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Structural design of powerhouses for hydropower projects

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Powerhouse for a hydropower project is defined as a building which houses the turbine, crane, the rotor assembly area, cable trays and other ancillary mechanical and electrical systems. Different structural systems for the superstructure are proposed in powerhouses already constructed or under construction in various parts of the world combining both RCC and structural steel elements. These systems are as enumerated as: (1) RCC superstructure with RCC girder for EOT cranes and trussed steel roof, (2) RCC superstructure with RCC girder for EOT cranes and portal steel roof, (3) RCC superstructure with steel girder for EOT cranes and trussed steel roof, and (4) Steel superstructure with steel girder for EOT cranes and portal steel roof. The substructure of the powerhouse consists of the scroll case and draft tube which varies with the type of turbine proposed viz. Pelton, Francis (both vertical and horizontal), Kaplan etc. The scroll case also can be only concrete or steel lining embedded in concrete. The design of the superstructure is basically a 3-dimensional frame design done using various state of art software like STAAD.Pro. Here the design is checked for serviceability conditions like deflection and crack width as well as for structural adequacy. The columns, beams and the girders that form part of the 3D frame are provided with adequate size to meet the serviceability criteria and adequate reinforcement to take care of different compressive, bending and tensile stresses. The design of the substructure on the other hand basically revolves around two components; the scroll case and draft tube. The scroll case is essentially tube carrying water with changing dimensions as it empties into the draft tube. As such it can be designed by taking cross-sections at regular intervals. For steel scroll cases, the design of the steel part lies with the electromechanical vendor. However the concrete embedment around the steel casing is done by civil team. The civil design majorly depends on the pressure to be taken by the steel part and the concrete embedment. An initial gap between the two parts is kept so that the head on the scroll case is shared. The draft tube on the other hand is like a box with increasing height as it goes and meets the tail race. Generally it is a RCC structure and is designed like a box with intermediate piers.

Biography

Honey Mehra has completed his BTech from IIT Delhi, India. He is a Consultant with Howe Projects Engineering Pvt. Ltd., a premier civil engineering consultancy organization. In past, he has worked with SNC Lavalin, SMEC, Geodata and EDF. He has been involved in detailed engineering of major hydropower projects like Kol Dam (800 MW), Srinagar (330 MW), Kameng (600 MW), Maheshwar (400 MW) and Pare (110 MW). He has published 2 books on Structural Engineering in RCC and Steel and has published papers in reputed journals like IABSE etc.

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