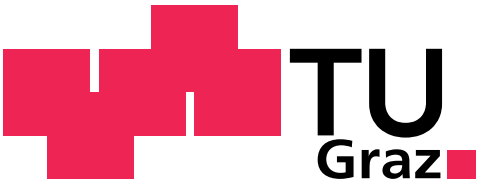
Graz University of Technology
Faculty of Civil Engineering
Institute of Hydraulic Engineering and Water Resources Management



How to write your thesis with LaTeX

Master thesis

submitted by

First name Second name

First reviewer: Prof. Zenz or Prof. Schneider

Second reviewer: Assistant

Graz, January 11, 2020

Abstract

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Kurzbeschreibung

Deutsche Übersetzung

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Acknowledgement

This thesis was written during my time at the Institute of Hydraulic Engineering and Water Resources Management at Graz University of Technology. Without the guidance and encouragement of several people this thesis wouldn't exist. . . .

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Statutory declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

January 11, 2020
. . . . . .
Date

. . . . . .
Signature

Nomenclature

Constants

g	Gravity	$\frac{m}{s^2}$

Greek

α	Angle	rad

Indices

i	Index

Operators

∇	Gradient

Variables

L	Length	m

Contents

1 Introduction

1.1 Example of a Figure

Before you compile the main document ”Thesis.tex”, change the content of the setup.tex file!

This is an example of a figure (see Figure 1.1)

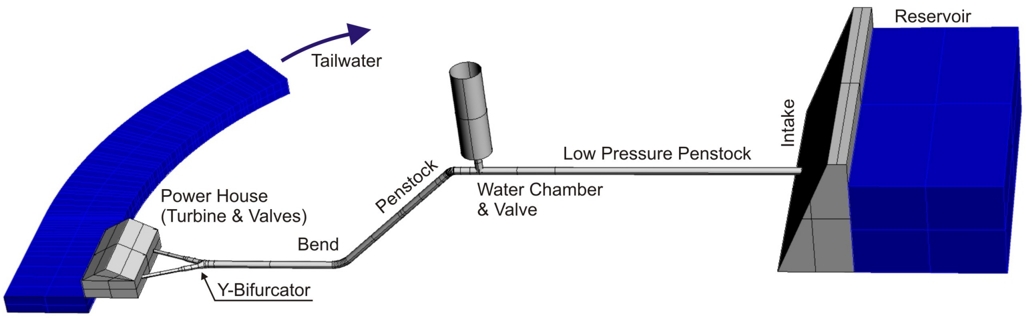

Figure 1.1: *Sketch of a general layout of a high-head pt*

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1.2 Example of Equations

Here are some equations .....
Equation Eq. 1.1 is the famous Bernoulli Equation ....

$$z_1 + \frac{P_1}{\rho g} + \frac{V_1^2}{2g} = z_2 + \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + \Delta h_{tot} \tag{1.1}$$

Equation Eq. 1.2 are 3 aligned equation

$$\begin{aligned} Term_1 &= \frac{\zeta_{Resistance}}{2 \cdot g \cdot A_{throttle}^2} \\ Term_2 &= -B - R \cdot |Q_{Pipe1}| - B - R \cdot |Q_{Pipe2}| \\ Term_3 &= H_{Pipe1} + B \cdot Q_{Pipe1} - H_{Pipe2} + B \cdot Q_{Pipe2} \end{aligned} \tag{1.2}$$

1.3 Example of a Table

Example of a table . . . Table 1.1

Table 1.1: *Components of PIV*

Laser	Litron Laser - Model: LDY303-PIV, Repetition rate: 0.2 - 10 kHz with 21.5 - 1.85 mJ, λ=527 nm
Camera	Photron FASTCAM SA-1 Camera, 5.4 kHz, $1024 \cdot 1024$, 16 GB Memory
Object lens	AF Micro-Nikon, 60mm f/2.8 D
Software	Dynamic Studio 2.20.18

1.4 Example of a literature reference

This idea is based on Anderson [1995]. In the Thesis.bib file all authors are listed; A .bib file can be created very easily with `www.zotero.org`.

2 Summary

Here comes more text Here comes more text

3 Outlook

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Bibliography

J. D. Anderson. *Computational Fluid Dynamics*. McGraw-Hill, Inc., internatio edition, 1995. ISBN 0-07-11321ß-4.

List of Figures

List of Tables

Appendix

3.1 Input File - *OpenFoam*

3.1.1 Folder 0

3.1.1.1 epsilon

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  1.7.1                                 |
|   \\  /    A nd           | Web:      www.OpenFOAM.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       volScalarField;
    location    "0";
    object      epsilon;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

dimensions      [ 0 2 -3 0 0 0 0 ];

internalField   uniform 1;

boundaryField
{
    MAIN // This is the entrance of the main pipe
    {
        type            turbulentMixingLengthDissipationRateInlet;
        mixingLength    0.0175;    // mixingLenght=
                                   // 0.07 * Hydraulic Diameter =
                                   // 0.07*0.250=0.0175
        value           uniform 1;   // placeholder
    }
```

```
    LEFT // This is the the outlet of the left pipe
    {
        type            inletOutlet; //  Switches epsilon between
                                     // fixedValue and zeroGradient
                                     // depending on direction of U
        inletValue      uniform 0.00861  ;
    }

    REIGHT // This is the the outlet of the right pipe
    {
        type            inletOutlet;
        inletValue      uniform 0.00861;
    }

   plexi_wall
    {
        type            epsilonWallFunction; //standard wall function
        value           uniform 0;
    }
}


// ************************************************************************* //
```

3.1.1.2 turbulent kinetic energy

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  1.7.1                                 |
|   \\  /    A nd           | Web:      www.OpenFOAM.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       volScalarField;
    location    "0";
    object      k;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

dimensions      [ 0 2 -2 0 0 0 0 ];
```

```
internalField   uniform 1;

boundaryField
{
    MAIN
    {
        type            turbulentIntensityKineticEnergyInlet;
        intensity       0.05;       // 5% turbulent intensity
        value           uniform 1;
    }

    LEFT
    {
        type            inletOutlet;
        inletValue      uniform 1;
    }

    REIGHT
    {
        type            inletOutlet;
        inletValue      uniform 1;
    }

   plexi_wall
    {
        type            kqRWallFunction;
        value           uniform 0;
    }
}


// ************************************************************************* //
```

3.1.1.3 Turbulent eddy viscosity

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  1.7.1                                 |
|   \\  /    A nd           | Web:      www.OpenFOAM.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       volScalarField;
```

```
    object      nuTilda;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

dimensions      [0 2 -1 0 0 0 0];

internalField   uniform 0;

boundaryField
{
    MAIN
    {
        type            zeroGradient;
    }

    LEFT
    {
        type            zeroGradient;
    }

    REIGHT
    {
        type            zeroGradient;
    }

    plexi_wall
    {
        type            zeroGradient;
    }
}

// ************************************************************************* //
```

3.1.1.4 Pressure

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  1.7.1                                 |
|   \\  /    A nd           | Web:      www.OpenFOAM.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
    class       volScalarField;
```

```
    object      p;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

dimensions      [0 2 -2 0 0 0 0];

internalField   uniform 0;

boundaryField
{
    MAIN
    {
       type            zeroGradient;
    }

    LEFT
    {
        type            fixedValue;
        value           uniform 0;
    }

   REIGHT
    {
        type            fixedValue;
        value           uniform 0;
    }

    plexi_wall
    {
        type            zeroGradient;
    }
}

// ************************************************************************* //
```

3.1.1.5 Velocity

```
/*--------------------------------*- C++ -*----------------------------------*\
| =========                 |                                                 |
| \\      /  F ield         | OpenFOAM: The Open Source CFD Toolbox           |
|  \\    /   O peration     | Version:  1.7.1                                 |
|   \\  /    A nd           | Web:      www.OpenFOAM.com                      |
|    \\/     M anipulation  |                                                 |
\*---------------------------------------------------------------------------*/
FoamFile
{
    version     2.0;
    format      ascii;
```

```
    class       volVectorField;
    object      U;
}
// * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * //

dimensions      [0 1 -1 0 0 0 0];

internalField   uniform (0 0 0);

boundaryField
{
   MAIN
    {
    type surfaceNormalFixedValue;
refValue uniform -3.26;
    }

    LEFT
    {
        type            inletOutlet;
        inletValue      uniform (0 0 0);
        value           uniform (0 0 0);
    }

   REIGHT
    {
        type            inletOutlet;
        inletValue      uniform (0 0 0);
        value           uniform (0 0 0);
    }

    plexi_wall
    {
        type            fixedValue;
        value           uniform (0 0 0);
    }
}

// ************************************************************************* //
```