

Crack Investigation And Proposing Remedies: A Case Study In “Jeewaka Hostel, Borella 436

Kasun Nandapala, G.H.S.Jayangani

Identifying Issues Related to Domestic Plumbing, Corrective and Preventive Measures: A Case Study 443

K.A.D.S. Karunarathna, Kasun Nandapala

Impact of Unexpected Rapid Price Fluctuations on Medium-Scale Building Construction Projects in Sri Lanka: A Case Study 448

R.M.T.K. Ranasinghe, Kasun Nandapala

TECHNICAL SESSION: Energy management and quantity surveying best practices for resilient industries 449

Mitigation of Financial Risks Involved in the Budget Performance of Building Construction Projects 450

K.H.S.U. Thilakarathna, S.R.M.P Seneviratne

The impact of challenges of current economic crisis on the performance of Sri Lankan building construction projects 459

G.A.S.Gunathilaka, U.Sivachelvy and S.R.M.P.Seneviratne

A Review of Emission Filtering and Controlling Systems Applicable for Fossil Fuel-Based Electricity Generators 469

I.M.D.W.Hasakelum, A.M.S.Amandani and S.V.R. Gamage

Guidelines to improve supply characteristics of Solar PV system components to improve sustainable supply chain practice 477

P. A. D. Madushan, S. R. M. P. Seneviratne

A Study on Lighting Technologies Used in Homes in Sri Lanka and its Impact on the Energy Demand of the Country 484

R.M.K.S.K Ranaweera, W.M.C.A Weerasekara, N K L K Pathum and P.M Perera

Energy management for the sustainability of Sri Lanka: Transition through green energy, Challenges & Future Prospects 487

D.S.B.Ratnayake

Identifying Issues Related to Domestic Plumbing, Corrective and Preventive Measures :A Case Study

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Abstract—Plumbing-related issues (Blockages, Leakages, and damages etc.) after construction are common in any type of buildings. Mostly it leads to damage the building structure, water waste, safety issues of users and as unexpected high maintenance cost etc. This study focuses on proposing corrective and preventive measures for common issues in plumbing and sanitary related. As a case study, three site locations that have plumbing problems have been selected in the Western South Department of Buildings, Survey Department, and Foreign Ministry Quarters. The most common issues have been identified by a technical inspection in the above three locations and using the analysis of financial cost usage for past 5 years of time. The main issues highlighted are leaks and damage to pipe fittings, pipes, sanitary fittings, and blockages in waste lines. It was established through a questionnaire that problems with most caused by poor maintenance. Then, corrective and preventive measures have been identified for these issues. Corrective measures have been proposed to repair, replace, and clean chemical blockages. As preventive measures, implementation of planned maintenance mechanism and facilitation of training for plumbers is recommended. Finally, it is recommended to focus more on preventive measures rather than corrective measures to minimise problems and reduce expenses.

Index Terms—plumbing, sanitary fittings, leakages, blockages, relative importance index value

I. INTRODUCTION

Common issues occurring with plumbing (pipe lines, fittings and sanitary fittings) in bath rooms are common problems in buildings. It is vital to provide effective solutions to the problems because we need to minimise water wastage, as we use the same drinking quality water in bathrooms, except for rain or treated water in Sri Lanka, and to avoid damage to the structure of the building and the interior of the buildings [1].

The aim of any construction project is to deliver a successful quality product or service to the client for as long as possible. In that context, the main possible causes of deviating from the aim qualities arise by arising common issues with pipe lines, fittings and sanitary fittings mainly in bathrooms within a very short time after handing over the project [2].

Relevant to this matter, different key main areas were identified as closely focused, such as blocking, leaking, low water pressure, and poor use of pipes and fittings [3]. By collecting data, with a determination of the related problems

and reasons, preventive and corrective measures could be introduced and scientifically proposed [4].

In the field, when building or maintaining projects, public and private buildings, houses, apartments, quarters, etc. the main area that can be pointed out is the regular encounter of problems and maintenance related to plumbing problems.

A technical inspection performed has identified common problems in the relevant area and has identified feather and relative plumbing problems by considering the most effective samples from the selected buildings.

When attending and identifying some problems, it was directly relevant to the faults of the clients, consultants, or contractors when doing the construction. If anything related to the prevention method identified during the construction stage, it better to attend to those rather than maintaining time to time after the construction, and has been identified as of the preventive measures for all three main parties to lock for in the study. It has covered selected specified areas under these identifications of issues. The preventive and corrective measures have been listed by summarising them under a particular major category, as has also been carried out in previous literature [5].

II. OBJECTIVES

The main objective of this study is to identify the most common problems with pipelines, pipe fittings, and sanitary fittings in bathrooms. Furthermore, it is intended to introduce effective preventive and corrective measures for these common issues.

III. METHODOLOGY

A. Overall Methodology

Three low-rise government quarters domestic type buildings that have raised the highest number of plumbing-related issues have been selected for the study. The three buildings are;

- The quarters of Survey Department, 150, Bernard soysa Mawatha, Colombo 05
- The quarters of Foreign Ministry, A/1/2, Colombo 05
- The quarters of Department of Buildings, 213, Torrington Avenue, Colombo 07

Initially, a visual site inspection survey was conducted of these buildings to identify the plumbing-related issues of the

TABLE I
DETAIL OF SELECTED OF LOCATIONS

Category	Quarters of Survey Dept.	Quarters of Foreign Ministry	Quarters of DoB
Location	Separately Unit	Inside of a Housing complex	Attached to the Office Building
Located Elevation(from G.L)	6 meters	3 meters	6 Meters
Floor area (m2)	750 Sq.ft	900 Sq.ft	1050 Sq.ft
Distance to O.H Tank	5 Meters	10 Meters	4 Meters
Category of Users	Residential Use for Max.5 Years per each users	-Do-	-Do-
Approx.Age of the Building	40 Years	25 Years	15 Years

^a

selected buildings, and the main issues have been identified. Then a questionnaire survey was conducted on the occupants to rank the identified issues according to their severity. And a desk study was conducted to analyse the maintenance expenses related issues of these buildings and ranked them accordingly. After finalising the critical issues, preventive and corrective measures are recommended based on the results obtained by an expert interview.

B. Data Collection methods

The method of collecting data for the study was survey-type data collection, and those have been collected as primary data. In that case, both questionnaires and telephone interview tools have been used to collect data from the technical staff for the study.

The Relative Importance Index (RII) was used to analyse the results of the questionnaire survey. The Relative Importance Index is calculated using the formula in Equation 1 [6].

$$\text{Relative Importance Index (RII)} = \frac{\sum_{i=1}^N W}{A \times N} \quad (1)$$

Where,

W = the weight given to each factor (1-5)

A = the highest weight = 5

N = the total number of respondents

C. Data Collection

Data were collected with the questionnaire from technical personnel who work in the field. Inspections have been carried out before the preparation of questionnaires to identify causes, corrective, and preventive measures for problems with the support of technical staff from the Department of Buildings. The relevant locations in the selected projects for the study are technically evaluated and recorded. Depending on the selected site areas for the reference source of main inspection to prepare the data collection questionnaire has been implemented for subsequent data collection, the responses have been recorded and the ranking order of the issues has been analysed [2].

The common issues of the related area has identified and recorded to furthermore analyze work. And cost of maintenance data were collected with available reports [7].



Fig. 1. Blockages, Leakages and Damages



Fig. 2. Leakages

IV. RESULTS

A. Results of the Visual Site Inspection Survey

As mentioned above, a visual site inspection survey was carried out to identify the extent of plumbing-related issues in the selected buildings. Figure 1 and Figure 2 exhibit some of the observed issues. Additionally, a list of issues has been prepared at each of the three locations and is presented in Table II.

B. Results of the Questionnaire Survey

The questionnaire survey was carried out to determine the perception of the occupants of each of the identified issues by visual site inspection.

- **Rank 1:** Leakages in pipe fittings
- **Rank 2:** Leakages in sanitary fittings
- **Rank 3:** Leakages in plumbing lines
- **Rank 4:** Leakages in waste lines
- **Rank 5:** Blockages in waste lines

TABLE II
LIST OF OBSERVED ISSUES IN EACH LOCATION

Location 1	Location 2	Location 3
Leakages in taps and valves	Damages in plumbing line	Damages in plumbing line
Leakages in Water closets	Damages in fittings due to time	Damages in sanitary fittings
Damages in pipe fittings	Leakages in taps and valves	Leakages in Water closets waste line
Damages in sanitary fittings	Blockages in drainage and waste line	
Blockages in waste line		

- **Rank 6:** Leakages in drainage lines
- **Rank 7:** Damages in sanitary fittings
- **Rank 8:** Blockages in sanitary fittings

By this, it is apparent that leaks in fittings and plumbing lines are frequent and are of high prominence over other issues.

C. Results of the Desk Study Performed to Analyse Expenses

The results of the desk study performed to analyse the expenditure of the identified issues during the last five years are presented in Table III. It presents the percentage of expenditure for each issue for each location, and the total expenditure of the particular issue out of the total cost of maintenance across the last five years. The ranking given in the table is based on the total expenditure for the given issues. The results show that leaks in fittings and plumbing lines cost more than blockages in sanitary fittings and even damages.

D. Results of the RII analysis on the causes of issues

As the next step, we identified the most probable causes of each of the identified issues and performed a relative importance index analysis to rank and identify the most probable cause to be addressed. The results are presented in Table IV. From the table, it can be deduced that poor maintenance is one of the major causes of plumbing-related problems. Moreover, it is apparent that the use of improper installation techniques is a cause that should not be understated.

V. RECOMMENDATIONS AND CONCLUSIONS

The most common and critical plumbing problems have been identified in the previous section. As summary, the following five problems have been prioritized in the above analysis.

- 1) Leakages in pipe fittings
- 2) Blockages in waste lines
- 3) Leakages in waste lines
- 4) Blockages in pipe and sanitary fittings
- 5) leakages in pipe joints

An expert interview was conducted to identify preventive and corrective measures for the identified problems. Expert recommendations are presented in Table V.

According to the table, it is apparent that the planned maintenance could address most of the common plumbing problems. In addition, it can be pointed out that well training of plumbers would prevent most plumbing-related problems in buildings. Since the corrective measures are expensive, focusing high on preventive measures is of utmost significance.

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TABLE III
RANKING ORDER OF ISSUES ON SUMMARY OF MAINTENANCE EXPENSES PERCENTAGE (IN LAST 5 YEARS)

S N	Issue	Quarters Location	% out of cost in Locations	% out of Total Cost	Rank order
1	Leakages in pipe fittings	Foreign Ministry Department of Buildings Survey Department	36.9% 20.6% 42.5%	24.6%	1
2	Leakages in sanitary fittings	Foreign Ministry Department of Buildings Survey Department	38.8% 27.2% 34.0%	23.8%	2
3	Leakages in plumbing lines	Foreign Ministry Department of Buildings Survey Department	61.9% 13.7% 24.4%	20.9%	3
4	Leakages in waste lines	Foreign Ministry Department of Buildings Survey Department	13.0% 68.4% 18.6%	10.5%	4
5	Blockages in waste lines	Foreign Ministry Department of Buildings Survey Department	20.9% 34.4% 44.8%	10.3%	5
6	Leakages in drainage lines	Foreign Ministry Department of Buildings Survey Department	50.4% 14.5% 35.1%	3.9%	6
7	Damages in sanitary fittings	Foreign Ministry Department of Buildings Survey Department	43.6% 43.6% 12.8%	3.5%	7
8	Blockages in sanitary fittings	Foreign Ministry Department of Buildings Survey Department	23.3% 34.9% 41.9%	2.4%	8

TABLE IV
RESULTS OF THE RELATIVE IMPORTANCE INDEX ANALYSIS CARRIED OUT TO RANK CAUSES FOR MOST COMMON ISSUES

Type of issue	Cause	RII value	Rank
Leakages in pipe fittings	Use fewer quality brands for fittings	0.80	1
	Poor maintenance	0.72	2
	Use incorrect installation techniques for fittings	0.57	3
	Use incorrect methods of laying pipes	0.33	4
	Use improper methods for jointing pipes	0.30	5
Blockages in waste lines	Poor maintenance	0.85	1
	Use incorrect installation techniques for fittings	0.77	2
	Use fewer quality brands for fittings	0.70	3
	Use incorrect methods of laying pipes	0.50	4
	Use improper methods for jointing pipes	0.30	5
Leakages in waste lines	Poor maintenance	0.86	1
	Use fewer quality brands for fittings	0.76	2
	Use incorrect methods of laying pipes	0.64	3
	Use incorrect installation techniques for fittings	0.54	4
	Use improper methods for jointing pipes	0.35	5
Blockages in the pipe and sanitary fittings	Use fewer quality brands for fittings	0.83	1
	Poor maintenance	0.77	2
	Use incorrect installation techniques for fittings	0.70	3
	Use improper methods for jointing pipes	0.58	4
	Use incorrect methods of laying pipes	0.32	5
Leakages in pipe joints	Use improper methods for jointing pipes	0.84	1
	Use incorrect methods of laying pipes	0.73	2
	Poor maintenance	0.56	3
	Use fewer quality brands for fittings	0.53	4
	Use incorrect installation techniques for fittings	0.36	5

TABLE V
SUMMARY OF CAUSE, CORRECTIVE AND PREVENTIVE MEASURES FOR COMMON ISSUES

Identified common issues	Reasons for the Issues	Corrective Measures	Preventive measures
Leakages in pipe fittings	Use fewer quality brands for fittings	Repair leaks on pipe valves and taps	Use correct installation techniques for fittings
	Poor maintenance Use incorrect installation techniques for fittings	Replace damaged parts of the fittings	Use best quality brands for fittings Well maintenance
Blockages in waste lines	Use fewer quality brands for fittings	Repair leak joints on pipe lines	Use correct installation techniques for fittings
	Poor maintenance Use incorrect installation techniques for fittings Use incorrect methods of laying pipes	Replace the pipe line newly	Use quality brands for fittings Well maintenance
Leakages in waste lines	Use fewer quality brands for fittings	Repair and Replace damage parts of the fittings	Use best quality brands for fittings
	Poor maintenance Use incorrect installation techniques for fittings Use incorrect methods of laying pipes		Well maintenance
Leakages in sanitary fittings	Use fewer quality brands for fittings	Repair damaged parts of the fittings	Use correct installation techniques for fittings
	Poor maintenance Use incorrect installation techniques for fittings Use incorrect methods of laying pipes	Replace damaged parts of the fittings	Use quality brands for fittings Well maintenance
Leakages in plumbing lines	Use fewer quality brands for fittings	Repair leak joints on pipelines	jointing pipes Use proper methods for
	Poor maintenance Use incorrect installation techniques for fittings Use incorrect methods of laying pipes	Replace damaged parts of the fittings	Use correct methods of laying pipes

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