The International Journal of Interdisciplinary Organizational Studies
ISSN: 2324-7649 (Print), ISSN: 2324-7657 (Online)
Volume 19, Issue 1, January-June, 2024

FAILURE ANALYSIS FOR CONSTRUCTION PROJECT MANAGEMENT A SPECIAL REFERENCE TO BUILDING FOUNDATION WORKS PROBLEMS

[1]A.Chandramohan & [2]Dr.RamyaThiyagarajan

1. Research scholar , Department of Management Studies, School of Commerce and Management, Bharath Institute of Higher Education and Research, Agaram Then Main Road, Chennai, India. Pin: 600073.

2 Associate Professor & Research Supervisor, Dept of Business Administration ,Faculty of Arts and Science, Bharath Institute of Higher Education and Research – BIHER, Selaiyur, Chennai, India. Pin: 600073.

ABSTRACT

Nowadays for effective functioning of project management 360^0 listening is required. Failure Mode Effect Analysis (FMEA) is the Tool is where the magic happens. It gives the concrete details about what the activity is under process, how it could be done better way, and what could be the possible problems may occur, what is the priority rating to controls, what corrective and preventive measure should be taken. FMEA is the Risk analysis methodology to validate, assess and avoid failures because of human error, uncertainty in the machines function and raw materials controlling. In the construction process it is very difficult to control and maintain all activities, To maximize the performance and outputs, it is very essential to support the management by guaranteed tools. This paper describes in detail how FMEA methodology can be applied in construction project management. The aim is for indicating its's benefits, methodology to used for construction activities. The ultimate objectives to indicate the failure modes in building foundation works, root causes identification, inspection plans , possible way of correction, and finally to move the organization towards continual improvement.

1.INTRODUCTION

Failure analysis is a potential problem identifying method. Initially it was applied in US military Forces in the late 1940s. Later on In 1960s, the aerospace industry used this methodology for design failure identification and to ensure safety and reliability. Ford Motor Company applied this analysis in automotive industry and ensured the regulatory compliance. Continuation to Ford Motors other fortune 500 companies used this methods and maintained the standards.

Any product and process problems can be identified in FMEA. Problem prevention, safety enhancement and customer satisfaction will be increase while FMEA usage. It is also used to improve design and production activities. Process FMEA is used in manufacturing industries viz manufacturing, food production, plastics and injection molding , power plant operation, software development, and healthcare maintaining and etc. After successful implementation of FMEA, the organization gets gains like (1) potential failure modes of products and processes:, (2) engaging

the work force to do work with lesser resource and expenditure; and (3) finally try to reduce the costs and expenditures.

Keywords: Process FMEA , Failure Analysis, Project Management, Design FMEA , RPN values.

2. SIGNIFICANCE

Challenges will be more and more during the development of organizations they forced face many difficulties. External and internal environments gives more pressure the organisation to do to redesign themselves periodically to meet the changing requirement.

3. PURPOSE OF THE STUDY

- ✓ Increase the product standard
- ✓ Continual Improvement
- ✓ Excellent customer service

4. OBJECTIVES OF THE STUDY

- ✓ To identify Potential Problems
- ✓ Categories the problems
- ✓ Assigning RPN Value
- ✓ Taking corrective and preventive actions

5. REVIEW OF LITERATURE

5.1 Literature reference : In 2020 – December - A failure mode and effect analysis (FMEA)-based approach for risk assessment of scientific processes in non-regulated research laboratories by A. Mascia, Anna Maria Cirafici, Antonella Bongiovanni in the Accreditation and Quality Assurance journal 25(8)DOI:10.1007/s00769-020-01441-9

Extract Details : FMEA is a systematic method for identifying overall risk in the process, product and service, manufacturing and assembly lines activities. This is a process analysis tool, it depends on identifying: (1) Failure mode: One of the ways in which a product can fail; one of its possible deficiencies or defects; (2) Effect of failure: The consequences of a particular mode of failure;(3) Cause of failure: One of the possible causes of an observed mode of failure; (4) Analysis of the failure mode: Its frequency, severity, and chance of detection

5.2 Book Reference: Handbook of Quality control for construction of roads and runways, second revision, Indian Roads Congress, Special Publication – 11, Pages 18 & 19, Tables 2.1 & 2.2

Table 2.1 Control Tests on Borrow Materials

S. No	Test	Test Method	Minimum desirable frequency
1.	Gradation@ / Sand-content	IS : 2720 Part IV-1985 (Reaffirmed 2006, Second Revision)	1-2 tests per 8000 m^3 of soil
2.	Plasticity index	IS : 2720 Part V-1985 (Second Revision)	-do-
3.	Standard Proctor Test	IS : 2720 Part VII-1980 (Reaffirmed 2011, Second Revision)	-do-
4.	CBR on a set of 3 specimens **	IS : 2720 Part XVI-1987 (Reaffirmed 2002, Second Revision)	One test per 3000 m^3
5.	Deleterious constituents	IS : 2720 Part XXVII – 1977	As required
6.	Natural moisture content	IS : 2720 Part II – 1973 (Reaffirmed 2010, Second Revision)	One test per 250 m^3 of soil

@ indicates the specifications call for such tests.

** indicates only for the purposes of design,

Table 2.2 Tests for Compaction Control

S. No	Test	Test Method	Minimum (desirable frequency)
1.	Moisture content just before compaction	IS : 2720 Part II-1973 (Reaffirmed 2010, Second Revision)	2-3 tests per 250 m^3 of loose soil
2.	Dry density of compacted layer	IS : 2720 Part XXVIII-1974 (Reaffirmed 2010, First Revision)	Generally, 1test /1000 m^2 of compacted soil area for the body of the embankment, to be increased to one test per 500-1000 m^2 of compacted area for top sub grade layer, i.e., top 500 mm portion of the embankment.

The organizations are required to use FMEA When; (1) a company wants to do a product with updated / new design ;(2) wants to do it's service with additional / new/ modified steps; (3) analyze failures of current processes or services or products ; (4) where the periodic checks during the life of a process , product or service. In the above process the Potential Failures need to be identifited for betterment of business.

6. RESEARCH METHODOLOGY

FMEA is a systematic method for identifying overall risk for a process, product, or service of failures in design, manufacturing or assembly lines. This is a process analysis tool, it depends on identifying: (1) Failure mode: One of the ways in which a product can fail; one of its possible deficiencies or defects; (2) Effect of failure: The consequences of a particular mode of failure;(3) Cause of failure: One of the possible causes of an observed mode of failure; (4) Analysis of the failure mode: Its frequency, severity, and chance of detection

Types of FMEA

Design FMEA : analyze risks associated with product design and it's malfunctions, product life time, and safety and regulatory concerns. Material Properties, The Geometry of the Product , Tolerances/Stack-Ups, Interfaces with other Components and/or Systems and Engineering Noise including User Profile, Environments, Systems Interactions & Degradation play major role.

Process FMEA : methodology used to discovers risks associated with process. It includes failure that impacts product quality, reduced reliability of the process, customer dissatisfaction, and safety or environmental hazards. 6Ms : Man, Methods, Materials, Machinery, Measurement, Mother Earth

HOW TO DO FMEA

Stage 1

Provide background information ;(a) Identify a name or item name ; (b) Identification of cross functional team members and development of the FMEA; (c) Record date of FMEA was first created and subsequent revisions; (d) Identify and record the owner or preparer of the FMEA

Stage 2

Listing of all process steps, identify variables or collecting of key inputs.

Stage 3:

Listing of all potential failure modes. The mode is defined as the manner in which a component , subsystem , process and etc. may potentially fail. This can be identified through existing data collection , brainstorming sessions when the process / product / service failures happened.

State 4:

Assign rating numbers to potential failure modes.

Guideline for assigning numbers for SEV, OCC and DET.

FMEA Severity Rating Factors

Rating	Degree of severity
1	Adverse effect will not be noticed by Customer
2	Customer will probability experience slightly
3	Customer will experience annoyance
4	Reduced performance and Customer dissatisfaction
5	Customer felt uncomfortable / productivity reduced/ Continued degradation effect
6	Complaints from warranty / assembly
7	High degree of customer satisfaction/ complete loss of function / scrap high / re-work level
8	High degree of customer satisfaction/ negative impact on safety and government regulations
9	Customer endanger / with warning adverse effect on safe system / violation of Government regulations
10	Customer endanger / with out warning adverse effect on safe system / violation of Government regulations

Guideline for OCCURANCE Rating Factors

Rating	Probability of Occurrence	
		Frequency (1 in ...)
1	Likelihood of occurence is remote	1,000,000
2	Low failure rate with supporting documentation	20,000
3	Low failure rate without supporting documentation	5,000
4	Occasional failures	2,000
5	Relatively moderate failure rate with supporting documentation	500
6	Moderate failure rate without supporting documentation	100
7	Relatively high failure rate with supporting documentation	50
5	Relatively moderate failure rate with supporting documentation	500
6	Moderate failure rate without supporting documentation	100
7	Relatively high failure rate with supporting documentation	50
8	High failure rate without supporting documentation	20
9	Failure is almost certain based on warranty data or significant Design Verification* testing	10
10	Assured of failure based on warranty data or significant Design Verification* testing	2

Stage 5 Risk Priority Number calculation for each failure modes
RPN Value : SEV (Severity) X OCC (occurrence) X DET (Detection)

Guideline for assigning numbers for

DETECTION.

Rating	Ability to Detect	
		Detection Certainty
1	Sure that the potential failure will be found or prevented before reaching the next customer	100%
2	Almost certain that the potential failure will be found or prevented before reaching the next customer	99%
3	Low likelihood that the potential failure will reach the next customer undetected	95
4	Controls may detect or prevent the potential failure from reaching the next customer	90
5	Moderate likelihood that the potential failure will reach the next customer	85
6	Controls are unlikely to detect or prevent the potential failure from reaching the next customer	80
7	Poor likelihood that the potential failure will be detected or prevented before reaching the next customer	70
8	Very poor likelihood that the potential failure will be detected or prevented before reaching the next customer	60
9	Current controls probably will not even detect the potential failure	50
10	Absolute certainty that the current controls will not detect the potential failure	< 50

7. RESEARCH METHODOLOGY for specific problem

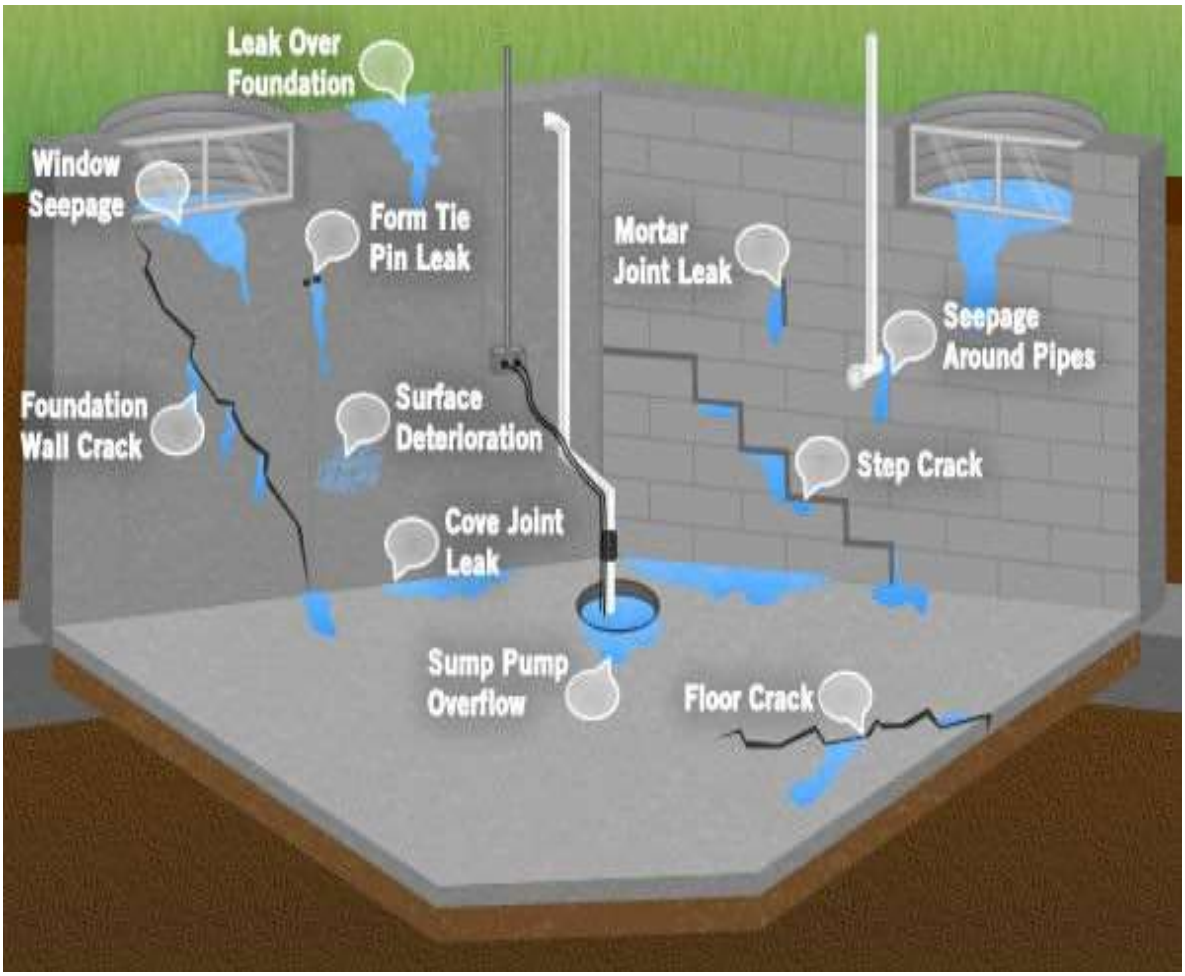
7.1 Problem identification

Leaking Basements : A leaky basement can be a common problem for structures close to a body of water where the water table is typically high (sea, lake, underground reservoir). The long term damages can affect the integrity of your structure and ultimately result in costly repairs.

7.2 DATA COLLECTION

Potential Failure Mode :

This manifests in four different ways: (1) Differencial Soil Settlement problem (2) Hydro-static Pressure ; (3) Lateral Pressure ; (4) Differential Settlement ; (5) Capillary Absorption ; (6) Failure in waterproofing system (waterproofing membranes are improperly placed, mishandled, or punctured);(6) waterproofing system design and detailing is primitive and inappropriate.



7.3 INSPECTION & ASSESSMENT

7.3.1 Soil Testing for the problem analysis

7.3.1.1 INTRODUCTION

Based on the request received for the Soil investigation , the Continuous Cone Penetration tests (CPT) were carried and Soil samples were taken out in the Site

7.3.1.2 PLAN OF INVESTIGATION.

The Soil investigation was planned with 3 Continuous Cone Penetration Tests with high resolution approach. At every 300 mm interval the data were noted.

The scope of work includes the following:

Conducting CPT

Conducting laboratory tests on samples collected

Natural Moisture Content

Specific Gravity

Grain Size Analysis

Results of the soil investigation and recommendations for suitable type of foundation for the proposed construction are presented in this report.

7.3.1.3 FIELD INVESTIGATION

In the site 3 continuous cone penetration tests were carried out at the Sited location. The Cone Penetration Tests consist of driving a 25 mm diameter cone, by a 10 kg drop weight with a free fall of 500 mm. The cone tests were conducted right from EGL, continuously up to 10 meters below EGL . The number of blows for each 300 mm penetration is termed as "Cone Penetration Resistance" (CPR). CPR is about 1.8 times the SPT value.

7.3.1.4 Laboratory Tests

The laboratory tests were conducted as per relevant parts of Indian Standard, in compliance with the technical specifications of the contract. The following parameters are evaluated:

7.3.1.5 Moisture Content & Density

Moisture content, bulk and dry densities were determined, in accordance with the procedures of IS: 2720. The results are interpreted and report presentation is carried out based on the findings..

7.3.1.6 Particle Density/Specific Gravity

The particle density was determined for samples in accordance with the small pycknometer method described in IS: 2720 (Part 3/Sec 1). Prior to testing, samples were ground down, if necessary, so as to pass the 2mm sieve. The test results are presented in summary of test results

7.3.1.7 Particle Size Distribution

The particle size distribution was determined, in accordance with the wet sieving method described in IS:2720 (Part 4). Compliance with the Standard, with respect to minimum sample quantity is dependent on the maximum sample available from the field test. In particular, for borehole hammer/ SPT samples, the quantity of soil available for testing is typically about 100g/200g. This sample quantity is considered representative where grain sizes range up to 4.75mm (i.e. to coarse sand size). Where significant quantities of coarser particles are present, the particle size distribution obtained from such samples should be regarded as indicative only. The test results are presented in summary of test results

7.3.1.8 SUBSOIL CONDITIONS -. Details are there in the lab reports attached.

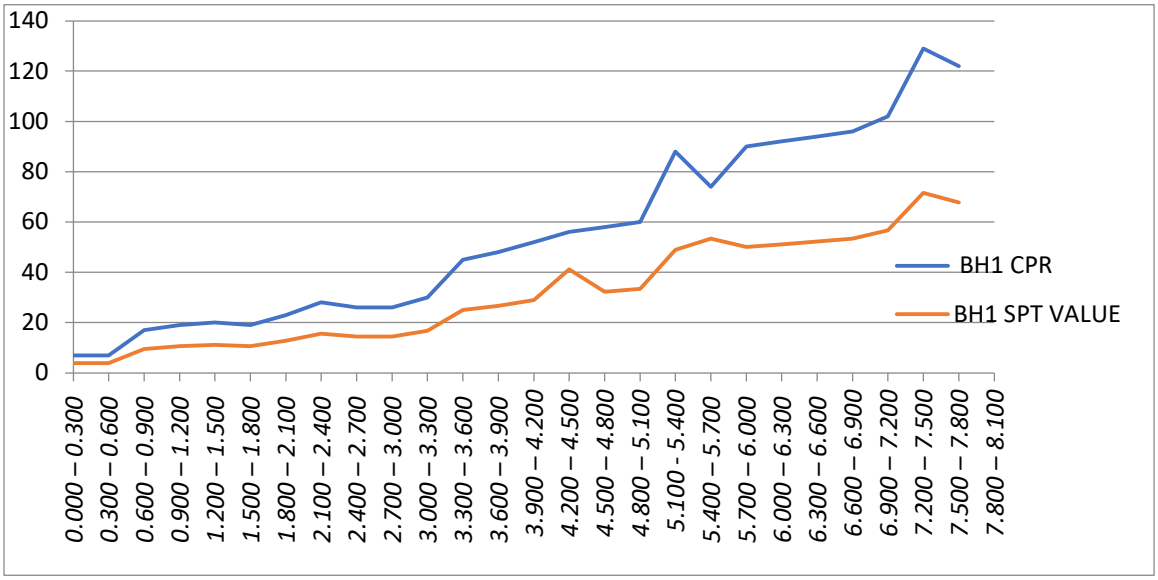
7.3.1.9 SPT VALUE RESULT :

7.3.1.10 CPR and SPT: BORE HOLE - BH1 (Front side of plot)

Sl No	Depth in Meters	BH3 CPR	BH3 SPT VALUE
1	0.000 – 0.300	7	4
2	0.300 – 0.600	7	4
3	0.600 – 0.900	17	9
4	0.900 – 1.200	19	11
5	1.200 – 1.500	20	11
6	1.500 – 1.800	19	11
7	1.800 – 2.100	23	13
8	2.100 – 2.400	28	16
9	2.400 – 2.700	26	14
10	2.700 – 3.000	26	14
11	3.000 – 3.300	30	17
12	3.300 – 3.600	45	25
13	3.600 – 3.900	48	27
14	3.900 – 4.200	52	29
15	4.200 – 4.500	56	41
16	4.500 – 4.800	58	32
17	4.800 – 5.100	60	33
18	5.100 - 5.400	88	49
19	5.400 – 5.700	74	53
20	5.700 – 6.000	90	50
21	6.000 – 6.300	92	51
22	6.300 – 6.600	94	52
23	6.600 – 6.900	96	53

24	6.900 – 7.200	102	57
25	7.200 – 7.500	129	72
26	7.500 – 7.800	122	68

7.3.1.11 Graphical representation CPR and SPT : BH1 (Front side of plot)

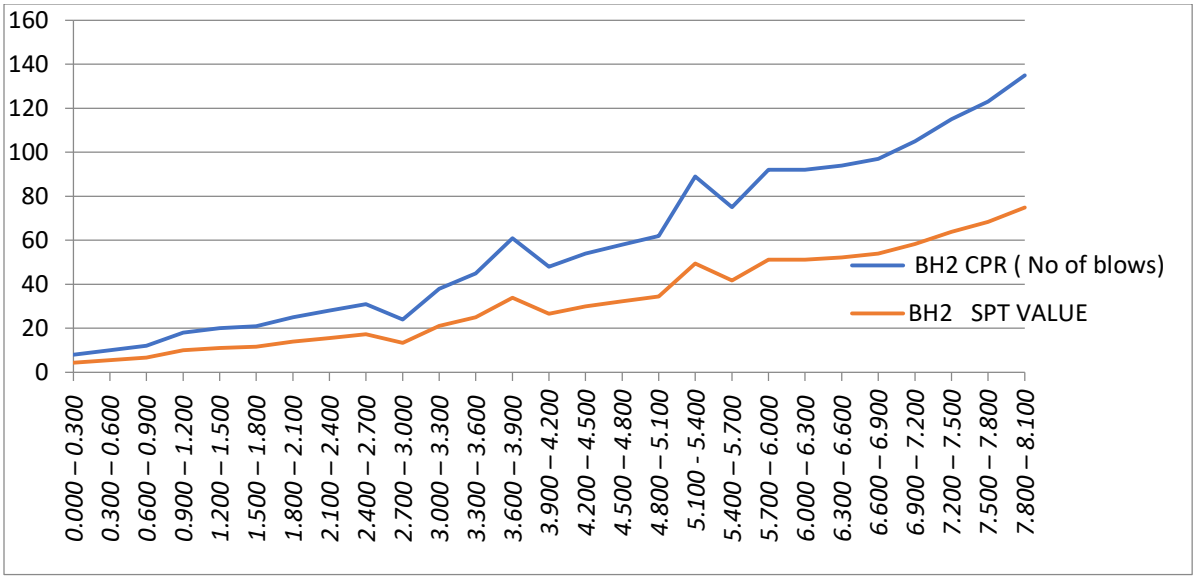


7.3.1.12 CPR and SPT: BORE HOLE - BH2 (Rear side of plot)

Sl No	Depth in Meters	BH2 CPR (No of blows)	BH2 SPT VALUE
1	0.000 – 0.300	8	4
2	0.300 – 0.600	10	6
3	0.600 – 0.900	12	7
4	0.900 – 1.200	18	10
5	1.200 – 1.500	20	11
6	1.500 – 1.800	21	12
7	1.800 – 2.100	25	14
8	2.100 – 2.400	28	16

9	2.400 – 2.700	31	17
10	2.700 – 3.000	24	13
11	3.000 – 3.300	38	21
12	3.300 – 3.600	45	25
13	3.600 – 3.900	61	34
14	3.900 – 4.200	48	27
15	4.200 – 4.500	54	30
16	4.500 – 4.800	58	32
17	4.800 – 5.100	62	34
18	5.100 - 5.400	89	49
19	5.400 – 5.700	75	42
20	5.700 – 6.000	92	51
21	6.000 – 6.300	92	51
22	6.300 – 6.600	94	52
23	6.600 – 6.900	97	54
24	6.900 – 7.200	105	58
25	7.200 – 7.500	115	64
26	7.500 – 7.800	123	68
27	7.800 – 8.100	135	75

7.3.1.13 Graphical representation CPR and SPT : BH2 (Rear side of plot)

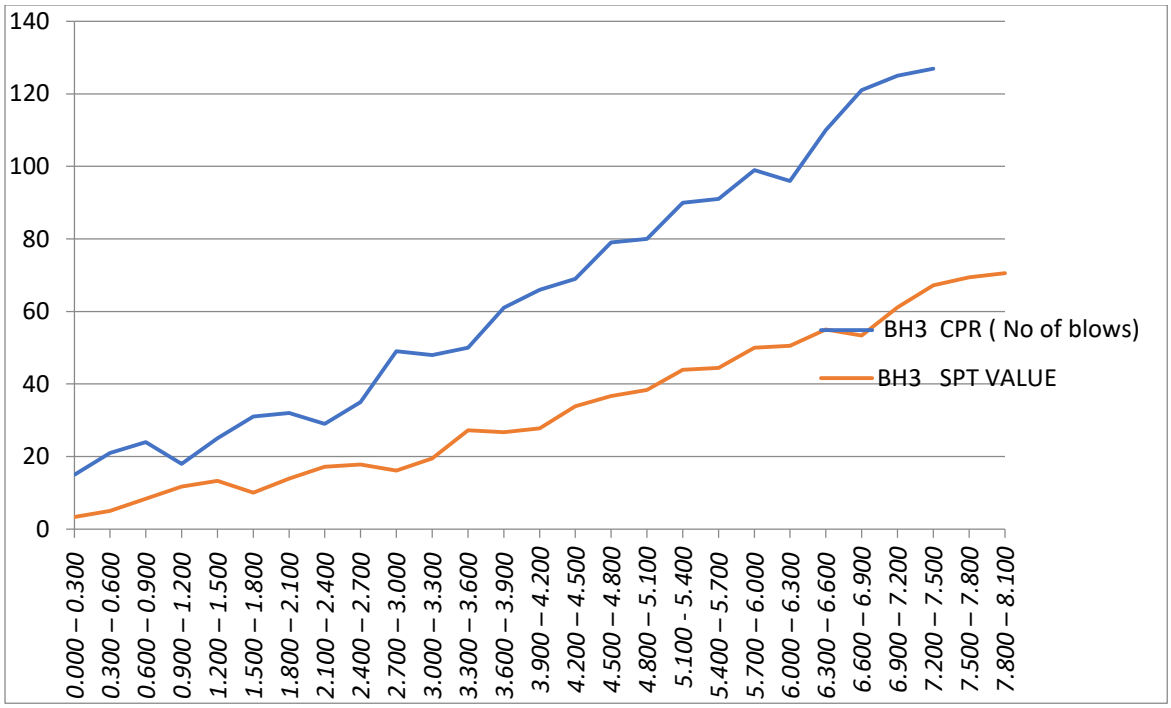


7.3.1.14 CPR and SPT: BORE HOLE - BH3 (Right Middle of plot)

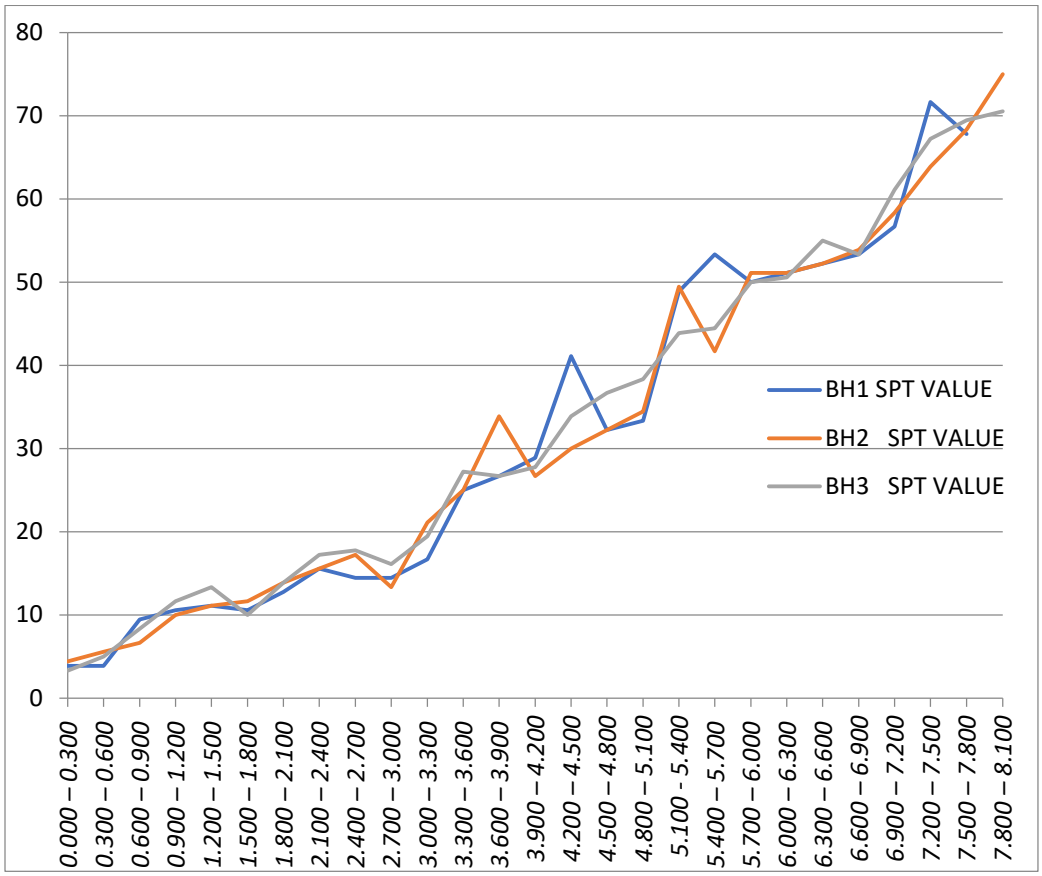
Sl No	Depth in Meters	BH3 CPR (No of blows)	BH3 SPT VALUE
1	0.000 – 0.300	6	3
2	0.300 – 0.600	9	5
3	0.600 – 0.900	15	8
4	0.900 – 1.200	21	12
5	1.200 – 1.500	24	13
6	1.500 – 1.800	18	10
7	1.800 – 2.100	25	14
8	2.100 – 2.400	31	17
9	2.400 – 2.700	32	18
10	2.700 – 3.000	29	16
11	3.000 – 3.300	35	19
12	3.300 – 3.600	49	27
13	3.600 – 3.900	48	27

14	3.900 – 4.200	50	28
15	4.200 – 4.500	61	34
16	4.500 – 4.800	66	37
17	4.800 – 5.100	69	38
18	5.100 - 5.400	79	44
19	5.400 – 5.700	80	44
20	5.700 – 6.000	90	50
21	6.000 – 6.300	91	51
22	6.300 – 6.600	99	55
23	6.600 – 6.900	96	53
24	6.900 – 7.200	110	61
25	7.200 – 7.500	121	67
26	7.500 – 7.800	125	69
27	7.800 – 8.100	127	71

7.3.1.15 Graphical representation CPR and SPT : BH3 (Right Middle of plot)



7.3.1.16 Comparative SPT Value of all 3 Points



Note :

The cone penetration tests consist of driving a 25 mm diameter cone, by a 10 kg drop weight with a free fall of 500 mm. The number of blows for each 300 mm penetration is termed as "Cone Penetration Resistance" (CPR).

7.3.1.17 RECOMMENDATIONS

Considering the results and characteristics of sub-soil strata the following recommendations are suggested. Then open Foundations (individual column footings or combined footings, if there are two or more columns close to each other, or Strip Raft combining each row of columns, if each row of columns are close to each other when compared to the distance or span between rows of columns, or raft foundation) can be adopted.

(i) Pressure Cement grouting Injection is suggested to reduce the soil porous and to avoid water leak .

(ii) PCC for the foundations can be laid on the compacted sand cushion layer.

(iii) A safe bearing capacity of 15 t/m^2 is recommended under the foundations at the depth 2.5 mts. However, the width of any column footing or strip raft shall not be less than 1 m.

(iv) At the time of excavation for foundations, if ground water table occurs within the recommended depth of excavation, sumps may be made to an additional depth of 0.3 m at one or more corners of the foundation pits for column footings/combined footings or at desired locations along the periphery of excavation for strip raft/raft foundation and the water collected in the sumps may be bailed out. At the time of laying the sand cushion layer, the bottom of excavation shall be relatively dry (not slushy). Dewatering shall be maintained until that part of the concrete in the foundations, which comes below the ground water table level, sets.

7.3.1.18 GUIDELINES FOR FILL MATERIAL AND FOR FILLING TO RAISE THE GENERAL GROUND LEVEL

In site two water sumps are constructed in the site. This depth are 2.3 and 2.5 meters Depth from the surface level. If the tanks are fouling in the foundation of proposed Building, these tank's foundations to be removed and refilling to be done based on the following norms.

Before filling to raise the general ground level, any organic matter or plants, if present in the Plot, shall be removed with roots. Relatively inert material such as sand or gravel shall be used for filling. The percentage of fines (grain size less than 0.075 mm) shall not exceed 20%. The liquid limit shall not exceed 30% and the plasticity index shall not exceed 10%. The fill material shall be free from contamination from decomposed organic matter and harmful chemicals.

Filling shall be done in layers of not more than 150 mm thickness, each layer. Each layer shall be well compacted at about the optimum moisture content of the fill soil. Compaction may be monitored by taking field density measurements at the rate of at least one test for every 750 square meters* of area compacted. At least 95% of the maximum dry density obtained in the laboratory Standard Proctor compaction test (as per IS: 2720, Part VII-1980 (Reaffirmed 2011, Second Revision): Methods of test for soils, Determination of water content-dry density relation using light compaction, Second Revision) shall be achieved in the field.

7.3.1.18 Procedure for Pressure Injection grouting

Sl No	Step by step Procedures
05	Before starting of work, approval of client as well as client Engineer should be obtained. Use safety protective devices.
10	Check all the machineries, tools and other at the work place
15	Mark the point with the client engineer and get approval from them to start the work
20	Ensure the process equipment , valves, injector , pump are working condition
25	Maintain the pressure 10 kg/ cm square
30	Make the 9 " (225 mm) Bore hole according the depth suggested
35	After making hole check bore depth and show to the client engineer
40	Record the bore depth
45	Place the 60 mm pipe in center of hole and ensure the perforations are free condition
50	Pack the hole as per foundation recommended level with Blue metal / Chips and M Sand as per the Standard operating procedure.
55	For Cement Injection : Fill 75 to 100 liters of water and mix one bag of Cement (50 kg)
60	Add the Calcium ligno sulphonate - one parts in 1500 parts of water.
65	Mix the compound and ensure the slurry is formed perfectly
70	Load the First load slurry in the Injector.

75	Apply the pressure up to 10 kg / cm square .
80	Ensure the slurry is properly going inside the bore hole
85	Load the consecutive loads and complete the target volume
90	Remove the Injection pipe immediately after the injection is over, because if time goes up , it is very difficult remove the pipe
95	Clean the Injection pipe with jet of water
100	Record the values in the Injection Report and make documentation with client side engineer.

Note : Mixing machine and Injection pump to be cleaned immediately after the work is completed other-wise serious problem will happen.

8. INTERPRETATION / SUGGESTIONS / CORRECTIVE MEASURES

First the source of the leak has been identified. Then the damages were evaluated based on the item wise costing. Next the corrective measure methods can be recommended accordingly. It is to be noted that the each case is unique. All repair solutions not will deliver the same results. Nevertheless, here are some common repair practices:

1) for floor cracks and cove seepage problem, hydrostatic pressure root cause, it is to be alleviated by providing the way to the ground to go somewhere else. This can be done by installing an internal drainage system that drive and directs the water to go way from the foundation. Then , floor cracks to be sealed by high pressure injecting through grouting pump to fill the gaps.

2) For wall crack problems, the most common way of repair is to inject it from the interior or exterior with expanding polyurethane. The polyurethane fills and seals the crack out to the soil and stays flexible when cured to prevent minor foundation movement from re-opening the crack.

3) For deterioration of concrete or at the rebars, initiation of corrosion occurrence, the reinforcing steel and concrete are to be treated and re-casted . This can be done by removing the concrete cover, wire brushing all the corroded steel, anti-corrosion coating on the steel bar , and recast the affected item using a special mortar.

4) To stop the seepage permanently in all joints viz a) wall and floor meeting ; b) mortar joints; c), porous walls or over the top of a wall is to install an exterior waterproofing membrane. But this

is a costly method because the perimeter of the exterior needs to be exposed, thus the need remove all the soil around the foundation.

9. OPPORTINITY FOR FUTURE DEVELOPMENT

This paper deals about the construction project management activity alone. Likewise it can be developed for : (1) Architectural Designing; (2) Structural Designing ; (3) Plumbing works; (4) Fire fighting works and etc.

SUMMARY

Quality and reliability of products /services are based on the and manufacturing processes are controlled. If the product usage is critical at the user end, the controlling mechanism right the raw material procurement stage, different stages of production process , final product quality and distribution stage and etc. are to be planned in scientific manner To fulfil customer's requirements in quality and reliability, some actions to be taken for assuring the quality and reliability of products or processes. In the way the FMEA is power quality improvement tool to determine risks involved the process. Before starting the actual FMEA , a adequate check list / worksheet needs to be prepared to do FMEA in effective ways. It should have the rating score guidelines of severity, occurrence and dete
ction. The aim of the paper is to identify the potential failures mode in the construction project management especially to basement water proofing process. This paper will surely enhance the involved person's knowledge in research area of designing, manufacturing, service and other processes.

LIMITATIONS

If the FMEA System not followed properly and Corrective Actions are not conducted, the effectiveness and efficiency will be lost in the organization.

JOURNAL REFERENCES :

1) 2020 – December - A failure mode and effect analysis (FMEA)-based approach for risk assessment of scientific processes in non-regulated research laboratories by A. Mascia, Anna Maria Cirafici, Antonella Bongiovanni in the Accreditation and Quality Assurance journal 25(8) DOI:10.1007/s00769-020-01441-9

2) 2019- Evaluation of polyurethane resin injection for concrete leak repair by Mohamed A.Safan Zeinab, A.Etman AlaaKonswa in the science direct.

3) 2019 - Root cause for water leakage in basement by CTL Group Qatar Laboratory, Industrial City, Al Kassarat Road - R/A 41, Doha, Qatar

4) 2018- Failure Mode and Effect Analysis (FMEA) Implementation: A Literature Reviewby Kapil Dev Sharma, Shobhit Srivastava in the Journal of Advance Research in Aeronautics and Space Science Volume 5, Issue 1&2 -, Pg. No. 1-17

5) A Literature Review. J Adv Res Aero SpaceSci 2018; 5(1&2): 1-17. Failure Mode and Effect Analysis (FMEA) Implementation: A Literature Review Kapil Dev Sharma1 , Shobhit Srivastava2 1,2Assistant Professor, Faculty of Engineering and Technology, Gurukul Kangri Vishwavidyalaya, Haridwar,Uttrakhand

6) 2016- Listening is an overlooked leadership tool by Melissa Daimlerin the Harvard Business Review.

7) 2014- Problems and Remedies for Basement Construction (In High Water Table Area) by Rathod Maulik A. Deep S. Civil Engineering Assistant Professor Government Engineering College in the International Journal of Engineering Research & Technology (IJERT)

8) 2014- What Is Causing My Basement To Leak? (10 Potential Reasons) by Ben Kissam

9) 2008- Case Studies of Moisture Problems in Buildings by G. Proskiw, PEng Member in the ASHRAECONFERENCE PROCEEDING

BOOK REFERENCE:

Latest Edition - Handbook of Quality control for construction of roads and runways, second revision, Indian Roads Congress, Special Publication – 11, Pages 18 & 19,