Energy performance regulations as a tool for the performance assessment of buildings: keep it simple!

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ABSTRACT

In principle, there is a strong consensus that energy performance regulations should be as simple as possible. In practice, several of the existing procedures are lengthy and far from easy to quickly understand. The paper tries to clarify the various challenges for achieving the required quality. Specific attention is given to summer comfort issues and passive and low energy cooling.

1. INTRODUCTION

The Energy Performance of Buildings Directive (EPBD) imposes all member states to implement an energy performance calculation procedure and to require minimum energy performance levels for all new buildings.

In practice, this means that at a European level more than a million of persons (architects, consultants, material suppliers, building contractors, building owners, administration….) directly or indirectly will be confronted with the national implementation(s) of the EPBD.

Since for most of these people, the energy performance of buildings is just one of the many aspects they have to deal with, it is evident to require that such regulations should be kept 'as simple as possible'.

2. KEEP IT SIMPLE

There probably is a wide consensus that EP regulations should be kept as simple as possible.

In practice, what does it mean? Should the target be to have a simple list of necessary measures? Should a method not be longer than 5…10 pages?

An example may illustrate some issues of concern. Assume that you are a decision maker and that you have the choice between 2 'similar' buildings but with 'some' differences:

- One building has a condensing boiler, the other building has an ordinary boiler.
- One building has a heat exchanger with an efficiency of 60%, the other of 80%.
- One building has efficient luminaries with daylight compensation and presence detection, the other not.
- One building has a lot of thermal bridges, the other not.
- One building has a solar collector, the other not.
- One building is very airtight, the other not.
- One building has a high thermal inertia, the other not.
- One building has a well designed control of solar gains, the other not.
- One building uses passive cooling, the other not.
- ….

Many more potential differences can be listed. Probably, for most of these differences, many people will agree that it is important that such differences should be handled (and rewarded) in an energy performance regulation.

This paper highlights some of the major expectations regarding energy performance regulations.

3. EXPECTATIONS REGARDING EP REGULATIONS

3.1 A correct driver for decisions regarding energy efficiency

In case a calculation method predicts a certain performance (e.g. the normalised primary energy consumption), a user of the regulation probably expects that the predicted performance (or change in performance due to a modification) has a reasonable degree of correlation with the performance to be found in practice or, in other words, that the customer and/or societal needs are correctly expressed by the performance specifications in the regulation (SAVE-ENPER).

In order to have a good correlation, it is important that (Wouters, 2000):

1. the performances at building level as predicted by the regulation is a reasonable indication of the typical performances (for an average user) in practice;
2. the prediction by the regulation concerning the impact of certain technological measures is globally in line with the tendency in the reality.

The first aspect is receiving by many people a high priority whereas the second aspect is often receiving a lower priority. However, the second aspect is at least as important as the first one.

As an illustration, 3 alternative prediction models for a standard are evaluated in Figure 1 and Figure 3.

The example of shows a model for which, on average, the building performance as predicted by the standard is of the same level as the real performance. As such, one can consider that the absolute level of the predicted performance is rather reliable.

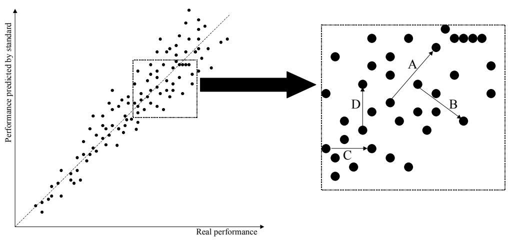

Figure 1: Predicted energy performance versus real performance: example of good global correlation but poor prediction of change of performance (explanations in text).

The example of Figure 2 clearly performs less good: the standard underestimates systematically the energy performance and such a standard should be improved.

In the example of Figure 3, there is a slight underestimation of the standard and some correction might be useful.

Whereas the example of Figure 1 predicts on average the absolute performance globally better than the example of Figure 3, this is not at all the case if the predicted impact of certain modifications is evaluated. In the example of Figure 3, there is a very good level of agreement between the predicted and real variation in the energy performance. In Figure 1, all possible relations are observed.

For the 4 considered cases in Figure 1, the following remarks can be made (including in italic a few practical examples):

Variation A:

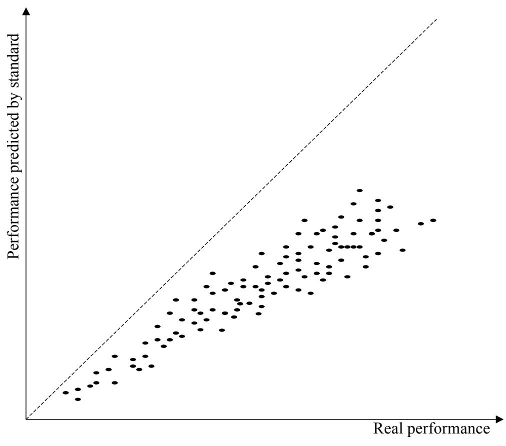

Figure 2: Systematic underestimation of the performance by the standard.

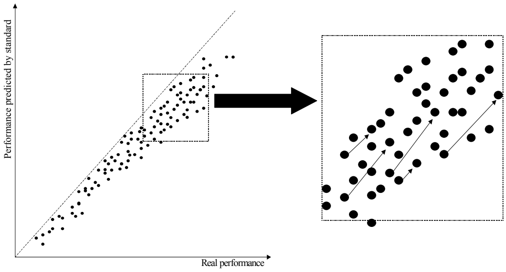

Figure 3: Predicted energy performance versus real performance: example of moderate global correlation but good prediction of change of performance.

➚ Predicted variation of a certain technological modification is of the same order of magnitude as the real change in performance.

Variation B:

➘ The standard predicts that the technological modification gives a performance reduction whereas in reality there is an improvement.

In case of a poorly designed air-to-air heat exchanger, it is possible that the gain (in primary energy units) due to an improvement in thermal efficiency of the heat exchanger will be completely lost by increased fan energy use (due to higher pressure losses). If a standard only focuses on the thermal performances of the heat exchanger without considering the fan energy, the predicted performances will be the opposite of the real performances.

Variation C:

➔ The technological modification gives a significant improvement in real performance whereas the standard does not at all consider this as a performance improvement.

A procedure which automatically considers a fixed energy reduction for daylight compensated luminaires without giving attention to the building and window design is not able to give a benefit for a good daylight design. Also if a fixed benefit is given to presence controlled lighting without considering the technology used, there is no motivation for industry for making use of very energy efficient presence detection systems.

A procedure which doesn't take into account thermal mass will not give a benefit to the. Increase of the thermal mass and as such not award the improved thermal comfort.

Variation D:

🡅 The technological modification gives no improvement in real performance whereas the standard predicts a substantial performance improvement.

Application of daylight compensated luminaires in offices without windows will in practice give no energy reduction at all. If the standard gives a fixed benefit for daylight compensated lighting, also this benefit will be given to luminaires in rooms without daylight or for luminaires installed at a distance of 6….15 meters from windows..

If a preference has to be made among the 3 models, the authors clearly prefer the model presented in Figure 3. Although in absolute terms not very precise, it gives the correct tendency as far as technological modifications are concerned. Such approach will effectively stimulate the use of more energy efficient technology.

3.2 Complexity in balance with importance

Many decision makers (architects,…) are not specialists with respect to the calculation of the energy performance of buildings. Moreover and especially for many small dwellings, the applied technology doesn't require very complex calculations for showing compliance with the regulations. Therefore, it is important that EP procedures are adapted for various degrees of complexity. In practice, the use of default values for certain products or type of performances can substantially shorten the learning curve for become familiar with EP calculations and also for carrying out such calculations.

Examples:

- The standard EN ISO 6946 (EN ISO 6946, 1996) deals with the calculation of the U-value of cavity walls. The method needs as input data the number of mechanical fasteners per m² of wall, the thickness and thermal conductivity of the mechanical fasteners, the percentage of mortar joints and the conductivity of the mortar. A precise collection of such data is completely unrealistic for (most) architects. By using default values (values which don't have to be proved), one can substantially reduce the calculation effort.
- For the estimation of the energy consumption due to lighting, one needs in principle information on the nominal power of the luminaries. By using a default value for ordinary luminaries (e.g. 20 W/m²), the work is substantially simplified and it is up to the user to decide whether or not to use this default value.
- Thermal mass is an important element in a strategy of passive cooling. It is essential that this parameter is taken into consideration but it should also be avoided that for ordinary small projects the determination of the ther-

mal mass requires a lot of building data.

3.3 No barrier for innovation

An EP regulation can be a major stimulus for the market uptake of innovative energy efficient technologies. However, it also can be a barrier if the procedures don’t have a consistent framework for handling innovative systems (RESHYVENT project).

Example:
During recent years, demand controlled ventilation, hybrid ventilation, night cooling strategies… are technologies which have received a lot of interest in research activities as well as in a whole range of demonstration projects and in more commercial projects. At present, many regulations don’t have clear procedures for handling such systems. If the result of such lack of procedures would be that these systems don’t receive a benefit, it is clear that an EP regulation will be a (major) barrier for such systems.

This issue has been studied in the framework of the EC RESHYVENT Project. The final report of this task is listed in the references.

It seems quite realistic to expect that, especially during the first coming years, strategies regarding passive and low energy cooling will not be well covered in the energy performance regulations as used in the various EU countries. As such, an energy performance regulation can be a barrier for the implementation and market uptake for such strategies.

3.4 Regulations should be respected

The key objective of the EPBD is NOT to have regulations in the member states but to achieve a substantial improvement of the energy efficiency of European buildings. The regulations should be seen as tools (among others) for achieving this key objective. Experience shows that it is not evident to assume that regulations automatically lead to better buildings. For a whole range of reasons, a sometimes substantial part of the buildings is not complying with the regulations. Therefore, it is important that each member state has a clear philosophy regarding the compliance strategy. The subsidiarity principle should surely be respected since the tradition and cultures in the different member states vary widely. However, just imposing regulations without any direct or indirect compliance check seems not the right strategy.

4. CONCLUSIONS

In general, there is a tendency for increasing the number and severity of the requirements regarding building performances: environmental impact, acoustical performances, building security, durability, energy… In principle, there is a wide consensus that energy performance regulations should be as simple as possible. However, and as illustrated in this paper, there is a whole range of challenges for an energy performance regulation. As a result, it seems impossible or at least not suitable to develop very simple methods since such methods may have adverse effects. On the other hand, it has for many, especially small, projects little sense to confront designers and other building partners with all the details of a very refined approach. One of the major challenges is to find an intelligent mixture between simplicity and detail.

As far as passive and low energy cooling strategies are concerned, specific attention should be paid to the correct handling of such systems in the context of energy performance regulations.

REFERENCES

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RESHYVENT project – Cluster project on Demand Controlled Hybrid Ventilation in Residential Buildings with specific emphasis on Integration of Renewables - www.reshyvent.com.

SAVE-ENPER project, www.enper.org.

EN ISO 6946, 1996. - Building components and building elements — Thermal resistance and thermal transmittance — Calculation method, August 1996.