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Design of Precast Concrete Panels for Basement of Building

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Abstract: **-- Basements are generally used as a utility space for a building where mainly parking is located. However, all the works are to be done in the congested underground environment inside the basement pit in confined space. In such places, precast concrete panels can be used. To make the application of precast concrete pavement economical and material effective, an attempt has been made to provide a curved bottom face. Curved panels are easy to place, consume less material, and are cost efficient making them more economical. They provide better consolidation of soil due to the curvature provided at the bottom face as compared to a regular (flat based) concrete panel. In order to optimize the curve, that needs to be provided at the bottom face, finite element analysis has been performed. The curved panels are optimised, based on the maximum shear force and bending moment obtained through analysis. Comparison of the key design parameters is made between the curved and regular panel. It is observed that values of optimised curved panels are less to regular panels.**

Index Terms— **Precast panel, curved panel, consolidation, finite element analysis, optimisation of curved panels, key parameters.**

I. INTRODUCTION

Basement construction can be done with concrete block, poured concrete, pre-cast concrete. The application of precast concrete structural systems have been attaining vast progress worldwide, particularly in India in the last few decades. This is due to the fact that the precast structural systems possess several advantages compared to monolithic systems, such as quality control, speedy construction, and suitable application to regularly modular systems. Precast panels that are created in a factory can adhere to much better and consistent standards in terms if drying and maximum strength characteristics since the environmental conditions are maintained at optimum levels. Heated mixtures and accelerants do not need to be added to help manage drying and temperature control of the concrete. Precast concrete basement can save money by reducing on-site costs. This type of basement construction uses factory-made concrete panels that are shipped to the site and assembled on site-built footings.

Advantages of precast panels used in basement of building are:

- Fast erection
- Provide immediate access and usage of basement after placement of panels
- High quality surface finish
- Economical in terms of quality and time saving

II. MODELLING AND ANALYSIS

Pavement panel is modeled in SAP 2000 software. Two types of panels are modeled; straight panel and curved panel. For the later type curve is provided at bottom with varying rise. Maximum shear force and maximum bending moment were obtained using SAP 2000 software. The description of panels is given below:

A. STRAIGHT PANEL

The model is prepared in SAP 2000 using grid template. In this grid template Cartesian option is used to model the straight panel of size 5 m × 3.5 m. M25 concrete material property is defined to prepare the panel. To define the section property shell elements are used. Meshing size ratio of 0.25 is used for analysis. Spring elements are assigned at the bottom of the panel. The stiffness assigned to the springs is calculated by formulae:

Stiffness = 40 to 80 x Safe bearing capacity of soil x spacing of spring elements x FOS (1)

Lump load of 100 kN is applied at the centre of the panel to calculate maximum shear force and bending moment. Figure 1 shows the model geometry of straight panel.

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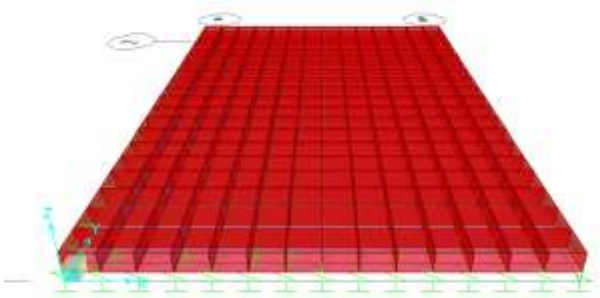

Figure 1. Geometry of straight panel

After analysis for thickness of 0.15m panel, the value of maximum shear force is 1199.035 kN and maximum bending moment is 4.496 kNm. Similarly, for thickness of 0.125m panel, the value of maximum shear force is 1032.711 kN and maximum bending moment is 2.689 kNm.

B. CURVED PANEL

For the curve panel, cylindrical option is used in grid template and small curved section of cylinder is taken. Same material and section properties as that of straight panel are assigned to the curved panel also. Figure 2 shows the geometry of curved panel.

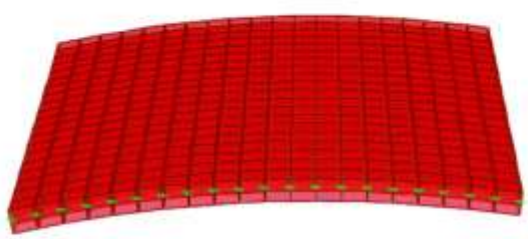

Figure 2. Geometry of curved panel

After the analysis for thickness of 0.15m panel the maximum shear force and maximum bending moment are shown in table 1.

Table 1 Maximum shear force and bending moment for 0.15m thickness.

Rise (h)	Maximum shear force (Smax)	Maximum bending moment (Mmax)
0.13	1257..52	4.145
0.14	954.14	4.249
0.15	878.14	3.888
0.16	968.21	3.153

For thickness of 0.125m panel the maximum shear force and maximum bending moment are shown in table 2.

Table 2. Maximum shear force and bending moment for 0.15m thickness

Rise (h)	Maximum shear force (smax)	Maximum bending moment (Mmax)
0.11	671.260	1.645
0.125	655.517	1.708
0.13	655.517	1.708
0.14	870.963	2.331
0.15	1131.676	3.06

III. OBSERVATIONS

After analysis, comparison of maximum shear force and bending moment between straight and curved panel for thickness 0.15m is done. For the curved panel as the rise varies the values of maximum shear force and maximum bending moment varies. The observation shows that for optimum maximum shear force and maximum bending moment values of rise 0.15m thick curved panel is much less in comparison to that of straight panel of 0.15m thick. Similarly analysis is done for 0.125m thick panel for curved and straight panel. The observation shows that for optimum maximum shear force and maximum bending moment values of rise 0.125m thick curved panel is much less in comparison to straight panel of 0.125m thick maximum shear force and maximum bending moment.

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