



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Escola Superior d'Enginyeries Industrial
Aeroespacial i Audiovisual de Terrassa

BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING

Study and implementation in C of the
Finite Element Method in dimension 2

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Budget

Preface

The purpose of this document is to explain the expenses of the final degree report. This includes transactional expenses but also other expenses such as labour, amortization, etc.

Although having a nice, final number is satisfactory, it is also deceiving. Indirect expenses would have been undertaken regardless of me pursuing this project. It would be disingenuous, however, to ignore the aid these granted me, hence they must be accounted for as well, although separately.

Here is a table with an overview of the budget:

Total costs of the study	
Direct costs	4,879 €
Indirect costs	1,212 €
Total	6,091 €

Direct costs

These costs are those that are directly and uniquely traceable to the project.

Direct costs of the study			
Labour	600 h	8.00 €/h	4,879 €
Gasoline	775 km	0.085 €/km	66 €
Electricity	112 kWh	0.116 €/kWh	13 €
Total			4,838 €

Labour

The time spent on the project is that prescribed by the university. I personally am in the position to know the exact value of my time because at work I get paid by the hour with a certain degree of freedom to pick how many hours. Thus the value of my time spent developing this project is the opportunity cost of not going to work.

Gasoline

I took fourteen round trips from Barcelona to Terrassa, which adds up to approximately 768 km. With a mileage of 5.80 L per 100km for my car ¹ and an average price of 1.45 €/L of gasoline ², the total price climbs up to 38 €.

¹Sourced from <https://tinyurl.com/yyyydk97m>

²Sourced online from <https://www.clickgasoil.com/m/precio-de-gasolina-95-barcelona>

Maintenance expenses are not accounted for due to their complexity and small impact on the global budget.

Electricity

This accounts for the electricity spent developing the study. The only traceable value is that spent by the computer. With 600 hours worked, minus the approximate three hours per meeting with my tutor (transport included), I get 558 hours sitting in front of the screen. Regarding energy usage, there does not appear to be a consensus in computer wattage, however most seem to agree on 200W. Electricity cost is 0.116 €/kWh according to my energy bill.

Indirect costs

These are the costs of items used for multiple purposes and thus not uniquely connected to this project.

Indirect costs of the study		
Matlab	IDE	300 €
Sublime Text	Code editor	87 €
Mathematica	Computational software	55 €
Books (12)	60 € each	720 €
Laptop	3 years old	50 €
Desk computer	6 years old	0 €
Total		1,212 €

Software

Most of the software used for this project is free and open-source. The only exceptions are the licenses for Matlab, Sublime Text and Mathematica. Thankfully the last two have free trials but continued use would require a purchase. They are useful tools by themselves and I have already used them in other projects. Regarding Matlab, I got it for free from the university. Their purchase prices can be found in ³, ⁴ and ⁵. The rest of the software was free, the most relevant of which is:

- Operating system: Linux Mint
- Data sharing and version control: Google Drive, Git
- Coding software: Compiler (GCC), Code Libraries, Python interpreter

³Matlab prices available at <https://es.mathworks.com/pricing-licensing.html?prodcode=ML>

⁴Mathematica prices available at www.wolfram.com/mathematica/pricing/

⁵Sublime Text prices available at <https://www.sublimetext.com/buy?v=3.0>

- Tex editor: Texmaker, PDFLatex, BibTex
- FEM software: FEniCS, Freefem++

Hardware

To price the usage of hardware the Spanish tax collection agency's amortization rate of 20% per annum⁶ is used. My desktop is long amortized so at this point it's free to use, but my laptop is still in its amortization lifespan. Since I used it exclusively for this project for one third of a year, a 6.66% of its price before VAT has been considered.

Books

Fortunately I needed not spend 720 € on books, my tutor lent me the collection. Most of them can be found in the bibliography of the projects. Some of them did not make it there, however they must be included in the budget since they were used in the research stage of the project, regardless of their usefulness afterwards. Their second-hand value on Amazon averaged 60 €.

⁶Obtained from the spanish revenue collection service at <https://tinyurl.com/y3f4r5c7>