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Systemtec

Fiksiranje tunelskih ventilatora Autoput Crna Gora

Kongres KGH, Podgorica 2022.

Investitor/Employer:
VLADA CRNE GORE, MINISTARSTVO SAOBRA ĆAJA I POMORSTVA / GOVERMENT OF MONTENEGRO, MINISTRY OF TRANSPORT AND MARITIME AFFAIRS

Izvođač/Contractor:
CHINA ROAD & BRIDGE CORPORATION D.O.O. PEKING, NR KINA-DIO STRANOG DRUŠTVA PODGORICA

Podizvođač/Subcontractor:

Vodeći projektant/Chief Designer: Peng Tingjia, dipl.inž.građ.

Odgovorni projektant/Responsible Designer: Tihomir Adžić, dipl.inž.el.

Projektanti/Designers: Li Gang

Saradnici/Assistants: Zhang Shiliang

Datum/Date: Dec.2015

Razmjera/Scale: 1:50

Naziv objekta/Project:
BAR-BOLJARE HIGHWAY

Dionica/Section: SMOKOVAC - MATEŠEVO
km 0+000 - km 40+871

Poddionica/Subsection:
LK19+600.00 - LK22+692.65
RK19+632.00 - RK22+611.33

Objekat/Structure:
Tunel/Tunnel 7 Vjeternik

Naziv crteža/Drawing:
Diagram for reserved positions for jet fans
Šematski prikaz predviđenih otvora za ventilatore

Faza projekta/Design phase:
GLAVNI PROJEKAT/MAIN DESIGN

Knjiga/Book: GL07

Crt.Br./Dr.No. **GL-7-7**

Šifra projekta/Design code:
BBC070TN007GL07

Diagram for reserved positions for jet fans
Šematski prikaz predviđenih otvora za ventilatore
1:50(unit:m)
1:50(jedinica:m)

a example.
will be presented in the ventilation main design.

kao primjer.
ate u glavnom projektu ventilacionog sistema.

d positions for jet fans
enih otvora za ventilatore

Datum revizije i pečat / Date of revision and stamp

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Tunel Vjeternik

Tunel broj 7 na trasi autoputa Smokovac – Mateševo.

Najduži tunel na trasi sa ukupnom dužinom od 5892 m – desna cev 2852m i leva cev 3039m.
Trasa izuzetno teška jer je pronadjeno oko 100 pećina što je posebno otežavalo radove.

Građevinska dozvola za izgradnju južne strane tunela Vjeternik izdata je 28. aprila 2016. a za severni deo 15. novembra iste godine, kada su se stekli uslovi za proboj tunela.

Tunel je probijen u Julu 2018te, tri godine nakon početka radova na trasi autoputa.

Danas predstavlja jedan od najmodernijih tunela na Balkanu !

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Rešenja za fiksiranje u tunelima za drumski i železnički saobraćaj

Kriterijumi koje moraju ispuniti elementi za fiksiranje u tunelima !

- Dug životni vek bez zahtevnog održavanja
- Sprečavanje uništenja strukture u slučaju požara
- Otpornost na požar
- Sigurnost u slučaju pojave zemljotresa

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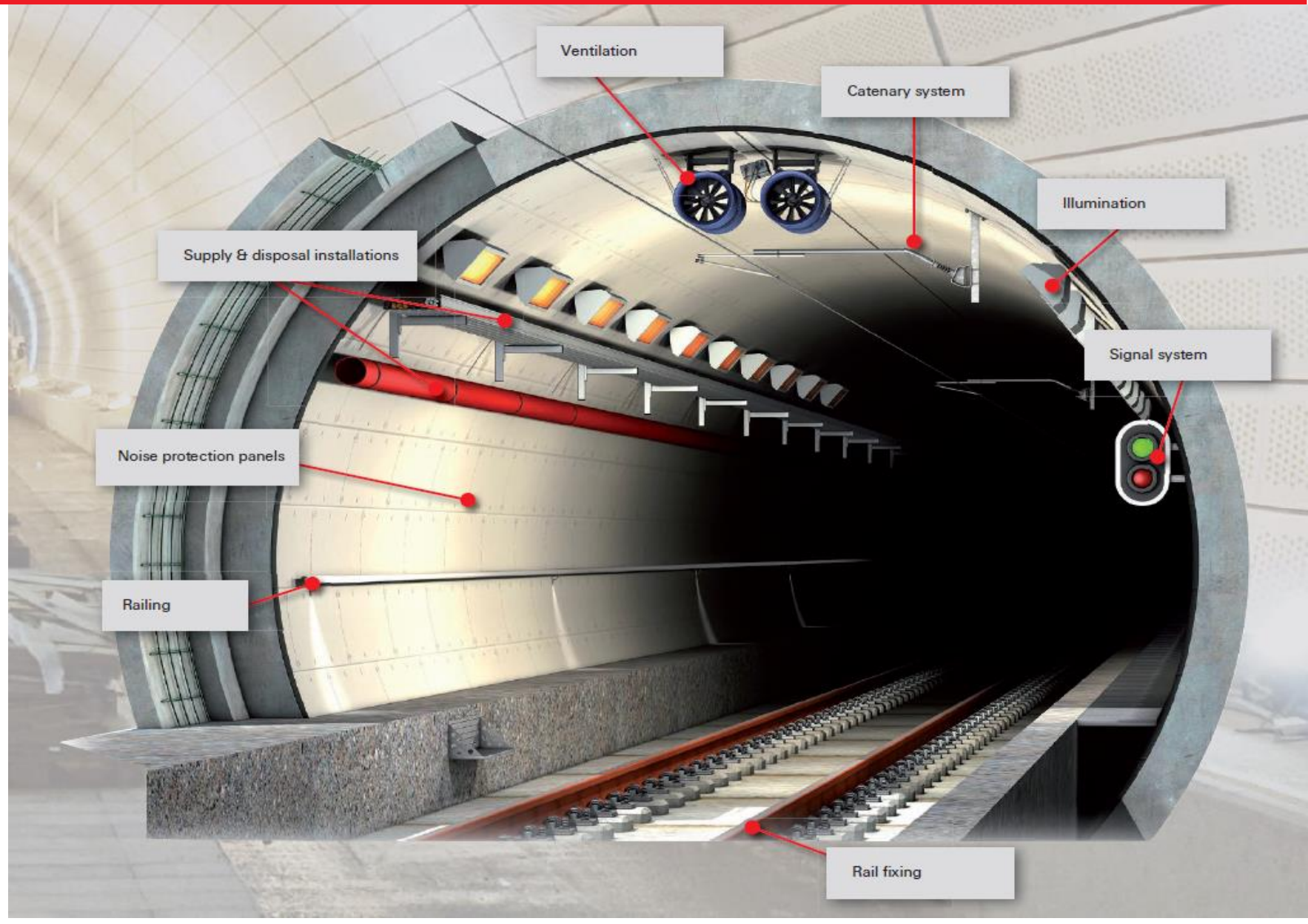
Rešenja za fiksiranje u tunelima za drumski i železnički saobraćaj

Šta je preporučuje Fischer da bude dobavljač sistema za fiksiranje u tunelima?

- Visoko-kvalitetni proizvodi i sistemska rešenja
- Kvalitetni materijali kao što je inox i čelik otporan na koroziju (tip C, 1.4529)
- Proizvodi koji su u mogućnosti da odgovore na tražene zahteve (požar/dinamika/seizmika ili „šok“ udari)
- Dizajn licenciranih inženjera i podrška na terenu



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Fischer reference kao preporuka

Gotthard Base tunnel

Challenge

Long-term safety and minimized maintenance requirements for decades, this was the main requirement of the project owner for the installation of the catenary system. At the same time the system supplier asked for an easy to install, economic solution with adjustable stand-off installation, high loads and limited drill-hole depth.

Solution

FIS A M16 to M30 made of high corrosion resistant steel (1.4529) together with FIS EM was used for about 40,000 fixing points of the catenary system. A systematic quality control with hundreds of successful pull-out tests was established. The heavy installation of the complete catenary system was overhead. Therefore fischer developed and delivered installation clips in nylon and steel, to prevent the heavy anchor bolt slipping out by proper weight, during the curing time of the chemical mortar.

Mont Blanc tunnel

Challenge

After the disastrous fire in 1999 the single tube tunnel with only one lane in each direction was completely refurbished and modernised. In the 11.6 km long tunnel also the tunnel ventilation systems had to be updated. Of course this applies also for the fixings of the 76 tunnel fans. New technical specifications with dynamic loads, high resistance to corrosion and latest standards for fire resistance had to be fulfilled.

Solution

In spite of the defined standards and based on latest state of the art know how, fischer decided to propose an alternative technical solution with anchors for dynamic loads and high corrosion resistance, the FHB Dyn 16x125/110 C. With the French certifying body CETU the needs in case of fire have been approved.

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Fischer reference kao preporuka

Metro Milan

Challenge

The project ML5 has been developed according to the requirements of the Milan Metro. fischer was the only player capable of providing all required subsystems for the rail fastening solution. fischer has provided engineering and technical support both on and off site throughout the full project period.

Solution

fischer has provided technical products for more than 35,000 rails attachment plates, in particular Rail Anchor M22x270 - 75,000 pcs and 4,800 cartridges of FIS EM 1500. All works have been executed on time and all testing was successful.

Hatfield tunnel UK

Challenge

Challenge on this project was to comply with stringent Highway Agency Design Manual BD 78/99 and Interim Advice Note 104/07. For the subcontractor, it was important that fischer offered a comprehensive package: advance and fully tested products backed up with a proactive technical support offering not only design consultancy but also site support with installation trainings and suitability site testing in accordance to BS5080 and vigorous IAN 104/07.

Solution

fischer was specified and used on all applications in this tunnel, fixing passive fire protection, M&E services, polyvision wall cladding and tunnel ventilation. FNA II 6x30/30 A4 nail anchor was specified because it was tested as part of the passive fire protection system and RWS fire tests were already available for FNA anchor in conjunction with the specified passive fire protection boards. For fixing jet fans FHB dyn M16x125/50C anchors were used because of its dynamic approval.

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Kako odabrati pravo rešenje za traženi zahtev?

Ventilation & smoke extraction

FHB dynamic with FIS HB

FZA

RGM with RM, RSB

FIS A with FIS V, FIS EM or FIS SB

FAZ II

Application:

Ceiling or wall mounted fans are, due to their dimensions and proximity to the passing heavy goods vehicle traffic, usually exposed to dynamic loads. For such cases the FHB dynamic is the right choice.

Fire traps, smaller fans, and fans not exposed to dynamic loads can be also fixed with standard bonded anchors or undercut anchors.

Šta je bilo potrebno uzeti u razmatranje:

- Opterećenje nastalo usled težine ventilatora
- Dinamička opterećenja
- Seizmička opterećenja
- Opterećenja u slučaju požara
- Povećani uticaj štetnih materija iz izduvnih gasova

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Norme koje su korišćene kod projektovanja

1.1 Used norms, approvals, test report and literature

- EN 1993-1-9
- EN 1993-1-1
- prEN 13381-3:2012
- RVS 09.01.23 → Austrian tunnel regulation RVS 09.01.23
- EOTA TR 029
- EOTA ANNEX C
- ETA approval FIS SB ETA-12/0258
- Fire test report FIS SB GS 3.2/11-243-2
- DIBT Approval FHB dyn Z-21.3-1748
- Stahlbaukalender 2006 - Grundlagen und Erläuterung der neuen Ermüdu
- Different test reports and technical documents from fischer fixings

Fischer Fixpirence

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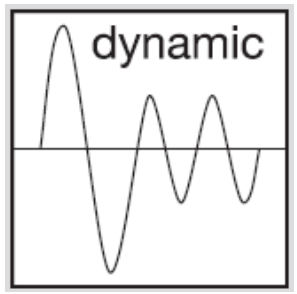
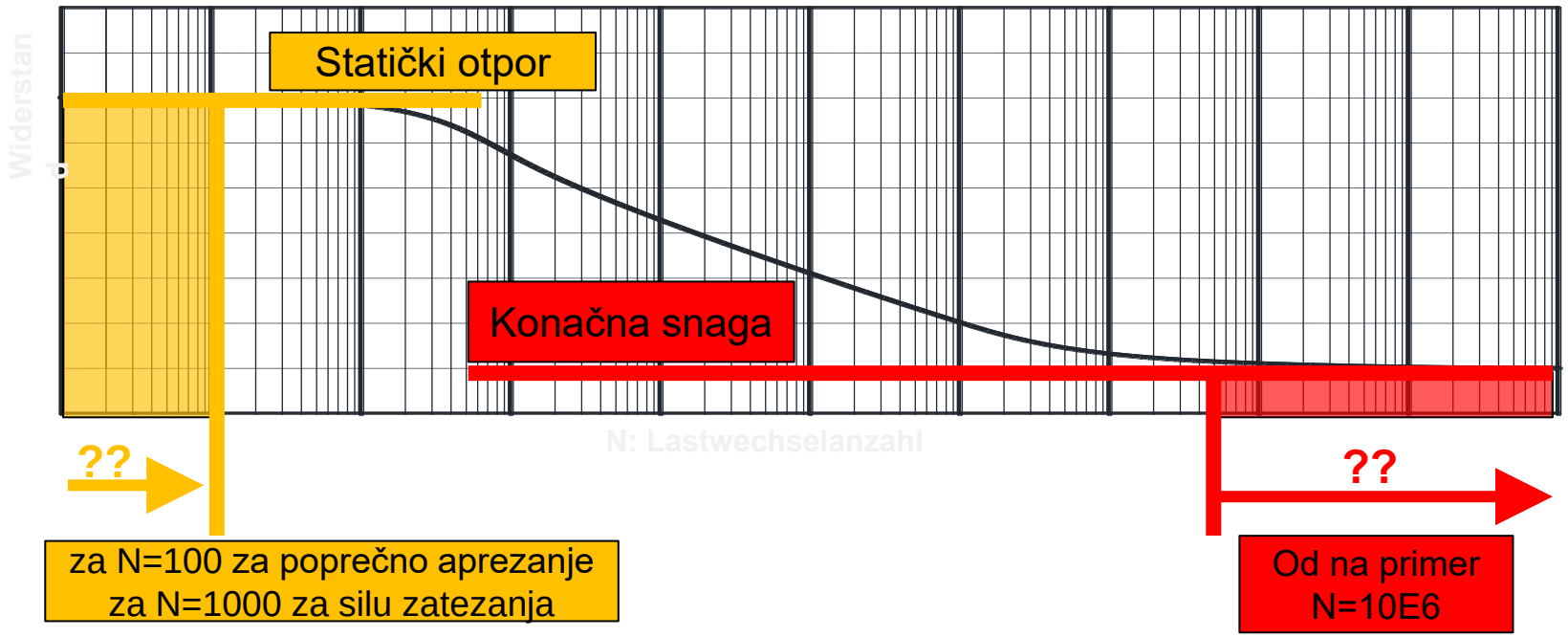


Dinamički uticaj i uticaj zamor materijala

Opšti građevinski pravilnik koji je odobren od strane nemačkog građevinskog instituta u Berlinu (DIBt) i evropski Tehnička odobrenja (ETA) su generalno isključivo za ankerisanje statičkih i pretežno statička opterećenja.

Međutim, za razliku od ovih trenutno važećih odobrenja, u praksi se javlja čitav niz dinamičkih efekata, npr. rastućih i naizmeničnih opterećenja uz mnogo promena u drumskom tunelu. Promene su pod uticajem gustog saobraćaja koji stvara dejstvo kompresije i usisavanja komponenti unutar njega.



Input data

Design method	Design Method EN1992-4:2017 bonded fastener
Base material	Normal weight concrete, C25/30, EN 206
Concrete condition	Cracked, dry hole
Reinforcement	No or standard reinforcement. No edge reinforcement. Without reinforcement against splitting
Drilling method	hammer drilling
Installation type	Push-through installation

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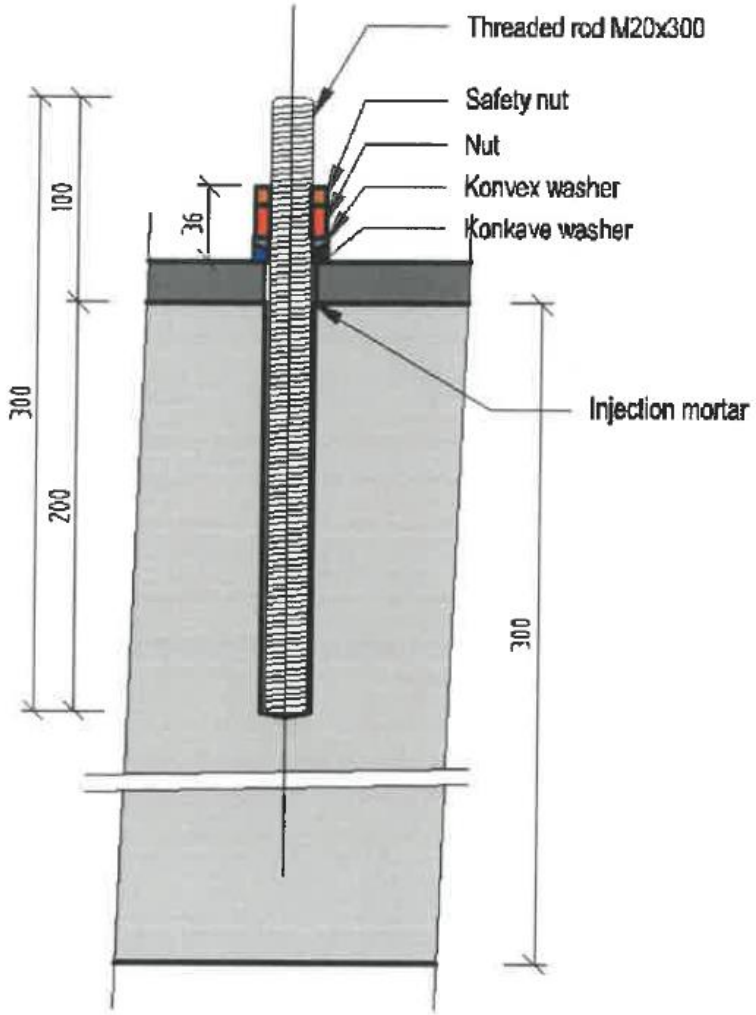
Design Specifications

Anchor

Anchor system	fischer Superbond-System
Injection resin	FIS SB 390 S
Fixing element	Threaded rod M20 x 205 (By job site.), high corrosion resistant steel, property class C-70
Calculated anchorage depth	170 mm
Design Data	Anchor design in Concrete according European Technical Assessment ETA-12/0258, Option 1, Issued 19/05/2016

Detalj ankera

3.1 Baseplate geometry and anchor placement)



Physycal anchorage depth:

$$h_{phys} := 200\ mm$$

Effective anchorage depth:

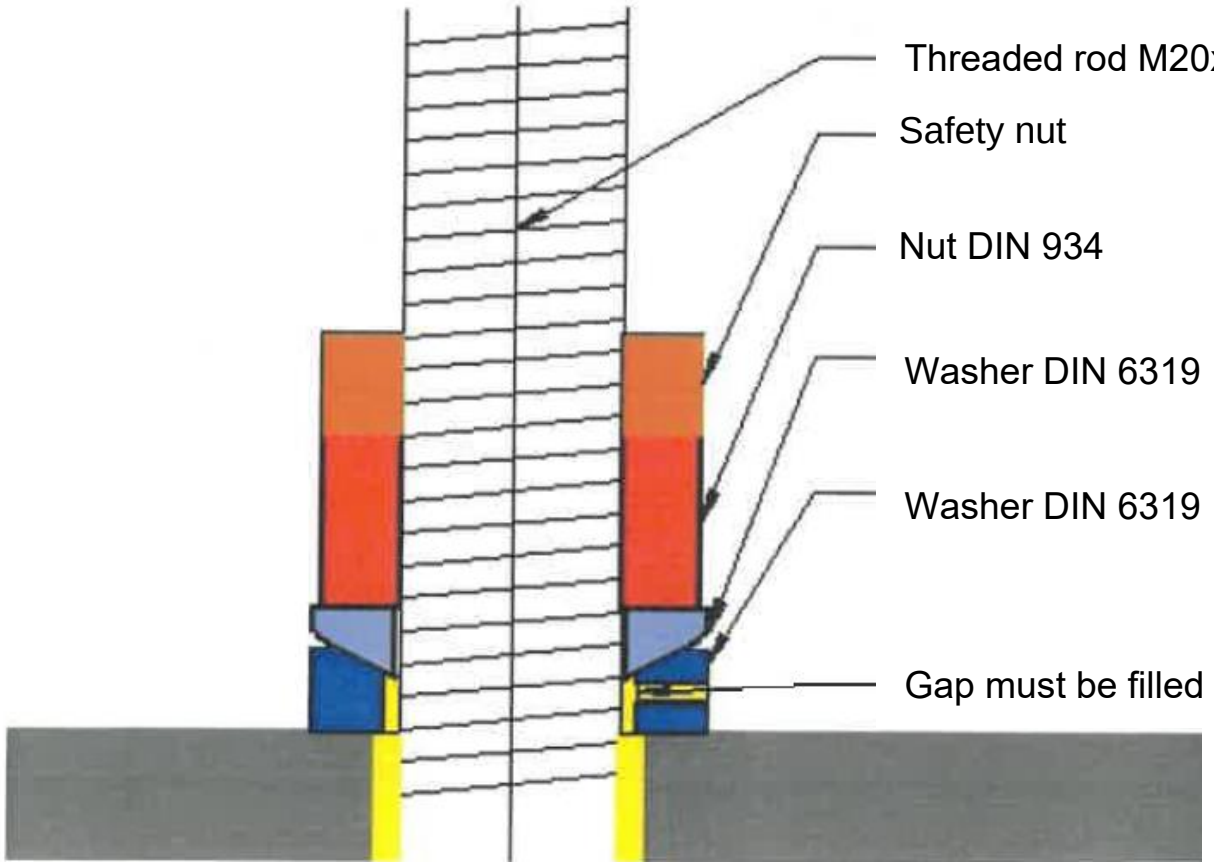
$$h_{ef} := h_{phys} - 1.5\ d = 170\ mm$$

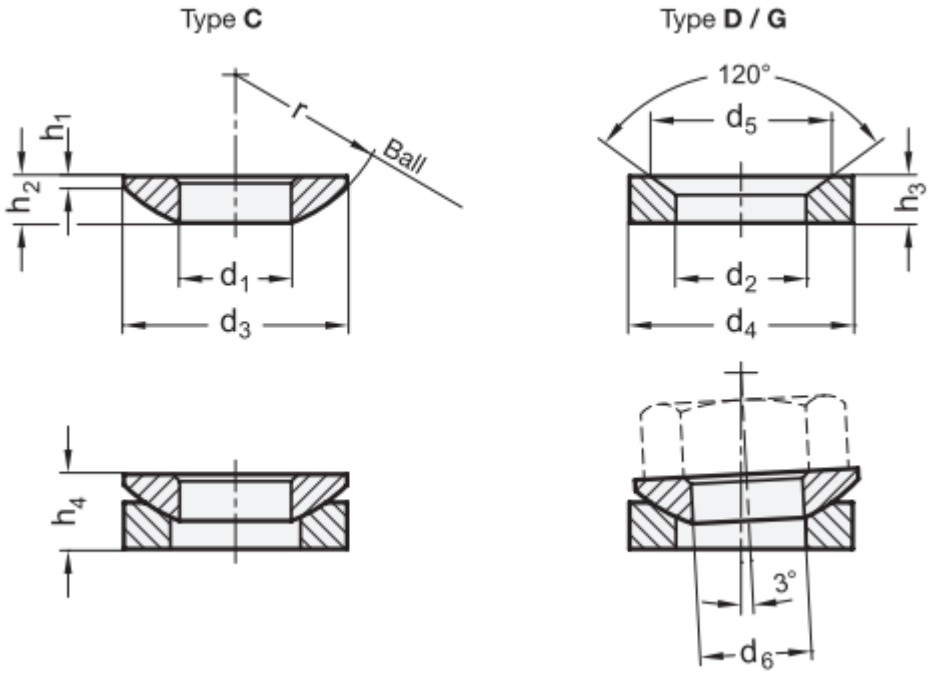
Concrete thickness:

$$h_c := 300\ mm$$

Detalj ankera

3.2 Deatiled fixing part geometry





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Korišćeni proizvodi

ICC ES ESR-3572 See ICC-ES Evaluation Report at www.icc-es.org

R 120

THIRD-PARTY VERIFIED EPD ISO 14025 and EN 15804

ETA CE

DoP Declaration of Performance

ICC ES See ICC-ES Evaluation Report at www.icc-es.org

SDS Safety Data Sheet

TDS Technical Data Sheet

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Korišćeni proizvodi

Stainless steel						
Steel Grade					Corrosion	
Material No.	Short Name	AISI	UNS	Designation of the Steel Group with	Resistance Class	Exposure and Typical Applications
1.4305	X8CrNiS18-9	303	S 30300	A1	I/light	Indoor climate except damp location.
1.4301	X5CrNi18-10	304	S 30400	A2	II/moderate	Accessible constructions without nameable content of chlorides or sulfur dioxide, except industrial atmosphere.
1.4307	X2CrNi 18-9	304L	S 30403	A2L	II/moderate	Accessible constructions without nameable content of chlorides or sulfur dioxide, except industrial atmosphere.
1.4362	X2CrNiN23-4	324	S32304	A4	III/medium	Constructions with moderate chloride and sulfur dioxide exposure and inaccessible constructions.
1.4401	X5CrNiMo17-12-2	316	S 31600	A4	III/medium	Constructions with moderate chloride and sulfur dioxide exposure and inaccessible constructions.
1.4404	X2CrNiMo17-12-2	316 L	S 31603	A4L	III/medium	Constructions with moderate chloride and sulfur dioxide exposure and inaccessible constructions.
1.4571	X6CrNiMoTi17-12-2	316 Ti	S 31635	A5	III/medium	Constructions with moderate chloride and sulfur dioxide exposure and inaccessible constructions.
1.4529	X1NiCrMo-CuN25-20-7	–	N 08926	1.4529	IV/strong	High corrosion exposure due to chlorine, chloride and/or sulfur dioxide, high humidity as well as accumulation of hazardous substances.

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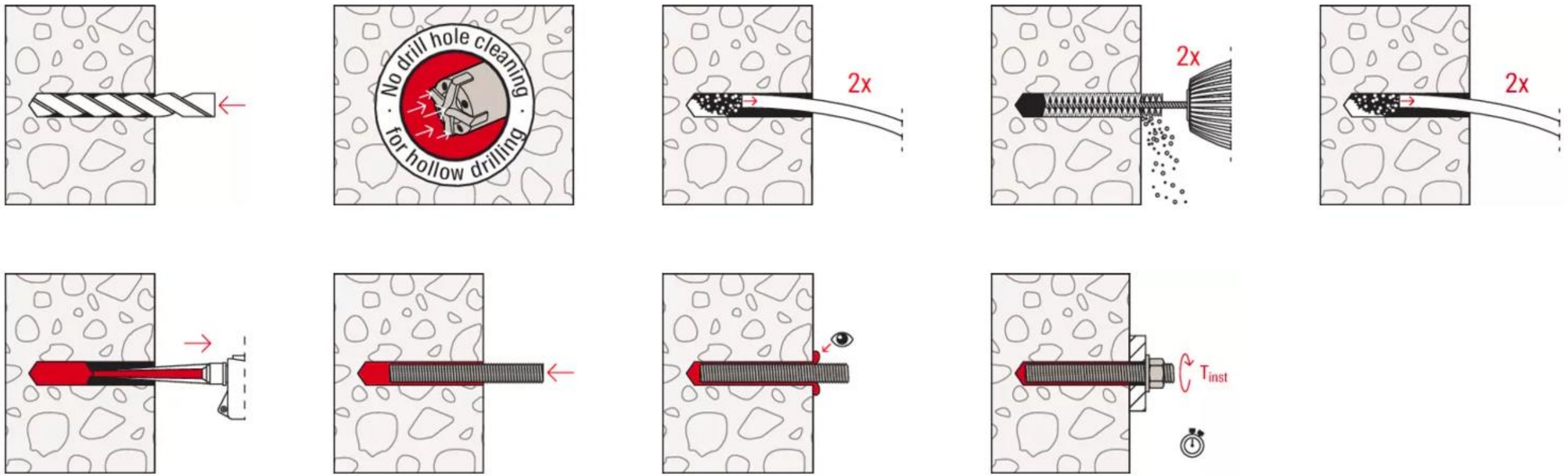
Instalacioni detalji

Thread diameter	M 20
Drill hole diameter	d_0 = 24 mm
Drill hole depth	h_2 = 180 mm



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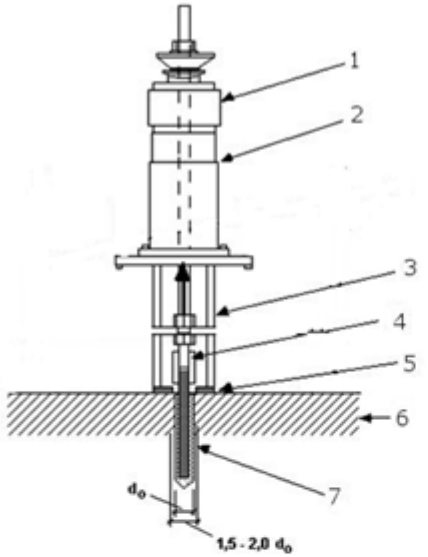
Pull-out test

- Nosilac posla je definisao postupak pull- out testa, postupak ispitvanja sile čupanja ankera
- Ankeri su podvrgnuti testiranju na silu koja 10x, 20x i 30x veća od realne težine ventilatora



1 load cell
2 load cylinder
3 support
4 socket
5 steel plate
6 tunnel concrete
7 injection anchor

3) Start the hydraulic ram manually to make the load cylinder work progressly,watch the pressure gauge carefully.When the reading reach 15.8kN (10 times of static load of jet fan for one anchor bolt),remain this pressure for 1 minutes to watch whether it has visual movement or other damage,then increase the reading to 31.6kN (20 times of static load of jet fan for one anchor bolt), remain this pressure for 1 minutes and check the anchor bolt again,at last increase the reading to 46kN-the pull-out test load, remain this pressure for 3 minutes to check the whether it has visual movement or other damage.

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KONAČNI BROJKE

- Težina najvećeg ventilatora oko 630 kg
- 6 anker mesta po ventilatoru
- 390 ventilatora na celoj trasi
- 2340 anker mesta
- 120 litara hemije za ankerisanje

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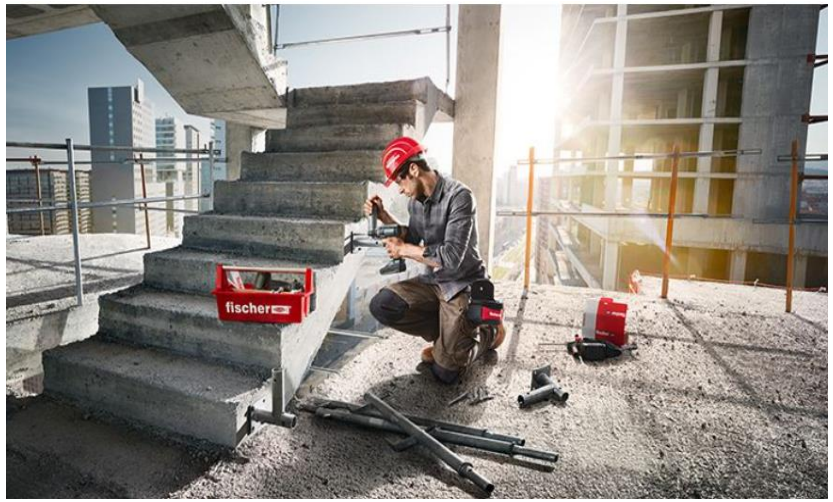
- Specijalista za bezbedne i ekonomične elemente za pričvršćivanje u gradjevinarstvu - jedan od **lidera** na tržištu u poslednjih šest decenija.
- fischer ima odgovarajuće **rešenje za svaki problem** pričvršćivanja bez obzria da li se radi o ankerima za velika opterećenja koji se koriste u izgradnji tunela, mostova ili postrojenja za proizvodnju električne energije za profesionalce, ili tiplovi za zidove i šupljine za „uradi sam“:
- Portfolio proizvoda obuhvata preko **15.000 artikala**.



Chemical fixings

Steel fixings

Standard fixings

- 15,5 miliona proizvoda za pričvršćivanje se proda svakog dana, 11.000 svakog minuta.
- Fischer poseduje najveći broj sertifikata o građevinskoj saglasnosti u celoj Evropi.
- Fischer sistemi za pričvršćivanje globalno prisutni - 49 podružnica i preko 100 uvoznika

fischer Installation Systems, obujmice

Installation Systems

Laka opterećenja

Channel FLS

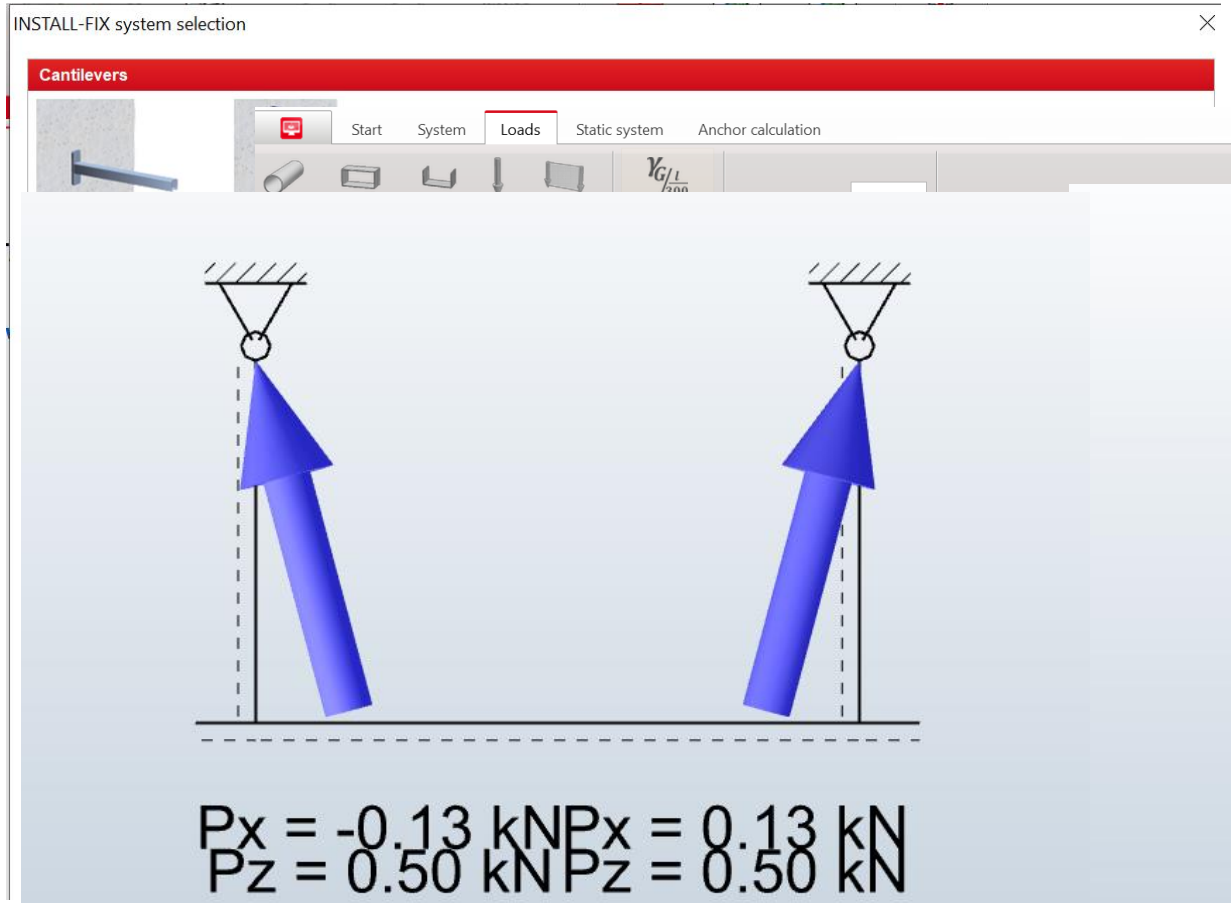
Srednje teška opterećenja

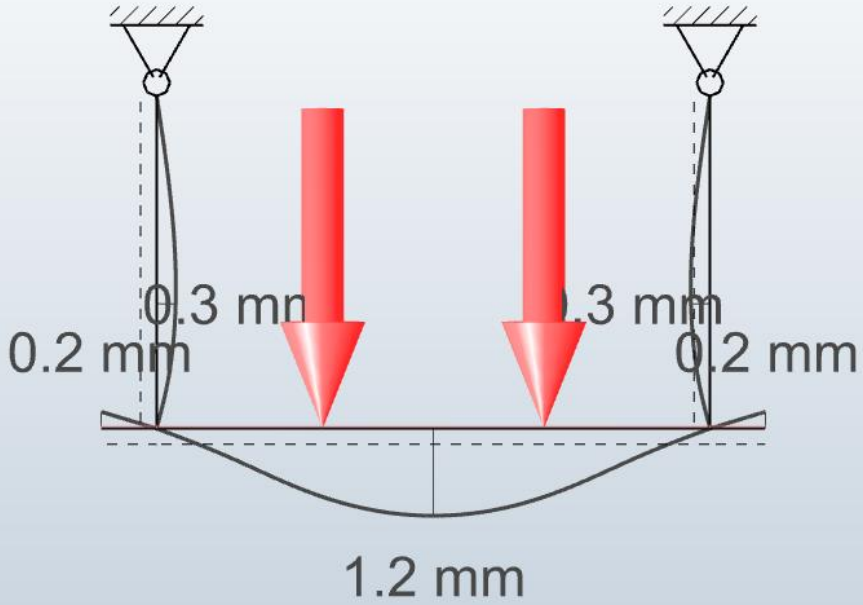
Channel FUS

Velika opterećenja

Massive profile FMP

Installation Systems





Hvala na pažnji !

Slavoljub Vukčević dipl. Ing.
Fischer Austria GmbH
Project and Business Developmant Manager
Instalacioni Systemi

Septembar 2022.