Calculation with LaTeX by means of CalcTeX

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Contents

1 Calculation with LaTeX

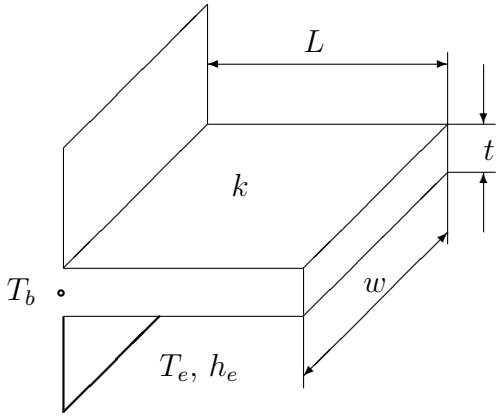
This folder consider couples of examples – all files `*-calc.tex` in LaTeX input format with defined operations that are included in a single pdf document with calculated operations by means of CalcTeX package.
For received a final calculation of all `*-calc.tex` files please use a LINUX prompt command: `sh go`.
For more info please visit a web page on: http://sg.bzip.pl/CalcTeX or contact me by e-mail: CalcTeX (at) onet (dot) eu
I am open for any kind of questions or commands.
The file "`1st-example-ke-eng-calc.tex`" is the simplest and I recommend this file for study of CalcTeX used at first.
The file " http://sg.bzip.pl/CalcTeX/example/all-in-one.tgz " consider all necessary files for calculation of this example if you have installed a LaTeX compiler and python language as well it's checked for LINUX system.
All files which suits to mask `*-iso-calc.tex` are autamaticlly calulated and included into single pdf format document in order to `ls *-calc.tex` comment and for calulation are included all `python` files available on `bin/py` folder. This following example based on Richard J. Pryputniewicz calulation available on
http://users.wpi.edu/~chslt/courses/es3003/index.html

1.1 PROBLEM 4

A straight rectangular fin has a length of $L := 3.5 \cdot \text{cm}$, a thickness of $t := 1.5 \cdot \text{mm}$, and is made of a material characterized by thermal conductivity of $k := 255 \cdot \text{W}/(\text{m} \cdot {}^{\text{o}}\text{C})$. The fin is exposed to a convection environment at $t_e := 20 \cdot {}^{\text{o}}\text{C}$ and $h_c := 1.5 \cdot \text{kW}/(\text{m}^2 \cdot {}^{\text{o}}\text{C})$. Determine the maximum possible heat transfer from this fin for the base temperature of $t_b := 150 \cdot {}^{\text{o}}\text{C}$. What is the actual heat transfer from this fin? What is its thermal efficiency?

1.1.1 Calculation

$L \cdot \mathrm{cm}^{-1} = 3.5$
$t \cdot \mathrm{cm}^{-1} = 0.15$
$w := 1 \cdot \mathrm{m}^{-1}$
$k \cdot (\mathrm{W}/(\mathrm{m} \cdot {}^{o}\mathrm{C}))^{-1} = 255.0$
$t_e \cdot {}^{o}\mathrm{C}^{-1} = 20.0$
$h_c \cdot (\mathrm{kW}/(\mathrm{m}^2 \cdot {}^{o}\mathrm{C}))^{-1} = 1.5$
$Q_{max} = ?$
$t_b \cdot {}^{o}\mathrm{C}^{-1} = 150.0$
$Q_{act} = ?$
$\eta_{fin} = ?$



$$L_c := L + 0.5 \cdot t \tag{1}$$

$$A_c := 2 \cdot (w \cdot L_c); \quad A_c \cdot \mathrm{m}^{-2} = 0.0715; \quad A_c \cdot \mathrm{cm}^{-2} = 715.0 \tag{2}$$

$$Q_{max} := h_c \cdot A_c \cdot (t_b - t_e); \quad Q_{max} \cdot \mathrm{kW}^{-1} = 13.9425 \tag{3}$$

$$A_m := L_c \cdot t; \quad A_m \cdot \mathrm{m}^{-2} = 5.3625e-05; \quad A_m \cdot \mathrm{cm}^{-2} = 0.53625 \tag{4}$$

$$mL_c := \sqrt{\frac{2 \cdot h_c}{k \cdot A_m}} \cdot L_c^{1.5}; \quad mL_c = 3.16607321581 \tag{5}$$

$$\tanh(mL_c) = 0.996449887141 \tag{6}$$

Where

$$\tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}} \tag{7}$$

$$\eta_{fin} := \frac{\tanh(mL_c)}{mL_c}; \quad \eta_{fin} = 0.314727367064; \quad \eta_{fin} \cdot \%^{-1} = 31.4727367064 \tag{8}$$

$$Q_{act} := \eta_{fin} \cdot Q_{max}; \quad Q_{act} \cdot \mathrm{kW}^{-1} = 4.38808631528 \tag{9}$$

1.1.2 Source – 4rd-eng-iso-calc.tex

```
This  following example based on
\linkurl{emailto: rjp@wpi.edu} {Richard J. Pryputniewicz}
%http://users.wpi.edu/~chslt/rjp.html
calulation available on\\
\linkurl{http://users.wpi.edu/~chslt/courses/es3003/index.html}{http://users.wpi.edu/\~{}chslt/courses/es3003/index.html}

\Task{PROBLEM 4}

A straight rectangular fin has a length of $L:=3.5 \cdot \cm","$
a thickness of $t:=1.5 \cdot \mm$, and is made of a material
characterized by thermal conductivity of $k:=255\cdot \W/(\m\cdot \oC)"."$
The fin is exposed to a convection environment at $t_e:=20\cdot\oC$
and $h_c := 1.5 \cdot \kW/(\m^2\cdot \oC)"."$
Determine the maximum possible heat transfer from this
fin for the base temperature of $t_b:=150\cdot \oC"."$
What is the actual heat transfer from this fin?  What is its thermal efficiency?

\Calculation{}

\begin{tabular}{l}
  $L\cdot \cm^{-1}$ \\
  $t\cdot \cm^{-1}$ \\
```

```
  $w:=1\cdot \m^{-1}$ \\
  $k\cdot \left( \W/(\m\cdot \oC)\right)^{-1}$ \\
  $t_e\cdot \oC^{-1}$ \\
  $h_c\cdot \left( \kW/(\m^2\cdot \oC)\right)^{-1}$ \\
  $"Q_{max}=?"$ \\
  $t_b\cdot \oC^{-1}$ \\
  $"Q_{act}=?"$ \\
  $"\eta_{fin}=\;?"$
\end{tabular}
\hfill
\begin{minipage}{0.5\textwidth}
\input{figs/p4e1.latex}
\end{minipage}

\begin{equation}
L_c:=L+0.5\cdot t
\end{equation}

\begin{equation}
A_c:=2\cdot \left(w\cdot L_c \right)
";\;\;\;\;\label{p4e1e1}"
A_c\cdot \m^{-2}
";\;\;\;\;\;"
A_c\cdot \cm^{-2}
\end{equation}

\begin{equation}
Q_{max}:=h_c\cdot A_c\cdot \left( t_b-t_e\right)
";\;\;\;\;\;\;"
Q_{max}\cdot \kW^{-1}
\end{equation}

\begin{equation}
A_m:=L_c\cdot t
";\;\;\;\;\;"
A_m\cdot \m^{-2}
";\;\;\;\;\;"
A_m\cdot \cm^{-2}
\end{equation}

\begin{equation}
mL_c:=\sqrt{\frac{2\cdot h_c}{k\cdot A_m}}\cdot L_c^{1.5}
";\;\;\;\;\label{p4e1e}"
mL_c
\end{equation}

\begin{equation}
\tanh(mL_c)
\end{equation}
Where
\begin{equation}"
\tanh(x)=\frac{e^{x} -e^{-x}}{e^{x} +e^{-x}}
\label{p4e1e}
"
\end{equation}

\begin{equation}
\eta_{fin}:=\frac{\tanh(mL_c)}{mL_c}
";\;\;\;\;\label{p4e1e}"
\eta_{fin}
";\;\;\;\;\;"
\eta_{fin}\cdot \opercent
\end{equation}

\begin{equation}
Q_{act}:=\eta_{fin}\cdot Q_{max}
";\;\;\;\;\label{p4e1e}"
Q_{act}\cdot \okW
\end{equation}
```