# **GREEK RESURRECTION**

Greece's financial woes have undoubtedly had an impact on the country's tunnelling activity, but the sector is resilient and has faced trials before. With many stalled projects under way again, and a few losses incurred to work still in the early phases of planning, things are far from perfect, but there is hope. **Sally Spencer** speaks with local companies and representatives of the Greek Tunnelling Society to get a handle on a tunnelling industry that in recent decades has been marked by extremes

REECE'S TUNNELLING sector has been on a rollercoaster ride during the last 25 years, experiencing both dizzying heights and depressing depths as it has tracked the country's economic fortunes.

Prior to 1990 there was relatively little tunnelling activity in the country – even Athens didn't have a metro system, for example. From 1990, however, and until the economic crisis began in 2007, hitting Greece really hard at the end of 2009, there was a huge infrastructure boom.

European Union funding, coupled with long-term planning of Greek infrastructure improvements saw tunnels being constructed in road, rail, mining and hydropower projects.

## **GOLDEN YEARS**

These projects included the Egnatia Odos (Roman Road) motorway, which connects the Epirus, Macedonia and Thrace Sally Spencer

Sally joins the Tunnels and Tunnelling team as a contributing editor this year

Below: CAT EPBM preparing to bore the Athens Metro extension to Pireus regions in northern Greece and which was one of the largest and most ambitious civil engineering projects in Europe at the time. The road will be a key route in the developing trans-European road network (TERN) and forms an integral part of European route E90. The 670km motorway includes 73 twin bore tunnels with a total single tube length of around 100km and was



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completed by June 2009, on the eve of the financial crisis.

The PATHE (Patras-Athens-Thessaloniki-Evzoni) motorway, which is the main north/south road through Greece, also features "numerous kilometres of tunnelling" along its 550km length.

As does the construction of new high-speed railway lines from Patras to Thessaloniki, again linking north and south.

Another major project, the Attiki Odos (Attica Tollway), forms a 70km ring road around the Athens greater metropolitan area and includes 9km of tunnels.

Greek companies thrived during this period of intense activity.

As an example, leading design company Omikron Kappa Consulting SA (OK) tripled its annual turnover and resources.

"During this time we executed detailed designs of more than 70km in road tunnelling projects, approximately 20km in railway/metro tunnelling projects and approximately 20km in mining/hydraulic tunnelling projects," said Nikolaos Koronakis, OK's president and chief executive officer.

Due to Greece's complicated geotectonic zonation and the fact



Above: Egnatia Odos motorway Tunnel

Below: The EKP Motorway, concession project: Panagopoula T26 twin bore tunnel that most of the projects included ventilation chambers and deep shafts, much of the work was pioneering, he said, which enhanced OK's expertise.

Just three of the many benchmark projects he cites by way of example are the longest highway tunnels in Greece: the 6km Tempi No. 2 twin bore tunnel including cross passages, ventilation chambers and shafts in the Maliakos-Kleidi motorway concession project; and the 4.5km Driskos twin bore tunnel in the Egnatia Odos motorway, which included a 200m deep vertical smoke extraction shaft.

OK also worked on the widest highway tunnels in Greece – the three-lane, plus emergency lane 4.5km Kakia Skala tunnels in the PATHE motorway.



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# The Human Response

The term "Grexit" is used to describe the potential exit of Greece from the European Union but it could just as easily be applied to the exodus of Greek designers and engineers seeking work abroad.

"In my case my departure from Greece was planned some time before the financial crisis, but it was certainly a catalyst for my leaving," said Ilias Michalis, adding that it was an example of every cloud having a silver lining.

"My co-operation with Deutsch Bahn International started in February 2012 and has given me the opportunity to work for the mega tunnelling Doha Metro project." Michalis is currently tunnel and underground structures manager on the Doha Metro Gold Line.

The regions attracting a Greek workforce include the Gulf, the Balkans, Central Europe, Australasia and China but their departure hasn't left a skills shortage thanks to the boost in the number of trained designers and engineers in the two decades preceding the economic crisis.

"There is still a significant pool of highly experienced and skilled engineers within Greece," said Omikron Kappa's Koronakis.

"The infrastructure boom that began in the 1990s led to the building up of significant human resources with very high training levels, impressive experience and state-of-the-art know-how that are sufficient to undertake the planned projects in Greece despite the sizeable 'brain drain' of Greek engineers and geologists," agreed the GTS's Raptopolous.

And there is belief that as tunnelling activity increases in Greece, some of those expatriated engineers and designers will return to work on home soil, bringing with them "broadened knowledge"

The next generation of civil engineers is also being nurtured.

"In 1998 the Faculties of Mining and Metallurgical Engineering and of Civil Engineering at the NTUA jointly established a postgraduate course for tunnelling, which leads to the postgraduate specialization diploma entitled Design and Construction of Underground Works," said Prof Sofianos.

The course begins each October and comprises two half-year semesters plus a third one for a thesis. The first two terms are devoted to lecture courses and associated activities, while the third is devoted to the preparation and presentation of the diploma dissertation.

Furthermore, a compulsory field trip to tunnels under construction takes place and during this week-long trip students are assigned projects to complete.

"Around 50-60 candidates apply for 20 places on the course each year," said Sofianos, adding that the course is free of fees.

"In addition, there is the possibility for our students to stay at the University facilities, where they can also have meals provided."

# PUBLIC PRIVATE PARTNERSHIPS LEAD CONSTRUCTION SURGE

At the core of Greece's surge in infrastructure construction, particularly since 2000, was Public-Private Partnership (PPP) funding.

"In early 2000 the Greek State launched procurement procedures for the construction of five motorways as PPP projects (concessions) with the concessionaires comprising Greek construction companies and European companies from several EU member states," said loannis Bakogiannis, a mining engineer and head of the directorate for planning of infrastructure concession projects at the Ministry of Infrastructure, Transport and Networks.

The five motorways are the Olympia Odos (including nine twin bore highway tunnels with a total single tube length of 16km), the Aegean Motorway (including three twin bore highway tunnels, with a total single tube length of 22km), the lonia Odos (including four twin bore tunnels with a total single tube length of 11km), the E65 (including six twin bore tunnels with a total single tube length of 9km) and the Moreas.

"These are part of the TERN and are considered to be among the most important infrastructure projects in Greece, connecting its regions and playing a decisive role in the

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Below: Completed Athens Metro Station country's efforts to overcome the recession," said Bakogiannis, adding that more than 6,000 jobs were expected to be created during their construction.

These concession agreements bundled the design, construction, operation, maintenance and financing phases together and are for a 30-year period, after which they will be returned to the State.

"The PPP model was selected mainly due to restrictions in increasing the country's sovereign debt levels," said Bakogiannis. Furthermore, he added, bundling all the project phases together in one long-term contract rather than spreading them between many parties created a shared acceptance of responsibility.

According to the initial agreements the design, construction, operation and maintenance of the roads during the first phase was to be financed from the public purse in the shape of a State Financial Contribution (SFC) and motorway tolls; and from the private purse in the form of long-term loans and concessionaires' equity.

The loans would be drawn progressively.

Tolls generated through the concession period are considered as public funds and one of the initial effects of the economic crisis when it hit in 2009/2010 was the 40 per cent reduction in traffic volume and subsequent loss of revenue. This, combined with the new credit environment the Greek government found itself in resulted in the lending banks retrenching.

"The Greek PPP projects were inextricably connected to the banking system, whereas the government-funded projects were mostly being financed by secured European funding schemes," said Koronakis.

"The lenders were very sceptical about



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the ability of the Greek government to meet all its contractual commitments for State financial contributions and other financial needs of the projects," said Bakogiannis.

Doubting the long-term viability of the projects, the banks suspended the drawdown payments for four of the concession projects – Olympia Odos, Aegean Motorway, Ionia Odos and E65 – resulting in the suspension of construction from spring 2011.

The Moreas was sufficiently well advanced to escape the suspension.

## INFRASTRUCTURE RESTRUCTURE

However, while work was severely delayed, no projects that were already under construction at the end of 2009 were abandoned, although significant delays were recorded. After a two-anda-half year hiatus, in December 2013 the four concession contracts were restructured and work re-commenced. The roads should now be completed by the end of 2016.

"The restructuring was agreed on the basis of a new fiscal balance model, mainly in the form of substantial State financial contribution and a recycling mechanism of toll revenues," said Stavros Raptopoulos, president of the Greek Tunnelling Society.

"In essence the State has taken up all the contractual risks, acting more as a last resort funder than as a partner in a PPP."

He added that re-starting the concession projects didn't involve any re-costing per se. Instead, some sections of the initial scope of works were dropped and will be constructed as conventional public procurement works.

"As for designs, no ad hoc amendments were made in order to reduce costs," said Raptopoulos.

"Some changes did occur, but not directly linked with the present fiscal crisis in Greece. For example, final linings are conventionally constructed in Greece using reinforced concrete. Before the current crisis, and due to the high cost of steel, some contractors had proposed the adoption of unreinforced concrete final linings in some instances (road tunnels or rail freight tunnels in competent rock and enough overburden cover)."

"Re-negotiations did not involve re-evaluation of tunnels' designs given the fact that the designs were generally considered to be as optimum as possible and fit for purpose," added Koronakis.

In practice only the concession projects have been renegotiated and,

# The Greek debt crisis

**Below:** The Kakia

Skala Tunnels

on the Pathe

Motorway

The financial spotlight fell on Greece with the onset of the global economic meltdown in 2008.

National spending had increased to alarming levels but this only became apparent to Greece's European Union counterparts when it announced in October 2009 that it had been understating its deficit figures for years. As a member of the EU, Greece was required to prevent its national budget deficit exceeding three per cent of its economic output. Greece continued to report a national deficit of 3.4 per cent while in reality that figure was more than 15 per cent.

Financial markets closed their doors to Greek borrowing but with the country heading towards bankruptcy by the spring of 2010, the so-called troika of the International Monetary Fund, the European Central Bank and the European Commission issued the first of two international bailouts for Greece. These bailouts totaled EUR 240bn (USD 264bn).

The conditions attached to the bailouts called for harsh austerity measures, budget cuts and sharp tax increases. The measures have hit the country hard – unemployment is now more than 25 per cent and the economy has shrunk by 25 per cent since 2010.

The Greek economy became even more volatile with the election this year of the anti-austerity Syriza party, which is now at loggerheads with the rest of the EU, particularly Germany, which is frustrated by Greece's apparent inability to carry out the required economic overhaul.

There are fears that if Greece were to default on its loans and exit the Eurozone, the shockwaves could be felt further afield, impeding many recovering, but fragile, economies.

As Tunnels and Tunnelling goes to press a possible third bailout has been negotiated, and short-term financing agreed. This has allowed the banks to re-open following their hiatus, but fears of Greece crashing out of the Eurozone are still strong, and the bailout has been widely criticised.

according to Bakogiannis, there is still profit to be had – and this will increase in the case of economic recovery and an increase in traffic loads.

There has been some company-specific impact, of course. For example, prior to the crisis, Geodata Greece, the Greek arm of Geodata Engineering was involved in three major tunnelling projects: the detailed design of the Klokova twin road tunnel (about 3km), which is part of the Ionia Odos motorway; the detailed design of the Agios Georgios twin road tunnel (about 410m) in the Patra-Pyrgos motorway; and the detailed design of Line 3 of the Athens metro extension to Pireus (double track single EPB/TBM driven tunnel of about 6.5km).

When the economic crisis hit, only the Athens metro project



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#### continued smoothly.

"The first two projects were put on hold," said Nikolaos Kazilis, Geodata Greece branch manager.

"The Klokova project then continued but the design was awarded to a different company [on cost grounds] and the Agios Georgios project was cancelled."

## EARLY STAGES PROJECT CULL

Perhaps the most far-reaching impact of the current financial maelstrom will be felt in the future as many projects that were in the early stages of planning have been postponed.

"There was an unparalleled cutback in new business developments in terms of launching new forthcoming tenders," said OK's Koronakis.

"Many designers were driven to offer unacceptably low design tenders in order to maintain a piece of the pie and occupy themselves at any cost," he said, adding that OK had made the decision not to adopt this strategy.

"We decided that under no circumstances would we consider cutting back on the quality, reliability and fit-forpurpose value of our designs and services," he said.

According to the GTS's Raptopolous, postponed tenders include Athens Metro Line 4, a state-of-the-art EUR 3.3bn (USD 3.65bn), 32km-long project destined to "dramatically upgrade the transportation system of Athens".

"The crisis brought about considerations for partial tendering of the project in five phases, A to E. A number of financing scenarios are under examination in order to create funding leverage using extra sources other than national or EU ones," said Raptopolous.

He added that the procurement of three new concession projects has been postponed: the 1.1km-long immersed tube road tunnel link from Salamis Island to Perama; the 1km-long immersed tube road tunnel link for Lefkas Island; and a new

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Above: The Albania Krrabe Tunnel on the Elbaban Motorway

Below: A mining project worked on by Omikron Kappa Consulting Elefsina-Thiva-Yliki motorway, bypassing Athens.

A number of rail projects, incorporating tunnels, had been severely delayed but are now back on track.

"Excavation and final lining at the 9km-long single track twin tube Kallidromo rail tunnel have been completed and the remaining civil and E/M works are in progress," said the Ministry of Infrastructure, Transport and Network's Bakogiannis.

"Also under way is the construction of the 5km-long single track twin bore rail tunnel in Panagopoula; and along the Lianokladi-Domokos rail section three small double track tunnels with a total length of 1.62km and the 6.4km-



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long single track twin bore tunnel of Mount Orthrys (including one 1km-long access tunnel) are under construction and 10 double track small tunnels and cut-and-covers are completed.

"Procurement of another section, including some rail tunnels, was announced at the end of March," added Bakogiannis.

"Over the last year some Greek PPP projects have been given the green light and are slowly but steadily being reactivated," said Koronakis. Among those that OK is involved in are the Maliakos-Kleidi (MK) motorway concession project and the Elefsina-Korinthos-Patras (EKP) motorway project.

"Both projects include the completion of a series of road tunnels with significant length," said Koronakis. "Tunnels Tempi No.1, Tempi No. 2 and Platamonas of the MK motorway total about 22km and the Panagopoula tunnels complex and Platanos tunnel of the EKP motorway total about 12km."

# GREEK HOPES FOR THE FUTURE

Looking to the future, there is hope and expectation that many more projects will go ahead.

"I strongly believe that infrastructure projects always have a boosting effect on any economy, especially during periods of recession," said Ilias Michalis, a Greek engineer now working for Deutsch Bahn International on the Doha Metro Gold Line (see boxed text).

"That has always been the case since the 1950s. The Greek construction industry suffered major disruptions in the 1980s and 1990s but it managed to recover.

"Now the situation isn't easy and new contract schemes must be used between the Greek State and the private sector," said Michalis. "These contracts must be focused on the development of existing infrastructures such as the airports and main ports at Greece's tourist destinations as I believe the tourist industry is the main pillar on which growth in the economy of Greece can be based."

Metros and motorways are high on the wish lists of other key players.

"I believe the main motorway concessions will go ahead with some modifications in their investment schedules," said Geodata's Kazilis. "And I think some metro jobs, both in Athens and Thessaloniki will proceed as the demand is always there and some of the funding has been secured."

"I would like to see the Metro projects for Thessaloniki, Athens and

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some other large cities, such as Patras, go ahead," added Professor Alexandros Sofianos, director of the design and construction of underground works postgraduate course at the Department of Mining and Metallurgy within the National Technical University of Athens (NTUA).

"Trenchless technology related to sewerage renovation and water outfall have a high potential, although little has been done yet," he added.

"Some immersed tubes should also be considered, such as for the Salamina strait crossing."

Along with Athens' and Thessaloniki's metro systems, Omikron Kappa would also like to see the construction of new high-speed railway lines in the mainland; the construction of new roadway stretches in the provincial road network, or in existing by-passes; the construction and/or modernisation of airports and ports and their connections to road and rail axes; and dam construction and affiliated civil works relevant to water supply and irrigation schemes.

"These are sectors that could and should be improved in order for the country to be able to rise to the future demands," said Koronakis.

Short to medium-term aspirations for the Greek Tunnelling Society include the aforementioned Athens and Thessaloniki Metro systems and the completion of the "BOAK" (Crete's north road axis), where only 41km of the total 310km have been constructed.

"It's crucial to complete this motorway, which is part of the Trans-European Transport Network," said Raptopolous.

He also cites the completion of the high-speed railway network from the west cost city of Patras to the Greek borders with FYROM, Bulgaria and Turkey and the linking to the EU and international rail network.

Others on the agenda are the construction, through a Concession scheme, of the "Castelli" international airport at Herakleion, Crete; various projects in the field of fluid and solid waste management and water resource management including small dams.

And importantly the construction of the Trans-Adriatic Pipeline and the so-called "Turkish Stream" natural gas pipelines and expansion of the natural gas local network.

## VARYING CONFIDENCE

Confidence and optimism levels differ depending on personal perspectives but there is a consensus that the Greek tunnelling sector will survive and, ultimately, prosper.

"Tunnelling projects will still have potential in Greece for a number of years because it's not just a matter of choice, it's a matter of need," said one contact.

"The construction sector must emerge stronger and with a different orientation," said Michalis.

"Some restructuring has already taken place and, in addition, the Greek construction sector has shown a significant extroversion, mainly in the areas of the Balkans and the Middle East," he added.

"These experiences will be extremely useful: they can provide the necessary financial means to the main Greek construction companies.

"And they can create confidence within those companies and their international competitors that co-operation is possible and can be beneficial under the

current conditions of strong competition in the world construction sector"

*Editor: The bulk of this article was researched and written early in the summer of 2015. The Greek situation being as fluid as it is, the status of some of these projects may change* 

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