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ORIGINAL ARTICLE

Experimental investigation of local scour around multi-vents bridge piers

Yasser A. Mohammed [a,*], Yasser K. Saleh [b], Abdel-Azim M. Ali [c]

[a] Water Eng. Dept., Faculty of Engineering, Zagazig University, Zagazig, Egypt
[b] Higher Technological Institute, 10th of Ramadan City, Egypt
[c] Hydraulic Research Institute, Egypt

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KEYWORDS

Bridge pier;
Local scour;
Collar;
Sacrificial pile;
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Hydraulic structures

Abstract The harmful effect of local scour around bridge piers and abutments can induce high maintenance costs or even bridge collapse resulting in the disturbance of traffic and possibly human losses. In the present research, an experimental study was carried out to investigate local scour around multi-vents bridge supports. Different methods of scour-countermeasures were applied to minimize and control the formed scour around bridge supports. It was found that, using collar around piers, current deflectors and sacrificial pile upstream piers reduced local scour depth by more 90%.

1. Introduction

Scour is the most serious waterway problem at which greater than 60% of the reported failures can be attributed to it [26]. There are many reports about bridges failure around the world due to scouring [10,15]. The mechanism of scouring around a bridge pier is very complex and has been reported by various investigators [9,14] and [5]. Abdelhafiz [3] studied the effect of pier shape and spacing on energy loss and scour around bridge piers. It was found that the maximum scour occurs upstream of the pier and the depth of scour hole increases as tail Froude number increases. Fotherby and Jones [8] used collars around bridge pier for reducing and controlling local scour depth. The authors recognized the potential usage of both a collar and a footing for scour reduction. Experimental studies were applied using piers provided with slots and collars under different flow conditions by Kumar [12]. Kumar et al. [13] studied the efficiency of slots with different lengths and angles of attack. It was concluded that a slot can be effective in reducing scour, particularly if it extends into the bed, and that the slot is practically ineffective if the approach flow has a high obliquity with respect to the slot. Zarrati et al. [27] worked on the application of a collar to control the scouring around rectangular bridge piers having a rounded nose. It was found that collar effectiveness improves as the collar becomes wider and as the level at which it is positioned on the pier becomes lower. Reduction of local scour in the vicinity of circular bridge pier groups using collars and riprap was studied by Zarrati et al. [28]. The effect of triangular collar around bridge pier was studied experimentally by Mohamed et al. [18]. Different shapes and

* Corresponding author. Tel.: +20 966 551 195 776.
E-mail address: Yasser_eng1997@zu.edu.eg (Y.A. Mohammed).
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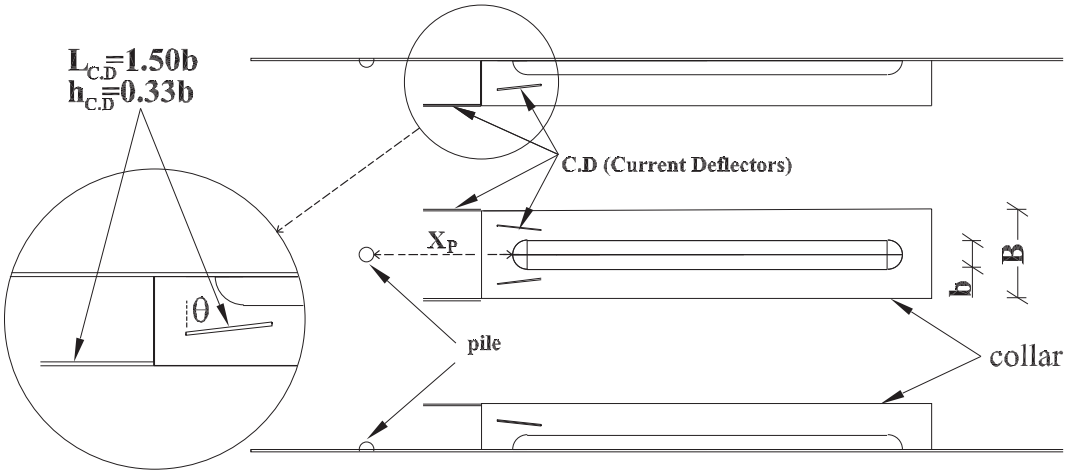

Figure 1 Sketch for experimental model details.

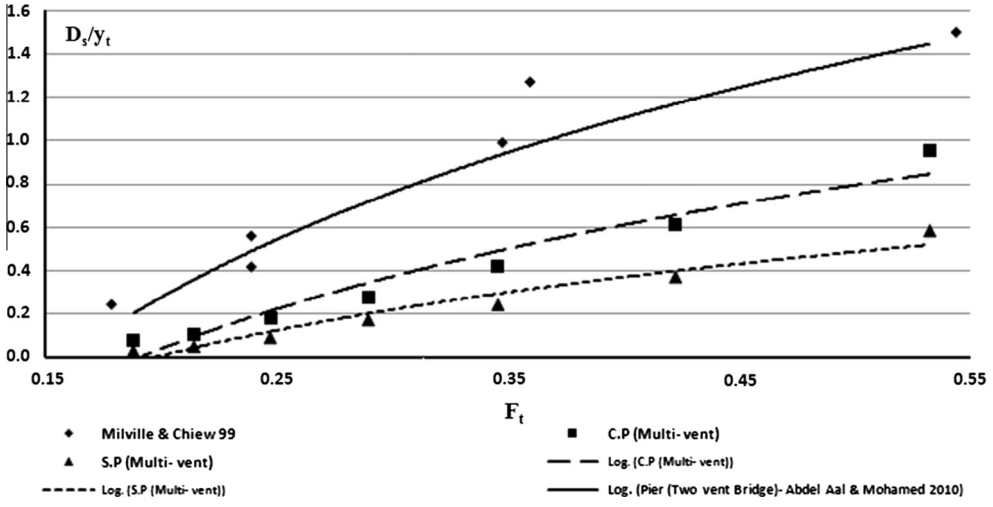

Figure 2 Relative scour depth D_s/y_t versus tail Froude number F_t for, (i) Central pier (C.P) and side pier (S.P) case of multi-vents bridge, (ii) case of two vents bridge.

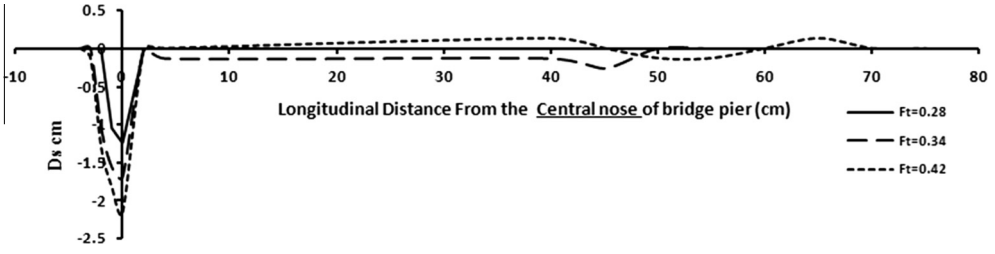

Figure 3 Scour profiles in case of C.P at different Froude numbers (F_t).