

3.000 CONF STATE-OF-THE-ART

LCC important

As is said in (11) there are surprisingly little done to find a thorough economic strategy for retrofitting existent housing. The fact is that I have not found any literature or papers that deals with the house as an energy system and at the same time deals with retrofitting, life-cycle costs and suitable optimization procedures. However, there are an immense amount of literature written about those parts of my subject and I have used something here and something there to make this thesis come true.

It has been an increased interest in the LCC-subject during the last years and in (23) an effort has been made to make an investigation about this type of literature. Unfortunately, for me, this book mostly deals with new office buildings. Not much is written about retrofitting. Nevertheless, the book gives an introduction to the subject LCC and gives a lot of references.

Some of the CIB (Conseil International du Batiment) congresses show papers about the LCC and building problems (6) (11). In 1980 a special volume of papers was edited (24) about this topic.

The conference in Espoo, Finland, 1984 also dealt with the LCC but mostly from the maintenance point of view. Ref (13) treats the LCC for windows and some results are given from Finland. Ref (14) dealt with the subject from a more general point of view. The author also says that "there is a lack of relevant knowledge of repair technology". He also makes a difference between two different life-cycle spans, i e the economical and the technical. He also says that it is impossible to find the precise value for the life-cycle of a component.

The topic is also treated in (19), where a brief presentation is made of the present value mathematics. A case study is discribed dealing with sewerpipes in USA. A Swedish author has in (16) made a more reasoning contribution to the

Espoo conference. She deals mostly with the subject "why is LCC important?" In (17) the author has approached the topic from a macroeconomic view and the LCC is discussed from both short- and longterm durability periods.

Some other references, that treat the LCC and energy conserving measures, are e g (18) and (53). Also in these papers the LCC are treated mostly from a principal view.

One paper that deals with both LCC and the optimization problem is (19). Unfortunately, the authors only optimize the distribution between capital-, energy-, maintenance costs for new houses. The different parts of the house are not considered. In (12) the authors have dealt with retrofitting measures and the LCC concept, but they do not consider the house as a system, and important parts of the heating system costs are not considered. Most of their article only considered new houses.

The work (8) is a very good introduction to the LCC procedure. The authors write that, for retrofitting, the savings-to-investment method is required from the US Federal Energy Management program. This method is a very good criteria, having a limited budget, but does not necessarily give the optimal retrofit strategy. In some manners this is provided in (11), where the optimal retrofit strategy has been examined for single-family houses. In this paper the cost-effectiveness are calculated for a number of retrofit measures. The most cost-effective measures were chosen and they were implemented on a hypothetical house. The retrofit investment cost and LCC are after that plotted in a graph.

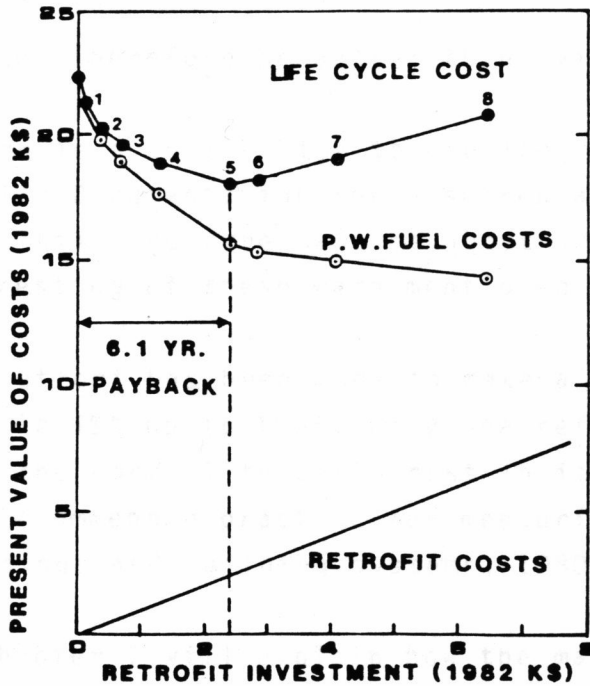


Figure 8. Present value of total energy costs versus the retrofit investment to establish the optimum investment (11).

In this case they found that the LCC had its lowest value when investing about 2.5 k\$ in the retrofit measures. The authors though only dealt with the climate envelope retrofits and were not looking at the house as a system. Perhaps the best solution was a heat pump instead of insulating the attic that was suggested in this article.

In (88) the subject LCC is treated extensively. However, this report is of the tutorial kind and no calculations are shown for real buildings. A retrofit LCC is presented, but no optimization techniques are discussed. As a first handbook in life-cycle costing it can be recommended, but no answers are given about optimal retrofit strategies.

One more reference in the LCC topic will be mentioned (25). In this paper energy conserving measures are treated as investments and compared to other investments. The author shows that the return is higher in many retrofit cases than in a lot of other traditional investments. Retrofitting in a

proper way might therefore be better than buying stocks.

In Sweden there is a possibility to use the Swedish Institute of Building Documentation for a search after literature in a subject. This procedure gave me about 60 references and the most interesting of these were mentioned above.

In (29) a big effort has been made to make a summary of the research done in USA up to 1985. Only one reference from about 200 has the words life-cycle cost in its title viz RT RUEGG et al: Recommended practise for measuring Life-cycle costs of Buildings and Building svstems, 1980. (See (12).)

In the next chapter I will explain how the mathematical model is built up and then I had to to make a lot of references to literature, which only to a part give a contribution to this thesis. In those cases, where I find it necessary, I will also give brief comments about the contents. Reading about all this literature here might be a little boring and furthermore, it would be unavoidable to reiterate a lot of the substance. Therefore, let met continue with the model.