# BEHAVIOUR OF A STIFFENED CIRCULAR SLAB

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## I. INTRODUCTION

Interesting structural problems were encountered in the planning and design of the cooling water system for the Madras Atomic Power Project at Kalpakkam. This system required an intake structure with a maximum inflow capacity of 1600 cft/sec. In order to arrive at the optimum dimensions and features of the structure, hydraulic model tests were carried out for different sea water levels. It was observed that the provision of a velocity cap would considerably reduce the head loss and air entrainment in the intake structure.

During storms the intake structure itself is exposed to the action of waves, approximately 6 m high. Therefore, it was essential to know the forces exerted by these waves on the velocity cap to be provided. By conducting another model study with the help of a pressure cell, it was established that the intensity of pressure exerted on the velocity cap would be of the order of 7.0 $T/m^2$. The probable maximum intensity of pressure in the upward direction is anticipated to be higher than the intensity of downward pressure. Considering this aspect, and the self weight of the slab, it was found desirable to design the slab for a reversible loading of 10 $T/m^2$.

II. STRUCTURAL DETAILS

A 600 mm thick circular slab stiffened by 300 mm x 1500 mm deep radial beams was proposed. From a preliminary analysis based on the behaviour of a circular plate simply supported at its periphery, it was considered advisable to provide a ring beam support to reduce the load on the radial stiffeners.

Figures 1 and 2 show details of the velocity cap and the adjoining portion of the intake structure.

III. APPROXIMATE ANALYSIS

A preliminary analysis was first carried out, making use of the symmetry of the layout and loading. Each radial beam was subjected to varying intensities of loading, represented by two triangles symmetrical with respect to the midpoint of the beam (Fig. 3). Bending moments in the beam, considering simple supports as well as fixed supports, were then determined by numerical integration.

IV. GRID IDEALISATION

In order to obtain a more accurate estimate of the moments and shear forces in the stiffened plate, an analysis based on grid idealisation of the structure was carried out. The slab was divided into segments and was represented by relevant radial and ring beam (Fig. 4). Computations were carried out for hinged and fixed supports as well as for partial fixity of the supports, as available from the adjoining structural elements. Values of moments for various cases are given in Table 1 below :

TABLE - 1

MOMENTS IN VELOCITY CAP

| | | Moment at Centre in TM | Moment at Support in TM |
|---|---|---|---|
| Approx. Method | Hinged | 222 | - |
| | Fixed | 58 | 164 |
| Grid Ideali-sation | Hinged | 158.1 | - |
| | Fixed | 45.7 | 159.1 |
| | Partial Fixity | 49.5 | 147.1 |

## V. CONCLUSIONS

From the results of this study it can be concluded that in case of symmetry of loading and layout an approximate method based on numerical integration provides fairly accurate values on which preliminary design can be based.

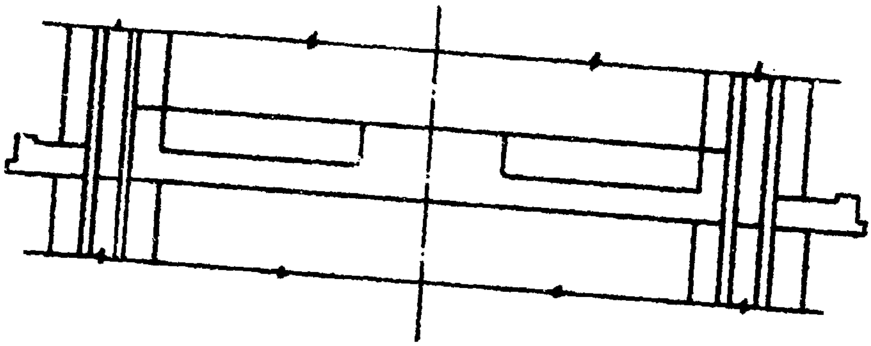

FIG. 2

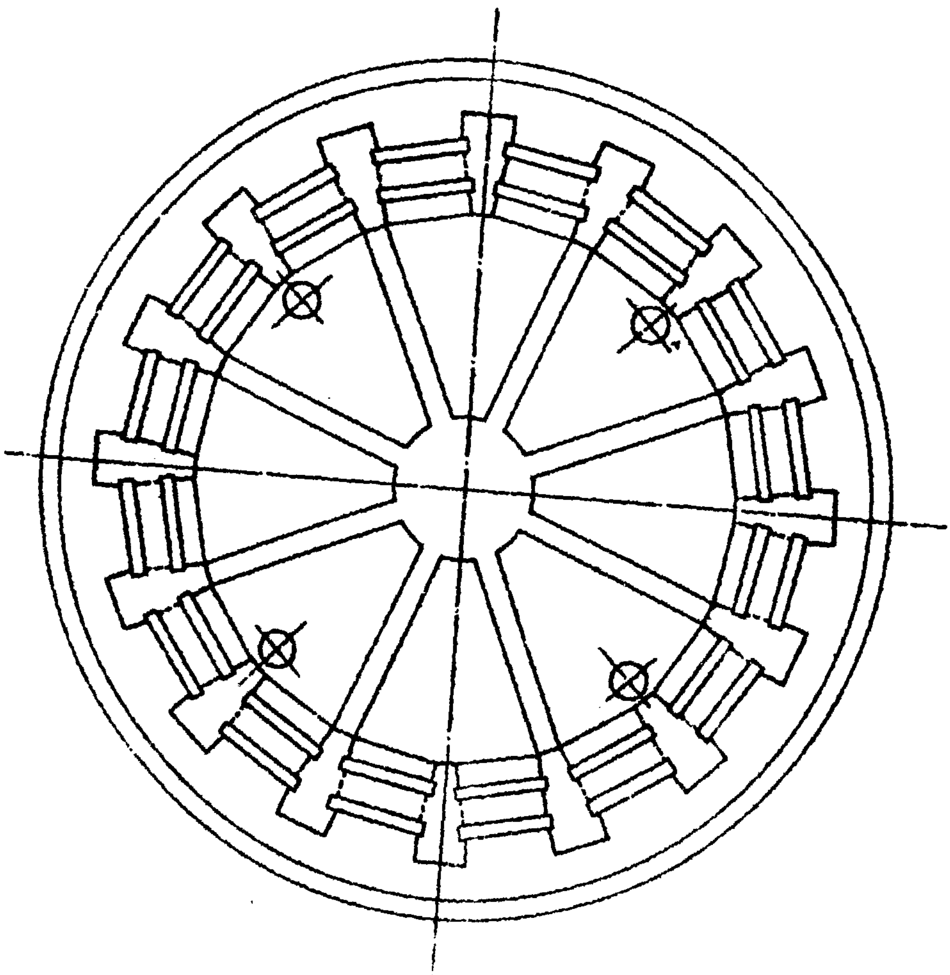

FIG. 1

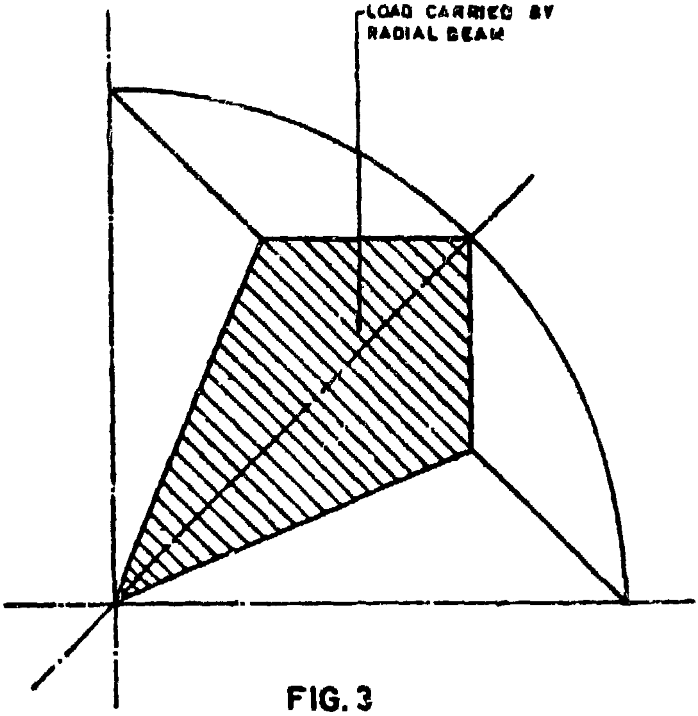


FIG. 3

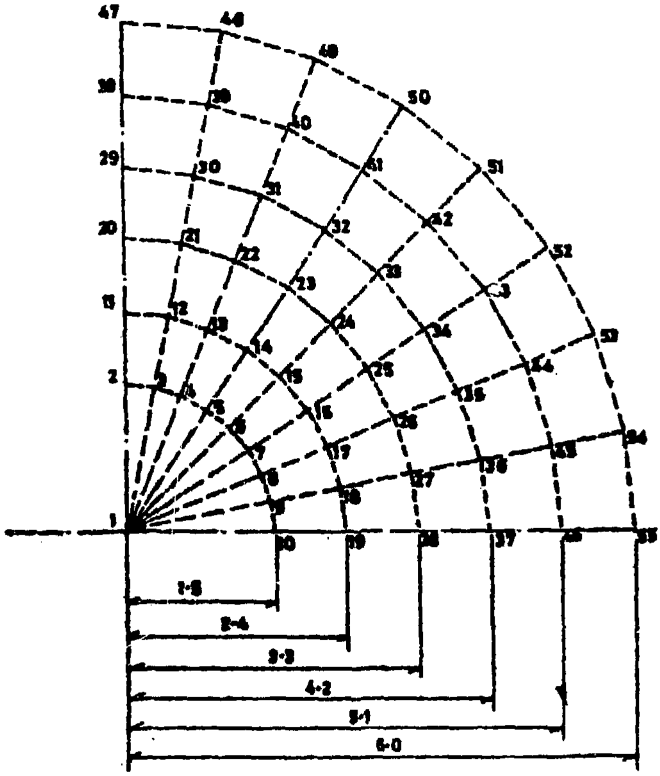


FIG. 4