

Learning System Thermopr@ctice for the Calculation of Exercises with Mathcad

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Outline

Didactic Concept

Example - How to Use Thermopr@ctice

Technical Realization

Application Concept and Use in Teaching

Effects on Study

Application Horizon

www.technische-thermodynamik.de

Interactive learning system Thermopr@ctice

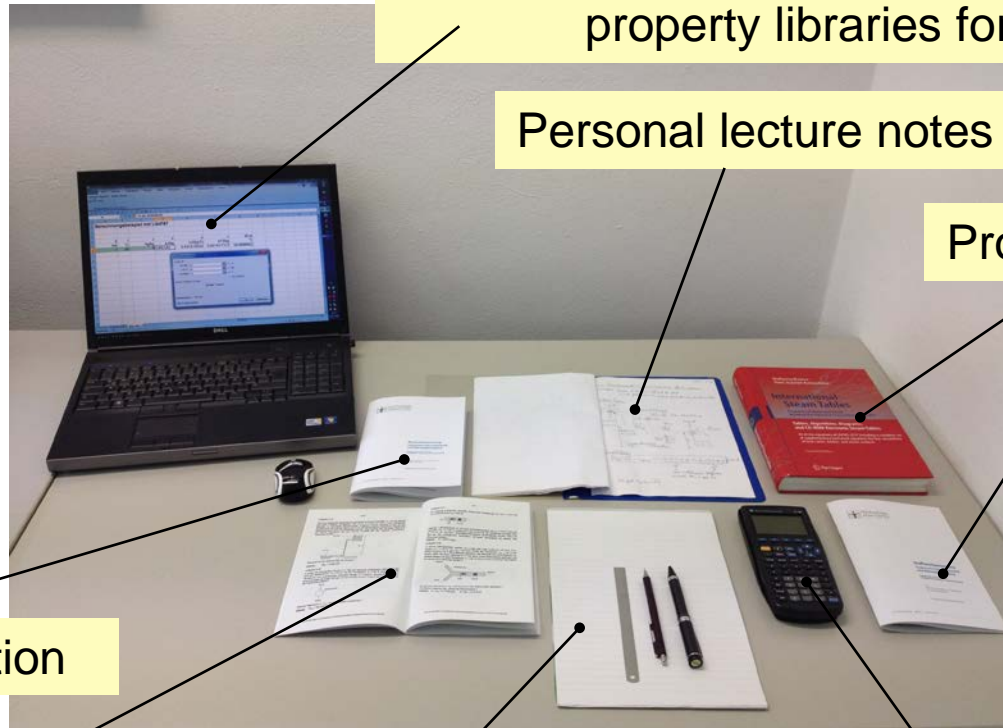


**System for the
individual calculation of exercises
with Mathcad**



**Supplement to the lecture
Technical Thermodynamics**

Initial Situation for Calculating Exercises



Laptop with online property calculations and property libraries for Excel®

Personal lecture notes

Property collections

Formula collection

Exercise collection

Paper worksheet and writing instruments

Pocket calculator with property-calculation software

**Calculation of exercises „by hand“
on a paper worksheet**

Replacement of the Paper sheet by a Working Screen

Criteria of the decision for Mathcad

- The notation of Mathcad is as much as when handwritten.

<p>Exercise 3.1 a</p> <p>Calculating the effective work</p> <p>Solution:</p> <p>given: $F_K = 1,25 \text{ kN}$ Required: W_{N12} $\Delta z = -0,40 \text{ m}$</p> <p>Solution:</p> <p>a) FS: $W_{N12} = \int_{z_1}^{z_2} F_K(z) dz$</p> <p>$W_{N12} = F_K \cdot \Delta z$</p> <p>$W_{N12} = -0,5 \text{ kJ}$</p> <p>(negative; given off by the system)</p>	<p>Exercise 3.1a kJ := 1000·J</p> <p>Calculating the effective work</p> <p>Parameters: $F_K := 1,25 \text{ kN}$ $\Delta z := -0,4 \text{ m}$ $d := 10 \text{ cm}$ $W_{W12} := 2,5 \text{ kJ}$</p> <p>Solution:</p> <p>a) <u>FS</u>: $W_{N12} := \int_{z_1}^{z_2} F_K(z) dz$</p> <p>$W_{N12} := F_K \cdot \Delta z$</p> <p>$W_{N12} = -0,5 \text{ kJ}$ negative; given off by the system</p>
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- Use of units
- Coupling options for DLLs

At Zittau/Goerlitz University: PC-pool licenses for Mathcad and Home-use-Licenses for Students

Didactic Concept

Selection of an exercise from the exercise collection and transfer it via Internet

Mathcad working screen

Example Calculation - Exercise code: 846545

Reference: D:\Dokumentationen\{aktuelle_Dokus\}\Lehrunterlagen\E-Learning\Abbildungen_Eng\TP_Units.mcd(R)

Task:

A water mass flow

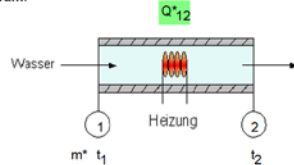
$m^* := 580 \frac{\text{kg}}{\text{hr}}$ with a temperature $t_1 := 10.^\circ\text{C}$ is heated stationary to $t_2 := 60.^\circ\text{C}$

with an electric flow heater.

The water can be considered with good approximation as an incompressible fluid. Calculate the rate of the heat flow Q^*_{12} that has to be fed!

Draw in the points of state and the given and required values into the system diagram before the calculation!

System diagram:



Formulas from the formula collection

Property data from the property collection

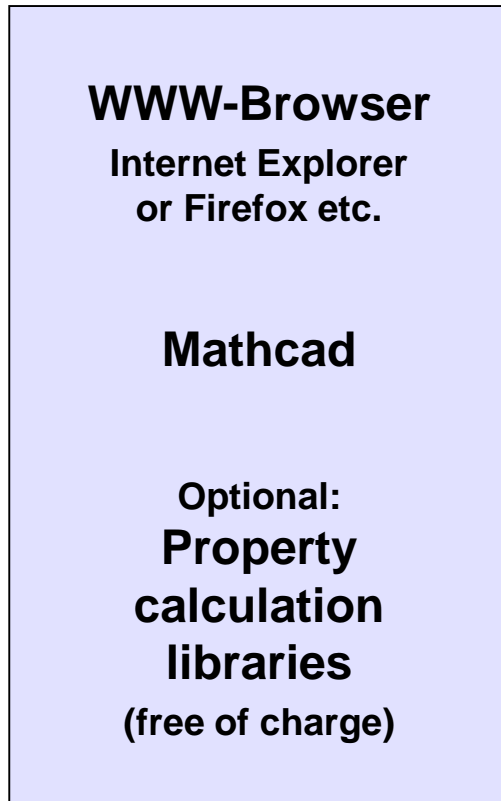
Calculation of property data using the property libraries in Mathcad

Organization of the interfaces by Thermopr@ctice

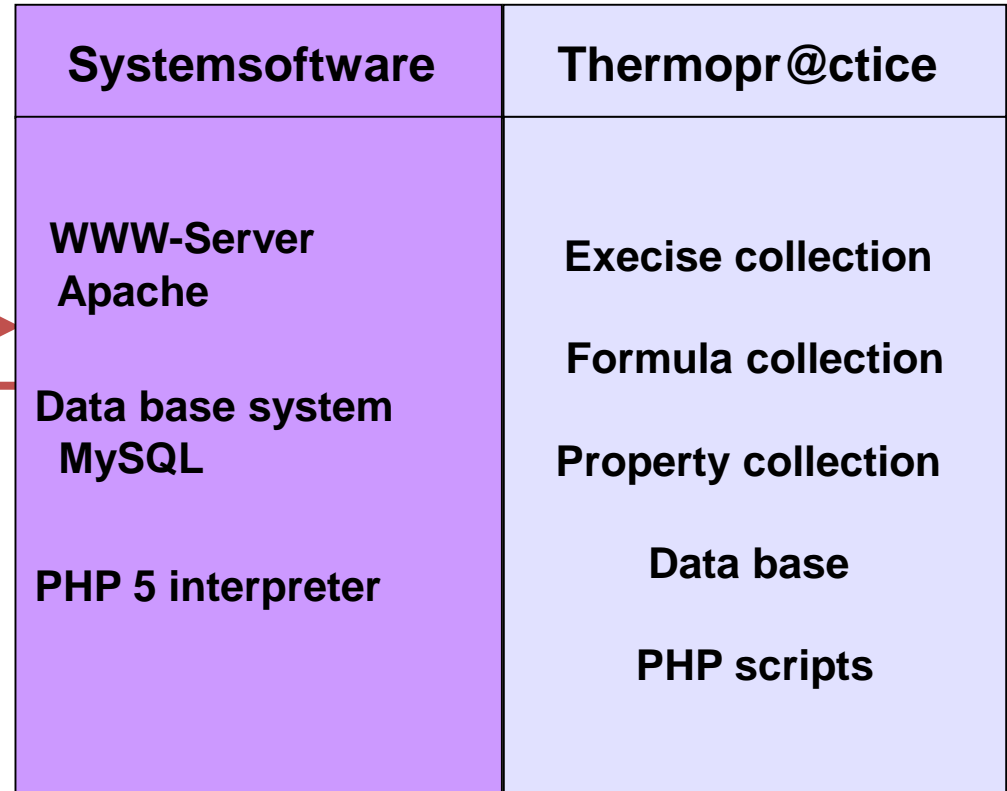
Transfer of results to server via internet
The system evaluates the results and gives feedback to the student.

Technical Solution and System Structure

Windows Client (student)



Internet Server



Communication via Internet

Application Concept for Thermopr@ctice

- **Workshop with a simple example (2 hours)**
- Installation of Mathcad on student's personal computer or laptop
- Exercises in PC-pools parallel to traditional exercises
- Calculation of the remaining tasks at home on the own computer
- **Exams using Thermopr@ctice in PC pools**

Use of Thermopr@ctice in Teaching

- Successful use of Thermopr@ctice since 2002
- Use of Thermopr@ctice in the subjects
 - Technical Thermodynamics I, II, III and
 - Refrigeration Technologies
- Thermopr@ctice comprises 230 exercises
- Use in continuing education for Siemens

Effects on Study

- Students independently execute exercises in individual variants and with individual values.
→ Active and independent learning is encouraged.
- Processing of tasks via Internet on student's own laptop corresponds to the interest of students.
→ The attractiveness of learning increases.
- Study tasks are processed at home.
→ The student's own laptop is used for learning purposes.
- Get to know a computer algebra system and use of modern tools, such as property calculation libraries are important for the course of study.
→ Modern working methods of the engineer are introduced.



As a result, on average, only 8.2% of the students failed their first exams in Technical Thermodynamics during the last 5 years.

Application Horizon

The technology of Thermopr@ctice can be applied for further subjects in which the acquisition of knowledge takes place by calculating exercises:

- Thermodynamics
- Fluid Mechanics
- Technical Mechanics
- Machine Elements
- Electrical Engineering
- Mathematics
- Physics
- Investment and Financing

Summary

- The eLearning system Thermopr@ctice was presented. It is intended as a supplement to the lectures.
- The conventional way of calculating exercises on the sheet of paper is replaced by calculation on the working screen of Mathcad.
- The learning materials in Mathcad format can be comfortably used via Internet.
- Students independently execute exercises in individual variants and with individual values.
- The students get feedback whether their calculation results are OK or not. If not, interim results are queried to facilitate the processing.
- The use of Thermopr@ctice was demonstrated using an example of Technical Thermodynamics.
- Application of Thermopr@ctice is possible to study subjects in which the acquisition of knowledge takes place by calculating exercises.
- Modern working methods of the engineer are introduced to students.

Login

www.thermopractice.de

The screenshot shows a web browser window displaying the login page of the Thermopractice learning system. The browser's address bar shows the URL <http://www.thermopractice.de/>. The page features a navigation menu with options like 'Deutsch | English', 'Vorgeschlagene Sites', 'Bing', 'Google', 'HRZ', and 'HSZG'. The main content area includes the title 'Learning System Thermopractice Version 2.4' and the subtitle 'Calculation of Exercises using Mathcad'. Below this, there is copyright information for Zittau/Görlitz University of Applied Sciences, Department of Technical Thermodynamics, and Prof. Dr.-Ing. habil. H.-J. Kretschmar. A section titled 'Tutors and developers of the learning system' provides links for 'General information about the system', 'Hints for first time users (PDF)', and 'Inhaltsverzeichnis'. The central focus is a 'Login' form with input fields for 'Login name:' and 'Password:', and a 'Login' button. Below the form, there are links for 'Register as new user' and 'I forgot my password or login name'. At the bottom, a footer mentions sponsorship by SMWK and BMBF in association with the network project Education Portal of Saxony. The browser's status bar at the bottom right indicates a zoom level of 100%.

Thank you for your attention.