

Highway Tunnel

T24 Tunnel

Elefsina - Korinthos - Patras - Pyrgos - Tsakona Motorway, Concession Project

Central & Southern Greece



Project

Highway tunnel

Construction Cost

Total project's cost: approx. € 2.8 b.

Project Schedule

Design: 2009 - 2011

Construction: 2009 - 2017

Project Description

Single bore highway tunnel

Length: 548m

Excavation cross section: 142 ~ 173m²

Emergency Access:

Length: 133m

Excavation cross section: 29m²

Method of tunnel excavation

NATM – Drilling & blasting – mechanical means

Final Lining

Reinforced concrete C30/37

Geology

Conglomerates

Max. overburden in T24: 70m

Max. overburden in emergency access: 60m

Our Services

- Geological – geotechnical interpretation and evaluation studies for tunnel main body & emergency access
- Detailed geotechnical & structural design of tunnel portals
- Detailed geotechnical design
- Detailed geotechnical design of the emergency access and of the portal

Construction Details

- Use of lattice girders
- "Closed ring" solutions

Client

APION KLEOS Construction JV

(VINCI CONSTRUCTION GRANDS PROJETS S.A.S. -

HOCHTIEF Construction AG - J&P-AVAX S.A. -

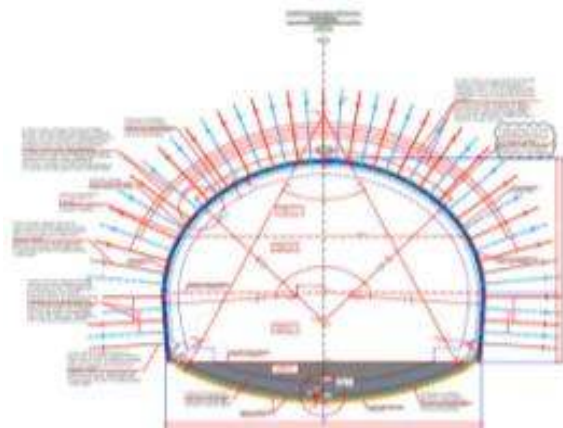
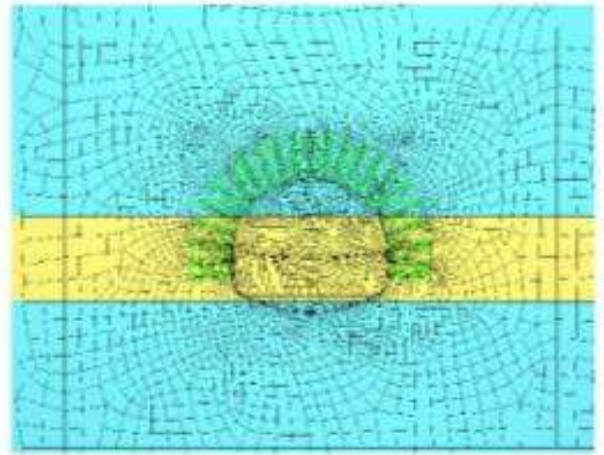
ATHENA S.A. - AKTOR S.A. - GEK/TERNA S.A.)

Highway Tunnel

T25 Tunnel

Elefsina – Korinthos – Patras – Pyrgos - Tsakona Motorway, Concession Project

Central & Southern Greece



Project

Highway tunnel

Construction Cost

Total project's cost: approx. € 2,8 b.

Project Schedule

Design: 2009 - 2011
Construction: 2009 - 2017

Project Description

Single bore highway tunnel
Length: 572m
Excavation cross section: 142 ~ 173m²
Emergency Access:
Length: 82m
Excavation cross section: 29m²

Method of tunnel excavation

NATM – Mechanical means & drilling & blasting at places

Final Lining

Reinforced concrete C30/37

Geology

Conglomerates, cherts, limestone breccia, limestones
Max. overburden in T25: 50m
Max. overburden in emergency access: 31m

Our Services

- Geological – geotechnical interpretation and evaluation studies for tunnel main body & emergency access
- Detailed geotechnical & structural design of tunnel portals
- Detailed geotechnical design
- Detailed geotechnical design of the emergency access and of the portal

Construction Details

- Use of lattice girders
- "Closed ring" solutions

Client

APION KLEOS Construction JV
(VINCI CONSTRUCTION GRANDS PROJETS S.A.S. - HOCHTIEF Construction AG - J&P-AVAX S.A. - ATHENA S.A. - AKTOR S.A. - GEK/TERNA S.A.)

Highway Tunnel T26 Tunnel, Elefsina - Korinthos - Patras - Pyrgos - Tsakona Motorway, Concession Project Central & Southern Greece



Project

Highway tunnel

Construction Cost

Total project's cost: approx. € 2,8 b.

Project Schedule

Design: 2009 - 2011
Construction: 2009 - 2017

Project Description

Twin bore highway tunnel
Length of south bound: 4,016m
Length of north bound: 3,173m
Excavation cross section: 120m²
Ventilation Adit:
Total length: 480m, Excavation cross section: 75m²
Emergency Accesses:
Total length: 140m, Excavation cross section: 28m²

Method of tunnel excavation

NATM – Drilling & blasting - mechanical means

Final Lining

Reinforced concrete C30/37

Geology

Conglomerates, limestones, cherts
Max. overburden in T26: 270m
Max. overburden in ventilation adit: 200m
Max. overburden in emergency accesses: 45m

Our Services

- Geological – geotechnical interpretation and evaluation studies for tunnel main body, tunnel's portals, ventilation adit and emergency accesses
- Final landslide study in tunnel 26 area
- Detailed geotechnical & structural design of main tunnel portals
- Detailed geotechnical & structural design
- Detailed geotechnical & structural design of ventilation audit & emergency accesses portals
- Detailed geotechnical & structural design of the ventilation audit & of the emergency accesses
- Designer on site services

Construction Details

- Flexible support by use of lattice girders with sliding joints in the highly squeezing parts of tunnel
- "Closed ring" solutions

Client

APION KLEOS Construction JV
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Highway Tunnel Platanos Tunnel Elefsina - Korinthos - Patras - Pyrgos - Tsakona Motorway, Concession Project

Central & Southern Greece



Project

Highway tunnel

Construction Cost

Total project's cost: approx. € 2,8 b.

Project Schedule

Design: 2009 - 2011

Construction: 2009 - 2017

Project Description

Twin bore highway tunnel

Length of south bound: 1,676m

Length of north bound: 1,565m

Excavation cross section: 120m²

Cut & Cover in Tunnel's South Bound Exit Portal.

Total length: 187m

Method of tunnel excavation

NATM – Mechanical means - drilling & blasting

Final Lining

Reinforced concrete C30/37

Geology

Marls, conglomerates, limestones

Max. overburden: 100m

Our Services

- Geological – geotechnical interpretation study
- Landslide assessment at east portals, main tunnel body & west portals areas
- Detailed geotechnical & structural design of the portals
- Detailed geotechnical & structural design of the tunnel
- Detailed geotechnical & structural design of the cut & cover in tunnel's south bound exit portal
- Designer on site services

Construction Details

- Support by use of steel sets of HEB type
- "Closed ring" solutions

Client

APION KLEOS Construction JV
(VINCI CONSTRUCTION GRANDS PROJETS S.A.S. - HOCHTIEF Construction AG - J&P-AVAX S.A. - ATHENA S.A. - AKTOR S.A. - GEK/TERNA S.A.)

Slopes, Cuts and Embankments

Slope Stability Audit of existing highway cuts and embankments

Elefsina – Korinthos – Patras – Pyrgos – Tsakona Motorway, Concession project

Southern Greece

Project

Detailed design of slope repair and remedial works for the existing embankments and cuts of Elefsina – Korinthos – Patras – Pyrgos – Tsakona Motorway

Construction Costs

Total Costs: approx. € ~5 m €

Project Schedule

Design: 2008 –
Construction: 2009 – 2011

Project Description

Rehabilitation of existing cuts and embankments

Geology

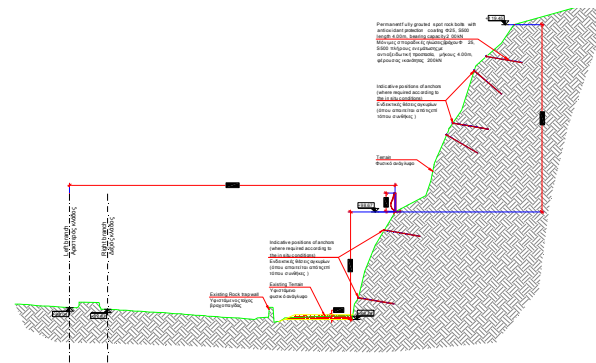
Limestones, marly limestones, conglomerates and artificial embankment bodies

Our Services

- Detailed geotechnical design
- Identification and registration of all problems and hazards
- Geological mapping and assessment of the geotechnical parameters
- Stability analysis to determine the potential failures and to work on the protection measures
- Determination of all necessary protection and rehabilitation measures (installation of rock fall barriers, slope support)
- Construction Drawings
- Bill of Quantities - Budget

Construction Details

- Scaling with the use of light mechanical means
- Installation of rockfall barriers
- Installation of slope protection measures
- Application of permanent rock bolts
- Installation of 3-D protection geogrid
- Application of hydroseeding
- Rehabilitation of damaged drainage culvert
- Construction of drainage ditch at the top of existing retaining wall
- Construction of support walls



Indicative cross section with the appropriate repair and remedial measures



Existing cut view

Client

APION KLEOS Construction JV
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- HOCHTIEF Construction AG - J&P-AVAX S.A. -
ATHENA S.A. – AKTOR S.A. – GEK/TERNA S.A.)

Technical Works

Retaining Walls with Strip Foundation

Elefsina – Korinthos – Patra – Pyrgos – Tsakona Motorway, Concession Project

Central & Southern Greece

Project

Highway retaining walls - structures

Construction Cost

Total cost: approx. € 8m.

Project Schedule

Design: 2009 - 2017
Construction: 2009 - 2017

Project Description

Retaining walls/structures

Total length: 14.000m
Height: 2.0m-11m

Geology

Marls, conglomerates, limestones, scree materials, alluvial deposits, gravels, clays, silts, sands

Our Services

- Estimation of the input geotechnical design parameters
- Definition of the geometry of the structures (cross section, height etc.)
- Elaboration of all the necessary analysis and checks for structures dimensioning
- Detailed construction drawings
- Detailed geotechnical & structural design

Construction Details

- Reinforced concrete C20/25, C30/37
- Surface / deep foundation
- Additional components at walls crest (safety barriers, sound barriers etc.)

Clients

- APION KLEOS Construction JV (VINCI CONSTRUCTION GRANDS PROJETS S.A.S. – HOCHTIEF Construction AG - J&P-AVAX S.A. - ATHENA S.A. – AKTOR S.A. – GEK/TERNA S.A.)
- OLYMPIA JOINT VENTURE (HOCHTIEF Construction AG - AKTOR S.A.)
- AKTOR S.A.
- VINCI CONSTRUCTION GRANDS PROJETS S.A.S.



Retaining wall general view



Retaining wall construction



Embankment construction behind the retaining wall

Special Geotechnical Applications

Reinforced Embankment Final Designs and Mechanically Stabilized Earth Wall Detailed Designs

Elefsina – Korinthos – Patras – Pyrgos – Tsakona Motorway, Concession Project

Central & Southern Greece



Mechanically stabilized earth-wall



Reinforced embankment

Project

Detailed designs of mechanically stabilized earth walls with height up to 15m and reinforced embankments of height up to 29m for treating with adverse geometries during the construction of highway embankments

Construction Cost

Total project's cost: approx. € 80 m.

Project Schedule

Design: 2009 - 2017

Construction: 2009 - 2017

Project Description

Total reinforced embankment and MSEW length: ~9500m

Maximum height: 29m

MSEW slope: 2.5:1 up to vertical

Reinforced embankment slope: 2:3 up to 2:1

Geology

Pliocene and Plio-pleistocene Marls, Conglomerates, Alternations of Marl-Conglomerates, Alluvial Deposits, Weathered slope materials, Sands, Gravels, Clay-Silts

Our Services

- 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 walls layout in geometrically complex areas
- Detailed design

Client

AKTOR S.A.

Special Geotechnical Applications

Complex Retaining Systems and Structures

Elefsina – Korinthos – Patras – Pyrgos – Tsakona Motorway, Concession Project

Central & Southern Greece



Retaining pilewall and surface protection with gabions



Pilewall retaining system with prestressed anchors

Project

Detailed designs for construction of retaining wall system with single or double pile-walls and application of permanent prestressed anchors for the secure execution of highway works in adverse geotechnical and geometrical areas

Construction Cost

Total project's cost: approx. € 9 m.

Project Schedule

Design: 2009 - 2017
Construction: 2009 - 2017

Project Description

Total length of complex retaining systems: ~1700m
Maximum height of retaining systems: 35 m

Geology

Pliocene and Plio-pleistocene Marls, Conglomerates, Alternations of Marl-Conglomerates, Alluvial Deposits, Weathered slope materials, Sands, Gravels, Clay-Silts

Clients

- OLYMPIA JOINT VENTURE (HOCHTIEF Construction AG - AKTOR S.A.)
- AKTOR S.A.



Composite retaining system with prestressed anchors

Our Services

- Geotechnical interpretation and design parameter assessment
- Geotechnical parameters optimization with slope stability back analysis
- Specific load check of the retaining system from random sliding surfaces
- Serviceability check of the retaining system
- Check and dimensioning of prestressed anchors according to EC7
- Assessment and determination of the seismic load according to the area's geotechnical profile
- Detailed design

Highway General Excavation Works Earthworks Designs

Elefsina – Korinthos – Patras – Pyrgos - Tsakona Motorway, Concession Project

Central & Southern Greece

Project

Detailed geotechnical earthwork designs in the Korinthos – Patras stretch from C.P. 20 up to C.P. 80 (Cuts & Embankments)

Construction Cost

Total project's cost: approx. € 180 m.

Project Schedule

Design: 2008 - 2017

Construction: 2008 - 2017

Project Description

Total length of Excavation Works

Cuts: 13,500m

Bare or partially reinforced embankments: 31,000 m

Open Cuts:

- Slope layout and reinforcement of open cuts
- Use of fully grouted permanent or prestressed anchors
- Slopes with gradient 1:2~ 12:1
- Maximum slope height: 12m
- Maximum total cut height: 65m

Embankments:

- Soil fill material
- Bare or partially reinforced embankments with geogrids due to seismic design
- Modulation Geometry: one or double sided
- Slopes with gradient 2:3
- Deck width: 30m - 50m
- Maximum height: 1

Geology

Pliocene and Plio-pleistocene Marls, Conglomerates, Alternations of Marl-Conglomerates, Alluvial Deposits, Weathered slope materials, Sands, Gravels, Clay-Silts, Limestones

Our Services

- Geotechnical interpretation and design parameter assessment
- Geotechnical parameters optimization with slope stability back analysis
- Stability evaluation with specialized software
- Appropriate geogrid application according to fill material characteristics
- Check and dimensioning of prestressed anchors according to EC7
- Assessment and determination of the seismic load according to the area's geotechnical profile
- Application of geocomposites for hydraulic erosion control as well as rock barrier – rock fall systems
- Detailed design



Open cut with prestressed anchors



High open cut with fully bonded permanent anchors and appropriate slope protection with anchored wire mesh



Open cut with fully bonded permanent anchors and appropriate slope protection with anchored wire mesh and rock fall protection barrier

Clients

- OLYMPIA JOINT VENTURE (HOCHTIEF Construction AG – AKTOR S.A.)
- AKTOR S.A.

Technical Works

Underpasses

Elefsina – Korinthos – Patra – Pyrgos – Tsakona Motorway, Concession Project

Central & Southern Greece

Project

Detailed design of eighteen (18) Underpasses

Construction Cost

Total cost: approx. € 6,5m.

Project Schedule

Design: 2009 - 2017

Construction: 2009 - 2017

Project Description

Three (3) types of underpasses

- Underpasses founded in two cast in situ reinforced concrete pile series
- Underpasses with surface (pad) foundation (box type)
- Underpasses consisting of two wall-type abutments founded in reinforced concrete piles
- Total underpasses length: 580m

Geology

Conglomerates, marls, scree materials, alluvial deposits, gravels, clays, silts, sands

Our Services

- Estimation of the geotechnical design parameters and the maximum groundwater level
- Definition of the geometry of the underpasses (cross section, height etc.)
- Elaboration of all the necessary analysis and checks for structures dimensioning
- Detailed construction drawings
- Detailed geotechnical & structural design

Construction Details

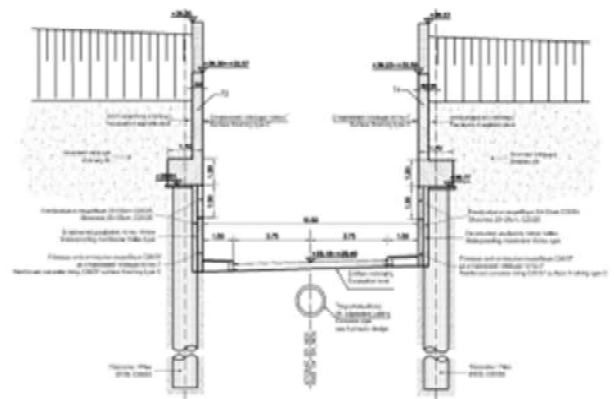
- Reinforced concrete C20/25, C30/37
- Surface foundation
- Foundation in piles

Clients

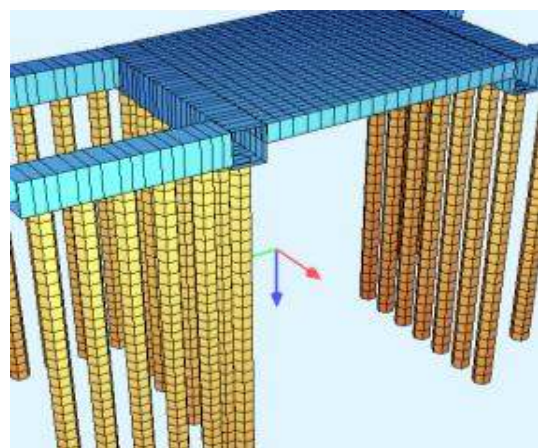
- OLYMPIA JOINT VENTURE (HOCHTIEF Construction AG – AKTOR S.A.)
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General view



Typical cross section



Simulation analysis model

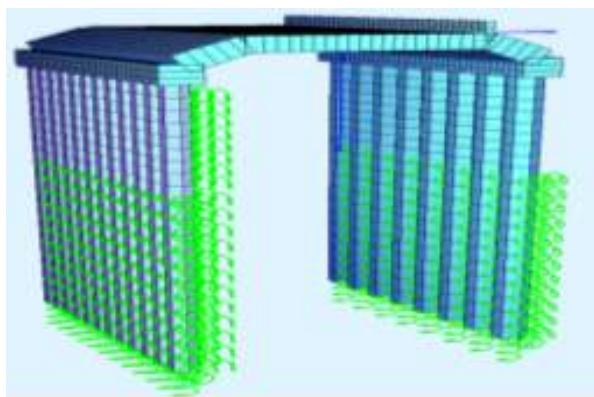
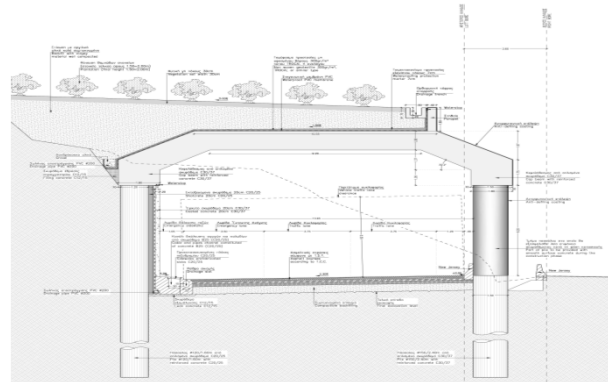
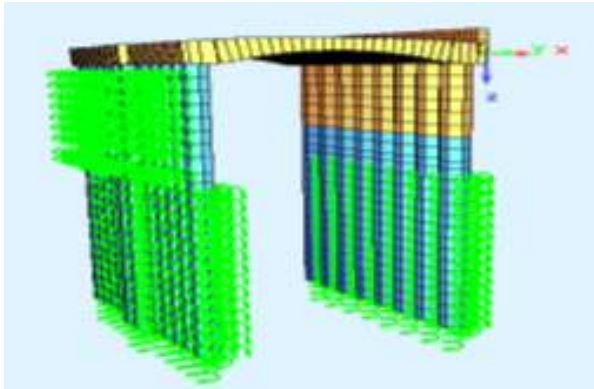
Technical Works

Lane Covers

Elefsina – Korinthos – Patras –

Pyrgos – Tsakona Motorway, Concession Project

Central & Southern Greece



Project

Final design of lane covers

Project Schedule

Design: 2009 - 2011

Construction: 2010 - 2011

Project Description

Lane covers founded in circular cross section columns and founded on cast in place reinforced concrete pile series

Length of Platanos lane cover: 38m

Length of Temeni lane cover: 118m

Length of Eliki East lane cover: 38m

Geology

Brecciated limestones, sands, gravels, clays

Our Services

- Evaluation of the geological – geotechnical investigations
- Geotechnical design of the lane covers
- Structural design of the lane covers
- Slope stability analysis for the temporary and permanent cut slopes
- Dimensioning and design of the lane covers
- Detailed construction drawings
- Final rehabilitation of the lane covers
- Detailed geotechnical & structural design

Client

AKTOR S.A.