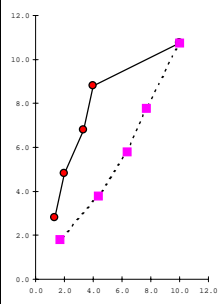
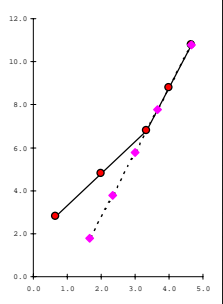
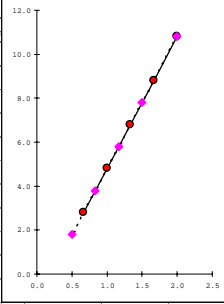
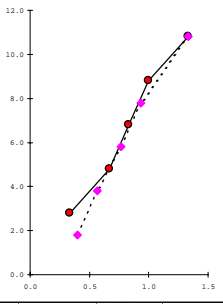
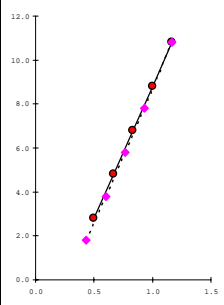
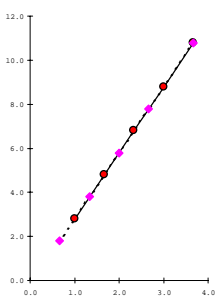
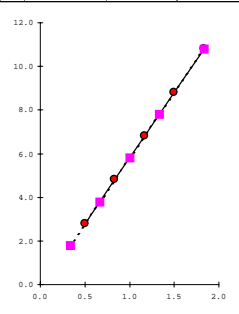
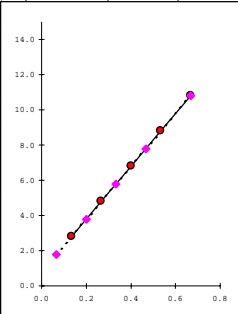
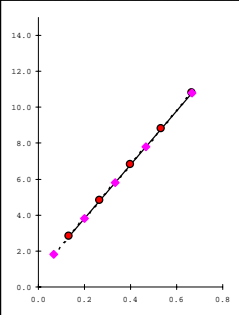
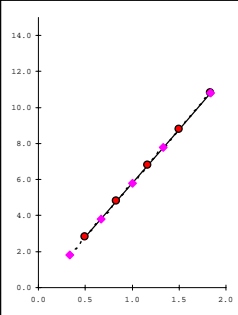
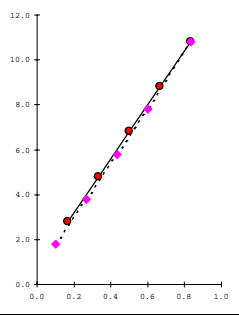
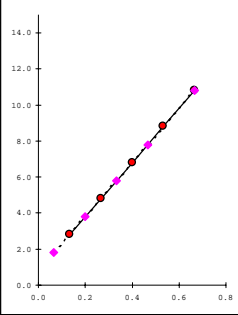
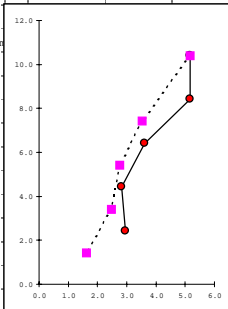
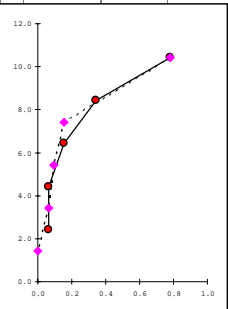
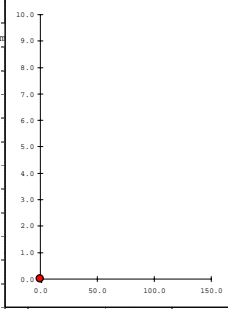
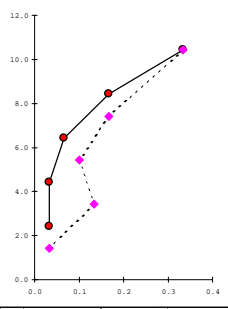
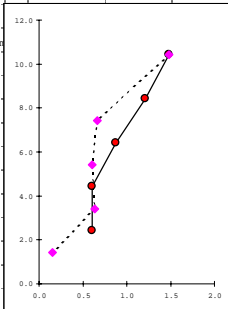
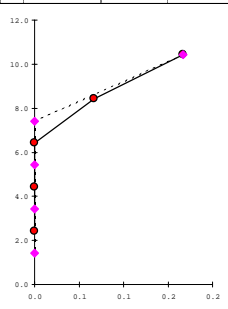


Location SD				Location SD			
Injecting Section				Injecting Section			
6 ~ 9 m				15 ~ 18 m			
Ground Water Level				Ground Water Level			
7.0 m				7.0 m			
Height of Pressure Gauge				Height of Pressure Gauge			
100.0 cm				100.0 cm			
Length of Test Section				Length of Test Section			
3.0 m				3.0 m			
Friction Loss per meter				Friction Loss per meter			
$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa				Pipe Length of Injecting Pa			
7.00 m				16.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	4.0	2.8	1.3	2.0	2.0	2.8	0.7
4.0	6.0	4.8	2.0	4.0	6.0	4.8	2.0
6.0	10.0	6.8	3.3	6.0	10.0	6.8	3.3
8.0	12.0	8.8	4.0	8.0	12.0	8.8	4.0
10.0	30.0	10.8	10.0	10.0	14.0	10.8	4.7
7.0	23.0	7.8	7.7	7.0	11.0	7.8	3.7
5.0	19.0	5.8	6.3	5.0	9.0	5.8	3.0
3.0	13.0	3.8	4.3	3.0	7.0	3.8	2.3
1.0	5.0	1.8	1.7	1.0	5.0	1.8	1.7
Lu' = 4.5				Lu = 4.4			
Pc = 8.8 kgf/cm ²				Pc = - kgf/cm ²			
							
Location SD				Location SD			
Injecting Section				Injecting Section			
9 ~ 12 m				18 ~ 21 m			
Ground Water Level				Ground Water Level			
7.0 m				7.0 m			
Height of Pressure Gauge				Height of Pressure Gauge			
100.0 cm				100.0 cm			
Length of Test Section				Length of Test Section			
3.0 m				3.0 m			
Friction Loss per meter				Friction Loss per meter			
$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa				Pipe Length of Injecting Pa			
10.00 m				19.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	2.0	2.8	0.7	2.0	1.0	2.8	0.3
4.0	3.0	4.8	1.0	4.0	2.0	4.8	0.7
6.0	4.0	6.8	1.3	6.0	2.5	6.8	0.8
8.0	5.0	8.8	1.7	8.0	3.0	8.8	1.0
10.0	6.0	10.8	2.0	10.0	4.0	10.8	1.3
7.0	4.5	7.8	1.5	7.0	2.8	7.8	0.9
5.0	3.5	5.8	1.2	5.0	2.3	5.8	0.8
3.0	2.5	3.8	0.8	3.0	1.7	3.8	0.6
1.0	1.5	1.8	0.5	1.0	1.2	1.8	0.4
Lu = 1.9				Lu = 1.2			
Pc = - kgf/cm ²				Pc = - kgf/cm ²			
							
Location SD				Location SD			
Injecting Section				Injecting Section			
12 ~ 15 m				21 ~ 24 m			
Ground Water Level				Ground Water Level			
7.0 m				7.0 m			
Height of Pressure Gauge				Height of Pressure Gauge			
100.0 cm				100.0 cm			
Length of Test Section				Length of Test Section			
3.0 m				3.0 m			
Friction Loss per meter				Friction Loss per meter			
$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa				Pipe Length of Injecting Pa			
10.00 m				22.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	1.5	2.8	0.5	2.0	3.0	2.8	1.0
4.0	2.0	4.8	0.7	4.0	5.0	4.8	1.7
6.0	2.5	6.8	0.8	6.0	7.0	6.8	2.3
8.0	3.0	8.8	1.0	8.0	9.0	8.8	3.0
10.0	3.5	10.8	1.2	10.0	11.0	10.8	3.7
7.0	2.8	7.8	0.9	7.0	8.0	7.8	2.7
5.0	2.3	5.8	0.8	5.0	6.0	5.8	2.0
3.0	1.8	3.8	0.6	3.0	4.0	3.8	1.3
1.0	1.3	1.8	0.4	1.0	2.0	1.8	0.7
Lu = 1.1				Lu = 3.4			
Pc = - kgf/cm ²				Pc = - kgf/cm ²			
							

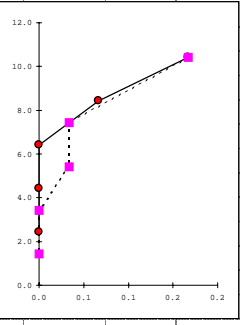
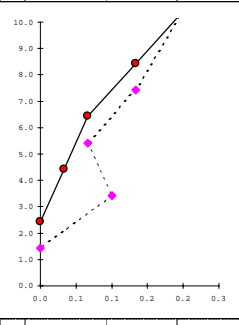
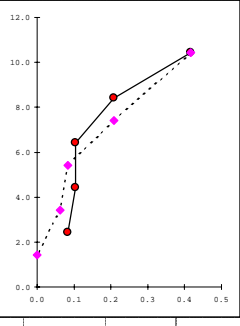
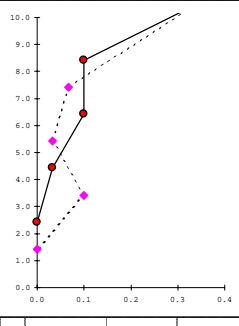
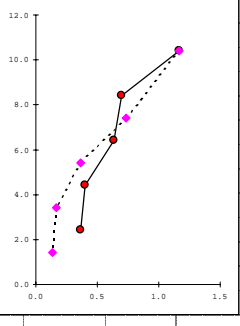
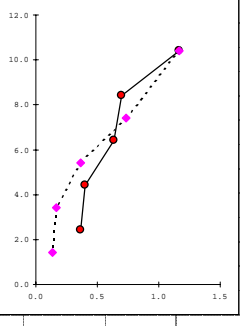
Result of Lugeon Test at Boreholes SD(1)-Timkit Dam Axist

Location SD				Location SD			
Injecting Section 24 ~ 27 m				Injecting Section 33 ~ 36 m			
Ground Water Level 7.0 m				Ground Water Level 7.0 m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 25.00 m				Pipe Length of Injecting Pa 34.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	1.5	2.8	0.5	2.0	0.4	2.8	0.1
4.0	2.5	4.8	0.8	4.0	0.8	4.8	0.3
6.0	3.5	6.8	1.2	6.0	1.2	6.8	0.4
8.0	4.5	8.8	1.5	8.0	1.6	8.8	0.5
10.0	5.5	10.8	1.8	10.0	2.0	10.8	0.7
7.0	4.0	7.8	1.3	7.0	1.4	7.8	0.5
5.0	3.0	5.8	1.0	5.0	1.0	5.8	0.3
3.0	2.0	3.8	0.7	3.0	0.6	3.8	0.2
1.0	1.0	1.8	0.3	1.0	0.2	1.8	0.1
Lu= 1.7				Lu= 0.6			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
							
Location SD				Location SD			
Injecting Section 27 ~ 30 m				Injecting Section 36 ~ 39 m			
Ground Water Level 7.0 m				Ground Water Level 7.0 m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 28.00 m				Pipe Length of Injecting Pa 37.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	0.4	2.8	0.1	2.0	1.5	2.8	0.5
4.0	0.8	4.8	0.3	4.0	2.5	4.8	0.8
6.0	1.2	6.8	0.4	6.0	3.5	6.8	1.2
8.0	1.6	8.8	0.5	8.0	4.5	8.8	1.5
10.0	2.0	10.8	0.7	10.0	5.5	10.8	1.8
7.0	1.4	7.8	0.5	7.0	4.0	7.8	1.3
5.0	1.0	5.8	0.3	5.0	3.0	5.8	1.0
3.0	0.6	3.8	0.2	3.0	2.0	3.8	0.7
1.0	0.2	1.8	0.1	1.0	1.0	1.8	0.3
Lu= 0.6				Lu= 1.7			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
							
Location SD				Location SD			
Injecting Section 30 ~ 33 m				Injecting Section 39 ~ 42 m			
Ground Water Level 7.0 m				Ground Water Level 7.0 m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 31.00 m				Pipe Length of Injecting Pa 40.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	0.5	2.8	0.2	2.0	0.4	2.8	0.1
4.0	1.0	4.8	0.3	4.0	0.8	4.8	0.3
6.0	1.5	6.8	0.5	6.0	1.2	6.8	0.4
8.0	2.0	8.8	0.7	8.0	1.6	8.8	0.5
10.0	2.5	10.8	0.8	10.0	2.0	10.8	0.7
7.0	1.8	7.8	0.6	7.0	1.4	7.8	0.5
5.0	1.3	5.8	0.4	5.0	1.0	5.8	0.3
3.0	0.8	3.8	0.3	3.0	0.6	3.8	0.2
1.0	0.3	1.8	0.1	1.0	0.2	1.8	0.1
Lu= 0.8				Lu= 0.6			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
							

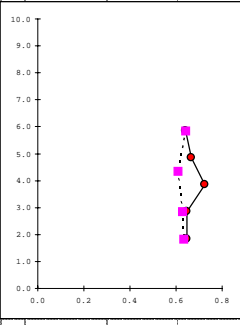
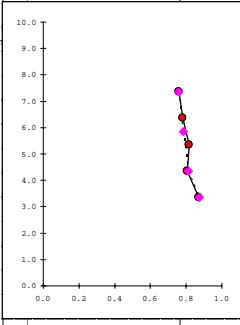
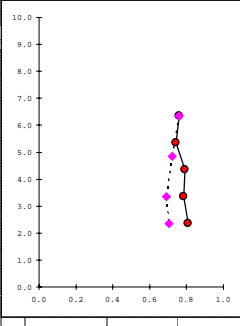
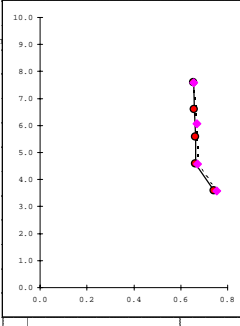
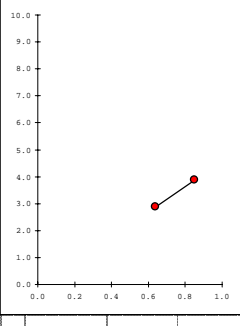
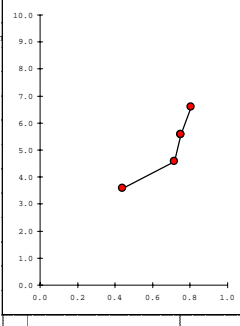
Result of Lugeon Test at Boreholes SD(2)-Timkit Dam Axist

Location SO				Location SO			
Injecting Section		12 ~ 15 m		Injecting Section		21 ~ 24 m	
Ground Water Level		3.2 m		Ground Water Level		3.2 m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		2.9 m		Length of Test Section		3.2 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		7.00 m		Pipe Length of Injecting Pa		22.30 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	8.6	2.4	3.0	2.0	0.2	2.4	0.1
4.0	8.2	4.4	2.8	4.0	0.2	4.4	0.1
6.0	10.5	6.4	3.6	6.0	0.5	6.4	0.2
8.0	15.0	8.4	5.2	8.0	1.1	8.4	0.3
10.0	15.0	10.4	5.2	10.0	2.5	10.4	0.8
7.0	10.2	7.4	3.5	7.0	0.5	7.4	0.2
5.0	8.0	5.4	2.8	5.0	0.3	5.4	0.1
3.0	7.2	3.4	2.5	3.0	0.2	3.4	0.1
1.0	4.7	1.4	1.6	1.0	0.0	1.4	0.0
Lu= 5.2				Lu= 0.7			
Pc= -		kgf/cm ²		Pc= -		kgf/cm ²	
							
Location SO				Location SO			
Injecting Section		15 ~ 18 m		Injecting Section		24 ~ 27 m	
Ground Water Level		3.2 m		Ground Water Level		3.2 m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		16.00 m		Pipe Length of Injecting Pa		25.50 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.0	0.0	0.0	0.0	2.0	0.1	2.4	0.0
1.0	413.0	-17.7	137.7	4.0	0.1	4.4	0.0
				6.0	0.2	6.4	0.1
				8.0	0.5	8.4	0.2
				10.0	1.0	10.4	0.3
				7.0	0.5	7.4	0.2
				5.0	0.3	5.4	0.1
				3.0	0.4	3.4	0.1
				1.0	0.1	1.4	0.0
Lu'= Leak				Lu= 0.3			
Pc= -		kgf/cm ²		Pc= -		kgf/cm ²	
							
Location SO				Location SO			
Injecting Section		18 ~ 21 m		Injecting Section		27 ~ 30 m	
Ground Water Level		3.2 m		Ground Water Level		3.2 m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.3 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		19.00 m		Pipe Length of Injecting Pa		28.50 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	2.0	2.4	0.6	2.0	0.0	2.4	0.0
4.0	2.0	4.4	0.6	4.0	0.0	4.4	0.0
6.0	2.9	6.4	0.9	6.0	0.0	6.4	0.0
8.0	4.0	8.4	1.2	8.0	0.2	8.4	0.1
10.0	4.9	10.4	1.5	10.0	0.5	10.4	0.2
7.0	2.2	7.4	0.7	7.0	0.0	7.4	0.0
5.0	2.0	5.4	0.6	5.0	0.0	5.4	0.0
3.0	2.1	3.4	0.6	3.0	0.0	3.4	0.0
1.0	0.5	1.4	0.2	1.0	0.0	1.4	0.0
Lu= 1.4				Lu= 0.1			
Pc= -		kgf/cm ²		Pc= -		kgf/cm ²	
							

Result of Lugeon Test at Boreholes SO(1)-Timkit Dam Axist

Location SO				Location SO			
Injecting Section 33 ~ 36 m				Injecting Section 44 ~ 47 m			
Ground Water Level 3.2 m				Ground Water Level 3.2 m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 34.00 m				Pipe Length of Injecting Pa 45.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	0.0	2.4	0.0	2.0	0.0	2.4	0.0
4.0	0.0	4.4	0.0	4.0	0.1	4.4	0.0
6.0	0.0	6.4	0.0	6.0	0.2	6.4	0.1
8.0	0.2	8.4	0.1	8.0	0.4	8.4	0.1
10.0	0.5	10.4	0.2	10.0	0.6	10.4	0.2
7.0	0.1	7.4	0.0	7.0	0.4	7.4	0.1
5.0	0.1	5.4	0.0	5.0	0.2	5.4	0.1
3.0	0.0	3.4	0.0	3.0	0.3	3.4	0.1
1.0	0.0	1.4	0.0	1.0	0.0	1.4	0.0
Lu= 0.1				Lu= 0.2			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
							
Location SO				Location SO			
Injecting Section 36 ~ 41 m				Injecting Section 47 ~ 50 m			
Ground Water Level 3.2 m				Ground Water Level 3.2 m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 4.8 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 37.20 m				Pipe Length of Injecting Pa 48.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	0.4	2.4	0.1	2.0	0.0	2.4	0.0
4.0	0.5	4.4	0.1	4.0	0.1	4.4	0.0
6.0	0.5	6.4	0.1	6.0	0.3	6.4	0.1
8.0	1.0	8.4	0.2	8.0	0.3	8.4	0.1
10.0	2.0	10.4	0.4	10.0	1.0	10.4	0.3
7.0	1.0	7.4	0.2	7.0	0.2	7.4	0.1
5.0	0.4	5.4	0.1	5.0	0.1	5.4	0.0
3.0	0.3	3.4	0.1	3.0	0.3	3.4	0.1
1.0	0.0	1.4	0.0	1.0	0.0	1.4	0.0
Lu= 0.4				Lu'= 0.1			
Pc= - kgf/cm ²				Pc= 8.4 kgf/cm ²			
							
Location SO				Location SO			
Injecting Section 41 ~ 44 m				Injecting Section 41 ~ 44 m			
Ground Water Level 3.2 m				Ground Water Level 3.2 m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 41.00 m				Pipe Length of Injecting Pa 41.00 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	1.1	2.4	0.4	2.0	1.1	2.4	0.4
4.0	1.2	4.4	0.4	4.0	1.2	4.4	0.4
6.0	1.9	6.4	0.6	6.0	1.9	6.4	0.6
8.0	2.1	8.4	0.7	8.0	2.1	8.4	0.7
10.0	3.5	10.4	1.2	10.0	3.5	10.4	1.2
7.0	2.2	7.4	0.7	7.0	2.2	7.4	0.7
5.0	1.1	5.4	0.4	5.0	1.1	5.4	0.4
3.0	0.5	3.4	0.2	3.0	0.5	3.4	0.2
1.0	0.4	1.4	0.1	1.0	0.4	1.4	0.1
Lu= 1.1				Lu= 1.1			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
							

Result of Lugeon Test at Boreholes SO(2)-Timkit Dam Axist

Location SGI				Location SGI																																																																																			
Injecting Section				Injecting Section																																																																																			
		4.8 ~ 10 m				20~ 25 m																																																																																	
Ground Water Level				Ground Water Level																																																																																			
		Nill m				Nill m																																																																																	
Height of Pressure Gauge				Height of Pressure Gauge																																																																																			
		100.0 cm				100.0 cm																																																																																	
Length of Test Section				Length of Test Section																																																																																			
		5.2 m				5.0 m																																																																																	
Friction Loss per meter				Friction Loss per meter																																																																																			
		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm																																																																																	
Pipe Length of Injecting Pa				Pipe Length of Injecting Pa																																																																																			
		5.80 m				21.00 m																																																																																	
<table border="1"> <thead> <tr> <th>P_0(kgf/cm²)</th> <th>Q_{av}(l/min)</th> <th>P(kgf/cm²)</th> <th>q(l/min/m)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>3.4</td><td>1.8</td><td>0.6</td></tr> <tr><td>2.0</td><td>3.4</td><td>2.8</td><td>0.6</td></tr> <tr><td>3.0</td><td>3.8</td><td>3.8</td><td>0.7</td></tr> <tr><td>4.0</td><td>3.5</td><td>4.8</td><td>0.7</td></tr> <tr><td>5.0</td><td>3.3</td><td>5.8</td><td>0.6</td></tr> <tr><td>3.5</td><td>3.2</td><td>4.3</td><td>0.6</td></tr> <tr><td>2.0</td><td>3.3</td><td>2.8</td><td>0.6</td></tr> <tr><td>1.0</td><td>3.3</td><td>1.8</td><td>0.6</td></tr> </tbody> </table>				P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	1.0	3.4	1.8	0.6	2.0	3.4	2.8	0.6	3.0	3.8	3.8	0.7	4.0	3.5	4.8	0.7	5.0	3.3	5.8	0.6	3.5	3.2	4.3	0.6	2.0	3.3	2.8	0.6	1.0	3.3	1.8	0.6					<table border="1"> <thead> <tr> <th>P_0(kgf/cm²)</th> <th>Q_{av}(l/min)</th> <th>P(kgf/cm²)</th> <th>q(l/min/m)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>4.4</td><td>3.3</td><td>0.9</td></tr> <tr><td>2.0</td><td>4.0</td><td>4.3</td><td>0.8</td></tr> <tr><td>3.0</td><td>4.1</td><td>5.3</td><td>0.8</td></tr> <tr><td>4.0</td><td>3.9</td><td>6.3</td><td>0.8</td></tr> <tr><td>5.0</td><td>3.8</td><td>7.3</td><td>0.8</td></tr> <tr><td>3.5</td><td>3.9</td><td>5.8</td><td>0.8</td></tr> <tr><td>2.0</td><td>4.1</td><td>4.3</td><td>0.8</td></tr> <tr><td>1.0</td><td>4.4</td><td>3.3</td><td>0.9</td></tr> </tbody> </table>				P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	1.0	4.4	3.3	0.9	2.0	4.0	4.3	0.8	3.0	4.1	5.3	0.8	4.0	3.9	6.3	0.8	5.0	3.8	7.3	0.8	3.5	3.9	5.8	0.8	2.0	4.1	4.3	0.8	1.0	4.4	3.3	0.9				
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)																																																																																				
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2.0	4.1	4.3	0.8																																																																																				
1.0	4.4	3.3	0.9																																																																																				
Lu' = 0.7				Lu' = 0.7																																																																																			
Pc = - kgf/cm ²				Pc = - kgf/cm ²																																																																																			
Location SGI				Location SGI																																																																																			
Injecting Section				Injecting Section																																																																																			
		10 ~ 15 m				25~ 30 m																																																																																	
Ground Water Level				Ground Water Level																																																																																			
		Nill m				24.8 m																																																																																	
Height of Pressure Gauge				Height of Pressure Gauge																																																																																			
		100.0 cm				100.0 cm																																																																																	
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		5.0 m				5.0 m																																																																																	
Friction Loss per meter				Friction Loss per meter																																																																																			
		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm																																																																																	
Pipe Length of Injecting Pa				Pipe Length of Injecting Pa																																																																																			
		11.00 m				26.00 m																																																																																	
<table border="1"> <thead> <tr> <th>P_0(kgf/cm²)</th> <th>Q_{av}(l/min)</th> <th>P(kgf/cm²)</th> <th>q(l/min/m)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>4.1</td><td>2.3</td><td>0.8</td></tr> <tr><td>2.0</td><td>3.9</td><td>3.3</td><td>0.8</td></tr> <tr><td>3.0</td><td>4.0</td><td>4.3</td><td>0.8</td></tr> <tr><td>4.0</td><td>3.7</td><td>5.3</td><td>0.7</td></tr> <tr><td>5.0</td><td>3.8</td><td>6.3</td><td>0.8</td></tr> <tr><td>3.5</td><td>3.6</td><td>4.8</td><td>0.7</td></tr> <tr><td>2.0</td><td>3.5</td><td>3.3</td><td>0.7</td></tr> <tr><td>1.0</td><td>3.5</td><td>2.3</td><td>0.7</td></tr> </tbody> </table>				P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	1.0	4.1	2.3	0.8	2.0	3.9	3.3	0.8	3.0	4.0	4.3	0.8	4.0	3.7	5.3	0.7	5.0	3.8	6.3	0.8	3.5	3.6	4.8	0.7	2.0	3.5	3.3	0.7	1.0	3.5	2.3	0.7					<table border="1"> <thead> <tr> <th>P_0(kgf/cm²)</th> <th>Q_{av}(l/min)</th> <th>P(kgf/cm²)</th> <th>q(l/min/m)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>3.7</td><td>3.6</td><td>0.7</td></tr> <tr><td>2.0</td><td>3.3</td><td>4.6</td><td>0.7</td></tr> <tr><td>3.0</td><td>3.3</td><td>5.6</td><td>0.7</td></tr> <tr><td>4.0</td><td>3.3</td><td>6.6</td><td>0.7</td></tr> <tr><td>5.0</td><td>3.3</td><td>7.6</td><td>0.7</td></tr> <tr><td>3.5</td><td>3.3</td><td>6.1</td><td>0.7</td></tr> <tr><td>2.0</td><td>3.4</td><td>4.6</td><td>0.7</td></tr> <tr><td>1.0</td><td>3.8</td><td>3.6</td><td>0.8</td></tr> </tbody> </table>				P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	1.0	3.7	3.6	0.7	2.0	3.3	4.6	0.7	3.0	3.3	5.6	0.7	4.0	3.3	6.6	0.7	5.0	3.3	7.6	0.7	3.5	3.3	6.1	0.7	2.0	3.4	4.6	0.7	1.0	3.8	3.6	0.8				
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)																																																																																				
1.0	4.1	2.3	0.8																																																																																				
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Lu' = 0.8				Lu' = 0.6																																																																																			
Pc = - kgf/cm ²				Pc = - kgf/cm ²																																																																																			
Location SGI				Location SGI																																																																																			
Injecting Section				Injecting Section																																																																																			
		15 ~ 20 m				30 ~ 35 m																																																																																	
Ground Water Level				Ground Water Level																																																																																			
		Nill m				24.8 m																																																																																	
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Pipe Length of Injecting Pa				Pipe Length of Injecting Pa																																																																																			
		16.20 m				31.00 m																																																																																	
<table border="1"> <thead> <tr> <th>P_0(kgf/cm²)</th> <th>Q_{av}(l/min)</th> <th>P(kgf/cm²)</th> <th>q(l/min/m)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>3.2</td><td>2.9</td><td>0.6</td></tr> <tr><td>2.0</td><td>4.3</td><td>3.9</td><td>0.9</td></tr> </tbody> </table>				P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	1.0	3.2	2.9	0.6	2.0	4.3	3.9	0.9					<table border="1"> <thead> <tr> <th>P_0(kgf/cm²)</th> <th>Q_{av}(l/min)</th> <th>P(kgf/cm²)</th> <th>q(l/min/m)</th> </tr> </thead> <tbody> <tr><td>1.0</td><td>2.2</td><td>3.6</td><td>0.4</td></tr> <tr><td>2.0</td><td>3.6</td><td>4.6</td><td>0.7</td></tr> <tr><td>3.0</td><td>3.8</td><td>5.6</td><td>0.8</td></tr> <tr><td>4.0</td><td>4.0</td><td>6.6</td><td>0.8</td></tr> </tbody> </table>				P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	1.0	2.2	3.6	0.4	2.0	3.6	4.6	0.7	3.0	3.8	5.6	0.8	4.0	4.0	6.6	0.8																																												
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)																																																																																				
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2.0	3.6	4.6	0.7																																																																																				
3.0	3.8	5.6	0.8																																																																																				
4.0	4.0	6.6	0.8																																																																																				
Lu' = 2.2				Lu' = 1.0																																																																																			
Pc = - kgf/cm ²				Pc = - kgf/cm ²																																																																																			

Result of Lugeon Test at Boreholes SG1(1)-Timkit Dam Axist

Location SG2				Location SG2			
Injecting Section 9 ~ 12 m				Injecting Section 18- 21 m			
Ground Water Level Nilll m				Ground Water Level Nilll m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 10.30 m				Pipe Length of Injecting Pa 19.30 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.0	0.0	0.0	0.0	0.1	44.0	1.9	14.7
0.3	80.0	1.0	26.7	1.0	70.0	2.4	23.3
				2.0	120.0	2.1	40.0
				1.0	110.0	1.4	36.7
				0.0	90.0	1.0	30.0
Lu' = 262				Lu = 155			
Pc = - kgf/cm ²				Pc = 2.4 kgf/cm ²			
Location SG2				Location SG2			
Injecting Section 12 ~ 15 m				Injecting Section 21- 24 m			
Ground Water Level Nilll m				Ground Water Level Nilll m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 13.30 m				Pipe Length of Injecting Pa 22.30 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.1	30.0	1.5	10.0	2.0	25.0	4.3	8.3
1.0	60.0	2.1	20.0	4.0	45.0	6.1	15.0
0.2	80.0	1.1	26.7	6.0	55.0	7.9	18.3
				5.0	50.0	7.0	16.7
				3.0	45.0	5.1	15.0
				1.0	30.0	3.2	10.0
Lu' = 141				Lu' = 22.1			
Pc = - kgf/cm ²				Pc = - kgf/cm ²			
Location SG2				Location SG2			
Injecting Section 15 ~ 18 m				Injecting Section 24- 27 m			
Ground Water Level Nilll m				Ground Water Level Nilll m			
Height of Pressure Gauge 100.0 cm				Height of Pressure Gauge 100.0 cm			
Length of Test Section 3.0 m				Length of Test Section 3.0 m			
Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm				Friction Loss per meter $7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm			
Pipe Length of Injecting Pa 16.30 m				Pipe Length of Injecting Pa 25.30 m			
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.1	25.0	1.8	8.3	2.0	24.0	4.6	8.0
1.5	45.0	3.0	15.0	4.0	40.0	6.4	13.3
3.0	70.0	4.2	23.3	6.0	42.0	8.4	14.0
1.0	80.0	2.0	26.7	8.0	55.0	10.1	18.3
0.0	50.0	1.5	16.7	10.0	65.0	11.9	21.7
				7.0	51.0	9.2	17.0
				5.0	40.0	7.4	13.3
				3.0	30.0	5.5	10.0
				1.0	22.0	3.6	7.3
Lu' = 52.4				Lu = 18.1			
Pc = 3.0 kgf/cm ²				Pc = - kgf/cm ²			

Result of Lugeon Test at Boreholes SG2(1)-Timkit Dam Axist

Location SG2				Location SG2			
Injecting Section		27~ 30 m		Injecting Section		36~ 39 m	
Ground Water Level		Nilll m		Ground Water Level		Nilll	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		28.30 m		Pipe Length of Injecting Pa		37.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	2.0	5.0	0.7	0.0	70.0	2.6	23.3
4.0	5.0	7.0	1.7	0.5	80.0	2.7	26.7
6.0	9.0	9.0	3.0				
8.0	12.0	11.0	4.0				
10.0	16.0	12.9	5.3				
7.0	11.0	10.0	3.7				
5.0	9.0	8.0	3.0				
3.0	6.0	6.0	2.0				
1.0	4.0	4.0	1.3				
Lu= 3.4				Lu'= 247			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
Location SG2				Location SG2			
Injecting Section		30~ 33 m		Injecting Section		39~ 42 m	
Ground Water Level		Nilll m		Ground Water Level		Nilll	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		2.8 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		31.30 m		Pipe Length of Injecting Pa		40.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	30.0	5.1	10.7	2.0	4.0	6.2	1.3
3.0	40.0	5.9	14.3	4.0	6.0	8.1	2.0
4.0	65.0	6.3	23.2	6.0	9.0	10.1	3.0
3.0	55.0	5.6	19.6	8.0	14.0	12.1	4.7
2.0	43.0	4.9	15.4	10.0	20.0	14.0	6.7
1.0	35.0	4.0	12.5	7.0	15.0	11.1	5.0
				5.0	11.0	9.1	3.7
				3.0	9.0	7.1	3.0
				1.0	6.0	5.1	2.0
Lu'= 31.5				Lu= 2.5			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			
Location SG2				Location SG2			
Injecting Section		33~ 36 m		Injecting Section		42~ 45 m	
Ground Water Level		Nilll m		Ground Water Level		Nilll	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		34.10 m		Pipe Length of Injecting Pa		43.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.5	55.0	3.3	18.3	0.5	50.0	4.2	16.7
1.5	68.0	4.0	22.7	1.0	55.0	4.5	18.3
2.3	80.0	4.3	26.7	2.0	76.0	4.7	25.3
1.0	69.0	3.4	23.0	2.3	80.0	4.8	26.7
0.0	50.0	3.0	16.7	0.5	60.0	3.9	20.0
Lu'= 65.0				Lu'= 242.8			
Pc= - kgf/cm ²				Pc= - kgf/cm ²			

Result of Lugeon Test at Boreholes SG2(2)-Timkit Dam Axist

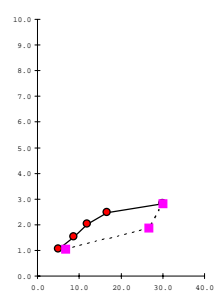
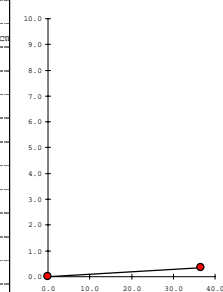
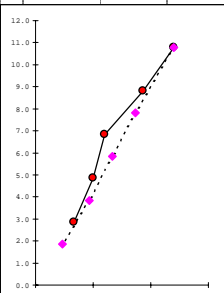
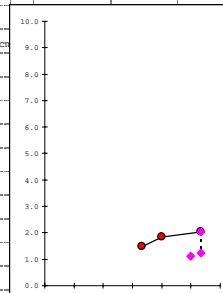
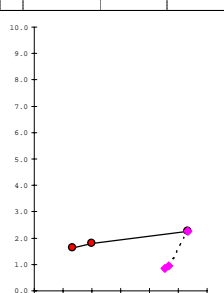
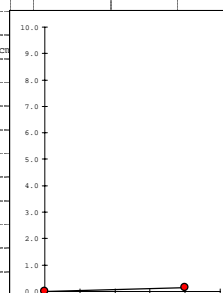
Location		SG2	
Injecting Section		45- 48 m	
Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		46.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	1.5	6.8	0.5
4.0	3.0	8.8	1.0
6.0	4.0	10.8	1.3
8.0	4.5	12.8	1.5
10.0	6.0	14.7	2.0
7.0	5.5	11.8	1.8
5.0	5.0	9.8	1.7
3.0	4.5	7.8	1.5
1.0	3.5	5.8	1.2
Lu=		0.8	
Pc=		- kgf/cm ²	

Location		SG2	
Injecting Section		48- 50 m	
Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm	
Length of Test Section		2.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		49.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	2.0	7.0	1.0
4.0	4.0	9.0	2.0
6.0	5.5	11.0	2.8
8.0	6.5	13.0	3.3
10.0	9.0	15.0	4.5
7.0	7.0	12.0	3.5
5.0	5.0	10.0	2.5
3.0	4.0	8.0	2.0
1.0	3.0	6.0	1.5
Lu=		1.4	
Pc=		- kgf/cm ²	

Location		SG2	
Injecting Section		45- 48 m	
Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		46.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	1.5	6.8	0.5
4.0	3.0	8.8	1.0
6.0	4.0	10.8	1.3
8.0	4.5	12.8	1.5
10.0	6.0	14.7	2.0
7.0	5.5	11.8	1.8
5.0	5.0	9.8	1.7
3.0	4.5	7.8	1.5
1.0	3.5	5.8	1.2
Lu=		0.8	
Pc=		- kgf/cm ²	

Location		SG2	
Injecting Section		48- 50 m	
Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm	
Length of Test Section		2.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		49.10 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	2.0	7.0	1.0
4.0	4.0	9.0	2.0
6.0	5.5	11.0	2.8
8.0	6.5	13.0	3.3
10.0	9.0	15.0	4.5
7.0	7.0	12.0	3.5
5.0	5.0	10.0	2.5
3.0	4.0	8.0	2.0
1.0	3.0	6.0	1.5
Lu=		1.4	
Pc=		- kgf/cm ²	

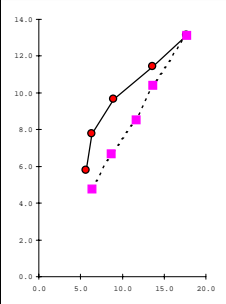
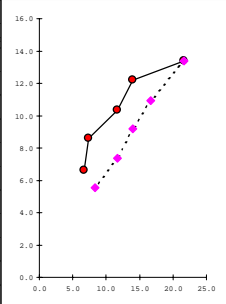
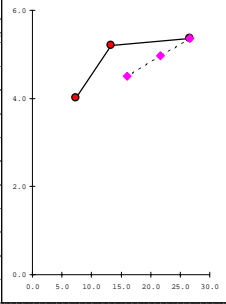
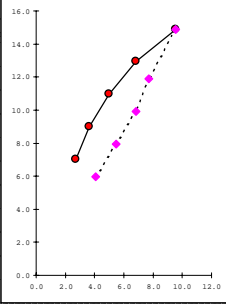
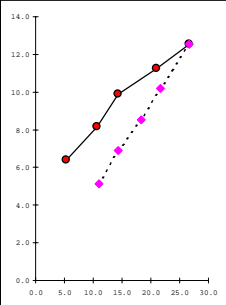
Result of Lugeon Test at Boreholes SG2(3)-Timkit Dam Axist

Location SG3				Location SG3			
Injecting Section		3 ~ 6 m		Injecting Section		12 ~ 15 m	
Ground Water Level		Nill m		Ground Water Level		Nill	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		4.00 m		Pipe Length of Injecting Pa		13.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.5	15.0	1.0	5.0	0.0	0.0	0.0	0.0
1.0	26.0	1.5	8.7	0.0	110.0	0.3	36.7
1.5	36.0	2.0	12.0				
2.0	50.0	2.5	16.7				
2.5	90.0	2.8	30.0				
1.5	80.0	1.9	26.7				
0.5	20.0	1.0	6.7				
Lu' = 69.6				Lu' = 1,051			
Pc = 2.2 kgf/cm²				Pc = - kgf/cm²			
							
Location SG3				Location SG3			
Injecting Section		6 ~ 9 m		Injecting Section		15 ~ 18 m	
Ground Water Level		Nill m		Ground Water Level		Nill	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		7.00 m		Pipe Length of Injecting Pa		16.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	10.0	2.8	3.3	0.0	50.0	1.5	16.7
4.0	15.0	4.8	5.0	0.5	60.0	1.8	20.0
6.0	18.0	6.8	6.0	1.0	80.0	2.0	26.7
8.0	28.0	8.8	9.3	0.2	80.0	1.2	26.7
10.0	36.0	10.8	12.0	0.0	75.0	1.1	25.0
7.0	26.0	7.8	8.7				
5.0	20.0	5.8	6.7				
3.0	14.0	3.8	4.7				
1.0	7.0	1.8	2.3				
Lu' = 11.7				Lu' = 312			
Pc = 6.8 kgf/cm²				Pc = 1.8 kgf/cm²			
							
Location SG3				Location SG3			
Injecting Section		9 ~ 12 m		Injecting Section		18 ~ 21 m	
Ground Water Level		Nill m		Ground Water Level		Nill	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		9.00 m		Pipe Length of Injecting Pa		19.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.5	20.0	1.6	6.7	0.0	0.0	0.0	0.0
0.7	30.0	1.8	10.0	0.0	120.0	0.1	40.0
1.5	80.0	2.2	26.7				
0.1	70.0	0.9	23.3				
0.0	68.0	0.9	22.7				
Lu' = 172				Lu' = 2,967			
Pc = 1.8 kgf/cm²				Pc = - kgf/cm²			
							

Result of Lugeon Test at Boreholes SG3(1)-Timkit Dam Axist

Location SG3				Location SG3			
Injecting Section		21 ~ 24 m		Injecting Section		27 ~ 30 m	
Ground Water Level		Null m		Ground Water Level		Null m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm ²		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm ²	
Pipe Length of Injecting Pa		22.00 m		Pipe Length of Injecting Pa		28.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.0	0.0	0.0	0.0	0.5	55.0	2.9	18.3
0.5	140.0	-0.2	46.7	1.5	80.0	3.2	26.7
				0.5	75.0	2.3	25.0
Lu' = Leak				Lu' = 194			
Pc = - kgf/cm ²				Pc = - kgf/cm ²			
Location SG3				Location SG3			
Injecting Section		22 ~ 24 m		Injecting Section		30 ~ 33 m	
Ground Water Level		Null m		Ground Water Level		Null m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		2.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm ²		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm ²	
Pipe Length of Injecting Pa		23.00 m		Pipe Length of Injecting Pa		31.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.0	0.0	0.0	0.0	0.0	20.0	3.2	6.7
0.3	100.0	1.1	50.0	1.5	40.0	4.4	13.3
				3.0	80.0	4.9	26.7
				2.0	70.0	4.2	23.3
				1.0	55.0	3.6	18.3
Lu' = 459				Lu' = 43.4			
Pc = - kgf/cm ²				Pc = 4.4 kgf/cm ²			
Location SG3				Location SG3			
Injecting Section		24 ~ 27 m		Injecting Section		33 ~ 36 m	
Ground Water Level		Null m		Ground Water Level		Null m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm ²		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm ²	
Pipe Length of Injecting Pa		25.00 m		Pipe Length of Injecting Pa		34.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.0	20.0	2.6	6.7	0.0	60.0	2.7	20.0
1.0	33.0	3.5	11.0	1.5	90.0	3.1	30.0
1.5	50.0	3.7	16.7	3.0	120.0	3.1	40.0
2.0	65.0	3.9	21.7	2.0	110.0	2.7	36.7
2.5	80.0	4.0	26.7	1.0	100.0	2.2	33.3
1.5	60.0	3.5	20.0				
0.5	40.0	2.9	13.3				
Lu' = 43.2				Lu' = 190			
Pc = 3.5 kgf/cm ²				Pc = 3.1 kgf/cm ²			

Result of Lugeon Test at Boreholes SG3(2)-Timkit Dam Axist

Location SG3				Location SG3			
Injecting Section		36 ~ 39 m		Injecting Section		45 ~ 48 m	
Ground Water Level		Nill m		Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		37.00 m		Pipe Length of Injecting Pa		46.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	17.0	5.8	5.7	2.0	20.0	6.6	6.7
4.0	19.0	7.8	6.3	4.0	22.0	8.6	7.3
6.0	27.0	9.7	9.0	6.0	35.0	10.4	11.7
8.0	41.0	11.4	13.7	8.0	42.0	12.2	14.0
10.0	53.0	13.1	17.7	10.0	65.0	13.4	21.7
7.0	41.0	10.4	13.7	7.0	50.0	10.9	16.7
5.0	35.0	8.5	11.7	5.0	42.0	9.2	14.0
3.0	26.0	6.7	8.7	3.0	35.0	7.4	11.7
1.0	19.0	4.8	6.3	1.0	25.0	5.5	8.3
Lu=		9.9		Lu=		10.8	
Pc=		-		Pc=		12.2 kgf/cm ²	
							
Location SG3				Location SG3			
Injecting Section		39 ~ 42 m		Injecting Section		48 ~ 50 m	
Ground Water Level		Nill m		Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		2.2 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		40.00 m		Pipe Length of Injecting Pa		49.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
0.0	22.0	4.0	7.3	2.0	6.0	7.0	2.7
1.5	40.0	5.2	13.3	4.0	8.0	9.0	3.6
3.0	80.0	5.4	26.7	6.0	11.0	11.0	5.0
2.0	65.0	5.0	21.7	8.0	15.0	12.9	6.8
1.0	48.0	4.5	16.0	10.0	21.0	14.9	9.5
Lu'=		37.6		Lu=		4.3	
Pc=		-		Pc=		-	
							
Location SG3				Location SG3			
Injecting Section		42 ~ 45 m		Injecting Section		42 ~ 45 m	
Ground Water Level		Nill m		Ground Water Level		Nill m	
Height of Pressure Gauge		100.0 cm		Height of Pressure Gauge		100.0 cm	
Length of Test Section		3.0 m		Length of Test Section		3.0 m	
Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm		Friction Loss per meter		$7 \cdot 10^{-6} \cdot Q_{av}^2$ kgf/cm	
Pipe Length of Injecting Pa		43.00 m		Pipe Length of Injecting Pa		43.00 m	
P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)	P_0 (kgf/cm ²)	Q_{av} (l/min)	P (kgf/cm ²)	q (l/min/m)
2.0	16.0	6.4	5.3	2.0	16.0	6.4	5.3
4.0	32.0	8.1	10.7	4.0	32.0	8.1	10.7
6.0	43.0	9.9	14.3	6.0	43.0	9.9	14.3
8.0	63.0	11.3	21.0	8.0	63.0	11.3	21.0
10.0	80.0	12.5	26.7	10.0	80.0	12.5	26.7
7.0	65.0	10.2	21.7	7.0	65.0	10.2	21.7
5.0	55.0	8.5	18.3	5.0	55.0	8.5	18.3
3.0	43.0	6.9	14.3	3.0	43.0	6.9	14.3
1.0	33.0	5.1	11.0	1.0	33.0	5.1	11.0
Lu'=		14.6		Lu'=		14.6	
Pc=		9.9 kgf/cm ²		Pc=		9.9 kgf/cm ²	
							

Result of Lugeon Test at Boreholes SG3(3)-Timkit Dam Axist

Azghar {Water Resources Development in Rural Area (DGH)}													Sheet No. 1 of 3						
Borehole No.:		SD1			Location:		Dam Axis, Right Abutment												
Ground EL. :		890 m			Drilling period:														
Total Length :		80.1 m			Hole inclination:		vertical												
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)	
	1	0.60	889.40	Colluvial dep.	90	37													1
	2			Weathered layer	96	62	2.00	E	3	c	CL	LM		Lu=258 Pc= -				2	
	3				94	82						M							3
	4				100	75		D	3	b	CL•C	M							4
	5	4.85	885.15			100	75	4.85				LM							
	6			Formation of Shaly Marl rhythmically alternated with black Limestone layers	100	90						ML						6	
	7				100	94													7
	8				100	96							MH		Lu=424 Pc=6.5				8
	9				100	96							ML						9
	10				100	96							M						10
	11				100	96			C	2•3	b	CM	LM		Lu=129 Pc= -				11
	12				100	96							M						12
	13				100	90							ML						13
	14				100	90							M		Lu=43.8 Pc= -				14
	15				100	90							MH						15
	16			100	100	100	16.00					LM						16	
	17			100	100	100						M		Lu=28.5 Pc=10.0				17	
	18			100	100	100						MH						18	
	19			100	100	100												19	
	20			100	100	100								Lu=25.6 Pc=9.0				20	
	21			100	100	100							1 21.3m					21	
	22			100	100	100												22	
	23			100	100	100								Lu=25.7 Pc=11.1				23	
	24			100	100	100		C	2	a•b	CM•CH	MH						24	
	25			100	100	100												25	
	26			100	100	100								Lu=23.3 Pc= -				26	
	27			100	100	100												27	
	28			100	100	100												28	
	29			100	100	100								Lu=17.6 Pc= -				29	
	30			100	100	100	30.00					H	2 29.5m					30	

Lu' : Converted Lugeon Value
Pc : Critical Pressure (kgf/cm²)
Lu : Lugeon Value

Borehole No.: SD1

Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)	
	31				100	100												31	
	32				100	100						H		Lu=15.1 Pc= -				32	
	33				100	100						M						33	
	34				100	100						MH						34	
	35				100	100		C	2	a•b	CM• CH		3 35.0m	Lu=4.4 Pc=9.0				35	
	36				100	100												36	
	37				100	100						H						37	
	38				100	100						MH		Lu'=3.6 Pc=9.2				38	
	39				100	100	39.20					H						39	
	40				100	100						M(L)						40	
	41			Formation of Shaly Marl with black Limestone layers	100	100								Lu=8.9 Pc=13.3				41	
	42				100	100													42
	43				100	100						H							43
	44				100	100								Lu'=0.6 Pc=9.2					44
	45				100	100													45
	46				100	100								4 45• 48m					46
	47				100	100							MH		Lu=0.5				47
	48				100	100													48
	49				100	100			C	1•2	a	CH							49
	50				100	100							H		Lu=0.4				50
	51			100	100													51	
	52			100	100													52	
	53			100	100									Lu=0.3				53	
	54			100	100							H(M)						54	
	55			100	100													55	
	56			100	100									Lu=0.4				56	
	57			100	100													57	
	58			100	100		57.70											58	
	59			100	100			C	2•3	a•b	CM			Lu=0.4				59	
	60			100	100		60.00					H						60	

Lu' : Converted Lugeon Value
Pc : Critical Pressure (kgf/cm²)
Lu : Lugeon Value

Borehole No.:		SD1																	
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)	
	61			Formation of Shaly Marl with black Limestone layers	100	100	30.00	C	3	a	CM	M						61	
	62				100	100									Lu=0.3				62
	63				100	100													63
	64				100	100													64
	65				100	100									Lu=0.4				65
	66				100	100													66
	67				100	100													67
	68				100	100									Lu=0.3				68
	69				100	100													69
	70				100	100			C	1	a	CH	H(M)		Lu=0.3				70
	71				100	100													71
	72				100	100													72
	73				100	100													73
	74				100	100									Lu=0.4				74
	75				100	100													75
	76				100	100													76
	77				100	100									Lu=0.4				77
	78				100	100													78
	79				100	100									Lu=0.8				79
	80				100	100		30.00	End of Borehole										80
														Lu' : Converted Lugeon Value					
														Pc : Critical Pressure (kgf/cm ²)					
														Lu : Lugeon Value					
														k : Coefficient of Permeability				(cm/sec)	

Azghar {Water Resources Development in Rural Area (DGH)} Sheet No. 1 of 3

Borehole No.: SD2 **Location:** Dam Axis, Right Abutment
Ground EL. : 850 m **Drilling period:**
Total Length : 80.1 m **Hole inclination:** Vertical

Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)			
	1			Colluvial dep.	100	0	X						X				1			
	2				71	0											2			
	3				63	0											3			
	4				57	0											4			
	5	5.00			845.00	29											0	5		
	6			Travertine	40	0		E•F	5	d	D	D L					6			
	7				31	0											7			
	8				65	0											8			
	9	9.00	841.00	89	10	9.00						1 8.5m	Lu'=446 Pc= -				9			
	10			Weathered layer	75	72		D•E	3•4	b•c	CL	LM L		Leak			10			
	11	11.20			838.80	100											100	11.20	11	
	12			Formation of Shaly Marl with black Limestone layers	100	100											12			
	13				100	100											13			
	14				100	100											14			
	15				100	100											15			
	16				100	100											16			
	17				100	100											17			
	18				100	100											18			
	19				100	100											19			
	20				100	100											19.20	4 20.8m	Lu=6.4 Pc=11.4	20
	21				100	100											21			
	22		100	100	22															
	23		100	100	23															
	24		100	100	23	3 23.0m	Lu=1.1 Pc=10.0	24												
	25		100	100	24	5 25.0m		25												
	26		100	100	25		Lu'=0.4 Pc=8.4	26												
	27		100	100	26			27												
	28		100	100	27			28												
	29		100	100	28			Lu=0.3 Pc= -	29											
	30		100	100	29	30.00			30											

Lu' : Converted Lugeon Value
Pc : Critical Pressure (kgf/cm²)
Lu : Lugeon Value

Borehole No.:		SD2																			
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)			
	31				100	100													31		
	32				100	100								Lu=0.3					32		
	33				100	100		C	1-2	a	CM-CH	MH							33		
	34				100	100													34		
	35				100	100	35.00							Lu=0.3					35		
	36				100	100													36		
	37				100	100													37		
	38				100	100								Lu=0.3					38		
	39				100	100													39		
	40				100	100													40		
	41				100	100								Lu=0.3					41		
	42				100	100													42		
	43				100	100													43		
	44				100	100								Lu=0.4					44		
	45				100	100													45		
	46				100	100								Lu=0.4					46		
	47				100	100													47		
	48				100	100		C	1	a	CH	H(M)							48		
	49				100	100													49		
	50				100	100								Lu=0.3					50		
	51				100	100													51		
	52				100	100													52		
	53				100	100								Lu=0.4					53		
	54				100	100													54		
	55				100	100													55		
	56				100	100								Lu=0.4					56		
	57				100	100													57		
	58				100	100													58		
	59				100	100								Lu=0.4					59		
	60				100	100	60.00												60		
														Lu' : Converted Lugeon Value							
														Pc : Critical Pressure (kg/cm ²)							
														Lu : Lugeon Value							

Borehole No.:		SD2																			
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)		RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	(large scale) Rock class	(small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)		
	61			Formation of Shaly Marl with black Limestone layers		100	100												61		
	62						100	100								Lu=0.4				62	
	63						100	100												63	
	64						100	100												64	
	65						100	100								Lu=0.4				65	
	66						100	100												66	
	67						100	100												67	
	68						100	100								Lu=0.4				68	
	69						100	100												69	
	70						100	100												70	
	71						100	100		C	l	a	CH	H(M)		Lu=0.3				71	
	72						100	100												72	
	73						100	100												73	
	74						100	100								Lu=0.3				74	
	75						100	100												75	
	76						100	100												76	
	77						100	100								Lu=0.4				77	
	78						100	100												78	
	79						100	100								Lu=0.5				79	
	80						100	100	80.00											80	
End of Borehole														Lu' :	Converted Lugeon Value						
														Pc :	Critical Pressure (kg/cm ²)						
														Lu :	Lugeon Value						
														k :	Coefficient of Permeability	(cm/sec)					

Azghar {Water Resources Development in Rural Area (DGH)}														Sheet No. 1 of 3					
Borehole No.:		SO1		Location:		Dam Axis, River Bed													
Ground EL. :		826 m		Drilling period:															
Total Length :		70.8 m		Hole inclination:		Vertical													
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G. W. L. S.P.T.	Lugeon Value	Sample	Casing	Cementation	Depth (m)	
	1		 Terrace dep.	 Weathered layer	50	0	 2.80	D	4	b	CL	L	 1 2.3m	 2 2.9m				1	
	2	2.40			823.60	40												0	2
	3	2.80			823.20	100												38	3
	4		 Formation of Shaly Marl with black Limestone layers	100	69						M(L)							4	
	5			100	90							H(M)							5
	6			100	96		C	1•3	a	CM•CH									6
	7			100	97							M							7
	8			100	100							H		Lu=1.8 Pc=6.3					8
	9			100	100	9.00													9
	10			100	100														10
	11			100	100							M		Lu=2.3 Pc=6.3					11
	12			100	100														12
	13			100	100														13
	14			100	100							M		Lu=27 Pc=6.1					14
	15			100	100							L M							15
	16			100	100		C	2•5	a	CM		LM							16
	17			100	100							MH		Lu=8.4 Pc=6.4					17
	18			100	100														18
	19			100	100														19
	20			100	100							M		Lu=23.7 Pc=6.2					20
	21			100	100			21.40											21
	22			100	100														22
	23			100	100		C	1•2	a	CH		H		Lu=1.3 Pc=6.4					23
	24			100	100			24.00											24
	25			100	100														25
	26			100	100		C	2•3	a	CM		M		Lu=1.2 Pc= -					26
	27			100	100														27
	28			100	100			27.50											28
	29			100	100		C	1•2	a	CH		H		Lu=1.5 Pc=6.4					29
	30			100	100			30.00											30

Lu' : Converted Lugeon Value
Pc : Critical Pressure (kg/cm²)
Lu : Lugeon Value

Borehole No.:		SO1																			
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)			
	31				100	100													31		
	32				100	100	32.30	C	2	a	CM	M(H)		Lu=1.7 Pc= -					32		
	33				100	100													33		
	34				100	100	33.80	C	3•4	a	CL•C M	LM M LM							34		
	35				100	100								Lu=1.8					35		
	36				100	100													36		
	37				100	100													37		
	38				100	100		C	1•3	a	CM			Lu=1.8					38		
	39				100	100													39		
	40				100	100													40		
	41				100	100								Lu=3.2					41		
	42				100	100	41.60												42		
	43				100	100		C	3•5	a	CL•CM	M(L) LM							43		
	44				100	100	43.50							Lu=3.1					44		
	45				100	100	44.80	C	1•3	a	CM	M(H)							45		
	46				100	100	45.90	C	4	a	CL•CM	LM							46		
	47				100	100		C	1•2	a	CH	H(M)		Lu=5.9					47		
	48				100	100	48.00												48		
	49				100	100													49		
	50				100	100		C	2•4	a	CM	M(L)		Lu=3.1					50		
	51				100	100													51		
	52				100	100	51.40												52		
	53				100	100								Lu=2.9					53		
	54				100	100													54		
	55				100	100		C	1•3	a	CM• CH	MH							55		
	56				100	100								Lu=3.1					56		
	57				100	100													57		
	58				100	100	58.50												58		
	59				100	100								Lu=0.9					59		
	60				100	100	60.00	C	3•4	a	CM	M(L) M							60		

Formation of Shaly Marl with black Limestone layers

Lu' : Converted Lugeon Value
 Pc : Critical Pressure (kgf/cm²)
 Lu : Lugeon Value

Borehole No.: SO1																			
Date	Depth(m)	EL.(m)	Log.	Rock type	Core (%)	RQD (%)	Depth(m)	Hardness	Joint interval	Joint condition	Rock class (large scale)	Rock class (small scale)	G.W.L. S.P.T.	Lugeon value	Sample	Casing	Cementation	Depth (m)	
	61			Formation of Shaly Marl with black Limestone layers	100	100												61	
	62				100	100		C	2+3	a	CM	M		Lu=0.9				62	
	63				100	100	63.00												63
	64				100	100													64
	65				100	100								Lu=0.8					65
	66				100	100													66
	67				100	100		C	1	a	CH	HM							67
	68				100	100								Lu=1.0					68
	69				100	100													69
	70				100	100	70.00												70
End of Borehole													Lu' : Converted Lugeon Value						
													Pc : Critical Pressure (kgf/cm ²)						
													Lu : Lugeon Value						
													k : Coefficient of Permeability				(cm/sec)		