

λ -frame dyke construction technique

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1. Abstract

A λ -frame dyke generally consists of foundation, λ -frames, wing-walls and slabs. It is a reinforced concrete hydraulic, detachable structure across a small stream valley to impound water for water conservation. Totally more than 500 dykes have been constructed in Shanxi Province of China since 1990s. After more than ten years of operation and observation, the dyke is proven successful in terms of social, economic and ecological benefits, and has been regarded as an effective measure for soil and water conservation by administrative departments concerned at various levels in the province. The structure has the advantage of solving sedimentation problem. When the dyke is silted up, slabs of the structure can be removed so that water flow can wash away the silt. When flood comes, the slabs are removed, after flooding they are reinstalled so that the dyke can be used for a long time. The paper mainly discusses how to conduct site selection, structure design and construction of the dyke.

Key words: λ -frame dyke, structure design, construction, sedimentation, water conservation

2. Introduction

A λ -Frame dyke is a reinforced concrete hydraulic and detachable structure, which is so named simply because it looks like the Latin letter “ λ ”. There are many “ λ ”-Frame dykes in Shanxi Province of Northern China and proven successful in terms of soil and water conservation, and economic, social and ecological benefits as well. It is an effective method for the solution to the constraints of water source shortage in small rivers or streams which are seasonal. It is mainly characterized with low cost, high benefits, simple, flexible and convenient operation of water storing and discharging, and solving the problem of sedimentation. It can be applied throughout the world.

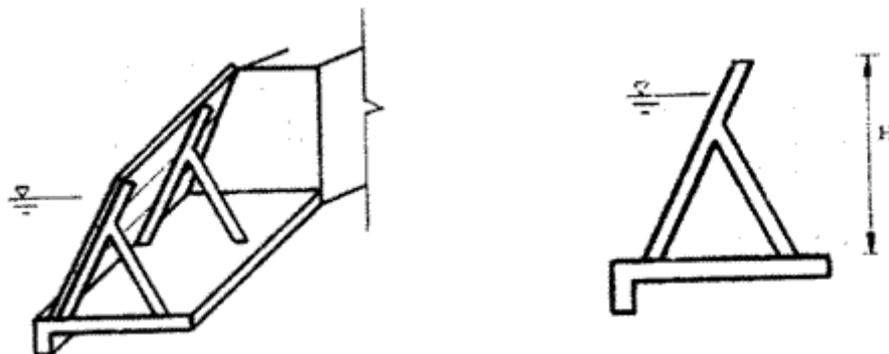


Figure 1 λ -frame dyke general sketch

3. Characteristics

The characteristics of the “ λ ”-Frame dyke include: (1) capable of solving sedimentation problems, so it

can be used for a long time; (2) no spillway is required; (3) low cost; (4) simple operation and management. The benefits of the structure are expected to have: (1) significant economic benefits; each structure can make 2 to 4ha of farmland irrigable, and fishery can also be developed, therefore annual economic benefits are high. (2) flood control benefit; a series of the structures can be constructed along rivers or streams, so that the flood peak flow can be remarkably reduced. (3) ecological benefits; a systematic development of the structure can effectively preserve water resources, reduce water loss and soil erosion, and improve ecological environment.

4. Site selection

The adapted areas for the structure construction should include (1) Topographic aspect: it is required that river channel gradient is relatively gentle, and water catchment area be appropriate; water storing area should be broad and gentle, and the dyke location should be as narrow as possible and with symmetric topography on both river sides. Thus, water storage is big and hydraulic condition is good. River bed width should be less than 50m. The dyke should be close to irrigated farmland. River channel with “V” formation or with steep slope, less farmland nearby, etc should be avoided for the site selection. (2) Geological aspect: to build the dyke on rock foundation, the area developed with longitudinal fissure along river should be avoided; for earth foundation, the loading force should be met to prevent uneven settlement; the area with bad geological conditions such as serious seepage in water storing area and river bed should be avoided. (3) Water source aspect: water source should conform to the comprehensive plan of local economic development and to the irrigation benefits. Generally, the water head stored by the dyke is 1.5 to 2.5m, adjusting total water volume of 5,000 to 20,000 cubic meters.

In general, sites for precast dykes should be selected according to the following features:

- Small river or stream
- Rocky foundation at dyke axis.
- Impounded area has good geological condition.
- Topographically, bottle neck but big capacity.
- Avoid location with v-formation
- Capacity should meet irrigation demand.
- Much farmland nearby.
- Integrated with existed facilities, such as fixed pump station, active pump or floating pump, supply for downstream canal, etc.
- Achieve high benefit, less investment, longevity, quick recovery.

5. General design

The capacity should be determined based on inflow and water use. Water use includes domestic water use and irrigation water use; domestic water use can be determined by counting number of people and livestock, based on 30l/d per person, and 50l/d per livestock. Irrigation water use can be determined according to proportion of crop planting composition, area, irrigation system, etc. (3) based on balance of inflow and water use, determine active storage capacity; then, according to water depth-storage capacity curve, determine water depth in front of the weir. A λ -Frame is a kind of prefabricated reinforced concrete, usually with the dimension of height 2 to 3m, width 0.2 to 0.25m, depth 0.15m, the distance between two λ frames 1.5m, and angle between frame leg and bed bottom 65.5° ; it should be embedded into foundation 0.5m deep. The slab is prefabricated reinforced concrete with the dimension of length 1.5m, width 0.4 to 0.6m, and the depth 0.08m; the weight of each slab should be controlled under 200kg, so that it can be installed and detached manually; refer to the

drawings below for detail. Foundation is built for energy dissipating, stability and seepage prevention; Height of wing wall is determined based on peak flow, then use open channel uniform flow formula to calculate.

6. Construction

Procedure of the construction includes:

- Precast frames and slabs.
- Foundation should be excavated to impervious layer, then stone masonry and concrete to design elevation.
- Frames are embedded into foundation
- Wing wall masonry
- Slab installation

For treatment of dyke foundation, there are two cases: (1) if it is rock foundation, excavation usually reaches fresh rock, then, based on design, stone masonry and concrete slab is cast; (2) if it is soft foundation, excavation should reach impervious foundation or at least 1.5m deep, then, tamping and stone masonry to design height. For its safe operation and sustainable use, it is necessary to detach stabs to discharge peak flow during flooding season and washing sedimentation away. After too much flooding period, the stabs will be reinstalled to impound water for water supply and irrigation.