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To Study the Condition Assessment Criteria of Open Drains

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Abstract: The criteria for evaluating the state of open drains are presented in this research. Open sewage drains are one of the most valuable resources for public health works agencies in developing nations. We now lack a coordinated system for evaluating open sewage drains. Because of this, we are unable to determine the current condition of open sewage drains. To calculate the cost of rehabilitation and the maintenance schedule, condition evaluation criteria are required. Through an expert opinion poll, a preliminary list of the most prevalent distresses in open brick and concrete drains was created in order to generate condition evaluation criteria for sewage drains. The types of distresses were grouped and the severity percentage was calculated on the basis of visual analysis. Based on the findings, it was determined that concrete and brick drains, respectively, experienced maximum severity of 35%y and minimum severity of 20%. The pair wise techniques of condition assessment provide more reliable results for open drains.

Keywords: Open Drains, Condition Assessment, Assessment Criteria

I. INTRODUCTION

In order to determine potential mitigation and corrective measures that are crucial for the area's sustainability, it is tough to analyze the status of open drains in rural and urban areas. The study of Shah and Qureshi (2000) on the Left Bank Outfall Drain (LBOD) project has helped sustainable agriculture and more desirable rural livelihoods [1]. O&M problems have been associated with intervals of pump breakdown and serviceability, electric and civil artwork disasters, negative renovation, insufficient floor drain functionality, loss of beneficiary involvement and insecurity of center [2]. The overall performance of tile drainage devices with farmers' participation is powerful and can be carried out on a big scale [3]. Masood and Gohar (2000) endorsed educating farmers on the want for water conservation and control thru lively participation at all stages, from planning to O&M. They emphasized that projects must be planned in session with farmers to reap their guide [4]. Lashari and Memon (2000) examine the phenomena of farmers estimated duty for O&M of drainage and irrigation timing within the LBOD task [5]. Alam and Hassan (2000) during their research project mentioned the highlighted the needs of networking in irrigation and drainage in Pakistan [6]. Tarar (1995) reviewed surface and subsurface drainage technologies inside the context of real overall performance in Pakistan, taking into consideration effluent first-class, water table manipulate, salt balance and salt effluent disposal sustainability [7]. The tube wells have to only be set up in fresh groundwater zones and that their capacity ought to be reduced [8]. The outcomes of Mirbahar and Sipraw (1995) showed that collaborative tile drainage is the most effective answer for destiny on-farm drainage in Pakistan. The study of Sheikh and Soomro (1995) showed changes in water table intensity, discharge, salinity, pumping installations and agricultural factors due to fallacious operation and bad preservation of tube wells and disposal drains [9]. Boers and Zuberi (1995) analyzed that waterlogging and salinity have advanced from an agricultural into an environmental hassle calling for brand spanking new research strategies regarding application of hydrological models [10]. Qamar (1998) worked on deep drainage and promoting subsurface pipe drainage. He supported the outfall drain from primary Punjab for effluent disposal into the sea and supported the brand-new institutional reforms for decentralization and management switch of irrigation and drainage structures proposed underneath the NDP [11]. Solanki and Singh (2000) studied farmers' perceptions and concluded that government and NGOs could not persuade farmers to install subsurface drainage, but political people controlled to motivate them [12]. Barla and Ajmera (2000) performed a survey of small, medium and big land-preserving farmers, predicted common gross incomes with and without subsurface drainage and evaluated cost-sharing by the beneficiaries [13]. Baig (2000) reviewed that for sustainable long term measures, improvement planning need to be incorporated with drainage necessities, taking the basin as a unit [14]. Ahmad (2000) claimed that water scarcity, degradation of water nice and lack of funds to keep and expand irrigation and drainage systems are signs of deeper problems of coverage and institutional and marketplace failure [15].

II. CONDITION ASSESSMENT TECHNIQUES

Assessment criteria for different infrastructure such as utilities, streets, roads, water distribution networks, sewerage system, irrigation canals, bridges etc. are developed based on systematic research are discuses below in details.

A. Road Assets Assessment

Different research groups and departments have created a set of systematic evaluation standards for roads. The Pavement Distress Index (PDI) approach is a set of assessment criteria that relies on the detection of distresses and expert opinion surveys to assign a percentage weight to each distress and grade them on a scale of 0 to 100 in accordance with their influence on riding quality [16]. The condition pavement distress index's main goal is to create an analytical technique for figuring out the weight factor and severity level for various forms of distresses and to come up with a reasonable value of PDI for pavement condition evaluation.

B. Pavement Surface Condition Rating Manual

The Ohio Department of Transportation created the Pavement Condition Rating (PCR) in 2004. This document serves as a benchmark for evaluating road infrastructure. The methods used involved giving distresses a percentage weight utilizing expert opinion surveys. Using the A.H.P technique, the experts assign percent weights to various distresses that occur in flexible pavement before assigning percent weights to the severity of those distresses.

C. Subway Infrastructure Condition Assessment Criteria

Assessment standards for subways have been devised by Gkountis et al. (2013) [17]. The approaches they have used include categorizing the many subway components, after which they consulted subject-matter experts to determine the frequent distresses in each component. A comprehensive infrastructure condition assessment index for different components of tunnels and stations is developed using customized technique for Order Preference by Similarity to Ideal Solution (TOPSIS).

D. Condition Assessment for Rehabilitation of Dumpsites

Kurian Joseph presented the priority for the rehabilitation of dumpsites in 2016 using the Integral Risk Based Approach (IRBA). On the basis of site inspections, literature reviews, expert opinions, and actual observations of operations, the conditions evaluation criteria are developed. The factors are divided into three categories and given a weight using pairwise comparison and the sensitivity index [18].

E. Percent Weight of Distresses in Infrastructure

Famurewa el al. 2014 and many other researchers used the expert opinion survey for determining the percent weight of distresses in different infrastructures [19,20].

F. Condition Index Assessment

The US Army Corps of Civil Engineers has developed a standardized process for evaluating the condition of civil works. Given the great range of mega structures, the condition evaluation parameters are used, along with other techniques, to allocate funds for prioritized maintenance and operations over the course of a fiscal year. The primary goal of condition assessment is to generate a distinct numerical value known as the Condition Index (C.I).

III. WEIGHTED MATRIX DELIVERY DECISION METHODS

In weighted matrix technique, four basic methods are used for calculation of percent weight of principle factors involved in a decision. These methods combine the objective and subjective methodologies. A more consistent and clear decision can be achieved using these methods. Such methods are discussed below:

A. Delphi Method

The Delphi method can be thought of as a communication technique that is particularly helpful when a group of experts are asked to make a complex choice. Using this technique, all the experts who have been assigned to a decision-taking assignment can come to a consensus. The experts engaged are typically not identified, and a series of questions are asked to find the best answer. In the second phase, all committee members receive advice from each expert member. Each expert may agree with, disagree with, or edit the contributions of other members.

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They may also use the contributions of others to change their own opinions. Repeating the iteration of inputs from each expert results in a final agreement to the inputs. Delphi method is also helpful to assess the differences in opinion/inputs of different experts in a quantitative way by evaluation of belief statements by the expert's committee. Each panel member remains anonymous till decision is achieved. In next phase the percent weight given by each expert is distributed among all members for endorsement, rectification or rejection based on reasoning.

B. Rank Order Centroid (ROC)

It is a method to deriving weights to a list of number of factors involved in a decision making problem. The factors are ranked in order of their importance i.e. in order of 1st, 2nd, 3rd and so on. The weight of each factor is calculated by conversion of ranking order using below given equation

$$Wi = \frac{1}{F}\sum_{x=i}^{F}\frac{1}{x} \qquad (1)$$

Where F is the number of factors and Wi is the weight for ith item.

C. Pair Wise Comparison

Pair wise comparison is also helpful to work out the significance scale of any number of factors or to decide the relative priority of factors to conclude a decision. In pairwise comparison only two factors are compared at a time, as one can best decide his preference out of two options rather than comparing all factors at a time. Method of pairwise comparison is widely adopted for setting preferences, public choices, voting systems, social choices & management decisions. Pair wise comparison technique is used in Analytical Hierarchy Process (AHP) to solve complex multi-criteria decisions.

IV. RESULTS AND DISCUSSIONS

The expert team for development of condition assessment was finalized from corps of engineers who had relevant knowledge and experience. These experts had worked in various structures and had practical knowledge. The expert team had to visit different sites where they interviewed the local site in charge and experts in order to identify the common distresses and explain the standard operating procedures for inspection methods in practice. The interaction was bilateral, as the local site experts were also briefed by the expert team about the scope of visit and the condition index assessment concepts. They have visited at least hundred different sites. Experts from different sites proposed diverse options and alternatives, due to different local priorities and standard practices. As a result of several visit the expert team analyzed the list of important distresses proposed/suggested by local site experts. They also analyzed the technical/logical impotence keeping in view the cause and impact of distresses, units of measurement of distress and the measurement method. As the local site expert had a diverse set of options some distresses were considered more important at a particular site while the same being considered least important on other sites. The expert's team finalized a tentative list of distresses which were considered to give a consistent assessment of assets condition. And C.I number from 0-100 was used to identify the physical condition of drains given in Table 1.

Table 1: Condition Index for Condition Assessment of Drains

Zone	Condition Index	Condition description	Recommended action
1	85 to 100 70 to 84	Excellent: No noticeable defects, some aging or wear may be visible. Good: Only minor deterioration or defects are evident.	Immediate action is not required
2	55 to 69 40 to 54	Fair: Some deterioration or defects are evident, but function is not significantly affected. Marginal: Moderate deterioration. Function is still adequate.	Economic analysis of repair alternative is recommended to determine the appropriate action
3	25 to 39 10 to 24 0 to 09	Poor: Serious deterioration in at least some portion of the structure. Function is inadequate Very poor: Extensive deterioration. Barely functional Failed: No longer functional. General failure or complete failure of a major structure component.	Detail evaluation is required to determine the need for repair, rehabilitation or reconstruction. Safety evaluation is recommended.

The approach adopted for conducting expert opinion survey for this work is pairwise comparison. During assessment it is observed that both of distresses are present. At this point it is necessary to mention that what was the severity level extent of distress “A” and “B”, else one may conclude that the asset is fully distressed. If distress “A” is observe with low severity & minor extent then its effect on assessment will be negligible. On other hand, if distress “B”, being less important than “A”, is observed with high severity and on major extent, then its effect will be notable. So it is important to quantify the severity and extent of occurrence of distress “A” and similarly distress “B”. Therefore, it is important to give due consideration to level of severity and extent of distress to fully represent the actual condition of asset. Level of severity or extents are finalized based on experience and presented in Figure 1. It is noted that maximum severity of 35% observed in concrete drains due to erosion. It is because of the different chemical present in the waste water flowing in the drains leads to chemical reaction with the concrete ingredient causes erosion of the drain. And least possibility of 20% cracking was observed in case of brick drains.

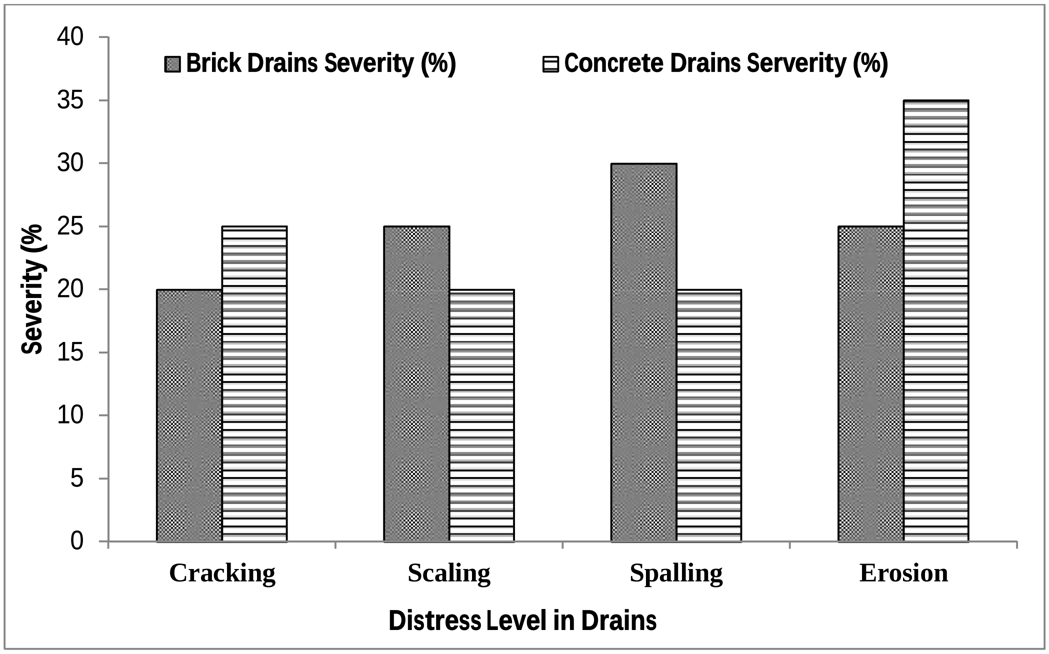

Figure 1: Structural Distress Level in Brick and Concrete Drains

V. CONCLUSIONS

It was concluded that brick drains had a minimum severity of 20% and a maximum severity of 35% for concrete drains. Concrete material erosion is the most dangerous scenario when there are open drains. It follows that concrete drains are less likely to experience scaling and Spalling problems. While in a brick drain, Spalling can cause serious distress and there is very little chance that it will crack. For open drains, the condition assessment methods used in pairs yield more trustworthy results. The pair wise techniques of condition assessment provide more reliable results for open drains. The condition of open drains can be evaluated using this criterion by the Public Health Engineering Department, the Water Supply and Sanitation Service, and the Municipal Department, which can also use the updated asset inventory to priorities budget usage.

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