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Studies on Strategic Flood Management of River Jhelum through Tunnel from Dogripora (Sangam) to Czhal (Boniyar) in the State of Jammu and Kashmir, India

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ABSTRACT

Jhelum is the main source of livelihood in the valley. It has been marred by extensive siltation in the past few decades. In absence of conservative measures, the river has lost its carrying capacity. The routing capacity of the Flood Spill Channel which starts from Padshahi Bagh and flows in Srinagar outskirts towards north Kashmir has got reduced to less than 4000 cusecs due to siltation and encroachment over the years. The drainage capacity of the River Jhelum and that of Flood Spill Channel has significantly reduced over time due to massive siltation and because dredging has not kept pace with the rate of siltation . The loss of wetlands that use to absorb water during the floods has resulted in increase in hydrograph peak.As a result Jhelum swells up quickly after just 100mm of rainfall in the catchment, spread over more than 8000 km2. Presently, Jhelum's maximum water carrying capacity is 60000 cusecs in south Kashmir. In Srinagar city , this capacity is to be restored to 35000 cusecs. The remaining 25000 cusecs is to be diverted through the flood spill channel, whose discharge capacity is also proposed to be increased. As observed in 2014, the discharge recorded in main Jhelum at Sangam was of the order of 1.2 lakh cusecs i.e. double the maximum carrying capacity of river. 60000 cusecs can be mitigated only when spill channel from Padshahibagh to Sopore could carry 25000 cusecs.and main River course, especially through Srinagar city, could take 35000 cusecs. The mitigation of balance 60000 cusecs is the burning problem. Studies on strategic flood management of river Jhelum through tunnel from Dogripora (sangam) to czhal (boniyar) in the State of Jammu and Kashmir, India as an alternative has been considered in the current studies. From the conclusion, it can be ascertained that a extra quantum of water can easily be diverted and floods like 2014 can be avoided.

Introduction

In Kashmir valley floods are causing devastation almost every five years. These floods occur through the river Jhelum. The only river flowing through the valley.

The flood problem in valley arises primarily from the inadequate carrying capacity of the Jhelum in its length from Sangam to Khadanyaar .The safe carrying capacity from Sangam to Wullar lake ranges between 40000 to 60000 cusecs and through the Srinagar town, only about 35000 cusecs. Compared to this flood discharge at Sangam rose to over 100000 cusecs in 1959.

In September 2014, the Kashmir region suffered disastrous floods across many of its districts caused by torrential rainfall.

On September 5, the Jhelum River was flowing at 34.7feet (10.7 m) which was 13.7 feet above the danger mark at Sangam in Anantnag. The discharge rate in the river was recorded as 115000-120000 cusecs against the normal discharge of 25,000 cusecs.

In order to increase the capacity of river, dredging is done of settled material, but dredging in this case is only a temporary remedial measure because the sedimentation is a recurring process. Therefore there is a need for a permanent flood mitigation measure.

One of the measures is construction of another 90 Kms.spill channel from Dogripora (sangam) to wullar. This involves land accusation and relocation of infrastructure facilities ,given the circumstances it is a Herculean task.

The permanent solution will be in the form of a tunnel starting from Dogripora to Czehal which will act as bypass for the extra discharge and thus the peak of flood hydrograph would get restricted to 60000 cusecs, there by averting the floods in the valley.

Causes

Flooding is not a one-dimensional phenomenon but a multi-dimensional one in which many factors play their respective roles as per the geography of the region and result in floods. The factors are –

1) Topography
2) Deforestation & depletion of detention basins
3) Reduction of velocity of flow in river
4) Change in the topography of a region
5) Random/Uncontrolled river bed material extraction
6) Urbanization and Encroachments
7) Climatic conditions.

Related Works

Many researchers have been done so far on the river Jhelum for the mitigation of floods.

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Some famous works are as below.

[1]: Mohammad Sultan Bhat, Akhtar Alam, Shabir Ahmad, Hakim Farooq Ahmad (university of Kashmir) and Bashir Ahmad helped to understand the hydrological behavior of various sub basins of Jhelum. They categorized sub basins of Jhelum into flood hazard potential zones.

[2]: Mohammad Sultan Bhat, Akhtar Alam, Shabir Ahmad, Hakim Farooq Ahmad (University of Kashmir), Bashir Ahmad, Bahadur S Kotlia and Ajay K Taloor suggested that flood frequency analysis is a reasonable approach to forecast the long term flow behaviour of the river. Present study has come up with flood frequency estimation at three gauging stations i.e. Sangam, Rammunshi Bagh and Asham.

[3]:Shah Faisal Saleh, Faisal Farooq Rather, Malik Jasif Jabbar (Department of civil engineering, Islamic University of Science and Technology Awantipora) says that people have to be made aware of potential and actual risks in order to induce their precautionary actions. Further, they say that floods can have a positive effects in different other policy fields like conservation of nature.

[4]: Abid Fayaz has done a research study on the flood management of Jhelum basin. His study includes flood frequency analysis and flood management.

[5]: Hakim Farooq, M Sultan Bhat, Akhtar Alam and Shabir Ahmad concludes that GIS mapping provide improved ways of presenting vulnerability and hazard risk that can be applied at local levels. The flood vulnerability analysis and mapping helps planner insurers and emergency services .It is a valuable tool for assessing flood risk and preparedness to mitigate the impact of flood. The study fully appraised the role of geo informatics in decision making process using GIS based flood hazard zoning maps.

[6]: C.M. Bhat, G.S. Rao, M. Farooq, P. Manjushree, A. Shukla studied that floods cannot be stopped but with advanced technologies, impact can be minimized during catastrophic disasters like Jhelum floods, satellites can play a major role in forecasting and monitoring the flood situation.

Methodology

For boring tunnel, machines will be used whose description is given below.

Tunnel boring machines (TBMs) and associated back-up systems are used to highly automate the entire tunnelling process, reducing tunnelling costs. In certain predominantly urban applications, tunnel boring is viewed as quick and cost effective alternative to laying surface rails and roads. Expensive compulsory purchase of buildings and land, with potentially lengthy planning inquiries, is eliminated. Disadvantages of TBMs arise from their usually large size – the difficulty of transporting the large TBM to the site of tunnel construction, or (alternatively) the high cost of assembling the TBM on-site, often within the confines of the tunnel being constructed.

There are a variety of TBM designs that can operate in a variety of conditions, from hard rock to soft water-bearing ground. Some types of TBMs, the bentonite slurry and earth-pressure balance machines, have pressurized compartments at the front end, allowing them to be used in difficult conditions below the water table. This pressurizes the ground ahead of the TBM cutter head to balance the water pressure. The operators work in normal air pressure behind the pressurized compartment, but may occasionally have to enter that compartment to renew or repair the cutters. This requires special precautions, such as local ground treatment or halting the TBM at a position free from water.

Concept Design

Manning's rugosity coefficient (η) = 0.015 (Adopted for smooth finished concrete)

Discharge (Q) = 60000 cusecs or 1700 Cumecs

Length (L) = 88kms

Coordinates at Dogripora = $35^{o}51'11.63"$ N and $75^{o}2'39.58"$E

HFL at Dogripora = 1584.7 +10.27 =1594.97 m

Invert level at off Take Dogripora = 1574.70 m say 1574 m

Tunnel end

R.L of Gantamulla U/S barrage = 1556.604 m

Distance of drop point from barrage = 9 Km

Bed grade = 1/130

Therefore level Difference = (1/130)*9000= 69.23 m

Coordinates of Drop point are $34^{o}10'39.43"$N and $74^{o}15'30.53"$E

Invert level at tail (at Czhal) = 1556.603-69.23 =1487.37 m say 1488

Slope = (1574-1488)/8500 = 1/988 Adopt 1:1000

Using economical circular section

Perimeter P =2.2395 D Area A = 0.6814 D^2 R=0.3042 D

$Q = A*1/n * R^{2/3} * S^{1/2}$

$1700 = (1/0.015)*(0.3042D)^{2/3}*(1/1000)^{0.5}*0.6814\ D^2$

D = 19.12 m say 19.50 m

Velocity when tunnel is flowing 81% full i.e 0.81D

$V=1700/.6814(19.50)^2$ =6.56 m/sec.

Thus steel lining may be used to avert abrasion.

Needs and Necessities

The floods destroy the cities, towns, villages, cultivable land, property, embankments, humans as well as animals. In order to reduce the losses due to floods, there is a serious need for the adoption of a permanent and long lasting measure.

Therefore, in order to mitigate the floods and save life (human and animal); private and public property, the design of this tunnel can prove extremely useful. The tunnel will act as a bypass for the extra discharge and thus save the areas down stream from flood threats.

Kashmir is full of tragic accounts of floods of the Jhelum River. Flooding over the cultivable lands brings famine, so the design of the tunnel can bring tremendous change in the fate of inhabitants and can save lives of the people, the hard earned money and in addition safe guard of the public property.

Raw Material

Reinforced cement concrete with M.S sheet lining will be used.

Conclusion

Flood is the most common natural disaster, a consequence of heavy rains, snowfall, overflowing rivers, broken dams, urban drainage basins, climatic changes, human activities, etc and results in loss of human life during and after the floods; damage to property, both private and public.

During September 2014, flood in J&K resulted in a huge loss of human life and property. The property loss was estimated over Rs. one Lakh corer. Even though government took many steps aftermath which included dredging as first priority and strengthening the embankments but all didn't show much results. TUNNELING as a flood mitigation measure, as discussed above can be an effective way to bye pass flood water without causing destruction of life and property.

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