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भारत सरकार – GOVERNMENT OF INDIA

रेल मंत्रालय – MINISTRY OF RAILWAYS

इमारत में नमी की रोकथाम

PREVENTION OF DAMPNESS IN BUILDING



केमटेक/2015/सि/डैम्पनेस/1.0

CAMTECH/2015/C/DAMPNESS/1.0

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अअमासं RDSO रेल अग्रदूत Transforming Railways

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इमारत में नमी की रोकथाम

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प्राक्कथन

कोई भी इमारत जो कि नवनिर्मित या पुरानी हो, की सबसे बड़ी आवश्यकता इसका शुष्क अथवा नमीरहित होना चाहिए। हवा में, सतह पर, या ठोस आकारों में मौजूद आद्राता के कारण नमी पैदा होती है जो कि इमारतों के घटिया कार्यात्मक प्रदर्शन, बदसूरत दिखावट तथा संरचनात्मक कमजोरी के रूप में सामने आती है। इस पुस्तिका में नमी के कारणों तथा स्त्रोतों एवं निवारक उपायों जो कि आमतौर पर नमी के समाधान के रूप में प्रचलित हैं, का जिक्र किया गया है।

यह आशा की जाती है कि कैमटेक द्वारा तैयार पुस्तिका सिविल संरचनाओं के रखरखाव की गतिविधियों में लगे भारतीय रेलवे के इंजीनियरिंग कर्मियों को काफी उपयोगी होगी।

कैमटेक,ग्वालियर (ए. आर. तुपे)
दिनांक 31.12.2015 कार्यकारी निदेशक

Foreword

The foremost requirement of any building i.e. newly constructed or old in nature should be dry or free from moisture. The moisture present in the air, on a surface, or in a solid causes dampness, which results in poor functional performance, ugly appearance and structural weakness of the buildings. The causes and sources of dampness and preventive measures as commonly prescribed to the solution of dampness are discussed in this booklet.

It is expected that the booklet prepared by CAMTECH will be quite helpful to the engineering personnel of Indian Railways engaged in maintenance activities of civil structures.

CAMTECH, Gwalior ***(A.R. Tupe)***
Date 31.12.2015 ***Executive Director***

भूमिका

एक बड़ा संगठन होने के नाते भारतीय रेलवे के पास सिविल इंजीनियरिंग संरचनाओं और इमारतों की विशाल सम्पदा मौजूद है जिनकी सेवा अवधि के दौरान रखरखाव की आवश्यकता होती है।

इमारत में नमी की रोकथाम' पर यह पुस्तिका आमतौर पर इस्तेमाल किए जाने वाले नमीरोधक उपचारों जिन्हें इमारतों में नमी की समस्याओं के प्रभावी समाधान के रूप में उपयोग किया जाता है, के बारे में सूचनात्मक जानकारी प्रदान करने के उद्देश्य से तैयार की गई है. यह पुस्तिका, रखरखाव कार्य में शामिल सिविल इंजीनियरिंग स्टाफ के मार्गदर्शन के लिए है।

यह पुस्तिका वैधानिक नहीं है तथा इसमें दी गई सामग्री का उद्देश्य केवल मार्गदर्शन है। अधिक जानकारी के लिए, इस पुस्तिका में वर्णित किसी भी तकनीक/ या विधि को अंतिम रूप से लागू करने से पहले विषय पर उपलब्ध प्रासंगिक कोड, मैनुअल और रिपोर्ट का अध्ययन संदर्भ रूप में किया जाना चाहिए।

हम आगे सुधार के लिए पाठकों से किसी भी सुझाव का स्वागत करते हैं।

कैमटेक, ग्वालियर (डी. के. गुप्ता)
दिनांक 30.12.2015 उप निदेशक / सिविल

Preface

Indian Railways is a big organisation having large assets of civil engineering structures and buildings, which require maintenance throughout their service life. Almost all buildings experience dampness due to excessive moisture, leaks, or flooding at some point. If dampness-related problems are to be prevented, it is essential to understand their causes.

This booklet on *'Prevention of Dampness in Building'* is prepared with the objective to provide informative details including commonly used damp proof treatments, which are used as effective solutions to the problems of dampness in building. The booklet is meant for the guidance of civil engineering staff involved in maintenance work.

This booklet is not statutory and contents are only for the purpose of guidance. For more in-depth information, the relevant codes. manual and reports on the subject may be referred before final implementation of any technique/ or method described in this booklet.

We welcome any suggestions from readers for further improvement.

CAMTECH, Gwalior ***(D. K. Gupta)***
Date 30.12.2015 ***Dy. Director/Civil***

संशोधन पर्चियों का प्रकाशन

इस लघु पुस्तिका के लिए भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जाएगा।

केमटेक/सि/2015/डैम्पनेस/1.0 सीएस # XX दिनांक ----------

जहाँ XX' संबन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)

प्रकाशित संशोधन पर्चियाँ

क्र. सं.	प्रकाशन की तारीख	संशोधित पृष्ठ संख्या तथा मद संख्या	टिप्पणी

ISSUE OF CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/C/2015/DAMPNESS/1.0/CS. # XX date ....

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

Sr. No. of C.Slip	**Date of issue**	**Page no. and Item No. modified**	**Remarks**

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1.0 प्रस्तावना / Introduction

Almost all buildings experience excessive moisture, leaks, or flooding at some point. If dampness-related problems are to be prevented, it is essential to understand their causes. From a technologic viewpoint, one must understand the source and transport of moisture in buildings, which depend on the design, operation, maintenance, and use of buildings in relation to external environmental conditions such as climate, soil properties, and topography.

Understanding that maintaining a dry building is the best method for ensuring healthy people, safe buildings and maximum asset value. One of the requirements of the building is that it should be dry or free from moisture travelling through walls, roofs and floors. It is important to note that building structure should be located on a high ground and well drained soil so that the structure can be safeguarded against foundation dampness.

Indeed, *a damp substrate is one which contains a level of moisture above that expected under normal environmental conditions.* Materials are meant to be damp to a certain extent. On account of granular nature of materials, moisture finds an easy access through the voids and this aided by capillary action assists the moisture to travel in different directions.

In subsequent sections, the causes of dampness and its effects on health and comfort of inhabitants are discussed in brief. The prevailing methods/ techniques to prevent dampness in building are included in this booklet for the purpose of knowledge dissemination.

2.0 नमी के कारण एवं स्त्रोत / Causes and Sources of Dampness

Absorption of moisture by the building materials is one of the chief causes, which may occur due to bad design, faulty construction or poor workmanship, and use of poor quality of materials. Thus, either on account of these causes, the moisture may find its way to interior of the building either through the foundation and plinth, walls, chajjas, floors or the roof. The moisture entering the buildings from foundation and roofs travels in different directions under the effects of capillary action and gravity respectively.

The main source of dampness is the moisture, which is present in the air, on a surface, or in a solid. The dampness gradually impairs the affected part of the building and often leads to the growth of molds, mites and bacteria that creates an unhealthy environment and causes health problems. The important sources of dampness in building are as follows:

(1) बढ़ती या केशिका नमी / Rising or Capillary Dampness:



All structures are founded on soils, which easily give an access to water to create dampness in buildings, through the foundations. This dampness further finds its way to the floors, walls, etc. through plinth. If the soil is pervious, moisture constantly travels through it and rises up into wall & floor on account of capillary action.

(2) गिरने या व्याप्त होने वाली नमी / **Falling or Penetrating Dampness:** Penetration of rain-water through unprotected tops of walls, parapets, compound walls, etc. may cause dampness. This dampness in buildings is of serious nature and may result in unhealthy living conditions or even in structurally unsafe conditions.

- Exposed tops of parapet and boundary walls should be protected from rain penetration by providing damp-proof course.

- If the walls are not properly treated, moisture will enter the wall causing dampness in the interior. If balconies and chajja projections do not have proper slope, water will accumulate on these & will enter the walls through their junctions.

(3) संघनन नमी / **Condensation Dampness:** The moisture present in the atmosphere gets deposited on the walls, roofs, floors, etc. Whenever the warm air in the atmosphere is cooled, it gives rise to the process of condensation because cool air contains lesser amount of water vapour than warm air. However, this source of dampness prevails only in certain places in India, where very cold climates exist.

(4) नमी के विविध स्त्रोत / **Miscellaneous Sources of Dampness:** Use of sub-standard and non-standard materials or workmanship is one of the major causes of leakage/dampness in buildings. Hence all the appliances, fixtures and materials shall conform to the relevant Indian Standards where they exist and shall have good workmanship.

- **Dampness due to leakages in wet areas of building:** Bathroom, kitchen, water closet and to a lesser extent varandah, balconies and sunshades may be termed as wet areas of a buildings which are more vulnerable to water due to their functional requirements. These wet areas are one of the main sources of leakage and dampness in a building which leads to unhygienic conditions affecting badly the health and comfort of the inhabitants and seriously deteriorating the stability of the building.

- **Dampness due to leakages from roofs**

  (i) In case of sloped roofs rain-water percolate through defective roof covering.
  (ii) Faulty valley gutters may allow rain-water to descend through the top of supporting wall.
  (iii) In case of flat roofs, inadequate roof slopes, improper rain-water pipe connections and defective junction between roof slab and parapet wall may prove to be source of dampness.
  (iv) Inadequate number & size of drainage outlets, spreading of water on roofs due to overflowing from water tanks, bad quality of concrete used in RCC roof slab, stagnation of water may also be the source of dampness.

- **Dampness due to imperfect orientation:** Whenever the orientation of the buildings is not proper or geographical conditions are such that the walls of building gets less of direct sunrays and more of heavy showers of rains, then such walls become prone to dampness.

- **Dampness due to poor drainage of the site:** In low lying areas, water can not be easily drained off and creates water logging if impervious soil is present underneath the foundation.

- **Dampness due to bad workmanship during construction:** Defective construction of joints in the roof, throating of sills and copings, fixtures in the building, etc., causes dampness by allowing entry of the water inside the building.

3.0 नमी की वजह से दोष / Defects caused by Dampness

The various effects (indirect defects) caused due to dampness in buildings, mainly result in poor functional performance, ugly appearance and structural weakness of the buildings. It causes aesthetic as well as physical damage to buildings resulting in disfigure of internal wall & ceiling finishes & external wall surfaces.

Dampness acts as a catalyst for building defects that may be summarized as under:

- corrosion of metals,
- efflorescence of brick & mortar
- damage of masonry & concrete,
- softening and crumbling of plaster,
- bleaching and flaking of paint with the formation of coloured patches,
- warping and decay of timber
- deterioration of electrical fittings,
- deterioration of floor covering materials like tiles, stones, etc
- promoting growth of termites, and
- breeding of mosquitoes

- creating unhealthy living conditions for the occupants
- breeding of the germs of tuberculosis, neuralgia, acute and chronic rheumatism, etc., which, sometimes, result in fatal diseases

4.0 नमी समस्या हेतु निवारक उपाय / Preventive Measures to Dampness Problem

It is imperative to identify the real cause of dampness before applying any remedial/ or preventive measures to the dampness problem in a building. The conventional techniques and methods generally adopted for treatment of dampness are as follows:

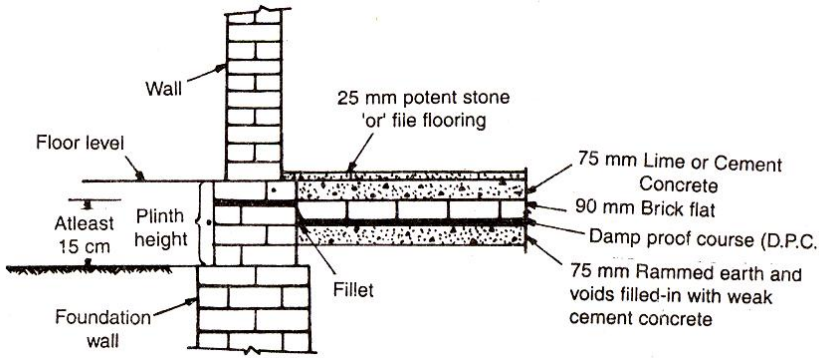
4.1 झिल्ली नमीरोधन / Membrane Damp-proofing

A continuous layer of damp proof or water repellent materials, such as bituminous felts, mastic, asphalt, plastic or polythene sheets, cement concrete, mortar, stones, etc., is provided between the source of dampness and the rest of the structure to prevent water rising from the sub-soil or ground and getting into the different parts of the building. The best position for D.P.C., in case of buildings without basements is at plinth level. Plinth level should be laid at least 60 cm above the ground level. Depending upon the source of dampness, DPC may be provided horizontally or vertically in floors, walls, etc. Provision of DPC in basement is normally termed as tanking.

Following general principles should be applied while providing DPC:

a) The DPC should cover the full thickness of walls excluding rendering, in order to act as an effective barrier to moisture under all conditions.

b) The mortar bed upon which DPC is to be laid should be made leveled, even and free from projections. Uneven base is likely to cause damage to DPC.
c) The DPC course should be placed in correct relation with other DPC courses, so as to provide a complete and continuous barrier to the passage of moisture from below, top or sides.
d) When a horizontal DPC is continued to vertical face (i.e. forming angle projection), a cement concrete fillet of 75 mm in radius should be provided at junction, prior to the treatment.
e) DPC should not be kept exposed on wall surface otherwise it may get damaged during finishing.



4.2 सतह का उपचार / Surface Treatment

The surface treatment is only useful when the moisture is superficial, i.e. not under much pressure. The moisture finds its way through the pores of materials used in finishing and makes the building damp. Surface treatments like pointing, plastering, painting, distempering, are given to the exposed surfaces and also to the internal surfaces to fill up the pores. Bituminous solution, cement

coating, transparent coatings, paints, varnishes, etc. are used for surface treatment.

Most commonly used treatment, to protect walls against dampness, is lime cement plaster of mix (1 cement: 1 lime: 6 sand) proportions. A thin film of waterproofing materials such as sodium or potassium silicates, aluminium or zinc sulphates, barium hydroxide and magnesium sulpahte, soft soap and alum, lime and linseed oil, coal tar, bitumen, waxes and fats, resins and gums, etc. can be applied to the surface to protect it against the ravages of heavy rain.

4.3 इंटीग्रल नमीरोधन / Integral Damp-proofing

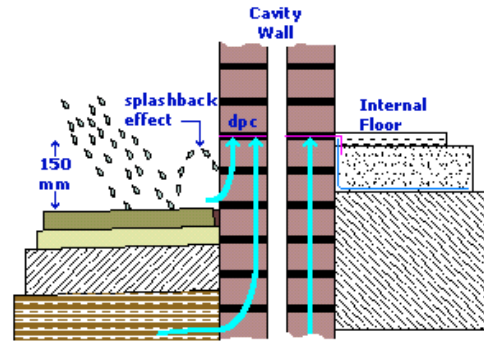
This consists of adding certain compounds to the concrete or mortar during the process of mixing, which when used in construction, increase its impermeability and act as barriers to moisture penetration under different principles.

- The compounds made from clay, sand or lime (chalk, fuller's earth, etc.) work on *mechanical action principle*, i.e. they fill the voids or pores present in concrete or mortar and make them denser and water proof.
- The compounds like alkaline silicates, aluminium sulphates, calcium chlorides, etc. work on *chemical action principle*, i.e. they react chemically when mixed with concrete and fill the pores to act as water-resistant.
- Some compounds like soaps, petroleum oils, fatty acid compounds such as stearates of calcium, sodium, ammonium, etc. work on *repulsion principle*, i.e. they are used as admixtures in concrete to react with it and become water repellent.

The synthetic compounds prepared under these principles are available in commercial forms in market. The quantity of compounds to be added to cement depends upon manufacturers' recommendations. In general, one kg of compound is added with one bag of cement to render the mortar or concrete water proof.

4.4 गुहा दीवारें या खोखली दीवारें / Cavity Walls or Hollow Walls

A cavity wall consists of two parallel walls or leaves (or skins) of masonry with a 5 cm to 8 cm cavity between them. The outer wall or leaf consists of a 10 cm thick wall and the inner wall or leaf (min. 10 cm thick), is sufficiently thick and strong to carry imposed load safely. The provision of continuous cavity in the wall efficiently prevents the transmission of percolation of dampness from outer wall or leaf to the inner wall or leaf. This cavity type construction is most desirable in hot dry and/ or hot-humid environment in India.



The advantages of cavity walls may be summarized as under:

- As there is no intimate contact between two leaves except at the wall ties, which are of impervious material, so the possibility of the moisture penetration is reduced to a minimum.
- As air in the cavity is non-conductor of heat, so it prevents the transmission of heat from the external face to the internal one.

Such cavity walls are best suitable for a tropical country like India.

- The cavity walls offer good sound insulation.
- The cavity tends to reduce the nuisance of efflorescence.
- This type of construction offers many other benefits such as better comfort, economy and hygienic conditions in buildings.

4.5 गुनाइटिंग (या शॉट कंक्रीट) / Guniting (or Shot Concrete)

This consists in depositing an impervious layer of rich cement mortar over the surface to be water proofed. The operation is carried out by use of a machine known as cement gun. The assembly broadly consists of a machine having arrangements for mixing materials and a compressor for forcing the mixture under pressure through a 50mm diameter flexible hose pipe. The hose pipe has nozzle at its free end to which water is supplied under pressure through a separate connection.

The surface to be treated is first thoroughly cleaned of dirt, dust, grease or loose particles and wetted properly. Cement and sand (or fine aggregates) usually taken in proportion of 1:3 to 1:4 are then fed into the machine. This mixture is finally shot on the prepared surface under a pressure of 2 to 3 kg per square cm by holding the nozzle of the cement gun at the distance of 75 to 90 cm from the working surface. The quantity of water in the mix can be controlled by means of regulating valve provided in the water supply hose attachment. Since the material is applied under pressure, it ensures dense compaction and better adhesion of the rich cement mortar and hence treated surface becomes water proof.

4.6 दबाव ग्रौटिंग या सीमेंटेशन / Pressure Grouting or Cementation

Pressure grouting is the process of forcing the cement grout (mixture of cement, sand and water) under pressure into the cracks, voids or fissures present in structural components (i.e. floors, walls and roofs) or ground (i.e. foundations). In this process, the holes are drilled at selected points in the structure and cement grout of sufficiently thin consistency to ensure complete penetration into cracks or voids is forced under pressure. This makes the structure water tight and restores its stability and strength to some extent.

This technique is also used for repairing structures, consolidating ground to improve bearing capacity, forming water cut-offs to prevent seepage, etc.

5.0 नमीरोधन के लिए प्रयुक्त सामग्री / Materials used for Damp-proofing

There are various materials, which are used as damp-proof courses depending upon the location, economy and degree of damp-proofing desired. While selecting a particular damp-proofing material, the following requirements should be kept in view –

- The material should be perfectly impervious and durable with life equal to building life.
- The material should not permit moisture penetration.
- The material should be capable of resisting both dead and superimposed load/ pressure.
- The material should be flexible to accommodate the structural movements without developing any cracks.

- The material should not be costly.
- The material should remain steady in its position.
- The only flexible materials, like mastic asphalt, bituminous felt, metal sheets, etc. should be used for parapet walls and other situations, where differential thermal movements are expected due to exposure.

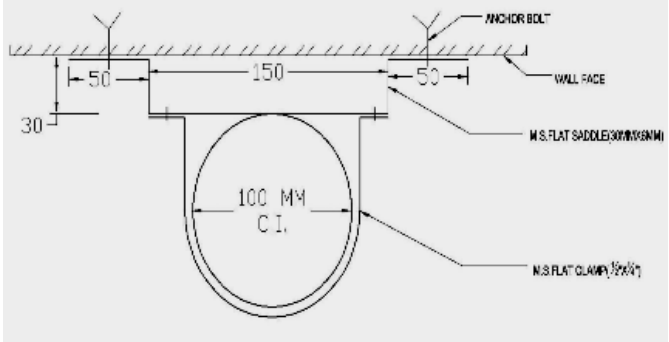
The materials commonly used to check dampness can be divided into the following four categories:

a) **Flexible materials** – Materials like bitumen felts (which may be hessian based or fibre/glass fibre based), plastic sheeting (polythene sheet), metal sheets of lead, copper, etc.
b) **Semi-rigid materials** – Materials like mastic asphalt or combination of material or layers.
c) **Rigid materials** – Materials like first class bricks, stones, slates, cement concrete, etc.
d) **Grouting material** – Materials like cement slurry and acrylic based chemicals/polymers.

6.0 सचित्र के रूप में कुछ मामलों में नमी के लिए निवारक उपाय / Preventive Measures for Dampness in some of the cases as illustrated

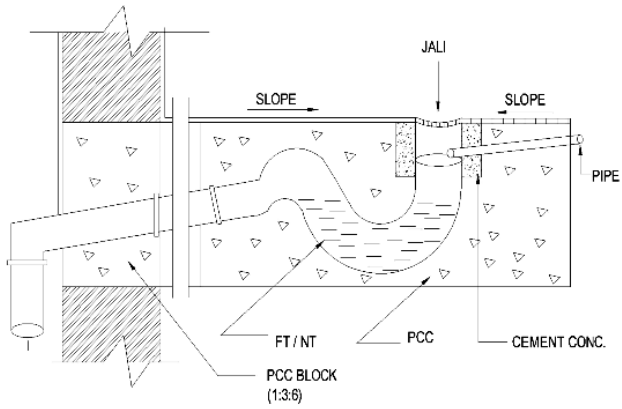
A) C.I. पाइप्स के लिए फिक्सिंग व्यवस्था / Fixing Arrangement for C.I. Pipes

These are generally provided for roof drainage. The size of pipe depends on average rate of rainfall in mm/hr & on the area of roof. RWP should be kept away from walls by using saddle plates as shown in Fig.



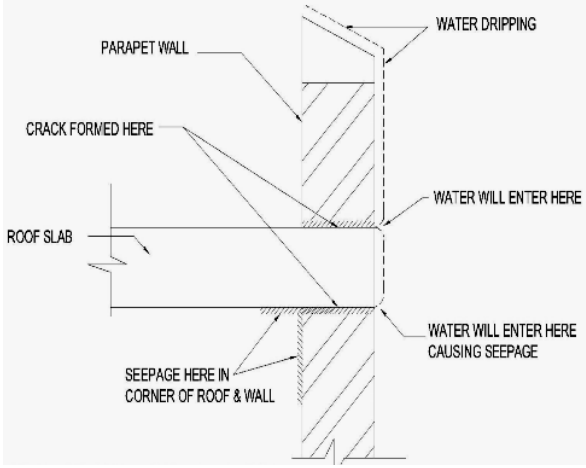
B) फ्लोर ट्रेप / नहानी ट्रेप / Floor Trap / Nahani Trap

For preventing passage of foul gas, traps with water seal are invariably used in floors in bath rooms, kitchen. For effective drainage, the slope should not be less than 1 in 100. Junction of the trap and the waste pipe which is embedded in the floor is a possible source of leakages. The joints should be thoroughly tested for leakages before doing the flooring (Fig).



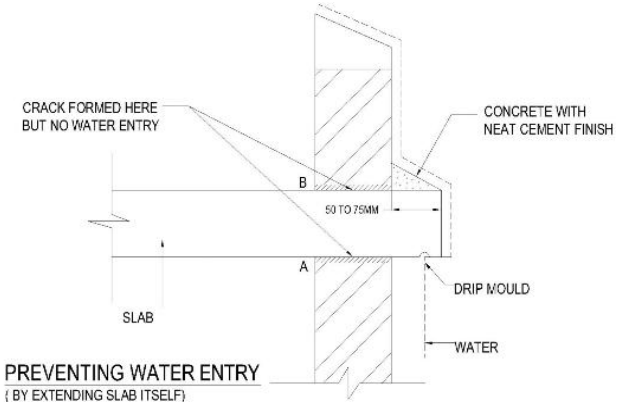
C) पानी प्रवेश के तंत्र / Mechanism of Water Entry

In absence of slab projection, the rain water travels along the walls & enters through crack at junction of Roof Slab and Wall.

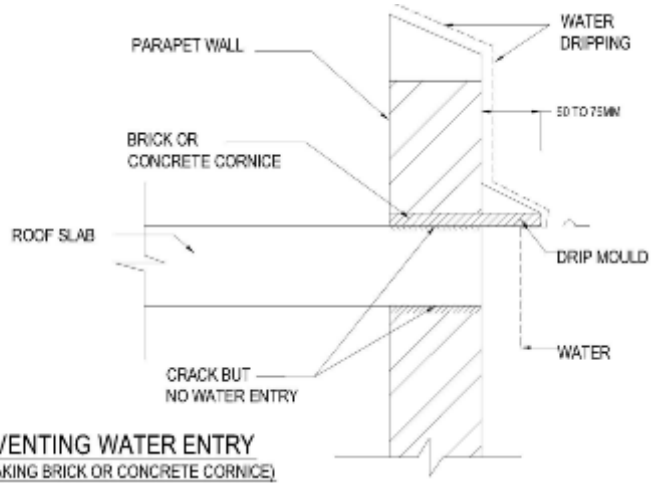


D) स्लैब में ही विस्तार करके पानी प्रवेश की रोकथाम / Preventing Water Entry by extending Slab itself

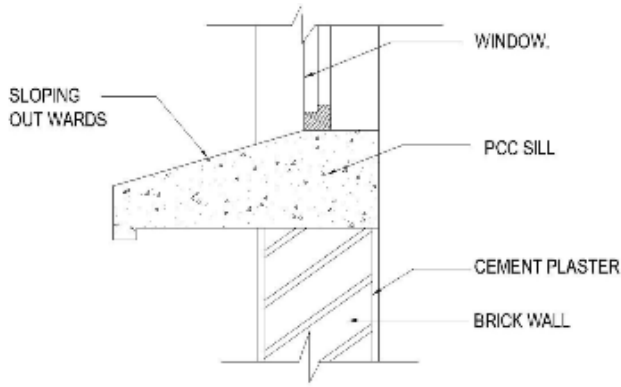
Roof slab to project beyond wall by 50 mm (minimum) with provision of drip mould can prevent entry of water in to the wall or can keep water-falls clear of the wall.



E) ईंट या कंक्रीट कंगनी बनाकर पानी प्रवेश की रोकथाम / **Preventing Water Entry by making Brick or Concrete cornice**

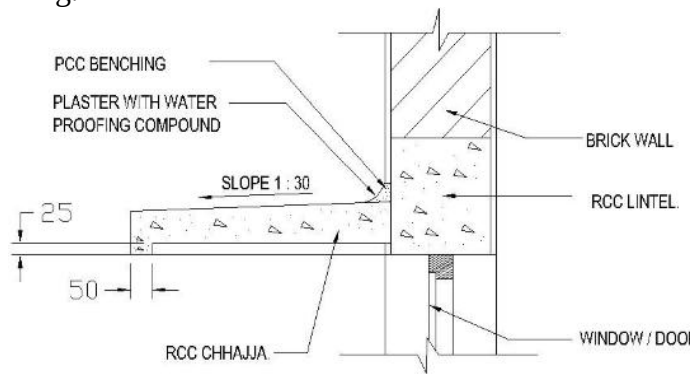


F) खिड़की दासा पर नमी निवारण के उपाय / **Dampness Prevention Measures at Window sill**



G) छज्जा पर नमी निवारण के उपाय / Dampness Prevention Measures at Chajja

A sloping or horizontal structural overhang usually provided over openings on external walls to provide protection. The details are as shown in fig.



H) ढ़के हुए पानी के पाइप / Concealed Water Pipes

A concealed water pipe is a possible source of leakage. All concealed water pipes must be thoroughly pressure tested for leakages before taking up the finishes.

***

संदर्भ
REFERENCES

S. No.	Description
1.	IS 13182:1991
2.	Refresher course for SAG officers (Session No. 837), presented on 23.10.2008 by Sh. J.K.Singla, CGE/SEC Rly, Bilaspur. Source: www.wiki.iricen.gov.in
3.	Building Construction by Sushil Kumar
4.	Building Construction by S.P. Arora and S.P. Bindra

✍ टिप्पणी / NOTES ✍

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गुणवत्ता नीति

रेलों में यात्री और माल यातायात की बढती माँग को पूरा करने के लिए गुणवत्ता प्रबंध प्रणली में अनुसंधान, डिजाइनों और मानकों में उत्कृष्टता तथा सत्त सुधारों के माध्यम से सांविधिक और नियामक अपेक्षाओं को पूरा करते हुए सुरक्षित, आधुनिक और किफायती रेल प्रौद्योगिकी का विकास करना।

QUALITY POLICY

To develop safe, modern and cost effective Railway technology complying with Statutory and Regulatory requirements, through excellence in Research, Designs & Standards and Continual improvements in Quality Management System to cater to growing demand of passenger and freight traffic on the Railways.

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हमारा उद्देश्य

अनुरक्षण प्रौद्यौगिकी और कार्यप्रणाली को उन्नयन करना तथा उत्पादकता और रेल्वे की परिसम्पत्ति एवं जनशक्ति के निष्पादन में सुधार करना जिससे अन्तर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस सन्दर्भ में कोई विचार और सुझाव देना चाहते हों तो कृपया हमें इस पते पर लिखें।

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OUR OBJECTIVE

To upgrade Maintenance Technologies and Methodologies and achieve improvement in Productivity and Performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability and Utilisation.

If you have any suggestion & any specific comments, please write to us:

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