



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 Issue: V Month of publication: May 2020

DOI: <http://doi.org/10.22214/ijraset.2020.5047>

www.ijraset.com

Call:  08813907089

E-mail ID: ijraset@gmail.com

Techno- Commercial Study of Advance Waterproofing System

Godavari Bandgar¹, Dipali Gavit², Daud Aniket³, Danish S. Pathan⁴, Sushma Sawadkatkar⁵

^{1, 2, 3, 4}BE Student, ⁵Assistant Professor, Department of Civil Engineering, DIT Pimpri Pune, India

Abstract: Shelter is a safeguard against sunlight, rainwater and other atmospheric factors, but the water can found its way in and cause various defects to the structure. it is necessary to keep water away, if the wetness or dampness is there, this will disturb the roominess of the building. To avoid the penetration of water or entry of dampness inside the structure, it is necessary to provide waterproofing to the inner or outer side of the structure.

It is a study of waterproofing systems applied to a G+1 residential building (Bungalow), also classification of waterproofing systems into different generic systems of waterproofing, and application of these systems to the major components of building (i.e. Basement, Walls, Wet areas, Water tank and Roof slab) which frequently get in contact with water. Comparison for the cost and effectiveness of waterproofing for above components also included.

Keywords: penetration, waterproofing methods, generic systems, wetness, Basement, walls, wet areas, water tanks, roof.

I. INTRODUCTION

Humans need a clear and dry environment for settling, shelter is safety against rain water and sunlight and provide a sustainable environment. But practically it not possible to keep structure 100% dry, so we need to waterproof the structure. Initially tree leaves are used as roofing material which allows water to drain out fast, then different types of sloping roof are used to prevent entry of rainwater. Slowly more precise methods are in use. Then bitumen is extensively used after invention of concrete, as quality of concrete begins with good mix design, though there is occurrence of hair line cracks in concrete, penetration of water may occur through these cracks. To keeps structure safe from different water born problems like deterioration, wetness, molds & mildews, corrosion of steel etc. proper waterproofing is must. In the modern construction five major components of a building (i.e. Roof slab, water tank, walls, wet areas, basement) are waterproofed, waterproofing is classified as integral waterproofing and tanked waterproofing; all the components of a building are waterproofed using only these two methods. Integral waterproofing is directly applied to concrete at the time of mixing and in tanked system waterproofing material is applied to inner, outer or at middle of the structural member. There are different generic systems which will use to decide methodology. There is a wide range of waterproofing product available in market with almost same characteristics and cost but different brands. Dr. Fixit is one of the leading brands in India for waterproofing products, products used in this project work are of same brand. According to methods above mentioned and generic systems waterproofing products are applied to different components of building and after curing some tests are conducted for analysis purpose. The life of product should be more and cost less, so we can achieve economy in construction. In this era waterproofing is started to gain its importance in construction industry due to increase in speed of work, construction now a days is very fast so the purpose of integral waterproofing is not fulfilled therefore various tanked methods are used. For the structure where we are not supposed to apply the product at the source side of structural member, injection waterproofing can be used for such members. Generic systems of waterproofing which are available now; may evolved in upcoming years and methods we are using now replaced by more effective methods which gives better results. Waterproofing for five components of a building will be the most appropriate practice of waterproofing. It results as no wetness on the walls, Deteriorations and corrosion of steel is not there, spalling of concrete and removal plaster is avoided and growth of molds and mildews is stop so heathy environment available etc.

II. NEED OF WATERPROOFING

During construction there are some bad construction practices adopted by workers, also use of faulty materials in construction etc. leads to the defects in structure which cause the unhealthy environment in side the building. To increase the structural integrity and to keep a building safe from different environmental factors (like; sun light, water, wind etc.), waterproofing is needed to maintain the structural harmony.

- A. Penetration of water through cracks.
- B. Absobtion of water by structural membrane.
- C. Seepage of water in the basement.

This results in,

- 1) Corrosion of reinforcement.
- 2) Wetness on walls
- 3) Efflorescence.
- 4) Failure of plaster.
- 5) Molds and mildews
- 6) Spalling of concrete etc.

Using waterproofing we can avoid these defects.

III. TYPES OF WATERPROOFING

A. Integral Waterproofing

In integral waterproofing method, material is directly mixed to the fresh concrete. Due to integral method capillary pores and hairline cracks are filled up to some extent and concrete heals itself. Integral products have crystalline characteristics which help in healing of concrete. Integral waterproofing may fails if compaction of concrete is improper, water cement Ratio of concrete is high and curing of member is not proper etc.

There are 2 types of integral w/p

- 1) *Hydrophilic Waterproofing*: Hydrophilic waterproofing allows water to wet the surface of component but does not allow the penetration into the surface.
- 2) *Hydrophobic Waterproofing*: Hydrophobic waterproofing material is design to make surface of component wet less, means it does not allow water to wet the surface. The material increases the contact angle of water with surface.

B. Tanked Waterproofing

Layers of waterproofing material provided on inner, outer or middle side of the structural member which cover the whole surface of the member and prevent entry of water.

There are three types of tanked waterproofing,

- 1) *Internal Waterproofing*: In internal method water proofing material is provided on the positive side of the surface of member, where the surface get in contact with water, to avoid the penetration of water into the member.
- 2) *Sandwiched Waterproofing*: Waterproofing is applied in between two layers of member. Construction of member should be done in parts.
- 3) *External Waterproofing*: Positive side of member, surface opposite to contact surface is coated with waterproofing material so as to avoid entry of water inside the structure.

IV. GENERIC SYSTEMS IN WATERPROOFING

These general are the base of every waterproofing system (chemical) whether it is for roof or any other building component.

A. Liquid Membrane System

Waterproofing product in the liquid form is applied to the surface of the component in different layers according to generic system.

This chemical seals the cracks and pours due to flow property also it is easy to apply.

Table (4.1): Liquide membrane system

Sr.	Generic system	Description	Features	Application
1	Integral waterproofing system	Surface active agent, Directly Mixed in concrete as an admixture	Increases integral durability and Reduces shrinkage crack in concrete.	For all RCC members with concrete.
2	Injection waterproofing system.	Epoxy material reacts with water form foam, Sealing cracks by injecting grouting in it.	Excellent continuous adhesion prevents the lateral migration of water along a concrete surface	For all active parts, where live water is present.
3	Crystalline Waterproofing System.	Crystalline capillary heal the micro-cracks (hair line cracks) in concrete.	Seal capillary cracks. Resist chemical attack of sewage and industrial waste	In all RCC members.
4	Cementations Elastomeric Polymer Waterproofing System.	Protective coating of best quality Portland cement, To form a safe coating for water tank.	Eco-friendly and low VOC content. Also Low water permeability.	Final finish coat for most of the surfaces.

B. Ready Membrane System

Ready membranes are generally sheets of polymeric material which used as coating on member. These ready membranes cover the whole surface of component so there is no passage for water. But this method is costly and application is difficult (skilled labours required.)

Table (4.2): Ready membrane system

Sr.	Generic system	Description	Features	Application
1	PVC Membrane waterproofing System.	Dimensionally stable and waterproof to guarantee stability in hot conditions.	Excellent resistance to weathering. Stability at high temperature. Outstanding bonding.	Roof. Industrial roof. Basement etc.
2	SBS Membrane Waterproofing System.	Self-adhesive waterproofing and protective membrane	Bitumen -based modified membranes. High puncture and tear resistance. Completely non bio-degradable.	Basement. Foundation. Swimming pool. Parking roof etc.
3	Bituminous Membrane Waterproofing System.	APP modified bitumen-based membranes for waterproofing	High strength, excellent resistance to puncture and stress. Dimensionally stable to normal structural movement	Roof, wet areas, foundation, basement etc.
4	TPO Membrane Waterproofing System.	Modified for critical application.	Resistance to root penetration. Excellent long-term performance. Cold applied. UV resistance.	Roof, roof garden, podium, foundation etc.
5	HDPE Membrane Waterproofing System	Pre- applied HDPE pressure sensitive adhesive waterproofing membrane which bonds to concrete.	Settlement of the substrate occurs. Facilitates flexible construction programming Basement waterproofing protection to grades.	Roof, water tank, storage, foundation, basement et.

V. WATERPROOFING TO THE COMPONENTS PARTS OF A BUILDING.

To avoid the entry of water in the building and to keep structure complete dry, waterproofing material should be applied to the key parts of building which are frequently get in contact with water.

In this study application of waterproofing to the component part of a G+1 Bungalow in a building model is shown.

A. Basement

Basement is highly affected by water. If there are cracks and other defects in concrete, it may leads to penetration of water in the in structure. Water encounter with concrete weakens the structure and causes damage to different structural elements.

B. Roof

Roof is the most important element in structure, to avoid direct contact with rain water and sun light it is necessary take some preventive measure and To avoid contact of roof slab with rain water, waterproofing is required.

C. Wet Areas in Building

Wet areas in a building (W/C, bathrooms, kitchen and balconies) are continuous in use of water. It is important to keep structure safe from penetration of water.

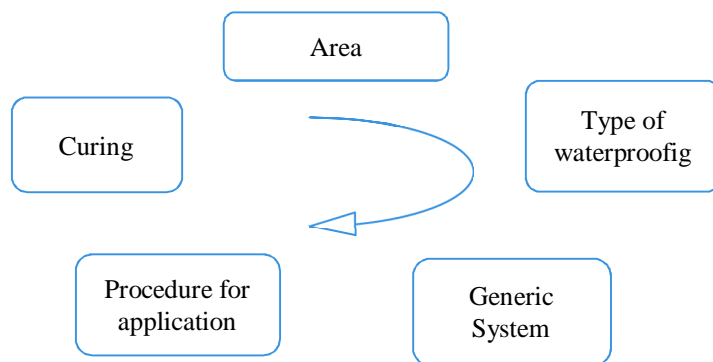
D. Water Tank

Water tanks are continuously in contact with water. If water start penetrating through the walls of water tank cause leakage and damage to the structure. This will also affects the availability of water for peoples.

E. Walls

Walls absorb moisture from the environment, it affects inside. In rainy season water penetrates in, To maintain the dryness in side the building, walls should be keep moisture and water tight.

VI. METHODOLOGY



Every material have it own way for the application. In table (). Area to be waterproof, Material used and method of application of these materials is given.

Table (6.1): Application of waterproofing

Building Component	Surface Preparation	Priming	Applicatn
Roof (Roof seal)	Clean the surface. Open cracks in v shape Fill grouting.	Angle fillet. Apply prime seal.	Apply 1st coat 1m ² /.75lit. Wait 12 hr. 2nd coat. 2 day curing
WATERTANK (Pidifin 2k)	Insure fixings. Remove loose materail using wire brush.	Saturate the surface. Mix powder and liquide component till homogeneous slurry obtained.	Apply 1st coat. Wait 6-8hr. Apply 2nd coat. Leave for 2 days.
Wall (Rain coat)	Plastered wall Remove undulations	Apply dr.fixit prime seal 2:1, prime:water. Dry for 2-3 hr.	Apply 1st coat. Wait 5-6hr. 2nd coat. Cure 7days.
Wet areas (Bath seal)	Insure all sanitary fittings. Remove undulations and loose material. Open cracks and fill with grouting.	-	-
Basement (Torchsheid) sbs	Clean, remove dust make surface smooth.	Apply bitumen primer 3-5 m ² /lit	Apply sheet on primed surfafe using double sided tape. Over lap of 100mm.
Integral (Lw+)	-	-	Mix with concrete. Properly place concrete and compact it properly

VII. COST ANALYSIS

There are various brands of waterproofing material in market with a wide range of prices. The rates of waterproofing materials are specified according to the materials weight, volume, area covered and length in running meter. As per the requirement we have to decide the material which is economical and durable.

In table () Ranges are given for different generic systems.

For the same generic system we can find verity of product in the given ranges.

Table (7.1): Cost range for generic systems.

Sr. No.	Generic System	Cost range (approx.)(Rs.)
1	Integral waterproofing system	100/Kg
2	Injection waterproofing system.	570/Kg
3	Crystalline Waterproofing System.	80/Kg 300/Kg
4	Cementations Elastomeric Polymer Waterproofing System.	40/kg 400/Kg
5	PVC Membrane waterproofing System.	75/sq. m 150/sq. m
6	SBS Membrane Waterproofing System.	1300/roll 2300/roll
7	Bituminous Membrane Waterproofing System.	900 / roll – 2000 / roll
8	TPO Membrane Waterproofing System.	40000/roll
9	HDPE Membrane Waterproofing System	40/sq. ft. 150/sq.ft.

Actual analysis of cost for waterproofing to be applied to a G+1 residential building (bungalow).

Table (7.2): Cost analysis for G+1 Bungalow

Building component (Product used)	Area to be covered in m ²	Cost/unit	Material required	Total cost (INR)
Roof (Foorseal)	111	340/lit.	84lit.	28,886
Water tank (pidifin 2k)	15.8	155/kg	22kg	3410
External walls (raincoat)	289	480/lit	82.57lit	39634
Wet areas (bathseal)	12	1800/unit	2 units	3600
Basement (torchsheild)	236 including walls	1700/roll	24 rolls	40800

From above analysis total area to be waterproofed is **663.8 m²** and the cost for the same is **1,16,330 INR**. To include labour cost add 30% of total cost. (Theoretical practices)

VIII. CONCLUSION

To avoid the entry of water and to make building habitable, good construction practices should be adopted on site at the time of construction. Additional care should be taken for areas which are frequently get in contact with water. A correct waterproofing system for a particular component of building will ensures the proper resistance against natural entities (like; water, sunlight etc.). Different generic systems have different types of application and this effect there durability and effectiveness. One can find appropriate product which is economical and effective in the case he requires using information given in table (4.1), table (4.2) and table (7.1).

Cost of each system vary with respect to there durability, area to be covered, availability in market and there method of application etc.

IX. RESULT

After the application and curing of waterproofing materials, basement, roof slab, water tank and W/C bath are kept ponded for 7days, there is no traces of wetness and leakage are found. Walls are directly ready after curing period so there is no check is done.

Total cost of waterproofing for G+1 building (bungalow) including labour cost is 151229 INR, so the cost for 1m² area is 227.82 INR (i.e. 21.16 INR / feet²)

Classification of waterproofing in generic systems is effective way to find out material and application of waterproofing to different parts in building.

REFERENCES

- [1] Dhiren J Panchal, Nehal H Shah, Chirag R Sindhav, Chaitanya Joshi, Awadhesh Chauhan. "WATERPROOFING CHALLENGES AND SUGGESTED REMEDIAL MEASURES FOR HIGH RISE BUILDINGS: A CASE STUDY" IJSRD Vol. 3, Issue 10, 2015.
- [2] Annu Baby1, Jeena Mathew2 "STUDIES ON PROPERTIES OF CONCRETE WITH VARIOUS WATERPROOFING COMPOUNDS". IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).
- [3] Md Azree Othuman Mydin1, Mohd Nasrun Mohd Naw1, Muhammad Arkam Che Munaaim "ASSESSMENT OF WATERPROOFING FAILURES IN CONCRETE BUILDINGS AND STRUCTURES." MCRJ Special Issue Vol. 2 | No. 2 | 2017
- [4] Ar. Soma Anil Mishra, Ar. Prakool Soni, Dr.R.K. Pandit "WATERPROOFING SYSTEMS IN BUILDING CONSTRUCTION." International Journal of Combined Research & Development (IJCRD) Volume: 3; Issue: 1; July -2014.
- [5] Leonas Ustinovichius1, Romas Rasiulis2, Ceslovas Ignatavicius3, Tatjana Vilutiene4 "ANALYSIS OF WATERPROOFING DEFECTS AND TECHNOLOGY DEVELOPMENT FOR CAR PARKING ROOFS: LITHUANIAN CASE". Journal Of Civil Engineering And Management Vol.2012.
- [6] Nur Liyana Othman, Mastura Jaafar, Wan Mariah Wan Harun, Fuziah Ibrahim "A CASE STUDY ON MOISTURE PROBLEMS AND BUILDING DEFECTS" ASIAN CONFERENCE ON ENVIRONMENT-BEHAVIOUR STUDIES". Chung-Ang University, Seoul, S. Korea, 25-27 August 2014.
- [7] Gaetan Rwaburindi, Dr.Om Prakash Netula, Saidu Ibrahim. "ROLE & BEHAVIOR OF CHEMICALS IN MODERN CONSTRUCTION MATERIALS". International Journal Of Engineering Sciences & Research Technology March-2017.
- [8] Jorge de Brito. "WATERPROOFING OF CONCRETE FOUNDATIONS". Article in Journal of Performance of Constructed Facilities · April 2014.
- [9] Alireza Biparva , Rishi Gupta "SMART WATERPROOFING SYSTEM".
- [10] Sina Kazemian, Bujang. B. K. Huat "ASSESSMENT AND COMPARISON OF GROUTING AND INJECTION METHODS IN GEOTECHNICAL ENGINEERING". European Journal of Scientific Research ISSN 1450-216X Vol.27 No.2 (2009).
- [11] Roslan Taliba, David Boyd, Susan Hayhowb, A Ghafar Ahmada, Mzailan Suliemana. "INVESTIGATING EFFECTIVE WATERPROOFING MATERIALS IN PREVENTING ROOF LEAKING; INITIAL COMPARATIVE STUDY: MALAYSIA, U.K."
- [12] Zhineng Tong. "RESEARCH ON WATERPROOF TECHNOLOGY OF CONSTRUCTION ENGINEERING". International Conference on Chemical, Material and Food Engineering (CMFE-2015).
- [13] Daniel W. Kessle. "EXPERIMENTS ON EXTERIOR WATERPROOFING MATERIALS FOR MASONRY" Journal of Research of the National Bureau of Standards, Volume 14, March 1935.
- [14] Darius Kalibatas, Vytautas Kovaitis. "SELECTING THE MOST EFFECTIVE ALTERNATIVE OF WATERPROOFING MEMBRANES FOR MULTIFUNCTIONAL INVERTED FLAT ROOFS" Journal Of Civil Engineering And Management Issn 1392-3730 / eISSN 1822-3605 2017 Volume 23(5): 650-66.
- [15] Ra.Jaikishan, M.Adiyaman, PG Student, Assistant professor. "STUDY OF WATERPROOFING SYSTEM IN CONSTRUCTION INDUSTRY". SSRG International Journal of Civil Engineering (SSRG-IJCE) – Volume 5 Issue 2- February 2018.
- [16] Jaeyoung Song, Kyuhwan Oh, Byoungil Kim and Sangkeun Oh. "PERFORMANCE EVALUATION OF WATERPROOFING MEMBRANE SYSTEMS SUBJECT TO THE CONCRETE JOINT LOAD BEHAVIOR OF BELOW-GRADE CONCRETE STRUCTURES". 7 November 2017.
- [17] Kofi Agyekum, Burcu Salgin , Anthony Kwame Danso. "CREATING AWARENESS ON THE NEGATIVE IMPACT OF DAMPNES ON THE HEALTH OF OCCUPANTS: A CASE FOR INHABITANTS LIVING IN DAMP BUILDINGS IN GHANA". International Journal of Development and Sustainability Volume 6 Number 8 (2017).
- [18] Usman Hasan Jalali1, Sher Afgan. "ANALYSIS OF INTEGRAL CRYSTALLINE WATERPROOFING TECHNOLOGY FOR CONCRETE". International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 10 | Oct 2018.
- [19] Subash TR, Abhilash Urs KR, Ananth M and Tamilselvan K. "PRE-GROUTING FOR LEAKAGE CONTROL AND ROCK IMPROVEMENT". Vol-3 2016.
- [20] <https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=video&cd=3&cad=rja&uact=8&ved=0ahUKEwi-2deV3rjmAhVpzDgGHQmlCeoQtwIIOTAC&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DTmrFUGl1C58&usg=AOvVaw0o6SM7gX7wOZvh8K1yLrFW>
- [21] https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=video&cd=2&cad=rja&uact=8&ved=0ahUKEwjCvdOt3rjmAhUIyDgGHeXKB4AQtwIIMTAB&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DkaKjJ6BZOlc&usg=AOvVaw1v9vleuFcn_vjrc4Xay2zx
- [22] https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=video&cd=5&cad=rja&uact=8&ved=0ahUKEwjCvdOt3rjmAhUIyDgGHeXKB4AQtwIIRjAE&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DiRf7F-Afylo&usg=AOvVaw1A5IEIq1e-JURC-_0RLVAs
- [23] <https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=video&cd=2&cad=rja&uact=8&ved=0ahUKEwiLp5LG3rjmAhXLzTgGHQDIBLQQtwIIMzAB&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3Dh7gUWyoGZg0&usg=AOvVaw1LuoT7Ek-FYAPYfqBFMZ0>
- [24] IS 16471:2017
- [25] IS 456:2000
- [26] IS 2645:2003



10.22214/IJRASET



45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24*7 Support on Whatsapp)