TRAYS
Steel Channel Cable Tray, Ventilated, Heavy Duty (HCT), Very Heavy Duty (VCT) cable trays.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: ANSI/NFPA 70, "National Electrical Code" (NEC)
Additional Information: See the ULC Online Certification Directory at www.ulc.ca for additional information

Only those products bearing the ULC Listing Mark should be considered as being covered by ULC's Listing and Follow-Up Service.

The ULC Listing Mark generally includes the following elements: the symbol ULC in a circle with the word "LISTED"; a control number (may be alphanumeric) assigned by ULC; and the product category name (product identifier) as indicated in the appropriate ULC Directory.

To confirm the status, validate the above information via the online directory.

Look for the ULC Listing Mark on the product.

Page 1 of 1

UL Certification*
(Chute Type Fire Doors)

CERTIFICATE OF COMPLIANCE

Certificate Number 20170811-R38825
Report Reference R38825-20170811
Issue Date 2017-AUGUST-11

Issued to: Sigma Factory for Steel Products
Saih Shuaib 3, 4 R/A Dubai Industrial City
Opposite DEWA Substation
Dubai UNITED ARAB EMIRATES

This is to certify that representative samples of CHUTE-TYPE FIRE DOORS
Chute-type fire door and frame assembly of the insulated type, rated up to and including 2 hr, 450°F Temperature Rise Rating.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: ANSI/UL 10B, Fire Tests of Door Assemblies
Additional Information: See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.

UL Certification*
(Fire Barrier)

CERTIFICATE OF COMPLIANCE

Certificate Number R40146
Report Reference R40146-20220524
Date 2022-May-25

Issued to: Sigma Factory for Steel Products
Saih Shuaib 3, 4 R/A Dubai Industrial City
Opposite DEWA Substation
Dubai AE

This is to certify that representative samples of MECHANICAL JOINT ASSEMBLIES
The products covered by this Section are mechanical joint assemblies designated Nexus Fire Barrier (NFB) for use in various joint systems described in the Fire Resistance Directory.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 2079, Tests for Fire Resistance of Building Joint Systems

Additional Information: See the UL Online Certifications Directory at https://iq.ulprospector.com for additional information

This Certificate of Compliance does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.

Bruce Mahrenholz, Director North American Certification Program
UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at http://ul.com/aboutul/locations/

SFSP Products

SFSP produces a variety of products ranging from cable management systems; cable trays, cable ladders, basket trays, trunkings and support systems, to mechanical cladding fixations, steel lintels and block work accessories, plasterers' beads, expanded metal and block work reinforcement, strut channel systems, pipe clamps & hangers, gypsum profiles as well as garbage and linen chutes. With the introduction of new machines and the enhancement of production methods, SFSP continues to develop its production methods systematically as well as thoroughly. Its design office in Stuttgart, Germany provides a comprehensive design and calculation case studies, enabling the factory to have the safety factors required for the usage of its products.

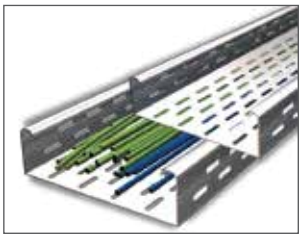
MEP Solutions

Cable Management Systems

Cable Management Systems are economical and designed to meet most requirements of cable and electrical wire installations and comply to international standards of fabrication and finishing.

Cable Trays & Accessories

Cable Trays are designed to meet most requirements of cable and electrical wire installations and comply to local and international standards of fabrications and finishes.

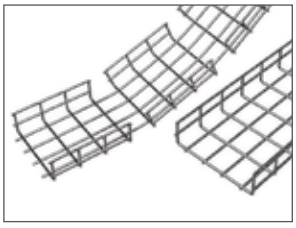


Cable Ladders (Welded & Swaged)

Cable Ladders of different side heights are available upon request.

Basket Trays & Accessories

SFSP's Basket Tray systems make connections fast and simple with limited need for tools. Its design allows for continuous airflow, and prevents heating up of cables. SFSP's Basket Tray comes in a full range of sizes and is made with high-strength welded steel wires.

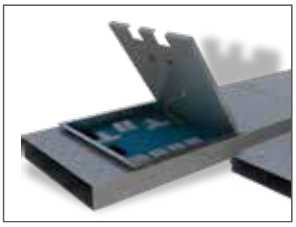


Cable Trunkings

Cable Trunkings and Accessories are offered in a comprehensive range. Mill galvanized, hot-dip galvanized, and powder coated are the various finishes produced in our factories.

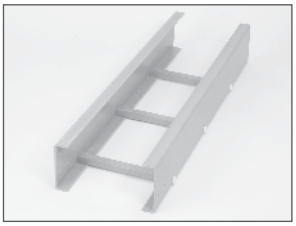
Underfloor Trunking

Underfloor Trunking Systems solutions incorporate a range of products for the distribution of power and data services , it is a coordinated set of containments that protect, segregate, contain, and route cables within a given environment.



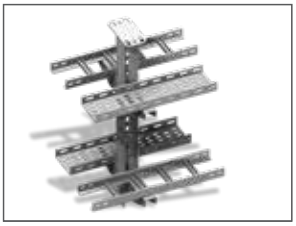
Fiberglass Reinforced Plastic (FRP) Cable Tray / Ladder

SFSP Fiberglass Reinforced Plastic (FRP) Cable Management Systems are designed, manufactured, and tested to be installed in most harsh environmental conditions of onshore and offshore facilities for several industries including Oil and Gas, Petrochemicals, Manufacturing, Mining and others.



Cable Management Support Systems

Cable Support Systems are well designed to provide necessary support for cable trays, cable ladders and trunkings. Cable supports are manufactured according to common standards from high quality raw materials.

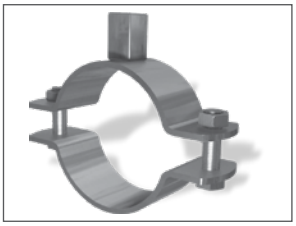


C-Channel Strut Systems

SFSP's Metal Framing Systems provide an economical solution for electrical, mechanical and industrial supports with a wide variety of applications in the construction industry.
Applications: - Pipe and Conduit Supports - Tunnel Pipe Stanchions - Racks and Shelvings - Wall Framings.

Pipe Clamps & Hangers

Pipe Clamps and Hangers from SFSP used in the support of pipes and equipments are manufactured according to the highest standards of fabrication. A diversified choice of Pipe Hangers, Pipe Clamps, EMT Straps, Omega Clamps, Beam Clamps, J and U-Bolts and Threaded Accessories.



Galvanized Threaded Rods and Accessories

Threaded rod, often referred to as a stud, is a rod of varying length that is threaded in a helical structure. Similar in appearance to a screw, the threading extends around and along the rod to cause rotational movements when in use.

Access Panels by FEROX

Ferox Access Panels provides complete solutions of several types of access panels including Hook Type, Pivot Type, Tiled Type as well as fire rated access panels and hygienic access panels. A variety of finishes are available including stainless steel of different grades, galvanized steel with powder coating.
Ferox Access Panels are manufactured from high quality material and assembled with stainless steel hardware.

Roof hatches by FEROX

Roof hatch provides safe and convenient access to commercial building roof areas using interior ladders and stairs for maintenance work. It can be installed on flat roofs with a maximum slope of 30°.Made of steel frames, doors and stainless steel hardware. Powder coated to provide corrosion resistance and outstanding exterior durability.

Architectural & Finishing Solutions

Mechanical Cladding Fixation (Stangle)

Stangle Cladding Fixation includes design, calculation and production of several types of mechanical fixings and accessories used for cladding purposes. Stainless and galvanized steel are among the various materials used in the fabrication.

Aluminium System for Stone Cladding

SFSP aluminum systems are designed and calculated to provide a practical & safe solutions of stone cladding. Wide range of aluminum profiles with different shapes to support different types of stone cladding.

Waste Management Sys. (Garbage & Linen Chutes)

Chutes from SFSP are very convenient, simple and low cost method of controlling and disposing of refuse and linen. Chutes meet the most stringent requirements of environmental health and safety.

Dry Wall & Ceiling Profiles

Gypsum Boards are considered among the most economic and ideal way for wall partitioning. Easy to install, saves time and money, gypsum boards can be used as a backing for wall treatments such as wall paper, fabric, title and wood paneling or it can simply be painted.

Metal Ceiling Grid Systems

SFSP Ceiling Grid System is a practical, convenient ceiling system. It has a complete range of main c-channel sections and complementary parts so that you can adapt the modules to suit your design needs and load requirements.

Expansion Joint System by Nexus

Our variety of expansion joints includes profiles for walls and floors, profiles for seismic movements, watertight profiles. Our products suit pedestrian as well as heavy load traffic areas.

Entrance Matting System by Nexus

Nexus Entrance matting systems provides heavy duty entrance mats, composed of aluminium profiles with carpet, brushes or rubber inserts. For any design of any shape, being round, square, oval, or any other symmetrical or asymmetrical shape, Nexus offers a variety of entrance matting profiles

Profiles by Nexus

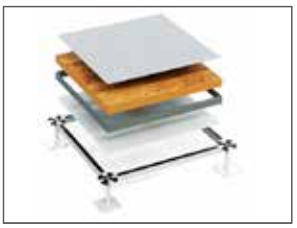
Nexus offer comprehensive solutions for the construction industry ranging from Expansion Joint Covers and Fire Barriers to Entrance Matting Systems, Wall and Floor Profiles, Tactile Solutions, etc... NEXUS range of products is manufactured according to most common international standards to meet the requirements of commercial, residential, governmental, transportation, healthcare and educational projects.

Phenolic Compartment by CUBIX

CUBIX phenolic compartment and partition systems are manufactured and customized to meet the precise needs of simple to complicated projects with its top-notch finish, quality of material and within a timely delivery. A complete solution with a wide selection of colors and textures are available.

Raised Access Flooring by PIXEL

PIXEL Raised Access Flooring offers comprehensive solutions of High Tech Raised Access Flooring Systems for the construction industry. PIXEL Raised Access Flooring are manufactured according to most common international standards to meet the requirements of commercial, residential, governmental, transportation, healthcare, and educational projects.



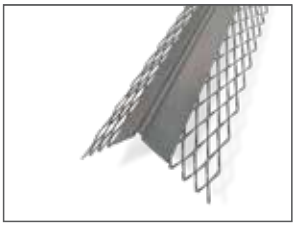
Metal Doors by FEROX

Ferox offers a wide variety of steel doors, manufactured according to international standards of fabrication and as per the legal requirement of commercial projects whether industrial environments, local authority buildings, leisure, hospitality, healthcare, transportation, education or retail offices, and shopping centers. Our range of steel doors includes fire rated steel doors, Insulated Doors , Acoustic Doors, Louvered Doors, Sliding Doors, Security Detonation Doors, Burglar Resistant Doors, Entry Gates and several other types to meet the requirements of all projects.

Civil Solutions

Expanded Metals, Plasterers' Beads

Expanded Metals help the formation of joints, protection of corners and resistance against cracks, chips and impact damage. SFSP manufactures inaccordance with BS EN 13658 – 2, ASTM C847-18, BS EN 845-3:2003+A1:2008, ASTM A 951/A 951M - 2016 standards.



Block Ladder Reinforcement

SFSP ladder and truss types are used for the reinforcement of brick and block masonry to give improved tensile strength to walls subjected to lateral loading e.g. wind and seismic. SFSP Block reinforcements reduces the risk of cracking either at stress concentration around opening.

Steel Lintels & Block Work Accessories

Steel Lintels provide a combination of strength and light weight, resulting in efficient load bearing performance and increased productivity on site. They are characterized by their ease of installation in addition to time as well as money saving. SFSP manufactures Steel Lintel in accordance with BS EN 845-2:2013+A1:2016 and according to relevant standards BS 5977 Part 2:1983.

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MARBLE & GRANITE FIXINGS

Stangle Cladding Fixation includes design, calculation and production of several types of mechanical fixings and accessories used for cladding purposes. Stainless and galvanized steel are among the various materials used in the fabrication.
Calculations are provided by our design office in Stuttgart, Germany.

INTERNATIONAL STANDARDS FOR CLADDING DESIGN

Design & Calculation Standards
Reference is made to the following standards for the design and structural calculations of Natural Stone Fixing Systems.

American Standards:
- Uniform Building Code 1997-Volume 2
- ASTM A 276 Standard specification for stainless steel bars and shapes.
- ASTM 666 Standard specification for annealed or cold-worked austenitic stainless steel sheets.
- ASTM C1354 / C1354M - 09 Standard Test Method for Strength of Individual Stone Anchorages in Dimension Stone

British Standards:
- BS 8298 Design and installation of natural stone cladding.
- BS 1449 Part 2 Steel plates, sheets and strips stainless and heat resisting.
- BS 6105 Corrosion resistant stainless steel fasteners.
- BS 5950 Structural use of steel work in building.
- CP3, Chapter 5, Part 2 Wind loads.
- BS 970 Part 3 1991, Mechanical properties for stainless steel.

German Standards:
- DIN 1045 Concrete and reinforced concrete, design and dimensioning.
- DIN 1053 Masonry, design and dimensioning.
- DIN 1055 Design loads for buildings.
- DIN 18 516 Cladding for external walls.
- DIN 18 800 Steel structures, design and dimensioning.
- DIN 18 801 Steel framed structures.

TYPES OF FIXINGS

Principles for the Fixing of Building Cladding
The fixing systems for building cladding are composed of several elements (angles, expansion bolts, screws, nuts, washers, etc), each of which shall present the appropriate mechanical features in respect to the requirements posed by the specific project. Any type of cladding, once fixed, is subject to two primary types of load:
- Permanent load (the dead load), due to the weight of the cladding itself;
- Variable load (applied loads), due to the wind, thermal expansions, seismic motions, etc.

Two fundamental types of fixing systems result:
- Load-bearing fixing: to support the permanent load and the vertical components of the variable loads.
- Restraining fixing: to support the horizontal components of the loads. Restraining fixings instead, serve to maintain the slabs in the positions specified by the project design. Thanks to the systems of adjustment with which they are equipped, the absence of perfect verticality in the external surfaces may be easily overcome.

TYPES OF FACADE BUILDING SUBSTRUCTURE
1- Stone fixed to concrete wall
2- Stone fixed to hollow block wall
3- Stone fixed to solid block
4- Stone fixed to composite substructure

LOADS
- Self load = (Dead Load)
- Wind load - Seismic load
- Temperature variation load

GENERAL INFORMATION

The most common types of stone are:

Granite

Travertine

Marble

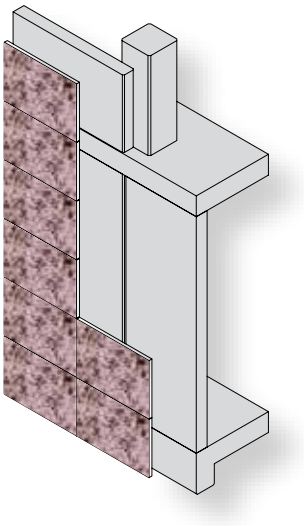
Slate

Limestone

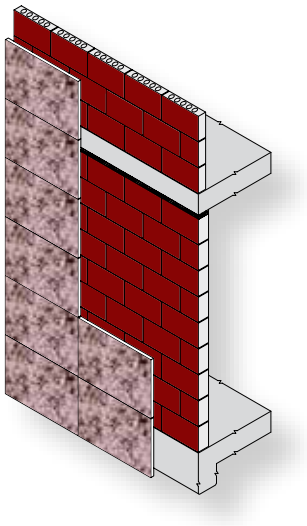
Natural stones have as much colors as you can imagine. The variety of color and texture of the natural stone is huge.

The very common finishes are:
- Polished, Honed, Bush Hammered and Sandblasted for Marble.
- Polished, Honed, Flamed, and Sandblasted for Granite.

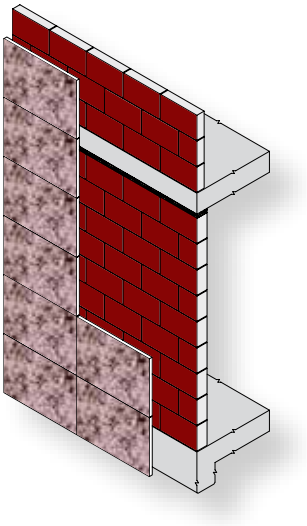
Types of Facade Building Sub-Structure



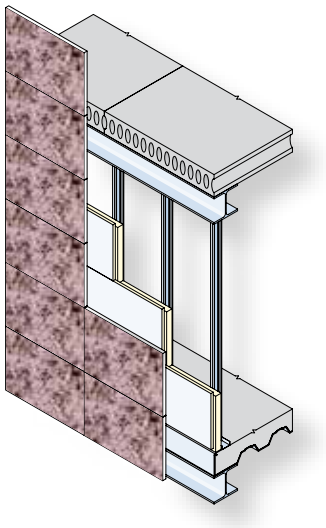
Stone fixed to concrete wall



Stone fixed to hollow block wall



Stone fixed to solid block wall



Stone fixed to composite substructure

Choice of Fixation System In Relation to The Components of The Stone Facades.

When natural or reconstituted stone has been chosen as a cladding material it is necessary to give consideration to the following key areas for the purposes of choosing the most appropriate fixing system:

1) Type of structural material (e.g. concrete / block)
2) Design of cavity (e.g. ventilated / full fill insulation)
3) Design of stone joint (e.g. open /closed)
4) Size of stone (e.g. thickness /panel size)
5) Design duration of building

Required Thickness of Stone Cladding

Thickness of stone and depth of slot for corbel plate.

Stone location	Stone type											
	Stone thickness , T				Minimum thickness of stone behind a cramp				Minimum depth of slot for a corbel plate, d			
	G Mw SL Q mm	T LS H mm	Mb mm	Ls Ss mm	G Mw SL Q mm	T Ls H mm	Mb mm	Ls Ss mm	G Mw SL Q mm	T Ls H mm	Mb mm	Ls Ss mm
Cladding (external)												
Less than 3.7 m above ground or floor level and continuously supported (incl. fascias)	20	20	20	50	7	7	7[2]	25[3]	Not applicable			
Fascias less than 3.7 m above ground or floor level (incl. fascias)	30	30	NA	50	12	12	NA	20[3]	20	20	NA	25[3]
More than 3.7m above ground or floor level (incl. fascias)	40	40	NA	75	15	15	NA	30[3]	25	25	NA	37[3]
Soffits (including inclined soffits)[4]	40	40	NA	75	15	15	NA	30[3]	Not applicable			
Sills, copings and supported reveals	30	30	NA	50	12	12	NA	20[3]	Not applicable			
stone faced concrete units	30	30	NA	50	Not applicable				Not applicable			
Lining (internal)												
Less than 7 m above ground or floor level and continuously supported (incl. fascias)[5]	20	20	20	50	7	7	7[2]	20[3]	Not applicable			
Less than 7 m but more than 3.7m above ground or floor level on corbels in slots (incl. fascias)	30	30	NA	50	12	12	NA	20[3]	20	20	NA	25[3]
More than 7m above ground or floor level (incl. fascias)	30	40	NA	75	12	15	NA	30[3]	20	25	NA	37[3]
Soffits (including inclined soffits)[4]	40	40	NA	75	15	15	NA	30[3]	Not applicable			

1) Abbreviations

G: Granites - **Ls:** limestones (e.g. Portland, Bath, Clipsham)
LsH: Hard limestones (e.g. Roman stone) - **Mb:** Brecciated marbles - **Mw:** Homogeneous marbles
Q: Quartzites m- m**SL:** Slates (those unlikely to delaminate). - **Ss:** Sandstone (e.g. York, Northumberland, Scottish) - **T:** Travertines

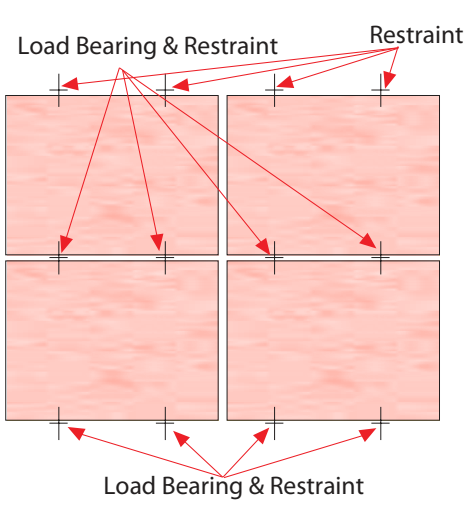
2) Breccated marbles may need to be reinforced with block liners but in assessing the minimum thiickness of stone behind a cramp mortice the thickness of the block liner should be ignored.
3) Half thickness if stone is more than 75 mm thick.
4) The figures in the table apply to soffit stones not exceeding 900mm x 600mm. If stones of a greater size are requiredconsideratin should be given to using some face fixings and/or additional fixings in the length and/or increased thickness. Internal soffit stone not less than 1.2m and not more than 3.7m above floor level, continuously supported at reveals may be 20mm thick for G, Q, SL, T, LsH, Mw, and 50mm for Ls and Ss.
5) Internal cladding between 3.7m and 7m in height in a continuous face should have an intermediate corbel course.

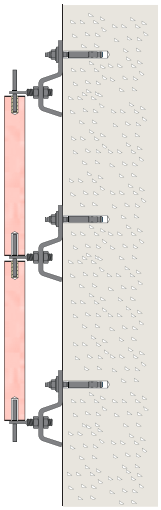
Table based on BS 8298 stone thickness table

FIXINGS IN HORIZANTAL OR VERTICAL JOINTS

Fixation In The Horizontal Joint

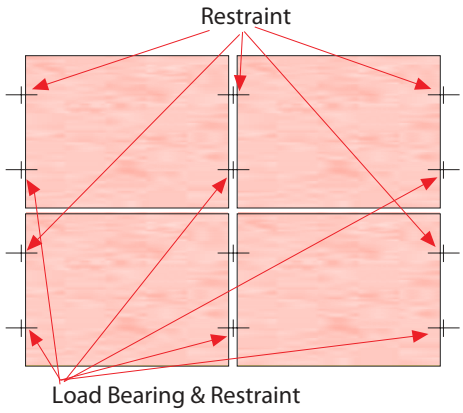
The brackets carry half the weight of the natural stone slabs in horizontal installation. Brackets bear half the weight of the slab above and also act as restraint, holding the slabs below and restraining them against wind pressure and suction.

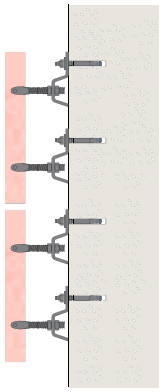




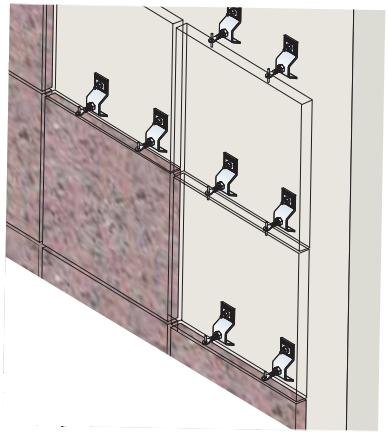
Fixation In The Vertical Joint

The load bearing carry the full weight of the natural stone slab in vertical installation. Each bracket bears half the weight of the slab on the right and half the weight of the slab on the left. Restraint brackets hold the slabs below and restrain them against wind pressure and suction.

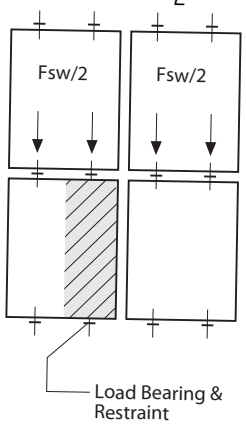




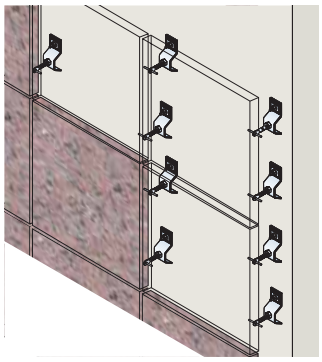
Installation At Horizontal Joints



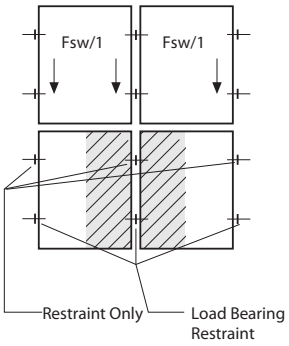
$$Fv = \frac{Fsw}{2}$$



Installation at vertical joints



$$Fv = \frac{Fsw}{1}$$



Determining Anchor Loading Fv

Fsw : self weight of natural stone panel
a) Support anchor in vertical joint One support anchor carries the dead load (Fv) of one natural-stone panel

Example :
Natural-stone panel b/h/s
(width/ height/ thickness) = 0.6/1.00/0.04m
Density (Design weight) = 27 kN /m³
Anchor loading Fv = 0.6 * 1.00 * 0.04 * 27 = 0.65kN = 65 kg.

Self weight per panel: Fsw = Fv = 65kg

b) Support anchor in horizontal joint One support anchor carries the dead load (Fv) of half natural-stone panel.

Example:
Natural-stone panel b/h/s = 0.6/1.00/0.04/m
Density= 27 kN/m³
Anchor loading Fv = Fsw/2 = 0.32kN
Fv = 32kg

The shape and the material of the facing to be anchored

Determining Anchor Loading FH (Wind loading):

Example:
Natural-stone panel = 0.6/1.00/0.04m
Wind load W = 1.1 kN/m³ (Wind pressure) for building height 20-100m

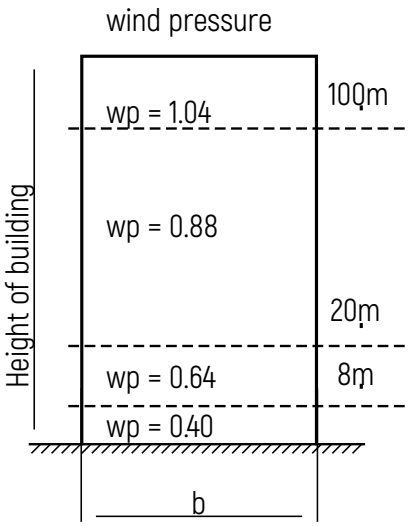
Wind load/ panel = 0.6 * 1.00 * 1.1 = 0.66 kN
Anchor load FH = 2 * 0.25 * 0.66 = 0.5 * 0.66 kN = 0.33kN

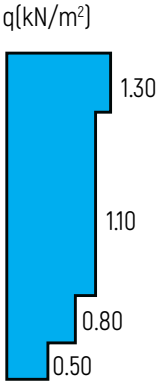
One anchor carries the wind loading of halph Natural-stone half-panel.

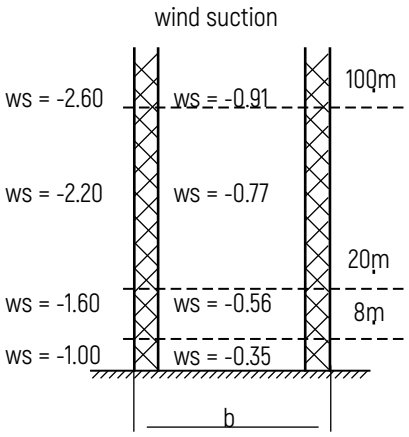
TYPES OF LOADS

WIND LOADS

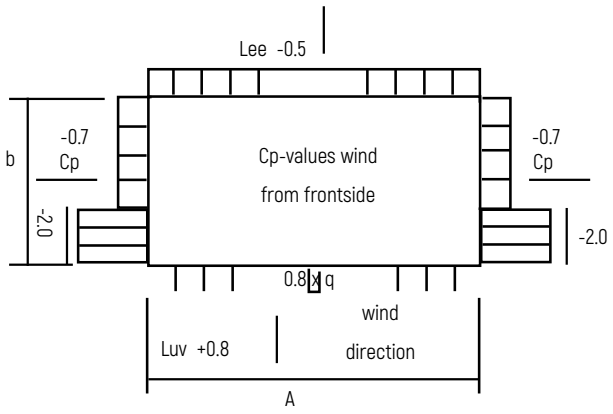
Wind Load for Cladding Facade According to Din 1055 Part 4

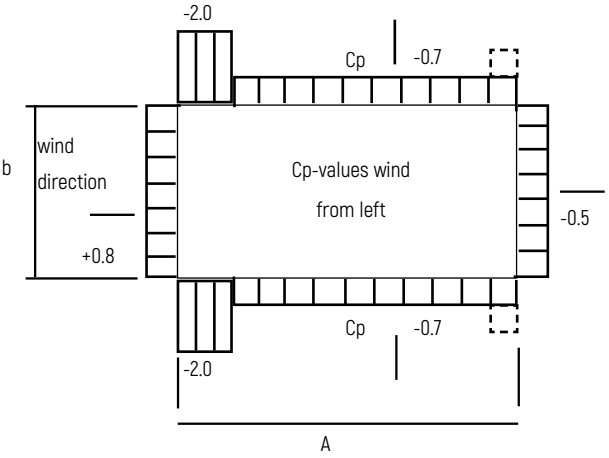






wind pressure= wp = cp x q
cp = aerodymnamic pressure coefficient





A = building length
b = building width
H = Height of building
q = velocity pressure
Wp = wind pressure
ws = wind suction

Cp =
-0.7 for H/b > 0.5
-0.5 for H/b < 0.25
Values in between can be obtained by interpolation.

WIND LOAD ACCORDING TO DIN 1055

Wind Force

The total wind force wich act on a structure or component
$W = C_f \times q_{(ze)} \times A$
C_f = The aerodynamic Coefficient
q_{ze} = The velocity pressure at the reference height
A = The reference Area

Wind Velocity and wind Pressure

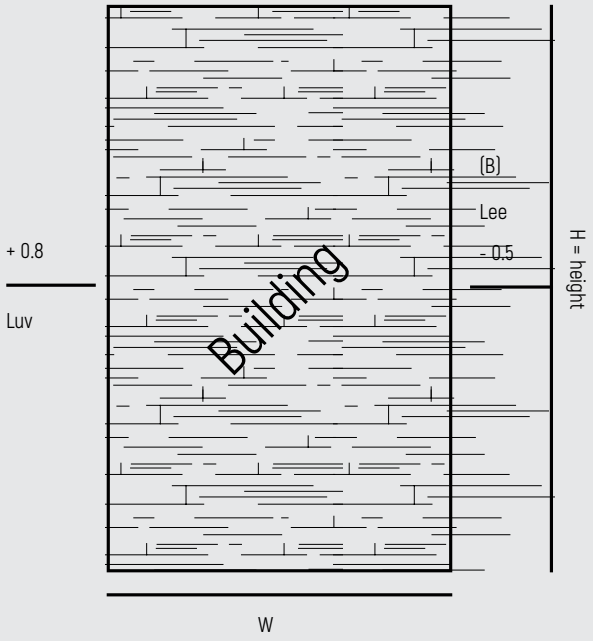
Height	0-8 m	>8 m - 20 m	>20 m - 100 m	>100 m
wind velocity m/s	28,3	35,80	42,00	45,6
wind q Kn/m²	0,50	0,8	1,10	1,30

Wind Suction
W = C x q
C = Wind Coefficient
q = Velocity Pressure

Suction Coefficient in area of discontinuity		
Increasing Coefficient C_p	Width of a (m)	Width of d (m)
-2,0	a<8 m	1,0 m
	8 m < a ≤ 16 m	a/8
	a > 16,0 m	2,0 m

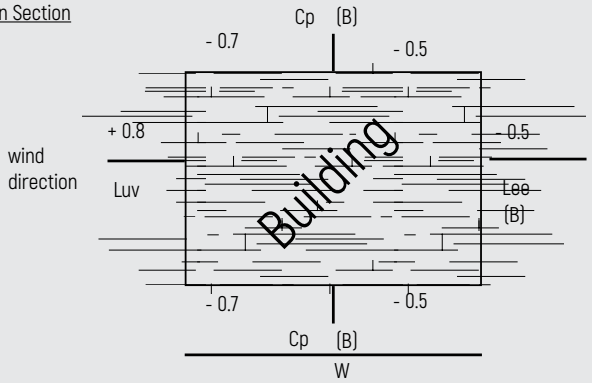
Wind Suction				
Height	0 - 8 m	> 8 m - 20 m	> 20 m - 100 m	> 100 m
Wind kN/m²	-1,00 (-2 x 0,5)	-1,60 (-2 x 0,8)	-2,20 (-2 x 1,1)	-2,60 (-2 x 1,30)

Wind Pressure = w = Cp x q
aerodynamic Pressure Factor CP
Elevation Section

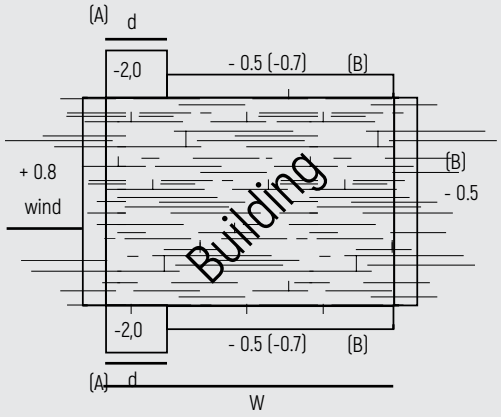


CP = -2,0
d = 1m for A < 8 m
d = W/P for 8m < A < 16 m
d = 2,0 m for W > 16 m

Lateral Walls
CP = -0,5 for H/W ≤ 0,25
CP = -0,7 for H/W ≤ 0,5
Plan Section

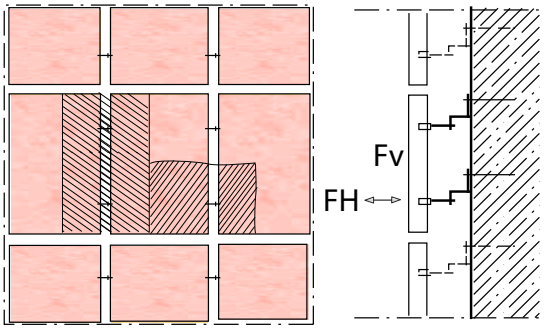


Wind pressure on corners
d = Corner



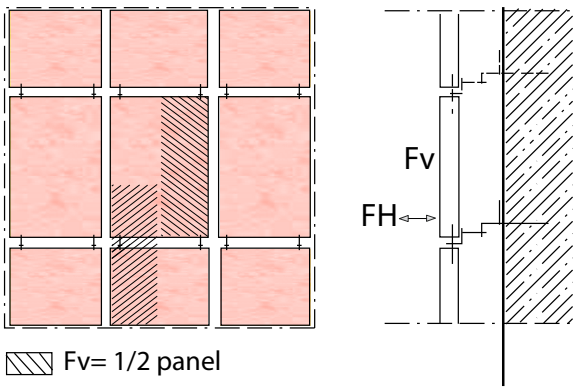
WIND LOAD ACCORDING TO DIN 1055

Vertical Joints



Fv= 1 panel
FH= 1/2 panel

Horizontal Joints



Fv= 1/2 panel
FH= 1/2 panel

Loads for Support Anchor

Characteristic weights of natural stone panels [kN/m²]						
Density kN/m³	Plate thickness [cm]					
	2,0	3,0	4,0	5,0	6,0	7,5
20	0,40	0,60	0,80	1,00	1,20	1,50
24	0,48	0,72	0,96	1,20	1,44	1,80
25	0,50	0,75	1,00	1,25	1,50	1,88
26	0,52	0,78	1,04	1,30	1,56	1,95
27	0,54	0,81	1,08	1,35	1,62	2,03
28	0,56	0,84	1,12	1,40	1,68	2,10
30	0,60	0,90	1,20	1,50	1,80	2,25

Characteristic loads per panel [kN] by panel thickness 3cm and stone density 26kN/m² (0,78kN/m²)										
self weight kN	Size m³	Wind pressure FH kN			Wind suction FH (A) kN			Wind suction FH (B) kN		
		0-8m	8-20m	20-100m	0-8m	8-20m	20-100m	0-8m	8-20m	20-100m
0,3	0,38	0,15	0,25	0,34	-0,38	-0,62	-0,85	-0,13	-0,22	-0,30
0,6	0,77	0,31	0,49	0,68	-0,77	-1,23	-1,69	-0,27	-0,43	-0,59
0,9	1,15	0,46	0,74	1,02	-1,15	-1,85	-2,54	-0,40	-0,65	-0,89
1,2	1,54	0,62	0,98	1,35	-1,54	-2,46	-3,38	-0,54	-0,86	-1,18
1,5	1,92	0,77	1,23	1,69	-1,92	-3,08	-4,23	-0,67	-1,08	-1,48
1,8	2,31	0,92	1,48	2,03	-2,31	-3,69	-5,08	-0,81	-1,29	-1,78

Characteristic loads per panel [kN] by panel thickness 4cm and stone density 28kN/m² (1,12kN/m²)										
self weight kN	Size m³	Wind pressure FH kN			Wind suction FH (A) kN			Wind suction FH (B) kN		
		0-8m	8-20m	20-100m	0-8m	8-20m	20-100m	0-8m	8-20m	20-100m
0,4	0,36	0,14	0,23	0,31	-0,36	-0,57	-0,79	-0,13	-0,20	-0,28
0,8	0,71	0,29	0,46	0,63	-0,71	-1,14	-1,57	-0,25	-0,40	-0,55
1,2	1,07	0,43	0,69	0,94	-1,07	-1,71	-2,36	-0,38	-0,60	-0,83
1,6	1,43	0,57	0,91	1,26	-1,43	-2,29	-3,14	-0,50	-0,80	-1,10
2,0	1,79	0,71	1,14	1,57	-1,79	-2,86	-3,93	-0,63	-1,00	-1,38
2,4	2,14	0,86	1,37	1,89	-2,14	-3,43	-4,71	-0,75	-1,20	-1,65

SEISMIC LOAD ACCORDING TO UBC

Seismic Load

Seismic loading is one of the basic concept of earthquake engineering which means application of an earthquake generated agitation to a structure. It happens at contact surface of a structure either with the ground or with adjacent structure:

$$= SL = \frac{(2.5 \times Ca \times I)}{R} \quad D, SL \geq 0.11\ Ca \times I \times D$$

SL = Seismic load, Ca = Seismic response spectrum = Lateral force value in 97 UBC table 160
I = Importance factor given in 97 UBC Table 16 K
R = Component response modification factor from 97 UBC Table 16N
D = Dead Load
It is common practice to oxpress the Seismic load as a percentage of dead load calculating only the coefficient term.

Zone	Seismic Load
1	0.06 7x D
2	0.122 x D
3	0.2 x D
4	0.244 x D

Seismic Zone	
Zone	Damage to Structure
0	No Domage
1	Minor
2	Moderate
3	Major
4	Huge

Table 16-K - Occupancy Category

Occupancy Category	Occupancy or functions of Structure	Seismic Importance Factor, I	Seismic Importance Factor[1], I_p	Seismic Importance Factor, I_w
1. Essential facilities[2]	Group I, Division 1 Occupancies having surgery and emergency treatment areas Fire and police stations, Garages and shelters for emergency vehicules and emrgency aircraft, Structures and shelters in emergency - preparedness centers Aviation control towers, Structures and equipment in government communication centers and other facilities required for emergency response Standby power - generating equipment for Category 1 facilities Tanks or other structures containing housing or supporting water or other fire - suppression material or equipment required for the protection of Category 1.2 or 3 structures.	1.25	1.50	1.15
2. Hazardous facilities	Group H, Divisions 1, 2, 6 and 7 Occupancies and structures therein housing or supporting toxic or explosive chemicals or substances, Nonbuilding structures housing, supporting or containing quantities for toxic or explosive substances that, if contained within a building, would cause that building to be classified as a Group H, Division 1, 2 or 7 Occupancy	1.25	1.50	1.15
3. Special occupancy structures[3]	Group A, Divisions 1, 2 and 2.1 Occupancies Buildings housing Group E, Divisions 1 and 3 occupancies with a capacity greater than 300 students, Buildings Housing Group B Occupancies used for college or adult education with a capacity greater than 500 students, Group I, Divisions 1 and 2 Occupancies with 50 or more resident incapacitated patients, but not included in Category I, Group I, Division 3 Occupancies All structures with an occupancy greater than 5.000 persons Structures and equipment in power-generating stations, and other public utility facilities not included in Category 1 or Category 2 above, and required for continued operation	1.00	1.00	1.00
4. Standard occupancy structures[3]	All structures housing occupancies or having functions not listed in Category 1, 2 or 3 and Group U Occupancy towers	1.00	1.00	1.00
5. Miscellaneous structure	Group U Occupancies except for towers	1.00	1.00	1.00

SEISMIC LOAD ACCORDING TO UBC

Table 16-N-Structural Systems1

BASIC STRUCTURAL SYSTEM 2	LATERAL-FORCE-RESISTING SYSTEM DESCRIPTION	R	O	HEIGHT LIMIT FOR SEISMIC ZONES 3 AND 4 (feet) x 304.8 for cm
1. Bearing wall system	1. Light-framed walls with shear panels a. Wood structural panel walls for structures three stories or less b. All other light-framed walls	 5.5 4.5	 2.8 2.8	 65 65
	2. Shear walls a. Concrete b. Masonry	 4.5 4.5	 2.8 2.8	 160 160
	3. Light steel-framed bearing walls with tension-only bracing	2.8	2.2	65
	4. Braced frames where bracing carries gravity load a. Steel b. Concrete[3] c. Heavy timber	 4.4 2.8 2.8	 2.2 2.2 2.2	 160 - 65
2. Building frame system	1. Steel eccentrically braced frame (EBF)	7.0	2.8	240t
	2. Light-framed walls with shear panels a. Wood structural panel walls for structures three stories or less b. All other light-framed walls	 6.5 5.0	 2.8 2.8	 65 65
	3. Shear walls a. Concrete b. Masonry	 5.5 5.5	 2.8 2.8	 240 160
	4. Ordinary braced frames a. Steel b. Concrete3 c. Heavy timber	 5.6 5.6 5.6	 2.2 2.2 2.2	 160 -- 65
	5. Special concentrically braced frames a. Steel	 6.4	 2.2	 240
3. Moment-resisting frame system	1. Special moment-resisting frame (SMRF) a. Steel b. Concrete[4]	 8.5 8.5	 2.8 2.8	 N.L. N.L.
	2. Masonry moment-resisting wall frame (MMRWF)	6.5	2.8	160
	3. Concrete intermediate moment-resisting frame (IMRF)[5]	5.5	2.8	--
	4. Ordinary moment-resisting trame (OMRF) a. Steel[6] b. Concrete[7]	 4.5 3.5	 2.8 2.8	 160 --
	5. Special truss moment frames of steel (STMF)	6.5	2.8	240

N.L.--no limit
[1]Sec Section 1630.4 for combination of structural systems.
[2]Basic structural systems are defined in Section 1629.6.
[3]Prohibited in Seismic Zones 3 and 4.
[4]1Includes precast concrete conforrning to Section 1921.2.7.
[5]Prohibited in Seismic Zones 3 and 4, except as permitted in Section 1634.2.
[6]Ordinary moment-resisting fi'ames in Seismic Zone 1 meeting the requirements of
Section 2211.6 may use a R value of 8.
[7]Total height of the building including cantilevered columns.
[8]Prohibited in Seismic Zones 2A, 2B, 3 and 4. See Section 1633.2.7.

BASIC STRUCTURAL SYS'TEM2	LATERAL-FORCE-RESISTING SYSTEM DESCRIPTION	R	O	HEIGHT LIMIT FOR SEISMIC ZONES 3 AND 4 (feet) x 304.8 for cm
4. Dual systems	1. Shear walls a. Concrete with SMRF b. Concrete with steel OMRF c. Concrete with concrete IMRF[5] d. Masonry with SMRF e. Masonry with steel OMRF f. Masomy with concrete IMRF[3] g. Masonry with masonry MMRWF	8.5 4.2 6.5 5.5 4.2 4.2 6.0	2.8 2.8 2.8 2.8 2.8 2.8 2.8	N.L. 160 160 160 160 -- 160
	2. Steel EBF a. With steel SMRF b. With steel OMRF	8.5 4.2	2.8 2.8	N.L. 160
	3. Ordinary braced frames a. Steel with steel SMRF b. Steel with steel OMRF c. Concrete with concrete SMRF[3] d. Concrete with concrete 1MRF[3]	6.5 4.2 6.5 4.2	2.8 2.8 2.8 2.8	N.L. 160 -- --
	4. Special concentr.ically braced frames a. Steel with steel SMRF b. Steel with steel OMRF	7.5 4.2	2.0 2.8	N.L. 160
5. Cantilevered column building systems	1. Cantilevered column elements	2.5	2.0	35[7]
6. Shear \vall-frame interaction systems	1. Concrete[8]	5.5	2.8	160
7. Undetined systems	See Sections 1629.6.7 and 1629.9.2	--	--	--

SEISMIC LOAD ACCORDING TO UBC

Table 16-0-Horizontal Force Factors, $_{Ap}$ and $_{Rp}$

ELEMENTS OF STRUCTURES AND NONSTRUCTURAL COMPONENTS AND EQUIPMENT[1]	ap	R_p	FOOTNOTE
1. Elements of Structures A. Walls including the following: (1) Unbraced (cantilevered) parapets.	2.5	3.0	
(2) Exterior walls at or above the ground floor and parapets braced above their centers of gravity	1.0	3.0	2
(3) All interior-bearing and nonbearing walls.	1.0	3.0	2
B. Penthouse (except when framed by an extension of the structural trame).	1.5	4.0	
C. Connections for prefabricated structural elements other than walls. See also Section 1632.2.	1.0	3.0	3
2. Nonstructural Components A. Exterior and interior Oll1amentations and appendages.	2.5	3.0	
B. Chimneys, stacks and trussed towers supported on or projecting above the roof: (I) Laterally braced or anchored to the structural frame at a point below their centers of mass.	2.5	3.0	
(2) Laterally braced or anchored to the structural frame at or above their centers of mass	1.0	3.0	
C. Signs and billboards.	2.5	3.0	
D. Storage racks (include contents) over 6 feet (1829 mm) tall	2.5	4.0	
E. Permanent floor-supported cabinets and book stacks more than 6 feet (1829 mm) in height (include contents).	1.0	3.0	
F. Anchorage and lateral bracing for suspended ceilings and light fixtures.	1.0	3.0	3,6,7,8
G. Access floor systems.	1.0	3.0	4,5,9
H. Masonry or concrete fences over 6 feet (1829 mm) high.	1.0	3.0	
I. Partitions.			
3. Equipment A. Tanks and vessels (include contents), including support systems.	1.0	3.0	
B. Electrical. mechanical and plumbing equipment and associated conduit and ductwork and piping.	1.0	3.0	5,10,11,12,13,14,15,16
C. Any flexible equipment laterally braced or anchored to the strue-tural frame at a point below their center of mass.	2.5	3.0	5,10,14,15,16
D. Anchorage of emergency power supply systems and essential communications equipment. Anchorage and support systems for battery racks and fuel tanks necessary for operation of emergency equipment. See also Section 1632.2.	1.0	3.0	17,18
E. Temporary containers with llammable or hazardous materials.	1.0	3.0	19

ELEMENTS OF STRUCTURES AND NONSTRUCTURAL COMPONENTS AND EQUIPMENT[1]	ap	R_p	FOOTNOTE
4. Other Components A. Rigid components with ductile material and attachments.	1.0	3.0	1
B. Rigid components with nonduetile material or attachments.	1.0	1.5	1
C. Flexible components with ductile material and attachments.	2.5	3.0	1
D. Flexible components with nonductile material or attachments.	2.5	1.5	1

Table 16-Q-Seismic Coefficient C_a

SOIL PROFILE TYPE	SEISMIC ZONE FACTOR, Z				
	Z= 0.075	Z= 0.15	Z= 0.2	Z= 0.3	Z= 0.4
S_A	0.06	0.12	0.16	0.24	$0.32N_a$
S_B	0.08	0.15	0.20	0.30	$0.40N_a$
S_C	0.09	0.18	0.24	0.33	$0.40N_a$
S_D	0.12	0.22	0.28	0.36	$0.44N_a$
S_E	0.19	0.30	0.34	0.36	$0.36N_a$
S_F	See Footnote I				

[1]Site-specific geotechnical investigation and dynamic site response analysis shall be perfomled to determine seismic coefficients tor Soil Profile Type S_F

[1]See Sectlon 1627 for definitions of flexible components and rigid components.
[2]See Sections 1633.2.4 and 1633.2.8 for concrete and masonry walls and Section 1632.2 for connections for panel connectors for panels.
[3]Applies to Seismic Zones 2,3 and 4 only.
[4]Ground supported steel storage racks may be designed using the provisions of Section 1634. Chapter 22, Division VI, may be used for design, provided seismic design forces are equal to or greater than those specified in Section 1632.2 or 1634.2, as appropriate.
[5]Only attachments, anchorage or restraints need be designed.
[6]Ceiling weight shall include all light fixtures and other equipment or partitions that are laterally supported by the ceiling. For purposes of determining the seismic force, a ceiling weight of not less than 4 psf (0.19 kN/m^2) shall be used.
[7]Ceilings constructed of lath and plaster or gypsum board screw or nail attached to suspended members that support a ceiling at one level extending from wall to wall need not be analyzed, provided the walls are not over 50 feet (15 240mm) apart.
[8]Light fixtures and mechanical services installed in metal suspension systems for accoustical title and lay-in panel ceilings shall be independently supported from the structure above as specified in UBC Standard 25-2, part III.
[9]w^p for access floor systems shall be the dead load of the access floor system plus 25 percent of the floor live load plus a 10-psf (0.48 kN/m$^{2)}$ partition load allowance.
[10]Equipment includes, but is not limited to, boilers, chillers, heat exchangers, pumps, air-handling units, cooling towers, control panels, motors, switchgear, transformers and life-safety equipment. It shall include major conduit, ducting and piping, which services such machinery and equipment and fire sprnkler systems. see section 163.2.2 for additional requirements for determining ap for nonrigid or flexibly mounted equipment.
[11]Seismic restraints may be omitted from piping and duct support if all the following conditions are satisfied:
[11.1] Lateral motion of the piping or duct will not cause damaging impact with other systems.
[11.2] The piping or duct is made of ductile material with ductile connections.
[11.3] Lateral motion of the piping or duct does not cause impact of fragile appurtenances (e.g., sprinkler heads) with any other equipment, piping or structural member.
[11.4] Lateral motion of the piping or duct does not cause loss of system vertical support.
[11.5] Rod-hung supports of less than 12 inches (305mm) in length have top connections that cannot develop moments.
[11.6] Support members cantilevered up from the floor are checked for stability.

THERMAL MOVEMENTS

General

It is essential to take thermal movements into account. These are the relative changes in length and height due to temperature differences between the cladding, and the structure to which the cladding is fixed. The magnitude of the movements is dependent on whether the frame is entirely or partly inside the building envelope, the ambient temperature, the coefficients of the thermal expansion of the various materials (see the table), and the temperature of the various components when the cladding is fixed.

For buildings in the KSA with modern standards of thermal insulation and air conditioning, the temperatures tabulated in table KSA may be used as a guide to the extremes likely to be experienced

Material	Coefficient of linear expansion 10^-6K^-1
(Steel (and any concrete casing to steel members	12
Concrete	
Dense gravel aggregate	to 14 10
(Crushed rock (except limestone	to 13 10
Limestone aggregate	to 8 7
Lightweight aggregate	to 12 8
Masonry	
Concrete brickwork and blockwork	to 12 6
Dense aggregate	to 12 6
(Lightweight aggregate (autoclaved	to 12 8
(Aerated (autoclaved	8
Calcium silicate brickwork	to 14 8
Clay or shale brickwork or blockwork	to 8 5
Natural stones	
Limestone	to 10 3
Sandstone	to 12 7
Granite	to 10 8
Slate	to 12 6
Marble	to 15 3
Quaritzte	to 12 9

Thermal Movements

1- Example of Calculation of thermal movement:

Consider a Building Construction type is an enclosed Concrete frame with Granite cladding (1000x500x30mm)
On a hot summer's day with the building complete and occupied the relative movement (in mm/m) of frame to cladding is given by the equation A =1000 [(tfs.tfe) Xf-(tcs-tce)Xc]
tfs = is temperature (in °C) of frame in Summer
tfe = is temperature (in °C) of frame on erection
Xf = is coefficient of thermal expansion of frame
tcs = is temperature (in °C) of cladding in Summer
tce = is temperature (in °C) of cladding on erection
Xc = is coefficient of thermal expansion of cladding using the following values:
tfs = 30°C, tfe = 40°,Xf = 13x10^-6 per °C,tcs = 80°C, ce= 10°C,Xc =(8 to 10) x 10 ^-6 per °C
If Xc = 8 x 10^-6 per °C, movement = 1000[(30-40) 13-(80-10)^8]
DL= 0,69mm/m, if Xc = 10, Dl = 0,83 mm/m in both cases , the movement shall be less than 1,0mm

Example Calculation of Deflection
Panel size : 1000mmx500mmx30mm
Granit with a density of 28 kN/m^3
Deflection on the support anchor with a section of (width x height) 35mmx4mm
Existing deflection = f = (Fv.a^3)/3xExI
Fv = Weight of cladding panel = 420 N
a = Cavity to pin in mm = 40mm
E= Modulus of Elasticity of bracket = 170000 N/mm^2
I = Moment of Inertia = 35x4^3/12 = 186,70mm^4
Allowable deflection f = (420Nx40^3 mm^3) / 3x170000 N/mm^2 x186,70mm^4)
f = 0,28 mm < 1.0mm

Coefficients Of Thermal Expansion

Material	Linear expansion ' (in/°F)
Aluminium	0.0000133
Brass	0.0000104
Bronze	0.0000101
Bronze	0.0000096
Concrete	0.0000079
Marble	0.0000073
Granite	0.0000078
Lime stone	0.0000060
Masonry	0.0000035
Mild steel	0.0000067

Thermal Expansion:

The thermal expansion of natural stone is an important consideration where natural stone is used with dissimilar materials to form large units which are rigidly fixed.
The coefficient of thermal expansion varies from one variety of natural stone to another, so theactual thermal characteristics of a specific natural stone should be obtained from the supplier when the final choice of a natural stone is made.
Thermal expansion is calculated as follows: $L = \alpha . h . T$ ~0.5 mm/m

Where
L Change in height of panel in [mm]
α : Coefficient of thermal expansion in [mm/mm/°C]
h: Height of panel in [mm]
T: Change in temperature in [°C]

We need joints, allowable movement thermal expansion

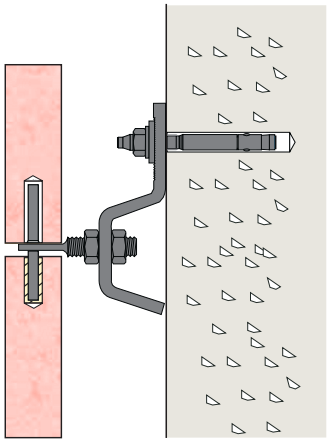
TYPES OF FIXINGS

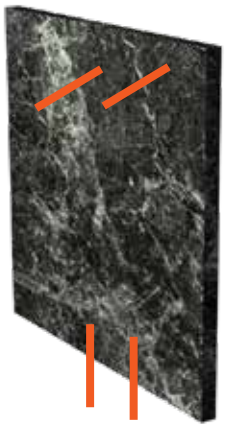
Principles for the Fixing of Building Cladding

The fixing systems for building claddings are composed of several elements (angles, expansion bolts, screws, nuts, washers, etc), each of which shall present the appropriate mechanical features in respect to the requirements posed by the specific project.

Any type of cladding, once fixed, is subject to two primary types of load:

- The permanent load (the dead load), due to the weight of the cladding itself;
- The variable load (applied loads), due to the wind, thermal expansions, seismic motions, etc.

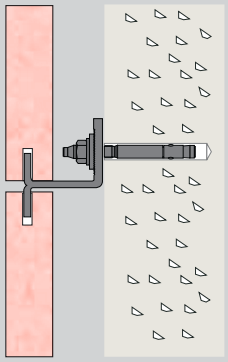




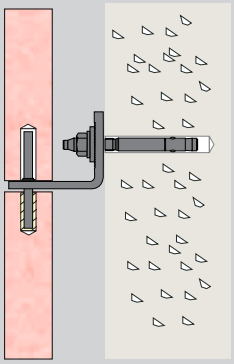
Two fundamental types of fixing systems result:

- Load-bearing fixing: to support the permanent load and the vertical components of the variable loads.
- Restraining fixing: to support the horizontal components of the loads.

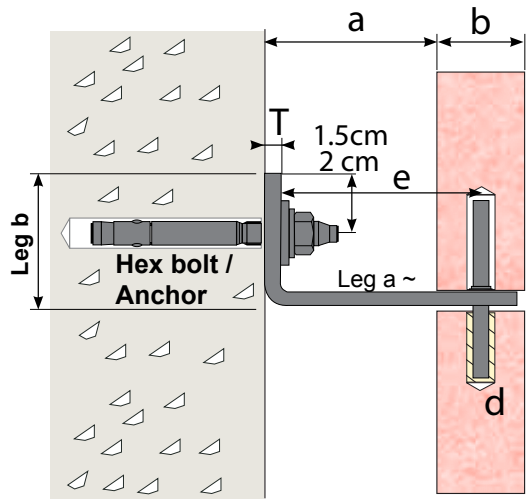
Load-bearing fixing are usually composed by angles (of adequate dimensions), firmly fixed to the building by the opportunely selected anchoring element complete with expansion anchors and bolts.



Restraining fixings instead, serve to maintain the slabs in the positions specified by the project design .Thanks to the system of adjustment with which they are equipped, the absence of perfect verticality in the external surfaces may be easily overcome.

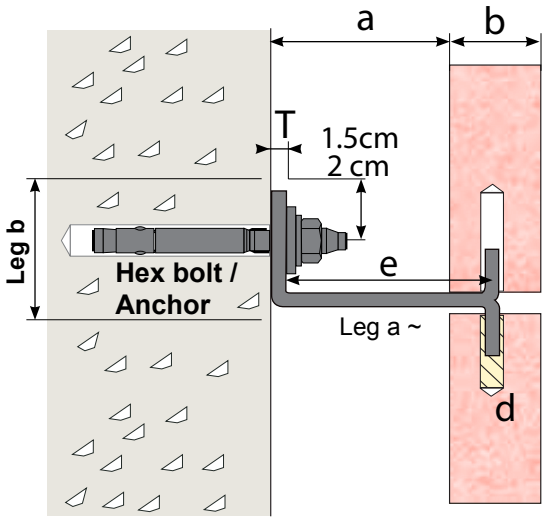


L-Bracket (Standard & Serrated) | Type ST- 500 1100 With Pin



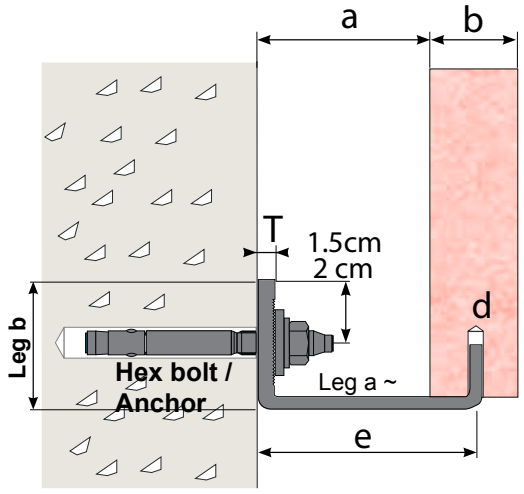
L-Bracket Holder With Pin	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

L-Bracket (Standard & Serrated) | Type ST- 500 1200 Up and Down



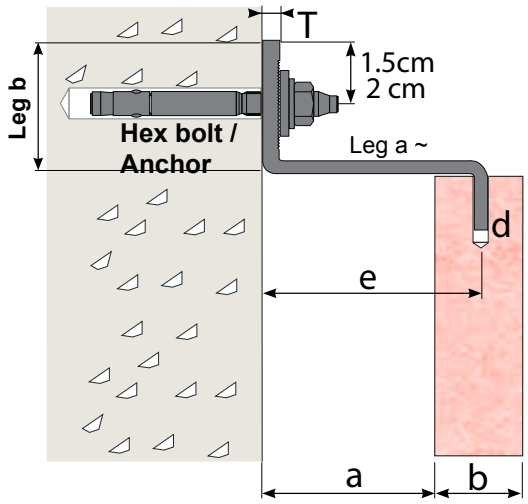
L-Bracket Holder Up and Down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

L-Bracket (Standard & Serrated) | Type ST- 500 1300 Up



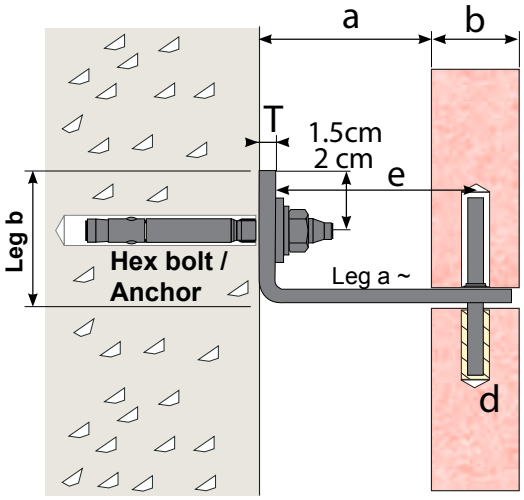
L-Bracket Holder Up	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

L-Bracket (Standard & Serrated) | Type ST- 500 1400 Down



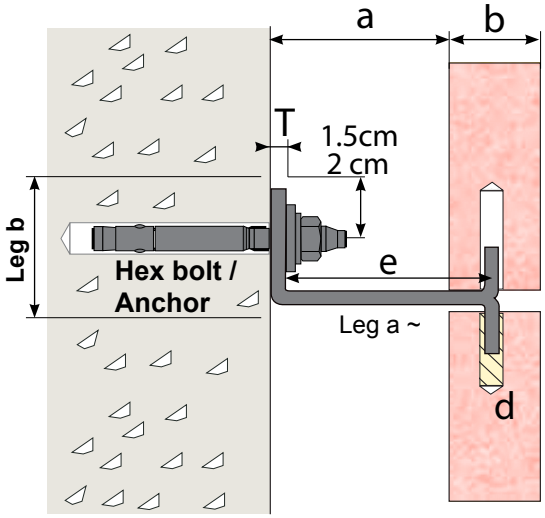
L-Bracket holder down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

L-Bracket (Standard & Serrated) | Type ST- 500 1500 With Two Pins



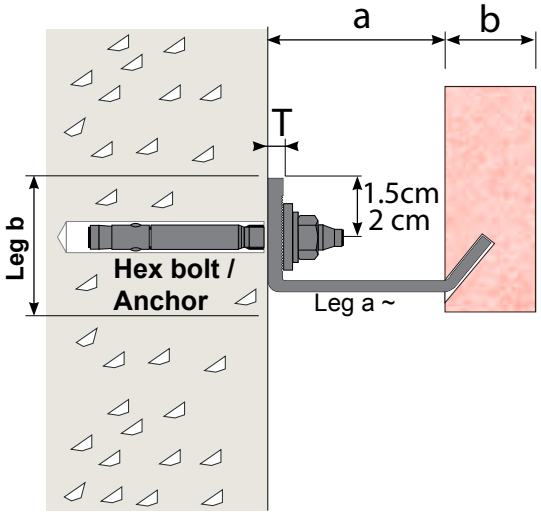
L-Bracket holder with pin	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

L-Bracket (Standard & Serrated) | Type ST- 500 1600 Double Up and Down



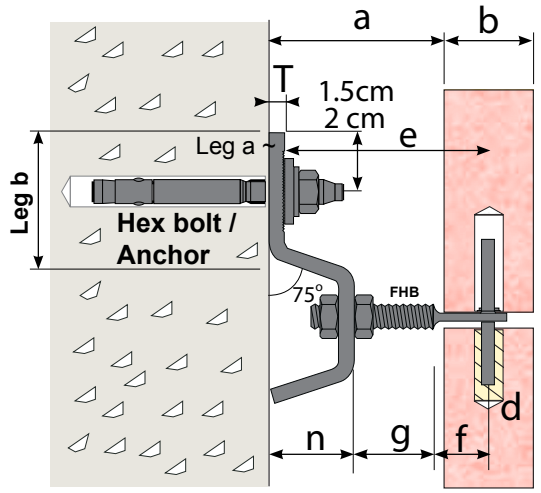
L-Bracket holder up and down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

L-Bracket (Standard & Serrated) | Type ST- 500 1700 With Curved Leg



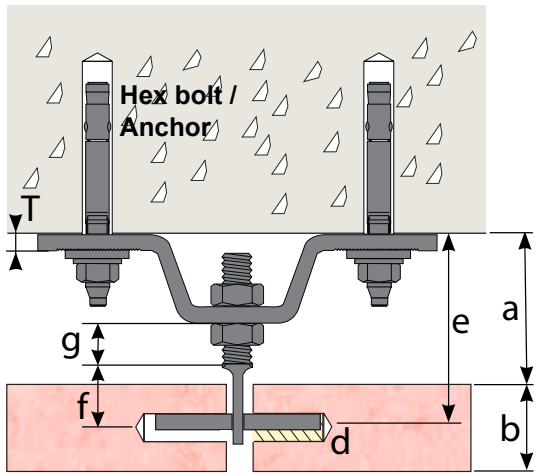
L-Bracket holder Curved	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
Economic for 20 < a ≤ 80mm	

Z-Bracket with returned Leg Horizontal joint (Staandard & Serrated) | Type ST- 600 1100



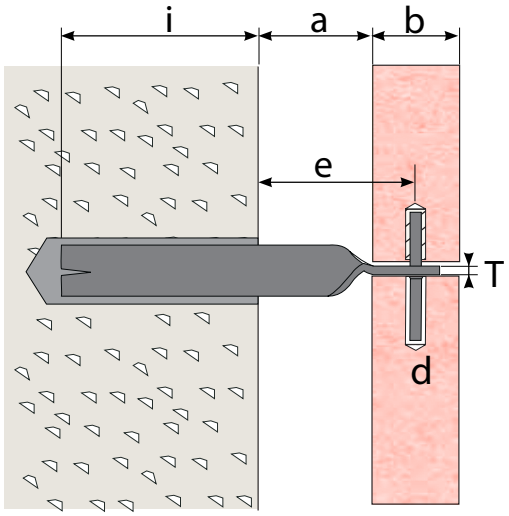
Z-returned bracket	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
f	Flat head parts
g	Threaded part
Economic for 50 < a ≤ 120mm	

Omega Bracket (Standard & Serrated) | Type ST- 700 1100



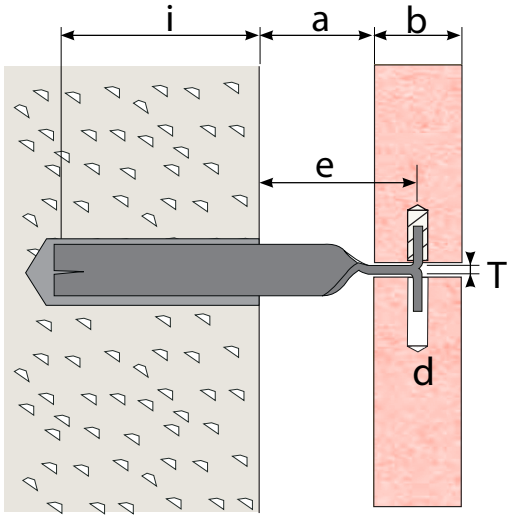
Z-returned bracket	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
f	Flat head parts
g	Threaded part
Economic for 50 < a ≤ 120mm	

Fishtail with Pin | Type ST- 800 1100



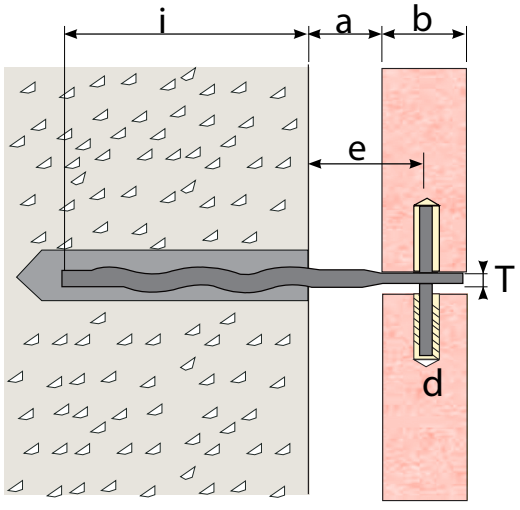
Fishtail with Pin	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
i	Embedment in wall
T	Fish tail thickness
Economic for 20 < a < 80mm	

Fishtail Up & Down | Type ST- 800 1200



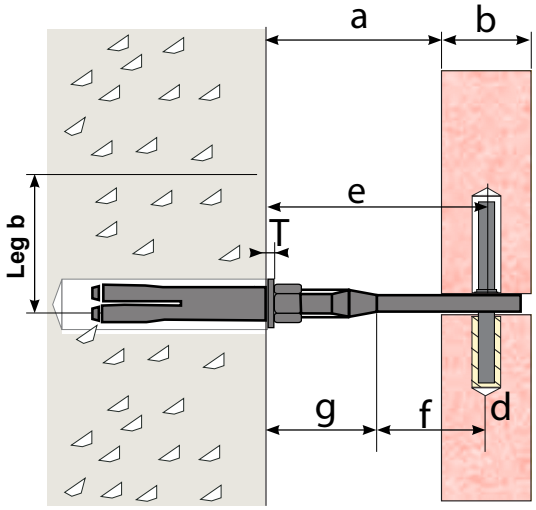
Fishtail Up & Down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
i	Embedment in wall
T	Fish tail thickness
Economic for 20 < a < 80mm	

Corrugated dowel | Type ST- 900 1100



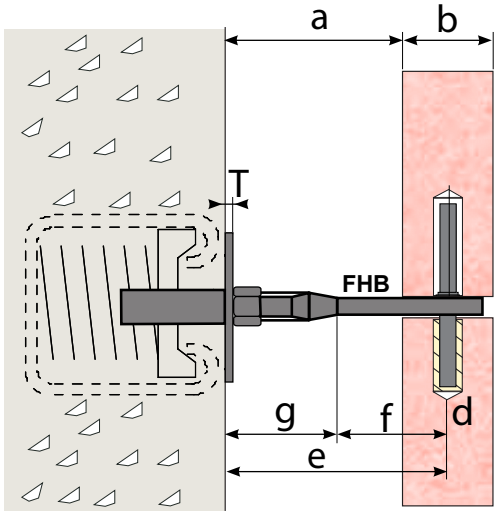
Corrugated dowel	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
i	Embedment in wall
T	Fish tail thickness
economic for 20 < a < 80mm	

Flat-Head-Bolt Direct in Wall



Flat-Head-Bolt direct in wall	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
f	Flat head parts
g	Rounded part
economic for 10 < a ≤ 60mm	

Flat-Head-Bolt in C-Channel



Flat-Head-Bolt in C-Channel	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
f	Flat head parts
g	Rounded part
economic for 10 < a ≤ 60mm	

Metals Used in Fixing Systems

The metals used for the realization of the various components comprising the fixing system set shall possess special features which, in addition to assuring a satisfactory mechanical resistance, shall also be immune to the varying forms of corrosion, in order to withstand both the static and dynamic load conditions to which they are subject throughout installation and the harmful atmospheric conditions which may arise as well, with extreme sturdiness and security.

Particular attention shall be dedicated to the phenomenon of galvanic corrosion, which comes about whenever a more noble metal is placed into direct contact with another metal in the presence of an electrolyte (water containing salts, acids or substances deriving from combustion).

Under such conditions, a chemical reaction takes place which tends to damage the less noble metal. Galvanic corrosion is particularly dangerous whenever the mass of the noble metal is inferior to that of the more noble metal. The ratio between these two masses, the direct-contact surface area, and the difference in potential between the two metals, determine the degree of corrosion or deterioration.

For this reason, the material most commonly-advised for the realization of a complete set of fixings is Stainless steel AISI 304 which, in addition to guaranteeing optimum mechanical resistance features, is suited to satisfactory resistance even in particularly harsh environmental surroundings.

Several combinations of different metals may be acceptable, provided that the designer is aware of the specific environmental conditions, and that the combination is compatible with the same. Below we provide a table showing the compatibility of different metals, from which an initial indication regarding combinations may be obtained.

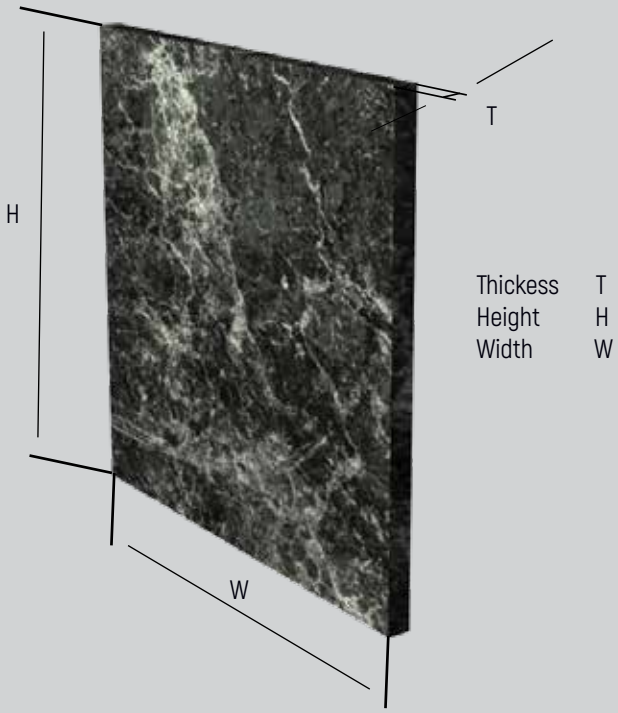
Surfaces of contact (metal)	SFSP Anchor bolts				
	Stainless steel	Aluminium bronze	Brass	Galvanized steel	Cast iron
Stainless steel	●	○	○	●	●
Aluminum bronze	○	●	●	●	●
Brass	○	●	●	●	
Copper	○	●	○	●	●
Galvanized steel	●	●	●	●	○
Mild steel	●	●	○	○	●
Cast iron	●	●	○	○	●
Lead	○	○	○	●	○
Aluminium	●	●	●	●	●

● Possibility to use these metals together in all conditions.
○ Possibility to use these metals together in dry conditions according to designer'sinstruction.
● These metals shall not be used together.

Design Criteria

The design for the supporting structures of buildings claddings should be based on some basic principles :
a) The shape and the material of the structure to which the cladding is to be anchored (concrete, hollow brick, etc);
b) The shape and the material of the facing to be anchored

Cladding type	Design weight (kN/m³)
Ceramic, Tuff	20
Limestone conglomerate,	25
Nagelflue, Travertine	26
Dolomite, Sandstone, Greywake	27
Granite, Porphyry, Syenite, Slate, Limestone, Marble	28
Basalt, Diorite, Gabbro, Gneiss	30



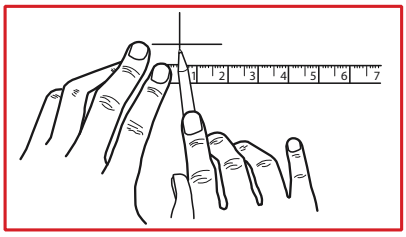
c) The forces to which the building itself may be subject (winds of particular intensity, seismic activity, etc);
d) The environmental surroundings in which the building is located, paying particular attention to harmful atmospheric conditions which may be found in industrial, marine or other areas.
e) Arrangement of panel anchor in vertical or horizontal joint

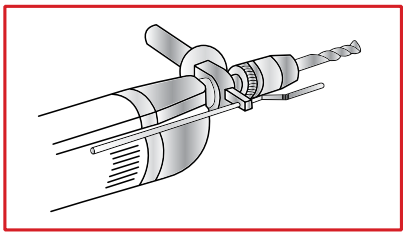
The awareness and a complete analysis of these factors is a necessary condition for the correct planning, in order to guarantee the highest safety levels possible.

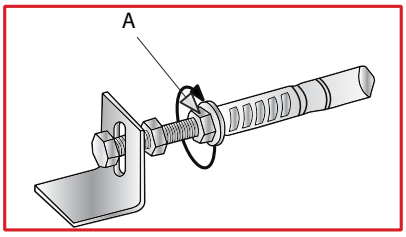
Installation Methods

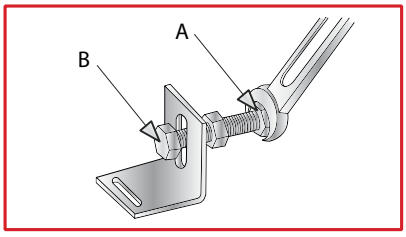
The Dry Fixing Installation Method

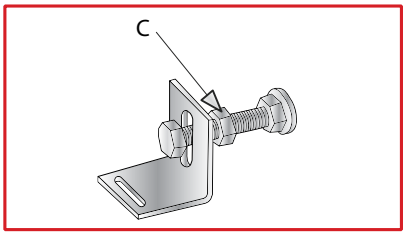
The principle installation phases of a set of fixings for cladding is represented as follows:
1) Accurately locate the position of the drilling hole.
2) Drill a hole of the required depth and diameter.)
3) Insert the expansion bolt into the hole and cause it to expand by screwing down the nut A.
4) To regulate the distance, from the wall to the angle, rotate the screw B, while keeping the nut A locked tightly in position. If necessary, to facilitate the operation, loosen the nut A, which will be re-tightened at the end of the operation.
5) Tighten the lock-nut C for the final locking of the angle in the desired position.
6) Insert the pin in the angle to match the hole in the cladding slab.

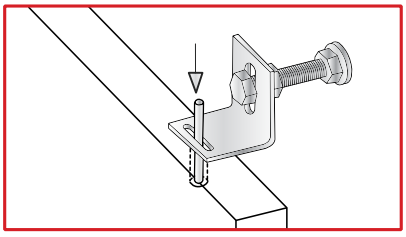










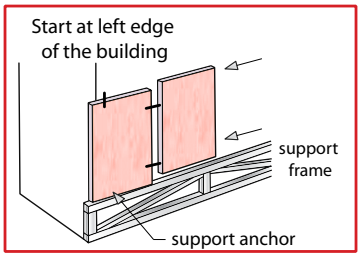


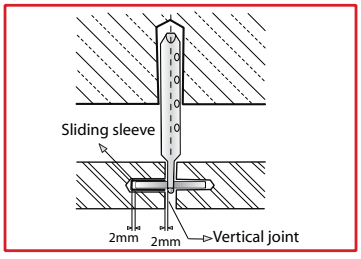
Mounting Instructions For Stangle Mortar Anchor (Wet Fixing)

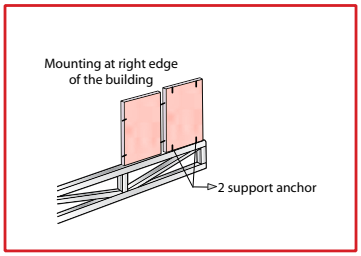
Arrangement of Anchors in Vertical Joint

Take exact measurements of building, allowing for existing tolerances. Make sufficiently large recesses in thermal insulation for natural-stone anchors. Drill out anchor-pin holes and remove drilling dust. Erect support frame for bottom row of panels. Panel mounting starts at the left edge of the building. Mount from left to right and from bottom to top.
Place first natural-stone panel on an anchor in horizontal joint and underlay with wedge. Wet anchor holes and fill with cement mortar.
Insert anchor in the two anchor holes. Put anchor pin through anchor and push into sliding sleeve. There shall be a clearance of about 2mm in the sleeve for the anchor pin. Leave clear space of at least 2mm on side (sliding-sleeve side) when inserting anchor. Pack mortar in anchor hole and re-insert cut-out thermal insulation for exact fit. Fill anchor holes of second panel with mortar, and then mount second panel, etc.

Mounting at right edge of building:
Anchor last panel but one at right edge, with pins on one side in vertical joint.
Mount last panel at right building-edge on 2 support anchors in horizontal joint.







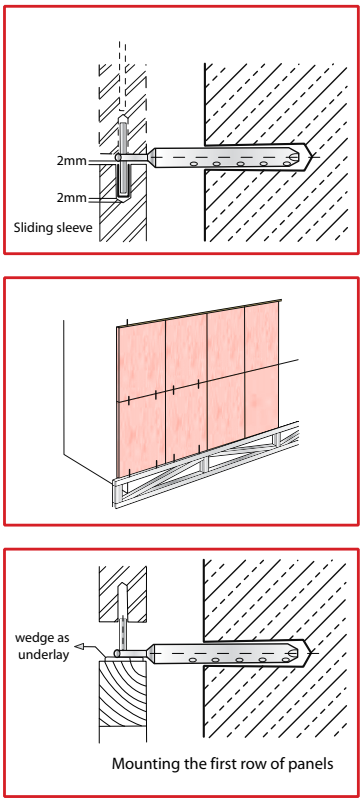
Mounting Instructions For Stangle Mortar Anchor (Wet Fixing)

Arrangemment of Anchors In Horizontal Joint

Take the exact measurements of the building façade, allowing for existing tolerances. Cut out recesses in thermal insulation, sufficiently large for natural-stone anchors. Drill anchor holes and remove drilling dust. Erect support frame for bottom row of panels. Wet anchor holes and fill with cement mortar. Insert support anchor for bottom row of panels and underlay with wedges.

Pack cements mortar in anchor holes. Insert cut-out thermal insulation for exact fit. Drill anchor-pin holes in first-row panels and fill with mortar. Insert sliding sleeve at top and then place natural-stone panel on support anchor; align top edge of panel and fix provisionally and with wall hook, etc.

Insert support anchor for second row of panels.
Provide clear space of 2mm between top edge of bottom row of panels and support anchor of second row.



Mounting the first row of panels

Installation Steps

Anchoring In Vertical Joint

1. Starting installation at the left hand of the building.
2. Position the first anchor under left bottom corner of the panel and install to the structure.
3. Position the first stone panel onto the first support anchor and wedge the right hand side.
4. Fasten the support anchor and restraint anchor for the first vertical joint and adjust.
5. Push the anchor Pin through the bracket and push into the sliding sleeve.
6. Fill the pin holes of the second stone panel with mortar
7. Push the second panel up to the first panel (leave a gap of 2mm on the sliding sleeve side)
8. Fit the next support anchor and restraint anchor.
9. Adjust and continue with the panel sequence
10. The second - last panel is anchored at the right - hand edge in the vertical joint with one-way pins.
11. The last panel at the right - hand edge of the building is placed onto 2 support anchors in the horizontal joint.

Anchoring in Horizontal Joint

1. Drill holes in the structure for the support anchors need for the first and second row of panels.
2. Align support anchors and fasten to the structure.
3. Fill the pin holes of the first panel with mortar and place the first panel on the bottom anchors.
4. Supporting the panel, adjust its second row support anchors to leave a gap (joint) of at least 2,5 mm between the top edge of the panel and the under - side of the second row support anchors
5. Push the plastic sliding sleeve into the top pin through the bracket and into the sleeve below.
6. Working left to right repeat these steps for the first row and subsequent rows of the panels.

The Range Of Production

The problems inherent in the fixing of cladding and their respective solutions are confronted by SFSP/STANGLE through either of two well-distinct approaches:

A) Standard fixing solutions:
Which have been done in response to the most representative and demanded dimensional characteristics. These products come to be illustrated in the chapter "Standard Types".

B) Special fixing solutions:

For which SFSP/STANGLE has organized a staff of specialized techni cians, in grade to provide a series of services at the complete disposal of the client. For greater detail, we shall illustrate these additional services to which our clients may avail themselves, as follows:

- Consultant service - Designing service -Testing service -Quality control service
-Installation service

Consultant Service
SFSP/STANGLE puts its entire technical staff specialized in fixing systems, at the complete disposal of the client, whenever indications regarding the most opportune decisions and methods to be adopted for the correct realization of any cladding fixing project are required. In addition, upon the request of the client, technical visits may be effected in the work yard, for the purposes of making realistic estimates, providing technical advice prior to construction, or for a follow-up in regard to the correct utilization of the advised fixing systems.

Designing Service
SFSP/STANGLE can affect a performance study and the complete designing of the most opportune fixing system for the cladding of buildings with marble facings, or facings of other materials.
The Design Department, after having received the essential information, will develop the project in respect to the necessary specifications supplied by the client.
The primary objective is to provide by best solution to problems posed by the respective project.

Testing service
SFSP grants particular importance to this structure, without which it would be difficult to make and manage an archive of knowledge that allows the preparation of new and advanced technical solutions to be subsequently applied for the perfection and maximum reliability of each specific project. In order to attain this aim, an effective system of collaboration has been evolved with testing centers.. In fact, SFSP is able to provide the documentation belonging to the trial and testing of its own products, whenever requested by interested parties.

Quality control service
Quality represents one of the most essential characteristics of the finished product for SFSP.
In accordance with this concept, the company invests energy, which results in additional advantages for the client. Control operations effected upon the raw material, upon the half-finished work-piece, and further verifications upon the finished product, mean guarantees in regard to the component materials, exact conformity with the desired dimensional features, and the faultless realization of even the smallest details.

Installation Service
SFSP is also ready to provide assistance service and to carry out the laying of the building cladding with specialized personnel. Our technical staff is at your complete disposal in order to supply any further clarification you should desire.

Product range
SFSP Steel angle range covers a wide variety of cavity, widths and load capacity. The steel angle consists of two main components, a bracket with a vertical slot, and a threaded flat head bolt with dowel pin. The vertical slot allows for up and down adjustment for connecting to the structure. The threaded flat head bolt allows in and out adjustment to accommodate variations in cavity wide steel angle can be bolted to C-Channel for maximum adjustment, or installed using drilled bolts. Steel angles are available in several configurations with a choice of either full or half dowel pins. Full dowel pins have a nurled zone to prevent the pin dropping through the hole in the flat head bolt.

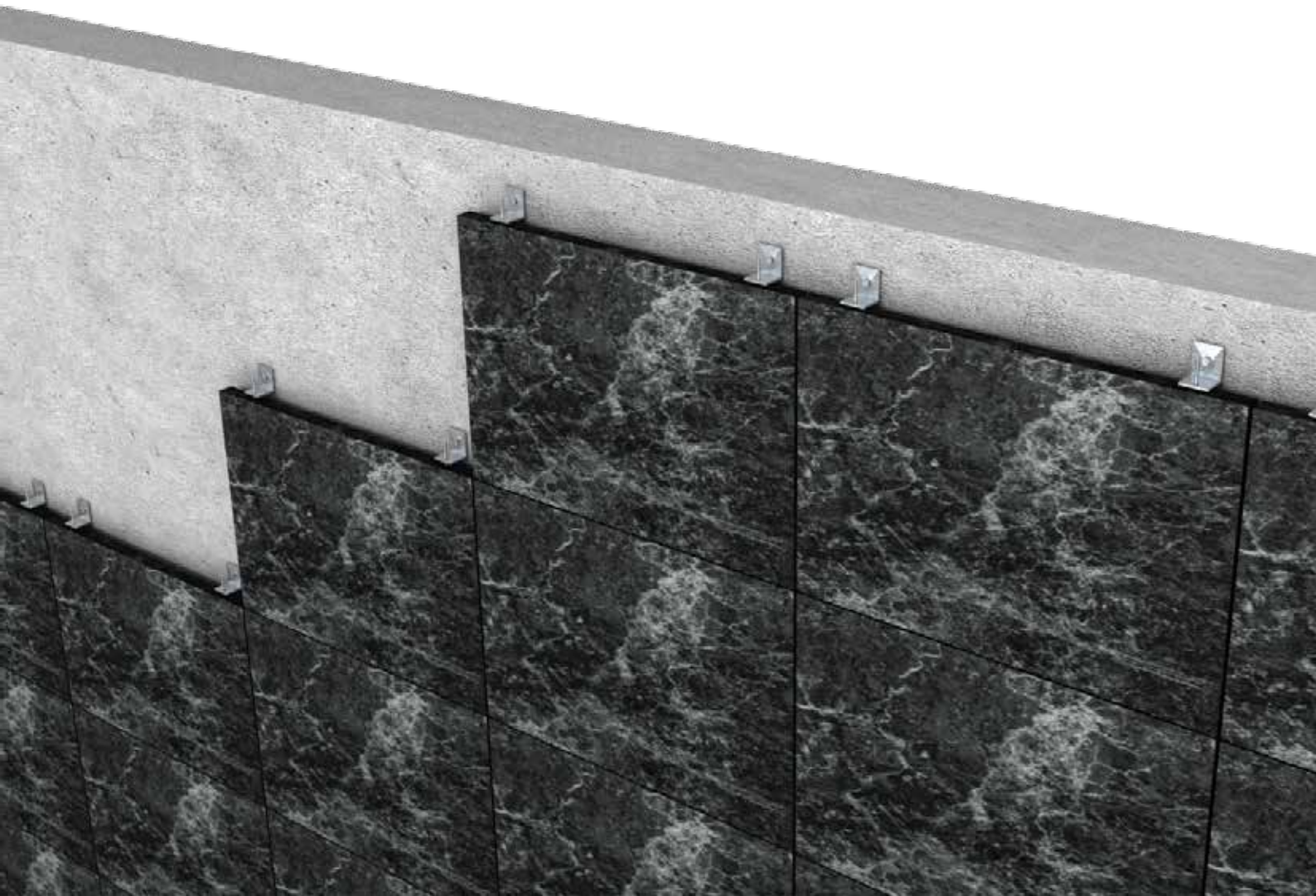
International Standards For Cladding Design

Design & Calculation Standards
Reference is made to the following standards for the design and structural calculations of Natural Stone Fixing Systems.

British Standards:
BS 8298 Design and installation of natural stone cladding.
BS 1449 Part 2 Steel plates, sheets and strips stainless and heat resisting.
BS 6105 Corrosion resistant stainless steel fasteners.
BS 5950 Structural use of steel work in building.
CP3, Chapter 5, Part 2 Wind loads.
BS 970 Part 3 1991, M Mechanical properties for stainless steel.

German Standards:
DIN 1045 Concrete and reinforced concrete, design and dimensioning.
DIN 1053 Masonry, design and dimensioning.
DIN 1055 Design loads for buildings.
DIN 18 516 Cladding for external walls.
DIN 18 800 Steel structures, design and dimensioning.
DIN 18 801 Steel framed structures.

American Standards:
ASTM A 276 Standard specification for stainless steel bars and shapes.
ASTM 666 Standard specification for annealed or cold-worked austenitic stainless steel sheets.
Uniform Building Code 1997-Volume 2



L- BRACKETS

Standard Types

Support Bracket

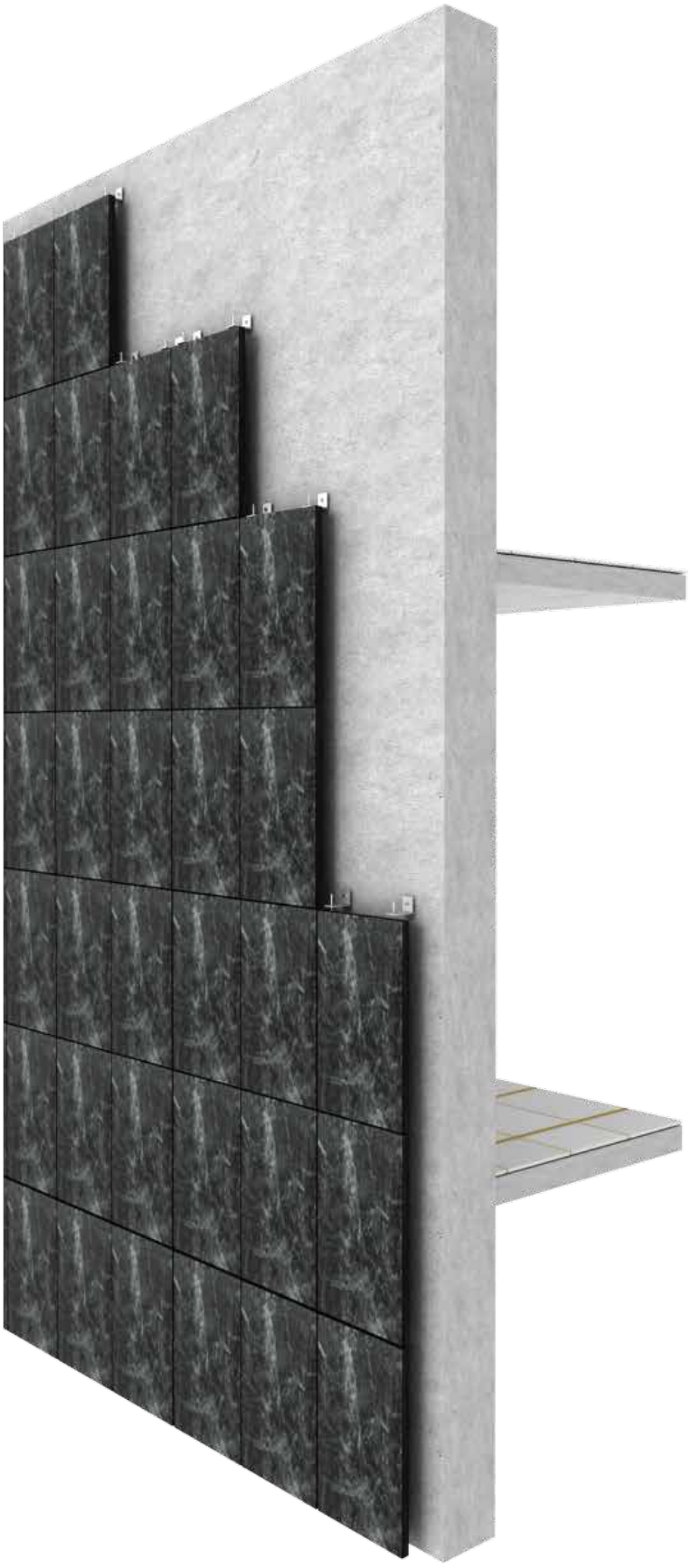
The structural analysis fully considers the dead load of panel, imposed wind loads and thermal stresses, in accordance with relevant DIN standards.

Loads caused by earthquakes can be transferred into the anchoring base.

The support and restraint brackets are Fixed using expansion anchors, chemical anchors, etc.

Using expansion bolts, an installation of the facade is also possible during the winter months.

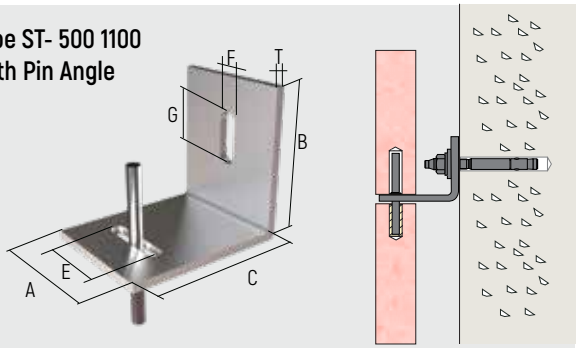
Due to the small drill hole dimensions of the expansion bolts, the facade can be installed very quickly.



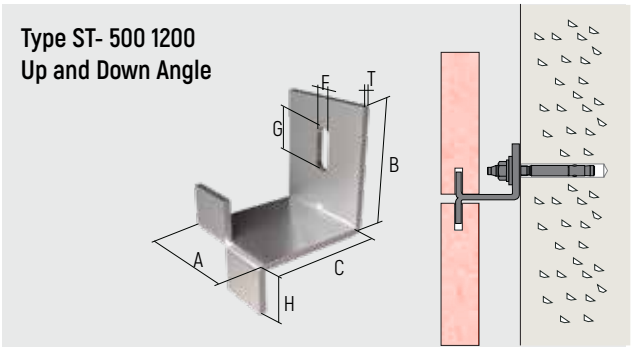
L- BRACKETS ST-500

L - Brackets

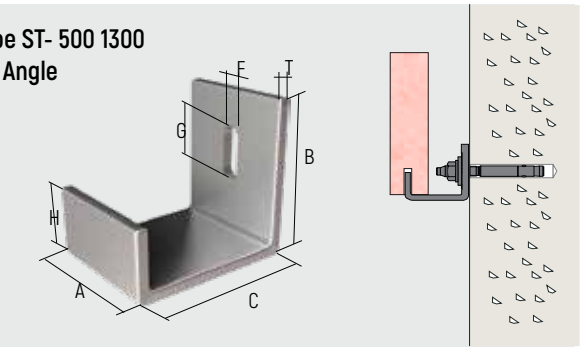
Type ST- 500 1100
With Pin Angle



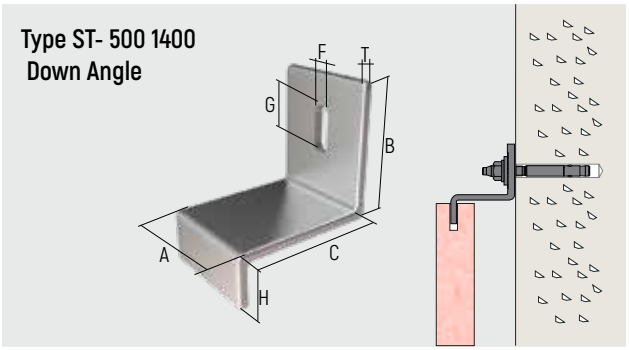
Type ST- 500 1200
Up and Down Angle



Type ST- 500 1300
Up Angle



Type ST- 500 1400
Down Angle



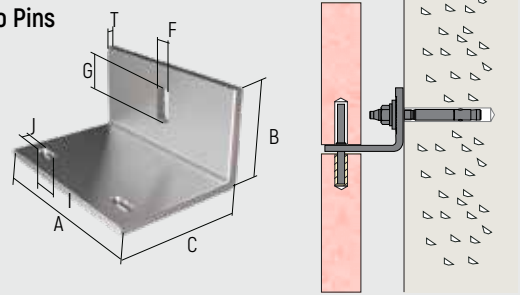
Load Table for ST-1100/1200/1300/1400/1700.

Materials: SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°c 24h average temperature

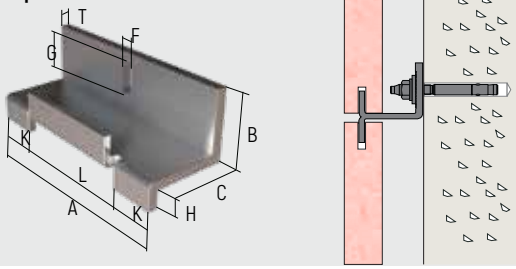
Leg B B mm	Cavity to Pin C mm	Deadload max DL kN	Windload max WL ± kN	Bracket Width A mm	Bracket Thickness T mm	Ø Pin mm	Anchor comb. Force kN*
45	30	0.06	0.11	35	2	4	1.40
45	35			40	2	4	1.60
45	40			35	3	4	1.70
45	45			35	3	4	1.90
45	50			35	3	4	2.00
45	30	0.09	0.17	35	3	4	2.30
45	35			35	3	4	2.60
45	40			35	3	4	2.80
45	45			35	3	4	3.10
45	50			40	3	4	3.30
45	30	0.15	0.28	40	3	4	3.60
45	35			40	3	4	4.00
45	40			35	4	4	4.40
50	45			35	4	4	3.40
50	50			35	4	4	3.70
45	30	0.20	0.33	35	4	4	4.60
45	35			35	4	4	5.10
45	40			35	4	4	5.60
50	45			40	4	4	4.40
50	50			40	4	4	4.70

Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary
* with safety 3.0

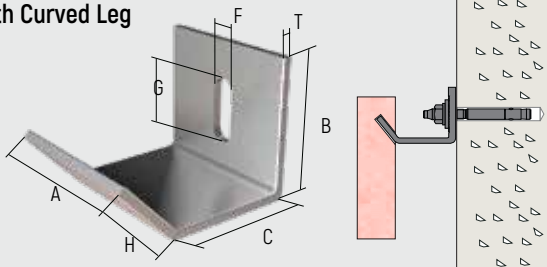
Type ST- 500 1500
With Two Pins



Type ST- 500 1600
Double Up and Down



Type ST- 500 1700
With Curved Leg



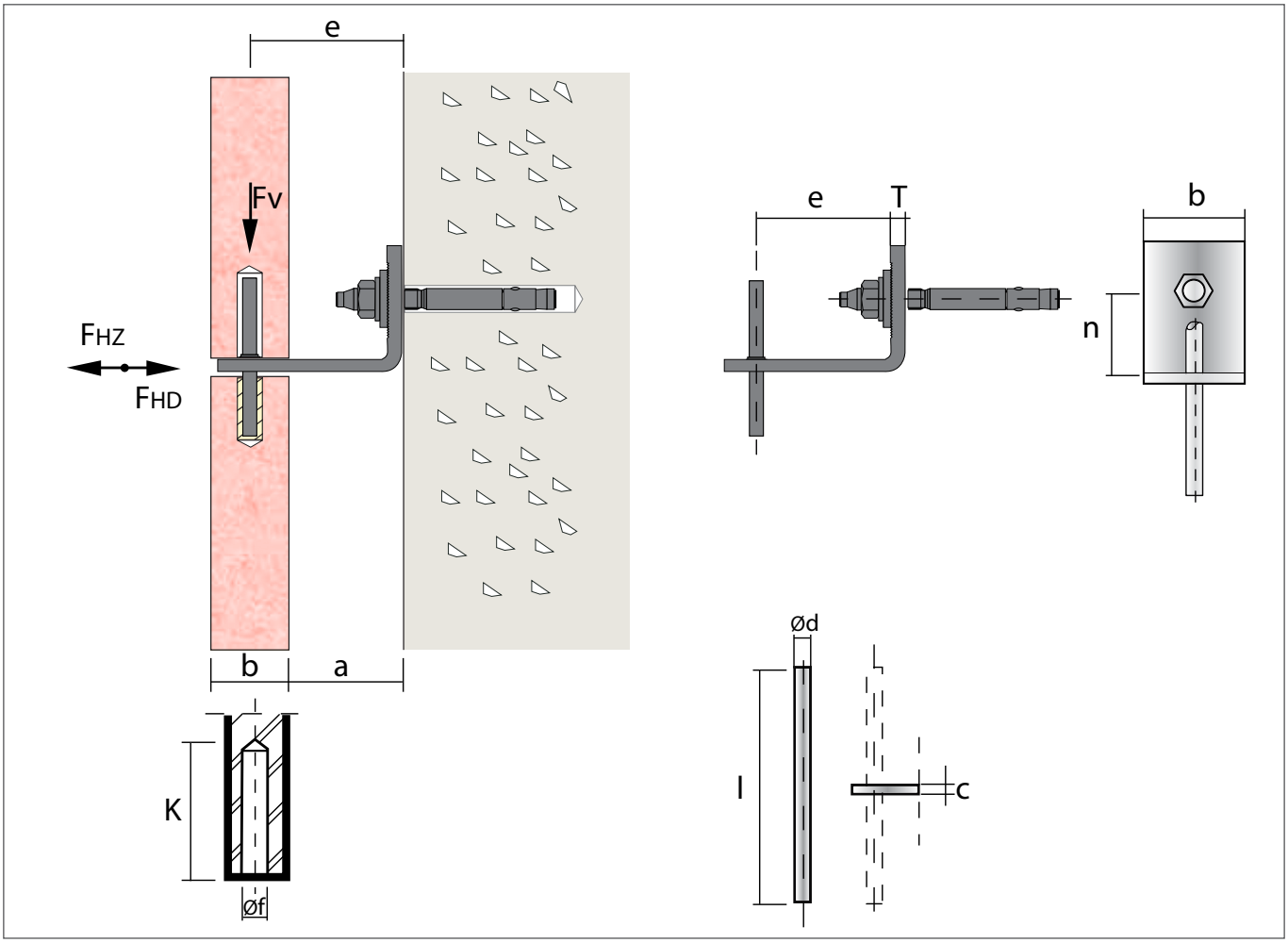
Load Table for ST-1500/1600.

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG £ 50°C 24h average temperature

Leg B B mm	Cavity to Pin C mm	Deadload max DL kN	Windload max WL ± kN	Bracket Width A mm	Bracket Thickness S mm	Ø Pin mm	Anchor comb. Force kN*
50	30	0,40	0,56	120	3	2x 4	5,80
50	35			120	3	2x 4	6,30
50	40			120	3	2x 4	6,80
50	45			140	3	2x 4	7,30
50	50			120	4	2x 4	8,90
50	30	0,50	0,70	120	3	2x 4	8,10
50	35			130	3	2x 4	8,90
50	40			120	4	2x 4	9,60
50	45			120	4	2x 4	10,40
50	50			120	4	2x 4	11,10
60	30	0,60	0,84	140	3	2x 4	7,00
60	35			120	4	2x 4	7,90
60	40			120	4	2x 4	8,40
60	45			120	4	2x 4	8,90
60	50			120	4	2x 4	9,40
60	30	0,70	0,98	120	4	2x 4	8,60
60	35			120	4	2x 4	9,20
60	40			120	4	2x 4	9,80
60	45			130	4	2x 4	10,40
60	50			140	4	2x 4	11,00

Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary
* with safety 3,0

SYSTEM TYPE ST 500 -1100 WITH PIN

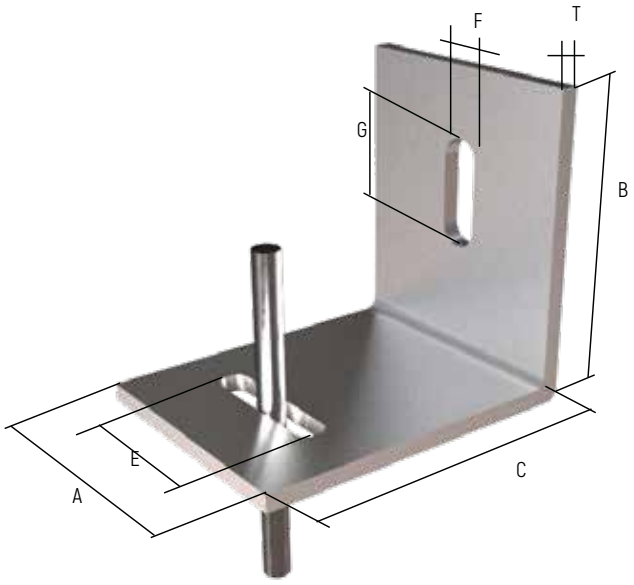


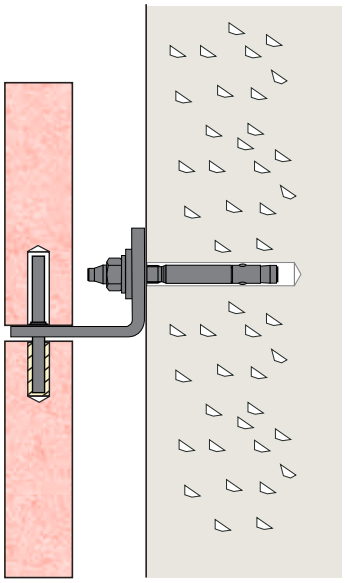
Fv perm = permissible vertical loading capacity
FR = existing load on the dowel with maximum load of the anchor

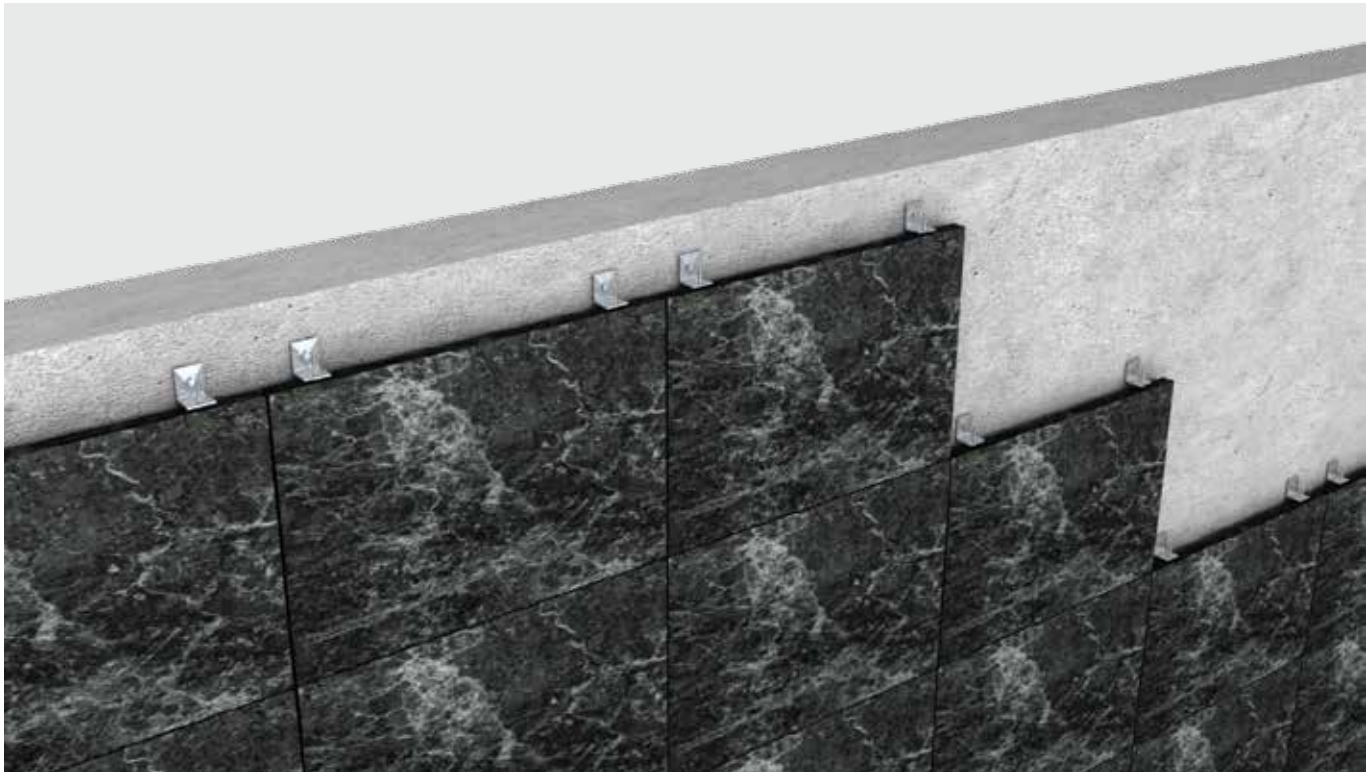
Anchoring base: acc. To the licence of the dowel chosen.

L-Bracket (Standard & Serrated) | Type ST- 500 1100 With Pin

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature Standard Items:





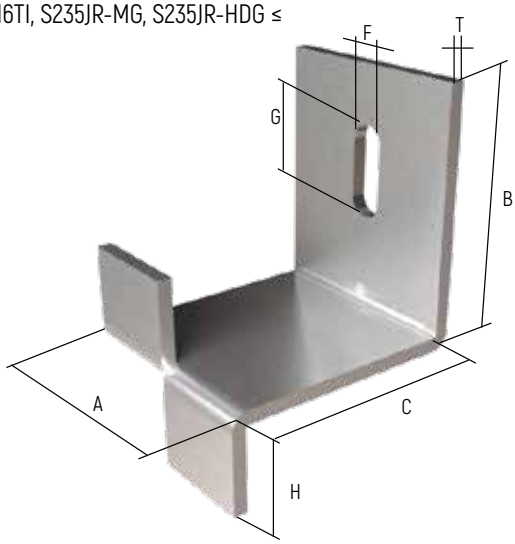


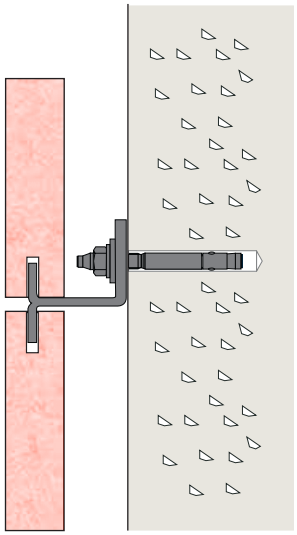
SYSTEM TYPE ST 500 -1200 WITH UP & DOWN LEGS

L-Bracket (Standard & Serrated) | Type ST- 500 1200 Up and Down

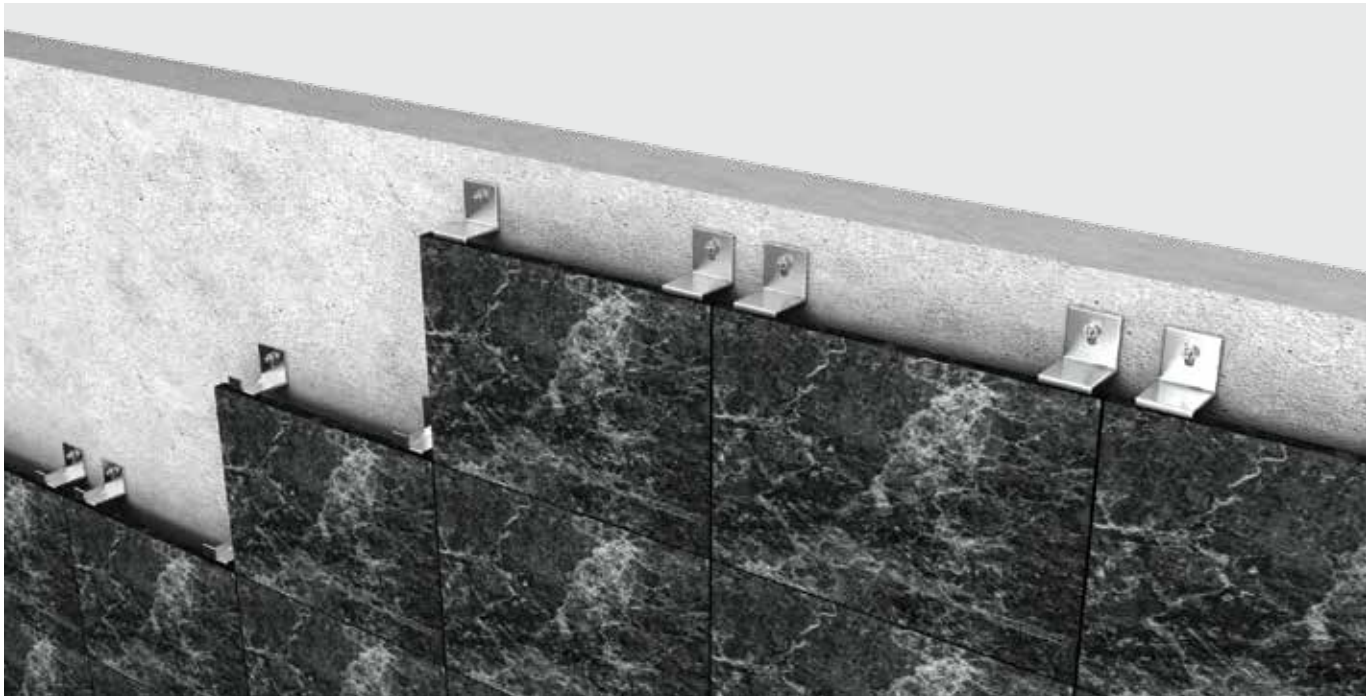
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature

Standard Items:





Item No.	T	A	B	C	H	sl hole
1200-35.45.30.2	2	35	45	30	15	6,5 x 22
1200-40.45.35.2	2	40	45	35	15	6,5 x 22
1200-35.45.30.3	3	35	45	30	15	6,5 x 22
1200-40.45.30.3	3	40	45	30	15	8,5 x 22
1200-35.45.35.3	3	35	45	35	15	6,5 x 22
1200-40.45.35.3	3	40	45	35	15	8,5 x 22
1200-35.45.40.3	3	35	45	40	15	6,5 x 22
1200-35.45.30.4	4	35	45	30	15	8,5 x 22
1200-35.45.35.4	4	35	45	35	15	8,5 x 22
1200-35.45.40.4	4	35	45	40	15	8,5 x 22
1200-35.50.45.4	4	35	50	45	15	8,5 x 22
1200-40.50.45.4	4	40	50	45	15	8,5 x 22

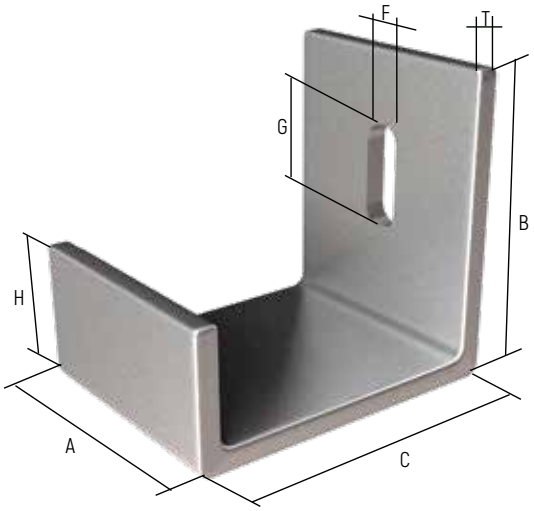


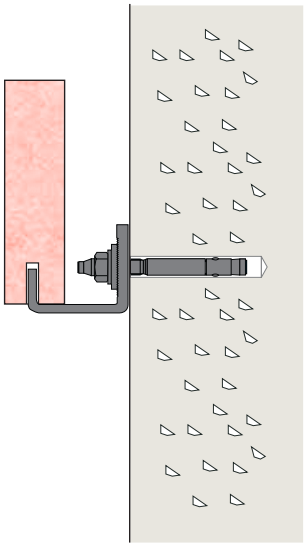
SYSTEM TYPE ST 500 -1300 WITH UP LEG

L-Bracket (Standard & Serrated) | Type ST- 500 1300 Up

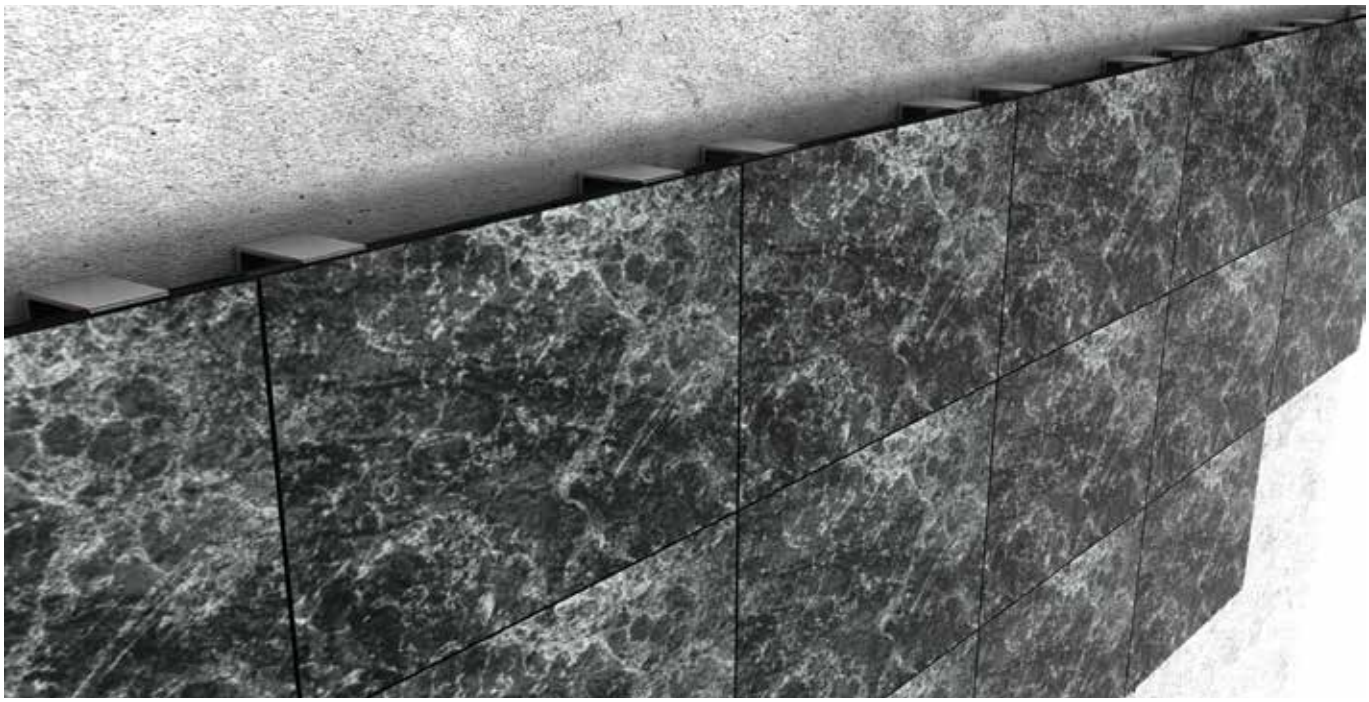
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature

Standard Items:





Item No.	T	A	B	C	H	sl hole
1100-35.45.30.2	2	35	45	30	4	6,5 x 22
1100-40.45.35.2	2	40	45	35	4	6,5 x 22
1100-35.45.30.3	3	35	45	30	4	6,5 x 22
1100-40.45.30.3	3	40	45	30	4	8,5 x 22
1100-35.45.35.3	3	35	45	35	4	6,5 x 22
1100-40.45.35.3	3	40	45	35	4	8,5 x 22
1100-35.45.40.3	3	35	45	40	4	6,5 x 22
1100-35.45.30.4	4	35	45	30	4	8,5 x 22
1100-35.45.35.4	4	35	45	35	4	8,5 x 22
1100-35.45.40.4	4	35	45	40	4	8,5 x 22
1100-35.50.45.4	4	35	50	45	4	8,5 x 22
1100-40.50.45.4	4	40	50	45	4	8,5 x 22

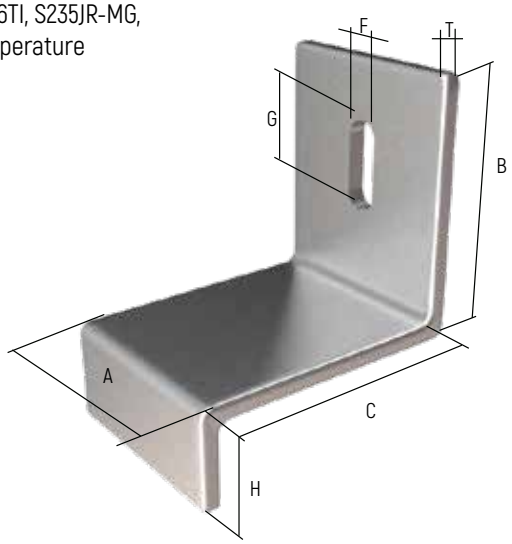


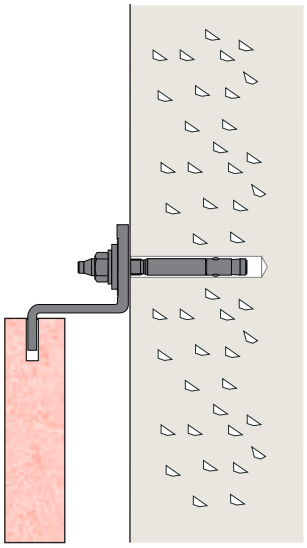
SYSTEM TYPE ST 500 -1400 WITH DOWN LEG

L-Bracket (Standard & Serrated) | Type ST- 500 1400 Down

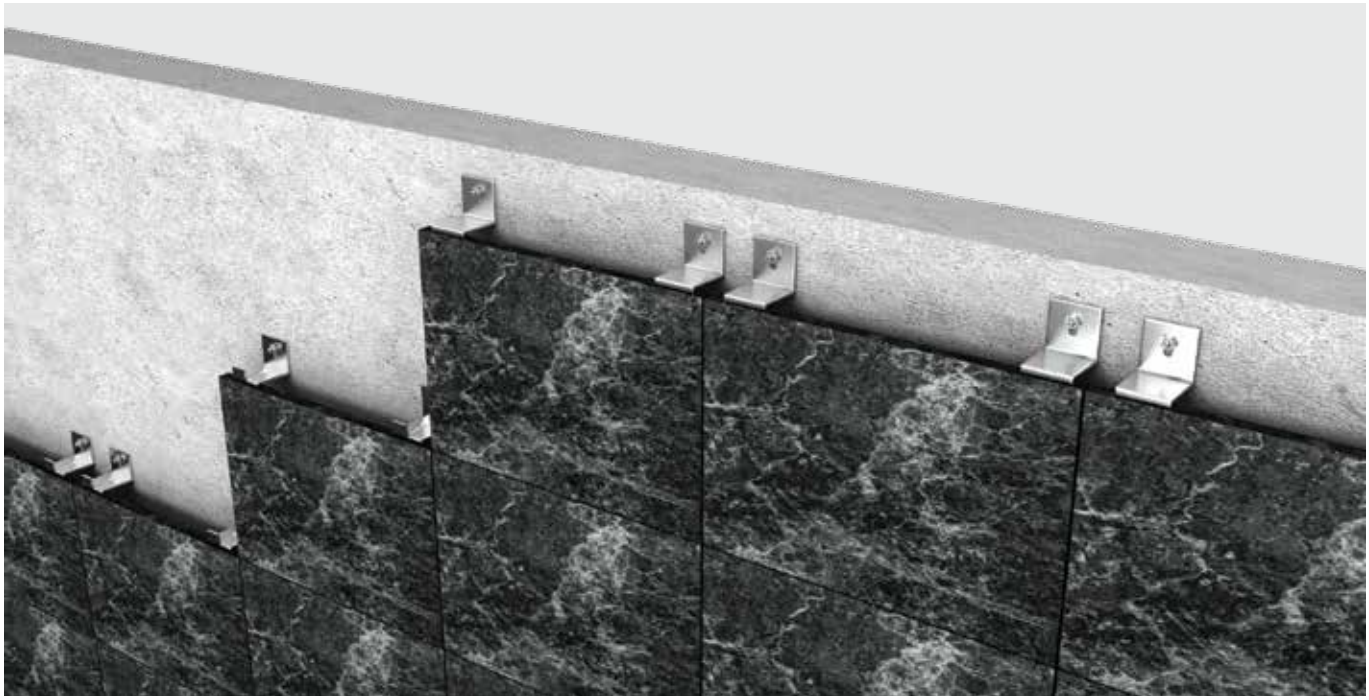
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature

Standard Items:





Item No.	T	A	B	C	H	sl hole
1200-35.45.30.2	2	35	45	30	15	6,5 x 22
1200-40.45.35.2	2	40	45	35	15	6,5 x 22
1200-35.45.30.3	3	35	45	30	15	6,5 x 22
1200-40.45.30.3	3	40	45	30	15	8,5 x 22
1200-35.45.35.3	3	35	45	35	15	6,5 x 22
1200-40.45.35.3	3	40	45	35	15	8,5 x 22
1200-35.45.40.3	3	35	45	40	15	6,5 x 22
1200-35.45.30.4	4	35	45	30	15	8,5 x 22
1200-35.45.35.4	4	35	45	35	15	8,5 x 22
1200-35.45.40.4	4	35	45	40	15	8,5 x 22
1200-35.50.45.4	4	35	50	45	15	8,5 x 22
1200-40.50.45.4	4	40	50	45	15	8,5 x 22

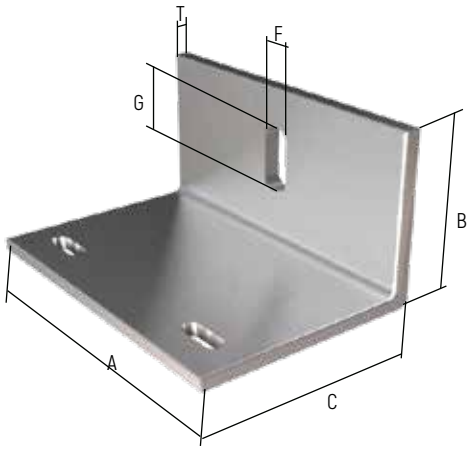


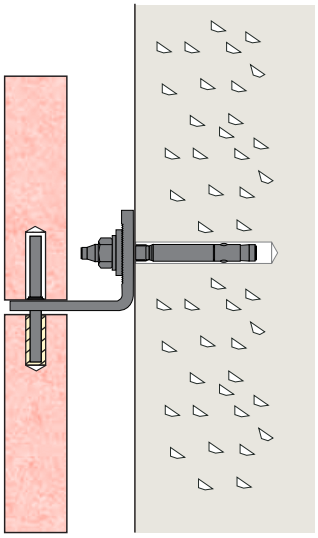
SYSTEM TYPE ST 500 -1500 WITH DOUBLE PIN

L-Bracket (Standard & Serrated) | Type ST- 500 1500 With Two Pins

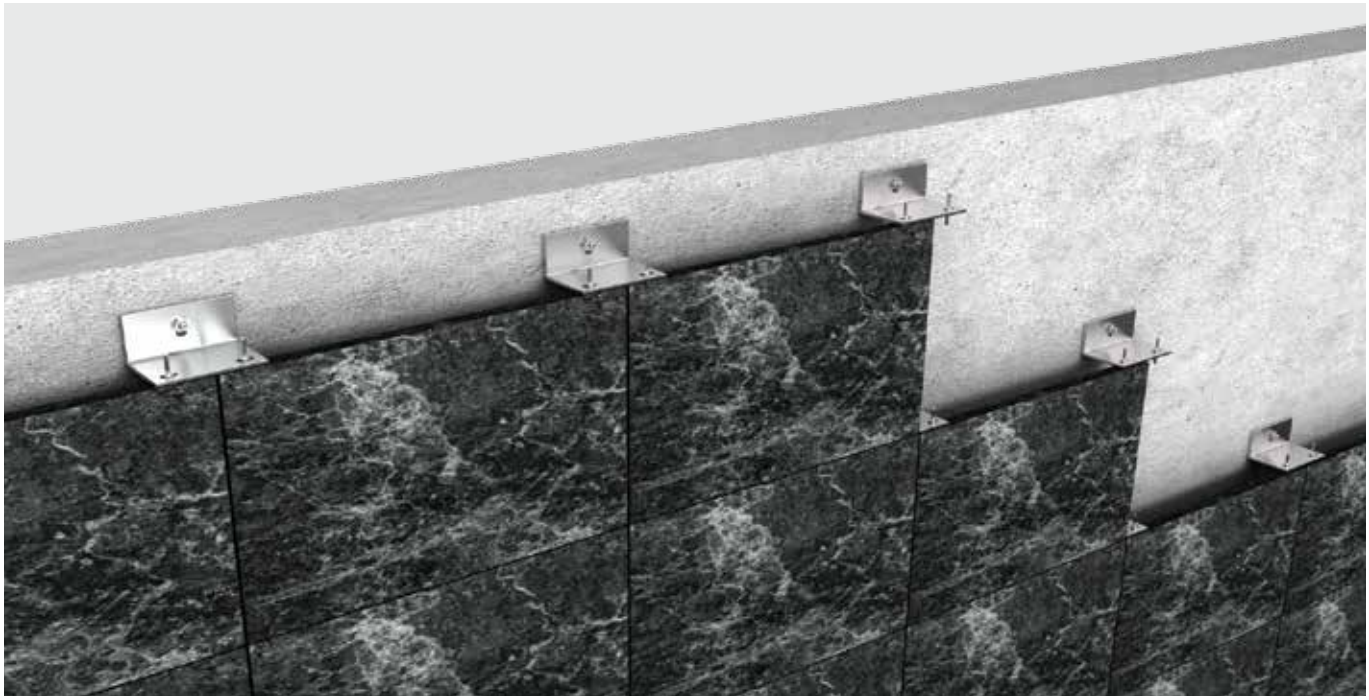
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG,
S235JR-HDG ≤ 50°C 24h average temperature

Standard Items:





Item No.	T	A	B	C	Pin	sl hole
1500-120.50.30.3	3	120	50	30	2x 4	8,5 x 22
1500-120.50.35.3	3	120	50	35	2x 4	8,5 x 22
1500-120.50.40.3	3	120	50	40	2x 4	8,5 x 22
1500-140.60.30.3	3	140	60	30	2x 4	8,5 x 22
1500-140.50.45.3	3	140	50	45	2x 4	8,5 x 22
1500-120.60.30.4	4	120	60	30	2x 4	8,5 x 22
1500-120.60.35.4	4	120	60	35	2x 4	8,5 x 22
1500-120.50.40.4	4	120	50	40	2x 4	10,5 x 22
1500-120.50.45.4	4	120	50	45	2x 4	10,5 x 22
1500-120.50.50.4	4	120	50	50	2x 4	8,5 x 22
1500-120.60.50.4	4	120	60	50	2x 4	10,5 x 22
1500-140.60.50.4	4	140	60	50	2x 4	10,5 x 22

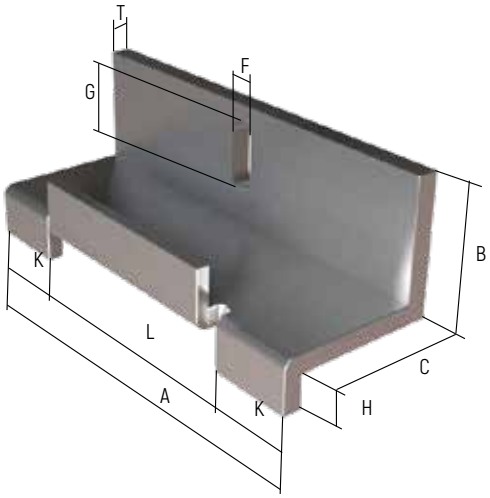


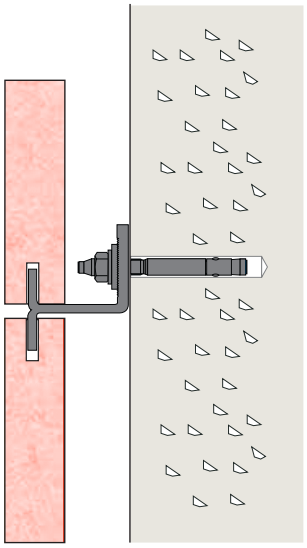
SYSTEM TYPE ST 500 -1600 WITH DOUBLE UP & DOWN LEGS

L-Bracket (Standard & Serrated) | Type ST- 500 1600 Double Up and Down

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature

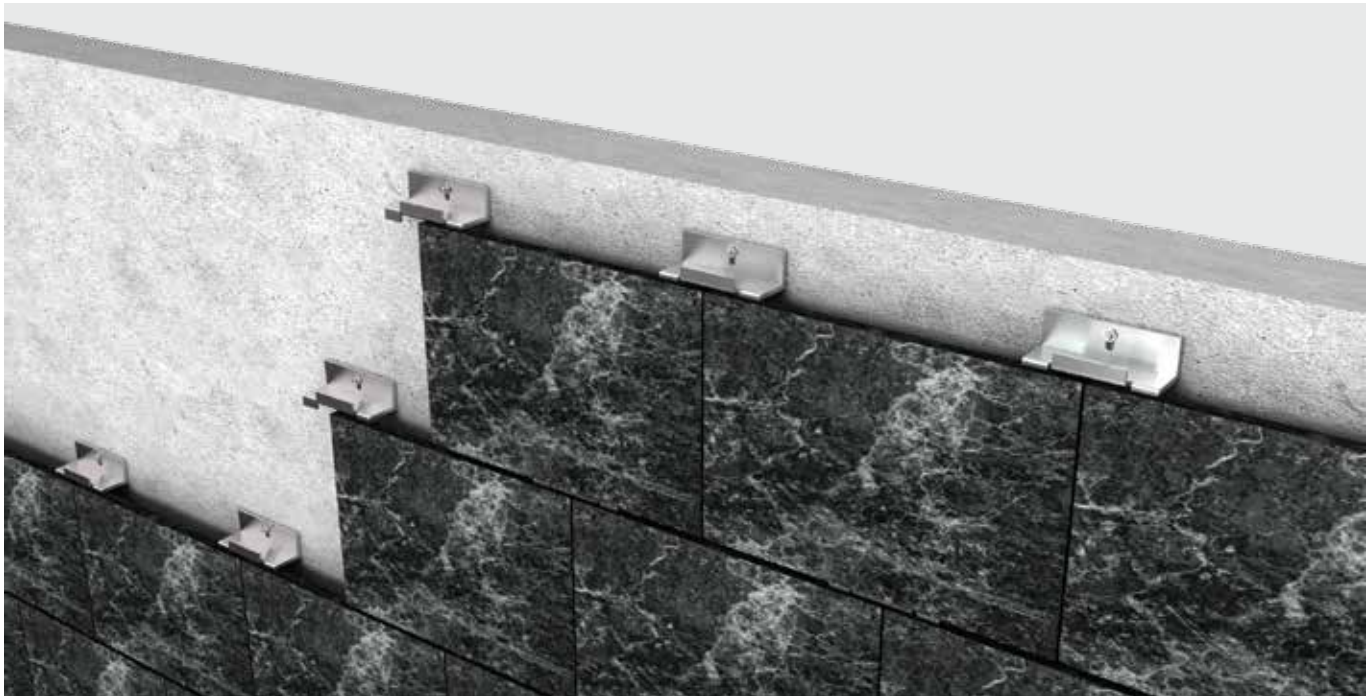
Standard Items:





L= A/2
K=A/4

Item No.	T	A	B	C	H	L	K	sl hole
1600-120.50.30.3	3	120	50	30	15	A/2	A/4	8,5 x 22
1600-120.50.35.3	3	120	50	35	15	A/2	A/4	8,5 x 22
1600-120.50.40.3	3	120	50	40	15	A/2	A/4	8,5 x 22
1600-140.60.30.3	3	140	60	30	15	A/2	A/4	8,5 x 22
1600-140.50.45.3	3	140	50	45	15	A/2	A/4	8,5 x 22
1600-120.60.30.4	4	120	60	30	15	A/2	A/4	8,5 x 22
1600-120.60.35.4	4	120	60	35	15	A/2	A/4	8,5 x 22
1600-120.50.40.4	4	120	50	40	15	A/2	A/4	10,5 x 22
1600-120.50.45.4	4	120	50	45	15	A/2	A/4	10,5 x 22
1600-120.50.50.4	4	120	50	50	15	A/2	A/4	8,5 x 22
1600-120.60.50.4	4	120	60	50	15	A/2	A/4	10,5 x 22
1600-140.60.50.4	4	140	60	50	15	A/2	A/4	10,5 x 22

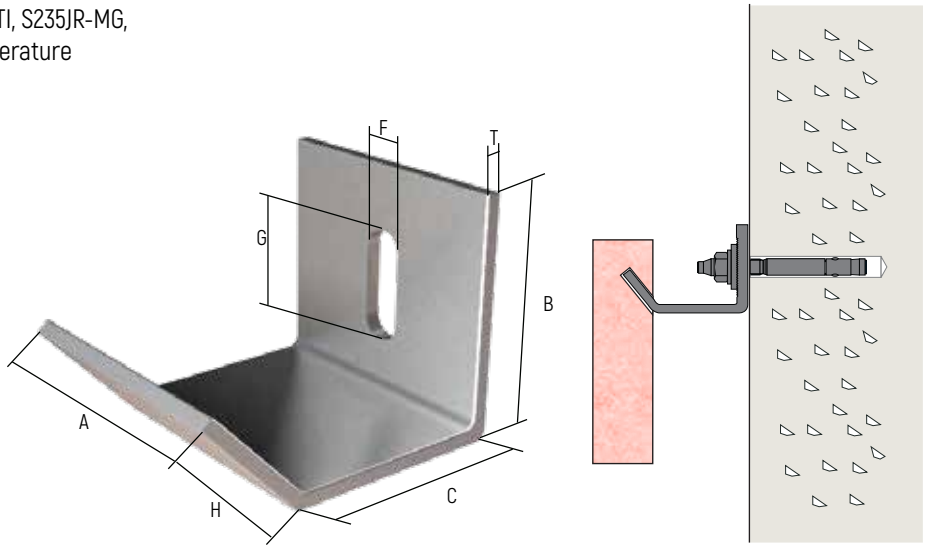


SYSTEM TYPE ST 500 -1700 WITH CURVED LEG

L-Bracket (Standard & Serrated) | Type ST- 500 1700 With Curved Leg

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG,
S235JR-HDG ≤ 50°C 24h average temperature

Standard Items:



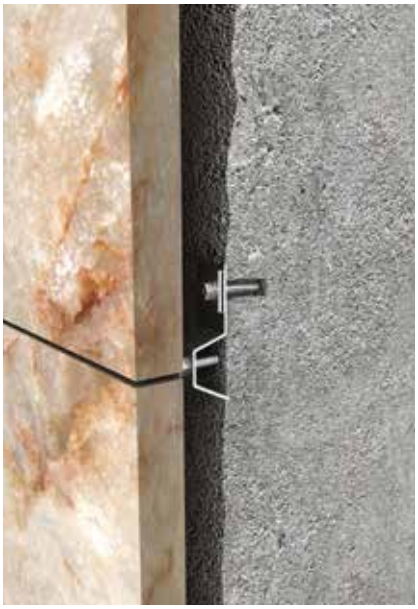
Item No.	T	A	B	C	H	sl hole
1700-3545.30.2	2	35	45	30	20	6,5 x 22
1700-4045.35.2	2	40	45	35	20	6,5 x 22
1700-3545.30.3	3	35	45	30	20	6,5 x 22
1700-4045.30.3	3	40	45	30	20	8,5 x 22
1700-3545.35.3	3	35	45	35	20	6,5 x 22
1700-4045.35.3	3	40	45	35	20	8,5 x 22
1700-3545.40.3	3	35	45	40	20	6,5 x 22
1700-3545.30.4	4	35	45	30	20	8,5 x 22
1700-3545.35.4	4	35	45	35	20	8,5 x 22
1700-3545.40.4	4	35	45	40	20	8,5 x 22
1700-35.50.45.4	4	35	50	45	20	8,5 x 22
1700-40.50.45.4	4	40	50	45	20	8,5 x 22

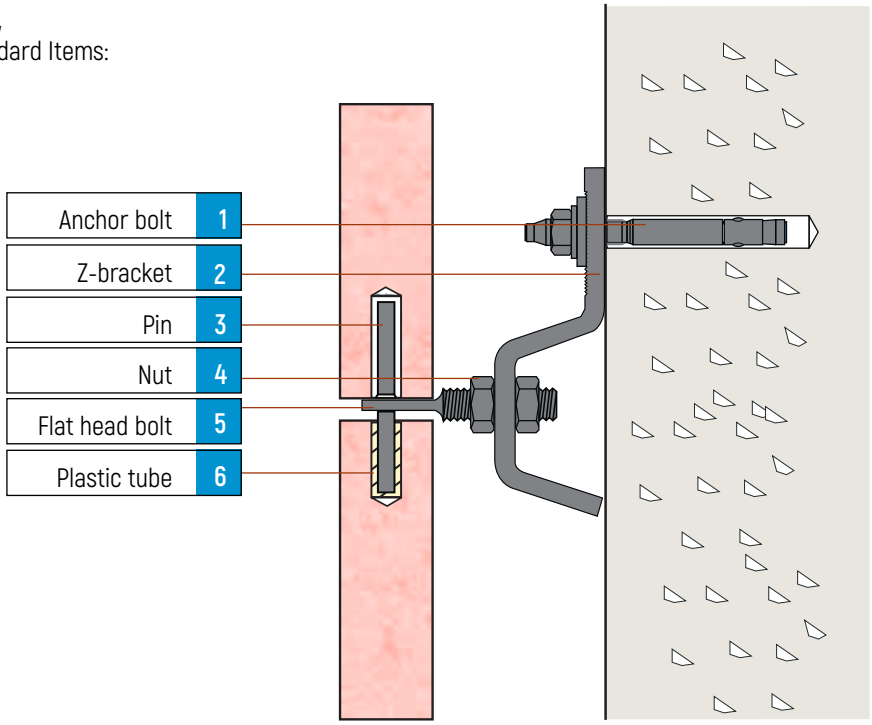
Z- BRACKETS

SYSTEM TYPE ST- 600 -1100 WITH RETURNED LEG

Z-Bracket with returned Leg

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG,
S235JR-HDG ≤ 50°C 24h average temperature Standard Items:

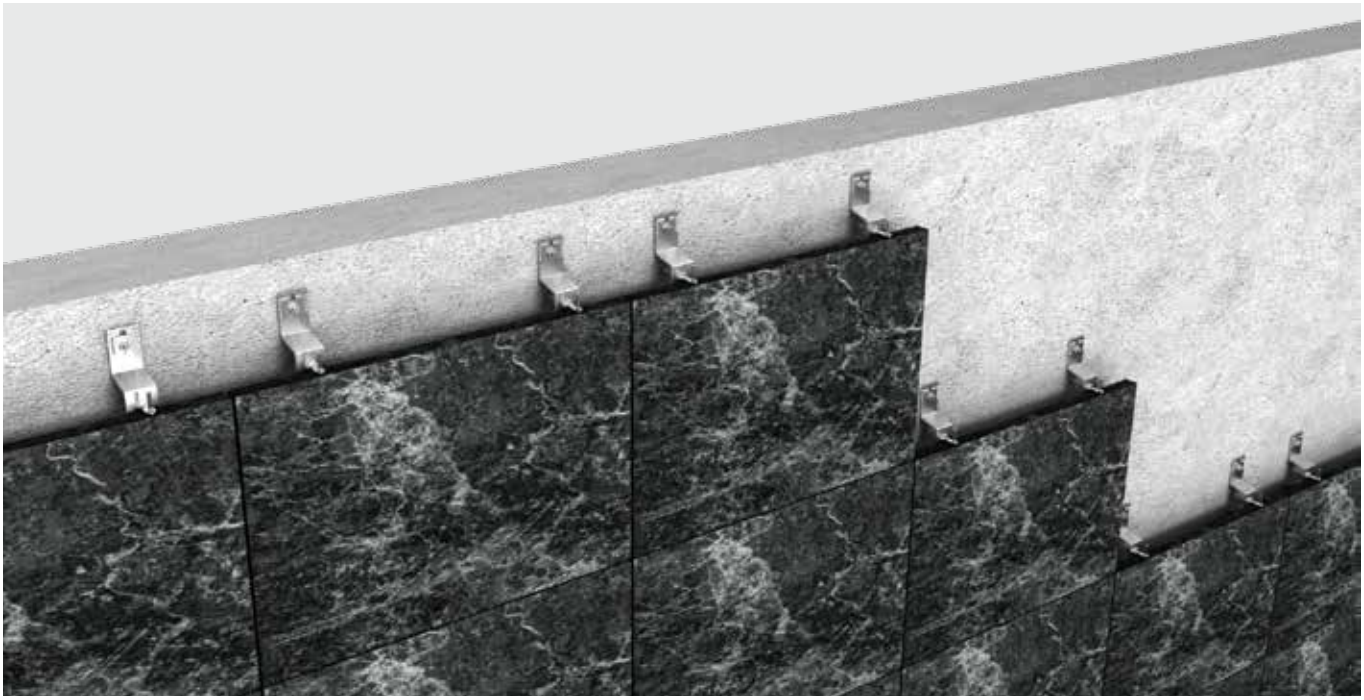




Application
According to DIN 18515 all cladding panels which are larger than 0.1 m2 have to be anchored.

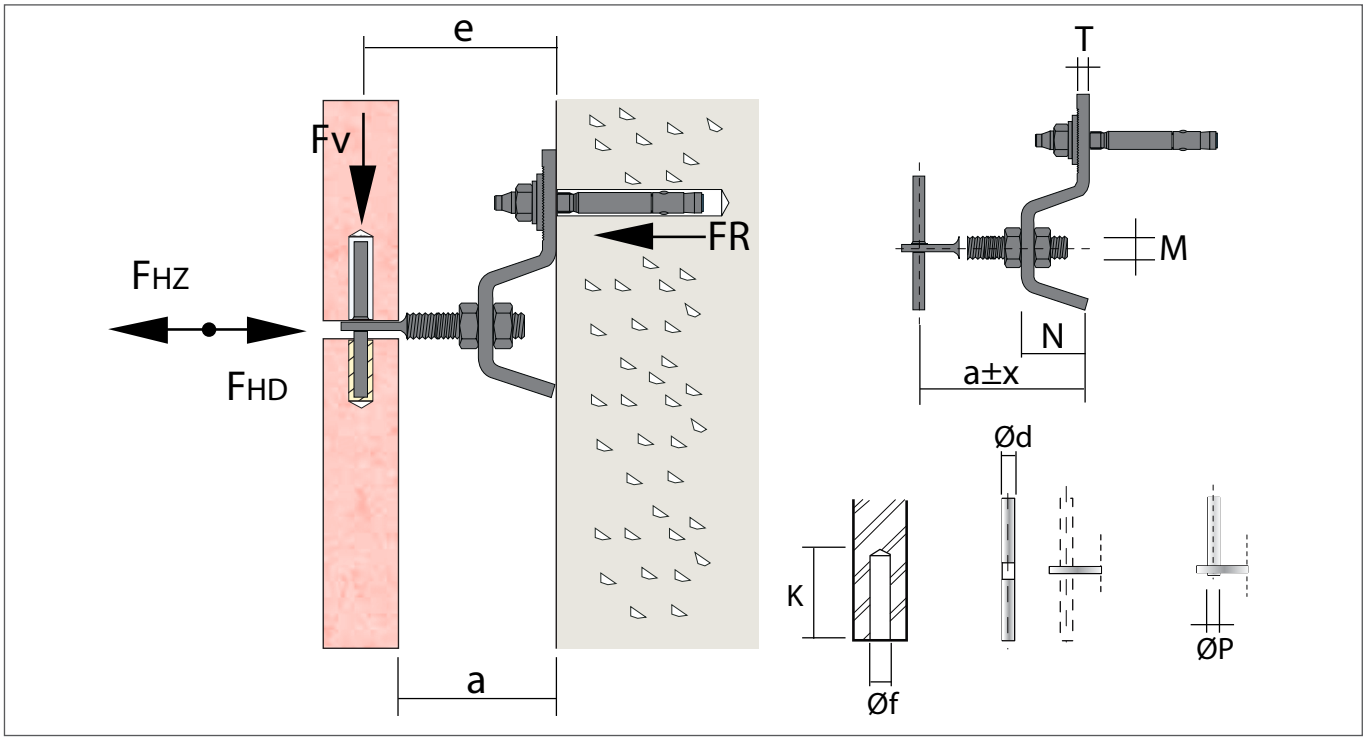
Material
Manufactured from stainless steel AISI 304, 316, 316L and 316Ti.
Adjustability in two directions.

Advantages
The panels are secured to the anchoring base material with absolute safety. Manufactured from stainless steel. The support and restraint brackets are adjustable in 2 directions. The brackets are fixed into the anchoring base by means of anchors. Due to the small drill hole dimensions of the anchors, the facade can be installed very quickly. The small size of drill hole into the anchoring base material means that heavy drilling equipment is not required.



SYSTEM TYPE ST- 600 -1100 WITH RETURNED LEG

Z-Bracket with returned Leg Horizontal joint (Standard & Serrated) | Type ST- 600 1100

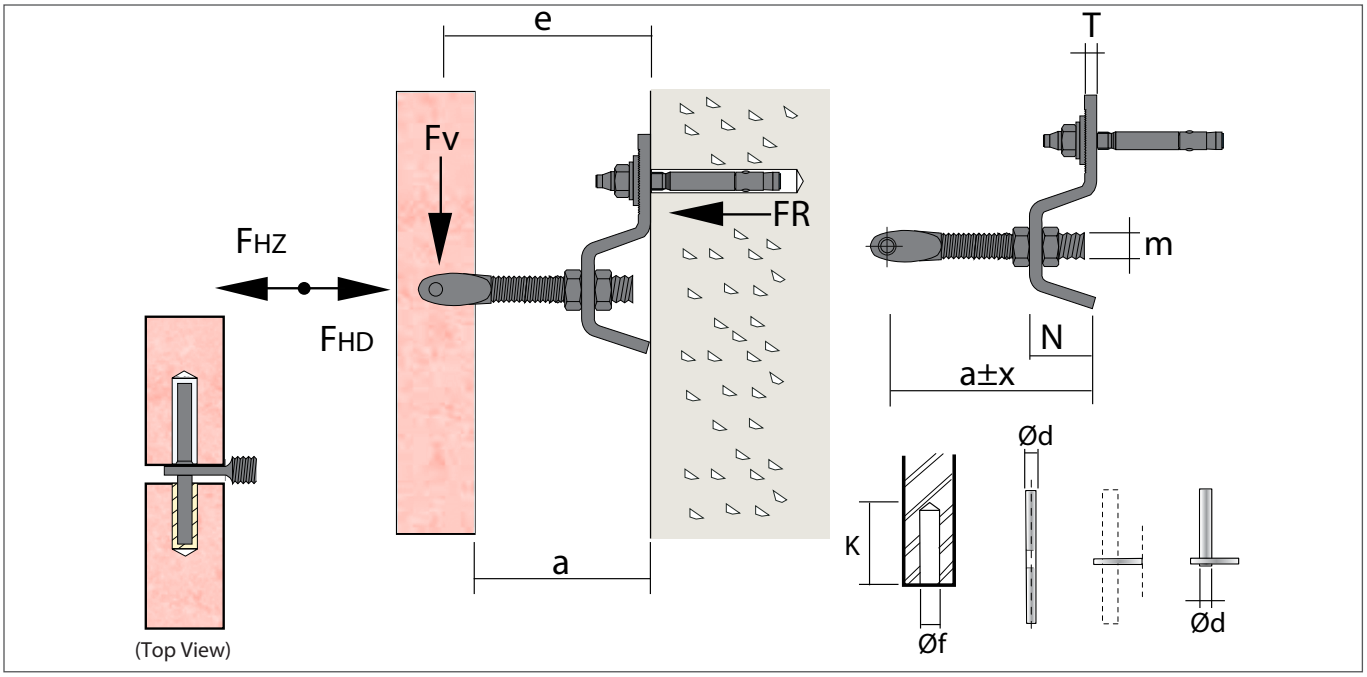


Anchoring base:
acc. to the licence of
the anchor bolt chosen.
a = cavity to backside to panel

Adjustibility:
in 2 directions
x = ± 10 mm
Z = ± 05 mm

FV perm. = permissible vertical loading capacity
FH perm. = permissible horizontal tensile load or pressure load
FR = existing load on the anchor with maximum

Z-Bracket with returned Leg Vertical joint (Standard & Serrated) | Type ST- 600 1100



SYSTEM TYPE ST- 600 -1100 WITH RETURNED LEG

Z-Bracket with returned Leg | ST-600-1100

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature

Standard Items:

Item No.	Width (W)	Thickness (T)	Offset (N)	FHB	Ø Pin	sl hole
600-1100 -35.3.20	35	3	20	M8	4	6,5 x 22
600-1100 -40.3.30	40	3	30	M8	4	6,5 x 22
600-1100 -45.3.40	45	3	40	M8	4	6,5 x 22
600-1100 -50.3.50	50	3	50	M8	4	6,5 x 22
600-1100 -40.4.20	40	4	20	M10	5	8,5 x 22
600-1100 -40.4.30	40	4	30	M10	5	8,5 x 22
600-1100 -45.4.40	45	4	40	M10	5	8,5 x 22
600-1100 -50.4.50	50	4	50	M10	5	8,5 x 22
600-1100 -40.5.20	40	5	20	M12	6	8,5 x 22
600-1100 -45.5.30	45	5	30	M12	6	8,5 x 22
600-1100 -45.5.40	45	5	40	M12	6	8,5 x 22
600-1100 -50.5.50	50	5	50	M12	6	8,5 x 22

Load Table of Z-Bracket with returned Leg

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature

Bracket Offset mm	Cavity to Pin min - max mm (e)	Deadload max DL kN	Windload max WL ± kN	Bracket Width mm	Bracket Thickness (T) mm	Ø Pin mm	FHB A2-70 A4-70	Anchor comb. Force kN *
20	50-60	0,16	0,21	35	3	4	M8	1,90
30	60-70			40	3	4	M8	2,00
40	70-80			45	3	4	M8	2,10
50	80-90			50	3	4	M8	2,10
60	90-100			40	4	4	M8	2,10
70	100-110			40	4	4	M8	2,10
20	50-60	0,28	0,37	40	4	5	M10	3,40
30	60-70			40	4	5	M10	3,60
40	70-80			45	4	5	M10	3,60
50	80-90			50	4	5	M10	3,70
60	90-100			50	4	5	M10	3,70
70	100-110			55	4	5	M10	3,80
20	50-60	0,45	0,66	40	5	6	M12	6,00
30	60-70			45	5	6	M12	6,00
40	70-80			45	5	6	M12	6,10
50	80-90			50	5	6	M12	6,20
60	90-100			55	5	6	M12	6,30
70	100-110			60	5	6	M12	6,30

Loads per 1 bracket

If loads are bigger or dimensions are different, an individual calculation is necessary

* with safety 3,0

SYSTEM TYPE ST- 600 -1100 WITH RETURNED LEG

Z-Bracket with returned Leg Horizontal joint

The structural analysis fully considers the dead load of panel, imposed wind loads and thermal stresses, in accordance with relevant DIN standards.

Loads caused by earthquakes can be transferred into the anchoring base.

The support and restraint brackets are fixed using expansion anchors, chemical anchors, etc.

The support and restraint brackets are adjustable in 2 directions.

Due to the adjustability of the brackets and the small drill hole dimensions of the anchors, the façade can be installed very quickly.

The restraint anchors of the system 1 to 5 are interchangeable so that any fixing problem can optimally be solved.

SYSTEM TYPE ST- 600 -1100 WITH RETURNED LEG

Z-Bracket with returned Leg Vertical joint

The structural analysis fully considers the dead load of panel, imposed wind loads and thermal stresses, in accordance with relevant DIN standards.

Loads caused by earthquakes can be transferred into the anchoring base.

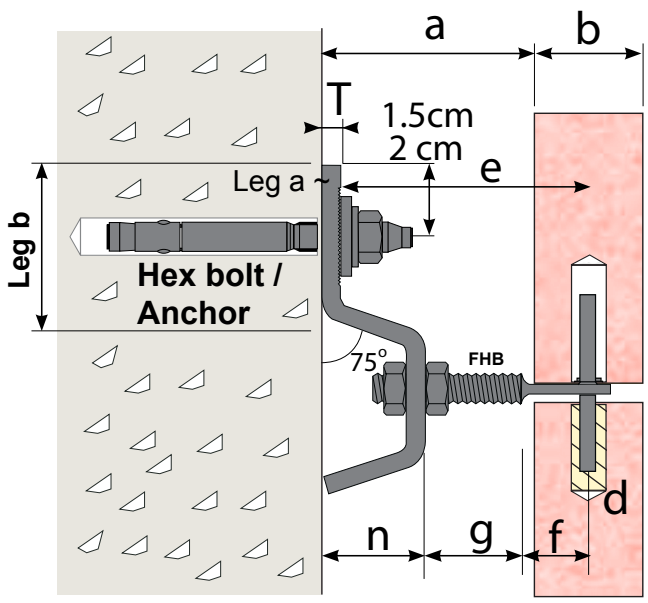
The support and restraint brackets are fixed using expansion anchors, chemical anchors, etc.

The support and restraint brackets are adjustable in 2 directions.

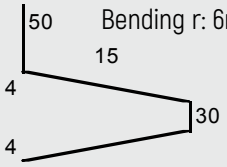
Due to the adjustability of the brackets and the small drill hole dimensions of the anchors, the façade can be installed very quickly.

CASE STUDY

PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800



Bending detail:



Bending r: 6mm min.

Z-Returned Bracket	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Offset to pin
f	Flat head parts
g	Threaded part
N	Bracket offset

Facade Panel:

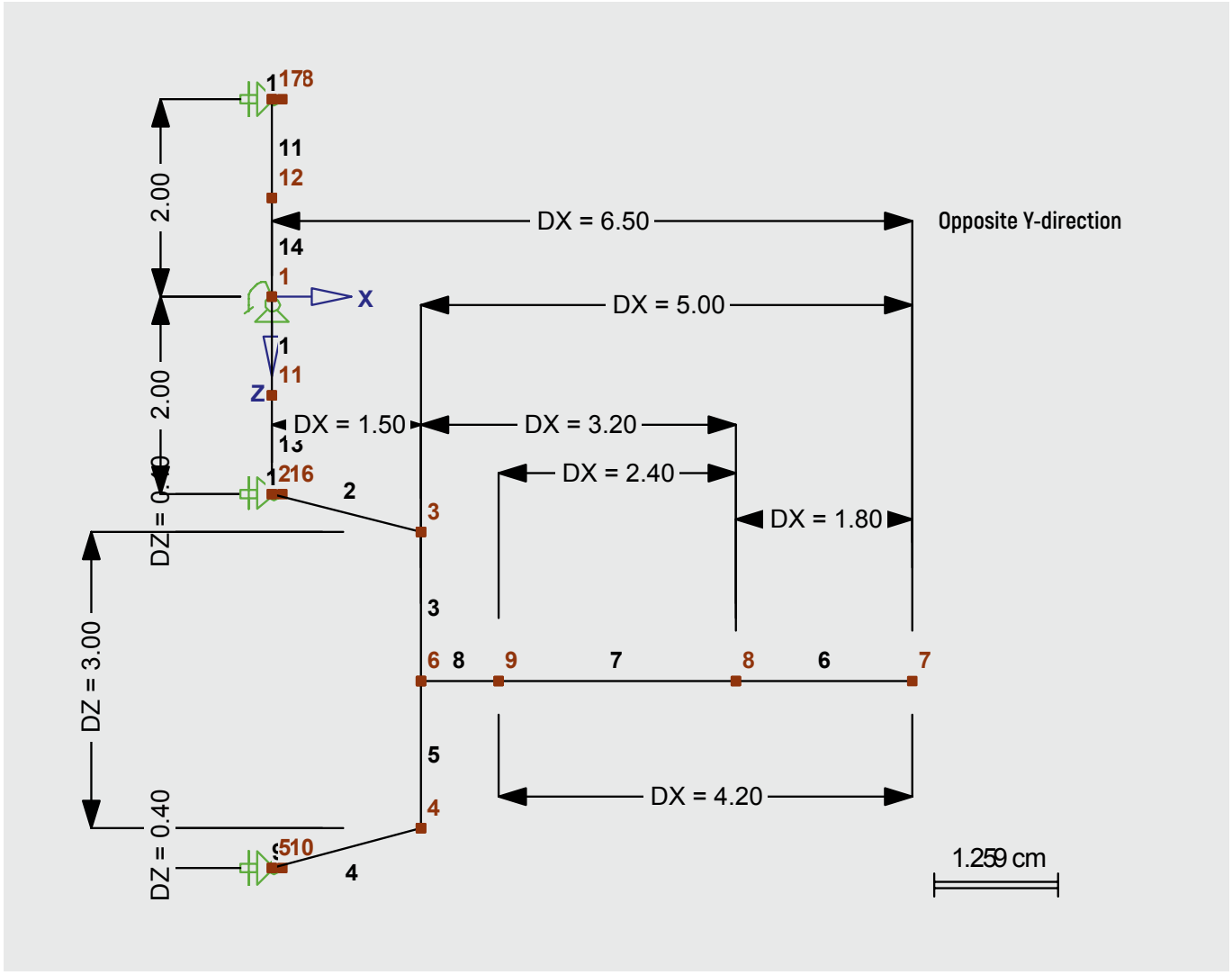
Width =	800	mm
Height =	450	mm
Thickness =	30	mm
Cavity a =	40	± 10 mm
Offset N =	15	mm
Cavity to Pin =	55	± 10 mm

Facade Bracket:

Sec 1:	min. w1 =	8	mm
	t1 =	3	mm
Sec 2:	thread =	M8	
Sec 3:	w3 =	40	mm
	t3 =	3	mm
Sec 4:	d =	4.0	mm
	l =	>= 40	mm
Pieces in 1 joint:		2	

Structural Data

Node Numbering
Element Numbering



General Data

LC No	LC Description	Factor	Combination Type	Dead Weight
1	Proper weight	1,0	Permanent	1.00
2	Wind pressure	1,0	Variable	-
3	Wind suction	1,0	Variable	-
4	Seismic Load	1,0	Exceptional	-

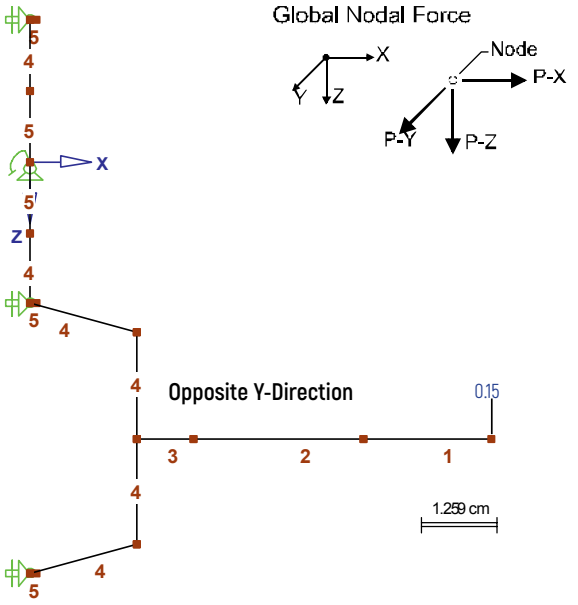
Load Groups

LG No	LG Description	Factor	Safety 8M	Load Cases in LG
1		1.00	1.10	1.35*LC1 + 1.50*LC2
2		1.00	1.10	1.35*LC1 + 1.50*LC3
3		1.00	1.10	LC1 + 1.50*LC3
4		1.00	1.10	LC1 + LC4
51	LC1 + LC2 (for deflection)	1.00	1.10	LC1 + LC2
52	LC1 + LC3 (for deflection)	1.00	1.10	LC1 + LC3

PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800

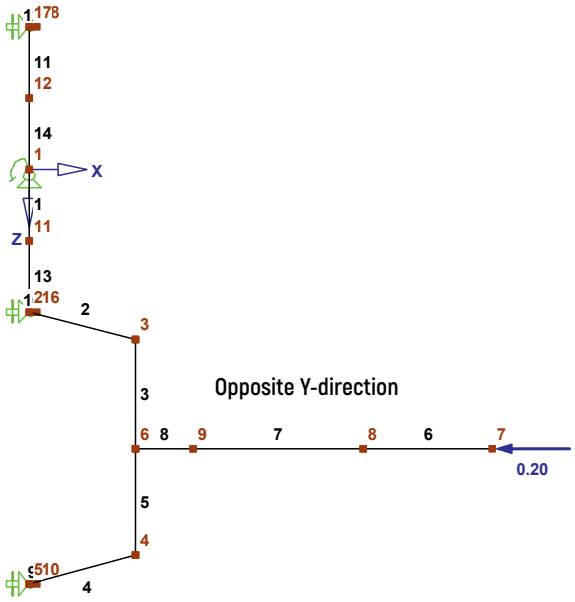
LOADS : LC 1 - Proper weight [kN]

NODAL FORCES				LC 1
No	Loaded Nodes	Nodal Forces		
		PX [kN]	PY [kN]	PZ [kN]
1	7	0.000	0.000	0.15



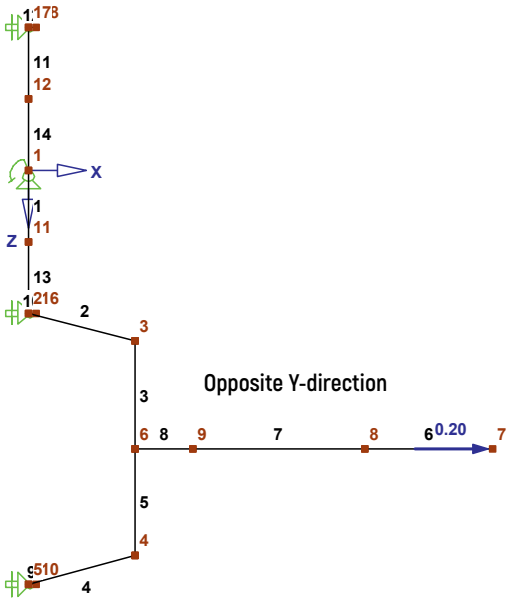
LOADS : LC 2 - Wind pressure [kN]

NODAL FORCES				LC 2
No	Loaded Nodes	Nodal Forces		
		PX [kN]	PY [kN]	PZ [kN]
1	7	0.2	0.000	0.000



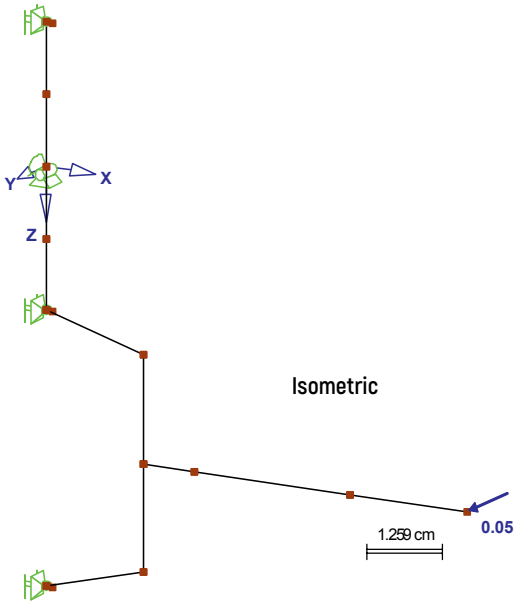
LOADS : LC 3 - Wind pressure [kN]

NODAL FORCES				LC 3
No	Loaded Nodes	Nodal Forces		
		PX [kN]	PY [kN]	PZ [kN]
1	7	0.2	0.000	0.000



LOADS : LC 4 - Seismic load [kN]

NODAL FORCES				LC 4
No	Loaded Nodes	Nodal Forces		
		PX [kN]	PY [kN]	PZ [kN]
1	7	0.000	0.05	0.000

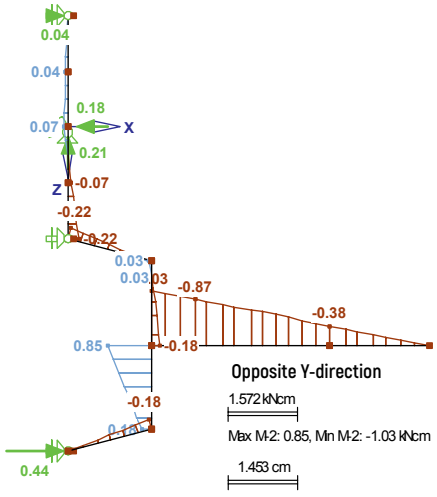


PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800

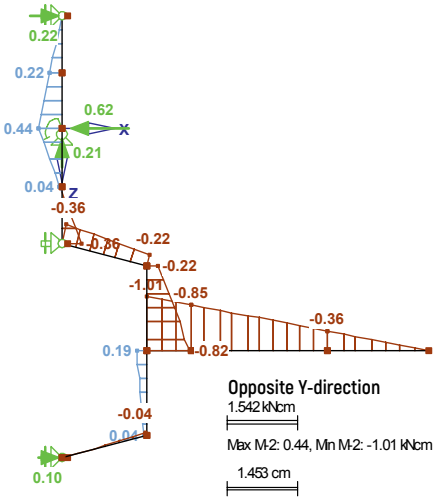
LOAD COMBINATIONS		
CO No	CO Description	Combination Criteria
1	LC1 or LC2 or LC3 or LC4	LG1 o LG2 o LG3 o LG4

LG-No	Factor Ny	Number Iterations	Eps-Convergence		Ny-fold Results	Tension Force Effect
			Existing	Wanted		
LG1	1.000	71	.00E+00	0.01	Yes	No
LG2	1.000	20	.25E-04	0.01	Yes	No
LG3	1.000	20	.14E-04	0.01	Yes	No
LG4	1.000	28	.92E-06	0.01	Yes	No
LG51	1.000	61	.00E+00	0.01	Yes	No
LG52	1.000	21	.16E-04	0.01	Yes	No

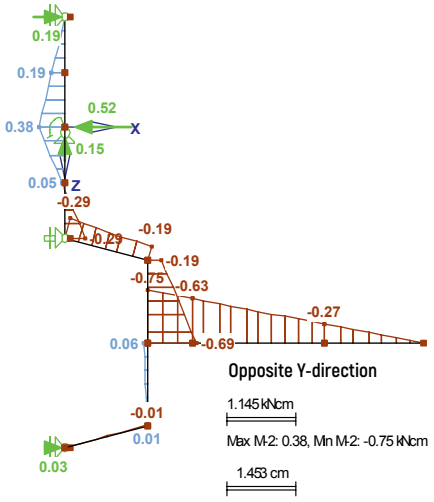
RESULTS : LG 1
Internal Forces M-2
Support Reactions



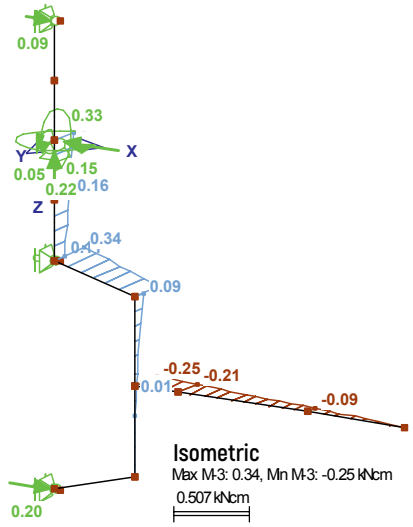
RESULTS : LG 2
Internal Forces M-2
Support Reactions



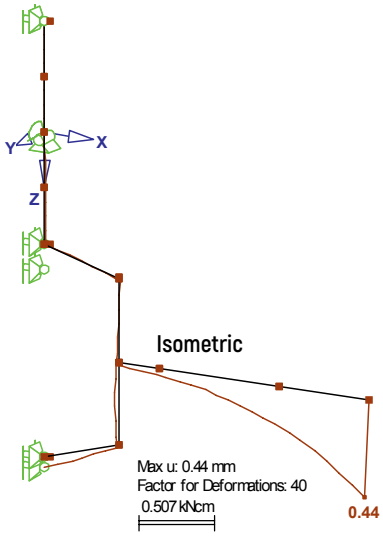
RESULTS : LG 3
Internal Forces M-2
Support Reactions



RESULTS : LG 4
Internal Forces M-2
Support Reactions



RESULTS : LG 51 - LC1 + LC2
(for deflection)
Deformations

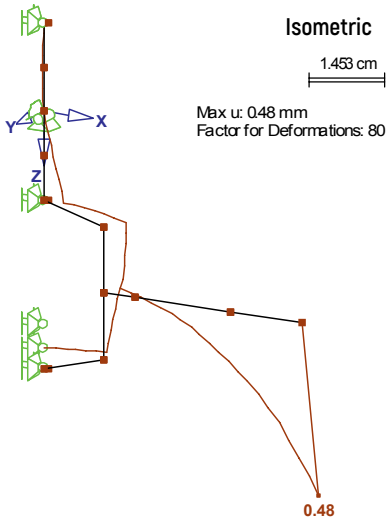


PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800

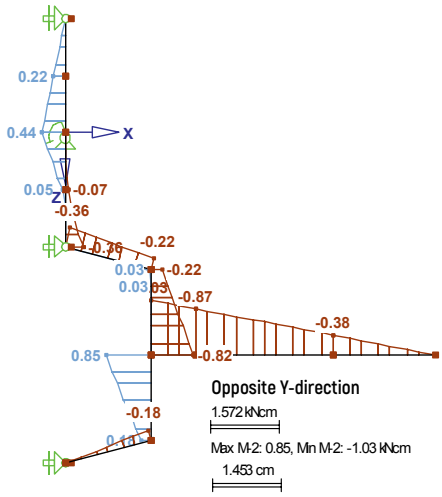
RESULTS : LG 52 - LC1 + LC3 (for def lection) | Deformations

MAX/MIN/CORR SUPPORT FORCES AND SUPPORT MOMENTS

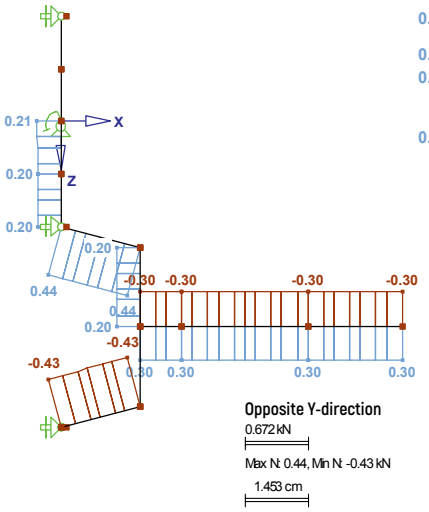
Node No	CO No		Support Forces [kN]			Support Moments [kNcm]		
			PX	PY	PZ	MX	MY	MZ
1	CO1	Max P-X Min P-X LC in Max P-X: LG2 LC in Min P-X:	.62 .00	.00 .00	.21 .00	.00 .00	.00 .00	.00 .00
		Max P-Y Min P-Y LC in Max P-Y: LG4 LC in Min P-Y:	.29 .00	.05 .00	.15 .00	-.22 .00	.00 .00	.33 .00
		Max P-Z Min P-Z LC in Max P-Z: LG1 LC in Min P-Z:	.18 .00	.00 .00	.21 .00	.00 .00	.00 .00	.00 .00
		Max M-X Min M-X LC in Max M-X: LC in Min M-X: LG4	.00 .29	.00 .05	.00 .15	.00 -.22	.00 .00	.00 .33
		Max M-Y Min M-Y LC in Max M-Y: LG2 LC in Min M-Y:	.62 .00	.00 .00	.21 .00	.00 .00	.00 .00	.00 .00
		Max M-Z Min M-Z LC in Max M-Z: LG4 LC in Min M-Z:	.29 .00	.05 .00	.15 .00	-.22 .00	.00 .00	.33 .00
10	CO1	Max P-X Min P-X LC in Max P-X: LC in Min P-X: LG1	.00 -.44	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00
		Max P-Y Min P-Y LC in Max P-Y: LC in Min P-Y: LG4	.00 -.20	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00
16	CO1	Max P-X Min P-X LC in Max P-X: LC in Min P-X: LG1	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00
		Max P-Y Min P-Y LC in Max P-Y: LC in Min P-Y: LG4	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00
18	CO1	Max P-X Min P-X LC in Max P-X: LC in Min P-X: LG2	.00 -.22	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00
		Max P-Y Min P-Y LC in Max P-Y: LC in Min P-Y:	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00	.00 .00



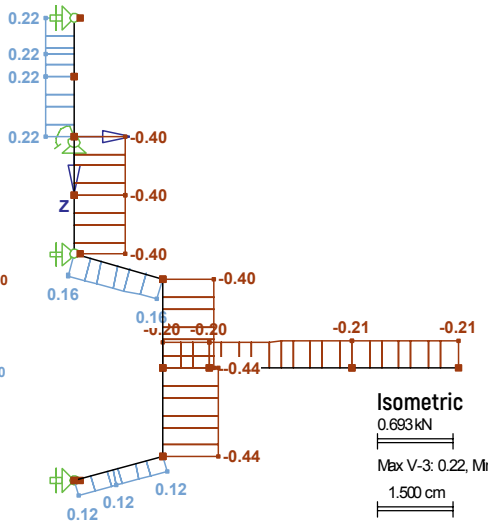
RESULTS : CO 1 - LC1 or LC2 or LC3 or LC4 | Max/Min Internal Forces M-2



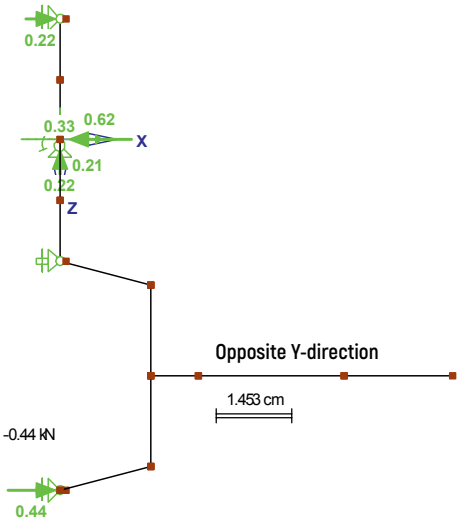
RESULTS : CO 1 - LC1 or LC2 or LC3 or LC4 Max/Min Internal Forces N



RESULTS : CO 1 - LC1 or LC2 or LC3 or LC4 Max/Min Internal Forces V-3



RESULTS : CO 1 - LC1 or LC2 or LC3 or LC4 Extreme Support Reactions



STEEL1 - SPANNUNGSANALYSE| GENERAL DATA

ELEMENTS TO DESIGN	All	
LOAD CASES TO DESIGN	LG1	1.35*LC1 + 1.50*LC2
	LG2	1.35*LC1 + 1.50*LC3
	LG3	LC1 + 1.50*LC3
	LG4	LC1 + LC4

Mat No	Material Description	Material Code, Criterion	Allowable Stresses [kN/cm^2] at 50°c		
			Sigma	Tau	Sigma eq
1	SS-304	Stainless Steel	16.1	9.3	17.7
2	A-70	Stainless Steel	40.9	23.6	40.9

Stress Type	Elem No	x Loc [cm]	S Point No	LC No	Stress [kN/cm^2]		Stress Ratio
					existing	allowable	
Section No 1 - Flat 8/3							
Sigma Total	6	1.80	3	LG1	-32.92	40.90	0.80
Tau Total	6	0.00	5	LG1	1.31	23.60	0.06
Sigma eq	6	1.80	3	LG1	32.92	40.90	0.80
Section No 2 - Round 6.8							
Sigma Total	7	2.40	28	LG1	-29.01	40.90	0.71
Tau Total	7	0.00	37	LG1	0.77	23.60	0.03
Sigma eq	7	2.40	28	LG1	29.01	40.90	0.71
Section No 3 - Round 13							
Sigma Total	8	0.80	28	LG1	-5.00	16.10	0.31
Tau Total	8	0.00	37	LG1	0.20	9.30	0.02
Sigma eq	8	0.80	28	LG1	5.00	17.70	0.28
Section No 4 - Flat 40/3							
Sigma Total	5	0.00	1	LG1	-14.17	16.10	0.88
Tau Total	13	0.00	1	LG 4	2.89	9.30	0.31
Sigma eq	5	0.00	1	LG1	14.17	17.70	0.80
Section No 5 - Flat 30/3							
Sigma Total	1	0.00	3	LG2	10.01	16.10	0.62
Tau Total	1	0.00	1	LG4	3.91	9.30	0.42
Sigma eq	1	0.00	3	LG2	10.01	17.70	0.57

OMEGA BRACKET

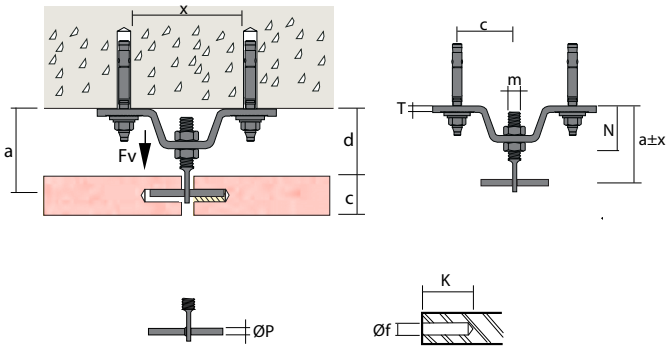
Omega Bracket (Standard & Serrated) | Type ST- 700 1100

It is is designed for fastening the natural stone panel beneath a concrete floor slab.

Anchoring base: acc. to the licence of the anchor bolt chosen.

Adjustibility:
in 2 directions x = ± 05 mm
Z = ± 10 mm

FVperm = permissible vertical loading capacity
FHperm.= permissible horizontal tensile load or pressure load
FR= existing load on the anchor with maximum load of the bracket



Codes	Width (W) mm	Bracket mm	Offset (N)	FHB A2-70 A4-70	Ø Pin mm	sl hole
700 1100-35.3.70	35	3	70	M8	4	6,5 x 22
700 1100-35.3.80	35	3	80	M8	4	6,5 x 22
700 1100-40.3.110	40	3	10	M8	4	6,5 x 22
700 1100-40.3.120	40	3	20	M8	4	6,5 x 22
700 1100-55.4.110	55	4	10	M10	5	8,5 x 22
700 1100-55.4.120	55	4	20	M10	5	8,5 x 22
700 1100-55.5.90	55	5	90	M12	6	10,5 x 22
700 1100-55.5.100	55	5	0	M12	6	10,5 x 22
700 1100-60.5.110	60	5	10	M12	6	10,5 x 22
700 1100-60.5.120	60	5	20	M12	6	10,5 x 22

Omega Brackets Load Table

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50C° 24h average temperature

Bracket Offset mm	Cavity to Pin min - max mm	Deadload max DL kN	Windload max WL ± kN	Bracket Width mm	Bracket Thickness (T) mm	Ø Pin mm	FHB A2-70 A4-70	Anchor comb. Force kN *
70	100-110	0.16	0.22	30	3	4	M8	2.30
80	110-120			30	3	4	M8	2.40
90	120-130			35	3	4	M8	2.50
100	130-140			35	3	4	M8	2.50
110	140-150			40	3	4	M8	2.50
120	150-160			40	3	4	M8	2.60
70	100-110	0.28	0.39	55	3	5	M10	4.10
80	110-120			55	3	5	M10	4.20
90	120-130			50	4	5	M10	4.30
100	130-140			50	4	5	M10	4.40
110	140-150			55	4	5	M10	4.50
120	150-160			55	4	5	M10	4.60
70	100-120	0.55	0.77	50	5	6	M12	8.80
80	110-130			50	5	6	M12	9.00
90	120-140			55	5	6	M12	9.20
100	130-150			55	5	6	M12	9.40
110	140-160			60	5	6	M12	9.60
120	150-170			60	5	6	M12	9.80

Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary with safety 3,0

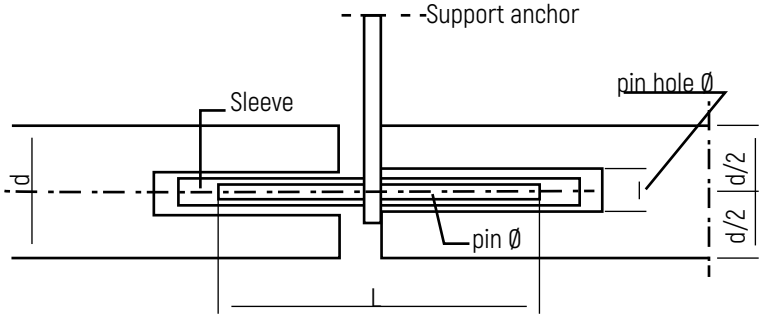
FLAT HEAD BOLT TECHNICAL DETAILS

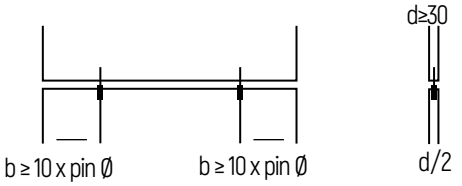
Flat Head Bolt

Materials A2-70, A4-70 ≤ 50°C 24h average temperature Fixing in reinforced concrete vertical wall, or steel substructure

Cavity to Pin min - max mm	Deadload max DL kN	Windload max WL ± kN	FHB A2-70 A4-70	Ø Pin mm
20-30	0.08	0.11	M6	4
30-40			M6	4
40-50			M8	4
50-60			M8	4
30-40	0.16	0.22	M8	4
40-50			M8	4
50-60			M10	4
60-70			M10	4
30-40	0.23	0.32	M10	5
40-50			M10	5
50-60			M10	5
60-70			M10	5
30-40	0.45	0.63	M12	6
40-50			M12	6
50-60			M12	6
60-70			M12	6

According to DIN 18515 part 3
Pins: pin hole shall be 3mm bigger than pin diameter.
Pin distances (d<30): Distance between pannel corner and middle pinhole is min 2.5 the pannel thickness.



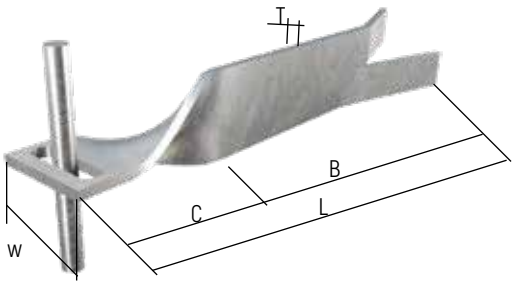


FISHTAIL BRACKET

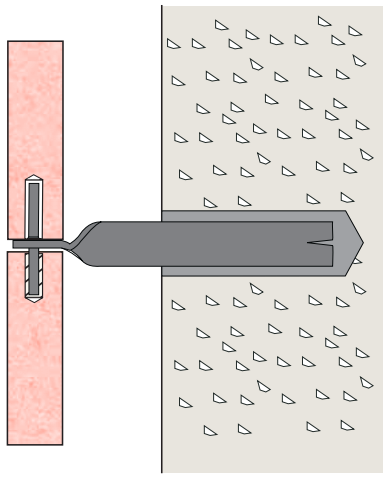
TYPE ST- 800 -1100

Fishtail with Pin | Type ST- 800 1100

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature
Standard Items:



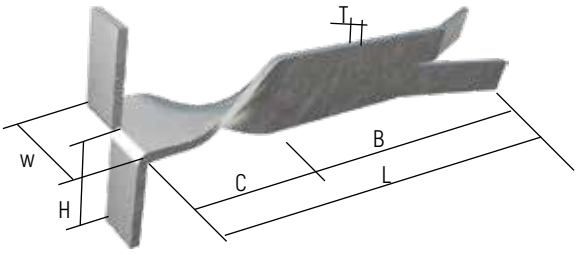
Codes	Width (W)	Thickness (T)	Length (L)	sl hole
800-1100-25.2.100	25	2	100	4.1 x 15
800-1100-25.2.120	25	2	120	4.1 x 15
800-1100-25.2.140	25	2	140	4.1 x 15
800-1100-25.2.160	25	2	160	4.1 x 15
800-1100-25.3.100	25	3	100	4.1 x 15
800-1100-25.3.120	25	3	120	4.1 x 15
800-1100-25.3.140	25	3	140	4.1 x 15
800-1100-25.3.160	25	3	160	4.1 x 15
800-1100-30.4.100	30	4	100	5.1 x 15
800-1100-30.4.120	30	4	120	5.1 x 15
800-1100-30.4.140	30	4	140	5.1 x 15
800-1100-30.4.160	30	4	160	5.1 x 15



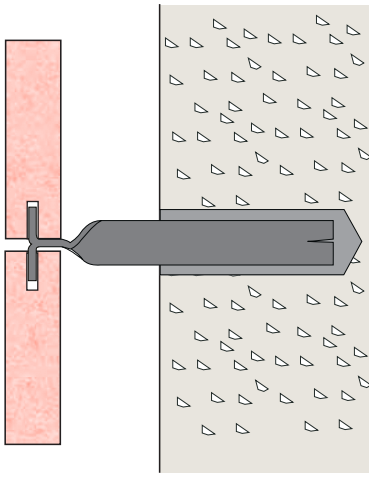
TYPE ST- 800 -1100

Fishtail Up & Down | Type ST- 800 1200

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature
Standard Items:



Codes	Width (W)	Thickness (T)	Length (L)	Height (H)
800-1200-25.2.100	25	2	100	15
800-1200-25.2.120	25	2	120	15
800-1200-25.2.140	25	2	140	15
800-1200-25.2.160	25	2	160	15
800-1200-25.3.100	25	3	100	15
800-1200-25.3.120	25	3	120	15
800-1200-25.3.140	25	3	140	15
800-1200-25.3.160	25	3	160	15
800-1200-30.4.100	30	4	100	15
800-1200-30.4.120	30	4	120	15
800-1200-30.4.140	30	4	140	15
800-1200-30.4.160	30	4	160	15



TYPE ST- 800 - 1200

Type ST- 800 (1100-1200) Fishtail (Pin & Up and Down)

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature
Fixing in reinforced concrete vertical wall

Cavity to Pin min - max mm	Deadload max DL kN	Winload max WL ± kN	Bracket Width mm	Bracket Thickness mm	Ø Pin A-70 mm	Embedment mm	Length mm
40-50	0,10	0,14	25	2	4	45	100
50-60			25	2	4	55	120
60-70			25	2	4	65	140
70-80			25	2	4	75	160
40-50	0,22	0,31	25	3	4	45	100
50-60			25	3	4	55	120
60-70			25	3	4	65	140
70-80			25	3	4	75	160
40-50	0.29	0.41	30	4	5	45	100
50-60			30	4	5	55	120
60-70			30	4	5	65	140
70-80			30	4	5	75	160

Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary

TYPE ST- 800 (1100-1200) FISHTAIL (PIN & UP AND DOWN)

Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°C 24h average temperature
Fixing in solid blockwork vertical wall

Cavity to Pin min - max mm	Deadload max DL kN	Winload max WL ± kN	Bracket Width mm	Bracket Thickness mm	Ø Pin A-70 mm	Embedment mm	Length mm
40-50	0,08	0,11	25	2	4	45	100
50-60			25	2	4	55	120
60-70			25	2	4	65	140
70-80			25	2	4	75	160
40-50	0,13	0,18	25	3	4	45	100
50-60			25	3	4	55	120
60-70			25	3	4	65	140
70-80			25	3	4	75	160
40-50	0.20	0.28	30	4	5	45	100
50-60			30	4	5	55	120
60-70			30	4	5	65	140
70-80			30	4	5	75	160

Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary

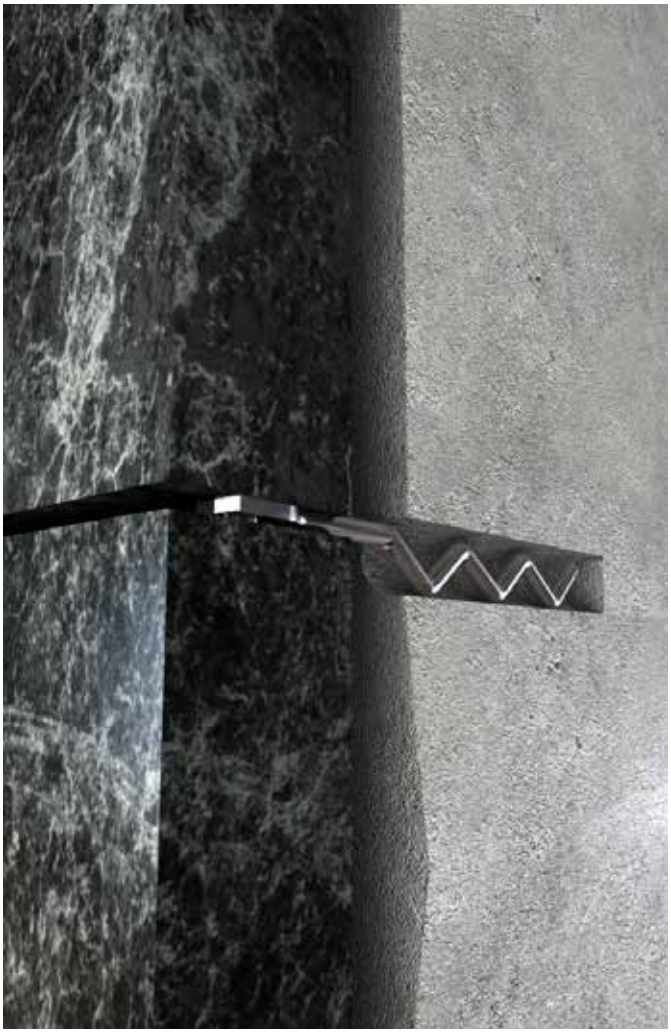
CORRUGATED DOWEL

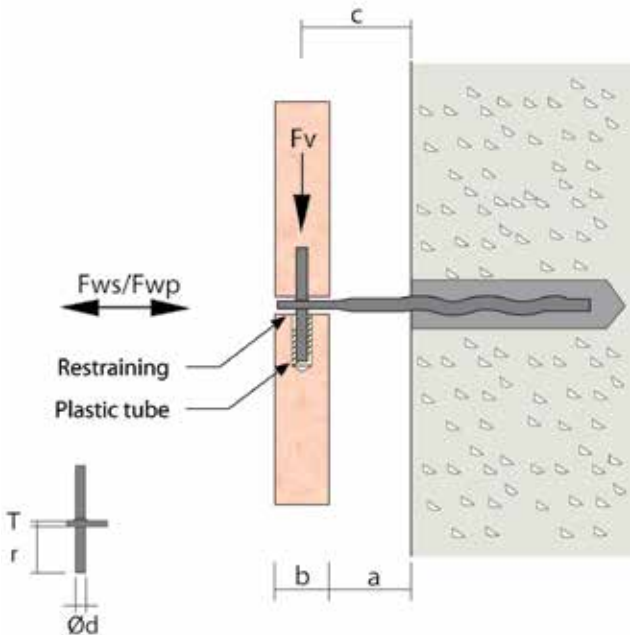
TYPE ST- 900 -1100 (CORRUGATED DOWEL)

Corrugated dowel | Type ST- 900 1100

The Mortar Anchor is a restraint anchor and is used to install last row of slabs on to concrete and
masonry walls at horizontal installation.
This anchor can be used for wind loads of up to 1000 N and can be used on projection ,in addition that it can be used both in horizontal and in vertical joints.

Load bearing and restraining corrugated stud.
Material: SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG.



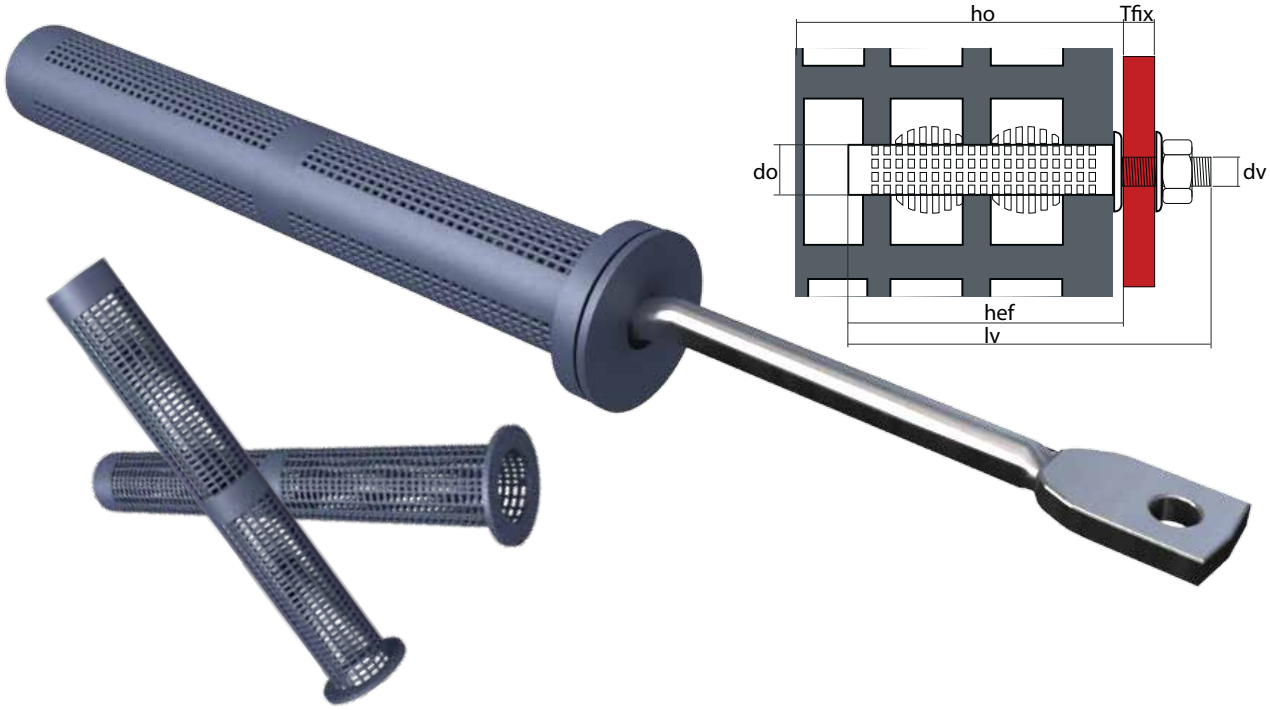


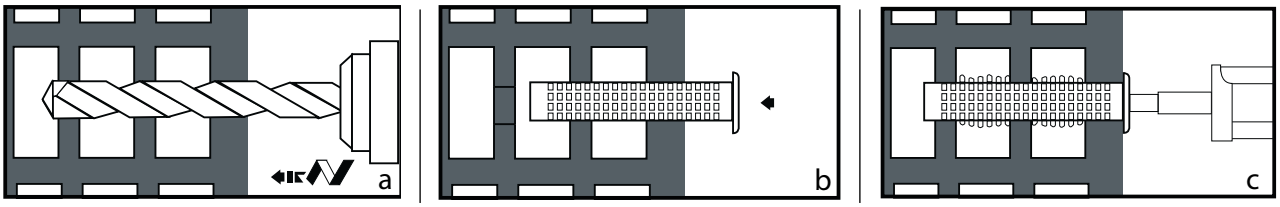
Load-bearing and retaining angles.
Material: SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG ≤ 50°c 24h average temperature

Standard items:

Net anchor	CODE	Ø stud	Stud length /EHD	Ø Hole	Ø inside	Hole depth	Fixable thickness /EHD	Hole volume	Resin volume to inject
Type	CODE	dv/mm	l/mm	do/mm	dv/mm	ho/mm	tfix/mm	cm^3	cm^3
BE 12x45	8708955	M6-M8	65	12	10	45	-	5,1	5,1
BE 12x60	8708956	M6-M8	80	12	10	60	-	6,8	6,8
BE 12x80	8708957	M6-M8	110	12	10	70	10	9,1	9,1
BE 15x85	8708952	M8-M10	110-160	15	13	85	30-55	15,0	15,0
BE 15x130	8708953	M8-M10	160	15	13	130	10	23,0	23,0
BE 20x85	8708954	M12	115	20	18	85	10	26,7	26,7
BM 11x1000	8708961	M8	.var	12	9.5	.var	-	-	-
BM 15x1000	8708962	M10	.var	16	13.5	.var	-	-	-
BM 20x1000	8708963	M12	.var	22	19.0	.var	-	-	-

Angles of different dimensions can be manufactured upon specific demand.

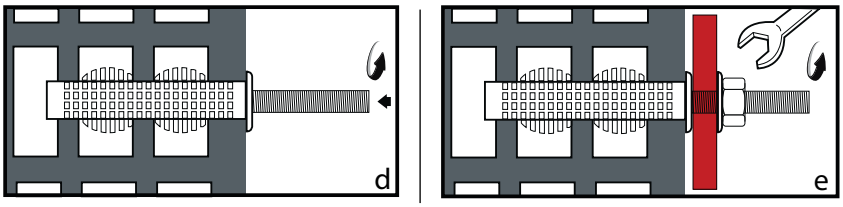




a- Drill to the suggested diameter.

b- Insert tube screen.

c- Inject the resin with the special nozzle.



d- insert the threaded stud turning it slowly.

e- After the hardening time fix the object.

Net anchor	CODE	Ø stud	Stud length/EHD	Ø Hole	Ø inside	Hole depth	Fixable thickness/EHD	Hole volume	Resin volume to inject
Type	CODE	dv/mm	l/mm	do/mm	dv/mm	ho/mm	tfix/mm	cm^3	cm^3
BE 12x45	8708955	M6-M8	65	12	10	45	-	5,1	5,1
BE 12x60	8708956	M6-M8	80	12	10	60	-	6,8	6,8
BE 12x80	8708957	M6-M8	110	12	10	70	10	9,1	9,1
BE 15x85	8708952	M8-M10	110-160	15	13	85	30-55	15,0	15,0
BE 15x130	8708953	M8-M10	160	15	13	130	10	23,0	23,0
BE 20x85	8708954	M12	115	20	18	85	10	26,7	26,7
BM 11x1000	8708961	M8	.var	12	9.5	.var	-	-	-
BM 15x1000	8708962	M10	.var	16	13.5	.var	-	-	-
BM 20x1000	8708963	M12	.var	22	19.0	.var	-	-	-

EXAMPLES OF STEEL BACKSUPPORT SYSTEMS

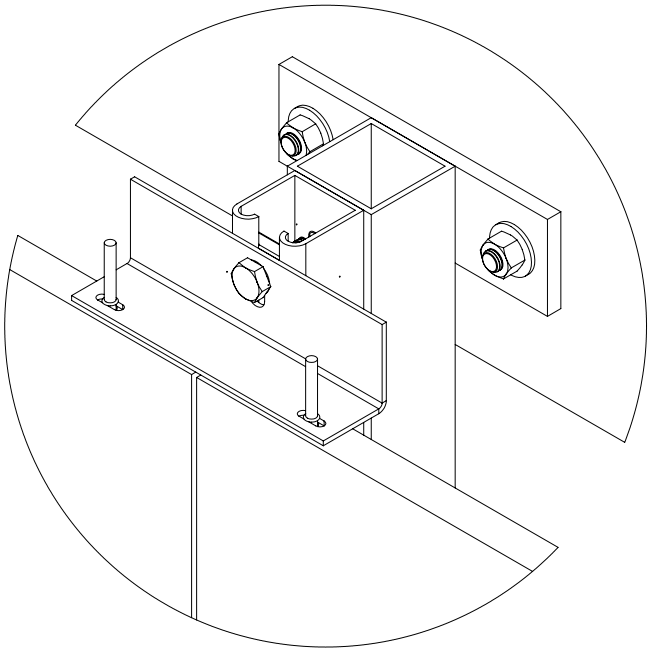
Example -1
Front To Back Channel with welded back plate and up & down bracket

Example -2
Square tube with welded channel & double pin L-bracket

Example -3
Single channel with Omega support and Z-brackets

Example -4
B2B with Omega support and Z-brackets

Example -5
Cantilever Arm with BTB and Flate Head Bolt



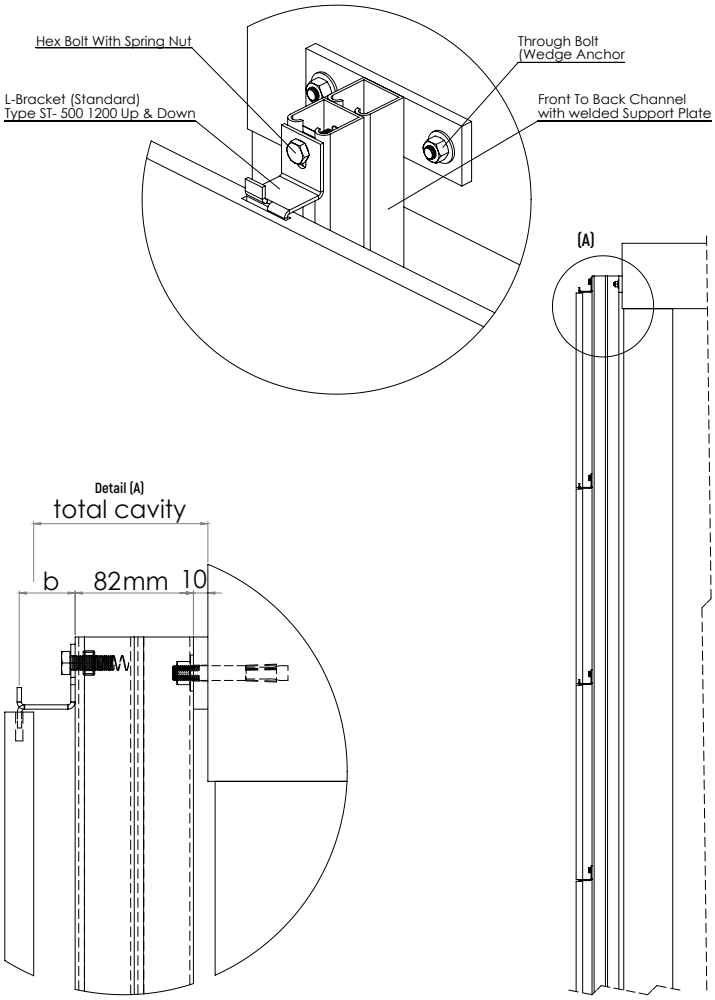
EXAMPLE -1

Front To Back Channel with welded back plate and up & down bracket

Floor to floor System using front to back channels with support plates and L-Brackets up & down with bolts and spring nuts fixed to the channels .

- Min cavity to backside of panel: 100 mm

- Span ≤ 3,0 mm



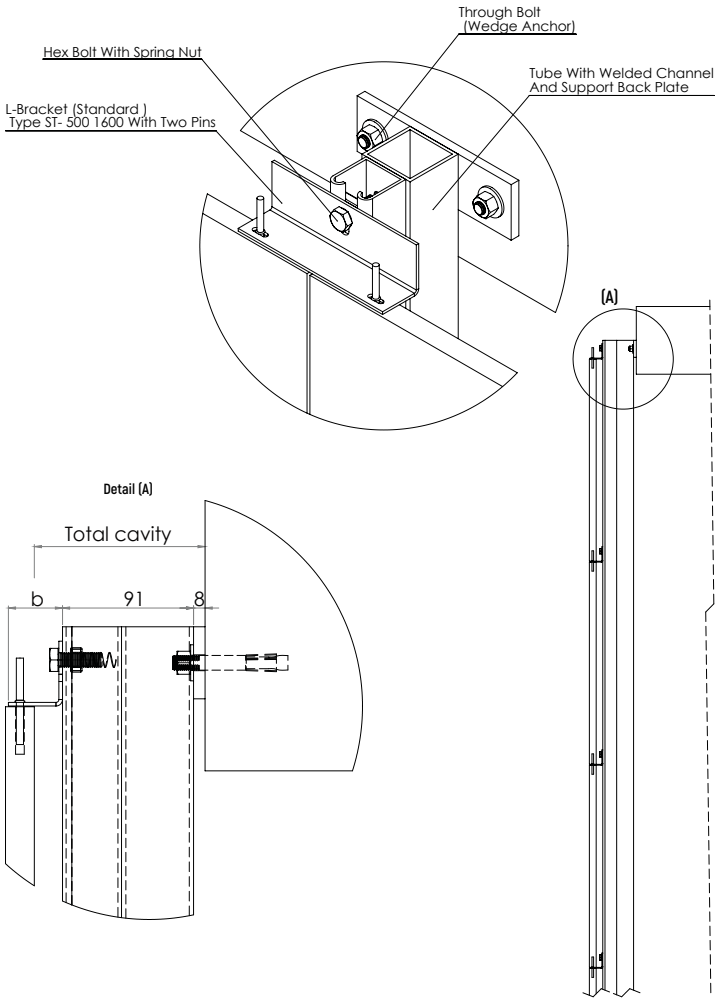
EXAMPLE -2

Square tube with welded channel & double pin L-bracket

Floor to floor System using square tubes with channels and L-Brackets double pin type with bolts and spring nuts fixed to the channels .

- Min cavity to backside of panel: 120 mm

- Span ≥ 3,0 mm



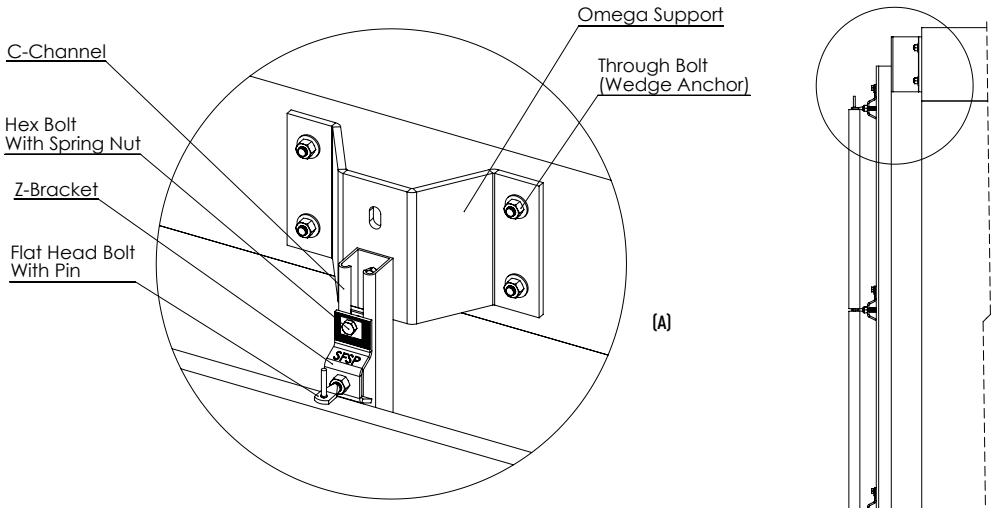
EXAMPLE -3

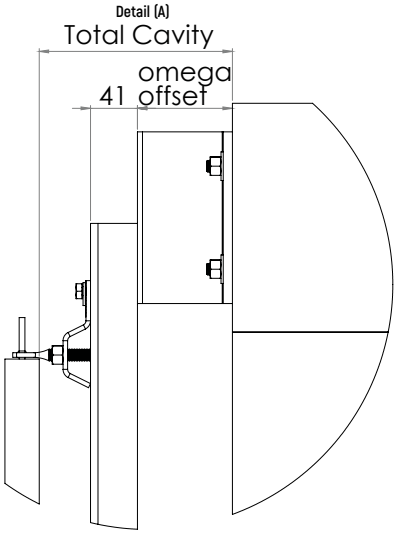
Single channel with Omega support and Z-brackets

Steel back-support system for large cavity using omega brackets, channels and Z- brackets with bolts and spring nuts fixed to the channels and adjustable flat head bolts .

- For cavity ≥ 150 mm

- Distance of Omega brackets ~150 cm (=Span of channels)





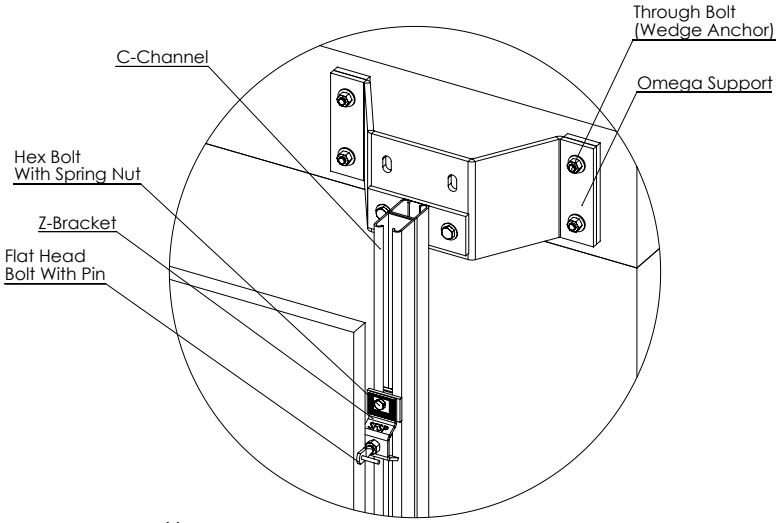
EXAMPLE -4

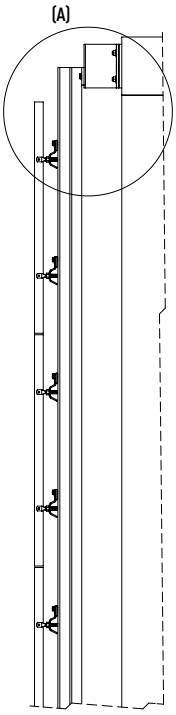
BTB with Omega Sapport and Z-brackets

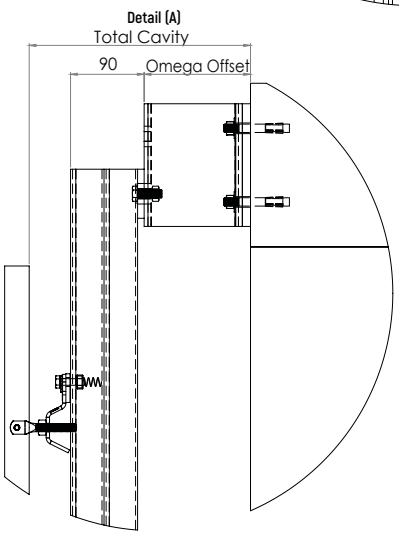
Steel back-support system for large cavity using omega brackets, channels and Z- brackets with bolts and spring nuts fixed to the channels and adjustable flat head bolts.

- For cavity ≥ 200mm

- distance of Omegabrackets ~200-300cm







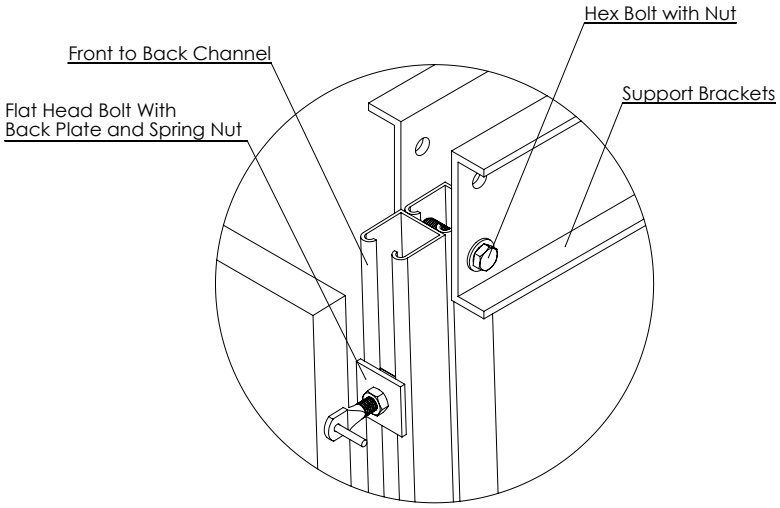
EXAMPLE -5

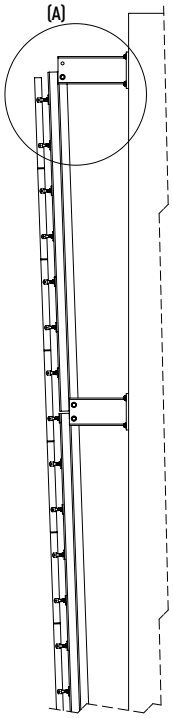
Cantilever Arm Support with BTB channel and Flate Head Bolt

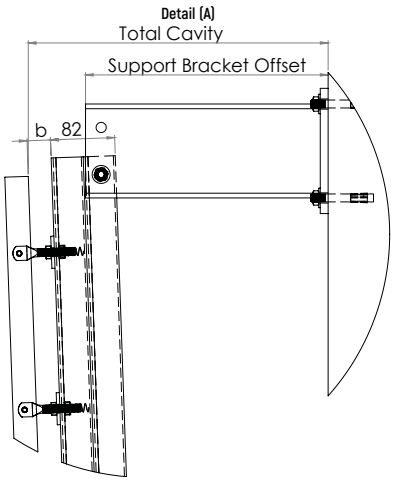
Steel back-support system for Adjustable large cavities using support brackets, front to back channels,and adjustable flat head bolts with back plates and spring nuts fixed to channels .

- For cavity ≥ 300 mm

- Distance of Omega brackets ~3 cm (=Span of channels).

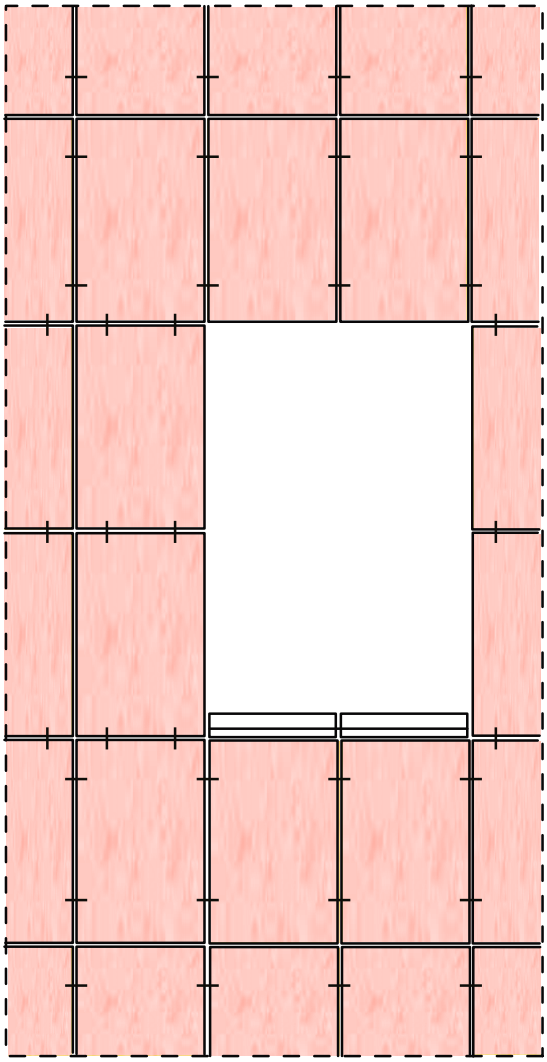


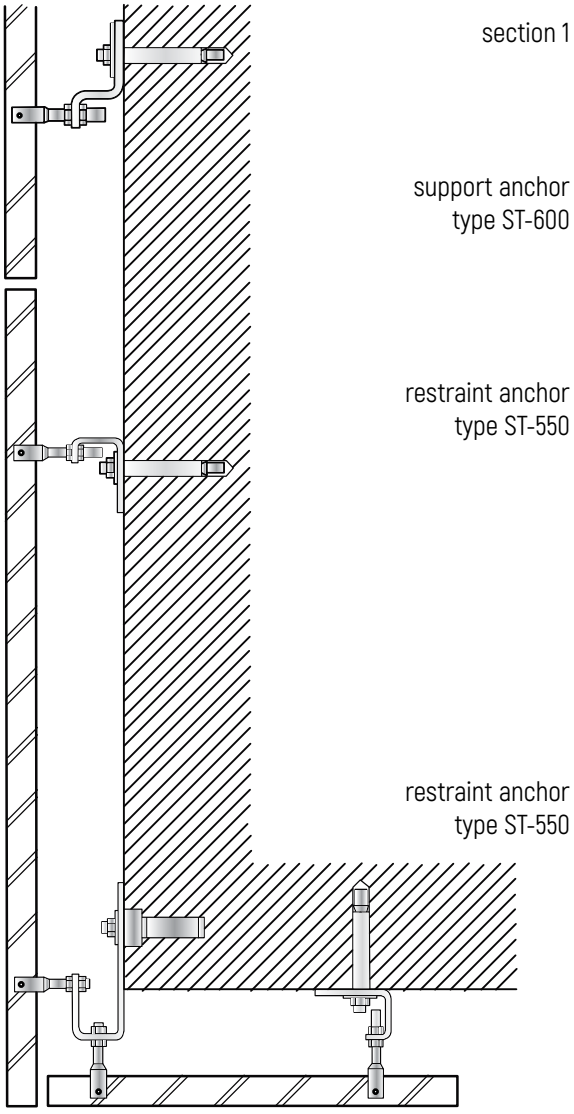




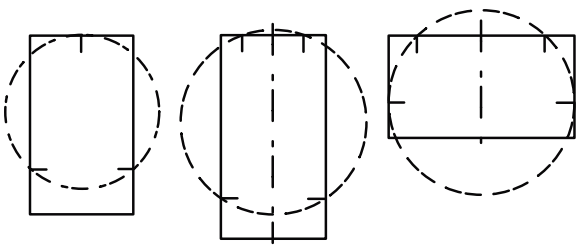
TECHNICAL DETAILS

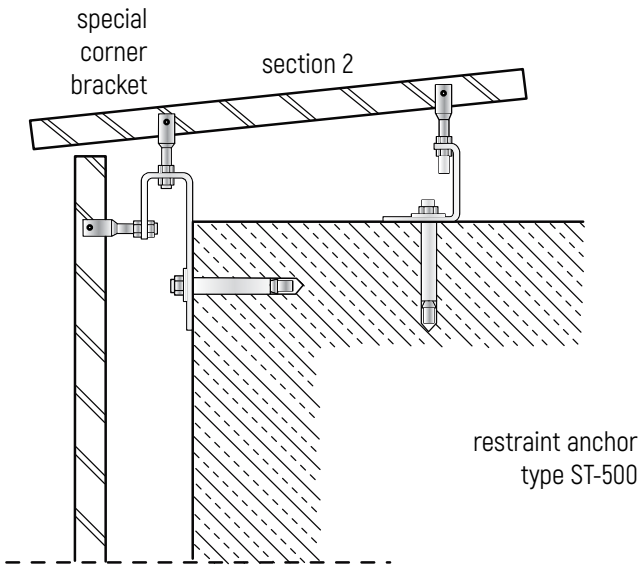
Detail solution: fixing of slabs at opening. ex . window





Fixings positions as per DIN 18516 part3. Slabs will be held usually at 4 points. minimum at 3 points. Fixings positions have to allow the slab to contract or expand freely when subjected to temperature. All fixing points have to be located on an imaginary circle if drawn through these points.





C-CHANNELS LOADS & SUPPORTS

Channel

SFSP's metal framing channel is cold formed on modern rolling machines from low carbon steel manufactured according to BS 6946:1988. A continuous slot provides the ability to make attachments at any point.

Lengths

Standard length: 3000mm with ± 3.2mm length tolerance.
Custom lengths vv available upon request.

Finishes

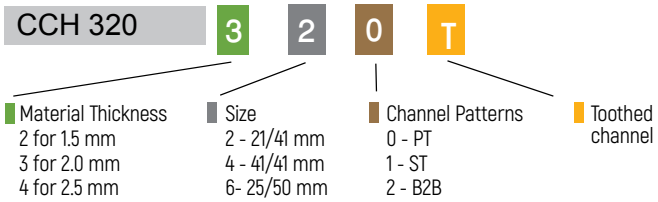
Standard Finishes: Pre-Galvanized finish (ASTM A653M coating G90 and G60). Hot Dip Galvanized after fabrication (ASTM A123 or BS EN ISO1461:2009). Other custom coatings are available upon request.

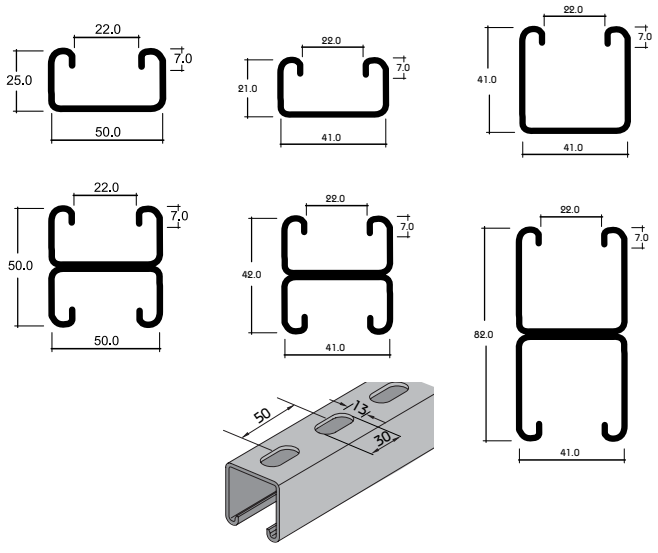
Metal Framing Channels

Selection Chart

Part No	Channel Dimensions		Thickness
	Height "H"	Width "W"	
CCH - 220/221	21.0 mm	41.0 mm	1.5 mm
CCH - 240/241	41.0 mm	41.0 mm	1.5 mm
CCH - 260/261	25.0 mm	50.0 mm	1.5 mm
CCH - 320/321	21.0 mm	41.0 mm	2.0 mm
CCH - 340/341	41.0 mm	41.0 mm	2.0 mm
CCH - 360/361	25.0 mm	50.0 mm	2.0 mm
CCH - 420/421	21.0 mm	41.0 mm	2.5 mm
CCH - 440/441	41.0 mm	41.0 mm	2.5 mm
CCH - 460/461	25.0 mm	50.0 mm	2.5 mm

For Toothed Channel add "T" after the Part no. ex: CCH-220T





Channel Hole Patterns

PT Type Channel

Part No	Thick. mm.	Height "H"
CCH-220	1.5	21.0
CCH-240	1.5	41.0
CCH-260	1.5	25.0
CCH-320	2.0	21.0
CCH-340	2.0	41.0
CCH-360	2.0	25.0
CCH-420	2.5	21.0
CCH-440	2.5	41.0
CCH-460	2.5	25.0

PT Plain Type

ST Type Channel

Part No	Thick. mm.	Height "H"
CCH-221	1.5	21.0
CCH-241	1.5	41.0
CCH-261	1.5	25.0
CCH-321	2.0	21.0
CCH-341	2.0	41.0
CCH-361	2.0	25.0
CCH-421	2.5	21.0
CCH-441	2.5	41.0
CCH-461	2.5	25.0

ST Slotted Type

B2B Type Channel

Part No	Thick. mm.	Height "H"
CCH-222	1.5	42.0
CCH-242	1.5	82.0
CCH-262	1.5	50.0
CCH-322	2.0	42.0
CCH-342	2.0	82.0
CCH-362	2.0	50.0
CCH-422	2.5	42.0
CCH-442	2.5	82.0
CCH-462	2.5	50.0

B2B Type

Toothed channel type

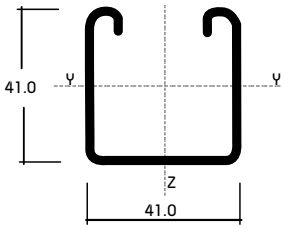
For Toothed Channel add "T" after the Part no.
ex: CCH-220T

CCH-240/241

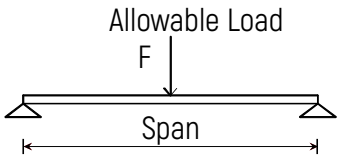
Load table for single beam with uniform (characteristic) Live-Load

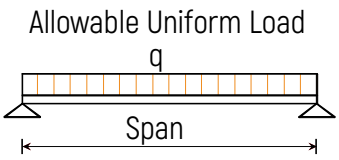
This associated data are considered for perforated and non-perforated c-channel types according to DIN 18.800

Thickness : 1.5 mm
Standard Length : 3.00 m
Finishes : Pre-Galvanized,
Hot-Dip Galvanized.



C-Channel:	41x41x1.5	
Area of Shear (A_z)	1.02	cm^2
Moment of Inertia (I_y)	3.87	cm^4
Moment of Inertia (I_z)	5.68	cm^4
min. Section Modulus (S_y)	1.76	cm^3
Warping Constant (I_w)	114.17	cm^6
Torsional Constant (I_T)	0.02	cm^4
Plastic Moment cap. ($M_{pl,y}$)	0.52	kNm
Self weight (G)	1.44	kg/m





Chosen Material:	40 B = S 235 JRG2	
Allowable Bending Stress	21,82	kN/cm^2
Allowable Shear Stress	12,60	kN/cm^2
Modulus of Elasticity	21.000	kN/cm^2

Beam Load Data

					Uniform Load* @	
Span (L)	Allowable Load*		Deflection		L / 360	L / 180
[cm]	q [kN/m]	F [kN]	U [mm]	[L /X]	q [kN/m]	q [kN/m]
50	6.60	1.70	0.83	610	6.60	6.60
60	4.60	1.40	1.19	500	4.60	4.60
70	3.30	1.20	1.59	440	3.30	3.30
80	2.60	1.00	2.13	380	2.60	2.60
90	2.00	0.90	2.63	340	1.90	2.00
100	1.60	0.80	3.20	310	1.40	1.60
125	1.00	0.60	4.89	260	0.70	1.00
150	0.73	0.50	7.40	200	0.40	0.70
175	0.53	0.50	9.96	180	0.30	0.50
200	0.41	0.40	13.14	150	0.20	0.30
225	0.32	0.36	16.42	140	x	0.24
250	0.26	0.33	20.34	120	x	0.18
275	0.22	0.30	25.20	110	x	x
300	0.18	0.27	29.20	100	x	x

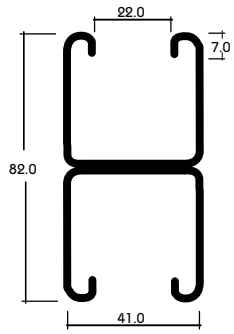
* Given loads are always "allowable characteristic live load"

CCH-242

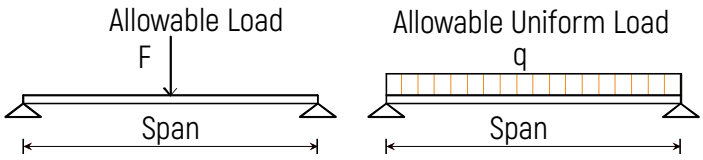
Load table for single beam with uniform (characteristic) Live-Load

This associated data are considered for perforated and non-perforated c-channel types according to DIN 18.800

Thickness : 1.5 mm
Standard Length : 3.00 m
Finishes : Pre-Galvanized,
Hot-Dip Galvanized.



C-Channel:	41x 41x1.5 b2b	
Area of Shear (A_z)	1.43	cm^2
Moment of Inertia (I_y)	21.11	cm^4
Moment of Inertia (I_z)	11.37	cm^4
min. Section Modulus (S_y)	5.15	cm^3
Warping Constant (I_w)	95.85	cm^6
Torsional Constant (I_T)	0.04	cm^4
Plastic Moment cap. ($M_{pl,y}$)	1.53	kNm
Self weight (G)	2.88	kg/m



Chosen Material:	40 B = S 235 JRG2	
Allowable Bending Stress	21,82	kN/cm^2
Allowable Shear Stress	12,60	kN/cm^2
Modulus of Elasticity	21.000	kN/cm^2

Beam Load Data

					Uniform Load* @	
Span (L)	Allowable Load*		Deflection		L / 360	L / 180
[cm]	q [kN/m]	F [kN]	U [mm]	[L /X]	q [kN/m]	q [kN/m]
50	19.20	4.80	0.44	1.130	19.20	19.20
60	13.30	4.00	0.63	950	13.30	13.30
70	9.80	3.40	0.86	810	9.80	9.80
80	7.50	3.00	1.13	710	7.50	7.50
90	5.90	2.70	1.42	630	5.90	5.90
100	4.80	2.40	1.76	570	4.80	4.80
125	3.10	1.90	2.78	450	3.10	3.10
150	2.10	1.60	3.90	380	2.10	2.10
175	1.60	1.40	5.51	320	1.40	1.60
200	1.10	1.10	6.46	310	0.90	1.10
225	0.80	0.90	7.53	300	0.70	0.80
250	0.58	0.70	8.32	300	0.50	0.60
275	0.44	0.60	9.24	300	0.40	0.40
300	0.34	0.50	10.11	300	0.30	0.30

* Given loads are always "allowable characteristic live load"

ANCHORS

heavy duty Anchors

General Information

Direction of Loading

The direction of the applied load shall be considered to determine the most appropriate anchor .

The tension and shear components shall be less than the recommended load/design resistance in the direction concerned.

Tensile Loads

Tensile loads are applied along the axis of fixing (see Fig.1).

Common examples include suspended ceiling applications and the suspension of mechanical services, pipework, ductwork, etc.

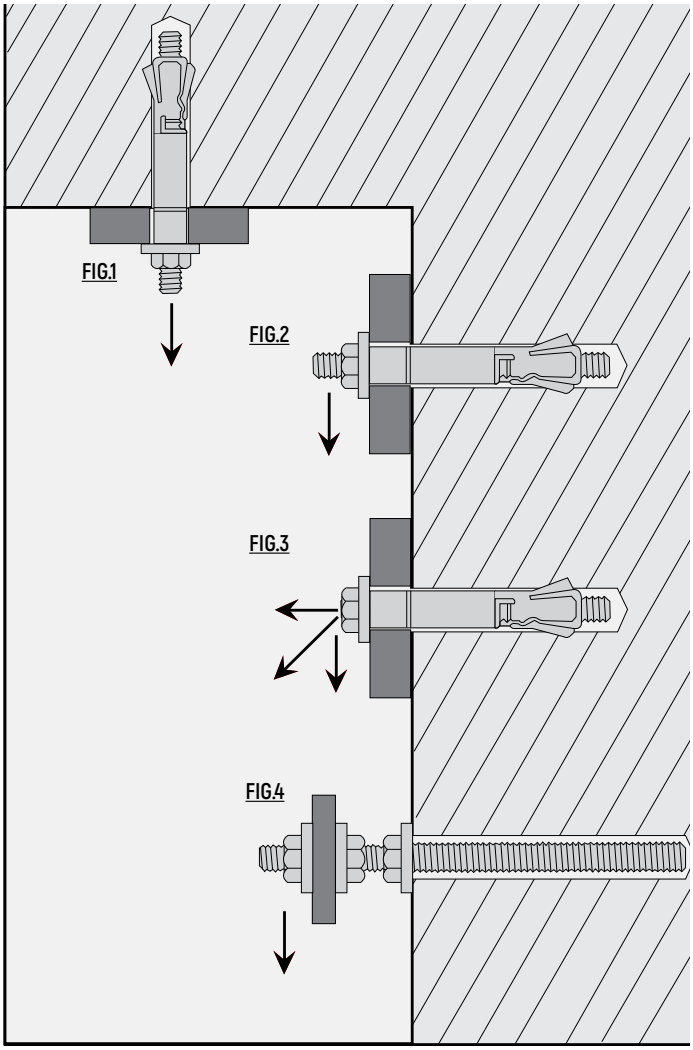
Shear Loads

Shear loads act at right angles to the axis of fixing and directly against the face of the structural material (see Fig.2).

Shear performance is governed mainly by the shear strength of the bolt material and by the comperssive strength of the supporting substrate.

Oblique / Combined Loads

Oblique loads are a combination of tension and shear components (see Fig.3).



If the angle of the applied oblique load is within 10° of pure tension or pure shear, the safe working load for that direction may be assumed. Otherwise, the applied oblique load shall be resolved into its shear and tensile components.

Offset Loads

Offset loads act at right angles to the fixing axis but are offset from the surface (see Fig.4).

In this situation, the deflection of the bolt due to bending needs to be considered as well as the shear capacity of the anchor.

Slotted Holes in Fixture

When fixing anchors through slotted holes; it is important to ensure that there is an adequate surface contact between the washer and the fixture to guarantee a positive clamping force. If in doubt, a square plate washer with a thickness of 3mm or above would be recommended in place of the standard washer supplied.

Diamond Drilled Holes

When holes are formed in the structure using a diamond drilling system; extra care is required to ensure the holes are thoroughly cleaned by brushing and blowing for at least three times.

Also, to make a key for the anchor (particulary if a bonded anchor is installed) the sides of the hole shall be roughened up by inserting a standard masonry bit into the hole attached to a hammer action drilling machine. A resin with minimal shrinkage shall be selected for diamond drilled holes.

Expansion Steel Anchor - STM

Typical Applications:
Cable trays, handrails, brackets, staircases, ladders, machines, window panels, base plates, scaffoldings and frameworks .

STM

Expansion Steel Anchor

STM/H

Features:

- Suitable for all screws or threaded bolts with metric thread.
- Low energy impact, power-saving assembly.
- Multiple removing and fixing.
- Inside threaded anchor, allows great flexibility.
- Can use variable lengths and art of threaded rods or bolts.
- Small edge distance and small distance between anchors.
- Provide uniform load by tightening the screw or hexagon nut, the cone pulls into the expansion anchor and tightens against the drilled hole.
- Suitable for use in concrete and natural stone.

Materials:

- zinc plated steel.
- stainless steel [SS 304 (A2) , SS 316 (A4)].

Technical Data:

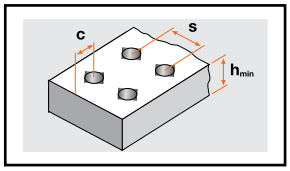
Recommended loads (non-cracked concrete C 20/25).

Type (order No)	Tension Load (KN)	Shear Load (KN)	Torque Moment (Nm)	Screw Grade
M6	2.5	2.3	10	4.6
M8	3.3	4.4	17	4.6
M10	4.7	6.5	34	4.6
M12	6.9	8.5	60	4.6

*for cracked Concrete we shall use 0,5 x this value (approximately)

Setting Data:

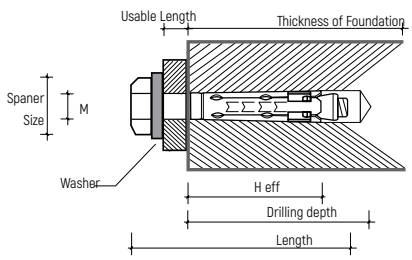
Edge distance > 1,5 x H eff., distance between anchors > 3 x H eff.
Thickness of foundation > 2 x H eff.



Size	H eff. (mm)	Edge Distance C (mm)	Distance Between Anchors S (mm)	Thickness of Foundation h_{min} (mm)	Washer (Ø)	Tightening Torque (Nm)	Spanner size (mm)
M6	40	60	120	100	x 1.6 12	10	10
M8	45	68	135	100	x 1.6 16	20	13
M10	55	83	165	110	x 2.0 20	40	17
M12	70	105	210	140	x 2.5 24	75	19

Installation Parameters:

H eff = Effective anchorage depth.



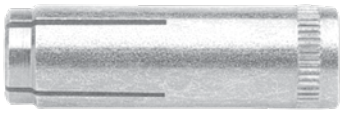
Bolt Size	Length exp.unit (mm)	Drill (Ø) (mm)	Drilling depth (mm)	H eff. (mm)	Usable Length (mm)	Screw Ø x Length (mm)
M6	45	10	55	40	5	M6 x 50
M8	50	12	60	45	10	M8 x 60
M10	60	15	80	55	20	M10 x 80
M12	75	18	90	70	25	M12 x 90

Drop in Anchor - SDA

Typical Applications:

- Pipes, ventilation ducts, suspended ceilings, sprinkler systems, brackets, threaded rods, cable trays.

SDA



Features:

- Provides permanently fixed threaded socket in concrete.
- Use in non-cracked concrete or cracked concrete and natural stone.
- The anchor will spread and tighten against the drilled hole after inserting with setting tool.
- Low setting depth, reduced drilling time.
- Enables cost-effective assembly .
- Multiple removing and fixing.

Materials:

- zinc plated steel.
- stainless steel [SS 304 (A2) , SS 316 (A4)].

Technical Data:

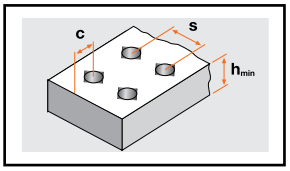
Recommended loads (non-cracked concrete C 20/25).

Threaded size	Tension Load (KN)	Shear Load (KN)	Torque Moment (Nm)
M6	2.0	1.2	4.0
M8	3.5	2.2	8.0
M10	4.25	3.5	15.0
M12	5.55	5.0	35.0

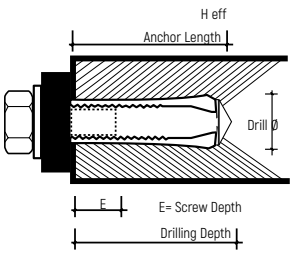
*for cracked Concrete we shall use 0,5 x this value (approximately)

Setting Data:

Edge distance > 1.5 x effective anchorage depth, distance between anchors > 3,0 x effective anchorage depth, min. thickness of foundation > 2,5 x H eff.



Size	H eff. (mm)	Edge Distance C (mm)	Distance Between Anchors S (mm)	Thickness of Foundation h_{min} (mm)	Tightening Torque (Nm)	Spanner size
M6	25	37.5	75	100	4	10
M8	30	45	90	100	9	13
M10	40	60	120	130	17	17
M12	50	75	150	140	30	19



Installation Parameters:

H eff = Effective anchorage depth.

Thread Size	Anchor Length (mm)	Thread Length (mm)	Drill (Ø) (mm)	Drilling Depth (mm)	Effective Anchorage Depth H eff. (mm)	Min. Screw Depth E (mm)	Max. Screw Depth E (mm)
M6	25	11	8	25	25	6	12
M8	30	13	10	30	30	8	13
M10	40	15	12	40	40	10	17
M12	50	20	16	50	50	12	18

Sleeve Anchor - SAS

Typical Applications:
Uni-channel ,railings, steel constructions , machines, high-racks, cable support systems and mechanical fixations.

SAS

Features:

- Suitable for use in concrete, natural stone, brickwork and blockwork- small distance between anchors.
- Optimum performance in most base material types.
- No protruding threads after installation.
- Small distance between anchors and from edge.
- Controlled expansion.
- Zinc plated > 5µm.
- Effective force distribution in the drilled hole.
- Sleeve anchor with hexagon screw or with threaded bolt.

Materials:

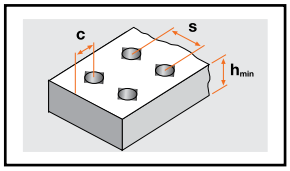
- zinc plated steel.
- stainless steel [SS 304 (A2) , SS 316 (A4)].

Technical Data:

Recommended loads (non-cracked concrete C 20/25).

Bolt Size	Tension Load (KN)	Shear Load (KN)	Torque Moment (Nm)
M6	1.40	2.0	10
M8	2.45	3.3	25.0
M10	3.5	5.0	40.0
M12	....	....	....

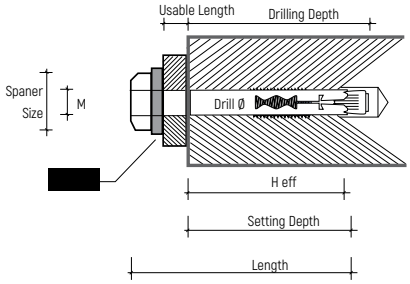
*for cracked Concrete we shall use 0,5 x this value (approximately)



Setting Data:

Edge distance > 1.5 x effective anchorage depth, distance between anchors > 3,0 x effective anchorage depth, min. thickness of foundation > 2,5 x H eff.

Bolt Size	H eff. (mm)	Edge Distance C (mm)	Distance Between Anchors S (mm)	Thickness of Foundation h_{min} (mm)	Washer (Ø) (mm)	Tightening Torque (Nm)	Spanner size
M6	35	52.5	105	70	x 1.6 18	8	10
M8	40	60	120	80	x 1.6 16	25	13
M10	50	75	150	100	x 2.0 20	40	17
M12	75	112.5	225	150	x 2.0 26	50	19



Sleeve Anchor - SAS:

with hexagon screw (non-cracked concrete C20/25).

Size	Length (mm)	Drill (Ø) (mm)	Hole Ø in Fixture (mm)	Drilling Depth (mm)	Setting Depth (Ø)	H eff. (mm)	Min.Usable Length (mm)
M6	45	8	10	55	35	35	5
M6	60	8	10	55	35	35	15
M8	60	10	12	60	40	40	15
M8	80	10	12	60	40	40	25
M10	70	12	14	70	50	50	15
M10	100	12	14	70	60	50	35

*for cracked Concrete we shall use 0,5 x this value (approximately).

Through Bolt (Wedge Anchor) - STB

Typical Applications:
Uni - channel, hand rails, steel construction, cable trays, supports, bracket, ducts and shelf feet.

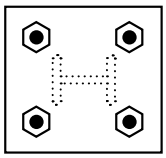
STB

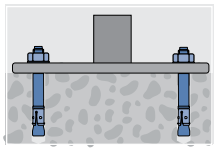
Features:

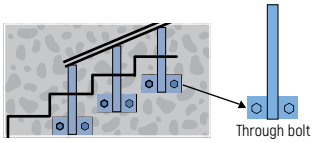
- Suitable for use in cracked concrete or in non-cracked concrete and in natural stone.
- Special design of the clip in stainless steel which ensures a safe hold in the hole.
- Torque controlled expansion.
- Zinc plated > 5µm.
- User friendly, face fixing or through fixing.

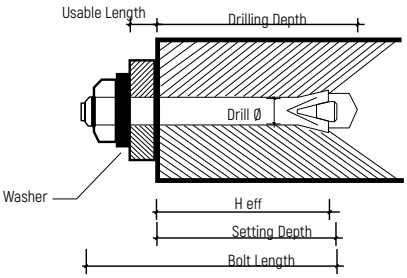
Materials:

- zinc plated steel.
- stainless steel [SS 304 (A2) , SS 316 (A4)].









Technical Data:

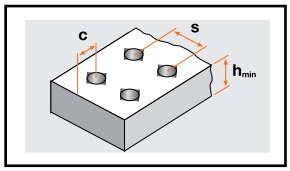
Through bolt zinc plated (non-cracked concrete C20/25).

Bolt Size	Tension Load (KN)	Shear Load (KN)	Torque Moment (Nm)
M6	2.0	1.90	4.0
M8	4.0	4.0	15.0
M10	5.95	5.95	30.0
M12	7.5	10.0	50.0
M16	12.0	16.0	100

*for cracked Concrete we shall use 0,5 x this value (approximately)

Setting Data:

Edge distance > 1,5 H eff. , distance between anchors > 3 x H eff.
Thickness of foundation > 2 x H eff.



Bolt Size	H eff. (mm)	Edge Distance C (mm)	Distance Between Anchors S (mm)	Washer (Ø)	Thickness of Foundation h_{min} (mm)	Tightening Torque (Nm)	Spanner Size
M6	40	60	120	x 1.6 12	100	7	10
M8	50	75	150	x 1.6 16	100	14	13
M10	58	87	174	x 2.0 20	120	30	17
M12	68	102	204	x 2.5 24	140	35	19
M16	80	120	240	x 3.0 30	160	80	24

Shield Anchor - SHA

Typical Applications:

For fixing : steel construction, handrail, console, bracket, ladders, gate and spacing design.

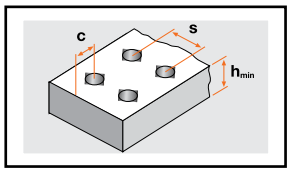
SHA

Features:

- Assembly detachable, multiple removing and fixing.
- Low energy impact, power-saving assembly.
- Force controlled expansion.
- Flexibility inside threaded anchor.
- Variable length and art of threaded rods or bolts.
- By tightening the screw, the cone pulls into the sleeve and tense against the drill hole.
- Small edge distance and small distance between anchor.
- Expansion elements are held together by a spring.
- Optimum taper nut angle for maximum expansion.
- Pressed steel segment ensure consistent dimensional accuracy.
- Provide a projecting stud to support fixture during installation and removal.
- Suitable for use in concrete, natural stone, Brick and sand stone.

Materials:

- zinc plated and die-cast.

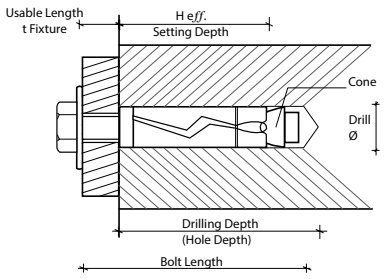


Technical Data:

Recommended loads (concrete C 20/25 and in brick work).

Bolt Size	Tension Load (KN)	Shear Load (KN)	Torque Moment (Nm)
M6	1.2	1.2	10
M8	1.6	1.6	25
M10	3.2	3.2	40
M12	4.8	4.8	60

*for cracked Concrete we shall use 0,5 x this value (approximately)



Setting Data:

Edge distance > 1,5 x H eff., distance between anchors > 3 x H eff.

Thickness of foundation > 2 x H eff.

Bolt Size	H eff. (mm)	Edge Distance C (mm)	Distance Between Anchors S (mm)	Thickness of Foundation h_{min} (mm)	Washer (Ø) (mm)	Tightening Torque (Nm)	Spanner size
M6	52.5	105	70	35	x 1.6 18	8	10
M8	60	120	80	40	x 1.6 16	25	13
M10	75	150	100	50	x 2.0 20	40	17
M12	90	180	120	60	x 2.0 26	50	19

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