

Francesco Petrella



Profession

Civil Engineer and Geotechnical Specialist

Current Position

Associate Director

Joined Arup

2005 (previously CH2MHill and the United Nations World Food Programme)

Years of Experience

18

Nationality

Italian

Languages

Italian (mother tongue)
English (fluent)
French (intermediate)
Danish (intermediate)

Qualification

MSc Civil and Environmental Engineering, La Sapienza University, Rome

MSc Economics and Environmental Management, Bocconi University, Milan

Professional Associations

International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE)

Danish Geotechnical Society (DGF)

Chartered Engineer in Rome

Publications

Petrella (2009), Soil-structure interaction analysis for the design of integral bridges, 4iYGEC 2009, Alexandria, Egypt.

Simpson and Hocombe (2010), Implications of modern design codes for earth retaining structures, Earth Retention 2010, Seattle (acknowledged contributor).

Petrella, Persio, Ferrero and Hocombe (2013), Behaviour of a large anchored basement wall in dense sands and gravels, 7th International Conference of Case

Francesco Petrella is a civil engineer and a geotechnical specialist with 18 years of experience working for Employer and Contractor clients as well as Lenders. He has worked in the UK, in Italy and been based in Copenhagen since 2012 where he leads ground engineering and is part of the Arup network of 600+ geotechnical engineers.

In Denmark Francesco has worked for the Danish Road Directorate, Metroselskabet and Femarn. He has also been involved in several large infrastructure projects Contractor-side, including the first part of the Storstrøm Bridge Competitive Dialogue, Sydhavn Metro, and two of the Marieholm Connection projects in Gothenburg.

His geotechnical experience includes onshore and offshore site investigation, EC7-compliant design of shallow, deep and mixed foundations, earth retaining systems, earthworks, settlement analysis, seismic design, soil-structure interaction, dynamic behaviour of foundations subject to ship impact loading, finite element modelling, geotechnical instrumentation and monitoring, pile/barrette load testing, damage assessment in urban areas, slope stability analysis and contaminated land. He is competent in assessing ground-born risks.

Francesco's experience ranges from preliminary to detailed design and execution. He has carried out a number of Lenders Technical Advice projects and of Independent Check projects. Francesco has site supervision experience in geotechnical and investigations as well as monitoring, remedial works and other civil engineering works. He is familiar with a broad range of ground conditions from soft soils to weak and competent rock formations.

Francesco is a published author. He has been a convenor of EC7 EC3. He is an invited lecturer, an industrial supervisor for MSc students at the Danish Technical University (DTU) and at Aarhus University as well as an External Examiner (Censor) in Denmark.

Francesco has worked on numerous complex projects developing quality geotechnical design solutions leveraging his technical and managerial skills.

Main Infrastructure Projects

High-speed railway HS2, Phase 1, Lot S1 and S2, UK (2020-)

Temporary works Lead of the High-speed railway HS2 Phase 1, Lots S1 and S2. The temporary works comprise compensation grouting, permeation and fissure grouting, dewatering/de-

Histories in Geotechnical Engineering, Chicago.

Petrella, Persio, Ferrero, Allievi and Mussi (2013), Structural and geotechnical design of a piled raft for a tall building founded on granular soil, Proceedings of the 18th ICSMGE, Paris.

Petrella, Minno, Persio and Pillai (2015), Finite element modelling of a piled raft for a tall building on cohesionless soil, 16th ECSMGE, Edinburgh.

Petrella (2016) Safe geotechnics by observation, Ground Engineering.

Petrella, Tradigo, Mussi and Pisanò (2017), Settlement prediction and monitoring of a piled raft foundation on coarse-grained soil: the case of the Allianz Tower in Milan, Proceedings of the 19th ICSMGE, Seoul.

Petrella, Rive and Wudzka, The use of the seismic flat dilatometer for soil characterisation and geotechnical design of a fjord crossing (accepted to the ISC 2020 conference).

Petrella, Martini and Zanetti, Settlement prediction and observed behaviour of a railway embankment induced by tunnelling in mixed faced conditions in Copenhagen (submitted for acceptance for the WTC 2021 conference).

pressurisation, underpinning as well as other mitigation or preventative works.

Lynetteholm Metro Programme Study, Denmark (2019-)

Project Director and Geotechnical Lead for the feasibility study of a new metro line in Copenhagen to connect the inner city with a proposed artificial island.

Fjordforbindelsen Frederikssund, Denmark (2014-2019)

Geotechnics Lead for a new 6.6km dual carriageway tolled motorway which includes a 1.4km bridge across the Roskilde Fjord as well as a 1km long retained cut between inclined sheet piled walls to be installed in a sensitive area. The foundations of the bridge are large diameter bored piles rock socketed in Danian Limestone subject to ice loading and an 11MN ship impact load.

Storstrøm Bridge, Denmark (2016)

Geotechnics Lead for the tender design of this 4km bridge between Masnedø and Falster for a Contractor JV consisting of Vinci, Hochtief and MTH until the first dialogue meeting. The bridge comprises approximately 45 viaduct spans of 80 m in length, and 2 navigational spans of 160 m each. The bridge has caisson foundations resting on natural or improved soil via disconnected rigid inclusions.

Copenhagen Metro – Branch Off to Sydhavnen (2017-)

Geotechnics Lead for the Detailed Design of the approximately 4.5km of Metro (bored tunnels and cut & cover tunnels), 5 underground stations, two cross over shafts, a track stop-end shaft and a passenger transfer tunnel.

Suurhoffbridge, Rotterdam, Netherlands (2016)

Independent Check of the geotechnical design of a pier foundation of an existing steel bridge undergoing an assessment for the replacement of its superstructure. The review entailed the comparison of the pile axial resistance derived from pile driving records with that estimated via cone penetration test results.

Fehmarnbelt, Denmark (2017)

Tender support for this planned immersed tunnel to connect the Danish island of Lolland with the German island of Fehmarn across a 18km crossing of the Baltic sea thus providing a combined road and rail link between Denmark and Germany.

Project Vesterbro Tunnel, Denmark (2015)

Project Director for the preliminary design of this water tunnel in the city of Copenhagen aimed at alleviating cloudburst-generated floods.

Marieholm Tunnel, Gothenburg, Sweden (2013)

Geotechnical Engineer for the tender design of a new road immersed tunnel and railway bridge crossing the Göta Älv River

which will connect the Port of Gothenburg and the industries at Hisingen with the central part of the city.

Marieholm Bridge, Gothenburg, Sweden (2013-2014)

Geotechnics Lead for the tender design of a 1.5km rail link including a lift-swing bridge over the Gota Alv navigational channel. The geotechnical works consist of the on-shore and near-shore bridge foundations and the construction of piled or lightweight fill embankments on the soft Gothenburg clays. The river crossing has piled foundations subject to a 32MN ship impact load.

Copenhagen Metro – Branch Off to Nordhavnen (2012-2015)

Outline geotechnical and hydrogeological design, contract documents preparation and tender assessment for 1800m of twin bored tunnel, one underground station approx. 15m deep, 20m wide and 120m long, a cut and cover tunnel and ramp section, an overhead viaduct section, and one above ground station. Detailed Design of the railway viaduct deep foundations.

Copenhagen Metro – Cityringen (2012-)

Technical advice to the Employer for geotechnical and environmental aspects associated to the detailed design and construction of the 17 new underground stations, tunnel shafts and transfer stations. Geotechnics Lead for the detailed design of 2 transfer tunnel structures.

Milan Metro Line 4 – Technical and Environmental Advisor (2013)

Technical and Environmental Consultant for the due diligence activities on behalf of the arranging banks. The project entails the construction of a new metro line consisting in 21 stations and 15km of bored tunnels with an estimated overall cost in excess of €1,7bn. The analysis entailed the technical review of the project, the contractual arrangements, environmental and technical risks, lifecycle costs and revenues projections.

Autovie Venete, Italy - Technical and Environmental Advisor (2011)

Technical and Environmental Consultant for the due diligence activities on behalf of the arranging banks. The project entails the widening of the existing A4 motorway and the upgrade to motorway standard of a link in the Veneto and Friuli region, with an estimated overall cost in excess of €2bn. The analysis entailed the technical review of the project, the contractual arrangements, environmental and technical risks, lifecycle costs and revenues projections.

Pedemontana Lombarda Highway, Italy - Technical and Environmental Advisor (2011-2012)

Technical and Environmental Consultant for the due diligence activities on behalf of the arranging banks. The project entails the construction of a new toll motorway in Lombardy with an

estimated budget in excess of €4bn. The analysis entailed the technical review of the project, the contractual arrangements, environmental and technical risks, lifecycle costs and revenues projections. The role also entails the monitoring during construction and the first years of operation.

A15-A22 Motorway Link, Italy (2012)

Geotechnical Lead for the tender design of a new 10km link between the “Cisa” (A15) and the A22 motorway for a Contractor JV led by Condotte. The project includes a complex junction with the live A1 motorway, a 1.9km viaduct over river Taro as well as numerous geotechnical structures.

Florence High Speed Railway Station, Italy (2009)

Geotechnical Lead for the Employer’s Independent Check of the D&B Contractor’s geotechnical design of the underground high speed railway station in Florence. Coupled finite element analysis of a 1.6m thick diaphragm wall to retain a 28m deep excavation in stiff clays for the 450m long and 52m wide station box. Use of BRICK and advanced built-in constitutive models in PLAXIS 2D.

La Spezia Highway Link, Italy (2009-2010)

Geotechnical Lead for the tender design of the viaduct foundations, various earth retention systems and a 250m-long cut & cover tunnel subject to sway of the new road link between the La Spezia Port and the A12 motorway for a Contractor JV led by BTP. The design of the cut & cover tunnel was based on the Observational Method including a construction control and monitoring protocol, as well as planned corrective actions.

Salerno Rail Cover, Italy (2007-2008)

Geotechnical Lead for the scheme and detailed design of the eastern extension of a railway cover and road underpass located in a congested, central area of Salerno. Design of a jacked box and temporary bridge passing beneath live railway tracks to complete the connection to the existing road underpass. Definition of a strict monitoring protocol and trigger levels for ground as well as adjacent structures movements.

Arcisate-Stabio Railway Line, Italy (2008-2009)

Geotechnical Lead for the tender design for 8km of new railway line between Arcisate and Stabio for a Contractor JV led by Itinera and Impregilo. The line has a design speed of 100km/h. The project includes two tunnels (overall length of 850m), one 450m long viaduct, three new stations, a number of overbridges and underpasses and 3km of diaphragm walls to retain an open cut section.

SS640 Highway, Italy (2009)

Geotechnical Lead for the tender design for the widening and improvement of 28km of road between Agrigento and Caltanissetta for a Contractor JV led by Condotte. The project

includes 9km of bored/ cut & cover tunnels, 15 viaducts and 6 junctions.

Ticino Highway Bridge, Italy (2008)

Geotechnical Engineer for the tender design of an arch bridge for a road crossing of the Ticino river near Vigevano, including the approach embankments and a junction for a Contractor JV led by CONSTA. The project included the review of the scheme design undertaken by a separate consultant for value engineering and Employer's requirement compliance. The geotechnical design of the bridge foundations required a complex soil-structure interaction analysis as well as the concept for the temporary works (cofferdam).

Wembley Light Rail Expert Witness (2009-2010)

Geotechnical Engineer for the Expert Witness of a slope failure of a reinforced soil railway embankment. Engineering advice to provide a preliminary opinion on what may have caused or contributed to the cause of the slope failures.

UK Highways Agency, Integral Bridge (2007)

Geotechnical Engineer for this multi-phase research study to develop a geotechnical design procedure for the cost-effective design of integral bridge abutments based on soil-structure interaction. The results of the study have been embedded in the PD 6694-1:2011.

Varesine Footbridge, Milan, Italy (2007-2008)

Geotechnical Engineer for the scheme and detailed design of the footbridge foundation of a pedestrian footbridge in central Milan. Soil structure interaction analysis of the footbridge foundation with the existing urban railway tunnel.

Mestre Highway Tunnel Portal (2005)

Geotechnical Engineer for the preliminary design of this motorway tunnel portal which features a large lake for amenity and environmental compensation in Mestre.

Main Buildings Projects

Project Ember, Confidential Data Centre Project, Europe

Geotechnical Engineer for the design of a proposed Data Centre. Arup are providing full Engineering Design and Architectural Services for the development of a hyperscale data centre campus site of approximately 175 hectares. The campus will consist of 5No. data centre buildings and be supported by a number of administration buildings. The Campus is designed to accommodate approximately 175 MW IT load.

Bispebjerg Hospital- Somatic, Denmark (ongoing)

Lead Geotechnical Engineer for a proposed 66,000m² hospital with 5-storey high buildings and a one level basement. Preparation of the specifications and procurement of the GI. Illustrative Design and Tender Documents preparation.

Confidential Data Centre, Denmark

Lead Civil & Geotechnical Engineer for the 60% design of a proposed Data Centre for a confidential Client to be built on a 100ha site.

Clever UFC, Denmark

Project Director for a proposed ultrafast charging station for electric vehicles covered by a steel and timber canopy.

Camp Adventure Tower, Denmark

Project Director and Lead Geotechnical Engineer for the design of a 45m high observation tower built within an existing activity park in Denmark.

Confidential Industrial Plant Expansion, Sweden

Lead Geotechnical Engineer for a feasibility study on the expansion of an existing industrial plan for a confidential Client in the north of Sweden.

Tor di Valle T1, Rome, Italy

Geotechnical Reviewer for the preliminary design of new office tower on soft ground conditions located within a flood plain.

Bispebjerg Hospital- Lab, Denmark

Preparation of the ground investigation specifications for a 14,000m² laboratory and logistics building including a one level basement. This new build includes laboratories, logistics and storage facilities, as well as research facilities within the premises of the existing Bispebjerg hospital.

New Hillerød Hospital, Denmark

Project Manager for the Preliminary Design at competition stage of this greenfield hospital with 600+ beds and a gross floor area of 124,000m². The multidisciplinary Design Team included Danish architectural firm BIG and US-based WHR Architects.

Former National Mint Redevelopment, Rome, Italy

Project Manager for the multidisciplinary due diligence of the former National Mint redevelopment. This listed building is located in Rome and is to be converted into a luxury hotel and high-end flats.

FGA Car Manufacturing Plant, Kragujevac, Serbia

Project Manager for the multidisciplinary design of the refurbishment works for an existing car manufacturing plant in

Kragujevac, Serbia in order to comply with the local regulations as well as the high corporate standards of Fiat Group.

Isozaki Tower Piled Raft Foundation, Milan, Italy

Scheme and detailed design of the piled raft for a 200m high tower. The design includes soil structure interaction analysis, estimation of creep-induced and cyclic actions-induced settlements as well as the geotechnical design of the settlement reducing piles. Definition, interpretation and backanalysis of load tests on fully instrumented piles.

Le Varesine, Milan, Italy

Site investigation and geotechnical detailed design of diaphragm walls for a 300m x 100m x 16m deep excavation for the basement of the Varesine development in Milan. Finite element analysis of diaphragm walls to study the adjacent railway tunnel behaviour and damage assessment of adjacent buildings. Backanalysis of wall behaviour through the interpretation of monitoring data. Preliminary and scheme foundation design of a major mixed use complex including a 130m-high tower founded on a mixed foundation system (raft on barrettes).

Mercati Generali, Rome, Italy

Contiguous pile wall design in normally consolidated clays of the perimeter walls for the redevelopment of Rome's former general market. High quality laboratory tests for the assessment of small strains stiffness of the NC clays. Finite Element Analysis of the perimeter wall to study the interaction with the adjacent live metro lines. Bored cast in situ pile design based on the backanalysis of load tests to failure on fully instrumented piles.

CityLife Basement Review, Milan, Italy

Project Manager for the multidisciplinary design review of a large basement and podium part of the CityLife development located in Milan. The geotechnical design review focussed on the interaction between the basement and adjacent high-rise towers as well as the new metro line passing through the development.

Main Masterplanning Projects

Ringkøbing K Masterplan, Denmark

Energy and sustainability strategy for a large residential development to be built in close proximity of an environmentally sensitive wetland along the western coast of the Danish peninsula. The masterplan envisages 1100 housing units design according to state-of-the-art technologies.

Holbæk Arena Masterplan, Denmark

Energy, water management and transport planning strategy for a new sport city located south of Holbæk. The masterplan envisages several sport facilities including a 10,000 seat stadium.

FredericiaC Masterplan Parallel Competition, Denmark

Civil engineering strategy for the masterplan of a former industrial area located on the waterfront of Fredericia in Denmark. The design services also include advice on COMAH, contaminated land, maritime engineering and scoring of ad hoc sustainability indicators.

Masterplan Nuova Manifattura Tabacchi, Rovereto, Italy

Civil and infrastructure masterplan design for the re-development of a former tobacco manufacturing plant to become a green technology cluster in north eastern Italy.