

A method of constructing shell structures

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Mr E. S. Pollard (M)

I wish to ask the Authors whether they could supply the actual centres for drilling the tapes for a family of ellipsoidal or spherical shells.

Living in a country where circular building is traditional it is fairly safe to say that every engineer has at some time or other attempted to find a new solution for roofing rondavels. The drawbacks of trying to make a cage with light rods on the lines of longitude and latitude are easy to see when one finishes with a bundle at the north pole and gaps at the equator. A geodesic pattern is obviously required and the Authors have given an elegant solution.

Professor B. Rawlings and Mr C. Melbourne, University of Sheffield

There has been an increasing interest in the construction of reinforced concrete shells having a wide variety of structural forms recently. It is well recognized that expenditure on form work constitutes a large part of the cost of such structures. Any developments which reduce the cost of form work are, consequently, to be welcomed, and the Authors of the Note are to be congratulated on an interesting and original solution to this problem. The photographs of the tape shells show the potential of their technique.

One possible difficulty might be the positioning of the rivet holes in the tapes, which could be an expensive process unless there were a high degree of repetition. In this case the form of the shell would be limited to some degree.

For some time the Department of Civil and Structural Engineering at Sheffield University has conducted studies in the field of thin walled structures and in the last 18 months a programme of research has been initiated into the properties of expanded metal mesh, with the realization that this material would have considerable potential as a basic element around which concrete shells and precast shell units might be formed.

It will be appreciated that the potential of such a material cannot be realized until its fundamental physical behaviour is understood. For this reason, a series of tests were conducted on the biaxial and transverse loading characteristics of typical pieces of mesh as produced by the manufacturers. It was found that such mesh could be deformed into a large variety of shapes, which would be capable of supporting the weight of wet concrete which might subsequently be cast around them. Studies into the behaviour of mesh reinforced thin walled structures have also begun. Attention is being directed towards one way reinforced concrete slabs but it is hoped that work will be extended to arch and shell forms.

The use of expanded metal mesh is not limited to structures in which the predominant stresses are compressive, but the material could be used in tensile structures, the surface being completed using some type of plastic such as a polyester resin.

Messrs Wood, Ogorkiewicz and Mundy

Hole positions for a family of ellipsoids have not yet been calculated because considerable changes in the existing computer program would be necessary to allow for this. For the ellipsoidal shape shown in the Note, positions of successive holes measured from the equatorial hole and expressed in terms of an equatorial radius (b)

DISCUSSION

of unity are:

0.24292
0.47351
0.68319
0.86757
1.02614
1.16098
1.27529
1.37266
1.52903
1.65037
1.75015
1.83722

The problem of uneven tape density over the surface, mentioned by **Mr Pollard**, unfortunately still remains whether the tapes follow meridional or sloping lines over the shell surface. The only solution seems to be to add further tapes in the sparsely covered regions and discontinue them where they tend to pack. Early termination of some of the tapes can be seen in Figs 3 and 4 of the Note.

The cost of drilling rivet holes accurately in the tapes is certainly reduced when all the tapes have identically spaced holes, as in the axisymmetric shells discussed in the Note, but they can also be rapidly machined in individual tapes if a long traverse drilling or vertical milling machine is available.

The use of expanded metal mesh to produce formed reinforcement for shells, suggested by **Mr Melbourne** and **Professor Rawlings** is an ingenious idea and could find wide application. The Authors hope to hear more of the results of these studies and thank all the contributors for their useful and interesting comments.