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AUTOMATIC ASSESSMENT OF A ROAD SURFACE CONDITION

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COLAS

The Road Eagle Colas (REC)

- **The REC aims at determining a road surface condition, and predicting its structural remaining life**
- **The REC is based on:**

A machine: road surface images and transverse profiles

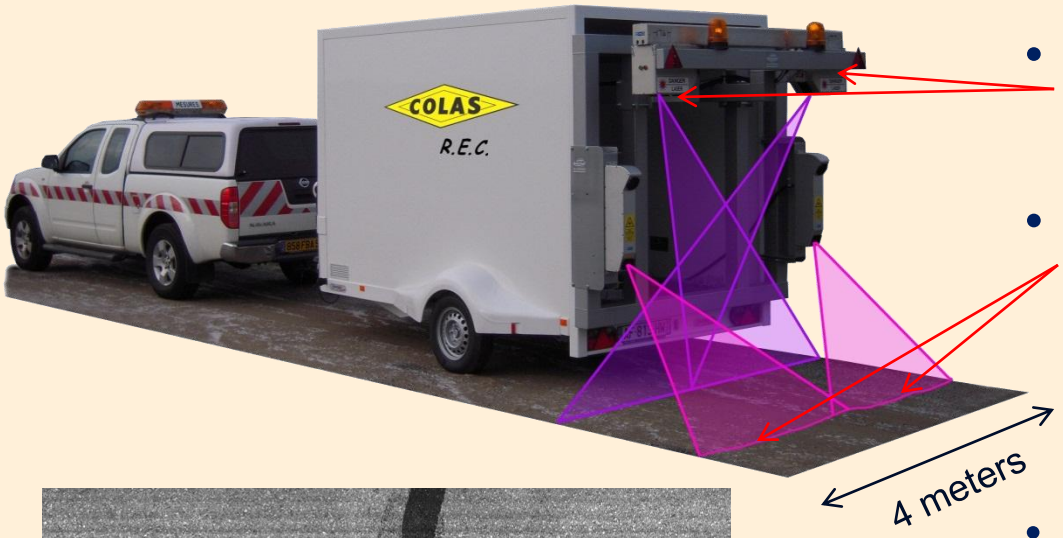
An expert system:

- **cracks and ruts detection**
- **resulting in degradation indexes and evolution rules**

	Road **OK for the next 10 years**
	Repairing in **5 to 10 years**
	Repairing **in 2 to 5 years**
	Repairing in **0 to 2 years**

The Road Eagle Colas: an expertise based on several steps

Step 1: REC Acquisition device




Data acquisition up to 100 km/h, driving within trafic

A trailer equipped with:

- **High-definition camera (pitch: 1mm per pixel)**
- **Transverse profilometer: 1 profile every 20 cm, 1 mm accuracy in depth**
- **Both provided by the Institut National d'Optique of Québec**

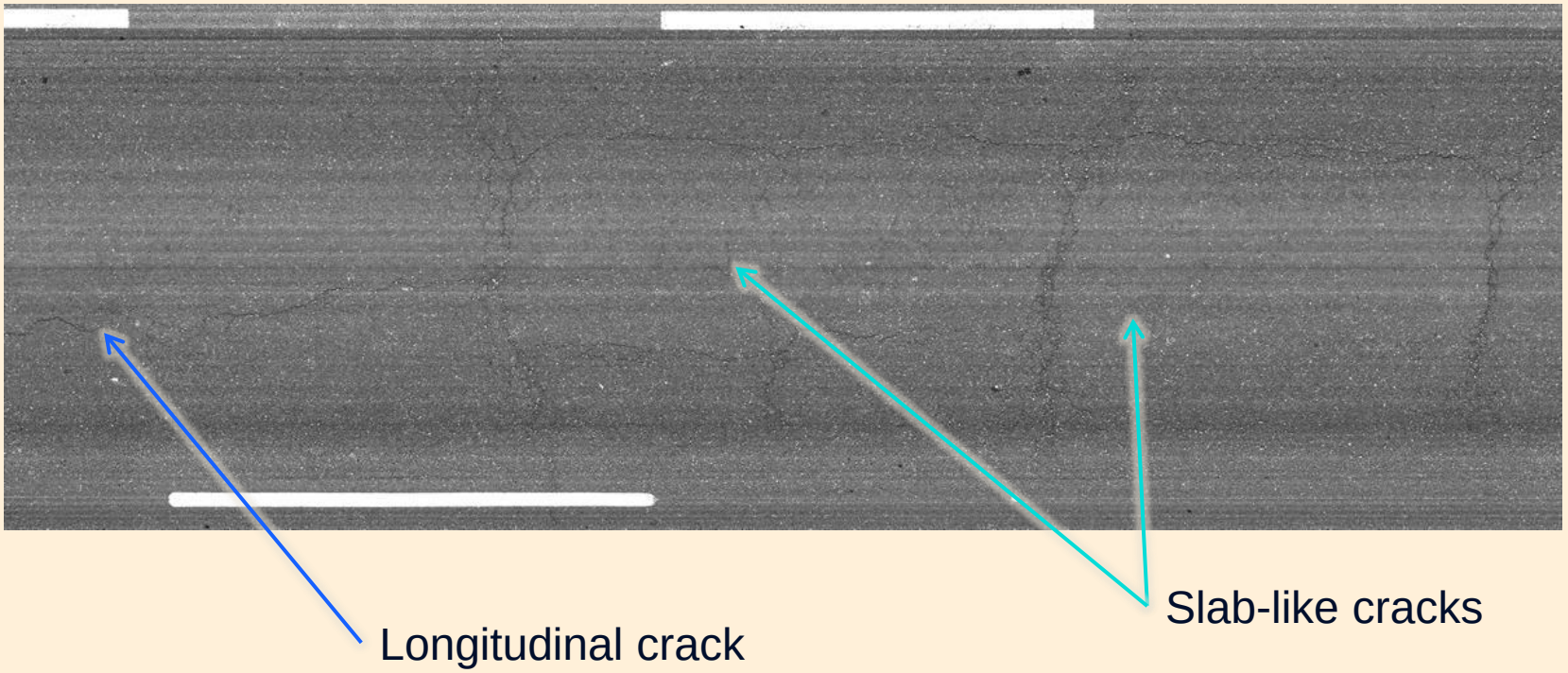
Step 2: Data processing

- **Data are gathered in 10 meters long, 4 meters wide segments**
- **Automatic detection of cracks, alligator cracking and sealings**
- **Automatic detection of ruts (small and large radius) and subsidences**

Assignment of a degradation severity index to every default

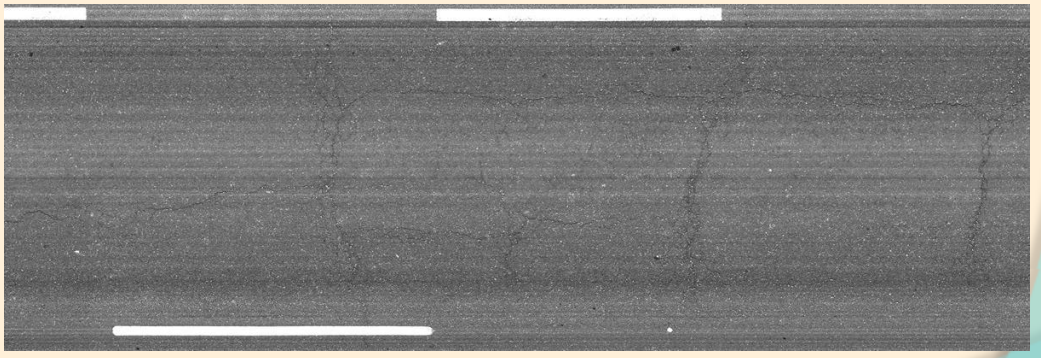
Step 2: Data processing - images

- **Input: one image (4 x 10 meters)**



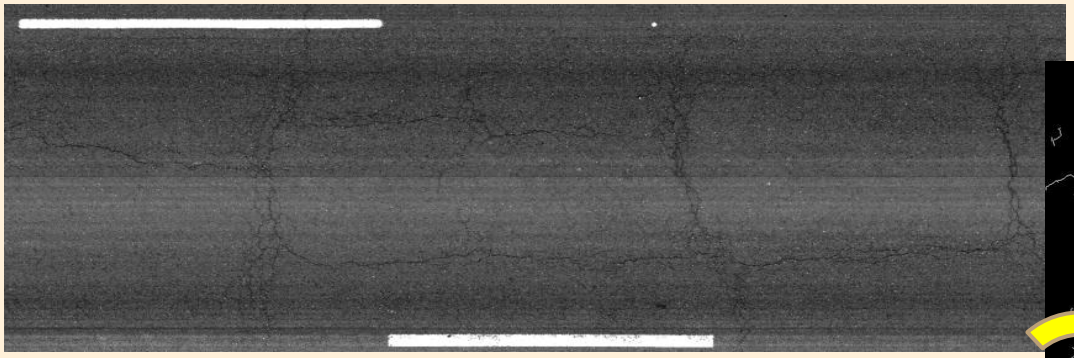
Step 2: Data processing - images

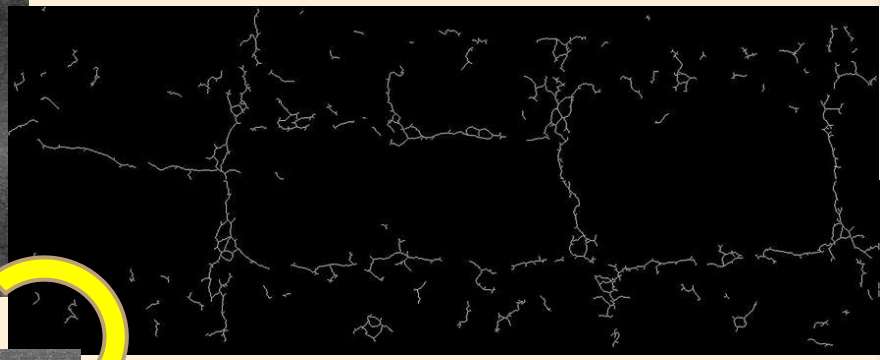
- **Processing contrainsts**
  - **High sensitivity: cracks as thin as 1~2 mm have to be detected**
  - **Few false detections (<5 %)**
  - **Computing time less than an hour per km (and per processor)**

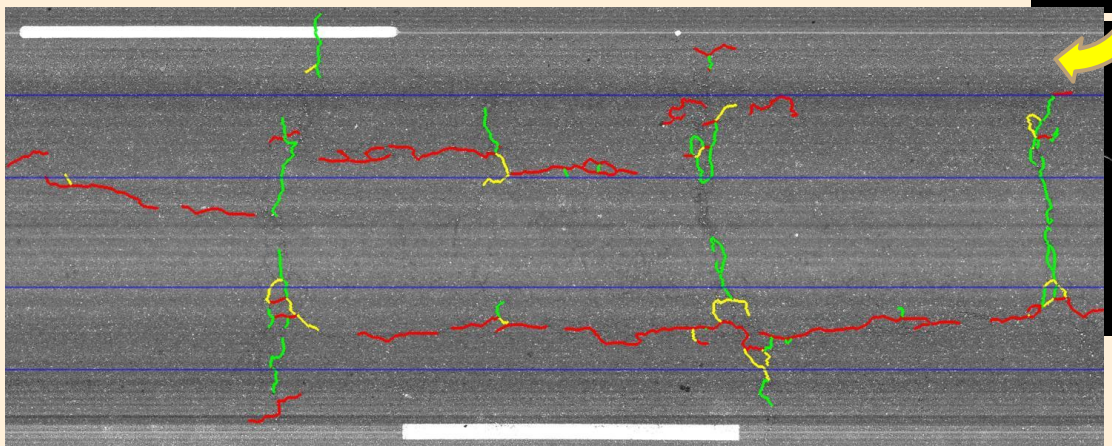


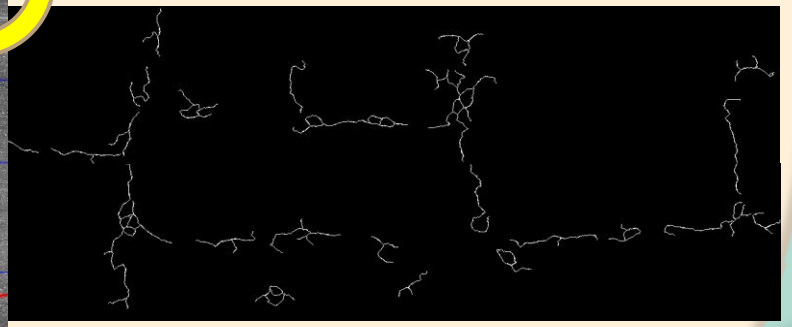
Step 2: Data processing - images

Processing: filtering, squeleton, classification…









Step 2: Data processing - images

Crack classification (according to their width)

- class 1 : less than 2 mm
- class 2 : between 2 and 5 mm
- class 3 : more than 5 mm
- class 4: double crack
- class 5: sealed cracks
- Alligator cracking

Crack orientation

- Longitudinal (red)
- Transverse (green)
- Other (yellow)

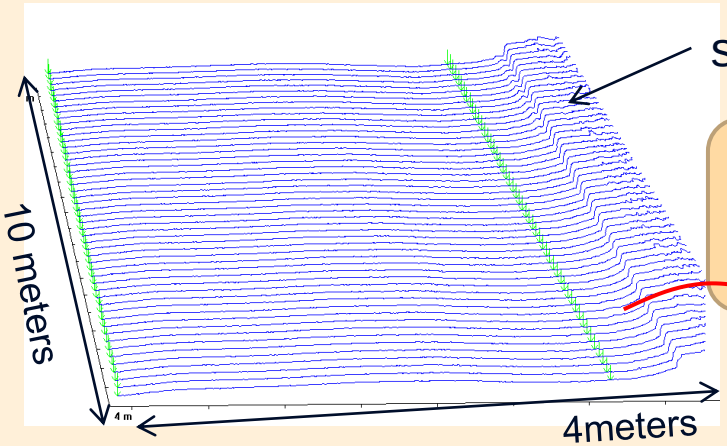
Crack position

- Inside/outside wheel paths…

Assignment of a crack-based degradation index ranging from 1 to 4

longitudinal crack inside wheel path = mark 1
slab-like cracks = mark 2

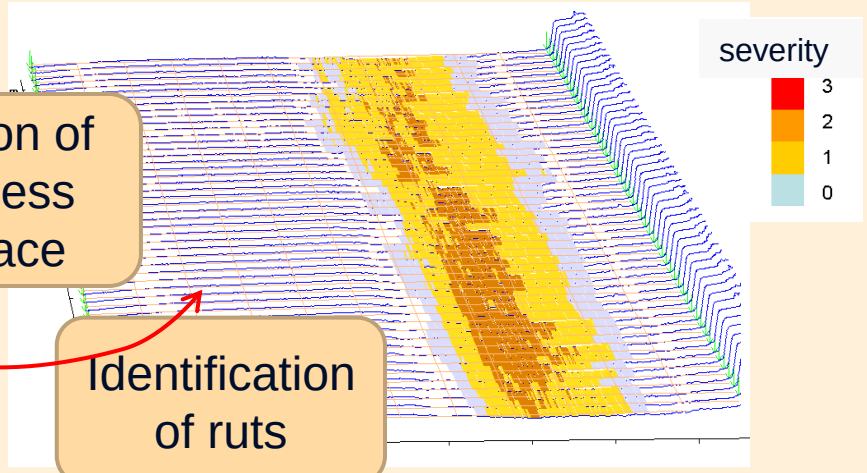
Step 2: Data processing - profiles



50 profiles gathered into a 10 meters long segment

Construction of a default-less road surface

Identification of ruts



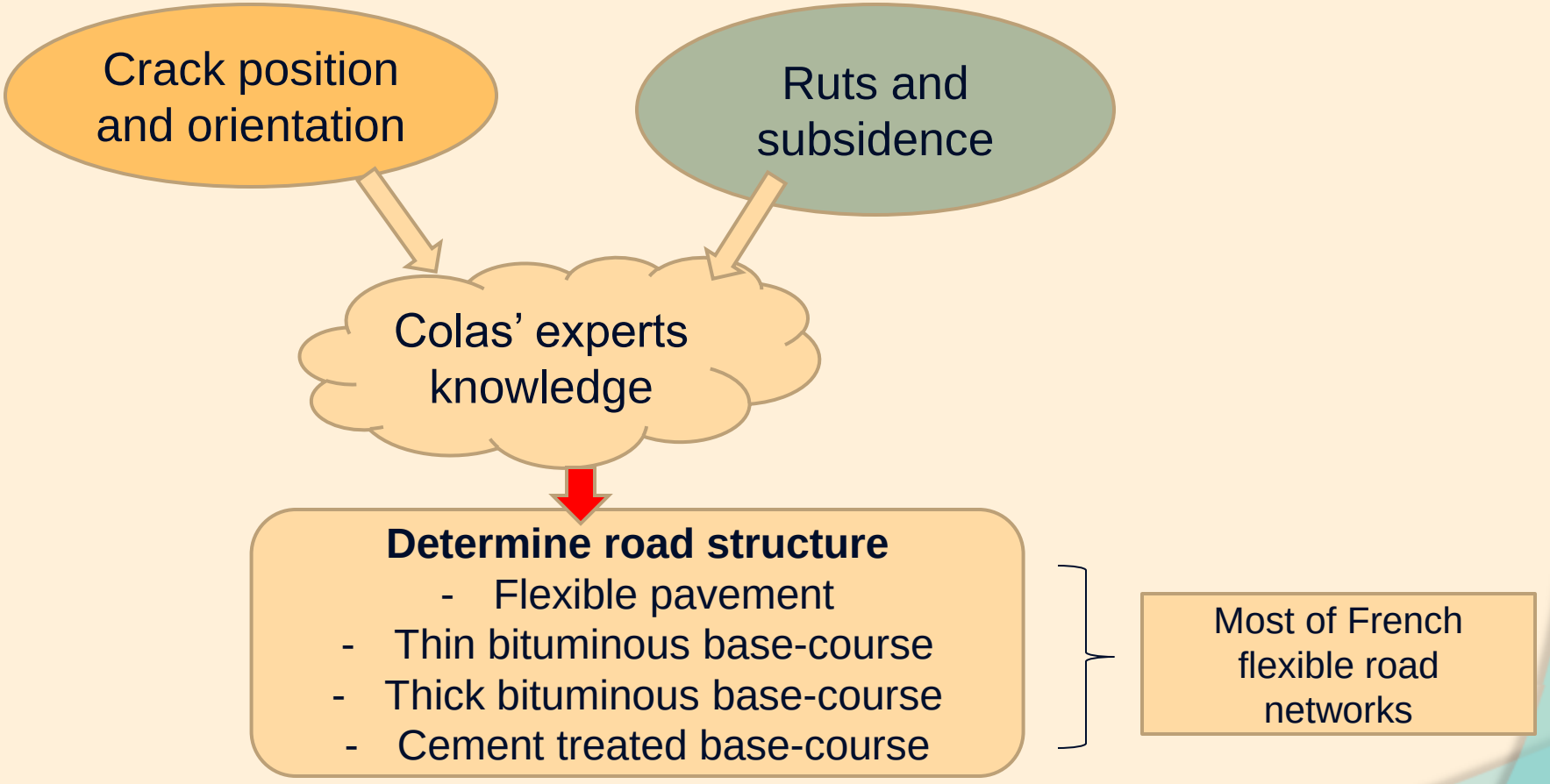
Classification into a 3 levels severity scale

- **Detection of small and large radius ruts**
- **Detection of edge subsidence**

→ Assignment of a profile-based degradation index

Step 3: Structural evaluation

1. Identify road structure



Step 3: Structural evaluation

2. Rate road structural potential

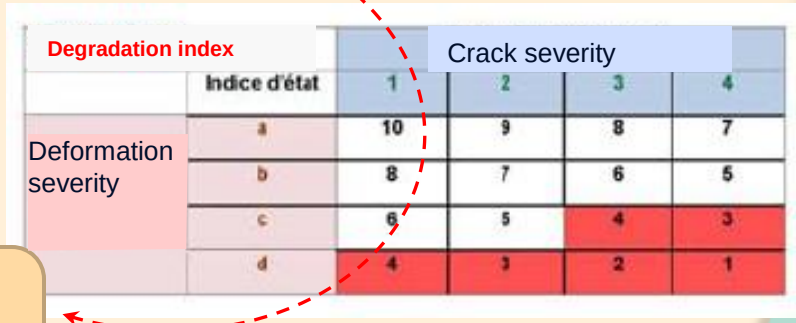
Identified road structure

Ruts and subsidence severity index

Crack position and severity index

Colas' experts knowledge

Road degradation level 1(bad) → 10 (good)



Road remaining structural lifetime

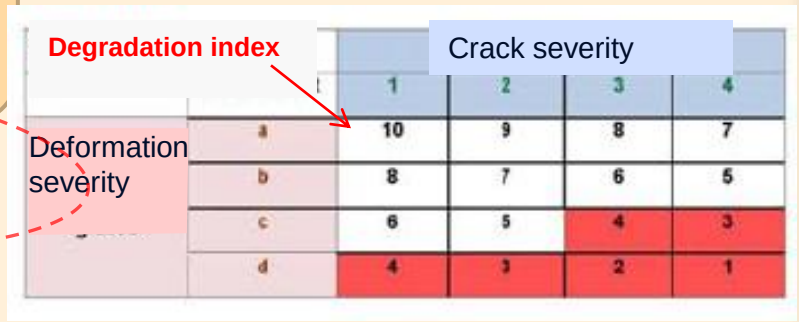
Step 3: Structural evaluation

3. Rate road future condition at 5 and 10 years

Colas' experts knowledge

Road degradation level 1(bad) → 10 (good)

Road remaining structural lifetime



Degradation index ≤4
Work on structure within 2 years

Degradation index ≥5
Road OK today
→ When will it fail ?

Apply evolution rules to determine road condition at 2, 5 and 10 years

Colas' expert knowledge

	Road **OK for the next 10 years**
	Repairing in **5 to 10 years**
	Repairing **in 2 to 5 years**
	Repairing in **0 to 2 years**

Step 3: Structural evaluation

- **Software integration**

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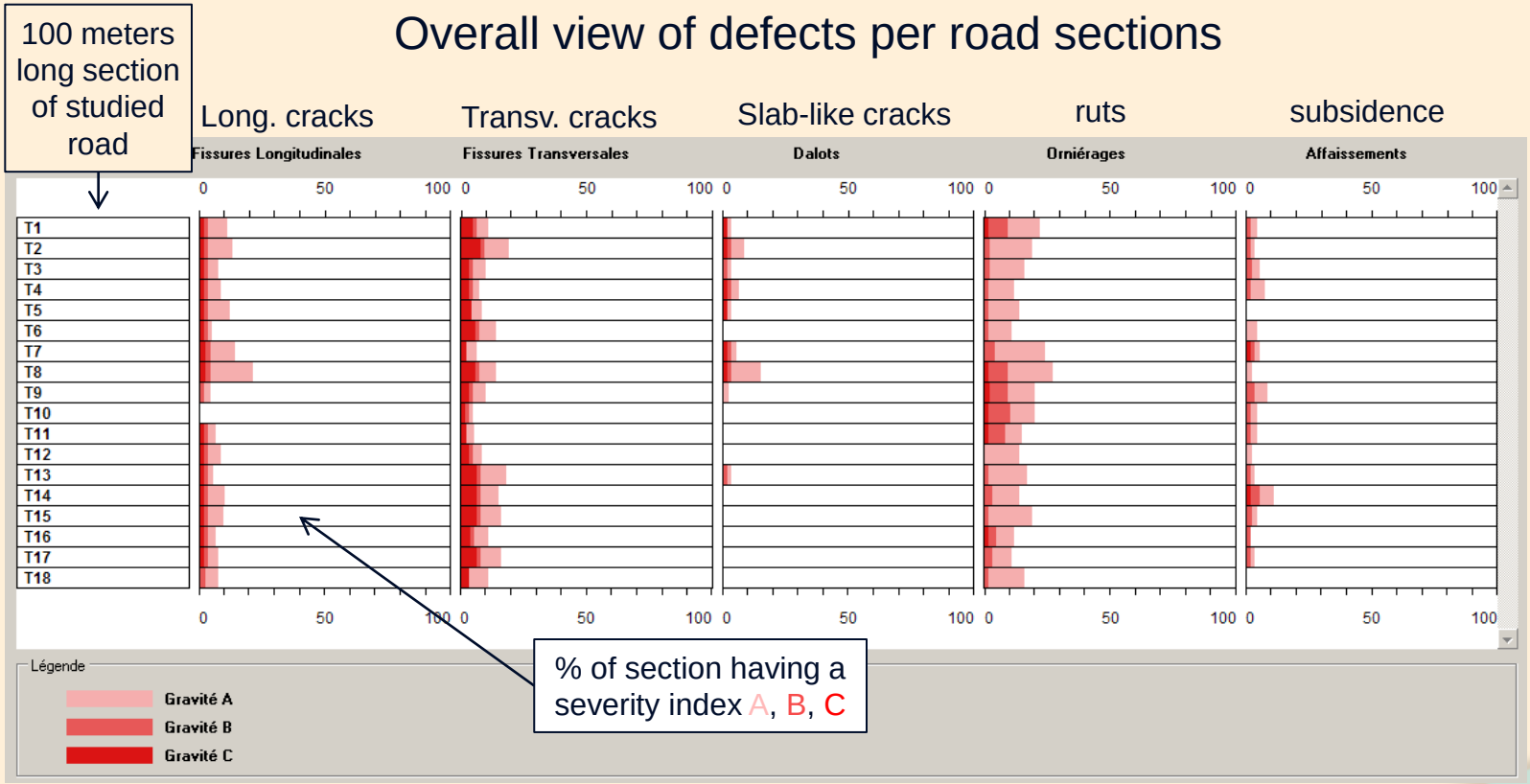

Step 3: Structural evaluation

- **Software integration**

Overall view of structural remaining life per road section

	Road **OK for the next 10 years**
	Repairing in **5 to 10 years**
	Repairing **in 2 to 5 years**
	Repairing in **0 to 2 years**

-10%

+10%

Nom	X - 0 (Minoré)	X - 5 (Minoré)	X - 10 (Minoré)	(M	X - 0 (Base)	X - 5 (Base)	X - 10 (Base)	É	X - 0 (Majoré)	X - 5 (Majoré)	X - 10 (Majoré)	(M
T1: 0 à 100 m	5	3	3		5	3	3		5	3	3	
T2: 100 à 200 m	5	3	2		5	3	2	2	5	3	2	
T3: 200 à 300 m	6	5	3	3	6	5	3	3	6	5	3	3
T4: 300 à 400 m	6	6	5	4	6	5	5	4	6	5	3	3
T5: 400 à 500 m	6	5	5	4	5	5	3	3	5	5	3	3
T6: 500 à 600 m	5	5	3	3	5	5	3	3	5	3	3	2
T7: 600 à 700 m	6	5	3	3	6	5	3	3	6	3	3	2
T8: 700 à 800 m	5	3	3	2	5	3	2	2	3	3	2	1
T9: 800 à 900 m	6	4	3	2	6	3	3	2	4	3	3	1
T10: 900 à 1000 m	6	6	4	3	6	6	4	3	6	4	4	2
T11: 1000 à 1100 m	6	6	4	3	6	6	4	3	6	6	4	3
T12: 1100 à 1200 m	6	5	5	4	6	5	5	4	6	5	3	3
T13: 1200 à 1300 m	5	5	3	3	5	5	3	3	5	3	2	2
T14: 1300 à 1400 m	5	3	3	2	5	3	3	2	5	3	3	2
T15: 1400 à 1500 m	5	5	3	3	5	3	3	2	5	3	3	2
T16: 1500 à 1600 m	6	5	3	3	6	5	3	3	5	5	3	3
T17: 1600 à 1700 m	5	5	3	3	5	3	3	2	5	3	3	2
T18: 1700 à 1720 m	6	5	5	4	6	5	5	4	6	5	3	3

Conclusion

The Road Eagle Colas

- Detects cracks, alligator cracking, sealings, ruts and subsidences (through dedicated algorithms)
- Based on Colas' expert knowledge of road evolution and degradation processes:
  - Assign degradation indexes based on the detection results
  - Establish evolution rules to predict road condition at 2, 5 and 10 years

The Road Eagle Colas is a complete tool to determine the remaining potential of road structures, based on visual inspection