5 Appendix

Petrographic Report

on German Autobahn Concrete Pavement

and

Synoptic Table on Standards and Practices

for Concrete Roads in Europe

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PETROGRAPHIC SERVICES REPORT

CTL Project No.: 154115 ***Date:*** July 30, 1992

Re: Microscopical Examination of a Concrete Fragment from the Autobahn near Berlin, Germany

One concrete fragment (Fig. 1) was received on July 13, 1992 from Mr. Lawrence Cole, Portland Cement Association. The fragment was reportedly taken from a section of the Autobahn concrete pavement near Berlin, Germany. The concrete is believed to have been placed in 1938. Petrographic examination of the sample was requested by Mr. Cole to determine the quality of the concrete.

FINDINGS AND CONCLUSIONS

Based on the results of the tests performed, the following findings and conclusions are presented:

1. The sample is a hard, dense, good quality concrete consisting of siliceous and calcareous aggregates in a portland cement paste. The paste-aggregate bond is tight and the concrete fractures through coarse and fine aggregate particles.

2. Estimated water-cement ratio, based on paste properties, is less than 0.35. Large residual cement particles (unhydrated portland cement clinker, UPC's) are abundant.

3. The concrete is not air entrained. Estimated air content is 1 to 2%. Most air voids are small and lined or filled with secondary deposits, mostly ettringite.

4. One major crack, parallel to a fractured surface, is present. This crack may have been produced during sampling. Microcracks are not observed

Additional data from the petrographic examination are contained in the attached form.

METHODS OF TEST

Petrographic examination of the concrete fragment was performed in accordance with ASTM C 856-83, "Standard Practice for Petrographic Examination of Hardened Concrete."

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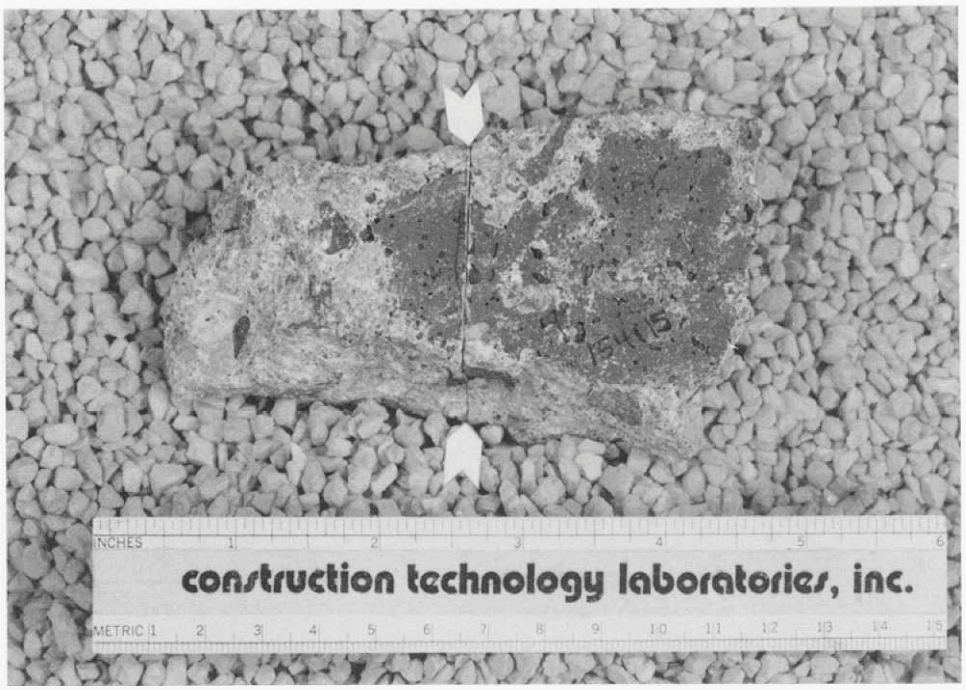

FIG. I CONCRETE FRAGMENT FROM AUTOBAHN NEAR BERLIN, GERMANY. BROWN SURFACE IS PROBABLY A MOISTURE BARRIER IMPRESSION. ARROWS SHOW LOCATION OF SAWCUT. PORTION OF SAMPLE ON LEFT IS SHOWN TN FIG 2.

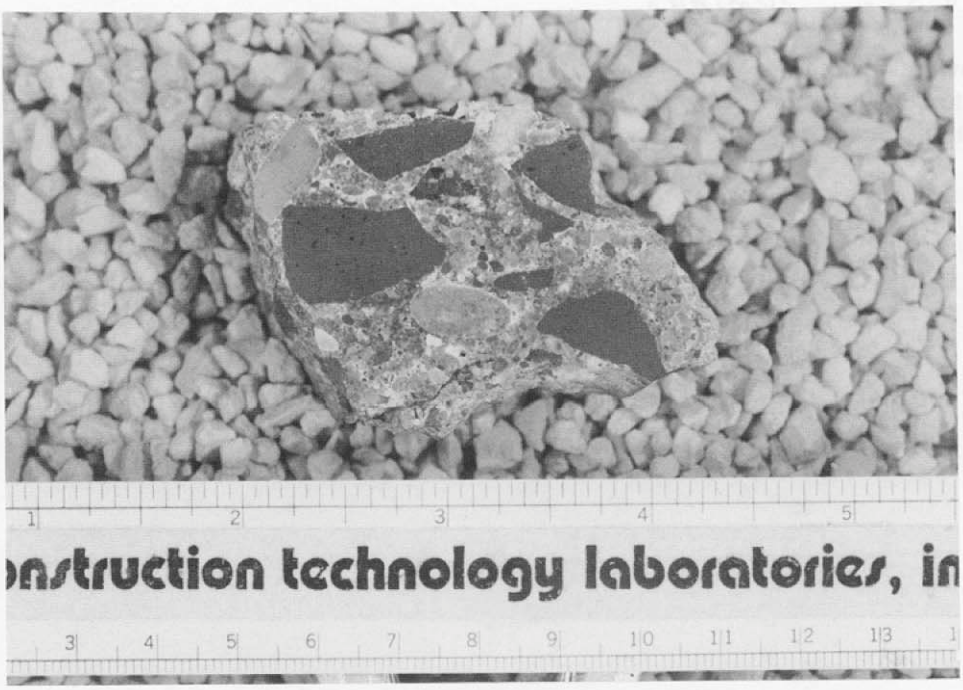

FIG. 2 LAPPED SURFACE OF AUTOBAHN CONCRETE FRAGMENT ORIENTED WITH BARRIER IMPRESSION AT TOP OF PHOTOGRAPH.

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The fragment was cut perpendicular to the formed surface and one portion was lapped. Lapped and freshly broken surfaces were studied using a stereomicroscope at magnifications up to 45X. A rectangular block, approximately l-in. wide and 2-m. long, was cut from the sample, placed on a glass microscope slide with epoxy resin, and reduced to a thickness of approximately 20 micrometers (0.0008 in.). The thin section was examined using a polarized-light microscope at magnifications up to 400X to determine aggregate and paste mineralogy and microstructure.

L. J. Powers-Couche

L. J. Powers-Couche
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LJP/djp

CTL

PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE, ASTM C 856

CTL PROJECT NO.: 154115
CLIENT: PCA Public Works Dept. #322
STRUCTURE: Concrete Pavement
LOCATION: Autobahn near Berlin, Germany,

DATE: JULY 30,1992
PROBLEM: Quality Evaluation
EXAMINED BY: L. Powers-Couche

SAMPLE:

Identification: None stated.

Dimensions: The sample is a broken fragment approximately 2.5-in. wide, 3.5-m long, and 1.7-m. thick. All surfaces but one are broken surfaces passing through coarse aggregates. One **surface** appears to be a formed surface, perhaps formed against a flexible barrier. The surface is smooth, undulating, dark brown, with abundant, irregularly-shaped, entrapped air voids up to 0.3-m diameter.

Cracks, Joints, Large Voids: One crack, 0.6-m long, is parallel to a fractured surface.

Reinforcement: None present.

AGGREGATES (A)

Coarse (C): Siliceous and calcareous gravel mainly consisting of basalt, fossiliferous limestone, granite, schist, and graywacke.

Fine (F): Siliceous and calcareous sand consisting of quartz, quartzite, limestone, feldspar, and a small amount of mica, iron oxides, and hornblende.

Gradation & Top Size: The aggregate appears to be evenly graded to **a** top size of 0.6 in.

Shape & Distribution: Both CA and FA are rounded to angular, and appear to be uniformly distributed. FA particles are equant to oblong. CA are oblong to elongated.

PASTE

Color: Medium to dark gray.

Hardness: Hard.

Luster: Subvitreous.

Calcium Hydroxide*: 5 to 7% uniformly distributed, small crystals, patches, and partial coatings on aggregates.

Unhydrated Portland Cement Clinker Particles (UPC's)*: 15 to 18% uniformly distributed large UPCs. Few relicts observed.

Depth of Carbonation: 0.03 in. carbonation measured from the smooth, formed surface.

Air Content: The concrete is not air entrained. 1 to 2% oval air voids up to 0.06-m diameter are nonuniformly distributed in the paste. Most voids occur adjacent to aggregate particles.

Fly Ash*: None present.

Paste-Aggregate Bond: Tight. The concrete fractures through coarse and fine aggregate.

Secondary Deposits: Voids are lined and/or filled with calcium hydroxide and ettringite. Ettringite occurs in clusters or clumps of long needles.

Microcracking: No significant microcracks observed.

ESTIMATED WATER-CEMENT RATIO: Less than 0.35.

MISCELLANEOUS: The portland cement was coarsely ground. One large clinker particle is 400 micrometers-long and 150 micrometers-wide.

*percent by volume of paste

6th INTERNATIONAL SYMPOSIUM ON CONCRETE ROADS

Madrid, 8-10 October 1990
PIARC/Cembureau/Oficemen

SYNOPTIC TABLE
on standards and practices for concrete roads in Europe

by

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with kind assistance from members and experts of the
PIARC Technical Committee on Concrete Roads

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Glossary of symbols used

Symbol/interpretation

- R Definitely required by specifications or regulations
- P Permitted by specifications under certain conditions or requirements
- X Specifically prohibited
- o c Optional with contractor
- N Not included in specifications
- A As shown on plans
- E Where directed or authorised by engineer
- M Motorways
- MR Main roads
- SR Secondary roads

Signification des symboles

Symbole/Interprétation

- R Formellement exigé par les prescriptions ou par la reglementation
- P Permis para les prescriptions dans certaines conditions ou pour faire face à certaines exigences
- X Formellement interdit
- OC A la discretion de l'entrepreneur
- N Non inclus dans les prescriptions communes ou spéciales
- A Conformement aux plans
- E Conformement aux instructions ou avec l'autorisation de l'ingénieur
- M Autoroutes
- MR Routes principales
- SR Routes secondaires

Zeichnerklärung

Zeichen/Bedeutung

- R Definitiv in Vorschriften oder Bestimmungen gefordert
- P Gestattet nach Vorschrift unter bestimmten Bedingungen oder zusätzlichen Forderungen
- X Definitiv verboten
- OC Dem Unternehmer freigestellt
- N Nicht in Bestimmungen enthalten
- A Nach Zeichnung
- E Wenn von der Bauleitung angeordnet oder zugelassen
- M Autobahnen
- MR Hauptstrassen
- SR Nebenstrassen

Significado de los simbolos

Símbolo/Significado

- R Exigido por las prescripciones técnicas
- P Permitido por las prescripciones bajo ciertas condiciones
- X Prohibido por las prescripciones
- OC A elección del contratista
- N No incluido en las prescripciones
- A Según lo indicado en los planos
- E De acuerdo con las instrucciones del Director de obra o con su autorización
- M Autopistas
- MR Carreteras principales
- SR Carreteras secundarias

COUNTRY AND NUMBER CODE

1. Austria
2. Belgium
3. Czechoslovakia
4. Denmark
5. Finland
6. France
7. Germany (Democratic Republic)
8. Germany (Federal Republic)
9. Great Britain
10. Italy
11. Netherlands
12. Norway
13. Portugal
14. Spain
15. Sweden
16. Switzerland

	Maximun axle or wheel load permitted / Charge maximale permise par essieu ou par roue / Höchstzulässige Achsoder Radlast / Carga máxima por eje o por rueda autorizada	Design traffic (commercial vehicles per day) / Trafic de projet (nombre de camions par jour) / Verkehrsbelastung (LKW/Tag) / Tráfico de proyecto (vehículos pesados por día)	Slab thickness / Epaisseur de la dalle / Plattendicke / Espesor del pavimento mm	Width of carriageway elements / Largeur des voies / Streifenbreiten / Ancho de los elementos de la calzada — Motorways / Autoroutes / Autobahnen / Autopistas: Traffic lanes / Voies pour le trafic / Fahrstreifen / Carriles para circulación m	Marginal strips / Surlargeurs / Randstreifen / Sobreanchos m	Hard shoulders / Bandes d'arrêt d'urgence / Standstreifen / Arcenes m	Lane for slow traffic / Voie supplémentaire en rampe / Kriechstreifen / Carril para vehículos lentos m
	1	2	3	4	5	6	7
1	10 t single axle	Equivalent number of 10 t single axles for 30 years	Depending on design traffic (150-250)	3,75	1,00 inside 0,50 outside	2,50	3,75
2	13 t	4.500	CRC 20 cm Plain concrete 23 cm	3,75	1,00	3,00	3,75
3	M 10 t single axle		M 240	3,75	0,50	2,50	3,50
4	10 t single axle From 1992: 11,5 t on driving axle Special rules for low loaders, often leading to axle loads of 12 t		M: 200-300 MR: 180-300	3,50-3,75	0,50	A	A
5	Single axle load 10 t	Not specified	Not specified (Min. 200 when provision for grinding is included)	3,75	0,50		3,50
6	Single axle 13 t	On design lane: T0 750-2000 T1 300-750 T2 150-300 T3 50-150	Related to design traffic and subgrade URC 280-220 URC, dowelled joints 230-180 CRC 220-170 Thick slab (not for T0) 370-300	3,50	Outside = 0,75-0,25 according to traffic Inside = 0,25	2,50-3,00	3,50
7	R Max. axle load 11 t	Traffic classification depending on number of equivalent 10 t axle passages	140-260 depending on = axle passages = strength of concrete = dowelled or undowelled joints	R 3,75	R 1,50 P 1,00	R 2,50	R 3,50
8	R Single axle 11 t (from 1992 11,5 t) Tandem axle 18,0 t (from 1992 19,0 t)	R M: >3200 MR: 1800-3200 300-1800 SR: 60-300 <60	R M: 280 MR: 240-220 SR: 200-180-160 depending on the (sub-) base	R 3,75 (preferred) 3,50	R Outside 0,50 Inside 0,50 or 1,00	R 2,50 2,00	R 3,75
9	Single axle 10 t	URC 200 to 10 000 JRC 300 to 10 000 CRC 1600 to 10 000 CRCR 900 to 10 000	A Related to traffic URC 150 to 340 JRC 150 to 320 CRC 200 to 260 CRCR 150 to 250 (plus 100 mm bituminous surfacing)	A 3,65	A 0.70	A 3,30	A 3,65
10	R Single axle: 12 t Tandem axle: 19 t	N	N 220-240 depending on type of pavement (CRC-JPC)	R 3,75	R 0,12-0,20 White painted mark	R 3,00	R 3,00
11	M MR SR Single axle 11,5 t	Number of single axles (tandem = 2 singles tridem = 3 singles)	N 180-250	R 3,50 (rural and urban)	R 0,60	R 3,00	N
12	R Single axle 10 t	Number of equivalent standard 10 t axles along design period	R ADT Min. tihcknes <5.000 130 8.000 140 15.000 180 50.000 200 (4 lanes) Normally 200-220	R 3,50	R 1,00	R 1,50 or 3,00 (depending on motorway class)	R 3.50
13	R Single axle 12 t Tandem axle 20 t Tridem axle 24 t	A lumber of standard axles 13 t	200-600	R 3,75	R 0,20	R 3,00	R 3,00-3,50
14	R Single axle 13 t Tandem axle 21 t	R Design based on number of commercial vehicles on the design lane in the year of opening to traffic	R 280-200 For one-way carriageways linear variation of thickness is specified. Thickness also depending on concrete strength				
15	Single axle 10 t (11,5 t: + 15 mm) (13,0 t: + 25 mm)	2000-4000	Depending on concrete streng 4,8 6 7 N/mm2 220 200 190 mm	4.50	0,50		
16	R Single axle 8,2 t	R T1 10- 30 T3 31- 100 T4 101- 1000 T5 1000- 3000	R 150-230 Depending on the base or sub-ba bearing capacity	R 4,00		R 2,50	R 4,00

Width of carriageway elements / Largeur des voies / Streifenbreiten / Ancho de los elementos de la calzada

	Main roads / Routes principales / Hauptstraßen / Carreteras principales				Secondary roads / Routes secondaires / Nebenstraßen / Carreteras secundarias		
	Traffic lanes Voies pour le traffic Fahrstreifen Carriles para circulación m	Marginal strips Surlargeurs Randstreifen Sobreanchos m	Hard shoulders Bandes d'arrêt d'urgence Standstreifen Arcenes m	Lane for slow traffic Voie supplémentaire en rampe Kriechstreifen Carril para vehículos lentos m	Traffic lanes Voies pour le trafic Fahrstreifen Carriles para circulación m	Marginal strips Bandes de guidage Randstreifen Sobreanchos m	Hard shoulders Bandes d'arrêt d'urgence Standstreifen Arcenes m
	8	9	10	11	12	13	14
1	3.50	0,50	N	3,50	A	A	A
2	3.50	None		3,50	3,00 to 3.50		
3							
4	3.50	0.50	A	A	A	A	A
5	3.50	0.25		3.50	3,00-3,50	0.25	0,25-0,50
6	3,00-3,50	Outside – 0,75-0,25 according to traffic Inside = 0.25	When used, 2,50-3,00	When used. 3.50	2,50-3,50	0.25	Seldom used
7	3,00-3,75 depending on traffic	R 1.50 P 1,00	N	3,00-3,50	2,50-3,25	A 1.00	N
8	R 3.75 3,50 3,25 3,00	R 0,50 0,25	R 2,50 2,00 1.50	R 3,75 3.00	R 3,75 3,50 3,25 3,00	0,50 0.25 0,00	R 1.50 or no hard shoulder
9	A 3.65	A 1.00	N	A 3.65	A 3.65 or 5,00	A 1,00	N
10	R 3,50-3,75	R 0,12-0,20 White painted mark	R 1,50-1,75	N	R 3,00-3,50	R 0,10-0,15 White painted mark	R 1,00-1,25
11	R 3,25 (rural) 3.10 (urban)	R 0,45	N	N	3.10: 2.75	N 0.45 (if lane width = 3,10 ml 0.20 (if lane width = 2.75 ml	N
12	R 3,25-3,75	R 0.50 or 1.00	R 2.56 2.00 1,50	R 3,75 3.00	II 3.75 3,50 3,25 3,00	0.50 0.25 0,00	A 1.50 or no hwd shoulder
13	R 3.50	R 0,15-0,20	N	A 3.65	A 3.65 or 5,00	A 1.00	N
14			R 1,50-1,75	N	R 3,00-3,50	R 0,10-0,15 White painted mark	R 1,00-1,25
15	N	N	N	N	N	N	N
16	R 3,50	R 0,50-1,00	Normally not used	R 3,00		R 0,50	

	Materials used and thickness / Nature des matériaux et épaisseur / Benutzte Baustoffe und Schichtdicke / Materiales utilizados y espesor mm		Requirements / Exigences / Anforderungen / Prescripciones			Requirements for other materials / Exigences pour autres materiaux / Anforderungen an andere Baustoffe / Prescripciones para otros tipos de materiales	Surface regularity / Uni / Oberflächenebenheit / Regularidad superficial
	Motorways and main roads / Autoroutes et routes principales / Autobahnen und Hauptstraßen / Autopistas y carreteras principales	Secondary roads / Routes secondaires / Nebenstraßen / Carreteras secundarias	Cement content / Teneur en ciment / Bindemittelngehalt / Contenido de cemento	Compressive strength or other / Résistance à la compression ou autres / Druckfestigkeit oder andere / Resistencia a compresión o de otro tipo	Other requirements / Autres exigences / Weitere Anforderungen / Otras prescripciones		
	15	16	17	18	19	20	21
	Cement treated / Traités au ciment / mit hydraulischen Bindemitteln / Tratados con cemento						
1	E 200 (sometimes 350)	E 150-180	Min. 90 kg/m³	7 day compressive strength: ≥ 3.0 N/mm² (mix design,	Frost-thaw durability (for materials with porous particles or cohesive constituents)		mm under 4 m straightedge
2	Lean concrete: 200		Lean concrete: 4 to 6%	6 N/mm² + 2 x standard deviation	Surface regularity: 10 mm under 3 m straightedge	SR Unbound crushed stone: 200 mm Plate bearing test: 110 N/mm²	mm under 3 m straightedge
3	200-250		M 6-9%	M Compressive strength at 7 days: ≥ 1,8-3,5 N/mm²	R M Frost resistance after 28 days	R M Compaction	R M unevenness max. 20 mm mm from true
4	cement-treated gravel: 150	Cement-treated gravel or sand: 150	100-120 kg/m³	Compressive strength: 5-10 N/mm²	Compaction		Max.number of irregularities at a random section 100 m long: Size of regularity ≥ — Max number M and MR — SR mm — 1 — 5 5 mm — 3 — 10 mm — 5 mm — 15
5	120-250	Min. 120	determined by laboratory tests (normally mm. 4%)	QC 4 N/mm² at 7 days	Gravel: Dmax = 64 mm (45 mm) Humus content must be checked Mixing in place and in plant is allowed	Ground blast furnace slag can be used as binder up to 70%	Upwards 10 mm Downwards 20 mm mm under 5 m straightedge
6	Related to design traffic, subgrade and type of pavement. Vibrated lean concrete: 120-220 Hydraulic binder treated base: 150.220	Seldom used	3.5 to sm. according to required strength and construction process	Vibrated lean concrete: splitting characteristic strength: 82 N/mm², 28 days Hydraulic binder treated base: tensile strength: ≥ 1,5 N/mm² at 360 days	Vibrated lean concrete: ≥ 3% air content		
7	150-200	"	150220 kg/m³	8-15 N/mm²	Improved frost-resistance: 100 freezing and thawing cycles Testing also in NaCl solution (1%		Max. 15 mm (transverse) Max. 10 mm (longitudinal) under 4 m straightedge
8	R Cement bound: 150 Cement treated: 150 Bituminous: 100 Cement bound or treated if there is no antifrost-layer: 200-250	R Bitominous: 80 or without subbase on an antifrost-layer Cement bound or treated if there is no antifrost-layer: 150-200	A Cement bound: >3,0% Cement treated according qualification test	R Cement bound: 9-12 N/mm² at 28 days Cement treated: 6 N/mm² at 28 days (only for determining the binder content)	R Degree of compaction: >98% Proctor Frost test: length variation ≤ 1‰ Notching of the subbase Cement bound: grading curve mixed in plant Cement treated: no grading curve mixed in place or in plant	R Bituminous: grading curve; min. bind content; percentage of voids; degre of compaction Unbound granular: grading curve; degree of compaction: >100/1039 deformation modulus: > 120 resp. > 100 MN/m²	R ment bound or treated: ≤ 15 mm Bituminous: ± 10 mm avel and crushed stone: ≤ 20 mm under 4 m straightedge
9	A Cement bound: 150 (on granular capping: 150 to 600)	A Cement bound: 150 (on granular capping: 150 to 600)	R >160 kg/m³	A > 10 N/mm² at 7 days	A Density: 95% of density of cube compacted to refusal Granulated slag blends: slag <65% Pfa blends: pfa < 50 %	A Granular capping layer to obtai minimun 15% CBR	+ 10-30 mm from true level
10	R Crushed stone, sand and gravel treated with cement: 200	R Sand and gravel treated with cement: 150	A 4 %	A 4,0-7,0 N/mm² at 7 days	R Dry density Optimun moisture content	A Sand-gravel or pozzolana: thickness: 150-200 mm	R ± 10 mm
11	A M Lean concrete: 150-200 MR Sand-cement or lean concrete: 150-200	A (sand a granular material used)	R Lean concrete: 75-125 kg/m³ A Sand-cement	Lean concrete: cube strength a, 7 days ≥ 3 N/mm² Sand-cement: cylinder (Proctor) strength at 28 days ≥ 5 N/mm²	Lean concrete: ratio sand/wars aggregate 1:1-1:3 A Lean concrete: ratio fly ash/cement ≤ 1 crushed masonry >4 mm	R Granular materials (e.g. slags, crust concrete): see «RAW Standard 199 (grading, «crushing value») A Non-erodable materials only X Erodable materials	5 mm under 3 m straightedge
12	Gravel or sand: 150-180	Gravel or sand ≥120	R Min. 3% Normally 5-7% Mix proportioning required	5 N/mm² at 7 days	R Freeze/thaw testing 100% Mod. Proctor Max. particle size: 37.5 mm Materials < 75 µm (cement + fill min. 10%		10 mm under 3 m straightedge 20 mm from true level
13	A Lean concrete: 150	A Cement bound granular material including soil-cement	A M, MR 6 % ± 1 %	A M, MR Mea" comp. strenght Cylinders Ø 150 x 300 mm 7 days ≥ 6 N/mm² 28 days ≥ 8 N/mm²	A M, MR Min. cement content: 110 kg/m Max dry density (lab.) BS 1924-Tes Field density: ≥ 98% dmax Thickness: ± 15 mm	A SR Granular material: 150-200 m	10 mm under 3 m straightedge
14	R Vibrated lean concrete: 150 Cement treated base (erosion-resistant): 150		R Vibrated lean concrete: min. 140 kg/m³ Cement treated base: min 59	R Either 8 N/mm² a, 7 days or 12 N/mm² at 90 days	R Vibrated lean concrete: fractio passing through 0.016 mm sie > 250 kg/m³ w/c = 0.75 1.50 Ire of air entraining agents compul	R SR Unbound granular subbase. 200 mm. if CBR of subgrade	R Vibrated lean concrete: between 0 and - 30 mm from true level 5 mm under 3 m straightedge Cement treated base: between 0 and - 1/5 thickness from true level 10 mm under 3 m straightedge
15	150		About 4.5%	10 N/mm² (Modified Proctor)			
16	R 150-300 (depending on soil bearing capacity)	R 150-200	R 3-9% according to soil type Min. 60 kg/m³	7 days: 2-4 N/mm²	Frost-thaw		Max. difference from true level: 20 mm 15 mm under 4 m straightedge

	Transverse contraction joints / Joints de retrait transversaux / Querscheinfugen / Juntas transversales de contracción					Transverse expansion joints / Joints de dilatation transversaux / Querraumfugen / Juntas transversales de dilatación				
	Spacing (i) unreinforced pavement (ii) reinforced pavement Ecartement (i) béton non armé (ii) béton armé Abstand (i) unbewehrt (ii) bewehrt Separación (i) pavimento en masa (ii) pavimento armado m	Reduction of section Réduction de la section uerschnittsschwächung Reducción de espesor mm or %	Construction method Méthode d'exécution Herstellungsverfahren Método de ejecución	Type of sealer Nature du produit de scellement Art der Fugenfüllung Tipo de producto de sellado	Sealing groove (i) width (ii) depth Gorge de scellement (i) largeur (ii) profondeur Fugenspalt (Aufweitung) (i) breite (ii) tiefe Surco de sellado (i) ancho (ii) profundidad mm	Spacing Ecartement Abstand Separación	Width Largeur Breite Ancho mm	Type of filler Nature du produit de scellement Fugeneinlage Tipo de material de relleno	Type of sealer Nature du produit de scellement Fugenfüllung Tipo de producto de sellado	Sealing groove (i) width (ii) depth Gorge de scellement (i) largeur (ii) profondeur Fugenspalt (i) breite (ii) tiefe Surco de sellado (i) ancho (ii) profundidad
	22	23	24	25	26	27	28	29	30	31
1	(i) 25 x slab thickness, max. 6.0: usually 5.5 (ii) not used	20.25% Usually ≥ 50 mm for 22 cm	Usually sawing	E Bituminous a neoprene	(i) 6 (ii) 20 (bituminous sealer) but usually joints, 2-3 mm wide. are left unsealed	Only at bridges l., lees, 2 at each side)	20	Wood	uminous or neopren	(i) 20 (ii) 30
2	(i) 5 to 6	33%	Sawing	Hot poured	(i) 10 (ii) 30	A Only e t special locations	20	Wood	Hot poured	lil 30 (ii) 30
3	(i) 4-6	About 25%	sewing	M Sealing mastic Modified hot asphalt	lil 6 liil 10.15					
4	(i) 5 (ii) Only at day stops, etc.	25-30%	Sewing. maximun width 3 mm	Joints are not sealed	N	Only et sepcial locations				
5	(i) 5	25.33%	Sewing	E	(i) 10 (ii) 25	A	16	E E.g. bituminous chipboard	E	(i) 20 II 40
6	R (i) variable: 4-5,5; average: 5 (ii) no, used	OC 20-25%	A Sewing P Wet-formed for low traffics	OC Elastomer-modified asphalt mastic, ccording to us Federal Specifications	(i) ≥5 (ii) ≥25	Only at special locations	10-15 CRC: 500, asphalt oncrete with rubber aggregates	R ompressible material xpanded polystyrene, wood,...	OC Elastomer-modified asphalt mastic, cording to US Federa Specifications	(i) 10.15 Gil >5
7	(i) 20-23 x thickness (without dowels) 24-25 x thickness (with dowels) (ii) N	R 25-30% (without dowels) D-33% (with dowels)	M, MR; sawing SR: vibrated	Bituminous	R (i) 12-20 (ii) ≥30	Every 10 transverse pints		OC E.g.. wood Compressibility under compressive stress of 5 N/mm² ≥50% Redeformation ≥50%	Bituminous or compressible filler	R (i) ≥20 (ii) 30-40
8	R (i) 4-6 5.0 as a rule permitted: 25 times thickness Gil not used as a rule	R 25-30%	M, MR: sawing SR: sawing or vibrated	A Bituminous compound or plastic or rubber inserts	R (i) 8-15 depending on the crack width Sil 25-35 depending on the sealing groove widt	R Inly et bridges but et east two to et every side	R Thickness of the joint filler: M,MR: 18 SR: 13	Softwood	tuminous compound	R (i) 2 more than the filler thickness Gil 1,5 times width
9	A (i) 5 or 6 with limeston (ii) 22 to 30 dependant cm reinforcemen, and slab thickness	R 014 to D/3	R Sswing or wet-formed (for winter work)	OC 1) Pitch/PVC hot-poured 21 Polysulphide cold-poured 3) Compression seals 41 Expending cork	R (i) 13 (ii) 1) 15 2) 13 31 25 4) 50 to 60	A URC: 60 thickness a225 mn 40 thickness <225 mn JRC: 66 to 90	R 25	OC Flexible cellular board or polyethylene foam	OC Pitch-PVC hot-poure 1) Polysulphide cold-poured) Compression seals 4) Expanding cork	R (i) 30 (ii) 1)25 21 20 3140 4140
10	A (i) 4-7	R 25-30%	R Sewing	A Hot or cold poured sealing compound	A (i) 5-8 (ii) 3 0 including filling material	A Only et special locations	R 20	A Wood or other compressible materia	A Hot or cold poured sealing compound	A (i) 20 (ii) 2025
11	A (i) 3,50-5,00	R 33%	R sawing or wet formed	R lii sealed) sealing compound	A (e.g. (i) 6 liil 201	A Only et bridges	A (e.g. 10-30)	A M Neoprene MR/SR Softwood or prefoam	A MR/SR Sealing compound	A (e.g. (i) 10-30 (ii) 12-30)
12	R (i) 5-7 (ii) ≤ 20 (normally no, used)	33%	Sewing Normally 3 mm ride sawcut, unsealed	When used: Bituminous compound or two components elastomeric sealant	when used: (i) 8-10 (ii) 30	A Only against bridges and other special locations	R 20	Preformed neoprene or other compressible materials	Bituminous materials approved for sealing	(i) 20 (ii) 30
13	R M, MA lil 4-5 (ii) not used	R M, MR 25-33%	R M, MR Sawing	R M, MR Hot poured reeling compound or mastic	R M, MR (i) 7-12 (ii) 25-35	A M, MR Only at special locations. e.g. near bridges. transition to other types of pav.	R M, MR 10-15	E M, MR Wood with bituminou compound or other	A M, MR Ho, pawed sealing compound or mastic	R M, MR (i) 7.12 (ii) 25-35
14	R (i) 5 with dowels (M) Max 4 (1:6 skew) without dowels (MR, SRI Gil Not used	R ≥25% slab thickness	R Sewing	R Hot-applied bituminous sealants or cold-applied two-components sealants (polysulphide based) or preformed neoprene profiles	R Hot-applied sealants (i) 7-10 (ii) 30-50 Cold-applied sealants: (i) 10-15 (ii) 30-50 Preformed neoprene profi (i) 4-8 (ii) 30-50	R Inly at special locatior xridges and curves wi radius < 200 m)	R 15-18	R	R Hot-applied bituminou sealants or cold-applie two-components seala (polysulphide based	R (i) 20 (ii) Mm. 30
15	(i) 5		Sewing		(i) 8-10 (ii) 30	N	N	N		
16	(i) 5 (ii) generally not used		Sewing	Rubber bitumen	(i) 6-8 (ii) 20	Only et special locations	12-19	Synthetic material or wood		(i) 12-19 (ii) 25

	Load Transfer a (i) Dowel diameter Dispositifs de transfert des (i) Diamètre (ii) longueur Lastübertragungs (i) Dübeldurchmesse Dispositivos de transmisión (i) Diámetro de los pasado	nsverse Joints ngth (iii) spacing es aux joints transversaux cartement des goujons bei Querfugen -länge (iii) -abstand rgo en juntas transversales) longitud (iii) separación	Longitudinal / Longitudinaux / Längsfugen / Longitudinales					
	Contraction joints Joints de retrait Scheinfugen Juntas de contracción	Expansion joints Joints de dilatation Raumfugen Juntas de dilatación	Sawn (i) width (ii) depth Sciés (i) largeur / (ii) profondeur Geschnitten (i) breite / (ii) tiefe Serradas (i) ancho / (ii) profundidad mm	Other types / Autres types / Andere Fugenausführungen, Otros tipos Type Description du joint Art Tipo	(i) Width / (ii) Depth i) Largeur / (ii) Profondeur RI Breite (ii) Tiefe i) Ancho / (ii) Profundidad mm	Tie bars i) diameter (ii) length (iii) spacing Barres d'ancrage diamètre (ii) longueur (iii) écartement (i)Ankerdurchmesser i) -länge (iii) -abstand Barras de unión diámetro (ii) longitud (iii) separación mm	Type of sealer Nature du produit de scellement Fugenfüllung ipo de producto de sellado	Sealing groove (i) width (ii) depth Gorge de scellement (i) largeur (ii) profondeur Fugenspalt (i) breite (ii) tiefe Surco de sellado (i) ancho (ii) profundidad
	32	33	34	35	36	37	3a	39
1	(i) 26 (ii) 500 Iiiii Slow lane: 11 dowels Overtaking lane: 7 dowels	(i) 26 (ii) 500 Iiii Slow lane: 11 dowels Overtaking lane: 7 dowels	(i) 2-3 (ii) 2530% of dab thickness	Construction joint	(i) 2-3 (ii) E	i) 14 steel group IV, V 20 steel group I 700 steel group IV. v low steel group I	E Bituminous or neoprene	(i) 8 Iii, 20 (bituminous) 40 (neoprene)
2	(i) 25 Iii 600 Iiii 300	(i) 25 (ii) 500 Iiii 300	Iii 4 Iiii 70	Construction joint Keyed		(i) 12 (ii) 1000 Iiii 750	Hot poured or cold poured or neoprene	Hot and cold poured sealers: (i) 7 (ii) 30 Neoprene: (1) 4 (ii) 35
3			(i) 3 Iii Min. 48				M Sealing mastic Modified hot asphalt	M (i) 8 (ii) 10-15
4	(i) 25 (ii) 600 Iiii 300 Dowels are coated against friction and corrosion Undowelled joints also used		(i) Maximum 3 (ii) 2530%			(i) 12 Gil 1000 Iiii 1000 Idle part coated against corrosion	Joints are unsealed	N
5	(i) min. 25 Iii 500 Iiii 270-300	(i) 25 (ii) 500 (iii) 270-300	Iii 3-4 Iiii 2533% thickness	Wet-formed joints (sertion of plastic strip)	Depth: 25.33% thickness	(i) 10 Iiii 800 (iii) 1000	E	E
6	R (i) 20-30 according to thickne (ii) > = 500 Iiii 300 (12 dowels per joint concentrate under wheel tracks)		OC Iii = <8 iii 20.25% acceding to slat thickness	P :-formed joint created by the slipform paver	OC (i) 4-5 (ii) 20% slab thickness usually, 40-50	R used in pavements with lled joints or in continuous einforced pavements (i) ≥ 10 (ii) 600 Iiii 750	OC Elastomer-modified asphalt mastic, according to US Federal Specifications	(i) ≥ 5 (ii) ≥ 25
7	(i) 25-28 (ii) 500 Iiii 300-600	(i) 25-28 (ii) 500 (iii) 300-600	R (ii) 35%	Wet-formed (plastic band filler)	(i) OC (ii) 35%	(i) ≥ 14 (ii) ≥ 600 iii) ≤ 1200 in straigth ctions; closer in curves	Sawn joints: bituminous Wet-formed: plastic band filler	
8	R (i) 25 mm (ii) 500 mm (iii) M,MI in the wheel tracks 250 ma between the tracks and in th overtaking lane 500 mm. SR a hard shoulder: 500 mm or no	R As in contraction joints	R (i) 6 (ii) 40-45% of slab thickness	P Drawn	(i) 0 (ii) 0	R I,MR: 20 mm SR: 16 mr LMR: 800 mm SR: 600 m (iii) 3 each slab	R Bituminous compound or plastic or rubber inserts	R (i) 6 Iiii 10
9	R (i) Slab ≥ 240 mm thick 25 >240 mm thick 2(Iii 400 (iii) 300	R Iii Slab ≥ 240 mm thick 32 <240 mm thick 25 Iii 600 Iiii 300	P (i) 5 (ii) 1/4 to 1/3 dab thickness	1) Wet-formed 2) Butted	R (i) 5 (ii) 1) D/4 to D/3 2) 25 min.	R (i) 12 (ii) 1000 (iii) 600	OC Hyethylene foam strip or poured compound or col xured compound or cork	R (i) 5 (ii) 25 min.
10	A (i) 22 Iii, 600 Iiiii A	A (i) 30 (ii) 600 Iiiii A	A (i) 5-8 (ii) 25.30% slab thickness	A Plastic strip inserted into the fresh concrete	A (i) 2 (ii) 0,25-0,30 thickness	R (i) 16 (ii) 800 Iiii 750	A Hot or cold poured sealing compound	R (i) 5 (ii) 30 including filling material
11	A (in general (i) 25 mm (ii) 500 mm (iii) 300 mm	A (in general (i) 25 mm (ii) 500 mm (iii) 300 mm)	R (i) 3 Iii, 40%			A Iii general Ii 16 mm (ii) 800 mm (iii) 3 per slab	A I.g. sealing compound or massive rubber insert)	A (e.g. (i) 8 (ii) 201
12	R (i) Min 25 (R) (ii) Min 400 (R) Iiii Normally 400	A (i) Min 25 Gil Min 400 Iiii 400	(i) 3 unsealed (normal) or 3-5 sealed (ii) 1/3 slab thickness	R Construction joint		R (i) Min 10 mm (ii) Min 500 mm (iii) 1000 mm	When used: bituminous compound	When used: (i) 3.5 Iii 1/3 slab thickness
13	II M, MR (i) 25-32 (ii) 350-500 Iiii 300	R M, MR (i) 25 (ii) 500 a 600 (iii) 300	R M, MR (i) 7-12 Iii 2533	P Preformed		A M, MR Iii 12 Iii 1000 Iiii 700-800	R M, MR Bituminous compound	R M, MR (i) 7-12 (ii) 25-35
14	R (i) 25 (ii) 500 (iii) 300 at slow lane; 600 overtaking lane	R (i) 25 (ii) 500 (iii) 300 at slow lane 600 at overtaking lane	R (i) N (ii) Min. 1/3 slab thickness			(i) 12 (ii) 1000 Iiii 1000		(i) 10 (ii) 30
15	(i) 20 (ii) 600 (iii) 300	N	(i) 3 (ii) 1/3 slab thickness			(i) 12 Iii 1000 Iiii 1000		(i) 10 (ii) 30
16	(i) 22 (ii) 500 (iii) 500	(i) 22 (ii) 500 (iii) 500	(i) 3 (ii) 30	Between concrete and bituminous pavement	(i) 10 (ii) 21	(i) 14 (ii) 500 (iii) 1000	Rubber bitumen	(i) 6-S (ii) 20

	REINFORCEMENT / ARMATURES, BEWEHRUNG / ARMADURAS			CEMENT / CIMENT / ZEMENT, CEMENTO		CONCRETE / BÉTON / BETON / HORMIGON			
	Continuous reinforcement / Armature continue / Durchgehende Bewehrung / Armadura continua		Jointed reinforced pavements Specified or permitted / levétements armés avec des joints Spécifiés ou permis / swehre Plattenbauweise Vorgeschrieben oder gesttatet / Pavimentos armados con juntas ;pecificados o permitidos	Type used / Désignation / Verwendete Zementart / Tipo utilizado	Restrictions governing use including Pfa / Restrictions particulières, y compris cendres volantes / Besondere Vorschriften, einschließlich der Verwendung von Flugasche / Limitaciones en su empleo, incluso cenizas volantes	Strength specified / Résistance exigées / Vorgeschriebene Festigkeit / Resistencia especificada		Type of specimen and test method / Type des éprouvettes et méthode d'essai / Prüfkörper und Prüfverfahren / Tipo de probeta y método de ensayo utilizado	Frequency of testing / Fréquence des essais / Häufigkeit der Prüfungen / Frecuencia de ensayos
	Specified or permitted % for each direction / Spécifiés ou permis pourcentage dans chaque direction / Vorgeschrieben oder gesttatet; % für jede Richtung / Especif. o permitidos; % de armadura en cada dirección	Method of steel placemer / Méthode de placement des armatures / Art der Bewehrungsverlegung / Método de colocación de las armaduras	kg/m²			Flexural / A la flexion / Biegezug / A flexotracción N/mm²	Other / Autres / Andere / Otros tipos N/mm²		
	40	41	42	43	44	45	46	47	48
1	N			Ordinary Portland cement PZ 275 (H) containing max 20% slag	Blaine < 3500 cm²/g, 28 days flexural strength ≥ 6,0 N/mm² Pfa not used	Min. 5,5 et 28 days	Compressive Min. 40 upper layer Min. 35 lower layer	Compressive: 20 cm cubes, 7 days under water; 21 days air, m °C, 65% rel. humidity Flexural: 12 x 12 x 36 cm beams, storage under water, centrepoint loading	one set of 3 per 20000 m²
2	Longitudinal 0,7% (0,67%) Transverse 0,08%	On metallic supports	None	P-40 HK-40	None		Compressive 55 + 2 x standard deviation	Cores: section 100 cm² height 10 cm	1 core per 1000 m²
3				Portland cement		Min. 4.5 et 28 days	P M compressive strength 24-32 Tensile strength 2.3	R M Beams 15 x 15 x 70 cm or cilynders Ø 15 x 30 cm	R M 1 every 600 m³
4	Longitudinal: 0,6-0,9 Transverse: 0,2-0,3	0 C	N	Low alkali		2-10	N		
5	A	A	A	Ordinary Portland (Ground blast furnace slag allowed partly)	Pfa not used	7 at 28 days (91 days when slag is used	Compressive 55 70 for wear resistant concrete	According to ISO 4012 and ISO 4013	Flexural strength: 1 specimen every 1000 m². min. 3 per day Compressive strength: 1 specimen every 500 m? min. 9 per day
6	R Logitudinal: 0.67 (reinforcing bars) 0,3 (notched strips) P Transverse: related to construction method	OC Longitudinal reinforcemen on supports or inserted int fresh concrete through guides	X	R CPA and CPJ, class 45 P Others	A Cement according to French standards P Addition of Pfa permitted	R Average flexural strength ≥5	R Characteristic splitting strength ≥2,4	Flexural strength: prismatic specimens, 20 x 20 x 80 cm (laboratory previous tests) Splitting strength: cylindrical specimens, Ø 15 x 30 cm (laboratory and control tests)	R 1 test every 300 m³ Minimum: 2 tests per day
7	N Not used			Portland cement PZ 35 PZ 4 0 PZ 4 5	Cement with the addition of ashes		splitting tensile strength: 2,7 3.0 . 3,3 3.7 - 4,0 Compressive strength: ≥ 25 - 235 5% quantile in both cases)	Cubes 15 x 15 x 15 cm Cores Ø 10 cm	0.35: 1 cube every 40 m³, max. 6 per day 0.45: 2 cubes every 40 m³, ML. 12 per day
8	N Not used		Not used as a rule R sed in special cases and for last slabs M, MR: > 3 SR: > 2	R Z 35 (Portland and Iron-Portland cement) Z 45L (Blast Furnace cement)	Pfa blended cements not used R Cement has to meet the Ger-man DIN 1164 and the require-ments (fineness of grinding < 4000 cm²/g, EN 196-6, set behaviour) of the Federal Mi-nistry of Transport	R M, MR: 5.5 SR: 4.5 et 28 days	R Compressive strength M, MA: average 40 min. 35 SR: average 30 min. 25 at 28 days	R Flexural: beams 15 x 15 x 70 cm compressive: cubes 20 x 20 x 20 cm or 15 x 15 x 15 cm	Specified for each project
9	A Surface slabs: 0,6 (longitudinal) Roadbase slabs: 0.4 (longitudinal) 12 mm at 600 c/s (transverse	OC Bars positioned on suppor on sits or prefabricated sheets placed on bottom layer	A 4.2 to 8.5 aries with sslab thickness for a given traffic	R Ordinary Portland (OPC) or OPC with ground granulated slag (OPC/ggb: or OPC with Pfa (OPC/Pfa	R OPC/ggbs: ggbs < 50% OPC/Pfa: Pfa 15 to 35%	N	R Compressive 40	A cub4 compression test BS 1881 RR 116	R 1 to 3 series of 3 specimens every day
10	R 0,69	R Manue placemeron supports fixed to subbas layer	Not used	R Portland 32,5 Pozzolanic 32,5	A Initial setting time > 2 hours at 30 °C C A content ≤ 8%	R ≥ 5,5 at 28 days	R Compressive strength: ≥ 50 at 28 days Splitting strength: ≥ 2,8 et 28 days	A Flexural: beams 15 x 15 x 60 cm Compressive: cubes 15 x 15 x 15 cm Splitting: cylinders Ø 15 x 30 cm	R M, MR: min. 3 series of beams per day (min. 3 beams per series) SR: min. 2 series of beams per day (min. 2 beams per series)
11	A 0,67 longitudinal	OC	Not used	R Portland. Portland Fly Ash or Blast Furnace Slag complying with NEN 3355	A Blast Furnace Slag Cement in top layers of M and MR	N	A M: in general. 845 (characteristic cube strength at 28 days: 45) MR. SR: in general, 835	R cubes 15 cm Compressive strength	Cubes: variable cores: every 50 m
12	Normally not used If used: Longitudinal 0,75 of cross-section (C 40 concrete) Transverse 0,2 of cross-section (C 40 concrete)	Placed in centre of cross-section	Not used	Ordinary Portland Cemen or modified Portland Cement (20% Pfa) or Offshore Cement (P30-4A)	R Min. 65% Portland clink,r Max. 10% microsilica	Variable A: min. 4.3	Compressive strength: variable. depending on traffic (studded tires) 45-75 at 28 days Normally. 75-90 R: mm. 40	10 cm cubes or Ø 15 x 30 cm cylinders or 15 x 15 x 75 cm beams (third point loading)	R Flexural: only in qualification test Compressive: qualification tes, and a, work start and every 1000 m² or once a day
13	N	N	N	R Ordinary Portland cement (CPN) Portland with Pfa (CPC)	R CPN 30-40 CPC 30	R M, MR 4,0-4,5 at 28 days mix design and control purposes	F cylinders > σ1 cubes > σ2 Control purposes only; σ1 and σ2 are fixed according to lab. study formulation	R Beams 15 x 15 x 55 cm Third point loading	R 1 pair of cubes per 600 m² or 6 per day 1 tested a, 7 days 1 tested a, 28 days
14	R Longitudinal reinforcement amount depending on concrete strength: HP-45 concrete: 0.7	N	Not permitted	R Types I, II, III, IV, V (UNE 80 301 Standard)	R Mixes in plant of cement and active additions not allowed Initial setting time, min. 2 h (1 h when air temperature > 30 °C	R HP-45 concrete: 4.5 (M, M HP-40 concrete: 4,0 (M, MR, SR) HP-35 concrete: 3,5 (MR, S Characteristic strength at 2 days (90 days when type cements are used)	N	R Beams 15 x 15 x 60 cm Third point loading	R Flexural: 9 specimens per day Compressive: 12 specimens per day Splitting: 9 specimens per day
15	Not used			Special cement	Pfa not used Silica fume no, used	4.8 6 7	Splitting strength on cores		3 cores every 3000 m²
16	0,5-0,6	Inserted automaticalh in the middle of slab thickness	N 2-5	Portland cement	No use of other cemen types	5 for concretes with 300 kg/m³ cement content 5.2 for concretes with 350 kg/m³ cement content	Compressive 34 for concretes with 300 kg/m³ cement content 38 for concretes with 350 kg/m³ cement content	Compressive: cubes, 12 x 12 x 12 cm Flexural: beams. third-point loading method	1 test every 5000 m²

	CONCRETE / BÉTON / BETON / HORMIGON					FINE AGGREGATE, GRANULAT FIN / FEINE ZUSCHLAGE , ARIDO FINO	
	Max. water / cement Mar. eau / ciment Max. Wasserzementwert Mar. agua / cemento	Minimum cement content specified Teneur minimale en ciment prescrite Vorgeschriebener Mindestzementgehalt Contenido mínimo de cemento especificado	Workability (test method and frequency) Maniabilité (méthode d'essai at fréquence) Verarbeitkarkeit (Prüfverfahren und -häugigkeit) Trabajabilidad (método da ensayo y frecuencia)	Mix proportions (by weight) Composition du melange (en poids) Mischungsverhältnis (nach Gewicht) Proporciones de la manta In peso)	Air entrained concrete / Béton à air occlus / Luftporenbeton , Hormigón con aire ocluido % air entrained (minimum and maximum) % air occlus (min. et max.) geforderter Luftgehalt in % (min. und max.) % aire ocluido (mínimo y máximo)	Method a l determining air content and frequency éthode da determination de teneur all sir at fréquence des essais erfahren und Häufigkeit der Luftporenprüfung Método da determinación il contenido de aire ocluido y frecuencia	Grading, if specified: percent by weight passing each sieve La granulométrie si celled est prescrite en % passant à travers chaque tamis Wenn vorgeschrieben, Korngrößenverteilung: Durchgang durch Siebe in Gew % / Masse % Granulometría especificada: porcentaje a-n- peso pasando por cada tamiz	Notes on Rne aggregate, types, frequency of testing. etc. Notes relatives aux granulats, nature. fréquence des essais, etc. Bemerkungen zu feinen Zuschlägen, Art, Häufigkeit der Prüfungen usw. Otras prescripciones sobre el árido fino, tipo, frecuencia d-e ensayos, etc.
	49	50	51	52	53	54	55	56
1	Usually <0,43	A	Verdichtungsmass, (compaction degree), daily	N	3,5-5,0	Air-pressure meter, min. 3 times/day icroscopic determination of spacing factor a , start of work	II	011 and 1/4 or 014 with guaranteed grading Grading daily Sand for upper concrete must contain at leas, 113 siliceous constituents
2	0.45	375 kg/m³					None Percent passing 0.080 mm sieve: < 5 %	
3	M 0.45	N	N	N Per m³: cement 370 kg, water 150-160 l, 0/8 630-690 kg, 8/16 460-470 kg, 16/32 650-700 kg, air entraining agent	II M 3,5-6,5	R M Pressure type air meter; min. 1 every 2 hours		M Grading: 1 test every 1000 m³
4	0,40 Alternatively 0.25 with superplasticizer, increased amount of microsílica, and no air entrainment	325 kg/m³ Alternatively fly ash, and reduced cement content			4-7	Microscopical evaluation of hardened concrete	N	N
5	0.42	350 kg/m³	Slump test and German flow table, min. 1 per day	E	2-4 No specified la wear resistant concrete	Air meter pressure method (ISO 4848)	E	Grading curve Specifications on content of: organic matter, silt
6	N	R 300-350 kg/m³ P ≥ 250 kg/m³	Laboratory previous tests: workability meter LCL 15-50 sec (NPF 18 452 Standard) Control tests: slump test ≤ 6 cm (NFP 18 451 Standard) Usually 1 test every 500 m³, min. 2 tests per day Reinforced control: 1 test every 100 m³, min. 4 tests per day	N	R 3.6	Pressure type air meter INF 16 353 Standard) Usually, 1 test every 500 m³, min. 1 test per day einforced control: 1 test every 100 m³, min. 4 tests per day	According to NFP 18 101 Standard	Fineness modulus ± 0,3 Friability <15 (NFP 18 576 Standard) Cleanliness ≤0,10 (methylene blue test, NFP 18 592 Standard)
7	R Max. 0,45 without air entraining agent Max. 0,55 with air entraining agent	300 kg/m³	A Walz test, min. 1 2 times per day	II	R 4-6	ressure air meter every 100 batches MI. 1 per day	Standard grading curve (0-4 mm) 0.25 mm 5-8 0,50 mm 9-18 1,00 mm 18-28 2,00 mm 25-37 4,00 mm 35-47	Grading frequency: every 400 t (min. 1 per week)
8	Variable, depending on specified compressive strength	R Min. 300 kg/m³	Thaulow's drop table concrete tester and dump test at least once per day	According to DIN 1045 and ZTV Beton, based on preliminary tests	R Without plasticizers: average 4.0. Min. 3.5 With plasticizers: average 5.0. Min. 4.5	Air mater (pressure compensation method) R Once an hour	R According to DIN 1045 M, MR: 1 mm <27% 2 mm <30%	R Content of cement and fine aggregates <0,25 mm: max. 450 kg/m³ Requirements according to DIN 4226, TL-Min-StB and RG-Min-StB Grading of fine aggregates ≤ 2 mm: once a day
9	R 0.5	R 300 kg/m³	R Slump test, 1 every 200 m³, min. 2 per day Vebe	N Based on trial mixes	R 5 ± 1-5 for 20 mm aggregate 4 ± 1-5 for 40 mm aggregate	Pressure type air meter, min. 6 per day (BS 1881 Pan 106)	II	Nd more than 25% of $CaCO_3$ in top 50 mm of slab
10	R 0,46	R 300 kg/m³	R Test method not specified When slump test is used, slump: 2-6 cm Workability tests performed every time a series of beams for control of strength is made	A Based on preliminary tests cement / water / aggregates 1 / 0,45 / 6	R 5 ± 1	R Pressure type air meter (ASTM C231, UNI 6385), 1 pa hour	II Based on preliminary tests	Sand equivalent > 80, 2 tests per day Passing 0,075 mm ≤ 2%, 2 tests per day Moisture content: every 360 m³
11	R M, MR: 0.45 SR: 0,50 Airport runways: 0.42	N 330 kg/m³	Slump test: every 100 batches Compacting factor test: every day	A Preliminary tests according to NEN 5950	A Generally, 3-5	R According to NEN 5861 (displacement method) or NEN 5962 (pressure type air meter) 1 test every 40 m³, 3 per day	R According to NEN 5905	A River sand
12	R 0.50	R 330 kg/m³	R Consistency: Walz compaction test, once a day	Based on required preliminary tests	R I-6 for ordinary concrete (C4 Ab not specified la high strength concrete > 65 MPa	Air mater pressure method At least 2 times per day	Not specified, but approval is required for each project	
13	R 0,45	R 320 kg/m³ for OPC 340 kg/m= for OPC/ggbs or OPC/pfa	R Compacting factor (BS 1881 Part 103): 1 per 300 m² or 6 per day	R Continuously graded 0 / 37 . According to laboratory preliminary tests	P 46	R Air meter pressure method, 1 test every 200 m³. min. 2 tests pal day	R n.° 4 95-100 n.° 8 65-90 n.° 16 50-70 n.° 30 40-57 n.° 50 10-30 n.° 100 2-10 n.° 200 0-5	R Grading: 1-2 tests every 500 m³ Sand equivalent: 2-4 tests every 500 m³ Water content: 1 test per day
14	A Based on preliminary tests 0,42-0,45	R ≥ 325 kg/m³	R UNI 7163, 1 per hour	II Based on preliminary test: Fraction passing through 0.016 mm sieve ≤ 450 kg/m³ (R)	R Max. 6 In frost mass. min. 4	R Pressure-type air mater Every time a series of beams for control of strength is made	R :.a mm 90-100 1,25 mm 65-90 0.63 mm 45-75 0.32 mm 27-55 0.16 mm 10-30 0,08 mm 2-10 0-5	R Siliceous fraction: min. 30% Sand equivalent: min. 75 (min. 80 in host areas) Variation of fineness modulus max. 5%
15	N	II	II		Depending on concrete strength 4.6 N/mm²: 5.5 6.0 N/mm²: 4.0 7.0 N/mm²: 3.5	Pressure type air meter: 2 tests per day 2 cores every 3000 m² l of host salt test and microscopic quality control	II	II
16	0,38-0,43	300-350 kg/m³		According to Swiss specification SIA 162/19	46	Pressure type air meter. 5-8 times par day	According to Swiss specification SIA 162 11969	According to Swiss specification SIA 16211969

	COARSE AGGREGATE, GAOS GRANULAT / GROBE ZUSCHLÄGE / ARIDO GRUESO			CONCRETE MIXING / FABRICATION D'! BETON / HERSTELLUNG OES BETOMMISCHGUTES / FABRICACION DEL HORMIGON			PAVING AND FINISHING / MISE EN PLACE ET FINITON / EINBAU / PUESTA EN OBRA Y ACABADO	
	Separate sizes used Différentes dimensions utilisées Gebräuchliche Korngruppen Tamaños utilizados	Grading, if specified: percent by weight passing each sieve La granulométrie si celle-ci est prescrite en % passant à travers chaque tamis Wenn vorgeschrieben, Korngrößenverteilung: Durchgang durch Siebe in Gew. % / Maesse - % Granulometría especificada: porcentaje en peso pasando por cada tamiz	Notes on coarse aggregate, types, frequency of testing, etc. Notes relatives aux granulats, nature, fréquence des essais, etc. Bemerkungen zu groben Zuschlägen, Art, Häufigkeit der Prüfugen usw. Otras prescripciones sobre el árido grueso, tipos, frecuencia de ensayos, etc.	Plant mixing. If specified, mixing time (seconds), type of mixer and minimum output Durée du malaxage (en seconds), type de malaxeur et débit minimal Mischanlage. Wenn vorgeschrieben: Mischzeit in Sekunden, Mischerbauart und Mindestleistung Planta de fabricación. Tiempo de amasado especificado (segundos), tipo de hormigonera y rendimiento mínimo	Truck mixing / Malaxage en camion / Transportbeton / Fabricación en camión hormigonera Specified or permitted Prescrit ou autorisé Vorgeschrieben oder oesttatat Especificada o permitida	Prescriptions Prescriptions Vorschriften Prescripciones	Placing temperatura minimum or maximun Température au moment de la mise en place (max. ou min.) Einbautemperatur min. und/oder max. / Temperatura máxima Temperatura máxima y/o mínima de puesta en obra Air temperature Température de l'air Lufttemperatur Temperatura ambiente °C	Concrete temperature Température du béton Betontemperatur Temperatura del hormigón °C
	57	55	59	60	61	62	63	64
1	4/8, 8/16 and 16/22	N	Grading daily Los Angeles: max. 20 PSV: ≥0,50	Min. 50 s	X		R: ±5 P: −3	min. ±5, 10 at air temperature of −3 max. 25 in warm weather
2	217 7/20 20132	None	PSV: ≥050		Prohibited	None	Minimum 1	None
3	M 014 or 0/8 8/16 16/32	M > max. lo% < max. 15%	R M Crushed rading: 1 test every 1000 m³		M Not permitted		R M Correlation with concrete temperature	R M Min. 5 Max. 25
4	N	N	N	Concrete mixed until uniform mix is obtained	X	N	Minimum: +5 aximum temperature will not e included in specifications, t planning will demand sprin · autum work, avoiding both summer and winter	N
5	E Dmax normally ≤32 mm	E	rost resistant, dense, durable Testing LA value, brittleness, particle shape, fracture value and grading curve	OC	Not permitted		Min. + 5	Max. 30 after casting
6	N	According to NFP 18 101 Standard	R Polished stone value: ≥0,55 (only for exposed aggregates) Cleanliness: ≤0,5 (NFP 18 591) Shape coefficient: ≤ 20 Los Angeles coefficient: ≤15 Wet micro-Deval: ≤15 (NFP 18 572) Soundness: <50% (NFP 18 593)	Type of mixer: N Mixing time: > 30 sec (NFP 18 305 Standard) Certified mixing plants included in aptitude relation	X		R 5-30 P 0-5 with protection	R 5-30
7	4. 8, 11, 16, 22. 32 mm	Standard grading curve: 8 mm 50-62 16 mm 72-80 32 mm 100	Every 400 t (min. 1 per day)	Mixing time: 60 s	ly when using concrete with superplasticizer	N	5-25 without protection ith protection, air temperatur ip to -5 or over 25 can be allowed, but concrete emperature must be always under 30	
8	R Min. req.M.ed: MR: 0/2, 2/8, >8 mm or 0/4, 4/8, >8 mm SR: 0/4, >4 mm Max. size: 16, 22 or 32 mm	According to DIN 1045	R M, MR: Aggregates >8 mm: min. 50% crushed stone Crushed stone content of combined grading: min. 35% Requirements according to DIN 4226, TL-Min-StB, RG-Min-StB Grading of aggregates >2 mm: once per week	R Mixing time will be specified in the new ZTV Beton-StB (91?): min. 45 s	X xception: mixing of super-lasticizers into the mixed-in-plant concrete	fin. quantity of superplasticizer quired: 8 to 4 cm³ per kg cemer lixing time: about 1 minute per ·³ concrete, at least 5 minutes ccording to Richtlinie für Beton nt Fliessmittel und für Fließetor (DAfStB)	Temperature < + 5 and > + 25: ecial precautions are to be take Temperature < -3 or continuous frost: works have to be stopped	R Min. + 5 during the first 3 days Max. +30 when paved
9	OC Normally 40-20 mm or 20.10 mm or 10-5 mm (for repairs)	N	Natural gravel, crushed rock to BS 822 or blastfurnace slag to BS 1047 or crushed concrete with quality requirements of BS 882	OC	P	N Main slabs P Kerbs and channels	R Min. 3	R Max. 30
10	3	N Based on preliminary tests	R, A Soft or weathered particles: ≤1% Particles with alcali reactive elements: ≤1% LA coefficient/Micro-Deval/PSV according to type of finishing and traffic Frequency of testing: 1 per day	R Min. output 120 m³/hour	N	N	A Tmin = 2 When 2-5. mixing water heated E Tmax	N 25.7
11	R According to NEN 5905	R According to NEN 5905 am the 'RAW Standaard 1990'	A River gravel Crushed material complying to the 'RAW Standaard 1990' in the top layer Frequency of testing: according to NEN 5905 and the 'RAW Standaard 1990'	N	E According to NEN 3502	NEN 3502	R Minimum +4 (mean daily temperature) A (in general: no concreting in winter months)	N
12	No, specified, but approval is required for each project			N	N		Min. 2	N
13	R M, MR According to pretended grading Min. 3 separate sizes	N	R M, MR L.A. : ≤30 mm Max. size : −37,5 mm Organic content : <0,5% % pass n.° 200 : <1% Sand equivalent : >80%	R M, MR Batch type min. 60 m³/h	N	N	R M, MR 5-30 depending on humidity and wind	N
14	R Min. 2 fractions	N	R Maximum size: 40 mm or 1/2 layer thickness Los Angeles: max. 35	R Mixing time: N Type of mixer: batching plar Min. output to allow a pave advance of 60 m per hour	R nly in SR or when pavemer surface ≤5000 m²	R Max. drum filling: 2/3 tota volume	N Depending on air temperatu and humidity, precautions must be adopted (E)	R 10-30
15	N			N About 90 s	N		Min. + 5	
16	According to Swiss specification SIA 162/1989	According to Swiss specification SIA 15211959	According to Swiss specification SIA 162/1989	Mixing time between 60-120 Various types of mixers Min. output depending on th mixing type. (N)	P Seldom used		5-30	5-25

	Paving method currently usec Méthode de construction normalement employée Gebräuchliche Einbauverfahre Método de puesta en obra utilizado normalmente	Type of final finishing or surface texture lature de la finition ou de k texture de surface Art des Fertigstellens der Oberfläche. Strukturierung Tipo de acabado o de textura superficial	Restrictions on time for finishing Unite de temps pour l'exécution des travaux de finition eitbeschränkung für die Fertigstellung estricciones en el plazo para k terminación	Method of dowel placement Méthode de placement des goujons Dübeleinbau Método de colocación de los pasadores	Is a super-smoother used for longitudinal finishing? Une poutre liseuse oscillante est-elle employée pour améliorer l'uni? Verwendung eines Längsglätters? ¿Se utiliza una maestra oscilante para mejorar la regularidad superficial?	Surface tolerance . Tolérance de surface / Oberflächentoleranzen / Tolerancia de acabado Maximun variation permitted Ecart maximal autorisé Höchstzulässige Unebenheiten Máxima irregularidad permitida	Method of evenness rrection or financial penalty Méthode de correction de l'uni ou pénalité Verfahren zur Beseitigung von Unebenheiten bm. finanzielle Abzüge Método de corrección de la regularidad superficial o penalizaciones	Texture depth or skidding resistance requirements Profondeur de k texture ou prescriptions sur la resistance au glissement Anforderungen an dk Texturtiefe oder an dk Griffigkeit Profundidad de la textura o prescripciones sobre resistencia al deslizamiento
	65	66	67	98	69	70	71	72
1	Slipform paver or super-plasticized concrete	Longitudinal texture or exposed aggregate	upper layer must be npacted within 1-Z hours 3 hours after compactior of lower layer	Vibrated into the fresh concrete	Yes	3 mm under 4 m straightedge	Grinding or financial penalty	
2	Slipform paver	[illegible] aggregate nishing	2 hours after mixing	metallic cradles or vibrated into the fresh concrete	Mainly	4 mm under 3 m straightedge	Financial penalty Grinding permitted	SFCI ≥0,45 SFCM ≥0,50 measured at 80 km/h
3	M Slipform paver	M Grooving of fresh concrete (brushing)	M Immediately		M Yes	R M 5 mm under 4 m straightedge ± 10 mm from true level	G i i	M Send patch test: min. 0,80 Coefficient of longitudinal friction (v = 60 km/h)
4	Slipform paving	xposed aggregate surface	N	Dowel craddles, unless the ntractor's paver is equipped to place the dowels with sufficient accuracy	Yes	ximum number of irregularities e random section 100 m long, measured by Viagraph ize ≥ M and MR SR 0 mm 0 0 5 mm 0 2 6 mm 2 3 5 mm 3 5 3 mm 9 15	Surface grinding	Skidding resistance ≥0.4 at 60 km/h on clean, wet pavement Reduction with 20 km/h increase of speed within the range 60-90 km/h: ≤0,1 Texture depth required: ≥1 mm
5	Slipform paver	Transverse brushing	lax. 2 hours from miring	Automatically inserted or fixed on cradles	Yes	5 mm under 5 m straightedge	amond grinding a financial penalty	2-3 mm
6	0 C Slipform paver	Transverse texturing or hemical stripping, related to traffic and short term maintenance	exturing: <30 min after spreading emical stripping: brushing performed 24 to 48 hours ha spreading. according to air temperature	R On cradles	Not recommended due to very variable results	Control with APL 25 or 72 Tolerances: 80% <4, 30% <8 end 100% <13	Diamond grinding and/or financial penalty	Sand patch test: > 1.5 mm
7	M, MR runways:slipform paver MR. SR: fixed lo"" paver Concrete with superplasticize in small works	Brushing		On baskets	No	IX. uneveness in mm under 4 m straightedge M MR Si ingle value 8 . 0 9-10 1 verage value 2.5 3-4	Planning through milling	spedd (km/h) >80 <80 <50 SRT single value 55 55 50 average value 60 60 55 Text. depth, mm single value 0.50 0,30 0.25 average value 0,80 0,50 0,35
8	Predominantly used: slipform paver Rarely used: fixed form equipment	R Finkhing float (smoother) and burlap or transverse brushing	N For finishing R two-layer placing: top concre ust be placed one hour after mpaction of the base concrete warm, dry weather, and two rs after in cool, damp weathe	Vibrated into the fresh . concrete by . dowel setting unit	Yes II For M,MR	R Max. ±20 mm from true pavement surface. M, M4: ≤4 mm under 4 m straightedge SR: ≤6 mm under 4 m straightedge	Grinding or financial penalty	N Several test methods used Texture: sand patch test or outflow meter or laser Skidding resistance: skid resistance tester (SRT) or Stuggarter Reibungsmesser (SRM)
9	0 C Fixed form train Slipform paver	R Transverse brushing, with wirebrush	R /ithin 3 hours of mixing or hours between 25 °C anc 3 °C concrete temperature	OC Pre-positioned or inserted into bottom laver	N	R ±6 mm from design level Max. number of irregularities in 300 m: mm 20 (M,MR) 40 (SR) mm 2 (M,MR) 4 (SR)	R Grinding or bump cutting and retexturing	R 0,65-1,35 mm on opening to traffic
10	R Slipform paver	A Tranverse brushing Chemical stripping Porous asphalt concrete	II	A Manual placement on cradles	N	R 3 mm under 3 m straightedge For CRCP with porous asphalt Concrete course (PCP): APL: CAPL 25<25 over 100 m lenght ARAN: MAS <3mm/m over 200 m lenght 5 mm under 3 m straightedge	N Financial penalty	N For PCP
11	Slipform paver	A In general: super smoother followed by transverse brushing	A In general: within 3 hours after mixing	0 C In general, mechanical insertion	Yes	R M/MR 5 mm under 3 m straightedge SR 15 mm under 3 m straightedge	A In general: grinding or removal of slab(s)	R Skiddding resistance at 50 km/h (86% slip) ≥0,52 A Texture depth (e.g. 0.7 mm)
12	Slipform paver most commo	Transverse brushing Surface texturing required	R Within 2 hours of mixing In cold weather 3 hours	Normally, automatic dowel placement	Normally	R mm under 3 m straightedg Max 15 irregularites > 3 mn per 10 m lane	Grinding or financial penalty	N
13	A M, MR Splipform paver	R M, MR Transverse or longitudinal brushing	R 2 hours	R Inserted into fresh concrete by vibration or installed on metal supports	N, A M, MR	R M, MR 3 mm under 3 m straightedg	N	R Texture depth (sand patch test): >1 mm, min. 0,6 mm
14	Slipform paver	R Usually, longitudinal texture (brushed or grooved) Also admitted transverse texture grooved) or chemical stripping (plus chipping if fraction of siliceous rerticles of fine aggregate <30%)	R Max 1 hour (2 hours if slow setting cements or retarders are used or under favourable weather conditions)	R Inserted into fresh concrete (usual) or on cradles	Yes	R For design speed ≥ 100 km/h: 3 mm under 3 m straightedge Viagraph coefficient: average val 5 dm/hm For design speed < 100 km/h: 5 mm under 3 m straightedge vi graph coefficient: average valu 7 dm/hm	R Grinding	R Sand patch test: 0.7-1 mm (min. value 0.5 mm) 2 checks per day (5 if one of the results is lower than 0.5 mm)
15	Slipform paver	N		Mechanical insertion	No	3 mm under 3 straightedge	Grinding	R Friction coefficient: 0.55 (special test method at 70 km/h, 17% slip)
16	Slipform paver Fixed form paver	Brushing of newly laid concrete	The work is continuous	Mechanical insertion	Yes	R Transverse 1‰	N Depending on the needed correction. Financial penalties are included	R 65 (with Pendel)

	PAVING AND FINISHING / MISE EN PLACE ET FINITION / EINBAU / PUESTA EN OBRA Y ACABADO				TEST CORES / CAROTTES / BOHRKERNENTNAHME / TESTIGOS			
	Initial protection / Protection initiale / Schutzmaßnahmen / Proteccion inicial		Curing / Cure / Nachbehandlung / Curado		To check / Pour contrôle de / Zur überprüfung / Para control de		Penalty / Pénalités / Abzüge / Penalizaciones	
	Type normally used	Protected length or number of hours	Type normally used	Minimun number of days when curing compound is not used	Strength	Thickness	For deficient strenght	For deficient thickness
	Méthode habituellement employée	Longueur protegée ou nombre d'heures	Méthode habituellement employée	Nombre de jours minimum si un produit de cure n'est pas employé	Résistance	Epaisseur	Pour insuffisance de résistance	Pour insuffisance d'épaisseur
	Gebräuchliche Maßnahmen	Geschützte Länge oder zeitliche Dauer	Gebräuchliche Arten	Mindestdauer, wenn kein Nachbehandlungsmittedl verwendet wird	Festigkeit	Dicke	Fur Minderfestigkeit	Für Minderdicke
	Método utilizado habitualmente	Longitud protegida o número de horas	Método utilizado habitualmente	Mínimo número de días cuando no se utiliza un producto de curado	Resistencia	Espesor	Por falta de resistencia	Por falta de espesor
	73	74	75	76	77	78	79	80
1	Curing compound applicable on fresh concrete Special curing compound if rain threatens		uring compound applicable on fresh concrete ipecial curing compound if rain threatens		When cubes and beams are not satisfactory		0 . 0 2 x price/m² x area x x strength deficiency	
2	Curing compound Plastic membrane when exposed aggregate finishing + curing compound after brushing		hite pigmented resin based curing compound		Yes (compressive strength)	Yes	RR = 0,2 pS (Eo-RM / 2 SR)² SR = standerd deviation S = surface p = unit price RM = average strength RR = penalty Ro: required strength	EE = pS (Eo-EE / Eo-0,8 Enom)² Eo = 0,95 Enom + 2 Standard deviation
3	M Curing compound	M Min. 7 days	M Curing compound		M Recommendation: – compressive strength – tensile strength – splitting strength – tensile strength of top laye	R M Every 3000 m²	Yes	Yes
4	Polyethylene membranes	Until the retarded mortar has been brushed off	25% cut-back bitumen in gassoline		N	Minimum thickness prescribed	Rejection	Rejection
5	Mobile cover	About 50 m	Curing compound or water spray	7	One core every 1000 m²			Yes
6	N Except for chemical stripping air flexible protective sheet between spreading and brushir	4-48 hours according to air temperature (500-2000 m)	Curing compound certified by COPLA itandardization on progress	R 3-7 days according to air temperature and humidity	When insufficient results of control tests Strength must be at least equ to that obtained on cores extracted from a reference stretc and tested at the same age		Removal of slab(s) or guarantee of service life	Removal of slab(s) or guarantee of service life
7	Curing tents	About 30 m	Plastic emulsion		One core every 150 m	One core every 150 m	I	I
8	R M, MR: concrete laying and finishing under tents Protective tents or canopies inmediately after finishing	N About 60-100 m E Protection is sometimes omitted	xraying with curing compounc nmediately after texturing	xraying with water at least 3 days /aterproof membranes and moist mats are permitted as well	R One core each 1000 m² anc construction lane	R Ine core each 1000 m² and construction lane	R Financial penalty or removal of slab(s)	R inancial penalty or removal of slab(s)
9	R Aluminised resin-based sprayed curing compound	N	R Aluminised resin-based sprayed curing compound	N	E For strenght R For density 3 cores per 1200 m	E	Removal of slab(s)	Removal of slab
10	R Polyethilene sheet (PCP)	24 hours	Curi compound	7 days	R Not less than 90% of specified strength	A Not more than 5 mm under specified thickness	A Reduction of 80% d unit price if extra tests required by engineer fall under 90% of specified strength	R Between 5 and 15 mm: price reduction coefficient = (average thickness/ (required thickness - 5)3 Between 15 and 25 mm: 20% Over 25 mm: removal of slab(s)
11	N		A Curing compound	N	A If specified: 12 cores every 10000 m² (compressive strength; if h < 100 mm, splitting strength)	A If specified: 12 cores every 10,000 m²	A If specified: removal of slab(s)	A If specified: removal of slab(s)
12	Curing membrane (+tent	R Min. 6 h against sun, rain and wind	Curing membrane		R 1 core per 2000 m² Min. 3 cores for areas < 2000 m² Min. 5 cores for areas > 2000 m²	R 1 core per 2000 m² Mtn. 3 cores	Financial penalty or removal of slab(s)	Financial penalty or removal of slab(s)
13	E Tents	E 1 h	R M, MR Curi compound	7 days	R M, MR Yes	R Yes	I	I
14	R In hot weather, spraying w water In rainy weather, protecti tents or plastic sheet or ra resistant curing compoun	R 50 m	Curing compound (min 200 g/m²)	R 3	R Only when strength of cas beams is < 90% of specifi value	R Min. 2 per day (5 if one of them has a thickness lov than nominal value)	R Fiiid penalty or remova of slab(s)	A Financial penalty or removal d slab(s)
15			Water curing	3-5	3 cores every 3000 m² fc compressive strength 3 cores every 3000 m² fc splitting strength 2 cores every 3000 m² fc frost resistance	Yes		
16	Tent when fixed form pav is used	About 100 m	Curing compound. 200 g/m	7 days	N Compression test at 28 days	Not. Control is done before or during the construction	N Removal of slab(s) or financial penalty	

	PAVEMENT DRAINAGE, DRAINAGE DU REVETEMENT, ENTWÄSSERUNG DER BEFESTIGUNG, DRENAJE DEL PAVIMENTO		SHOULDERS FOR MOTORWAYS AND GENCE POUR AUTOROUTES ET ROUT AUTOBAHNEN UND HAUPTSTRAßEN,	...DS / BANDES D'ARRÊT D'UR- PRINCIPALES, STRANDSTREIFEN AN CENES DE ATPISTAS, Y CTRAS.PLES.	OFFICIAL SPECIFICATIONS / PRESCRIPTIONS OFFICIELLES / VORSCHRIFTEN, PRESCRIPCIONES OFICIALES	
	Is a drainage system provided for the water infiltrated under the concrete slabs? Un système de drainage pour évacuer l'eau s'infiltrant sous la revêtement est-il employée? Wird ein Entwässerungssystem zur Ableitung des Wassers unter der Betondecke vorgesehen? ¿Se dipone algún sistema de drenaje del agua infiltrada bajo el pavimento de hormigón?	Method employed Méthode utilisée Angewandte Systeme Método utilizado	Concrete shoulders Thickness B.A.U. en béton Epaisseur Betonstandstreifen Dicke Arcenes de hormigón Espesor	Other types Autres types Andere Ausführungen Otros tipos	Authority issuing Administration compétente Herausgeber Organismo redactor	Year of latest version and date of supplements Date da la dernière édition et date des suppléments Jahr der letzten Ausgabe und Daten der Nachträge Año de la última versión y fecha de los suplementos
	81	92	83	64	85	86
1	Yes	Lateral drainage or drainage under transverse joints	Same thickness es carriageway		Austrian Highway Research Board RVS 8.06.32 «Deckenarbeiten-Betondecke -Deckenherstellung»	1990
2	A	A Permeable shoulder foundation f	A 200 CRCP 230 PC	A 50 mm bituminous surfacing 150 mm treated subbase or granular subbase or porous lean concrete	Ministry of Public Works	1988
3			240		Government standards and specifications set by investor	1988
4	Yes	A	A	A	The Danish Road Directory	1984
5	Yes	Well-drained gravel layer under the subbase	Same thickness as pavement	Asphalt shoulders (more used)	lo official specifications for concrete P C - -	
6	R Lateral drainage P Permeable layer under concrete slabs	Permeable marginal strip: porous concrete or pervious granular material, according to traffic Permeable geotextile: sheets or strips	qual to pavement thicknees, but often using less resistant concrete	Related to traffic Hydraulic binder treated layers on unbound granular materials (often permeable)	1 Direction des Routes-CCTG fascicule 28-Execution des chaussées en béton de ciment 2 SETRA-LCPC-Catalogue des structures types de chaussées neuves SETRA-LCPC-Directive pour la realisation de chaussées en béton de ciment Norme NF 98 170 Chaussées en béton de ciment-Execution, suivi et contrôles (in progress)	1. 1976 2. 1977 and 1966 3. 137s
7	N		Like traffic lane			1999
8	R According to RAS-drainage, but no special system for concrete roads as a rule	E Several systems tested: longitudinal and transverse drains, fleeces, geotextile	R As the traffic lane	M, MA: other types normally not used MR, SR: unbound granular material	Bundesministerium für Verkehr (Federal Ministry of Transport)	Design: RStO 1966, suppl. 1989 Pavement: ZTV Beton 1976, suppl. 1980, 1362 and 1990 Sub-base: ZTVV-StB 1961 ZTVT-StB 1966
9	Yes	A Crossfall to sub-base and longitudinal drain R Polythene sheet under layer	A Same es carriageway	X	lepartment of Transport, England; cottish Development Department; /elsh Office: DOE Northern Ireland	6th Edition 1966 Supplement 1996 (Appendix L) 17th Edition due end of 1990)
10	A Yes	R For CPC: porous concrete For JPCP: longitudinal drainage	For PCP: porous concrete, 220	N	siglio Nationale delle Ricerce (CNR lazienda Nazionale Strade (ANAS) Società Autostrade SpA	CNR: 1972 ANAS: 1976 Autostrade: 1969
11	N		Same thickness as concrete pavement	N	1) «Richtlijnen voor het ontwerpen van rijkswegen (ROA)», 1975 (Guidelines for the design of motorways) 2) «Richtlijnen voor het ontwerpen van niet-autosnelwegen (RONA)», 1984 (Guidelines for the design of non-motorways) 3) «RAW Standard 1990», 1990 NEN Standards	1) 1975 2) 1984 3) 1990
12	R Yes	R Draining on both sides Draining material are required in subbase	Same es pavement	Asphalt concrete on penetrated base	rwegian Public Roads Administratio	1980 Official specifications under revision. Considerable changes will be proposed
13	R Yes	R M, MR Crossfall > 2% Porous concrete associated with drainage layer material or slotted pipe,	A 150-250 depending on slab thickness	A Bituminous layer on granular or cemen treated layers	unta Autónoma de Estradas (J.A.E.)	1965 1966. suplements
14	N Usually in case of undowelled joints	E Usually marginal permeable strip (lean concrete or unbound granular) (frequently combined with longitudinal slotted pipes)	R Same thickness es concrete slab in a 40 cm wide marginal strip. Rest of shoulder: 150 mm	A Bituminous surfacing plus cement-treate base or soil-cement or permeable unbound roadbase mater	Ministerio de Obms Públicas y Urbanismo	«Pliego de Prescripciones Técnicas Generales para Obras de Carreteras y Puentes PG-4» (Chapter 550), 1990 «Instrucción 6.1. y 62-H: sobre secciones de firme» 1969
15	NO		Not used	Asphalt shoulders	Road Administration	1990
16	NO		Not used	Bituminous surfacing	VSS-specifications For concrete, SIA specifications	Specifications have been revised during the last years on various pans. Last revision referred to concrete: 1989