

SUSTAINABLE DEVELOPMENT ENVIRONMENTAL IMPACTS ON ROADWAYS



Roberto Kochen, Ph. D.

- President, UPADI's Technical Council
- Director of GeoCompany Technology, Engineering and Environment, São Paulo, SP, Brazil (www.geocompany.com.br)
- Prof. Dr., Polytechnic School of Engineering, University of São Paulo

www.geocompany.com.br

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ENVIRONMENTAL IMPACTS ON ROADWAYS

◆ Abstract

Environmental impacts on roadways and other long infrastructure works (e.g., oil and gas pipelines, railways, and so on); can be large and hard to repair.

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◆ 1 – Introduction

- Environmental impacts can be defined as the damage to the nature caused by a certain activity (or set of activities) performed by human beings, that generate risk to the well being of the nearby communities, and therefore must be repaired to maintain the environmental quality of a certain place.
- Construction, operation and maintenance of roadways can be responsible for significant impacts on the environment.

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◆ Main Themes

- Environmental impacts generated during rehabilitation of aged roadways.
- Methodology of environmental impact assessments on existing roadways in Brazil.
- Rehabilitation program of Sao Paulo Roadway Authority in Brazil.

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◆ 2 – Environmental Impacts Assessments in Roadways

- Environmental impact assessments are today of utmost importance.
- Society has today low level of tolerance to environmental damages.
- Environmental impacts have to be avoided or repaired.
- Care must be taken to estimate the damages and repairing costs associated with these damages.

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◆ Important Points

- Rehabilitation of existing roadways.
- High amount of investments.
- Utmost importance the correct assessment of the impacts and repairing methods.

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◆ 3 – Environmental Impacts Assessments in Existing Roadways

The methodology developed has 2 phases:

- **1rst Phase** – Delimitation of Environmentally Damaged Zones in the roadway: using aerial and satellite photos, as well as Soil, Geological and Geomorphologic maps, zones of the roadway prone to environmental damages or with probable environmental liabilities are defined.

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- **2nd Phase** – Geological and Geomorphologic Assessments to identify Environmental Liabilities : in this phase, environmental liabilities are identified with the following criteria :
 - identification of terrain patterns changes.
 - identification of erosion prone zones on terrain surface.
 - identification of erosion prone materials in earth fills and cut slopes.
 - Identification of weathered and special soils zones (expansive soils, etc.)

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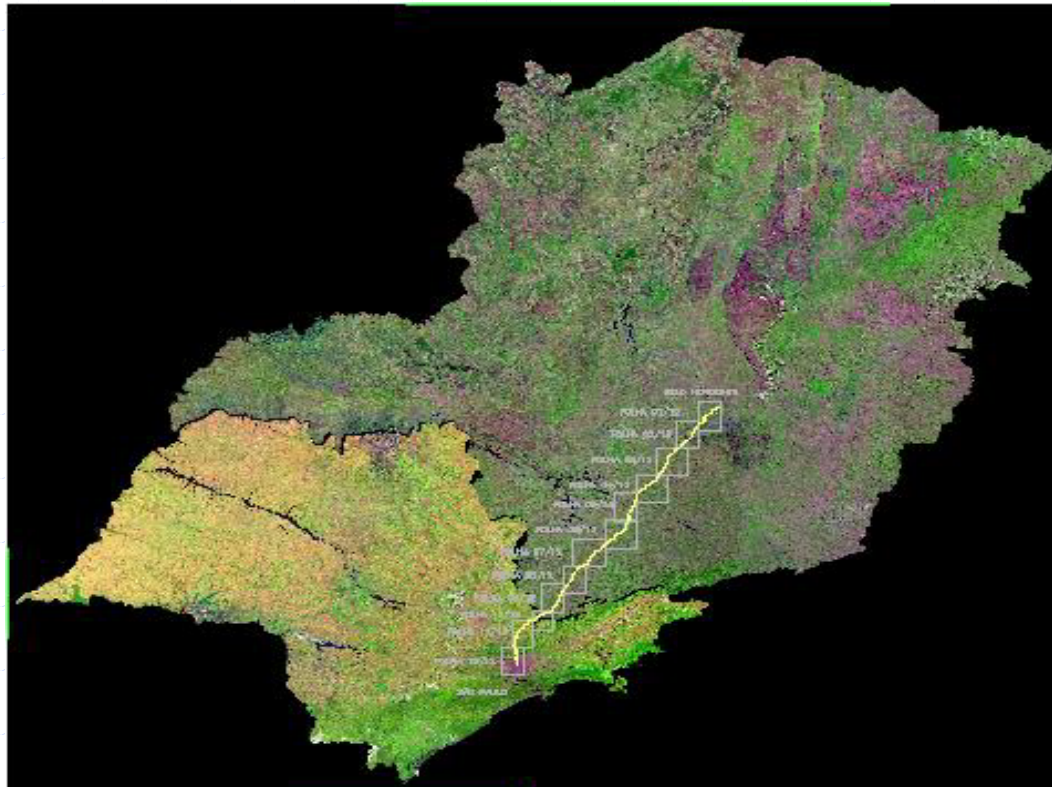


Figure 1 - satellite image of Sao Paulo – Belo Horizonte roadway

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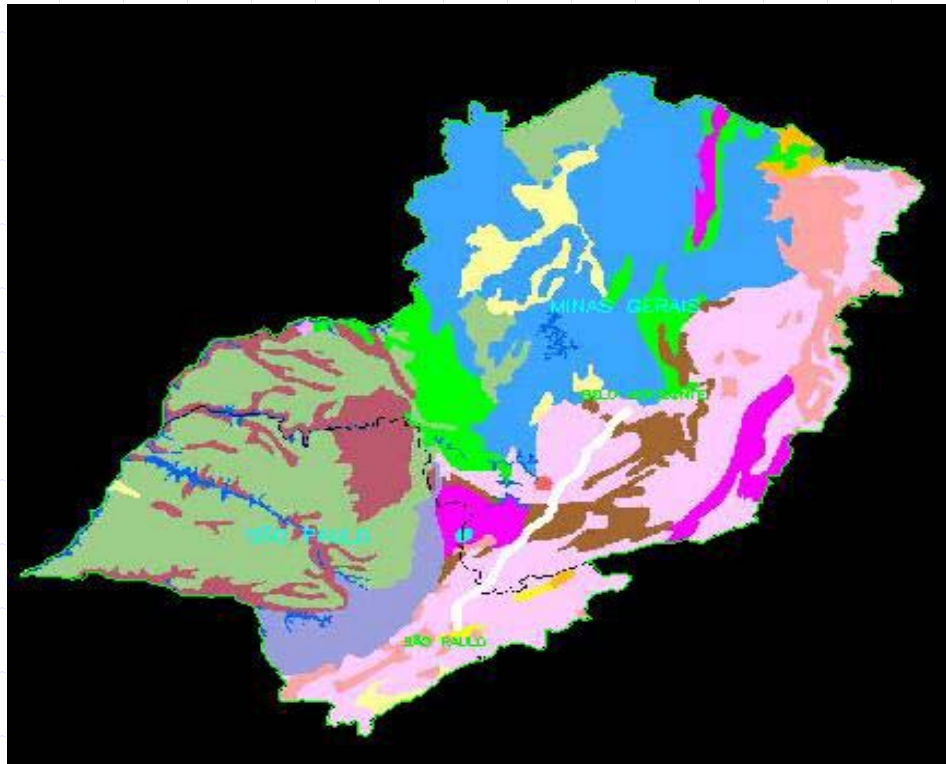


Figure 2 - Geological Map

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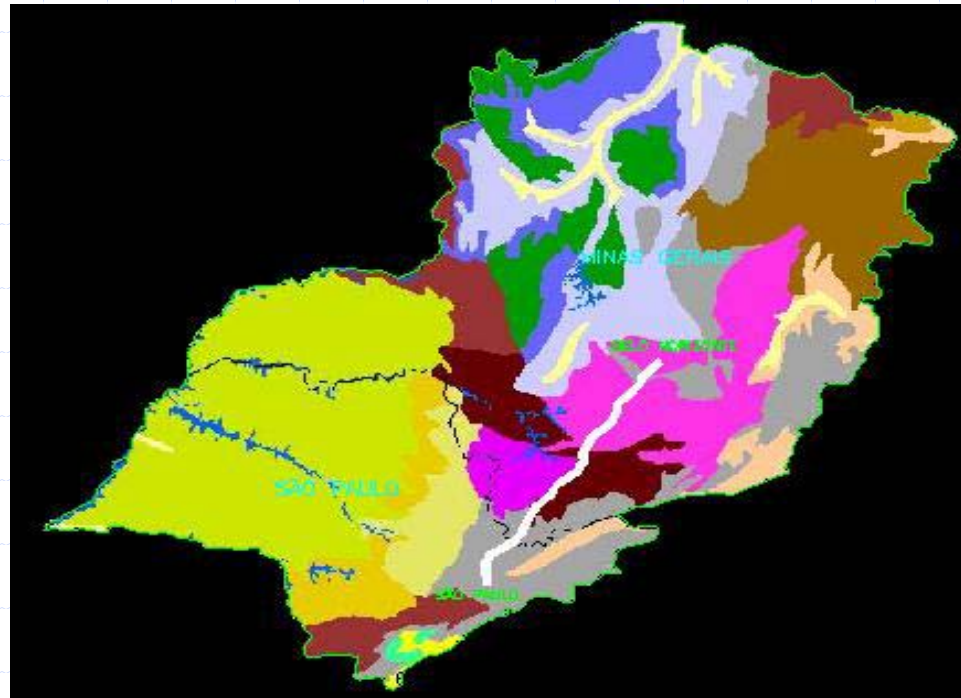


Figure 3 - Terrain Map

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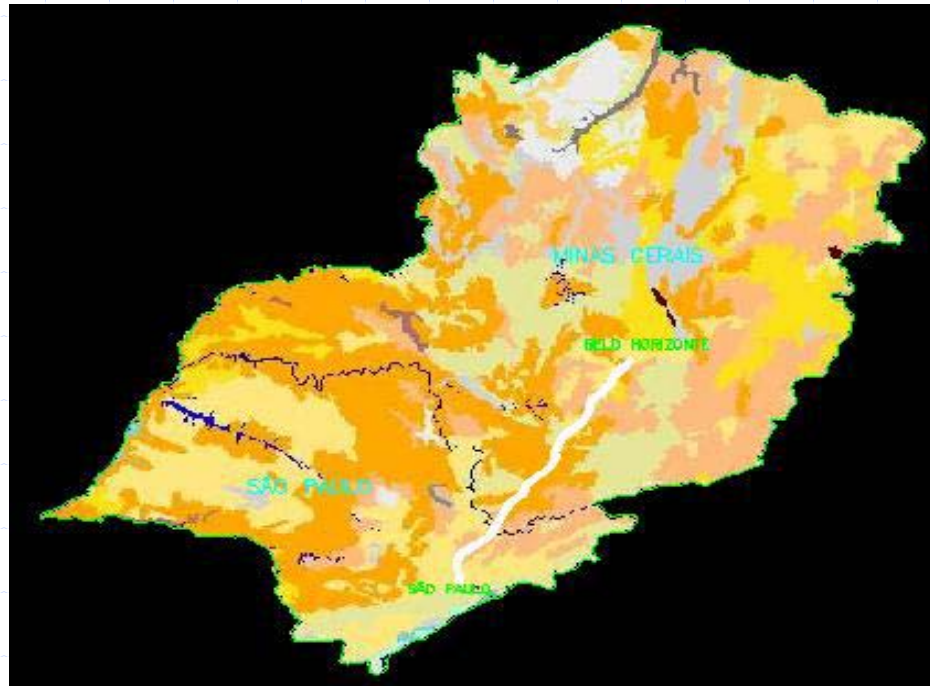


Figure 4 - Soil Map

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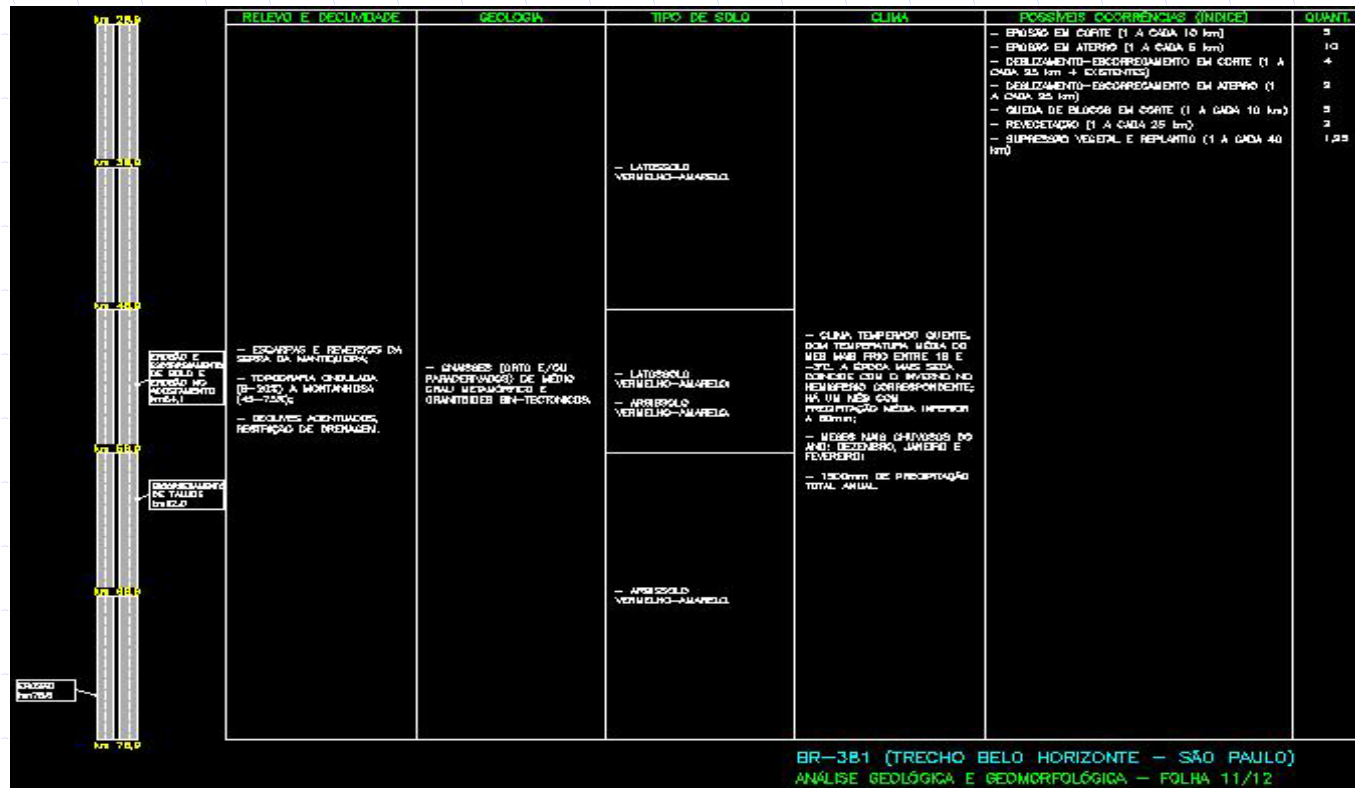


Figure 5 - Delimitation of Environmental Assessment Zones

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4 - Detailed Design for Environmental Liability Repair in Existing Roadways.

- Planning of the field works for the detailed environmental assessment in the existing roadway.
- Execution of the field assessment in the existing roadway.
- Environmental Damages and Liabilities assessment and evaluation of impacts and rehabilitation measures.
- Definition of mitigation and rehabilitation measures.
- Detailed design for repairing environmental damages.

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◆ Main environmental impacts in existing roadways are generally:

- Cut slopes and earth fills prone to erosion and instabilities.
- Borrowing and disposal areas for fill material not properly restored after use.
- General stability problems in the roadway.
- Man made activities like use of the roadway domain area for purposes not acceptable regarding environmental criteria.
- Other environmental impacts and liabilities.

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◆ Classify environmental impacts:

- Extent of impact to the environment.
- Priority assigned to suppress, minimize or repair the impact.
- Damage to the populations nearby or the environment in general.

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◆ 5 - Example of a Detailed Design for Environmental Repair Works

- The example refers to roadway SP 122, in Sao Paulo State, Brazil, crossing an environmentally protected area at Serra do Mar mountains, where native forests, urban zones and chemical plants are located together. There is also an old railway (Santos Jundiai Railway), crossing the zone.
- The roadway crosses zones of protected forests, with distinct geological patterns, comprising hills, quaternary sediments, and also gneissic rocks.

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◆ **Main problems in this roadway are clearly associated with the rain season, provoking the following impacts:**

- Superficial soil slope failures.
- Rock wedge failures.
- Earth fill border failure in the roadway.
- Superficial erosion.
- Borrow and disposal area degradation

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- ◆ **Almost all the environmental impacts mapped at the field were limited to the domain area of the roadway.**

- ◆ **One of the main environmental damages in this roadway was due to an earth fill failure, shown in a photo below, near the entrance of Paranapiacaba city.**

- ◆ **The repair of the mapped environmental works in this roadway required only simple and inexpensive solutions, like:**
 - Erosion control.
 - Rain water collection and proper drainage.
 - Periodic maintenance of drainage works.

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Figure 6 - earth fill failed at the entrance of the city.

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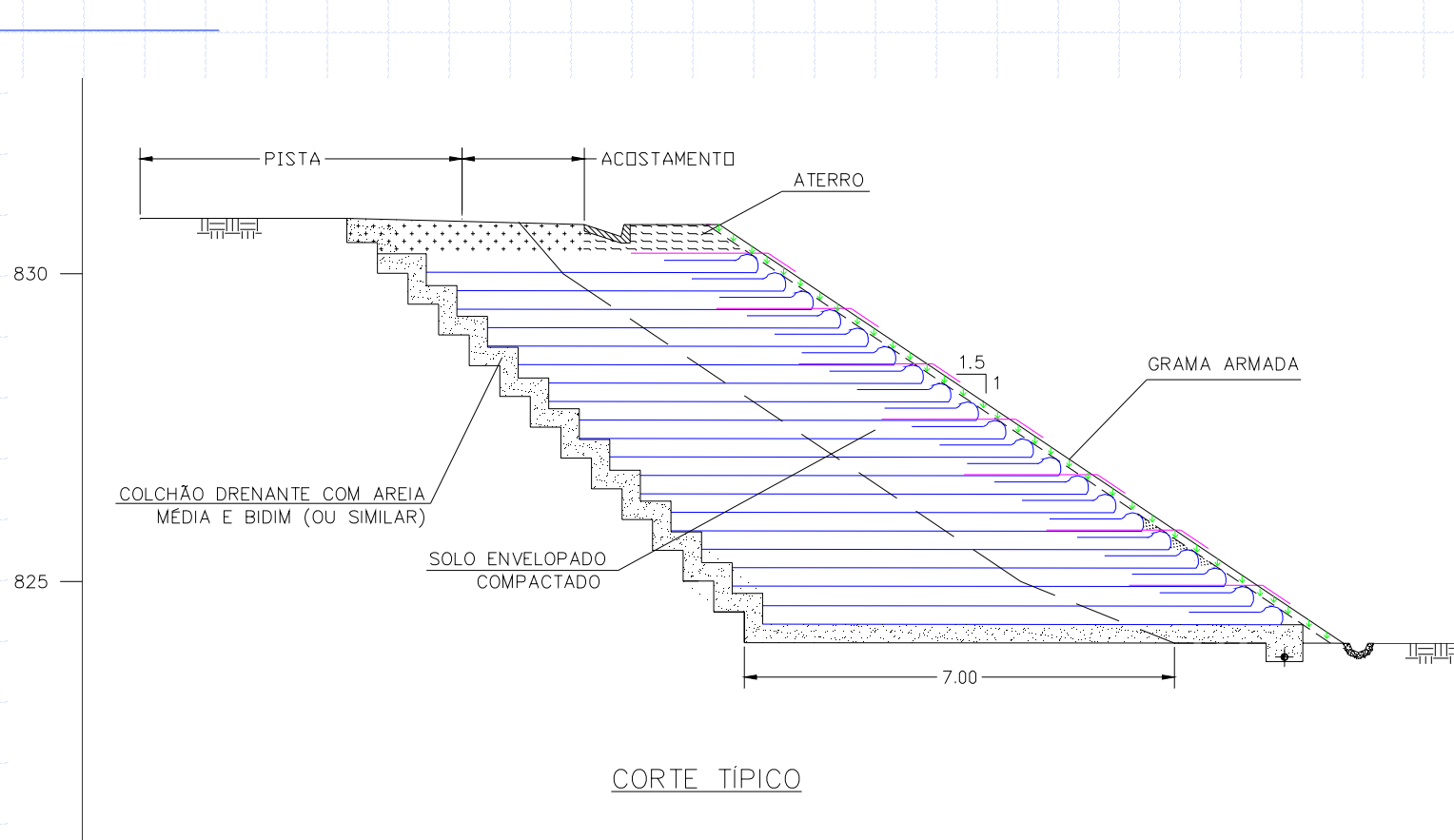


Figure 7 - solution of the earth fill failure with reinforced soil.

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Figure 8 - environmental damage in a cut slope due to failure of the soil mass.

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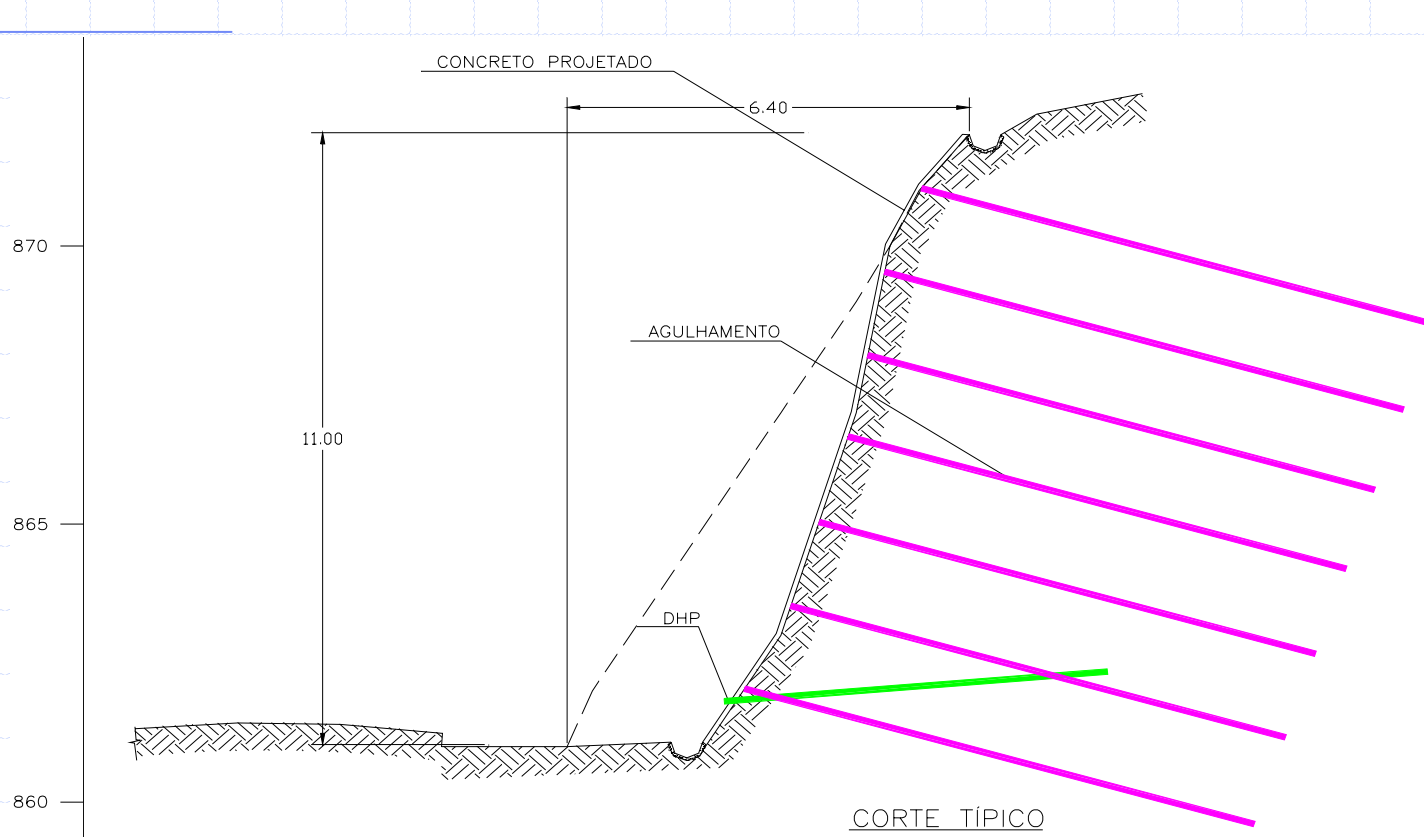


Figure 9 - solution to the cut slope failure using soil nailing.

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Figure 10 - borrowing area with erosion and instable cut slope.

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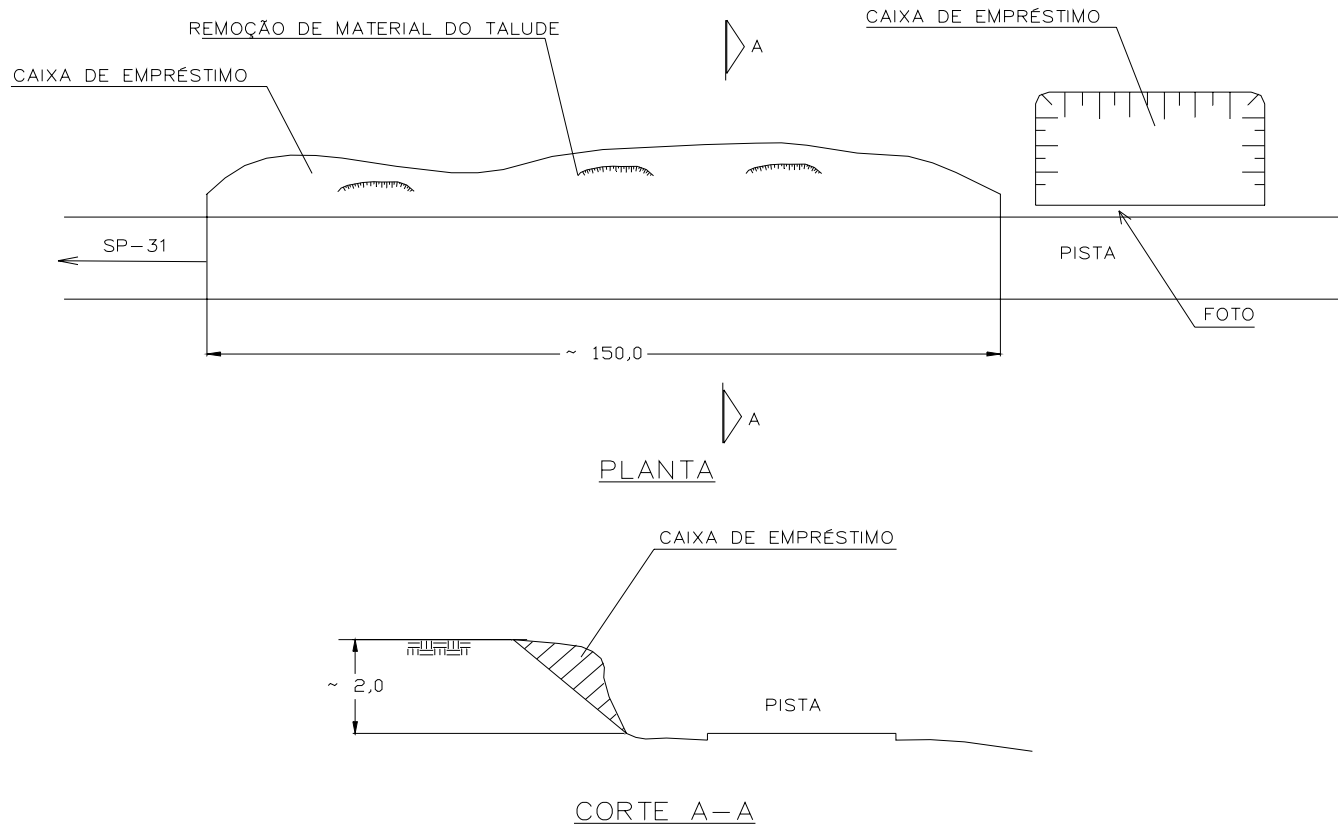


Figure 11 - typical solutions to the borrowing area with erosion and instable cut slope

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◆ 6 – Final Remarks

- This paper presented a methodological procedure to identify environmental impacts on roadways, and define efficient corrective measures to suppress the effects of these environmental impacts. For existing roadways, the main impacts on the physical, biological and man made medium has already, making possible an environmental management of the roadway with simple and inexpensive measures to suppress the environmental impacts.
- Some impacts can occur in the operational phase of the roadway, like noise, vibration, gas emissions by vehicles and so on. But in existing roadways the main environmental impacts are due to constructions or maintenance faults, and can be corrected, in most of the cases, with simple and inexpensive measures.