

Florian Landstorfer



Florian Landstorfer is a Dam Safety Engineer for VERBUND Hydro Power (Austria). He has 15 years of experience in project management, dam surveillance and dam safety. He is responsible of 6 dams (1 gravity, 1 arch and 4 embankment) having heights ranging from 19 m to 120 m,

Using European research to investigate the potential for suffusion at a dam in Austria

Eberlaste dam is a 28 m-high embankment dam with an asphalt core and a foundation cut-off wall. As the cut-off wall did not reach bedrock, under-seepage was expected. Significant foundation settlement, with a rate of 3–4 mm/year after 50 years of operation, suggested the presence of internal erosion in the foundation. According to a theoretical assessment of contact erosion, the various foundation soils can act as a filter for the particular base material. Hole erosion tests showed a low resistivity against piping. However, pipe collapse during these tests indicates that the likelihood of concentrated leak erosion is very low. Consequently, the main focus of the internal erosion assessment was suffusion. Various theoretical criteria were applied using a large number of gradation curves. In addition, laboratory suffusion tests were carried out.

A cooperative research project was established with Université de Nantes, Electricité de France, IMSRM (Ingénierie des Mouvements de Sol et des Risques Naturels) and VERBUND Hydro Power to investigate, among other things, the influence of suffusion due to hydraulic loading on the mechanical behaviour of soil specimens by also taking into account the various scalping processes. This project aims to improve the understanding of the mechanical process of suffusion and the interpretation of test results.



ICOLD Bulletin 164 Internal Erosion Workshop



Using European research to investigate the potential for suffusion at a dam in Austria

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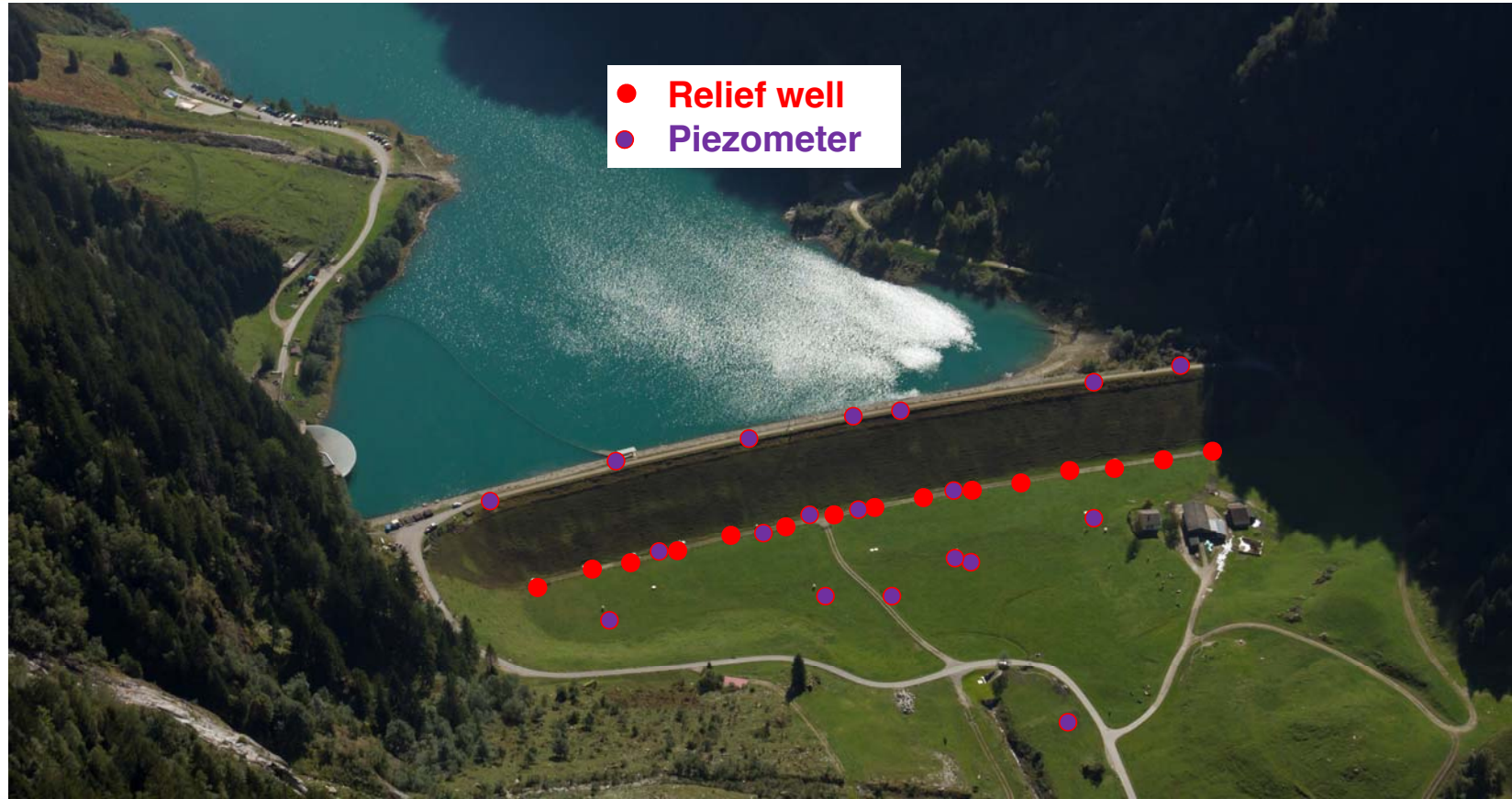
Eberlaste Dam – Location and Basic Data

- Dam height 28 m
- Dam crest 1124 m asl
- Crest length ~ 480 m
- Storage Volume 6.800.000 m³
- First impounding 1969





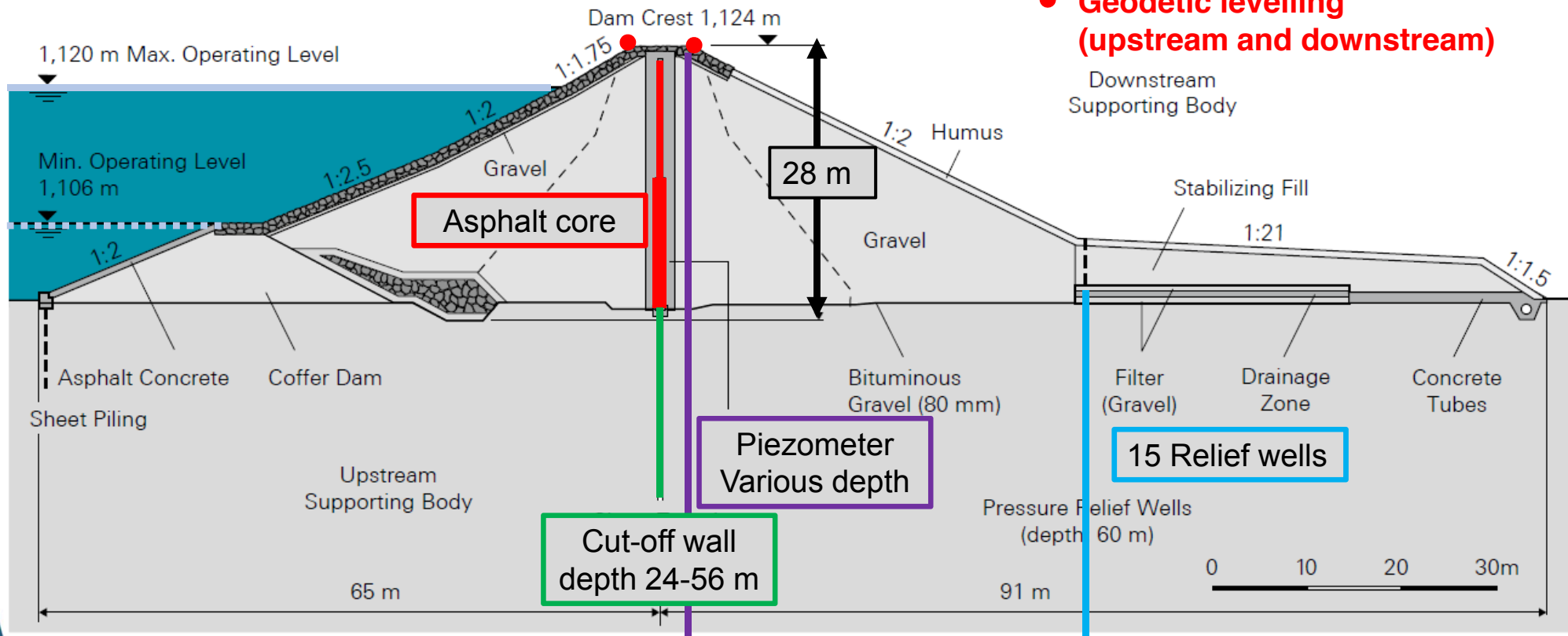
Overview – Monitoring System



Verbund



Dam design 1



- **Geodetic levelling (upstream and downstream)**

Downstream Supporting Body

Stabilizing Fill

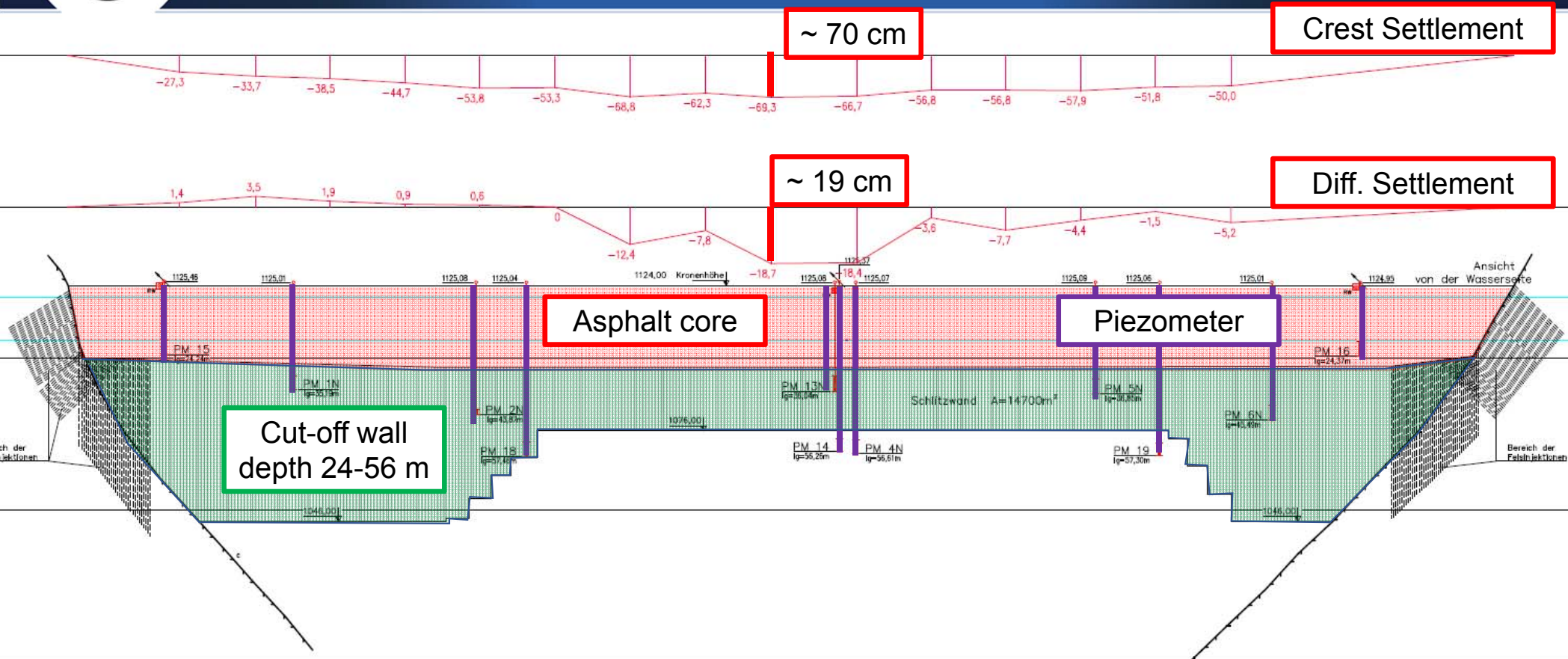
15 Relief wells

Piezometer Various depth

Cut-off wall depth 24-56 m

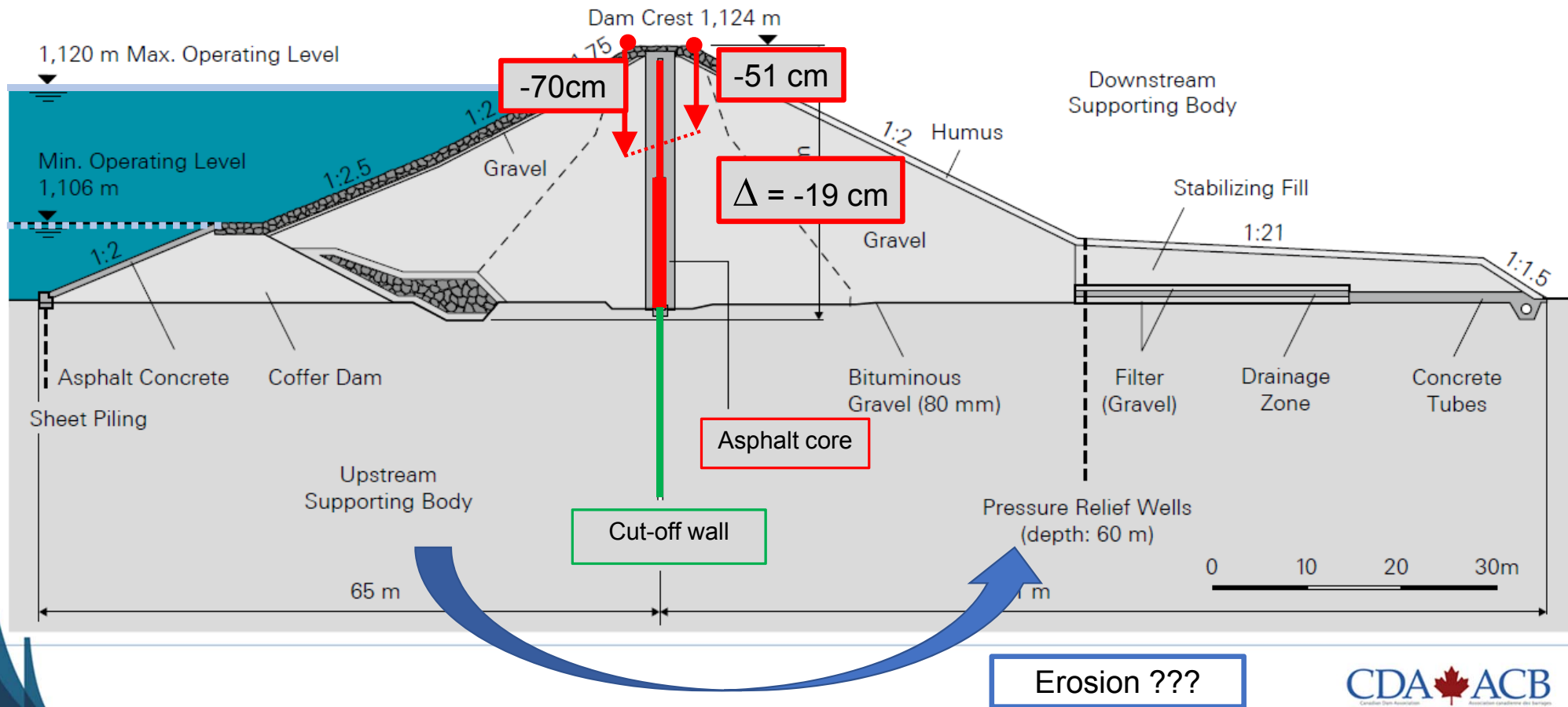


Dam design 2





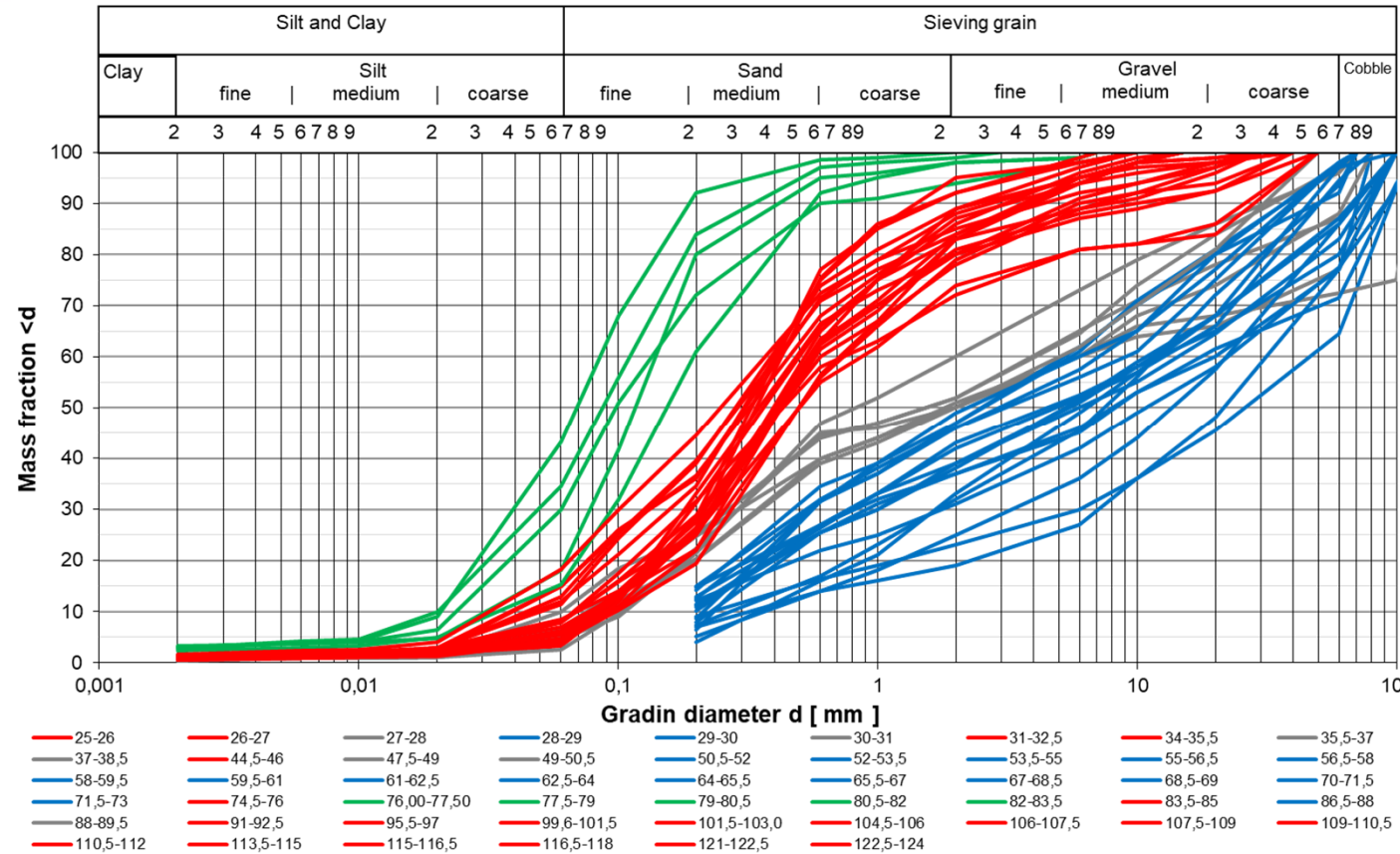
Crest settlement since 1968





Geology

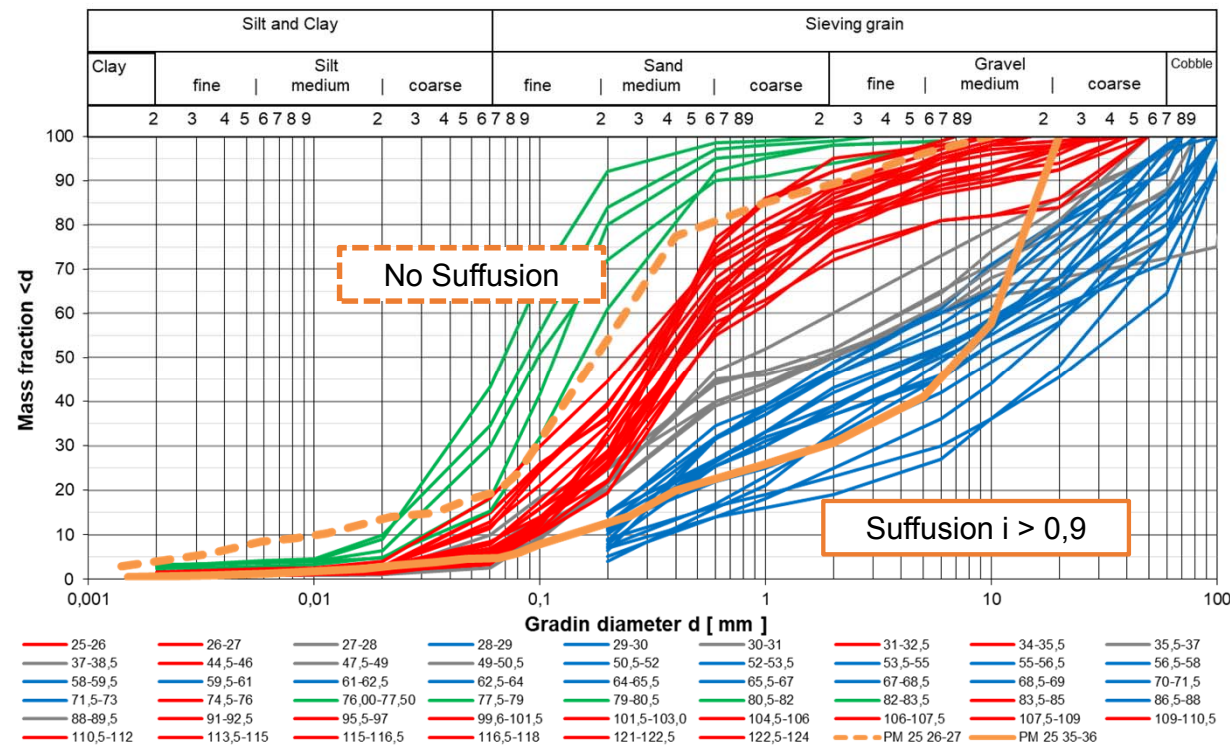
- **Silt & Sand**
- **Medium Sand with silt and gravel**
- Silt-Sand-Gravel
- **Sandy gravel**
- **No distinct layers**
- **Bedrock elevation unknown**





Suffusion Assessment 1

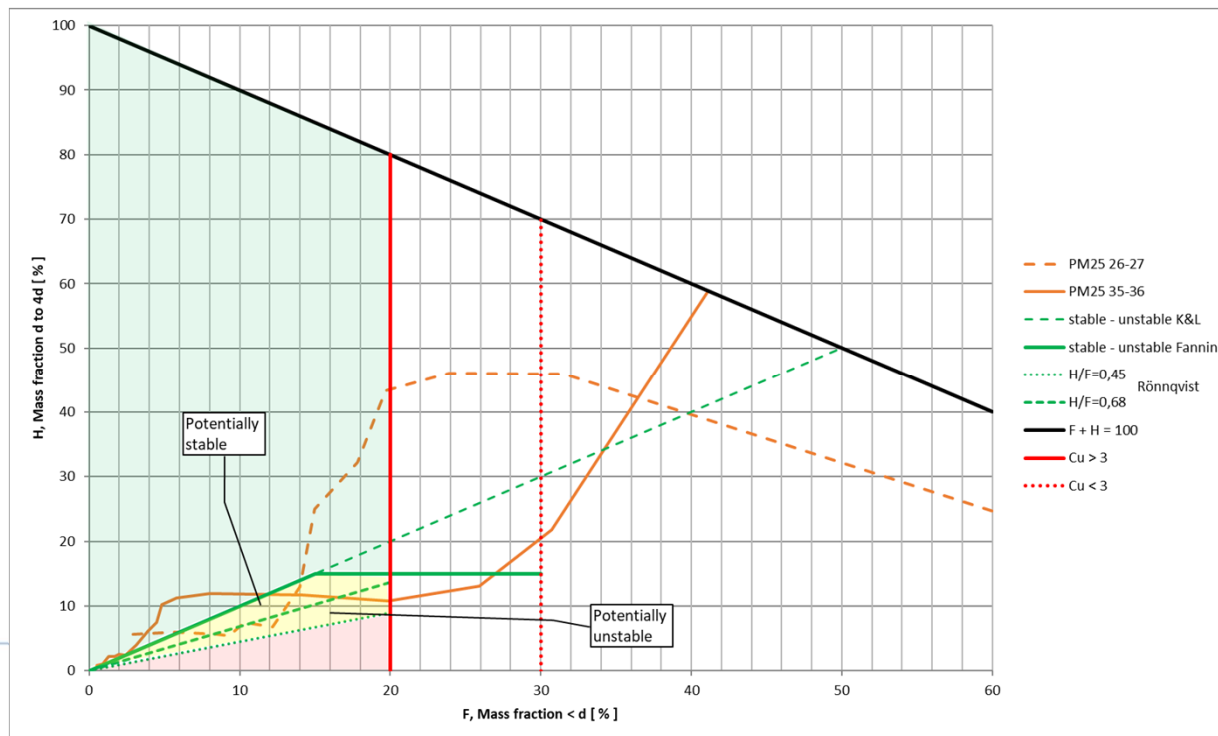
- Laboratory Test
 - Moderate suffusion
 $i_{crit} = 0,9$
- Theoretical Assessment
 - Geometric
 - Wan & Fell
 - Kenney and Lau
 - Witt
 - Lubockov
 - Hydraulic





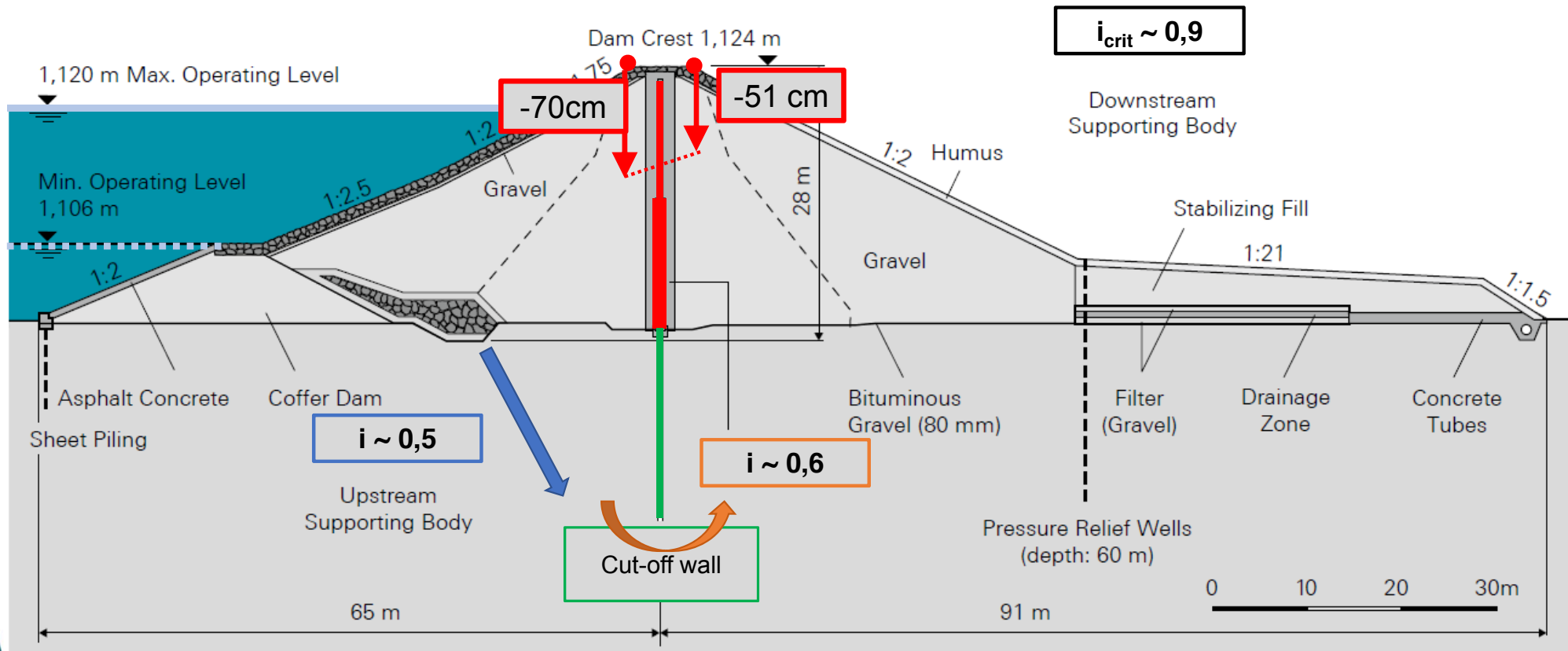
Suffusion assessment 2

	Lab Test	Wan & Fell	Kenney & Lau	K&L modified	Witt	Lubbockov
PM25 26-27	Green	Green	Red	Yellow-Green	15%	Green-Red
PM25 35-36	Red	Red	Red	Orange	25%	Green





Suffusion assessment 3 – Hydraulic





Research Project



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edf



Verbund

Experimental contribution to the study of the risks of hydraulic earth structures



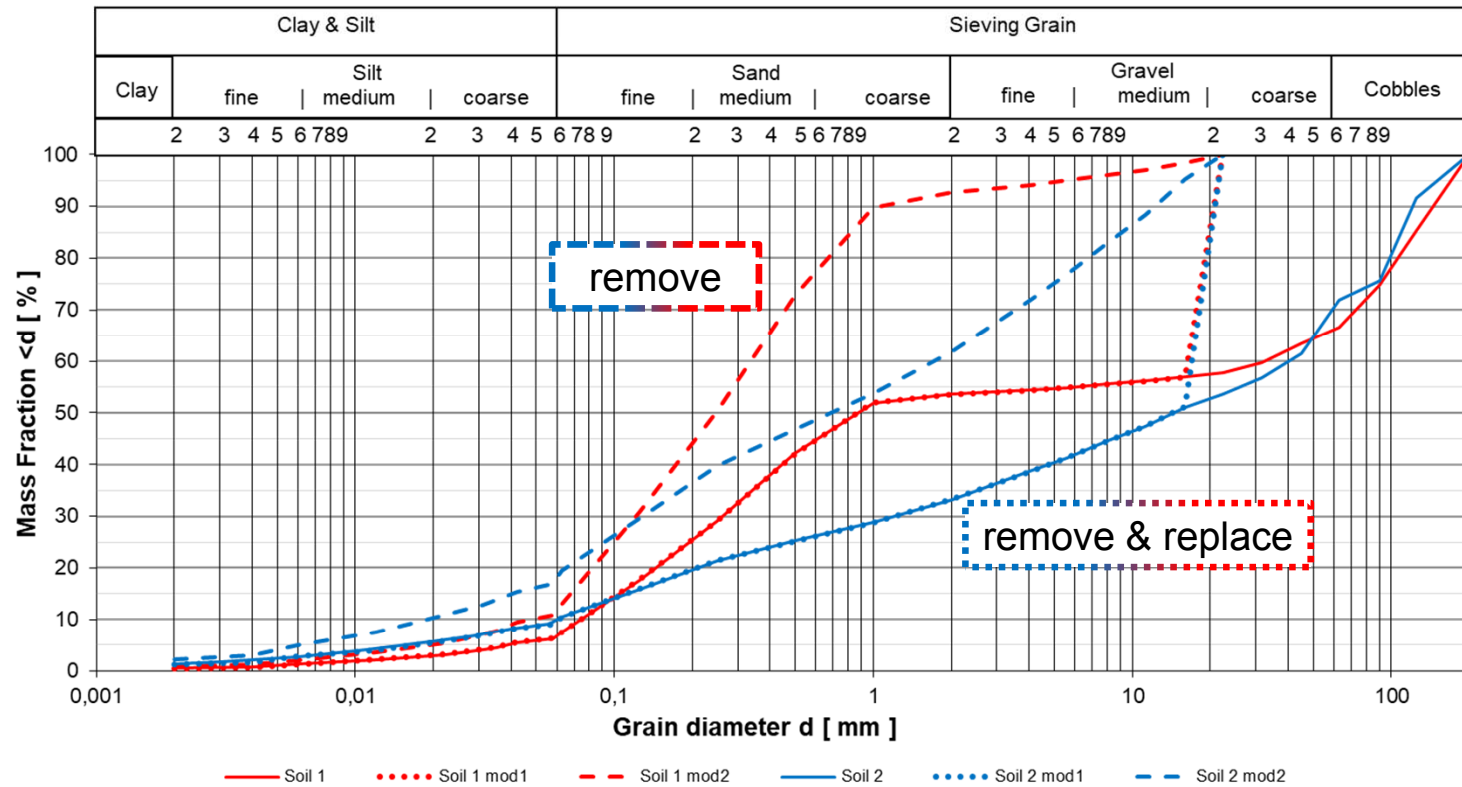
Research Project – Objectives

- International experimental benchmark
- Characterization of suffusion and soils mechanical behavior subjected to complex hydraulic loadings
- Characterization of suffusion and soils mechanical behavior under complex mechanical states
- Verification of the intrinsic character of several erosion law parameters
- **Study of the influence of various scalping process on soils mechanical behavior**
- Contribution to the development of a finite element tool



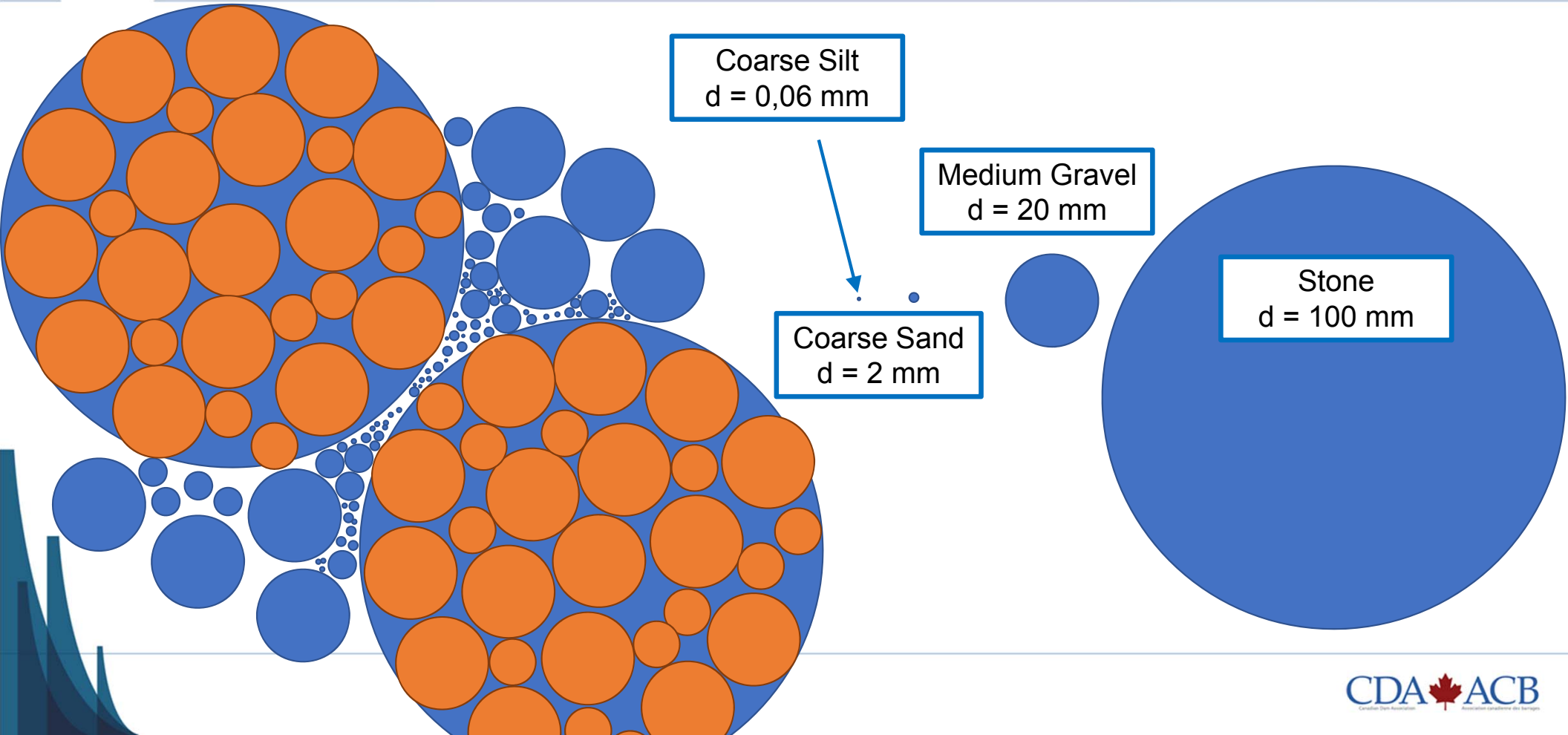
Clipping of grading curves

- Mod1 = remove and replace
- Mod2 = remove





Clipping of grading curves

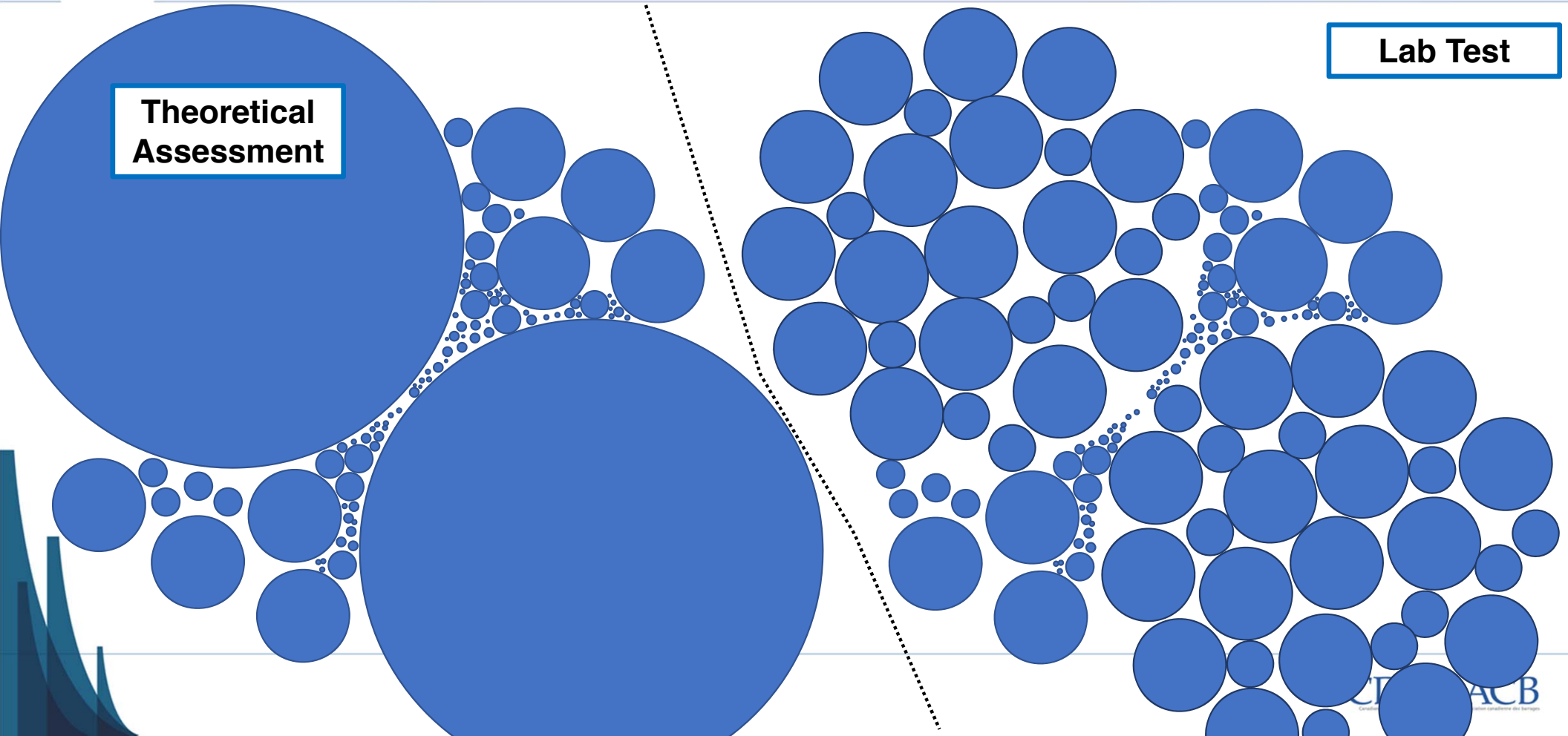




Clipping of grading curves

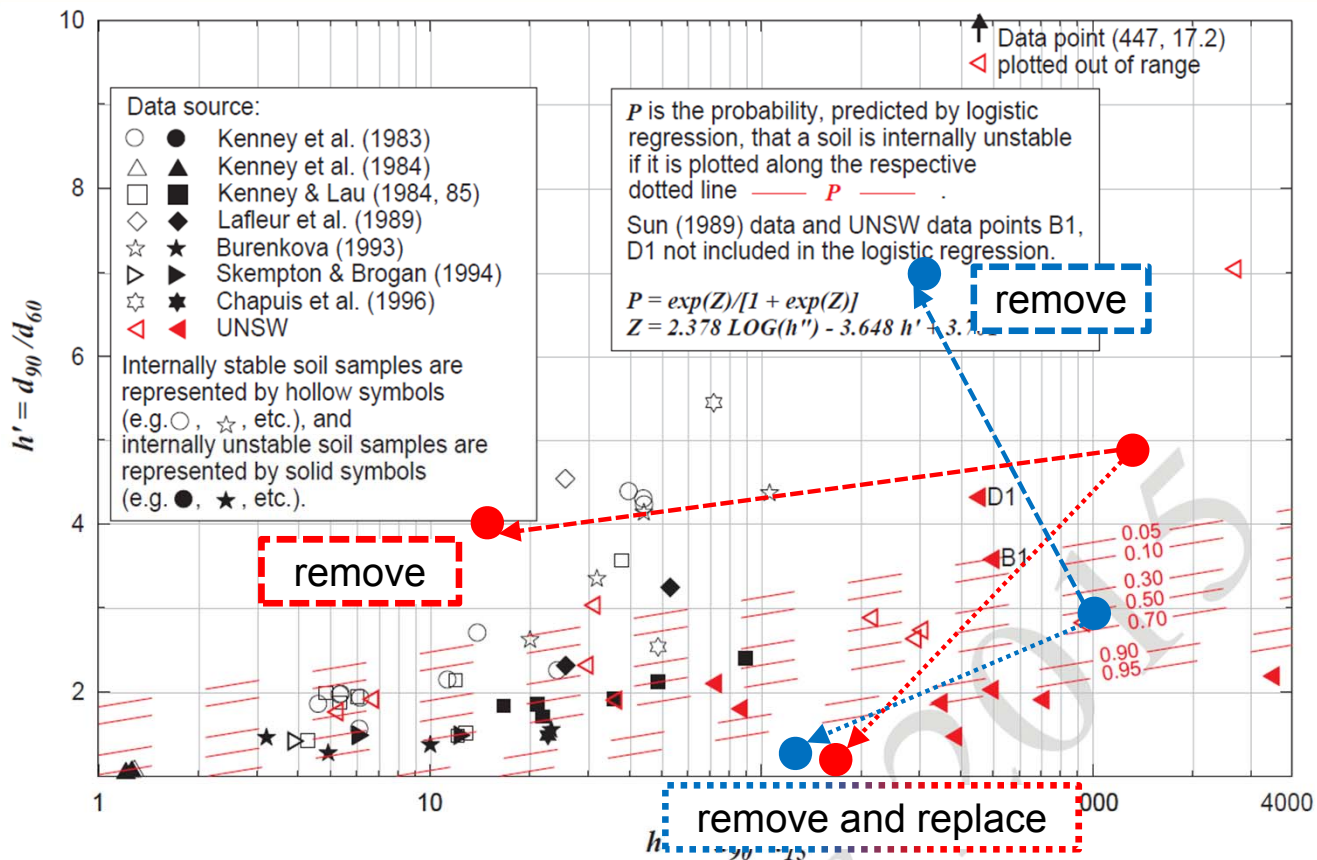
**Theoretical
Assessment**

Lab Test



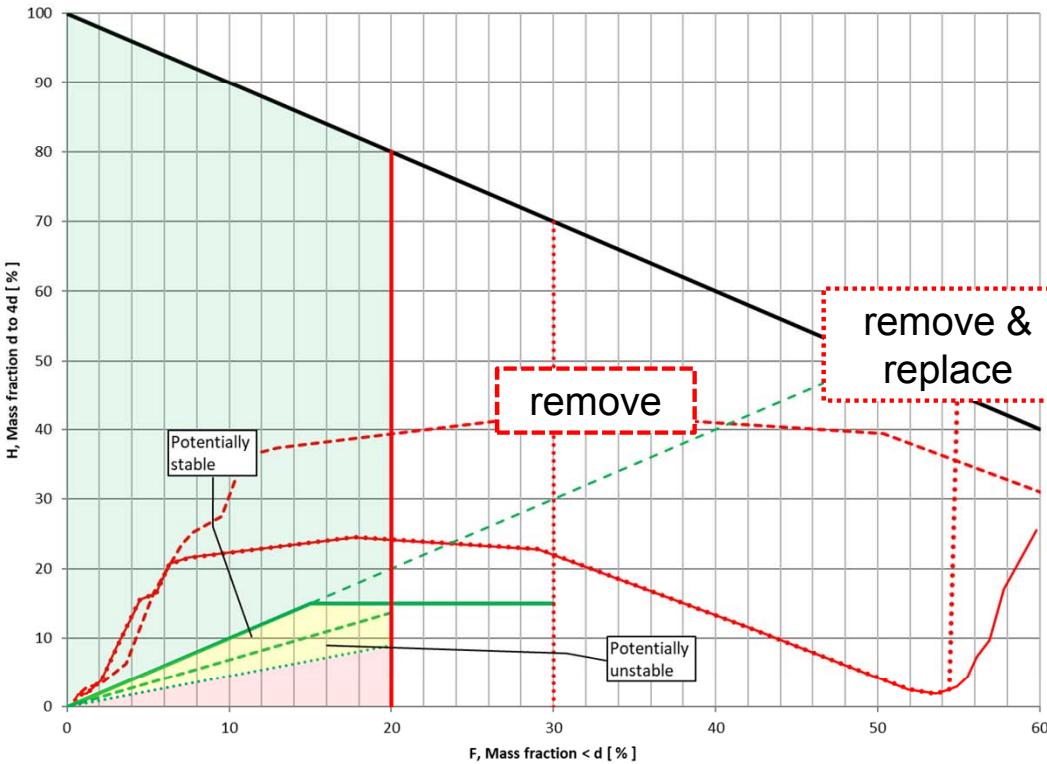


Clipping - Wan & Fell

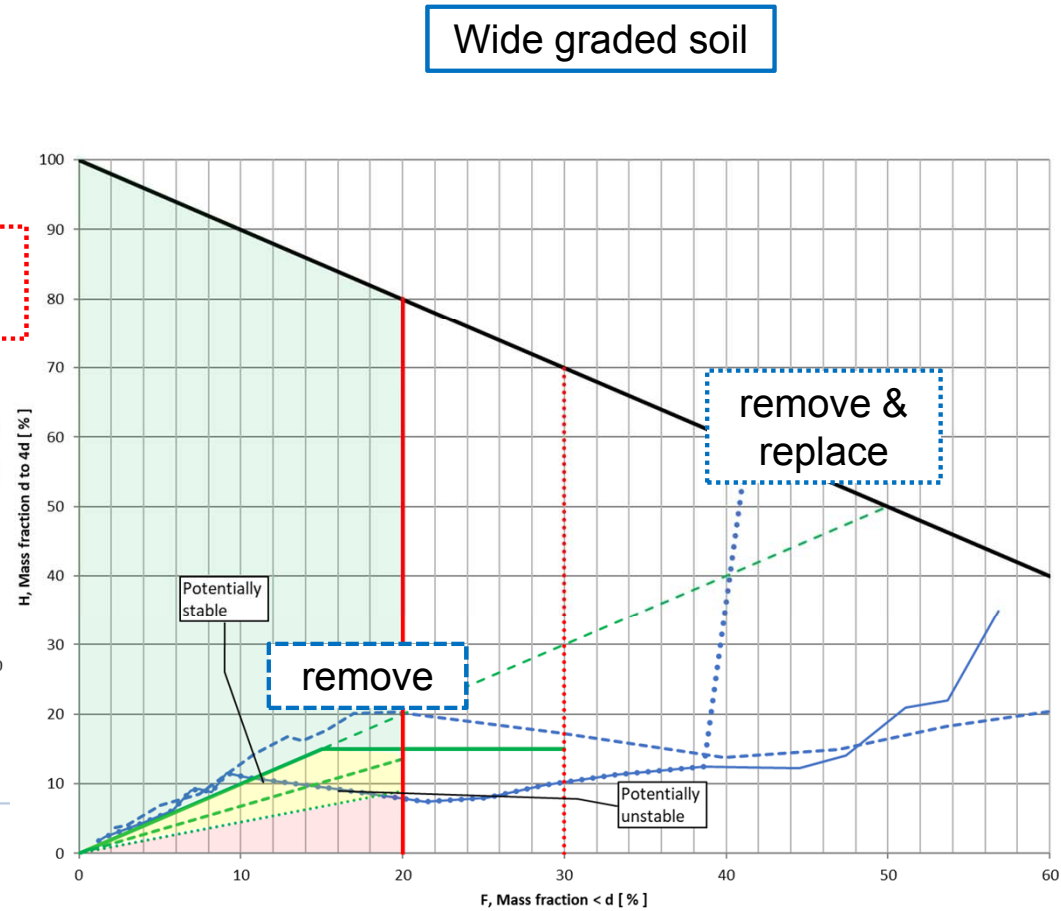




Clipping – Kenney & Lau



Gap graded soil



Wide graded soil



Clipping – Summary

		Lab Test	Wan & Fell	Kenney & Lau	K&L modified	Witt	Lubockov
Gap graded	Original soil					15%	
	Remove & Replace					15%	
	Remove					20%	
Wide graded	Original soil					30%	
	Remove & Replace					30%	
	Remove					15%	

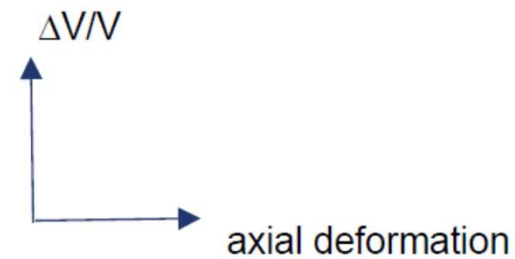
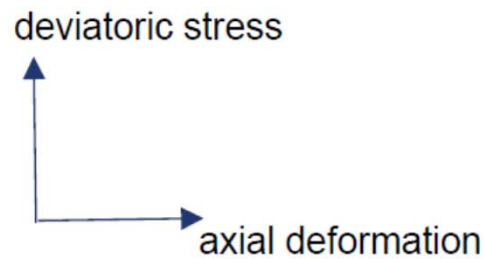


Clipping – Lab tests

- Triaxial Erodimeter
 - D = 200 mm
 - Gap graded and concave graded soil
 - Initial, remove only & remove/replace

Total number of tests for this study: 24 tests

Expected results





Thank you for your attention

- More information about Eberlaste Dam
 - 1970 Montreal Q.36 R.15 & Q.37 R.15
 - 1973 Madrid Q.42 R.45
 - 1976 Mexico Q.45 R.14