Streszczenie w języku angielskim

The analysis of the behavior of reinforced concrete elements and structures at ultimate and serviceability limit states according to Eurocode 2 is commonly used in designing. In many cases, such as earthquakes, explosions or traffic catastrophes as from static loads, reinforced concrete structures may operate in post-critical deformation states. In this case, the structures must exhibit sufficient load-bearing capacity after the transition to the plastic state. Structures which are subjected to large deformations accompanied by plasticisation of concrete and steel should exhibit adequate ductility. In post-critical deformation states, inelastic buckling of the longitudinal reinforcement bars is very common. Among the factors that influence the post-plasticisation behavior of elements are the degree of longitudinal reinforcement, the configuration and spacing of stirrups, the type of reinforcing steel and the strength of the concrete.

The research problem addressed in the dissertation is the quantitative and qualitative assessment of the influence of concrete lagging on the inelastic buckling of reinforcing bars. The first part presents a literature review of damage and forms of failure in reinforced concrete structures including buckling of longitudinal reinforcement. The paper presents an analysis of the results of research to date on reinforcing bars and their inelastic buckling. The role of concrete wrapping of bars in load transfer in columnar elements is also indicated.

The second part of the dissertation consists of experimental tests on reinforcing bars in concrete cover. The tests were carried out for two types of reinforcing steel: plain A-II and ribbed A-IIIN and for three thicknesses of concrete cover of class C35/45. The experimental tests were carried out using the ARAMIS system for non-contact measurements of displacements and deformations. ARAMIS non-contact displacement and strain measurement system. This made it possible to observe the formation of cracks on the surface of the lagging concrete. In addition to the experimental investigations, numerical analyses were carried out in the ABAQUS/CAE application. Using two-dimensional beam finite elements, buckling stresses were determined. The material properties of the concrete and steel determined in the experimental tests were used in the calculations. Analyses of members of other diameters and in concrete cover of other classes were carried out using a calculation model. Relationships for the determination of the buckling capacity of reinforcing bars are also given.

Experimental tests carried out on reinforcing bars and numerical calculations determined the values of buckling stresses depending on the type of reinforcing steel and lagging thickness. They showed that concrete lagging has a positive effect on the buckling load capacity. Smooth bars showed higher buckling capacities compared to ribbed bars, which was due to the better adhesion of the concrete to the steel. Observation of the development of cracks on the concrete surface has made it possible to determine the point at which the first cracking occurs. In addition, the comparison of the experimental results with the results obtained from the numerical calculations and the analytical solution confirmed the correctness of the model, and allows the to accurately determine the load capacity for different steel and concrete parameters.

This dissertation on the topic of inelastic buckling of reinforcing bars complements the aspect of the influence of concrete cover on the buckling capacity of the reinforcement.