Highway Tunnel

T1 Tunnel, Pathe Section Maliakos - Kleidi Motorway Concession Project

Central Greece

Project
Highway tunnel

Construction Cost

Total project's cost:	approx. € 1,25 b.

Project Schedule

Design:	2008 - 2014
Construction:	2008 - 2017

Project Description
Twin bore highway tunnel

Length of south bound:	1,902.90 m
Length of north bound:	1,945.90 m
Excavation cross section:	85 – 150 m^2

Method of tunnel excavation
NATM – Drilling & blasting - mechanical means

Final Lining
Reinforced and/or unreinforced concrete C30/37

Geology
Amphibolite, Marbles, Phyllites, Amphibolitic Schists
Max. overburden: 140m

Our Services
- Geological – geotechnical interpretation and evaluation studies for tunnel main body & tunnel's portals
- Detailed geotechnical & structural design of tunnel portals'
- Detailed geotechnical & structural design of the tunnel
- Detailed hydraulic design
- Designer on site services
- Designs elaborated by OMIKRON KAPPA CONSULTING S.A., ILF CONSULTING ENGINEERS, Innsbruck & HOCHTIEF CONSULT INFRASTRUCTURE, Essen

Construction Details
- Use of lattice girders
- "Closed ring" solutions

Client
MALIAKOS KLEIDI CONSTRUCTION JV
(HOCHTIEF - AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)

Highway Tunnel

T2 Tunnel, Pathe Section Maliakos - Kleidi Motorway Concession Project

Central Greece




Project
Highway tunnel

Construction Cost
Total project's cost: approx. € 1,25 b.

Project Schedule
Design: 2008 - 2014
Construction: 2008 - 2017

Project Description
Twin bore highway tunnel
Length of south bound: 5,969.18 m
Length of north bound: 5,983.53 m
Excavation cross section: 85 – 150 m²
Smoke Extraction Shaft VF-1:
Total length: 120 m
Excavation diameter: 6.20 m
Smoke Extraction Shaft VF-3:
Total length: 50 m, Excavation diameter: 7 m
Smoke Extraction Gallery VF-2:
Total length: 100 m, Excavation cross section: 48m²

Method of tunnel excavation
NATM – Drilling & blasting - mechanical means

Final Lining
Reinforced and/or unreinforced concrete C30/37

Geology
Limestones, Phyllites
Max. overburden 296m

Our Services
- Geological – geotechnical interpretation and evaluation studies for tunnel main body, tunnel's portals, smoke extraction shafts and smoke extraction gallery
- Detailed geotechnical & structural design of main tunnel portals'
- Detailed geotechnical & structural design of the tunnel
- Detailed geotechnical & structural design of the smoke extraction shafts and of the gallery
- Designer on site services
- Designs elaborated by OMIKRON KAPPA CONSULTING S.A., ILF CONSULTING ENGINEERS, Innsbruck & HOCHTIEF CONSULT INFRASTRUCTURE, Essen

Construction Details
- Use of lattice girders
- "Closed ring" solutions

Client
MALIAKOS KLEIDI CONSTRUCTION JV
(HOCHTIEF - AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)

Highway Tunnel

T3 Tunnel, Pathe Section Maliakos - Kleidi Motorway Concession Project

Central Greece

Project
Highway tunnel

Construction Cost

Total cost:	approx. € 1,25 b.

Project Schedule

Design:	2008 - 2014
Construction:	2008 - 2017

Project Description
Twin bore highway tunnel

Length of south bound:	2,799.08 m
Length of north bound:	2,786.03 m
Excavation cross section:	85 – 150 m^2

Method of tunnel excavation
NATM – Drilling & blasting - mechanical means

Final Lining
Reinforced concrete C30/37

Geology
Limestones, serpentinized peridotites, ophiolites, cataclasites-mylonites, alluvial deposits
Max. overburden : 150m

Our Services
- Geological – geotechnical interpretation and evaluation studies for tunnel main body and tunnel's portals
- Detailed geotechnical & structural design of tunnel portals
- Detailed geotechnical & structural design of the tunnel
- Designer on site services
- Designs elaborated by OMIKRON KAPPA CONSULTING S.A., ILF CONSULTING ENGINEERS, Innsbruck & HOCHTIEF CONSULT INFRASTRUCTURE, Essen

Construction Details
- Use of lattice girders
-"Closed ring" solutions

Client
MALIAKOS KLEIDI CONSTRUCTION JV
(HOCHTIEF - AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)

Highway Cut Slopes

TEMPI VALLEY - Slope Stabilization and Rockfall Protection Detailed Design, PATHE SECTION MALIAKOS – KLEIDI MOTORWAY, CONCESSION PROJECT

Central Greece

Project

Slope stabilization and rockfall protection detailed design at Tempi Valley (National Roadway of Athens – Thessaloniki)

Construction Cost

Total Cost: approx. 3m. €

Project Schedule

Design: 2008 - 2009
Construction: 2010 - 2011

Project Description

Assessment of the cut slope stability and determination of the necessary slope stabilization works and rockfall protection measures
Length: 5.0km

Geomorphology - Geology

Mountainous terrain, very steep rocky slopes of significant height up to 150m
Thick to medium bedded crystalline limestones, Phyllites, soil like formations (limestone boulders, scree – debris materials)

Our Services

- Detailed geotechnical design
- Identification and evaluation of the potential slope failure mechanisms – elaboration of detailed stability audit
- Execution of stability analysis (rockfalls, planar failure, rock wedge formation, toppling, circular slip failure)
- Determination of the necessary support - stabilization measures
- Detailed dimensioning of the mitigation systems, technical specifications and construction method statement
- Elaboration of technical report, construction drawings and BoQ's
- Consulting services during on site application

Construction Details

- Scaling works performed manually or/and with the use of mechanical means
- Installation of approx. 1,900m of rockfall protection barriers
- Installation of approx. 5,500m^2 slope stabilization systems (fully anchored Tecco type mesh, Spider type net)
- Application of approx. 1,350m of permanent, fully grouted rock bolts
- Rehabilitation of the existing fences and the drainage ditches

Rockfall protection barriers Installation

Slope stabilization systemapplication

Client

MALIAKOS KLEIDI CONSTRUCTION J/V
(HOCHTIEF – AKTOR – J& P AVAX– VINCI CGP – AEGEK – ATHENA)

Highway Cut Slopes

PANTELEIMONAS AREA (PLATAMONAS) PATHE SECTION MALIAKOS – KLEIDI MOTORWAY, Concession Project, Slope Stabilization and Rockfall Protection Detailed Design

Central Greece

Project

Slope stabilization and rockfall protection detailed design at Panteleimonas area (Platamomas) of the National Roadway Athens – Thessaloniki

Construction Cost

Total Cost: approx. 0.5 m. €

Project Schedule

Design: 2008
Construction: 2010

Project Description

Assessment of the cut slope stability and determination of the necessary stabilization works and rockfall protection measures
Length: 2.5km

Geomorphology - Geology

Steep rocky slopes of average height 10 - 20m
Crystalline Limestones, soil formations (limestone boulders, scree materials)

Our Services

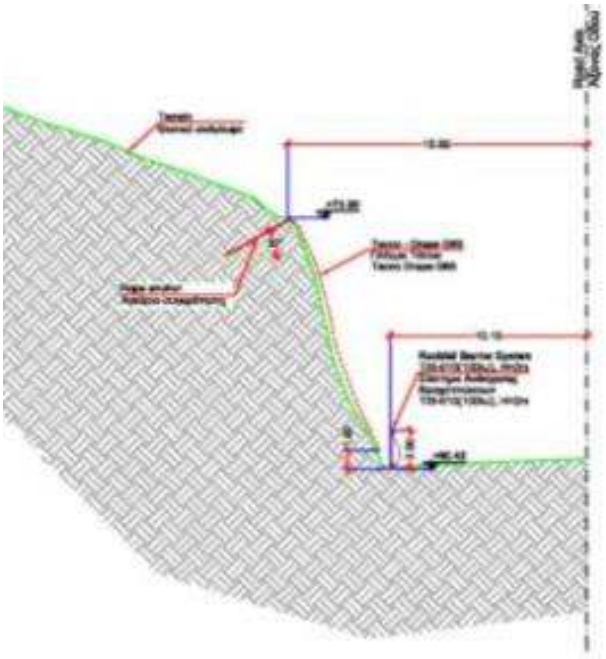
- Detailed geotechnical design
- Identification and evaluation of the potential slope failure mechanisms – elaboration of detailed stability audit
- Execution of stability analysis (rockfalls, wedge failure)
- Determination of the necessary support and stabilization measures
- Detailed dimensioning of the mitigation systems, technical specifications and construction method statement
- Elaboration of technical report, construction drawings and bill of quantities (BOQ)
- Consulting services during on site application

Construction Details

- Scaling works performed manually or/and with the use of mechanical means
- Installation of approx. 100m of rockfall protection barriers
- Installation of approx. 2,500m^2 slope stabilization systems (fully anchored Tecco type mesh, drape, Spider type net)

Client

MALIAKOS KLEIDI CONSTRUCTION JV
(HOCHTIEF - AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)



Typical cross section with installation of rockfall barrier and mesh

Slope stabilization systems application

Highway General Excavation Works

Highway Excavation Works, PATHE SECTION, Maliakos – Kleidi Motorway, Concession Project

Central Greece

Project
Highway excavation works for Maliakos Kleidi Motorway GU 10 ~ 14, GU 16 ~ 19, GU 24 ~ 25

Construction Cost
Total Cost: approx. € ~600 m.

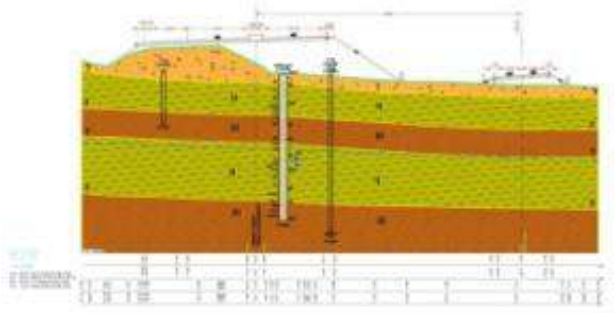
Project Schedule
Design: 2007 - 2017
Construction: 2007 - 2017

Project Description
Total length of excavation works:
Embankments: 33km
Open Cuts: 8,6 km

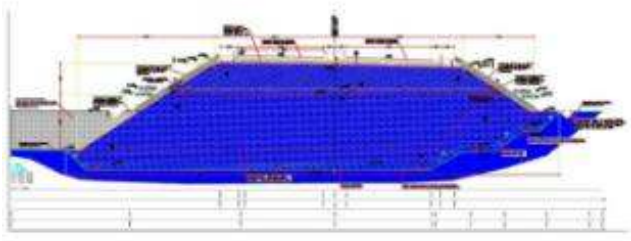
1. Embankments : soil fill or rock fill material reinforced or loose with geogrids
   Modulation geometry: one or double sided
   Reinforced slopes with gradient 1:3 ~ 2:1
   Maximum Height: 19m
2. Open Cuts :Modulation and support of open cuts
   Slopes with gradient 1:2 ~ 3:1
   Maximum height: 38m

Geology
GU 10 ~ 14: Recent disposals, Phyllites
GU 16 ~ 19: Recent Disposals, ophiolithic sequence, Limestones, marbles
GU 24 ~ 25: Disposals, ophiolithic sequence

Our Services
- Ground geotechnical interpretation report
- Geotechnical drawings of longitudinal and cross sections
- Detailed geotechnical design
- Construction drawings



Geotechnical evaluation model



Embankment 's typical cross section

Construction Details
1. Embankments :
- Construction of drainage trenches at the foot of the slope
- Construction of embankments with soil fill or rock fill materials
- Foundation of the embankments with reinforced geogrids
- Construction of support walls
- Construction of embankments with severe gradient and gabion facing
- Foundation of the embankments with the use of piles

2. Open Cuts:
- Installation of anchors
- Installation of meshes
- Construction of support walls

Client
MALIAKOS KLEIDI CONSTRUCTION JV
(HOCHTIEF - AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)

Special Geotechnical Applications

Retaining Works inside a Landslided Area
Pathe Section Maliakos – Kleidi Motorway, Concession Project

Central Greece

Project
Construction of retaining wall system with single or double pile-walls for the secure execution of highway works inside landslided area

Construction Cost
Total project's cost: approx. € 1,5 m.

Project Schedule
Design: 2010 - 2011
Construction: 2017 - 2017

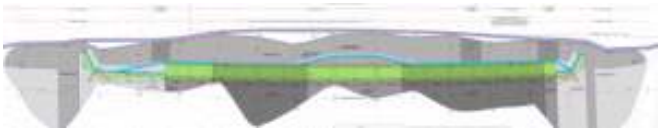
Project Description
Construction of retaining wall system with single or double concrete cantilever pilewalls for the secure execution of highway works inside a landslided area
Total length of pilewall system: ~300m
Maximum height of pilewall system: 10m
Total slope height: 20m

Geology
The bedrock of the landslide area includes ophiolite rocks
The overlying soil materials consist of a sequence of slided masses

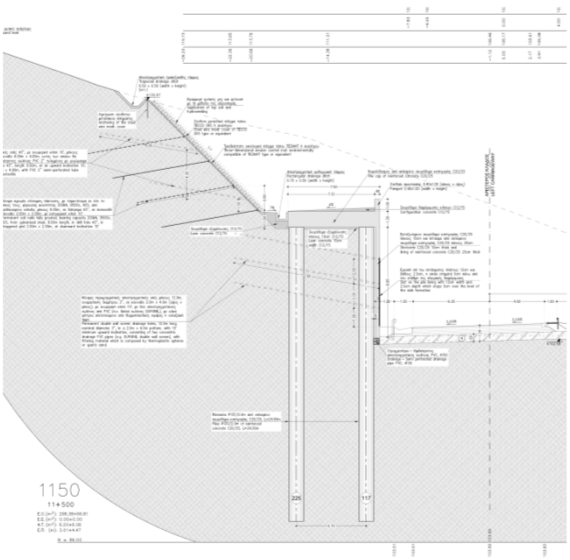
Our Services – Design Details
- Detailed design of permanent open cut
- Geotechnical interpretation and design parameter assessment
- Special design and dimensioning of the pile system with finite elements software
- Specific load check of the retaining system from random sliding surfaces
- Serviceability check of the retaining system
- Assessment and determination of the landslided area's seismic load

Client
MALIAKOS KLEIDI CONSTRUCTION JV
(HOCHTIEF - AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)

Layout depicting the landslided areas



Excavations and the retaining system structure plan view



Cross Section with double retaining wall pile series

Special Geotechnical Applications

Embankment Designs with lightweight materials, Pathe Section Maliakos – Kleidi Motorway, Concession Project

Central Greece

Project

Bridge replacement by Embankment with lightweight materials (EPS) in combination with special protection structures for the protection of the central natural gas pipeline and the high speed railway line from Athens to Thessaloniki

Construction Cost

Total project's cost: approx. € 18 m.

Project Schedule

Design: 2011 - 2016
Construction: 2011 - 2017

Project Description

Combination of conventional and lightweight embankment with EPS application for the protection of the central natural gas pipeline and the high speed railway line from Athens to Thessaloniki and optimization of the construction conditions
Total embankment length: ~700m
Maximum embankment height: 19m
Total lightweight embankment length: ~230m
Maximum lightweight embankment height: 18m
Lightweight embankment slopes: 2:3 up to vertical

Geology

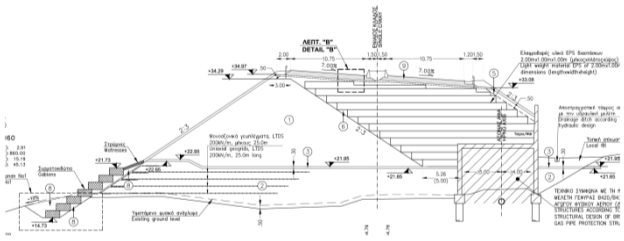
Alluvial deposits, silt-clay of low to medium plasticity
Bedrock formation from weathered layers of amphibolitic schist

Our Services – Design Details

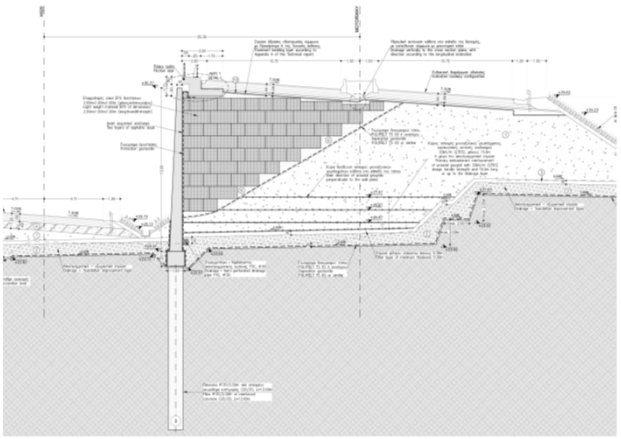
- Detailed geotechnical design
- Geotechnical investigation and pile loading tests
- Trial embankment monitoring for a 3-month time period
- Technoeconomic design for minimizing construction cost
- Geotechnical foundation design and optimization of the protection structures of the central natural gas pipeline, the National Road and the high speed railway from Athens to Thessaloniki
- Structural and seismic protection design of the conventional and lightweight embankment
- Design of retaining wall for lightweight and conventional embankment with mixed foundation on piles and slab-type footing

Client

AKTOR S.A.



Composite embankment with conventional and lightweight materials and protection structure for the natural gas pipeline



Retaining wall founded on piles with EPS fill

Special Geotechnical Applications

Mechanically Stabilized Earth Walls Pathe Section Maliakos – Kleidi Motorway, Concession Project

Central Greece

Project
Mechanically stabilized earth walls with height 10-16m constructed by gabions as retaining walls or bridge abutments

Construction Cost
Total project's cost: approx. € 5 m.

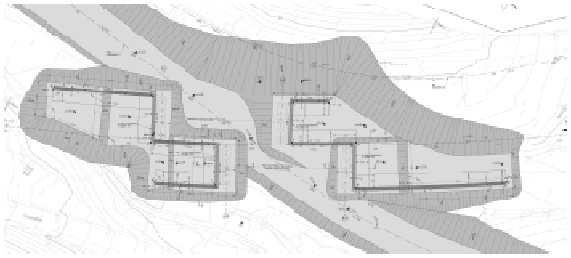
Project Schedule
Design: 2009 - 2017
Construction: 2011 - 2017

Project Description
Mechanically stabilized earthwalls with height 10-15m constructed by gabions as retaining walls or bridge abutments
Total MSEW length: ~1500m
Maximum height: 10-15m
MSEW slope: 3:1 up to vertical

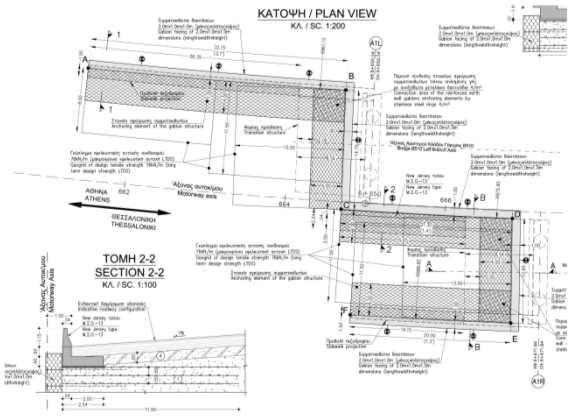
Geology
GU 10 ~ 14: Recent deposits, Phyllites
GU 16 ~ 19: Recent deposits, ophiolithic sequence, limestones

Our Services – Design Details
- Detailed geotechnical design
- Geotechnical interpretation and design parameter assessment
- Stability evaluation of MSEW with specialized software
- Internal and External stability checks
- Appropriate geogrid application according to fill material characteristics
- Gabion modulation in geometrically complex areas

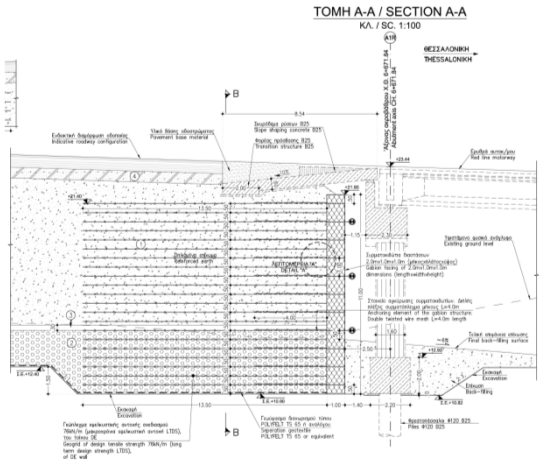
Client
MALIAKOS KLEIDI CONSTRUCTION J/V
(HOCHTIEF – AKTOR – J&P AVAX – VINCI CGP – AEGEK – ATHENA)



MSEW foundation area excavation layout



Grid and gabion connection plan view and details



MSEW bridge abutment longitudinal section