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Design of Elevated Metro Bridge

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Abstract: *A metro system is a railway transport system in an urban area with a high capacity, frequency and the grade separation from other traffic. Metro System is used in cities, agglomerations, and metropolitan areas to transport large numbers of people. An elevated metro system is more preferred type of metro system due to ease of construction and also it makes urban areas more accessible without any construction difficulty. An elevated metro system has two major elements pier, piles cap, and box girder. The present study focuses on two major elements, pier, piles cap and box girder, of an elevated metro structural system.*

The performance assessment of selected designed pier showed that, the Force Based Design Method may not always guarantee the performance parameter required and in the present case the pier achieved the target requirement. In case of Direct Displacement Based Design Method, selected pier achieved the behaviour factors more than targeted Values. These conclusions can be considered only for the selected pier.

The parametric study on behaviour of box girder bridges showed that, as curvature decreases, responses such as longitudinal stresses at the top and bottom, shear, torsion, moment and deflection decreases for three types of box girder bridges and it shows not much variation for fundamental frequency of three types of box girder bridges due to the constant span length. It is observed that as the span length increases, longitudinal stresses at the top and bottom, shear, torsion, moment and deflection increases for three types of box girder bridges. As the span length increases, fundamental frequency decreases for three types of box girder bridges. Also, it is noted that as the span length to the radius of curvature ratio increases responses parameter longitudinal stresses at the top and bottom, shear, torsion, moment and deflection are increases for three types of box girder bridges. As the span length to the radius of curvature ratio increases fundamental frequency decreases for three types of box girder bridges.

In the future, India wants to extent its existing metro system. An elevated metro system high above the city is one of the possible concepts in this concept and moreover in whether there can be gained profit on the elevated metro structure by applying Ultra High-Performance Concrete or Fibre Reinforced Polymers instead of conventional concrete. The objective is to determine the dimensions and normative structural verifications of the elevated metro structure when this is made of conventional concrete, Ultra High-Performance Concrete or Fibre Reinforced Polymers and to compare these designs with each other.

The design study concerns the structural design and analysis of the elevated metro structure and results in three designs made of respectively conventional concrete, Ultra High-Performance Concrete (UHPC) and Fibre Reinforced Polymers (FRP). The literature and preliminary study give information about important aspects of elevated metro systems, UHPC and FRP and has as major objective to determine the height and span of the elevated railway for the application of an elevated metro system in India.

Ultra-High-Performance Concrete (UHPC) is a result of the search for a concrete with a higher strength. The strength classes of UHPC range between C90/105 and C200/230. The creation of UHPC is made possible by changing the design of the concrete mix by: improving the homogeneity and the microstructure, increasing the package density, adding steel fibres and reducing the water cement ratio. The material has a high durability and can result in more slender structures. The costs are however high compared with conventional concrete. Furthermore, the mix design of UHPC is complex and deserves special attention. It is assumed to be the best to utilize precast UHPC elements instead of in-situ UHPC. For the design of the elevated railway made from UHPC in the design study a thesis is used.

Fibre Reinforced Polymers (FRP) is a composite material. FRP consists of load-bearing fibres and a polymer resin matrix in which they are embedded. Whereas the fibres exercise the actual load-bearing function, the polymer matrix essentially has four functions:

• Fixing the fibres in the desired geometrical arrangement
• Transferring the forces to the fibres
• Preventing buckling of the fibres under compression actions
• Protecting the fibres from humidity etc.
There is a wide range of FRP producible which has resulted in few standard composites and standard codes. FRP has a very high strength at low weight and by adding additives it can be mixed for many suitable applications. And as there is a wide range of FRP producible there are also many manufacturing processes. Points of interest are the possibility of delamination and the stiffness of the bridge. The cost for FRP is relatively high. Sandwich construction is commonly used with composites to increase structural efficiency, with the FRP forming the outer skins and bonded to a variety of core materials. For the design of the elevated railway made from FRP in the design study a thesis is used..

Keywords: Metro Bridge

REFERENCES

[1]. Abdelfattah, F. A. (1997). Shear lag in steel box girders. Alexandria Eng. J., Alexandria Univ., Egypt, 36 (1), 1110–1118.
[2]. Armstrong, W. L. and Landon, J. A. (1973). Dynamic testing of curved box beam bridge. Fed. Hwy. Res. and Devel. Rep. No. 73-1, Federal Highway Administration, Washington, D.C.
[3]. Balendra, T. and Shanmugam, N. E. (1985). Vibrational characteristics of multicellular structures. J. Struct. Engrg. , ASCE, 111 (7), 1449-1459.
[4]. Bazant, Z. P. , and El Nimeiri, M. (1974). Stiffness method for curved box girders at initial stress. J. Struct. Div., 100 (10), 2071–2090.
[5]. Buchanan, J. D., Yoo, C. H., and Heins, C. P. (1974). Field study of a curved box-girder bridge. Civ. Engrg. Rep. No. 59, University of Maryland, College Park, Md.
[6]. Chang, S. T., and Zheng, F. Z. (1987). Negative shear lag in cantilever box girder with constant depth. J. Struct. Eng., 113 (1), 20–35.
[7]. Chapman, J. C. , Dowling, P. J. , Lim, P. T. K. , and Billington, C. J. (1971). The structural behavior of steel and concrete box girder bridges. Struct. Eng., 49 (3), 111–120.
[8]. Cheung, M. S., and Megnounif, A. (1991). Parametric study of design variations on the vibration modes of box-girder bridges. Can. J. Civ. Engrg., Ottawa, 18(5), 789-798.
[9]. Cheung, M. S., and Mirza, M. S. (1986). A study of the response of composite concrete deck-steel box-girder bridges. Proc., 3rd Int. Conf. on Computational and Experimental Measurements, Pergamon, Oxford, 549-565.
[10]. Cheung, M. S., Chan, M. Y. T., and Beauchamp, T. C. (1982). Impact factors for composite steel box-girder bridges. Proc., Int. Assn. for Bridges and Struct. Engrg. IABSE Colloquium, Zurich, 841-848.
[11]. Abdelfattah, F. A. (1997). Shear lag in steel box girders. Alexandria Eng. J., Alexandria Univ., Egypt, 36 (1), 1110– 1118.
[12]. Armstrong, W. L. and Landon, J. A. (1973). Dynamic testing of curved box beam bridge. Fed. Hwy. Res. and Devel. Rep. No. 73-1, Federal Highway Administration, Washington, D.C.
[13]. Balendra, T. and Shanmugam, N. E. (1985). Vibrational characteristics of multicellular structures. J. Struct. Engrg. , ASCE, 111 (7), 1449-1459.
[14]. Bazant, Z. P. , and El Nimeiri, M. (1974). Stiffness method for curved box girders at initial stress. J. Struct. Div., 100 (10), 2071–2090.
[15]. Buchanan, J. D., Yoo, C. H., and Heins, C. P. (1974). Field study of a curved box-girder bridge. Civ. Engrg. Rep. No. 59, University of Maryland, College Park, Md.
[16]. Chang, S. T., and Zheng, F. Z. (1987). Negative shear lag in cantilever box girder with constant depth. J. Struct. Eng., 113 (1), 20–35.
[17]. Chapman, J. C. , Dowling, P. J. , Lim,
[18]. P. T. K. , and Billington, C. J. (1971). The structural behavior of steel and concrete box girder bridges. Struct.

Eng., 49 (3), 111–120.
[19]. Cheung, M. S., and Megnounif, A. (1991). Parametric study of design variations on the vibration modes of box-girder bridges. Can. J. Civ. Engrg., Ottawa, 18(5), 789-798.
[20]. Cheung, M. S., and Mirza, M. S. (1986). A study of the response of composite concrete deck-steel box- girder bridges. Proc., 3rd Int. Conf. on Computational and Experimental Measurements, Pergamon, Oxford, 549-565.
[21]. Cheung, M. S., Chan, M. Y. T., and Beauchamp, T. C. (1982). Impact factors for composite steel box-girder bridges. Proc., Int. Assn. for Bridges and Struct. Engrg. IABSE Colloquium, Zurich, 841-848.
[22]. Cheung, Y. K. , and Cheung, M. S. (1972). Free vibration of curved and straight beam-slab or box-girder bridges. IABSE Periodica, Zurich, 32(2), 41-52