

# The role of the FWD in the “SOFICO” campaign in Wallonia, Belgium



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DIRECTION GÉNÉRALE OPÉRATIONNELLE  
DES ROUTES ET DES BÂTIMENTS





# The SOFICO campaign

- Main national roads and motorways only
- Need information about the structural capacity of the road and of the different layers separately (asphalt, concrete, base course,...)
- Campaign asked by the Walloon Road Directorate and SOFICO and executed by BRRC and GINGER-CEBTP



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SPW  
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de Wallonie

# The SOFICO campaign

- 2 deflection measuring devices were used

- Curviameter

- Continuous measurement (18km/h)
    - Inadequate on concrete roads
    - Inadequate on curvy roads
    - Back-calculation based on four points on deflection curve



- FWD

- 65 kN or 100 kN
    - Usually one point of measurement every 100 meter
    - Back-calculation based on nine sensors (9 points on the deflection curve)





# The SOFICO campaign

- The SOFICO manages 3600 km of roads
- 1000 km are measured at this time and 500 km more will be investigated in fall 2013.
- 370 km were measured with the Falling Weight Deflectometer
- Budget: 575.000 €
- Network + Project Level approach



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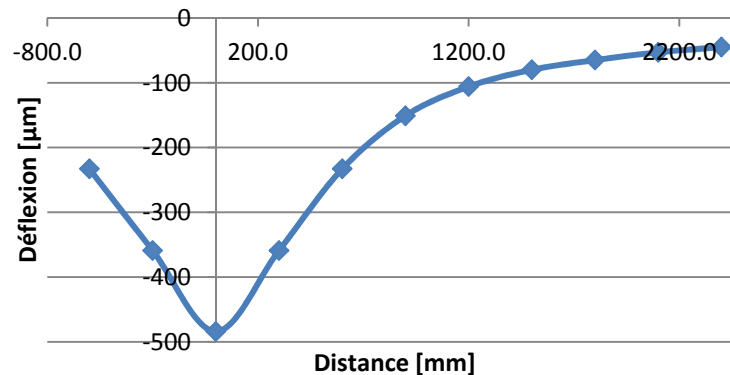
# Project level

- Works are already planned on the section
- We want to know if a structural intervention must be done at the same time
- Use of the back calculation with the « Qualidim » software
- Condition estimation of the base course and of the others layers



# Purpose and concept of back calculation (project level)

- Finding the elastic modulus of the different layers from:
  - The deflection points measured by the FWD and the technical characteristics of the FWD

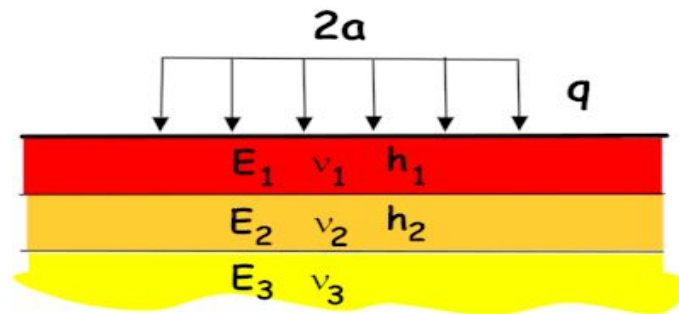


- The thickness of the different layers
- Grip rating between the layers and Poisson's ratio estimation



# Purpose and concept of back calculation

- The back calculation is based on the Burmister's theory for a three layer model



- The software will calculate by iterations a theoretical structure which will match with the measured deflection bowl

# Particular case: N552

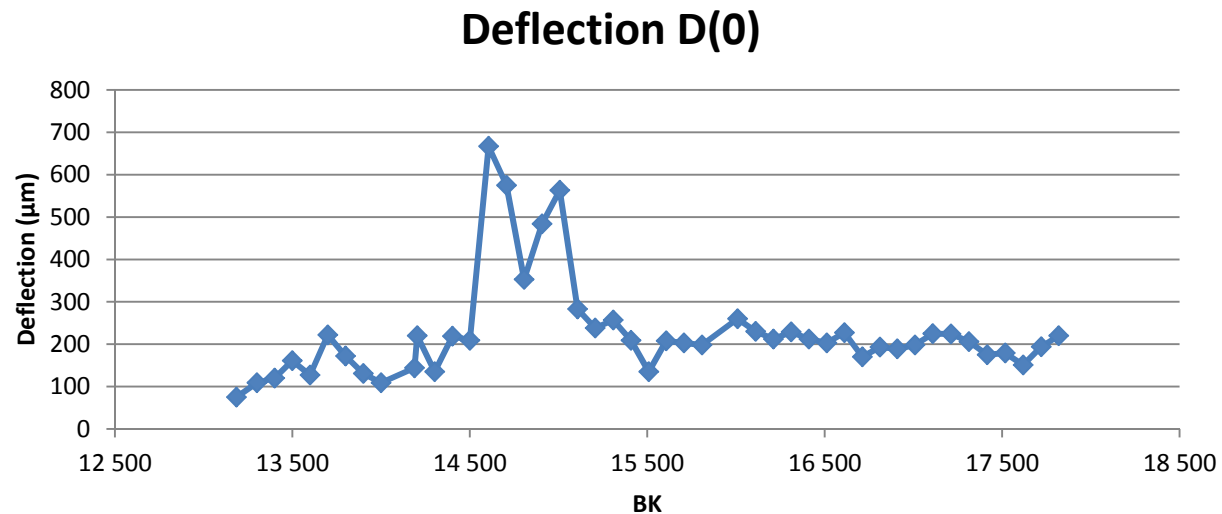
- North of the city of Mons
- Near a new industrial park  
(3000 trucks/day)
- From km 13 to km 18
- Several roundabouts on the section  
=> Measured with the FWD





# Particular case: N552

- 3 homogeneous sections



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# Particular case: N552



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# Particular case: N552

- Road structure

Homogenous section	Asphalt thickness	Base course thickness	Base course materials
BK 13-14,4	19 cm	27 cm +10,5 cm	low cement concrete + cemented sand
BK 14,4-15	17 cm	23 cm	crushed stone
BK 15-18	25 cm	19 cm	reinforced concrete



# Particular case: N552

- FWD measures and back calculation results  
(Made with the « Qualidim » software)

BK	Deflexion measures									Layer data					Calculated elastic modulus			Mean difference between measured and calculated deflexion (µm)
										C1		C2		C3	E1	E2	E3	
	D(0)	D(300)	D(600)	D(900)	D(1200)	D(1500)	D(1800)	D(2100)	D(2400)	Thickness (mm)	Poisson's ratio	Thickness (mm)	Poisson's ratio	Poisson's ratio				
13,500	161	133	114	96	78	63	51	41	34	190	0,35	275	0,25	0,5	36440	3142	299	2,19
13,500	161	133	114	96	78	63	51	41	34	190	0,35	275	0,25	0,5	18808	7122	270*	3,72
13,900	131	100	84	74	64	53	45	37	30	190	0,35	275	0,25	0,5	9360	16552	353	1,07
14,600	667	441	249	127	72	43	30	23	20	170	0,35	230	0,3	0,5	5223	52	354	6,24
14,700	575	458	327	224	154	104	73	51	36	170	0,35	230	0,3	0,5	13019	37	208	5,15
14,800	353	267	185	128	88	60	43	31	24	170	0,35	230	0,3	0,5	16848	118	312	4,69
14,900	484	359	233	151	106	80	65	53	45	170	0,35	230	0,3	0,5	7831	360	211	0,78
17,000	198	148	127	109	91	75	65	55	47	250	0,35	190	0,25	0,5	6081	16614	242	0,49



# Particular case: N552

- Durability of the structure  
(Made with the « Qualidim » software)

Homogenous section	Amount of trucks expected (20 years)	Amount of trucks supported by the structure	Breaking probability (20 years)	Lifetime for a breaking probability of 50%
13-14,4	2,68E+07	8,48E+08	6,70%	>20 years
14,4-15		1,28E+06	100%	1 year
15-18		5,51E+07	37,70%	>20 years



# Particular case: N552

- Use of the «Qualidim» software to approve a new structure on the 2<sup>nd</sup> homogeneous section

The screenshot shows the 'Renforcement - Inlay' software interface. The window title is 'Renforcement - Inlay' and it has menu options: 'Sauver structure', 'Charger structure', and 'Rapport'. The main area is titled 'Inlay' and contains several sections:

- Types de renforcement:** Radio buttons for 'Overlay' and 'Inlay' (selected).
- Revêtement:** A table for 'Nombre de couche(s) (1 à 4)' with columns for 'Type' and 'h (mm)'.

Enr. Bit.	Type	h (mm)
<input type="checkbox"/>	(*)SMA-10-2/6 (50/85-50)	50
<input type="checkbox"/>	AC-20base3-8(15/25)	60
<input type="checkbox"/>	AC-20base3-8(15/25)	60
- Nombre de poids lourds prévus:** Input field with value '2,68E+007'.
- Estimation des performances de la structure globale:**
  1. Probabilité de rupture (%) après 20 années: Input field with value '35,7'.
  2. Pour une probabilité de rupture de 50%:
    - Nombre d'années: Input field with value '> 20'.
    - Nombre de poids lourds: Input field with value '6,24E+007'.
- Adhérence:** 'Modèle' dropdown set to 'Valeurs par défaut', 'Période de temps' dropdown set to '0-10ans', and a 'Détails...' button.
- Fondation liée:** Checked. 'Type' dropdown set to 'Béton maigre (R'bk = 10MPa)', 'Module (N/mm²)' input field with value '360', and 'h (mm)' input field with value '170'.
- Fondation non liée:** Unchecked. 'Module (N/mm²)' input field with value '360' and 'h (mm)' input field with value '0'.
- Sous-fondation:** Checked. 'Type' dropdown set to 'Module (N/mm²)', 'Module (N/mm²)' input field with value '211', and 'h (mm)' input field with value '400'.
- Sol:** 'Type' dropdown set to 'Module (N/mm²)', 'Module (N/mm²)' input field with value '211', and 'Degré d'anisotropie' input field with value '1'.

At the bottom of the interface are buttons for 'Calcul', 'Ornière', and 'Retour'.



# Network approach

- Much more extended sections
- No specific project and no back calculation
- Use of an indicator to classify the sections in 5 different categories
- Insertion of these indicators in the Walloon road database



# Ingredients from FWD measurements

- Characteristic deflection:  $D(0) + 2.\sigma$  (bearing capacity)
- Radius of curvature  $R0$  (layer cohesion)
- “Tragfähigkeitszahl”  $Tz = \sqrt{\quad}$  (bearing capacity)
- $\frac{(\quad)}{\quad}$  (surface layer cohesion)
- Hysteresis curve: englobed surface and tangency  
(energy dissipation)
- Combined with traffic information:  
classification of “structural health”







# Conclusions

- Structural quality is an important feature of the roads
- The Walloon region and SOFICO understand that and invest money to better know their roads
- The final purpose of these campaigns is to investigate each section every five years to observe the structural evolution

