



Technology & Innovation

heavy duty- and facade raw plug



INNOFIXX equipment GmbH
Wehlener Straße 46
01279 Dresden
Tel.: 0351 26993-0
Fax: 0351 26993-19
info@innofixx.com
www.innofixx.com

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1. Introduction

A fitting heavy duty raw plug for spaced mounting

INNOFIXX has the right raw plug for every kind of spaced mounting. The raw plug is made up of multiple steel parts that and with its pipe sleeve between 12 and 51mm outer diameter and a thickness of two to six millimetres it can bridge a distance of up to 300 millimetre. The smaller raw plugs, with a diameter of 12, 16 or 20 millimetres are suitable for facade substructures.



Image-No. 1 Product offering

The simplified assembly and deployment process makes it possible to fix hanging and ventilating facades in different cladding's to various constructions and walls in a secure and fast way. Weather shells can be easily anchored and new facade parts can be easily added to existing constructions.



Image-No. 2 Estate in Dresden

The refurbishment of facades with old heat insulation composite systems or the deployment of energy modernization and renovation is simplified with the usage of heavy duty raw plugs.

The effort of fixing **balconies, emergency stairs or external lifts** to existing buildings is reduced since significantly fewer raw plugs are necessary and the need for a supporting structure along the building wall is eliminated.

The **INNOFIXX** heavy duty raw plug is distinguished because of its high carrying capacity, prevention of spot fixing thermal bridges and significantly reduced assembly time.



Image-No 3 Deployed raw plug

Ventilated curtain facades, mounted with **INNOFIXX** heavy duty raw plugs.

Simply manufactured, large market potential

The manufacturing of the heavy duty raw plugs from multiple steel parts is simple. The core part is a pipe sleeve with 12 to 51 mm outer diameter and a thickness of 2-6mm, which carries occurring lateral/transverse loads.



Image-No. 4 raw plug

Cross-recesses ensures a safe deformation-controlled expansion of the system within the building structure. An inner threaded rod fastens the system and transfers the tensile and compressive loads. This way, distances up to 300mm are bridged. Potential customers are raw plug manufactures, building-material dealers, manufactures of substructures and mounting and construction companies. The inventor, Gerhard Heying, estimates that demand will be large.



Image-No. 5 Gerhard Heying (left) and Axel Herzprung

2. History

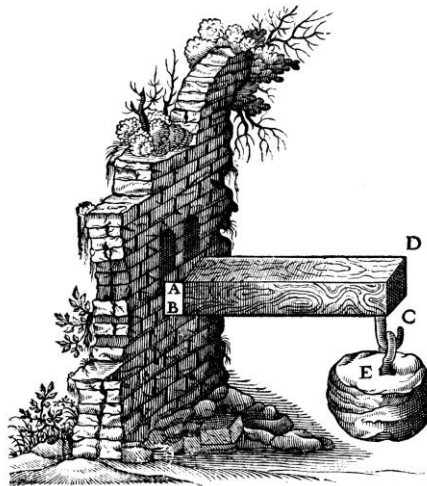


Abb. 28. *Eingespannter, am freien Ende belasteter Balken.* Aus GALILEI: *Discorsi e dimostrazioni matematiche*. Leiden 1638, S. 114. Vgl. A. VON OETTINGENS Übersetzung des zugehörigen Textes in OK Nr. 11, S. 97–100.

Image-No. 6 Even Galileo Galilei thought about the problem of overhanging parts

From the idea to the patent

The idea of a raw plug to bridge large distances along securing heavy loads came to construction engineer and expert Dipl.-Ing. Gerhard Heying a decade ago during the modernization of a hospital, to which a facade could not be mounted. »With the available raw plugs at that time it was impossible to fixate the building parts necessary for the construction« remembers Heying, who was asked for his expert opinion on structural damage. This obvious problem asked for a solution and so the development started with practice partner Axel Herzsprung in 2002.

The patent for the heavy duty and facade raw plug was submitted in May 2002.

In 2005 the patent was granted for 27 countries in Europe.

Gold medal for the innovation

During the IENA 2007, an international trade fair for ideas, inventions and new development, both inventors of the raw plug-innovation were awarded the gold medal.

In 2009 both innovators reached the finals for the Steal-Innovation price.

Technical certification by the Deutsche Institut für Bautechnik (DIBt)

The Deutsche Institut für Bautechnik certified (No. Z-21.1-194) the product after extensive testing for the special properties of the raw plug when used for distance bridging construction on roofs, facades and the carrying of lateral, transverse and tensile loads. With this regulatory certification, the patented product is now nationally approved for use in Germany.

»This product can do a lot and we close a gap in the market« says Gerhard Heying, Managing Director of the specifically created company **INNOFIXX, focusing on commercialisation of the innovative raw plug**

3. Broad field of application

Since the 90s buildings with exterior composite thermal insulation or curtain facades, new windows or technical building equipment have been extensively renovated and refurbished.

It can generally be assumed, for the existing three layered outer wall parts that the old carrying anchors of the facing layers can not carry additional loads at the stage of facade renovation and refurbishment.

a) **INNOFIXX** heavy duty raw plug

The anchoring of the three layer plates (facade construction) was done using standard raw plugs available in the market. Existing raw plugs were not able to cover multiple defining areas at the same time i.e. unable to carry lateral, transverse and tensile loads at the same time in combination and over larger distances and transferring the load securely into the load-bearing construction. Additional problems were caused by the assembly, which was extensive or only possible through extra preparation with machinery.

The **INNOFIXX** heavy duty raw plug is also applicable in the following areas:

- as single-mount roof anchor on flat roofs
- as scaffold anchors
- for ventilated curtain facades
- for adding balconies, sun blinds, cantilever roofs, chimneys , etc.
- for brick facades
- for antennae masts, facade parts like advertising, etc.
- for subsequent mounting for bullet proof glass on government buildings
- for the renovation and refurbishment of exterior composite thermal insulation without complete deconstruction

b) INNOFIXX facade raw plug

Different wall supports, thermoplastic parts, supporting profiles (usually aluminum, see images 7 and 8) and raw plugs are used for current ventilated facades. The cladding's are fixed on top of the supporting profiles.



Image-No. 7 An aluminum wall fixing done on a at the time standard facade (Estate in Dresden)



Image-No. 8

The wall fixing, made up of angle- respectively u-formed aluminum profiles, have to be separated through thermal layers from the supporting base (see mast on detail image 8), because of thermal conductivity and compliance with the energy saving ordinance. Moreover, the current raw plugs used to fix the wall fixture only sustain no or very low bending moments.

Error prone examples of conventional distance bridging assembly



Image-No. 9 Dubai – complicated, error prone distance bridging construction, assembled with standard aluminum sub-constructions. –Are these structurally safe?



Image-No. 10

If the base is uneven, tilted or has a rough surface it can cause construction errors as seen on images 9 and 10.

The innovative facade raw plug by **INNOFIXX** avoids such problems and is able to carry the loads of the facade cladding's over large distances, with short assembly times, higher assembly safety and decreased heat-bridging (see chapter 4).

4. The energy perspective

The energy perspective looks promising. Isothermal characteristics prove, that compared to current mounting systems, the heavy duty and facade raw plug has significantly lower heat-bridging. (see Images 11 and 12). The central fastening point of an individual raw plug in the base is significantly lower compared to the anchoring structure of other aluminum facade systems.

A direct comparison shows that the 1,4° higher Interior surface temperatures are demonstrated mathematically.

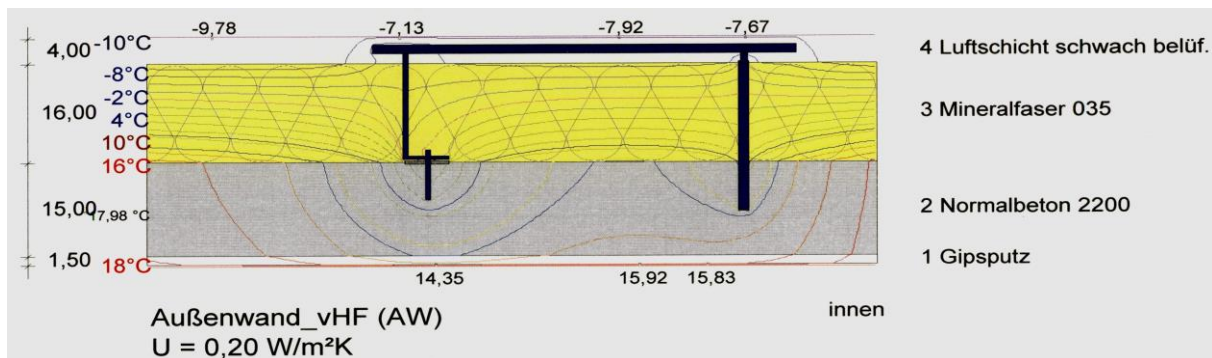


Image-No. 11

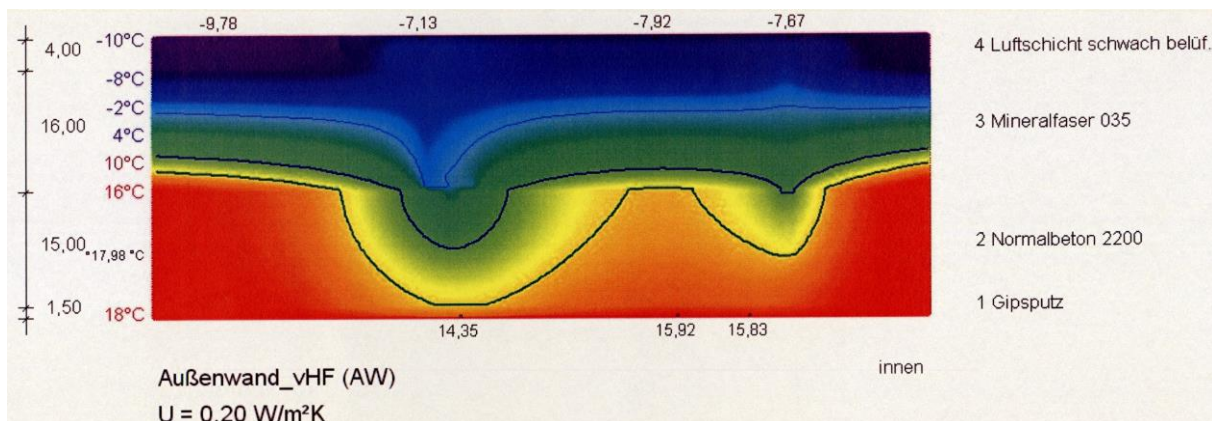


Image-No. 12

Left shows a current aluminum construction, right a single **INNOFIXX**-raw plug with low central fastening point.

5. Technical description

Modular construction of the INNOFIXX raw plug

Heavy duty raw plug (HDD) - Facade raw plug (FD)

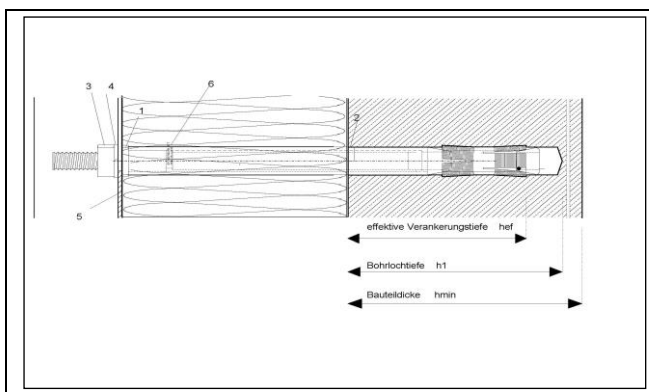


Image-No. 13

The raw plug is made of corrosion-proofed VA materials and is assembled by combining multiple modules:

1. tubular sleeve with multiple slots on the raw plug tip and a minimum of two eccentrically located slots on the raw plug head. The slots allow the spread of the raw plug body.
2. threaded bar and special head to take on setting/assembly tools (e.g. hexagonal screw driver)
3. expansion element for the raw plug top with drill hole and internal screw thread
4. double expansion sleeve with opposing slots

Special components for special cases: counter support (raw plug head) with drill hole and internal screw thread. The counter support (raw plug head) contains a circumferential collar to control the spreading of the raw plug head. A spreading of the raw plug head of the tubular sleeve is possible, depending on the counter support body.

Functioning

The raw plug is inserted with the help of setting tools after the drill hole has been created.

Holding the raw plug head (hexagonal or drill hole) and at the same time turning the threaded rod clockwise ensures that the raw plug head supports itself from the circumferential collar on the tubular sleeve and hence enables the movement of the expansion element into the inside.

The raw plug pipe sleeve spreads into the structure and enables an anchoring of lateral, transverse and tensile loads.

Depending on the length and circumference of the pipe sleeve, it can transfer higher lateral/transverse loads securely over longer distance into the supporting structure.

Nearly all kinds of ventilating facades can be used due to the unique design of the raw plug (see description above). Existing weather shells as well as new facade elements can be anchored into the supporting structure using longer raw plugs. With this feature we present a solution for refurbishing facades with old heat insulation composite systems. The same applies to new buildings.

Even the fixation of new balconies to existing buildings is now a real possibility.

The time of deployment is significantly reduced because of the simple assembly of the raw plug.

Differentiation from existing techniques

So far it was not possible to use a single kind of raw plug that can at the same time transfer lateral/transverse loads to re-anchor heavy weather shells. Moreover, current raw plugs do not allow to additional elements (balconies) onto the external building structure.

The patented and German, certified INNOFIXX raw plug addresses all of the above requirements.

Technical Advantages

- The raw plug can be used in reinforced and non-reinforced and normal concrete that is of minimum strength class C20/25 and highest C50/60 after DIN EN 206-1:2001-07 "Beton - Teil 1: Festlegung, Eigenschaften, Herstellung und Konformität".
- The raw plug can also be used for multiple fixation for distance bridging in cracked and non cracked concrete well as the transfer of lateral and pressure loads. The combination of the pipe sleeve with the fastening head, the head and the threaded rod, makes the raw plug perfectly fitting for pressure and lateral load carrying sub constructions.
- Moreover the raw plug can be used for multiple fixings over long distance bridging in cracked or non cracked concrete to carry and transfer/distributes lateral, transverse and tensile loads. This is due to the pipe sleeve in combination with the fastening head, the head and the threaded rod.
- In case standard fire protected tubes are used, the fire resistance time threshold for the raw plug SFD is up to F90 when used with ventilating facades (at the same time with adjusted supporting profiles).
- The fixation of the raw plugs with a diamond drill toll will decrease the assembly time further and at the same time increase the fixation safety. High carrying loads are only dependable on the diameter of the pipe sleeve. The use of machines and hence the costs of tools are reduced. Various distances can be covered.

The assembly

Facade raw plug (SFD) for ventilated facades.

The product is a raw plug made from stainless steel of the same construction as the SLD but with a smaller diameter (Ø 12, 16, 20mm).

- Creating a drill hole with a impact drill using the drill with the correct diameter (diameter + <1,0mm)
- Cleaning of the drill hole and checking the depth

- Assembly of the raw plug by using the assembly tool, which must be placed at the head of the fastening screw.
- Use torque wrench to precisely apply torque to raw plug
- Mounting of sub-construction of the facade
- Assembly of any other parts of the sub-construction

Heavy duty raw plug (SLD) for facade re-anchoring

- Standard diamond drill fixed to the facing shell.
- Creation of drill hole with a diameter of 34,5 and 56 mm.
- Removal of drill core from the drill hole.
- Cleaning of the drill hole and checking the depth.
- Assembly of the raw plug by using the assembly tool, which must be placed at the head of the fastening screw.
- Change of the drill head on the diamond drill to the head.
- Connect the head to the milled hexagonal head of the heavy duty raw plugs threaded rod , hold the assembly tool and use the drill tool to fasten the raw plug.
- Disassemble the drill tool and check the pre-tensioning forces, with the help of a standard torque wrench.

Exceptions (Examples)

Cantilever roofs, balconies or chimneys can easily be added by using heavy duty raw plugs. Compared to usual constructions, the elements in images 14 and 15 can therefore be avoided. This enables the architect to create more appealing and creative constructions.



Image-No. 14

Usual balconies added later to the building, with four supporting structures (steel).

Refurbishment of facades using heat insulation composite systems

Many of the heat insulation composite systems used in the last 20 years show unappealing side effects like algae infestation, dirt, spilling or moisture generation.

Insulating building walls with thick insulation creates optimum conditions for algae. Insulated facades reduce the heat circulation which stops heat from reaching the plaster. That means that the plaster is much colder as with usual facades, resulting in excessive moisture on the plaster areas. The raw plaster structures in combination with dust create together the optimum substrate for micro organisms like algae.



Image-No. 15 Explanatory facade that is infested with algae as presented in the ARD TV report Plusminus on 23.11.11)

Antidote: Biocidal that harm the environment or complete removal of the facade.

The innovative facade raw plug by **INNOFIXX** avoids any such problems. Now it is possible to drill the new raw plugs through the existing, old and unappealing facade using heat insulation composite systems, without removing it completely. This means the existing heat insulation can be easily upgraded using new energetic mineral thermal insulation combined with a ventilating facade.

This reduces the maintenance costs significantly!

6. Marketability

The industry trade association FVHF reported that annually 6-8 million. m² ventilating facades are build in Germany alone and all German speaking countries (Germany, Austria, Switzerland) combined 9 million. m².

An explanatory model calculation on a ventilating facades showed that using the new heavy duty raw plug would result in actual costs savings between seven and 20 Euros per square meter. The faster mounting additionally means lower wage costs of one to two Euros per square meter. The reduced material- and wage costs results in an area/surface price for sub constructions of 15 to 20 Euros per square meter.

The heavy duty raw plug, patented in 27 European countries and certified since 2011 to be used in Germany, can simultaneously support high vertical and horizontal loads to bridge large distances.

Examples of Use

- Creation of ventilating facades using raw plugs and carrying profiles of various cladding's/covers like natural stone, ceramic, aluminum plates
- Re-anchoring of three layer outer wall parts used for prefabricated buildings.
- Re-anchoring of multi layer pre-constructed elements
- Porches, balconies, loggias, emergency stairs, elevators on existing buildings without larger effort
- Creating glass facades
- Subsequent creation of carrying, from the facade hanging, bullet proof glass to secure the rooms behind without the loss of ventilation provided by existing windows.
- Heavy duty anchoring for formwork construction

Potential customer groups i.e. market segments

- Raw plug manufacturers
- Engineers and architects
- Building material dealers
- Manufacturers of substructures for ventilating curtain facades
- Mounting companies for ventilated curtain facade
- Construction

Business case and usability

- Quick and cost saving mounting of various fixtures for facades.
- High savings in terms of wage costs and increased competitive advantage
- Easy assembly with increased assembly safety.
- Few raw plugs, apart from the unique **INNOFIXX** raw plug, can handle traction and compression forces as well as high lateral forces.
- Additionally a high level of fire protection can be reached. (special case)

Environmentally friendly

- Environmentally friendly because recycling and re-using is possible.

Cost advantage

- The simple manufacturing process of the raw plugs ensure lower manufacturing costs since multiple parts can be produced using multi-spindle machine.
- An easy assembly results in decreased wage cost.
- A decreased usage of machines and tools on site lowers the general overhead.
- The handling of high lateral forces, combined with the handling of traction and compression forces reduces the deployment of additional raw plugs or special carrying constructions (for example as necessary when adding balconies)
- In case lateral and traction forces have to be handled at the same time, then the price for competitive products is about ca. 30 - 50 % higher because at least two different kinds of raw plugs have to be used.
- Price comparisons can not be presented since steel prices on the world markets are subject to heavy fluctuations. However compared to standard raw plugs, a cost saving of up to 20 % is realistic.
- Taking the example of ventilated facades with a grid of 60 cm and a floor height of 2,80 m using standard aluminum sub-constructions would require at least 4 standard raw plugs. Using the facade raw plug, the total number of necessary raw plugs is reduced to 3 and at the same time avoids the usage of aluminum wall blocks with thermostop-elements.

7. Advantages of the INNOFIXX raw plug

- Carries and distributes lateral, transverse and tensile loads
- Can be deployed in cracked or non cracked concrete
- Significantly lower heat-bridges
- Bridging distances up to 300mm
- Fast and easy assembly
- Cost savings in terms of time and money
- Covers a wide range of applications for example facade construction, re-anchoring of weather shells, fixing **balconies, chimneys, sun blinds and** cantilever roofs