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Serviceability analysis of slabs on grade

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A slab on grade is defined as a concrete slab placed on earth, ground or some strata. These are encountered in construction as mass concrete, reinforced concrete or prestressed concrete depending on the practical situation. These find applications in pavement slabs found in footpaths, walk ways, airport runways, highways, basement floors and bottom slab of swimming pools. The basic characteristic of slabs on grade is that there are two different sets of environmental conditions at the top and bottom surfaces of the slab. These conditions vary from humid tropical situations to moisten

cold weather or to dry extreme cold climates. The observed behaviour of some of these slabs is that they are fractured or cracked due to serviceability problems or construction defects. This study is aimed at investigating the former which is a time dependent phenomenon. The critical stages of these slabs can be assessed on short term or long term basis or both. The effects often treated are creep and shrinkage of concrete and relaxation of prestressing steel if relevant and temperature effects. In this study the latter is excluded from the main influencing parameters for serviceability behaviour.

Another important aspect experienced in slabs on grade is the differential variation of parameters through the thickness of the slab. This makes standard methods available in research literature not directly applicable. The procedure adopted recognises the main influences but requires a computer tool to conduct an efficient study. The analysis procedure involves evaluation of several integrals which are systematically coded using computer spreadsheets. The variables considered are relative humidity, thickness of the slab, age of concrete at loading, age of concrete at stress calculation, ambient temperature, type of cement and the amounts of both reinforcing and pre-stressing Steels. Therefore, a large number of analyses needed to be performed.

The results presented graphically describe the variations of final stresses as tensile or compressive with the information related to top and bottom fibres shown separately. In a given slab on grade combined loading (dead, imposed plus time dependant) could produce cracking of concrete. As the thickness of the slab increases, these effects become less significant. The results also show that most changes occur within the first 10 days but almost cease after about one year. A notable conclusion is that stress changes can be reduced if moisture at the bottom surface is retained by providing membrane sheets beneath rather than laying the concrete directly on ground.

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