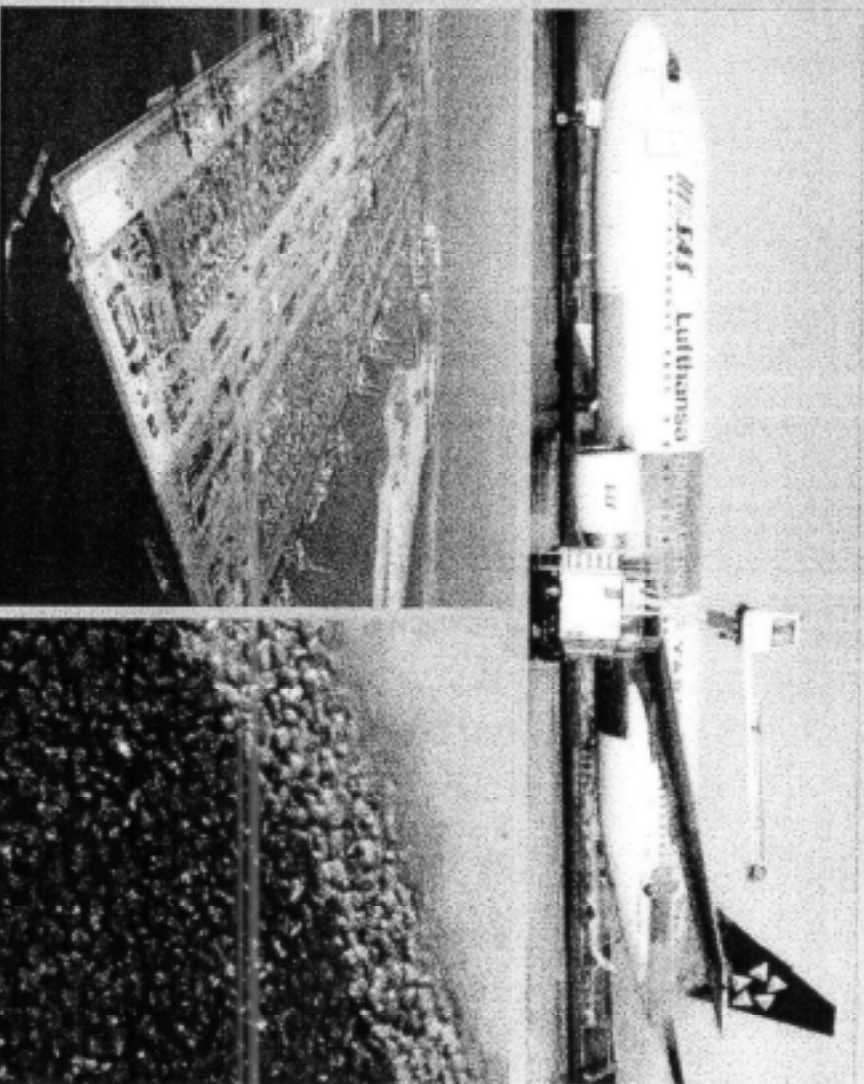
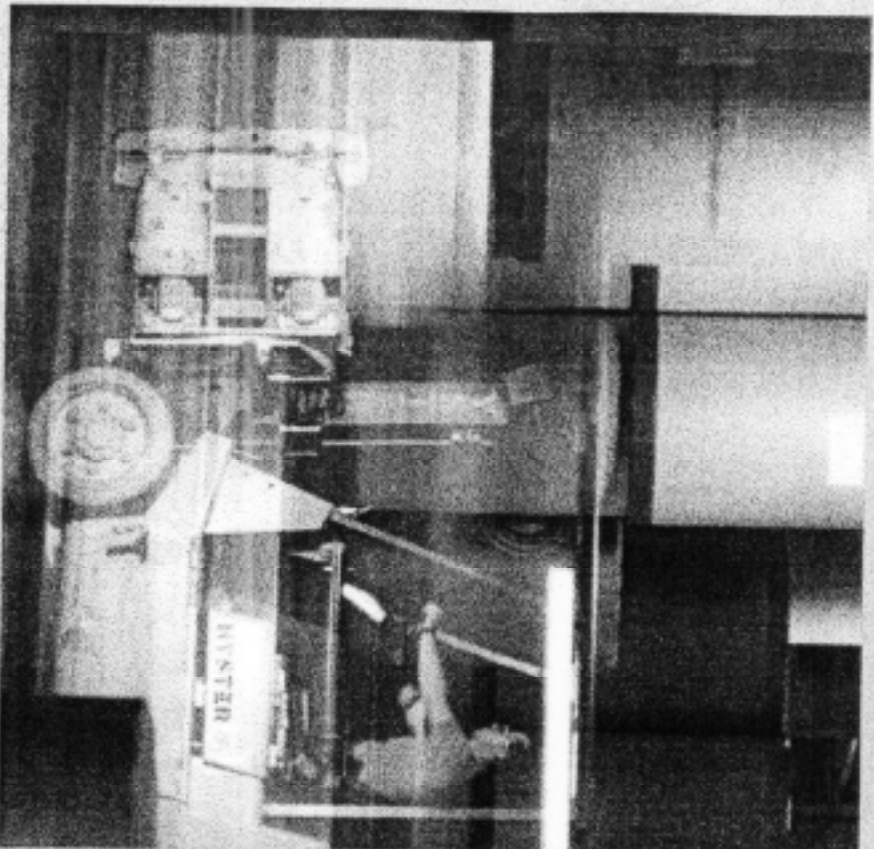


DENSIPHALT®

- a new generation of joint-free pavements



Densit USA Inc.

2158 Avenue C * Suite 205 * Bethlehem, PA 18017
Douglas Duvall, Densiphalt Business Developer
201 Leppo Road * Westminster, MD 21158
Direct Line: 410 346 0165, Mobile: 410 790 0567

Densit


* Densit USA Inc. * Douglas Duvall, Densiphalt Business Development Manager * Phone (410) 346 - 0165 * Fax (410) 346 - 0166
E-mail: DDV@densit.com * www.densit.com

CONTENT

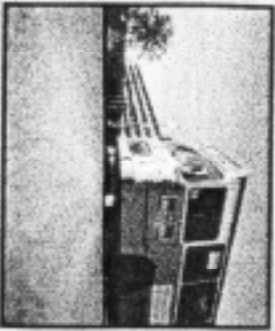


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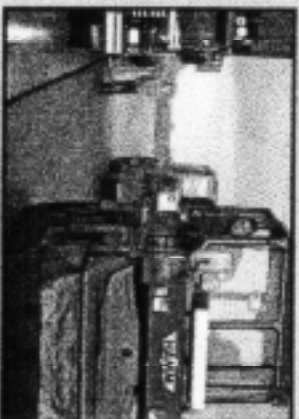
DENSIPHALT®

Densiphalt 

**ASPHALT
CONTRACTOR**



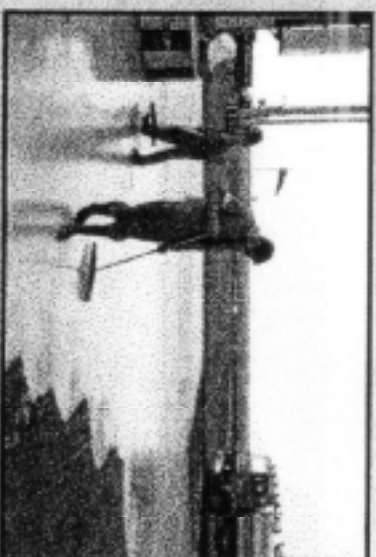
ASPHALT



MORTAR

Densit 

Densiphalt 

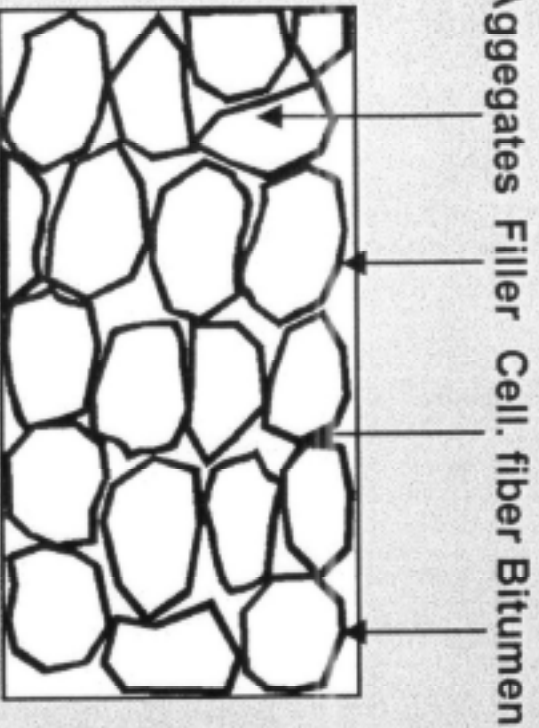


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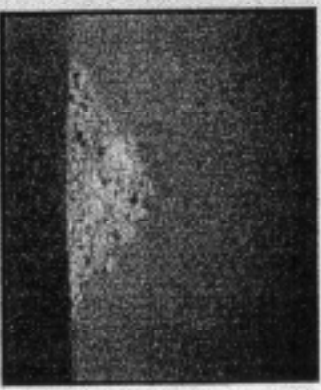
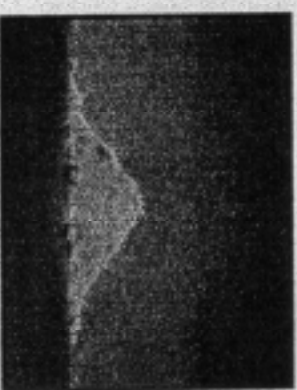
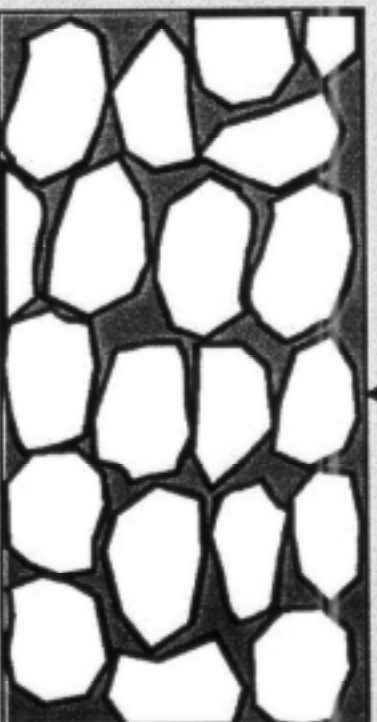
COMPOSITION OF THE DENSIPHALT® SYSTEM

Densiphalt 

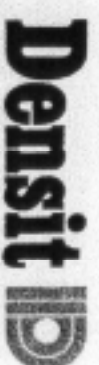
- Densiphalt® asphalt:
 - > Single open textured asphalt
 - > 25 - 30% void content
 - > Bitumen
 - > Limestone filler
 - > Cellulose fibre
 - > Granite (5/8 or 8/12) aggregates
- Densiphalt® mortar:
 - > Special cement
 - > Microsilica
 - > Superplasticizer
 - > Quartz sand
 - > Water (w/p-ratio 0.27)



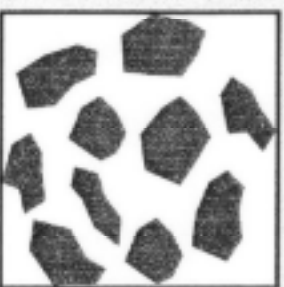
Densiphalt® mortar



DENSIT[®] - BASIC PRINCIPLE



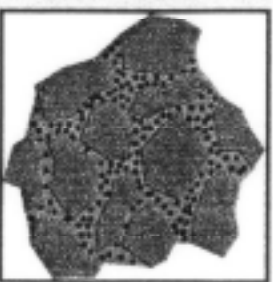
- Densit[®] = Densified System with ultrafine Particles



CEMENT PASTE
(Cement particles and water)
w/c = 0,50-0,70

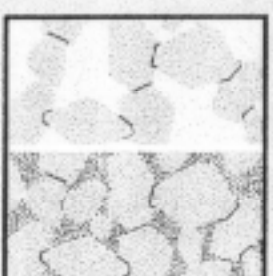


SUPER PLASTICISED CEMENT PASTE
(Cement particles,
Superplasticiser and water)
w/c = 0,30-0,35

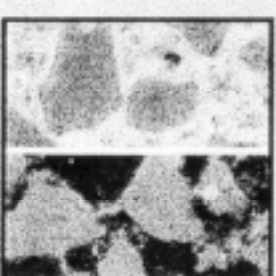


DSP TECHNOLOGY
(Cement, Microsilica,
Superplasticiser and water)
w/p = 0,18-0,22

Concrete Densit[®]



Microstructure



Thin section

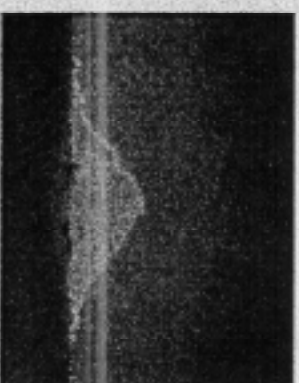
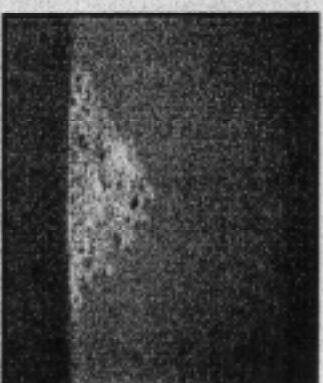


Fracture surface

DENSIT[®] - MATERIAL COMPOSITION

Densit 

- **Cement:**
 - Binding material, main contributor to compressive strength
- **Microsilica:**
 - Densifier, contributes to compressive strength and “lubricates” the particles
- **Superplasticiser:**
 - Lubricates and packs the particles
- **Aggregates**



DENSIT® COMPONENTS EFFECT



- Special cement, C_3S

Curing:	Fast
Hydrate strength:	High
Heat development:	Low
Water consumption:	Low



- Hydrates are the binding material
- CH : $Ca OH_2$ formes the alkaline negative ion OH^- which creates an anti-corrosive environment $pH \approx 12,6$

DENSIT[®] COMPONENTS EFFECT



- Microsilica, S

Reaction:

Slow

Hydrate strength:

High

Heat development:

Low

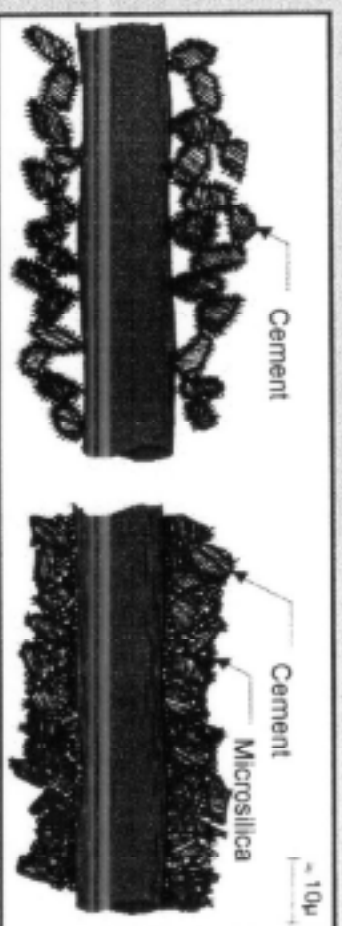
Water consumption:

Neutral

S + CH → HYDRATES



- Contributes up to 40 % of the compressive strength
- Lubricate particles like ball bearing
- Densifies the matrix
- Increases bonding to aggregates and reinforcement



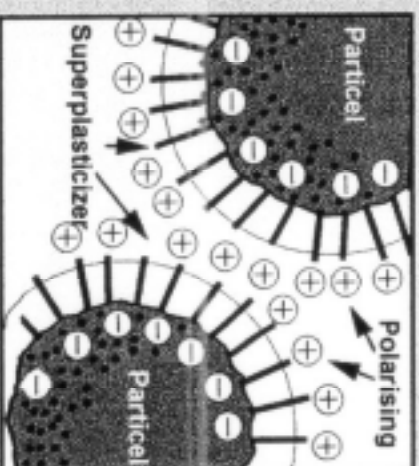
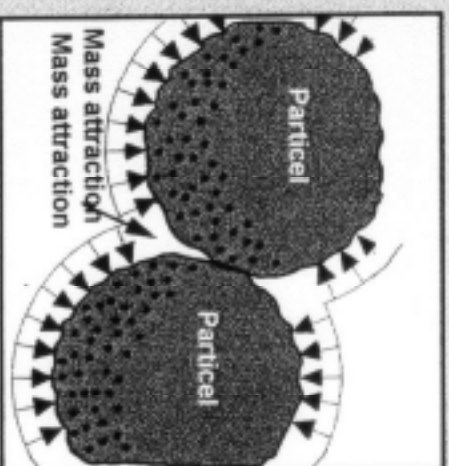
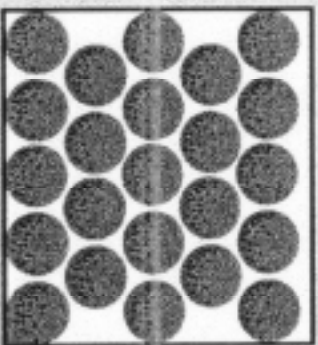
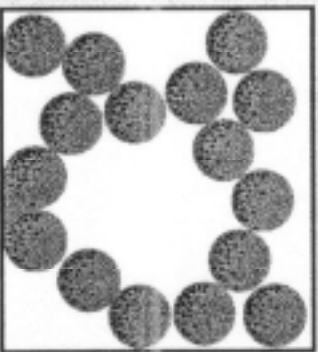
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DENSIT® COMPONENTS EFFECT



Superplasticizer

- Disables the forces of mass attraction
- Lubricates by physical blockade and electric repellent forces between particles
- Densifies the matrix by increasing particle concentration from 0,4 to 0,8



DENSIPHALT® VS. CONCRETE AND ASPHALT



PRODUCT/PAVEMENT TYPE	ADVANTAGES	DISADVANTAGES
Flexible pavement (bitumen based)	Flexible, jointless, sound dampening, fast application and ready to use	Limited strength, no/limited static load bearing capacity, dark colour
Stiff pavements (concrete)	Durable, high load bearing capacity, high wear, impact and chemical resistance and light colour	Long curing time, joints, cracks and great thickness
Densiphalt® (semi-flexible concrete asphalt)	Semi-flexible, jointless, high load bearing capacity (compared to asphalt), high wear, impact and chemical resistance, light colour, fast application and curing time	Two applications cycles, limited load bearing capacity compared to concrete

PAVEMENT TYPES



Demonstrates comparative build-up required for Densiphalt® against conventional materials:

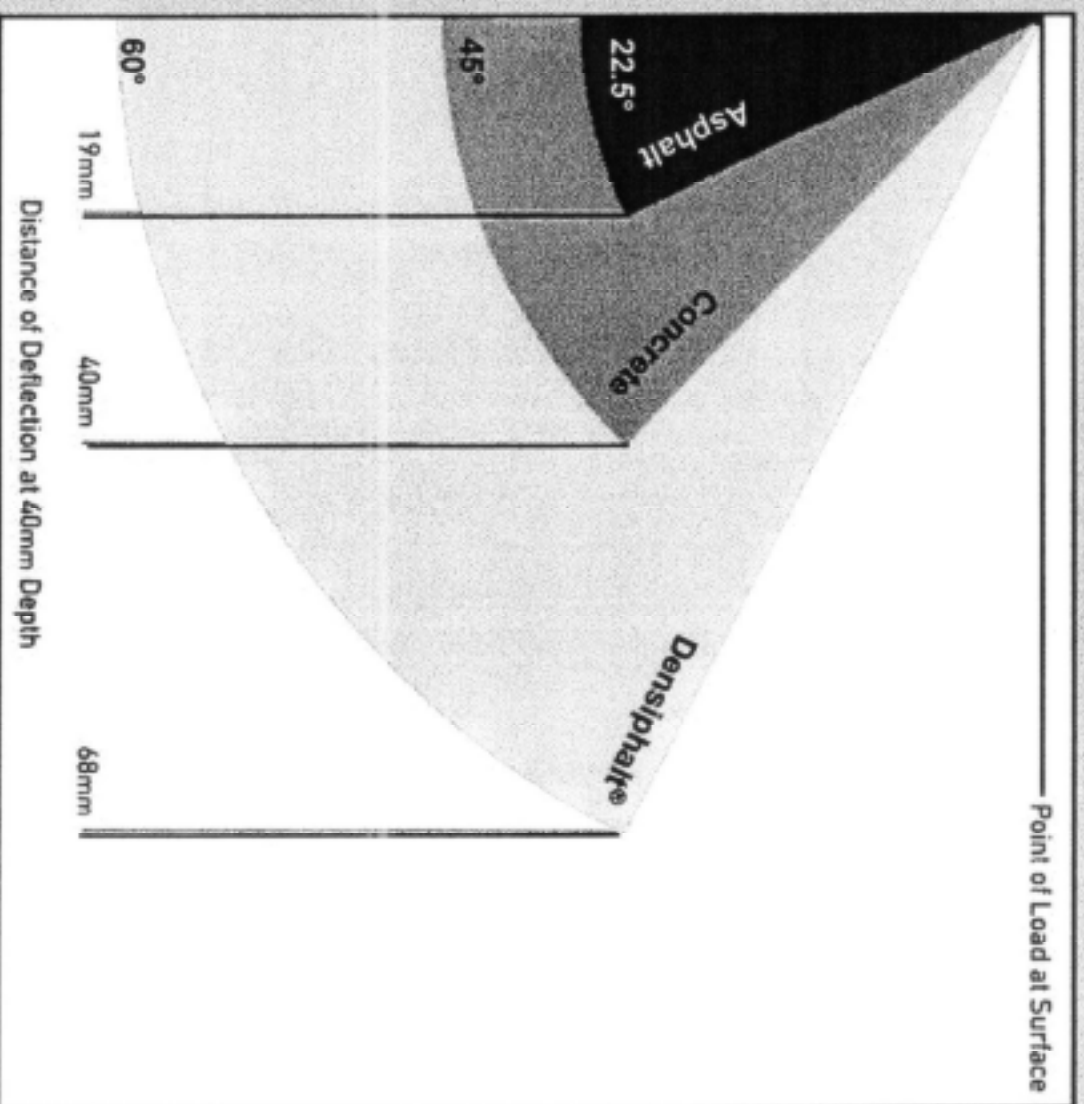
<p>DENSIPHALT®</p> <p>ROAD BASE Can be lean mix or bituminous*</p> <p>SUB BASE Can be stone or lean mix</p> <p>CAPPING Can use soil stabilisation</p> <p>SUB GRADE Subject to CBR reading</p>	<p>BITUMEN SURFACE</p> <p>BASE COURSE</p> <p>LEAN MIX ROAD BASE</p> <p>SUB BASE Can be stone or lean mix</p> <p>CAPPING Can use soil stabilisation</p> <p>SUB GRADE Subject to CBR reading</p>	<p>CONCRETE BLOCK PAVING</p> <p>LAYING COURSE</p> <p>LEAN MIX ROAD BASE</p> <p>SUB BASE Can be stone or lean mix</p> <p>CAPPING Can use soil stabilisation</p> <p>SUB GRADE Subject to CBR reading</p>	<p>PAVEMENT QUALITY CONCRETE</p> <p>SUB BASE Can be stone or lean mix</p> <p>CAPPING Can use soil stabilisation</p> <p>SUB GRADE Subject to CBR reading</p>

*In light traffic situations a road base will not be required under a Densiphalt® system

LOAD DEFLECTION

Densiphalt

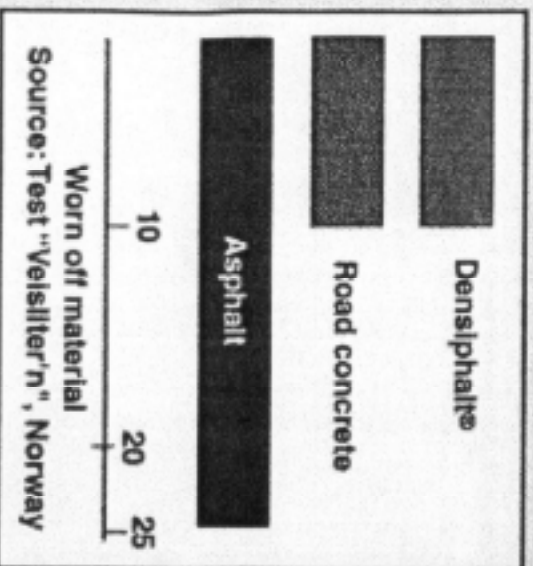
- Semi-flexibility of Densiphalt® gives:
 - Higher load deflection than both asphalt and concrete
 - Shallower construction depths
 - Cost reduction



MATERIAL PROPERTIES OF DENSIPHALT®

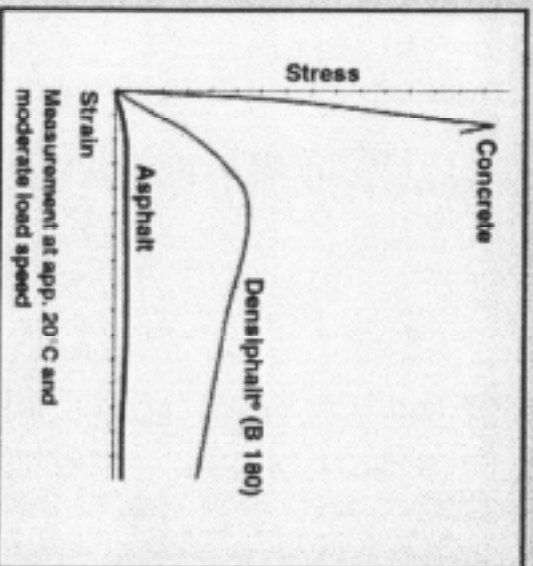
Densiphalt

Wear resistance



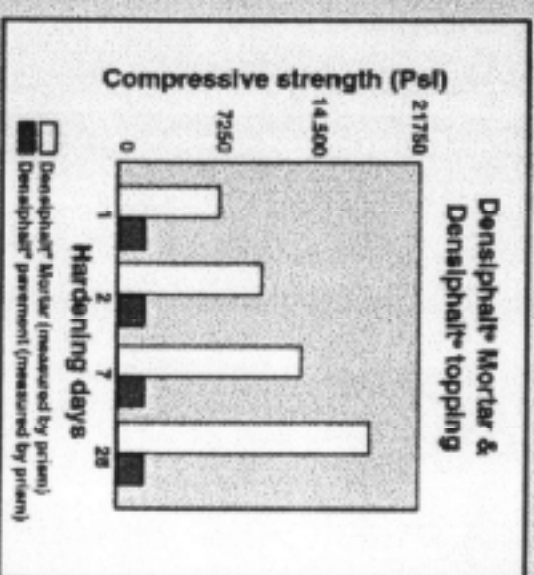
According to "Veisliter'n", Norway

Stress/strain diagram



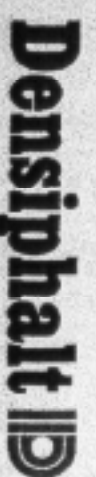
According to ISO 4013

Compressive strength

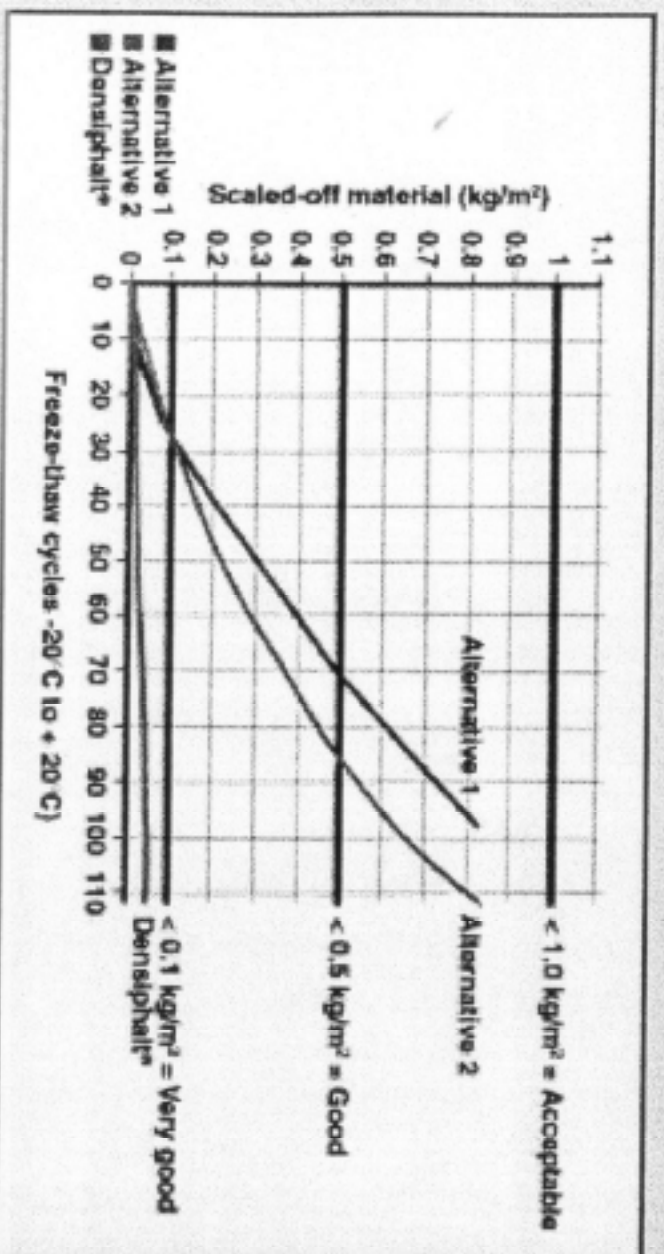


According to ISO 4012

MATERIAL PROPERTIES OF DENSIPHALT®

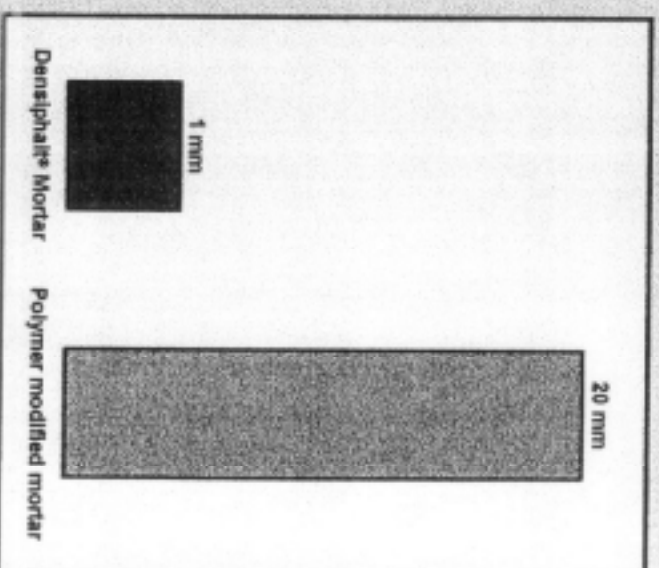


Freeze-thaw scaling



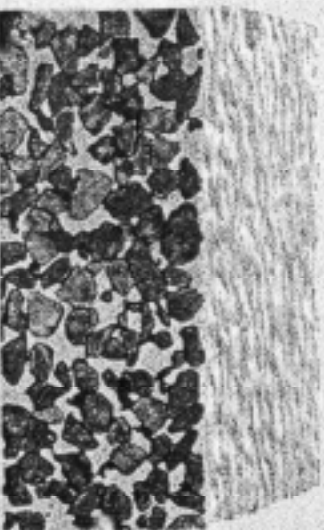
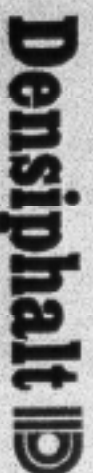
According to frost resistance test SS 137244

Water permeability



According to DIN 1048

DATA SHEET FOR DENSI PHALT®



CONSUMPTION	per m ²
Densiphalt® per mm thickness	0.55 kg
Densit® Curing Compound	0.25 kg
Densidur 00	3-4 kg

SPECIFICATION

The base course is sealed with bitumen emulsion. The open-graded asphalt is laid (special recipe). The dry Densiphalt® mortar is mixed with water in a special continuous flow mixer or batch mixer. The open-graded asphalt is filled with Densiphalt® mortar. The surface is finished with a rubber scraper. Finally, the surface is sealed with Densit® Curing Compound or by sand saturation with e.g. Densidur 00.

Densiphalt® system

- mortar and asphalt


The properties depend upon curing temperature. The data given are typical for curing at 20°C.

PROPERTY	Standard	Value	1 day	7 days	28 days
Compressive strength (MPa)	BS 1881		5-7	7-10	8-12
Dynamic E modulus (MPa)	DWW 94530	10.000-14.000			
Wear resistance (cm ³ /50 cm ²)	DIN 52 108	7-8			
Freeze-thaw resistance	SS 137244	Very good			
Impermeability	DIN 18130	Non-permeabel			
Slip resistance	BS 812: 1989	50-60; 80 SRT ¹⁾			
Coefficient of expansion	EN 1770	$\alpha_n = 12.5 \cdot 10^{-6}/^{\circ}\text{C}$			
Electrical conductivity (S)	DIN 51953	approx. 10^6 ²⁾ - approx. 10^7 ³⁾			
¹⁾ Standard and shot-blasted surfaces respectively. ²⁾ Resistance through layer. ³⁾ Surface resistance.					
Compressive strength (MPa)	EN 12190		50	80	110
Flexural strength (MPa)	EN 196		7	12	15
Density (kg/m ³)	EN 12190	2200-2250			
Setting time (hours)	EN 196-3	7-9			

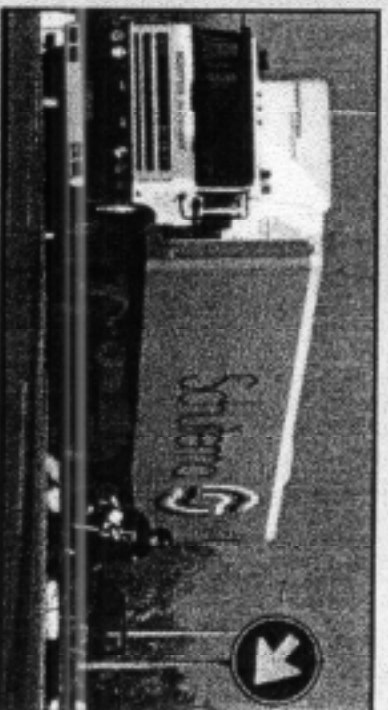
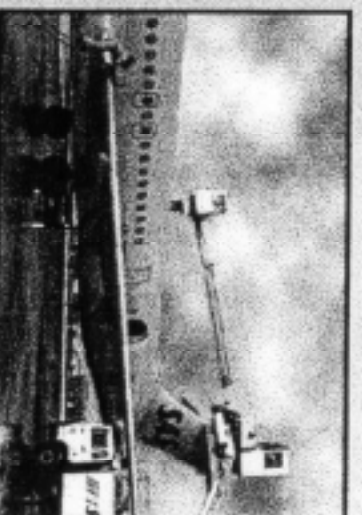
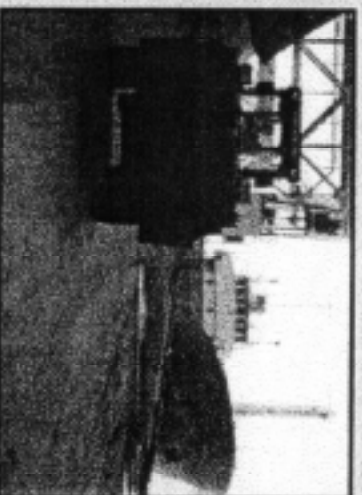
Densiphalt® - mortar

For further information, please refer to the TECHNICAL INFORMATION section of the catalogue, and the Densiphalt® Handbook.

FUNCTIONAL DEMANDS TO DENSIPHALT®

Densiphalt 

- Minimum maintenance
- Freeze/thaw resistance
- Resistant to heavy static loads
- High wear and skid resistance
- Resistance to rutting and thermal movement
- Impermeable and resistant to liquids and fuels

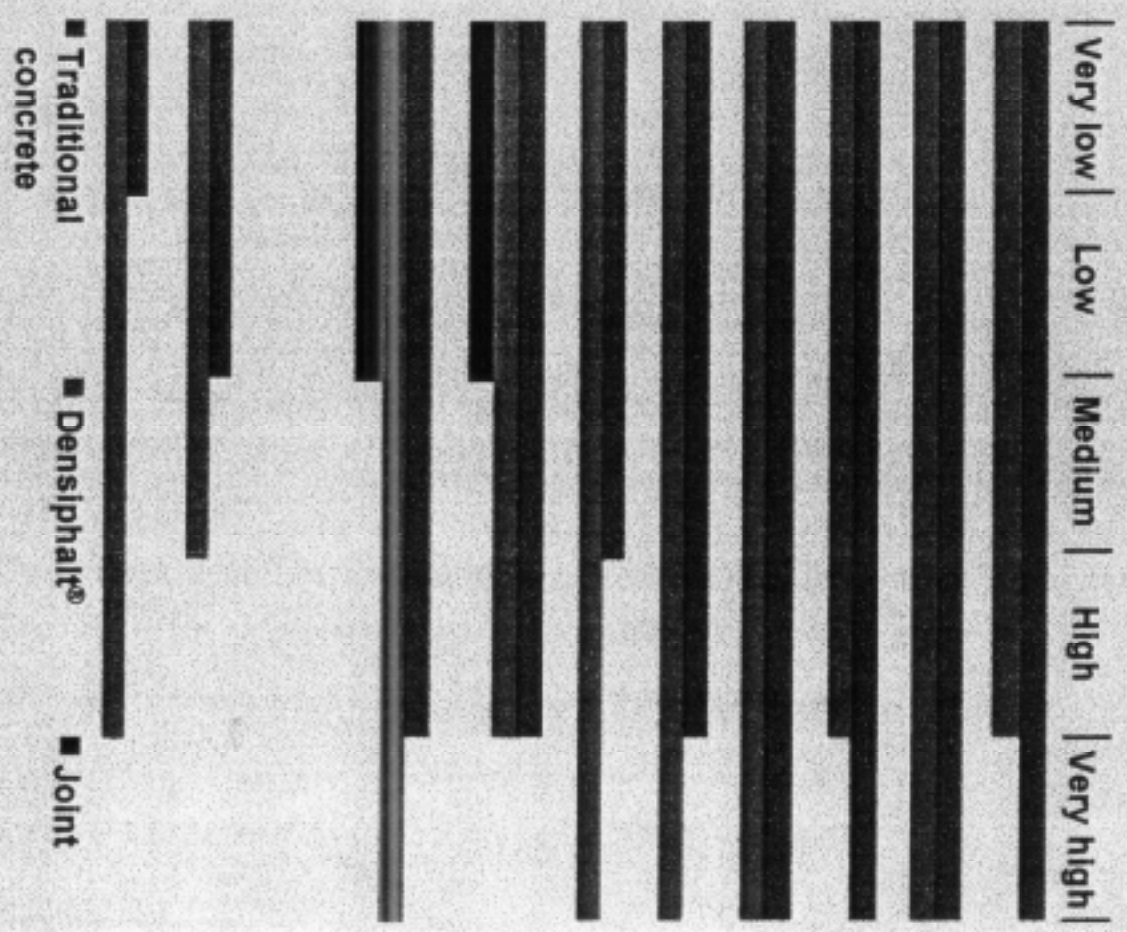


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DENSIPHALT® PERFORMANCE



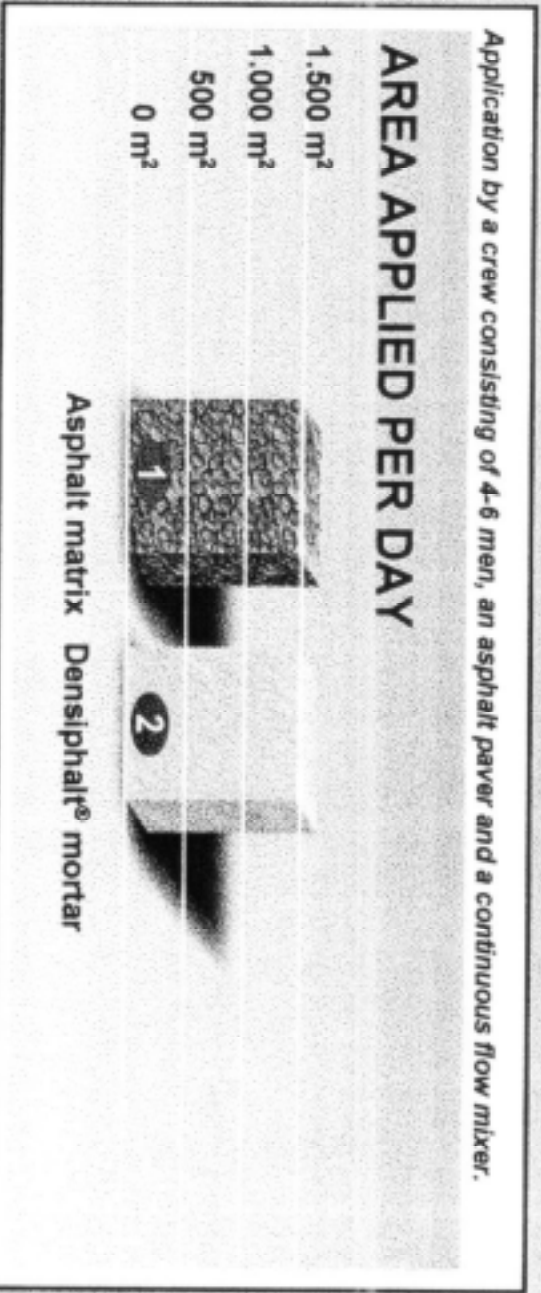
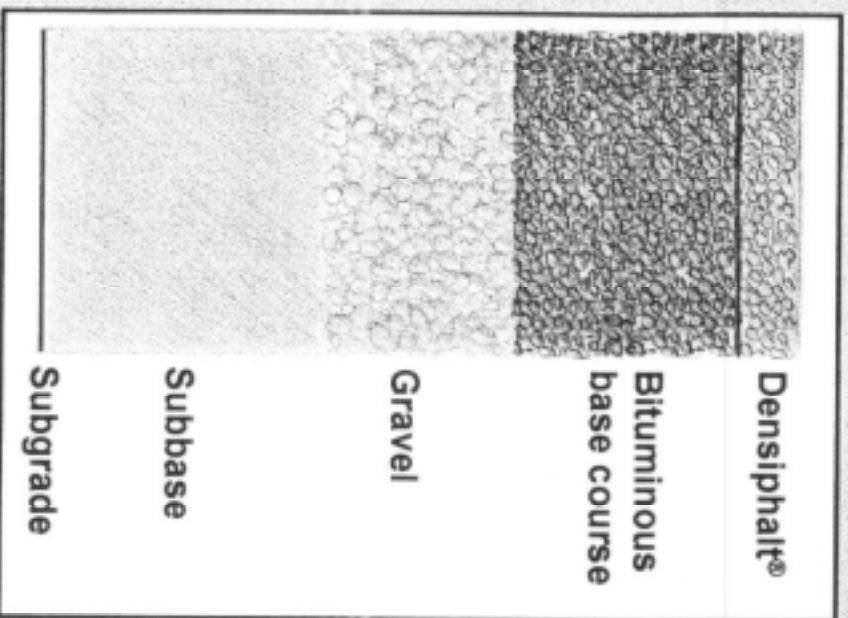
- Pavement performance
 - > Static loads
 - > Wear resistant
 - > Resistant to rutting
 - > Skid resistance
 - > Freeze/thaw resistant
 - > Resistant to thermal movements
 - > Impermeable and resistant to De-icing liquids and spill from jet-fuel
 - > Minimum maintenance
- Repair
 - > Application speed
 - > Ready to use



DENSIPHALT® BASE COURSE NEW BUILDING



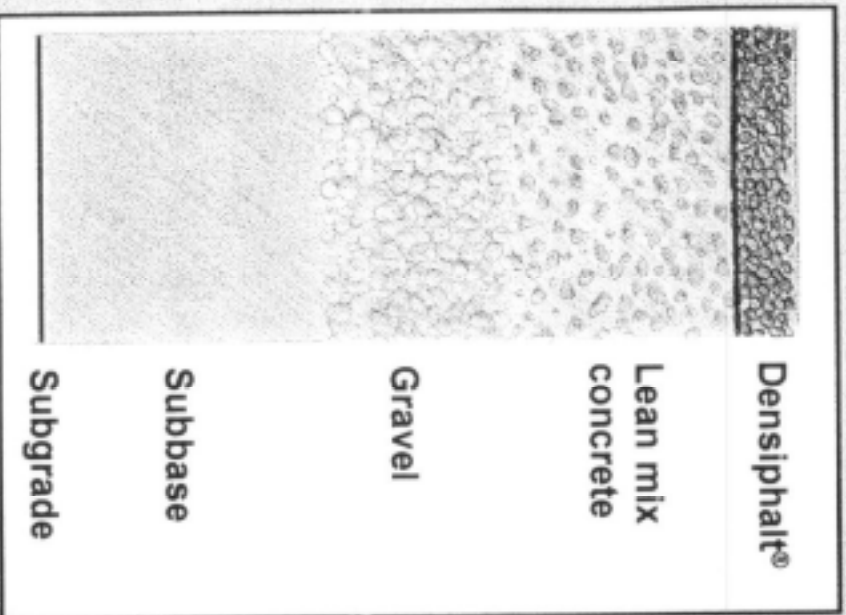
- Bituminous base course



DENSIPHALT® BASE COURSE NEW BUILDING

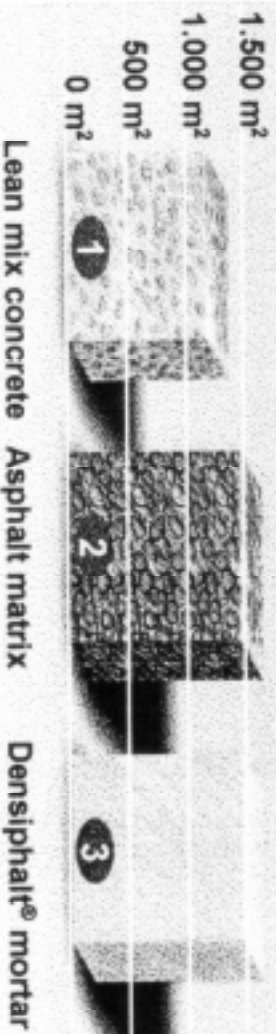


- Lean mix concrete



Application by a crew consisting of 4-6 men, an asphalt paver and a continuous flow mixer.

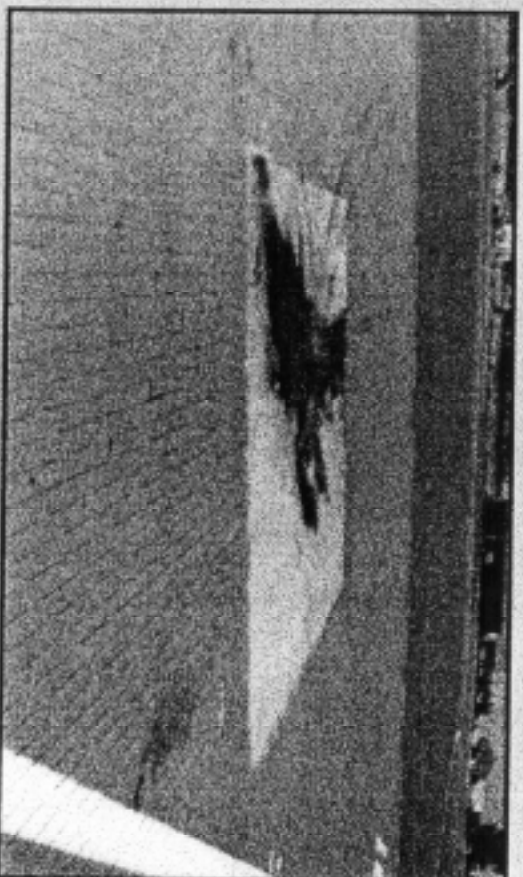
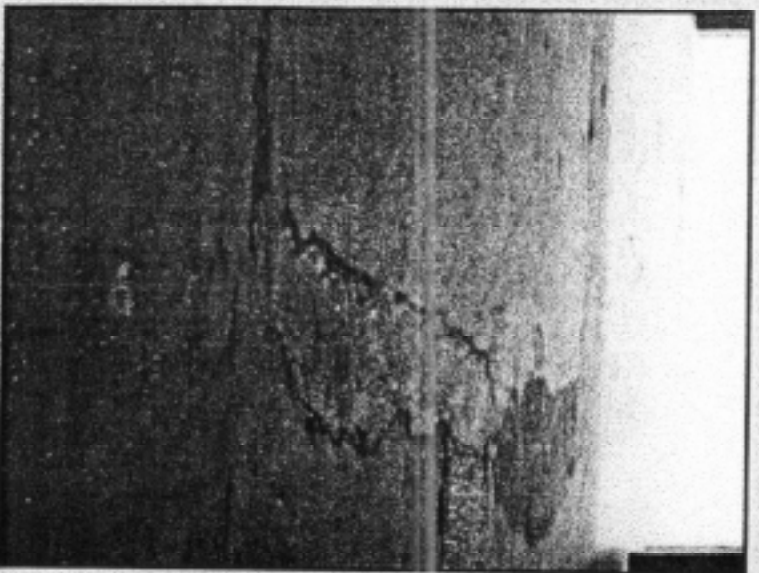
AREA APPLIED PER DAY



DENSIPHALT® BASES COURSE REFURBISHMENT

Densiphalt 

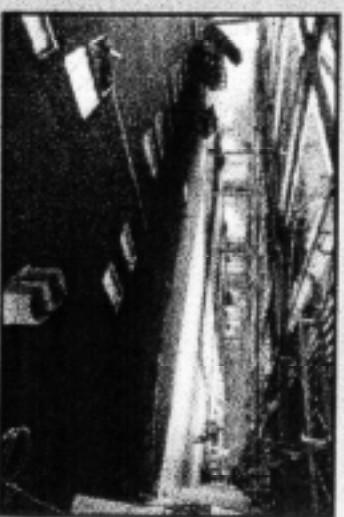
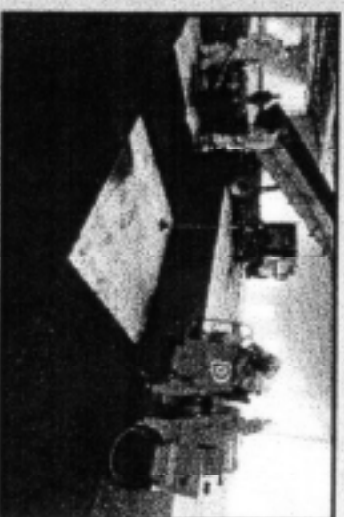
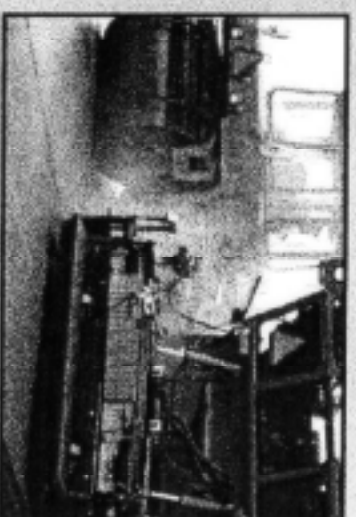
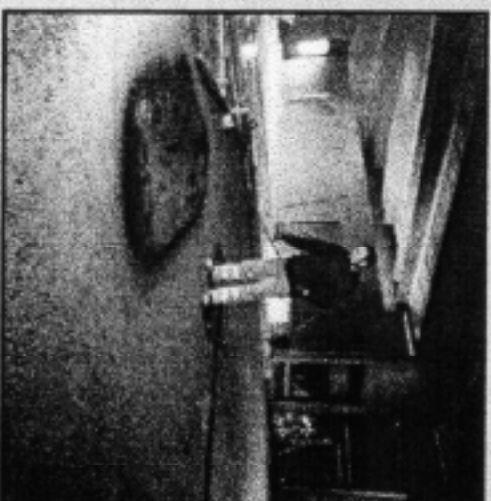
- Refurbishment
 - > Concrete paving blocks
 - > Concrete (joint cut/slabs)
 - > Asphalt



INSTALLATION OF DENSIPHALT® ASPHALT

Densiphalt

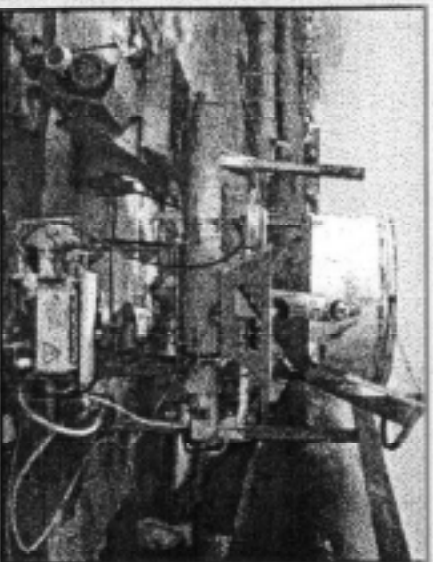
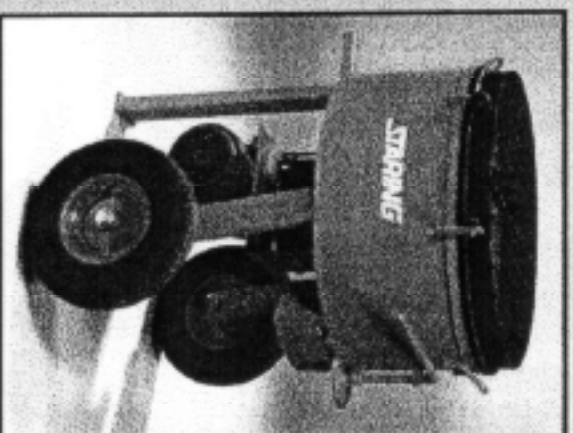
- Tack coating
 - > Asphalt: 300-700 g/m²
 - > Lean mix: 700-900 g/m²
- Installation of open-graduated asphalt
 - > Regular paving equipment
 - > Smooth-wheeled non-vibrating roller
 - > Soap water for lubrication
- Cooling of asphalt (T < 30°C)
- Cover the asphalt with plastic



MIXING OF DENSIPHALT® GROUT

Densiphalt

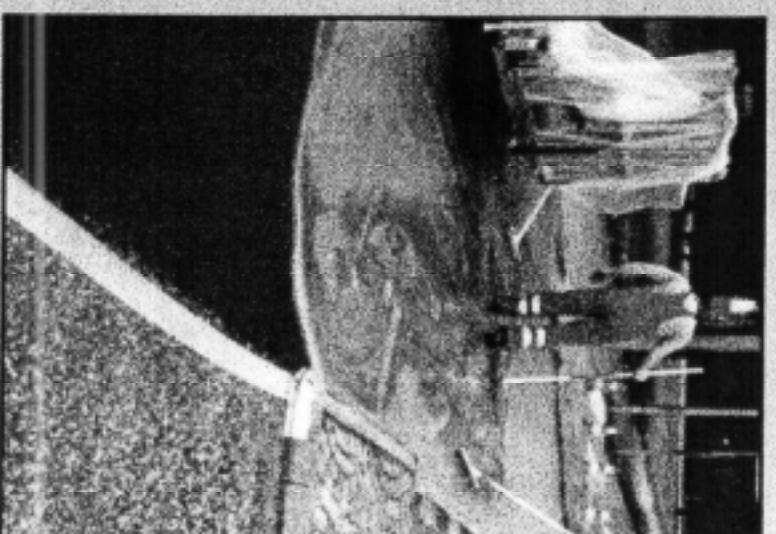
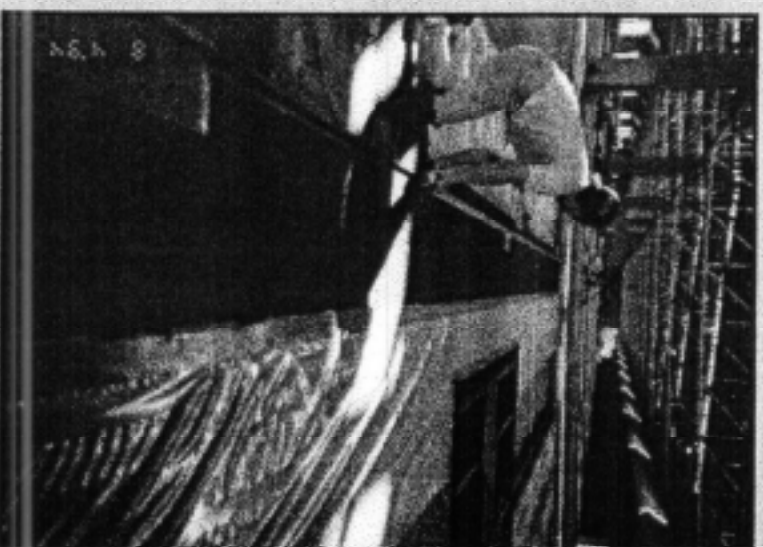
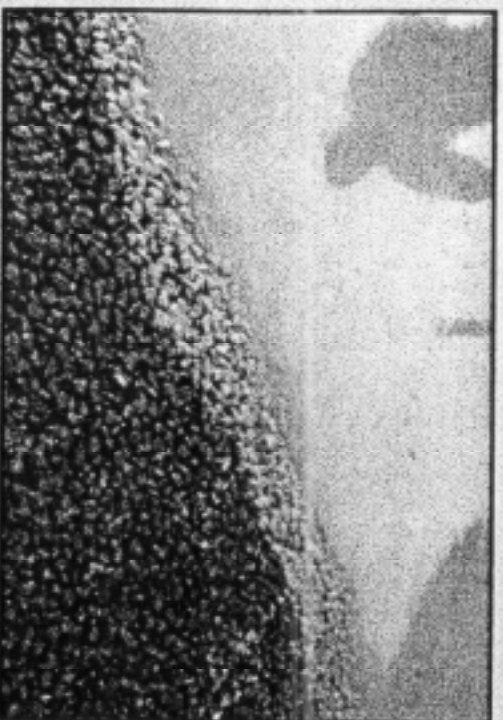
- Putzmeister or panmixer
- Panmixer: 60 m²/hour with a crew of 5 to 6
- Continuous mixer: 300 m²/hour with crew of 5 to 6
- Ready-mix concrete plant
- Inspection: flow time for 1 litre Densiphalt® through a special funnel (min. 10 sec. and max. 18 sec.)



PREPARING FOR DENSIPHALT® GROUT

Densiphalt 

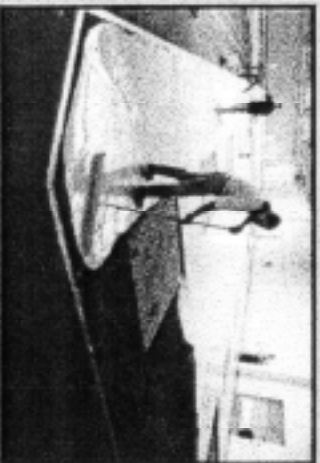
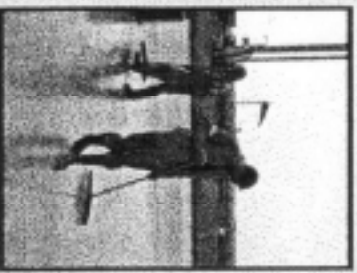
- Sealing of manholes, drains or sewer systems
- In case of colouring, taping and covering of areas



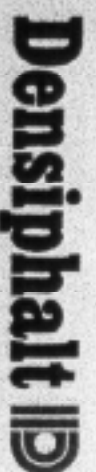
INSTALLATION OF DENSIPHALT® MORTAR

Densiphalt 

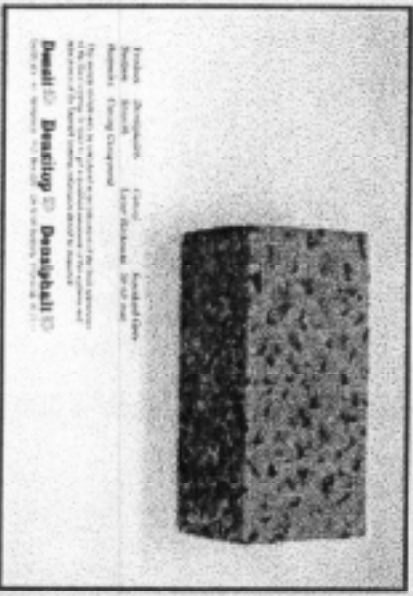
- Distribution of Densiphalt® mortar
- Penetration for approx. 10 min.
- Complete penetration (5-6 kg/m²/cm)
- No vibration or power floating
- Addition of mortar for filling the asphalt mix
- Scraping with rubber scrapers



FINISHED SURFACE OF DENSIPHALT®



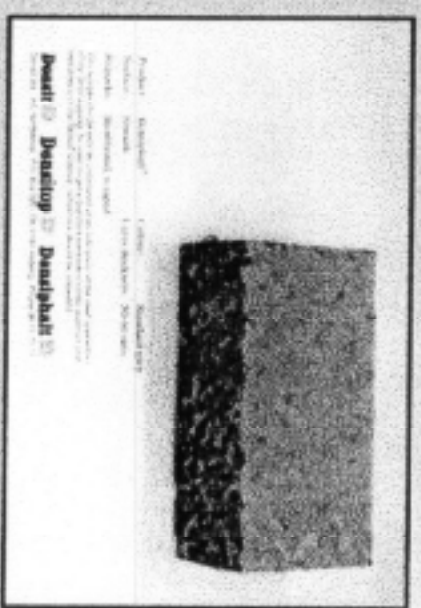
Standard



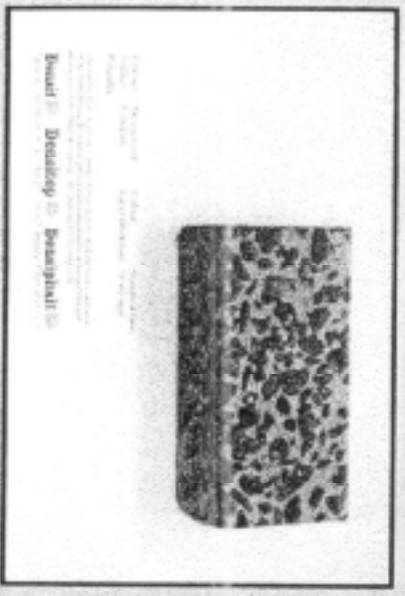
Shot blasted



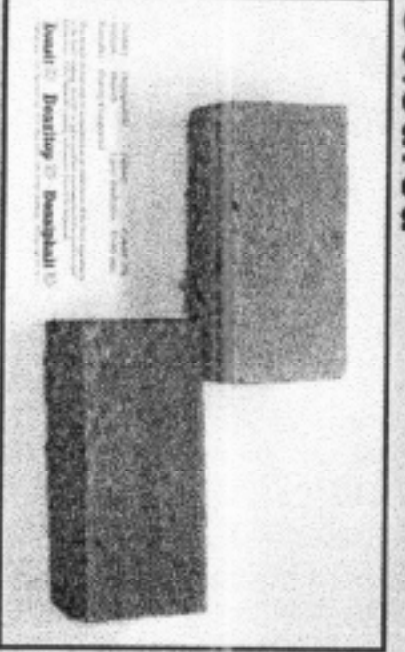
Skim coated



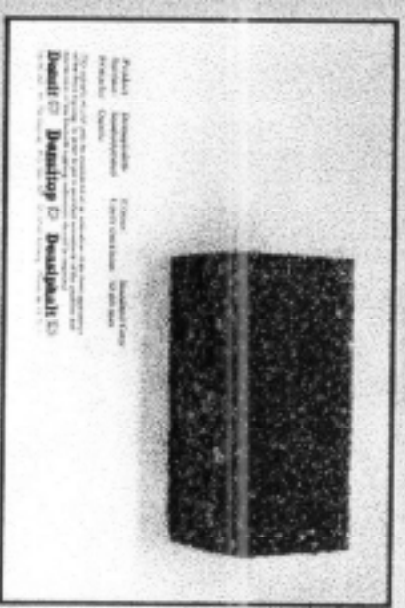
Polished



Coloured



Sand saturated

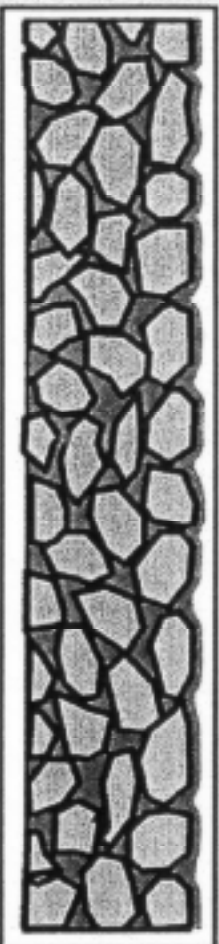


Densiphalt® can be coloured in: White, Red, Green, Blue, Yellow etc.
 Densiphalt® can be sand saturated in: White, Red, Green, Blue, Yellow etc.

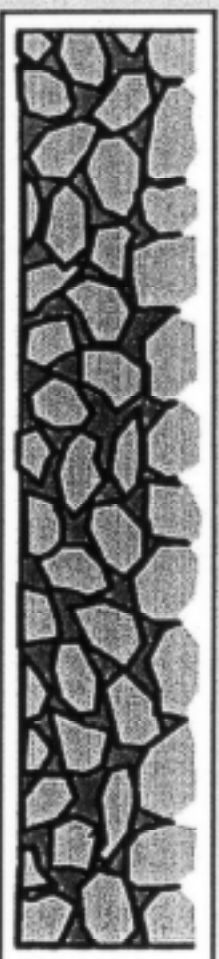
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SURFACES OF DENSIPHALT®

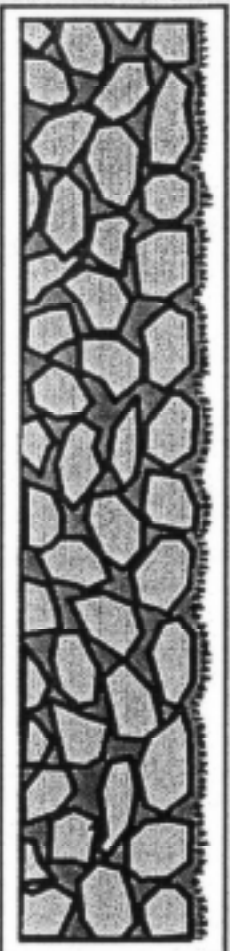
Densiphalt 



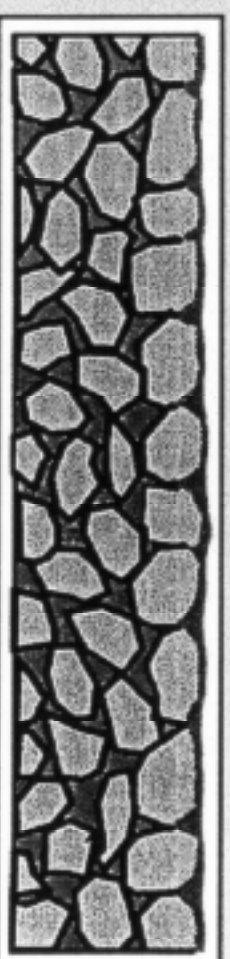
Standard



Shotblasted



Sandsaturated



Skimcoated



Broomed

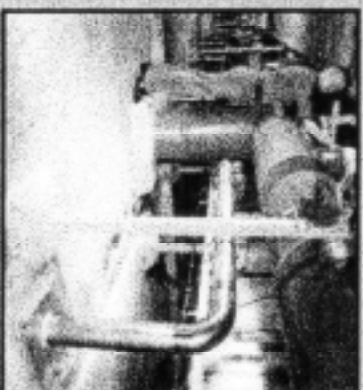
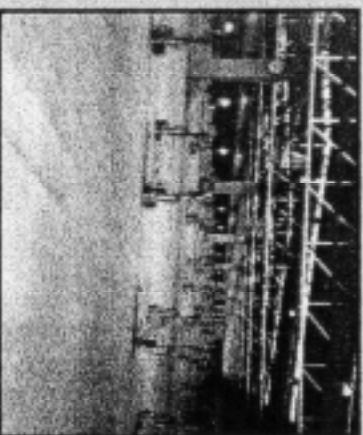
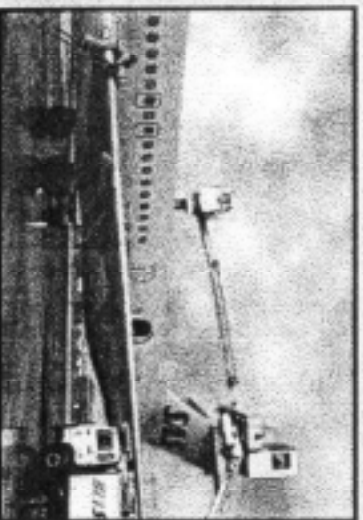
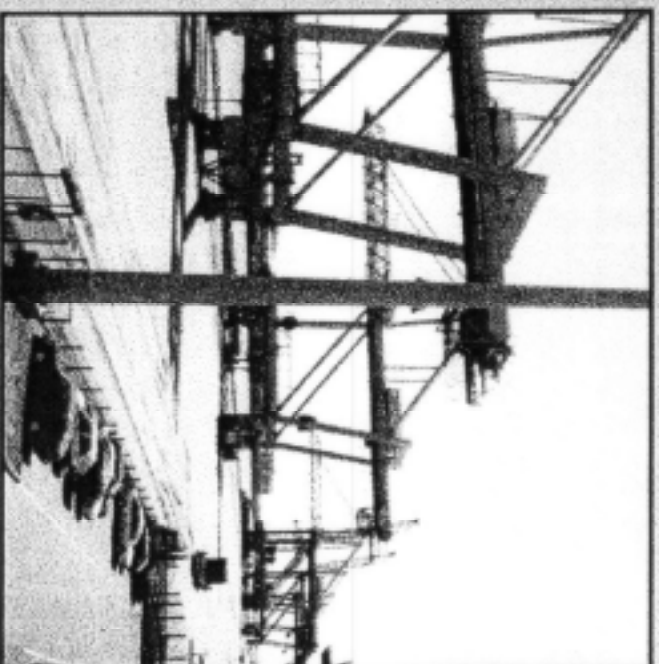


Polished


DENSIPHALT® APPLICATION TARGETS

Densiphalt 

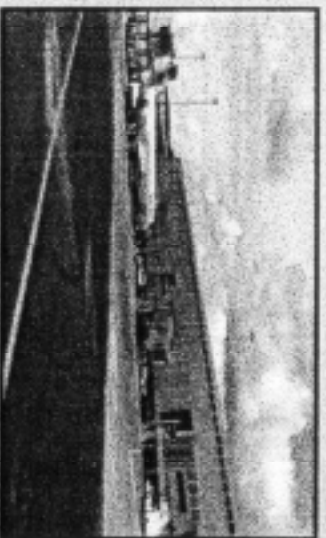
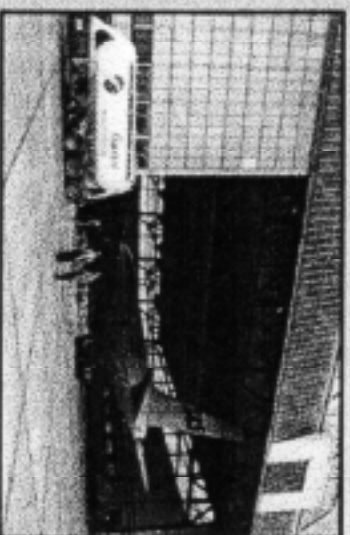
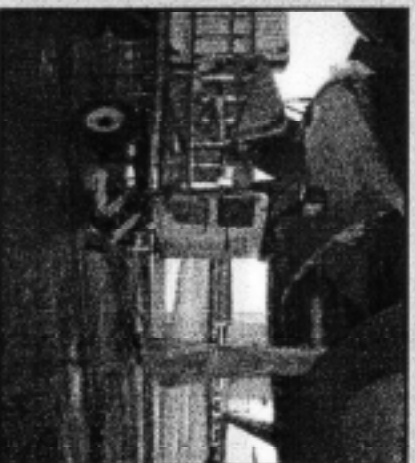
- Airports
- Harbours
- Car parks and heavy trafficked surfaces
- Warehouses/distributions centres
- Supermarkets/retail
- Light industry



DENSIPHALT® IN AIRPORTS

Densiphalt 

- Aircraft aprons
- Push-back areas
- Apron taxi ways
- Taxi-holding positions
- Holding bays
- Refuelling pads
- De-icing areas
- Runway ends
- Hangars and cargo centres

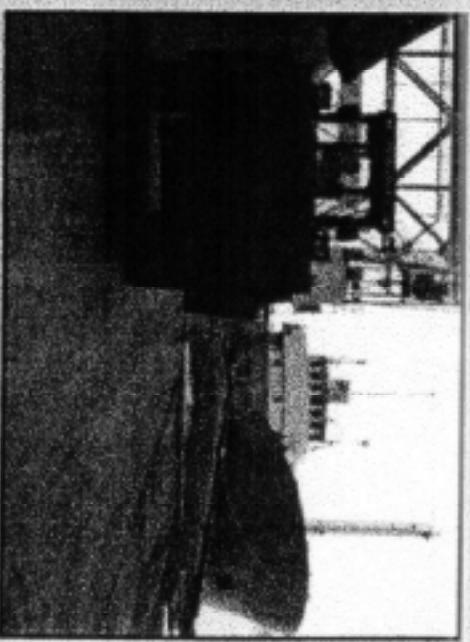
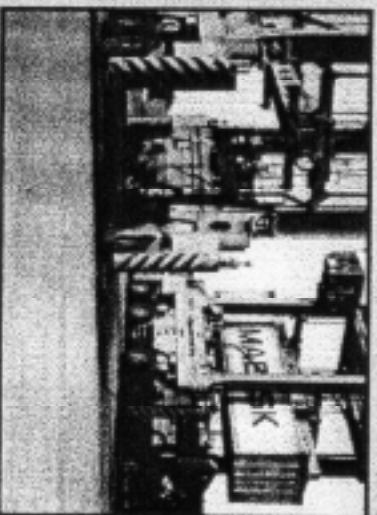
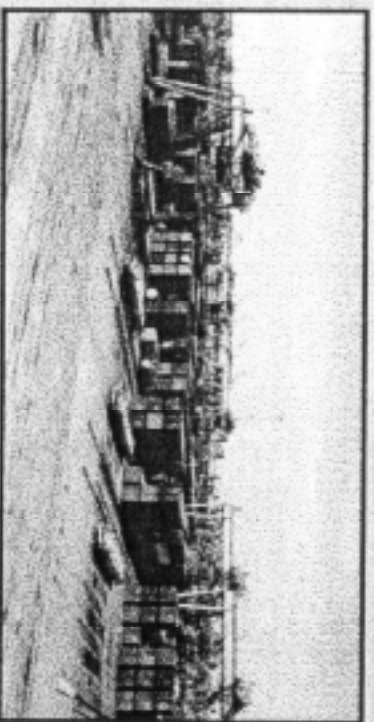
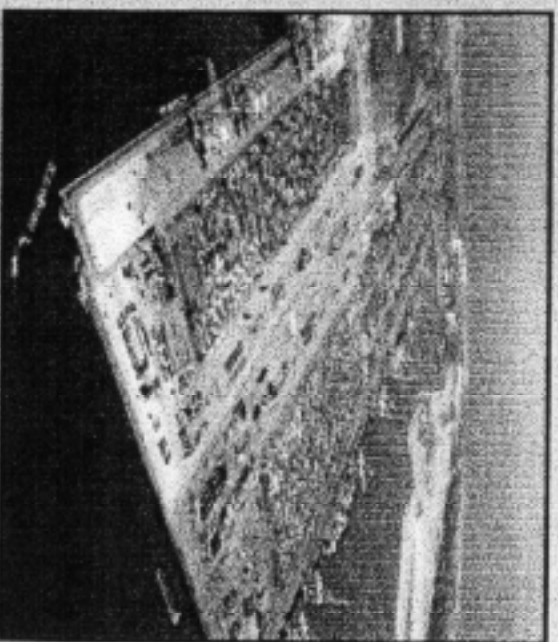
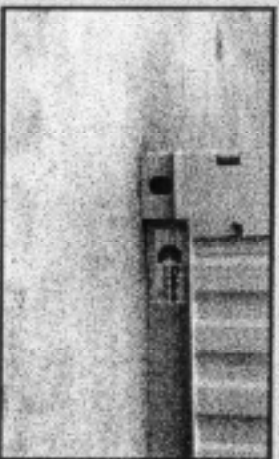


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DENSIPHALT® IN HARBOURS

Densiphalt 

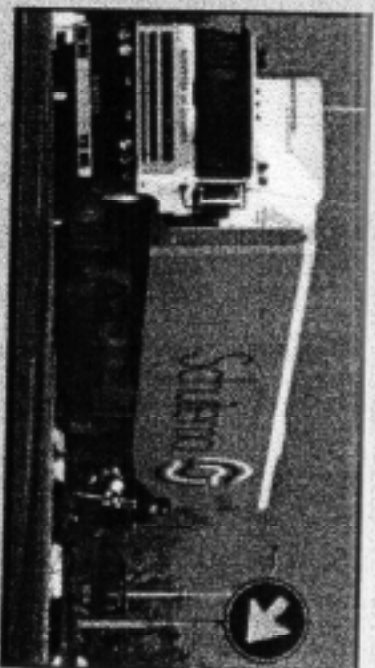
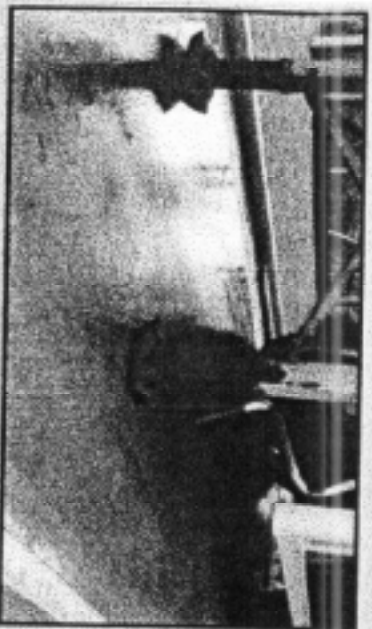
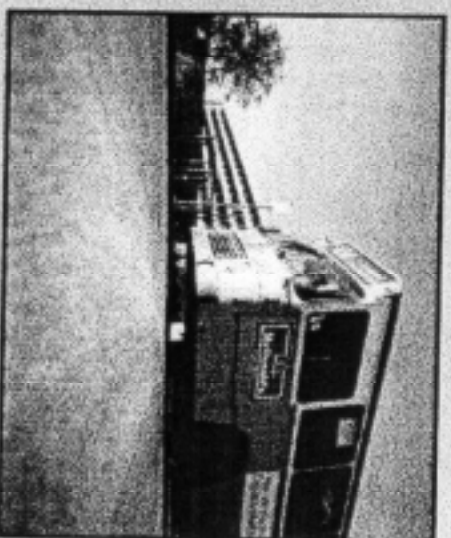
- Container terminals
- General cargo terminals
- Ro/Ro and Lo/Lo terminals
- Bulk terminals
- Harbour storage and warehouse facilities



DENSIPHALT® IN HEAVY TRAFFICKED SURFACES


Densiphalt 

- Bus lay-bys
- Bus and car terminals
- Heavily trafficked roads
- Crossroads and roundabouts
- Driveways
- Loading and unloading bays

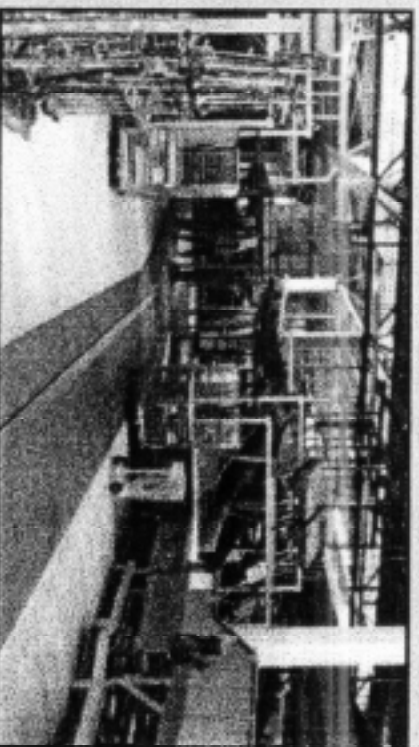
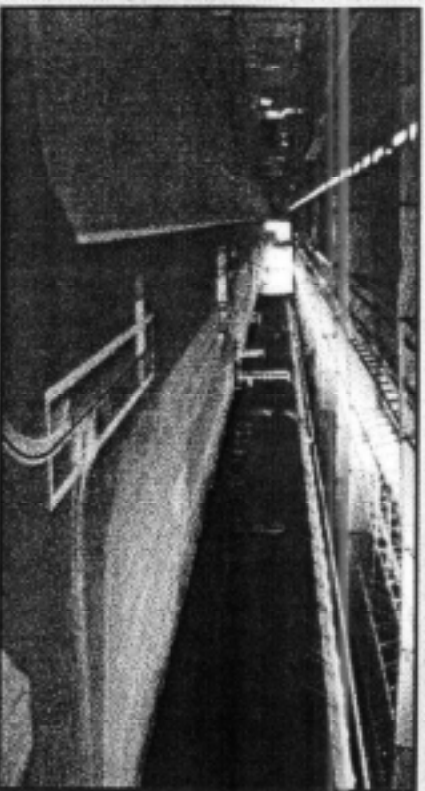
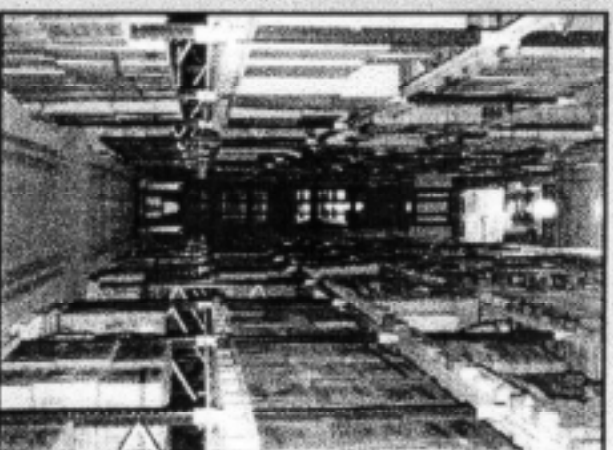


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DENSIPHALT® IN WAREHOUSES/ DISTRIBUTION CENTRES

Densiphalt 

- Warehouses
- Pallet shelf storage
- Low and high shelf storage
- Pick storage
- Cargo centres
- Distribution centres
- Goods terminals

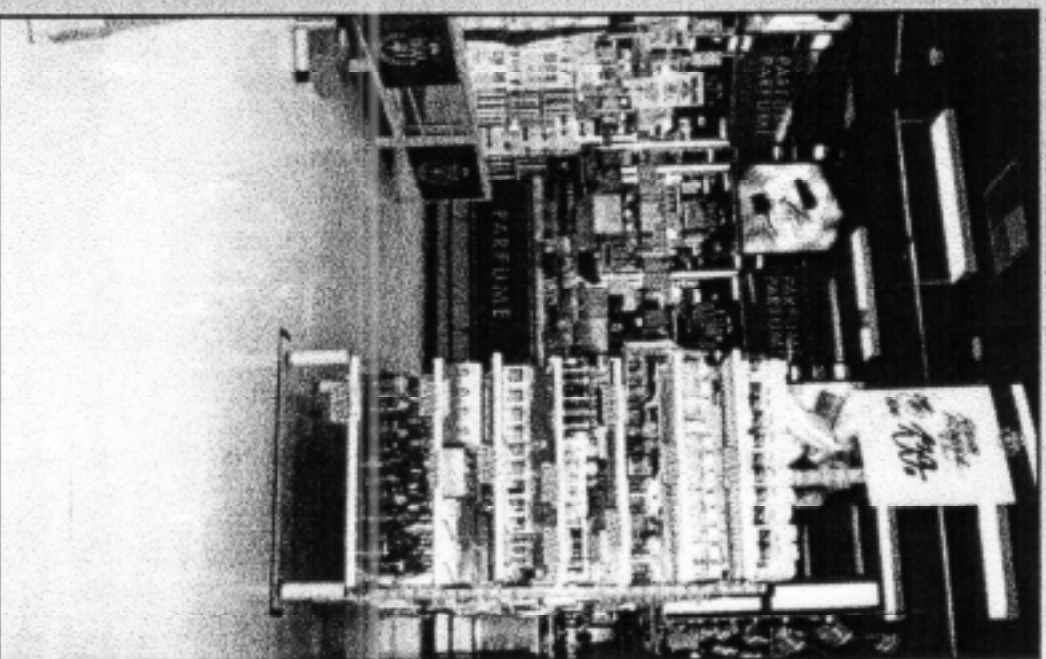
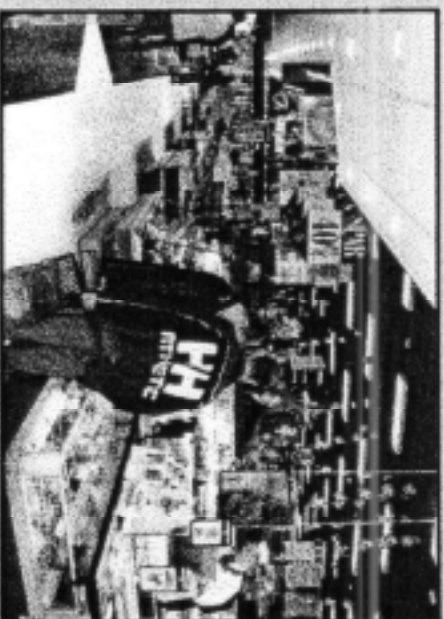


TECHNOLOGY • APPLICATION • FINISHES • TARGETS • CASES

DENSIPHALT® IN SUPERMARKETS/RETAIL

Densiphalt 

- Shops
- Sales places
- Display rooms
- Storages
- Loading bays

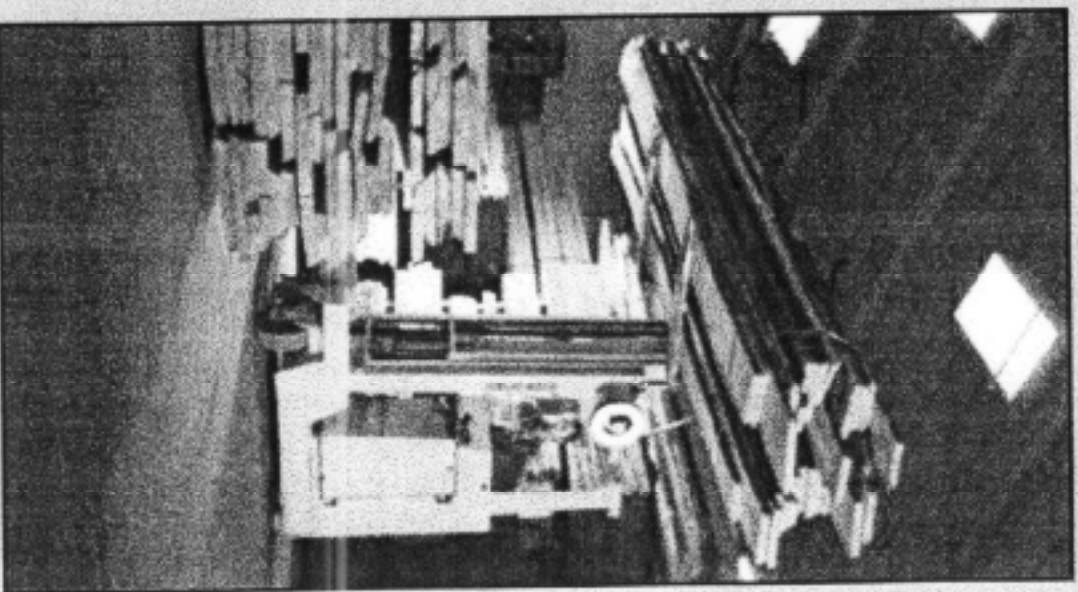
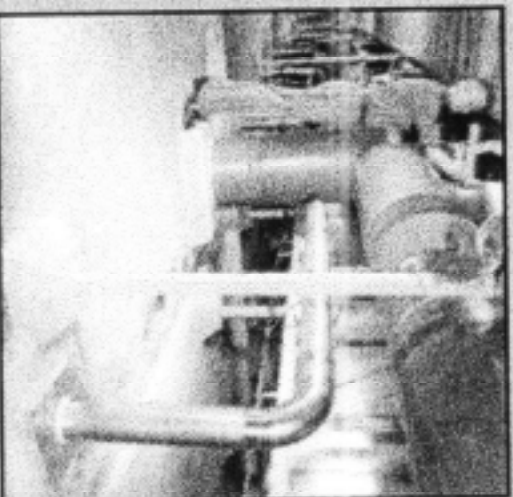
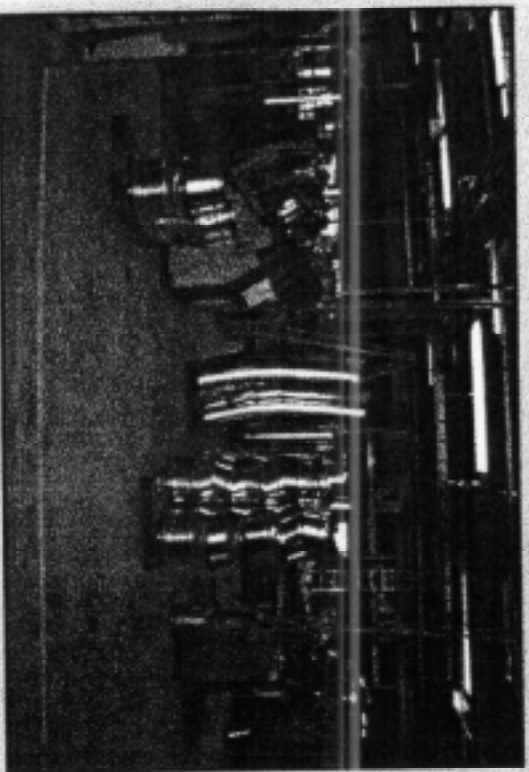


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DENSIPHALT® IN LIGHT INDUSTRY

Densiphalt 

- Electronic industry
- Production halls
- Wood processing industry
- Plastic industry
- Textile industry



TECHNOLOGY • APPLICATION • FINISHES • TARGETS • CASES

CASE STORY - PORT OF ROTTERDAM

Densiphalt

- Container terminal project
 - > 170.000 m² owned by Europe Container Terminal
 - > The world's largest port with 5.5 mio. TEU's

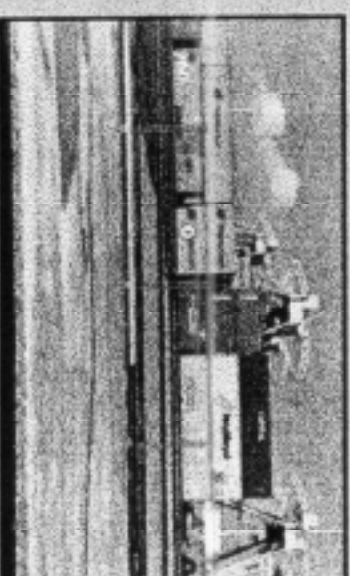
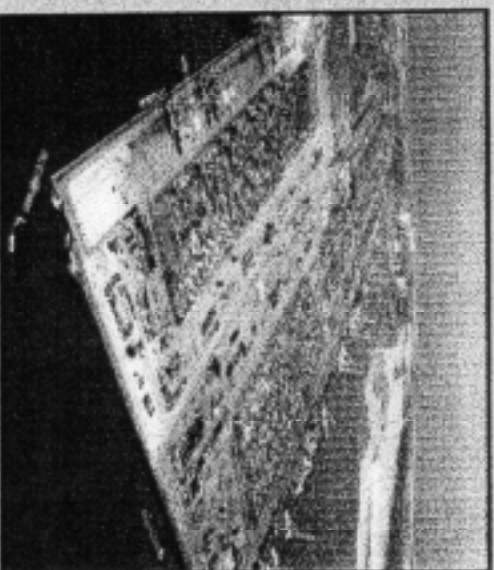
After the removal of the paving blocks and grinding of the existing underlying cement bound material, the Densiphalt® pavements were laid in accordance with the following design.

Densiphalt®	40 mm
Polymer modified asphalt	80 mm
Polymer modified asphalt	80 mm
E = 4000 MPa design value	
CBM	200 mm
(50 % crushed aggregates 0/40 mm)	
E = 6500 MPa	Compressive strength: 8-10 MPa
CBM	450 mm
(Cement bound material with sand)	
E = 6500 MPa	Compressive strength: 3,5 MPa
Subgrade	
CBR = 15 %	

DESIGN LOAD

- 20 tons single wheel load.
- 100 containers pr. Hour.
- No container storage.

In the year 2000, a new container terminal project consisting of approximately 75,000 square metres new building was paved with Densiphalt®.



CASE STORY - COPENHAGEN AIRPORT

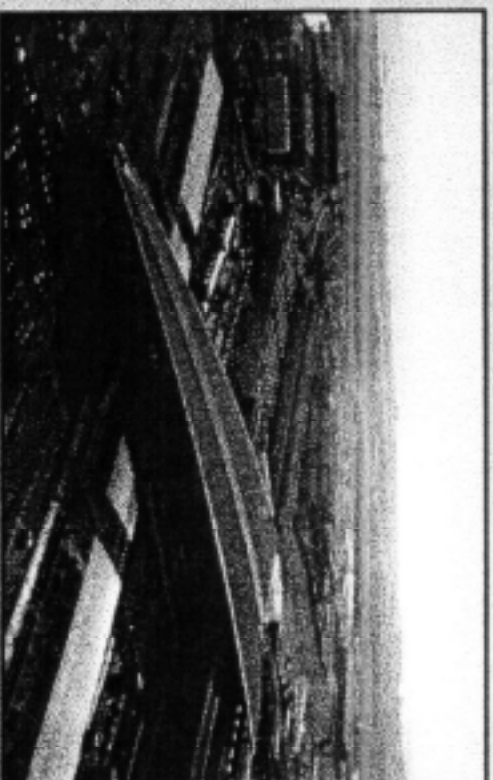
Densiphalt

- Airport with annual 17 mio. Passengers, 380.000 tonnes freight
 - Primary airport for SAS with direct connection to more than 125 airports

The aprons are designed to withstand category C aircrafts and have the following pavement design:

Densiphalt®	50 mm
E = 8000 MPa design value	
Bituminous binder course	50 mm
E = 5000 MPa	
Bituminous binder course	150 mm
E = 2000 MPa	
Recycled concrete	200 mm
E = 500 MPa	
Frost protection	400 mm
E = 500 MPa	
Subbase	
E = 50 MPa	

The airport comprises an area of 12.4 square kilometres, and has three runways, three passenger terminals and 114 aprons. In accordance with the general increase in air traffic, the airport undergoes constant expansion.

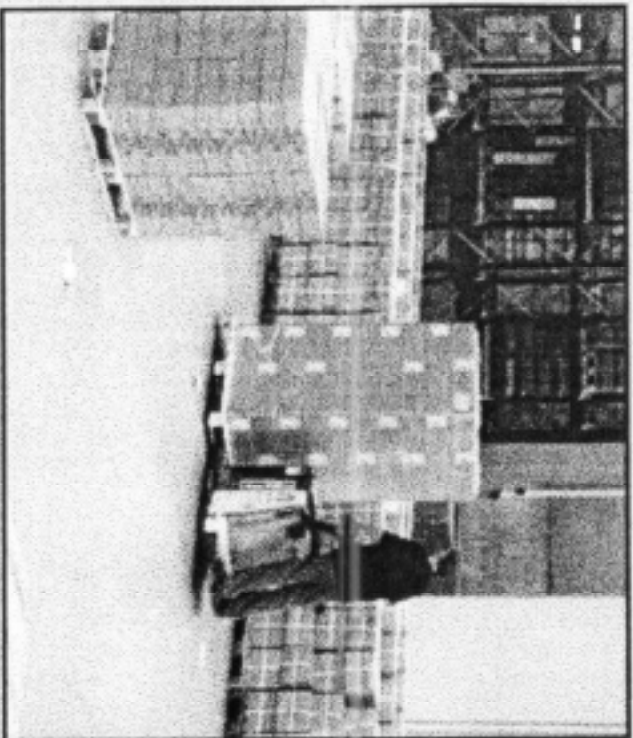


CASE STORY - JYSK SENGETØJSLAGER

Densiphalt 

- Denmark's largest retail chain in household, linen and furnitures
 - More than 600 outlets in Denmark, Sweden, Norway, Germany, Polen etc.

In 1996 the old warehouse was extended with a new warehouse building of 11,000 square metres, which was surfaced with Densiphalt®.



The levelness of the flooring is of great importance because the narrow forklift trucks must reach up to a height of 10 metres during goods handling. Even the slightest unevenness will cause imbalance of the forklift truck, resulting in unnecessary wear on the vehicle and slower goods handling. Resistance to rutting in the floor is of equal importance, since the vehicles drive repeatedly along the same routes, not least in the corridors.

