PROSJEKT- OG HOVEDOPPGAVER
FORSLAG FOR HØSTEN 2020/VÅREN 2021

Nedenfor finner du en tabell med en rekke forslag til prosjekt. Dette er en foreløpig liste og flere oppgaver kan/vil komme, mellom annet fra våre kontakter i næringslivet. De foreslåtte tema kan være frittstående prosjektoppgaver, eller de kan være forstudier for hovedoppgaven til våren. Les gjennom og se om du finner noe du kan ha interesse av å ta kontakt med oss.

SPECIALIZATION PROJECTS AND MASTER THESISES
PROPOSED TOPICS FOR THE FALL 2020/SPRING 2021

Proposed projetc topics is included in the table below. This is a prelimenary list and additional topics may be added, for instance from the industry. The proposed topics may be considered as an independent study, or as a pre-study fot the master thesis for the spring 2021. Please take contact with one of us uf you are insterested in one or more of the proposed topics.

Arnfinn.Emdal@ntnu.no 9754 7729
Steinar.Nordal@ntnu.no 9003 1845
Gustav.Grimstad@ntnu.no 4130 0948
Gudmund.Eiksund@ntnu.no 477 56016
Rao.m.singh@ntnu.no 484 03416
Seyed.amiri@ntnu.no 980 67405
Priscilla.paniagua@ntnu.no 948 29 497 (priscilla.paniagua@ntnu.no)
Yutao Pan, cvepany@gmail.com
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ANALYSEOPPGAVER – PRAKTISK GEOTEKNIKK OG FUNDAMENTERING			
Nr.	Hovedområde	Tittel og beskrivelse	Eksterne firma
A - 1	Analyseoppgaver / praktisk geoteknikk og fundamentering	**Ditt eget prosjektforslag - generell geoteknikk** **Proposal of your own Example projects from consulting engineers – general** Beskrivelse/Description: Dette er et generelt prosjekt som er etablert for at studenter som har egne prosjektideer, for eksempel etter kontakt med firmaer i løpet av studietiden (sommerjobb, deltidsarbeid), kan fremme disse som studentprosjekt og kanskje også for master til våren. Her gjelder det egentlig alle prosjekter som grenser mot stabilitet av skråninger, fyllinger, utgravinger, støttemurer, elveforbygninger, grunnforsterkning, fundamentering, grunnundersøkelser ... kort sagt alt en kan komme bort i som rådgiver i geotekniske spørsmål. Om du har hatt eller skal ha sommerjobb hos geoteknisk rådgiver, hos en entreprenør eller hos byggherre, om det er urbant eller landlig, i lavlandet eller i fjellet, på land eller i sjø/vann/fjord så vil det kunne være relevante problemstillinger å studere. Ta med deg dine ideer for en prat med oss. *This general project is ment for students who have been in contact with the industry during summer internship (summer jobs) and taken interest in special topics. The projects/cases/measured data can be used brought for discussion with the department staff to see if they are suitable for projects or master thesis. These can be e.g. settlements and stability of fills on soft soils, landslide studies, risk analyses, design of protective measures etc.* *Predictions compared to measurements are always of special interest.* *Several students possible.* Samarbeidspartnere/Collaboration: Consulting companies. Statens vegvesen/Jernbaneverket, Norges Geotekniske Institutt, SINTEF Kontaktpersoner/Contact: Arnfinn.Emdal@ntnu.no Steinar.Nordal@ntnu.no Gustav.Grimstad@ntnu.no Gudmund.Eiksund@ntnu.no Rao.m.singh@ntnu.no	Alle geotekniske firmaer, Entreprenører, Forskningsinstitutter

ANALYSEOPPGAVER – PRAKTISK GEOTEKNIKK OG FUNDAMENTERING			
A - 2	Analyseoppgaver / praktisk geoteknikk og fundamentering	**Ditt eget prosjektforslag - samvirke jord-konstruksjon** **Proposal of your own Example projects from consulting engineers - soil structure interaction** **Finite element method (FEM)** Beskrivelse/Description: Dette er et generelt prosjekt som er etablert for at studenter som har egne prosjektideer, feks etter kontakt med firmaer i løpet av studietiden (sommerjobb, deltidsarbeid), kan fremme disse som studentprosjekt og kanskje også for master til våren. Her gjelder det samvirkeanalyseprosjekter basert på elementmetoden, feks ABAQUS, PLAXIS, GeoSuite eller andre relevante verktøy. Modellering av konstruksjon og jord i samvirke skiller seg fra de klassiske håndregnemetoder med grenselikevekt for skråningsstabilitet, spuntanalyser, peler etc. ved at stivhet av alle elementer kommer inn, og analysen dermed blir mer realistisk. *The stiffness of a structural element and the soil in which it is installed is a complex combination that requires analyses with numerical methods like e.g. finite elements. In geotechnical engineering this is commonly used in bridge and building foundations, either direct or on pile groups, support structures like sheet pile walls for excavated large building pits, anchors, buried culverts, quays, wind turbine foundations, oil platforms/seabed structures etc. Students who are in contact with the industry may bring proposals/cases/data to discuss if these are suited as possible student projects or master thesis topics.* *Several students possible.* Samarbeidspartnere/Collaboration: Consulting companies, Statens vegvesen/Jernbaneverket, Norges geotekniske institutt, SINTEF Kontaktpersoner/Contact: Arnfinn.Emdal@ntnu.no Steinar.Nordal@ntnu.no Gustav.Grimstad@ntnu.no Gudmund.Eiksund@ntnu.no Rao.m.singh@ntnu.no	Alle geotekniske firmaer, Entreprenører, Forskningsinstitutter
A - 3	Analyseoppgaver / praktisk geoteknikk og fundamentering	**Skråningsstabilitet. Progressiv bruddutvikling pga peleramming** **Slope stability, progrtessive development of faliure due to piledriving** Beskrivelse/Description: Denne oppgaven er knyttet til forskingsprosjektet REMEDY (https://www.ngi.no/Prosjekter/REMEDY-et-BegrensSkade-prosjekt) som har som må å redusere risiko for skader i forbindelse med byggeprosjekt. En aktivitet i REMEDY er å studere effekten peleramming kan ha på skråningsstabilitet. Denne oppgaven går ut på å studere analytiske, empiriske og numeriske metoder for modellere progressiv bruddutvikling pga peleramming. This task is connected to the research project REMEDY (https://www.ngi.no/Prosjekter/REMEDY-et-BegrensSkade-prosjekt). The aim for the REMEDY project is to reduce the risk for damage in connection with building and construction projects. One activity in REMEDY is to study the effect pile driving (installation) may have on slope stability. The topic for this task is to study analytical, empirical and numerical methods to estimate progressive failure development due to pile driving. Kontaktperson/Contact: Gudmund Eiksund gudmund.eiksund@ntnu.no Yeganeh Attari yeganeh.attari@ntnu.no	**REMEDY**
A - 4			removed

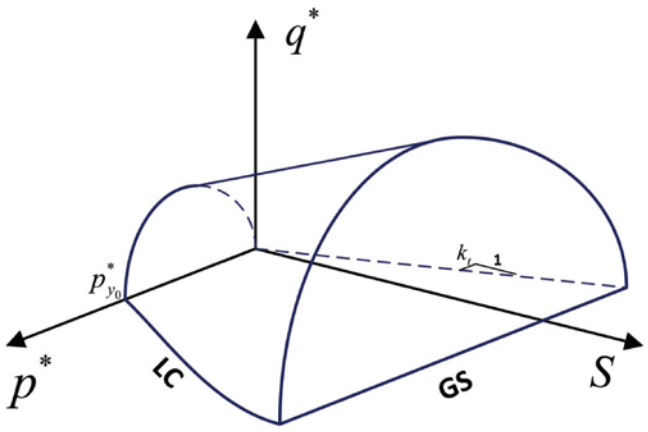
ANALYSEOPPGAVER – PRAKTISK GEOTEKNIKK OG FUNDAMENTERING			
A - 5		**CPTU correlations in clays: range of applications & physical effects, development with Machine Learning** In 2019, a new set of correlations for Norwegian clays based on CPTU data and good quality laboratory data from block samples was presented and tested, see this paper for further information. Further analyses with Machine Learning have been done later at NGI. The purpose of the present project is to evaluate the proposed correlations on several cases of Norwegian clays in order to much better define the range of applications of the correlations, identify the effect of the different parameters on the correlations and the connection with the Machine Learning methods. Kontaktpersoner/Contact Prof. Gudmund Eiksund Gudmund.eiksund@ntnu.no Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Aleksander Worren Aleksander.Worren@ngi.no NTNU is starting a PhD- in 2020 in cooperation with Statens vegvesen on this topic: Sigurdur Mar Valsson sigurdur.mar.valsson@vegvesen.no	

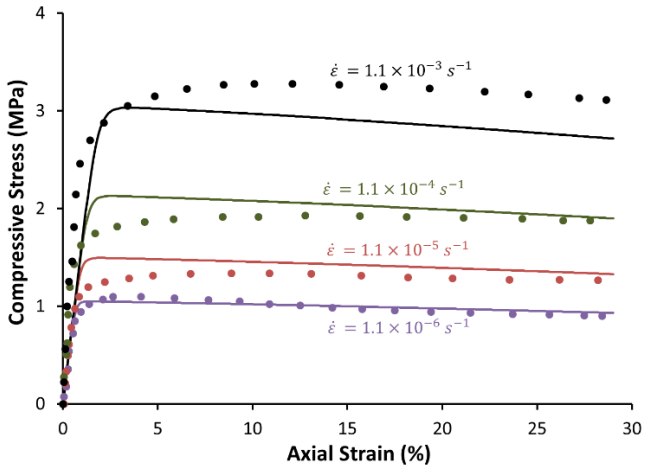
PROBABILISTISKE ANALYSER – STATISTISKE METODER			
Nr.	**Main Area**	**Title and Description**	**External Firm**
P - 1	Seepage analysis; Numerical method; cut-off wall	**Leakage risk of cut-off walls with construction errors** Cut-off walls are widely used in various geotechnical contexts to limit groundwater migration, including deep excavation, coffer dams and landfills. Although they are installed with due discretion, some cut-off walls suffer from construction errors, which later lead to leakages. The quality control of cut-off walls is usually done during and after the wall construction. However, at this stage, the leakage may have already started, and remedial measures may be expensive and time-consuming. Is there a way to pre-set a rational safety margin to mitigate the leakage risk? The aim of this project to conduct a leakage risk assessment of cut-off walls with construction errors. The student will need to learn an existing numerical algorithm and apply this algorithm to a particular type of cut-off wall. Generally, it takes one master student 3-4 months of dedication to finish. Kontaktpersoner/Contact Yutao Pan, cvepany@gmail.com (temporary email address, will be updated once he joins NTNU in July/August, 2020.	
P - 2	Random finite element method; slope stability	**Risk assessment of slope stability with spatial variability** Risk assessment of slope stability is a very important topic in Norway. Normally a deterministic analysis is conducted assuming homogeneous or layer soil properties, and a safety factor is used to account for the uncertainties such as soil property. One rational way to consider the property variability is random finite element method (RFEM). With this approach, the spatial variability can be rationally considered. In this project, an RFEM analysis on slope stability will be conducted to evaluate the impact of spatial variability. Rationally conservative equivalent strength will be inferred to see how much discount should be applied to the mean strength if a homogeneous assumption is adopted. This project involves a large volume of calculations. Kontaktpersoner/Contact Yutao Pan, cvepany@gmail.com (temporary email address, will be updated once he joins NTNU in July/August, 2020.	
P - 3			Removed

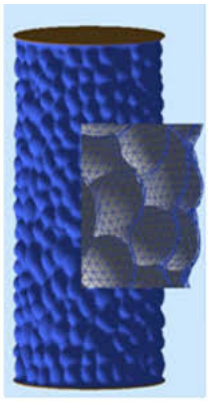
GEODYNAMIKK/GEODYNAMICS			
Nr.	Hovedområde	Tittel og beskrivelse	Eksterne firma
G - 1	Geodynamikk/ Geodynamics geotechnical design piles	**Vibroinstallasjon av pelar** Installation of piles using vibration Beskrivelse/Description: Foreslåtte søkeord for Youtube for dette temaet: Vibro installation of piles Proposed Youtube search Stikkord/Keywords: Installasjon av peler med tungt rammeutstyr genererar støy og vibrasjonar. Vibrasjonar kan gi skader på bygg. I samband med peleraming til havs kan støy kan vere skadeleg for dyreliv og då særskilt for sjøpattedyr. Alternative installsjonsmetoder som vibrering er difor aktuelt. Eit hinder for å ta i bruk denne metoder er at metodene for kapasitetsberegning er basert på erfaringar tradisjonell installasjon med bruk av pelehammer. Prosjektoppgava vil vere eit literaturstudie av vibroinstallasjon av pelar og metoder for kapasitetsbereging. *Installation of piles by the use of heavy piling rigs generates both noise and vibrations. The vibrations may result in damages on buildings while the noise is disturbing. For offshore piling the vibrations is usually a minor problem while the noise (sound waves in water) may be a major concern and possibly damaging to wildlife and sea mammals in particular. Alternative installation methods may therefore be required. One obstacle for the use of the vibration technique is that the existing design methods are based from experience driven piles. The project will consist of a literature study on vibroinstallation of piles and methods for calculating pile capacities.* Kontaktpersoner/Contact: Prof. Gudmund Eiksund, gudmund.eiksund@ntnu.no Prof. Steinar Nordal, steinar.nordal@ntnu.no	
G - 2	Geodynamikk/ Geodynamics Numerisk modellering	**Bender element - modellering av treakstest i ABAQUS eller PLAXIS** Modeling of benderelement test in ABAQUS or PLAXIS Beskrivelse/Description: Benderelement montert i topp og bunn triakprøver blir brukt for å måle forplantingshastighet for skjær og trykkbølger. Tolkning av resultatene er basert på antatt bølgeforplantingsmønster fra sender og mottaker element. Måleresultatene blir brukt til å beregne skjærmodul for små tøyningsnivå (G-max). Oppgaven går ut på å modellere triaksapperaturen inkludert jord, vann i triakscella plexiglas sylinder, topp og bunnstykket i ABAQUS eller PLAXIS. Formålet er å studere bølgeforplanting for å undersøke antatt bølgeforplanting stemmer med antagelsene. *Bender elements installed in the top and bottom of soil samples in a triaxial apparatus can be used to measure shear and compression wave velocities. The interpretation is based on assumed stress wave propagation patterns between the transmitter and receiver element. The measurement results is used to derive small strain shear stiffness (Gmax). The project task will be to model the triaxial apparatus including soil, water in the cell, the plexiglass cylinder ant the top and bottom plates in ABAQUS. The purpose is to study the stress wave propagation and check if the assumptions in the interpretations is reasonable.* Kontaktpersoner/Contact: Prof. Gudmund Eiksund, gudmund.eiksund@ntnu.no	

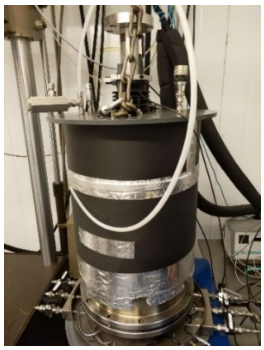
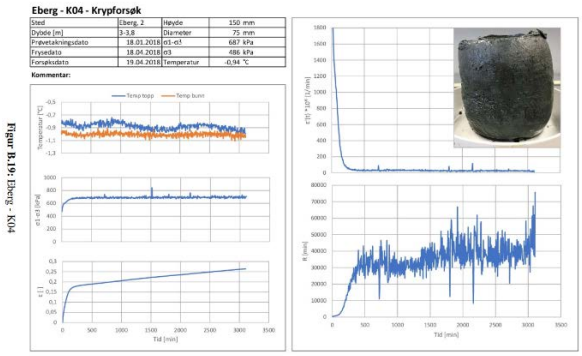
G - 3	Geodynamikk/ Geodynamics laboratorieforsøk	**Bender element måling i triaks-celle (Dynamisk stivhet)** Beskrivelse/Description: Måling av dynamisk stivhet ved bølgeforplantning gjennom treaksprøver. Vurdering av konsolideringsforhold og prøveforstyrrelse. Mulig sammenligning med feltforsøk. Det skal vurderes ulike leirer og forplantningshastighet i ulike retninger med tanke på anisotropi i materialet. Kontaktpersoner/Contact: Prof. Steinar Nordal, steinar.nordal@ntnu.no	Koordineres med L-7
G - 4	Geodynamikk/ Geodynamics feltforsøk	**Feltmålinger av G-max med mellomhulls-metode på Flotten** **Field measurement of G-max by cross-hole testing at quick clay site Flotten** Comparison to dynamic data from other dynamic testing methods, seismic CPTU and dilatometer, and surface wave methods. Kontaktpersoner/Contact: Prof. Steinar Nordal, steinar.nordal@ntnu.no Arnfinn Emdal, arnfinn.emdal@ntnu.no	**NGTS** **Quick Clay Site**
G - 5			Removed

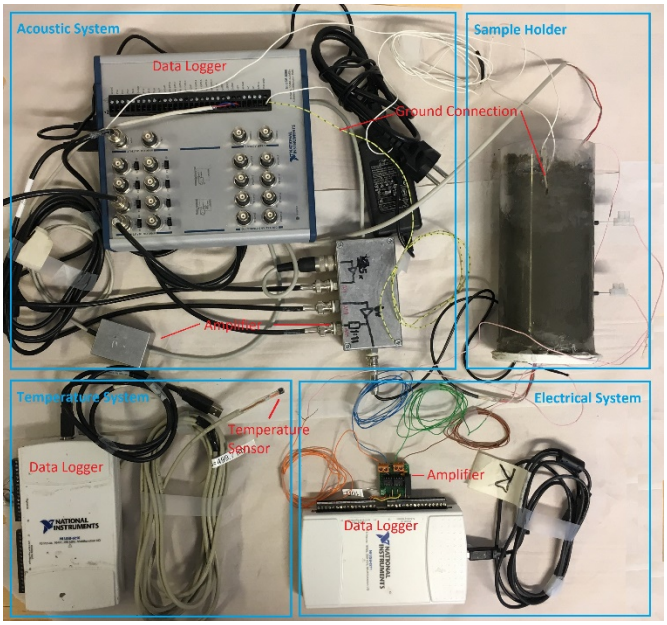
NUMERICAL MODELLING			
N - 1	Numerical Modelling	**Simulating 1D frost heave test using X-FEM** Description: Frost heave is defined as an up-ward movement of the ground surface due to transport of water as a result of temperature gradient. Frost heave is the major cause of damage to infrastructures in cold regions with frost susceptible soils (e.g. silt). It is a coupled thermo-hydro-mechanical phenomenon which might be simulated as an average deformation of the elements using a continuum approach, or more precisely, as distinct ice lenses in a discontinuous approach. After a successful experience of frost heave modelling in the context of continuum mechanics, we are now working on a more precise model using the discontinuous approach. In this context, cracks will appear in the soil body and ice lens might grow in these cracks. The Extended Finite Element Method (XFEM) is used in this model in order to simulate the discontinuity of the solution domain. This master project will focus on simulating a 1D frost heave test to find the position and thickness of the major ice lenses formed in the sample (See the figure below) . In frost heave test, a soil sample is subjected to a negative temperature from the top boundary, while the temperature in the bottom boundary keeps constant at a positive temperature. The soil sample has access to water from the bottom boundary, so that it can suck-in water and frost heave can occur.  Kontaktpersoner/Contact: Seyed Ali Ghoreishian Amiri, seyed.amiri@ntnu.no	**SFF PoreLab**

NUMERICAL MODELLING			
N - 2	Numerical Modelling	**Elastoplastic behavior of saturated frozen soils** Description: Saturated frozen soil is a natural particulate composite, composed of solid grains, ice, and unfrozen water. In frozen soils, due to the existence of ice and its interaction with solid grains and unfrozen water, temperature and ice content are the additional factors influencing the behavior. Their influence on the mechanical behavior and the coupling effects on the reverse direction can be mentioned as the main difference between frozen and unfrozen soils. In the light of this difference, we developed an elastoplastic constitutive model to describe the stress–strain behavior of saturated frozen soils. The efficiency of the model was successfully tested against drained triaxial tests. In this master project, we want to simulate the behavior under undrained condition.  Three-dimensional view of the yield surface of the model Kontaktpersoner/Contact: Seyed Ali Ghoreishian Amiri, seyed.amiri@ntnu.no	

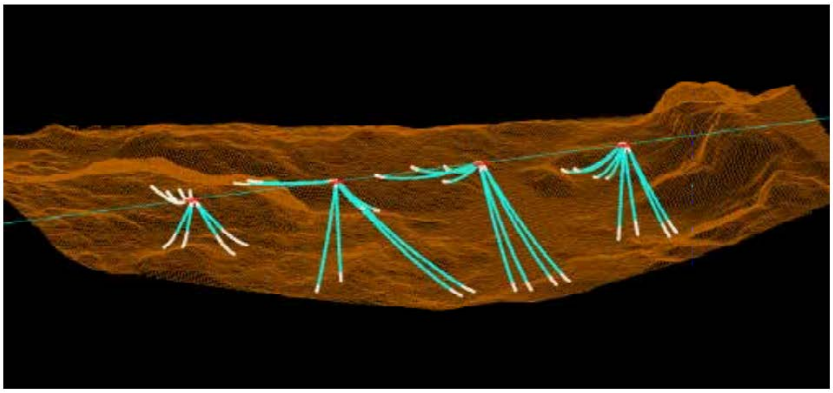
NUMERICAL MODELLING			
N - 3	Numerical Modelling	**Rate-dependent behavior of saturated frozen soils** Description: Saturated frozen soil is a natural particulate composite, composed of solid grains, ice, and unfrozen water. Considering the highly rate-dependent behavior of ice, rate-sensitive behavior of frozen soils is expected. This rate dependency is affected by the amount of ice existed in the composite. We developed an elastic-viscoplastic constitutive model to describe the rate dependent behavior of saturated frozen soils. The efficiency of the model was tested against few experimental results (see the figure below). In this project, we plan to check the model against more laboratory data.  Comparison between the measured and predicted stress-strain curves for frozen Fairbanks silt (-3°C) under different strain rates Kontaktpersoner/Contact: Seyed Ali Ghoreishian Amiri, seyed.amiri@ntnu.no	
N - 4			Removed – merged with F-2
N - 5		**Experimental and numerical investigation of thermal properties of Norwegian soils** Study of heat transfer in soil required in many applications such as geothermal energy structures, ground source heat pump, nuclear waste repository, landfill liner performance, buried services (e.g. high voltage electric cables and hot water pipes) and thermally enhanced clean-up of contaminated land. Heat transfer in soil is governed by its thermal properties such as thermal diffusivity, thermal conductivity and specific heat capacity. Thermal diffusivity is a function of thermal conductivity and specific heat capacity. Heat properties of a soil depend upon its water content, dry density, soil texture and mineralogy. In this project student will carry out experimental study and numerical study to determine soil thermal properties (especially thermal conductivity and specific heat capacity). There are two experimental techniques used viz. steady state and transient state to measure thermal conductivity. There are various mathematical models to predict the thermal properties mainly function of amount of soil solids, water and air. Kontaktperson/Contact: Prof Rao Martand Singh Rao.m.singh@ntnu.no	

NUMERICAL MODELLING			
N - 6	Numerical Modelling	**YADE – distinct element code – simulation of triaxial and oedoemeter in loading and unloading** Yade is an extensible open-source framework for discrete numerical models, focused on Discrete Element Method. The computation parts are written in c++ using flexible object model, allowing independent implementation of new alogrithms and interfaces. Python is used for rapid and concise scene construction, simulation control, postprocessing and debugging. Requires programming skills and interest.  A Review on the Discrete Element Modeling of Dynamic Laboratory Tests for Liquefaction Assessment by akhila.m@research.iiit.ac.in , Neelima Satyam https://yade-dev.gitlab.io/trunk/publications.html	Passer for en eller flere studenter/ One or several students may work on this
N - 7			Removed
N - 8			Removed
N - 9			Removed

LABORATORIE OG FELT			
L - 1	Frostlab	**Triaxial experiment of frozen soil** **Supervisor**: Gustav Grimstad, Seyed Ali Ghoreishian Amiri, Chuangxin Lyu Permafrost degradation due to global warming can trigger natural geo-hazards, result in settlement and instability of infrastructures and even release old carbon from the tundra to atmosphere. Therefore, geotechnique design requires laboratory tests of warm frozen soil and reliable effective stress based constitutive models. However, measurement of pore pressure can be quite challenging for frozen soil. Because pressure transducer should be completely connected with pore pressure in soil and some experimental issues can block the connection between them such as ice growth in porous stone. In addition, temperature variation can also highly influence laboratory results under near thawing temperature. In NTNU, we recently build up triaxial frozen soil setup with good temperature control (± 0.05 ºC) and well-designed pore pressure measurement in figure 1. The preliminary creep test results of frozen clay sample under -1 ºC is in figure 2. This study can be extended into master thesis topic. This project has helped Kjetil and Morten to finish their master project and thesis in 2019-2020. You can contact them how they feel 😊. This project looks for students who are hard-working, like challenging themselves and want to do something amazing. If you think you are, please contact me! **Kjetil Lien:** kjetil.94.lien@gmail.com; **Morten Hovind:** mhovind@hotmail.com;  Figure 1. Triaxial setup  Figure 2. Preliminary results Kontaktpersoner/Contact: Chuangxin Lyu, chuangxin.lyu@ntnu.no Prof. Gustav Grimstad, gustav.grimstad@ntnu.no	**Nunataryuk**

LABORATORIE OG FELT			
L - 2		**Joint acoustic and electrical measurements for unfrozen water content (UWC) estimate in frozen soil** **Supervisor**: Gustav Grimstad, Thomas Ingeman-Nielsen, Chuangxin Lyu Frozen geomaterials are essentially multiphase materials, where water-ice phase transition is a gradual process due to capillarity, osmosis, and adsorption (Watanabe and Mizoguchi, 2002). This phase transition can change the mechanical, hydraulic and thermal properties of the soil up to several orders of magnitude. Two most commonly used geophysical methods, acoustic and electrical resistivity can provide quite different estimation of unfrozen water content (Lyu et al, 2019). In this project, we try to apply joint measurements of electrical resistivity and acoustic velocity for frozen soil and propose joint models to estimate UWC. This work has been partially done by Tonje Roås Mikalsen. In this project, we plan to extend this joint measurement to monitor 1D freezing for saline clay. This project has helped Tonje Roås Mikalsen to finish her master project and thesis in 2019-2020. You can contact them how she feels ☺. This project looks for students who are hard-working, like challenging themselves and want to do something amazing. If you think you are, please contact me! **Tonje Roås Mikalsen:** tonjerm@gmail.com;  Figure 1. Frozen soil-Vp vs. R Kontaktpersoner/Contact: Chuangxin Lyu, chuangxin.lyu@ntnu.no Prof. Gustav Grimstad, gustav.grimstad@ntnu.no	
L - 3			Removed
L - 4		**Suction measurement on fresh mini-block samples** Sample quality evaluation from suction measurements immediately after sampling is a technique that is under development. Various probes shall be tested, on sample surface (Don DeGroot/UmAmherst/NGI) and inserted needle probe. This is a continuation of a work by Helene Amundsen PhD 2018. Arnfinn Emdal Steinar Nordal	**NGTS- Flotten**
L - 5			Removed

LABORATORIE OG FELT			
L - 6		**CPTU – probe with multiple pore pressure sensors.** A CPTU proble with 4 pore pressure sensors is made to evaluate the pore pressure field around a penetrating cone. The device shall be tested in field conditions on clay and silt. Annika Bihs Annika.bihs@ntnu.no Arnfinn Emdal arnfinn.emdal@ntnu.no Steinar Nordal Steinar.nordal@ntnu.no	
L - 7		**Kalk-sement-testing i laboratoriet/***Lime cement stabilization in laboratory* **1. Sammenligning av prosedyrer og evaluering av spredning i styrke og stivhet/***comparison of procedures and evaluation of statistical spread of strength and stiffness* Kalksement som metode for forsterkning av jord er basert på laboratorieforsøk sammen med feltundersøkelser av installerte kalksementpeler. I laboratoriet er det vanskelig å gjenskape en jord-kalk-sement-blanding som blir sammenlignbar med det vi oppnår i felt. Dette er en stor utfordring når design parametere skal velges. Utførelsen av laboratoriearbeidet er svært viktig for å skape homogene og repeterbare resultater. Resultatene kan derfor få stor spredning dersom dette ikke oppnås. Vi har i dag to metoder for å lage laboratorieprøvestykker og prosjektet skal: 1) Lage prøvestykker med begge metoder 2) Teste prøvestykkene i laboratoriet med enaksial og treaksial testing 3) Evaluere metodene og komme med forslag til forbedring Målsettingen er å finne kritiske element i prosedyrene som øker spredningen av resultatene og å lage en anbefaling til gjennomføring av testene. Forsøkene vil bli gjort på leirmateriale fra den norske kvikkleire test site Flotten på Tiller i Trondheim. Dette er prioritert virksomhet. Arbeidet er basert på erfaringer fra tidligere master prosjekt av Sivert Eidsmo og Anders Stokka. Arbeidet vil også inngå i verdiskapingen for KlimaGrunn, et prosjekt i regi av Statens Vegvesen. Statsbygg og BaneNor. **2. Måling av skjærbølgehastighet av kalk-sementforsterkede prøver i laboratoriet/***measuring shear wave velocity in lime-cement-improved laboratory samples* For å vurdere hvordan jord øker styrke og stivhet etter innblanding med kalk og sement kan vi bruke dynamiske målinger i laboratoriet. Prosjektet skal: 1) Lage prøvestykker for testing – helst i samarbeid med oppgave 1. ovenfor 2) Måle skjærbølgehastighet i laboratoriet kort tid etter innbygging, deretter 1, 7, 14 og 28 dager 3) Korrelere resultatene med styrke og stivhet fra tidligere prosjekter og fra oppgave 1. ovenfor Kontaktpersoner: Arnfinn Emdal arnfinn.emdal@ntnu.no Steinar Nordal Steinar.nordal@ntnu.no Priscilla Paniagua priscilla.paniagua@ntnu.no Bjørn Kristian Fiskvik Backe Bjorn.Kristian.Fiskvik.Bache@ngi.no	**NGTS Flotten – Norwegian Geotechnical Test Site** **KlimaGrunn** Dette er oppgaver som passer godt for to studenter som vil jobbe sammen i lab og rapportere felles eller hver for seg. **Bør koordineres med oppgave G-3**

LABORATORIE OG FELT			
L - 8	Lab	**Undersjøiske skred** **Submarine landslides** Denne oppgava er knytta til prosjektet Ferjefri E39. Sideforakra flytebruer er ein aktuell brutype for fjordkryssing. Undersjøiske skred og den potensielle skaden dei kan føre til skad på forankringssystemet er eit av rissikomomenta som må vurderast. Ein PhD og ein Post Doc jobbar med denne problemstillinga. I dette prosjektet er planen å utvikle nymeriske modellar for simulering slike skred. Til dette arbiede treng vi modelforsøk som kan nyttast til å sjekke om modellane gir realistiske resultat. Prosjeket og masteroppgåva vil handle om planlegging og gjennomføring av modellforsøk av undersjøiske skred.  *Figure 4 Illustration of mooring line system for the side-anchored floating bridge, connecting four of the pontoons to the seabed (Multiconsult, 2017).* Kontakt NTNU: Gudmund Eiksund, Erik Sørlie	

LABORATORIE OG FELT

L - 9

Joint acoustic and electrical measurements for unfrozen water content (UWC) estimate in frozen soil

Frozen geomaterials are essentially multiphase materials, where water-ice phase transition is a gradual process due to capillarity, osmosis, and adsorption (Watanabe and Mizoguchi, 2002). This phase transition can change the mechanical, hydraulic and thermal properties of the soil up to several orders of magnitude. Two most commonly used geophysical methods, acoustic and electrical resistivity can provide quite different estimation of unfrozen water content (Lyu et al, 2019). In this project, we try to apply joint measurements of electrical resistivity and acoustic velocity for frozen soil and propose joint models to estimate UWC. Finally, we can compare them with other UWC estimate methods like dew point meter. The goal is to obtain the consistent and accurate UWC estimates for frozen clay.

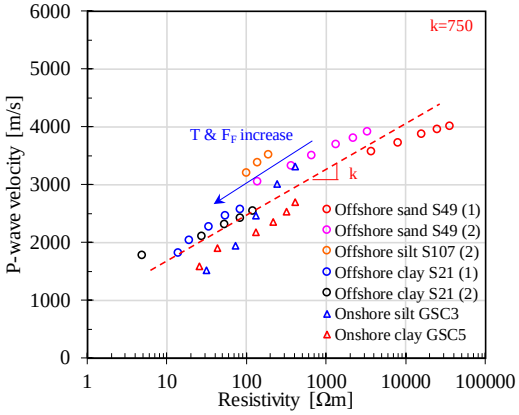


Figure 1. Frozen soil-Vp vs. R (King et al. 1982)

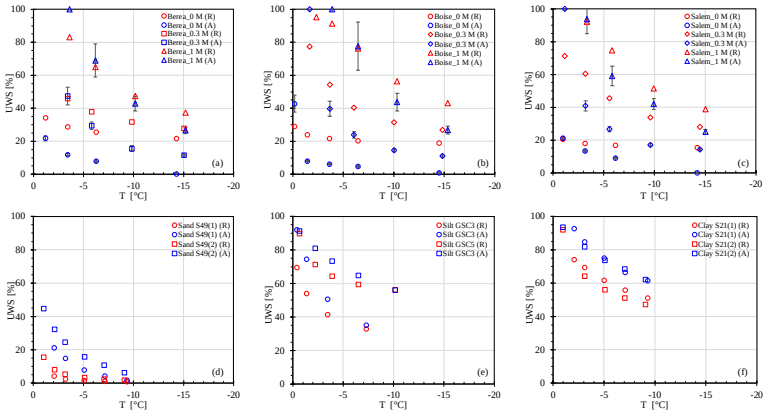
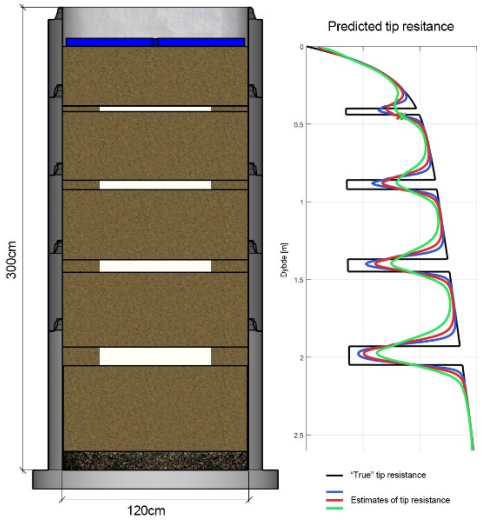
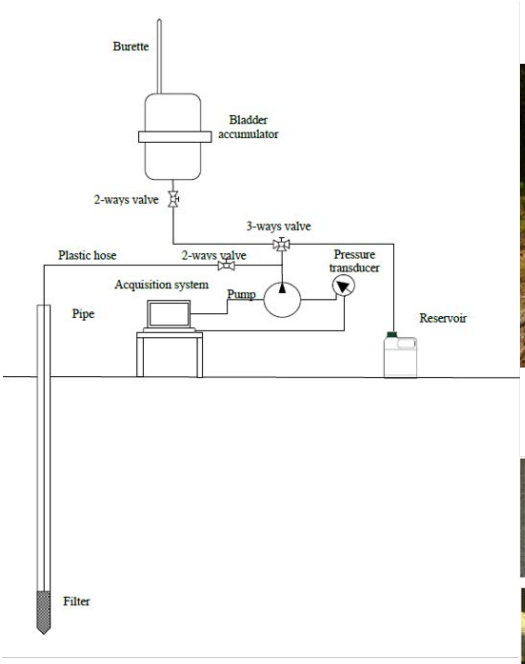


Figure 2. UWS estimates of consolidated and unconsolidated permafrost (Berea: Berea sandstone; Boise: Boise sandstone; Salem: Salem limestone; 0~1 M: Salinity; R: Resistivity results; A: Acoustic results) (Lyu et al, 2019)

Gustav Grimstad Gustav.grimstad@ntnu.no

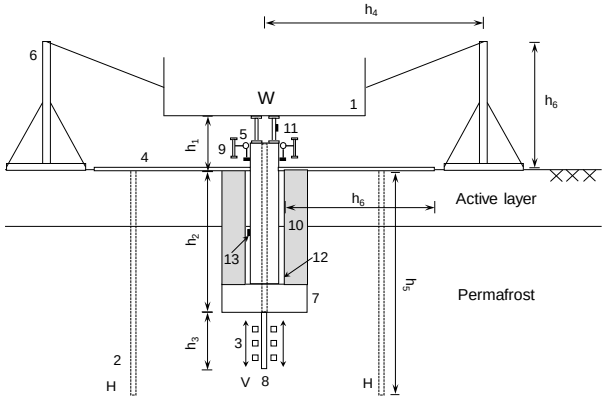
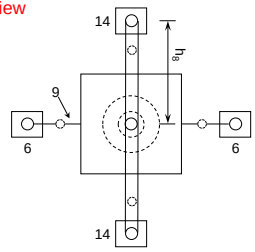
LABORATORIE OG FELT			
L - 10		**Suction measurement of unsaturated soils using indirect methods** Study of moisture transport in unsaturated soils has been a topic of great interest. Initially water movement in subgrade material, which is a common cause of the structural failure of pavement surfaces, attracted the attention of highway engineers and scientists who found the wetting was attributed to a 'transpiration current' or an upward movement of moist air through the unsaturated soil from the water table. The other problems of interest, where moisture movement in unsaturated soils is an important phenomenon, are high level radioactive waste disposal, landfill liner performance, geothermal energy pile, diurnal moisture movement in the ground, buried services (e.g. high voltage electric cables and hot water pipes) and thermally enhanced clean-up of contaminated land. All these problems require an understanding of unsaturated soil behaviour which is basically controlled by soil water potential also known as suction. In this project student will measure the suction of unsaturated soils in laboratory and use mathematical models to predict the suction behaviour. There is also possibility of developing a sensor to measure suction. Kontaktperson/Contact: **Prof Rao Martand Singh** Rao.m.singh@ntnu.no	
L - 11		**CPTU – large scale model testing – identifying thin layers of clay in sand sediments** Identifying thin layers of clay in a silt sediment by CPT can be challenging, but is very important for evaluating slope stability. This research project of NTNU, NGI and Dr. techn Olav Olsen AS aims to improve our ability to identify thin clay layers and their properties in sand sediments. A large scale model test program was for this purpose developed and performed in the IBM-lab in spring 2020 with MSc student Hallvard Berner Hammer. CPTU tests were run in a laboratory built test chamber built with concrete manhole rings of 1.2 meter in diameter. Very interesting results were found, but at the same time they indicate a great potential in more testing in the chamber as well as in interpreting the test results. In principles the set-up as indicated here. The work requires manual work in the laboratory in close interaction with our technical staff.  Steinar Nordal steinar.nordal@ntnu.no Hallvard Berner Hammer – Dr. techn Olav Olsen AS Jean-Sebastien L'Heureux jsl@ngi.no	

LABORATORIE OG FELT			
L - 12		**Measurement of lateral stresses in clay in the field by instrumentation** Estimating the horizontal stress in situ is essential in geotechnical engineering, but measuring it is a challenging task. Several methods and procedures are suggested and partly used including earth pressure cells and dilatometers. Another method successfully used in rock mechanics to measure the minor principal stress is hydraulic fracturing. Hydraulic fracturing has been attempted in clays, but the results are so far not very reliable. It seems that we may not fully understand what happends downhole during the tests. This project extends initial testing performed in cooperation with NGI on the NGTS site Flåtten by the MSc student Beatriz Almarza Galdon in spring 2020. Both field and lab work in cooperation with NTNU technical staff are suggested in order to reveal what happens during the tests and get reliable K_0' values. Overcoring by a block sampler after a hydraulic fracturing test is one option. Theoretical considerations and numerical simulations may be used in the interpretation of the results. The set up in field is indicated by the figure: MSc Beatriz Almarza Galdon of Rambøll will be available for guidance and advice.     Steinar Nordal steinar.nordal@ntnu.no Beatriz Almarza Galdon (Rambøll) Jean-Sebastien L'Heureux jsl@ngi.no	
L - 13			

GEOFARER – GEOHAZARDS			
H - 1	Numerical/literature/field work	**Entrainment by debris flows: data collection and numerical modelling** Debris flows are a particular type of landslide, travelling at high velocities and for long distances along mountainous and torrential channels. Their travelling distance and destructive capacity can be increased due to entrainment of bed sediments during the flow along the channel. Debris flow events can be back-calculated using a numerical model, which can include an entrainment model. To correctly back-calculate the debris flow event and the entrainment phenomenon, reliable field data are necessary. This project first aims at creating a database of relevant debris flow events, where entrainment was significant. Data – including initial volume, entrainment volume, deposition, slope angle, type of material, information on the bed water content, estimated flow properties, etc. – should be collected and analysed critically. This will be fundamental to simulate numerically the debris flow events. Some of the debris flow events can finally be back-calculated using a numerical model (e.g. RAMMS).  Contact: Hervé Vicari, herve.vicari@ntnu.no	**Klima 2050**

GEOFARER – GEOHAZARDS			
H - 2		**Landslide susceptibility mapping using Machine Learning algorithms (GBV 2019/2020)** Analysis and prediction of climate-driven geohazards, such as rainfall-induced landslides and slope failures in general, is becoming more challenging given the changing climate where extreme events are inevitable. Therefore, there is a need to move beyond the use of conventional sources of data and to consider multiple types of data for more accurate analysis and prediction of landslides. Data Fusion and Machine Learning have been playing an important role to pave the path towards a better understanding of the problem and to find more accurate models at regional and local levels that incorporate several contributing factors for slope failure. A preliminary study was done for the spatial modelling of shallow landslides near Kvam in Norway using three machine learning (ML) algorithms, the 'ensemble' Random Forest (RF), the 'ensemble' Gradient Boosted Regression Tree (GBRT) and the Multi-Layer Perceptron neural network (MLP). The study demonstrated the strengths of applying ML techniques to identify potential release areas for landslides in steep terrain. This MSc program proposes to improve the application of ML algorithms in landslide susceptibility mapping. The project consists of 1) a comprehensive literature survey and identify relevant ML models for assessment; 2) handling of unbalanced dataset between non-landslide and landslide pixels within a catchment; 3) selection of landslide conditioning and triggering factors; 4) verification of the robustness of existing ML algorithms; 5) Summary and recommendations. Samarbeidspartnere/Collaboration: NGI Kontaktperson/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Zhongqiang Liu Zhongqiang.Liu@ngi.no Carl Harbitz, carl.bonnevie.harbitz@ngi.no, Section Head of RiSK	
H - 3		**Runout analysis of tailings dam (SP 12)** The waste products of mining processes are called “tailings” and are granular materials composed primarily of sand-, silt- and clay-sized particles with chemical and processing fluids from mills, washeries or concentrators that remain after the extraction of the valuable resources. Tailings often contain contaminants used to process the mined ore. In Tailings Storage Facilities (TSFs), or “tailings” dams, the tailings slurries consolidate to form a very soft material. Mine tailings are a major waste stream and pose a risk to people and the environment. Failure of a TSF will have a catastrophic physical, environmental and societal impact on the surroundings. In the past four years only, nine tailings dam failures of significant scale, e.g. Mont Polley, Canada and Bento Rodrigues (Fundão) and Brumadinho, Brazil, give ample evidence that TSFs are not always safe. This MSc program focuses on: 1) identify the probable failure mechanisms and the failure precursors; 2) hydrological modelling and dam break analyses, including runout analyses using NGI in-house software, i.e. BingClaw; 3) Summary and recommendations. Samarbeidspartnere/Collaboration: NGI Kontaktperson/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Zhongqiang Liu Zhongqiang.Liu@ngi.no Øyvind Torgersrud, oyvind.torgersrud@ngi.no, Section Head of Advanced Geomodelling	

GEOFARER – GEOHAZARDS			
H - 4		**Fibre optic technology to monitor and predict slope movements.** Literature investigation on the use of fibre optic sensing to monitor pre-failure strain and soil water content that trigger landslides. Review on the use of fibre optic in real slope-moment applications. Samarbeidspartnere/Collaboration: NGI Kontaktperson/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Luca Piciullo Luca.Piciullo@ngi.no	
H - 5		**Early Warning Systems for nedbørinduserte løsmasseskred (KLIMA 2050)** Definition of a near-real time early warning system at slope scale. The aim is to gather data and measurements from different monitoring sensors installed on a slope and through the internet of thing (IoT) create a near-real time stability analysis. Samarbeidspartnere/Collaboration: NGI Kontaktperson/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Luca Piciullo Luca.Piciullo@ngi.no	**KLIMA2050**

FROST/ARKTISK TEKNOLOGI FROZEN SOIL/ARCTIC TECHNOLOGY			
F - 1	ARKTISK/FROST ARCTIC/FROZEN SOIL	**Fundamentering på permafrost** Beskrivelse/Description: Fundamentering på isrik permafrost forutsetter at varmen fra bygget ikke varmer opp og tiner underliggende permafrost. I Longyearbyen, Svalbard, er den mest tradisjonsrike fundamenteringsmetoden trepeler, satt ned til 5-6 meter og innfrosset i gysemasse. For byer som Barentsburg og Pyramiden, samt næringsbygg i Longyearbyen og Svea brukes ofte andre fundamenteringsmetoder, som feks plate på mark, grove betongpeler eller tradisjonell fundamentering på bankett under det aktive laget. Bruk av isolasjon og/eller ventilering der kald vinterluft sirkuleres for å holde sedimentene under fundamentet frosne, er aktuelle metoder. Masterprosjektet går på vurdering av forskjellige fundamenteringsmetoder og erfaringer med disse samt et påfølgende studie med sikte på forbedring av en eller flere av disse metodene. Samarbeidspartnere/Collaboration: Instanes Polar A.S., UNIS Svalbard Kontaktpersoner/Contact: Arne Instanes (arne@instanes.no), Tlf. 48003443 Instanes Polar AS Prof. Arne Aalberg, arne.aalberg@unis.no Prof. Gustav Grimstad, gustav.grimstad@ntnu.no	**UNIS** **Instanes Polar**
F - 2	ARKTISK/FROST ARCTIC/FROZEN SOIL	**Plate loading test** Beskrivelse/Description: Plate loading test is one of effective field tests to estimate possible settlement of infrastructure especially for permafrost since creep behavior and thawing effect become significant in the summer. Mechanical testing results from lab experiment and constitutive models should also be verified by field tests. However, there are few studies to apply the plate loading test into permafrost study especially in high salinity marine sediment permafrost which is expected to degrade more substantially with global warming. NTNU cooperates with UNIS and plan to deploy plate loading test in Svalbard this summer with financial support of NUNATATYUK project. Figure 1 shows the initial design of pile test in Svalbard. It can be interesting to summarize previous plate loading test on permafrost, analyze the field test result and do some simple THM simulation. This project can extend into master thesis topic. **Design sketch** Main view  1. Weighted platform 2. Inclination meter (monitoring well) 3. Magnetic settlement system 4. Thermal plate (Boundary T control) 5. Dial gauges 6. Overhanging frame 7. Load plate 8. Vertical displacement monitoring well 9. Reference beam 10. Well refilling or refreezing 11. Strain gauge (Actual force measurement) 12. Pipe casing 13. Thermometer (Temperature measurement) 14. Reference frame Ice content and salinity info. (???) Pore pressure sensor (???) Top view  Figure 1. Initial pile loading test setup Kontaktpersoner/Contact: Prof. Arne Aalberg, arne.aalberg@unis.no Chuangxin Lyu, chuangxin.lyu@ntnu.no Prof. Gustav Grimstad, gustav.grimstad@ntnu.no	**Nunataryuk** **UNIS**

BÆREKRAFT / SUSTAINABILITY			
B - 1	BÆREKRAFT/SUSTAINABILITY	**Alternative binders for improvement of soft soils** Beskrivelse/Description: In Norway, a considerable part of future infrastructure projects will be carried out in areas where soft soil deposits such as peats or quick clays are encountered, including InterCity Sandbukta-Moss-Såstad and E6 Kvithammar-Åsen. The most common ground improvement method for these challenging soils is dry deep mixing in which lime, cement or a mixture of both is added to the soil to improve its strength and deformation properties. These stabilisation works can significantly contribute to the environmental impact of infrastructure projects. For instance, at the E6 Klett project 26% of the overall carbon dioxide (CO_2) emissions can be related to ground improvement works (Juvik et al. 2019). Nowadays, there is an increasing focus on reducing greenhouse gas emissions during the development of construction and infrastructure projects. For example, Statens vegvesen and Bane NOR aim to reduce the greenhouse gas emissions of their construction projects by 40% in 2030. This implies that there is an urgent need to develop more sustainable alternative methods to stabilise typical Norwegian soils. While most research aimed at optimising the content of typical binders such as lime and cement, there is a lack of studies that investigated alternative materials. The purpose of this project and master studies will be to investigate the feasibility of using more sustainable materials such as biochar, zinc slag, ladle furnace slug and biomass ashes, for example, to improve the geotechnical properties of sensitive clays and peat. In Norway, a considerable part of future infrastructure projects will be carried out in areas where soft soil deposits such as peats or quick clays are encountered, including InterCity Sandbukta-Moss-Såstad and E6 Kvithammar-Åsen. The most common ground improvement method for these challenging soils is dry deep mixing in which lime, cement or a mixture of both is added to the soil to improve its strength and deformation properties. These stabilisation works can significantly contribute to the environmental impact of infrastructure projects. For instance, at the E6 Klett project 26% of the overall carbon dioxide (CO_2) emissions can be related to ground improvement works (Juvik et al. 2019). Nowadays, there is an increasing focus on reducing greenhouse gas emissions during the development of construction and infrastructure projects. For example, Statens vegvesen and Bane NOR aim to reduce the greenhouse gas emissions of their construction projects by 40% in 2030. This implies that there is an urgent need to develop more sustainable alternative methods to stabilise typical Norwegian soils. While most research aimed at optimising the content of typical binders such as lime and cement, there is a lack of studies that investigated alternative materials. The purpose of this project and master studies will be to investigate the feasibility of using more sustainable materials such as biochar, zinc slag, ladle furnace slug and biomass ashes, for example, to improve the geotechnical properties of sensitive clays and peat. The main tasks of this project will be to conduct a laboratory study to understand the effects of mixing these alternative materials into soils and binder/soil mixtures. First, this will involve characterising the chemical and physical properties of these alternative materials. Second, different mixtures of the alternative materials, binder and soil will be prepared and typical geotechnical properties (e.g. shrinkage limit tests, plasticity limit tests, pH and unconfined compressive strength (UCS) tests) will be quantified. Third, different performances of these mixtures will be analysed by studying their microstructure and chemical composition using scanning electron microscopy (SEM) and X-ray powder diffraction tests. Finally, a LCA-analysis will be carried out to evaluate the sustainability of using these alternative materials to improve soils. Samarbeidspartnere/Collaboration: NGI Kontaktpersoner/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Stefan Ritter sri@ngi.no Prof. Rolf Andre Bohne rolf.bohne@ntnu.no	The topic can be shared between four students, for example, one focusing on the geotechnical and geochemical part of the study either on sensitive clays or peat, and the others one focusing more on the environmental part (LCA) for both soil types.

BÆREKRAFT / SUSTAINABILITY			
B - 2	BÆREKRAFT/SUSTAINABILITY	**Reusing tunnel muck – the impact of the tunnelling method** Problem description An important aspect when assessing the sustainability of a tunnelling project is to consider different excavation methods (i.e. TBM and drill and blast). However, the impact of these methods on the potential to reuse tunnel muck including fill material and concrete aggregate has often received scant attention. This work aims to overcome this shortcoming by studying the influence of different tunnelling methods on the quantity and quality of the produced muck. Student tasks The methodological approach will be based on a life-cycle assessment which replicates the entire tunnelling process starting with the excavation at the tunnel face and a potential reuse of the excavated material. This will consider the volume of produced tunnel muck, which likely changes with the used tunnelling method, the requirement for mineral processing and the need for landfill. Typical parameters that will be quantified include embedded energy, greenhouse gas emissions and economic costs. The procedure will be applied to a tunnelling project in Norway. This investigation will provide an opportunity to incorporate the reuse of tunnel muck when deciding about the most sustainable tunnelling method. Kontaktpersoner/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Stefan Ritter sri@ngi.no Dr. Jenny Langford jpe@ngi.no Prof. Rolf Andre Bohne rolf.bohne@ntnu.no	
B - 3	BÆREKRAFT/SUSTAINABILITY	**Reusing tunnel muck – geotechnical properties and applications** Problem description If the utilization of TBM spoil can be increased, this method of tunnelling can potentially become more sustainable and cost effective. So far, TBM- spoil has been considered of little value in the tunnelling industry. However, the Georecirc project has shown that the spoil is non-polluted (clean) and can be utilized as a quality construction fill on-land and to cap contaminated sediments. Other possible utilization areas are: • Aggregate for concrete (studied by researchers in central Europe, and at the Follo-line project) • Reclamation of land (ongoing study at the NGI) • Capping layer for landfills There is a need for further analysis of soil properties for these applications. Student tasks For concrete, the mechanical properties and requirements on chemical contents related to the bedrock type needs to be investigated. This has been studied by researchers in central Europe and at the Follo-line project, where TBM-spoil was to be re-used in the tunnel lining. There is likely a large data set and background information from the Follo-line project. For reclaimed land, the turbidity when placing the material in the sea is essential for evaluating potential environmental effects. Specifically, it is vital to assess if the placement of TBM material can meet requirements set by the authorities. NGI has performed laboratory tests to study the turbidity and a full scale test filling will likely be performed. For the possible use for capping of landfills, compaction and resulting hydraulic conductivity needs to be investigated in detail. This can be analysed by performing laboratory or model tests in the NGI laboratory. Kontaktpersoner/Contact: Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no Dr. Stefan Ritter sri@ngi.no Dr. Jenny Langford jpe@ngi.no Prof. Rolf Andre Bohne rolf.bohne@ntnu.no	

BÆREKRAFT / SUSTAINABILITY			
B - 4		**Ground improvement using environmental friendly bio-grout technique** When the ground is soft and weak, its strength is improved by various geotechnical engineering techniques but often they have large carbon foot print. In Norway lime or cement mixing is a popular ground improvement method but it is carbon intense. This project investigates the use of bio-grout technique which is greener, environmental friendly and utilises nature to improve the ground strength. Bio-grout method employs micro-organism to produce calcite which acts as a bonding agent between soil particles. Microbial induced calcite precipitation (MICP) by urea hydrolysis has shown to be a viable ground improvement alternative which can mitigate soil liquefaction potential, stabilize coastal sand dunes and slopes, increase bearing capacity of foundations and strengthen soft marine clays. In this project a student will carry out laboratory scale study to investigate the use of bio-grout (i.e. MICP) method to improve soil strength and stiffness using unconfined compressive strength (UCS) and triaxial testing. Kontaktperson/Contact: Prof Rao Martand Singh Rao.m.singh@ntnu.no Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no	

Energi piles and related topics			
E - 1		**Thermo-mechanical behaviour of Geothermal Energy Pile in soft clays** Geothermal energy piles also known as thermal piles or energy foundations or energy piles are a direct adoption of vertical borehole closed loop ground source heat pump (GSHP) technology into pile foundations where closed heat exchanging loops are installed within the pile foundation. Thermal piles have great potential of improving energy efficiency of a new building resting on pile foundation by using ground as heat source/sink to provide space heating/cooling to superstructure. Recently, the use of thermal piles especially in European countries such as UK, Austria, Switzerland, and Germany has increased significantly as European Union is committed to reduce greenhouse gas emission to 40% below 1990 levels by 2030 as set out in the Paris Agreement. While construction of thermal piles is increasing but limited investigation of their thermodynamic and geotechnical aspect is available to date. No energy pile has been installed in Norway and therefore it is going to be the first attempt to investigate the energy pile potential in Norway. In this project student will carry out laboratory scale model study of thermo-mechanical behaviour of energy pile embedded in Norwegian soft clays. Kontaktperson/Contact: Prof Rao Martand Singh Rao.m.singh@ntnu.no Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no	
E - 2		**Enhancement of thermal and sealing performance of grout used in borehole heat exchanger (BHE)** Borehole heat exchanger (BHE) also known as vertical ground source heat pump (GSHP) is used to provide heating and cooling to a building where heat exchanging loops are installed in a borehole. The borehole size and number depends upon the heat demand of a building. Borehole length generally varies from 50 to 100 m and diameter varies from 0.1 to 0.15 m depending upon the local geology and number of heat exchanging loops. Generally one loop is placed in a borehole but sometimes two loops can be placed as well but engineers should make sure they do not short circuit. After installation of loops, borehole is filled with cement-bentonite based grout. Efficiency of BHE system depends upon heat transfer capability (i.e. thermal conductivity) of grout. Another important function of grout is to provide sealing to prevent cross contamination between aquifers in case of deep boreholes. In this project student will investigate experimentally what polymer or chemical can be mixed with grout to improve its thermal and sealing performance. Kontaktperson/Contact: Prof Rao Martand Singh Rao.m.singh@ntnu.no Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no	

Energi piles and related topics			
E - 3		**Thermo-mechanical behaviour of soft clays intended for thermal energy storage** Borehole thermal energy storage (BTES) is a novel technique of storing waste heat energy and use it in winter to heat buildings. Many industries produce excessive heat which is generally wasted to atmosphere and BTES can play a vital role to store waste heat. In addition, during summer the ground can be heated by using solar thermal water and the stored heat can be utilised when it is needed during winter when solar thermal does not work either. There is an increasing interest in the BTES technology nationally and internationally. Thermal energy storage in the ground will be an important piece in the green energy puzzle. Geotechnical and stability issues related to the establishment of BTES with high temperatures (50-80oC) in areas with marine clay remains a challenger for the technology. Stability issues and volume changes as a consequence of heating, as well as the operation of the thermal storage with large temperature variations needs to be evaluated. This project will investigate thermo-mechanical behaviour of soft clay at high temperatures. The work will be done in cooperation with the research project RockStore. This project is going to run in collaboration with Municipality of Oslo and Asplan Viak. Kontaktperson/Contact: Prof Rao Martand Singh Rao.m.singh@ntnu.no Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no	
E - 4		**Challenges with drilling energy wells in difficult ground conditions** Energy wells are basically vertical borehole heat exchangers employ ground source heat pump to extract/store energy. It can be difficult to drill boreholes for energy wells in areas with challenging ground conditions especially in soft clays. Sometimes inappropriate drilling method may cause ground settlement that can result in damaging nearby buildings. There is a need for developing a technical approach which evaluates different drilling techniques and considerations needed to whether drill or not to drill energy wells due to the challenging ground conditions. This project is going to run in collaboration with Municipality of Oslo, Asplan Viak and drilling companies. Student will require to investigates some case studies where drilling has caused ground settlements and investigate in laboratory and field to improve drilling techniques to prevent volume changes in soils to stop ground movement. Kontaktperson/Contact: Prof Rao Martand Singh Rao.m.singh@ntnu.no Assoc. prof. Priscilla Paniagua priscilla.paniagua@ntnu.no	

Oppgaver fra NGI Norges geoteknisk institutt – hentet fra nettsiden 21. april 2020

Denne listen blir jevnlig oppdatert – sjekk nettsiden:

https://www.ngi.no/Karriere/Studenter/Prosjekt-og-masteroppgaver

Temaer for prosjekt- og masteroppgaver

Basert på vår erfaring med veiledning og oppgaver viser vi nedenfor eksempler på forslag til prosjekt- og masteroppgaver med veiledning fra NGI. Selve innholdet vil utarbeides i samarbeid med student, veileder ved universitetet og NGIs veileder. En sommerjobb på NGI kan ofte være inngangen til kontakt med fagekspert på NGI for valg av prosjekt- eller masteroppgave. Her er en liste over titler/temaer for slike oppgaver. Nedenfor er det en kort beskrivelse av disse.

1. Jordskjelvlaster på kjellervegger og tuneller
2. Numerical (and experimental) modelling of a new laboratory testing device for establishing monotonic and cyclic p-y curves for piles
3. Analyse av temperatur og strekkbelastning på brustruktur
4. Pile group response, improved procedures based on calibration with FEA
5. Lateral response of piles in sand
6. Modellforsøk – installasjonseffekter fra boring i sand
7. Probabilistiske stabilitetsberegninger og risikoanalyse av høye jordskråninger i Hønefoss sentrum
8. 3D-effekter på skråningsstabilitet
9. Characterisation of excavation-induced soil displacements
10. Avanserte Lagdelingsmodeller
11. Alternative binders for improvement of soft soils
12. Reusing tunnel muck – the impact of the tunnelling method
13. Reusing tunnel muck – geotechnical properties and applications

FORKLARINGER - FORKORTELSER

PLAXIS-3D: Vi har svært god kontakt med FEM-miljøet hos PLAXIS i Nederland og har derfor felles interesse i bruk av PLAXIS-produktene for studier av geotekniske fenomener. Det nyeste er den 3-dimensjonale versjon av PLAXIS som gjør det mulig å studere 3D-effekter ved konstruksjoner.

FEM: Elementmetode

LEM: Limit equilibrium, grenselikevekt

ABAQUS: Dette er et multifunksjons 3D som er i stand til å regne på svært mange ingeniørproblemer. For tiden er vår interessert i å modeller konstruksjoner av skall-typen i samvirke med jord.

GeoSuite: Dette er et felles norsk/nordisk prosjekt for å lage et totalverktøy for geoteknisk prosjektering. Prosjektet er et samarbeid mellom NTNU, NGI, Multiconsult, ViaNova, SINTEF og Statens Vegvesen, Vegdirektoratet.

Geofuture II: Forskningsprosjekt for utvikling av geoteknisk programvare og analyseprosedyrer. https://www.ngi.no/eng/Projects/Geofuture

UNIS: Universitetsstudiene på Svalbard. Faggruppe for Geoteknikk har godt inngrep med UNIS og har hatt flere studenter på kortere eller lengre opphold på Svalbard. Lars Grande er professor II ved UNIS og er vår kontakt mot aktivitetene der.

DNV GL: DNV GL Høvik jobber med mange geotekniske problemstiller rettet mot offshore industrien. I avdeling "Subsea & Foundation" ønsker DNV å knytte til seg studenter med geoteknikk som spesialfelt, og DNV GL kan tilby både prosjektoppgaver, sommerjobber og hovedoppgaver.

GeoVita: Geoteknisk konsulentfirma i Oslo. www.geovita.no

NGI: Norges geotekniske institutt ligger i Oslo ved Ullevål og har aktiviteter innen alle geoteknikk og geologidisipliner. www.ngi.no

SINTEF: I Trondheim. Norges største forskningsinstitusjon. Vi samarbeider med SINTEF Byggforsk – avdeling berg og geoteknikk. www.sintef.no

Multiconsult: Et av norges største multidisiplin konsulentfirmaer. Egen geoteknisk avdeling - tidligere NOTEBY. Beliggenhet hele landet, hovedkontor Skøyen. www.multiconsult.no

Maxit: Internasjonalt konsern som produserer lettklinker. I Norge produserer maxit leca i løsvekt og i blokker og andre konstruksjonselement. www.leca.no, www.maxit.no

Rambøll: Nordisk konsern som har stor geoteknikkavdeling i Trondheim, tidligere Kummeneje og Scandiaconsult. www.ramboll.no

SVV: Statens vegvesen. En av våre samarbeidspartnere gjennom mange år. Både ute hos vegkontor og i vegdirektoratet på Brun i Oslo har våre studenter arbeidet med prosjekter og hovedoppgaver. www.vegvesen.no

Sweco Norge AS: Sweco er et skandinavisk multidisiplin konsern med Sweco Norge AS som underavdeling.

Norconsult: Et av norges største multidisiplin konsulentfirmaer. Egen geoteknisk avdeling. Beliggenhet over hele landet. Hovedkontor Sandvika. www.norconsult.no.