ReBuild

Vol. 4 No. 2 (Apr-Jun 2010) A Quarterly Newsletter

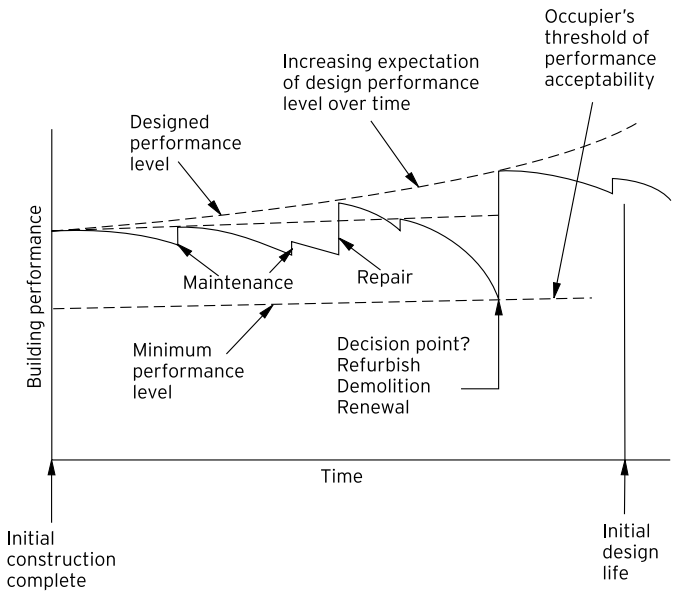
REPAIR AND MAINTENANCE NEEDS OF CONCRETE STRUCTURES

Dr. Fixit Institute
of Structural Protection & Rehabilitation

A Not-for-Profit Knowledge Centre

Maintenance to Repair to Refurbishment in the Life Cycle of a Building

I start with the reproduction of a commonly presented schematic of the Life Cycle of a building as furnished below :



Life cycle of a building

(Source : The Technology of Refurbishment and Maintenance by Mike Riley and Alison Cotgrave, Palgrave McMillan, New York, 2005)

It is well known that during their lives buildings deteriorate and become obsolete; they require maintenance and refurbishment to different orders at different points of time in their span of service life. The increased drive towards a sustainable built environment brings into focus the importance of building maintenance. From the moment that a building is completed and occupied there is a requirement to undertake maintenance activity to ensure that it performs at an acceptable level. The process of maintenance is not driven simply by the need to correct defects that occur over time, but rather to attempt to avoid these defects in the first place.

The concept of buildings as financial assets is highly relevant to the processes associated with building maintenance. The extent of building maintenance is driven by the need to protect the financial asset as well as the need to maximize the building functionality. For this reason it is rather imperative for any organization to establish some form of strategic maintenance plan or policy to maximise the economic and technical effectiveness of the maintenance of their buildings. In establishing such a policy any organization typically takes into account some of the following issues:

- Intended life-span of a building
- Likely time periods to major repair activity
- Required standard of the building condition
- Permissible time between recognizing the maintenance or repair requirement and its execution

The operations that one may consider as "maintenance" are varied and sometimes complex. In order to manage the involved processes efficiently and effectively, items are classified in the following categories:

- **Planned or preventive maintenance:** The items included within this category are obviously those which are planned to take place at defined and regular intervals in order to keep the building in good order (Table: 1).
- **Reactive maintenance:** The items within this category include day-to-day items of repair and breakdown of the associated plant and machinery. This may include elements of accidental and unforeseen damage to the building fabric. It is generally understood that the level of reactive maintenance will reduce with increased expenditure on planned maintenance.
- **Cyclical maintenance:** This category includes items that must be dealt with routinely and regularly and may include items such as cleaning of drainage gutters, servicing of lifts and so on.

"Refurbishment", strictly speaking, is not an element of maintenance. The issue of deciding at which point maintenance should be changed to refurbishment is driven by a number of factors. Typically, an owner or user of a building will ask the following questions before deciding to effect a major refurbishment rather than simply maintaining an existing building:

i. Does the building satisfy the user's requirements in terms of functionality standards and technical needs ?

ii. Does it satisfy the current statutory requirements (e.g., fire exits, disabled access, etc.) ?

iii. Is the cost of maintenance quite high as compared to the refurbishment cost ?

Based on the correct replies to the above questions, major refurbishment operations are identified at key stages in the life of the building. As might be expected, the level of reactive maintenance reduces following a refurbishment programme and the degree of planned maintenance varies from year to year as the functional lifespan of components is reached. Planning of the maintenance programme aims to even out the expenditure profile as much as possible for obvious reasons of cash flow management.

Risk assessment is another critical issue in refurbishment projects. Here emphasis needs to be placed on particular persons at risk, such as children and the elderly, as well

Table: 1 Maintenance norms : frequency of application of finishing items

Sl.No.	Item	Periodicity				
		Res. Bldg.	Office Bldg.	Hospitals	Laboratories	Schools
[1]	[2]	[3]	[4]	[5]	[6]	[7]
1.	White Washing/Colour Washing	2 years	2 years	2 years	2 years	2 years
2.	Applying dry distemper	2 years	2 years	2 years	2 years	2 years
3.	Painting with plaster paint, Synthetic enamel paint, Oil bound distemper, acrylic paint, acrylic distemper	3 years	2 years	1 year – Corridor O.T. Rooms 2 years – Other areas	2 years	3 years
4.	Painting external surface with waterproofing cement paint	3 years	3 years	3 years	3 years	3 years
5.	Cleaning and disinfecting of water storage/ distribution tanks, water mains	6 months	6 months	3 months	3 months	6 months
6.	Cleaning of manholes/Gully chambers/inspection chambers and flushing of building sewers	1 year	1 year	6 months	1 year	1 year
7.	Cleaning of storm water drains	1 year	1 year	1 year	1 year	1 year
8.	Painting steel water tanks inside with bitumastic paint	2 years	2 years	1 year	2 years	2 years
9.	Polishing wooden doors/windows with spirit polish/Polish/synthetic acrylic polish	5 years	5 years	5 years	5 years	5 years
10.	Text mat or polymat based equivalent synthetic silicon based exterior paint	5 years	5 years	5 years	5 years	5 years
11.	Cleaning electrical installations, fans etc.	1 year	1 year	1 year	1 year	1 year
12.	Premix, Semi dense/dense carpeting of roads	5 years	5 years	5 years	5 years	5 years
13.	Collection of water samples for physical, chemical and bacteriological analysis of water	6 months	6 months	3 months	6 months	6 months

(Source: CPWD Manual of Maintenance of Buildings)

as the risk to site workers and the general public. Needless to emphasize that risk assessments in refurbishment jobs are project specific and they relate to the risks associated with the work in hand, while in the new build projects the risk assessments are more generic in nature.

Building owners, managers and construction professionals are now more inclined to look at the maintenance, repair and refurbishment issues in the context of "Whole-Life" and "residual service life" costs in a more holistic and structured manner. This type of approach enables them to understand more clearly all the relevant costs and revenues associated with the acquisition and ownership of an asset.

I would like to close this editorial by reminding you the "de Sitters Law of Five's". It states that "one sterling pound spent on getting a structure designed and built correctly is as effective as five sterling pounds spent in subsequent preventive maintenance in the pre-corrosion phase. This one sterling pound is as effective as 25 sterling pounds spent in repair and maintenance when local active corrosion is taking place and this is as effective as one hundred twenty five sterling pounds spent when overall corrosion has occurred and where major repairs become necessary, possibly including replacement of complete members".

This law emphasizes the importance of the concept, planning, design and specification phases and the major influence they have upon the whole-life cost and life-cycle performance. Accordingly, it is very important to make the right decisions early in the life a building or a structure.

In India, still the concept of building maintenance has not penetrated deep and wide into the owners and professionals engaged in the building industry. I do hope, this issue of "Rebuild" dedicated to this topic will generate some ripples of interest amongst our patrons and readers.

Special lecture delivered by Dr. P. R. Swarup, Director General, Counstruction Industry Development Council (CIDC), New Delhi on "Repair & Maintenance needs of the concrete structures in India"

As is the case globally, a significant percentage of India's civil structures have eroded with age, neglect, misuse, weather factors, rebar corrosion, extraneous loading and natural disasters adding to basic design deficiencies in many cases. Particularly given our tropical monsoon location, water permeation, and seepage have highlighted the crying need for renewal engineering and water proofing to be more specific. Neglecting the need to put down proper repair and maintenance systems results in loss and erosion of capital value, wastage of precious resources and lends for a poor quality of life. With multiple historic monuments and heritage buildings dotting our landscape, the need to address this damage is only more accentuated.

In a country with one of the fastest growing economies in the world, the increasing concentration of middle class populations and with the majority of our people unable to even manage two square meals a day, infrastructure and housing are key focus areas for the Indian Government. While there are major investments being pumped in to construct new structures, the spiraling costs of building these structures make them practically unaffordable to all but a very marginal few. We have 1.4 million concrete structures - residential, commercial industrial and others that are over forty years old. While one sees many of these still standing strong and looking like they can go on for another four decades and more, there are several relatively newer structures that are in bad shape. A key factor influencing the health and long-life of concrete structures is the implementation of timely and effective repair and maintenance procedures.

A major factor influencing the service life of concrete structures is the nature of exposure conditions. Generally Reinforced concrete apartment buildings in India lasts only for 30 to 50 years compared to the expectation of 70 to 80 years. The short life span is an economic burden for not only owners and residents but to the nation as a whole. A recent Japanese report urged housing industry in that country to adopt, as a goal, an average life span of 200 years. This will enable reducing the wastes during demolition, energy conservation, and harmony with environment, resistance to disasters like earthquakes and cyclones and achieving good behaviour by regular and easy maintenance. The major factor influencing long-term service life of concrete structures is the nature of exposure conditions and environment to which concrete is subjected to especially soon after casting and subsequent early ages. It is to be noted that while the manufacture of concrete is under the control of the engineer environment during early age is a factor beyond human control and not accounted for either during construction or during design. Adverse conditions such as ground contamination, high temperature, humidity, fluctuating temperature and relative humidity can cause damage and reduce the life span of the structure.

While reinforcing steel is protected by design by ensuring adequate cover, there are several electrical, plumbing and other steel items which are embedded in the cover region of concrete as inserts not knowing the damage they can cause for long-term serviceability. It is indeed, the interaction between concrete, steel insert and environment that dictate the material performance and hence the life of the structure itself. The exposure conditions in the coastal areas and especially on the east coast where Chennai is located are recognised as some of the most aggressive climatic conditions which pose severe challenges to the design and construction engineer.

Total assets created in the country including industrial and commercial projects and public properties are estimated at Rs 3, 50,000 crore, which is equal to 20% of the income generated every year. It is estimated by the council that Rs 32, 000 crore is required to rebuild India's damaged concrete structures. Housing sector alone has assets worth more than Rs 50,000 crore and will require more than Rs 17,000 crore for repair and maintenance every year.

Instead of the house owners selling their assets after 12 years and invest in a new property, he said instead they should be wise enough to spend on regular maintenance. They can make use of the durable materials like blended cement and steel bars besides modern construction designs now available.

CIDC (Counstruction Industry Development Council) has recommended to the Central Government that an asset management agency be formed as a regulatory body as part of the urban renewal mission to make it mandatory for house owners for ensure proper maintenance of their buildings failing, which they have to pay higher property tax and loose subsidies.

(Lecture was deliverd at Sheraton Park Hotel & Towers, Chennai on 4th December, 2009 as part of Healthy Construction Lecture Series organized by Dr. Fixit Institute of Structural Protection & Rehabilitation.)

Understanding Common Building Defects, Solutions & Maintenance Management

[Excerpts from the website www.bd. gov. hk/english/documents/code/bmg]

1. Common Building Defects and Their Symptoms

1.1 Background

Defects occur in various forms and to different extents in all types of buildings, irrespective of age. The followings all contribute to the occurrence of defects in buildings:

The large varieties of building materials used that may not be well congruent with one another;

- Construction techniques that may not be defect proof, inconsistent or sub-standard workmanship;
- Use of unsuitable construction details;
- Extreme site conditions undermining performance standards;
- Natural deterioration;
- Attacks by pollutants; and
- Improper uses of the completed buildings.

1.2 Defects in Buildings

Summary of common defects in the buildings are given in Table: 1.

Structural cracks deserve immediate attention. They indicate that the structure of the building, or at least a part of it, is overstressed. A structure, when stressed beyond

Table: 1 Common building defects and their symptoms

Common Defects	Symptoms/Phenomenon	Possible Causes
i. Defective concrete, spalling or loose plaster in ceilings	• Surface with water/rust staining, water leakage • Patterned cracking • Bulging, falling off of concrete patches with reinforcement exposed, often rusty • falling off of plaster/tiles	Defective concrete as a result of ageing is commonly found in old buildings. Persistent water leakage may affect the steel reinforcement. Weak concrete caused by the use of salty water in concrete mix, or overloading are also common causes in spalling
ii. Water seepage from external wall, window, roof, or from ceiling	• Water staining • Peeling off of paint or wall paper • Water dripping • Growth of fungus • Defective concrete, plaster or tiles • Rust staining	External water seepage could be due to a variety of reasons including cracks on external wall, honey comb concrete, defective sealant at window, defective water-proofing membrane at roof, defective external water and drainage pipes, etc
iii. Structural cracks in walls	• Cracks that penetrate through finishes into the concrete or bricks • Long, continuous cracks across width of wall • Diagonal cracks at corners of window or door • Cracks with rust staining	Structural cracks may be caused by many factors, e.g. excessive movement of the building structure, unwanted ground settlement, serious overloading, weaknesses caused by corrosion/deterioration of materials, or damage by accidents, or poor design/ construction, etc. Detailed investigation must be carried out to identify the cause(s) which must be removed or rectified before the cracks are repaired
iv. Structural cracks in columns & beams	• Cracks that penetrate through finishes down to the concrete or bricks • Spalling	Same as item (iii) above.
v. Non-structural cracks (usually in plaster or other finishes with cement sand rendering as base)	• Hairline cracks • multi-directional cracks (shrinkage cracks) • Cracks between panel walls and structural elements e.g. brick wall and beams/columns	Cosmetic shrinkage cracks in plaster or other forms of finishes will affect the appearance only and do not pose any safety concern. They are small hairline cracks developed within the finishes layer not penetrating down to the reinforced concrete structure
vi. Defective external wal finishes/mosaic tiles/ ceramic tiles/stone cladding/curtain wall	• Debonding of finishes/tiles from wall structure resulting in "hollow sound" when tapped with a hammer • Cracking of wall surfaces • Bulging with hollow base • Falling off • Cracks • Loosening of parts	The defects could be due to ageing, structural move-ments, defective workmanship during installation, ther-mal movement, defective or missing expansion joints, damage by external factors (e.g. falling objects during typhoon), ingress of water into the gap between the finishes or tiles and the structure, etc.

its capacity, may collapse without further warning signs. When such cracks suddenly develop, or appear to widen and/or spread, the findings must be reported immediately to the Authority. A building professional such as a Registered Structural Engineer is usually required to investigate the cause(s) of the cracks, to assess their effects on the structure, to propose suitable rectification and remedial works, and supervise the carrying out of such works.

1.3 Defects in Building Services Installation

Most of the mechanical components of the building services installations have a relatively shorter life span than the building structure. Defects in the mechanical components usually lead to failure requiring repair or servicing. It is therefore necessary to have a planned schedule for foreseeable servicing and replacement for components. Avoid exhausting the designed lifespan of such components can prevent sudden breakdown of services that causes undesirable or even disastrous consequences. Common defects in building services installations are summarized in Table : 2.

Table: 2 Causes and symptoms of common defects in building services

System	Symptoms/Phenomenon	Possible Causes
i. Water Supply	• Insufficient water pressure or flows • Brownish water / grit and deposit • Stoppage of supply • Water seepage • Unclean water, algae growth, dirt and deposit • Sudden rise in consumption • Noisy water pumps, noisy water inlets	• Blockage or leakage of components of the supply system such as pipes or valves • Rusty pipes or dirty supply tanks • Pump failure, breakage of supply pipe • Defective water tanks, pipes (pipe joints) or valves • Defective or missing water tank cover • Leakage in the system after water meters • Defective water pumps, undue water pressure
ii. Electricity Supply	• Stoppage of supply / system breakdown • Sudden or frequent fuse or circuit breaker cut off leading to stoppage • Heating of switches & wires • Sudden or frequent stoppage and larger power consumption • Electric sparks or shocks, electrocution	• Failure of fuse or circuit breaker • Earth leakage, overloading • Overloading • Uneven distribution of phases • Inadequate earth bonding
iii. Fire Services	• Alarm not working (when tested), false alarm or warning lights on signal panels • Portable equipment lost or misplaced, glass panels of alarm switch- box broken • Non-functioning of equipment	• Alarm wiring defect, short circuit • Inadequate protection or poor management • Inadequate maintenance or servicing
iv. Lift and Escalator	• Stoppage, excessive noise during operation, indicator lamps off, unstable lifting, malfunction of buttons and indicator lamps • Occasional overrun • Doors not closing properly • Defective mechanical parts, frequent stoppage, alarm signals	• Ageing of parts, mechanical failure • Landing misalignment • Parts ageing, mechanical failure, rubbish obstructing operation • Inadequate servicing
v. Air Conditioing / Heating	• Not cool enough, not warm enough • Noisy, no air movement • Engines sound normal but no air movement • Noisy blowers or propellers movement • Poor indoor air quality • Dripping and substandard output of cool or warm air • Noisy blowers or propellers movement	• Poor efficiency, leakage of refrigerant dust and dirt at heat transmission fins • Loosen parts, blowers or propellers breakage • Dust screens blocked, air ducts and grilles needs cleaning • Misalignment of motor shafts • Insufficient fresh air intake, mal-function of intake air filter • Insulation failure • Misalignment of motor shafts

Other building services installations that require regular checking and maintenance include gas supply, security system and alarm, radio, telephone and television signaling systems, etc

1.4 Water Seepage and Drainage Nuisance

They are common defects in causing nuisances to occupiers across floors. Though it is obvious that water migrates downwards by gravity, it is sometimes very difficult to identify the source or cause of water seepage. An extensive investigation may be necessary with the use of special detectors or apparatus to track down the source of leakage. Colour dyes, samples collection for analysis, tests to the possible sources or the specific spots, etc, are usual means adopted in identifying the source. It can be a long and enduring process which requires patience and co-operation from all parties concerned. Some examples are listed in Table: 3.

Table: 3 Water leakages and their causes

Location of Leakage or Seepage	Possible Causes
i. Underside of roofs (such as flat roof, podium roofs) and bottom of light wells	• Damage or deterioration of waterproofing layer • Leakage at access doors or top hatch doors • Deterioration of corrugated steel roofing materials and joints • Defective enclosure for water tanks • Cracks of parapet walls affecting the waterproofing membrane • Inadequate protection / improper installation of sleeve around openings through roof slab • Excessive movements of construction joints
ii. Ceiling with internal areas above	• Leakage from bathroom or kitchen above usually caused by seepage from fitments, bathtubs, shower trays, buried pipes or drains due to improper construction of joints, installation of sealants or occurrence of cracks • Waterproof cement rendering underneath floor tiles for the floor above not installed/specified or such waterproofing features damaged by installation of sockets or conduits • mal-function of waterproofing in nearby external features such as balconies or external walls above
iii. Wall	• Water penetration through external wall defects such as cracks, joints, honeycombs, spalling, weak points, holes, punctures, leftovers of debris, and movement of external wall components • Water penetration through defective external wall finishes such as loosened mosaic tiles, cracked ceramic tiles & paint surface; through poor cladding or curtain walls constructions; or weaknesses in water-resisting components • Water leakage through party walls between units of pre-fabricated elements, or between buildings
iv. Floor	• Seepage from defective pipeworks or sanitary fitments • Temporary floods and overflows • Defective bathroom fitments such as bathtubs, shower trays or hand wash basins, or the improper installation of pipeworks or necessary sealants
v. Window	• Improper fillings around frames • Deformation of frame and sashes, defective gasket, sealant or putty for window glass setting or frames • Air conditioning box or platform tilting inwards • Insufficient sealant around air conditioning units
vi. Basement	• Inadequate or damaged waterproofing tanking (may be due to movements or punctures) • Deterioration of water stops at construction/movement joints
vii. Buried or underground drains or pipes	• Seepage through defective joints or pipes caused by poor installation or differential movements/ settlements, movement of building structures or ground or water table • Corrosion of pipes at junctions with floors or walls • Invasion of water into conduits and distribute throughout the network • Blockage leading to excessive pressure built up • Attack by rodents or roots of plants
viii. Exposed (or in pipe ducts) supply pipes or drains	• Inadequacy in design of drains such as insufficient diameter of drains, bends being too sharp, etc. • Blockage of drains by rubbish/sand collected in the system especially in bends or traps • Insufficient number or deterioration of brackets leading to hammering and breakage of supply pipes • Blockage of open joints such as hoppers of down pipes by plants or rubbish • Unauthorized additions overloading the drainage system

Many different techniques for investigation and repair for the above defects are available in the market. Readers should consult a building professional especially when the cause of the problem is not obvious or cannot be easily identified.

Construction or repair of waterproofing components requires specialist materials and applicators. Normally, long-term warranty will be provided after application. Once the sources of the leakage are diagnosed, appropriate repair methods and suitable materials may be used to tackle the problem.

1.5 Defects in Windows and External Appendages

1.5.1 Common defects in windows

Windows are perhaps the most vulnerable building element in external building envelopes, and the need for some windows to be openable further aggravates the problem. Glass panels should always be replaced once cracks occur.

Common defects in traditional steel windows usually arise from rusty frames, and deterioration or loss of putty or sealant to hold the glass panels.

Aluminum windows have been widely used in new developments and as replacement of steel windows in existing buildings but recent incidents of their failure have aroused safety concerns.

Aluminum window system involves assembly of a certain number of components by rivets, screws, hinges and fixing anchors. These accessories, which are prone to failure, require regular servicing and maintenance to prevent failure. The friction slide hinges are delicate parts of the window which demand close attention to avoid accumulation of dirt that obstruct the sliding motion and mild lubrication to reduce friction of the moving parts. Without the required servicing and maintenance, hinges may become too tight to operate, rivets may loosen up and screws may be corroded that shorten their life-span. When excessive forces are applied to operate such windows or when they are subject to wind load, distortion or dislodgement of the window sashes or even the frame may result, causing fatal or serious injuries to the public.

1.5.2 Common defects in external appendages

External appendages are usually cantilevered structures which include eaves, mouldings, projections, architectural projecting features, air-conditioning hoods, canopies and balconies, drying racks, projecting panels and claddings. Although the structural designs of these elements have already catered for their cantilevered performance, lack of maintenance and repair to combat natural weathering would attract development of defects, unduly shorten their life-span and eventually result in collapse. Worst still, such collapse might be sudden without prior obvious symptoms such as deflections leading to catastrophic consequences.

There are two main reasons why cantilevered structures demand close monitoring. Firstly, they are often exposed to weather attack or weakened by unauthorized building works. Secondly, unlike the conventional reinforced concrete structures that the main reinforcements are placed near the bottom to the element, reinforcements are placed near the top surface of such structures where cracks will also first start to develop. Therefore, if waterproofing at the top is inadequate or damaged by the cracks allowing ingress of water, corrosion of the reinforcements will result. The corrosion will reduce the effective cross-sectional area of the reinforcement bars resulting in sudden collapse. Common defects are:

- Cracking at junctions
- Bulging (gaps occuring between finishes and parent wall) or peeling-off of finishes
- Spalling of concrete or uncovering of steel reinforcement
- Rusting of metal parts
- Damage by fungus or vegetation growth
- Water seepage through the features
- Corrosion or loosening of attachments

Except for canopies which are mostly found in podium levels, other appendages are usually thin and small in sizes but large in numbers which are difficult to check and monitor. Therefore, adequate resources should be allocated for regular inspection and repair in order to prevent them from becoming falling hazards.

Windows and balconies of individual units usually provide vantage points for inspection of the defects in the exterior of the building. Owners spotting any defects in the exterior of the building should report to the property manager or the Society of the building for their action, irrespective of whether the defects are at the exterior of their own units or other units.
The some of the solutions to the above building defects are explained in following sections.

2. Solutions

2.1 Repair of structure

2.1.1 Defective concrete/ concrete spalling

(i) Patch repair

It is the most common repair method for minor concrete defects such as surface spalling. Damaged or defective concrete is to be hacked off down to sound substrate. After all defective concrete has been hacked off, rusty reinforcement bars should be properly cleaned, and primed with suitable cement/epoxy based primer matching the mortar used for patching and thereafter substrate should be patched up with appropriate repair mortars such as cementitious mortars and polyester-

modified cementitious mortar or Resin-based mortars such as epoxy resin mortar and polyester resin mortar.

(ii) Replacement of reinforcement bars

The process involves identification of the type of existing steel bars, assessment on the required replacement/ supplement of reinforcement bars and the required lapping of the new and old bars. Structural calculations may also be required.

2.1.2 Structural cracks

After identifying and addressing the problem causing the cracks, the repair of the cracks is usually done by pressure injection of non-shrinkage grout or epoxy resin or by open-up and refill/recast with concrete.

2.2 Repair of external walls

2.2.1 Wall tiles/finishes

Proper preparation of the exposed surfaces after removing loose parts of the existing wall for a physical key with the new mortar; use of suitable bonding agents or adhesives for the mortar; and special adhesives for the tiles are essential means for this purpose.

2.2.2 Cracks

Cracks should be repaired by injection of specially designed chemicals or through open-up and repair by mortar.

2.3 Waterproofing

2.3.1 Roof

(i) Types of waterproofing materials

The common waterproofing materials used can be classified based on their application methods, namely, liquid-applied and membrane applied. Some materials can be exposed to weather and sunlight but others require protection such as cement sand screeding or tile finishes. Some materials are more elastic and suitable for anticipated movements in the roof structure. Life spans of such materials is more than 5 years.

(ii) Workmanship

Good workmanship is vital in waterproofing works. Areas of concern include:

- Gradient of roof surfaces which should be laid to provide an adequate fall to avoid ponding;
- The thickness of the waterproofing materials applied;
- Overlapping of the material at junctions ;
- Upturns of the material at parapets and walls, protruding pipes and ducts, sharp corners are potential areas of problems;
- Downturns of the material into drain holes; and
- Prevention of excessive movement caused by equipment installed on top.

Effective waterproofing work also depends largely on whether their integrity will be damaged by pumps/ condensers of air conditioning systems causing excessive movements, unauthorized building works, pipe supports, etc.

(iii) Testing

Flooding/ponding tests and thermal scanning should be carried out after the laying of the materials to verify its waterproofing performance.

(vi) Other repair methods

There are other repair methods such as use of chemical additives to existing concrete surfaces or polyurethane (PU) injection into the cracks and voids. Since they can be applied from the negative side or floor below to stop the leakage, they are recommended as a temporary measure when the upper floor or the roof owner is not co-operative in the repair work . However, the result may not sustain as water will still find its way down via other weak points.

2.3.2 External Walls

(i) Common sources of leakage

Apart from sleeves, common sources of leakage in external walls are:

- Deep cracks/crevices penetrating the finishes and the body of the wall.
- Defective concrete found in the wall.
- Defective or loss of external finishes to protect the wall from direct attack of rain.

(ii) Common repair methods

- Cracks/crevices on external walls can either be repaired by chemical injection or opening up followed by repair with waterproofing mortar.
- Weak points in the wall such as holes, honeycombs, dirt and foreign matters should be removed and patched up by suitable waterproofing mortar.

The repair can be done internally or externally, depending on the location of the weak spot. Upon application of the repair mortar or chemical injection, the surface can be smoothened and plastered. The external wall should then be covered with finishes to match with existing ones. If considered necessary, special additives to the mortar or rendering on the external wall can be applied to improve its waterproofing abilities.

2.3.3 Bathrooms, Kitchens or Balcony Floors

(i) Sources of leakage

In bathrooms or kitchens, the source of the leakage must be identified before any repair works can be considered. If it is the loosening of components in the drainage system

such as bottle traps under the sink, basin or bathtub, simple fixing can stop the leak. However, if defective water supply pipes are identified as the culprit, licensed plumbers should be engaged to replace the defective parts or overhaul the entire system.

(ii) Repair

Before reconstructing the waterproofing layer of a floor, all the sanitary fitments and finishes should be removed to allow the formation of a continuous waterproofing construction.

Waterproof cement sand screeding or other similar materials is commonly used. The screeding should be applied to have sufficient upturns at the base of the walls, and have an adequate fall to the floor drain to prevent water ponding.

Sanitary fitments are to be installed on top of the waterproofing layer without penetrating it. The floor surface under the bathtub or shower tray should be formed with a fall to avoid trapping water at their bases if water leakage ever occurs.

(iii) Finishing

Tiles should be fully bedded with tile adhesives. After applying the floor finishes, the joints between tiles should be grouted properly with tile grouts. Junctions of wall finishes and bathtub or shower trays should be sealed with suitable silicon sealant.Gaps between marble tiles should be fixed with flexible waterproofing joint sealant to prevent long term minor movement giving rise to cracks for water penetration.

3. Need for Effective Maintenance and Management

After reading through the preceding sections of this Chapter, readers can appreciate the size and complexity of problems and the paramount importance of effective maintenance and management. Formulation of long-term maintenance as well as surveillance and control plans are initial steps to ensure a safe and pleasant living environment.

4. Principles of Long Term Maintenance

Effective maintenance of buildings not only improves the quality of living environment but is also a vital means to uphold or even raise the value of properties.

Maintenance in general can be classified into servicing, repair, replacement and upgrading. There is also a marked difference in terms of methods, management and the result of "breakdown maintenance" versus "planned or preventive maintenance".

Planned maintenance gives the owners and the property managers more time to prepare for the works and, more importantly, to secure the necessary funding. It usually starts out by a thorough condition survey to assess the current situations, identify the full extent of works required and lay down the level of expectation. Considerations include implementation programs, standard of performance and reliability, as well as maintenance strategy, budget, and life cycles of certain elements and facilities.

Daily maintenance of essential features such as cleaning of surface water channels to avoid blockage of drains, servicing of small components of equipment or easily wearable items such as children's play furniture are essential to ensure safe and smooth operation. A detailed plan for maintenance to be carried out everyday should be drawn up as per the equipment supplier's recommendations, needs and expectations of the owners and priority in allocation of resources.

5. Principles of Inspection, Surveillance and Control

5.1 Inspections

5.1.1 Day-to-day inspection

The day-to-day inspection is to ensure the proper and safe functioning of different building elements, installations, services and facilities of a building. Examples of items that should be included in the checklist are:

- Water pipes and pumps;
- Gates and locks, fire doors and closers, intercoms and TV signaling, lights and fittings;
- Hose reels, nozzle boxes and alarm glass;
- Letter boxes and breakable panels;
- Security TV and cameras, timer switches;
- Surface water channels, drains, manholes covers, oil interceptors and grease traps;
- Club facilities, flower beds and planters, playground equipment especially children's play furniture such as swings;
- Staircases, windows, lobbies, false ceiling, sprinklers;
- Air-conditioning units and pipes for coolants and condensate water;
- Building structures, external appendages and finishes

Fire has taken many lives in the past. Readers' attention is drawn in particular to the importance of inspecting the provisions in fire service installations and means of escape as follows:

5.1.2 Special inspections

(i) Means of escape

- Fire resisting doors (Fig. 1), smoke lobby doors and emergency doors (Fig. 2) should be kept closed, and the door-closers should work effectively. All such doors shall bear appropriate signs reminding people that they should always be kept close.

Fig. 1: Fire-resisting door

Fig. 2: Emergency exit door

- No alteration such as door or ventilation openings should be made to walls enclosing staircases, smoke lobbies and exit routes unless prior approval from the Authority on these alterations has been obtained.
- Staircase windows and vent openings should not be blocked. Normally, the frames should be made of steel instead of aluminum in order to comply with the required fire resisting requirements.
- Artificial and emergency lighting in staircases and exit routes including battery operated exit signs should be maintained in working order.
- The swing of doors or gates should not encroach onto exit routes, such as common corridors, staircases and rear lanes, causing obstruction to escape.
- Doors or gates in common parts should be readily openable from the inside without the use of a key.
- Doors giving access to the roof of single-staircase buildings should be readily openable from the inside without the use of a key.
- Exit routes should be free of any obstructions such as racks, shelves, cabinets, storerooms, or rubbish.
- Access from one stairway to an alternative stairway via a common corridor should best be available on each floor.
- Exit stairs at ground floor level should be separated from the rest of the building, such as storerooms, ground floor shops or other uses.
- Exit doors should open in the direction of exit when the room capacity exceeds 30 persons.
- Doors or gates should be set back at ground floor exit where there is a drop in level or a step. When they open outwards, they should not obstruct the public pedestrian flow.

(ii) Means of access for firefighting and rescue

- Fireman's lifts are used by firemen for rescue in the event of fire. Access to fireman's lift at ground level should be available directly from a street and free from obstructions.
- Fireman's lift lobbies protect the firemen in using the lift for rescue. No alteration should be made to the lobby walls and doors.
- Exit staircases are used by the firemen for both access and rescue purposes. They should be free from obstructions.

5.1.3 Inspecting fire resisting components and construction

(i) Regular maintenance

Buildings are made up of different components. Some of them are designed to be fire-rated for resisting spread of fire. Building owners should keep these fire-resisting components under proper maintenance. Unauthorized alterations to such components may affect their fire-resisting ability and thus the fire safety of the building and its occupiers. If there is unauthorized alteration or defective fire-resisting component, the advice of an Authorized Person (AP) on the conditions and remedial proposals is necessary. This section introduces the common types and functions of fire-resisting components and construction in a building. They should not be altered without proper professional advice and the prior approval by the Authority.

(ii) Walls and Floors

Most of the walls and floors in buildings serve to prevent the spread of fire and smoke from one part of a building to other parts, or from one building to another. No unprotected opening should be made in such walls and floors. If in doubt, the building owners should seek advice from an AP.

(iii) Staircases

Other than the required fire-fighting equipment and artificial lighting installations, staircases should not normally accommodate electrical cables, air ducts or similar services. Otherwise, such installations have to be properly protected by appropriate fire resisting enclosures.

(iv) Fire-resisting door (Fire door or smoke door)

Fire-resisting doors prevent the spread of fire and smoke from one part of a building to others and therefore must not be removed. They should have adequate fire-resisting properties with self-closing device to keep them in a closed position. Replacement should be avoided unless with doors of the same performance. Usually, the main entrance door to a flat or unit is a fire-resisting door. The vision panel on a fire-resisting door, if found broken, should be replaced with suitable fire-resisting.

(v) Other fire-resisting enclosures

Examples of fire-resisting enclosures include the enclosures to special hazard rooms such as commercial kitchens, dangerous goods stores, plant & machinery rooms, switch rooms, electric cable ducts, refuse chutes and refuse storage rooms. The enclosures, walls, floors and doors should be maintained as fire-resisting elements.

5.1.4 Fire service installations

The following are fire service installations and equipment commonly found in different places:

- Fire alarm system (Fig. 3),
- Fire/smoke detection system (Fig. 4),
- Fire hydrant/hose reel (Fig. 5),
- Automatic sprinkler system (Fig. 6),
- Automatic gas extraction installation,
- Emergency lighting system (Fig. 7),
- Exit sign (Fig. 8),
- Fireman's lift (Fig. 9),
- Fire extinguisher (Fig. 10),
- Dynamic smoke extraction system,
- Fire dampers in ventilating / air-conditioning control system.

Fig. 3: Fire alarm system

Fig. 4: Fire/smoke detection system

Fig. 5: Fire hydrant/hose reel

Fig. 6: Automatic sprinkler system

Fig. 7: Emergency lighting system

Fig. 8: Exit sign

Fig. 9: Fireman's lift

Fig. 10: Fire extinguisher

5.1.5 Testing and routine maintenance requirements

To ensure that these essential installations work efficiently at all times, a registered fire service installation contractor should be employed by the building owners to inspect and maintain at least once every year.

When the fire service installations are found to be not working properly or damaged, a registered fire service installation contractor should be employed immediately to inspect and repair as necessary.

If the owners have any doubt about the qualification of a contractor for fire service installations, they may consult the Fire Protection Command of the Fire Services Department.

5.2 Surveillance

Surveillance serves to prevent or stop misuses, trespasses, theft or crime in the premises. The plan should include routes and frequencies of patrol going through all accessible common areas and hidden corners. The patrol route should include staircases, roof tops, lobbies, open space, side and rear lanes, swimming pools, yards and podiums, machine rooms, switch rooms and ducts, refuse rooms and hidden corners.

5.3 Control

The surveillance, checking and inspection carried out by the management personnel help all the owners to exercise control over the building for a safe, clean and pleasant living environment. Some areas requiring control are listed as follows:

- Identify all the malfunction and defective elements and facilities for immediate attention and repairs according to the agreed strategy and standard for proper functioning
- Stop wedging open of fire doors to ensure proper protection of exit routes.
- Remove rubbish or obstructions from means of escape and other common parts, and give warnings to occupiers who have caused the irregularities as described above or violated the house rules.
- Prevent illegal extensions or misuses at the earliest possible time to prevent deterioration of environment.
- Stop any illegal connections of electricity, water, drainage, or signal cables for ensuring safety and proper functioning of utility supplies.
- Identify and prevent trespassers or any weak point in security which will lend itself to burglaries and trespasses.

Maintenance of Roads

[Excerpts from: Civil Engineering Construction Review, March 2010 and website http:/www.ilo.org/public/english/employment/recon/eiip/download/India_mp_v1.pdf]

Road development helps tremendous improvement for socio-economic development as compared to rail or air transport. As per NHAI (National Highway Authority of India) India has about 34 lakh km road network out of which 200 Km Express Highways, 70,548 Km National Highways(NH), 1,31,899 Km State-Highways(SH), 4,67,763 Km Major District Roads(MDR), and rest is Rural and Other Roads. This is next only to USA, but the standards are quite poor. Earlier financial allocation were deficient even for maintenance let alone development. But in recent years due to growth of Indian economy the road development and maintenance are taken care as a programmed one by which in another decade, India would definitely have better developed and maintained road. Some of the maintenance aspects of roads are discussed in the following sections.

Types of pavements

Flexible Pavements : These pavements consists of different layers of granular materials of varying thickness and materials on top, depending on traffic volume.

Rigid Pavement: This type of pavement consists of a cement concrete pavement laid on a well prepared sub-base or base course.

Cement concrete or rigid pavements have much longer life than flexible pavements. Due to hard surface, they are fuel efficient, have good riding quality, have increased load carrying capacity and have very low maintenance cost compared to the flexible pavements.

Non-conventional road construction materials

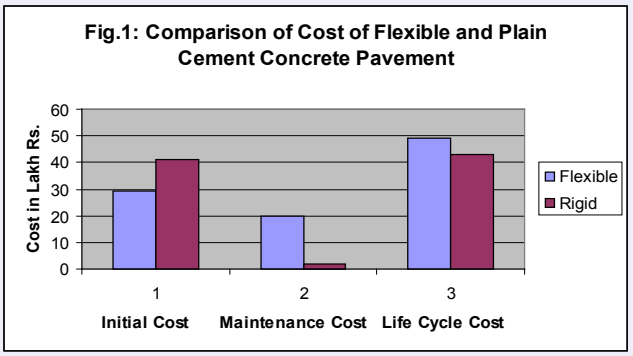
There is need to produce and use high quality construction materials which are suitable to various environment and geoclimatic conditions to sustain the traffic demand. Non-conventional road construction materials such as fly ash, iron and steel slag, marble dust from quarry, processed municipal wastes, plastic wastes, jute and geo-textiles can be used as replacement for the conventional materials wherever they are economical. In hilly regions and desert a special pavement technique as inter-locking pavement blocks may be helpful. Advanced pavement materials such as geosynthetics, polymer modified bitumen, rubberized mastic asphalt, etc. are useful for extending life of pavements. Introducing nano technology materials can improve fluidity, strength and durability of the roads.

Pavement Performance

Several forms of structural distress are developed which ultimately result into functional failures. The most important to a road user is the functional condition which determines the comfort, safety, user cost. Structural damage usually results increased functional deterioration. Present performance is very complex phenomenon due to the fact that large variations are observed on account of change in material characteristics, quality of construction, traffic volume and loadings, environment factors, maintenance inputs and so on. The distress in low volume flexible pavements are rutting, cracking, pothole and edge drops. The different alternatives for limiting cracking are base improvement, crack sealing and overlay.

Maintenance cost and Life cycle cost

The maintenance cost includes the maintenance of pavement during the design life of pavement to keep the pavement at the specified service level. A comparison of different costs are shown in Figure 1.



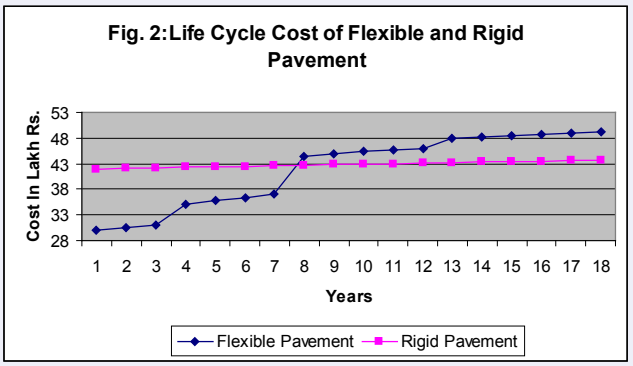


Figure 2 shows the comparison of life cycle costs of flexible and rigid pavements. The cost of maintenance of flexible pavement is much higher (more than 11 times) than the maintenance cost of rigid pavement. Figure 2 shows that the break even point is at 8th year from construction of the road i.e. after 8 years the life cycle cost of flexible pavement becomes higher than that for rigid pavement. As the design life of the pavements in general is more than 8 years, cement concrete pavements may prove to be economical.

Maintenance of State Roads

Majority of the road length under the state roads other

than national highways is single lane only. The funds available for maintaining the roads, in traffic worthy conditions, are not adequate and no tools are available for making the inputs in a scientific manner. A variety of vehicles are used for the transportation of goods. They range from animal drawn bullock-carts to the fast moving vehicles. The extent of overloading on 2-axle trucks is very high. Presently pavement maintenance of rural roads based on the judgment and experience. It is therefore desirable that there should be systematic PMS (Pavement Management System) based on the relevant data. Different maintenance and improvement alternatives can be used to upkeep the pavement life.

Maintenance objectives

The basic objective of maintenance is to maintain and operate the road system in such a manner that:

- Comfort, convenience and safety are assured;
- The investment in roads, bridges and appurtenances is preserved;
- The aesthetics and compatibility of the highway system with the environment are achieved, and
- The necessary expenditure of resources is accomplished with continuing emphasis on economy.

Maintenance Operations and Activities

Indian Road Congress (IRC) 2002 makes a distinction between preventive and corrective maintenance. Road maintenance operations are further classified as:

- Routine maintenance (described in IRC, 2002, as "ordinary repairs");
- Periodic maintenance (described in IRC, 2002, as "periodical renewals");
- Flood damage repairs / emergent repairs.

These categories are compatible with conventional international practice of dividing maintenance operations into Routine, Periodic and Emergency activities. IRC (2002) distinguishes between 46 routine and 33 periodic maintenance activities for gravel and bituminous roads. Some of the main activities under each type of maintenance are explained below.

Road users normally judge the quality of a road and maintenance effectiveness on the basis of the ride it offers and its appearance. The comfort with which users can travel and the speeds which can be achieved with safety are no doubt important aspects for maintenance.

However, for preserving roads as assets, there are other important activities such as clearing and repairing drainage structures and erosion control which would also reduce the incidence of emergencies requiring special repairs. The balancing of these routine maintenance activities along with a regular programme of periodic maintenance and prompt response to emergencies would make an effective maintenance programme as given below:

a) Routine ("Ordinary") (frequent)

Activities required to be carried out once or more per year on a road section. These activities are typically small scale or simple, but widely dispersed, and mainly require unskilled labour under skilful supervision. The need for these can, to a large degree, be estimated and planned and can often be carried out on a regular basis.

Activities include:

i. Inspection

ii. Keeping the roadway clear of debris

- Cleaning / excavating ditches and drains
- Cleaning culverts, inlets and outlets
- Minor repairs on drainage structures (mainly culverts)
- Reshaping, grading, dragging unpaved surfaces
- Patching potholes (paved and unpaved surfaces)
- Resealing minor cracked areas
- Repairing traffic signs, road markings
- Repairing erosion damage and it's control measures
- Controlling vegetation

iii.Reporting major damages to the road

b) Periodic (infrequent)

Activities required on a road section at intervals of a few years. They are normally large scale and require specialist equipment and skilled resources. These activities are costly but can be planned well in advance.

They include: (i) regravelling (ii) resealing (iii) resurfacing and (iv) major structural repairs

Emergency ("special repairs" or "flood damage repairs / emergent repairs")

These are activities that are required from time to time whenever sudden and unforeseen damage occurs, such as flood damage, major landslides or and damage to structures. Emergency activities cannot be estimated based on the annual maintenance needs assessment and no advanced planning for specific cases may be made. However, it is necessary to reserve a certain proportion of the overall maintenance funds for emergency cases.

Activities include :

i. Repair and rehabilitation of failed drainage structures

ii. Repair and restoration after landslides and slips

iii. Repair and restoration after washouts

The above norms of maintenance of roads along with GIS(Geographical Information System) based pavement management systems are available, for collecting and collating road inventory data through GPS (Geographical Positioning System) integrated non-destructive technology based instruments, to achieve timely intervention of maintenance activities.

Concrete Bridge Maintenance

[Excerpts from NBM&CW, Vol. 15, Issue 10 , PP 142 - 144 by Dr. Surendra P. Bhatnagar, Tech-Dry (India) Pvt. Ltd.]

The durability of structural concrete bridges has become a serious problem, costing billions of dollars to various national economies, besides influencing the productivity, international competitiveness, and quality of life in those countries. India, for example, the Indian Railway network has 120,000 bridges as old as 140 years. Although these bridges are old, proper repair, rehabilitation and protection can extend their service lives for several years more.

Performance requirements for the system

Independent of the bridge deck waterproofing system choice, certain performance criteria have to be met in order to avoid potential concerns regarding leakage, poor bonding, and embitterment or softening of the membrane in service, such as:

- Impermeability to water under all conditions
- Good adhesion to deck and surfacing
- Capability of bridging shrinkage cracks in concrete
- Highly mechanical properties to handle traffic loads including shear forces in curves and during braking and accelerating
- Tolerant of deck texture and details
- Tough enough to withstand site damage and operations
- Safe to apply
- Ability to withstand elevated surface temperatures
- Can be applied over a wide range of ambient conditions
- Non-degradable

How to protect Bridges

There are several methods that can be used to rehabilitate reinforced concrete. When unprotected external reinforced concrete is placed in the environment, deterioration begins immediately. The main environmental factors which contribute to the deterioration of concrete are oxygen, water, carbon dioxide and chloride ion (salt). The damage to concrete may include:

- Carbonation of the concrete causing corrosion of the reinforcing steel
- Spalling due to corrosion of reinforcing steel
- Cracking caused by wetting and drying
- Rust Stains and other stains
- Salt penetration from marine rain causing salt erosion and spalling

Exclusion of The Factors of Corrosion from Concrete

The aim of repairing a bridge is to extend its life. Inappropriate repair action may actually reduce the life expectancy of the bridge. It is also possible that money spent on extensive and costly repair will not extend the life of the bridge significantly and would be better put towards a new bridge. In concrete structures, defects such as corrosion of reinforcement may not be apparent at the present time, but the effects may show up in the form of concrete cracking and spalling at a future date. It may not be appropriate to spend money on repairing some localized defects if much more extensive defects are likely to show up in the near future. Investigation by specialists into the complete structure may be warranted prior to undertaking costly repairs of concrete. It is possible using the science of building protection to effectively exclude water, chloride ion and carbon dioxide from new or old concrete so that deterioration does not proceed.

Impregnation

It is the process of applying a silane based compound on the concrete surface which penetrates into the substrate and polymerizes forming a permanent hydrophobic layer, for resisting penetration of water, chloride ions and other pollutants.

Anti-Carbonation

Carbon dioxide and carbonation can be specifically excluded by the practice of coating with an Anti-Carbonation Coating. This is a special coating produced to stop carbon dioxide diffusion through the coating into the concrete while allowing water vapour to pass through easily. This then stops carbonation of the concrete so the concrete remains alkaline enough around the steel to keep the steel protected from corrosion. For superior state of the art concrete protection, concrete structures should be impregnated to exclude water and chloride ion from the structure followed by the application of an anticarbonation coating to exclude carbon dioxide. This gives double protection against concrete corrosion.

Protective Coatings

Surface coatings are used on concrete structures to provide additional protection against ingress of water, water soluble salts and atmospheric gases. In addition they enhance the aesthetic appearance and help in hiding the patchy appearance of concrete that has been repaired in different places.

Basically there are two types of protective coatings:

- Film forming – relying on adhesion over concrete.
- Non-film forming – penetrate into concrete surface.

Generally, film-forming coatings are highly efficient against ingress of moisture, water-soluble salts (chlorides), gases and vapours (carbon dioxide). However build up of water vapour pressure behind them, especially if water is able to get into the concrete from another face, can cause the coating to blister and peel off unless the adhesion of the film to concrete is very good. Also, if the film lacks elasticity and fails to bridge over active cracks or subsequently formed shrinkage cracks, pollutants will find easy ingress into the concrete at the site of cracked coating and will eventually cause deterioration in concrete.

International Journal of 3R's (Repair, Restoration and Renewal of Built Environment)

ISSN 0975-8968

The institute has started publishing a quarterly techno-scientific Journal of International status and quality. The journal comprises an Editorial board consisting from national and international personalities from academies, research institutes and industries in this field. The first issue of the journal has been circulated worldwide and has been accepted very well among the readers.

Journal Scope

To promote and coordinate developments and practices for enhancing the service life of Built Environment.

Subscription

The subscription of this quarterly journal is from January to December for Rs. 1200/-. Please contact our Editorial office for subscription form.

Call for Papers

Papers of scientific research, general discussion, case studies and point of view can be submitted through email to *editor3r@pidilite.co.in* and *info@drfixitinstitute.com.*

Also, papers can be submitted online on http://www.drfixitinstitute.com/articles/index.php.

However, in unusual circumstances authors may submit papers in duplicate hard copies along with a soft version.

Queries about submissions from potential authors should be addressed to *editor3r@pidilite.co.in.*

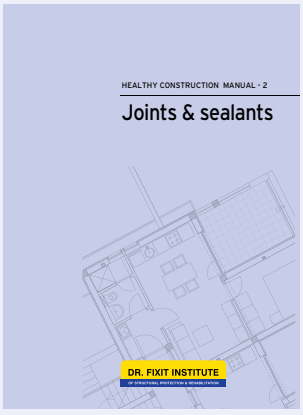
For author's guidelines please visit our website http://www.drfixitinstitute.com

The Editor

Dr. Fixit Institute of Structural Protection & Rehabilitation
C/o Pidilite Industries Limited,Ramkrishna Mandir Road,
Andheri(East),Mumbai-400059, India
Tel : +00-91-22-28357973
Fax : +00-91-22-28357149
E-mail : *editor3r@pidilite.co.in*

Healthy Construction Manual Series

The Manual on **"Protective Coatings for Concrete and Masonry Surfaces"** covers all systems to be used for protective coatings for long term durability of the structure. It contains various properties, test methods and their relevant standards, characteristics and performances of different coating families, the method of application including various types of defects, quality assurance and safety precautions to be taken. It provides guidance on specification, measurement and rate analysis for preparation of tender documents and various tables for coating application on different surfaces and environments. It also gives different types of coatings available in the Indian market. The manual is illustrated with quite a large number of photographs. It will help all Practising Engineers, Contractors, Applicators, Manufactures, Researchers, Students and Faculties as a reference manual.



The Manual on **"Joints and Sealants"** covers different types of joints and their need for providing in concrete structures. It explains the movement of joints and how to design such joints at different locations consisting of different materials of cast-in-situ as well as precast constructions. It also provides solutions to seal those joints with different types of sealants and also guides for selection of materials for structures with fluid pressure and industrial floor joints and how to install those sealants including use of water stops. The safety, health and environmental aspects are also covered. It will help all Practising Engineers, Architects, Designers, Contractors, Applicators, Students and Faculties as a reference manual.

The purchase enquiries for the above publications may be sent to Deputy Director, Dr. Fixit Institute of Structural Protection & Rehabilitation, Ramkrishna Mandir Road , Andheri(E), Mumbai-400059, India. by Tel/ Fax : 00-91-22-28357149 or E-mail : info@drfixitinstitute.com and ch.page@pidilite.co.in

Training Programmes conducted

In-house Training programmes.

Building Maintenance – Waterproofing & General Repair

Date : 14th and 15th January 2010

Attendees : M/s. M. N. Dastur & Co., Grasim Industries Ltd, RCF Ltd, BPCL, Municipal Corporation of Greater Mumbai, I.I.T. Madras, Sunil Mantri Realty Ltd, CIDCO, Archana Structural Engineering Ltd and Shammi Enterprises.

Corrosion and Protective Coatings

Date : 26th February 2010

Attendees : Godrej Properties Ltd., Bank of India, Sainath Developers, NABARD, PWD, BMC and Maharashtra Police Housing Co. Ltd.

Making Concrete with Performance Additives

Date : 30th April 2010

Attendees : Ambuja Cements Limited, JMC Projects Ltd, ITD Cementation and H.R. Johnson Ltd

National Level Joint Training programmes

Construction Chemicals – Waterproofing & Repair Applications

Date : 4th January to 8th January 2010

Jointly with : Ministry of Micro, Small and Medium Enterprises (MSME)

Venue : MSME Development Institute, Sakinaka, Mumbai

Structural Diagnosis & Condition Analysis of RCC Structures

Date : 6th February 2010

Jointly with : Indian Concrete Institute, Pune Chapter

Venue : Prabhat Road, Pune

Structural Protection, Repair and Rehabilitation of Buildings

Date : 18th & 19th March 2010

Jointly with : Building Materials and Technology Promotion Council, New Delhi

Venue : Guwahati, Assam

Corporate Training Programmes

National

Waterproofing of Critical Building Areas

Organisation : Lodha Developers Limited, Mumbai

Date : 4th March 2010

Venue : Dr. Fixit Institute, Andheri, Mumbai

Waterproofing – Concepts, Technology and Materials

Organisation : Pride Purple Group, Pune

Date : 11th March 2010

Venue : Aundh, Pune

International

Concrete Technology and Usage of Chemical Admixtures

Organisation : Advanced Technologies Limited, Dhaka, Bangladesh

Date : 16th to 18th February 2010

Venue : Dhaka, Bangladesh

Technical Seminars

Sponsored Sir Bernard Feilden Lecture on "Constructing Cultural Significance: Challenges for Conservation in India" by Mr. Rahul Mehrotra, Director, SMArchs programme, MIT, USA and organised by IA & B (Indian Architect & Builder Magazine) at Coomaraswamy Hall, Kalaghoda, Mumbai on 12th March 2010.

Training Programmes and Courses

DFI-SPR has scheduled the following training programmes for the up-gradation of knowledge base of Practising Engineers, Waterproofing and Repair Contractors, Consultants, Architects, Faculties and Students from Engineering Colleges.

Training programmes for June - July 2010

Sr. No.	Date	Venue	Topic	Fees	Details of the topic
1	19th June	Indian Concrete Institute, Prabhat Road, Pune	Waterproofing of New Buildings.	Rs. 800/-	• Waterproofing – Definitions and Concepts • Waterproofing Technologies of different building sections
2	25th June 2010	Sardar Patel College of Engineering, Andheri (W), Mumbai	Cracks in Concrete and Crack Repairs	Rs. 1500/-	• Cracks in Concrete. Corrosion Cracking and Environmental effects. • Crack Repair – Systems and Methodolgy. • Structural cracks in concrete structures. • Retrofitting of RC Structures
3	28th June - 2nd July 2010	MSME, Sakinaka, Mumbai	Construction Chemicals – Waterproofing & Repair Applications	Rs. 5000/-	• A complete comprehensive module on Waterproofing & Repairs
4	22nd - 23rd July 2010	DFISPR, Kondivita, Mumbai	Build Your Structures Waterproof	Rs. 3000/-	• Cause and need of waterproofing of structures. • Building Envelope – A Design Consideration. • Waterproofing of roofs and terraces. • Waterproofing of internal wet areas. • Basement waterproofing. • Waterproofing of walls
5	26th - 28th July 2010	MSME, Madgaon, Goa	Construction Chemicals – Waterproofing & Repair Applications	Rs. 5000/-	• A Complete comprehensive module on Waterproofing & Repairs

Corporate Training Programme

In addition to the above scheduled programmes, we do organize separate corporate training programmes on specific topics as per the needs of the customer.

Distance Education Correspondence Courses Jointly with NICMAR

Six Month Graduate Certificate Distance Education Courses are being counducted by DFI-SPR jointly with NICMAR, Pune for practicing Engineers in the following subjects:

- Waterproofing and Maintenance of Concrete Structures
- Advance Technology for Concrete Repair
- Application of Polymeric Materials in Construction

Contact Details:

Mr. Tirtha Pratim Banerjee
Phone: (022) 28357683
Mobile: 9930650145
E-mail: tirtha.banerjee@pidilite.com

Dr. George Varghese
Phone: (022) 28357499
Mobile: 9819978211
E-mail: george.varghese@pidilite.co.in

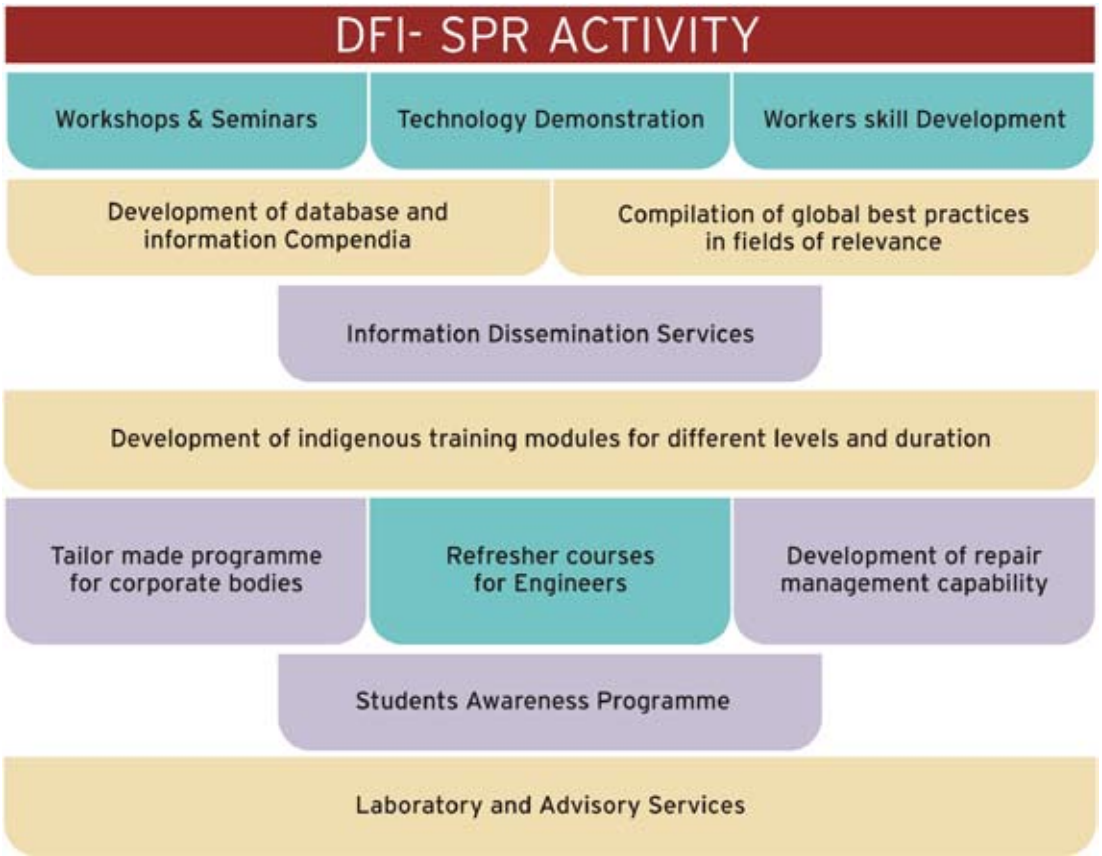
VISION

To become a premier national knowledge and skill development center in waterproofing and other areas of renewal engineering through international networking in order to proliferate the global best practices in the country.

MISSION

To act as a platform for enhancing the service life of built environment through global sharing of knowledge and practices in the field of waterproofing, structural protection, repairs and rehabilitation.

DFI – SPR : ACTIVITY CHART



Editorial Advisor : Dr. A. K Chatterjee, Director, Dr. Fixit Institute of Structural Protection & Rehabilitation
Printed & Published by Dr. Fixit Institute of Structural Protection & Rehabilitation,
Ramkrishna Mandir Road, Post Box No.17411, Andheri (E), Mumbai 400 059 INDIA. Tel +91-22-28357149

Reader's Feedback & Interaction Solicited

(For feedback kindly use our postpaid reply card placed inside)

Our Newsletter is focused on good concreting practices, waterproofing, repair, rehabilitation and maintenance of concrete structures and buildings. Any reader, who wishes to contribute his or her experience or achievements in this field to our Newsletter for wider dissemination, may send the details to:

The Editor – 'Rebuild'
Dr. Fixit Institute of Structural Protection & Rehabilitation

C/o **Pidilite Industries Limited**
Ramkrishna Mandir Road, Andheri (E), Mumbai 400 059
Tel : 022 – 2835 7973 / 2835 7149
E-mail : suresh.pattanaik@pidilite.co.in
info@drfixitinstitute.com
Visit us at : www.drfixitinstitute.com

DR. FIXIT INSTITUTE
OF STRUCTURAL PROTECTION & REHABILITATION