Pervious Concrete Pavements

Mainstreaming Urban Water Conservation and Efficiency

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33,198

Km of roads in Delhi

15%

of area of Delhi

~ 40 Km²

Single lane and low volume roads in Delhi

+ Parking Lots, Medians, Footpaths and other non-load bearing paved areas

Conservation Strategies

Passive

Simply reduce impervious area by replacing with pervious

Best for small areas, existing areas with minimal scope for changes

Active

Maintain total runoff from an area before and after paving

Eg.: Collect and drain into rain water harvesting ponds

Ideal for larger areas, new constructions, re-construction, etc.

Passive strategies are typically part of the overall Active strategy

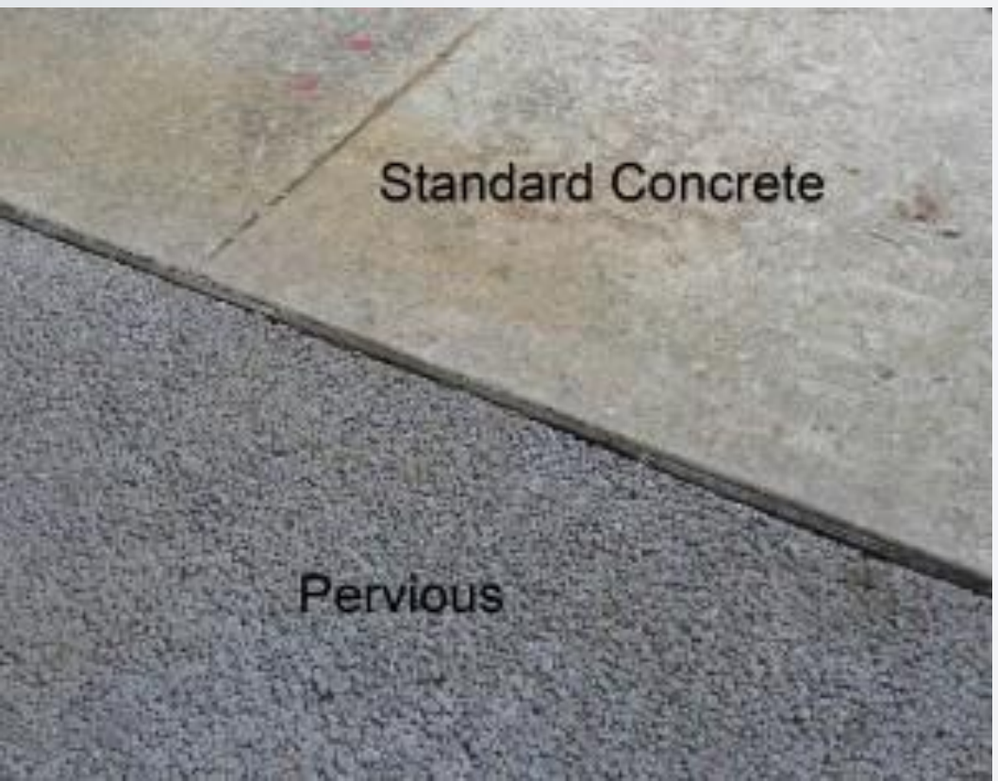
Pervious concrete

Where can we use pervious concrete?

Footpaths, aesthetic concrete.

What about parks and gardens?

Parking lots and Driveways?



Can Pervious Concrete be used on highways?

Not on the main carriageway…

…perhaps on the shoulders and median.

What about on low volume roads?

Low volume metaled roads.

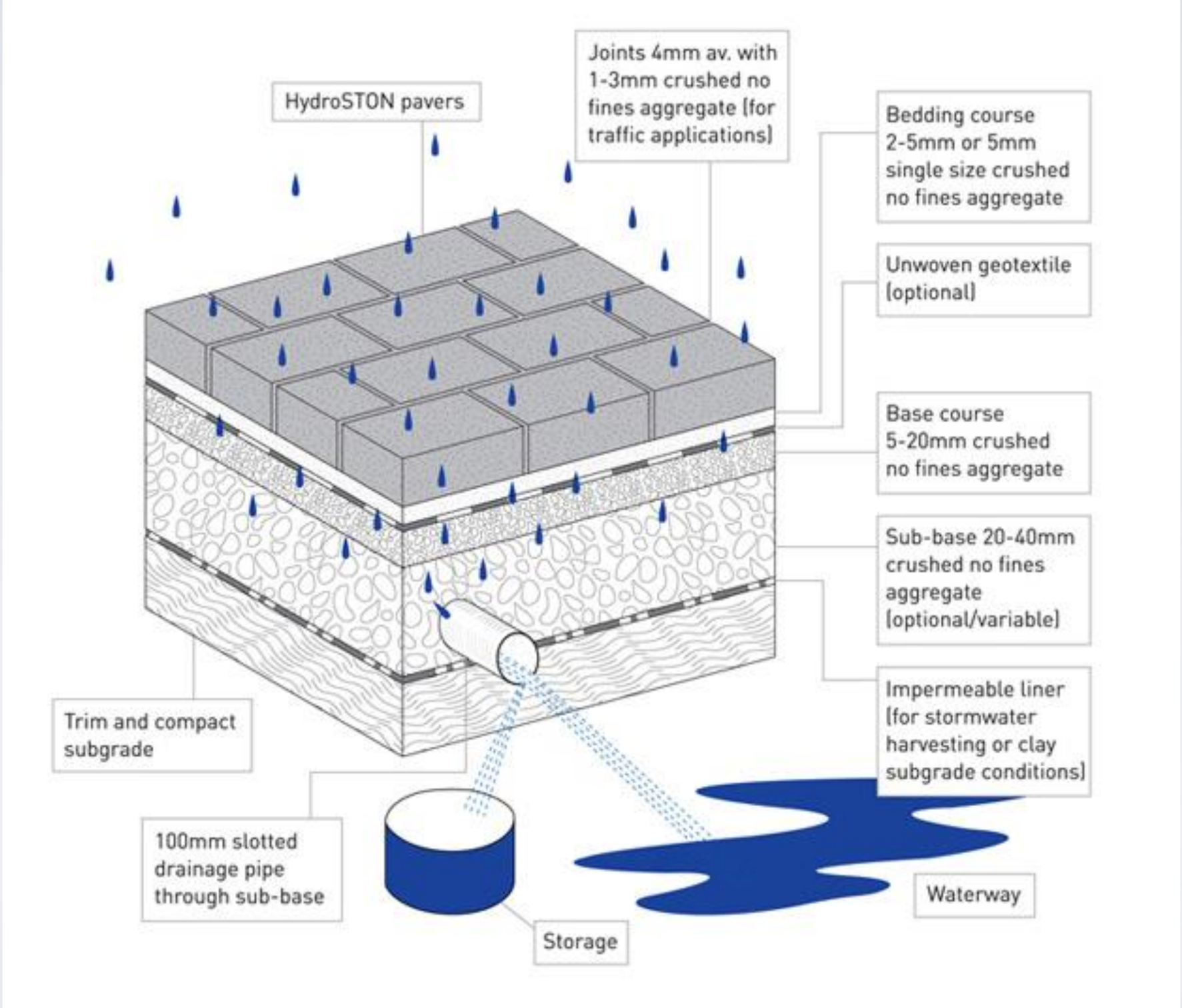
Dirt roads being upgraded.

Low volume roads with military vehicle traffic?

Trucks, perhaps yes…

…but probably not tanks.

Areas with clayey soil?



Design of Pervious Concrete

Estimated Rainfall and/or Desired Runoff

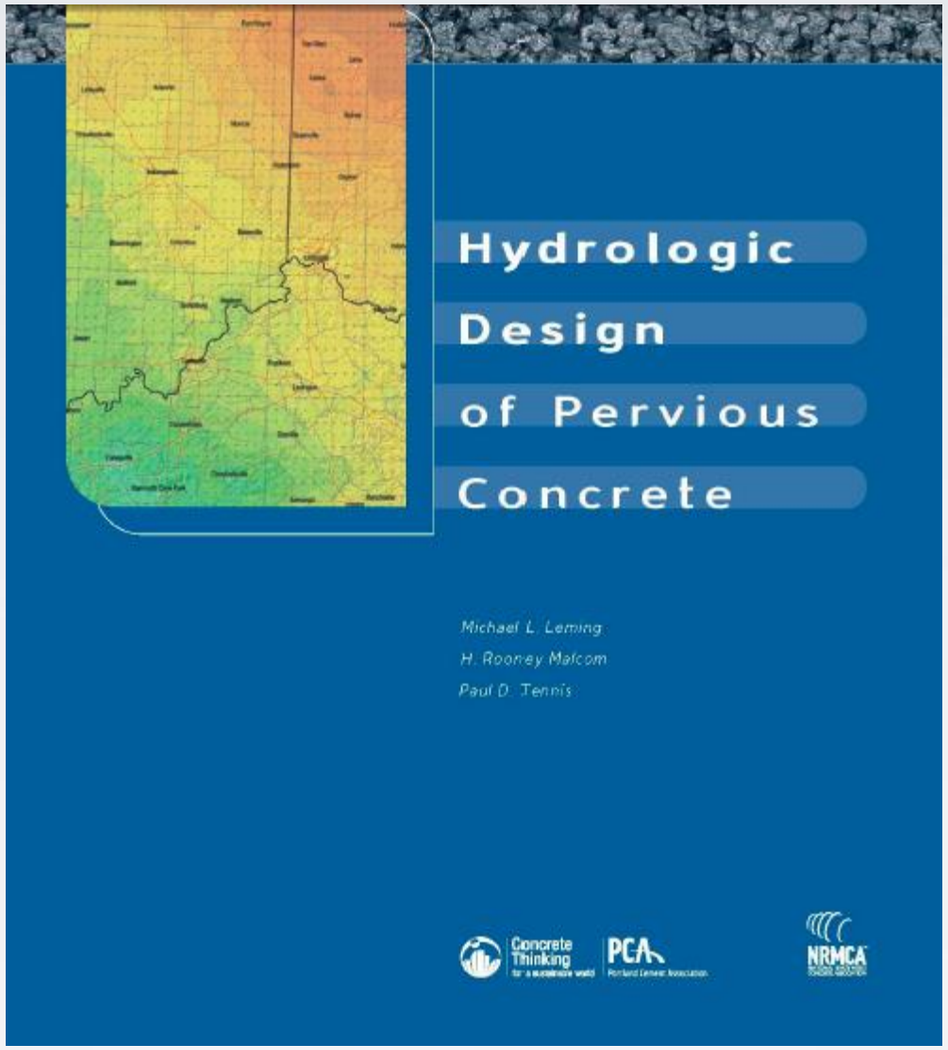
Expected Structural Loading

Environmental considerations

Slopes and permeability of underlying layers

Other Factors:
Cost
Maintenance

Structural and Hydrological Design



http://www.rmc-foundation.org/images/PCRC Files/Hydrological Environmental Design/PC_DesignManual.pdf

Hydrologic Design – Pre- and Post- Development Runoff

	Runoff, in. (mm)	
	2-year storm: 4 in. (100mm)	10-year storm: 6 in. (150 mm)
Pre-development	0.8 (20)	2.0 (51)
Post-development		
(1) 450,000 ft2 impervious; no pervious concrete	2.6 (66)	4.5 (114)
(2) 150,000 ft2 impervious; 300,000 ft2 pervious	0.2 (5)	2.0 (51)
(3) 300,000 ft2 impervious; 300,000 ft2 pervious	0.8 (20)	2.8 (71)

Environmental Considerations – Pollutant Treatment

Stormwater Function	Level 1 Design	Level 2 Design
Annual Runoff Volume Reduction (RR)	45%	75%
Total Phosphorus (TP) EMC Reduction1 by BMP Treatment Process	25%	25%
Total Phosphorus (TP) Mass Load Removal	59%	81%
Total Nitrogen (TN) EMC Reduction1	25%	25%
Total Nitrogen (TN) Mass Load Removal	59%	81%

**State of Virginia, USA

Structural Design

Soil Type	Traffic Loading		Typical Porosity	Min. Depth (mm)	Optional Elements	
	Axle Load (kN)	Repetitions			Base Course*	Geotextiles
Sandy Well draining, low water table (IC > 13 mm/hr)	18	Unlimited	Up to 35%	100	Not required	Not required (but sand bed or filler may be needed)
	53	< 10 / day	Up to 35%	150	Typically required	Not required (but sand bed or filler may be needed)
	80	2 – 3 / day	Up to 18%	200	Required	Typically Required
	80	< 100 / day	Up to 18%	Special design	Required	Typically Required
Sandy to Silty (IC = 3 – 13 mm/hr)	18	Unlimited	Up to 35%	100	Not required	Not required (but sand bed or filler may be needed)
	53	< 10 / day	12 – 35%	150	Typically required	Typically required
	80	2 – 3 / day	12 – 35%	200	Required	Required
	80	< 100 / day	< 12%	Special design	Required	Required
Silty to Clayey (IC < 0.3 mm/hr)	Special Design * Aggregate Base Course of ~20% porosity or Clean Stone of ~ 40% porosity					

Type Selection

Design Factor	Micro-Scale Pavement	Small-Scale Pavement	Large-Scale Pavement
Impervious Area Treated	250 to 1000 sq. ft.	1000 to 10,000 sq. ft.	More than 10,000 sq. ft.
Typical Applications	Driveways Walkways Court Yards Plazas Individual Sidewalks	Sidewalk Network Fire Lanes Road Shoulders Spill-Over Parking Plazas	Parking Lots with more than 40 spaces Low Speed Residential Streets
Most Suitable Pavement	IP	PA, PC, and IP	PA, PC and IP
Load Bearing Capacity	Foot traffic Light vehicles	Light vehicles	Heavy vehicles (moving & parked)
Reservoir Size	Infiltrate or detain some or all of the Tv	Infiltrate or detain the full Tv and as much of the CPv and design storms as possible	
External Drainage Area?	No	Yes, impervious cover up to twice the permeable pavement area may be accepted as long as sediment source controls and/or pretreatment is used	
Observation Well	No	No	Yes
Underdrain?	Rare	Depends on the soils	Back-up underdrain
Required Soil Tests	One per practice	Two per practice	One per 5000 sq. ft of proposed practice
Building Setbacks	5 feet down-gradient	10 feet down-gradient	25 feet down-gradient

Design Factor	Porous Concrete (PC)	Porous Asphalt (PA)	Interlocking Pavers (IP)
Scale of Application	Small and large scale paving applications	Small and large scale paving applications	Micro, small and large scale paving applications
Pavement Thickness 1	5 to 8 inches	3 to 4 inches	3 inches 1, 8
Bedding Layer 1, 8	None	2 inches No. 57 stone	2 inches of No. 8 stone
Reservoir Layer 2, 8	No. 57 stone	No. 2 stone	No. 2 stone 3-4 inches of No.57 stone
Construction Properties 3	Cast in place, seven day cure, must be covered	Cast in place, 24 hour cure	No cure period; manual or mechanical installation of pre-manufactured units, over 5000 sf/day per machine
Design Permeability 4	10 feet/day	6 feet/day	2 feet/day
Construction Cost 5	$ 2.00 to $6.50/sq. ft.	$ 0.50 to $1.00/ sq. ft.	$ 5.00 to $ 10.00/ sq. ft.
Min. Batch Size	500 sq. ft.		NA
Longevity 6	20 to 30 years	15 to 20 years	20 to 30 years
Overflow	Drop inlet or overflow edge	Drop inlet or overflow edge	Surface, drop inlet or overflow edge
Temperature Reduction	Cooling in the reservoir layer	Cooling in the reservoir layer	Cooling at the pavement surface & reservoir layer
Colors/Texture	Limited range of colors and textures	Black or dark grey color	Wide range of colors, textures, and patterns
Traffic Bearing Capacity 7	Can handle all traffic loads, with appropriate bedding layer design.		
Surface Clogging	Replace paved areas or install drop inlet	Replace paved areas or install drop inlet	Replace permeable stone jointing materials
Other Issues		Avoid seal coating	Snowplow damage
Design Reference	American Concrete Institute # 522.1.08	Jackson (2007) NAPA	Smith (2006) ICPI

Typical Structural Patterns

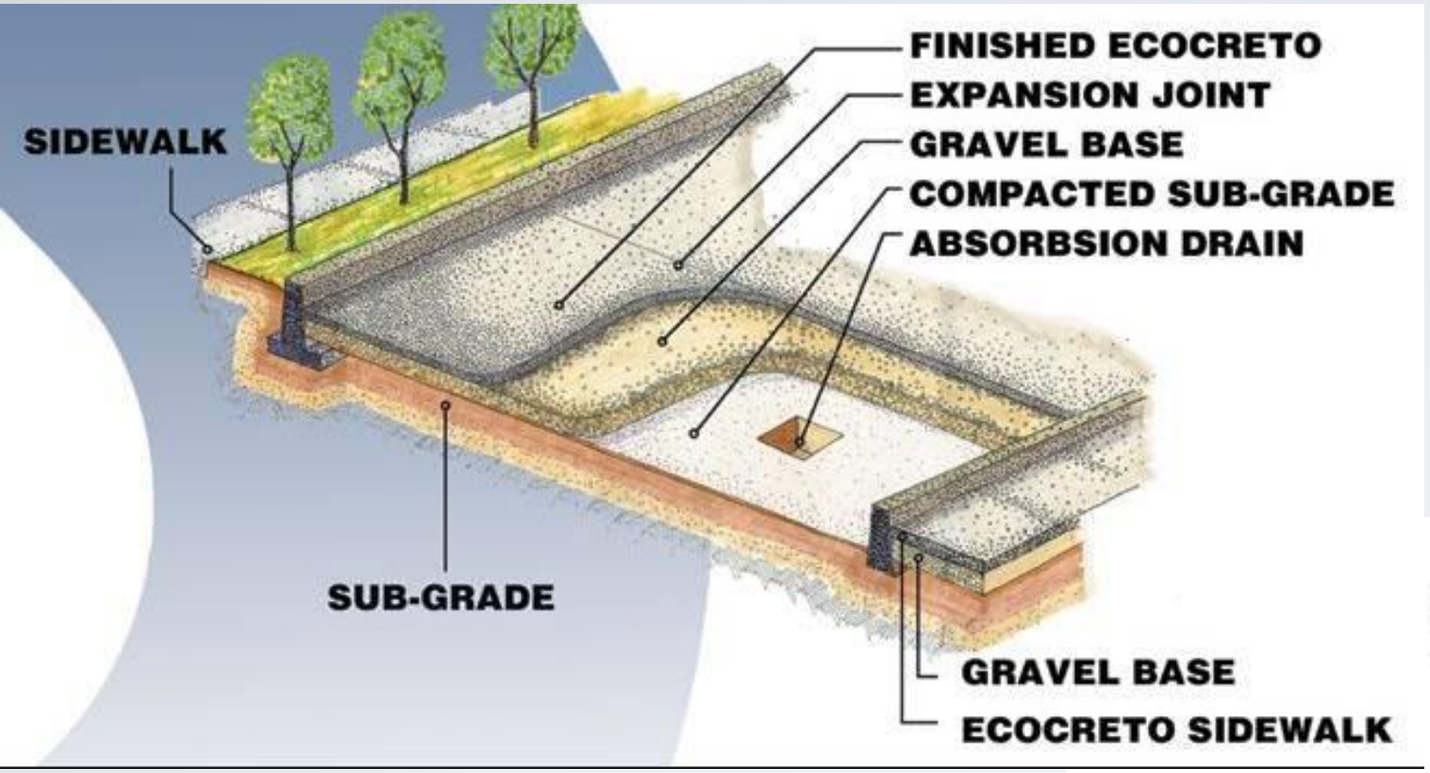


Image courtesy: https://www.ecocreto.com