

Braga Municipal Stadium



LOCATION:

Braga, Portugal

SUBMITTING FIRM:

PROAFA - Serviços de
Engenharia, SA
(AFACONSULT)

FIDIC MEMBER:

Associação Portuguesa de
Projectistas e Consultores



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A dramatic state-of-the-art engineering and architectural stadium was built to receive the EURO 2004 football championship. The site where the client wanted a 30 000 seat stadium was a hill with a very good granite quarry on its top, in Dume, Braga, Portugal.

The Architect imagined one stadium with only two stands – one would be carved into the rock as in an amphitheatre; the other one would rise up from the ground.

The roof was to be compatible with the idea of integrating the Stadium into the environment. It was also to be as light and clean as possible, and for that reason became the most noticeable element of this building. It is made up of pairs of full locked coil cables, spaced 3.75m apart from each other, which support two concrete slabs that cover the two stands of the stadium. Its span (202m), and the fact that the cables are free in the central zone were its main challenges.

Due to the innovative nature of the project, several entities were involved. Three studies were carried out with regard to its wind behaviour (rigid and aeroelastic).

The rainwater is drained from the roof along one side only, collected in two stainless steel "aqueducts", running along the plinth of the embankment. The variation in the length of the various pairs of cables along the roof ensure its required scope to the hill.

The front edge of the two concrete slabs of the roof support a triangular transversal truss, initially designed as stiffness beam, but modified to accommodate the floodlights and loud speakers.

The roof is supported on two large beams at the top of both stands – east and west, where the cables are anchored.

The east stand is structurally made up of 50m-high uprights that are "pierced" by the slabs of the different floors of foyers of the stadium. Its longitudinal stability is guaranteed by the existing slabs under the steps of the stands. The uprights of the east stand, which are only 1m thick, are extremely elegant.

The west stand is perhaps the most complex structural element, due to the diversity of the problems it involved: the uprights anchored in the rock, the functioning of the structure with the ground, compatibility between the structural functioning of elements with very different stiffness, the laying of foundations in unstable embankments. Among the several solutions encountered it is difficult to pick out one worthy of special mention.

The so-called pitch is in fact the building that is hidden underneath it self. It has two floors and covers the whole area of the pitch. It includes a car park, changing rooms and all the EURO 2004 backup services. It did not cause particular structural difficulties apart from the control of the consequences of shrinkage and temperature variations, which led to the installation of

bearings between the columns and the slab for the pitch platform, especially well integrated into the architecture.

The excavation and stabilisation of embankments that preceded the construction of the stadium was in itself a huge task. In total 1,700,000 m³ of hard rock and gravel were excavated, which led to the need to contain enormous rock embankments, in which, unfortunately, the fractures were in an unfavourable direction. The embankment was contained with a net of anchors and rock bolts to guarantee its stability.

The behaviour of the embankments is assessed through a set of in-place inclinometers and anchor load cells, linked to the stadium monitoring system.

The variety and complexity of the technical problems involved in the design and construction of the "New Braga Municipal Stadium" constituted a great challenge for the design team and, at the same time, it was an excellent opportunity to increase our know-how.

In this process we were aware of the risk that arises from constantly "pushing beyond the limits", and controlled it through an intensive research methodology. Risk assessments, redundancies, independent teams studying the same problem, cross-checking results, all allowed us to gradually drop the inevitable initial "extra safety margins". During the 4 years of the project planning and execution, cost and time schedules lived side-by-side with the technical demands and aesthetic aspirations of the Project. It is rewarding to realise now that to talk about the stadium's structure is also to talk about its architecture, and that to explain its architecture is to tell the story of the engineering problems it brought up and how they were overcome.

Team Design

Architecture: SOUTO MOURA ARQUITECTOS Lda
Landscaping: Daniel Monteiro
Consultants: Arup Associates – Dipesh Pattel (Stadium Brief)

Engineering Design: AFASSOCIADOS (AFAconsult in the present)
Cables detail design and construction: Tensotecci
Wind Studies: Arup + RWDI + Politecnico di Milano

Contractors:
Soares da Costa + Assoc

Photography:
Christian Richter
AFAssociados (AFAconsult in the present)