

DuraTough[®]

INNOVATIVE. FLEXIBLE. STRONG.



 **LAFARGE**
Building better cities™

ABOUT LAFARGE & PAVEMENT SOLUTIONS

ABOUT LAFARGE

Lafarge is Canada's largest provider of diversified construction materials and a member of the global group, LafargeHolcim. We have a sixty year history in Canada, and have over 6,000 employees and 400 sites across the country. Our mission is to provide construction solutions that build better cities and communities.

COMMITMENT TO A SUSTAINABLE FUTURE

Through LafargeHolcim's 2030 Plan, we are committed to using sustainable manufacturing practices and improving the environment in and around our operations. We work continually to reduce carbon dioxide emissions and restore wetlands for native plants and animals. We also identify waste materials that can be recycled and used in our operations.

INNOVATION LEADERSHIP

Backed by a world-class research center in Lyon, France, Lafarge is the leader in industry innovation. Lafarge's technical centers and testing labs provide new product development, continuous improvement in product quality and performance. Lafarge finds solutions to project challenges through in-depth technical advisory, expertise and advanced materials development. We translate your vision and objectives into innovative designs.



ADVANCED PAVEMENT SOLUTIONS



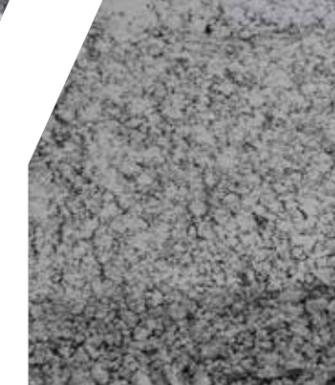
Soil Stabilization TerraCem®

Improve soil properties by stabilizing with TerraCem. It can increase shear strength, compressibility and durability. It reduces dusting and permeability. TerraCem is effective for a wide range of projects.



Cementitious Grouted Asphalt DuraTough®

This two-part pavement provides the flexibility of asphalt and the durability of concrete. It has a porous asphalt support matrix flooded with a specially formulated cementitious grout. It can be used in a variety of applications.



Roller Compacted Concrete Pavamax®

Roller compacted concrete (RCC) has the durability, strength and longevity of conventional concrete, plus the simplicity, speed of placement and economics of asphalt pavements. It is used where high strength and heavy duty pavements are required.

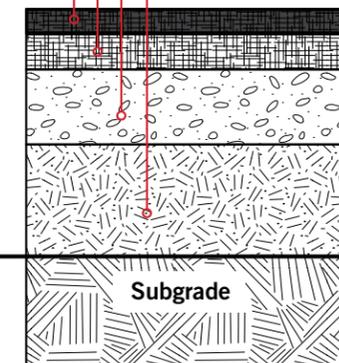


Concrete Paving

Extreme durability and low maintenance make concrete a sustainable and long lasting choice for highways, roadways and industrial applications. They have controlled cracking, do not rut, and are less prone to forming potholes than asphalt pavements.

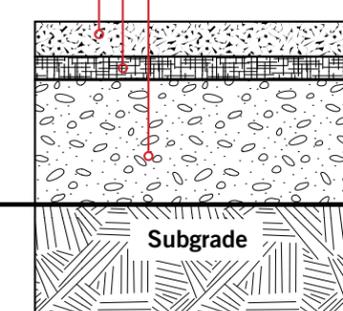
Maximizing Structural Design Equivalent Structure Comparison (Approximation)

Asphalt
Asphalt Base
Granular Base
Subbase



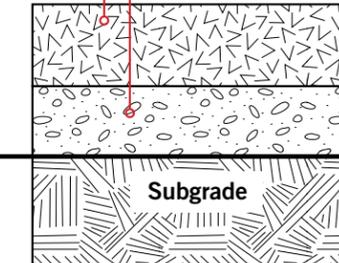
Asphalt

DuraTough
Asphalt Base
Granular Base



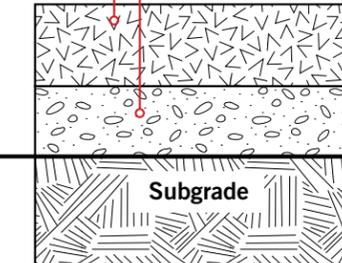
Cementitious Grouted Asphalt
DuraTough®

Concrete
Granular Base



Roller Compacted Concrete
Pavamax®

Concrete
Granular Base



Concrete Paving



INTRODUCTION TO DURATOUGH

DuraTough combines the flexibility of asphalt pavement, with the strength and imperviousness of concrete pavement, in a two-part semi-rigid pavement. It is durable and long lasting.

DuraTough is a grouted composite pavement. It is a cost-effective and fast curing alternative to concrete pavement. DuraTough can be opened to pedestrians within 3 hours and accept vehicular traffic within 24 hours.

The strength of DuraTough stems from the base of gap-graded asphalt whose voids are filled with a cementitious grout. Once the grout has cured it has strength similar to that of concrete, with more flexibility; which reduces cracking and jointing requirements.

The impervious surface with the cementitious grout prevents volatiles from penetrating the asphalt structure and compromising the pavement's integrity.

Benefits

- ✓ **Tintable for delineating laneways, cordoning off sites or safety zoning**
- ✓ **Light colour that increases safety and reduces lighting requirements**
- ✓ **Resistant to salt and chemicals, including fuels and deicing fluid**
- ✓ **Five times stronger than conventional asphalt pavements**
- ✓ **Reduced overall pavement structure**
- ✓ **Quick access, within 24 hours**
- ✓ **Gains 18 MPa within 24 hours**
- ✓ **Impermeable surface**
- ✓ **No shoving or rutting**
- ✓ **Strength of concrete**
- ✓ **Low maintenance**



MUNICIPAL APPLICATIONS

Duratough is an ideal pavement to resist deformation under heavy and high-traffic volumes, repetitive left hand turning, and in transit corridors. It minimizes time for road outages during maintenance and repairs.

Depend on DuraTough to stand up to increasing municipal traffic:

- ☑ Bus stops & transit stations
- ☑ Turning lanes & intersections
- ☑ Interchanges
- ☑ Traffic circles
- ☑ High volume & heavy load roadways
- ☑ Tunnels & hard to access areas

LIGHTING UP TUNNELS

Vehicular Tunnels, Coquitlam, B.C.

In 2015, the general contractor working with the B.C. Ministry of Transportation and Infrastructure on a road project required a pavement solution that was quick, durable and light coloured. The highway project included two tunnels already in use located on Highway #1 in Coquitlam; one at the entrance of the Mary Hill bypass, and the other at Fawcett Road and United Boulevard.

The Lafarge team proposed DuraTough and provided the general contractor with a pavement design for the tunnels. The placement of DuraTough in the tunnels was completed in one day for each tunnel, minimizing traffic disruption. It was placed on slopes ranging from 3% to 6%. The tunnels were opened to traffic 24 hours following the pavement placement.



REHABILITATION FOR PERFORMANCE

170th St. and 107th Ave., Edmonton, Alberta

In 2017, a section along a major roadway in the City of Edmonton in the McNamara Industrial area was identified for a Duratough trial. The two-laned road required complete reconstruction due to rutting and shoving as a result of vehicular turning patterns of large trucks, buses, and generally heavy traffic.

The original asphalt had failed and so to facilitate the reconstruction, it was completely milled out, and all granular base course was removed from the site. The subbase was treated with Lafarge's cement soil stabilization, TerraCem. A new 450 mm thick granular course was placed on the treated base. Next, the crew placed 110 mm of City B Mix asphalt, which acts as a base level surface. It was followed by the Duratough pavement system.



BUILDING DURABLE ROADWAYS

197th St., Langley Township, B.C.

An industrial road in Langley suffered asphalt failure from increasing heavy truck and industrial traffic due to ongoing urban development.

The township was looking for a long-term solution to handle the growing truck traffic from industrial facilities along the roadway. They chose DuraTough as it is an affordable semi-rigid pavement that could be placed and accessed quickly. The DuraTough for this roadway was designed to accommodate 20 million equivalent single axle loads (ESALs) over the life of the pavement. It was placed in 2017, on two lanes over a distance of 545 m, for a total of 6,540 m².



AVIATION APPLICATIONS

Airport pavements need to be tough. DuraTough is tough and durable. It can stand heavy loads, a wide variety of aircraft types and traffic patterns including repetitive turning and braking. It resists various chemicals and hydrocarbons. The relatively quick application and curing process allows you to meet limited construction windows, and allows access to the pavement sooner.

DuraTough has been used for a number of airport applications across Western Canada. These include:

Airside

- Apron areas
- Taxiways
- Approach intersections
- Fueling/deicing areas
- Hangar bays

Groundside

- Vehicle entry/exit ways
- Parking lots
- Passenger loading zones
- Bus areas/stops/lanes
- Loading bays

INTEGRATING PAVEMENTS

Air Canada Jazz Terminal, Calgary, Alberta

DuraTough has been performing exceptionally for over 10 years at the Air Canada Jazz terminal in Calgary. It was installed to address the high stress from the aircraft wheels turning in a repetitive pattern. DuraTough integrated well with the surrounding asphalt pavement and utilized the existing base structure. The repair sections were open to aircraft the following day.



DURABLE AND FAST

Boundary Bay Airport, Delta, B.C.

Two high-traffic asphalt pavement areas near the hangar bays were showing signs of distress caused by the turning patterns of the planes. The airport is busy with light aircraft and helicopters, making waiting for concrete to cure unfeasible. The repairs were made with DuraTough as part of the maintenance and upgrade plan at the airport in September, 2015. The Lafarge crews placed 400 m² of DuraTough; the airport was open to air traffic within 24 hours.



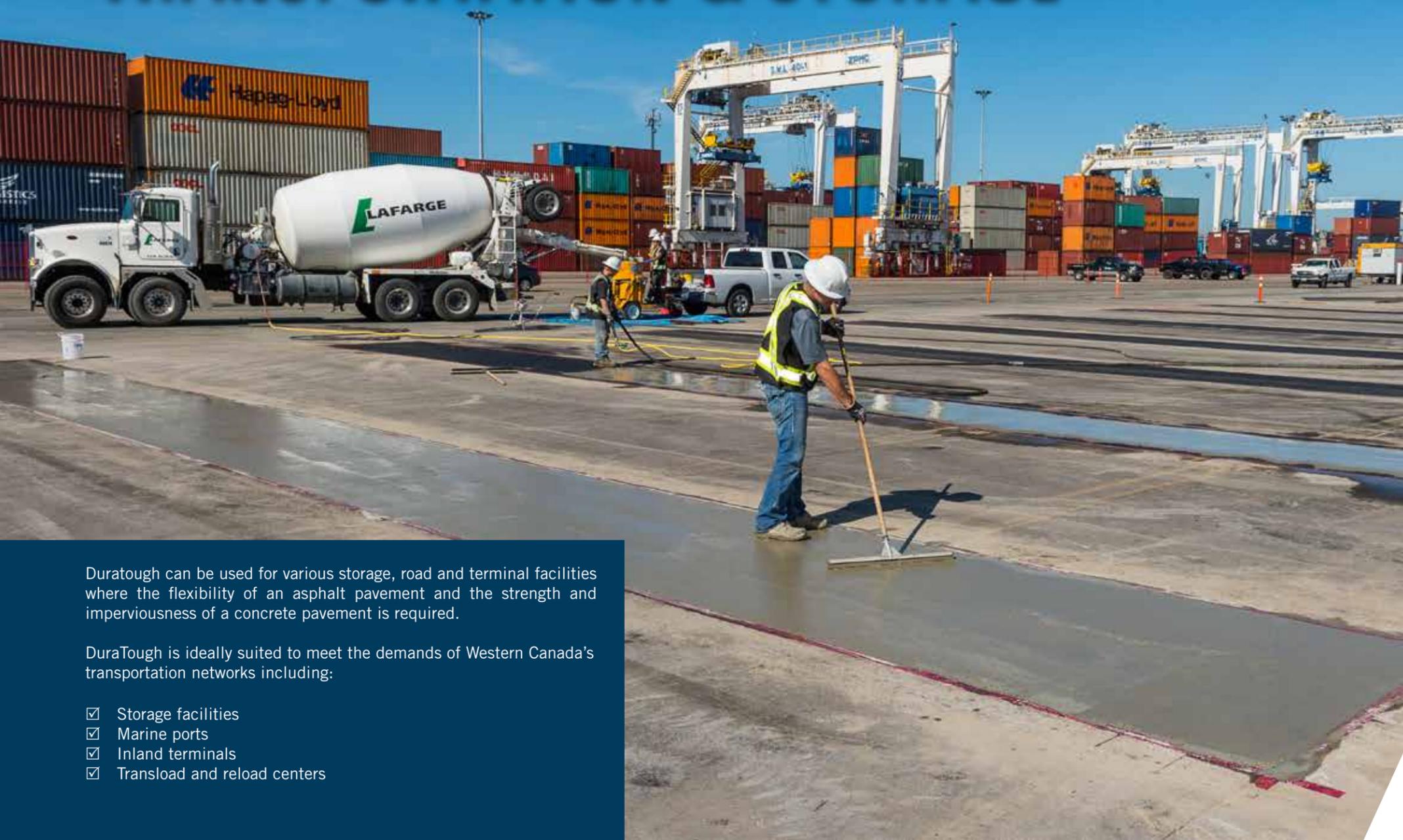
LONG TERM PERFORMANCE

SunWest, Calgary, Alberta

In 2012, over 20,000 m² of DuraTough was placed at SunWest's private aviation facility. The pavement was designed for large aircraft like Boeing 737s. The owner chose DuraTough as an economical and durable alternative to concrete pavement. The solution improved the construction schedule, due to its ability to cure quickly. The DuraTough was installed over 1 week and traffic resumed 24 hours later.



TRANSPORTATION & STORAGE



Duratough can be used for various storage, road and terminal facilities where the flexibility of an asphalt pavement and the strength and imperviousness of a concrete pavement is required.

DuraTough is ideally suited to meet the demands of Western Canada's transportation networks including:

- Storage facilities
- Marine ports
- Inland terminals
- Transload and reload centers

REDUCING TERMINAL DOWNTIME

CN Logistics Park, Calgary, Alberta

CN's Calgary logistics park opened in January 2013 and operates 24 hours a day, 7 days a week. As part of the facility design a series of high-strength dolly pads were required. The construction schedule would not allow for the traditional concrete pavement due to unseasonably cold weather and the oncoming peak shipping season. CN wanted minimal facility downtime during installation. Lafarge worked with the CN to design a DuraTough pavement that had the strength and durability required with a short curing time. In November 2013, the Lafarge construction team installed DuraTough. The pavement supports up to 64 loaded containers on chassis. The dolly pad strips opened the next day and have been performing well since.



SAFETY ZONING

Westcan Bulk Transport, Calgary, Alberta

In 2004, Westcan Bulk Transport wanted to turn a parcel of low wetlands, adjacent to their rail access, into a storage lot for their tractor trailer/tank units. The new site would have limited access to power for site lighting. Construction for these types of storage yards are generally designed with asphalt pavement, using concrete areas for the dolly pads.

The Lafarge crews placed conventional asphalt throughout the site. To withstand point loading the dolly strips were paved with DuraTough. The DuraTough grout was coloured to delineate the dolly pad areas in varying lighting conditions. Using coloured grout for facility zoning allows Westcan Bulk to easily organize the site and increases safety by highlighting different zones.



MIXED COMMERCIAL USE



Duratough has impermeable qualities that make the pavement system resistant to hydrocarbons and various chemicals. Its high-strength properties allow it to last for years with minimal maintenance.

Applications

DuraTough is a versatile and aesthetically pleasing pavement solution for any mixed commercial use site. It is a sustainable building material because of its low maintenance, reduced lighting requirements, resistance to chemical and hydrocarbon spillages, and is produced using Lafarge's environmentally conscience cement.

Commercial Developments

- ✓ Commercial parking lots and loading areas
- ✓ Commercial roadways and driveways
- ✓ Delineation of pedestrian pathways using DuraTint®



Retail and Restaurants

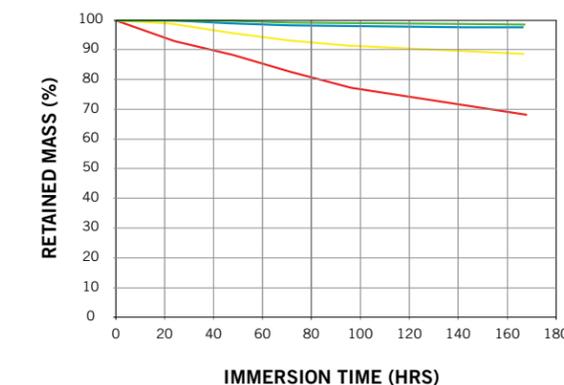
- ✓ Vehicular drive-through
- ✓ Waste storage areas
- ✓ Customer parking areas



Fueling Stations

- ✓ Fueling areas
- ✓ Loading and storage areas
- ✓ Car wash bays

Resistance to Fuel Ingress



— DuraTough® in Kerosene
— DuraTough® in Diesel
— Asphalt (Fuel Resistant Binder) in Kerosene
— Asphalt (Pen Grade Binder) in Kerosene

DuraTough can be designed for your entire site. Contact Lafarge today to explore the possibilities of integrating DuraTough into your next project.

TECHNICAL INFORMATION

We developed DuraTough in our research lab in Edmonton for our customers, who needed the strength and imperviousness of concrete with the flexibility of asphalt.

DuraTough is a two part system that consists of an open-graded asphalt support coat with 20% air void content, filled with a high strength cementitious grout. The low viscosity of the grout ensures that each void is completely filled throughout the asphalt layer. The resulting pavement provides load spreading ability and is impermeable to fuels and chemicals. It is resistant to shoving and rutting and offers smooth rideability.

Asphalt Support Coat Properties

The DuraTough base is a 12.5 mm or 16.0 mm nominal size asphalt support coat which provides a minimum 20% void structure for the DuraTough grout. The support coat consists of high-quality 100% crushed aggregates and asphalt cement.

Key Properties

- DuraTough typically gains full strength of 60 MPa at 28 days
- Rapid strength gain, typically in excess of 18 MPa at 2 days
- DuraTough can withstand 5 times more traffic loading compared to conventional asphalt pavement
- NAT Indirect Tensile Stiffness Modulus: 6,000 MPa
- Flexural strength: 2.5 to 3.0 MPa
- Skid friction (British pendulum test): 80 Dry & 65 Wet

Quality Control

Samples of the hot mix asphalt support coat are certified for compliance with the project's job mix formula. Quality control testing also includes asphalt cement content and gradation analysis. The grout is tested during placement to monitor viscosity and samples are retained to determine the compressive strength. Coring can be done after project completion to ensure complete penetration to the bottom of the support coat.



Core Sample

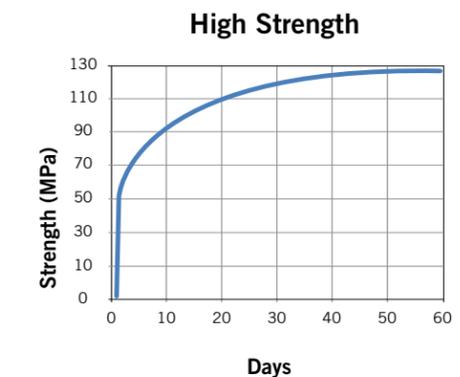
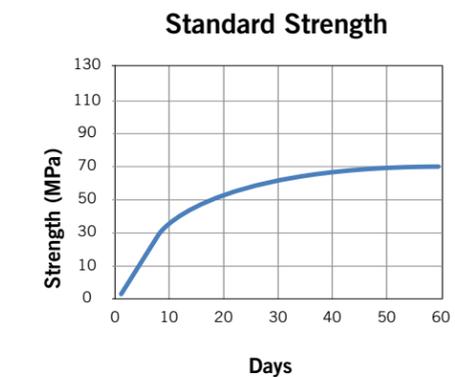
Cementitious Grout Properties

The DuraTough grout is a high strength proprietary blend with the hardness of concrete. The grout is available in two options, standard strength and high strength. Grout designs can be formulated to meet local and project specifications.

For typical applications, standard strength grout should achieve approximately 35 MPa (7 day compressive strength) and 60 MPa (28 day compressive strength). The high strength grout is ideal for high point load applications. It has strength values of 60 MPa (7 day compressive strength) and 100 MPa (28 day compressive strength), respectively.

The grout is blended in a specially-designed mixer and is applied to the support coat. It is placed using vibratory rollers to ensure full integration into the support coat prior to curing. The low viscosity grout completely fills the voids in the asphalt support coat.

Two Grout Options





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