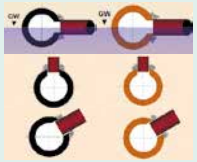
Table 4. Results, Case 2: Lateral connection repair in a non-rehabilitated main sewer

IKT Comparative Product-Test of repair methods for lateral connections



Rehabilitation task: Rehabilitation of three damage scenarios in each case in a non-rehabilitated concrete and non-rehabilitated vitrified-clay main sewer (DN 300)

- Damage Scenario I: "Defective (leaking) sewer connection" at the side zone of the main sewer (45° angle to/in the main sewer's longitudinal axis); DN 150 vitrified-clay pipe is presented up externally to the concrete/vitrified-clay pipe (main sewer). Groundwater influx at start of rehabilitation
- Damage Scenario II: "Defective (leaking) sewer connection" at the crown of the main sewer (90° angle to the main sewer's longitudinal axis); DN 150 vitrified-clay pipe is inserted to half the sewer's wall thickness into the concrete/vitrified-clay pipe (main sewer)
- Damage Scenario III: "Defective (leaking) sewer connection" between side zone and crown of the main sewer (45° angle outgoing perpendicular to the main sewer's longitudinal axis); DN 150 vitrified-clay pipe is inserted into the concrete/vitrified-clay pipe (main sewer); max. inward projection: 1 cm

Contractor	KATEC Kanaltechnik Müller & Wahl GmbH	Kuchem GmbH	PLITT-ROHRSANIERUNGS-GESELLSCHAFT mbH	Swietelsky-Faber GmbH Kanalsanierung	Geiger Kanaltechnik GmbH & Co.KG	IBG HydroTech GmbH[1]
Robot-based method using • Resin system	KA-TE PMO with • EPOXONIC Ex 1824 rapid • MC BAUCHEMIE Konodur Robopox 10	KA-TE PMO with • EPOXONIC Ex 1824 rapid	KA-TE PMO with • Sika Robotec 61	KASRO with • MC BAUCHEMIE KonudurRobopox CI	KA-TE PMO with • EPOXONIC Ex 1824 rapid	IBG HydroCut injection system with • resinnovation Harz 10
IKT test result	**GOOD (1.6)**	**GOOD (1.6)**	**GOOD (2.2)**	**SATISFACTORY (2.7)**	**SATISFACTORY (3.2)**	**ADEQUATE (4.5)**
System tests in test lengths (85 %)	**Good (1.7)**	**Good (1.7)**	**Good (2.4)**	**Satisfactory (2.8)**	**Satisfactory (3.5)**	**Deficient (4.7)**
Functionality[2] (50 %)	**2.4**	**2.0**	**1.9**	**2.2**	**3.1**	**3.6**
after completion (20 %)	2.3	1.9	1.9	2.1	3.0	3.5
after HP cleaning (80 %)	2.4	2.0	1.9	2.2	3.1	3.7
Tightness[3] (50 %)	**1.0**	**1.5**	**3.0**	**3.5**	**4.0**	**5.8**
Short-term groundwater exposure 2.0 m (20 %)	1.0	1.5	3.0	3.5	4.0	5.0
Long-term groundwater exposure 2.0 m (80 %)	1.0	1.5	3.0	3.5	4.0	6.0
Quality assurance[4] (15 %)	**Very Good (1.0)**	**Very Good (1.0)**	**Very Good (1.0)**	**Good (2.0)**	**Very Good (1.0)**	**Satisfactory (3.0)**
Process manual (20 %)	+	+	+	-	+	+
Operator training (20 %)	+	+	+	+	+	+
Test certificates for the materials used (20 %)	+	+	+	+	+	- (no DIBt approval)
Third-party supervision (20 %)	+	+	+	+	+	-
No particular problems (20 %)	+	+	+	+	+	+
Additional information: Impression from on-site investigations	Practically-orientated implementation	Practically-orientated implementation	Practically-orientated implementation	Practically-orientated implementation	Practically-orientated implementation	No date stated
Internal-pressure test at 0.5 bar after completion of the test programme and opening	6x tight	6x tight	4x tight, 2x not tight	5x tight, 1x not tight	5x tight, 1x not tight	2x tight, 4x not tight
Year of manufacture of robot	approx. 2008	approx. 1997	Not known	2012	approx. 2003	approx. 2013
Days of use on site	4 days	2 days	3 days	2 days	2 days	4 days
Time needed for rehabilitation (cutting) of 6 lateral connections (ca.)	7.8 hours (3.2 hours)[5]	5.4 hours (2.6 hours)	11.3 hours (5.0 hours)	13.8 hours (8 hours)[6]	9.2 hours (3.7 hours)[6]	11 hours (4.6 hours)[7]
Material consumption for 6 lateral connections (ca.)	24 kg	16 kg	48 kg	55 kg	28 kg	22 kg
Costs per lateral connection (net)/ depot (ca.)	720 €/ NRW	670 €/ NRW	700 €/ Lower Saxony	920 €/ NRW	830 €/ NRW	440 €/ Hesse

1 The complete repair scope was performed by IBG. Use was made of equipment supplied by the Horst Drzysga company only for the cutting work.
2 Evaluation based on visual assessment by municipalities by means of award of grades (1-6). Decimal places permissible (20 % weighting after completion; 80 % weighting after HP cleaning)
3 Evaluation on the basis of external water-pressure exposure. Grades awarded by points: No infiltration 0/green; Problems – 0.5/yellow; Perceptible infiltration – 1.5/red. 0 points = 1.0; 1 point = 2.0; 2 points = 3.0; 3 points = 4.0; 4 points = 5.0; above 5 points = 6.0
4 Evaluation: "+"= demonstrated; "-"= deficient; Approval/Certificates/Analyses must apply to the materials used in the test
5 One lateral connection was injected a second time
6 Two lateral connections were injected a second time
7 Five lateral connections were injected a second time

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.