



Ministry of Transport of the Republic of Latvia  
LATVIAN ROAD ADMINISTRATION

# Guidelines for the management of bridges



Norwegian Public Roads Administration  
Directorate of Public Roads



# FOREWORD

This manual sets out the provisions and guidelines for the management of bridges on national roads. Responsibilities are detailed described in order to promote the organization's major objectives in traffic safety, reliability, service life and traffic-flow on bridges.

The Roads Administration carries out these tasks in accordance with the guidelines. In special circumstances the Head of the Bridge Division can make exceptions to the rules contained in the guidelines.

The Roads Administration's guidelines shall be considered only as internal guidelines for the organization. These are not regulations and thus cannot be cited by the public. Any deviation from in-house guidelines will only be subject to internal reference and action, and such circumstances will not give the public any basis for grievance.

Roads Administration  
Bridge Department  
May 1998

***Remarks:***

These guidelines have been prepared on the basis of the Norwegian Public Roads Administration's guidelines for «The Management of Bridges», and changed in co-operation with the Latvian Roads Administration.

Because of the Latvian Roads Administration wishes to use the equivalent of the Norwegian terms, all references to Norwegian administrative documents and handbooks have been retained in this edition.

# CONTENTS

<b>A MANAGEMENT.....</b>	<b>7</b>
A-1 INTRODUCTION.....	7
A-2 OBJECTIVES .....	7
A-3 DEFINITIONS.....	8
A-3.1 GENERAL DEFINITIONS.....	8
A-3.2 DEFINITIONS FOR BRIDGE MANAGEMENT .....	8
A-3.3 DEFINITION OF BRIDGE RENEWAL.....	9
A-3.4 OTHER TERMS USED .....	9
A-4 AREA OF APPLICATION .....	10
A-5 RESPONSIBILITIES.....	10
A-5.1 GENERAL .....	10
A-5.2 RESPONSIBILITY FOR BRIDGE MANAGEMENT.....	10
A-5.3 AUTHORITY - BRIDGE OWNER.....	10
A-5.4 OWNERSHIP OF THE GROUND BELOW BRIDGES .....	11
A-6 FUNDING AND MAINTENANCE STRATEGY.....	11
A-6.1 GENERAL .....	11
A-6.2 ALLOCATIONS OF FUNDS .....	12
A-6.3 PRIORITIZING .....	12
A-7 RESPONSIBLE AUTHORITY'S DUTIES.....	13
A-7.1 GENERAL .....	13
A-7.2 PRINCIPAL ACTIVITIES.....	13
A-7.3 THE HANDING OVER PROCESS.....	14
A-7.4 OTHER MANAGEMENT TASKS .....	15
A-8 APPROVAL OF PLANS IN THE OPERATIONAL LIFE.....	16
A-9 DOCUMENTATION REQUIREMENTS FOR BRIDGES.....	17
A-9.1 GENERAL .....	17
A-9.2 PLANNING PHASE .....	17
A-9.3 DESIGN AND CONSTRUCTION PHASE.....	17
A-9.4 RECORDS.....	17
A-10 COMPUTER SYSTEMS .....	18
<b>B INSPECTION .....</b>	<b>19</b>
B-1 GENERAL .....	19
B-2 INSPECTION ACTIVITIES .....	19
B-2.1 INSPECTION RELATED TASKS .....	19
<i>B-2.1.1 Inspection plan.....</i>	<i>19</i>
<i>B-2.1.2 Inspection program.....</i>	<i>19</i>
<i>B-2.1.3 Carrying out inspections.....</i>	<i>19</i>
<i>B-2.1.4 Recording inspection results.....</i>	<i>20</i>
<i>B-2.1.5 Assessment of condition and description of maintenance measures.....</i>	<i>20</i>
<i>B-2.1.6 Documentation and statistics .....</i>	<i>20</i>
B-2.2 INSPECTION TYPES.....	20
<i>B-2.2.1 Acceptance inspection.....</i>	<i>20</i>
<i>B-2.2.2 Guarantee inspection.....</i>	<i>22</i>
<i>B-2.2.3 General inspection .....</i>	<i>23</i>
<i>B-2.2.4 Major inspection .....</i>	<i>24</i>
<i>B-2.2.5 Major inspection of cables.....</i>	<i>26</i>
<i>B-2.2.6 Major inspection under water.....</i>	<i>27</i>
<i>B-2.2.7 Special inspection .....</i>	<i>28</i>
B-2.3 ACCESS EQUIPMENT .....	30

B-2.4 MEASUREMENTS AND MATERIALS INVESTIGATIONS .....	30
<i>B-2.4.1 Measurements</i> .....	30
<i>B-2.4.2 Materials investigations</i> .....	31
B-2.5 ASSESSMENT OF DAMAGE AND CONDITIONS .....	32
<i>B-2.5.1 Damage assessment</i> .....	32
<i>B-2.5.2 Degree of damage</i> .....	32
<i>B-2.5.3 Consequences of any damage</i> .....	32
<i>B-2.5.4 Correlating degree and consequence of damage</i> .....	33
<i>B-2.5.5 Cause of damage</i> .....	33
<i>B-2.5.6 Activating condition</i> .....	33
B-2.6 DESCRIPTION OF ACTION TO BE TAKEN .....	33
<i>B-2.6.1 General inspection</i> .....	33
<i>B-2.6.2 Other inspections</i> .....	33
<i>B-2.6.3 Alternative strategies</i> .....	34
<b>C MAINTENANCE .....</b>	<b>35</b>
C-1 GENERAL .....	35
C-2 MAINTENANCE RELATED TASKS .....	35
C-2.1 PREPARING A MAINTENANCE PLAN .....	35
C-2.2 PREPARING A MAINTENANCE PROGRAM .....	36
C-2.3 UNDERTAKING MAINTENANCE .....	36
C-2.4 MAINTENANCE CHECKS .....	36
C-2.5 MAINTENANCE REPORTS .....	36
C-2.6 DOCUMENTATION AND STATISTICS .....	37
C-3 MAINTENANCE TYPES .....	37
C-3.1 ROUTINE MAINTENANCE .....	37
C-3.2 PERIODIC MAINTENANCE .....	38
C-3.3 REHABILITATION .....	39
<b>D RENEWAL .....</b>	<b>41</b>
D-1 TYPES OF RENEWAL .....	41
D-1.1 STRENGTHENING .....	41
D-1.2 RECONSTRUCTION .....	41

Appendix 1: Excerpts from «Instructions for the Directorate of Public Roads and the Regional Offices of the Public Roads Administration»

Appendix 2: Proposed agreement on foreign installations



# **A MANAGEMENT**

## **A-1 INTRODUCTION**

These guidelines have been prepared based on the «Instructions for the Norwegian Public Roads Administration» (NPRA), see Appendix 1, and changed in co-operation with the Latvian Roads Administration (LRA). It applies to major provisions governing the management of bridges on national roads.

## **A-2 OBJECTIVES**

Major administrative documents for managing and maintaining bridges include, besides general transportation policies, the current Norwegian Roads and Road Traffic Plan. Furthermore, provisions in White Paper no. 41 (1993-94) from the Norwegian Parliament regarding the reorganization of roads administration establish requirements on political controllability and efficiency, including a separation between management and production.

In addition the process has resulted in the following challenges for the Road administration:

- Be regarded as a professional and progressive contracting client
- Increasingly contribute to environmental and community planning
- Make traffic safety and maintenance contributions more apparent

In bridge management the objective is to elaborate on the following:

- Road user mobility and safety on bridges must be as good as in the road network in general
- The assets that bridges represent must be preserved and renewed/replenished
- Within a given framework all travelers shall be able to safely use the bridges
- The Bridge Division shall maintain an appropriate preparedness to reconstruct severed bridge connections

Aesthetics and architectural requirements also apply in the operational life. The objective of these guidelines is to provide a general framework for the management of bridges to ensure that tasks are performed in, for society, the most economical manner, while facilitating environmental and safety concerns.

## **A-3 DEFINITIONS**

The following definitions are based on the generally accepted roads administration terminology.

### **A-3.1 General definitions**

<b>Bridges</b>	All types of bridge structures such as road bridges, pedestrian bridges, movable bridges, floating bridges, as well as culverts, pipes and vaults in fills. Structures are considered to be bridges when the accumulated spans or total length equals or exceeds 2.0 m.
<b>Responsible for management</b>	The Head of the Bridge Division, Roads Administration, is in charge of administering the management of bridges on national roads.

### **A-3.2 Definitions for bridge management**

<b>Management</b>	Includes the administrative contracting client tasks that must be performed in the operational life to ensure the preservation of bridge assets as well as maintaining safety and functionality. This involves the planning and execution of inspections, and planning and carrying out follow-up maintenance. In addition it involves general office routines, classification work, keeping bridge records, emergency bridge materials etc. Management shall be performed in accordance with current guidelines and approved annual plans or management-by-objectives documents.
<b>Inspection</b>	Visual checks combined with measurements and materials investigations shall be performed to assess the state of repair and safety levels. Inspections shall reveal needs for maintenance as well as any needs for strengthening or reconstruction work.
<b>Maintenance</b>	Execution of planned activities necessary to maintain bridges at a predetermined level of quality or standard, thus facilitating their use for the purpose intended throughout its operational life.
<b>Routine maintenance</b>	Tasks which not require detailed operational planning or special demands for qualifications of the executor. This includes such as cleaning, removing debris or the manning and servicing of movable bridges. In addition, routine maintenance will cover repairing occasional damage and dealing with other unexpected events such as reshaping/replacing guard-rails or joints, clean-up river course and replacing protection facility for foundations which have been washed away.

<b>Periodic maintenance</b>	Planned activities are carried out at regular intervals so as to maintain bridge elements, before serious damage occurs. Action may also be taken following an inspection, e.g. surface treatment of concrete bridges; painting of steel or repairing ruts on the asphalt wearing course
<b>Rehabilitation</b>	Repair works performed to bring the functionality of damaged elements back to their original standard, e.g. mechanical repairs of concrete defects, major reshaping/replacing of guardrails, joints, bearings etc. to the minimum level of the original standard.

### **A-3.3 Definition of bridge renewal**

<b>Renewal</b>	Includes the administrative activities necessary for planning, contracting and the execution of renewal.
<b>Strengthening</b>	Activities to increase the load carrying capability of a bridge or an element, damaged or not, relative to its original capability.
<b>Reconstruction</b>	Work to modify the function, usage or standard of a bridge or element. May include widening or increased vertical clearance, replacement of the bridge deck or the entire superstructure, attachment of walk-ways etc.

### **A-3.4 Other terms used**

<b>Carrying capability activities</b>	Activities intended to maintain or restore the carrying capability of a damaged element or structure, e.g. placing additional strengthening where the original reinforcement has been weakened by corrosion or the chiseling of concrete in statically vulnerable areas.
<b>Activities related to non-carrying capabilities</b>	Activities that do not affect the carrying capability of an element or structure, e.g. repairs of minor scaling damage caused by reinforcement corrosion
<b>Replacement</b>	In this connection it includes the construction of a new bridge to replace an existing one at an current bridge location.
<b>Operational life</b>	Functioning period for an element or a bridge. May be determined by load carrying capacity, mobility, aesthetics etc.
<b>Full replacement value</b>	Costs associated with replacing an existing bridge of similar width but designed in accordance with current specifications.
<b>Handing over</b>	The handing over of the contractor's work in accordance with the tender documents. The handing over procedure consist of an acceptance inspection prior to acceptance of the handing over agreement.
<b>Internal handing over</b>	Internal handing over from the department responsible for construction to the division in charge of the management of the bridge.

## **A-4 AREA OF APPLICATION**

Guidelines for road bridges and pedestrian bridges on national roads as well as bridges where the Roads Administration has responsibility for management.

This also applies to bridges on national roads where maintenance is carried out by municipal authorities or others.

The guidelines are recommended for use on municipal or private roads open to general traffic.

## **A-5 RESPONSIBILITIES**

### **A-5.1 General**

The Road Administration is responsible for management being performed in accordance with these guidelines. The local district is responsible for general inspection, routine maintenance and following up contractors in accordance with agreements.

### **A-5.2 Responsibility for bridge management**

The Head of the Bridge Division is responsible for all bridge related management. The position requires a civil engineering graduate with technical knowledge in assessing statics, safety and load carrying capability. Furthermore, it requires competence in planning cost efficient management activities based on inspections, measurements and materials investigations.

### **A-5.3 Authority - bridge owner**

Generally the authority responsible for the roadway also has the responsibility for the management of the bridge carrying the road. The Roads Administration thus has the responsibility for the bridges carrying national roads.-

Municipal or privately built bridges over national roads will normally be the responsibility of the municipal or private road owner. Deviations must be agreed in writing. Agreements regulating responsibilities should already have been prepared in the planning phase.

When constructing municipal and private bridges to carry new national roads, new structures affecting the existing road network or reclassifying existing roads, a written agreement must be made to determine the responsibilities for management.

For existing municipal and private bridges which lacking any special authority agreement, should such an agreement be made.

The management of bridges which are worth preserving and previously were national roads, but have since come under a different jurisdiction because of new routes, reclassification or the such like, are still the responsibility of the Roads Administration unless otherwise agreed.

When national roads are reclassified to municipal road status the responsibility for their management will be transferred to the municipality.

Railroad bridges crossing national roads are the responsibility of the national railroad authorities. For other companies agreements will be reached case by case.

## **A-5.4 Ownership of the ground below bridges**

The rights to the ground under bridges are detailed in the agreements on land acquisition already made or in the general or special preconditions on which they have been based. Assessment maps, as-built plans, survey certificates etc. will normally state property rights.

The Road Administration's rights to ground under bridges fall into the following four categories:

- The Roads Administration has full property rights
- The Roads Administration has the property rights, but neighbors or others have usufruct (right of use) or similar of the area
- The Roads Administration does not have the property right, but a right to have a bridge crossing over the area and access for inspecting and maintaining the bridge. Such cases may be covered by other clauses, e.g. restrictions on storing inflammable material, digging, fills etc. to ensure the safety of the bridges
- The Roads Administration cannot document that land has been acquired or invoke any other rights

Where there are no legal judgments or agreements, or property rights are not mentioned, an individual assessment must be made as to the need for such an agreement. The basis for such assessment could be any provisions for roadway width that applied at the time the bridge was built.

For future land acquisitions in conjunction with new bridge projects, property and jurisdictional circumstances must be evident from agreements or surveys.

## **A-6 FUNDING AND MAINTENANCE STRATEGY**

### **A-6.1 General**

National road bridge standards or service conditions must be as nearly as possible similar throughout the country. All bridge elements shall function as presupposed. They shall not have suffered damage which can reduce their function or be a risk for users, and they shall also be aesthetically attractive according to the original design.

Maintenance activities shall be performed in accordance with the standards described in the Road Administration Handbook: «Maintenance Standards». The description in the documents mentioned above is, in addition, detailed and explained more thoroughly in the Road Administration Handbook: «Inspection Handbook for Bridges».

## A-6.2 Allocations of funds

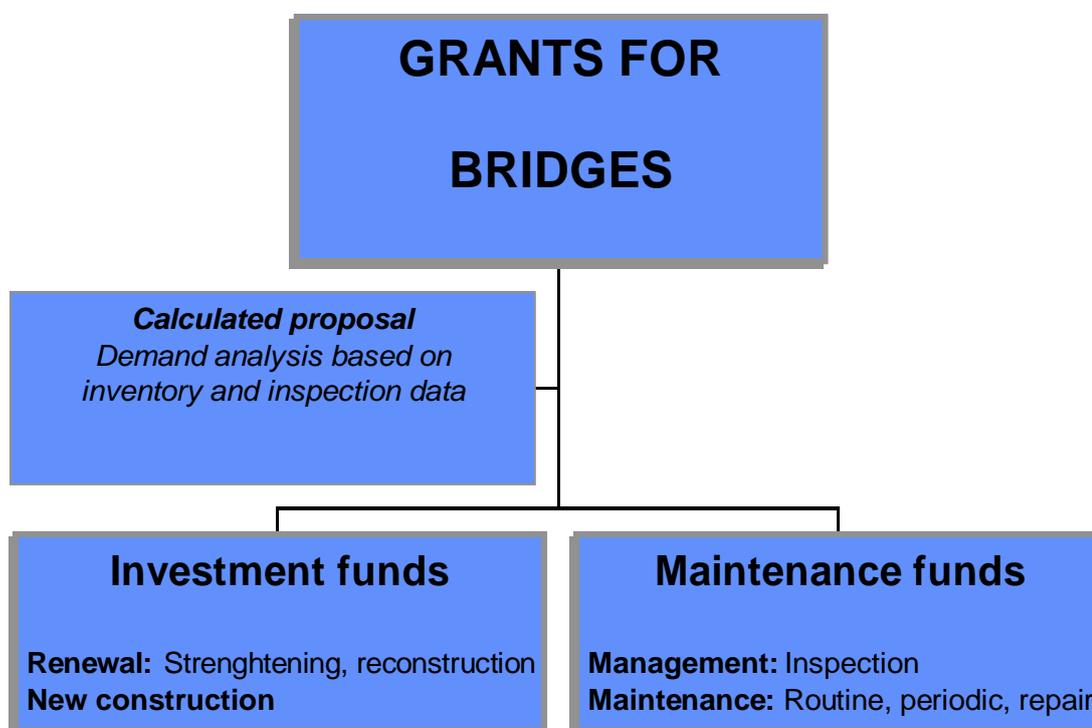
Funds for national road bridges are allocated primarily from the following two major items/sections in the national budget, also see figure 1:

- Investments
- Maintenance

The Bridge Division prepares proposals for the management and maintenance budgets, and reports the need for the renewal or reconstruction of existing bridges both in the short term (1 year) and the long term (up to 10 years). Renewal and new constructions will be considered as alternatives to maintenance activities when bridges no longer satisfy mobility and safety requirements.

Budgetary needs are presented to the departments/ministries in charge. The joint allotment is made available to the Bridge Division which reports to the department in charge.

When renewal or reconstruction is to be undertaken as an alternative to maintenance, the Bridge Division must follow-up such measures especially to ensure that planning and implementation takes place as intended.



**Figure 1: Example of the allocation of funds for bridges during their operational life.**

## A-6.3 Prioritizing

Maintenance shall be performed in accordance with the Roads Administration's regulations/handbook «Maintenance Standard», but bridges demanding the use of resources may cause delayed maintenance of other bridges. In such cases priority assessments shall be performed to determine which other bridges will be least affected by delayed maintenance.

Whenever costs for a given activity exceed the level indicated in chapter B-2.6 alternative maintenance strategies shall be investigated.

If funds are unavailable to follow an optimal strategy for the individual bridges, prioritizing shall be based on which approach will cause the least detrimental economic impact. A revised strategy could also be considered.

## **A-7 RESPONSIBLE AUTHORITY'S DUTIES**

### **A-7.1 General**

The Bridge Division is charged with the management, that is planning, execution and follow-up, of the following main tasks:

- Inspection
- Maintenance and renewal

In addition the Bridge Division has the responsibility for the following remaining management tasks:

- As project manager dealing with a client's paperwork for all bridges during the operational life
- Acceptance requirements in the handing over process
- Computer systems for bridges during the operational life
- Maintaining bridge records
- Classification by bearing capacity of bridges
- Special types of vehicular transport over bridges
- Maintenance instrumentation
- Emergency bridge
- Reporting back on experience gained from the implementation of new bridge projects
- Preparing statistics and give annual progress reports and other general information about bridges

The following elaborates more on these tasks.

### **A-7.2 Principal activities**

#### **Documents**

All regulatory documents for this professional area, such as guidelines, normative handbooks etc.

## **Inspection**

The primary requirement is that periodic inspections of all bridges must be carried out. The inspector shall evaluate if the bridge's elements have reached a condition level which would trigger repair work. He should also write a report in «LAT-BRUTUS» after each inspection.

From the time new bridges are handed over Bridge Division is in charge of inspections. This includes, among other things, planning and supervision to ensure that the bridges are inspected in accordance with chapter B-2.

An acceptance inspection should be the first inspection to be undertaken of new bridges. The construction management is in charge of this inspection, but it is to be undertaken in co-operation with the Bridge Division.

If nothing else has been agreed on the Bridge Division is responsible for the guarantee inspection being performed. This duty also includes calling a joint guarantee inspection together with those who have undertaken/have had the responsibility for the bridge when necessary and to prepare minutes from the inspection.

Bridge Division is in charge of the final inspection plan and its updating. Where needed special inspections shall be undertaken.

## **Maintenance**

The principal requirement is that the technical condition of bridges shall be ensured through planned maintenance. The Bridge Division is charged with prioritizing in accordance with stated objectives and budgets, preparing and updating maintenance plans as well as implementing, follow-ups and reporting.

## **Renewal**

With weak bridges or serious damage the Bridge Division shall assess the need for strengthening/reconstructing parts of or the entire bridge. Plans should be made in accordance with the Roads Administration Handbook «Design Requirements for Bridges» and the handbook series on bridge classification.

## **A-7.3 The handing over process**

The service life and requirements for the maintenance of bridges are very much dependent on the quality that is achieved during the construction period. The Bridge Division will participate as proxy for the contract client and act as monitor of product quality requirements. Furthermore it will ensure that calculations, drawings and other documentation are filed in the records.

The handing over process, whereby the owner of the structure takes over the work executed by the contractor, shall be undertaken in accordance with the current agreement. This is the both of new bridges or of a bridge after extensive maintenance or renewal work carried out by a contractor.

In addition to these contract terms the following shall also be carried out:

- Acceptance inspection
- Guarantee inspection

### **Acceptance inspection**

The taking over which is based on the report of the «Acceptance Inspection» of the completed structure shall be done in accordance with the Conditions of the Contract.

Minutes of the discussions from the hand over meeting are also to be drawn up. Details of the purpose, timing, scope etc. for this inspection are described in chapter B.

### **Guarantee inspection**

When the contractors have terminated their workmanship it is important that the contract documents include adequate provisions for the client to claim and receive compensation for the unsatisfactory execution of the job or other defects during the period. The time for guarantee starts immediately after the date of handing over and the limit for such claims is stated in the contract documents as 2 years. By the end of this period, a «Guarantee Inspection» must be carried out in time. Details of the purpose, timing, scope etc. of this inspection are described in chapter B.

## **A-7.4 Other management tasks**

### **General office duties**

These include general office work related to bridges in the operational life, e.g. internal and external information on bridges, approval of installations etc.

### **Responsibility for computer systems for bridges in the operational life**

The Bridge Division is in charge of data filing and updating of the bridge computer system in this operational life. The computer systems form the basis for the preparation of annual reports on bridge works completed, statistics and information on bridges.

### **Maintaining the records**

The Bridge Division is in charge of keeping the bridge records updated and of ensuring that drawings, as-built bridge plans and other documents are updated when work is undertaken.

### **Bridge classification**

Bridge classification means checking calculations for existing bridges to determine the user classification or allowable traffic load. Bridge classification is to be performed in accordance with the handbooks on bridge classification.

### **Exceptional transport on bridges**

The Bridge Division gives dispensation for special types of heavy goods vehicles exceeding the maximum permissible specifications for weight, height, length or width. In accordance with Paragraph 5.6 of the «Regulations for the Use of Vehicles» the Bridge Division can grant dispensation for such vehicles to cross bridges. The Roads Administration's own Handbook on bridge classification should be employed to determine which bridges can be used by these vehicles.

The Bridge Division shall notify affected departments about any circumstances that might lead to changes in mobility or load carrying capability.

### **Maintenance instrumentation**

The Bridge Division is responsible for the planning and following-up of instrumentation needed to monitor conditions during the operational life.

### **Emergency bridge**

The Bridge Division is responsible for emergency bridge. This includes ensuring that material is stocked and adequately maintained and that it is used for the purpose intended. Moreover, the Division should ensure that records are being kept of where the material is located and the condition it is in.

A record should also be kept of how much the bridge can tolerate and who has technical responsibility for the construction, as well as which inspection procedures should be followed.

### **Experience feedback**

The Bridge Division should ensure that experience gained from the construction period are passed on to the benefit of projects involving the designing and constructing of new bridges. The Division shall also set the requirements when planning new bridge projects.

### **Reporting**

The Bridge Division is responsible for ensuring that reports are made to other responsible departments about plans and completed tasks involving the management, maintenance and renewal of bridges. Annual reports are to be about completed bridge maintenance and renewal tasks using «LAT-BRUTUS», as well as about implementation costs from data recorded in the accounting system.

Extraordinary occurrences where bridges are threatened or damaged by floods, or from being hit etc. shall be reported immediately.

## **A-8 APPROVAL OF PLANS IN THE OPERATIONAL LIFE**

### **Inspection plan**

When bridge inspection plans are prepared according to this guideline, they are in principle considered to be approved. The Bridge Division may still request that the district offices perform additional inspections when needed.

### **Maintenance and renewal plans**

Maintenance plans that do not affect a bridge's carrying capability significantly can be approved by the district offices as long as costs are within current authorization.

Maintenance affecting the carrying capability of bridges, as well as strengthening and reconstructing shall be approved by the Bridge Division.

When reconstruction of the entire or large parts of a bridge is required, current approval procedures applying this connection reference is made to the Roads Administration Handbook «Design Rules for Bridges».

### **Installation of Utilities**

Plans for installing/hanging up cables, tubes or other bridge installations from other organizations can be approved by the district offices when the carrying capability is not affected. Otherwise the Bridge Division approves the plans. All foreign installations shall be designed in such a way as not to obstruct future inspections or maintenance.

In conjunction with the approval of plans for installing/hanging up cables or tubes, an agreement must be made regarding the preconditions for the approval, that is for the

length of the agreement period and who is responsible for dismantling at the end of the period. Moreover, who is responsible for the maintenance, finances etc. should also be agreed. See proposed agreement form detailed in Appendix 2.

The main principle for allowing such installations on bridges is that the costs of installation away from the bridge site have been documented as significantly greater. Those wishing to use the bridge for utilities installations must document this by presenting the costs for alternative solutions.

## **A-9 DOCUMENTATION REQUIREMENTS FOR BRIDGES**

### **A-9.1 General**

After the handing over of new bridges the Bridge Division shall receive documentation of the planning, design and construction of the bridges. Such documentation is to be in accordance with the «Inventory Handbook».

The following presents the documentation requirements for each of these phases.

### **A-9.2 Planning phase**

In the planning phase, that is when preparing municipal and zoning plans, bridge numbers should be selected as early as possible to ensure reliable identification of archive data, e.g. basic data, assumptions for calculations, written documents and drawings.

Bridge numbers should be in accordance with the «Inventory Handbook», which gives each bridge a unique identification number independent of the bridge name or road network which later may be changed.

A file should be prepared for each bridge. Only the preliminary project selected shall have the bridge number recorded and filed. Discontinued projects may be filed separately.

The responsible department will be charged with ensuring that these tasks are carried out.

### **A-9.3 Design and construction phase**

In the design and construction phase data relevant to future management shall be collected and processed.

Documentation should normally be in accordance with the Roads Administration Handbook «Design Rules for Bridges»; detailed documentation requirements are given in the «Inventory Handbook».

For large or complex bridges the designer/construction management shall draw up a proposed inspection and maintenance plan based on design criteria and experience/occurrences taken from the construction period. This applies to bridges or elements that require special routine or periodic maintenance.

### **A-9.4 Records**

To ensure the efficient management of bridges, complete, accessible and updated records with the necessary drawings and documentation must be available. When a bridge is completed, documentation and drawings are to be hand over. The bridge numbers must be used as a key in the archive process because this provides a reliable form of identification for the entire organization and will also be utilized in the computer system.

## **A-10 COMPUTER SYSTEMS**

### **LAT-BRUTUS**

The roads organization's management computer system for bridges, «LAT-BRUTUS», has been developed as a tool to undertake tasks described in these guidelines.

LAT-BRUTUS is to be used for planning tasks in the management of bridges and in the follow-up of these tasks. The Bridge Division has been charged with the duty of recording and filing inspection and maintenance results.

The Bridge Division is also responsible for filing data about new bridges using LAT-BRUTUS as well as updating these whenever changes are made to the bridges e.g. after reconstruction and strengthening.

### **Others**

In addition the Bridge Division can typically also be charged with the responsibility of keeping the bridge related registers of the Road Data Bank.-

## **B INSPECTION**

### **B-1 GENERAL**

To handle the responsibility for bridge management, inspections shall be undertaken routinely for all bridges. Inspection is required to assess safety levels and bridge carrying capabilities and suggest maintenance activities or renewal where necessary.

### **B-2 INSPECTION ACTIVITIES**

#### **B-2.1 Inspection related tasks**

Inspection of bridges includes the following:

- Preparation of inspection plans
- Preparation of inspection programs
- Undertaking inspections
- Recording inspection results
- Assessment of condition and description of activities
- Documentation and statistics

The following is an elaboration of these tasks.

##### **B-2.1.1 Inspection plan**

For each bridge an inspection plan shall be drawn up on the basis of the regulations set out in these guidelines. An inspection plan means an overview of which inspections, measurements and materials investigations are to be performed for each bridge, as well as the intervals and timing of these. Any inspection equipment needed shall be identified, and in addition the plan should contain special information from the planning, construction and operational life that require special follow-ups during inspections.

##### **B-2.1.2 Inspection program**

An inspection program means an overview of all inspections, measurements and materials investigations to be performed in a given year. The basis for the inspection program are the inspection plans that are prepared for the various bridges. The program should also include guarantee inspection when required.

##### **B-2.1.3 Carrying out inspections**

Inspections, measurements and materials investigations that are part of the final inspection program shall be performed before the end of the year in question at the latest. For some types of measurements, such as leveling, several measurements per year can be necessary. The measurements are then to be undertaken in accordance with the intervals specified in the inspection plan. Guarantee inspections should be completed before the claims deadline.

Inspections, measurements and materials investigations shall be undertaken and assessed in accordance with chapters B-2.2 and B-2.5. For additional details reference is made to the «Inspections Handbook for Bridges».

#### **B-2.1.4 Recording inspection results**

Systematic recording shall be made of damage uncovered and measurements and materials investigations performed. Data shall be recorded in «LAT-BRUTUS».

#### **B-2.1.5 Assessment of condition and description of maintenance measures**

Using the results from inspections, measurements and materials investigations, an assessment of the condition of the various bridge elements and the entire bridge is to be made. The assessment shall be made in accordance with chapter B-2.5.

For elements with maintenance needs, a description of their condition shall be prepared in accordance with chapter B-2.6.

#### **B-2.1.6 Documentation and statistics**

Annual statistics and overviews shall be prepared documenting objectives achieved and provide management parameters to ensure as nearly optimal bridge inspections as possible.

### **B-2.2 Inspection types**

The inspection types reflect the thoroughness and frequency of inspections. The bridge inspection cycle starts when construction is complete at which point the following inspection types shall be performed:

- Acceptance inspection
- Guarantee inspection

An acceptance inspection with associated measurements and materials investigations shall be the first inspection to be performed on the bridge. After bridges have been handed over, routine inspections shall be carried out for the rest of the bridge's service life. This involves the following inspection types:

- General inspection
- Major inspection
- Major inspection of cables
- Major inspection under water

To complement these inspections, or in the event of extraordinary occurrences there may be a need to perform:

- Special inspection

The following points give a detailed description of what is involved in these inspection types, how often they shall be performed etc.

#### **B-2.2.1 Acceptance inspection**

##### **Purpose**

Uncover any deficiencies, damage or defects to the structure which have arisen during the constructing phase, as well as identifying inappropriate design solutions and any sources of deterioration that may be of significance in conjunction with future maintenance. Act as a basis for accepting a hand over or not.

Check the quality of maintenance work and act as a basis for accepting these or not.

### **Timing**

An acceptance inspection is to be undertaken before or simultaneously with the handing over of new bridges, or after the maintenance/renewal of existing ones have been completed.

### **Scope**

Acceptance inspections should include a visual check of the entire bridge together with any supplementary measurements and materials investigations as indicated below. For new bridges major inspections under water or of cables may also be required.

### **Visual check**

For new bridges a close visual check of all bridge elements is required. How all the bridge elements function together shall be assessed as well as the bridge in its entirety.

When performing maintenance on existing bridges, checks shall be carried out to verify that work has been done in accordance with the technical description.

Visual checks shall indicate any damage, faults or deficiencies in the bridge and their causes. The location and extent of such damage, faults and deficiencies are also to be described, supplemented with sketches or photos when needed. Indications shall be given if the recorded damage, faults or deficiencies should be accepted or not.

### **Measurements**

Measurement results from acceptance inspections shall be documented. The same applies to any measurements or material investigations done during the constructing period. Indications should be given as to whether measurements are to be carried out regularly up to the time of the guarantee inspection, and also whether these should be extended. Possible measurements include:

- Leveling
- Horizontal distance/displacement
- Evenness measurements
- Sag

### **Materials investigations/checks**

Materials investigations shall be documented either by way of new investigations or investigations performed during construction. Possible investigations include:

- Locating reinforcements
- Concrete surface treatment check
- Torque check
- Steel surface treatment check

### **Inspections/maintenance plan**

Acceptance inspections should form the basis for supplementary or adjusted inspections and maintenance plans, or alternatively for the preparation of such plans in the event that they do not exist.

### **Reporting**

Acceptance inspection reports should be prepared in order to form a basis for the handing over process. These reports will follow the format as shown in the «Inspections Handbook for Bridges».

### **Access**

In order to perform an acceptance inspection, equipment must be used which facilitates access to within prescribed distances.

### **Qualification of inspectors**

Inspectors should have been educated as civil engineers and possess a good general knowledge of bridge durability characteristics and statics. They should also be certified as a bridge inspector.

## **B-2.2.2 Guarantee inspection**

### **Purpose**

To check that any work done during the construction phase or repairs following the completion inspection are acceptable, and that no new damage, faults or deficiencies have appeared on the bridge. Any new sources of deterioration of relevance for later maintenance should also be identified.

### **Timing**

Guarantee inspections shall be undertaken well before the claims deadline.

### **Scope**

The guarantee inspection should include a visual check of the entire bridge, if necessary supplemented by measurements and materials investigations as stated below. For new bridges a major inspection under water or of cables is to be undertaken where relevant.

### **Visual check**

The scope of the checks shall be the same as for a guarantee inspection (see B-2.2.1). Repairs done after the acceptance inspection shall also be especially examined.

### **Measurements**

Measurements of bridges are to be performed when so indicated during the acceptance inspection. If unforeseen deformations or settlements have occurred during the guarantee period, these shall be measured or leveled.

Any displacements of bearings and joints shall be measured and registered. Additional measurements will be undertaken as needed.

### **Materials investigations**

Performed as needed.

### **Reporting**

A guarantee inspection report must be prepared and should be organized in a similarly to a completion inspection report.

### **Access**

As with acceptance inspection.

### **Qualification of inspector**

As with acceptance inspection.

## **B-2.2.3 General inspection**

### **Purpose**

Checking for damage that can affect the load carrying capability of structures, traffic safety, future maintenance or adversely affect the environment/aesthetics.

Minimum requirements are that damage assessed as requiring repairs by the next inspection shall be recorded, that is Damage Degree 3 or 4.

### **Intervals**

The normal requirement is that general inspections are performed **each year**, and that the first inspection happens during the year after the hand over. General inspections may be dropped in the year of a major inspection.

### **Scope**

General inspections have to include a simple visual check. No measurements, materials investigations or use of inspection equipment are required. Exposed details or locations should be specially checked.

### **Visual check**

A visual check is to be made of the bridge superstructure and substructure above water level together with parts that can be observed from below water. The inspection check can be performed from a distance using binoculars, if needed, to study details.

Checks are to be made to ensure that maintenance has been carried out as intended and that no damage has occurred that might affect load carrying capability or safety. This includes checking the cleaning of structures, joints, bearings, bearing supports etc. Moreover, checks should ensure that water flow is unrestricted and that wearing courses, joints, guardrails etc. comply with maintenance standards.

Signs of overloading, settlement, deformation, erosion, collision damage etc. as well as other major faults or deficiencies in the structure should be checked for. In cases of serious damage the Bridge Division must be notified immediately.

## Reporting

Reports of general inspections should include a description of any damage recorded as well as an assessment of this in relationship to the «Inspections Handbook for Bridges».

## Qualification of inspectors

It is a requirement that inspectors have a general knowledge of bridges. For complicated bridges such as suspension bridges, cable-stayed bridges, movable bridges, the inspector should have been educated as a civil engineering or possess similar skills.

## B-2.2.4 Major inspection

### Purpose

Ensuring that the condition of the entire bridge is functional; determining any need for maintenance activities, and making cost estimates for these activities.

### Intervals

A major inspection is generally required every **fifth year** for bridges. The first major inspection shall be performed at the required interval after the end of the claims deadline.

### Changes in intervals

If a bridge has suffered damage whose potential for development remains unknown, then far more frequent than normal inspections should be considered. These intervals must be determined for each case and adapted for the bridge in question. Some significant conditions to consider include:

- Traffic volumes
- Proportion of heavy traffic
- Bridge type and size
- Significance of the road network
- Low load carrying capability
- Condition and damage development that might lead to too low capacity
- Bridges exposed to flooding or erosion

Checking machinery etc. on movable bridges should normally be made simultaneously with routine servicing. Intervals for these are determined individually in each case.

### Scope

Major inspections will include a visual check of the entire bridge structure.

For major inspections of suspension cables and cable-stayed bridges reference is made to chapter B-2.2.5. For major inspections of foundations under water reference is made to chapter B-2.2.6.

Major inspections can be supplemented with by measurements and materials investigations as necessary to assess the bridge's condition.

### **Visual check**

The inspection is to be of the close visual type, which means that the inspector can touch the structure. This requirement may be deviated from when one can discern anticipated damage from a distance with certainty. This can be the case for uniform steel and concrete surfaces. In such cases critical/representative areas shall be selected for close visual control, while the remaining areas may be checked from an appropriate distance.

A close visual check shall always be made of exposed elements such as bearings, hinges etc.

### **Measurements**

For bridges affected by settlement, displacement, deformation or when such are suspected to have occurred, measurements shall be performed to determine the extent of any movement.

If a measurement program proves to be necessary, this must be described and included in the inspection plan. Tracking measurements should be taken and possibly checked if the remaining wearing course thickness is greater than that allowed for.

### **Materials investigations**

The extent of materials investigations will be assessed relative to climatic exposure and previous checks, and may possibly be dropped. Such investigations shall be considered random.

### **Inspection and maintenance plan**

A major inspection will form basis for supplementing or adjusting the inspection and/or maintenance plans. It may be necessary to prepare such plans when none exist.

### **Reporting**

Reports of major inspections shall include a comprehensive description of all damage registered, photo documentation, and an assessment of these in accordance with the «Inspections Handbook for Bridges».

In the case of large bridges an expanded report may be required describing the maintenance, costs and timing of special inspections already performed. Alternative strategies should be assessed in the event of high maintenance costs. These shall include the impact of utilizing the remaining service life only.

Where a major inspection uncovers the need for extensive maintenance or proves to be insufficient in determining the type of damage, impact, and their extent or cause, a special inspection shall be undertaken. Indications shall be given as to which inspection/materials investigation is to be performed and to their scope and location.

### **Access**

To perform a major inspection requires equipment that makes it possible to come within the prescribed distance.

### **Qualification of inspector**

The inspectors should have been educated as a civil engineer and possess a good general knowledge of bridge durability characteristics and statics. In addition they should be certified as a bridge inspectors.

## **B-2.2.5 Major inspection of cables**

### **Purpose**

Undertake a check of the condition of cables, hangers with connections and anchoring to verify their functionality. Determine any maintenance needs and make cost estimates for these activities.

### **Intervals**

Major cable inspections shall be performed **every fifth year**.

### **Changes in inspection intervals**

Cables with uncertain damage development should be considered inspected more often than the general five year interval. Intervals must be determined in each case adapted to the bridge in question. Important considerations include:

- Traffic volumes
- Proportion of heavy traffic
- Bridge type and size
- Significance for the road network
- Low load carrying capability
- State and development of damage leading to reduced capacity

### **Scope**

Major inspections of cables shall include a visual check of cables, hangers with connections and anchoring. The inspection shall be supplemented by measurements and materials investigations where necessary to assess the condition of these elements.

### **Visual check**

A close visual check shall be carried out for all relevant elements. Close visual check means that the inspector should be able to touch the elements. This requirement may be deviated from in special cases if anticipated damage can be discerned from a distance. This may be the case for free lengths of cables or hangers. In such cases representative areas shall be selected for close visual checking, while remaining areas may be examined from a distance.

### **Measurements**

Where hanger slippage has been observed or suspected, measurements of the slippage or of the relative sag should be taken.

If there appears to be a need to execute a measurement program this must be described and included in the inspection plan.

### **Materials investigations**

The need for materials investigations will be assessed in each individual case. The investigation shall be based on random checks .

### **Inspections and maintenance plan**

Reference is made to chapter B-2.2.4 Major Inspection.

### **Reporting**

Reference is made to chapter B-2.2.4 Major Inspection.

### **Access**

Reference is made to chapter B-2.2.4 Major Inspection.

### **Qualification of inspectors**

The inspector should have been educated as a civil engineer, possess a good general knowledge of bridge durability characteristics and statics and be certified as a bridge inspector.

## **B-2.2.6 Major inspection under water**

### **Purpose**

To check the condition of any foundations under water and that of the bottom to ensure that they are functional. Determine the need for maintenance activities and make cost estimates for these.

### **Intervals**

The general requirement is that major inspections under water shall be carried out **every fifth year**.

### **Changes in inspection intervals**

Foundations exposed to erosion or undermining should be considered for inspection more often than is generally required. The timing must be determined in each case, adapted to the structure in question.

In special cases, extended intervals for major under water inspections may be accepted. This applies to foundations bedded in rock, or where there is no risk of erosion and under-mining. The precondition for this is that the Bridge Division considers it to be safe.

An under water inspection of such foundations will be undertaken during the completion inspection, guarantee inspection and the initial major inspection. This does not apply to foundations where unrepaired damage has been observed.

### **Scope**

Major under water inspections shall include a visual check of foundations and the bottom.

The inspection shall be supplemented by measurements and materials investigations to the extent required to assess the condition of the foundations.

### **Visual checks**

A close visual check shall be made of all relevant elements. Close visual checking means that the inspector shall be able to touch the structure.

To be able to perform the inspection any remaining formwork and growth must be removed. Special checks should all be made for erosion around the foundations.

### **Measurements**

The need for probing the bottom to check for any ongoing erosion shall be assessed. Should the need for a measurement program be proven, this must be described and included in the inspection plan.

### **Materials investigation**

The need for a materials investigation shall be assessed based on the anticipated strain on the foundation and the extent of any previous investigations. Such an investigation shall be considered a random check .

### **Inspection and maintenance plan**

Reference is made to chapter B-2.2.4 Major Inspection

### **Reporting**

Reference is made to chapter B-2.2.4 Major Inspection

### **Access**

Reference is made to chapter B-2.2.4 Major Inspection

### **Qualification of inspector**

Diver must have been educated as a civil engineer and possess a certificate for bridge inspections and have experience of checking foundations under water.

## **B-2.2.7 Special inspection**

### **Purpose**

Investigate closer any damage, movement and/or deterioration observed during previous inspections or from notes made. Describe any costly and/or complicated activities which might be anticipated.

### **Intervals**

Special inspections may be considered in the following situations:

- Previous major inspections have proven the need
- Accidents such as a collision

- Overloading
- Flood or flooding
- When experience with similar types of bridges and environment so indicates

### **Scope**

A special inspection is normally undertaken of particularly exposed or damaged elements, but may also encompass the entire bridge.

It may include a visual check, measurements or materials investigations or a combination of these.

### **Visual check**

A visual inspection shall at least be as thorough as a major inspection.

### **Measurements**

The type and scope of measurements shall be as indicated for previous inspections; nevertheless this shall be assessed throughout by the inspector as to whether the scope may be reduced or expanded. In the absence of any previous inspections that might have initiated the special inspection, the need will be assessed by the inspector before and during the inspection.

### **Materials investigations**

Materials investigations shall be performed to the extent described in previous inspections, but shall nevertheless be assessed throughout by the inspector as to whether it should be reduced or expanded. In the absence of previous inspections that might have initiated the special inspection, the need will be assessed by the inspector before and during the inspection. Check of rivets and bolts can be part of this investigation.

### **Reporting**

After special inspections there will often be a need for comprehensive reporting. Reports may contain the following points:

- Damage data
- Test results
- Damage assessment
- Statics calculations
- Suggested repairs
- Repair costs
- Present worth analysis
- Service life analysis

When using external inspectors, agreement shall be made on which of the above points are to be included.

Damage assessment shall be performed in the same manner as for the major inspection.

It is important that the report is given a structure and content that forms a reliable basis for prioritizing and evaluating proposed repairs.

Additional details are given in the «Inspections Handbook for Bridges» on how special inspections shall be reported.

### **Access**

Reference is made to chapter B-2.2.4 Major Inspection.

### **Qualifications for inspectors**

An inspector shall have been educated as a civil engineer, possess a certificate for inspecting bridges and have a good general knowledge of bridge or materials technology, damage assessment etc.

An expert with special skills must be brought in where necessary. This applies both to materials technology, statics and geotechnology.

## **B-2.3 Access equipment**

Inspection equipment is that which is needed to get to the bridges to perform inspections, measurements and materials investigations. Such equipment may include:

- Ladders
- Scaffolding
- Boat
- Raft
- Bridge lift

The need for such equipment will vary with inspection and bridge type. For each bridge the type of inspection equipment required for the various inspections should be registered. No inspection equipment is required for general inspections.

## **B-2.4 Measurements and materials investigations**

Measurements and materials investigations shall be performed in accordance with the «Inspections Handbook for Bridges».

### **B-2.4.1 Measurements**

Inspections can be supplemented by measurements to the extent necessary to determine the bridge's condition. Which measurements should be performed depends on inspection type, bridge type, location and visual observations. The following measurements should be considered:

- Leveling
- Horizontal distance/displacement
- Wearing course thickness
- Tracking
- Evenness measurements
- Sag

For each bridge the measurements to be performed together with the various inspections shall be registered.

For some bridges special measurement routines shall be executed in accordance with the established inspection plan.

### **B-2.4.2 Materials investigations**

The inspections can be supplemented by a materials investigation to the extent necessary to assess the bridge's condition. Which materials investigations to consider depends on the inspection type, bridge type, location and visual observations.

Materials investigations may be performed on:

- Concrete
- Steel
- Stone
- Wood

In addition, a surface treatment check may be performed on concrete, steel etc.

Which materials investigation shall be undertaken for each bridge should be registered.

For some bridges special routines for materials investigations may be executed. These will be performed in accordance with the established inspection plan.

## **B-2.5 Assessment of damage and conditions**

When inspecting bridges, a description of the damage/deficiencies observed in the various elements shall be prepared. An assessment shall be made on how the damage/deficiency could affect each element, the bridge, bridge users and/or the environment indicating the level and impact of the damage.

### **B-2.5.1 Damage assessment**

The description of the damage/deficiency observed should be made verbally. To obtain as uniform a description as possible standard 'Types of Damage' are to be used to indicate what kind of damage has been found. Reference is made to the «Inspections Handbook for Bridges».

The location of the damage/deficiencies to the bridge and/or element should also be recorded. Damage/deficiencies may be documented using sketches and/or photos. This should normally be done in connection with typical serious damage or deficiencies.

### **B-2.5.2 Degree of damage**

The degree of damage is measured on a numbered scale used to give a technical assessment of the magnitude of the damage/deficiency; that is, whether maintenance activities must be employed or not and if so, how soon. The degree of damage must be viewed in conjunction with basic cause.

The following code shall be used to indicate the degree of damage:

- 1 Slight damage/deficiency, no action required
- 2 Medium damage/deficiency, action needed during next 4 -10 years
- 3 Serious damage/deficiency, action during the next 1-3 years
- 4 Critical damage/deficiency, immediate action required or within ½ year at the latest
- 9 Not inspected

Budgetary concerns shall not be taken into account in the assessment of the degree of damage. That must be handled later in conjunction when prioritizing between bridges.

The degree of damage shall also be used in connection with acceptance and guarantee inspections. However, an assessment must be made at a later time on what damage/deficiencies are the liability of the constructor and within which time frame these shall be rectified.

### **B-2.5.3 Consequences of any damage**

The impact of damage is represented by a letter code used to indicate the consequences any damage/deficiency might have for the bridge, the bridge users and/or the environment.

The following codes shall be used to indicate the consequences of the damage:

- B Damage/deficiency threatening load carrying capability
- T Damage/deficiency threatening traffic safety
- V Damage/deficiency that may increase maintenance costs

M Damage/deficiency that may affect the environment/aesthetics

#### **B-2.5.4 Correlating degree and consequence of damage**

The results of measurements and materials investigations shall, along with inspections, form the basis for establishing the degree of damage and the consequences of the damage.

The codes for the degree of damage and the consequence of damage shall be used together when damage is to be assessed. An example of this could be as follows:

**3B** Serious damage/deficiency that can reduce the bridge carrying capability if it remains untouched for more than 1-3 years. Action required within 1-3 years.

#### **B-2.5.5 Cause of damage**

For a general inspection there is no requirement to indicate the cause of the damage.

For major inspections and special inspections the cause(s) of the damage should be uncovered as far as possible. This may be of major significance in order not only to determine the proper action but also to document experience for use in conjunction with new bridges and in the revision of handbooks. In addition to a verbal description of the cause of the damage, it should also be coded in accordance with the damage code given in the «Inspections Handbook for Bridges».

#### **B-2.5.6 Activating condition**

The term activating condition means that a structure or an element has suffered damage or developed faults or deficiencies that require maintenance action. This condition or standard is described for each damage type in the «Inspections Handbook for Bridges».

When inspecting bridges, the activating condition must be determined, that is what can be accepted and what will require action. This shall be indicated using the degree of damage in the following manner:

**Degree of damage 1:** Condition may be accepted without action.  
**Degree of damage 2- 4:** Condition will require short or long-term action (up to 10 years).

### **B-2.6 Description of action to be taken**

The inspections shall form the basis for a description of any maintenance action, and the timing and costs of implementing these. The maintenance activities shall be undertaken at an economically optimal time. The description of such activities should as far as possible be prepared during the inspection.

#### **B-2.6.1 General inspection**

For a general inspection a description should be prepared of the actions to be performed by next inspection, ref. requirement of extent of damage.

#### **B-2.6.2 Other inspections**

Based on the damage description and the condition assessment, proposals for repairing damage of Degree of Damage levels 2, 3 or 4, shall be prepared from work

descriptions/process codes. Cost estimates are to be prepared for the proposed action, and an indication should be given which year these activities shall/should be performed in so as to ensure that the specified standard is maintained. Reference to this is made in the «Inspections Handbook for Bridges».

### **B-2.6.3 Alternative strategies**

When the cost of necessary repair activities following from a major inspection or special inspection exceeds 20% of a bridge's replacement value, alternative strategies should be investigated.

At least two different strategies will be investigated depending on what is relevant. In addition to maintenance costs they should also include road user costs and any costs to society if affected by the various strategies.

The following strategies may be considered:

1. Temporary action : Minor repair activity carried out during one period to postpone major work or replacement of a bridge.
2. Major action : Extensive repair work during a brief period to significantly extend the remaining service life of the bridge.
3. New element/bridge: No repair work undertaken; however, the existing element/bridge is replaced at the end of its service life.

For each strategy different technical solutions may be considered.

When maintenance costs exceed 50% of replacement value, strategy 3 must be considered. Special consideration should also be given to the elements.

The present worth of the selected strategies shall be estimated and these will form the basis for selecting an optimal strategy. Factors that normally do not enter into cost estimates shall also be included before the final selection of a strategy.

Such factors may include :

- Bridge age, remaining service life
- Carrying capability
- Bridge width/road curvature
- Vertical clearance
- Traffic safety
- Mobility
- Future usage
- Aesthetics
- Historic value

If funds are not allocated to carry out the optimal strategy, prioritizing between the various bridges will have to be undertaken.

## **C MAINTENANCE**

### **C-1 GENERAL**

The objective of bridge maintenance is that it shall retain the intended level of safety and standard throughout its operational life.

Maintenance shall be performed at such times so that costs are kept at their lowest possible at the same time as carrying capability is retained and users provided with the necessary safety and mobility. Moreover, it is necessary to ensure that bridges do not adversely affect the environment.

### **C-2 MAINTENANCE RELATED TASKS**

Bridge maintenance includes the following tasks:

- Preparing a maintenance plan
- Preparing a maintenance program
- Undertaking maintenance
- Checking of maintenance carried out
- Reporting on maintenance carried out
- Documentation and statistics

#### **C-2.1 Preparing a maintenance plan**

The objective of a maintenance plan is to simplify planning and undertake the correct action at the right time and at optimal costs.

To attain this, the maintenance plan must include information on which activities are to be undertaken and when, namely :

- Which activities together with quantities are to be undertaken (work description/process codes)
- Where shall the activity be carried out (bridge elements and axis)
- What materials/methods will be used
- When will the activity be carried out
- Cost of implementing the activity

Maintenance plans may in addition be based on experience/occurrences from the planning, construction and operational life.

A maintenance plan must be prepared for all new and existing bridges on national roads and for other bridges that are the responsibility of the Roads Administration. The maintenance plan should be updated during the operational life.

For large and/or special bridges a proposed maintenance plan will normally be prepared during the design/construction phase.

The maintenance plan forms the basis for producing work orders and for seeking tenders.

Some maintenance activities require to be performed at regular intervals, but the intervals may vary depending on the local environment. An inspection shall, whenever necessary, adjust the timing and scope of these activities in the maintenance plan.

The maintenance standard forms the basis for assessing this maintenance.

Other activities might be considered only once or just a few times throughout the operational life. These are added to the maintenance plan as single activities.

## **C-2.2 Preparing a maintenance program**

An annual maintenance program shall be prepared listing those bridges to undergo maintenance that particular year. The activities included in the program must not exceed the funds allocated.

Where the funds allocated do not cover needs, prioritizing must be undertaken to provide resources for those bridges most in need of repair.

## **C-2.3 Undertaking maintenance**

The basis for undertaking maintenance in accordance with the maintenance program shall be the work schedules prepared, based on the maintenance plan and/or inspection reports. A work schedule means a detailed description of the work to be performed, using process codes and quantities, where the work shall be performed, indicated by elements and axis, what products and equipment shall be utilized.

## **C-2.4 Maintenance checks**

Maintenance performed in accordance with the work schedule and materials used shall be checked in accordance with the specifications.

The handing over of work performed by a contractor will be executed in accordance with current regulations.

## **C-2.5 Maintenance reports**

When performing maintenance two types of report shall be produced :

- Financial reports
- Technical reports

### **Financial reports**

Include the continuous updating of data for maintenance costs incurred. Hours, materials and equipment used should also be recorded for each individual bridge or group of bridges.

### **Technical reports**

Include reporting on the type of work undertaken, the date and possibly also its quality.

In practice this means that all deviations from the work schedule shall be recorded together with the reason given for the deviation.

## **C-2.6 Documentation and statistics**

Each year an overview together with statistics shall be prepared for all maintenance performed on bridges showing how this compares with the objectives that apply at any given time. These objectives may be defined annually or by period, road plan or similar.

An overview together with statistics shall be prepared for at least the following :

- Annual costs for maintenance undertaken
- Maintenance performed compared to plan
- Planned maintenance costs for the next ten years.

## **C-3 MAINTENANCE TYPES**

Bridge maintenance in these guidelines means:

- Routine maintenance
- Periodic maintenance
- Rehabilitation

### **C-3.1 Routine maintenance**

#### **Purpose**

Attempt to provide the same traffic safety and mobility as offered on the adjoining road network and maintain a favorable visual environment. Ensure that the bridge functions as intended, that is, ensure that it is open and passable by all road users at all times under all weather conditions.

#### **Timing**

Action undertaken in accordance with the intervals given in the maintenance plan, or proposed as a result of inspections or from notes made of any damage.

#### **Scope**

Routine maintenance includes work such as:

- Cleaning of the various bridge elements. Cleaning of the roadway is considered to be part of the general maintenance activities to be undertaken
- Clearing/removal over and under water and ground work after erosion, undermining etc.
- Repairing damaged structure details and equipment
- Daily operational tasks on movable bridges
- Operation of buildings belonging to bridges
- Checking/servicing of machinery and other equipment

### **Special requirements**

Routines should be established for the general maintenance of all bridges e.g. cleaning up exposed structure elements and details such as edge beams, bearings, joints, drainage systems and bridge parapets together with clearing river courses when their capacity has been reduced. Such tasks must be carried out before any consequential losses occur after the relevant requirements had been stated in the inspection report or notification of damage.

After mishaps or accidents temporary securing of the damaged element must be carried out if maintenance cannot be performed immediately.

The joint threshold must be adjusted such that the joint is not higher than 5 mm over the wearing course during the winter and all unfastened joint parts must undergo a safety check/repair work.

Damage to a parapet which presents a risk to users shall be repaired immediately, while bends greater than 100 mm have to be repaired within 1 month.

The distance between the lowest section of a rut on an asphalt wearing course and a waterproof membrane, must never be less than 15 mm. If this is not the case, the waterproof membrane can become damaged.

Unfixed concrete or others parts which can threaten traffic safety, particularly on a flyover, have to be secured or removed immediately.

### **Qualifications of those who carrying out the work**

The general requirement for those performing routine maintenance is that they have practical experience of similar work. Moreover, the contractor must be able to document that he has an acceptable quality control system and possesses a certificate of road maintenance.

## **C-3.2 Periodic maintenance**

### **Purpose**

Preventing damage that can affect mobility or carrying capability, traffic safety, environment and service life. Repair/maintenance activities shall be carried out at such times that will result in the lowest possible costs.

### **Timing**

The various maintenance activities shall be performed at the time stated in the maintenance plan or after recommendations given in a major inspection or special inspection report and which result in the least inconvenience to road users/traffic operation.

### **Scope**

Periodic maintenance includes work such as:

- Surface treatment of steel
- Surface treatment of concrete
- Surface treatment of wood
- Wearing course and membrane work

### **Special requirements**

Routines shall be established for the prevention of damage to e.g. surface treatment of steel, concrete, wood or to waterproof membranes on the bridge deck. These routines should be carried out at an optimal point and at optimal cost.

#### **Qualification of the contractor**

The general requirement is that the contractor has previous experience of similar work. Moreover, the contractor shall document that he has an acceptable quality control system and possesses a certificate of bridge maintenance.

### **C-3.3 Rehabilitation**

#### **Purpose**

Restore the functionality of a damaged element without completely replacing it and without mobility, traffic safety or service life being reduced as a consequence.

#### **Timing**

The timing of repairs is determined at a major inspection, special inspection or after notification of the damage or mishap.

#### **Scope**

Includes work such as:

- Repairing damage to foundations and concrete over/under water
- Repairing damage to substructures and superstructures made of steel, stone, wood or any other material
- Replacing of damage to structure details

#### **Special requirements**

Detailed plans shall be prepared for the rehabilitation work to be undertaken.

#### **Qualifications of the contractor:**

There is a general requirement that the contractor has prior experience of similar work. Moreover, the contractor shall be able to document that he operates an acceptable quality control system and possesses a certificate of bridge maintenance.



## **D RENEWAL**

### **D-1 TYPES OF RENEWAL**

In these guidelines renewal of bridges means:

- Strengthening
- Reconstruction

#### **D-1.1 Strengthening**

##### **Purpose**

Increase carrying capability of one or more elements or of the entire bridge, whether damaged or not, compared to the initial carrying capability in order to improve traffic flow.

##### **Timing**

Strengthening is performed when axle loads have increased, increasing traffic volumes suggest a need for this or deficiencies have been uncovered , e.g. design errors.

##### **Scope**

The scope of any strengthening will be based on the results of a major or special inspection and on the damage classification which should state which elements are to be reinforced and how this is going to be done.

##### **Special requirements**

Detailed plans shall be prepared and accepted in order for the strengthening to be undertaken.

##### **Qualifications of the contractor**

There is a general requirement that the contractor has previous experience of similar work. Moreover, the contractor must be able to document that he operates an acceptable quality control system and possesses a certificate in bridge construction.

#### **D-1.2 Reconstruction**

##### **Purpose**

The objective of reconstructing a bridge or a bridge element is to improve traffic flow and/or traffic safety. It can also be an alternative to undertaking maintenance activities after serious damage has been sustained.

### **Timing**

The timing will be decided according to needs.

### **Scope**

Reconstruction includes work such as:

- Widening
- Attaching a pedestrian walk-way
- Increasing vertical clearance
- Replacing bridge deck
- Replacing the entire superstructure
- Replacing or reconstructing the substructure

### **Special requirements**

Detailed plans shall be prepared and accepted in order for the reconstruction to be undertaken.

### **Qualifications of the contractor**

There is a general requirement that the contractor has previous experience of similar work. Moreover, documentation should be available showing that the contractor operates an acceptable quality control system and possesses a certificate in bridge construction.

## **APPENDIX 1**

**EXCERPTS FROM «INSTRUCTIONS FOR THE DIRECTORATE OF PUBLIC  
ROADS AND THE COUNTY ROADS OFFICES' REGIONAL ADMINISTRATION»**



«INSTRUCTIONS FOR THE NORWEGIAN DIRECTORATE OF PUBLIC ROADS'  
AND THE COUNTY ROADS OFFICES' REGIONAL ADMINISTRATION»

«Instructions for the Directorate of Public Roads' and the County Roads Offices' Regional Administration» state which tasks the Directorate of Public Roads shall undertake and what authority they have.

«The Instructions» were established by the Ministry of Communications on 22. January 1996 in accordance with an Act of 21. June 1963 (the Roads Act), § 9, an Act of 18. June 1965 (the Roads Traffic Act), § 40, with the authority of royal assent on 15. December 1972.

«The Instructions» state the following:

As the central authority for the Public Roads Administration, the Directorate of Public Roads shall amongst other things:

- a) Explore, prepare and propose guidelines for the development, maintenance and use of the public roads network, including ferry connections.
- b) Explore the needs for roads and investigate, prepare and propose plans and budgets for the national road network for a period of several years.
- c) Approve plans and otherwise supervise planning, development and management of the national road network.

The public roads regional administration shall amongst other things:

- a) Undertake the planning, development, maintenance and management of the national and county road network, including ferry connections, as well as work on traffic and transportation user aspects of the road network.
- b) Prepare proposed plans and budgets for national and county roads for a period of several years and prepare these for subsequent processing within the county.
- c) Promote proposals to the Directorate of Public Roads on cases assigned to the directorate in its capacity as central authority for national roads.



## **APPENDIX 2**

**PROPOSED AGREEMENT ON**

**THE INSTALLATION OF UTILITIES**



## AGREEMENT ON THE INSTALLATION OF UTILITIES

Bridge no.: \_\_\_\_\_ Bridge name: \_\_\_\_\_

Bridge cat.: \_\_\_\_\_ Road no.: \_\_\_\_\_

Bridge type: \_\_\_\_\_

### DESCRIPTION OF UTILITIES INSTALLATION

- El. cable                       Water pipeline                       Tel. cable  
 High tension cable                       Outlet pipe                       Other: .....

Responsible department: \_\_\_\_\_

Maintained by: \_\_\_\_\_

Time period:                      From \_\_\_\_\_ To \_\_\_\_\_

Location: \_\_\_\_\_

\_\_\_\_\_

Weight: \_\_\_\_\_

### CONSEQUENCES FOR THE BRIDGE

Affecting bridge carrying capability:                       No                       Yes

Needing approval from the Directorate:                       No                       Yes

If yes, approved by Directorate's letter: \_\_\_\_\_ (letter enclosed)

### CONDITIONS FOR ATTACHING UTILITY INSTALLATIONS

Date \_\_\_\_\_

\_\_\_\_\_  
Roads Administration

Date \_\_\_\_\_

\_\_\_\_\_  
Responsible for the  
Utilities installation