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Complementary Report

II-2 Prof. E. FUMAGALLI

Monsieur le Président, Mesdammes et Messieurs, en tenant compte que mon rapport est déjà à vos mains, pour mieux documenter l' activité de l' ISMES dans le domaine des modèles de conténiteurs nucléaires en précontraint, je me permets d' utiliser le temps à disposition pour vous proposer la projection d' un bref documentaire relatif à deux modèles récemment essayés à l' ISMES. A ce sujet je donne la parole à M. Verdelli qui a suivi personellement l' éxécution et les essais des modèles susdits.

II-2 Mr. G. VERDELLI

A short film is shown to illustrate the tests dealt with in Report II-2 more effectively; it summarizes the most interesting aspects of the construction and the tests carried out at ISMES during the last year on thin models in the scale 1 : 20. The film is divided into two parts. The first part shows the most important construction stages and the tests carried out on thin model no. 2 (see paper). The collapse of this model occurred at a pressure of 120 Kg/cm^2 with the breaking of a large number of the hoop cables of the barrel. The second part of the film has no commentary and illustrates the ultimate tests carried out in successive stages on thin model no. 3 described in detail in the report in question and only recently finished. In the initial stage of the ultimate tests the maximum pressure reached was 90 Kg/cm^2 corresponding to the first clearly visible cracks which concerned the central part of the barrel. In the two overpressure tests up to 115 Kg/cm^2 which were later carried out, although there were an increased number of cracks (limited however to the central part of the barrel) the elastic behaviour of the prestressing cables was still evident. Final collapse, at 140 Kg/cm^2, occurred with the collapse of the central part of the upper slab. This type of unexpected collapse is caused by the yield of the wires of the slab hoop cables, the diameter - in this third model - not having been increased as were the wires in the other cable systems.

II-3 Ing. R. RICCIONI

Mr. Chairman, Ladies and Gentlemen; I trust you will allow me to apologize not only for myself but also on behalf of Prof. Fanelli and Dr. Robutti for the delay in presenting our paper. A delay hardly justified by the fact of our being in an own house here, but perhaps excusable on account of our work, based on numerical methods, is only a simple chess piece, dependent on the other pieces in the game - that is to say - the project, the available information of the physical model and the specified rheological input.

The substance of our work is not only a verification of the structure of a nuclear vessel with finite element method - as it would seem to appear at first sight - but is infact an exact indication of the necessity and possibility of complementarity for those involved in the designing, verification of physical and numerical modelling, as well as for those who provide information on rheological behaviour of materials.

In our case the information obtained from the physical model suggested an investigation in the elastic linear field and has allowed an evaluation of the elastic modulus of concrete. The results of tests carried out on samples of concrete of the same type as that used in the physical model - elaborated with the matematical one - allowed evaluation of the elastic modulus by other means. The compatibility between the figures obtained through completely different methods was morethansatisfactory.

The determination of the optimum prestressing sequence of cables and of local safety factors, complete the picture of information available and confirm a "modus operandi" which must be considered fundamental for structures, such as nuclear vessels, whose safety must not be in doubt.

II - 4 Dr. F.K. GARAS

I must apologize for not giving the participants enough time to read my paper, but if you work for a commercial organization you will realize it is not always easy to find time to write papers. However, I will try in the next few minutes to highlight some of the key points mentioned in the paper. The paper deals mainly with the problem of high shear stresses which have to be accommodated in the design of prestressed concrete pressure vessels as shown in figure 1 of the paper. This shows a section through the Hartlepool/Heysham podded boiler type pressure vessel. There are four vessels of this design under construction at present in the U.K.

Pressure vessels for the containment of nuclear reactors include structural members which rely for their safety on the capacity of concrete to resist high shear stresses. Typical examples are end slabs, the barrel wall and boiler closures. These members are geometrically deep in relation to their span and subject to flexure, but the large deformations which would normally be induced are restricted by lateral restraint in the form of either prestressing or the continuity of the structure around the element considered. The first part of the paper is a summary of an experimental investigation into circular end slabs. Figure 7 in the paper shows the type of model which was used. To date we have tested 23 models to failure. They varied in scale between 1/24th and 1/8th scale. The parameters studied included the amount of hoop prestress, bonded reinforcement, span to depth ratio, boundary conditions, penetration liners, sustained temperature and concrete strength.