



Job Report Cold Recycling

# WR 2500: Rehabilitation of the Tabarja – Chekka Highway, Lebanon





## Wirtgen Cold Recycling:

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## Introduction

Lebanon is a pocket country that is located in the eastern coast of the Mediterranean Sea. Due to the lack of vital natural resources such as oil, gas, or gold mines the main income of this country that is surrounded by green mountains and the blue sea is tourist attractions. Because of that and 25 years of civil war that hurt this country and because of the non-existing maintenance of the road network, the governors took into consideration the use of the recycling technology to protect the natural resources. Post-war reconstruction and rehabilitation of the road network with the length of 4,000 km was taken over by the Council for Development and Reconstruction (C.D.R).



Aerial view of Tripoli – Lebanon.

## History

Lebanon has two major cities, Beirut and Tripoli, which are connected by a highway. This crucial transit way that is linking the North section and the South section of the country was constructed twenty-five years ago in order to ease ground transportation. The Tabarja-Chekka part that was mostly distressed and suffered from various types of prob-

lems such as bleeding in vast areas, rutting, and parts which were patched and filled, different types of crocodile cracking, longitudinal and transverse cracks, this part of the highway was to be rehabilitated. The total length of this part is 80 km (660.000 m<sup>2</sup>) from Tabarja to Chekka and vice versa with varied widths in special sections.



Typical pavement condition prior to recycling.

## Traditional design

Based on the 25 years of design life the consultant engineers came up with various rehabilitation solutions which are as follows:

- Overlaying three layers of asphalt
- Removing the asphalt layer in the long section, placing 25 cm of selected material and overlaying three layers of asphalt
- Milling of 5-10 cm of asphalt layer and paving three layers with a total thickness of 18 cm

Because of the fact that the cracks would reflect to the surface of the new overlay after a short period of time, removing and stock-piling of asphalt in the nature would cause pollution in the wild life, none of the above mentioned suggestions convinced the authorities.

## Latest rehabilitation methods

The SOTEG construction company using the road recycling equipment of Wirtgen came up with the idea of cold recycling with foamed bitumen and cement.

The idea was accepted by the Ministry of Road and Transportation and the World Bank Organization because rapid execution, cost effectiveness and the re-definition of the longitudinal and transverse profile of the road were guaranteed.

## Initial investigation & mix design

Regarding the project length, various test pits were undertaken and series of tests were carried out.

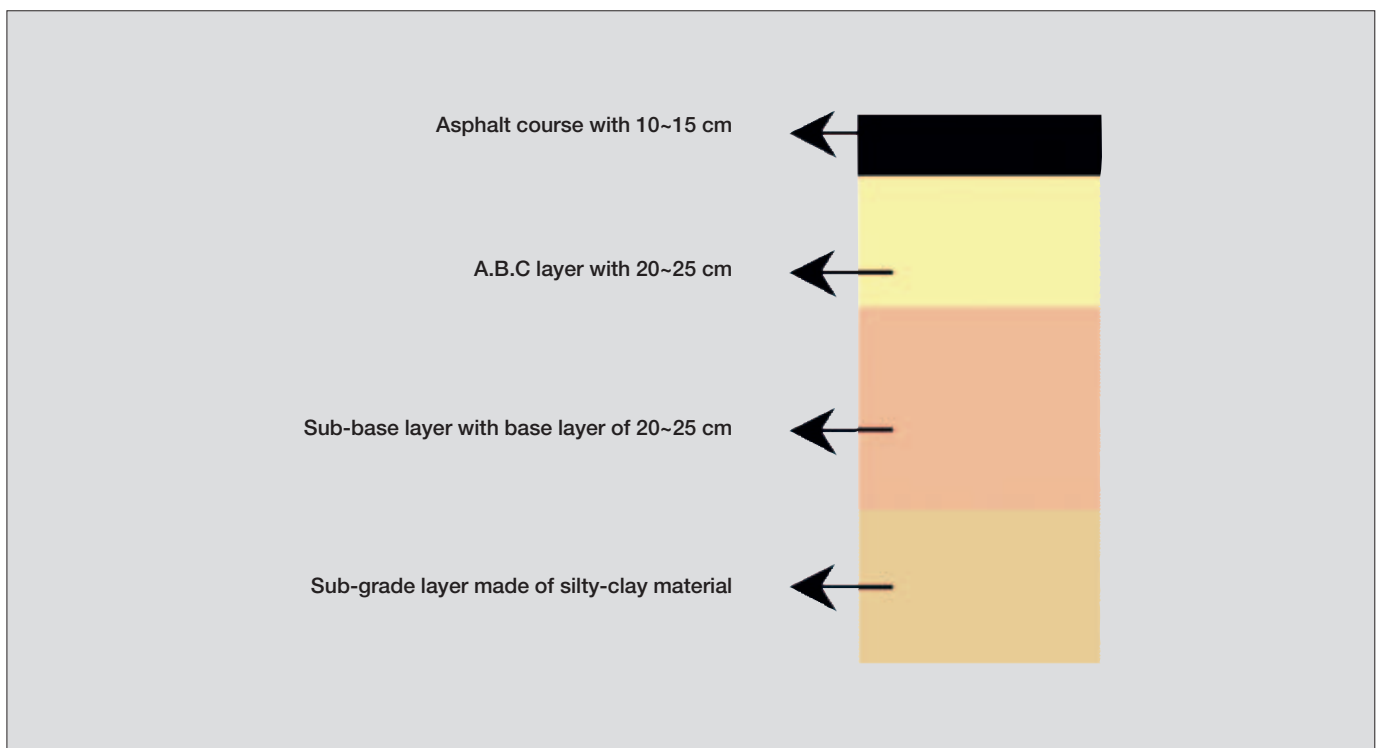
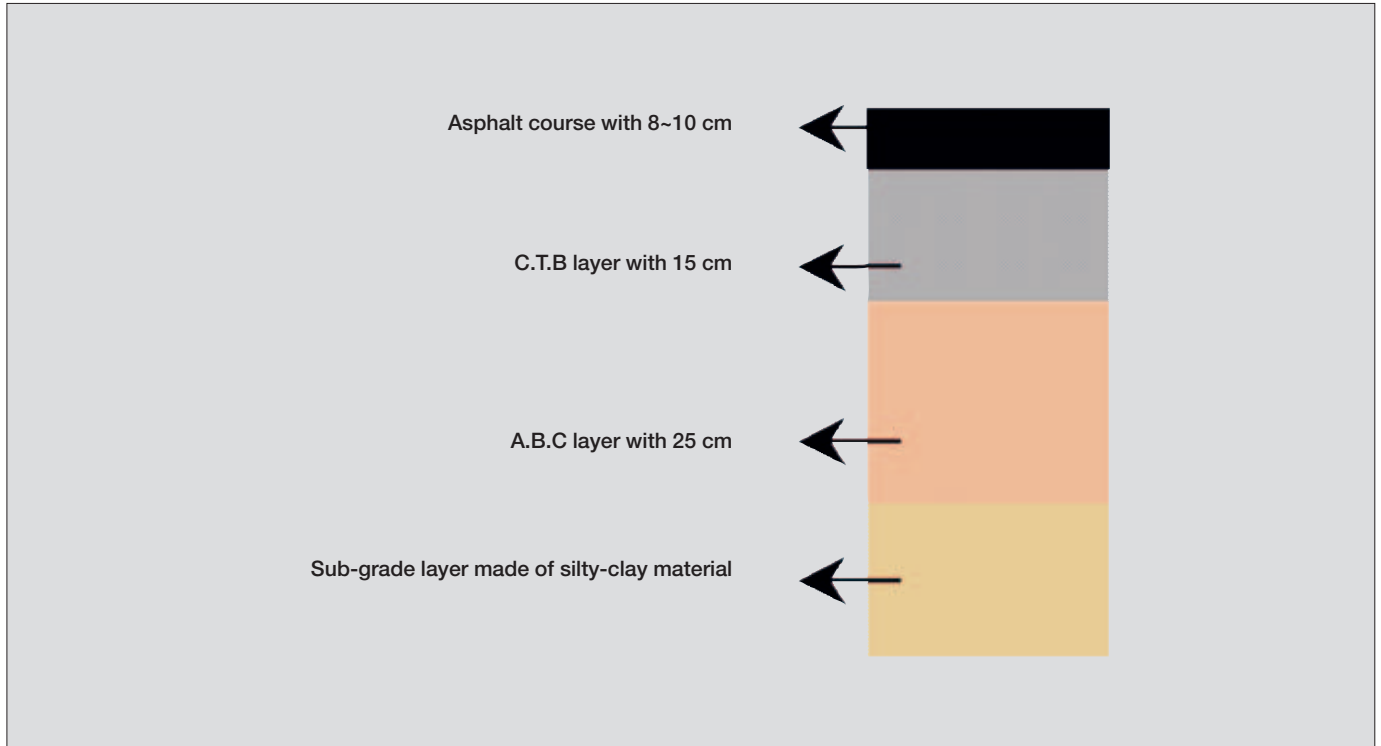
The tests included:

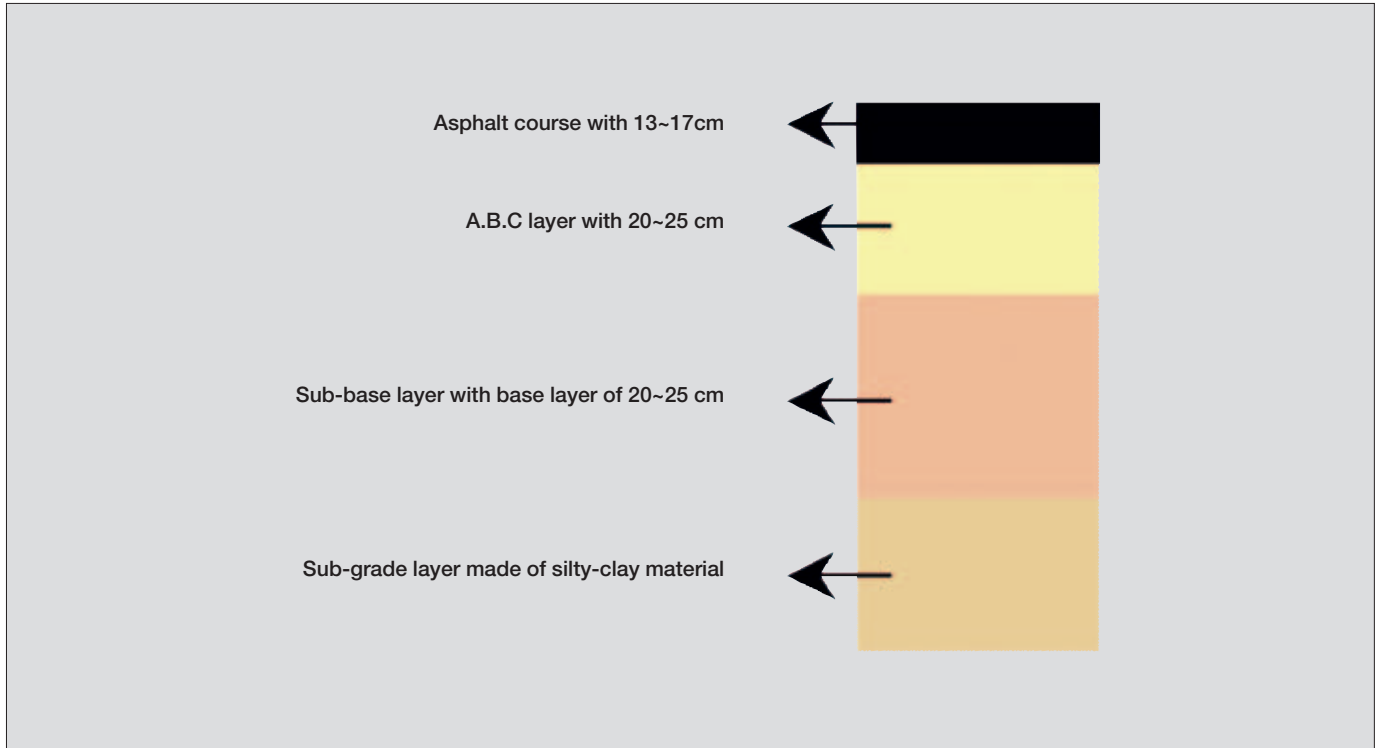
- The number of asphalt layers and their thickness
- The thickness of the base and sub-base layers
- Plasticity index of the selected base and sub-base
- Extraction of the selected asphalt samples
- Proctor test
- Gradation control



Pavement structure.

The following design models for the new road structure were discussed:





## Foamed bitumen structural design

Concerning the 25 years of design life,  $EASL = 30 \times 10^6$  and a sub-grade CBR = 5, the recycled layer thickness was calculated as 25 cm. This layer should be covered by two layers of hot asphalt with a thickness of 13 cm.

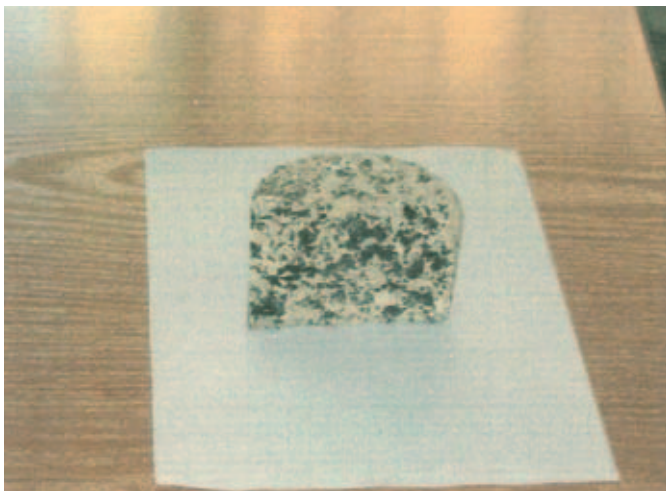
By studying the asphalt thickness along the road and its bitumen content, numbers of mixes were prepared for different sections.

The additives percentages were:

- ▶ Bitumen: 1.7 ~ 3 %
- ▶ Cement: 1.5 %
- ▶ Foam water: 2.5 %
- ▶ Compaction water: 1.5 ~ 2 %

## Quality control

Samples were taken from the recycled material and 9 briquettes were prepared. The tests which were carried out to control the quality of the recycling process were:

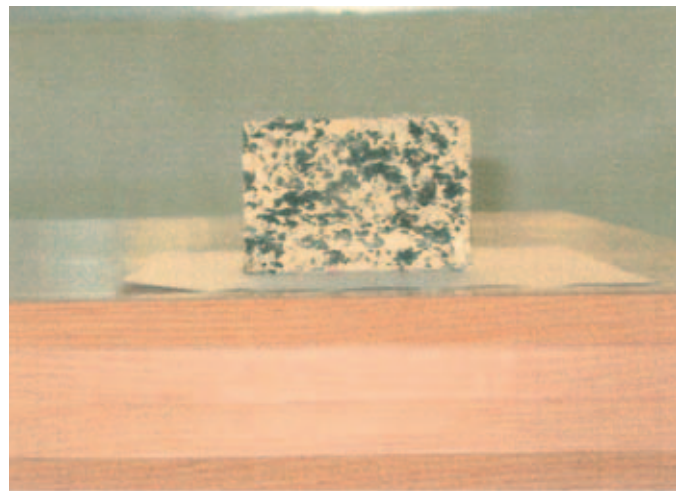


Foamed bitumen samples.

By taking into consideration that the number of initial test-pits wouldn't be enough compared to the length of the road and in order to get a more accurate knowledge about the variation of the pavement conditions, a blueprint of probing prior to the recycling process was set up:

- Analysis of the asphalt thickness every 100 m (three points in a row).

- Dry ITS (min. 200 kPa)
- Soaked ITS (min. 100 kPa)
- Soaked Marshall stability (min. 700 kg)
- Extraction
- Moisture content



- Performance of a 25 cm depth test pit with the WR 2500 every 500 m to take out the samples for determining the moisture, bitumen content and the gradation of the mixture of ABC and asphalt.

Based on the above mentioned secondary analyses, the correspondent mix design for that specific part was applied, re-defining the gradation by adding fillers or other sizes, particularly in the areas which were stabilized by cement.



Spreading the recycled material to get the required profile.



Spreading fines to modify the gradation.

## Road profile re-definition

Wirtgen cold milling machines were used prior to the recycling train to mill off the asphalt. This eased the post recycling grading works.

## Conclusion

The project time was 6 months and 660,000 square meters were recycled. Up to the time when this report was prepared the first asphalt layer was executed. The foam bitumen technology proved to be a fast, cost effective, reliable, and environment friendly solution for the future of this road considering the increasing traffic load.



The rehabilitated highway with the asphalt overlay.





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