

IKT Comparative Test "Manhole Rehabilitation"



Task: Rehabilitation of an approximately 5 m high DN 1000 concrete manhole in which defined defects had been installed, against a rising groundwater table.

- 8x "isolated damage": point damage in the form of a 10 mm dia. drill hole.
- 4x "area damage": nine drilled holes of 5 mm dia. in a 20 cm x 20 cm area, with simulation of point defects in substrate preparation (mould release agent)
- 5x "leaking ring joint": ring joint with four 6 mm dia. drill holes

Contractor	Hobas Rohre GmbH	PCI Augsburg GmbH	Trummelelektregulieren W. Schwarz GmbH	Sika Deutschland GmbH	Aarsleff Rohrsanierung GmbH	PSL Handels GmbH	Hermes Technologie GmbH & Co. KG
Systems	GRP inner manhole shaft	Nanocret R4	PE-HD segmental lining	Sewer reprofiling mortar	GRP, back-anchored	Oldodur WS 56	Ergelit KS1
Installed by	Aarsleff Rohrsanierung GmbH ⁴	Aarsleff Rohrsanierung GmbH ⁴	Schacht + Trummelelektregulieren W. Schwarz GmbH	Peter Priesch - Kunststoffverarbeitung GmbH	Aarsleff Rohrsanierung GmbH	Schulz Bau GmbH	DTrom Kanaltchnik GmbH
IKT test results*	GOOD (1.6)	GOOD (1.7)	GOOD (2.1)	GOOD (2.1)	GOOD (2.2)	SATISFACTORY (2.6)	SATISFACTORY (2.7)
System tests (85 %)	Very Good (1.2)	Very Good (1.3)	Good (2.0)	Very Good (1.5)	Good (2.1)	Good (2.3)	Good (2.5)
Infiltration water tightness (40 %)	1.0	1.0	1.0	1.0	1.0	1.0	1.2
• Short-term exposure to groundwater, in increments up to 5 m, holding time: 17.5 days (3.5 days per load level) (20 %)	1.0	1.0	1.0	1.0	1.0	1.0	1.2
• Long-term exposure to groundwater, constant at 5 m, holding time: 67 days (20 %)	1.0	1.0	1.0	1.0	1.0	1.0	1.2
Load-bearing capability (20 %)	1.0	1.0	5.0	1.0	5.0	1.0	5.0
Robustness¹ (20 %)	1.0	1.3	1.0	2.0	1.0	6.0	2.0
to point defects in substrate preparation	1.2	1.4	1.1	1.9	1.7	1.8	3.3
Acceptability of completed work² (15 %)	5.0	5.0	5.0	5.0	5.0	5.0	2.0
Quality Assurance³ (15 %)	Satisfactory (3.5)	Adequate (4.0)	Good (2.5)	Deficient (5.5)	Satisfactory (3.0)	Adequate (4.5)	Adequate (4.0)
Method description (20 %): Method description (10 %), Technical note sheets (10 %)	+	+	+	-	+	+	+
Training provisions (20 %): Training of rehabilitator (10 %), Manufacturer's training courses (10 %)	-	-	+	-	+	+	-
Test certificates (20 %)	0	-	-	-	0	-	+
Third-party supervision (20 %)	+	+	+	-	+	-	-
"Particular abnormalities" (20 %)	In situ: mixing of grout and waste water (-)	In situ: mixing of mortar by eye (-)	no abnormalities(+)	In situ: no bid (-)	In situ: rehabilitation declined (-)	In situ: Drying of reprofiling mortar, using local blowair (-)	System test and in situ: Making of mortar by eye (-)
Addition information (with no grading):							
Static system	self-supporting	adhesive bond	self-supporting	adhesive bond	support elements	adhesive bond	adhesive bond
MAC stiffness (intact system = 100 %) ³	after rehabilitation > 150 %	after rehabilitation > 150 %	after rehabilitation > 150 %	after rehabilitation > 150 %	after rehabilitation no contribution to stiffness	after rehabilitation 100 - 150 %	after rehabilitation > 150 %
Leaking points on the access system	0 of 10 climbing iron connections	0 of 18 access systems	0 of 32 climbing iron connections	2 of 18 access systems	17 of 18 access systems	0 of 18 access systems	1 of 18 access systems
Surface preparation: Implementation and time required (approx.)	no surface preparation	manual high-pressure-water-jetting at 400 bar, 1 Std.	no surface preparation	manual abrasive jetting at 8 bar, 1 Std.	no surface preparation	manual high pressure-water-jetting at 310 bar, 1 Std.	mechanical high-pressure-water-jetting with granulate and 385 bar, 1 h
Rehabilitation: Implementation and time required (approx.)	manual, segment-by-segment, 6 h	hand-held trowel, 5 h	manual, segment-by-segment, 9 h	hand-held trowel, 8 h	manual, 15 h	hand-held spray gun, 1 h	hand-held trowel, 3 Std.
Total working hours (approx.) / days on site	12 h / 2 d	10 h / 2 d	15 h / 3 d	14 h / 2 d	27 h / 2 d	5 h / 2 d	12 h / 2 d
Filling level test after rehabilitation	passed	passed	passed	passed	passed	passed	passed
Costs, not including VAT	8,950 EUR	2,870 EUR	6,250 EUR	5,270 EUR	6,410 EUR	7,350 EUR	2,820 EUR

* Note calculation based on non-rounded values. ** System failure after 6 days of short-term exposure to groundwater: formation of two bubbles, no entry to the manhole possible. Inspection, testing and evaluation cancelled.

1 Robustness to point defects in substrate preparation: simulation of inadequate pre-treatment, as can occur in practice.

2 Impression made at on-site acceptance inspection: entry to manhole and video evaluation by members of the steering committee.

3 Protective action against aggressive environmental conditions: is considered demonstrated provided the relevant documents can be submitted, e.g. OIB approval. Grouts awarded on the basis of pH class and, where appropriate, passing of random-sampling test.

4 The in-situ work was performed by Sanierungstechnik Domini GmbH, since Aarsleff Rohrsanierung GmbH declined to perform rehabilitation.

5 The in-situ work was performed by Schulz Bau GmbH, since Aarsleff Rohrsanierung GmbH declined to perform rehabilitation.

6 System failure: signifies that there is an immediate need for rehabilitation because, for example, entry to the manhole is no longer possible and/or the hydraulic properties of the manhole have been severely impaired.

7 Notes on the supplementary load-bearing action of the systems: here, the increase in overall stiffness is measured against the initial stiffness of the intact manhole shaft using the MAC system (http://www.dtu.dk/~/media/Files/Technical%20documents/Technical%20reports/2015/20150601_mac.pdf) after rehabilitation.

Evaluation key for test results: Very Good = 1.0 - 1.5, Good = 1.6 - 2.5, Satisfactory = 2.6 - 3.5, Adequate = 3.6 - 4.5, Deficient = 4.6 - 5.5, Inadequate = 5.6 - 6.0

