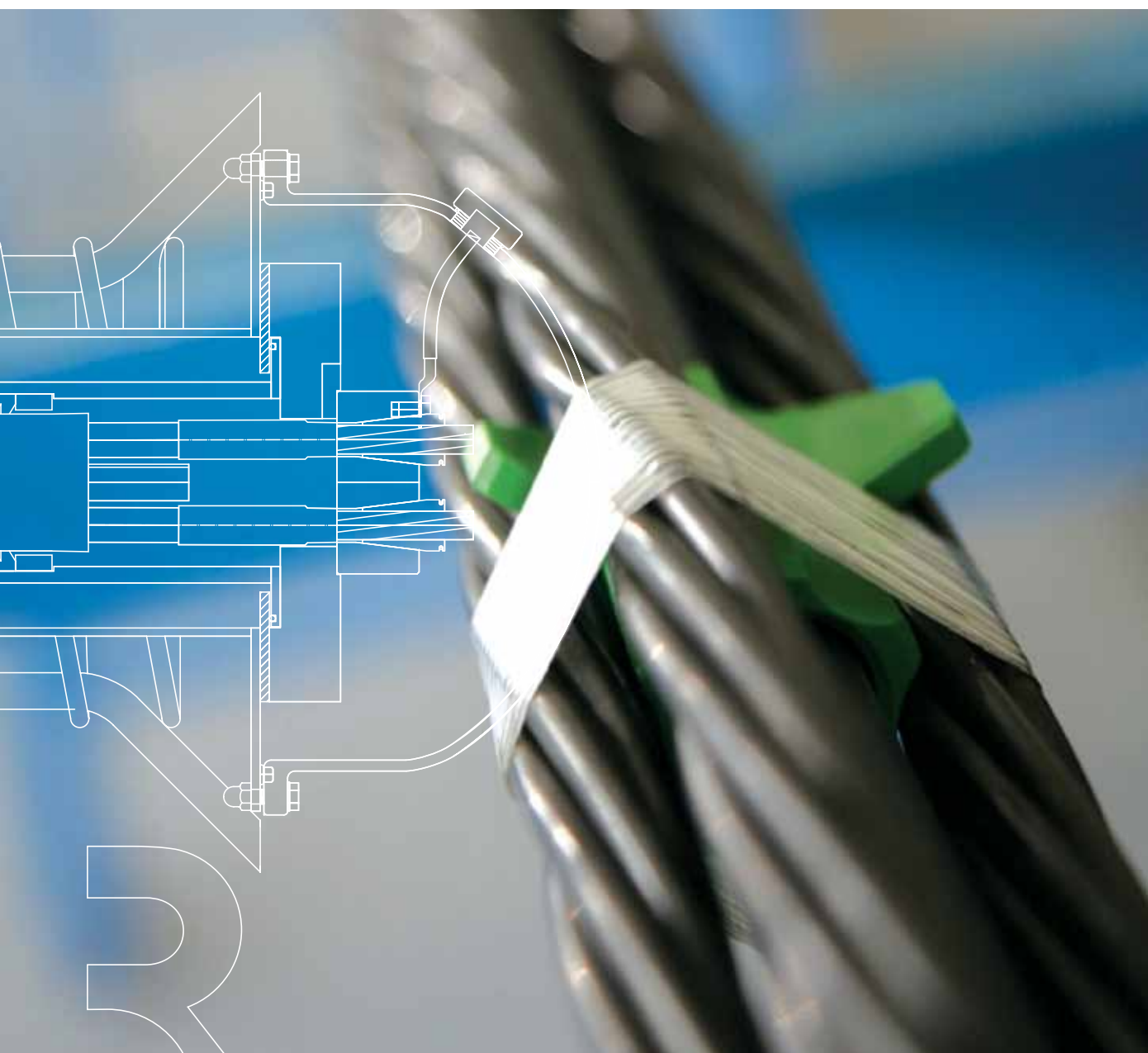




TRAJNO PREDNAPETO GEOTEHNIČNO SIDRO TPGS RAFAEL 10



PERMANENT PRESTRESSED
GROUND ANCHOR
TPGS RAFAEL 10



01 TRAJNA KAKOVOST

Družba Rafael je specializirani strokovnjak za izvajanje gradbenih storitev na področju:

- sanacije plazov,
- železniških in cestnih gradenj,
- hidrogradenj,
- proizvodnje in vgradnje geotehničnih sider.

Dobre odnose z deležniki, že od leta 1992, gradimo na celovitem pristopu k vsakemu posameznemu projektu ter z zagotavljanjem inovativnih rešitev, storitev in uporabo najkakovostnejših materialov.

Leta 2010 smo na področju geotehnike postali certificirani proizvajalec geotehničnih sider, našo odličnost pa zagotavljajo tudi drugi pridobljeni slovenski in mednarodni certifikati: certifikat kakovosti goo1, Slovensko tehnično soglasje (STS) in Evropsko tehnično soglasje (ETA).

Svoje izkušnje in poslovanje nenehno nadgrajujemo in izpopolnjujemo z novimi znanji, inovativnimi rešitvami ter tehnološko napredno opremo, kar nam zagotavlja tudi uspešen vstop na tuje trge.

POSŁANSTVO

Ustvarjamo varno sobivanje z naravo.

Smo gradbeni specialist na področju železniških, cestnih, vodnih in zemeljskih gradenj:

- z našimi gradnjami železniški promet naredimo hitrejši in varnejši,
- s sanacijo plazov sile narave umirimo in prek vgradnje zemeljskih sider površine pripravimo za učinkovito uporabo,
- z vodnimi gradnjami omogočamo obvladovanje vodne energije in njeno varno uporabo,
- končnim objektom vdihnemo naravno podobo, ki se sklada z okoljem, v katerem se nahajajo.

VIZIJA

Podjetje Rafael je v naslednjih desetih letih najbolj priznan slovenski specialist za železniško, cestno, hidrogradnjo in sanacijo plazov ter največji dobavitelj geotehničnih sider na področju JV Evrope.

VREDNOTE

- natančnost
- zanesljivost
- inovativnost
- zaupljivost
- varnost



PERMANENT QUALITY

The Rafael Company provides their partners quality services in the fields of:

- rehabilitation of avalanches,
- railway and road constructions,
- hydro-constructions,
- anchoring.

Since 1992 a good relationship with our business partners has been based on the overall approach to every single project, as well as on the assurance of innovative solutions, services and the utilization of top-quality materials.

In the year 2010 the Rafael Company became a certified manufacturer in the field of geo-technical anchors. Our excellence is also proved by attained nationally and internationally recognised certificates: the ISO 9001, the Slovene Technical Approval (STS), and the European Technical Approval (ETA).

Our experiences and business activities are regularly improved and implemented by new knowledge, innovative solutions, and technologically advanced equipment which enable our successful launching on to the international markets.

MISSION

Creating a safe co-existence with nature.

The company is an expert in the field of railway, road, hydro and ground constructions:

- our constructions make railway traffic faster and safer,
- we manage to fight the forces of nature with the rehabilitation of avalanches, and make the ground surface ready for an effective usage by the in-building of the ground anchors,
- our hydro-constructions enable dealing with water energy and using it in a safe way,
- final constructions are given a natural appearance matching perfectly with the environment they belong to.

VISION

In the next ten years, the Rafael Company is the most recognised Slovene expert in the field of railway, road and hydro constructions, rehabilitation of avalanches, and the biggest manufacturer of geo-technical anchors in the south east of Europe.

VALUES

- precision
- reliability
- innovativeness
- trust
- safety

O2 INOVATIVNI RAZVOJ SIDER

Lasten razvoj, nenehno iskanje novih inovativnih rešitev in uporaba napredne tehnologije so v podjetju Rafael vodili k vzpostavitvi lastne proizvodnje trajno prednapetih električno izoliranih geotehničnih sider (TPGS RAFAEL 10).

Uporaba tovrstnih sider je primarno namenjena varovanju nestabilnih pobočij ali podobnih konstrukcij v kamninah in zemljinah, saj so sidra Rafael eden glavnih nosilnih gradbenih elementov, ki zaradi uporabe pramen iz visoko vrednega jekla trajno prenašajo natezno silo s sidrane gradbene konstrukcije v tla. Trajna življenjska doba sidra pomeni, da je njegova uporabnost daljša od dveh let oziroma da je enaka življenjski dobi sidranega objekta.

S postopkom sidranja dosegamo stabilizacijo (oziroma izboljšanje deformacijskega stanja) pobočja ali drugih konstrukcij, brez večjih pomikov sidranega objekta. Sidra Rafael so primerna za uporabo pri varovanju:

- gradbenih jam,
- vkopov z upornimi zidovi,
- izkopov pri gradnji tunelov,
- sidranja upornikov premostitvenih objektov,
- sanacije plazov, usadov in brežin,
- hidrogradenj,
- železniških gradenj,
- drugih storitev.

Sidra Rafael se med seboj razlikujejo glede na način uporabe:

- **Osnovna ali konstrukcijska sidra** so del sidrane konstrukcije.
- **Preskusna ali testna sidra** so namenjena preiskavi sider do rušitve. Opremljena so z dodatnim pramenom in služijo ugotavljanju zunanje nosilnosti na območju testnega sidra - del sidranega objekta, ki služi končnemu verificiranju projektne rešitve sidranja.
- **Kontrolna sidra** omogočajo izvajanje dodatnih preskusov nosilnosti v katerem koli času.
- **Merilna sidra** so opremljena z napravo za merjenje sidrskih sil (merilna celica oz. dinamometer). Spremljava sidrskih sil je mogoča v vsakem trenutku, tudi na daljavo (npr. iz pisarne).





ADVANCED DEVELOPMENT OF ANCHORS

The proper development, constant search for new, innovative solutions and the involvement of the advanced technology, have led the Rafael Company to the establishment of its own production of permanent pre-stressed, electrically insulated geo-technical ground anchors (TPGS RAFAEL 10).

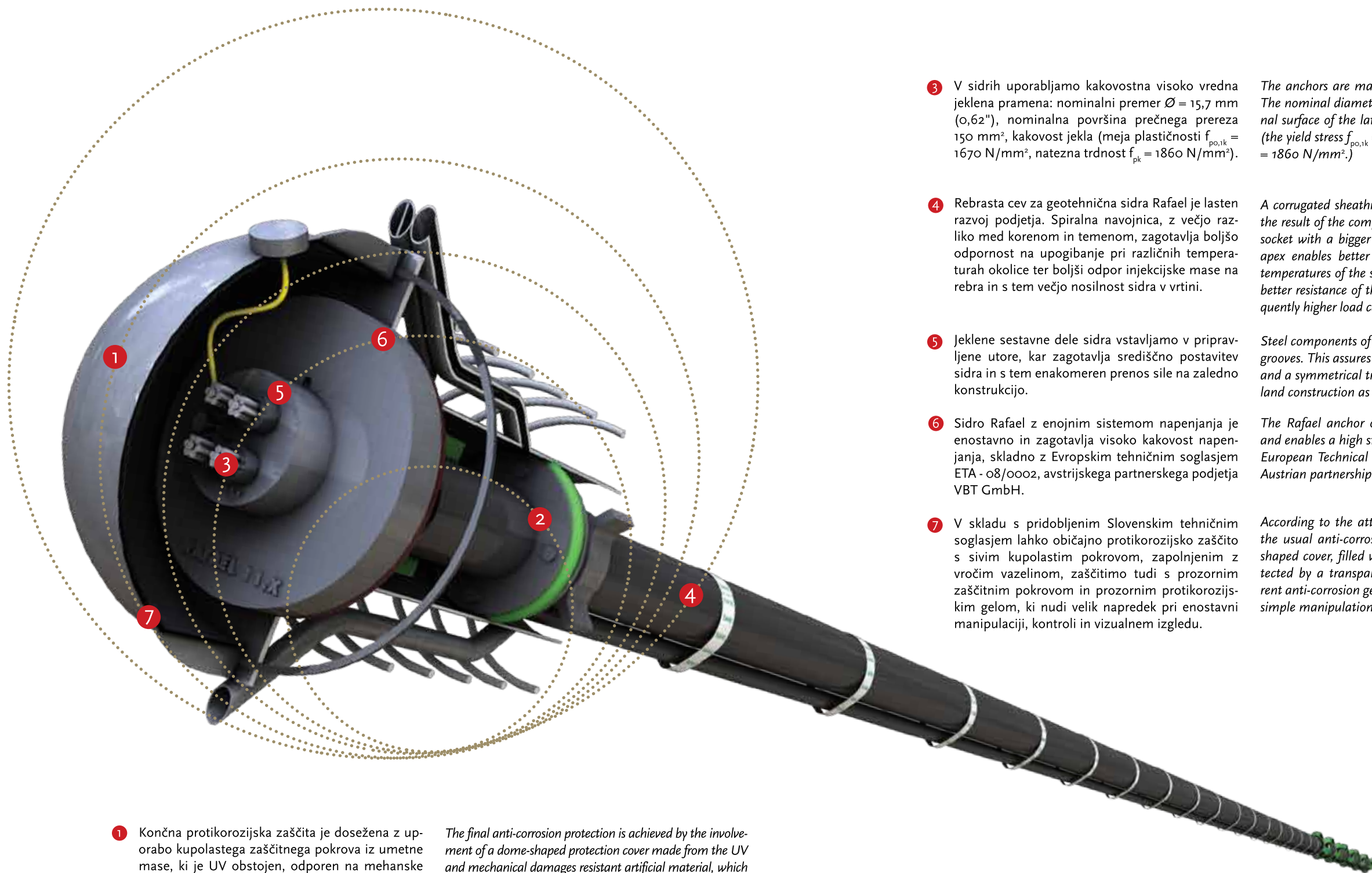
The involvement of these anchors is primarily designed for the protection of unstable inclines or similar constructions in aggregates and soil ground since the Rafael anchors are one of the vital supporting construction elements which due to high quality steel strands permanently withstand the stress of stretching from the ground-anchored construction. A permanent life expectancy of the anchor would mean that its usability overcomes two years and can match the life-expectancy of the anchored structure.

The process of anchoring enables high stabilisation (or the improvement of the state of deformation) of the incline or of other constructions without any necessary movements of the anchored structure. The Rafael anchors are suitable for the protection of:

- building pit,
- incision with support walls,
- excavations at tunnel constructions,
- anchoring of bridging structures supports,
- rehabilitation of avalanches, landslides, and embankments,
- hydro-constructions,
- railway constructions,
- other services.

The Rafael anchors differ from each other according to the way of their use:

- **Basic or construction anchors** are parts of an anchoring construction.
- **Testing anchors** are intended for testing purposes of anchors till pulling-down. They are equipped by an additional strand and are supposed to control the outside load capacity of the area of the testing anchor – a part of an anchored structure, which serves for the final verification of the anchor project solution.
- **Control anchors** enable the implementation of additional load capacity testing at any time.
- **Measuring anchors** are equipped by an anchor force measuring device (a measuring cell or dynamometer); the control over anchoring forces is able to be implemented at any time, even from a longer distance (i.e., from an office).



1 Končna protikorozijska zaščita je dosežena z uporabo kupolastega zaščitnega pokrova iz umetne mase, ki je UV obstojen, odporen na mehanske poškodbe ter nespremenljiv v območjih megle ob soljenih cestah in obmorskih vremenskih razmerah. Namestitev kupole je enostavna, saj ni potrebe po vrtnanju dodatnih lukenj za pritrdilna sredstva. Zaščitni pokrov je sive barve, ki se sklada z betonsko konstrukcijo.

The final anti-corrosion protection is achieved by the involvement of a dome-shaped protection cover made from the UV and mechanical damages resistant artificial material, which remains if exposed to fog, salt and coastline weather conditions. The placement of the dome is simple, no additional openings are required to be drilled for the means of fixing. The protection cover is of gray colour which matches well with the concrete construction.

2 Dvojno varnostno tesnjenje sidrne glave, z dodatnim drenažnim odtokom, ščiti glavo sidra pred pronicanjem zaledne vode. Tesnila so rezultat razvoja podjetja Rafael ter zagotavljajo visoko raven tesnjenja okroglih in elipsastih zaščitnih cevi sidra.

Double protection-sealing of the anchor head with an additional drain protects the anchor head from the penetration of hinterland water. The seals are the result of the Rafael Company development and enable a high-level sealing of circular and elliptical protection tubes of the anchor.

3 V sidrih uporabljamo kakovostna visoko vredna jeklena pramena: nominalni premer $\varnothing = 15,7$ mm (0,62"), nominalna površina prečnega prereza 150 mm², kakovost jekla (meja plastičnosti $f_{po,1k} = 1670$ N/mm², natezna trdnost $f_{pk} = 1860$ N/mm²).

The anchors are made from high quality steel strands: The nominal diameter $\varnothing = 15,7$ mm (0.62"), the nominal surface of the lateral section 150 mm², steel quality (the yield stress $f_{po,1k} = 1670$ N/mm²; tensile strength $F_{pk} = 1860$ N/mm².)

4 Rebrasta cev za geotehnična sidra Rafael je lasten razvoj podjetja. Spiralna navojnica, z večjo razliko med korenem in temenom, zagotavlja boljšo odpornost na upogibanje pri različnih temperaturah okolice ter boljši odpor injekcijske mase na rebra in s tem večjo nosilnost sidra v vrtini.

A corrugated sheathing involved in the Rafael anchor is the result of the company's proper development. A spiral socket with a bigger difference between the thread and apex enables better resistance to bending at different temperatures of the surrounding environment, as well as better resistance of the injection mass to ribs and consequently higher load capacity of the anchor in the hole.

5 Jeklene sestavne dele sidra vstavljamo v pripravljene ure, kar zagotavlja središčno postavitev sidra in s tem enakomeren prenos sile na zaledno konstrukcijo.

Steel components of the anchor are arranged into ready grooves. This assures the central setting-up of the anchor and a symmetrical transfer of the force on to the hinterland construction as a result.

6 Sidro Rafael z enojnim sistemom napenjanja je enostavno in zagotavlja visoko kakovost napenjanja, skladno z Evropskim tehničnim soglasjem ETA - 08/0002, avstrijskega partnerskega podjetja VBT GmbH.

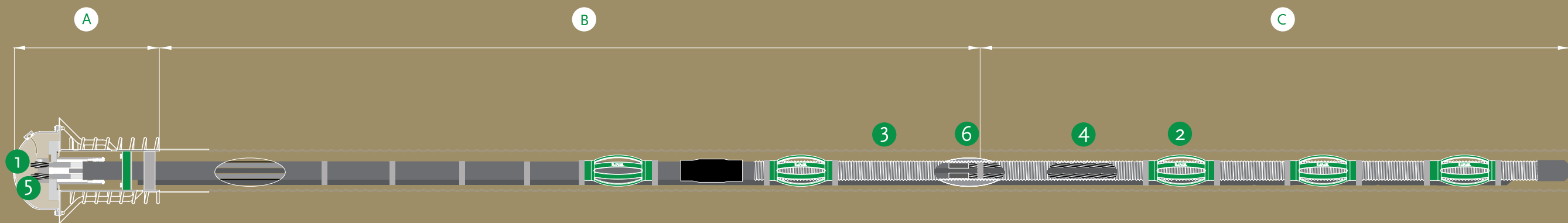
The Rafael anchor of a single-stress system is simple and enables a high stress quality in compliance with the European Technical Conformity ETA - 08/0002 of the Austrian partnership company VBT GmbH.

7 V skladu s pridobljenim Slovenskim tehničnim soglasjem lahko običajno protikorozijsko zaščito s sivim kupolastim pokrovom, zapolnjenim z vročim vazelinom, zaščitimo tudi s prozornim zaščitnim pokrovom in prozornim protikorozijskim gelom, ki nudi velik napredek pri enostavni manipulaciji, kontroli in vizualnem izgledu.

According to the attained Slovene Technical Approval, the usual anti-corrosion protection with a gray dome-shaped cover, filled with hot vaseline, may also be protected by a transparent protection cover and transparent anti-corrosion gel which means a huge progress at a simple manipulation, control and visual outlook.

Proizvodi podjetja Rafael so izdelani v skladu z veljavno regulativo Republike Slovenije – Zakon o gradbenih proizvodih. S svojo hitro odzivnostjo na želje in potrebe naročnikov zagotavljamo kratke dobavne roke sider, v primerih načrtovanja daljšega skladiščenja, pa, z namenom zaščite in preprečevanja oksidacije golih jeklenih pramen v veznem delu, notranjost sidra zaščitimo z inertnim plinom.

The Rafael products are manufactured according to the Regulative of the Republic of Slovenia – Construction Products Act. The company's prompt reaction to the customers' wishes and requirements assures quick delivery of the anchors. In case of a planned long-term storage, the inside of the anchor is protected by inert gas in order to prevent the oxidation of bare steel strands in the fixed anchor length.



- A** Sidrna glava - silo iz vezanega dela prenaša na konstrukcijo
Anchor head – transmits the force of the fixed anchor length to the structure
- B** Prosti del sidra - prenaša silo iz vezanega dela na sidrno glavo
Free anchor length - transmits the force of the fixed anchor length to the anchor head
- C** Vezni del sidra - natezno silo prenaša v zaledje
Fixed anchor length - tensile force is transmitted to the rear

Razpredelnica prikazuje primerjavo sidrer Rafael v odvisnosti od števila jeklenih pramen (obremenitve pramen so določene v skladu s sliko 12 standarda SIA 267/1).

The table shows the comparison between the Rafael anchors according to the number of steel strands (strand loadings are defined in compliance with the Figure 12 of SIA 267/1 standard).

Število pramen Number of strands	A_p [mm ²]	P_{pk} [kN]	$P_{p,max}$ [kN]	$P_{pv,max}$ [kN]	$P_{o,min}$ [kN]	$P_{o,max}$ [kN]	P_{min} [kN]	P_{max} [kN]
2	300	558	419	474	167	335	167	391
3	450	837	628	711	251	502	251	586
4	600	1116	837	949	335	670	335	781
5	750	1395	1046	1186	419	837	419	977
6	900	1674	1256	1423	502	1004	502	1172
7	1050	1953	1465	1660	586	1172	586	1367

- A_p površina prečnega prereza sidra / *ateral section surface*
- P_{pk} natezna trdnost pramena sidra / *tensile strength of an anchor strand*
- $P_{p,max}$ maksimalna preskusna sila pri preskusu naperjanja / *maximal testing force of test-stressing (0,75 Ppk)*
- $P_{pv,max}$ maksimalna preskusna sila pri preiskavi sidra / *maximal testing force of anchor-testing (0,85 Ppk)*
- $P_{o,min}$ minimalna sila zaklinjanja / *minimum force of wedging (0,30 Ppk)*
- $P_{o,max}$ maksimalna sila zaklinjanja / *maximum force of wedging (0,60 Ppk)*
- P_{min} minimalna sila tekom življenjske dobe sidra / *minimum force of an anchor in its life-expectancy (0,30 Ppk)*
- P_{max} maksimalna sila tekom življenjske dobe sidra / *maximum force of an anchor in its life-expectancy (0,70 Ppk)*



03 NAPREDNA PROIZVODNA ZNANJA

Napredne tehnologije in sodobni trendi trga geotehničnih sider zahtevajo nenehen razvoj, napredek in nove, inovativne ideje, ki našim strankam zagotavljajo celovite in kakovostne rešitve.

Proizvodnja sider Rafael poteka v lastnih prostorih, pod budnim očesom strokovne ekipe, z dolgoletnimi izkušnjami, in najnaprednejšo računalniško vodeno opremo za nameščanje jeklenih pramen.

Računalniško vodenje strojne opreme zagotavlja doseganje konstantne najvišje ravni kakovosti izdelkov in storitev, ki jih spremljamo in preverjamo z vzpostavljenim sistemom notranje kontrole, ki je pod stalnim nadzorom akreditiranega organa (ZAG Slovenija), ter skladno z določili certifikata 9001.

Željam in potrebam naših strank se posvečamo celovito in individualno, zato vsak izdelek proizvedemo po naročilu in ga do namestitve skladiščimo v varnostnih jeklenih kletkah, ki nam omogočajo najvišjo raven zaščite pred predhodnimi poškodbami.

Naše delo odlikujejo inovativni pristopi k reševanju gradbenih problemov, bogate izkušnje, strokovna znanja, napredni razvoj, visoka kakovost, zagotavljanje slovenskih in evropskih standardov ter dolgoročni partnerski odnosi.



Slovensko tehnično
soglasje STS-10/0038



Evropsko tehnično
soglasje ETA-08/0002



Slovenian technical
approval STS-10/0038



European technical
approval ETA-08/0002

INNOVATIVE PRODUCTION KNOWLEDGES

Advanced technologies and contemporary trends from the market of geo-technical anchors require a constant development, progress and new, innovative ideas which provide our customers with complex and quality solutions.

The production of the Rafael anchors is carried out in the venue of the company, under the surveillance of the professional team with long standing experiences, and with the most on-line computerised steel strands-setting equipment.

The computerised equipment assures a constant achievement of the top-quality of products and services that are followed and tested with the system of internal control under a permanent supervision of the accredited body (ZAG Slovenia), as well as in compliance with the 9001 certificate provisions.

Our customers are treated comprehensively and individually. For this reason, each product is produced by request and stored in protection steel cages until its setting-up, thus enabling as good protection from eventual damages as possible.

Our work is distinguished for its innovative approach to the sorting out the problems in the building trade, rich experiences, professional knowledge, advanced development and high quality, matching both the national and European standards, as well as long-lasting partnerships.





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ISO 9001
BUREAU VERITAS
Certification

ZAG IZOLACIJA

EOTA

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