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Quality of Buildings — Quality of Engineers

Qualité des constructions — qualité des ingénieurs

Qualität von Bauwerken — Qualität von Ingenieuren

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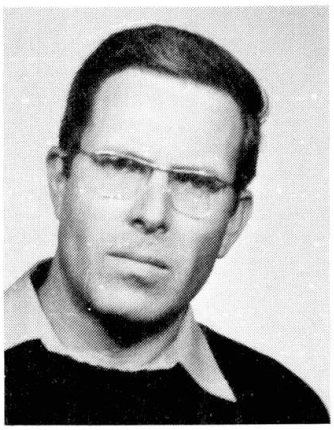

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SUMMARY

Assuming causality to exist between abilities and qualification level of structural engineers and the quality of buildings, some relevant problems of higher education are considered. Education has its responsibility to develop human and professional abilities, and to impart material knowledge directly affecting the quality of engineering work; still conception and methods expect to be improved.

RESUME

En supposant qu'il existe un lien de causalité entre les aptitudes, le niveau de qualification des ingénieurs de structures et la qualité des constructions, quelques problèmes de formation des ingénieurs sont traités. L'éducation des ingénieurs de structures a pour objectif de développer les aptitudes humaines et professionnelles et de donner les éléments de la connaissance qui influencent directement la qualité de l'activité d'ingénieur. Néanmoins la conception et les méthodes doivent être encore perfectionnées.

ZUSAMMENFASSUNG

Davon ausgehend, dass eine Kausalität besteht zwischen dem Qualifikationsniveau des Bauingenieurs und der Qualität der Bauwerke, werden einige relevante Probleme der Ingenieurausbildung geprüft. Die Ausbildung von Bauingenieuren hat die Förderung von humanen und fachlichen Fähigkeiten zum Ziele und bezweckt die Vermittlung von Fachkenntnissen, die die Qualität der Ingenieurarbeit unmittelbar beeinflussen; Konzepte und Methoden müssen jedoch weiterentwickelt werden.

1. INTRODUCTION

Authors of the Introductory Notes are nearly unanimous in enhancing the relation between the human factor and the building quality. Let me quote:

-"due to the ... barely progressing or even decreasing qualification of personnel involved, errors give rise to increasing trouble among builders and clients alike."(p. 1, Mrs Kersken-Bradley)
-"Most failures can be shown to occur because of gross human errors..."(p. 13, Mr Melchers)
-"...a tendency for a diminishing qualification is apparent." (p. 38, Mr Hillemeier)
-"In most cases collapses and other failures of load bearing structures seem to be caused by some kind of gross error." (p. 6o, Mr Essunger)([1]).

These statements are duly supported by statistics, and are coincident with observations in Hungary.

Taking as granted that among the mentioned human mistakes those due to engineers prevail, let us have a deeper insight into the relation between errors leading to building deficiencies, and human-professional qualities of structural engineers, in order to find possibilities and responsibilities of higher education in improving the human factor. Our comments -certainly intuitive- rely on over a decade of exprience in lecturing on reinforced concrete structures, and on being well acquainted with views on the side of industry.

Beyond questions of quality assurance in the building industry, professionals are deeply interested internationally in problems of moral appreciation, performance, responsibility and qualification of structural engineers ([2],[3]).

2. HUMAN FACTOR AND HIGHER EDUCATION

As concerns the relation of quality assurance to the human factor, the statement seems to lie at hand that positive properties enabling one to high-niveau, low-error performance are partly inherent moral and mental features, partly professional abilities and knowledge. The former include:

-intelligence,
-responsibility,
-self-control,
-consistency,
-aesthetic exactingness etc.

These characteristics essential both for individual performance (designer) and for teamwork (constructor) may override material knowledge in importance. They have mostly developed before university studies and subsquently cannot be generated but furthered, developed, by methods belonging to the area of general education.

Among professional abilities

-creativity,
-general realistic attitude (sense to mathematics and mechanics)
-visuality,
-organizational sense

may be stressed, the development of which is largely expected from

university education. At last, there are material knowledge, rules, experience concerning buiding quality, to be acquired partly as subject matters, but mainly through practice.

In final account, higher education is expected to be a priming for the human factor in building quality. As a matter of fact, fulfilment of this task has to overcome ever more obstacles. Let's consider some of them.

3. PROBLEMS OF FURTHERING ABILITIES

The first obstacle is to select those fit to the structural engineering from among a decreasing number of applicants. Secondary-school curricula do not tend to, teenagers' minds are not grasped by, the science of structural engineering, resulting in a blurred scanty image of the profession before the public. "In general the outlook of engineers has been too narrow" ([2]).

As concerns fundamental mental abilities, working ability and mental fitness of the present age-group are inadequate, a strong drawback in this profession. Though temporarily out of mind, it is rather a commonplace that in any profession, a high standard can only be achieved with endurance and diligence.

Opinions about role and importance of mathematics and structural are fairly divergent. Higher education is often reproached for focusing on analysis rather than to enhance constructivity. From the aspect of quality assurance alone, theoretical knowledge and numerical calculation ability needed for structural analysis are in fact insufficient but indispensable. Danger lies only in the unquestioning faith in numbers; not in mathematics itself but in starting assumptions. Apart from certain inspired architects, a good sense of constructivity develops from experience gathered in course of great many analyses. An engineer inexperienced in computation is unable to quick assessments, in delicate situations this is a hindrance to correct decisions, maybe a source of errors.

The use of a computer requires clear problem setting, survey of the process, safe handling of input and output data. An important percentage of time saving from mechanical computation work is spent on the minutious interpretation of outcomes, including e.g. correct use of sign rules. All these are creative activities, demand efforts, and observations show that students in engineering unwillingly assume them.

Visuality, ability of spatial seeing, precondition of constructivity is unfortunately in shortage among future engineers. This is closely related to deficiencies of imaging and general drawing abilities, which may partly raise coarse design errors, exemplified by concrete cases, and partly, induce general depreciacion of engineering achievements, projected on the final product if not as "gross error" then as "negligence", or simply as lack of good taste.

4. PROBLEMS OF TEACHING QUALITY

How professional knowledge in "quality assurance" can be instructed? Beyond possibilities of developing abilities, and of professional training, higher education has facilities to impart positive knowledge. However, two considerations prevail:

-In this field, empirical knowledge is much more efficient than is encyclopaedical knowledge. Site visits, inspections may be rather impressioning while a dead text of even the most spectacular case study leaves little imprint in students.

-Most essential knowledge matter on quality assurance is at a low level within the curriculum hierarchy. For instance,the almost internationally codified subject matter of reinforced concrete structures relies on the principles of safety to local failure, tradition, and fitness to be imparted. Problems of serviceability are relegated to the background by being unclear and difficult; so are global stability problems and those of interaction with the soil by being too complex. On the other hand, seemingly obvious problems are therefore held to be of secondary importance, e.g. lifting problems in prefabrication. Beyond meeting safety and serviceability requirements, whether a structure is covered or exposed is no criterion though it should be.

5. CONCLUSIONS

Assuming causality to exist between qualification niveau of structural engineers and the quality of buildings, some relevant problems have been considered. In spite of difficulties, partly reducible to causes outside the profession, higher education of structural engineers has its possibilities and responsibility to develop human and professional disposition, and impart material knowledge directly affecting the quality of engineering work, still conception and methods expect to be improved.

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