

Annexure-1

| Sl. No. | Condition State | Condition | Extent & Severity of Distress | Type of maintenance |
|---------|-----------------|--|--|---|
| 1 | Excellent | Sound structural condition; component do not individually or as a whole impair the strength, stability, traffic safety, durability and serviceability of the structure. | Only constructional deficiencies may be present. Extent of deficiencies is nil or insignificant. Severity of deficiencies is very low. | No need of repair except routine maintenance. |
| 2 | Good | More than satisfactory structural condition; component do not individually or as a whole impair strength/stability: traffic safety, durability and/or serviceability of the structure might be impaired slightly in the long term. | Extent of deficiencies is minor; Severity of deficiencies is low. | Specialized maintenance and repairs may be needed at convenience. |
| 3 | Fair | Satisfactory structural condition; strength, stability and traffic safety of the components/ structure is assured however considerable reduction is possible in the long term; serviceability and durability of the affected component is reduced and durability of the structure might be impaired considerably in the long term. | Extent of deficiencies is major; Severity of deficiencies is medium. | Specialized maintenance and repairs needed soon. |

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|----------------|------------------------|--|---|--|
| 4 | Poor | Structurally deficient bridge; strength/stability/traffic safety no longer assured; durability may be affected in short term; monitoring is required; restriction of use of the bridge may be needed. | Extent of deficiencies is large; Severity of deficiencies is high. | Rehabilitation / replacement on program basis is needed; measures for reconstruction or warning signs for upholding traffic safety might be necessary in the short-term; detailed investigations and economic analysis is required for justification of funds. |
| 5 | Critical | Weak structural condition; partial failure or risk of total failure of the component or as a whole; durability of the structure is no longer ensured; immediate propping of the structure and closing may be required. | Extent of deficiencies is very large/ expensive; Severity of deficiencies is very high. | Repair/rehabilitation/ replacement is required immediately; design strength, expected serviceability and desired remaining service life of a component/bridge can no more be achieved with economic costs. |

Annexure-2

| Sl. No. | Name of Component | Type of Distress | Remedial measures |
|--------------------|---|---|--|
| Foundations | | | |
| 1 | Open Foundation | (a) Erosion of soil/ exposure of footing | (a ₁) Protection by boulders, crates, concrete blocks etc. (a ₂) Floor protection (a ₃) Construction of spur / dykes |
| | | (b) Undermining | (b ₁) Filling undermined portion by non-erodible material and protection as per (a ₁) above. (b ₂) Grouting (b ₃) Apron |
| | | (c) Cracking and spalling | (c ₁) Treatment of cracks and spalls Jacketing |
| | | (d) Settlement | (d ₁) Regaining stability by base treatment, strengthening by increasing size and modification of footing by re-building new footing around it. |
| 2 | Pile Foundation (Concrete piles) including caps | (a) Erosion of concrete above scour level and splash zone | (a ₁) Rectification by high strength concrete (a ₂) Steel lining |
| | | (b) Settlement | (b ₁) Stabilizing of soil (b ₂) Review design of foundation & sub-structure and provide suitable measures including redesign & re-construction of necessary components (b ₃) Modification of pile group by adding new pile/piles |
| | | (c) Disintegration/cracking | (c ₁) Removal of damaged concrete and Re-building of section by suitable concrete in the damaged portion |

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|---|---|---|---|
| 3 | Well Foundation | (a) Tilting & Shifting beyond the initial levels at the time of commissioning | (a ₁) Review design of foundation & sub-structure and provide suitable measures including redesign & re-construction of necessary components |
| | | (b) Cracking | (b ₁) Treatment of cracks and spalls (b ₂) Stitching (b ₃) Filling the well with concrete to relieve load on steining |
| | | (c) Excessive scour | (c ₁) Garlanding with or without Peripheral Piling |
| Sub-Structure | | | |
| 4 | Abutment, Pier Abutment caps and Pier cap | (a) Crushing, disintegration cracks, spalling, honey combing etc. | (a) As per Table 5.1(1) |
| | | (b) Lateral deflection beyond design limit | (b) Improvement/control by stiffening |
| Bearings | | | |
| 5 | Steel Rocker and Roller Bearings | <ul style="list-style-type: none">• Tilting• Flat roller• Displacement• Breaking of lugs and keys• Sliding in transverse direction• Corrosion of steel• Pedestal damage | <ul style="list-style-type: none">• Resetting/Re-alignment• Cleaning and greasing• Replacement |
| 6 | Elastomeric Bearings | <ul style="list-style-type: none">• Damages including embrittlement of elastomer• Cracking and tearing• Displacement | Replacement |
| 7 | Pot Bearings | <ul style="list-style-type: none">• PTFE/Elastomer and fixtures• Displacement• Failure of elastomeric piston/disc | Replacement |
| Note : Repairs for bearings can be used in isolation or combination | | | |

| Sl. No. | Name of Component | Type of Distress | Remedial measures |
|------------------------|---|--|---|
| Super-Structure | | | |
| 8 | Girders Beams and Slabs | <ul style="list-style-type: none"> • Deflection • Cracking (dead / dormant), spalling and damage to Concrete • Displacement | <p>Strengthening in shear and flexure by steel plates, FRP or external prestressing</p> <p>Treatment by grouting and/or filler material micro concrete and by FRP</p> <p>Realignment by lifting and correcting the position of superstructure</p> |
| 9 | Deck system | Cracks (dead / dormant), spalling, peeling and damage to concrete | <ul style="list-style-type: none"> • Overlaying • Re-casting |
| 10 | Expansion Joints | Non-functioning of joints due to Clogging or wearing out and failure of anchoring system, | Replacement by new modern joints. |
| 11 | Appurtenances | Damages and non-functioning | Repairs & replacement as necessary |
| 12 | Super structure of balanced cantilever bridge | Sagging at the end of balanced cantilever | Construction of continuity girder |
| 13 | Approach slab | Settlement and damage of slab | Relaying of slab |

Annexure-3

| Sl. No. | Nature of Distress | Cause of Distress | Principal Possible Measures for Remedy |
|---------|--|---|---|
| 1 | <ul style="list-style-type: none"> • Cracking • Delamination • Spalling • Disintegration | (A) Mechanical Impact, Overloading, Movement, Settlement, Explosion, Vibration, Seismic | <ul style="list-style-type: none"> • Crack Filling: By Injection of suitable grouting and/or filler material after sealing them, Active cracks due to corrosion, ASR or foundation settlement etc. should not be injection grouted. • Concrete Restoration: By Hand applied mortar, Spraying of mortar (Guniting), Spraying of concrete (Shotcreting), Recasting of concrete, Replacement of old element by new one. • Structural Strengthening: By Addition of new reinforcement externally, Bonding of steel plates, Wrapping/ Bonding by Fiber Reinforced Plastic (FRP), Encasing the member partly or wholly either by concrete or by mortar or ultra-high performance concrete reinforced or non-reinforced, Addition of new reinforcement by drilling holes & embedding in concrete, Prestressing by external cables. |

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|---------|---|--|---|
| 2 | | (B) Chemical Alkali Aggregate Reaction, Aggressive Agents(Acids, Salts (sulphates, phosphates, etc.), Biological Activities | <ul style="list-style-type: none"> • Protection against Ingress: By Sealing & Injection of cracks (for dormant / dead cracks only), of cracks, Impregnation of surface, Application of membranes, Surface coating, Providing external panels. • Moisture Control: By Coating of the exposed surface, Cladding over the surface, Impregnation of hydrophobic material. • Increasing Resistance to Chemicals: By Overlays, Coatings, Impregnation |
| 3 | | (C) Physical <ul style="list-style-type: none"> • Shrinkage, • Erosion, • Wear and Tear, • Fire | <ul style="list-style-type: none"> • Protection against ingress • Moisture control • Structural strengthening • Increasing Physical Resistance: By Overlays, Coatings, Impregnation |
| 4 | Uniform Corrosion: Cracking & Delamination | Carbonation of Concrete | <ul style="list-style-type: none"> • Preserving or restoring passivity • Control of Anodic areas. |
| 5 | Pitting & Stress corrosion: Spalling | Corrosive contaminants: Sodium chloride, Calcium chloride & Others | <ul style="list-style-type: none"> • Cathodic control • Cathodic protection • Chloride of anodic areas • Restoring passivity |
| 6 | Scaling of steel: severe loss of surface area | Severe progress of corrosion due to above effects | Local replacement of steel reinforcement or part or full replacement of the member |