

DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/MANAGEMENT/
COMMERCIAL PRACTICE – APRIL -2020.

BUILDING MAINTENANCE AND SERVICES

(Maximum Marks :75)

[Time : 2.15 hours]

PART–A

Marks

I. Answer **any three** questions in one or two sentences. Each question carries 2 marks.

1. State any two major factors which affect the durability of concrete.
2. State types of maintenance based on its periodicity.
3. List the two basic classifications of cracks.
4. List any two common defects in Sewage and Sullage system.
5. State the purpose of shoring.

(3x2=6)

PART - B

II Answer **any four** of the following questions . Each question carries 6 marks.

1. List the parameters to be considered while planning the expected durability of structure.
2. What are the common defects in flooring.
3. What are the common defects in wooden roof and mention remedial measures.
4. What are the common types of A/C and discuss the factors affecting in determining required capacity.
5. Discuss common defects in stair case.
6. Explain underpinning with the help of a figure.
7. List the steps involves in restoration works.

[4x6 =24]

PART - C

(Answer **any of the three units** from the following. Each full question carries 15 marks)

UNIT I

III (a) Discuss the importance and economic aspects of maintenance. (8)

(b) What are the aspects to be considered while planning for the maintenance of structures. (7)

OR

- IV** (a) Discuss the environmental factors that affect the durability of structures and the remedial measures. (8)
- (b) Differentiate different types of maintenance with example. (7)

UNIT- II

- V** (a) Identify the common defects in foundation and masonry. Suggest remedial measures. (8)
- (b) What are the factors that cause corrosion of steel structures and reinforcement? How it can be prevented?. (7)

OR

- VI** (a) Classify the cracks, discuss the causes of cracks in building, their measurement and methods of repair. (8)
- (b) Identify the causes and damages due to fire. How it can be mitigated. (7)

UNIT- III

- VII** (a) Draw the vertical section of a lift shaft and mark the components and state its function. (8)
- (b) List the common defects in water supply system. (7)

OR

- VIII** (a) Explain the functions of Buss bar, rising main, earthing and ELCB in the electrical system of a building. (8)
- (b) Explain the RTT of a lift and explain factors to be considered in selecting the lift location. (7)

UNIT – IV

- IX** (a) Explain the need for restoration and retrofitting of structures. (8)
- (b) List the causes for deterioration of monumental and historical buildings and suggest remedial measures. (7)

OR

- X** (a) What are the challenges in the restoration and retrofitting of buildings. (8)
- (b) What are the common retrofitting works carried out. (7)

MALABAR POLYTECHNIC CAMPUS CHERPULASSERY

DEPT. OF CIVIL ENGINEERING

Course Name: Building Maintenance And Services		Course Code: 5011
Class : S5		Department: CIVIL
QUES. NO	Test No: 1	Month & Year: APRIL 2020
	ANSWER	MARKS
	PART A	
I.1	<ol style="list-style-type: none"> 1. Physical – Temperature, Moisture 2. Chemical – Chloride, sulphate, acid rain 3. Biological – Tree root penetration 	2
2	<p>Special maintenance</p> <p>Routine maintenance</p>	2
3	<p>Building failure can be classified into two:</p> <ol style="list-style-type: none"> 1. Structural failure – failure in foundation, RCC, etc 2. Non-structural failure – failure in plastering, painting, etc 	2
4	<ol style="list-style-type: none"> (1) Deterioration of materials (2) Root infiltration (3) Design and construction issues (4) Blockage 	2
5	<p>Shoring is a temporary supporting structure to support an unsafe structure. It is used when addition and alterations need to done on unsafe structures.</p>	2
	PART B	
II		
1	<ol style="list-style-type: none"> 1.The first thing that you should consider when picking construction materials is durability. 2. materials must be able to withstand the wear and tear of everyday use, as picking low-quality materials would only cause structural concerns that will bring more challenges to your project. 3.Workmanship: - workers should be good 4. The environmental factors 5.Humidity condition 6.Chemical factors 	(1X6=6)

Remarks:

2

Defects in flooring			
No	Defect	Causes	Remedies
1	Cracks	<ul style="list-style-type: none"> • Due to shrinkage or expansion of concrete 	<ul style="list-style-type: none"> • Proper filling of cracks
2	Discoloration of timber	<ul style="list-style-type: none"> • Due to chemical attacks 	<ul style="list-style-type: none"> • Provide any preservation methods
3	Scratches	<ul style="list-style-type: none"> • Marks formed on finished surface due o rubbing action of abrasives, dust, etc 	<ul style="list-style-type: none"> • Use sand paper and apply finishes
4	Sealant failure	<ul style="list-style-type: none"> • Adhesives used in floors may fail due to improper bonding and bad workmanship 	<ul style="list-style-type: none"> • Give time to set for adhesives before using floor • Proper workmanship
5	Wear	<ul style="list-style-type: none"> • Weathering of some portion of flooring materials due to continuous loading & usage 	<ul style="list-style-type: none"> • Proper selection of flooring materials and good workmanship

Causes 3

Remedies
3

3

Defects in wooden structures			
No	Defect	Causes	Remedies
1	Chip mark	<ul style="list-style-type: none"> • Marks formed on finished timber surface by tools 	<ul style="list-style-type: none"> • Polish/chisel well
2	Diagonal grain	<ul style="list-style-type: none"> • Due to improper sawing of timber 	<ul style="list-style-type: none"> • Proper sawing
3	Chemical stain	<ul style="list-style-type: none"> • Wood dis-coloured by chemical action 	<ul style="list-style-type: none"> • Apply proper preservation methods
4	Knot	<ul style="list-style-type: none"> • Continuity of wood fibers is lost due to knots making them weak 	<ul style="list-style-type: none"> • Can use as a single piece
5	Rind gall	<ul style="list-style-type: none"> • Due to abnormal growth at points where branches are improperly cut 	<ul style="list-style-type: none"> • Can use as a single piece
6	Beetles	<ul style="list-style-type: none"> • Creates holes in wood for food making fine flour like powder in the wood 	<ul style="list-style-type: none"> • Strength considerably reduces. So better to avoid. If using, use with care and use preservatives
7	Termites	<ul style="list-style-type: none"> • Eats wood fastly 	<ul style="list-style-type: none"> • Strength considerably reduces. So better to avoid. If using, use with care and use preservatives

Causes 3

Remedies
3

Remarks:

4	<p>Types of AC</p> <p>(1) Room air conditioner a. Split air conditioner o Also known as packaged terminal air conditioner</p> <ul style="list-style-type: none"> • Suitable for small rooms • Capacity = 0.75 to 2 tons <p>b. Window air conditioner o Also known as ‘unitary AC system’</p> <ul style="list-style-type: none"> • Most common and cheapest for single rooms <p>(2) Package air conditioner a. Water cooled condenser o Bigger version of window air conditioner</p> <ul style="list-style-type: none"> • Water or air should be supplied continuously • Higher cooling or heating capacity • Can able to cool an entire house or a commercial building • Capacity: 3 – 15 tons <p>(3) Centralized air conditioner a. Direct expansion air conditioner o Best for large buildings – more space needed</p> <ul style="list-style-type: none"> • Fitting individual units is expensive in large buildings • There will be a large compressor • Fitting individual units is expensive in large buildings • Mainly used in shopping malls, airports, etc <p>b. Chilled water central air conditioning plant</p> <p>(4) Portable air conditioner o Can be moved from room to room</p> <ul style="list-style-type: none"> • Noisier than other systems • Faster cooling • Discharges exhaust heat through the exterior wall by means of a hose vent 	6
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Remarks:

5	Defects in staircase			1x6=6
	No	Defect	Causes	
1	Uneven steps/risers	<ul style="list-style-type: none"> • If all steps are having same height and one slightly higher, it creates a psychological abnormality to us. 	<ul style="list-style-type: none"> • Provide consistent dimensions; especially regarding height 	
2	Low headroom	<ul style="list-style-type: none"> • If vertical height b/w tread and overhead obstruction less than 2 m, head of people may hit there • Due to less gap b/w obstruction and tread of stair 	<ul style="list-style-type: none"> • Provide minimum headroom clearance > 2m 	
3	Handrail issues	<ul style="list-style-type: none"> • Due to insufficient length of handrail • Misaligned position 	<ul style="list-style-type: none"> • Provide handrail throughout the stair • Properly align position of handrail 	
4	Baluster issues	<ul style="list-style-type: none"> • Absence of balusters creates psychological issues • Due to small height of balusters • Insufficient gap → Child safety issues 	<ul style="list-style-type: none"> • Provide balusters having sufficient height, width and proper spacings • Tighten balusters 	
5	Slippery treads	<ul style="list-style-type: none"> • Due to issues with flooring material • Presence of moisture, over polishing 	<ul style="list-style-type: none"> • Use of proper flooring material • Provide rough materials for floor gripping 	
6	Squeaking steps	<ul style="list-style-type: none"> • Due to issues with flooring material • Improper fastening and fixing methods 	<ul style="list-style-type: none"> • Use of proper flooring material • Provide proper fastening and fixing methods 	

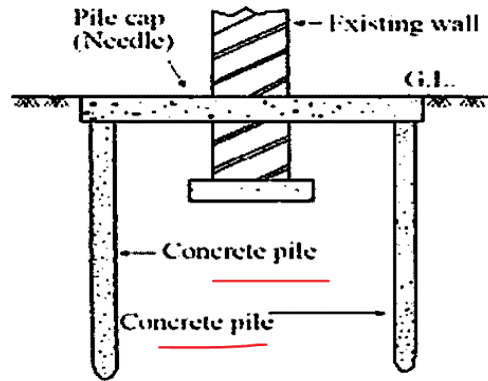
6 Placing of a new foundation below an existing foundation is called underpinning. Also defined as the process of strengthening an existing foundation.

Methods of underpinning

1. Pit (Mass concrete underpinning) method
 - a. Traditional method of underpinning
 - b. Method involves extending the old foundation till it reaches a stable stratum
 - c. The soil below the existing foundation is excavated
 - d. When strata suitable is reached, the excavation is filled with concrete and kept for curing.

2. Pile method
 - a. Piles are driven on adjacent sides of the wall that supports the weak foundation
 - b. A needle or pin penetrates through the wall that is in turn connected to the piles
 - c. These needles behave like pile caps

Remarks:



7

1. Analysis of the site should be the first step in the restoration process.
2. Extensive documentation must be conducted. This includes taking an inventory of all objects and fixtures within the building. Photographing the building inside and outside is mandatory. Every element and feature of the building must be photographed and documented in writing such as their location and function
3. Before any work on the site is done, a conservator will develop a collection management policy for the restoration
4. All materials from the selected restoration period will be preserved for restoration.
5. If a part of the building, fixtures, or design features are deteriorated, conservators must first attempt to repair the damage.
6. If a restoration requires an addition to the building, these changes must be proven through historical documentation and physical proof
7. Any treatments undertaken during restoration efforts will follow best practices for the material being treated

1x6=6

Remarks:

<p>III a.</p>	<p style="text-align: center;">PART C</p> <p style="text-align: center;">UNIT I</p> <p>The important economic aspects considering maintenance of a building are:</p> <ul style="list-style-type: none"> • Technologies getting changed every day. • Most things regarding maintenance are uncertain – cost of inspection, maintenance policies, plans and decisions. • They may arise at any point of time. • Investments and returns should be properly defined. • User benefits (time, cost and safety) should be established. • Regional growth of economic activities need to be considered. • Health and Safety of labours – insurance schemes should be included. <p>b. The important planning aspects considering maintenance of a building are:</p> <ul style="list-style-type: none"> • Planning starts from design stage • Planning continues throughout the life of building • All buildings should have a maintenance manual <p>To develop a cost-effective way to maintain value of asset</p> <ul style="list-style-type: none"> • Property get organized and maintained in systematic way • Building services can monitored for better use • Emergency corrective maintenance can be reduced • Will get an idea of time frame which helps in proper planning and execution of maintenance works. • Can have the financial assessment for the respective repair or restorations to be done. <p style="text-align: center;">OR</p> <p>IV a. Higher humidity and moisture content leads to efflorescence</p> <ul style="list-style-type: none"> • Wind blowing abnormally results in fatigue action (cyclic loading) • Freezing and thawing – water trapped inside cracks get expanded when it changes to ice due to freezing. This volume expansion leads to cracks. • Sulphate attack – common in industrial situations. Whitish appearance is an indication of sulphate attack. • Acid attack – strong acids damages stones and leads to weathering. • Carbonation – main reason for corrosion of reinforcements 	<p style="text-align: center;">1X8=8</p> <p style="text-align: center;">1x7=7</p> <p style="text-align: center;">8</p>
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Remarks:

- b.
1. Preventive Maintenance :- The maintenance work done before the defects occurred or damage developed in the structure is called preventive maintenance. It includes proper planning's, inspections and execution of works. It depends on specifications, condition and usage of the structure.
Eg:- **chemical treatments done on bathroom floorings to protect from dampness** .
 2. Remedial Maintenance :It is done after the occurrence of defects. Eg: - if cracks are formed, remedies like epoxy injection are done
 3. Routine Maintenance : It is given to the structure periodically at regular intervals of time.
Nature of work done and interval of time at which it is done depends upon: Specifications and materials of structure, purpose, intensity and condition of use.
Eg: - **Sweeping daily, painting once in a year, white washing**
 4. Special maintenance : Repairs carried out to overcome special problems or conditions as soon as they occur are known as special repairs.
Eg:- **tilt of leaning tower of pisa corrected in small level, Strengthening of foundation and foundation soils, anti-termite treatments, rectification of leaking roofs, etc.**
 5. Pre monsoon maintenance

UNIT II

V
a.

Defects in Foudation			
No	Defect	Causes	Remedies
1	Unequal settlement of subsoil leads to cracks in structure	<ul style="list-style-type: none"> • Presence of mining areas • Shrinkable soils • Unequal load distribution on soil strata 	<ul style="list-style-type: none"> • Seek professional help while constructing in mining areas. • Use pile foundation • Resting foundation on rigid soil
2	Unequal settlement of masonry	<ul style="list-style-type: none"> • Masonry b/w ground level and concrete footing has mortar joints which may shrinks unequally. 	<ul style="list-style-type: none"> • Use mortar of proper strength. • Using thin joints • Properly curing the masonry. • Limiting height of masonry: <ul style="list-style-type: none"> • lime mortar = 1 m/day • cement mortar = 1.5 m/day

**Causes 4
Remedies
4**

Remarks:

3	Sub Soil moisture movement	<ul style="list-style-type: none"> • When water table drops down, shrinkage of subsoil take place and cracks are formed 	<ul style="list-style-type: none"> • Use pile foundation • Adopt provisions to retain level of water table which is practically too difficult.
4	Overturning	<ul style="list-style-type: none"> • Due to lateral pressure on walls. Eg: Wind • When constructed on slopping grounds 	<ul style="list-style-type: none"> • Design properly by considering lateral loads • Use sheet piles
5	Lateral movement of subsoil	<ul style="list-style-type: none"> • Very soft soils get laterally displaced when heavy loads acts above the structure. 	<ul style="list-style-type: none"> • Provide sheet piles to strengthen soil and prevent lateral movement of soil.
6	Atmospheric action	<ul style="list-style-type: none"> • Agents like sun, wind and rain affect surface of foundation. 	<ul style="list-style-type: none"> • Provide appropriate plinth protection.
7	Weathering of foundation due to trees	<ul style="list-style-type: none"> • Presence of vegetation and remains of old cut trees 	<ul style="list-style-type: none"> • Remove vegetation from its root level itself.

b. Corrosion of steel is a major problem influencing the long-term performance of RCC structures.

- If steel is embedded in highly alkaline medium, it will not rust.
- It occurs due to attack of aggressive agents:
 - o Chloride attack reduction of alkalinity destruction of passive layer which protects reinforcement from attacks.
 - o De-icing Salts
 - o Carbonation

Different Types of Corrosion Prevention Methods

Barrier Coatings. One of the easiest and cheapest ways to **prevent corrosion** is to use barrier coatings like paint, plastic, or powder. ...

Hot-Dip Galvanization. This **corrosion prevention** method involves dipping steel into molten zinc.

Alloyed Steel (Stainless) ...

Cathodic Protection

4

3

Remarks:

OR

VI
a.

causes of cracks in buildings

- Use of unsound materials
- Bad workmanship
- Use of high water-cement ratio
- Bad jointing techniques

Techniques to repair cracks are:

(1) Epoxy Injection

2) Gravity filling :- Low viscosity monomers and resins can be used to seal cracks width

o High molecular weight methacrylate, urethanes, and some low viscosity epoxies have been tested successfully.

(3) Routing and sealing o Common technique for crack treatment

- The crack is made wider at the surface with a saw or grinder, and then the groove is filled with a flexible sealant.
- Cracks repaired using crack sealers
- Prevent entry of harmful liquids and gases

o Steps: i. Enlarge the crack along its length (chasing/routing)

ii. Groove depth = 6 to 25 mm

iii. Groove is cleaned

iv. Apply sealant material (epoxies, silicones, urethanes, polysulfides, asphaltic materials, polymer mortars,..)

v. Allow sealant to cure for its curing period.

b.

Causes:-(1) Electrical hazards

o Damaged wiring

o Damaged plugs

o Damp or wet wires

o Overloaded motors

o Broken switches, outlets or sockets, etc.

(2) House-keeping hazards

o Piles of scrap

o Waste materials and thrash

o Blocked emergency exits

(3) Friction hazards o Hot bearings

o Misaligned and broken machine parts

3

5

4

Remarks:

- o Choking or jamming of materials
 - o Poor adjustments of moving parts
 - o Inadequate lubrication
 - (4) Storage hazards
 - o Materials stacked too high blocking sprinkler heads
 - o Flammable materials stored too close to heat sources
 - o Inadequate ventilation in storage areas
- Remedies:- Fast Flow Extinguishers.

Fire engine.

Fire blanket.

Fire engine red.

Fire extinguisher

3

VII
a.

UNIT III

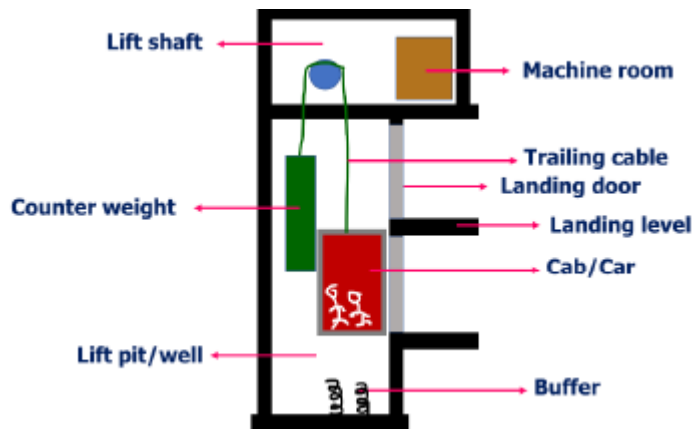


Fig 4

- (1) **Lift car/cab** - Vertically moving cabin in which passengers and goods are transported.
- (2) **Lift shaft/hoist** - space in which the lift cabin moves.
- (3) **Machine room** - Room from which the lift functions are loaded and controlled
- (4) **Lift pit or Lift well** - Specially dug hole into which the lift is "housed"
- (5) **Buffer** - Provided in lift pit for safe landing of cab at bottom
- (6) **Counter weight or balance weight** - a separately guided mass that partly counterbalances cabin & secures ropes pressure to a driving pulley
- (7) **Trailing/suspension cable** - Cable which holds car and counter-weight

4

Remarks:

b.

Defects in water supply			
No	Defect	Causes	Remedies
1	Rusting / corrosion	<ul style="list-style-type: none"> • Presence of moisture • Presence of salts 	<ul style="list-style-type: none"> • Proper inspections and cleanings • Inspect for leakage • Apply anti-corrosive paints
2	Leakage	<ul style="list-style-type: none"> • Loose pipe fittings, cracks, pressure variations • Inappropriate fastenings and fixtures 	<ul style="list-style-type: none"> • Proper inspections • Regular maintenance works • Timely replacement of old/damaged pipes
3	Dents and buckles	<ul style="list-style-type: none"> • Changes in pipe shape and size (expansion) • Dents formed when rocks come in contact with pipe wall • Buckles formed due to excessive bending/compression 	<ul style="list-style-type: none"> • Proper inspections • Install advanced machinery and live monitoring system for water supply system
4	Blockage	<ul style="list-style-type: none"> • Slow water flow in the pipe – sedimentation occurs • Blocks produced by debris 	<ul style="list-style-type: none"> • Remove blockages before getting situation worst • Inspect water pressure level in pipeline
5	Cracks	<ul style="list-style-type: none"> • Fatigue, stress reversals, corrosion, welding defects 	<ul style="list-style-type: none"> • Proper inspections, Proper welding, Replacement of older/damaged pipes quickly
6	Design issues	<ul style="list-style-type: none"> • Bad design 	<ul style="list-style-type: none"> • Proper design
7	Tree root entry	<ul style="list-style-type: none"> • Roots try to take water from pipe → cracks 	<ul style="list-style-type: none"> • Restrict growth of large trees nearby pipelines

1x7=7

OR

VIII **Buss bar :**

a . In electrical power distribution, a bus bar is a metallic strip or bar, typically housed inside switch gear, panel boards and busway enclosures for local high current power distribution.

- ○ Also termed as Bus bar/bussbar
- ○ Metallic strip/bar used for local high power distribution.
- ○ Usually placed inside switch gears, panel boards, etc

4x2=8

Rising electrical mains: are a type of electrical main which distributes power and electricity within multi-storey commercial buildings. This can include hospitals, car parks, apartments and more, which the electric power needs to go across multiple levels. Here at The Local Electrician, our electricians are here to help connect buildings power through rising electrical mains.

Earthing or grounding is the process of transferring the immediate discharge of electricity directly to the **earth** plate, by **means** of low resistance electrical cables or wires.

ELCB – Earth-leakage Circuit Breaker

Remarks:

<p>b.</p>	<ul style="list-style-type: none"> • Automatically switches off electrical circuit during abnormal conditions – Overloads and Faulty circuits • ELCB is a better option to provide a sense of security, and it also helps to prevent shocking to others • ELCB is used to stop the flow of supply current if someone get shock due to the operation of the circuit <p>RTT: Average time required by the lift in taking one full load of passengers from ground floor, discharging them in various upper floors and coming back to the ground floor for taking fresh passengers for the next trip</p> <p>Location of Lift</p> <ul style="list-style-type: none"> o Lift can be provided inside or outside the building o Inside near staircase or independent to staircase o Outside with access to the building landing o Need to provide easy access for all building users o Not preferred at corners o Should give provision for future expansions, if any o Provides much comfort to the users o Increases efficiency of transportation <p style="text-align: center;">UNIT IV</p>	<p>3</p> <p>4</p>
<p>IX a.</p> <p>b.</p>	<p>To ensure the safety and security of a building, employees, structure functionality, machinery and inventory.</p> <ul style="list-style-type: none"> • Essential to reduce hazard and losses from non-structural elements • Predominantly concerned with structural improvement to reduce seismic hazard. • Important buildings must be strengthened whose services are assumed to be essential just after an earthquake like hospitals. • Upgradation of lateral strength of the structure. • Increase in the ductility of the structure • To enhance its structural and mechanical properties • Provide existing structures with more resistance to seismic activity. <p>Causes of deterioration</p> <ol style="list-style-type: none"> 1. Trouble caused by Animals and Birds like bats 2. Negligence of people preserving them 3. Temperature effects – thermal expansion, solar effects 	<p>1x8=8</p> <p>4</p>

Remarks:

	<p>4. Atmospheric effects – water and humidity, wind, pollution 5. Due to living beings – Biological effects – insects, fungus, etc 6. Acid rain 7. Root and vegetation 8. Humidity Preservation ideas</p> <ul style="list-style-type: none"> • Removal of salt & protection from salt action • Eradication by regular cleaning • Closure of openings • Regular Maintenance • Proper monitoring and preventive measures <p style="text-align: center;">OR</p> <p>X a. Restoration:-Small patches may indication of big failures – should patch</p> <ul style="list-style-type: none"> • Inappropriate additions to heritage buildings • Meeting modern building codes without ruin the building • Find best team for the restoration works • Lack of proper equipment and facilities <p>Retrofitting:-Interior and exterior space constraints</p> <ul style="list-style-type: none"> • Unforeseen problems or costs – bad weather & storage Uncertainties relating to permissions and approvals • Coordination of residents become difficult • Difficulties sourcing energy - use monitoring equipment • Difficult to achieve desirable performance with min cost • Proper design and optimization should be done <p>b.</p> <ol style="list-style-type: none"> 1. Routing and sealing 2. Base isolation method <ul style="list-style-type: none"> o Isolation of superstructure from the foundation o Most powerful tool for structural vibration control o Isolate building from ground motion o Action of seismic loading gets reduced 3. Grout/epoxy injection 4. Stitching 5. Jacketing (study separately) 	<p style="text-align: center;">3</p> <p style="text-align: center;">4</p> <p style="text-align: center;">4</p> <p style="text-align: center;">7</p>
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Remarks:

6 . Mass Reduction Technique

o By removal of one or more storey's

o By removal of mass, time period is decreased strength increases

7. Surface treatment (Shotcreting)

o Requires shotcreting system – pressurized hoses and pump

o Concrete is pumped to the surface – enough compaction

Remarks:

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Remarks: