



SIKA AT WORK

TAMOIOS HIGHWAY PROJECT, BRASIL

CONCRETE: SikaFiber®, Sigunit®, Viscocrete®

BUILDING TRUST



TAMOIOS HIGHWAY PROJECT

PROJECT DESCRIPTION

Rodovia dos Tamoios (SP-099) is located between Caraguatatuba and São José dos Campos, in the State of São Paulo, Brazil. The current highway consists of a stretch at sea level, followed by a stretch of mountains and, finally, a stretch of plateau that leads to São José dos Campos. The current project foresees to double the capacity with the construction of a new highway with two lanes and an emergency shoulder towards São José dos Campos.

The duplication of the existing highway will relieve the heavy traffic flow, providing more safety for users, more regular ramps, and smoother curves. It will also improve the product flow capacity through the port of São Sebastião, contributing to the Brazilian economy. The construction is well aligned with the completion date scheduled for March 2022.

It is important to note that the terrain between Caraguatatuba and São José dos Campos is mountainous and the current alignment is only possible through road tunnels. Due to specific geographical circumstances, all tunnels are sloped and road traffic will be rising all the time. The difference in total height over 15 km is estimated at 750 m or an average ramp of 0.05 (5%). About 85% of the project is located in the Serra do Mar State Park, an environmental protected tropical forest area.

TECHNICAL DETAILS

Location: Caraguatatuba, North coast of São Paulo State
The project consists of ten fly-overs, four tunnels and 21 km of highway.

- 12.85 km of road tunnels
- 2.57 km of bridges and fly-overs (total ten)

Tunnel 1:	2.889 m
Tunnel 2:	714 m
Tunnels T3-T4:	5.555 m (longest road tunnel in Brazil)
Tunnel 5:	3.696 m
Bridges:	2.577 m (longest = 948 m)
Earthmoving:	6.145 m ³
Sections:	main tunnel 120 m ² / emergency tunnel 30 m ²
Excavation method:	NATM (1.9 million m ³ in rocks)
Total extension:	21,555 m

PROJECT REQUIREMENTS

Top and residual Strength – EN14488-3

The flexural tensile strength must be estimated according to the test proposed by EN14488-3. This test is performed by reading the load through the crack opening of the core, where, for each crack opening, the strengths are estimated. It will be used to homologate the mix the operational process for applying shotcrete, the mix of fiber-reinforced shotcrete and the

technical control during the execution of the services will be performed on cylindrical cores extracted from fiber-reinforced shotcrete plates through the tensile strength test by double punching (Barcelona Test – AENOR UNE 83515)

The fiber dosage was determined in order to obtain **fr4 = 1.0 MPa**

Barcelona Test for Determination of Residual Tensile Strength

The tensile strength by double punching, also called Barcelona test, has been defined as the composite quality control test.

Minimum 0.5 (MPa) – fr2.5

Assumptions Considered in the Evaluation of a Fire Event

ISO 834 fire curve

Fire duration of 150 minutes

Maximum temperature of 1,200°C

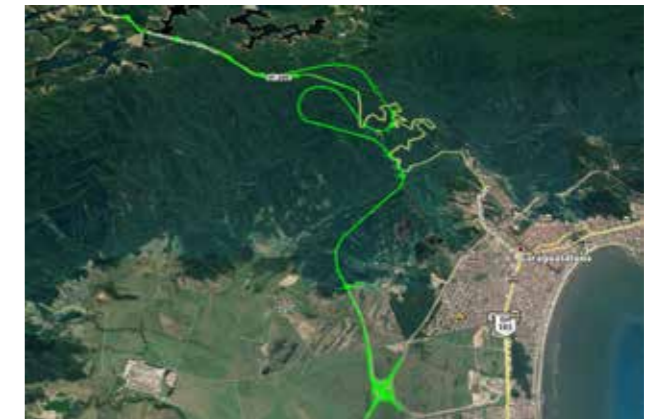
Verification of support conditions under the action of fire whose characteristics fall within the ISO 834 curve (1975).

To ensure passive protection against fire, the use of synthetic microfiber SikaFiber® Micro PP 12 was defined, in a dosage of 1.2 kg / m³ of concrete, certified through tests carried out at the Technological Research Institute of Universidade de São Paulo (IPT-USP).

SIKA SOLUTIONS

The greatest challenge of duplicating the Tamoios Highway was to understand the technical needs of the project and to develop the best formulation in concrete admixtures.

In addition to the superplasticizer, there was a need to replace the wire mesh used as shotcrete reinforcement using both macro and microfiber, which allowed great gains in productivity for the construction company.



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RESULTS ACHIEVED BY THE CLIENT

In terms of logistics, the use of SikaFiber® PP-48 synthetic fibers represented approximately 1/5 of the volume of metallic fibers, which resulted in less transport, storage and handling.

The use of synthetic fibers has reduced the risk inherent in the installation of wire mesh, as well as the risk of being under unstable areas, with the danger of displacement of rocks. Synthetic fibers are also the best option for aggressive environments, since both wire mesh and metallic fibers undergo oxidation. In addition, synthetic fibers provided less wear on equipment (hydraulic pump, hoses, rotors) and gains in productivity and quality of sprayed concrete.

As the Main Contractor produces part of the raw materials used in concrete, the admixture Sika® Viscocrete® 6090 HW made it possible to use only a single fine aggregate in the mix (artificial sand). This allowed significant savings for the construction company. Sika® Viscocrete® 6090 HW also provided slump keeping up to 3 hours without loss in workability and without changes in compressive strengths, which facilitated transportation and productivity gains in the application of concrete, whether structural or spray applied.

The use of Sigunit®-L-500 AF shotcrete accelerator made it possible to achieve initial strengths over 1 MPa at 1 hour, necessary for the safety of the spraying process, with a minimum of reflection. According to EN14487-1, this corresponds to a J2 curve, which represents a high quality concrete for tunnels. In addition to the above mentioned products, others were also supplied, such as cementitious grouts (SikaGrout®-250) and epoxies (Sikadur®-31, Sikadur®-32 and Sikadur®-52).

SIKA PRODUCTS USED

- Sigunit®-L-500 (shotcrete accelerator)
- Sika® Viscocrete®-6090-HW (high range superplasticizer)
- SikaFiber®-12 Micro PP (synthetic micro fiber)
- SikaFiber® Force PP-48 (synthetic macro fiber)

PROJECT PARTICIPANTS

Client: Tamoios Concessionária
Main Contractor: Queiroz Galvão Construtora
Design: CJC Engenharia

Our most current General Sales Conditions shall apply. Please consult the most current local Product Data Sheet prior to any use.



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