

KPIs for pavement condition

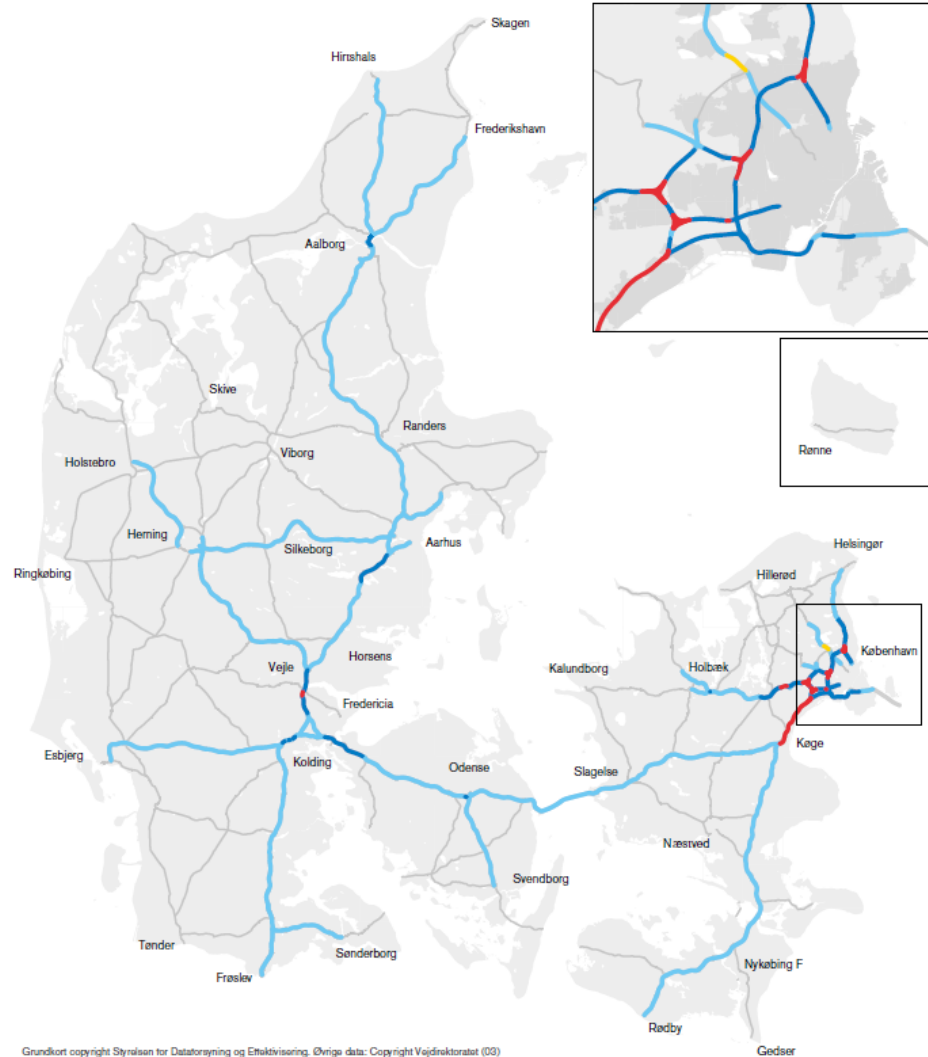
At the Danish Road
Directorate (DRD)

Armand Der-Stepanian, ards@vd.dk
Niels Skov Dujardin, nsd@vd.dk



ERPUG

The Danish Road Directorate



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Numbers and facts about the roads DRD manage.

Infrastructure:

Approximately 5 % of the road network in Denmark

Motorways	1227 km
Other roads	1588 km

Transport:

Approximately 50 % of the road transport in Denmark

Motorways	18,3 billions driven km a year
Other roads	7.2 billions driven km a year

Speed limits

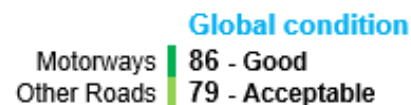
58% of the motorways is	130 km/h
38% of the motorways is	110 km/h
Other roads is typically	80 km/h

Objective

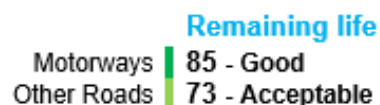
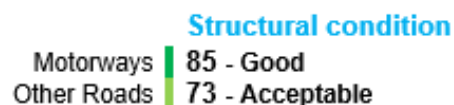
- Report pavement condition in general terms to non-experts
- Report on network level
- Pavement condition is based on measurement and not visual inspections
- Economy is not part of the report
- Do it on one page

COLLECTIVE SUMMARY – ROAD CONDITION AT THE DANISH STATE ROADS (2018)

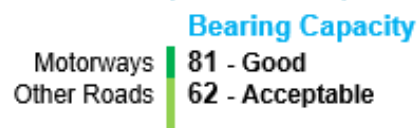
Global indicator (0-100 scale)



Combined indicators (0-100 scale)



Single indicators (0-100 scale)



Measured condition (Distributed in categories from good to critical, % of road network)

	Bearing capacity					Evenness					Rutting					Texture					Road Markings				
Motorways	53,9	25,0	14,9	4,4	1,8	16,8	81,8	1,2	0,1	0,1	92,5	7,3	0,2	0,0	0,0	97,9	1,6	0,5	0,1	0,0	45,3	15,5	21,4	4,9	12,9
Other Roads	11,9	42,0	32,4	10,2	3,4	27,4	65,2	5,2	1,3	0,8	59,3	37,4	3,0	0,3	0,0	92,7	5,1	1,8	0,3	0,0	53,7	15,1	17,7	3,5	10,1

█ Good
 █ Acceptable
 █ Moving toward Poor
 █ Poor
 █ Critical

KPIs for pavement condition – The Danish Road Directorate

Evenness

	GOOD	ACCEPTABLE	MOVING TOWARDS POOR	POOR	Critical
	No maintenance	Minor maintenance effort	Part of the network need maintenance	Comprehensive maintenance is needed	Urgent need for maintenance
Motorways (IRI, m/km)	0,8 and below	0,9 – 1,6	1,7 – 2,4	2,5 – 3,2	Above 3,2
Other roads (IRI, m/km)	1,0 and below	1,1 – 2,0	2,1 – 3,0	3,1 – 4,0	Above 4,1
EVENNESS	Good comfort. No or very few uneven surfaces	Ordinary comfort. Some unevenness due to minor surface damages and/or patches.	Much unevenness is detected. In general the road will be perceived as uneven	Poor comfort, Can lead to safety issues.	Poor comfort with safety issues
Percentage on motorways 2018	16,8 %	81,8 %	1,2 %	0,1 %	0,1 %
Percentage on motorways 2017	18,6 %	80,1 %	1,2 %	0,1 %	0,1 %
Percentage on other roads 2018	27,4 %	65,2 %	5,2 %	1,3 %	0,8 %
Percentage on other roads 2017	23,9 %	69,0 %	5,2 %	1,1 %	0,8 %

Road Marking visibility

	GOOD	ACCEPTABLE	MOVING TOWARDS POOR	POOR	Critical
	No maintenance	Minor maintenance effort	Part of the network need maintenance	Comprehensive maintenance is needed	Urgent need for maintenance
(Retroreflecsion, mcd/lux/m ²)	150 and above	130 - 149	100 - 129	90 - 99	Below 90
Road Marking Visibility	The road marking appears new	The road marking is clearly visible and do not cause any safety issues	Road markings are visible but the drivers need to be focused. Visibility is problematic in rain and at night	The visibility is poor in any conditions. And will be a safety issue to the road users	Road markings are not visible and an urgent replacement is needed. It is not safe for the road users.
Percentage of road markings on motorways 2018	45,3 %	15,5 %	21,4 %	4,9 %	12,9 %
<i>Percentage of road markings on motorways 2015-17</i>	35,2 %	16,7 %	27,6 %	10,7 %	9,9 %
Percentage of road markings on other roads 2018	53,7 %	15,1 %	17,7 %	3,5 %	10,1 %
<i>Percentage of road markings on other roads 2015-17</i>	38,1 %	18,6 %	24,8 %	8,9 %	9,7 %

	GOOD	ACCEPTABLE	MOVING TOWARD POOR	POOR	CRITICAL
	No maintenance	Minor maintenance effort	Part of the network need maintenance	Comprehensive maintenance is needed	Urgent need for maintenance
BEARING CAPACITY (Remaining structural life based on TSD-screening)	20 years or above	15 – 19 years	5 – 14 years	0 – 4 years	below 0 years
	Sufficient Bearing Capacity	Ordinary condition, minor part of the road network needs reinforcement	Reinforcement should be considered when paving a new wearing course	Moderate to high risk of insufficient bearing capacity. Reinforcement needed.	High risk of insufficient bearing capacity. Reinforcement needed.
EVENNESS (IRI, m/km)	0,8 and below (motorways)	0,9 – 1,6 (motorways)	1,7 – 2,4 (motorways)	2,5 – 3,2 (motorways)	above 3,2 (motorways)
	1,0 and below (Other roads)	1,1 – 2,0 (Other roads)	2,1 – 3,0 (Other roads)	3,1 – 4,0 (Other roads)	4,1 – 5,0 (Other roads)
	Good comfort. No or very few uneven surfaces	Ordinary comfort. Some unevenness due to minor surface damages and/or patches.	Much unevenness is detected. In general the road will be perceived as uneven	Poor comfort, Can lead to safety issues.	Poor comfort with safety issues
RUTTING (depth, mm)	5 mm and below	6 – 10 mm	11 – 15 mm	16 – 20 mm	above 20 mm
	No rutting. No risk of aquaplaning	Discomfort when changing lanes. Low risk of aquaplaning	Risk of aquaplaning at heavy rain and high traffic speeds. Discomfort when changing lanes	Risk of aquaplaning and possibility of insufficient bearing capacity. The condition can be a safety issue	High Risk of aquaplaning and properly insufficient bearing capacity
TEXTUR (MPD, mm)	0,5 and above	0,40 – 0,49	0,30 – 0,39	0,20 – 0,29	below 0,20
	Very low risk of insufficient friction	Low risk of insufficient friction	Moderate risk of insufficient friction	High risk of insufficient friction	Very high risk of insufficient friction
ROAD MARKING VISIBILITY (mcd/m ² /lux)	150 and above	130 - 149	100 - 129	90 - 99	below 90
	The road marking appears as new	The road marking is clearly visible and do not cause any safety issues	Road markings are visible but the drivers need to focus. Visibility is problematic in rain and at night	The visibility is poor in any conditions. And will be a safety issue to the road users	Road markings are not visible and an urgent replacement is needed. It is not safe for the road users.

Single indicators

- The Framework for Performance Indicators, PIARC 2004
- **Single indicators (0-100)**
 - 1 x percentage of the road network in the *Good* condition
 - + **0,75** x percentage of the road network in the *Acceptable* condition
 - + **0,5** x percentage of the road network in the *Moving towards poor* condition
 - + **0,25** x percentage of the road network in the *Poor* condition

• Value of condition indicator

- 80 – 100
- 60 – 79
- 40 – 69
- 20 – 49
- 0 – 19

Qualitative assessment

- Good
- Acceptable
- Moving towards poor
- Poor
- Critical

Combined and global indicators

- Combined indicators

- Three KPIs from the Danish road standards (normally assessed visually)

	Bearing capacity	Eveness	Rutting	Texture	Road markings
Remaining life	50%	25%	25%		
Safety		10%	30%	30%	30%
Comfort		50%	25%		25%

- Two new indicators

	Bearing capacity	Eveness	Rutting	Texture	Road Markings
Structural condition	50%	25%	25%		
Functional condition		25%	25%	25%	25%

- Global indicator

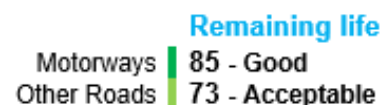
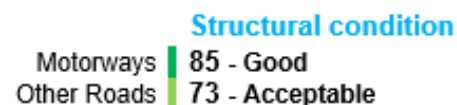
	Structural condition	Functional condition
Global condition	50 %	50 %

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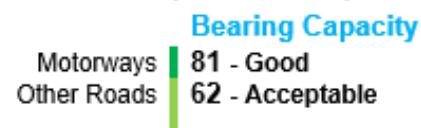
Global indicator (0-100 scale)



Combined indicators (0-100 scale)



Single indicators (0-100 scale)



Measured condition (Distributed in categories from good to critical, % of road network)

	Bearing capacity					Evenness					Rutting					Texture					Road Markings				
Motorways	53,9	25,0	14,9	4,4	1,8	16,8	81,8	1,2	0,1	0,1	92,5	7,3	0,2	0,0	0,0	97,9	1,6	0,5	0,1	0,0	45,3	15,5	21,4	4,9	12,9
Other Roads	11,9	42,0	32,4	10,2	3,4	27,4	65,2	5,2	1,3	0,8	59,3	37,4	3,0	0,3	0,0	92,7	5,1	1,8	0,3	0,0	53,7	15,1	17,7	3,5	10,1

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 █ Poor ¹⁰
 █ Critical

Further work

- In 2020 a *Surface condition indicator* will be added that will rely on results from an ARAN9000 with Pavemetrics LCMS2 lasers mounted. At least including:
 - Cracks
 - Raveling and/or pick outs
 - Potholes and delamination
 - Patches and sealings
- In 2020 friction will be measured on network level to validate that our current texture screening is functioning correct.

Thank you

Armand Der-Stepanian,
Niels Skov Dujardin,

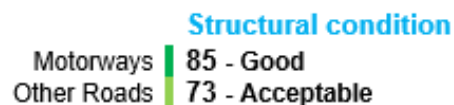
ards@vd.dk
nsd@vd.dk

COLLECTIVE SUMMARY – ROAD CONDITION AT THE DANISH STATE ROADS (2018)

Global indicator (0-100 scale)



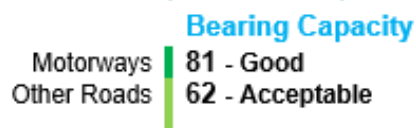
Combined indicators (0-100 scale)



Road surface condition



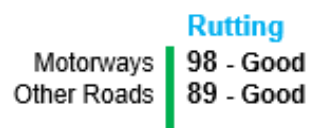
Single indicators (0-100 scale)



Cracks



raveling



potholes



Repairs

Measured condition (Distributed in categories from good to critical, % of road network)

	Cracks					raveling					potholes					Repairs									
	Bearing capacity					Evenness					Rutting					Friction Texture					Road Markings				
Motorways	53,9	25,0	14,9	4,4	1,8	16,8	81,8	1,2	0,1	0,1	92,5	7,3	0,2	0,0	0,0	97,9	1,6	0,5	0,1	0,0	45,3	15,5	21,4	4,9	12,9
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