CASE STUDY

Niarchos Foundation Cultural Center

K.LIAROMATIS

STRUCTURAL STEELWORK

SNFCC with a total extent plot of 210 acres, accommodates National Lyric Scene, National Library, Car Park of 1.000 quartering places, Market Place that constitute link for all operations and a Park of 170 acres, that includes an artificial hill.

DESCRIPTION

It was October 2006 when Stavros Niarchos Foundation announced its intention to assume responsibility to fund the studies and implementation of this massive public project. That included the construction and equipping of new facilities for the National Library of Greece and the Greek National Opera, together with the colossal task of transferring them.

The awarding of the project on September 2012 was the happy ending of long term procedures including legislation issues, planning matters and the final stage for the offers. The architectural design is signed by the internationally reowned architect Renzo Piano, who has also the general responsibility of coordinating a large number of specialized design offices from Greece and abroad, who have worked on the completion of this multi-complex project.

On February 23, the SNFCC held an imposing ceremony to mark its handover to the Greek state, as was the original intention. Now, this multifunctional complex of culture, learning and creativity belongs to Greek society.

The new facilities of the Greek National Opera (left) and the National Library of Greece (right) with the seawater pool.

SCOPE OF WORKS

With view of the coastal front of Athens, 4.5 km south of the city center, on the edge of the Faliraki Delta, the location of SNFCC expresses the name of the surrounding community, "Kallithea", restoring its initial communication with the sea. Stavros Niarchos Park re-connects the neighboring areas with a design that is a continuation of their urban fabric.

Elements of the Greek ecological landscape have been incorporated into its design. Main goal of the project, was being a model of sustainability, emerged in all aspects of its design which also acts in green roof of the building, at the Canal which provides additional flood protection for the whole space, as well as at the photovoltaic roof that produces energy for the needs of two buildings and contributes to low CO2 emissions.

Through environmentally innovative projects and practices, the project has been awarded the LEED Platinum Green Award, the first such distinction in Greece, as well as the first for such a scale project in Europe. The building has been designed and built using strategies that were intended at improving energy efficiency and water efficiency, reducing CO2 emissions, improving the quality of the indoor environment, rationalizing resources and addressing their impacts.

DETAILS OF PROJECT

Commencement Construction Date
December 2011

Contractior
J/V Salini Impregilo-TEPNA

Completion Date
February 2017

Total Value of Donation
630 mill. Euros

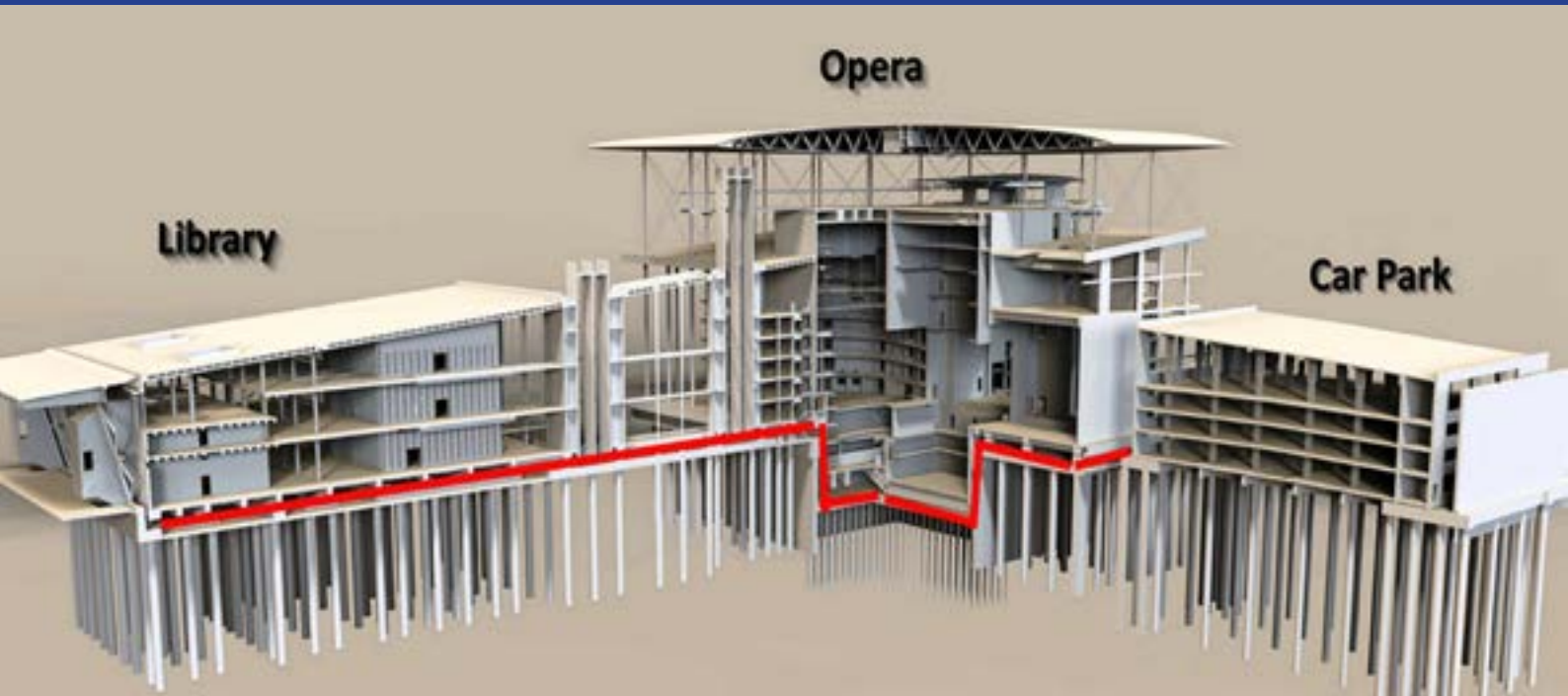
Total Area
210 Acres

Employed On Site
6.000 Employees

Work Placements
2.300 Employments

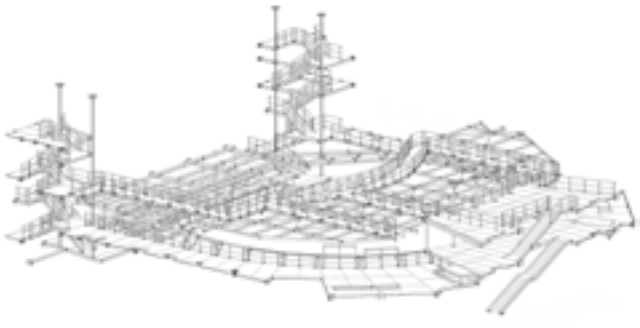
GDB Contribution Assessment
1,1 bill. Euros

Hosting Capability
32.000 Visitors

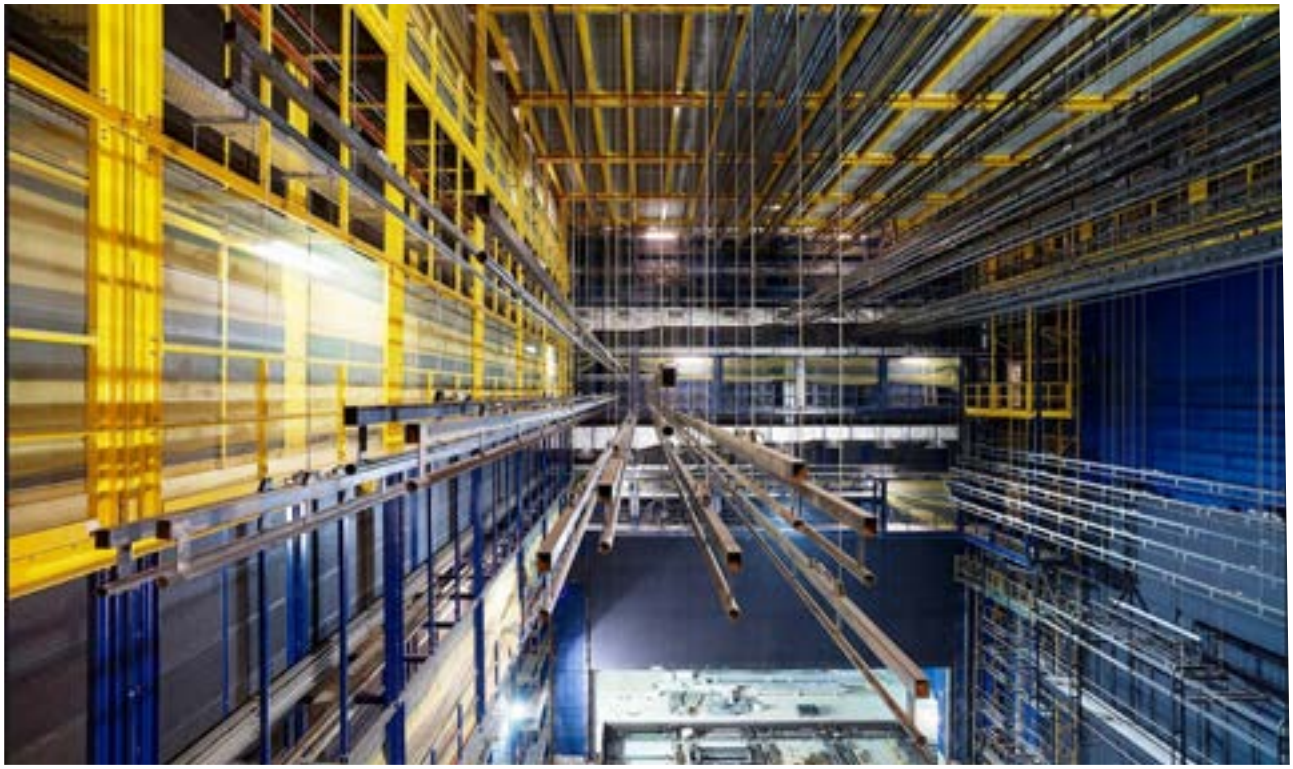


GREEK NATIONAL OPERA

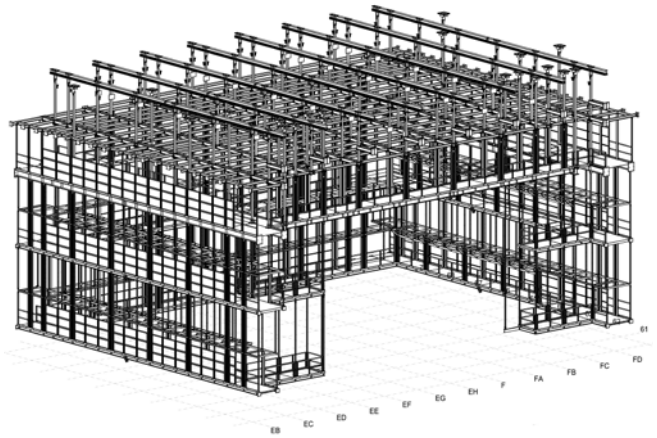
Impressive, modern and highly functional, the new home of the Greek National Opera covers a total area of 28,000 sq/m. Its operations are spread out over six levels and is capable of hosting even the most demanding opera and ballet productions. The Alternative Stage, with 474 seats, is a multipurpose venue that will focus mainly on contemporary and new forms of artistic expression. It will host a pioneering programmed organized into three daily sections: education, society & art.



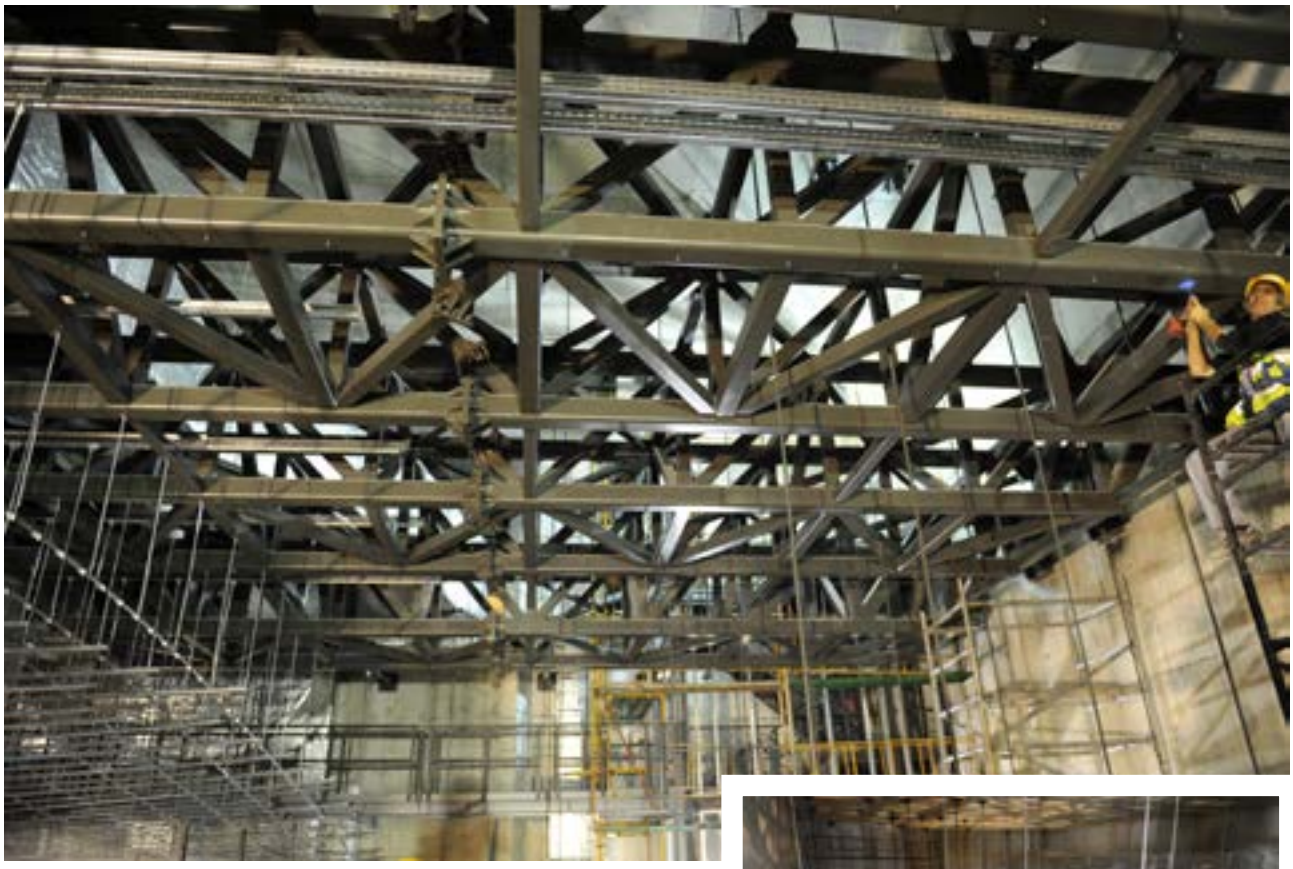
FLY TOWER



Orchestra scene with a basement span of 43m can accommodate up to 120 musicians, supports Wagner projects. Steel construction of the fly tower which is suspended from the roof has 13m depth. From the impressive roof with «Smile» hanging the Singu work that moves with fans and the time of the show will go up to not disturb the viewers.

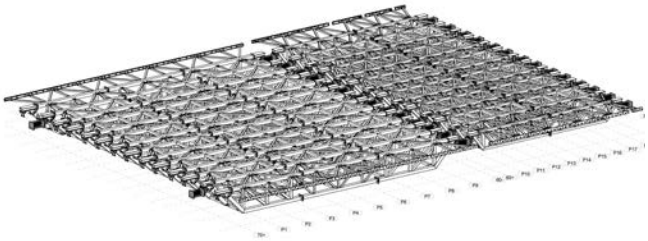


FLY TOWER PROPPING

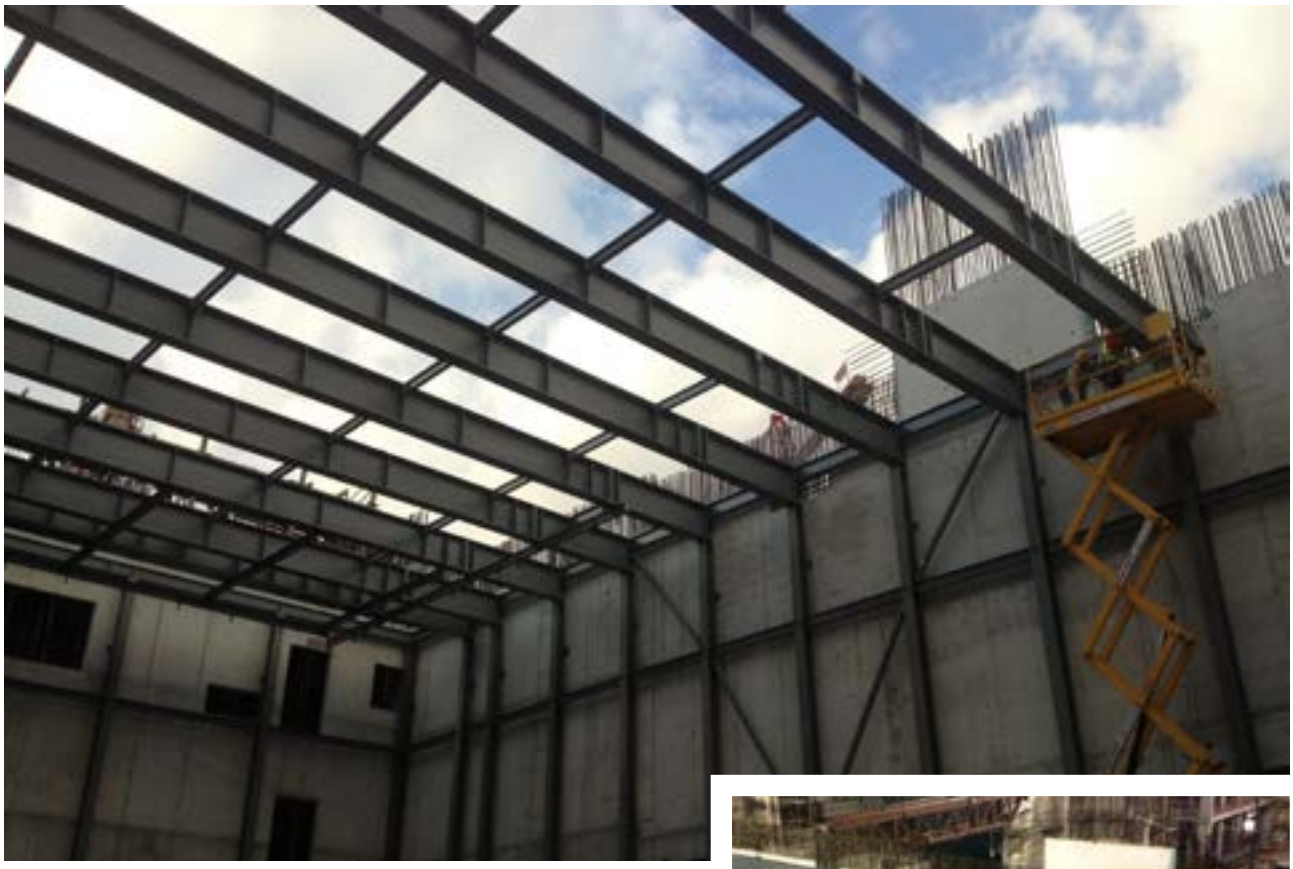


Six meters height concrete walls dominate the reception area, make the impression that you are in the interior of the quarry and preparing the visitor for the lyrical drama that unfolds on the stage. The main space of the lyrical stage is surrounded by a series of suspended lobbies, with entrances leading to the hall offering viewers the chance to enjoy closest the stunning scenery.

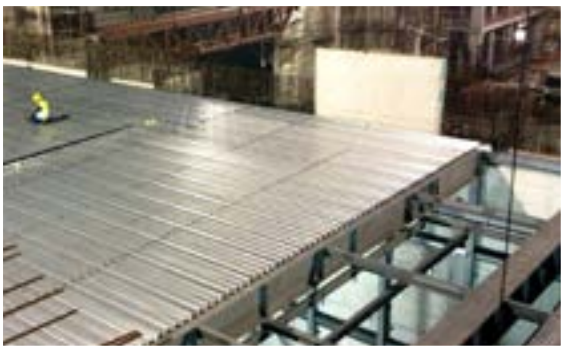
- Beam Profiles SHS 300x12mm separately divided with lengths of 22,3m



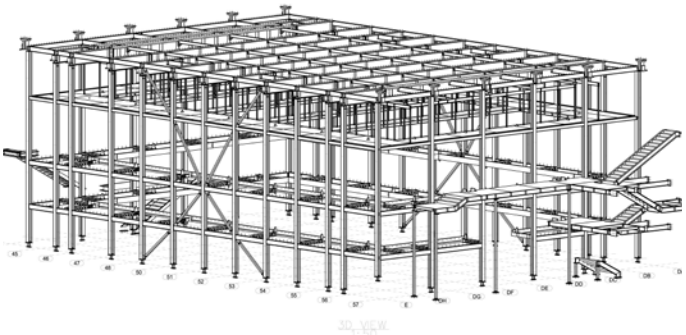
STEEL STRUCTURE OF PERFORMANCE HALL 2



Second theatre stage will be the main reason for the modern creation of education & society with special emphasis on all fields of musical theater. Two balconies feature the alternative lyric stage which is made from cherry wood, with a total capacity of 460 people and the possibility of multiple designs. Ballet, chorus, orchestra, solo, dressing rooms, as well as a recording studio complement the lyric spaces.

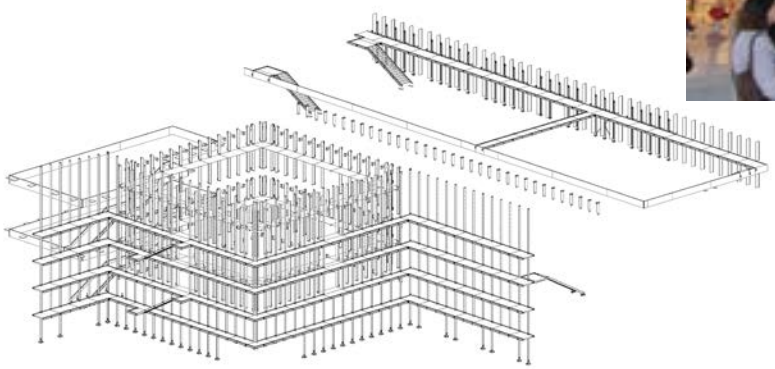


- Built-Up Welded Beams with a total length of 11m



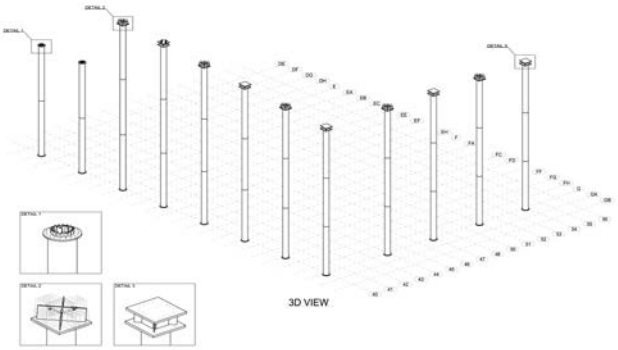
NATIONAL LIBRARY OF GREECE

The existing services of the National Library of Greece (NLG) will be moved to the new three-level, 23,000 sq/m. premises. The National Research Library will hold more than 4,500 priceless manuscript codices dating from the 9th to the 19th century, along with a large number of important historical documents and archives. The new building has a current capacity of one million books, a figure which could be raised to two million in the future.



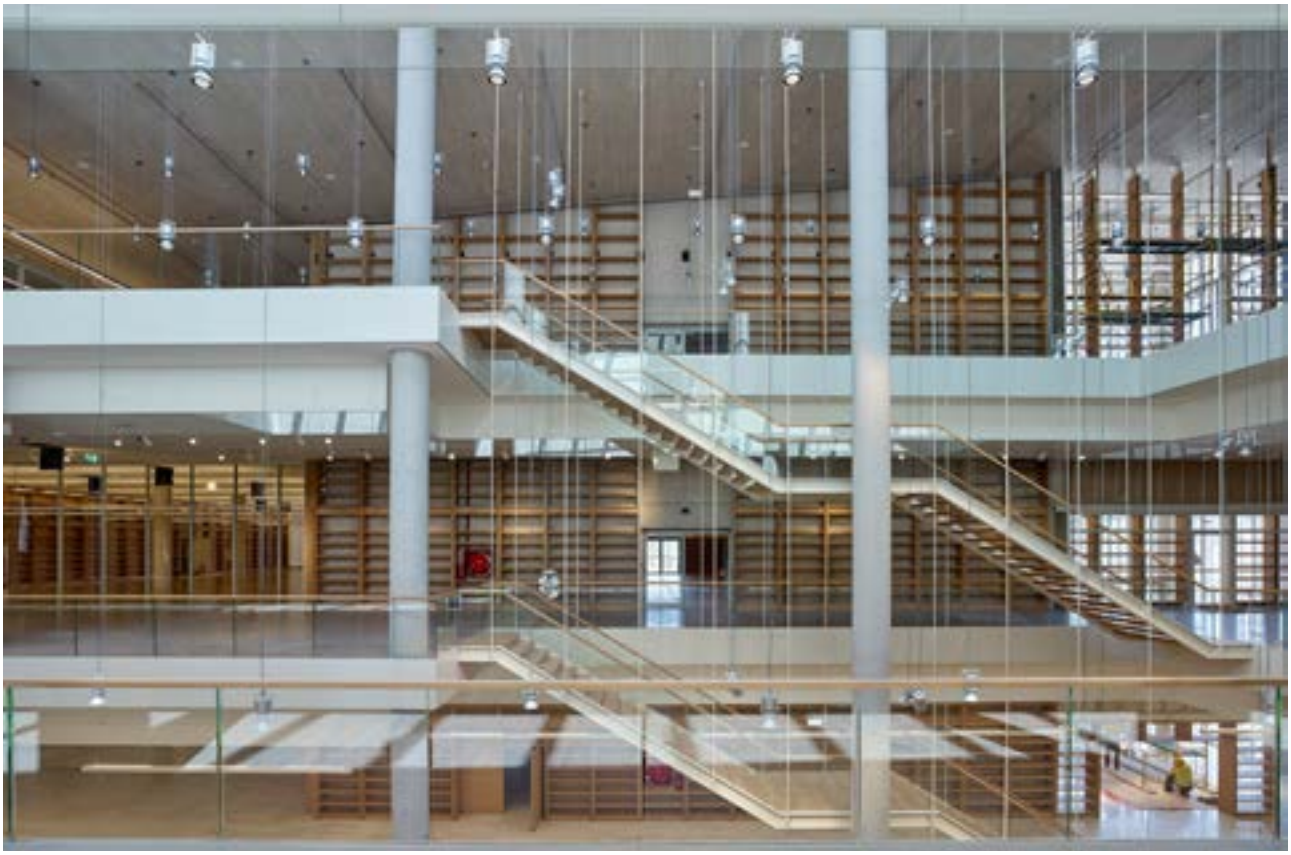
ATRIUM

The main entrance to the Library is a crucial area for first impressions and activities of interest to the local population, as well as visitors to Athens. Access is from the Agora into the atrium, a space that reaches the full height of the building, that unifies the whole building and that allows those entering to appreciate the locations of the different functions.



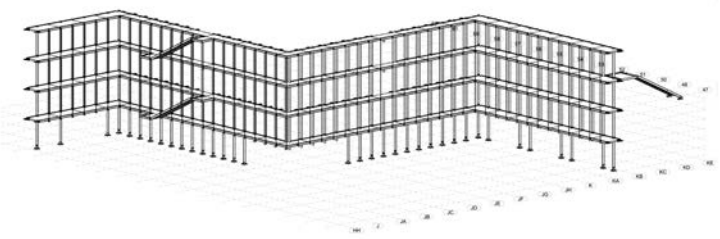
- Built-Up Welded Beams with a total length of 27m

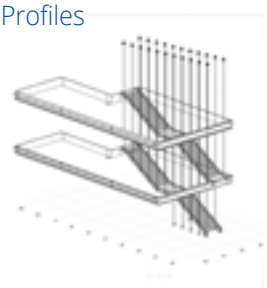
BALCONIES & STAIRCASES



A system of balconies, which resembles linear red lines, is the unifying element of three spaces: Market, Opera and the Library. While at the entrance of the Opera, the balconies are used to link the different levels of seats, the Library connects the different half-timbers building system. In both cases, the balconies are distinguished by the tall glass facades. As they appear from the entrance areas of the Opera and the Library, the balconies rise externally on the western façade of the Agora, emphasizing its depth.

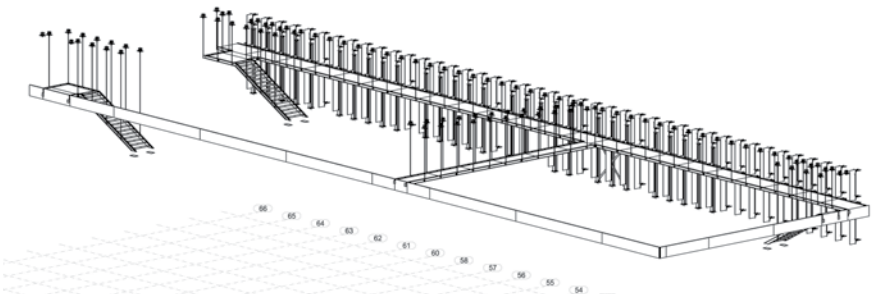
- FB Beam Profiles





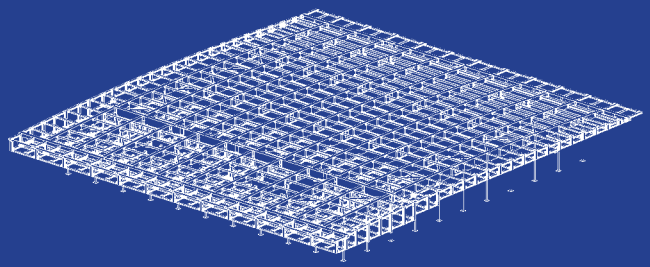
READING ROOM

At the top of the Park visitors come across a 900 sqm multifunctional space with a glass shell: the Reading Room. Visitors will arrive at the highest point of the Park to enjoy the view of the nearby sea and visual contact to the city. Beyond the view, however, the Reading Room will offer visitors a quiet place to read and think, or to gather in small groups for seminars, study and various cultural and educational events.



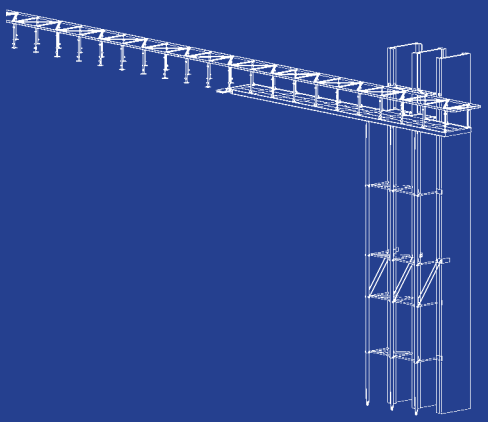
LIGHTHOUSE

On the 8th floor of the building there is the «Lighthouse», an isolated space for meditation and quiet work, while at the same time transformed into a multipurpose space for events located at the most beautiful point of the complex with panoramic view across the Attica basin. It is easily accessible via two lifts from Agora.



LIGHTHOUSE BRIDGE

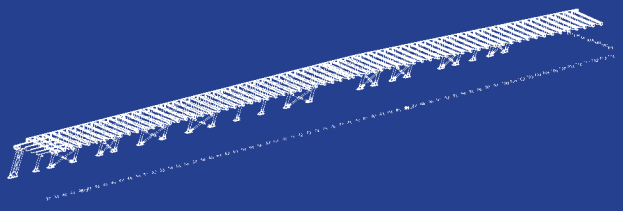
Almost... the visitor is flying on the glass bridge. On the 7th floor, above Lyric, under the roof, overlooking 360° degrees, throughout Athens, admires Acropolis and Faliro, sea and the city! View travels to the horizon, and every time the eye changes position, the field of view changes.



- Beam Profiles CHS 610x25mm

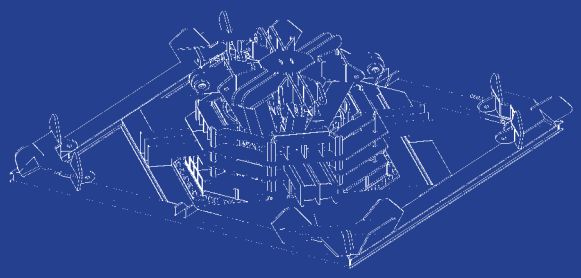
BUFFER ZONE

Measures have been taken in the transition area between the hill and the buildings where the Buffer Zone is intercepted so that no vibrations are transmitted because in the event of an earthquake the less compact hill with the oscillations could have adverse effects on the foundations of the buildings. It is a separation zone between the Kallithea Municipal Park and the Niarchos Park, while exhibitions or small concerts can take place in this section.

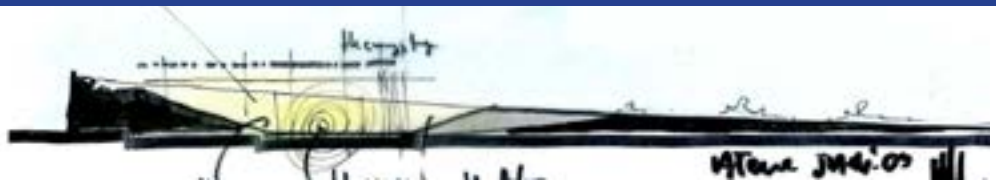


ROOF SUSPENSION SYSTEM

The roof is designed to receive seismic & wind loads. It is hanging on thirty steel columns which support the roof top linked with suspension units. Each of these suspension units consists of four springs, two dampers and a three-dimensional metal frame carrier



Planning - Study



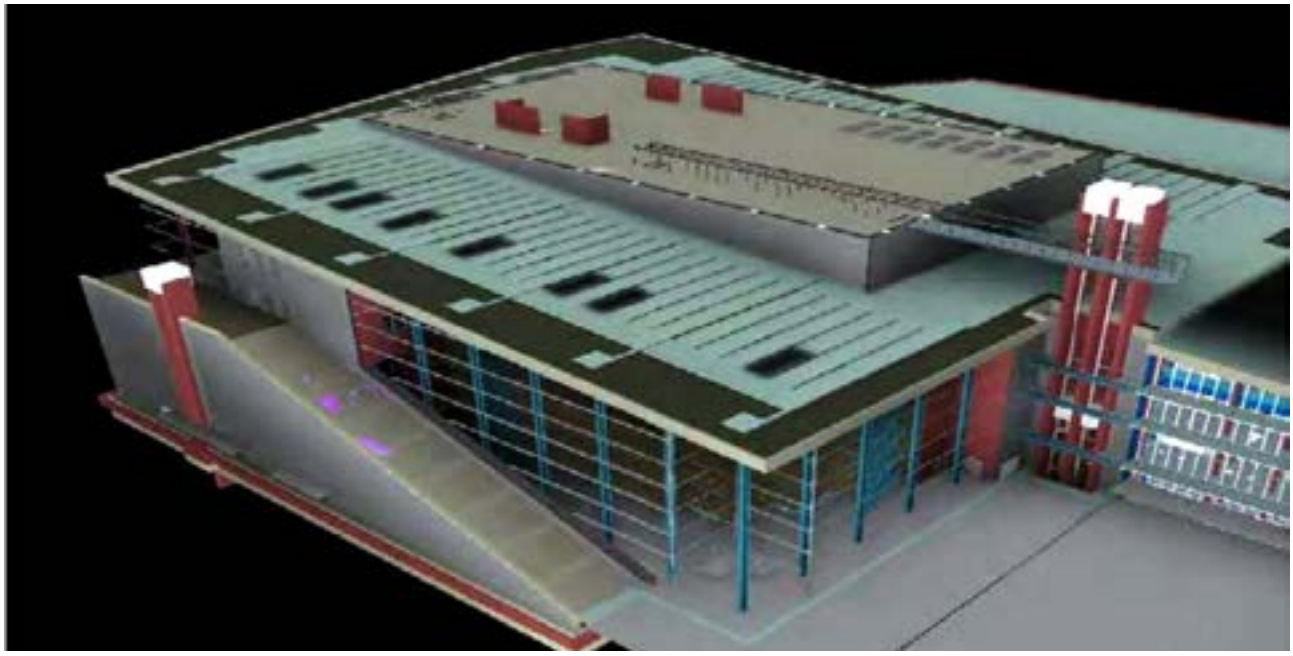
The study had five main challenges:

- Anti-Seismic construction with insulators
- Ferrocement roof of 10acres,
- Column heights of 40m,
- Glass panels of 25m height and
- Architectural visible concrete.

There were, however, other issues of considerable interest, such as: the steel construction of the stage tower, which is suspended from the ceiling, the triple BufferZone bow with the planted roof, the ceiling-hung library of the National Library and many others.

Engineering Design

Modern Building Information Modeling (BIM), which has been used since the early stages of designing the project, has been extended to the production of construction projects. «Smart» three-dimensional modeling has been implemented, serving the purposes of the final design and construction details of the project. It facilitated, among other things, the effective coordination of the different tasks, the integration of the various elements added by specialized subcontractors and the precise detailed record of the complex engineering systems. The «As Built» designs capture the exact and detailed final image of the project and provide a versatile background for the next stage, which is the management of the facilities, ie the operation and maintenance of the project.



Construction

It focuses on the modules: work quality (labor and materials), environmental protection, respect for the community and new technologies of developmental nature.

Weldings

The production of Built-Up beams was carried out in an automatic SAW machine with two-sided continuous-stitching connections of a suitable thickness.

Quality Control

The whole process of manufacturing and incorporating into the steelworks project has been followed by all appropriate certification and control steps through strict quality assurance protocols both inside and outside of the site.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR 250 18 - Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL: +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr

CASE STUDY

Arched Bridge of Tsakona

K.LIAROMATIS

STRUCTURAL STEELWORK


ΚΑΤΑΣΚΕΥΗ:

DESCRIPTION

The Arched Bridge of Paradisia-Tsakona was the last part to be delivered, on the motorway A7-Moreas (Tripoli-Kalamata), constructed by the Government with a total budget of €22,850,000 which at the present time is under the management of «Moreas» Consortium.

The construction of the arched bridge started in 2008 and was delivered to traffic in January of 2016. It was planned to pass over and therefore avoid a large landslide, which in 2003 disrupted completely the traffic in the highway. The landslide involved mobilization of both flysh colluviums and manmade deposits about 6.000.000m3.

Is the 2nd largest in Greece in terms of openness while among the 50 largest arches of bridges globally and it is an aesthetic landmark. A real engineering featuring, built over an active landslide in an intense area of seismicity presenting excellent complexity, both the foundations and superstructure.

The project includes a huge bow with a maximum height of 45m that has been set up on two podiums while the bridge hanging from it without been affected by the underneath landslided area. The bridge rests on three points: a mainstay on each side and a bracket located near to the top of the bridge podium, consisting of a giant prefabricated building ensuring the stability of the bridge.

TECHNICAL SPECIFICATIONS

The main span of 300m length, which passes over the landslide, consists of two vertical steel arches with rise of 45m and a steel-concrete composite deck, 22,80m wide, fully suspended by the arches with 2x20 vertical hangers. The approach to the main span of the bridge is achieved by a V-shaped prestressed concrete bridge 90m long and 20,40m wide.

The bridge consists of a steel arched body mounted to a composite deck with length of 260m, combined with an access section of prestressed concrete on the side of Tripoli's of 130m length. It has a total length of 390m and a max. Span of 300m. Deck has prestressed portion width of 20.40m and in arched 22.80m, while includes 4 lanes & restraining island with a width of 2m. Section of bow, which is an important novelty for Greece, consists of two parabolic arcs joined together by external wind bracings.

Totally on the project employeed over 600 Greek citizens such as: researchers, consultants, supervisors, engineers and inspectors, subcontractors, operators, foremen, technicians & workers.

PROJECT DETAILS

Commencement Date
2008

Contractor
Terna SA

Completion Date
28/01/2016

WorkTime
50 Months

Employeed
600 Persons

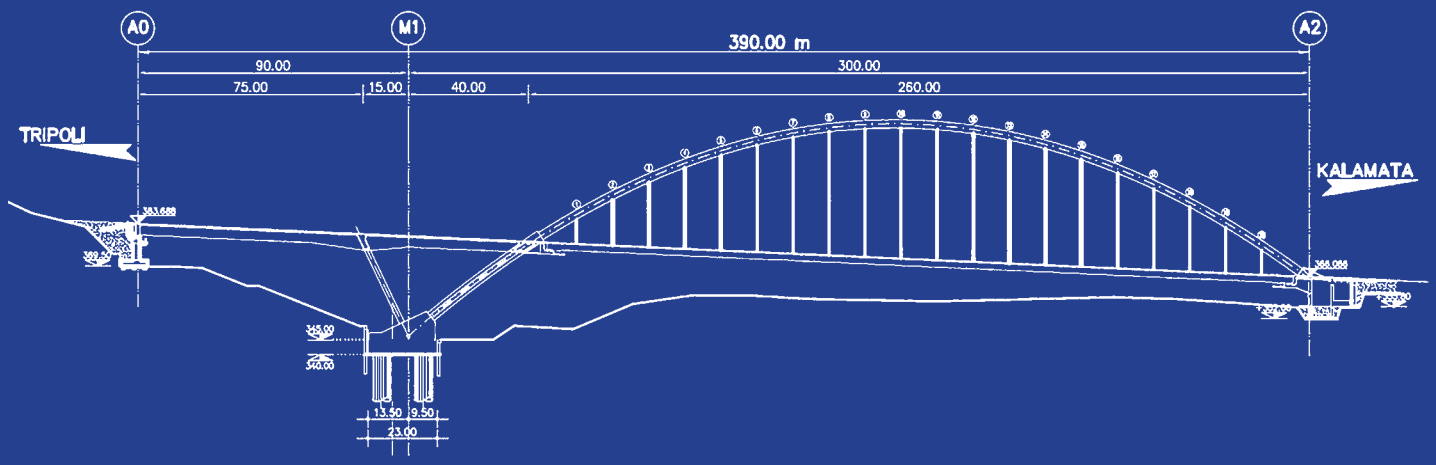
Estimated Materials:
- 22.500m^3 concrete
- 3.290tn reinforcement & prestressing steel
- 3.720 steel for deck, arch & hangers

PROJECT DATA

- For the erection of the arches was chosen as more suitable the heavy lifting method using hydraulic jacks with support of built sections on temporary steel towers suitable acquired in landslide.
- Drafted the relevant structural design of temporary steel towers, foundations thereof & auxiliary structures as well as the entire building methodology.
- Special attention was given to achieve quality controls with an emphasis on weldings which were commissioned on Certified and specialized partners.

PROJECT REQUIREMENTS

Design was in accordance with German DIN Regulations although because of the manufacturing importance checked the compliance with Eurocodes requirements. Category of the bridge was 60/30 according to the DIN 1072 with dynamic charging factor of 1.00 to 1.40, while it has also tested for Standard Charging Class 1 according to EN1991 1-2.

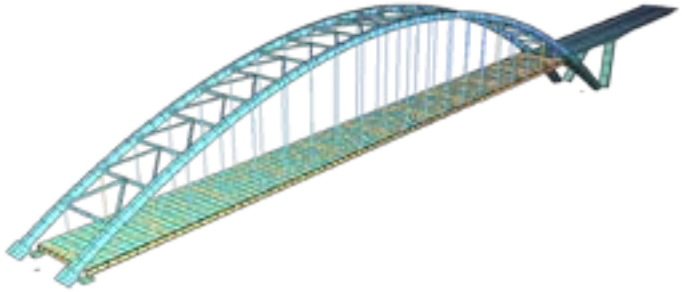


DESIGN AGAINST OPERATING ACTIVITIES

- Viaducts Loads - DIN 1072
- Concrete structures - DIN 1045 - DIN 4227 - DIN 1075
- Steel Structures - DIN 18800 - DIN 18809 – VBT - Ri

SPECIAL ISSUES & CONTROLS

Special issues, which the above German regulations do not adequately cover, were using Eurocodes in order of safety.



ANTISEISMIC PROOF DESIGN

- The Greek Instructions for designing bridges in earthquake zones (E39/99)
- The Greek Instructions to study bridges with seismic isolation (OAMG-2006)
- The Greek Anti-Seismic Regulation for the design of structures under seismic actions (EDC-1999/2003).

SIMULATION & ANALYSIS

- Detailed description of geometry and actions according to the phases of construction
- Linear and nonlinear analyses of 1st and 2nd class (check of arches camper)
- Fasma analyses (control of isolation).

MATERIAL SPECIFICATIONS

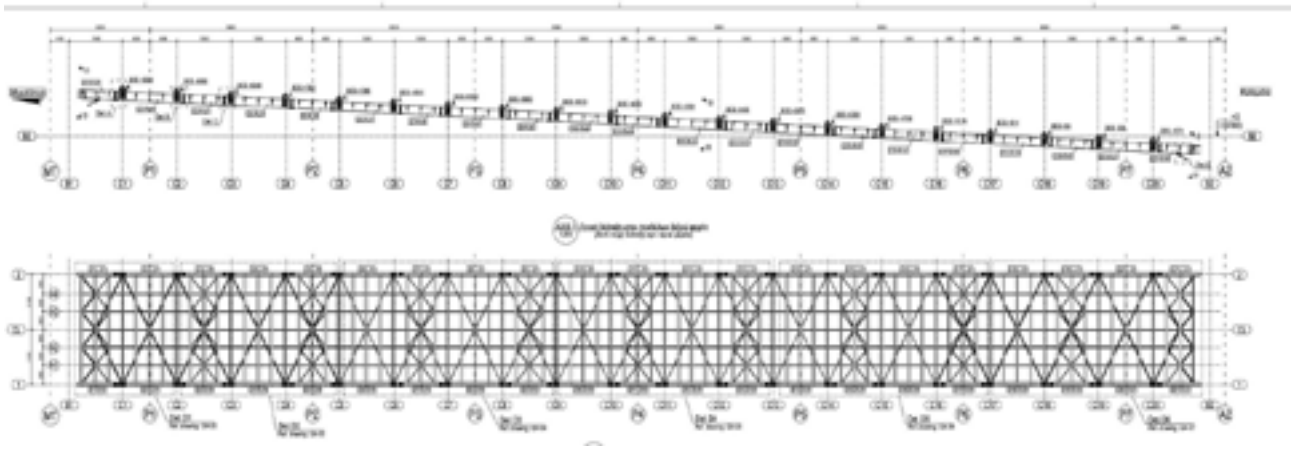
Special attention was given to the selection of steel for the supply of raw materials since the specifications of the study required high-strength steel, large thicknesses and guaranteed leak threshold.

STRUCTURAL STEEL

- Bows (soles and logs) with a guaranteed yield strength fyk ≥ 355MPa for soles of arcs regardless of the thickness - J2 S355 + N
- Other main minerals (main beams, cross sections, arc, wind bracings, mounts etc) - J2 S355 + N
- Longitudinal trapezoidal sheets - J2C S355 + N
- Secondary minerals (wind bracings, spacers, couplings of composite deck etc) - S355 JR
- Cross section nails type Nelson F22/200 from S235-J2 + n + C450
- Main elements such galvanized bolts class-GV 10.9 m = 0.50
- Black bolts & subcomponents class-SL 8.8.

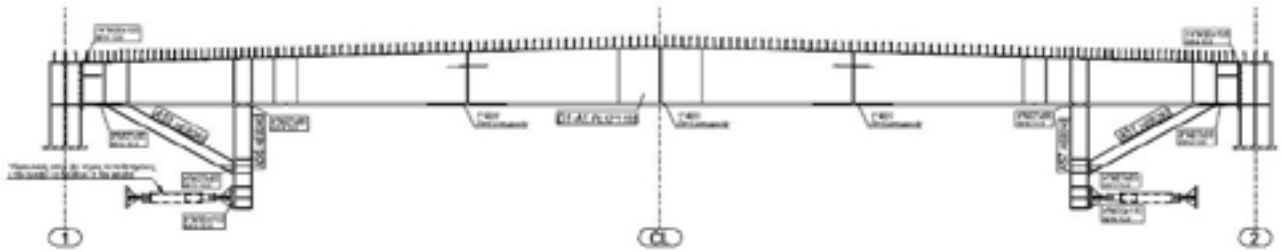
COMPOSITE DECK

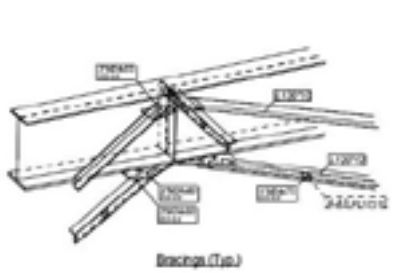
Composite steel deck consists of 2 steel main beams, 83 steel cross sections and reinforced concrete slab. Each main rafter beam has shaped cross-section I with fixed height 1.80m, and consists of plates dimensions 600 × 25mm for the upper tread, 1715 × 20mm for the trunk and 800 × 60mm for the bottom tread. The total length of 248.50m is divided into 21 sections, with lengths from 9m to 15m, which are connected between them with full strength connections that occur through double plate's trunk and feet with prestressed bolts.

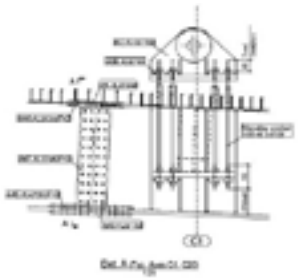


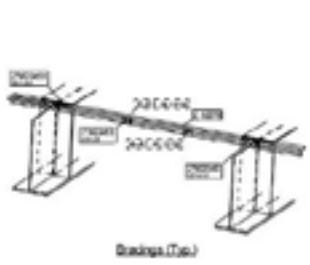
CROSS SECTIONS & SUB COMPONENTS

Cross sections have an opening 21.55m in length and are placed per 3.00m. They have variable cross-section height, from 870mm and supports up to 1210mm in aperture, and consist of sheets with dimensions 400 × 20mm for the upper foot, 12mm (Center section) or 15mm (extreme parts) for the trunk, and 500 × 35 (central part) or 500 × 25 (extreme parts) for the bottom tread. The wood is connected with the main beam through a frontal plate and prestressed bolts.









The steel body of the deck includes some subcomponents that provide sufficient durability and lateral stability against wind. These items are only active during steel body assembly and pour the slab. The reinforced slab concrete C30/37 is being over on galvanized steel deck 100/1.5 with a solid thickness of 25cm. The shear plate connection with main and crossbeams ensured through shear spot head F22/200.

QUALITY CONTROL OF WELDINGS

- Persons Certification carrying out non destructive tests (ISO 9712:2012).
- Persons Certification carrying out non destructive tests with industrial radiography (RT) – level I, II and III: castings and welds.
- Certification of persons interpreting industrial radiographs (RI) – level I and II: castings and welds.
- Persons Certification carrying out non destructive tests with ultrasound (UT)

  - level I, II and III: castings and welds.

  - level I and II: inspection and thickness measurement of plating.

- Persons Certification carrying out non destructive tests with ultrasound (UT) using transceivers of phased array (phased array transducers) – level I and II .
- Persons Certification carrying out non destructive tests with ultrasound (UT) using the technique of time delay ultrasonic beam on existing defects (Time of Flight Diffraction (ToFD). – Level I and II : soldering .
- Persons Certification carrying out non destructive tests with Visual testing (VT) – level I, II and III: General construction products .
- Persons Certification carrying out non destructive tests with magnetic particles (MT) – level I, II and III: General construction products .
- Persons Certification carrying out non destructive tests with liquid penetrants (PT) – level I, II and III: General construction products.

Quality Controls

An integral part of the larger process of industrialization is a quality control that closely monitors all stages aiming to achieve correct implementation of strict requirements in EN ISO 9001 and EN 1090.

STEEL BRIDGES

Paint System

Steel surfaces are protected with a paint system of minimum 15 years lifetime, suitable for ambient conditions Category C2.

STEEL BRIDGES

Cutting

Based on the detailed three-dimensional design of the project, the cutting sheets were produced, which were processed by a state-of-the-art CNC pantograph, giving high precision and quality.

Cutting, Drilling & Marking

Featuring modern and fully automated CNC cutting equipment, are creating, material management and branding have too high machining speeds and accuracy greatly increasing our production capacity and fulfilling demanding and strict delivery times.

Built-Up Welded Beams

The connection of the trunk and the top of Built-Up beams were made to ultra-modern automatic welding machine to submerged arc procedure with bilateral appropriate receiving constant thickness in 100% of shear flow.

SandBlast

Sandblast at closed tunnel according to Swedish standards: Sa 2 ½.

Assembling

The sheets rigidity (longitudinal and transverse) of the main beams was placed with stitching welds of appropriate thickness.

Modular Deck Links

The deck is connected to the arc through modular connections with vertical ropes per 12,00m and is secured with dowels.

Paint Coatings

Base coat primer 80 µm.
Intermediate layer epoxy base 100 µm
Final layer coat of polyurethane 60 µm.
Total thickness: 240mm.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR 250 18 - Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL: +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr

CASE STUDY

Maritime Industrial Area of Platigiali Aetoloakarnanias

K.LIAROMATIS
STRUCTURAL STEELWORK

DESCRIPTION

The Port of Astakos is strategically located on the Western Coast of Greece, close to the main international shipping lines, providing a unique opportunity of developing a commercial gateway between the European Union countries and the East, as well as linking the Adriatic, Balkan and Black Sea areas. The mooring area is located in the Gulf of Aetoloakarnania, on the west coast of Greece. Numerous incentives for the port's users result directly from the legal status of the Maritime Industrial Area as a free industrial and customs zone.

The total area amounts today 1910 acres, 700 of which constitute the district of service with harbor installations, 600 acres industrial plots and the rest are green, communal and public areas.

The Astakos Terminal S.A. was founded in 1999 for the development, exploitation, organization and administration of M.I.A. allocating harbour installations. After the important investments made it is considered to be the most important center of merchandising transit in Western Greece.

SECTORS & ACTIVITIES

- Terminal Container and CFS activities
- General and Bulk Hub Charge
- Car Terminal & Ro/Ro
- Industrial Area
- Naval Agency
- Transportation Services
- Safety (ISPS Code)
- Management

Also operates public services for customer's transactions such as:

- A Class Customs
- Port Control
- Service of Foreigners (Entrance Gate)
- Station of Sanitary Veterinary Control
- Station of Sanitary Plant Control

STEEL BUILDINGS

CONTROL TOWER

Three storey steel tower of particular architecture for the control of the Port with dimensions: Length 13,2m, width 24,6m, height 15,42m.

LOGISTICS WAREHOUSES A & B

The total covered area amounts 10000m^2 and was constructed in two stages of 5000m^2 each, with total dimensions: Length 168m, width 60m, height 7,5m. The building includes canopies 5m wide along both sides covering a total surface of 1700m^2.

ENTRANCE GATE

Entrance Gate of M.I.A. presented particular architectural requirements which affected its construction. One of them was the frame of the roof from variable cross sections. Dimensions: Length 81,5m, width 15m.

STEEL BUILDINGS

TEBILYD BUILDING 1

The specific building belongs to the Port's Warehouses with total surface amounting 2269m2 and dimensions: Length 65,65m, width 34,56m, height 4,5m.

TEBILYD BUILDING 2

The specific building for special/extra needs has a total surface of 1043m2 and dimensions: Length 30,30m, width 34,41m, height 4,5m.

TEBILYD BUILDING 3A AND 3G

The 3A building belongs to the maintenance and fixing of lifting cars and carriers team and its total surface amounts 469m2 with dimensions: Length 29,84m, width 15,72m, height 11,40m. The building 3G also belongs to the carrier teams (transportation means containers) with dimensions: Length 20m, width 20m, height 22,5m. There were special static requirements due to the quite small dimensions of length and width compared with the height of 22,5m. The doors were also made with special construction roll ups with dimensions: width 6,2m, height 17m.

In all of the above specific projects the initial study included protection of constructions against marine environment with special dyes. Timetable was strictly followed as well as the planned safety precautions were taken according to the company's plan and the particularities of each project.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR 250 18 - Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL: +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr

CASE STUDY

Bridge T8 Egnatia MotorWay

K.LIAROMATIS

STRUCTURAL STEELWORK

DESCRIPTION

Modern Egnatia Motorway borrows its name from the homonymous Roman work which was built between 146-120 BC, on the traces of an ancient Roman road stretching from Adriatic to Aegean.

Nowadays, there is a 680 km closed motorway, starting from Igoumenitsa, crossing Epirus, northern Greece ending at Evros, the Greek-Turkish border. It contains a number of tunnels, bridges and interchanges being in the completion phase.

TECHNICAL SPECIFICATIONS

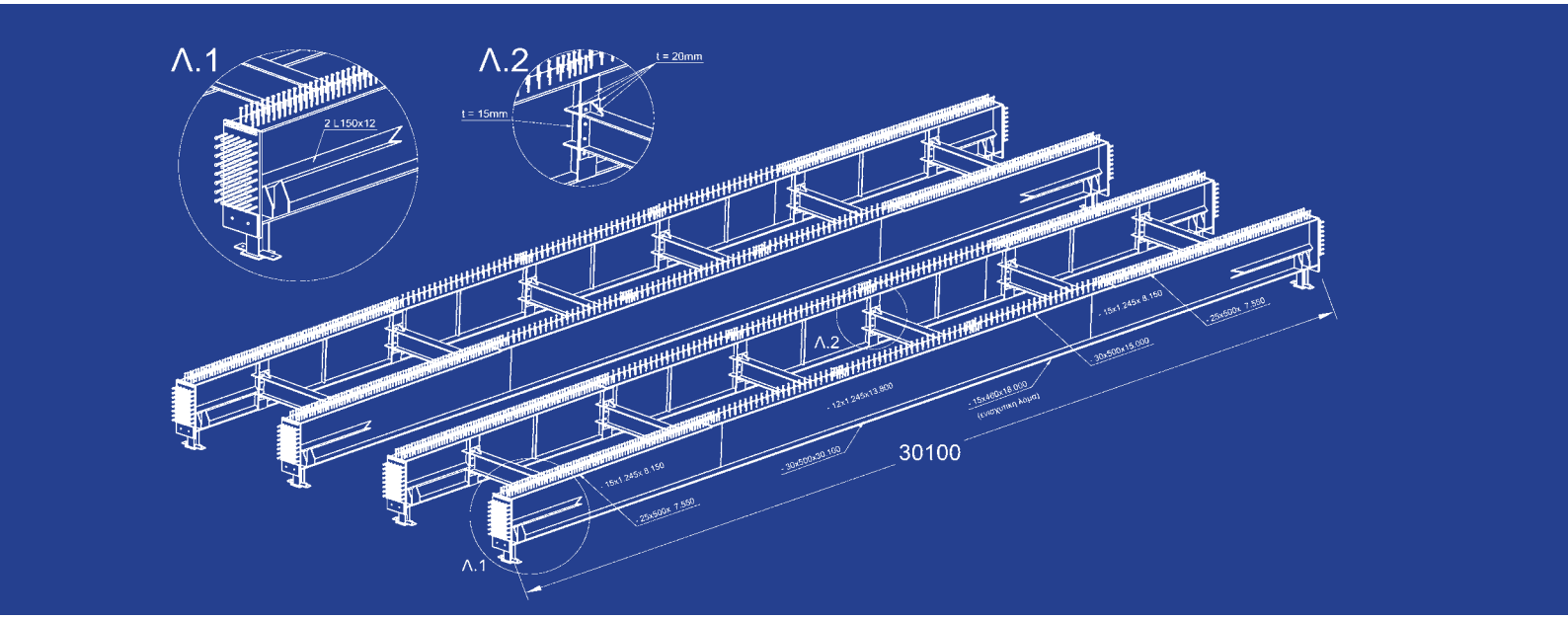
- Two-lane motorway per branch, with a separating traffic island and a right-hand Emergency Lane.
- 62 connection knots through road
- 350 upper and lower entry / exit crossings
- 529 large bridges, total length 40 km.
- 73 tunnels with a maximum length of 4.8 km. and a total length of 49.5 km or 99 km
- 43 river passes
- 11 crossroads with railway lines

The section from Arachthos A / C to Chrysovitsas - Peristerios is 9km long. This is one of the most difficult parts especially from the exit of the T8 tunnel to the Chrysovitsa A / C because of the intense geotechnical problems that needed special measures to stabilize the lands. The final study was completed in spring 2006 where the project was auctioned. With the completion of the project, travel time is reduced by approximately 40 minutes from the center of Ioannina to Metsovo while the traffic safety is significantly increased.

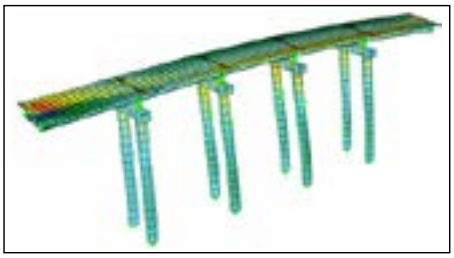
In the section of Egnatia Motorway, Drosochori - Arachthos, on behalf of the contractor AEGEK, metal deck was constructed, consisting of two traffic sectors with a total length of 650m. The total width is 13.70m including two traffic lanes of 3.75 m, emergency lane of 2.50m, two pavements 1.00m each to express lane and 1.25m emergency lane as well as two lateral lanes of 0.50m and 0.95m.

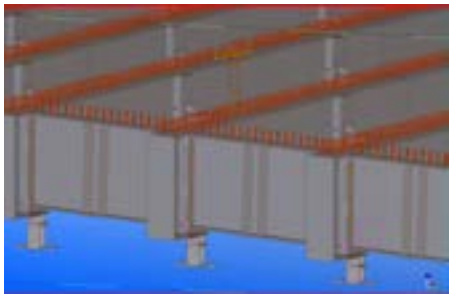
STUDY & DESIGN

The bridge was designed on the basis of the German regulations in validy until 2003 and some issues were covered in accordance with the methodology developed in the EC3 and EC4 Eurocodes. The seismic design of the project was carried out in accordance with ESA 2000 and the Greek Guidelines for the Design of Bridges in Seismic Areas. The extremely short construction time, the inaccessibility of the area and the winter season were taken into account.



The bridge consists of two practically parallel branches with a composite continuous deck, supported by elastomeric bearings on reinforced concrete frames, consisting of circular columns and rectangular cross section. Due to the length of the bridge and the soil morphology, each branch bridge is subdivided by a joint into two sub-bridges of approximately ~ 175.0m. Each subway has 6 openings with a variety length as it follows: 25.20 - 31.00 - 31.00 - 31.00 - 31.00 - 25.20. The cross section is formed with 4 composite steel rods, 1.30m high, connected together by a horizontal joint and a circular plate of 0.32m thick, with a total depth of deck of 1.6m. Shear connections on this composite steel/concrete structures was made by “Nelson” type headed studs.





Basic element without a union concerned the length of the beams ~ 30m, benefiting from increased strength, road transport, reduction of erection time and reduced maintenance requirements.

STEEL BRIDGES

Materials Specifications

The S355 J2 G3 (St 52.3N) was classified as S355 J3 (St 52.3N) according to EN 10113. For the S355 J0 diaphragm, (St 53.3U) and the leakage and failure limits were proportional to the thickness of the steel sheet. Nelson studs of 22/200 and 19/225 bolts of S235 J2 G3 + C450 steel (ST 37-3K) were used in shear joints, while screws were generally of Class 8.8.

Paint System

For environment C2, a nominal life of more than 15 years and a degree of wear of Ri3, the following dyeing system was completely factory-fitted, exceeding the requirements of standard EN ISO 12944. In all cases the primer application was performed immediately after sandblasting the same day. a) The visible surfaces were Sa 2½ sandblasting, Basic primer primer 80 μm, 100 μm Intermediate 100 μm epoxy base layer and 60 μm final polyurethane base with a total thickness of 240 μm. b) At the concrete / steel interfaces, Sa 2½ sandblasting, 80 μm Base Epoxy Primer was applied while another layer of 60 μm thick epoxy was applied to all corners at a depth of 25 mm from the edge. c) Saw bundles Sa 3, and a 40 μm zinc alumina base primer.

Controls & Certificates

Material Certifications according to EN 10204 3.1B. Welding processes according to EN 288-2. Certificate of welding processes according to EN 288-3, EN 14555. Certificate of welders according to EN 287-1. Size checks according to EN 1090-1. Visual inspection of welds according to EN 970, EN 25817 / C. Extrusion control with penetrating fluids according to EN 571, EN 25817 / C. Recordings instead of the previous point in accordance with EN 1290, EN 25817. Ultrasonic beam welding of weld beams according to EN 1712, -13, -14 / CLAS83. Radiographic control instead of the previous EN 1435, EN 25817 / C. Inspection of log seams with penetrating fluids according to EN 571, EN 25817 / C. Recordings instead of the previous point according to EN 571, EN 25817 / C. Preparation of surfaces for painting. Sandblast Sa 2.5 according to ISO 12944-5. Dyeing thickness measurements according to ISO 12944-5. Dye Protocols according to Technical Specification. Inspections of shearing poles according to ELOT EN ISO 14555.

Construction Details

In order to cope with the bending arrow of the steel rods, a pre-conditioning was provided during their manufacture. The steel rods are connected in place at two intervals with the cross members and the horizontal coupling and are placed as crane joints on the pedestals, on temporary bearings. On the already installed steel rods are placed with the crane the prefabricated panels, on which the reinforcement of the circular plate is laid, while the two outer cantilevers of the plate are concreted in two phases.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR 250 18 - Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL: +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr

CASE STUDY

LOGISTICS CENTRE & REGIONAL HEADQUARTERS

K.LIAROMATIS

STRUCTURAL STEELWORK

DESCRIPTION

Affiliated company of German Group Super Market ALDI in 2008 bought from ETVA at the Industrial Area of Patras, land space of 155 acres investing important capitals over 30 millions of Euros.

The project includes storage areas of different temperatures suitable for full product line, staff facilities, plant rooms, the regional headquarters as well as parking areas. Special requirements of the project were the construction of a continuous storage space divided solely by fire curtains for faster distribution of goods, the revision of the land use plan with unification of three plots and the provisions for future extension of the office and the storage areas.

The total surface of building amounts 34.000 sq.m. with volume of 304.500 m3 and dimensions:

- Length: 360m,
- Width: 90m in 6 frames of 15 m,
- Height: 7,70~8,00m.

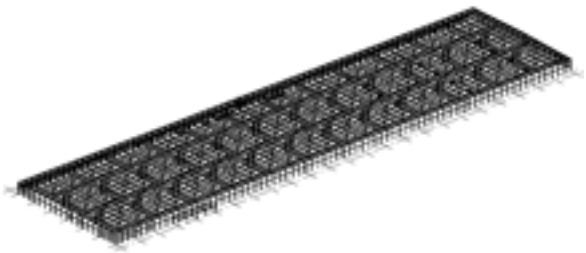
ALDI GROUP

- It was created in 1948 by the brothers of Albrecht and currently numbers over 10.000 in 18 countries
- employs more than 100,000 workers
- annually has a turnover of 50 billion dollars

Particular, supermarket chain Aldi Süd, which has made investments in Greece, has a presence in many countries of the world in the form of individual regional companies as well as more than 390 Hofer-branded stores in Austria.

TECHNICAL SPECIFICATIONS

The cross sections were made from HEA 280, 300, 360, HEA 450, HEA 450 columns, K-bracings from circular hollow sections CHS 273,0 x 10,0mm - S 355 grade. The bolts, washers and the nuts for the connections of the individual members of the construction were galvanized, grade 8.8 according to ISO 4014 specifications.



Paint System

A double hot dip galvanizing system according to DIN EN ISO 1461 and a C2 grade paint for internal steel constructions including a primer coat and two paint coat with a total thickness of 160µm, respectively for the external C5-M class according to DIN EN ISO 12944-2 one primer coat and two paint coats with a total thickness of 240µm. The remaining steel parts were sandblasted up to SA 2 1/2 grade, followed by epoxy Primer painting, providing the ability to subsequently accept fire resistant paint R30-90min on the site.

The welds required by certified welders following EN 25817 Standard.

Logistics Centre

Anticorrosion protection of the steel parts was carried for reasons of industrial pollutants due to installation in the Industrial Area of Patras plus small distance from the sea.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR 250 18 - Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL: +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr

CASE STUDY

Rion - Antirrion Bridge

K.LIAROMATIS

STRUCTURAL STEELWORK

DESCRIPTION

The Greek company Gefyra S.A. was founded in 1995 by the French VINCI and six Greek construction companies for the Rion-Antirion bridge. The total construction period was 7 years (1998-2004).

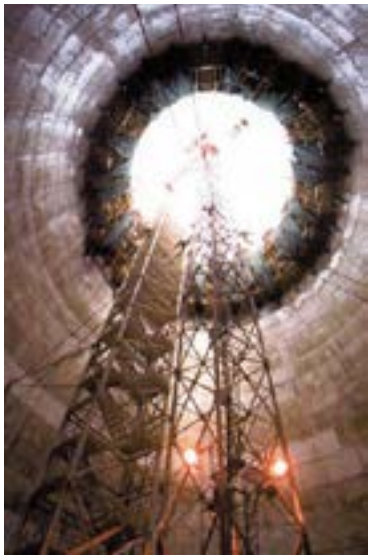
The critical factor for the design of the bridge lays was in the seismic approach, where the Greek State has imposed stringent design seismic loading: a peak ground acceleration equal to 0.48 g and a maximum spectral acceleration equal to 1.20 g between 0.2 and 1.0 second.

The bridge also can sustain the impact of an 180,000-ton tanker sailing at 18 knots as well as with the most powerful winds. The bridge covers a distance of 2.5000m and consists of a 2.252 meter long, 4 pylon cable-stayed bridge with a span distribution equal to 286 meters, 560 meters, 560 meters, 560 meters and 286 meters, two approach viaducts, with 392 meters on Rion side and 239 meters on Antirion side.

The deck is 27.2 meters wide with two traffic lanes plus safety lane and a pedestrian walkway in each direction. The pylons are of typical structure 220 meters high from sea bottom to pylon head. The piers are lying in around 60 meters in water. Pylon bottom is from 25 meters to 45 meters (for the two central pylons) above sea level, leaving a shipping clearance below the deck of 52 meters in the middle of the strait. Pylons rise by 115 meters to a maximum height of 160 meters above sea level. Manufactured projects at Rion - Antirion bridge concerned mainly specialized steel constructions.

PARTICULARITIES OF THE BRIDGE

1. Allocates Four Pylons.
2. Steps in the seabed of the sea at depths from 45m till 65m.
3. Continuous length of Deck 2.252m.
4. Cables of suspension with a total length of 63 km.



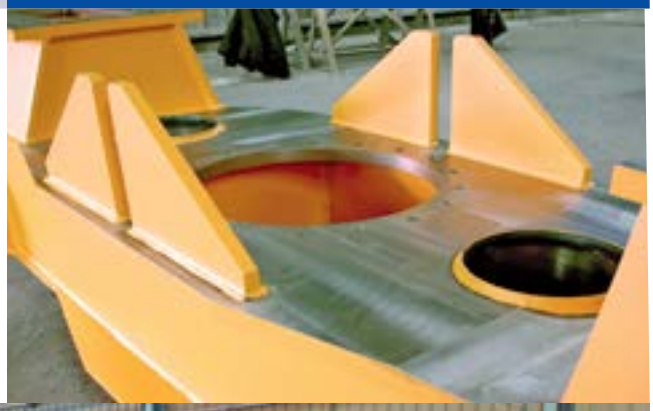
QUALITY CONTROL

The company used experienced certified personell for weldings and carried out Non Destructive Tests with Ultrasonic and Dyes Penetration.

All fillet welds controlled by visual examination and by dye penetrate tests.

In all cases certificates for materials and records of Quality system were required.

SPECIALIZED STEEL CONSTRUCTIONS



SHOOTBLASTING & PAINT SYSTEM

All materials are protected against corrosion by shoot blasting of type SA 2.5 with a painting system constituted from primer 60μm and dye of 2 layers of 120μm.

The requested average warranty period was 15 months after delivery.

SPECIALIZED STEEL CONSTRUCTIONS

Steel Retaining Wall

Metal construction for the prevention of water penetration at the first stage of pylons construction with diameter of 90m, height of 5,5m and total weight of 360tn. Techniques of waterproof connections with special requirements for welding and dyes were required.

Staircases of Pylons

Vertebrate staircase construction of 15 parts with total height per pylon of 55m. The dimensions of each one of them are: Length 4060mm, Width 2100 mm, Height 3600mm and Weight of 2,7tn..

Support Beams

Fabrication of (2) pieces of support beams from stainless steel grade S 355 JO, with dimensions: Length 2700mm, Width 850mm, Height 815mm and weight of 1550kg.

Lifting Lugs

Fabrication of (8) pieces of lifting lugs from stainless steel grade S 355 JO, with dimensions: Length 960mm, Width 600mm Height 500mm and weight of 446kg.

Rigidness Beams

Two pieces in each pylon at the shaft of abudtment box type with dimensions Length 19,6m and weight of 15tn including, a 5tn perimetric platform for visits.

Skid shoes for segment on Pylon

Specialized parts (12) from stainless steel grade S 355 JO - 42 CR MO4 with dimensions: Length 1020mm, Width 800mm Height 572mm and total weight of 8280kg.

Spreader Beam

They were constructed for lifting precasted items.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR 250 18 - Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL: +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr

CASE STUDY

HARAKAS BRIDGE

K.LIAROMATIS

STRUCTURAL STEELWORK

DESCRIPTION

The contract was signed at the end of 2013 with regard to the operational rehabilitation - security on the provincial road Nr.25 Argostoli - Fiskardo of Kefalonia, in the area of Harakas, in order to restore part of it, which had subsided due to a tectonic fault, leaving it only with one traffic lane.

Due to the geomorphology of this area, with increased chances of unstable and landslides combined with high steep slopes and intense seismicity, the construction of a composite bridge of a 82.00m beams was made, thus by-passing the fall of the area and freeing up additional works backing. It was also considered to fit harmoniously in the re-lief of the area without particular aesthetic effects reducing the same time considerably the required construction time.

For the construction of the bridge, full space was required, and additional space before and after the bridge to prepare the construction. The width of the deck is 13,80m, consist-ing of a traffic zone width of 10,00m wide, sidewalks of 1,9m with a safety guardrail.

The basic principle of the construction methodology is that the main beams are divided into ten sub-sections, while the outermost beams are divided into three. For purely practi-cal reasons the construction of the bridge started from the A2 hillside which is located in zone III and finished at the A1 hillside which is located in Zone II.

Both ends of the bridge were fitted with «two-way» joints with a minimum travel capacity of 180mm length and 85mm across the deck. The circulating zone was formed by sealing membrane 5-19cm variable gradient concrete and two asphalt layers of 9mm thickness simply supported.

TECHNICAL SPECIFICATIONS

The project is designed to withstand earthquakes with an increased seismic acceleration coefficient of 0.45g as Kefallonia is one of the most seismic regions of Greece, including a maximum seismic coefficient of 0.36g in the Antiseismic Regulation.

It was built as simply supported bridge because it bridges the area of the active rupture of Ag. Euphemia. Due to the widening of the fault after the earthquakes in 2014, the bridge's abutments were shifted, while for the reduction of seismic forces and movements it was insulated through four simple spherical slide bearings, allowing horizontal movement of up to 0.5m, providing the greatest possible safety of movement round Northern Kefalonia.

On the 13,80m wide deck there are two traffic sectors of 5,00m width and 1,90m wide pavements with all necessary guardrails for vehicles and pedestrians.

In order to protect the road from collapsing rocks, 3.00m high hedges have been placed in length of 340m and 10.000m2 protection mat in two layers on the upstream slopes have been installed.

PROJECT DETAILS

Employer:
Region of the Ionian Islands - Regional Unity of Kefallonia

Structural design:
A. Alexopoulos– N. Loukatos & Acossiates, ADT Omega & Domi S.A

Commencement Date:
September 2013

Contractor:
J/V Ionios S.A
& K. Kourtidis S.A

Project Cost:
6.980.000 Euros

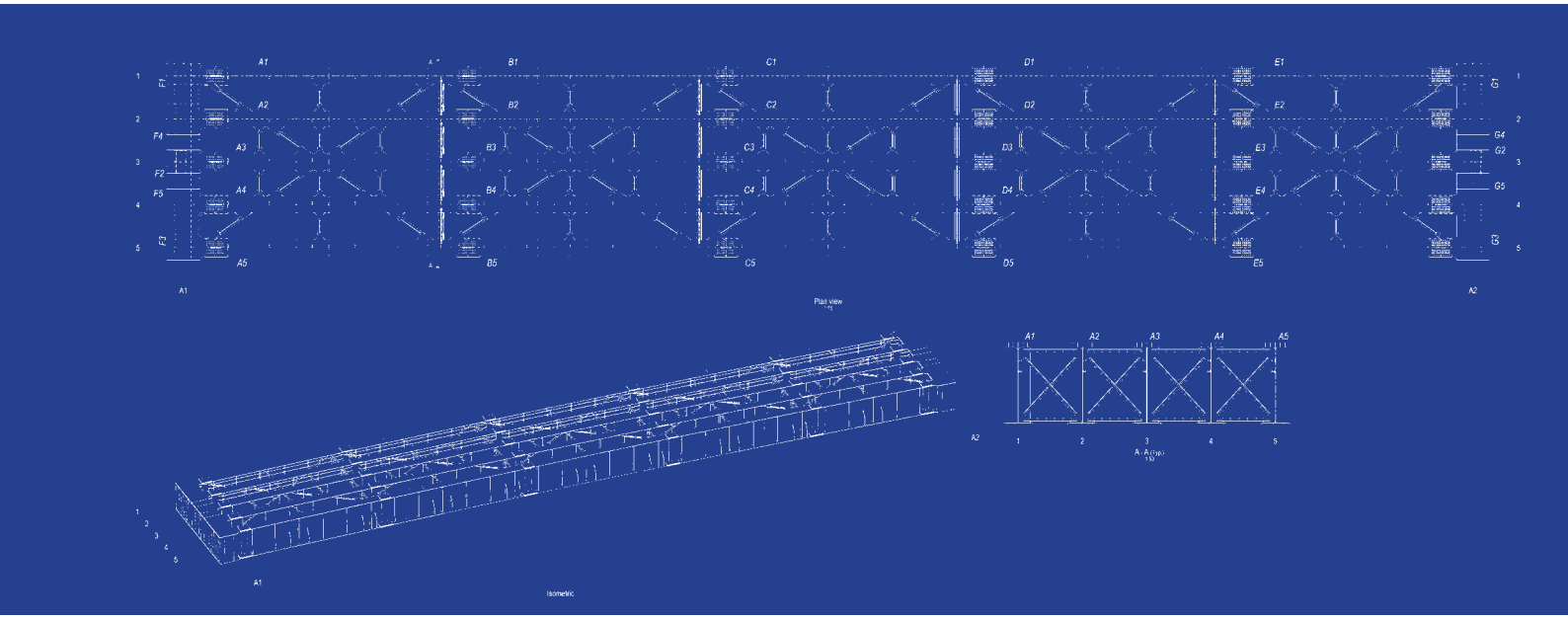
Completion Date:
June 2017

PROJECT DATA

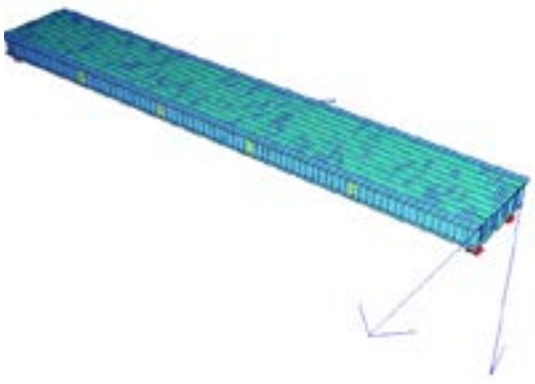
- Great attention has also been drawn to the hydraulic protection of the bridge, preventing the rainwater from falling or creating torrents causing damage. The waters, through ditches created in the mountain, are gathered and directed into a pipeline creating a peculiar bypass.
- The carrier of the bridge is divided into sub-sections welded to the manufacturing plant which are transported and assembled with locks on the spot. The limitation of the dimensions of the individual parts ensures both their smooth transportation and the requirement for smaller and more flexible forklift construction equipment.

PROJECT REQUIREMENTS

The design was carried out in accordance with Greek Instructions & Regulations, while compliance with the requirements of Eurocodes and German DIN regulations was checked. Elements covered below concerned Earthquake-planning, operational actions but also specific issues and critical controls.



- Circular MEPP for implementation
- of German DIN-Fachberichte in Greece.
- Guidelines for Road Design Studies -
- Cross sections (OEME-D, 2001).
- Guidelines for the Study of Road Works - (MUNS-Road Construction Projects - Civil Engineering Projects-2003).
- Concrete Technology Regulation (Government Gazette 317 / B / 17-4-97) and its Amendment (Government Gazette 537 / B / 1-5-02) and its Accompanying Standards.
- Steel Technology Regulation (KTX)
- and its Accompanying Standards.
- Greek Regulation of Reinforced Concrete
- (ECOS 2000).
- Greek Earthquake Regulation (EAK 2000).
- Guidelines for the Earthquake Study of Bridges
- (Circular E39-99).
- Guidelines for the Study of Seismic Insulated Bridges (OSI).



MATERIAL SPECIFICATIONS

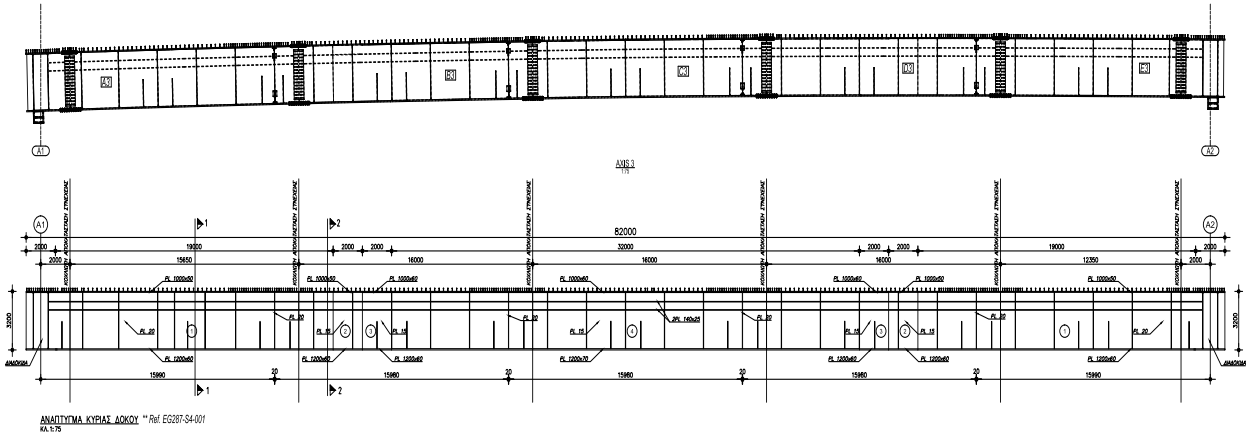
Particular attention was paid to the choice of the steelworks to supply the raw materials as the design specifications required high strength steel sheets, high thicknesses and guaranteed leakage limits.

STRUCTURAL STEEL

- Extruded sections: S 355 J2G3 & S 275 JR according to EN 10025.
- Extruded Steel Sheets: S 355 J2G3 according to EN 10025.
- Hollow sections: S 355 J263H according to EN-10210-1.
- Pre-assembled Galvanized Class GV 10.9 bolts according to EN 20898-1.
- Quality nuts 10 according to EN 20898-2.
- C 45 E Steel Flanges - Cylinders in accordance with EN 10083-1.
- Nelson F22 shears, h = 175mm, fuk = 450 N / mm2, according to DIN 32500.
- Anchors 8.8 threaded along their entire length

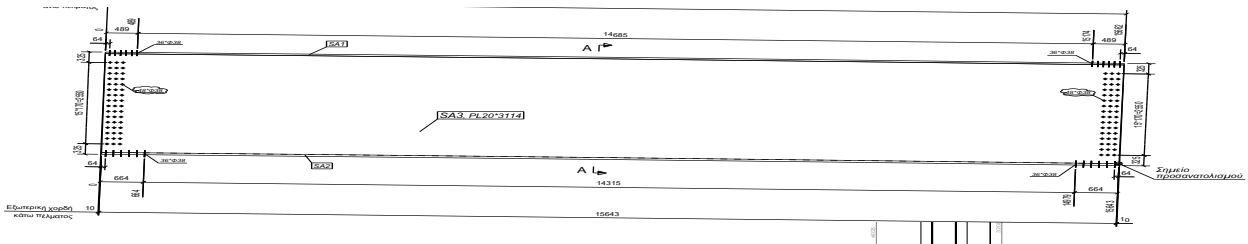
COMPOSITE DECK

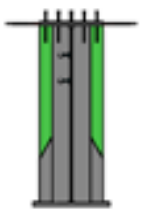
It consists of a composite cross section metal carrier and a traffic deck plate on it. It includes 5 main Twin T beams which are spaced 2660mm apart and are supported by 2 transverse beams. The upper and lower bevels of the beams have a width of 1000 and 1200mm in thicknesses of 60 and 70mm respectively while the logs are 3070mm high with a thickness of 20mm. Beams were provided with transverse and longitudinal reinforcements to prevent bending. In the upper flanges of the main beams were placed shear diameters of diameter Φ22, height 170mm and strength fuk = 450 N / mm2. The two transversal beams are supported in total at 4 points so that the carrier is simply seated. Intermediately, the carrier is supported laterally by 4 lattice beams of L sections. In addition, a horizontal cross section L is created across the entire deck for the overall stability of the carrier during the phase before the composite beam operation.

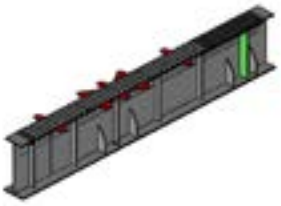


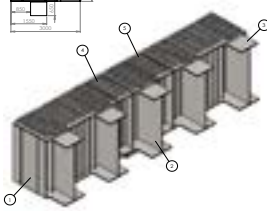
CROSS SECTIONS & SUB COMPONENTS

The beams result in two transverse beams of box-shaped form, which consist of upper and lower soles of width 2000mm and thickness 70mm. The logs of the box have a height of 3060mm and a thickness of 20mm spacing between them of 1000mm. Each beam is supported on two points and is mounted on two plain spherical plain bearings (single slip surface) of the EPS type of radius of curvature R = 2.235 m and a nominal coefficient of slip μ = 7% (± 20%). Perpendicular holes are made per 16m, which serve to stabilize the metal main beams and, above all, to secure against out-of-plane buckling during the construction phase of the bridge. These inner cross-section bars are made (upper and lower flanges, cross-sectional joints) of 2L120 x 12. In addition to the overall lateral stability of the bridge, a horizontal system of stiffeners and additional horizontal elements of 2L120 x 10 cross sections is constructed.









The bridge is supported by four ball bearings in reinforced concrete plinths, each of which is grounded in an array of 6 holes 1,20m in diameter and 15,00m deep. Its connection to the land area is made by joints with the possibility of moving up to 40cm in the longitudinal direction of the bridge.

WELDINGS

- All weldings were made on the basis of approved WPS. WPSs were made in accordance with EN ISO 15609-1: 2004. WPS reported on the WPQR certified welding method. During the welding phase, it was possible to modify it under the supervision of the welding co-ordinator.

- Welding co-ordination took place throughout the welds at the factory by mechanical welding (IIW, EWF).
- The welds were made in accordance with EN ISO 4063: 2010.
- Checkpoints determined the percent control points according to: Optical & geometrical control of edges & welding, Intrusion control with special penetrating liquids or magnetic particles, X-ray or ultrasonic inspection.

Quality Control

An integral part of the wider process of industrialization is the quality control that closely follows all the stages, aiming to achieve the correct application of the strict requirements according to ISO EN 9001 and EN 1090.

STEEL BRIDGES

Surface Treatment

All steel surfaces are protected by a paint system with a minimum life span of 15 years, suitable for Class C2 environmental conditions.

STEEL BRIDGES

Cutting Plans

Initially, the cutting plans were created with NC files that were created automatically by the design program. This ensures that there will be no human error in programming, but indicatively are reported:

- Dimensions, type and quality of raw materials to be used.
- The corresponding pieces of the drawings that will occur.
- The machine that will take the process.
- Tips & other information to the operator.

Cutting, Drilling & Marking

The cutting and punching of the plates was carried out on a CNC pantograph. The cutting and drilling of nodal plates was carried out on a special CNC machine which carries out both stages. The cutters were cut into an automatic cutting line. All workstations also marked the traceability of each piece in terms of its design number.

Built-Up Welded Beams

After the process of preparing the individual members in the first stage, the frontal joints of the logs were placed in a boom using the method of the submerged arc to produce the final length equal to the length of the respective beam. Then the main beams were assembled and the longitudinal welding was carried out.

SandBlast

All pieces of the deck and the hangers were sandblasted in a closed blasting tunnel. All dye surfaces were prepared according to EN ISO 8501-1: 2007 equivalent to the Swedish standards: Sa 2 ½.

Assembling

The assembly was carried out on the basis of the approved designs. The components to be welded were aligned and held in place by welding. The necessary tolerances were ensured, but also that the final fitment was consistent with the dimensions regardless of further processes.

Studs

The positions of the studs were in accordance with the approved designs & requirements of EN ISO 13918: 2008. Welding's of the studs was done according to the requirements of standard EN ISO 14555: 2006 by certified welders.

Paint Coatings

The dye was made in accordance with EN ISO 12944-7: 1998 by the following procedure:
Primary primer coat: Zinc phosphate 70µm.
Intermediate layer of epoxy base - 70µm ferrous bicarbonate.
Intermediate layer of polyurethane 60µm.
Final polyurethane paint RAL 9010 - 60µm.

K.LIAROMATIS
STRUCTURAL STEELWORK

Patras
Industrial Area
GR - 250 18
Greece

PLANT
TEL: +30 2610 647491
FAX: +30 2610 647494

ATHENS OFFICE
TEL. +30 210 2723252
FAX: +30 210 2719820

info@liaromatis.gr
www.liaromatis.gr