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THE EFFECTIVENESS OF RECTANGULAR AND CYLINDRICAL CONCRETE BLOCKS AS ENERGY DISSIPATION STRUCTURES IN SPILLWAY AND STILLING BASIN

NORHIDAYAH BINTI HAMIDON

A final year project report submitted in fulfillment of the requirements for the award of the degree of Bachelor in Civil Engineering

Faculty of Civil Engineering and Earth Resources

Universiti Malaysia Pahang

NOVEMBER 2009

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"Specially dedicated to my beloved late father, mother, brothers and sister, lecturers and friends…."

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ABSTRACT

Velocity of flow water in a channel will increase when there are different between water level at upstream and downstream of a channel. High velocity of flow water can be possessed by water flow in a spillway which the flow is caused by the gravitational force. A high velocity of flow water could possibly cause bad impacts such as erosion and scouring of riverbed and bank. Besides, this problem could also cause some destruction to the hydraulic structure like spillway and stilling basin. Regarding to this matter, the suitable precaution method need to be considered in order to control the high velocity of flow water. Therefore, a rectangular open channel model structure (40 cm x 60 cm) consists of spillway and stilling basin parts is constructed and used to conduct an experiment to study the performances and effectiveness of rectangular and cylindrical concrete blocks as energy dissipation structures. In this study, concrete blocks are arranged in row arrangement and various pattern of arrangements in spillway and stilling basin of a channel. The water flow depth and flow velocity are recorded and analyzed before and after locating energy dissipaters. For row arrangements, the increase in number of row and number of blocks can reduced the velocity of flow water more effectively and alternate arrangement of concrete blocks give the best result in reduction of flow velocity for various pattern of arrangements. In this study, the rectangular concrete block is proved to be more effective in reducing the flow velocity compared to the cylindrical concrete block with percentage of reduction of 73.68% for row arrangement and 75.41% for alternate pattern of arrangement.

ABSTRAK

Halaju air yang mengalir di dalam saluran akan bertambah apabila adanya perbezaan aras air di antara kawasan hilir dan hulu saluran. Aliran air berhalaju tinggi boleh berlaku apabila air mangalir melalui struktur alur limpah di mana aliran air adalah disebabkan oleh daya tarikan graviti bumi. Aliran air berhalaju tinggi bukan sahaja boleh memberi kesan negatif terhadap alam sekitar seperti hakisan dan kerukan di dasar dan tebing sungai, malah turut menyebabkan berlakunya kerosakan terhadap struktur hidraulik seperti struktur alur limpah dan lembangan penenang. Oleh yang demikian, satu langkah pengawalan yang berkesan perlu diambil kira bagi mengawal aliran air yang berhalaju tinggi. Dalam kajian ini, sebuah model saluran terbuka berbentuk segi empat tepat (40 cm x 60 cm) yang terdiri daripada bahagian alur limpah dan lembangan penenang telah dibina di makmal untuk menjalankan ujikaji bagi mengkaji penggunaan serta keberkesanan blok konkrit berbentuk segiempat tepat dan silinder sebagai struktur pengurangan halaju. Blok-blok konkrit yang diuji disusun mengikut corak susunan berbaris dan pelbagai corak susunan rawak di bahagian alur limpah dan lembangan penenang. Ukur dalam air dan halaju air akan diambil dan dianalisis sebelum dan selepas struktur pengurangan halaju diletakkan di kawasan uji kaji. Bagi susunan berbaris, penambahan jumlah baris blok serta penambahan kuantiti blok memberi kesan pengurangan halaju yang lebih baik dan corak susunan selang seli didapati paling efektif dalam mengurangkan halaju air bagi pelbagai corak susunan rawak. Blok konkrit berbentuk segiempat tepat memberi kesan pengurangan halaju yang lebih baik berbanding blok konkrit berbentuk silinder iaitu sebanyak 73.68%^untuk susunan berbaris dan 75.41% bagi corak susunan selang seli.

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LIST OF SYMBOLS

Symbol		Item
v	-	Measured velocity
v_0	-	Initial velocity
y	-	Measured flow depth
y_0	-	Initial flow depth
Q	-	Flow rate
A	-	Area of hydraulic section
m	-	Meter
mm	-	Millimeter
m^3/s	-	Meter cubic per second
m/s	-	Meter per second
m^2	-	Meter squared
E	-	Specific energy
h	-	Height of channel's wall
L_1	-	Length of spillway
L_2	-	Length of stilling basin
B	-	Width of channel
Fr	-	Froude number
Δv	-	Reduction in flow velocity
d	-	Distance between rows of concrete blocks
s1	-	Distance between concrete block and channel's wall
s2/s3/s4/s5/s6	-	Distance between concrete blocks

γ	-	Unit weight of water
φ	-	Angle of channel with the horizontal
w	-	Weight of water in jump control volume
USBR	-	United States Bureau of Reclamation
MASMA	-	Manual Saliran Mesra Alam Malaysia

LIST OF APPENDICES