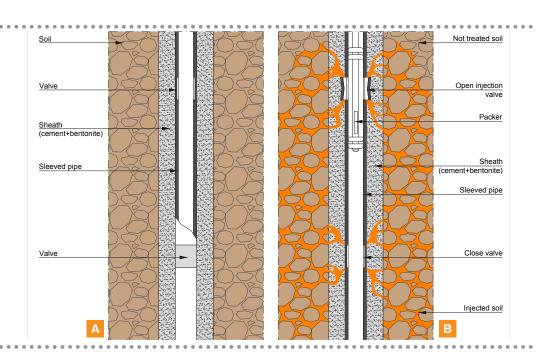




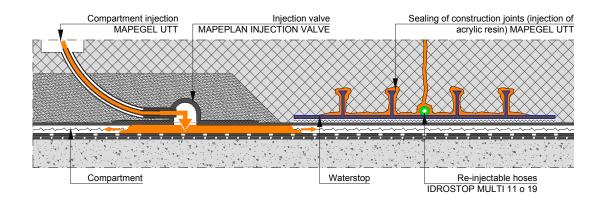
Phase 4 INJECTION

# Mechanical packer IDROSTOP MULTI ST Hydraulic binderLAMPOSILEX o epoxy adhesiveADESILEX PG1 Crack Concrete Injection resin

Injection phases
A - BOREHOLE DRILLING, POSITIONING OF
SLEEVED PIPE, REALIZATION OF SHEATH
B - INJECTION



Acrylic resin injection (with valve) inside compartments realized with synthetic waterproofing membrane; replacing waterstop and sealing joints with acrylic resins injection (using re-injectable hoses).



Phase 1
OPENING OF CRACK

Phase 2
DRILLING OF HOLE,
CLEANING OF HOLE AND
CRACK SURFACE

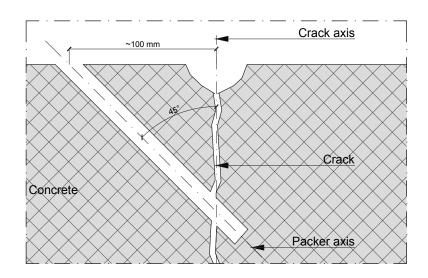
# Phase 3 POSITIONING OF PACKER AND SEALING OF CRACK

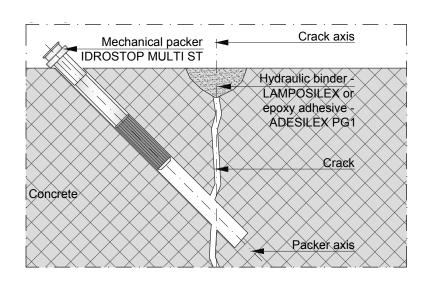
Crack axis

Crack -20-40 mm

Crack

Crack







WATER CONDITION

SOIL INJECTION							
clay	silt	sa	ınd	gravel	rock		
		fine-grained (low permeability)	coarse-grained (high permeability)				
10-8	10 <sup>-6</sup>	10-5	10 <sup>-3</sup>	10 <sup>-2</sup>	10		
Permeability							

				Permeability					
		RESFOAM 1KM (one-component, foaming only in presence of water, foaming ratio in presence of water: 30-40 times, reaction time: fast, accelerator is needed)	<b>666</b>						
		RESFOAM 1KM FLEX (one-component, foaming only in presence of water, low viscosity, low and slow foaming ratio depending on water quantity, reaction beginning/ending: 20"-1'/1'-5', accelerator is needed)	<b>666</b>						
		FOAMJET F (two-component, foaming in presence and in absence of water, foaming ratio: 20-30 times, reaction beginning/ending: 10"/3'-5')							
	polyurethane	FOAMJET F ST (two-component, structural, foaming in presence and in absence of water, foaming ratio in presence of water: 7-8 times, foaming ratio in absence of water: 1 times, reaction beginning/ending: 4'-5'/20'-30')	<b>66</b>						
		FOAMJET T (two-component, foaming only in presence of water, foaming ratio in presence of water: 3-10 times, reaction beginning/ending: 30"-1'15"/3'-8')	<b>∆ ∆ ∆ ∑ ∑ ∑ ∑ ∑ ∑ ∑ ∑ ∑ ∑</b>						
SESINS		FOAMJET 260 LV (two-component, elastic, low viscosity, not expanding, reaction time: 7'-180')	<b>∆∆∆⊗⊗</b>						
INJECTION RESINS		SILICAJET EXP (two-component, foaming in presence and in absence of water, foaming ratio: up to 40 times, reaction beginning/ending: 10"-30"/2'-3')	<b>∆∆∆∆</b>						
INJ		SILICAJET EXP/4 (two-component, structural, foaming in presence and in absence of water, low foaming ratio, reaction beginning/ending: 15"-20"/3'-5')	<b>∆∆∆⊗⊗</b>					V	
	organo-mineral	SILICAJET ST (two-component, structural, not expanding, reaction beginning/ending: 1'-2'/5'-10')	<b>66 ==</b>					<b>Y</b>	
		SILICAJET ST HP (two-component, structural, not expanding, reaction beginning/ending: 1'-2'/5'-10')	<b>66 ==</b>					V	
		SILICAJET ST FLEX (two-component, structural, flexible, not expanding, reaction beginning/ending: 1'-2'/5'-10')	<b>666</b>						
	acryilic	MAPEGEL UTT (three-component, low viscosity, not expanding, gel time: 30"-45")	<b>66</b>			V		V	
	ероху	<b>EPOJET LV</b> (two-component, low viscosity, structural, not expanding, workability/hardening: 30'-70'/5-8h)	Х						
NO		MAPEJET SYSTEM N (two-component, low viscosity, workability: 30')	*********			<b>Y</b>	<b>Y</b>	<b>Y</b>	
INJECTI		MAPEJET SYSTEM C40 (two-component, low viscosity, workability: 40')	***************************************						
CHEMICAL INJECTION		MAPEJET SYSTEM LP (two-component, low viscosity, workability: 3h)	**********						<b>Y</b>
픙		MAPEJET SYSTEM NS 15 (two-component, very low viscosity, workability: 45')							
MICRO-FINE CEMENTS		MICROCEM 8000 (micro-fine hydraulic binder for ground consolidation and waterproofing injection of cementitious-based mixes)	<b>6</b>			<b>Y</b>	<b>M</b>	<b>Y</b>	
MICRO		MICROCEM 12000 (micro-fine hydraulic binder for ground consolidation and waterproofing injection of cementitious-based mixes)	<b>6</b>						
		MAPEGROUT COMPACT (premixed product with controlled rheology and fluidity)	<b>66 ==</b>						
	cementitious grout with wash-out resistance	MAPEGROUT COMPACT AWM (premixed structural product with controlled rheology and fluidity)	<b>66</b>						
IORTA		MAPEGROUT COMPACT VV (pre-mixed product, mechanical resistance up to10 Mpa, controlled rheology and fluidity)	<b>66 ==</b>						
		MAPEGROUT COMPACT HP (pre-mixed product, very high wash-out reistance, controlled rheology and fluidity)	<b>66 ==</b>						
EMENT		MAPEGROUT COMPACT PS (two-component grout, wash-out resistance, with controlled rheology and fluidity and low specific weight)	<b>66 ***</b>						
	expanding	<b>EXPANJET</b> (one-component pre-mixed mixture, very fine expanding ratio: 0.7)	<b>\oint{\oint}</b>	M	M				
	extended workability	MAPEQUICK CBS SYSTEM (two-component system for cement-based grout, workability: 72 h)	<b>66 **</b>						

EQUIPMENT	COMPATIBILITY		
IDROSTOP MULTI 11 (PVC re-injectable hoses)	injection resins		
IDROSTOP MULTI 19 (PVC re-injectable hoses)	micro-fine cements		
IDROSTOP MULTI ST (mechanical packer, different size available)	injection resins, chemical injection		

FILLING OF CAVITY	CONCRETE INJECTION			TBM IN.	JECTION	COMPARTMENT INJECTION	RE-INJECTABLE HOSES INJECTION	
	STRUCTURAL	WATERPROOFING	CERTIFICATION	PRE-GROUTING	OVERLEAF SEGMENTS			
			CE (EN 1504-5)					
			CE (EN 1504-5)					
			CE (EN 1504-5)					
			CE (EN 1504-5)					
			CE (EN 1504-5)					
			CE (EN 1504-5)					
							<u></u>	

LEGEND			
Х	dry condition	888	pressurized water inflow
<b>\oldot</b>	surface damp, water leakage		water saturated soils
8	water inflow	М	soil mechanical re-compression



# MAPEI UTT Underground Technology Team

# **UTT TECHNICAL ASSISTANCE PROVIDES:**

- Great technical skills according to deep knowledge of products, production phases and construction systems;
- Assistance during construction and design phases, in order to focus on the correct products and technical solutions;
- Global intervention, 24 hours per day and 365 days per year;
- Production optimization and costs reduction.

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- TUNNEL MAINTENANCE, REHEABILITATION AND COATING PRODUCTS

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