

Concrete Interlocking Pavements Advanced and New Applications



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Agenda

1. Concrete Block Paving (CBP)
 - 1.1 Products and Areas of Application
 - 1.2 Advanced and New Applications
2. Sustainable Urban Drainage Systems (SUDS)
3. Permeable Concrete Block Paving (pCBP)
 - 3.1 Products and Areas of Application
 - 3.2 Requirements and Design Considerations
 - 3.3 Example



Fidenza Meeting

06 giugno 2008

ore 10.30

L'urbanistica di domani nelle città d'Italia

Una soluzione innovativa per la pavimentazione di strade urbane



Advanced and New Applications



Types of Concrete Paving Blocks

Interlocking Paving Blocks

Design Paving Blocks

Advanced Paving Blocks

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Interlocking Paving Blocks

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La forme
d'ancrage
en L limite les
mouvements
sur trois axes
d'appui.



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Design Paving Blocks



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Areas of Application

Residential



Residential



Municipal



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Car Parking



Roads



Industrial



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Filling Stations



Permeable Paving



Flags in Roads



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Market Situation

Market Shares and Sales Trends of CBP in Germany (1996)

Type	Market Share	Sales Trend
Standard Block Paving	~ 65 %	↘
Design Block Paving	~ 25 %	↗
Eco Block Paving	~ 10 %	↗ ↗

Market Shares/Sales Trends of Eco Block Paving in Germany

Type
Widened Joints
Drainage Openings
Porous Paving Blocks

Volume in Germany:

Total: 183 Mio. m² (1998)

Permeable CBP: 18 Mio. m²

Growth of Eco Block Paving in Germany 1995 – 1996: 20 %

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Development of Concrete Paving Blocks

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... Advanced Application:

**When Structural Performance
meets Environmental Benefits and
Sophisticated Design!**

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An Excellent Example is: SUDS

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pCBP: Sustainable Urban Drainage Systems

SUDS: Preference of Local Infiltration Techniques

Infiltration: Environmental and Economical Benefits

Permeable Paving: An Efficient Component of SUDS

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Sustainable Urban Drainage Systems

Importance for Water Resources Management

- Reduces Sealing of the Surface
- Reduces Surface Runoff
- Relieves Sewage Systems and

Ecological and Environmental Importance

- Prevents Flood Peaks
- Saves Water
- Improves Water Quality
- Elevates Ground Water Level
- Improves Climate

Economical Importance

- Keeps Rainwater in the Natural Water Cycle
- Improves Living Conditions of Plants and Animals
- Saves Stormwater Pipes in Planned Built-up Areas
- Saves Expenses for Sanitation, Repair and Maintenance of Present Sewage Systems
- Saves Investments for Future Stormwater Detention Facilities

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Principles

- **Alternative Drainage**

⇒ the runoff from minor contaminated precipitation is to be infiltrated rather than discharged

- **Decentralized Drainage**

⇒ the runoff from minor contaminated precipitation is avoided, attenuated or curbed locally

- **Regular Drainage**

⇒ the infiltration does not affect the construction or the security of buildings or pavements

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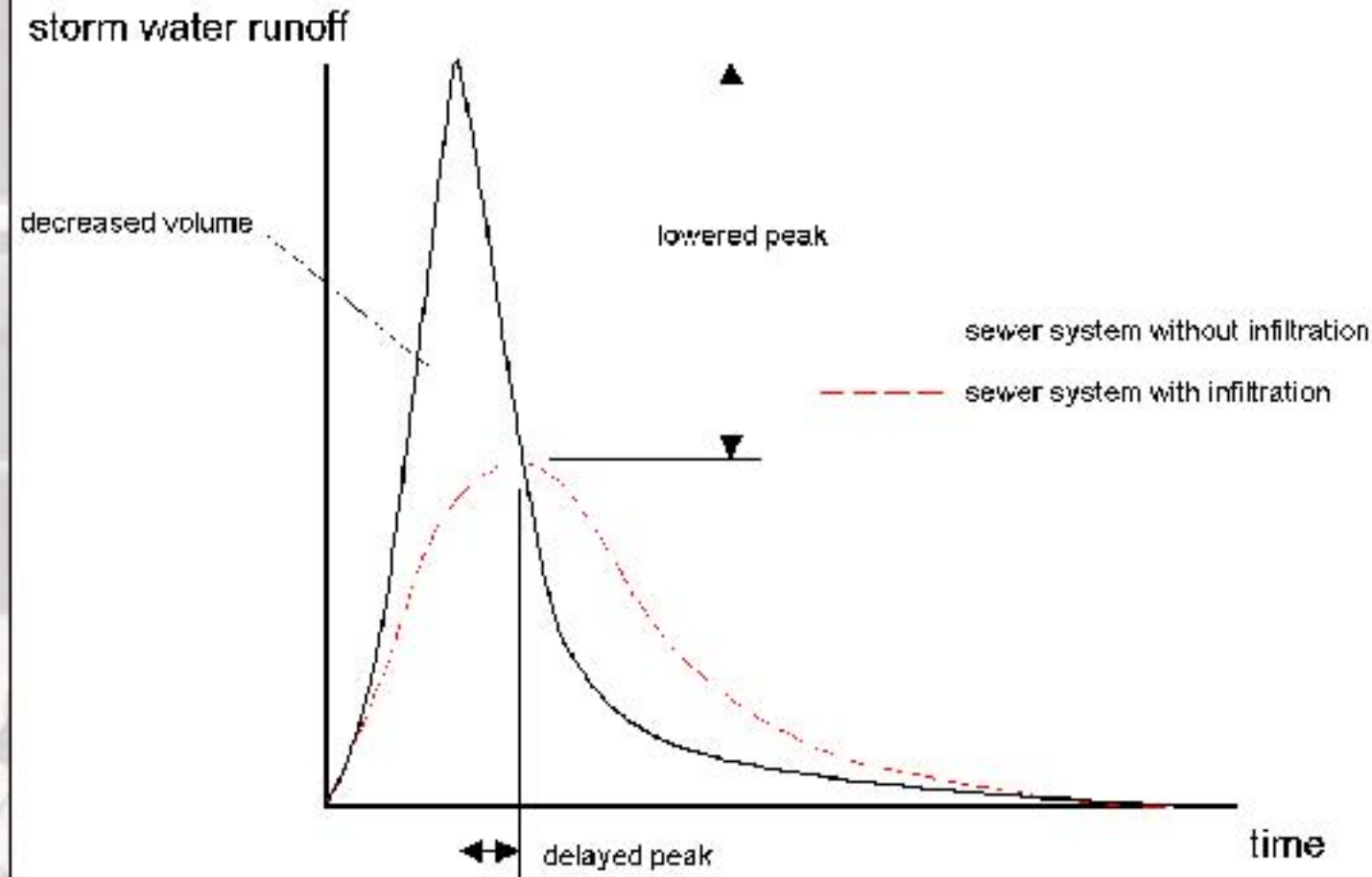
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BORGWARDT UND BROSCHMANN GBRATUNG

Effort: Relieving Sewage Systems w/ Infiltration

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Method: Reducing Runoff w/ pCBP

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- **Absorption of Precipitation**
 - ⇒ With Permeable Surface
- **Temporary Retention of Infiltrated Rainwater**
 - ⇒ With Permeable Pavement Structure
- **Partial Infiltration of Seepage Water**
 - ⇒ Through the Formation Level depending on the Permeability of the Soil
- **Restricted Recharge or Collection of the Remaining Runoff**
 - ⇒ With Connected Drainage or Collection Facilities

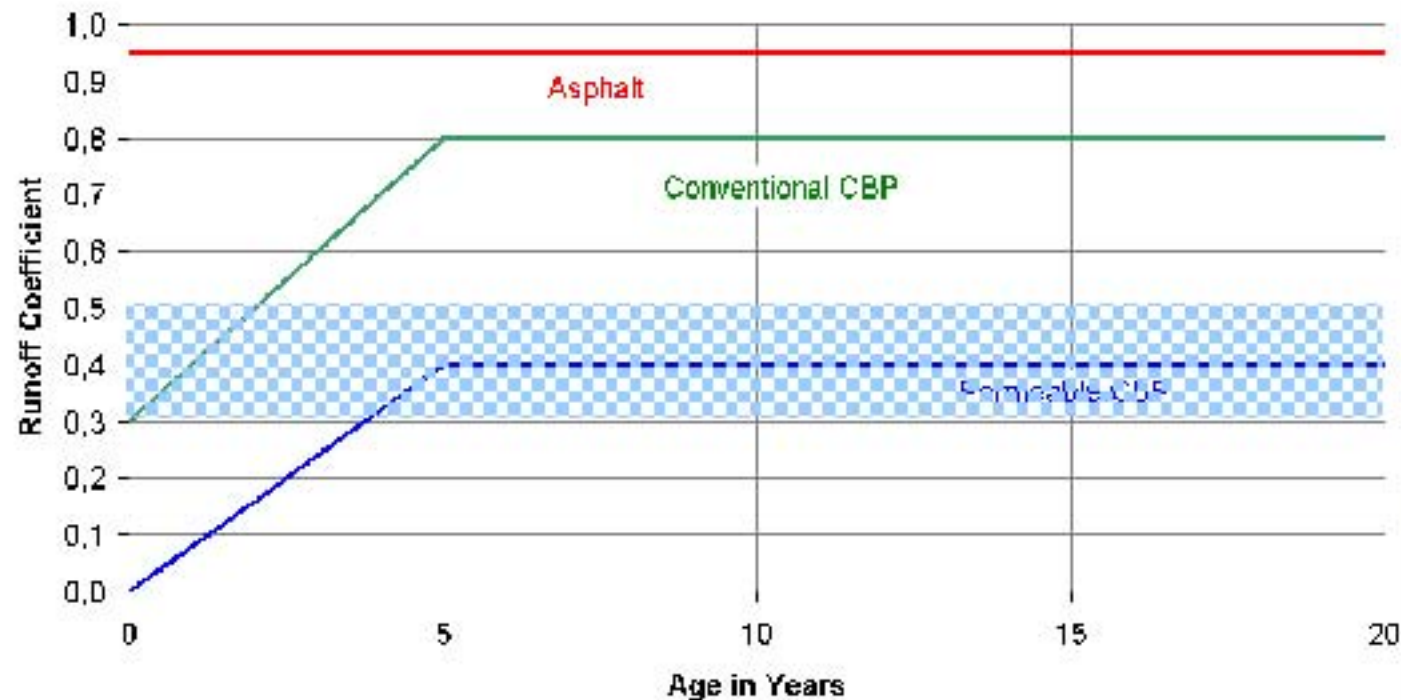
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BORGWARDT WIRTSCHAFTSFLIESS VERBUND

Goal: Reduced Runoff w/ pCBP

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Types of Permeable Paving Blocks

Porous Paving Blocks

Permeable Paving Blocks with Widened Joints

Permeable Paving Blocks with Drainage Openings

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Porous Paving Blocks

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Porous Paving Blocks: Areas of Application

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Permeable Paving Blocks w/ Widened Joints

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Widened Joints: Areas of Application



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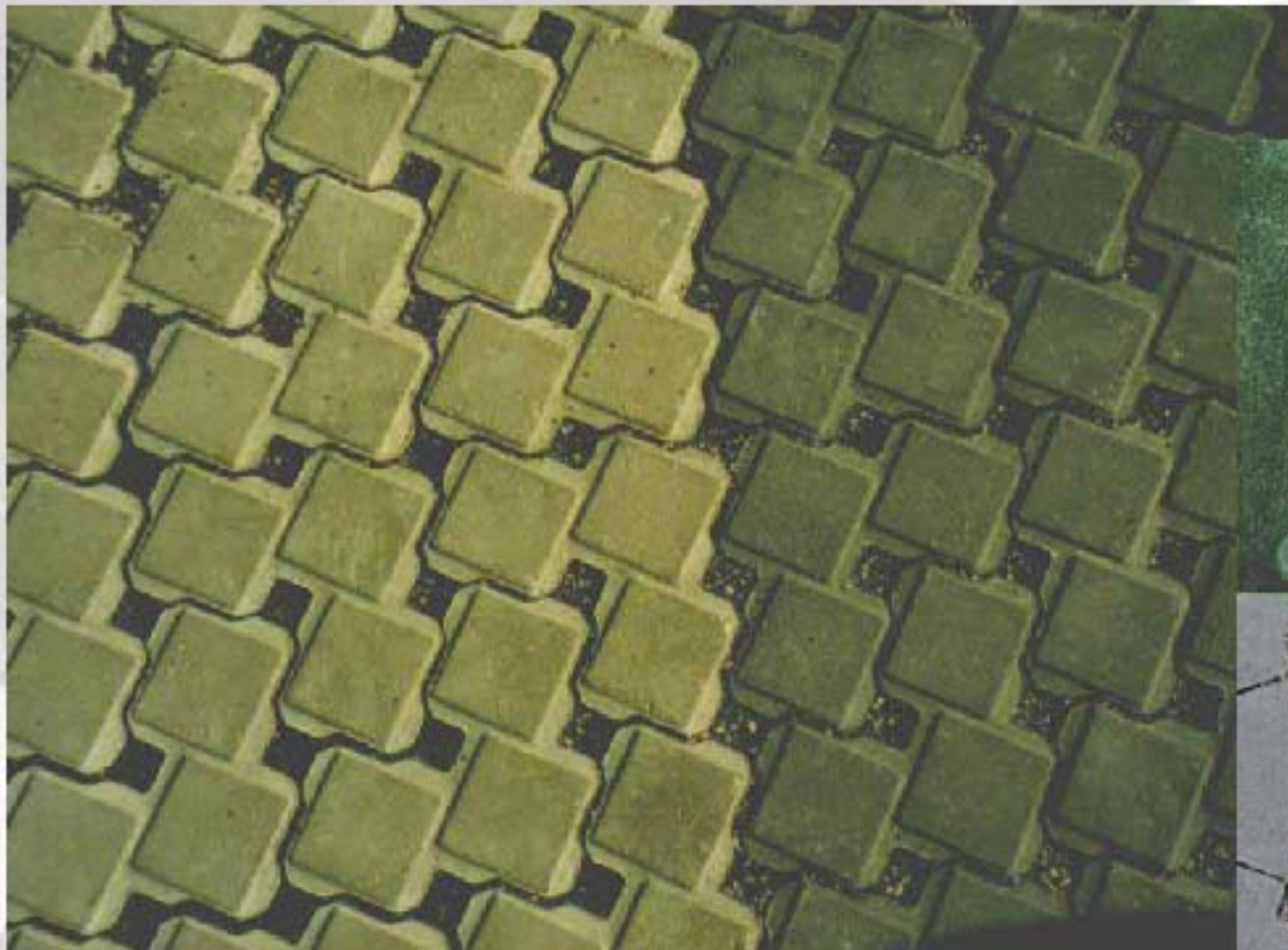
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Permeable Blocks w/ Drainage Openings

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Permeable Blocks: Areas of Application

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Areas of Application

Traffic area	Use
Roads	Residential Roads, Access Roads, Service Roads
Parking Areas	Parking Areas occasional in use for Truck and Bus Traffic, Parking Areas constantly in use for Car Traffic and minor Truck/Bus Traffic
Industrial Traffic Areas	Industrial Roads with minor Traffic, Industrial Parking Areas, Container Hard Standings
Special Traffic Areas	Track and Rail Areas of Public Transport, Airbase Aprons and Parking Areas for Planes
Other Traffic Areas	Platforms for Public Transport, Farm and Forestry Roads, Emergency Escape Ramps
Residential/ Private Areas	Cycle Ways and Footpaths, Real Property Entries, Landscape and Garden Areas

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Areas of Application

Traffic area	Paving with drainage openings		Paving with widened joints		Paving with grassed joints		Paving with porous blocks	
	inter-locking	rectan-gular	inter-locking	rectan-gular	inter-locking	rectan-gular	inter-locking	rectan-gular
Heavy traffic	+	-	-	-	-	-	-	-
Light moving traffic	+	0	0	0	0	0	0	0
Stationary traffic	+	+	+	+	+	+	+	+
Bicycle or pedestrian traffic	0	0	0	0	0	0	+	+

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Pavement Design with Permeable CBP

Base Course Thickness: Depending on Soil Permeability

Materials: Permeability according to Design-Rainfall

Permeable Paving: Depending on Traffic Load

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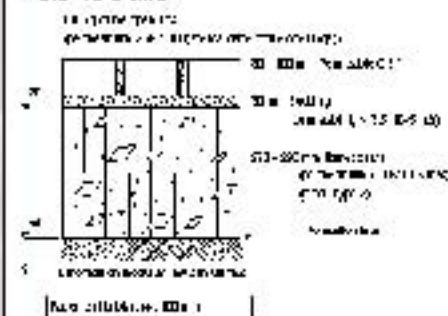
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Pavement Design with Permeable CBP

Required thickness (Examples)

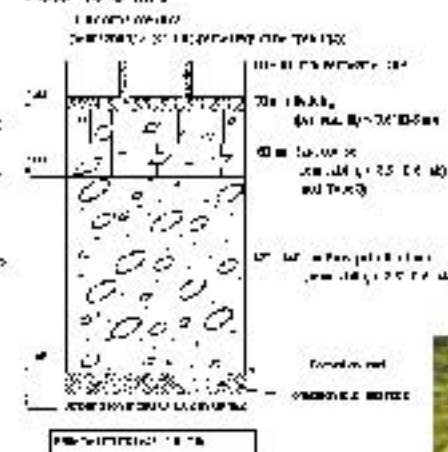
1 Permeability of the subsoil
 $> 3.6 \cdot 10^{-5} \text{ m/s}$



2 Permeability of the subsoil
 $3.6 \cdot 10^{-5} \text{ to } 3.6 \cdot 10^{-6} \text{ m/s}$



3 Permeability of the subsoil
 $< 3.6 \cdot 10^{-6} \text{ m/s}$



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Monitoring: Testing the Subgrade

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Monitoring: Testing the Base Course

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Testing the Performance w/ a Infiltration-meter



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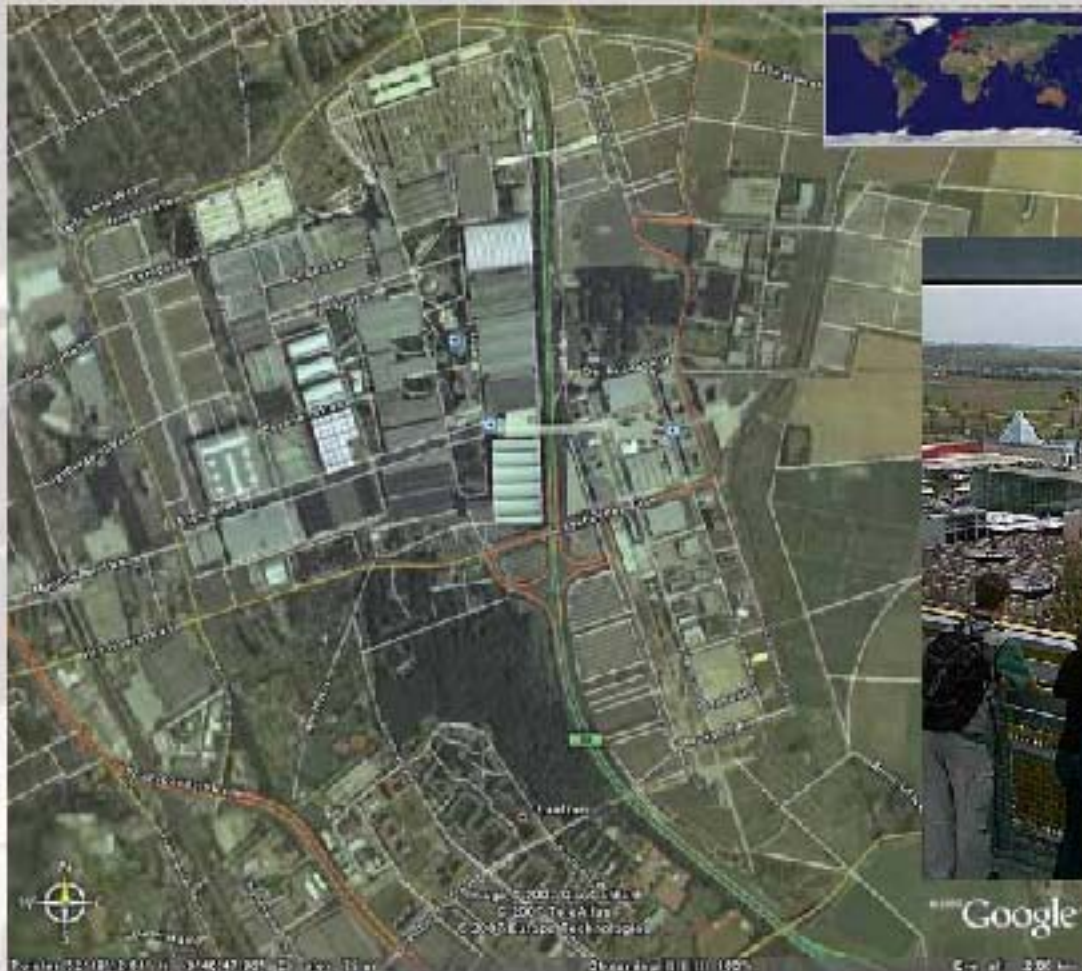
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Example: EXPO 2000 World Exposition

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Example: EXPO 2000 World Exposition

- 25,000 Car Parking Lots, 1,600 Bus Parking Lots on 650,000 m²,
- 300,000 m² Permeable Paving Blocks,
- Construction Time 1996 – 2000
- Costs of Construction: 22,000,000 EUR

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Example: EXPO 2000 World Exposition



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Certainly an Advanced Application for
Concrete Interlocking Pavements!

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