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

Band: 34 (1981)

Artikel: Bridging the gaps: an intermezzo

Autor: Blaauwendraad, Johan

DOI: https://doi.org/10.5169/seals-26926

Bridging the Gaps: an Intermezzo[1])

Une nouvelle approche dans la recherche

Ueberbrückung von Gräben: ein Intermezzo

JOHAN BLAAUWENDRAAD
Professor of Civil Engineering
Delft University of Technology, Delft
Rijkswaterstaat - Bouwresearch, Utrecht, The Netherlands

SUMMARY
There often exist serious communication gaps between researchers and designers and even between researchers themselves.
The Dutch experience in this field confirms this statement, and it is supported by the general discussion during the colloquium.
To bridge these gaps, a new approach in research is needed, which is explained here.

RÉSUMÉ
Il y a souvent des abîmes de communication entre les chercheurs et les auteurs de projets et même entre les chercheurs eux-mêmes.
L'expérience néerlandaise dans ce domaine confirme cette affirmation qui est confirmée par la discussion générale de ce séminaire.
Pour jeter un pont entre les chercheurs et les auteurs de projets, une nouvelle façon d'aborder la recherche est nécessaire, qui fait l'objet de cet article.

ZUSAMMENFASSUNG
Es bestehen oft breite Kommunikationsgräben zwischen Forschern und entwerfenden Ingenieuren, ja sogar selbst zwischen Forschern.
Diese Behauptung wird bestätigt durch die einschlägige niederländische Erfahrung, als auch durch die allgemeinen Diskussionen an diesem Kolloquium.
Um diese Gräben zu überbrücken, ist ein neuer Ansatzpunkt für die Forschung nötig, welcher hier kurz erörtert wird.

[1]) Lecture presented to fill the gap caused by the cancellation of the lecture by Prof. Valente, Italy, who was prevented to come.

1. ON PLATEAUS, GAPS AND LONELY PEOPLE

The general discussions during this colloquium concentrated among others on the relation between scientific people in the research field and designers in the engineering society. Many interesting remarks were heart, which made us remember in what way we discussed similar points in The Netherlands. A series of pictures will be shown to illuminate this, providing plenty of opportunity to draw the attention to corresponding comments raised by attendents of this colloquium.
It is a manyfoldly heart complaint that only a poor interaction exists between the research society and design practice. Both parties are living on their own plateau and have their own language (Fig. 1); the researcher will formulate his work and results in mathematical terms, but the designer needs information on structures to be erected.

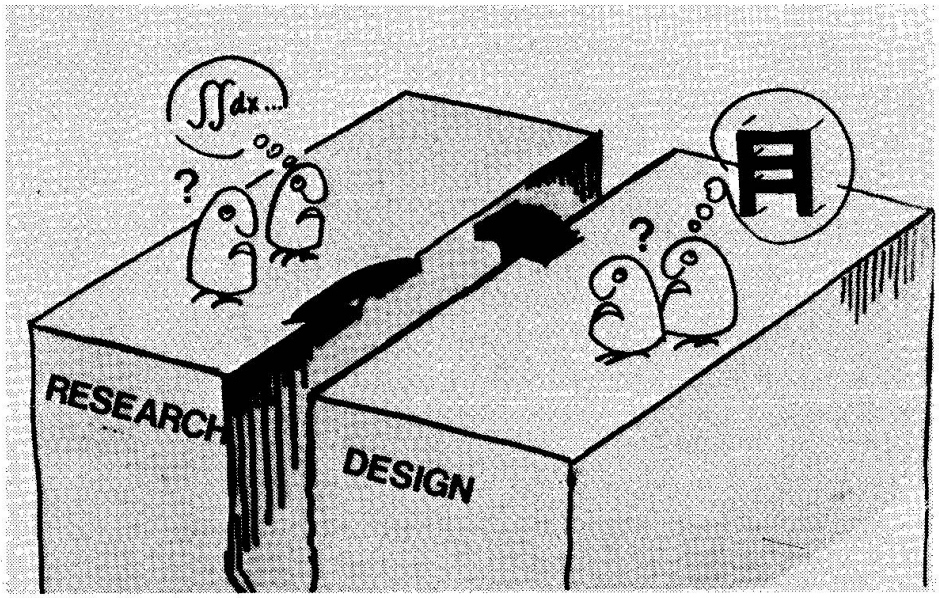

Fig. 1. A deep gap exists between research and design practice. Well-intentioned trials to bridge the gap often fail.

A deep gap proves to exist between the two plateaus. To do justice it must be said that individuals are found on both plateaus that seriously try to bridge this gap. However, each is doing so starting from his own point of view and the erected bridge parts do not meet each other properly .
This is also displayed in Fig. 1.
It may even be worse. In many cases research people hardly understand each other! Within the research society gaps can exist also. A particular research discipline may develop a so specialistic jargon, that colleagues in an adjacent discipline cannot communicate with them at all. It was felt in The Netherlands that such a situation can initiate between the research in reinforced concrete structures and the research in applied and structural mechanics. Fig. 2 shows the separate plateaus for the concrete people and the mechanics people.
This figure now displays the three different plateaus which have been mentioned earlier in the symposium by prof. Scordelis and prof. Van der Vlugt.

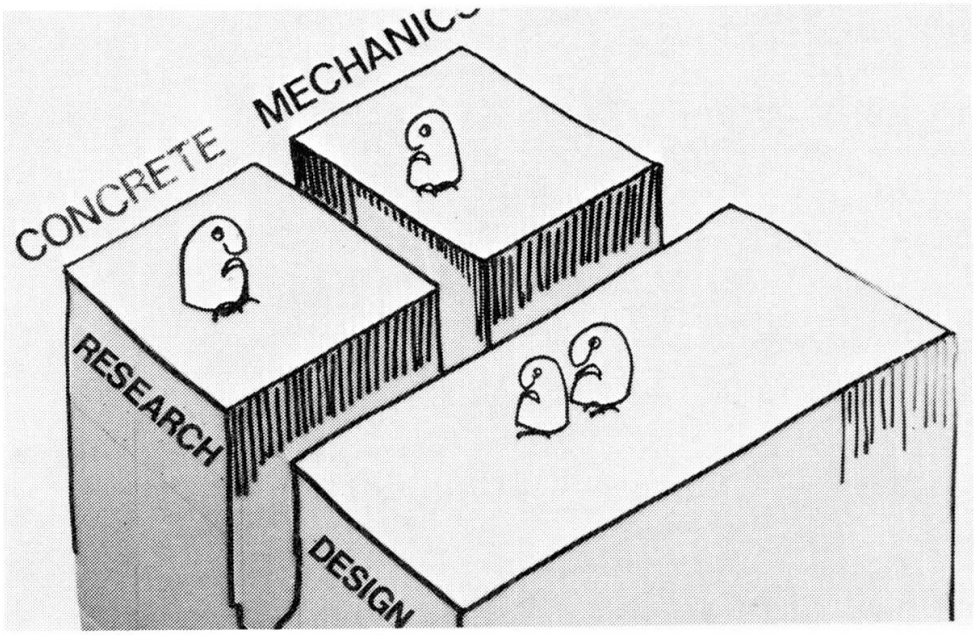

Fig. 2. In some research disciplines such a jargon may develop, that colleagues in an adjacent discipline hardly can communicate any more. Another gap.

Let us consider which experience has been gained in the two research disciplines mentioned above. The concrete research (see Fig. 3) has mainly concentrated on small scale model tests in the laboratory and has indeed done a good job in the past. We might entitle the way in which the concrete doctor examines his patient 'surface view'. Deflections, crack patterns and average strains can be recorded, but one still needs quite a bit of nerve to derive from such data what exactly is happening internally in the structure.

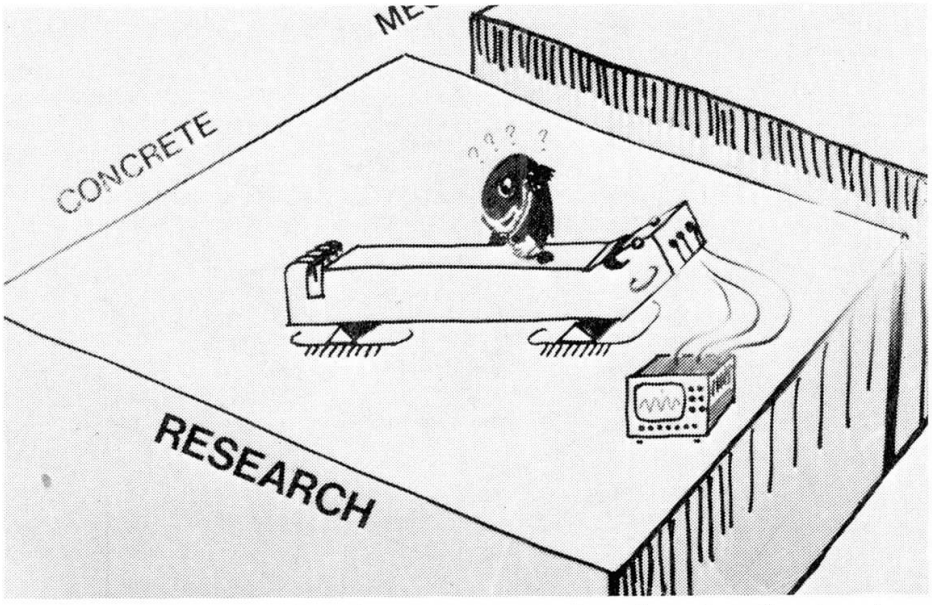

Fig. 3. In conventional concrete research a total structure is investigated. The concrete specialist is very capable for 'surface view'.

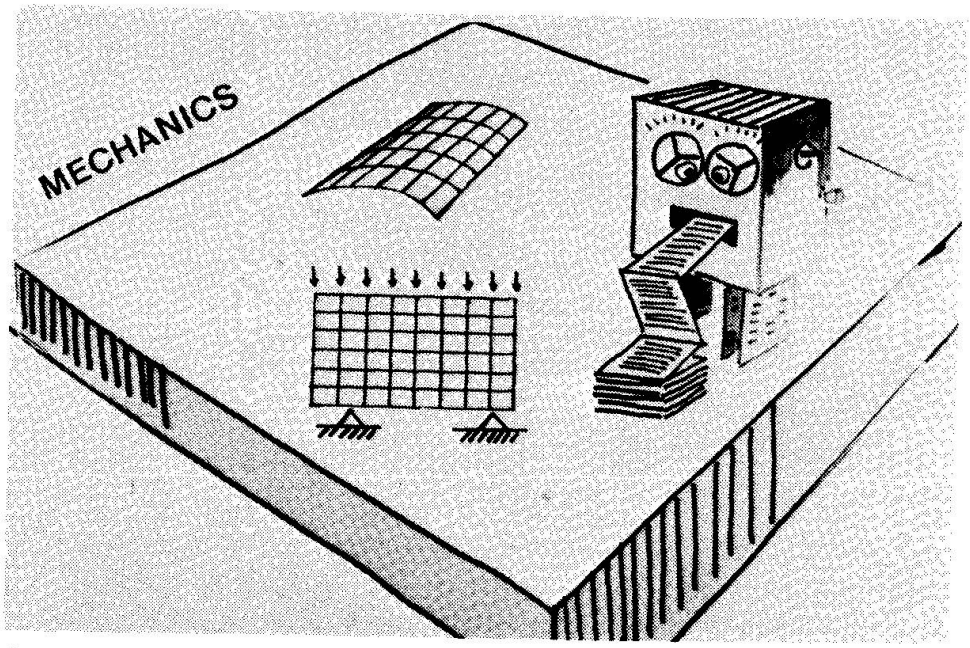

Fig. 4. Nowadays the mechanics doctor uses a dissecting-knife for his observations. The patient is firstly splitted in small separate basic components, the elements, which then are processed.

Let us now visit the mechanics plateau (Fig. 4). The old-day methods of differential equations have been replaced by analytical procedures of which the finite element method is the most familiar one. The mechanics doctor now handles a dissecting-knife in his observations and splits his patient in small separate parts, the elements. He is more like a specialist for internal diseases, and therefore clearly differs in his method from the surface view of his colleague in the concrete society.

The initiators of the Dutch joint project 'betonmechanica' (Concrete Mechanics) are aiming for bridging the gap between the two research plateaus (Fig. 5). The intention is to combine the advantages of both plateaus and to eliminate the disadvantages. How to achieve that?

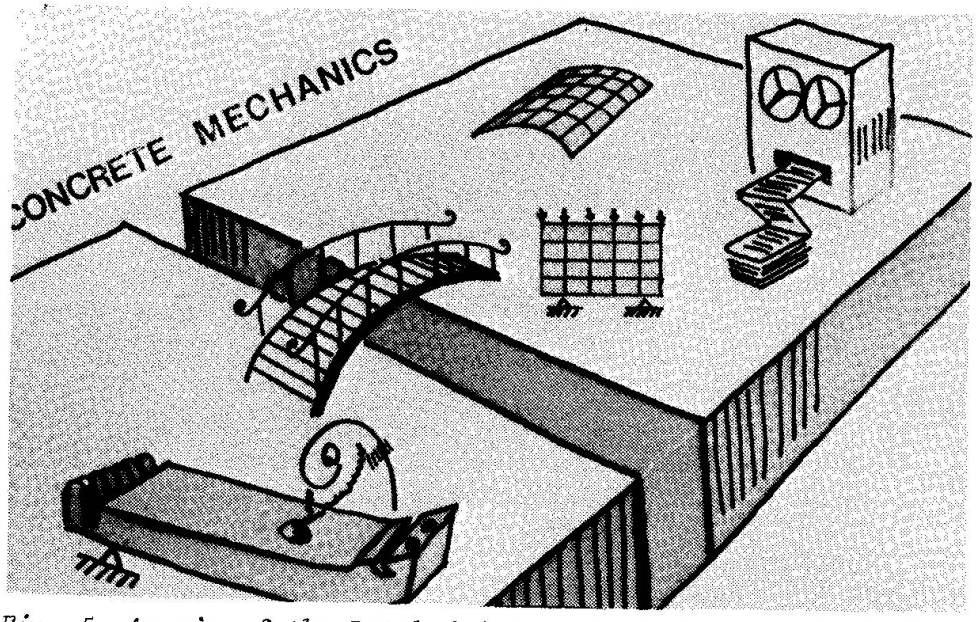

Fig. 5. An aim of the Dutch joint project 'betonmechanica' is to bridge the gap between the two research plateaus for concrete and mechanics.

2. A NEW APPROACH IN RESEARCH IS NEEDED

To answer the question at the end of the previous chapter we more seriously examine the two procedures again. The study of the real world of structures in a (small scale) laboratory model typically refers to a total structure, or a total structural member (beam, column). In this approach we have a prompt registration of the total behaviour, see Fig. 6. The advantages are clear. The ultimate aim is reached directly and design recommandations may be induced immediately. However, also disadvantages exist. Problems arise of unique interpretation, having normally only few signals but a lot of parameters to be solved. Above that, we lack detailed information and therefore do not get basic understanding.

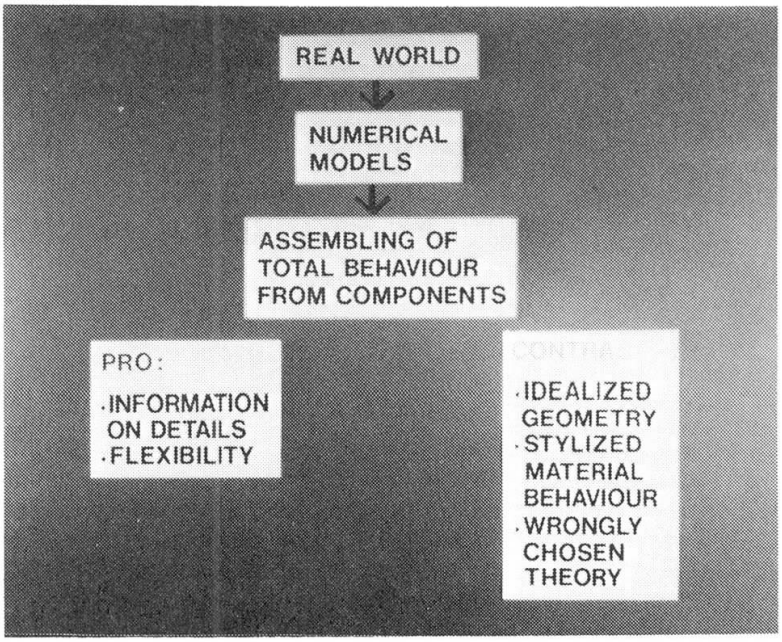

Fig. 6. Typical aspects of conventional model scale tests in a laboratory.

When we study the real world of structures by numerical models, we use the behaviour of many small separate components and assemble the behaviour of a total structure or structural member from these components (Fig. 7). The advantage of this approach is that we get information on details. In a flexible way also structures of other shapes can be examined. But some severe drawbacks exist as well. You have to idealize the geometry and to stylize the material behaviour. In cases where you have to choose some theory, you may choose the wrong one.

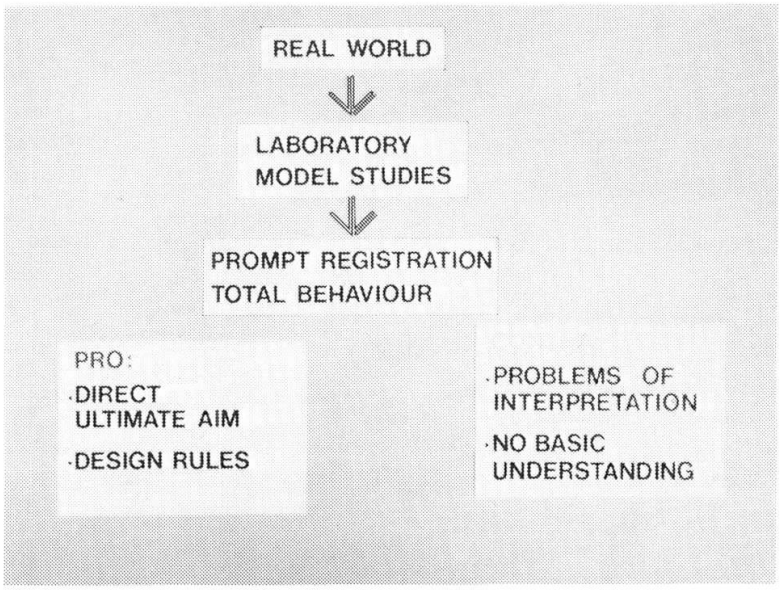

Fig. 7. Typical aspects of the nowadays use of numerical models.

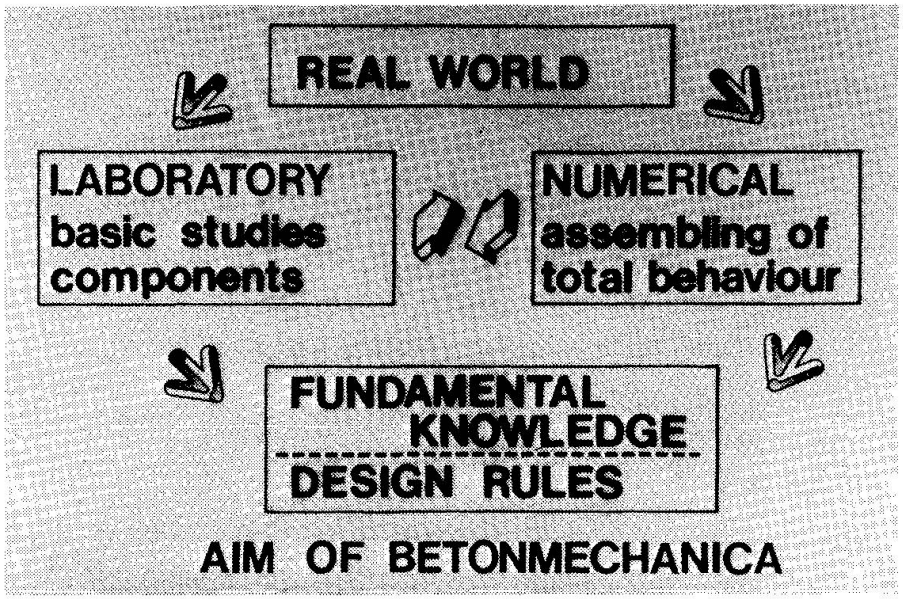

Fig. 8. Goal of 'betonmechanica': interaction and co-operation of the modern concrete research and the new possibilities of the numerical methods in structural mechanics.

When you compare the two approaches of laboratory models and numerical models it can be concluded that they are complementary to each other. The aim of the Dutch project 'betonmechanica' is to combine the advantages and to eliminate the drawbacks. So, the specialists in concrete matters and the specialists in mechanics shake hands (Fig. 8). You can do so by concentrating on basic studies for small component behaviour in the laboratory and by exploring the analytical techniques to assemble the total behaviour. Along these lines one can hope to increase fundamental knowledge. Later on, the new knowledge may form a firm basis to derive design rules for practizing engineers.
It is important to realize that the concrete specialists not just do another type of research, but that they must present their results in a different way as well. Prof. Kerstle already focussed attention on this point. The concrete researcher must be aware of the way in which his results are used by the structural analyst. This will influence the set up of his experiments and will mean a way of presentation of results which was not familiar to him in the past.

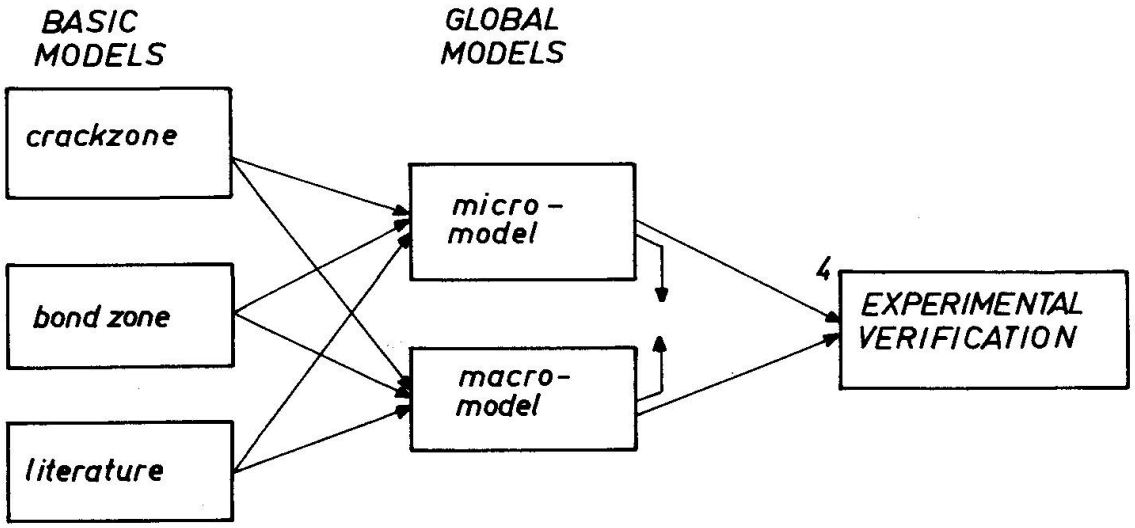

Fig. 9. The results of material basic model studies (1st colloquium day) are fed in the analytical global models (2nd colloquium day). The global models must be varified using experimental investigations (3rd colloquium day).

The studies on *basic models* concentrate on the behaviour of the crack zone and the bond zone, see the left part of Fig. 9. This was more or less the topic of the first day of the colloquium. Other basic studies are found in the literature as well, for instance on the anchoring zone. The numerical models, in which we assemble the total behaviour of a structure from its basic models, can be called *global models*. In this colloquium we noticed that a lot of people distinguish between Micromodels and Macromodels, see mid part of Fig. 9. This we also did in The Netherlands. In a Micromodel we really take in account all possible basic models. In this colloquium such Micromodels provide for single sharp crack analysis or discrete crack analysis. In a Macromodel, on the contrary, a smeared out approach for cracks is used. This area of interest was covered more or less in the second day of the present-day colloquium.
Finally we want to confront our global models with the results of *experimental investigations*, see the right hand part of Fig. 9. In the colloquium this was the subject-matter of the third day.

3. ON ORGANIZATION, FINANCES AND EXPECTATIONS

In many countries some type of coordination on the advanced mechanics of reinforced concrete structures has been achieved. A working commission of the American Society of Civil Engineers is well-known in this respect.
From the working papers of this colloquium and the explanation of prof. Okamura we can know that Japanese firms and universities joint together as well in Napra, a non-linear program research association. In The Netherlands a number of institutes , universities and organizations joint together in the project 'betonmechanica'. Other countries have similar modes of co-operation.
Such efforts clearly cost a lot of money.
In The Netherlands more than 8 million guilders (about 4 million dollars) will be spent in 8 years. Fig. 10 shows how the several partners contribute in these funds.

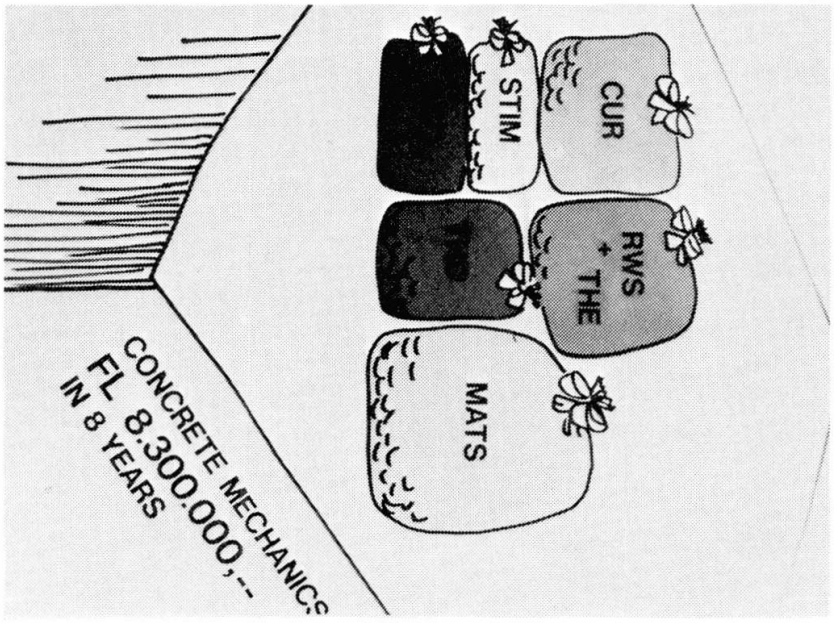

Fig. 10. To finance the joint project each contribution is welcomed.

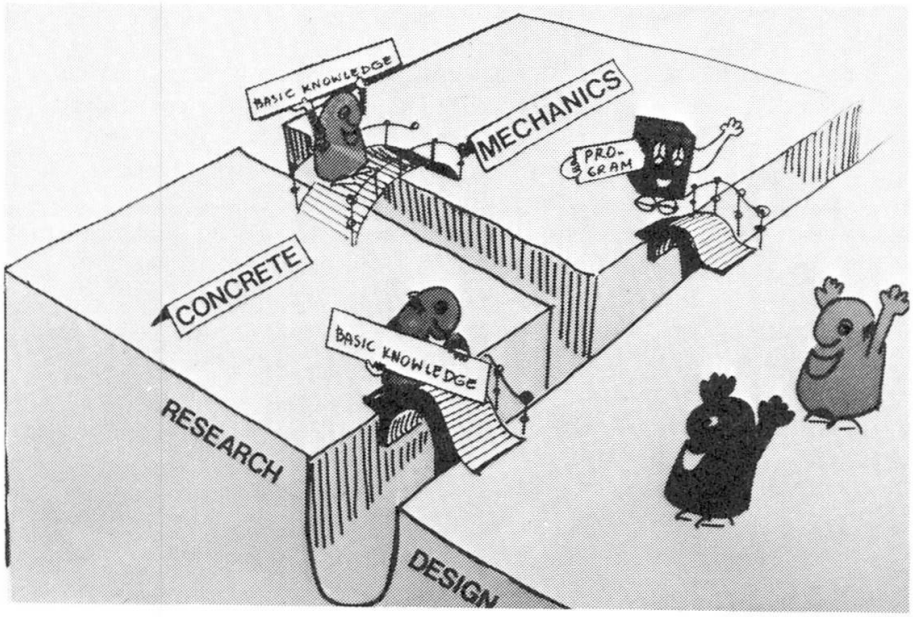

Fig. 11. The design practice looks forward to a positive final result. The newly gained knowledge will not fail of its effect on futural codes and can become available in the same time in computer programs for designing engineers.

Coming back to the plateaus and gaps at the beginning of this intermezzo, we give expression to good hopes on better communication in future between researchers, and on an improved interaction between research and design (Fig. 11). If the job is well done, the concrete research will result in much basic knowledge which immediately can be fed in numerical models. Such basic knowledge can also be made available to the design society in course of time, when it influences codes and specifications. The written programs can be placed at the disposal of designers likewise. We nourish great hopes that the sombreness of the persons at the several plateaus will change in joy in the future. And that intensive crossing of the newly built bridges may be seen.