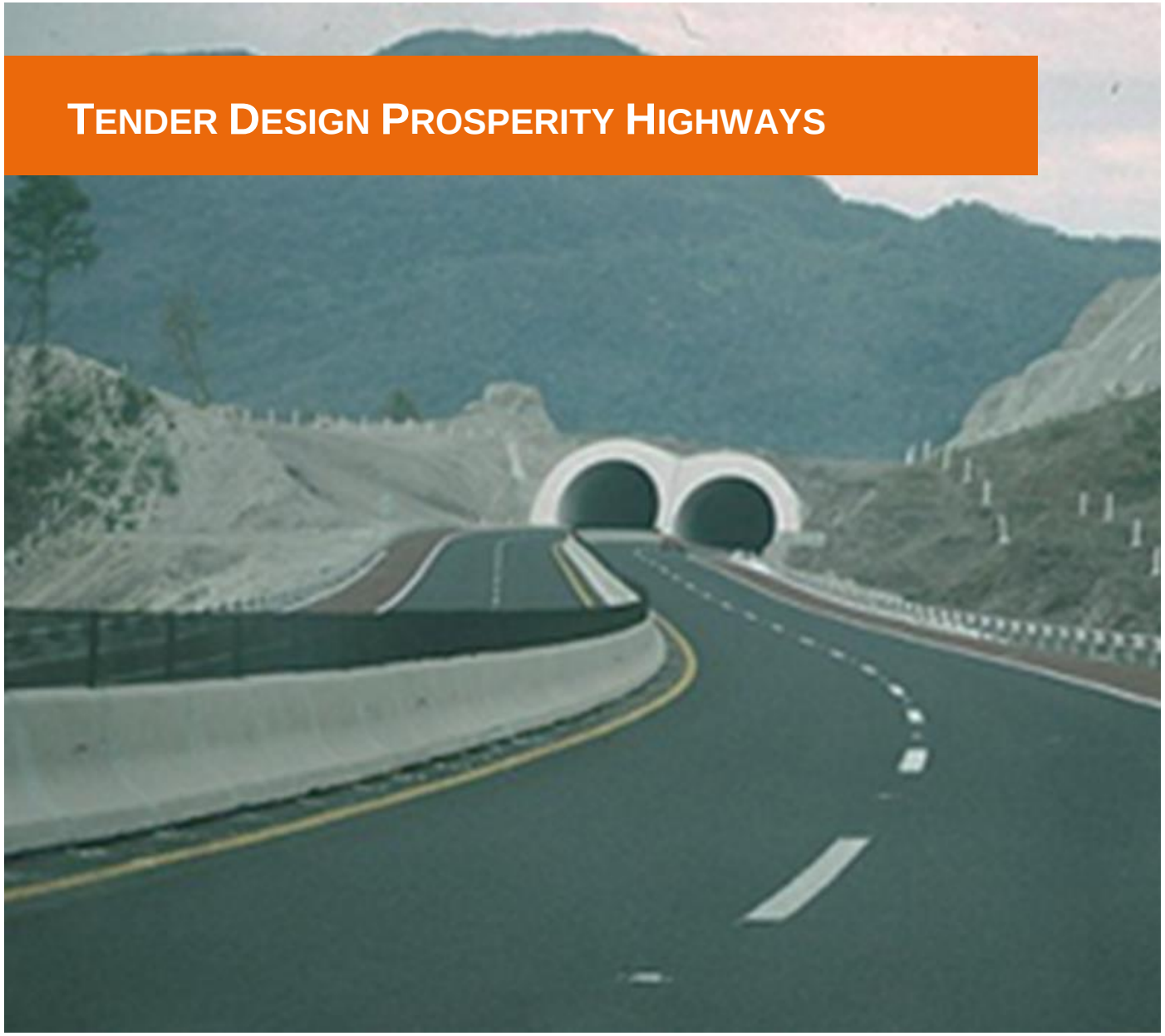
TENDER DESIGN PROSPERITY HIGHWAYS



Prosperity Highways, tender design of two long highway sections, Medellin area, Columbia

Tender design for the 32 km long “Pacífico 1” and 42 km long “Mar 1” highway sections.

Scope

- The 32km long Pacífico 1 section includes the two major 1.6 and 4.1km long Sinifaná and Amagá tunnels.
- The 42km long Mar 1 section originally includes 18 tunnels in total, one tunnel is the 4km long twin Occidente tunnel.
- Various viaducts and crossing structures
- Ground works as embankments and slope stabilization.

Challenges

- Both highway sections are in mountainous area with unstable slopes.
- Very limited accessibility, both for investigations and construction work.
- Most geological units consist of weathered rock and highly fractured lithology.

Amberg Services

- Alignment optimization
- Geological investigations and assessment
- Preliminary design for tunnel portals and alignment n
- Specification of tunnel installations
- Slope excavation design and support scheme
- Foundation design for viaducts and structures
- Materials re-use and disposing
- Various drawings and plans
- Budgeting

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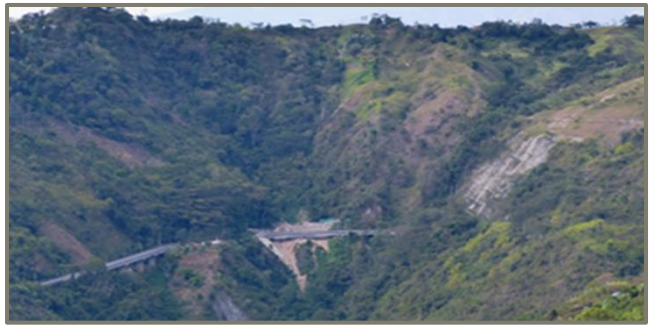

- Instable area with visible hang sliding

- Construction of viaduct over instable area

- Hang stabilization and viaduct completed

AMBERG FACTS

Contracted value Amberg

- Total € 130.000

Project Phases & Duration

Tender designs	2014 - 2015
Construction works	2016 - 2021
Commissioning expected	2021

Project Details

- Earth compensation has been analyzed, to find the optimal usage and balance.
- Slope stabilization and embankment designs have been performed including optimum geometrical shape and support measures.
- Foundation of the viaducts and other structures has been investigated and assessed.
- Tunnel excavation and supporting has been designed in different terrain.
- Drainage and water proofing has been investigated and assessed.
- Ventilation as well as other tunnel installations have been designed.

CLIENT FACTS

Overall costs

- Total of two sections, over € 1.200 mio

Project Overview

- The 4th Generation Highway program includes the Prosperity Highway and seven concession sections.
- The investment is over € 4.000 mio
- The total length of new and refurbished roadway is approx. 900km.
- The design speed is 80 km/h and the max. slope 6%
- The project has an important social-economic impact

Geology

- Both alignments of the Prosperity Highway is located in a variety of rock types such as volcanic, metamorphic and sedimentary nature.
- The structural pattern reveal a number of faults affecting the alignment.
- The rock formation is often highly weathered and fractured.
- Quaternary soils are often present along the alignment.
- Geomorphological processes often in conjunction with deep erosion and landslides, etc. form a rather rough and difficult accessible terrain.

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CHALLENGES

Typical instable slope area with hang slide

Narrow schedule and logistical challenge

- Short period for client proposal presentation,
- Long extension of both highway sections,
- Remote work areas
- Difficult access to the particular work locations.

ENGINEERING APPROACH

Imposing stabilization measures, difficult access

Geotechnical project approach

- Experienced expert's input was the approach for the ongoing work in an area with difficult and not always fully known geotechnical soil and rock conditions.
- A comprehensive team of experts was mastering all the tasks of the project in the available time frame.
- Tunnels have been a major concern with respect to economic terms. Their alignment and design were during the preliminary design phase, especially the two main tunnels of Pacífico 1 section.
- The 18 tunnels in Mar 1 section were reduced to 7 and work units were optimized to match the constrained budget

TECHNICAL SOLUTIONS

Controlled excavation of instable hang area

Conclusive services

- Contractor's proposals and offers were prepared in due time
- The offers were technically at state of the art and economically competitive.
- The advantage of this proceeding was fully appreciated by the client.

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AMBERG KEY PEOPLE INVOLVED

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