



UNIVERSITAT POLITÈCNICA DE CATALUNYA  
BARCELONATECH

Escola Superior d'Enginyeries Industrial,  
Aeroespacial i Audiovisual de Terrassa

# Air distribution in street canyons: a CFD study

Document:

Budget

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**BACHELOR FINAL THESIS**

# List of Tables

1	Total budget . . . . .	2
2	Human resources cost . . . . .	3

# Budget

In the current document all the costs associated to the thesis *Air distribution in street canyons: a CFD study* are presented and broken down. Every cost and concept is detailed in this document.

Among the broken down costs we can find the part related to the supposed engineer work hours, as well as the director's work hours, the cost associated to the computational resources and the licensing. Only these concepts are taken into account as for this thesis no prototype nor experiment has been built.

	Units	Unit price	Subtotal
<b>Human resources (wages)</b>			6,260.00 €
Academic personnel	386 h	10.00 €/h	3,860.00 €
Research director	60 h	40.00 €/h	2,400.00 €
<b>Computational resources</b>			108.75€
Personal computer amortization	4 months	325 €/year	108.33 €
Energetic resources	0.04 MWh	10.53 €/MWh	0.42 €
<b>Licensing</b>			35 €
Ansa v21.0.1 (UPC partnership)	1 unit	0.00 €	0.00 €
Matlab r2019b (student license)	1 unit	250.00 €	250.00 €
<b>TOTAL</b>			<b>6,618.75 €</b>

Table 1: Total budget

All the costs reflected in *Table 1* are detailed detailed below in order to have a deep understanding of how these concepts have been taken into account.

## Human resources (wages)

Among the human resources which have been considered in this budget, there are two distinguishable parts. The first one is the estimation related to *Ivette's* work, the director of this thesis, which include meetings, reports revision, state of the art study, etc. All these tasks have an estimated time of 60 hours, and about 24 of them correspond to the weekly meetings scheduled since February.

On the other hand we have the time invested by the author of this thesis, which is itemised in *Table 2*.

Human resources (wages)		
Concept	Time (h)	Cost (€)
Project charter	4	40.00
State of the art review	10	100.00
Data collection and analysis	10	100.00
Ansa learning	6	60.00
Meshing (all three cases)	20	200.00
OpenFoam learning	25	250.00
Cases implementation in OpenFoam	40	400.00
ParaView learning	15	150.00
Post-processing	95	950.00
Thesis redaction	75	750.00
Annex and Budget	30	300.00
Final project revision	32	320.00
Meetings	24	240.00
<b>TOTAL</b>	<b>386 h</b>	<b>3,860.00 €</b>

Table 2: Human resources cost

The highest part of this project's cost is related to the post-processing step, which also includes the validation with the literature and by using *Matlab*.

The cost per hour chosen for an engineering student is 10.00€, as the average salary of a junior engineer in Spain is around 25,000 €/year[1], which by taking into account 1,888 work hours per year, we obtain an average result of 13 €/h. As we are not graduated engineers, choosing a slightly lower salary is coherent.

## Computational resources

The cost of the computational resources has been divided in two parts: the amortization of the personal computer used for carrying out all the 19 simulations, and the energetic cost of the electricity consumed.

The cost of the computer used is around 1,300€, by choosing an amortization time of 4 years, the cost corresponding to the four months that it has been used for this thesis the corresponding cost is 108.33€.

Regarding to the energetic cost of the electricity consumed, we have to take into account the 60 Wh that the computer consumes and the whole use time of the computer. During the processing process a total of 19 simulations have been performed with an average time of 10 hours per simulation. The 190 hours of simulation time added to the 386 hours of personal work, we obtain a total of 576 hours of computer work time. This time represents a total consumption of around 0.04 MWh and, as the average cost of the electricity in Spain is 10.53 €/MWh[2], we obtain the final electricity expense of 0.42 €.

## Licensing costs

The software used for running the simulations is *OpenFoam*, an open-source software that requires no license. On the other hand, *Ansa v21.0.1*, used for the geometry creation and the meshing, and *Matlab r2019b* are private.

By using the annual educational *Matlab* license, whose cost is 250 €/year[3], and the provided *Ansa* license obtained via the sponsorship that the *UPC* has with *BETA CAE Systems*, which is free, the total software cost is just 250€.

# Bibliography

- [1] Sueldo: Ingeniero junior — glassdoor. [https://www.glassdoor.es/Sueldos/ingeniero-junior-sueldo-SRCH\\_K00,16.htm](https://www.glassdoor.es/Sueldos/ingeniero-junior-sueldo-SRCH_K00,16.htm), 08/05/2021.
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- [3] Pricing and licensing - matlab simulink. <https://es.mathworks.com/pricing-licensing.html?prodcod=ML&intendeduse=edu>, 08/05/2021.

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*Thesis submitted in partial fulfillment of the  
requirements for the degree*

*of*

**Bachelor's degree in Industrial Technologies Engineering**

*by*

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Under the supervision of

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