Zeitschrift: IABSE reports of the working commissions = Rapports des commissions de travail AIPC = IVBH Berichte der Arbeitskommissionen

Band: 31 (1978)

Artikel: The influence of the computer on the professional ethics

Autor: Uherkovich, I.

DOI: https://doi.org/10.5169/seals-24924

IABSE
A I P C
I V B H

COLLOQUIUM on:
"INTERFACE BETWEEN COMPUTING AND DESIGN IN STRUCTURAL ENGINEERING"
August 30, 31 - September 1, 1978 - ISMES - BERGAMO (ITALY)

The Influence of the Computer on the Professional Ethics

L'influence de l'ordinateur sur l'ethique de la profession

Einfluss des Computers auf das Berufsbild

I. UHERKOVICH

Head of the Design Office
Losinger Ltd - VSL International
Berne, Switzerland

Summary

The use of calculation programmes developed by third parties entails a serious encroachment on the ethics of the engineering profession. Complex calculations cannot be verified by the ordinary practising engineer. The lack of effective possibilities of checking leads automatically to the question of the legal responsibility for the results and the ethical justification of the use of such calculation. The consequences of this transformation cannot be ignored by the engineer profession.

Résumé

L'utilisation de programmes d' ordinateur développés par des tiers engendre de sérieux empiètements sur l'éthique de la profession d'ingénieur en raison de l'impossibilité pour l'ingénieur praticien de vérifier par lui-même l' exactitude des résultats de calculs complexes. Cette situation met indubitablement en question la responsabilité juridique des résultats ainsi que la justification éthique de l'utilisation de tels calculs. L'ingénieur ne peut se permettre d'ignorer les conséquences de cette évolution.

Zusammenfassung

Die Anwendung von auswärts hergestellten Berechnungsprogrammen bedeutet einen schweren Eingriff in die Ethik des Ingenieurberufes. Komplexe Berechnungen sind für einen normalen Ingenieur nicht übersehbar. Mangels richtiger Kontrollmöglickeiten stellt sich automatisch die Frage nach der rechtlichen Verantwortung für das Resultat der programmierten Berechnung und der ethischen Verantwortbarkeit der Anwendung solcher Berechnungsmethoden. Die eingeleitete Wandlung des Berufsbildes bringt Konsequenzen mit sich, welche unbedingt zu berücksichtigen sind.

1. INTRODUCTION

To call the invention of the computer a revolution has become a cliché. In most cases it is used in connection with the machine, whereas the revolution is actually somewhere else.

Up to now every university graduate is proud of the fact, that he comprehends the complexities of his work and not barely the working methods themselves. The method is of course already clear to him based "on his higher level of education". Thus a proudly defended line exists today between engineers graduated from universities and those from engineer colleges.

Very often one hears the statement that a university-engineer does not have to know the formulae by heart nor to look them up in a book as he can develop them himself.

I have no intention to talk about the differences between good and bad engineers. What interests me in this connection is the professional image and the professional work in general. I therefore ask myself the question: is the above criterion still valid today after the introduction of computer-programmed calculations? Did not the computer degrade the engineer to a technician? I would try to analyze this question in a sort of question-and-answer-game.

2. WHAT IS THE INFLUENCE OF USING PROGRAMMED CALCULATIONS ON THE ACTIVITIES OF A CONSULTING OFFICE ?

Outsiders will of course immediately state that the productivity increases. To this I would like to make the following comments from my own experience: Recently our office designed a bridge which was similar in size and concept to one which I had designed some 17 years ago together with some colleagues. Adding the time spent (engineers and draftsmen) for the later bridge I came to approximately 10'000 working hours. A comparison made with the earlier bridge revealed that only some 6'000 hours were spent on that project. Despite the fact that at that time we only had an electronic calculator and that for the later project we used the computer facility practically to its fullest extent (35 kg of print-out will prove this) we required today almost twice as much time to achieve the same. Increased productivity? Hardly!

From my experience the effect of the computer is not in the quantitative area even if it is true that the computer delivers many more figures than has it been analyzed earlier.

In the earlier days the personnel structure of a consulting office was quite manifold. The engineer in charge knew exactly who could perform how much. Even though everybody could present similar graduation certificates, not everybody was given the same type of work.

Today it is much more difficult to know the real limits of theoretical capacity of an engineer. All or almost all will analyze structural problems in the same way: with the help of a computer programme independent of the fact

whether without computer they would be able to solve the problem or not. To say it a bit exalted: with a computer programme we have created a means which will allow also the incompetent to give the impression of being competent.

HOW CAN ONE TRUST THE RESULTS OF COMPUTER CALCULATIONS ?

The machine can not be wrong is an argument which very often leads to an almost superstitious reverence of the print-outs from a computer. Despite that we almost daily come across errors "made by the computer"; starting with wrong results from sports events to the erroneous reminders of invoices which have been paid long ago. And in engineering it is no different.

It is clear that the machine rarely makes errors and once it happens it will be clearly visible. The sources of errors are however numerous. They can range from wrong interpretation of the instructions, erroneous selection of the rheological model, syntax errors etc. to the wrong interpretations of the results. Many of these possibilities of errors also exist with traditional calculations. They are however detected much easier.

To check an output of several hundred pages would actually destroy the advantages that result from computer calculations. Certainly there is also the possibility of making intelligent checks but where there are doubts about the intelligence of the checker, there will be little reliability in the figures of an output. In addition there are two more important considerations:

- Most checking methods require the command of traditional calculation methods and are therefore the result of the so-called old school.

  The young generation has however a completely different approach to the problems. They master the computer much better; however, rarely do they have the experience of the traditional design methods which would give them the possibility to do a quick check.

- The automatic interlinked calculations with a highly complicated model and high accuracy requirements which I have tried to show in my paper "Possibilities and problems in connection with construction stage analysis..." will give very few if any possibilities to check the results with the required accuracy. Even the most experienced engineer will here only be in a position to detect major errors.

WHO IS RESPONSIBLE FOR THE CORRECT FUNCTIONING OF THE PROGRAMMES ?

This is a question for a lawyer rather than for an engineer.

You all know the famous sentence below the heading of almost any computer programme manual: "this programme has been tested to the best of our knowledge, any responsibility in connection with the use of this programme must however be declined".

In other words you are buying a cook-book but you will have to convince yourself about the edibility of the meals cooked according to the listed recipes.

With these culinary specialities it will be rather simple, although not without cost, if you only have to cook the meal once to verify the result.

The body of a programme, however, contains such a number of ramifications that to examine them all by the user is out of the question. Certainly when we make calculations by hand, we have already trusted the theories we learnt from a teacher at school or found somewhere in a technical newspaper. The author of a paper does not bear the legal consequences of the application of his theory either, here only the possibility of a large control is given to the professional readers. A wrong statement in a professional article rarely remains unobjected.

Programmes on the other hand are "top secrets" - hardly anybody published his list. There are not only technical but mainly economical obstacles to this. The possibility of recuperation of the generally important costs would practically be nil from the moment of publication. Unfortunately there is no institute in the world to my knowledge which would check the correct functioning of foreign programmes and which would confirm the result of such a check by its seal. Therefore nothing else remains than to use programmes for which nobody takes any responsibility (apart from proper developments which, however, might be exceptions rather than the rule).

IS A SPECIALIZATION BETWEEN THE DESIGNER AND THE EXCLUSIVELY ANALYTICALLY WORKING MATHEMATICIAN THE WORKING PROCEDURE OF THE FUTURE ?

In the early use of computers for engineering calculations nobody thought about the question of responsibility. The computing plant was inaccessible for most of the offices for cost and handling reasons. This situation led to a solution which still is considered the best by many people: a division of the duties between design offices and computing centres offering a full computing service.

The development has partly reversed this solution - firstly because the "hardware" has become so cheap that a powerful machine today is even within the reach of investments of a smaller office, and secondly, because the division between the two different offices is quite disadvantageous, especially when flexibility is concerned. Nevertheless, the danger of specialization is not overcome, it has only been displaced from outside, i.e. from the institutions, to inside, into the office. This is due to the fact that in offices that own a computing plant, the computer is not accessible to all engineers. In such offices there are engineers who know how and what to calculate - but they have no influence on the utilization of the results, and on the other hand, there are others who are designing, but from whom the original duty of an engineer - mastering of the forces flowing in a structure and forming the structure adequately for this force flow - slowly escapes.

What has already happened half a century ago with buildings, the division of the profession into architects and engineers is presently going on in other fields of civil engineering.

Although we may deplore such a development with nostalgic regret, we can hardly stop it.

CONCLUSION

As a summary of the analysis in this contribution we can say the following on the development of the engineering profession after the introduction of programmed computation:

- The larger volume of calculations caused by outer circumstances (better knowledge of the material properties, perfectionistic codes, complicated construction methods a.s.o.) renders the use of computers compulsory.

- The existing possibility for analysing a structure without mastering the theoretical bases of such an analysis, coupled with the difficulty to control computerized calculation, leads to well founded doubts about the acceptability of such a situation.

- The division of programme manufacturing and the calculation itself generates serious questions about the legal responsibility for the effects of faulty programmes.

- The specific claims of the direct users of computers lead to a further specialisation of the engineering profession.

It is the duty of schools, engineering societies and organisations to consider these facts in order to remove the negative effects of the computer revolution and in order not to let the engineering profession drop to a narrow-minded level.

New steps are therefore required:

- at school
- in the transmission of new findings
- in the proofing of programme qualities
- in the check of the calculations.

Leere Seite
Blank page
Page vide