WALO USA

“THE CHALLENGES OF DAMS IN COLD CLIMATES”

NHA & USSD Workshop – Alaska
Thursday 21st September 2017
WHAT IS DENSE ASPHALT CONCRETE (DAC)?

There are many examples of engineered asphalt construction in the Middle East that have survived the millennia.

The secret to this longevity is durability and being dense enough to resist oxidisation.

This is an example of asphalt being used to impound water dating back some 3000 years.
WHAT IS DENSE ASPHALT CONCRETE (DAC)?

- DENSE ASPHALTIC CONCRETE (DAC) IS NOT A PROPRIETARY SYSTEM
- CONSISTS OF HIGH QUALITY, CRUSHED AGGREGATES, SANDS, FILLERS AND BITUMEN
- EVERY PROJECT HAS UNIQUE, SPECIFICALLY DESIGNED MATERIALS, USING LOCAL SOURCE MATERIALS
- NO ONE STANDARDISED SOLUTION
- LOCAL STATIC MIXING PLANTS OR MOBILE INSTALLATIONS
- PRODUCTION IS HIGHLY CONTROLLED AND MONITORED TO THE HIGHEST STANDARDS TO ENSURE QUALITY
WHAT IS DENSE ASPHALT CONCRETE (DAC) USED TO LINE…?
DENSE ASPHALTIC CONCRETE (DAC)

- SATISFACTORY HYDRAULIC CONDUCTIVITY (IMPERMEABLE)
- STABLE ON EVEN STEEP SLOPES AND QUICK TO LAY
- THIN, FLEXIBLE AND INCREDIBLY STRONG
- RESISTANT TO CHEMICAL, BIOLOGICAL AND MECHANICAL FORCES
- PROVEN LONGEVITY
- ACCEPTANCE BY REGULATORY AUTHORITIES
- ACCEPTABLE INSTALLATION TECHNIQUES
- REALISTIC COST
DAC LINING SYSTEM PROPERTIES

• DESIGNED AND CONSTRUCTED TO ENSURE IT:
  • IS WATERTIGHT AGAINST REQUIRED MAXIMUM HYDRAULIC PRESSURE
  • HAS A SPECIFIED VALUE OF HYDRAULIC HEAD OF WATER OF UP TO 200 M AND A HYDRAULIC CONDUCTIVITY UNDER SUCH A HEAD NOT EXCEEDING $1 \times 10^{-12}$ M/S
  • DOES NOT CONTAIN MOBILE TOXIC COMPOUNDS
  • SUFFICIENTLY STABLE WHEN PLACED HOT AND UNCOMPACTED TO ENABLE RELIABLE COMPACTION ON SLOPES UP TO 1:1.6
  • HAS A TOTAL AIR VOIDS CONTENT NOT EXCEEDING 3% UPON COMPLETION OF COMPACTION
TYPICAL ASPHALTIC LINING SYSTEM

Typically consists of:

- 200-300 mm stabilising/drainage layer (min stiffness modulus of 50 MN/m² – Min CBR 15%)
- 60mm of Asphaltic Binder Layer (ABL) (10% - 15% air voids)
- 80mm of dense asphaltic concrete (DAC) (max 3% air voids)
- Mastic seal coat
ADVANTAGES OF ASPHALTIC LINING SYSTEMS

Cold and Heat

Resistance Natural and Mechanical Forces

Operation

Maintenance
HOW DO YOU PLACE ASPHALT ON VERY STEEP SLOPES?
HOW DO YOU PLACE ASPHALT ON VERY STEEP SLOPES?

Vertical and Horizontal Placing of Asphalt on Slopes
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Vertical and Horizontal Placing of Asphalt on Slopes
ASPHALT CORE DAMS - INTRODUCTION

• INTERNAL SEALING SYSTEMS FOR EMBANKMENT DAMS

• ASPHALTIC CONCRETE USED FOR OVER 75 YEARS

• ASPHALT CORE EMBANKMENT DAMS (ACED)
  i. WATERTIGHT ‘WALL’ ALONG THE AXIS
  ii. FIRST BUILT IN GERMANY 1961/62
ASPHALT CORE DAMS - PRINCIPLES

• CORE IS PROTECTED
• CONSTANT TEMPERATURES
• IDEAL FOR DIFFICULT WEATHER CONDITIONS
• VERY FLEXIBLE IN DESIGN AND CONSTRUCTION
ASPHALT CORE DAMS - ADVANTAGES

• EXISTING SUBSTRATE – NOT CRITICAL
• SMALL AMOUNT OF GOOD QUALITY AGGREGATES
• IMPOUNDING DURING CONSTRUCTION
• FAST CONSTRUCTION
• EARTHQUAKE RESISTANCE
• SELF-HEALING ABILITY
• GEOMETRY OF DAM AXIS
• LOW MAINTENANCE COST
ASPHALT CORE DAMS - DESIGN

- CORE WIDTH 0.8% OF HYDRAULIC HEAD
- CORE WIDTH ≥ 40 CM
- WIDENING TOWARD THE BASE
- TRANSITION ZONES ON BOTH SIDES (1.5 M)
- DAM AXIS ADAPTED TO TOPOGRAPHY / GEOLOGY
- VOID CONTENT ≤ 3.0 %
- WORKABILITY DURING CONSTRUCTION
- FLEXIBILITY
- TO BE DETERMINED:
  - MAXIMUM AGGREGATE SIZE 16 – 25 MM
  - BITUMEN GRADING (70/100)
  - BITUMEN CONTENT (6.0 – 7.0 %)
  - FILLER CONTENT (10 – 15 %)
ASPHALT CORE DAMS - CONSTRUCTION

- CONCRETE PLINTH AND/OR GROUTING
- SANDBLASTING AND PRE-COATING
- MASTIC LAYER
- ASPHALT IN LAYERS (200MM – 250 MM THICK)
- COMPACTION (TRIALS)
- QUALITY CONTROL
ASPHALT CORE DAMS - CONSTRUCTION

• CLEAN AND HEAT PREVIOUS LAYER
• REQUIRES HIGH DEGREE OF CONTROL IN PLACEMENT
• SIMULTANEOUS PLACING OF ASPHALT CORE MATERIAL AND FILTER MATERIAL
• DEMAND FOR HIGH INITIAL COMPACTION
ASPHALT CORE DAMS - CONSTRUCTION
ASPHALT CORE DAMS - CONSTRUCTION
ASPHALT CORE DAMS - CONSTRUCTION
ASPHALT CORE DAMS - VIDEO