40-Year Life Project – A Sustainability Initiative

Federal Aviation Administration

Presented to: CAPTG Sustainable Workshop

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Outline

- General, disjointed, sustainability discussion.
- Comparative energy use in construction.
- Pavement life extension and sustainability.
- FAA 40-year design life initiative.

Recent Anti-Sustainability Factors

- **Concrete airport pavement design thicknesses have recently been made significantly thicker by a simple change in the design AC.**
- **Perpetual asphalt pavements are being promoted for airport use.**
- **Field compaction requirements will increase when gyratory mix design replaces Marshall for asphalt pavements.**

Recent Anti-Sustainability Factors

- **At least one large airport has built an end-around taxiway to eliminate the need for airplanes to cross active runways. Greatly reduces the risk of incursions.**

Do These Examples Mean:

- **At an airport, conservative design will always trump cost until the money runs out.**
- **At an airport, safety will always trump every other consideration.**

ACRP Synthesis 10 on Airport Sustainability Practices

- **ACRP = Airport Cooperative Research Program.**
- **Administered by TRB with support from the FAA Office of Airport Safety and Standards, $10 million per year.**
- **http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_010.pdf**
- **Completed surveys from 25 US and international airports.**

Survey Results

U.S. [and non-U.S.] airports mainly identified environmental practices as key priorities for the future, followed by social and then economic practices. Under environmental practices, respondents from large and medium airports consistently mentioned energy, green buildings, and climate change. The sustainability practices included:

Survey Results, cont.

- Energy conservation, efficiency, demand management, and baseline audit.
- Emission (CO2) reductions.
- Clean energy production and clean fuel vehicles.
- Use of green building principles, sustainable design, and high-performance buildings.
- Green building certification using Leadership in Energy and Environmental Design (LEED), a green building rating system developed by the U.S. Green Building Council.

Survey Results, cont.

To understand how airports value sustainability practices, the survey included questions on life-cycle costing, quantifying financial and nonfinancial savings, and forecasting potential future costs. Survey respondents listed the following practices related to quantifying sustainability at their airports:

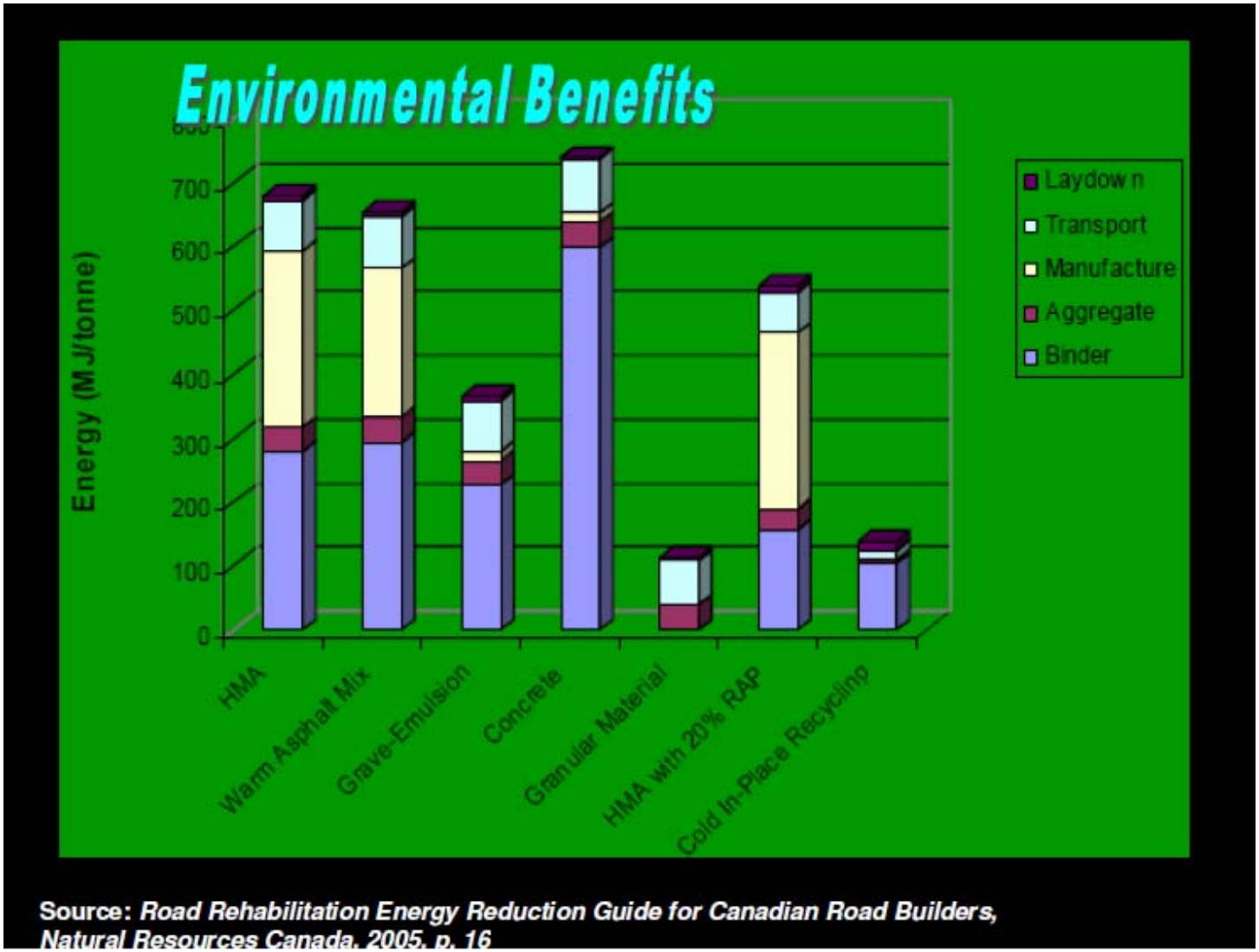
- All new projects require life-cycle costing before implementation [pavements as well?].
- etc.

Survey Results, cont.

The survey respondents identified state/regional and federal regulations as key drivers for implementation of sustainability practices at airports, along with airport policies, corporate responsibility, and stakeholder concerns/relations.

For the future, global issues such as climate change were identified as the most common drivers for implementation of airport sustainability practices and programs.

Construction Comparative Energy Use



Source: *Road Rehabilitation Energy Reduction Guide for Canadian Road Builders, Natural Resources Canada, 2005, p. 16*

Construction Comparative Energy Use

Treatment	Energy Consumption (MJ/t)	Energy Consumption (MJ/m^2)	Percentage Decrease from HMA (%)
Hot Mix Asphalt	680	82	-
Warm Mix Asphalt	654	78	5
Recycled Asphalt Shingle Hot Mix	535	64	12
In-Place Recycling	139	31	62
Micro Surfacing	496	9	89
High Performance Chip Seal	667	12	85

Source: *Road Rehabilitation Energy Reduction Guide for Canadian Road Builders, Natural Resources Canada, 2005, p. 16*

Both slides cited by Kunnawee Kanitpong, January 2010.

Warm mix is now being promoted on environmental factors.

Is Extending Pavement Life a Sustainability Initiative?

- **In simple terms, if pavements last twice as long, almost half the quantities of materials are needed.**
- **40 years is a long, long, time in airport pavement years.**
- **Determining how sustainable life extension might be is way more complicated than a simple Net Present Value calculation.**

Extending Pavement Life

- **Current bidding process for AIP projects is based on “best” design to give 20-year structural life.**
- **Bidding process for extended life pavements must include functional failure as well as structural failure components.**
- **How to develop rational life cycle cost bidding guidelines?**
- **How to define pavement life anyway?**

Why Double Pavement Life for AIP Projects?

- **The Office of Airports (ARP) 2011 Business Plan has as one of its Core Activities to "Establish strategy and time frame to double the expected life of any runway construction at a large-hub airport (ie 40 year pavement vs 20 year pavement). Due July 31, 2011."**
- **A Project Management Plan was submitted to AAS on July 31 and project funding requested by AJP-6312 for FY 2013.**

Pavement Life – Traffic or Time?

- **AC 150/5320-6E (Pavement Design) states:**
  - "Pavements designed and constructed in accordance with FAA standards are intended to provide a minimum **structural** life of 20 years that is free of major maintenance if no major changes in forecast traffic are encountered. Rehabilitation of surface grades and renewal of skid-resistant properties may be needed before 20 years because of destructive climatic effects and the deteriorating effects of normal usage."

Pavement Life – Traffic or Time?

- **AC 150/5320-6E (Pavement Design) also states:**
  - "The FAA design standard for pavements is based on a 20-year design life. The computer program [FAARFIELD] is capable of considering other design life time frames, but the use of a design life other than 20 years constitutes a deviation from FAA standards."
- **Structural design usually implies that time is unimportant except in that increasing time will increase the amount of traffic.**

Pavement Life – Structural or Functional?

- **FAA Order 5100.38C (AIP Handbook, 2005, a new one is in preparation):**
  - Places “funding limits on construction of pavement longer, wider, or stronger than specified in advisory circulars.”
  - And also states that: “The reconstruction, rehabilitation, pavement overlays, or major repairs of facilities and equipment are defined as eligible capital costs generally considered permanent with a 20-year life expectancy.”

Structural vs. Functional Failure

- **The two excerpts from the AIP Handbook are apparently mutually exclusive.**
  - Design initially for 20 years.
  - Mill and replace the surface to correct a functional failure after, say, 12 years.
  - The structure will fail in 20 years and destroy the new surface after 8 years.
- **Anecdotal reports indicate that asphalt surfaces are replaced, in one way or the other, every 8 to 12 years.**

Definition of Pavement Life

- **Extending the life of a pavement to 40 years will mean that more major maintenance to correct functional failures is likely to be needed over the structural life of the pavement.**
- **Clearly, pavement life needs to be better defined – but this is not easy.**

Dick Ahlvin Quote on Pavement Life

"Pavement failure is a conceived condition, which rarely, if ever, can be considered as a sudden occurrence or even a condition attained at a particular discernible time. Deterioration and development of distress occur over a period of time with continuing use. We speak of failure as a particular condition and we attempt to quantify some combination of attributes [distresses], which have themselves had to be quantified in some fashion [PCI and SCI], as a particular measure of failure. We need to do this and to continue to perfect the process, but we must not let this lead us to believe in a unique failure point or condition."

Operational Life Report, FAA/AR-04/46

"However, in practice, the end of pavement life is determined by the airport operator, or by other external factors, and may occur when SCI is significantly lower than 80, or when PCI has reached a threshold value requiring remediation even though the SCI is still significantly above 80. In addition, threshold values are different for pavements with different functional purposes (runway, taxiway, or apron) and when the pavements are located in different environmental or geographical regions. The threshold value also depends on the airport size: large, medium, or small hub, or general aviation airport."

Many Attributes Signifying Failure

- **Attributes do not develop at the same rate (20 vs. 40 years?).**
- **Life cycle cost analysis is increasingly being used to bid jobs.**
- **Flexible and rigid pavements do not fail in the same manner.**
- **Flexible and rigid pavements are not maintained in the same manner.**

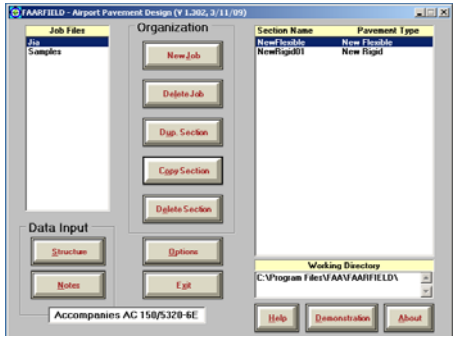
Life Cycle Cost Analysis (LCCA)

- **Over 100 pages in AC 150/5320-6E.**
  - 4 ½ pages devoted to LCCA.
- **300 pages in Order 5100.38C.**
  - 1 page devoted to LCCA methodology.
- **Is this enough?**
- **Should costs be provided from a standard repository for commercial jobs?**

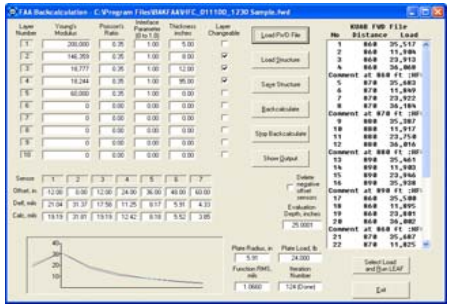
Proposal for Preliminary Work During 2011 and 2012

- **Continue developing PAVEAIR for use as an FAA supported server deployment.**
  - Improve the M&R modules.
  - Make the AAPTP Life Cycle Cost Analysis Excel application AIRCOST compatible with PAVEAIR.
  - Enter construction project data whenever possible.
  - Start designing a cost module.

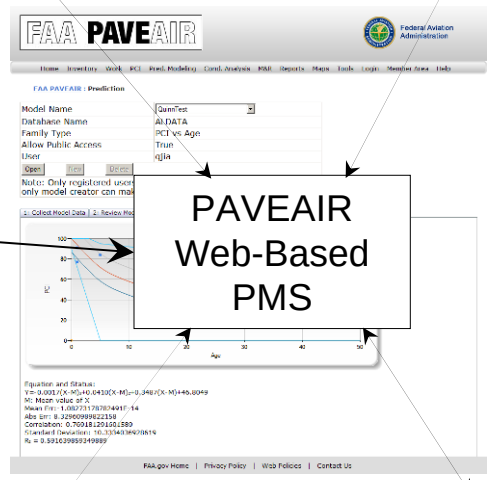
PAVEAIR and Other Applications



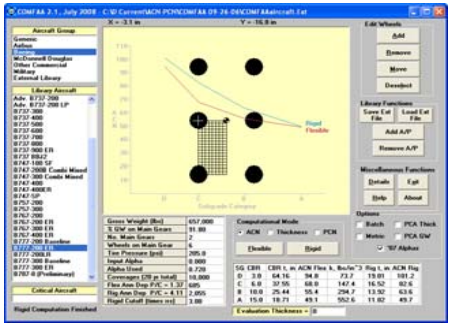
FAARFIELD Thickness Design



BAKFAA Strength Evaluation

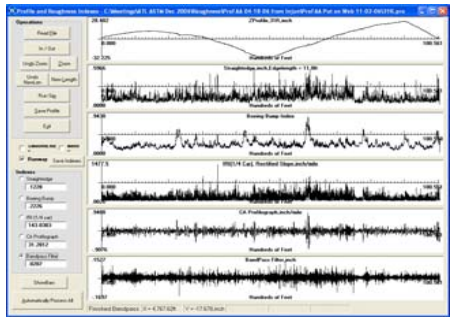


PAVEAIR Web-Based PMS



COMFAA PCN Load Rating

ProFAA Roughness Condition Evaluation



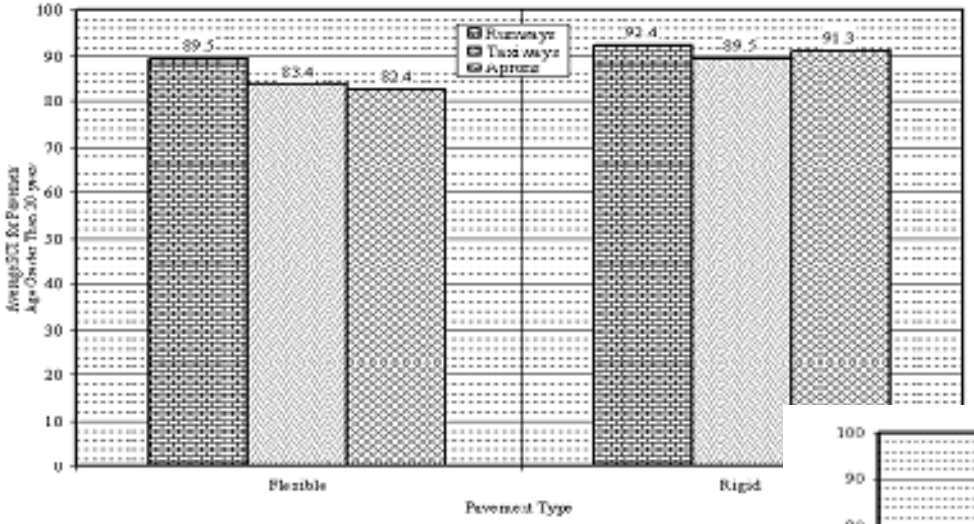
More Proposals for Preliminary Work During 2011 and 2012

- **Consider full-scale testing of a "perpetual" asphalt pavement.**
- **Continue with the ASR work.**
- **Continue testing trapezoidal grooves particularly for deformation in asphalt surfaces.**
- **Continue developing the roughness ride quality index.**

Fully Funded Project Starting 2013

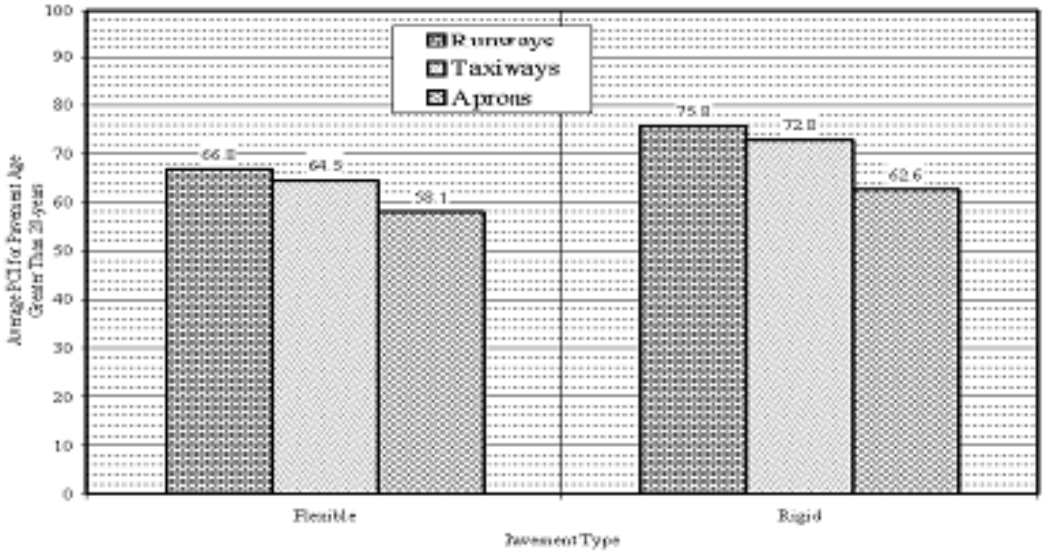
- **Collect construction and maintenance data for new and recent AIP funded projects and deposit the data in PAVEAIR.**
- **Produce annual summaries for each project.**
- **Develop a comprehensive guide to LCCA for airport pavements, coupled with alternative thickness design strategies.**
- **Develop an automated procedure for LCCA which is compatible with PAVEAIR.**
- **Deliver recommended procedures for designing runway pavements for 40 years by 20??**

The Structural Design Procedures are Effective – Operational Life Report, 2004



SCI

PCI



AJP-6310 10-Year R&D Plan

- **The Airport Technology Team, AJP-6310, is currently working on a formal plan for the next 10 years of R&D work at the Technical Center.**
- **The last plan was published in 1993 and the proposed projects have been largely completed successfully.**
- **The report for the new plan expands on much of the material in this presentation, particularly:**
  - Life extension,
  - Life cycle cost analysis, and
  - Software integration.

1993 R&D Plan – Download From Website

http://www.airporttech.tc.faa.gov