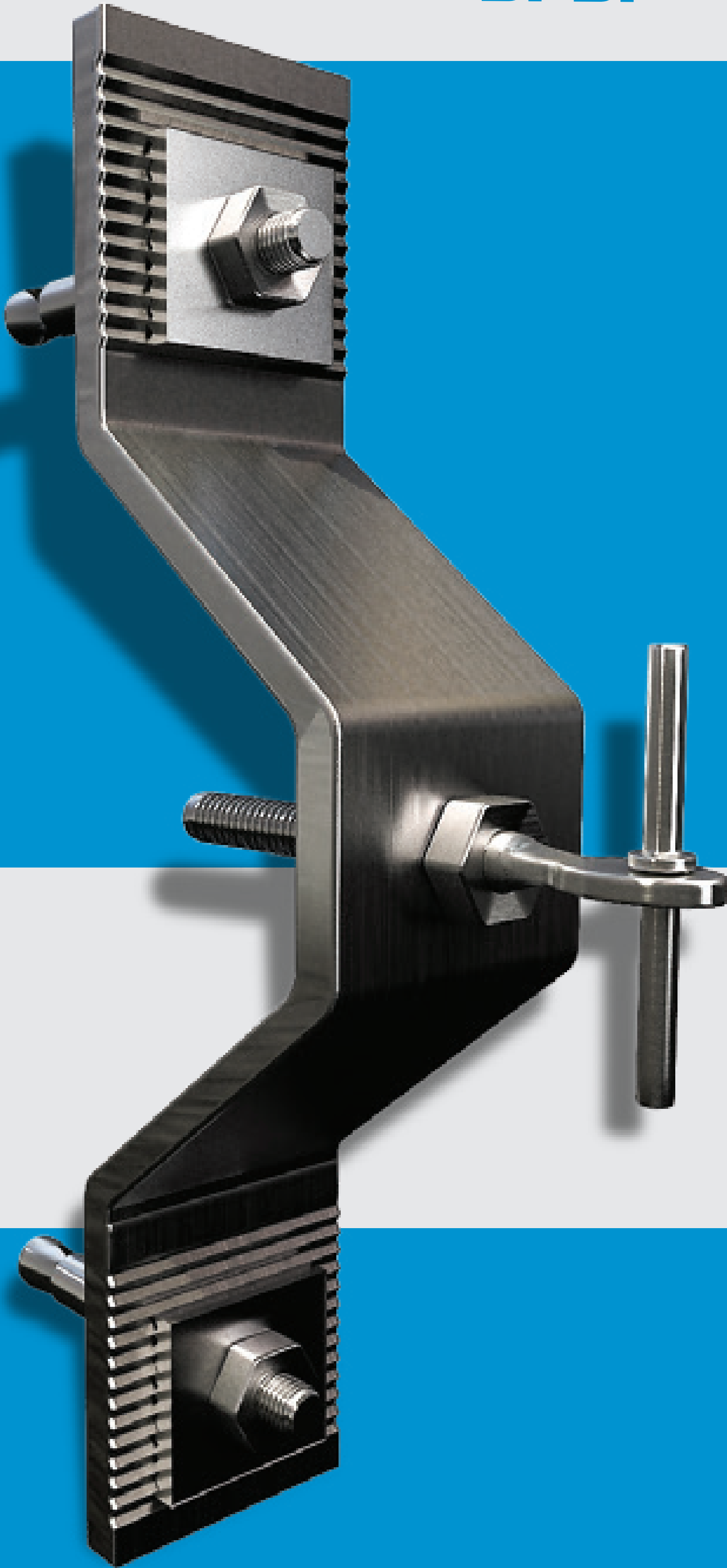
Specialized Factory for Steel Products
SIGMA Factory for Steel Products

SFSP

MECHANICAL CLADDING FIXATION

CATALOGUE



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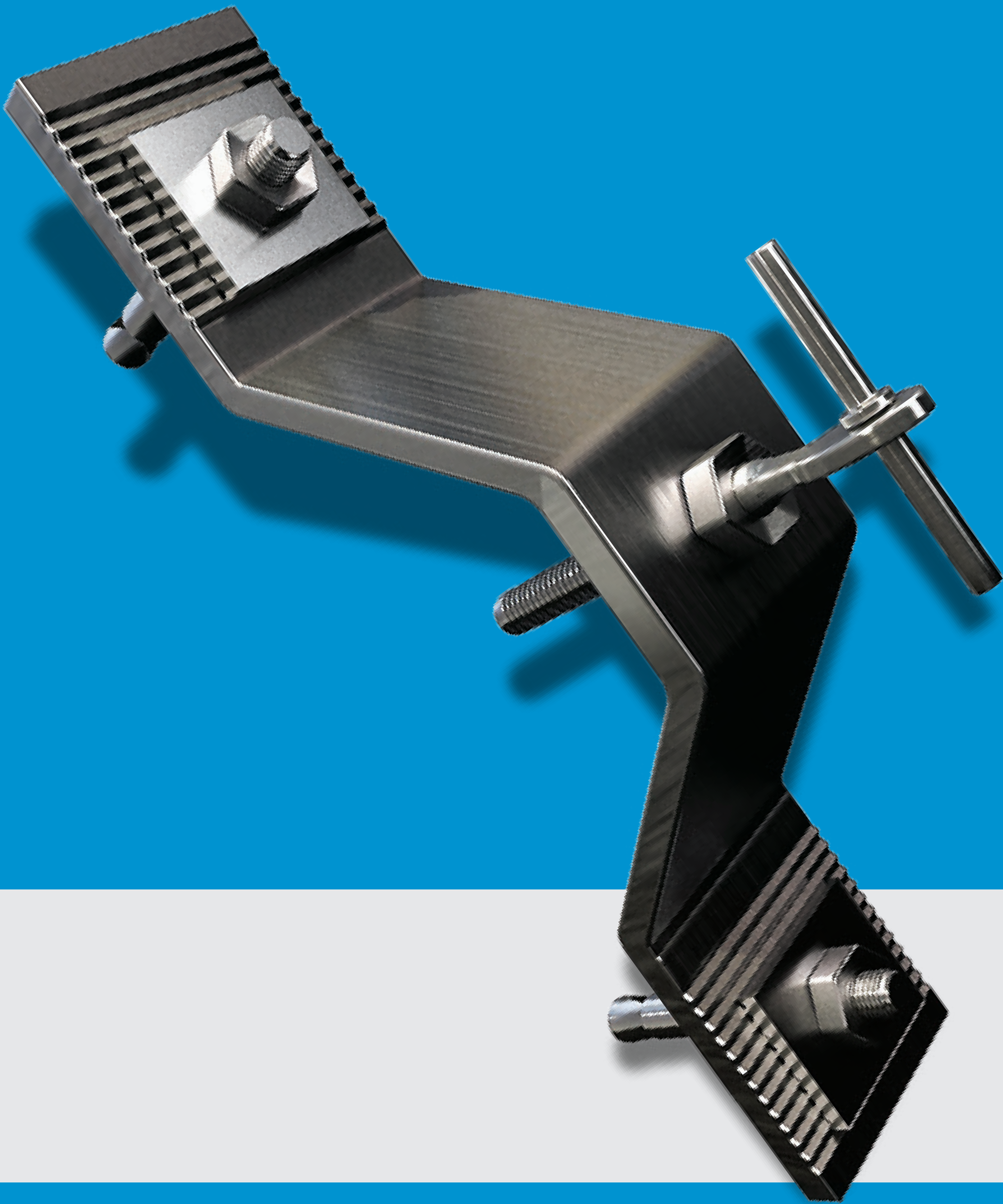
Mechanical Cladding Fixation



www.sfsp-ikk.com

ABOUT SFSP

Specialized Factory for Steel Products Co. Ltd
Sigma Factory for Steel Products
www.sfsp-ikk.com

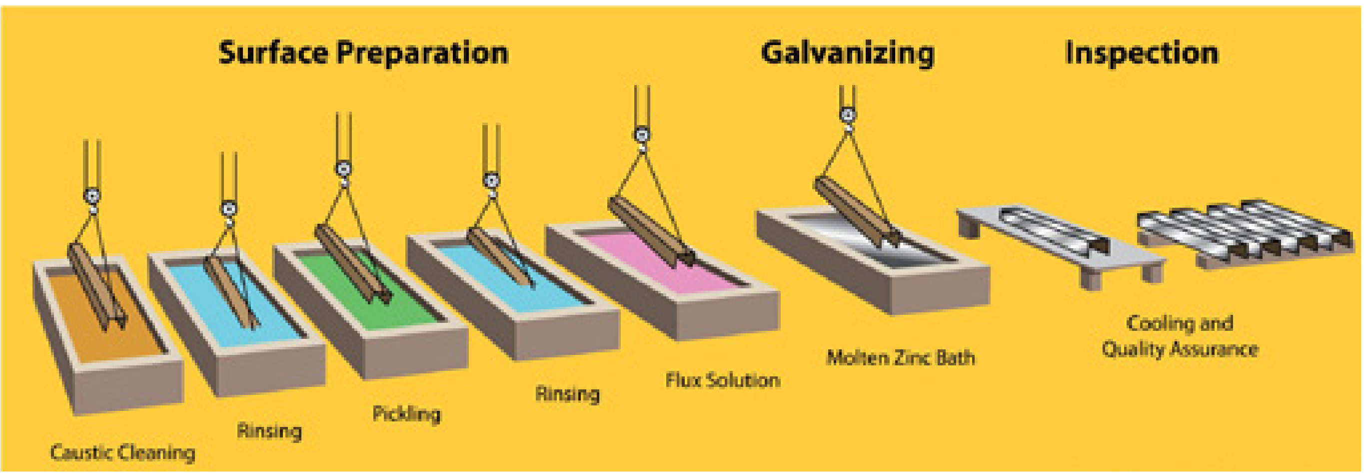
Specialized/Sigma Factory for Steel Products (SFSP) was first established in KSA in 1989 and has been expanding ever since through a variety of products and through its geographical presence.
Production at the factory is observed using modern practices of manufacturing methods in the steel construction industry with a definite compliance to international standards of fabrication.

SFSP has manufacturing facilities in KSA, UAE, Egypt, and Lebanon. SFSP adapts quickly and easily to market demands and requirements. The factory is operating a top of the line production machinery, fully automated with highest technology to ensure quality and maintain speed with delicacy.

Quality at SFSP is uncompromised; the factories have been able to acquire ISO 9001: 2008 Quality Management System, ISO 14001:2004 Environmental Management certified factory, and OHSAS 18001:2007 Occupational, Health and Safety Management factory.

HOT-DIP GALVANIZATION

SFSP has an in-house state of the art Hot-Dip Galvanization facility, which permits a full control of the quality of its finished products, offering better services to our clients globally.



Specialized Factory for Steel Products Co., ltd, which is part of Isam Khairi Kabbani Group of companies is a leading fabricator of steel construction products serving the kingdom of Saudi Arabia since 1989.

The factory operates under TQM ISO modules, using the latest modern technology in the steel fabrication and manufacturing industry in conformity with International standards for safety and in compliance with the environmental regulations in the Kingdom.

The factory has inaugurated its new manufacturing facilities which is located in the 3rd Industrial Area of Jeddah with a total built facilities of 37,000 squared meters.

The facilities include two manufacturing areas, a hot dip galvanization advanced section, warehousing areas and administrative building. The project is an advanced environmental low emissions factory built with a definite consideration of the safety of its workers and visitors.

TECHNICAL SERVICES

A crucial factor in the job of a factory is to provide continuous technical services and consultations. That's why SFSP has invested in a professional team of researchers and specialists.

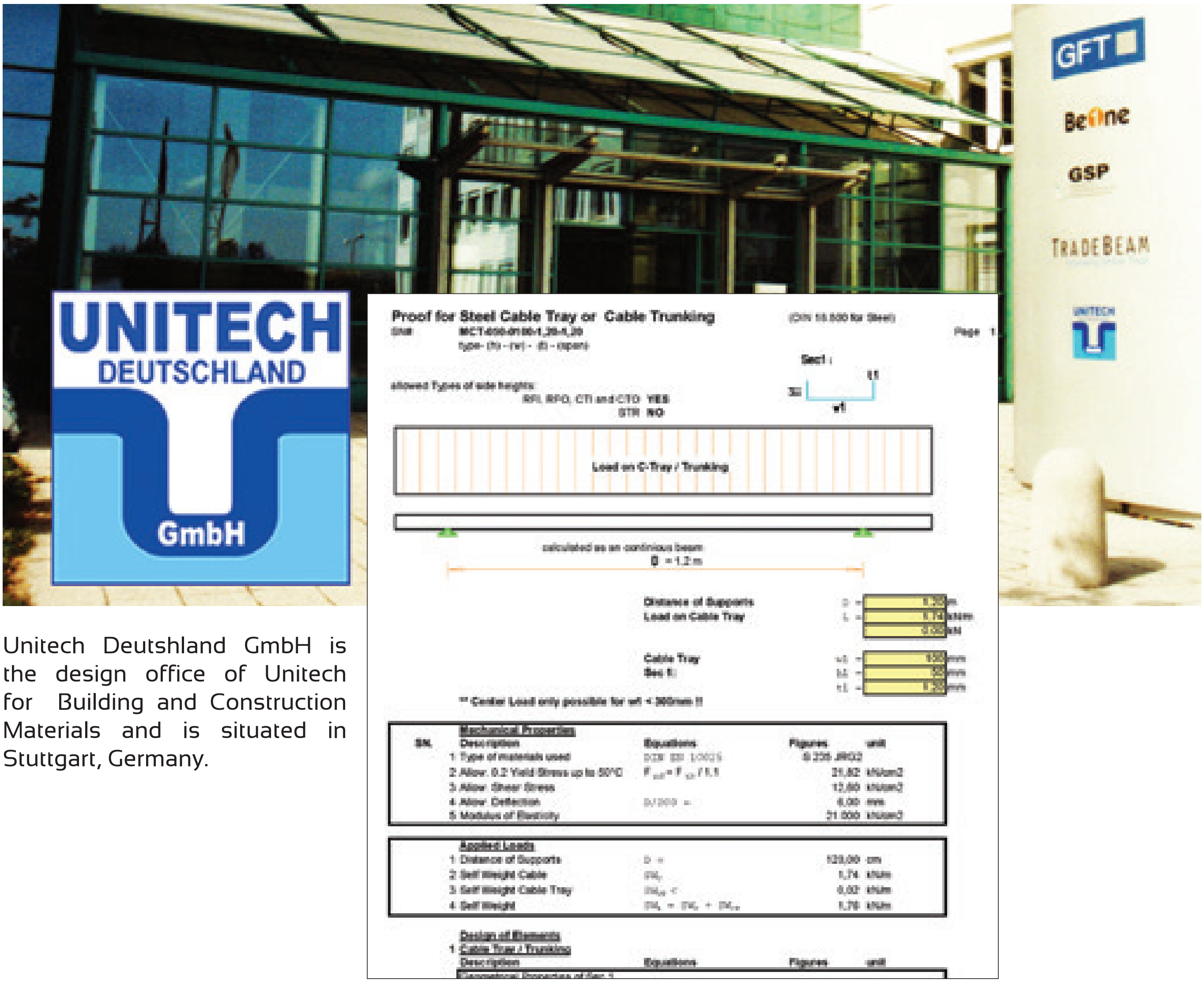
SFSP has recruited brilliant graduates and experienced engineers having the appropriate knowhow on the on latest technology changes and development in the steel building materials industry.

The product range is developed and updated according to the relevant standards of fabrication across markets, whilst the business processes are evaluated to achieve maximum efficiency.

SFSP R&D Core Objectives

- Carry out responsibilities effectively in a safe and healthy work environment.
- Develop and implement research programs relevant to the products and solutions introduced and ensure that the results are communicated clearly in-house and among the clients , concisely and accurately.

DESIGN AND ENGINEERING OFFICE - GERMANY



Unitech Deutshland GmbH is the design office of Unitech for Building and Construction Materials and is situated in Stuttgart, Germany.

SOCIAL RESPONSIBILITY

Being socially responsible is a part of who we are and how we do our business. We aim to provide useful products and services, to provide jobs and development opportunities for our communities, and to gain satisfaction through meaningful work.
We make a difference by acting on the values and principles of our societies and we inspire others to do so. At SFSP, we anticipate and reduce threats caused by environmental changes or natural disasters, and we are well adapted to significant social changes.
We contribute to a more sustainable society by means of value and support to our consumers, supply chains, and stakeholders. We are keen to identify ways they can improve our impacts on the people and places we work and live in, and thereby become more valuable and valued members of society.

- Organizational governance: We promote accountability and transparency at all levels, thus, promoting responsibility
- Human care: We treat individuals with respect; and make efforts to help members of vulnerable groups
- Labor practices: We provide just, safe and favorable conditions to workers
- Environment: At SFSP, we Identify and improve environmental impacts of our operations, including the resource use of natural resources and waste disposal.
- Fair operating practices: Practicing accountability and fairness in dealings with other businesses

At SFSP, we are committed to continuous improvement ongoing learning, process review and innovative thinking that foster new initiatives; and better practices. Our environmental programs evolve to meet today's changing needs while; protecting resources for future; generations.

HEALTH AND SAFETY

The Factory Management regard the health and safety of the employees, clients and all others that may be affected by their operations to be of a major importance.

In support of this, the management promotes health and safety throughout the Factory's operations and endeavour to engender a positive attitude in all employees towards the prevention of accidents and maintenance of healthy working arrangements.

The Factory satisfies the requirements of the Health, Safety and related legislation by setting out the responsibilities of all levels of staff and the arrangements for carrying out those responsibilities and in particular do what is reasonably practicable to:

1. Maintains safe & healthy working conditions.
2. Ensures that all facilities and equipment are safe and properly maintained.
3. Provides products that can be applied and used safely and without risk to health.
4. Provides and maintain working procedures, that are safe and without risk to health, throughout the its operations in respect of:
   - The use, handling, storage, transports and disposal of materials and substances.
   - The use of factory equipment.
   - Potential emergency situations, including first aid, fire and escape of substances.
5. Ensure the competence of employees.

The factory is an OHSAS 18001:2007 Occupational, Health and Safety Management certified Factory.

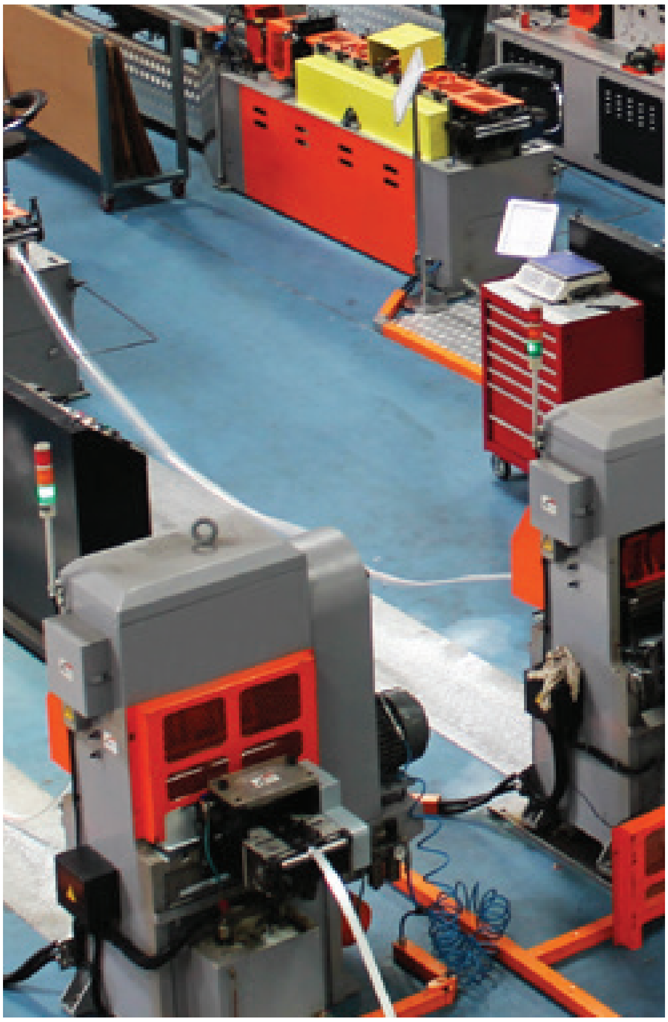
ENVIRONMENTAL AWARENESS

SFSP is committed to the following:

- Compliance with all statutory and regulatory requirements related to its activities, products and services and the environmental aspects.
- Identifying quality and environmental objectives by review and audit of the processes both in-house and on-site.
- Formally setting objectives based on the results of the process reviews and their significance in relation to their impact on the environment and the continual improvement of the quality and environmental management system.
- Implementing management programs to achieve these objectives.
- Investing in a well-trained and motivated workforce.
- Working closely with suppliers and customers to ensure mutual understanding and benefits of the environmental aspects consideration.
- Reviewing our policy and objectives as part of the Management Review Process.
- Communicating this policy to all persons working for or on behalf of the organization.
- Preventing and minimizing Pollution to the environment.

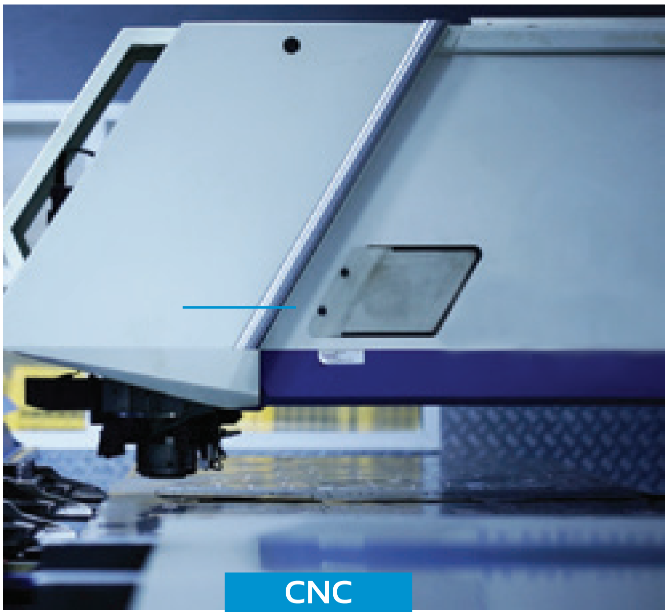
SFSP operates under environmental management system certification BS EN ISO 14001:2004 and maintain it through registration and annual review.

SFSP facilities are equipped with the most technologically advanced machinery amongst are Laser Cut Machines, Robot Bending Sets, Welding Robot Sets, sophisticated Cable Management Production Lines, as well as Specialized Industrial Sections for its Hot Dip Galvanization facilities.



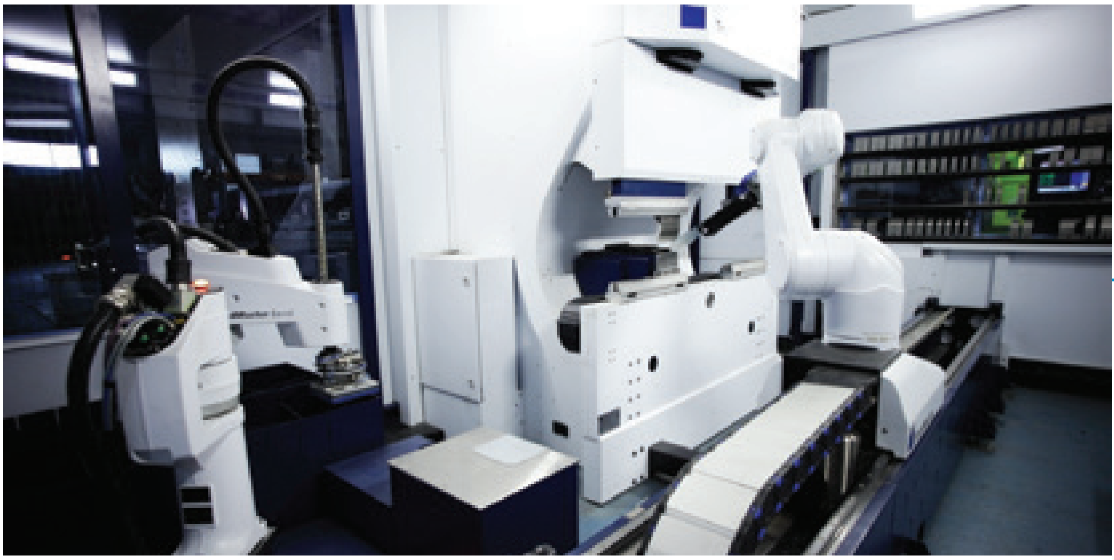
CNC MACHINES

WELDING ROBOT SETS



CNC PUNCHING

FIBER LASER CUT



ROBOTIC BENDING CELL

SFSP CERTIFICATION

ISO 9001 certified
(Quality Management System)

CERTIFICATE OF REGISTRATION

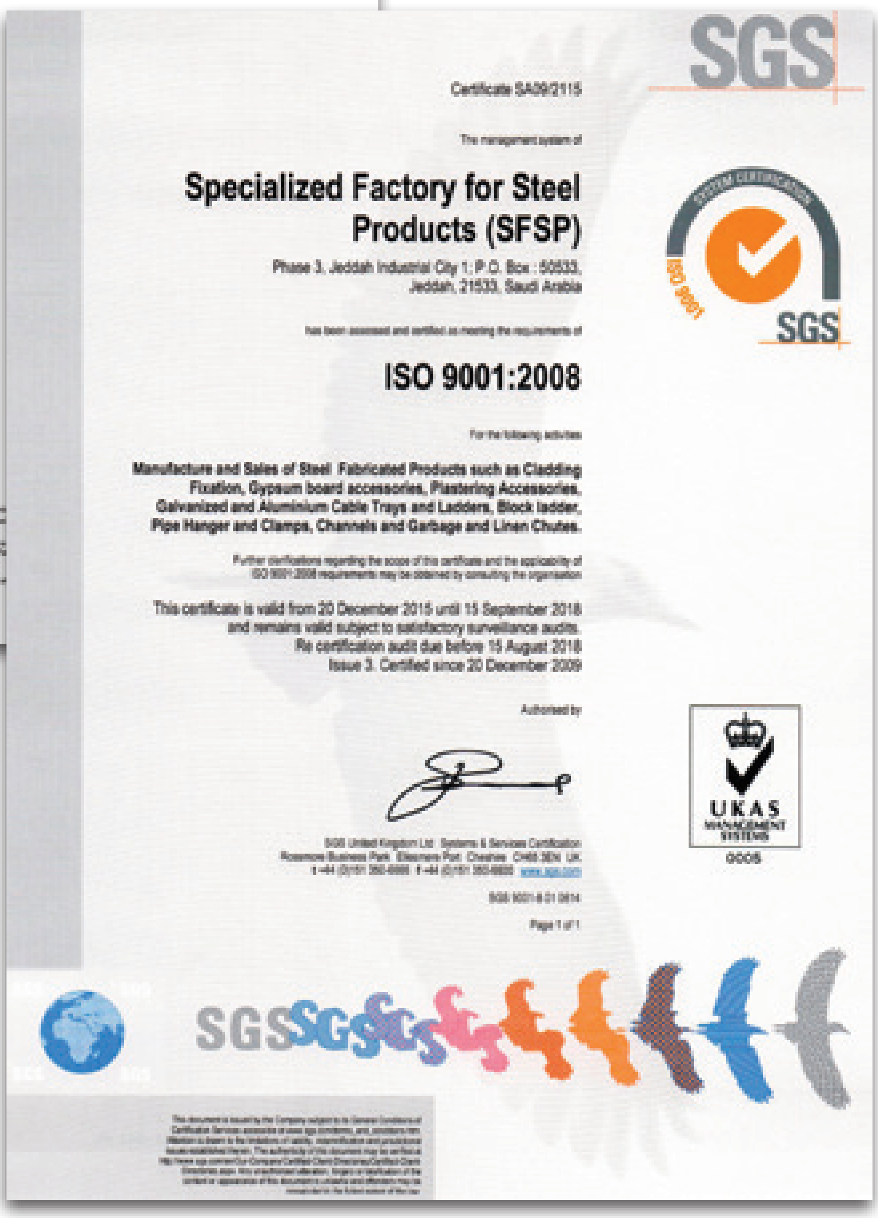
This is to certify that

Sigma Factory for Steel Products
P.O. Box 37991
Salh Suhaib - 3, 4 Round About
Dubai Industrial City
Dubai
United Arab Emirates

has been audited and found to meet the requirements of standard
ISO 9001:2015 Quality Management System

Scope of certification
Trading and Manufacturing of all kinds of Steel Related Construction Materials

Certificate number: 5965



Certificate SA09/2115

The management system of

Specialized Factory for Steel Products (SFSP)

Phase 3, Jeddah Industrial City 1; P.O. Box : 50533, Jeddah, 21533, Saudi Arabia

has been assessed and certified as meeting the requirements of

ISO 9001:2008

For the following activities

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.

This certificate is valid from 20 December 2015 until 15 September 2018 and remains valid subject to satisfactory surveillance audits. Re certification audit due before 15 August 2018. Issue 3. Certified since 20 December 2009

Authorised by

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ISO 14001 Certified
(Environment Management System)

CERTIFICATE OF REGISTRATION

This is to certify that

Sigma Factory for Steel Products
P.O. Box 37991
Saih Shuaib - 3, 4 Round About
Dubai Industrial City
Dubai
United Arab Emirates

has been audited and found to meet t[illegible]
ISO 14001:2015 Environmental Mana[illegible]

Scope of certification
Trading and Manufacturing of all kinds [illegible]
Materials

Certificate number: 2524
Issue number: 2018-01
Certificate start date: 22 September 2015
Certificate expiry date: 21 September 2018
Date of initial certification: 22 September 2015

ISO 18001 Certified
(Health & Safety Management system)

BMTRADA

CERTIFICATE OF REGISTRATION

This is to certify that

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

has been audited and found to meet the requirements of standard
OHSAS 18001:2007 Health & Safety Management System

Scope of certification
Trading and Manufacturing of All Kinds of Steel and Construction Materials

Certificate number: 1006

Signed on behalf of Tom Johnston
General Manager
Central Certification Services

UL Certification*

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.

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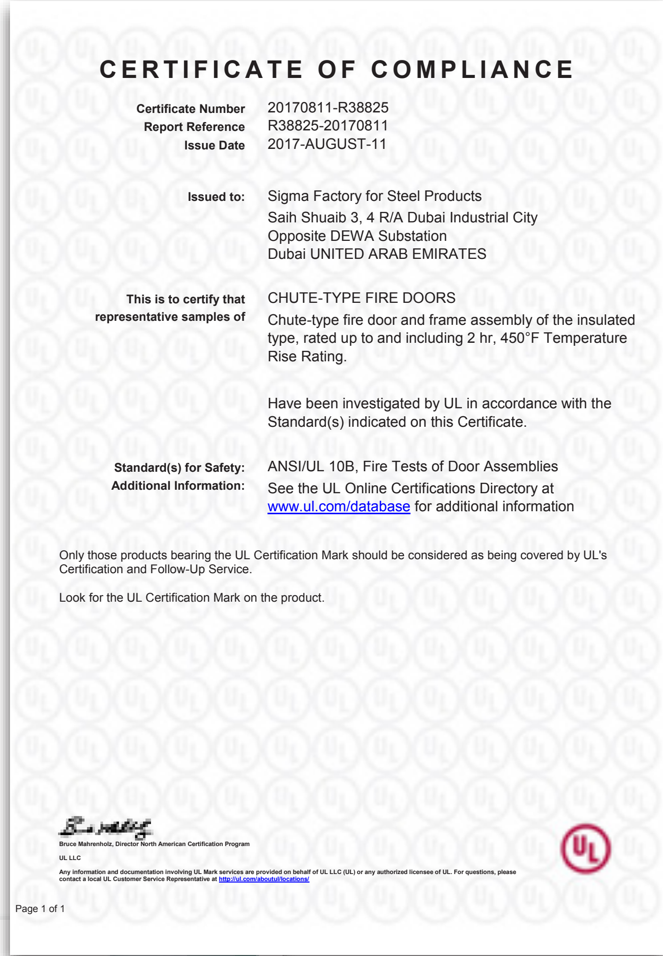

CERTIFICATE OF COMPLIANCE

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.

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/

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CERTIFICATE

DEKRA

Product: Cable management system

Trade name: SFSP

DEKRA Certification B.V.

Managing Director

Certification Manager

ACCREDITED BY THE DUTCH ACCREDITATION COUNCIL

KEMA KEUR

SFSP PRODUCTS

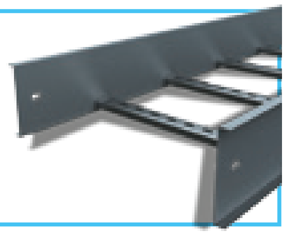
SFSP produces a variety of products ranging from cable management systems; cable trays, cable ladders, basket trays, trunkings and support systems, to mechanical cladding fixations, steel lintels and block work accessories, plasterers' beads, expanded metal and block work reinforcement, strut channel 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.

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.

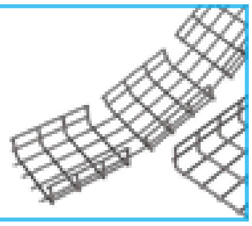
CABLE LADDERS (WELDED & SWAGED)

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.

CABLE MANAGEMENT SUPPORT SYSTEMS

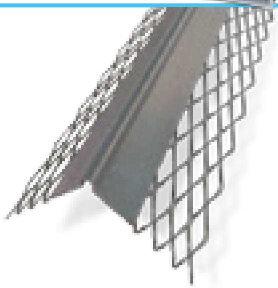
Cable Support Systems are well designed to provide necessary support for cable trays, cable ladders and trunkings. Cable supports are manufactured according to common standards from high quality raw materials.

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.

EXPANDED METALS, PLASTERERS` BEADS

Expanded Metals help the formation of joints, protection of corners and resistance against cracks, chips and impact damage.



BLOCK LADDER REINFORCEMENT

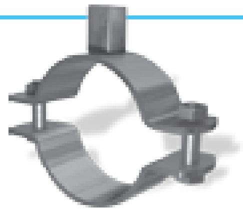
SFSP ladder and truss types are used for the reinforcement of brick and block masonry to give improved tensile strength to walls subjected to lateral loading e.g. wind and seismic. SFSPblock reinforcements reduces the risk of cracking either at stress concentration around opening.

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.

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.



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.

DRY WALL & CEILING PROFILES

SFSP provides a complete product range for dry wall and ceiling constructions. Studs, Runners, Furring Channels, Ceiling Channels and Wall Angles are among the range of products produced to service the dry wall installers.

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. Chutes are used as original equipment in new buildings, such as : Hotels, Hospitals, High Rises and Residential Towers.

SFSP Products are solely distributed by UNITECH for Building and Construction Materials

All Products Manufactured by SFSP are Solely Distributed by SFSP Sister Companies in the Following Countries

KSA

Isam Kabbani & Partners for Building and Construction Materials Co., Ltd.

شركة عصام قباني وشركاه لمواد الأنشاء والتعمير المحدودة

BAHRAIN

Isam Kabbani Trading Est.

مؤسسة عصام قباني التجارية

UAE

Issam Kabbani Trading Est.

مؤسسة عصام قباني للتجارة

KUWAIT

Hassan Kabbani for General Contracting Est.

مؤسسة حسان قباني للمقاولات العامة للمباني

OMAN

Isam Kabbani & Partners Trading Co.

شركة عصام قباني وشركاه للتجارة

EGYPT

UNITECH Egypt for Building Materials

شركة يونيتك مصر لمواد البناء

JORDAN

Jordan Build Co. for Building & Construction Materials

شركة بناء الأردن لمواد الإنشاء و التعمير و الكهرباء

LEBANON

UNITECH ME s.a.r.l

شركة يونيتك ميدل إيست ش.م.م

SFSP CUSTUMER SERVICE CALL CENTER

KSA

+966 13 8590097, Ext. 3214

UAE

+971 4 8181925, Ext. 4269

IKK Group of Companies
www.ikkgroup.com

IKK
Group of Companies

The IKK Group is a major business institution, serving most of the Arab World in the industrial, construction and trading fields, as well as in specialized maintenance and services.

Today, the IKK Group of Companies is a pioneer in waterproofing, weatherproofing, building material supplies, UPVC and CPVC and high density polyethylene pipes and fittings and several other products for the construction industry.

The Group is also represented in the sanitary products, steel production, kitchen manufacturing, telecommunications, food, decoration, re-insurance and real estate business domain.

Composed of 60 companies, the IKK Group operates through almost 200 divisions, branches and outlets; it is spread over 12 countries, covering all major cities in the region and employing around 13,000 employees.

Our vision is to maintain and improve our leading position as a contractor whose reputation is built on the ability to completely satisfy customers by providing high quality services. As specialists in their respective fields, our teams of professionals are dedicated to a standard of excellence for quality and performance, through continuous development, which will set standards in our industry.
We are simply providing solutions for a future of success.

Our mission is to provide our part of the Arab World with local and reliable services in a variety of sectors and products.

To create employment to thousands of personnel and in-house training for hundreds of young Arab graduates in crucial sectors to the benefit of the IKK Group, the graduates themselves and their own communities.

To set a good example of our basic business philosophy: "Hire well, train well, pay well and treat well."

UNITECH
For Building and Construction Materials

UNITECH
ISAM KABBANI & PARTNERS FOR BUILDING & CONSTRUCTION MATERIALS

Isam Kabbani & Partners for buildings & construction materials co. Ltd (UNITECH) which is part of the IKK group of companies is recognized and acknowledged for the quality and reliability of its products and services as well as for the commitment, professionalism and experience of its employees.

Isam Kabbani & partners for buildings & construction materials co. Ltd (UNITECH) core valuse are to offer value products and services to its clients, to work closely with them in a lasting business partnership that provides an outstanding performance.

A partnership based on trust, harmony, and a hard to beat services and solutions.

Our Factories have acquired, in addition to ISO 9001:2008 Quality Management System, the ISO 14001:2004 Environmental Management System.

Our care for the environment has been translated via Isam Kabbani &partners for buildings &construction materials co. Ltd (UNITECH)'s membership in the US Green Building Council as a Golden Member.

Our Vision
UNITECH to be the Customer's First Choice.

Our Mission
We have the conviction to be the leader in building & construction industry through:
- Providing Excellence in Services with Passionate and Educated Sales Force
- Strengthen Culture through Unified Sense of Purpose
- Innovative Product Range which is Customer Centric
- Reputable and Quality Service Company
- Attracting, Engaging and Retaining Talent

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.

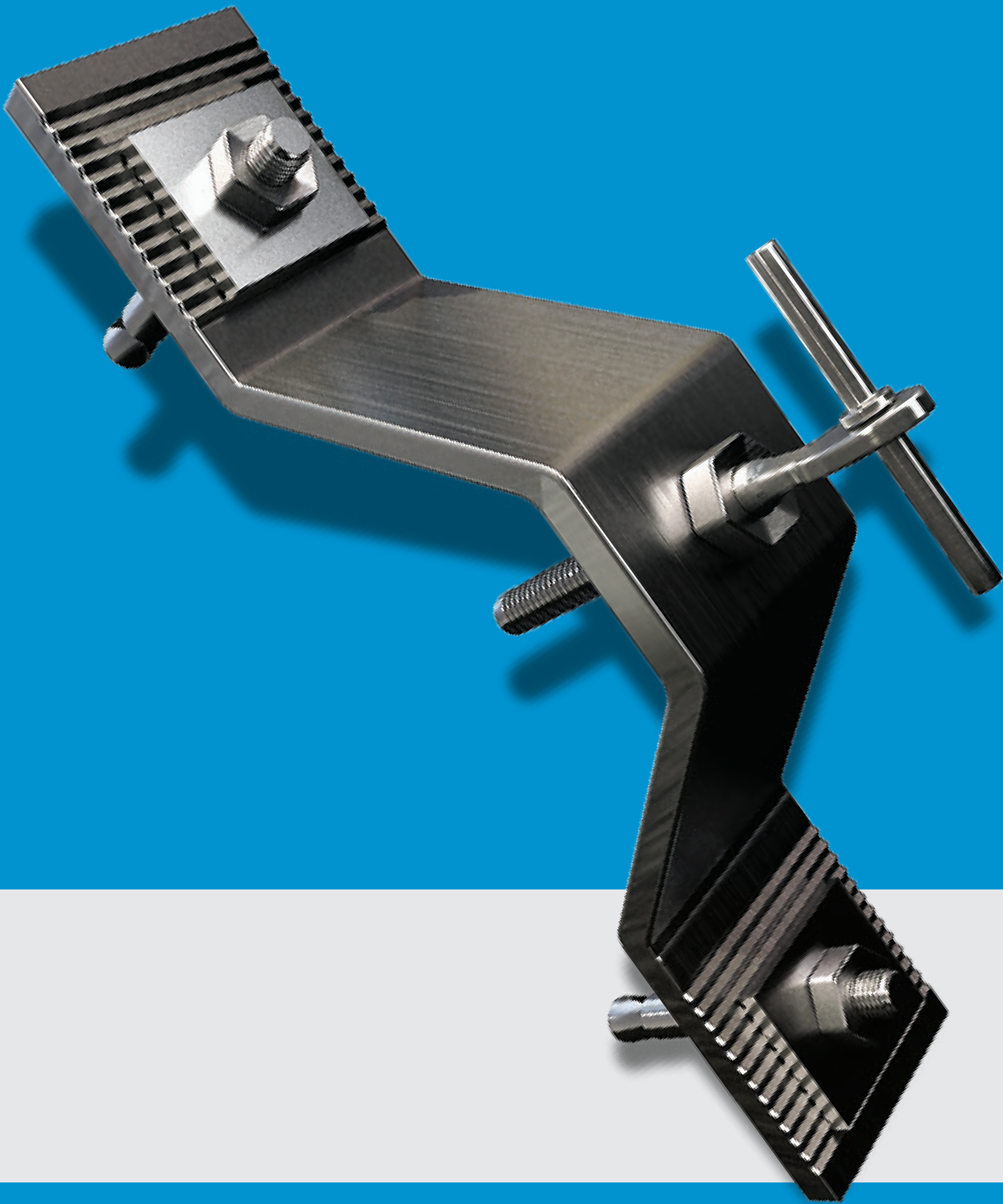
Two fundamental types of fixing systems result:
- Load-bearing fixing: to support the permanent load and the vertical components of the variable loads.
- Restraining fixing: to support the horizontal components of the loads. Restraining fixings instead, serve to maintain the slabs in the positions specified 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



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GENERAL INFORMATION

The most common types of stone are:

Granite

Travertine

Marble

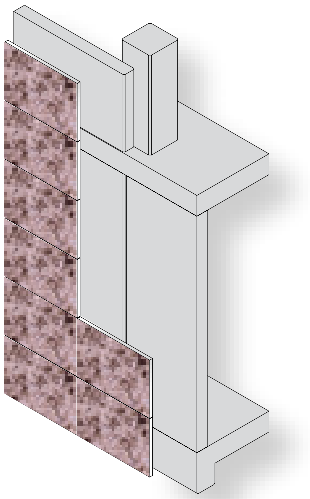
Slate

Limestone

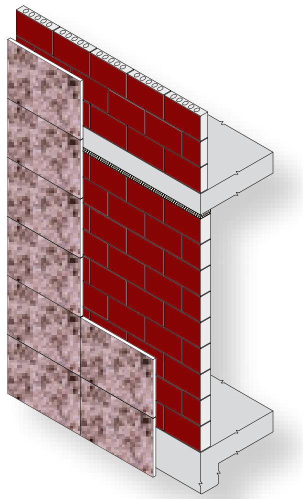
Natural stones have as much colors as you can imagine. The variety of color and texture of the natural stone is huge.

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

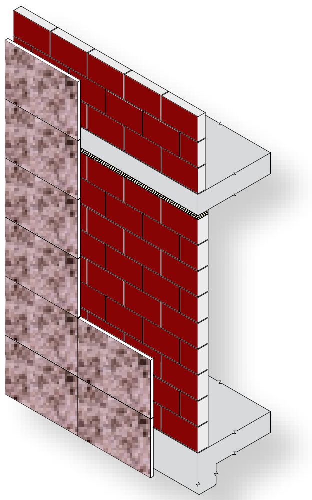
Types of Facade Building Sub-Structure



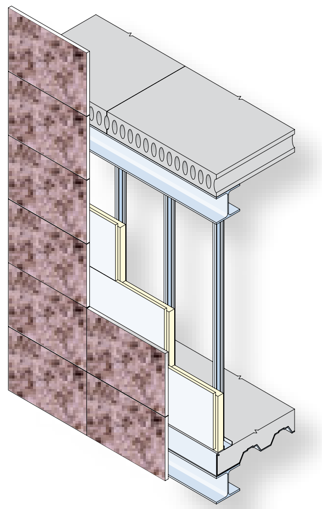
Stone fixed to concrete wall



Stone fixed to hollow block wall

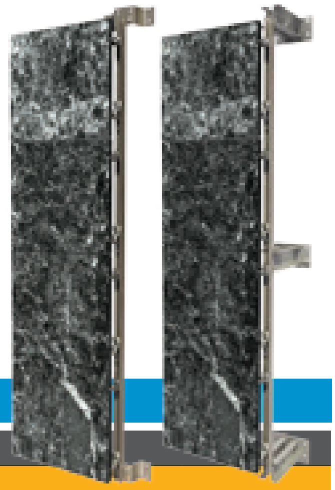


Stone fixed to solid block wall



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.

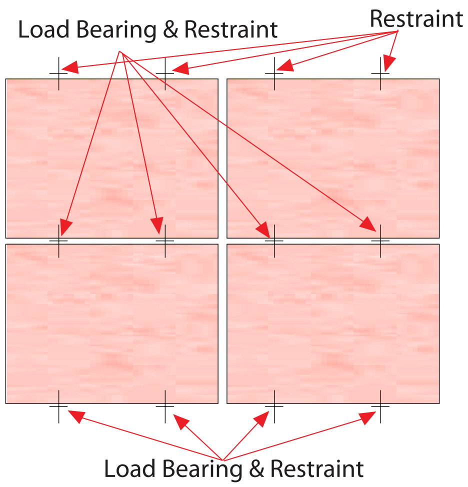
5) Internal cladding between 3.7m and 7m in height in a continuous face should have an intermediate corbel course.

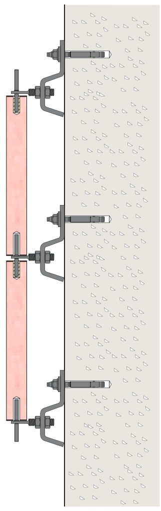
Table based on BS 8298 stone thickness table

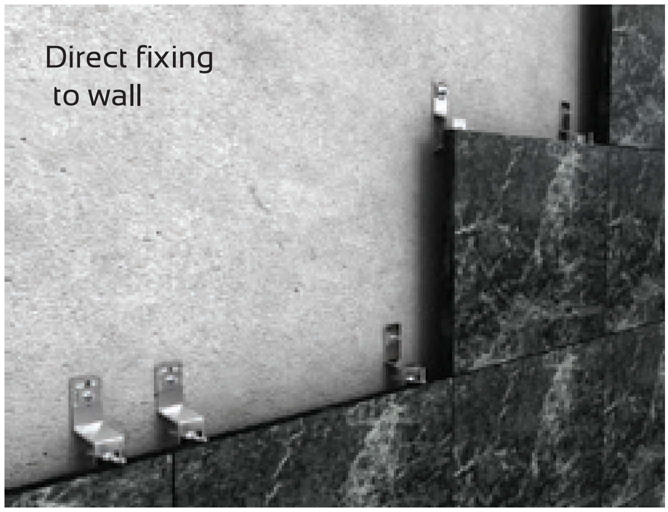
FIXINGS IN HORIZANTAL OR VERTICAL JOINTS

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.

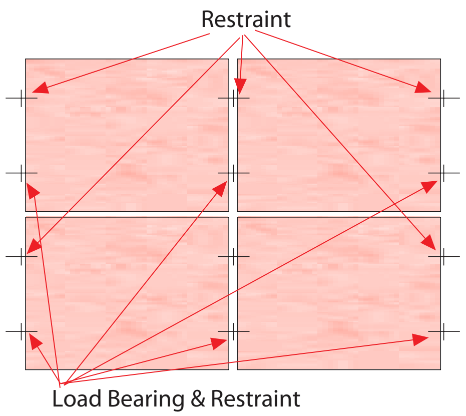


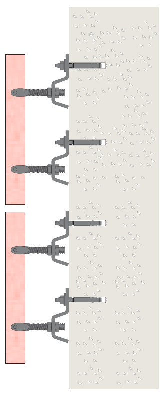


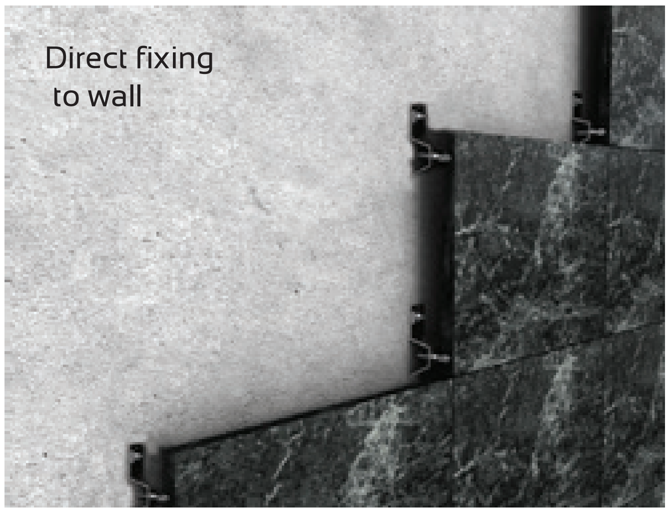


Fixation In The Vertical Joint

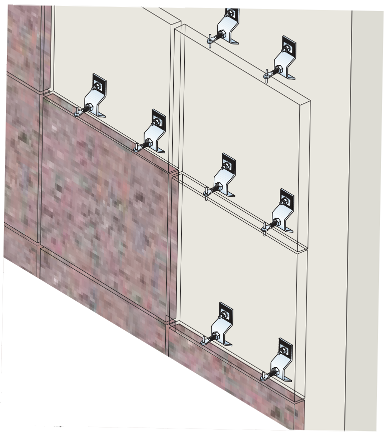
The load bearing carry the full weight of the natural stone slab in vertical installation. Each bracket bears half the weight of the slab on the right and half the weight of the slab on the left. Restraint brackets hold the slabs below and restrain them against wind pressure and suction.



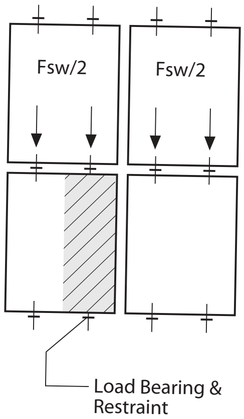




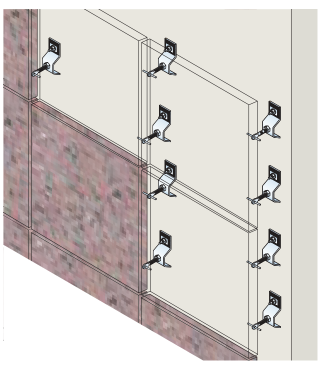
Installation At Horizontal Joints



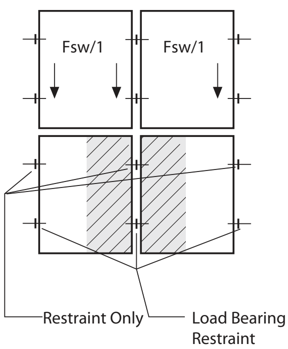
$$Fv = \frac{Fsw}{2}$$



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 /m
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/m
Anchor loading Fv = Fsw/2 = 0.32kN
Fv = 32kg

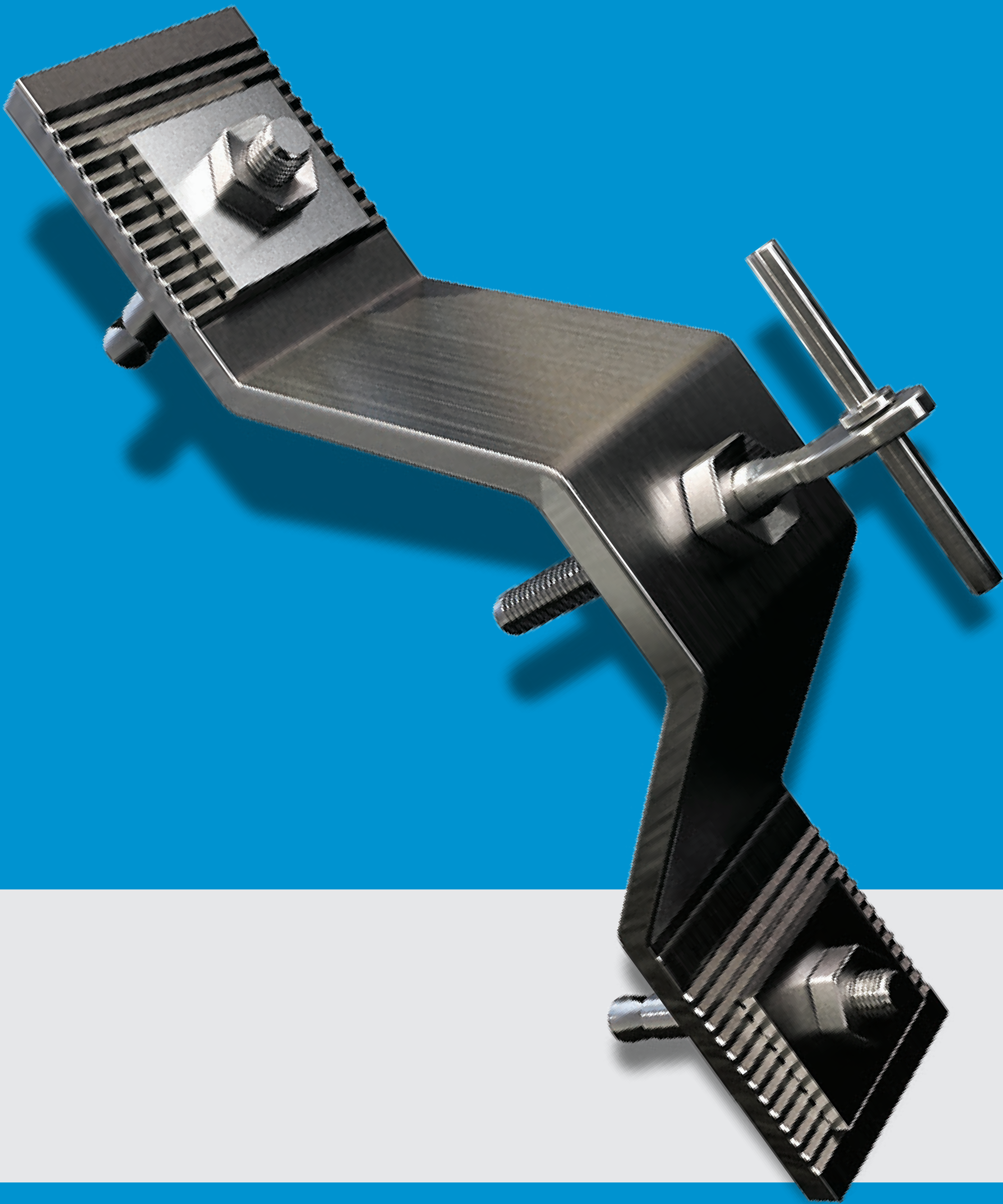
The shape and the material of the facing to be anchored

Determining Anchor Loading FH (Wind loading):

Example:
Natural-stone panel = 0.6/1.00/0.04m
Wind load W = 1.1 kN/m (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.



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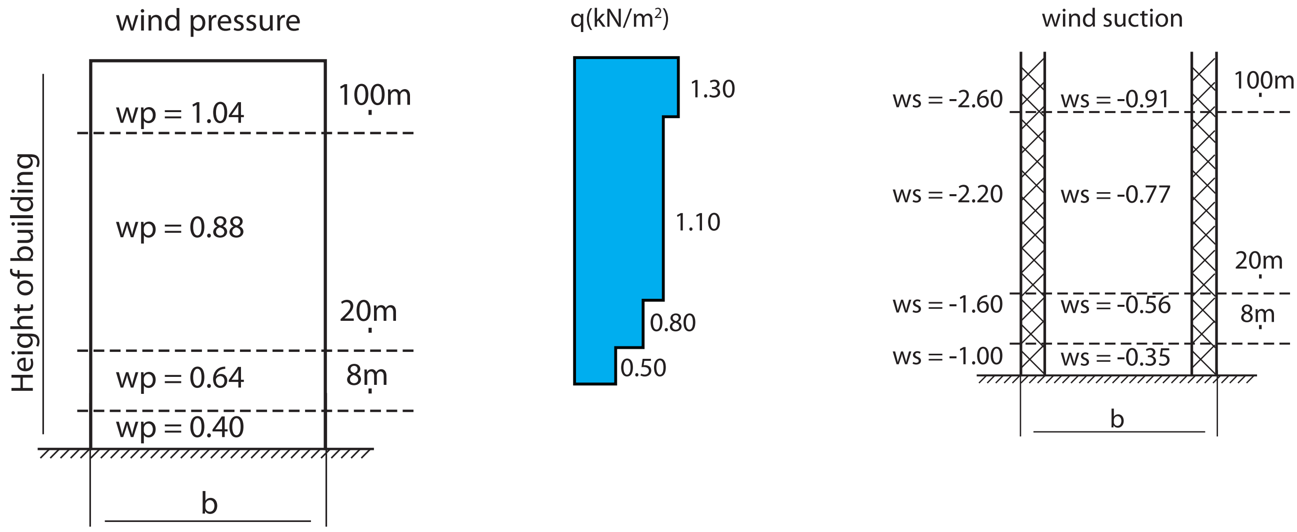
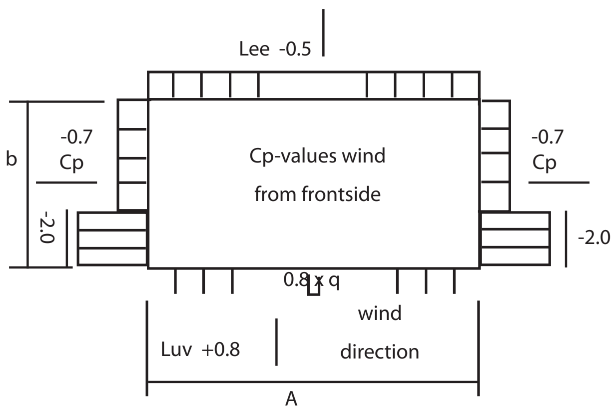
TYPES OF LOADS

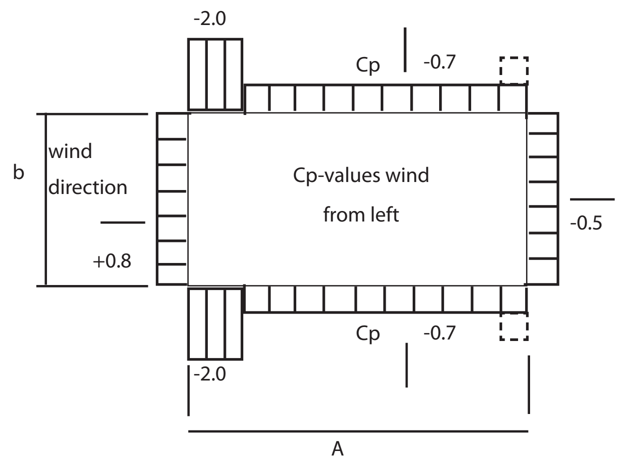
WIND LOADS

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

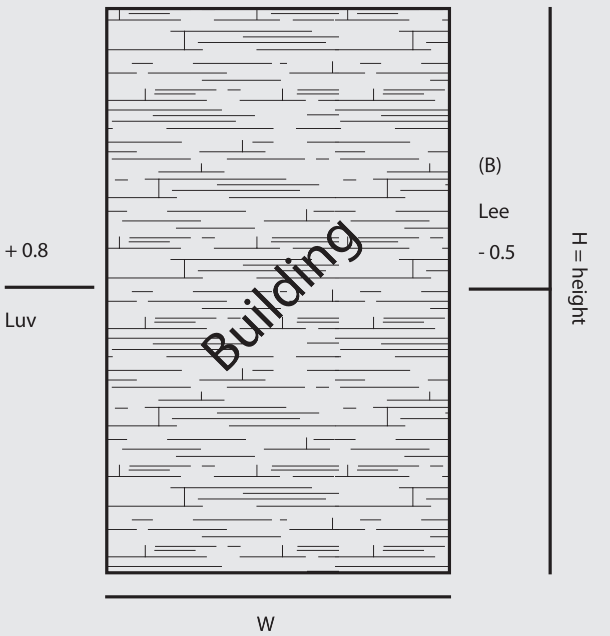
Suction Coefficient in area of discontinuity

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

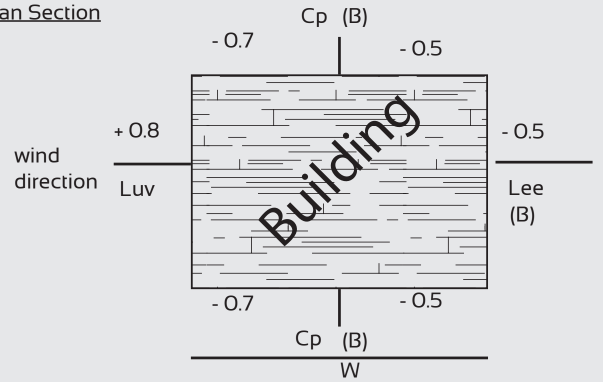
Height	0 - 8 m	> 8 m - 20 m	> 20 m - 100 m	> 100 m
Wind kN/m^2	-1,00 (-2 x 0,5)	-1,60 (-2 x 0,8)	-2,20 (-2 x 1,1)	-2,60 (-2 x 1,30)

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

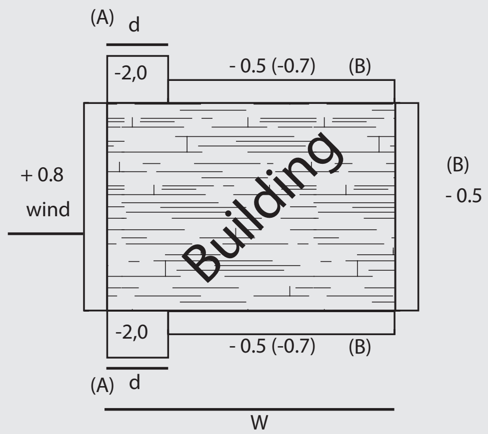


CP = -2,0
d = 1m for A < 8 m
d = W/P for 8m < A < 16 m
d = 2,0 m for W > 16 m

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

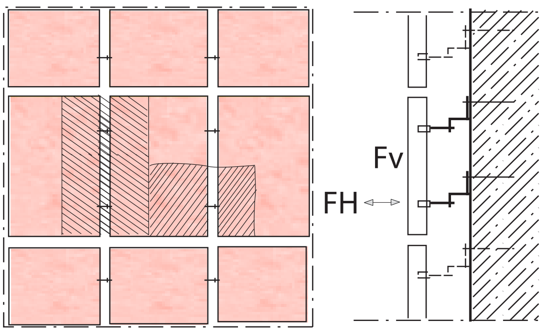


Wind pressure on corners
d = Corner



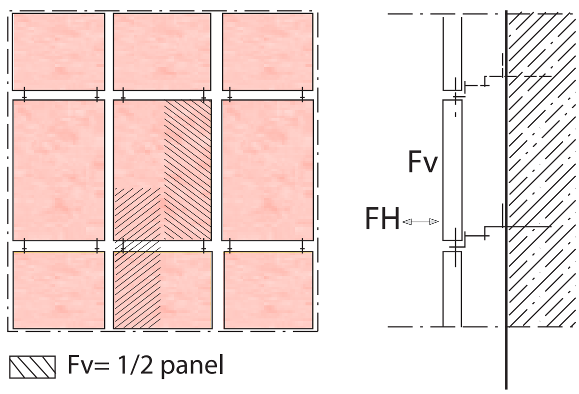
WIND LOAD ACCORDING TO DIN 1055

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/m]

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/m (0,78kN/m2)

self weight kN	Size m²	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/m (1,12kN/m2)

self weight kN	Size m²	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:

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

SL = Seismic load, Ca = Seismic response spectrum = Lateral force value in 97 UBC table 16O
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]Includes 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	8.5	2.8	N.L.
	a. Concrete with SMRF	4.2	2.8	160
	b. Concrete with steel OMRF	6.5	2.8	160
	c. Concrete with concrete IMRF[5]	5.5	2.8	160
	d. Masonry with SMRF	4.2	2.8	160
	e. Masonry with steel OMRF	4.2	2.8	--
	f. Masomy with concrete IMRF[3]	6.0	2.8	160
	g. Masonry with masonry MMRWF			
	2. Steel EBF			
	a. With steel SMRF	8.5	2.8	N.L.
	b. With steel OMRF	4.2	2.8	160
	3. Ordinary braced frames			
	a. Steel with steel SMRF	6.5	2.8	N.L.
	b. Steel with steel OMRF	4.2	2.8	160
	c. Concrete with concrete SMRF[3]	6.5	2.8	--
	d. Concrete with concrete 1MRF[3]	4.2	2.8	--
	4. Special concentr.ically braced frames	7.5		
	a. Steel with steel SMRF	4.2	2.0	N.L.
	b. Steel with steel OMRF		2.8	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-O-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: (l) 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
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

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:

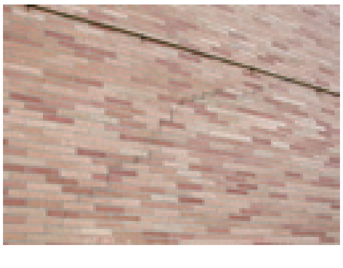
Consider a Building Construction type is an enclosed Concrete frame with Granite cladding (1000x500x30mm)
On a hot summer´s day with the building complete and occupied the relative movement (in mm/m) of frame to cladding is given by the equation A =1000 [(tfs.tfe) Xf-(tcs-tce)Xc]
tfs = is temperature (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

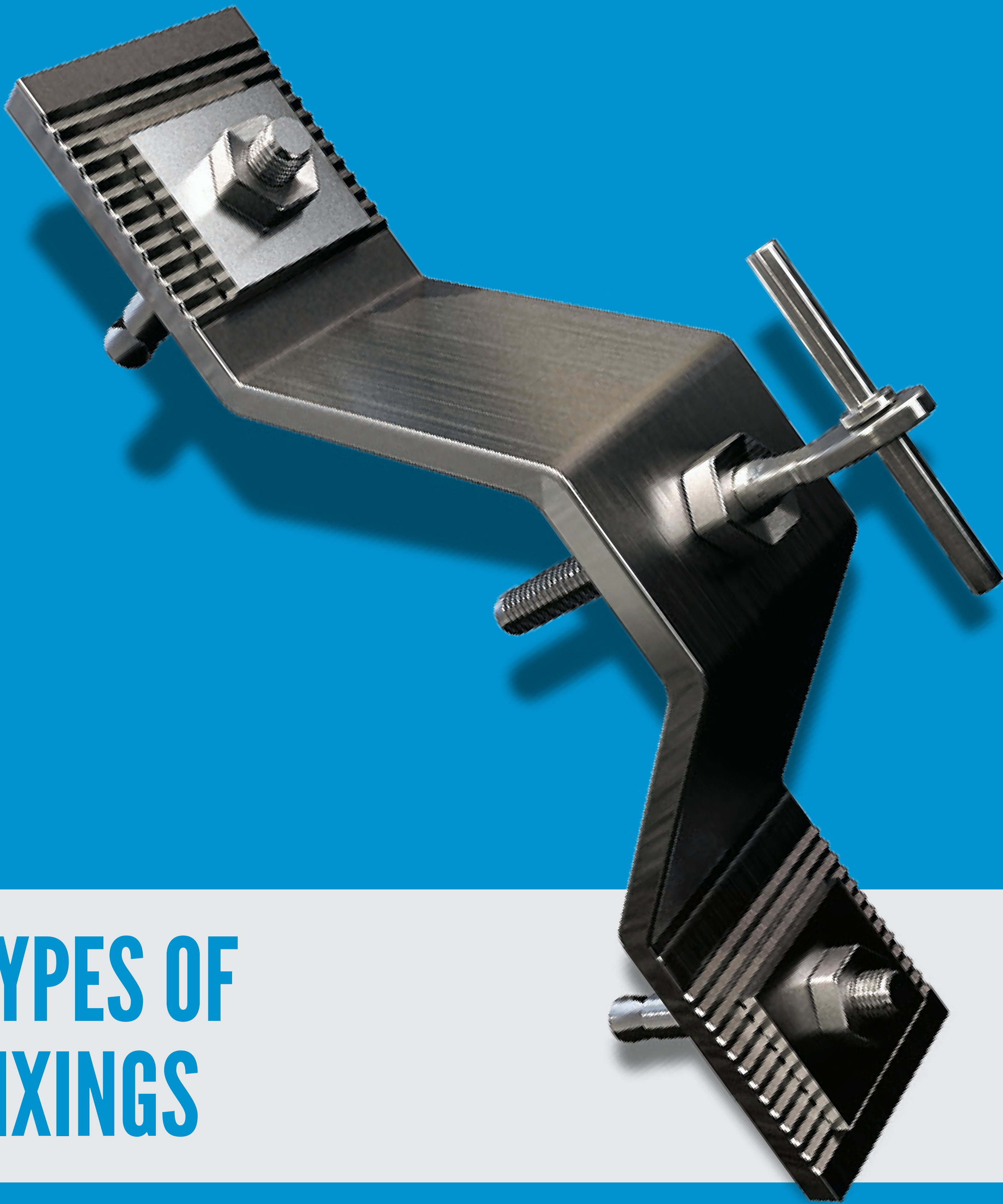
Coefficients Of Thermal Expansion	
Material	Linear expansion' (in/°F)
Aluminium	0.0000133
Brass	0.0000104
Bronze	0.0000101
Bronze	0.0000096
Concrete	0.0000079
Marble	0.0000073
Granite	0.0000078
Lime stone	0.0000060
Masonry	0.0000035
Mild steel	0.0000067

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

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 = α . 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

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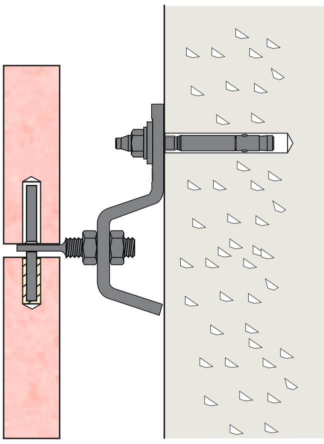
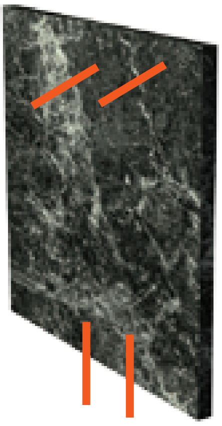
Principles for the Fixing of Building Cladding

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.

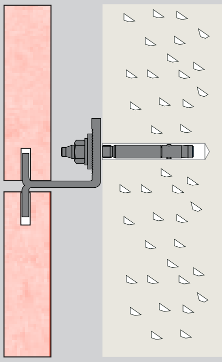




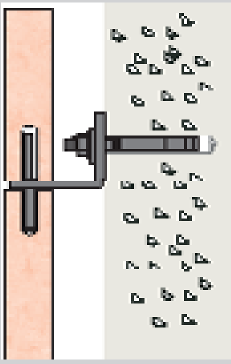
Two fundamental types of fixing systems result:

- 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.

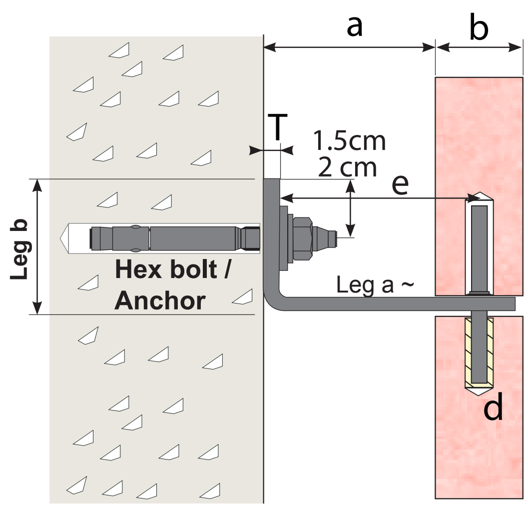
Load-bearing fixing are usually composed by angles (of adequate dimensions), firmly fixed to the building by the opportunely selected anchoring element complete with expansion anchors and bolts.



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.

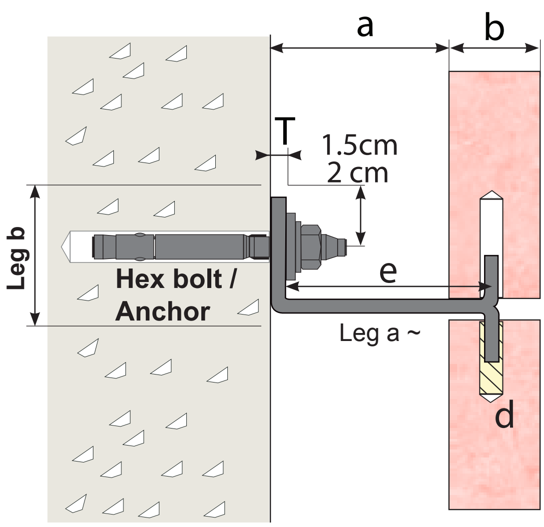


L-Bracket (Standard & Serrated) | Type ST- 500 1100 With Pin



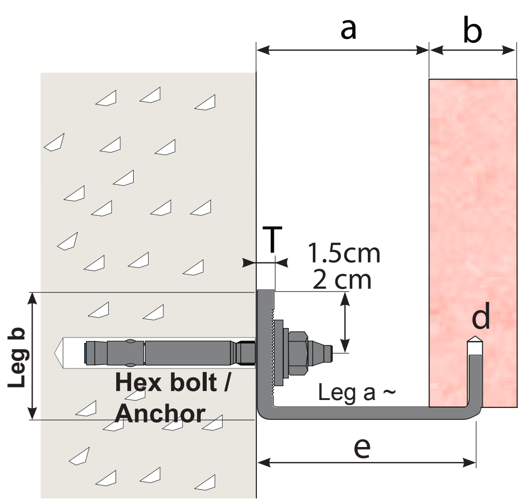
L-Bracket Holder With Pin	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

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



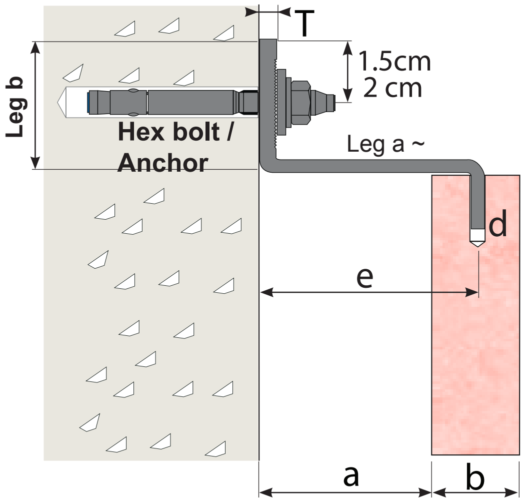
L-Bracket Holder Up and Down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

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



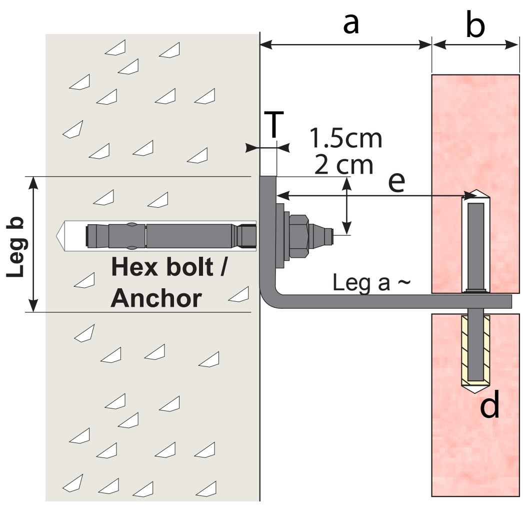
L-Bracket Holder Up	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

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



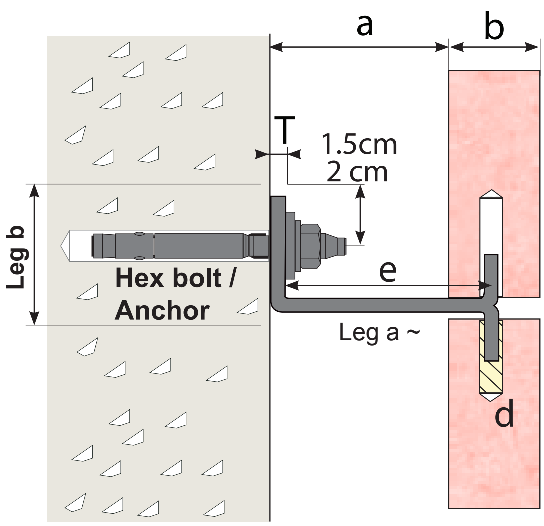
L-Bracket holder down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

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



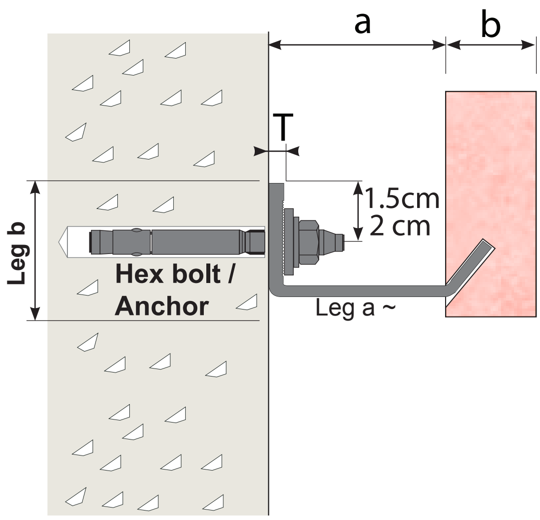
L-Bracket holder with pin	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

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



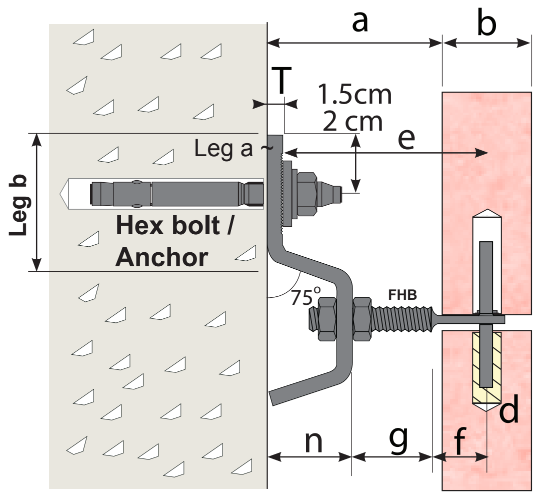
L-Bracket holder up and down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
e	Cavity to pin
Economic for 20 < a ≤ 80mm	

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



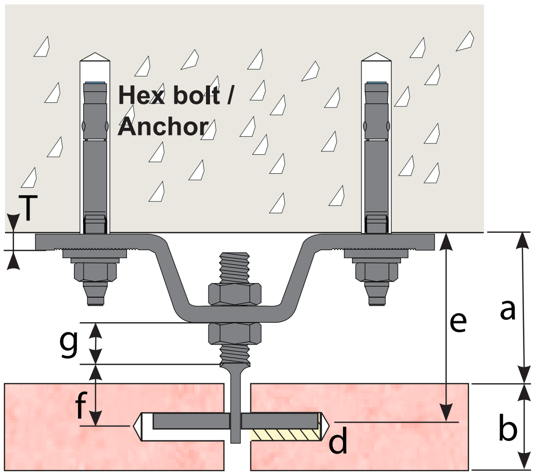
L-Bracket holder Curved	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
Economic for 20 < a ≤ 80mm	

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



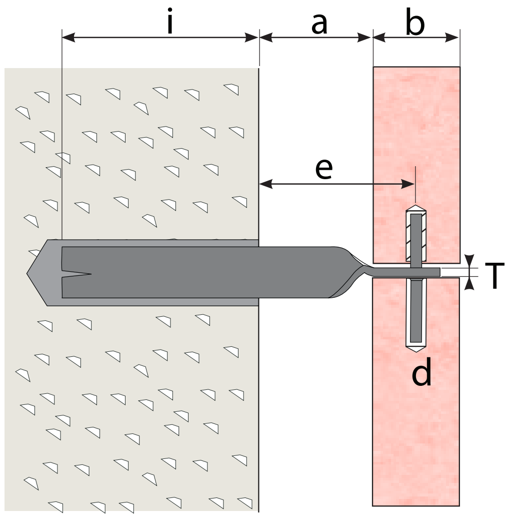
Z-returned bracket	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
f	Flat head parts
g	Threaded part
Economic for 50 < a ≤ 120mm	

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



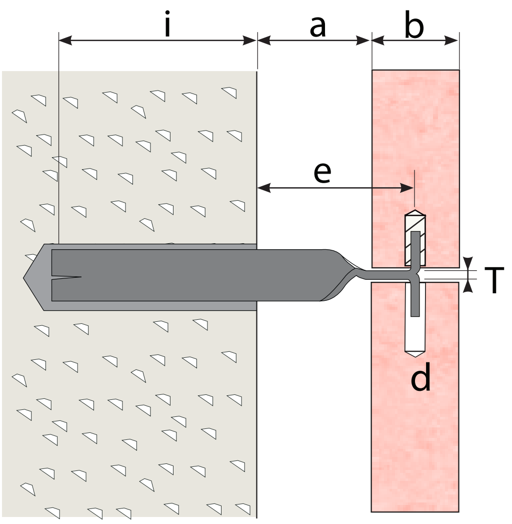
Z-returned bracket	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
f	Flat head parts
g	Threaded part
Economic for 50 < a ≤ 120mm	

Fishtail with Pin | Type ST- 800 1100



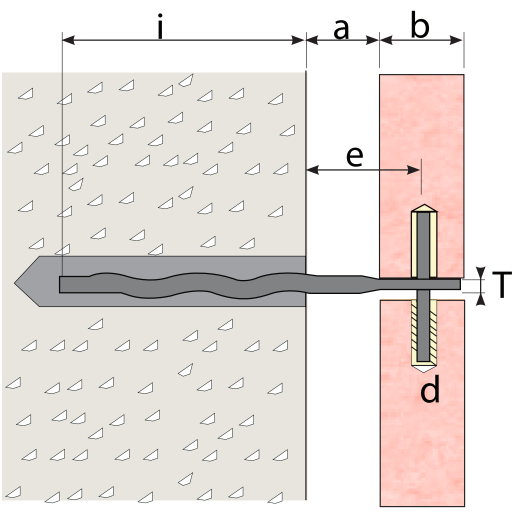
Fishtail with Pin	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
i	Embedment in wall
T	Fish tail thickness
Economic for 20 < a < 80mm	

Fishtail Up & Down | Type ST- 800 1200



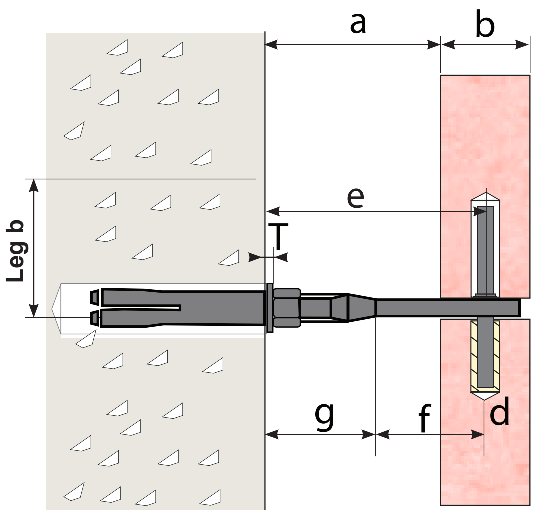
Fishtail Up & Down	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
i	Embedment in wall
T	Fish tail thickness
Economic for 20 < a < 80mm	

Corrugated dowel | Type ST- 900 1100



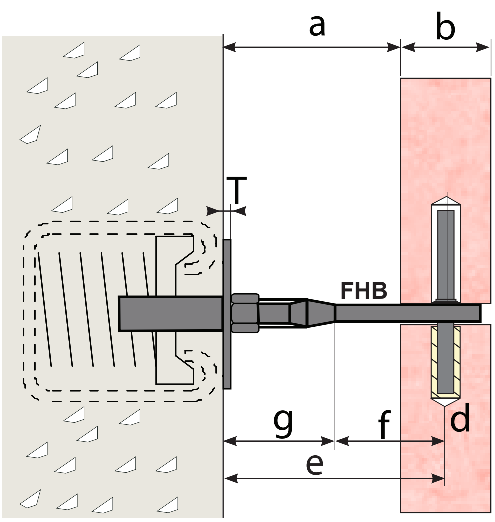
Corrugated dowel	
a	Cavity to back side panel
b	Panel thickness
T	Bracket thickness
d	Diameter of pin
e	Cavity to pin
i	Embedment in wall
T	Fish tail thickness
economic for 20 < a < 80mm	

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.

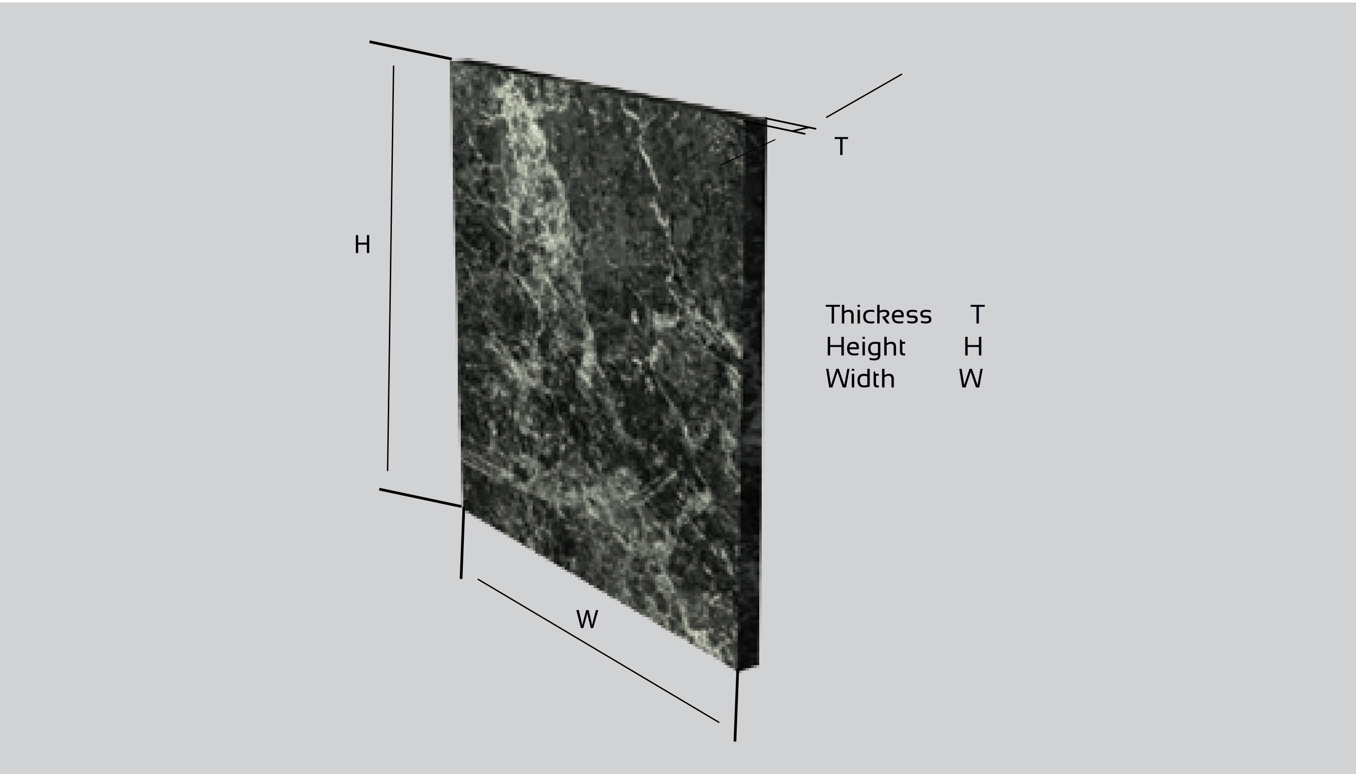
Surfaces of contact (metal)	**SFSP Anchor bolts**				
	Stainless steel	**Aluminium bronze**	**Brass**	**Galvanized steel**	**Cast iron**
Stainless steel	●	○	○	🔴	🔴
Aluminum bronze	○	●	●	🔴	🔴
Brass	○	●	●	🔴	
Copper	○	●	○	🔴	🔴
Galvanized steel	🔴	🔴	🔴	●	○
Mild steel	🔴	🔴	○	○	●
Cast iron	🔴	🔴	○	○	●
Lead	○	○	○	🔴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



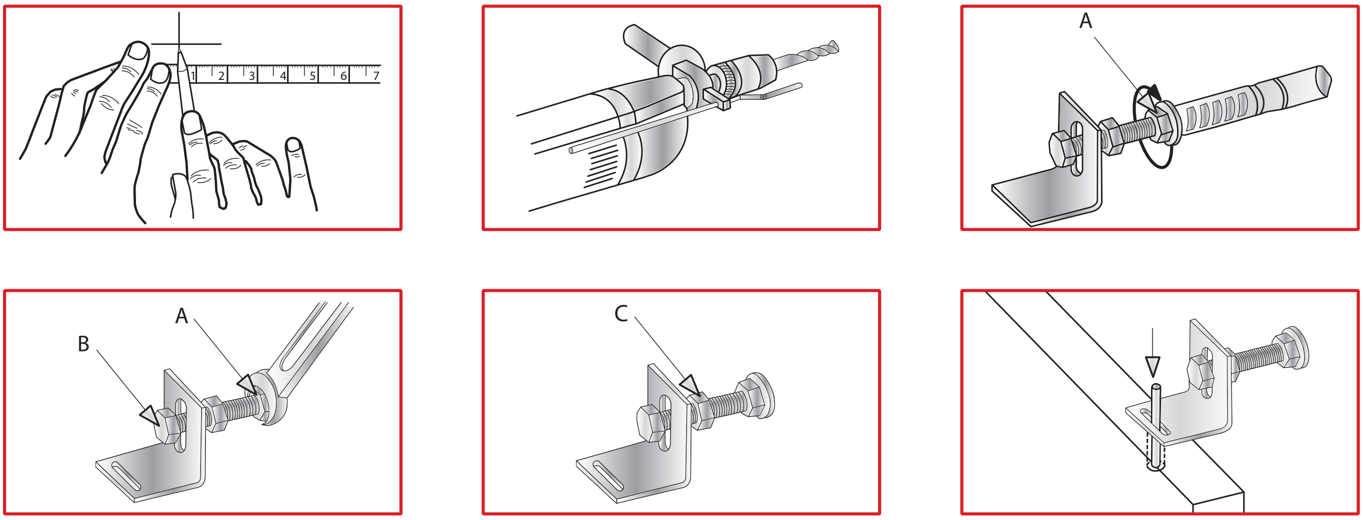
c) The forces to which the building itself may be subject (winds of particular intensity, seismic activity, etc);
d) The environmental surroundings in which the building is located, paying particular attention to harmful atmospheric conditions which may be found in industrial, marine or other areas.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

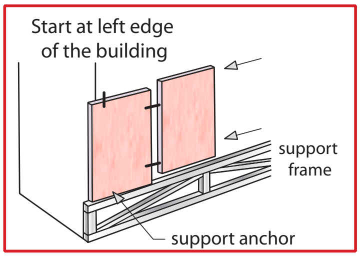
The principle installation phases of a set of fixings for cladding is represented as follows:
1) Accurately locate the position of the drilling hole.
2) Drill a hole of the required depth and diameter.)
3) Insert the expansion bolt into the hole and cause it to expand by screwing down the nut A.
4) To 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.

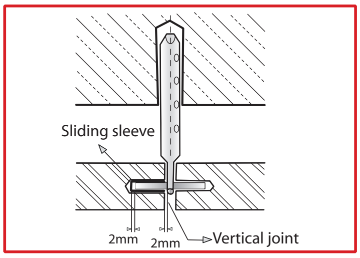


MOUNTING INSTRUCTIONS FOR STANGLE MORTAR ANCHOR (WET FIXING)

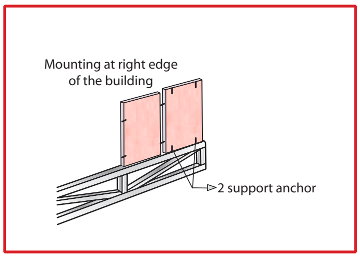
Arrangement of Anchors in Vertical Joint

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.





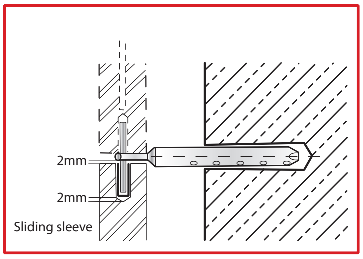
Mounting at right edge of building:
Anchor last panel but one at right edge, with pins on one side in vertical joint. Mount last panel at right building-edge on 2 support anchors in horizontal joint.

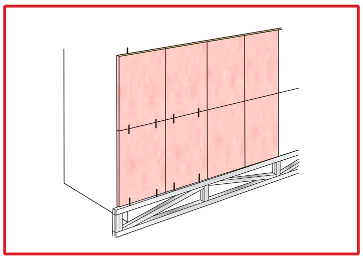


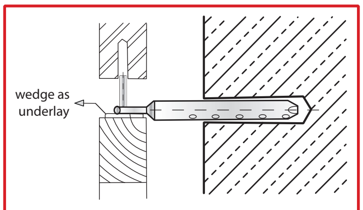
MOUNTING INSTRUCTIONS FOR STANGLE MORTAR ANCHOR (WET FIXING)

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.

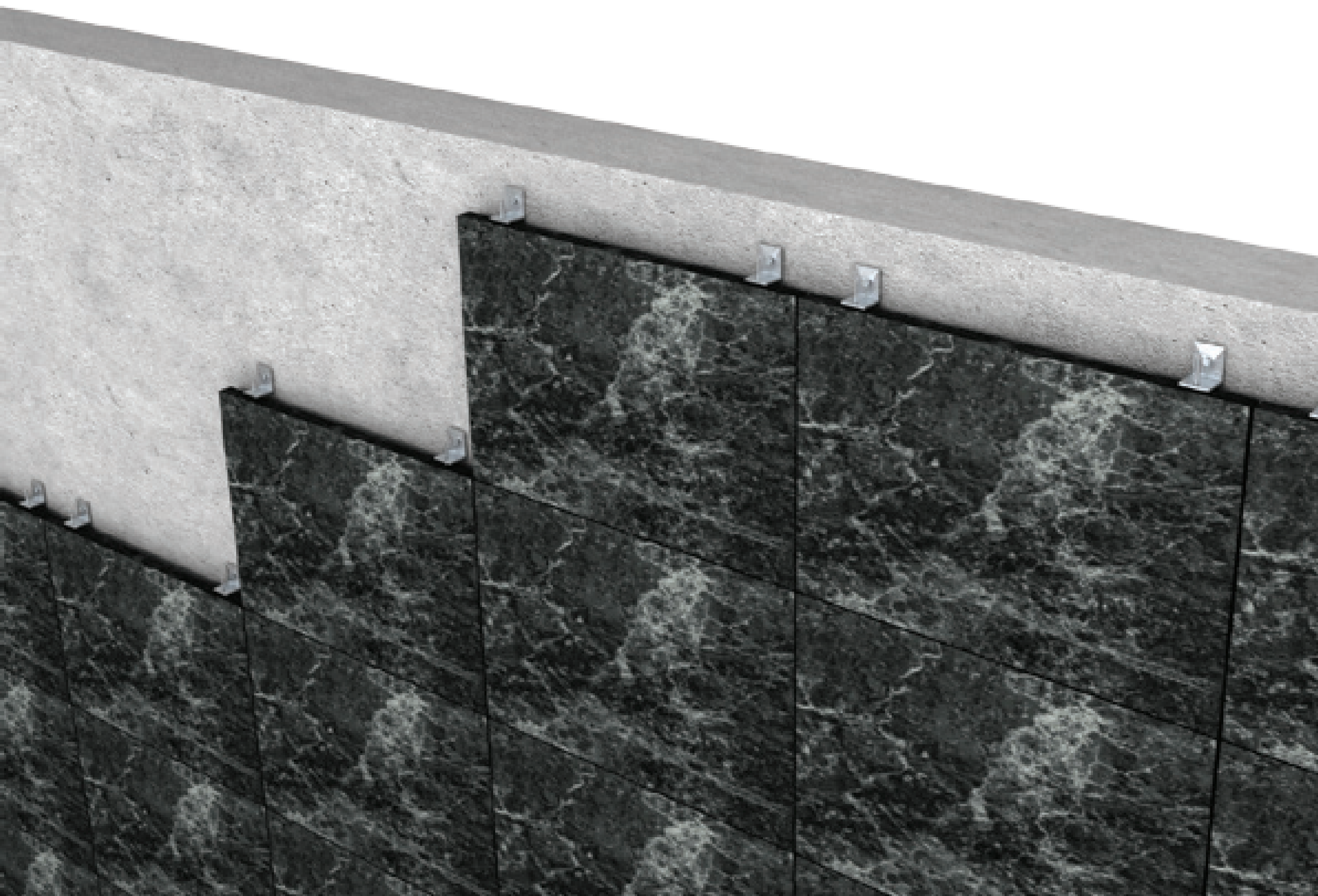
INTERNATIONAL STANDARDS FOR CLADDING DESIGN

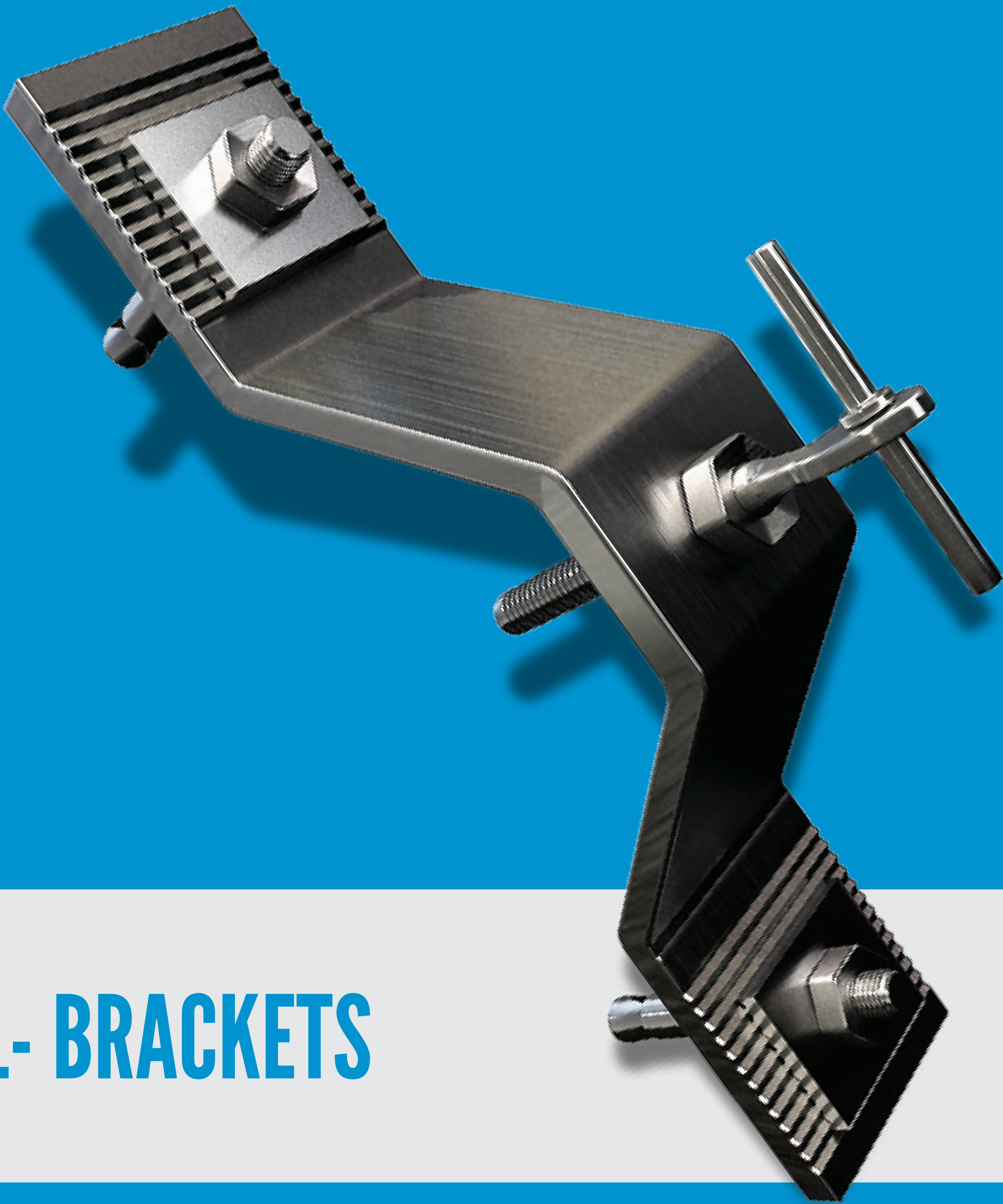
Design & Calculation Standards
Reference is made to the following standards for the design and structural calculations of Natural Stone Fixing Systems.

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

ISO 14001 SGS SYSTEM CERTIFICATION

SYSTEM CERTIFICATION BMTRADA ISO 9001

www.sfsp-ikk.com

STANDARD TYPES

Support Bracket

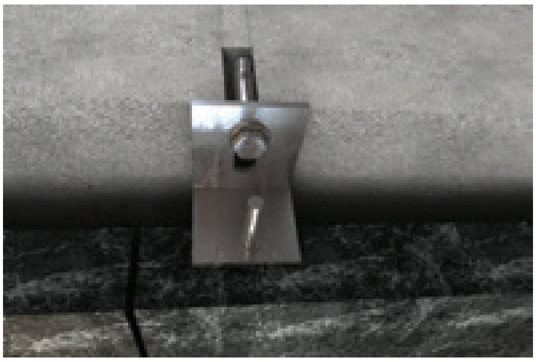
The structural analysis fully considers the dead load of panel, imposed wind loads and thermal stresses, in accordance with relevant DIN standards.

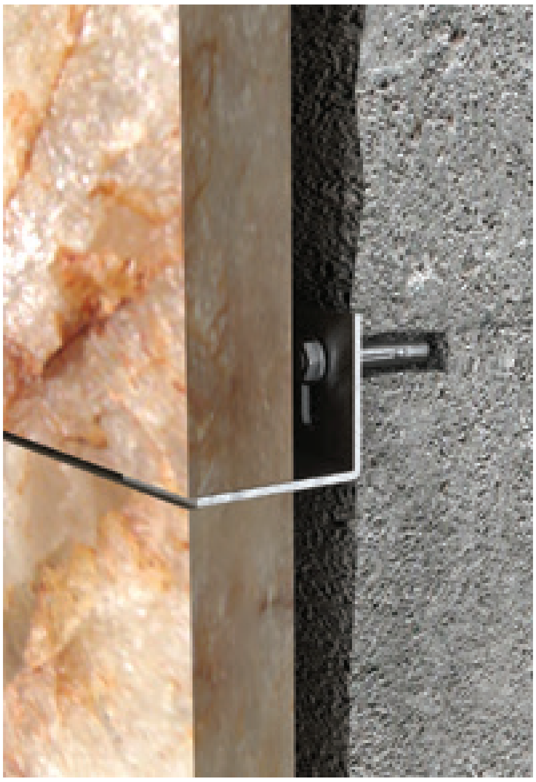
Loads caused by earthquakes can be transferred into the anchoring base.

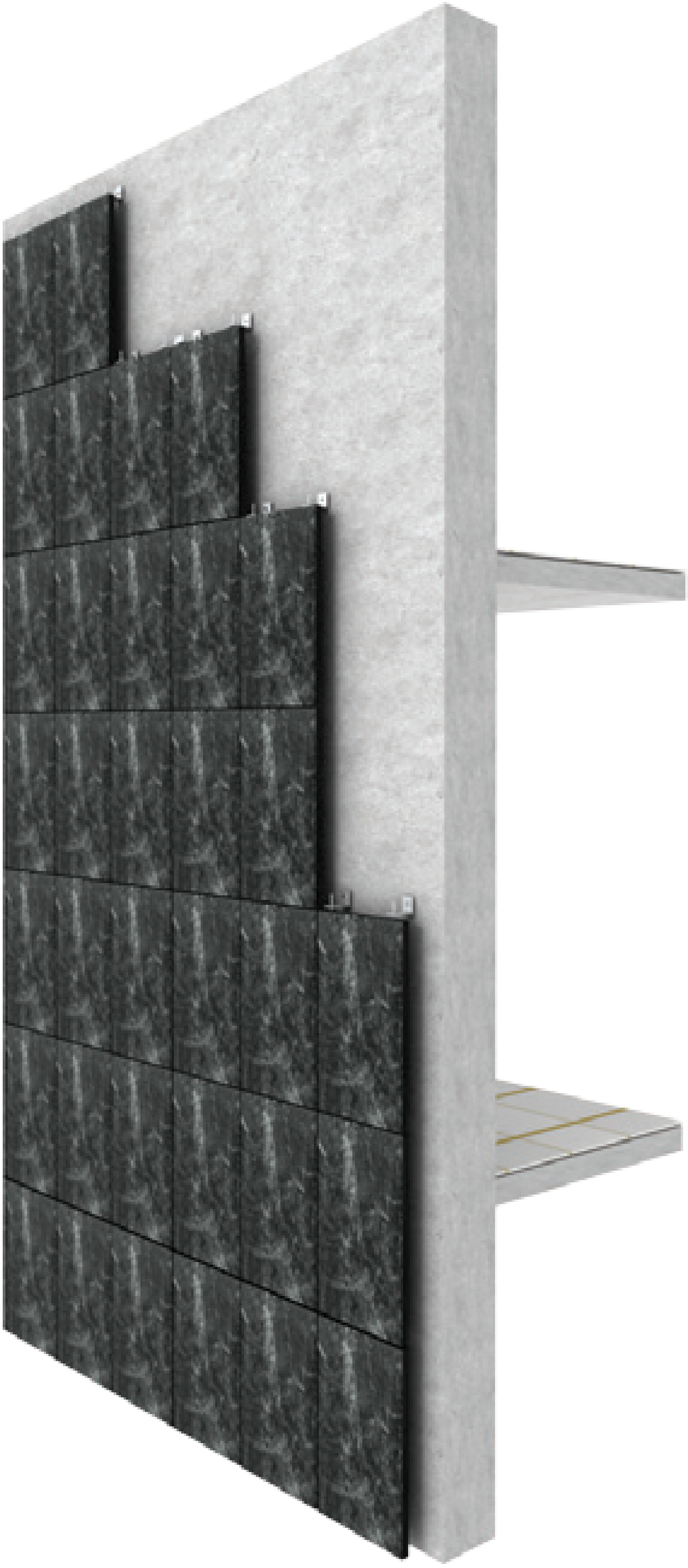
The support and restraint brackets are Fixed using expansion anchors, chemical anchors, etc.

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.

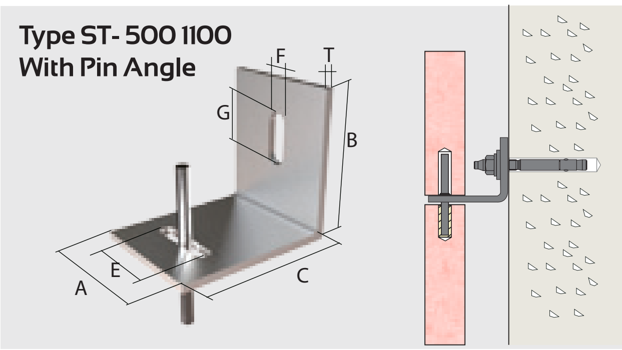




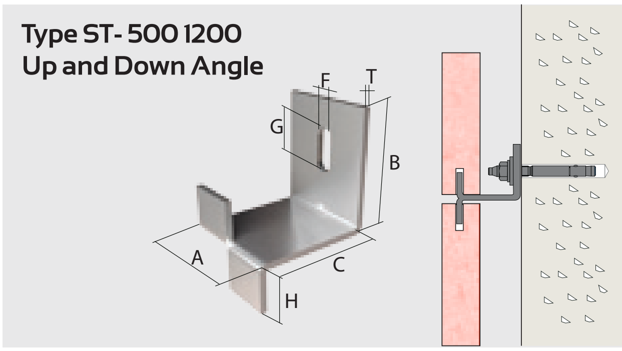


L - Brackets

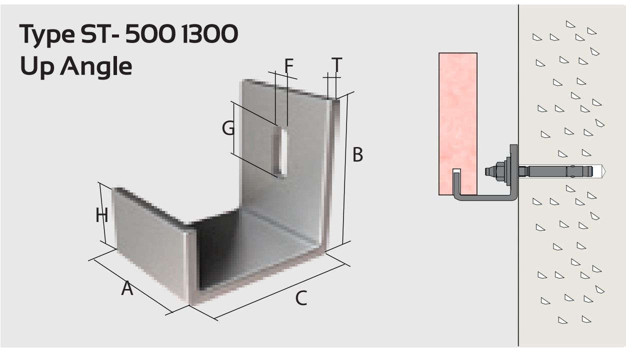
Type ST- 500 1100
With Pin Angle



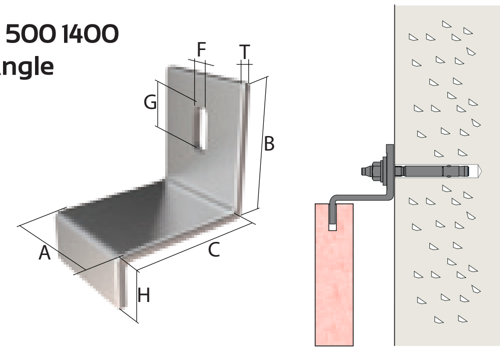
Type ST- 500 1200
Up and Down Angle



Type ST- 500 1300
Up Angle



Type ST- 500 1400
Down Angle

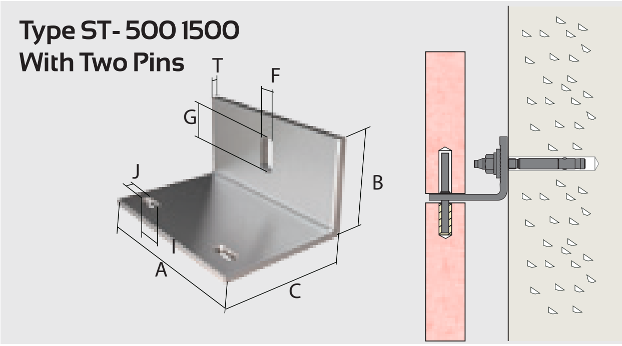


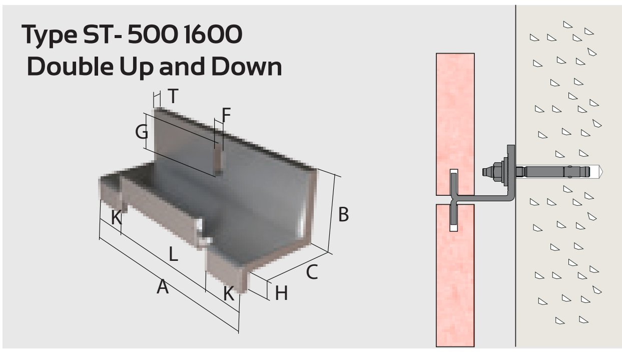
Load Table for ST-1100/1200/1300/1400/1700.

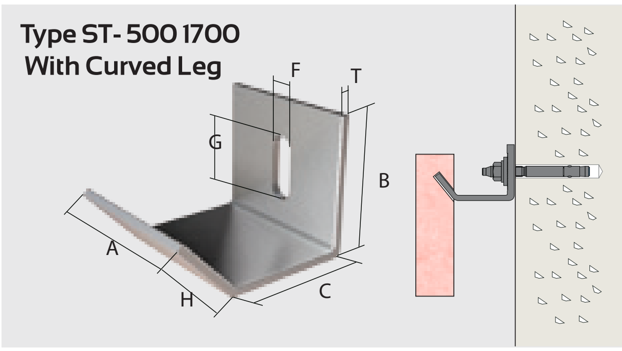
Materials: SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG 50°c 24h average temperature

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







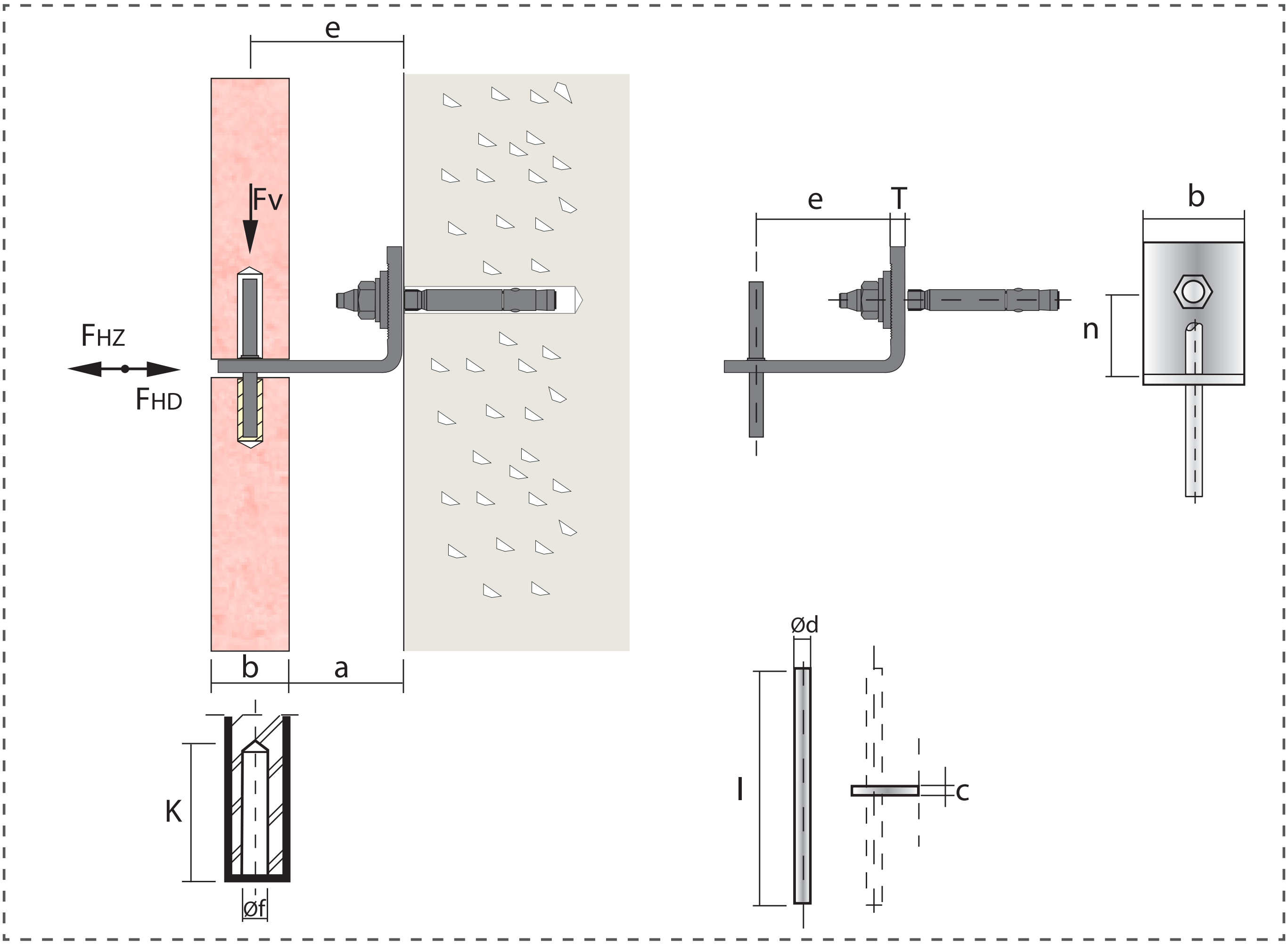
Load Table for ST-1500/1600.

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			120	3	2x 4	5,80
50	35			120	3	2x 4	6,30
50	40	0,40	0,56	120	3	2x 4	6,80
50	45			140	3	2x 4	7,30
50	50			120	4	2x 4	8,90
50	30			120	3	2x 4	8,10
50	35			130	3	2x 4	8,90
50	40	0,50	0,70	120	4	2x 4	9,60
50	45			120	4	2x 4	10,40
50	50			120	4	2x 4	11,10
60	30			140	3	2x 4	7,00
60	35			120	4	2x 4	7,90
60	40	0,60	0,84	120	4	2x 4	8,40
60	45			120	4	2x 4	8,90
60	50			120	4	2x 4	9,40
60	30			120	4	2x 4	8,60
60	35			120	4	2x 4	9,20
60	40	0,70	0,98	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

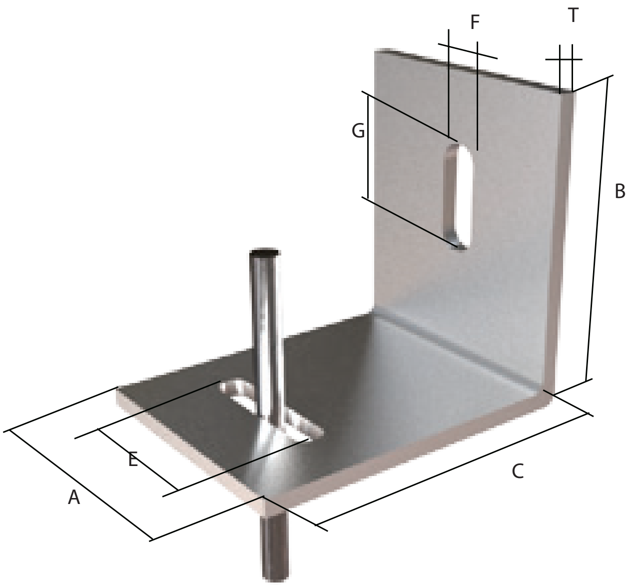


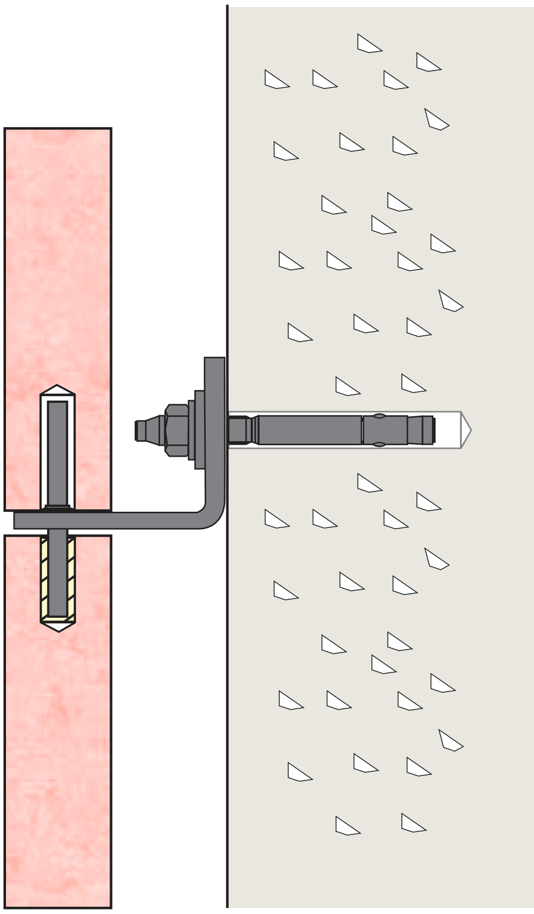
Fv perm = permissible vertical loading capacity
FR = existing load on the dowel with maximum load of the anchor

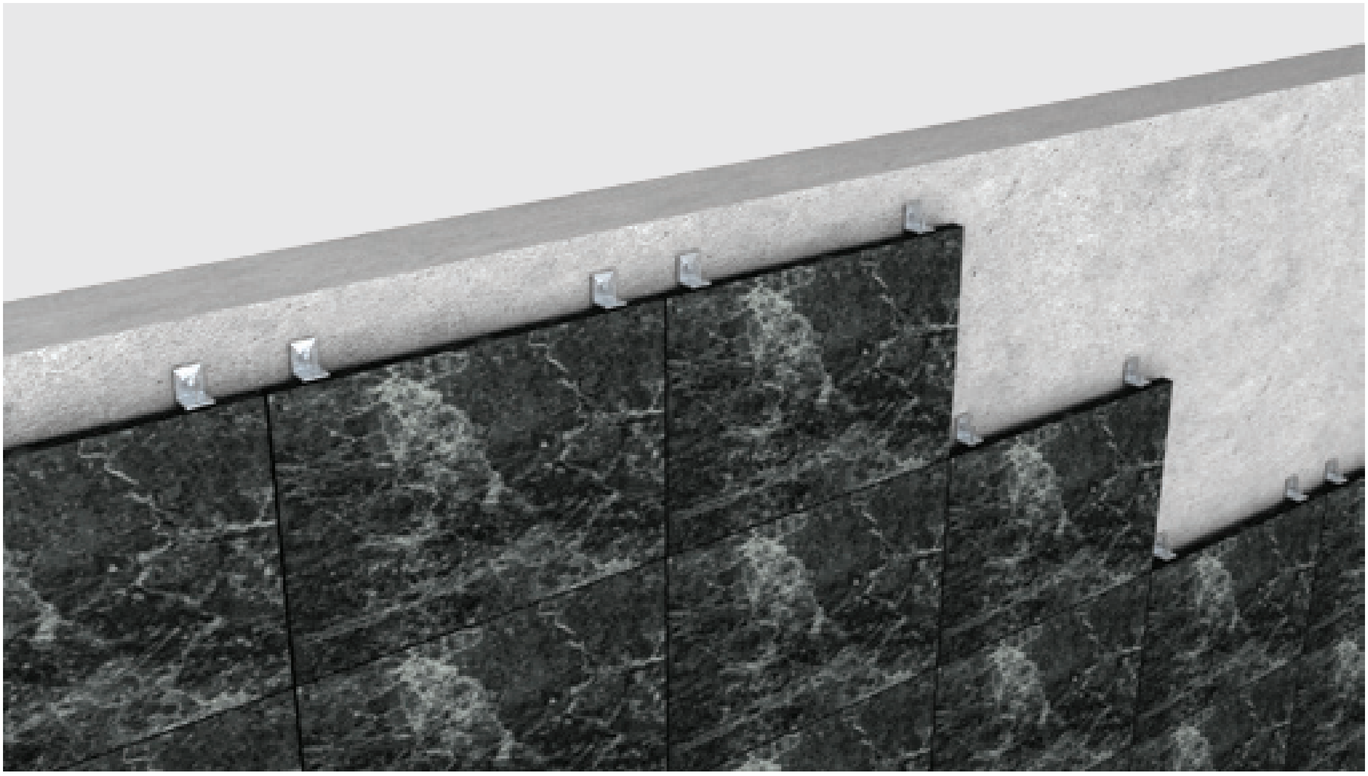
Anchoring base: acc. To the licence of the dowel chosen.

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:





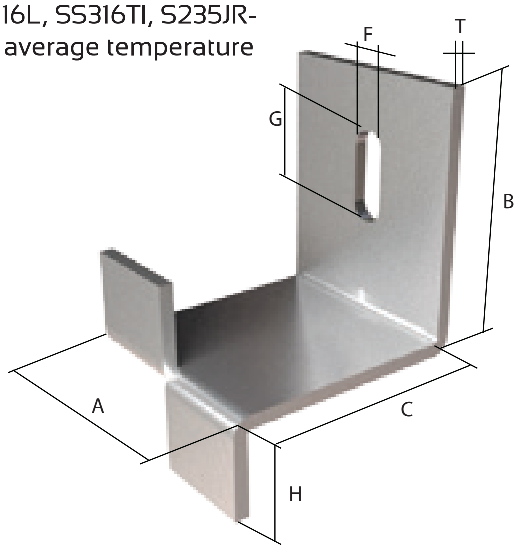


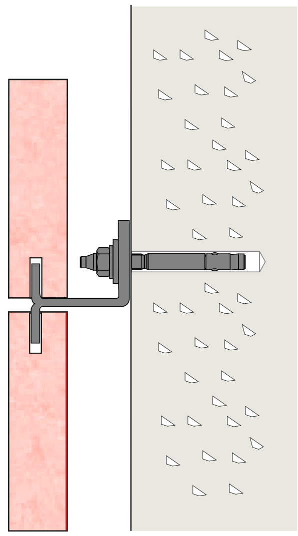
SYSTEM TYPE ST 500 -1200 WITH UP & DOWN LEGS

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

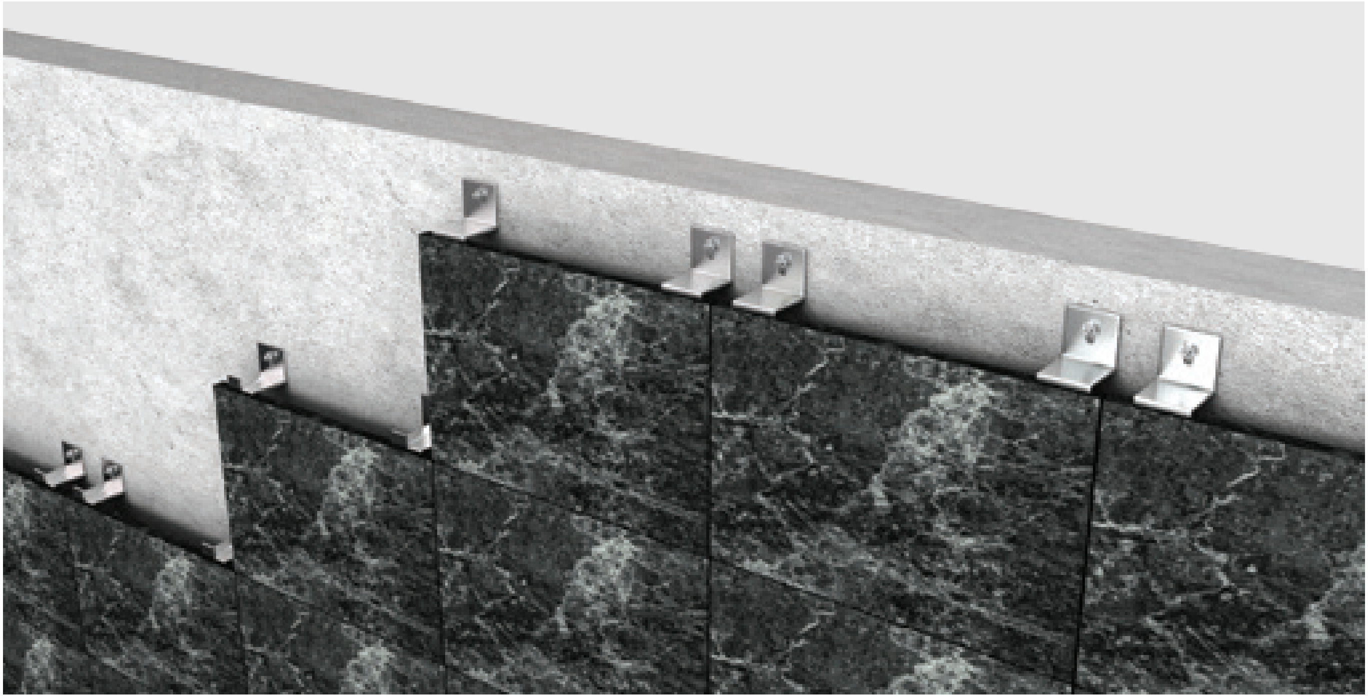
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG 50°C 24h average temperature

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

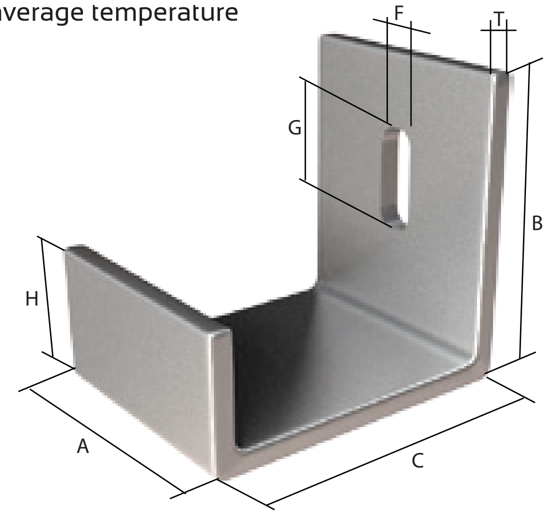


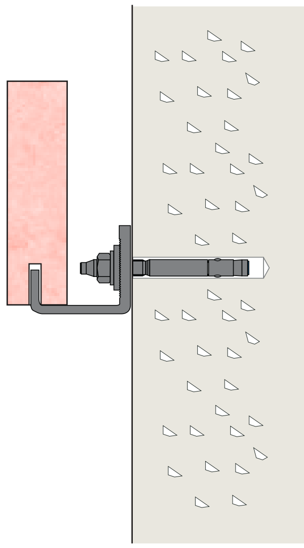
SYSTEM TYPE ST 500 -1300 WITH UP LEG

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

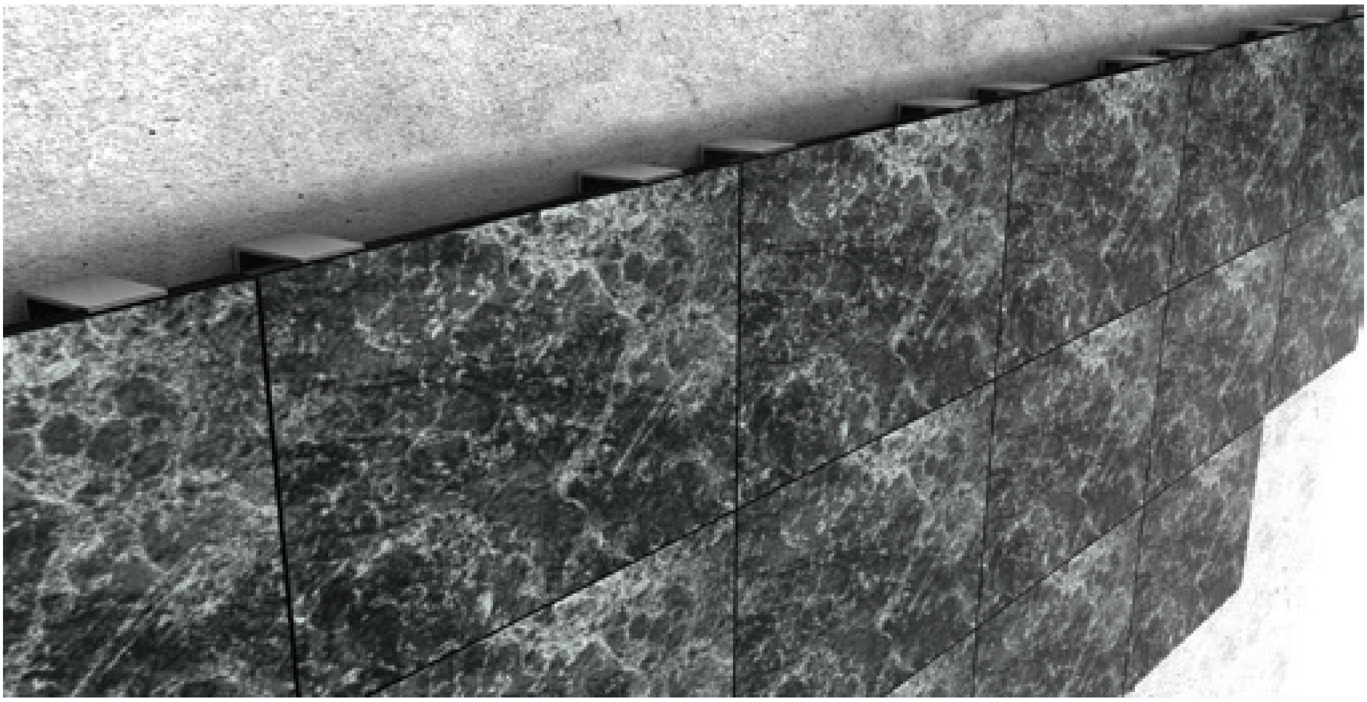
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG 50°C 24h average temperature

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

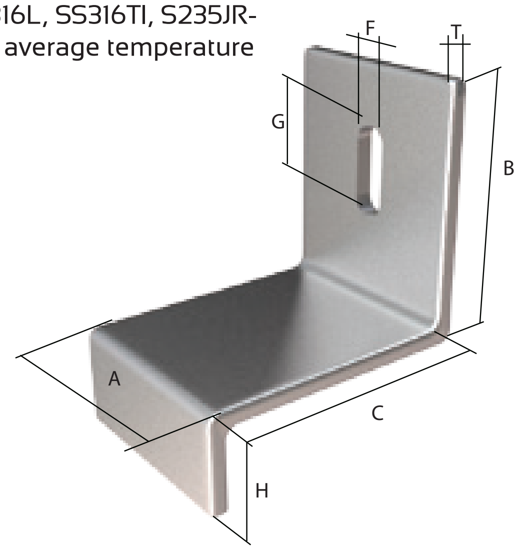


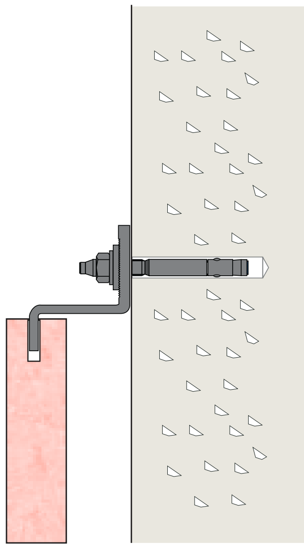
SYSTEM TYPE ST 500 -1400 WITH DOWN LEG

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

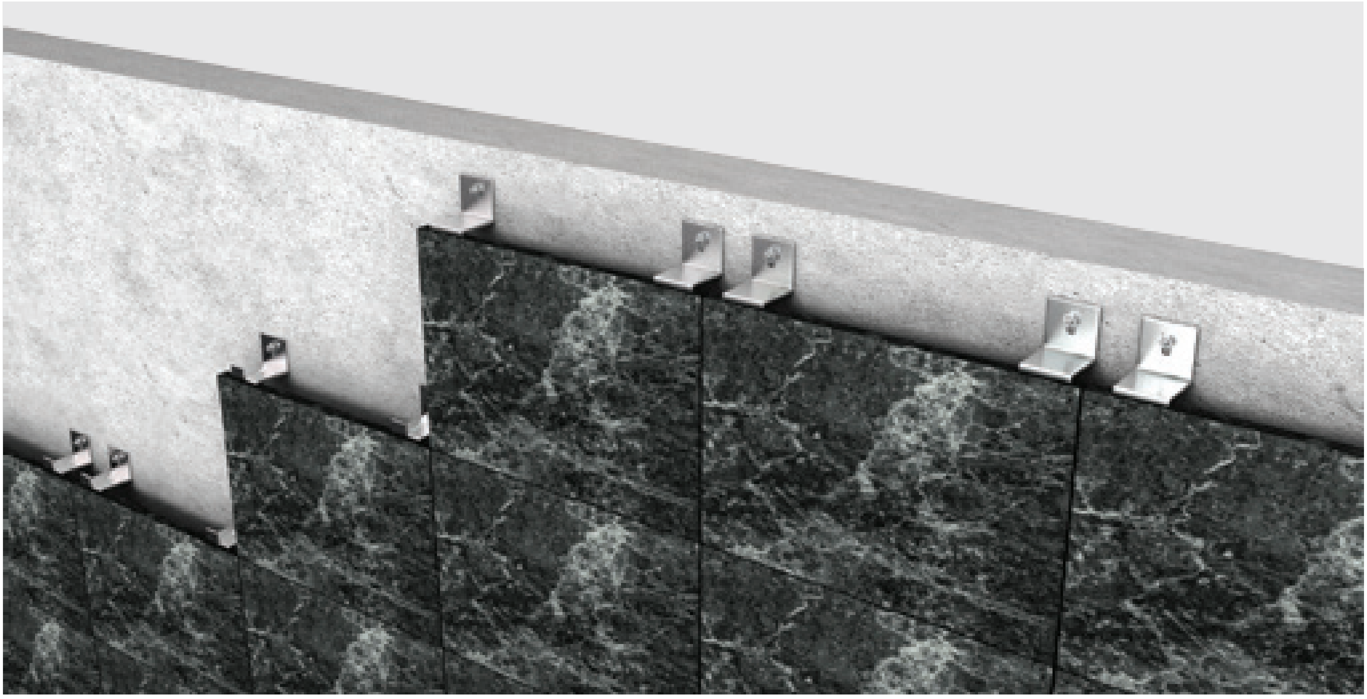
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG   50°C 24h average temperature

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

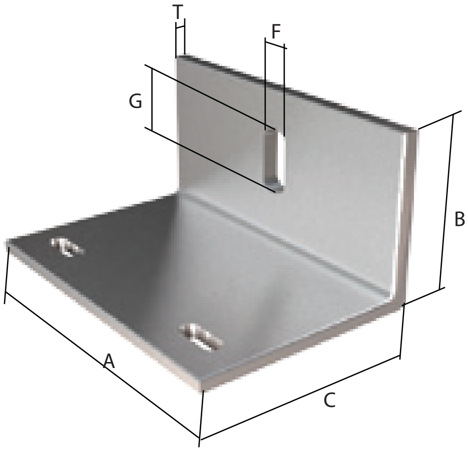


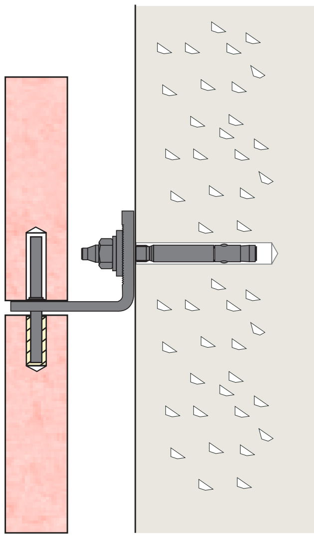
SYSTEM TYPE ST 500 -1500 WITH DOUBLE PIN

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

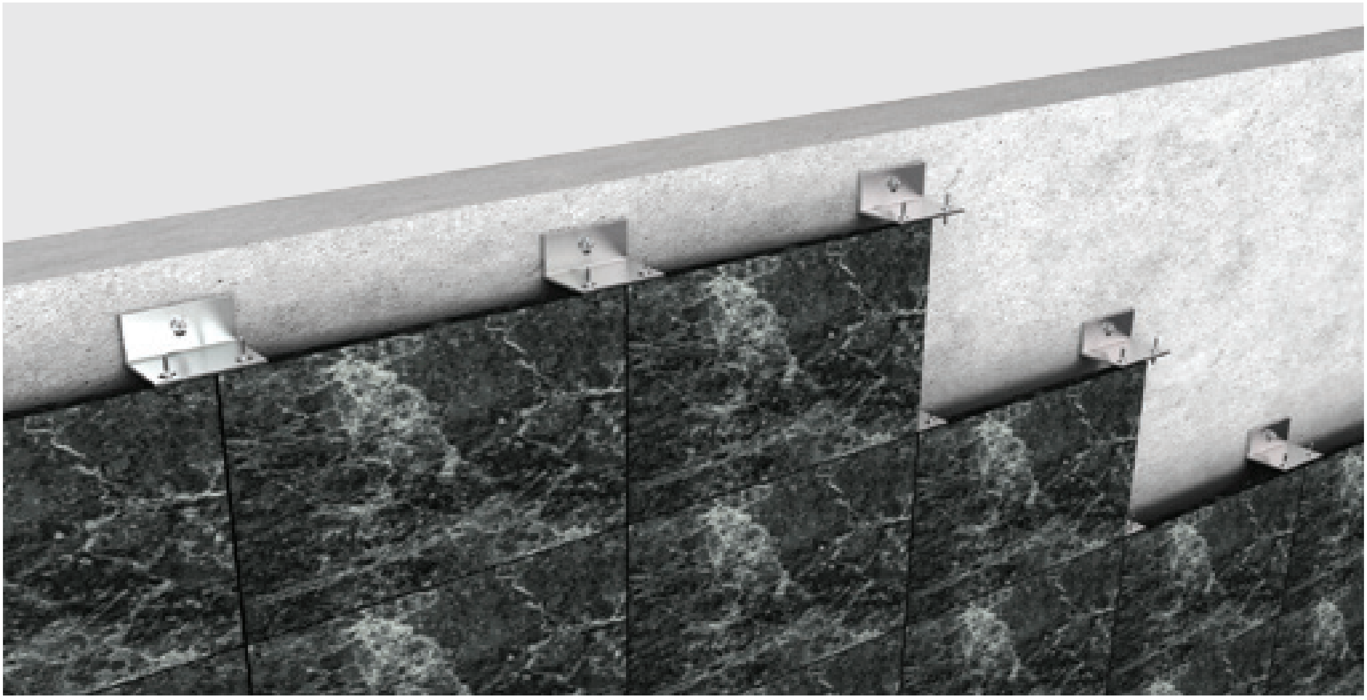
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG 50°C 24h average temperature

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

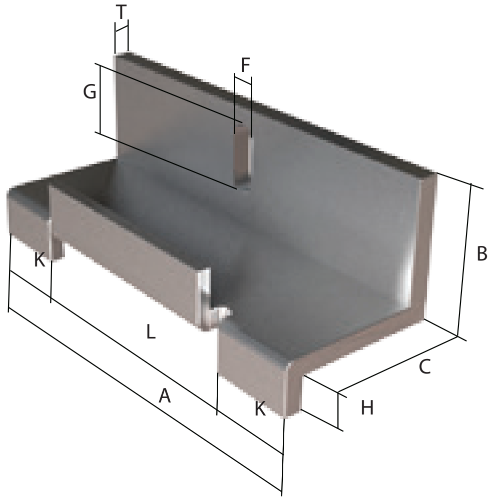


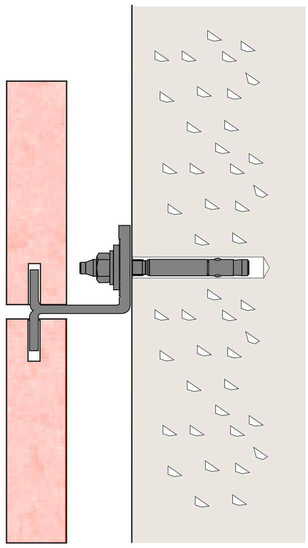
SYSTEM TYPE ST 500 -1600 WITH DOUBLE UP & DOWN LEGS

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

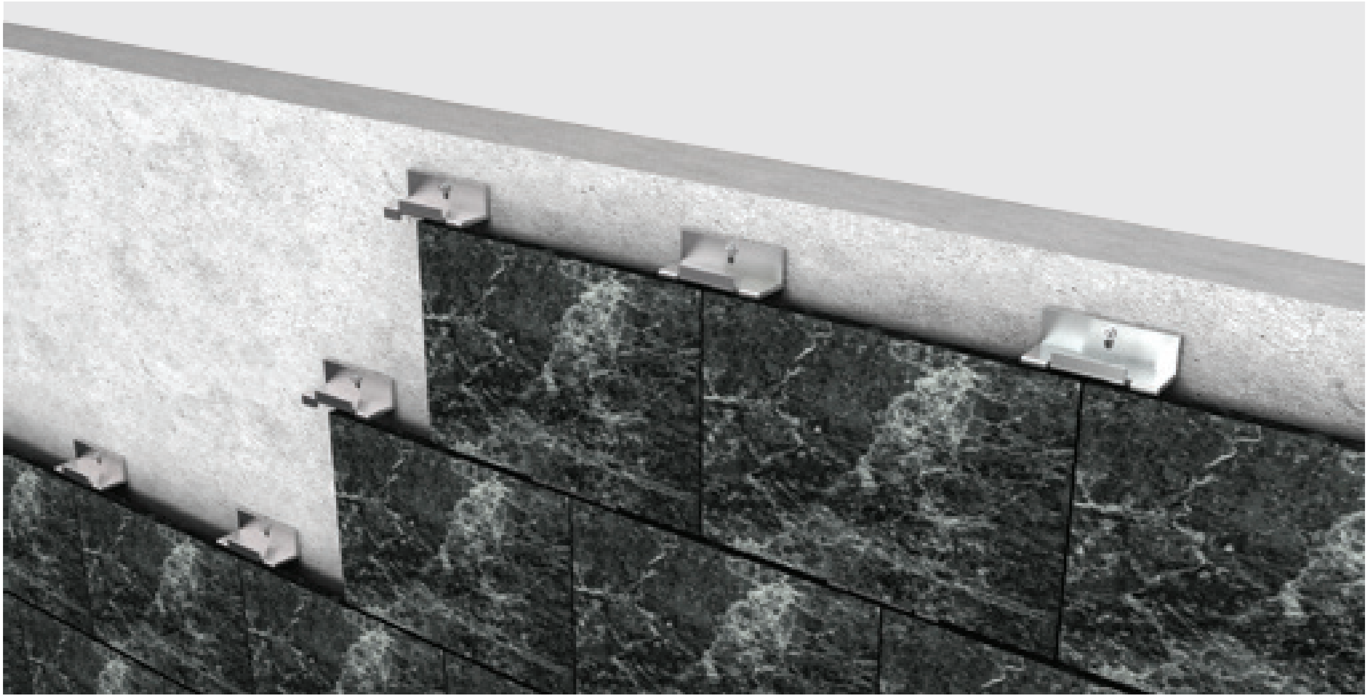
Standard Items:





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

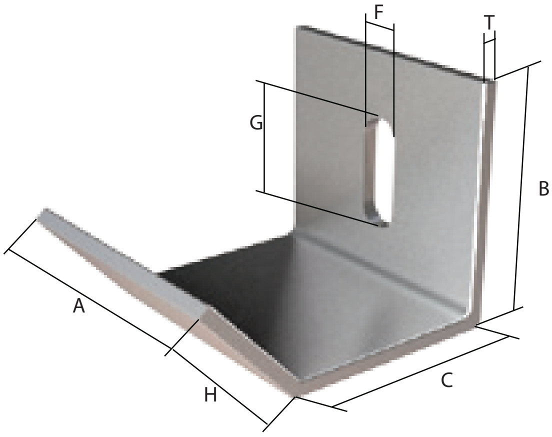


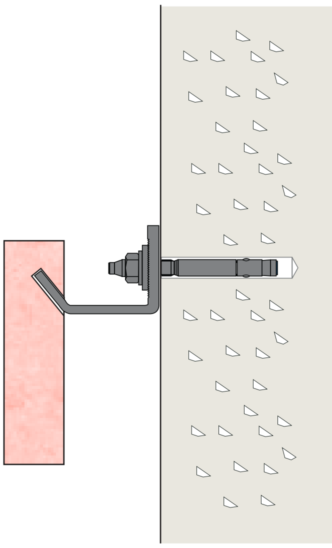
SYSTEM TYPE ST 500 -1700 WITH CURVED LEG

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

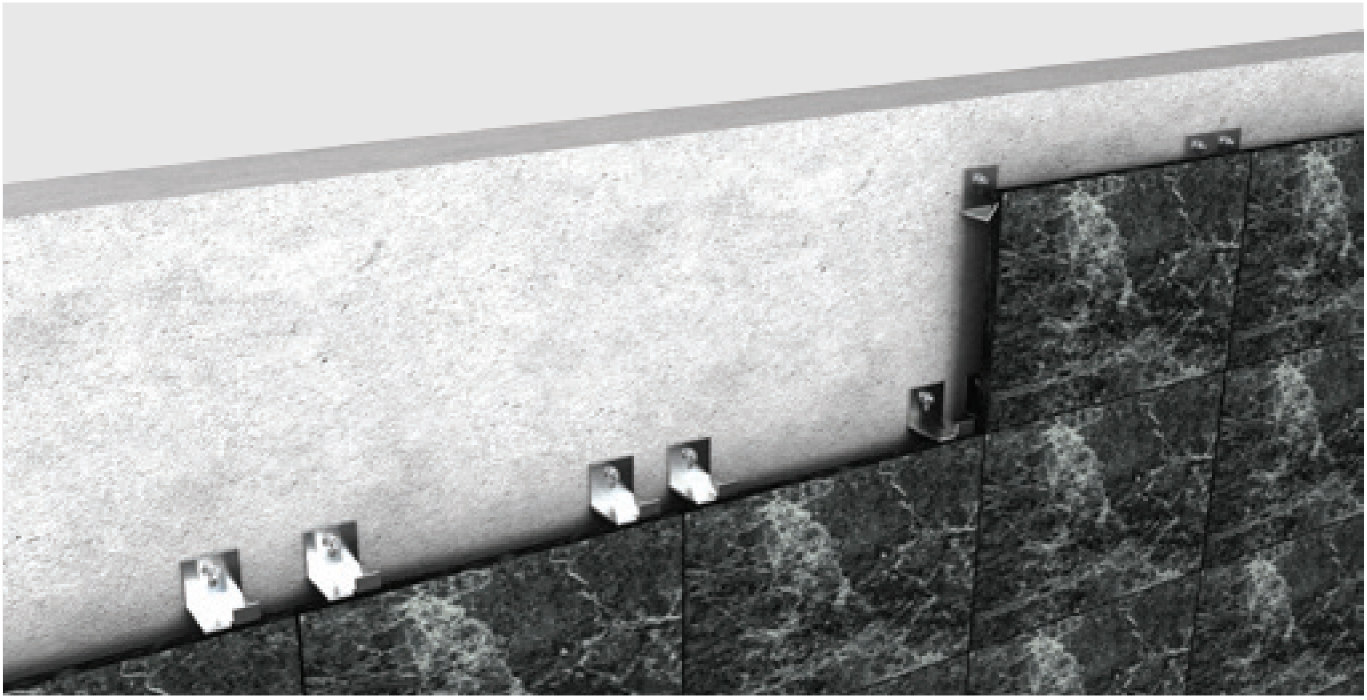
Materials SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG 50°C 24h average temperature

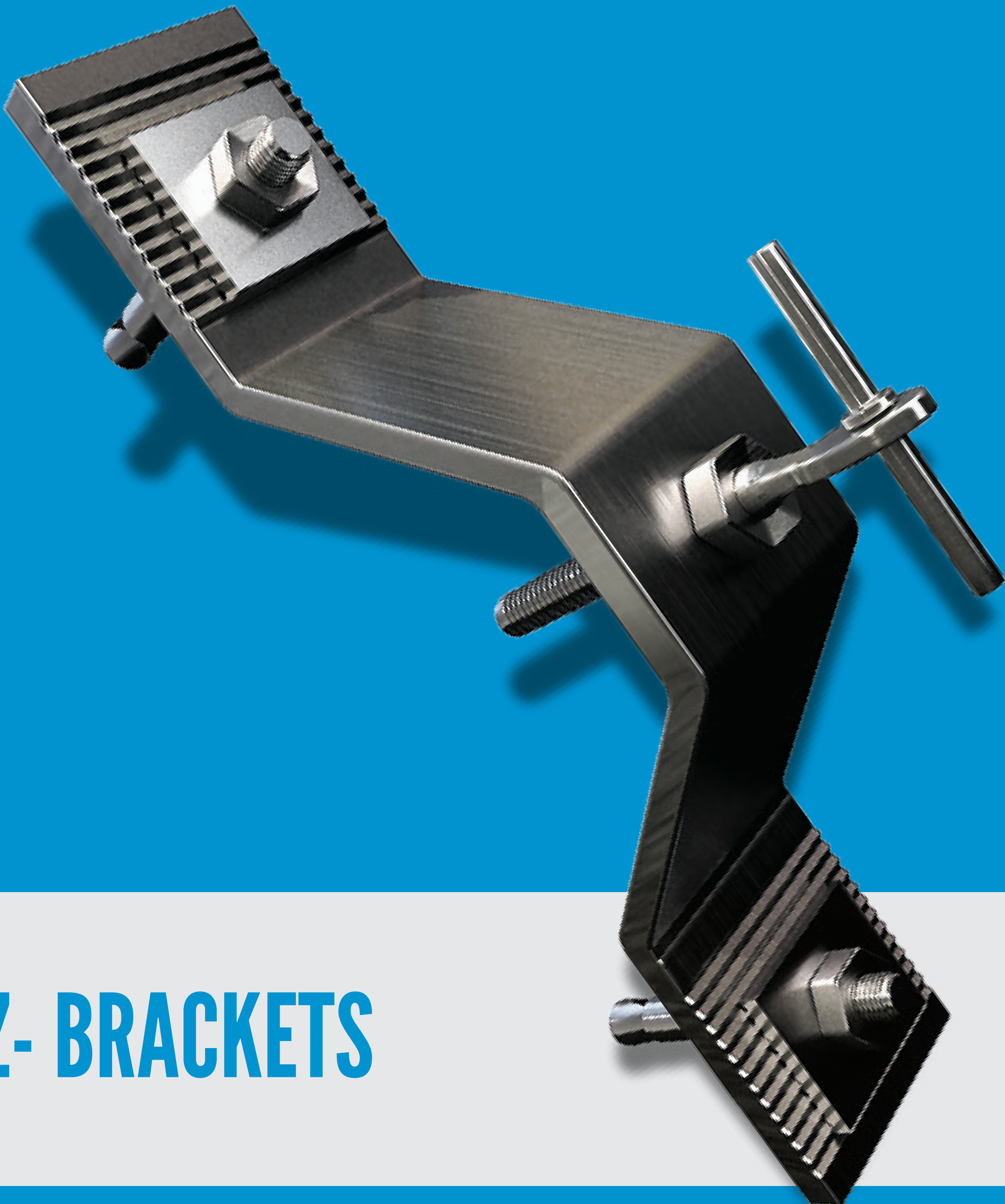
Standard Items:





Item No.	T	A	B	C	H	sl hole
1700-35.45.30.2	2	35	45	30	20	6,5 x 22
1700-40.45.35.2	2	40	45	35	20	6,5 x 22
1700-35.45.30.3	3	35	45	30	20	6,5 x 22
1700-40.45.30.3	3	40	45	30	20	8,5 x 22
1700-35.45.35.3	3	35	45	35	20	6,5 x 22
1700-40.45.35.3	3	40	45	35	20	8,5 x 22
1700-35.45.40.3	3	35	45	40	20	6,5 x 22
1700-35.45.30.4	4	35	45	30	20	8,5 x 22
1700-35.45.35.4	4	35	45	35	20	8,5 x 22
1700-35.45.40.4	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

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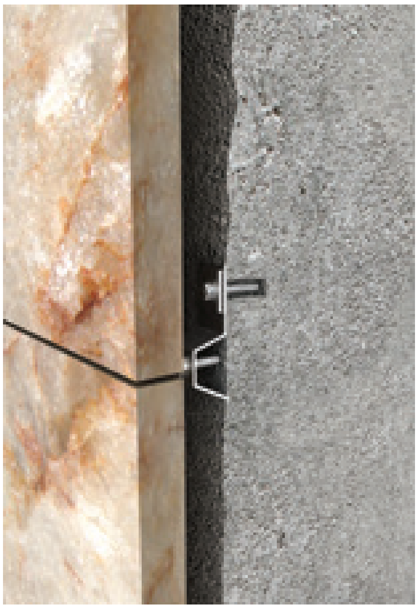
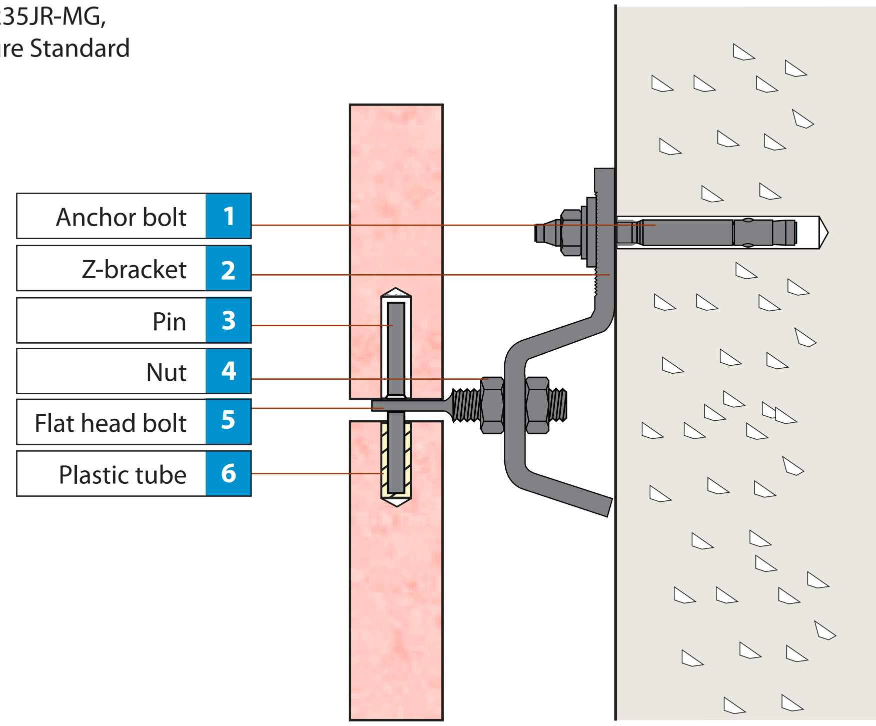
SYSTEM TYPE ST- 600 -1100 WITH RETURNED LEG

Z-Bracket with returned Leg

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

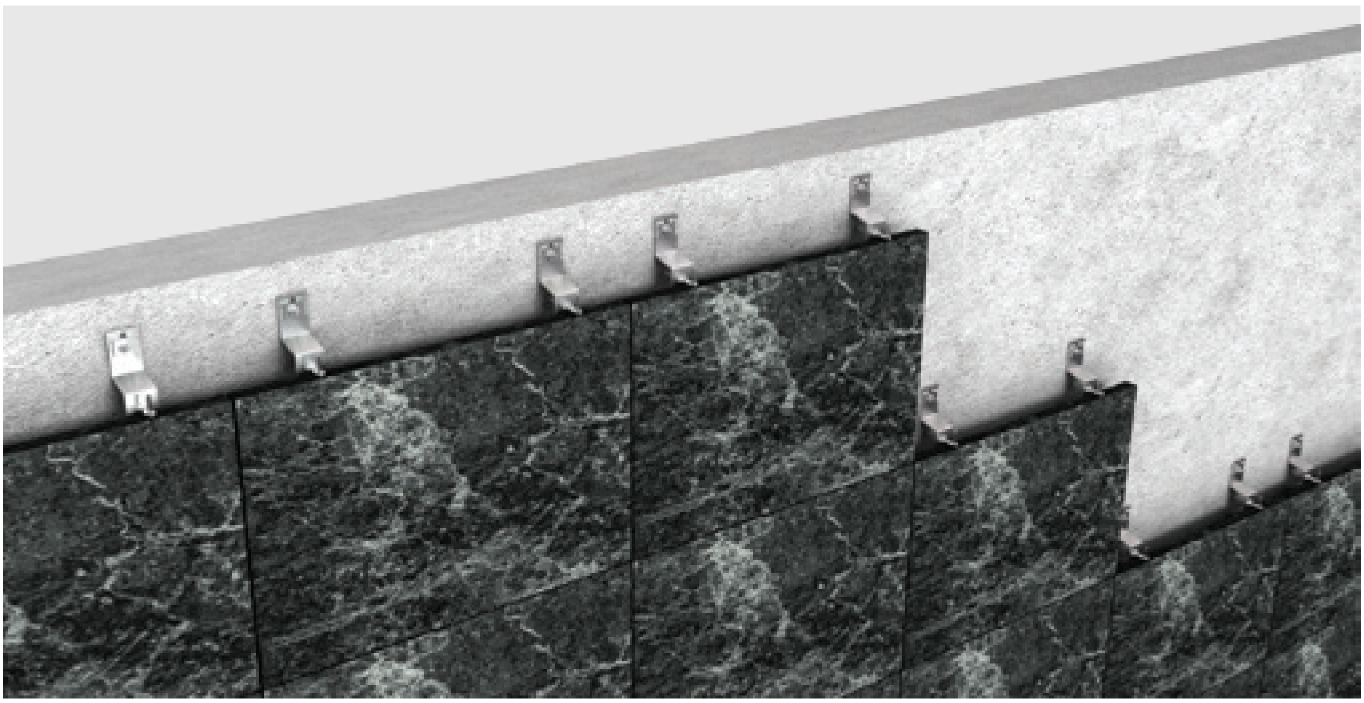




Application
According to DIN 18515 all cladding panels which are larger than 0.1 m2 have to be anchored.

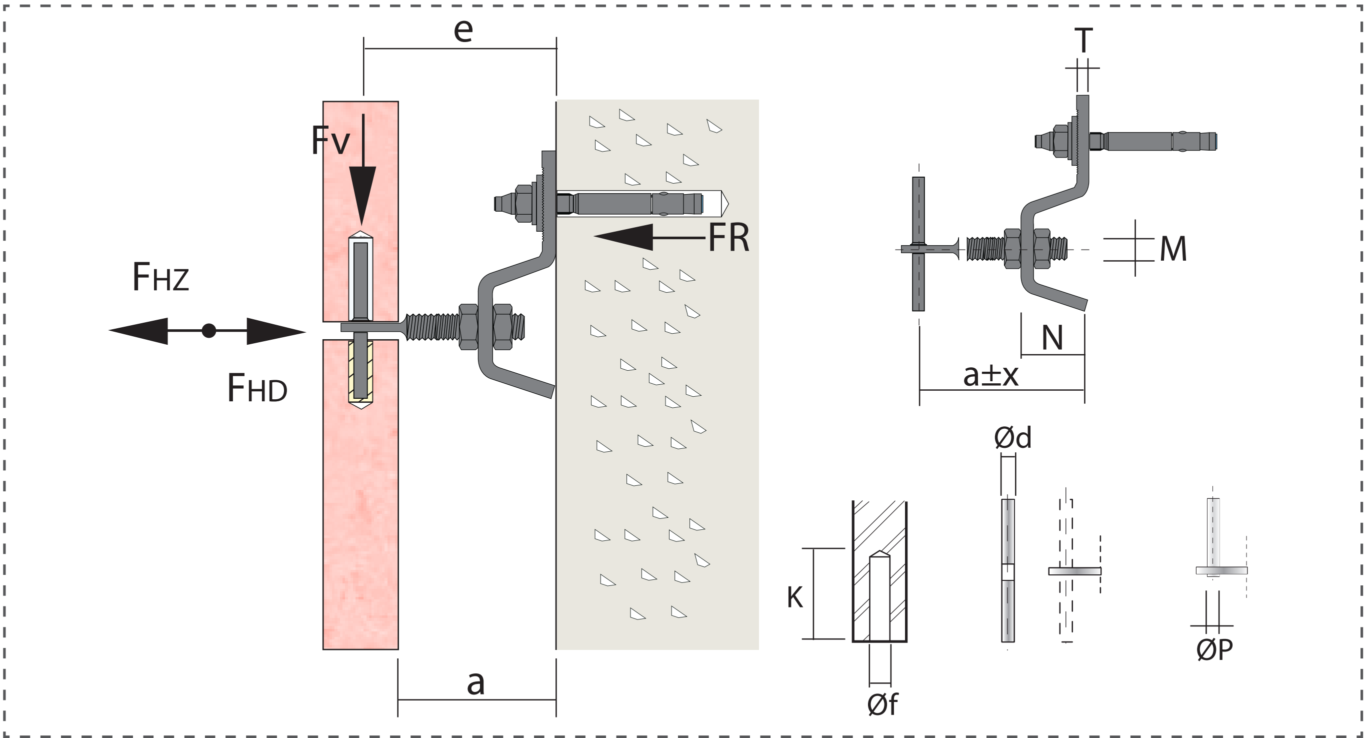
Material
Manufactured from stainless steel AISI 304, 316, 316L and 316Ti.
Adjustability in two directions.

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

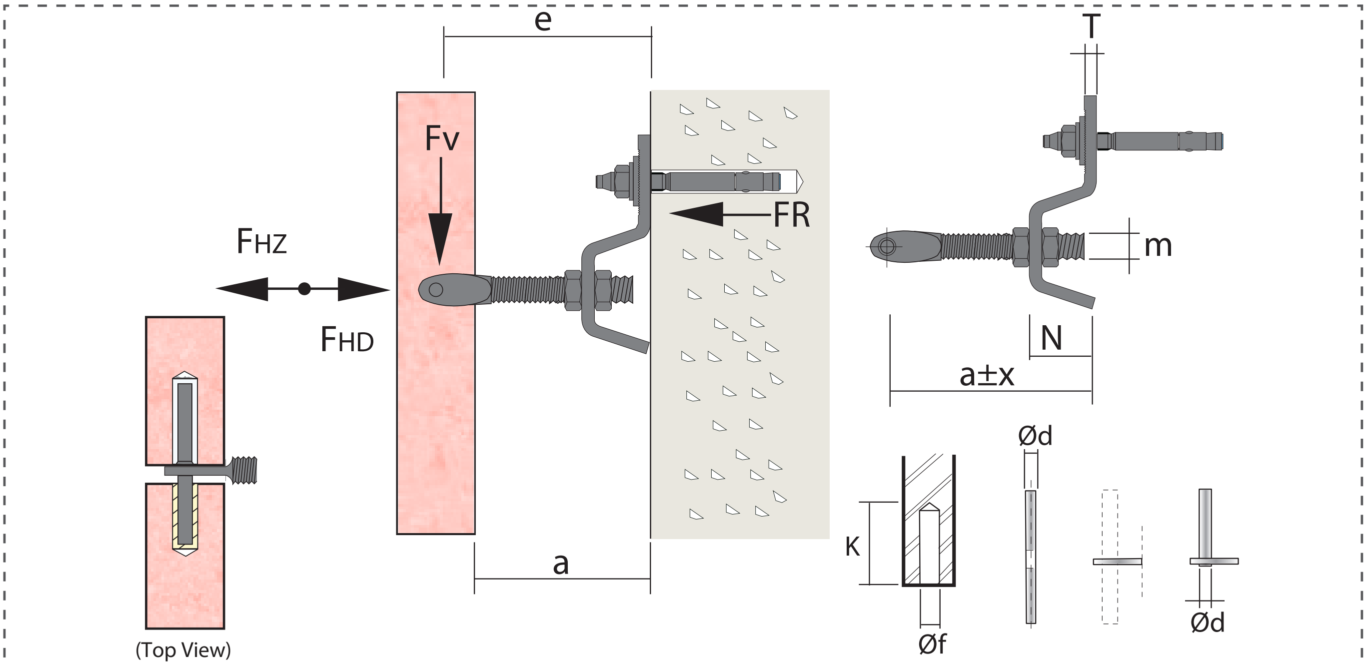


Anchoring base:
acc. to the licence of
the anchor bolt chosen.
a = cavity to backside to panel

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.

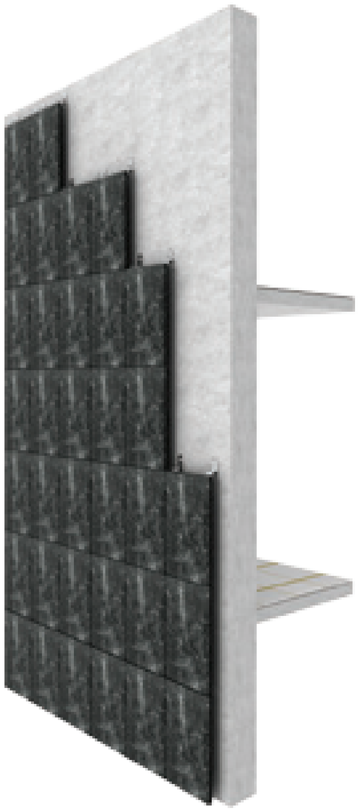
Loads caused by earthquakes can be transferred into the anchoring base.

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

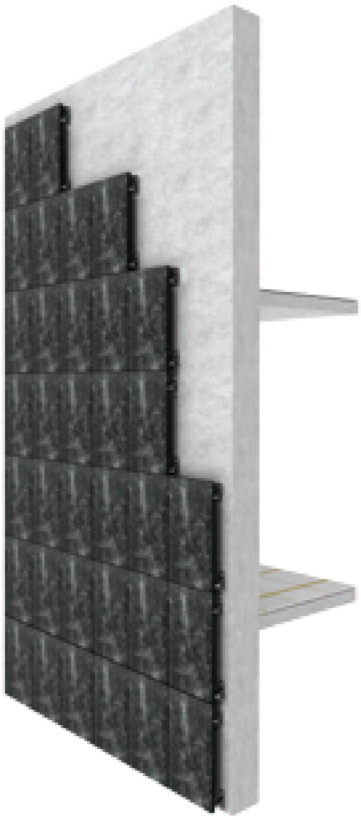
The structural analysis fully considers the dead load of panel, imposed wind loads and thermal stresses, in accordance with relevant DIN standards.

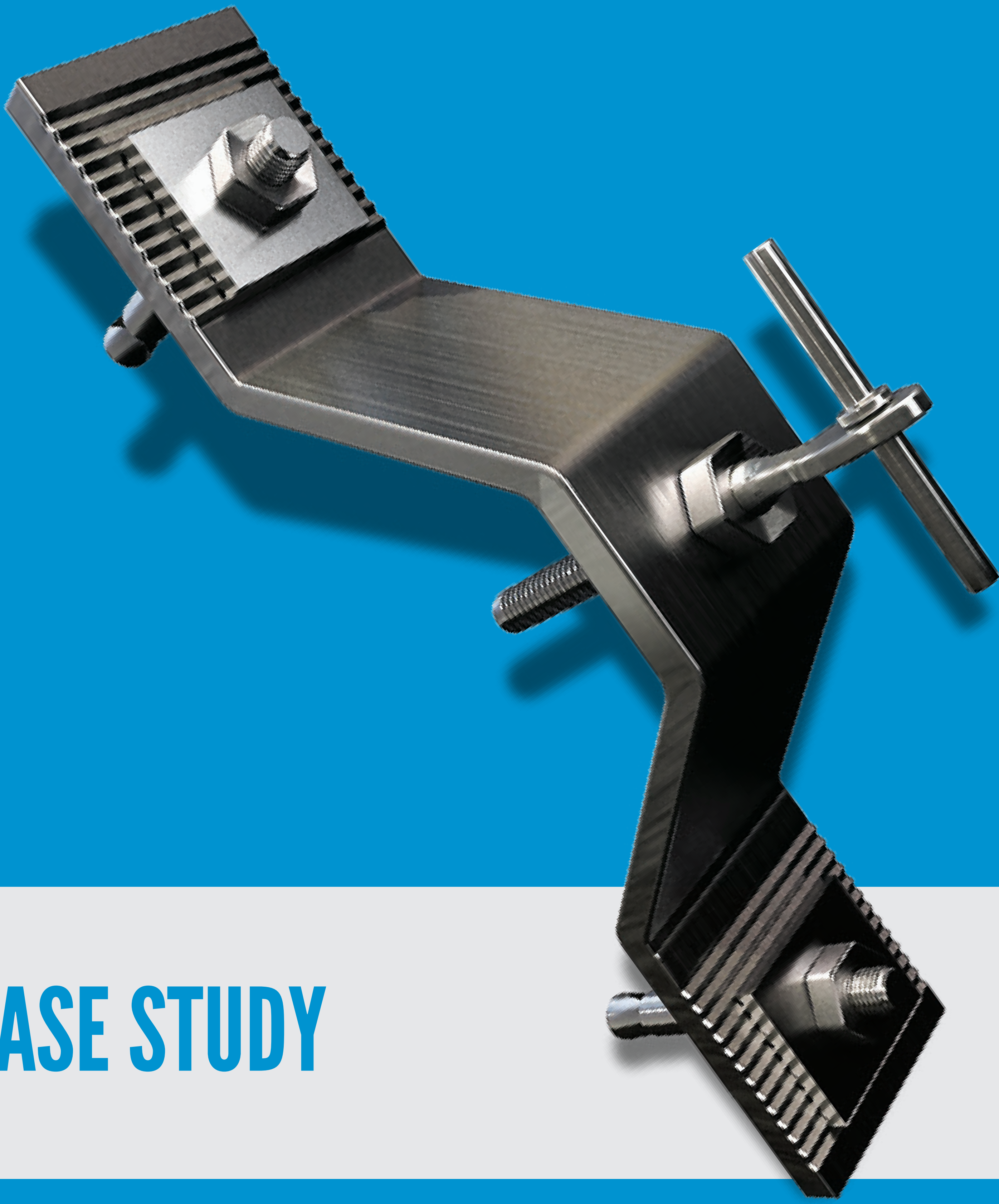
Loads caused by earthquakes can be transferred into the anchoring base.

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

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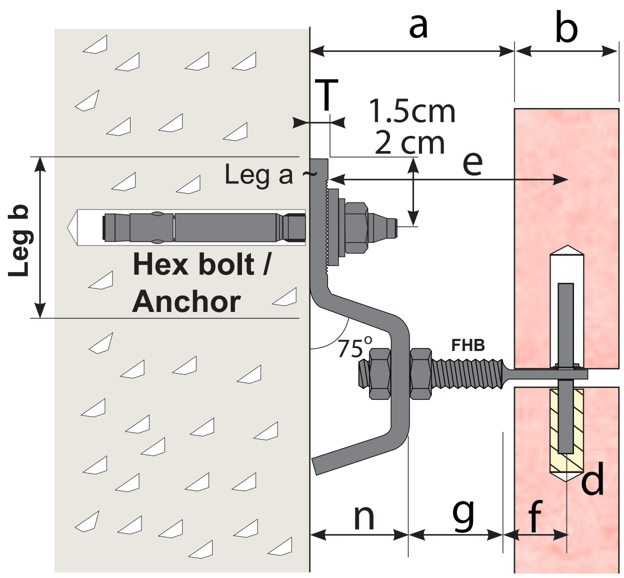
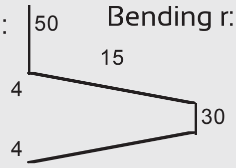
PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800



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

Bending detail:



Bending r: 6mm min.

Facade Panel:

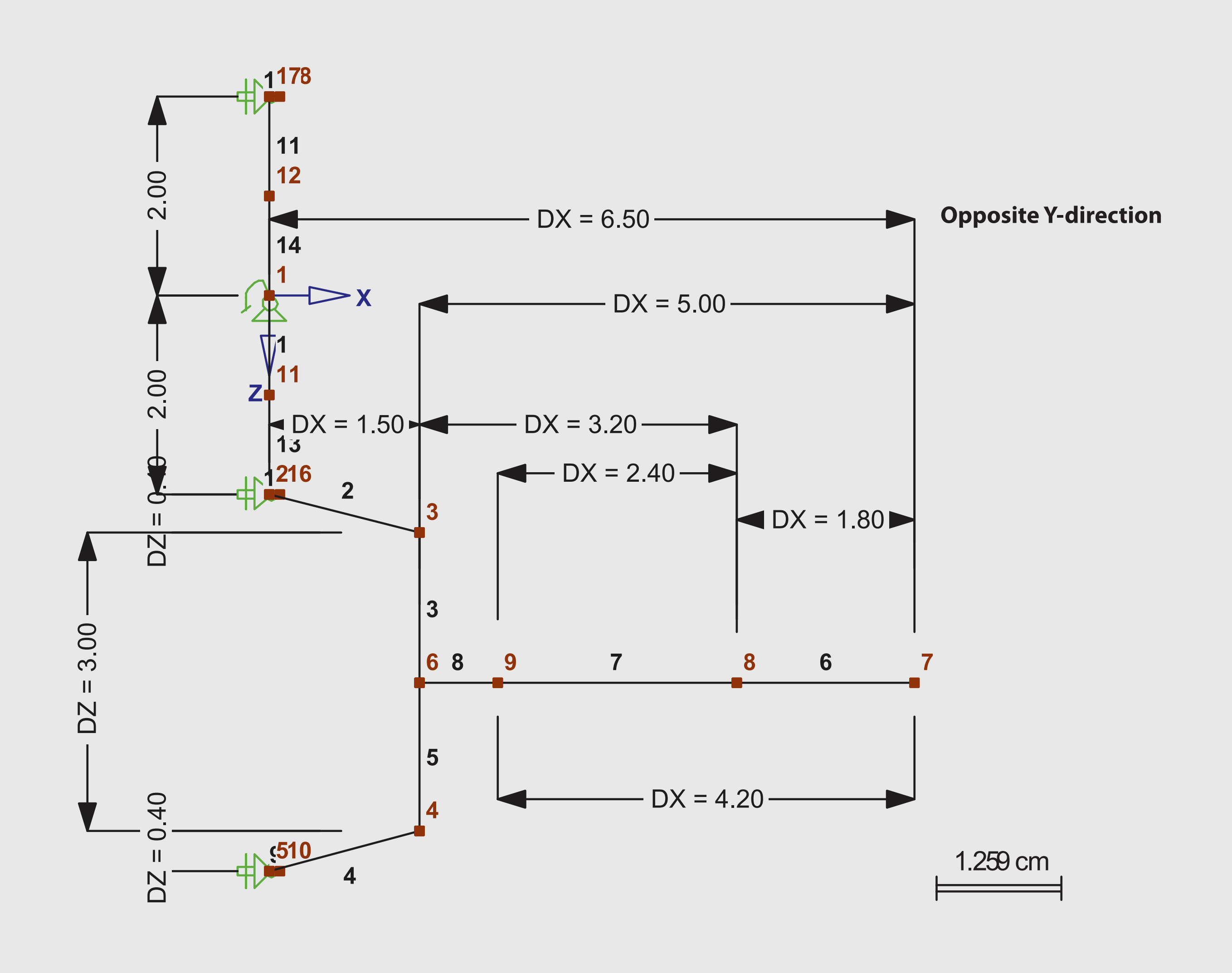
Width =	800	mm
Height =	450	mm
Thickness =	30	mm
Cavity a =	40	± 10 mm
Offset N =	15	mm
Cavity to Pin =	55	± 10 mm

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	-

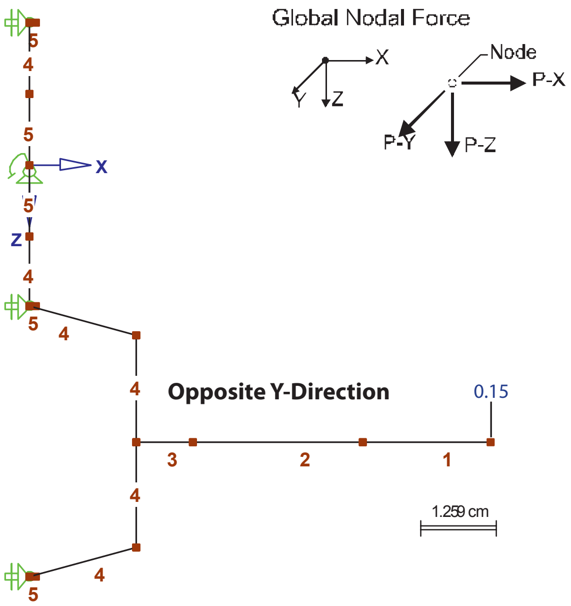
Load Groups

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

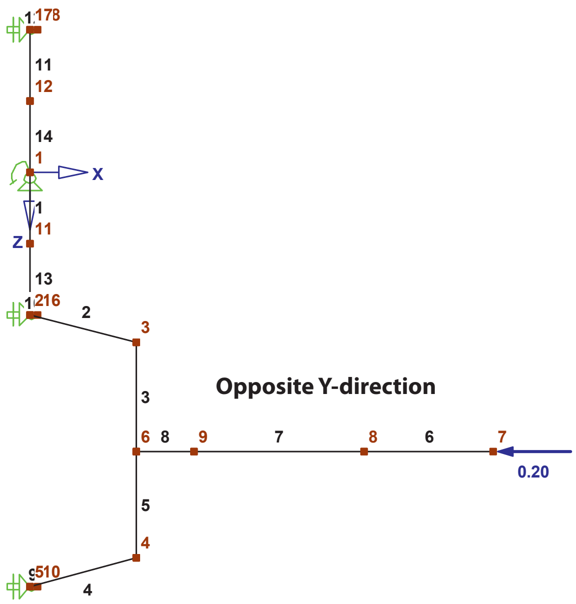
LOADS : LC 1 - Proper weight [kN]

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



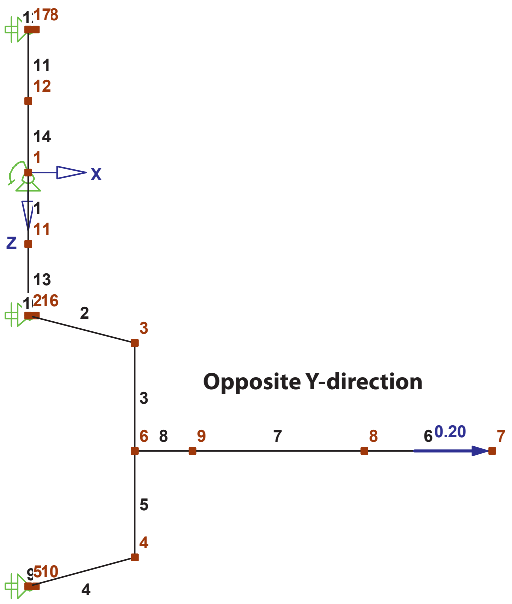
LOADS : LC 2 - Wind pressure [kN]

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



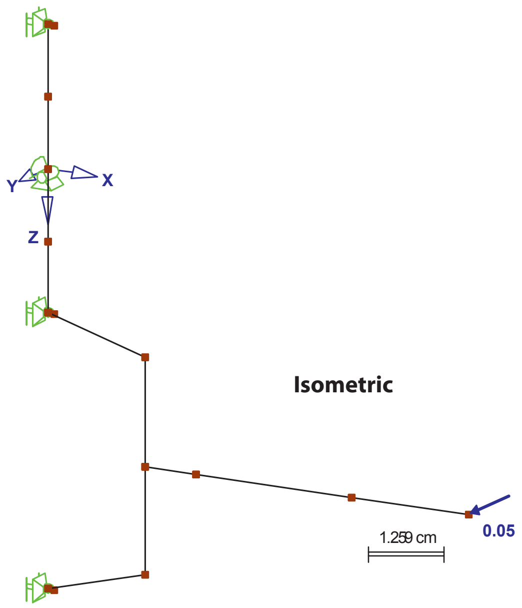
LOADS : LC 3 - Wind pressure [kN]

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

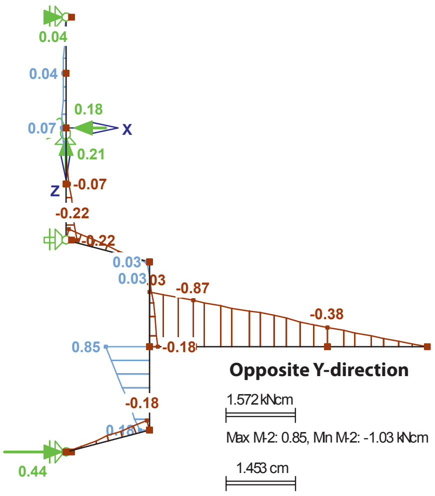


PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800

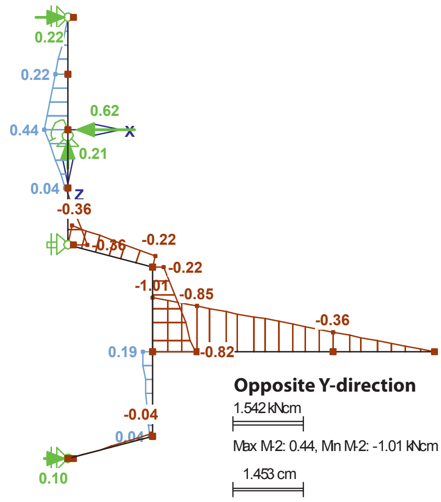
LOAD COMBINATIONS		
CO No	**CO Description**	**Combination Criteria**
1	LC1 or LC2 or LC3 or LC4	LG1 o LG2 o LG3 o LG4

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

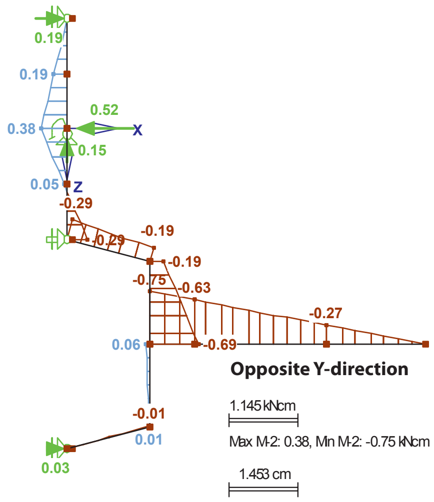
RESULTS : LG 1 | Internal Forces M-2 | Support Reactions



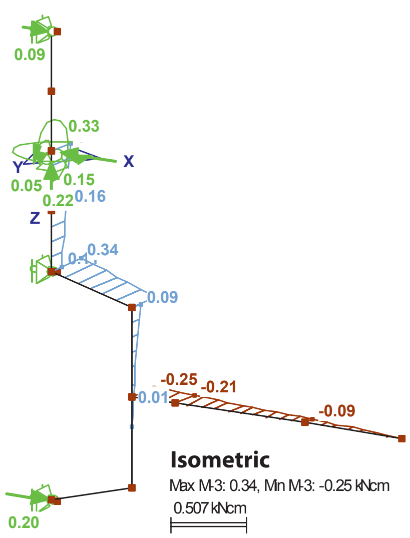
RESULTS : LG 2 | Internal Forces M-2 | Support Reactions



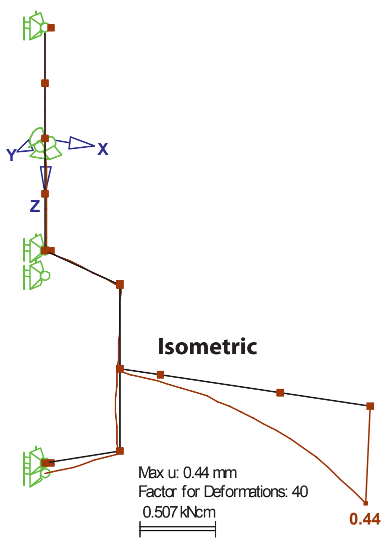
RESULTS : LG 3 | Internal Forces M-2 | Support Reactions



RESULTS : LG 4 | Internal Forces M-2 | Support Reactions



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

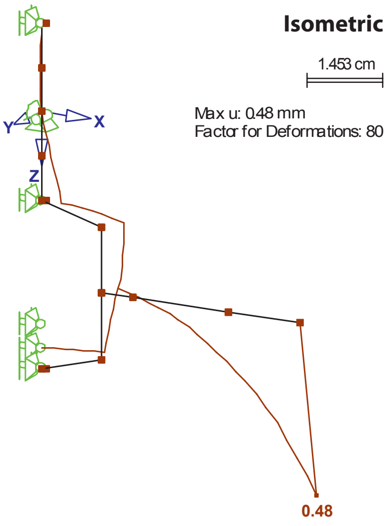


PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800

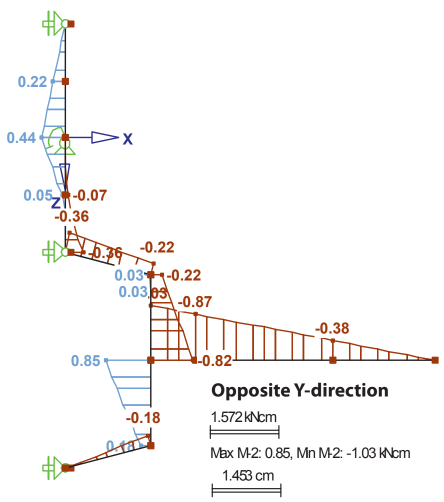
RESULTS : LG 52 - LC1 + LC3 (for deflection) | Deformations

MAX/MIN/CORR SUPPORT FORCES AND SUPPORT MOMENTS

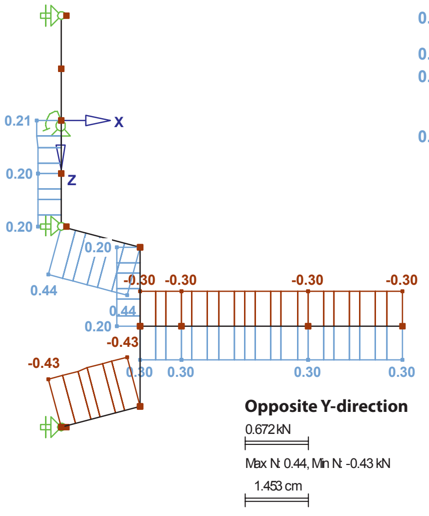
Node No	CO No		Support Forces [kN]			Support Moments [kNcm]		
			PX	PY	PZ	MX	MY	MZ
1	CO1	Max P-X Min P-X LC in Max P-X: LG2 LC in Min P-X:	.62 .00	.00 .00	.21 .00	.00 .00	.00 .00	.00 .00
		Max P-Y Min P-Y LC in Max P-Y: LG4 LC in Min P-Y:	.29 .00	.05 .00	.15 .00	-.22 .00	.00 .00	.33 .00
		Max P-Z Min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



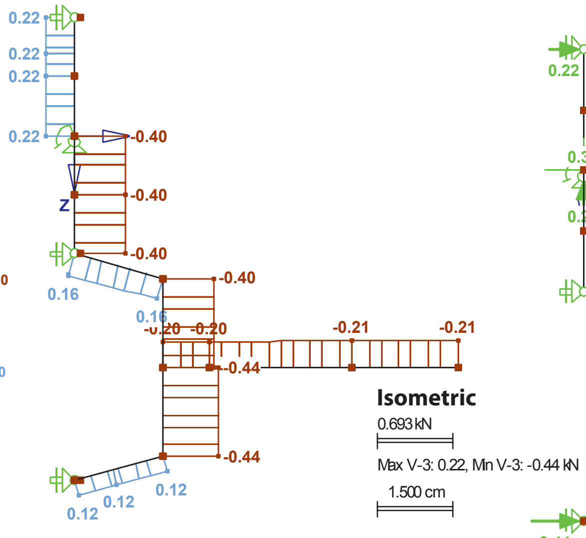
RESULTS : CO 1 - LC1 or LC2 or LC3 or LC4 | Max/Min Internal Forces M-2



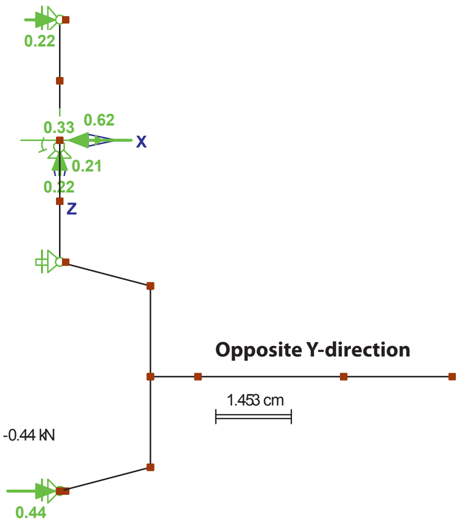
RESULTS : CO 1 - LC1 or LC2 or LC3 or LC4 | Max/Min Internal Forces N



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 | ExtremeSupport Reactions

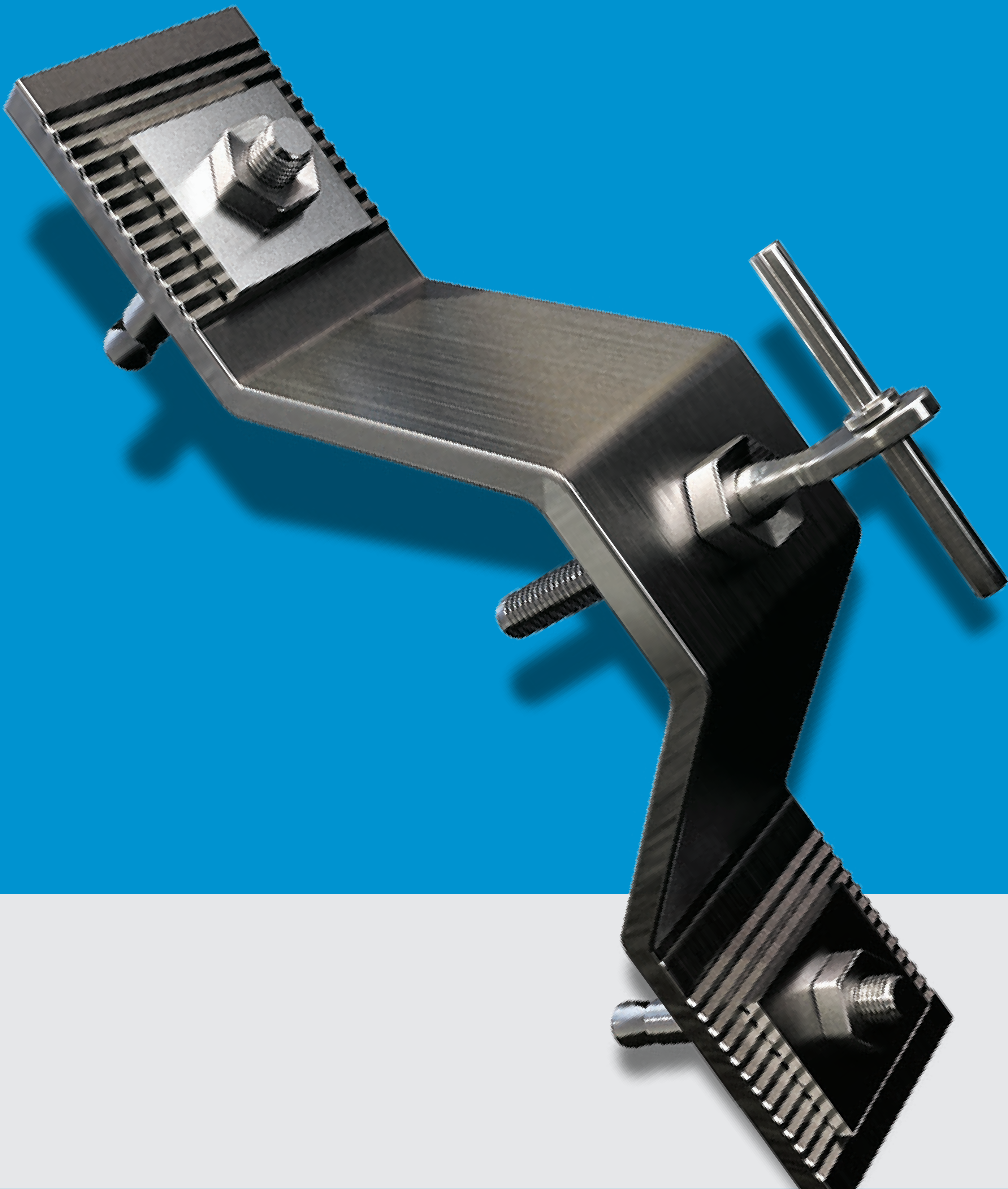


STEEL1 - SPANNUNGSANALYSE| GENERAL DATA

ELEMENTS TO DESIGN LOAD CASES TO DESIGN	All	
	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 50ºc		
			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



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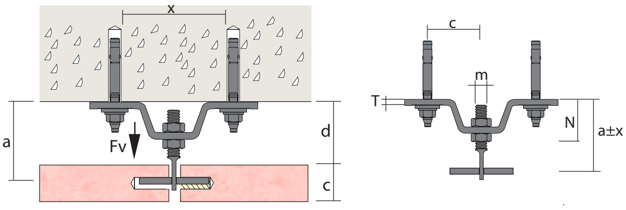
OMEGA BRACKET

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

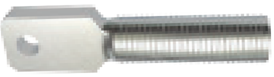
Bracket Offset mm	Cavity to Pin min - max mm	Deadload max DL kN	Windload max WL ± kN	Bracket Width mm	Bracket Thickness (T) mm	Ø Pin mm	FHB A2-70 A4-70	Anchor comb. Force kN *
70	100-110	0.16	0.22	30	3	4	M8	2.30
80	110-120			30	3	4	M8	2.40
90	120-130			35	3	4	M8	2.50
100	130-140			35	3	4	M8	2.50
110	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

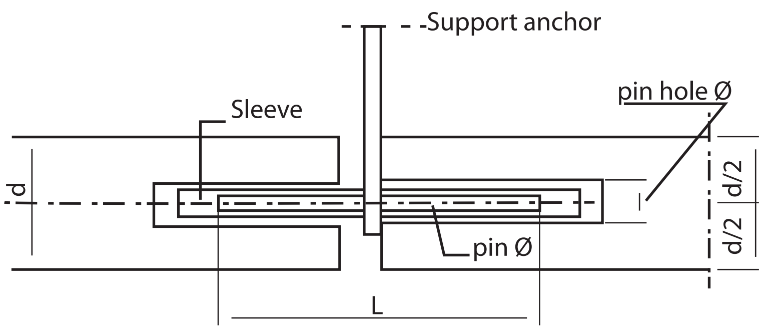
Flat Head Bolt

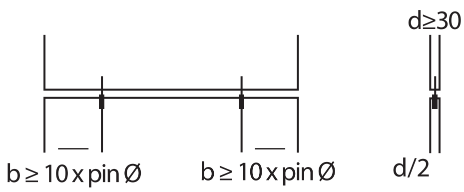
Materials A2-70, A4-70 50°C 24h average temperature Fixing in reinforced concrete vertical wall, or steel substructure

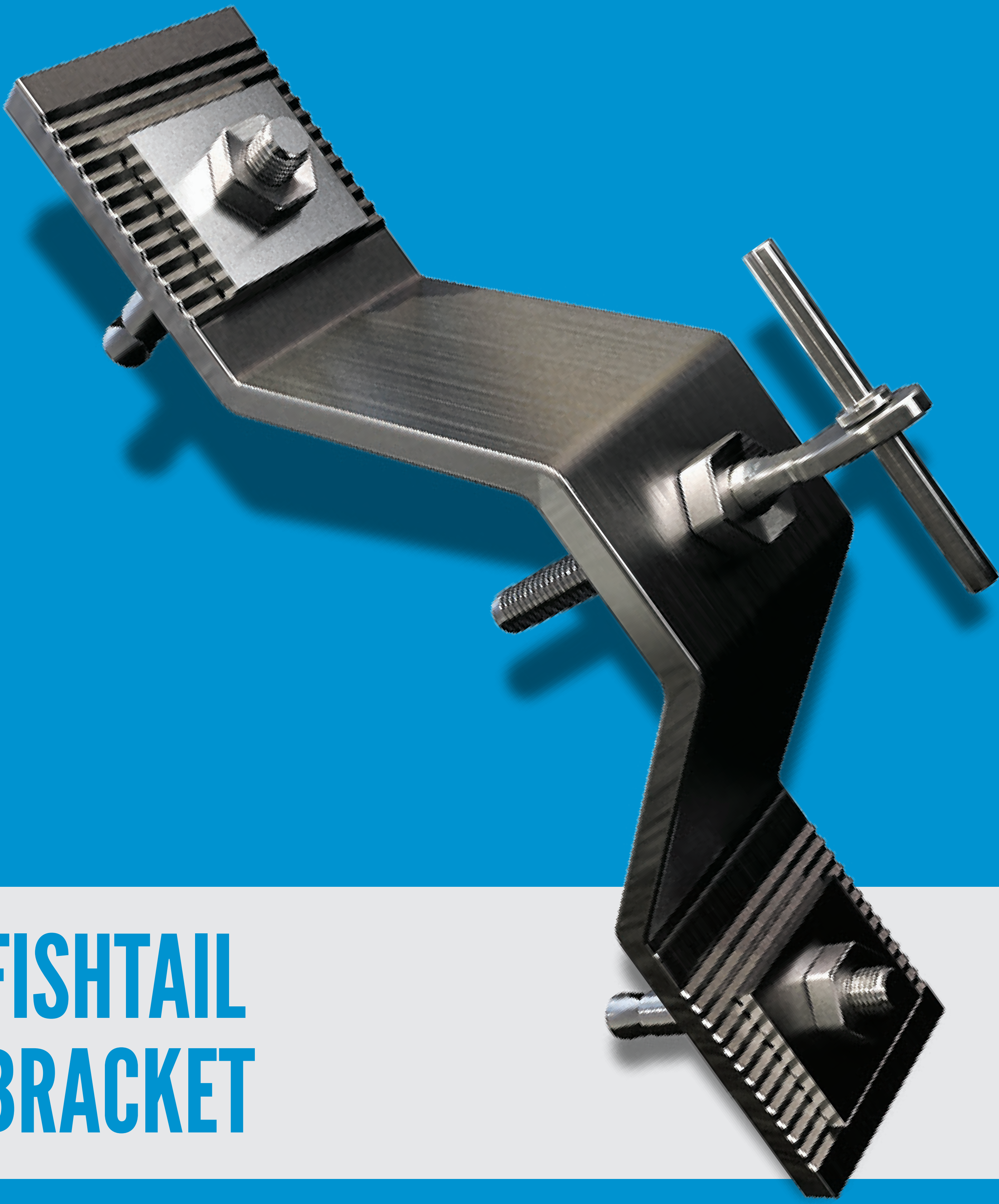


Cavity to Pin min - max mm	Deadload max DL kN	Windload max WL ± kN	FHB A2-70 A4-70	Ø Pin mm
20-30	0.08	0.11	M6	4
30-40			M6	4
40-50			M8	4
50-60			M8	4
30-40	0.16	0.22	M8	4
40-50			M8	4
50-60			M10	4
60-70			M10	4
30-40	0.23	0.32	M10	5
40-50			M10	5
50-60			M10	5
60-70			M10	5
30-40	0.45	0.63	M12	6
40-50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

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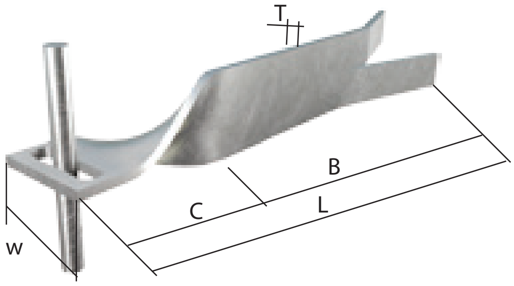
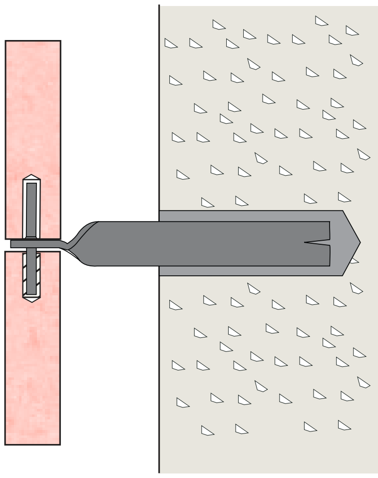
TYPE ST- 800 -1100

Fishtail with Pin | Type ST- 800 1100

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



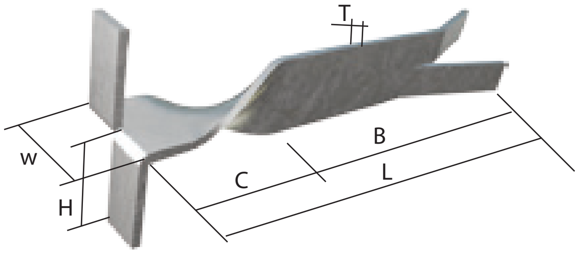
Codes	Width (W)	Thickness (T)	Length (L)	sl hole
800-1100-25.2.100	25	2	100	4.1 x 15
800-1100-25.2.120	25	2	120	4.1 x 15
800-1100-25.2.140	25	2	140	4.1 x 15
800-1100-25.2.160	25	2	160	4.1 x 15
800-1100-25.3.100	25	3	100	4.1 x 15
800-1100-25.3.120	25	3	120	4.1 x 15
800-1100-25.3.140	25	3	140	4.1 x 15
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



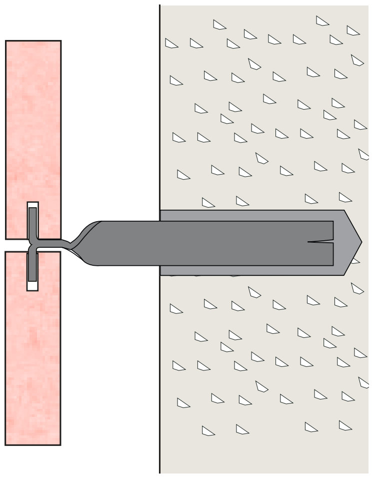
TYPE ST- 800 -1100

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

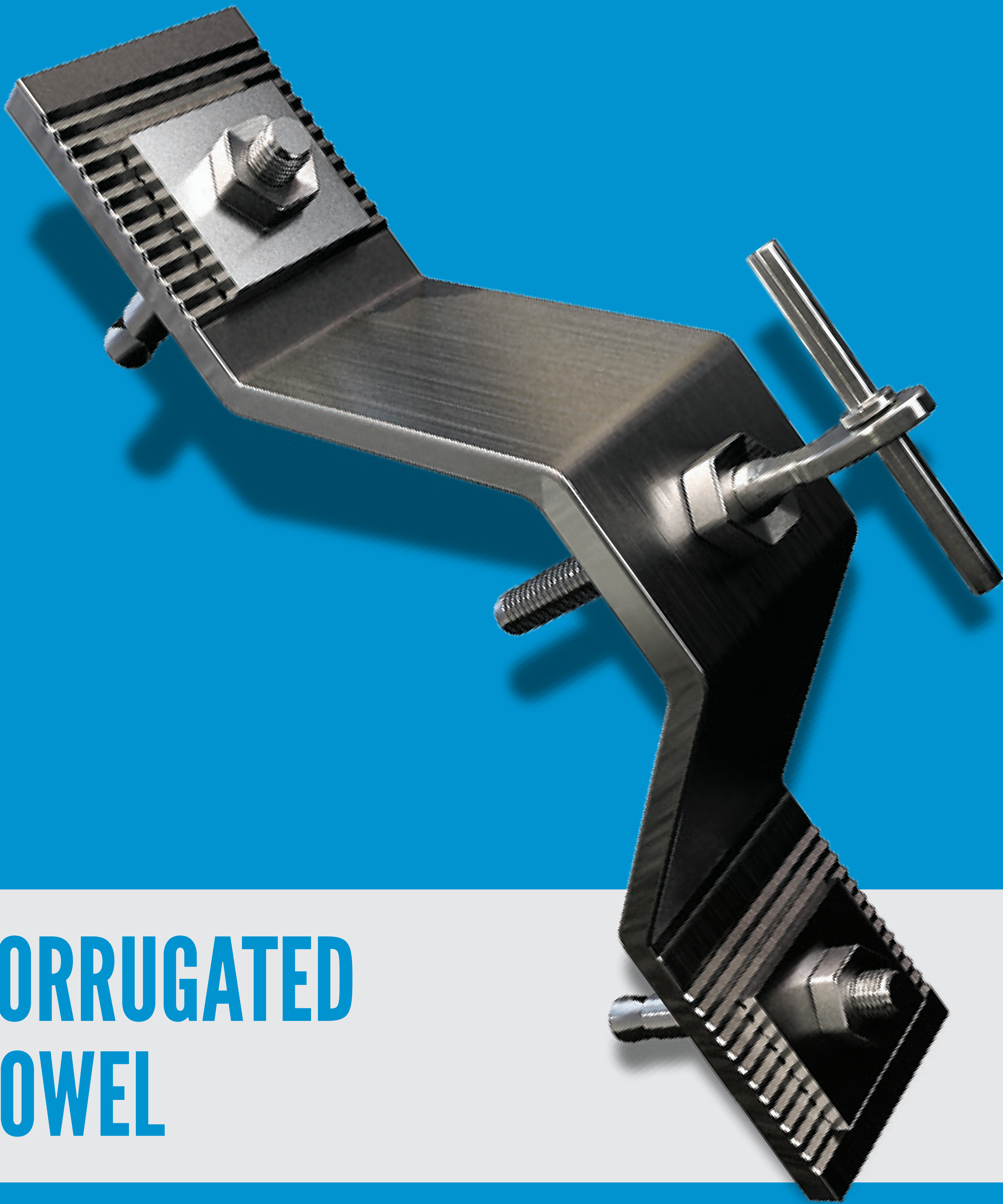
Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary

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

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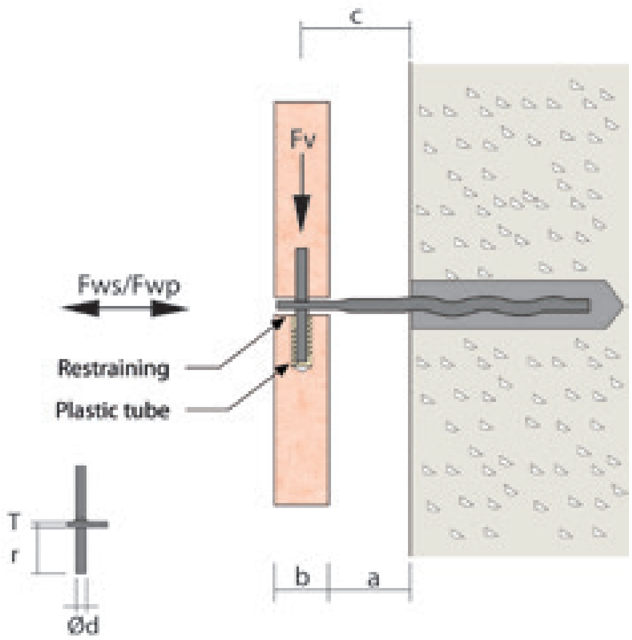
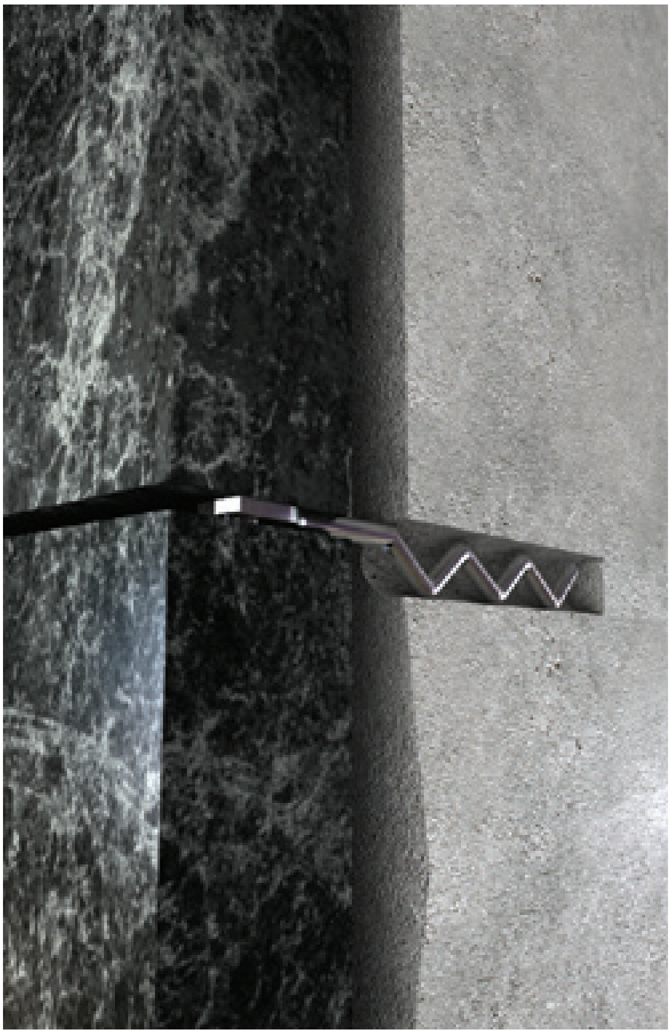
TYPE ST- 900 -1100 (CORRUGATED DOWEL)

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.



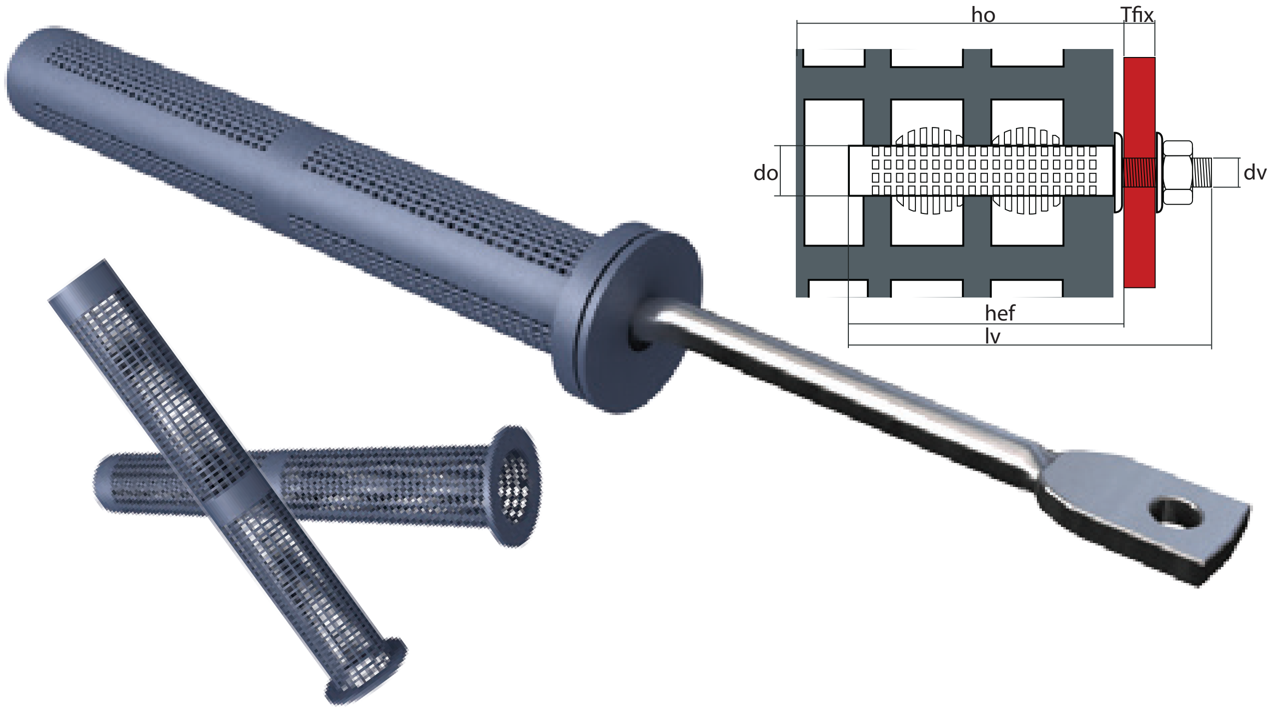


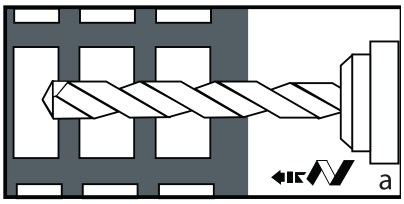
Load-bearing and retaining angles.
Material: SS304, SS316, SS316L, SS316TI, S235JR-MG, S235JR-HDG 50°c 24h average temperature

Standard items:

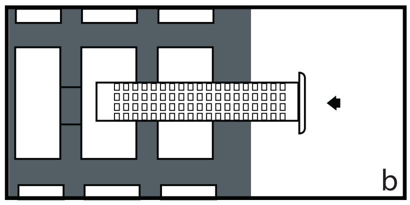
Net anchor	CODE	Ø stud	Stud length /EHD	Ø Hole	Ø inside	Hole depth	Fixable thickness /EHD	Hole volume	Resin volume to inject
Type	CODE	dv/mm	l/mm	do/mm	dv/mm	ho/mm	tfix/mm	cm^3	cm^3
BE 12x45	8708955	M6-M8	65	12	10	45	-	5,1	5,1
BE 12x60	8708956	M6-M8	80	12	10	60	-	6,8	6,8
BE 12x80	8708957	M6-M8	110	12	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.

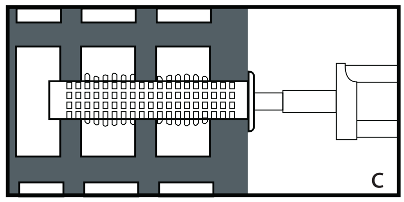




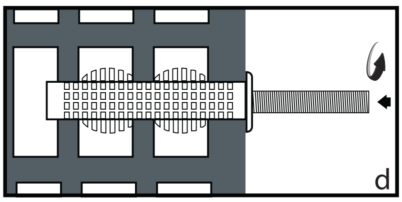
a- Drill to the suggested diameter.



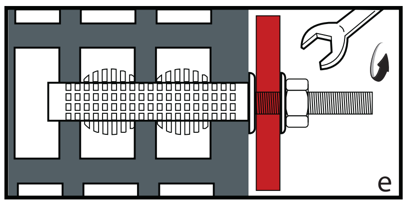
b- Insert tube screen.



c- Inject the resin with the special nozzle.

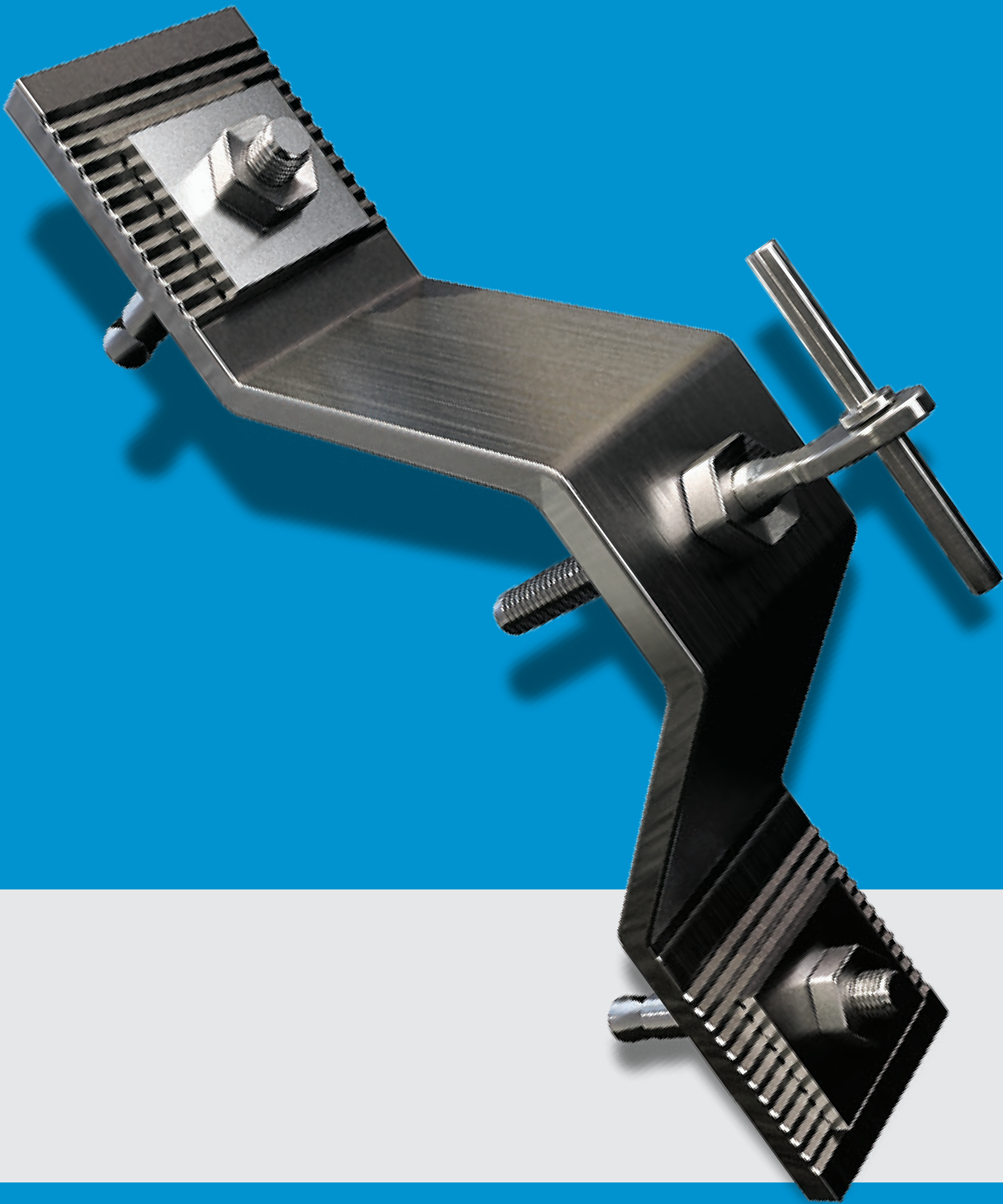


d- insert the threaded stud turning it slowly.



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	-	-	-



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EXAMPLES OF STEEL BACK SUPPORT SYSTEM

EXAMPLES OF STEEL BACKSUPPORT SYSTEMS

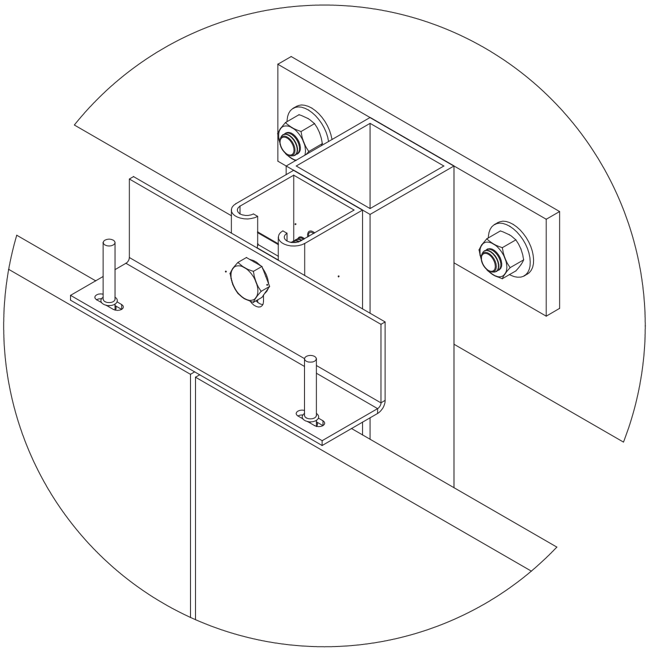
Example -1
Front To Back Channel with welded back plate and up & down bracket

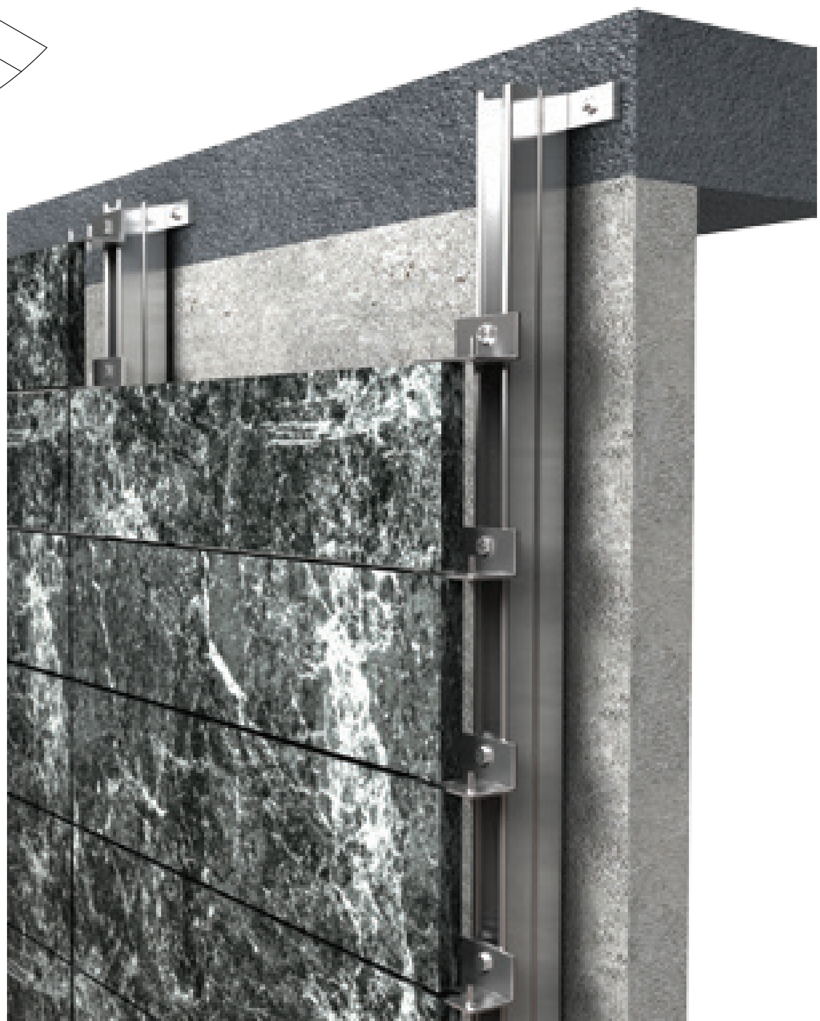
Example -2
Square tube with welded channel & double pin L-bracket

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





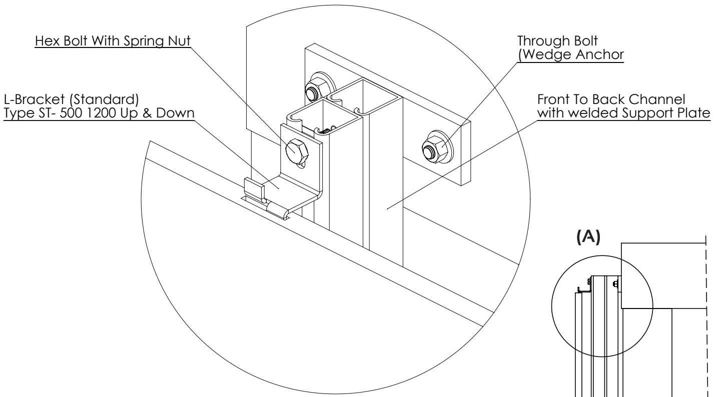
EXAMPLE -1

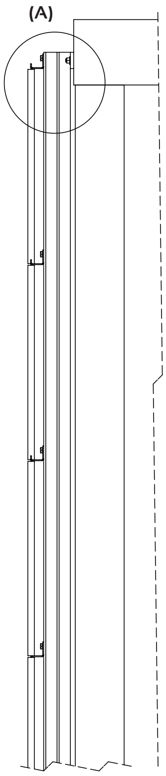
Front To Back Channel with welded back plate and up & down bracket

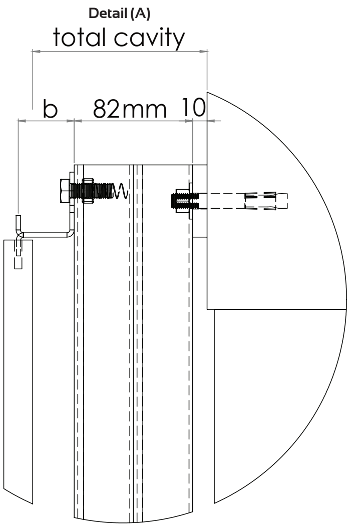
Floor to floor System using front to back channels with support plates and L-Brackets up & down with bolts and spring nuts fixed to the channels .

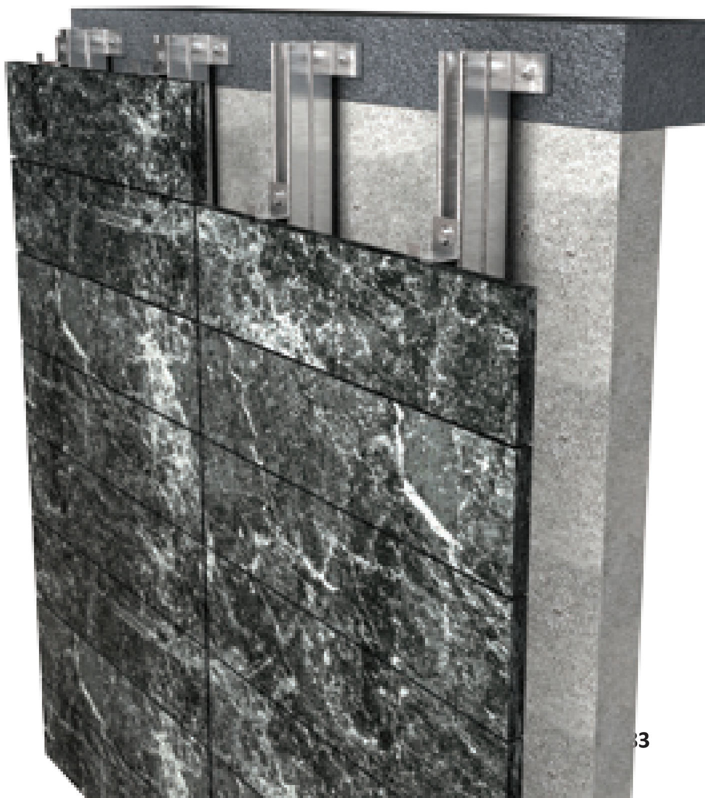
- Min cavity to backside of panel: 100 mm

- Span ≤ 3,0 mm









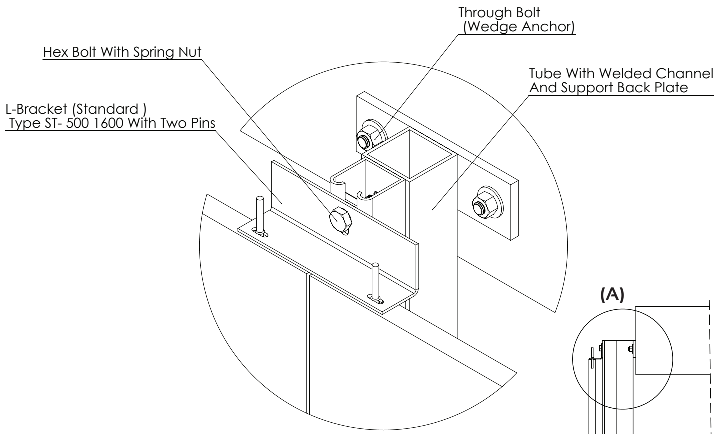
EXAMPLE -2

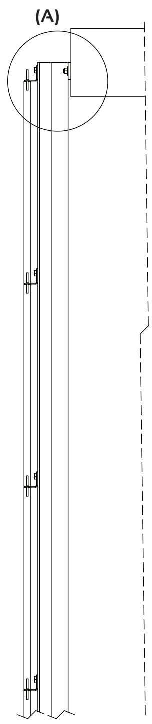
Square tube with welded channel & double pin L-bracket

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

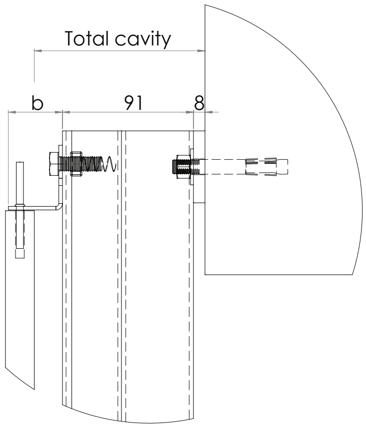
- Min cavity to backside of panel: 120 mm

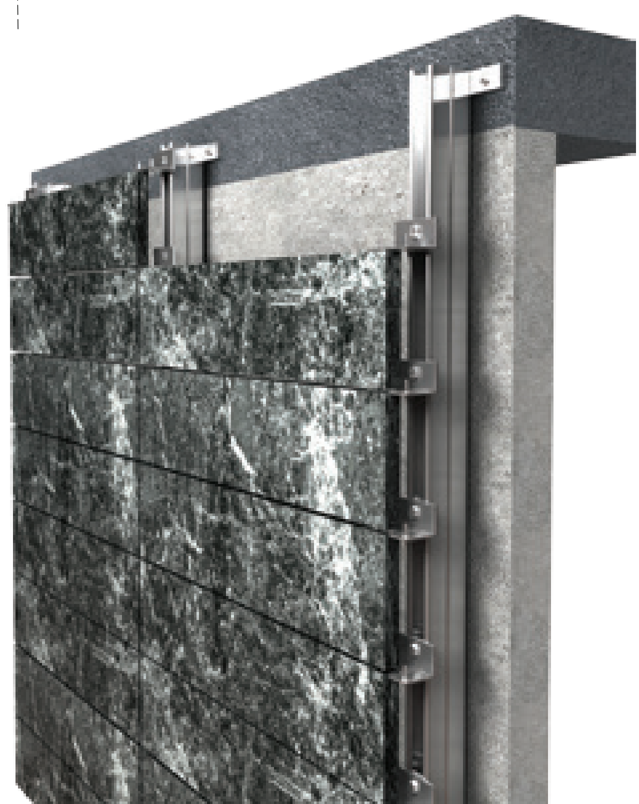
- Span 3,0 mm





Detail (A)





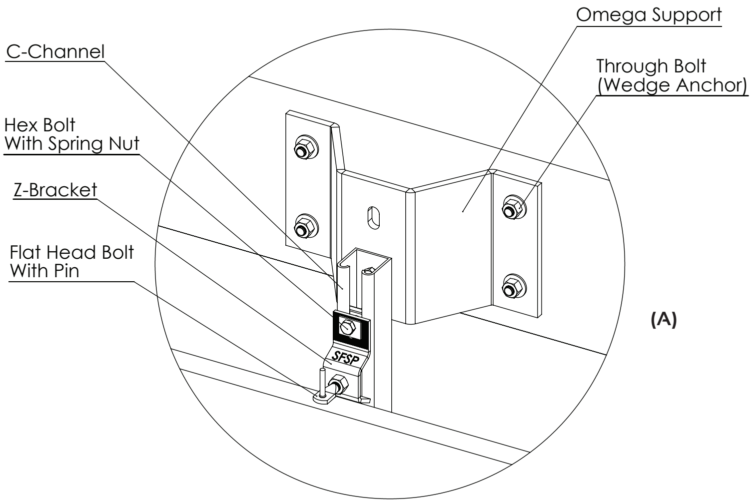
EXAMPLE -3

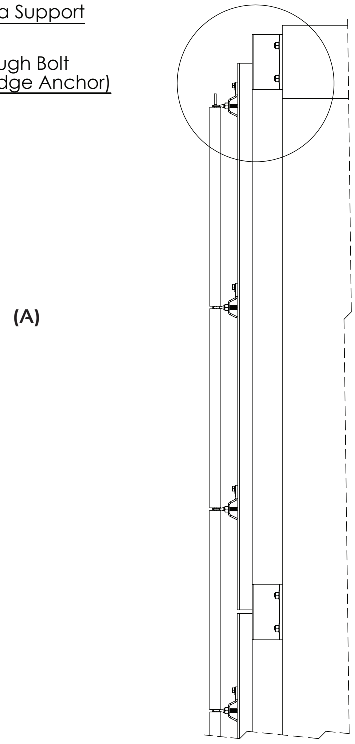
Single channel with Omega support and Z-brackets

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 .

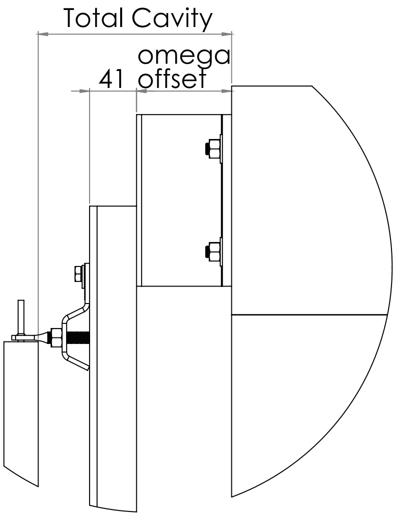
- For cavity 150 mm

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





Detail (A)



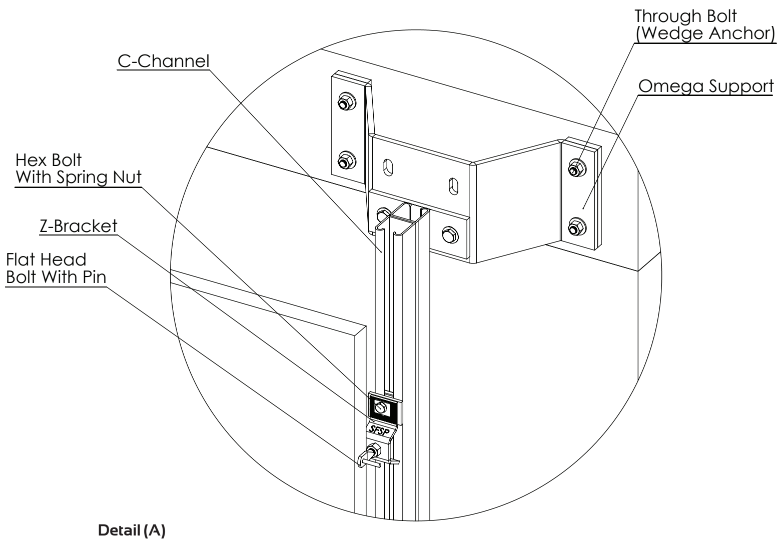
EXAMPLE -4

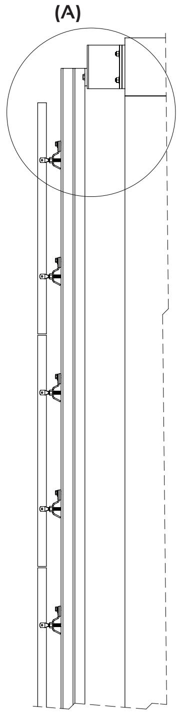
BTB with Omega Sapport and Z-brackets

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.

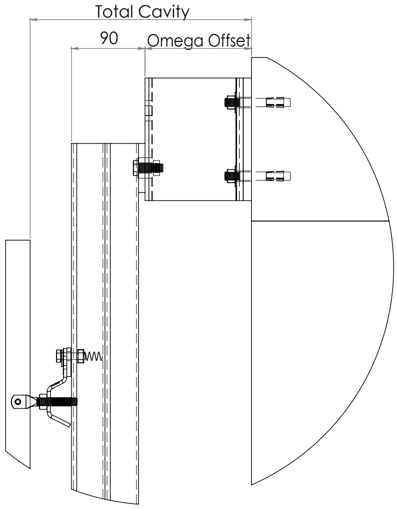
- For cavity   200mm

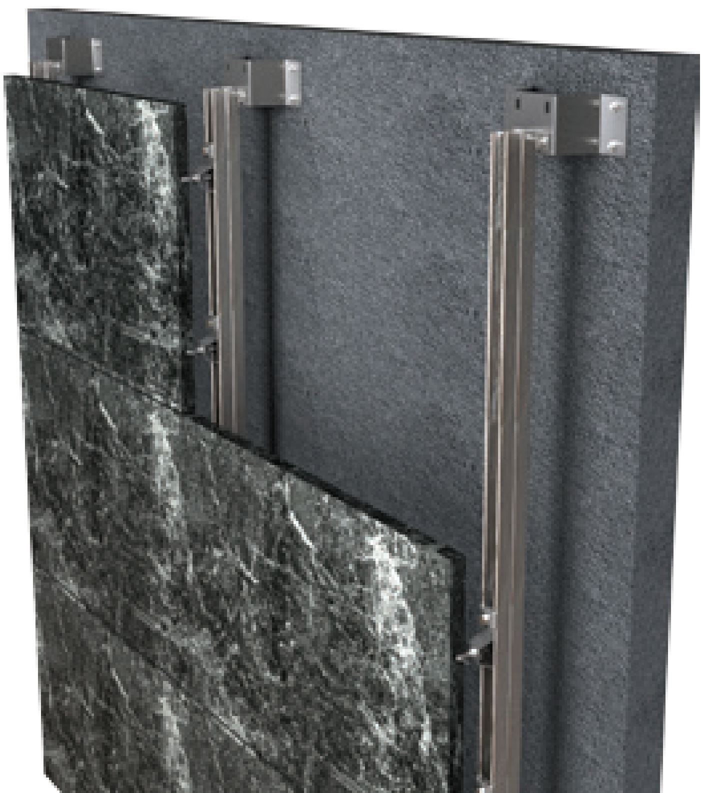
- distance of Omegabrackets ~200-300cm





Detail (A)





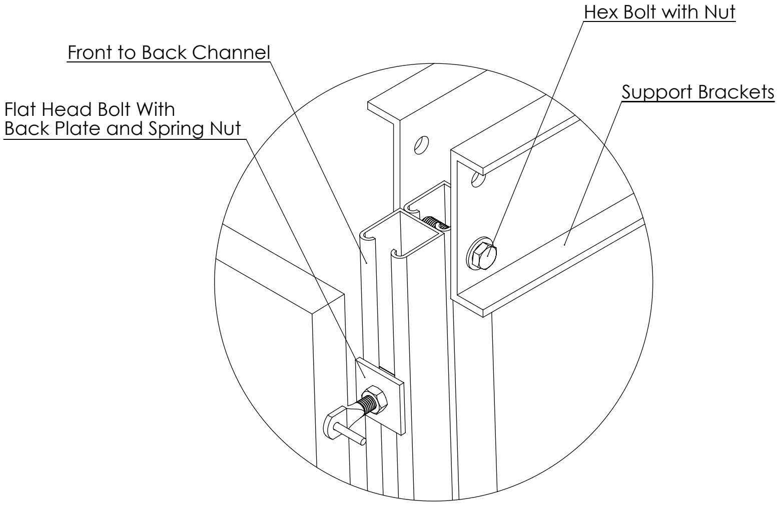
EXAMPLE -5

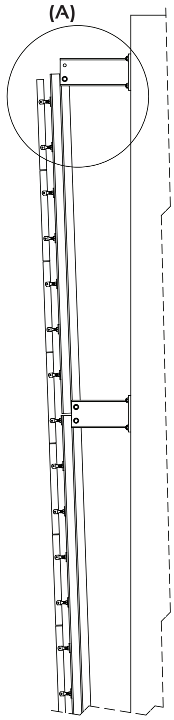
Cantilever Arm Support with BTB channel and Flate Head Bolt

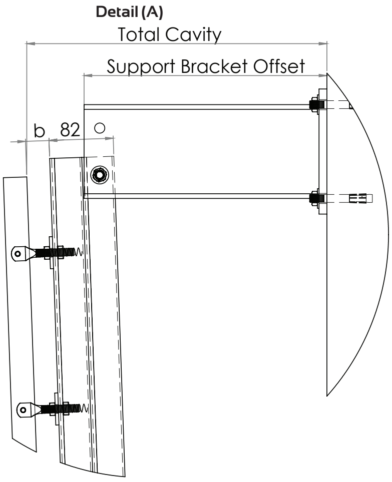
Steel back-support system for Adjustable large cavities using support brackets, front to back channels,and adju-stable flat head bolts with back plates and spring nuts fixed to channels .

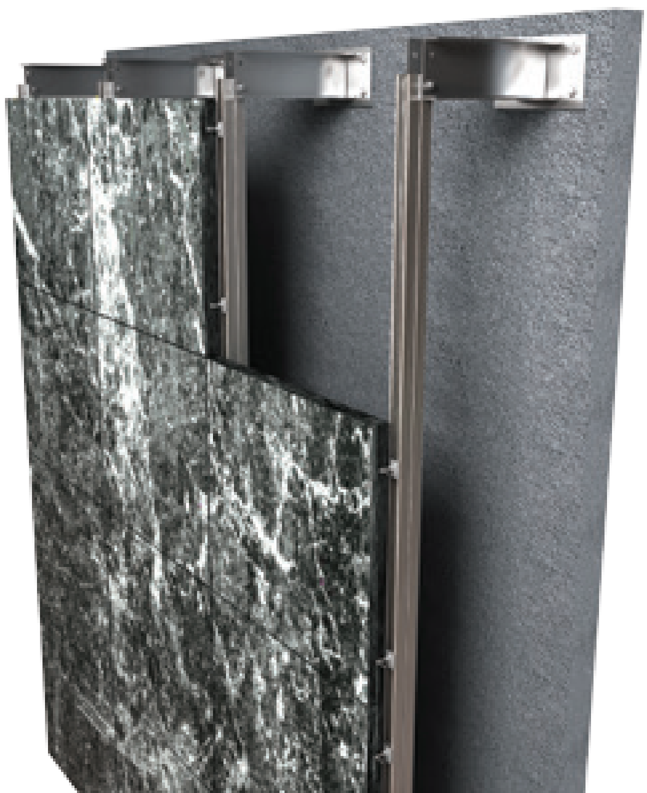
- For cavity 300 mm

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

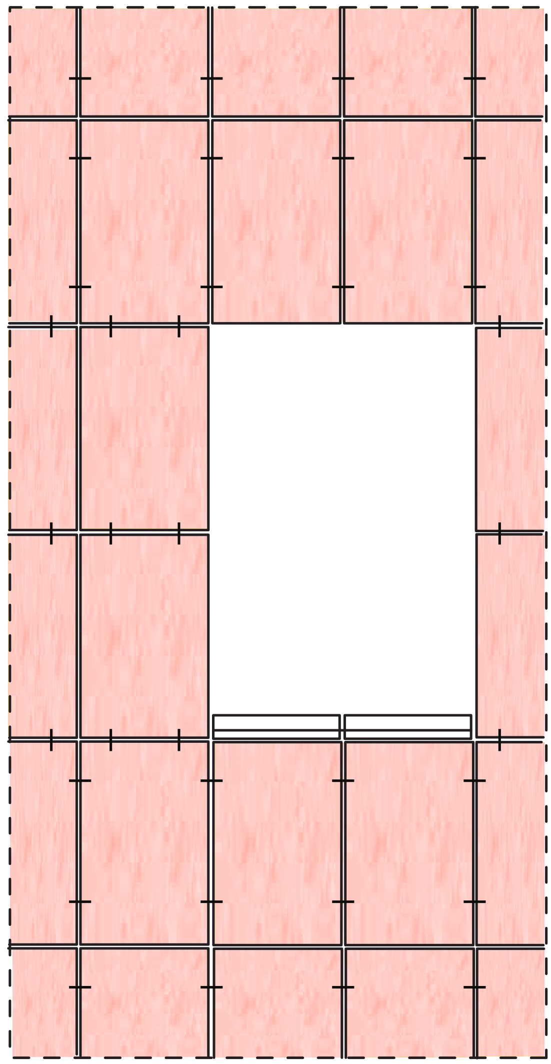


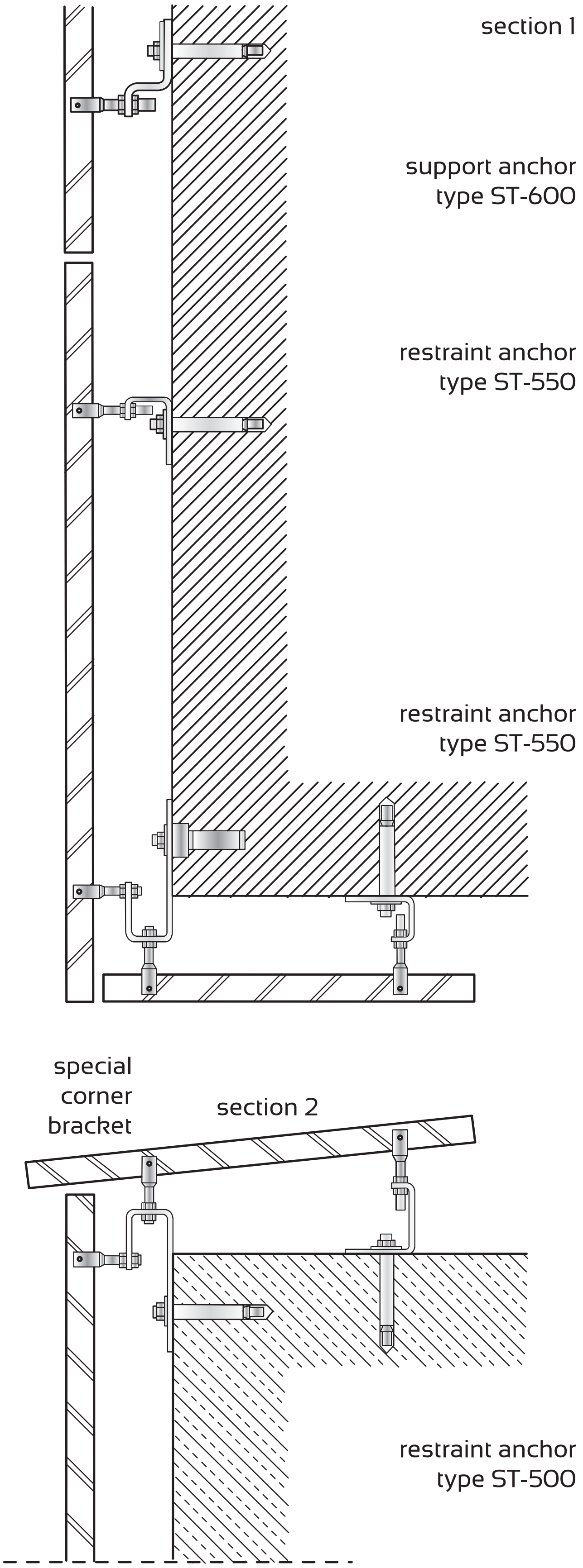




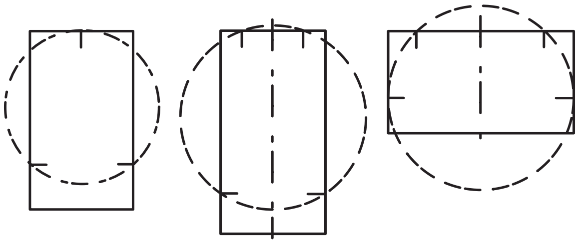


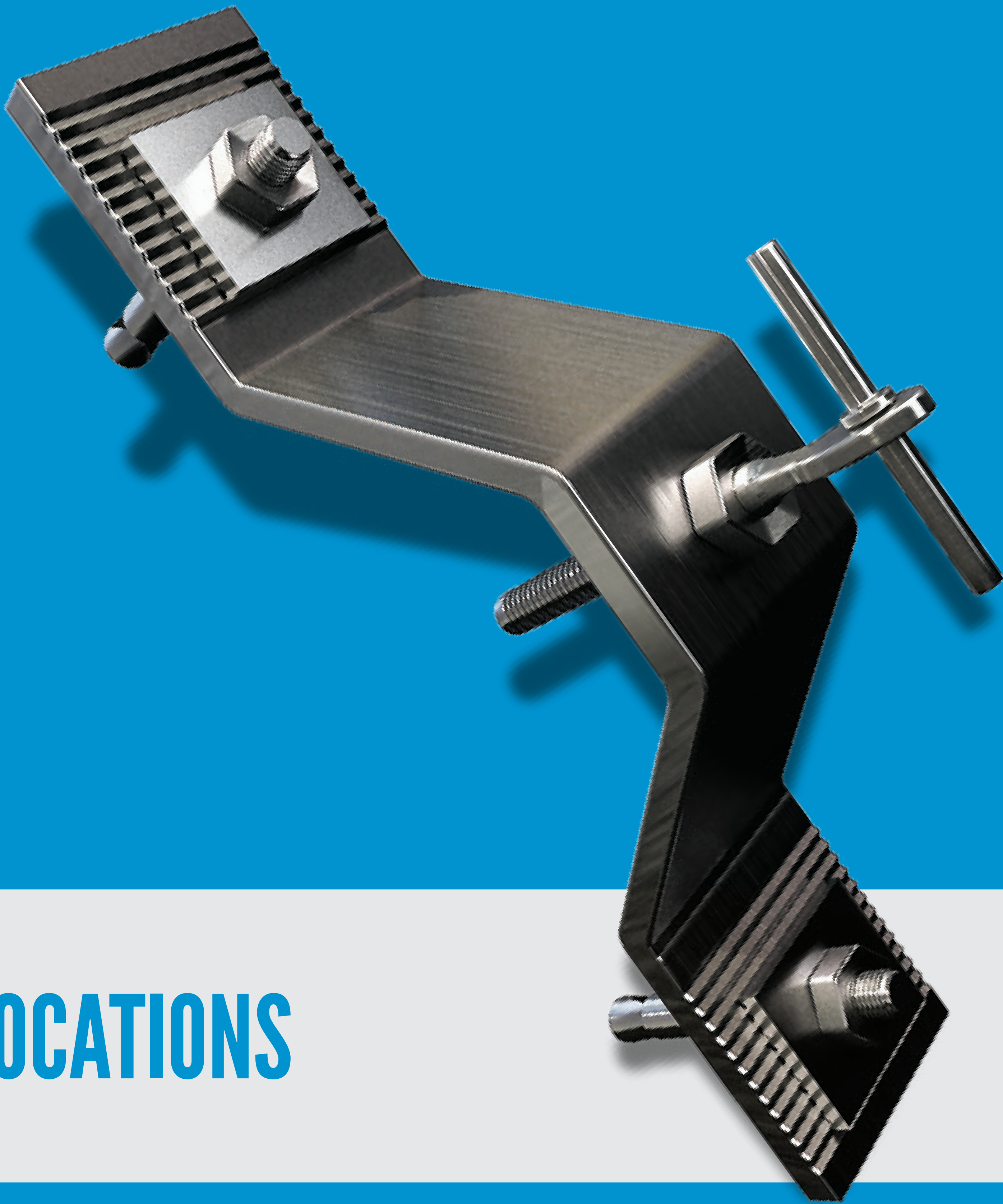
Detail solution: fixing of slabs at opening. ex . window





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.





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