"Since the rule of the game is to achieve the difficult and create a difference, we must base our knowledge on solid foundations in this regard"

# INSTRUMENTATION & MONITORING GROUP

ZEMİNAŞ®

www.zeminas.com.tr

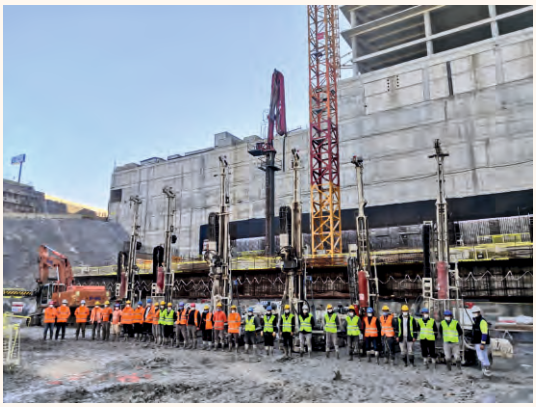
ISO 9001:2015 | ISO 14001:2015 | ISO 45001:2018 | ISO 27001:2022


**“The main factor that attracts us to geotechnics should be the prominence of the risk element in the field of activity. Let’s not forget that in any situation dominated by risk, the need to overcome difficulty takes precedence. After all, we are dealing with soil, a material of nature.**

**We are the actors of a challenging engineering approach, responsible for considering different engineering risks simultaneously in the design and implementation of construction engineering foundations or soil strength structures that sit on or are located within the soil, while taking both safety and economy into account.**

**Since the rule of the game is to achieve the difficult and create a difference, we must base our knowledge on solid foundations in this regard.”**

**Prof. Dr. H.Turan DURGUNOĞLU**



## *OUR VISION*

- *To uphold the principles of objectivity, quality, and customer satisfaction in Soil Investigation and Engineering solutions, while fulfilling our environmental sustainability and social responsibility commitments.*
- *To provide innovative, reliable, and cost-effective services in the industry by utilizing technology and innovation.*
- *To support the continuous development of our employees and ensure the highest standards in occupational health and safety, information security, and risk management.*
- *To achieve leadership in the industry, establish a presence in global markets, and continuously grow.*

## *OUR MISSION*

- *By providing reliable and innovative engineering services, producing high-quality, cost-effective, and sustainable solutions within the framework of value engineering.*
- *To become a trusted business partner in the industry by combining technology and engineering knowledge.*

## *OUR VALUES*

*Reliability*
*Ethical Approach*
*Quality*
*Innovation*
*Sustainability*
*Customer Orientation*
*Environmental and Social Responsibility*
*Occupational Health and Safety*
*Teamwork*
*Expertise*
*Continuous Improvement in Business Processes*
*Employee Development*
*Merit and Equality*
*Employee Commitment and Belonging*
*Recognition and Reward*

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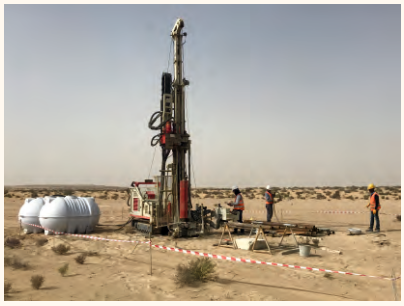
# ZEMİN ETÜD VE TASARIM AŞ



ZEMİNAŞ - Zemin Etüd Ve Tasarım AŞ, with its extensive sectoral experience, was established in 2006 as a group company after separating from ZETAŞ – Zemin Teknolojisi AŞ, which laid the foundation of its structure.

ZEMİNAŞ, whose roots trace back to the establishment of ZETAŞ (1988), has over 37 years of knowledge, experience, and competence in the fields of geotechnical research, modeling, and instrumental observation. The company encompasses the following departments:

- Geotechnical research,
- Geophysical measurement,
- Soil and rock mechanics laboratory,
- Geotechnical projects,
- Instrumentation and monitoring,
- R&D and production.

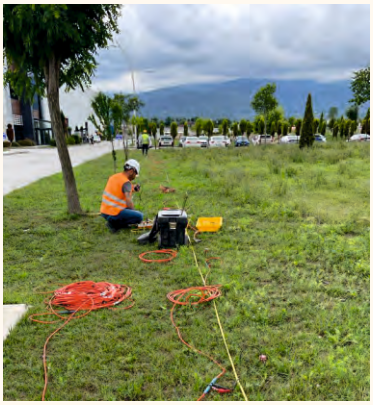
These departments propose sevices of:

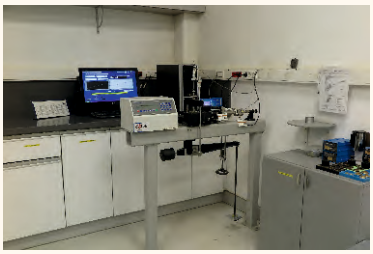
- Land and nearshore drillings,
- Geotechnical field tests,
- Surface geophysics,
- Borehole geophysics / geophysical borehole logging,
- Geotechnical engineering evaluation and design,
- Quality control and inspection,
- Water resources and environmental geotechnical engineering,
- Soil and rock mechanics laboratory tests,
- Instrumental monitoring and data validation and
- Structural health monitoring.

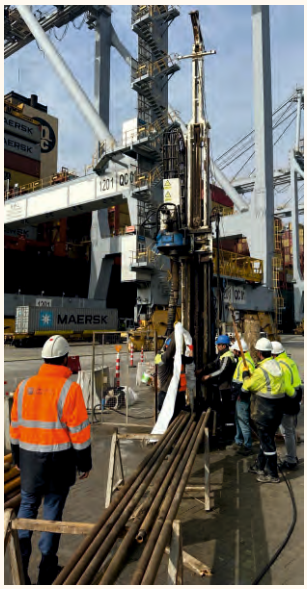
ZEMİNAŞ plays an active role in significant projects both in Türkiye and abroad. In many of the projects it undertakes, ZEMİNAŞ is the pioneer of many firsts in Türkiye. Its activities are led by Prof. Dr. H.Turan Durgunoğlu (Ph.D., UC Berkeley, CA 1972), with a team of over 25 experienced geologists, geophysicists, and geotechnical engineers with degrees of M.S. and Ph.D., as well as technicians in soil-rock mechanics and R&D production laboratories, and more than 40 operators, technicians, and field workers.

ZEMİNAŞ is an active member of the Geological Engineers, Geophysical Engineers, and Civil Engineers Chambers, and is also a member of the ZMGM (Soil Mechanics Geotechnical Engineers) and TMD (Foundation Contractors) associations. Our company holds IAS accreditation and the following quality certifications:

ISO9001:2015 (Qlt. Mgmt. Sys.), certificate no. 9.24.7877.10930.I
ISO14001:2015 (Env.Mgmt. Sys.), certificate no. 14.24.7877.20462.I
ISO45001:2018 (Occup.I Health and Safety Mgmt. Sys.), certificate no. 45.24.7877.30441.I
ISO 27001:2017 (Info. Security Mgmt. Sys.), certificate no. 27.24.7877.60157.I







In engineering projects, structures and the geological environment conditions interacting with them are affected by various external factors. Due to these factors, changes occur in their physical conditions over time. The monitoring of these changes over time is defined as INSTRUMENTAL MONITORING.

As ZEMİNAŞ Instrumentation & Monitoring Group, we are proposing our core services on:

- Instrument supply,
- Instrumentation & monitoring project design,
- Monitoring system installation,
- Data management, validation, reporting,
- Developing data management and warning software,
- Supervision services on installation, maintenance and management,
- Technical support services for repair, replacement and maintenance,

in extensive range of:

- Geotechnical engineering,
- Foundation engineering,
- Pavement engineering,
- Environmental engineering,
- Soil and rock mechanics,

and in various instrumentation & monitoring projects of:

- Deep excavations and retaining structures,
- Buildings and foundations,
- Tunnels, underground excavations and effected structures,
- Dams,
- Historical structures,
- Marine embankments and port structures,
- Bridges,
- Viaducts,
- Slopes
- Hydrogeological researches,
- Open pit and undergroung mines,
- Tailing dams and waste dumps,
- Meteorological Observations.

# INSTRUMENT SUPPLY

Inclinometer Probs and Logging Systems

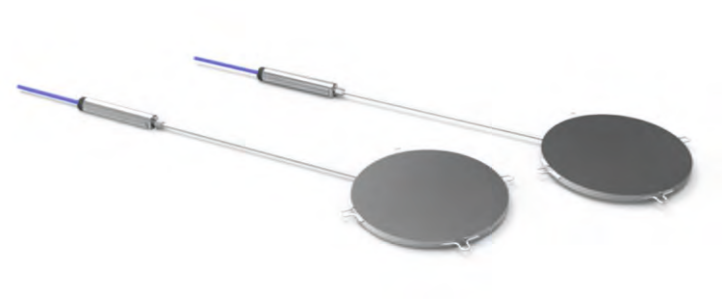
Inclinometer Casings


Tiltmeters

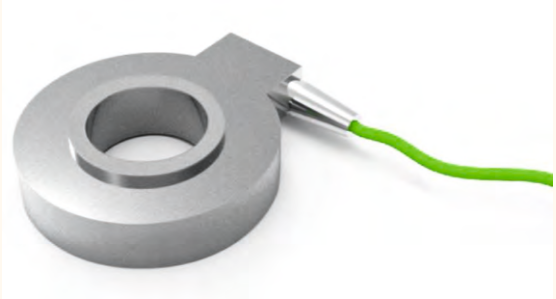
In-Place Inclinometers (IPI)

Piezometers

Hydraulic Settlement Sensors



Pressure Cells



Anchorage Load Cells

In instrumental monitoring studies, measurement accuracy, and more importantly, the reliability of measurement values, are of great importance.

The quality of sensors, signal cables, RF systems, and data recording devices that read, record, and transmit data, determine the quality of the measurements and the quality of our services. Our group provides the most accurate and competent sensors, data transmission, and recording-transmitting systems, specifically tailored to each project.

Borehole Rod Extensometers
and Displacement Transducers

Crackmeter Sensors

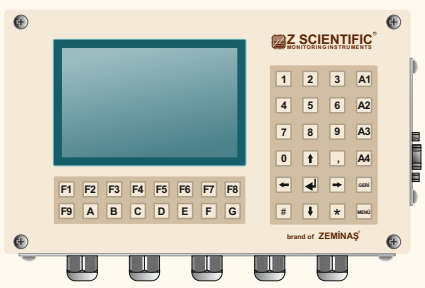
Strain-Gauges


Portable Dataloggers and Readouts

Meteorological Sensors


GNSS System Sensors

Temperature Sensors




Analog Datalogger

Sensor Terminal Box

Grounwater Level
Indicator

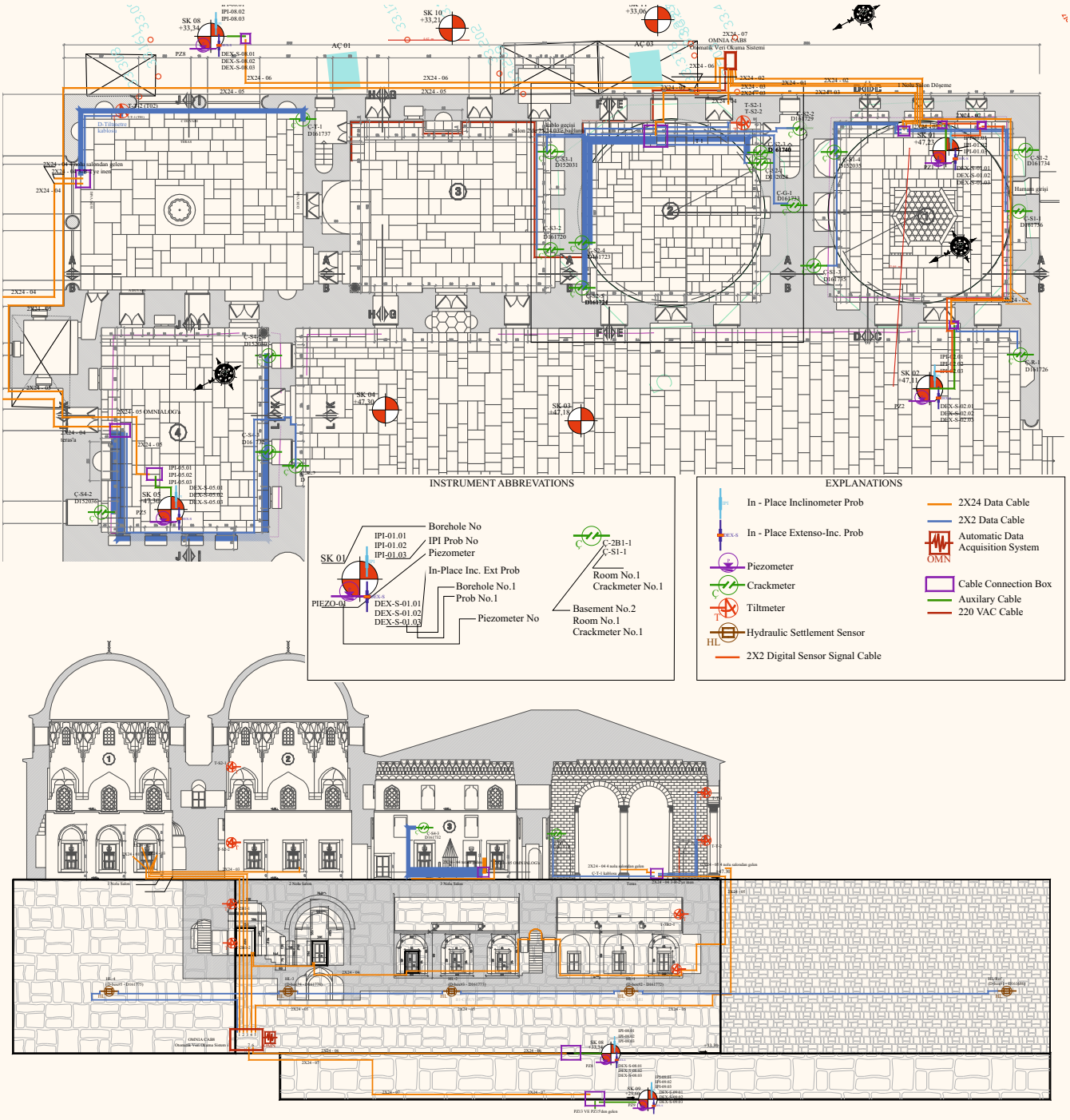
Magnetic Extensometer
Ring Indicator

# INSTRUMENTATION & MONITORING DESIGN

In instrumentation and monitoring studies the main problem is the answer of question: "*Which sensor should be used where and how should it be installed?*".

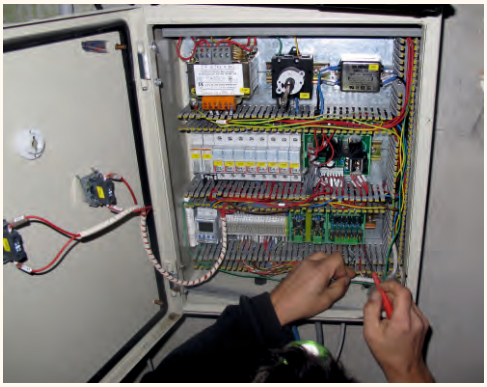
Our group works in coordination with other the ZEMİNAŞ groups, provides instrumentation and monitoring project designs for the services in engineering structures.

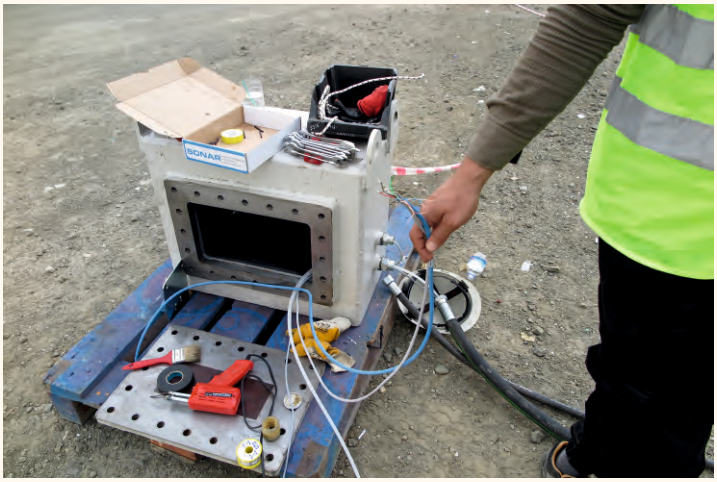
In this context, in order to understand the current conditions of the structure and to ensure on its reactions against various loads: the right type of sensor is determined in the most appropriate measurement range, in the most accurate standards, and the most reliable data transmission method are designed. And finally the most proper installation method is developped.



The installation of monitoring system on project structures is another important requirement for the accuracy and reliability of the data.

The installations are carried out precisely by our experienced staff and full sensor-structure interaction is executed.





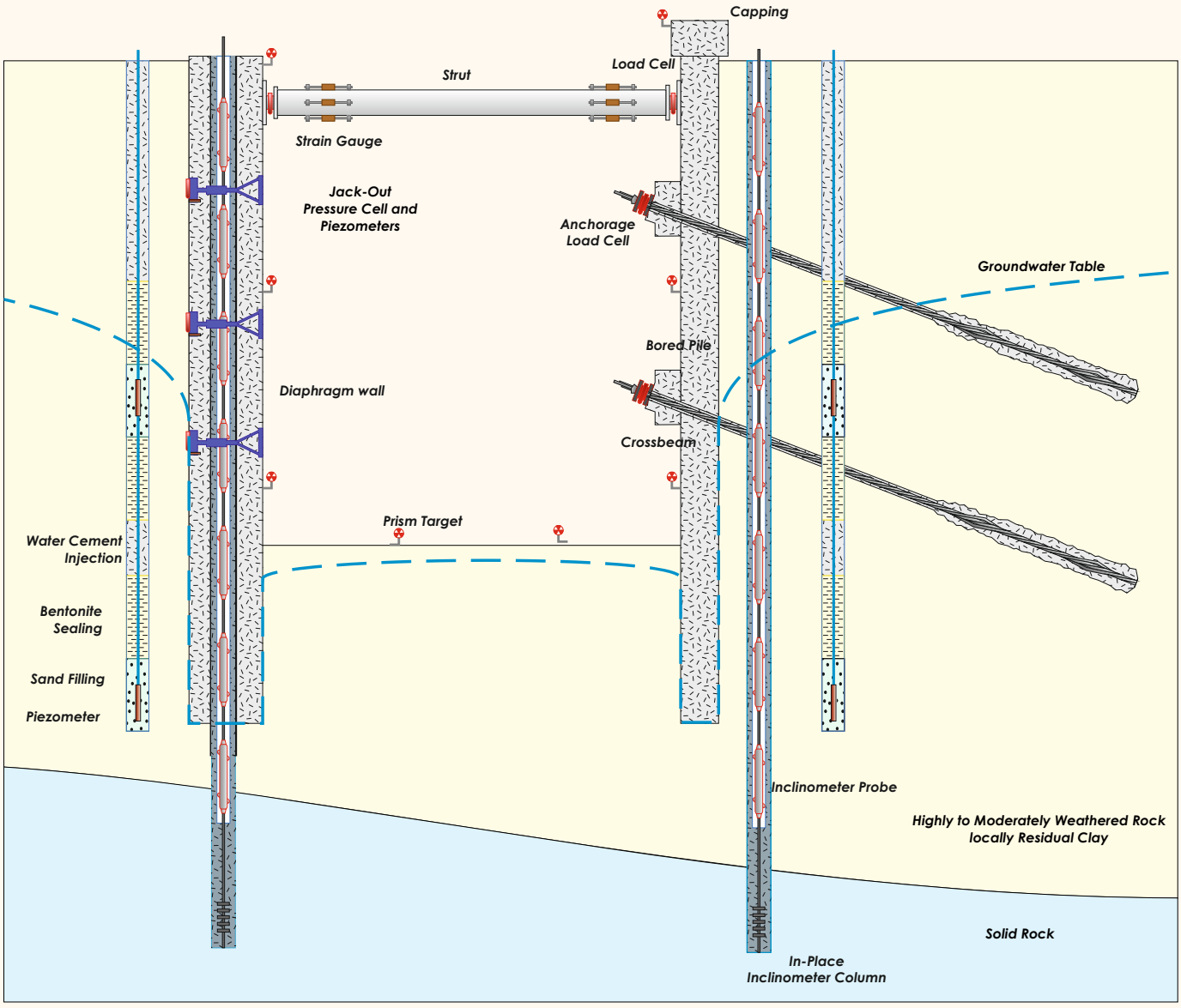
## Deep Excavations and Retaining Structures

Generally, in these temporary studies, it is necessary to be aware of the differences between design parameters and the actual field conditions during the applications. Therefore, monitoring studies are of great importance in terms of safety of life and property.

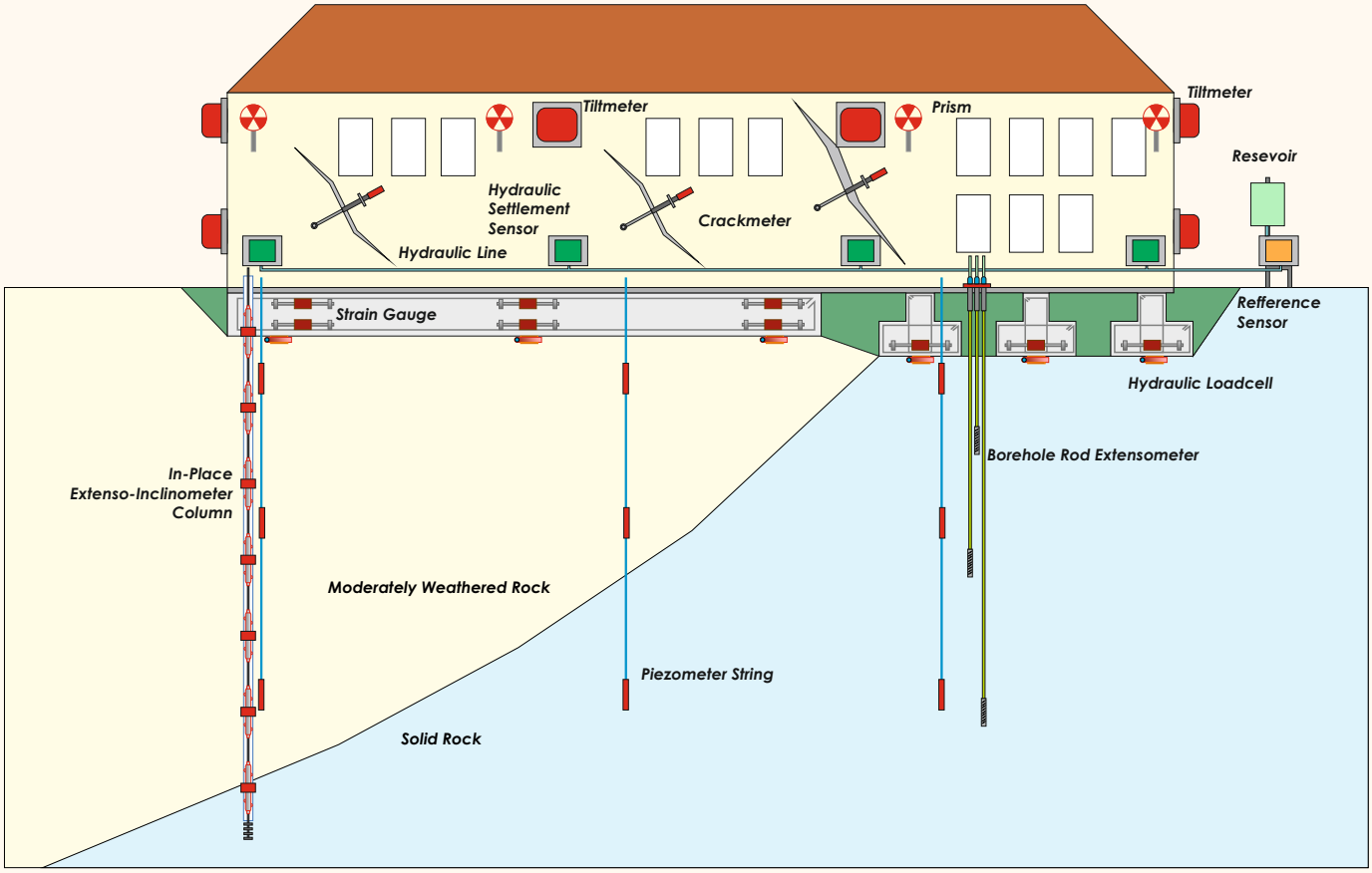
The main instruments can be listed as:

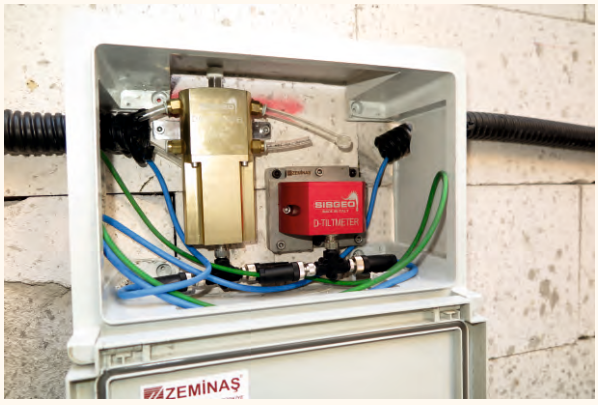
- ***Piezometers,***
- ***In-place Inclinometer measurement columns,***
- ***Jack-out-Pressure cell and Piezometers,***
- ***Strain Gauges,***
- ***Hydraulic Load Cells,***
- ***Anchor Load Cells,***
- ***Prism Reflectors,***

In special projects, different types of sensors may also be used depending on the design requirements.



## Buildings and Foundations




Due to differential settlements observed in the foundations, various deformations occur in structures. In these environments, it is necessary to monitor shape changes, vertical-horizontal displacements, total pressures from structural loads, and pore water pressures.

For this purpose, the main instruments used are:

- ***Piezometers,***
- ***In-place Extensometer - Inclinometer measurement columns,***
- ***Pressure Cells,***
- ***Strain Gauges,***
- ***Rod Extensometers (brehole type rod extensometer),***
- ***Total Pressure Cells,***
- ***Hydraulic Settlement Sensors,***
- ***Tiltmeter Sensors and***
- ***Prism Reflectors.***

## Tunnels, Underground Excavations and Effected Structures

Instrumental Observation is an indispensable monitoring study used in tunnel and underground excavation applications. Regardless of how competent the design is, monitoring various engineering values is of great importance.

In these engineering applications, it is necessary to monitor the processes before, during, and after construction. During the works, subsidence, swelling, and flow movements can be observed in surrounding zones and on the surface, which can significantly affect the safety and costs of underground works, and furthermore, may cause negative impacts on the structures located on the surface.

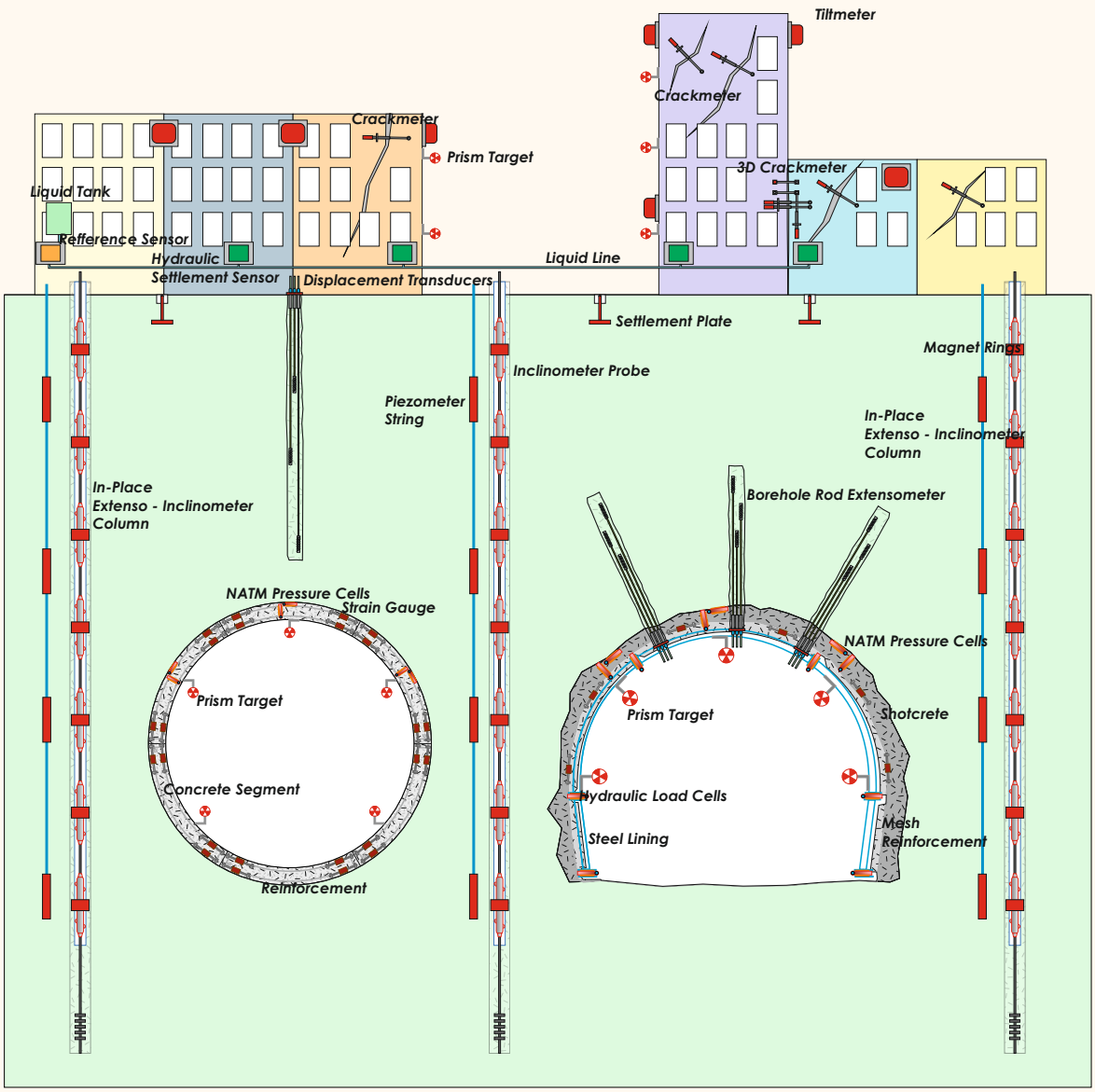
Piezometric pressures that occur depending on the ground water levels and geological structure, displacements of rock blocks determined by structural discontinuities, and the pressures exerted on the support structures, form the primary values that need to be monitored.

## Tunnels, Underground Excavations and Effected Structures

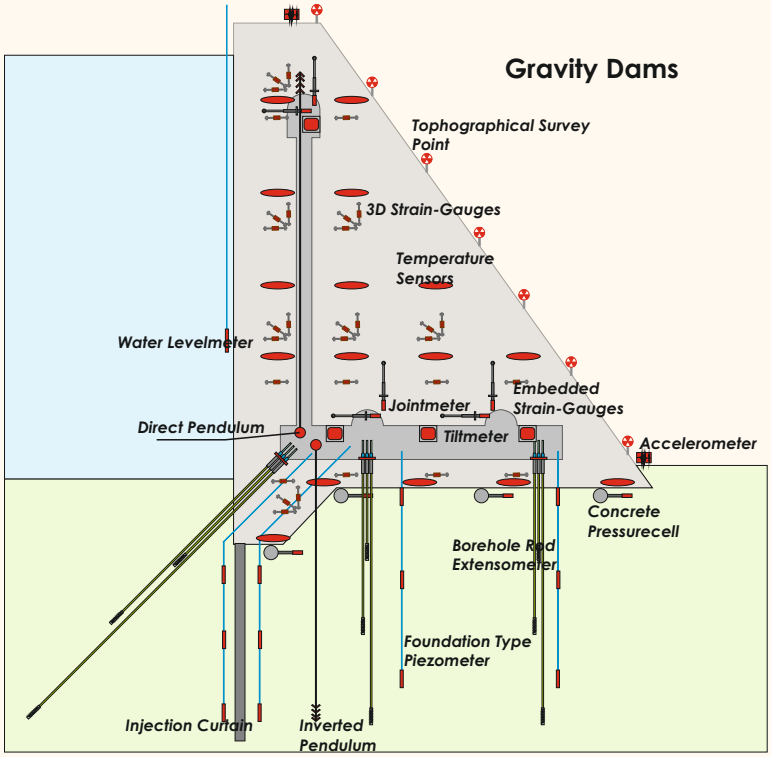
The effects of underground works on surface structures are another objective of these monitoring works. Openings of cracks and joints of the structures, angular changes on their surfaces, settlement and swelling values are observed.

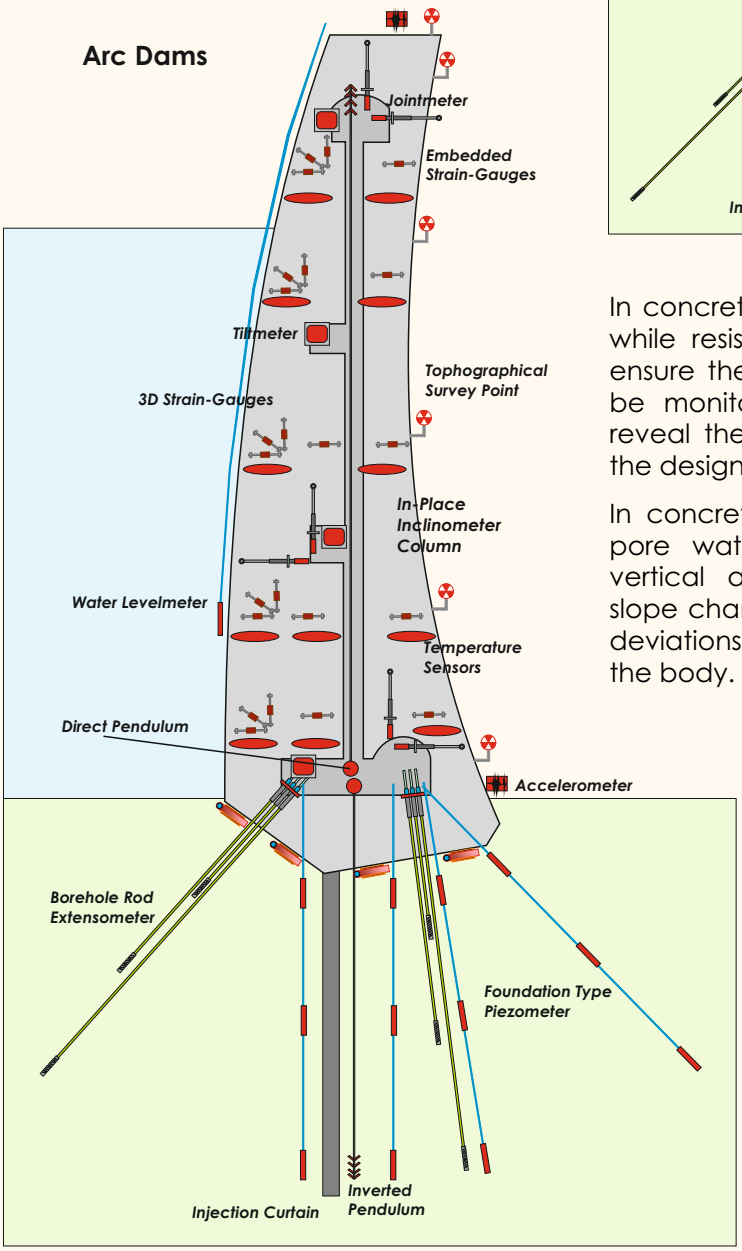
Main instruments frequently used are listed as:

- ***Piezometers,***
- ***In-place and/or portable Extensometer - Inclinometer measurement columns,***
- ***Pressure Cells,***
- ***Strain Gauges,***
- ***Rod Extensometer (well-type rod extensometer),***
- ***Total Pressure Cells***
- ***Hydraulic Settlement Sensors,***
- ***Tiltmeter Sensors,***
- ***Prism Reflectors,***
- ***Crackmeters.***



## Dams



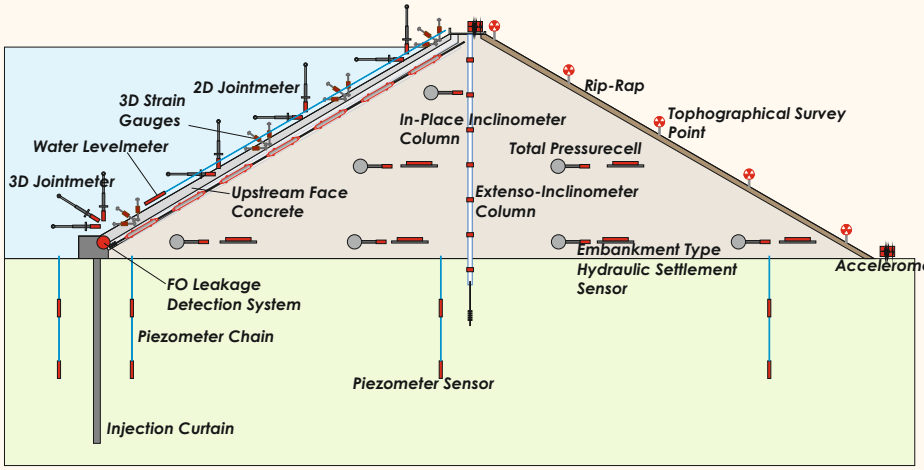

In concrete dams, the body is subjected to various loads while resisting the water pressure from the reservoir. To ensure their safety, the behavior under these loads must be monitored. Instrumental observation studies aim to reveal the differences between the field conditions and the design predictions.

In concrete dams, the main observation values include pore water pressures in the foundation environment, vertical and horizontal displacements, joint openings, slope changes, temperature, strain (deformation), vertical deviations, vibration, and acceleration measurements on the body.

In this context, the following are commonly used:

- ***Piezometers,***
- ***Rod-Extensometers,***
- ***Concrete Pressure Cells***
- ***Total Pressure Cells***
- ***Strain Gauges,***
- ***Thermometers,***
- ***Jointmeters***
- ***Tiltmeters,***
- ***Pendulums (both direct and invert),***
- ***Prism Reflectors,***
- ***Accelerometers.***

## Dams





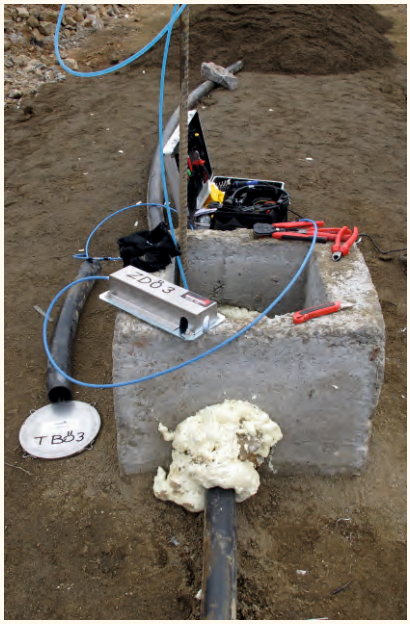
**Concrete Face Rockfill Dams**

In embankment dams: For the safety of the downstream areas, it is necessary to monitor the safety of the dam body and the differences between the field conditions and design predictions. While the dam body resists the water pressure from the reservoir, horizontal and vertical displacements, embankment pressures, and piezometric pressures within the fill material are observed with various sensors.

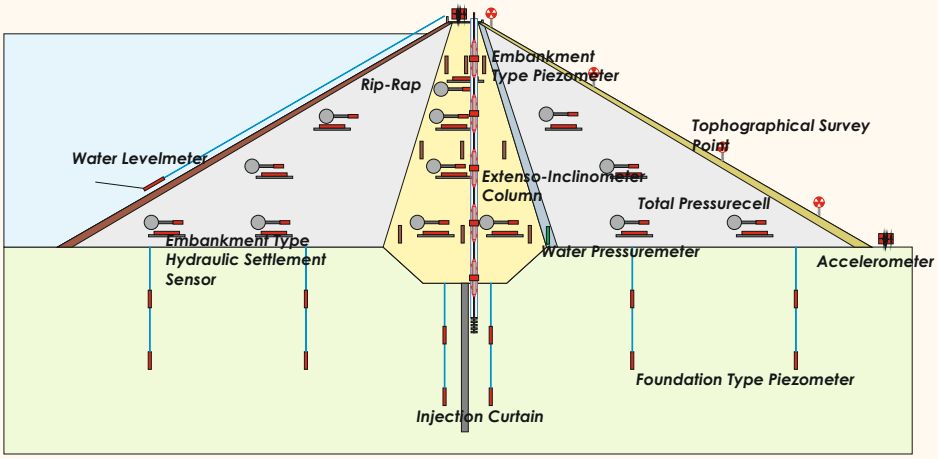
The main instruments used are:

- ***Embankment and Foundation Type Piezometers,***
- ***In-place Extensometer - Inclinometer Measurement Columns,***
- ***Total Pressure Gauges,***
- ***Embankment Settlement Gauges,***
- ***Pore Pressure Gauges,***
- ***Topographic Observation Points,***
- ***Accelerometers.***

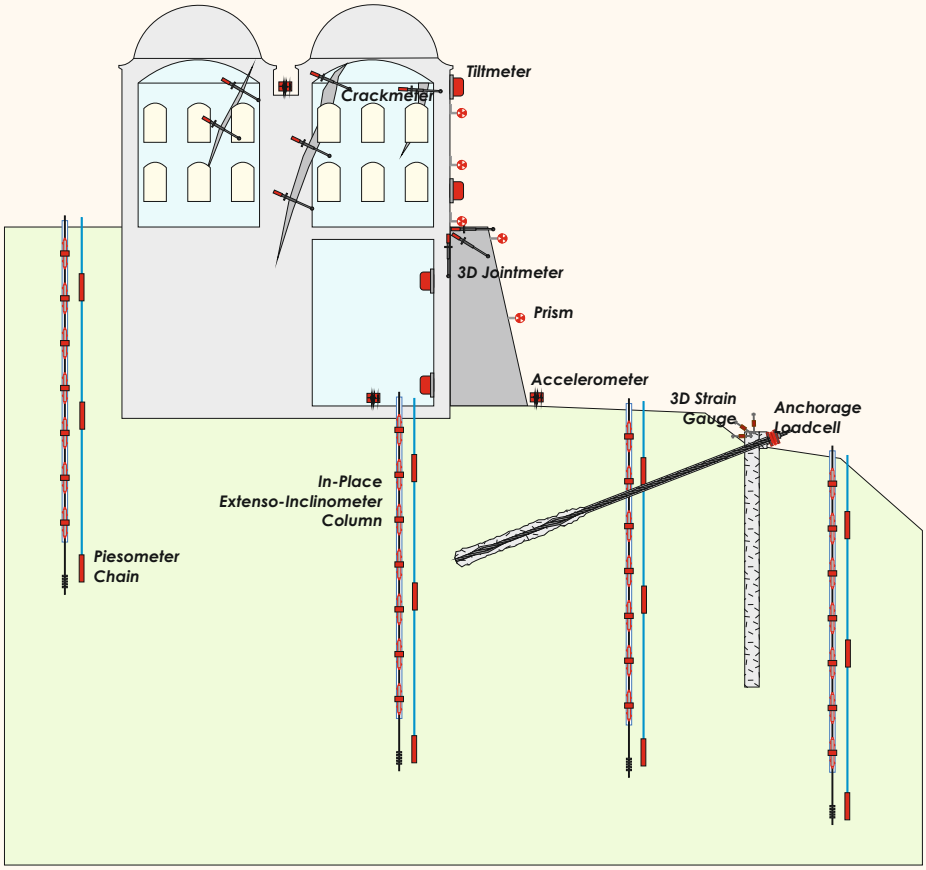
On the other hand, the stability of the slopes and embankments within the reservoir area should also be monitored and tracked with instrumental monitoring studies.



**Clay Core Embankment Dams**



## Historical Strucures




Despite the engineering craftsmanship in their designs, historical structures have been subjected to harsh environmental impacts over time, such as atmospheric effects (alteration of building stones), vibrations, and seismic movements. On one hand, cracks and changes in inclinations can be observed on their surfaces, while on the other hand, settlement or swelling may occur in their foundations, and they are exposed to various vibrations.

To observe these changes, the following instruments are commonly used:

- ***Piezometers,***
- ***In-place Extensometer - Inclinometer measurement columns,***
- ***Pressure Cells,***
- ***Strain Gauges,***
- ***Borehole Type Rod Extensometers,***
- ***Total Pressure Gauges,***
- ***Hydraulic Settlement Sensors,***
- ***Tiltmeter Sensors,***
- ***Prism Reflectors,***
- ***Vibration Sensors and Accelerometers.***

## Shore Embankments and Port Structures

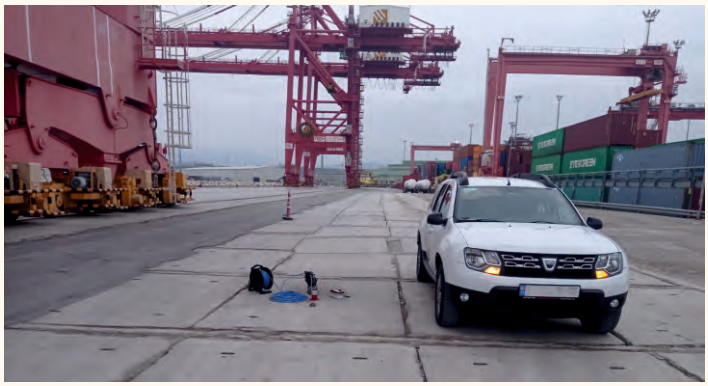
Understanding the behavior of marine fills and port structures under load, and monitoring the differences between design predictions and field conditions, is necessary.

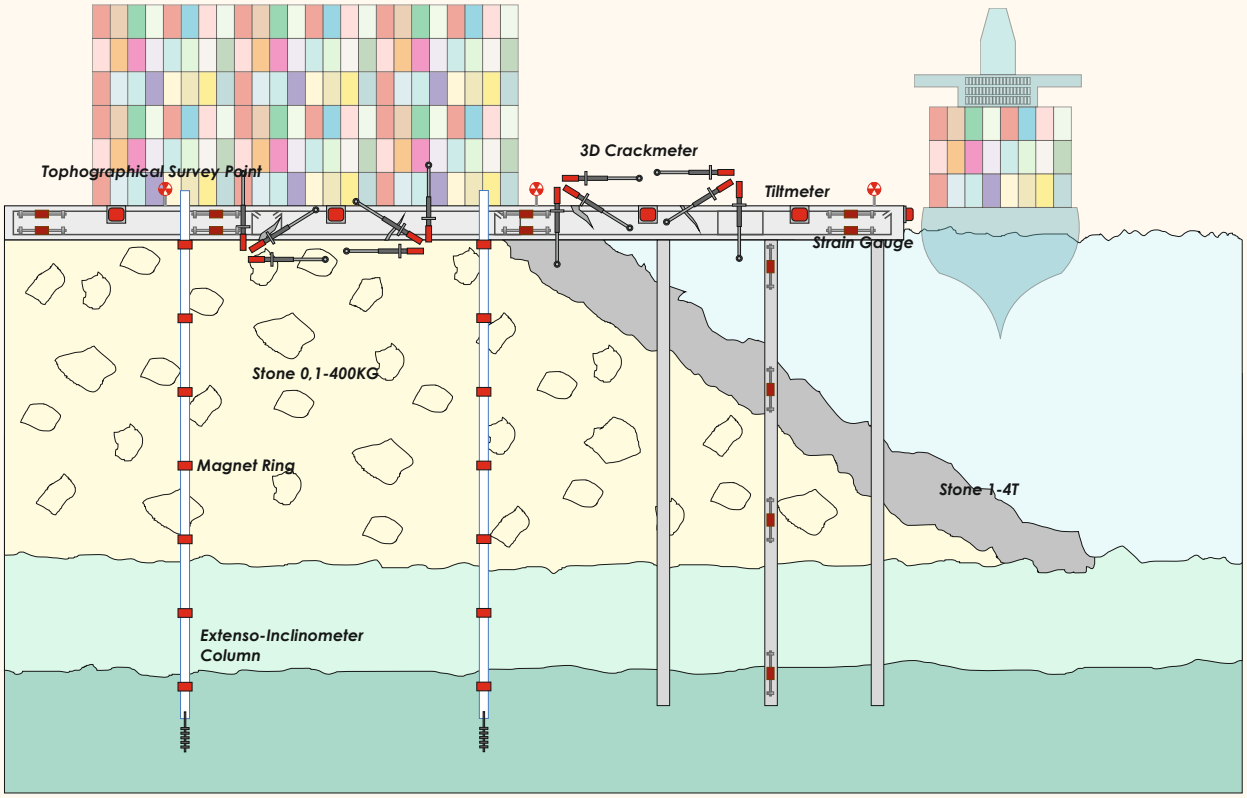
Vertical movements are frequently expected. In pile applications, deformations in reinforcement or steel piles, vertical and horizontal displacements at different levels in the fill material, openings in joints or cracks in concrete structural elements, and changes in slope need to be observed.

For this purpose,

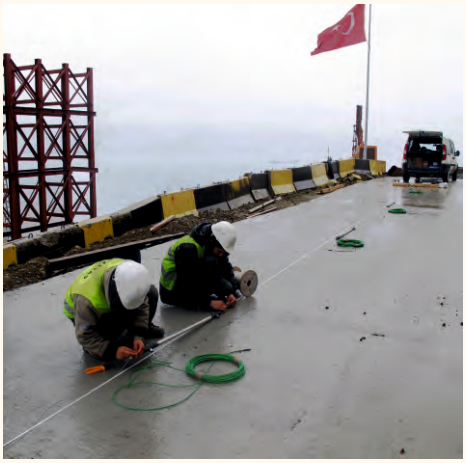
- ***In-place or portable Extensometer - Inclinometer measurement columns,***
- ***Strain Gauges,***
- ***Joint-Crack Gauges,***
- ***Tiltmeter Sensors,***
- ***Prism Reflectors,***
- ***Vibration Sensors and Accelerometers,***

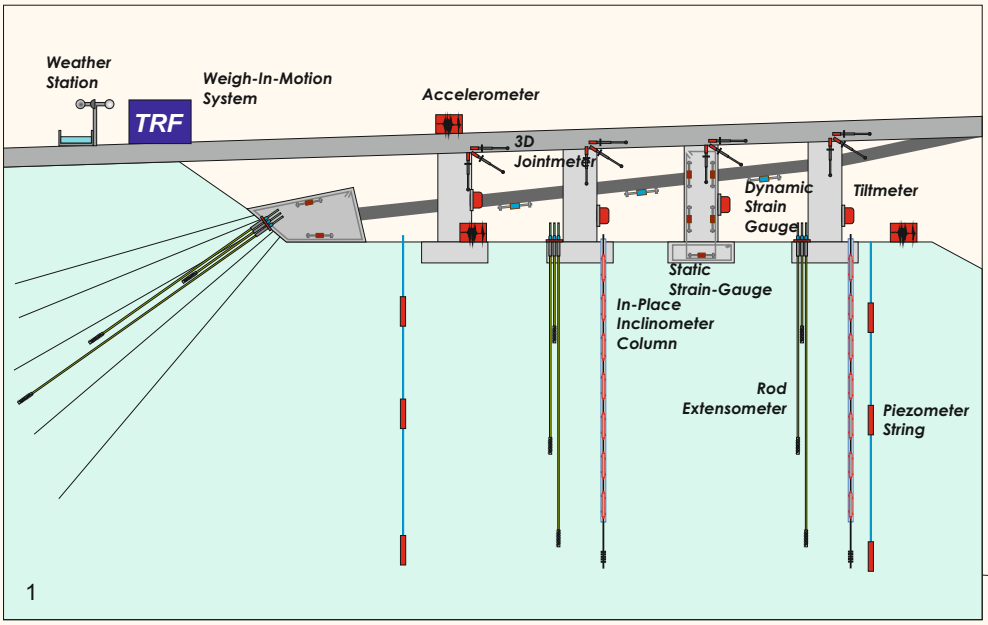
are commonly preferred.



## Bridges



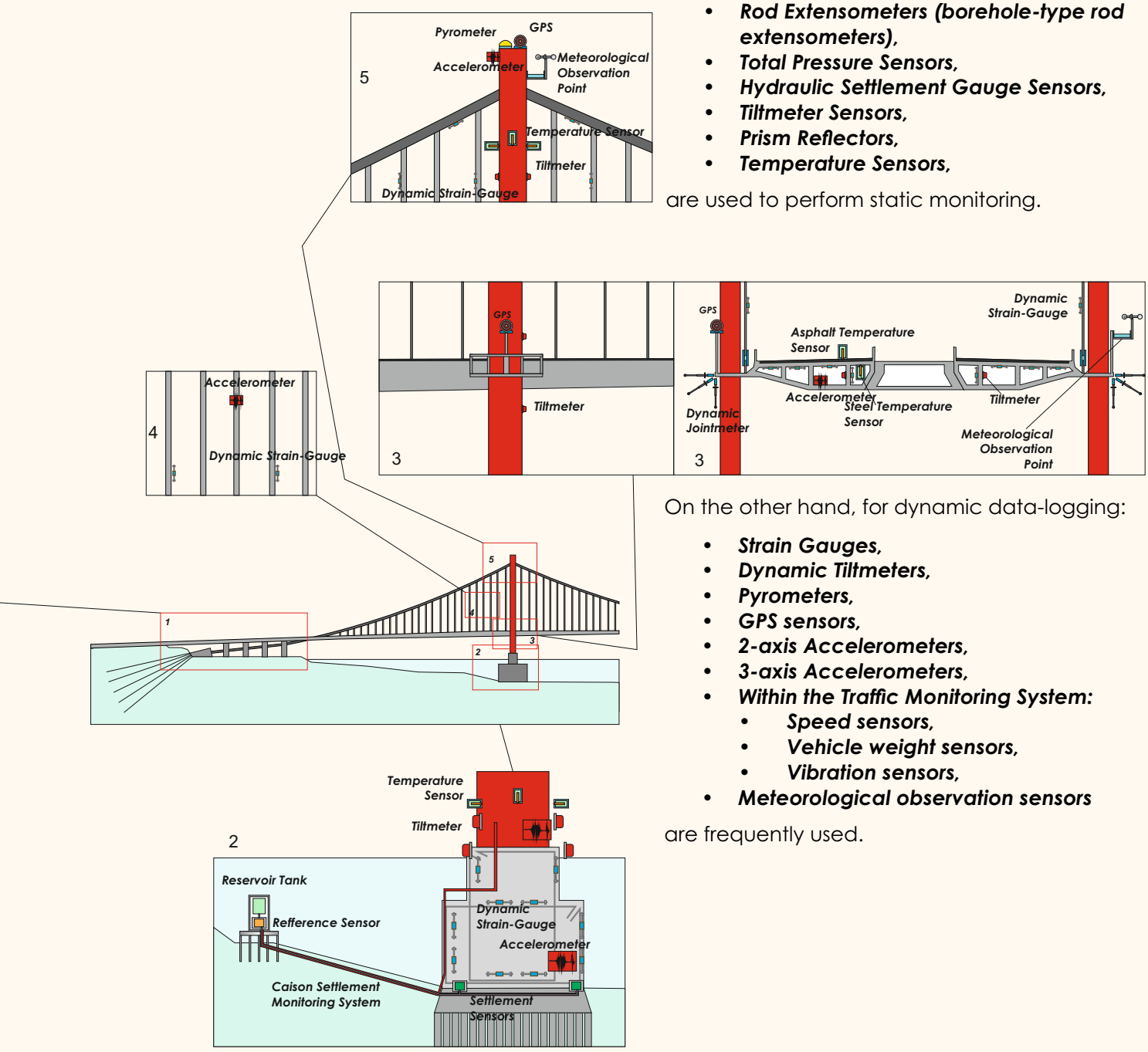

Weather Station
Weigh-In-Motion System
TRF
Accelerometer
3D Jointmeter
Dynamic Strain Gauge
Tiltmeter
Static Strain-Gauge
In-Place Inclinometer Column
Rod Extensometer
Piezometer String
1

## Bridges

Bridges are engineering projects where instrumental monitoring studies are conducted throughout the entire construction proceses and the structure's service life. In these monitoring works, not only static monitoring sensors are used, but also dynamic sensors that can take measurements in real-time are employed. In these projects:

- ***Piezometers,***
- ***In-place Extensometer - Inclinometer measurement columns,***
- ***Pressure Cells,Strain Gauges,***
- ***Rod Extensometers (borehole-type rod extensometers),***
- ***Total Pressure Sensors,***
- ***Hydraulic Settlement Gauge Sensors,***
- ***Tiltmeter Sensors,***
- ***Prism Reflectors,***
- ***Temperature Sensors,***

are used to perform static monitoring.




On the other hand, for dynamic data-logging:

- ***Strain Gauges,***
- ***Dynamic Tiltmeters,***
- ***Pyrometers,***
- ***GPS sensors,***
- ***2-axis Accelerometers,***
- ***3-axis Accelerometers,***
- ***Within the Traffic Monitoring System:***
  - ***Speed sensors,***
  - ***Vehicle weight sensors,***
  - ***Vibration sensors,***
- ***Meteorological observation sensors***

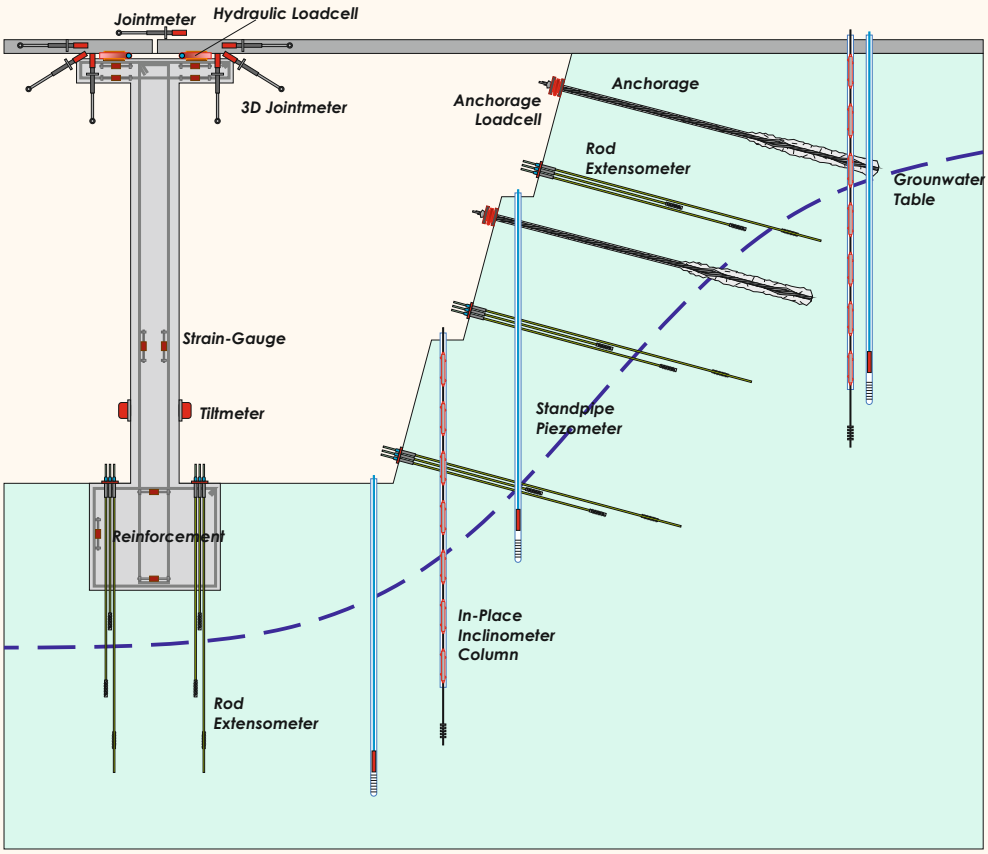
are frequently used.

## Viaducts

Viaducts are structures frequently used in highway construction projects. While they are under the influence of dynamic loads and vibrations caused by vehicle traffic, they may also be exposed to settlement, subsidence, or tilting effects as a result of their interaction with the underlying soil conditions.

In viaducts and similar engineering applications, the following are used on structural elements and foundations:

- ***Piezometers***
- ***In-place Inclinometers (IPI),***
- ***Anchorage Load Cells,***
- ***Strain Gauges ,***
- ***Borehole Rod Extensometers,***
- ***Total Pressure Cells,***
- ***Hydraulic Load Cells,***
- ***Tiltmeters,***
- ***Prism Reflectors,***
- ***Jointmeters.***



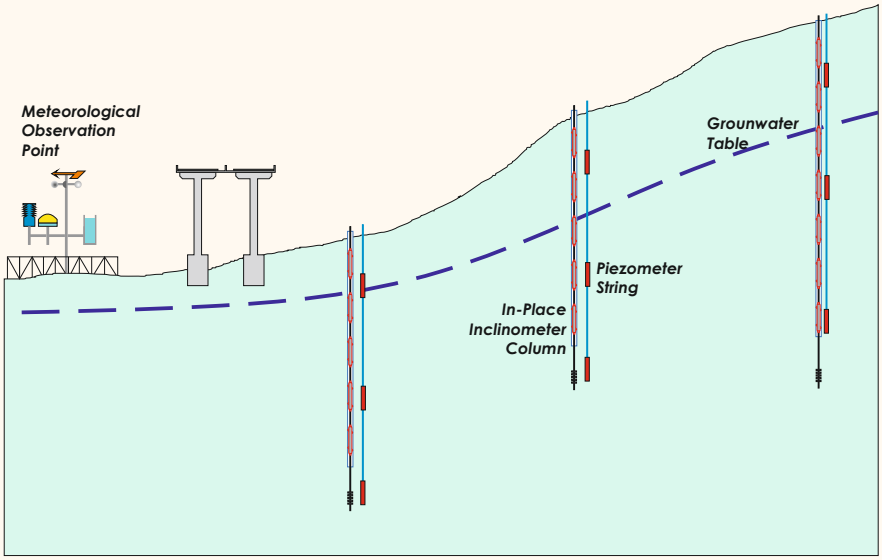
## Slopes

Engineering applications conducted on sloped surfaces in nature, such as road cuts, embankments, and excavations, can lead increaeses in strains and decreases in resistances within the environment.

The ground water level, piezometric pressures, lateral movements, and meteorological data form the foundation of instrumental monitoring studies on natural slopes.

- ***Portable or In-place Inclinometer Observation Columns,***
- ***Piezometer Strings***
- ***Meteorological Observation Points***,

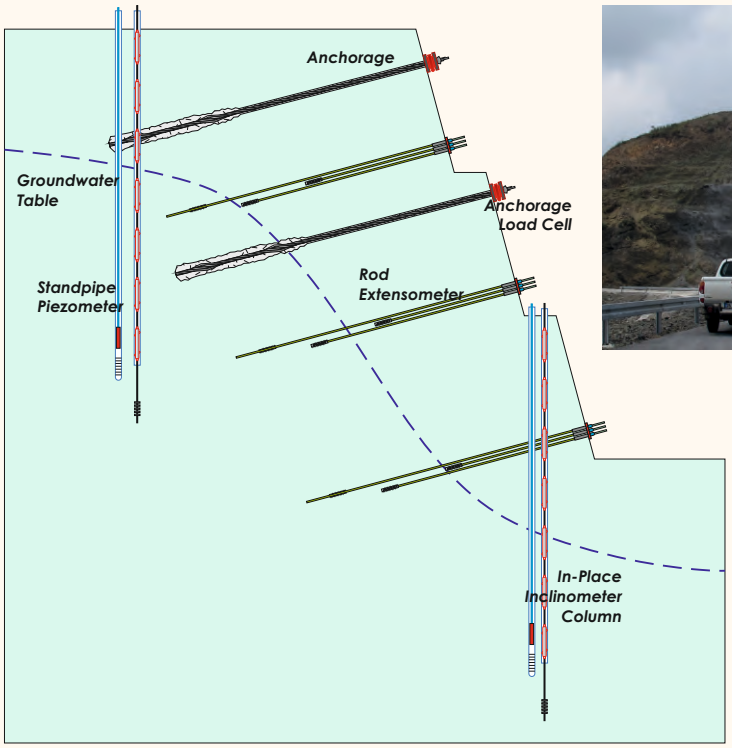
are main instruments.




Slopes are artificially created inclined surfaces in various engineering projects. Their stability may vary depending on the conditions they are exposed to in their environment.

- ***Portable or In-place Inclinometer Columns,***
- ***Piezometer Arrays,***
- ***Borehole Piezometers,***
- ***Anchor Load Cells,***
- ***Rod Type Extensometers,***

are commonly used systems.

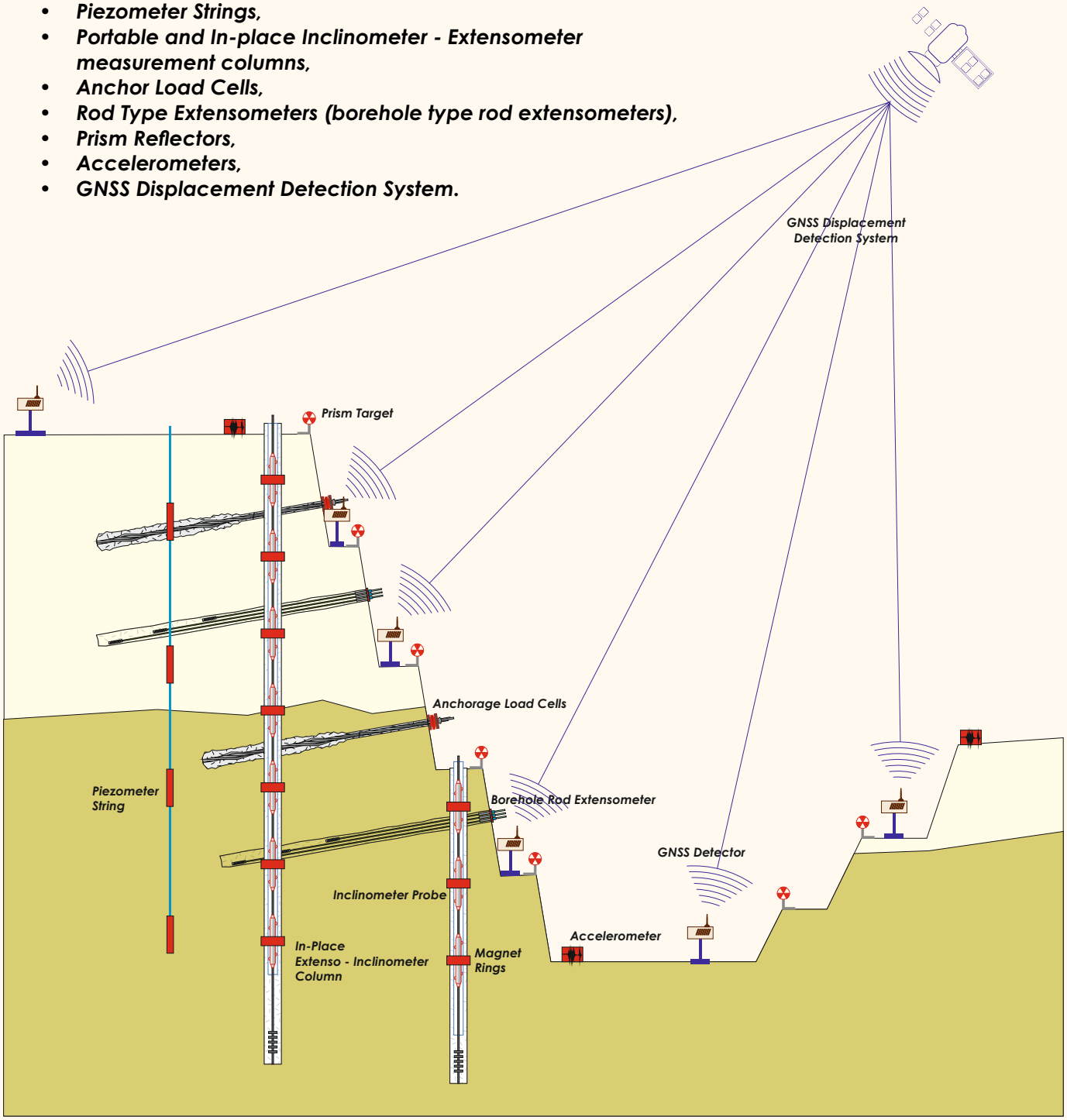


## Open Pit Mines

In open-pit mining operations, the stability of the slopes created by excavation significantly affects the safety of the operation. Geotechnical studies and excavation designs determine and apply parameters such as slope angles, heights, and bench widths, while factors that may negatively impact slope stability are monitored through various observations. These factors include groundwater levels, pore water pressures at specific points, horizontal and vertical displacements, loads on support structures, geostatic pressures at certain points in the project, changes in slope angles on support and slope surfaces, vibrations occurring during the works, and potential causes of sliding and subsidence.

The sensors and measurement systems used in open-pit mining sites include:

- ***Piezometers,***
- ***Piezometer Strings,***
- ***Portable and In-place Inclinometer - Extensometer measurement columns,***
- ***Anchor Load Cells,***
- ***Rod Type Extensometers (borehole type rod extensometers),***
- ***Prism Reflectors,***
- ***Accelerometers,***
- ***GNSS Displacement Detection System.***



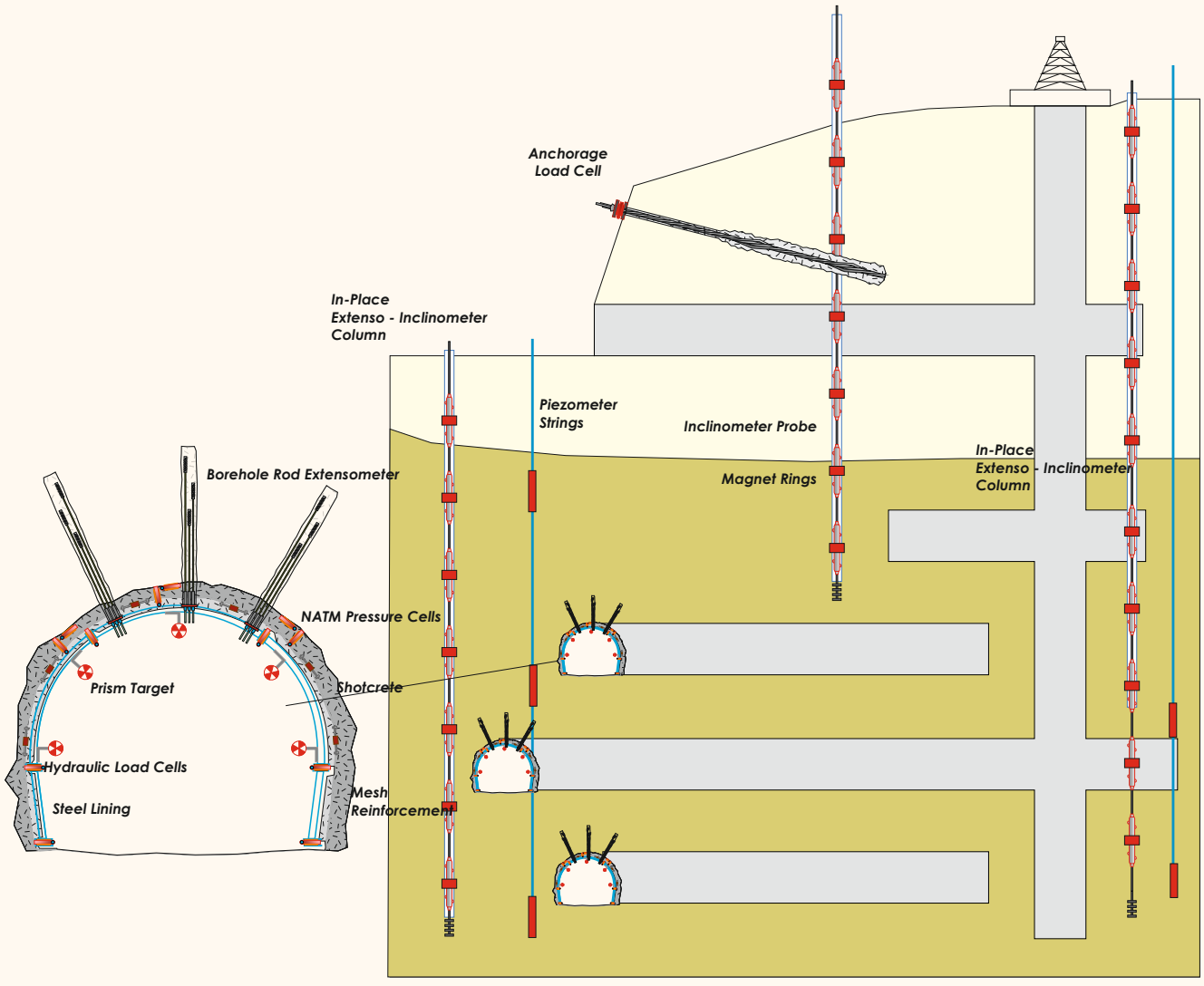
## Underground Mines

In underground mining, excavation safety is critical for both occupational health-safety and the efficiency of mining operations. The ongoing excavation processes, drilling, and blasting directly affect the safety of the underground mining system. The impact of these activities on the stability of underground structures such as tunnels, shafts, ramps, and chambers must be studied and monitored.

Structural discontinuities such as cracks and faults in the rocks, pore water pressures in the geological environment, horizontal and vertical displacements, loads and pressures on support elements, deformations in support structures, and the changes in these measurement values over time are the key features that need to be observed.

Commonly used sensors and systems in monitoring include:

- ***Portable and In-place Inclinometer-Extensometer Observation Columns,***
- ***Piezometers, Piezometer Strings,***
- ***Hydraulic Load Cells,***
- ***NATM Pressure Cells***
- ***Strain Gauges,***
- ***Borehole Rod Extensometers,***
- ***Total Pressure Cellss,***
- ***Prism Reflectors.***



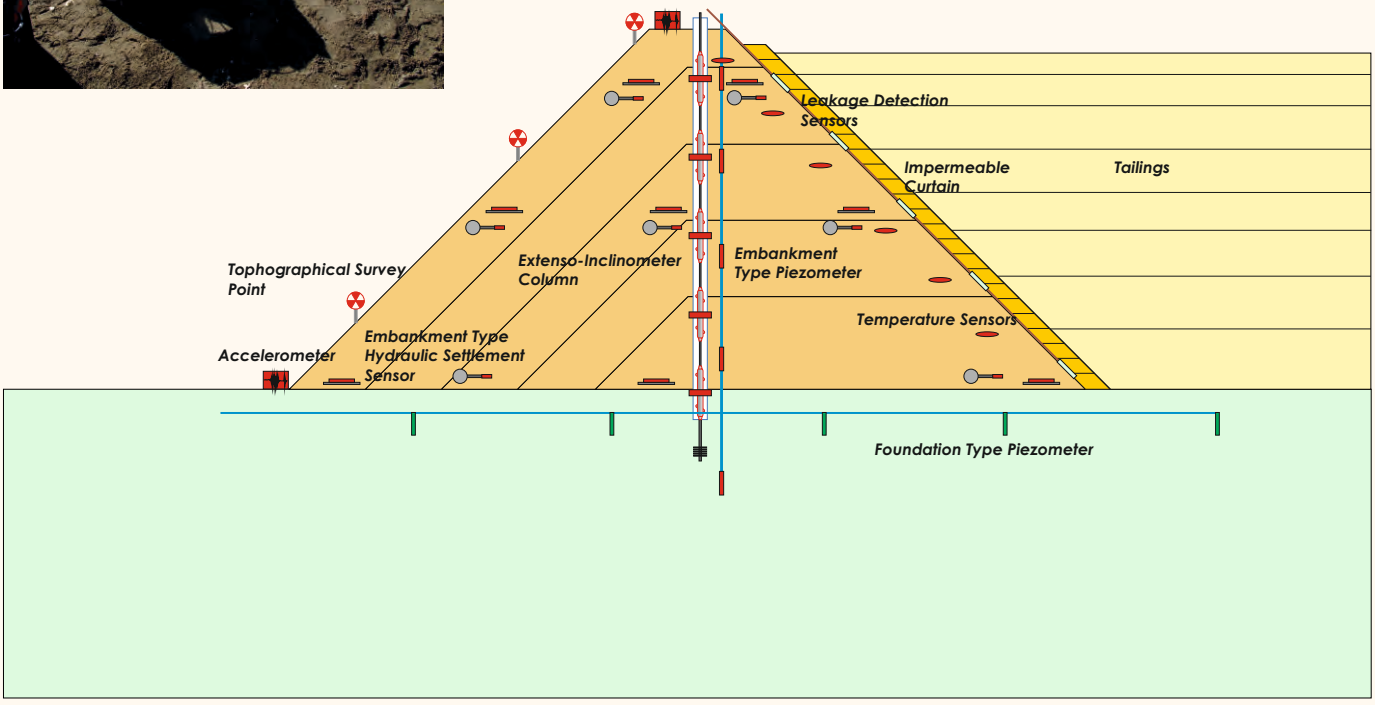
## Tailing Dams and Waste Dumps

Waste Dams (Tailings Dams) are structures created for the safety of piles where waste materials generated in energy plants and mining operations are stored. In mining, various chemicals generated during ore processing, as well as substances like slag and ash produced from coal combustion in energy plants, are accumulated in specially designated and prepared areas. Waste dams are constructed to minimize the environmental and biological damage caused by this storage.

The stability of waste dams is crucial for environmental safety, the health of living organisms, and sustainability. To prevent pollution in groundwater, avoid structural failures that could lead to environmental disasters, and ensure the integrity of the dam, it is necessary to monitor horizontal and vertical displacements in the fill material, piezometric pressures, temperature and humidity values, and potential leakage in critical fill zones using specialized sensors.

Main instruments used:

- ***Embankment and Foundation Type Piezometers***
- ***In-place Extensometer-Inclinometer Measurement Columns***
- ***Total Pressure Sensors***
- ***Embankment Type Hydraulic Settlement Sensors***
- ***Leakage Detection Sensors***
- ***Topographic Observation Points***
- ***Accelerometers***



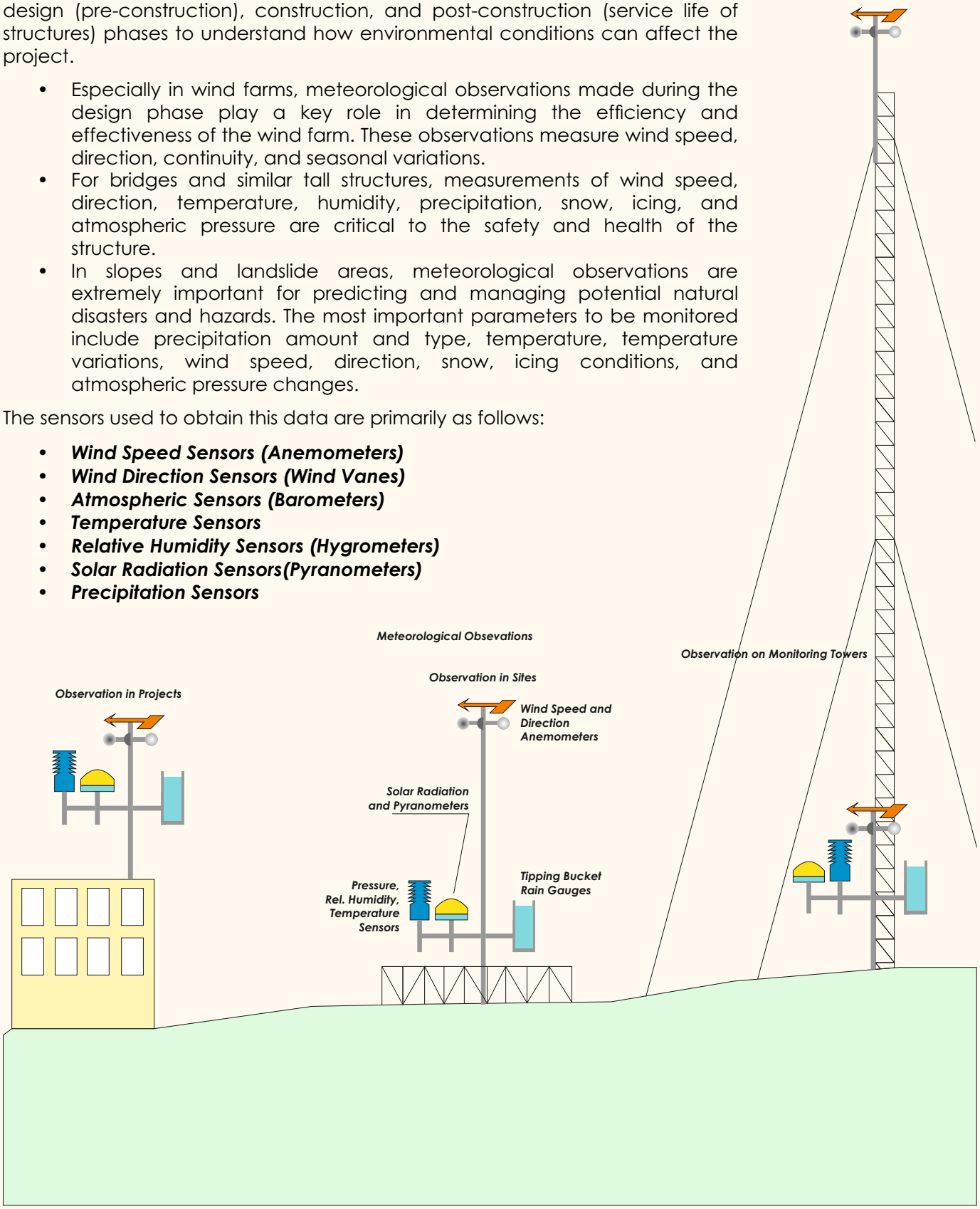
## Meteorological Observations

Meteorological observations take very importantl role in the success, safety, and efficiency of engineering projects. These observations are carried out in the design (pre-construction), construction, and post-construction (service life of structures) phases to understand how environmental conditions can affect the project.

- Especially in wind farms, meteorological observations made during the design phase play a key role in determining the efficiency and effectiveness of the wind farm. These observations measure wind speed, direction, continuity, and seasonal variations.
- For bridges and similar tall structures, measurements of wind speed, direction, temperature, humidity, precipitation, snow, icing, and atmospheric pressure are critical to the safety and health of the structure.
- In slopes and landslide areas, meteorological observations are extremely important for predicting and managing potential natural disasters and hazards. The most important parameters to be monitored include precipitation amount and type, temperature, temperature variations, wind speed, direction, snow, icing conditions, and atmospheric pressure changes.

The sensors used to obtain this data are primarily as follows:

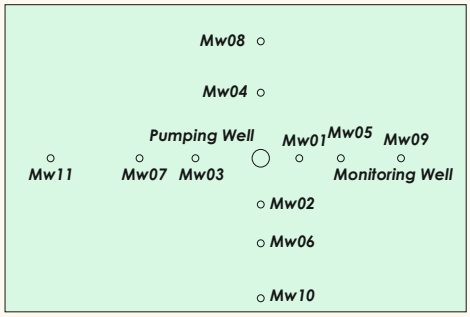
- ***Wind Speed Sensors (Anemometers)***
- ***Wind Direction Sensors (Wind Vanes)***
- ***Atmospheric Sensors (Barometers)***
- ***Temperature Sensors***
- ***Relative Humidity Sensors (Hygrometers)***
- ***Solar Radiation Sensors(Pyranometers)***
- ***Precipitation Sensors***



## Hydrogeological Researches

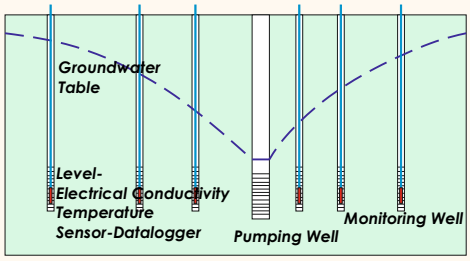
Hydrogeological monitoring has great importance in:

- Sanitary landfills,
- Waste water treatment plants,
- Water storage areas,
- Groundwater supply,
- Infiltration and flotation problems in geotechnical projects.




In this scope our group is provided core services on:

- Determing the potential of grounwater,
- Determination of hydraulic properties in aquifers,
- Measuring groundwater flows in boreholes,
- Determination of contamination and pollution dynamics,
- Well rehabilitation works and
- Pumping tests and
- Aquifer inverstigations.




In these studies:

- **Piezometers,**
- **Data Logger Piezometers (Loggers for pumping tests),**
- **Piezometer Probes include Electrical Conductivity and Temperature Sensors,**
- **Heat Pulse Flowmeter Probs**

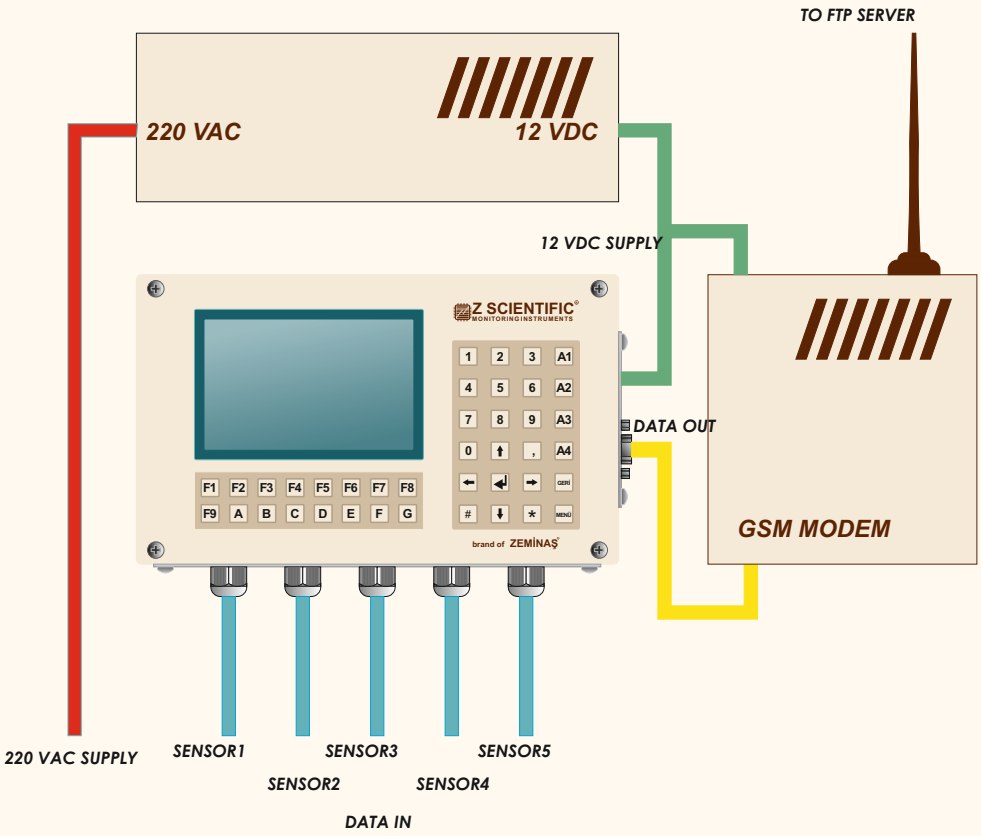
are used.

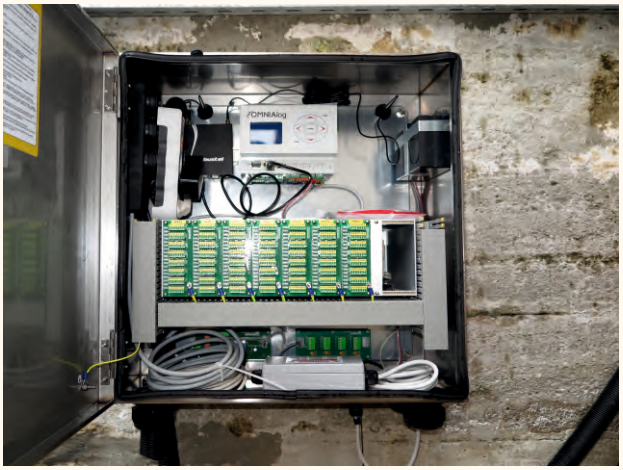
Instrumentation and monitoring systems, created with different setups in engineering projects, exhibit various characteristics in each project.

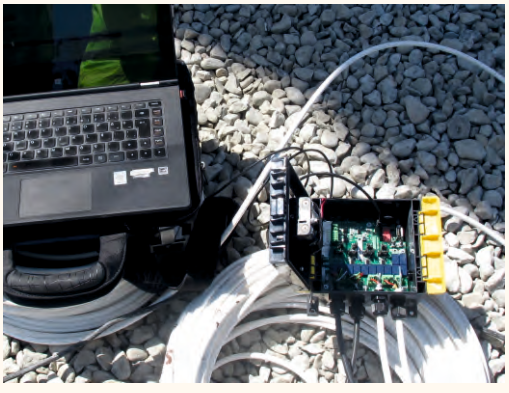
The types of sensors used, their measurement ranges, sensitivities, accuracies, and other production characteristics, as well as the system's measurement frequency, are specifically determined based on the project requirements.

The success of the monitoring studies depend on ensuring complete interaction between the sensor and the structure and on the proper installation method of the system.

# DATA PROCESSING-REPORTING & SOFTWARE DEVELOPMENT



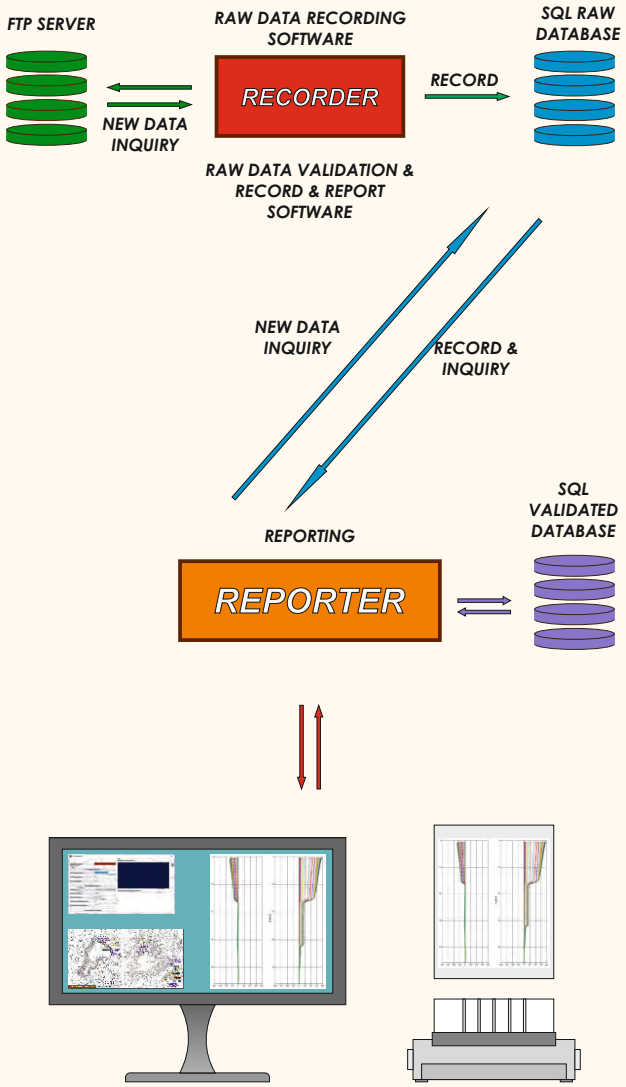



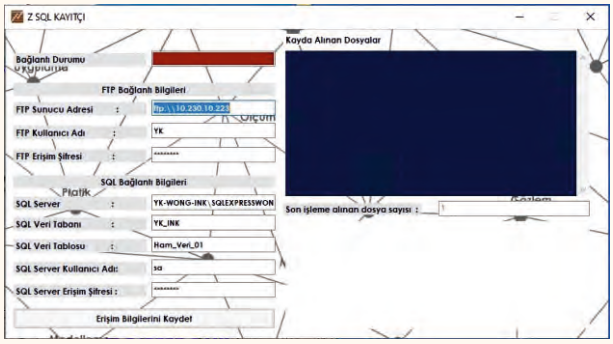


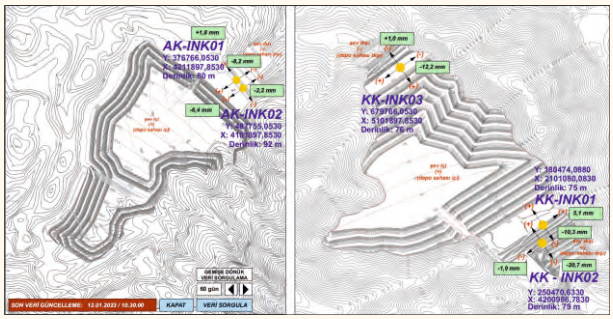
Instrumentation & Monitoring Group provides data processing, reporting and software development services in project basis. validation,

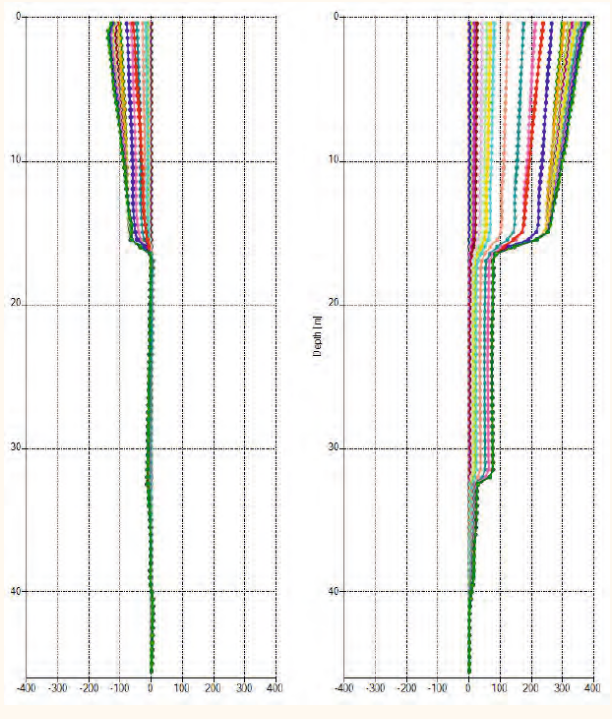
Processing and reporting procedures start with the selection and supplying of the most accurate and highest quality automatic data acquisition systems. The installations are performed by experienced engineers and technicians. After measurement data is sent to servers. The records are parsed with special software and saved in the SQL or similar databases. In the next mining stage, data is queried and processed by validation and verification sequences. Subsequently, monitoring reports are prepared with validated data. Incase excessing any treshold values (given by designer) of project, warning messages are generated and delivered. Current situation of monitoring tasks is proposed on monitoring computers. Measurement values and charts are updated realtime.

The monitoring softwares are developed by our group engineers.

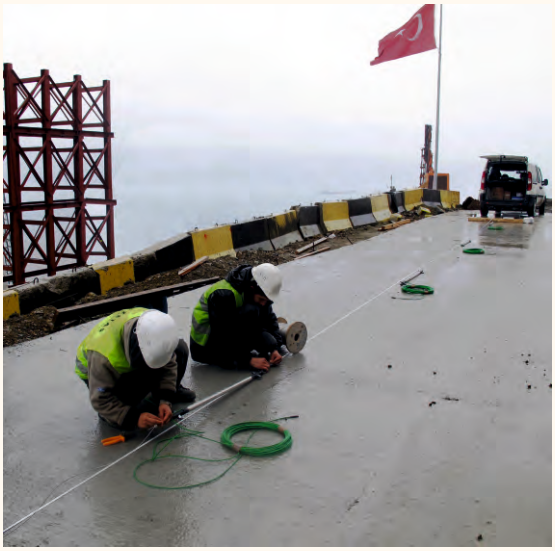


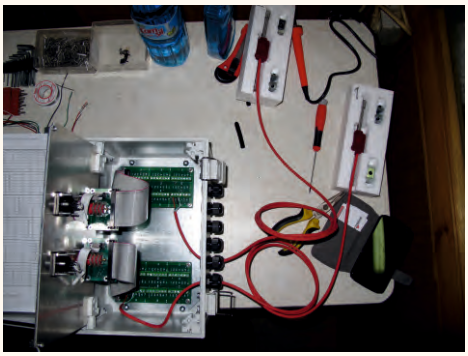



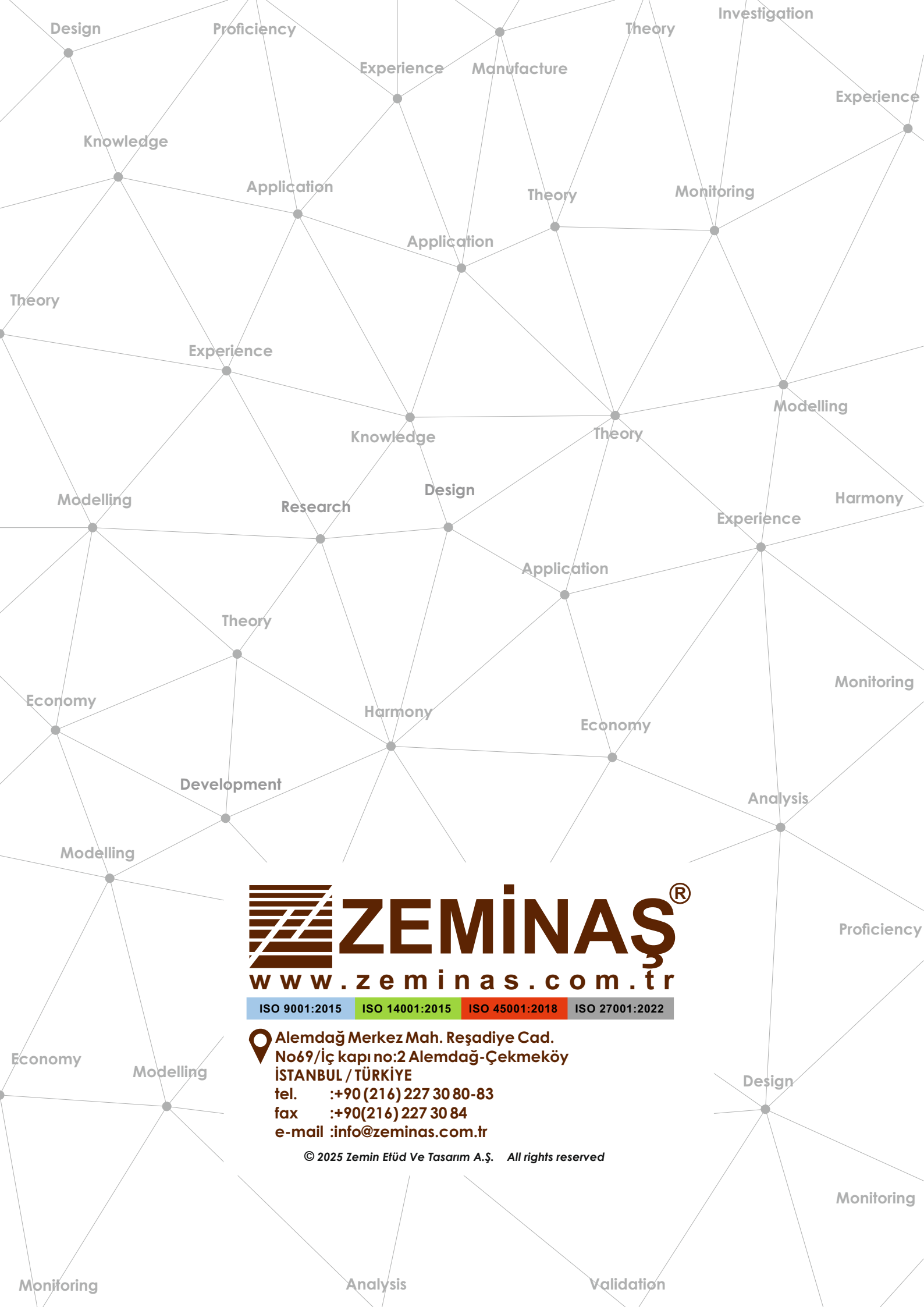
# INSTRUMENTATION & MONITORING SUPERVISION

Instrumentation & Monitoring Group provides supervision, by performing consultancy and training services for installation, commissioning, maintenance, management, data processing and reporting on any customer inquiries.

Our group provides technical support services for design, installation, data collection, reporting, system maintenance, repair, management, software development and testing in instrumentation and monitoring projects.



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