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Y-Y’ Calculus in Physical Sciences and Engineering with Particular Reference to Fundamentals of Soil Consolidation

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Abstract : Advancements in soil consolidation are discussed, and further improvements are proposed with particular reference to Tewatia’s Y-Y’ Approach, which is called the Settlement versus Rate of Settlement Approach in consolidation. A branch of calculus named Y-Y' (or y versus dy/dx) is suggested (as compared to the common X-Y', x versus dy/dx, dy/dx versus x or Newton-Leibniz branch) that solves some complicated/unsolved theoretical and practical problems in physical sciences (Physics, Chemistry, Mathematics, Biology, and allied sciences) and engineering in an amazingly simple and short manner, particularly when independent variable X is unknown and X-Y' Approach can’t be used. Complicated theoretical and practical problems in 1D, 2D, 3D Primary and Secondary consolidations with non-uniform gradual loading and irregularly shaped clays are solved with elementary school level Y-Y' Approach, and it is interesting to note that in X-Y' Approach, equations become more difficult while we move from one to three dimensions, but in Y-Y' Approach even 2D/3D equations are very simple to derive, solve, and use; rather easier sometimes. This branch of calculus will have a far-reaching impact on understanding and solving the problems in different fields of physical sciences and engineering that were hitherto unsolved or difficult to be solved by normal calculus/numerical/computer methods. Some particular cases from soil consolidation that basically creeps and diffusion equations in isolation and in combination with each other are taken for comparison with heat transfer. The Y-Y’ Approach can similarly be applied in wave equations and other fields wherever normal calculus works or fails. Soil mechanics uses mathematical analogies from other fields of physical sciences and engineering to solve theoretical and practical problems; for example, consolidation theory is a replica of the heat equation from thermodynamics with the addition of the effective stress principle. An attempt is made to give them mathematical analogies.

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