PLAXIS 3D 2011

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PREFACE

PLAXIS 2D is a two-dimensional finite element program, developed for the analysis of deformation, stability and groundwater flow in geotechnical engineering.

It is part of the PLAXIS product range, a suite of finite element programs that is used worldwide for geotechnical engineering and design.

The development of PLAXIS began in 1987 at Delft University of Technology as an initiative of the Dutch Ministry of Public Works and Water Management (Rijkswaterstaat). The initial purpose was to develop an easy-to-use 2D finite element code for the analysis of river embankments on the soft soils of the lowlands of Holland. In subsequent years, PLAXIS was extended to cover most other areas of geotechnical engineering. Because of continuously growing activities, the PLAXIS company (Plaxis bv) was formed in 1993.

In 1998, the first PLAXIS 2D for Windows was released. In the meantime a calculation kernel for 3D finite element calculations was developed which resulted in the release of the 3DTunnel program in 2001. 3DFoundation was the second three-dimensional PLAXIS program, and was developed in cooperation with TNO. The 3DFoundation program was released in 2004. However, in neither 3DTunnel nor 3DFoundation it is possible to define arbitrary 3D geometries, because of their geometrical limitations. PLAXIS 3D is a full three-dimensional PLAXIS program which combines an easy-to-use interface with full 3D modelling facilities. The PLAXIS 3D program was released in 2010.

Goals and objectives: PLAXIS is intended to provide a tool for practical analysis to be used by geotechnical engineers who are not necessarily numerical specialists. Quite often practising engineers consider non-linear finite element computations cumbersome and time-consuming. The PLAXIS research and development team has addressed this issue by designing robust and theoretically sound computational procedures, which are encapsulated in a logical and easy-to-use shell. As a result, many geotechnical engineers world-wide have adopted the product and are using it for engineering purposes.

Plaxis Development Community: Research and development of the PLAXIS software is supported by the Plaxis Development Community (PDC), in which a consortium of more than 30 international companies participate. The consortium contributes financially to the PLAXIS developments and checks the efficiency and quality of the resulting software products. The consortium provides a valuable link with engineering practice. Future developments are discussed within the consortium and feedback is provided after new releases.

Memberships: The PLAXIS company and its employe contribute to the development of civil and geotechnical engineering throughout the world. The PLAXIS company is member of NAFEMS, a non-profit organization with the goal to simulate the use of the finite element method in various types of engineering.

Scientific network: The development of the PLAXIS products would not be possible without world-wide research at universities and research institutes. To ensure that the high technical standard of PLAXIS is maintained and that new technology is adopted, the development team is in contact with a large network of researchers in the field of geo-mechanics and numerical methods.

Direct support is obtained from a series of research centres:

Delft University of Technology, Civil Engineering (NL)	Prof. Frans Molenkamp, Prof. Michael Hicks, Prof. Frits van Tol, Prof. Bert Sluys
Delft University of Technology, Mathematics & Informatics (NL)	Prof. Kees Vuik, Dr. Wim Bronsvoort
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The editors

OVERVIEW OF THE FULL MANUAL

General information

IMPORTANT WARNING AND DISCLAIMER

PLAXIS is a finite element program for geotechnical applications in which soil models are used to simulate the soil behaviour. The PLAXIS code and its soil models have been developed with great care. Although a lot of testing and validation have been performed, it cannot be guaranteed that the PLAXIS code is free of errors. Moreover, the simulation of geotechnical problems by means of the finite element method implicitly involves some inevitable numerical and modelling errors. The accuracy at which reality is approximated depends highly on the expertise of the user regarding the modelling of the problem, the understanding of the soil models and their limitations, the selection of model parameters, and the ability to judge the reliability of the computational results. Hence, PLAXIS may only be used by professionals that possess the aforementioned expertise. The user must be aware of his/her responsibility when he/she uses the computational results for geotechnical design purposes. The PLAXIS organization cannot be held responsible or liable for design errors that are based on the output of PLAXIS calculations.

PLAXIS PRODUCTS AND SERVICES

Update versions and new releases of PLAXIS, containing various new features, are released frequently. In addition, courses and user meetings are organised on a regular basis. Registered users receive detailed information about new developments and other activities. Valuable user information is provided by means of the Plaxis bulletin and the website www.plaxis.com.

PLAXIS 2D: A large range of geotechnical problems may be analysed using this high capacity version. It is possible to use extensive 2D finite element meshes. The PLAXIS 2D is supplied as an extended package, including static elastoplastic deformation, advanced soil models, stability analysis, consolidation, safety analysis, updated mesh and steady-state groundwater flow.

Dynamics: Dynamics is an add-on module to PLAXIS 2D. This module may be used to analyse vibrations in the soil and their influence on nearby structures. Excess pore pressures can be analysed. Liquefaction, however, is not included in this version, but some liquefaction models as UBC-Sand model are available as user-defined soil models on special request.

PlaxFlow: PlaxFlow is an add-on module to PLAXIS 2D. This module may be used for the analysis of fully coupled flow deformation analysis, steady-state and transient groundwater flow. The module incorporates sophisticated models for saturated / unsaturated groundwater flow, using the well-known "Van Genuchten" relations between pore pressure, saturation and permeability. It provides state-of-the-art facilities to incorporate time-dependent boundary conditions. The Barcelona Basic model for unsaturated soil behaviour is available as a user-defined soil model on special request.

PLAXIS 3D: PLAXIS 3D is a geotechnical finite element program with a full 3D pre-processor that allows CAD objects to be imported and further processed within a geotechnical context. The program is supplied as an extended package, including static elastoplastic deformation, advanced soil models, stability analysis, consolidation and safety analysis.

3DFoundation: This program is designed for the analysis of excavations, raft foundations, piled raft foundations and offshore foundations. Large 3D finite element meshes can be generated. 3DFoundation is supplied as an extended package, including static elastoplastic deformation, advanced soil models, consolidation and safety analysis.

3DTunnel: This program is designed for the analysis of tunnel projects, but it also enables the analysis of a large range of other geotechnical problems. Large 3D finite element meshes can be generated. 3DTunnel is supplied as an extended package, including static elastoplastic deformation, advanced soil models, stability analysis, consolidation, safety analysis, updated mesh and steady-state groundwater flow.

PLAXIS VIP: PLAXIS VIP is an additional subscription system on top of the traditional perpetual licenses. PLAXIS VIP members benefit from the latest releases of their PLAXIS software and support from Plaxis technical experts. In addition, some features of PLAXIS programs are only available for PLAXIS VIP members. An overview of these features and more information about PLAXIS VIP are available at the internet site www.plaxis.com.

PLAXIS Demo CD: An introductory version of PLAXIS software is available for interested persons who wish to learn about the program features and capabilities before

ordering the software. The PLAXIS Demo CD is based on PLAXIS software but there is a limited number of material sets and calculation phases. In addition, it is not possible to copy or print. A Tutorial Manual with examples specifically generated for the PLAXIS Demo CD is included.

PLAXIS Courses: Courses dealing with both theoretical and practical aspects of computer modelling in geotechnical engineering are given on a regular basis in several countries, with support from the scientific network. In these courses, application exercises and case studies are included during which participants have the opportunity to carry out various types of computer analyses. Although PLAXIS is intensively used, the courses are not primarily intended to teach the details of the computer programs. The main aim of these courses is to teach finite element modelling in geotechnical engineering, with direct applications to practical problems.

PLAXIS Bulletin: An international bulletin, issued twice a year, is provided to all registered PLAXIS users. This bulletin contains descriptions of practical projects in which PLAXIS has been used, backgrounds on the use of advanced soil models, information on new developments, hints for optimised usage of the program and a diary of activities. Ideas and experiences with the PLAXIS programs are highly appreciated.

Website: The Plaxis website www.plaxis.com is the main source of information about the latest news, events, products and services. Besides this information on the site includes a support section and E-Plaxis, an extensive library with a collection of bulletins, publications, models and much more. Via the website it is also possible to purchase product and register for events. Visit the site on a regular basis to stay in contact with Plaxis.

User support: Priority technical support is provided by e-mail for members of PLAXIS VIP. A professional helpdesk is available for clients who wish to obtain prompt and extensive technical and scientific support.

PLAXIS Expert Services: PLAXIS Expert Services are professional services exclusively meant for users of PLAXIS software. The purpose of this service is to help our clients on any FE modelling related issue such that they can be assisted in their simulation work and improve their own modelling capabilities. PLAXIS Expert Services provides high-level technical assistance with advanced finite element modelling issues, fit-for-purpose training courses which can be customized to your specific requirements, and personal mentoring with on-call simulation expertise.

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SHORT REVIEW OF FEATURES

PLAXIS is a finite element package intended for the two-dimensional or three-dimensional analysis of deformation, stability and groundwater flow in geotechnical engineering. Geotechnical applications require advanced constitutive models for the simulation of the non-linear, time-dependent and anisotropic behaviour of soils and/or rock. In addition, since soil is a multi-phase material, special procedures are required to deal with hydrostatic and non-hydrostatic pore pressures in the soil. Although the modelling of the soil itself is an important issue, many geotechnical projects involve the modelling of structures and the interaction between the structures and the soil. PLAXIS is equipped with features to deal with various aspects of complex geotechnical structures. A brief summary of the important features of all PLAXIS programs is given below.

Graphical input of geometry models: The input of soil data, structures, construction stages, loads and boundary conditions is based on convenient CAD drawing procedures, which allows for a detailed modelling of the geometry. From this geometry model, a finite element mesh is easily generated.

Boreholes: Soil layers are defined by means of boreholes. Multiple boreholes can be placed in the geometry to define a non-horizontal soil stratigraphy or an inclined ground surface. PLAXIS automatically interpolates layer and ground surface positions in between the boreholes. Alternatively, a TIN surface can be assigned to a borehole to characterize the ground surface.

Automatic mesh generation: PLAXIS allows for automatic generation of unstructured finite element meshes with options for global and local mesh refinement.

High-order elements: Quadratic 6-node and 4^{th} order 15-node triangular elements are available in PLAXIS 2D to model the deformations and stresses in the soil. Quadratic tetrahedral 10-node elements are available in PLAXIS 3D.

Interfaces: Joint elements are available to model soil-structure interaction. For example, these elements may be used to simulate the thin zone of intensely shearing material at the contact between a tunnel lining and the surrounding soil. Values of interface friction angle and adhesion are generally not the same as the friction angle and cohesion of the surrounding soil.

Plates: These special features can be used to model thin two-dimensional structures in the ground with a significant flexural rigidity (bending stiffness).

Beams: Beam elements can be used to model slender one-dimensional objects with a significant flexural rigidity. The stiffness of these elements is defined using linear elastic material orthotropy.

Anchors: Elastoplastic spring elements are used to model anchors and struts. The behaviour of these elements is defined using a normal stiffness and a maximum force. A special option exists for the analyses of prestressed ground anchors and excavation supports.

Geogrids: Geogrids (or geotextiles) are often used in practice for the construction of reinforced embankments or soil retaining structures. These elements can be simulated in PLAXIS by the use of special tension elements. It is often convenient to combine these elements with interfaces to model the interaction with the surrounding soil. The behaviour of these elements is defined using a normal stiffness and a maximum tension force.

Embedded piles: These special elements consist of beam elements with embedded interface elements to describe the interaction of the pile with the soil at the skin and the foot of the pile. The beam element is considered to be linear elastic and its behaviour is defined using elastic stiffness properties. The embedded interface elements are considered to be elasto-plastic. The failure behaviour of the embedded pile elements is defined by their bearing capacity.

Tunnels: The PLAXIS program offers a convenient option to create circular and non-circular tunnels using arcs and lines. Plates and interfaces may be used to model the tunnel lining and the interaction with the surrounding soil. Fully isoparametric elements are used to model the curved boundaries within the mesh. Various methods have been implemented to analyse the deformations that occur as a result of various methods of tunnel construction.

Loads: The program allows for various types of loads (point loads, line loads and distributed loads) that could be applied in the model. Different loads and load levels can be activated independently in each construction stage.

Mohr-Coulomb model: This robust and simple non-linear model is based on soil parameters that are known in most practical situations. Not all non-linear features of soil behaviour are included in this model, however. The Mohr-Coulomb model may be used to compute realistic bearing capacities and collapse loads of footings, as well as other applications in which the failure behaviour of the soil plays a dominant role. It may also be used to calculate a safety factor using a 'phi-c reduction' approach.

Advanced soil models: As a general second-order model, an elastoplastic type of hyperbolic model is available, which is called the Hardening Soil model. This model allows for plastic compaction (cap hardening) as well as plastic shearing due to deviatoric loading (shear hardening). To account for the increased stiffness of soils at small strains, the Hardening Soil model with small-strain stiffness is available. To analyse accurately the time-dependent and logarithmic compression behaviour of normally consolidated soft soils, a Creep model is available, which is referred to as the Soft Soil Creep model. More detailed information on these models can be found in the Material Models Manual.

User-defined soil models: A special feature in this PLAXIS program is the user-defined soil models option. This feature enables users to include self-programmed soil models in the calculations. This option is primarily of interest for researchers and scientists at universities and research institutes, but it may also be useful for practising engineers. An overview of existing user-defined soil models is available on the PLAXIS website.

Soil tests: The soil test option in PLAXIS is a convenient procedure to check the behaviour of the selected soil material model with the given material parameters. After entering the model parameters, the user can quickly simulate several standard soil tests and compare the results against the results from actual laboratory tests.

Orthotropic structural behaviour: Structural behaviour may be defined as linear elastic material orthotropy. This applies to beams, plates, geogrids. Geometric orthotropy of plates with a particular profile can also be emulated to a certain extend.

Steady state pore pressure: Complex pore pressure distributions may be generated on the basis of a combination of phreatic levels or direct input of water pressures. In PLAXIS 2D a steady-state groundwater flow calculation can be performed as an alternative to calculate the pore pressure distribution in problems that involve steady flow or seepage. Transient flow and fully coupled flow-deformation analysis are available in

PlaxFlow module.

Excess pore pressures: PLAXIS distinguishes between drained and undrained soils to model permeable sands as well as almost impermeable clays. Excess pore pressures are computed during plastic calculations when undrained soil layers are subjected to loads. Undrained loading situations are often decisive for the stability of geotechnical structures.

Automatic load stepping: The PLAXIS program runs in an automatic step size and automatic time step selection mode. This avoids the need for users to select suitable load increments for non-linear calculations and it guarantees an efficient and robust calculation process.

Arc-length control: This feature enables accurate computations of collapse loads and failure mechanisms to be carried out. In conventional load-controlled calculations the iterative procedure breaks down as soon as the load is increased beyond the peak load. With arc-length control, however, the applied load is scaled down to capture the peak load and any residual loads.

Staged construction: This powerful PLAXIS feature enables a realistic simulation of construction and excavation processes by activating and deactivating clusters of elements, application of loads, changing of water pressure distributions, etc. This procedure allows for a realistic assessment of stresses and displacements as caused, for example, by soil excavation during an underground construction project.

Consolidation analysis: The decay of excess pore pressures with time can be computed using a consolidation analysis. A consolidation analysis requires the input of permeability coefficients in the various soil layers. Geometry boundaries can be set open or closed for consolidation. Automatic time stepping procedures make the analysis robust and easy-to-use.

Safety analysis: The factor of safety is usually defined as the ratio of the failure load to the working load. This definition may be suitable for foundation structures, but not for sheet-pile walls or embankments. For this latter type of structure it is more appropriate to use the soil mechanics definition of a safety factor, which is the ratio of the available shear strength to the minimum shear strength needed for equilibrium. PLAXIS can be used to compute this factor of safety using a 'phi-c reduction' procedure.

Parameter variation and sensitivity analysis: After creation of a 'Master project' upper and lower bound values of model parameters and water levels may be defined and evaluated using a parameter variation analysis. A sensitivity analysis may be performed to evaluate the influence of individual parameters.

Updated Lagrangian analysis: Using this option, the finite element mesh is continuously updated during the calculation. For some situations, a conventional small strain analysis may show a significant change of geometry. In these situations it is advisable to perform a more accurate Updated Lagrangian calculation, which is called *Updated Mesh* in PLAXIS.

Preview option: A convenient preview option is available to check model and calculation settings in a graphical 2D or 3D environment. Since calculations can be quite time consuming, it is important to check the model carefully before starting the calculation process.

Presentation of results: The PLAXIS postprocessor has enhanced graphical features for displaying computational results. Exact values of displacements, stresses, strains and

structural forces can be obtained from the output tables. Plots and tables can be sent to output devices or to the Windows® clipboard to export them to other software.

Stress paths: A special tool is available for drawing load-displacement curves, stress paths and stress-strain diagrams. Particularly the visualization of stress paths provides a valuable insight into local soil behaviour and enables a detailed analysis of the results of a PLAXIS calculation.

NEW FEATURES IN PLAXIS 2D 2011

The PLAXIS 2D 2011 includes several new features compared to the previous Version 9. Some of these new features are described briefly below:

Pack project: Version 2011 of the PLAXIS 2D program offers the new *Pack project* feature that enables compression of the projects. The feature offers the option of automatically selecting the required information to be send to the PLAXIS support team.

CAD import: The import facility has been extended with the option to import CAD-based geometries composed of points and straight lines (with AcdbLine property) from external sources in different formats like AutoCAD native (*.DWG) and interchange (*.DXF) file formats. The *Import* facility is a PLAXIS VIP feature.

Undrained behaviour: Undrained behaviour and undrained strength are difficult issues to model. The various ways to model this in PLAXIS have been made more explicit using the options *Undrained (A)*, *Undrained (B)* and *Undrained (C)*:

Undrained (A)	Uses an effective stress approach with an additional bulk stiffness for the pore water, whereas soil stiffness and strength are modelled with effective parameters.
Undrained (B)	Also uses an effective stress approach, but the strength is modelled as an undrained shear strength.
Undrained (C)	Uses a total stress approach in which all parameters are defined undrained.

Material database: The new version of the program offers the possibility of exchanging material parameters between the databases in PLAXIS 2D and PLAXIS 3D.

Constitutive models: New models have been added for the modelling of rock behaviour (Hoek-Brown model) and the anisotropic undrained strength of clay-type materials (NGI-ADP model). User-defined soil models for special purposes are available on request, such as the Hypoplastic model (void ratio dependency of properties), UBCSAND model (cyclic loading and liquefaction), Barcelona Basic model (unsaturated soil behaviour), and other models. For more details see www.plaxis.com > E-PLAXIS > Models. The Hoek-Brown model, the NGI-ADP model and the User-defined soil models are PLAXIS VIP features.

Calculation modes: As a consequence of the implementation of fully coupled flow-deformation, a distinction has been made between three different calculation modes. The first one is the *Classical* mode, which uses Terzaghi's definition of stress and is very similar to the old PLAXIS 2D versions. The second one is the *Advanced* mode, which uses Bishop's definition of stress instead of Terzaghi's stress and is suitable for calculating unsaturated response of soils and for performing fully coupled hydro-mechanical behaviour of soils. The last one is the *Flow* mode, in which pure groundwater flow calculations under saturated and unsaturated conditions can be performed. The *Advanced* mode and the *Flow* mode are available in the PlaxFlow module.

Calculation options: To improve consistency, the *K0 procedure* has been included as a calculation option. For the initial phase a choice can be made between *K0 procedure* and *Gravity loading*. For a consolidation analysis a new option is available: Consolidation until a prescribed degree-of-consolidation.

Flow and coupled analysis: The PlaxFlow features have been fully integrated in the new PLAXIS 2D version. Steady-state flow and transient flow have been integrated in the PLAXIS calculation kernel, and are even more versatile then previous versions. In the *Advanced* calculation mode, PLAXIS allows for fully coupled flow-deformation analysis, taking into account unsaturated soil behaviour and suction above the phreatic surface.

Dynamics module: The Dynamics module has been extended with independent horizontal and vertical acceleration components for earthquake loading. Moreover, the module allows for free vibration analysis to analyse eigen frequencies of soil-structure systems. The post-processor allows for amplification analysis and pseudo-spectral acceleration response spectra.

Output: The new 2D Output program is based on the 3D version. Apart from a major increase in performance when dealing with plots and tables, the *Curves* facility is fully integrated and the *Report generator* and *Animations* facilities have been renewed. New output features have been added: *Forces view* (to visualize stresses and forces on an arbitrary composition of elements), moving cross sections, cross section curves, value indication, and many more.

NEW FEATURES IN PLAXIS 3D 2011

Modelling options:

Polycurves — Available in the *Structures* mode of the Input program. It enables creating polycurves composed of line and arc segments (Section 5.2.3 of the Reference Manual).

Contraction — Available in the *Structures* mode of the Input program. It enables 'shrinking' a surface or simulating a volume loss around a tunnel lining (Section 5.4.4 of the Reference Manual).

Hydraulic condition — Available in the *Structures* mode of the Input program. It enables creating wells, drains line or surface and surface ground water flow boundary conditions (Section 5.6 of the Reference Manual).

Flow boundary conditions — Available in the *Water levels* and *Staged construction* modes of the Input program. This feature enables assigning either open or closed flow conditions at the model boundaries (Section 3.7.4 of the Reference Manual).

Material database: The new version of the program offers the possibility of defining anisotropic behaviour for geogrids (Section 6.5 of the Reference Manual).

Calculation facilities:

Pore pressure calculation — Available in the *General* tabsheet of the *Phases* window. It enables selecting how the pore pressures are generated in the current phase (Section 7.4 of the Reference Manual).

Solver — Available in the *Parameters* tabsheet of the *Phases* window. It enables selecting the solver that assembles and solves the sparse linear equation systems (Section 7.6.2 of the Reference

Manual).

Output features: The *Measurement line* feature is further improved to give more detailed information on deformation.

HARDWARE SPECIFICATIONS

System requirements: The program runs on Pentium PC's using Windows® XP Professional 32-bit, Windows® Vista Business 32-bit and 64-bit and Windows® 7 Professional 32-bit and 64- bit. Windows® 7 Professional 64- bit is recommended. Version 1.3 or higher of OpenGL should be installed.

USB port: To insert the dongle a USB port is required.

Graphics card: The program requires a graphics card with at least 64 MB RAM. The graphics card should support OpenGL Version 1.3 (or higher).

Processor: For PLAXIS 2D a Pentium IV processor or better is recommended. For PLAXIS 3D a dual-core processor is recommended.

Hard disk: To install the package, at least 500 MB of hard disk space must be available for the 2D application itself and at least 750 MB must be available for the 3D application.

In addition, a minimum workspace of 500 MB is recommended, but for large projects more disk space may be required. PLAXIS 3D also requires a minimum amount of free hard disk space of 10 GB of the disk containing the TEMP-folder.

Random Access Memory (RAM): The minimum recommended amount of free RAM in the computer is 2 GB. When more memory is used, a faster operation can be performed or more elements can be used. For PLAXIS 3D an amount greater than 4GB of free RAM is recommended.

Video modes: Both PLAXIS 2D and PLAXIS 3D program require a minimum screen resolution of 1024 x 768 pixels and a 32 bit colour palette. However, it is highly recommended to have a screen resolution of at least 1280 pixels in horizontal direction and 900 pixels in vertical direction.

Mouse: A graphical pointing device (mouse) with two or three buttons is required.

Output devices: Graphical and tabulated output can be printed on all modern types of laser or inkjet printers (including colour printers). Printing is fully controlled by the Windows® operating system. For more information on the installation of output devices reference should be made to the respective manuals.

PC network: A single version may be installed on a PC network. However, single versions can only be run on one workstation at a time using a local dongle. A multiple licence network version is available upon request.

INSTALLATION

The package is installed by using an easy-to-use installation program. The program acts like a wizard and guides the user through the installation settings.

At the end of the installation procedure, a new program group is automatically created in the *Programs / Plaxis* submenu of the *Start* menu. The installation of the program does not affect other PLAXIS products. Installation under the various Windows ® versions as mentioned in the system requirements is similar. Make sure that you have the *Administrator* rights to be able to update the Windows registry and to write all files.

Program installation

- Insert the PLAXIS installation USB stick into the computer.
- Select *Open folder* to view files, or open the drive assigned to this USB device.
- Select the "AUTORUN.EXE" application.
- A screen appears, which will guide you through the rest of the installation process.
- When asked for user name and registration code please refer to the sticker on the back of this booklet. The registration data is spacing and case sensitive.
- With the CodeMeter dongle attached to the computer, the PLAXIS software is now ready for use.

Local dongle installation

PLAXIS continuously checks for the presence of the dongle that is included in the package. The dongle must be inserted in a USB port of the computer. Normally a device driver for the dongle is installed during the setup. The document "CodeMeterInstallation.pdf" that can be found on the PLAXIS installation USB stick of the program describes the procedure to follow.

Network dongle installation

Alternatively it is possible to use a shared multiple license dongle over the network. The document "CodeMeterInstallation.pdf" that can be found on the PLAXIS installation USB stick of the program describes the procedure to follow.

Program uninstall and install

Should you wish to uninstall or reinstall PLAXIS you can either use the Windows' *Add/Remove* programs utility from the *Control Panel* or re-run the installation from the PLAXIS Connect.

TROUBLESHOOTING

In exceptional cases the installation program fails to install the PLAXIS package. Some possible error messages during the execution of the program are:

- The program starts with a message and then closes immediately
- Problems with OpenGL

Additionally the following problems may occur:

- Mesh generation fails or calculation hangs directly after starting
- Codemeter problems with IP protocol

The appropriate actions to be taken on the problems are described below:

Program start with a message and then closes immediately

Make sure that the dongle is inserted in a USB port of the computer. In addition, make sure that the latest drivers are installed. These can be found on the PLAXIS website: www.plaxis.com in the *Downloads* section. Download the drivers for the right system type (32-bit or 64-bit Operating System).

Problems with OpenGL

In case of problems with OpenGL make sure that the latest drivers for the graphics card have been installed. In addition, the settings of the graphics card can be changed via the windows dialog *Display Properties*, tabsheet *Settings*, button *Advanced*. This way the quality of the display can also be increased.

Codemeter problem with IP protocol

As Codemeter dongles require IP protocol and firewalls may prevent this, the firewall should explicitly allow the Codemeter dongles over the IP port. To allow this, one can allow both TCP and UDP protocol for port 22350.

A more detailed description is given in the document "CodeMeterInstallation.pdf" that can be found on the PLAXIS installation CD of the program.