

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

Empowering contractors to make informed decisions on concrete mixes and designs to meet relative humidity requirements on time.

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Introduction

Concrete curing is most effective when it stays nearly saturated at an optimal temperature until the cement fully reacts. However, when installing flooring materials that require low relative humidity (RH) in the concrete, rapid drying becomes essential. This drying process is often slow and can disrupt construction timelines. In the worst-case scenario, flooring may be installed before the RH reaches an acceptable level, leading to costly testing, legal disputes, and repairs.

In 2022, Heidelberg Materials introduced HETT²² [1], a software designed to simulate early-age temperature and strength development in concrete. BI Dry 3.0 builds on the same platform, utilizing COMSOL Multiphysics® and COMSOL Compiler™. While BI Dry 3.0 shares similar equations with HETT²², BI Dry 3.0 extends the functionality by solving a convection-diffusion equation for moisture content, coupled with heat transfer, in addition to using the Maturity Method.

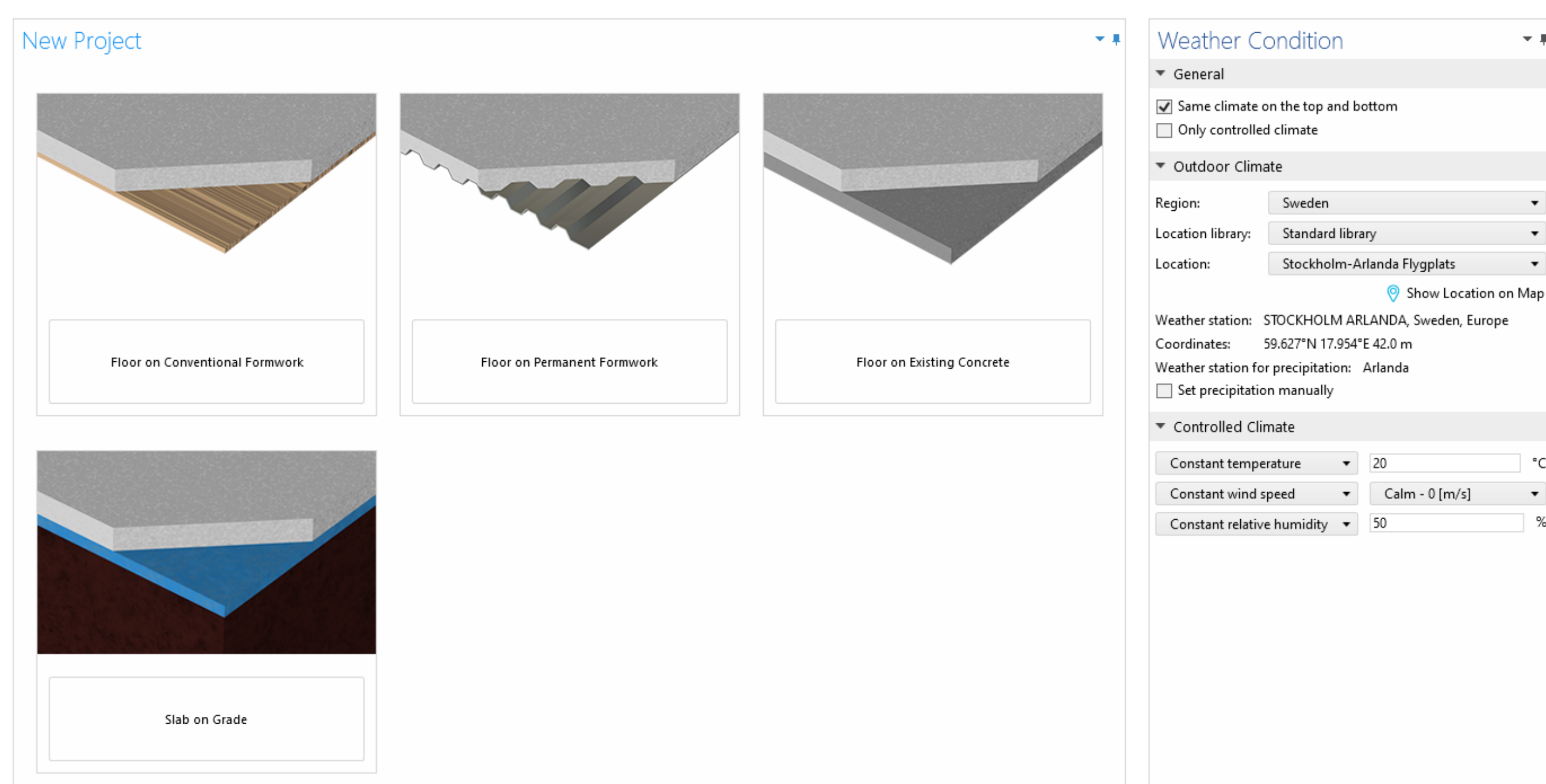


FIGURE 1. Left: When launching the app, the user can choose from various slab structures. Right: Settings for Weather Condition which uses climate data from ASHRAE 2021 and precipitation data from SMHI.

Features

BI Dry includes a selection of predefined slab structures, such as slabs on grade, formwork-cast slabs, and top layer applications on existing concrete. While computations are done in 2D, some visualizations use 3D. Users select the concrete type, set requirements, and define the construction schedule—from casting in an open environment to moving indoors with controlled temperature and humidity, and finally to flooring. Weather data (temperature, wind, RH) comes from the ASHRAE 2021 database, while Swedish projects use precipitation data from SMHI. BI Dry allows users to import sensor data from construction sites, enabling direct comparisons between simulated results and real-world measurements for validation.

Results

Once calculations are complete, a variety of visualization options are available for analyzing relative humidity (RH) and temperature over time. Graphs and information windows provide clear insights into whether the construction is adequately dry or if additional measures are needed to meet the requirements. The software also facilitates easy comparison of different results. BI Dry 3.0 features an intuitive graphical user interface, allowing contractors to run simulations without the need for a background in physics. By selecting the right concrete for specific conditions, significant cost savings and environmental benefits can be achieved. Scheduled for release in fall 2024, BI Dry 3.0 will be available at no cost.

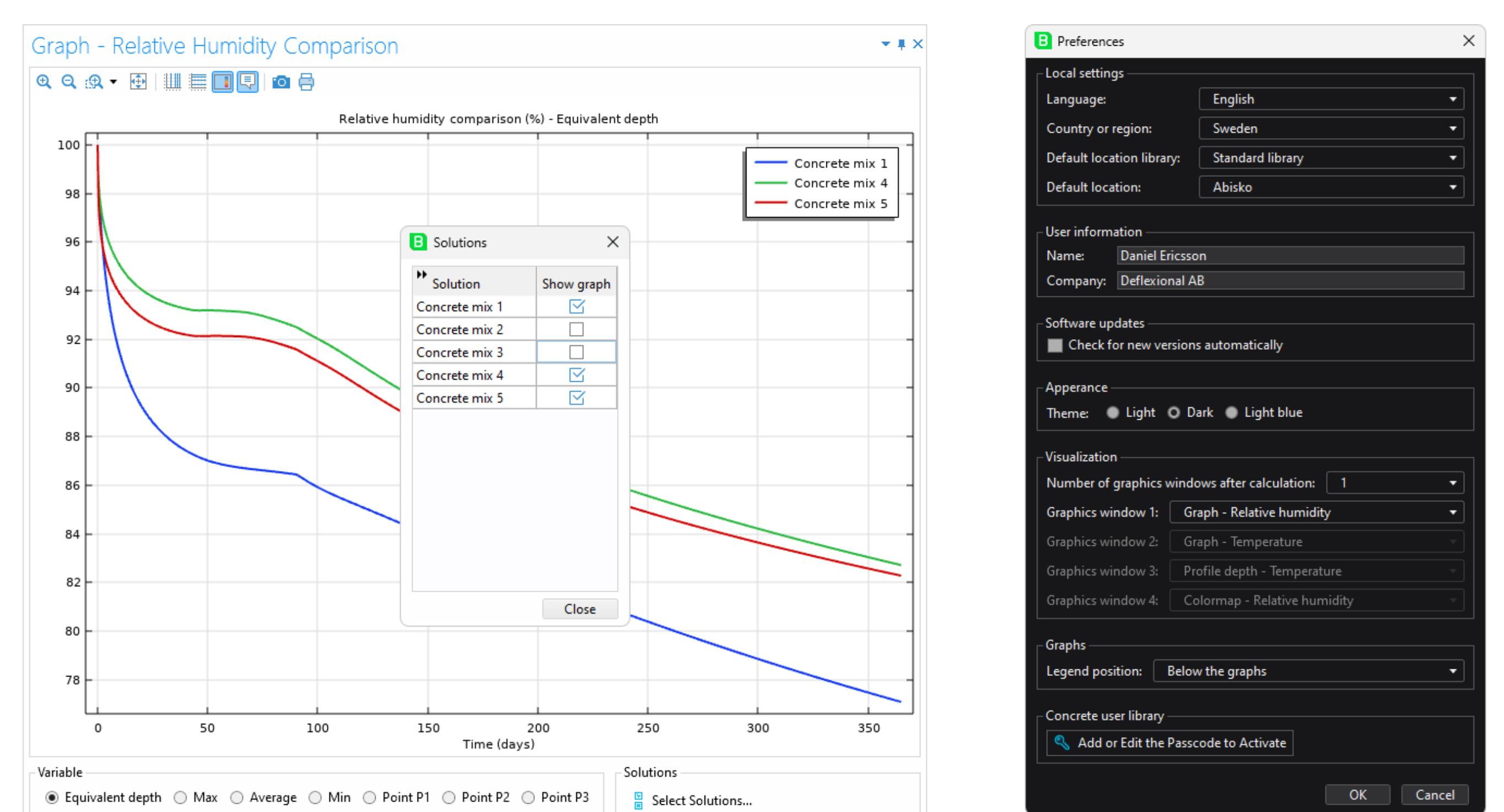


FIGURE 2. Left: BI Dry comes with an innovative tool to easily compare and visualize different solutions. Right: Dialog for preferences in dark theme.

REFERENCES

1. D. Ericsson et al., COMSOL Conference 2023 Munich.

