BUILDING PERFORMANCE STARTS AT HAND-OVER: THE IMPORTANCE OF LIFE SPAN INFORMATION
Performance-over-time and life span information

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Abstract

Life cycle information is regaining attention throughout the building industry, and in particular among those involved in managing the existing building stock. Due to the increasing attention for the performance concept in building, for sustainable building and changes in maintenance policies, the importance of reliable life span information is felt by more people. Life span information is necessary to support investment decisions and to calculate the environmental impact of buildings and building components. Life span is an ambiguous term, however. It can be interpreted in many different ways. So what kind of information are we looking for?

Keywords: Performance concept, performance over time, life spans of building components, sustainable building, building use

1 Introduction: The performance concept in building

Due to a changing real-estate market, the building sector has to become more “consumer-oriented”, in line with other industries. In Western Europe the post-war quantitative need for buildings, both dwellings and offices, is more or less fulfilled. The demand is concentrating on quality aspects. The market is changing from supply driven to demand driven. The building has to fulfil user requirements. The user requirements contain a mix of building regulations, social and cultural standards and specific, individual requirements set by the building owner and user. Communication should include information on the performance of the building in relation to these requirements and should pay attention to changes in either requirements or the performance supplied by the building. Communication on buildings should be using terminology, which can be understood by the customers: the occupants and building owners. It should focus on the use of the building rather than on technical issues.
These developments are in line with the ideas of the performance concept in building. A building is considered to be a functional product with a performance, rather than a combination of technical components.

So far, attention has been paid primarily to the performance of a building at hand-over. At that moment – or a few months afterwards – the building team is officially dismissed and the building process is deemed to be over. For the building owner and user, the process only starts at that moment. For them, the performance at hand-over is only the beginning. After the building is taken into use, its performance will change continuously under the influence of climate, use, maintenance and the quality of the building itself. The building owner and user have to deal with this performance over time. If insufficient attention has been paid to the performance over time in the design and construction process, considerable efforts may have to be made to keep the building in shape afterwards.

In a consumer-driven market, the attention for the building performance over time will grow. This explains for instance the increasing research into performance and maintenance contracts. In maintenance contracts, parties (such as the building manager and a maintenance contractor) agree on a performance level to be maintained over the contracted period.

The attention for building performance over time supports an increasing awareness of life spans: When can the building performance be said to be ended or, in other words: when does the building or building component’s lifetime end?

2   Life span in relation to performance and requirements

In general, the life span of a building component can be defined as the period a building component can fulfil its requirements. Unfortunately, both the performance of the component and the requirements change over time. Depending on the type of change, the life span of a product will be longer or shorter (figure 1).

![Life span in relation to performance and requirements](image)

Fig. 1: Some examples of the life span of a component in relation to its performance and requirements
Building owners and users are looking for ways to agree on the period a building or component will deliver its performance, and the minimum performance supplied during this period (figure 2).

![Graph showing time, performance, and contract issues](image)

Fig. 2: Agreements on minimum performance over time and minimum life span

### 3 Application of life span information

Life span information can serve several goals in the different phases of a building’s life cycle:

- Choosing between alternative building components;
- Calculating exploitation costs of alternative buildings;
- Long term maintenance planning;
- Determining depreciation periods;
- Calculating the environmental impact of components.

Life cycle information indicates when a component should be replaced. This information is useful when setting budgets for the exploitation of a building. If the expected period of use of a building as a whole is given, the life spans of the composing parts of the building can be attuned to this expected time of use.

Life span information also indicates when maintenance activities are necessary. Traditionally, building management focussed on minimising short term maintenance costs. Currently a change can be seen towards optimising maintenance in relation to organisational goals and means in the middle and long term. The maintenance sector shows a transition from technical aspects to functional aspects. The “why” of building maintenance is becoming a focal point: which objectives does an organisation have for its buildings, and which are the budgets available for realising those objectives? Maintenance is seen as one of the means to manage real estate, next to for instance buying and selling and refurbishment.

The new generation of maintenance systems explicitly takes the required performance into account in planning maintenance activities. The earlier generation centred on what was technically needed to restore a building in an acceptable condition. The condition aimed at was more or less fixed. The new
generation adjusts the condition aimed at, to the organisational objectives. Attuning maintenance activities to requirements asks for information on the intended period of use as well: if requirements change, the maintenance activities should be adapted.

4 Sustainable building

Until about ten years ago, the term “durable” meant “to last as long as possible”. The meaning of the word has changed, however, to “fulfilling the set requirements for as long as those requirements exist and with minimal environmental impact”. The term has therefore become more complex and specific. To indicate this transition and to prevent misunderstanding, the word “durable” is nowadays often replaced by the word “sustainable”.

According to the definition, sustainable building implies that the requirements of future building users are known. It also implies that the duration of the requirements is known. And on top of that, the requirements have to be answered in a way that the effects to the environment are minimised. The solution found will always be based on the existing state of the art in building technology. Meaning that the knowledge of the actual environmental impact of a product and the production means available, change over time.

The period of use of a product, indicating the time elapsing before a product is being disposed of, is an important parameter in the determination of the environmental impact of the product. The environmental impact is proportional to the period of use. Reliable life span information is essential in reviewing the durability (or “sustainability”) of a building or building component.

5 Types of life spans

For manufacturers, life span information can be a competition item: They will try to present their product in the most favourable way. Agreements are therefore necessary, on how the life span of a product should be determined and presented. First of all, it should be clear what is meant by the word “life span”. Depending on the perspective, “life span” can be defined as, for instance, “time of existence”, “period of use” or “depreciation period”. When giving life span information, it is of the utmost importance to indicate which perspective is represented. The most important types of life span are the technical life span, the functional life span and the economic life span.

5.1 The technical life span

The technical life span in its most limited meaning, stands for the time that a product physically exists. Of course, the concept of “physical existence” should be specified: Masking weak spots or leakages can prolong the life span of a bituminous roof cover. At what stage of deterioration is the life span of the roof considered to be ended? In other words: how many repairs are acceptable and when should replacement be considered? As the technical life span will rarely be used completely, the precise determination of the technical life span of components is not of interest to the building owner or user. Agreements can be important, though, in relation to the determination of environmental impact.
In daily practice, the technical life span is considered to be the period that a building component can physically supply the required performance. In the Netherlands, the Building Research Foundation (Stichting Bouwresearch) publishes a report called “Life spans of building components. Practice-based values.”

When determining the technical life span it is important to define the circumstances in which the life span will be reached precisely. The technical life span strongly depends on the materials used, detailing, building location. The intensity and type of use and maintenance also play an important role. “The” technical life span therefore does not exist. It is always a life span under specified conditions. Unfortunately, sufficient knowledge on the impact of these conditions is still lacking. As the number of factors is huge, empirical life span research is costly and complex.

5.2 Period of use

The period of use or functional life span of a building component is the life span the building component is actually used. The question is what type of use is still considered to be functional? If a door is used as a tabletop, is this form of use included in the “functional life span” or not? If it is, how can future applications be foreseen at the moment a building component is put on the market? The type of use should be indicated to be able to set a functional life span. At the other hand, as long as a building component can have a function, regardless of the type of function, it will not be disposed of. This is in favour of the environment and re-use for other functions should therefore be taken into account in determining the period of use for environmental calculations.

From a practical viewpoint, the functional life span is defined as the period a building component can fulfil the function for which it was originally made. Re-use (for the same function) and high or low level recycling possibilities should be indicated. In the current building practice, information on the actual, real-life periods of use of building components is still lacking almost completely.

5.3 Economic life span

The economic life span is the period that no alternative exists with lower or at least equal exploitation costs for a building component. The subject for debate is the comparison of the equality of alternatives. Technological developments are not on hold during the building’s use. Therefore new and improved products will become available during a product’s life cycle. Components are therefore hardly ever replaced identically. In nearly all cases some kind of performance improvement will be realised as well. This improvement should be accounted for in determining the economic life span of a building.

The economic life span and environmental requirements can be on bad terms: replacement for economic reasons may not be very sustainable, unless the environmental impact of replacement is translated into costs and included in the price of the alternative.

If a component is being replaced by a more environmental friendly component, the environmental impact of replacing a still-functioning component and the profit in terms of prevented environmental impact caused by replacing the old component, should be weighed against the impact of the new component.
6 Life spans and building components

There is a relationship between the type of building component and the type of life span most relevant to the component:

- For structural parts the technical life span in general is endless. Their life span depends on the period of use of the building as a whole. Usually, a fictional life span is set for those components, for instance 75 years. This number does not indicate the real period of use, but is an endpoint of a planning horizon, for instance in maintenance plans. The actual period of use (until demolition) of buildings usually is a lot longer, in the Netherlands approximately 100 years.

- For external building components, such as the facade and roof, the life span strongly depends on maintenance activities. The life span of the component is “technical” and is related to the design, use and maintenance of the component. For office buildings there can be a different situation, if for instance the image of the facade is important and replacement of the facade is induced by the need for a aesthetic face-lift, rather than deterioration of the facade components.

- User appreciation and the primary processes of the user organisation determine the life span of interior components. If there are changes in the way the building is used or if the taste of the building user changes, components are being replaced. Functional criteria, rather than technical criteria determine the life span.

- The life span of building services nowadays strongly depends on technological developments. Automation of building services causes obsolescence due to outdated software, before any technical deterioration of the apparatus itself can occur. Also changes of regulations can cause an early end of lifetime, for instance if energy regulations are tightened.

Life span information of building components should represent the above most important reasons for replacement. The components should be designed in a way fitting the life span: their technical life span should be attuned to the functional and economic life span. If a component will be replaced often, for instance due to rapid changes in fashion, the connections of the component should facilitate easy replacement. Components with a life span as long as the building’s period of use, can have more fixed connections.

7 Conclusions

Life span is a complex term with many different interpretations, differing from mere “time of existence”, to “period of use”. Life span information is needed to support decisions relating to investments in new or existing buildings and to calculate the environmental impact of components and buildings in order to make sustainable decisions in planning, designing and upkeeping the building stock. Agreements are necessary between those offering life span information and those using life span information on what interpretation of the word life span is relevant in a particular situation. This paper indicates the different types of life
span which may be worthwhile discriminating between. The type of life span relates to the reason why a component is being disposed of. This can be for technical reasons (the component is not able to perform any longer), for economic reasons (there are products on the market with a better price/quality ratio) or for functional reasons (the demand is changing and the component cannot fulfill the changed requirements).

When designing a building, the most likely reason for replacement of the individual components should be assessed. Then the moment when the replacement will take place should be estimated, based on practical experiences with similar components in other situations. This actual, practice-based period of use should be the starting point for environmental calculations.

8 References


*NOTE: The author is changing position, from Damen Consultants to KPMG Management Consultants, starting 1 January 1999.