



Temperature Effects on Box Girder for Changsha Medium-low Speed Maglev under Solar Radiation

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Abstract

The admissible value of the gap between the Maglev train and track beam is small, so the requirement of structural deformation in a maglev bridge is strict. However, under the effects of solar radiation, the box girder in a medium-low speed maglev bridge could induce noticeable temperature gradient, impacting the bridge deformation and the geometric alignment of rail. To determine the changing law of the temperature field and deformation, some temperature sensors were embedded in the concrete box girder and approximately one year temperature data were obtained. Based on the field experiment, the temperature field and the longitudinal and transverse temperature gradient of a box girder were discussed. In addition, a finite element model is established to represent the box girder of China Changsha Medium-Low Speed Maglev Railway, for studying the temperature gradients and thermal deformation of box girder under solar radiation. With the three-dimensional finite element model, the value of thermal deformation caused by the temperature gradient was discussed. Medium-low speed Maglev Bridge is a new structure, the research focused on the temperature effect is creative and meaningful to similar structure. It is hopeful that the findings from this study provide some insights on the temperature distribution of a box girder and the temperature effects on medium-low speed maglev rails.

Keywords: Maglev railway; temperature gradient; thermal deformation; solar radiation; FE analysis

1 Introduction

By virtue of small noise, shorter turning radius, strong gradeability, energy saving and environmental protection, middle-low speed maglev train enjoys vast prospect in urban transportation, among which concrete simply supported beam is extensively applied to maglev bridge structure¹. Due to the low thermal conductivity of concrete, under sunlight or cold wave, the adverse non-linearity temperature gradient will form inside hollow box girder and between external wall, which will generate

temperature stress and temperature deformation with influencing the safety as well as comfort of maglev train².

At present, various countries' researches on bridge temperature field mostly focus on railroad and highway bridges, where those about temperature mode of box girder are in detail³. However, since there is great difference between structural style of maglev simply supported beam and existing bridge structure, the adoption of same temperature mode carries irrationality to some extent^{4,5}. The researches on concrete box girder temperature field and deformation mainly