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THE SCIENCE OF CONSTRUCTION MAINTENANCE

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Abstract

It is difficult to find a clear-cut definition for the notion of construction maintenance. Even among practising professionals there is no complete agreement on this matter. Experts dealing with buildings and their colleagues dealing with other types of constructions usually use different interpretations of maintenance. Maintenance and operation of constructions are incorporated in the scope of construction management. Apart from natural assets the greater part of our national wealth is constituted by constructions. Safety – as well as value – of constructions decrease unless designing is carried out with sufficient foresight. Maintenance of roads, bridges and the railway system is governed by legal regulations. Unfortunately, no similar legal framework has been set up so far in the field of buildings. That is partly due to the complexity, caused by the existence of various kinds of buildings. The costs of maintenance are the ones to be paid all through the life-cycle of a building. (Even if the building is not operating for some reason, maintenance must be carried out to preserve consistence!) Therefore planning of costs related to maintenance is essential. Activities of maintenance include the elimination of deficiencies, upkeep and renovation. Maintenance significantly alters the wearing process of constructions. The activities related to maintenance of constructions are represented in the management plan. Planning and organisation of maintenance activities require the expertise of numerous well trained qualified engineers but at present this field is neglected on the national scale. That is so, even if appropriate human resources are available, for instance at our department.

Keywords: maintenance, operation, management, upkeep of constructions, elimination of deficiencies, management plan.

The Science of Construction Maintenance

A title that rings well. It may even sound a little pretentious, since all engineers understand what it is supposed to refer to. Or maybe it is not so obvious? Anyone may judge it if first we make a few things clear. Basically, what we need to clarify is what we mean by the maintenance of constructions and whether it is a science. Finally, there is the question of why, if at all, we have to talk about maintenance of constructions.

1. Clarification of the Basic Notions

It is difficult to find a clear-cut definition for the notion of construction maintenance. In the everyday use, the word ‘maintenance’ means the survival of a thing, securing

its continued existence in the material sense. That definition is simple and easy to understand but it provides no details. That is where the problem lies, since even basic regulations interpret it differently and practising professionals do not agree on its meaning. For instance, TEÁOR (the classification of the branches of economic activities) lists repairing, upkeep and reconstruction as the constituents of maintenance of constructions [1]; according to the Statute of apartment houses, maintenance consists of operation and upkeep [2]; the Technical Regulations related to road bridges define the person responsible for the management and maintenance of bridges to be one and the same [3]; The Regulation of the Management of National Public Roads, on the other hand, lists maintenance and operation as well as other activities among the duties of the manager [4]; according to the decree issued by the Ministry of the Interior, which defines the contents and exam requirements of vocational training of facility managers, maintenance consists of operation, upkeep and renovation [5].

Even among practising professionals there is no complete agreement on this matter yet. Experts dealing with buildings and their colleagues dealing with other types of constructions usually use different interpretations of maintenance. By comparing the different opinions of professionals we may find two main tendencies: one of them treats maintenance and operation as two activities easy to separate, and discusses them independently of each other, whereas the other one defines operation as part of maintenance and as such inseparable from it. There is a third, 'intermediate' view, which is of primary use for the maintenance of buildings, and it is shared by few people only. The essence of this latter view is that although maintenance and operation may be examined separately, the significance of this fact gradually decreases as both things are directly connected and interact in a complex way. *Fig. 1* shows the position that maintenance most typically occupies, in my opinion, in the system of activities related to construction.

The main related notions include:

Construction management encompassing activities aiming at the optimal operation of the construction in its given function. (Note: it consists of maintenance, operation and direction.)

Maintenance involving activities carried out so that the technical condition of the built elements of the construction ensure the functional operation of the construction. (Note: it consists of repairs, upkeep, renovation and maybe modernisation.)

Operation comprising activities necessary for the proper use of the construction. (Note: it consists of use and operation (public utilities, the operation of basic functional, 'convenience' and other technologies, etc.))

2. The Role of Construction Maintenance

Apart from natural assets the greater part of our national wealth is constituted by constructions. That is, the constructions that exist! At the beginning of the year 2001 Hungary possessed a total of 4 million flats, 30300 km of public roads, 7900 km

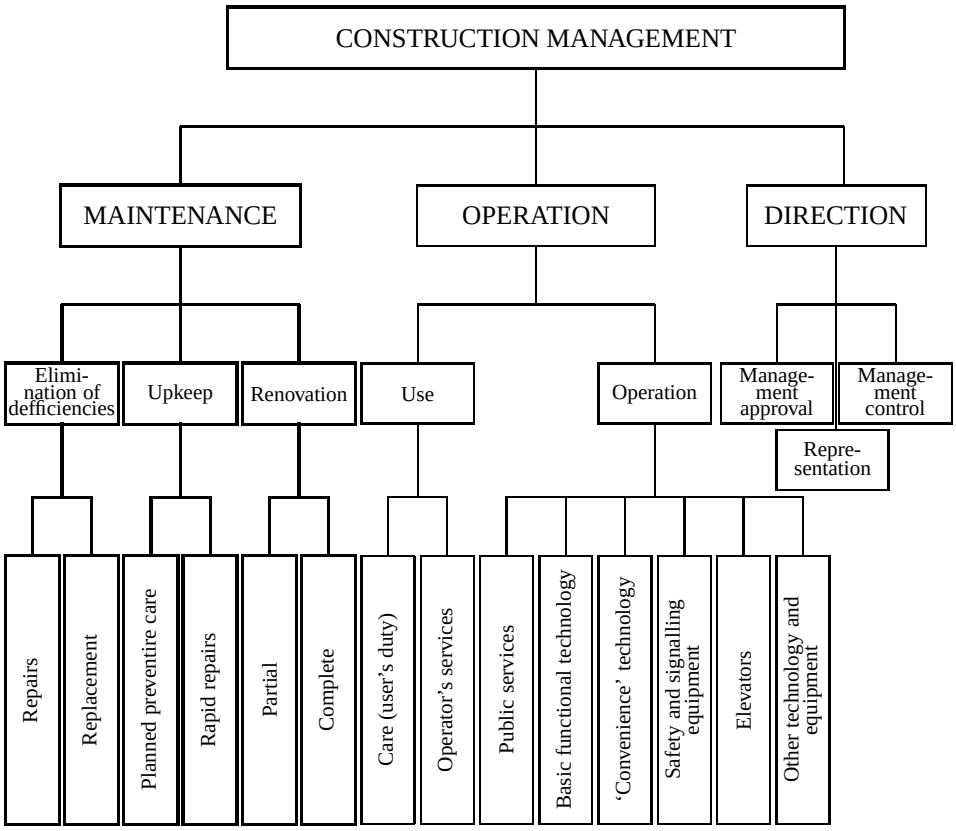

Fig. 1.

of railway and an estimated 7300 km of pipelines. Generally speaking, if we do not carry out the continuous maintenance and periodical renovation of constructions or if we do those without the sufficient amount of attention and foresight, safety – as well as the value – of constructions decreases. Another issue demanding care is the costs necessary for the operation of existing, operating and functioning constructions. Related costs consume enormous sums of money on the national scale.

Three main types of maintenance may be distinguished on the basis of their peculiarities:

A) maintenance of buildings (MB)
B) maintenance of the traffic infrastructure (MTI)
C) maintenance of the pipeline infrastructure (MPI)

The new Register of Constructions, which is already based on the statistical system of the European Union, has been applied since the 1st of January, 2001. It distinguishes 46 different kinds of construction (its predecessor distinguished 67 kinds). Type A) is most often applied for the maintenance of three of the six categories of construction, namely: Residential buildings, Non-residential buildings and Other constructions yet to be classified. Constructions belonging to the group of Traffic infrastructure usually need maintenance type B), whereas Pipelines, telecommunication and electric line networks and engineering structures associated with those most often require type C). Maintenance of constructions in the category of Complex industrial establishments is most frequently MB or MPI. Constructions in the category of Other constructions often need also MB to some extent.

Effective Management Regulations issued in the past are available to aid the managers of linear constructions in their activities of management, maintenance and operation. By the power of law, the regulation states the intervals and specifies the occasions for compulsory bridge controls, bridge inspections and bridge examinations. The statute also defines the professional qualifications of the controller, the methods to be applied, the required documentation, and the duties of operation, maintenance, etc. are also regulated in detail.

Unfortunately, this level of regulation is not yet achieved concerning the maintenance of buildings. That is partly explained by the complexity arising from the application of several kinds of structures and a multitude of building materials produced by numerous technologies, as well as from the intention of meeting many different kinds of functional requirements and demands for comfort simultaneously. Therefore I will primarily examine the activities related to the maintenance of buildings.

The following costs of technical nature are to be taken into account during the life-cycle of buildings from the first concept of construction to the demolition:

- the costs of establishment (including all the costs of designing, organisation, construction, the expert's services, taxes, fees and duties, etc.)
- the costs of management, including:
  - the costs of operation (all the costs necessary for the operation of the structures, equipment and other devices of the construction and thereby securing the functional use of the construction);
  - the costs of maintenance (all the costs needed to maintain the proper technical standard of the building and its loadbearing structure); and finally
- the costs of demolition (consisting of elements similar to the costs of establishment, but here the aim is final elimination.)

The ratio of the kinds of costs, as well as the total sum of costs largely depend on the technical content incorporated in the building. It may be said on the basis of the economic analyses of the recent years that around 80 percent of the costs spent on a building during its whole life-cycle are the costs of maintenance and operation. However, maintenance costs are the ones to be expected all through the life-cycle

of a building. (Even if the building is not operating for some reason, maintenance must be carried out for preserving its consistence!)

The elimination of deficiencies is a kind of maintenance activity that is carried out occasionally, when it is necessary. Upkeep has to be done continuously. Renovations 'traditionally' tend to be scheduled periodically, but it is irrational to think and plan in terms of that periodicity. It is the increase in the costs and the amount of work related to repairing and upkeeping that signal the timeliness of renovation.

Maintenance significantly alters the wearing process of constructions, which leads to changes in the technical value. (However, that is only true until a certain optimal level, beyond which no economical solution is possible.)

Renovations and modernisations, which are renovations adding to the value of the building, have an important role among activities of maintenance. Even if the original function of the building is left unchanged and its structure operates properly there are several reasons which may call for renovation or modernisation. Such reasons are among others:

- the elimination of unfavourable aesthetic effects;
- the increase of sanitary standards;
- the application of a more efficient system of installed machinery;
- the development of IT networks (phone, fax, PC networks and any other systems of communication or building surveillance);
- the application of more durable structures;
- the replacement of structures judged to be harmful;
- (building-physical, environmental, etc.) changes prescribed by the authorities.

That manifold task may only be carried out successfully if it is done continuously, on the basis of a plan and with sufficient foresight!

3. Planning Maintenance of Constructions

Provided that the person in charge of planning the maintenance possesses the adequate technical, financial and legal expertise, professional experience required by the particular kind of construction, and all the necessary information, which is unfortunately rarely the case in practice, then that person may prepare the management plan of the construction with sufficient foresight.

The management plan is the sum of data and plans of activities represented in a written or electronic form which aim at ensuring the continuous functional use of a construction:

- *by observing and making others observe the regulations of sanitation and life-protection,*
- *by making no distinction between private and public property,*
- *by making the maximum use of the economic conditions,*

- *by meeting the requirements of the owners and the users (tenants) in an optimal way.*

The maintenance and operation plans are the most important parts of the management plan. As these two have a complex interaction it is advisable to devise a combined plan of maintenance and operation in the case of buildings. The following pieces of information are essential for the preparation of such plans:

- the ownership of the construction,
- the natural characteristics of the construction (m, m^2, m^3, pcs, etc.),
- the time covered by the plan (short-, medium- or long-term plan, duration in years),
- financial resources available and the scheduling of their accessibility,
- the owner's or the user's intentions for the period concerned,
- the technical state of the construction(s),
- the consumption and financial data of the period(s) directly preceding the preparation of plans,
- possibly, data of human resources (number of employees, requirements),
- the demand for the operation of stand-by equipment and safety services,
- the nature of outsourcing requirements and the ways of meeting them, etc.

Needless to say, unforeseen events arising in the period concerned and requiring instant measures are to be expected and provided for in the plan in the form of both personnel and financial reserves. The necessary amount of those may be estimated quite precisely after a few years' practice. The estimation is aided by up-to-date knowledge of the technical state of the construction, which may be achieved in some cases (especially certain bridge constructions, buildings frequented by many people) by daily inspection of the premises on the basis of a specifically compiled checklist. At any rate it is advisable to prepare a daily, weekly or monthly plan of action carefully considered in advance. When the plan(s) has (have) been prepared all that is left to do is to act always according to the instructions.

To achieve a high standard of his trade the expert of maintenance must have great skills, or in other words apply the science of construction maintenance, to co-ordinate the activities mentioned above. That may be the most difficult part of this profession and its success hinges entirely on that issue.

4. On the Training of Specialist Engineers

The training of engineers capable of creating (designing) constructions may be regarded as a task solved. At the same time we are in need of another kind of training to transmit the special combination of engineering and economic knowledge related to the competent professional maintenance of constructions. We are fully aware of the fact that all young people preparing to work in the building industry have the original desire of creating something on their own and therefore they primarily wish

to take part in the designing, or less frequently, in the building of constructions and thus have practically no prior knowledge of maintenance. That is especially true of the operation of buildings: the study of the questions of operation is neglected even where issues of maintenance are discussed. The social esteem of professionals of maintenance is low – even if there has been a recent change for the better. The protection of the enormous wealth deposited in real estate requires the expertise and competence of numerous well trained qualified engineers specialising in the maintenance of constructions.

The scientific body of learning and the adequately qualified and experienced staff of expert-trainers are available for such a training.

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