**MINISTRY OF TRANSPORT AND INFRASTRUCTURE**

**No ...../.....**

**MINISTRY OF DEVELOPMENT, PUBLIC WORKS AND ADMINISTRATION**

**No ...../.....**

# ORDER

## for the approval of the technical regulation 'Technical instructions regarding determination of the technical condition of roads of national interest – reference number CD 155-2025'

In accordance with the provisions of Article 10(2) of Law No 10/1995 on quality in construction, republished, as amended and supplemented, and Article 57(h), (j) and (k) of Government Order No 43/1997 on the rules governing roads, republished, as amended and supplemented.

By virtue of the provisions of Article 9(4) of Government Decision No 370/2021 on the organisation and functioning of the Ministry of Transport and Infrastructure, as amended and supplemented, and Article 12(6) of Government Decision No 477/2020 on the organisation and functioning of the Ministry of Development, Public Works and Administration, as amended and supplemented,

**the Minister for Transport and Infrastructure and the Minister for Development, Public Works and Administration** issue the following:

# ORDER

**Article 1. The** technical regulation 'Technical instructions regarding determination of the technical condition of roads of national interest – reference number CD 155-2025', as set out in the Annex which forms an integral part of this Order, is hereby approved.

**Article 2**. – From the date of entry into force of this Order, the provisions of Order of the Minister for Transport, Construction and Tourism No 625/23.10.2003 on the approval of the technical regulation 'Rules regarding determination of the technical condition of modern roads (revision CD 155-1985), reference number CD 155-2001', published in the Official Gazette of Romania, Part I, No 786 of 7 November 2003, shall apply only to roads of county and local interest.

**Article 3.** This Order shall be published in the Official Gazette of Romania, Part I.

Annex to the Order of the Minister for Transport and Infrastructure

No ..... / .....

and

Order of the Minister for Development, Public Works and Administration

No ...../ .....

**TECHNICAL INSTRUCTIONS REGARDING DETERMINATION OF THE TECHNICAL CONDITION OF ROADS OF NATIONAL INTEREST – REFERENCE NUMBER CD 155-2025**

## CHAPTER 1

## *General provisions. Scope*

**Article 1.** – These instructions refer to the methodology for determining the technical condition of roads of national interest equipped with modern surfaces (bituminous materials/concrete) managed by the Compania Națională de Administrare a Infrastructurii Rutiere S.A. (CNAIR S.A.).

**Article 2.** – The technical condition of roads of national interest with modern road surfaces, managed by CNAIR S.A. shall be determined on the basis of the values of their characteristics specified in Chapter 4. The technical characteristics are valid for all roads with modern surfaces.

**Article 3.** – The methodology for determining the technical condition is an integral part of the system of optimised management of modern roads and which, in accordance with the legal provisions in force, establishes the obligation of the road manager to organise and monitor the behaviour of the structures and maintain them over time.

**Article 4.** – The technical condition of roads shall be determined for the purpose of establishing the periodic maintenance works and ongoing repair works, works intended to bring the technical condition to the level demanded by increasing traffic volumes.

**Article 5.** – The provisions of these instructions do not apply to determining the technical condition of dirt roads, gravel roads and paved roads.

**Article 6.** – The terminology used in these instructions is in accordance with SR 4032-1.

## CHAPTER 2

### *Normative references*

**Article 7. – (1)** The provisions of the following reference documents shall apply to the use of this regulation:

| Item No | Technical regulation/legislative act reference number | Approval act<br><br>Legislative references: paragraph (2) |
|---|---|---|
| 1 | AND 514 | Technical regulation *'Regulation on the acceptance of maintenance works on roads and bridges – reference number AND 514'* |
| 2 | AND 519 | Technical regulation *'Departmental technical instructions on the methodology for the statistical interpretation of the results of laboratory and field measurements to determine the quality of the road complex – reference number AND 519'* |
| 3 | AND 540 | Technical Regulation *'Rules for assessing the state of degradation of surfaces for flexible and semi-rigid road structures – reference number AND 540'* |
| 4 | AND 547 | Technical regulation *'Rules for preventing and remedying defects in modern road surfacing – reference number AND 547'* |
| 5 | AND 554 | Technical regulation *'Rules for the maintenance and repair of public roads – reference number AND 554'* |
| 6 | AND 563 | Technical regulation *'Technical instructions on the methodology for determining the flatness of road surfaces using the APL 72 longitudinal profile analyser – reference number AND 563'* |
| 7 | AND 564 | Technical regulation *'Technical instructions on the methodology for determining the load-bearing capacity of roads with the MLY 10,000 deflectometer – reference number AND 564-2001'* |
| 8 | AND 565 | Technical regulation *'Technical instructions on the methodology for determining the flatness of road surfaces using the Bump Integrator (BI) – reference number AND 565'* |
| 9 | AND 584 | Technical regulation *'Rules for determining design traffic for road design in terms of load-bearing capacity and traffic capacity – reference number AND 584'* |
| 10 | AND 596 | Technical regulation *'Rules for motorway maintenance based on performance criteria – reference number AND 596'* |
| 11 | AND 599 | Technical regulation *'Rules for the maintenance of national roads based on performance criteria – reference number AND 599'* |
| 12 | AND 605 | Technical regulation *'Hot-mix asphalt mixtures. Technical conditions for design, preparation and commissioning – reference number AND 605'* |
| 13 | AND 606 | Technical regulation *'Technical instructions on the methodology for determining road roughness using GripTester equipment – reference number AND 606'* |
| 14 | AND 608 | Technical regulation *'Technical instructions on the methodology for determining the load-bearing capacity of roads using equipment PRI 2100/PRIMA 2100 – reference number AND 608'* |
| 15 | AND 609 | Technical regulation *'Technical instructions on the methodology for determining the state of road degradation using DEGY equipment – reference number AND 609'* |

| | | |
|---|---|---|
| 16 | | Technical regulation *'Instructions on the methodology for determining the flatness and roughness of roads using the HAWKEYE 1000 equipment'* |
| 17 | | Technical regulation *'Instructions on the methodology for determining the flatness, roughness and depth of road ruts using HAWKEYE 2000 equipment'* |
| 18 | CD 31 | Technical regulation *'Rules for determining by deflectography and deflectometry the load-bearing capacity of roads with flexible and semi-rigid road structures (revision CD 31-1994) – reference number CD 31'* |
| 19 | SR 4032-1 | Road works. Terminology |
| 20 | SR EN ISO 13473-1 | Characterisation of pavement texture by use of surface profiles. Part 1: Determination of mean profile depth |
| 21 | SR EN 13036-1 | Road and airfield surface characteristics. Test methods. Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique |
| 22 | SR EN 13036-4 | Road and airfield surface characteristics. Test methods. Part 4: Method for measurement of slip/skid resistance of a surface. The pendulum test |
| 23 | SR EN 13036-6 | Road and airfield surface characteristics. Test methods. Part 6: Measurement of transverse and longitudinal profiles in the evenness and megatexture wavelength ranges |
| 24 | SR EN 13036-8 | Road and airfield surface characteristics. Test methods. Part 8: Determination of transverse unevenness indices |
| 25 | SR CEN/TS 15901-7 | Road and airfield surface characteristics. Part 7: Procedure for determining surface roughness using constant longitudinal slip ratio equipment (LFCG): GripTester® |
| 26 | H.G. nr. 273/1994 | Government Decision No 273/1994 approving the Regulation on the acceptance of constructions, as amended and supplemented |
| 27 | H.G. nr. 845/2018 | Government Decision No 845/2018 approving the Regulation on the acceptance of constructions in the field of road and rail infrastructure of national interest, as amended |
| 28 | Ordin M.T. nr. 1295/2017 | Order of the Minister for Transport No 1295/2017 approving the *Technical rules on the establishment of the technical class of public roads* |

**(2)** For undated references to Romanian standards, the last edition of the mentioned Romanian standard shall be used, including all amendments and errata, unless otherwise provided for in the legislation in force.

## CHAPTER 3

### *Optimised modern pavement management system (PMS)*

**Article 8. – (1)** The optimised modern pavement management system (PMS) represents all the activities that ensure the sound use of the funds allocated for road maintenance and repairs, in order to bring them up to the level of technical condition required by road traffic.

**(2)** The technical condition shall be determined on the basis of the periodic inspection of the road network.

**Article 9. –** The optimised modern pavement management system (PMS) consists of the following steps:

a) the technical analysis, which consists of determining the technical condition on the basis of the periodic inspection of the road network;

b) the transfer of data and its storage in the road data bank, with files specially designed for the application of the optimised pavement management system;

c) the planning of periodic maintenance and ongoing repair works by road category, depending on the technical condition determined, in the form of a priority list for the network of roads of national interest, under the administration of CNAIR S.A., equipped with modern surfaces, related to each territorial administration unit, applying the type of work required to improve their technical condition.

**Article 10. – (1)** The optimised modern pavement management system (PMS) is currently operated by the Compania Națională de Administrare a Infrastructurii Rutiere for the following purposes:

a) drawing up, on an annual basis or for a prospective period, a programme of regular maintenance and ongoing repairs;

b) applying periodic maintenance and ongoing repair programmes.

**(2)** Depending on the budget allocated, on the basis of a technical and economic analysis, and only at the level of periodic maintenance and ongoing repairs, the road manager may establish, with justification, its own strategy for bringing the existing road infrastructure into line with the admissible level of functionality, in accordance with the technical regulations in force.

## CHAPTER 4

## *Characteristics used to determine the technical condition*

**Article 11. –** The technical condition of modern roads shall be determined by means of the following characteristics:

a) the *flatness of the running surface*, expressed through the flatness index value (IRI);

b) *the roughness of the road surface*, expressed through the values: MTD/ETD, PTV (SRT), µGT(/GN):

i) MTD/ETD – mean macrotexture depth, texture depth;

ii) PTV (SRT) – surface adhesion;

iii) µGT / GN – longitudinal coefficient of friction;

c) *the load-bearing capacity of the road complex*, expressed through the characteristic elastic deflection value, $d_{1c,20}$, corresponding to the dynamic measurement technique, and $d_{BM20,}$ corresponding to the static measurement technique;

d) *the state of degradation of the road surface*, characterised by the following degradation indices:

i) global degradation index (GI), for bituminous surfaces;

ii) degradation index (DI), for bituminous and concrete surfaces.

## CHAPTER 5

### *Determination of the characteristics used to assess the technical condition of modern roads*

**Article 12. –** The technical condition of a road network shall be determined over its entire length. For this purpose, the road network shall be divided into homogeneous sections of road, characterised by the same data regarding: traffic characteristics, type of road structure, year of last intervention and state of degradation.

**Article 13. –** The characteristics of homogeneous road sections shall be recorded in the summary form set out in Annex 1.

**Article 14. – (1)** The type of road structure shall be classified according to its composition as follows:

a) flexible road structure with bituminous surface, which does not include any layer containing hydraulic or pozzolanic binders;

b) semi-rigid (mixed) road structure, with bituminous surface and at least one layer of natural aggregates stabilised with hydraulic or pozzolanic binders;

c) rigid road structure with concrete or cemented macadam surface.

**(2)** The composition of road structures shall be in accordance with the technical book for roads and the existing technical documentation, or shall be established on the basis of surveys.

**(3)** The traffic class shall be determined in accordance with Article 49(2) of these instructions, based on the results of the latest traffic census and traffic volume forecasts.

**Article 15. – (1)** In order to fill the database of the PMS, measurements of road characteristics shall be taken using high-performance equipment, in accordance with the equipment's own instructions for use, if it complies with EU/international technical regulations, at the following stages:

a) the initial measurement stage;

b) ongoing measurement stages.

**Article 16. – (1)** *The initial measurement stage* corresponds to the first measurement stage after the upgrading/rebuilding/reinforcement/periodic maintenance of roads.

**(2)** The results obtained shall constitute the reference values on the basis of which the subsequent evolution of the technical condition of roads is to be assessed.

**(3)** For the existing road network, the initial measurement stage shall take place on the basis of the schedule drawn up by the road manager.

**(4)** The initial measurement stage shall take place at least one year after the acceptance of the completed works and commissioning, prior to the final acceptance, so that the results may be used by the final acceptance committee.

**Article 17. – (1)** *The ongoing measurement stage* shall be determined according to the road category at intervals of 1– 4 years, in accordance with Table 1 or whenever necessary, except for degradation, which shall be assessed annually.

Table 1 - Interval between measurement stages

| No | Category of road | Interval between measurement stages | | | | |
|---|---|---|---|---|---|---|
| | | Load-bearing capacity | Flatness IRI | Roughness | | State of degradation |
| | | | | µGT GN | MTD/ETD/PTV (SRT)* | |
| 1 | Motorway, expressway | 2 years | 1 year | 2 years | 1 year | 1 year |
| 2 | International (European) road | 2 years | 2 years | 3 years | 2 year | 1 year |
| 3 | Main national road | 3 years | 2 years | 3 years | 2 years | 1 year |
| 4 | Secondary national road | 4 years | 3 years | 4 years | 3 years | 1 year |

PTV (SRT)* - accepted only for secondary national roads, in accordance with Article 28(2) of these instructions.

**(2)** The interval between the ongoing measurement stages may be reduced if the results of the previous measurement stage show a rapid change in one of the road characteristics.

**Article 18. –** The technical condition of roads shall be determined on the basis of measurements carried out in the field, which shall be stored in the database of the PMS.

**Article 19. –** For roads with MEDIOCRE and POOR load-bearing capacity, it is no longer necessary to determine the state of degradation, roughness and flatness if periodic maintenance works / ongoing repairs / major repairs are scheduled to be carried out within a maximum of one year of the measurements being taken.

**Article 20. – (1)** The road characteristics required for the database of the optimised modern pavement management system (PMS) shall:

a) be determined as far as possible on the same traffic lanes that were assessed in the initial stage, in order to fill the database of the PMS;

b) determine the most degraded traffic lanes, for roads to be included in the PMS database.

**(2)** The measurement period shall be determined according to the measurement conditions set out in Table 2.

Table 2 – Measurement period of road characteristics

| No | Road characteristic | Measurement conditions | Measurement period |
|---|---|---|---|
| 1 | Flatness | In compliance with the operating conditions for the measuring equipment. | All year round, during periods with no precipitation.<br>The surface must be clean and free of mud and sludge. The surface must not be stripped or milled. |
| 2 | Roughness | In compliance with the operating conditions for the measuring equipment. | All year round, during periods with no precipitation.<br>The surface must be clean and free of mud and sludge.<br>The surface must not be stripped or milled. |
| 3 | Load-bearing capacity | All year round, subject to the operating conditions for the measuring equipment.<br>Minimum condition: the average temperature of the last five consecutive days before inspection must be above 5 °C. | During periods when the road complex operates under the most unfavourable hydrological conditions, namely:<br>- spring after thawing or at most 15 days after the period of spring rains;<br>- autumn after 5–10 days of rain, with average daily air temperatures above zero, but not lower than +5 °C.<br>In the case of other hydrological conditions or of another measurement period, the measurement results shall be corrected in accordance with Table 4. |
| 4 | State of degradation | All year round, at temperatures below 30 °C, at least one year after acceptance upon completion of works and commissioning. | It is recommended that the road be viewed after the thawing period or immediately after rain, when the running surface is drying out. |

**(3)** The measurement and interpretation of characteristics shall be carried out in accordance with specific technical regulations, as well as in compliance with the scope and measurement conditions specified in the measuring equipment's own instructions.

### 5.1. Determination of road surface flatness

**Article 21. –** The flatness of the road surface is a functional characteristic of the road expressed by the International Roughness Index (IRI).

**Article 22. – (1)** The equipment used to determine the flatness of roads depends on their category, namely:

a) Hawkeye equipment, APL, etc. – for all categories of roads;

b) Bump Integrator, ROUGHOMETER, etc. – for secondary national roads.

**(2)** The equipment listed above is not exhaustive.

**Article 23. – (1)** The measurements shall be taken on roads with a flexible, semi-rigid (mixed) and rigid road structure, along their entire length, regardless of their technical class, as follows:

a) to fill the database of the PMS: as far as possible on the same traffic lanes that were assessed in the initial stage;

b) to establish the initial stage in the database of the PMS, to conduct specialised studies, technical surveys, etc.: on one lane (the most degraded) in the case of two-lane roads, and on two lanes (the most degraded) in the case of three- or four-lane roads.

**(2)** In order for the works carried out to be accepted, the specific technical regulations in force must be complied with.

**Article 24. – (1)** The methodologies for measuring and determining the flatness index (IRI) are specific to the equipment's own rules for use which shall comply with the provisions of EU/international technical regulations, including those in our country.

**(2)** Where APL equipment is used, measurements shall be taken along the measuring line located in the middle of the traffic lane. The measurement results shall be processed for 200 m intervals along the entire length of the road.

**(3)** Where the Bump Integrator is used, measurements shall taken along the measuring line corresponding to the wheel tracks in the lane. The measurement results shall be processed for intervals of a maximum of 1 000 m along the entire length of the road.

**(4)** Where HAWKEYE equipment is used, measurements shall be taken on the measuring line corresponding to the wheel tracks in the lane. The measurement results shall be processed for intervals of 100 m along the entire length of the road.

**Article 25. –** The flatness index (IRI) shall be calculated using the measuring equipment's own calculation programmes and shall be measured in m/km.

### 5.2. Determination of the roughness of the road surface

**Article 26. – (1)** The roughness of the surface of the pavement is a functional characteristic of the road and is characterised by the following values:

a) MTD/ETD (mean macrotexture depth),

b) µGT/NG (coefficient of friction),

c) PTV (SRT) (surface adhesion).

**(2)** The MTD/ETD, µGT/GN and PTV (SRT) values shall be determined in accordance with the equipment's own instructions for use, provided that they comply with EU/international technical regulations.

**Article 27. – (1)** The measurements shall be taken on roads with a flexible, semi-rigid (mixed) and rigid road structure, along their entire length, regardless of their technical class, as follows:

a) to fill the database of the PMS: as far as possible on the same traffic lanes that were assessed in the initial stage;

b) to establish the initial stage in the database of the PMS, to conduct specialised studies, technical surveys, etc.: on at least one lane (the side lane) on one or both wheel tracks, according to the measuring equipment.

**(2)** In order for the works carried out to be accepted, the specific technical regulations in force must be complied with.

**Article 28. – (1)** The database of the PMS for motorways, expressways, international (European) roads and main national roads shall be filled using high-performance equipment.

**(2)** PTV (SRT) pendulum-type static devices are recommended for use where, due to technical constraints (working parameters), high-performance inspection methods cannot be used.

**Article 29. –** Technical parameters such as the mean macrotexture depth (MTD/ETD), the coefficient of friction μGT/GN (determined with specific equipment) and the surface friction (PTV (SRT)) shall be expressed according to the measuring equipment in mm or dimensionless.

**Article 30. –** When determining both the mean macrotexture depth and the coefficient of adhesion or friction on a road section, and their values lead to different roughness ratings, the most unfavourable rating shall be adopted.

**Article 31. –** For motorways, expressways, international (European) roads and main national roads, high-performance equipment shall be used.

### 5.3. Determination of the load-bearing capacity of the road complex

**Article 32. –** The load-bearing capacity of the road complex is a structural characteristic of the road expressed by the characteristic elastic deformation (deflection) values.

**Article 33. –** Deflection shall be measured by:

a) **dynamic equipment,** such as dynamic load deflectometers, in accordance with the equipment's own instructions for use, if they comply with EU/international technical regulations;

b) **static equipment,** such as Benkelman beam deflectometers, in accordance with the technical regulation *'Rules for determining by deflectography and deflectometry the load-bearing capacity of roads with flexible and semi-rigid road structures with the Lacroix deflectograph and the Benkelman beam-type deflectometer – reference number CD 31'*.

**Article 34. – (1) Deformation measurements using dynamic load deflectometers** shall be used to determine the load-bearing capacity of roads of national interest administered by CNAIR S.A., equipped with modern (flexible and semi-rigid) surfaces, regardless of their technical class, as follows:

a) to fill the database of the PMS: as far as possible on the same traffic lanes that were assessed in the initial stage;

b) to establish the initial stage in the database of the PMS, to conduct specialised studies, technical surveys, etc.:

i) along the entire length of the homogeneous road section, on the wheel track located at distances of 0.75-1.00 m from the edge of the carriageway, at measuring points located at distances of no more than 200 m;

ii) in the case of existing two-lane roads, the measurements shall be taken on one lane and in the case of three- or four-lane roads, the measurements shall be taken on marginal lanes.

**(2)** Measuring principles:

a) with the dynamic deflectometer, by lowering a set of weights onto a sprung platform (rubber dampers), the shock load being transferred to the road surface through a load plate. When subjected to a load, the road surface deforms and a deflection occurs. Deflections recorded by geophones located at different distances from the load centre shall be recorded and stored in a data file, or

b) with the continuous-reading dynamic deflectometer that works by determining in real time the deformation basin caused by the load on the deck of a moving truck, by considering the Doppler shift of laser beams that continuously scan the carriageway – 'traffic speed deflectometer' (TSD).

**(3)** The dynamic load applied simulates the effect of the standard 115 kN axle load permitted nationally in our country and has the following characteristics:

a) dual wheel load 57.5 kN;
b) contact pressure 0.625 MPa;
c) radius of the circular surface equivalent to the tyre–road contact surface 0.171 m.

**Note***: Since the measured deflection is dependent on the applied load, the measured deflection values shall be corrected, where appropriate, by the force applied, in accordance with the formula set out in point 1 of Annex 2 to these instructions.*

**(4)** The lanes to be measured shall be chosen taking into account the following.

a) The state of degradation of the road. It is recommended that the most degraded traffic lanes be measured.

b) The type of transverse profile. In the case of roads with a mixed transverse profile, it is recommended that the measured traffic lane be on the embankment side.

**(5)** In order for the works carried out to be accepted, the specific technical regulations in force must be complied with, along with the following conditions.

a) For acceptance upon completion of the works (before commissioning), measurements shall be taken on all lanes.

b) For final acceptance, measurements shall be taken under traffic conditions, with specific safety measures, on the marginal lanes only. Load-bearing capacity measurements may be taken on all traffic lanes only when traffic is completely stopped.

**(6)** The deflection taken into account for the direct assessment of the load-bearing capacity of roads is the characteristic deflection on homogeneous road sections, corresponding to a reference temperature of 20 °C and unfavourable hydrological conditions of road complexes.

**(7)** For roads with bituminous surfaces, the temperature inside the asphalt layers shall be measured at the same time as measuring deflections on the ground. The temperature inside the asphalt layers shall be measured at the beginning of the inspection and every hour thereafter until the measurements are completed.

**(8)** The homogeneous road section is characterised by the characteristic deflection value obtained by statistical processing of the deflections measured under loading with sensor/geophone 1, corresponding to the reference temperature of 20 °C, $d_{1c20}$ , using the formula:

$$d_{1c20} = d_{1med20} + t_{\square} \cdot s_{n-1,20} \in \mu m \qquad (1)$$

where:

$d_{1c20}$ – *characteristic deflection value at 20 °C* on each homogeneous section;

$d_{1med20}$ – *average deflection value at 20 °C* on each homogeneous section;

$s_{n-1}$ – *mean square deviation* of the series of deflection values;

$t_{\alpha}$ – *coefficient* that depends on the probability of occurrence of deflection values greater than the characteristic deflection, according to Table 3.

**Note**: *In the case of road sections with lengths of less than 1 km, a minimum of five points shall be measured. For the remaining sections, the measurement step shall be determined in accordance with Article 34(1)(b) (maximum 200 m).*

**(9)** The division of the road into sections which are homogeneous in terms of load-bearing capacity shall be carried out by visual examination of the series of deflection values recorded during deformation measurements. The requirement for the homogeneity of the analysed section shall be considered achieved if Cv, coefficient of variation of the series of deflection values, is lower than 25% for motorways and national roads where all road layers are new and 30% for rebuilt / reinforced motorways and national roads. The coefficient of variation, Cv, shall be independent of the measurement temperature and shall be determined using the formula:

$$Cv = s_{n-1}/d_{1m} \text{ x } 100, \text{ in } \% \qquad (2)$$

where:

$s_{n-1}$ — *mean square deviation of* the series of deflection values;

$d_{1m}$ – *average deflection value* of the homogeneous road section.

**(10)** To obtain the characteristic deflection value at 20 °C, $d_{1c20}$, the following steps must be followed:

a) determine the average value of the deflection on the homogeneous section, $d_{1\,med}$, at the temperature θ °C, during the measurements, using the relationship:

$$d_{1\,med} = \sum_{i=1}^{n} d_{1\,i}/n, \text{ in } \mu m \qquad (3)$$

where:

$d_{1\theta i}$ – *individual values* of deflection under sensor 1, at measurement temperature θ, in μm;

n – *the number of individual values* taken into account.

b) determine the average deflection value of the homogeneous section, $d_{1\,med\,20}$, at the reference temperature of 20 °C, using the formula:

$$d_{1\,med\,20} = d_{1\,med\theta} \cdot \frac{1}{1 + 0.451 \cdot lg\frac{\theta}{20}} \qquad (4)$$

where:

$d_{1\,med}$ – the average value *of the* deflection at Θ°C on each homogeneous section shall be determined in accordance with point (a);

θ — *temperature* inside the bituminous layers, during measurements.

c) $t_\alpha$ shall be determined according to Table 3 depending on the technical class of the road measured and the number of data points recorded during the measurement, on the homogeneous section.

Table 3 – $t_\alpha$ values

| No | Number of deflection values, n | Technical class | |
|---|---|---|---|
| | | I, II, III | IV, V |
| | | 1.5% | 2.5% |
| | | $t_\alpha$ values | |
| 1 | n ≤ 20 | 2.34 | 2.09 |
| 2 | n > 20 | 2.20 | 1.96 |

d) the mean square deviation of the data measured in the field on the homogeneous section, $s_{n-1}$, shall be determined using a scientific calculation tool (calculator) or the formula:

$$s_{n-1}=\sqrt{\frac{\sum\left(d_{1\theta i}-d_{1med\theta}\right)^2}{(n-1)}} \qquad (5)$$

where: n, $d_{1\theta i}$ and $d_{1med}$ are defined above.

e) the mean square deviation corresponding to the reference temperature of 20 θ°C shall be determined by correcting $s_{n-1}$, using the calculation formula (4);

f) if the deformation measurements are taken during periods other than unfavourable periods, as specified in Table 2, and the type of soil in the bearing stratum is P3/P4/P5, the measurement results shall be corrected by multiplying the characteristic deflection value, $d_{1c20}$ , by the correction coefficients, in accordance with Table 4.

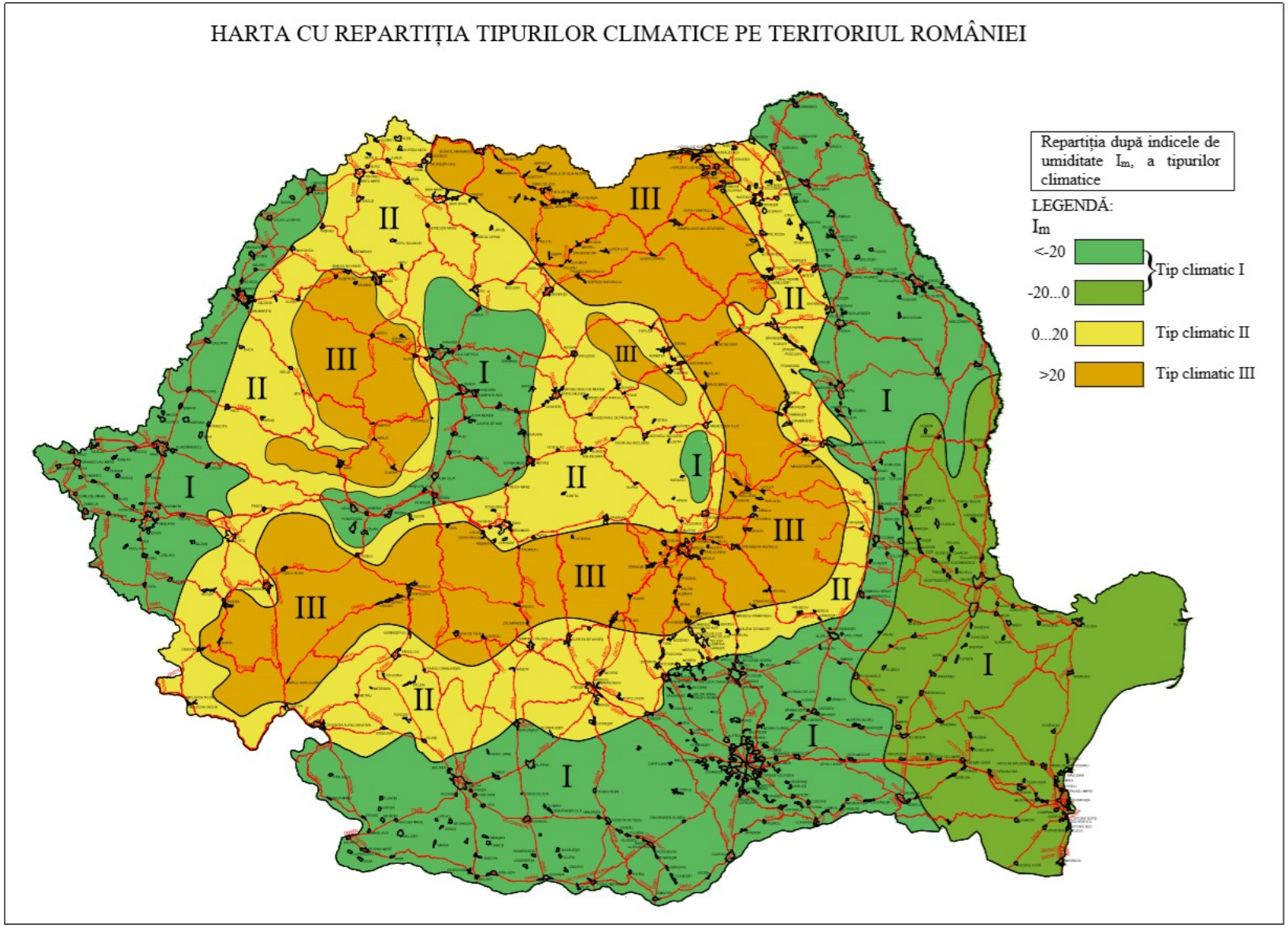


Figure 1. Distribution according to the humidity index $I_m$ of climate types in Romania

Table 4 – Characteristic deflection correction coefficients for the flexible/semi-rigid road structures

| No | Road structure type | Climate type | | | | | |
|---|---|---|---|---|---|---|---|
| | | I | | II | | III | |
| | | Embankment | Ground level or cut, mixed profile | Embankment | Ground level or cut, mixed profile | Embankment | Ground level or cut, mixed profile |
| | | Correction coefficients | | | | | |
| 1 | Flexible or semi-rigid road structure | 1.05 | 1.09 | 1.09 | 1.09 | 1.14 | 1.14 |

**Note***: The climate type of the area is shown in Figure 1.*

*In the case of hydrological regime 1 under PD177, no correction coefficient shall be applied.*

**(11)** Annex 2 provides an example calculation for the processing of deflections recorded in the field with dynamic equipment.

**Article 35. – (1) Deformation measurements with a Benkelman beam-type deflectometer** shall be used to determine the load-bearing capacity of secondary national roads, in accordance with the provisions of the technical regulation *'Rules for determining by deflectography and deflectometry the load-bearing capacity of roads with flexible and semi-rigid road structures – reference number CD 31'*.

**(2)** Measurements shall be taken on homogeneous road sections.

**(3)** A road section shall be considered homogeneous if it is characterised by the same data relating to:

a) the predominant transverse profile type (embankment, cut, ground level, mixed);

b) the arrangement of the verges (waterproofed or non-waterproofed);

c) the state of degradation of road surfaces (Good, Average, Poor), in accordance with standard AND 540.

**(4)** The length of a measurement section shall be determined as follows, but shall not exceed 500 m:

a) on mountain or high hill routes, the length of the measurement sections may be shorter, since the traverse profile of the road varies frequently;

b) the measurement sections shall be located as evenly as possible along the length of a homogeneous road section.

**(5)** Homogeneous road sections shall be determined after visual inspection of the state of road surface degradation, in accordance with standard AND 540.

**(6)** Each homogeneous road section shall have at least three measurement sections and the total length of the measurement sections shall not be less than 1/10 of the length of the road section.

**(7)** For each measurement section, the deflection measurement using the beam deflectometer shall be taken in a minimum of 10 transverse profiles, along the measuring line located 1.0 m from the edge of the carriageway, at distances of no more than 50 m between them, on a single lane.

**(8)** In the case of three- or four-lane roads, the deflection measurement shall be taken with along the line located 1.0 m from the edge of the carriageway, on one of the side lanes.

**(9)** In the case of roads with a mixed transverse profile, it is recommended that the measured

traffic lane be on the embankment side.

**(10)** For each measurement section, the characteristic deflection corresponding to the reference temperature of 20 °C shall be calculated in accordance with the technical regulation *'Rules for determining by deflectography and deflectometry the load-bearing capacity of roads with flexible and semi-rigid road structures – reference number CD 31'*.

**Article 36. –** If the deformation measurements are taken during periods other than unfavourable periods, as specified in Table 2, the measurement results shall be corrected by multiplying the characteristic deflection value, in accordance with Table 4.

**Article 37. –** Regardless of the measurement technique, the statistical processing of deformation measurement results shall identify the single maximum values (peaks) indicating local drainage anomalies or localised defects in the road complex (especially reduced thicknesses of the road structure).

**Article 38. –** The occurrence of single maximum values of elastic deformation requires additional studies to determine the causes of their occurrence, to be carried out when drawing up the documentation establishing the reinforcement solution.

## 5.4. Determination of the state of degradation

**Article 39. –** The state of degradation is a structural characteristic of the road.

**Article 40. –** The state of degradation shall be determined by visual examination or with high-performance equipment containing continuous degradation recording devices and complying with EU/international regulations, including those in our country.

**Article 41. —** The state of degradation of road surfaces is characterised by the global degradation index (GI), determined in accordance with standard AND 540, or the degradation index (DI), determined in accordance with the methodology in these instructions.

**Article 42. – (1)** The road surface shall be examined on the most degraded traffic lane on two-lane roads and on the most degraded side lane on three- or four-lane roads.

**(2)** The visual examination of the running surface shall be carried out in accordance with standard AND 540, by a team of two persons travelling in a car/on foot, for the measurement section.

**(3)** It is recommended that the direction of travel be opposite to the direction of the sun. The most favourable period for examining the road surface is immediately after rain, when the running surface is drying out.

**Article 43. –** A visual inspection of the road surface shall not be carried out on new road sections or on sections where reinforcement, rebuilding, upgrading, major repairs, ongoing repairs or periodic maintenance works have been carried out within the last year.

### 5.4.1. *Determination of the state of degradation for bituminous road surfaces*

**Article 44. – (1) For bituminous road surfaces,** the state of degradation shall be determined in accordance with standard AND 540 in the case where the visual examination is carried out by establishing representative samples, or with the provisions of these instructions in the case of measurements with equipment containing devices for continuous recording of types of degradation, by processing the measurements with specialised software.

**(2)** The assessment of the state of degradation of bituminous road surfaces according to standard AND 540 shall be carried out on homogeneous sections, on a number of samples proportional to their length and depending on the category of road, with the observations noted in summary forms, in accordance with Annex 4a/Annex 4b of these instructions.

**(3)** The quantitative assessment of degradations in accordance with standard AND 540 shall be carried out by taking into account the types of degradations and their severity, weight and frequency of occurrence, differentiated by structural and surface degradations.

**(4)** The state of degradation of each sample is characterised by the value of the overall degradation index (GI) calculated using the following formula:

$$GI = \sqrt{IEST * IESU} \qquad (6)$$

where:

IEST – the structural assessment index and represents how much of the surface is not affected by structural degradation;

IESU – the surface assessment index and represents how much of the surface is not affected by surface degradation.

**(5)** The method used to calculate these indices is in accordance with standard AND 540.

**(6)** The state of degradation of each homogeneous section is characterised by an average global index, representing the average of the values of the global indices of samples on the homogeneous road section in question.

**(7)** The assessment of the state of degradation of bituminous road surfaces, in accordance with the methodology set out in these instructions, shall be carried out for the entire analysed road section or for homogeneous sections, with the observations noted in the summary form, in accordance with Annex 4a/Annex 4b to these instructions.

**(8)** The quantitative assessment of degradations shall be carried out by taking into account all types of degradations.

**(9)** The state of degradation in each homogeneous section is characterised by the degradation index (DI), calculated using the following formula:

$$ID = S_{degr} / S_{total\ assessed} \times 100\ (\%) \qquad (7)$$

where:

$$S_{degr} = D1 + 0.7xD2 + 0.7xD3 + 0.2\ D\ 4 + 0.7xD5\ (m^2) \qquad (8)$$

$$S_{total\ assessed} = L \times W\ (m^2), \text{ total lane area assessed} \qquad (9)$$

where:

$D_1$ = area affected by potholes + 0.7 x the surface area filled ($m^2$);

$D_2$ = area affected by crocodile cracking and multiple cracks/fissures in different directions ($m^2$);

$D_3$ = area affected by transverse and longitudinal cracks and fissures (= 0.5 x length of cracks, fissures and edge failure ($m^2$));

$D_4$ = total weathered surface, with pitting, corrugated surface, streaked surface, bleeding surface, polished surface;

$D_5$ = area affected by longitudinal ruts (= 0.3 x rut length);

L = length of the assessed traffic lane;

W = width of the assessed traffic lane.

**Note:** *The coefficients 0.7 and 0.2 represent the weighting of the respective damage the coefficients 0.5 and 0.3 represent the width over which the surface is affected by the type $D_3$ and $D_5$ degradations respectively, to be expressed in $m^2$.*

**(10)** The state of degradation on each homogeneous section is characterised by the average value of the degradation index, determined on the homogeneous road sections.

### 5.4.2. *Determination of the state of degradation for concrete surfaces*

**Article 45. – (1)** For concrete surfaces, the state of degradation shall be determined according to the methodology in these instructions.

**(2)** The assessment of the state of degradation shall be carried out on homogeneous road sections, with observations noted in the summary form in accordance with Annex 5 to these instructions.

**(3)** The quantitative assessment of degradations for concrete surfaces shall be carried out by taking into account all types of degradations and their weighting.

**(4)** The state of degradation in each homogeneous section is characterised by the degradation index (DI), calculated using the following formula:

$$ID = S_{degr} / S_{total\ assessed} \times 100\ (\%) \qquad (10)$$

where:

$$S_{degr} = S_{slab} \times (N_{sunken} + 0.5\ N_{filled\ and\ crocodile\ cracked}) + D3 \times N_{cracks\ and\ fissures} + 0.3\ D4 \times N_{delaminated} \qquad (11)$$

$$S_{Total\ assessed} = L \times W\ (m^2) \qquad (12)$$

where:

$S_{slab}$ = surface area of a slab;

$N_{sunken}$ = number of sunken slabs;

$N_{filled\ and\ crocodile\ cracked}$ = number of filled and crocodile cracked slabs;

$N_{cracks\ and\ fissures}$ = number of slabs affected by cracks and fissures;

$N_{delamination}$ = number of slabs affected by delamination;

D3 = area affected by cracks and fissures, regardless of type (= 0.5 x length of cracks and fissures, regardless of type ($m^2$));

D4 = delaminated surface area;

L = length of the assessed traffic lane;

W = width of the assessed traffic lane.

**Note:** *The coefficients 0.5 and 0.3 applied to crocodile cracking and delamination respectively represent the weighting of the respective defect.*

*In the case of slabs showing multiple types of degradation, these will be considered in the formula only once, but affected by the most serious defect (in the following order: settling, crocodile cracking, advanced delamination, cracks and fissures, and early-stage delamination).*

**(5)** The state of degradation on a homogeneous road section is characterised by the average value of the degradation index (DI), calculated on homogeneous road sections.

## CHAPTER 6

### *Determination of the technical condition of modern roads*

**Article 46. –** The technical condition of modern roads shall be determined on the basis of the ratings given to road characteristics on homogeneous sections of road.

**Article 47. – (1)** ***The road flatness rating*** shall be determined according to the road category and the flatness index value (IRI), in accordance with Table 5.

**(2)** The flatness index value (IRI) taken into account is the average of the individual IRI values measured on the respective road section, in accordance with the provisions of Chapter 5(1) of these instructions.

Table 5 – Determination of the road flatness rating

| No | Road category | Flatness index, IRI, m/km | | | |
|---|---|---|---|---|---|
| | | POOR | MEDIOCRE | GOOD | VERY GOOD |
| 1 | Motorway, expressway, international (European) road | > 4.0 | 3.0 < IRI ≤ 4.0 | 2.5 < IRI ≤ 3.0 | ≤ 2.5 |
| 2 | Main national road | > 4.5 | 3.5 < IRI ≤ 4.5 | 3.0 < IRI ≤ 3.5 | ≤ 3.0 |
| 3 | Secondary national road | > 5.0 | 4.0 < IRI ≤ 5.0 | 3.5 < IRI ≤ 4.0 | ≤ 3.5 |

**Note:** *When the works are accepted, the flatness index IRI shall be interpreted in accordance with the provisions of the 'Regulation on hot-mix asphalt mixtures. Technical conditions for design, preparation and commissioning of asphalt mixtures – reference number AND 605'.*

**Article 48. – (1)** ***The road roughness rating*** shall be determined according to the road category and the MTD/ETD, µGT/GN, PTV (SRT) values according to Tables 6, 7 and 8.

Table 6 – Determination of road roughness rating according to MTD/ETD values

| No | Road category | Mean macrotexture depth, MTD/ETD, mm | | | |
|---|---|---|---|---|---|
| | | POOR | MEDIOCRE | GOOD | VERY GOOD |
| 1 | Motorway, expressway, international (European) road | < 0.4 | 0.4 ≤ MTD/ETD < 0.6 | 0.6 ≤ MTD/ETD < 0.8 | ≥ 0.8 |
| 2 | Main national road Secondary national road | < 0.3 | 0.3 ≤ MTD/ETD < 0.5 | 0.5 ≤ MTD/ETD < 0.6 | ≥ 0.6 |

**Note:** *When the works are accepted, the mean macrotexture depth, MTD/ETD, shall be interpreted in accordance with the provisions of the 'Regulation on hot-mix asphalt mixtures. Technical conditions for design, preparation and commissioning of asphalt mixtures – reference number AND 605'.*

Table 7 - Determination of road roughness rating according to µGT/GN values

| No | Road category | Coefficient of friction, µGT/GN | | | |
|---|---|---|---|---|---|
| | | POOR | MEDIOCRE | GOOD | VERY GOOD |
| 1 | Motorway, expressway, international (European) road | < 0.42 | 0.42 ≤ µGT/GN < 0.47 | 0.47 ≤ µGT/GN < 0.52 | ≥ 0.52 |
| 2 | Main national road Secondary national road | < 0.37 | 0.37 ≤ µGT/GN < 0.42 | 0.42 ≤ µGT/GN < 0.47 | ≥ 0.47 |

**Note:** *When the works are accepted, the coefficient of friction, µGT/GN, shall be interpreted in accordance with the provisions of the 'Regulation on hot-mix asphalt mixtures. Technical conditions for design, preparation and commissioning of asphalt mixtures – reference number AND 605'.*

Table 8 - Determination of road roughness rating according to PTV (SRT) values

| No | Road category | Surface adhesion, PTV (SRT) | | | |
|---|---|---|---|---|---|
| | | POOR | MEDIOCRE | GOOD | VERY GOOD |
| 1 | Motorway, expressway, international (European) road | < 55 | 55 ≤ PTV (SRT) < 60 | 60 ≤ PTV (SRT) < 65 | ≥ 65 |
| 2 | Main national road Secondary national road | < 50 | 50 ≤ PTV (SRT) <55 | 55 ≤ PTV (SRT) < 60 | ≥ 60 |

**Note:** *When the works are accepted, the surface adhesion, PTV (SRT), shall be interpreted in accordance with the provisions of the 'Regulation on hot-mix asphalt mixtures. Technical conditions for design, preparation and commissioning of asphalt mixtures – reference number AND 605'.*

**(2)** The MTD/ETD, µGT/GN and PTV (SRT) values in Tables 6, 7 and 8 are average values for the section analysed, in accordance with the provisions of Chapter 5(2) of these instructions.

**(3)** In the case of concrete surfaces, the assessment of the road roughness shall be carried out using high-performance equipment.

**(11)** If the results of the surface roughness measurement using several pieces of equipment lead to different ratings, the least favourable rating shall be adopted.

**Article 49. – (1)** ***The load-bearing capacity rating*** for flexible and semi-rigid road structures with bituminous surfaces shall be determined according to the traffic class and the characteristic deflection value, in accordance with Table 9 in the case of measurements taken with the dynamic load deflectometer, and in accordance with Table 10 in the case of measurements taken with the Benkelman beam-type deflectometer.

Table 9 – Determination of load-bearing capacity based on measurements with the dynamic load deflectometer

| No | Traffic class | Design traffic MSA | Load-bearing capacity | | | |
|---|---|---|---|---|---|---|
| | | | POOR | MEDIOCRE | GOOD | VERY GOOD |
| | | | Characteristic deflection, $d_{1c20}$, 0.01 mm | | | |
| 1 | VERY LIGHT | < 0.03 | ≥ 180 | 160 ≤ $d_{1c20}$ < 180 | 140 ≤ $d_{1c20}$ < 160 | < 140 |
| 2 | LIGHT | 0.03– ≤ 0.10 | ≥ 150 | 120 ≤ $d_{1c20}$ < 150 | 100 ≤ $d_{1c20}$ < 120 | < 100 |
| 3 | MEDIUM | 0.10– ≤ 0.30 | ≥ 110 | 85 ≤ $d_{1c20}$ < 110 | 70 ≤ $d_{1c20}$< 85 | < 70 |
| 4 | HEAVY | 0.30– ≤ 1.00 | ≥ 80 | 60 ≤ $d_{1c20}$ < 80 | 50 ≤ $d_{1c20}$ < 60 | < 50 |
| 5 | VERY HEAVY | 1.00– ≤ 3.00 | ≥ 65 | 50 ≤ $d_{1c20}$ < 65 | 45 ≤ $d_{1c20}$ < 50 | < 45 |
| 6 | EXCEPTIONAL, cat.1 | 3.00– ≤ 10.00 | ≥ 50 | 40 ≤ $d_{1c20}$ < 50 | 35 ≤ $d_{1c20}$ < 40 | < 35 |
| 7 | EXCEPTIONAL, cat.2 | > 10.00 | ≥ 40 | 35 ≤ $d_{1c20}$ < 40 | 30 ≤ $d_{1c20}$ < 35 | < 30 |

Table 10 - Determination of load-bearing capacity based on measurements with the Benkelman beam deflectometer

| No | Traffic class | Design traffic MSA | Load-bearing capacity | | | |
|---|---|---|---|---|---|---|
| | | | POOR | MEDIOCRE | GOOD | VERY GOOD |
| | | | Characteristic deflection, $d_{BM20}$, 0.01 mm | | | |
| 1 | VERY LIGHT | below 0.03 | ≥ 200 | 185 ≤ $d_{BM20}$< 200 | 165 ≤ $d_{BM20}$< 185 | < 165 |
| 2 | LIGHT | 0.03–0.10 | ≥ 175 | 145 ≤ $d_{BM20}$ < 175 | 130 ≤ $d_{BM20}$ < 145 | < 130 |
| 3 | MEDIUM | 0.10–0.30 | ≥ 140 | 115 ≤ $d_{BM20}$ < 140 | 100 ≤ $d_{BM20}$ < 115 | < 100 |
| 4 | HEAVY | 0.30– 1.00 | ≥ 110 | 90 ≤ $d_{BM20}$ < 110 | 80 ≤ $d_{BM20}$ < 90 | < 80 |
| 5 | VERY HEAVY | 1.00–3.00 | >95 | 80 ≤ $d_{BM20}$ < 95 | 75 ≤ $d_{BM20}$ < 80 | < 75 |
| 6 | EXCEPTIONAL | 3.00–10.00 | >85 | 75 ≤ $d_{BM20}$ < 85 | 70 ≤ $d_{BM20}$ < 75 | < 70 |

**(2) The design traffic volume $N_c$** shall be calculated in accordance with the technical *regulation 'Rules for determining design traffic for road design in terms of load-bearing capacity and traffic capacity – reference number AND 584'.*

a) The traffic class shall be determined on the basis of the determined design traffic Nc. It shall be identified using columns 1 and 2 of Tables 9 and 10.

b) For acceptance upon completion of works (RTL) and final acceptance (after expiry of the warranty period), the load-bearing capacity rating shall be established for the traffic class specified in the calculation of the dimensioning of the road structure (calculation summary, an integral part of the technical design).

c) For load-bearing capacity measurements made at least five years after final acceptance, the load-bearing capacity rating shall be established for a design traffic Nc determined over a 10-year design period.

d) For roads where, on the section under consideration, there was no traffic-counting post, there is no automatic traffic recording post or there is no traffic study drawn up on the basis of the latest traffic survey, it is necessary to carry out a short-term traffic survey.

**Note:** *The load-bearing capacity rating cannot be allocated for the traffic class established when the road structure is designed, for the entire design period, because during a design period of 20–30 years, traffic flows can change considerably due to the construction of new roads, rebuilding or upgrading. For this reason, after a minimum of five years from final acceptance, it is recommended that the load-*

*bearing capacity rating be reported in relation to the Nc value established for a 10-year design period, according to the latest traffic survey.*

**(2) The characteristic deflection value** corresponds to a reference temperature of 20 °C and unfavourable hydrological conditions and shall be determined as follows:

a) when using the dynamic load deflectometer measurement technique, the characteristic deflection value shall be determined in accordance with the provisions of Article 34(9) of these instructions on road sections that are homogeneous in terms of load-bearing capacity;

b) when using the Benkelman beam-type deflectometer measurement technique, the characteristic deflection value represents the average of the individual characteristic deflection values measured on each homogeneous road section, in accordance with the provisions of Article 35 of these instructions.

**(3)** The characteristic deflections in Tables 9 and 10 correspond to flexible road structures as well as semi-rigid (mixed) road structures with stabilised aggregate in their composition.

*Note: The deflections in Tables 9 and 10 shall be reduced by 20 % in the case of semi-rigid (mixed) road structures with a service life of less than 10 years.*

**(4)** Acceptance of the works carried out requires verification of the requirement for uniformity of load-bearing capacity, as follows:

a) Cv ≤ 25%, for motorways and national roads where all road layers are new;

b) Cv ≤ 30%, for rebuilt/reinforced motorways and national roads;

**Note:** *The coefficient of variation Cv shall be determined in accordance with Article 34(9) of these instructions.*

**Article 50. – (1)** ***For rigid road structures with concrete surfaces*** it is recommended (without being mandatory) that the performance of the joints between concrete slabs be assessed by analysing the following characteristics of the deflection basin, resulting from the measurements taken with the dynamic deflectometer:

a) Load Transfer (LT);

b) Load Transfer Efficiency (LTE).

**(2)** The configuration of the deflection sensors when measuring the transverse joint of the slabs is shown in Annex 3.

**(3)** ***The load transfer*** is calculated using the following formula:

$$LT = (d_3/d_2)\ 100\%$$

where:

$d_2$ deflection measured with sensor 2, located on the loaded slab, at the edge of the joint;

$d_3$ deflection measured by sensor 3, located on the adjacent, unloaded slab.

**(4)** ***The load transfer efficiency*** is calculated by reference to:

$LTE = 2d_3 / (d_2 + d_3)$, where $d_2$ and $d_3$ have the meanings given above.

**Criteria for assessing the load transfer to the joint**

Table 11

| No | **Indicator** | **Class** | | |
|---|---|---|---|---|
| | | **1** | **2** | **3** |
| 1 | LT (%) | Over 75 | 50…..75 | Under 50 |
| 2 | LTE (%) | Over 80 | 50….80 | Under 50 |
| 3 | Rating | Very good | Good | Low |

**Article 51. – (1)** ***The state of degradation rating*** shall be determined on the basis of the degradation index DI or GI, as shown in Table 12.

Table 12 – Determination of state of degradation rating

| No | Rating | Degradation index | |
|---|---|---|---|
| | | GI | DI |
| 1 | POOR | GI < 77 | DI > 13 |
| 2 | MEDIOCRE | 77 ≤ GI < 90 | 7.5 < DI ≤ 13 |
| 3 | GOOD | 90 ≤ GI < 95 | 5 < DI ≤ 7.5 |
| 4 | VERY GOOD | GI ≥ 95 | DI ≤ 5 |

**(2)** The values of the degradation indices shall be the average of the individual values determined for each homogeneous road section, in accordance with Articles 41 and 44(1), (4) and (9) of these instructions.

**Article 52. –** The values of the road characteristics and their ratings are summarised in the sheet in Annex 6.

**Article 53. – (1)** The technical condition class shall be divided into five classes based on the road characteristics ratings, in accordance with Annex 7 or Annex 8 to these instructions, depending on the type of road structure.

**(2)** The technical condition class shall be determined by the characteristics measured in the field: load-bearing capacity, flatness, roughness and state of degradation. If these characteristics lead to the technical condition being classified in more than one class, the lower class shall be adopted.

**(3)** The thickness of bituminous reinforcement layers shall be determined through calculations, in accordance with the legal technical specifications in force.

**Article 54. –** Depending on the technical condition determined in accordance with these technical instructions, periodic maintenance and ongoing repair works on roads shall be established in accordance with Annexes 7 and 8 to these instructions.

**Annex 1**

## SUMMARY FORM FOR THE ESTABLISHMENT OF HOMOGENEOUS ROAD SECTIONS

Unitatea de administrare teritorială

Drum

km..... km.....

| Kilometraj | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trafic | MZA =1766 vehicule fizice | | | | | | | | | | | | | | | | MZA = 2900 vehicule fizice | | | | |
| Tip structură | Suplă | | | | | | | | Rigidă | | | | | Mixtă | | | | | | | |
| Anul ultimei | 2005 | | | | | 2011 | | | | | 2013 | | | | | | 2007 | | | | |
| intervenții | Tratament | | | | | Ranforsare | | | | | Covor | | | | | | Reciclare | | | | |
| Starea de degradare | Rea | | | | | Foarte bună | | | | | Foarte bună | | | Bună | | | Mediocră | | | | |
| Tronsoane omogene | 1 | | | | | 2 | | | 3 | | 4 | | | 5 | | | 6 | | | | |
| km | | | | | 5+000 | | | 8+000 | | 10+000 | | | 13+000 | | | 15+700 | | | | | 21+000 |

| | |
|---|---|
| Unitatea de administrare teritorială | Territorial administration unit |
| Drum | Road |
| km ..... km..... | km …….. km ……. |
| Kilometraj | Road section |
| Trafic | Traffic |
| Tip structură | Type of structure |
| Anul ultimei intervenții | Year of last intervention |
| Stare de degradare | State of degradation |
| Tronsoane omogene | Homogeneous sections |
| MZA = 1766 vehicule fizice | Average daily traffic = 1 766 physical vehicles |
| MZA = 2900 vehicule fizice | Average daily traffic = 2 900 physical vehicles |
| Suplă | Flexible |
| Rigidă | Rigid |
| Mixtă | Mixed |
| Tratament | Treatment |
| Ranforsare | Reinforcement |
| Covor | Surfacing |
| Reciclare | Recycling |
| Rea | Poor |
| Foarte bună | Very good |

| | |
|---|---|
| Bună | Good |
| Mediocră | Mediocre |

**Annex 2**

## EXAMPLE CALCULATION FOR PROCESSING OF DEFLECTIONS RECORDED IN THE FIELD WITH DYNAMIC EQUIPMENT

### Problem data:

It is requested that the load-bearing capacity rating be established for DN 67, measured in 2017, using a dynamic load deflectometer, at an atmospheric temperature of 35 °C and a temperature inside the road structure of 34.3 °C.

DN 67 was inspected under favourable hydrological conditions (in July), from 200 to 200 m, with the first location inspected being km 1 + 450 and the last location measured being km 164 + 962.

DN 67 falls within climate type II, according to Figure 1 of these instructions, is constructed on an embankment and has a mixed road structure with stabilised aggregate in its composition.

The rating of the load-bearing capacity of the road is established using the following calculation steps.

### Calculation steps:

#### *1. Establishment of homogeneous road sections*

The requirement for homogeneity of the road section shall be met if Cv ≤ 30 %, in accordance with Article 49(5) of these instructions.

The first homogeneous road section for which this requirement is met is the section km 1 + 450 – km 8 + 402, characterised by the deflection values shown in Table A2.1, recorded in the field in summer 2017, with a dynamic load deflectometer.

Table A2.1 – Deflections recorded and corrected for force on DN 67

| Drum | Poz.Km. | Deflexiune 0,01 mm | Temperatura în straturile asfaltice | | Drum | Poz.Km. | Deflexiune 0,01 mm | Temperatura în straturile asfaltice |
|---|---|---|---|---|---|---|---|---|
| DN 67 | 1+450 | 34,42 | 34,3°C | | DN 67 | 4+997 | 20,64 | 34,3°C |
| DN 67 | 1+601 | 34,11 | 34,3°C | | DN 67 | 5+202 | 30,73 | 34,3°C |
| DN 67 | 1+801 | 39,3 | 34,3°C | | DN 67 | 5+401 | 17,92 | 34,3°C |
| DN 67 | 2+300 | 52,95 | 34,3°C | | DN 67 | 5+601 | 42,49 | 34,3°C |
| DN 67 | 2+201 | 26,13 | 34,3°C | | DN 67 | 5+800 | 18,27 | 34,3°C |
| DN 67 | 2+400 | 36,81 | 34,3°C | | DN 67 | 5+988 | 32,32 | 34,3°C |
| DN 67 | 2+592 | 24,05 | 34,3°C | | DN 67 | 6+201 | 62,61* | 34,3°C |
| DN 67 | 2+800 | 30,19 | 34,3°C | | DN 67 | 6+401 | 33,93 | 34,3°C |
| DN 67 | 3+200 | 27,8 | 34,3°C | | DN 67 | 6+600 | 21,56 | 34,3°C |
| DN 67 | 3+193 | 14,18 | 34,3°C | | DN 67 | 6+801 | 36,79 | 34,3°C |
| DN 67 | 3+406 | 47,23 | 34,3°C | | DN 67 | 6+995 | 33,78 | 34,3°C |
| DN 67 | 3+601 | 26 | 34,3°C | | DN 67 | 7+200 | 26,69 | 34,3°C |
| DN 67 | 3+801 | 29,85 | 34,3°C | | DN 67 | 7+399 | 34,73 | 34,3°C |
| DN 67 | 4+100 | 19,18 | 34,3°C | | DN 67 | 7+605 | 24,54 | 34,3°C |
| DN 67 | 4+200 | 19,38 | 34,3°C | | DN 67 | 7+802 | 26,26 | 34,3°C |
| DN 67 | 4+401 | 42,61 | 34,3°C | | DN 67 | 7+989 | 28,37 | 34,3°C |
| DN 67 | 4+602 | 34,57 | 34,3°C | | DN 67 | 8+202 | 47,19 | 34,3°C |
| DN 67 | 4+801 | 22,44 | 34,3°C | | DN 67 | 8+402 | 22,59 | 34,3°C |

Drum Road

| | |
|---|---|
| Poz.K m. | km location |
| Deflexiune 0,01 mm | Deflection 0.01 mm |
| Temperatura în straturile asfaltice | Temperature in asphalt layers |

*[*]The deflection value at km 6+201 indicates a local anomaly requiring monitoring during use and further studies to determine the causes of its occurrence.*

The deflections considered in the calculation of the characteristic deflection are those measured with geophone 1 and on the loading plate, respectively.

Prior to statistical processing of deflections, if applicable, each recorded/measured deflection shall be corrected in advance for force, using the following relationship:

measured deflection = 57.5 *x* d / P in 0.01mm

where:

d – recorded deflection value, in 0.01 mm

P – registered load on the rear axle of the measuring vehicle, in kN.

The coefficient of variation, Cv, is determined in accordance with Article 34(9), using the following calculation formula:

$$Cv = s_{n-1}/d_{1m} \; x \; 100, \text{ in } \%$$

where:

$s_{n-1}$ – mean square deviation of the series of deflection values;

$d_{1m}$ – average deflection value of the homogeneous road section.

Result: Cv = 30.4% (the calculation method for $s_{n-1}$, and $d_{1m}$ is presented below).

***2. Calculation of the characteristic deflection corresponding to the reference temperature of 20 °C, $_d$ 1c20 on the homogeneous section km 1 + 450 – km 8 + 402***

In accordance with Article 34(8) of these instructions, the homogeneous road section is characterised by the characteristic deflection value obtained by statistical processing of the deflections measured under loading with sensor 1, corresponding to the reference temperature of 20 °C, $d_{1c20}$, using the formula:

$$d_{1c20} = d_{1med20} + t_{\square} \cdot s_{n-1,20} \in 0.01mm$$

where:

$d_{1c20}$ – characteristic deflection value at 20 °C on each homogeneous section;

$d_{1med20}$ – average deflection value at 20 °C on each homogeneous section;

$s_{n-1.20}$ – mean square deviation of the series of deflection values;

$t_{\alpha}$ – coefficient that depends on the probability of occurrence of deflection values greater than the characteristic deflection.

***2.1. Calculation of the average deflection on the homogeneous section $d_{1med}$, at temperature θ°C,*** during measurements, using the calculation formula:

$$d_{1med} = \sum_{i=1}^{n} d_{1i} n, \text{ in 0.01 mm}$$

where:

$d_{1i}$ – deflection value recorded by sensor 1 in each measurement location at temperature θ;

n – number of deflation values recorded;

For the deflection values presented in Table 1, the following results are obtained: $d_{1med,34.3} = 30.3$ (0.01 mm).

***2.2. Calculation of the average deflection on the homogeneous section,*** $d_{1\,med\,20}$***, at the reference temperature of 20 °C***, using the calculation relationship:

$$d_{1\,med\,20} = d_{1\,med\theta} \cdot \frac{1}{1 + 0.451 \cdot \log \frac{\theta}{20}}$$

where:

$d_{1\,med}$ – average *deflection value at temperature* $\theta$ on the homogeneous section established in accordance with point 1 of this example calculation;

$\theta$ – temperature inside the bituminous layers during deformation measurements (34.3 ℃).

Result:

$$d_{1med,20} = 27.4 \text{ (0.01 mm)}$$

***2.3. Determination of*** $t_\alpha$

According to Article 34(10)(c) of these instructions, $t_\alpha$ shall be determined on the basis of Table 3, depending on the technical class of the road measured and the number of data points recorded during the measurement, on the homogeneous section in question.

Please note that DN 67, km 1+450 – 8+402 belongs to technical class III, since the average daily traffic = 4 367 physical vehicles, according to the traffic survey from 2015.

Result:

$$t_\alpha = 2.20$$

***2.4. Calculation of the mean square deviation of the data measured in the field over the homogeneous section,*** $s_{n-1\theta}$, at the measurement temperature, using the calculation relationship:

$$s_{n-1,} = \sqrt{\frac{\sum \left( d_{1\theta i} - d_{1\,med\theta} \right)^2}{(n-1)}}$$

Result:

$$s_{n-1} = 9.2 \text{ (0.01 mm)}$$

***2.5. Correction of the previously determined mean square deviation at the reference temperature of 20 °C*** using the same calculation relationship:

$$s_{n-1.20} = s_{n-1,34.3} \frac{1}{1 + 0.451 \cdot \log \frac{34.3}{20}} = 8.32 \text{ (0.01 mm)}$$

The characteristic deflection value corresponding to the reference temperature of 20 °C, d1c20, on the homogeneous road section under analysis shall be determined after completion of the calculation steps set out in point 2.

Result:

$d_{1c\,20} = 27.4 + 2.2\,x\,8.32 = 45.7\,(0.01\,mm)$¿

***3. Calculation of the characteristic deflection, d1c, on the homogeneous section***

Taking into account the measurement period (July), the value d1c shall be obtained by correcting the value $d_{1c20}$, in accordance with Article 34(10)(f) of these instructions.

For the section under analysis, since the field inspections were carried out in summer, under favourable hydrological conditions, the characteristic deflection value corresponding to the reference temperature of 20 °C, d1c20, shall be corrected, in accordance with Table 4 of these instructions, according to: the climate type of the area in which the road is located, the type of transverse profile and the type of road structure.

Result:

$$d_{1c} = 1.09 \; x \; 45.7 = 49.81 \text{ (0.01 mm)}$$

## *4. Determination of the load-bearing capacity rating*

In accordance with Article 49 of these instructions, the load-bearing capacity rating of a homogeneous road section shall be determined according to the traffic class and the characteristic deflection value, $d_{1c}$, in accordance with Table 9, in the case of measurements carried out with the dynamic load deflectometer.

### *4.1. Determination of the traffic class of the road*

In accordance with Article 49(2) of these instructions, the traffic class shall be determined on the basis of the design traffic volume $N_{c,}$ expressed in million standard axles of 115 kN, established for a 10-year design period. Thus, the value $N_c$ for the analysed road section calculated for the 2017–2027 design period is 0.30 MSA, which places this section in the MEDIUM traffic class. The calculations were carried out on the basis of the national road traffic survey conducted in 2015 and using the regulation for determining design traffic for road design in terms of load-bearing capacity and traffic capacity, reference number AND 584.

### *4.2. Determination of the load-bearing capacity rating*

According to Table 9 of these instructions, for MEDIUM traffic classes and the characteristic deflection of 49.81 (0.01 mm), the load-bearing capacity of the homogeneous road section km 1+450 – 8+402 is VERY GOOD.

**Annex 3**

## LOAD TRANSFER EFFICIENCY AT THE JOINT

The efficiency of load transfer at the joint is a parameter that may be calculated from the deflections measured with the dynamic deflectometer in order to characterise the ability of the joints and cracks of rigid road structures to effectively transmit the load applied on one side of the joint or crack to the other side of the joint or crack. This can be achieved in the field with a dynamic deflectometer by applying a load to one side of the joint or crack and measuring the deflections obtained on the loaded and unloaded slab. Figure A3.1 shows the concept of load transfer at the joint.

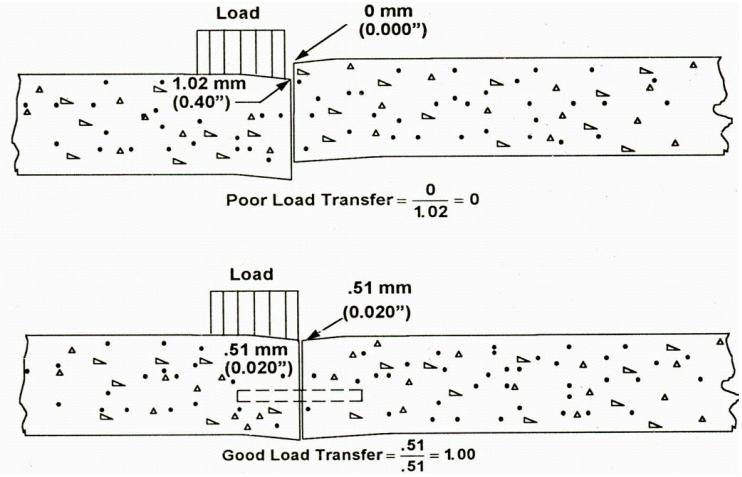


Figure A3.1. The concept of load transfer at the joint

Figure taken from 'Using Falling Weight Deflectometer Data – Volume I, Final Report, 2017, FHWA-HRT-16-009'

### I. Establishment of measurement points

1. Measurements shall be taken on slabs during a period when the temperature gradient is low or non-existent, so that the joints are open and therefore in their most unfavourable position.

2. The sensors shall be positioned so as to measure the deflections on either side of the joint (both on the loaded slab and on the unloaded slab).

3. The configuration of the deflection sensors when measuring at the transverse joint of the slabs is shown in Figure A3.2, and the distance of the sensors from the centre of the load plate for rigid road structures is as follows:

a) sensor $d_3$ = − 300 mm (behind the load plate);

b) sensor $d_2$ = − 200 mm (behind the load plate);

c) sensor $d_1$ = 0 mm (in the centre of the load plate);

d) sensor $d_4$ = 450 mm (in front of the load plate);

e) sensor $d_5$ = 600 mm (in front of the load plate);

f) sensor $d_6$ = 750 mm (in front of the load plate);

g) sensor $d_7$ = 900 mm (in front of the load plate);

h) sensor $d_8$ = 1 200 mm (in front of the load plate);

i) sensor $d_9$ = 1 500 mm (in front of the load plate);

j) sensor $d_{10}$= 1 800 mm (in front of the load plate).

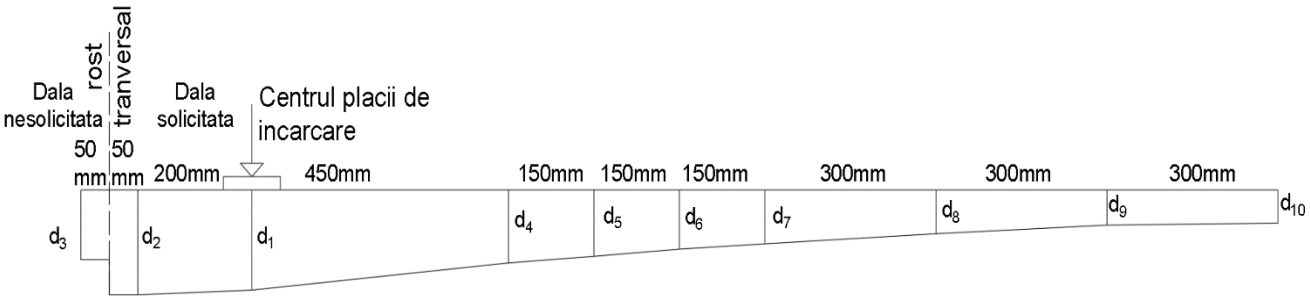


Figure A3.2. – Configuration of the deflection sensors when measuring at the transverse joint of the slab

4. The tests shall be carried out at the transverse joints of the slabs, in the coded position (24), according to Figure A3.3;

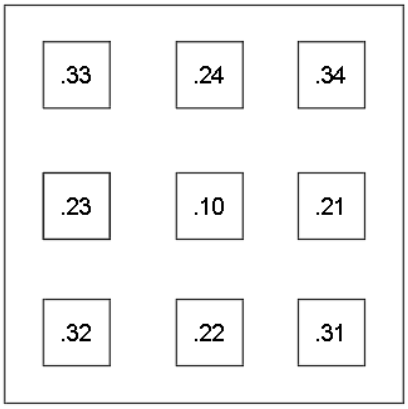


Figure A3.3. Coding of measuring points on the slab

In the files obtained from the dynamic deflectometer measurements, the joints inspected shall be identified by their kilometre position and measurement code 24. The figure below shows an extract from a measurement file.

```
$2
Chainage [m]..... 69
Lane.................
Pavement description... beton
Remarks.............. C+24 (LeavingCenter) []
Position of Drop:       Longitude: 25°59'20.3040"E      Latitude: 43°54'44.9220"N       Altitude: 26.0 m
$3
Sequence: 1/1   No. of drops: 2 Fallheight: 167 Time: 12:13

Drop    D(1)    D(2)    D(3)    D(4)    D(5)    D(6)    D(7)    D(8)    D(9)    D(10)   kPa     kN      Air     Sur.    Man.    Pulse time
2       105.0   111.6   84.8    67.3    57.8    48.0    41.3    29.2    20.9    16.3    798     56.39   12.0    16.8    10.6    27.25
```

Figure A3.4 Example of a data file obtained in the field

## II. Assessment of joint condition

For rigid structures with a surface made of concrete slabs, the condition of the joints shall be assessed on the basis of deformation measurements carried out on both sides of the joints (at point 24, according to Figure A3.3).

This assessment system is extremely important because the presence of voids can create different support conditions on each side of the joints. This is caused by the asymmetrical loading conditions of the slabs near the joint.

The load transfer at the joint shall be determined according to the deflection of the unloaded slab and the deflection of the loaded slab and expressed as a percentage.

The performance of the joints between concrete slabs shall be determined by analysing the following characteristics of the deflection basin, resulting from the measurements taken:

a) load transfer (**LT**);

b) load transfer efficiency (**LTE**).

***The load transfer*** is calculated using the following formula:

$$LT = (d_3/d_2)\ 100\%$$

where:

$d_2$ deflection measured with sensor 2, located on the loaded slab, at the edge of the joint;

$d_3$ deflection measured by sensor 3, located on the adjacent, unloaded slab.

***The load transfer efficiency*** is calculated by reference to:

$LTE = 2d_3 / (d_2 + d_3)$, where $d_2$ and $d_3$ have the meanings given above.

The assessment of the performance of the joints shall be carried out on the basis of the criteria in Table A3.1:

Table A3.1 – Criteria for assessing load transfer at the joint

| **No** | **Indicator** | **Class** | | |
|---|---|---|---|---|
| | | **1** | **2** | **3** |
| 1 | LT (%) | Over 75 | 50–75 | Under 50 |
| 2 | LTE (%) | Over 80 | 50–80 | Under 50 |
| 3 | Rating | Very good | Good | Low |

LT values greater than 75% are considered acceptable, although the results are affected by the temperature at the time of testing, with better load transfer being achieved at high temperatures, when the concrete slab expands and the contact between the slabs is better.

A LT value of 100% indicates ideal conditions, where a load is distributed equally on both sides of the joint. **The threshold value for assessing the efficiency of load transfer shall be LTE > 80%.**

The most restrictive of the two indicators shall determine the performance rating of the joints.

Table A3.2 presents a concrete example with calculation results for the LT and LTE indicator values for assessing the load transfer at the transverse joints.

Table A3.2 – Example calculation

| **Track/ lane** | **km** | **$d_2$ (0.01 mm)** | **$d_3$ (0.01 mm)** | **LT %** | **LT rating** | **LTE %** | **LTE rating** | **Joint performance** |
|---|---|---|---|---|---|---|---|---|
| C1B1 | 0+069 | 11.16 | 8.48 | 76 | Very good | 86 | Very good | Very good |
| | 0+110 | 9.43 | 8.76 | 93 | Very good | 96 | Very good | Very good |
| | 0+142 | 7.53 | 7.02 | 93 | Very good | 96 | Very good | Very good |
| | 0+201 | 11.42 | 8 | 70 | Good | 82 | Good | Good |
| | 0+290 | 10.12 | 6.8 | 67 | Good | 80 | Good | Good |
| | 0+396 | 14.55 | 11.3 | 78 | Very good | 87 | Very good | Very good |
| | 0+568 | 12.4 | 9.43 | 76 | Very good | 86 | Very good | Very good |

**Annex 4a**

## BITUMINOUS SURFACE DEGRADATION SURVEY

| Road | SECTION km .... km ... | TYPE OF ROAD STRUCTURE | | SURVEY OF DEGRADATION TO BITUMINOUS SURFACES | DATE |
|---|---|---|---|---|---|
| | SECTION km .... km ... | Flexible | Mixed (Semi-rigid) | | |

| Symbol | Type of degradation | Measurement unit | Lane | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 km | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 2 km | 1 | 2 | 3 | Total Lane left 1 | Total Lane left 2 | Total Lane right 3 | Total Lane right 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D1 | Potholes | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Filled surfaces | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D2 | Crocodile cracking | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Multiple cracks and | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | fissures in different directions | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D3 | Transverse cracks and fissures | m | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Longitudinal cracks and fissures | m | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Edge failure | m | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D4 | Weathered surface | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Pitted surface | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Streaked surface | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Bleeding surface | $m^2$ | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D5 | Longitudinal ruts | m | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |

**Annex 4b**

# EXAMPLE PROCESSED DATA FILE – EQUIPMENT FOR CONTINUOUS RECORDING OF TYPES OF DEGRADATIONS

| Nr drum | Lungime sector (m) | Latime banda (m) | Suprafata gropi (mp) | Suprafata plombari (mp) | Degradari datorate oboselii (mp) | Suprafata faiantata | Fisuri Longitudinale (mp) | Fisuri Transversale (mp) | Fisuri colmatate (mp) | Suprafata afectata de ciupituri (mp) | Suprafata afectata de valuriri (mp) | Suprafata exudata (mp) | Fagase (ml) | Suprafata degradata (mp) | Suprafata totala (mp) | ID (%) | Calificativ Stare de Degradare |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.93 | 0.48 | 0.28 | 0.35 | 0.00 | 75.00 | 100.00 | 22.06 | 350 | 6.30 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.93 | 0.00 | 0.60 | 1.33 | 0.00 | 1.62 | 0.00 | 75.00 | 100.00 | 23.33 | 350 | 6.67 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.20 | 0.11 | 3.91 | 0.00 | 75.00 | 100.00 | 22.61 | 350 | 6.46 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.02 | 0.00 | 0.00 | 0.00 | 0.63 | 0.45 | 0.00 | 7.85 | 0.00 | 75.00 | 100.00 | 23.35 | 350 | 6.67 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.24 | 0.00 | 9.34 | 0.00 | 75.00 | 100.00 | 23.19 | 350 | 6.63 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.03 | 0.00 | 0.00 | 0.00 | 0.27 | 0.25 | 0.00 | 11.13 | 0.00 | 75.00 | 100.00 | 23.62 | 350 | 6.75 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.43 | 0.00 | 1.85 | 0.81 | 0.00 | 9.81 | 0.00 | 75.00 | 100.00 | 25.13 | 350 | 7.18 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.22 | 0.00 | 12.27 | 0.00 | 75.00 | 100.00 | 23.74 | 350 | 6.78 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.10 | 0.00 | 11.24 | 0.00 | 75.00 | 100.00 | 23.91 | 350 | 6.83 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.21 | 0.00 | 12.30 | 0.00 | 75.00 | 100.00 | 23.81 | 350 | 6.80 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.58 | 0.11 | 0.00 | 10.26 | 0.00 | 75.00 | 100.00 | 23.53 | 350 | 6.72 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.08 | 0.09 | 11.62 | 0.00 | 75.00 | 100.00 | 23.52 | 350 | 6.72 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.60 | 0.83 | 0.07 | 8.75 | 0.00 | 75.00 | 100.00 | 23.75 | 350 | 6.79 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.83 | 0.47 | 0.00 | 8.44 | 0.00 | 75.00 | 100.00 | 23.59 | 350 | 6.74 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.32 | 0.23 | 0.00 | 7.54 | 0.00 | 75.00 | 100.00 | 23.60 | 350 | 6.74 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.65 | 0.81 | 0.14 | 8.48 | 0.00 | 75.00 | 100.00 | 24.42 | 350 | 6.98 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.32 | 0.92 | 0.00 | 8.18 | 0.00 | 75.00 | 100.00 | 24.20 | 350 | 6.91 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.06 | 0.96 | 0.00 | 8.97 | 0.00 | 75.00 | 100.00 | 24.21 | 350 | 6.92 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.51 | 0.00 | 1.33 | 2.43 | 0.00 | 8.25 | 0.00 | 75.00 | 100.00 | 25.64 | 350 | 7.33 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.01 | 1.05 | 0.08 | 6.59 | 0.00 | 75.00 | 100.00 | 23.76 | 350 | 6.79 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.48 | 1.35 | 0.13 | 7.29 | 0.00 | 75.00 | 100.00 | 24.44 | 350 | 6.98 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.32 | 0.71 | 0.05 | 7.38 | 0.00 | 75.00 | 100.00 | 23.89 | 350 | 6.83 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 2.15 | 2.08 | 0.00 | 6.92 | 0.00 | 75.00 | 100.00 | 25.35 | 350 | 7.24 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 1.21 | 1.37 | 0.00 | 6.24 | 0.00 | 75.00 | 100.00 | 24.05 | 350 | 6.87 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.20 | 0.00 | 4.37 | 3.86 | 0.06 | 4.56 | 0.00 | 75.00 | 100.00 | 27.82 | 350 | 7.95 | Mediocra |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 2.31 | 1.98 | 0.08 | 7.80 | 0.00 | 75.00 | 100.00 | 25.56 | 350 | 7.30 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 17.70 | 0.00 | 0.00 | 2.37 | 4.30 | 0.00 | 10.11 | 0.00 | 75.00 | 100.00 | 40.08 | 350 | 11.45 | Mediocra |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 6.67 | 0.57 | 0.00 | 2.67 | 2.69 | 0.00 | 8.86 | 0.00 | 75.00 | 100.00 | 31.60 | 350 | 9.03 | Mediocra |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 12.31 | 0.00 | 0.00 | 2.05 | 1.40 | 0.51 | 2.75 | 0.00 | 75.00 | 100.00 | 32.58 | 350 | 9.31 | Mediocra |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.42 | 0.00 | 2.82 | 1.73 | 0.00 | 5.17 | 0.00 | 75.00 | 100.00 | 25.50 | 350 | 7.29 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 10.70 | 0.64 | 0.00 | 2.96 | 1.68 | 0.08 | 9.32 | 0.00 | 75.00 | 100.00 | 34.04 | 350 | 9.73 | Mediocra |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 6.40 | 2.63 | 0.00 | 8.25 | 0.00 | 75.00 | 100.00 | 28.97 | 350 | 8.28 | Mediocra |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.48 | 0.00 | 1.67 | 1.95 | 0.00 | 8.90 | 0.00 | 75.00 | 100.00 | 25.64 | 350 | 7.33 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 2.24 | 2.87 | 0.00 | 7.64 | 0.00 | 75.00 | 100.00 | 26.11 | 350 | 7.46 | Buna |
| DN 73G calea 1 | 100 | 3.5 | 0.00 | 5.25 | 0.23 | 0.00 | 2.82 | 2.55 | 0.37 | 4.73 | 0.00 | 75.00 | 100.00 | 29.54 | 350 | 8.44 | Mediocra |
| DN 73G calea 1 | 4 | 3.5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | 0.07 | 0.00 | 3.00 | 4.00 | 0.95 | 14 | 6.80 | Buna |

**Annex 5**

## SURVEY OF DEGRADATION TO CONCRETE SURFACES

| Road | SECTION<br>km .... km ... | TYPE OF ROAD STRUCTURE | SURVEY OF DEGRADATION<br>TO CONCRETE SURFACES | DATE |
|---|---|---|---|---|
| | Section<br>km .... km ... | Rigid | | |

| Symbol | Type of degradation | Measurement unit | Lane | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 km | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 2 km | 1 | 2 | 3 | Total Lane left 1 | Total Lane left 2 | Total Lane right 3 | Total Lane right 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D1 | Settling of slabs | Number of slabs | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D2 | Crocodile cracking | Number of slabs | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Filled surfaces | Number of slabs | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D3 | Transverse cracks | m | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | and fissures at the corner | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| | Irregularly shaped longitudinal cracks and fissures | m | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |
| D4 | Delaminated surface | Number of slabs | left | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X |
| | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X |
| | | | right | 3 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | X |
| | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |

**Annex 6**

## ROAD CHARACTERISTICS SUMMARY SHEET

| Road | Type of road structure | Year of construction | Year of last reinforcement | Measurement stage |
|---|---|---|---|---|
| | | | | Year |

Road characteristics

| Measurement section | Flatness | | Roughness | | | | | | Load-bearing capacity | | State of degradation | | Technical condition class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IRI | Rating | µGT/GN | Rating | MTD/ETD | Rating | PTV (SRT) | Rating | $dc_{20}$ | Rating | GI or DI | Rating | |
| km.....<br>km..... | | | | | | | | | | | | | |
| km.....<br>km..... | | | | | | | | | | | | | |
| km.....<br>km..... | | | | | | | | | | | | | |

**Note***: When determining both the mean macrotexture depth and the coefficient of friction on a road section, and their values lead to different roughness ratings, the most unfavourable rating shall be adopted*.

**Annex 7**

**DETERMINATION OF THE TECHNICAL CONDITION AND MANDATORY PERIODIC MAINTENANCE AND ONGOING REPAIRS FOR ROADS WITH FLEXIBLE AND MIXED ROAD STRUCTURES (SEMI-RIGID, WITH A LAYER OF NATURAL AGGREGATES STABILISED WITH HYDRAULIC OR POZZOLANIC BINDERS)**

<table>
<tr><td rowspan="2">No</td><td rowspan="2">Technical condition</td><td rowspan="2">Technical condition class</td><td colspan="4">Characteristics rating</td><td colspan="2" rowspan="2">Mandatory periodic maintenance and ongoing repairs</td></tr>
<tr><td>Load-bearing capacity</td><td>State of degradation</td><td>Flatness</td><td>Roughness</td></tr>
<tr><td>1</td><td>VERY GOOD</td><td>5</td><td>V. GOOD</td><td>V. GOOD</td><td>V. GOOD</td><td>V. GOOD</td><td>-</td><td rowspan="5">Periodic maintenance</td></tr>
<tr><td>2</td><td rowspan="2">GOOD</td><td rowspan="2">4</td><td rowspan="2">At least GOOD</td><td>At least GOOD</td><td>At least GOOD</td><td>At least MEDIOCRE</td><td>Bituminous treatments/bituminous surfacing*</td></tr>
<tr><td>3</td><td>At least MEDIOCRE</td><td>At least GOOD</td><td>GOOD to POOR</td><td>Very thin bituminous layers/bituminous surfacing*</td></tr>
<tr><td>4</td><td>MEDIOCRE**</td><td>3</td><td>At least MEDIOCRE</td><td>At least MEDIOCRE</td><td>At least MEDIOCRE</td><td>V. GOOD to POOR</td><td>Bituminous surfacing</td></tr>
<tr><td>5</td><td>POOR</td><td>2</td><td>At least MEDIOCRE</td><td>At least MEDIOCRE</td><td>At least POOR</td><td>V. GOOD to POOR</td><td>Cold/hot recycling in accordance with applicable regulations***</td></tr>
<tr><td>6</td><td>VERY POOR</td><td>1</td><td>POOR</td><td>V. GOOD to POOR</td><td>V. GOOD to POOR</td><td>V. GOOD to POOR</td><td>Road structure reinforcement</td><td>Ongoing repairs</td></tr>
</table>

* Applies to motorways.

** At least one of the four road characteristics must have a MEDIOCRE rating

*** Cold or hot recycling shall be performed in accordance with the applicable technical standards, namely *AND 532 'Regulation on the cold recycling of road layers'* or *DD 509 'Regulation on the hot recycling of asphalt mixtures in fixed, semi-mobile and mobile preparation plants'*.

**Notes:**

1. The technical condition class shall be determined by the road characteristics ratings. If these characteristics lead to the technical condition being classified in more than one class, the lower class shall be adopted.

2. The thickness of bituminous reinforcement layers shall be determined in accordance with the legal technical specifications in force.

**Annex 8**

**DETERMINATION OF THE TECHNICAL CONDITION AND MANDATORY ROUTINE MAINTENANCE AND ONGOING REPAIR WORKS IN THE CASE OF ROADS WITH A RIGID ROAD STRUCTURE (WITH A CONCRETE OR CEMENTED MACADAM SURFACE)**

| No | Technical condition | Technical condition class | Characteristics rating | | | Periodic maintenance and ongoing repairs for road structures with concrete surfacing | |
|---|---|---|---|---|---|---|---|
| | | | State of degradation | Flatness | Roughness | | |
| 1 | VERY GOOD | 5 | V. GOOD | V. GOOD | V. GOOD | - | - |
| 2 | GOOD | 4 | V. GOOD AND GOOD | GOOD | V. GOOD and GOOD | Bituminous treatments/bituminous surfacing* | Periodic maintenance |
| 3 | MEDIOCRE** | 3 | At least MEDIOCRE | At least MEDIOCRE | At least MEDIOCRE | Very thin bituminous layers/bituminous surfacing* | |
| 4 | POOR | 2 | At least POOR | At least POOR | At least POOR | Road structure reinforcement | Ongoing repairs |
| 5 | VERY POOR | 1 | POOR | POOR | MEDIOCRE to POOR | | |

* Applies to motorways

** At least one of the degradation, flatness and roughness characteristics must be MEDIOCRE

Notes:

1. The technical condition class shall be determined by the road characteristics rating. If these characteristics lead to the technical condition being classified in more than one class, the lower class shall be adopted.
2. Bituminous treatments or very thin layers of bituminous materials shall be applied after maintenance and repair of concrete surfaces.
3. The thickness of reinforcement layers shall be determined in accordance with the legal technical specifications in force. Anti-crack solutions shall be installed, in accordance with the regulations in force.