Experiences in adopting AGS and future requirements

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Status of AGS use at NGI

- Offshore Division working with AGS data for SI
  - Common practice since 2015
- Requirement in Offshore projects
  - NGI have had increased exposure to AGS data
- Offshore Division capable of working with AGS data
- Delivery of AGS, to date, has not been a requirement for NGI clients

- Onshore Divisions do not receive AGS data or use AGS data

National database onshore in Norway

- *Nasjonal database for grunnundersøkelser* (NADAG)
- Norwegian onshore data management and processing tool
  - GeoSuite (& GeoFuture)
  - Based on SOSI standard for Geotechnical Surveys
  - XML files

- Onshore Industry contrasts significantly with the implementation of AGS in the Offshore Industry in Norway

Overall challenges as a Geotechnical Institute

- Collection of data in house and externally (e.g. Offshore and Onshore)
- Storage system
- Transfer of data – receiving and issue of data
- Analysis of data – tools vary
- Reporting
  - Meet the evolving needs of clients both onshore and offshore
  - Customisation of data formats for clients
- Develop more efficient work processes and data sharing facilities

How we handle AGS data at present

- Evolution of established and trusted work routines to deal with Offshore AGS data sets
  - Competent in receiving and working with AGS data, often through in-house scripting routines
- NGI have begun to generate AGS data sets
  - Commissioned Keynetix system in house for Laboratory 2016
  - Basic index tests in AGS format
- Use of HoleBASE SI software for a commercial offshore project
- Trial use of HoleBASE SI and gINT software
  - Modification of groups
  - Creations of new groups and fields for client requirement
  - Implementation on project level at present

Potential for further development?

- Adopted work routines must be robust enough to evolve to serve:
  - Variety of incoming data formats – may need pre-processing
  - Client delivery requirements – flexibility in systems to meet needs
  - Wide range of geotechnical data – e.g. Advanced laboratory test results
  - The need to understand standard reference terms
  - Third-party software can be cumbersome and fixed character fields less flexible to handle data flavours (AGS4+modifications!)

Advancement of AGS in relation to Lab data

- Typical data that is included in AGS
  - *Classification data*

Boring No.	Tube ID	Depth	Water content	Soil unit weight		Unit weight of solid part	INDEX STRENGTH Fall cone		SENSITIVITY Fall cone	PLASTICITY DATA Plastic limit	Liquid limit	Plast.Index	GRAIN SIZE DISTRIBUTION clay	clay+silt	clay+silt +sand
			w	γ (dim)	γ (w c)	γ_s	s_u	$s_{u,rem}$	$S_t^{Fall\ Cone}$	w_P	w_L	I_p	< 2 µm	< 0.063 mm	< 2 mm
		m	%	kN/m³	kN/m³	kN/m³	kPa	kPa	-	%	%	%	%	%	%
BHXXX	1-B-1	6.96	60.0	16.00		26.26	25	10.0	2.5	20.0	65.0	45.0	65	89	100
BHXXX	1-B-2	6.96	55.0	16.00			12	5.0	2.4	20.0	65.0	45.0	65	90	100

  - *Triaxial test data – only key parameters*

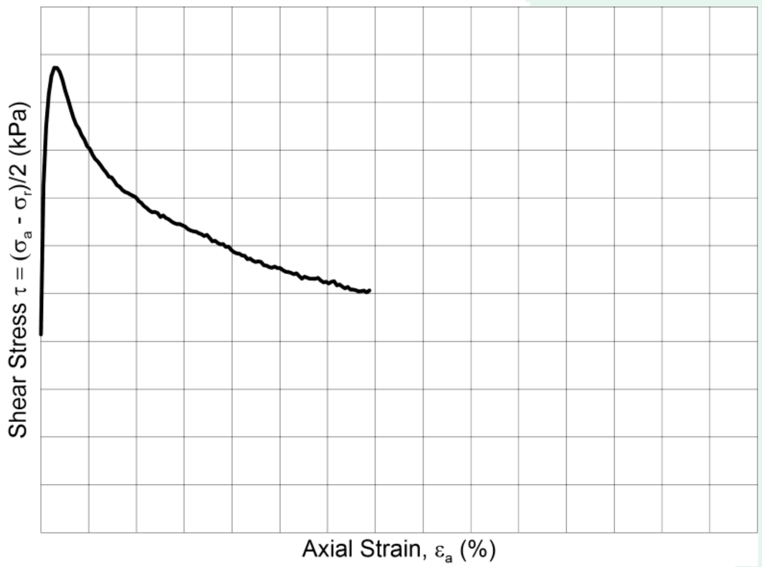
Boring No.	Tube part test	Depth	INDEX PROPERTIES Water content		I_p	Clay cont.	Unit weight	Type of test 1)	CONSOLIDATION Estim. p_o'	σ_a' final	σ_r' final	ε_{vol}	ε_{ac}	B	Perm k	UNDRAINED. STATIC TESTING s_u	U_f	ε_f	s_u/σ'_{ac}	$\Delta e/e_i$ 2)	Sample quality 3)
			w_i	w_c																	
		m	%	%	%	%	kN/m³		kPa	kPa	kPa	%	%	%	m/s * 10^{-9}	kPa	kPa	%	-	-	-
BHXXX	1-B-1	6.96	60.0	58.5	45	65.0	16.00	CAUC	42.0	42.0	25.0	0.59	0.57	99.0		19.5	11.0	0.6	0.46	0.009	1
BHXXX	1-B-2	6.96	60.5	59.0	45	65.0	16.00	CAUE	42.0	42.0	25.0	0.71	0.65	98.8		9.0	-1.4	1.8	0.21	0.011	1

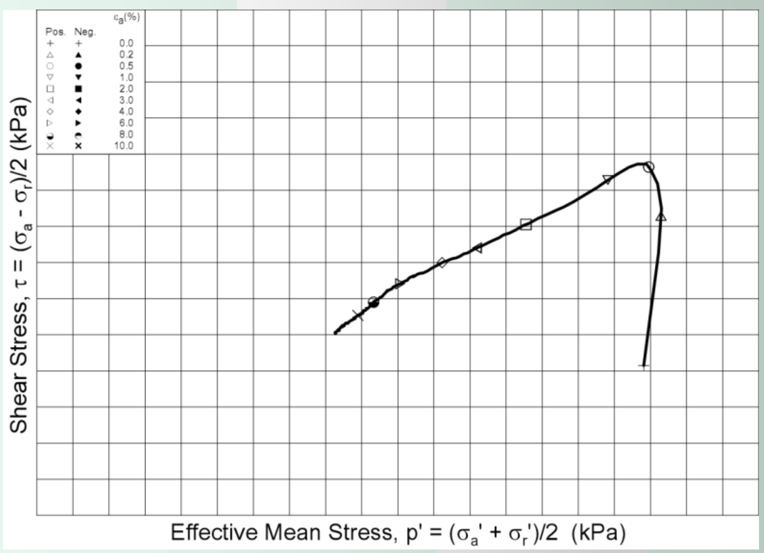
Advancement of AGS in relation to Lab data

- Typical data that is included in AGS – well aware of these headings
- Data that is *not* included in AGS
  - How do we handle cyclic triaxial/DSS test data sets?
  - How do we manage advanced test – stress strain data set?
  - What to include and not include (as test results can be very extensive)?
- Would be good to see progress in the future for advanced test results

Advancement of AGS in relation to Lab data

- Part of monotonic data that is currently *not* included in AGS
  - Stress-strain data from monotonic triaxial testing
  - PP development and stress-path with strain markers





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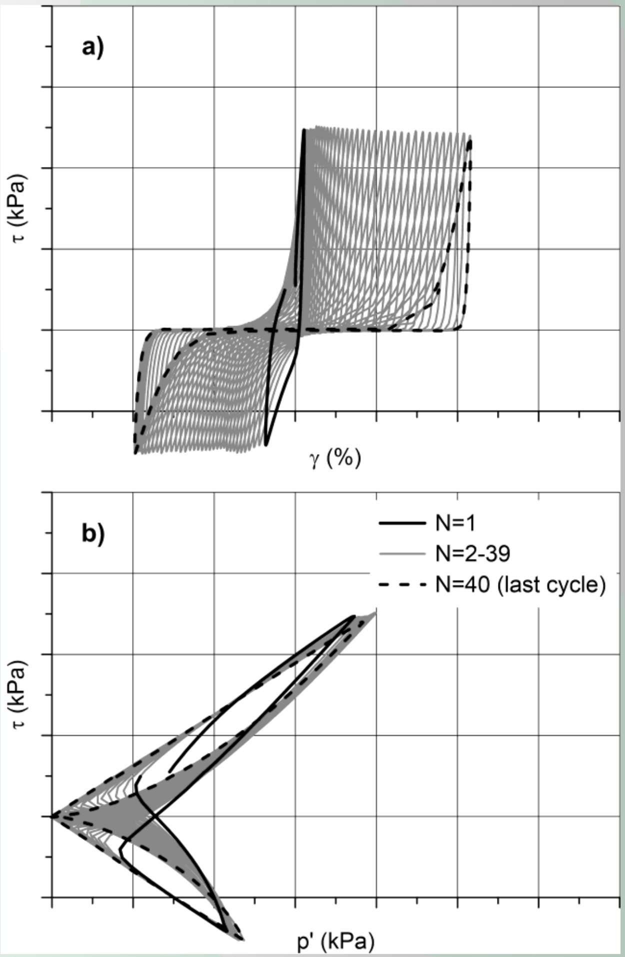
Advancement of AGS in relation to Lab data

- Advanced cyclic testing *not* in AGS at present
  - Average and cyclic shear stresses during cyclic triaxial/DSS testing defined
  - Stress-strain data with time and number of cycles
  - PP development and stress-path with time and number of cycles
  - Frequency/Period of loading pulse (0.1 Hz)
  - ++



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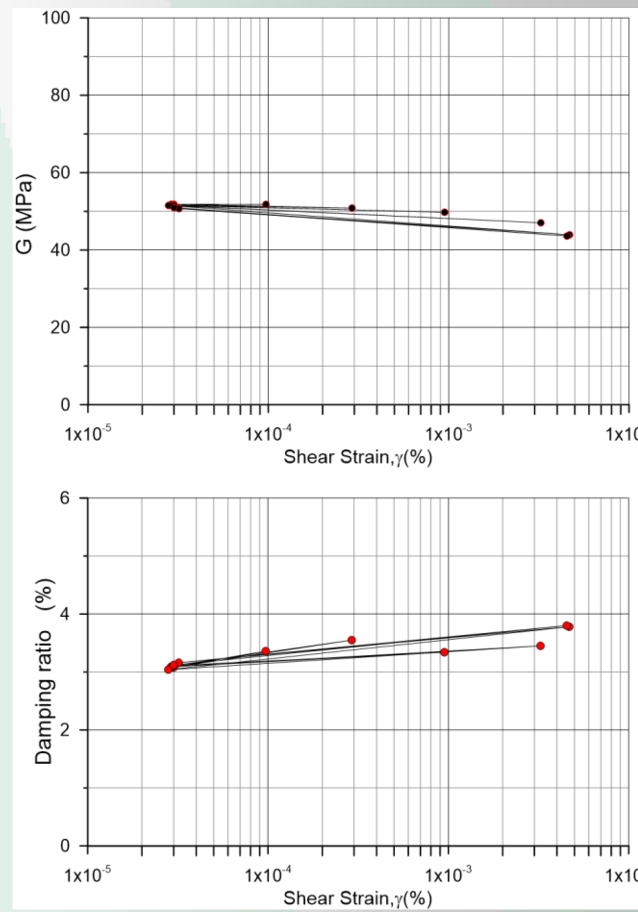
Advancement of AGS in relation to Lab data

- Resonant column *not* in AGS at present
  - Consolidation stage during Resonant column test (can have 1 or more stages)
  - Small strain shear modulus, G_{max} and damping, D with time during consolidation stage (e.g. 1, 2, 4, 8 min etc. until end of consolidation)
  - G_{max} and D with increasing shear strain
  - ++



Lessons learned in working with AGS data

- Work process have begun to become more standardised
- Can manage large data sets without the need for customised software as a result of AGS (open-source)
  - Importance on knowing corrections e.g. depth correction for CPTU.
- Challenges importing AGS data into commercial software e.g. decimal places for a particular parameter, user defined parameters etc.

Key concerns for NGI as a Geotechnical Institute

- Freedom to work with AGS data – how we interface with AGS data sets – import and creation of data sets
- Analysis of data and how we do this effectively – through software or an alternative open-source approach?
  - Probably both…
- Using alternative work routines to increase flexibility for various types of data sets – cannot impose one format at NGI
- Reduce cost for programme licences
- Need for increased exposure to AGS data

Conclusions

- Can we achieve a seamless transition to new standards?
  - Yes, as NGI are active and competent in use of AGS data
    - Room for further development - Yes
  - Challenges in adopting production of AGS data for laboratory tests
    - Currently in commission phase of AGS production in the laboratory
    - Many tests not in standards
- NGI have realised the benefits of adapting to work with AGS formats
- Not all clients require or supply data in AGS format
- NGI plan to establish a Geodata Integration for Offshore and Onshore data management