

HETT²² – A COMSOL[®] App to Accurately Simulate, Plan and Monitor Concrete Castings



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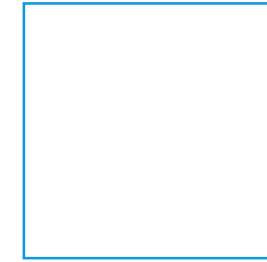
⁴ Heidelberg Materials Betong Sverige AB, Stockholm, Sweden

Contents

- Introduction
- The Maturity Method
- Installation
- The Graphical User Interface
- Exploring & Understanding
- The Underlying COMSOL Model
- Application Features
- Conclusions

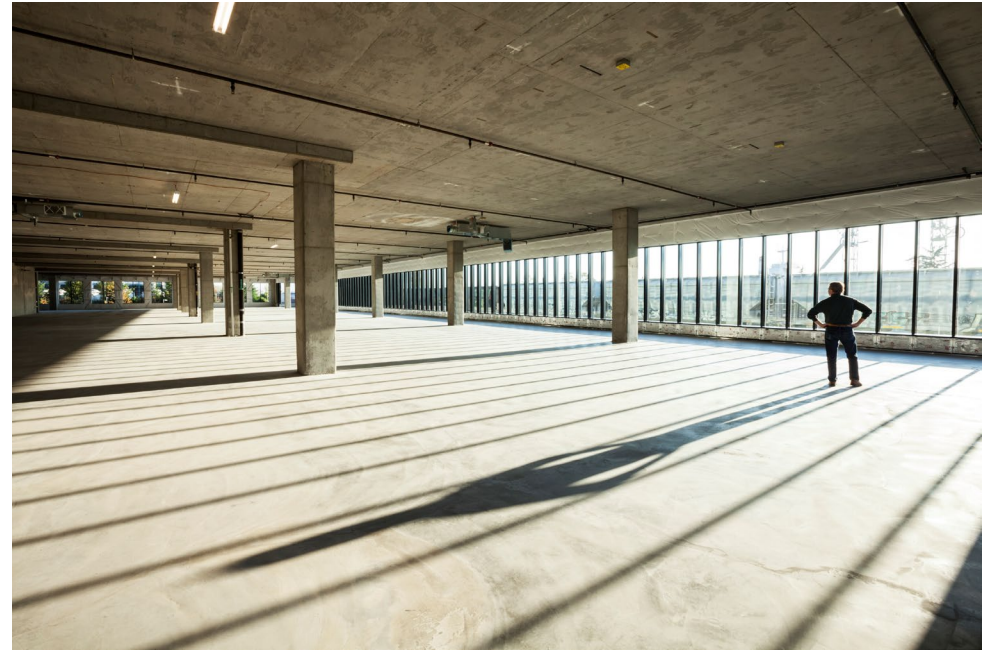
Introduction

Background and benefits of the software



Background

- Concrete is the world's most utilized building material
- The early-age performance of concrete depends on temperature, wind conditions, construction type, and dimensions
- Significant cost savings and environmental benefits can be realized by choosing the right concrete and design for specific conditions



Reductions & Savings

- Reduce CO₂ emission by
 - decreasing the amount of binder
 - not using too high concrete quality
 - adding a binder combination with slag or fly ash
 - choosing the right design
- Cost savings by
 - building the construction faster
 - preventing failures



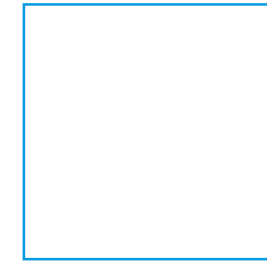
History & Present

- Heidelberg Materials, a global leader in building materials, has long provided customers with finite element-based software solutions to predict heat generation and strength development in concrete
- Existing software was becoming outdated and in need of an update, incorporating new functionalities and features
- Deflexional, a Certified COMSOL Consultant, was commissioned to undertake the development of HETT²², leveraging the versatile capabilities COMSOL[®]



The Maturity Method

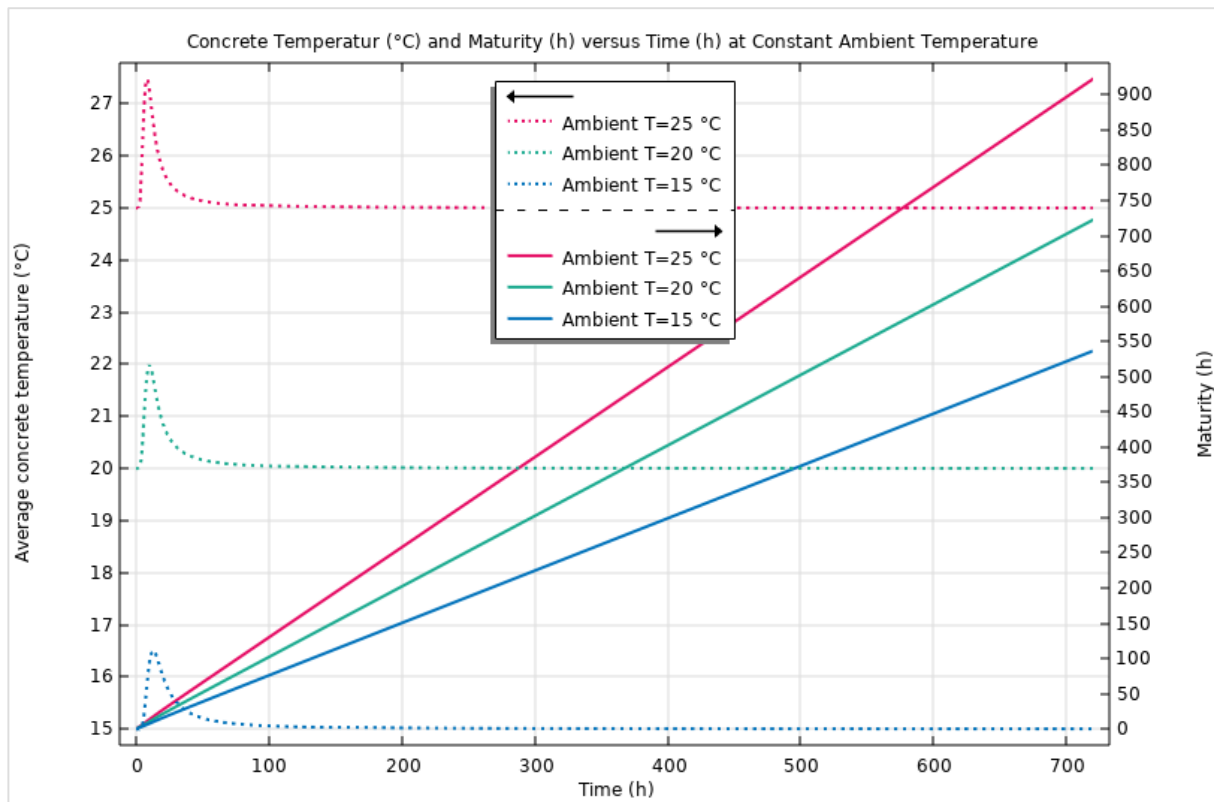
Prediction of concrete strength over time



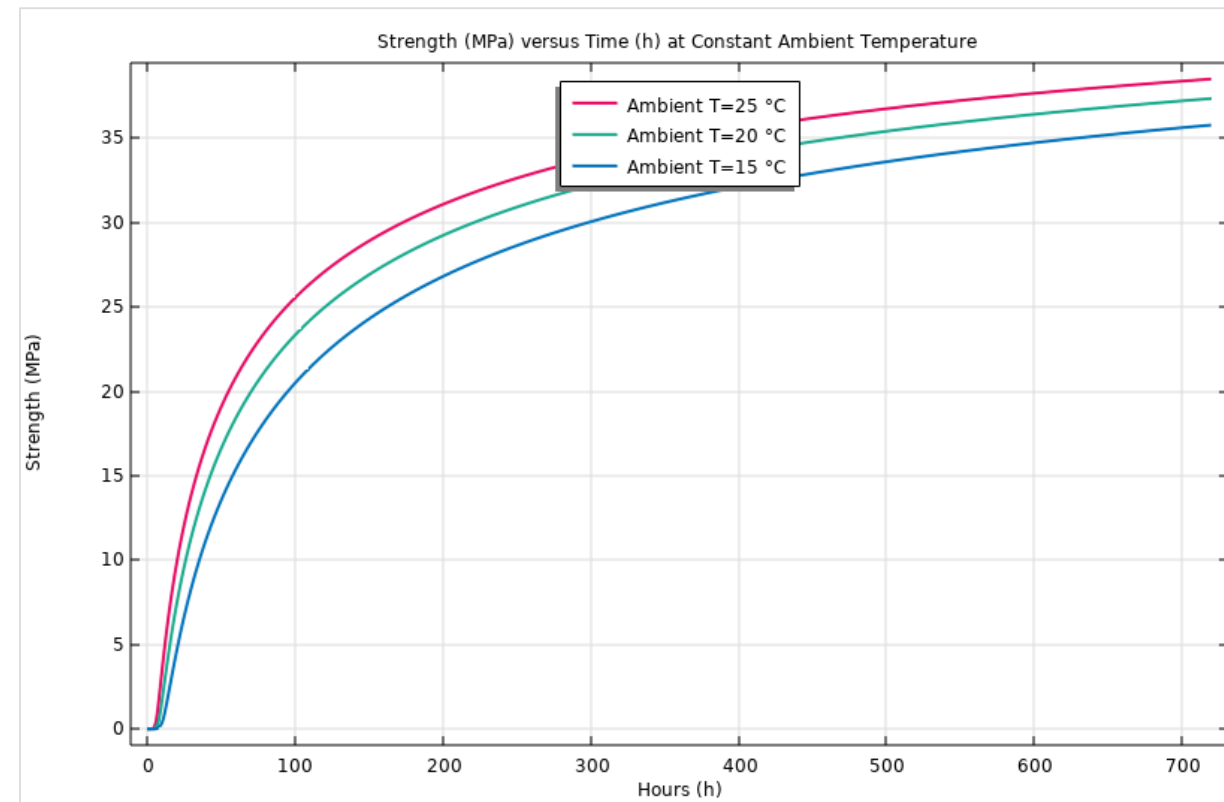
Based on Discoveries of Svante Arrhenius

- Concrete gains strength as it cures, and this process is highly temperature dependent
- The maturity method is founded on the principle that the rate of concrete strength gain is directly influenced by the temperature history
- Utilizing the Arrhenius Equation, the so-called equivalent time, and thus, the concrete maturity can be determined during the concrete hardening process
- The equivalent time represents the total amount of time at a standard reference temperature that is equivalent to the actual time-temperature history experienced by the concrete
- The concrete strength is based on the concrete maturity

Temperature, Maturity & Strength



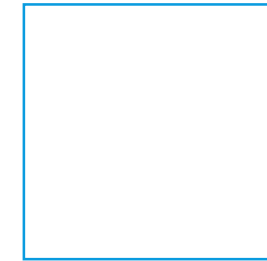
The maturity increases with increased ambient temperature



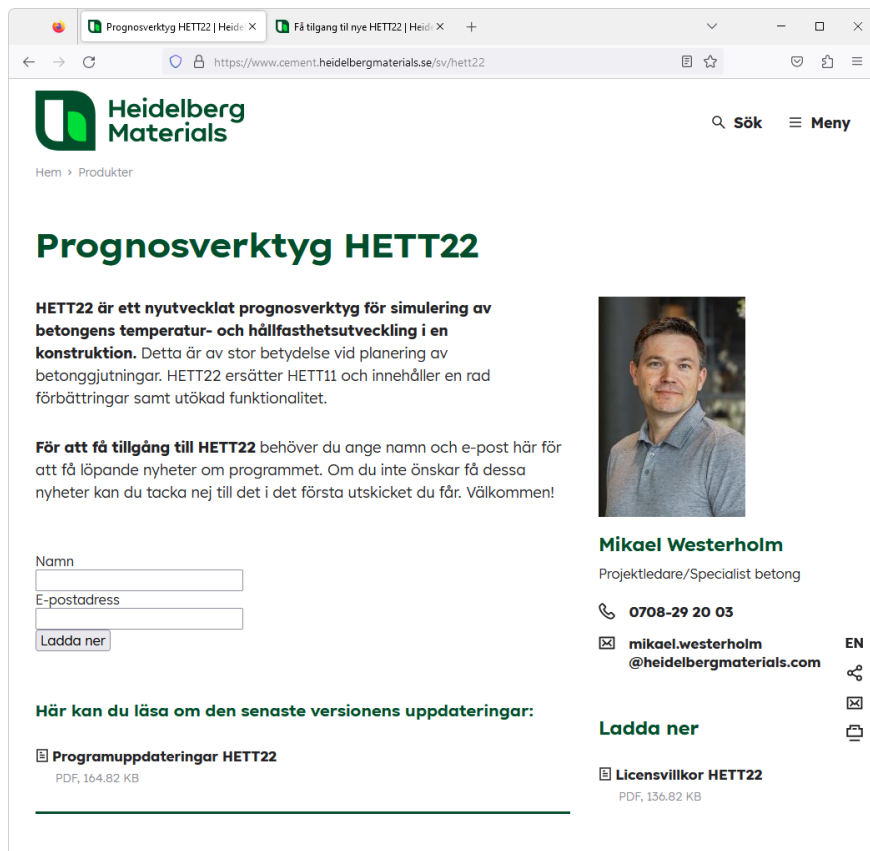
The strength increases with increased ambient temperature

Installation

A powerful tool accessible to contractors



Download the Installer



Prognosverktyg HETT22 | Heidelberg Materials

Heidelberg Materials

Hjem > Produkter

Prognosverktyg HETT22

HETT22 är ett nyutvecklat prognosverktyg för simulering av betongens temperatur- och hållfasthetsutveckling i en konstruktion. Detta är av stor betydelse vid planering av betonggjutningar. HETT22 ersätter HETT11 och innehåller en rad förbättringar samt utökad funktionalitet.

För att få tillgång till HETT22 behöver du ange namn och e-post här för att få löpande nyheter om programmet. Om du inte önskar få dessa nyheter kan du tacka nej till det i det första utskicket du får. Välkommen!

Namn

E-postadress

Ladda ner

Här kan du läsa om den senaste versionens uppdateringar:

- Programuppdateringar HETT22 PDF, 164,82 KB
- Licensvillkor HETT22 PDF, 136,82 KB

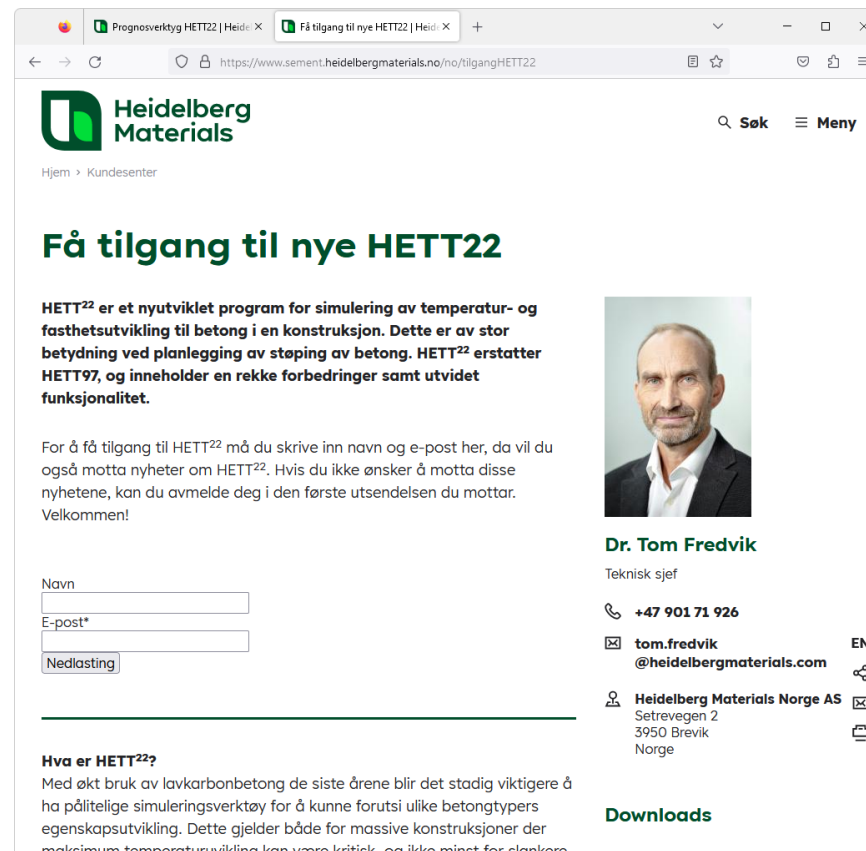
Mikael Westerholm
Projektleddare/Specialist betong

0708-29 20 03

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Ladda ner

www.cement.heidelbergmaterials.se/sv/hett22



Prognosverktyg HETT22 | Heidelberg Materials

Heidelberg Materials

Hjem > Kundesenter

Få tilgang til nye HETT22

HETT²² er et nyutviklet program for simulering av temperatur- og fasthetsutvikling til betong i en konstruksjon. Dette er av stor betydning ved planlegging av støping av betong. HETT²² erstatter HETT⁹⁷, og inneholder en rekke forbedringer samt utvidet funktionalitet.

For å få tilgang til HETT²² må du skrive inn navn og e-post her, da vil du også motta nyheter om HETT²². Hvis du ikke ønsker å motta disse nyhetene, kan du avmelde deg i den første utsendelsen du mottar. Velkommen!

Navn

E-post*

Nedlasting

Hva er HETT²²?

Med økt bruk av lavkarbonbetong de siste årene blir det stadig viktigere å ha pålitelige simuleringstøytøy for å kunne forutsi ulike betongtypers egenskapsutvikling. Dette gjelder både for massive konstruksjoner der maksimum temperaturutvikling kan være kritisk, og ikke minst for slankere

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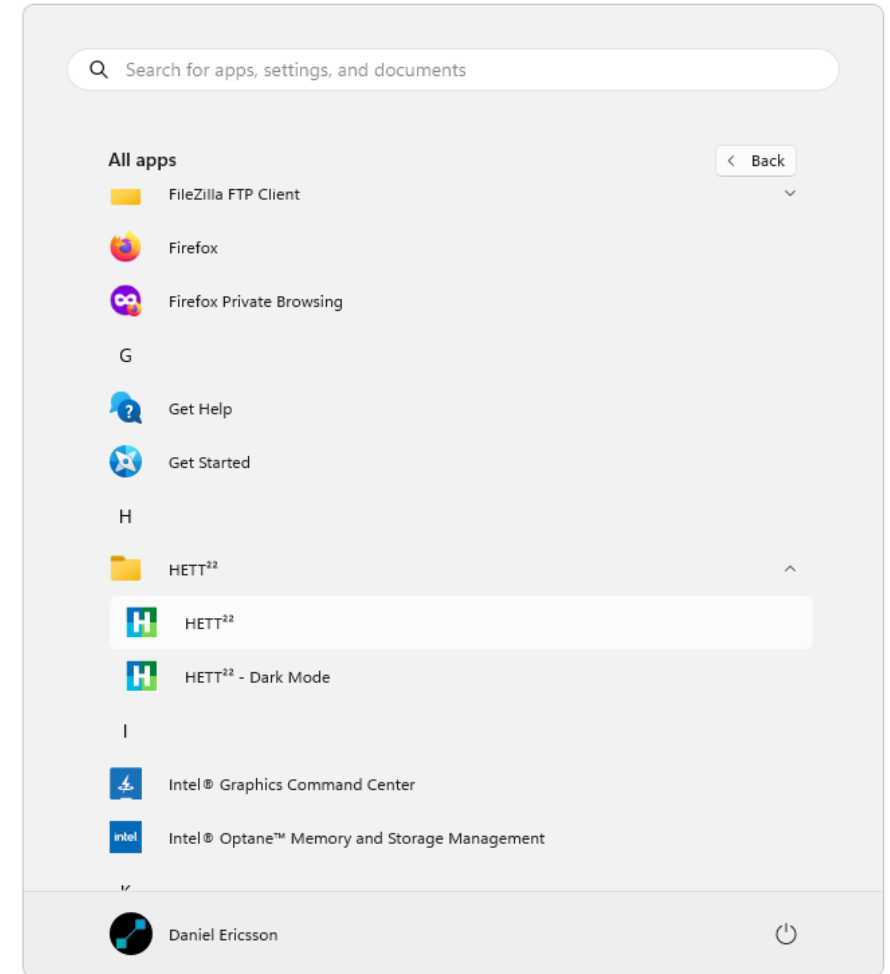
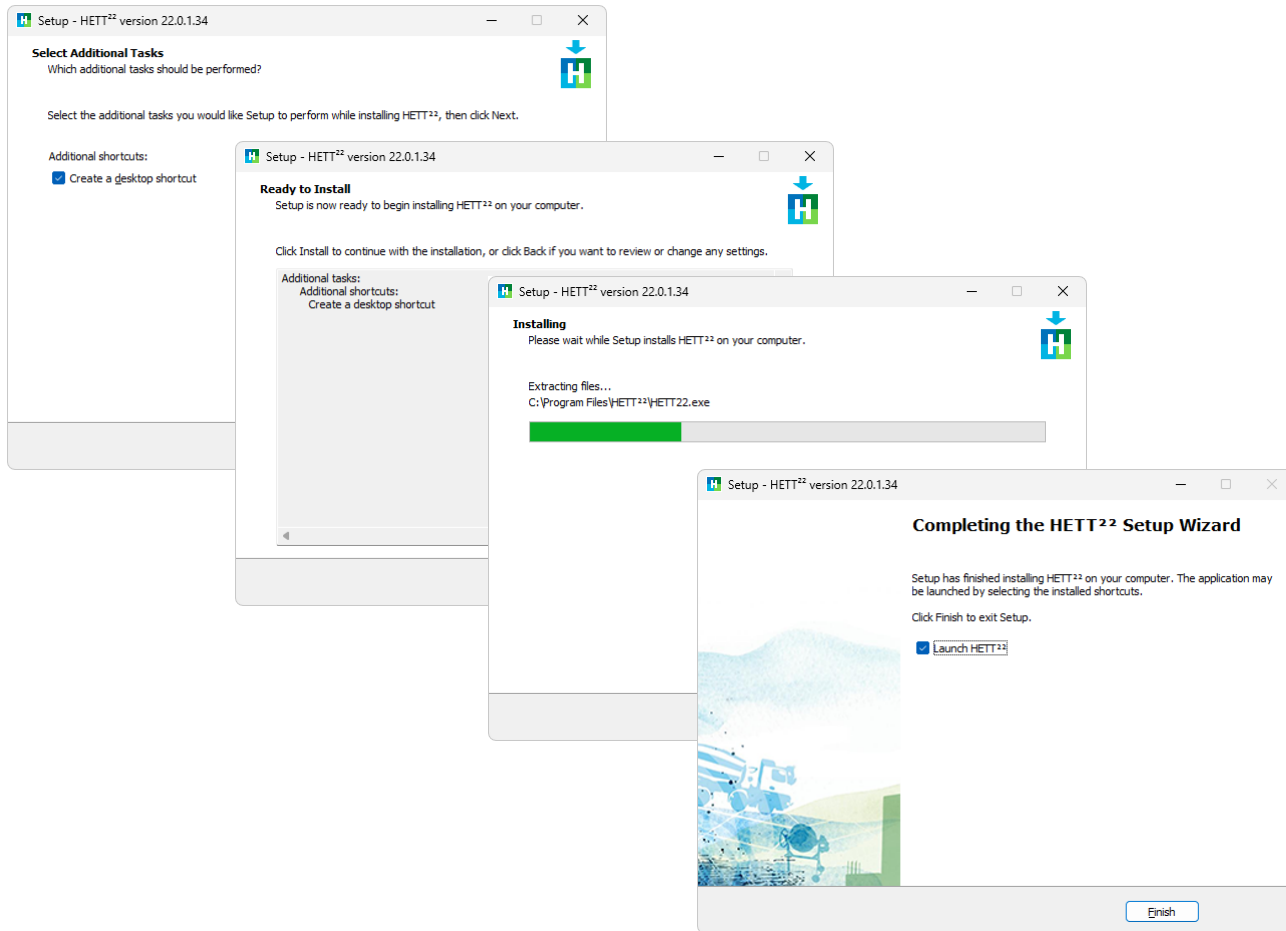
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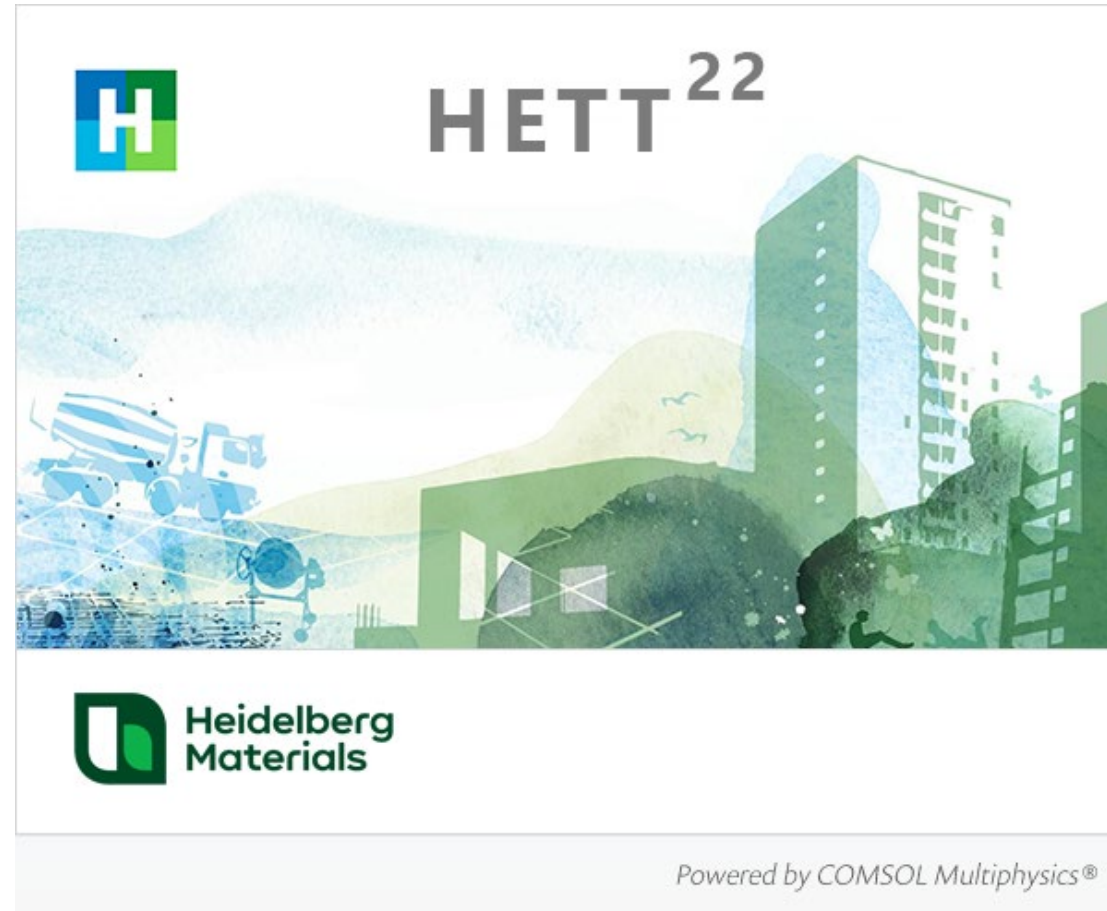
Downloads

www.sement.heidelbergmaterials.no/no/tilgangHETT22

Run the Installer



Splash Screen



If COMSOL Runtime™ is not already installed, it will be automatically downloaded

Terms of Use

The image shows the HETT22 software interface with a 'Terms of Use' dialog box open. The software window has a ribbon menu with categories: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap), Time Development, Measurements, Data (Table, Compare), Documentation (Report), and Libr (Parameters). The main area displays the HETT22 logo and a background image of a cityscape. Below the image are form fields for Language (English), Country or region (Rest of the world), Concrete library (Cement Sverige), Name (Daniel Ericsson), and Company (Deflexional AB). A large button labeled 'Open and Accept the Terms of Use' is highlighted with a red box. At the bottom, the version number is 22.0.1.34 and the expiration date is 2025-05-01.

Terms of Use

TERMS OF USE – HETT22

(Last updated: 30 March, 2023)

INTRODUCTION

These Terms of Use (the "Terms") apply to your use of the software developed for planning concrete works, called HETT22 (the "Software"). The Software simulates the heat- and strength development of concrete under different conditions. More information about the Software is available at www.cement.heidelbergmaterials.se and www.sement.heidelbergmaterials.no.

The Terms constitute a binding contract between you, duly acting on behalf of a corporation or other legal entity (the "User", "you" or "your"), and Heidelberg Materials Northern Europe Aktiebolag ("HMNE", "we" or "us"). The Software is solely intended for commercial or other professional use, to the exclusion of any private use. HMNE grants you the right to use the Software pursuant to these Terms. Please read the Terms carefully before using the Software. You accept these Terms by clicking "Accept Terms of Use" in the Software or otherwise using the Software. If you for any reason do not accept parts of these Terms do not proceed by clicking "Accept Terms of Use" and do not attempt to access the Software.

We reserve the right to alter the content of these Terms, at any time, without prior notice, by publishing an updated version of the Terms on www.cement.heidelbergmaterials.se/sv/ladda-ner-hett22, by updating the Software to incorporate the new Terms or by otherwise providing the new Terms to you as appropriate. By using the Software or by continuing to use the Software after an update to these Terms, you acknowledge your full understanding of and accept the updated Terms. The Terms apply until you have destroyed or deleted the Software and

Open a PDF-file with the Terms of Use

I accept the Terms of Use

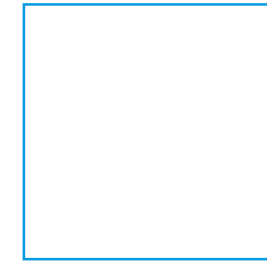
I do not accept the Terms of Use

OK

HETT²² version number: 22.0.1.34
Expiration date: 2025-05-01

The Graphical User Interface

Equipped with pre-defined construction scenarios



Select case

The screenshot displays the HET22 software interface. At the top, there is a title bar with the text 'HET22' and standard window controls. Below the title bar is a ribbon menu with tabs for 'File' and 'Home'. The 'Home' tab is active, showing a series of icons for various functions: New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Graphics Windows (One, Two, Four), and Preferences. Below the ribbon is a large panel titled 'New Project'. This panel is organized into several categories, each with a header and a grid of options:

- Wall**: Wall with Equal Sides, Wall with Different Sides, Wall against Other Material, Sandwich Wall, Wall on Other Material, Wall on Other Material, Edge Section.
- Floor**: Floor on Conventional Form, Floor on Left Form, Floor on Precast Concrete Form.
- Slab**: Slab on Ground, Slab on Ground, Edge Section.
- Column**: Column, Circular, Column, Rectangular.
- Imported Measurements**: Measured Data.

File Menu

Ribbon

Navigation

The screenshot displays the HETT22 software interface. At the top, the window title is 'HETT22'. Below it is a ribbon with tabs for 'File' and 'Home'. The ribbon contains various icons for 'Project' (New, Open, Save), 'Simulation' (Compute), 'Graphics' (Geometry, Mesh, Graph, Colormap, Time Development), 'Data' (Table, Compare), 'Documentation' (Report), 'Library' (Parameters, Locations), 'Graphics Windows' (One, Two, Four), and 'Settings' (Preferences).

On the left side, there is a 'Menu' panel with categories: Construction (Construction, Concrete, Time, Weather Condition), Measures (Weather Protection, Insulation, Cover, Pipe, Heating Cable), Measurements (Temperature), and Results.

The main area is divided into three sections:

- Construction:** Contains settings for 'Concrete Dimensions' (Wall thickness, w: 0.2 m; Wall height, h: 2.4 m), 'Other Material' (Floor width, w2: 2 m; Floor thickness, h2: 0.2 m; Source: Standard library; Material: Old concrete), 'Conventional Form 1' (Source: Standard library; Material: Steel 3 mm, uninst; Form removal at: Strength; Strength: 15 MPa), and 'Conventional Form 2' (Source: Standard library; Material: Steel 3 mm, uninst; Form removal at: Strength; Strength: 15 MPa).
- Graphics:** Shows a 3D model of a wall structure. The wall is labeled 'Wall on Other Material' and has a thickness of 'w=0.20m'. It is supported by a base of 'Other Material' with a width of 'w2=2.0m'. The wall has a height of 'h=2.4m'. The base has a height of 'h2=0.20m'. The wall is divided into four sides: Side 1 (blue), Side 2 (green), Side 3 (red), and Side 4 (green). The wall is made of 'Concrete' and is supported by 'Conventional Form 1' and 'Conventional Form 2'.
- Status:** A message at the bottom of the Graphics panel states: 'No solution is available yet.'

Settings

Status

Graphics

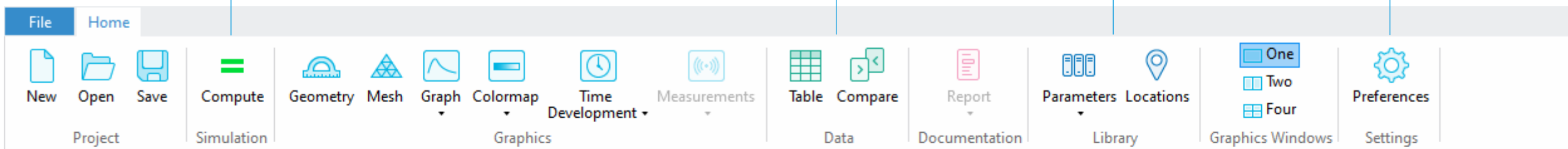
Ribbon

Compute

Results as numerical data

Standard libraries and user libraries

User preferences



Create a new project, save, and open

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

Microsoft® Word® and Microsoft® PowerPoint® reports

Number of concurrent graphics windows

File Menu

The screenshot shows the 'File' menu of a software application. The menu is open, displaying the following options:

- New (Ctrl+N)
- Open (Ctrl+O)
- Save (Ctrl+S)
- Check for Updates
- Preferences
- About HETT²²
- Exit
- About

The ribbon above the menu is divided into several groups:

- Graphics: Refresh, Graph, Colormap, Time Development, Measurements
- Data: Table, Compare
- Documentation: Report
- Library: Parameters, Locations
- Graphics Windows: One, Two, Four
- Settings: Preferences

Two blue lines point from the 'Check for Updates' and 'About HETT²²' menu items to the text labels 'Check for new version' and 'License information' respectively.

Check for new version

License information

Navigation

Construction

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Construction

> Concrete

▼ Concrete Dimensions

Floor thickness, h: m

Floor width, w: m

▼ Precast Concrete Form

Source: ▼

Material: ▼

Standard library

Navigation

Construction

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Construction > Concrete

▼ Concrete Dimensions

Floor thickness, h: m

Floor width, w: m

▼ Precast Concrete Form

Source:

Material:

- Concrete 40 mm
- Concrete 50 mm
- Concrete 70 mm

Material

Navigation

Construction

The screenshot displays the software's navigation and configuration interface. On the left is a vertical 'Menu' with categories: 'Construction' (selected), 'Concrete', 'Time', 'Weather Condition', 'Measures' (including Weather Protection, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable), 'Measurements' (including Temperature), and 'Results'. The main area is titled 'Construction' and contains a '> Concrete' link. Under 'Concrete Dimensions', there are input fields for 'Floor thickness, h:' (0.2 m) and 'Floor width, w:' (2 m). Under 'Precast Concrete Form', there are 'Source:' and 'Material:' labels. The 'Source:' dropdown menu is open, showing 'Standard library' (selected), 'Standard library', 'User library' (highlighted with a blue line and labeled 'User library'), and 'User-defined'.

Navigation

Construction

The image shows a software interface with a navigation menu on the left and a main settings panel on the right.

Navigation Menu:

- Menu
- Construction
- Concrete
- Time
- Weather Condition
- Measures
 - Weather Protection
 - Cover
 - Trowelling
 - Infrared Heating
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Construction Panel:

Construction > Concrete

▼ Concrete Dimensions

Floor thickness, h: m

Floor width, w: m

▼ Precast Concrete Form

Source:

Material: Material

Navigation

Construction

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Construction > Concrete

▼ Concrete Dimensions

Floor thickness, h: m

Floor width, w: m

▼ Precast Concrete Form

Source:

Material:

User-defined

Navigation

Construction

The screenshot displays a software interface with a navigation sidebar on the left and a main settings panel on the right. The sidebar includes sections for Menu, Measures, Measurements, and Results. The 'Construction' menu item is highlighted. The main panel shows settings for 'Concrete' and 'Precast Concrete Form'. A blue arrow points from the text 'User-defined' to the 'Source' dropdown menu, which is currently set to 'User-defined'.

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Construction > Concrete

Concrete Dimensions

Floor thickness, h: m

Floor width, w: m

Precast Concrete Form

Source: User-defined

Density: kg/m³

Heat capacity: J/(kg·K)

Thermal conductivity: W/(m·K)

Floor thickness: m

Navigation

Construction

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Construction > Concrete

Concrete Dimensions

Floor thickness, h: m

Floor width, w: m

Precast Concrete Form

Source:

Density: kg/m³

Heat capacity: J/(kg·K)

Thermal conductivity: W/(m·K)

Floor thickness: m

Save material

Save to user library

New name:

Navigation

Construction

The screenshot displays a software interface with a navigation sidebar on the left and a main settings panel on the right.

Navigation Sidebar:

- Menu
 - Construction
 - Concrete
 - Time
 - Weather Condition
- Measures
 - Weather Protection
 - Cover
 - Trowelling
 - Infrared Heating
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Construction Panel:

- Construction > Concrete
- Concrete Dimensions
 - Floor thickness, h: 0.2 m
 - Floor width, w: 2 m
- Precast Concrete Form
 - Source: User library
 - Material: Special concrete 6l

A blue line points from the text "Saved material" to the "Special concrete 6l" dropdown menu.

Navigation

Concrete

The screenshot shows a software interface for configuring concrete. On the left is a navigation menu with categories: Menu, Measures, Measurements, and Results. The 'Concrete' option is highlighted in blue. The main panel is titled 'Concrete' and has a breadcrumb trail: Construction > Concrete > Time. The 'Concrete' section is expanded, showing several dropdown menus: Source (Standard library), Concrete quality (C32/40), Cement type (Bascement), and Additions 1 (None). There is an unchecked checkbox for 'Manual settings'. Below this are three input fields: Binder content (350 kg/m³), 28-days strength (40 MPa), and Retardation (0 h). The 'Concrete Temperature' section is expanded, showing a 'Casting temperature' input field set to 15 °C. Two blue lines with text labels point to specific elements: 'Select concrete' points to the 'Concrete' breadcrumb, and 'Temperature' points to the 'Concrete Temperature' section header.

Menu

- Construction
- Concrete**
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Concrete

< Construction > Time

▼ Concrete

Source: Standard library

Concrete quality: C32/40

Cement type: Bascement

Additions 1: None

Manual settings

Binder content: 350 kg/m³

28-days strength: 40 MPa

Retardation: 0 h

▼ Concrete Temperature

Casting temperature: 15 °C

Select concrete

Temperature

Navigation

Time

The screenshot displays the 'Time' configuration interface. On the left is a navigation menu with the following items:

- Menu
 - Construction
 - Concrete
 - Time**
 - Weather Condition
- Measures
 - Weather Protection
 - Cover
 - Trowelling
 - Infrared Heating
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

The main content area is titled 'Time' and shows the following settings:

- Navigation: < Concrete | Weather Condition >
- Simulation: 7 d (labeled 'Simulation time')
- Start Time (labeled 'Start time'):
 - Year: 2023
 - Month: October
 - Day: 16
 - Hour: 18
 - Minute: 55
- Buttons: Get the current time
- Advanced Time Settings (expanded)

Navigation

Weather Condition

Menu

- Construction
- Concrete
- Time
- Weather Condition**

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Weather Condition

< Time > Weather Protection

▼ Weather Condition - Side 1

Weather description: Data from YR

Source: Standard library

Location: Sweden - Stockhol

Show Weather Show on Map

Use the same properties for Side 2

▼ Precast Concrete Form

Initial temperature: 15 °C

Weather

Navigation

Weather Protection

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection**
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

- Results

Weather Protection

< Weather Condition > Cover

▼ Weather Protection - Side 1

Use weather protection

Temperature increase: °C

Wind condition:

Use the same properties for Side 2

▼ Weather Protection - Side 2

Use weather protection

Temperature increase: °C

Wind condition:

Navigation

Cover

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover**
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

- Results

Cover

< Weather Protection > Trowelling

▼ Cover - Side 1

Use cover

Description:

Source:

Material:

Time, cover on: h

Time, cover off: h

Navigation

Trowelling

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling**
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

- Results

Trowelling

< Cover > Infrared Heating

▼ Trowelling

- Use trowelling
- Strength at start: MPa
- Strength at end: MPa
- Maximum time required: h

Navigation

Infrared Heating

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating**
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Infrared Heating

< Trowelling > Pipe

▼ Infrared Heating - Side 1

Use Infrared heating
 Use the same properties for Side 2

Description: Power on/off ▼

Power: 40 W/m²

Time, power on: 0 h

Time, power off: 72 h

▼ Infrared Heating - Side 2

Use Infrared heating

Description: Power on/off ▼

Power: 40 W/m²

Time, power on: 0 h

Time, power off: 72 h

Navigation

Pipe

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe**
- Heating Cable

Measurements

- Temperature

Results

Pipe

< Infrared Heating > Heating Cable

▼ Pipe

Series:

Position:

Use series

Position

Start point, x: m

Start point, y: m

Distance in x-direction: m

Distance in y-direction: m

Number in x-direction:

Number in y-direction:

Data

Source:

Material:

Medium:

Flow rate: l/min

Description:

Time, power on: h

Time, power off: h

Temperature: °C

Navigation

Heating Cable

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable**

Measurements

- Temperature

Results

Heating Cable

< Pipe > Temperature

▼ Heating Cable

Series: Series #1

Position: In concrete

Use series

Position

Start point, x: 1 m

Start point, y: 0.1 m

Distance in x-direction: 0.2 m

Distance in y-direction: 0.05 m

Number in x-direction: 1

Number in y-direction: 1

[Show Heating Cable Positions](#)

Data

Description: On/off

Time, power on: 5 h

Time, power off: 96 h

Source: Standard library

Material: 10 W/m

Navigation

Temperature

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Temperature

< Heating Cable > Results

▼ Imported Measurements

Data description

One file per channel One file for all channels

Date format: Relative time [h] ▼

Number of channels: 4 ▼

Channels

1:	Not active ▼	Import	Visualize
2:	Not active ▼	Import	Visualize
3:	Not active ▼	Import	Visualize
4:	Not active ▼	Import	Visualize

Visualize Measured Data in all Active Channels

Show Measurement Positions in Concrete

Navigation

Results

Menu

- Construction
- Concrete
- Time
- Weather Condition

Measures

- Weather Protection
- Cover
- Trowelling
- Infrared Heating
- Pipe
- Heating Cable

Measurements

- Temperature

Results

Results

< Temperature

▼ Trowelling

Trowelling, start:	8.9 h, 0.12 MPa
Trowelling, end:	10.1 h, 0.25 MPa

▼ Results During the Simulation

Temperature, max:	23.5 °C
Temperature, min:	3.9 °C
Temperature difference, max:	13.34 °C
Final strength, average:	29.4 MPa

▼ Notifications and Warnings

✓ The results give no warnings.

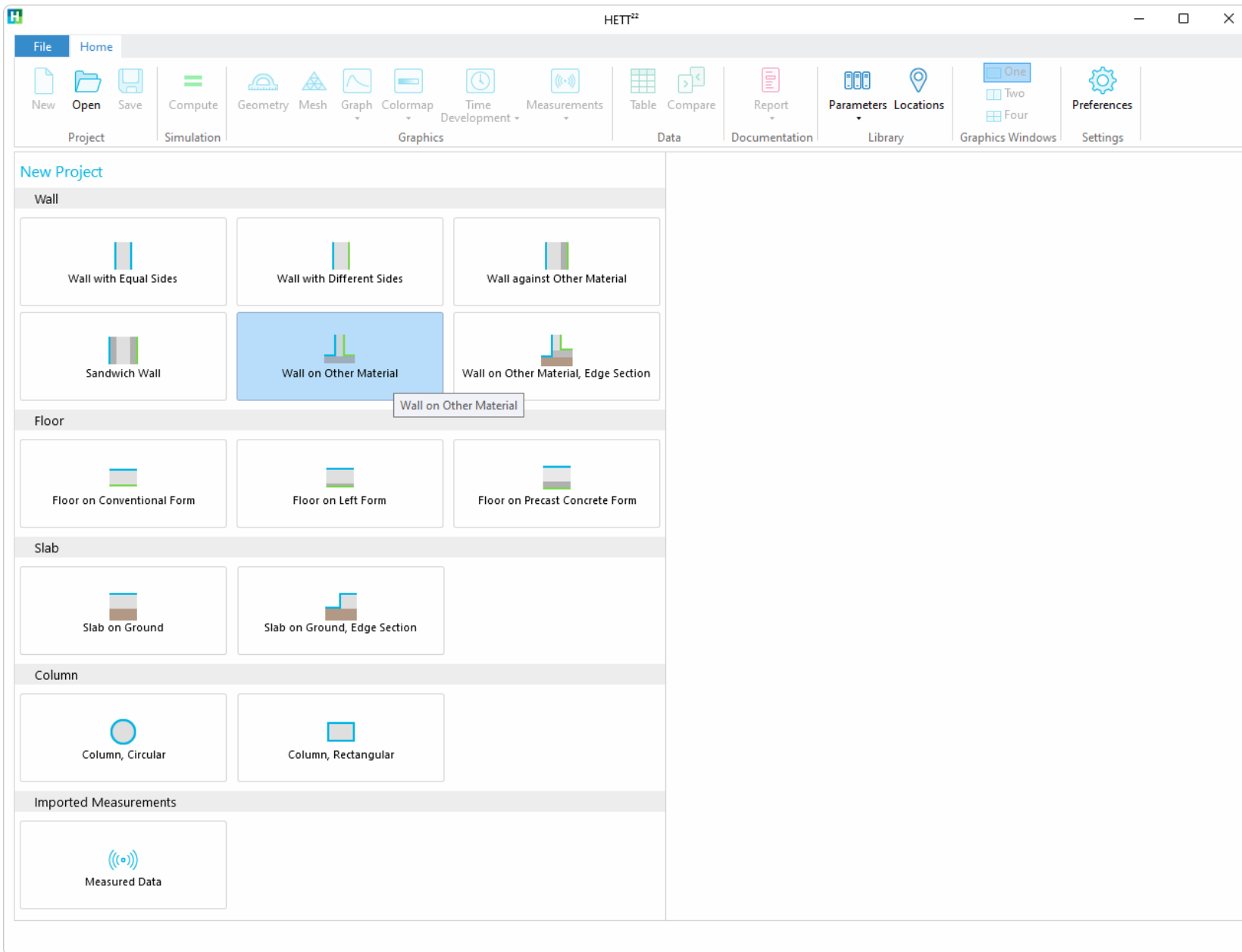
Exploring & Understanding

Example of casting a wall onto a concrete floor



Scenario

- Casting of a wall onto a concrete floor
- Construction site in Luleå in Northern Sweden
 - A significant portion of these mathematical models were developed in Luleå
- Start of casting on October 12th, 2023, at 15:00
- Select a construction and a concrete that will
 - Keep the time plan to remove the form after 18 hours
 - Minimize the carbon footprint



Select *Wall on Other Material*

HETT²²

File Home

New Open Save Compute Geometry Mesh Graph Colormap Time Development Measurements Table Compare Report Parameters Locations One Two Four Preferences

Project Simulation Graphics Data Documentation Library Graphics Windows Settings

Menu

- Construction
- Concrete
- Time
- Weather Condition
- Measures
 - Weather Protection
 - Insulation
 - Cover
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Construction

Concrete Dimensions

Wall thickness, w: 0.2 m

Wall height, h: 2.4 m

Other Material

Floor width, w2: 2 m

Floor thickness, h2: 0.2 m

Source: Standard library

Material: Old concrete

Conventional Form 1

Source: Standard library

Material: Steel 3 mm, uninst

Form removal at: Time

Time: 18 h

Use the same properties for Conventional Form 2

Conventional Form 2

Source: Standard library

Material: Steel 3 mm, uninst

Form removal at: Time

Time: 18 h

Graphics

Geometry

Wall on Other Material

Side 3 w=0.20m

Concrete

Side 1

Side 2

Conventional Form 1

Conventional Form 2

Other Material

h=2.4m

h2=0.20m

w2=2.0m

Side 4

The input has been changed since the last simulation.

Set dimension and set the time of form removal to 18 hours

HETT²²

File Home

New Open Save Compute Geometry Mesh Graph Colormap Time Development Measurements Table Compare Report Parameters Locations One Two Four Preferences

Project Simulation Graphics Data Documentation Library Graphics Windows Settings

Menu

- Construction
- Concrete
- Time
- Weather Condition
- Measures
 - Weather Protection
 - Insulation
 - Cover
 - Pipe
 - Heating Cable
- Measurements
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- Results

Concrete

< Construction > Time

Concrete

Source: Standard library

Concrete quality: C28/35

Cement type: Basement

Additions 1: None

Manual settings

Binder content: 320 kg/m³

28-days strength: 35 MPa

Retardation: 0 h

Concrete Temperature

Casting temperature: 15 °C

Graphics Geometry

Wall on Other Material

Side 3 w=0.20m

Concrete

Side 1 Side 2

Conventional Form 1

Conventional Form 2

Other Material h2=0.20m

w2=2.0m

Side 4

h=2.4m

The input has been changed since the last simulation.

Select the concrete quality C28/35

The screenshot displays the HETT22 software interface, which is used for simulating concrete casting. The interface is divided into several sections:

- Top Bar:** Contains the application name "HETT22" and standard window controls (minimize, maximize, close).
- File Menu:** Includes options for File and Home.
- Toolbars:** A series of icons for various functions: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap, Time Development), Data (Table, Compare), Documentation (Report), Library (Parameters, Locations), Graphics Windows (One, Two, Four), and Settings (Preferences).
- Left Panel (Menu):** A vertical list of navigation options including Construction, Concrete, Time, Weather Condition, Measures (Weather Protection, Insulation, Cover, Pipe, Heating Cable), Measurements (Temperature), and Results.
- Time Settings Panel:** Located in the center-left, it allows users to configure simulation parameters:
 - Simulation:** Simulation time is set to 7 days.
 - Start Time:** Year is 2023, Month is October, Day is 12, Hour is 15, and Minute is 00. A "Get the current time" button is also present.
 - Advanced Time Settings:** A section for further time-related configurations.
- Graphics Panel:** On the right, it shows a 3D model of a concrete wall structure. The model includes:
 - Wall on Other Material:** A vertical concrete wall with a width of 0.20m (Side 3).
 - Concrete:** The main vertical section of the wall.
 - Conventional Form 1:** A horizontal section above the concrete.
 - Conventional Form 2:** A horizontal section below the concrete.
 - Other Material:** A base layer with a height of 0.20m (h2=0.20m) and a width of 2.0m (w2=2.0m).
 - Sides:** The wall is labeled with Side 1 (left), Side 2 (right), Side 3 (top), and Side 4 (bottom).
 - Dimensions:** The total height of the wall section is 2.4m (h=2.4m).
- Status Bar:** At the bottom, a message states: "The input has been changed since the last simulation."

Set the simulation time and the start time for the casting

HETT²²

File Home

New Open Save Compute Geometry Mesh Graph Colormap Time Development Measurements Table Compare Report Parameters Locations One Two Four Preferences

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- Concrete
- Time
- Weather Condition
- Measures
 - Weather Protection
 - Insulation
 - Cover
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Weather Condition

< Time > Weather Protection

Weather Condition - Side 1

Weather description: Data from YR

Source: User-defined

Latitude, Longitude: 65.585,22.161

Show Weather Show on Map Save Location

Use the same properties for Side 2

Use the same properties for Side 3

Use the same properties for Side 4

Other Material

Initial temperature: 15 °C

Graphics Geometry

Wall on Other Material

m

2.8

2.6

2.4

2.2

2

1.8

1.6

1.4

1.2

1

0.8

0.6

0.4

0.2

0

-0.2

-0.4

-0.6

-2

-1.5

-1

-0.5

0

0.5

1

1.5

2

m

Side 3
w=0.20m

Concrete

Side 1

Side 2

h=2.4m

Conventional Form 1

Conventional Form 2

Other Material

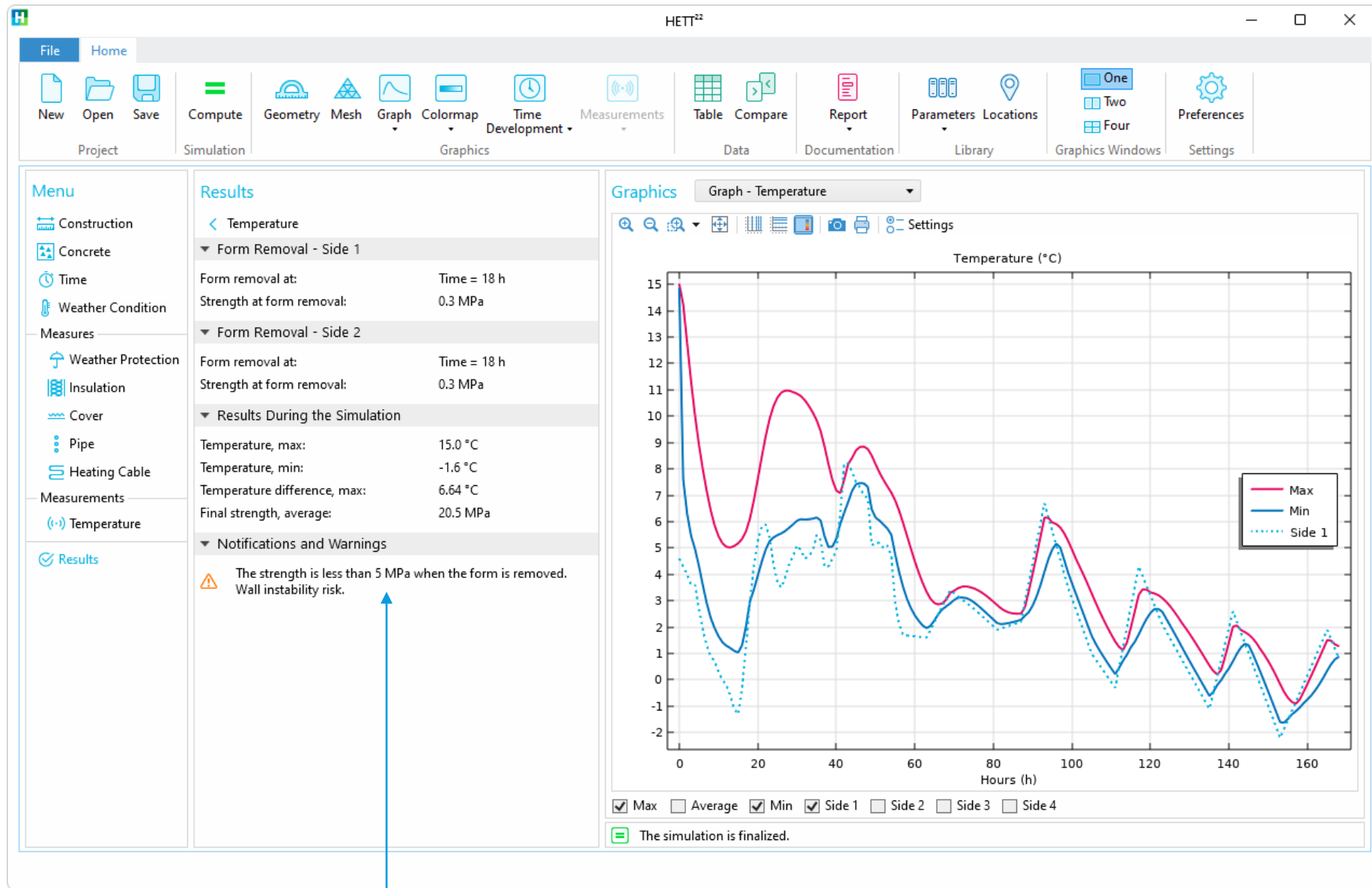
w2=2.0m

h2=0.20m

Side 4

The input has been changed since the last simulation.

Set the weather condition and use a forecast from YR using latitude and longitude



With the chosen construction and concrete quality, the form cannot be removed after 18 hours

Try a Higher Concrete Quality

- Cures faster
- Higher cost
- Increased environmental impact



HETT²²

File Home

New Open Save Compute Geometry Mesh Graph Colormap Time Development Measurements Table Compare Report Parameters Locations One Two Four Preferences

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Menu

- Construction
- Concrete
- Time
- Weather Condition
- Measures
 - Weather Protection
 - Insulation
 - Cover
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Concrete

< Construction > Time

Concrete

Source: Standard library

Concrete quality: C35/45

Cement type: Basement

Additions 1: None

Manual settings

Binder content: 370 kg/m³

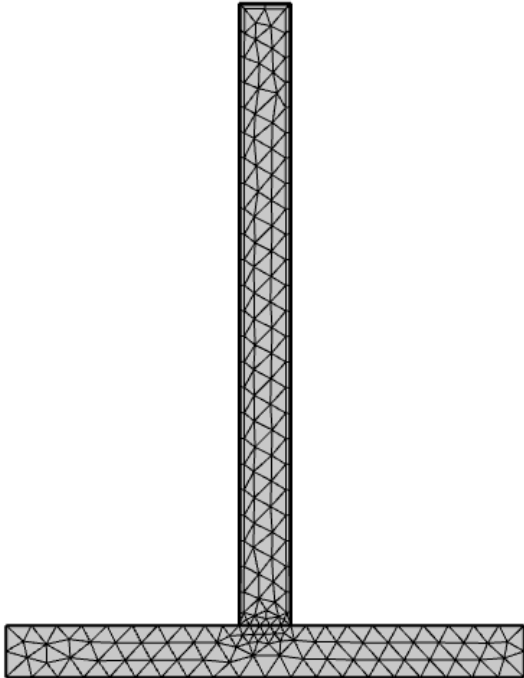
28-days strength: 45 MPa

Retardation: 0 h

Concrete Temperature

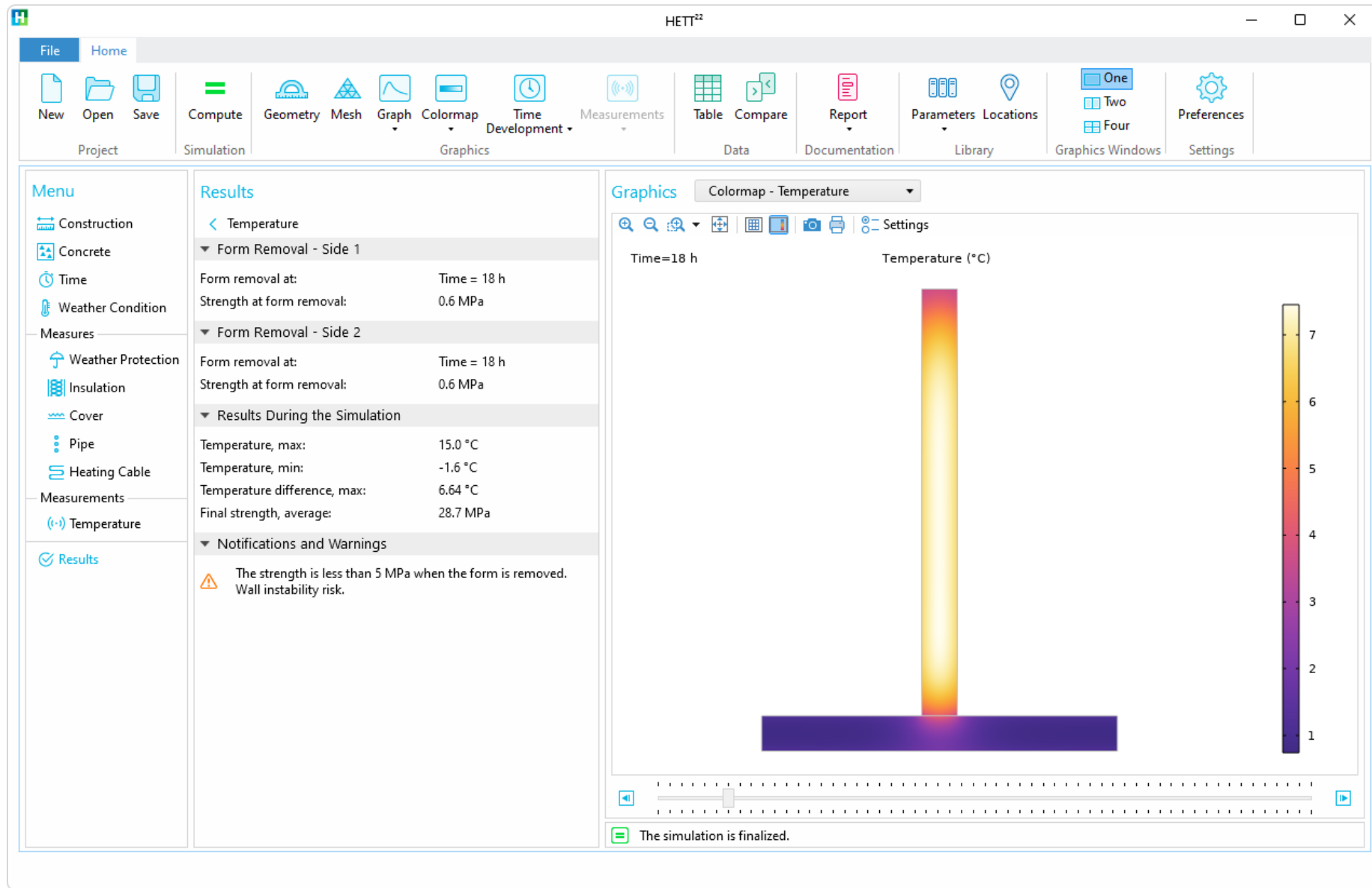
Casting temperature: 15 °C

Graphics Mesh



The input has been changed since the last simulation.

Increase the concrete quality and simulate again



Even with the higher concrete quality, the form cannot be removed after 18 hours

Increasing the Temperature

- Increase the strength of the concrete by elevating the temperature
- One approach to achieve this is by incorporating insulation into the formwork
- Transition from an uninsulated steel form to a Plywood form with 30 mm XPS foam

HETT²

File Home

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Menu

- Construction
 - Concrete
 - Time
 - Weather Condition
- Measures
 - Weather Protection
 - Insulation
 - Cover
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Construction

Concrete Dimensions

Wall thickness, w: 0.2 m

Wall height, h: 2.4 m

Other Material

Floor width, w2: 2 m

Floor thickness, h2: 0.2 m

Source: Standard library

Material: Old concrete

Conventional Form 1

Source: Standard library

Material: Plywood 12 mm +

Form removal at:

Time:

Use the same properties fo

Conventional Form 2

Source: Plywood 12 mm + XPS foam 30 mm

Material:

Form removal at:

Time:

Plywood 14 mm, insulated

Plywood 15 mm, insulated

Plywood 17 mm, insulated

Plywood 18 mm, insulated

Plywood 19 mm, insulated

Plywood 12-19 mm, well insulated

Plywood 12 mm + XPS foam 30 mm

Plywood 14 mm + XPS foam 30 mm

Plywood 15 mm + XPS foam 30 mm

Plywood 17 mm + XPS foam 30 mm

Plywood 18 mm + XPS foam 30 mm

Plywood 19 mm + XPS foam 30 mm

Plywood 12-19 mm + XPS foam 50 mm

Plywood 12-19 mm + XPS foam 70 mm

Plywood 12-19 mm + XPS foam 100 mm

Plywood 12-19 mm + XPS foam 120 mm

Plywood 12-19 mm + XPS foam 150 mm

Wood 25 mm, uninsulated

Wood 25 mm, insulated

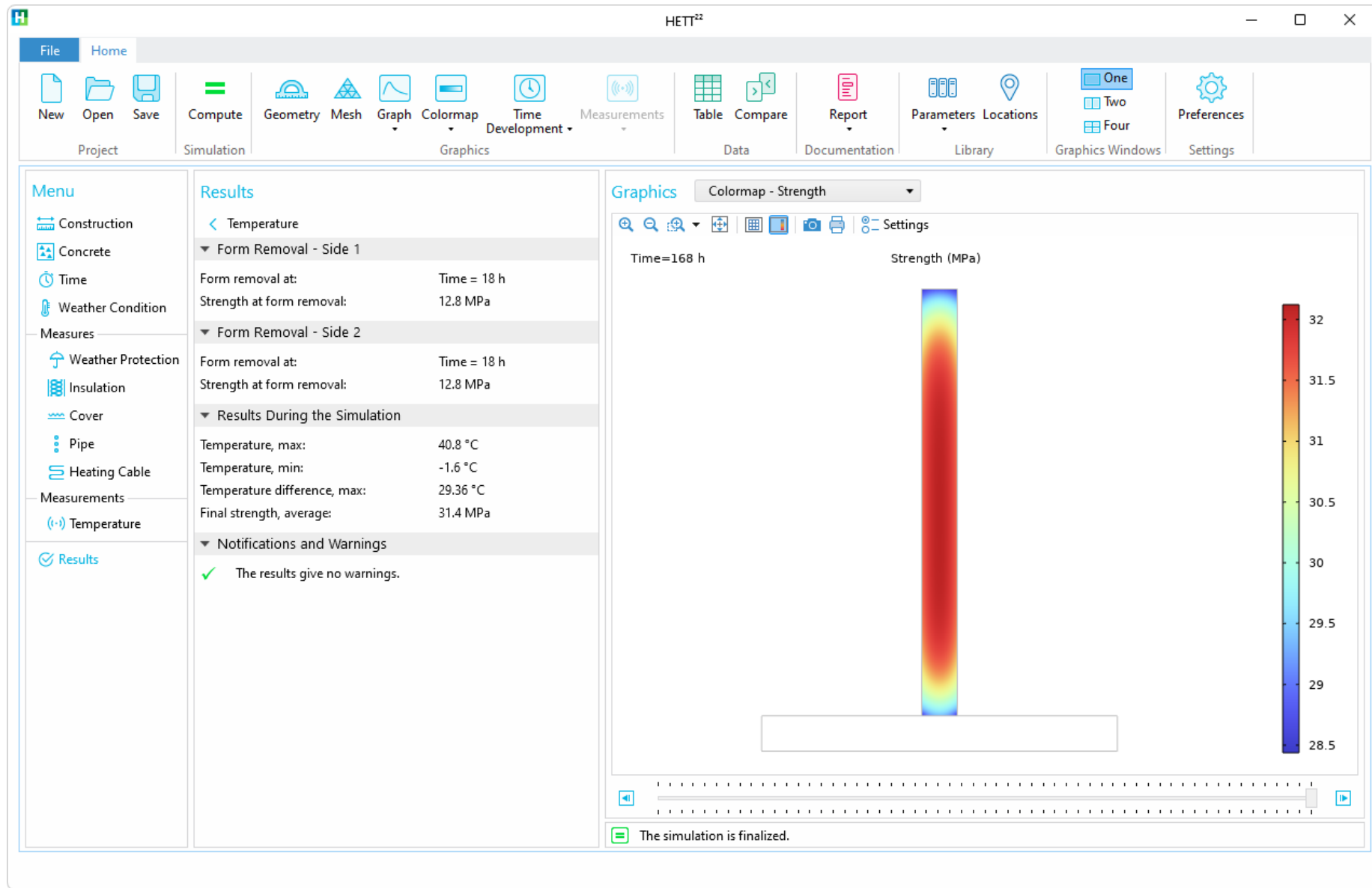
Wood 25 mm, well insulated

Graphics Colormap - Temperature

Time=18 h Temperature (°C)

The input has been changed since the last simulation.

Select plywood with insulation



No warnings with the chosen construction and concrete quality

Lesson Learned

- Using concrete quality C28/35 or C35/45 with an un-insulated form is not sufficient to remove the form after 18 hours
- Concrete C28/35 and C35/45 can be used by changing the construction to an insulated plywood form



Reducing CO₂ emissions

- To reduce emissions, a binder combination with slag can be chosen and this will
 - Decrease the early strength
 - Decrease the environmental impact



Name	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5	Solution 6	Solution 7	Solution 8	Solution 9	Solution 10
Case	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...		
Results, temperature, max [°C]	15.0	15.0	36.6	41.6	32.7	29.3	38.0	35.6		
Results, temperature, min [°C]	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6		
Results, temperature difference, max [°C]	6.68	6.68	26.30	29.88	23.52	21.04	27.50	25.74		
Results, final strength, average [MPa]	20.6	28.7	22.7	31.7	20.3	17.9	28.8	26.0		
Results, all requirements fulfilled	Warning!	Warning!	OK	OK	OK	Warning!	OK	OK		
Results, risk for early freezing	OK	OK	OK	OK	OK	OK	OK	OK		
Results, risk for high temperature	OK	OK	OK	OK	OK	OK	OK	OK		
Results, risk for no form removal due to low strength	--	--	--	--	--	--	--	--		
Results, risk for low strength (<5MPa) at form removal	Warning!	Warning!	OK	OK	OK	Warning!	OK	OK		
Results, time of form removal [h], side 1	--	--	--	--	--	--	--	--		
Results, strength at form removal [MPa], side 1	0.3	0.7	8.5	14.0	6.1	4.0	11.1	8.3		
Results, time of form removal [h], side 2	--	--	--	--	--	--	--	--		
Results, strength at form removal [MPa], side 2	0.3	0.7	8.5	14.0	6.1	4.0	11.1	8.3		
Construction, concrete dimension wall thickness, w [m]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		
Construction, concrete dimensions, wall height, h [m]	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4		
Construction, other material, floor width, w2 [m]	2	2	2	2	2	2	2	2		
Construction, other material, floor thickness, h2 [m]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		
Construction, other material, source	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Construction, other material, material	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete		
Construction, other material, density [kg/m^3]	2350	2350	2350	2350	2350	2350	2350	2350		
Construction, other material, heat capacity [J/(kg*K)]	950	950	950	950	950	950	950	950		
Construction, other material, thermal conductivity [W/(m*K)]	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7		
Construction, conventional form, source, side 1	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Construction, conventional form, material, side 1	Steel 3 mm,...	Steel 3 mm,...	Plywood 12...	Plywood 12...	Plywood 12...	Plywood 12...	Plywood 12...	Plywood 12...		
Construction, conventional form, thickness [m], side 1	0	0	0	0	0	0	0	0		
Construction, conventional form, thermal conductivity [W/(m*K)]	0	0	0	0	0	0	0	0		
Construction, conventional form, U-value [W/(m^2*K)], side 1	49.8	49.8	1.58	1.58	1.58	1.58	1.58	1.58		
Construction, conventional form, form removal, side 1	Time	Time	Time	Time	Time	Time	Time	Time		
Construction, conventional form, form removal, strength, side 1	--	--	--	--	--	--	--	--		
Construction, conventional form, form removal, time, side 1	18	18	18	18	18	18	18	18		
Construction, conventional form, source, side 2	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Construction, conventional form, material, side 2	Steel 3 mm,...	Steel 3 mm,...	Plywood 12...	Plywood 12...	Plywood 12...	Plywood 12...	Plywood 12...	Plywood 12...		
Construction, conventional form, thickness [m], side 2	0	0	0	0	0	0	0	0		
Construction, conventional form, thermal conductivity [W/(m*K)]	0	0	0	0	0	0	0	0		
Construction, conventional form, U-value [W/(m^2*K)], side 2	49.8	49.8	1.58	1.58	1.58	1.58	1.58	1.58		
Construction, conventional form, form removal, side 2	Time	Time	Time	Time	Time	Time	Time	Time		
Construction, conventional form, form removal, strength, side 2	--	--	--	--	--	--	--	--		
Construction, conventional form, form removal, time, side 2	18	18	18	18	18	18	18	18		
Concrete, source	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Concrete, concrete quality	C28/35	C35/45	C28/35	C35/45	C28/35	C28/35	C35/45	C35/45		
Concrete, cement type	Bascement	Bascement	Bascement	Bascement	Bascement	Bascement	Bascement	Bascement		
Concrete, cement type 2	--	--	--	--	--	--	--	--		
Concrete, additions 1	None	None	None	None	10 % Slagg	20 % Slagg	10 % Slagg	20 % Slagg		
Concrete, additions 2	--	--	--	--	--	--	--	--		
Concrete, setting time [h]	--	--	--	--	--	--	--	--		

Compare

Lösning 1-10

Name	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5	Solution 6	Solution 7	Solution 8	Solution 9	Solution 10
Case	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...	Wall on Oth...		
Results, temperature, max [°C]	15.0	15.0	36.6	41.6	32.7	29.3	38.0	35.6		
Results, temperature, min [°C]	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6		
Results, temperature difference, max [°C]	6.68	6.68	26.30	29.88	23.52	21.04	27.50	25.74		
Results, final strength, average [MPa]	20.6	28.7	22.7	31.7	20.3	17.9	28.8	26.0		
Results, all requirements fulfilled	Warning!	Warning!	OK	OK	OK	Warning!	OK	OK		
Results, risk for early freezing	OK	OK	OK	OK	OK	OK	OK	OK		
Results, risk for high temperature	OK	OK	OK	OK	OK	OK	OK	OK		
Results, risk for no form removal due to low strength	--	--	--	--	--	--	--	--		
Results, risk for low strength (<5MPa) at form removal	Warning!	Warning!	OK	OK	OK	Warning!	OK	OK		
Results, time of form removal [h], side 1	--	--	--	--	--	--	--	--		
Results, strength at form removal [MPa], side 1	0.3	0.7	8.5	14.0	6.1	4.0	11.1	8.3		
Results, time of form removal [h], side 2	--	--	--	--	--	--	--	--		
Results, strength at form removal [MPa], side 2	0.3	0.7	8.5	14.0	6.1	4.0	11.1	8.3		
Construction, concrete dimension wall thickness, w [m]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		
Construction, concrete dimensions, wall height, h [m]	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4		
Construction, other material, floor width, w2 [m]	2	2	2	2	2	2	2	2		
Construction, other material, floor thickness, h2 [m]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		
Construction, other material, source	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Construction, other material, material	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete	Old concrete		
Construction, other material, density [kg/m^3]	2350	2350	2350	2350	2350	2350	2350	2350		
Construction, other material, heat capacity [J/(kg*K)]	950	950	950	950	950	950	950	950		
Construction, other material, thermal conductivity [W/(m*K)]	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7		
Construction, conventional form, source, side 1	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Construction, conventional form, material, side 1	Steel 3 mm,...	Steel 3 mm,...	Plywood 12,...	Plywood 12,...	Plywood 12,...	Plywood 12,...	Plywood 12,...	Plywood 12,...		
Construction, conventional form, thickness [m], side 1	0	0	0	0	0	0	0	0		
Construction, conventional form, thermal conductivity [W/(m*K)]	0	0	0	0	0	0	0	0		
Construction, conventional form, U-value [W/(m^2*K)], side 1	49.8	49.8	1.58	1.58	1.58	1.58	1.58	1.58		
Construction, conventional form, form removal, side 1	Time	Time	Time	Time	Time	Time	Time	Time		
Construction, conventional form, form removal, strength, side 1	--	--	--	--	--	--	--	--		
Construction, conventional form, form removal, time, side 1	18	18	18	18	18	18	18	18		
Construction, conventional form, source, side 2	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Construction, conventional form, material, side 2	Steel 3 mm,...	Steel 3 mm,...	Plywood 12,...	Plywood 12,...	Plywood 12,...	Plywood 12,...	Plywood 12,...	Plywood 12,...		
Construction, conventional form, thickness [m], side 2	0	0	0	0	0	0	0	0		
Construction, conventional form, thermal conductivity [W/(m*K)]	0	0	0	0	0	0	0	0		
Construction, conventional form, U-value [W/(m^2*K)], side 2	49.8	49.8	1.58	1.58	1.58	1.58	1.58	1.58		
Construction, conventional form, form removal, side 2	Time	Time	Time	Time	Time	Time	Time	Time		
Construction, conventional form, form removal, strength, side 2	--	--	--	--	--	--	--	--		
Construction, conventional form, form removal, time, side 2	18	18	18	18	18	18	18	18		
Concrete, source	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...	Standard lib...		
Concrete, concrete quality	C28/35	C35/45	C28/35	C35/45	C28/35	C28/35	C35/45	C35/45		
Concrete, cement type	Bascement	Bascement	Bascement	Bascement	Bascement	Bascement	Bascement	Bascement		
Concrete, cement type 2	--	--	--	--	--	--	--	--		
Concrete, additions 1	None	None	None	None	10 % Slagg	20 % Slagg	10 % Slagg	20 % Slagg		
Concrete, additions 2	--	--	--	--	--	--	--	--		
Concrete, setting time [h]	--	--	--	--	--	--	--	--		

Close

Simulations show that two setups work



C28/35 with 10% slag

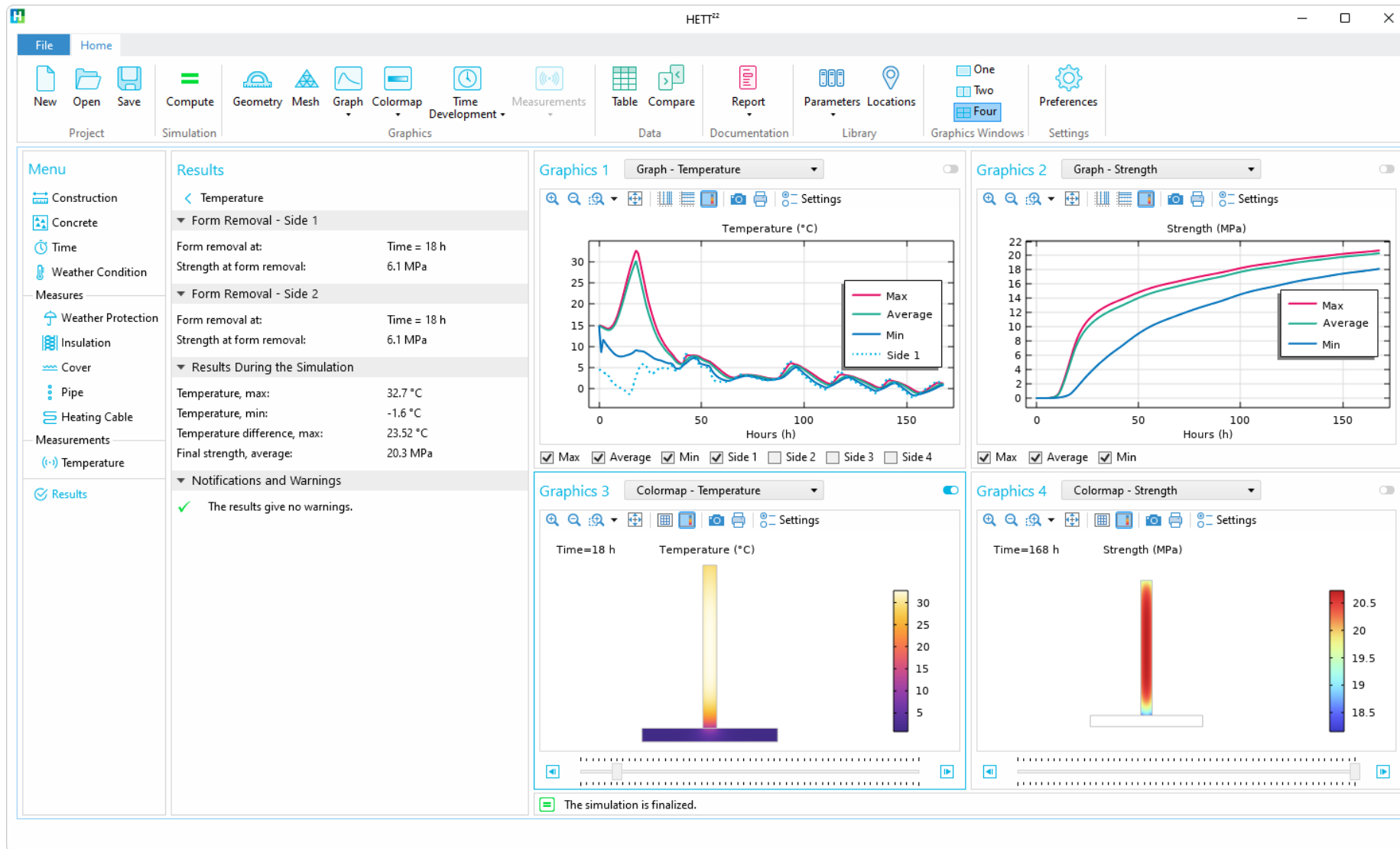
C35/45 with 20% slag

Which is the most environmentally friendly option?

Comparison

Concrete Quality	Form	Time for 5 MPa (h)	CO ₂ Measure (kg/m ³)
C28/35	Uninsulated steel	≥ 30	208
C35/45	Uninsulated steel	≥ 25	241
C28/35	Insulated plywood	≥ 15	208
C35/45	Insulated plywood	≥ 13	241
C28/35 + 10 % slag	Insulated plywood	≥ 17	189
C28/35 + 20 % slag	Insulated plywood	≥ 20	170
C35/45 + 10 % slag	Insulated plywood	≥ 14	218
C35/45 + 20 % slag	Insulated plywood	≥ 15	196

C28/35 + 10 % slag and Insulated Form



Reports

AutoSave On example_report.docx - Compatibility Mode • Last Modified: Just now

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Clipboard Font Paragraph Styles Adobe Acrobat

Normal No Spacing Heading 1

Comments Editing Share

Create PDF and share link Create PDF and share via Outlook Request Signatures Dictate Editor Reuse Files Add-ins

Table of Contents

Weather Condition

Time, start time, day	0
Time, start time, hour	0
Time, start time, minute	0
Time, output step size [s]	1
Time, new value step size [s]	1

Weather Condition

Weather condition, weather description, side 1	--
Weather condition, weather description, source, side 1	--
Weather condition, weather description, location, side 1	--
Weather condition, weather description, coordinates, side 1	--
Weather condition, temperature description, side 1	Time-varying
Weather condition, air temperature, constant [°C], side 1	--
Weather condition, wind, source, side 1	User-defined
Weather condition, wind, wind speed selection, side 1	Time-varying
Weather condition, wind, wind speed [m/s], side 1	--
Weather condition, weather description, side 2	--
Weather condition, weather description, source, side 2	--
Weather condition, weather description, location, side 2	--
Weather condition, weather description, coordinates, side 2	--
Weather condition, temperature description, side 2	Time-varying
Weather condition, air temperature, constant [°C], side 2	--
Weather condition, wind, source, side 2	User-defined
Weather condition, wind, wind speed selection, side 2	Time-varying
Weather condition, wind, wind speed [m/s], side 2	--
Weather condition, weather description, side 3	--
Weather condition, weather description, source, side 3	--
Weather condition, weather description, location, side 3	--
Weather condition, weather description, coordinates, side 3	--
Weather condition, temperature description, side 3	Time-varying
Weather condition, air temperature, constant [°C], side 3	--
Weather condition, wind, source, side 3	User-defined
Weather condition, wind, wind speed selection, side 3	Time-varying
Weather condition, wind, wind speed [m/s], side 3	--

Results

Summary

Cue

Results, temperature, max [°C]	36.6	Wall on Other Viewport
Results, temperature, min [°C]	-16.6	Mid
Results, temperature difference, max [°C]	28.14	Mid
Results, fluid strength, average [MPa]	34.4	Mid
Results, all requirements fulfilled	OK	
Results, risk for early freezing	OK	
Results, risk for high temperature	OK	
Results, risk for no form removal due to low strength	OK	
Results, risk for low strength (100% of form removal)	--	
Results, time of form removal [h], side 1	0.1	
Results, time of form removal [h], side 2	--	
Results, strength at form removal [MPa], side 1	--	
Results, strength at form removal [MPa], side 2	0.1	

Table of Material Properties

Cover, cover, side 2	Yes
Cover, description, side 3	Cover strap
Cover, source, side 3	Standard library
Cover, material, side 3	9000 cover 90 rev
Cover, thickness [m], side 3	0.05
Cover, thermal conductivity [W/(m·K)], side 3	0.034
Cover, U-value [W/(m²·K)], side 3	0
Cover, time, cover on [h], side 3	1
Cover, time, cover off [h], side 3	16

Graphs:

- Temperature (°C) vs Hours (h)
- Strength (MPa) vs Hours (h)
- Temperature Difference (degC) vs Hours (h)
- Boundary Heat Flux (kW/m²) vs Hours (h)
- Heat Resistance (K²m²/W) vs Hours (h)
- Wind Speed (m/s) vs Hours (h)
- Colormap Temperature (°C) vs Time (h)
- Colormap Maturity (h) vs Time (h)
- Strength (MPa) at Time=168 h vs Colormap
- Maturity (h) at Time=168 h vs Colormap
- Time Development: Temperature (°C) and Strength (MPa) on the colormap and Time (h) on the z-axis
- Maturity (h) on the colormap and Time (h) on the z-axis

Report Dialog:

Report

Create Word Report

Name: Daniel Ericsson

Company: Deflexional AB

Title: Example for COMSOL Conference

Project description:

This example project compares different constructions and concrete.

OK Cancel

Page 6 of 15 820 words English (United States) Text Predictions: On Accessibility: Unavailable

Focus 39%

Reports

Report

Create PowerPoint Report

Name:

Company:

Title:

Project description:

The report and the images are based on the latest solution. The generated images are using the current graphics settings.

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36 Results - Colormap

37 Results - Colormap

38 Results - Colormap

39 Results - Time Development

40 Results - Time Development

41 Results - Time Development

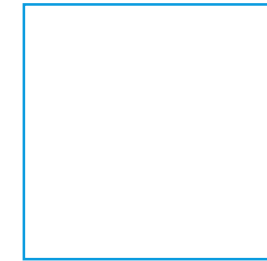
Results - Time Development

Temperature (°C) on the colormap and Time (h) on the z-axis

Slide 39 of 41 English (Sweden) Accessibility: Investigate Notes 77%

The Underlying COMSOL Model

Combining the Model Builder with methods



Geometry

- The geometry is dynamically generated using methods in the Application Builder based on the selected construction case
- A second *2D Component* is used to visualize the construction drawing with dimensions, colors, and textual elements

Physics Interfaces

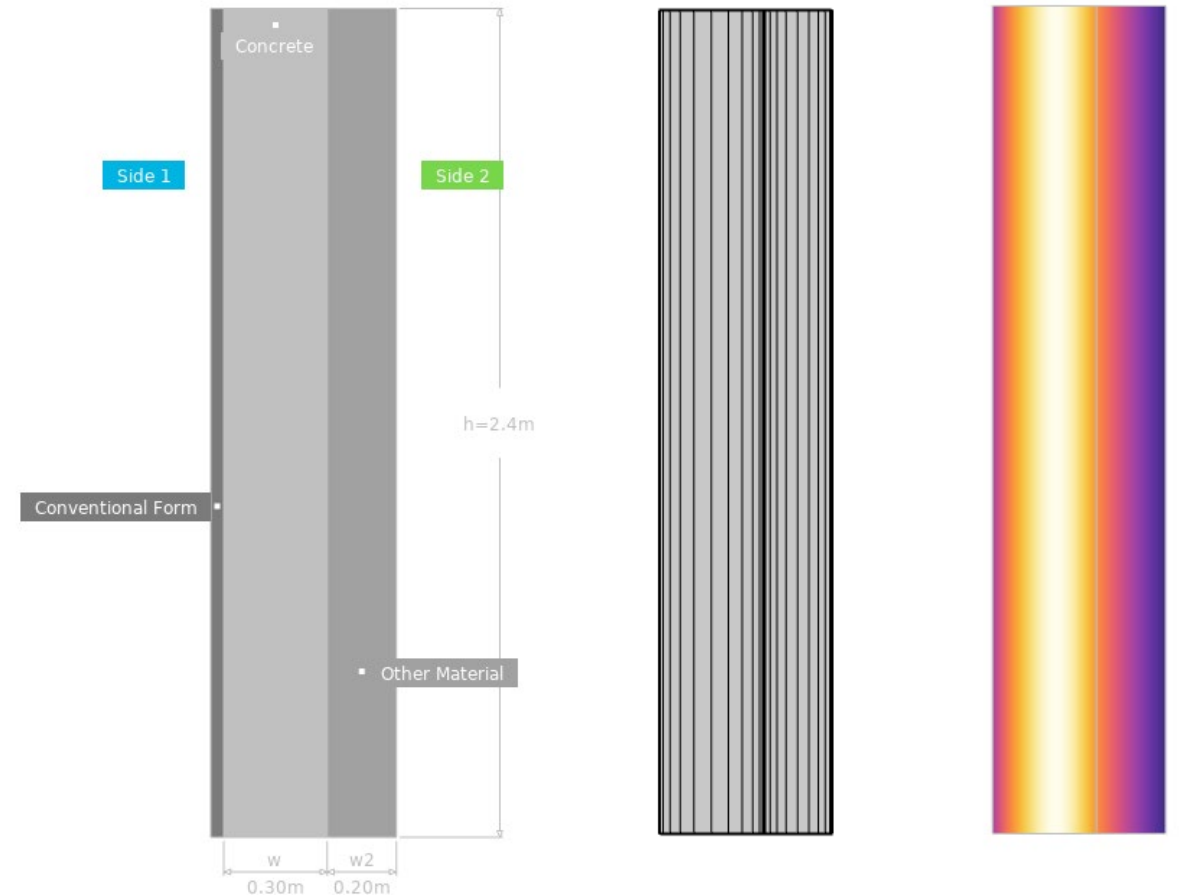
- Heat Transfer in Solids
 - Heat Source
 - Heat Flux
 - Thin Layer
- Domain ODEs and DAEs
 - Calculate the equivalent time (maturity) and concrete strength
- Events
 - Efficiently manages dynamic changes in the model such as formwork removal, cover additions, or the activation/deactivation of heating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

Mesh

- The mesh is automatically adjusted for the specific construction cases
- Can be a mix of triangular elements and mapped meshes
- Boundary layer meshing ensures that temperature gradients are resolved close to important areas
- The discretization is set to quadratic lagrange for the *Heat Transfer in Solids* physics interface

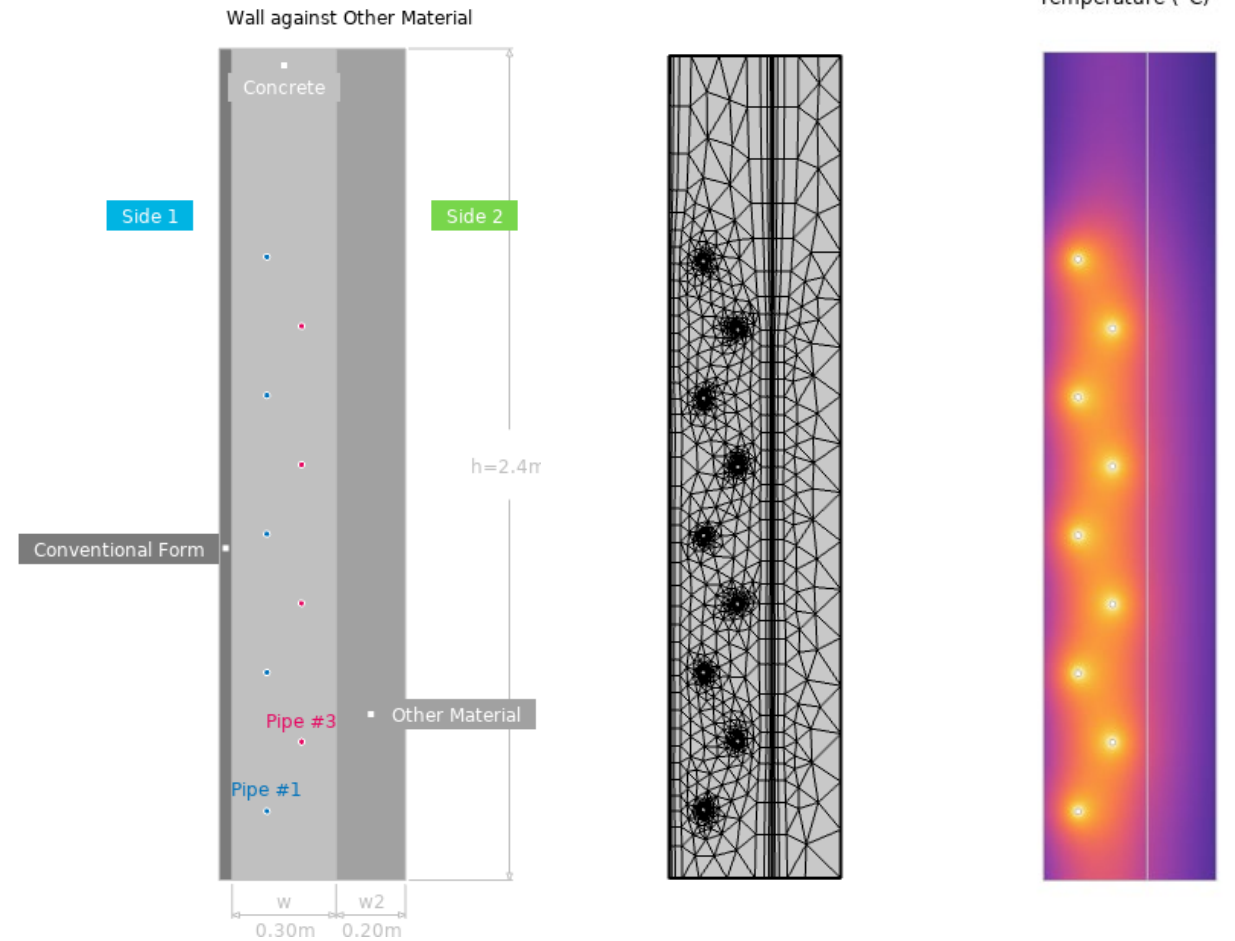
Mesh Example #1

- The heat flux condition (the temperature and wind) are not varying in the y-direction
- The model could be solved in 1D
- The 2D model uses only one element in the y-direction to save computational time
- The mesh is refined close to the walls and interfaces



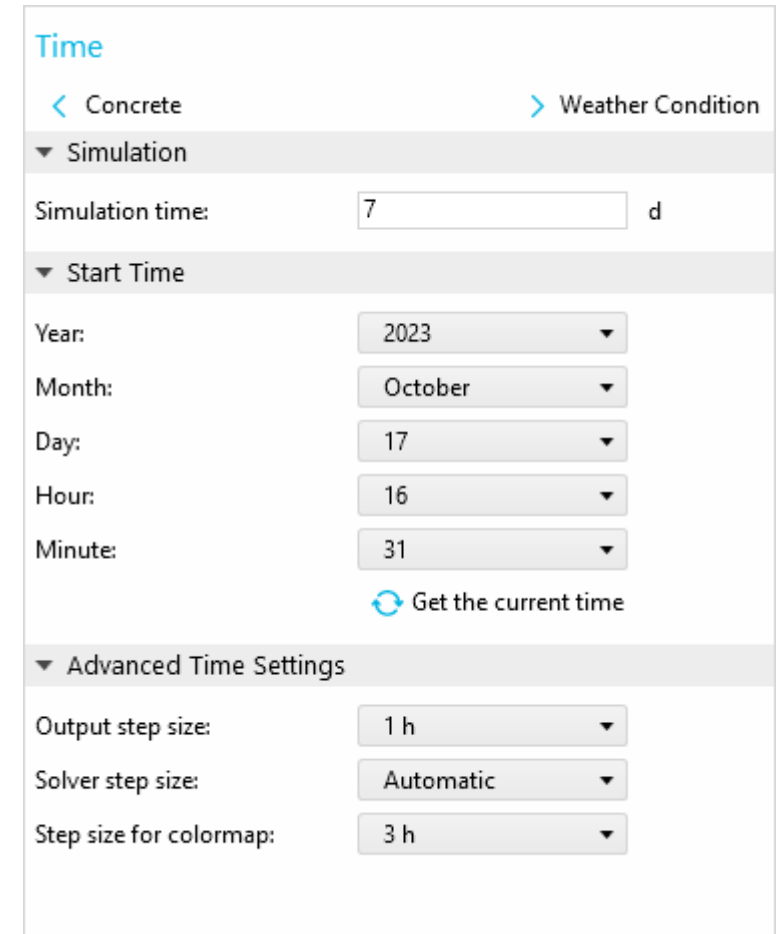
Mesh Example #2

- Pipes with hot water are introduced, and the model must be solved in 2D
- The mesh is refined with boundary layers:
 - Close to the walls
 - Around the pipes



Solver Settings

- The solver uses MUMPS
- The time stepping method is set to BDF
- The app users can control
 - The output step size
 - The solver step size
 - Automatic
 - Manual with a maximum step size
 - Step size for colormap
 - Sets the step size for 2D visualizations



Time

< Concrete > Weather Condition

▼ Simulation

Simulation time: 7 d

▼ Start Time

Year: 2023

Month: October

Day: 17

Hour: 16

Minute: 31

Get the current time

▼ Advanced Time Settings

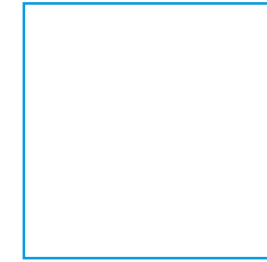
Output step size: 1 h

Solver step size: Automatic

Step size for colormap: 3 h

Application Features

Encompasses functionalities that are likely unique



Weather Forecasts

Automatically transform forecast into appropriate boundary conditions

Weather Forecasts

- The way concrete matures is highly dependent on the surrounding air temperature and wind speed
- To improve the prediction of near-future conditions, HETT²² can automatically download weather forecasts from smhi.se and yr.no through JSON document retrieval
- The data is automatically transformed into the appropriate boundary conditions

Weather Condition

The screenshot displays the HETT22 software interface. The top ribbon includes tabs for File, Home, and a search bar. The ribbon contains various tool groups: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap, Time Development), Measurements, Data (Table, Compare), Documentation (Report), Library (Parameters, Locations), Graphics Windows (One, Two, Four), and Settings (Preferences).

The left sidebar shows a Menu with categories: Construction, Concrete, Time, Weather Condition (highlighted), Measures (Weather Protection, Insulation, Pipe, Heating Cable), Measurements (Temperature), and Results.

The central panel is titled "Weather Condition" and is divided into "Time" and "Weather Protection" sections. Under "Weather Condition - Side 1", the settings are: Weather description: Data from YR; Source: Standard library; Location: Sweden - Stockholm; and a checked box for "Use the same properties for Side 2". Under "Other Material", the initial temperature is set to 15 °C. There are also "Show Weather" and "Show on Map" options.

The right panel, titled "Graphics", shows a 3D model of a wall assembly. The wall is labeled "Wall against Other Material" and has a height of h=2.4m. It is divided into "Side 1" (blue) and "Side 2" (green). The wall is made of "Concrete" and is supported by "Conventional Form". Two pipes are shown: "Pipe #1" (blue) and "Pipe #3" (red). The wall is adjacent to "Other Material". The base dimensions are w=0.30m and w2=0.20m.

A status bar at the bottom indicates: "The input has been changed since the last simulation."

Weather Condition

The screenshot displays the HETT22 software interface. The top ribbon includes tabs for File, Home, Project, Simulation, Graphics, Data, Documentation, Library, Graphics Windows, and Settings. The main workspace is divided into three sections: Menu, Weather Condition, and Graphics.

Menu: Lists various simulation components such as Construction, Concrete, Time, Weather Condition, Measures (Weather Protection, Insulation, Pipe, Heating Cable), Measurements (Temperature), and Results.

Weather Condition: This panel is currently active. It shows settings for "Weather Condition - Side 1".

- Weather description: Data from YR
- Source: Standard library
- Location: Sweden - Stockholm (with a dropdown menu open showing a list of locations including Switzerland - Bern, Syria - Damascus, Taiwan - Taipei, Tajikistan - Dushanbe, Tanzania - Dodoma, Thailand - Bangkok, Timor-Leste - Dili, Togo - Lomé, Tokelau - Nukunonu, Tonga - Nuku'alofa, Transnistria - Tiraspol, Trinidad and Tobago - Port of Spain, Tristan da Cunha - Edinburgh of the Seven Seas, Tunisia - Tunis, Turkey - Ankara, Turkmenistan - Ashgabat, Turks and Caicos Islands - Cockburn Town, Tuvalu - Funafuti, U.S. Virgin Islands - Charlotte Amalie, and Uganda - Kampala).
- Use the same properties for Other Material:
- Initial temperature: (empty field)

Graphics: Shows a 3D model of a wall assembly titled "Wall against Other Material". The wall is labeled "Concrete" and has a height of $h=2.4\text{m}$. It is divided into "Side 1" (blue) and "Side 2" (green). The wall is supported by a "Conventional Form" and is adjacent to "Other Material". Two pipes are shown: "Pipe #1" (blue) and "Pipe #3" (red). The base dimensions are $0.30\text{m} \times 0.20\text{m}$. A status bar at the bottom indicates "put has been changed since the last simulation."

Weather Condition

The screenshot displays the HETT22 software interface. The top ribbon includes tabs for File, Home, and a search bar. The ribbon contains various tool groups: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap, Time Development), Data (Table, Compare), Documentation (Report), Library (Parameters, Locations), Graphics Windows (One, Two, Four), and Settings (Preferences).

The left sidebar shows a Menu with categories: Construction, Concrete, Time, Weather Condition (highlighted), Measures (Weather Protection, Insulation, Pipe, Heating Cable), Measurements (Temperature), and Results.

The main workspace is divided into two panels. The left panel, titled "Weather Condition", is currently set to "Time" and "Weather Protection". It shows settings for "Weather Condition - Side 1":

- Weather description: Data from YR
- Source: Standard library
- Location: Standard library
- Use the same properties for Side 2:
- Initial temperature: 15 °C

The "Other Material" section is also visible.

The right panel, titled "Graphics", shows a 3D model of a wall assembly. The wall is labeled "Wall against Other Material" and has a height of $h=2.4\text{m}$. The wall is composed of "Concrete" and "Other Material". The wall is divided into "Side 1" (blue) and "Side 2" (green). The wall is supported by "Conventional Form" and has two pipes, "Pipe #1" and "Pipe #3". The wall width is 0.30m and the pipe width is 0.20m .

A status bar at the bottom indicates: "The input has been changed since the last simulation."

Weather Condition

The screenshot displays the HETT22 software interface. The top ribbon includes tabs for File, Home, and a main menu with icons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Graphics Windows (One, Two, Four), and Preferences.

The **Weather Condition** panel is active, showing settings for **Weather Condition - Side 1**. The **Time** section includes a dropdown for "Data from YR", "Source" set to "User-defined", and "Latitude, Longitude" set to "59.309,18.030". There are options for "Show Weather", "Show on Map", and "Save Location". A checkbox "Use the same properties for Side 2" is checked. The **Other Material** section has an "Initial temperature" set to "15 °C".

The **Graphics** panel shows a 3D model of a vertical wall structure. The wall is labeled "Wall against Other Material" and has a height of "h=2.4m". The top part is labeled "Concrete". The bottom part is labeled "Other Material". The wall is divided into "Side 1" (left) and "Side 2" (right). A "Conventional Form" is shown on the left side. Two pipes are labeled "Pipe #1" and "Pipe #3". The base dimensions are "w" and "w2", with a total width of "0.30m0.20m".

A status bar at the bottom indicates: "The input has been changed since the last simulation."

Forecasts

The screenshot displays the HETP22 software interface. The main window is titled "HETP22" and features a ribbon menu with tabs for File, Home, Project, Simulation, Graphics, and Data. The Simulation tab is active, showing the "Weather Condition" settings for "Side 1".

Weather Condition - Side 1

- Weather description: Data from YR
- Source: User-defined
- Latitude, Longitude: 59.309, 18.030
- Show Weather, Show on Map, Save Location
- Use the same properties for Side 2
- Other Material: Initial temperature: 15 °C

The Graphics window shows a 3D model of a pipe structure. The pipe is labeled "Pipe #1" and "Pipe #3". The structure is supported by "Conventional Form" and "Other Material". Dimensions are shown: height $h=2.4\text{m}$ and width $0.30\text{m} \times 0.20\text{m}$.

A "Weather" dialog box is open, displaying a table of weather forecast data:

Time relative to start [h]	Temperature [°C]	Wind speed [m/s]	Time stamp
3.48	8.6	4.5	2023-10-17T20:00+02:00[...]
4.48	8.1	3.8	2023-10-17T21:00+02:00[...]
5.48	7.5	3.9	2023-10-17T22:00+02:00[...]
6.48	7.0	3.5	2023-10-17T23:00+02:00[...]
7.48	6.4	3.4	2023-10-18T00:00+02:00[...]
8.48	5.9	3.2	2023-10-18T01:00+02:00[...]
9.48	5.5	3.2	2023-10-18T02:00+02:00[...]
10.48	5.0	3.8	2023-10-18T03:00+02:00[...]
11.48	4.7	4.0	2023-10-18T04:00+02:00[...]
12.48	4.5	4.9	2023-10-18T05:00+02:00[...]
13.48	4.9	5.2	2023-10-18T06:00+02:00[...]
14.48	5.5	5.1	2023-10-18T07:00+02:00[...]
15.48	6.0	4.3	2023-10-18T08:00+02:00[...]
16.48	6.8	4.4	2023-10-18T09:00+02:00[...]
17.48	7.2	4.4	2023-10-18T10:00+02:00[...]
18.48	7.5	4.6	2023-10-18T11:00+02:00[...]
19.48	7.3	4.6	2023-10-18T12:00+02:00[...]
20.48	7.1	4.5	2023-10-18T13:00+02:00[...]
21.48	6.9	4.6	2023-10-18T14:00+02:00[...]
22.48	6.4	4.0	2023-10-18T15:00+02:00[...]
23.48	5.8	3.6	2023-10-18T16:00+02:00[...]
24.48	4.8	4.3	2023-10-18T17:00+02:00[...]
25.48	4.4	3.3	2023-10-18T18:00+02:00[...]
26.48	3.9	4.2	2023-10-18T19:00+02:00[...]
27.48	3.4	3.8	2023-10-18T20:00+02:00[...]
28.48	3.2	3.8	2023-10-18T21:00+02:00[...]
29.48	3.2	3.6	2023-10-18T22:00+02:00[...]
30.48	3.0	3.6	2023-10-18T23:00+02:00[...]

The dialog box also shows a 3D model of the pipe structure with dimensions $h=2.4\text{m}$ and $0.30\text{m} \times 0.20\text{m}$. A message at the bottom of the dialog box states: "The input has been changed since the last simulation."

Maps

The image displays a software interface for a simulation, overlaid with a Google Maps window. The software interface includes a menu on the left with options like Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Pipe, Heating Cable, Measurements, Temperature, and Results. The main panel shows the 'Weather Condition' settings for 'Side 1', including 'Weather description' (Data from YR), 'Source' (User-defined), 'Latitude, Longitude' (59.309, 18.030), and 'Initial temperature' (15 °C). A 'Show on Map' button is visible. The Google Maps window shows the location 59°18'32.4"N 18°01'48.0"E in Stockholm, Sweden, with a red pin and a search bar containing the coordinates. Below the map, a technical diagram shows a vertical structure with a 'Conventional Form' section and an 'Other Material' section. The height is labeled as h=2.4m, and the width is labeled as 0.30m x 0.20m. A message at the bottom of the diagram states: 'The input has been changed since the last simulation.'

Tip: Right-click in Google Maps to get the location's coordinate!

Sensor Data Import

Comparing simulations with measurements from construction sites

Sensor Data Import

- For improved accuracy and validation, HETT²² enables users to import sensor data measurements from construction sites, facilitating a direct comparison between simulation and real-world observations
- Supports multiple sensor data formats and importing data from a Microsoft[®] Excel[®] file is straightforward
- Sensors can be placed both in the air and inside the concrete
 - If a temperature sensor is situated inside the concrete, a 1D simulation will convert the temperature data to strength, allowing for comparison with the results generated by the 2D simulation

Sensor Data Import

The screenshot displays the HETT22 software interface, which is used for simulating heating cable systems. The window title is "HETT22". The interface is divided into several sections:

- Top Ribbon:** Contains various toolbars for file operations (New, Open, Save), simulation (Compute), geometry (Geometry, Mesh), graphics (Graph, Colormap, Time Development), data (Table, Compare), documentation (Report), parameters and locations, graphics windows (One, Two, Four), and settings (Preferences).
- Left Panel (Menu):** Lists various simulation components such as Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Pipe, Heating Cable, Measurements, and Results. The "Temperature" measurement is currently selected.
- Temperature Panel:** Shows the configuration for the selected "Temperature" measurement. It includes:
 - Heating Cable:** A sub-section for "Imported Measurements".
 - Data description:** Options for "One file per channel" (selected) or "One file for all channels".
 - Date format:** Set to "Relative time [h]".
 - Number of channels:** Set to "4".
 - Channels:** A list of four channels, each currently set to "Not active". Each channel has "Import" and "Visualize" buttons.
 - Visualization options:** Checkboxes for "Visualize Measured Data in all Active Channels" and "Show Measurement Positions in Concrete".
- Graphics Panel:** Displays a 3D model of a "Wall against Other Material". The wall is labeled "Concrete" and has a height of $h=2.4\text{m}$. It is supported by a "Conventional Form" at the base. The wall is divided into "Side 1" (blue) and "Side 2" (green). The base width is labeled as w and w_2 , with a value of 0.20m and 20m respectively. A "Other Material" is shown on the right side of the wall.

At the bottom of the Graphics panel, a message states: "No solution is available yet."

Sensor Data Import

The screenshot displays the HETT22 software interface. The top ribbon includes tabs for File, Home, Project, Simulation, Graphics, Data, Documentation, Library, Graphics Windows, and Settings. The left sidebar contains a 'Menu' with options like Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Pipe, Heating Cable, Measurements, and Results.

The main workspace is divided into two panes. The left pane, titled 'Temperature', shows the 'Heating Cable' settings. Under 'Imported Measurements', the 'Data description' section has 'One file per channel' selected. The 'Date format' dropdown is set to 'Relative time [h]'. The 'Number of channels' dropdown is also set to 'Relative time [h]'. Below this, there are four 'Channels' listed, each with a 'Not active' button. The right pane, titled 'Graphics', shows a 3D model of a wall against other material. The wall is labeled 'Concrete' and has a height of 'h=2.4m'. The width is labeled 'w' and 'w2', with a value of '0.20m'. The wall is divided into 'Side 1' (blue) and 'Side 2' (green). A 'Conventional Form' is shown on the left side of the wall, and 'Other Material' is shown on the right side. A message at the bottom of the graphics pane states: 'No solution is available yet.'

Sensor Data Import

The screenshot displays the HETP22 software interface. The main window shows a ribbon with tabs for File, Home, and HETP22. The ribbon includes buttons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, and Measurements. The left sidebar contains a Menu with options like Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Pipe, Heating Cable, Measurements, and Results. The central panel is titled 'Temperature' and shows 'Heating Cable' settings. Under 'Imported Measurements', the 'Data description' is set to 'One file for all channels' and the 'Date format' is 'yyyy-MM-dd HH:mm'. There are six channels listed, all currently 'Not active'. A 'Visualize Measured Data in all Active Channels' checkbox is checked. The 'Import Measured Data' button is highlighted. An 'Import/Edit Measured Data' dialog box is open, showing a table of data points for Channel 1 from 08:00 to 21:23 on 2021-07-06. The data values range from 24 to 58.7. The dialog has 'OK' and 'Cancel' buttons. At the bottom of the main window, a message states 'No solution is available yet.'

yyyy-MM-dd HH:mm	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6
2021-07-06 08:00	24					
2021-07-06 08:23	25.8					
2021-07-06 08:53	25					
2021-07-06 09:23	24.9					
2021-07-06 09:53	24.9					
2021-07-06 10:23	25.1					
2021-07-06 10:53	25.3					
2021-07-06 11:23	26					
2021-07-06 11:53	27					
2021-07-06 12:23	28					
2021-07-06 12:53	29					
2021-07-06 13:23	30.6					
2021-07-06 13:53	32.6					
2021-07-06 14:23	34.7					
2021-07-06 14:53	37					
2021-07-06 15:23	39.4					
2021-07-06 15:53	42.1					
2021-07-06 16:23	45					
2021-07-06 16:53	47.8					
2021-07-06 17:23	50					
2021-07-06 17:53	52					
2021-07-06 18:23	53.5					
2021-07-06 18:53	54.7					
2021-07-06 19:23	55.8					
2021-07-06 19:53	56.8					
2021-07-06 20:23	57.5					
2021-07-06 20:53	58.2					
2021-07-06 21:23	58.7					

Sensor Positions

The screenshot displays the HETT22 software interface. The top ribbon includes tabs for File, Home, and Simulation. The Simulation tab is active, showing icons for Compute, Geometry, Mesh, Graph, Colormap, Time Development, and Measurements. The Measurements group is expanded, showing a list of channels for temperature monitoring.

Temperature

< Heating Cable > Results

Imported Measurements

Data description

One file per channel One file for all channels

Date format: yyyy-MM-dd HH:mm

Channels

Channel	Material	Coordinates (x, y)	Status	Action
1:	In the concrete	x: 0.15 m, y: 0.3 m	Active	Visualize
2:	Not active		Not active	Visualize
3:	Not active		Not active	Visualize
4:	Not active		Not active	Visualize
5:	Not active		Not active	Visualize
6:	Not active		Not active	Visualize

Visualize Measured Data in all Active Channels

Show Measurement Positions in Concrete

Graphics Geometry

Wall against Other Material

Concrete

Side 1

Side 2

h=2.4m

Conventional Form

Other Material

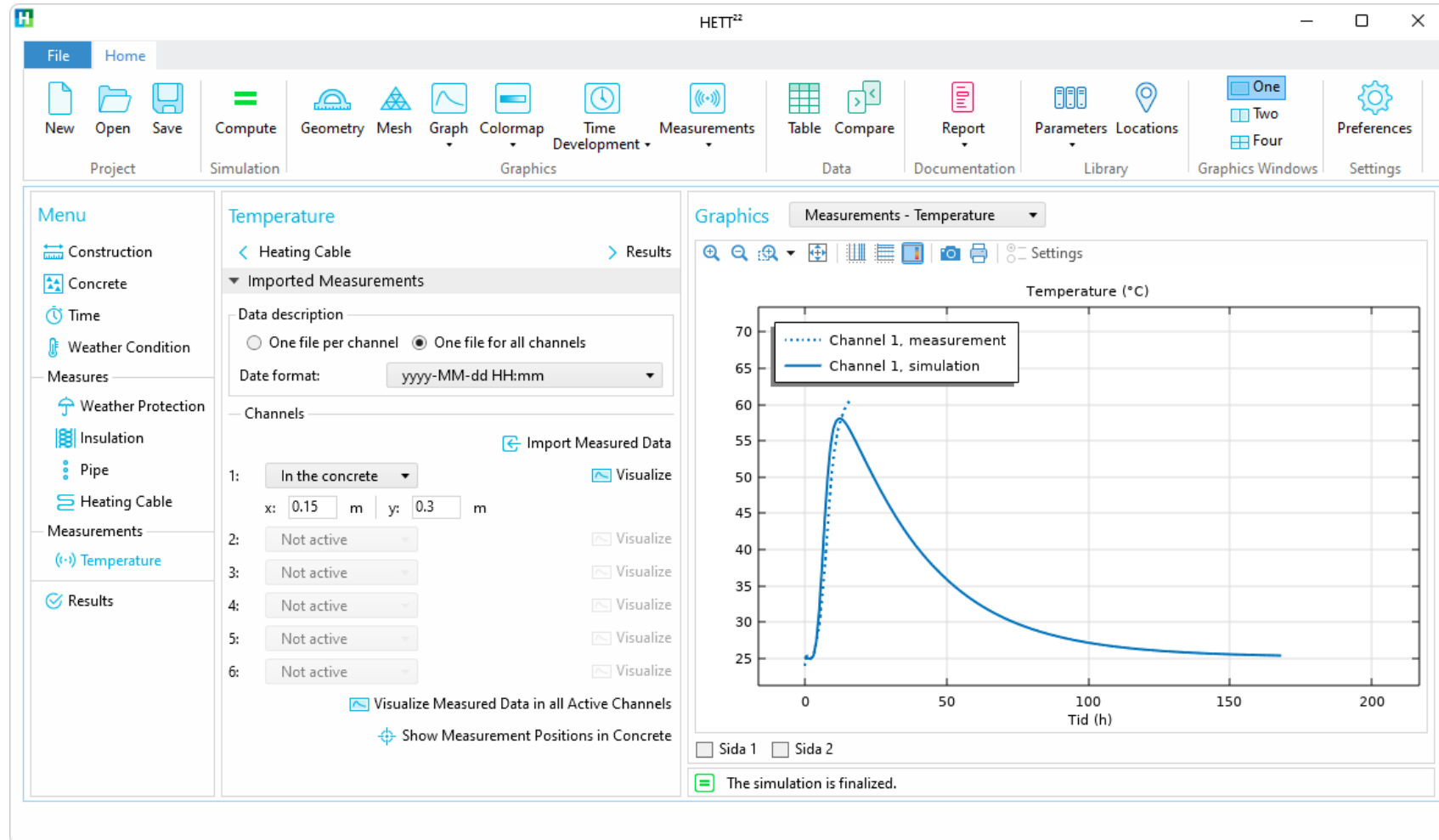
M01

w w2

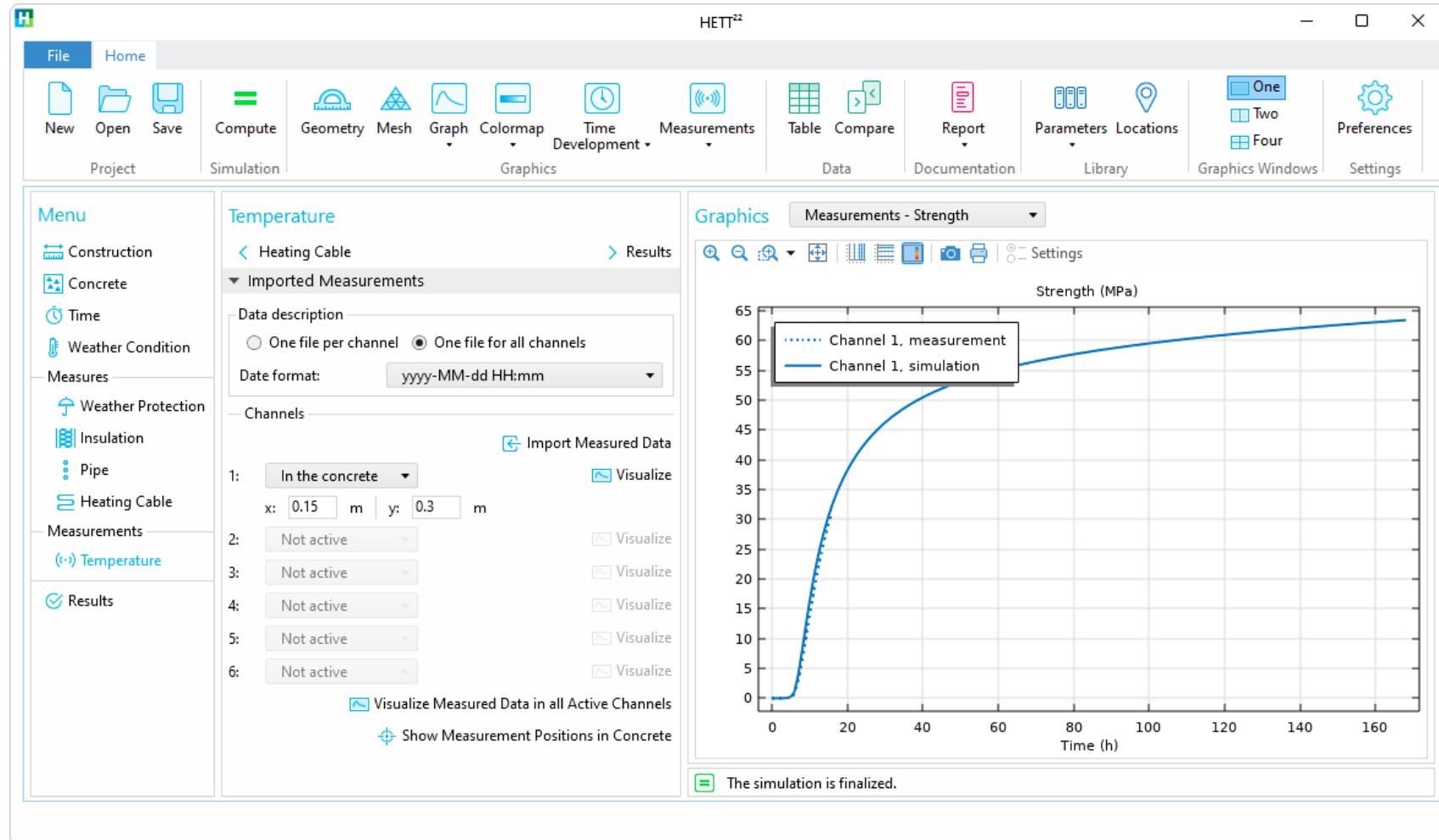
0.20 @ 0.20m

The simulation is finalized.

Measurements & Simulation



Measurements & Simulation



Libraries

An extensive library of construction materials and more

Libraries

- Features an extensive library of construction materials
- Rather than manually inputting e.g., thermal conductivity, density, and heat capacity for specific materials, users can conveniently select materials from combo-boxes
- Besides the pre-installed standard library, users have the option to expand their library
- Also contains a library for construction site locations

Material Library

The screenshot displays the HETT22 software interface, specifically the Material Library for Concrete. The interface is divided into several sections:

- Menu:** A vertical sidebar on the left containing options like Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable, Measurements, Temperature, and Results.
- Construction Panel:** A central panel titled "Construction" with a sub-section for "Concrete". It contains the following parameters:
 - Concrete Dimensions:** Slab thickness, h: 0.2 m; Slab width, w: 2 m.
 - Other Dimensions:** Width, w1: 2 m.
 - Ground Floor Insulation:** (Expanded)
 - Ground:** (Expanded)
 - Conventional Form:** Source: Standard library; Material: Steel 3 mm, uninsu; Form removal at: Strength; Strength: 15 MPa.
- Graphics Panel:** A window titled "Graphics" showing a cross-section of a "Slab on Ground, Edge Section". The diagram includes:
 - A "Conventional Form" layer with a height of $h1=2.0m$.
 - A "Concrete" layer with a thickness of $h=0.2m$.
 - A "Ground Floor Insul" layer with a thickness of $h2=0.1m$.
 - The "Ground" layer below.
 - Dimensions: $w1=2.0m$ and $w=2.0m$ for the slab width, and $h1=2.0m$ for the form height.
 - A "Side 1" label is present.

At the bottom of the Graphics panel, a message states: "No solution is available yet."

Material Library

The screenshot displays the HETP22 software interface. The top menu bar includes 'File', 'Home', and 'HETP22'. Below the menu is a toolbar with icons for 'New', 'Open', 'Save', 'Compute', 'Geometry', 'Mesh', 'Graph', 'Colormap', 'Time Development', 'Measurements', 'Table', 'Compare', 'Report', 'Parameters', 'Locations', 'One', 'Two', 'Four', and 'Preferences'. The main workspace is divided into three panels: 'Menu', 'Construction', and 'Graphics'.

Menu Panel: Contains icons for 'Construction', 'Concrete', 'Time', 'Weather Condition', 'Weather Protection', 'Insulation', 'Cover', 'Trowelling', 'Infrared Heating', 'Pipe', 'Heating Cable', 'Measurements', 'Temperature', and 'Results'.

Construction Panel: Shows the 'Concrete' material library. Under the 'Conventional Form' section, the following parameters are defined:

- Concrete Dimensions
 - Slab thickness, h: 0.2 m
 - Slab width, w: 2 m
- Other Dimensions
 - Width, w1: 2 m
- Ground Floor Insulation
- Ground
- Conventional Form
 - Source: Standard library
 - Material: Steel 3 mm, uninsu
 - Form removal at: Strength
 - Strength: 15 MPa

Graphics Panel: Displays a 2D cross-section of a concrete slab on ground. The slab has a width $w_1 = 2.0\text{m}$ and a height $h_1 = 2.0\text{m}$. The ground below is labeled 'Ground'. A 'Conventional Form' is shown on top of the slab. A 'Insul' layer is shown on the right side of the slab with a height $h_2 = 0.1$. The top of the slab is labeled 'Slab on Gr'. A message at the bottom of the graphics panel states: 'No solution is available yet.'

Material Library

Parameters

Library: Conventional Form

Library type: Standard library User library

Standard library

Name	Thickness [m]	Thermal conductivity [W/(m*K)]	U-value [W/(m ² *K)]
Steel 3 mm, uninsulated	0	0	49.8
Steel 3 mm, insulated	0	0	2.8
Steel 3 mm, well insulated	0	0	1.1
Plywood 12 mm, uninsulated	0	0	9.46
Plywood 14 mm, uninsulated	0	0	8.33
Plywood 15 mm, uninsulated	0	0	7.87
Plywood 17 mm, uninsulated	0	0	7.07
Plywood 18 mm, uninsulated	0	0	6.73
Plywood 19 mm, uninsulated	0	0	6.42
Plywood 12 mm, insulated	0	0	2.26
Plywood 14 mm, insulated	0	0	2.19
Plywood 15 mm, insulated	0	0	2.15
Plywood 17 mm, insulated	0	0	2.09
Plywood 18 mm, insulated	0	0	2.06
Plywood 19 mm, insulated	0	0	2.03
Plywood 12-19 mm, well insulated	0	0	0.99
Plywood 12 mm + XPS foam 30...	0	0	1.58
Plywood 14 mm + XPS foam 30...	0	0	1.55
Plywood 15 mm + XPS foam 30...	0	0	1.53
Plywood 17 mm + XPS foam 30...	0	0	1.5
Plywood 18 mm + XPS foam 30...	0	0	1.48
Plywood 19 mm + XPS foam 30...	0	0	1.47
Plywood 12-19 mm + XPS foam...	0	0	0.99
Plywood 12-19 mm + XPS foam...	0	0	0.73
Plywood 12-19 mm + XPS foam...	0	0	0.52
Plywood 12-19 mm + XPS foam...	0	0	0.44
Plywood 12-19 mm + XPS foam...	0	0	0.35
Wood 25 mm, uninsulated	0	0	5

OK Cancel

Material Library

Parameters

Library: Conventional Form

Library type: Standard library User library

User library

Name	Thickness [m]	Thermal conductivity [W/(m*K)]	U-value [W/(m ² *K)]
My conventional form 1	0	0	10
My conventional form 2	0.01	0.1	0

↑ ↓ + ✕ 📄

OK Cancel

Material Library

The screenshot displays the HETT22 software interface. The top menu bar includes File, Home, and various tool categories: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap, Time Development), Data (Table, Compare), Documentation (Report), Library (Parameters, Locations), Graphics Windows (One, Two, Four), and Settings (Preferences).

The left sidebar contains a Menu with sections for Construction, Measures, and Results. The 'Construction' section is expanded to show 'Concrete' and 'Conventional Form'. The 'Material' dropdown is set to 'Steel 3 mm, uninst.', and a list of alternative materials is displayed.

The main workspace shows a 'Graphics' window titled 'Slab on Ground, Edge Section'. It displays a cross-section of a slab with dimensions $w_1=2.0\text{m}$ and $w_2=2.0\text{m}$. The slab is composed of a 'Conventional Form' layer (height $h_1=2.0\text{m}$), a 'Concrete' layer (height $h=0.20$), and a 'Ground Floor Insul' layer (height $h_2=0.1$). The ground level is labeled 'Ground'. A message at the bottom of the graphics window states: 'No solution is available yet.'

Material Library List:

- Source: Standard library
- Material: Steel 3 mm, uninst.
- Form removal at:
- Strength:
- Steel 3 mm, insulated
- Steel 3 mm, well insulated
- Plywood 12 mm, uninsulated
- Plywood 14 mm, uninsulated
- Plywood 15 mm, uninsulated
- Plywood 17 mm, uninsulated
- Plywood 18 mm, uninsulated
- Plywood 19 mm, uninsulated
- Plywood 12 mm, insulated
- Plywood 14 mm, insulated
- Plywood 15 mm, insulated
- Plywood 17 mm, insulated
- Plywood 18 mm, insulated
- Plywood 19 mm, insulated
- Plywood 12-19 mm, well insulated
- Plywood 12 mm + XPS foam 30 mm
- Plywood 14 mm + XPS foam 30 mm

Material Library

The screenshot displays the HETP22 software interface. The top ribbon includes tabs for File, Home, and a toolbar with icons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Library, Graphics Windows, and Preferences. The left sidebar contains a Menu with sections for Construction, Measures, and Results. The main workspace is divided into three panes: Construction, Graphics, and a central Graphics window.

Construction Pane: Shows a tree view under 'Concrete' with sub-items: Concrete Dimensions, Other Dimensions, Ground Floor Insulation, Ground, and Conventional Form. The 'Conventional Form' item is selected, showing a dropdown menu for 'Source' with options: Standard library, Standard library, User library, and User-defined. The 'Strength' is set to 15 MPa.

Graphics Pane: Shows a 'Slab on Ground, Edge Section' diagram. The diagram illustrates a cross-section of a slab on ground. The total width is 4.0m (two 2.0m segments). The slab height is 0.20m. The ground below the slab is 0.1m thick. The diagram is labeled 'Side 1' and includes a 'Conventional Form' label.

Central Graphics Window: Displays the 'Slab on Ground, Edge Section' diagram. The diagram shows a cross-section of a slab on ground. The total width is 4.0m (two 2.0m segments). The slab height is 0.20m. The ground below the slab is 0.1m thick. The diagram is labeled 'Side 1' and includes a 'Conventional Form' label. A message at the bottom of the window states: "No solution is available yet."

Material Library

The screenshot displays the HETP22 software interface. The top ribbon includes tabs for File, Home, and a toolbar with icons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Library, Graphics Windows, and Preferences. The left sidebar contains a Menu with categories like Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable, Measurements, Temperature, and Results.

The main workspace is divided into three panels:

- Construction:** A tree view showing a hierarchy: Concrete Dimensions, Other Dimensions, Ground Floor Insulation, Ground, and Conventional Form. The 'Conventional Form' item is expanded, showing a 'Source' dropdown set to 'User library', a 'Material' dropdown set to 'My conventional f...', a 'Form removal at' dropdown set to 'My conventional form 1', and a 'Strength' input field with '10' and 'MPa'.
- Graphics:** A 2D cross-section titled 'Slab on Ground, Edge Section'. It shows a 'Side 1' view of a slab with a width of $w=2.0\text{m}$ and a height of $h1=2.0\text{m}$. The slab is composed of a 'Conventional Form' layer (grey) and a 'Concrete' layer (orange). Below the concrete is a 'Ground Floor Insul' layer (red). The ground is shown as a brown area. Dimensions for the concrete and insulation layers are $h=0.20$ and $h2=0.1$ respectively.
- Status Bar:** A message at the bottom reads: "No solution is available yet."

Material Library

The screenshot displays the HETP22 software interface. The top ribbon includes tabs for File, Home, and Graphics. The Graphics tab is active, showing a 'Geometry' dropdown menu. The main workspace shows a cross-section of a 'Slab on Ground, Edge Section'. The slab is 2.0m wide (w1=2.0m, w=2.0m) and 2.0m high (h1=2.0m). It consists of a 'Conventional Form' layer (0.20m thick) and a 'Concrete' layer (0.1m thick). The ground is shown below the slab. The 'Material Library' is open, showing the 'Concrete' material selected. The 'Source' is set to 'User library', 'Material' is 'Standard library', 'Form removal at' is 'User-defined', and 'Strength' is 15 MPa. The 'Graphics' panel shows a 'No solution is available yet.' message.

Menu

- Construction
- Concrete
- Time
- Weather Condition
- Measures
 - Weather Protection
 - Insulation
 - Cover
 - Trowelling
 - Infrared Heating
 - Pipe
 - Heating Cable
- Measurements
 - Temperature
- Results

Construction

- Concrete Dimensions
- Other Dimensions
- Ground Floor Insulation
- Ground
- Conventional Form
 - Source: User library
 - Material: Standard library
 - Form removal at: User-defined
 - Strength: 15 MPa

Graphics

Geometry

Slab on Ground, Edge Section

Side 1

w1=2.0m w=2.0m

h1=2.0m

h=0.20

h2=0.1

Conventional Form

Concrete

Ground Floor Insul

Ground

No solution is available yet.

Material Library

The screenshot displays the HETP22 software interface, which is used for thermal simulation. The window title is "HETP22". The interface is divided into several sections:

- Top Ribbon:** Contains tabs for "File" and "Home". The "Home" tab is active, showing various tool icons grouped into categories: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap, Time Development), Data (Table, Compare), Documentation (Report), Library (Parameters, Locations), Graphics Windows (One, Two, Four), and Settings (Preferences).
- Left Panel (Menu):** A vertical navigation menu with categories: Construction (with a sub-menu for Concrete), Time, Weather Condition, Measures (Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable), Measurements (Temperature), and Results.
- Construction Panel:** Shows a tree view under "Construction" with a sub-menu for "Concrete". The "Conventional Form" option is selected. Below this, there are input fields for:
 - Source: User-defined
 - Material description: U-value
 - U-value: 49.8 W/(m²·K)
 - Form removal at: Strength
 - Strength: 15 MPa
- Graphics Panel:** Displays a 2D cross-section of a "Slab on Ground, Edge Section". The slab is 2.0m wide (w1=2.0m, w=2.0m) and 2.0m high (h1=2.0m). It consists of a "Conventional Form" layer (0.20m thick), a "Concrete" layer (0.1m thick), and "Ground Floor Insul" (0.1m thick). The ground is shown below the slab. A message at the bottom of the graphics panel states: "No solution is available yet."

Material Library

The screenshot displays the HETP22 software interface. The top ribbon includes tabs for File, Home, and a toolbar with icons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Graphics Windows, and Preferences. The left sidebar contains a Menu with categories like Construction, Measures, and Results. The main workspace is divided into three panes: Construction, Graphics, and a central visualization area.

Construction Pane: Shows a tree view for 'Concrete' with sub-items: Concrete Dimensions, Other Dimensions, Ground Floor Insulation, Ground, and Conventional Form. The 'Conventional Form' material properties are displayed below:

- Source: User-defined
- Material description: U-value
- U-value: W/(m²·K)
- Form removal at: Strength
- Strength: 15 MPa

Graphics Pane: Shows a 'Slab on Ground, Edge Section' diagram. The diagram illustrates a cross-section of a slab with a width of 2.0m (labeled 'Side 1') and a height of 2.0m (labeled 'h1=2.0m'). The slab is composed of a 'Conventional Form' layer (grey) and a 'Concrete' layer (orange). Below the concrete is a 'Ground Floor Insul' layer (red), and below that is the 'Ground' (brown). The height of the concrete layer is 0.20m (labeled 'h=0.20') and the height of the insulation layer is 0.1m (labeled 'h2=0.1').

Central Visualization Area: Displays a message: "No solution is available yet."

Material Library

The screenshot displays the HETP22 software interface, specifically the Material Library for Concrete. The window title is "HETP22". The interface is divided into several sections:

- File Home:** Contains icons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Graphics Windows (One, Two, Four), and Preferences.
- Menu:** Lists various simulation and analysis options such as Construction, Concrete, Time, Weather Condition, Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable, Measurements, and Results.
- Construction > Concrete:** Shows a tree view of construction elements including Concrete Dimensions, Other Dimensions, Ground Floor Insulation, Ground, and Conventional Form.
- Conventional Form Properties:**
 - Source: User-defined
 - Material description: Thermal conductivity
 - Thickness: 0.02 m
 - Thermal conductivity: 0.12 W/(m·K)
 - Form removal at: Strength
 - Strength: 15 MPa
- Graphics > Geometry:** Displays a 2D cross-section of a "Slab on Ground, Edge Section". The diagram shows a concrete slab of thickness $h_1 = 2.0\text{m}$ and width $w = 2.0\text{m}$ on top of a ground layer of thickness $h_2 = 0.1\text{m}$. A "Conventional Form" layer is shown on top of the concrete, and "Ground Floor Insul" is shown between the concrete and the ground. A "Side 1" label is present.

At the bottom of the Graphics window, a message states: "No solution is available yet."

Material Library

The screenshot displays the HETP22 software interface. The top menu bar includes File, Home, and a toolbar with icons for New, Open, Save, Compute, Geometry, Mesh, Graph, Colormap, Time Development, Measurements, Table, Compare, Report, Parameters, Locations, Graphics Windows, and Preferences. The left sidebar contains a Menu with categories like Construction, Measures, and Results. The main workspace is divided into Construction and Graphics panels. The Construction panel shows a tree view with 'Concrete' expanded, and a 'Save to user library' dialog box is open over it, with 'New name: Wood -20 mm' entered. The Graphics panel shows a 'Slab on Ground, Edge Section' diagram with dimensions (w=2.0m, h1=2.0m, h2=0.1) and material layers (Concrete, Ground Floor Insul). A status bar at the bottom indicates 'No solution is available yet.'

Material Library

The screenshot displays the HETP22 software interface. The top menu bar includes File, Home, and a title bar with the HETP22 logo and window controls. Below the menu bar is a ribbon with various tool icons categorized into Project, Simulation, Graphics, Data, Documentation, Library, Graphics Windows, and Settings.

The main workspace is divided into three panels:

- Menu:** A vertical sidebar on the left containing icons for Construction, Concrete, Time, Weather Condition, Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable, Measurements, Temperature, and Results.
- Construction:** A central panel with a tree view under 'Concrete'. The 'Conventional Form' item is expanded, showing a configuration table:

Source:	User library
Material:	Wood - 20 mm
Form removal at:	Strength
Strength:	15 MPa
- Graphics:** A large central panel showing a 2D cross-section of a 'Slab on Ground, Edge Section'. The diagram includes:
 - A 'Conventional Form' layer with a height of $h1=2.0m$.
 - A 'Concrete' layer with a height of $h=0.20$.
 - A 'Ground Floor Insul' layer with a height of $h2=0.1$.
 - A 'Ground' layer below the insulation.
 - Dimensions for the slab width: $w1=2.0m$ and $w=2.0m$.
 - A label 'Side 1' is positioned above the concrete layer.

At the bottom of the Graphics panel, a message reads: "No solution is available yet."

Material Library

Parameters

Library: Conventional Form

Library type: Standard library User library

User library

Name	Thickness [m]	Thermal conductivity [W/(m*K)]	U-value [W/(m ² *K)]
My conventional form 1	0	0	10
My conventional form 2	0.01	0.1	0
Wood - 20 mm	0.02	0.12	0

↑ ↓ + - ✂ 📄

OK Cancel

Locations

The screenshot displays the HET22 software interface. The top ribbon includes tabs for File, Home, Project, Simulation, Graphics, Data, Documentation, Library, Graphics Windows, and Settings. The left sidebar contains a 'Menu' with categories like Construction, Concrete, Time, Weather Condition, Measures, and Results. The 'Weather Condition' panel is active, showing settings for 'Weather Condition - Side 1'. The 'Location' dropdown is open, listing various global locations, with 'Abkhazia - Sukhumi' selected. The 'Graphics' window shows a cross-section diagram titled 'Slab on Ground, Edge Section'. The diagram illustrates a concrete slab on a ground surface. The slab has a width of 2.0m on each side of a central 'Conventional Form' (total width 4.0m) and a height of 0.20m. Below the slab is a layer of 'Ground Floor Insul' with a thickness of 0.1m. The ground below is labeled 'Ground' with a height of 2.0m. A message at the bottom of the graphics window states: 'No solution is available yet.'

Weather Condition

Time > Weather Protection

Weather Condition - Side 1

Weather description: Data from YR

Source: Standard library

Location: Abkhazia - Sukhumi

Ground Floor Insulation

Initial temperature:

Ground

Initial surface temperature:

Ground temperature:

Graphics Geometry

Slab on Ground, Edge Section

Side 1

w1=2.0m w=2.0m

Conventional Form

Concrete

Ground Floor Insul

h=0.20

h2=0.1

h1=2.0m

Ground

No solution is available yet.

Locations

The screenshot displays the HETP22 software interface. The top ribbon includes tabs for File, Home, and a 'Locations' tab which is currently active. The ribbon contains various tool groups: Project (New, Open, Save), Simulation (Compute), Graphics (Geometry, Mesh, Graph, Colormap, Time Development), Measurements, Data (Table, Compare), Documentation (Report), Library (Parameters), Graphics Windows (One, Two, Four), and Settings (Preferences).

The left sidebar features a 'Menu' with categories: Construction, Concrete, Time, Weather Condition, Measures (Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable), Measurements (Temperature), and Results.

The central 'Weather Condition' panel is set to 'Side 1' and includes the following configuration:

- Weather description: Data from YR
- Source: Standard library
- Location: Abkhazia - Sukhun
- Buttons: Show Weather, Show on Map
- Ground Floor Insulation: Initial temperature: 15 °C
- Ground: Initial surface temperature: 15 °C, Ground temperature: 6 °C

The 'Graphics' window shows a cross-section titled 'Slab on Ground, Edge Section'. The diagram includes a 'Conventional Form' layer, a 'Concrete' layer, and 'Ground Floor Insul' (insulation) layer. Dimensions are indicated: total width $w=2.0\text{m}$ (split into two $w1=2.0\text{m}$ segments), total height $h1=2.0\text{m}$, concrete thickness $h=0.20$, and insulation thickness $h2=0.1$. A message at the bottom states: 'No solution is available yet.'

Locations



Regional Support

Supported languages include Swedish, Norwegian, and English

Languages

- The translations are integrated as an Excel file, making it easy to add additional languages in the future
- Apart from language support, it's worth noting that the background equations differ somewhat for the two type of concrete libraries supported in HETT²²

Preferences

The screenshot displays the HETT22 software interface with the Preferences dialog box open. The window title is "HETT22". The ribbon at the top includes tabs for File, Home, and Settings. The Settings tab is active, showing various tool categories like Project, Simulation, Graphics, Data, Documentation, Library, and Graphics Windows. The Preferences dialog is divided into several sections:

- Menu:** A list of application features including Construction, Concrete, Time, Weather Condition, Measures, Weather Protection, Insulation, Pipe, Heating Cable, Measurements, Temperature, and Results.
- Construction:** A section for configuring construction elements, currently expanded to show "Concrete" settings.
 - Concrete Dimensions:** Wall thickness, w: 0.2 m; Wall height, h: 2.4 m.
 - Sandwich Wall 1:** Sandwich wall thickness, w1: 0.2 m. There is an unchecked checkbox for "Use the same properties for Shell Wall 2".
 - Sandwich Wall 2:** Sandwich wall thickness, w2: 0.2 m.
- Graphics:** A preview window showing a 3D model of a vertical wall structure. The wall is labeled "Sandwich Wall" and has a height of $h=2.4\text{m}$. It is divided into "Side 1" (left) and "Side 2" (right). The top section is labeled "Concrete". The wall is composed of three layers: "Sandwich Wall 1" (left), "Sandwich Wall 2" (right), and a central "Concrete" core. Dimensions at the bottom indicate $w1=0.20\text{m}$, $w=0.20\text{m}$, and $w2=0.20\text{m}$.

At the bottom of the Graphics preview, there is a red circle with a slash icon and the text "No solution is available yet."

Preferences

The screenshot shows the HETT22 software interface with the Preferences dialog box open. The main window displays a 2D model of a sandwich wall with the following dimensions:

- Wall thickness, w : 0.2 m
- Wall height, h : 2.4 m
- Sandwich wall thickness, w_1 : 0.2 m
- Sandwich wall thickness, w_2 : 0.2 m

The bottom of the main window shows a message: "No solution is available yet."

The Preferences dialog box is open on the right, showing the following settings:

- Local settings:**
 - Language: English
 - Country or region: Rest of the world
 - Concrete library: Cement Sverige
- User information:**
 - Name: Daniel Ericsson
 - Company: Deflexional AB
- Software updates:**
 - Check for new versions automatically
- Visualization after computation:**
 - Number of graphics windows: 1
 - Graphics 1: Graph - Temperature
 - Graphics 2: Graph - Strength
 - Graphics 3: Colormap - Temperature
 - Graphics 4: Colormap - Strength
- Imported concrete libraries:**
 - Add or Remove Imported Libraries
- Concrete user library:**
 - Add or Edit the Passcode to Activate

Buttons: OK, Cancel

Language

The screenshot displays the HETP22 software interface. The main window shows a 3D model of a sandwich wall with a central concrete core and two outer insulation layers. The wall is labeled with 'Side 1' and 'Side 2'. The height is indicated as $h=2.4\text{m}$. The wall thicknesses are $w_1=0.20\text{m}$, $w=0.20\text{m}$, and $w_2=0.20\text{m}$. The software interface includes a menu on the left, a construction panel with input fields for wall dimensions, and a graphics panel showing the model. A preferences dialog box is open on the right, showing settings for language, user information, software updates, and visualization options.

Preferences Dialog Box:

- Local settings:
 - Language: English (dropdown menu)
 - Country or region: Swedish (dropdown menu)
 - Concrete library: English (dropdown menu)
- User information:
 - Name: Daniel Ericsson
 - Company: Deflexional AB
- Software updates:
 - Check for new versions automatically
- Visualization after computation:
 - Number of graphics windows: 1
 - Graphics 1: Graph - Temperature
 - Graphics 2: Graph - Strength
 - Graphics 3: Colormap - Temperature
 - Graphics 4: Colormap - Strength
- Imported concrete libraries:
 - Add or Remove Imported Libraries
- Concrete user library:
 - Add or Edit the Passcode to Activate

Buttons: OK, Cancel

Language

The screenshot displays the HETT22 software interface in Swedish. The main window is titled "HETT22" and features a ribbon menu with categories: Projekt, Simulering, Grafik, Data, Dokumentation, Bibliotek, and Inställningar. The left sidebar contains a "Meny" section with options like "Konstruktion", "Betong", "Tid", "Väderförhållande", "Åtgärder", "Väderskydd", "Isolering", "Rör", "Värmekabel", "Mätningar", "Temperatur", and "Resultat".

The central "Konstruktion" panel shows the following parameters:

Betongdimensioner	
Väggjocklek, w:	0.2 m
Vägghöjd, h:	2.4 m

Skalvägg 1	
Skalväggstjocklek, w1:	0.2 m
<input type="checkbox"/> Använd samma egenskaper för Skalvägg 2	

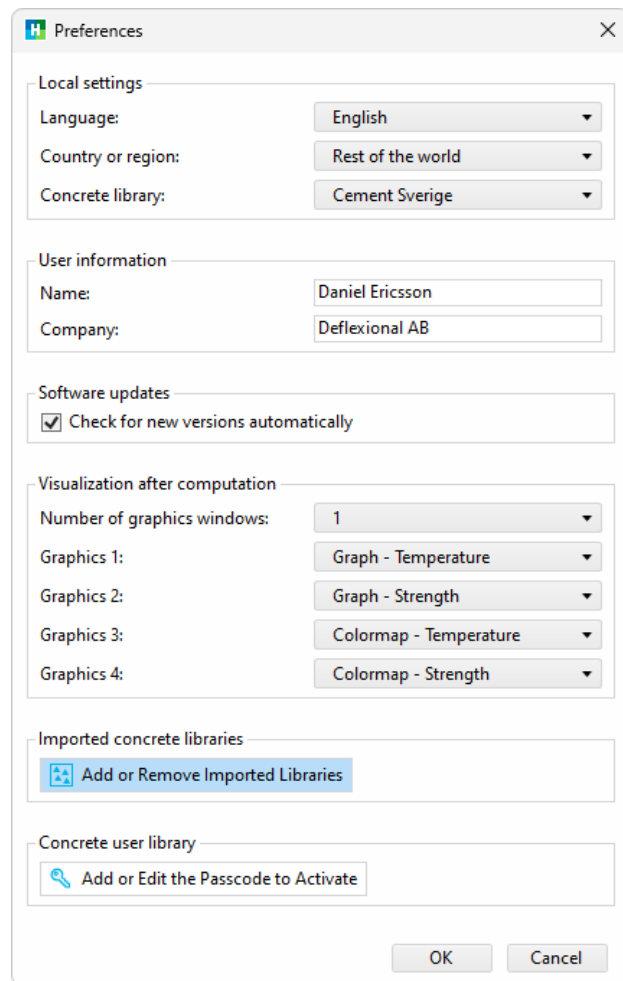
Skalvägg 2	
Skalväggstjocklek, w2:	0.2 m

The "Grafik" panel shows a 2D cross-section of a wall. The wall consists of a central concrete core ("Betong") and two insulation layers ("Skalvägg 1" and "Skalvägg 2"). The total height is labeled as $h = 2.4\text{ m}$. The insulation layers are labeled "Sida 1" and "Sida 2". The wall thicknesses are labeled w_1 , w , and w_2 , with values 0.20 m , 0.20 m , and 0.20 m respectively. A message at the bottom of the graphic panel states: "Ingen lösning tillgänglig ännu."

Imported Concrete Libraries

Concrete producers can include and share their encrypted concrete data

Imported Concrete Libraries



Preferences dialog box showing various settings. The 'Imported concrete libraries' section is highlighted with a blue box, containing an 'Add or Remove Imported Libraries' button.

Local settings

Language: English

Country or region: Rest of the world

Concrete library: Cement Sverige

User information

Name: Daniel Ericsson

Company: Deflexional AB

Software updates

Check for new versions automatically

Visualization after computation

Number of graphics windows: 1

Graphics 1: Graph - Temperature

Graphics 2: Graph - Strength

Graphics 3: Colormap - Temperature

Graphics 4: Colormap - Strength

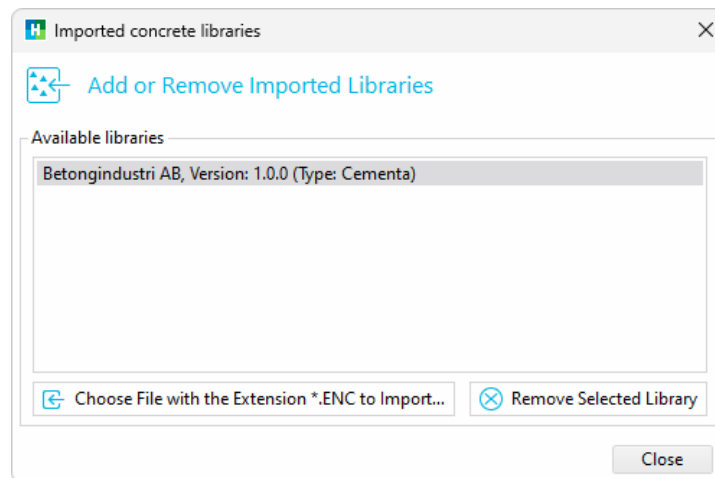
Imported concrete libraries

Add or Remove Imported Libraries

Concrete user library

Add or Edit the Passcode to Activate

OK Cancel



Imported concrete libraries dialog box. It features a title bar, a close button, and a main area with a list of available libraries. A teal arrow points from the 'Add or Remove Imported Libraries' button in the Preferences dialog to this dialog.

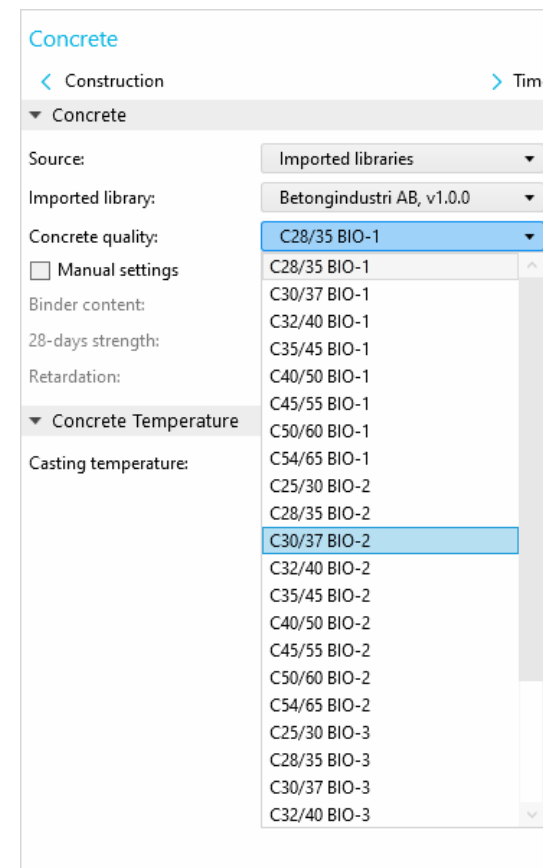
Add or Remove Imported Libraries

Available libraries

- Betongindustri AB, Version: 1.0.0 (Type: Cements)

Choose File with the Extension *.ENC to Import... Remove Selected Library

Close



Concrete settings panel. It shows a list of imported concrete libraries. A teal arrow points from the 'Remove Selected Library' button in the 'Imported concrete libraries' dialog to this panel.

Concrete

< Construction > Time

Concrete

Source: Imported libraries

Imported library: Betongindustri AB, v1.0.0

Concrete quality: C28/35 BIO-1

Manual settings

Binder content:

28-days strength:

Retardation:

Concrete Temperature

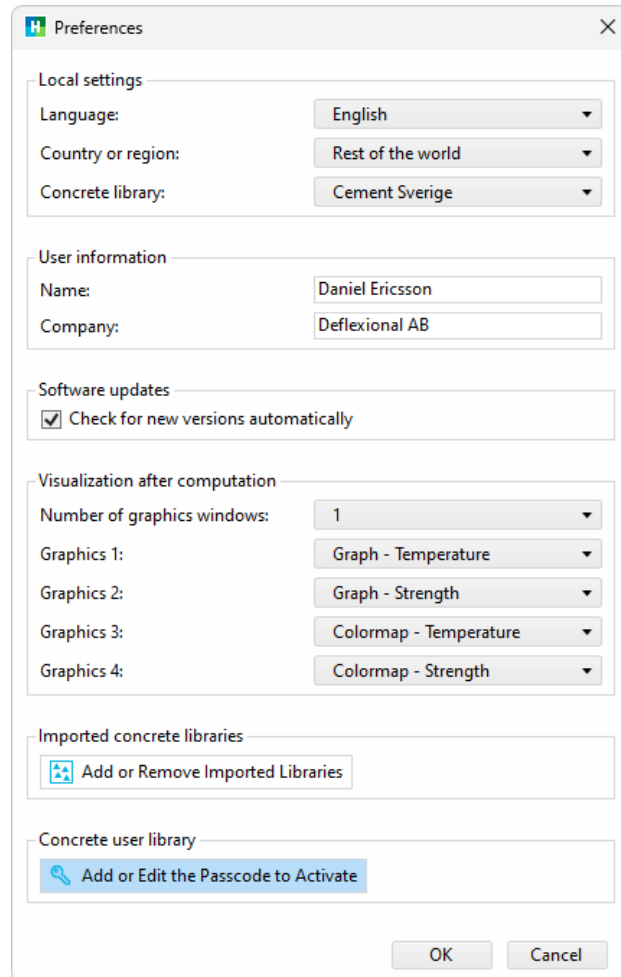
Casting temperature:

- C28/35 BIO-1
- C30/37 BIO-1
- C32/40 BIO-1
- C35/45 BIO-1
- C40/50 BIO-1
- C45/55 BIO-1
- C50/60 BIO-1
- C54/65 BIO-1
- C25/30 BIO-2
- C28/35 BIO-2
- C30/37 BIO-2
- C32/40 BIO-2
- C35/45 BIO-2
- C40/50 BIO-2
- C45/55 BIO-2
- C50/60 BIO-2
- C54/65 BIO-2
- C25/30 BIO-3
- C28/35 BIO-3
- C30/37 BIO-3
- C32/40 BIO-3

Access to Specific Functionality

A portion allocated for advanced users and researchers

Concrete User Library



Preferences

Local settings

Language: English

Country or region: Rest of the world

Concrete library: Cement Sverige

User information

Name: Daniel Ericsson

Company: Deflexional AB

Software updates

Check for new versions automatically

Visualization after computation

Number of graphics windows: 1

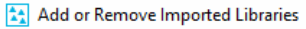
Graphics 1: Graph - Temperature

Graphics 2: Graph - Strength

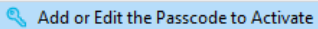
Graphics 3: Colormap - Temperature

Graphics 4: Colormap - Strength

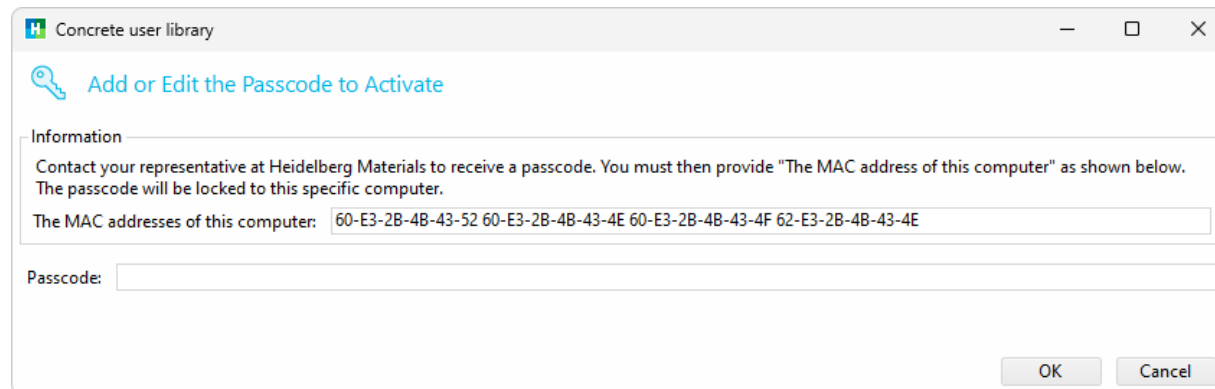
Imported concrete libraries




Concrete user library



OK Cancel



Concrete user library

 Add or Edit the Passcode to Activate

Information

Contact your representative at Heidelberg Materials to receive a passcode. You must then provide "The MAC address of this computer" as shown below. The passcode will be locked to this specific computer.

The MAC addresses of this computer: 60-E3-2B-4B-43-52 60-E3-2B-4B-43-4E 60-E3-2B-4B-43-4F 62-E3-2B-4B-43-4E

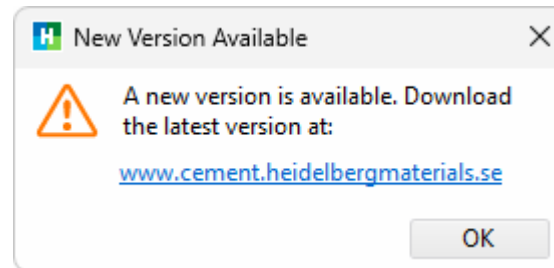
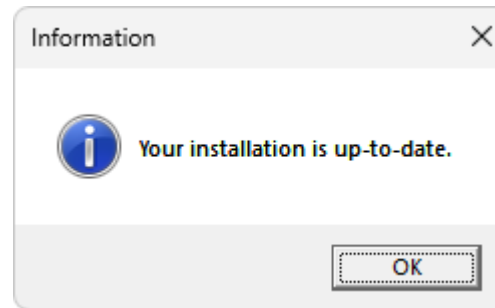
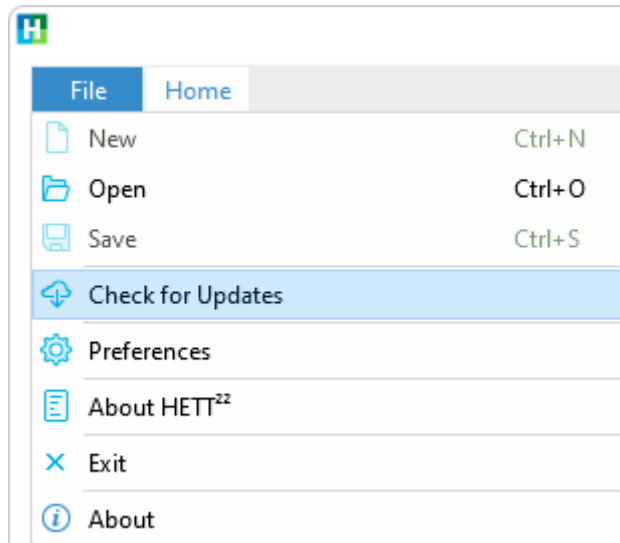
Passcode:

OK Cancel

Check For Updates

When a new version is released, users will receive notifications

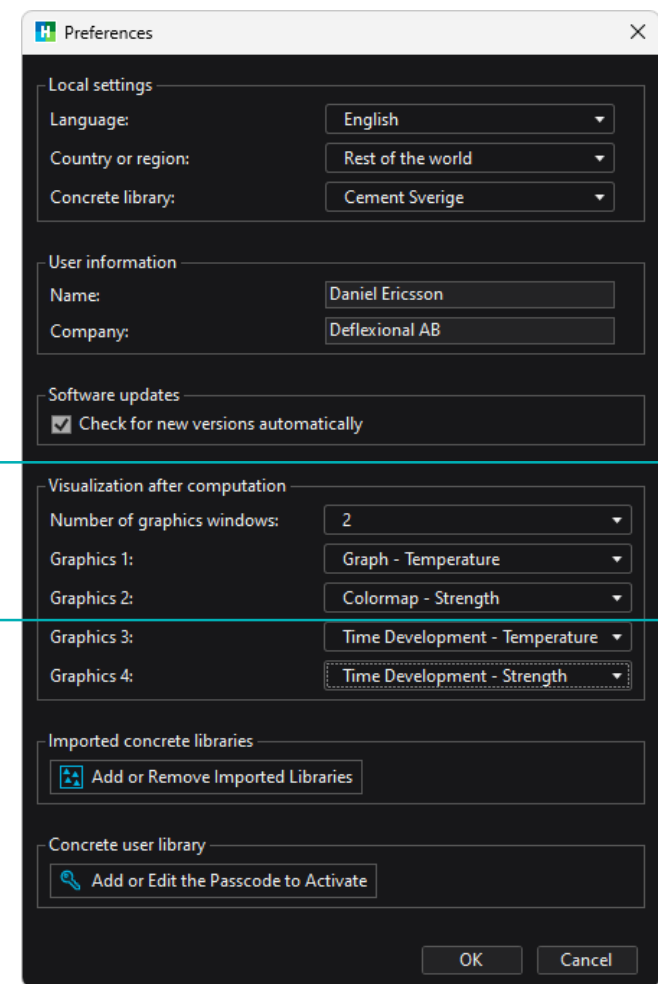
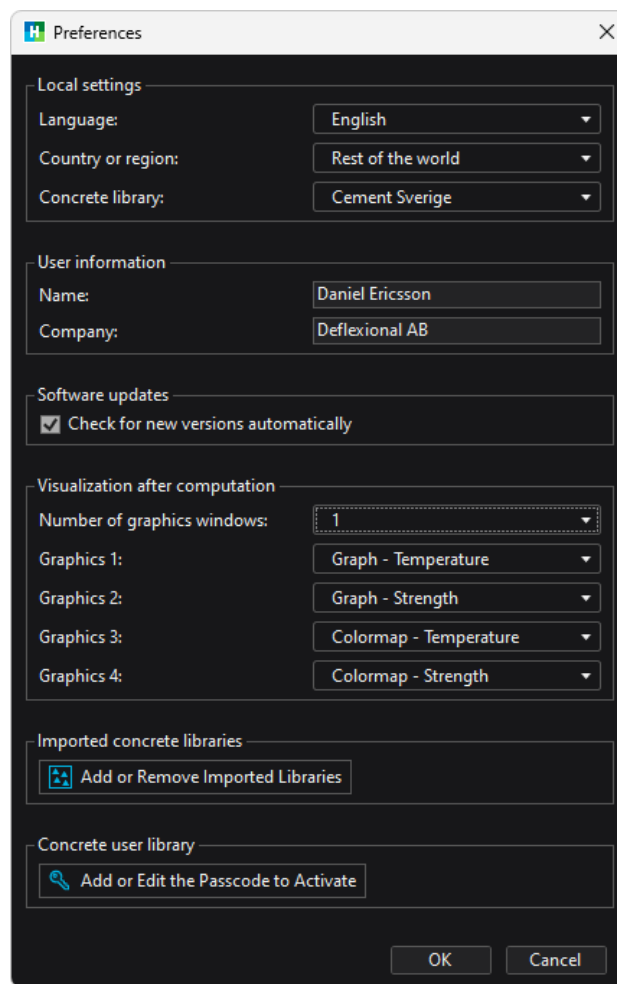
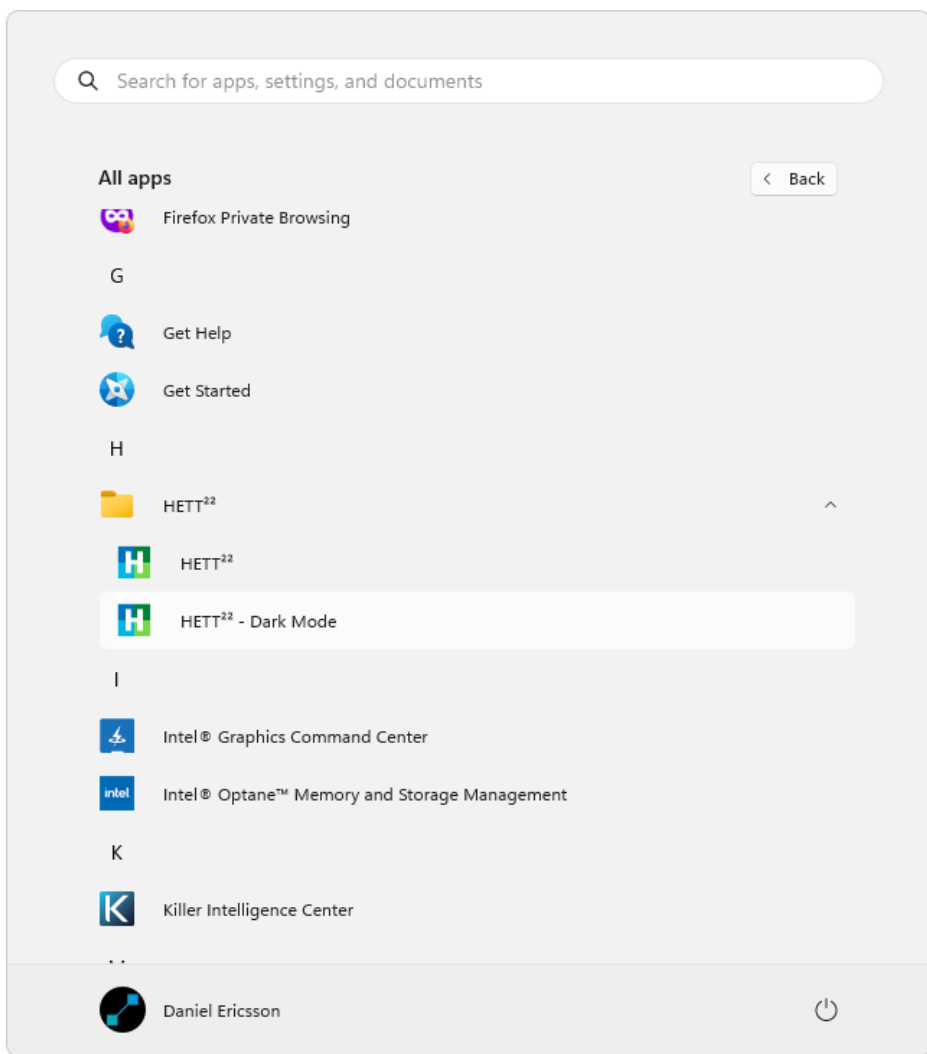
Check For Updates



Visual Preferences

Match the individual visual preferences

Dark Mode



Dark Mode

The screenshot displays the HETT22 software interface in dark mode. The window title is "HETT22". The interface is organized into several sections:

- File Bar:** Includes "File" and "Home" tabs, and icons for "New", "Open", and "Save".
- Toolbars:** A row of icons for "Compute", "Geometry", "Mesh", "Graph", "Colormap", "Time Development", "Measurements", "Table", "Compare", "Report", "Parameters", "Locations", "Graphics Windows" (One, Two, Four), and "Preferences".
- Left Panel (Menu):** A vertical sidebar with categories: "Construction", "Concrete", "Time", "Weather Condition", "Measures" (Weather Protection, Insulation, Cover, Trowelling, Infrared Heating, Pipe, Heating Cable), "Measurements" (Temperature), and "Results".
- Time Settings Panel:** Located below the menu, it shows "Concrete" and "Weather Condition" tabs. Under "Simulation", "Simulation time" is set to 8 days. Under "Start Time", the date is set to 2023, October 18, at 13:00. There is a "Get the current time" button and an "Advanced Time Settings" section.
- Graphics 1:** A window titled "Graph - Temperature" showing a line graph of "Temperature (°C)" vs "Hours (h)". The y-axis ranges from 8 to 25, and the x-axis from 0 to 150. Two data series are plotted: "Min" (solid blue line) and "Side 1" (dotted blue line). Both show a diurnal cycle with peaks around 20-25°C and troughs around 8-10°C. A legend at the bottom right of the graph identifies the series. Below the graph are checkboxes for "Max", "Average", "Min", and "Side 1", with "Min" and "Side 1" checked. A status bar at the bottom of this window says "The simulation is finalized."
- Graphics 2:** A window titled "Colormap - Strength" showing a heatmap of "Strength (MPa)" at "Time=192 h". A vertical color scale on the right ranges from 37.2 (blue) to 38.8 (red). A horizontal color bar is visible above the heatmap area.

From October 18th to October 26th

Dark Mode

The screenshot displays the HETT22 software interface in dark mode. The window title is "HETT22". The interface is divided into several sections:

- File Bar:** Contains "File" and "Home" tabs, and icons for "New", "Open", and "Save".
- Command Bar:** Includes icons for "Compute", "Geometry", "Mesh", "Graph", "Colormap", "Time Development", "Measurements", "Table", "Compare", "Report", "Parameters", "Locations", "Graphics Windows", and "Preferences".
- Menu:** Lists various simulation components like "Construction", "Concrete", "Time", "Weather Condition", "Measures", "Weather Protection", "Insulation", "Cover", "Trowelling", "Infrared Heating", "Pipe", "Heating Cable", "Measurements", "Temperature", and "Results".
- Weather Condition Panel:** Shows settings for "Weather Condition - Side 1".
 - Weather description: Data from YR
 - Source: User-defined
 - Latitude, Longitude: 48.265, 11.672
 - Ground Floor Insulation: Initial temperature: 15 °C
 - Ground: Initial surface temperature: 15 °C, Ground temperature: 6 °C
- Graphics 1:** A line graph titled "Graph - Temperature" showing "Temperature (°C)" on the y-axis (8 to 25) and "Hours (h)" on the x-axis (0 to 150). It displays two data series: "Min" (solid blue line) and "Side 1" (dotted blue line). A legend at the bottom indicates "Max", "Average", "Min", and "Side 1".
- Graphics 2:** A 3D heatmap titled "Time Development - Temperature" showing "Temperature (°C) on the colormap and Time (h) on the z-axis". The z-axis ranges from 0 to 192 hours, and the x and y axes range from -2 to 2 meters. A color scale on the right indicates temperature from 10 to 35 °C.

A status bar at the bottom of the interface displays a green checkmark icon and the text: "The simulation is finalized."

Conclusions

HETT²² streamlines the construction process



Conclusions

- Cost savings and environmental benefits can be realized by choosing the right concrete and construction
- The maturity 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 develop HETT²²
- Any contractor can now harness the capabilities of COMSOL Multiphysics®

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