October 15th, 2026

Best Practices for Rapid Repair, Rehabilitation, and Reconstruction of Concrete Airport Pavements



ACPTP

Airport Concrete Pavement Technology Program

ARA

What does this webinar cover?

- Introductions
- Vision of the research
- What is Rapid 3R?
- Data gathered for this project
- Analysis
- Findings of the research
- Changes you can make today to reduce rigid pavement construction time
- Research Products

Research Team

- **Project Panel**
  - Peter Taylor, PhD, PE
  - Quintin Watkins, PE
  - A.C. White
  - Anthony Cochran
  - David Brill, PhD, PE
  - Gary Mitchell, PE
  - Harold Honey, PE
  - Jeb Tingle
  - John Romaine
  - Sarah Dalton, PE
- **Project Team**
  - ARA
    - Scott Murrell, PE (PI)
    - Timothy Parsons, PhD, PE
    - Christopher Mazzotta
    - Douglas Evans
    - Christopher Tomlinson, PE
    - Aaron Pullen
    - Ebenezer Duah
    - Eric Breder
    - Russell Knieriem, PE
    - Le Duong
  - Christopher Senseney, PhD, PE
  - Oscar Antommattei, PE
- **Contributing Airports**
  - Seattle-Tacoma International Airport
  - Dyess Air Force Base
  - Port Authority of New York and New Jersey (Laguardia)
  - Raleigh-Durham International Airport
  - Charlotte Douglas International Airport
  - Louisville Muhammad Ali International Airport
  - Vancouver International Airport
  - Metropolitan Washington Airports Authority (Dulles)
  - Hartsfield-Jackson Atlanta International Airport
  - United States Air Force
- **Contributing Consultants and Contractors**
  - ADC Engineering, Inc.
  - Crawford, Murphy, & Tilley, Inc.
  - Hatch Ltd.
  - Michael Baker International, Inc.
  - Antouns Construction Pty Ltd.
  - Baldi Brothers, Inc.
  - Kiewit Corporation
  - Summers Concrete Contracting, Inc.

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SE
Senseney Engineering, LLC

Kiewit

Vision and Goal of the Research

- **VISION:** The basic research is essentially completed. Guidance is needed to standardize (mainstream) practice.

- **GOAL:** Develop tools and/or standards that will allow for fast-track pavement design and construction without the need for a MOS.



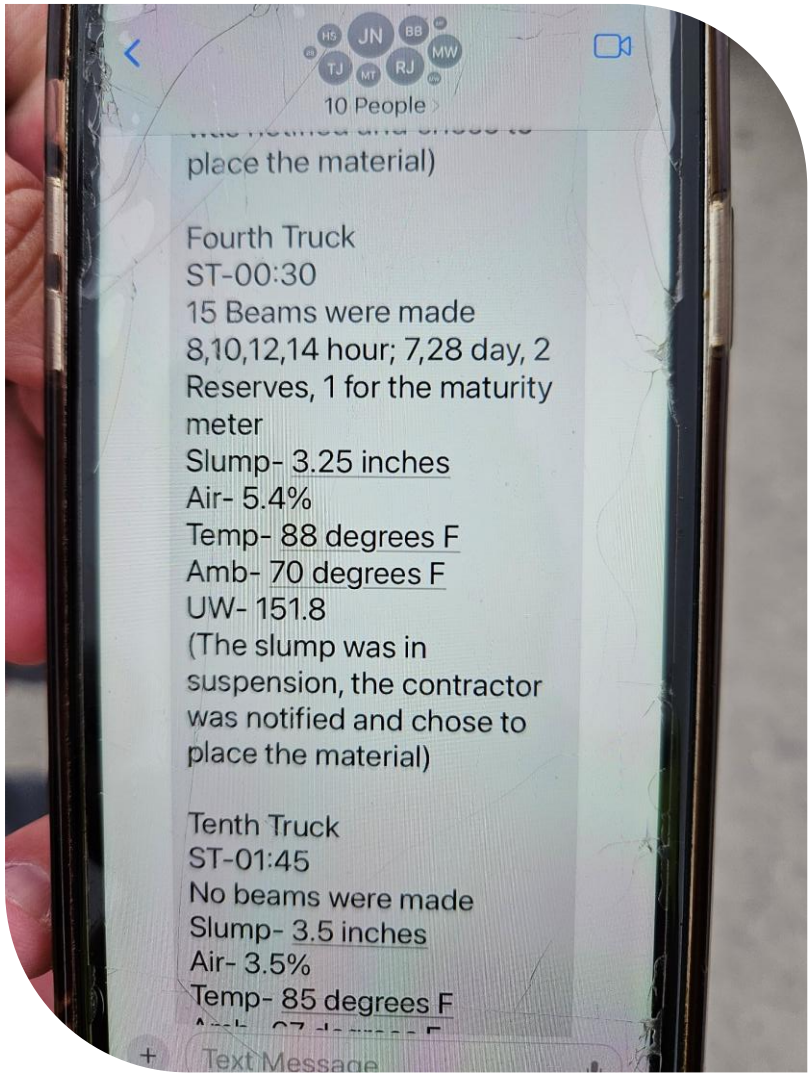
What is Rapid 3R?

- Any concrete pavement repair, rehabilitation or reconstruction project completed with a compressed schedule.
- Every aspect of the project from existing pavement evaluation to reopening strength verification is considered to compress schedule.
- It is much more than specifying a HES or VHES Concrete



Data Gathering – Questionnaire/Interviews

Airport/ Airbase		Stakeholder		
		Owner	Designer	Contractor
ATL	1	X	X	X
CHS	2		X	X
CLT	3	X		X
BAD	4			X
DYS	5	X		X
IAD	6	X		
LGA	7	X	X	
MEL	8			X
RDU	9	X		
SDF	10	X		X
SEA	11	X		
SPI	12		X	
YVR	13	X	X	X
SAV	14			X



Data Gathering – Documentation

Data Type	Airfield															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	ATL	CHS	CLT	BAD	DYS	EWR	IAD	LGA	MEL	QW	RDU	SDF	SEA	SFO	SPI	YVR
Plans		X	X		X	X	X	X			X	X	X		X	X
Specifications			X		X	X	X	X	X		X	X	X	X	X	X
Performance			X	X	X		X	X		X			X			
QA/QC	X		X					X				X	X			X
Mix Design	X		X		X			X				X				
Photos			X		X			X	X	X		X	X			X
Presentations							X	X		X	X				X	X
Other												X				X
Cost	Provided by 7 airports; redacted to preserve anonymity															

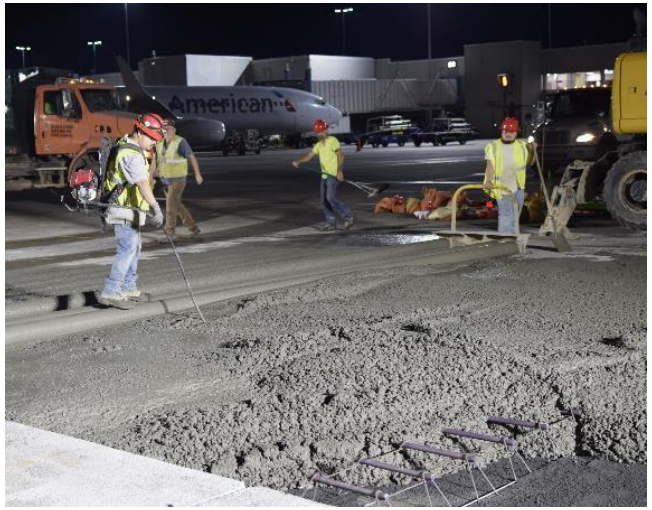
Data Gathering – Case Studies/Site Visits

- SEA
- LGA
- YVR
- CLT
- Dyess AFB
- Louisville
- RDU





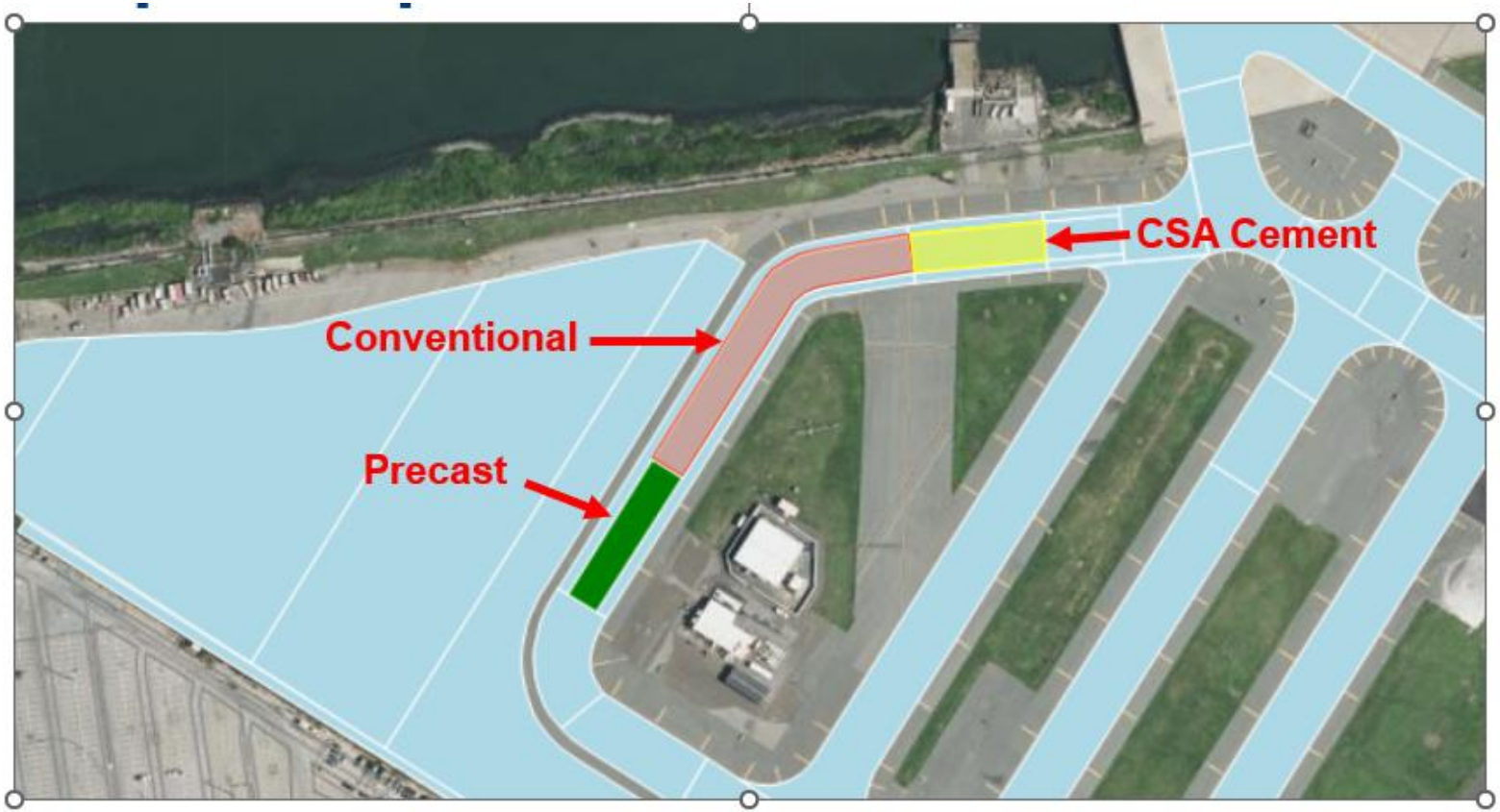








Comparison of Rapid to Conventional Performance



Rapid Repair Section	Last Major M&R	Structure	Comparable Conventional Section	Last Major M&R	Structure
DD01-B (Precast)	7/1/2002	12-16" PCC	DD01-D	5/12/2003	16" PCC
DD02-B (CSA)	7/1/2002	16" PCC			

LGA Site Visit



Conventional



CSA Cement

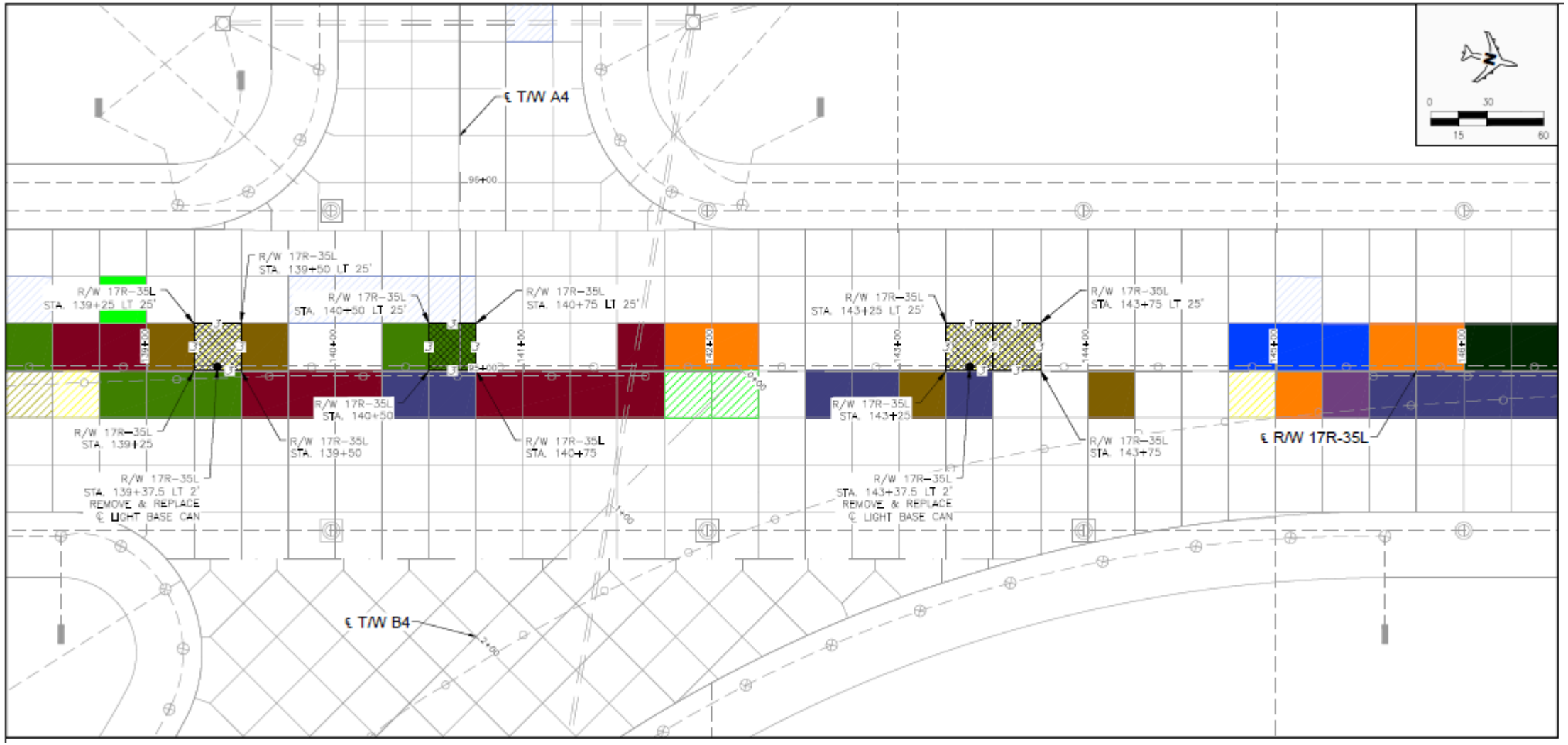


Precast

PCI vs. Year

Section ID	PCI							Reasons for Major PCI Change
	2002	2003	2006	2009	2012	2017	2021	
DD01-D (Conv.)	N/A	100	N/A	82	80	94	97	2002 → 2003: Reconstruction (Major M/R) 2012 → 2017: Unknown M&R
DD01-B (Rapid Precast)	100	100	95	53	70	95	91	2006 → 2009: Small Patching and Scaling 2009 → 2012: Joint Seal Replacement (Assumed) 2012 → 2017: Unknown M&R
DD01-B (Rapid CSA)	100	100	98	88	72	93	96	2009 → 2012: Scaling 2012 → 2017: Unknown M&R

Replacement Slab Performance



SDF Site Visit



Distressed Slab



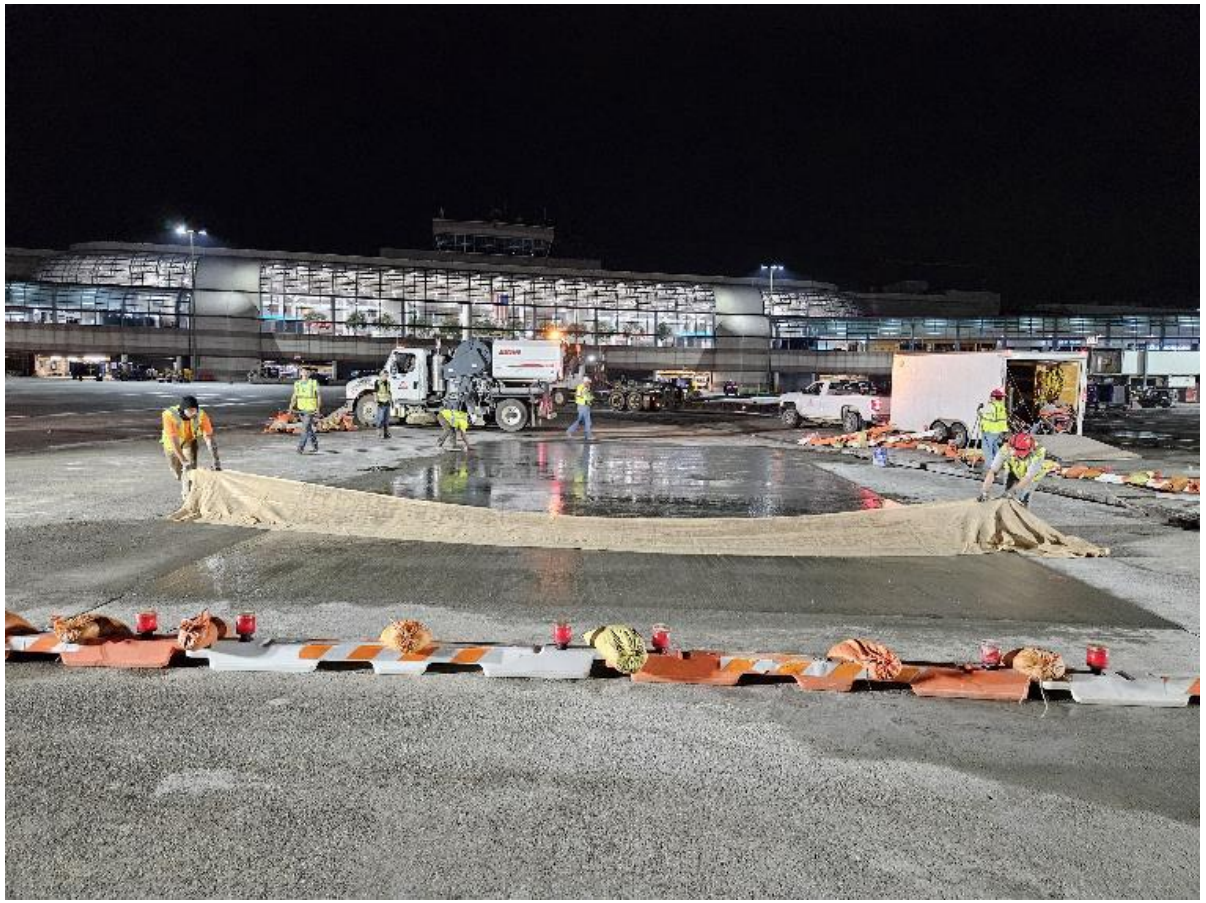
Previously Replaced Slab



Recently Replaced Slab

Findings- Planning

- Operations drives Rapid 3R
- Benefit/Cost Analysis typically not performed
- One Modification of Standards found (airports self funding)
- Often contractors prequalified to bid
- Planning meetings including airlines, FAA, operations, engineers – not contractors.
- Damages for delay typical.



Findings - Design

- High Portland/limestone cement content mixes more common than CSA cement
- P-501 specification “tweaked” more than rewritten.
- HWD testing used to identify subgrade issues.
- Base treatment options included in plan set.
- Conventional now 7-day cure
- Volumetric Mixers used for CSA slab replacement



Findings - Construction

- Pre-placement Meeting
- In-pavement lights pose challenges
- Test Placement
- Communications
- Pre-sawing slabs sometimes permitted.
- Equipment redundancy
- Maturity Meter for construction loads and opening. Beams otherwise.
- Allowance $ for the unexpected
- **Good performance despite some questionable construction**



Recommendations - Planning

- Detailed Evaluation of Existing Pavement
- Alternatives Development including cost, construction duration and work hours
- Benefit Cost Analysis
- Prequalify Contractors
- Appropriate Liquidated Damages
- Contingency Fund Bank and contract provisions to address unforeseen conditions.



Recommendations – Design

- Allow slab pre-sawing operations during a work period prior to demolition
- Detailed phasing requirements
- Base/Subbase/Soil treatment details including alternatives
- Steel dowels to reestablish load transfer
- Require stand by equipment on-site (saws, screed, etc.)
- Reinforcement to hold any shrinkage cracks tight



Recommendations- Construction

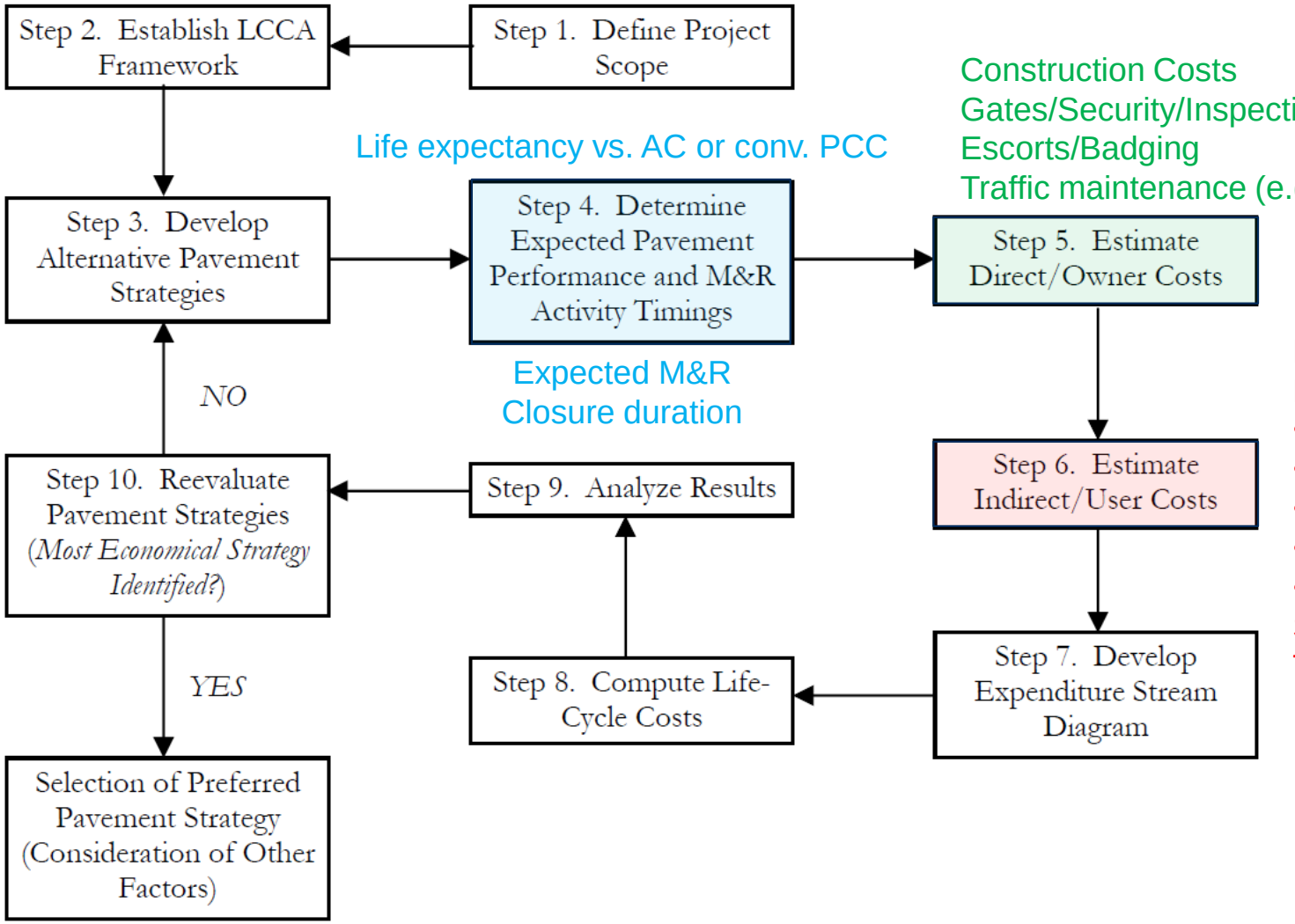
- Equipment redundancy
- Light cans are paved over with concrete and then are cored out later
- Pre-placement Meeting
- “Real” Test Placement
- Communications, and more communications
- Decision makers available when needed
- Investigate impact of opening strengths below requirements for the project mix.



Products

- 150/5370-16 - Rapid Construction of Rigid (Portland Cement Concrete) Airfield Pavements
- AC 150/5320-6 - Airport Pavement Design and Evaluation
- AC 150/5370-10 - Standard Specifications for Construction of Airports – Cement Concrete Pavement Modified for Rapid 3R
- AC 150/5370-10 - Standard Specifications for Construction of Airports - Item P-50X High Early Strength Cement Concrete Repairs
- 150/5370-12 - Quality Management for Federally Funded Airport Construction Projects
- FAARFIELD and PAVEAIR software recommendations
- Final report

LCCA for BCA: Rapid 3R vs. Conventional



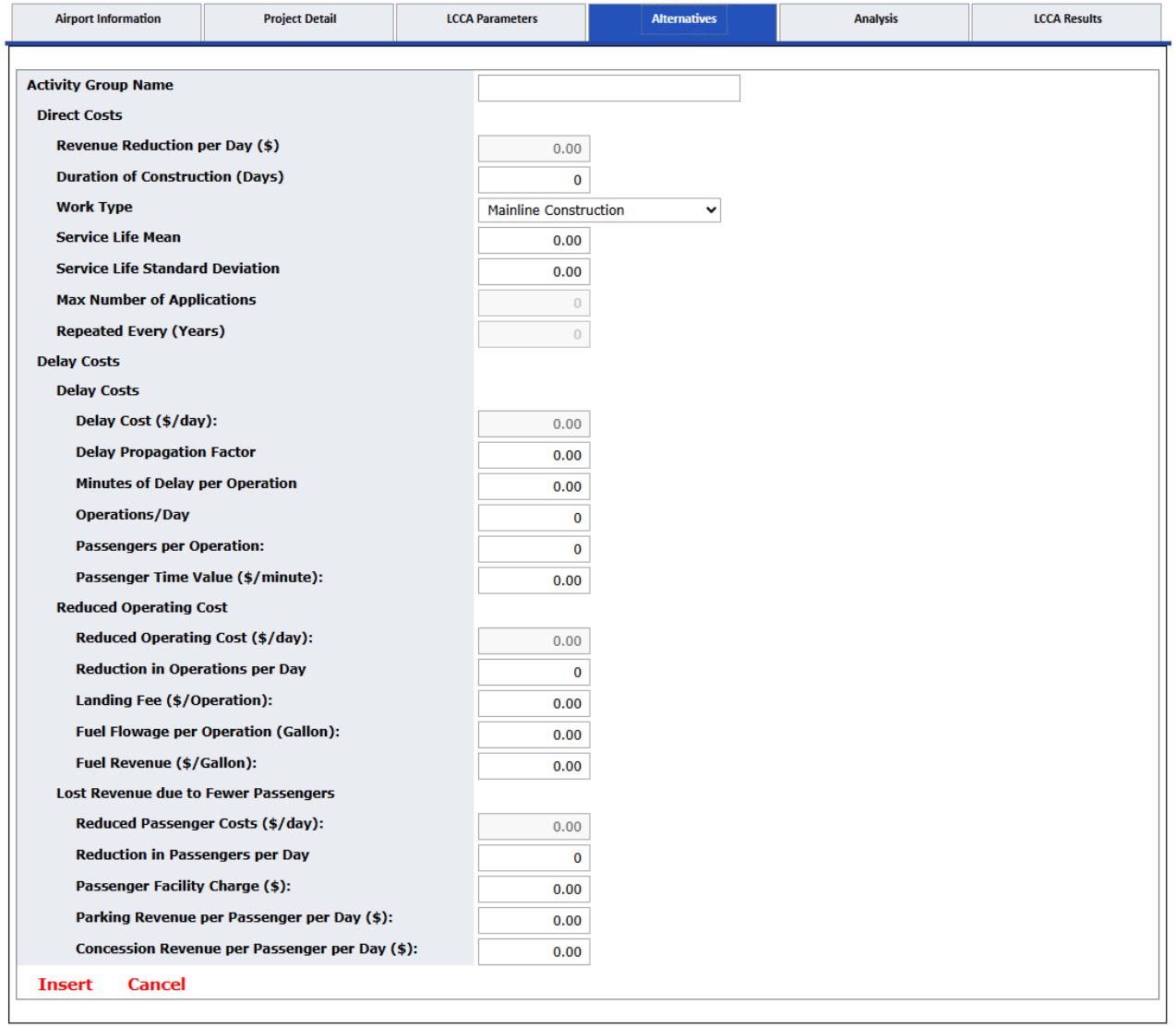
Construction Costs
Gates/Security/Inspection
Escorts/Badging
Traffic maintenance (e.g. flaggers)

Delay costs
Reduced:
- PFC
- Concessions
- Parking
- Landing fees
- Fuel Flowage

Safety issues/costs
Tenant relocation/temp gates

Applied Research Associates (2011). "Life Cycle Cost Analysis for Airport Pavements", Report 06-06, Airfield Asphalt Technology Program, pg. 35, Auburn, AL.

PAVEAIR Proposed BCA Interface

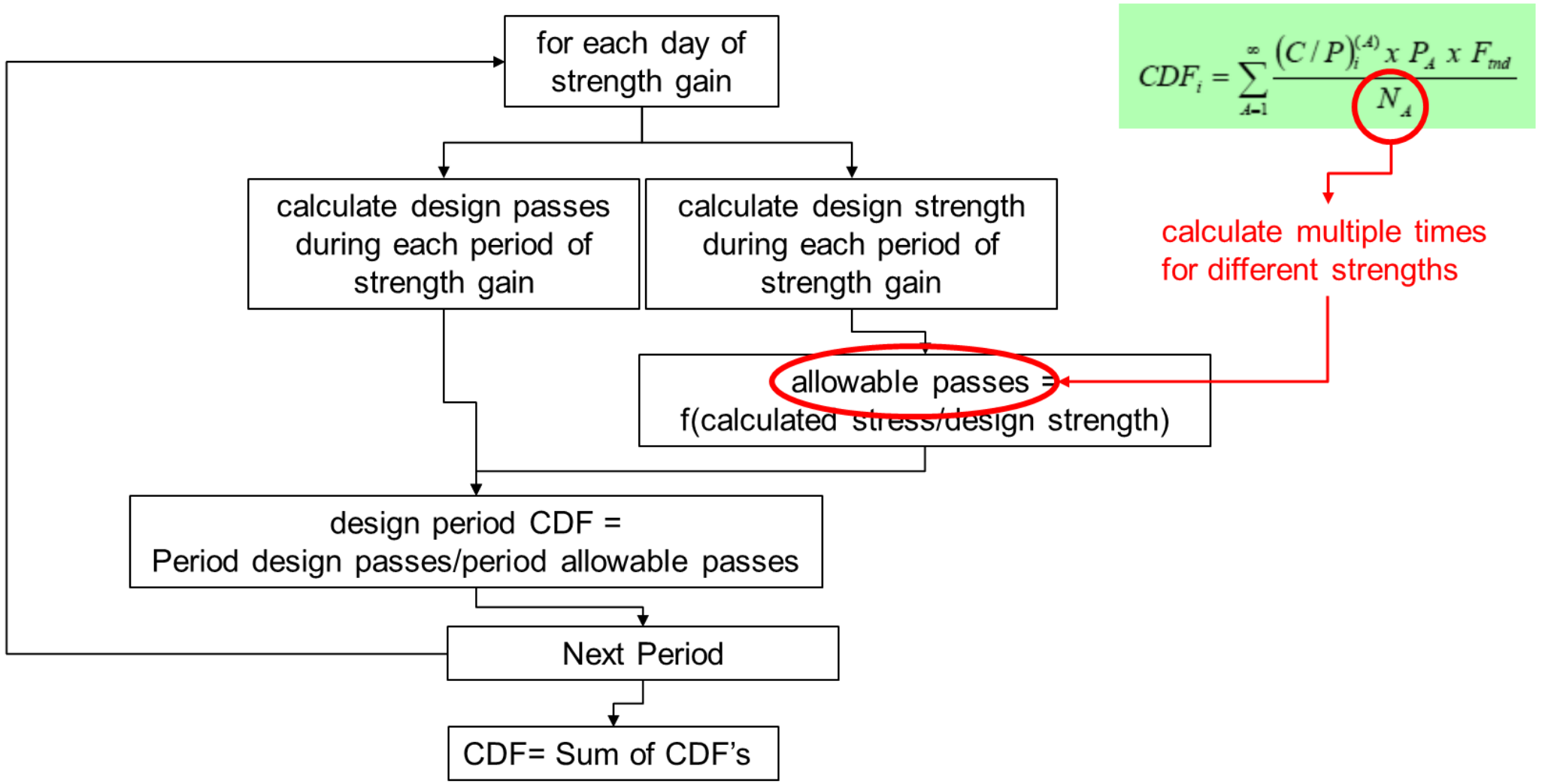


BCA Case Study: Two-Gate Closure

- Benefit from reducing delay:
  - 142 planes / day
  - 14 gates = 10.14 planes per gate
  - 913 min / gate / day (90-min turnaround)
  - 12 gates = 11.83 planes per gate
  - 1,065 min / gate / day (90-min turnaround)
  - Delay = (1065-913)=152 min of potential delays per gate x 12 gates = 1824 min
  - 1824 min x $74.20/min = **$135,000 / day**
- Rapid 3R cost:
  - 20 CSA slabs = $1,000,000
  - 20 OPC slabs = $250,000
  - Cost = $1,000,000-$250,000 = **$750,000**
- $\frac{B}{C} = \frac{\$135{,}000 * 7 days}{\$750{,}000k} = \frac{\$945{,}000}{\$750{,}000} = \mathbf{1.26}$



FAARFIELD – Modified CDF Approach for Early Opening



FAARFIELD Proposed Output for Early Opening

Status | Gear | Structure | Strength Gain Grid

New Rigid Analysis of New Structure 1 Completed
Run Time: 28 seconds
%CDFU = 0.00; Life = 10.8 yrs;
PCC CDF = 1.85; Early Opening CDF = 2.75; Total CDF Contribution = 4.60

Federal Aviation Administration FAARFIELD 2.1 Structure Report

FAARFIELD 2.2.0.a (Build 11/14/2024)

Job Name: New Job 1

Structure: New Structure 1

Analysis Type: New Rigid

Last Run: Life Analysis 2025-03-31 10:34:55

Calculated Life = 10.8 Years

Total thickness to the top of the subgrade = 26.0in.

Age at opening = 168 hours

CDF Contribution: 1.85

Early Opening CDF: 2.75

Total CDF Contribution: 4.60

Pavement Structure Information by Layer

No.	Type	Thickness (in.)	Modulus (psi)	k (pci)	Poisson's Ratio	Strength R (psi)
1	P-501 PCC Surface	15.0	4,000,000	0	0.15	650
2	P-401/P-403 HMA Stabilized	5.0	400,000	0	0.35	0
3	P-209 Crushed Aggregate	6.0	40,304	0	0.35	0
4	Subgrade	0	15,000	172.4	0.4	0

Airplane Information

No.	Name	Gross Wt. (lbs)	Annual Departures	Early Opening Departures	% Annual Growth
1	B737-900 ER	188,200	1,200	24	0

Additional Airplane Information

No.	Name	CDF Contribution	Early Opening CDF	Total CDF Contribution	CDF Max for Airplane	P/C Ratio
1	B737-900 ER	1.85	2.75	4.60	1.85	3.53

Questions?