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Post-Fire Behavior of Post-Tensioned Segmental Concrete Beams under Monotonic Static Loading

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Abstract

This paper presents a study to investigate the behavior of post-tensioned segmental concrete beams that exposed to high-temperature. The experimental program included fabricating and testing twelve simply supported beams that divided into three groups depending on the number of precasting concrete segments. All specimens were prepared with an identical length of 3150 mm and differed in the number of the incorporated segments of the beam (9, 7, or 5 segments). To simulate the genuine fire disasters, nine out of twelve beams were exposed to a high-temperature flame for one hour. Based on the standard fire curve (ASTM – E119), the temperatures of 300°C (572°F), 500°C (932 $^{\circ}$F), and 700°C (1292°F) were adopted. Consequently, the beams that exposed to be cool gradually under the ambient laboratory condition, after that, the beams were loaded till failure to investigate the influence of the heating temperature on the performance during the serviceability and the failure stage. It was observed that, as the temperature increased in the internal layers of concrete, the camber of tested beams increased significantly and attained its peak value at the end of the time interval of the stabilization of the heating temperature. This can be attributed to the extra time that was consumed for the heat energy to migrate across the cross-section and to travel along the span of the beam and deteriorate the texture of the concrete causing microcracking with a larger surface area. Experimental findings showed that the load-carrying capacity of the test specimen, with the same number of incorporated concrete segments, was significantly decreased as the heating temperature increased during the fire event.

Keywords: Segmental Beam; Post-tensioning; Fire Test; Gradual Cooling; Serviceability; Load Capacity.

1. Introduction

Post-tensioned segmental concrete girders have a significant implementation in bridge engineering due to the facilities that offered during the construction process. This method of construction has many advantages such as substantial economical savings due to the possibility of weather-independent segment production and a shorter construction period, simple element assembly at the job site, replacement ability of deteriorated tendons, the concreting and prestressing operations are independent, small light segments, profiling of the main external steel is easier to check, and the friction may be reduced [1]. It is well known that the strength of reinforced concrete and prestressed concrete members decreases after the exposure to a fire disaster. The main fire safety objectives are to protect life and prevent failure. Following a fire, if no collapse happens, there is a possibility of fire-induced damage. It should be noted that the study of the heating history of concrete is very significant to define whether the concrete structure exposed to fire and its components remain intact from the structural aspect. The evaluation of concrete

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