A method to compare computational fluid dynamics (CFD) and multizonal dynamics simulations in building physics

Jade DELTOUR[1], Geoffrey VAN MOESEKE[1], Mathieu BARBASON[2], Sigrid REITER[2]

[1] Architecture & Climat, Faculty of Architecture, Architectural Engineering and Urban Planning, Université catholique de Louvain, Belgium

[2] Local Environment Management and Analysis, Faculty of Applied Sciences, Université de Liège, Belgium

SIMBA : SIMulation for Building Applications : A European Project

Simba project defines guidelines for architects and building engineers :

⇒ to evaluate the occupant thermal comfort

⇒ to determine the building energy consumption for cooling and heating

http://www.project-simba.eu

Our Research Objectives

⇒ Comparing CFD and multizonal simulations with measurements to evaluate : accuracy, computational runtime… for a heterogeneity of physics phenomena at different scales.

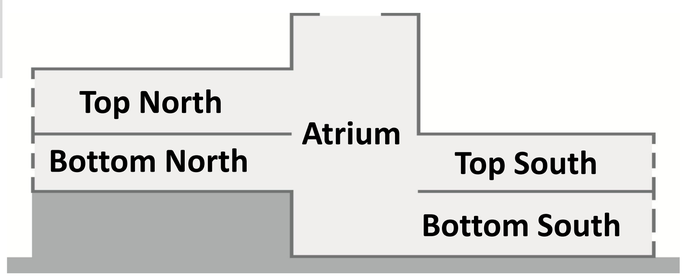
⇒ Bringing out complementarities of CFD and multizonal approaches by a new evaluation method.

More than a traditional comparison based on absolute and relative differences

⇒method based on a spatial representation of the results

Case Study

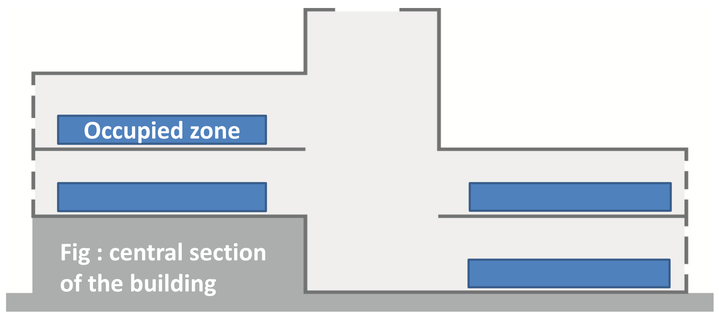
In the C. Walker Ph.D. thesis, experimental results are presented for an unpartitioned office building with natural ventilation.



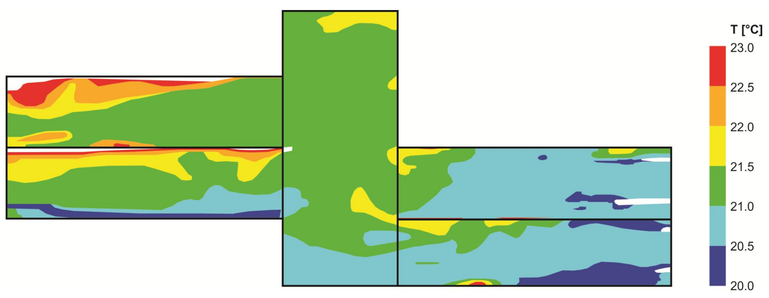
Hypothesis	Walker	Trnsys	Fluent
Boundary temperature [°C]	13	13	13
Air supply temperature [°C]	13	13	13
Internal gain by zone [W]	500	500	500
U wall [W/m²K]	0.39	0.39	Adiabatic
South fenestration by zone [m²]	0.0336	0.0336	0.0336
North fenestration by zone [m²]	0.04788	0.04788	0.04788
Inlet speed [m³/s]	0.1	0.1	0.1
subdivision	-	5 zones	1 244 722 cells

Methodology

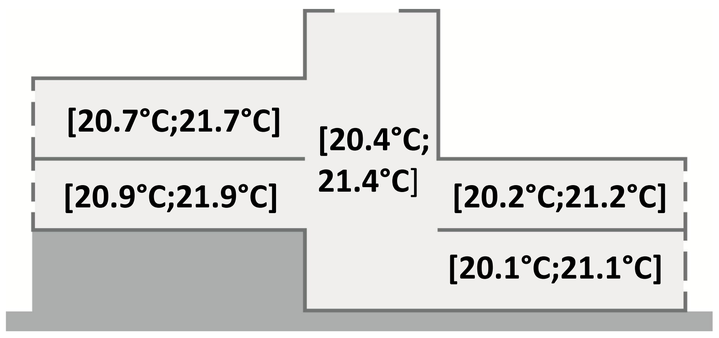
1 : To determine occupied zones (by the norm EN 13779)



2 : To display CFD results on a building section



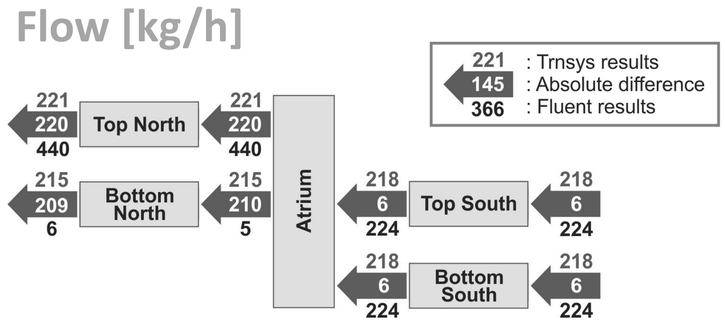
3 : To determine range of multizonal results (single point value +/- 0.5°C)



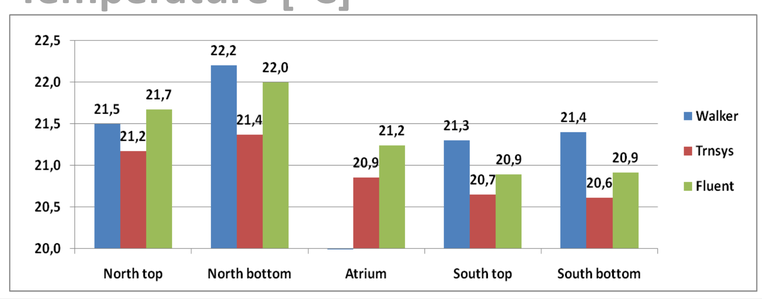
Traditional comparison – differences

Between Walker measurements, Multizonal results obtained with Trnsys17 and CFD results obtained with Fluent.

Flow [kg/h]

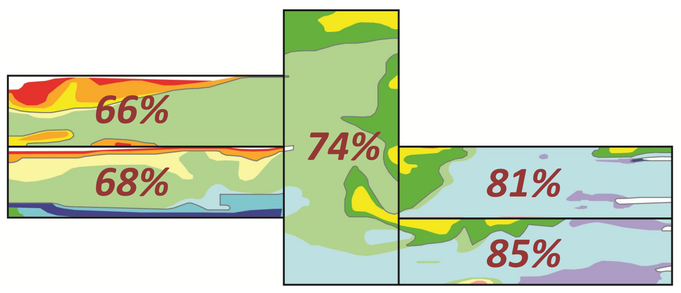


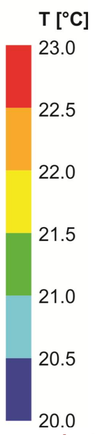
Temperature [°C]



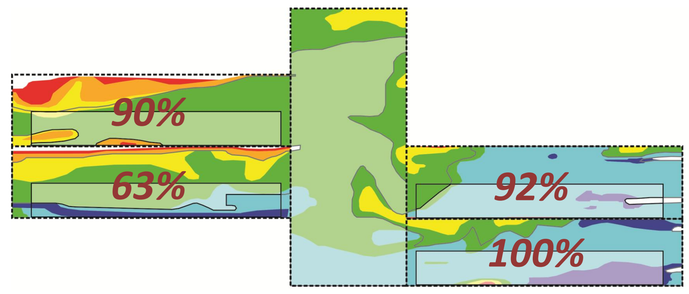
New comparison method – spatial matching

Matching of multizonal results for each entire zone (transparent ☐)





Matching of multizonal results for each occupied zone (transparent ☐)



Percentage of space where the multizonal approach is correct

Compared to CFD the absolute differences (between simulations and Walker),

⇒ never achieved the precision objective (0.5°C) for multizonal

Using the new method multizonal results give,

⇒ better matching in south zones, where flows are better estimated by Trnsys

⇒ better results when considering only occupied zones

Conclusion

Using conventional comparison, CFD which needs more computational runtime leads to more accurate results.

The **new evaluation method** presented in this poster brings out some differences in results comparison and **improves** the appreciation of the **multizonal evaluation.**

⇒ Differences between CFD and multizonal are smaller if analysed in the occupied zone only

⇒ Multizonal needs less computational runtime and is precise enough in the occupied zone

Future work : evaluation of the new method on all cases studied in the first step of the project.

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