HETT[22] – A COMSOL® App to Accurately Simulate, Plan and Monitor Concrete Castings

Significant cost savings and environmental benefits can be realized by choosing the right concrete for specific conditions.
HETT[22] represents a state-of-the-art solution for streamlining concrete construction processes.

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Introduction

The early-stage behavior of concrete is influenced by factors such as temperature, wind conditions, construction methods, and dimensions. Considering these crucial factors, contractors need to make thoughtful decisions about the type of concrete they use. This involves choosing the right construction methods and the most suitable building materials. Specialized software plays a pivotal role in this regard, offering early support to the construction team.

The maturity method is a construction industry technique used to predict concrete strength development over time. (Ref. 1). This method has been incorporated into the COMSOL® platform. To make this powerful tool accessible to contractors without requiring expertise in numerical analysis, the Application Builder and COMSOL Compiler™ were used to create HETT[22]. This allows any contractor to harness the capabilities of COMSOL Multiphysics®.
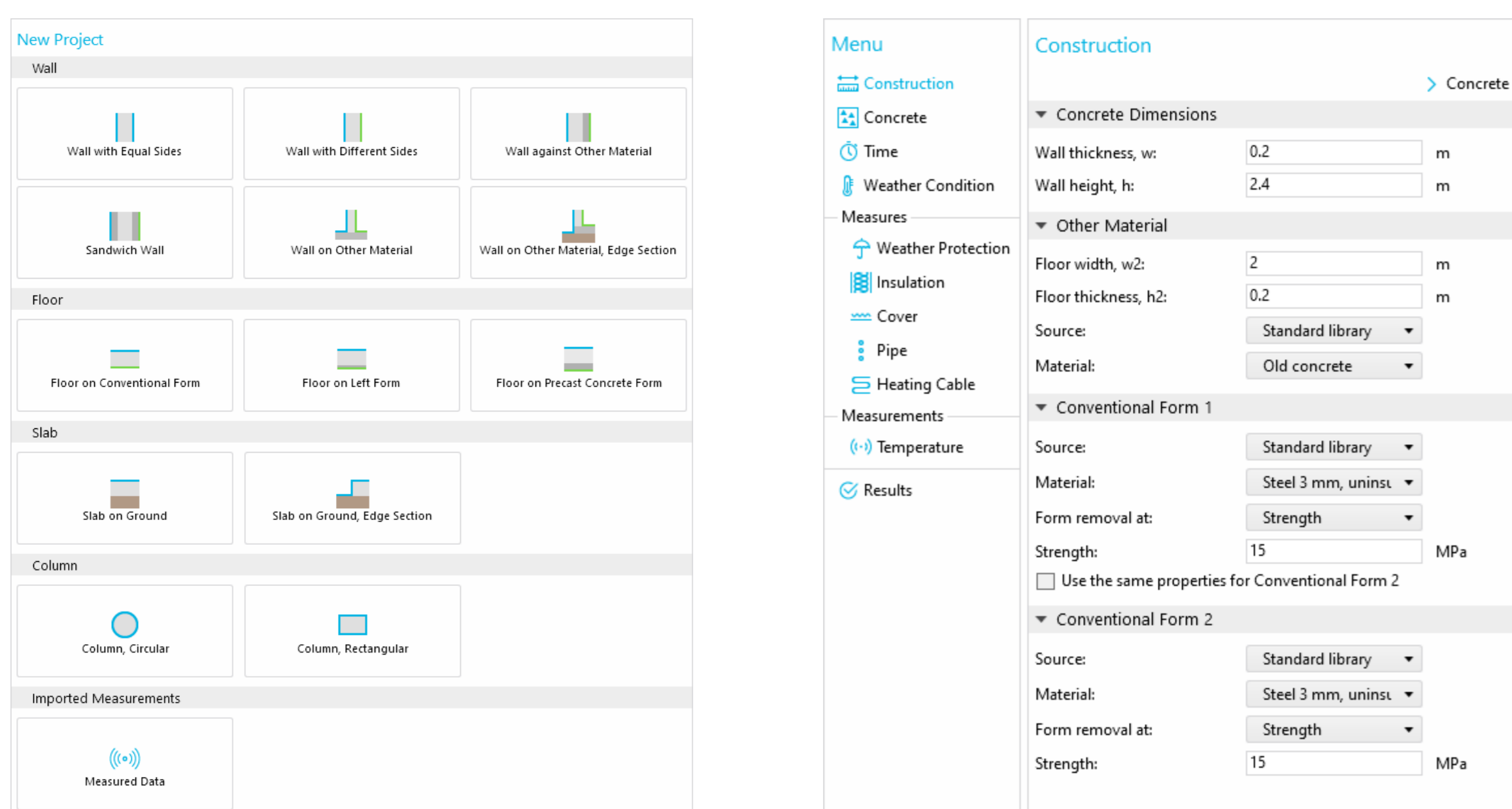

FIGURE 1. Left: When launching the app, the user can choose from various construction cases.
Right: Settings for selected construction, *Wall on Other Material*.

Implementation

The maturity method is implemented in a COMSOL® model utilizing the *Heat Transfer in Solids* physics interface to simulate the heat transfer. The equivalent time is calculated with the *Domain ODEs and DAEs* physics interface and the concrete strength is based on the equivalent time.
The application offers a variety of pre-defined construction scenarios, encompassing different structures like walls, floors, slabs, and columns. It also offers the import of sensor measurements.
The primary components of the graphical user interface consist of a left-sided navigation menu, a settings window, right-sided graphics, and a top ribbon menu.

Key Features

Key features of this application include an installer for deployment, an integrated check-for-updates mechanism, multi-language support, an extensive material library that can be extended, a passcode system granting users access to specific functionalities, and the flexibility to choose between light and dark themes. To improve the prediction of near-future conditions, HETT[22] can automatically download weather forecasts from smhi.se and yr.no through JSON document retrieval. The data is then transformed into the appropriate boundary conditions. For validation, HETT[22] enables users to import sensor data measurements from construction sites, facilitating a direct comparison between simulated results and real-world observations.
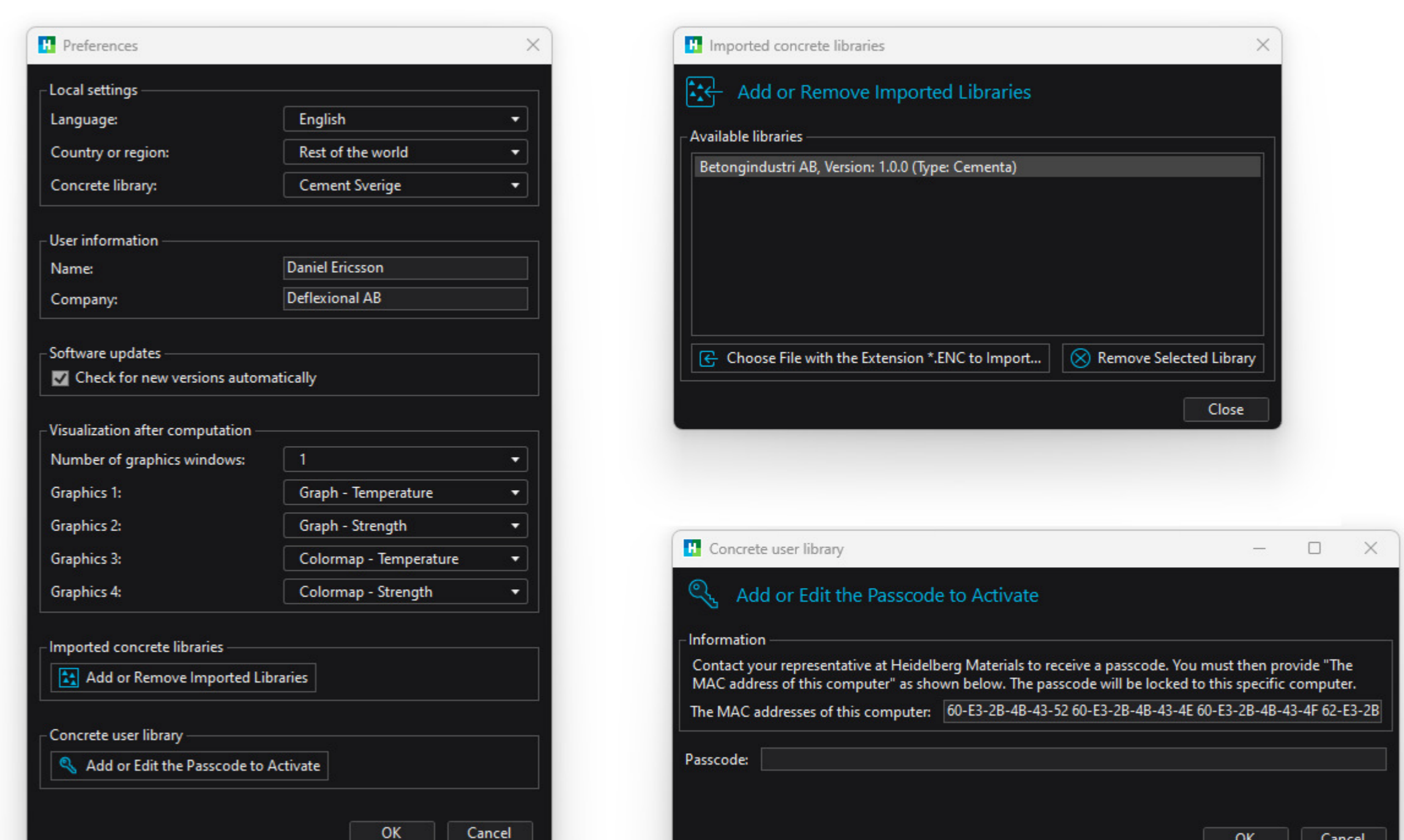

FIGURE 2. Left: Dialog for preferences in dark theme.
Right top: Dialog to import concrete libraries.
Right bottom: Passcode to activate certain features.

REFERENCES

1. P. Fjellström, Measurement and modelling of young concrete properties, Luleå University of Technology, Department of Civil, Environmental and Natural Resources Engineering, Structural and Construction Engineering., 2013.