Alexandria Engineering Journal (2017) **xxx**, xxx–xxx

HOSTED BY

ELSEVIER

Alexandria University

Alexandria Engineering Journal

www.elsevier.com/locate/aej
www.sciencedirect.com

ORIGINAL ARTICLE

Effect of drains coverings on environment by using value engineering

Walaa Y. El-Nashar

Water Engineering Department, Zagazig University, 44519, Egypt

Received 6 March 2016; revised 21 January 2017; accepted 7 May 2017

KEYWORDS

Drains coverings;
Surface drains;
Value engineering;
Life cycle cost;
Egypt

Abstract Drains coverings (DC) are used to pass the small discharge to function as bridge. There are two types for coverings, pipe or box type. The main problems which lead to a perceived need to cover a drain are: to minimize the adverse impact of a polluted drain, especially close to residential areas, need to use the land area occupied by the drain for an access road or some other use, poor soil stability leading to bank failure, and to protect them from pollution. DC has many effects on the environment. The main objective of this study is using value engineering (VE) to explain the effects of DC on the environment. Life cycle cost (LCC) methodology is used also to compare between two alternatives for drains. These alternatives are (i) surface drains, (ii) drains coverings. Results show that the best alternative for the environment is drains coverings.

1. Introduction

Agricultural drainage means to get rid of excess water, whether surface or subsurface water in the root zone in order to create suitable environment for plant growth and get greater productivity of crops yield. Other importance of drainage is for human health where it is to get rid of many types of disease-carrying insects. Also the drainage affects the physical and chemical properties of soil where the lack of a good drainage leads to the lack of air inside the pores of the soil leading to stop the oxidation of organic materials operations and shift some soluble compounds in water to insoluble compounds which accumulate in the pores of the soil and transform it into impermeable soil unfit for cultivation. Drainage networks divided into open surface drainage and subsurface drainage. Surface drainage network consists of field drains which collect the excess water from field and convey it to the branch collector which collect the water from field drains and convey it to main collectors which collect the water from branch collectors and convey it to main drains.

The covering is used for main collectors or main drains. Covering likes as closed canal or industrial type (culvert). It is created to pass the discharge of waterway under the road or railway line. The protection of agricultural drains against pollution resulting from illegal dumping of both liquid and solid wastes in residential areas can be achieved in different ways.

There are a lot of researches about environmental effect of drainage, coverings, value engineering and life cycle cost (LCC). Gershenson [10] described a new curricular review process that incorporates value-engineering tools in the form of curricular review matrices. Nasralla [12] studied the environmental side effects of agricultural land drainage mentioning the other aspects only occasionally. He explained the positive

E-mail address: walaanashar@yahoo.com

Peer review under responsibility of Faculty of Engineering, Alexandria University.

http://dx.doi.org/10.1016/j.aej.2017.05.013
1110-0168 © 2017 Faculty of Engineering, Alexandria University. Production and hosting by Elsevier B.V.

and negative impacts of drainage especially those related to soils, crops and health hazards. Abdelatey [1] measured the impact of drainage system and drainage projects in Egypt on the environment. Focus was directed towards the effects of providing subsurface drainage to agricultural lands. He measured the environmental impact assessment of subsurface agricultural land drainage both positive and negative. Schiller and Dirlich [14] used application of LCC analysis for settlement and infrastructure strategic planning to describe current challenges of the water sector in Europe such as demographic change or climate change. Rezania et al. [13] used value engineering to ensure the success of irrigation and drainage projects. Annappa and Panditrao [5] presented the basic fundamental of value engineering that can be implemented in any product to optimize its value. A case study of a Universal Testing Machine (UTM) was discussed in which the material, design of components was changed according to the value engineering methodology. Abdel Aziz et al. [2] investigated the interactive environmental impact of the reinforced concrete covering and the irrigation water compared to standards. Aboueshagh et al. [3] proposed a novel framework for assessing economic LCC of dams considering system's performance from sustainability aspect. Alom and Khan [4] studied the effects of environmental and social change due to improper drainage system and investigated health hazard of urban people produced by drainage problems to find out the possible ways for mitigating the problems. Annappa and Panditrao [6] introduced how to apply theories and methods of Value Engineering in the industry. They used the tools such as Function analysis, Functional Evaluation and Decision Matrix to find the best possible alternative from the choices. Elnashar and Mowafy [8] invented a new approach for covering of drains and introducing the design charts for the new approach of covering. Khiry et al. [11] evaluated the drains coverings in Egypt according to the hydraulic and economic points.

The main objective of this study is application of new techniques by using value engineering (VE) to explain the effect of drains coverings (DC) on the environment and choose the best alternative (surface drains or drains coverings) for the environment. Life cycle cost (LCC) methodology is used also to compare between these two alternatives and select the best alternative for the environment.

2. Problem identification

There are many factors of drainage affecting the environment. The main problem of the drainage is the environmental pollution.

The objectives of drains coverings (DC) are:

i. Minimizing the adverse impact of a polluted drain, especially close to residential areas.
ii. Need to use the land area occupied by the drain for an access road or some other use.
iii. Bank failure due to poor soil stability.

3. Value engineering (VE)

Value engineering (VE) was introduced into the construction industry in the early 1960s by Dell'Isola and became a trend thereafter. It is a systematic and organized process that maximizes the different values of multi-disciplinary stakeholders in a construction project. Traditionally, VE is a value enhancing tool rather than just a method of cost cutting [7].

VE is an intensive, interdisciplinary problem solving activity that focuses on improving the value of the functions that are required to accomplish the goal, or objective of any product, process, service, or organization. VE is an organized approach directed at analyzing the function of systems, equipment, facilities, services and supplies for the purpose of achieving their essential functions at the lowest life cycle cost consistent with required performance, quality effectiveness and safety. The highest performance in VE is achieved especially when the purpose is mainly increasing the value rather than reducing the costs. VE is used to determine the best design alternatives for projects.

3.1. Value engineering methodology

The systematic applications of recognized techniques which identify the functions of the product or service, establish the worth of those functions, and provide the necessary functions to meet the required performance at the lowest overall cost.

VE uses rational logic (a unique "how" – "why" questioning technique) and the analysis of function to identify relationships that increase value. It is considered a quantitative method similar to the scientific method, which focuses on hypothesis-conclusion approaches to test relationships, and operations research, which uses model building to identify predictive relationships.

All VE methodology should contain the following minimal essential features:

i. Description of the objectives and scope of the project in enough detail to assure direction of the study.
ii. Goals for the study.
iii. Schedule for completion of each phase of VE including the anticipated VE study timing.
iv. Establishment of a target data for formal presentation of project results.

Table 1 Six phases of VE methodology.

Phase	Description
Information	In this phase, the project current conditions and identifies the study goals are defined and reviewed
Function analysis	In this phase, the functions are defined using two-words, active verb/measurable or noun. These functions are reviewed and analyzed to determine which need to meet the project's goals
Creative	Creative techniques are employed to perform the function of the project by identifying other ways
Evaluation	A structured evaluation process is followed to select those ideas that offer the value improvement potential while delivering the functions of the project and considering requirements of performance and resource limits
Development	Development of the selected ideas with a sufficient level of documentation to allow decision makers to determine if the alternative should be implemented
Presentation	Development of a report that documents and coveys the adequacy of the alternatives