NEXT LEVEL ROAD CONCRETE

Roads and highways are a critical part of a country's infrastructure – connecting towns and cities, enable trade and social exchange and usually accommodate the majority of goods and passenger traffic. In short, roads are vital for the continued growth of economies and the development of any nation.

This underlines the importance of building long-lasting and reliable road infrastructure with minimal disruption to serviceability.

Due to the high maintenance costs associated with asphalt roads and their relatively short life span of approximately 15-20 years, concrete roads are becoming an increasingly popular alternative for major road construction projects.

Concrete is one of the most versatile construction materials. It is more durable than e.g. asphalt and therefore exhibits a long service life. With an average of lifespan of 30-50 years, concrete roads have twice to four times the service life of asphalt roads.

And despite concrete roads being about 20% more expensive to build initially, the total lifecycle cost of concrete roads compared to asphalt roads is usually about 20-25% cheaper.

Enhanced service life and reduced maintenance costs are the main reasons for governments to convert more roads into concrete roads in the future.

For example, cost of construction including reconstruction, repairs and maintenance of United States highways and streets amounted to around 70.3 billion UDS in 2017. According to the American Concrete Pavement Association, the national market volume for concrete pavements in 2019 grew by about 7% to around 51.2 million cubic yards (39.1 million cubic meters) from 48 million cubic yards (36.7 million cubic meters) in 2018.

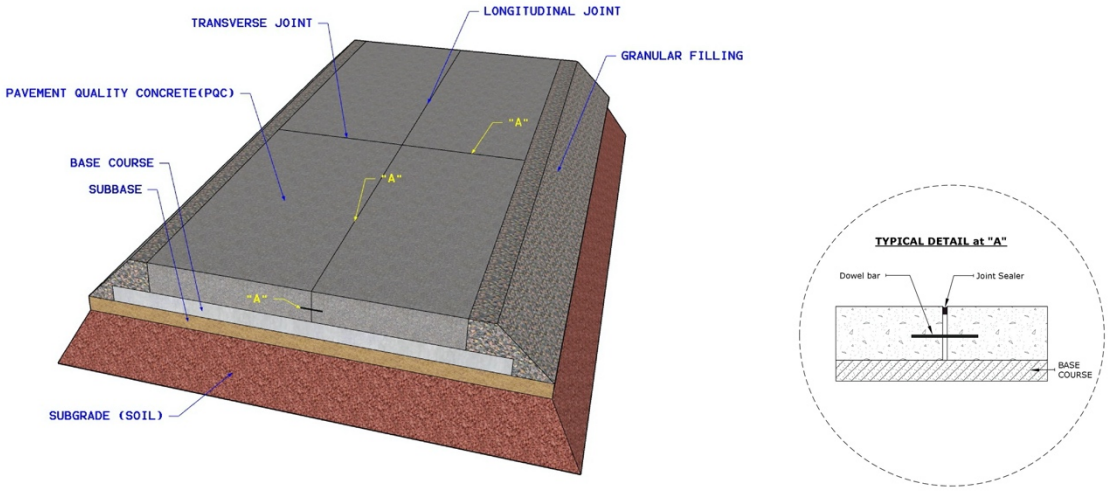
Apart from durability and low lifecycle cost aspects concrete roads provide additional benefits in regard to safety, downtimes and fuel consumption.

Concrete roads are less prone to heavy vehicle ruts and subsequent deterioration. They are easier to see at night and provide shorter stopping distances even in wet weather conditions (due to transverse or longitudinal brushing or tining). The low maintenance requirement results in less roadworks that could become potential hazard zones.

In addition, fewer maintenance downtimes result in a smoother traffic flow due to lesser lane closures.

Fuel consumption of commercial vehicles on concrete roads is also lowered (some studies indicate 15-20%) since a concrete road surface does not get deflected under the wheels of heavy vehicles.

Concrete roads typically consist of a compacted subgrade (existing soil), if needed a granular subbase, a base course (lean concrete) and a surface course made of pavement quality concrete. The surface course is usually jointed, and the joints are typically reinforced with some form of dowel bar or rebar.



Typical concrete road construction (cross section)

Conventional concrete roads – the better alternative with drawbacks

While concrete roads usually have a longer service life compared to asphalt roads, it has to be understood that concrete is not immune to deterioration either.

Microcracks pores and capillaries render concrete a permeable material. Through these pores water and waterborne contaminants are allowed to enter the concrete. If not prevented, this process will set in motion a variety of deterioration effects in the concrete directly affecting concrete durability and service life.

Concrete roads can be exposed to severe environmental conditions causing the cracking of the concrete. Different types of cracking may also occur as a result of settlement, insufficient curing, stresses in the concrete, misalignment of dowels, misplaced joints, shrinkage, blow ups and alkali-silica-reactions.

Water in the concrete matrix speeds up the deterioration of concrete road surfaces.

Roads in freezing conditions are exposed to spalling and scaling of the concrete surface, exposure of the aggregates, D-cracking and breaking off of concrete.

When water trapped inside the concrete starts to freeze it expands in volume. This increase in volume is approximately nine percent. Without any room to compensate for this volume expansion the frozen water will exert osmotic and hydraulic pressures on the capillary tracts and cracks in the concrete.

The force created as a result of the expansion can cause distress in the concrete and eventually leads to a widening of existing capillaries as well as new cracks within the concrete matrix. With rising temperatures, the water contained in the concrete thaws and travels deeper into the capillaries and microcracks, where it will eventually freeze again. Over time freeze-thaw cycles will directly increase the permeability of concrete and negatively impact its service life.

In addition, the increased permeability allows road salts and other deicing chemicals to enter and accelerate the deterioration process of the concrete by attacking any embedded reinforcement steel.

Maritime concrete roads are exposed to chloride penetration. Chlorides enter concrete in an aqueous solution and lower the pH/alkalinity of concrete. Once a certain chloride threshold around the steel reinforcement is reached, the passivation of the steel is affected, and corrosion will begin. Corroding steel expands in volume, exerts internal pressure on the concrete and results in cracking.

Road damage caused by alkali-silica-reactions also require water to be present in the concrete in order to manifest.

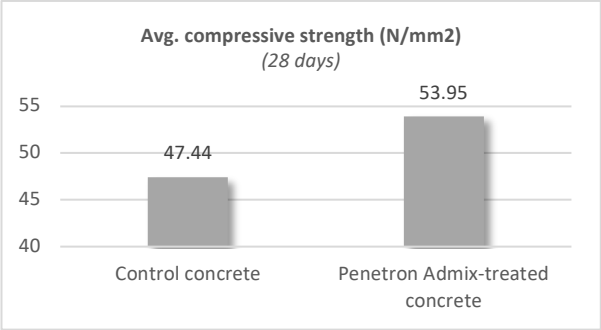
Due to this the durability of concrete roads can be significantly increased by making concrete impermeable and preventing water from penetrating the surface course.

Next level road concrete – with PENETRON ADMIX

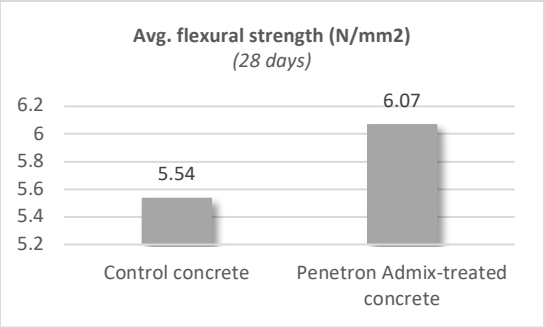
PENETRON ADMIX is the world's first, tested and proven durability admixture for road concrete. When added at the time of batching, PENETRON ADMIX effectively reduces the permeability of concrete by sealing microcracks, pores and capillaries with insoluble crystals. These crystals form as a result of a reaction between the chemical components of PENETRON ADMIX, water, calcium hydroxide and aluminum as well as other metals and salts contained in the concrete. In addition, the hydrophilic nature of PENETRON ADMIX will further produce crystals in any new cracks that may appear in the surface course over time – creating a completely impermeable and self-healing concrete layer. Water and waterborne contaminants including salts and chlorides will then no longer be able to penetrate the concrete matrix, significantly increasing concrete durability.

PENETRON ADMIX impacts the durability of conventional concrete and road concrete on many levels. Adding a durability admixture to road concrete directly addresses the main deterioration issues of conventional road surfaces.

Concrete containing PENETRON ADMIX is stronger than untreated concrete. This reduces the risk of crack development in the first place. Treated concretes have displayed increased compressive and tensile strengths, which make them preferential for use in road construction compared to conventional road concrete.



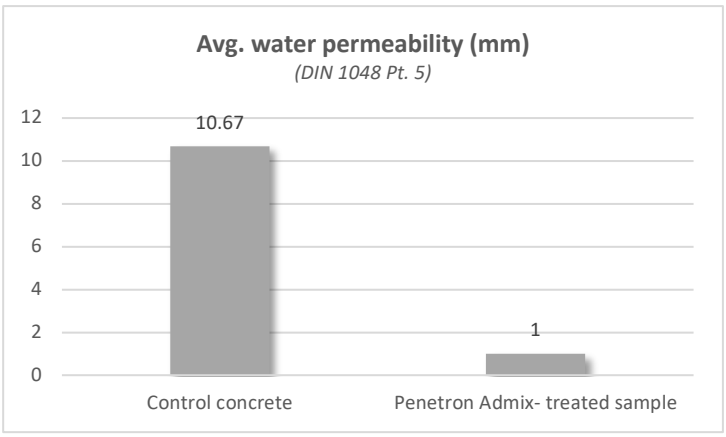
Avg. compressive strength Control vs. Treated



Avg. flexural strength Control vs. Treated

It is widely understood that the durability of a concrete mix depends on its permeability. The lower the permeability, the higher its durability.

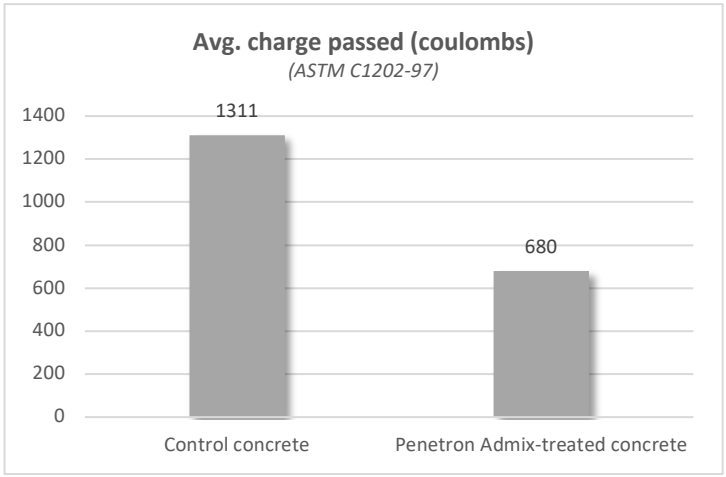
PENETRON ADMIX is specifically designed to reduce concrete permeability. Pavement quality concrete (PQC) containing this unique durability admixture have shown significantly reduced permeability of up to 97.6% (as per Darcy's Law) when compared to untreated control PQC.



Avg. water permeability of PQC

Roads (especially those exposed to marine environments and subjected to deicing salts) can now be protected more efficiently. Preventing chloride penetration slows down deterioration of roads exposed to chloride-induced deterioration. This enhances the service life of the road structure and leads to lesser maintenance costs and subsequent road closures.

Chloride penetration in PENETRON ADMIX-treated samples is over 50% lower compared to untreated concrete.



Avg. chloride penetration Control vs. Treated

The unique self-healing properties of PENETRON ADMIX actively support durability and service life expectancy. Sealing new cracks autonomously, ultimately denying the entry of water and providing a completely impermeable concrete matrix.

Concretes containing PENETRON ADMIX are proven to be extremely durable and extend service life of concrete by 60 years or more in critical environments.

This makes PENETRON ADMIX is the number one contender for effectively future-proofing critical road infrastructure around the globe - enhancing service life, reducing operating costs and keeping traffic flowing.