

# HISTORY AND REVIEW OF THE ASTM INTERNATIONAL TEST STANDARDS FOR THE INTERFACE SHEAR TEST AND FUTURE CONSIDERATIONS

Geosynthetics 2020

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## AGENDA

- Background
- Running the test
- History
- Current standards
- Challenges
- Current/future considerations
- Q&A

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## Interface Shear Background

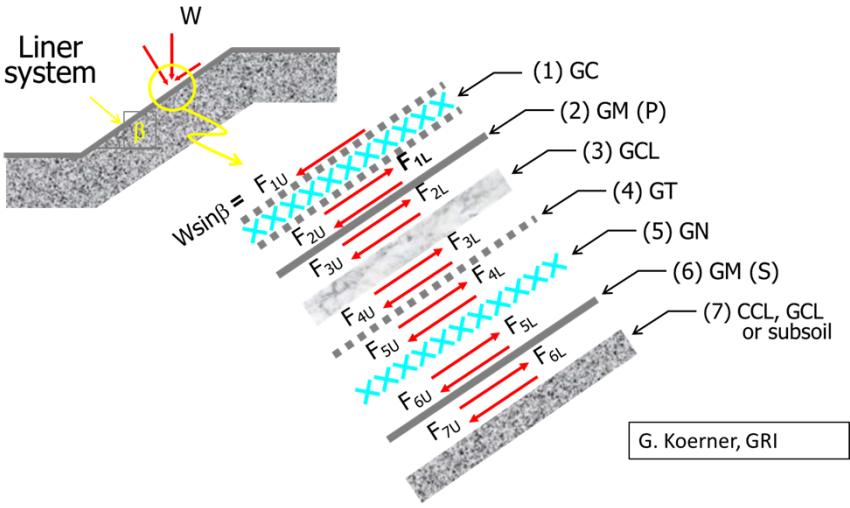
- Performance test
  - Site-specific geosynthetics and soils
  - Anticipated loads, moisture-density conditions, etc.
- Slope stability
  - Waste impoundments, canals, walls, reservoirs
- Conducted during many stages of a project
  - Design, selection of materials, MQA/MQC, CQA/CQC, \*\*failure analysis!



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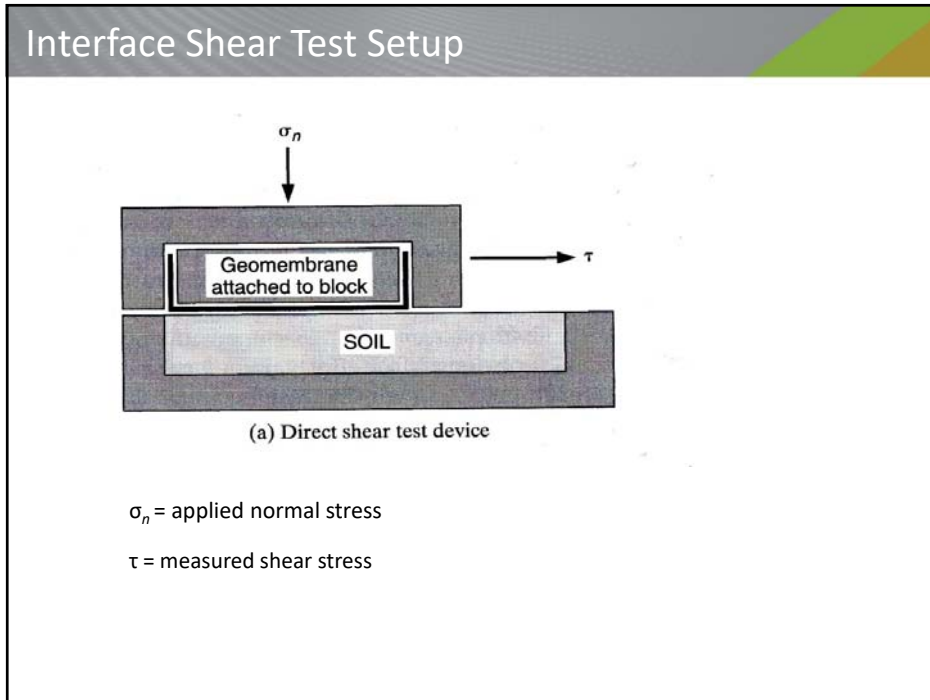
## Multi-lined Side Slope Considerations

Necessary for Stability Analysis

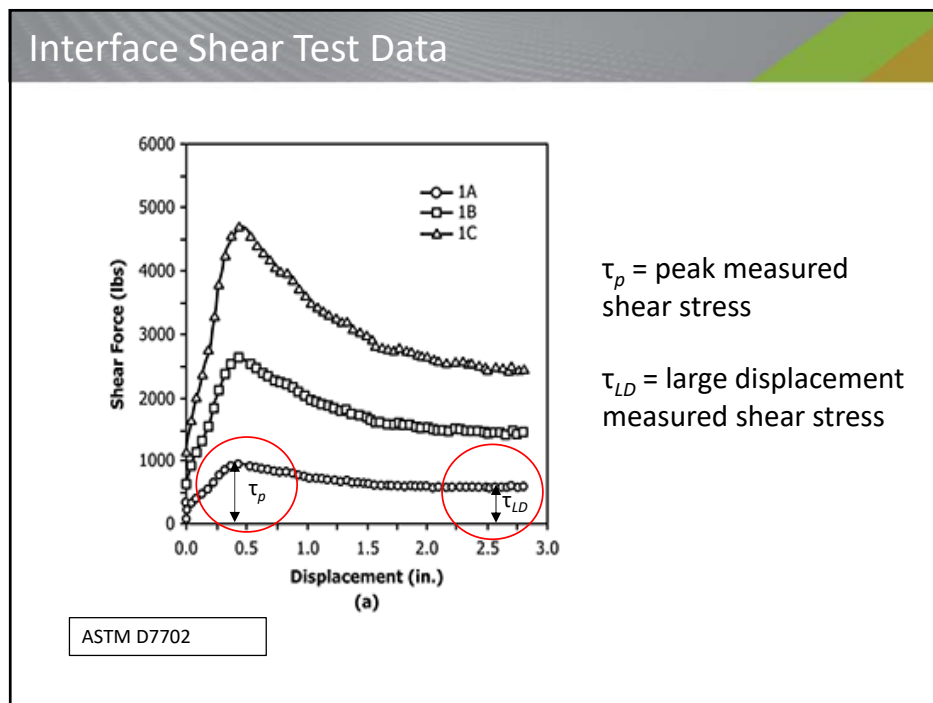


G. Koerner, GRI

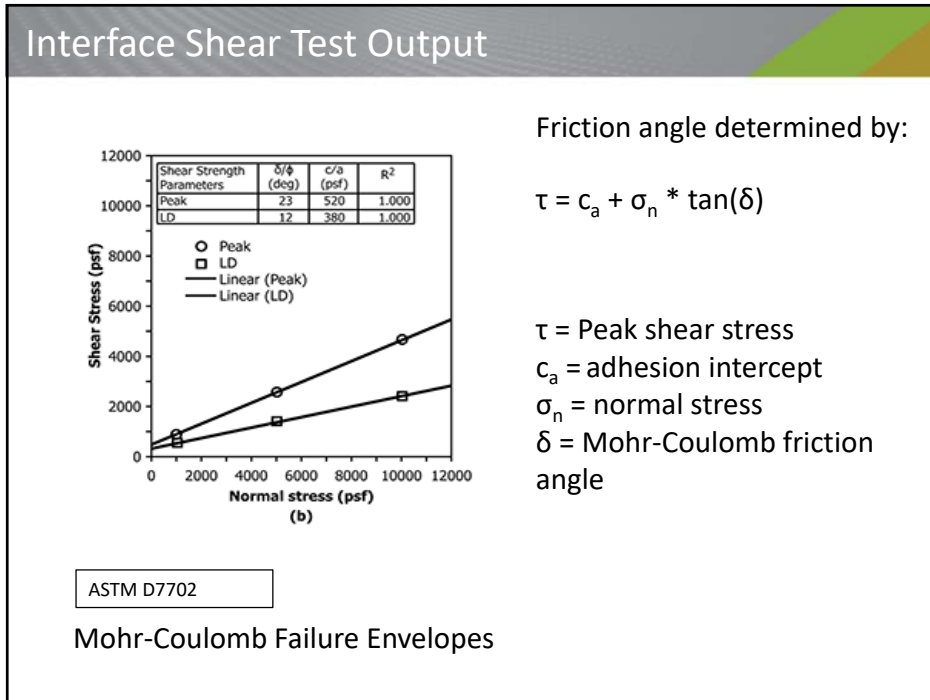
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### Interface Shear – How Did We Get Here?

Year	Event
1776	First direct shear tests performed by Coulomb
1986	Started work on an ASTM procedure – first meeting in Louisville, KY (R. Koerner, Swan, Williams, Bennett, Christopher); initially, biggest issue was box size! Other important contributors included: Bove, G Koerner, Richardson, Miles
1988	March 19 - Kettleman Hills Slope Failure** First textured HDPE shear test performed at Geosyntec (Swan)
1992	ASTM D5321 approved -revised and approved in 1997, 2002, 2008 (heavily revised after work done on D6243), 2012, 2014, 2017, 2019, 2020 -much effort on improving round robin test results to establish precision and bias

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## Interface Shear – How Did We Get Here?

Year	Event
1995	GAI-LAP accredits interface shear testing (today 18 labs accredited)
1998	ASTM D6243 approved -revised and approved in 2006, 2008, 2013, 2016 **major differences to accommodate GCLs (including internal shear), conditioning and shear rate
2011	ASTM D7702 approved -revised and approved in 2014 Checklist added to D6243 (originally a guidance document on specifying/performing test)
2011-now	Ongoing work to tighten up/align both procedures and improve reproducibility and improve communication between laboratory and engineer/specifying entity

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## Current ASTM International Test Standards

D5321/D5321M – 19 - Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic Interfaces by Direct Shear (Task Group Leader – Torosian)

- Soil vs. geosynthetic and geosynthetic vs. geosynthetic
- Excludes interfaces involving GCLs
- Checklist for specifying test
- Recently passed ballot
  - Pre-test material characterization
  - Method for multi-layer testing in appendix
- Future ballot (2020)
  - Considerations for multi-layer tests
  - Displacement rates
  - Precision & bias statements

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## Current ASTM International Test Standards

### D6243/D6243M – 16 - Standard Test Method for Determining the Internal and Interface Shear Strength of Geosynthetic Clay Liner by the Direct Shear Method (Task Group Leader – Kline)

- Soil vs. GCL, geosynthetic vs. GCL and Internal GCL
- Excludes interfaces not involving GCLs
- Guidance on clamping, gripping, hydration & consolidation
- Checklist for specifying test
- Revised standard – 2020
  - Pre-test material characterization
  - Gripping plate clarification
- Future ballot (2020)
  - Procedure and considerations for multi-layer tests

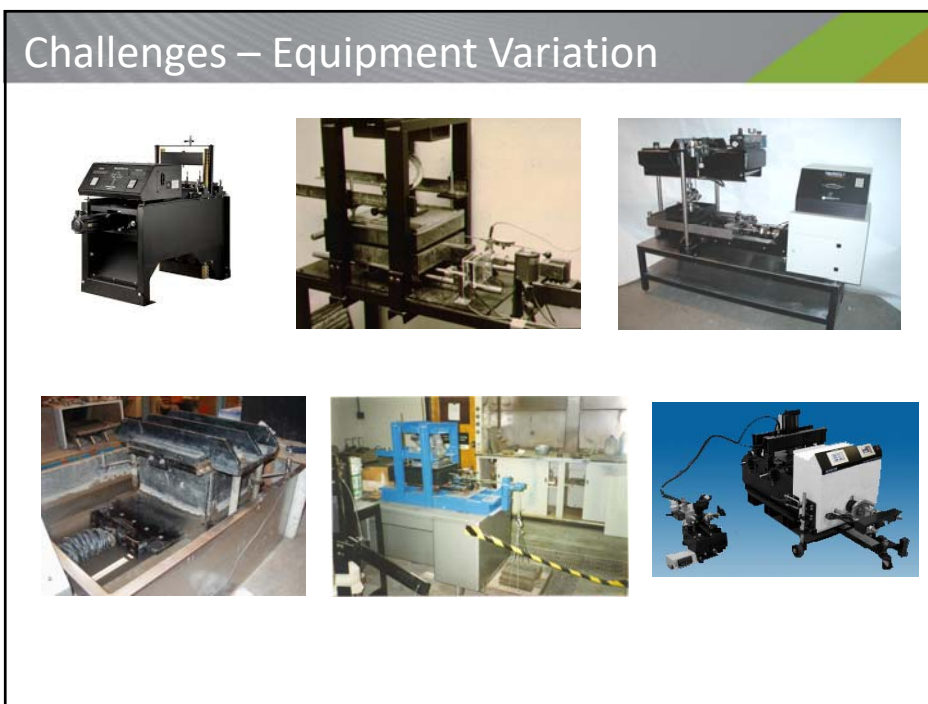
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## Current ASTM International Test Standards


### D7702/D7702M – 14 - Standard Guide for Considerations When Evaluating Direct Shear Results Involving Geosynthetics (Task Group Leader - Kline)

- Guidance evaluating interface shear test results:
  - Evaluation of Mohr-Coulomb failure envelope
  - Interpreting cohesion and adhesion
  - Evaluating shear-displacement curves
  - Comparison to historical data
  - Post-test sample inspection
  - Evaluating multi-layered tests
- Future Ballot (2021)
  - Further guidance on multi-layered tests

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Component	Parameter	Standard Guidance	User-specified
Geosynthetic	Orientation	X	X
	Hydration/swelling/consolidation time/load/loading sequence/duration	X	X
	Type of clamping and/or gripping surfaces	X	
	Sub- and Super-strata	X	X
Soil	Soil equilibration time	X	
	Soil density and moisture condition		X
Interface	Configuration - top to bottom		X
	Interface saturation condition		X
	Test normal load		X
	Test normal load application sequence/duration	X	X
	Shear displacement rate	X	X

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## Challenges - Interpretation

- ASTM D7702 - Guidance evaluating interface shear test results:
  - Evaluation of Mohr-Coulomb failure envelope
  - Interpreting cohesion and adhesion
  - Evaluating shear-displacement curves
  - Comparison to historical data
  - Post-test sample inspection
  - Evaluating multi-layered tests

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## Current/Future Considerations

### D5321/D6243

- Multi-layered testing
  - No clamping, multiple interfaces tested at once
  - Passed D5321 – ballot soon in D6243
  - New guidance in D7702
- Shear rates
  - Too fast in many cases
  - Proposed inclusion of a table with suggested strain rates based on soil types
- Precision and bias
  - 2 attempts (2005 and 2013)
  - Will use GRI data

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## Current/Future Considerations

### D5321/D6243

- Equipment variances
- Standardized gripping surfaces (GCL)
- Hydration/consolidation times and loading sequence
- Temperature effects (reduction factor)

**D5321, D6243 and D7702 task groups will all next meet in Boston July 1-3, 2020**

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## Consensus Process

### Standards Development

- Members identify the need; or
- Outside representatives approach ASTM
- ASTM brings stakeholders together
- ASTM provides the forum and the process



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## Sources

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**Questions?**

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