Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 3, Issue, 12, pp.158-159, December, 2011

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECT OF WATER EROSION ON STRUCTURAL STABILITY OF PIERS BRIDGE USING MATHEMATICAL MODELS

Farshid Hemmati* and Mahta Yazdi Nezhad

Department of Civil Engineering, Shoushtar Branch, Islamic Azad University, Shoushtar, Iran

ARTICLE INFO

Article History:
Received 26th August, 2011
Received in revised form
17th October, 2011
Accepted 17th November, 2011
Published online 31th December, 2011

Key words:
Water scour,
Piers,
Mathematical model.

ABSTRACT

Water erosion is a phenomenon causes piers to be destructed. Effect of water erosion on structural stability of piers in Khouzestan Sate, Iran is the main purpose of this research. Happening flood and existence of flood plain in this area causes to study the case study subject. The mathematical methods to study about stability changes rather than water erosion are valuable to be considered by applied and useful result obtained to be applicable to prevent destructing rate critically. The Izard-Bravley and Chitale methods have the least errors rather than reality. We reach to the conclusion that, the best methods of determining the depth of scour khouzestan state bridges was Izard-Bravley and Chitale. The end off, reconciling the methods show in this research %8.8 and %2.41 the better than original methods.

INTRODUCTION

Water erosion around hydraulic structures is one of important parameters to influence on operation and stability hydraulically.(6). Existence of piers in river currents routs through canals needs fastening them and study changing to analyze and optimize materials of the structures about water erosion. As a result of this phenomenon, materials of bottom separate from the flood of river canal and will be transferred to other locations in canal by current stress, and so water erosion affect on river canal hydraulically. We can say many bridges have been destructed due to water erosion so far, for example in the sachuhary river of New York in 1987. And 5 bridges in California in 1995. Leading to 7 persons death. The purpose through this paper following one research is considering accuracy and correctness of the relations about water scour of piers comparing with this phenomenon values measured in field. In this research using zonal analyze of flood, statistical-probability analyze the partial series and then field information, water erosion of hydraulic structures will be consider and studied and at last, theoretical fundamentals of preventing destruction the structures will be presented.

MATERIALS AND METHODS

To do this research, fourteen bridges were selected to investigate, 4 through Ramhormoz-Bahbahan,3 through Ramhormoz-Baghmalek, 1 through Ahwaz-Bandar emam, 1 though Andimeshk-Ahwaz and 5 bridges througd Dezful-Shoushtar called: Karimi,Armash, old julaki, Hosseinieh, Zolfeghar, Rood zard, Shoor khalfahad, Ramshir, Balarood and etc. to determain deby of rivers, we have used relations to cover bridges on non-main rivers (5).

***Corresponding author:** fhemmati@gmail.com

The case study relations

a) Formula and relations for determining theorical water erosion. There are some numerical methods and mathematical relations to study theorical water erosion through river canals:

$\frac{ds}{y} = 2.15(\frac{b}{y})^{0.4}(\frac{v}{\sqrt{gy}})^{0.33}$ Livetal (1961)

$\frac{d_s}{y} = 2(\frac{b}{y})^{2/3}.F_r^{2/3}$ Live (1961)

$\frac{d_s}{y} = 6.65F_r - 0.51 - 5.49F_r^2$ Chitale (1962)

$\frac{d_s}{y} = 1.95(\frac{b}{y})^{1/4} - 1$ Arunachlam (1965)

$\frac{d_s}{b} = 3.4(\frac{y}{b})^{1/3}.F_r^{2/3}$ Shen (1969)

$d_s = 1.05b^{0.75}$ Shen (1971)

$\frac{d_s}{y} = 2.2(\frac{b}{y})^{0.65}F_r^{0.43}$ Clorado Univ (1975)

$\frac{d_s}{y} = 2k_1k_2(\frac{b}{y})^{0.65}F_r^{0.43}$ Clorado Univ (1988)

$d_s = 1.49b^{0.9}.(\frac{V^2}{2g})^{0.1}$ Calman

$\frac{ds}{b} = 2.089(Fr)^{2/3}.(\frac{y}{b})$ Johnson's (1992)

For determining of theoretical water erosion at the case study pier bridges, identified hydraulic river characteristics and the parameters that affect on this phenomenon such as pier widths and form, sediment texture of the river bed, appropriate manning coefficient, river bed slope in location of piers and river profile were surveyed, by field study. River debies obtained by arithmetic methods, then theoretical water erosion calculated.

b) Mathematical relations to the study deby

As a result of some case study rivers were seasonal and lack of hydrometery sites, we used regional flood relations for determining of around piers debies in Ramhurmoz-behbahan basin, and for determing the same parameter in Ramhormuz-Baghmalek, we applied statistical of partial cerise; Also Because of accessibility to annual flood data, we applied different periodic of debies approach ; that results were presented as followings:

For Ramhormoz-Bahbahan Basin
$Q_{2year} = 0.2691A+12.079$ $R^2=0.91$
For Ramhormoz-Baghmalek Basin
$Q_{ave} = 0.2263A^{1.2541}$ $R^2=0.74$

The result of theorical-field scour ratio in case study pier bridges and average of relative errors demonstrated that Izard-Bravley and Chitale relationships had minimum of average relative errors.

The percentage of relative error for scour used so far in many of researches is as following.

$$\lambda = \text{Percentage of relative error} = \frac{\text{theorical water erosion}}{\text{field water erosion}} \times 100$$

$$\text{Average of relative errors} = \frac{\sum_{i=1}^{n} \lambda}{n}$$

IV. RELATIONS ADJUSTMENT

Izard-Bravley and Chitale relationships had least average errors than the other water erosion relationships. Therefore adjustment Izard-Bravley and Chitale relationships are necessary for achieving to appropriate relations in the study area.

(Izard-Bravley adjusted relation)

$$\frac{d_s}{b} = 6.1437\, F_r^{1.2315} .(\frac{y}{b})^{1.0086}$$

(Chitale adjusted relation)

$$\frac{d_s}{y} = 60.586F_r^2 - 19.351F_r + 2.437$$

DISCUSSION AND CONCLUSION

1. The obtained results show that percentages of relative error differ with each other under hydraulic conditions of the zone about estimating water scour depth, yet for the bridges, it may theoretical water scour depth will be measured several times rather than theoretical one. We have found that, there are some effective factors to influence on water scour through river canals.
2. The used relation in the paper prove depth of current, hydraulic depth section and pier diameter affect on water erosion.
3. Chitale relation predicts the least relative error for water section depth.
4. We can conclude that Chitale relation and Izard-Bravley one are applicable to appoint water erosion depth in khouzestan State.
5. Improved and corrected relations through this research have accuracies of %8.8 and %2.41 rather than main ones.

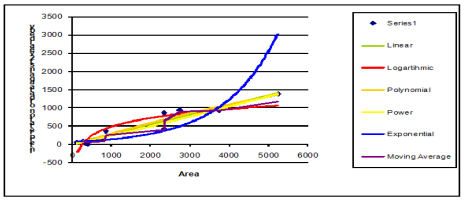

Fig.1. Interpretation of data against 2 year deby

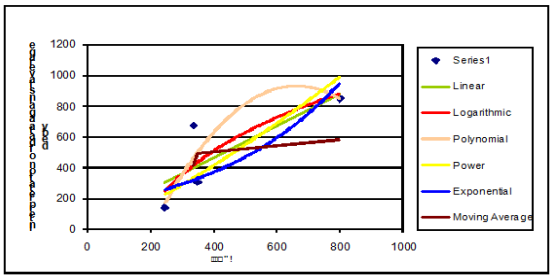

Fig. 2. Interpretation of data against average deby

REFERENCES

[1] Afshin, N. and Yazdan Doost, F.,(1996). Investigate and analyze the Local water scour of pier, MSc thesis of hydraulic structures, Nasir Toosi Univ.
[2] Hassooni Zade, H. and Bajestani, Sh.(1997). Considering water scour of piers, Shahid Chamran Univ.
[3] Publications of Management and Programming org. press,(2002). Manual of appointing water scour depth in methods of piers protection.
[4] First and Second studies of water supply reports, water eng. Company, Hydraulic report of Dezful.
[5] First and Second studies of water supply reports, 4&5 water-power force stations, Report of Hydrological studies.

****