Providing efficient and reliable geotechnical solutions for the most challenging projects

Capability Statement: Offshore & Marine Projects

LONDON – DUBLIN – EDINBURGH - BELFAST
Who We Are...

GAVIN AND DOHERTY GEOSOLUTIONS (GDG)

GDG is a specialist geotechnical and civil engineering consultancy, providing innovative geotechnical solutions to a broad range of engineering problems. GDG is a UK and Irish based company that provides engineering services to the international market, including concept design, tender design, detailed design, in-situ monitoring and general geotechnical advice. With offices located in London, Edinburgh, Dublin and Belfast, we are well placed to service the demands of our diverse range of clients.

GDG has developed from a strong background in applied geotechnical and civil engineering research. Through application of these skills, we offer progressive and reliable designs across a range of industry problems. GDG provides a unique engineering service that combines state of the art research with industry and leads to the most efficient geotechnical designs.

We are actively involved in a diverse range of international projects ranging from major civil infrastructure projects, port redevelopments, harbours/marinas, road and railway schemes, development of offshore oil/gas fields, onshore and offshore windfarms, and commercial structures. Our clients include large civil contractors, project developers, end-users/operators and engineering consulting firms.
Overview

The design team at GDG have experience across a variety of offshore and marine projects. Whether operating in several kilometers of water for Oil & Gas exploration or in a few meters of water for a harbour redevelopment scheme, GDG has the knowledge and engineering expertise to successfully deliver your project. Through value engineering and innovative design methodologies, we provide efficient and robust geotechnical designs. Our service offering includes all aspects of geotechnical interpretation, ground modelling and soil-structure interaction. The design applications extend across a wide range of sectors, including quay wall design, marina engineering, offshore structures, dredge design, coastal flood protection and much more!

GDG has developed skills in marine and offshore design, including preliminary design, detailed design, installation analysis, technical advice through the construction process and post-construction monitoring. Ultimately our objective is to de-risk marine projects for our clients, particularly those involving complex construction or challenging ground conditions. Our team has worked throughout the world and has gained valuable experience in a wide range of soil conditions from super plastic clays off the African coast to highly crushable calcareous sands and the white chalks of Dover.

Key Sectors

- Port & Harbour Redevelopment
- Offshore Wind Substructure Design
- Oil & Gas Structures
- Harbours and Marina Designs
- Inspections & Remediation of Existing Marine Structures & Quay Walls
- Wave and Tidal Substructure Engineering
- Offshore Pipelines and Cable Routes
GDG have an expert team of geotechnical engineers and engineering geologists who specialise in the design of marine and offshore structures.

Starting from the project outset, we provide specialist advice to scope and manage the site investigation campaign including design, procurement, management, site supervision, laboratory testing schedules and ultimately technical auditing of the factual report. We tailor specific investigative methods based on the early site appraisal work to target the testing to match the proposed construction and anticipated ground conditions.

GDG has experience of both 2D and 3D ground modelling and development of integrated ground profiles that incorporate geophysical survey information and intrusive field data.

By combining our geotechnical knowledge and statistical expertise, we provide detailed spatial analysis of ground risk, which is often presented in the form of hazard maps. For example, the adjacent map predicts the zones of high drilling risk and driveability refusal for an offshore wind farm.

**Design Tools & Capabilities**

- Site Investigation Scoping & Management
- Offshore Supervision / Offshore Client Representation
- Geotechnical Interpretation & Reporting
- GIS based ground modelling including developing 2D and 3D ground stratigraphy profiles using ARCGIS software
- Geotechnical Design Reports
- Geohazard Mapping
Ports & Harbours

Ports and harbours are often faced with significantly challenging ground conditions due to the nature of the sediment and the depositional environment. These challenges are compounded by the engineering requirements for multi-purpose quay structures, deep water navigation channels and the harsh environmental conditions including saltwater corrosion. GDG has a team of geotechnical engineers with experience in marine civils and offshore design, who can provide efficient design of ports and harbour developments by accurately modelling the interaction of the marine structures with the supporting soils. This allows optimisation of pile lengths, reductions in steel weights and efficient sequencing of the construction works, whether from floating plant or from onshore temporary works.

Recent ports and harbour projects have included:

- Dublin Port Alexandra Basin Redevelopment
- Dover Port Redevelopment
- Prince Charles Wharf in Dundee
- Bantry Harbour
- Harbour dredge design in Wicklow, Ireland
- Concrete pier design in Dun Laoghaire
- Soil-Structure-Jackup analysis of 3 French ports

Design Tools & Capabilities

- Geotechnical Interpretation
- Quay Wall Design
- Mooring Dolphin Design
- Pile Driveability Analysis
- Existing Quay Wall Inspections & Remediation Design
- Marina/ Harbour Engineering
- Open piled structures
- Stone Revetment Designs
- Analysis of temporary bund stability
- Dredge design
- Dredge Contamination Assessments
- Land reclamation and material analysis
- Analysis of construction sequencing
Offshore Wind

The offshore wind sector has grown dramatically over the past two decades, with projects transitioning into deeper waters further from shore. While early stage offshore wind farms utilised technology developed from their onshore counterparts, the evolution and maturing of this sector has required new and bespoke design tools to be developed. GDG has been at the heart of this evolution, where we have focused on bespoke innovation and dedicated research to evoke design efficiencies that ultimately bring down the cost of offshore wind energy while simultaneously de-risking critical aspects of the construction processes.

The design team at GDG include several subject matter experts in the areas of offshore substructures, where we have developed dedicated design tools for monopile optimisation, jacket pile analysis, gravity base deployments and quantification of installation risk. For example, several members of our staff were intimately involved in recent Joint Industry Projects such as the PISA initiative, led by DONG Energy, and the LEANWIND project, supported by the European Commission. The GDG team have applied this expert knowledge at several wind farms across Europe, including for Dutch, German, UK, French and Portuguese projects. In addition to our geotechnical capabilities and foundation design experience, GDG routinely undertake jackup suitability assessments, drilling studies, pile installation analysis, etc.

Design Services

- Monopile Engineering
- Gravity Base Foundation Design
- Scour Protection Design
- Jacket pile design and analysis
- Pile installation analysis
- Jackup suitability assessments
- Suction caisson design
- Geohazard assessment
- Installation risk modelling
- FEM analysis of soil-structure interaction
GDG has been involved in the Oil & Gas sector from company inception in 2011, where we have provided specialist technical advice, analysis and design support to other service providers and directly to offshore energy supermajors. Our capabilities in the Oil & Gas sector are focused on all geotechnical aspects linked to the development and operation of offshore fields. GDG utilise specialist expertise within geotechnics, marine civil engineering, offshore geology, geophysics and structural design which allows us to develop robust but cost-effective solutions for our clients. We are committed to solving the most complex of offshore problems by developing practical designs in partnership with the wider Oil & Gas industry. Our expertise includes interpretation of subsea sediments, design of offshore structures, well installation analysis, geohazard assessments and pipeline engineering. We have also developed specialist skills in instrumentation design and interpretation of offshore structural performance.

Our involvement in Oil & Gas projects has included both new installations and analysis of existing structures. For example, one of our most challenging projects to date has examined the installation of 120m long piles for a gas field off the Myanmar coast. Other recent projects have included capacity assessments of 30 year old piled jacket platforms in the Persian Gulf which require new topside installations; conceptual design of piles in highly crushable calcareous sands and fatigue analysis of well conductors in very soft clays.
Offshore Renewables – Wave & Tidal

The wave and tidal sector is still in its infancy in comparison to the wider offshore industry and therefore there is a stronger need for novel design approaches and value engineering to help the industry reach sustainable construction and deployment costs. GDG have worked with many of the larger offshore renewable developers and turbine companies in the conceptual development of subsea structures. GDG apply novel design tools and leverage both our practical soil-structure analysis capabilities from other offshore projects and our strong commitment to R&D to help develop the most optimised solution. The geotechnical challenges for these projects are exacerbated by the highly eroded seabed features, the harsh operating conditions and the challenges of installing subsea frames in such high energy environments.

Numerical Modelling of Marine & Offshore Structures

The design team at GDG are predominantly PhD qualified engineers with a track record in numerical analysis. Design tools such as Finite Element Modelling are often employed on complex projects to examine the real soil-structure interaction and to assess the stress-strain response of various structures. The adjacent image (top right) shows a 3D numerical model developed to quantify the impact of a jack-up vessel on an adjacent quay wall for a port in France. Other numerical modelling projects have considered gravity structures (below) and quay wall remediation (bottom right).
Inspections of Marine Structures & Quay Walls

Considering the harsh nature of the marine environment, it is essential to undertake routine inspections of maritime assets to ensure they meet their service requirements throughout their operation lifetime. GDG have expertise in the inspection of marine structures to examine issues such as scouring of pile toes, corrosion of quay walls and investigating unplanned service issues, such as ground/structure movements.

The information gathered during the inspection phase are often interrogated and analysed to examine the impacts on the structure. Where inspections highlight specific issues, GDG undertake full remediation designs to reinstate the structural integrity to meet the required lifetime.

Instrumentation & Monitoring

- Instrumentation System Design
- Develop Monitoring Strategies
- Install & Calibrate Sensors
- Interpretation of Data
Technical Advisory & Design Support

As technical specialists in the areas of geotechnical design and marine engineering, we provide direct advice and support to offshore developers, marine contractors and multi-disciplinary consultancy companies. With a team of PhD qualified staff and having written hundreds of technical publications in areas such as marine piling, GDG are recognised as leading experts in this field. In recent years, we have also extended our advisory services to include forensic engineering, technical support on legal disputes (particularly those relating to unforeseen ground conditions!) and expert witness services. We also provide a research and development service where clients are interested in exploring new ideas, design philosophies or implementing new technology.

GDG Vision

As a specialist SME, we pride ourselves on offering technically efficient and robust design solutions to the international market. Through a first-principals approach we always consider novel and innovative solutions which provide value to the client, allowing projects to be completed on time and in budget. At all times, we focus on the quality of project delivery by ensuring we are both responsive and flexible regardless of the size or complexity of the project. The GDG vision is well captured by the cost-quality-time triangle presented above!
Project References

- Dundee Heavy Loaded Quay Design (2016)
- Dublin Port Cross Berth Quay (2016)
- Monopile Design Management for 3 Offshore Wind Projects in Northern France (2016)
- Dover Port Redevelopment (2016)
- Bray Estuary Revetment and Quay Wall Designs (2015)
- Bray Harbour Dredge Analysis (2016)
- Borsselle Offshore Wind Farm (2016)
- Tidal Turbine Array offshore Normandy (2016)
- Bay of Fundy Tidal Turbines (2015)
- Killybegs Port - Rock Dredge/Ripability (2016)
- Dun Laoghaire Baths – Pier Design (2016)
- Belfast Deep Water Berth, D3 (2016)
- Portbury RoRo Berth Design (2016)
- Ringaskiddy Container Terminal and Heavy Load Quay (2016)
- Cape Clear Harbour Rock Anchors (2015)
- Persian Gulf Gas Jacket Analysis (2015)
- Neart na Gaoithe Offshore Wind Farm (2015)
- Mike Well Conductor Drivability (2014)
- Knightstown Mooring Piles (2015)
- K07 well conductor design (2015)
- Bantry Pier Redevelopment (2015)
- Wick Harbour Pile Driveability (2015)
- Grimsby Slipway Temporary Works Analysis (2015)
- Dublin Port Cofferdam design (2015)
- Rampion Offshore Wind Farm (2014)
- Detailed Design of Buoyant gravity Base (2016)
- Greenore Port Quay Inspections (2015)
- Forensic Analysis of Suction Bucket Installation (2015)
- Dogger Bank Jackup Suitability Assessment (2012)
- Zarzis MODU analysis (2011)
- Jacket Pile Design for BAUER (2013)
- Leanwind Offshore R&D Project (2013)
- Horizont Offshore Jacket Pile Design (2011)
- Drive-Drill-Drive Pile Design (2014)
- Greystones Marina Pile Design
- DFI Vibratory Pile Installation Analysis (2014)
- Shell Conductor Fatigue Installation Analysis (2014)
- UK Port Suitability Analysis for Heavy Loaded Construction (2014)