Full Depth Reconstruction versus Refurbishment of Concrete Apron

A Case Study from Pulkovo International Airport

SNC-Lavalin Inc.

Background

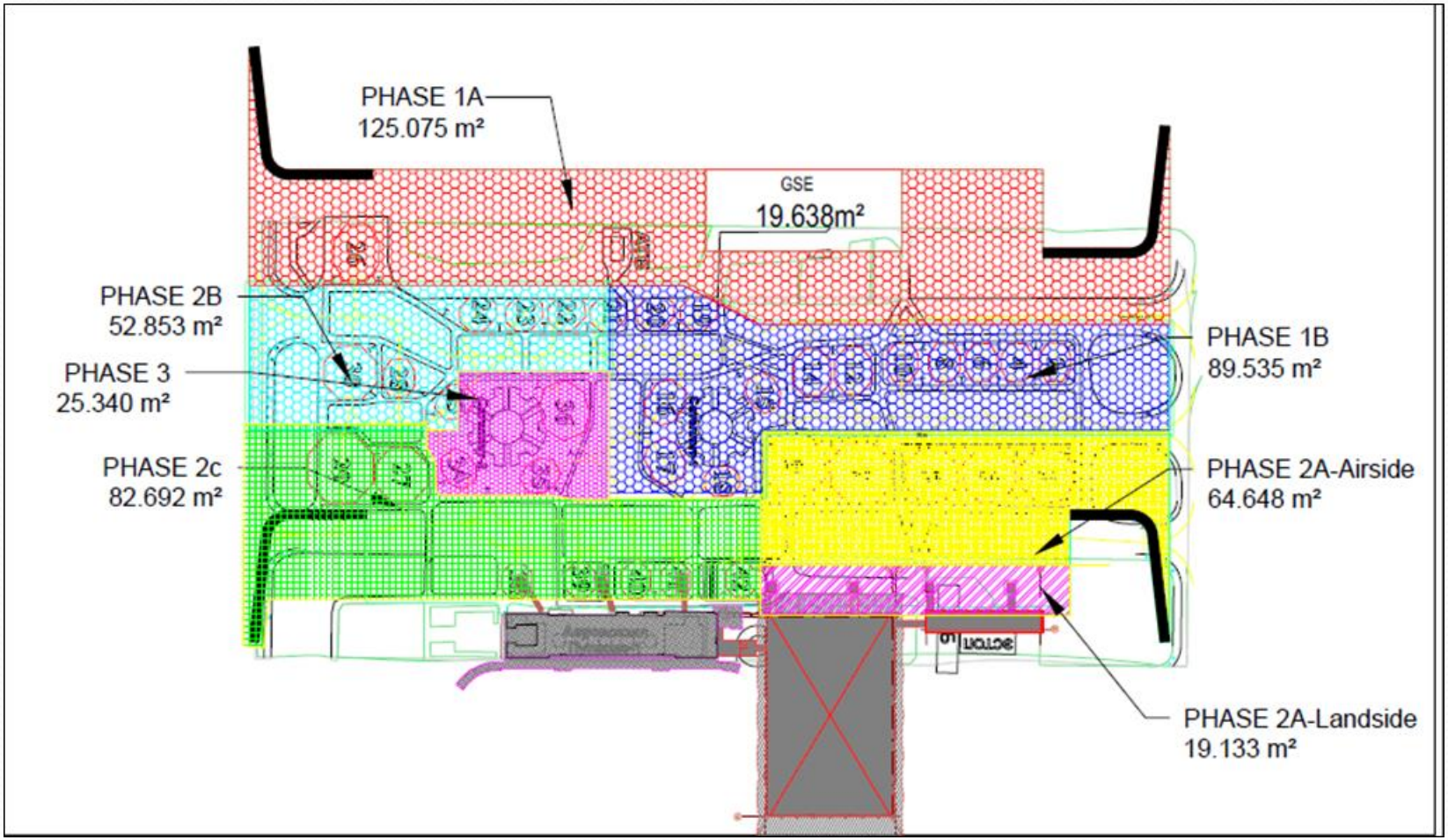
- Pulkovo International Airport serves St. Petersburg, Russia, and is operated by Northern Capital Gateway LLC (NCG)
  - Part of a 30 year concession since 2010
  - Operated by consortium of Fraport AG, VTB Capital and Copelouzos
  - SNC Lavalin Inc is the Employer's Advisor
- The airport's Phase 1 Development Programme (USD 1.0 billion) includes an expansion and refurbishment of Passenger Apron No.1
- During the design phase, the project was faced with the decision on the nature and extent of the refurbishment of the existing Apron No.1
- This presentation discusses the options, the merits and implications of the choices faced and the reasoning behind the final decision
- SNC-Lavalin's Airport Pavement Design and Contract Administration specialists were able to assist the Client make prudent decisions and provide justification on Airside work that saved NCG over 30 million euro.

Pulkovo International Airport – Phase 1 Development **BEFORE**

Pulkovo International Airport – Phase 1 Development DURING

Pulkovo International Airport – Phase 1 Development AFTER

Apron Works Phasing



PHASE 1A
125.075 m²
PHASE 1B
89.535 m²
PHASE 2c
2A-Airside
m²
PHASE 2A-Landside
19.133 m²

Case Study

Pulkovo International Airport

Passenger Apron No. 1

Refurbishment Options

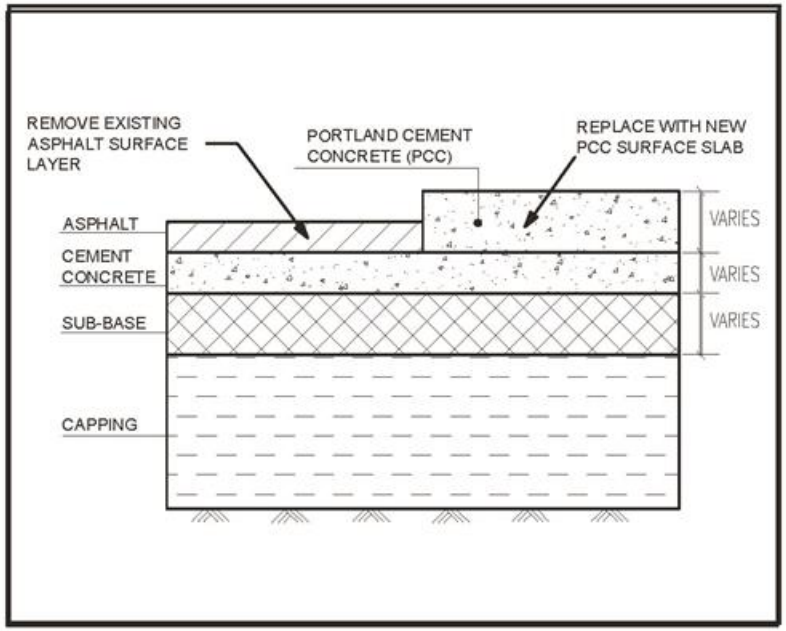
Refurbishment Options

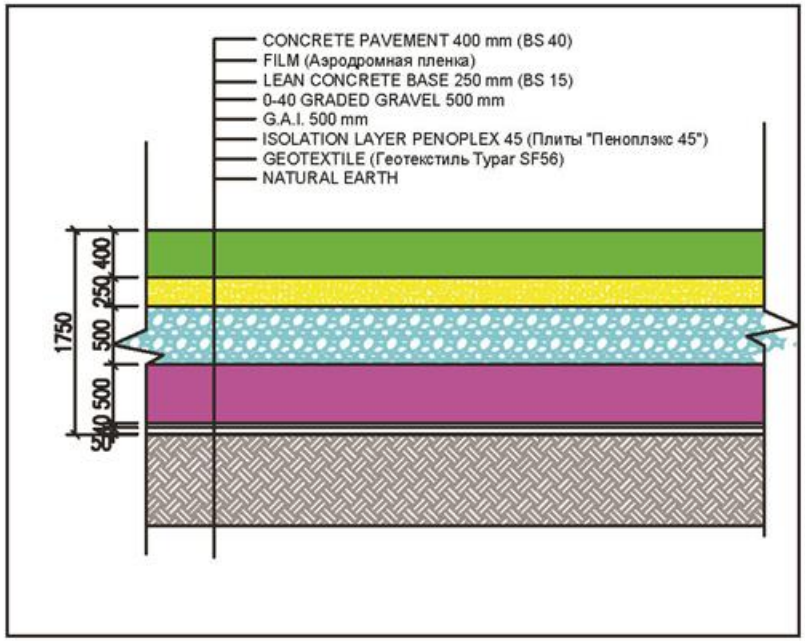
Partial Reconstruction

- Remove existing asphalt layer
- Turn underlying concrete into an artificial sub-base by in-situ vibro-resonant destruction, followed by compaction
- Construct a new concrete slab above the artificial sub-base layer

Full Depth Reconstruction

- Full dismantling of existing airfield pavements by vibro-resonant demolishing method
- Replacement with new rigid pavement



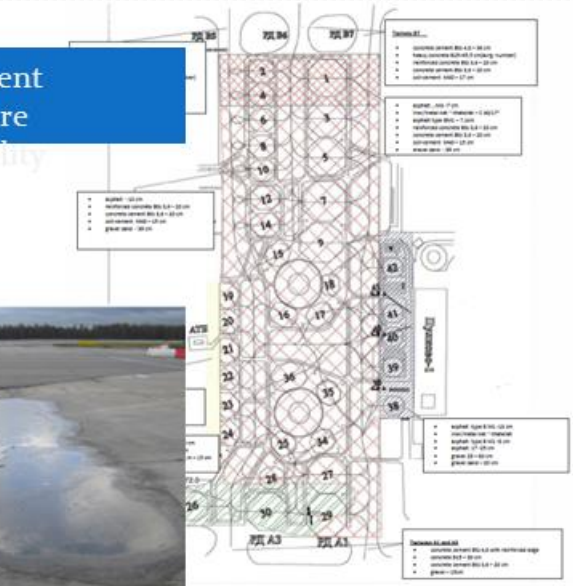


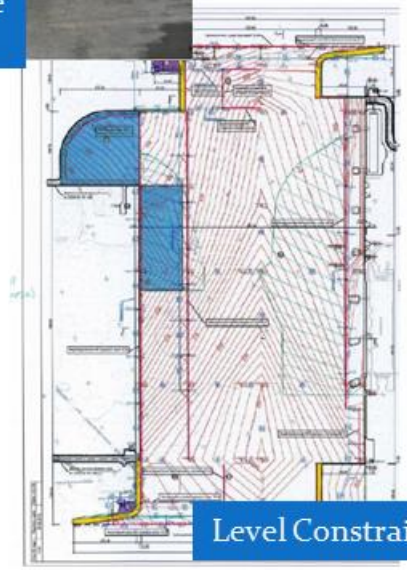
Partial Reconstruction

- Partial Reconstruction was considered as an option because:
  1. Cost constraints
  2. Time constraints
  3. Industry accepted methods (rubbelizing existing pavement into a sub-base)

Factors affecting Decision

- Pavement Condition
  - Variability in pavement structure in different areas
    - History of construction and refurbishment
  - Level constraints on the Apron
    - To match new Terminal
    - To ensure adequate surface drainage
- Design Requirements
  - **Pavement gradients requirements for surface water run-off**
  - Traffic loads
- Soil and other Conditions
  - Soil permeability and sub-surface drainage
  - Segregation potential (frost heave)
  - Works in the vicinity that require full depth reconstruction (demolition of satellite terminals)
- Regulatory
  - Regulator may not accept apron with pavement load rating lower than runway pavements
- Life cycle Impacts
  - Risk of differential settlement between partial and full reconstructed areas
  - Increased maintenance an
  - Disruption to operations during unanticipated maintenance





Counter Arguments

- Variability of Pavement Sections
  - Previous studies suggest highest variability is limited to asphalt layer thicknesses; these were to be removed in all cases anyway. Variability may not be as severe as feared.
- Poor surface and sub-surface drainage
  - Similar challenge was mitigated during runway rehabilitation using Perimeter Drains to improve water evacuation .
- Regulatory Resistance
  - Precedence of similar challenges and approved solutions exist from runway rehabilitation in 2008-2009.

Final Analysis

- Although……Partial Reconstruction is viable, Full depth reconstruction would provide added value in a number of areas

- However ……..Full depth reconstruction is the most expensive solution and therefore the last option considered after all others have been demonstrated to fail

- Ultimately …… a decision should be made based on the Life Cycle **Cost** and **Benefit** of the two options

Full Depth Reconstruction

- The added value of the full depth reconstruction is that it provides:
  - A deeper pavement structure with non frost susceptible materials than existing, hence better frost protection.
  - A more uniform pavement structure throughout the apron, hence less likely to suffer from differential settlement or differential load transfer at joints.
  - An improved draining capacity which would result in a more uniform behaviour through the changing weather conditions.
  - An improved design life compared to partial reconstruction avoiding the need for overlay or rehabilitation before end of the concession period

Final Cost-Benefit Assessment

Incremental Cost of Full Depth versus Partial Reconstruction: **25 million Euro**

Incremental Benefits (Net Present Value): **28.5 million Euro**

- Avoidance of additional maintenance (crack sealing, spall repairs, panel replacement)
- Avoidance of Operational Disruption (downtime of Contact Gates, additional equipment and personnel for diversions)
- Surface drainage and Utility Betterments
- Increased pavement life and avoidance of major rehabilitation downstream

Decision ..... **Full Depth Reconstruction**

Other Considerations

- Mix Design
  - Adherence to Specifications
- Consolidation at Placement
  - Paver Capacity
- Seasonal Conditions (Cold Weather Concreting)
  - Rain weakening the concrete
  - Risk of damages due to frost action
  - Protection methods

About SNC-Lavalin

- Established in 1901, SNC-Lavalin Inc. (SLI) is Canada's largest Engineering firm.
- The SLI Airport Team is equipped with the specialists, track record and tools to assist Clients with all their airfield pavement needs.
- SLI Pavement Specialists have worked on over 100 airport pavement projects on several continents, with recent successful assignments in Canada, Russia, Libya, Jamaica, Tanzania, Peru, Jamaica and Malta.
- The team utilizes current tools to perform Finite Element Analysis and 3D modeling and is fully conversant with pavement software such as FAARFIELD, BAKFAA and PAVER.
- The Airport Team is fully conversant with industry standards from ICAO FAA and ASTM.
- SNC-Lavalin owns its own Heavy Weight FWD testing equipment.

- The SNC-Lavalin Inc. Airport Team Value Proposition
  - Strong understanding of contractual and regulatory requirements to enhance safety, minimize risks and extra costs
  - Knowledge of contemporary standards and equipment to adapt existing facilities to new aircraft and technology cost effectively
  - Innovative design development to minimize disruption to airport operations and incorporating climate changes variables to minimize downtime, extend the life of existing pavements and minimize the investment in costly pavement rehabilitation

Questions