CMGP Manuals No. 04: LRBICS

Local Road and Bridge Inventory and Condition Survey (LRBICS) Manual

For the collection of GIS data on local roads and bridges

Department of the Interior and Local Government

2020

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DEFINITION OF TERMS

A

Abutment - End support of the superstructure of bridges and usually have the additional functions of retaining earth fill for the bridge approaches
Approach Embankment-the earth work or earth fill that forms a transition road up to the bridge abutment
Approach Road – the road near abutting the bridge

B

Barrel – the main part of an arch/culverts which supports fill and roadway
Beam – a narrow structural member such as girders, stringers, floor beams, cross beams (diaphragms), edge beams, etc.
Bed (River Bed) – the bottom of the river
Boom – the upper (top chord) and lower (bottom chord) longitudinal members extending the full length of a truss
Box Girder– a hollow beam with box shape

B

Camber – the slight convexity (curve) required for construction of bridges, provided to compensate for the dead load deflection
Caissons – type of masonry or concrete foundations, built like a tube
Cantilever – a beam, fixed at one end and free to move at the other
Chainage- a point in the road represented in meters or by LRP + displacement Corrosion – defect done to steel (or other metal) by air, water, salts, etc.
Corrugated Steel – thin sheet of steel which have been shaped to make strong
Concrete Cover – the thickness measured from the surface of the concrete to the face of the nearest reinforcing bar.
Cracking (in Concrete) - a linear fracture in concrete that extends partly or completely through the member.
Cracking (in Steel) - a linear fracture in the steel that are mainly produced due to fatigue and can, under certain conditions, lead to brittle fracture.

D

Debris – rubbish and other unwanted things
Deck Slab – top of bridge superstructure

Deformation - permanent deformation of steel members can take the form of bending, buckling, twisting or elongation, or any combination of these.
Distress- defects in the road
Downstream – where the river flows away from a bridge
Drainage – system for taking away water (usually rainwater)

E
Embankment – soil bank which supports the roadway pavement
Erosion – removal of earth by the action of wind, rain or flowing water

F
Fill – soil placed in front of the abutment.
Flexible Pavement- road with asphalt or bituminous surfacing
Foundations – the lowest part of the bridge which sits or in the ground

G
Gabion – wire basket filled with stones
Galvanizing – a thin layer of zinc on steel to protect it against corrosion
Girder – a beam usually made of steel and reinforced concrete
Gauging Length- length of 50 meters usually from the start of the segment to represent the percent of defects for the whole segment

H
Headwall – a wall at the end of a culvert to hold the soil fill above the culvert pipe
Honeycombing – badly made concrete with lots of holes
Landslide – soil and rocks slipping down a mountain or hill
Loose connections - Loose tightening or missing in bolted or riveted connections
LRBICS Team - Staff from the Planning and Maintenance Divisions of the LGU Engineering office
M
Masonry – bricks or stones set together with mortar. Mass Concrete – concrete without any steel in it Moisture – some water or dampness

O
Overloaded – carrying too much weight

P

Panel – a flat frame or plate.
Parapet – a wall or rail along the edge of bridge.
Pier – a support between abutments for bridges with more than one span.
Pile – a long, thin, foundation driven deep into the ground; bored pile - a cast-in-place pile
Piled Walls – walls made of long pieces of material driven into the ground.
Prestressed – a way of making concrete stronger with prestressing steel bars or cables

R

Rater - person gathering/collecting survey data in the field Rebar – steel bars in reinforced concrete, to make it stronger Retaining Wall – a wall to hold back soil
Rigid Pavement - road with concrete wearing surface
Riprap – layer of loose rocks to protect the river bank from scour.
ROCOND Survey – survey done annually by the LGU to determine the actual condition of the road during the prescribe period of time.

S

Safety Pins – the small clips on a bailey bridge, that stop the panel pins from falling out
Scaling - the local flaking or loss of the surface portion of concrete or mortar
Scour – erosion of the river bed or bank caused by the flow of the river
Segment - portion of the section to be rated usually from kilometer post to the succeeding kilometer post with homogenous surface type
Services – cables and pipes for service facilities and utilities such as water, electricity and telecommunication belonging to other authorities
Settlement – small movement downwards of a structure
Severity - gravity of the defects
Sheet Piled Wall - a wall made from steel panels, concrete piles or timber bored hammered into the ground to form a wall
Shrinkage (in Timber) - Shrinkage happens when the timber dries up below its fiber saturation point
Slab – a large piece of concrete (For example a bridge deck)
Spall – to break off in a piece
Spalling – an area where concrete has broken away; e.g. due to

corrosion of reinforcing steel bars
Span – the part of a bridge, or the distance, between the supports; span length refers to the length of a bridge
Splitting - Splitting happens when the interior member remains above the fiber saturation point while the outer layers shrink
Spread Foundations – wide base to a pier or abutment, usually made of reinforced concrete
Substructure – all parts of a bridge below the bridge seats, or below the springing line of arches, and including abutments, piers, wingwalls and bents below the level of the top of cap
Superstructure – all of the deck, including parapets, trusses, beams and running surface
SurveyForms - forms use in the actual ROCOND Survey data collection

T
Truss Bridge – a bridge consisting of truss spans

U
Upstream – the direction where the water is coming from
Unsealed Pavement - unpaved road either with gravel or earth surfacing

W
Weephole – a hole to allow water to come through
Wingwalls– walls which are at the side of the abutments and part of it

GLOSSARY

ADB	Asian Development Bank
AIP	Annual Investment Program
CDP	Comprehensive Development Plan
CEO	City Engineering Office
CLUP	Comprehensive Land Use Plan
CO	Central Office
CW	Carriageway Width
DILG	Department of Interior and Local Government
DPWH	Department of Public Works and Highways
GIS	Geographic Information System
GPS	Global Positioning System
HDM 4	Highway Development Management version 4
HPM	Highway Planning Manual
IRI	International Roughness Index
KM	Kilometer (Station) Post
LGU	Local Government Unit
LRBICS	Local Road and Bridge Inventory and Condition Survey
LRM	Local Road Management
LRP	Locational Referencing Point
LRS	Locational Referencing System
M	Meter (length)
MD	Maintenance Division
MEO	Municipal Engineering Office
PDD	Planning and Design Division
PDPFP	Provincial Development and Physical Framework Plan
PEO	Provincial Engineering Office
PPDO	Provincial Planning and Development Office
PMS	Pavement Management System
PPA	Programs, Projects and Activities
PRMF	Provincial Roads Management Facility
RBIA	Road and Bridge Information Application
RBIS	Road and Bridge Information System
RBIVA	Road and Bridge Infrastructure Vulnerability Audit
RIMSS	Road Information Management and Support System
RMMS	Routine Maintenance Management System
RO	Regional Office
ROCOND	Road Condition
RROW	Road Right of Way
SDWF	Sum of Distresses Weight Factor

SLRF	Special Local Road Fund
UTM VCI	Universal Transverse Mercator Visual Condition Index
WB	World Bank
WF	Weight Factor

References

DILG Local Road Management Manual DILG Special Local Road Fund Manual DPWH Visual Road Condition Manual DPWH Bridge Inspection Manual DPWH Highway Planning Manual
DPWH Road Construction and Management Manual

PART 1
OVERVIEW AND INSTITUTIONAL ARRANGEMENT

I. Introduction

The Philippines has a total length of about 200,000 kilometers of road network, of which about 32,000 kilometers are classified as national road under the management of the Department of Public Works and Highways (DPWH), and the remaining road network of about 168,000 kms are classified as local roads under the jurisdiction and management of Local Government Units (LGU) concerned.

The existing local roads are classified in terms of administration, namely: Provincial, Municipal, City and Barangay. These road systems have varying surface type: Concrete, Asphalt, Gravel and Earth and are assessed at every segment as Good, Fair, Poor or Bad.

For national roads, the DPWH developed the Highway Planning Process under the Road Information Management Support System (RIMSS) through the World Bank and Asian Development Bank assistance to effectively manage the existing national road network. The process involves data collection and monitoring of the condition of national roads and bridges that are utilized for the formulation of work programs based on needs resulting in better choice of maintenance treatments, effective utilization of funds, and ultimately effective management of road network.

The DPWH's Road and Bridge Information Application (RBIA) and related road and bridge data collection procedures are established as repository of data used for analysis, reporting and information dissemination. The RBIA and the data collection and management for the new highway planning process have been institutionalized in the DPWH in 2004 through Department Order No. 54.

The Road and Bridge Information System (RBIS) is a cloud-based system designed to capture data on *local roads* which could be used for local road development planning

For local roads, the Australian-assisted Provincial Roads Management Facility (PRMF) provided technical assistance to DILG in the formulation of the Local Roads Management (LRM) Manual. The purpose of the LRM manual is to provide guidance to the LGUs on the planning, programming, design, construction and maintenance of local roads. Also, the LRM manual is envisioned as a valuable tool for LGUs in sustainably managing their local road network. The LRM manual is supported by a data collection tool and information system to aid the LGUs in the road service delivery.

Hence, the Road and Bridge Inventory System (RBIS) is developed under the PRMF for pilot testing in the ten participating provinces. These PRMF provinces are provided with Geographic Position System (GPS) units and Geographic Information System (GIS) software as a tool in collecting the information and stored in the RBIS. For provinces without the required hardware and software, the MS Excel is the chosen software for this task considering the requirements of the database, its availability, ease of use, staff knowledge, and capabilities throughout the LGUs. This software can perform all the necessary functions likely to be required within the foreseeable future and is generally known by most computer operators or can be easily understood with a minimum of teaching. It is also considered the most suitable for use at Local Government level as well as with DILG.

The concerned LGU should have a complete inventory and condition of all its road and bridge assets. This information is essential in the formulation of the Comprehensive Development Plan(CDP) and Comprehensive Land Use Plan (CLUP) as required by the Local Government Code. The DILG's role in the administration of the local roads is more that of an "overview" of the network as a whole and therefore the database requirement should be such that this can be easily set up and readily maintained with a minimum of staff time input.

The data and information recorded in the DILG database should therefore be applicable to general project selection in a national scope rather than at provincial or city level. In thisrespect, the database considered appropriate to fulfill these requirements for the DILG should be simplistic in format and capable of partial (or complete) up-loading or down- loading to other databases within the Regions or Provinces.

This manual takes off from the existing inventory, condition, and planning manuals available and being used in the country today. The DPWH has specifically recommended to DILG the use of the Road Condition (ROCOND) manual. The references used in this manual are: DILG Local Road Management Manual, DILG Special Local Road Fund, DPWH Visual Road Condition Manual, DPWH Bridge Inspection Manual and DPWH Highway Planning Manual.

II. LRBICS Organization

The engineering offices of LGUs from the provincial to the municipality level have overall responsibility for roads construction, improvement, repairs and maintenance. Given that, at the municipal level, the Office of the Municipal Engineer does not have the organization, workforce and technical knowhow to undertake its responsibilities over local roads other than construction supervision. Cities LGUs are viewed to already have sufficient organization, capability, workforce and finances to fund and undertake its local roads responsibilities. The basic organizational structure of the Engineering Office of LGUs vary in terms of classification as an LGU, with those belonging to the 1st and 2nd classes having bigger engineering offices than lower class LGUs. Typical LGU engineering office organizational structures are outlined in Figures 1-1 to 1-3.

Figure 1.2.1: Typical Organizational Chart - Provincial Engineer's Office

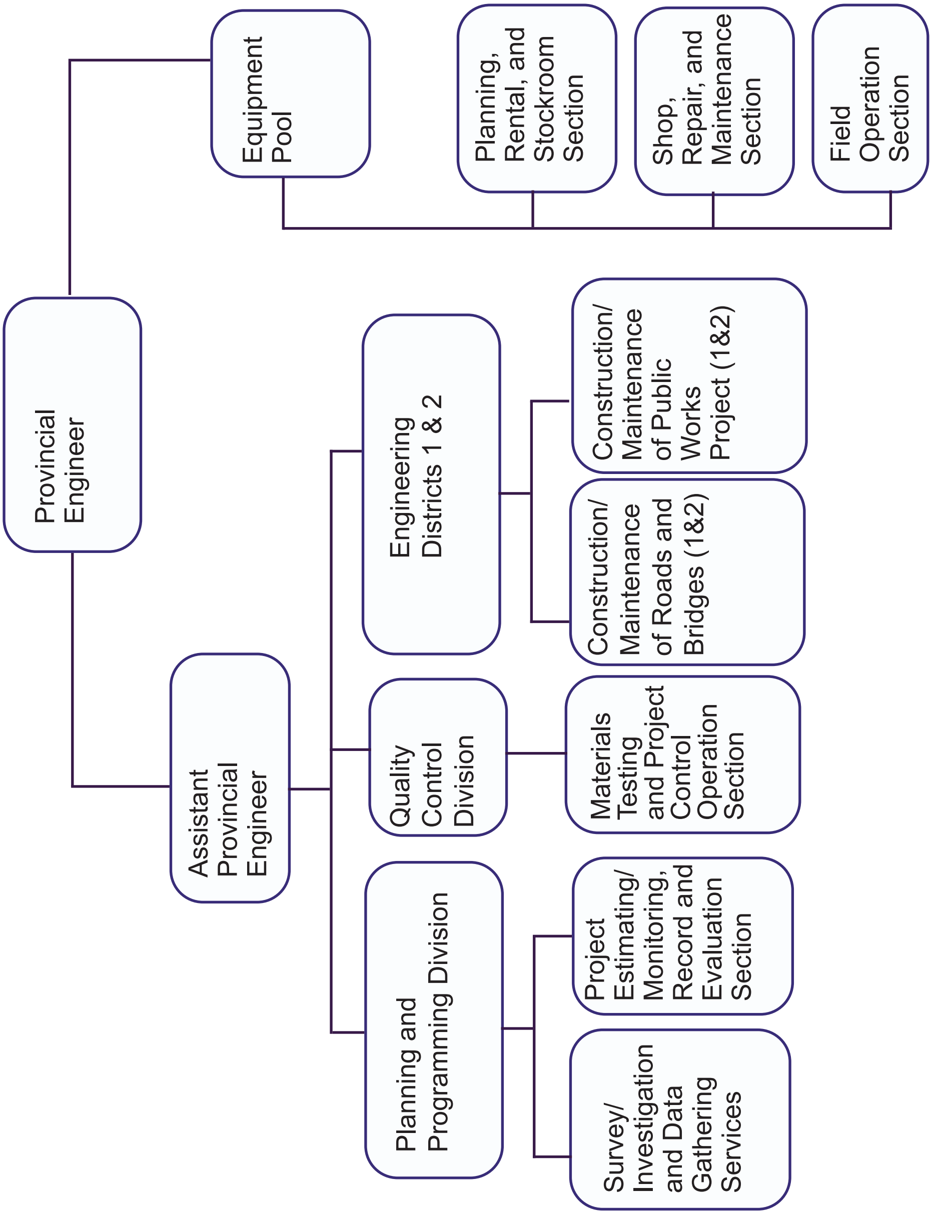


Figure 1-2-2:Typical Organizational Chart - City Engineer's Office

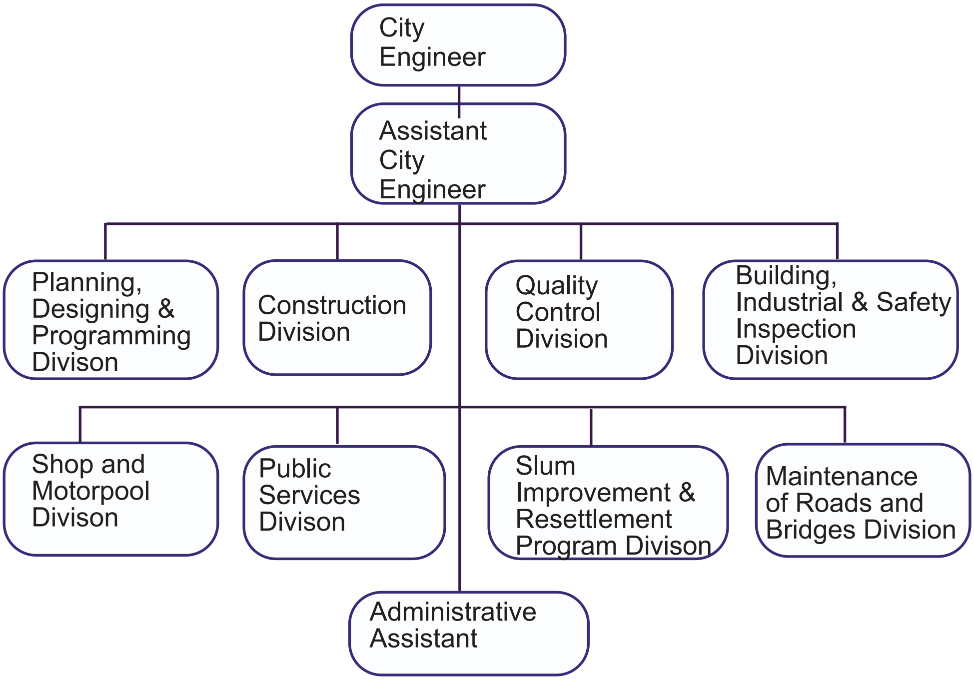
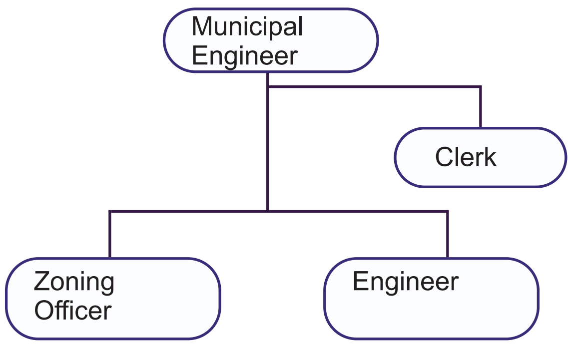


Figure 1-2-3: Typical Organizational Chart - Municipal Engineer's Office



The Provincial Engineer's Office (PEO) have to either takeover or assist the province's lower level LGUs in the road and b idge inventory and condition survey, although some cost sharing (allowance and fuel expenses) is sometimes agreed upon. In other cases, when the province has some financial resources, it may choose to undertake on its own account the survey of selected local roads of its lower level LGUs including its own.

Some Provincial LGUs created composite team from the Provincial Planning and Development Office (PPDO) and PEO as part of the Road and Bridge Inventory Team. The PPDO usually stores and manages the information.

The collection and updating of road inventory and condition data should be one of the major final outputs of all the LGU Engineering offices (and the local planning offices in some cases) in the country and should be reflected in DBM LBP Form 5-Functional Statements,Objectives, and Expected Results. The budget officer and local chief executive should ensure that LRBICS activities are budgeted annually and reflected as one of its Programs, Projects and Activities.

II.1 IMPLEMENTATION OF LRBICS

This manual will be utilized for "road and bridge inventory and condition reporting" that is used to:

- Measure and record all local road, bridge, drainage and safety structures;
- Measure and record condition throughout the road and bridge system;
- Describe the condition of the road and bridge at the time of the rating;
- Provide a sequence of recorded condition that can be analyzed to indicate performance trends;
- Provide condition data for analysis in the DILG's Road and Bridge Information System; and,
- Provide information on the traffic volume.

This manual is designed for use by field technical personnel. A team of at least five (5) staff is required and should comprise the trained

LRBICS personnel. An experienced team can rate up to 16 km of gravel road per day depending upon traffic and road condition.

The assessment and measurement of road condition follow one or two formats. Some items (side drains and shoulders) are rated on a scale of 1 to 5 while other items for gravel and earth are rated on a scale of 1 to 4 utilizing condition descriptions with some simple dimensions. Other items particularly for concrete and asphalt are rated by the severity of distress and extent of distress exhibited. Severity levels are used and extent is measured in terms of the percentage of area affected by the particular distress.

Roads are inspected and condition reported for defined segments that are of same surface type generally between two-kilometer posts or at least 50m in length for paved road or even less for gravel road. The inspection procedure caters for different pavement types and/or surface condition. Some items are necessarily evaluated by sampling. The rating ascribed to each item is deemed to report the average condition of the whole segment at the time of rating.

The PEO's Planning Division Chief will supervise and monitor the survey, and validate the condition data submitted by the LRBICS Team. The quality control check must cover at least 5% (minimum 10 segments) for each surface type. If there is discrepancy of greater than 15 VCI on more than 10% of the segments for any surface type, then all of the segments for that surface type much be resurveyed.

The Planning Division of the LGU Engineering office has the overall responsibility for the collection and management of road inventory and condition data.

Maintenance of the data in the RBIS is the responsibility of the Provincial LGU and Highly Urbanized City LGU. The specific responsibilities are:

The LGU:

- Maintaining the integrity of data in the LRBICS and RBIS
- Notification of physical changes which affect the LRS and Inventory records
- Producing information and reports
- Collection and quality assurance of inventory and visual

condition survey data
- Liaison with DILG Regional Coordinators or Contractors for undertaking special surveys

The DILG:

- Updating locational referencing and inventory information
- Maintaining the integrity of data in the LRBICS and RBIS
- Maintaining the geographic representation of the road network LRS
- Maintaining an inventory of all spatial data in the provinces and cities
- Providing services as necessary to produce maps (hard copy and electronic) for other DILG units and government agencies
- Coordinating, designing and implementing training on the LRBICS and RBIS at the provincial, city, municipal and barangay levels and maintaining training documentation
- Overseeing the roles of the LRBICS and RBIS Coordinators, particularly the monitoring of performance indicators for the RBIS and SLRF.
- Maintenance and dissemination of procedural manuals

2.1.1 Training and Orientation

The raters, who are the designated LRBICS team, should have undergone the LRBICS training and orientation being conducted by the DILG and understand completely the proper methods and procedures of inspection and the criteria and guidelines for the evaluation of road and bridge distresses. They will be provided with inspection manuals, tools and equipment including funds for the inspection vehicle and allowances.

The Regional SLRF Coordinators of DILG shall serve as RBIS Coordinator and attend the annual briefing and orientation on LRBICS in the Central Office by the RBIS Team of DILG. They should participate as resource person in the conduct of LRBICS training in the Region or Province.

2.1.2 Scheduling

LRBICS survey is being done annually by the LGUs preferably during the fourth quarter of the year so that it will be timely utilized by other systems for analysis in preparation for the local AIP for the succeeding year and the annual maintenance work program for the current year. The typical schedule for the conduct of LRBICS is shown in Table 1-1.

III. LRBICS Organization

The LRBICS Survey Team of the Provincial and City Engineering Offices shall be composed of five (5) members from the Planning and Design Divisions with support from the Maintenance Division. It is a composite team; the members may come from PPDO and PEO. For municipal and barangay LGUs with smaller engineering team, they may request technical assistance from the Provincial and City Engineering Offices.

The team collecting line and point data can collect information for 15 kms a day covering both road inventory and condition. For bridges, an average of 4 bridges a day can be collected.

Below are the team composition and their respective roles and responsibilities:

Table 1-1: LRBICS Survey Team Composition and Responsibilities

Role	Responsibilities
Team Leader	The Team Leader shall sit on the front seat (next to a driver) and observe the following: • General inventory of the road • General condition of the road, focusing on condition of the right side lane and right side features of the road. When stopped at every 100 m (or 500 m), s/he shall be responsible for recording all road conditions/measurement results on including left side conditions based on observation of the Team Members.

Team Member A	Team Member A shall: • sit on the left side of rear seat. • observe left side lane condition and features of the left side road. When stopped, s/he shall inform observation results to Team Leader.
Team Member B	Team Member B shall: • sit on the right side of rear seat. • be responsible to announce distance at every 100m, so that other team members know the distance based on the portable GPS reading. Note that a portable GPS device functions only outside the car; therefore, he needs to open the window and put the GPS outside the window.
Team Member C	Team Member C shall: • sit on the center of the rear seat. • be responsible in noting down in the survey sheets the inventory results.
Team Member D	Team Member C shall: • sit on the driver seat. • assist in measuring the road and bridge asset

The following preparations should be made by the LGU Engineering office prior to the conduct of LRBICS survey:

- Get a copy of the LRBICS survey report of previous year and review the recorded inventory, distresses and established segments for each road section.
- Prepare Survey Forms in pre-printed and blank forms. The number of forms will depend on the number of road segments to be assessed.
- Establish the LRBICS Survey Team. In LGUs with limited

personnel, a Team can be composed of only the rater and the assistant.

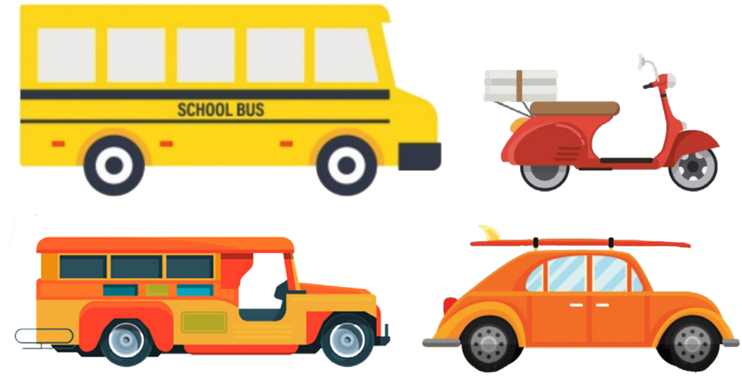
- Prepare the required equipment and safety gadgets.

Table 1-2: Typical LRBICS Schedule

IMPLEMENTATION SCHEDULE

ACTIVITIES		PRECEEDING YEAR			
		SEP	OCT	NOV	DEC
A	**LRICS SURVEY**				
1	Prepare Survey Requirements				
2	Conduct Briefing to Survey Team				
3	Conduct of the Road Inventory				
4	Conduct of the Bridge Inventory and Condition Survey				
5	Conduct of Road Condition Survey				
6	Traffic count				
7	Review and validate the LRICS Data				
8	Import data to the RBIS database				
9	Make LRICS data available for road prioritization				
B	**PLANNING AND BUDGETING**				
1	Prepare Updated Road and Bridge Profile				
2	Prepare Annual Maintenance Work Program				
3	Updating of Planning and Budgeting Database				
4	Prepare Priority Road Projects				
5	Preparation and approval of the Annual Investment Plan				
C	**PROJECT IMPLEMENTATION**				
1	Implementation of AMWP				
2	Implementation of Road and Bridge Projects				
3	Updating of the Road Inventory Upon Completion of Road and Bridge Projects				

CURRENT YEAR											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC



PART II
ROAD ASSET INVENTORY AND TRAFFIC ASSESSMENT

1. Introduction

The primary requirement for the management of the road network is a comprehensive database that incorporates the exact locations of the roads, their geometric and structural conditions, furnitures (or inventory elements), traffic volumes, and vehicle types using the road.

The database must also include details of road structures such as bridges ,cross-drains, side drainage, safety devices and other major physical features such as retaining walls, major erosion protection requirements etc.

The database should be set out to identify roads and numbers of structures and general conditions of these aspects. A separate database is required for details of bridge structures and major culvert structures.

All Provincial and City LGUs in the country have developed a road inventory system using the SLRF format. However, not all Municipal and Barangay LGUs have embarked on a full scale road inventory data collection exercise although some had developed basic inventories on some sections of their respective LGUs during the preparation of the CDP and CLUP. Because of this, it has been necessary to conduct a fairly detailed introduction into the methods required to ensure a reasonably homogeneous data collection process for local roads.

The DILG database requirement and the more detailed LGU database requirement will be covered in detail as well as traffic details required from the LGUs.

This part covers the road’s physical asset and traffic assessment.

2. Road Classification

The DILG’s Local Road Management Manual has extensively covered the discussion on the administrative and functional classification of roads in the Philippines. This manual will use the administrative classification of the roads according to road hierarchies and government agencies responsible for the development and management of the road shown in Table 2-1 below.

Table 2-1: Administrative Classification of Roads System

National Roads	
Primary arterial roads	Connect major cities (each with at least around 100,000 people in the year 2000)
Secondary roads	Connect cities to primary arterial roads, except in metropolitan areas Connect major ports and ferry terminals to primary arterial roads Connect major airports to primary arterial roads Connect tourist service centers to primary arterial roads or other secondary arterial roads Connect cities (other than major cities) Connect provincial capitals within the same region Connect major national government infrastructure to primary arterial roads or other secondary arterial roads
Expressways	Limited-access highways, normally with interchanges; may include facilities for levying tolls for passage in an open or closed system
Toll roads	Roads where a toll for passage is levied in an open or closed system
Provincial roads	• Connect cities and municipalities without traversing national roads • Connect national roads to barangays through local areas • Connect to major provincial government infrastructure
Municipal and city roads	• Within the Poblacion • Connect to provincial and national roads • Provide inter-barangay connections to major municipal and city infrastructure without traversing provincial roads

Barangay roads	Public roads (officially turned over) within the barangay that are not covered in the above definitions

3. Location Identifier

3.1. Locational Referencing

Any road inventory is as good as its geographical content. In order to share road-related data among many users, a consistent Locational Referencing System (LRS) is required. Simply, it must answer the question “Where is it?” in a language that everybody can understand.

The LRS is a set of office and field procedures that includes techniques for recording, maintaining, and retrieving location information. It must be meticulously maintained to allow independent sets of data, whether computerized or manual, to be related to each other.

Figure 2-1: Kilometer Post

The DILG LRS defines the road network using the following entities and definitions.

- Road Names
- Road Sections
- Nodes
- Locational Reference Points (LRPs)
- Cross-Sectional Position (XSP)

A Road Name (e.g. 'Pisaan-Del Monte Road') is simply a grouping of Road Sections.

Each Road Name is associated with a Road ID (e.g. '0679000000001') and Administrative Classification. A Road Section is a linear representation of a road's centerline and has a defined length and direction (always in the direction of increasing kilometer posts). It is associated with one Road Name. Road section starts and ends with the barangay.

Each Road Section is associated with a ‘Start’ Node and an ‘End’ Node, and may also contain ‘Intermediate’ Nodes. Each Road section is created to be as long as possible, provided that:

- It is a contiguous length of road without any breaks or forks; and,
- Does not cross Provincial and City boundaries.
- Nodes are connectivity elements defined and associated with locations along Road Sections in the following instances:
- Junction between all Provincial and City Roads;
- Junction between National Road and other roads (e.g. provincial, municipal roads);
- End of a road; and
- LGU boundary up to barangay level

A *Locational Reference Point (LRP)* is a permanent physical feature on or adjacent to the carriageway, whose location along the Road Section is known. LRPs are, in most cases, kilometer posts, and they are a vital kind of road inventory in that they act as intermediate reference points when a location is addressed using the ‘LRP+ Displacement’ of the Locational Referencing Method. Nodes also act as LRPs, but an LRP cannot be a node.

Cross-Sectional Position (XSP)

Cross-Sectional Position is use to specify the lateral location of the road elements along the road section.

3.2 Road Names and Road ID

All roads have an official name and in many provinces and cities a road number. However, these are not tied into a National system but are more Regional or Local Government Area specific. The road ID coding system will adopt the Philippine Standard Geographic Code (PSGC). The PSGC provides the standard code for geographic areas of the country that rationalizes and integrates different existing geographic codes being used by various government agencies. With the universal adoption and use of the standardized and integrated geographic code, uniformity and compatibility of statistics produce from related areas at the regional level down to the barangay level by different government agencies is expected to be attained.

The Road ID System that will be included in the database for the road inventories is based on the following concepts:

Region	Use the PSG Code
Province	Use the PSG Code
For the Road	Use the 4 digits
City	Use the PSG Code
For the Road	Use the 4 digits
Municipality	Use the PSG Code
For the Road	Use the 4 digits for Municipal Road
Barangay	Use the PSG Code
For the Road	Use the 4 digits for Barangay Road

For the Road, use a Number with a combination of the Codes

Use 4 digits for Provinces and Cities and 4 digits for Municipalities and Barangays. Example:

Region VI		06
Province	Capiz	061900000
City	Roxas	061914000
Municipal	Dumarao	061904000
Barangay	Bayog	061904009
FULL CODE for Bayog Road		0619040090001
FULL CODE FOR Roxas City Road		0619140000006
FULL CODE FOR Capiz Province Road		0619000000001
FULL CODE FOR Capiz Municipal Road		0619040000001

The numbering and coding system used has been specific to each Province, City, Municipality or Barangay.

For example, the following section of a Table has been extracted from the actual Database.

Table 2-2: Provincial Roads Inventory, Guimaras Province

LOCAL ROADS INVENTORY				REGION	VI
Province:	GUIMARAS			Provincial Roads	
Code:	GUI				
Road ID	Road Name	Class	Length (km)	Form (width)	C-Way (width)
0679000000001	Sto. Rosario-Buenavista		0.54		
0679000000002	San Isidro-San Roque		4.96		
0679000000003	Banban-Calumigan		1.84		
0679000000004	Salvacion-San Roque		2.48		
0679000000005	Pina-Suclaran		10.96		
0679000000006	Cansilayan-Tanag		3.07		
0679000000007	Supang-Navalas		3.83		
0679000000008	Calingao-Tacay		4.52		
0679000000009	Daragan-Rizal		4.64		
0679000000010	East Valencia-Gaban		7.2		
0679000000011	Salvacion-Dagsaan		4.6		
0679000000012	Jordan-Sanao		2.2		

LOCAL ROADS INVENTORY				REGION	VI
Province:	GUIMARAS			Provincial Roads	
Code:	GUI			GUIM	
Road ID	Road Name	Class	Length (km)	Form (width)	C-Way (width)
	Municipality of Buenavista (BU)				
0679010000001	Avila Nat'l (Circumferencial) Rd.		2.4		
0679010000002	San Nicolas-Sitio Carazan-Purok Paho FMR		5		
0679010000003	Daragan-Rizal		2.5		
0679010000004	San Roque-Tinadtaran Rd.		1.6		
0679010000005	San Roque-Nazareth Rd.		1.2		
0679010000006	San Roque-Salvacion Rd.		1.9		
0679010000007	Banban, Bacjao-Navalas		1.8		
0679010000008	Old Poblacion		1		
	Municipality of San Lorenzo (LO)				
0679040000001	Tamborong-Aguilar Rd.		3.45		
0679040000002	Aguilar Bdry.-SuclaranBdry.		2.96		
0679040000003	Gaban-East Valencia Bdry.		3.7		

4. Physical Inventory

The main inventory items used in recording road inventory elements are:

4.1. Locational Reference Points (LRP)

The presence of an LRP and its location such as kilometer posts shall be recorded.

Table 2-4: LRP Code and Description

Code	Description
K	Kilometer Post

4.2. Congressional District and Administrative Boundaries

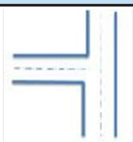
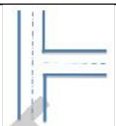
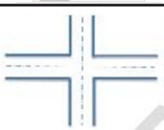
The limits of congressional districts, provinces, municipalities, cities and barangays shall be recorded at the start of each Road Section and if there is any change in congressional jurisdiction and administrative boundaries along it.

4.3. Junctions

The presence of any type of public road junction and names shall be recorded. The chainage shall be measured at the center of the intersection of the road being surveyed.

4.4. Place Name

Table 2-5:Junction Code and Description

Code	Description
L	Junction Left 
R	Junction Right 
C	Crossing 

The names of any city, municipality, and barangays where displayed on a sign or arch shall be recorded. Names and location of public places (schools, hospitals, church, etc.) shall also be recorded.

4.5. Right of Way (ROW)

The ROW width shall be recorded at the start of road sections, including changes in width along it. ROW if acquired or not acquired can be taken from office records.

The LRM Manual provides the following road right-of-way width.

Table 2-6: Road Right-of-Way Width, LRM Manual

Road Classification	Width (in meters)
Provincial Roads	15-60
City Roads	10-60
Municipal Roads	10-60
Barangay Roads	10

Table 2-7:DPWH Minimum Design Standards for Philippine Highways

AADT	Width (in meters)
Under 200	20
200-400	30
400-1,000	30
1,000-2,000	30
More than 2,000	60

4.6. Carriageway Width

The width of the carriageway shall be recorded at the start of road section and if there is any change in surface type, Pavement type and width along it. To distinguish between the edge of carriageway and the shoulder, the following guidelines shall be used:

1. Painted continuous markings on the edge of the road

shall delineate between the carriageway and the shoulder.

2. When no painted marking is provided or visible, the carriageways comprise the entire paved width.
3. When there is no visible marking, but there is a clear change of pavement (i.e. in terms of its use) for widths of less than 3m, the width beyond that pavement width shall be recorded as "shoulder".
4. On unsealed roads (gravel or earth), the width shall be measured between the most extreme wheel paths on the road.

4.7. Number of Lanes and Directional Flow of Traffic

Figure 2-4-1: Carriageway Width

Photos courtesy of DPWH

The number of lanes shall be recorded at the start of road section and if there is any change in the number of lanes along it. A minimum carriageway width of 4m is considered as 2-lanes. The directional flow of traffic shall also recorded at the start of road section if one-way or two-way passage.

4.8. Surface and Pavement Type

a. The surface type of the road shall be recorded from the start of road section and if there is any change in the wearing surface. The dominant surface material shall be deemed as the "Surface Type" using the following codes:

Table 2-8: Surface and Pavement Code and Description

Code	Description
C	Concrete
A	Asphalt
G	Gravel
E	Earth

Figure 2-2: Pavement Type

b. The pavement type shall be recorded at the start of road section and if there is any change in properties. This can be obtained from office records “As Built Plans”.

Table 2-9: Surface and Pavement Code and Description

Code	Description
AMGB	Asphalt Mix on Granular Base
AMAB	Asphalt Mix on Asphalt Base (i.e. Bitumen Stabilized Base)
AMAP	Asphalt Mix on Asphalt Pavement

AMCP	Asphalt Mix on Concrete Pavement
JPCD	Joint Plain Concrete Pavement + Dowel
JPCO	Joint Plain Concrete Pavement without Dowels
CRCP	Continuous Reinforced Concrete Pavement
AM-CRCP	Asphalt Mix Continuous Reinforced Concrete Pavement Gravel
SBST	Single Bituminous Surface Treatment
DBST	Double Bituminous Surface Treatment
SS	Slurry Seal
G	Gravel
E	Earth
M	Macadam

Figure 2-4-2: Asphalt Mix on Granular Base

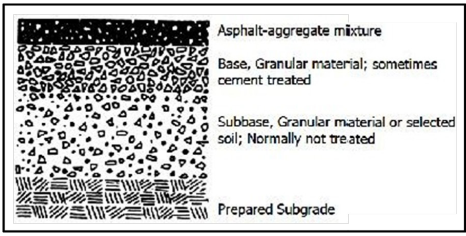


Figure 2-4-3: Asphalt Mix on Asphalt Pavement

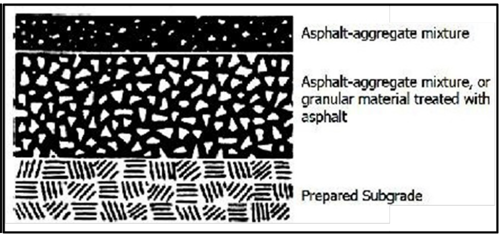


Figure 2-4-3: Asphalt Mix on Asphalt Pavement

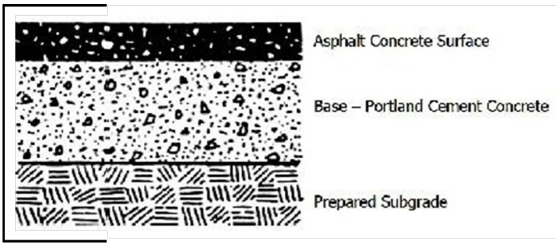


Figure 2-4-5: Joint Plain Concrete Pavement + Dowel

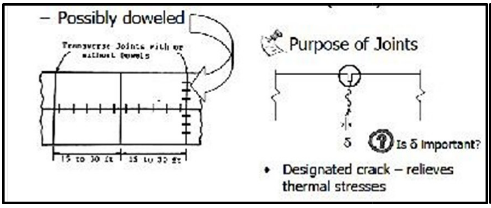
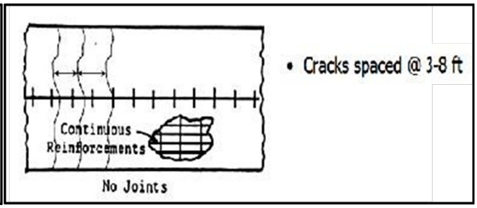


Figure 2-4-6: Continuous Reinforced Concrete Pavement



The re-construction year, or the year of last surfacing and re-gravelling, shall also be recorded and this can be obtained from office records.

Any work that involves removal or modification of existing base course is deemed to be re-construction.

4.9. Pavement Thickness

a. a. For asphalt pavement, the most recent surface thickness of the road shall be recorded at the start of road section and if there is any change along it. The most recent thickness is t e depth of overlaid materials ranging from 10-200mm. The thickness prior to overlay is called the previous surface thickness ranging from 20-1,000mm.
b. For concrete pavem nt (no asphalt overlay), the thickness is the slab thickness and the previous surface thickness is none. If with asphalt overlay, the most recent thickness is the thickness of asphalt layer.
c. For gravel, the most recent surface thickness is the total depth of in-placed gravel materials along the road and no previous surface thickness will be recorded.

4.10. Year of Last Surfacing

The year of last surfacing shall be recorded at the start of each road section and at each change along it.

Note that for gravel pavements, the year of last resurfacing is the year that gravel was last added to the pavement, i.e. last regravelling

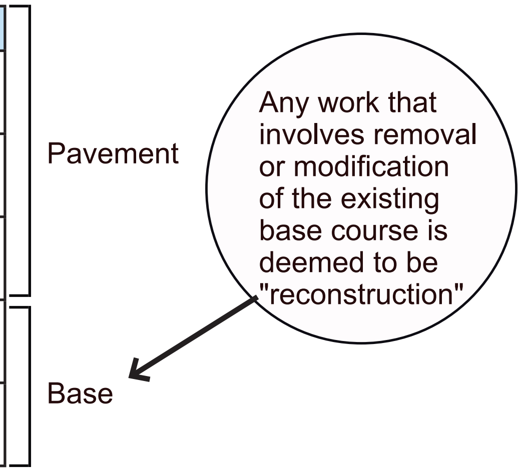
4.11. (Re) Construction Year

The year of pavement construction or reconstruction shall be recorded at the start of each road section and at each change along it. Reconstruction shall be deemed to include any treatment that involves reworking of the existing base course (or portion thereof).

Note that for gravel pavements, the year of reconstruction year shall be the same year of last surfacing (i.e. the year that gravel was last added to the pavement).

Figure 2-4-7: (Re) Construction Year

Year	
2002	Overlay No. 3 Asphalt = 50mm
1995	Overlay No. 2 Asphalt = 80mm
1985	Overlay No. 1 Asphalt = 70mm
1979	Original Asphalt Surface = 50mm
1979	Original Cranular Base = 300mm



4.12. Median

The type of median shall be recorded for every occurrence. The start, end, width and its location shall also be recorded.

Table 2-10: Surface and Pavement Code and Description

Code	Description
D	Depressed
R	Raised
F	Flush

Figure 2-4-8: Surface and Pavement Description

4.13.Shoulders (Left and Right)

The type, width and location of shoulders shall be recorded at the start of road section and if there is any change along it. The type of shoulders is classified with the following codes:

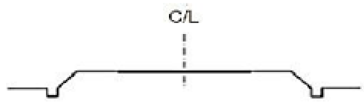
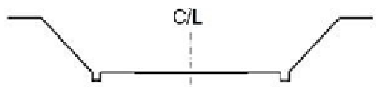
Table 2-11: Shoulders Code and Description

Code	Description
C	Concrete
A	Asphalt
G	Gravel
E	Earth
N	None

4.14. Side Slope (Left and Right)

The type of side slope and its location shall be recorded in every occurrence. The types of side slope are classified with the following codes:

Figure 2-4-8: Surface and Pavement Description

Code	Description	
E	Embankment (Edge of surfacing>0.3m of ground level)	
C	Cut (Edge of surfacing <0.3m of ground level.	

The slope angle of the side slope shall be recorded with the following codes:

Table 2-13: Shoulder Code and Description

Code	Description
SH	Shallow (<5 degrees)
MD	Medium (5 to 30 degrees)
ST	Steep (>30degrees)

4.15. Sidewalks (Left and Right)

The type, width and location of sidewalks shall be recorded in every occurrence using the following codes:

Table 2-14: Sidewalk Code and Description

Code	Description
C	Concrete
A	Asphalt
G	Gravel

4.16. Ditches (Left and Right)

The type, size and location of lateral drainage shall be recorded in every occurrence using the following codes:

Table 2-15: Ditches Code and Description

Type		Size	
Code	**Description**	**Code**	**Description**
UN	Unlined ditch	S	Shallow (<0.5m deep)
LO	Lined open ditch	M	Medium (0.5m to 1.5m deep)
LC	Lined closed ditch	L	Large (>2m largest dimension)

Figure 2-4-9: Types of Ditches

Unlined Ditch

Lined Open Ditch

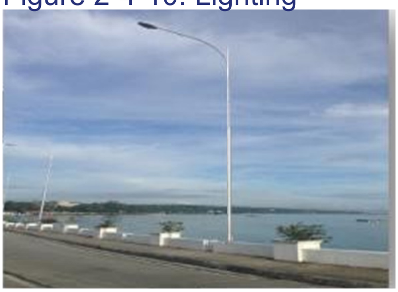
4.17. Lightings (Left and Right)

The type and location of lightings in every occurrence shall be recorded at the start of road section using the following code:

Table 2-16: Lightings Code and Description

Code	Description
E	Exists

Figure 2-4-10: Lighting



4.18. Guardrails (Left and Right)

The type and location of guardrails in every occurrence shall be recorded using the following codes:

Table 2-17: Guardrails Code and Description

Code	Description
S	Steel (Steel guardrails)
W	Wall (Concrete wall or parapet)
T	Temporary (Wood, etc.)

Steel Guardrail

Concrete wall Guardrail

4.19.Markings (Centerline)

Pavement markings at the road centerline and its type shall be recorded at the start of road section using the following codes:

Table 2-18: Markings Code and Description

Code	Description
N	None
P	Painted
S	Studs

4.20.20. Hazards (Left and Right)

The type of hazard, risks and its location along the road section shall be recorded. Hazard treat shall be recorded using the following codes:

Table 2-19: Hazards Code and Description

Type		Size	
Code	**Description**	**Code**	**Description**
L	Landslip	L	Low
F	Flood	M	Medium
E	Erosion	H	High

4.21.21. Roadside Friction

The roadside friction shall be recorded at the start of road section and every change thereof. The roadside friction is classified with the following codes:

Table 2-20: Roadside Friction Codes and Description

Code	Description
N	None (No houses along the roadway)
L	Light (Pedestrian and other slow moving traffic observed occasionally, 100- 200m between houses and/or road intersections)
M	Medium (Pedestrian and other slow moving traffic observed frequently, 50- 100m between buildings and/or road intersections)
H	Heavy(Pedestrian and other slow moving traffic tent to disrupt the motor vehicle traffic and re-duced travel speed to 30km/hr. Less than 50nm between buildings

4.22.22. Roadside structures (Left and Right)

The type and location of roadside structures in every occurrence shall be recorded using the following codes:

Table 2-21: Roadside Structures Code and Description

Code	Description
R	Retaining wall
O	Obstruction
P	Parking

4.23.23. Terrain

The terrain shall be estimated and recorded from the start of road section and if there is change along it. It was recorded as follows:

Table 2-22: Terrain Code and Description

Code	Description
F	Flat (< degrees)
R	Rolling (2 to 6 degrees)
M	Mountainous (>6 degrees)

4.24.24. Bridges

The occurrence of bridges reckoning at the low chainage at the back of the backwall of abutment “A”. The bridge length shall be measured and bridge name shall be recorded. Bridges are classified according to types using the codes below:

Table 2-23: Bridges Code and Description

Code	Description
C	Concrete (Concrete substructure & superstructure)
S	Steel (Steel trusses ad steel girders)
T	Temporary (Timber, Bailey Panel, etc.)

4.25.25. Culverts

The chainage of culvert or culvert group shall be taken at the center. The culvert length and dimensions shall be measured using a 5m steel tape. Properties of culvert shall be recorded. Culverts are classified according to type using the following codes:

Table 2-24: Culverts Code and Description

Code	Description
P	Pipe (RCPC or Circular type)
B	Box (RCBC or Square or rectangular type)
A	Arch (Semi- circular type)
O	Others (Not classified as above)

The following properties shall be recorded:

1. Culvert type (Pipe, Box, Arch & Others)
2. Number of barrels (1-50)
3. Size or Barrel diameter for RCPC or Barrel Length &Width for RCBC)
4. Culvert condition (Good, Fair Poor)
   i. Good <25% siltation
   ii. Fair 25%-50% siltation
   iii. Poor >50% siltation
5. Barrel length (1-30m)
6. Barrel material type (Concrete, Steel, Timber, Masonry & Other)
7. Headwall material type (Concrete, Steel, Timber, Masonry &Other)
8. Apron type (Stone pitching, Concrete, gabion, Other, None)
9. Invert type (Stone pitching, Concrete, Gabion, Other, None)
10. Slope (Piled walls, Stone Pitching, Riprap, Masonry, Gabion, Timber, Other)

4.26. Spillways

The type, length and width of spillway shall be recorded. Spillways in most cases are made of concrete.

4.27. Causeways

The occurrence of causeway along the road section shall be recorded.

Figure 2-4-13: Spillway

Figure 2-4-14: Causeway

4.28. Slope Protection

a. Coconet bio-engineering
b. Rubble concrete
c. Concrete slope protection
d. Grouted riprap
e. Stone masonry
f. Gabions
g. Sheet piles
h. Erosion control mats, roving and cellular confinement systems
i. Permanent ground anchors
j. Shotcrete (concrete spray)
k. Mechanically-stabilized earth retaining walls
l. Wet stone masonry (cobble stone)

Figure 2-4-16: Grouted Riprap

Figure 2-4-15: Coconet with vetiver

The above items define the quantum of the road assets maintained by the LGU and hence it is vital that an accurate record of these be maintained. The minimum information of the road and bridge database to be collected by DILG and each LGU level is shown in Table 2-25. The Road Inventory Data Sheet is attached in Annex A.

The DILG's RBIS acts as the custodian of this information to ensure that there is only one single set of data used by all stakeholders. In addition to the above items, an extensive list of other inventory items is also maintained by the RBIS for other planning purposes.

The process of maintaining the integrity of this data is key to deriving quality outcomes from the planning process. In particular, there is a need for updating the inventory data whenever there are changes in road network definition (e.g. through road conversions or new road construction) and simply through replacement of existing infrastructure (e.g. pavement overlay). In either case careful adhered to ensure data integrity.

Table 2-25: Information Requirement of the Road and Bridge Database

Data Elements	DILG		City	Municipal-ity	Barangay
Region	✓	✓	✓	✓	✓
Province	✓	✓	✓	✓	✓
City	✓	✓	✓	✓	✓
Barangay	✓	✓	✓	✓	✓
Congressional District	✓	✓	✓	✓	✓
Road Name	✓	✓	✓	✓	✓
Road ID	✓	✓	✓	✓	✓
Road Sections	✓	✓	✓	✓	✓
Locational Reference Points	✓				
Roadway Features					
Road right-of-Way	✓	✓	✓	✓	✓
Carriageway Width	✓	✓	✓	✓	✓
Data Elements	**DILG**		**City**	**Municipal-ity**	**Barangay**
Number of Lanes	✓	✓	✓	✓	✓
Surface and Pavement Type	✓	✓	✓	✓	✓
Pavement Thickness		✓	✓		
Pavement Strength		✓	✓		
Roadside Features					
Shoulders		✓	✓		
Side Slope		✓	✓		
Sidewalks		✓	✓		
Slope protection		✓	✓		
Roadside friction		✓	✓		

Bridges and Drainage					
Ditches		✓	✓	✓	
Bridges		✓	✓	✓	✓
Culverts		✓	✓	✓	✓
Spillways		✓	✓	✓	
Road Safety Devices					
Guardrail		✓	✓		
Signages		✓	✓		
Median		✓	✓		
Lightings		✓	✓		
Road Hazards		✓	✓		
Traffic					
Average Annual Daily Traffic	✓	✓			

5. Road Vehicle Classification

The DPWH has developed 12 basic vehicle classification scheme which satisfies the user requirements to the optimum extent for recognizing: vehicle size, use and function; easy use in field; traffic volume projections (traffic growth rates); consistency between the vehicle types used in count and axle load surveys forms; and easy aggregation into higher but less detailed level of vehicle class, group and category. The DPWH vehicle classification scheme defines which vehicle makes and models belong to which vehicle types.

The basic vehicle classification should at the same time allow for easy aggregation into vehicle classifications required by all other functions for which the traffic data is used. The basic vehicle classification should be easy to use by the count staff in the field following written and verbal instructions by the supervising staff from the PEO or CEO.

The DPWH's basic vehicle classification has recognized details such as:

- Size of vehicles
- Suitability with the three traffic growth rate applications:
- Private Passenger Transport (Vehicle Types 1-2);
- Public Passenger Transport (Vehicle Types 3, 5 and 6); and
- Freight Transport (Vehicle Types 4, and 7-12)
- Compatibility with counts produced by the automatic traffic classifiers in case the LGU will install it along its major roads

For local roads, non-motorized vehicle is extensively used. The non-motorized traffic such as bicycles, pedicabs, pushcarts, animal-drawn carts will be included from the vehicle classification. Agricultural tractors (with or without trailers), which are seen more on local roads, fire trucks and road construction equipment such as motor-graders, excavators, front- end loaders, bulldozers (except if these types of construction equipment are carried piggy-back on truck semi-trailers or trailers) will be included in the manual counting. The LRBICS vehicle classification scheme is shown in Table 2-26.

Table 2-26: LRBICS Vehicle Classification Scheme

Vehicle Description	Vehicle Type	Vehicle Class	Vehicle Group	Vehicle Category
Bicycles, Animal-drawn carts	1. Non-motorized vehicles			Non-Motorized Traffic (NMT)
Motorcycle	2. Motorcycle	Motorcycle		Non-Motorized Traffic (NMT)
Motor-tricycles	3. Motor-tricycles	Motor-tricycles		Motorized Traffic (MT)
Passenger Cars/Vans Taxis Owner Jeeps Sports Utility Vehicles (SUV)	4. Passenger Cars	Passenger Cars		

Jeepneys, PUJ Jeepneys, private Minibuses (less than 13 seats) Mega-taxis	5. Passenger Utilities	Utility Vehicles	Light Vehicles	Motorized Traffic (MT)
Pick-ups Delivery Vans Small Trucks (max. 4 tons GVW)	6. Goods Utilities			
Buses, 13-30 seats	7. Small Buses	Small Buses		
Buses (more than 30 seats)	8. Large Buses	Large Buses		
Rigid trucks, 3 axles Rigid trucks, 4 axles	10. Rigid Trucks, 3+ axles			
Truck semi-trailers, 3 axles Truck semi-trailers, 4 axles	11. Truck Semi-Trailer, 3 and 4 axles	Truck Semi-Trailers		
Truck semi-trailers, 5 axles Truck semi-trailers, 6 axles	12. Truck Semi-Trailer, 5+ axles	Truck Semi-Trailers	Heavy Vehicles	
Truck trailers, 4 axles	13. Truck Trailers, 4 axles	Truck Trailers		
Truck trailers, 5 axles Truck trailers, 6 axles	14. Truck Trailers, 5+ axles	Truck Trailers		

GVW = gross vehicle weight, PUJ = public utility jeepney. Notes:
1. "Vehicle type" is the basic vehicle classification to be used during data collection in the field.
2.Firetrucks and road construction equipment are classified according to truck axle configuration. Source: Department of Public Works and Highways

6. Traffic Surveys

6.1. Classified Volume Vehicle Count

Classified Volume Vehicle Count is used in planning, design, control, operation and management analysis. This is to obtain accurate information about the number and movement of vehicles and/or pedestrians within or through an area or at selected points within the area.

6.1.1. Location of Traffic Surveys

The DPWH lays out traffic sections and associated survey sites on national roads, then applies traffic volume data collected at a given survey site to the full length of the associated traffic section. Under the regime of superior-subordinate survey sites, traffic volume variations (over a day, week, month, or year) established from traffic volume data collected at a given superior survey site can be applied to subordinate survey sites. This regime allows traffic volume data to be collected more quickly (and at less cost) at subordinate survey sites.

A traffic section is a coherent road section where traffic volume by vehicle type can be considered uniform throughout its length. Traffic on this road section can also be said to be generally uniform or homogeneous. Uniform or homogeneous traffic is defined according to the confidence targets for traffic volume data, and includes a variation of up to around ±15% in the traffic volume by vehicle type along a given traffic section.

In general, traffic sections in network analysis should not be shorter than 1,000 meters. Shorter sections could be dealt with in feasibility or other special studies. Traffic sections are isolated through the observation of features of the local road network, such as network configuration, urban areas, or side roads that could affect traffic volume on a given part of the network. The process of establishing and updating traffic sections, as well as survey sites, involves (1) initial, office-based identification, and (2) verification in the field. A survey site is a single point on the road where traffic data are collected. On a survey site for the collection of traffic volume data, the traffic volume by vehicle type should be representative of the traffic volume on the traffic section as a whole. In other words, it should be around the mean of the traffic volume along the traffic section.

The location of a survey site for local roads must also suit the data collection technique used in the survey. While different criteria apply to different data collection techniques, the segment of road near the survey site location, for example, should generally have good sight distance for manual count sites. The identified and verified survey sites for all traffic data collection are ultimately cross-referenced against the locational referencing system.

The regime of superior-subordinate survey sites is a referencing system that interlinks the different surveys sites according to traffic volume variations over a day, week, month, or year at each survey site. Counts for provincial and city roads can be adjusted with seasonal traffic data from the count machines on the nearest national road. All one-day traffic counts will be adjusted to average annual daily traffic (AADT).

All local road sections will be included in the traffic count. The survey point will be the mid- way between population centers and not on an intersection or adjacent to traffic generating source. For long local roads (more than 10 kms), the road sections will be divided into two or more based on the possible homogenous traffic.

6.2. Types of Traffic Count

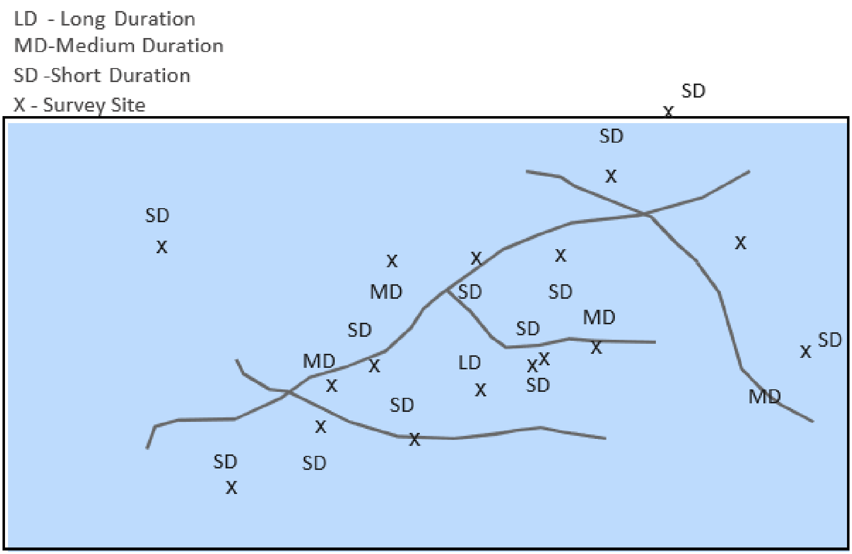
Three (3) basic types of traffic counts are used in DPWH. These types are defined by a combination of the number of hours per day, the number of consecutive days, and the frequency per year of data collection, as follows:

- Long-duration counts at key superior survey sites to record daily, weekly, and seasonal traffic variations, either 24 hours a day for seven consecutive days, 12 times a year (once a month), or hourly throughout the year.

- Medium-duration counts at other superior and subordinate survey sites to record daily and weekly traffic variations, 24 hours a day for seven consecutive days, once to four times a year.

- Short-duration counts at subordinate survey sites to record base traffic volumes, from one week every three years to two weekdays a year over 12 hours of daylight.

Figure 2-6-1: Illustration of Traffic Count Hierarchy



Due to the limited resources of the LGUs, the following guidelines are adopted:

- Survey Method - Manual traffic volume count by vehicle type and direction using the form in Annex A.

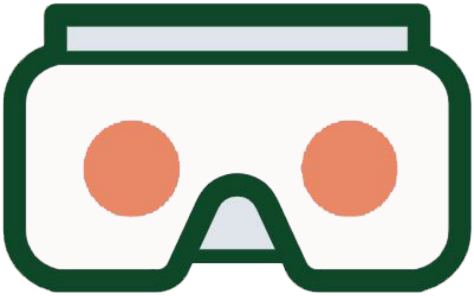
- Survey Form is composed of 14 vehicle types covering both motorized and non- motorized vehicles.

- Survey Time: 14 hour count from 6:00 am to 8:00 pm on a week day for one day only. The data will be adjusted using daily and seasonal factors to reflect AADT.

- The survey team will be composed of 2~3 members depending on the volume of traffic per road section.

- Survey points: All key road segments will be included in the traffic count. The survey point will be the mid-way between population centers and not on an intersection or adjacent to traffic generating source.

- The following special conditions should be avoided in the survey: abnormal weather conditions, fiesta celebrations, local and national holidays.



PART III
VISUAL ROAD CONDITION SURVEY

1. Introduction

This manual will guide LGU Engineers in monitoring the condition of and evaluating the distresses in the existing local road network for all types of pavement.

The LGUs conducted an annual inventory of the existing local roads and their conditions to update the statistical record of the provincial and city road assets in a database. This is one of the requirements in accessing the SLRF. The current condition assessment used by SLRF is shown in the tables below:

Table 3-1: Assessment Guide on Bitumen Surface

Pavement Condition	Description
Good	Sound, well-shaped, even and waterproof, normal speed ok at 80-90 km/hr.
Fair	Uneven, bad shape but still waterproof, normal speed ok at 60-90 kph
Poor	Very uneven and porous, normal speed 40-60 kph
Bad	Very broken up, rough, can only travel very slowly, normal speed at 20-40 kph

Table 3-2: Assessment Guide on Gravel

Rating	Description
Good	Good shape and surface, does not hold water, normal speed ok at 80-90 km/hr.
Fair	Surface raveling and holding some water, normal speed ok at 60-90 kph
Poor	Breaking up, normal speed 40-60 kph.
Bad	Impassable when wet

Table 3- 3: Assessment Guide on Drainage

Rating	Description
Good	Adequate and well maintained
Fair	Inadequate
Poor	Inadequate and no maintenance
Bad	No drainage installed

Table 3-4: Assessment Guide on Shoulder

Rating	Description
Good	Adequate and maintained
Fair	Adequate width but poor maintenance
Poor	Inadequate width and no maintenance
Bad	No effective shoulders

There are limitations to the SLRF tool, namely:

- The road condition is based on the average condition of the whole length of the road. It fails to provide detailed condition for one segment or at least an interval of 100m.
- Limited qualifiers per condition
- Non-inclusion of crown shape, gravel thickness and material quality in the condition assessment of the gravel road which are vital elements in the determination if it is in maintainable condition or not
- Visual Road Condition is highly subjective which is entirely based on the appreciation of the PEO/CEO assessors.

The Road Board recommended to DILG the adoption of the DPWH's Visual Road Condition Assessment Manual as a tool in collecting the condition of the local road assets. The DPWH manual has been used since 2006 and further improvements introduced by DPWH particularly on the procedure and method of measurements, and most importantly on the safety and comfort of the rater.

This manual will adopt the DPWH ROCOND manual with some modifications to fit the requirements of the LGU. The constraints for the LGU are: limited time, inadequate workforce and meager financial resources in conducting the road assessment. The DPWH ROCOND has very extensive assessment of concrete and asphalt roads but the inventory of paved local roads only accounted for 20% of the total road network. This makes the visual condition survey easier to execute for local roads.

2. Inspection Methods and Procedures

2.1. General

This manual for visual road condition rating is designed only for roads with either a “local” or “non-metropolitan urban” environment and is aimed to assist in the rating of current road conditions in a uniform and consistent manner. This will ensure the uniformity of input to the Road and Bridge Information System (RBIS) and other applications to be developed by the DILG or LGU for the local road planning and management process that depend upon data integrity.

The raters are the designated LGU LRBICS Survey Team who are trained in the proper methods and procedures of inspection with experience in road maintenance, construction or material testing that ensures a common and consistent approach to road condition assessment.

Rating the road can be done using such comments as: good, fair, poor or bad. However, the opinion of what was good, fair, poor or bad vary from rater to rater. Hence, rating is done instead using measurements, which is a more precise method. The rating usually involves measuring some dimensions of the item being rated. The definition of what each rating means is found in the words that accompany the item’s condition codes.

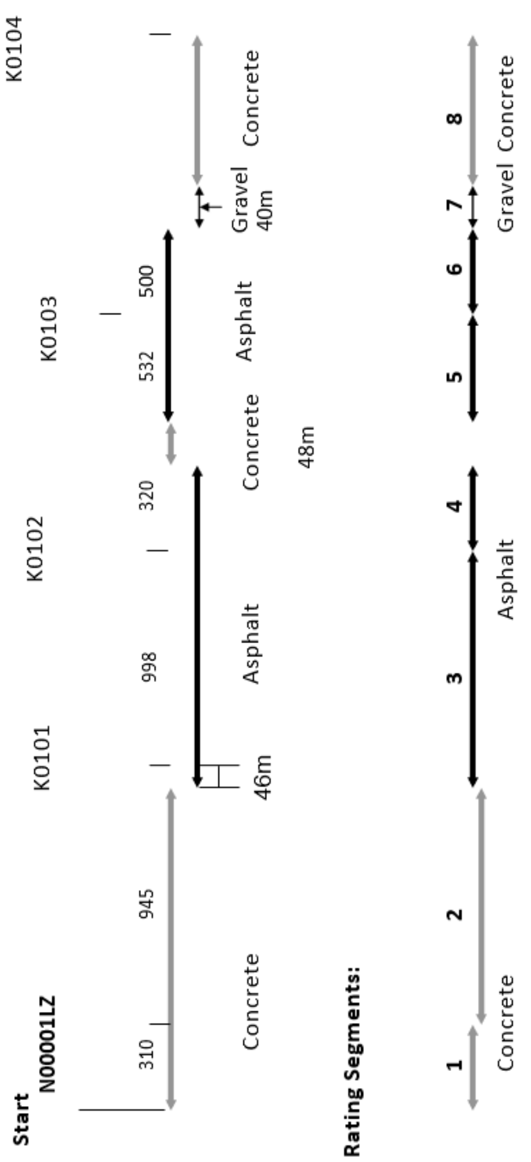
Where the condition of any item constitutes a hazardous situation at a particular location, the matter should be reported immediately to the relevant authority for urgent attention.

2.2. Rating Segments

The application of LRBICS rating system will require the assessment of segments generally designated as between consecutive kilometer posts or based on the following conditions (refer to Figure 3-1 and 3-2):

- A new segment is created in between two consecutive kilometer posts.
- A new segment is created when the surface type changes, hence there can be more than one segment on two consecutive kilometer posts.
- Only pavement lengths that are greater than or equal to 50m in length are to be surveyed, with the exception of gravel/earth segments, which area rated irrespective of their length.
- If there is less than 50m of the same surface type before or after a kilometer posts then this should be added to the adjacent segment.
- If there is a missing kilometer post that is already established in the RBIS, adopt the chainage in the RBIS
- If the distance of two (2) consecutive kilometer posts exceed 1,300m of homogenous surface, adopt the 1,000m rating
- If there is totally no existing kilometer post (for newly converted sections), adopt the 1,000m rating interval
- If the number of lanes changes for more than 50m then this should also be considered a separate segment.
- Bridge regardless of length is considered as not assessable segment in the LRBICS Assessment hence, this should always be cut from the road assessment. The limit or length of the bridge is at back of back wall of both abutments. For steel deck, bailey and timber bridges, adopt the preceding inventory surface type as the LRBICS Assessment type. For concrete and steel bridges, adopt the running surface type (either asphalt or concrete).
- A segment can be cut if there is a difference in the year of surfacing/re- construction and if there is a distinct change in the condition of the pavement.

Figure 3-1: LRPs and Surface Types



Rating Segments:

START	END	LENGTH	ASSESSMENT TYPE
K0100-310	K0100+000	310	Concrete
K0100+000	K0100+945	945	Concrete
K0100+945	K0102+000	1044	Asphalt
K0102+000	K0102+320	320	Asphalt
K0102+368	K0103+000	532	Asphalt
K0103+000	K0103+500	500	Asphalt
K0103+500	K0103+540	40	Gravel
K0103+540	K0104+000	560	Concrete

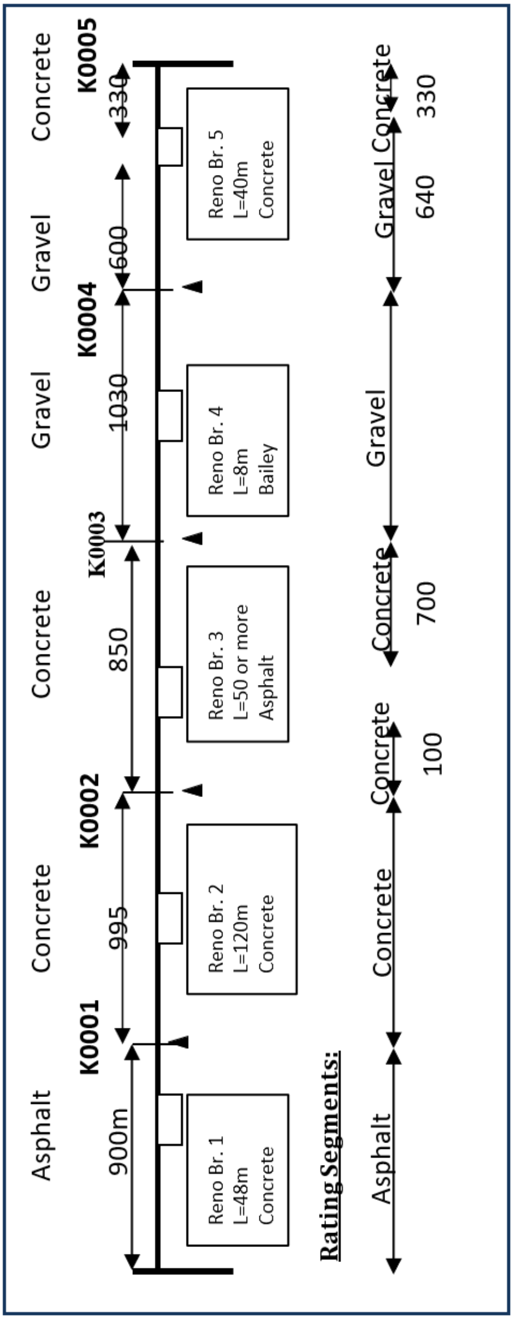


Figure 3-2: LRP Bridges and Surfaces

To ensure that the raters correctly identify the required segment, pre-printed forms will be used. These clearly show which segment between consecutive kilometer posts requires assessment.

In other cases, kilometer posts may not be available for location referencing or have not been previously entered into the RBIS. In this situation, the rater must complete the Location Details on the Condition Assessment Form manually. In these cases, the maximum segment length is 1,000m unless the next segment is less than 50m in length, in which case it will then be included with the previous segment.

Within segments, some items are rated on the basis of a two lane 50 meter gauging length that is located between 0m and 50m from the beginning of the segment to be rated. The position of the gauging length can be moved if there is a valid reason, see Section 2.2.

It is suggested that the established segment and gauging points be marked with paint in the pavement edge or adjacent permanent reference so that in the conduct of survey in the succeeding years, the points will not be measured again and eventually the duration of survey/inspection will be shortened.

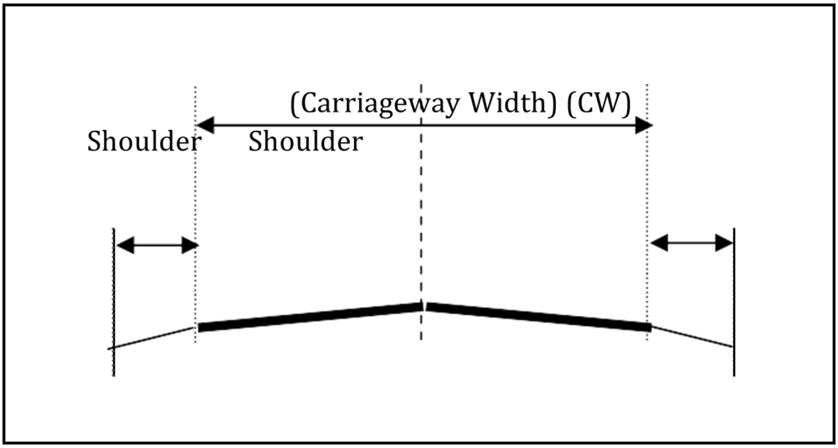
3. Condition of Local Road to be assessed

3.1. Carriageway

Due to the nature of road construction, the pavement type is usually uniform across its width. However, carriageway widths will vary. Carriageway Width (CW) is the width of surfacing designed to carry traffic and is used in computations for calculating the area affected by various pavement distress types. For the purposes of this methodology it is to be measured at the start point of the 50m gauging length.

The main instance that carriageway width will be determined is illustrated in Figure 3-3. Other situations may also occur that require interpretation. These other situations usually occur where there are no edge lines and there are excessively wide shoulders. For combination of asphalt and concrete surface types, adopt only the carriageway width of the surface type being assessed.

Figure 3-3: Carriageway Width



3.2. Distress Types and Rating Methods

Once the segments have been selected as described in Section 2.2, the rating process can begin. On a two-lane road, some items are rated over the segment's total carriageway area, while other items are rated over a 50m gauging length or the first 10 slab joints. A summary of the distress types rated by the two methods is detailed in Table 3-5.

Table 3-5: Distress Types Rating Method

Surface Type	Distress Type	Method of Measurement
Flexible Pavement (Asphalt)	Rutting	Measured over the 50m gauging length (2 lanes)
	Edge Break	Measured over the whole segment
	Patches	Measured over the whole segment
	Potholes/Base Failure	Measured over the whole segment
	Surface Failures	Measured over the whole segment
	Wearing Surface	Measured over the whole segment
	Cracking	Measured over the whole segment
	Road Cut/Slip	Measured over the whole segment

Rigid Pavement (Concrete)	Shattered Slabs	Measured over the whole segment
	Wearing Surface	Measured over the whole segment
	Multiple Cracking	Measured over the whole segment
	Road Cut/Slip	Measured over the whole segment
	Joint Faulting	Measured over the 1st 10 slab joints (1 lane only)
	Joint Spalling	Measured over the 1st 10 slab joints (1 lane only)
	Joint Sealant	Measured over the 1st 10 slab joints (1 lane only)
Unsealed Pavement (Gravel/Earth)	Gravel Thickness	Measured over the whole segment
	Material Quality	Measured over the whole segment
	Crown Shape	Measured over the whole segment
	Roadside Drainage	Measured over the whole segment
	Road Cut/Slip	Measured over the whole segment
Other Items	Drainage (Side Drains)	Measured over the whole segment
	Unsealed Shoulders	Measured over the whole segment
	Sealed Shoulders	Measured over the whole segment

3.3. Gauging Length

As mentioned in Section 2.2, segments are sometimes rated on the basis of a representative gauging length: a 50 meter gauging length for flexible pavements (asphalt), and first 10 slabs for rigid pavement (concrete) both measured from the beginning of the segment to be rated.

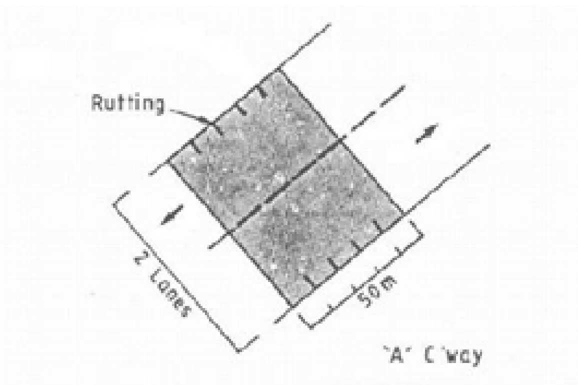
3.3.1. Measurement Over Gauging Length for Flexible Pavement

The 50m gauging length for flexible pavement (asphalt) is to be located between 0m and 50m from the start of the segment in the direction of increasing chainage. The position of the gauging length can be moved from 0m if this occurs on a bridge, in an intersection, there is on-going road works, or if there are other obstructions (shattered slabs, patches, sealants) influencing the ability to perform the measurement. Where possible, the position of the gauging length should remain in the same year. If the gauging length is not positioned at the start of the segment, then the gauging length location must be recorded in the comments field. The reason that the same gauging length should be used every year is for comparison of the road condition from one year to the next.

Rutting is the only type of distress in flexible pavement that is measured over the 50m gauging length (refer to Table 3-5). On multi-lane roads, only the outer two lanes are rated for rutting. The inner lanes can be used in cases where the road has been widened and the inner lanes have many more defects than the outer lanes. Refer to Figures 3-4 to 3-6.

On divided carriageways (that are recorded as separate sections), each carriageway is treated as a separate road and assessed accordingly. The outer lanes are again rated for the

Figure 3-4:Two Lane Road Gauging Length



rutting. Refer to Figure 3-7.

On multilane local roads, (flexible pavements) only the outer two lanes are rated for rutting. The inner lanes can be used in cases where the road has been widened and the inner lanes have many more defects than the outer lanes.

Figure3-5: Four Lane Road Gauging Length

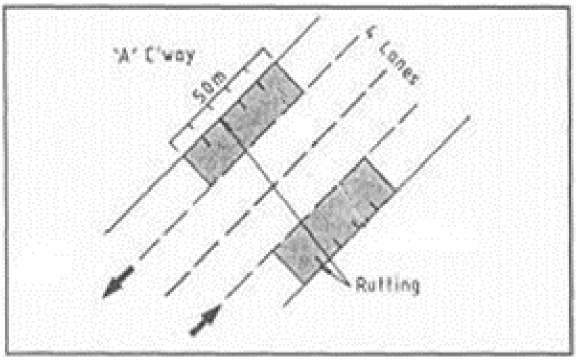


Figure 3-6: Three Lane Road Gauging Length

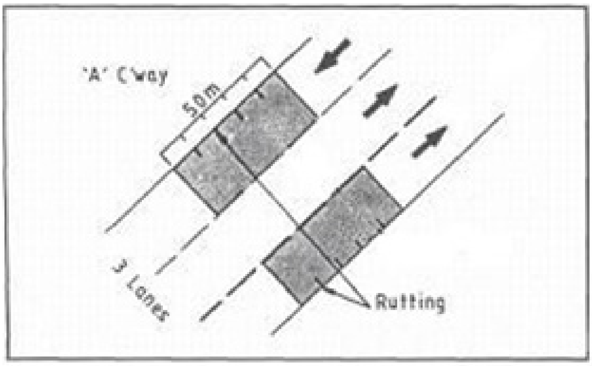
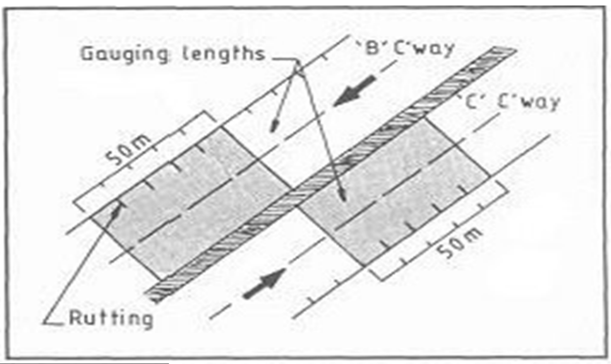


Figure 3- 7: Divided Carriageway Gauging Length

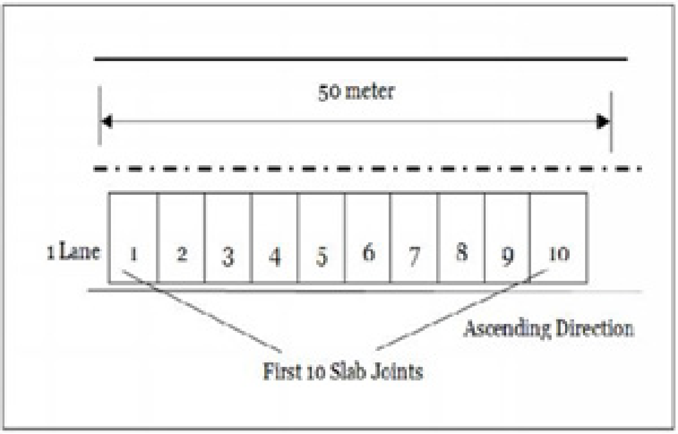


On divided carriageways (that are recorded as separate sections) each carriageway is treated as a separate road and assessed accordingly. The outer two lanes are again rated for rutting.

3.3.2. Measurement Over Gauging Length for Rigid Pavement

For rigid pavement roads (concrete), regardless of the number of lanes, the gauging length of first 10 slabs is to be applied only in SINGLE lane in the direction of increasing chainage but can be assessed on the side of the road with decreasing chainage if that side of the road is in an inferior condition, possibly due to heavier traffic. The three distress types that are rated over the gauging length of first 10 slabs of road segment are: joint faulting, joint spalling, an joint sealant. The location of gauging length of first 10 slabs should follow the provisions for rigid pavement in Section 3.4.2. Refer to Figure 3-8.

Figure 3-8 :Two Lane Rigid Pavement Road



3.4. Location in the Road System

The location of start and end points for each rating segment is described by reference to the nearest kilometer post. The distance of the start and end point of the survey is clearly marked at the top of the form. In situation where there is less than 1 km of continuous pavement with the same surface type between two kilometer posts may be more than one form to complete (one of each pavement length that is greater than 50m in length).

In certain cases where there are no kilometer posts, the start and end points of each kilometer will have to be determined from Location Reference Reports and measuring distance from the nearest node. In this situation the rating segments should be greater than 50m but not more than 1000m. The locations of the start and end point of each segment are to be determined using the same principles as described in section 2.2. It is suggested that each rater obtain a hard copy of a report from RBIS detailing the locations of surface types, as this can be used to assist with identifying the start and end points of segments in the field. Other RBIS reports that provide location details of nodes and bridges may be also useful for this purpose.

Any field discrepancies in location information should be checked and referred to PEO/CEO Planning Division for resurvey and updating of the LRS.

3.5. Procedure for Rating

3.5.1. General Survey Procedure

The rater should follow the general procedure for the conduct LRBICS survey as follows:

a. The LRBICS Coordinator should brief the Survey Team on the proper methods and procedures.
b. Prepare the Survey Forms to be accomplished for each day based on the program.
c. Check the tools, equipment and other materials to be used.
d. At the site, locate the location of the start of the segment

to be assessed based on the information in the pre-printed forms.

e. Measure the distances of sections/points to be assessed within the segment length as follows:

   - Gauging length for flexible pavement: every 10m from the start of segment for a distance of 50m
   - Gauging length for rigid pavement: every slab starting from the start of the segment for the first 10 slabs
   - Every 100m from the start of segment for the entire length of segment for all types

f. Mark the measured distances with paint along the edge of the pavement or other adjacent permanent references in increasing chainage. These markings will be the bases of the next surveys to avoid re-measurement of distances and shorten the duration of survey.

g. Using a slow moving vehicle, observe and look for defects.

h. Stop at every location of road distress. Measure the affected area and assess the severity of damage.

i. At all times during the survey, be aware of running vehicles and always observe safety.

j. Have the accomplished forms for each day compiled properly for encoding.

k. After encoding, submit the hard copy and electronic copy together with the duly signed LRBICS Assessment Survey Form to the PEO/CEO Office.

3.5.2. Condition Rating Procedure

The individual segments are assessed by walking over segment`s total carriageway area. Information is recorded on the appropriate field worksheet in Section 4 for input into the RBIS.

For newly constructed/rehabilitated/overlaid, unsealed roads and/or roads with few defects, it is recommended that the condition of items be assessed on one side of the roadway at a time. The side being traveled should be the one assessed and the opposite on the return pass. This enables more accurate condition assessment, calculation of affected areas and is safer.

It is suggested that initially, a number of passes be undertaken to assess the condition of items rated over the total carriageway area of segment. However, with experience and depending upon pavement condition and traffic volumes, most segments can be properly rated with a single pass in each direction.

The items rated in this way are indicated in Table 3.5. The total carriageway area of the segment over which the above items are rated is defined as the carriageway width (as measured at the start point lengths) times the length of the segment.

When the two lane 50 meter (for flexible pavement) or first 10 slabs (for rigid pavement) gauging length is selected, information is gathered on the field worksheet for output into the RBIS.

The two lane 50 meter (for flexible pavement) or first 10 slab (for rigid pavement) gauging length is then marked and the items within this length are assessed. These items include: rutting for flexible pavement, and joint sealant, joint faulting and joint spalling for rigid pavement.

This information is recorded on the appropriate field worksheet for output into the RBIS. This spreadsheet carries out the necessary computations and the import files for loading into RBIS.

Any relevant comments a rater wishes to make should be written at the bottom of the survey form so that it can be taken into account during data entry. Data entry of these comments should start at the provided pick list as shown below to enable easy searching of the comment field. Comments may record various circumstance including:

- Committed Project (Key word-“ Committed”)
- For “not assessable segment” (keywords-Under Construction, Length <50m, Bridge, etc.)

Also, even if the segment is not assessable, it is required to have an assessment form indicating the location details, existing surface type and the reasons why the segment is not assessable in the raters comment.

This information is useful for the LRBICS Regional Coordinators in the Regional Offices and should be noted during the processing of data.

This completes the rating of segment and the procedure is repeated until all segments have been rated.

3.5.3. Recording of Ratings

The condition rating assessment is to be recorded on the field worksheet provided in Annex B. Two types are provided; the first is a pre-printed type, which provides a guide and details of the segments to be rated, based on current data available in the RBIS. The second is a blank form that is to be used where data is not available for the road in the RBIS. This may typically occur when the data in the RBIS has not yet been updated or otherwise in situations where kilometer posts are not available for location referencing.

A blank form is also used where the pavement type differs from that of the pre-printed form. It is suggested that the blank copy of the field worksheet be kept as an original and photocopied to obtain additional sheets as required.

Refer to Section 4for the details of survey forms.

3.6. Equipment

A number of equipment items, some specialized, are required during the course of assessing various items. These items include:

- Straight Edge, 1.2m long
- Measuring Wedge
- Ruler in mm
- Crack Width Scale

- Measuring Wheel
- Spray Paint (or other appropriate road marking materials, e.g. Chalk)

PEO/CEO should purchase or manufacture all equipment. Dimensioned drawings to assist in making the straight edge, measuring wedge and crack width scale are shown in Section 6.

During the survey, some items in the rating segment are examined in detail at representative lengths. On these occasions or when the vehicle is stopped for quick inspections, the rating vehicle should be moved to the side so that wherever possible, there is no obstruction to traffic.

Safety equipment for traffic guidance should include:

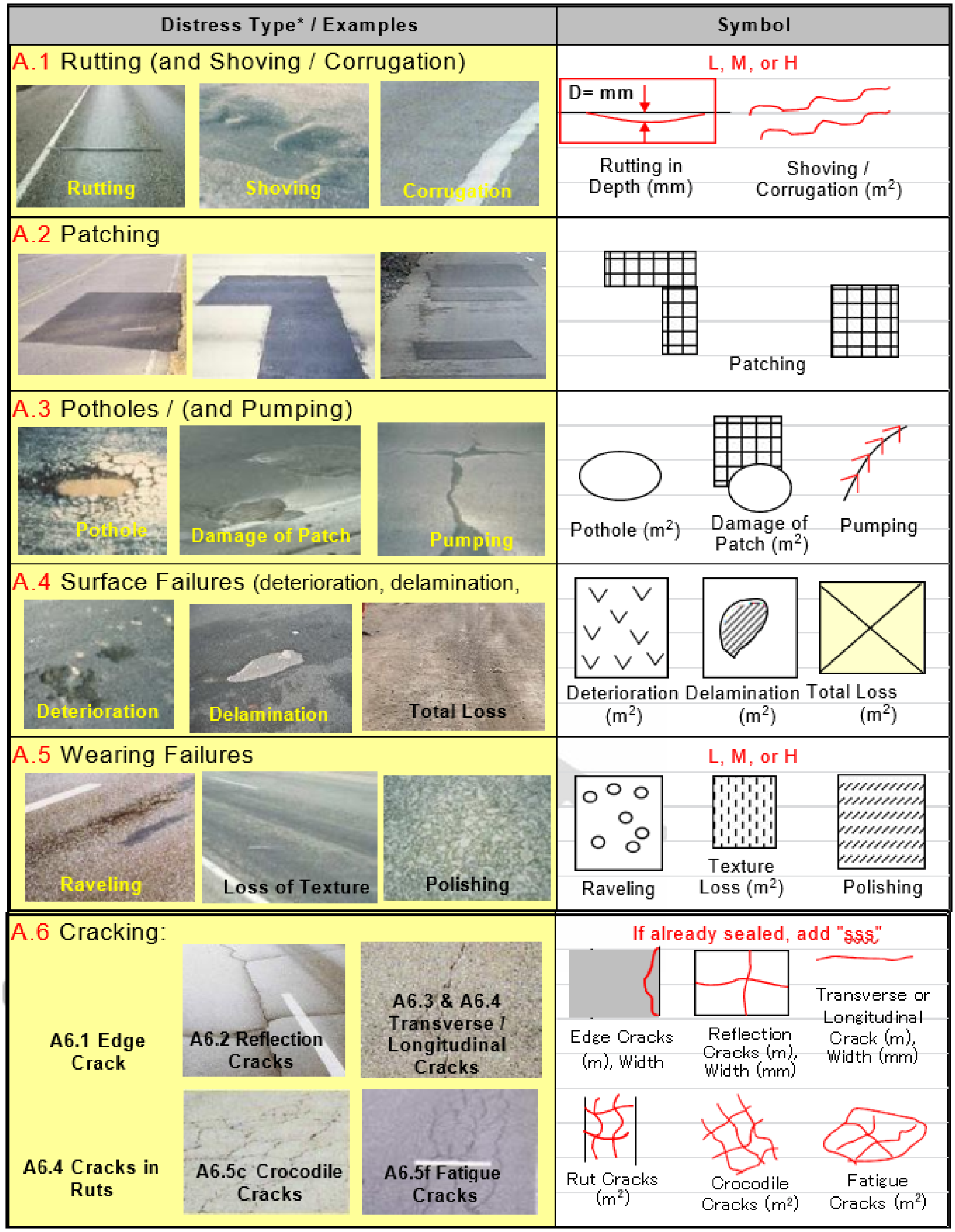
- Safety Vests
- Traffic Guidance Cones
- Appropriate Advance Warning Signs

Note: A traffic controller may be required in some sections where there is difficult alignment or high traffic volumes.

3.7. Sample Surface Distress

The DPWH Guidebook for Road Construction and Maintenance Management provides the typical defects or distresses of Asphalt Concrete Pavement (ACP) and Portland Cement Concrete Pavement (PCCP) shown in Figures 3-9and 3-10. Also, the same guidebook provided major causes and repair methods for each distress of ACP and PCCP as shown in Tables 3-6 and 3-7. About 20% of the local roads are sealed/paved roads and manifest any of the sample surface distresses. The illustrations will guide the rater in conducting the road condition survey.

Figure 3-9:Asphalt Concrete Distress



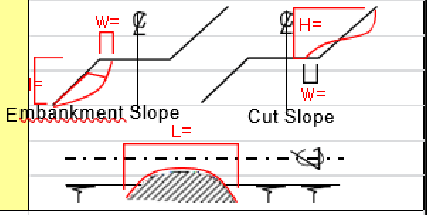
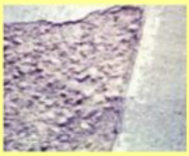
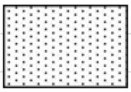
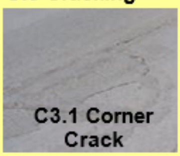
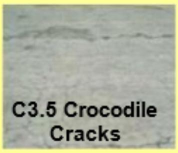
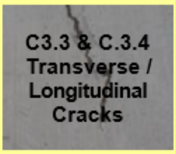
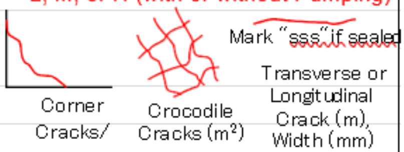
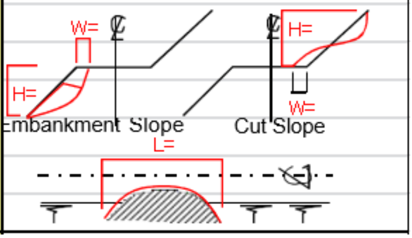
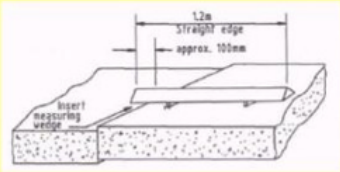
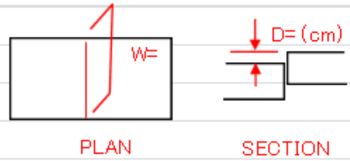
A.7 Road Cut/Slip  	L, M, or H 
Notes: 1. Distress type in accordance with RECOND/DPWH	
2. L (Low), M (Moderate) and H (High) severity	

Figure 3- 10: PCCP Distress

Distress Type* / Examples	Symbol
C.1 Shattered Slabs (and Patch)   	L, M, or H (with or without Pumping)  Area (m^2) and number of panels; Area (m^2) and number of panels
C.2 Scaling   	L, M, or H  Area (m^2) and number of panels
C.3 Cracking   	L, M, or H (with or without Pumping) 
C.4 Road Cut/Slip  	L, M, or H 

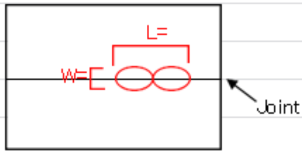
C.5 Joint Faulting





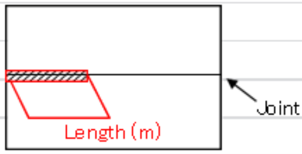
C.6 Joint Spalling

L, M, or H (with or without Pumping)



C.7 Joint Sealant

L, M, or H (with or without Pumping)



Notes: 1. Distress type in accordance with RECOND/DPWH
2. L (Low), M (Moderate) and H (High) severity

Table 3-6: Pavement Distress, Major Causes and Repair Methods for ACP

Distress Type	Major Causes	Common Repair Method
A.1 Rutting (corrugation and shoving)	Consolidation and lateral movement of AC, base, overload Lack of AC stability (too much asphalt, too much fines, round aggregates, lack of aeration)	Overlay, mill and resurfacing Remove and reconstruct or patches, plane surface and overlay
A.2 Edge Break	Insufficient compaction, loss of lateral support, aging	Patch

A.3 Potholes	Weakness in pavement (little asphalt, spot thickness defects, less fine or excess fines, poor drainage	Remove, replace and patch
A.4 Surface Failures (deterioration, delamination, edge)	Aging, weather, improper tack coat between PCC and AC overlay, construction on wet PCC	Overlay (after spot failure repair), Patches
A.5 Wearing Surface (Raveling, flushing, polishing)	Insufficient compaction, construction during wet, dirty aggregate, asphalt overheating, insufficient asphalt	Seal coat, Thin overlay
A.6 Cracking: A.6.1 Edge cracks A.6.2 Reflection cracks A.6.3 Transverse and Longitudinal cracks A.6.4 Cracks along ruts A.6.5 Crocodile cracks/ Fatigue Cracks	• Lack of lateral support, settlement (poor drainage or weak foundation), lack of lateral support • Reflection of cracks from underneath (concrete pavement joints, SCB cracks, AC cracks) • Volume change of surface or base materials, low asphalt penetration, aging, etc. • Overloads, passing of heavy vehicles (see rutting) • Excessive deflection over unstable base and subgrade, overload, poor drainage, aging	Crack sealing, patches
A.7 Road Cut/ Slip	Slope failure, landslide, scouring, slip	(depends on causes and condition)
A.8 Shoulder (Erosion, pothole, high gap, insufficient fill, vegetation)	Steep slope, lack of maintenance, pass of traffic, inadequate cross-fall, side drainage, lack of surface protection, lack of shoulder materials	Add materials and compaction, Sealing, patches, grading, grass cut

Table 3-7: Pavement Distress, Major Causes and Repair Methods for PCCPRepair Methods for ACP

Distress Type	Major Causes	Common Repair Method
A.1 Shattered Slabs	Sun grade and/or base failure, lack of dowel bars (load transfer problem), insufficient slab thickness, foundation settlement, low concrete quality	Full depth repair (slab replacement)
A.2 Scaling/ Wearing Surface	Over-finishing, improper curing, unsuitable aggregates, chemical action	Slurry seal, a skid resistance treatment, AC overlay
A.3 Cracking: A.3.1 Corner cracks A.3.2 Diagonal cracks A.3.3 Longitudinal cracks A.3.4 Transverse cracks A.3.5 Multiple cracking	• Traffic loads on unsupported corners, spot weak subgrade/base • Traffic loads on unsupported slab end, subgrade settlement, pumping Shrinkage of concrete, expansive base/ subgrade, loss of support from edge pumping • Overloads, repeated bending on pumping slabs, failure of foundation, shrinkage • Improper load transfer devise, base/ • subgrade weakness, insufficient slab thickness, settlement	Crack sealing, remove and replace
A.4 Road Cut/ Slip	Slope failure, landslide, scouring, slip	(depends on causes and condition)
A.5 Joint Faulting (+ Pumping)	Inadequate transfer, pumping Freewater on or in subgrade or base and deflection of slab	Raise of slabs Drainage improvement, joint resealing, dowel bar introduction

A.6 Joint Spalling	Segregation of aggregate, improper load transfer device, improper joint forming, joint sawing, joint compression	Joint spall repair (Epoxy patching, AC patching
A.7 Joint Sealant	Aging, low quality, pumping, cracking	Joint resealing
A.8 Shoulder (Erosion, pothole, high gaps, insufficient fill, vegetation)	Steep slope, lack of maintenance, pass of traffic, inadequate cross-fall, side drainage, lack of surface protection, lack of shoulder materials	Add materials and compaction, Sealing, patching, grading, grass cut

4. Survey Forms

There are different types of visual condition assessment forms developed for LRBICS survey depending upon the type of road since each type has different attributes to be assessed for distresses with different methods of measuring the distresses.

The number of forms to be used depends upon the number of segment to be assessed: one form for each segment. Survey forms are either pre-printed or blank.

4.1. Survey Form for Flexible Pavement (Asphalt)

The survey form to be used to rate the condition of flexible pavement (asphalt)can be found in Annex B.

The form includes the location details/ description of the road section and segment to be assessed and the measurement of distresses for condition rating.

Table 3-8: Type of Distress to be Evaluated, Asphalt

Type of Distress	Segment to be Assessed
Rutting	50 m gauging length
Edge Break	Whole segment
Patches	Whole segment
Potholes	Whole segment
Surface Failures	Whole segment
Wearing Surface	Whole segment
Cracking	Whole segment
Road Slip/Cut	Whole segment
Other Items	
(Drains, Unsealed Shoulder & Sealed Shoulder)	Whole Segment

The following procedure should be followed in accomplishing the form:

Table 3-9: Procedure for Recording Type of Distress, Asphalt

Type of Distress	Procedure
Rutting	The depth of rutting in mm is recorded for every 10m of the 50m gauging length equivalent to 5 locations in 4 points across the road: the outer and inner wheel paths of increasing chainage, and the inner and outer wheel paths of decreasing chainage. Refer to Section 5.1.6.
Edge Break	The length of edge break in meters and severity of distress (S-small, M-medium, L-large) are recorded for every 100m of the road segment being assessed (generally 10 sub-segments between kilometer posts). Refer to Section 5.1.8.
Patches	The length of patches in meters is recorded for the corresponding width of 0.5m, 1.0m, 1.5m, or 2.0m for every 100m of segment

Potholes and Surface Failures	The number of potholes or surface failures (a number has an area equivalent to 0.5mx0.5m or 0.25 sq.m.) is recorded for every 100m of segment length. For base failure, the number of equivalent potholes is 1 sq.m. of base failure is equivalent to 1 pothole. Refer to Sections 5.1.2 and 5.1.4.
Wearing Surface	The length of wearing surface in meters and severity of distress (M- minor, S-severe) are recorded for the corresponding width of 0.5m, 1.0m, 1.5m, 2.0m or the whole lane width for every 100m of segment length. Refer to Section 5.1.7.
Cracking	The length of cracking in meters and severity of distress (N-narrow, W-wide) are recorded for the corresponding width (transverse or longitudinal cracking-0.5m, crocodile cracking-0.5m, 1.0m, 1.5m, 2.0m or the whole lane) for every 100m of segment length. Refer to 5.1.5.
Road Slip/Cut	This item is assessed over the total carriageway area of the segment and is rated simply by checking the supplied box. Refer to Section 5.1.3.
Other Items (Drains, Unsealed Shoulder & Sealed Shoulder)	The rating in the scale of 1 to 5 are recorded for every 100m of the segment length, the average (rounded off to the nearest whole number) are recorded as the final rating of the segment. Refer to Sections 5.4.1, 5.5.1 and 5.5.2.

Rater's comment shall be supplied as indicated in Section 3.4.2 at the bottom of the form.

The carriageway and lane width, date of survey and the name of the rater should be properly indicated at the top portion of the sheet. The description of the road and segments are indicated in the location details also seen at the top portion of the pre-printed forms.

4.2. Survey Form for Rigid Pavement (Concrete)

The survey form to be used to rate the condition of rigid pavement (concrete) is shown in Annex B.

The form includes the location details/description of the road section and segment to be assessed and the measurement of distresses for condition rating.

Table 3-10: Type of Distress to be Evaluated, Concrete

Type of Distress	Segment to be Assessed
Shattered Slab	Whole segment
Joint Faulting	First 10 slabs
Joint Spalling	First 10 slabs
Joint Sealant	First 10 slabs
Scaling	Whole segment
Cracking	Whole segment
Road Slip/Cut	Whole segment
Other items	Whole segment

The following procedure should be followed in accomplishing the form:

Table 3-11: Procedure for Recording Type of Distress, Concrete

Type of Distress	Procedure
Shattered Slab	The number of shattered slabs is recorded for the corresponding lane every 100m of segment length. Refer to Section 5.2.5.
Joint Faulting	The depths of faulting in mm at the outer and inner sides of transverse joint are recorded for the first 10 slabs (gauging length) of the segment. Refer to Section 5.2.2.
Joint Spalling	The width in mm and length in meters of spalling at longitudinal and transverse joints are recorded for the first 10 slabs (gauging length) of the segment. Refer to Section 5.2.3.

Joint Sealant	The length of transverse and longitudinal joints in meters with sealant deterioration are summed up and recorded for the first 10 slabs (gauging length) of the segment. Refer to Section 5.2.1.
Wearing Surface	The length of wearing surface defects in meters and severity of distress (M-minor, S-severe) are recorded for the corresponding lane every 100m of segment length. Refer to Section 5.2.7.
Cracking	The length of cracking in meters and severity of distress (N-narrow, W-wide) are recorded for the corresponding width (transverse or longitudinal cracking-0.5m, multiple cracking-for every lane, for every 100m of segment length. Refer to Section 5.2.4.
Road Slip/Cut	This item is assessed over the total carriageway area of the segment and is rated simply by checking the supplied box. Refer to Section 5.2.6.
Other Items (Drains, Unsealed Shoulder & Sealed Shoulder)	The rating in the scale of 1 to 5 are recorded for every 100m of the segment length, the average (rounded off to the nearest whole number) are recorded as the final rating of the segment. Refer to Sections 5.4.1, 5.5.1 and 5.5.2.

Rater's comment shall be supplied as indicated in Section 3.4.2 at the bottom of the form.

Other information to be supplied is the same with that for flexible pavement.

4.3. Survey Form for Unsealed Pavement (Gravel)

The survey form to be used to rate the condition of unsealed pavement (gravel/ earth) is found in Annex B.

The form includes the location details/description of the road section and segment to be assessed and the five (5) criteria for condition rating.

The Five(5) Criteria to be evaluated are:

Table 3-12: Type of Distress to be Evaluated, Gravel

Type of Distress	Segment to be Assessed
Gravel Thickness	Whole segment
Material Quality	Whole segment
Crown Shape	Whole segment
Roadside Drainage	Whole segment
Road cut/Slip	Whole segment

The following procedure should be followed in accomplishing the form:

Table 3-13: Procedure for Recording Type of Distress, Gravel

Type of Distress	Procedure
Gravel Thickness	The thickness of gravel surfacing is assessed for the whole segment length and the thickness will be measured at the mid-point of the segment. Refer to Section 5.3.1.
Material Quality	The quality of gravel surfacing is assessed for every 100m of segment length and the average (rounded off to whole number) for the whole segment is recorded. Refer to Section 5.3.2.
Crown Shape	The shape of the crown of the carriageway of gravel surfacing is assessed for every 100m of segment length and the average (rounded off to whole number) for the whole segment is recorded. Refer to Section 5.3.3.
Roadside Drainage	The ability to drain water away from the carriageway of the road of gravel surfacing is assessed for every 100m of segment length and the average (rounded off to whole number) for the whole segment is recorded. Refer to Section 5.3.4.
Roadcut/Slip	This item is assessed over the total carriageway area of the segment and is rated simply by checking the supplied box. Refer to Section 5.3.5.

Check appropriate box if surface type is gravel or earth.

Rater's comment shall be supplied as indicated in Section 3.4.2 at the bottom of the form.

Other information to be supplied is the same with that for flexible and rigid pavement.

5. Condition Rating

5.1. Flexible Pavement (Asphalt)

5.1.1. Patches (Flexible Pavement)

Assessed over total area of segments

Definition

For rating purposes, a patch is defined as a successfully executed permanent repair. It provides a surface condition equivalent to the surrounding pavement surface and provides a waterproof seal over its surface and around its perimeter. Any defects found within a patch should be recorded under the applicable item.

E.g. a patched that is cracked should not be rated as a patch but the cracks should be rated as cracks or a patch that is disintegrating should be rated

Figure 3- 11:A cracked patch which is rated as cracking and not patching followed by a successful path which is rated as patch

as wearing surface or surface failures unless the disintegration penetrates into the unbound layer, in which case it should be rated as a pothole.

Purpose

If a road repair has been successful, there may be no pavement defects to rate in that segment of road. A new road also has no defects. That there are no defects to rate may imply that the road is brand new. However, we know that if the road has been repaired, it is probably older and more likely to fail again than a brand new road. We therefore rate even the successful patches as a way of gaining some understanding of the likely life of the remainder of the pavement in that segment. Thus there is no limit to the size of a patch. Patches of all sizes should be rated.

Method

This item is assessed over the total carriageway area of the segment. (Refer to Section 3.4.2). Patches is rated according to t e areas affected within the carriageway area over the total carriageway area and expressed as a percentage.

Measurement

The length of patches per width band is rated and recorded every 100m lengths.

Example: (Assessed over total carriageway area of segment)

In the first 100m of a segment there are 3 patches, all 0.5m wide and measuring 1.5, 3.0 and 1.0m in length. There are 5 patches in the fourth 100m segment, two with a width of 0.5m or less and a length of 0.5 and 1.0m. Another two patches 1.5 m wide with lengths of 3.0 and 4.0m long. These patches will be recorded as follows:

Width	Length (m)									
	100	200	300	400	500	600	700	800	900	1000
0.5	5.5			1.5						
1.0										
1.5				7.0						
2.0										

5.1.2. Potholes (Flexible Pavement)
Assessed over total area of segments

Definition

Figure 3-12: Example of Pothole

Holes of various shapes and sizes in the pavement surface. For rating purposes, severe cracking with base failure/ settlement/depression (unbound layer) shall also be considered as potholes. Localized crocodile cracking around potholes should be assessed under "Potholes. Road Slip or Cut are not considered as Potholes but are marked in the applicable check box.

A successfully patched area is not a pothole. (See the item "Patches (Flexible Pavement)" in section 5.1.1).

Purpose

Many of the potholes rated in this item will be fixed in a matter of weeks and as such, are of little value to the long-term determination of maintenance strategies.

However, the measurement of these potholes in a road gives a good indication of the general condition of the pavement and future deterioration.

Method

This item is assessed over the total carriageway area of the segment. (Refer to "Procedure For Rating" in section 3.4.2)

Potholes are rated according to the number of potholes, recorded according to the diameter of the potholes within the carriageway area over the total length of the segment.

Measurement

The number of potholes is rated per 100m lengths. One (1) pothole is equivalent to 0.25 m2, however, for a base failure greater than 1m2 in area then each 1m2 is counted as a pothole. A base failure covering an area of 2m x 1.5m is counted as 3 potholes. The number of potholes is convertedto represent the number of potholes on an equivalent 1000m long road that is 5.5m wide. Therefore a segment 500m long and 5.5m wide that has 1 pothole is equivalent to 2 potholes on a 1000m segment that is 5.5m wide. This calculation is done within the RBIS.

Example: (Assessed over total carriageway area of segment)

In the first 100m of a segment there are 2 potholes, both 0.5m wide and measuring 0.5 and 1.0m in length. There is 1 base failure in the third 100m segment, measuring 1.5m by 4m. These potholes will be recorded as follows:

Number of Potholes									
100	200	300	400	500	600	700	800	900	1000

5.1.3. Road Slip/Cut (Flexible Pavement)
Assessed over total area of segments

Definition
Road Slip/Cut is a serious problem due to slope failure and requires immediate attention.

Purpose
Road Slip/Cut should be fixed in a matter of weeks and as such, is of little value to the long-term determination of maintenance strategies. This item is not included calculations but is included as a warning that immediate attention is required.

in the VCI calculations, but is included as a warning that immediate attention is required.

Method

This item is assessed over the total carriageway area of the segment and is rated simply by checking the supplied box if there are any Road Slip/Cut present irrespective of the number of occurrences per segment.

5.1.4. Surface Failures (Flexible Pavement)

Assessed over total area of segment

Definition

Surface Failures, are loss of a discrete and large area of the wearing course layer. These Failures can be caused by wearing course deterioration, surface delamination or mechanical damage. Surface delamination frequently occurs in asphalt that has been overlaid on a concrete pavement. Usually there is a clear delineation of the wearing course and the concrete layer below.

A successfully patched area is not a surface failure. (See the item "Patches (Flexible Pavement)" in section 5.1.1).

Figure 3-13:Example of Surface Failure due to wearing course deterioration

Figure 3-14: Surface failure due to delamination

Many of the surface failures rated in this item will be fixed in a matter of weeks and as such, are of little value to the long-term determination of maintenance strategies. However, the measurement of these surface failures in a road gives a good indication of the general condition of the surface.

Method

This item is assessed over the total carriageway area of the segment and is rated using the same methodology as used when assessing Potholes. (Refer to "Procedure For Rating" in section 3.7.2)

Surface Failures are rated according to the number of surface failures, recorded according to the diameter of the surface failures rounded to the nearest 0.5m within the carriageway area over the total length of the segment.

Measurement

The number of surface failures is rated per 100m lengths. One (1) surface failure is equivalent to o.25 m2. The number of surface failures is converted to represent the number of surface failures on an equivalent 1,000m long road that is 5.5m wide (2 lanes). Therefore a segment 500m long and 5.5m wide that has 1 surface failure is equivalent to 2 surface failures on a 1,000m segment that is 5.5m wide. This calculation is done within the RBIS. For 2 surface failures on a 1,000m segment that 5.5m side is computed as 1 surface failure on 1,000 segment that that is 11m wide (4 lanes).

Example: (Assessed over total carriageway area of segment)

In the first 100m of a segment there are 2 surface failures, both 0.5m wide and measuring 0.5 and 1.0m in length. There is 1 surface failure in the third 100m segment, measuring 2m by 1m. These surface failures will be recorded as follows:

Number of Surface Failures									
100	200	300	400	500	600	700	800	900	1000
3		8							

5.1.5. Pavement Cracking (Flexible Pavement)
Assessed over total area of segment

Definition
Cracking is the indicator of surface failure in flexible pavements. (Localized cracking around potholes should be assessed under "Potholes (Flexible Pavement)" in section5.1.2.)

Note: This pavement rating item includes all forms of cracking in flexible pavements. Identification of cracking requires careful examination of the pavement while on foot. It cannot be adequately recognized from a moving or stationary vehicle. Temperature cracks are not considered cracks but reflection cracks are rated as cracks. Cracks that are well sealed are still considered cracks with only narrow severity.

Purpose
Road pavements are designed assuming that the moisture content will remain constant. However, if the road surface is cracked, moisture will enter the pavement and the design assumptions will be void. The deterioration of a road is accelerated if the road is cracked. Cracking is one of the most

frequent forms of distress and one of the most significant. It is therefore important to measure the cracking of a road.

A pavement management system is designed to allow a manager to plan the long term management of a road. Cracking is one of the most significant early signs of long term pavement distress. A detailed examination is required if the early signs of cracking are to be detected.

Method
This item is rated over the entire segment length. (Refer to "Procedure For Rating" in section 3.4.2).

Pavement cracking in the selected lane is inspected on foot and rated according to:

- the type of cracking.
- the severity of distress as indicated by crack width; and
- the length of distress as indicated, this is converted to extent(%) by the data entry spreadsheet.

Severity of cracking is rated according to the predominant average crack width as measured with the Crack Width Scale (see section 6.2) and using the Flexible Pavement Marks.

Extent of cracking is calculated by the RBIS according to the total area of cracking within the segment over the total area of the segment and expressed as a percentage.

Type
The cracking is recorded on the form according to the type of crack.

- Longitudinal Cracking: This is cracking running longitudinally along the pavement. It may be wandering in plan to some extent but is approximately parallel to the road centerline and does not exhibit strongly developed transverse branches.
- Transverse Cracking: This is cracking running transversely across the pavement. The length of such cracks should exceed 0.6 m in order to be significant for rating purposes.
- Crocodile Cracking: This is cracking consisting of

interconnected or interlaced cracks forming a series of small polygons resembling a crocodile hide.

Severity
The severity of distress is:

Narrow 'N'	≤ 3 mm average crack width
Wide 'W'	> 3 mm average crack width

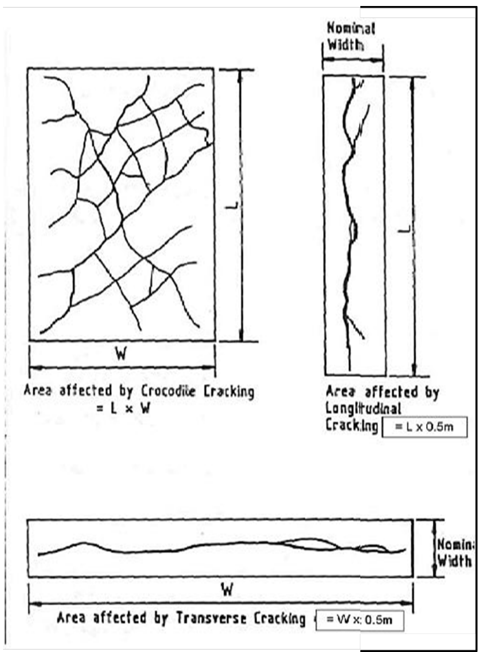
The severity to be adopted is the predominant severity.

Extent
The length of cracks is recorded in meters for Longitudinal and Transverse cracks. The length of Crocodile cracks is recorded in meters per band width.

The affected area of cracking at a location is defined to be rectangular in shape and dependent upon extremities of the cracking.

The affected area for single longitudinal cracking is calculated as the product of the length and a width of 0.5 m. If branching or meandering of the crack affects a more extensive width, then the affected width is used in the calculation. Similarly, the width of the area affected by transverse cracks is taken as 0.5 m unless more extensive. These calculations are done within the RBIS. The sketch illustrates concept.

Figure 3-15: Crocodile Longitudinal and Transverse Cracking



Example:
The following cracks were found in the segment:

- In the first 100m, Longitudinal cracks of 4.0m (N), Crocodile cracks with a width of 0.5m and length of 3.5m (N), width of 2.0m and length of 1.0m (N) and Transverse cracks of 4.0m (N).
- In the second 100m, Lo gitudinal cracks of 2.0m (W), Crocodile cracks with a width of 1.0m and length of 1.5m (W) and the full lane width for 12.0m (Wide).
- In the third and fourth 100m's only two Longitudinal cracks were found 1.5m (N) and 3.0m (W) respectively.

These cracks will be recorded on the form as shown in the following table:

Cracking Flexible Pavement										
Longitudinal	Length	4.0	2.0	1.5	3.0					
	Severity	N	W	N	W					
Crocodile	Width	Length and Severity								
		100	200	300	400	500	600	700	800	900
	0.5	3.5								
	1.0		1.5							
	1.5									
	2.0	1.0								
	Lane		12.0							
	Severity	N	W							
Transverse	Length	4.0								
	Severity	N								

5.1.6. Pavement Rutting (Flexible Pavement)

Assessed within 50 meter gauging length

Definition

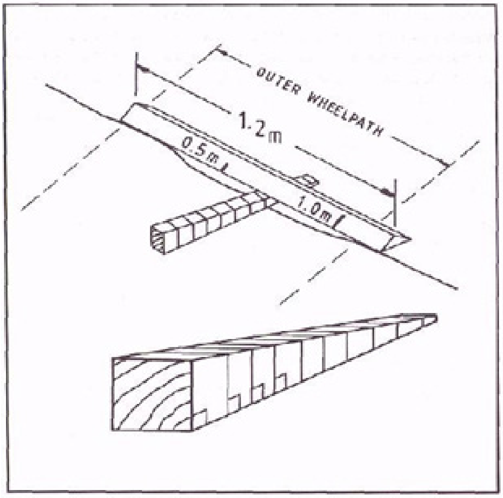
Rutting is defined as a longitudinal depression that forms in the wheel paths of a road under traffic loading.

Rut depth is defined as the maximum surface level variation measured from an imaginary line between two points on the surface at a spacing of 1.2 m (measured using a 1.2 m straight edge and a wedge – see Figure 3-16). Measurements are taken on the inner and outer wheel paths.

Purpose

Rutting is one of the principal ways in which a road fails. Measuring rutting gives a direct indication of the structural condition of the road. A rutted road will usually require a major treatment. Because rutting is such an important indicator of condition, LRBICS identifies the early stages of rutting so that future maintenance work can be anticipated.

Figure 3-16: Wooden Straight Edge and Measuring Edge



Method

This item is rated within the 50 meter gauging length.

Measurements are taken at locations 10,20,30,40 and 50 m in the inner and outer wheel paths of each lane rated in the gauging length. (Refer to "Procedure For Rating" in section 3.4.2).

Twenty rut measurements are recorded. However, only those measurements equal to or greater than 5mm are used in the calculations.

The severity of rutting is calculated in the RBIS according to the average rut depth for both inner and outer wheel paths. This is the sum of the readings ≥ 5mm over the number of readings ≥5mm.

The extent of this distress is calculated by the RBIS.

When measuring rut depth, use of the wedge minimizes measurement error and time required to take the measurement. This practice also reduces fatigue and enhances safety. The rutting portion of the wedge and the rutting side of the straight edge are painted the same color to avoid confusion with the faulting measurement procedure. A wedge is illustrated on the previous page. A dimensioned drawing of a wedge and a template to locate the scribed measurement marks are shown in Figure 3-33. Ensure that readings are taken using the "RUTTING - FLEXIBLE PAVEMENT" scale.

DISTRESS SCALES

Severity
The severity of rutting is calculated according to the average rut depth for both inner and outer wheel paths. This is the sum of the readings □ 5mm over the number of readings □ 5mm. It is recorded to one decimal place in units of millimeters as shown in the example opposite.

Extent
The extent is calculated by the RBIS as the percentage of the area with rutting □ 5mm in depth and is recorded to one decimal place as shown in the example opposite.

Example: Two Lane Local Road (Assessed within two lane 50 m gauging length)

Positive Direction		Negative Direction	
Outer Wheel Path (mm)	Inner Wheel Path (mm)	Outer Wheel Path (mm)	Inner Wheel Path (mm)
5	4	10	12
7	5	8	14
3	0	4	8
9	4	4	4
4	2	0	6

5.1.7. Wearing Surface Defects (Ravelling/Flushing)
Assessed over total area of segment

Definition
This is a distress that only occurs on flexible pavements. The wearing surface item typically occurs in the wheel path.

The smoothness of the surface is the condition rated. Smoothness is due to excessive bitumen, stone wear, stone deterioration or stone loss depending on the type of surface and will lead to surface deterioration and an unsafe traveling surface.

Flushing is the occurrence of excessive bitumen at the surface of an Asphalt Concrete pavement.

Method

Figure 3-16: Wooden Straight Edge and Measuring Edge

This item is assessed over the total carriageway area of the segment. (Refer to "Procedure For Rating" in Section 3.4.2).

Although initially assessed from a slow moving vehicle, closer inspection of the suspected affected areas is required. A simple test should be carried out on each affected area, after alighting from the vehicle, to determine whether wearing surface distress is actually present. A hand feel test is a convenient method to assess the degree of distress.

Measurement
The length of wearing coarse defect per width band is rated per 100m lengths. This item is rated in the same way that patching is rated.

Severity
The severity of distress is:

- Minor 'M' = Surface still relatively smooth with only some loss of fine aggregate or in the case of bleeding there are some signs of excess binder
- Severe 'S' = Surface rough or pitted with both fine and coarse aggregate lost or in the case of bleeding the surface is covered with excess binder with skid resistance poor

The severity is the predominant severity.

Example: (Assessed over total carriageway area of segment)

In the first 100m of a segment there are flushing in both wheelpaths each 0.5m wide and 70m long in minor severity, in the third and fourth 100m segments there is raveling the entire length and lane width in severe severity. The wearing surface will be recorded as follows:

Width	Number of Surface Failures									
	100	200	300	400	500	600	700	800	900	1000
0.5										
1.0										
1.5										
2.0										
Lanes										
Severity	M		S	S						

5.1.8. Edge Break (Horizontal)
Assessed over total area of segment

Definition
Horizontal Edge Break is defined as fretting along the edge of a seal or asphalt concrete surfacing and is associated with rutting or erosion of the shoulder in the vicinity of the edge of bitumen.

Method
This component is assessed for both edges for full segment being rated and is assessed from the vehicle.

Significant edge break is taken as a loss of seal exceeding 20 mm in width. Edge break less than 20 mm is not considered in the assessment. Edge break extending into the wheel path is not rated as edge break but rated as a pothole if the unbound layer has been exposed.

Severity is rated as the predominant severity distress occurring along the segment.

Extent of edge break is calculated by the RBIS as the total edge length displaying significant (>20 mm) edge break (i.e. the length of Slight, Moderate and Large edge break as measured on both sides of the road equals the "total length of edge break") over the total length of edges and expressed as a percentage.

DISTRESS SCALES

Severity

The severity of distress is:

- Slight 'S' = 20 - <75 mm average width of fretting
- Moderate 'M' = 75 - 200 mm average width of fretting
- Large 'L' = > 200 mm average width of fretting The severity is the predominant severity.

Extent

The extent of the distress is calculated by the RBIS.

Example: (Assessed over total edge length of segment)

On a segment that is 560m long there is slight edge break over the entire length on the left side of the segment and severe edge break for the first 100m on the right side of the segment and moderate edge break for 20m in the third 100m on the right hand side. The first 100m has 100m of Slight and 100m of Largeedge break, this will be recorded as 200m of Large edge break as there is no predominant severity so the more extreme is recorded. In the third 100m there is 100m of slight edge break and 20m of Extreme edge break therefore Slight is the predominate severity with a total length of 120m.

	100	200	300	400	500	600	700	800	900	1000
Length	200	100	120	100	100	60				
Severity	L	S	S	S	S	S				

5.2. Rigid Pavement (Concrete)

Representative Single Lane 50M Gauging Length
There are three rigid pavement items to be assessed within the 50m gauging length. Joint Sealant, Faulting and Spalling are rated over ten joints starting at the beginning of the 50 meter gauging length and proceeding until ten joints or cracks are assessed.

Localized Surface Defects shall be assessed over the entire segment.

All rigid pavement items apart from Local Surface Defects must be rated on foot for detailed inspection. Conditions cannot be adequately assessed from a vehicle.

Rigid Pavements Overlaid with Asphalt Concrete
In many situations rigid pavements (i.e. concrete pavements) are covered (surfaced) with asphalt concrete (asphalt). Where this has occurred, the pavement should be rated according to the predominant surfacing type (e.g. if the surface area of asphalt is greater than the concrete surface area, then the segment should be rated as a Flexible Pavement).

In situations where the segment is rated as a Rigid Pavement but asphalt partially covers the surface and the item's condition cannot be assessed, this should be recorded under the Rater’s comments. If possible the gauging length position must be selected on a portion of the segment where there is no asphalt concrete covering the concrete.

In each case, it must be determined whether the condition of an item can be properly assessed as to its ability to perform the function required of it. For example, joint sealant distress is a concern because it may allow water and/or incompressible material into the joint creating long-term problems. However, if the joint is covered with asphalt concrete, the true condition of the joint sealant cannot be determined and it is therefore "not assessable".

The impact of asphalt concrete cover is addressed in each item rating discussion.

5.2.1. Joint Sealant Distress (Concrete Pavement)

Assessed within 50 meter gauging length

Definition

An elastic joint sealant should be present in all sawn or preformed joints in concrete pavements. Joint sealants can be factory-molded sealants that are compressed and inserted into a prepared joint. Joint sealants can also be poured or gunned into the joint when supplied in the fluid state. The function of the joint sealant is to allow movement whilst excluding the lodgment of water and incompressible materials such as sand and silt in the joint.

Method

This item is rated within the selected single lane 50 meter gauging length. (Refer to "Procedure For Rating" in Section 3.4.2).

Ten slabs within the gauging length are inspected on foot to allow assessment of the extent of joint sealant deterioration that is representative of all lanes. The transverse joint at the start of the slab and the adjacent longitudinal joint is considered. The extent of the deterioration is based on the amount of joint length showing loss or extrusion of the sealant over the total length of joints and is calculated by the RBIS. It may be necessary to continue beyond the end of the selected 50 m gauging length to reach this number.

Where the rigid pavement joint is covered by an asphalt concrete overlay, the condition of the underlying pavement cannot be assessed and this should be recorded under the Rater’s comments. However, the gauging length can be moved to assess the defects.

In the case of continuously reinforced concrete, which has no joints, the joint sealant deterioration should be rated as 0.

Figure 3-18: Sealant in Transverse Joints

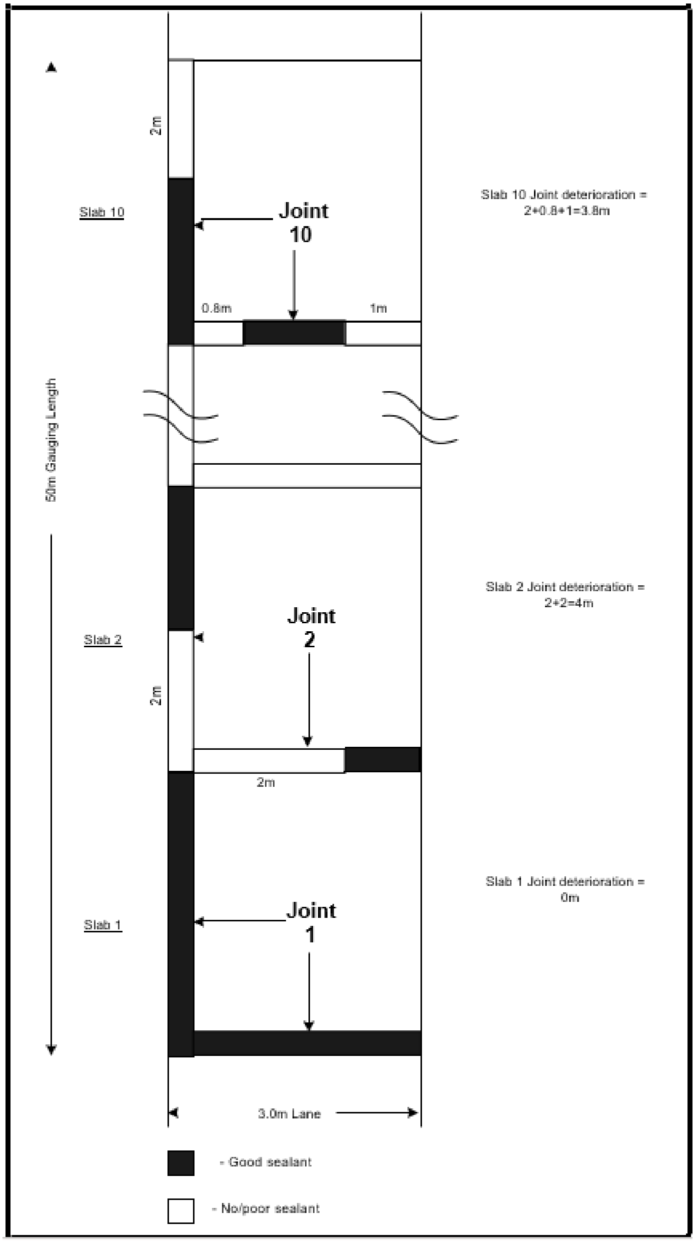
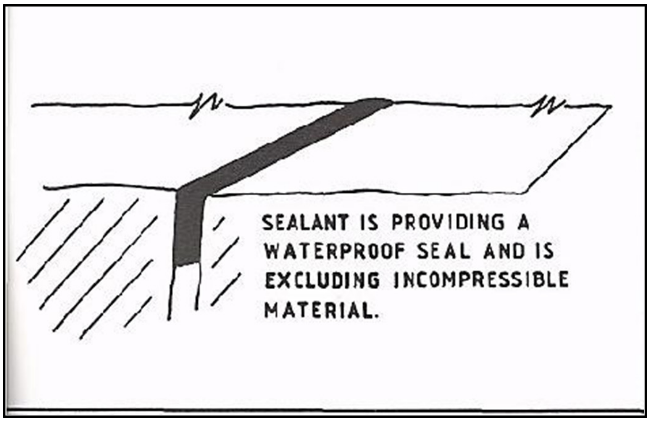


Figure 3-18: Sealant in Transverse Joints



Measurement
The length of deteriorated joint are recorded to one decimal place for each joint as shown in the example opposite. The length of deteriorated joint sealant cannot exceed the length of both transverse and longitudinal joints. The total length of the joints is not recorded, as this is equal to the lane width and slab length.

Example: (Assessed within single lane 50m gauging length. See Figure 3-18 Sealant in Transverse Joints)

Measurements:

Joints	Length of Joint with no or poor sealant
Joint 1	7.0 m
Joint 2	4.0 m
Joint 3	1.5 m
Joint 4	3.0 m
Joint 5	0.0 m

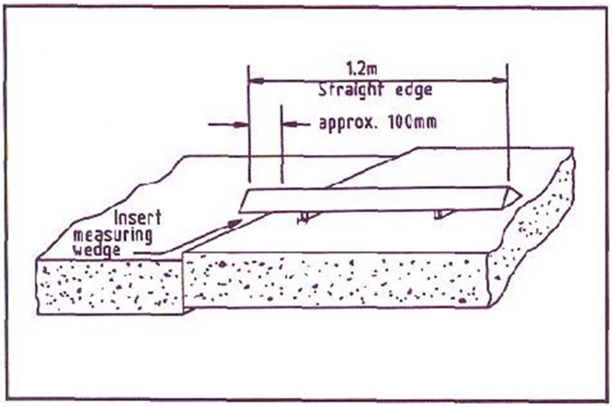
Joint 6	2.5 m
Joint 7	0.0 m
Joint 8	2.0 m
Joint 9	0.0 m
Joint 10	6.8 m
Total	**26.8m**

5.2.2. Joint Sealant Distress (Concrete Pavement)
Assessed over ten transverse joints

Definition
Joint faulting is defined as a difference in the levels of abutting concrete slabs at a transverse joint. This assessment is concerned with faulting at transverse joints (including planned cracks). Faulting at unplanned cracks and longitudinal joints should be reported separately in the comments field on the field worksheet.

Method
This item is rated over ten joints within the selected single lane beginning at the start of the 50 meter g a u g i n g length. (Refer to "Procedure For Rating" in section 3.4.2).

Figure 3-20:Measurement of Step Height



The "fault" is measured as the vertical displacement at each joint as indicated by a 1.2 m straight edge with 10 mm feet which is placed on the elevated slab with approximately

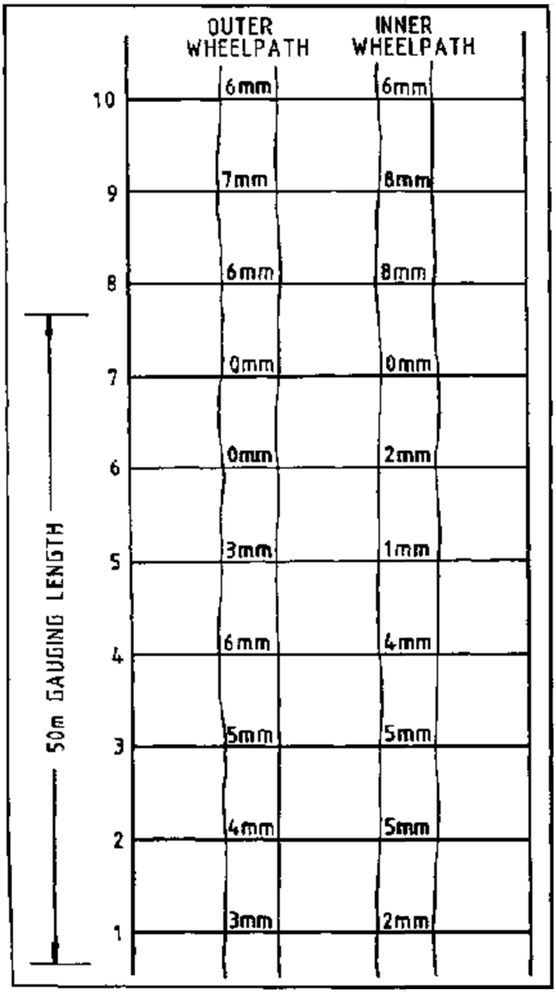
100 mm projecting over the lower slab as illustrated. The 10 mm feet are designed to allow for irregularities such as shoving of the asphalt at the joint or extrusion of the joint sealant thus not giving a flat surface from which to measure. The measurement is taken using the Measuring Wedge and reading from the 'FAULTING - RIGID PAVEMENT" scale which is painted the same color as the Faulting portion of the straight edge. The Measuring Wedge is used as close to the step as possible to avoid any local surface variations.

Two measurements, one in each wheel path, are made at each transverse joint of the lane within the single lane 50 m gauging length. If a joint is not stepped in one of the wheel paths, a measurement of "0" mm is recorded.

There will always be 20 measurements obtained from 2 Wheel paths at 10 joints. It may be necessary to continue beyond the end of the selected 50 m gauging length to reach this number.

Where the joints are covered by an asphalt

Figure 3-21: Faulting Transverse Joints



concrete overlay, the condition of the underlying pavement cannot be assessed and this should be recorded Rater's comments. However, assessment can be moved to assess the defects.

In the case of continuously reinforced concrete, which has no joints, the Faulting should be rated as 0.

Where the overlaid asphalt is faulted, and reflects the condition of the pavement, it should be rated using the normal method.

Where the rigid pavement is covered by an asphalt overlay that is in good condition, the underlying pavement cannot be assessed and this should be recorded under the Rater's comments.

DISTRESS SCALES

Severity

The severity of faulting is recorded as the step height over the 50m gauging length and is recorded in units of millimeters as shown in the example opposite

Extent

The extent is calculated by the RBIS as the percentage of the joints with an average faulting □ 3mm in depth and is recorded to one decimal place as shown in the example opposite.

Example: (Assessed over ten transverse joints. See Figure 3-21: Faulting at Transverse Joints)

Joints	Measurements	
Joint 1	3 mm	2 mm
Joint 2	4 mm	5 mm
Joint 3	5 mm	5mm
Joint 4	6 mm	4 mm
Joint 5	3 mm	1 mm
Joint 6	0 mm	2 mm
Joint 7	0 mm	0 mm
Joint 8	6 mm	8 mm
Joint 9	7 mm	8 mm
Joint 10	6 mm	6 mm

5.2.3. Spalling at Joints (Rigid Pavement)
Assessed over ten joints

Definition
Spalling is the breaking and chipping of discrete pieces of concrete. Spalling is measured at both the Transverse and Longitudinal joints. Spalling does not usually extend vertically through the whole slab thickness but tends to intersect a joint at an angle. Cracking at joints is not considered spalling but rated under the cracking item. The minor Spalling caused by the removal of forms during construction is not considered as Spalling for the purpose of these surveys. Any Spalling with a width of less than 10mm excluding the joint width will not be rated.

Method
This item is rated over ten joints within the selected single lane beginning at the start of the 50 meter gauging length. (Refer to "Procedure For Rating" in Section 3.4.2).

Two width measurements must be taken for each of the ten joints. A measurement is taken at the 1/3 point and 2/3 point along the length of the spalling, where there is only one length of spalling on the joint. Where spalling appears at both ends of the joint, on each side of an un-spalled length, a width measurement is taken at the center points along the length of the two spalls. If there are more than two areas of Spalling on a single slab then the average width of all the spalls must be recorded in both width columns. When a joint is not spalled, two width measurements of "0" mm are to be recorded.

There will always be 20 width measurements obtained from 10 transverse joints.

When measuring the width of spalling at joints, the width of the joint gap is not included. When assessing Longitudinal joints only the Spalling in the lane being assessed is considered. See diagram on following page.

The length of spalling at each joint is recorded in meters. Where two or more lengths of spalling occur on the one joint, all lengths are combined. At any joint with no spalling, a length of "0" m is recorded for the "extent" calculation. For each joint both width measurements and the length measurement must be 0 or all three measurements must be greater than 0.

It may be necessary to continue beyond the end of the selected 50 m gauging length to encounter ten occurrences of transverse joints.

Where the joints are covered by an asphalt concrete overlay, the condition of the underlying pavement cannot be assessed and this should be recorded under the Rater’s comments. However, assessment can be moved to assess the defects.

In the case of continuously reinforced concrete, which has no joints, the joint spalling should be rated as 0.

Figure 3-22: Spalling at Joints

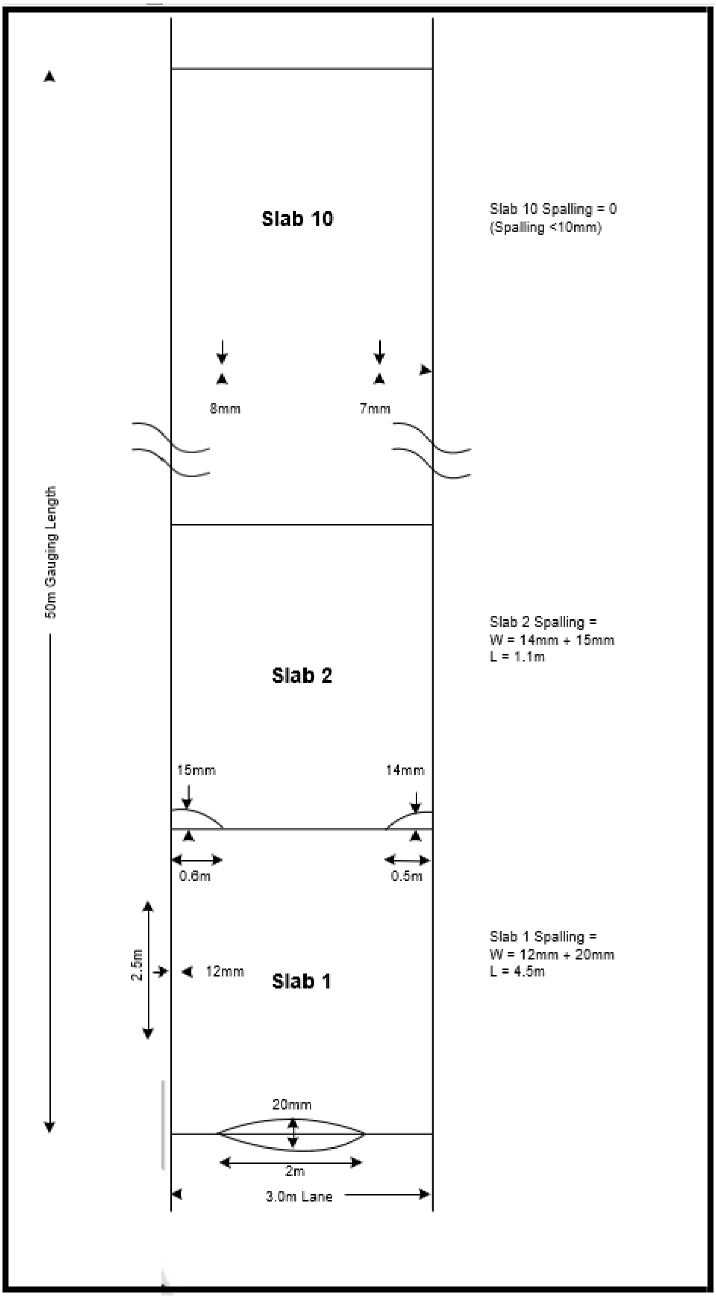
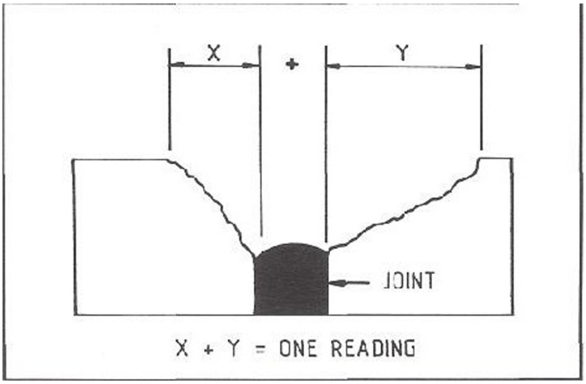


Figure 3-23: Spalling as Measured at Joints



5.2.4. Pavement Cracking (Rigid Pavement)

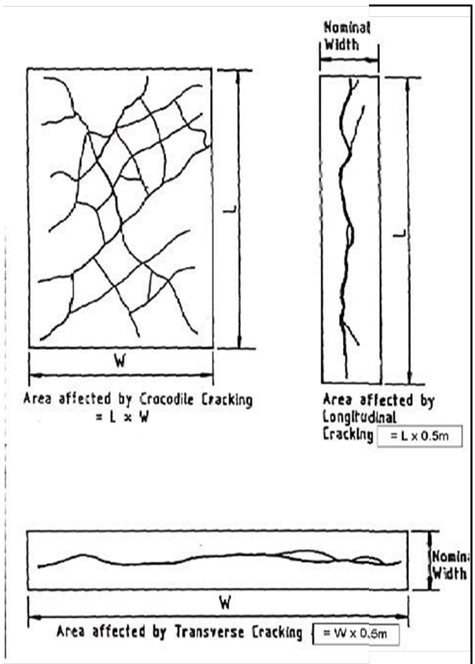
Assessed over total area of segment

Definition

Cracking is an indicator of rigid pavement breakup. The severity of cracking is determined by the crack width but hairline cracks are deemed not significant and are disregarded. Slabs that are considered shattered shall not be rated under cracking.

This pavement rating item includes all forms of cracking in rigid pavements Identification of cracking requires careful examination of the pavement while on foot. It cannot be adequately recognized from a moving or stationary vehicle.

Figure 3-24: Crocodile Longitudinal and Transverse Cracking



Pavement cracking over the whole segment is inspected on foot to allow assessment of severity and extent of cracking according to the defined scales. Temperature cracks are not considered cracks but reflection cracks are rated as cracks. Cracks that are well sealed are still considered cracks with only narrow severity.

Severity of cracking is rated according to the predominant average crack width as measured with the Crack Width Scale (see Section 6.2) and using the Rigid Pavement marks.

Extent of cracking is calculated by the RBIS according to the total area of cracking over the total area of the segment and expressed as a percentage.

The number of Cracked Slabs is also recorded this excludes Shattered Slabs.

In the case of continuously reinforced concrete the cracked areas must be rated as equivalent cracked slabs. Every 4.5m cracked per lane width is equivalent to one cracked slab.

Distress Scale
Note: Wherever a condition has an "Extent" of 0%, no code is entered for "Severity".

Severity
The severity of distress is:

- Narrow 'N' ≤ 3 mm average crack width
- Wide 'W' > 3 mm average crack width

The severity is the predominant severity.

Extent
The length of cracks is recorded in meters for Longitudinal and Transverse cracks. The length of Crocodile cracks is recorded in meters per band width.

The percentage of slabs cracked is calculated by the RBIS.

The affected area of cracking at a location is defined to be rectangular in shape and dependent upon the extremities of the cracking. The affected area for single longitudinal cracking is calculated as the product of the length and a width of 0.5 m. If branching or meandering of the crack affects a more extensive width, then the affected width is used in the calculation. Similarly, the width of the area affected by transverse cracks is taken as 0.5 m unless more extensive. These calculations are done within the RBIS. The sketch illustrates this concept.

Example:
The following cracks were found;

- In the first 100m - Longitudinal cracks of 3.0m (Narrow), multiple cracks in lane 1 and length of 0.9m and another in lane 4 and 4.5m long both with a narrow severity.
- In the second 100m - Longitudinal cracks of 2.0m (Wide), multiple cracks in lane 2 and 18.0m long with a severity of narrow.
- In the third 100m - Longitudinal cracks 1.5m long(Narrow) and Transverse cracks 2.0m long (narrow).
- In the fourth 100m - Longitudinal cracks 3.0m long (Wide) and Transverse cracks 2.0m long (narrow).

These cracks will be recorded on the form as shown in the following table.

Cracking Concrete Pavement										
Longitudinal	Length	3.0	2.0	1.5	3.0					
	Severity	N	W	N	W					
Multiple	Width	Length and Severity								
		100	200	300	400	500	600	700	800	900
	Lane 1	9.0								
	Lane 2		18.0							
	Lane 3									
	Lane 4	4.5								
	Severity	N	N							
Transverse	Length			2.0						
	Severity			N						
Number of Cracked Slabs		4	5	2	1					

5.2.5. Shattered Slabs (Rigid Pavement)

Assessed over total area of segment

Definition
Shattered slabs are slabs that are badly cracked or disintegrating. Slabs normally considered if a slab is damaged to an extent where it needs to be re-blocked then it is considered shattered. Slabs may have only one (1) sever crack but with base failure and/or settlement/displacement are considered shattered slabs. Road Slip/Cut is not considered as shattered slabs.

Method
This item is assessed over the total carriageway area of the segment. (Refer to "Procedure For Rating" in section 3.4.2).

Shattered slabs are rated according to the number of slabs affected within the carriageway area for each lane over the total length of the section.

Measurement
This item is a count of failed slabs. In the case of continuously reinforced concrete the shattered areas must be rated as equivalent shattered slabs. Every 4.5m shattered per lane width is equivalent to one shattered slab.

Figure 3-25:Assessed over Total Carriageway area of segment

In the first 100m of a segment there are 2 shattered slabs in lane 1, 2 shattered slabs in lane 3 and 1 shattered slab in lane 4. In the second 100m segment there are no shattered slabs.

There are 4 shattered slabs in lane 2 recorded as follows:

Number of Slabs										
	100	200	300	400	500	600	700	800	900	1000
Lane 1	2									
Lane 2			4							
Lane 3	3									
Lane 4	1									

5.2.6. Pavement Cracking (Rigid Pavement)
Assessed over total area of segment

Definition
Road Slip/Cut is a serious problem due to slope failure and requires immediate attention.

Purpose
Road Slip/Cut should be fixed in a matter of weeks and as such, is of little value to the long-term determination of maintenance strategies. This item is not included in the VCI calculations but is included as a warning that immediate attention is required.

Method
This item is assessed over the total carriageway area of the segment and is rated simply by checking the supplied box if there are any Road Slip/Cut present irrespective of the number of occurrences per segment.

5.2.7. Wearing Surface (Rigid Pavement)
Assessed over total area of segment

Definition
This is a distress that only occurs on rigid pavements.

Scaling and polishing is the disintegration or loss of concrete from the surface of the pavement. Initially only fine aggregate and mortar is lost but large aggregate is also lost when the defect becomes more severe.

Method
This item is assessed over the total carriageway area of the segm nt. (Refer to "Procedure For Rating" in section 3.4.2). Although initially assessed from a slow moving vehicle, closer inspection of the suspected affected areas might be required.

Figure 3-26: Example of Severe Scaling - rough texture

Measurement
The length of scaling defect per width band is rated per 100m lengths. If a segment has 6 lanes with Scaling then this is recorded under 4 lanes and 2 lanes. This item is rated in the same way that wearing surface in asphalt pavement is rated.

Severity
The severity of distress is:

- Minor 'M' = Surface still relatively smooth with only some loss of fine aggregate
- Severe 'S' = Surface rough or pitted with both fine and coarse aggregate lost

The severity is the predominant severity.

Example: (Assessed over total carriageway area of segment)

In the first 100m of a segment there is minor scaling in lane 1 and 70m long, in the second 100m there is 20m of minor scaling in lane 1 and lane 2 and in the fourth 100m segment there is 80m severe scaling in lane 4. The scaling will be recorded as follows:

Width	Length (m)									
Lane 1	70	20								
Lane 2		20								
Lane 3										
Lane 4				80						
Severity	M	M		S						

5.3. Unsealed Pavement (Gravel/Earth)

Unsealed Roads

Rating of unsealed roads is to be assessed in conjunction with an experienced maintenance supervisor familiar with the particular road's history of performance and deterioration characteristics.

Unsealed roads are to be rated under four separate condition items. The items are Gravel Thickness, Gravel Quality, Crown Shape and Drainage from road.

Both Gravel roads and Earth roads are considered Unsealed Roads. Earth roads are formed only and have no imported material. Gravel roads are both formed and surfaced with an imported material and are rated on both formation and pavement condition items.

- Gravel thickness in the wheel path is taken at regular sample representative locations at points approximately at the middle of the segment length.
- Quality of materials refers to the type, suitability and effectiveness of material present on the surface. (% of fines, loose stones.)
- Crown Shape is determined to be the height of the center of the road above the edge of the road.

- Roadside Drainage refers to the ability of water to drain away from the road.

5.3.1. Gravel Thickness

Assessed over total length of segment

Definition

This component applies only to unsealed roads that are surfaced with an imported material
i.e. gravel roads. If the road has not been surfaced with imported gravel then the road is an earth road and the gravel thickness is 0mm and rated with a condition score of 4.

Method

To determine the thickness closer inspection (exit vehicle) at regular representative intervals (500m) is necessary. This inspection may involve digging test holes in the pavement wheelpath at the midway of the segment length.

The condition score is the number against the condition description which best describes the predominant condition of gravel thickness existing over the total segment length. If there are isolated areas that vary from the rest of the segment then these can be noted under "Raters Comments".

Condition Score

Score	Definition
1	Sufficient Gravel - Depth of gravel > 100mm
2	Isolated sub-grade exposure (<25%) - Depth of gravel 50 > 100mm
3	Moderate Sub grade exposure (25-75%) - Depth of gravel 25 > 50mm
4	Extensive Sub-grade exposure (>75%) - Depth of gravel 0 > 25mm

Note: Appropriate Condition Score
The chosen condition rating should reflect the predominant condition over the total segment length.

5.3.2. Material Quality
Assessed over total length of segment

Definition
If an unsealed road has been surfaced with in imported gravel then this gravel quality is rated along with any sub-grade that has been exposed, in the case of an earth road the insitu material is rated.

Method
To determine the material quality closer inspection (exit vehicle) at regular representative intervals (500m) is necessary.

The condition score is the number against the condition description which best describes the predominant condition of material quality existing over the total segment length. If there are isolated areas that vary from the rest of the segment then these can be noted under "Raters Comments".

Condition Score

Score	Definition
1	Good Material Quality – even size distribution with sufficient plasticity to bind the material – no significant oversize material (>50mm is considered oversize)
2	Fair Material Quality – loose material or stones clearly visible (Poor grading and/or Plasticity too low)
3	Poor Material Quality – Poor particle size distribution with excessive oversize material - Plasticity high enough to cause slipperiness or low enough to cause excessive loose material resulting in loss of traction
4	Bad Material Quality – Poorly distributed range of particle sizes – Zero or excessive plasticity – safety hazard – Excessive oversize

Note: Appropriate Condition Score
The chosen condition rating should reflect the predominant condition over the total segment length.

5.3.3. Crown Shape

Definition
Crown Shape is determined to be the height of the center of the road above the edge of the road. This determines the ability of the road to shed water from it surface.

Method
The height difference between the center of the road and the edge of the road is estimated and not actually measured. If there are isolated areas that vary from the rest of the segment then these can be noted under “Raters Comments”.

Condition Score

Score	Definition
1	Good Camber – >2% crossfall – no significant ponding
2	Flat Camber – crossfall mostly <2% - some unevenness
3	Uneven Camber – No crossfall – Depressions common and drainage impeded
4	Very Uneven Camber – Extensive Ponding – Water tends to flow on the road

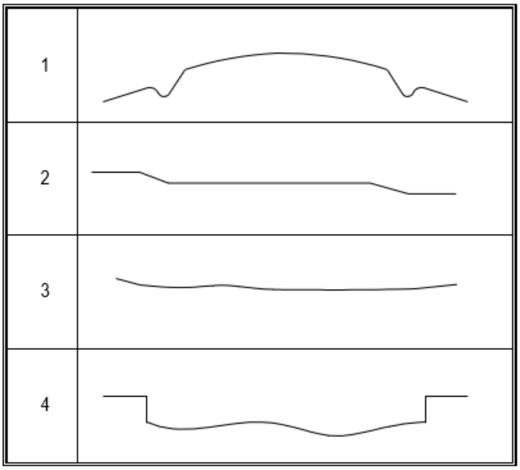
Note: Appropriate Condition Score
The chosen condition rating should reflect the predominant condition over the total segment length.

5.3.4. Roadside Drainage
Assessed over total length of segment

Definition
Roadside drainage is determined to be the height of the side of the road above the side drains or adjacent ground level. This item determines the ability of the roadside drainage to remove water away from the side of the road. This can be done by means of side drains, turn out drains or by having side slopes which lead the water away from the road.

Method
The condition score is the number against the condition description which best describes the predominant condition of drainage existing over the total segment length. If there are isolated areas that vary from the rest of the segment then these can be noted under "Rater's Comments".

Figure 3-27: Graphical example of Different ratings on roadside drainage



Condition Score

Score	Definition
1	Good - Road edge well above side drains/ ground level – well defined side drains or sufficient side slopes to drain water
2	Fair - Road edge level with side drains/ground level – ineffective side drains – water can cross the road in many places
3	Poor - Road edge slightly below ground level – no side drains or totally blocked side drains – some pond of water
4	Bad - Road edge well below ground level – road serving as a drain to surrounding areas

Note: Appropriate Condition Score
The chosen condition rating should reflect the predominant condition over the total segment length.

Figure 3-32 gives a graphic example for the different ratings.

5.3.5. Road Slip/Cut

Assessed over total area of segment

Definition
Road Slip/Cut is a serious problem due to slope failure and requires immediate attention.

Purpose
Road Slip/Cut should be fixed in a matter of weeks and as such, is of little value to the long- term determination of maintenance strategies. This item is not included in the VCI calculations but is included as a warning that immediate attention is required.

Method
This item is assessed over the total carriageway area of the segment and is rated simply by checking the supplied box if there are any Road Slip/Cut present irrespective of the number of occurrences per segment.

5.4. Drainage

Other Items
All of the items covered in Section 3.4 to Section 3.5 are OTHER ITEMS. These items are assessed from a slow moving vehicle and the existing conditions on both sides of the road are observed in each direction over the total length of the segment.

When returning to the selected 50 meter gauging length, the items may be inspected more closely if necessary. The average condition of the items is assessed and rated according to the condition descriptions. The appropriate condition score is then assigned.

OTHER ITEMS are assessed and rated from a maintenance perspective. They are rated to determine the need for maintenance treatments that will prolong the pavement lifespan. The consequential effect is an improved and better maintained road which enhances road user safety.

These hazardous conditions should be reported as soon as possible to the relevant authority for action to be taken.

5.4.1. Side Drains
Assessed over total length of segment

Definition
Side drains provide for drainage of the road pavement and shoulder and condition is rated according to their ability to collect and discharge water runoff.

Method
The total length of provided drain on both edges of the road is inspected over the length of the segment.
The condition score is the number against the condition description which best describes the average condition of side drains existing over the total segment length.

This item is of secondary importance as the condition can change after a storm or maintenance action. The surveyor should not be distracted from the main aim of the survey, the road condition.

Condition Score

Score	Definition
1	Adequate shape and depth. Negligible scour, siltation or vegetation. Correct Longitudinal grade
2	Pavement run-off not affected Obstruction (siltation, vegetation, scour) <30mm in drain waterway
3	Slight obstruction 30 < 50mm to runoff entering drain Obstruction (siltation, vegetation, scour) 30 < 50mm in drain waterway.

4	Moderate obstruction 50 < 100mm to runoff entering drain Obstruction (siltation, vegetation, scour) 50 < 100mm in drain waterway
5	Extreme Obstruction >100mm to runoff entering drain Obstruction (siltation, vegetation, scour) >100mm in drain waterway

Note: Appropriate Condition Score
Evidence of only one of each condition's description needs to be present for that Condition Score to be applicable.

The chosen condition description should reflect the average condition over the total segment length.

5.5. Shoulders

Note: Special Considerations
Unsealed shoulders are not rated if the seal extends for more than 0.5 meter outside a painted edge line. Where this occurs, the road is deemed to have a sealed shoulder and this sealed shoulder is rated accordingly.

Occasionally a segment will have an unsealed shoulder on one side and a sealed shoulder on the other or have a sealed shoulder in the beginning of the segment and an unsealed shoulder at the end of the segment. In these circumstances, both the unsealed and sealed shoulder is rated. Comments regarding the length or position of shoulders can be recorded in the comments field. The purpose of a shoulder is to provide support to the carriageway area on which the traffic is designed to run. A poor shoulder condition contributes to the break down in structural condition of the designed carriageway area.

Therefore, shoulders are rated on their pavement support role not their safety aspect.

5.5.1. Unsealed Shoulders

Assessed over total length of segment

Definition
Unsealed shoulders provide a hard and safe surface for

occasional use by vehicles and to provide for drainage of surface runoff.

Method
The total length of unsealed shoulder on both edges of the road is inspected over the length of the segment.

The condition score is the number against the condition description which best describes the average condition of unsealed shoulders existing over the total segment length.

Condition Score

Score	Definition
1	Adequate crossfall for drainage - Compact gravel - No loose stones - No scouring
2	No restriction to surface run-off - Minor scouring <25mm - Loose stones <30% of shoulder area -Adequate crossfall
3	Slight restriction to surface runoff - Scouring 25 < 40mm - Soft patches <10% of area - Loose stones covering >30% of area - Inadequate crossfall
4	Moderate restriction to surface run-off - Scouring 40 <80mm - Soft patches 10 < 50% of area - Inadequate or exaggerated crossfall - Loose stones 30 < 50% area
5	Major restriction to surface run-off - Scouring >80mm - Soft patches > 50% of area - Loose stones > 50% area -Inadequate or exaggerated crossfall

Note: Appropriate Condition Score
Evidence of only one of each condition's description needs to be present for that Condition Score to be applicable.

The chosen condition description should reflect the average condition over the total segment length.

5.5.2. Sealed, Asphalt Surfaced and Concrete Shoulders

Assessed over total length of segment

Definition

A sealed shoulder is only rated if it has a width of 0.5m or greater. Defective areas may be potholed, unsuccessfully patched, deformed, faulty or stripped.

Method

For this item, the total length of shoulder on both edges of the road is inspected over the length of the segment.

It is the surfaced area within the first two meters outside the painted edge line that is assessed to determine average condition. Shoulders are generally constructed up to a maximum of 2m width, beyond 2m is classified as parking.

If the condition score varies greatly between left and right shoulders (in the direction of increasing chainage), a separate score for each shoulder is required in the field worksheet comment field, i.e. left shoulder - 2, right shoulder – 5. Only the worst score is recorded under Sealed Shoulder. (See note in Section 5.5.1concerning the combination of sealed and unsealed shoulders.)

The condition score is the number against the condition description which best describes the average condition of sealed shoulders existing over the total segment length.

Condition Score

Score	Definition
1	Defective area 0 - <2%/shoulder/length of sealed shoulder
2	Defective area 2 - <5%/shoulder/ length of sealed shoulder
3	Defective area 5 - <15%/shoulder/ length of sealed shoulder
4	Defective area 15 - 25%/shoulder/ length of sealed shoulder
5	Defective area > 25%/shoulder/ length of sealed shoulder

6. Equipment

6.1. Straight Edge (1.2 m) and Wedge

Figure 3-28: Measuring Wedge

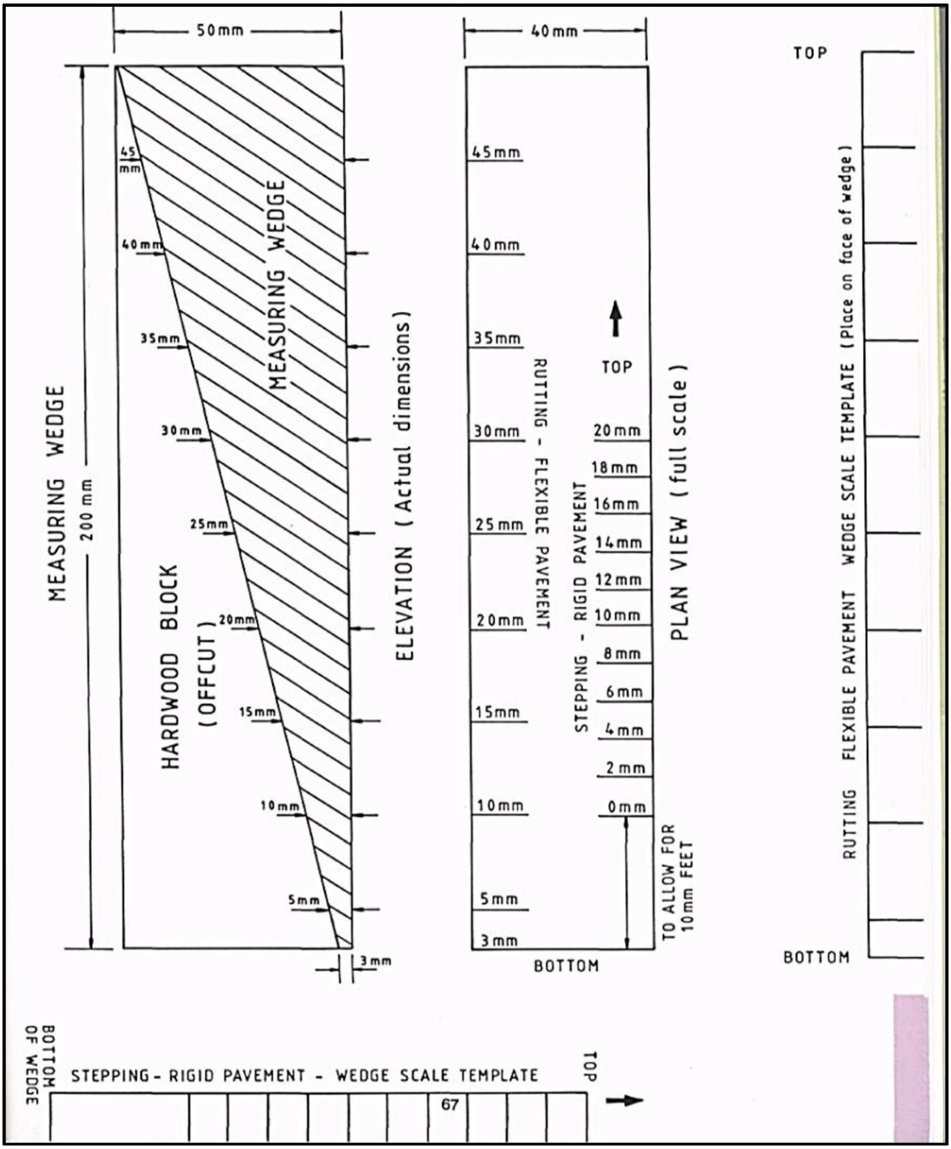
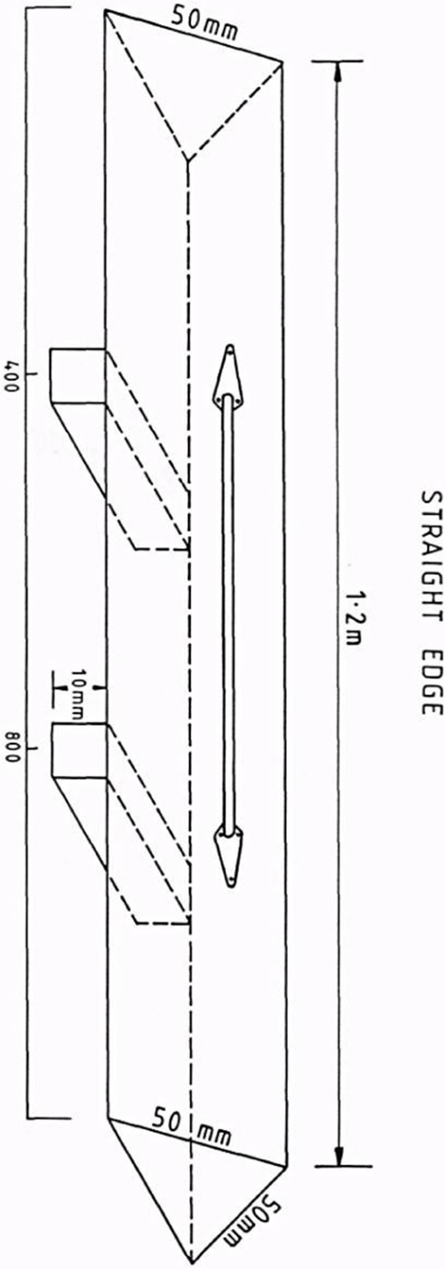


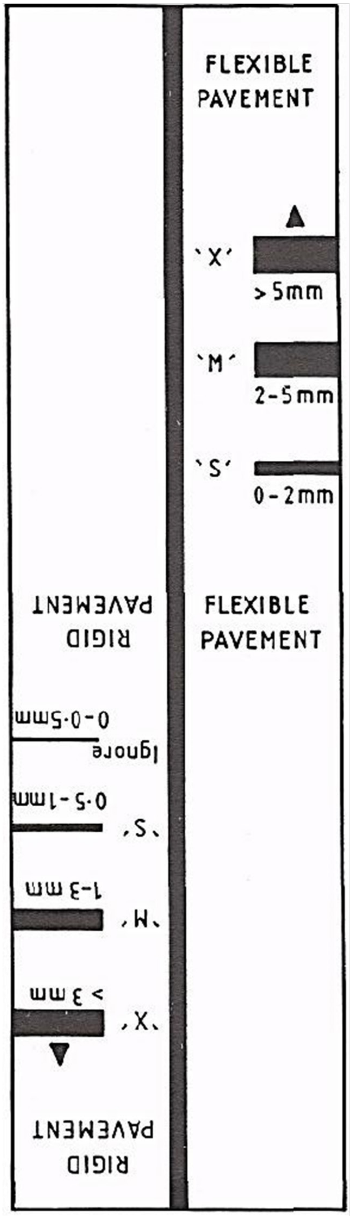
Figure 3-29: Straight Edge



- Measuring beam must be exactly 1.2m long
- It should be constructed from hardwood timber offcuts
- For measuring stepping on Rigid Pavements it is recommended that two 10mm high feet be attached at the 400mm and 800mm points on one face to allow for AC overlay shoving or joint extrusion. The feet must not protrude from the sides of the face. The Rigid Pavement Wedge is then used to measure the stepping at transverse joints.
- A handle may be added for convenience of carrying, ensuring that one side remains flat when laid on the surface.

6.2. Template for Cracked Width Scale

Figure 3-30: Cracked Width Scale



- Test the crack gap by working from narrowest to widest mark width
- Align bottom of mark with one side of crack
- The first mark wide enough to cover .the crack gap will show the correct "severity" code
- Ensure correct pavement type scale is used
- These are full scale drawings and should not be altered or reduced
- It is recommended that this be copied and pasted to a sheet of cardboard for durability

7. LRBICS Data Evaluation

Introduction

The VCI formula was based on a formula that was developed for other countries using the HDM method of visual assessments. The formula has been modified due to the different defects that have been rated; the formula was also simplified as the original formula contained unnecessary maximum values for all distresses. The weight factors were determined by applying the weight factors to individual defects and comparing the results to the values obtained from HDM-4, the weight factors were then adjusted until a good comparison was made with the HDM-4 results. The overall rating obtained from the VCI formula tends to be more severe than the rating obtained from HDM-4. This is due to the fact that HDM-4 only looks at a single defect (worst) to determine the condition rating, whereas the VCI formula combines all defects in determining the condition rating.

7.1. Asphalt VCI Formula

Each Distress has a Weight Factor (Wf) as shown in Table 3-14. The first step in the calculation is to determine a weighted value for each distress. Edge Break, Wearing Surface and Cracking have additional severity ratings, which must also be considered. Edge Break severity is rated as large, medium or small, the rating must be multiplied by 3 for large, 2 for medium and 1 for small extent before the weight factor can be applied. Wearing Surface has separate weight factors for Minor and Severe Wearing Surface. Cracking has separate weight factors depending on the type and severity of the crack.

Table 3-14: Distress Weight Factor, Asphalt

Distress	Weight factor
Cracking - Crocodile - Narrow	3.5
Cracking - Crocodile - Wide	9
Cracking - Transverse - Wide	8.5
Cracking - Transverse - Narrow	3.3
Edge Break (large)	1.25

Edge Break (medium)	0.82
Edge Break (small)	0.41
Patching	1.25
Potholes (number)	5.5
Surface Failures	0.7
Rutting (RDM)	4
Wearing Surface (Ravelling / Flushing) - Minor	0.55
Wearing Surface (Ravelling / Flushing) - Severe	1.2

Each segment can have only one type of cracking. The first part of the formula determines the sum of the weighted distresses.

SDWf is the sum of weighted distress

SDWf = (Cracking * Wf) + (Edge Break * Wf) + (Pathing * 1.25) + (Potholes * 5.5) + (Surface Failures * 0.7) + (Rutting RDM * 4) + (Wearing Surface defects * Wf)

[1] Choose the relevant weight factor for cracking dependent on the type and severity
[2] Choose the relevant weight factor for Edge Break dependent on the severity
[3] Choose the relevant weight factor for Wearing Surface dependent on the severity

The final step is to calculate the VCI.

VCI=MAX(1,(100*(1-SQRT(1-((100-SDWf/3.0*100)/100))^2)

For SDWf value more than 300, use 300 (maximum)

7.2. Concrete VCI Formula

Each Distress has a Weight Factor (Wf) as shown in Table 3-15. The first step in the calculation is to determine a weighted value for each distress. Scaling has separate weight factors for Minor and Severe Wearing Surface. Cracking has separate weight factors depending on the type and severity of the crack.

Table 3-15: Distress Weight Factor, Concrete

Distress	Weight factor
Cracking - Crocodile – Narrow	3.6
Cracking - Crocodile – Wide	9.4
Cracking - Transverse – Wide	9
Cracking - Transverse – Narrow	3.5
Spalling (spalling severity)	3
Faulting (faulting average)	8
Shattered Slabs (number)	5.5
Scaling – Severe	1.2
Scaling – Minor	0.55
Transverse Joint Sealant	0.28

Each segment can have only one type of cracking. The first part of the formula determines the sum of the weighted distresses.

SDWf is the sum of weighted distress

SDWf = (Cracking*Wf)+(Spalling*3) +(Faulting*8)+(Shattered Slabs*5.5)+(Joint Sealant*0.28)+(Scaling*Wf)

[1] Choose the relevant weight factor for cracking dependent on the type and severity

[2] Choose the relevant weight factor for scaling dependent on the severity

The final step is to calculate the VCI.

VCI=MAX(1,(100*(1-SQRT(1-((100-SDWf/3*100)/100))^2)

For SDWf value more than 300, use 300 (maximum)

7.3. Gravel VCI Formula

Each Distress has a Weight Factor (Wf) as shown in Table 3-16. The first step in the calculation is to determine a weighted value for each distress. The formula is exactly the same for Earth roads.

Table 3-16: Distress Weight Factor, Gravel

Distress	Weight factor
Cracking - Crocodile – Narrow	3.6
Cracking - Crocodile – Wide	9.4
Cracking - Transverse – Wide	9
Cracking - Transverse – Narrow	3.5

The first part of the formula determines the sum of the weighted distresses.

SDWf(Sum of weighted distress) = (Gravel Thickness*10)+(Gravel Quality*12) +(Crown Shape*8)+(Drainage from Road*6)

The final step is to calculate the VCI.

VCI=MAX(1,(100-(SDWf-SWf))

Where SWf is the sum of the weight factors (36)

The VCI value determines the condition of the segment assessed (see Table 3-17 below)

Table 3-17: Gravel VCI Formula

VCI Ranges	Condition Rating
1 – 20	Bad
20.1 – 40	Poor
40.1 – 70	Fair
70.1 – 100	Good

The road rating/condition with the corresponding general condition and treatment measures is shown in table below.

Table 3-18: General Condition/Treatment Measures

Road Condition	General Condition/Treatment Measures
GOOD	Little or no maintenance required (routine maintenance).
FAIR	Needs some partial/full depth repairs (preventive maintenance)
POOR	Needs extensive full depth repairs, some full slab replacement/rehabilitation
BAD	Needs to rebuild pavement (Total reconstruction).

PART IV
GUIDELINES FOR BRIDGE INVENTORY AND CONDITION

1. Introduction

he LGUs in the country has a huge stock of bridges along the local road networks. There are 3438 provincial and 722 city bridges in the country. Basic data and information relating to bridges is collected using the Local Government data collection system. O n l y the number of structures are collected for the DILG database using the SLRF inventory form. A separate database on bridges has been developed within DILG. It is recommended that this database is made available to the Local Government Units for completion and regular updating.

The MVUC-SLRF can be used for bridge and structure maintenance. The specific activities eligible in SLRF are: repairs of hand rails, replacement of damaged or deteriorated structural members, replacement of timber decks, epoxy sealing of cracks in concrete decks, change of bearing plates, addition of shear plates or cable restrainers, sand blasting and painting of structural members, repair of retaining walls, foundation protection, stream clearing and debris removal, and hire charges for a bailey or other temporary bridging. Hence, it is imperative for DILG to maintain a database on bridges as way to check funding support to the local bridges.

Table 4-1: Current Condition Rating for Bridges under SLRF

Rating	Description
Good	No work required
Repair	Routine repairs only required
Structural	Some minor structural works required
Unsafe	Major structural works or replacement required

Table 4-1 provides the current condition rating for bridges under SLRF:

For national roads, there are 7,928 national bridges with an aggregate length of 348,574 linear meters under the responsibility of the national government through the Department of Public Works and Highways (DPWH). The DPWH developed a Bridge Management System (BMS) which has been functioning as computer-based system since 2004 and revised BMS Bridge Inspection Manual developed

through JICA assistance.
The main purpose of this guideline is to provide the LGU Engineering office and other users with guidelines and procedures to undertake effective bridge inventory and condition surveys for rehabilitation, replacement and maintenance programming. Inspecting a bridge is a very responsible job. It is not an easy job, and there are many things to learn before you can inspect a bridge properly. Basically a bridge accredited inspector is a qualified engineer. But sometimes, there are not enough engineers to do this work, and other people become bridge inspectors. For a more detailed inspection procedure, the LGU Engineering office is referred to the BMS of DPWH.

This guideline provides the different parts or components of bridges. It explains the different kinds of bridges and how bridges can be inspected. It also gives you basic information about concrete, steel, masonry and timber, as they are used in bridges. Then this guideline helps you how to inspect a bridge and accomplish an inventory, inspection and evaluation report form.

2. Bridge Components

2.1. General

The parts of a bridge include the deck slab, superstructure, substructure (pier, abutment and foundation) and approach roads as shown in Figure 4-1.

The bridge approach is provided to make a smooth transition between the bridge deck and roadway pavement so as to minimize the impact forces on the abutment header from vehicles and provide safe driving conditions for the motorists.

Figure 4-1: Single Span Bridge

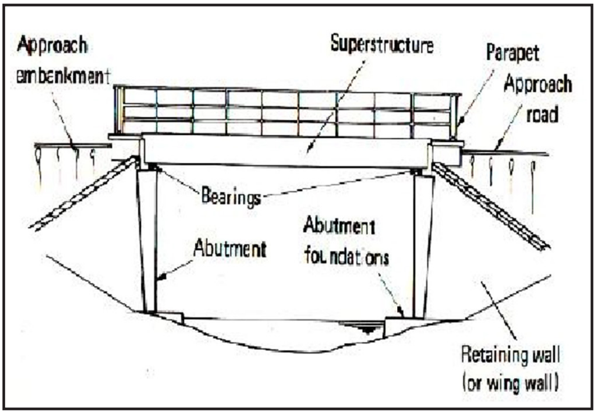
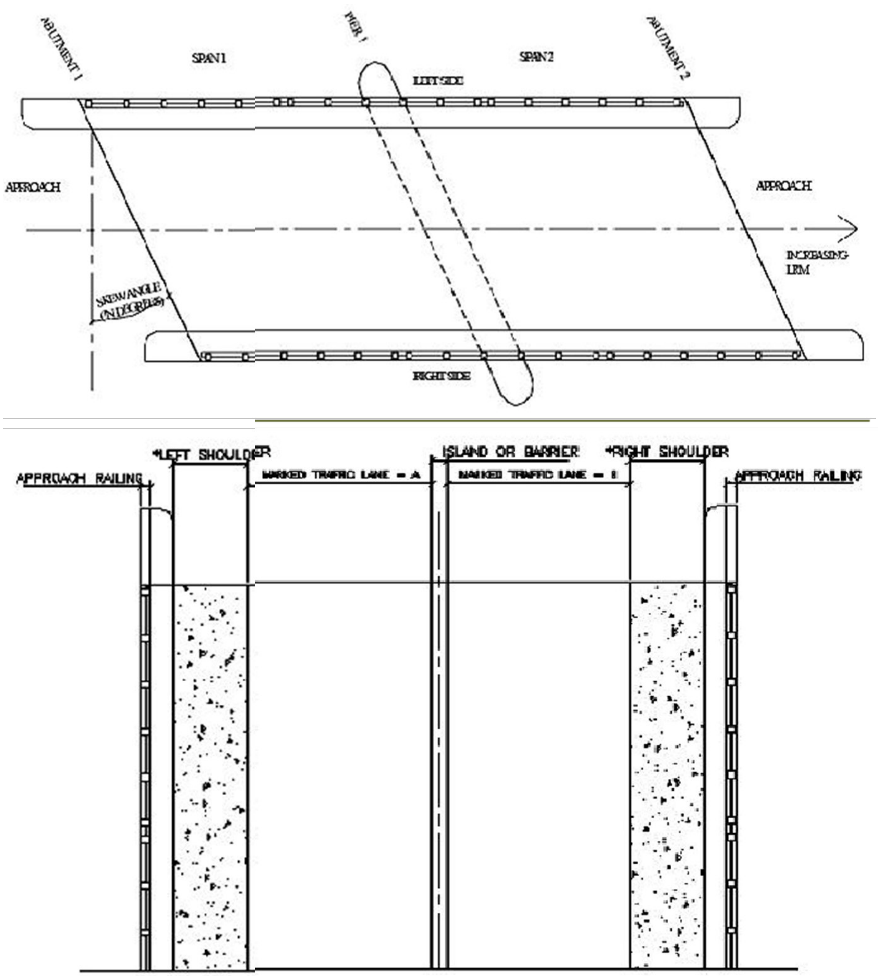


Figure 4-2: Carriageway Width



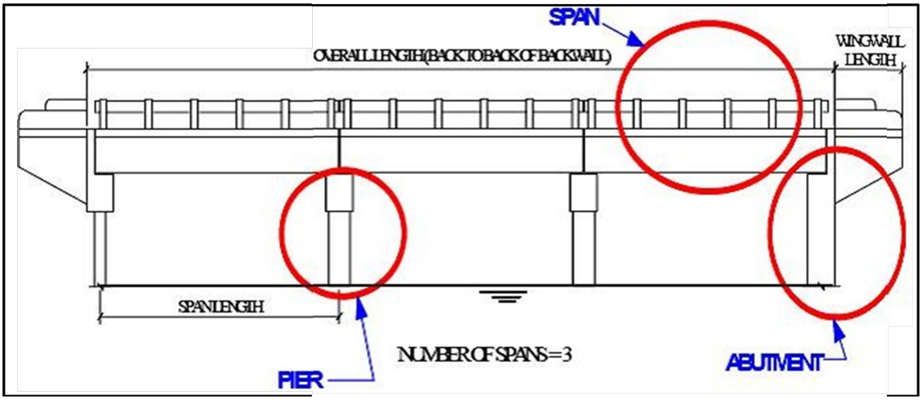
CARRIAGEWAY WIDTH = A + B

Note: APPLICABLE ONLY FOR BRIDGES WITH SHOULDERS

2.2. Superstructure

The superstructure is the main structural component that spans the obstacle; it transmits the load to the substructure.

Figure 4-3: General Bridge Data

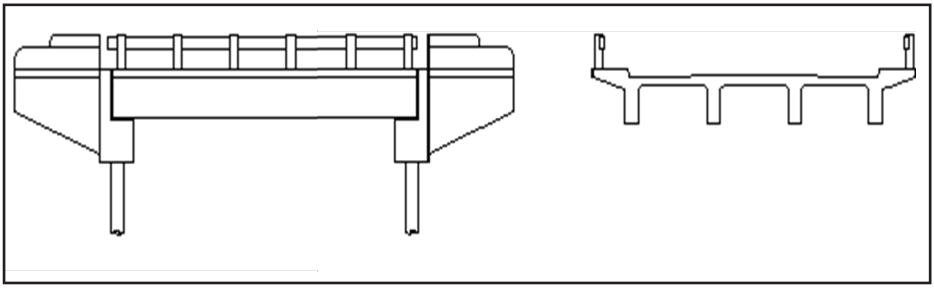


2.2.1. Deck Girder

The most common type of bridge is the Deck Girder as shown in Figure4.4. This type of bridge comes in different forms such as simple span, continuous spans and cantilever spans. The basic sectional stresses present in this type of bridge are flexural. Since the development of reinforced concrete and pre-stressed concrete, the girder type superstructure has become economical for spans of up to 40.0 m. The most common reinforced concrete deck bridges are the Slab Bridge, Concrete Deck Girder, Box Girder and Pre-stressed Concrete Bridge.

The primary function of the deck is to carry traffic load and transfer it to the main structural systems. The concrete slab is the most common deck type. And the substructures are piers

Figure 4-4: Deck Girder



and abutments that transfer the loads to the ground.

2.2.1.1. Reinforced Concrete Slab (RCS)

Slab bridges are usually suitable for bridges with end spans of up to about 12m and interior spans proportionally longer. The practical ranges in span length can be increased by using the haunched or voided slab.

This type of bridge has particular advantage when vertical clearance is critical. The optimum depth to span ratio is 1/25.

Figure 4-5: Reinforced Concrete Slab (Solid)

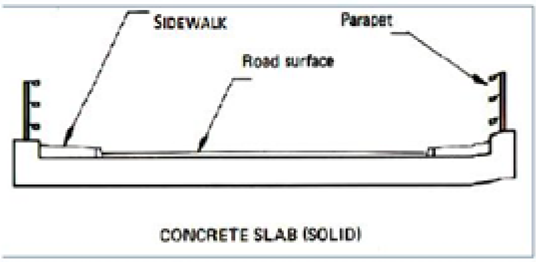
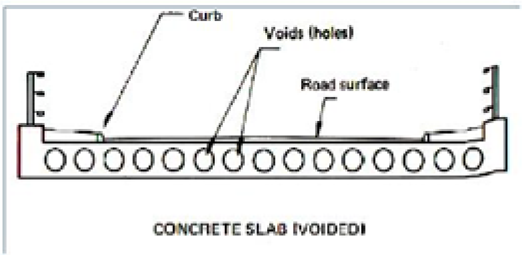


Figure 4-6: Reinforced Concrete Slab (Voided)

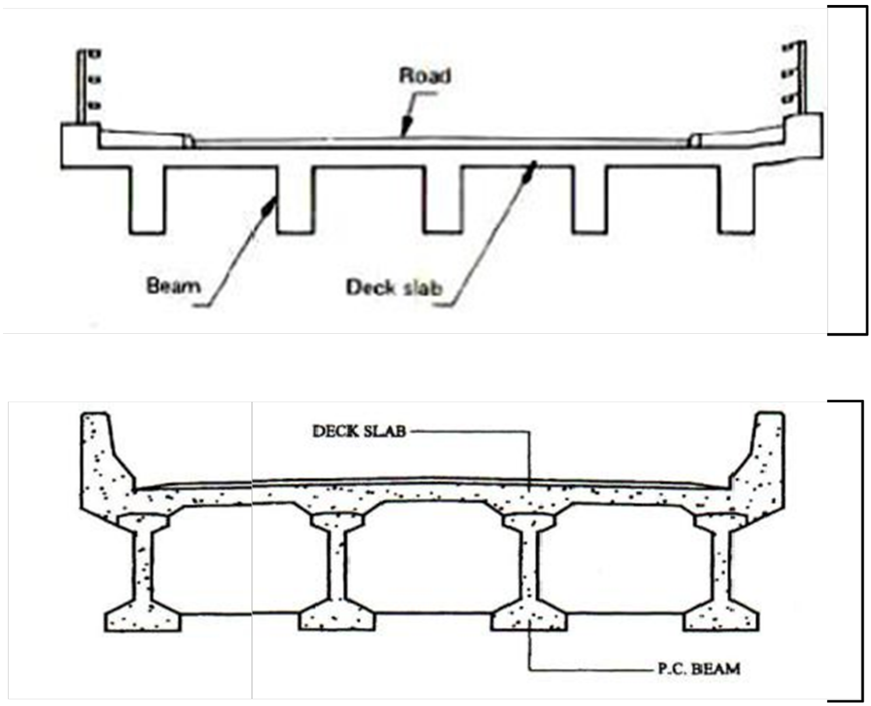


2.2.1.2. Concrete Girder (RCDG/PSCG)

The main problems with Concrete girder are maintaining vertical clearance and false work during construction and deck replacements after many years of service.

The deck replacement of a Concrete girder structure requires extensive engineering analysis to be compatible with the monolithically constructed existing bridge system. The Concrete girder is used for longer spans however, construction cost are greatly increased as the spans are increased. Pre-stressed concrete girders are competitive from a standpoint and they require little maintenance. Optimum depth to span ratio is 1/18 to 1/20.

Figure 4-7: Concrete Girder

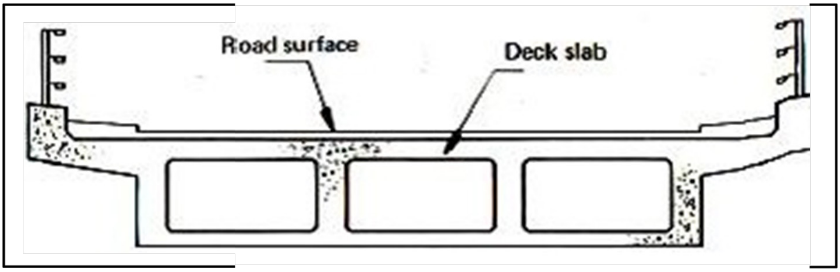


2.2.1.3. Concrete Box Girder (RC/PC)

The concrete box Deck Girder is structurally desirable and aesthetically suitable for urban locations, where roadways have a high degree of horizontal curvature as well as large skew angles. This type of bridge is clearance is limited.

The disadvantages of concrete box girders are initial high cost, cracks over the piers and problems of deck replacements requiring shoring and extensive design analysis. The generally used depth to span ratio are 1/18 and 1/20 for simple and continuous spans, respectively.

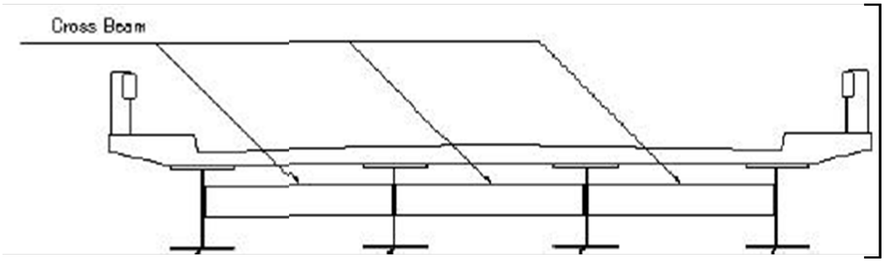
Figure 4-8: Concrete Box Girder



2.2.1.4. Steel Plate Girder/I-Beam

The major characteristic advantages of structural steel over other material are strength and ductility. In addition to the increased structural capacity, steel makes more efficient and economic use of material. As a result, structural steel bridges offer simplicity and beauty. The emphasis of highway safety and sight distance requirements has favored the use of steel girders due to their ability to support longer span lengths. To achieve further economy, composite construction with the concrete deck slab as an integral part of the beam section is used.

Figure 4-9: Steel Plate Girder



2.2.2. Steel Truss Bridge

When the bridge span is longer than the span limit for Deck Girder, Steel Truss is applied. The Type of Truss is mainly selected as through type.

Figure 4-10: Steel Truss Bridge

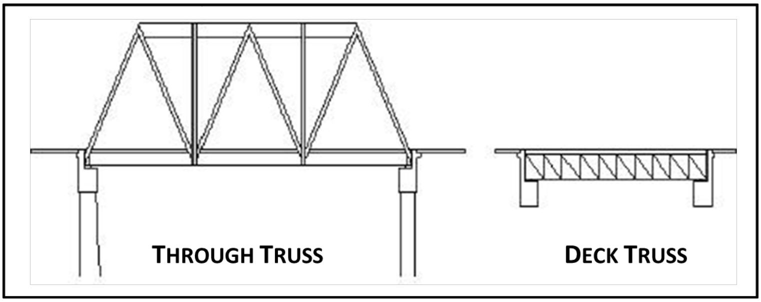
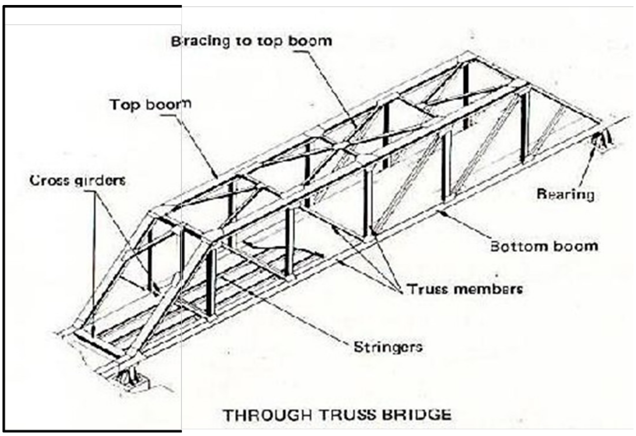


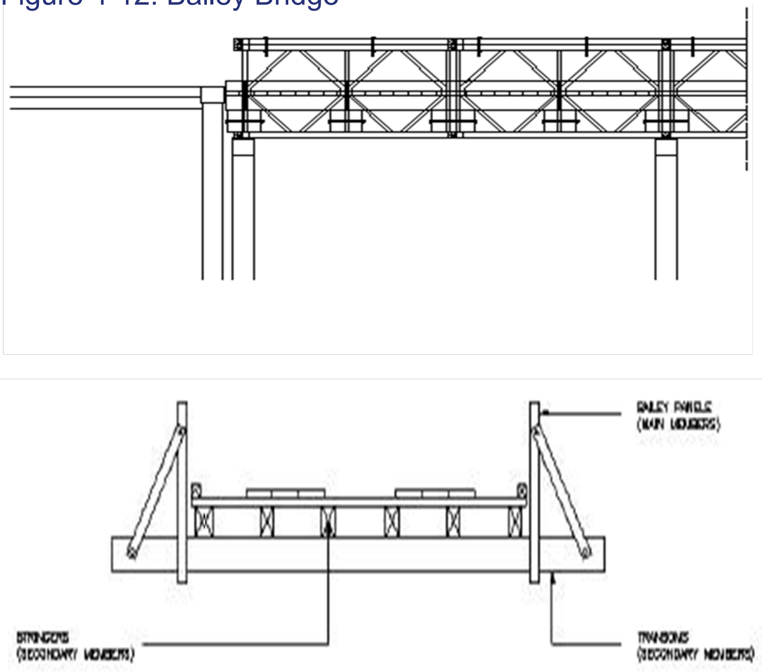
Figure 4-11: Parts of Through Truss Bridge



2.2.3. Bailey Bridge

This bridge is "through" type of truss which is prefabricated for urgent use for disaster. The main girders are formed from modular panels 10 ft. long pinned together end to end for quick assembly.

Figure 4-12: Bailey Bridge



2.2.4. Arch Bridge

The arch bridge has a very long history and because arches have good performance in long span structure. It is far the most popular type to bridge builders. Compared with the Deck Girder where loads are resisted by flexure, the arch bridge has compression as its primary stresses. The arch form is intended to reduce bending moments in the superstructure and should be economical in material compared with an equivalent straight, simply supported girder or truss.

Figure 4-13: Langer Arch Bridge

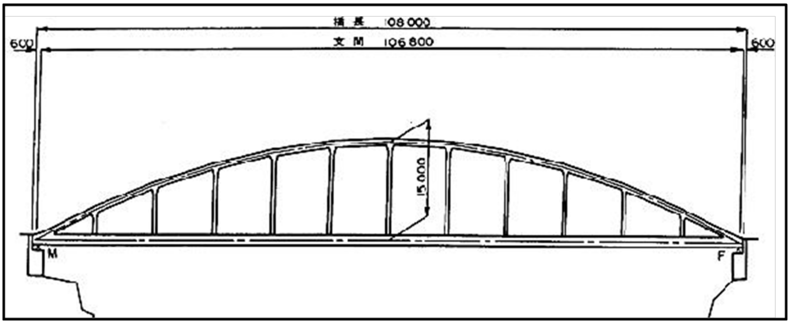
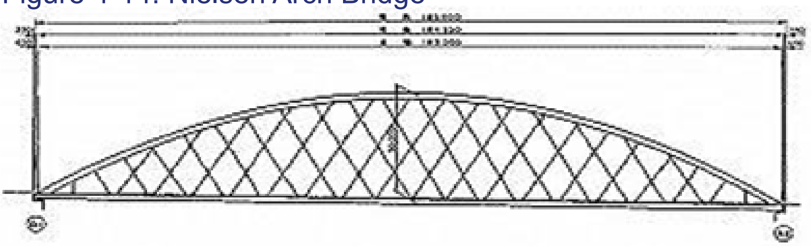


Figure 4-14: Nielsen Arch Bridge



2.2.5. Timber Bridge

This covers log bridges, bridges made of timber beams and bridge made of laminated timber beams. Log bridges are often poorly maintained and have a short life, but can last a long time if they are properly constructed and well maintained. This bridge is classified as temporary use.

Figure 4-15: Timber Bridge

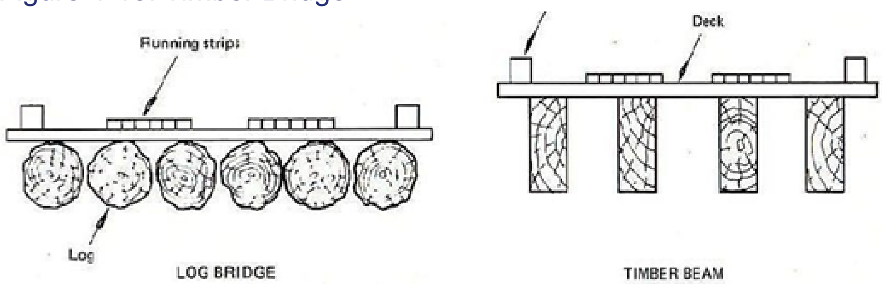


Figure 4-16: Timber Bridge

2.3. Abutments, Wing Walls and Retaining Walls

The substructure, the lower structural portion of a structure, transmits the dead load and live load and other forces to the supporting foundation. Main components of the substructure are bearings, pier or abutment and foundation.

Figure 4-17: Abutment

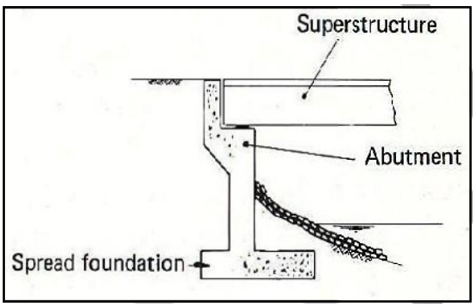


Figure 4-18: Abutment on Spread Foundation

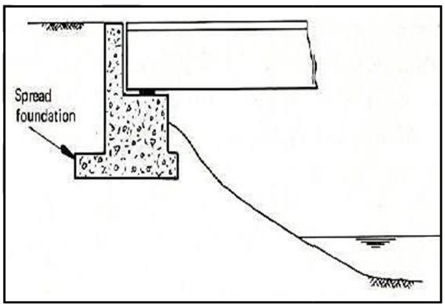


Figure 4-19: Abutment on Piles

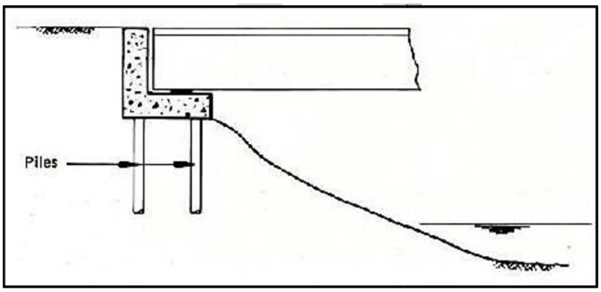
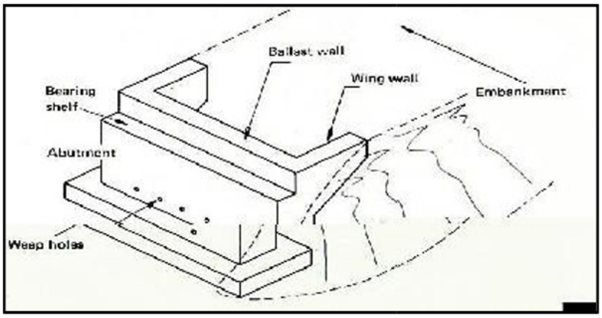


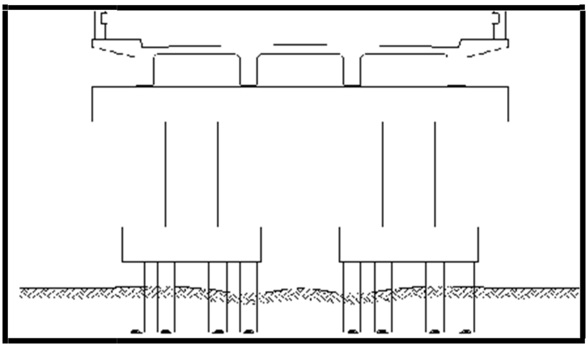
Figure 4-20: Abutment and Wing Walls



2.4. Piers

The pier supports the bridge spans and is located to minimize the constriction of traffic or flow of water underneath the bridge. Abutments are used at the ends of bridges, where it connects with the approach roadway, to retain the embankment and carry horizontal loads from the

Figure 4-21: Multiple Columns with Pile Foundation



superstructure.

2.5. Foundations

All vertical loads and horizontal forces from the superstructure and substructure are ultimately supported by foundations.

Refer to Figure 4-26. There are th
ree types of foundation that are commonly used, the spread footings, piles and caisson. Spread footings are supported on suitable soil or rock without piles. If not, Pile foundation is added with spread

Figure 4-22: Spread Foundation

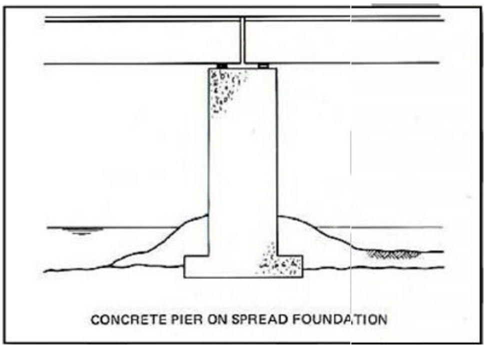


Figure 4-23: Pile Foundation

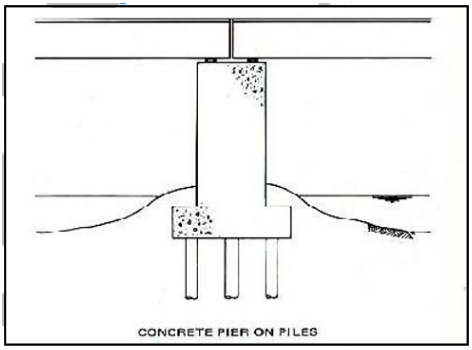
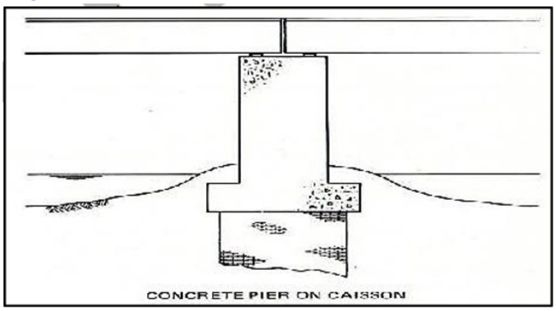


Figure 4-24: Caisson Foundation



footing.

2.6. Bearings

Bearings are designed to provide free movement of girders and should be cleared of debris. These movements are accommodated by flexible materials, rockers, sliding plates and rollers. There are 2 types of Bearings as follows.

Figure 4-25: Rubber-Type Bearing

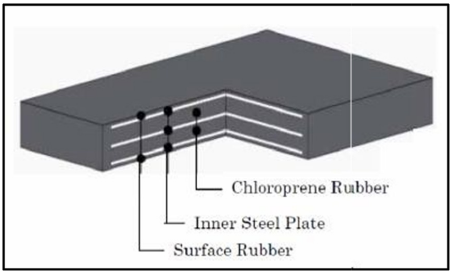
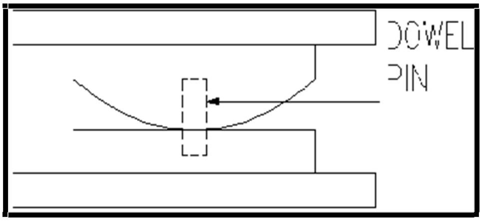


Figure 4-26: Steel-Type Bearing



2.7. Expansion Joint

At the road surface, between the deck and the parapet, there will be an expansion joint. There are many different types of expansion joints. The simplest joints are made by using steel angles in the end of the deck, and in the top of the Abutment ballast wall.

Figure 4-27: Steel Angle Joint

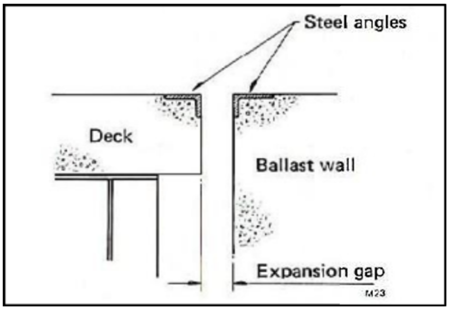


Figure 4-28: Steel Angle Joint with Water Bar

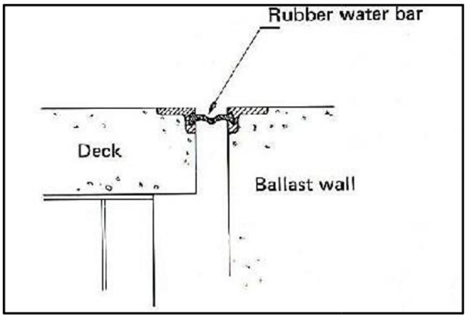


Figure 4-29: Steel Finger Joint

Figure 4-30: Steel and Rubber Composite Joint

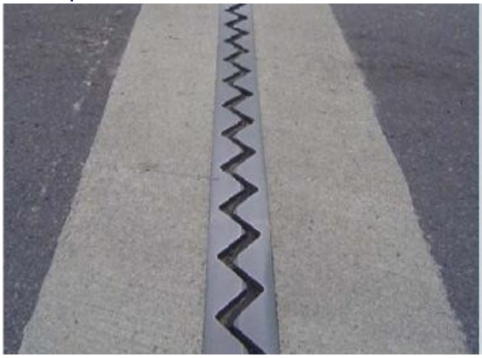
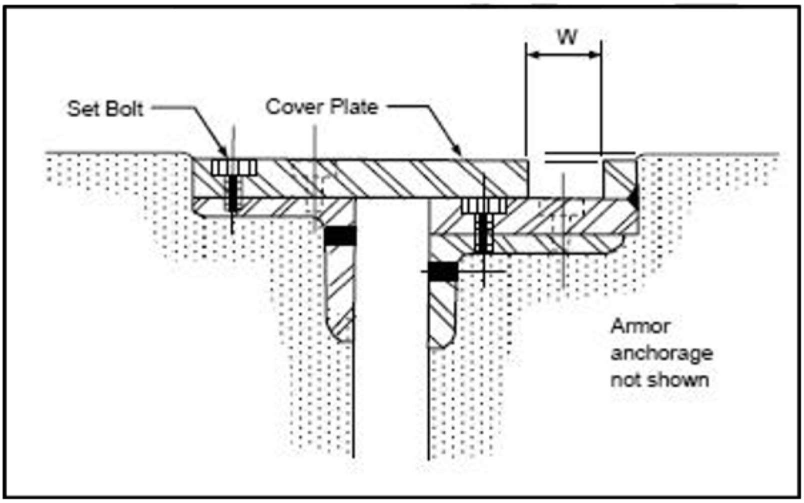


Figure 4-31: Steel Angle Joint

Figure 4-32: Steel Plate Slide Joint



2.8. Drainage Pipe

The surface water from rain shall pan through drainage pipe from the road surface. The drainage pipe is embedded in concrete slab. It is important that girder surface should not be affected by rain water.

Figure 4-33: Drainage Pipe

2.9. Railing

The railings are made for the safety of vehicles and pedestrian from accident.

Figure 4-34: Railing

3. Bridge Inventory Data Collection

3.1. General Information

The bridge field survey data collection tool is in Annex C. The guidelines in filling up the bridge inventory data are discussed in this section.

3.1.1. Geographic Information

Geographic information such as the name of the Municipality and Barangay as well as name of the river in which the subject bridge is located, shall be recorded through LGU Engineering office and/or interview of the residents living at the vicinity of the site.

3.1.2. Road Name

The surveyor shall confirm the name of road the bridge is located before starting the site survey through existing data.

3.1.3. Station Number

Station Number (or kilometorage) of the bridge location shall be confirmed by using an odometer equipped in a portable GPS device by measuring distance from kilometer post.

3.1.4. Year Built

The year built of the existing bridge shall be confirmed through existing inventory data, staff of the LGU Engineering office and/or indication board beside the bridges if any.

3.1.5. Load Limit (tons)

The Load Limit of the bridge shall be confirmed through the staff of the LGU Engineering and/or indication board beside the bridges if any.

3.1.6. Coordinates

The coordinate of bridge center portion shall be measured by GPS. The coordinate system shall be “Luzon 1911 Philippines (UTM)”.

3.2. Information on Environment

Information on the environment at the bridge site such as terrain and land use shall be recorded according to following criteria.

3.2.1. Terrain
Terrain of bridge location shall be selected from 3 types which are a) Flat, b) Rolling and c) Mountainous, according to the elevation and/or gradient of slope.

3.2.2. Alternative Route:
If there is an alternative route when the bridge becomes impassable within 5 km from the bridge, mark “Yes”.

3.2.3. Land use:
Confirm and select the land use of the bridge surrounding area from

- Residential/Commercial: many or some buildings/ residential houses are built
- Agricultural Use: Paddy field, Plowed field Coconuts field, etc.
- Forest: covered by trees
- Waste Land: bush and/or vacant lot

3.2.4. Structures/Houses in ROW
If you find structures or houses inside R.O.W, mark “Yes” and sketch the situation in the Sheet-3 of Annex C

3.2.5. Utilities
If you find the utilities on the bridge or beside the girder, check the type of the existing lines such as Water Supply, Sewerage, Electricity and Telephone.

3.3. Super-Structure

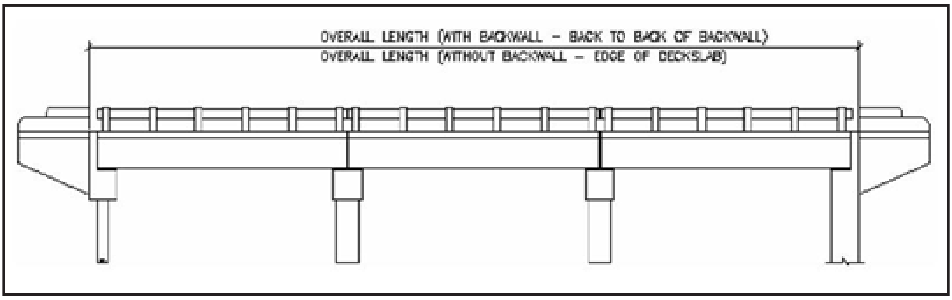
3.3.1. Structure Type
Type of Superstructure will be selected from following type: Bailey Bridge, Steel Girder, Steel Truss, RC Slab, RC Girder PC Girder, Others. In case of “Others”, please describe.

3.3.2. Bridge Length

The total length of the bridge shall be measured between the back to the back walls of the abutments, or between the ends of the deck if there is no backwall.

3.3.3. Span Arrangement:

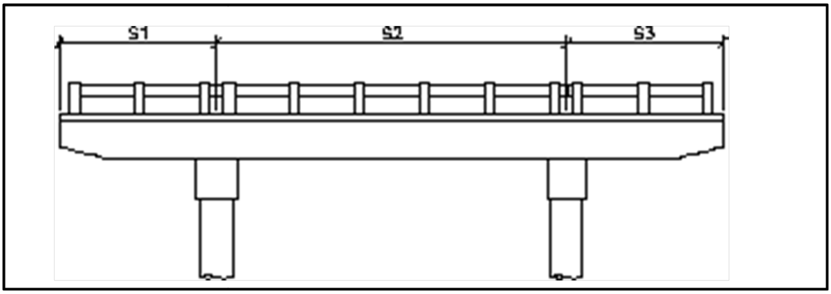
Figure 4-35: Bridge Length



The span arrangement shall be recorded from the beginning side of kilometer post. In case the length of 1st, 2nd and 3rd spans are 20m, 30m and 15m, respectively, the span arrangement shall be recorded as “20m+30m+15m”.

3.3.4. Number of Girders:

Figure 4-36: Span Arrangement

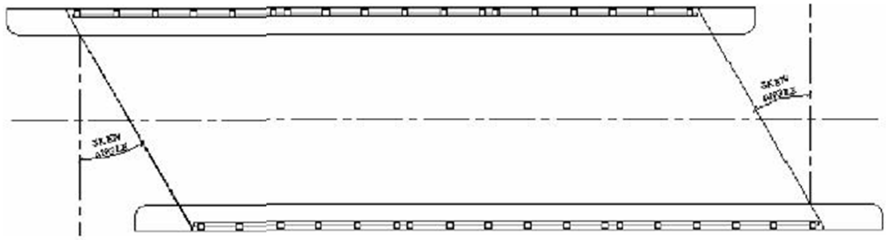


In case the type of superstructure is steel, RC or PC girder bridge, the number of girders shall be counted and recorded.

3.3.5. Skew

The acute angle of transverse line and back wall line shall be approximately measured in degrees as follows.

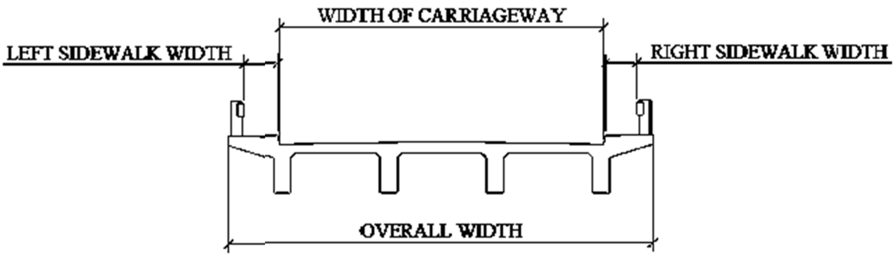
Figure 4-37: Skew



3.3.6. Dimension of Deck

No. of Lanes, Overall Width, Carriageway Width (including shoulders) and Sidewalk Width shall be recorded.

Figure 4-38: Dimension Deck



3.3.7. Bearing Type:

The type of the Bearing shall be selected from following items:

- Elastomeric
- Steel Plate
- Others

3.3.8. Surfacing:

The type of surfacing such as “Concrete” and “Asphalt” shall be confirmed by observation.

3.3.9. Expansion Joint Type:

The type of the Expansion Joint shall be selected from following items: None, Steel Plate Type, SteelFinger Jointand Rubber Type.

3.3.10. Railing Type:

The main structure of the railing (Reinforced Concrete or Steel) shall be recorded.

3.4. Sub Structure

3.4.1. Type of Abutment, its foundation and protection:
The typical abutment types are shown below. In case the type cannot be identified due to protection and/or earth covering, "Unknown" can be selected. The foundation of the abutment shall be selected from a) Spread Footing, b)PC/RC Concrete Pile, c) Cut-in-place (CIP) Concrete Pile d) Others. When it is not visible, select e) Unknown.

The type of protection is selecte (describe the type):
3.4.2 Type of Pier, its Foundation and Protection
The typical pier types are shown below. The foundation of

Figure 4-39: Pile Bent Abutment

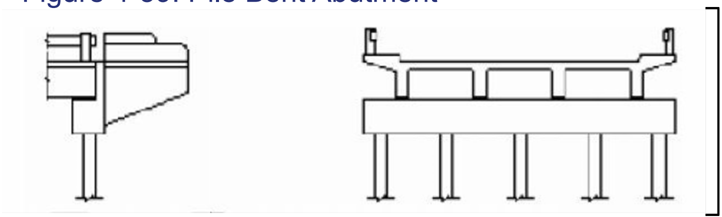


Figure 4-40: Cantilever-Type Abutment

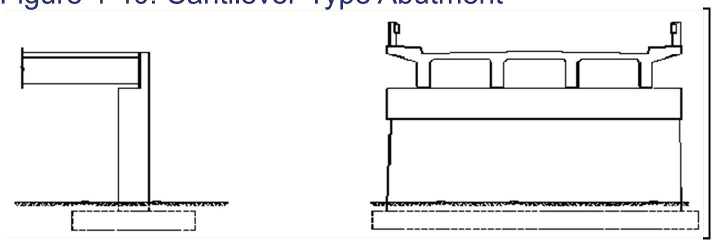
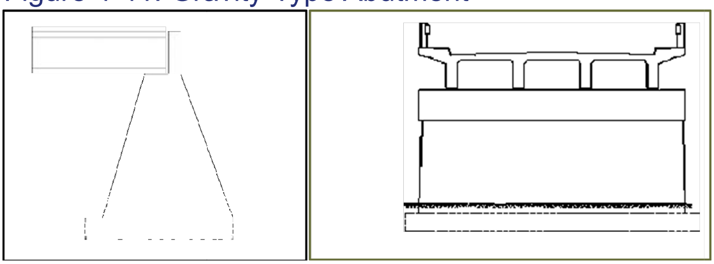


Figure 4-41: Gravity-Type Abutment



the piers shall be selected from a) Spread Footing, b)PC/RC Concrete Pile, c) CIP Concrete Pile d) Others. When it is not visible, select e) Unknown. The type of protection is selected from a) Gabion, b) Riprap, c) None and d) Others (observe the type). In case the protection cannot be confirmed due to under water, “Unknown” is selected.

3.5. River Hydraulic Condition

Figure 4-42: Pile Bent Type

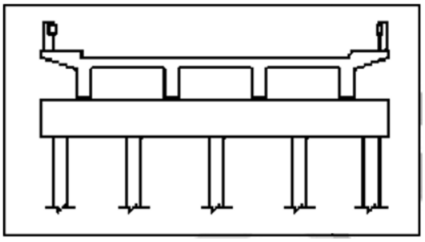


Figure 4-43: Wall Type

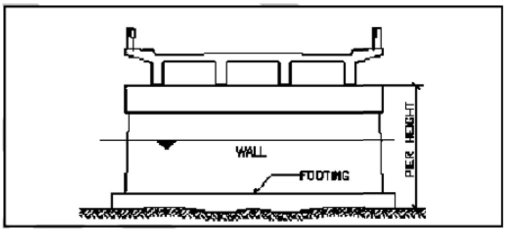


Figure 4-44: 1-Column Type

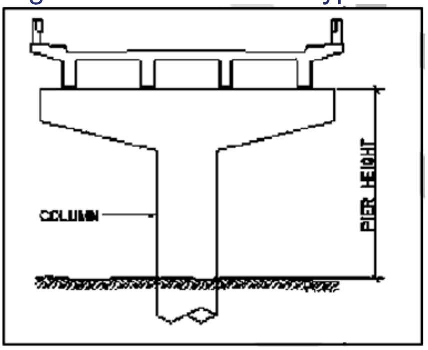
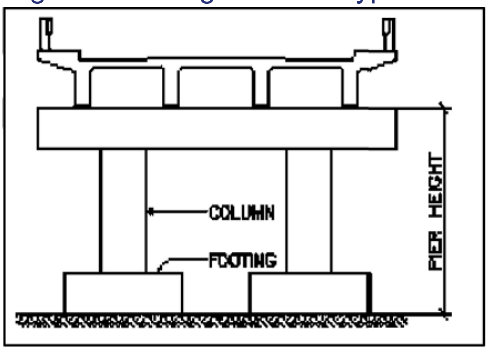


Figure 4-45: Rigid Frame Type



3.5.1. Maximum Flood Level

Approximate maximum flood level shall be investigated through interview to LGU

Engineering office and/or residents at the vicinity of the bridge. Following condition shall be confirmed by the interview: a) Overflowed, b) At the Girder Level,and c) Under the Girder Level

(Approximately how many meters from the bottom of Girder).

3.5.2. River Alignment and Width at the Bridge
River alignment whether it is Straight or Curve, and the approximate width of river shall be recorded and sketched.

3.5.3. Debris Flow
The amount of debris flow especially the flowing trees shall be confirmed by interviewing residents at the vicinity of the bridge whether there are many, few or none.

3.5.4. River-bed Variation
Confirm through interview to the residents or staff of LGU whether the river bed has been rising, lowering or unvaried. If the river bed condition can be visually observed, investigate the condition of sediment around piers and abutments to confirm the localized scouring.

3.5.5. Navigation Clearance
In case navigation clearance under the bridge is required, confirm if the clearance is
sufficient or not, through interview to people concerned. If there are some damage under the girder, vertical clearance under the girder can be insufficient.

4. Bridge Condition and Evaluation

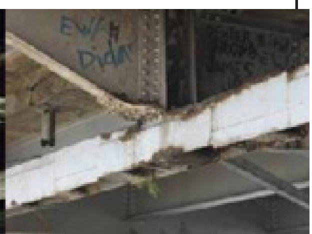
Figure 4-46: Damage and Deformation under the Girders

4.1. Super-Structure

4.1.1. Main Girder / Main Structures of Steel Bridge
The 3-type of defects such as a) Deterioration of Painting, 2) Corrosion at Girder or Main Structures and 3) Break or Crack at Main Structure shall be investigated and recorded its severity. The location of each defect shall be recorded in the BRIDGE SHEET-3 Sketch of the Bridge" by using the following legend and symbols:

4.1.2.
The 3-type of defects such as a) Flexural Crack at the center of girder bottom, 2) Shear Crack at edge of the girder and 3)

Figure 4-47: Types of Defect of Steel Bridge

STEEL STRUCTURES	SAMPLE PHOTOGRAPH
[Type of Defect] Deterioration of Painting [Prospective Location] Girders, Diaphragms, Bearings **[Legend]** (Light): L (Heavy): H	  Light Loss Heavy Loss
[Type of Defect] Corrosion [Prospective Location] Girders, Diaphragms, Bearings [Legend] L / H / LS L: Light H: Heavy, LS: Loss	  Heavy Corrosion Loss of Member

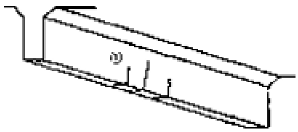
[Type of Defect] Crack [Prospective Location] Girders, Diaphragms, Bearing [Legend] ○	  Crack of Steel Members
[Type of Defect] Braking [Prospective Location] Girders, Diaphragms [Legend] ●	 

Exposure of Re-bar shall be investigated and recorded its rate. The location of each defect shall be recorded in the "BRIDGE FIELD SURVEY SHEET-3 Sketch of the Bridge" found in Annex C by using the following legend and symbols:

4.1.3. Deck Slab

The 4-type of defects such as a) Linear Crack at the Bottom of Slab, b) Water Leakage w/ Isolated Lime at the Bottom of Slab,

Figure 4-48: Defect of Concrete Girder

STEEL STRUCTURES	SAMPLE IMAGE
[Type of Defect] Flexural and Shear Crack **[Prospective Location]** Girders, Diaphragms, **[Legend]** 	 Flexural Crack at the Center  Shear Crack at the Edge
[Type of Defect] Exposure of Re-bar **[Prospective Location]** Bottom and Edge of Girders **[Legend]** 	 Exposure of Re-Bar

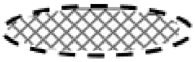
c) Alligator Crack at the Bottom of Slab and d) Exposure of Re-bar at the Bottom shall b investigated and recorded its severity. The location of each defect shall be recorded in the BRIDGE SHEET-3 Sketch of the Bridge found in Annex C" by using the following legend and symbols:

4.1.4. Bridge Surface Facilities

4.1.4.1. Cracks and Depression at Deck Surfacing

Figure 4-49: Defect of Deck Slab

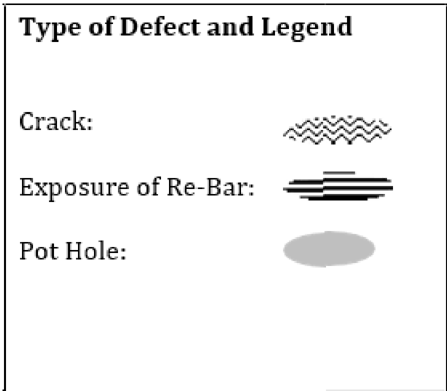
CONCRETE STRUCTURE	SAMPLE PHOTOGRAPH
[Type of Defect] Linear Crack **[Prospective Location]** Bottom of Slab [Legend]	 Linear crack at the bottom of the slab

[Type of Defect] Water Leakage Isolated Lime **[Prospective Location]** Slab, Girder, Abutment, Pier **[Legend]** 	  Water Leakage Isolated Lim
[Type of Defect] Alligator Crack **[Prospective Location]** Bottom of Slab **[Legend]** 	  Alligator Crack Alligator Crack w/ Isolated Lime
[Type of Defect] Re-Bar Exposure **[Prospective Location]** Bottom of Slab **[Legend]** 	  Girder Slab

If it is observed that there are cracks, depression and/or any damage at the surface of the bridge, the severity of damage shall be recorded. The types of defect to be sketched in BRIDGE SHEET-3 Sketch of the Bridge" are shown as below.

4.1.4.2. Damage at Railing

Figure 4-50: Damage of Deck Surfacing



Damage at the Railing of bridge shall be investigated, and its severity shall be recorded.

4.1.4.3. Sign of Settlement of Pier/Abutment

In case the piers or abutments were settled, some sign could be

Figure 4-51: Image of Damage Railing

observed at the surface of bridge. For example:

- Vertical alignment of the bridge is not in a straight line.
- Railing Post inclines towards a supporting pier settled.

If the sign such as above could be observed, mark "Yes" and describe the sign found.

4.2. Sub-structure

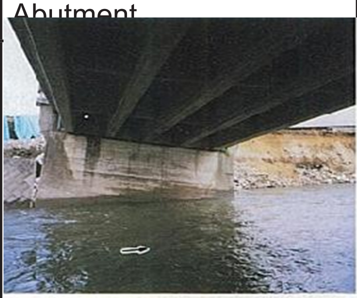
4.2.1. Abutment/Pier

Tilting, Settlement, Local Scoring, Exposed Foundation, Cracks, Expose of Re-Bar and Damage at Abutment Protection shall be investigated and its severity shall be recorded. Each condition and locations of these defects shall be recorded in the sketch of the Bridge in detail shown in Annex C.

4.3. Approach Road

Scoring or Washout at the behind of Abutment, and depression of road surface at the behind of abutment shall be investigated.

Figure 4-52: Type of Defect on Abutment/Piers

	Abutment	Pier
Tilting / Settlement		
Exposed Foundation / Local Scoring		

Crack		
Exposure of Re-bar		

4.4. Overall Evaluation

After checking the all items above mentioned, condition of the bridge will be evaluated according to following categories:

Figure 4-53: Washout at the back of the Abutment

Figure 4-54:Depression of Road Surface at the back of the Abutment

5. Sketch of the Bridge

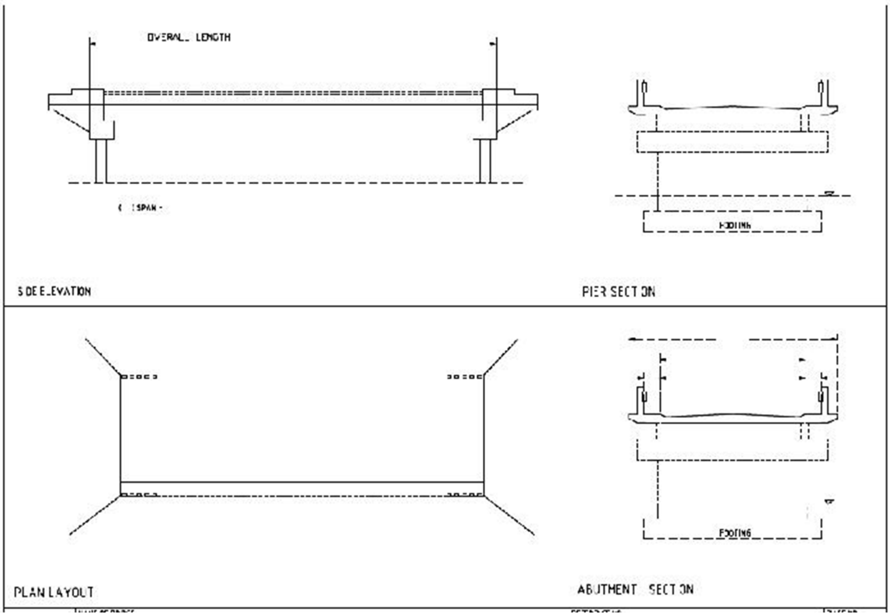
Side Elevation, Plan Layout, Pier Section and Abutment Section for each bridge shall be sketched using the sample in Figure 4-55.

Category	
Good	The Bridge is free of defects affecting bridge performance, durability and integrity
Fair	May have defects that affect bridge durability
Poor	Bridge may have defects that affect bridge performance and structural integrity
Bad	Bridge has major defects that require major rehabilitation/strengthening or bridge replacement

6. Photographs

Photographs of each bridge shall be taken using digital camera.

Figure 4-55: Sketch of a Bridge



Resolution of the photographs shall be around 300,000 pixel to minimize the data size. The composition of photo shall include Deck Slab, Under the Girder (Slab), Side-view and river condition (up- stream and downstream from the bridge) as shown in Figure 4-56.

Figure 4-56: Bridges Photographs

BRIDGE NAME: LUCAHON

Photos			
Scene	Deck Slab	Side View	Bridge to Downstream of River
Photos			
Scene	Under the Girder	Bridge to Upstream of River	Others (Abutment)

PART V
ROAD AND BRIDGE INFRASTRUCTURE VULNERABILITY AUDIT (RBIVA)

1. The Context

Development gains are eroded continually by disasters. Economic losses, manifested in terms of lower productivity, lost opportunity, damage to property and even human deaths, result from the inability of affected communities to cope with natural and human-induced disasters.

In the last few years, the Philippines passed key legislations on Disaster Risk Reduction and Management (RA 10121) and Climate Change (RA 9729) that outline policy directions to a) uphold the rights to life and property by addressing the root causes of vulnerabilities to disasters, strengthening the country's institutional capacity for disaster risk reduction and management and building the resilience of local communities to disasters including climate change impacts; and b) fully protect and advance the right of the people to a healthful ecology.

As managers of development in their localities, local government units have to be capable and ready to manage the consequences of disasters and the phenomenon associated with climate change; thus reducing disaster risk on human settlements, livelihood and infrastructure, and zero or less casualties and minimum damages to properties (DILG[1]).

It is DILG's objective to assist LGUs to build their resiliency to cope with and respond to natural disasters and adapt to climate change and mainstream disaster risk reduction and climate change in pre-disaster planning and infrastructure audit. The latter in particular will ensure resiliency of critical infrastructure such as roads and bridges.

In light of this and as part of the project "Enhancing LGU Capacity on Climate Change Adaptation and Disaster Risk Reduction Management Framework" DILG has produced and rolled out the Infrastructure Audit Form/Checklist for Buildings.[2] A similar set of tools for roads and bridges, herein referred to as **Road and Bridge Infrastructure Vulnerability Audit (RBIVA)**, is being developed and tested.[1]

The tools being developed consist of a set of rapid assessment tools to assist in the determination of urgent interventions. They serve as early warning systems to trigger the implementation of both remedial measures and continuing activities geared towards reducing the vulnerability of road elements to various hazards. The tools are meant to be simple and easily implementable at the LGU and community levels.

The RBIVA is not intended to supersede the more rigorous road and bridge inventory system and the design review. In fact, it is envisioned to take advantage of the results of various analyses including hazard mapping, community mapping, detailed design investigation and testing.

1 1DILG is the Vice-Chair for Disaster Preparedness under the Disaster Risk Reduction and Management Act of 2010. The agency is mandated to build the capacities of LGUs to effectively address and mitigate the impacts of disasters and calamities.

2 In a review of available literature, a similar undertaking could be the road safety audit which is a formalised
assessment of road facilities to identify possible and probable road safety in new and proposed road and infrastructure projects, existing roadways and infrastructure, and road works and infrastructure under construction.

2. The Framework

The five (5) pillars of Disaster Risk Reduction and Management, as identified in the current policy framework of the government, include:

a. risk identification, assessment, and monitoring;
b. risk reduction;
c. risk financing and transfer;
d. emergency preparedness and response; and
e. sustainable recovery

RBIVA is embedded in the first pillar. It advocates the development of an infrastructure audit procedure to identify critical infrastructure components and recommend appropriate engineering solutions in the design of new road and bridge infrastructure or in the improvement of existing ones to make them more resilient.

RBIVA capitalizes on LGU-based hazard identification and vulnerability assessment using thematic vulnerability maps and other assessment tools as input to design and construction. The RBIVA procedure consists of three major components, namely:

a. RBIVA Inventory Tools
b. RBIVA Analytical Tools
c. RBIVA Reporting Tools

In the assessment of risk, there are three (3) essential interacting components, namely:

a. Hazard occurrence probability, defined as the probability of occurrence of a specified natural hazard at a specified severity level in a specified future time period
b. Elements at risk, an inventory of those people or facilities which are exposed to the hazard; and
c. Vulnerability, the degree of loss to each element should a hazard of a given severity occur.

Figure 4-55: Sketch of a Bridge

3. Working Definitions and Ratings

Hazards are events that can lead to loss of diversity, extent, quality and function of ecosystems. They affect the ability of an infrastructure system to support human activities. These may include natural hazards as well as man-made pressures.

Vulnerability is defined as the potential for attributes of any system to respond adversely to hazardous events. It is a function of the level of defense provided by existing countermeasures in the infrastructure design. The Climate Change Act defines Vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including variability and extremes. It is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity. Some practical definitions of vulnerability ratings and the corresponding scoring system are provided below:

a. **Very High (Score 1)** - characterized by a facility often subjected to hazardous events and for which the countermeasures are inadequate. Hazardous events may occur more than once per year.

b. **High (Score 2)** – characterized by a facility moderately subjected to hazardous events and for which the countermeasures are inadequate. Hazardous events may occur once in every 1-3 years
c. **Moderate (3)** – a facility moderately subjected to hazardous events and for which the countermeasures are marginally inadequate. Hazardous events may occur once in every 3-7 years
d. **Low (4)** - a facility not normally subjected to hazardous events and for which the countermeasures are adequate. Hazardous events may occur once every 7-20 years

Disaster Risk is defined as the potential disaster losses in lives, health status, livelihood, assets and services, which occur over some specified future time period. The main approaches to mitigating disaster risks involve a wide range of interventions aimed at lowering if not totally eradicating the impact of losses. The impact of losses can be rated according to the following scale:

a. **Devastating** – the facility is damaged beyond habitable use, repair or restoration and normally characterized by multiple fatalities
b. **Severe** – the facility is partially damaged but remains intact. Some components are damaged beyond repair. The facility may be closed for a period of up to two weeks and some portions may be closed for an extended period of at least one month. May be characterized by some fatalities and major injuries.
c. **Moderate** – the facility is temporarily closed and unable to operate, but can continue without interruption of more than one day. While some components are damaged, the majority of the facility remains unaffected. May be characterized by minor injuries.
d. **Low** – the facility experiences no significant impact on operations with downtime of less than half a day. No injuries are noted.

Combining Impact of Loss Rating with Vulnerability Rating can provide a Qualitative Risk Rating for a particular Hazard. This is can be depicted by the color scheme shown below, with red indicating “high risk”, yellow signifying “medium risk” and green “low risk”.

Table 5-1: A Qualitative Risk Rating

VULNERABILITY TO HAZARDS					
IMPACT OF LOSS		Very High (4)	High (3)	Moderate (2)	Low (1)
	Devastating (4)	8	7	6	5
	Severe (3)	7	6	5	4
	Moderate (2)	6	5	4	3
	Low (1)	5	4	3	2

The ratings may be interpreted as follows:

a. Red-High Risk for which countermeasures to mitigate these risks should be implemented as soon as possible
b. Yellow – Moderate Risk for which countermeasures should be planned in the near future
c. Green- Low Risk for which countermeasures are not urgency required but are recognized with the potential of improving security

Strategies to mitigate disaster risks may involve not only the infrastructure components, but encompass a range of policies, institutions and even long-term programs. The need to focus the analytical tool to a specific component of the disaster risk framework is recognized. Hence, the present tool centers on the elements at risk, i.e. the road and bridge system and develops a methodology to rapidly assess the level of vulnerability of these elements to various hazards.

The tools are based on a similar template developed by DILG and now being utilized for rapidly assessing vulnerabilities of settlement structures. Two separate forms have been developed for roads and bridges.

4. A Guide to Undertaking the Infrastructure Vulnerability Audit

A glossary of terms and list of acronyms are provided at the forward section of these guidelines. The User is encouraged to refer to these sections as needed. The form for undertaking road audit and bridge audit are found in Annex D.

Supporting documents and references may be secured from other agencies involved in disaster management. These may include various hazard maps from DENR, PAG-ASA, PHILVOCS, and DOST such as flooding maps, tsunami maps, locations of active volcanoes, typhoon and fault maps, among others. These maps may be supplemented by land use maps and topographic maps from NAMRIA and local government units. Plans and reports on the design of the specific road section and bridge under audit will be helpful in understanding the structural characteristics of these facilities.

ANNEXES

ANNEX A
Road Inventory Forms

Local Road Inventory Survey Field Sheet "A"

Department of th
Road and Bridge
Local Road Inv

Road Name ____________________
Section ID ____________________
Nodes ____________________
Start ____________ Station ___
End ____________ Station ___

Carriageway												
Chainage			Sur-face Type	Width (T)	No. of	Direc-tional Flow of Traffic	Pavement Type	Slab Thick-ness	Most Recent Thick-ness	Previous Surface Thick-ness	Year of Last Surfac-ing	Year of Recon-struc-tion
Start	End	Length										

ne Interior and Local Government
e Information System
entory Survey Field Sheet "A"

Engineering Office ____________________
Date ____________________
Assessor ____________________

	SHOULDER						Sidewalk					Ditch				
Ter-rain	Start	End	Length	Type	Width	Side	Start	End	Type	Width	Side	Start	End	Type	Size	Side

Local Road Inventory Survey Field Sheet “B”

Department of th
Road and Bridge
Local Road Inve

Road Name ______________________
Section ID ______________________
Nodes ______________________
Start ____________ Station ___
End ____________ Station ___

Centerline Marking			Place		Locational Referencing Points				Culvert			
Start	End	Type	Start	Name	Start	Side	Number	Remarks	Start	Type	No. of Barrels	Diam Size

e Interior and Local Government
e Information System
entory Survey Field Sheet "B"

____

____

Engineering Office ______________
Date ______________
Assessor ______________

								Bridge					Median			
neter	Condi-tion	Length	Barrel Material Tyoe	Head-way Material Type	Apron Type	Invert Type	Slope Pro-tection	Bridge ID	Start	Type	Length	Name	Start	End	Type	Width

Local Road Inventory Survey Field Sheet "C"

Department of th
Road and Bridge
Local Road Inve

Road Name ______________________
Section ID ______________________
Nodes ______________________
Start ____________ Station ____
End ____________ Station ____

Junction			Signs				Structure			
Start	Type	Name	Start	Type	Size	Side	Start	Type	Size	Side

e Interior and Local Government
e Information System
entory Survey Field Sheet "C"

Engineering Office ________________
Date ________________
Assessor ________________

	Safety Device				Roadside Friction			Hazard			
	Start	Type	Size	Side	Start	End	Type	Start	End	Type	Risk

Local Road Inventory Survey Field Sheet “D”

Department of th
Road and Bridge
Local Road Inv

Road Name ______________________
Section ID ______________________
Nodes ______________________
Start ____________ Station __
End ____________ Station __

Side Slope					Gradient			Causeway		
Start	End	Type	Side	Angle	Start	End	Angle	Start	Type	Length

Side Slope

Type Description
E Embankment (Edge Surfacing >m of ground level
C Cut (Edge of Surfacing <3m of ground level)

Angle

SH Flat (<5 degrees)
MD Medium (5 to 30 degrees)
ST Steep (>30 degrees)

Side

L Left Side
R Right Side

Gradient

Angle -30 to 30 degrees

he Interior and Local Government
e Information System
entory Survey Field Sheet "D"

Engineering Office ____________
Date ____________
Assessor ____________

<table>
<tr><th colspan="3">Spillway</th><th colspan="3">Lightings</th><th colspan="3">Environment</th><th colspan="3">Congressional District</th></tr>
<tr><th>Start</th><th>Type</th><th>Length</th><th>Start</th><th>End</th><th>Side</th><th>Start</th><th>End</th><th>Type</th><th>Start</th><th>End</th><th>Name</th></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">Right of Way</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Chainage</td><td rowspan="2">Functional Class</td><td rowspan="2">ROW Width</td><td colspan="2">Status</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>From</td><td>To</td><td>Acquired</td><td>Not Acquired</td></tr>
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LightingsSide

L Left Side
R Right Side

Environment Type

R Rural
UM Urban (Metropolitan)
UNM (Urban (Non-Metropolitan)

Congressional Ditrict

Name Name of Congressional District

Right of Way

Chainage Start and end of homegenous ROW Width
Func Class Functional Classification of Road
ROW Width The width of ROW limit
Acquired If ROW is already acquired & paid by the gov't
Not Acquired If ROW is not yet acquired by the gov't

Manual Classified Traffic Count

MANUAL CLASSIFIED TRAFFIC COUNT
SINGLE-DIRECTION COUNT FORM

DILG-LRBICS
VERSION 2014

SITE ID:	Province:	Municipality:
ROAD SECTION ID:	ROAD NAME:	
KM STATION: +	SITE DESCRIPTION:	
DAY OF THE WEEK:	DATE (MM / DD / YYYY): / /	HOUR (FROM – TO): –

COUNT DIRECTION	From: To :										
1. NON-MOTORIZED											
2. MOTORCYCLE											
3. MOTOR-TRICYCLE											
4. PASSENGER CAR											
5. PASSENGER UTILITY											

6. GOODS UTILITY											
7. SMALL BUS											
8. LARGE BUS 11 or 12											
9. RIGID TRUCK 2 axles 11											
10. RIGID TRUCK 3+ axles 12 or 22 or 13											
11. TRUCK SEMI-TRAILER 3 and 4 axles 12-1											
12. TRUCK SEMI-TRAILER 5+ axles 12-2											
13. TRUCK TRAILERS 4 axles 11-11											
14. TRUCK TRAILERS 5+ axles 11-12											

ANNEX B
Road Condition Assessment Forms

Visual Road Condition Assessment Form – Asphalt Pavement

Visual Road Condition Assessment Form
Asphalt Pavement

Date of Survey	
Rater	

Province		Office	
Road ID		Road Name	
Section ID		Section Length	meters

ROAD SEGMENT TO BE ASSESSED

From KM		Segment Length	meters	Year of Last Surfacing	
To KM		Carriageway Width	meters	Update Surface Type	
LRPs		Lane Width	meters	Where Changed	

RUTTING: Thickness of rutting for every 10m of the first 50m of segment length

Direction		*Position* 10m	20m	30m	40m	50m
Positive	Outer Wheel Path (mm)					
	Inner Wheel Path (mm)					
Negative	Inner Wheel Path (mm)					
	Outer Wheel Path (mm)					

ROAD SLIP/CUT

OTHER ITEMS

Condition		
Drains		
Unsealed Shoulder		
Sealed Shoulder		

EVALUATED DEFECTS FOR EVERY 100 METERS OF SEGMENT LENGTH

Severity of Defects		*Length of Defects (in meters) for evary 100 m of segment length* 100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
EDGE BREAK: Length of edge break in meters for every 100m of segment length														
Width	S													
	M													
	L													
PATCHES: Length of patches in meters for every 100m of segment length														
Width (meters)	0.5													
	1.0													
	1.5													
	2.0													

1-Lane Wide														
POTHOLES: Number of equiv. potholes: Potholes (Area X 4) or Base Failures (Area X 1) for every 100m														
Number														
SURFACE FAILURES: Number of surface failures (Area X 4, for A<1m2) or (Area X 1, for A>1m2) for every 100m														
Number														
WEARING SURFACE: Length of wearing surface for a specified width for every 100m of segment length														
0.50 m	M													
Wide	S													
1.00 m	M													
Wide	S													
1.50 m	M													
Wide	S													
2.00 m	M													
Wide	S													
1-Lane	M													
Wide	S													
LONGITUDINAL CRACKING: Length in meters with assumed affected width of 0.50m														
0.50 m	N													
Wide	W													
CROCODILE CRACKING: Length in meters by width or entire lane														
0.50 m	N													
Wide	W													
1.00 m	N													
Wide	W													
1.50 m	N													
Wide	W													
2.00 m	N													
Wide	W													
1-Lane	N													
Wide	W													
TRANSVERSE CRACKING: Length in meters with assumed affected width of 0.50m														
0.50 m	N													
Wide	W													

RATER'S COMMENT:	

Visual Road Condition Assessment Form – Concrete Pavement

Visual Road Condition Assessment Form
Concrete Pavement

Date of Survey	
Rater	

Province		Office				
Road ID		Road Name				
Section ID		Section Length		meters		

ROAD SEGMENT TO BE ASSESSED

From	KM		Segment Length		meters	Year of Last Surfacing	
To	KM		Carriageway Width		meters	Update Surface Type	
		LRPs	Lane Width		meters	Where Changed	

REPRESENTATIVE ROAD LENGTH FOR THE WHOLE SEGMENT - FIRST 10 JOINTS

JOINT NO.	*Dimension*		*Defects*						
	SLAB		FAULTING			SPALLING			SEALANT
	Length (m)	Width (m)	Readings (mm)			Width (mm)		Length (m)	Detertn (m)
1				&					
2				&					
3				&					
4				&					
5				&					
6				&					
7				&					
8				&					
9				&					
10				&					

ROAD CUT/SLIP ☐

OTHER ITEMS

Drains ☐

Unsealed Shoulder ☐

Sealed Shoulder ☐

EVALUATED DEFECTS FOR EVERY 100 METERS OF ROAD LENGTH FOR THE WHOLE SEGMENT

Severity of Defects	*Length of Defects (in meters) for evary 100m of segment length*												
	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300
SHATTERED SLAB: Number of shattered slab for every 100m length of the segment													
Number													

SCALING: Length of scaling in meters by width in terms of no. of lanes (max. of 100m length for every lane)														
1-Lane Wide	M													
	S													
2-Lanes Wide	M													
	S													
3-Lanes Wide	M													
	S													
4-Lanes Wide	M													
	S													
5-Lanes Wide	M													
	S													
LONGITUDINAL CRACKING: Length in meters with assumed affected width of 0.50 m														
0.50 m Wide	N													
	W													
CROCODILE CRACKING: Length in meters by width or entire lane														
0.50 m Wide	N													
	W													
1.00 m Wide	N													
	W													
1.50 m Wide	N													
	W													
2.00 m Wide	N													
	W													
1-Lane Wide	N													
	W													
TRANSVERSE CRACKING: Length in meters with assumed affected width of 0.50 m														
0.50 m Wide	N													
	W													
TOTAL CRACKED SLAB: Number of slab with cracks excluding Shattered slab for every 100m of segment length														
Number														

RATER'S COMMENT:	

Visual Road Condition Assessment Form – Gravel/Earth

Date of Survey	
Rater	

Visual Road Condition Assessment Form
Gravel/Earth Pavement

Province		Office	
Road ID		Road Name	
Section ID		Section Length	meters

ROAD SEGMENT TO BE ASSESSED

From KM		Segment Length	meters	Year of Last Surfacing	
To KM		Carriageway Width	meters	Update Surface Type	
LRPs		Lane Width	meters	Where Changed	

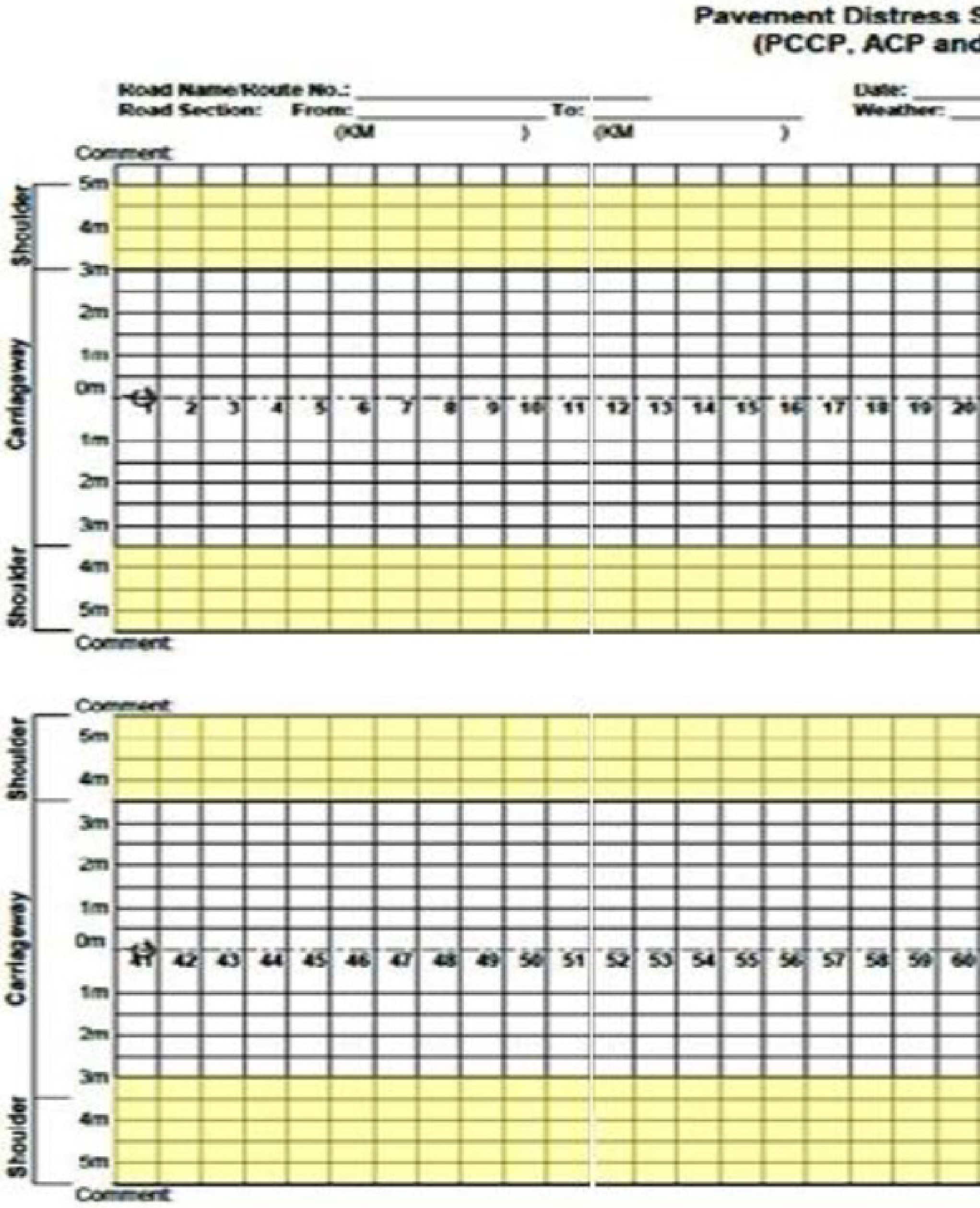
Gravel ☐ Earth ☐

ROAD SLIP/CUT ☐

ITEMS FOR ASSESSMENT	CONDITION	Condition Rating of Items (1,2,3 or 4) for every 100 m													Overall Rating
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	
Gravel Thickness	1 >100mm														
	2 >=50mm<100mm														
	3 >=25mm<50mm														
	4 <25mm														
Material Quality	1 Good														
	2 Fair														
	3 Poor														
	4 Bad														
Crown Shape	1 Good														
	2 Flat														
	3 Uneven														
	4 Very Uneven														
Roadside Drainage	1 Good														
	2 Fair														
	3 Poor														
	4 Bad														

RATER'S COMMENT:

Pavement Distress Survey Sheet (PCCP, ACP, and Gravel)


Pavement Distress S
(PCCP, ACP and

Road Name/Route No.: ______
Road Section: From: ______ To: ______
(KM) (KM)
Date: ______
Weather: ______

Comment
Shoulder 5m 4m 3m
Carriageway 2m 1m 0m
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1m 2m 3m
Shoulder 4m 5m
Comment

Comment
Shoulder 5m 4m
Carriageway 3m 2m 1m 0m
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
1m 2m 3m
Shoulder 4m 5m
Comment

Survey Sheet
Gravel)

Surveyed by: ______________________
Sheet No.: ________

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40 m

61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80 m

ANNEX C
Local Bridge Field Survey Sheet

Local Bridge Field Survey Sheet 1

LOCAL BRIDGE FI

Bridge Inv

BRIDGE NAME: ____________________

Inspection Date :	

GENERAL:				
Local Engineering Office:			ROAD NAME :	
MUNICIPALITY :			Station No. :	
BARANGAY :			NAME OF RIVER :	
ENVIRONMENT :				
Terrain :	☐Flat	☐Rolling	☐Mountainous	
Alternative Route:	☐Yes	☐No	Land use:	☐Re
Structures/Houses in ROW? :	☐Yes	☐No	Utilities on Bridge :	☐Wa
SUPER-STRUCTURE :				
Structure Type :	☐Bailey	☐Timber	☐Steel Truss	☐RC
Span Arrangement (No of Span and Span Length):			( )-( )Span;	____
Bridge Length (m) :		No. of Lanes :		Bear
No. of Girders :		Total Width (m) :		Surfa
Skew (deg):		Carriageway Width (m) :		Exp.J
		Sidewalk Width (m) :		Railin
SUB-STRUCTURE				
Abutment Type :	☐Pile Bent	☐Cantilever	☐Gravity	☐Ot
Abutment Foundation Type :	☐Spread Footing	☐PC/RC Concrete Pile	☐CIP Conc. I Pile	☐Ot
Abutment Protection :	☐Gabion	☐Grouted Riprap	☐ None	☐Ot
Pier Type :	☐Pile Bent	☐Wall Type	☐1-Column	☐Rig
Pier Foundation Type :	☐Spread Footing	☐PC/RC Concrete Pile	☐CIP Conc. I Pile	☐Ot
Pier Protection :	☐Gabion	☐Riprap	☐ None	☐Ot
HYDRAULIC CONDITION				
Max. Flood Level	☐Overflowed	☐At the Girder Level	☐Under the Girder Level	
River Alignment at the Bridge	☐Straight	☐Curve	River Width (m):	
Debris Flow:	☐Many	☐Few	☐None	
River-bed Variation	☐Rising	☐Lowering	☐Unvaried	
Navigation Clearance:	☐Not Required	☐Insufficient	☐Sufficient	

ELD SURVEY SHEET-1

ventory Data

	Inspected by :		Checked by :	

		YEAR BUILT :		
		LOAD LIMIT (tons) :		
		COORDINATE :	X:	Y:
sidential/Commercial		☐Agricultural Use	☐Forest	☐Waste Land
ater	☐Sewerage	☐Electricity	☐ Telephone	
Slab	☐RC Girder	☐PC Girder	☐Others;	
ing Type :	☐Elastomeric Pad	☐Steele Plate	☐Others;	
cing:	☐Concrete	☐Asphalt		
Joint Type :	☐None	☐Steel Plate Type	☐Finger Joint	☐Rubber Type
ng Type :	☐RC	☐Steel		
hers:		☐Unknown		
hers :		☐Unknown :		
hers :				
gid Frame	☐Others :			
hers :		☐Unknown :		
hers :		☐Unknown		
(Approx.__________m from the bottom of Girder)			REMARKS;	

Reference No.

Local Bridge Field Survey Sheet 2

LOCAL BRIDGE FIE

Bridge Conditi

BRIDGE NAME:

SUPER-STRUCTURE :		
MAIN GIRDER / MAIN STRUCTURES OF STEEL BRIDGE	1. Deterioration of Painting?	☐Heavy
	2. Corrosion at Girder or Main Structures?	☐Loss o
	3. Break or Crack at Main Structure?	☐Yes, w
MAIN GIRDER OF CONCERT BRIDGE	1. Flexural Crack at the Center of Girder Bottom?	☐Many
	2.Shear Crack at the Edge of Girder?	☐Many
	3. Exposure of Re-bar at the Girder?	☐Many
DECK SLAB	1. Linear Crack at the Bottom of Slab?	☐Many
	2. Water Leakage w/ Isolated Lime at the Bottom of Slab?	☐Many
	3. Alligator Crack at the Bottom of Slab?	☐Many
	4. Exposure of Re-bar at the Bottom?	☐Many
BRIDGE SURFACE FACILITIES	1. Cracks and Depression at Deck Surfacing?	☐Many
	2. Damage at Railing	☐Many
	3. Sign of Settlement of Pier/Abutment?	☐Yes, w
SUB-STRUCTURE		
ABUTMENT:	1. Tilting the Abutment?	☐Yes
	2. Settlement of Abutment?	☐Yes
	3. Exposed Foundation?	☐Yes
	4. Damage at Abutment Protection?	☐Much
	5. Cracks at the Abutment?	☐Many
	6. Exposure of Re-bar?	☐Many
PIER:	1. Tilting Column?	☐Yes
	2.Settlement of Pier?	☐Yes
	3. Local Scoring?	☐Yes
	4. Exposed Foundation?	☐Yes
	5. Cracks at the Pier?	☐Many
	6. Exposure of Re-bar?	☐Many
APPROACH ROAD		
1. Scouring or Washout at the behind of Abutment?		☐Much
2. Any Depression of Road Surface at the behind of Abutment?		☐Much
OVERALL EVALUATION		

ELD SURVEY SHEET-2

ion & Evaluation

y Loss of Painting		☐Light Loss	☐None
f Member	☐Heavy Corrosion	☐Light Corrosion	☐None
here: ( )		☐No	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
hat: ( )			☐No
	☐No		
	☐No		
	☐No		
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐No		
	☐No		
	☐No		
	☐No		
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
	☐Few	☐None	
		☐A Good ☐B:Fair ☐C:Poor ☐D:Bad	

Reference No.

Local Bridge Field Survey Sheet 3

LOCAL BRIDGE FI

Sketch o

BRIDGE NAME: ____________________

SIDE ELEVATION

PLAN LAYOUT

ELD SURVEY SHEET-3

f the Bridge

	PIER SECTION
	ABUTMENT SECTION

Reference No.

LOCAL BRIDGE FI

Phot

BRIDGE NAME: ______________________

Photos		
Scene	Deck Slab	
Photos		
Scene	Under the Girder	Br

ELD SURVEY SHEET-4

ographs

Side View	Bridge to Downstream of River
idge to Upstream of River	Others ( )

Reference No.

Local Bridge Field Survey Sheet 5

LOCAL BRIDG

Condi

BRIDGE NAME: ____________________

Photos		
Scene		
Photos		
Scene		

E FIELD SURVEY SHEET-5

ion Photographs

Reference No.

ANNEX D
Road and Bridge Infrastructure Vulnerability Audit Forms

LGU INFRASTRUCTURE AUDIT FORM (FOR ROADS)

I. GENERAL INFORMATION

A. IDENTIFICATION

Province and Region: ______________________

City/Municipality: __________________________

Barangay: _______________________________

B. INSPECTION

Head of Inspection Team: ___________________

Position: ________________________________

Office: _________________________________

Inspection Date/Time: ______________________

C. ROAD INFORMATION

Road Name: _____________________________

From Sta:_____________ To Sta:___________

Coordinates

Longitude: ___________ Longitude: __________

Latitude: ____________ Latitude: ___________

(PHOTOGRAPH OF ROAD SECTION WITH STATION LIMITS AND NAME)

Road Section ID :
From Sta:_____________ To Sta:_______________
Coordinates
Longitude:_____________ Longitude:____________
Latitude:______________ Latitude:_____________

Road Administrative Classification:_____________
Type of Surfacing:
☐ Portland Cement Concrete Pavement ☐ Asphalt
☐ Gravel ☐ Earth
☐ Others, specify____________________________
Date Originally Constructed:___________________
Date Last Improved:__________________________
Date Last Rehabilitated: ______________________
Available Records/Documents:
☐ Road Inventory ☐ Traffic Survey
☐ Topographic Survey ☐ Alignment Survey
☐ Hydrologic Study ☐ Hydraulic Investigation
☐ Geotechnical Investigation ☐ Geometric Design
☐ Pavement Design ☐ Drainage Design
☐ Other Drawings, specify

Location of Documents:
Contact Person: ______________________________
Office: ______________________________________
Contact Number:_____________________________

II. RAPID HAZARD AND VULNERABILITY ASSESSMENT

D. POTENTIAL NATURAL HAZARDS AND FREQUENCY OF OCCURENCE[3]

Hazard	More than once per year	Once every 1-3 years	Once every 3-7 years	Once every 7-20 years, or less
☐ Ground Shaking	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Ground Rupture/ displacement	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Liquefaction	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Landslides	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Tsunami	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Storm/Typhoon	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Flooding	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Volcanic Eruption	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Others Specify__________	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4

E. POTENTIAL MAN-MADE HAZARDS

☐ Overloading
☐ Quarrying
☐ Dumpsite
☐ Settlement
☐ Others ________________

F. DOMINANT LAND USE

☐ Residential
☐ Institutional
☐ Commercial
☐ Industrial
☐ Mining
☐ Agricultural
☐ Forest
☐ Open/Wasteland
☐ Others ________________

G. VULNERABILITY TO EARTHQUAKE - INDUCED HAZARDS*

Approximate Distance from a known Active Fault

☐ (1) less than 5 meters
☐ (2) 5m to less than 1 km
☐ (3) 1 km to less than 10 km
☐ (4) greater than 10 km

Foundation Condition
☐ (1) Organic (i.e. peat / muck)
☐ (2) Cohesionless (i.e. sand / gravel)
☐ (3) Cohesive (i.e. clay / silt)
☐ (4) Rock (i.e. adobe, limestone/ shale)

Score (S):________________

H. VULNERABILITY TO LIQUEFACTION[2]

Approx. distance from bodies of water:
☐ (1) less than 100 meters
☐ (2) 100m to less than 500m
☐ (3) 500m to less than 1km
☐ (4) greater than 1km

Within reclamation area:
☐ (0) Yes ☐ (1) No

Within low-lying area:
☐ (0) Yes ☐ (1) No

Score (S):________________

[3] Scores are qualitative hazard ratings. Higher scores indicate less severe hazards.
[4] Hazard ratings are indicated in parenthesis ( ).

(May be vulnerable to Earthquake-induced Hazard if S < 4)

(May be vulnerable to Liquefaction Hazard Hazard if S < 4)

I. VULNERABILITY TO LANDSLIDE/SOIL EROSION[2]

1.1 Approx. distance from hillside/cliff/ravine
☐ (1) less than 5 meters
☐ (2) 5m to less than 10m
☐ (3) 10m to less than 20m
☐ (4) greater than 20m

1.1 2Approx. road gradient:
☐ (1) greater than 15%
☐ (2) 10% to less than 15%
☐ (3) less than 10%
☐ (4) generally flat (~ 0%)

I.3 Within low-lying area
☐ (0) Yes ☐ (1) No
I.4 Presence of landslides and debris
☐ (0) Yes ☐ (1) No
I.5 Presence of bulging slopes
☐ (0) Yes ☐ (1) No
I.6 Presence of cracks/fissures in side
☐ (0) Yes ☐ (1) No
I.7 Presence of fallen rocks
☐ (0) Yes ☐ (1) No

Score (S):________________________
(May be vulnerable to Landslide/Soil Erosion if S < 4)

J. VULNERABILITY TO TSUNAMI[2]

J.1Approx. Distance from Coast/ Shoreline in meters
☐ (1) less than 5 km
☐ (2) 5km to less than 20km
☐ (3) 20km to less than 50km
☐ (4) greater than 50km
J.2 Presence of Water Barriers (e.g. Breakwater. Seawall etc.)
☐ (1)Yes ☐ (0)No

Score (S):___________________
(May be vulnerable to Tsunami Hazard if S < 4)

K. VULNERABILITY TO FLOODING[2]

K.1 Approx. distance from bodies of water (e.g lakes, bay, sea) :
☐ (1) less than 5 meters
☐ (2) 5m to less than 1 km
☐ (3) 1 km to less than 10 km
☐ (4) greater than 10 km

K.2 Within low-lying area:
☐ (0)Yes ☐ (1) No

Score (S):________________
(May be vulnerable to Flooding Hazard if S < 4)

L. VULNERABILITY TO OTHER HAZARDS[2]

Within typhoon-prone area :
☐(0)Yes ☐ (1)No
Within 20km radius of active volcano:
☐ (0)Yes ☐ (1)No
Within 10km from garbage dumping area:
☐ (0)Yes ☐ (1)No

Score (S):___________________
(May be vulnerable if S =0 on the identified hazard)

M. Remarks on Hazards

N. ROAD COMPONENTS			
COMPONENTS	PHOTOS	COMPONENTS	PHOTOS
Road Surfacing: ☐ PCCP ☐ Asphalt ☐ Gravel ☐ Earth ☐ Others, _______________		Road Side Area : ☐ With Vegetative Cover ☐ With Slope Stabilization ☐ Cut Section ☐ Fill Section	
Road Shoulder : ☐ PCCP ☐ Asphalt ☐ Gravel ☐ Earth ☐ Others, _______________		Guard Rails : ☐ Reinforced concrete ☐ Steel ☐ Wood	
Road Shoulder : ☐ PCCP ☐ Asphalt ☐ Gravel ☐ Earth ☐ Others,		Cross drainage : ☐ Ordinary Pipe ☐ Reinforced Concrete Pipe Culvert ☐ Reinforced Concrete Box Culvert ☐ Others : _______________	

III. VISUAL SCREENING OF ROAD SECTION FOR POTENTIAL HAZARDS (BASED ON SCORES FROM "II.RAPID HAZARD AND VULNERABILITY ASSESSMENT")		
TYPE OF HAZARD	**SCORE**	**ROAD SECTION MAY BE VULNERABLE TO HAZARD? (Yes or No)**
A. Earthquake-induced Hazard		
B. Liquefaction		
C. Landslide/Soil Erosion		

[5]Indicate location and number of inspected section. Indicate whether the structure is vulnerable to a particular type of hazard and if the condition of the road component will worsen if left unattended. Indicate, as well, if the observation is design related or if a regular maintenance issue.

D. Tsunami		
E. Flooding		
F. Typhoon		
G. Volcanic Eruption		
H. Others (Identify)		

IV. CONDITION OF ROAD COMPONENTS		
COMPONENT	CONDITION	Remarks[5]
A. Vertical Road Alignment	☐Long segments of steep gradients ☐ Presence of sharp horizontal curves on steep gradients	
B. Horizontal Road Alignment	☐ Within 2m from a cliff ☐Within 2m from foot of a mountain/hill ☐Presence of reverse curves	
C. Road Surfacing	☐Presence of Road Distress (Refer to Road Inventory) ☐ Absence of Cross-slope (i.e., Camber or Crown)	
D. Base/Subbase	☐Exposure (i.e., Absence of Surfacing) ☐Sign of Failure or Weakness (e.g. Surface Rutting)	
E. Shoulder	☐ Absence of road shoulder ☐ Absence of shoulder cross-slope ☐Sign of Shoulder Distress (Refer to Road Inventory)	
F. Cross drainage	☐Absence of Cross-drainage ☐Clogged-up cross drainage ☐ Damaged cross-drainage ☐ Sign of overflow (i.e., indication of overcapacity)	

G. Side drainage	☐Absence of Side Drainage ☐Absence of drainage lining ☐ Sign of overflow (i.e., indication of overcapacity)	
H. Road Side Area	☐Steep side slope (more than 45%) ☐Loose rock and soil formation ☐ Deteriorated Slope stabilization structure ☐ Absence of Vegetative Cover	
I. Miscellaneous Road Facility	☐Absence of road markings ☐Deterioration of road markings ☐Absence of road signs in critical sections ☐Deterioration of road signs ☐Absence of traffic signals in critical intersections ☐ Non-working traffic signals ☐Absence of guard rails in dangerous sections ☐Deteriorated or damaged guard rails ☐ Others, (specify) ______________________________	

V. CONDITION OF ROAD COMPONENTS (Use additional sheets if necessary)		
COMPONENT	**OBSERVATIONS**	**REMARKS**

VI. SUMMARY OF OVERALL PHYSICAL CONDITION

(Responses may be in Narrative/Pictures/Sketches. Use additional sheets if necessary.)

1. Description of Hazards to which the road section and its specific components are susceptible.

2. Identification of Critical Road Components Based on Assessment

VII. ANNEXES/ATTACHMENTS
(Photos, sketches, drawings, plans, other documents attached to this Audit Form)

VIII. RECOMMENDATIONS (To be filled up by Authorized Civil/Road Engineer)

1. For Critical Road Components
☐ For detailed inspection by a competent authority, if inspector is not an engineer
☐ For detailed design investigation, if inspector is an engineer:
☐ Further review of detailed plans / design calculations
☐ Conduct of detailed structural testing
☐For maintenance of identified components.

2. For Miscellaneous Components OR Ancillary/Auxiliary Equipment and Facilities
☐ Immediate action based on identified components and assessment above.
☐ For maintenance of identified components

3. If other courses of action are recommended, please state and include the justification below (e.g., retrofitting, relocation of facility, re-alignment, abandonmentetc.)

Component	Recommended Courses of Action	Justification/Remarks

For Referral to:

- ☐ **DILG**
- ☐ **DPWH**

____

Name & Signature of Provincial/City / Municipal Engineer

Date: ____________________________________

LGU INFRASTRUCTURE AUDIT FORM (FOR BRIDGES)

(PHOTOGRAPH OF BRIDGE STRUCTURE, FRONT ELEVATION WITH LOCATION AND NAME)	A. IDENTIFICATION Province and Region: ______________________ City/Municipality: __________________________ Barangay: ______________________________ B. **INSPECTION** Head of Inspection Team:___________________ Position:_______________________________ Office: _________________________________ Inspection Date/Time: _____________________ C. BRIDGE INFORMATION Bridge Name:___________________________ Name of Road Section where Bridge is located : ______________________________________ Bridge Classification by Jurisdiction: ______________________________________ Length of Bridge: ___ m. No. of Spans:____ No. of Lanes:_____ **Bridge Condition Type**: ☐ Permanent ☐ Bailey ☐ Temporary **Bridge Construction Type**

☐ Reinforced Concrete (RCDG) ☐ Pre-stressed Concrete (PCDG)
☐ Structural Steel (SDG) ☐ Timber Bridge
☐ Slab Bridge

Date Constructed/Age of Bridge:________/____years
Reference Code/NSCP used:____________________
Original Construction: ☐ Yes ☐ No
Rehabilitated: ☐ Yes ☐ No
Available Records/Documents:
☐ Geotechnical Investigation ☐ Construction Plan
☐ As-Built Plan
☐ Other Drawings, specify ____________________
Location of Documents :
Contact Person:____________________________

II. RAPID HAZARD AND VULNERABILITY ASSESSMENT

D. POTENTIAL NATURAL HAZARDS AND FREQUENCY OF OCCURENCE[6]

	More than once per year	Once every 1-3 years	Once every 3-7 years	Once every 7-20 years, or less
☐ Ground Shaking	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Ground Rupture/ displacement	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Liquefaction	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Landslides	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Tsunami	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Storm/Typhoon	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Flooding	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Volcanic Eruption	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4
☐ Others Specify__________	☐ Score 1	☐ Score 2	☐ Score 3	☐ Score 4

E. POTENTIAL MAN-MADE HAZARDS

☐ Overloading
☐ Quarrying
☐ Dumpsite
☐ Settlement
☐ Others ____________________

[6] Scores are qualitative hazard ratings. Higher scores indicate less severe hazards.

F. DOMINANT LAND USE

☐ Residential
☐ Institutional
☐ Commercial
☐ Industrial
☐ Mining
☐ Agricultural
☐ Forest
☐ Open/Wasteland
☐ Others ________________

G. VULNERABILITY TO EARTHQUAKE - INDUCED HAZARDS[7]

Approximate Distance from a known Active Fault

☐ (1) less than 5 meters
☐ (2) 5m to less than 1 km
☐ (3) 1 km to less than 10 km
☐ (4) greater than 10 km

Foundation Condition
☐ (1) Organic (i.e. peat / muck)
☐ (2) Cohesionless (i.e. sand / gravel)
☐ (3) Cohesive (i.e. clay / silt)
☐ (4) Rock (i.e. adobe, limestone/ shale)

Score (S):________________________
(May be vulnerable to Earthquake-induced Hazard if S < 4)

H. VULNERABILITY TO LIQUEFACTION[2]

Approx. distance from bodies of water:
☐ (1) less than 100 meters
☐ (2) 100m to less than 500m
☐ (3) 500m to less than 1km
☐ (4) greater than 1km

Within reclamation area:
☐ (0) Yes ☐ (1) No

Within low-lying area:
☐ (0) Yes ☐ (1) No

Score (S):________________________
(May be vulnerable to Liquefaction Hazard Hazard if S < 4)

I. VULNERABILITY TO LANDSLIDE/SOIL EROSION[2]

1.1 Approx. distance from hillside/cliff/ravine
☐ (1) less than 5 meters
☐ (2) 5m to less than 10m
☐ (3) 10m to less than 20m
☐ (4) greater than 20m

1.1 2Approx. road gradient:
☐ (1) greater than 15%
☐ (2) 10% to less than 15%
☐ (3) less than 10%
☐ (4) generally flat (~ 0%)

I.3 Within low-lying area
☐ (0) Yes ☐ (1) No
I.4 Presence of landslides and debris
☐ (0) Yes ☐ (1) No
I.5 Presence of bulging slopes
☐ (0) Yes ☐ (1) No
I.6 Presence of cracks/fissures in side
☐ (0) Yes ☐ (1) No
I.7 Presence of fallen rocks
☐ (0) Yes ☐ (1) No

Score (S):________________________
(May be vulnerable to Landslide/Soil Erosion if S < 4)

J. VULNERABILITY TO TSUNAMI[2]

J.1Approx. Distance from Coast/ Shoreline in meters
☐ (1) less than 5 km
☐ (2) 5km to less than 20km
☐ (3) 20km to less than 50km
☐ (4) greater than 50km
J.2 Presence of Water Barriers (e.g. Breakwater, Seawall etc.)
☐ (1)Yes ☐ (0)No

Score (S):____________________
(May be vulnerable to Tsunami Hazard if S < 4)

K. VULNERABILITY TO FLOODING[2]
K.1 Approx. distance from bodies of water (e.g lakes, bay, sea) :

L. VULNERABILITY TO OTHER HAZARDS[2]

Within typhoon-prone area :

M. Remarks on Hazards

☐ (1) less than 5 meters ☐ (2) 5m to less than 1 km ☐ (3) 1 km to less than 10 km ☐ (4) greater than 10 km K.2 Within low-lying area: ☐ (0)Yes ☐ (1) No Score (S):________________ (May be vulnerable to Flooding Hazard if S < 4)	☐(0)Yes ☐ (1)No Within 20km radius of active volcano: ☐ (0)Yes ☐ (1)No Within 10km from garbage dumping area: ☐ (0)Yes ☐ (1)No Score (S):____________________ (May be vulnerable if S =0 on the identified hazard)

N. BRIDGE STRUCTURAL AND OTHER COMPONENTS			
COMPONENTS	PHOTOS	COMPONENTS	PHOTOS
Slab deck: ☐ Timber ☐ Steel plate ☐ Reinforced concrete		Abutments and Wing Walls: ☐Reinforced concrete ☐ Other:	
Beams and Girders: ☐ Timber ☐ Structural steel ☐ Reinforced concrete ☐Prestressed concrete		Railings: ☐ Reinforced concrete ☐ Steel: ☐ Other: Rail posts: ☐Reinforced concrete ☐ Steel: ☐ Other: ____________________	
Columns and Piers: ☐Timber ☐ Structural steel ☐ Reinforced concrete ☐ Pre-stressed concrete		Others :	

[7] Hazard ratings are indicated in parenthesis ( ).

VII. VISUAL SCREENING OF BRIDGES FOR POTENTIAL SEISMIC HAZARDS (AFTER FEMA HANDBOOK 154 for High Seismicity Regions: If Final Score < 2.0, structure may be vulnerable to Seismic Hazards)[8]			
TYPE OF CONSTRUCTION	TIMBER	STEEL	CONCRETE
A. Basic Score			
Single span OR	3.8	3.2	2.5
2 to 3 spans OR	3.8	3.2	2.9
More than 3 spans	3.8	3.2	3.1
B. Vertical Irregularity	-2.0	N/A	-1.5
C. Plan Irregularity	-0.5	-0.5	-0.5
D. Age of bridge structure			
Pre-Code (constructed before 1972)	-1.0	-0.6	-1.2
Post Benchmark (constructed after 1992)	+2.4	N/A	+1.4
E. Soil Type			
Soil Type C9 (Soft Rock/Very Dense Soil)	-0.4	-0.4	-0.4
Soil Type D10(Stiff Soil, ORif No Data assume for all 1-3-span bridge)	-0.8	-0.6	-0.6
Soil Type E11(Soft Soil, OR if No Data assume for all bridges >3 spans)	-0.8	-1.0	-1.2
FINAL SCORE, S (If less than 2.0, bridge structure may be vulnerable to Seismic Hazards)			

VIII. RAPID IDENTIFICATION OF OTHER POTENTIAL HAZARDS (BASED ON SCORES FROM “II.RAPID HAZARD AND VULNERABILITY ASSESSMENT”)		
TYPE OF HAZARD	SCORE	BRIDGE MAY BE VULNERABLE TO HAZARD?
A. Earthquake-induced Hazard		
B. Liquefaction		
C. Landslide/Soil Erosion		
D. Tsunami		

E. Flooding		
F. Typhoon		
G. Volcanic Eruption		
H. Others (Identify)		

IX. CONDITION OF STRUCTURAL COMPONENTS)

	TIMBER BRIDGE	STEEL/METAL BRIDGE	CONCRETE BRIDGE	COMPOSITE	Remarks[12]
A. Foundation, Piles and Pile Caps	☐ Visible Settlement ☐ Visible Tilting ☐ Rotting ☐ Scouring Around Piles	☐ Visible Settlement ☐ Visible Tilting ☐ Cracks ☐ Scouring Around Piles	☐ Visible Settlement ☐ Visible Tilting ☐ Cracks ☐ Scouring Around Piles	☐ Visible Settlement ☐ Visible Tilting ☐ Cracks ☐ Scouring Around Piles	
B. Columns	☐ Leaning ☐ Buckled ☐ Fractured ☐ Decayed ☐ Missing/Loose/ Corroded Bolt Connections ☐ Insect Infestation/ Damaged ☐ Separation from Concrete Pedestal	☐ Leaning ☐ Buckled ☐ Fractured ☐ Corrosion ☐ Missing/Loose/ Corroded Bolt Connections ☐ Tearing	☐ Leaning ☐ Buckled / Fractured ☐ Cracks ☐ Spalling ☐ Bulging ☐ Honeycombs ☐ Delamination	☐ Leaning ☐ Buckled ☐ Fractured ☐ Decayed ☐ Missing/ Loose/ Corroded Bolt Connections ☐ Insect Infestation ☐ Separation from Concrete Pedestal	
C. Beams	☐ Sagging/Deflection	☐ Sagging/ Deflection	☐ Sagging/ Deflection	☐ Sagging/ Deflection	

8This assessment form streamlines the information derived from the DILG-developed assessment form and FEMA Handbook 154. This assessment is aimed mainly at screening buildings for potential seismic hazard, and not to determine the present condition of the structure.
9[1200ft/s < measured shear wave velocity,Vs ≤ 2500ft/s] OR [SPT N > 50] OR [Undrained Shear Strength, Su > 2000psf]
10[600ft/s < Vs ≤ 1200ft/s] OR [15<SPT N≤ 50] OR [1000psf< Su≤ 2000psf]
11[Vs ≤ 600ft/s] OR [Soil > 100ft deep w/ Plasticity Index > 20, Water content > 40%, and Su<500 psf]
12Indicate location and number of inspected member. Indicate whether the structure is vulnerable to a particular type of hazard and if the condition of the bridge component will worsen if left unattended. Indicate as well if the observation is structurally related or if a regular maintenance issue.

Girders	☐ Splitting ☐ Decayed ☐ Missing/ Loose/ Corroded Bolt Connections ☐ Insect Infestation/ Damaged	☐ Corrosion ☐ Tearing ☐ Missing/ Loose/ Corroded Bolt Connections	☐ Cracks ☐ Spalling ☐ Honeycombs ☐ Delamination	☐ Corrosion ☐ Tearing ☐ Missing/ Loose/ Corroded Bolt Connections	
D. Cross-members, Diagonals,	☐ Deflection/ Misalignment ☐ Missing and Corroded Connections ☐ Cracks ☐ Buckling	☐ Deflection/ Misalignment ☐ Missing and Corroded Connections ☐ Cracks ☐ Buckling	☐ Deflection/ Misalignment ☐ Missing and Corroded Connections ☐ Cracks	☐ Deflection/ Misalignment ☐ Missing and Corroded Connections ☐ Cracks ☐ Buckling	
E. Deck/ Flooring	☐ Sagging / Deflection ☐ Splitting ☐ Decayed ☐ Insect Infestation/ Damage ☐ Leaks	☐ Sagging / Deflection ☐ Corrosion ☐ Deterioration of Connection to Frame ☐ Leaks ☐ Surfacing Distress	☐ Sagging / Deflection ☐ Cracks ☐ Spalling ☐ Leaks ☐ Delamination ☐ Surfacing Distress	☐ Sagging / Deflection ☐ Cracks ☐ Spalling ☐ Corrosion ☐ Deterioration of Connection to Frame ☐ Leaks ☐ Surfacing Distress	

F. Wingwall and Backwall	☐ Cracks ☐ Erosion ☐ Scouring of Backfill ☐ Exposure of Reinforcement ☐ Separation of Gabions, rocks, boulders	☐ Cracks ☐ Erosion ☐ Scouring of Backfill ☐ Exposure of Reinforcement ☐ Separation of Gabions, , rocks, boulders	☐ Cracks ☐ Erosion ☐ Scouring of Backfill ☐ Exposure of Reinforcement ☐ Separation of Gabions, , rocks, boulders	☐ Cracks ☐ Erosion ☐ Scouring of Backfill ☐ Exposure of Reinforcement ☐ Separation of Gabions, , rocks, boulders	

V.		
COMPONENT	OBSERVATIONS	REMARKS

VI. SUMMARY OF OVERALL PHYSICAL CONDITION
(Responses may be in Narrative/Pictures/Sketches. Use additional sheets if necessary.)

1. Description of Hazards to which the structure and its specific components are susceptible.

2. Identification of Critical Structural Components Based on Assessment

3. Description of Non-Structural Components Affected by Hazards

VII. ANNEXES/ATTACHMENTS
(Photos, sketches, drawings, plans, other documents attached to this Audit Form)

VIII. RECOMMENDATIONS (To be filled up by Authorized Civil/Structural Engineer)

1. For Structural Components
   - ☐ For detailed inspection by a competent authority, if inspector is not an engineer
   - ☐ For detailed structural investigation, if inspector is an engineer:
   - ☐ Further review of detailed plans / structural calculations
   - ☐ Conduct of detailed structural testing
   - ☐ For maintenance of identified components.

2. For Non-structural Components OR Ancillary/Auxiliary Equipment and Facilities
   - ☐ Immediate action based on identified components and assessment above.
   - ☐ For maintenance of identified components

3. If other courses of action are recommended, please state and include the justification below (e.g., retrofitting, relocation of facility, condemnation, etc.)

Component	**Recommended Courses of Action**	**Justification/Remarks**

For Referral to:
☐ **DILG**
☐ **DPWH**

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Name & Signature of Provincial/City / Municipal Engineer