

BI Dry 3.0 – A COMSOL® App for Simulating Concrete Drying



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- Setting Up a Model
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- Underlying COMSOL Model
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Introduction

Background and benefits of the software

Concrete Drying

- Moisture enhances concrete curing, but fast drying and low relative humidity (RH) are essential for flooring to prevent deterioration of flooring adhesive
- Drying is slow and can delay construction, resulting in premature floor installation and costly testing, disputes, or repairs
- Factors like temperature, wind, rain, construction type, and dimensions affect drying rates

Simulating Concrete Drying

- An effective way to predict concrete drying is through finite element-based simulations
- Setting up a finite element model requires expertise, but the process is simplified with a compiled COMSOL® app
 - Any contractor can leverage the power of COMSOL Multiphysics®
- By using simulations, contractors can choose the optimal concrete mix, minimizing **environmental impact** and **reduce costs**

Reductions & Savings



CO₂ Emission Reductions

- Decrease the amount of binder
- Use lower-grade concrete where applicable
- Incorporate binder combinations with slag, fly ash and other additions
- Select an optimal design



Cost Savings

- Accelerate construction timelines
- Prevent costly failures

Background



Longstanding Expertise

For decades, Heidelberg Materials has offered customers finite element-based software solutions



Launch of HETT²² in 2022 [1]

A COMSOL Multiphysics[®]-based tool, HETT²² was developed to simulate early-age temperature and strength development



Development of BI Dry 3.0

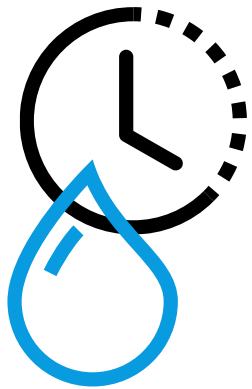
Following the success of HETT²², Heidelberg Materials chose the same platform to support BI Dry 3.0, a software focused on simulating concrete drying

Differences between HETT²² and BI Dry



Timescale

While HETT²² and BI Dry share similarities, concrete drying in BI Dry spans months or years, unlike the shorter timescale of hours or days required for early-age strength development in HETT²².



Modeling

Both HETT²² and BI Dry utilize the Maturity Method and the heat transfer equation. Additionally, BI Dry solves a convection-diffusion equation for moisture content, which is coupled with heat transfer.

Joint Efforts



Collaborative Development of HETT²²

Created through a partnership between Deflexional AB, a COMSOL Certified Consultant, and Heidelberg Materials



BI Dry 3.0 Development Team

Deflexional worked closely with concrete drying experts from Lund University and Heidelberg Materials



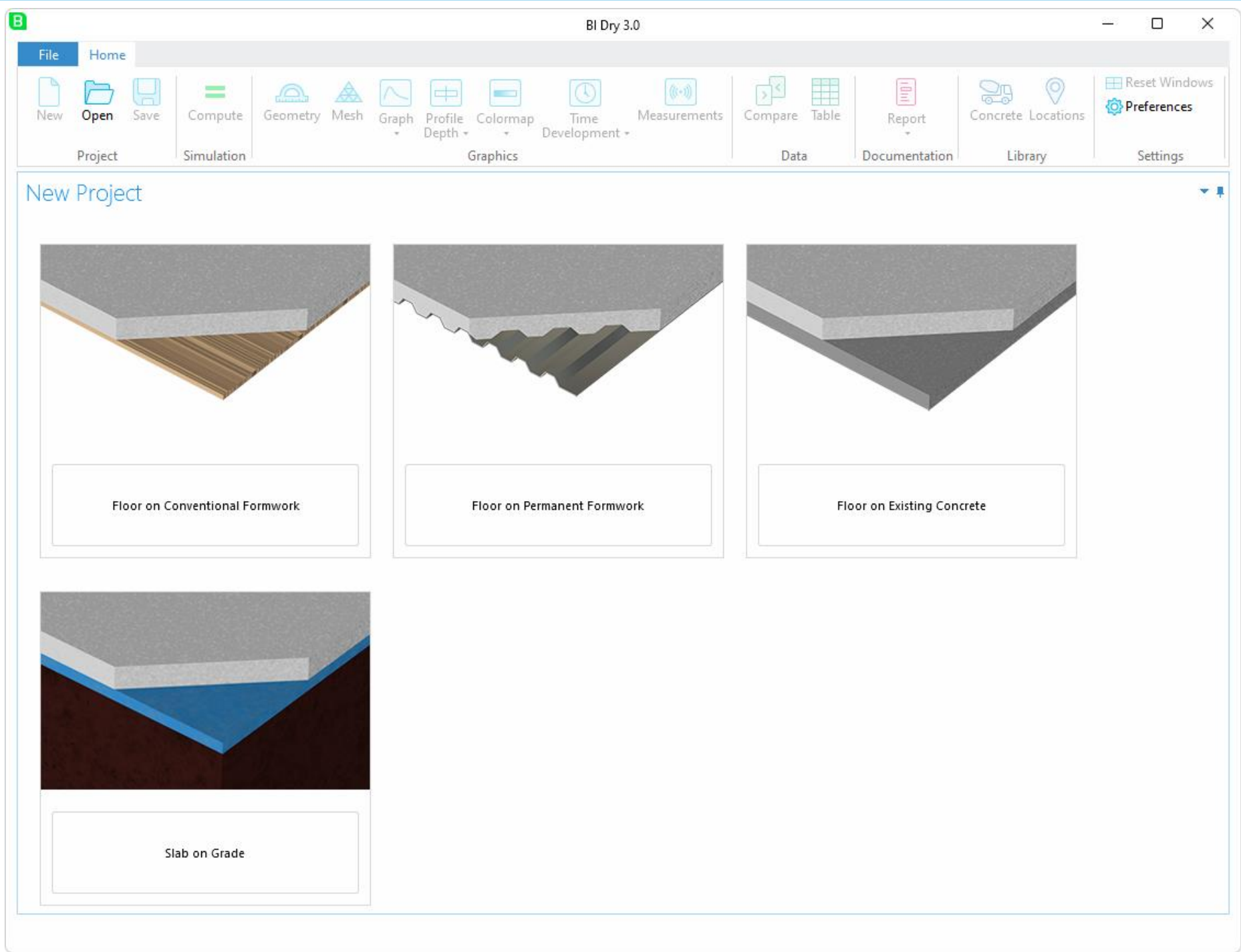
LUNDS
UNIVERSITET

Project Success

The achievements of this project underscore the essential contributions and collaboration from all involved parties

Graphical User Interface

An intuitive interface enables contractors to perform advanced simulations with ease



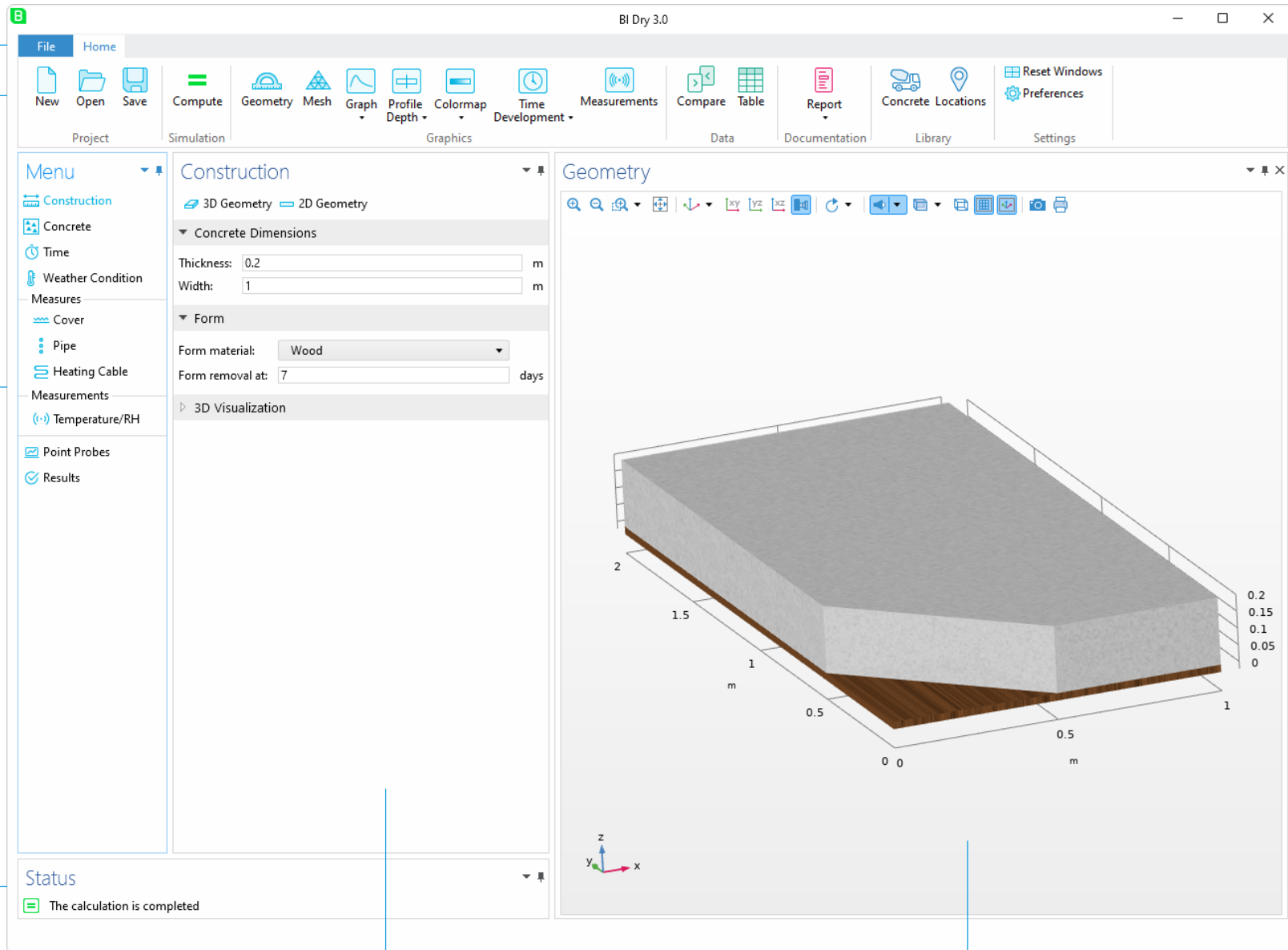
Select construction scenario to start a new project

File Menu

Ribbon

Menu

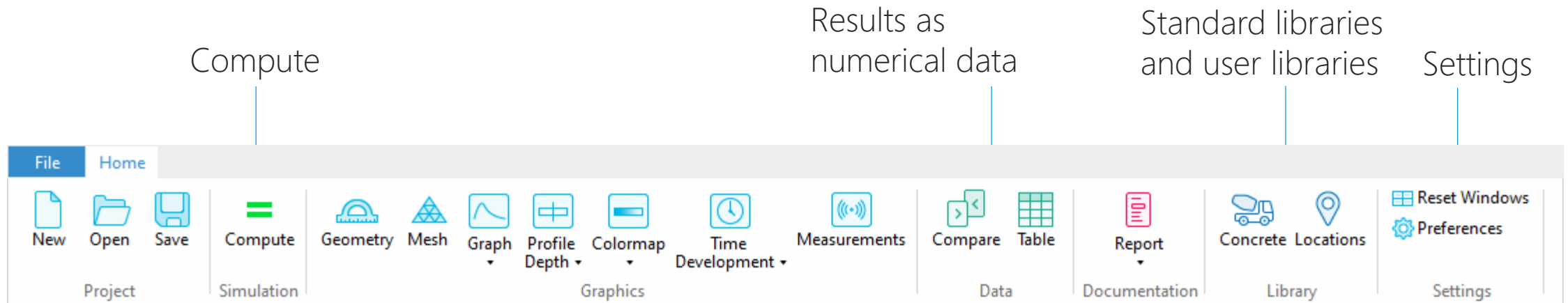
Status



Settings

Graphics

Ribbon

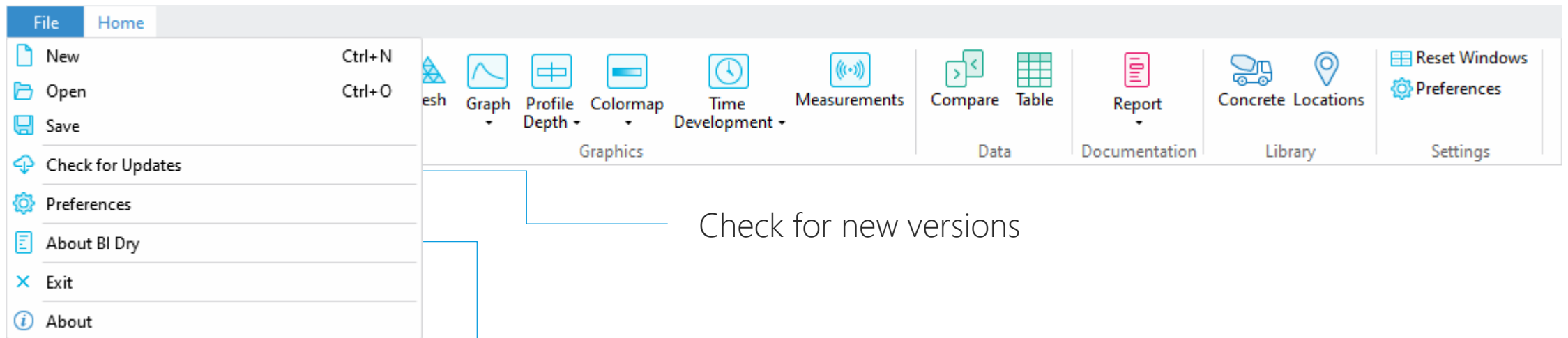


Create a new project, open, and save

Visualize geometry, mesh, graphs, 2D plots, and 3D plots

Microsoft® Word® and Microsoft® PowerPoint® reports

File Menu



Check for new versions

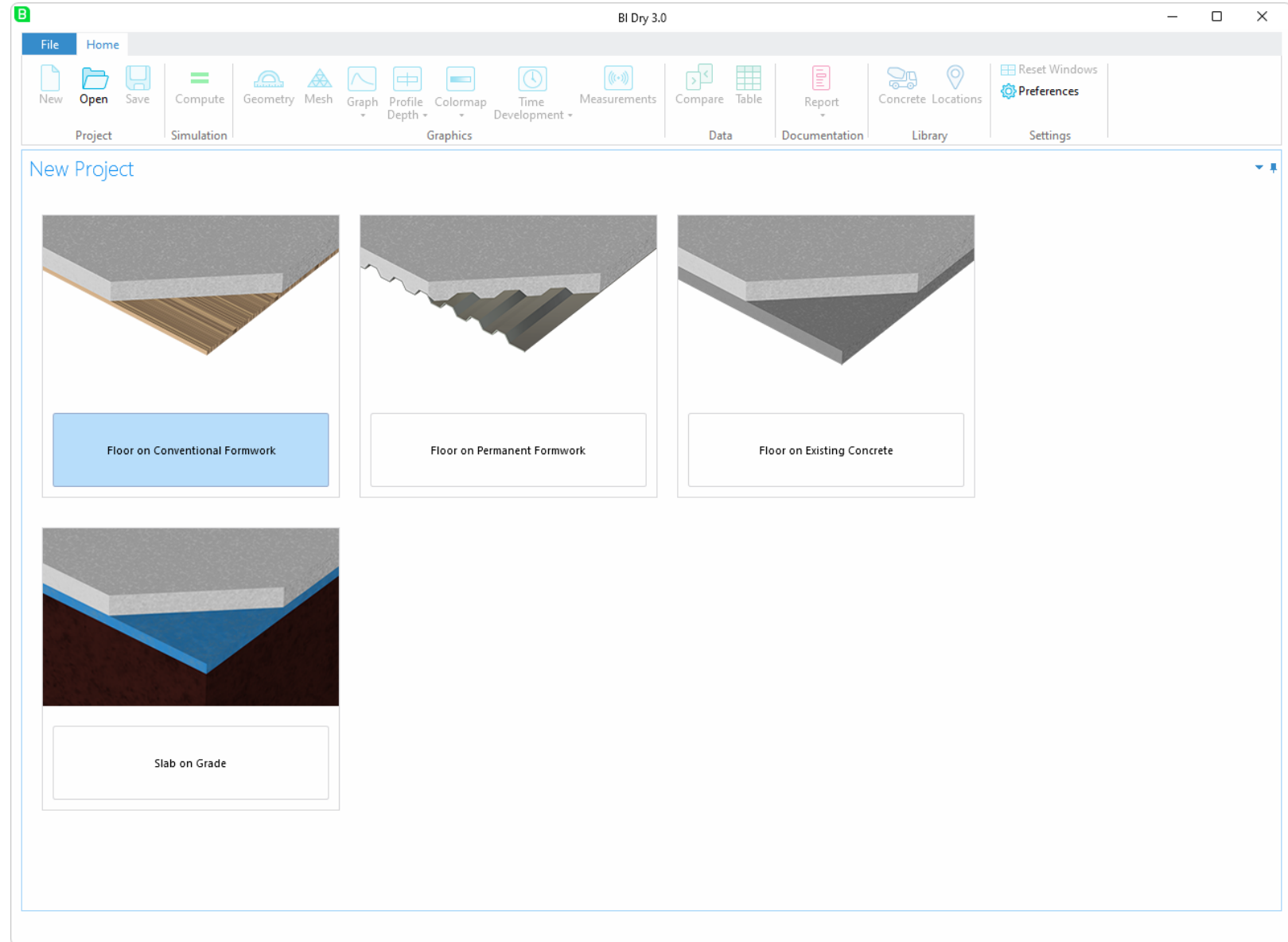
License information

Setting Up a Model

Follow the left menu step-by-step from start to finish

New Project

- Select the construction scenario



Menu

Construction

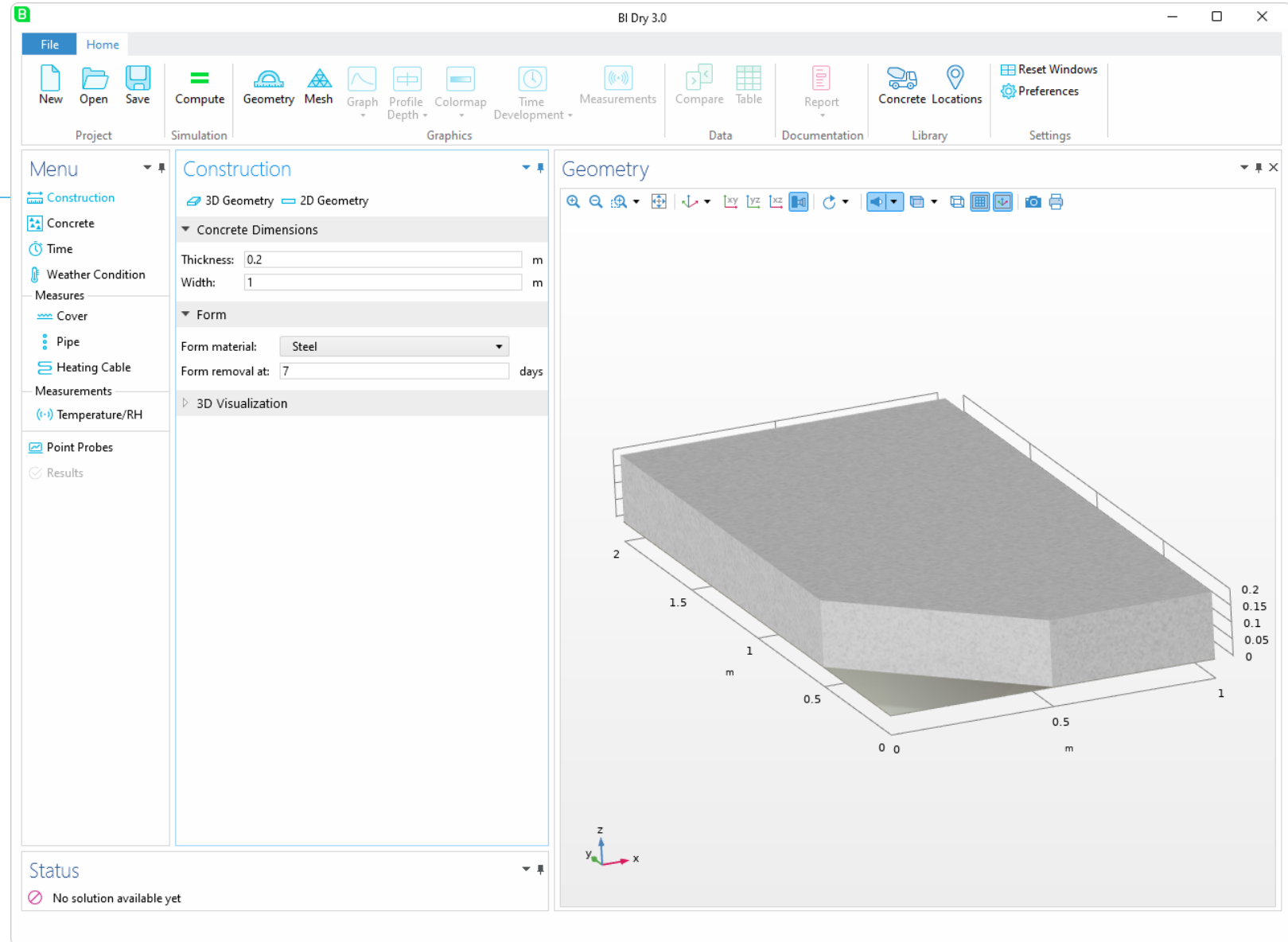
- Change dimensions and materials

The screenshot displays the BI Dry 3.0 software interface. The top menu bar includes File, Home, and various tool icons. The left sidebar shows a 'Menu' with options like Construction, Concrete, Time, Weather Condition, Measures, Cover, Pipe, Heating Cable, Measurements, Temperature/RH, Point Probes, and Results. The main workspace is divided into three panels: 'Construction', 'Geometry', and 'Status'. The 'Construction' panel is active, showing '3D Geometry' and '2D Geometry' tabs. Under 'Concrete Dimensions', 'Thickness' is set to 0.2 m and 'Width' is 1 m. Under 'Form', 'Form material' is 'Wood', 'Form removal at' is 'Wood' (with 'Plywood' also listed), and '3D Visualization' is 'Steel'. The 'Geometry' panel shows a 3D model of a concrete slab with dimensions 1.5 m by 1 m by 0.2 m. The 'Status' panel at the bottom indicates 'No solution available yet'.

Menu

Construction

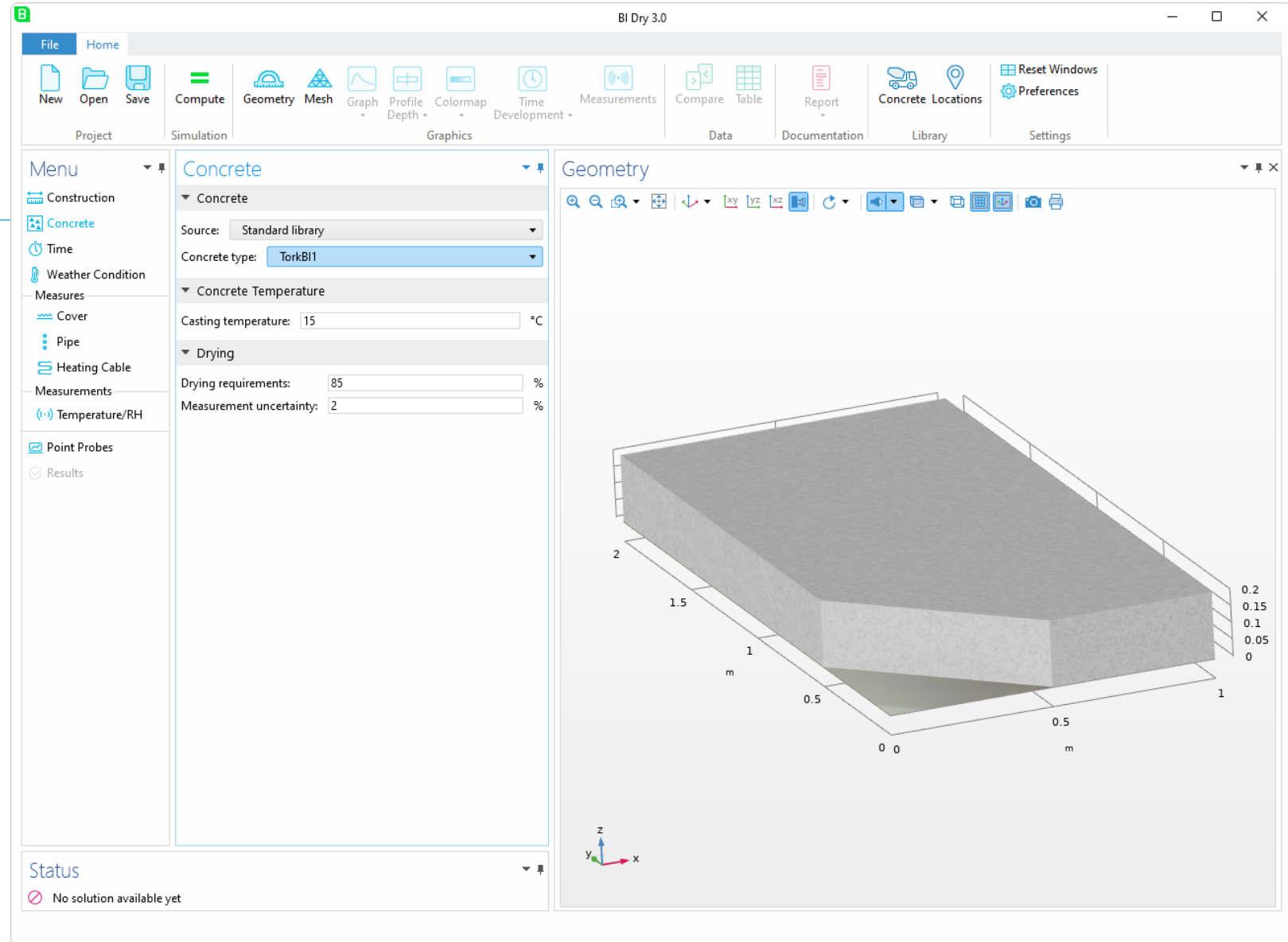
- Visualization in 3D of the construction and the materials



Menu

Concrete

- Set the concrete type and the casting temperature
- Define drying requirements



Menu

Time

- Set dates for the different events
- The time between the casting and the simulation time after flooring will be the total simulation time

The screenshot displays the BI Dry 3.0 software interface. The top ribbon includes tabs for File, Home, and various tool categories: Project (New, Open, Save), Simulation (Compute), Geometry (Geometry, Mesh, Graph, Profile Depth, Colormap), Graphics (Time Development), Measurements, Data (Compare, Table), Documentation (Report), Library (Concrete, Locations), and Settings (Reset Windows, Preferences).

The left sidebar shows a 'Menu' tree with categories: Construction, Concrete, Time (selected), Weather Condition, Measures (Cover, Pipe, Heating Cable), Measurements (Temperature/RH), Point Probes, and Results.

The main 'Time' panel is expanded to show the following settings:

- Casting:** Year: 2024, Month: October, Day: 15, Hour: 17:00. Includes a 'Get the current time' button.
- Weatherproof:** Set date automatically. Time between casting and weatherproof: 60 days. Year: 2024, Month: December, Day: 14.
- Controlled Climate:** Occurs simultaneously on top and bottom. Set date automatically. Time between weatherproof and controlled climate: 30 days. Year: 2025, Month: January, Day: 13.
- Flooring:** Set date automatically. Time between controlled climate and flooring: 245 days. Year: 2025, Month: September, Day: 15. Simulation time after flooring: 30 days.

The 'Advanced Settings' section is partially visible at the bottom of the Time panel.

The right pane shows a 3D model of a concrete slab with dimensions: length 1.5m, width 1m, and height 0.2m. The z-axis is vertical, and the x and y axes are horizontal. A status bar at the bottom left indicates 'No solution available yet'.

Menu

Weather Condition

- Temperature, wind, and RH comes from the ASHRAE 2021 database
- Precipitation days per month must be set manually for locations outside of Sweden
- For Sweden, precipitation data is sourced from SMHI

The screenshot displays the BI Dry 3.0 software interface. The top ribbon includes tabs for File, Home, Project, Simulation, Graphics, Data, Documentation, Library, and Settings. The left sidebar shows a 'Menu' with options like Construction, Concrete, Time, Weather Condition, Measures, Cover, Pipe, Heating Cable, Measurements, Temperature/RH, Point Probes, and Results. The 'Weather Condition' panel is active, showing settings for General, Outdoor Climate, and Controlled Climate. The Outdoor Climate section is set to Worldwide, Standard library, and Italy - Rome. The weather station is identified as ROMA URBE, Italy, Europe, with coordinates 41.952°N 12.501°E 24.0 m. A table shows precipitation days per month for each month, all set to 15. The Controlled Climate section is set to Constant temperature (20 °C), Constant wind speed (Calm - 0 [m/s]), and Constant relative humidity (50 %). The 3D model on the right shows a building with dimensions 1.5m by 1m by 0.2m. A status bar at the bottom indicates 'No solution available yet'.

Weather Condition

General

- Same climate on the top and bottom
- Only controlled climate

Outdoor Climate

Region: Worldwide

Location library: Standard library

Location: Italy - Rome

Show Location on Map

Weather station: ROMA URBE, Italy, Europe

Coordinates: 41.952°N 12.501°E 24.0 m

Precipitation days per month:

Jan	Feb	Mar	Apr	May	Jun
15	15	15	15	15	15

Jul	Aug	Sep	Oct	Nov	Dec
15	15	15	15	15	15

Controlled Climate

Constant temperature: 20 °C

Constant wind speed: Calm - 0 [m/s]

Constant relative humidity: 50 %

Status

No solution available yet

Menu

Weather Condition

- The Location Library makes it easy to re-use data for construction sites

The screenshot displays the BI Dry 3.0 software interface. The top ribbon includes tabs for File, Home, Project, Simulation, Graphics, Data, Documentation, Library, and Settings. The left sidebar shows a 'Menu' with options like Construction, Concrete, Time, Weather Condition, Measures, Cover, Pipe, Heating Cable, Measurements, Temperature/RH, Point Probes, and Results. The 'Weather Condition' panel is active, showing settings for General, Outdoor Climate, and Controlled Climate. The 'Outdoor Climate' section includes a 'Location library' dropdown set to 'Standard library', with a list of options: Standard library, User library, and Manually. Below this, the weather station is identified as 'ROMA URBE, Italy, Europe' with coordinates '41.952°N 12.501°E 24.0 m'. A table shows precipitation days per month for each month, with 15 days for all months. The 'Controlled Climate' section has fields for 'Constant temperature' (20 °C), 'Constant wind speed' (Calm - 0 [m/s]), and 'Constant relative humidity' (50 %). The 'Geometry' panel on the right shows a 3D model of a building structure with dimensions in meters. The status bar at the bottom indicates 'No solution available yet'.

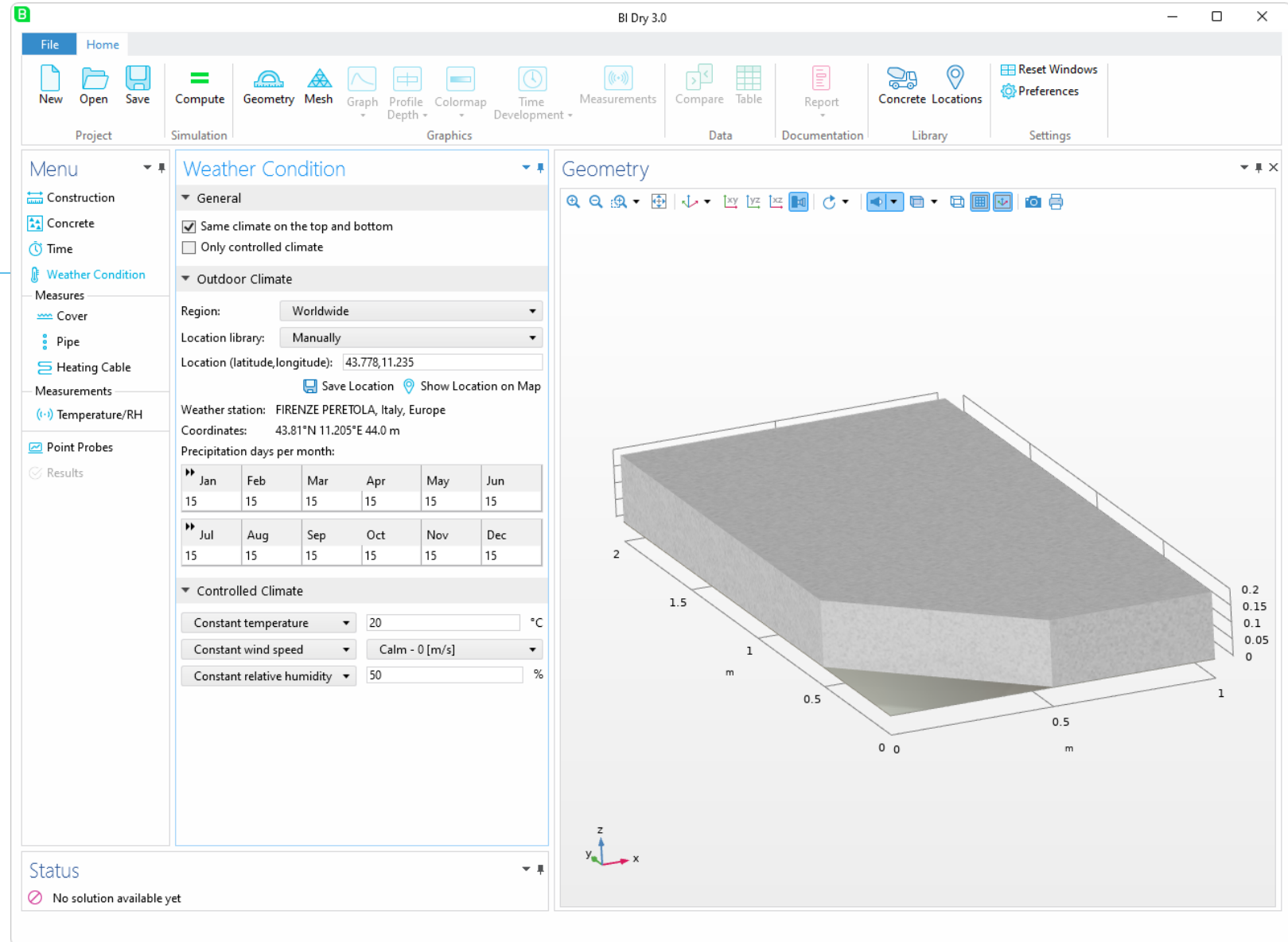
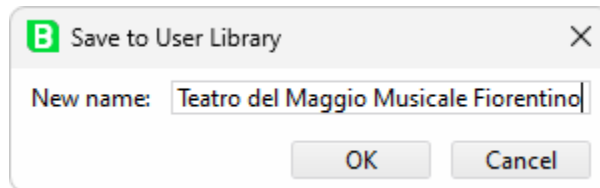
Jan	Feb	Mar	Apr	May	Jun
15	15	15	15	15	15

Jul	Aug	Sep	Oct	Nov	Dec
15	15	15	15	15	15

Menu

Weather Condition

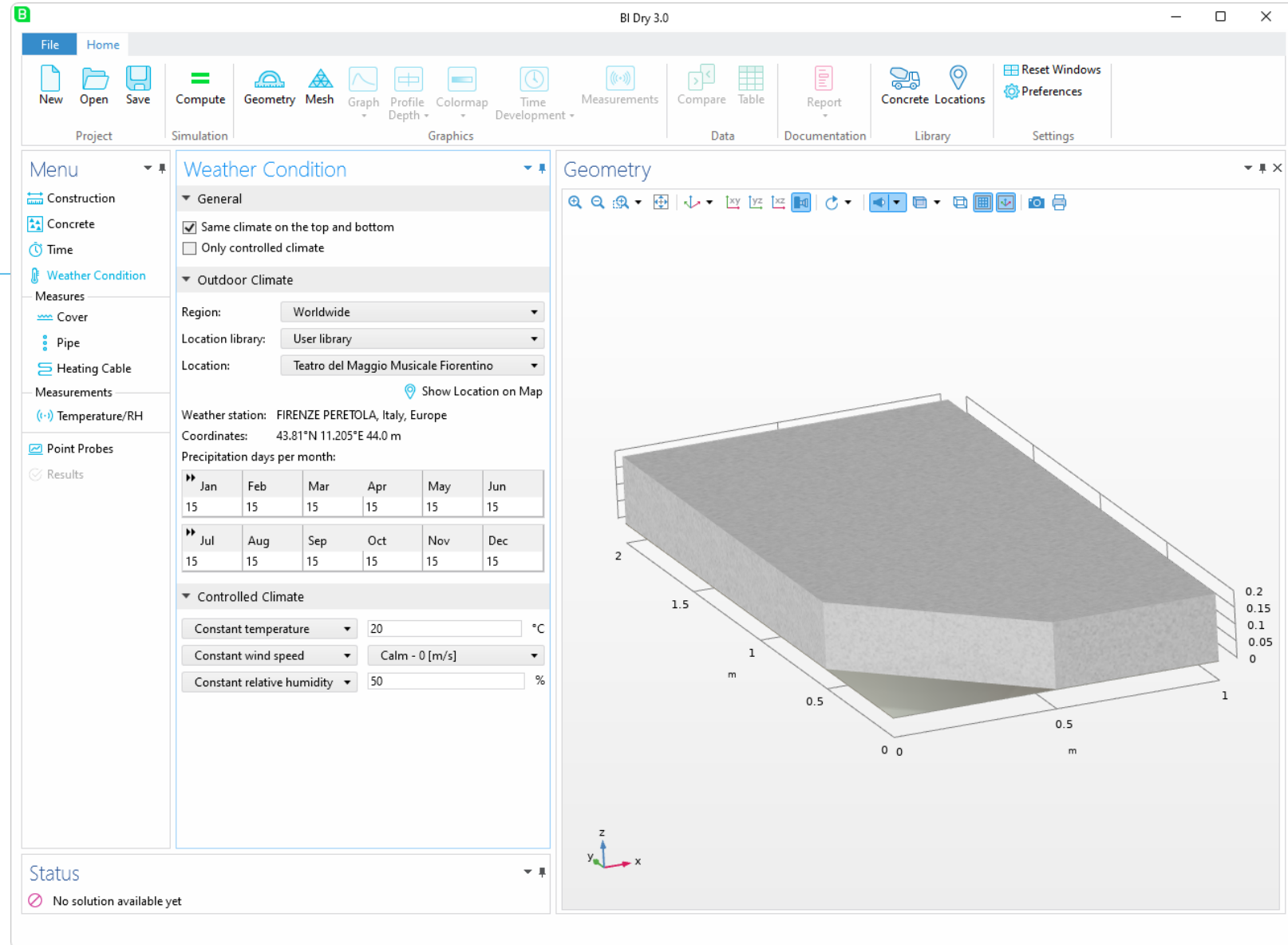
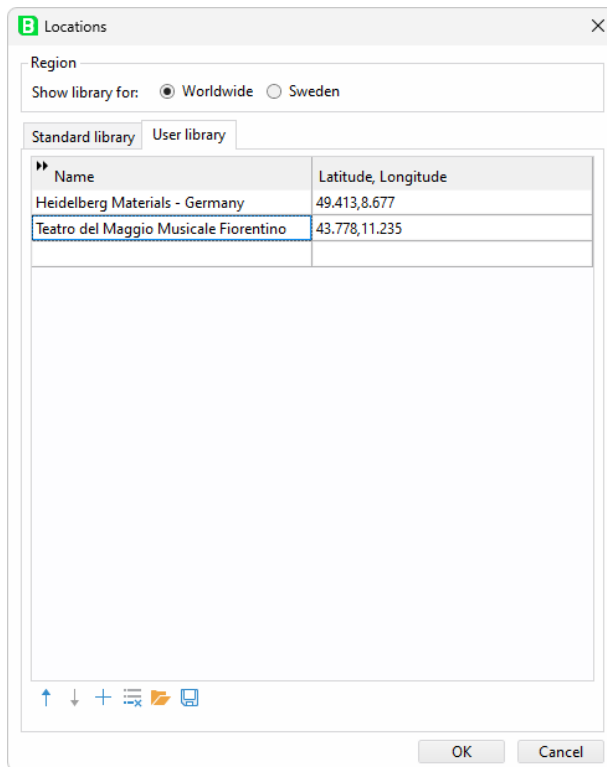
- Enter the coordinates for Teatro del Maggio Musicale Fiorentino
- *Show Location on Map* opens Google Maps
- *Save Location* opens a new dialog to save the location:



Menu

Weather Condition

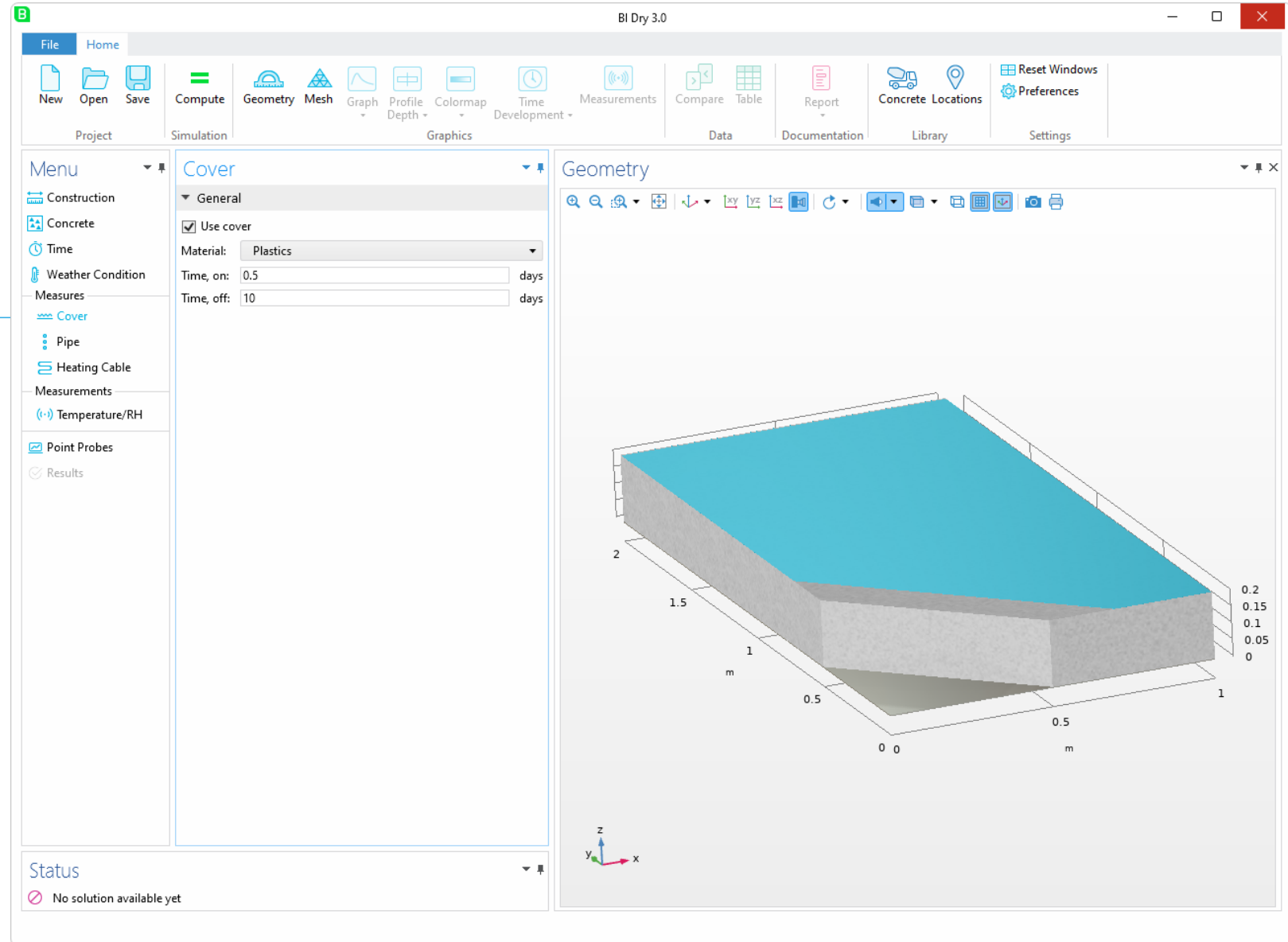
- Locations are saved to the library



Menu

Cover

- Cover of different materials can be added
- Time for on/off condition



Menu

Pipe

- Pipes with fluid can cool or heat the concrete

The screenshot displays the BI Dry 3.0 software interface. The top menu bar includes File, Home, and various tool icons. The left sidebar shows a 'Menu' with categories like Construction, Concrete, Time, Weather Condition, Measures, Cover, Pipe, Heating Cable, Measurements, Temperature/RH, Point Probes, and Results. The main 'Pipe' configuration panel is active, showing the following settings:

- General:**
 - Series: Series #1
 - Use series
 - Position:
 - Start point, x: 0.1 m
 - Start point, y: 0.100 m
 - Distance in x-direction: 0.15 m
 - Distance in y-direction: 0.1 m
 - Number in x-direction: 6
 - Number in y-direction: 1
- Data:**
 - Outer diameter: 20 mm
 - Material thickness: 2 mm
 - Thermal conductivity, solid: 45 W/(m-K)
 - Medium: Water
 - Flow rate: 25 l/min
 - Description: On/off
 - Time, on: 0.5 days
 - Time, off: 10 days
 - Temperature: 10 °C

The right side of the interface shows a 3D model of a concrete slab with a grid of pipes. The slab dimensions are 1.5m by 1.5m. The pipes are arranged in a grid with 6 pipes in the x-direction and 1 pipe in the y-direction. The z-axis represents the vertical height, ranging from 0 to 0.2m. A coordinate system (x, y, z) is shown at the bottom left of the 3D view.

The Status bar at the bottom indicates: No solution available yet

Menu

Pipe

- Can include several pipe series with different properties
- The pipe medium can be altered

The screenshot displays the BI Dry 3.0 software interface. The top menu bar includes File, Home, and various tool icons. The left sidebar shows a 'Menu' with options like Construction, Concrete, Time, Weather Condition, Measures, Cover, Pipe, Heating Cable, Measurements, Temperature/RH, Point Probes, and Results. The main 'Pipe' configuration panel is open, showing the following settings:

- General:** Visualize the Pipe Positions in 2D, Series: Series #1, Use series checked.
- Position:** Start point, x: 0.15 m; Start point, y: 0.05 m; Distance in x-direction: 0.15 m; Distance in y-direction: 0.1 m; Number in x-direction: 6; Number in y-direction: 1.
- Data:** Outer diameter: 20 mm; Material thickness: 2 mm; Thermal conductivity, solid: 45 W/(m-K); Medium: Glycol/water; Mixture: 25% glycol; Flow rate: 25 l/min; Description: On/off; Time, on: 0.5 days; Time, off: 10 days; Temperature: 10 °C.

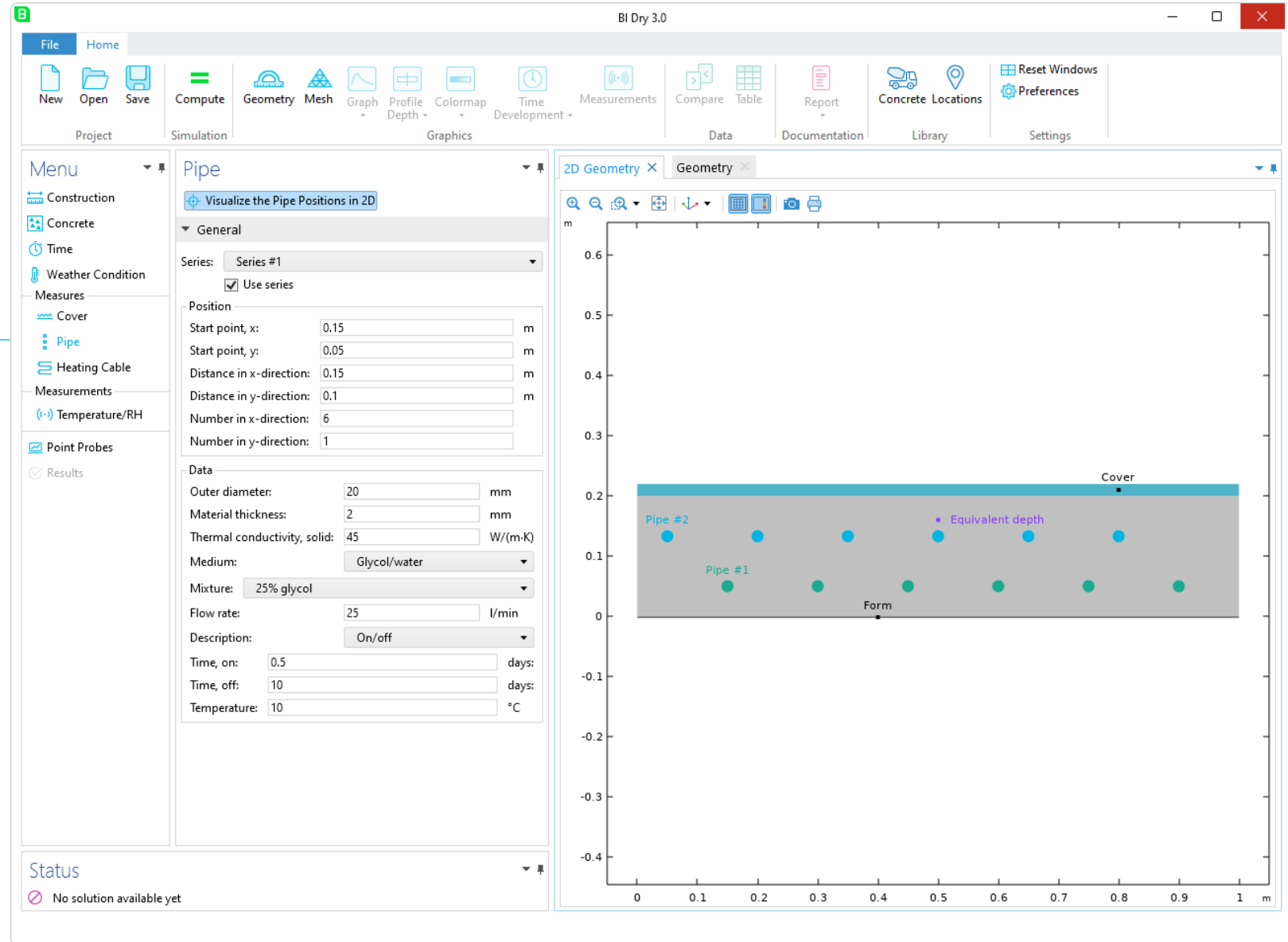
The 'Geometry' panel on the right shows a 3D visualization of a concrete slab with a grid of pipes. The slab dimensions are 1.5m by 1.5m by 0.2m. The pipes are arranged in a grid with a spacing of 0.15m in the x-direction and 0.1m in the y-direction. A coordinate system (x, y, z) is shown at the bottom left of the 3D view.

Status: No solution available yet

Menu

Pipe

- 2D visualization provides an easy-to-use interface for geometric dimensioning



Menu

Heating Cable

- Heating cables can be arranged in a manner similar to pipe installation

The screenshot displays the BI Dry 3.0 software interface. The top menu bar includes File, Home, and various tool icons. The left sidebar shows a 'Menu' with options like Construction, Concrete, Time, Weather Condition, Measures, Cover, Pipe, Heating Cable, Measurements, Temperature/RH, Point Probes, and Results. The main workspace is divided into three panels: 'Heating Cable', 'Geometry', and 'Status'. The 'Heating Cable' panel is active, showing configuration for 'Series #1'. The 'Geometry' panel shows a 3D model of a concrete slab with heating cables installed in a grid pattern. The 'Status' panel at the bottom indicates 'No solution available yet'.

Heating Cable Configuration:

- Series: Series #1
- Use series
- Position:
 - Start point, x: 0.1 m
 - Start point, y: 0.100 m
 - Distance in x-direction: 0.15 m
 - Distance in y-direction: 0.1 m
 - Number in x-direction: 6
 - Number in y-direction: 1
- Data:
 - Description: On/off
 - Time, on: 0.5 days
 - Time, off: 10 days
 - Power: 30 W/m

Geometry Panel: Visualize the Heating Cable Positions in 2D. The 3D model shows a concrete slab with a blue top surface and a grey bottom surface. Heating cables are represented by blue lines forming a grid on the bottom surface. The x-axis ranges from 0 to 1.5 m, and the y-axis ranges from 0 to 1 m. The z-axis ranges from 0 to 0.2 m.

Menu

Measurements

- Add measurements to compare simulations with on-site sensor data
- Capable of handling large datasets efficiently
- Accepts local user settings in a comma-delimited format

BI Dry 3.0

File Home

New Open Save Compute Geometry Mesh Graph Profile Depth Colormap Time Development Measurements Compare Table Report Concrete Locations Reset Windows Preferences

Project Simulation Graphics Data Documentation Library Settings

Menu

Construction

Concrete

Time

Weather Condition

Measures

Cover

Pipe

Heating Cable

Measurements

Temperature/RH

Point Probes

Results

Status

No solution available yet

Measurements - Temperature/RH

Data Import

Import Measurements...

Status: No measurements imported

Use measurements

Import of Measurements

Settings for the first column

Time format: Relative time [days]

Import type

Select CSV file and Start Import of Measurements...

Paste from Excel Copying

Relative time [days]	T1 [°C]	RH1 [%]	T2 [°C]	RH2 [%]	T3 [°C]	RH3 [%]
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Instructions

Create an Excel file with at least 2 columns and a maximum of 7 columns. Column 1 represents the time. When relative time is chosen, this represents the time compared to the start of the casting. For other choices, the absolute time is indicated, and several different formats are supported. The selected time format in the first column must be followed exactly by the format in the Excel file.

Columns 2, 4, and 6 represent the measured temperature (°C) in three temperature sensors.

Columns 3, 5, and 7 represent the measured relative humidity (%) in three moisture sensors.

If a row starts with a % sign, it is excluded from the import.

Download an Excel Template with the Different Formats

Instructions for importing a CSV file

The Excel file should be saved in CSV (Comma delimited) format to be imported.

Instructions for pasting from Excel copying

Select and copy the cells in Excel. Then return to BI Dry and click on Paste from Excel Copying.

OK Cancel

0.2
0.15
0.1
0.05
0

0.5
m

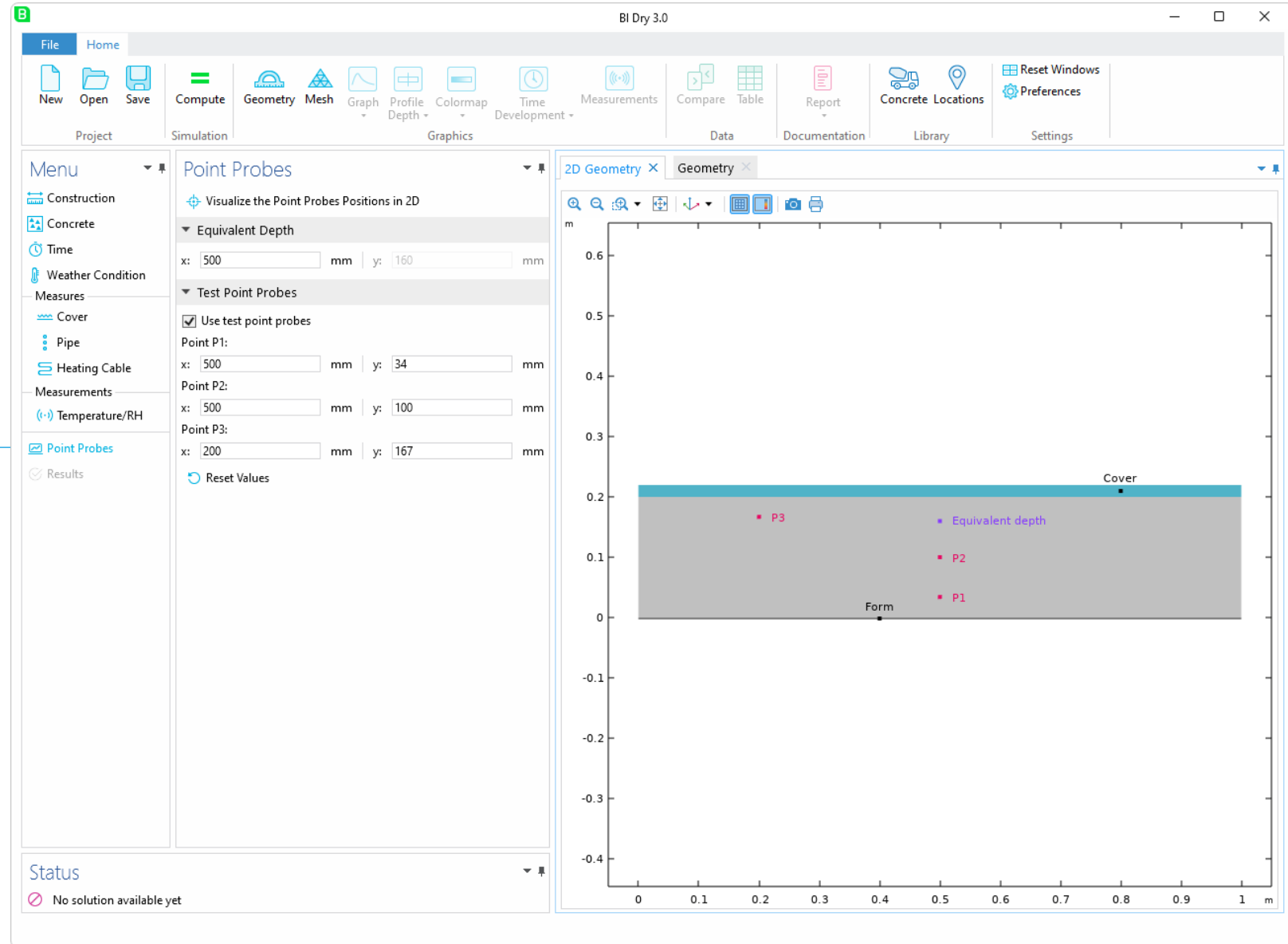
1

deflexional

Menu

Point Probes

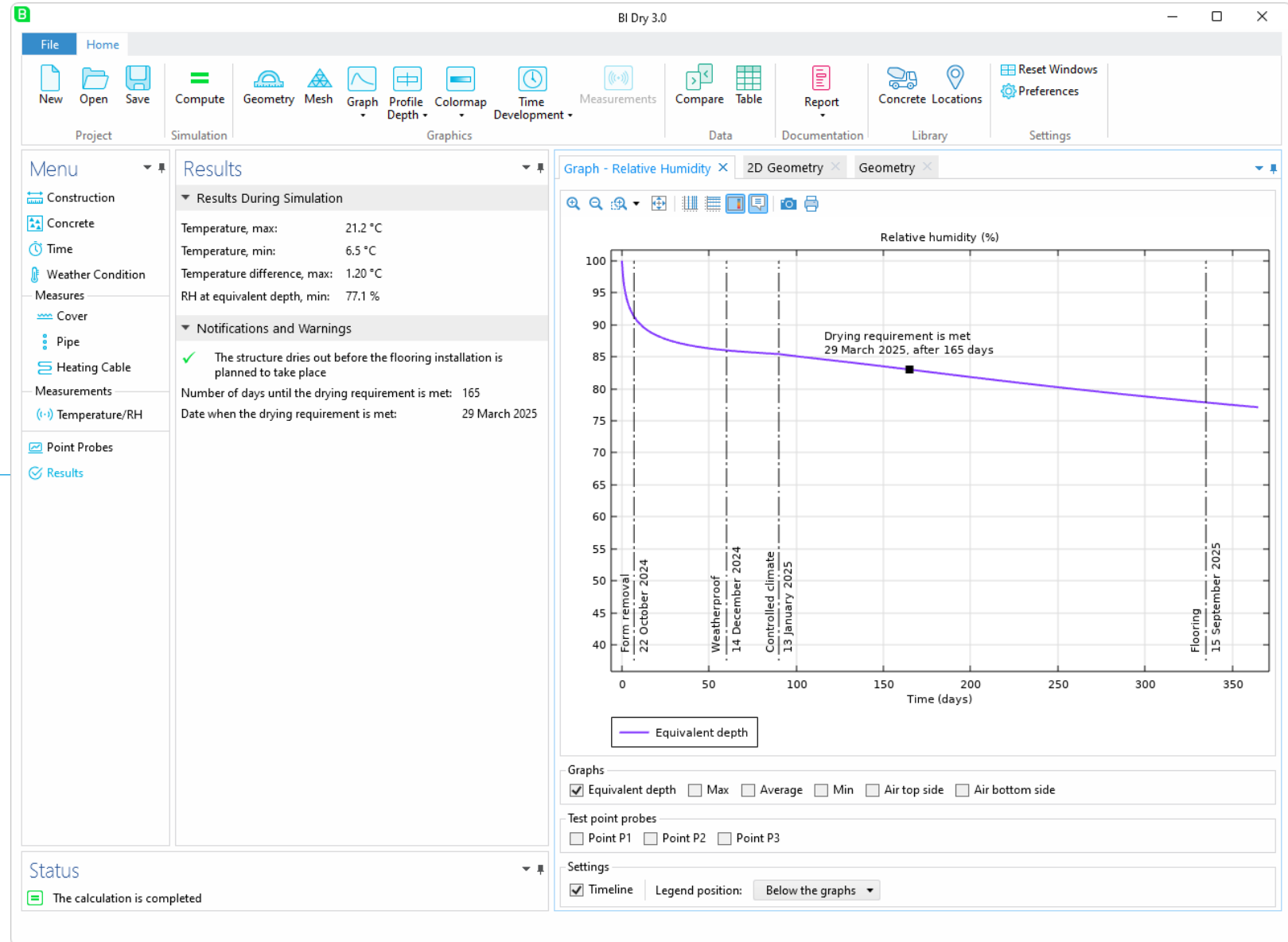
- Enables the visualization of output data at selected points
- The y-coordinate for the equivalent depth is fixed and cannot be edited, as it depends on the construction type
- The x-coordinate is crucial when using pipes or heating cables



Menu

Results

- Notifications and warnings
- Date when drying requirement is met

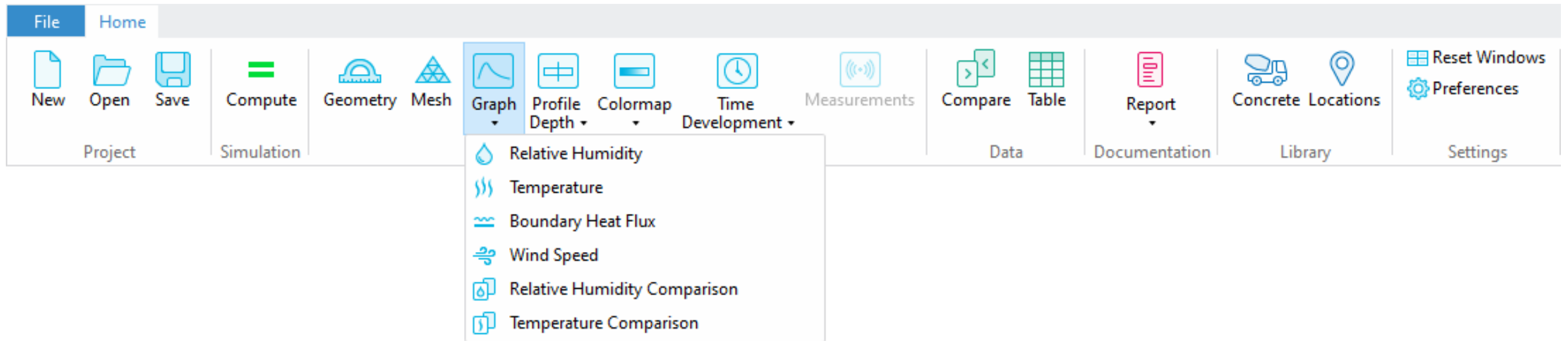


Graphics

Results visualization

Graphics

Graph Menu

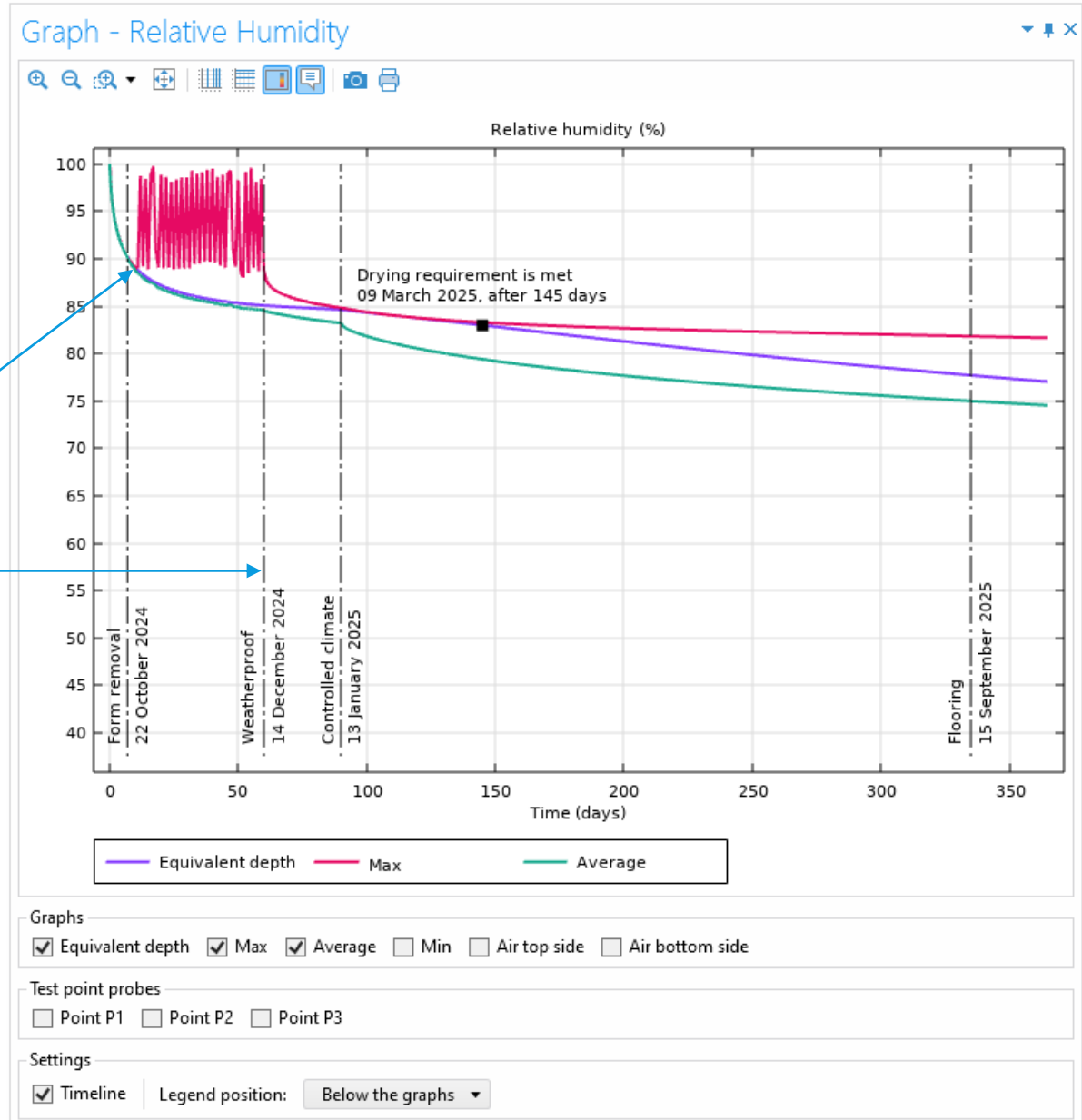


Graphics

Graph - Relative Humidity

Cover removed

Weatherproof

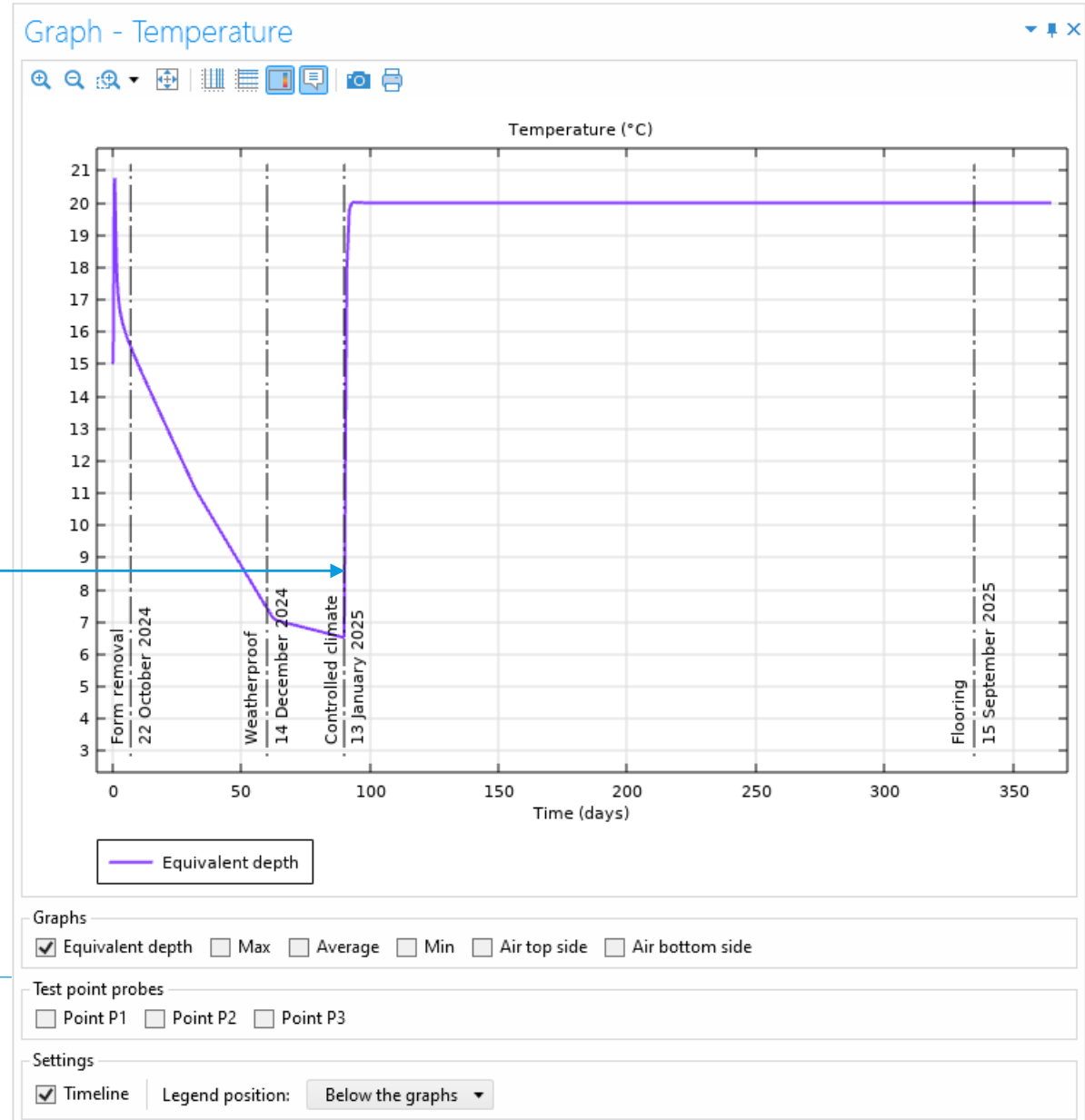


Graphics

Graph - Temperature

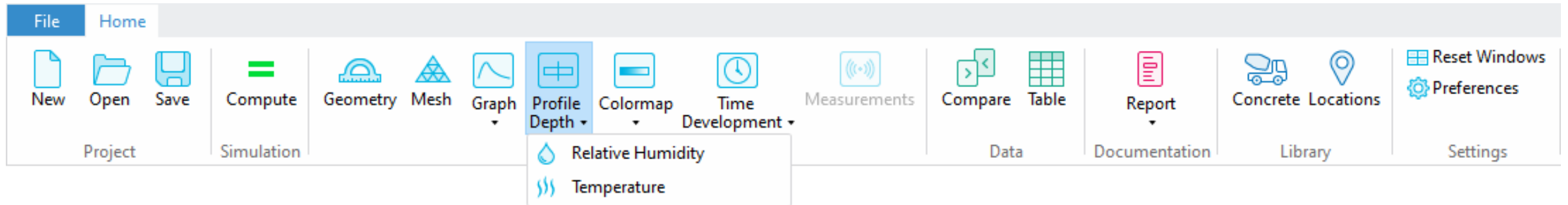
Controlled climate

Select graphs



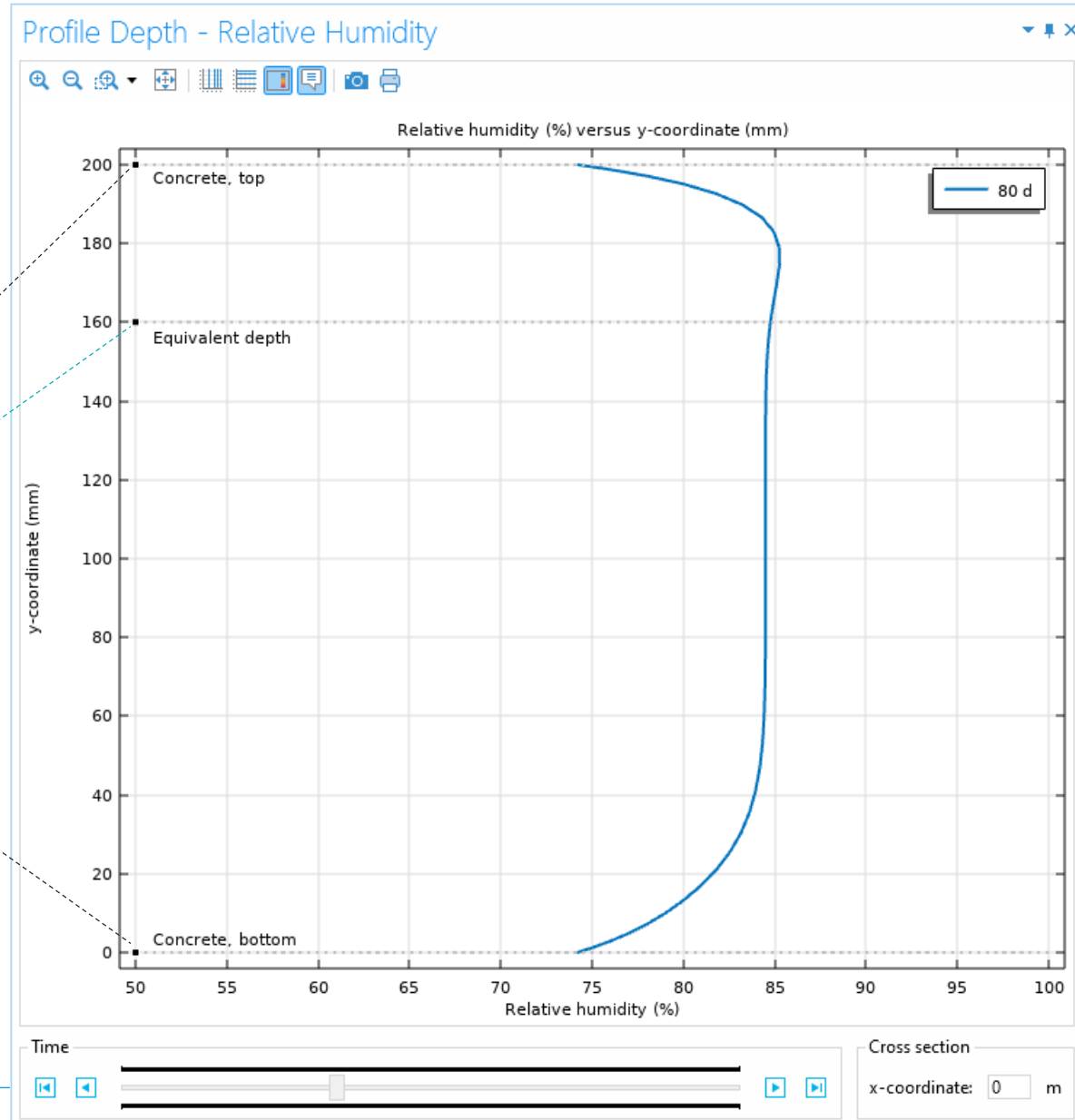
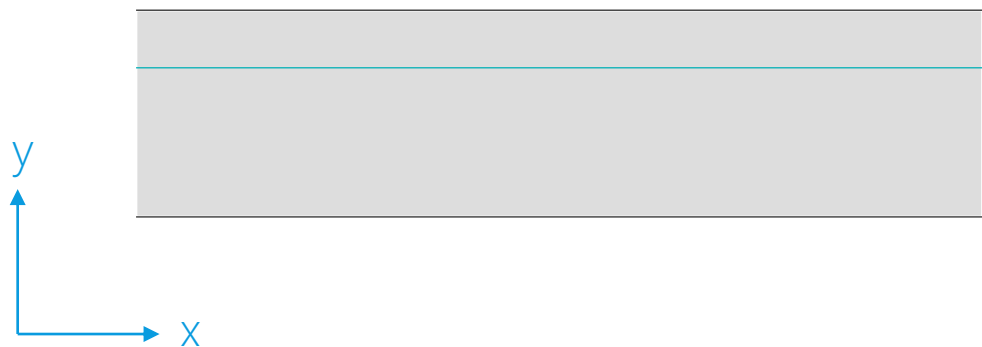
Graphics

Profile Depth Menu



Graphics

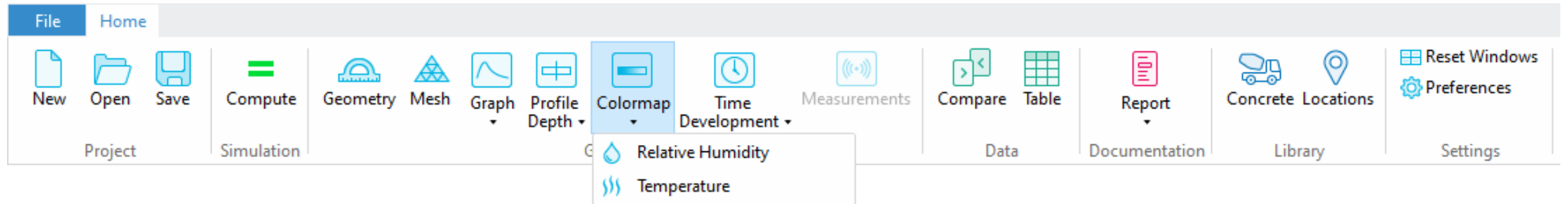
Profile Depth – Relative Humidity



Drag slider to change time step

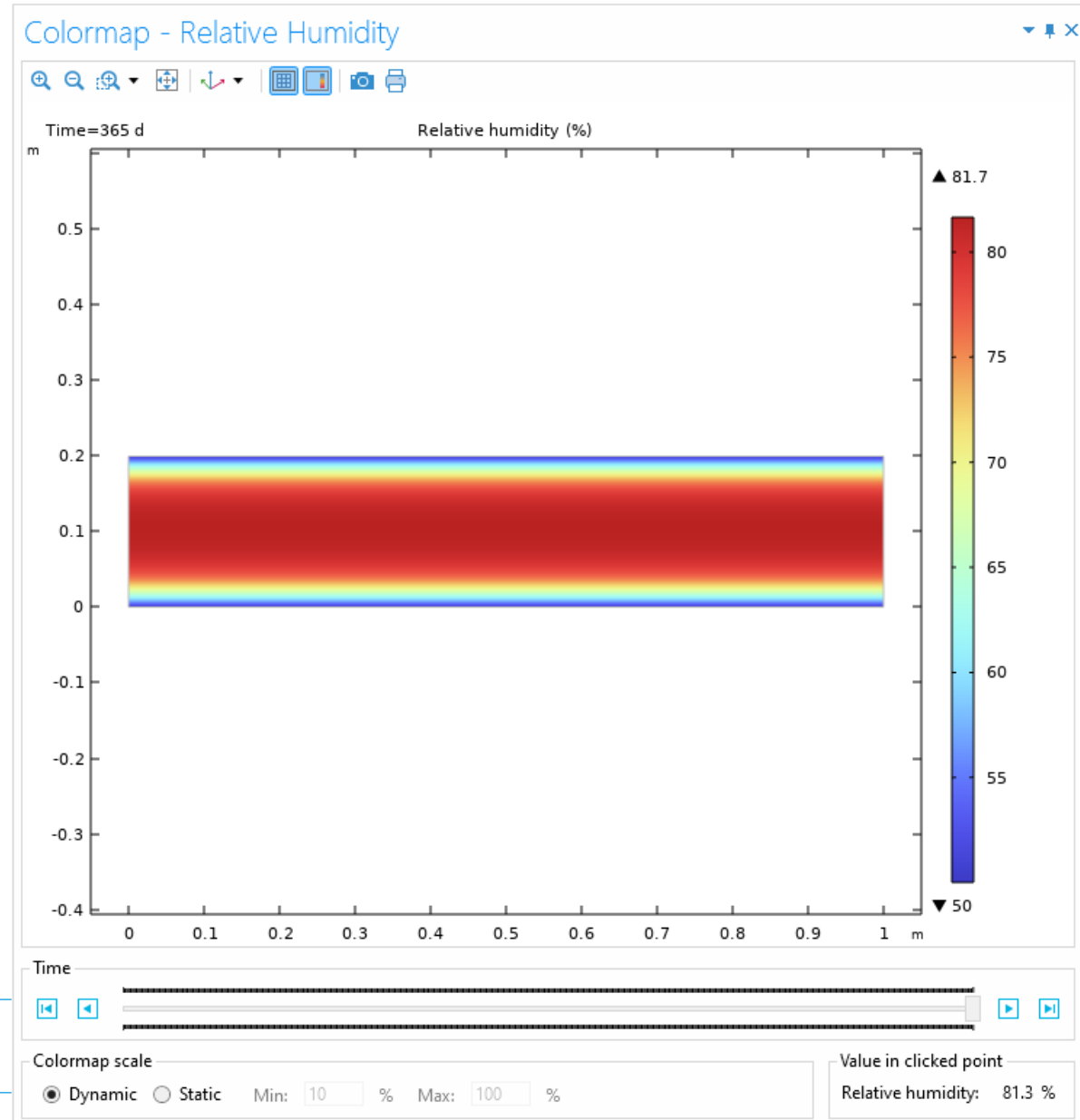
Graphics

Colormap Menu



Graphics

Colormap – Relative Humidity

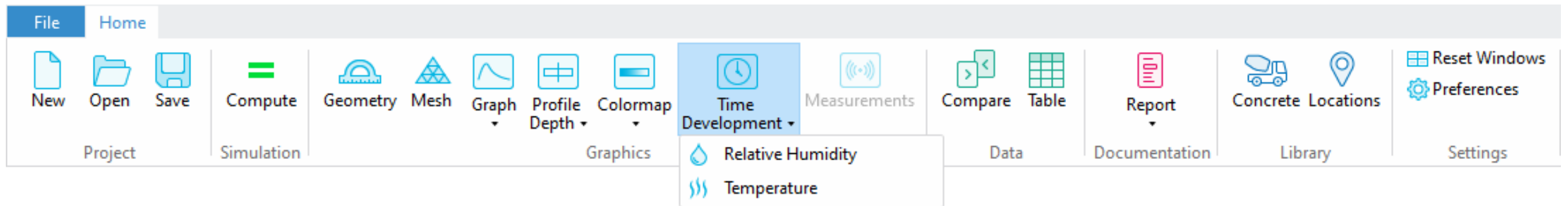


Drag slider to change time step

Set dynamic or static colormap scale

Graphics

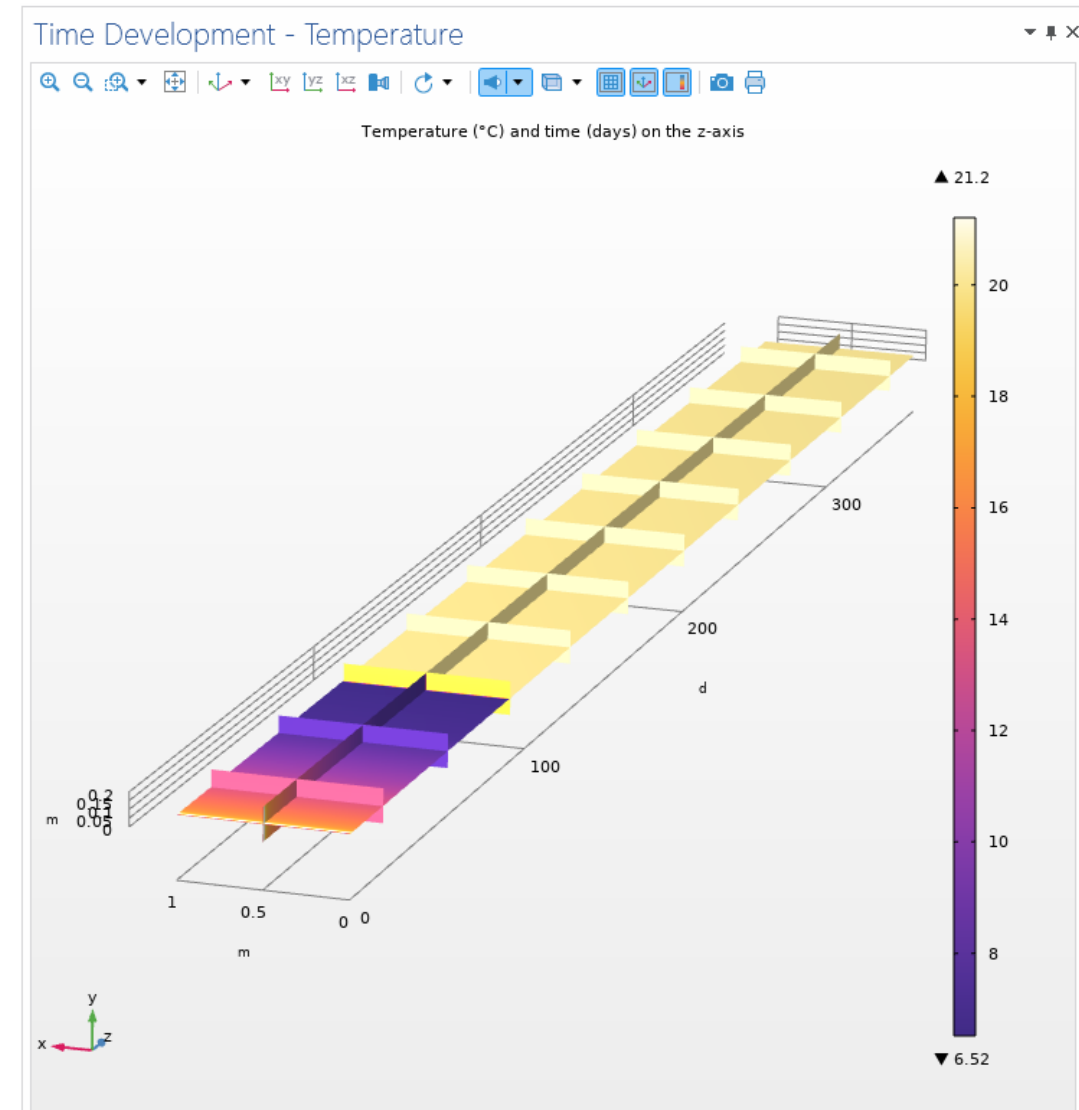
Time Development Menu



Graphics

Time Development - Temperature

- The z-coordinate represent time (days)



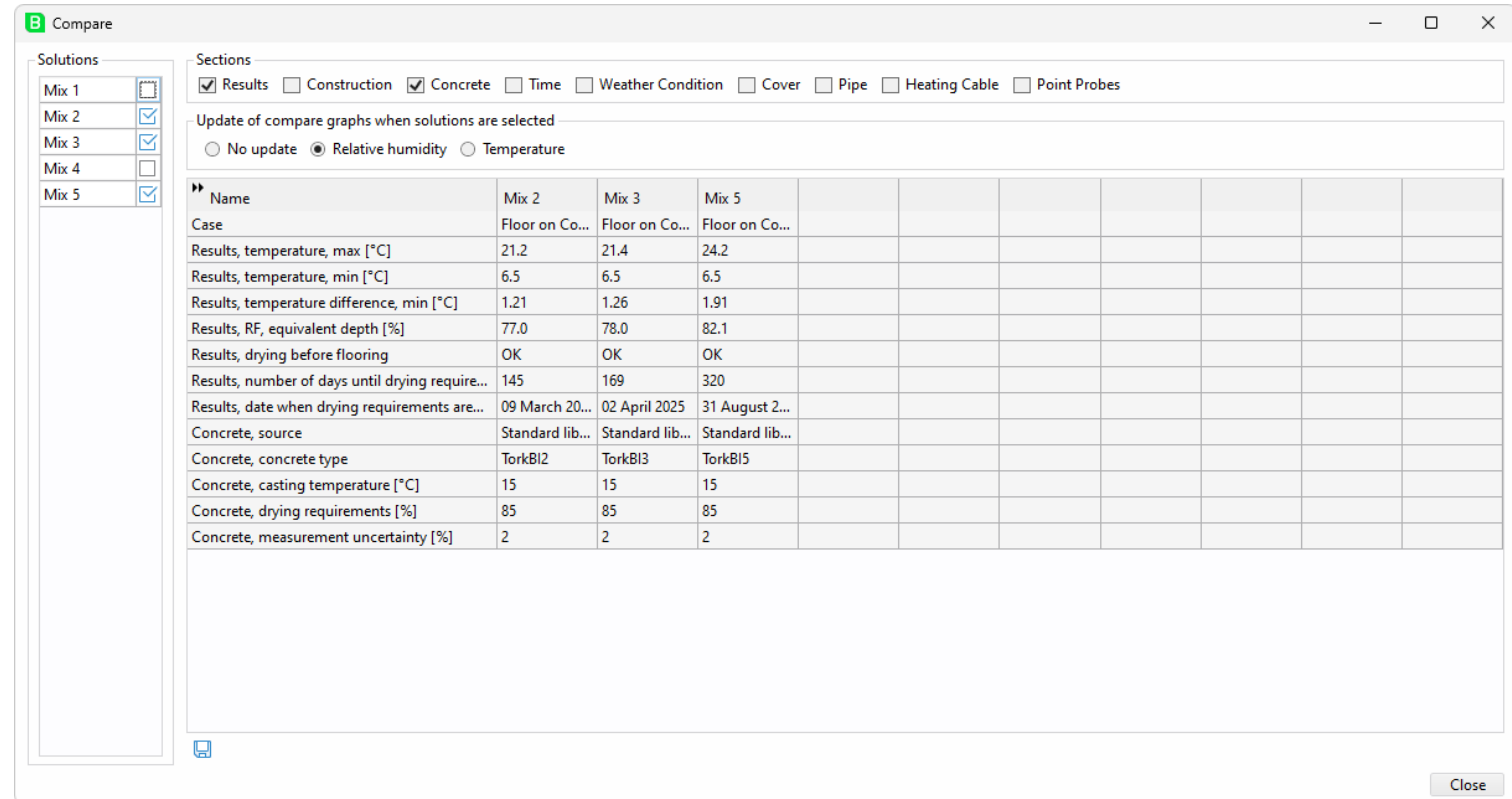
Results

Compare data and create reports

Compare

Compare and Visualize Different Solutions

- Each time a solution is computed, relevant data is saved, allowing for easy comparison of different inputs and outputs
- Solutions can be renamed and sections can be filtered
- Plots can be updated automatically



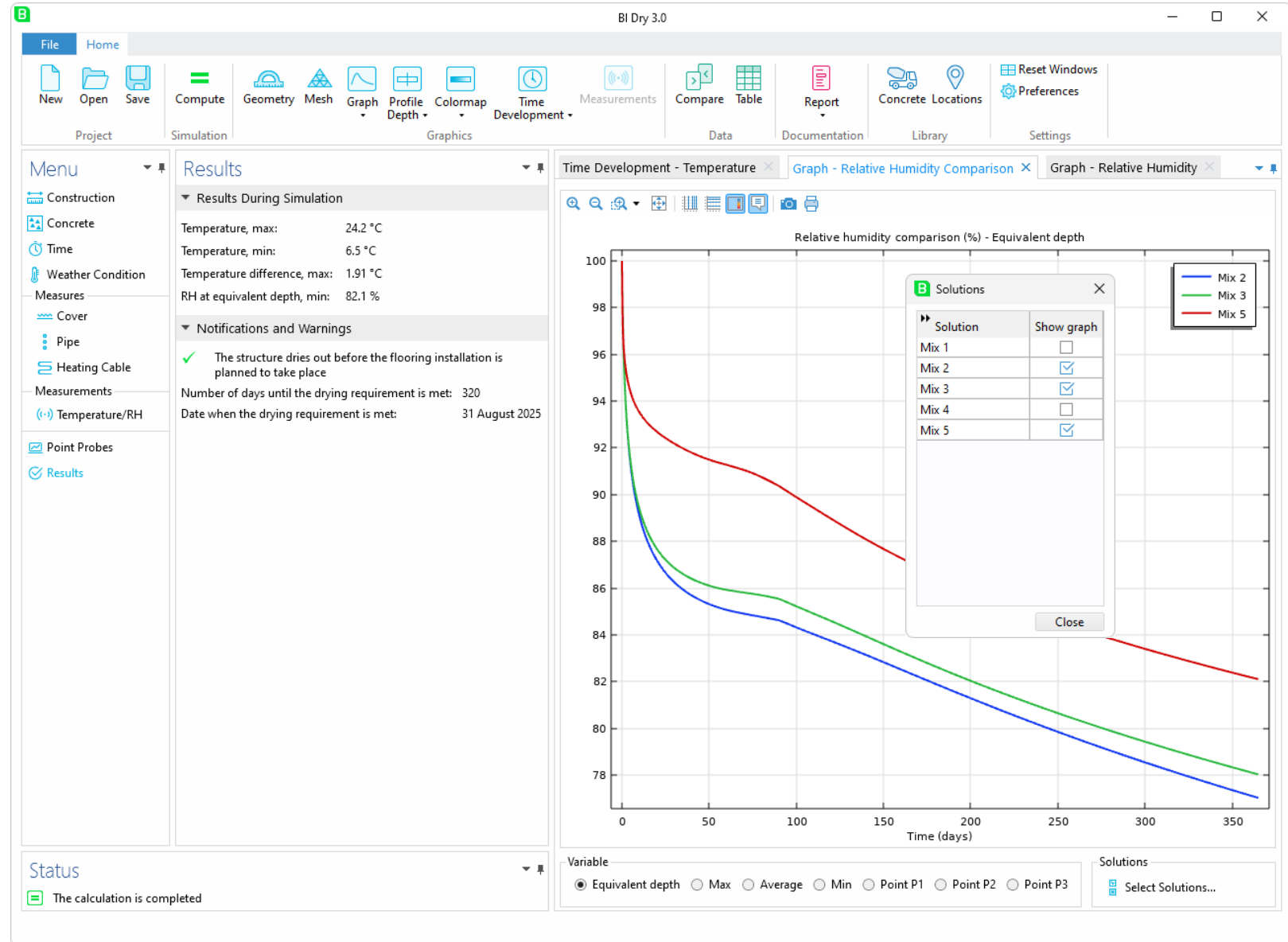
The screenshot shows the 'Compare' window with a 'Solutions' list on the left and a 'Sections' filter at the top. The main area contains a table with the following data:

Name	Mix 2	Mix 3	Mix 5							
Case	Floor on Co...	Floor on Co...	Floor on Co...							
Results, temperature, max [°C]	21.2	21.4	24.2							
Results, temperature, min [°C]	6.5	6.5	6.5							
Results, temperature difference, min [°C]	1.21	1.26	1.91							
Results, RF, equivalent depth [%]	77.0	78.0	82.1							
Results, drying before flooring	OK	OK	OK							
Results, number of days until drying require...	145	169	320							
Results, date when drying requirements are...	09 March 20...	02 April 2025	31 August 2...							
Concrete, source	Standard lib...	Standard lib...	Standard lib...							
Concrete, concrete type	TorkBI2	TorkBI3	TorkBI5							
Concrete, casting temperature [°C]	15	15	15							
Concrete, drying requirements [%]	85	85	85							
Concrete, measurement uncertainty [%]	2	2	2							

Compare

Visualize

- Easy to rename and enable/disable the visualization of different solutions



Report

Microsoft Word

B Report [Close]

Create Word Report

Settings

Name:

Company:

Title:

Project description:

The report and images are based on the latest solution. Generated images use the current graphics settings.

concrete_floor_florence.docx - Compatibility Mode - Saved

File Home Insert Draw Design Layout References Mailings Review View Help Acrobat

Clipboard Font Paragraph Styles Editing Adobe Acrobat

Segoe UI Light (Headings) 28

Normal No Spacing Heading 1

Comments Editing Share

Create PDF and Share link Create PDF and Share via Outlook Request Signatures Dictate Voice Editor Add-ins

Contents

- Library
- Input data
- Construction
- Concrete
- Time
- Weather Condition
- Point Probe
- Results
- Summary
- Graph
- Public Input
- Calibration
- Time Development

Summary

Name: Daniel Ericsson

Company: Deflexional AB

Report date: 2024-05-05

SI Dry version: 38214

Case: Floor on Conventional Formwork

Project description: Concrete floor in Florence

Input data

Construction on

Construction, concrete dimensions, thickness [m]	0.2
Construction, concrete dimensions, width [m]	1
Construction, form, form material	Steel
Construction, form, form removal [days]	7
Construction, insulation, depth [m]	2

Point Probes

Equivalent depth [m]	(0.0156)
Point P1 [m]	(0.0156)
Point P2 [m]	(0.0156)
Point P3 [m]	(0.0156)

Concrete

Concrete, source	Standard library
Concrete, concrete type	Totals8
Concrete, casting temperature [°C]	15
Concrete, drying requirement [%]	0.0
Concrete, measured porosity [%]	2

Time, setting, date and time	15 October 2024 17:00
Time, weatherproof, set date, automatically	Yes
Time, weatherproof, time between setting and weatherproof [days]	40
Time, weatherproof, date	14 December 2024
Time, controlled climate, on	Yes
Time, controlled climate, on top and bottom	Yes
Time, controlled climate, top, set date, automatically	Yes
Time, controlled climate, top, time between weatherproof and controlled climate [days]	30
Time, controlled climate, top, date	15 January 2025
Time, controlled climate, bottom, set date, automatically	Yes
Time, controlled climate, bottom, time between weatherproof and controlled climate [days]	30
Time, controlled climate, bottom, date	15 January 2025

Time, flooring, set date, automatically	Yes
Time, flooring, time between controlled climate and flooring [days]	245
Time, flooring, date	15 September 2025
Time, flooring, simulation time, after flooring	30
Time, advanced settings, high nuclear resolution, until [days]	8
Time, advanced settings, step size for high resolution [days]	0.1

Weather condition, controlled climate - top, relative humidity	Constant relative humidity
Weather condition, controlled climate - top, constant relative humidity [%]	50
Weather condition, controlled climate - top, time-varying relative humidity, time format	---
Weather condition, controlled climate - top, time-varying relative humidity [%]	---
Weather condition, controlled climate - bottom, temperature	---
Weather condition, controlled climate - bottom, constant temperature [°C]	---
Weather condition, controlled climate - bottom, time-varying temperature, time format	---
Weather condition, controlled climate - bottom, time-varying temperature [°C]	---
Weather condition, controlled climate - bottom, time-varying relative humidity, time format	---
Weather condition, controlled climate - bottom, time-varying relative humidity [%]	---
Weather condition, controlled climate - bottom, constant wind speed	---
Weather condition, controlled climate - bottom, time-varying wind speed, time format	---
Weather condition, controlled climate - bottom, time-varying wind speed [m/s]	---
Weather condition, controlled climate - bottom, relative humidity	---
Weather condition, controlled climate - bottom, constant relative humidity [%]	---
Weather condition, controlled climate - bottom, time-varying relative humidity, time format	---
Weather condition, controlled climate - bottom, time-varying relative humidity [%]	---
Weather condition, controlled climate - bottom, cover, use cover	Yes
Cover, material	Plastics
Cover, time, on	0.5
Cover, time, off	10

Page 1 of 15 709 words English (United States) Text Predictions: On Accessibility: Unavailable

Report

Microsoft PowerPoint

Report

Create PowerPoint Report

Settings

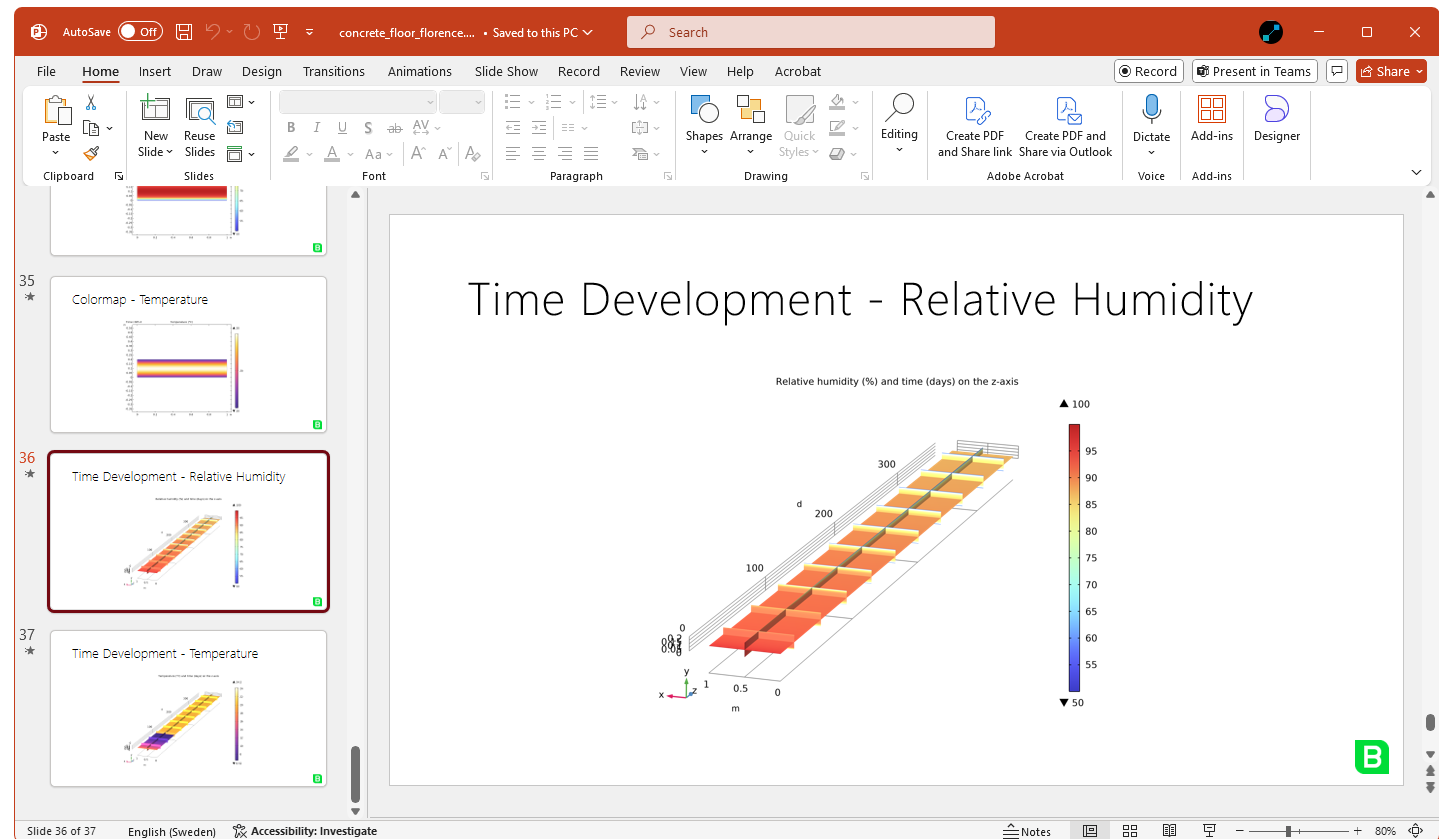
Name:

Company:

Title:

Project description:

i The report and images are based on the latest solution. Generated images use the current graphics settings.



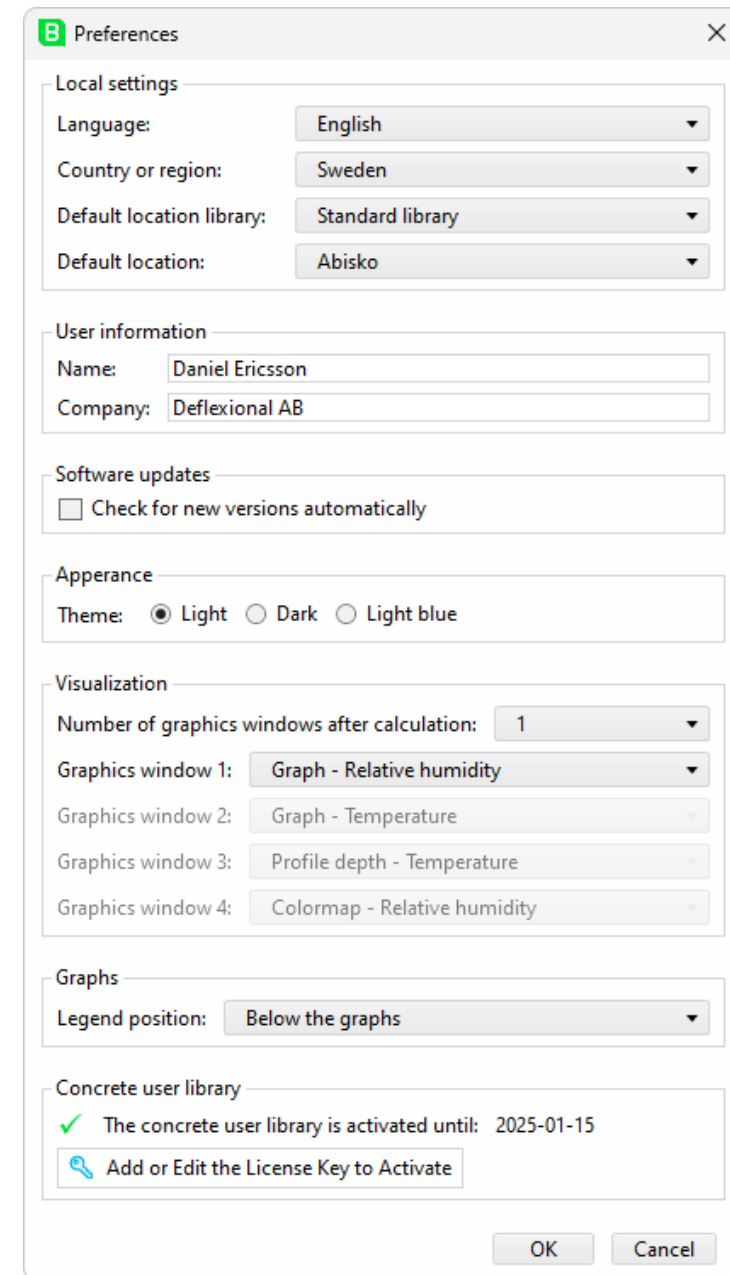
Preferences

Set language, region, appearance, and more

Preferences

Local Settings

- Language can be set to English or Swedish
- If the region is set to Sweden, precipitation data averaged from 1991 to 2020 is provided by the Swedish Meteorological and Hydrological Institute (SMHI).



The screenshot shows a 'Preferences' dialog box with the following sections and settings:

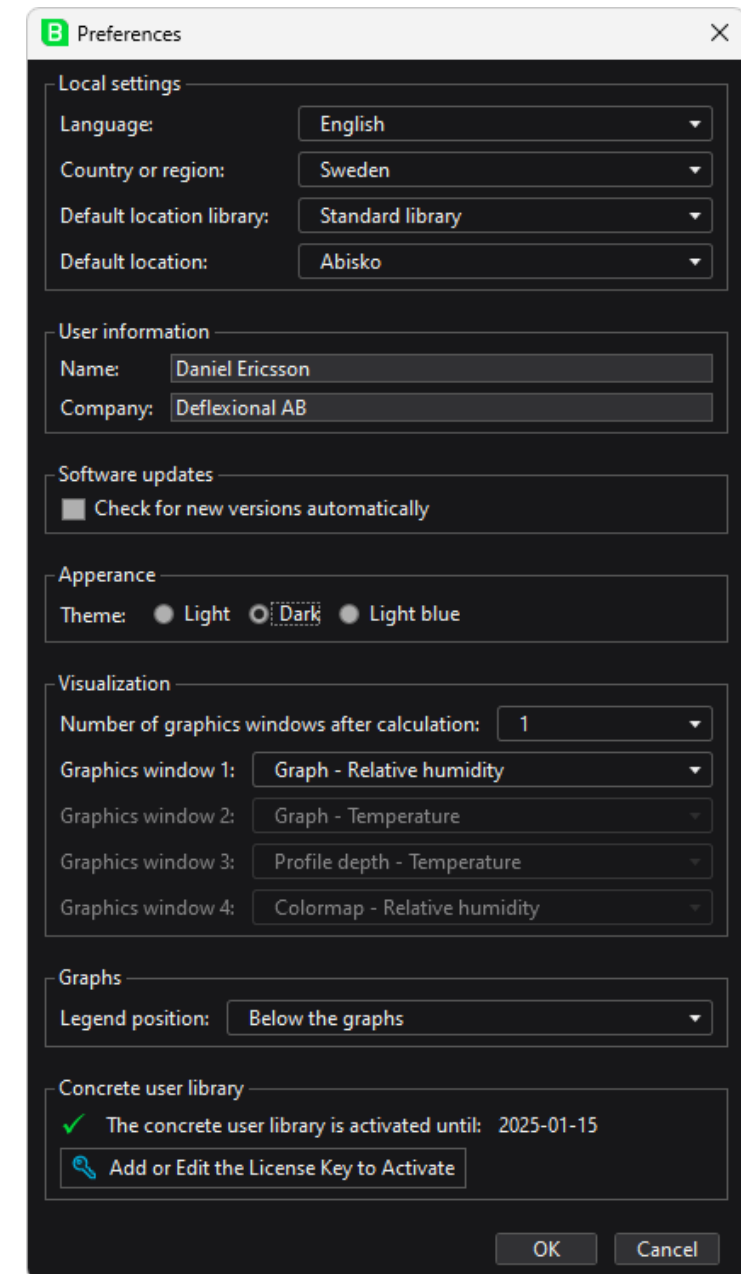
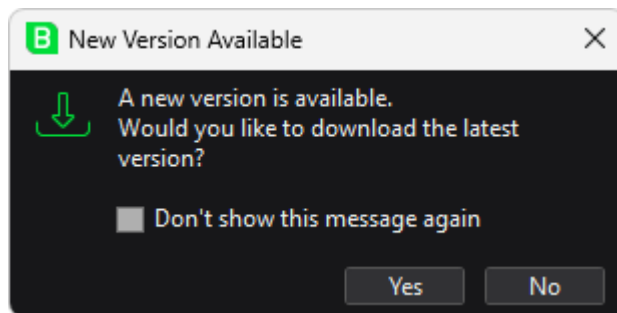
- Local settings:**
 - Language: English
 - Country or region: Sweden
 - Default location library: Standard library
 - Default location: Abisko
- User information:**
 - Name: Daniel Ericsson
 - Company: Deflexional AB
- Software updates:**
 - Check for new versions automatically
- Appearance:**
 - Theme: Light Dark Light blue
- Visualization:**
 - Number of graphics windows after calculation: 1
 - Graphics window 1: Graph - Relative humidity
 - Graphics window 2: Graph - Temperature
 - Graphics window 3: Profile depth - Temperature
 - Graphics window 4: Colormap - Relative humidity
- Graphs:**
 - Legend position: Below the graphs
- Concrete user library:**
 - The concrete user library is activated until: 2025-01-15
 -

Buttons: OK, Cancel

Preferences

Software Updates and Appearance

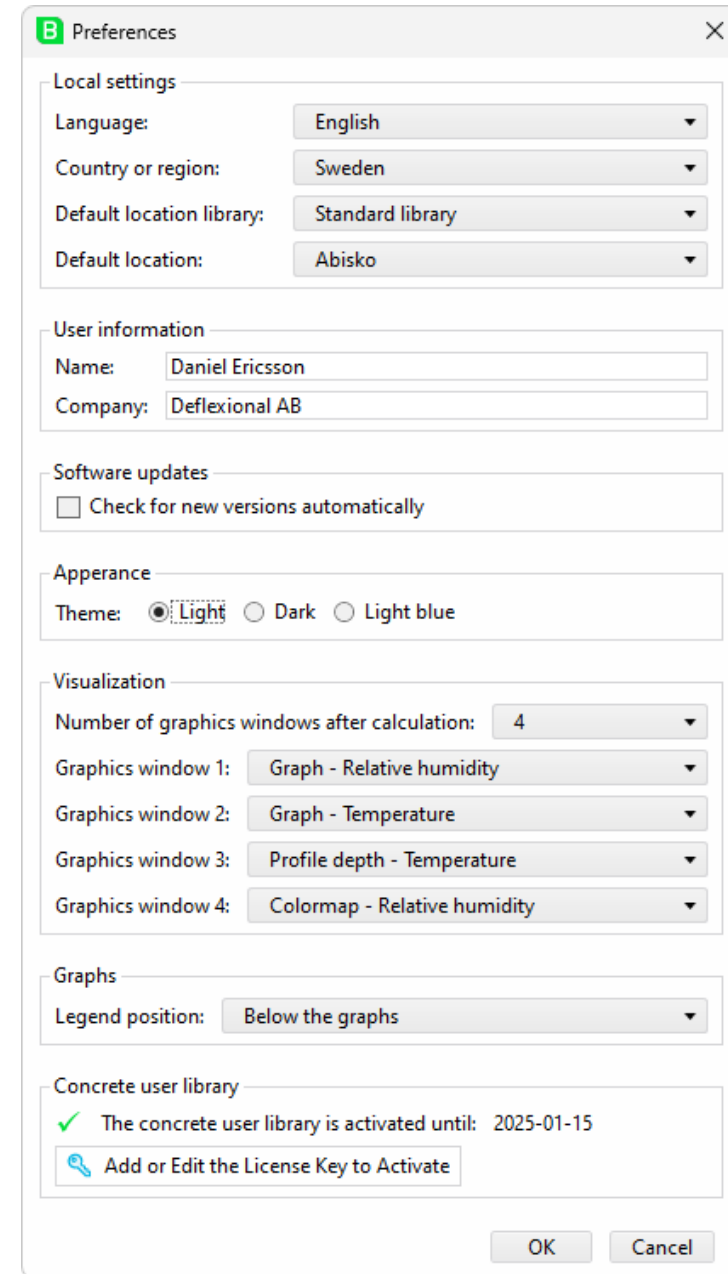
- The user can choose between three different themes
- Every time BI Dry starts it can check for new versions automatically



Preferences

Visualizations and Graphs

- The number of graphics windows after a calculation can be adjusted from 1 to 4
- Each graphics window can have a default plot
- For graphs, the default position for the legends can be set



The screenshot shows the 'Preferences' dialog box with the following settings:

- Local settings:**
 - Language: English
 - Country or region: Sweden
 - Default location library: Standard library
 - Default location: Abisko
- User information:**
 - Name: Daniel Ericsson
 - Company: Deflexional AB
- Software updates:**
 - Check for new versions automatically
- Appearance:**
 - Theme: Light Dark Light blue
- Visualization:**
 - Number of graphics windows after calculation: 4
 - Graphics window 1: Graph - Relative humidity
 - Graphics window 2: Graph - Temperature
 - Graphics window 3: Profile depth - Temperature
 - Graphics window 4: Colormap - Relative humidity
- Graphs:**
 - Legend position: Below the graphs
- Concrete user library:**
 - The concrete user library is activated until: 2025-01-15
 - [Add or Edit the License Key to Activate](#)

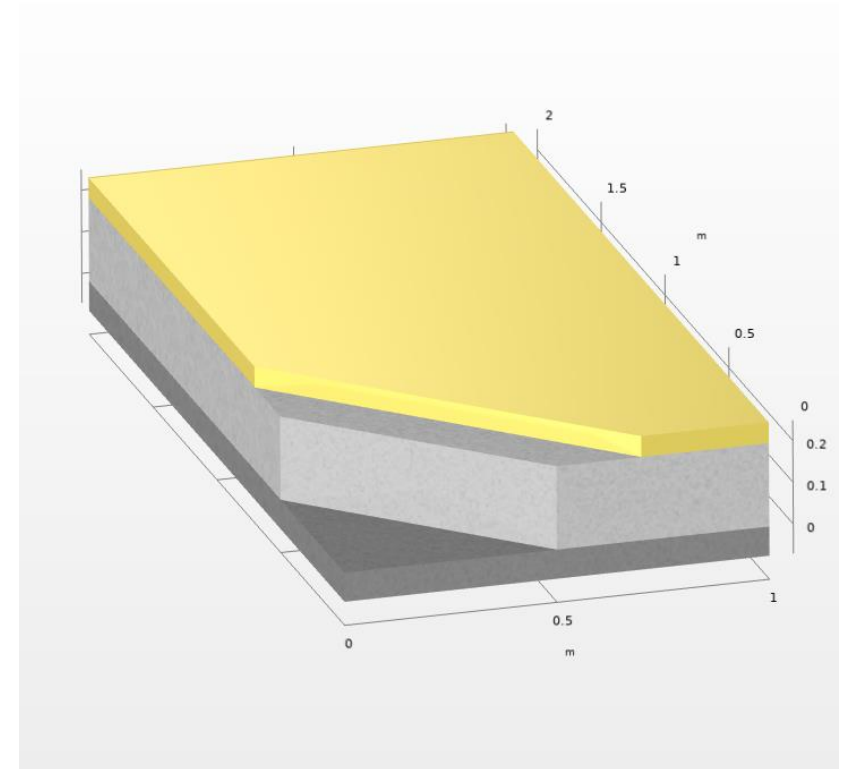
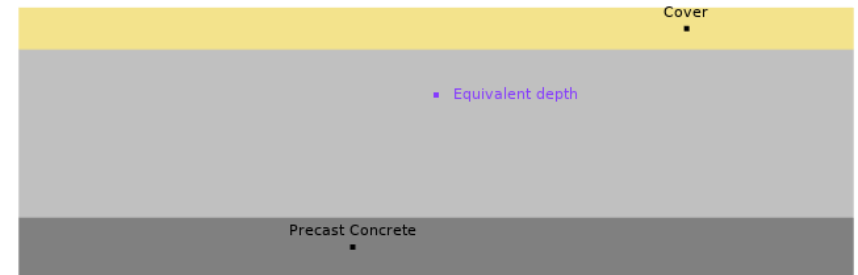
Buttons: OK, Cancel

Underlying COMSOL Model

Combining the Model Builder with methods

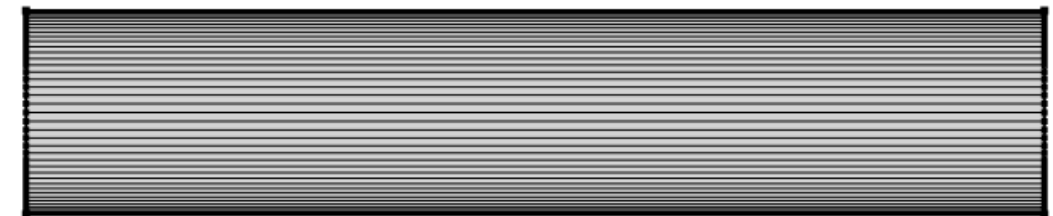
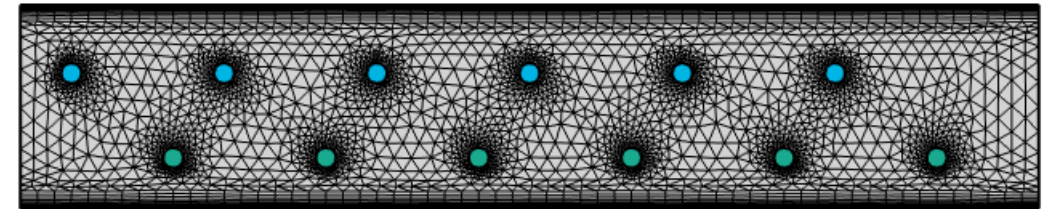
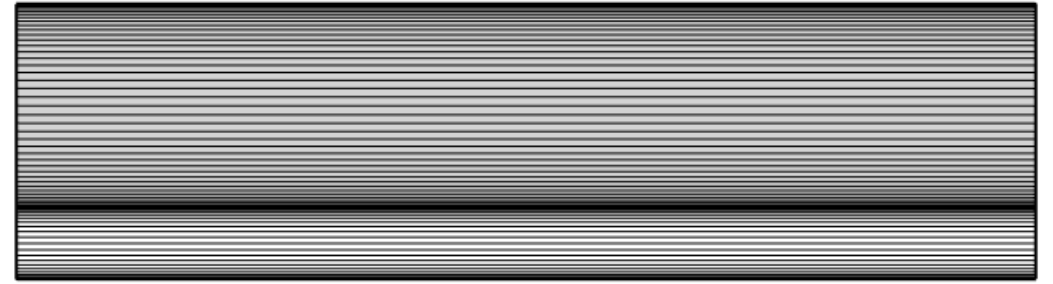
Geometry

- The 2D geometry is dynamically generated in the Application Builder using methods tailored to the selected construction case
- A secondary 3D component is used to visualize the construction with material colors



Mesh

- The mesh automatically adjusts to the selected construction scenario.
- If pipes or heating cables are included, boundary layer meshing is added automatically
- The problem is always solved in 2D, but the mesh has only one element in the x-direction, effectively reducing it to 1D when possible



Physics Interfaces

- Heat Transfer in Solids
 - Heat Source
 - Heat Flux
 - Thin Layer
- Stabilized Convection-Diffusion Equation
- Domain ODEs and DAEs
 - Calculate the equivalent time (maturity)
- Events
 - Efficiently manages dynamic changes in the model such as formwork removal, cover additions, or the activation/deactivation of heating cables or pipes

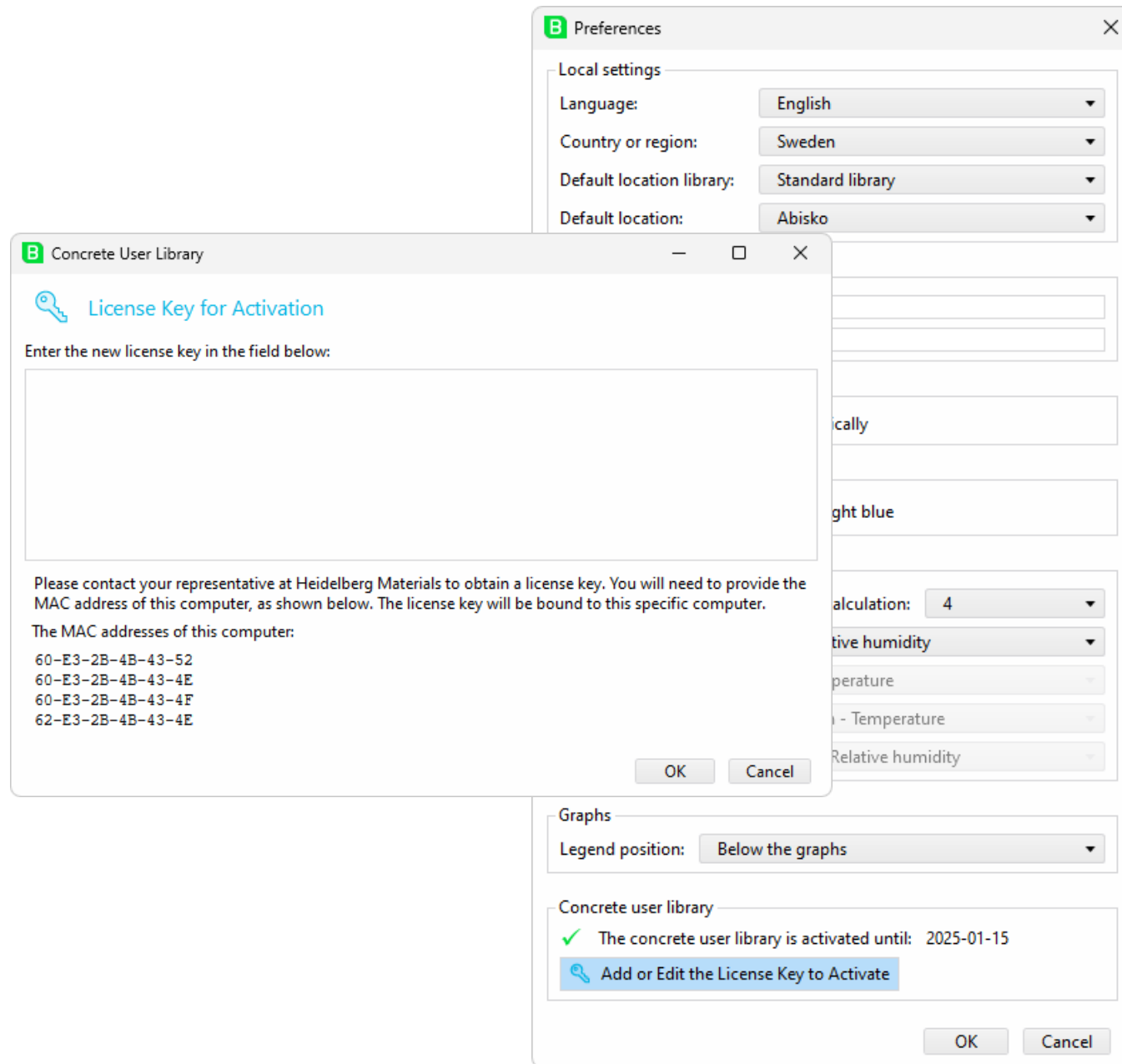
Access to Specific Functionality

A portion allocated for advanced users and researchers

Preferences

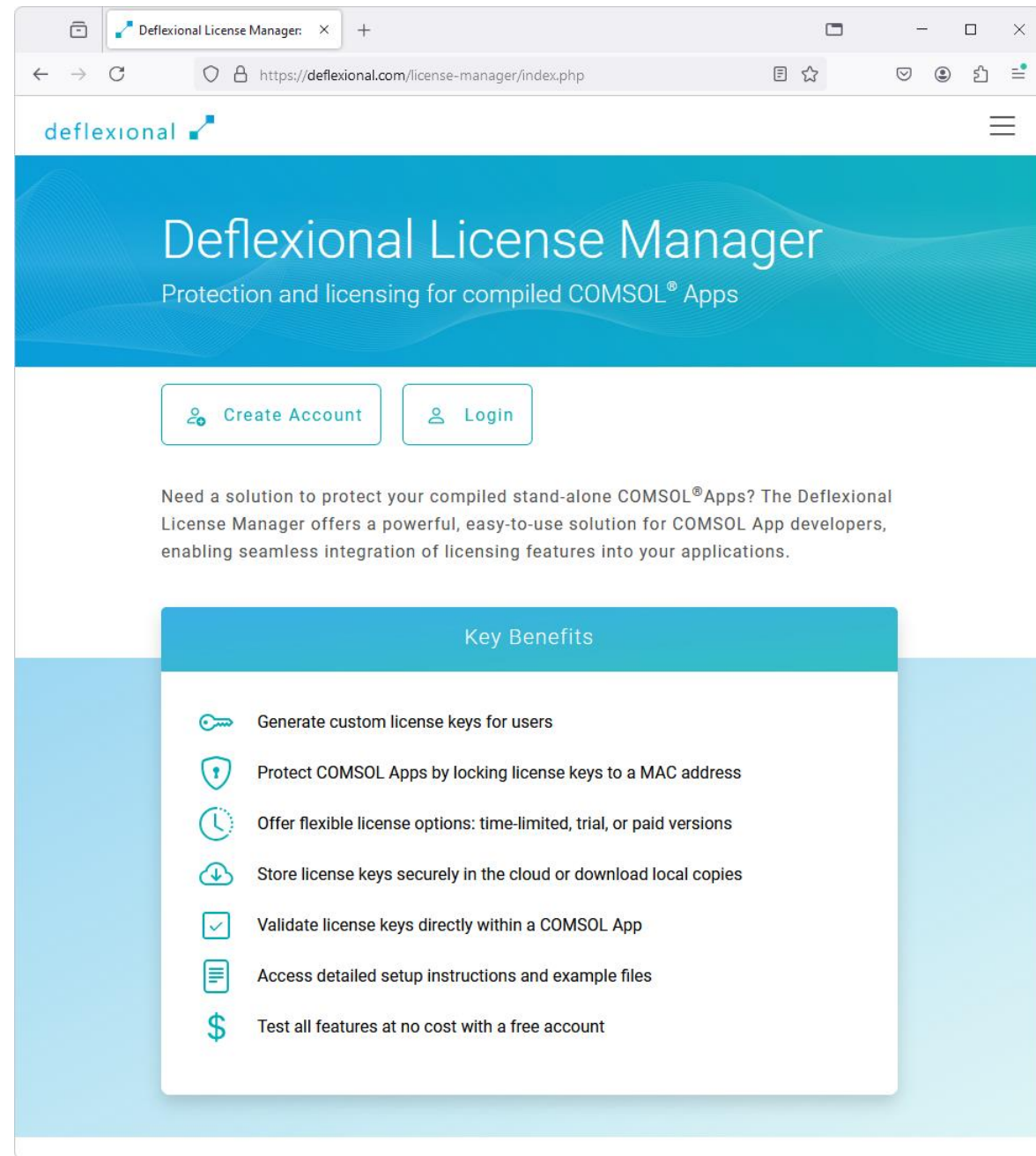
Concrete User Library

- The Concrete User Library enables researchers to add their own concrete mixes
- Requires a license key which is bound to the MAC address



License Keys

- The Deflexional License Manager manages license key generation and integration with the COMSOL App
- Can be tested for free at: deflexional.com/license-manager



The screenshot shows the Deflexional License Manager website. The browser address bar displays the URL <https://deflexional.com/license-manager/index.php>. The website header features the Deflexional logo and the title "Deflexional License Manager" with the subtitle "Protection and licensing for compiled COMSOL® Apps". Below the header, there are two buttons: "Create Account" and "Login". A central text block states: "Need a solution to protect your compiled stand-alone COMSOL® Apps? The Deflexional License Manager offers a powerful, easy-to-use solution for COMSOL App developers, enabling seamless integration of licensing features into your applications." Below this is a "Key Benefits" section with a list of features:

- Generate custom license keys for users
- Protect COMSOL Apps by locking license keys to a MAC address
- Offer flexible license options: time-limited, trial, or paid versions
- Store license keys securely in the cloud or download local copies
- Validate license keys directly within a COMSOL App
- Access detailed setup instructions and example files
- Test all features at no cost with a free account

Deflexional License Manager - ×

https://deflexional.com/license-manager/license-create.php?framework-nr=21

deflexional [Home](#) [Our way](#) [Applications](#) [Testimonials](#) [License Manager](#) [About](#) [Contact](#)

Deflexional License Manager for COMSOL® Apps

- > Home
- ✓ App Frameworks
 - Create App Framework
 - My App Frameworks
- ✓ Licenses
 - Heat Transfer Process Analyzer
 - BI Dry 3.0**
- ✓ Account
 - Settings
 - Logout
- ✓ Documentation
 - Introduction
 - Getting Started Guide
 - Resources
 - Contact/Support

BI Dry 3.0

[List License Keys](#) [Create New License Number](#)

Trial license

Lock license key to MAC address

MAC address:* [?](#)

60-E3-2B-4B-43-4Y

Time limitation:* Version:*

First name:* Last name:*

Email:* Company:*

Country:

[Create New License Number and License Key](#)

Deflexional License Manager - F X

https://deflexional.com/license-manager/doc-resources.php


deflexional [Home](#) [Our way](#) [Applications](#) [Testimonials](#) [License Manager](#) [About](#) [Contact](#)

Deflexional License Manager for COMSOL® Apps

- > Home
- ✓ App Frameworks
 - Create App Framework
 - My App Frameworks
- ✓ Licenses
 - Heat Transfer Process Analyzer
 - BI Dry 3.0
- ✓ Account
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 - Logout
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 - Getting Started Guide
 - Resources**
 - Contact/Support

Resources


Download the files described in the [Getting Started Guide](#) using the links below.
All files require COMSOL Multiphysics version 6.2.

 **License Manager JAR file**

This library provides a comprehensive set of functions for decrypting and validating license keys. The file is needed to use the Deflexional License Manager.


Open your app in COMSOL Multiphysics and navigate to the Application Builder. In the Application Builder window, right-click on *Libraries* and select *External JAVA Library*. Under the *Import Library* section, click *Browse* and choose the JAR file.

- [Download the License Manager JAR file](#)
- [View screenshot](#)

 **License Keys Test App**

This ready-to-use COMSOL Multiphysics file with app included allows you to test the license keys you've created. This file showcases all the features of the Deflexional License Manager and includes the essential code to guide you through the integration process. Experiment with the generated license keys and see how they work in action.

- [Download the License Key Test App](#)
- [View screenshot](#)

 **Example App**

Conclusions

Contractors can now use the latest technology to simulate drying of concrete

Conclusions

- Given the success of HETT²², BI Dry 3.0 has been completely rebuilt on the same platform utilizing COMSOL Multiphysics[®] and COMSOL Compiler[™].
- BI Dry 3.0 uses the Maturity Method and the heat transfer equation plus a convection-diffusion equation for moisture content, coupled with heat transfer.
- By using simulations, significant cost savings and environmental benefits can be realized by choosing the right concrete and construction under certain conditions.
- BI Dry 3.0 is scheduled for release before the end of 2024.
- Any contractor can now leverage the power of COMSOL Multiphysics[®] to simulate the drying of concrete.

We maximize the benefits of engineering simulations

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CEO & Founder

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www.deflexional.com

deflexional 

Deflexional License Manager

Protection and licensing for compiled COMSOL[®] Apps

deflexional.com/license-manager

