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FRILO Insight.

The magazine for FRILO users

Interview with Prof. Dr.-Ing. Seeßelberg

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DC-Software

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HeidelbergCement

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Dear readers,

I would like to take you on a little journey back in time to the recent past. In November 2020, we successfully launched the FRILO BIM Connector with a special feature. You may remember: The BIM Connector was the first FRILO solution that could be licensed on a subscription basis for a monthly fee.

Around Easter, we have some interesting FRILO news. In future, you will also be able to purchase all programs from our portfolio in a subscription model. The response of the last few months has shown us that this popular model is accepted and demanded by our customers. We are convinced that we have created another attractive option for the purchase of our programs.

I would also like to inform you that FRILO acquired DC-Software at the beginning of April. With the acquisition of the foundation engineering specialist, you now have access to a broader solution portfolio for your daily tasks. Therefore, learn more about the acquisition and the subscription in the first issue of our new FRILO magazine.

I hope you enjoy reading it!

Your Markus Gallenberger
CEO

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A declaration of love for concrete

HeidelbergCement's new Group headquarters impress

HeidelbergCement is one of the world's largest manufacturers of building materials. With the construction of a new corporate headquarters, the DAX-listed company from Heidelberg has demonstrated that their remarkable range of concrete offers attractive building materials. The consulting engineers from Wulle Lichti Walz GmbH were responsible for the structural design in the planning team of the impressive building and provide insights into their work.

The wavy facade of the corporate headquarters at night. (©Thilo Ross)

For a long time, the employees of HeidelbergCement were spread across various office buildings in the Heidelberg city area. To put an end to this situation and bring the entire workforce together at a common hub, the Group built new, impressive corporate headquarters in the Neuenheim district of Heidelberg. The new state-of-the-art building, which was ready for occupation after three years of construction in June 2020 as planned, offers space for up to 1,000 employees. In the design and erection, however, HeidelbergCement not only placed importance on sufficient space for its workforce, but also on an innovative and energy-efficient building concept. The certification of the building according to the "Platinum" standard of the German Sustainable Building Council establishes evidence of the environmentally friendly and sustainable design.

The facade and the foyer form highlights

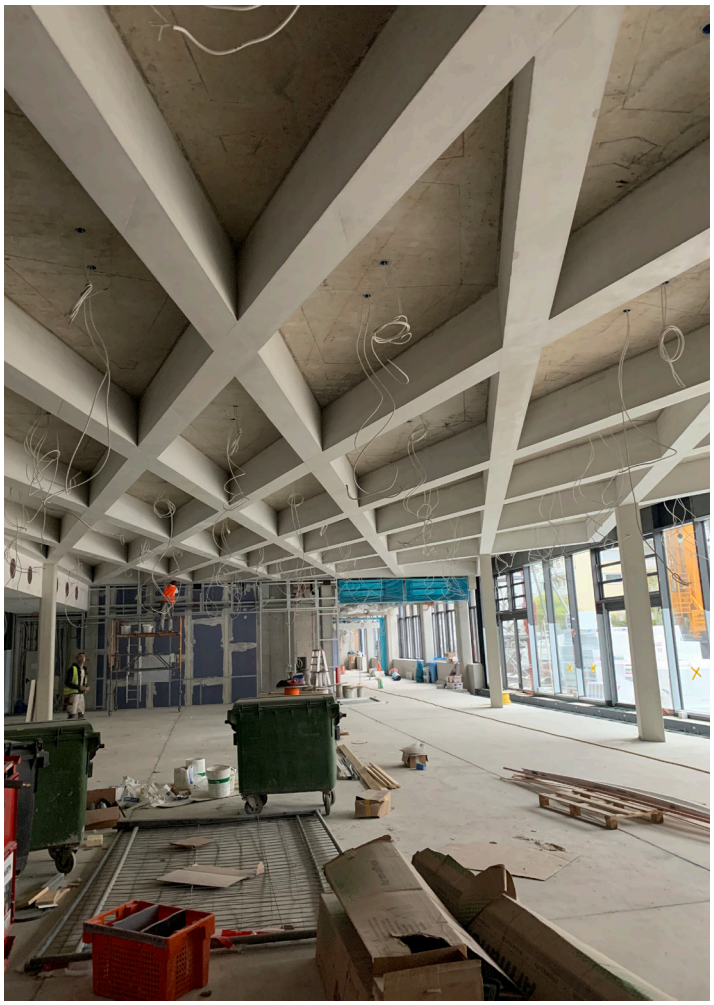
The complex covers a gross floor area of 51,975.60 m². It is composed of three cube-shaped building parts of different heights, which are interwoven and merge into one unit. The corporate headquarters with seven floors above ground and two underground floors is designed as a reinforced concrete skeleton structure with reinforced concrete circular columns and bracing wall cores. The integral structure, which only has joints at the two ends of the bridges on the 1st and 2nd floors, has a total of 182,418.20 m³ of enclosed space. In addition to the generously designed interior, separate, lavishly landscaped inner courtyards and the company's own canteen (the casino) contribute to a comfortable and communicative working environment. When selecting the materials, the DAX-listed company was particularly keen to showcase the versatile and aesthetic application possibilities of concrete as a building material. The guiding principle in the design and planning was that the new headquarters should reflect the company and its products. The first lasting impression is left by the wavy facade, which conveys an inviting transparency as a mixture of a lot of glass and white precast concrete elements.

This remarkable appearance is continued in the entrance area. The self-compacting fine concrete of the highest exposed concrete class SB 4, which was used there for the partially filigree and densely reinforced exposed concrete components (walls, columns, ceilings), radiates harmony, elegance and lightness. Architectural and static highlights are the three 11-metre-high tree supports made of reinforced concrete that stand in the room and transfer the load from the storeys above. The special construction, as slender as it is complex, owes its name to its outer shape, which resembles that of a tree.

Load transfer via the building model

In the framework of the building design, the consulting engineers from Wulle Lichti Walz GmbH were responsible for the structural supervision of the construction work. Based on a 3D model previously drawn in Allplan, they first determined the load transfer of the entire building with the help of the FRILO program Building Model GEO. "The GEO was a great help because it provides the user with a quick overview of the vertical load transfer, especially with complex building structures," says Dipl.-Ing. Oliver Lichti, who placed vertical supports in the building model that differed from the actual shape of the inclined tree supports in order to create a support point and simulate the transfer of the loads. "Once the information is in the GEO, changes can be made easily. With special connection solutions, the details can then be worked out," adds the structural engineer.

The floor stab above basement in the FRILO Building Model GEO. (©Wulle Lichti Walz)



The casino ceiling with lattice work of beams. (©Wulle Lichti Walz)

The head point of the tree support with connection reinforcement for the floor stab above the foyer. (©Wulle Lichti Walz)

Component design on the upper floor

After determining the load transfer, the building model was divided at the floor slab above the basement in order to process the two basement floors and the seven upper floors separately during the structural component design. The structural analysis of the slabs was performed after the transfer from the building model to the FRILO program Slabs by Finite Elements PLT. For the design of the reinforced concrete beams, the program Continuous Beam DLT was used. Especially for the calculation of the floor slab above the casino with its latticed configuration of downstand beams, which spans an area of 34.65 x 14 metres without supports, both programs were a great help. To form the sharp edges, sixty-four custom-made hollow sections with slightly conical edges were placed on the formwork, which could be removed downwards when stripping the formwork. The program Reinforced Concrete Column B5+ was used for the verification of uniaxially and biaxially loaded reinforced concrete columns and walls. For the spatial calculation of the tree supports, the responsible engineers used a framework program. All in all, the structural engineers created almost 3,600 reinforcement and 2,000 formwork drawings. "These are huge dimensions, which our office had never dealt with before, especially in view of the tight schedule," Lichti admitted.

System change in the basement

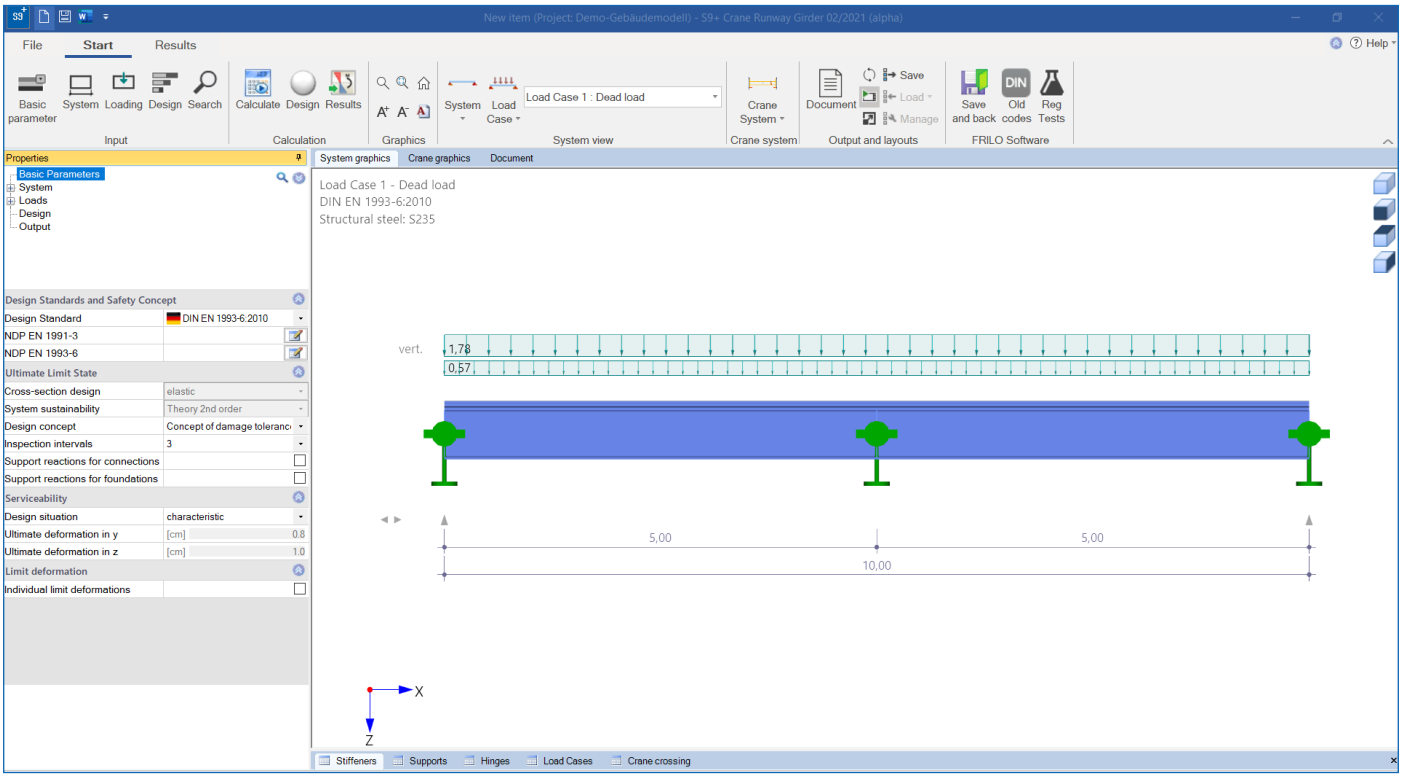
As typical for projects involving an underground car park, a system change was made for the slab above the basement. The slab that rests on the basement has a thickness of 50 to 100 cm and absorbs the loads of the upper floors via a beam grid. The beams are so densely reinforced that they could not be cast together with the slab. Four layers of diameter 32 were laid in the floor slab in the basement floors. Because of the roadway in the underground car park, neither beams nor columns could be provided in the basement in the area of the tree supports in the foyer. Consequently, a lying steel grate “Europilz®” of almost twenty-two tonnes and supplementary HALFEN shear reinforcement was installed in the floor slab above the basement underneath each of the three tree columns. For the tree columns on the ground floor, the self-compacting C50/60 concrete was pumped into the supports from below with the help of welded-in baffles and pressed upwards into the formwork eleven metres high. "In terms of concrete technology and structural stability, this procedure was a real challenge. It is unbelievable what actually can be done when dealing with concrete," enthused Lichti, who will always remember his decisive involvement in the new construction of the HeidelbergCement Group headquarters.

Author: Tim Kullmann

Three eleven-metre-high tree supports adorn the foyer. (©Thilo Ross)

„Replacing a crane runway is like open-heart surgery“

Numerous crane runways in the Federal Republic of Germany are getting on in years. At the same time, they are considered the lifeblood of many industrial enterprises. Against this background, crane runway expert Prof. Dr.-Ing. Christoph Seeßelberg from Munich University of Applied Sciences talks about today's safety standards with regard to fatigue, clever concepts for dealing with existing crane runways and the strategic decisions operators are facing.



The surface of the FRILO solution crane runway girder S9+, with which the verification can be carried out when building a new crane runway girder.

Good day, Mr Seeßelberg. Crane runway girders are simple structural systems. Nevertheless, they are considered special load-bearing structures in steel construction. What is the reason for this?

Seeßelberg: Although crane runway girders are actually just straight pieces of steel, they deserve special attention for five reasons. Because the crane moves across the girder; the loads are firstly dynamic and they constantly change their point of application. This leads to the problem of a load transfer without stiffeners, as every point on the beam is a potential load transfer point. Thirdly, we have to deal with extremely complex stability cases. Fourthly, serviceability plays an incredibly significant role. For about half of all newly built crane girders, the cross-section is determined by the deflection limit. And last but not least, special attention must be paid to the issue of fatigue where crane runway girders are concerned.

These special conditions are accompanied by challenges in the planning, construction, and maintenance of crane girders. In view of current trends and developments, what challenges are currently shaping your work?

Seeßelberg: In addition to participating in the development of the successor standards in the

field of crane runway Eurocodes, I am currently particularly concerned with the ageing industrial infrastructure in Germany. This includes crane runway girders, many of which were built between the 1950s and 1980s. Therefore, the targeted service life of a crane runway girder of 25 years has been exceeded in many places. Consequently, we have to think about clever concepts for the proper handling of existing crane runways. The topic of “Building in Existing Contexts” plays an overriding role here.

“Building in Existing Contexts” is a good keyword. The ability to create new quality from existing building fabric is sustainable and resource-efficient and can therefore be identified as a general future trend in the construction industry. What understanding of "Building in the Existing Context" underlies the handling of crane runway girders?

Seeßelberg: Even when crane runway girders are completely replaced, I still refer to this as “Building in Existing Contexts”, because the portal frame structure is often to be retained. Replacing a crane runway girder during ongoing production often resembles open-heart surgery and is much more complex than building a completely new crane hall "on a greenfield site". The decision between replacing or continuing to use a crane girder is of strategic nature.

What aspects influence this strategic decision?

Seeßelberg: Crane runway girders are very often the lifeblood of companies such as steelworks or foundries. If crane systems are out of operation due to a damage, this can produce economic losses in the millions. Operators must therefore weigh up two options with foresight and care when making their decision. Firstly, should a crane runway girder be replaced as a precaution because it is approaching the end of its service life, even though it still functions properly? Or secondly, should an existing construction continue to be used, even though the risk of fatigue damage increases with the time of use? It can suddenly occur and then force unexpected operational shutdowns. To make these strategic decisions, it must be possible to forecast as precisely as possible how long a crane runway girder can be used in the future and how likely failure will occur.

The age of crane runway girders is a decisive criterion in this assessment. What is the situation regarding the stability of existing crane runways that were planned and built before the introduction of the currently valid Eurocodes?

Seeßelberg: Basically, we have experienced three phases in crane runway standardisation since the 1930s. In the first phase, from 1936 to 1980, DIN 120 was used, which is now considered an unsafe old standard. Because the assumptions made at that time about material fatigue and the magnitude of the horizontal forces from crane operation were incorrect, we can no longer expect that installations designed in accordance with DIN 120 before 1980 have a sufficiently high level of stability. And this could affect an estimated share of 30 % of existing crane installations. In the second phase from 1981 to 2012, DIN 4132 was the relevant standard. The state of the art on which DIN 4132 was based essentially corresponds to what we still consider to be correct today. Crane systems that were designed according to DIN 4132 are therefore still considered stable today. In 2012, we entered the third phase with the introduction of the Eurocodes.

For about 30 % of the crane installations built before 1980, it may be unclear whether they meet today's stability standards. That is quite a lot. What specific problems can arise with old crane runways?

Seeßelberg: On the one hand, we are concerned with the problems in the ultimate limit state. It is about making the crane runway girders safe for the loads due to crane operation. Sometimes companies operate new or additional cranes with higher lifting loads on old crane runway girders. This can lead to overloading of the old crane runways. With intelligent concepts, crane runway girders can be strengthened and crane

bridges modified so that the stresses resulting from crane operation are reduced. And where reinforcement measures are not possible, the control of the crane system can possibly be adjusted so that the crane loads are sufficiently reduced - at the price of a slightly lower hoisting performance. Then, in some cases, crane bridges with somewhat higher lifting loads can also be operated on the old crane runways.

And the other hand?

Seeßelberg: On the other hand, dealing with fatigue is complex. In many cases, it is no longer possible to demonstrate sufficient fatigue safety for crane runways older than 25 years. A crane runway system may still appear to be completely intact on the outside, but the stress resistance of the construction has decreased over time. The challenge is to make it clear to the decision-makers in the companies, even to those who not experts in the field, that crane runways, even if they appear to be free of damage externally may nevertheless have reached the end of their life cycle due to preliminary fatigue damage. But even if fatigue safety can no longer be proven, there are still some strategies for continued use, such as closer inspections to detect damage at an early stage, repair it and thus avoid sudden failures at least.

About the person

Prof. Dr.-Ing. Christoph Seeßelberg has been Professor of Structural Engineering, Steel Construction and Crane Construction at Munich University of Applied Sciences since 2016. The author shares his expertise in the field of crane construction in the book " Kranbahnen - planen, konstruieren, berechnen, fertigen, inspizieren, ertüchtigen", which is already in its 6th edition.

How do these inspections work in practice?

Seeßelberg: Unfortunately, there are no regulations in the Eurocodes that govern the handling of old crane systems. This is where the engineers' common sense comes into play. Potentially critical areas are first visually inspected for damage. If damage can already be detected with the naked eye, more precise tools such as the dye penetrant method are used to detect cracks. All damage is repaired before the crane runway is allowed to go back into operation. Then a safe operating interval is determined using the methods of fracture mechanics and thus the next inspection time is set. Until then, the crane runway can continue to be used for the time being. The decision must always be made anew as to whether continued use is worthwhile despite repairs and associated downtimes to be expected, or whether it is more economical to rely on replacing the crane runways instead. In this respect, a lot of experience is needed to be able to give the decision-makers sound advice.

...and a corresponding software. To what extent does FRILO software support you in your advisory work?

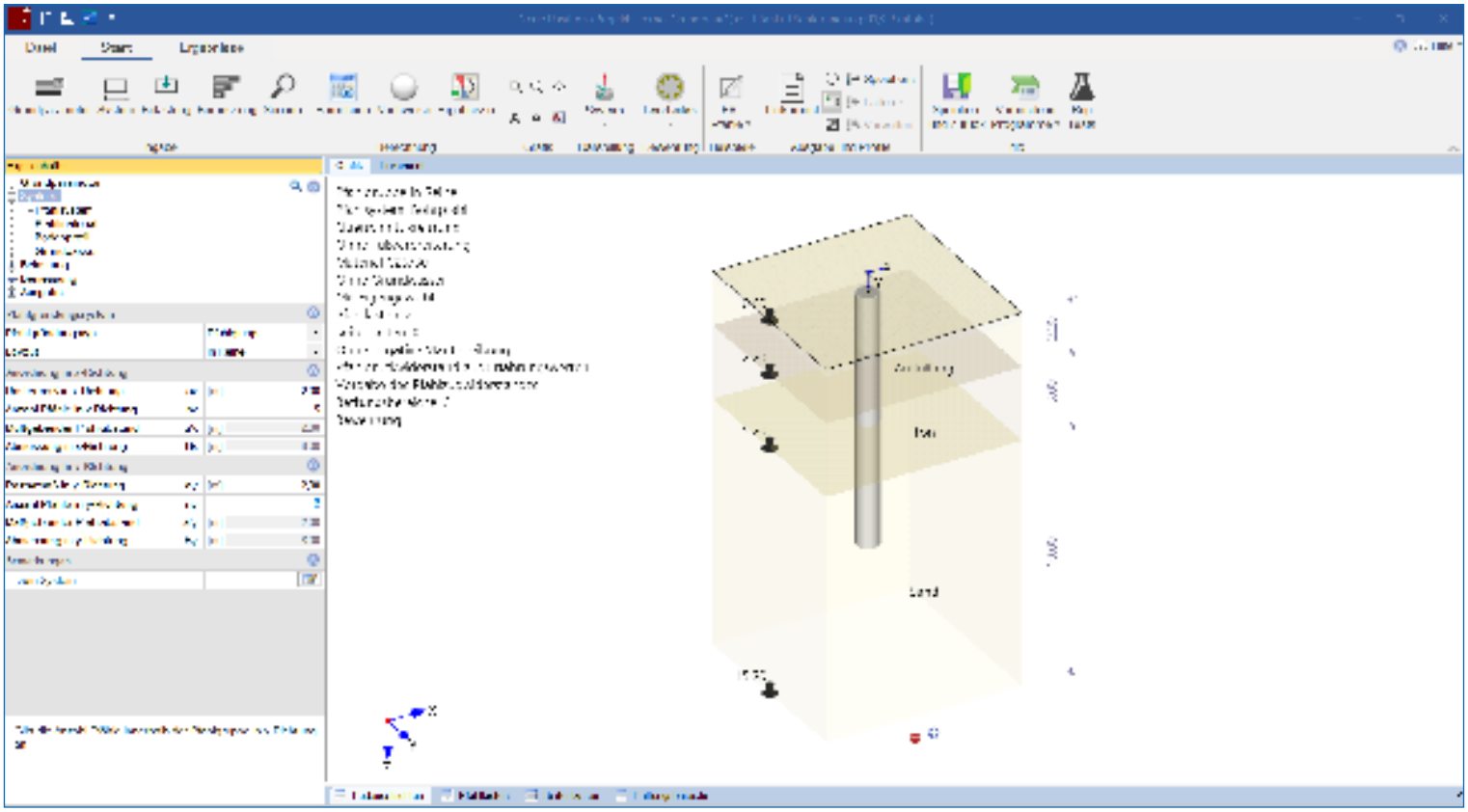
Seeßelberg: For 25 years I have been using the programme BTII+ for the calculation of crane runway girders in a second-order analysis. The results are of reference character for me. In contrast to the programme S9+ Crane Runway Girder, which can be used for the complete verification of a new crane runway girder, BTII+ is also suitable for the calculation of very complex cases. I like to use BTII+ to determine the remaining service life of an old crane runway because it allows me to calculate the fatigue-relevant stresses in the girders.

The interview was conducted by: Tim Kullmann

Verify the load-bearing capacity for pile foundations comprehensively and reliably

FRILO Pfahl+ provides the solution for structural challenges in foundations with piles

If soil or rock layers with insufficient load bearing capacity have to be bridged in the subsoil during construction work, pile foundations are used. To make sure that the piles provide a safe foundation for supporting structures complex requirements, such as the non-linear resistance-settlement curve, and special foundation-specific actions must be considered. The FRILO program Pfahl+ takes all these requirements relating to pile foundations into account.



The program Pfahl+ shows the pile foundation with the soil layers.

In a construction project, pile foundations are usually needed if the subsoil near the surface has insufficient load-bearing capacity. As a result, piles are drilled or driven into the subsoil to transfer loads from supporting structures to deeper, load-bearing soil or rock layers. Once a layer with a satisfactory load-bearing capacity has been reached at depth, special structural challenges have to be overcome in the dimensioning and verification of the piles used. The Pfahl+ program, newly developed by FRILO, provides for reliable verification of the internal and external load-bearing capacity of drilled piles with rectangular or circular cross-sections.

Negative skin friction and lateral earth pressure definable as actions

The friction that occurs between the soil and the pile is caused by relative deformations between the soil and the pile shaft. It is referred to as skin friction. If the soil around the pile shaft experiences greater settlement than the pile itself, this is referred to as negative skin friction. With reverse conditions, there is positive skin friction. Because the negative skin friction is to be considered as a permanent action according to the partial safety concept, it produces an additional stress component. By comparing the pile settlements to the soil settlements along the pile skin surface, an action from negative skin friction up to the neutral point can be optionally applied.

Soil displacements in soft cohesive soil also produce actions transverse to the pile axis. The lateral earth pressure to be applied is derived either from the flow pressure or from an earth pressure difference. In each case, the smaller one of the resulting total forces is decisive. Thanks to the direct connection to the proven FRILO programs Soil Settlement (SBR+) and Earth Pressure Calculation (EDB+), both the soil settlements in the pile surroundings (and thus the negative skin friction) and the lateral earth pressure acting on the piles can be automatically taken into account.

Verification of vertical load transfer via skin friction and end-bearing pressure

The verification of the external load-bearing capacity of the pile in the vertical direction is performed for pile foundations considering the positive skin friction and the end-bearing pressure of the piles. Positive skin friction is the friction that occurs between the subsoil and the pile along the surface of the pile when pressure is applied from above. The remaining compressive forces act on the toe of the pile. The axial pile resistances, which can be mapped via non-linear resistance-settlement curves and which result from skin friction and end-bearing pressure, can optionally be derived by evaluating static or dynamic pile test loads separately for the serviceability limit state (SLS) and the ultimate limit state (ULS). Alternatively, a derivation of the resistance-settlement curve based on empirical values given by the recommendations of the pile work group “Arbeitskreis Pfähle” is possible. For a resulting tensile load in the pile, the axial pile resistances from skin friction are verified analogously. For tension piles, the verification of the safety against uplift (UPL) is optionally performed with the help of an attached soil prism.

Verification of the horizontal load transfer via the subgrade reaction

The subgrade reaction modulus method is used to check the external pile load-bearing capacity in the horizontal direction. For this purpose, subgrade reaction regions can either be derived from the soil stratification or be defined by the user. The resulting horizontal stresses must not exceed the maximum earth resistance stress at any point. If necessary, the subgrade reaction regions must be adjusted after the first calculation in order to redistribute the horizontal stresses to greater depths if the limit condition is exceeded.

Design calculation

In order to verify the internal load-bearing capacity, the reinforced concrete cross-sections are designed on the basis of a non-linear calculation. In this calculation, the second-order additional loads and the actual pile stiffnesses due to freely selectable reinforcement are taken into account. As a result, the required bending and shear reinforcement quantities are output.

Authors: Manuel Walter/Tim Kullmann

FRILO acquires 100% of the shares in DC-Software

Significantly expands its portfolio in foundation engineering through strategic acquisition

FRILO Software GmbH has successfully completed the acquisition of the software company DC-Software Doster & Christmann GmbH as of 01.04.2022. The Munich-based company has been developing special software solutions for foundation engineering since 1989. With the acquisition, FRILO is strategically expanding its product portfolio in the foundation engineering segment and thus strengthening its position as a leading provider of structural design programs.

With more than 30 programs, DC Software covers a comprehensive range of digital foundation engineering solutions. The software company's portfolio is divided into two subsegments of foundation engineering. Users use the powerful programs of the DC-Soil segment for subsoil exploration, soil and contaminated site investigations and the display of geothermal boreholes and geothermal probes. The DC-Foundation program group, on the other hand, comprises sophisticated software solutions for geotechnical calculations, foundation engineering as well as groundwater drawdown and infiltration.

Since its foundation in 1989, DC-Software has developed into a sustainably growing and profitable company. With the takeover of the company, which is established on the DACH market, FRILO is expanding its portfolio in the foundation engineering segment in a trend-setting way. “We are extremely pleased to have gained many years of expertise in software development in the specialist field of foundation engineering for our customers with DC-Software," says Markus Gallenberger, CEO of FRILO. "Due to the addition of our foundation engineering solutions, our customers benefit from an enormous portfolio of solutions that FRILO provides for their day-to-day business. A consistently growing and beneficial product portfolio always makes the difference for our customers.”

“We attach great importance to ensuring continuity for customers and employees with the takeover. I am convinced that FRILO and the Nemetschek Group provide the appropriate conditions for this,” says Dr.-Ing. Armin Doster, co-founder of DC-Software. “We expect this step to enable us to profitably utilise the strong synergies between the two companies and to benefit from new impulses.”

Author: FRILO

Subscription model on the rise

How to benefit from the new pricing model at FRILO

More and more software manufacturers are moving to subscription-based licensing. FRILO has also decided to offer its products not only for sale but also for subscription in the future. This is because subscriptions can be a win-win situation for both the buyer and the vendor. We point out the particular benefits for licensees of a software.

Streaming services like Spotify and Netflix have long since overtaken CDs and DVDs. Subscription models for cars are gaining in popularity because acquiring a new car has never been easier. Some studies even see subscription as the major guarantor for the future success of the automotive industry. Obvious developments like these make it clear: the spirit of times has changed. Where once the ownership of physical goods was paramount, the need to use borrowed products is spreading more and more. In the software industry, too, it is noticeable that subscriptions are slowly gaining ground. Instead of buying a product, software users are increasingly making use of services. But why has the demand for such subscription models actually increased? To what extent do the licensees benefit? We have compiled the most striking advantages:

Low start-up costs

The initial investment is significantly lower with the subscription model compared to the perpetual license. Thus, initial obstacles to implementing a new software are overcome and the financial risk of the acquisition is reduced.

Increased flexibility

The possibility to cancel the subscription annually provides users with unrivalled flexibility. They can flexibly react on changes in their requirements. In addition, they can quickly change the provider if a more lucrative offer appears on the market.

Increased customer satisfaction

More flexibility has the positive effect that software providers must place greater emphasis on customer satisfaction. Only satisfied customers are willing to renew a subscription. Those who succeed in providing very good (technical) customer support build sustainable and strong relationships.

Shorter innovation cycles

Due to these changes in the relationship of customer and vendor users benefit in addition from the increased pressure to innovate manufacturers are subjected to. Only solutions that are up-to-date and tailored to the needs of users can hold their own in the market. Empty promises and a lack of substancefail to take effect.

The perpetual license at FRILO

For all solutions offered by Frilo, perpetual licenses can be bought. Customers who hold a perpetual license have unlimited access to the product. In addition, there is the option of concluding a maintenance contract, the so-called Software Service Agreement (SSA). This maintenance contract includes free technical customer support, continuous software maintenance and access to the latest version of all licensed programs (including standard adaptations). For the term of the maintenance contract, a monthly fee that depends on the number of licensed programs is charged.

The subscription at FRILO

Since this year, FRILO solutions are also available on a subscription basis. With the FRILO Basic Suite, you can purchase the complete FRILO portfolio for a price of 499€ per month. In the event that the all-round carefree package exceeds your needs, FRILO also offers a range of application-oriented packages. All subscriptions can be cancelled after a minimum term of 12 months. For the duration of the subscription, you will have access to all solutions included in your selected package. All the benefits you know from the SSA are included in the subscription. If you opt for a minimum term of 36 months when ordering, you will receive an attractive discount of up to 20 % on your monthly fee.

Autor: Tim Kullmann

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