

Department of Civil and Environmental
Engineering

PhD programme in Structural, Seismic and
Geotechnical Engineering



POLITECNICO
MILANO 1863

COLLOQUIA DOCTORALIA

PhD Final Exam

29 October 2018 at 15:30

Lilla Room
Building 5, Campus Leonardo



SCHEDULE OF THE DAY

Gianluca Caramiello (XXX Cycle)

*Hydraulic pressure induced fracture and
permeability evolution in brittle geomaterials*

Supervisor: Prof. Anna Marina Pandolfi
Co-supervisors: Prof. Gabriele Della Vecchia

16:30 – 17:00 Final Committee Meeting

17:00 – 17:15 Proclamation

Committee members

- Prof. **Carlo Callari**
(Università degli Studi del Molise)
- Prof. **Guido Musso**
(Politecnico di Torino)
- Prof.ssa **Cristina Jommi**
(Politecnico di Milano)

THESIS ABSTRACT

**Hydraulic pressure induced fracture and
permeability evolution in brittle geomaterials**

Gianluca Caramiello – XXX Cycle

Hydraulic fracturing (HF) is a process characterized by the nucleation and propagation of multiple diffused fractures in soil or rock masses as a consequence of a localized solicitation driven by hydraulic pressure.

HF is used extensively in the petroleum industry to stimulate hydrocarbon wells, in order to increase or activate their production. The process is characterized by a strong hydro-mechanical coupling. To date, no predictive mathematical model is available to support the planning of operative procedures in realistic field conditions.

For optimal design of HF treatments, one of the most sought information is the extension (surface and volume) of fractures as a function of treatment parameters.

The onset and the propagation of hydraulic fractures in brittle rocks is the topic of this work, as a first step towards a predictive model of HF procedures. A recently developed brittle damage model for porous rocks has been implemented into a finite element code and used to predict the evolution of the hydraulic conductivity during HF processes.

The constitutive model has been validated against triaxial tests on several types of rocks. The finite element code has then been used to reproduce a laboratory HF experiment and to perform a sensitivity analysis on mechanical and hydraulic parameters. The simulation of HF processes at the field scale allowed to appreciate the influence of the HF design parameters on the evolution of fractures.