FINAL PROJECT

THE EFFECTS OF COOLING FLUID REYNOLDS NUMBER ON MASS CONCRETE TEMPERATURE

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ABSTRACT

The uneven temperature distribution in mass concrete, caused by the heat of cement hydration, poses a serious risk of thermal cracking that can compromise structural integrity and durability. To prevent cracking a cooling system, such as precooling or post-cooling system is necessary. This study investigates the influence of Reynolds number on the effectiveness of post-cooling systems in managing internal concrete temperatures and controlling thermally induced stress. A numerical simulation approach was employed using ANSYS Fluent for thermal analysis and ANSYS Structural for stress evaluation. Temperature distributions and corresponding thermal stresses were analyzed under different Reynolds numbers to assess cooling performance and mechanical impact. The results show that an increase in Reynolds numbers enhances convective cooling, resulting in greater temperature reduction. The cooling effectiveness is maintained further along the pipe length, leading to steeper temperature, but at the same time, it creates an adverse effect in the form of an increase in thermal stress around the cooling pipe. These findings highlight the dual role of Reynolds number in improving thermal control while also influencing internal stress development, emphasizing the need for optimal flow conditions to reduce cracking risk in mass concrete structures.

Keywords: mass concrete, Reynolds numbers, post-cooling system, temperature distribution