An Ennobling Maintenance – a Maintenance Philosophy

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The influence of maintenance/alteration decisions on the building functions are greater than most people think and it is often these decisions taken years after the completion of the building that affects the building performance most during its lifetime.

Maintenance is often defined as "Measures aimed at restoring the function of the object" [1] and in practice this means Preservation or Slow Degeneration Maintenance. Maintenance decisions taken years after the completion of the building are the decisions that affects the building performance most during its lifetime. It is therefore important that maintenance is not seen just as restoring the objects original function, with the original materials and techniques. This would be like preservation of a monument in its original state and this hardly ever happens in real life. Often the original materials are replaced with cheaper and not necessarily better replacements and the building gradually deteriorates with time. In this paper I argue for the developing of maintenance philosophies for each building that allows the building to evolve with time. The argument is for philosophies as bases for eventual detailed maintenance plans and their continual revisions since philosophies can accommodate changes in building use, material changes, new rules and regulations, increased environmental concern, etc. A maintenance philosophy that does this I have called an Ennobling Maintenance since this type of maintenance philosophy could make the building better and better over time in filling its changing functions. Within this concept function must consider all the dimensions of a product and that a building or component is not functional when it no longer successfully fills its role.

The importance of maintenance/alterations

The building industry is the second largest industry in the world (after agriculture) [2].

Nearly half all refuse in Sweden comes from demolition and new building. A large amount of this building material is thrown out – not because it is worn out but because it is considered not to be modern! Most of the material which is deposited could be reused. Through selective demolition,

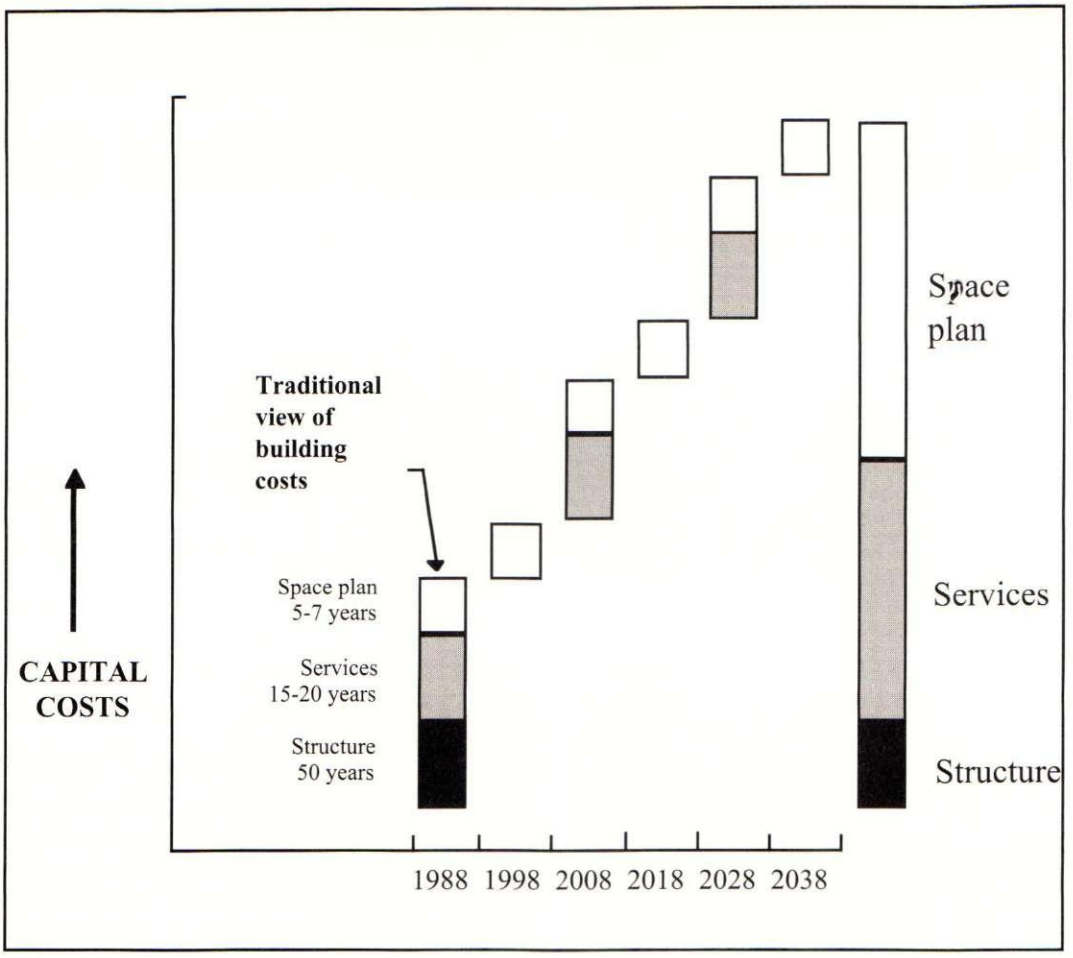

Figure 1. Over fifty years, the changes within a building cost three times more than the original building. The Structure expenditure is overwhelmed by the cumulative financial consequences of three generations of Services and ten generations of Space plan changes. That's the map of money in the life of a building. The figure was redrawn from [2] but originally from [4].

reuse and recycling it is possible to develop material cycles for buildings [3].

A modern building takes perhaps one year to plan, one year to build and then is used for perhaps 50 years. The time of maintenance is considerably longer than the building time and must be considered to be a very important part of work in the "building industry".

Although maintenance is important during most of a buildings lifetime and often represents the largest accumulated cost (Fig. 1). It is often neglected as Stewart Brand writes:

> ...People get in a permanent state of denial about the need for building maintenance. It is all about negatives, never about rewards. Doing it is a pain. Not doing it can be catastrophic. A constant draining expense, it never makes money. You could say it does save money in the long run, but even that is a negative because you never see the saving in any accountable way. ... When, after months or years of nagging, you finally do the work – refinish the floor, hire the roofers, replace the damned furnace – you have nothing new and positive, just a negated negative. The problem that needed fixing turned into an even worse problem during the chaos of repair, and then it went away... [2]

Maintenance?

What is maintenance? Is it merely keeping it all together? Is it slowly trying to fix the mistakes made in the original construction? Can it be used to bring new knowledge into the construction? Can it all be done at once?

In Sweden, SABO, a large housing association, and the Property Owners Association have accepted a property management agreement. In this agreement, maintenance is defined as: "Measures aimed at restoring the function of the object." [1].

Maintenance has been considered a lowly job that the caretaker looks after more or less as an extra job in the evening. Some houses do not need more than that, for example, the dry laid granite houses in Sartene, Corsica, need little continuous maintenance to keep them from falling apart. They just stand there.

It can perhaps be said now, with hindsight, that it is a pity that so many buildings were built during the past 50 years, a time when so many new unproved materials and techniques were introduced. However, it would not be possible to build the quantities which were needed without new technology. In a sense, the maintenance problems we have today are the result of large-scale experiments started a number of decades ago. It should also be remembered that the poorly built buildings of over a century ago are no longer around for us to try to maintain.

During this century we have "developed" building techniques and materials which are not so easy to reuse. During the "million" project in Sweden buildings were built to last 30 years. "Maintenance free" buildings were built. This concept usually means that they are "impossible to repair". Disposable buildings! [5] When working with the restoration of Katarina Church, Stockholm, after a devastating fire questions arose as to the choice of materials and techniques. What is the intended length of life for this work? Katarina church has existed over 300 years. Other Swedish churches have stood over 900 years. What is a reasonable life for a church? Maybe 500 years? On the other hand there are some modern churches for which 30 years seems a long life. Today buildings are expected to have a life of 30 to 50 years. The choice of materials reflect this [6].

As mentioned above maintenance thus often concentrates on replacing with the "same" if possible or with "cheaper and better". This leads to a conservation or more often to a gradual degradation of the function of the building. Thus, a maintenance philosophy is needed.

Maintenance Plans

In the mid 1980's the idea of calculating all the costs a building would incur during its entire life, (Life-Cycle-Costing) was still treated more as an utopian project than a real alternative in evaluation. Computer power was expensive and nowhere near the present capacities and the basic raw data was just starting to be collected and correlated. Even these early projects of collecting basic data with the intention of being able to evaluate future costs were small scale and lacked the problems of large scale reality. Using Life-Cycle-Costing concepts a number of different projects were carried out during the 80's to develop "maintenance plans".

With the speedy development of computer power, maintenance plans could be developed with more and more detail. Connecting to drawings and CAD programmes the dream was to have full control over all repairs and be able to plan 30 maybe even 50 years in advance making perfect budgets and clear goals an obvious expectation.

The idea that maintenance costs could even be included in the consideration of designing new building was raised.

Under the leadership of Professor Thomas A. Markus at the Strathclyde University in Glasgow 1983–85 I was part of a project involving Life-Cycle-Costing and design of industrial buildings [7]. The aim was to show how it could be possible to bring the maintenance values into the design process. Work on this project showed that it can often be seemingly unimportant expenses that in a long term add up to the largest costs. Small costs that are incurred often fast outweigh the one off large costs. Cleaning costs in "clean" industries stood out when added over time. Another important problem which this project showed was how much the comparative values and evaluation of particular measures to be carried out in the future are influenced by the financial market and the interest rates investments are related to.

Some of my conclusions from this project have been that the dream of a perfect maintenance plan defined in detail that will be valid for many years, is in fact not a plausible path. If a maintenance plan is used it has to be continuously revised, not just updated. There is a clear need rather to develop a maintenance philosophy, and concept as to how to handle maintenance as a total over time, to be able to handle this revision process. There are a number of factors

which need to be related and evaluated against each other to be able to define a valid maintenance concept for each building or estate:

- Building materials and construction type and quality
- Tenants requirements and expectations
- Expected variability in requirements over a longer time
- Economical strength and expected future strength of all parties involved.
- The national and international scene surrounding the given object

Preservation or Evolution

With the development of a consciousness of the need for maintenance in broader circles the choice of materials, the choice of techniques and the methods of maintenance work carried out during the 60's has been questioned. A generally "accepted" ideal is that the best way of maintaining a building is by using the building techniques of its time. A building built in the 1600 should use techniques and materials known then to maintain it in the "best" way etc. This must be considered to be a very pessimistic evaluation of the centuries of development since then.

It is important to consider the difference between buildings which are chosen to be conserved and those which are to "just" live on. Conserved as true as possible to the original construction, material, technique etc. to be kept as objects of reference, as museums. These are important so that it is possible to have reference objects and to evaluate over long time different techniques and materials but these are not the majority of our buildings. Most of our buildings are to be used, to live and develop with the changes in time and knowledge and are to be maintained in such a way that they develop with the society using them [8].

Maintenance work therefore needs also to evolve with time. It is important that there is the possibility to take advantage of new knowledge and not to be bound by old contracts and methods. Knowledge is developing quickly. At present there are many projects and much research being done to find out ways of evaluating the environmental load of building materials and techniques, as well as new ways of treating, disposing of or reusing products. There needs to be a way of incorporating this development in such a way that pure trends are avoided and that the effects of mistakes or misinterpretations are minimised. Therefore it is important that there can be a continual evaluation of all maintenance work in each individual situation.

The conserving ideal of traditional maintenance work, at best, does not allow for new and increased knowledge to be incorporated into our existing built environment.

The evaluation of environmental load is a new concept which was not on the agenda when most of our existing buildings were built. If maintenance is allowed to continue as being the preservation of the original object there will only be a very slow change. If however all maintenance work is allowed to consider an environmental load value there is a large possibility of changing the environmental load caused by the building industry.

The challenge is to find the best available materials and techniques new or old, which can be used in old buildings in a sensitive and knowledgeable way so as to develop our built environment to be suitable for present day requirements.

Exchange old for new and better?

With the oil crisis values changed in the choice of action and method in maintenance. Save energy at all cost, has since been a key guideline. At times the total energy involved to change to an energy saving construction can perhaps be questioned. How much energy has been used to make the new windows to then transport them to replace the old, then dispose of the old etc. etc. as compared to the energy saved from slightly less heat loss? This is dependent on how bad the old windows were, what is used to replace, what else could have been done... The most environmentally friendly way of treating any material is to use it until it has worked its time and then dispose of it in the most satisfactory way possible at that time. This is of course with the exception of materials which are dangerous in themselves or which emit gases, fumes or chemicals which are unacceptable. An example of this thinking is how to treat PVC floor covering. PVC floor covering is not a recommendable material in terms of the environmental load it is responsible for. However if it is still in an acceptable state there is no environmental gain to tear it out and replace it with a more environmentally favourable material. It must be considered an advantage to allow the PVC flooring to remain where it is and be maintained with well chosen cleaning agents, until it is worn and needs to be changed. At this time the

PVC flooring should be taken out and returned to the PVC process or be destroyed in the best way known at that time. Hopefully with time even this knowledge will improve.

Contracts, decisions, expertise

Problems often arise from having a complete contract before the work starts. It is often impossible to know exactly what must be done before the work is started and the construction opened. This puts a demand on the possibility of making many decisions post-contract [9].

These decisions have to be taken by the maintenance manager or site manager unless they are left up to those who actually do the work.

Much of the maintenance, repair and improvements needed demand more professional expertise and a higher level of workmanship than new constructions [10]. Many of the most important maintenance decisions are made at the design stage before the building is built.

> The old adage that 'prevention is better than cure' could be extended to a new concept that prevention is economically sound, socially desirable, technologically possible and environmentally friendly. [11].

An Ennobling Maintenance – an enlarged maintenance philosophy

An Ennobling Maintenance (EM) scheme or strategy should be possible. This entails a form of maintenance that gradually improves buildings for their present functions. The building becomes more suited to the actual use of the time. Life styles change, tenants/members profiles change, requirements and wishes change over time and the buildings should accommodate such changes. Cecilia Enflo Jensfelt [12] described a process of reconciliation when the characteristics of the building and the user requirements are too un-alike then a rebuilding is carried out to minimise these discrepancies. EM does the same, using small increments so that it resembles a continuous process. Since generally rents/payments for buildings are paid at regular intervals EM allows costs to be more evenly distributed and better reflect the incomes. In this way interest rates etc. become less influential on the property balance and money paid directly to the bank is reduced. EM should mean that an area maintains a continual level of attraction to the market, which in itself improves the social atmosphere. In this way EM helps to avoid slow degradation from reaching a point where there becomes an acute need for large-scale investments to stop a sharp decline in property prices. The investment which is unplanned creates a need for large rises in monthly payment. The decline in property prices or a rise in payment would cause a strain on the individuals' financial situation (in the case of ownership or co-operative). Figure 2 tries to illustrate how EM makes the building properties "chase" after the wished properties of the building.

What EM could mean to a property:

- Continual but gradual change over time
- Always relatively good fit with tenant requirements
- Continual attraction to the market
- Money in = money out
- Saved money and environment

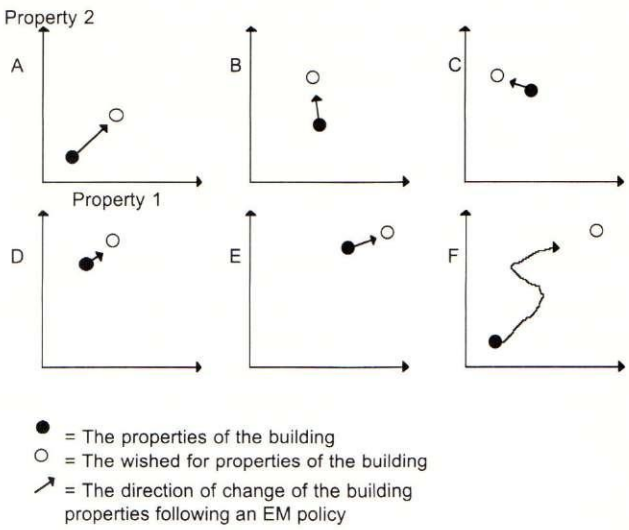

Figure 2. This figure shows two properties of a building in a two dimensional co-ordinate system. The filled circle represents the present properties of the building and the open circle the wished for properties of the building. The arrow shows the direction of change in properties following an EM policy. The change, in properties, wished for properties and the direction of change in these properties over consecutive time (A–E) and the path the building properties have actually taken (F) are illustrated. Every property of a building can in principle be represented by a value on one axis in a multidimensional co-ordinate system.

Is EM possible?

Yes, but to make it really happen certain new practices might have to be adopted. The following are suggestions of some of the possible key issues needed to be adopted.

A long term policy for EM is needed. It is important that it is a policy and not a detailed plan to be able to accommodate changes in recommendations, legislation, technical innovations, changing habits etc.

The manager should have a well-grounded knowledge of Architecture, rather than other specialist fields, to be able to steer the maintenance so that it becomes ennobling and thus improves all aspects of function. Some buildings are built "complete" and seem not to leave space for change. Other buildings, most of those we build today, have a much higher demand on upkeep. It is a mistake to consider maintenance as a simple task which can be taken care of when time permits. The builders who are good at new production are not automatically capable of good maintenance work. This is reflected in a number of building companies having separate new building teams and maintenance teams. The builder working on maintenance not only needs the capacity of finding new solutions to totally un-standard and unexpected problems, they also need to be able to handle the social demands of working with tenants living in their workplace and often having opinions about everything they do.

Contractors hired should be of a manageable size for the manager/association so that a tight control over contractors and detailed contracts are possible when needed. The company should be large enough not to be totally reliant on the client for work but small enough that the client's work is of real interest.

Maintenance work carried out by many small contracts rather than a few large events places higher demands on a continual log of work done. It is important to be able to keep a check to ensure that no part of the buildings are "forgotten". An operation and maintenance manual is a starting point and continual updating of this manual is essential.

> The maintenance manager should also be allowed to provide technical inputs to the design development and become an integral member of the building team. The production of an operation and maintenance manual for each building as an essential element of project documentation should be made mandatory. This should comprise, at minimum, "as built" drawings, operating and maintenance instructions on all the building components and elements, and information sources from which spares could be procured. [9]

As Agenda 21 is influencing our lifestyles and there is a greater consciousness of the importance of the environmental impact of projects, there is now a call for "environment logs" for all building projects. This should be an integral part of the operation and maintenance manual and also updated continually.

To make EM possible the following is needed:

- Policy
- Manager - Architect
- Contractors of manageable size
- Log of work done + continuous evaluation
- An environmental log

If EM

A building perfectly designed from a maintenance viewpoint will always be easier to maintain. However, some degree of maintenance will always be required. EM philosophy is to be recommended in order to give a better scope for including new knowledge, codes and requirements into the development of the buildings.

It is of course possible to do large-scale reconstruction work when the building totally misses the requirements, but this means that a longer time is spent with miss fits and a short time with, at best, perfect fit. With EM, there is the chance of a near fit most of the time. EM also avoids large trendy mistakes more easily as it is a process rather than a single big bang (Fig. 3). In addition, it makes good environmental sense to use existing buildings and materials as long as they do their job satisfactorily and for replacements to be made, only when needed, by environmentally chosen products.

Using EM, the buildings will gradually be rebuilt, and materials and components will be exchanged, providing the opportunity of choosing products better suited to the function and to modern environmental ambitions.

With EM, the buildings will evolve with time rather than being conserved in time.

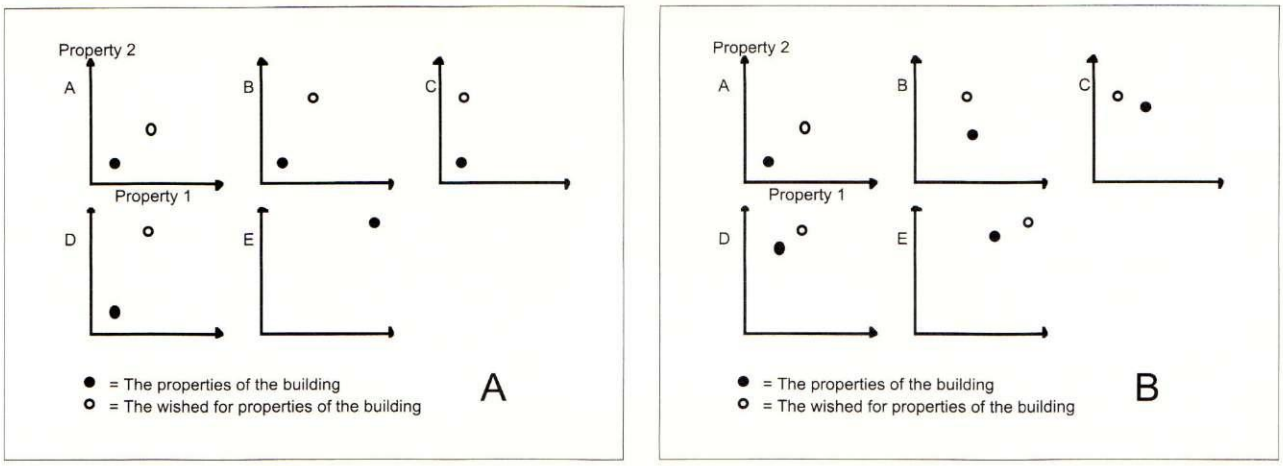

Figure 3. With traditional maintenance (A) and large refurbishments the building properties will over a long time (A:a–d) be far from the wished for properties of the building until the refurbishment (A:e). With EM (B) the building properties will change over time but will never be far from the wished for properties of the building.

Maintenance and occupants life style (Maintaining the life style of occupants?)

Is it all about maintenance and well educated maintenance engineers, architects etc. or is there even more to it. What do the occupants mean to a buildings well being?

The occupants life style effects the building directly and effects the possibility of making maintenance policies feasible. Maintenance philosophies must be developed to suit the occupants but the occupants must then in their turn live a life style suitable to the chosen philosophy.

Recently new plans have been presented for removing floor drains when renovating bathrooms in multi-storey housing. This concept is developed because insurance companies have found that large number of damages are caused by leakage from around floor drains. The concept requires that people understand that a bathroom should not be showered, that water shall only be in containers, bath, shower recess, basin etc. It relies on a change in life style from that which many have become used to these last decades [13]. It is only during the last few decades that bathrooms have become the wet area they are today. People perhaps took a weekly bath they filled some water into the tub, carefully crept into it, washed themselves and then climbed out. The daily shower with its steam, spray etc. is a relatively new ideal. Are we to keep it? [14].

At Bo Mässa 97 (Housing exhibition 1997, Staffanstorp, Sweden) one house was entirely designed around the shower and bathroom. A large section of tiled floors and walls with a round shower in the centre had the place of honour in this house.

Do we want to develop that life style? What life style do we want to build for, to renovate for? What are the important values? today, tomorrow?

Perhaps the concept of "maintenance" needs to be extended even further. While working with maintenance of a housing area which was built to last 20–25 years, 26 years ago it is more and more apparent that an integral part of maintenance is life style and expectation. To bring a housing area into a more sustainable phase of its life there is an essential demand on the consciousness of the users. A life style conscious of the reality of the buildings, of their strengths and weaknesses is necessary. It is not possible with the arguments of absolute equality to demand "fully the same conditions" in all buildings, all homes, each solution has its advantages and its disadvantages.

First we shape our buildings then they shape us, then we shape then again – ad infinitum. Function reforms form, perpetually [2].

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