Three-Dimensional Thermal Modeling of Temperature Variation in Concrete Box-Girders Using COMSOL Multiphysics®

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Abstract

COMSOL's Heat Transfer module was used in this study to evaluate the temperature distribution in concrete box-girders subjected to exterior thermal conditions. The included thermal loads were air temperature, wind speed in addition to solar radiation. Moreover, the reflected radiation from the ground and other surroundings in addition to the mutual radiation between the different surfaces of the girder and the re-radiation of the exterior surfaces to atmosphere were modeled. The model's output temperatures were compared with experimental measurements from a full-scale concrete girder segment, which was constructed for this purpose. The results showed good agreement between the experimental records and the COMSOL Multiphysics® finite element model. The average absolute error between the measured temperatures of more than 60 experimental thermocouples and the COMSOL's predicted temperatures at the same locations was in general less than 1.5℃.