



Degree in Industrial Technologies

Bachelor's or Master's final project

This is the title of your project

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Thank yous

And other important information

Abstract

Abstract content

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Notation	Description
x_t	Value of variable x at time step t

Acronyms

Notation	Description	Page List
FIB	Focused Ion Beam	1

Chapter 1

An overview of L^AT_EX

In this section, a few basic tools will be presented. In following sections more advance functionality and complex tools will be showcased. **Use this as examples and to your advantage!**

1.1 Basics of L^AT_EX

1.1.1 Text styles

The following table showcases some of the more common text styles in L^AT_EX.

Style	Code	Ouput
Quotes	<code>``Quotes''</code>	“Quotes”
Boldface	<code>\textbf{Boldface}</code>	Boldface
Italics	<code>\textit{Italics}</code>	<i>Italics</i>
Emphasis	<code>\emph{Emphasis}</code>	<i>Emphasis</i>
Underline	<code>\underline{Underline}</code>	<u>Underline</u>
Typewriter	<code>\texttt{Typewriter}</code>	Typewriter
Mathematical	<code>\$Mathematical^{\pi\cdot i}\$</code>	$Mathematical^{\pi\cdot i}$
L ^A T _E X Comments	<code>% Some text</code>	

Table 1.1: Text styles in L^AT_EX.

1.1.2 Structure of a L^AT_EX document

For this template, which is based in the **book** class, we have the following major sections:

1. `\part{}`: Parts are fully self-contained portions of information. They leave a full blank page with only the title of the part. **This is not used and not recommended!**
2. `\chapter{}`: Your normal chapters, as you can see above. We are in the “*An overview of L^AT_EX*.”
3. `\section{}`: Normal sections for a chapter. We are in “*Basics of L^AT_EX*.”
4. `\subsection{}`: Subsections. We are in “*Structure of a L^AT_EX document*.”
5. `\subsubsection{}`: Subsubsections. This level tends to be quite deep and will most likely not appear in the index unless we include `\setcounter{secnumdepth}{3}` in the preamble¹.
6. `\paragraph{}`: One step deeper. By default paragraphs are not numbered.

You just have to write what you want between the `{}` for each command, and L^AT_EX does the rest. It typesets the titles/sections, it adds them to the table of contents and numbers them consistently!

1.1.3 Mathematical notation

L^AT_EX provides several ways to include symbols and write maths. The most basic way is to include mathematical notation or symbols into the text. This is known as *inline* and can be done with `$...$`. Whatever is between the `$` symbols, is typeset in mathematical notation. This is an example: $2 = \frac{4}{2}$. This is produced using `$2 = \frac{4}{2}$`.

Another method is to write mathematical formulas in *display* mode, which is separated from the text. This can be done by wrapping the text in `\[...\]`. **This is not recommended** as the next method is better. Here is an example:

$$2 = \frac{4}{2}$$

Normally, the best way is to use mathematical environments. These environments will provide more functionality and generally number the equations and allow them to be labelled. Here are a few examples:

$$2 = \frac{4}{2} \tag{1.1}$$

The equation above, eq. (1.1), is produced by writing:

¹The preamble is the part before `\begin{document}`, basically, the setup section.

```

0 \begin{equation} \label{eq:simpleeq}
  2 = \frac{4}{2}
\end{equation}

```

Lets showcase some more environments that help us write beautiful formulas!
The `\begin{array}` environment helps us write vertically aligned formulas!

$$f(t) = \begin{cases} A_0 + A \cdot e^{-\frac{t-t_0}{t_d}} & \text{for } t \geq t_0 \\ A_0 & \text{for } t < t_0 \end{cases} \quad (1.2)$$

```

0 \begin{equation} \label{eq:abaqus-exponential-decay}
  f(t) = \left\{
    \begin{array}{l}
      A_0 + A \cdot e^{-\frac{t-t_0}{t_d}} \text{ \& for \& } t \geq t_0 \\
      A_0 \text{ \& for \& } t < t_0
    \end{array}
  \right.
\end{equation}

```

The `\begin{aling}` environment may be easier to use, but it has a few quirks.
Read the documentation² for more information.

$$a_{11} = b_{11} \qquad a_{12} = b_{12} \quad (1.3)$$

$$a_{21} = b_{21} \qquad a_{22} = b_{22} + c_{22} \quad (1.4)$$

```

0 \begin{align}
  a_{11} &= b_{11} \& \\
  a_{12} &= b_{12} \& \\
  a_{21} &= b_{21} \& \\
  a_{22} &= b_{22} + c_{22} \\
5 \end{align}

```

The `\begin{subequations}` allows us to have several formulas numbered into the same reference. As shown in eq. (1.5), with the first entry being eq. (1.5a).

$$XSYMM \equiv U1 = UR2 = UR3 = 0 \quad (1.5a)$$

$$ZSYMM \equiv U3 = UR1 = UR2 = 0 \quad (1.5b)$$

²<http://tug.ctan.org/info/short-math-guide/short-math-guide.pdf>

```

0 \begin{subequations} \label{eq:symmetry-bc}
  \begin{equation} \label{eq:x-symmetry-bc}
    \text{\texttt{XSMM}} \equiv U1 = UR2 = UR3 = 0
  \end{equation}
  \begin{equation}
5    \text{\texttt{ZSYMM}} \equiv U3 = UR1 = UR2 = 0
  \end{equation}
\end{subequations}

```

1.1.4 References

One of the strongest points of L^AT_EX is its wonderful and powerful referencing system. We can reference whatever we want by putting on a “tag” with the command `\label{xxx}`. Wherever the `\label` is, it will refer to it. You can see some examples above where we referred to a few equations by their labels, which are inside the `\begin{equation}` environment. This way, L^AT_EX knows automatically what type of thing they are referring.

Here, lets see what types of refences we can generate!

Package	Command	Result
L ^A T _E X	<code>\ref{eq:simpleeq}</code>	1.1
	<code>\pageref{eq:simpleeq}</code>	2
hyperref	<code>\autoref{eq:simpleeq}</code>	Equation 1.1
	<code>\autoref{fig:textstyles}</code>	Table 1.1
	<code>\autopageref{eq:simpleeq}</code>	page 2
cleveref	<code>\cref{eq:simpleeq}</code>	eq. (1.1)
	<code>\Cref{eq:simpleeq}</code>	Equation (1.1)
	<code>\cpageref{eq:simpleeq}</code>	page 2
	<code>\cref{eq:simpleeq,eq:symmetry-bc}</code>	eqs. (1.1) and (1.5)
	<code>\crefrange{eq:simpleeq}</code>	eqs. (1.1) to (1.5)
	<code>{eq:symmetry-bc}</code>	

Table 1.2: Different reference mechanisms. **The author recommends `cleveref`!**. It is included in this template.

1.1.5 Bibliography

Bibliography management is another strong point of L^AT_EX! We just need to add bibliographic entries to the bibliography database, which for this template it is the

main.bib file. Here is what such an entry can look like:

```

0 @book{lovecraft2016el,
    author = {Lovecraft, H. P.},
    title = {El élerigo malvado y otros relatos},
    publisher = {Alianza Editorial},
    year = {2016},
5    address = {Madrid},
    isbn = {9788491042105}
}

```

In order to cite the entry we just have to use `\cite{}` with the entry’s identifier, like so `\cite{lovecraft2016el}` [1]. We can also have multiple cites in the same command, [1, 2] (`\cite{lovecraft2016el,norton_creep}`). It is that simple! They get automatically printed in the bibliography section.

IMPORTANT: this template uses **biblatex** as the management system, which is a powerful, flexible and modern tool. Therefore, you will need to run the **biber** command to build the bibliography after the first compilation of your document; then you will have to recompile after **biber** has run. Most editors do this by default.

1.1.6 Tables, images and floating environments

Probably, the part of L^AT_EX that causes the most confusion among new users, are the so called *floating environments*. **Tables, images, algorithms, etc are floating environments.** This means that **L^AT_EX can position them where it sees fit, not where they are written by the user.** In reality, L^AT_EX is trying to optimise your document’s layout and leave as little empty space as possible.

Sooo... How do we solve L^AT_EX moving our floating environments? Here are a few solutions:

- We don’t solve it. L^AT_EX referencing tools allow us to easily point the reader to the table, image, etc. Therefore, it is not that problematic that the *floats* may not be where we put them!
- We can ask L^AT_EX to try to place the image where it appears in our document. This is done with the “*here*” [h] placement modifier, more on placement modifiers later. **This is not a definitive solution.** This will just tell L^AT_EX to try hard to do what we are asking. There is the [h!] modifier, which is even stronger.
- **A really good solution is to use \FloatBarrier.** It comes from the `placeins` package, included in this template. `\FloatBarrier` forces L^AT_EX to

put all floating environment that have already appear before the position where `\FloatBarrier` appears. This is very useful to force L^AT_EX to put all floats before another section that may not be related to the topic of those floats. Here is an example:

```

0 \section{Some topic}

   \begin{figure}
     XXX
   \end{figure}
5
   \begin{table}
     XXX
   \end{table}

10 \FloatBarrier % All previous floats will appear before this point.

    \section{Some unrelated topic}
    XXX

```

- We can use the placement modifier `[H]` to force the float to appear *HERE*. This is provided by the `float` package. However, **this solution is not recommended!** It can lead to some wierd and nasty document layouts!

Now, how do we actually include figures, tables, etc? They all follow the same structure, here are some examples:

Figures are declared in the `figure` environment (*SHOCK!*). You can see the image rendered in fig. 1.1.

```

0 \begin{figure}
   \centering % Center image horizontally
   \includegraphics[keepaspectratio, trim = 1050 12 150 30, clip, width=0.5\
   linewidth, height=0.3\textheight]{Images/monoblock-material-overview-mesh.png}
   }
   \caption[Overview of \gl{sentryname{FEM}} mesh used for the final analysis.]{
   Overview of \gl{xtrshort{FEM}} mesh used for the final analysis.}
   \label{fig:monoblock-overview-mesh}
5 \end{figure}

```

The key here is `\includegraphics`, it is what loads the graphics and allows us to set its properties. The above example is rather complex, most times you do not need these many options. Nonetheless, here is what they do:

keepaspectratio Keeps the size ratio of the image. Very useful if you set **height** and **width** at the same time.

trim It allows us to trim/cut the image. It cuts X amount of pixels from the **left**, **bottom**, **right**, **top**. This is useful if your image is too large and you only care about a small portion of it.

clip Only show the trimmed image.

width and height Sets the maximum size with respect to the width and height. We use `\linewidth` and `\textheight` to limit the size of the image in the page by using the page's natural lengths.

Then we have `\caption`, which is what adds the text to the image. We use `\caption[]` here, to modify the text that will appear in the “List of Figures”, as I do not want my acronym **FEM** to be linked there, and therefore I use `\glsentryname` to control that. But more about acronyms and glossaries in section 1.2 Finally, we have `\label{}` is what allows us to give an identifier to our image so that we can reference it.

Tables are fairly easy to do once we get used to their nature. It uses the **table** floating environment with another environment that allows us to type tabulated data. A basic example is given below and shown in table 1.3.

```

0 \begin{table}
   \centering % To center the table
   \begin{tabular}{lcr}
     \toprule
     Heading 1 & Heading 2 & Heading 3 \\
     \midrule
     Left aligned & Center aligned & Right aligned \\
     \cmidrule{2-3} % Example of a controlled rule
     Some info & Some info & Some info \\
     \bottomrule
10 \end{tabular}
    \caption{Example of a table.}
    \label{tab:example-table}
  \end{table}

```

IMPORTANT: the `&` symbol is used as a column break in all alignment environments!

The column alignment options for the `tabular` environment can be `l`, `c`, `r`, `m` or `p` among others. They refer to left, center, right alignment and the `m` and `p` refer to a limited size column whose vertical alignment is either centered or natural. You could use them as `m{0.3\linewidth}` for

example. If you want to align the text horizontally with `m` or `p` you would write `>\centering\arraybackslash m{0.3\linewidth}`. You can change the `\centering` for a `\raggedright` for a right aligned column. But this is getting too advance! One final bit of knowledge about very long tables and dynamically sized columns. This template includes the package `xltabular`, which includes the well-known `tabularx` environment and merges it with the `longtable` environment (for tables that can span more than one page) generating its own `xltabular` environment. Please read the documentation of the `tabularx`, `longtable` and `xltabular` if you need to build complex tables!

Also, **there are online tools to help you generate L^AT_EX tables from Excel sheets**. One such example (which I am not very familiar with nor endorse) is Tableconvert.

Finally, if you have `.csv` files or similar and you want to print them in your L^AT_EX document, you can see table 1.4, which was automatically generated using `pgfplotstable`.

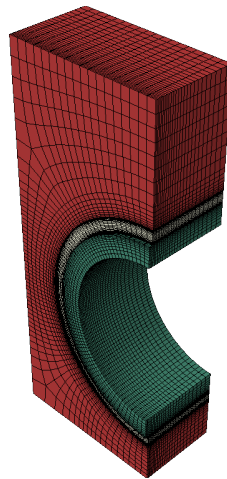


Figure 1.1: Overview of FEM mesh used for the final analysis.

Heading 1	Heading 2	Heading 3
Left aligned	Center aligned	Right aligned
Some info	Some info	Some info

Table 1.3: Example of a table.

1.2 Glossaries

1.3 Automatic formatting of table data

The following table, table 1.4, is formatted using the following general setup for `pgfplotstable`:

```

0 % Configure the general setting of pgfplotstable
\pgfplotstableset{
  every odd row/.style={
    before row={\rowcolor{gray!20}}
  },
5  every head row/.style={
    before row=\toprule,
    after row=\midrule,
    % Don't print the row name or the row index!
    output empty row
10  },
  every last row/.style={
    after row=\bottomrule
  },
  header=false,
15  format=file,
  col sep=tab,
  search path={Data},
  font={\small}
}

```

And then the actual table:

```

0 \begin{table}
  \newcommand{\prop}{Expansion}
  \newcommand{\propunit}{[\unit{\milli\meter\per\celsius\per\milli\meter}]}
  \centering
  \pgfplotstabletypeset[
5  every head row/.append style={
    before row={
      \toprule
      \multicolumn{2}{c}{\glentryname{Cu-OFHC}} \\
      \midrule
10     \multirow{2}{\widthof{\propunit}}{\centering \prop\ \propunit} & \multirow
      {2}{\widthof{Temperature}}{\centering Temperature [\unit{\celsius}]} \\
      \\
    },
  },
}

```

```

15 ]{ITER Cu You-harden for WPDIV phase II_\prop_f_T.txt}
   \caption{Automatically formatted table using \texttt{pgfplotstable}.}
   \label{tab:automatic-reading-csv}
\end{table}

```

OFHC-Cu	
Expansion [mm °C ⁻¹ mm ⁻¹]	Temperature [°C]
1.68 · 10 ⁻⁵	20
1.7 · 10 ⁻⁵	50
1.72 · 10 ⁻⁵	100
1.74 · 10 ⁻⁵	150
1.76 · 10 ⁻⁵	200
1.78 · 10 ⁻⁵	250
1.79 · 10 ⁻⁵	300
1.81 · 10 ⁻⁵	350
1.82 · 10 ⁻⁵	400
1.84 · 10 ⁻⁵	450
1.85 · 10 ⁻⁵	500
1.87 · 10 ⁻⁵	550
1.88 · 10 ⁻⁵	600
1.9 · 10 ⁻⁵	650
1.91 · 10 ⁻⁵	700
1.93 · 10 ⁻⁵	750
1.96 · 10 ⁻⁵	800
1.98 · 10 ⁻⁵	850
2.01 · 10 ⁻⁵	900

Table 1.4: Automatically formatted table using `pgfplotstable`.

Bibliography

- [1] H. P. Lovecraft. *El clérigo malvado y otros relatos*. Madrid: Alianza Editorial, 2016. ISBN: 9788491042105.
- [2] F. H Norton. *The creep of steel at high temperatures*. McGraw-Hill, 1929. URL: <https://archive.org/details/creepofsteelathi00nort>.

BIBLIOGRAPHY

Appendix A

This is an appendix

