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Expert Group Meeting on the Development of
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DEVELOPMENT OF ENGINEERING DESIGN IN BRAZIL 1/

by

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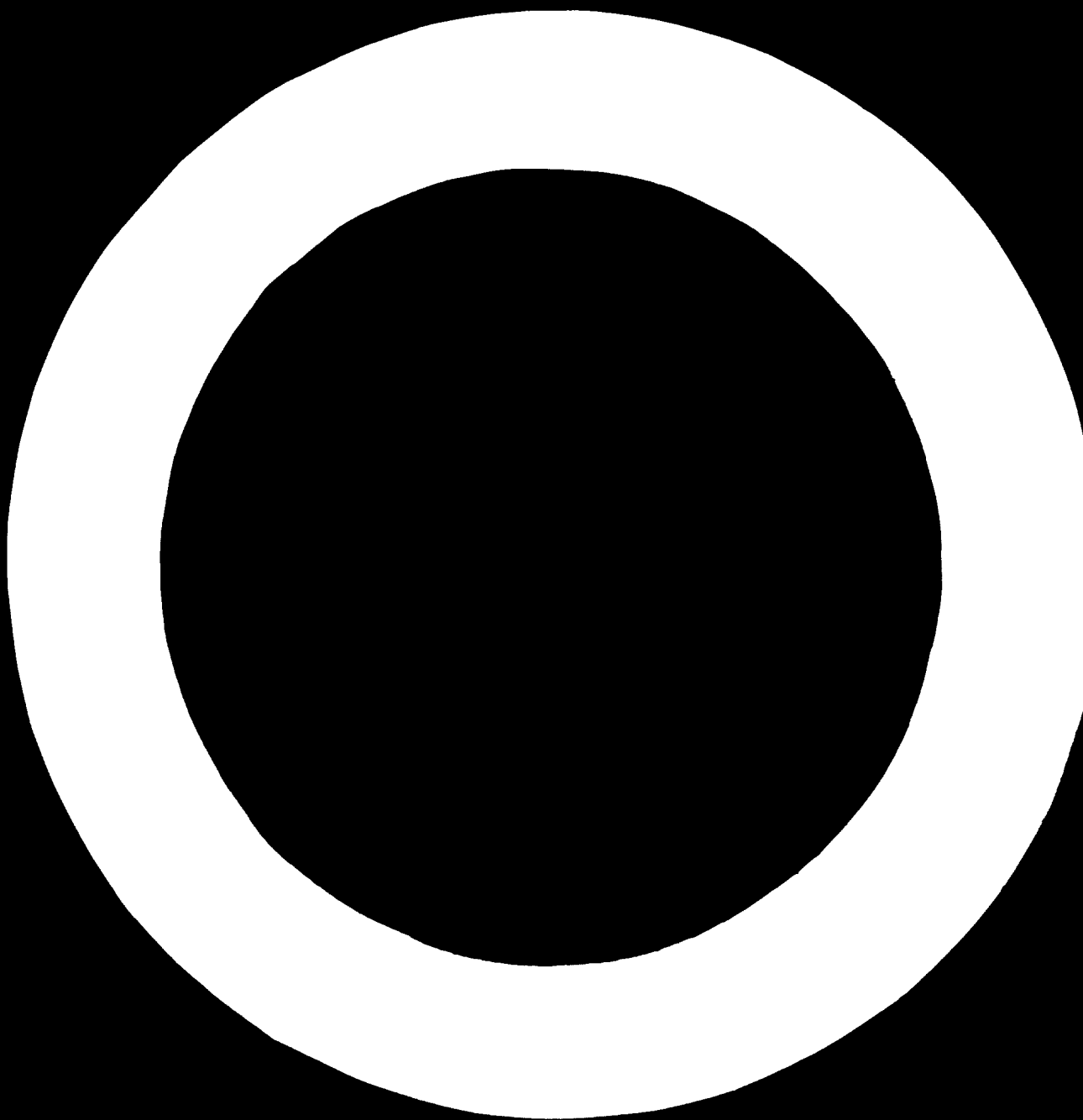


1. Introduction.
2. Regular courses on Mechanical Design at ITA (TECHNOLOGICAL INSTITUTE OF AERONAUTICS).
3. Brasilian simposium on Mechanical Engineering design: education and development.
4. Design Centers in Brazil.

1. INTRODUCTION

In preparing this preliminary report for the Vienna meeting we tried to keep it related only to our personal experience with the subject. So we related the above items to coincide with the reunion's Agenda. We don't intend to give a general view of Brazil's situation with respect to design, since there exists a lack of precise information and data, and also due to the danger of generalizing wrongly or presenting partially true conclusions.

We are holding a large amount of meetings with expert people on design, in order to collect more facts, ideas and recommendations on the subject, and we expect to arrive in Vienna with a more general view of our specific situation and knowing better our needs so that we may make conscious decisions.

2. REGULAR COURSES OF MECHANICAL DESIGN AT ITA

2.1 - Design Mach. Elements

This is an undergraduate course on the upper level which treats of analysis and design of machine elements. Particular emphasis is given to fatigue design and group dynamic tecniques are employed.

One semester is spent with three hours of lectures, four hours of class exercises and three hours of home work.

Home work consists of reading the text book and answering related questions.

Lectures are organized in three different ways:

- explanation by the teacher
- explanation by the students
- programmed group discussions

Student explanations generally consist of comments on design magazine articles, reports, design news, new design approaches and personal technical production. One or two students present the subject and the rest of the class participates.

The class exercises are the most important part of such a design analysis course.

Problems are presented together with special Machine Drawings from Michigan University: ("Machine Analysis and Design Problems" - H.H. Alvord, J.R. Pearson - K.W. Hall). We devide the class into three or four student groups; each group must do three or four problems (one for each student) with previous discussion and planning of the solution by the whole group.

The main purpose of this training is to give the students some ideas about the design of machine elements in relation with a more complex machine, with space and form limitations induced by the assembly problems. Problems are proposed in such a way to permit the group or the students to make their own choices by means of a proper combination of dimensions, materials and process fabrication. Graphs, data and tabulation on mechanical engineering materials are given together with catalogues for mass production machine parts such as bearings, belts, clutches, brakes, couplings, etc.

This year we intend to include in the course special problems in design evaluation and analysis. These problems will be based on small drawings and notes about new developments in machine design. Stu

dents will begin discussing the advantages and disadvantages, then evaluate the importance of the proposed idea, try to anticipate the main difficulties, and suggest some approaches for a detailed solution. We consider this type of problem very important, mainly in countries like ours with little or no tradition in mechanical design.

2.2 - Dynamics of Machinery and Mechanical Vibrations

This is a one-semester undergraduate course:

3 hours of lectures, 4 hours of exercises, 5 hours of home work.

One half semester covers the subjects normally related under the title of Dynamics of Machinery, and one half semester covers the subject related to Mech. Vibrations.

Problems are again formulated together with complete machine drawings; graphic methods are emphacized, card board models are made by the students and synthesis problems are developed by the students.

We gave mechanical engineering students and mechanical engineers working at road maintenance, a derivation of this course (Mech. Design Analysis) at Campina Grande Engineering School. The course lasted 20 days with five hours of lectures per day, along with student work. At the end of the course each student presented a complete report about one machine design, with velocity and acceleration polygons, cardboard models, graphic differentiation curves, flywheel calculations, motor choice considerations, speed reduction problems. The report was completed by an oral explanation with general comments on mechanisms used in the design.

2.3 - Machine Design

During this one semester course the student should develop the complete design of a machine or a part of it.

Machines to be developed on such courses must meet the following requirements:

1º) Have high loads in order to justify element calculations.

2º) Have partial or total alternative solutions and several operational modalities.

3º) Envolve if possible some industry interest in order to motivate the students.

4º) Have considerable space, limitations with respect to the loads in order to put the students in contact with assembly problems.

We generally give the design to a small group to two or three students. This has some desadvantages as far as individual training is concerned, but it permits the students to design more complex systems.

We have a large amount of difficulties concerning this sort of course:

1º) To succesfully stimulate the student to begin to draw at the beginning of the course, making free-hand sketches and scale sketches in such a manner that he obtains sooner good understanding of space and assembly problems involved.

2º) To make the student advance from a simple lay-out design to a more detailed design where fabrication problems and tolerance problems will be more evident.

3º) To employ a teaching staff with industry design experience.

4º) To have enough technical data and catalogues about materials, components and devices.

5º) To present all the preliminary specifications in a pratical way.

We do not have a tradition in mech. design. Our scholls and industries are just beginning on this subject.

It is necessary to analyse these kinds of problems in meetings between our engineering and technical schools, design institutes and industries in order to establish some design policy adequate to our specific conditions.

3. BRAZILIAN SIMPOSIUM ON ENGINEERING DESIGN EDUCATION AND DEVELOPMENT

Since 1969, we have tried to get a Brazilian engineering schools conference on design education and development. This is a fundamental problem for our country and we have to try to attain a broader view on the subject. It would have been good if this meeting had preceded the Vienna Reunion. As this will not be the case we intend to receive from this meeting a general view and some experience for planning a specific national conference. We intend to plan this simposium in two distinct parts:

At the beginning of 1971, let only with the academic staff; the other, at the end of 1971, with experts from industry, government, institutes and particular design groups.

4. DESIGN'S CENTERS IN BRAZIL

At the proceedings of the "First Conference on Engineering Design Education" - a conference sponsored jointly by the American Society for Engineering Education and Case Institute of Technology and held on the Case Campus, September 8 and 9, 1960 Professor James B. Reswick, Director of Engineering Design Center, reports the experience of this Design Center through the following important goals.

1. To provide a means for students, both graduate and undergraduate, to take part in a true professional research and/or development project, working as partners with outstanding staff people.

2. To explore means where by the creative performance of individuals and teams may be enhanced.

3. To undertake important projects in science and engineering in areas where (the Institute), by virtue of its staff and equipment, is uniquely able to make major advances, and the staff in turn may continue to grow and remain at the forefront of their professions.

4. To develop broad design criteria in areas where industry and others may later make important applications.

5. To provide a continuous flow of new knowledge into the teaching programs at both the graduate and undergraduate levels.

6. To provide a body of young instructors who, through their own involvement, understand the design process and who, therefore, can guide undergraduate students in engineering design courses.

7. To provide facilities and direction to students pursuing technical hobbies and projects.

To the proceedings enumeration we add the following ones for better adaptation of our environmental conditions and better accomplishment of its finalities:

8. To canalize resources destined for research at Engineering Schools and Institutes each the researches are technological ones involving design development.

9. To identify the capital designs to be developed, taking into account the school or special Institute habilitation, the design center human and equipment resources, and the main developing countries' necessities.

10. To be an direction and stimulation center for the industrial development in sectors of its concern with the aim of transferring to the industry its more ambitious and imperious projects for the country developments.

Designs' Centers could be of different size and satisfy some or all the finalities we mentioned before.

They could develop inside the schools, outside them independently, or parallel to them.

In S. José dos Campos together with an Aeronautics Eng. School, a Design Center, I.P.D., has developed. This center maintains three departments: materials, electronics, design and homologation.

By successive approaches, a brazilian policy for airplane design and construction has been established. The most important result was the design and prototype fabrication of the Bandeirante, the first brazilian [illegible]. After the production of two prototypes which function successfully. A logical consequence was the foundation of a governamental Industrial for series production which also will fabricate under licence, six [illegible] jets.

In the north east there are several centers for Industrial Development. Generally, these centers are more related to economical aspects of industrial implantation and rentability. With some modifications and improovements they could be coupled to a specific design center. Presently they are receiving some an infra structure which will help to identify and to plan projects of good local interest. Together with designs centers they could develop means and capacities to design for these specific projects.

In some states the Eng. School and an Institute of Tech. Research can be found together. Actually most of these Institutes function more like laboratories for materials tests though some of them, like IPT in S. Paulo, have really established conditions for a Design Center.

Thus, there are conditions for establishing some design centers in the country with possible foreign cooperation, depending on the specific case.

Problems related to location, type of industrial support, specific destination, staff habilitation, economic support are being discussed during a series of interviews with experts.

Our aim is to collect data and suggestions that will permit us to do the following:

1º) Be up to date on our country's situation

2º) Collect ideas on design center implantation, location, and improvment.

3º) Exchange ideas about the first brazilian conference on this subject.

With this purpose in mind we are planning and holding interviews with the following organizations:

Planning Ministery Expert Groups.

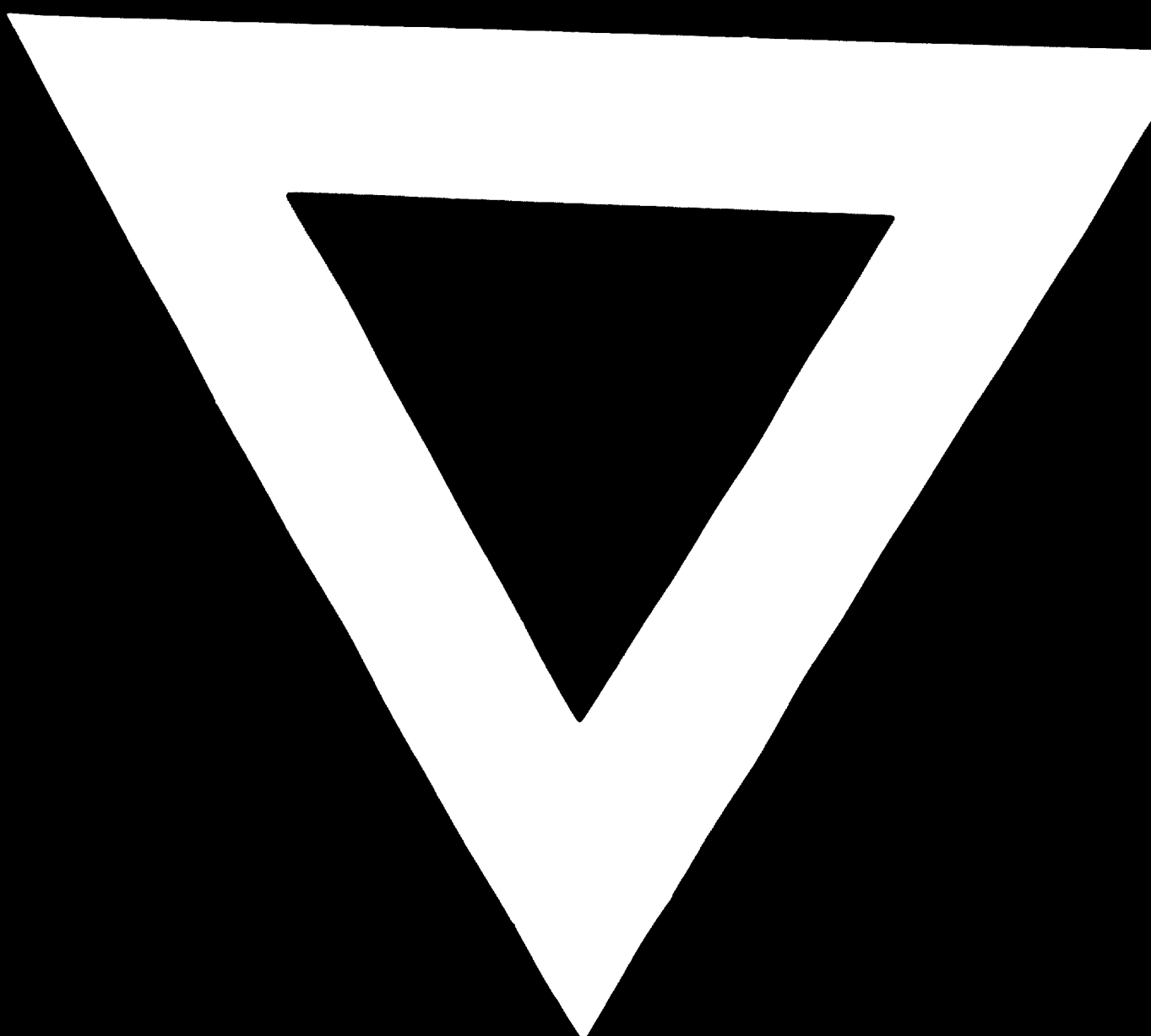
Educational Eng. Level and Tech. Level Expert Groups.

Eng. Schools.

Industry Design Teams.

Actual and virtual Design Centers.

Experts.



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