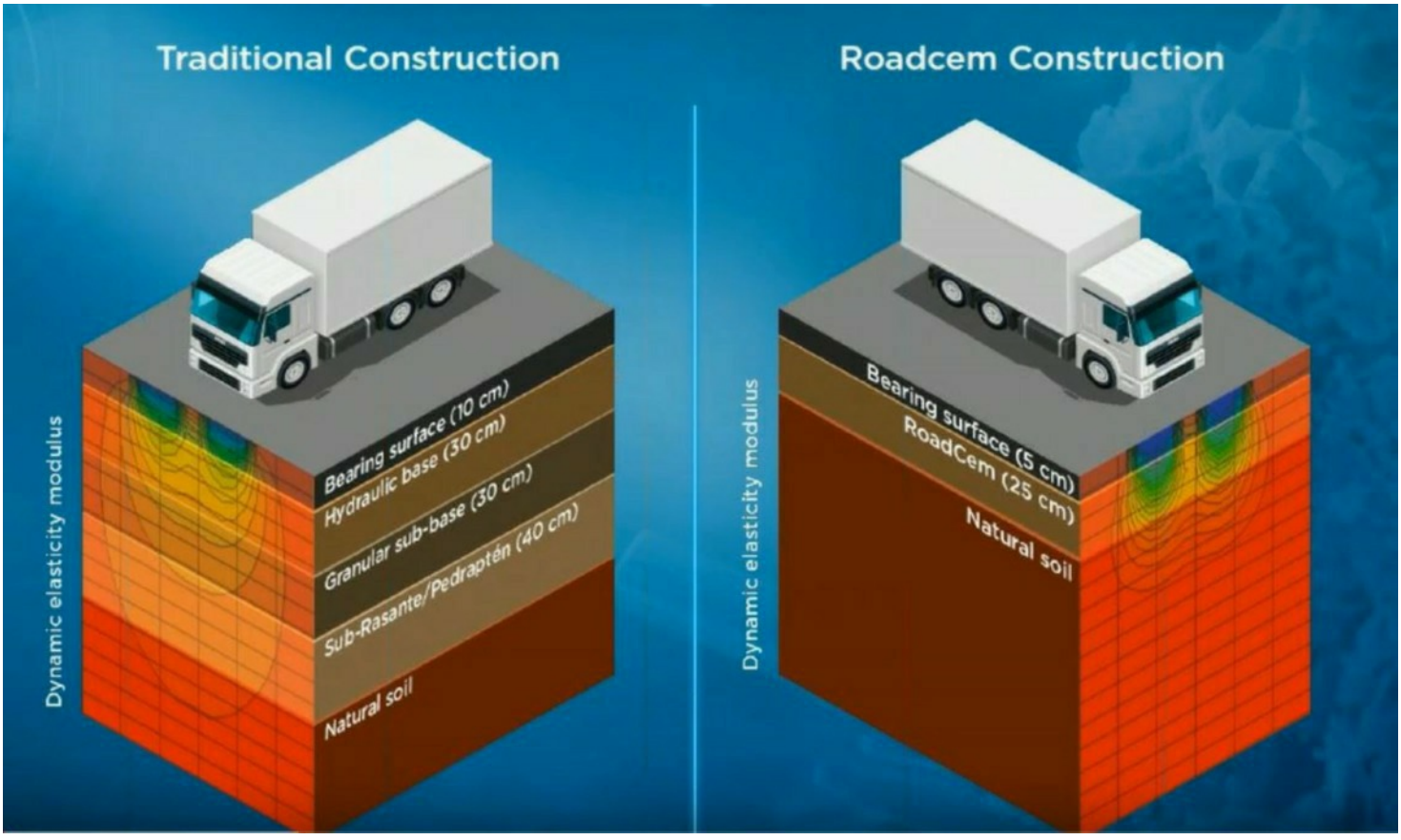
Highway SP-333 in Brazil Constructed using RoadCem Zeolite Soil Base, using just the in-situ site soils……..

Design and Testing by ARCADIS BV
Traditional Construction Life Span 10.3 years
RoadCem Construction Life Span 30 + years





CONCLUSION (full report available on our website)

Hereby, we provide our conclusion which is based on the results of the research conducted, historical input, and our interpretations of all the information disclosed in the Dynatest report. In the conclusion, a comparison is presented between the functional lifetime, leading towards reduced maintenance, lower costs, and longer structural lifetime.

1. The functional lifetime of a RoadCem stabilization is longer than a traditional asphalt construction, in cases where the asphalt thickness (8 cm in two layers) is the same. In the traditional construction, rutting occurred at an earlier stage than with the RoadCem stabilization. The test results demonstrated a rutting value higher than 7 mm over all the measurement points once the traditional construction reached over 171.999 axle load repetitions of 160 kN while in the RoadCem construction, it only reached over 200.692 axle load repetitions of 160 kN.

Construction	Stiffness asphalt prior to load	Stiffness asphalt after 10 year	Reduction	Stiffness foundation prior to load	Stiffness foundation after 10 year	Reduction
Traditional	11000 N/mm^2	3000 N/mm^2	-72,72%	3500 N/mm^2	525 N/mm^2	-85%
RoadCem	11000 N/mm^2	3000 N/mm^2	-72,72%	26000 N/mm^2	26000 N/mm^2	0%

Table 21 Reduction structural performance of the materials

On the RoadCem pavement, the difference is relatively smaller before and after the load, at some point there is not even A measurable increased deflection after loading (position=1 m), what seems to be the perpetual pavement behaviour.

Based on the calculated elastic modulus after 10 years, a full BISAR calculation was made to evaluate the ongoing structural lifetime of the pavement.

Construction	Strain value	Fatigue formula	Rest lifetime
Traditional	133 □m/m	$N_{eff} = \exp^{(0,33796*(\ln(E))\text{^}2-7,3642*\ln(E)+77,142-5,2438*\ln(□))}$	0,3 years
RoadCem	14 □m/m	$N_{eff} = 10^{(22,9-8,561*\log(□))}$	> 20 years

Table 22 Indicative lifetime

RoadCem construction has a longer lifetime due to a large safety factor held in the design methodology, since in-situ materials are stabilized as shown in test procedures.

Overall performance and maintenance

Based on the tests performed with a load of 160 kN, the scattering in data of deformation in the asphalt is very diverse, and therefore not possible to determine the intervention moments. However, the intervention moments will be reduced by using RoadCem due to the effect of the stronger support on the asphalt applied on top of the base. Also, the results show that maintenance will be reduced when using RoadCem.

Based on the deflection tests, prior and after loads, an indicative estimation was calculated on the structural lifetime. By using RoadCem it is clear that the structural performance after 10 years will be extended for an additional 20-year lifetime when loads of 80 kN are applied. In comparison, the traditional construction needs to be fully reconstructed, resulting in higher costs once it reaches the 10 year lifetime.

Dutch project inspections

Projects constructed in the Netherlands were also visited and inspected prior to issue this report.
Such projects show no deformation occurred in the asphalt after 5 years over the RoadCem base. In the Netherlands, the allowed axle load is 100 kN, which we believe to be more than the limit axle load allowed in Brazil. Also, the long structural lifetime performance of stabilized material can be expected, especially in case low strains are occurring in the material.

RESEARCH METHODS

Simulation

DYNATEST used a Heavy Vehicle Simulator (Figure 5), to simulate the test of the construction during the functional and structural lifetime of 10 years. With this test a wheel load of 2*80 kN is driving over the pavement on a conditioned (temperature, moist) test track, in the asphalt the temperature is conditioned. In the DYNATEST report [2] this data is described for deformations and deflections.

Figure 5 Heavy Vehicle Simulator

3.2 Structural lifetime

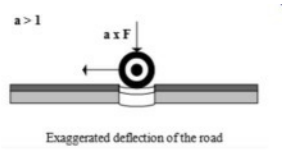
To observe the structural lifetime, tests were done prior to any load was applied on the pavement and at the end of the simulation. Based on deflection measurements the reduction in strength can be measured. In the beginning the deflection will be low, in time the deflection will increase due to the loss of strength of the materials after a certain amount of loads.

3.2.1 Deflection

Several tests where done to evaluate the pavement constructions. For the structural performance, tests with the Benkelman beam where done as well as Falling Weight Deflection (further FWD) tests..

Why does RoadCem create such an improvement in deflection results? When you take a look at a RoadCem stabilised soil road base design, The first most obvious thing is, that the base needed is just the single layer RoadCem base, which can be constructed in-situ from the existing soils. That means that time, money and any need for imported virgin materials will be saved in construction.

The use of RoadCem raises the modulus of elasticity and the flexibility (tensile) strength of the base, so that the following occurs. Let us look at our segment, which is loaded by force “F”. The factor “a” means, that because of the higher modulus of elasticity, a higher load is now needed to cause the same amount of deflection.



After the load has passed the segment, no deformation will remain, because of the high flexibility of the RoadCem base. This is essential because the segment will be loaded again and again during normal use of the road. Therefore RoadCem stabilised materials are able to stand this alternating stress for longer periods.

On the RoadCem pavement, the difference is far smaller before and after the load, at some point there is not even a measurable increased deflection after loading, in what seems to be the perpetual pavement behaviour.