

# Field Work Report at Wind Tunnel

## 1. Temporary Title

THE CONTRIBUTION OF THE URBAN DESIGN FOR A BIOCLIMATIC ARCHITECTURE

## 2. Associated Institutions

Faculty of Engineering (FEUP) / CITTA -Oporto University

Welsh School of Architecture (W SA) / Architectural Science Group -Cardiff University

## 3. Objectives

This project is a fundamental component of the PhD research thesis and, therefore a crucial chapter of the investigation over the wind effects on urban areas.

First hand, an urban area conceived over bioclimatic principles must regard strategies that allow higher solar radiation at winter and protect the building facades at summer for the opposite purpose. Second hand, it also should conciliate the correct building disposition over the urban area to allow the mitigation of the inauspicious wind effects without depreciate the wind benefit. Its summer's influences will work as a thermal stabilizer which increases the thermal exchange between facades and the surrounding environment and achieves the essential urban ventilation and oxygenation.

The main purpose of this PhD thesis is to present bioclimatic guidelines both for urban configurations and building forms focusing solar radiation and wind parameters.

During my investigation period in Cardiff I developed a research about wind effects in urban area and its influences in buildings and surrounding areas, which was completed with wind tunnel simulations. In my study I considered a specific area in the city of Espinho that was reproduced in four different models in order to achieve the results that could confirm my research and predict unexpected wind effects for this new spreading area.

## 4. Work report

The report's main purpose is to evaluate the performance of the intervention area under the wind effects considering all the distinctive urban solutions. Therefore, we developed some studies over the wind erosion effects in the wind tunnel of the Environmental Laboratory of Welsh School of Architecture, Cardiff University, (

Figure 2 and Figure 3).



Figure 2 – Wind tunnel front view



Figure 1 – Wind tunnel rear view

With these studies we intend to identify possible areas with high wind influence and acceleration both due to the exposure or building's forms and to urban settlements.

Planning to use the valuable time in Cardiff University to study and develop the simulations, the models (in a total of 4) were built in Portugal at the scale of 1/500 with a mean dimension of 1,50x1,20m. (Figure 3)

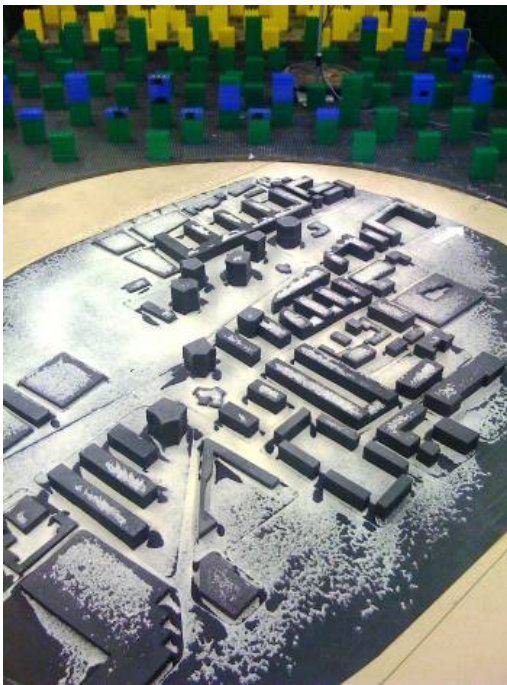


Figure 3 –1<sup>st</sup> Proposal at wind tunnel

The first model (Figure 5) corresponds to the original proposal, the second model (Figure 4) corresponds to the 1<sup>st</sup> proposal, the third model (Figure 7) corresponds to the 2<sup>nd</sup> proposal and finally the fourth model (Figure 6) corresponds to the proposal with the set of the unities with better results in solar access perspective.

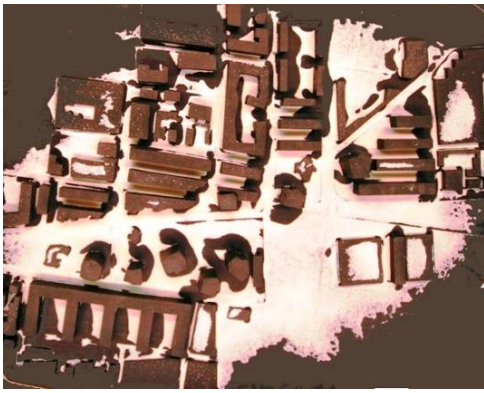


Figure 5 – Original model

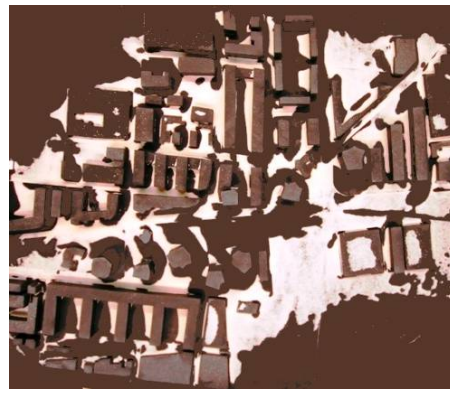


Figure 4 – 1st Proposal model

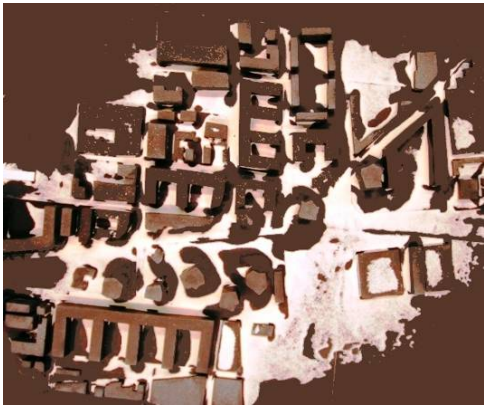


Figure 7 – 2sd Proposal model

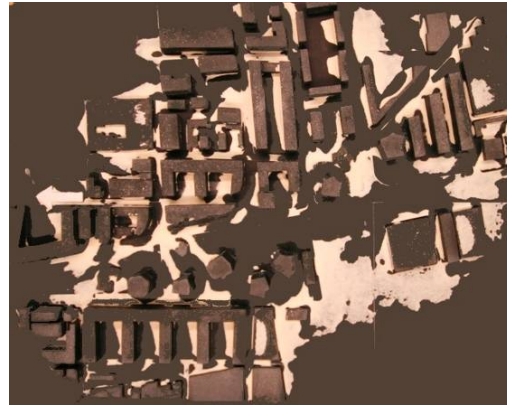


Figure 6 – Best of all solar access model

At the wind tunnel with Dylan and Huw Jenkins's supervision, firstly we developed initial calibration tests (Figure 9) suitable to the 1/500 models scale of the studied area with the original landscape model (Figure 8).

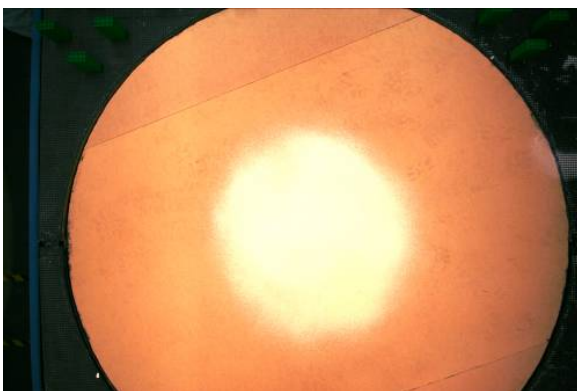


Figure 9 – Calibration test

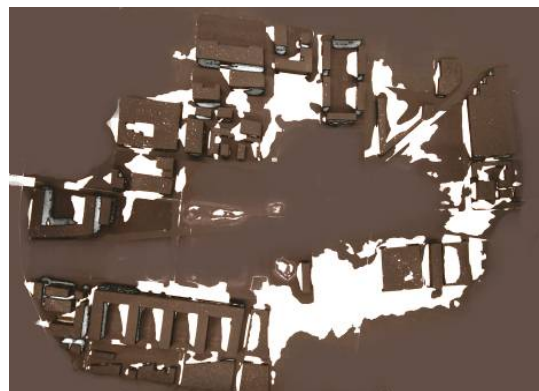


Figure 8 – Erosion test in the original landscape scenario

Secondly the tests were based on the first model, which tries to evaluate the distinctive wind effects in the buildings and surrounding urban space using different wind directions and progressive speeds.

Thirdly it was developed the same procedure on a second and third model and finally with a fourth model which was obtained by the best solar radiation results buildings.

Finally this study was concluded with the combination of 6 erosion pictures forms in each model that resulted in a final composed picture for each model and wind direction.

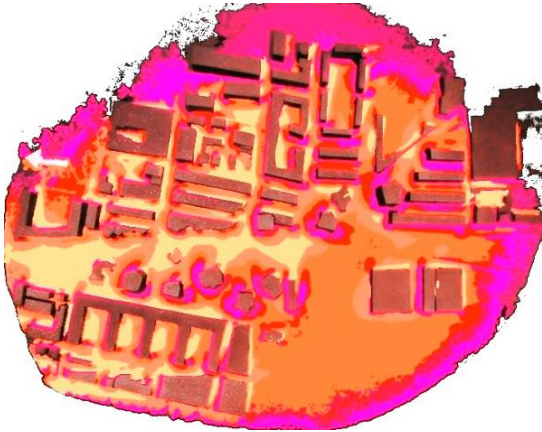


Figure 11 – Original model NW wind

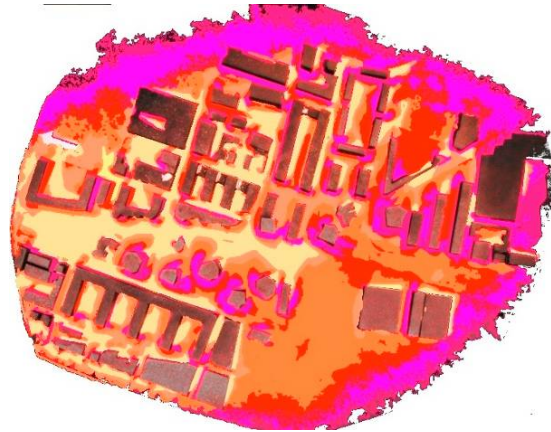


Figure 10 – 1st Proposal NW wind



Figure 13 – Proposal 2 NW wind

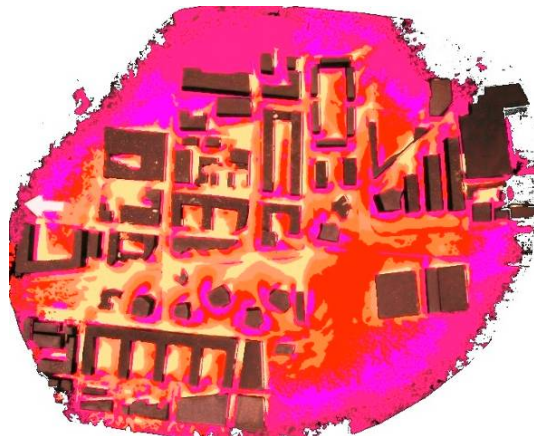


Figure 12 – Best of all solar access model

## 5. Conclusion

The studies developed in the wind tunnel were important to complete the research as well as helping reach the final conclusions, which will be achieved in the next days during my intense work on the PhD thesis.

Considering these research's efforts to establish guidelines for an urban design with bioclimatic concerns especially from the solar radiation/wind's perspective, the comparative

analysis of the tested models will help achieving the main objectives purposed on the beginning of this work.

Porto, 2009 June, 11

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