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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 Deutschland 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.
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.

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 CERTIFICATION

ISO 9001 certified
(Quality Management System)
ISO 14001 Certified
(Environment Management System)

ISO 18001 Certified
(Health & Safety Management System)
# Certificate of Compliance

**Certificate Number:** 20170811-R38825

**Report Reference:** R38825-20170811

**Issue Date:** 2017-AUGUST-11

**Issued To:** Sigma Factory for Steel Products
Sahi 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.
SFSP PRODUCES

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.
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. SFSP block reinforcements reduces the risk of cracking either at stress concentration around opening.

STEEL LINTELS & BLOCK WORK ACCESSORIES
Steel Lintels provide a combination of strength and light weight, resulting in efficient load bearing performance and increased productivity on site. They are characterized by their ease of installation in addition to time as well as money saving.

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.

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.
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.
ضا عن شركاء عصام قباني للمقاولات العامة

BAHRAIN
Isam Kabbani Trading Est.
مؤسسة عصام قباني التجارية

UAE
Issam Kabbani Trading Est.
مؤسسة عصام قباني التجارية

KUWAIT
Hassan Kabbani for General Contracting Est.
مؤسسة حسان قباني للمقاولات العامة

OMAN
Isam Kabbani & Partners Trading Co.
شركة عصام قباني المحدودة وشركاه

EGYPT
UNITECH Egypt for Building Materials
شركة يونيت طم مصر للإنشاء و التعمير و الكهرباء

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 يونيت طم ميدل إيست ش.م.م

SFSP CUSTOMER SERVICE CALL CENTER

KSA
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UAE
+9714 8181925, Ext. 4269
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
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 values 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.

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
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
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

<table>
<thead>
<tr>
<th>Stone location</th>
<th>Stone type</th>
<th>Thickness of stone and depth of slot for corbel plate.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stone thickness , T</td>
<td>Minimum thickness of stone behind a cramp</td>
</tr>
<tr>
<td>G Mw SL Q mm</td>
<td>T Ls H mm</td>
<td>Mb Ls Ss</td>
</tr>
<tr>
<td>Cladding (external)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 3.7 m above ground or floor level and continuously supported (incl. fascias)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Fascias less than 3.7 m above ground or floor level (incl. fascias)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>More than 3.7m above ground or floor level (incl. fascias)</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Soffits (including inclined soffits)</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Sills, copings and supported reveals</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>stone faced concrete units</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Lining (internal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 7 m above ground or floor level and continuously supported (incl. fascias)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Less than 7 m but more than 3.7m above ground or floor level on corbels in slots (incl. fascias)</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>More than 7m above ground or floor level (incl. fascias)</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Soffits (including inclined soffits)</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

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- mSL: Slates (those unlikely to delaminate) - Ss: Sandstone (e.g. York, Northumberland, Scottish) - T: Travertines

2) Brecciated marbles may need to be reinforced with block liners but in assessing the minimum thickness 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 required consider it 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
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.
**Determining Anchor Loading ** $F_v$

$F_{sw}$: self weight of natural stone panel

a) Support anchor in vertical joint

One support anchor carries the dead load ($F_v$) 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 $F_v = 0.6 \times 1.00 \times 0.04 \times 27 = 0.65kN = 65$ kg.

Self weight per panel: $F_{sw} = F_v = 65$kg

b) Support anchor in horizontal joint

One support anchor carries the dead load ($F_v$) 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 $F_v = F_{sw}/2 = 0.32kN$

$F_v = 32$kg

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 = $0.6 \times 1.00 \times 1.1 = 0.66$ kN

Anchor load $FH = 2 \times 0.25 \times 0.66 = 0.5 \times 0.66$

$kN = 0.33$kN

One anchor carries the wind loading of halph Natural-stone half-panel.
TYPES OF LOADS
### Wind Loads

#### Wind Load for Cladding Facade According to DIN 1055 Part 4

<table>
<thead>
<tr>
<th>Height of Building</th>
<th>Wind Pressure</th>
<th>Wind Suction</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 m</td>
<td>1.04</td>
<td>-2.60</td>
</tr>
<tr>
<td>20 m</td>
<td>0.88</td>
<td>-2.20</td>
</tr>
<tr>
<td>100 m</td>
<td>0.64</td>
<td>-1.60</td>
</tr>
<tr>
<td></td>
<td>0.50</td>
<td>-1.00</td>
</tr>
</tbody>
</table>

\[ wp = 1.04 \text{ for } 8 \text{ m} \]
\[ wp = 0.88 \text{ for } 20 \text{ m} \]
\[ wp = 0.64 \text{ for } 100 \text{ m} \]
\[ wp = 0.50 \]

\[ ws = -2.60 \text{ for } 8 \text{ m} \]
\[ ws = -2.20 \text{ for } 20 \text{ m} \]
\[ ws = -1.60 \text{ for } 100 \text{ m} \]

\[ wp = 0.88 \text{ for } 8 \text{ m} \]
\[ wp = 0.64 \text{ for } 20 \text{ m} \]
\[ wp = 0.50 \text{ for } 100 \text{ m} \]

\[ ws = -2.60 \text{ for } 8 \text{ m} \]
\[ ws = -2.20 \text{ for } 20 \text{ m} \]
\[ ws = -1.60 \text{ for } 100 \text{ m} \]

\[ ws = -2.60 \text{ for } 8 \text{ m} \]
\[ ws = -2.20 \text{ for } 20 \text{ m} \]
\[ ws = -1.60 \text{ for } 100 \text{ m} \]

\[ ws = -0.91 \]
\[ ws = -0.77 \]
\[ ws = -0.56 \]
\[ ws = -0.35 \]

\[ wind pressure = wp = cp \times q \]
\[ cp = \text{aerodynamic pressure coefficient} \]

#### Wind Load according to DIN 1055

\[ A = \text{building length} \]
\[ b = \text{building width} \]
\[ H = \text{Height of building} \]
\[ q = \text{velocity pressure} \]
\[ Wp = \text{wind pressure} \]
\[ ws = \text{wind suction} \]

\[ Cp = \]
\[ -0.7 \text{ for } H/b > 0.5 \]
\[ -0.5 \text{ for } H/b < 0.25 \]

Values in between can be obtained by interpolation.

#### Wind Force

The total wind force which act on a structure or component
\[ W = C_f \times q_{ze} \times A \]

\[ C_f = \text{The aerodynamic Coefficient} \]
\[ q_{ze} = \text{The velocity pressure at the reference height} \]
\[ A = \text{The reference Area} \]
Wind Suction
\( W = C \times q \)
\( C = \) Wind Coefficient
\( q = \) Velocity Pressure

Wind Pressure = \( w = C_p \times q \)
aerodynamic Pressure Factor \( C_p \)

Elevation Section

Wind Coefficient in area of discontinuity

<table>
<thead>
<tr>
<th>Increasing Coefficient ( C_p )</th>
<th>Width of ( a ) (m)</th>
<th>Width of ( d ) (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2,0</td>
<td>( a &lt; 8 ) m</td>
<td>1,0 m</td>
</tr>
<tr>
<td>( 8 ) m &lt; ( a \leq 16 ) m</td>
<td>( a/8 )</td>
<td>2,0 m</td>
</tr>
<tr>
<td>( a &gt; 16,0 ) m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wind Suction

<table>
<thead>
<tr>
<th>Height</th>
<th>0 - 8 m</th>
<th>&gt; 8 m - 20 m</th>
<th>&gt; 20 m - 100 m</th>
<th>&gt; 100 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind kN/m²</td>
<td>-1,00 (-2 x 0,5)</td>
<td>-1,60 (-2 x 0,8)</td>
<td>-2,20 (-2 x 1,1)</td>
<td>-2,60 (-2 x 1,3)</td>
</tr>
</tbody>
</table>

Wind Pressure on corners
\( d = \) Corner

Lateral Walls
\( C_p = -0,5 \) for \( H/W \leq 0,25 \)
\( C_p = -0,7 \) for \( H/W \leq 0,5 \)

Plan Section

Vertical Joints

Horizontal Joints

Fv= 1 panel
FH= 1/2 panel

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

WIND LOAD ACCORDING TO DIN 1055
Seismic Loading is one of the basic concepts of earthquake engineering, which means the application of an earthquake-generated agitation to a structure. It happens at the contact surface of a structure either with the ground or with adjacent structures.

\[
SL = \frac{(2.5 \times Ca \times I)}{R} \times \text{D, SL} \geq 0.11 \text{ Ca x I x D}
\]

Where:
- \( SL \) = Seismic load
- \( Ca \) = Seismic response spectrum = Lateral force value in 97 UBC table 160
- \( I \) = Importance factor given in 97 UBC Table 16 K
- \( R \) = Component response modification factor from 97 UBC Table 16N
- \( D \) = Dead Load

It is common practice to express the Seismic load as a percentage of dead load calculating only the coefficient term.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Seismic Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.06 7x D</td>
</tr>
<tr>
<td>2</td>
<td>0.122 x D</td>
</tr>
<tr>
<td>3</td>
<td>0.2 x D</td>
</tr>
<tr>
<td>4</td>
<td>0.244 x D</td>
</tr>
</tbody>
</table>

For Support Anchor

### Characteristic weights of natural stone panels [kN/m²]

<table>
<thead>
<tr>
<th>Density kN/m³</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
<th>5.0</th>
<th>6.0</th>
<th>7.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.40</td>
<td>0.60</td>
<td>0.80</td>
<td>1.00</td>
<td>1.20</td>
<td>1.50</td>
</tr>
<tr>
<td>24</td>
<td>0.48</td>
<td>0.72</td>
<td>0.96</td>
<td>1.20</td>
<td>1.44</td>
<td>1.80</td>
</tr>
<tr>
<td>25</td>
<td>0.50</td>
<td>0.75</td>
<td>1.00</td>
<td>1.25</td>
<td>1.50</td>
<td>1.88</td>
</tr>
<tr>
<td>26</td>
<td>0.52</td>
<td>0.78</td>
<td>1.04</td>
<td>1.30</td>
<td>1.56</td>
<td>1.95</td>
</tr>
<tr>
<td>27</td>
<td>0.54</td>
<td>0.81</td>
<td>1.08</td>
<td>1.35</td>
<td>1.62</td>
<td>2.03</td>
</tr>
<tr>
<td>28</td>
<td>0.56</td>
<td>0.84</td>
<td>1.12</td>
<td>1.40</td>
<td>1.68</td>
<td>2.10</td>
</tr>
<tr>
<td>30</td>
<td>0.60</td>
<td>0.90</td>
<td>1.20</td>
<td>1.50</td>
<td>1.80</td>
<td>2.25</td>
</tr>
</tbody>
</table>

### Characteristic loads per panel [kN] by panel thickness 3cm and stone density 26kN/m³ (0.78kN/m²)

<table>
<thead>
<tr>
<th>Self weight kN</th>
<th>Size m²</th>
<th>Wind pressure FH kN</th>
<th>Wind suction FH (A) kN</th>
<th>Wind suction FH (B) kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.38</td>
<td>0.15</td>
<td>-0.38</td>
<td>-0.13</td>
</tr>
<tr>
<td>0.6</td>
<td>0.77</td>
<td>0.31</td>
<td>-0.77</td>
<td>-0.27</td>
</tr>
<tr>
<td>0.9</td>
<td>1.15</td>
<td>0.46</td>
<td>-1.15</td>
<td>-0.40</td>
</tr>
<tr>
<td>1.2</td>
<td>1.54</td>
<td>0.62</td>
<td>-1.54</td>
<td>-0.54</td>
</tr>
<tr>
<td>1.5</td>
<td>1.92</td>
<td>0.77</td>
<td>-1.92</td>
<td>-0.67</td>
</tr>
<tr>
<td>1.8</td>
<td>2.31</td>
<td>0.92</td>
<td>-2.31</td>
<td>-0.81</td>
</tr>
</tbody>
</table>

### Characteristic loads per panel [kN] by panel thickness 4cm and stone density 28kN/m³ (1.12kN/m²)

<table>
<thead>
<tr>
<th>Self weight kN</th>
<th>Size m²</th>
<th>Wind pressure FH kN</th>
<th>Wind suction FH (A) kN</th>
<th>Wind suction FH (B) kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>0.36</td>
<td>0.14</td>
<td>-0.36</td>
<td>-0.13</td>
</tr>
<tr>
<td>0.8</td>
<td>0.71</td>
<td>0.29</td>
<td>-0.71</td>
<td>-0.25</td>
</tr>
<tr>
<td>1.2</td>
<td>1.07</td>
<td>0.43</td>
<td>-1.07</td>
<td>-0.38</td>
</tr>
<tr>
<td>1.6</td>
<td>1.43</td>
<td>0.57</td>
<td>-1.43</td>
<td>-0.50</td>
</tr>
<tr>
<td>2.0</td>
<td>1.79</td>
<td>0.71</td>
<td>-1.79</td>
<td>-0.63</td>
</tr>
<tr>
<td>2.4</td>
<td>2.14</td>
<td>0.86</td>
<td>-2.14</td>
<td>-0.75</td>
</tr>
</tbody>
</table>

### Seismic Load According to UBC

#### Loadings

- **Self Weight**
- **Wind Pressure FH**
- **Wind Suction FH (A)**
- **Wind Suction FH (B)**

### Seismic Load Table

<table>
<thead>
<tr>
<th>Zone</th>
<th>Seismic Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.06 7x D</td>
</tr>
<tr>
<td>1</td>
<td>0.122 x D</td>
</tr>
<tr>
<td>2</td>
<td>0.2 x D</td>
</tr>
<tr>
<td>3</td>
<td>0.244 x D</td>
</tr>
<tr>
<td>4</td>
<td>0.372 x D</td>
</tr>
</tbody>
</table>

### Seismic Zone Table

<table>
<thead>
<tr>
<th>Zone</th>
<th>Damage to Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Damage</td>
</tr>
<tr>
<td>1</td>
<td>Minor</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>Major</td>
</tr>
<tr>
<td>4</td>
<td>Huge</td>
</tr>
</tbody>
</table>
Table I6-K - Occupancy Category

<table>
<thead>
<tr>
<th>Occupancy Category</th>
<th>Occupancy or functions of Structure</th>
<th>Seismic Importance Factor, I</th>
<th>Seismic Importance Factor1, I1</th>
<th>Seismic Importance Factor2, I2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Essential facilities</td>
<td>Group I, Division 1 Occupancies having surgery and emergency treatment areas Fire and police stations, Garages and shelters for emergency vehicles and emergency 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.</td>
<td>1.25</td>
<td>1.50</td>
<td>1.15</td>
</tr>
<tr>
<td>2. Hazardous facilities</td>
<td>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</td>
<td>1.25</td>
<td>1.50</td>
<td>1.15</td>
</tr>
<tr>
<td>3. Special occupancy structures</td>
<td>Group A, Divisions 1 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</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>4. Standard occupancy structures</td>
<td>All structures housing occupancies or having functions not listed in Category 1, 2 or 3 and Group U Occupancy towers</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>5. Miscellaneous structure</td>
<td>Group U Occupancies except for towers</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

SEISMIC LOAD ACCORDING TO UBC

Table I6-N-Structural Systems

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

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

<table>
<thead>
<tr>
<th>LATERAL-FORCE-RESISTING SYSTEM DESCRIPTION</th>
<th>R</th>
<th>O</th>
<th>HEIGHT LIMIT FOR SEISMIC ZONES 3 AND 4 (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shear walls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Concrete with SMRF</td>
<td>8.5</td>
<td>2.8</td>
<td>N.L.</td>
</tr>
<tr>
<td>b. Concrete with steel OMRF</td>
<td>4.2</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>c. Concrete with concrete IMRF</td>
<td>6.5</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>d. Masonry with SMRF</td>
<td>5.5</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>e. Masonry with steel OMRF</td>
<td>4.2</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>f. Masonry with concrete IMRF</td>
<td>4.2</td>
<td>2.8</td>
<td>--</td>
</tr>
<tr>
<td>g. Masonry with masonry MMRWF</td>
<td>6.0</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>2. Steel EBF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. With steel SMRF</td>
<td>8.5</td>
<td>2.8</td>
<td>N.L.</td>
</tr>
<tr>
<td>b. With steel OMRF</td>
<td>4.2</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>3. Ordinary braced frames</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Steel with steel SMRF</td>
<td>6.5</td>
<td>2.8</td>
<td>N.L.</td>
</tr>
<tr>
<td>b. Steel with steel OMRF</td>
<td>4.2</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>c. Concrete with concrete SMRF</td>
<td>6.5</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>d. Concrete with concrete 1MRF</td>
<td>4.2</td>
<td>2.8</td>
<td>--</td>
</tr>
<tr>
<td>4. Special concentrically braced frames</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Steel with steel SMRF</td>
<td>7.5</td>
<td>2.0</td>
<td>N.L.</td>
</tr>
<tr>
<td>b. Steel with steel OMRF</td>
<td>4.2</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>5. Cantilevered column building systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Cantilevered column elements</td>
<td>2.5</td>
<td>2.0</td>
<td>35'</td>
</tr>
<tr>
<td>6. Shear wall-frame interaction systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Concrete</td>
<td>5.5</td>
<td>2.8</td>
<td>160</td>
</tr>
<tr>
<td>7. Undetermined systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See Sections 1629.6.7 and 1629.9.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SEISMIC LOAD ACCORDING TO UBC

#### Table 16-0: Horizontal Force Factors $\alpha_p$ and $R_p$

<table>
<thead>
<tr>
<th>ELEMENTS OF STRUCTURES AND NONSTRUCTURAL COMPONENTS AND EQUIPMENT</th>
<th>$\alpha_p$</th>
<th>$R_p$</th>
<th>FOOTNOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Elements of Structures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Walls including the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Unbraced (cantilevered) parapets.</td>
<td>2.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>(2) Exterior walls at or above the ground floor and parapets braced above their centers of gravity</td>
<td>1.0</td>
<td>3.0</td>
<td>2</td>
</tr>
<tr>
<td>(3) All interior-bearing and nonbearing walls.</td>
<td>1.0</td>
<td>3.0</td>
<td>2</td>
</tr>
<tr>
<td>B. Penthouse (except when framed by an extension of the structural frame).</td>
<td>1.5</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>C. Connections for prefabricated structural elements other than walls. See also Section 1632.2.</td>
<td>1.0</td>
<td>3.0</td>
<td>3</td>
</tr>
<tr>
<td>2. Nonstructural Components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Exterior and interior ornamentations and appendages.</td>
<td>2.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>B. Chimneys, stacks and trussed towers supported on or projecting above the roof:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Laterally braced or anchored to the structural frame at a point below their centers of mass.</td>
<td>2.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>(2) Lateral bracing to or anchored to the structural frame at or above their centers of mass</td>
<td>2.0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>C. Signs and billboards.</td>
<td>2.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>D. Storage racks (include contents) over 6 feet (1829 mm) tall</td>
<td>2.5</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>E. Permanent floor-supported cabinets and book stacks more than 6 feet (1829 mm) in height (include contents).</td>
<td>1.0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>F. Anchorage and lateral bracing for suspended ceilings and light fixtures.</td>
<td>1.0</td>
<td>3.0</td>
<td>3,6,7,8</td>
</tr>
<tr>
<td>G. Access floor systems.</td>
<td>1.0</td>
<td>3.0</td>
<td>4,5,9</td>
</tr>
<tr>
<td>H. Masonry or concrete fences over 6 feet (1829 mm) high.</td>
<td>1.0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>I. Partitions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Tanks and vessels (include contents), including support systems.</td>
<td>1.0</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>B. Electrical, mechanical and plumbing equipment and associated conduit and ductwork and piping.</td>
<td>1.0</td>
<td>3.0</td>
<td>5,10,11,12,13,14,15,16</td>
</tr>
<tr>
<td>C. Any flexible equipment laterally braced or anchored to the struc-tural frame at a point below their center of mass.</td>
<td>2.5</td>
<td>3.0</td>
<td>5,10,14,15,16</td>
</tr>
<tr>
<td>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.</td>
<td>1.0</td>
<td>3.0</td>
<td>17,18</td>
</tr>
<tr>
<td>E. Temporary containers with flammable or hazardous materials.</td>
<td>1.0</td>
<td>3.0</td>
<td>19</td>
</tr>
<tr>
<td>4. Other Components</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Rigid components with ductile material and attachments.</td>
<td>1.0</td>
<td>3.0</td>
<td>1</td>
</tr>
<tr>
<td>B. Rigid components with nonductile material or attachments.</td>
<td>1.0</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>C. Flexible components with ductile material and attachments.</td>
<td>2.5</td>
<td>3.0</td>
<td>1</td>
</tr>
<tr>
<td>D. Flexible components with nonductile material or attachments.</td>
<td>2.5</td>
<td>1.5</td>
<td>1</td>
</tr>
</tbody>
</table>

---

**Table 16-0-Horizontal Force Factors $\alpha_p$ and $R_p$**
### Table 16-Q- Seismic Coefficient $C_a$

<table>
<thead>
<tr>
<th>SOIL PROFILE TYPE</th>
<th>SEISMIC ZONE FACTOR, Z</th>
<th>(Z = 0.075)</th>
<th>(Z = 0.15)</th>
<th>(Z = 0.2)</th>
<th>(Z = 0.3)</th>
<th>(Z = 0.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_a$</td>
<td>0.06</td>
<td>0.12</td>
<td>0.16</td>
<td>0.24</td>
<td>0.32$N_a$</td>
<td></td>
</tr>
<tr>
<td>$S_f$</td>
<td>0.08</td>
<td>0.15</td>
<td>0.20</td>
<td>0.30</td>
<td>0.40$N_a$</td>
<td></td>
</tr>
<tr>
<td>$S_b$</td>
<td>0.09</td>
<td>0.18</td>
<td>0.24</td>
<td>0.33</td>
<td>0.40$N_a$</td>
<td></td>
</tr>
<tr>
<td>$S_c$</td>
<td>0.12</td>
<td>0.22</td>
<td>0.28</td>
<td>0.36</td>
<td>0.44$N_a$</td>
<td></td>
</tr>
<tr>
<td>$S_d$</td>
<td>0.19</td>
<td>0.30</td>
<td>0.34</td>
<td>0.36</td>
<td>0.36$N_a$</td>
<td></td>
</tr>
<tr>
<td>$S_e$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_f$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$1^{st}$ Site-specific geotechnical investigation and dynamic site response analysis shall be performed to determine seismic coefficients for Soil Profile Type $S_a$.

$2^{nd}$ See Section 16.27 for definitions of flexible components and rigid components.

$3^{rd}$ See Sections 16.33.2.4 and 16.33.2.8 for concrete and masonry walls and Section 16.32.2 for connections for panel connectors for panels.

$4^{th}$ Applies to Seismic Zones 2, 3 and 4 only.

$5^{th}$ Ground supported steel storage racks may be designed using the provisions of Section 16.34, Chapter 22, Division VI, may be used for design, provided seismic design forces are equal to or greater than those specified in Section 16.32.2 or 16.34.2, as appropriate.

$6^{th}$ Only attachments, anchorage or restraints need be designed.

$7^{th}$ 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/m²) shall be used.

$8^{th}$ 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.

$9^{th}$ 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.

$10^{th}$ 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/m²) partition load allowance.

$11^{th}$ 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 sprinkler systems. see section 16.3.2.2 for additional requirements for determining $ap$ for nonrigid or flexibly mounted equipment.

$12^{th}$ Seismic restraints may be omitted from piping and duct support if all the following conditions are satisfied:

- Lateral motion of the piping or duct will not cause damaging impact with other systems.
- The piping or duct is made of ductile material with ductile connections.
- 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.
- Lateral motion of the piping or duct does not cause loss of system vertical support.
- Rod-hung supports of less than 12 inches (305mm) in length have top connections that cannot develop moments.
- 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.
Thermal Movements

I- Example of Calculation of thermal movement:

Consider a Building Construction type is an enclosed Concrete frame with Granite cladding (1000x500x30mm)

On a hot summer’s day with the building complete and occupied the relative movement (in mm/m) of frame to cladding is given by the equation A =1000 [(tfs-tfe) Xf-(tcs-tce)Xc ]

tfs = is temperature (in °C) of frame in Summer
tfe = is temperature (in °C) of frame on erection
Xf = is coefficient of thermal expansion of frame
tcs = is temperature (in °C) of cladding in Summer
tce = is temperature (in °C) of cladding on erection
Xc = is coefficient of thermal expansion of cladding using the following values:
tfs = 30°C, tfe = 40°, Xf = 13x10^-6 per °C, tcs = 80°C, ce = 10°C, Xc = (8 to 10) x 10^-6 per °C

If Xc = 8 x 10^-6 per °C, movement = 1000[ (30-40) 13-(80-10)^8]

DL= 0,69mm/m, if Xc = 10, DL = 0,83 mm/m in both cases, the movement shall be less than 1,0mm

Example Calculation of Deflection
Panel size : 1000mmx500mmx30mm
Granit with a density of 28 kN/m³

Deflection on the support anchor with a section of (width x height) 35mmx4mm

Existing deflection = f = (Fv.a³)/3xEIx

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 (420N×40¹ mm³) / 3x170000 N/mm² ×186,70mm^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 the actual 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
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 $20 < a \leq 80\text{mm}$

---

**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 $20 < a \leq 80\text{mm}$

---

**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 $20 < a \leq 80\text{mm}$
### 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**

![Diagram of L-Bracket holder Curved]

### L-Bracket holder Curved

- **a**: Cavity to back side panel
- **b**: Panel thickness
- **T**: Bracket thickness

Economic for $20 < a \leq 80$mm

---

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

![Diagram of Z-returned bracket]

### 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 $50 < a \leq 120$mm

---

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

![Diagram of Z-returned bracket]

### 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 $50 < a \leq 120$mm
### Fishtail with Pin | Type ST- 800 1100

- **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 $20 < a < 80$mm

### Fishtail Up & Down | Type ST- 800 I200

- **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 $20 < a < 80$mm

### Corrugated dowel | Type ST- 900 I100

- **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 $20 < a < 80$mm
Flat-Head-Bolt Direct in Wall

Flat-Head-Bolt direct in wall

<table>
<thead>
<tr>
<th>a</th>
<th>Cavity to back side panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Panel thickness</td>
</tr>
<tr>
<td>T</td>
<td>Bracket thickness</td>
</tr>
<tr>
<td>d</td>
<td>Diameter of pin</td>
</tr>
<tr>
<td>e</td>
<td>Cavity to pin</td>
</tr>
<tr>
<td>f</td>
<td>Flat head parts</td>
</tr>
<tr>
<td>g</td>
<td>Rounded part</td>
</tr>
</tbody>
</table>

economic for 10 < a ≤ 60mm

Flat-Head-Bolt in C-Channel

Flat-Head-Bolt in C-Channel

<table>
<thead>
<tr>
<th>a</th>
<th>Cavity to back side panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Panel thickness</td>
</tr>
<tr>
<td>T</td>
<td>Bracket thickness</td>
</tr>
<tr>
<td>d</td>
<td>Diameter of pin</td>
</tr>
<tr>
<td>e</td>
<td>Cavity to pin</td>
</tr>
<tr>
<td>f</td>
<td>Flat head parts</td>
</tr>
<tr>
<td>g</td>
<td>Rounded part</td>
</tr>
</tbody>
</table>

economic for 10 < a ≤ 60mm
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.

<table>
<thead>
<tr>
<th>Surfaces of contact (metal)</th>
<th>SFSP Anchor bolts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>●</td>
</tr>
<tr>
<td>Aluminum bronze</td>
<td>○</td>
</tr>
<tr>
<td>Brass</td>
<td>○</td>
</tr>
<tr>
<td>Copper</td>
<td>○</td>
</tr>
<tr>
<td>Galvanized steel</td>
<td>●</td>
</tr>
<tr>
<td>Mild steel</td>
<td>●</td>
</tr>
<tr>
<td>Cast iron</td>
<td>●</td>
</tr>
<tr>
<td>Lead</td>
<td>○</td>
</tr>
<tr>
<td>Aluminium</td>
<td>●</td>
</tr>
</tbody>
</table>

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

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 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)

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.
Arrangement 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.

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

Materials: SS304, SS316, SS316L, SS316Ti, S235JR-MG, S235JR-HDG  50°C 24h average temperature

<table>
<thead>
<tr>
<th>Leg B mm</th>
<th>Cavity to Pin C mm</th>
<th>Deadload max DL kN</th>
<th>Windload max WL ± kN</th>
<th>Bracket Width A mm</th>
<th>Bracket Thickness T mm</th>
<th>Ø Pin mm</th>
<th>Anchor comb. Force kN*</th>
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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

<table>
<thead>
<tr>
<th>Leg B mm</th>
<th>Cavity to Pin C mm</th>
<th>Deadload max DL kN</th>
<th>Windload max WL ± kN</th>
<th>Bracket Width A mm</th>
<th>Bracket Thickness S mm</th>
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<th>Anchor comb. Force kN*</th>
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</table>

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**

\[ F_v \text{ perm} = \text{permissible vertical loading capacity} \]
\[ FR = \text{existing load on the dowel with maximum load of the anchor} \]

**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:

[Diagram of L-Bracket with dimensions A, B, C, D, E, F, G, T]
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:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>T</th>
<th>A</th>
<th>B</th>
<th>C</th>
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**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 \( \leq 50°C \) 24h average temperature

**Standard Items:**

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SYSTEM TYPE ST 500 -1400 WITH DOWN LEG

L-Bracket (Standard & Serrated) | Type ST- 500 l400 Down

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

Standard Items:

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**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:**

![Diagram of L-Bracket](image)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>T</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<th>sl hole</th>
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<tr>
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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:

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<tr>
<th>Item No.</th>
<th>T</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>H</th>
<th>L</th>
<th>K</th>
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**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:**

![L-Bracket Diagram]

<table>
<thead>
<tr>
<th>Item No.</th>
<th>T</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>H</th>
<th>sl hole</th>
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<tr>
<td>1700-35.45.30.2</td>
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<tr>
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<td>40</td>
<td>50</td>
<td>45</td>
<td>20</td>
<td>8,5 x 22</td>
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</tbody>
</table>
Z- BRACKETS

www.sfsp-ilbk.com
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

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.

Items:
1. Anchor bolt
2. Z-bracket
3. Pin
4. Nut
5. Flat head bolt
6. Plastic tube
Adjustibility:
in 2 directions $x = \pm 10 \text{ mm}$
$Z = \pm 0.5 \text{ mm}$

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

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

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:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Width (W)</th>
<th>Thickness (T)</th>
<th>Offset (N)</th>
<th>FHB</th>
<th>Ø Pin</th>
<th>sl hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>600-1100 -35.3.20</td>
<td>35</td>
<td>3</td>
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<td>6,5 x 22</td>
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<td>600-1100 -40.3.30</td>
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<td>3</td>
<td>30</td>
<td>M8</td>
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<td>6,5 x 22</td>
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<tr>
<td>600-1100 -45.3.40</td>
<td>45</td>
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<td>M8</td>
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</tr>
<tr>
<td>600-1100 -50.3.50</td>
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<tr>
<td>600-1100 -40.4.20</td>
<td>40</td>
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<td>M10</td>
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<tr>
<td>600-1100 -40.4.30</td>
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<td>30</td>
<td>M10</td>
<td>5</td>
<td>8,5 x 22</td>
</tr>
<tr>
<td>600-1100 -45.4.40</td>
<td>45</td>
<td>4</td>
<td>40</td>
<td>M10</td>
<td>5</td>
<td>8,5 x 22</td>
</tr>
<tr>
<td>600-1100 -50.5.50</td>
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<td>5</td>
<td>50</td>
<td>M10</td>
<td>5</td>
<td>8,5 x 22</td>
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</table>

**Load Table of Z-Bracket with returned Leg**

Materials SS304, SS316, SS316L, SS316Ti, S235JR-MG, S235JR-HDG  50°C 24h average temperature

<table>
<thead>
<tr>
<th>Bracket Offset (mm)</th>
<th>Cavity to Pin mm min - max mm (e)</th>
<th>Deadload max DL kN</th>
<th>Windload max WL ± kN</th>
<th>Bracket Width mm</th>
<th>Bracket Thickness (T) mm</th>
<th>Ø Pin mm</th>
<th>FHB A2-70 A4-70</th>
<th>Anchor comb. Force kN *</th>
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</thead>
<tbody>
<tr>
<td>20</td>
<td>50-60</td>
<td>0,16</td>
<td>0,21</td>
<td>35</td>
<td>3</td>
<td>4</td>
<td>M8</td>
<td>1,90</td>
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<tr>
<td>30</td>
<td>60-70</td>
<td></td>
<td></td>
<td>40</td>
<td>3</td>
<td>4</td>
<td>M8</td>
<td>2,00</td>
</tr>
<tr>
<td>40</td>
<td>70-80</td>
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<td></td>
<td>45</td>
<td>3</td>
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<td>M8</td>
<td>2,10</td>
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<tr>
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<td>80-90</td>
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<td>90-100</td>
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<tr>
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<td>5</td>
<td>6</td>
<td>M12</td>
<td>6,30</td>
</tr>
</tbody>
</table>

**Loads per 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

www.sfsp-Ilkht.com
**PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800**

---

**Z-Returned Bracket**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Cavity to back side panel</td>
</tr>
<tr>
<td>b</td>
<td>Panel thickness</td>
</tr>
<tr>
<td>T</td>
<td>Bracket thickness</td>
</tr>
<tr>
<td>d</td>
<td>Diameter of pin</td>
</tr>
<tr>
<td>e</td>
<td>Offset to pin</td>
</tr>
<tr>
<td>f</td>
<td>Flat head parts</td>
</tr>
<tr>
<td>g</td>
<td>Threaded part</td>
</tr>
<tr>
<td>N</td>
<td>Bracket offset</td>
</tr>
</tbody>
</table>

---

**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

---

**Bending detail:**

- Bending r: 6mm min.
  - 50
  - 15
  - 4
  - 30

---

**Bending detail:**

- Leg a
- Leg b
- Hex bolt / Anchor
- FHB

---

**Bending detail:**

- 1.5cm
- 2 cm
- 75°
Structural Data

Node Numbering
Element Numbering

Opposite Y-direction

1.259 cm

DZ = 0.40

DX = 3.20
DZ = 3.00

DX = 1.80
DX = 4.20

DX = 1.50
DX = 2.40

DX = 6.50
DX = 5.00

DX = 1.50
DX = 3.20

DX = 3.00

General Data

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<th>LC Description</th>
<th>Factor</th>
<th>Combination Type</th>
<th>Dead Weight</th>
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<tr>
<td>3</td>
<td>Wind suction</td>
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Load Groups

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<tr>
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<th>LG Description (for deflection)</th>
<th>Factor</th>
<th>Safety 8M</th>
<th>Load Cases in LG</th>
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### PROOF FOR Z-RETURNED BRACKET ACCORDING TO DIN 18.800

#### LOADS: LC 1 - Proper weight [kN]

<table>
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<tr>
<th>No</th>
<th>Loaded Nodes</th>
<th>Nodal Forces</th>
<th>PX [kN]</th>
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<th>PZ [kN]</th>
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#### LOADS: LC 2 - Wind pressure [kN]

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#### LOADS: LC 3 - Wind pressure [kN]

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<th>PX [kN]</th>
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#### LOADS: LC 4 - Seismic load [kN]

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LOAD COMBINATIONS

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<th>CO Description</th>
<th>Combination Criteria</th>
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<tr>
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<td>LC1 or LC2 or LC3 or LC4</td>
<td>LG1 o LG2 o LG3 o LG4</td>
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<table>
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<tr>
<th>LG-No</th>
<th>Factor Ny</th>
<th>Number Iterations</th>
<th>Eps-Convergence</th>
<th>Ny-fold Results</th>
<th>Tension Force Effect</th>
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RESULTS: LG1 | Internal Forces M-2 | Support Reactions

RESULTS: LG2 | Internal Forces M-2 | Support Reactions

RESULTS: LG3 | Internal Forces M-2 | Support Reactions

RESULTS: LG4 | 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

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<td>LC in Min M-Z:</td>
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<td>LC in Min P-X:</td>
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<td>LC in Max P-Y: LG4</td>
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<td>LC in Min P-X:</td>
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<td>Max P-Y</td>
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<td>Min P-Y</td>
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<td>.00</td>
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<td>LC in Max P-Y: LG4</td>
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<td>LC in Min P-Y:</td>
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RESULTS: CO1 - LC1 or LC2 or LC3 or LC4 | Max/Min Internal Forces M-2
### STEEL1 - SPANNUNGSANALYSE | GENERAL DATA

#### ELEMENTS TO DESIGN

<table>
<thead>
<tr>
<th>Load Cases to Design</th>
<th>All</th>
<th>LG1</th>
<th>LG2</th>
<th>LG3</th>
<th>LG4</th>
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<tbody>
<tr>
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<td>1.35<em>LC1 + 1.50</em>LC2</td>
<td>1.35<em>LC1 + 1.50</em>LC3</td>
<td>LC1 + 1.50*LC3</td>
<td>LC1 + LC4</td>
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#### Materials and Description

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<thead>
<tr>
<th>Mat No</th>
<th>Material Description</th>
<th>Material Code, Criterion</th>
<th>Allowable Stresses [kN/cm²] at 50°C</th>
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<tbody>
<tr>
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<td>Stainless Steel</td>
<td>Sigma 16.1, Tau 9.3, Sigma eq 17.7</td>
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<td>2</td>
<td>A-70</td>
<td>Stainless Steel</td>
<td>Sigma 40.9, Tau 23.6, Sigma eq 40.9</td>
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#### Stress Type

<table>
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<tr>
<th>Section No</th>
<th>Elem No</th>
<th>x Loc [cm]</th>
<th>S Point No</th>
<th>LC No</th>
<th>Stress [kN/cm²]</th>
<th>Stress Ratio</th>
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<td>existing</td>
<td>allowable</td>
<td></td>
<td></td>
<td></td>
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</table>

#### Example Stress Details

- **Section No 1 - Flat 8/3**
  - Sigma Total: 6, x Loc 1.80, S Point 3, LC1, Stress 32.92, Allowable 40.90, Ratio 0.80
  - Tau Total: 6, x Loc 0.00, S Point 5, LC1, Stress 1.31, Allowable 23.60, Ratio 0.06
  - Sigma eq: 6, x Loc 1.80, S Point 3, LC1, Stress 32.92, Allowable 40.90, Ratio 0.80

- **Section No 2 - Round 6.8**
  - Sigma Total: 7, x Loc 2.40, S Point 28, LC1, Stress 29.01, Allowable 40.90, Ratio 0.71
  - Tau Total: 7, x Loc 0.00, S Point 37, LC1, Stress 0.77, Allowable 23.60, Ratio 0.03
  - Sigma eq: 7, x Loc 2.40, S Point 28, LC1, Stress 29.01, Allowable 40.90, Ratio 0.71

- **Section No 3 - Round 13**
  - Sigma Total: 8, x Loc 0.80, S Point 28, LC1, Stress 5.00, Allowable 16.10, Ratio 0.31
  - Tau Total: 8, x Loc 0.00, S Point 37, LC1, Stress 0.20, Allowable 9.30, Ratio 0.02
  - Sigma eq: 8, x Loc 0.80, S Point 28, LC1, Stress 5.00, Allowable 17.70, Ratio 0.28

- **Section No 4 - Flat 40/3**
  - Sigma Total: 5, x Loc 0.00, S Point 1, LC4, Stress 14.17, Allowable 16.10, Ratio 0.88
  - Tau Total: 13, x Loc 0.00, S Point 1, LC4, Stress 2.89, Allowable 9.30, Ratio 0.31
  - Sigma eq: 5, x Loc 0.00, S Point 1, LC1, Stress 14.17, Allowable 17.70, Ratio 0.80

- **Section No 5 - Flat 30/3**
  - Sigma Total: 1, x Loc 0.00, S Point 3, LC2, Stress 10.01, Allowable 16.10, Ratio 0.62
  - Tau Total: 1, x Loc 0.00, S Point 1, LC4, Stress 3.91, Allowable 9.30, Ratio 0.42
  - Sigma eq: 1, x Loc 0.00, S Point 3, LC2, Stress 10.01, Allowable 17.70, Ratio 0.57
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.

Adjustability:
in 2 directions  x = ± 0.5 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

<table>
<thead>
<tr>
<th>Codes</th>
<th>Width (W) mm</th>
<th>Bracket mm</th>
<th>Offset (N)</th>
<th>FHB A2-70 A4-70</th>
<th>Ø Pin mm</th>
<th>sl hole</th>
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<tbody>
<tr>
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<td>3</td>
<td>70</td>
<td>M8</td>
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<td>80</td>
<td>M8</td>
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<td>6.5 x 22</td>
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<td>700 1100-40.3.120</td>
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Omega Brackets Load Table

Materials SS304, SS316, SS316L, SS316Ti, S235JR-MG, S235JR-HDG  50°C 24h average temperature

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<th>Cavity to Pin mm - max mm</th>
<th>Deadload max DL kN</th>
<th>Windload max WL ± kN</th>
<th>Bracket Width mm</th>
<th>Bracket Thickness (T) mm</th>
<th>Ø Pin mm</th>
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<td>0.77</td>
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<td>M12</td>
<td>9.80</td>
</tr>
<tr>
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<td>140-150</td>
<td>0.55</td>
<td>0.77</td>
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<td>6</td>
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<td>9.80</td>
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<td>150-170</td>
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<td>55</td>
<td>5</td>
<td>6</td>
<td>M12</td>
<td>9.80</td>
</tr>
</tbody>
</table>

Loads per 1 bracket
If loads are bigger or dimensions are different, an individual calculation is necessary with safety 3,0
According to DIN 18515 part 3
Pins: pin hole shall be 3mm bigger than pin diameter.
Pin distances (d<30): Distance between panel corner and middle pinhole is min 2.5 the panel thickness.

Flat Head Bolt

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

<table>
<thead>
<tr>
<th>Codes</th>
<th>Width (W)</th>
<th>Thickness (T)</th>
<th>Length (L)</th>
<th>sl hole</th>
</tr>
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<tbody>
<tr>
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<td>25</td>
<td>2</td>
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<td>4.1 x 15</td>
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<td>2</td>
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<td>4.1 x 15</td>
</tr>
<tr>
<td>800-1100-25.3.100</td>
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<tr>
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<tr>
<td>800-1100-30.4.100</td>
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<td>5.1 x 15</td>
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<td>800-1100-30.4.120</td>
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<td>5.1 x 15</td>
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## TYPE ST- 800 -1200

**Fishtail Up & Down | Type ST- 800 1200**

Materials SS304, SS316, SS316L, SS316Ti, S235JR-MG, S235JR-HDG  50°C 24h average temperature

Standard Items:

<table>
<thead>
<tr>
<th>Codes</th>
<th>Width (W)</th>
<th>Thickness (T)</th>
<th>Length (L)</th>
<th>Height (H)</th>
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<td>15</td>
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<td>800-1200-25.2.140</td>
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<td>140</td>
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<td>800-1200-25.2.160</td>
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<td>800-1200-25.3.100</td>
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<td>800-1200-25.3.120</td>
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<td>800-1200-25.3.140</td>
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<td>800-1200-25.3.160</td>
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<td>800-1200-30.4.100</td>
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</table>
### Type ST- 800 (II00-I200) 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

<table>
<thead>
<tr>
<th>Cavity to Pin min - max mm</th>
<th>Deadload max DL kN</th>
<th>Winload max WL ± kN</th>
<th>Bracket Width mm</th>
<th>Bracket Thickness mm</th>
<th>Ø Pin A-70 mm</th>
<th>Embedment mm</th>
<th>Length mm</th>
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<td>70-80</td>
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<td>4</td>
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<td>30</td>
<td>4</td>
<td>5</td>
<td>75</td>
<td>160</td>
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</tbody>
</table>

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

---

### Type ST- 800 (II00-I200) 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

<table>
<thead>
<tr>
<th>Cavity to Pin min - max mm</th>
<th>Deadload max DL kN</th>
<th>Winload max WL ± kN</th>
<th>Bracket Width mm</th>
<th>Bracket Thickness mm</th>
<th>Ø Pin A-70 mm</th>
<th>Embedment mm</th>
<th>Length mm</th>
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<td>25</td>
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<td>65</td>
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<td>70-80</td>
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<td>60-70</td>
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<td>30</td>
<td>4</td>
<td>5</td>
<td>75</td>
<td>160</td>
</tr>
</tbody>
</table>

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

www.sfsp-lltt.com
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:

<table>
<thead>
<tr>
<th>Type</th>
<th>CODE</th>
<th>dv/mm</th>
<th>l/mm</th>
<th>do/mm</th>
<th>dv/mm</th>
<th>ho/mm</th>
<th>ffix/mm</th>
<th>cm³</th>
<th>cm³</th>
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<tbody>
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<td>BE 12x45</td>
<td>8708955</td>
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<td>.var</td>
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<td>-</td>
</tr>
</tbody>
</table>

Angles of different dimensions can be manufactured upon specific demand.
Net anchor | CODE | ø stud | Stud length/ EHD | ø Hole | ø inside | Hole depth | Fixable thickness/EHD | Hole volume | Resin volume to inject |
<table>
<thead>
<tr>
<th></th>
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<tr>
<td>BE 12x45</td>
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<td>110-160</td>
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<tr>
<td>BE 15x130</td>
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<td>M8-M10</td>
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<td>13</td>
<td>130</td>
<td>10</td>
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<td>23,0</td>
</tr>
<tr>
<td>BE 20x85</td>
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<td>M12</td>
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<tr>
<td>BM 11x1000</td>
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<td>9.5</td>
<td>.var</td>
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<tr>
<td>BM 15x1000</td>
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<td>.var</td>
<td>16</td>
<td>13.5</td>
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<tr>
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<td>19.0</td>
<td>.var</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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.
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
**EXAMPLE -3**

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

- For cavity 200mm
- distance of Omegabrackets ~200-300cm
EXAMPLE -5

Cantilever Arm Support with BTB channel and Flate Head Bolt

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

- For cavity 300 mm
- Distance of Omega brackets ~3 cm (=Span of channels).
Fixings positions as per DIN 18516 part 3. 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.
OUTLETs

FACTORIES

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SFSP / Kingdom of Saudi Arabia
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Fax: +966 12 636 1963

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