EUPAVE
EUROPEAN CONCRETE PAVING ASSOCIATION

FACT SHEET

Long Service-Life
Low Life-Cycle Impact and Cost
Low Maintenance, less Disruption

Concrete roads are made with local raw materials, offer a long service life and are 100% recyclable

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Roads are essential for the transportation of goods and people and thus play an important role in a country's economic and social development.

Therefore, we need roads that allow a smooth traffic flow through a high level of availability. This in turn means that the number of construction sites for repairs, maintenance or reconstruction must be limited.

The choice of concrete pavements in road construction offers the advantages of "load-bearing capacity plus durability" both for pavements in a national or trunk road network and for local roads in a municipal road network. These advantages will become even more important on motorways given that an increase in traffic volumes is still predicted on these networks and guaranteed mobility and trouble-free freight traffic are necessary in an international and local economy.

Lifetimes of 30 to 40 years or more without structural damage are easily achieved with concrete pavements. Thanks to a long service life and low maintenance costs, the total life-cycle cost of concrete roads is low. The minimal number of road closures required for maintenance work entails less traffic disruption and thus offers significant ecological and economic benefits. A long, low-maintenance service life also means that the time until building materials are needed for new construction is extended. After demolition, the concrete is crushed and sieved and will be used again as recycled concrete aggregate in the construction of the new road, either in the sub-base or base layer, or to replace virgin aggregate in a new concrete mix. A long service life and recycling are both applications of circular construction; they conserve natural resources and reduce unavoidable emissions in producing building materials. Finally, thanks to modern construction techniques, concrete pavements allow a significant reduction in rolling noise emissions, rolling resistance and fuel consumption. In addition, they ensure a slip-free, non-deformable and bright surface, which is therefore safe for driving.

SOME MORE INFORMATION

ROAD AVAILABILITY

The term sustainability includes many different aspects, the significance of which varies with the circumstances. We expect roads to be as safe and comfortable as possible and ideally, free of congestion, allowing the movement of persons and goods at all times.
Traffic jams caused by road works or repairs have a negative impact on sustainability due to:

- traffic diversions, supported by current navigation technology, which often result in excessive traffic along alternative routes and consequently a structural overload on these routes;
- loss of valuable living, working and delivery time;
- excess fuel consumption and additional CO_2 emissions when stationary, in traffic jams and on detours;
- an increased number of accidents on construction sites and in the bypass area.

A sustainable traffic route should therefore be a free-flowing traffic route; a sustainable pavement should be durable and low maintenance.

LONG-LIFE PAVEMENTS AND THE RELATIONSHIP WITH SUSTAINABILITY

Service life is the period from construction until the end of a road's use. In technical terms, it is also referred to as the durability of a construction. To keep a road pavement in service, the two main construction methods, concrete and asphalt, require different maintenance efforts. During the design service life of concrete pavements – mostly 30 years – they require almost no scheduled maintenance, except for renewal of the joint sealing. (Other maintenance and preservation techniques are detailed further in the section on "Concrete pavement preservation"). In addition, in practice concrete pavements are usually used much longer, sometimes for more than 50 years for motorways and even reaching 100 years for low traffic volume roads. Thanks to the dimensioning methods and innovative materials and construction techniques available today, it is possible to create adapted designs to ensure lifetimes of up to 50 years or more. This is the special potential of the concrete construction method, which has not yet been fully implemented in the current road design rules.

The longevity of concrete pavements is beneficial when full life cycle analyses are made. This applies to both economic analysis (LCCA) and environmental impact studies (LCA). Such a holistic approach is the correct way to compare different alternatives (choice of pavement or renovation method, etc.) based on a long-term vision.

With comparable initial costs for roads in asphalt and concrete, but significantly lower maintenance costs for concrete, the whole life cost is always in favour of concrete.

In the concept of a "circular economy", longevity also plays a crucial role. Indeed, prevention is the preferred option in the waste hierarchy.

Prolonging the lifespan of a roadway by making the right design choices will be more resource efficient compared to frequent maintenance and rehabilitation or reconstruction.

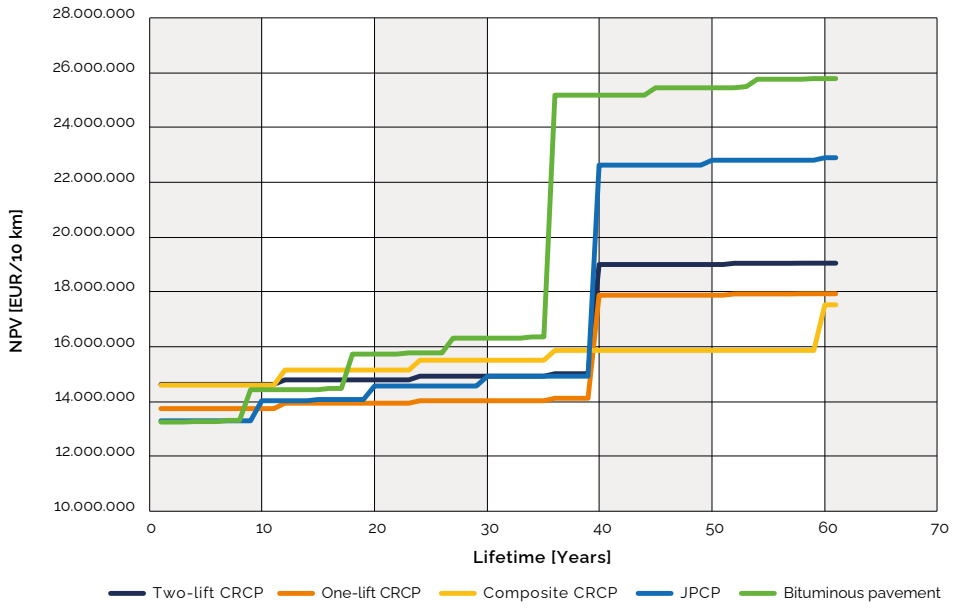
PPP (PUBLIC-PRIVATE PARTNERSHIP) PROJECTS

To illustrate this aspect of motorway construction, it is worth taking a look at some privately built highway sections in Germany from the last 15 years. Indeed, the basic contractual aspects of such projects, combining construction and operation, establish the most important economic sustainability criteria quite accurately:

- due to the contractual combination of construction and (30+ year) operation, the usual contractual warranty clause of two to five years is changed into direct responsibility for the quality for the entire duration of the operating contract.
- due to high contractual penalties for shutdown periods, the operator has a strong economic self-interest in ensuring maximum availability of the routes at all times.

Belgian motorway E40/A3, built as a 20 cm thick continuously reinforced concrete pavement: in service for 50 years

In addition, all motorway sections, built as PPP projects are provided within a shorter construction period and are built to a high standard of quality. The latter aspect is of particular economic importance, because at the end of the contractual operating time of mostly 30 years, these roads are not at the end of their service life but are still available to the public sector in a contractually-defined, good condition for use. The motorway can therefore be used immediately and without restrictions and have a high residual usage potential.



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Comparison of the life-cycle cost (construction – maintenance – reconstruction) over an analysis period of 60 years for different motorway structures in concrete and asphalt.

CRCP = Continuously Reinforecd Concrete Pavement

JPCP = Jointed Plain Concrete Pavement

Urban road 50+ years old and still in good, serviceable condition

Due to these contractual requirements, almost all construction and operator consortia and the financiers behind them have chosen concrete pavements, as this meets the contractual requirements with a secure, long-term prognosis.

CONCRETE ROADS ALLOW EFFICIENT ASSET MANAGEMENT

Road investments are expensive, impacting public budgets and debts, and therefore need a long-term perspective. Concrete is a very predictable building material. If concrete road pavements are correctly designed, they are able to withstand traffic loads without changing their structural properties. The main criterion for adequate dimensioning is the thickness of the pavement: the thicker it is, the longer the design service life of the structure. For instance, an increase in slab thickness of only 2 cm provided for in the current design rules means an extension of the calculated predicted service life by 10 to 15 years.

Concrete construction offers the possibility of long-term technical and economical network management. With appropriate road monitoring, it is possible to forecast very precisely and plan in advance which sections need to be renewed at what time. Since concrete structures degrade very slowly, the time windows for renewal are relatively large, at 5 to 10 years. With appropriate knowledge of the structural capacity, the maintenance of a network can be planned over the long term and also offers time reserves. This allows farsighted determination of demand and planning of the use of financial resources. An intelligent rehabilitation management also takes into account maintaining sufficient network availability in the event of construction activity.

CONCRETE PAVEMENT PRESERVATION (CPP)

The FHWA (U.S. Federal Highway Administration) report "Strategies for Concrete Pavement Preservation" (Van Dam et al.) introduces a new and broader definition of CPP: "*a strategy of extending concrete pavement service life as long as possible by arresting, greatly diminishing or avoiding the pavement deterioration process*".

There are three ways to achieve this strategy:

1. **Designing and constructing durable long-life concrete pavements.** This means they are structurally adequate and relatively distress-free throughout a long service life. Key factors for this are structural design, durable materials, and appropriate construction techniques.

2. **Overlays (asphalt or concrete) as a preservation treatment.** In this case, the existing road structure serves as a base for the new pavement, which allows a reduction in the need for new materials, their transportation, associated emissions and construction time and cost. Materials savings come from reduced design thickness and the absence of a new base layer. Concrete overlays over existing concrete roads, with an interlayer of geotextile or asphalt, have proven to be very durable and cost-effective solutions. On existing CRCP (continuously reinforced concrete pavement), an asphalt wearing course is also an option. Although it needs periodical replacement, it provides a comfortable surface while the underlying concrete keeps on fulfilling the structural function.

3. **Maintaining the serviceability of the existing concrete pavement using CPR (restoration) treatments.** Preventive maintenance and minor rehabilitation activities consist mainly of joint renewal and partial and full-depth repairs. However, several other techniques are available to repair structural or surface distresses. For example, dowel bar retrofit (DBR) is the placement of dowels across joints or cracks in an existing concrete pavement to restore

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Grinding machine in operation and a finished very low-noise "Next Generation Concrete Surface"

load transfer and solve the problem of moving transverse joints and associated noise and vibrations. And old noisy and bumpy surfaces can be turned into silent, smooth roads thanks to grinding and grooving, the so-called 'Next Generation Concrete Surface'.

It is clear that CPP is perfectly in line with the concept of long-life concrete roads.

OTHER BENEFITS OF CONCRETE PAVEMENTS

In our previous fact sheets, you can find more information on:

- Cool, light reflecting surfaces: https://www.eupave.eu/resources/how-high-albedo-contributes-to-reduction-of-carbon-emissions-from-road-transport/
- Less fuel consumption: https://www.eupave.eu/resources/fact-sheet-less-fuel-consumption/
- 100% recycling: https://www.eupave.eu/resources/fact-sheet-100-recycling/
- Climate resilience: https://www.eupave.eu/resources/fact-sheet-climate-resilience/

More environmental benefits from concrete roads can be found on EUPAVE's infographic "Concrete Pavements Make Roads More Sustainable" (2019), https://www.eupave.eu/resources-files/infographic

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