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SOME ASPECTS OF STUDY OF A LINED CANAL SYSTEM

S. L. Atmapoojya[1] and S. R. Kathikar[2]

ABSTRACT

The study of a lined canal system is very extensive hence here various aspects of the study of a lined canal system have been proposed. The entire study about the lined canal system can be carried out completely by adopting the aspects and it can be done quite conveniently. These aspects of study are: Economical Feasibility Aspects (EFA), Optimal Design Aspects (ODA), Seepage Control Aspects (SCA), Structural Stability Aspects (SSA), Construction and Management Aspects (CMA), Failure and Maintenance Aspects (FMA). The aim of the proposed methodology is to provide the data base for the study of a lined canal system.

Keywords: *Economical Feasibility Aspects (EFA), Optimal Design Aspects (ODA), Seepage Control Aspects (SCA), Structural Stability Aspects (SSA), Construction and Management Aspects (CMA) and Failure and Maintenance Aspects (FMA).*

INTRODUCTION

Canal is a hydraulic structure which is provided to convey water from the source to a required point. Depending on various criteria the canal is divided in various categories. As per the surface available in the canal section, the canal section is divided into two categories:

- Unlined canal system
- Lined canal system

The lined canal system is one in which another coating is provided for some specific purpose. The lining can be provided in following modes- i) Uniform lining, in this system only one lining material is provided throughout the periphery with uniform cost ii) Nonuniform lining, in this system more than one lining material is provided throughout the periphery iii) Partial lining, in which lining is provided either on the bed or on the sides and other face is remain as unlined. Before providing lining in a canal system the proper study should be carried because it is not worthwhile to provide lining always. Hence various aspects of the study of the canal system are proposed here and the entire study about a lined canal system will be completed. These aspects are:

i. Economic Feasibility Aspects (EPA)
ii. Optimal Design Aspect (ODA)
iii. Seepage Control Aspect (SCA)
iv. Structural Stability Aspect (SSA)
v. Construction and Management Aspect (CMA)
vi. Failure and Maintenance Aspect (FMA)

Each of the above aspects is to be studied for final validity and complete information about the canal system.

ASPECTS OF STUDY

i) Economical Feasibility Aspects: This aspect will deal with the financial justification of the lining of the canal system; if it is economically justified to provide the lining there only lining of the canal system is to be provided. The lining of the canal system needs additional cost and which is to be invested initially. The benefits of the lining are.

i) Reduction in seepage losses
ii) Reduction in area of construction
iii) Increase in the command area because of the flater slope is to be provided for lined canal
iv) Reduction in maintenance cost.

These benefits are to be calculated on annual basis. Hence the cost invested for lining and benefits are too converted into the same scale. The initial cost is to be converted in terms of annual basis by multiplying the initial cost by a factor which is known as capital recovery factor (CRF), which is calculated from the rate of interest (i) by which the money is to be deposited and may get per year basis the design period (N) year, for which the lining is provided.

Now let, C_1 =Cost of lining invested initially

C_2 = Total benefits obtained for the lining per year

i= Rate of interest

N= Design period

Capital recovery factor CRF = $\frac{i(1+i)^N}{(1+i)^N-1}$

The cost in terms of annual basis = C_2

Benefits cost ratio = $\frac{C_2}{C_1 * CRF}$

For the financial justification of lining benefit cost ratio should be greater than unity.

ii) Optimal Design Aspects: It is necessary to fix the cross section of the lined canal system. As the lined canal in the non erodible canal, hence this canal can be designed by using flow equations like Manning's equation, Chezy's equation, resistance equation etc. It is worthwhile to design the canal section which will be the most economical. Hence in this aspect a canal cross section is to be designed which will need least cost of construction. The suitable lining materials are to be selected based on the necessity. Various methods are suggested to fix the optimal canal section. There are two approaches for the canal design as follows: i) Flow area approach: In this approach the canal section is designed for the known discharge (Q) for the given flow area (A). The flow area is known if flow velocity (V) is specified. The value permissible flow velocity (v) is

1. *Prof. and Head*
Email (corresponding author): atmapoojya@yahoo.com
2. *Assist. Prof., Dept of Civil Engineering, KITS, Ramtek-441106*
Manuscript No. 1498

recommended as per the type of lining materials. ii) Section Factor Approach: In this approach flow velocity is not specified and the section is designed for a given section factor ($AR^{\frac{2}{3}}$), where A is flow area and R is hydraulic mean depth. Two methods are adopted to design optimal canal design: i) Method of differentiation, ii) Lagrangion undetermined multiplier technique

Sometimes direct solution is possible otherwise trial error solution approach is adopted to get optimal canal section. Free board is also considered in deriving the optimal section and it is considered as discharge dependent and on depth dependent free board.

iii) Seepage Control Aspects: The purpose of lining is to control seepage loss from the canal section. The amount of seepage loss to be controlled depends on the type of lining provided in the bed and sides of the canal section. The size of the canal is also one of the factors of the seepage loss. Position of ground water table also plays an important role in seepage loss. In this aspect the studies about the magnitude of seepage loss to be controlled are to be carried out. Various methods are adapted to measure seepage loss and these methods are illustrated in the paper included in the proceeding on canal lining (1988), seepage meters are also described in the proceeding. The minimum seepage loss section is also recommended by Swamee et al (2000), by using resistance equation, Atmapoojya et al. (2001) have suggested the dimensions of minimum seepage loss section by using Manning's equation.

iv) Structural Stability Aspects: In general the lining is provided in the canal section to reduce the seepage loss from the canal but the lining should be sustained for a suitable time in canal section, hence stability aspect also should be studied. A suitable type of lining should be provided in the canal system. Cost of lining is also one of the controlling factor but it slight improvement is given to the lining to provide more stability by increasing the cost suitably. If some reinforcement is provided in the lining or proper anchorage is provided between the lining and the substrata of the canal, it will increase the life of the lining. Sometimes lining is provided in the canal system to increase the stability of the section such boulder lining, porous lining, etc. In this aspect proper justification should given to the lining material to improve the section stability.

v) Construction and Management Aspects: This aspect deals with the construction methodology of lined canal system. The specification for various types of lining is published by Bureau of Indian Standards. These specifications should be considered during the construction of lined system. Management of construction policies and control over it should be mainly observed. Central Design Organization, Irrigation Engineering Research Institute are also publishing the guide lines regarding canal designs. If the methodology for construction is adopted properly the effective lined canal system will be planned and will be satisfactory unlined by the water users.

vi) Failure and Maintenance Aspects: The canal system should be checked time to time and any type of failure is seen, the system should be rectified immediately. Proper maintenance of the canal system should be done. Working of under drainage system, plugs and pressure release valves (PRV) should be checked time to time. As suggested by Katti (1994), Cohesive non swelling (CNS) soil layer is provided below the lining to increase life of the lining and for the proper maintenance on canal lining.

This concept about the lining of the canal section has been described in the proceeding of seminar on canal lining (1988), manual on canal lining technical report no 14 (1975).

CONCLUSION

The extensive study on a lined canal system can be carried out with consideration of various aspects of the study. This division provides an idea about the detailed study, for the purpose of the entire study about the lining of the canal system, these aspects have been illustrated and it will be convenient for the research in these divisions.

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