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A Comparison of Spectators Induced Grandstand Vibrations and Fans Behavior during Two Ice Hockey Games between the Same Teams in the Regular Season and in the Playoffs

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Abstract

The paper deals with spectators induced vibration on a grandstand and monitoring of fans behavior during ice hockey games. The previous experiments focused on the football spectators behavior and grandstand vibrations were carried out at the AC Sparta football stadium in Prague in 2013 and in 2015 [1, 2, 3]. The followed experiments described in the paper continued on above mentioned ones. The topic is the same, only fans are different – ice hockey fans. The experiments were realized at the ice hockey stadium in Pilsen and compared the behavior of spectators during two matches of the same two teams but in different phases of the competition – the regular season and playoffs. The experiment was focused on the part of the stadium where the most active fans of the home team are usually concentrated. The observed grandstand vibrations were substantially smaller than at the football stadium. It was caused partially by the different grandstand structural systems and also by the dissimilar behavior of football and ice hockey spectators.

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Keywords: grandstand; ice hockey stadium; concrete frame structure; playoffs; sport fans' behavior; experiment; vibration

1. Introduction

At present time, the dynamic load of grandstands is not described in any standard with acceptable precision. However, new spectator's crowd dynamic load models have been currently developed that are based on stochastic

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approaches [4, 5, 6]. There is a lack of suitable in situ experiments that could be used as a basis for its improvement or verification [7, 8, 9], and moreover, these experiments are focused only on football matches [8, 9] or concerts [9].

The paper introduces the brief summary and comparison of basic results evaluated after monitoring of grandstand vibrations during two ice hockey games. The experiments were focused on the fans behavior and its influence on the level of induced vibrations. They were realized at the ice hockey stadium in Pilsen. It is the home stadium of the HC Skoda Pilsen which fought its way into playoff. Its rival in the first round was the team HC Mora Olomouc. Two matches between the above mentioned teams were chosen for evaluation – their last match of the regular season of the Czech Ice Hockey Extraleague and the first match of the playoff (quarterfinal).

In the monitored area (see Fig. 1), where the most active fans of the home team were gathered, the load bearing structure of the grandstand is the reinforced concrete frame constructed of horizontal beams, sloping beams and columns mainly (see Fig. 1). This type of a structure is naturally less sensitive to dynamic excitation than the steel cantilever grandstand monitored during the experiments performed on the football stadium [1, 2, 3].

The main aim of the experiments was to monitor spectators' behavior and induced vibrations in the selected grandstand area to prepare an experimental basis for specification and verification of new spectators' crowd load models that have been developed newly [4, 5].

Fig. 1. The view on the observed grandstand sector, where the most active home fans are usually gathered (left) and the bottom view on the same sector with the location and orientation of the accelerometers used in the experiments (right).

2. The Experiment Arrangement and Description of the Monitored Games

The grandstand vibrations were observed in three points on the bottom surface of the grandstand (see Fig. 1). The four piezoelectric acceleration transducers Brüel&Kjær of type 4507 B005 were used for both experiments. Two vertical transducers (Sensor No. 1 and Sensor No. 3 in Fig. 1) were placed on the sloping main girders of the grandstand in the middle of their spans. The other two transducers were placed on the T-shaped reinforced concrete beam in the middle. One of them measured the vertical accelerations (Sensor No. 2 in Fig. 1) and the second one measured horizontal transversal accelerations (Sensor No. 4 in Fig. 1). There was chosen a T-shaped beam on which the highest concentration of the core of fans was supposed. The data acquisition of the grandstand vibration during both monitored matches was realized by the measurement system Front-end 3050-B-040 and the software Pulse of the company Brüel&Kjær. The measured accelerations gave us only an idea about the effect of spectators' behavior but it is also necessary to know which type of the behavior induces which type and level of grandstand vibration. For this reason the studied area of the grandstand was monitored by a camera placed on the opposite site of the stadium.

The experiments were carried out during two ice hockey games with the same rivals, concretely in the regular season and in the playoffs. The first observed game was played on the 2nd February 2016 between the teams HC Škoda Pilsen and HC Mora Olomouc. The home team won 3:2 after shootout. The second observed game between