

Report on a visit to the University of Manchester, Institute of Science and Technology, in behalf of the Royal Society in London

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REPORT ON A VISIT TO THE UNIVERSITY OF MANCHESTER
INSTITUTE OF SCIENCE AND TECHNOLOGY, IN BEHALF OF
THE ROYAL SOCIETY IN LONDON

Mariahout - Lieshout, October 1973

Dr.Ir. H.J.J. Kals

- Beam element programmes, based upon the beamlike topological representation of a structure.
- Finite element programmes, which in comparison with the beam element programmes allow a better geometric similarity between actual structure and topological model.

Where beam element programmes are available to calculate static as well as dynamic properties, the finite element programmes cater only for the static deformation analysis of machine tool structures and their constituent elements, including both bolted and sliding joints.

For the static analysis of the pipe manufacturing machine a programme was used, containing beam elements and finite elements as well.

A study was made of the finite element method and as it was merely the aim of learning the applicability of the different types of programme, special attention was paid to the possible limitations induced by the choice of the displacement equations for the different types of elements. From this there may rise difficulties when simultaneously using different types of elements (triangular, rectangular etc.) because of discontinuities in the displacements described on both sides of a mutual boundary. This in fact is the reason why in spite of a poorer similarity between the actual structure and the topological model, in some cases - in particular in the case of a coarse grid - the application of simple beam elements can lead to better results than is the case when topologically more adapted finite elements are used.

In the same period two lectures, i.e. Metal Cutting and Machinability, have been attended.

Some time has been spent on a study of dynamic testing of machine tools. An article on dynamic stability in cutting - to be published in a special edition of the dutch workshop magazine "Metaalbewerking" - was also written.

Finally it is mentioned that during that period the author was involved in a research programme concerning the measurement of the dynamic transfer function of the cutting process.

A visit was paid to Mirrlees Blackstone LTD.

The following period - from January the 2nd until April the 30th - has been spent on metal cutting only.

The continued lectures of Metal Cutting and Machinability were attended.

A great number of articles, reports and books concerning the mechanical and thermal loading of cutting tools, tool wear and tool failure have been studied. From the knowledge collected a lecture on Cutting Technology for use at the University of Technology in Eindhoven has been composed.

A survey of this lecture is given below.

- Chapter I Analysis of the cutting process.
- Chapter II Characteristic tendencies in cutting.
- Chapter III Cutting temperatures and tool-life.
- Chapter IV Cutting with multi-cutter-tools.
- Chapter V Grinding.

It appeared that with respect to the stress distribution at the clearance face of a cutting tool the available knowledge was very poor. The stress distribution being shown to be important in relation to tool wear, it was decided to carry out an investigation into this mechanical problem and consequently preparations were made for experiments to be carried out.

From May the 1st until August the 15th the time has mainly been spent in carrying out experiments concerning the stress distribution on the clearance face during cutting with carbide inserts.

Simultaneously the author was involved in a research project on wear of H.S.S. tools. In particular attention was paid to possible atmospheric influences on the friction conditions between chip and tool on the rake face.

In connection herewith the Department of Physics at the University of Cambridge was visited. As the subject appeared to be a matter of mutual interest, a program of cooperative work was drawn up.

The investigation into the stress distribution on the clearance face of cutting tools revealed some very interesting results, the first of them

being that the stresses increase with the length of the wear scar attaining values which are considerably higher than ever have been reported before.

Secondly, it appeared that when the length of the flank wear land exceeds a certain value, the uncut chip thickness - and herewith the actual chip thickness - decreases substantially, if the depth of cut remains constant.

From these findings it occurs that beyond a certain measure of wear, plastic deformation will take place on the tool-work interface and consequently the existence of an important third heat zone becomes evident. Except for the fact that higher stresses directly will lead to higher wear rates, a considerable increase in wear rate will result from the temperature rise at the clearance face which is due to occur when the length of the flank wear land exceeds a certain value. This provides an explanation of the typical form of the curve showing tool wear versus time.

Other activities during this period were a study concerning the position of postgraduate engineers in British industry and visits to the University of Salford, the University of Birmingham and Turners Asbestos Co. in Wigam (Lancs.).

As has been reported on August the 21st by separate letter, the author had to leave the U.K. prematurely on August the 15th because of medical reasons.

The research programm mentioned ample before will be continued at the University of Technology in Eindhoven.

As to future research in the field of cutting technology, it is agreed to cooperate on subjects of mutual interest.

This report may well demonstrate that the whole visit has been of invaluable experience.

Also the experience of living for nearly one year in a much different country has been very much fascinating to the author and his family as well.

It is with respect to both that the author wishes to convey his sincere thanks to the Royal Society, the University of Technology in Eindhoven

and the Dutch Organization Z.W.O. who made this visit possible. Finally he expresses his sincere thanks to Professor F. Koenigsberger, head of the Machine Tool Division, Dr. A. Cowley and Dr. G. Barrow for their willingness to accept my application and for their great help extended during his stay.

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Dr. Ir. H.J.J. Kals