Variation In Discharge With Other Parameter Constant

Syed Zafar Syed Muzaffar, S. L. Atmapoojya, D. K. Agarwal,

Abstract: - This paper deals with the study of variation in discharge with other parameter constant. In this paper the condition for the optimal trapezoidal round cornered Canal section having radius is less than depth of flow, considering the total cost of Optimal lined section per meter length has been developed. This method is based on trial and error numerical technique. Computer program is prepared in C language and the results are seen by variation in discharge with other parameter constant in two cases when r = f(y) and r = constant. For both cases graphs are plotted and results have been observed. The effect of cost of curve has been seen on the Optimal cost of section. When r = f (y) and r = constant it is observed that for the same values of discharge, cost of side, cost of base, cost of curve the optimal cost of section and b/y ratio is found high in case of r = f (y) as compared to r = constant. The methodology can be used very conveniently by the designers to design the optimal Canal Section.

Keywords: - Discharge of Canal, Round cornered trapezoidal section, Depth of flow, Canal Section, Free board, TCCNS = C, Design of lined Canal section.

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1. INTRODUCTION :

A canal Netowrk is provided to convey water from a source to the required point. The Canal system should be planned and designed in such a way that it should be economical and efficient. Some times the soil is erosive in nature hence higher velocity cannot be allowed through the Canal which affects economy in Canal system. Hence to prevent soil erosion due to high velocity, lining is provided to canal system. A lined Canal section is designed as a stable cross section. In general trapezoidal shape is provided for the canals. Sometimes rectangular shape can be provided in case of transitions and Canal structures. For small discharge circular or triangular shapes are also preffered. The lined canals are designed for a designed discharge for a permissible velocity. The permissible velocity is decided as per the non silting criteria and non erodible criteria which depends on the lining materials. Hence a lined canal may be designed by using flow equations. In general Mannings equation is used for canal design. To get economy in the canal construction the section should be designed in such a way that its total cost of construction should be minimum. The problem of optimal cross section for a trapezoidal canal has been solved by number of researchers, however the assumptions made by them are different and there is need to obtained more general and simple condition for design of optimal cross section. The computer C program is developed and run successfully. Results obtained were checked and compared with java and ANN for different values of discharge. The graphs were plotted for r = f(y) and r = constant cases as described and shown below. Lining of the canal is essential for the efficient use of land and water resources.

- Assistant Professor, Anjuman College of Engineering, Nagpur- India. syedzafar64@yahoo.co.in
- Professor & Head Kavikulguru Institute of Technology and Science, Ramtek, Nagpur-India Ex. Dean, Faculty of Engineering & Technology,RSTM & Research, Nagpur University, Nagpur-India.

The lining provide the rigid boundaries ensures protections against bad and bank erosion if canal is constructed in black cotton soil area, the canal lining become essential for the stability of canal bank , due to lining the maintenance cost can be reduce. Different types of materials are used for the canal lining the selection of material is mainly depend upon the degree of water tightness which is required for the construction of canal . Brick lining and burnt clay lining are the popular lining as they provide reasonable water tightness along with strength. We have derive the development condition for the most economical condition trapezoidal section by considering total cost of canal in terms of excavation cost which include free board area lining cost with a provision for different unit cost of lining in base , side and curve and filling cost for round corner trapezoidal section. Amlan Das derived the conditions for Optimal Canal Section with composite roughness using Lagrangian multiplier technique and provided computational methodology for optimal design on computer program. Atmapoojya and Ingle have derived the development of condition for most economical trapezoidal section by considering the total cost of canal in terms of excavation cost which includes free board area lining cost with a provision of different unit cost of lining is base and on the sides for sharp cornered trapezoidal section. The attempt has been made by various researchers to obtained the optimal trapezoidal section but rounding of corner having less than dept of flow were not consider. The methods for optimal canal design of the canal based on total cost of construction gives the total optimization. As the design is made in generalized form by considering the canal in partially cutting and partially filling hence, this method is very useful and suitable for optimal canal design.

2. METHODOLOGY:

The micro economic theory gives the minimum cost concept. It is based on Lagrangian undetermined multiplier technique and it is used for Cost optimization. The concept of microeconomic theory is obtained by eliminating undetermined multiplier from the expression. The concept of this theory is used by Trout (1982) in designing a trapezoidal section with minimum lining cost. But the conditions for the Optimal section are in complex form. This theory can be used to derive an Optimal section corresponding to the minimum lining cost for given discharge and velocity of flow is not known. When the Canal section is to be design for known discharge, bed slope and roughness characteristics then the Canal design is governed by section factor $AR^{2/3}$. The canal section is designed for a fixed value of section factor which is expressed in terms of discharge, bed slope and roughness characteristics, which is also a function of bed width depth of flow and slopes and radius of curve.

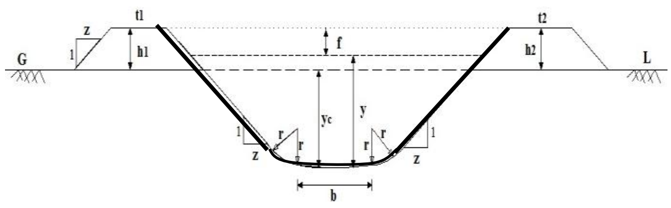


Fig No. 1
Standard trapezoidal Round Cornered Canal Section (Partially cutting & partially filling)

The expression for total cost of lined section is given as follows for the unit length of canal

$$TCCONS = [\, b \times k1(y+f) + 2\, r\, k1(y+f)\, z1 + k12\, (y+f)^2 z - 2 r^2 z1 + r^2 z2]\, Ce$$

$$+ [\, t1\, (y+f)(1-k1) + z(y+f)^2\, (1-k1)^2]\, Cf$$

$$+ [\, t2\, (y+f)(1-k1) + z(y+f)^2\, (1-k1)^2]\, Cf$$

$$+ bcb + 2rz2Cc + [\, 2(y+f)\sqrt{1+Z^2} - 2r\, z1]$$

$$Cs \ldots\ldots\ldots\ldots (1)$$

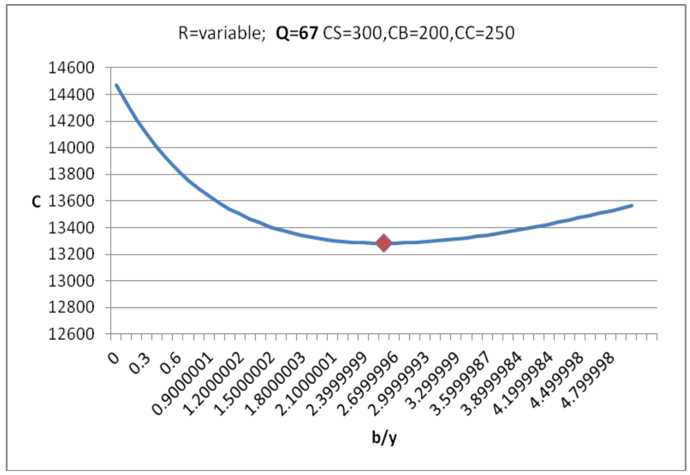
The flow area A of the section is expressed as follows

$$A = by + r^2 z2 + Zy^2 + 2ryz1 - 2r^2 z1 \ldots\ldots\ldots\ldots (2)$$

And the wetted perimeter P of the section is given by

$$P = b + 2y\sqrt{(1+z^2)} - 2rz1 + 2rz2 \ldots\ldots\ldots\ldots (3)$$

In this approach a generalized solution is obtained with the help of trial and error method. The design obtained by this approach gives the actual optimized section because all the parameter are considered in the design.



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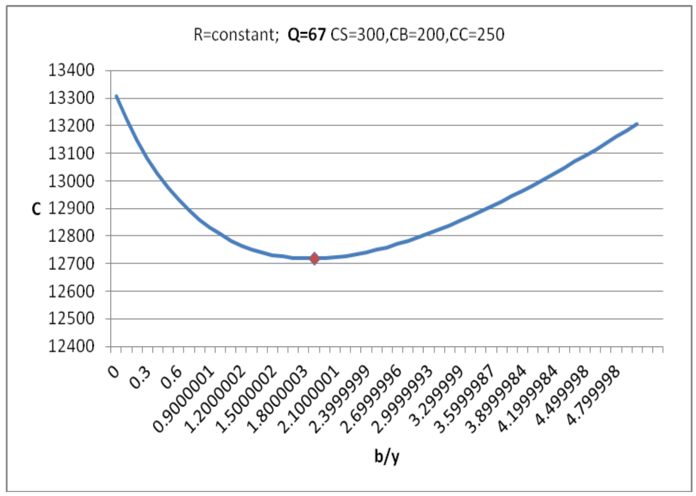

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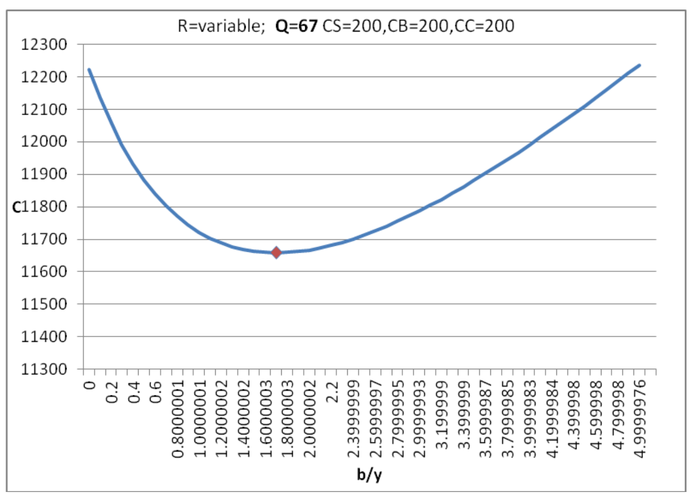

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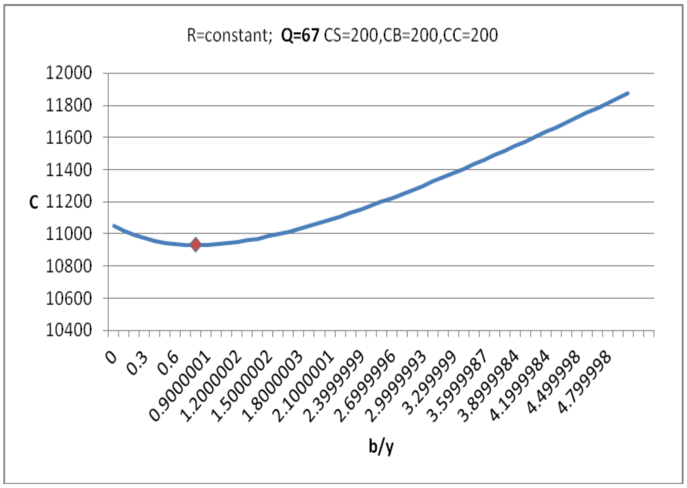

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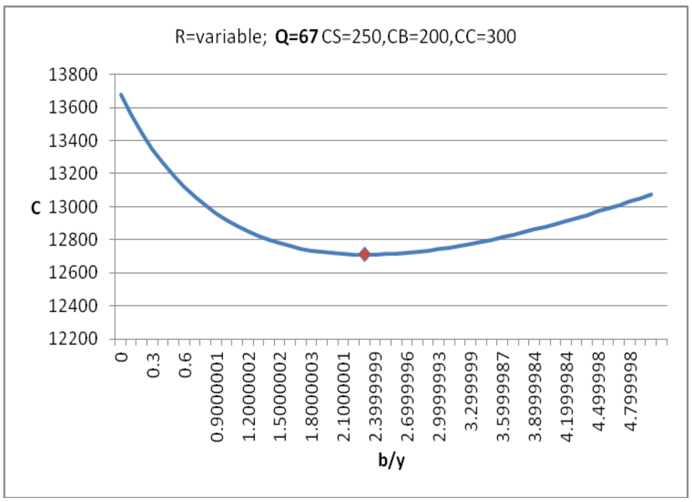

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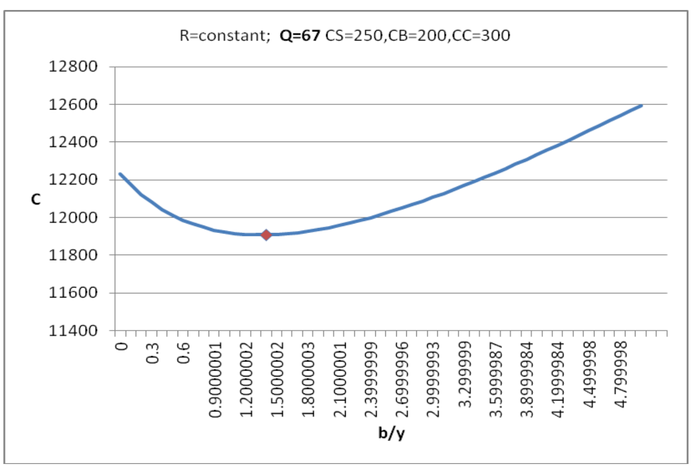

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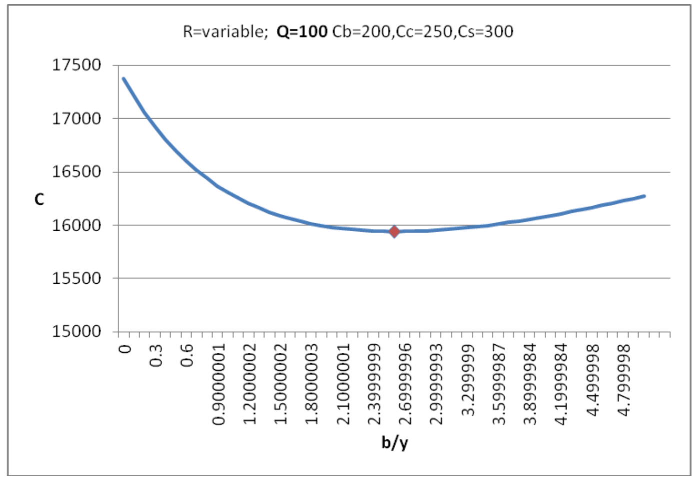

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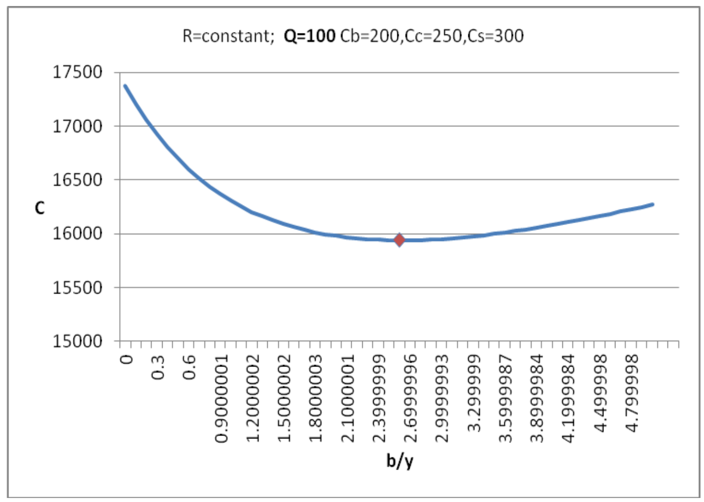

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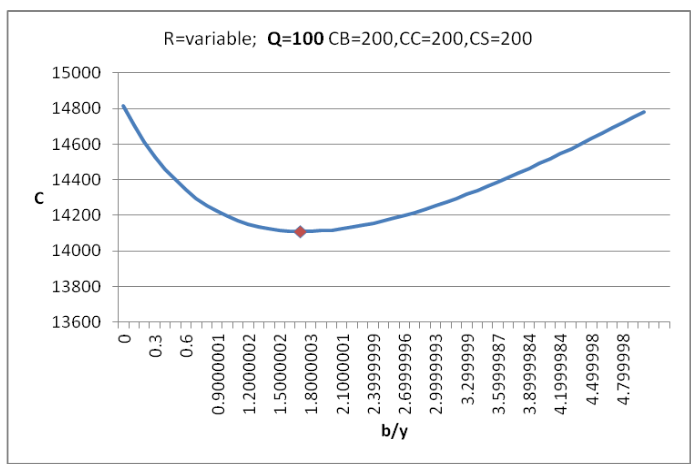

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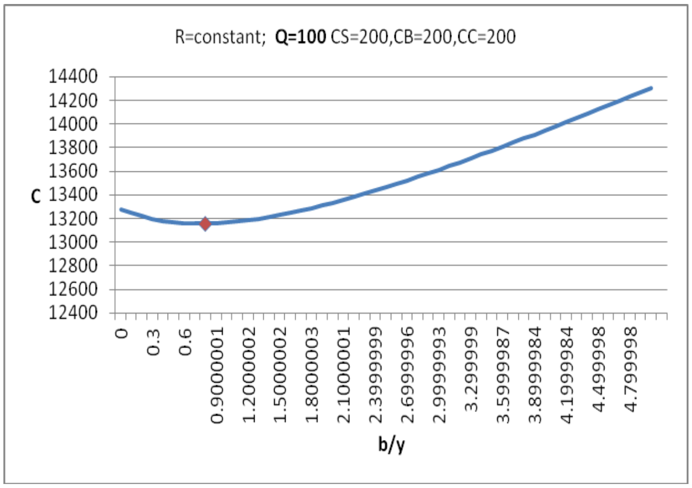

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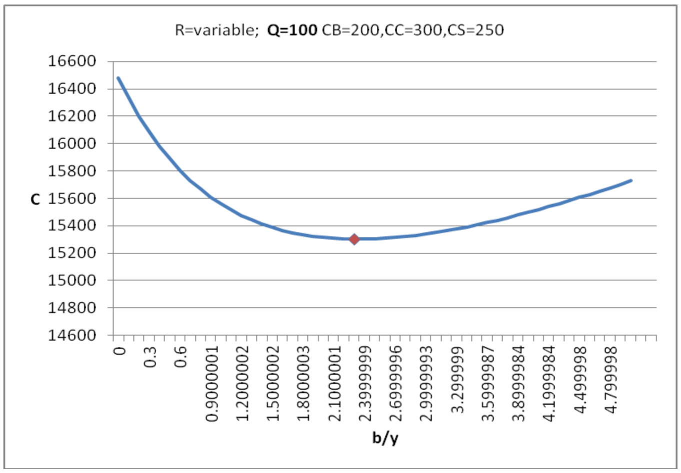

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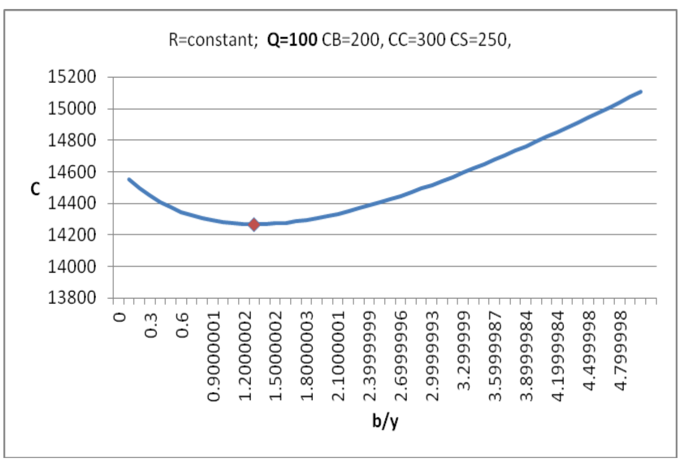

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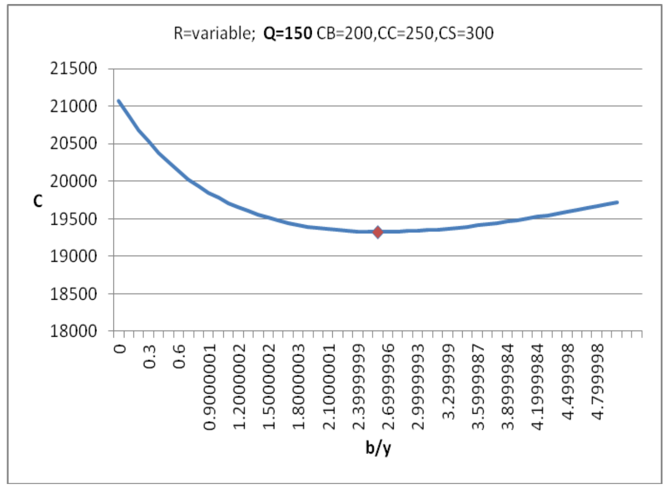

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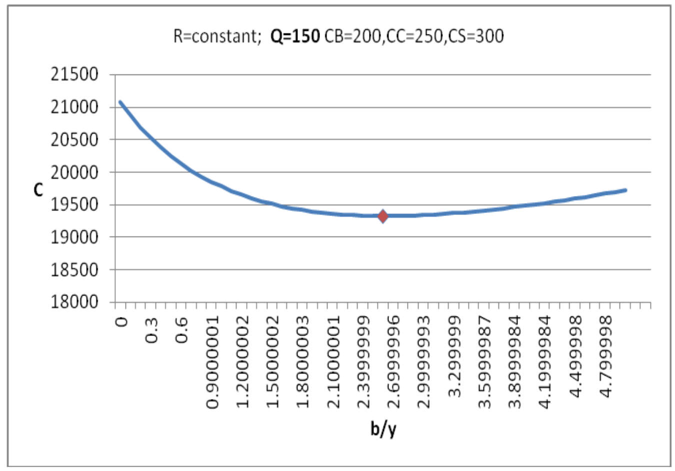

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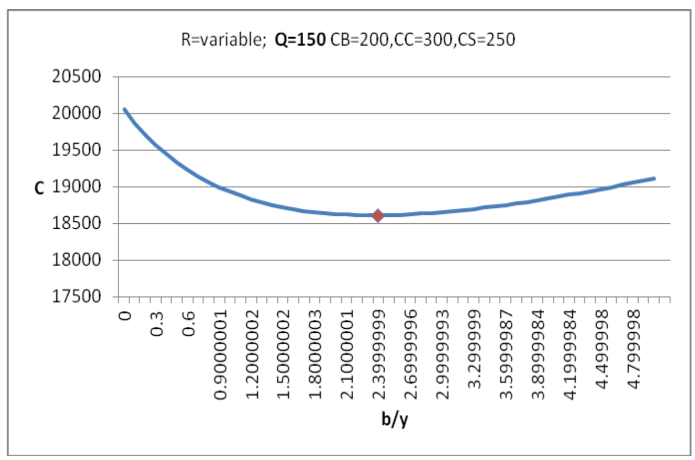

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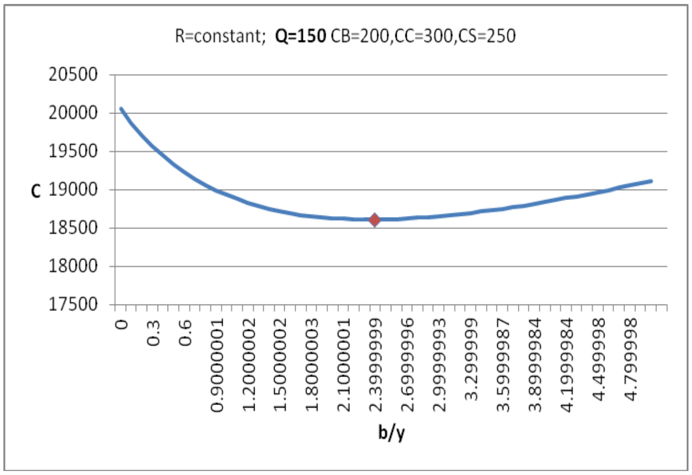

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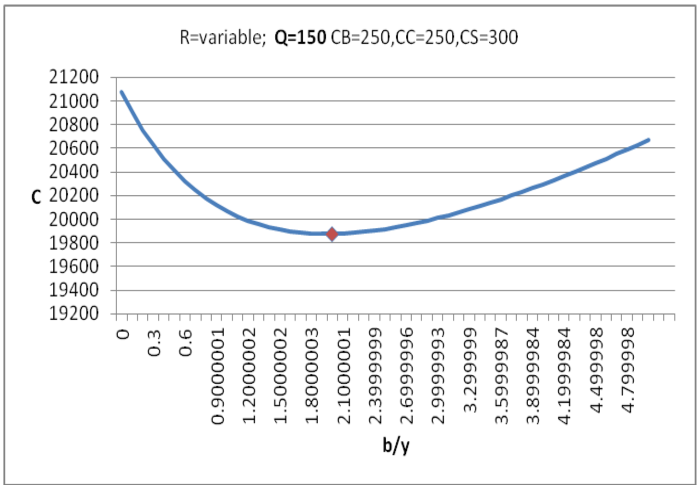

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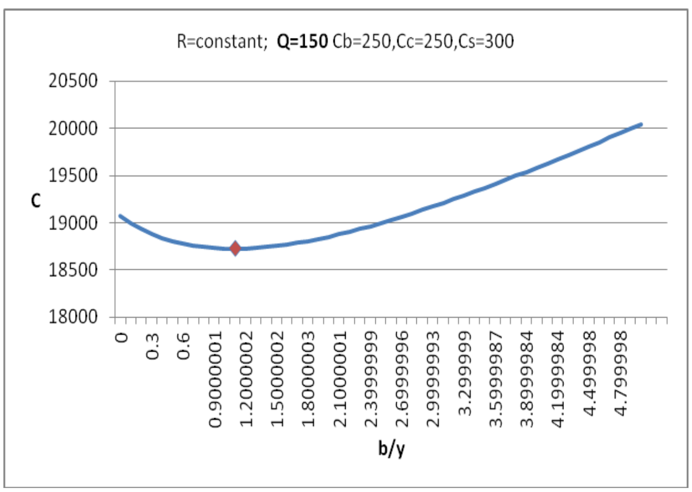

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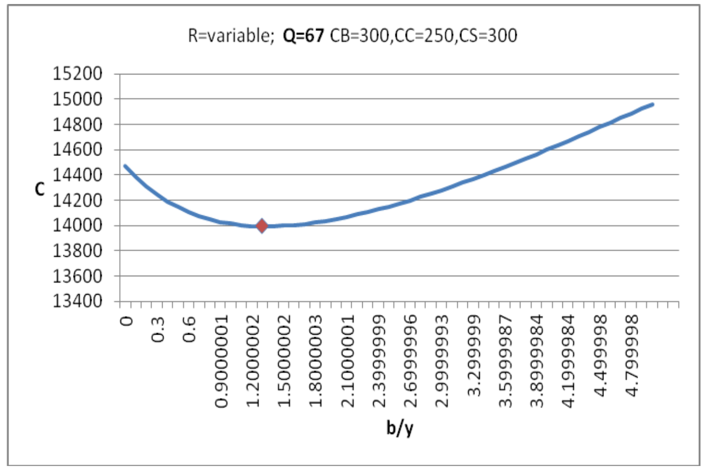

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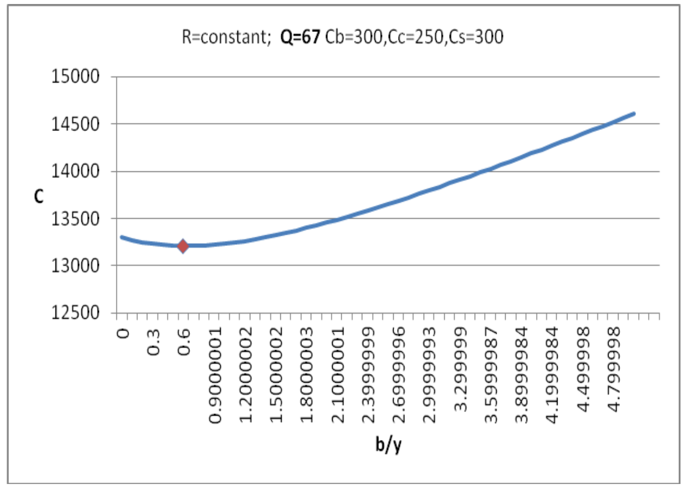

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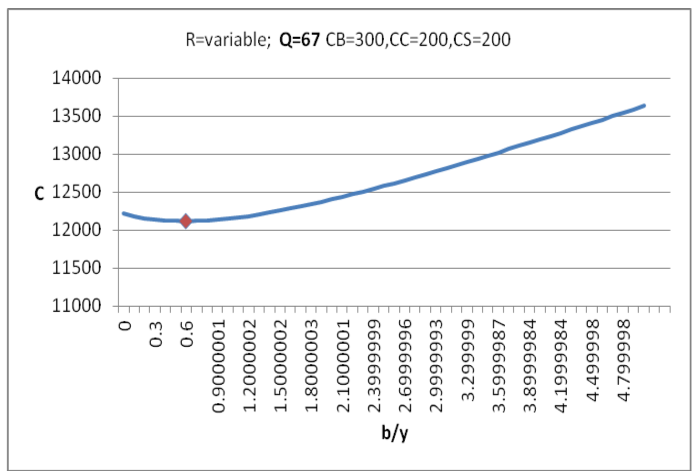

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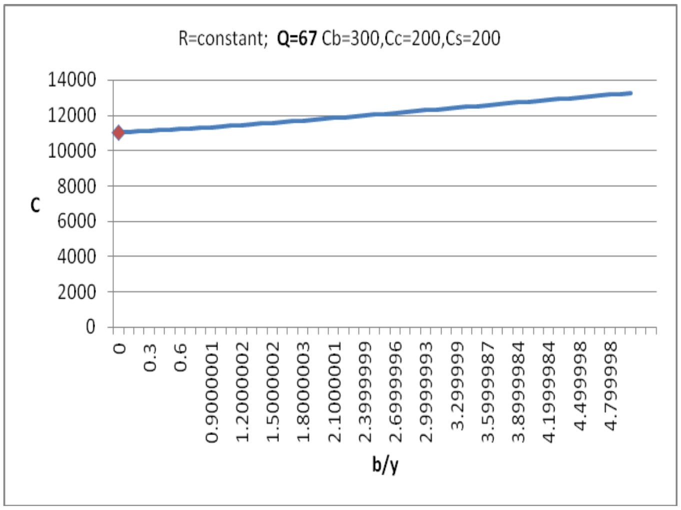

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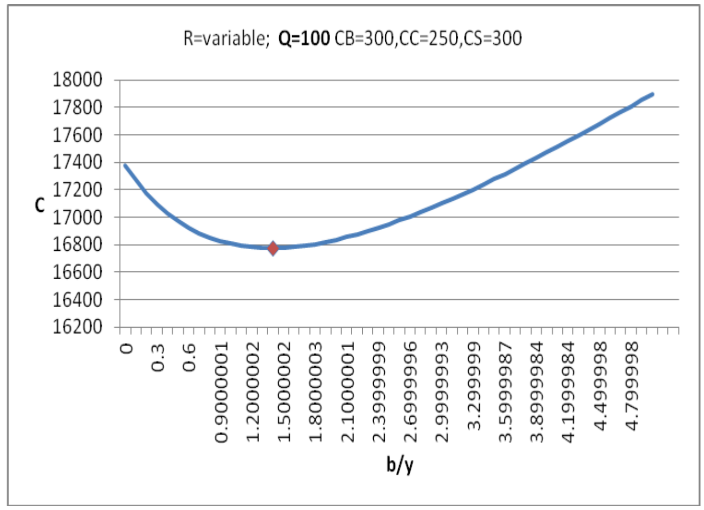

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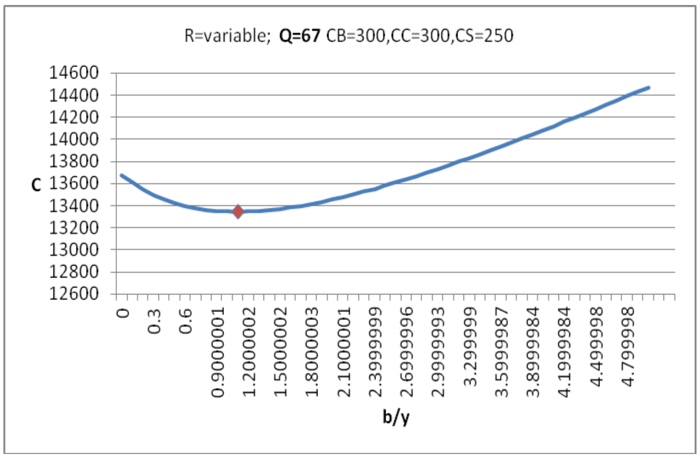

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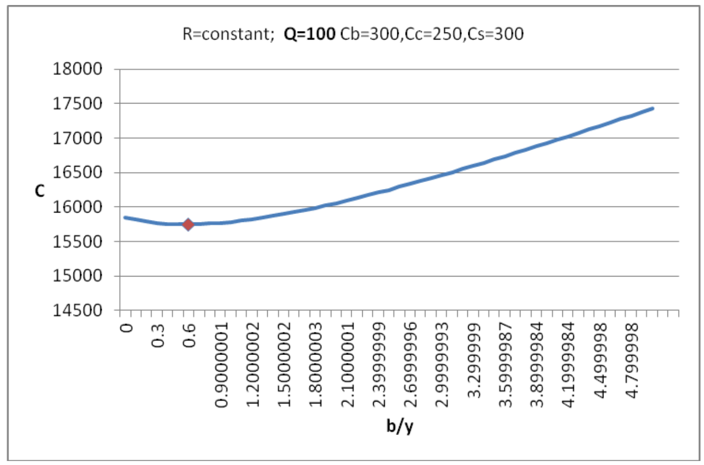

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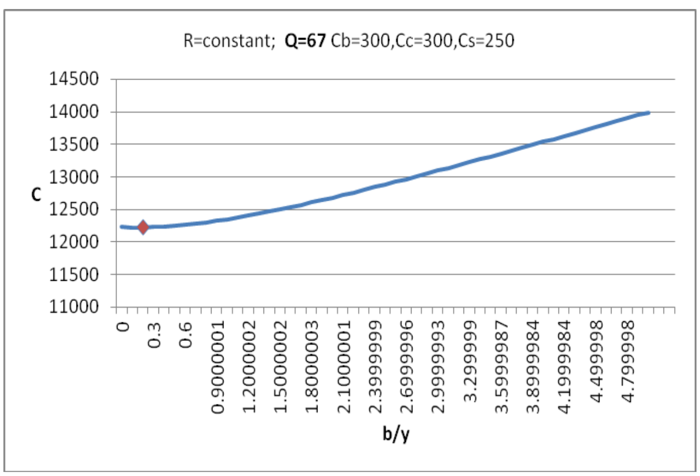

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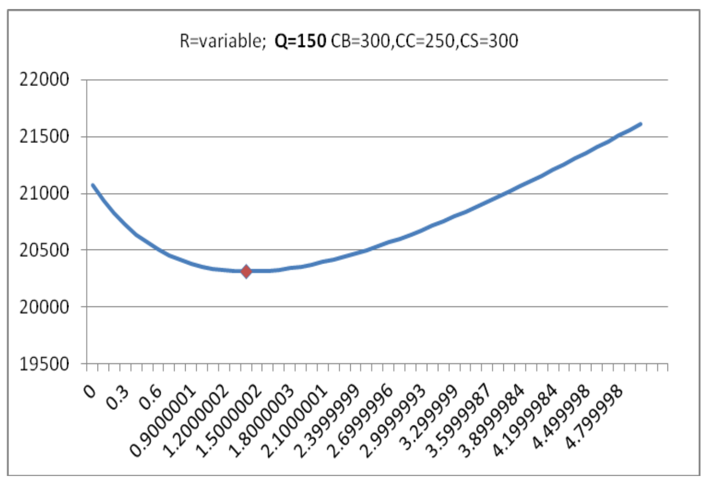

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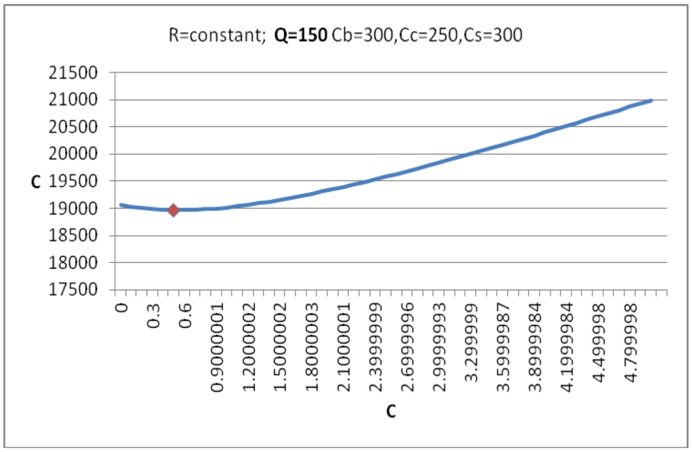

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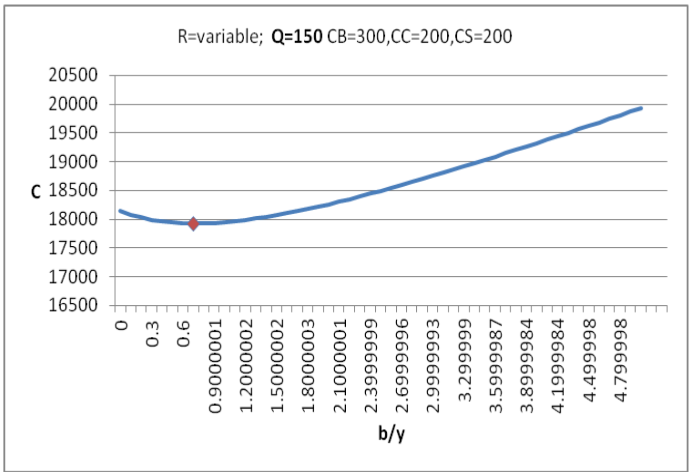

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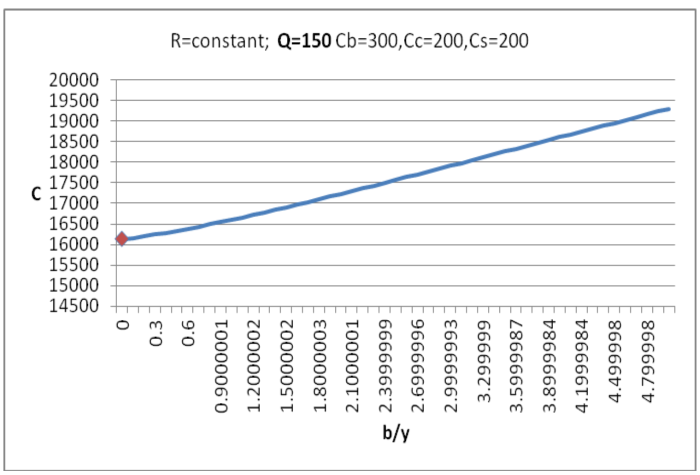

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3. Conclusion:

The condition for the optimal trapezoidal round cornered Canal section having radius is less than depth of flow, considering the total cost of lined section has been developed and the method based on trial and error numerical technique are suggested for the optimal design following conclusion are drawn from the study of variation in discharge with other parameter constant in the design of the optimal canal section.

When discharge is 67m³/sec, the optimal cost of lined section obtained high value as well as b/y ratio is also high when r = f (y) as compared to r = constant.

When discharge is 100m³/sec, it is observed that the optimal cost of section is nearly closed as well as b/y ratio is also approximately equal in both cases when r = f(y) and r = constant.

When discharge is taken 150m³/sec, it is observed that we obtained the more economical lined section in case of r = constant as compared to r = f (y).

The effect of cost of curve has been seen on the optimal cost of section. When r = f (y) and r = constant it is observed that for the same values of discharge, cost of side, cost of base, cost of curve the optimal cost of section and b/y ratio is found high in case of r = f (y) as compared to r = constant.

Hence in this investigation and results obtained in the design of the lined canal section the proposed method can be adopted to design the optimal section in lined canal projects.

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