# Study The Effect Of Off-Take Angle On Sediment Trapping At Channel Bifurcation In Krishna Canal

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***Abstract:*** *A bifurcation occurs when channel splits into two branches. Due to sedimentation flow had been reduced in irrigation canal is well as threatening the blockage of water during low water flow Sediment trapping at different off-take angles depends on distribution of sediment at that angle of bifurcation. From this study we get the sediment distribution pattern at different off-take angles $30^O$, $45^O$, $60^O$& $90^O$, for different discharges $Q_1$,$Q_2$,$Q_3$ . As discharge of main channel changes the behavior of sediment with respect to off-take angle also changes. The main purpose of this study is to minimize sediment trapping in open channel.$60^O$ off-take angle gives more uniform flow which gives maximum off-take outlet discharge. At 60 $^O$ off-takes distribution of sediment is more as compared to other off-take angles. For $45^O$ off-take angle receives the maximum sediment trapping as compared to $30^O$ & $60^O$ off-take angle. We conclude that $60^O$ off-take angle is optimum angle for minimum sediment trapping in trapezoidal channel.*

*Keywords: channel section, off-take angles, channel bifurcation, flow rates, bed load, suspended load*

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Notations:

| | |
|---|---|
| $Q_1$,$Q_2$,$Q_3$ | : Main channel discharge |
| $Q_{off}$ | : Off-take discharge |
| Ø | : Off-take angle |
| S | : Sediment trapped |
| $Q_{out}$ | : Cut throat discharge. |
| Ms | : Main channel sediment. |

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## 1.INTRODUCTION

The study of flow diversion in open channel which has been since long under consideration by hydraulic engineering .Canal irrigation are widely used for Agriculture purpose. Canal is defined as man-made channels for flow of the water with the help of gravity force. A bifurcation occurs when canal or stream splits into two branches, it occurs when a middle bar forms in a channel or a distributor carries flow from the main canal. The angle that the off-take channel makes with the outer part of the main canal is called the off-take angle or angle of twist. Sediment is a naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice by the force of gravity acting on the particle itself. There are two forms of sediment; one is bed load and another suspended load. Bed load is describes particles in a flowing fluid usually water that are transported along the bed. Bed load moves by rolling, sliding, and satiating. Generally bed load downstream will be smaller and more rounded than bed load upstream a process known as downstream fining. This is due in part to attrition and abrasion which results from the stones colliding with each other and against the channel, suspension by the turbulence in the flowing water and consists of particles generally of the fine sand, silt and clay size. Some of the factors that may influence suspended and bed load sediment distribution, includes main channel discharge, geometry and condition of the approaching channel which has greater importance. Sedimentation causes following problems,

i) Reduction in flow discharge capacity of the channel.
ii) Rough material could lead them to corrosion of channel walls.
iii) Sedimentation helps the conditions for vegetation growing which increase channel flow resistance.
iv) Sedimentation leads to expensive canal dredging work.

Sedimentation is main problems in open channel. Due to sedimentation flow had been decreased in irrigation canal is well as threatening the blockage of water during low water flow. Water plays main role for sediment transport in open channel. Sediment transport is the movement of solid particles (sediment),due to a combination of the force of gravity acting on the sediment, and/or the movement of the water in which the sediment is entrained. Transportation of sediment on open channel plays important role in sediment trapping. As discharge of main channel changes, the

sediment transport rate also changes which causes trapping of sediment. In Krishna canal the $90^O$, off-take angles are used to distribution of water due to $90^O$ off-take angle the discharge is decrease; the sediment distribution at that off-take angle is less so sediment trapping in the canal channel increased.

responsible for the planning of water projects may be expected to consider the optimum off-take angle for the canal off-take as one of the important factor to be considered in the alignment of the off-take

## 2. EXPERIMENTAL SETUP AND PROCEDURE:

When hydraulic problem is beyond an analytical solution, the physical models could be used to address such problems which may include sediment trapping and distribution problems, Physical model is commonly used to optimize structural design or ensure that a structure can operate properly. The physical model used for the experimental work is constructed using metal sheet on scale ratio of 1:50 for horizontal and 1:15 for vertical with a distortion 3.30 the metal sheet having with of 17 cm welded together to form the base of channel section. The main trapezoidal channel section is 400 cm long.

The discharge from main channel is measured by means of 'V' shaped notch of $90^O$ .The water depth in the upstream of the main channel is 5cm,4cm,3cm.For $Q_1$,$Q_2$,$Q_3$ discharges 'V' notch have been calibrated for finding the discharge. To perform test of experiments first of all discharges

The determination of the optimum off-take angle to limit the rate of siltation of the secondary canals would obviously reduce the frequency of dredging and untimely minimize the total cost associated with the operation and maintenance of installation downstream. Engineers particularly those

channels. Although much research is done on the flow pattern and sediments distribution, most of them are directed towards

the transmission of bed load. None of them carried out on off-take angle in trapezoidal channel. So we suggest 60 $^O$ off- take angles for minimum sediment trapping in Krishna canal.

of main channel $Q_1$=0.786l/s,$Q_2$=0.450l/s and $Q_3$=0.250l/s calculated respectively. We require four different

off-take angles of $30^O$, $45^O$, $60^O$& $90^O$ which are fitted at main trapezoidal channel with inclined bank. For off-take angle discharge at trapezoidal channel 1.5 cm diameter pipe is provided.

For measuring the main channel discharge at the end of channel the cut throat flume method is used. The detailed plan view of the model and its C/s are shown in fig. 2. The experimental work was carried out at the hydraulic laboratory of Civil Engineering Department. The experimental set up was sub divided into three major components mainly the water supply unit. Sediment supply unit and measuring unit. The circulation of water within the model was a closed system with a continuous supply of water is provided.

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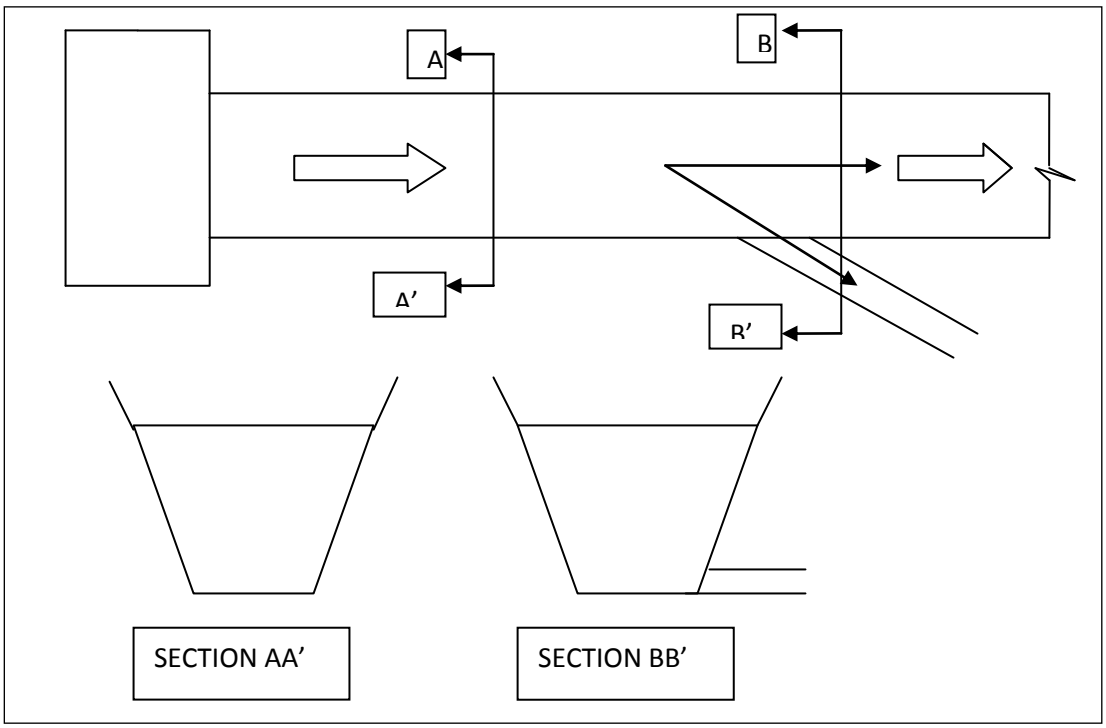


"Figure1 shows the detailed plan view of the model and it's C/s"

The hopper is used for continuous and proportionally the experimental work was carried out at the hydraulic laboratory of Civil Engineering Department. The experimental set up was sub divided into three major components mainly the water supply unit. Sediment supply unit and measuring unit. The circulation of water within the model was a closed system with a continuous supply of water is provided .The hopper is used for continuous and proportionally supply of sediment in channel section.

In the main channel, three flow rates with corresponds to the discharges $Q_1$, $Q_2$ & $Q_3$ was established. The flow depths corresponding to each of the flow rates were established and marked on the walls of main channel. The water in the sump was pumped to the elevated tank and supplied water to channel with a pipe. The valve is used to maintain the required water level.

Materials that have been used for the experimental work are soil, sand which is available on actual site of canal. A 250 gm of coarse materials were weighted out and added in to hopper, then sediment were dropped in channel uniformly This was done after one of the desired main channel flow rates which has been established by reference point.

In each case, the water level was controlled up to the level marked on trapezoidal channel, which gave the discharges $Q_1$, $Q_2$ & $Q_3$ .After given time interval samples in the channel at every off-take angles $30^O$, $45^O$, $60^O$& $90^O$ respectively. The sediments were travelled in channel section continuously up to water flow.

Samples are collected in beakers for every experiment performed. The beakers were weighted empty and thereafter weighted with samples before oven dried at temp. $103^O$C-$105^O$C,for twenty-two hours. The samples were also weighted after oven dried to determine the total sediment tapped at every off-take angle. For weighting the sediment the gravimetric method is used. The result obtained and was recorded as in presented in result.

## 3. RESULT AND DISCUSSION

| Q (l/s) | Ms (gm) | Ø | S (gm) | $Q_{off}$ (l/s) | $Q_{out}$ (l/s) |
|---|---|---|---|---|---|
| $Q_1$=0.786 | 250 | $90^O$ | 27.81478 | 0.144 | 0.640 |
| | | $60^O$ | 7.90611 | 0.186 | 0.600 |
| | | $45^O$ | 17.37736 | 0.124 | 0.662 |
| | | $30^O$ | 15.69103 | 0.162 | 0.624 |
| $Q_2$=0.450 | 250 | $90^O$ | 19.17364 | 0.118 | 0.332 |
| | | $60^O$ | 4.24098 | 0.168 | 0.282 |
| | | $45^O$ | 9.89412 | 0.120 | 0.330 |
| | | $30^O$ | 8.16263 | 0.150 | 0.300 |
| $Q_3$=0.219 | 250 | $90^O$ | 16.83618 | 0.78 | 0.141 |
| | | $60^O$ | 3.77719 | 0.102 | 0.117 |
| | | $45^O$ | 13.76718 | 0.084 | 0.135 |
| | | $30^O$ | 6.77284 | 0.094 | 0.125 |

Data obtained from the experimental work was used for final result. Result depicts the effect of discharge on the sediment trapping as obtained from table 1, the sediment distribution and sediment tapping at an various discharges of the main channel and off-take angles. An increase in main channel discharge will substantially increase the off-take discharge and consequently increase the off-take sediment distribution which minimizes the sediment trapping in channel. For off-take angle of $90^O$ & $45^O$ the off-take discharge was less as compared to the off-take $60^O$ & $30^O$. Due to less off-take discharge the distribution of sediment was less and trapping was more. For instance the off-take angle of $30^O$ with main channel flow rates of $Q_1$,$Q_2$ & $Q_3$ yielded sediment trapping values of 7.9061 gm, 4.2409 gm and 3.77719 gm respectively. This off-take sediment trapping values indicate that the maximum sediment distribution at an off-take angle gives minimum sediment trapping as compared to off-take angle $90^O$ with main channel flow rate Q1,Q2 & $Q_3$ yielded sediment trapping values of 27.0171, 19.1736 & 16.8361 respectively. For discharge $Q_1$ sediment transport

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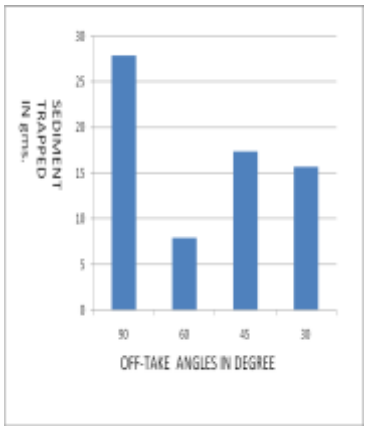
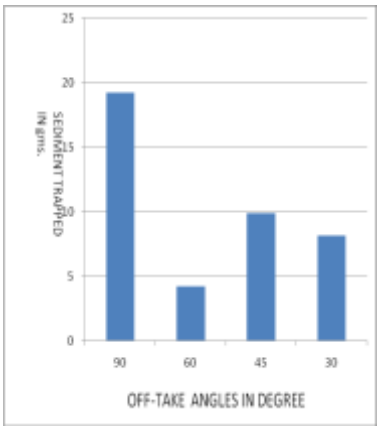
rate was more compared to $Q_2$ discharge. Hence sediment was more trapped for discharge $Q_1$.

Thus previous studies indicate that the increase in main channel discharge resulted in an increase in the off-take discharge corresponds to off-take angle. Also flow pattern displace different off-take angle discharge. Due to formation of eddies at $90^O$ off-take angle gave less discharge, while $60^O$ flow pattern gives mere uniform flow which gave maximum discharge.

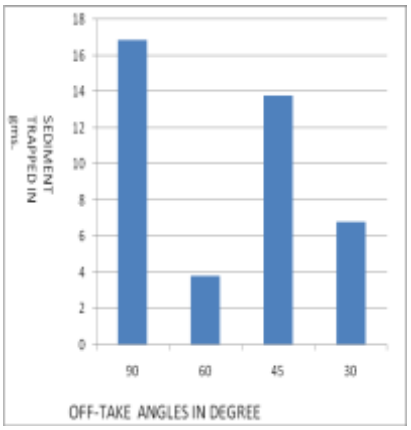
Sediment trapped at trapezoidal channel reveal that the minimum main channel flow rates of $Q_3$ yielded the minimum sediment trapping while $Q_1$ which was the maximum trapped. Main channel flow rates yielded maximum sediment trapped at on $90^O$ off-take angle.




For discharge $Q_1$




For discharge $Q_2$




For discharge $Q_3$

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## 4. CONCLUSION

In this study, experiment was conducted to measure the amount of sediment trapped at different off-take angles on a trapezoidal channel under different flow condition. Using obtained data it was found that the minimum main channel flow rate of $Q_3$ yielded the minimum sediment trapped at $60^O$ off-take angle.$Q_1$ which was the maximum main channel flow rate yielded the maximum sediment trapped at $90^O$ off-take angle. Also at higher discharge $Q_1$ sediment transport rate is more as compared to $Q_3$ discharge in open channel.$90^O$ off-take angle flow pattern form more Eddies which directly effects on discharge, while $60^O$ gives uniform flow pattern, increase off-take discharge in the main channel.

The sediment distribution pattern at an off-take angle $60^O$ received the minimum sediment concentration and maximum sediment distribution while those at $90^O$ off-take angle received maximum sediment concentration and minimum sediment distribution for the experimental study.

We suggest that for Krishna River $60^O$ off-take angles is optimum angle for minimum sediment trapping.

## 5. FUTURE WORK

For $45^O$ off-take angle receives the maximum sediment trapping as compared to $60^O$ & $30^O$ off-take angle.

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