



Maintenance and repair techniques for concrete slabs

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Facts of OAT

- Est. 1977
- 100% family-owned business
- 7 branches with 250 employees in Germany
- 40 million EUR turnover
- Germany's leader in the branch "traffic pavement preservation"
- Affiliates Europe-wide and projects worldwide



OAT Services

- Joint renewal
- Concrete repair with resin-based mortars, cross stitching, crack sealing and so on
- Grooving and Grinding
- Lifting and stabilizing of slabs
- Replacement of single and consecutive slabs with fast-hardening concretes or precast concrete slabs



OAT Services

- Deep cuts and joint works
- Bridge joints (Asphalt / PUR)
- Rail joints and rail underfilling
- Exposed aggregate concrete surfaces
- Thin layers of cold-applied asphalt (DSK, DSK-AIR)



ZTV BEB-StB 15

Forschungsgesellschaft für Straßen- und Verkehrswesen



Arbeitsgruppe Betonbauweisen

Zusätzliche Technische
Vertragsbedingungen und Richtlinien
für die Bauliche Erhaltung
von Verkehrsflächenbefestigungen
– Betonbauweisen

R 1

ZTV BEB-StB

Ausgabe 2015



Condition characteristics/ Damage characteristics		Appearance Cause	Structural maintenance
Evenness	<i>Evenness in the longitudinal profile</i>	<i>Slab offset</i>	- Maintenance - Repair - Renewal
		<i>Changed bedding conditions</i>	
	<i>Evenness in the transverse profile</i>	<i>Slab offset</i>	
		<i>Changed bedding conditions</i>	
Roughness	<i>Skid resistance</i>	<i>Polished surface</i>	
		<i>Wear</i>	
Substance characteristics	<i>Longitudinal and transverse cracks</i>		
	<i>Damaged edges and broken corners</i>		
Damage characteristics	<i>Defective joint filling</i>		
	<i>Miscellaneous surface damages</i>		

Image 1: Features for concrete driving surfaces, source: ZTV BEB-StB 15

Methods in this presentation

- Cross stitching
- Partial depth repair
- Lifting and stabilizing of slabs
- Full depth repair



Maintenance

Appearance	Maintenance methods according to Section				
	2.3.3.1 <i>Repairing joint fillings</i>	2.3.3.2 <i>cutting and sealing of cracks</i>	2.3.3.3 <i>Dowelling and anchoring</i>	2.3.3.4 <i>Repairing damaged edges and broken corners</i>	2.3.3.5 <i>Concrete surface work</i>
<i>Polished surface</i>	-	-	-	-	-
<i>Defective joint filling</i>	+	-	-	-	-
<i>Vertical slab movements</i>	-	-	+	-	-
<i>Longitudinal and transverse cracks</i>	-	+	+1)	-	-
<i>Damaged edges and broken corners</i>	-	-	-	+	-
<i>Surface damage</i>	-	-	-	-	+
<i>Insufficient surface drainage</i>	-	-	-	-	+
<i>Step formation at joints and cracks</i>	-	-	-	-	+2)
<i>Noisy surface</i>	-	-	-	0	+3)

+ suitable, 0 conditionally suitable, - not suitable

Table 2: Maintenance methods, source: ZTV BEB-StB 15



Cross stitching

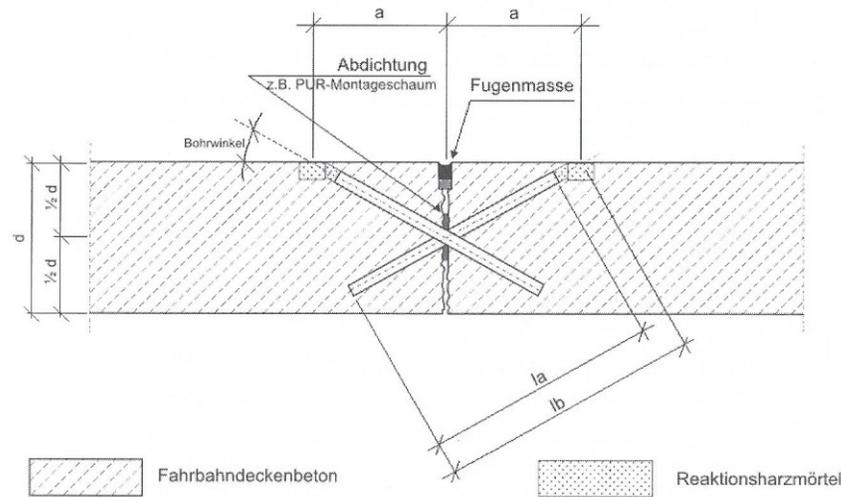


Bild 6: Schrägverankerung

Tabelle 5: Bohr- und Ankermaße beim Schrägverankern

Deckendicke (auf volle cm gerundet)	Ankerlänge	Bohrwinkel	Bohrloch- länge	Abstand der Bohrung vom Riss oder von der Fuge a
D [cm]	I_a [cm]	α [°]	I_b [cm]	a [cm]
22 – 25	35	27 – 30°	40	20
26 – 27	45	27 – 30°	50	23
28 – 30	50	27 – 30°	55	27
bis 40	70	27 – 30°	75	37

Cross stitching



Cross stitching



Partial depth repair



Partial depth repair



Partial depth repair



Repair

Appearance	Repair methods according to Section					
	2.4.3.1 <i>Replacing joint fillings</i>	2.4.3.2 <i>Surface treatment with reactive resin</i>	2.4.3.3 <i>Surface treatment with reactive resin mortar</i>	2.4.3.4 <i>Stabilizing and lifting slabs</i>	2.4.3.5 <i>Replacing slabs and slab sections</i>	2.4.3.6 <i>Replacing entire lanes</i>
<i>Defective joint fillings</i>	+	-	-	-	-	-
<i>Vertical slab movements/slab offset</i>	-	-	-	+	+	+
<i>Longitudinal and transverse cracks</i>	-	-	-	+	+	+
<i>Broken edges</i>	-	-	-	+	+	-
<i>Locally limited surface damage (e.g. fire damage)</i>	-	-	+	-	-	-
<i>Cracks due to over stressing (undersized concrete pavement)</i>	-	-	-	-	-	-
<i>Polished surface or pop out of coarse aggregates</i>	-	+	+	-	-	-
<i>Surface texture with high noise emission</i>	-	+	+	-	-	-

+ suitable, - not suitable

Table 3: Repair methods, source: ZTV BEB-StB 15



Lifting and stabilizing of slabs

- Lifting in case of stepping between adjacent slabs
- Stabilizing as soon as possible when vertical movements of slabs occur
- Movements are indicated by spillage of water or fine sand
- Improving bearing conditions and thus extending useful life of concrete slab



Injection materials

Injection material	Concrete slabs on bound sub-strata	Concrete slabs on unbound sub-strata	Re-levelling of slabs	Stabilisation of slabs	Durability	Deep injection	Rapid curing
Expanding Polyurethane resin	++	++	++	+	+	+	++
Silicate resin	++	++	+	++	++	++	++

+ = practice ++ = best practice



Drilling of injection holes



Surveillance of level and injection works



Successful result

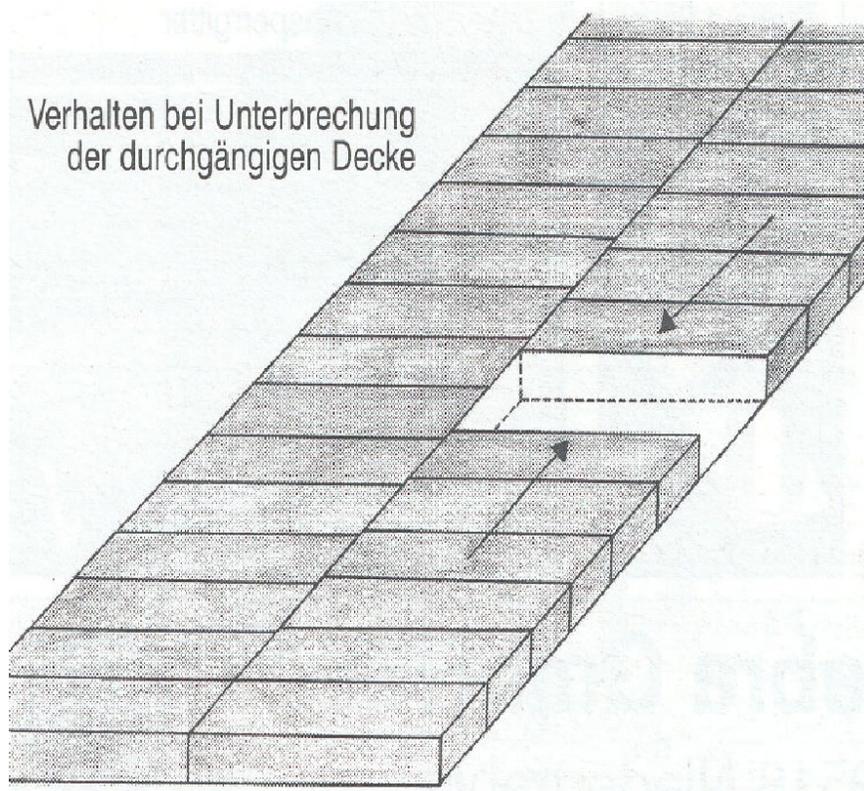


Full-depth repair of slabs / slab sections

- High requirements regarding staff and machinery → proof of qualification
- Replacement of slabs which are damaged by breakup of corners, vertical movements or cracks
- Repair of heat damages
- Minimum dimensions of 1,50 m in transversal or longitudinal direction
- Valid for adjacent slabs up to 25 m



Slab movements and heat damages



Quelle: M BEB

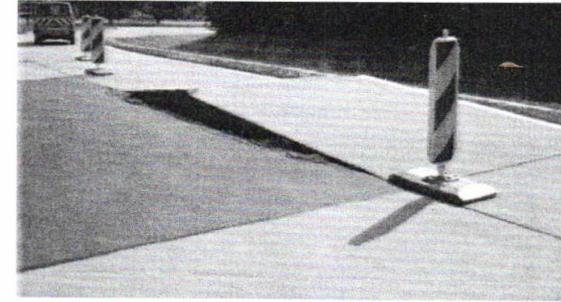


Bild 47: Typischer Hitzeschaden mit „Dachprofil“ als Folgeschaden eines Plattenersatzes im benachbarten Fahrstreifen in Asphaltbauweise

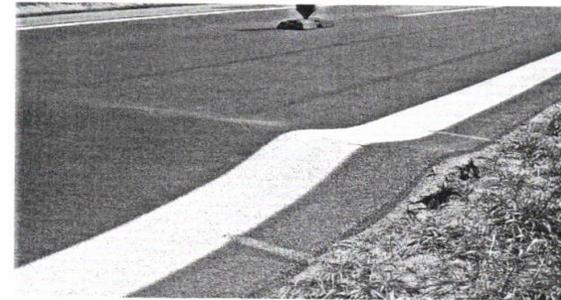


Bild 48: Verwerfung in der Asphaltdecke durch Längsspannungen in der verbliebenen und dickenreduzierten Betondecke

Removal of slabs or slab sections

- Deep cuts for separating slab and protection cuts must be put out for tender
- Possibly required further cuts for reduction to small pieces have to be calculated by the contractor
- Gently removal: No damage to adjacent slab and as little effect on sub-base as possible
- Use of spalling hammer and breaker prohibited



Former method: Shattering



Removal of damaged slab



Materials

- Road concrete
- Accelerated road concrete
- Rapid-hardening concrete
 - Type A – ready-mix
 - Type B – premixed dry mortar, coarse aggregates added on site
 - Type C – completely premixed dry concrete, only water added on site



Anchor bars



Pouring of rapid-hardening concrete – mixing on site (Type B and C)



Surface finishing



Alternative: Precast slabs

- Advantages:
 - Short traffic disturbance
 - Preinstalled internal fittings possible
 - High quality due to production in protected environment
 - Installation independent of weather conditions



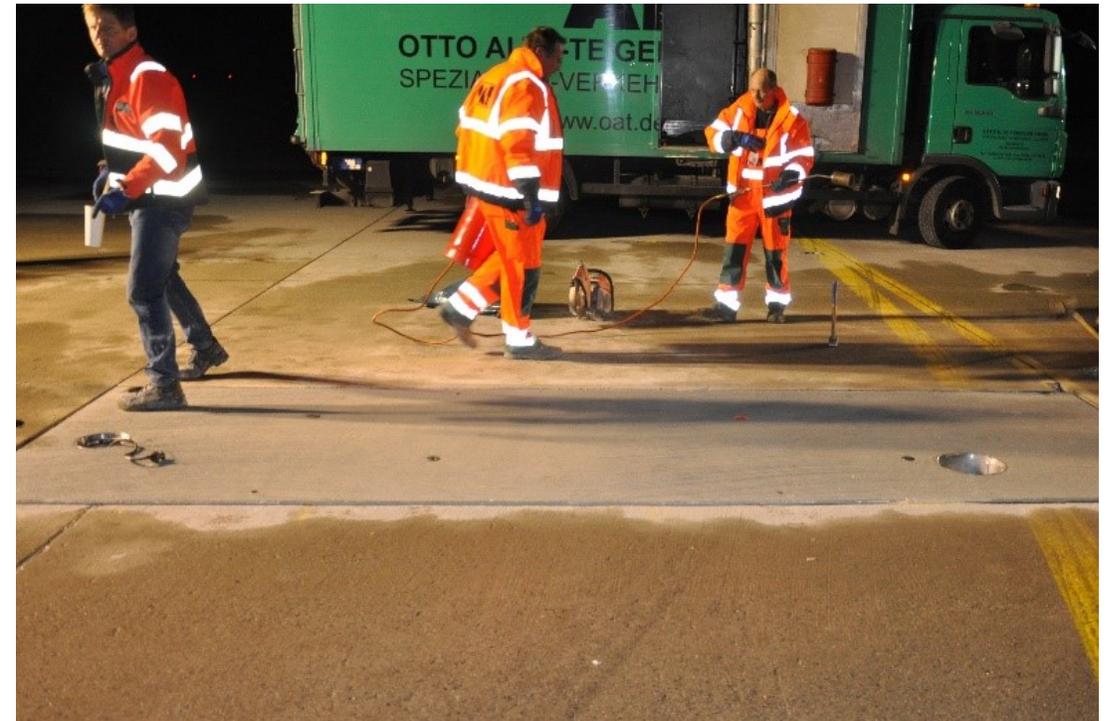
Installation and levelling of precast slab



Different methods of levelling



Injection of silicate resin and finished product



Round precast slabs for broken corners



Conclusions

- Concrete pavements are durable and have low preservation requirements
- In case of defects there are many different methods to repair concrete
- It is important to choose the suitable repair technique for any pattern of damage
- In order to ensure the long service life of concrete pavements, repair measures have to be applied on short notice after damages occur
- ZTV is a helpful tool for concrete preservation and show the different preservation methods





Thank you
for your attention

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