

## **USING UNPARALLEL NETTED PLATES FOR CONTROLLING WAVES IN HIGH PREVENTING IN RIVER BEND WITH PHYSICAL MODELING**

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### **ABSTRACT**

The effect of fluid flow around cylindrical barriers placed in the path of the shear layer and thus the overlap caused by these parathion vortex flow lines, the waves perpendicular to flow is formed. Moreover, these waves in channels cause to raise water height in channels and as a result rising water level up to channel free height that is made other problems. In this study the phenomenon of waves perpendicular to the flow in the flume (a laboratory flume by 6 m in length, 72 m in width, and 60 cm in height with 0.005 grades is modeled. It was evaluated by constructing barriers. Barriers to the flow direction, a wooden cylinder with a diameter of 5 cm and a height of 35 cm on a metal plate mounted on the bottom of the flume (Tests did in 3 steps. And netted plates put between rows of barriers zigzag form, every other raw, and mixed. By changing the hydraulic conditions at different rates with different conditions in the wave flume was formed. In the wave resonance mode, a direct relationship between the wavelength of the waves and the arrangement of flat plates were laboratory. The frequency of the wave's perpendicular to the flow, a non-parallel arrangement and staggered barriers compared. The results showed that the waves generated in a Staggered arrangement mode is lower and the most decreasing in the waves' frequency was when 100% of an area used for cylinder was covered by netted plates in zigzag form that decreasing rate in frequency range was 80 to 82 percent.

**Keywords:** *Waves' Frequency, Netted Plates, Unparallel, Zigzag Decoration, River Bend*

### **INTRODUCTION**

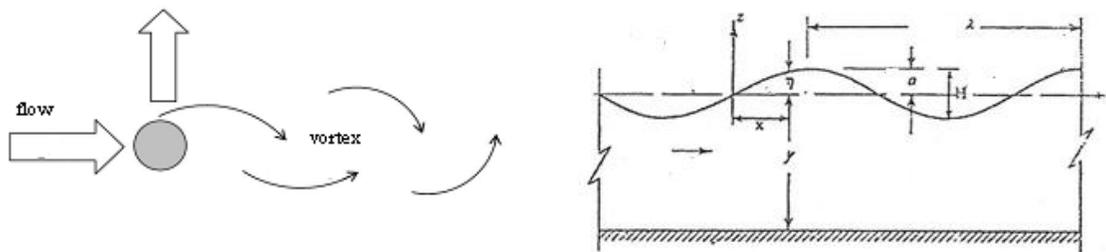
Wave is any turbulence that spread in space and often is result of energy. When we talk about wave, immediately we remember sea's shouting waves coming toward beach and beat themselves to rocks, these waves bring large quantities of energy far fetched sea to beach.

Waves always move to beach so, water only go up and down or front and back in its place. But wave is not only this type but we can name various kinds of waves that we see them in daily life for example, movement of trees' leaves by blowing wind, a little stone that fall into water, sound waves, electromagnetic waves, and other thousands samples.

Waves are divided two groups: water surface waves and water internal waves. Water surface waves are usually made by wind and have 3 to 25 alternation period and made main external specifications of coast areas. Internal waves are created by motion cutting on fluid. Knowing these waves and forces arising from them in order to designing coast projects is necessary.

These waves are main determining factors if coast geometry and they play an efficient role in some cases like programming and designing anchorages, waterways, coast protection methods, hydraulic factors and other developing and martial activities in coasts. Estimating waves' conditions mainly is necessary in all studies about coast engineering.

Perpendicular wave on current is a kind of internal waves and is a hydrodynamic phenomenon that is created in open conduits due to run fluid currents around barriers have put in fluid way. Vortex is created because of existing barriers in fluid way in open conduits like wharf and legs of the bridge and plant cover. These vortexes cover each other and consequently, transversal waves are made. At downstream some divided stream line may cause that wake and vortex will be happened at figure (1) schematic formation and other parameters of flow around bridge pier will appear.



**Figure 1: Schematic form of flow around bridge and width waves**

Transversal waves generated in open conduits can cause to erode river coast and also destroy legs of a bridge and make many social and economic loss. Therefore men's effort to avoid of generating these ruinous transversal waves can decrease resulted loss. There are many cases in open conduits that stable current flows among fixed barriers existed in current way. In order to strike fluid to these barriers, a boundary layer is formed on top edges and separated lines of current are formed on lower edges of barriers. Therefore, forming a boundary layer and separated lines can made vortex. Transversal waves generated because of vortexes covering.

First study about vertex formation have been studied at Gas Condition: struohal (1878), figured at noise from wires at wind blowing have direct relationship with wire diameter. Another studies about Gas fluid had been done by (Fitz-Hugh, 1973), (Belvins, 1985), (Ziada *et al.*, 1989) and (Hamakawa *et al.*, 2001). Besides, about vortex and its formation at flow many researches were been done. First study is about wave's production at open channel (Crasse, 1939). (Schuster, 1967) had studied some oscillation phenomenon about bridge pier (Laysand-Tison, 1968) had studied about some wave distribution come from bridge pier. Jim and Ackerman, (2002) proposed a new formula in order simulating maximum length of waves as none dimensional ( $AL$ ) equation. Assi *et al.*, (2006) have studied about wave between two- cylindrical blocks at open channel. Ghomeshi *et al.*, (2007) have studied reason of some vertical wave production at flow channel and a new formula non dimensional equation and calculating struohal number have been proposed. About possibility of formation and Investigation of vertical wave at flow conditional. When flow passed and some blocks existence at flow path didn't study yet. Kamanbedast *et al.*, (2010) Investigate of height preventing structures for vertical wave against flow in open channels by physical modeling.

#### **Materials and Methods-Specifications of a Laboratory Flume**

A laboratory flume used in this research, was a flume with a rectangle cut and variable slope that in tests of this research flume draft has been fixed 0.005. Flume length was 6m, flume width was 72.5 cm and its height was 60 cm. a schematic façade of a laboratory flume has been shown in figure 2.



**Figure 2: A schematic façade of a laboratory flume**

**Research Article**

**To Build Cylinder Barriers**

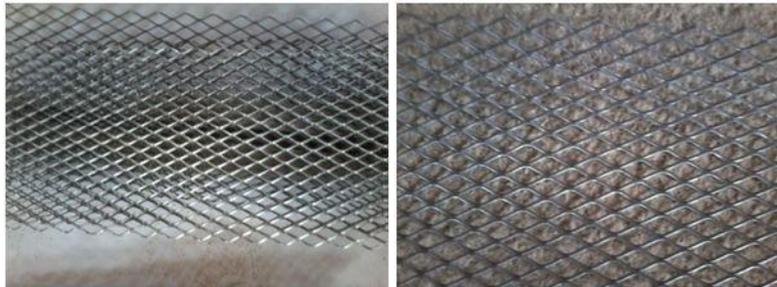
To do these tests 50 wooden cylinders by 25cm height and 5cm diameter were made. These cylinders should be so that can install them vertical on current way. In order to install these cylinders on steel plates' bottom of flume, on bottom of pedestal centre of cylinders and just vertical on the surface of the pedestal was drilled a 3mm hole by a legged drill and 4mm gimlet and then to install wooden cylinders on steel plates were used twisted wires by 4mm diameter and 4 cm length. And at the end in order to put netted plates between cylinder barriers, 2 fissures by 1\*1 dimensions (cm) were grooved through in the height of barriers by a groove machine. A sample of used cylinder barriers is shown in figure 3.



**Figure 3: Made cylinder barriers**

**Making Steel Netted Plates**

After making wooden cylinders and steel plates, netted plates are made in follow dimensions (35\*10). To make these plates we used steel netted screens that their nets diameter survey ratio of the screen grid diameter is about 80% (computation method of survey percentage of screen grid diameter to screen closed survey that used, do by opening area). Netted screen plates in various sizes were cut like figure 4.



**Figure 4: Netted plates made in different sizes**

In order to place cylinders and plates between the fissure of it and also plate's stability against current, plates' edges were nailed like figure 5.



**Figure 5: Barriers and netted plates arrangements in first step of tests**

**Research Article**

**Required Parameters in a Test and Measuring Method**

The object of tests done was to void of covering vortexes arising of barriers during forming waves with maximum range (wave's resonance condition) by using netted plates. For carrying out tests, mean depth of current, minimum and maximum oscillations of water surface were noted before installing plates.

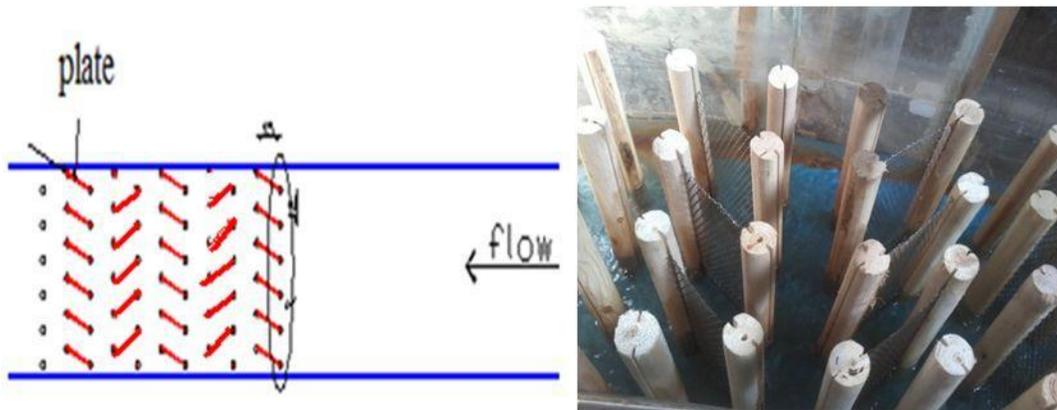
Firstly, in every step barriers were drowned and then in order to forming transversal waves and aggravating them, end gate was brought down 3 to 4mm every time.

After observing maximum oscillation of waves arising of barriers, netted plates were installed between cylinders unparallel and zigzag form and maximum and minimum oscillation of water surface and mean depth of current was measured again.

**Tests of the First Step (Every Other Rows Arrangement of Netted Plates)**

In this step setting netted plates in every other row between cylinder barriers was surveyed. Here like previous situation distance between cylinders in continuous rows and between barriers rows along flume was chosen 10cm (unparallel arrangement) and after flowing current with different discharge( l/s) and setting current depth trough existed window in lower part of the flume, waves vertical on current were generated.

After generating perpendicular waves on waves arising of cylinder barriers and measuring waves' oscillation, netted plates were placed shrewd and via unparallel between barriers rows like figure 6.



**Figure 6: Barriers and netted plates in second step tests**

**Second Step Tests (Zigzag Arrangement of Netted Plates)**

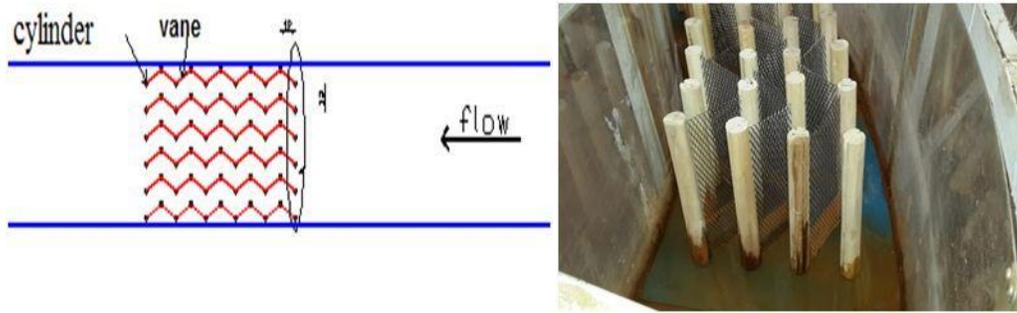
Second step tests were begun when distance between continuous barriers in every row and distance between rows of barriers along a flume was chosen 10cm (zigzag form).

After flow current by different discharges( l/s) and arrange current depth through the existed gate down of the flume, conditions for generating waves vertical on current was provided.

According to the aim is to generate wave by maximum oscillation, at first the window of the flume was raised to drown all cylinder barriers ( in this situation wasn't generated any wave), then the window was brought 3 to 4mm in every time to generate waves with maximum oscillation.

Maximum and minimum oscillation of waves was measured in 3 points of the flume (in beginning, between legs, at the end) by a ruler installed on the wall of the flume that the mean number is used in parameters.

Then, netted plates put between rows as zigzag form like figure 7 and then minimum and maximum oscillation of waves was measured. In index b have came barriers and netted plates.



**Figure 7: Setting netted plates between cylinder barriers in zigzag form**

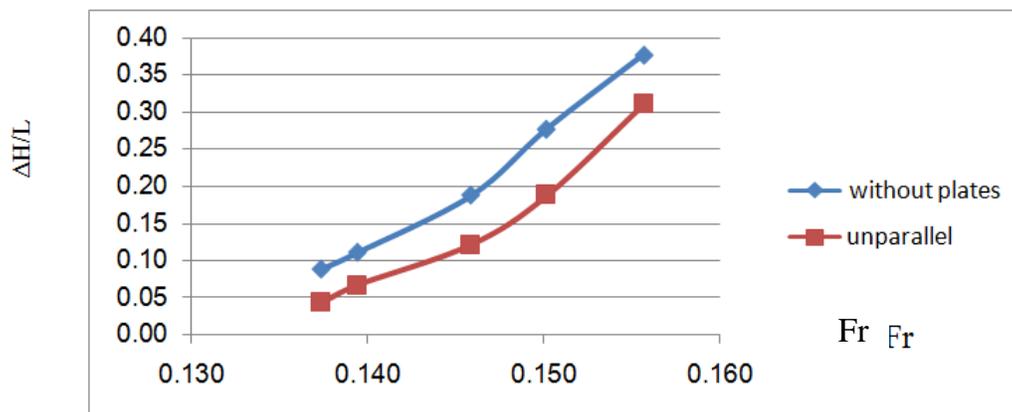
At first step of tests, distance between continuous rows and distance between rows along a flume was increased and tests repeated by zigzag arrangement of netted plates again. In figure 7 have shown pictures of barriers arrangement and netted plates in the first step of tests. It is necessary to say that in this step, after setting netted plates as scattered form between rows, generated waves frequency was observed ,ore than first and second steps; figure 8.



**Figure 8: The method of measuring wave in both models (unparallel and zigzag)**

## RESULT AND CONCLUSION

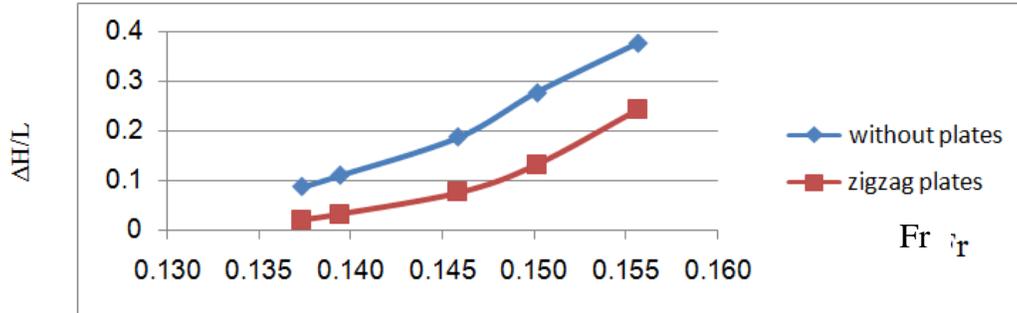
According to tests in hydraulic laboratory of KWPA of Khozestan has obtained results that will come following. In first step that netted plates installed unparallel between barriers rows and was covered by netted plates, decreasing rate in wave frequency .Comparison of the wave without plate and unparallel, first step tests in Figure 9.



**Figure 9: Comparison of the wave without plate and unparallel, first step tests**

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In second step that netted plates installed between barriers rows as zigzag form and 100% area that covered by barriers was covered by netted plates, decreasing rate in wave frequency more. Comparison of the wave without plate and zigzag, second step tests in Figure 10.

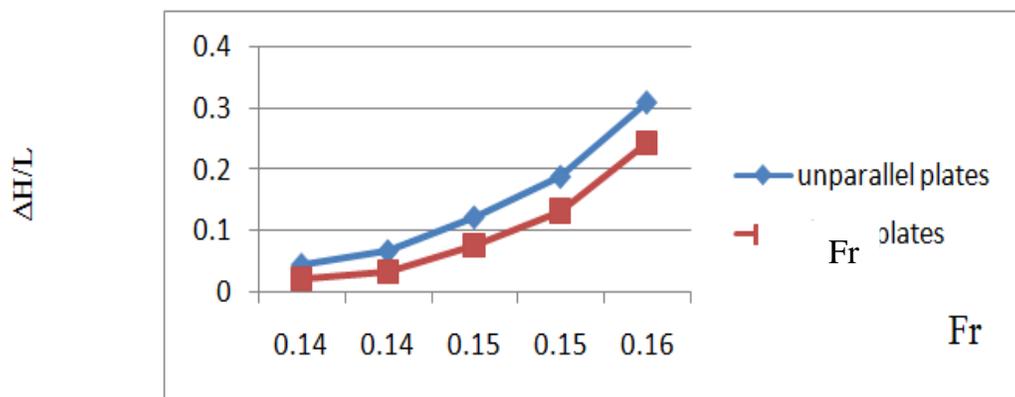


**Figure 10: Comparison of the wave without plate and zigzag, second tests**

Furthermore, investigation of relationship between percentage in wave in first step test and second, illustrate that the wave frequency with zigzag is less than the unparallel plate, because influence area is much more than the another (Table 2 and figure 11).

**Table 2: Comparison of the wave with unparallel plate and zigzag**

Q(ltr/s)	B(m)	L(m)	Y(m)	V(m/s)	FR	ΔH unparallel	ΔH/L unparallel	ΔH zigzag	ΔH/L zigzag
0.011	0.600	0.090	0.122	0.150	0.137	0.004	0.044	0.002	0.022
0.012	0.600	0.090	0.128	0.156	0.139	0.006	0.067	0.003	0.033
0.013	0.600	0.090	0.131	0.165	0.146	0.011	0.122	0.007	0.078
0.014	0.600	0.090	0.135	0.173	0.150	0.017	0.189	0.012	0.133
0.015	0.600	0.090	0.138	0.181	0.156	0.028	0.311	0.022	0.244



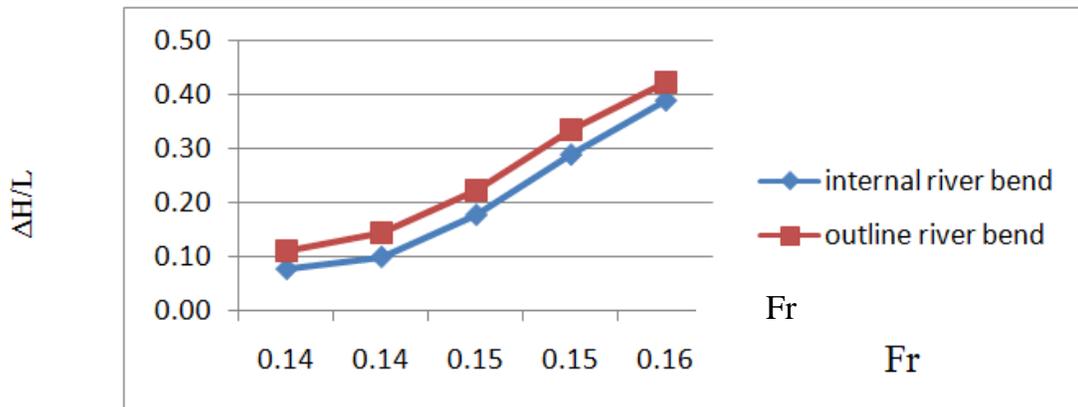
**Figure 11: Comparison of the wave in unparallel and zigzag model**

Observation shows that by 50% increasing in numbers of netted plates between barriers (zigzag model), can decrease approximately half of transversal waves frequency, while arising of covering barriers' vortex more desirable condition and better output.

In additional, it is important that relationship between percentages in wave in a bend of flume shows that the wave's frequency generated in the inner and outer arc (Table 3, Figure 12).

**Table 3: Barriers and netted plates arrangement in third step tests**

Q(ltr/s)	B(m)	L(m)	Y(m)	V(m/s)	FR	$\Delta H$ outline bend	$\Delta H/L$ outline bend	$\Delta H$ internal bend	$\Delta H/L$ internal bend
0.011	0.600	0.090	0.122	0.150	0.137	0.010	0.111	0.007	0.078
0.012	0.600	0.090	0.128	0.156	0.139	0.013	0.144	0.009	0.100
0.013	0.600	0.090	0.131	0.165	0.146	0.020	0.222	0.016	0.178
0.014	0.600	0.090	0.135	0.173	0.150	0.030	0.333	0.026	0.289
0.015	0.600	0.090	0.138	0.181	0.156	0.038	0.422	0.035	0.389



**Figure 12: Comparison of the wave in the outer and inner of bend**

### CONCLUSION

- 1- According to decrease velocity and specific energy cause to increase water depth, therefore each one of these netted plates cause to decrease velocity and energy of water. After setting netted plates mean depth of water was increased in any step of test but wave frequency was decreased.
- 2- In first step that netted plates installed unparallel between barriers rows and 35 percent of area covered by barriers was covered by netted plates, decreasing rate in wave frequency was between 40 and 50 percent.
- 3- In second step that netted plates installed between barriers rows as zigzag form and 100% area that covered by barriers was covered by netted plates, decreasing rate in wave frequency was between 70 and 80 percent.
- 4- Studying shows that by 50% decreasing in numbers of netted plates between barriers, can decrease half of transversal waves frequency, arising of covering barriers' vortex and obtain more desirable economic condition and better output.
- 5- Relationship between percentage in wave in a bend of flume shows that the waves frequency generated in the outer arc.

### ACKNOWLEDGMENT

This paper is taken from the research, of Hydraulic Structures, Ahvaz Branch, Islamic Azad University (IAU), and the authors would like to Special thanks to Office of Researches and Standards of Khuzestan Water and Power Authority and also thanks to Water Group of Khuzestan Water and Power Industry Educational Complex which helped us in research process of this paper.

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