QUASI-STATIC AND DROP HAMMER LOADING OF PLAIN AND SKIN REINFORCED CONCRETE PLATES

BY
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Dedicated to

My daughters

CERTIFICATE

This is to certify that the thesis entitled **"Quasi-static and Drop Hammer loading of plain and skin reinforced concrete plates"** by Mehtab Alam has been prepared under our supervision and has attained a standard required for a Ph.D. degree of the Institute. The thesis is record of bonafide research work carried out by him and its contents have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Concrete is the most commonly used building material and should be a natural choice for the construction of impact and blast resistant structures, or in general for structures under heavy dynamic loads. However it is weak in tension and to improve its tensile strength, it is reinforced by steel in the form of embedded bars (unstressed or pre stressed) and it is called reinforced or pre-stressed concrete. Other option to improve could be external reinforcement by steel sheet using some strong binder and it may be named as skin reinforced concrete (SRC). This could be very effective under impact loading.

To understand the behaviour of plain concrete and SRC plates under impact it is necessary to study, first, their behaviour under quasi-static loading.

In the present study experiments have been performed on plain concrete plate specimens of thickness 25 and 35 mm and of regular strength, 15, 25, 35 MPa, with edge ring (peripheral) and without edge ring. To reinforce these plates of plain concrete, thin steel sheets (0.15 mm and 0.2 mm thick) have been used on rear face or on both faces using Araldite glue. Experiments on these plate specimens of plain concrete and skin reinforced concrete have been performed using a cylindrical penetrator with spherical nose positioned at the centre of the plate (under quasi-static loading and under the impact). Experimental results, in the form of load-deformation and energy- deformation curves have been prepared.

Using the data of present experiments, critical loads have been calculated from Nielsen's analytical formula and Regan's empirical relation, necessary to cause punching of conventional reinforced concrete slabs under a flat cylindrical punch

at the centre. These loads have been compared. A common percentage of reinforcement which satisfies the two formulae has been worked out for different combinations of the parameters and diameter of the cylindrical punch.

Results obtained from the present series of experiments on SRC plates are found to follow the trend of Nielsen's analytical results, while results from plain concrete plates are obviously quite different and do not follow Nielsen's formula meant for R.C.C. Nielsen's results have been modified to incorporate the effect of a hemispherical nose added to the flat cylindrical punch by introducing a so called NOSE SHAPE FACTOR (NSF). The flat punch diameter, multiplied by this factor, and then used in Nielsen's formula, gives the experimental results obtained from quasi-static tests on SRC plates. The NSF value is 0.55 for single skin (at back) and 0.95 for double skin (on both faces), and is obtained from ALL the available data for single skin or double skin plates, using the least square method.

Experimental results from plain concrete plates and SRC plates under impact loading (by a cylindrical impactor with hemispherical nose) have been discussed in the later half of the thesis and interesting conclusion have been drawn from these.

Thus the thesis presents an extensive experimental study on plain concrete plates and SRC plates (having skin on rear face or on both the faces) under quasi-static loading and impact; by cylindrical penetrator, having spherical nose. The present work also suggests the use of nose shape factors for the SRC plates so that Nielsen's analytical results, using flat penetrator, can be modified for more practical cases of hemispherical and other shaped noses.

In the end some suggestions for further research work are given.

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