Asset Management in NL

Leo Klatter

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Rijkswaterstaat

Outline presentation

- Introduction
- Life cycle based maintenance management
- Management of an ageing bridge stock
- Traffic loads
- Risk based inspections

National highways Network

3100 km highway,

of total 60 000 km road outside cities

- of which 2400 km motorway,
- approx. 1100 km with traffic control systems (ITS):
  - 7 road traffic control centers
  - 91 dynamic route info signs
  - 51 ramp metering points
  - 11 peak hour lanes

Traffic movements

- 45 % (vehicle-kilometers)

Asset types

Bridges in the Netherlands

Life-cycle based maintenance management

Maintenance key factors

Asset

- Type and size
- Use
- Performance
- Maintenance programs aimed at performance

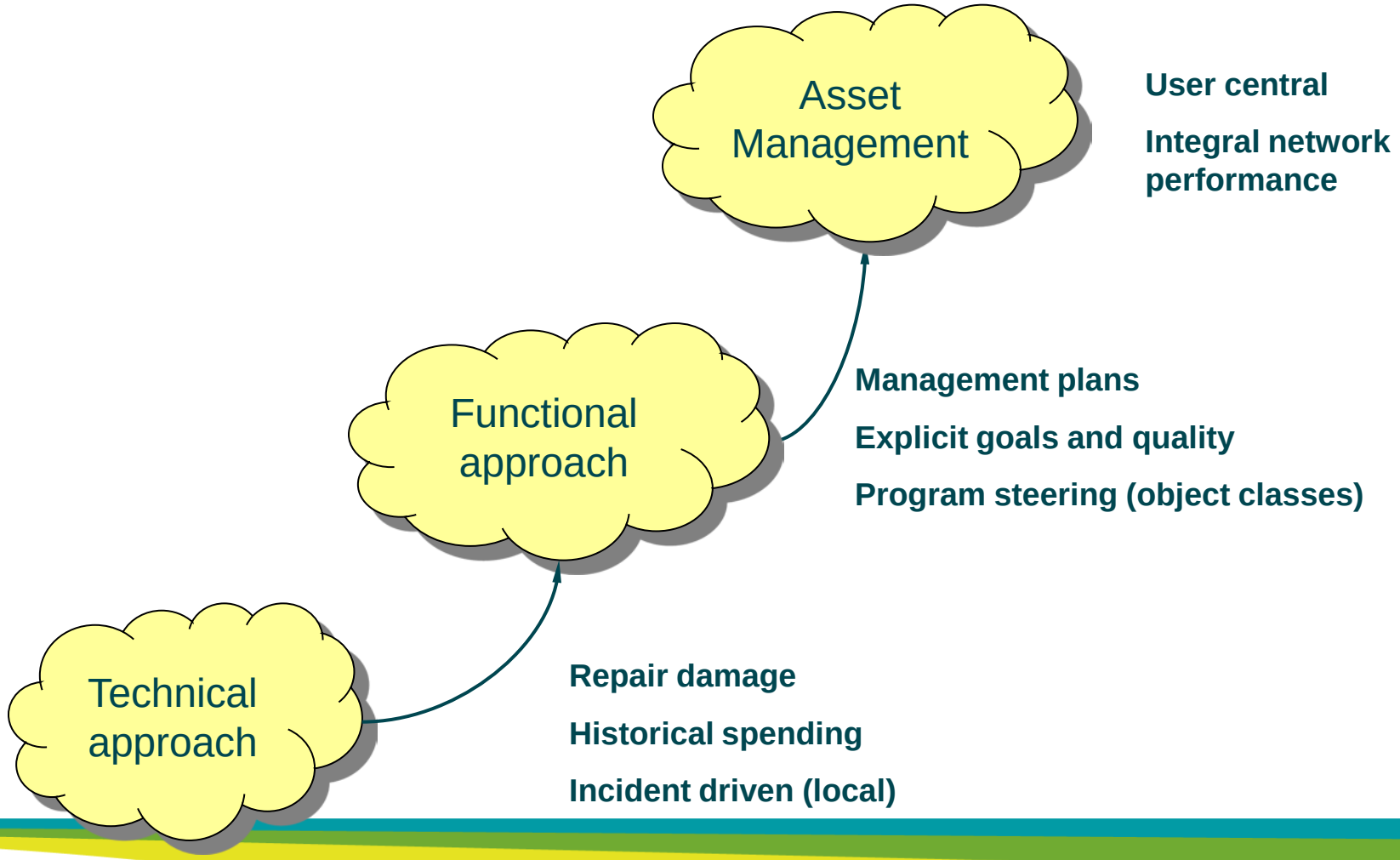
Looking ahead

- Future performance
- Life Cycle cost
- Risk based

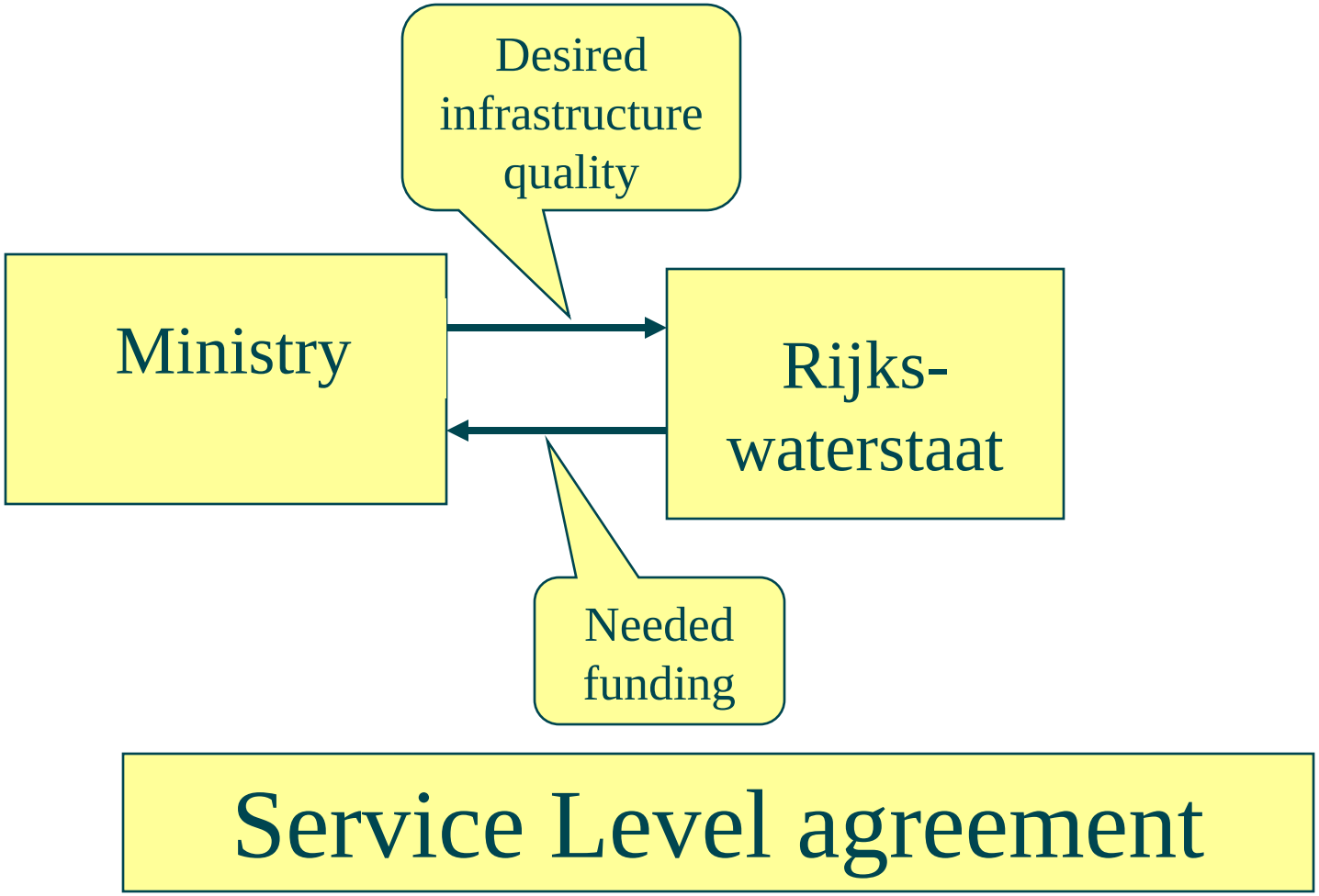
Structures in national networks

Structure type	Quantity	Replacement value [Billion Euro]
Movable bridge	58	
Concete bridge (> 200m)	45	
Concrete bridge (<200 m)	571	
Steel bridge	37	
Underpass	531	
Tunnel	14	
Viaduct in highway	1515	
Viaduct over highway	930	
subtotal highways	3700	12.0
Movable bridge	100	
Concete bridge (> 200m)	15	
Concrete bridge (<200 m)	70	
Steel bridge	79	
Underpass	6	
Subtotal water network	270	1.3
Total	3970	13.3

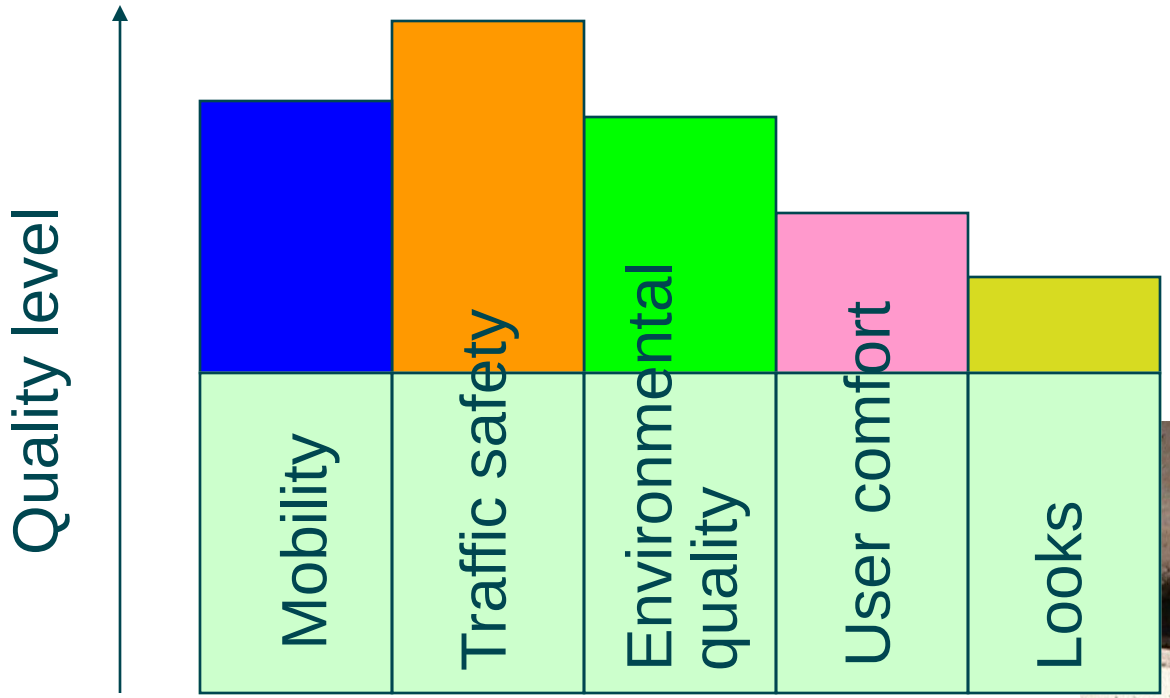
Development in Maintenance



Balance performance - budget



Basic Level of Maintenance



Describe basic level of maintenance
Example:
Intervention level expansion joints

Epoxy beams;

Bonded seal

Damage profile	Intervention level
Defects beam	- No fracture - Crack width max. 0,4 mm.
Joint seal	No leakage

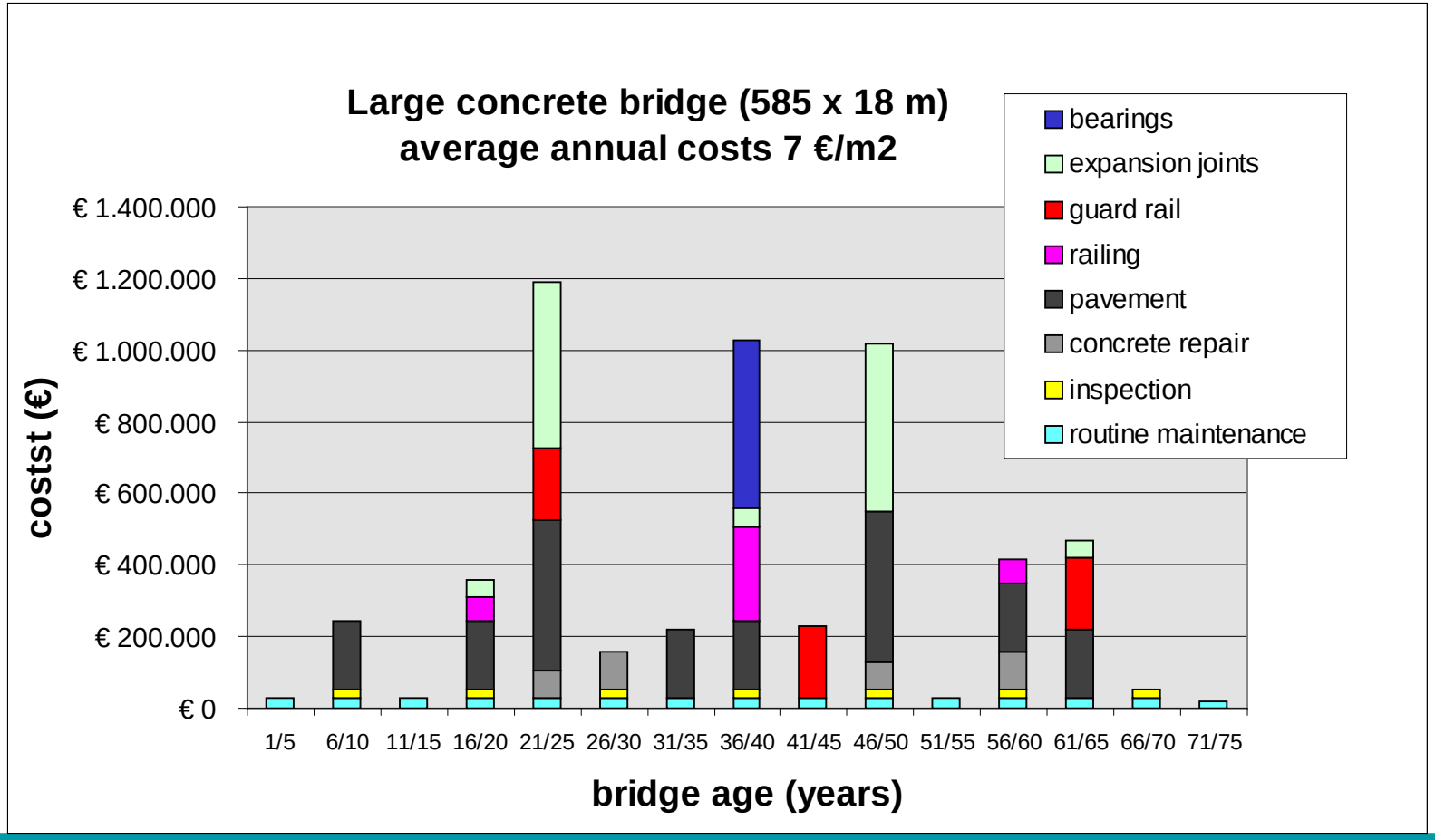
Preservation plans

Decomposition into elements for maintenance measure planning

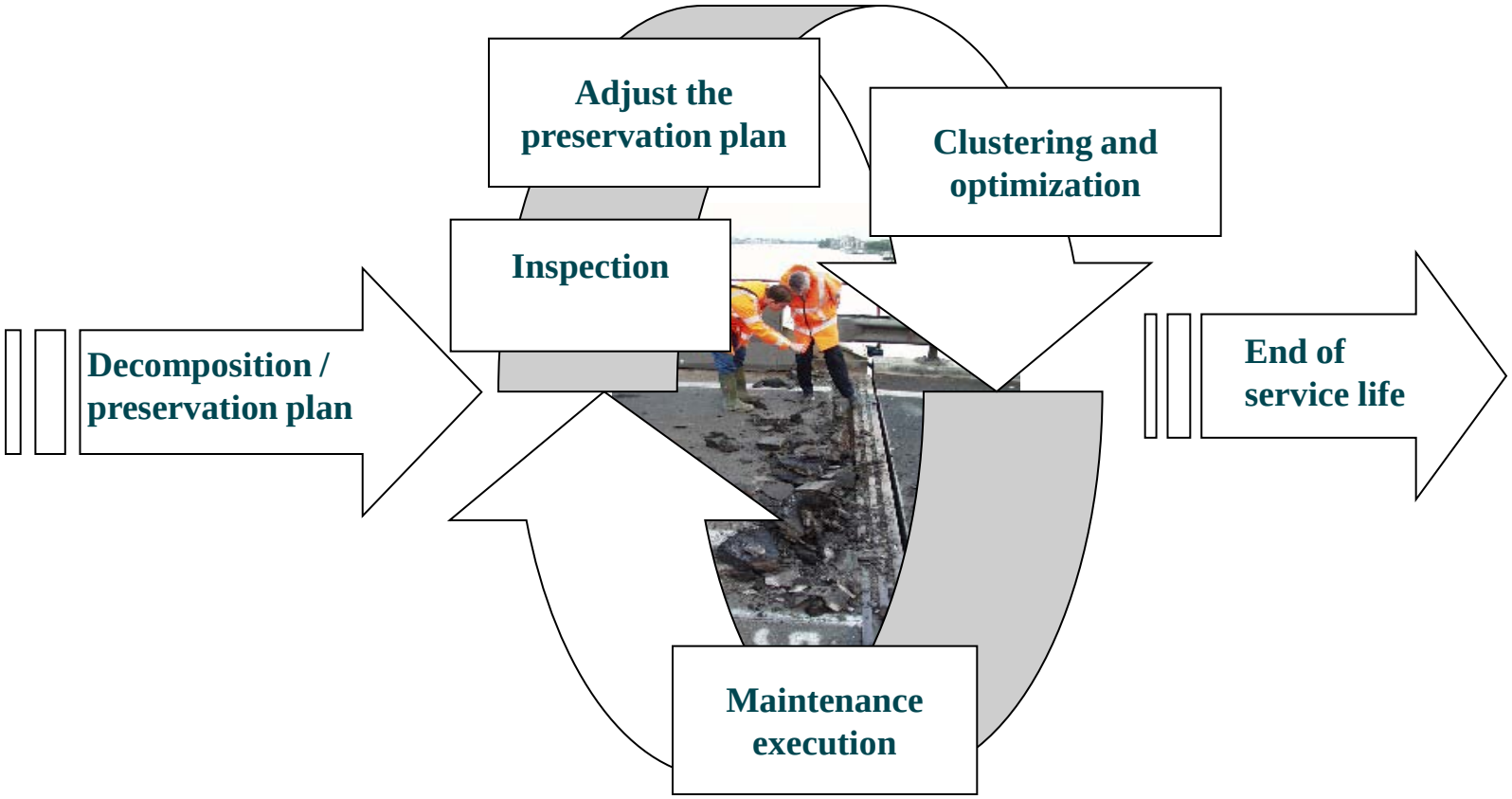
Example decomposition concrete bridge

Main structure
Kerbs
Piers
pavement
Expansion joints
bearings
Guard rail
Railing
Drainage system
abutments

Maintenance costs reference object



Life-cycle based maintenance management



Bridge management system

03G-306-01	Viaduct over de Tilweg (Zijldijk) (IN)	Rijksweg 46 Hectometer 32,9 +06 Bouwjaar 1976 Beheerder Dkr. Groningen	<< Terug	Naar hoofdscherm

IHP-inspectie 2006 6 2012 — Instandhoudingsinspectie 5000 2012

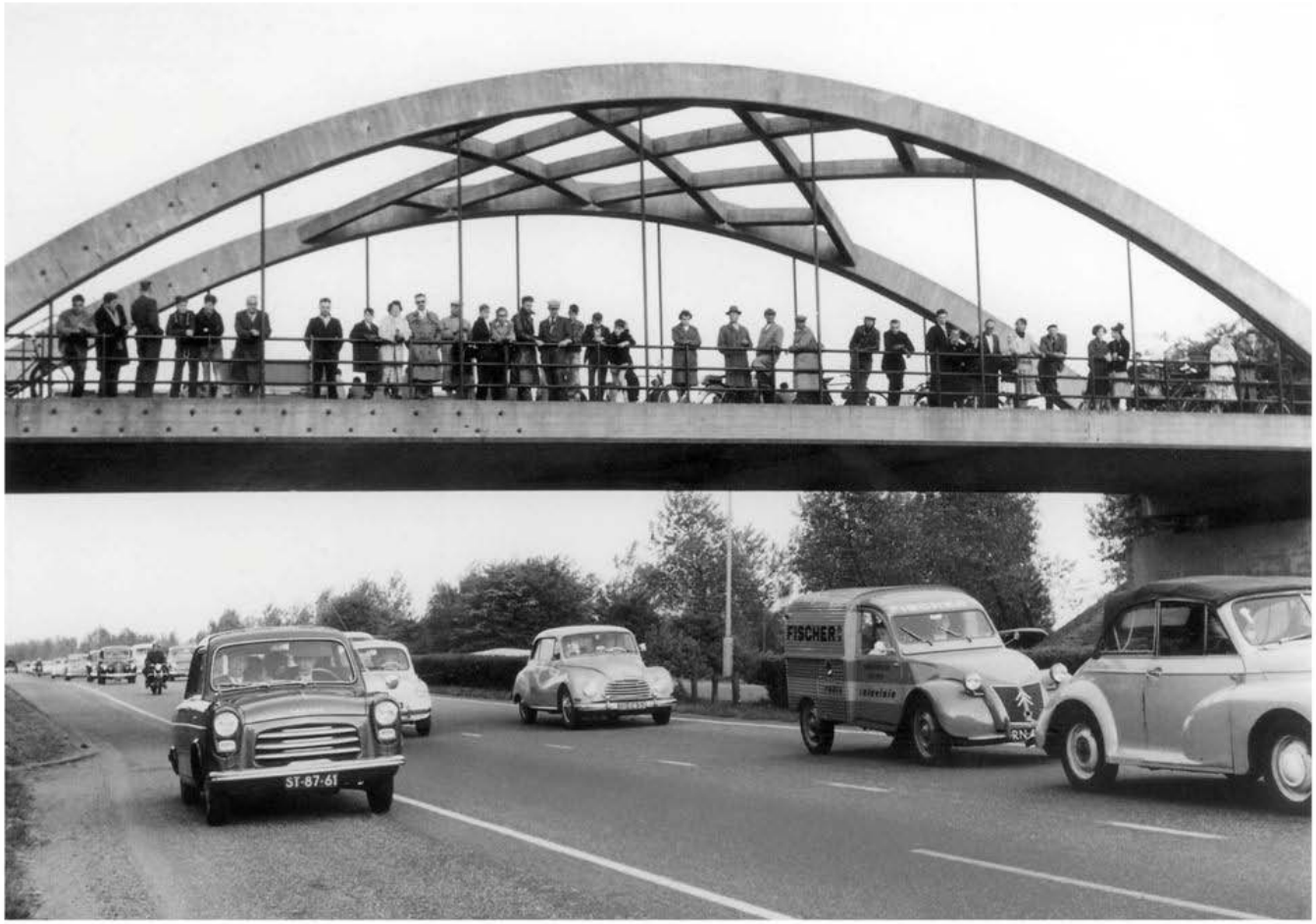
Referentiegegevens — **Advies Rijkswaterstaat Bouwdienst**

IHP-Maatregel	Laatste JvU	Std Int.v	Berek. JvU	Kosten vlgs kengetal (€)	Maatregel informatie / Actie nr. DISK	Adv. JvU	Uiterst JvU	Geraamde Kosten (€)	Planjaar / District	TOTAAL : Kosten per planjaar (K€) 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
													20	111		17				

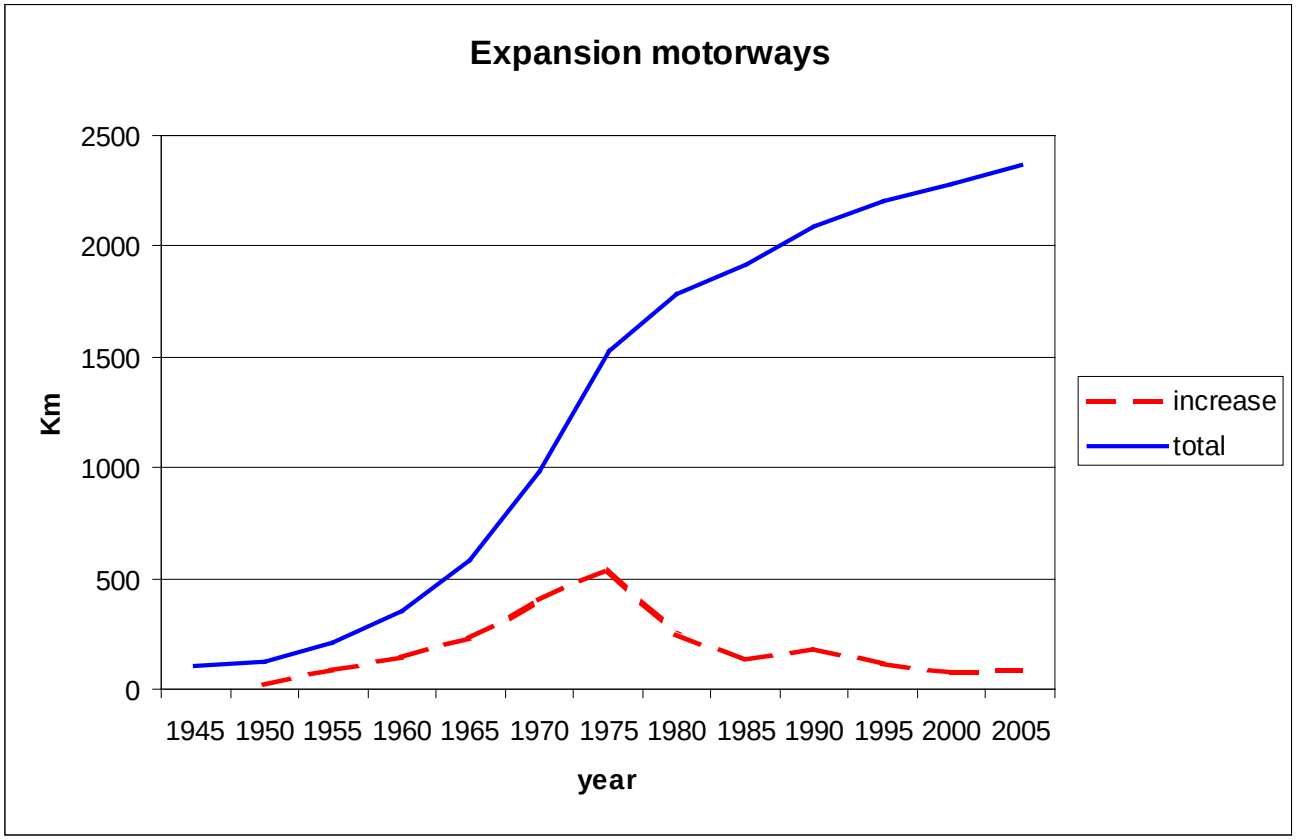
Instandhoudingsonderdelen

geleiderailconstructie																					
Groot Onderhoı	1976	12	1988	€ 2.856	Actie: vervangen stijlen	2009	2012	€ 10.000	2010					10							
Vervangen	1976	25	2001	€ 6.678		2020															
hemelwaterafv.syst.																					
Groot Onderhoı	1976	10	1986	€ 1.200	Actie: aanpassen HWA	2008	2010		2010					1							
Vervangen	1976	50	2026	€ 3.176		2026															
leuning																					
Groot Onderhoı	1976	12	1988	€ 3.132		2020															
Vervangen	1976	62	2038	€ 9.222		2038															
asfaltconstructie																					
Groot Onderhoı	1998	10	2008	€ 480	Actie: vervangen ZOAB t	2009	2010	€ 20.000					20								
Vervangen	1998	20	2018	€ 8.160		2018															
hoofddraagconstructie																					
Groot Onderhoı	1976	30	2006	€ 2.646	Actie: Uitvoeren betonrep	2007	2008	€ 100.000	2010					100							
Vervangen	1976	90	2066	€ 313.404		2066															
oplegging																					
Groot Onderhoı	1976	22	1998	€ 32.664		2020															
Vervangen	1976	45	2021	€ 51.192		2021															
schampkant																					
Groot Onderhoı	1976	12	1988	€ 680		2020															

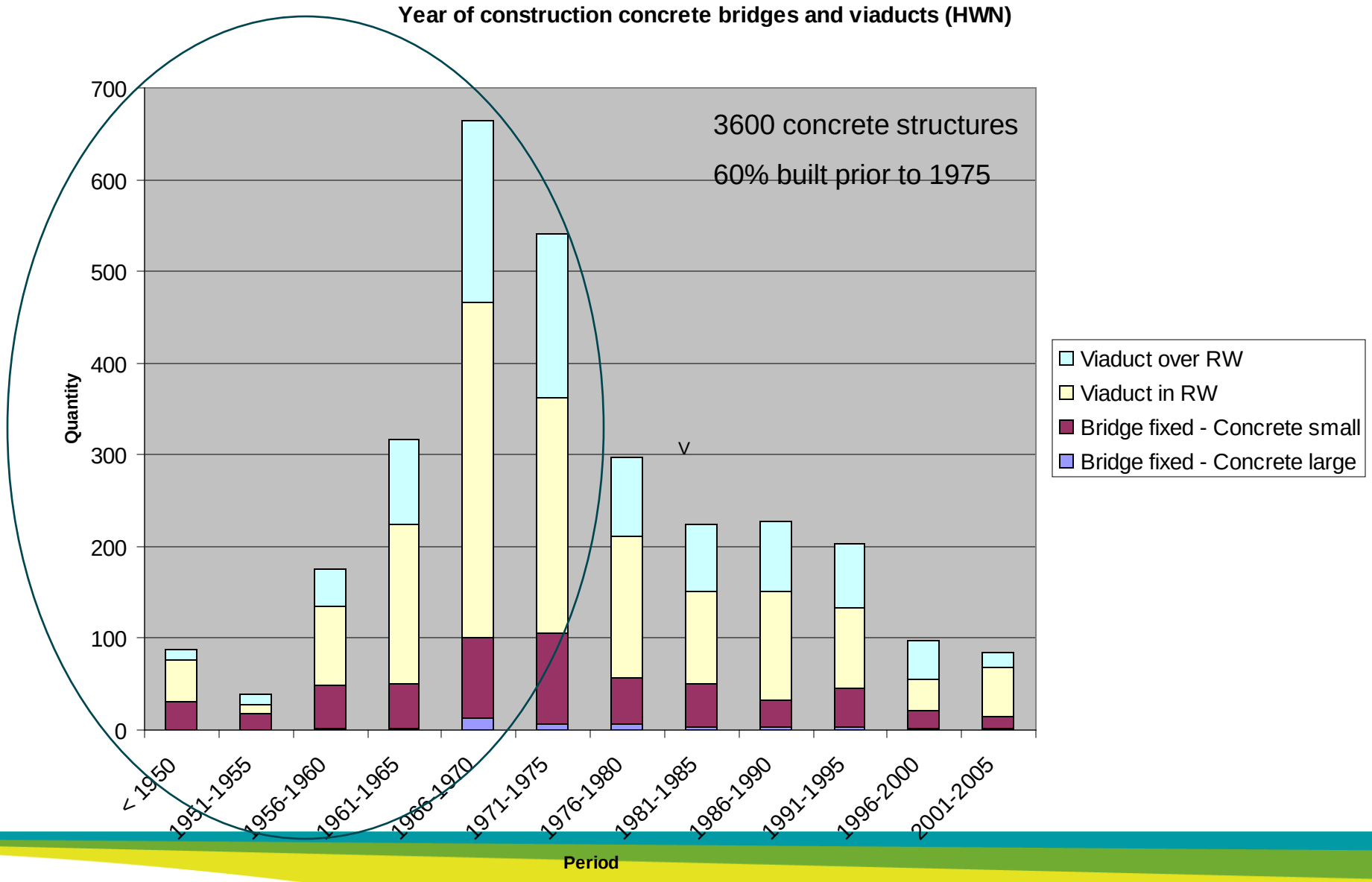
Management of an ageing bridge stock



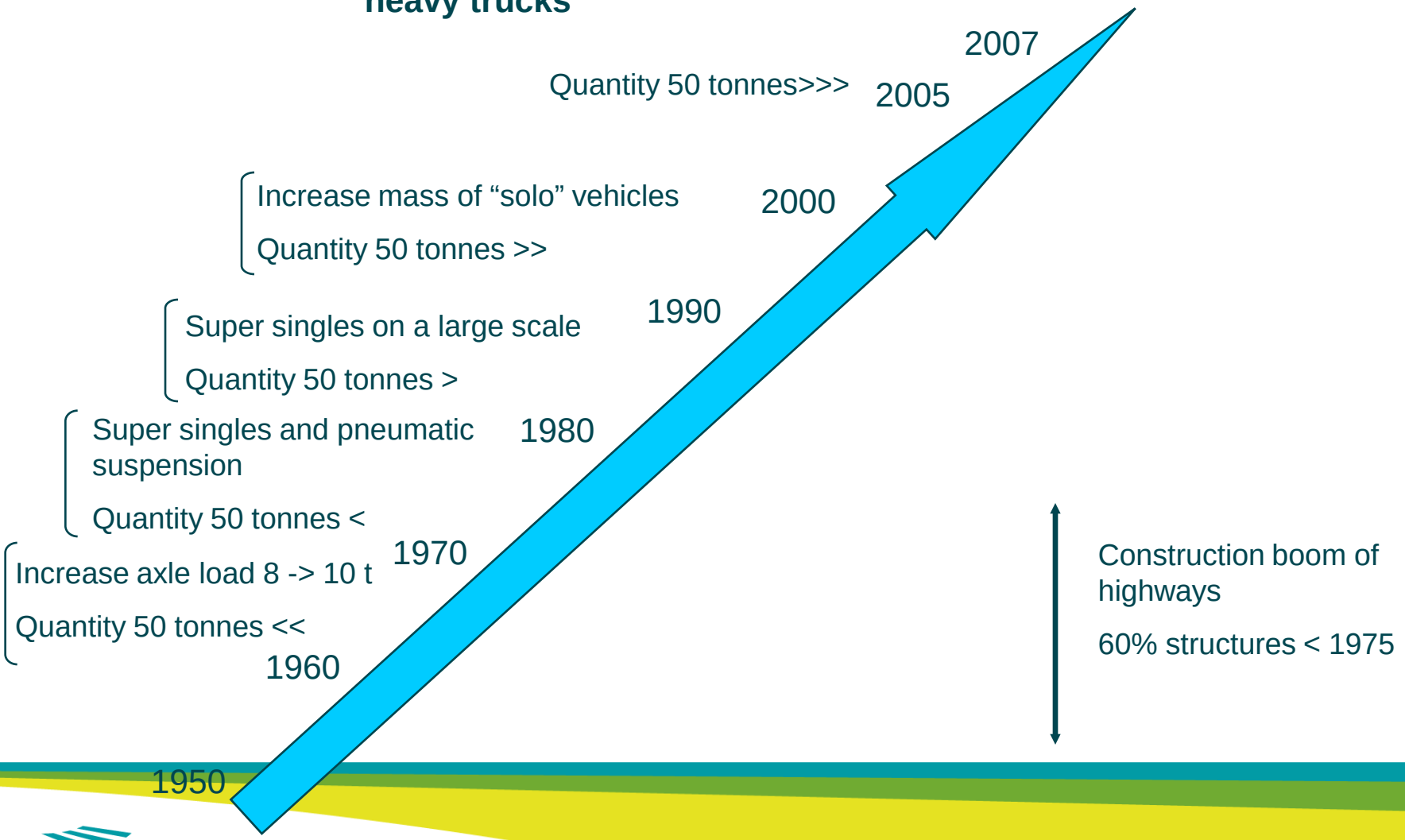
Development motorways



Number of vehicles 0.5 million (1960) -> 7 million (2007)


Year of construction concrete bridges and viaducts (HWN)
3600 concrete structures
60% built prior to 1975
Quantity
700
600
500
400
300
200
100
0
< 1950
1951-1955
1956-1960
1961-1965
1966-1970
1971-1975
1976-1980
1981-1985
1986-1990
1991-1995
1996-2000
2001-2005
Period
Viaduct over RW
Viaduct in RW
Bridge fixed - Concrete small
Bridge fixed - Concrete large

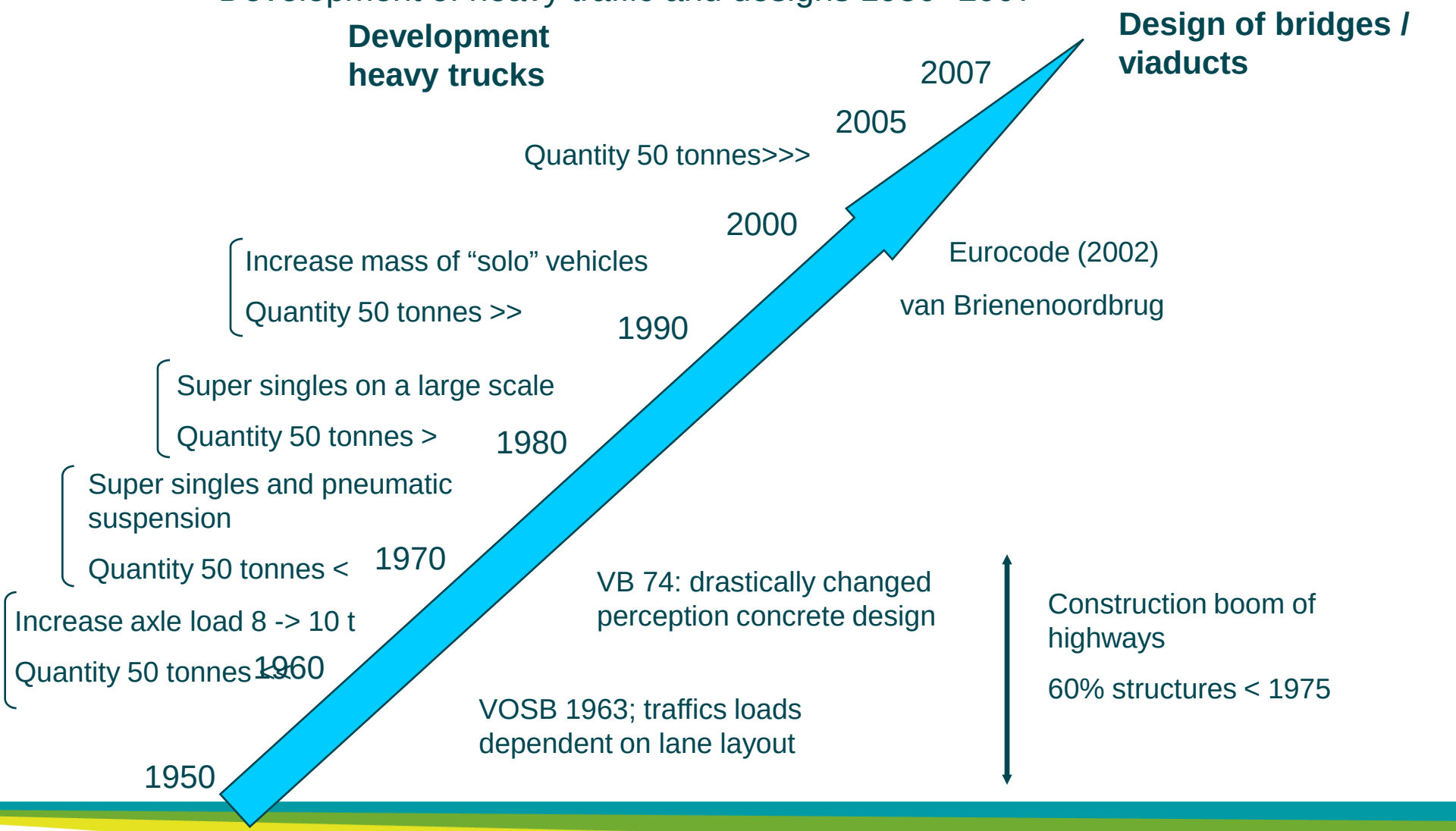
Development of heavy traffic and designs 1950 -2007



Bigger, heavier, larger numbers

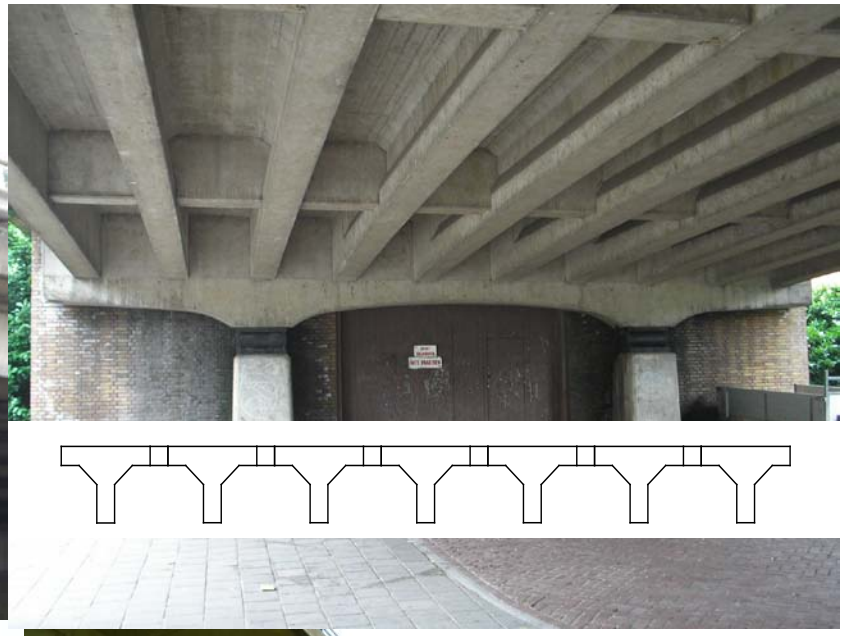
1960 - 2007

Development of heavy traffic and designs 1950 -2007

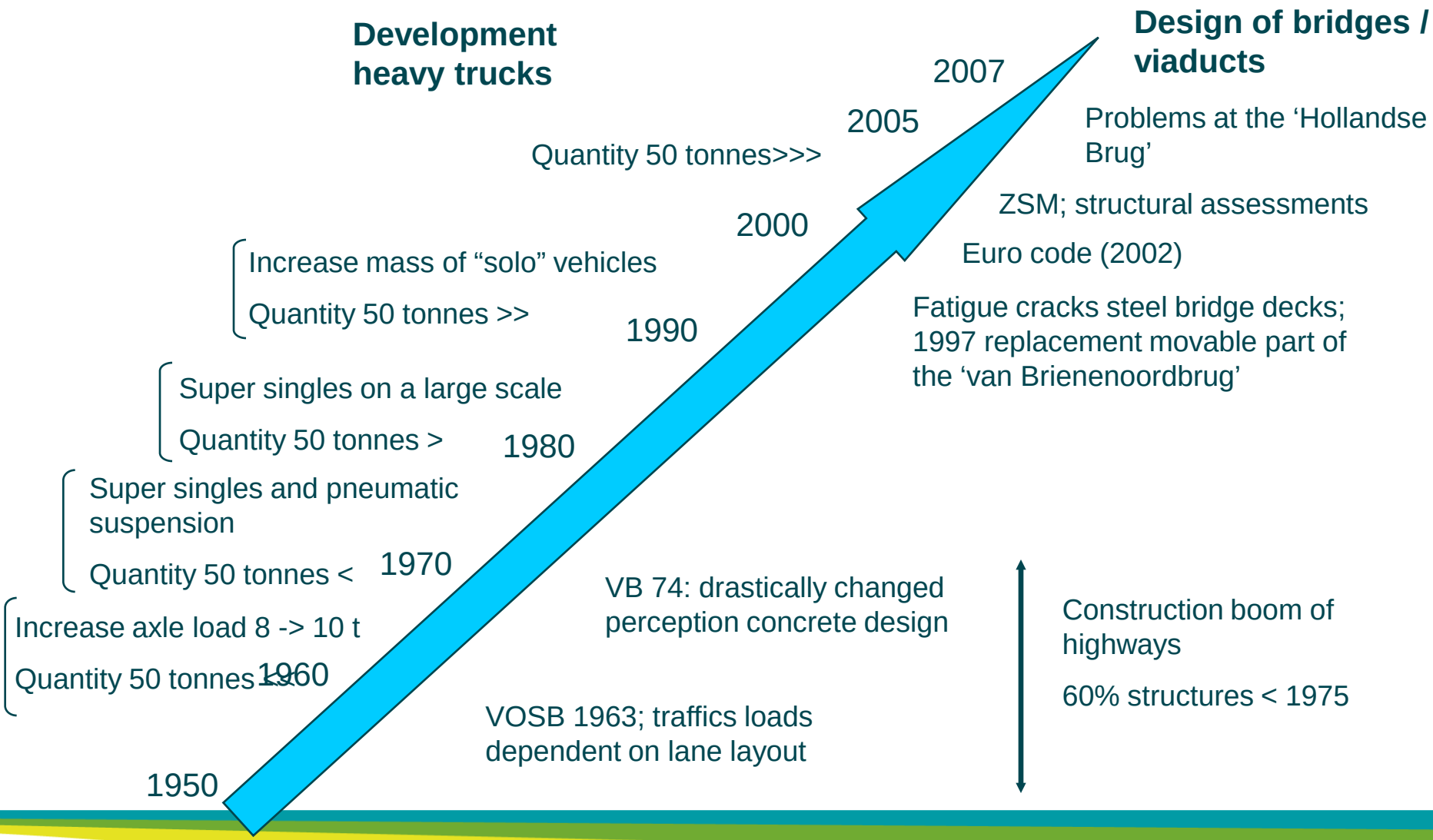


Steel bridges: fatigue cracks in orthotrope decks

Concrete bridges; structural reliability at stake



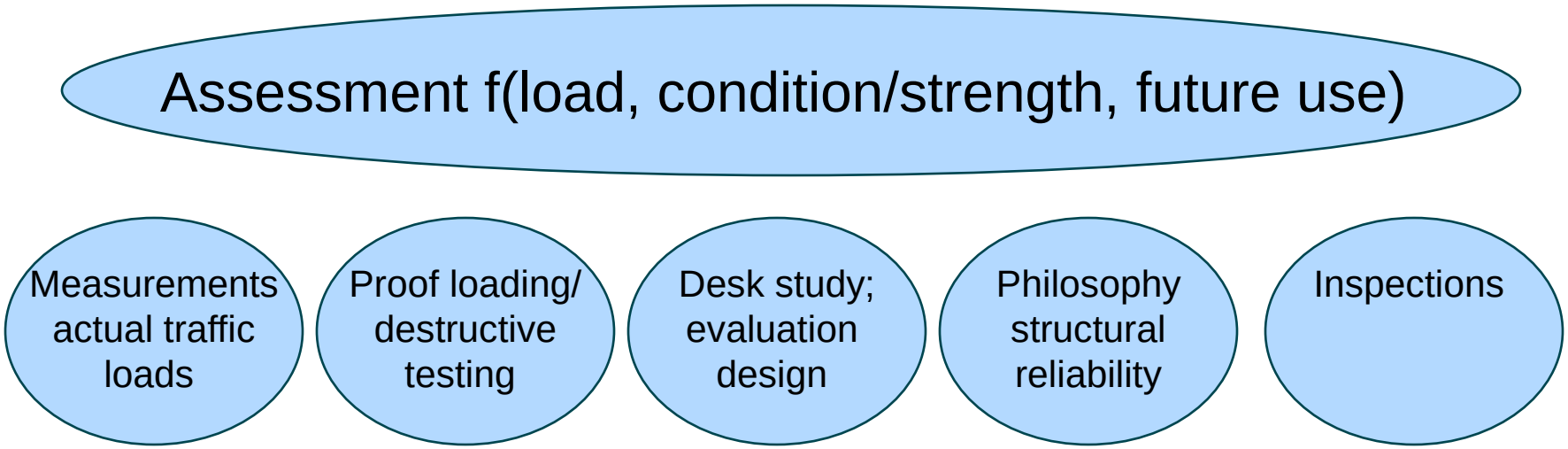
Development of heavy traffic and designs 1950 -2007



Structural reliability at stake

Sense of urgency – Hollandse Brug

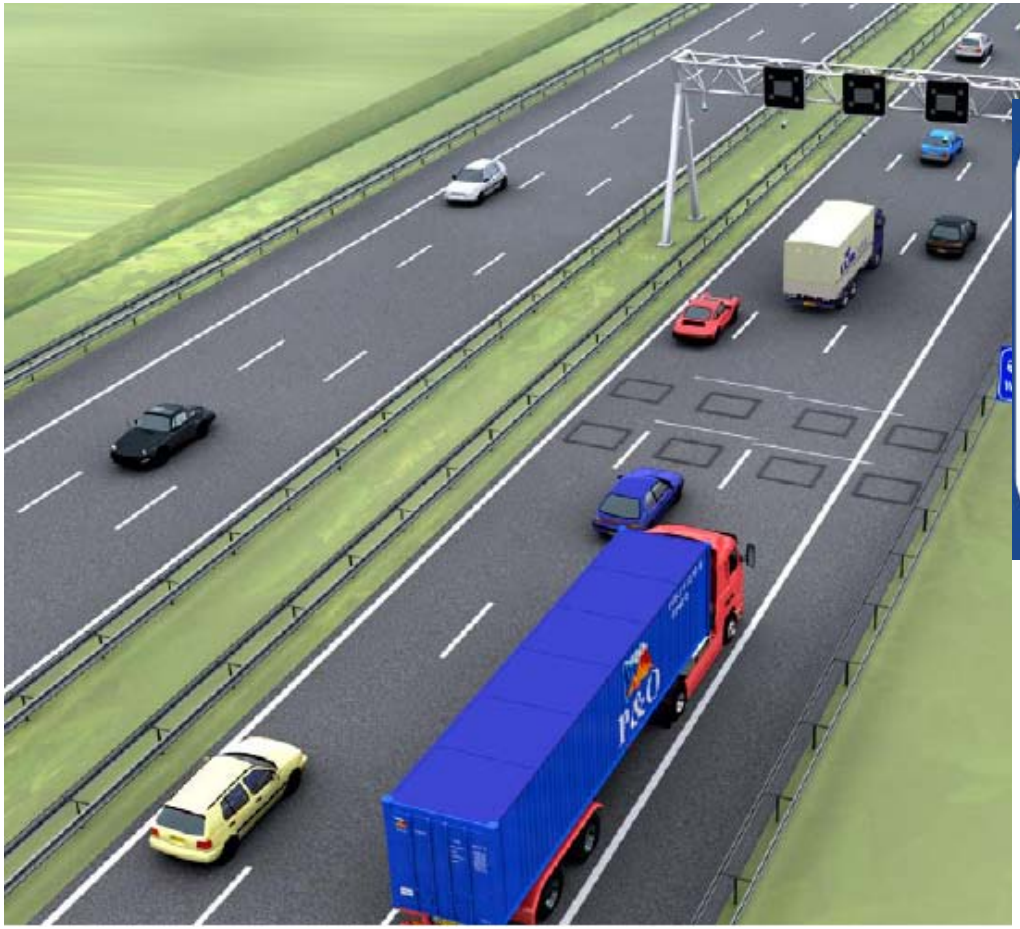
Research Approach



Traffic loads

- Measurement real-life loads
- Prognosis of development
- Analysis of structural effects
- Heavy transports

Use in practice: weight in motion



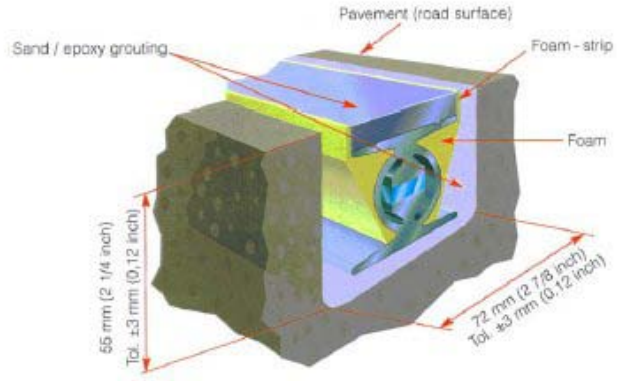
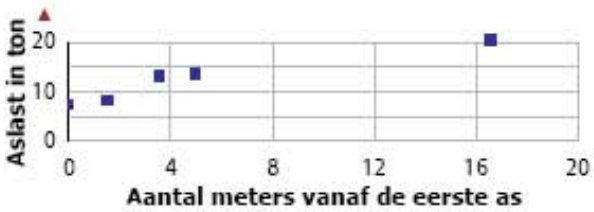


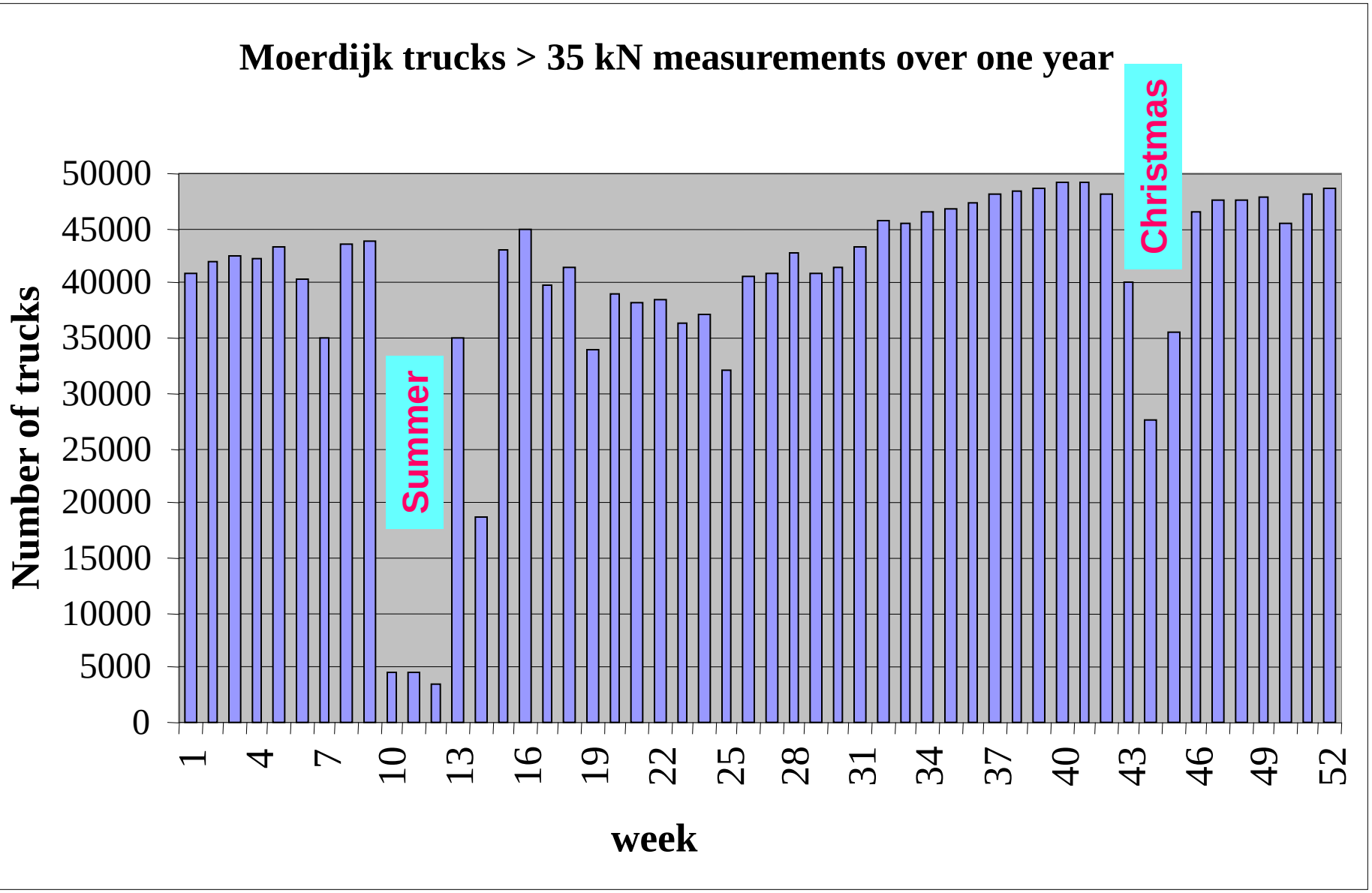
Figure 1, section of Kistler sensor

Example extreme axle load

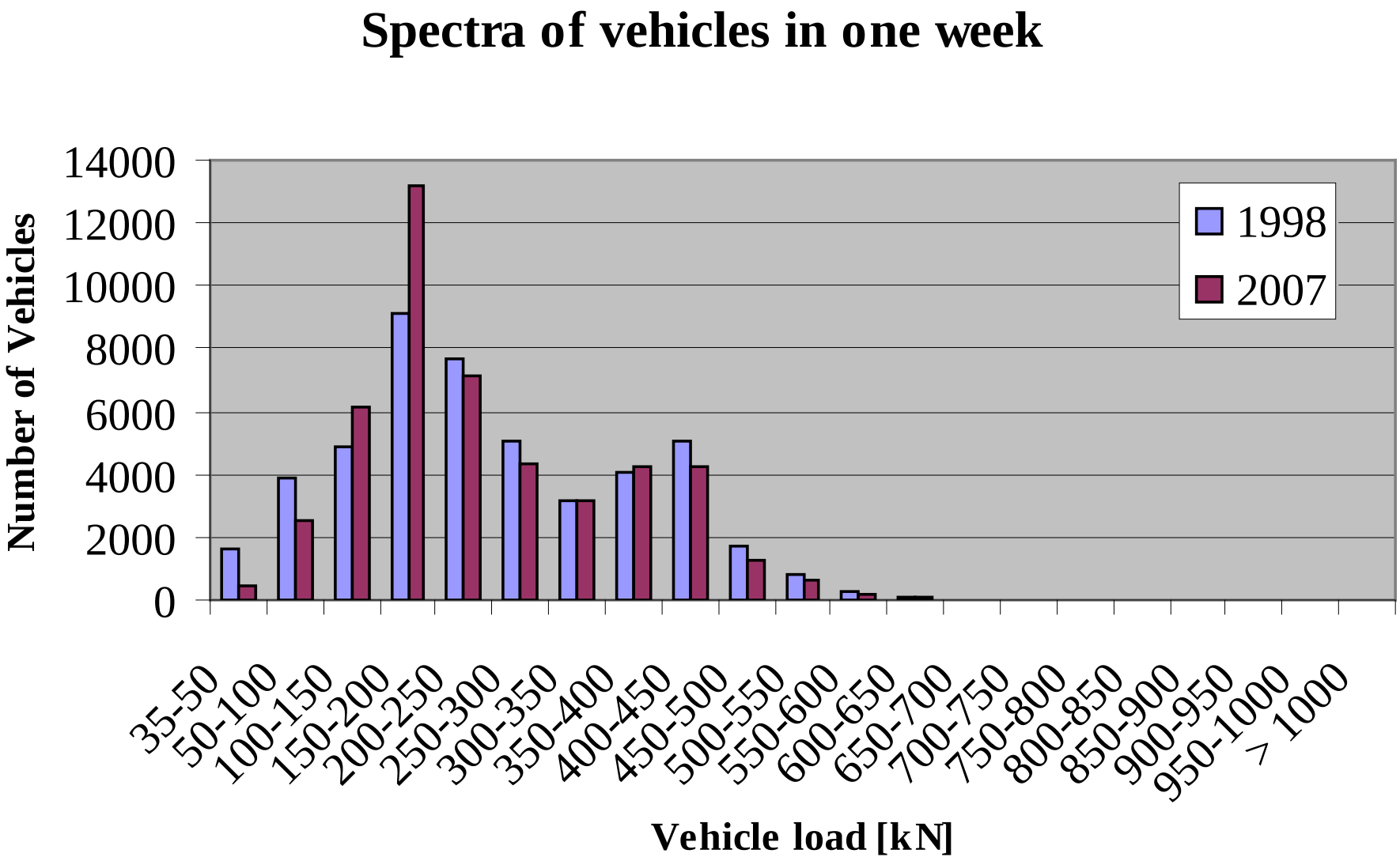
Datum:	7 december 2007
Tijd:	16:03:52
Voertuig nr:	57771400
Rijstrook:	5 R-L
Meetlocatie:	RW 004 1 HR L
Subcategorie:	O222
Snelheid (km/uur):	83

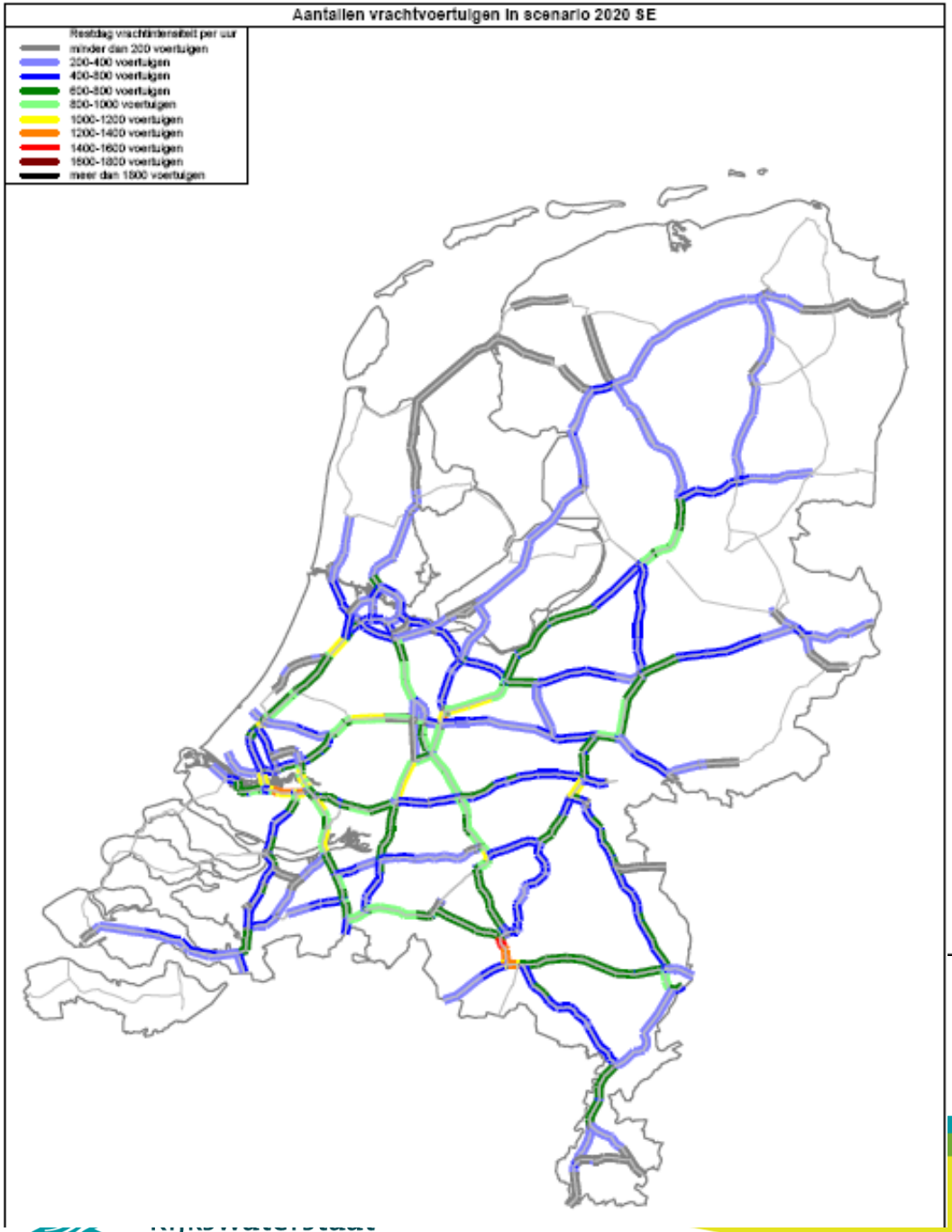


asdruk (ton)			
	dynamisch	statisch	lengte (m)
totaal	102,0	0,0	19,70
	dynamisch	statisch	afstand (m)
as 1	7,4		0,00
as 2	8,3		1,51
as 3	13,3		2,06
as 4	13,6		1,40
as 5	20,5		11,58
as 6	38,9		1,62


Moerdijk trucks > 35 kN measurements over one year
Number of trucks
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Summer
Christmas
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
week

Vehicle spectra





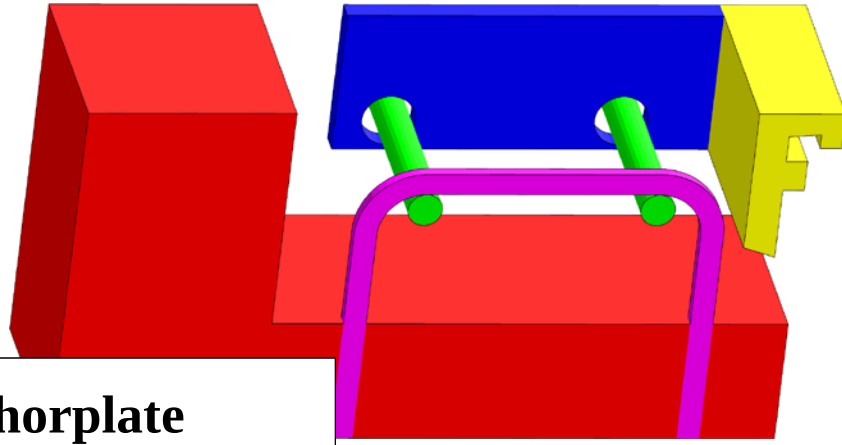
Pronosis 2020

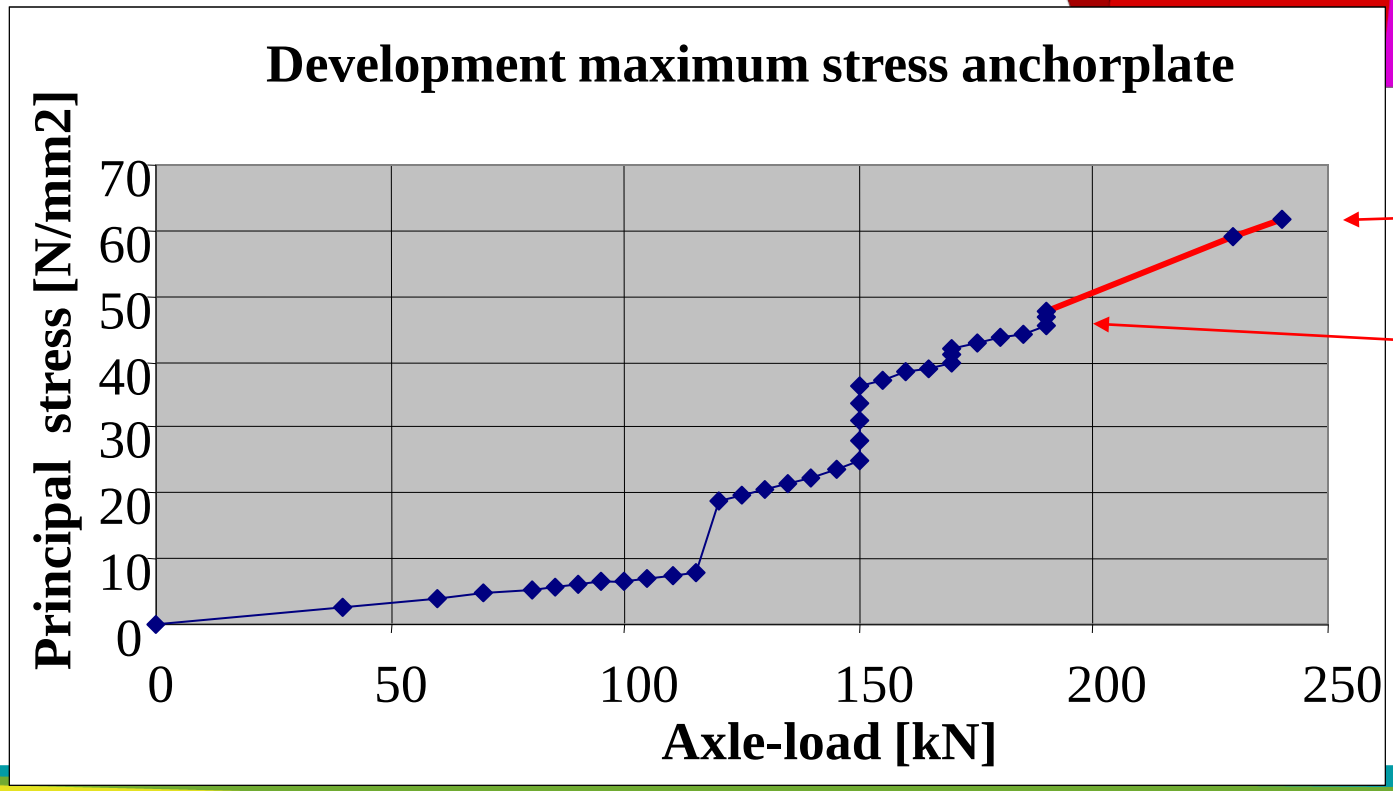
Traffic intensity trucks per hour

- < 200 vehicles
- 200-400 vehicles
- 400-600 vehicles
- 600-800 vehicles
- 800-1000 vehicles
- 1000-1200 vehicles
- 1200-1400 vehicles
- 1400-1600 vehicles
- 1600-1800 vehicles
- > 1800 vehicles

Structural details: Expansion joint

Extra damage expansion joint;
Old recommendation:
Max. axle load was **190** kN
New measurements:
Max. axle load becomes **240** kN





New situation:
Sxx=60,5 N/mm^2
means:
2 million cycles

Old situation:
Sxx=47,8 N/mm^2
means:
20 million cycles

Risk based inspections

- Inspection focused at timely identification of current and future RAMS-risks:
  - Reliability
  - Availability
  - Maintainability
  - Safety
- Aimed at construction specific or material specific risks
- Aimed at use-specific risks
- Aimed at function specific risks

Example risk based inspection

Large scale concrete damage at abutments:
Condition based: Bad condition;
Risk based: low risk

Bad detail in the main span with no (visual) damage:
Condition based: good condition
Risk based: high risk

Critical bridges come up

Thank you for your kind attention