LaTeX Typesetting - Getting Started Spring 2020

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Objectives

1. Why LaTeX? Who cares?
2. Installing the necessary software
3. A typical LaTeX file
4. Document type and packages
5. Equations
6. Figures
7. References
8. Using LaTeX in MS PowerPoint
9. Conclusions
10. Questions

1. Why LaTeX?

Answer: To write technical articles or documents that include equations, equation numbers, and figures with equations.

Example:

It is possible to consider cases of buckling that include the effect of a nonzero w applied laterally to the column. However, for the purposes herein it is appropriate to assume $w = 0$. As a result,

$$\frac{d^4v}{dx^4} + \frac{P}{EI}\frac{d^2v}{dx^2} = 0. \tag{19}$$

Finally, for convenience, setting $\lambda^2 = \frac{P}{EI}$ and substituting into (19) yields

$$\frac{d^4v}{dx^4} + \lambda^2\frac{d^2v}{dx^2} = 0. \tag{20}$$

Equation (20) has the general solution

$$v = A\sin\lambda x + B\cos\lambda x + Cx + D. \tag{21}$$

1. **Who cares?**

Answer: Writers in science, math, and engineering. Anyone wanting to write technical documents that will include lots of formulas. Students headed to graduate school. Professors.

Example:

4.3 The Algorithmic Tangent Modulus

Before summarizing the algorithm, the *consistent* or *algorithmic tangent modulus* is derived. The algorithmic tangent modulus is

$$C_{n+1}^{(k)} = \frac{\partial \sigma_{n+1}^{(k)}}{\partial \varepsilon_{n+1}^{(k)}}. \tag{4.20}$$

In the following derivation the superscript k is omitted. Some preliminary results are obtained for the derivation. First, differentiate the trial stress σ_{n+1}^{trial} to get
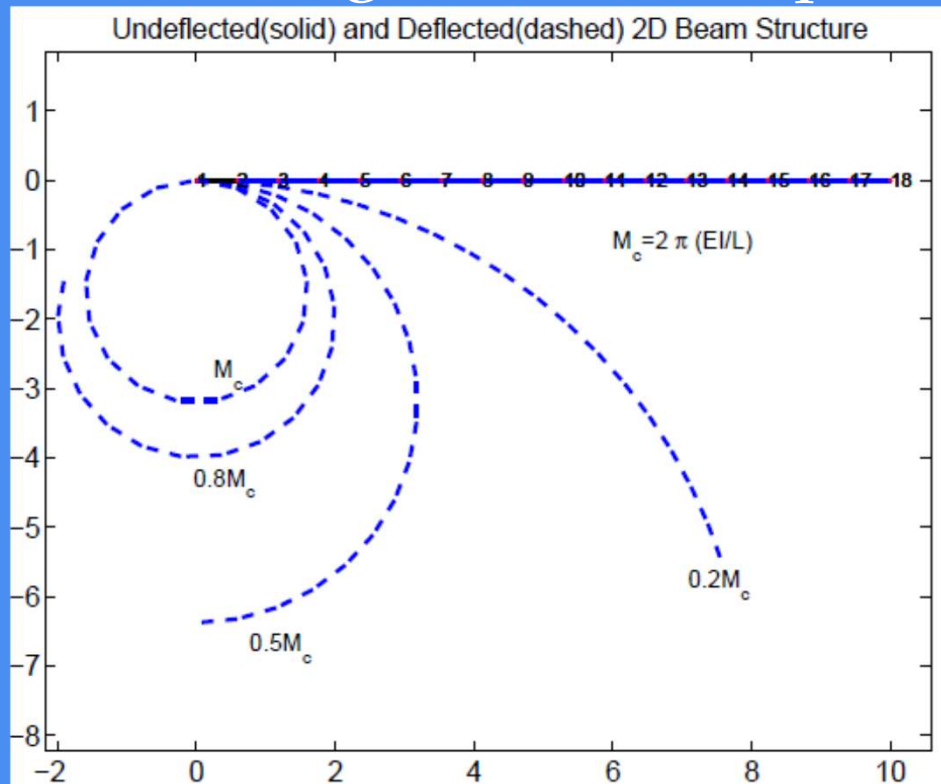
$$\frac{\partial \sigma_{n+1}^{trial}}{\partial \varepsilon_{n+1}} = E. \tag{4.21}$$

2. Installing the necessary software (ALL FREE and available for download from the internet)

i.   MiKTeX (The LaTeX typesetting software, similar to a compiler), MiKTex.org
ii. Adobe Acrobat Reader
iii. Ghostscript, www.ghostscript.com
iv. Ghostview, (*may not be strictly needed) www.ghostgum.com.au/software/gsview.htm
v.   TeXnicCenter (a LaTeX integrated text editor), www.texniccenter.org
vi. Ipe (Drawing editor that incorporates LaTeX), ipe.otfried.org

2. Additional software

vii. MatLab, (not free) not necessary but great for encapsulated postscript (.eps) plots

viii. Octave, alternative to MatLab, not necessary but great for encapsulated postscript (.eps) plots

Undeflected(solid) and Deflected(dashed) 2D Beam Structure

$M_c = 2 \pi \ (EI/L)$

M_c

$0.8 M_c$

$0.5 M_c$

$0.2 M_c$

Note: MatLab can use LaTeX Commands to generate formulas, Greek letters, and formulas on a plot

2. Installing the necessary software
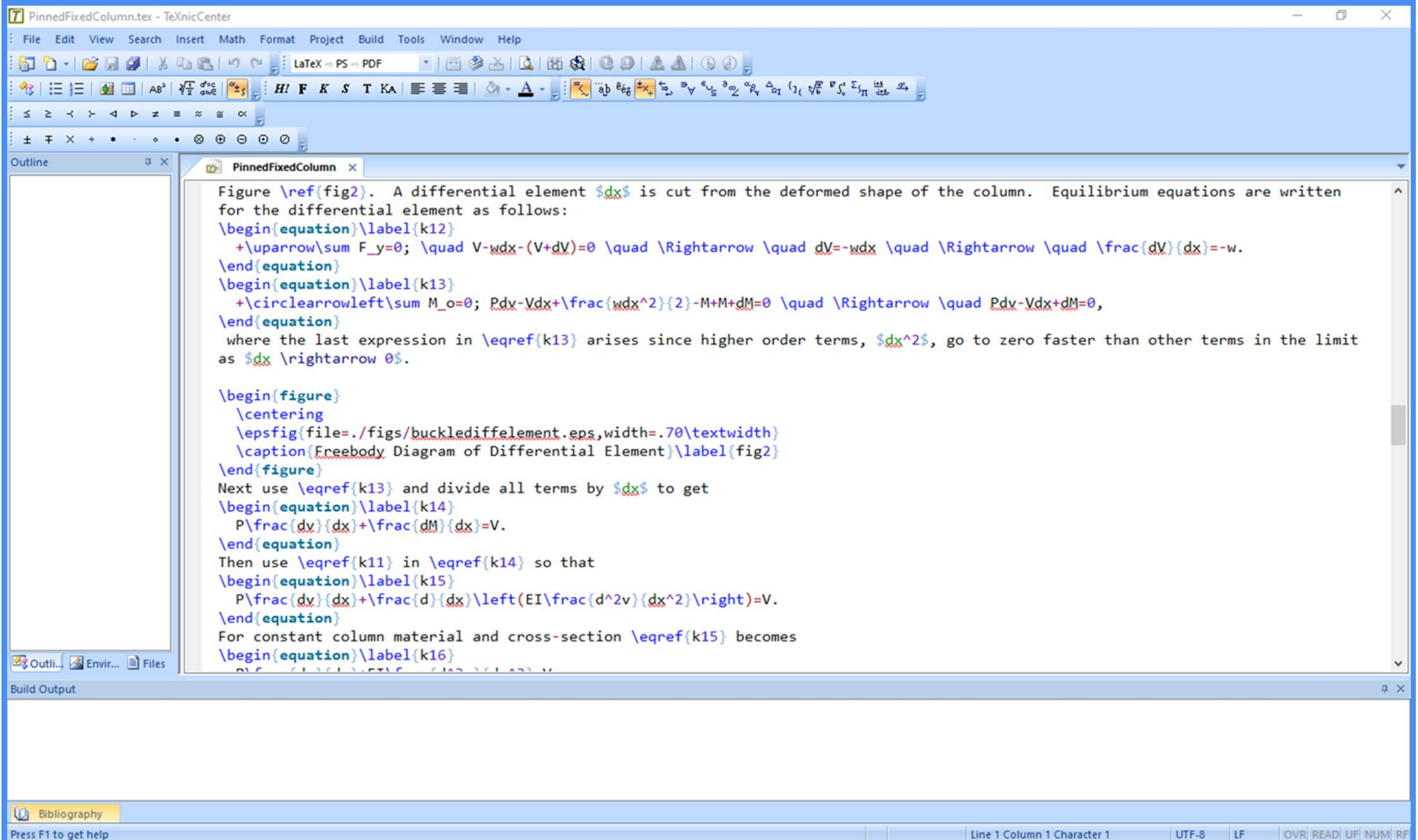 - The various software will make use of the following file formats

i.   .tex (Text file for the LaTeX document)
ii.   .eps or .ps (encapsulated post script file)
iii. .pdf (portable document file)
iv.   .bib (file of bibliography information, advanced)

2. Software – Order of installation, something like…

    a. Install MiKTeX (32 bit or 64 bit)
        i. Automatically download packages? (yes)
        ii. Default paper choice? (letter)
    b. Install Ghostscript
    c. Install Ghostview (recommended)
    d. Install Adobe Acrobat Reader (if not present)
    e. Install TeXnicCenter – follow setup, it will find MiKTeX on your computer automatically
    f. Install Ipe

2. Software – TeXnic Center (LaTeX text editor)

PinnedFixedColumn.tex - TeXnicCenter

File   Edit   View   Search   Insert   Math   Format   Project   Build   Tools   Window   Help

LaTeX ⇒ PS ⇒ PDF

Outline

PinnedFixedColumn

```
Figure \ref{fig2}.  A differential element $dx$ is cut from the deformed shape of the column.  Equilibrium equations are written
for the differential element as follows:
\begin{equation}\label{k12}
  +\uparrow\sum F_y=0; \quad V-wdx-(V+dV)=0 \quad \Rightarrow \quad dV=-wdx \quad \Rightarrow \quad \frac{dV}{dx}=-w.
\end{equation}
\begin{equation}\label{k13}
  +\circlearrowleft\sum M_o=0; Pdv-Vdx+\frac{wdx^2}{2}-M+M+dM=0 \quad \Rightarrow \quad Pdv-Vdx+dM=0,
\end{equation}
 where the last expression in \eqref{k13} arises since higher order terms, $dx^2$, go to zero faster than other terms in the limit
as $dx \rightarrow 0$.

\begin{figure}
  \centering
  \epsfig{file=./figs/bucklediffelement.eps,width=.70\textwidth}
  \caption{Freebody Diagram of Differential Element}\label{fig2}
\end{figure}
Next use \eqref{k13} and divide all terms by $dx$ to get
\begin{equation}\label{k14}
  P\frac{dv}{dx}+\frac{dM}{dx}=V.
\end{equation}
Then use \eqref{k11} in \eqref{k14} so that
\begin{equation}\label{k15}
  P\frac{dv}{dx}+\frac{d}{dx}\left(EI\frac{d^2v}{dx^2}\right)=V.
\end{equation}
For constant column material and cross-section \eqref{k15} becomes
\begin{equation}\label{k16}
```

Outli...   Envir...   Files

Build Output

Bibliography

Press F1 to get help   Line 1 Column 1 Character 1   UTF-8   LF   OVR READ UF NUM RF

2. Software – Ipe (LaTeX integrated drawing editor)

3. A typical LaTeX file – Getting started

i.   Setup a folder on your computer to contain your LaTeX document (maybe call it "LaTeXExample")

ii. Within "LaTeXExample" create subfolder for figures (call it "figs")

iii. Run the text editor application called TeXnicCenter

iv. Go to File, select New, select File

v.   Choose File, select Save As, and save the file as "Example.tex" and be sure it is saved in your folder "LaTeXExample"
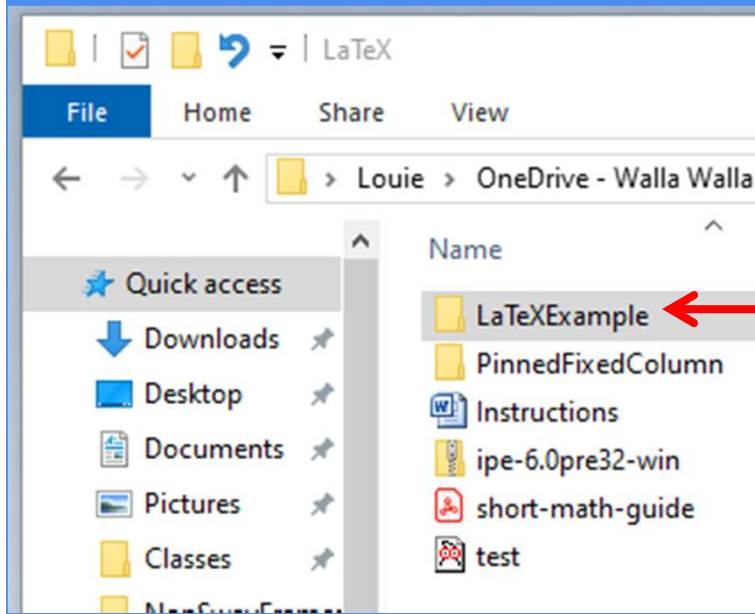
Create Folder
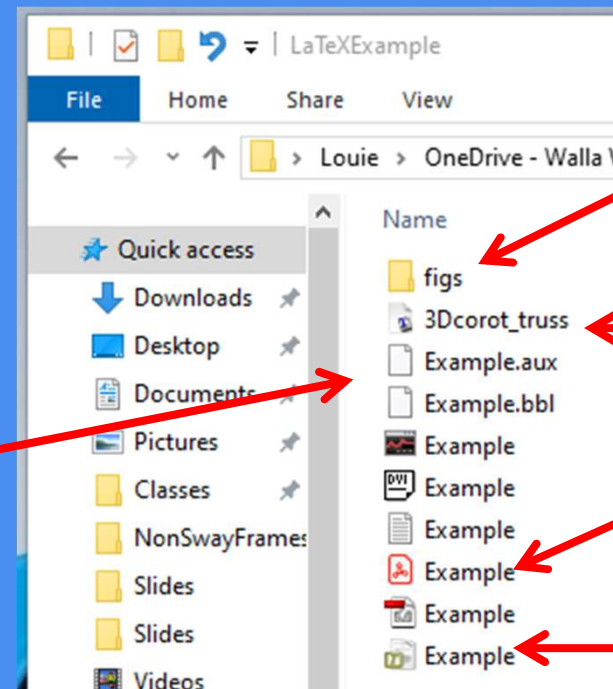
Create folder for .eps figures

Create bibTeX file

Contents of older

Output .pdf file

Create .tex LaTeX file

3. A typical LaTeX file

Typically a LaTeX file has 2 parts
i. <u>A preamble</u> of document type, packages, and some document formatting information
ii. <u>The body</u> of the document, Title, abstract, sections, subsections, tables, figures, equations, bibliography

Generic pseudo example:

```
%My LaTeX File
%Specify Document type
%Specify Packages to include

%Beginning of document starts here
\begin{document}

%Body of report goes here

%End of document
\end{document}
```

% symbol denotes comments

\ denotes a LaTeX command

- Now we are ready to construct a LaTeX file template (example)
- You can modify, practice, and learn with the template

3. A typical LaTeX file

- Create the preamble
- Type or copy the following into your latex file "Example.tex"

```
%My example LaTeX file
\documentclass[12pt]{article}
\usepackage{amsmath,amssymb,amsfonts} % Typical math resource packages
\usepackage{epsfig} %for including figures in your document
\usepackage[margin=1in]{geometry} %Many features, here just setting margins
\usepackage{enumerate} %Not used in this example (creates enumerated lists)
```

- Notice a comment at top to explain what the file is
- The document type is "article"
- 12 pt font is specified
- Various packages are included, these will be adequate for a lot of your needs
- Other packages can be added as you become more of an expert

3. A typical LaTeX file

- Start Body of the report
- Include the following in your LaTeX document
- Begin document with the \begin{document} command
- Include title, author information, then tell LaTeX to generate document title

```
%Beginning of document starts here
\begin{document}
\title{\vspace{-1.5in}Example \LaTeX Document}
\author{Author's Name}
\maketitle
```

3. A typical LaTeX file

- Include an abstract section if needed

```
\begin{abstract}
        The abstract text goes here.
\end{abstract}
```

3. A typical LaTeX file

- Add a section with a section title
- In the section add some text
- In the section include a numbered equation

```
\section{Introduction}
Here is the text of your introduction with equation \eqref{eq1}.
See \cite{Hughes} or \cite{Simo1} for more details.

\begin{equation} \label{eq1}
        P_{cr}= \frac{\pi^2 EI}{(kL)^2}
\end{equation}
```

- Notice equation environment is for equations
- Notice how equation is referenced within the text with **\eqref{}**
- See how in-text citations are included with **\cite{}**
- See how you give equation a name with **\label{}**
- Later we will learn how to insert equations within sentences

3. A typical LaTeX file - continued

- Add a subsection with a title
- In the subsection add some text
- Include a figure

```
\subsection{Subsection Heading Here}
        Write your subsection text here.  See Figure \ref{fig1}
\begin{figure}[h]
    \centering
    \epsfig{file=./figs/pinfixcolumn.eps,width=.75\textwidth}
    \caption{Figure title here}\label{fig1}
\end{figure}
```

- Notice how figure is referenced within the text with \ref{}
- See how \epsfig command refers to subfolder "figs" created earlier
- See how you give the figure a name with \label{}
- Must put a .eps file in the folder "figs" with the name "pinfixcolumn.eps", created with Ipe or MatLab for instance

3. A typical LaTeX file - continued

- Add a section for the conclusion
- In the conclusion add some text
- Include your bibliography of in-text citations from bibTeX file
- Indicate the end of the document

```
\section{Conclusion}
        Write your conclusion here.

%Commands to insert references/bibliograpy here
\bibliographystyle{plain}
\bibliography{3Dcorot_truss}

%Command to indicate end of document here
\end{document}
```
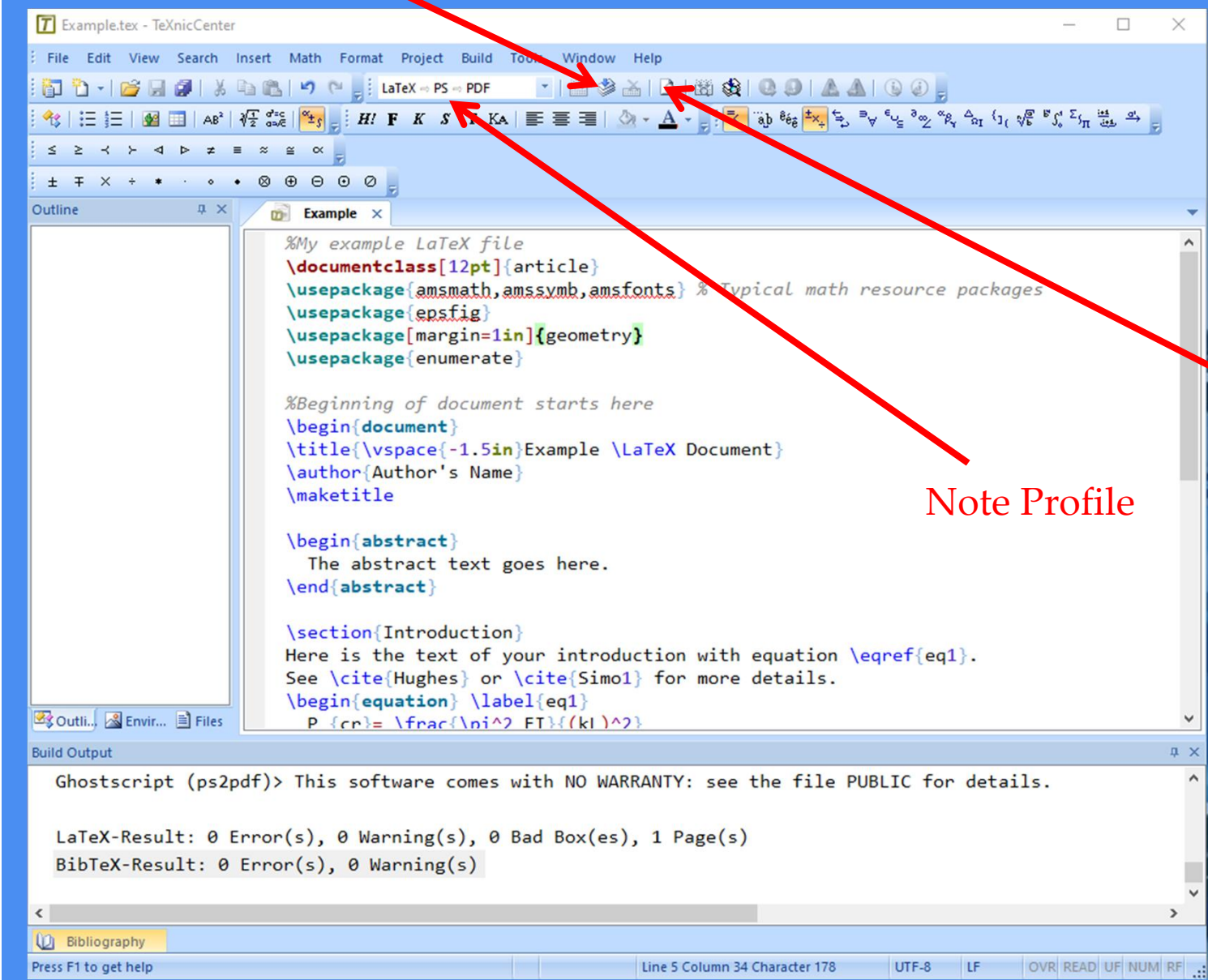
- Notice the bibTeX file name is "3Dcorot_truss"
- You must create a bibTeX file with your references in proper format
- Other bibliography styles are available besides "plain"
- More bibTeX information later

3. A typical LaTeX file

- Save & "build" or process the LaTeX file within TeXnicCenter

Open built
document
In pdf

Note Profile

Error can occur
If Build output
Profile not
Setup correctly

From build
Menu, Define
Output Profiles

. . .

3. A typical LaTeX file – Resulting document

Example LaTeXDocument

Author's Name

March 21, 2020

Abstract

The abstract text goes here.

1 Introduction

Here is the text of your introduction with equation (1). See [1] or [2] for more details.

$$P_{cr} = \frac{\pi^2 EI}{(kL)^2} \tag{1}$$

1.1 Subsection Heading Here

Write your subsection text here. See Figure 1
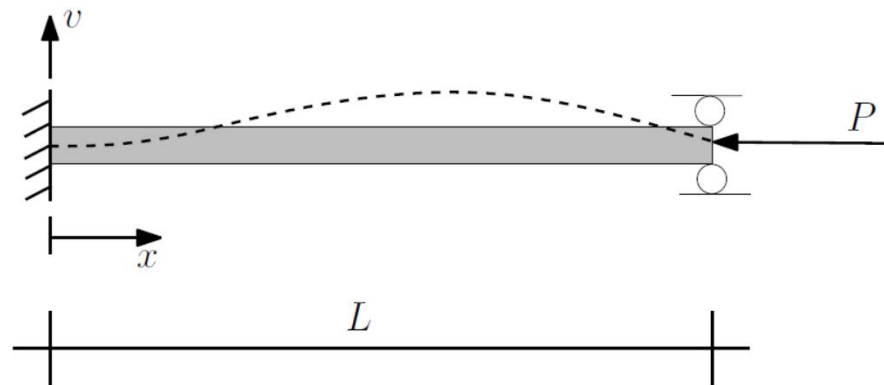
Figure 1: Figure title here

3. A typical LaTeX file – Resulting document continued

2 Conclusion

Write your conclusion here.

References

[1] T. J. R. Hughes. *The Finite Element Method - Linear Static and Dynamic Finite Element Analysis.* Dover, Mineola, NY, 1st edition, 2000.

[2] J. C. Simo and R. L. Taylor. Return mapping algorithm for plane stress elastoplasticity. *International Journal for Numerical Methods in Engineering,* 22:649–670, 1986.

1

4. LaTeX document type and packages

Document type can be specified with following command:

\documentclass[12pt]{article}

Common document classes are:
- article
- report
- book
- Other document classes are available

Common document class options are:
(fontsize, papersize, landscape,…)

4. LaTeX document type and packages

Packages can be specified with the \usepackage{} command:

\usepackage{amsmath, amssymb, amsfonts}
\usepackage{epsfig}
\usepackage{enumerate}
\usepackage[margin=1in]{geometry}

Notes:
- Many packages are available
- The above minimum is to let you get started trying out making your own documents
- A lot can be accomplished with just the above

5. Equations

(For a great resource of how to do equations, see: Downes, Michael, *Short Math Guide for LaTeX*, American Mathematical Society. This can be easily found on the internet as a 17 page pdf file.)

Greek Symbols

A, \alpha	$\Rightarrow$	A, α
B, \beta	$\Rightarrow$	B, β
\Gamma, \gamma	$\Rightarrow$	Γ, γ
\Delta, \delta	$\Rightarrow$	Δ, δ
E, \epsilon	$\Rightarrow$	E, ϵ
Z, \zeta	$\Rightarrow$	Z, ζ

etc.

5. Equations

- Subscripts, A_i, B_{ij}, C_{pqrs} $\Rightarrow A_i,\ B_{ij},\ C_{pqrs}$

- Superscripts, A^2, B^{ij}, C^{pq}_{rs}

$$\Rightarrow A^2,\ B^{ij},\ C^{pq}_{rs}$$

- \sqrt{b^2-4ac} $\Rightarrow \sqrt{b^2-4ac}$

- Fractions, \frac{ab}{cd} $\Rightarrow \frac{ab}{cd}$

- Sums,
e=\sum\limits_{k=0}^{\infty}\frac{1}{k!}

$$\Rightarrow e = \sum_{k=0}^{\infty} \frac{1}{k!}$$

5. Equations

In the body of the document use the equation environment to insert numbered equations

\begin{equation}\label{quadratic}

    x=\frac{-b\pm \sqrt{b^2-4ac}}{2a}

\end{equation}

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad (8)$$

See \eqref{quadratic} for the quadratic equation.
See (8) for the quadratic equation.

5. Equations

- Integrals, \int\limits_{0}^L \sin{\frac{\pi x}{L}} dx

$$\int\limits_{0}^{L} \sin \frac{\pi x}{L} dx$$

- Derivatives, \frac{d^2y}{dx^2} $\frac{d^2 y}{dx^2}$

- Partial Derivatives,
\frac{\partial ^4\phi}{\partial x^2 \partial y^2}

$$\frac{\partial^4 \phi}{\partial x^2 \partial y^2}$$

5. Equations

Matrices with parenthesis,

A = \begin{pmatrix}

A_{11} & A_{12} & A_{13} \\ \

A_{21} & A_{22} & A_{23} \\ \

A_{31} & A_{32} & A_{33}

\end{pmatrix}

$$A = \begin{pmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{pmatrix}$$

With brackets, Brackets,

A = \begin{bmatrix}

A_{11} & A_{12} \\ \

A_{21} & A_{22}

\end{bmatrix}=\begin{Bmatrix}

A_{11} & A_{12} \\ \

A_{21} & A_{22}

\end{Bmatrix}

$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} = \begin{Bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{Bmatrix}$$

5. Equations

- Use dollar signs $ $ to create an equation environment within a sentence.

- Within text use $\sqrt{81}=9$ to get equations within the paragraphs or sentences of the document.

- Within text use $\sqrt{81} = 9$ to get equations within the paragraphs or sentences of the document.

6. Figures

- Use \usepackage{epsfig}
- Generate .eps figures either in MatLab or Ipe

- Insert figures into the document where you want them as follows:

```
\begin{figure}[h]
    \centering
    \epsfig{file=./figs/pinfixcolumn.eps,width=.75\textwidth}
    \caption{Figure title here}\label{fig1}
\end{figure}
```

- Notice it looks for the .eps file in a sub folder called "figs". This keeps things cleaner. Keep your figures all in one separate folder for a given document.

7. References

- Use

\bibliographystyle{plain}
\bibliography{3Dcorot_truss}

- Must create a .bib file in your LaTeXExample folder, in this case

3Dcorot_truss.bib

- The above is a BibTex file which contains all your bibliographic information. It is created in the proper format according to journal articles, books, proceedings, etc.
- Use \cite{refname} within text to do in-text citations

7. References

- Book format for BibTex file

@BOOK{Anton,   AUTHOR ={Anton, H. and C. Rorres},
TITLE ={Elementary Linear Algebra},   PUBLISHER={John
Wiley and Sons},   ADDRESS={New York}, EDITION={8th},
      YEAR ={2000}   }

- Journal Article format for BibTex file

@article{Belytschko, author = {Belytschko, T. and B. J. Hsieh},title
= {Non-linear transient finite element analysis with convected
coordinates},journal={International Journal for Numerical
Methods in Engineering},year = {1973},volume = {7},pages = {255-
-271},}

Notice defined name for this reference, so in-text citation is \cite{Belytschko}

8. Using LaTeX in MS PowerPoint

- You may have realized that LaTeX equations have been inserted into this PowerPoint presentation
- LaTeX equations are included by using an add-in to PowerPoint called IguanaTeX
- See http://www.jonathanleroux.org/software/iguanatex/
- The above website has instructions for installing IguanaTex into PowerPoint
- You must have MikTeX installed on your computer to use IguanaTeX with PowerPoint

$$ax^2 + bx + c \qquad A = \pi r^2$$

9. Conclusion

- There is a learning curve to learn LaTeX
- LaTeX is for writing documents with many equations
- LaTeX helps automatically do a lot of the formatting and equation numbering
- Just insert an equation and LaTeX will renumber all the equations for you, similarly for figures, and tables
- LaTeX is common for research, graduate school, and academia in general
- Best way to learn is try it!
- Many resources can be found online to help you
- If you don't know how to do it, Google it!
- Be brave, you can do it!
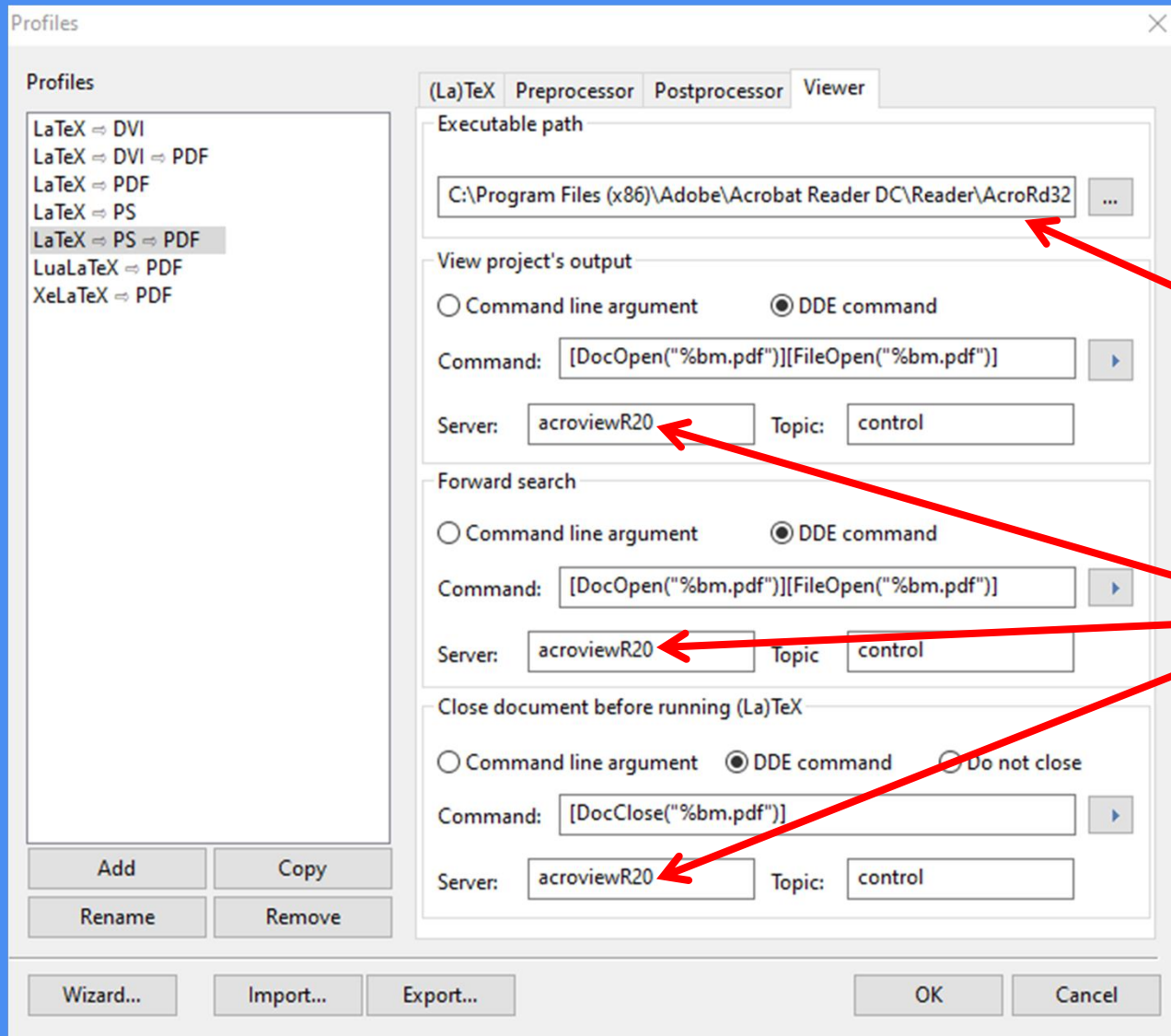- This presentation will be made available to you

10. Questions

Extra – Build profile, in TeXnicCenter, select "Build" menu and select "Define output profiles". TeXnicCenter likely has this done already correctly
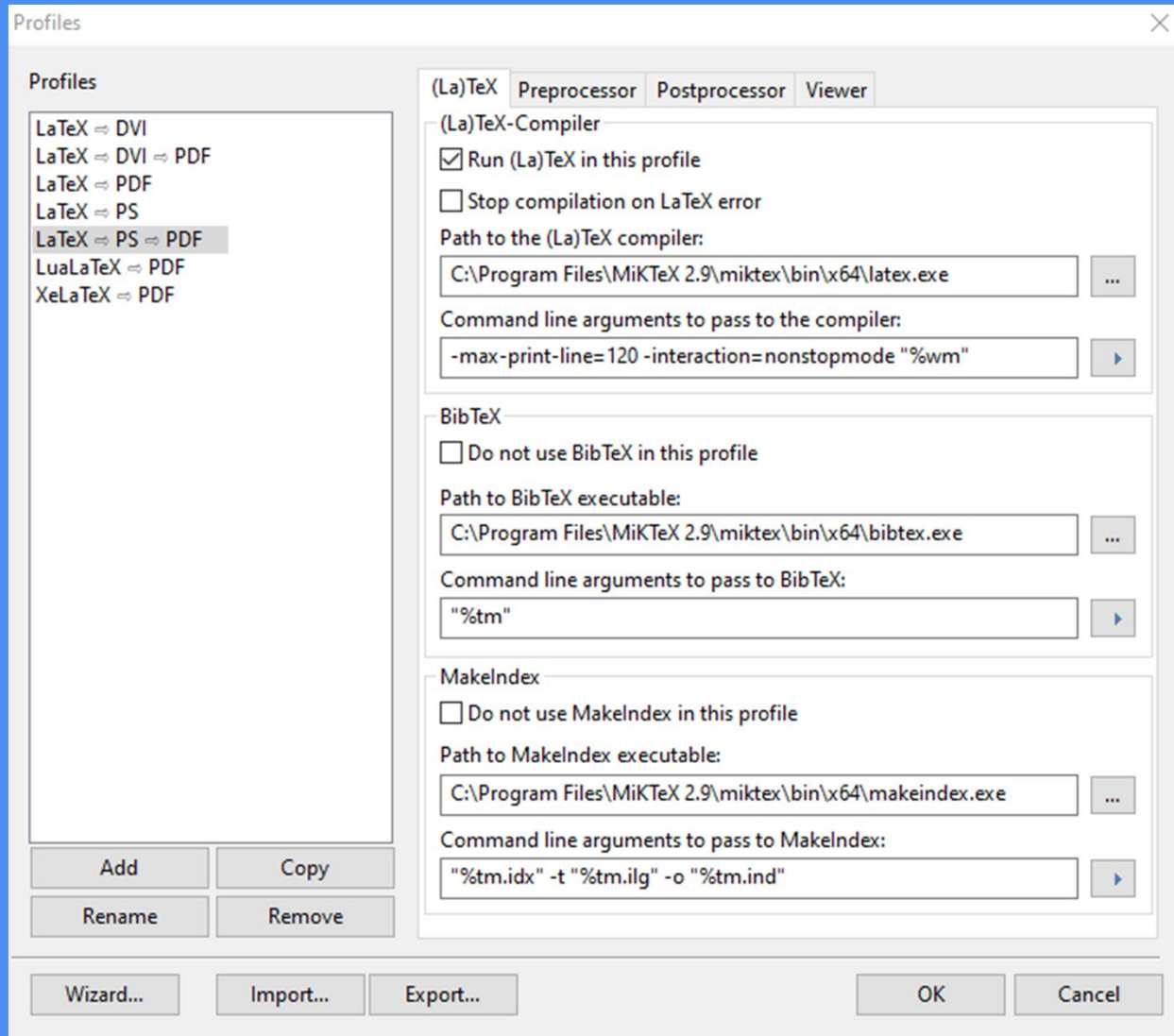
Extra – Build profile, in TeXnicCenter, select "Build" menu and select "Define output profiles". Then select the viewer tab, it should look similar to below

Usually correct, Sometimes must Edit.

When acrobat Reader updates Sometimes need To edit. In 2021 it may need to edit to "acroviewR21"

Extra – Can insert enumerated lists into document

- An enumerated list (document preamble requires \usepackage{enumerate})

```
\begin{enumerate}[(a)]
        \item My first list item
        \item My second list item
        \item My third list item
\end{enumerate}
```

→

(a) My first list item
(b) My second list item
(c) My third list item

- Notice we have specified the enumerate format to be (a), (b), (c), …
- Use [(i)] to do list with lowrcase roman numerals
- If you use itemize instead of enumerate you get a bullet list

```
\begin{itemize}
        \item My first list item
        \item My second list item
        \item My third list item
\end{itemize}
```

→

- My first list item
- My second list item
- My third list item

Extra – Example BibTex file

@BOOK{Anton, AUTHOR ={Anton, H. and C. Rorres}, TITLE ={Elementary Linear Algebra}, PUBLISHER={John Wiley and Sons}, ADDRESS={New York}, EDITION={8th}, YEAR ={2000}}

@article{Belytschko, author = {Belytschko, T. and B. J. Hsieh},title = {Non-linear transient finite element analysis with convected coordinates},journal={International Journal for Numerical Methods in Engineering},year = {1973},volume = {7},pages = {255--271},}

@PhdThesis{Battini,author = {Battini, Jean Marc},title = {Co-rotational beam elements in instability problems},school = {Royal Institute of Technology, Department of Mechanics},year = {2002},address = {SE-100 44 Stockholm, Sweden}}

@Unpublished{Filippou,author = {Filippou, Filip C.},title = {Lecture Notes - {CE221} - Nonlinear Structural Analysis},note = {UC Berkeley},year = {2007}}

@TECHREPORT{fries:meshfree, AUTHOR ={Fries, T. P. and H. G. Matthies}, TITLE ={Classification and Overview of Meshfree Methods}, NUMBER = {Informatikbericht-Nr.~2003-03}, INSTITUTION={Institute of Scientific Computing, Technical University Braunschweig}, ADDRESS ={Braunschweig, Germany}, YEAR ={2004} }