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BEEP Building Energy and Environmental Performance Tool

Development of a method to compare the true energy efficiency of buildings

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1 Introduction

Regulatory devices for the energy efficiency of buildings currently in use, including the new EU "Directive on the Energy Performance of Buildings" and especially the methods currently proposed in the various member states to determine and judge the energy performance of buildings as required by this directive deal only with energy demand and not with energy efficiency. This paper proposes a method which allows the true energy efficiency of a building design to be determined and thus a real comparison of various building design options. Energy efficiency is understood here as the relationship between the quality of the internal thermal environment in a building and the quantity of energy consumption required to maintain this environment. The BEEP value in the proposed method is an indicator for total Building Energy and Environmental Performance.

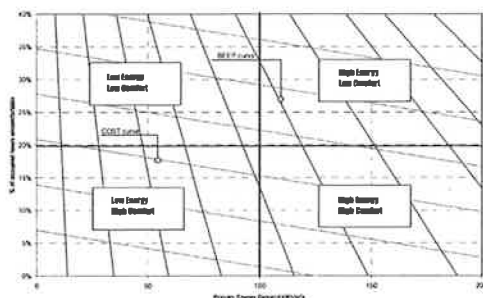


Figure 1 BEEP Chart

2 Methods

The goal of the study was to develop a chart which allows the energy efficiency of various building designs to be plotted and thus compared. In order to measure the energy efficiency of the considered options it is necessary to relate the quality of the internal environment to the energy use necessary to maintain this. It is proposed here that the quality of the internal environment be indicated by the

number of hours whereby comfortable conditions are not achieved; this in turn is measured by determining how many hours the "Predicted Percentage Dissatisfied" (PPD) is greater than 10%. In a second step four design options for a hypothetical office building were examined using dynamic thermal simulation and plotted on the chart as a means of testing the suitability of the proposed method.

3 Results

Figure 1 shows the BEEP chart which was developed to allow the energy efficiency of various building designs to be plotted and thus compared. The x-coordinate of a given point represents the primary energy demand of the building design for heating, cooling, lighting and fans and the y-coordinate the percentage of occupied hours in a year with PPD > 10% as an indication of the comfort level achieved. Buildings which lie on the same BEEP curve may be said to be equally energy efficient.

4 Conclusions

The proposed method allows a comprehensive comparison of the true energy efficiency of various options. The study of the four design options shows that the current one-sided approach with concentration on energy consumption can lead to situations whereby seemingly high energy efficiency is only being achieved on paper. If the indoor environment is not acceptable, systems will be adjusted or new systems added to achieve a better environment at the cost of higher energy consumption. In terms of conserving energy or possibly even from an ecological point of view, concentrating on reducing energy demand is possibly a legitimate approach but is it really sustainable? Achieving sustainability is complex and consideration of the economic and social aspects may mean that conserving energy at the expense of a lower quality of internal environment is not the most sustainable approach.