Federal Aviation Administration
Airport Pavement Working Group Meeting

Backcalculation of Rubblized PCC Sections

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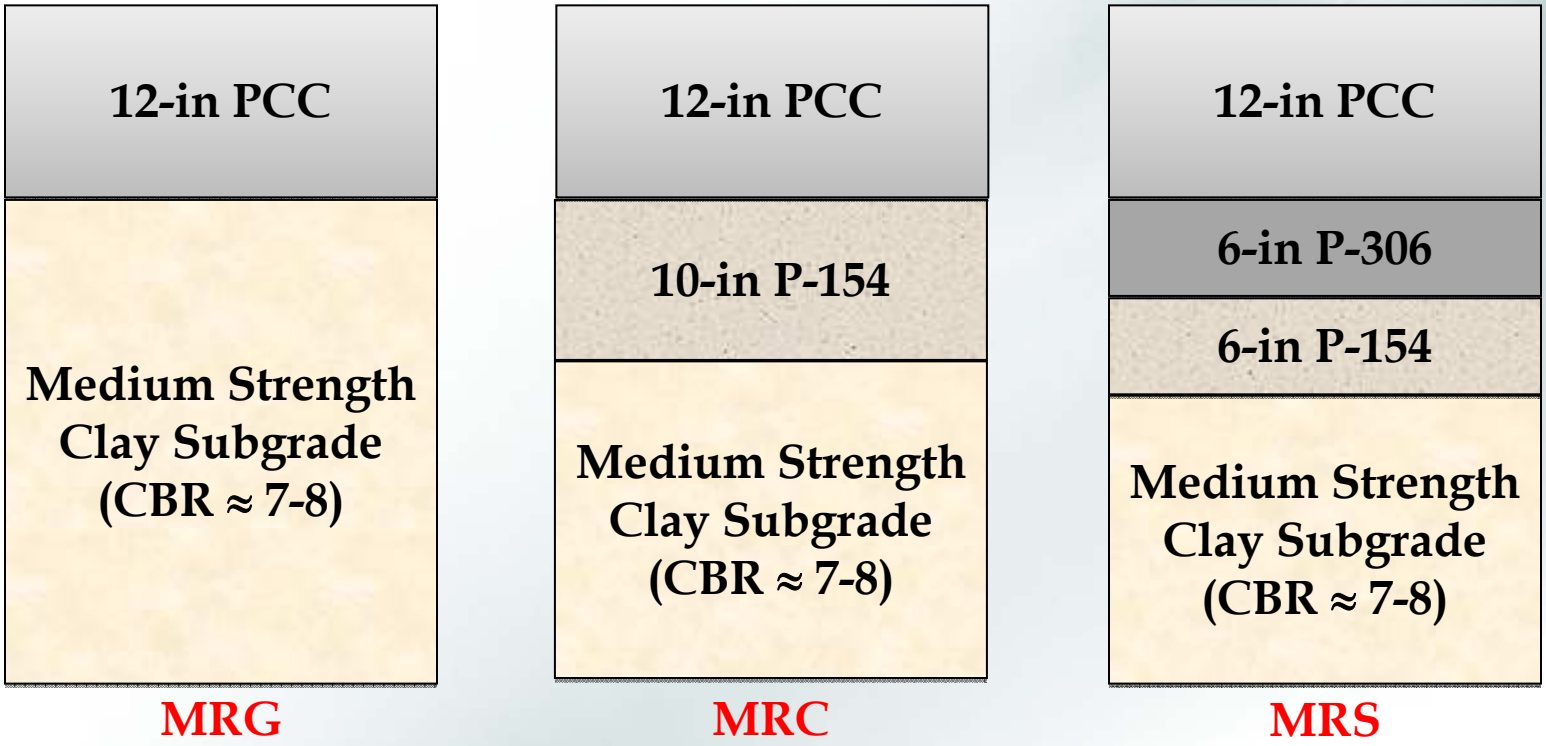
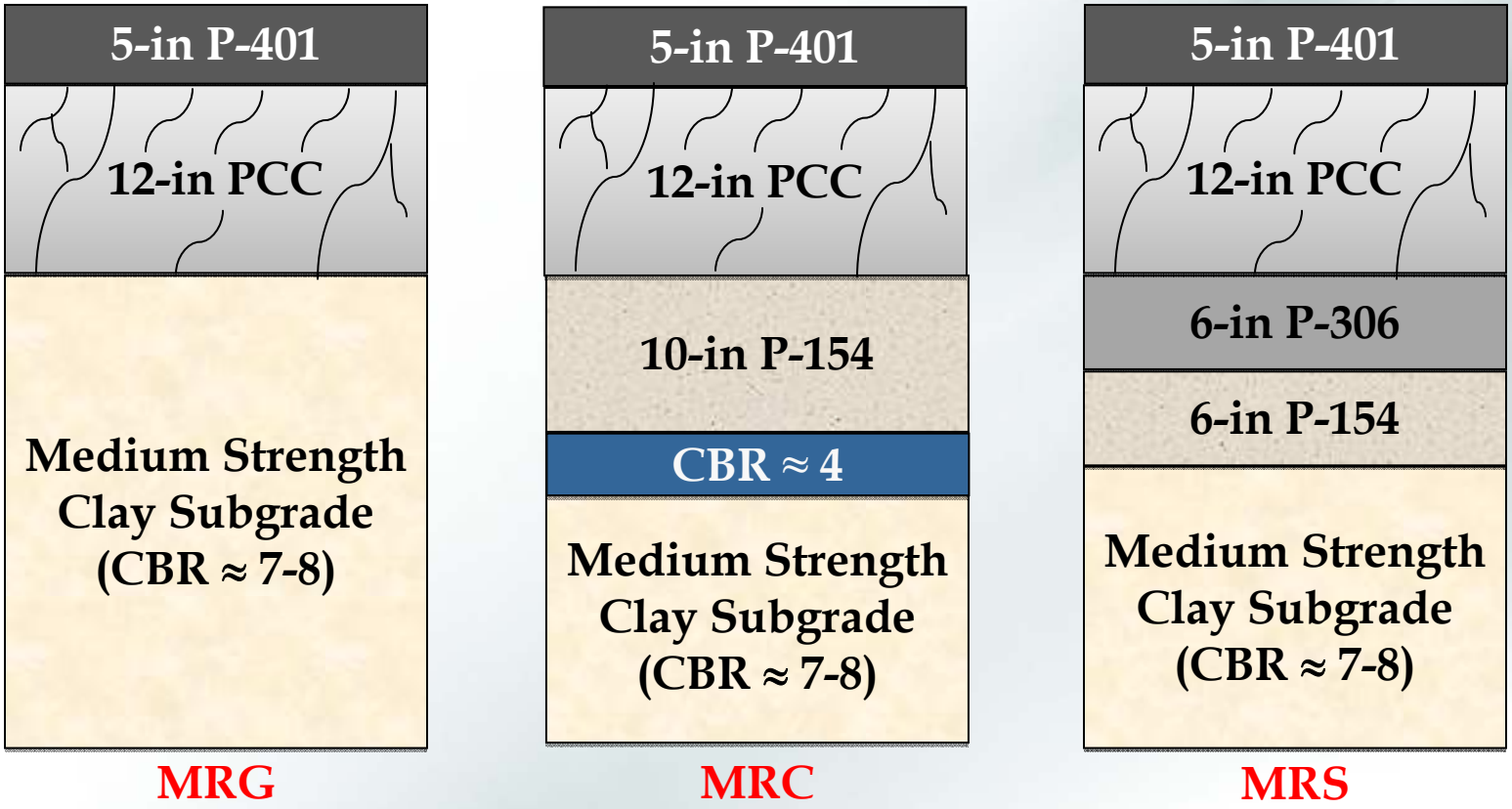
PCC Sections

- **April 2004:** PCC construction completed at NAPTF (CC2)
- **December 2004:** Completed trafficking (SCI < 20)



Rubblization/P-401

- **January 2005:** Rubblized PCC using a resonant breaker
- **June 2005:** 5″ P-401 placed



Trafficking Rubblized Sections

- **July 7, 2005:** Trafficking started on rubblized sections
  - Dual-tandem gear (55 kips per wheel): 5,000 repetitions
  - Dual-tridem gear (65 kips per wheel)

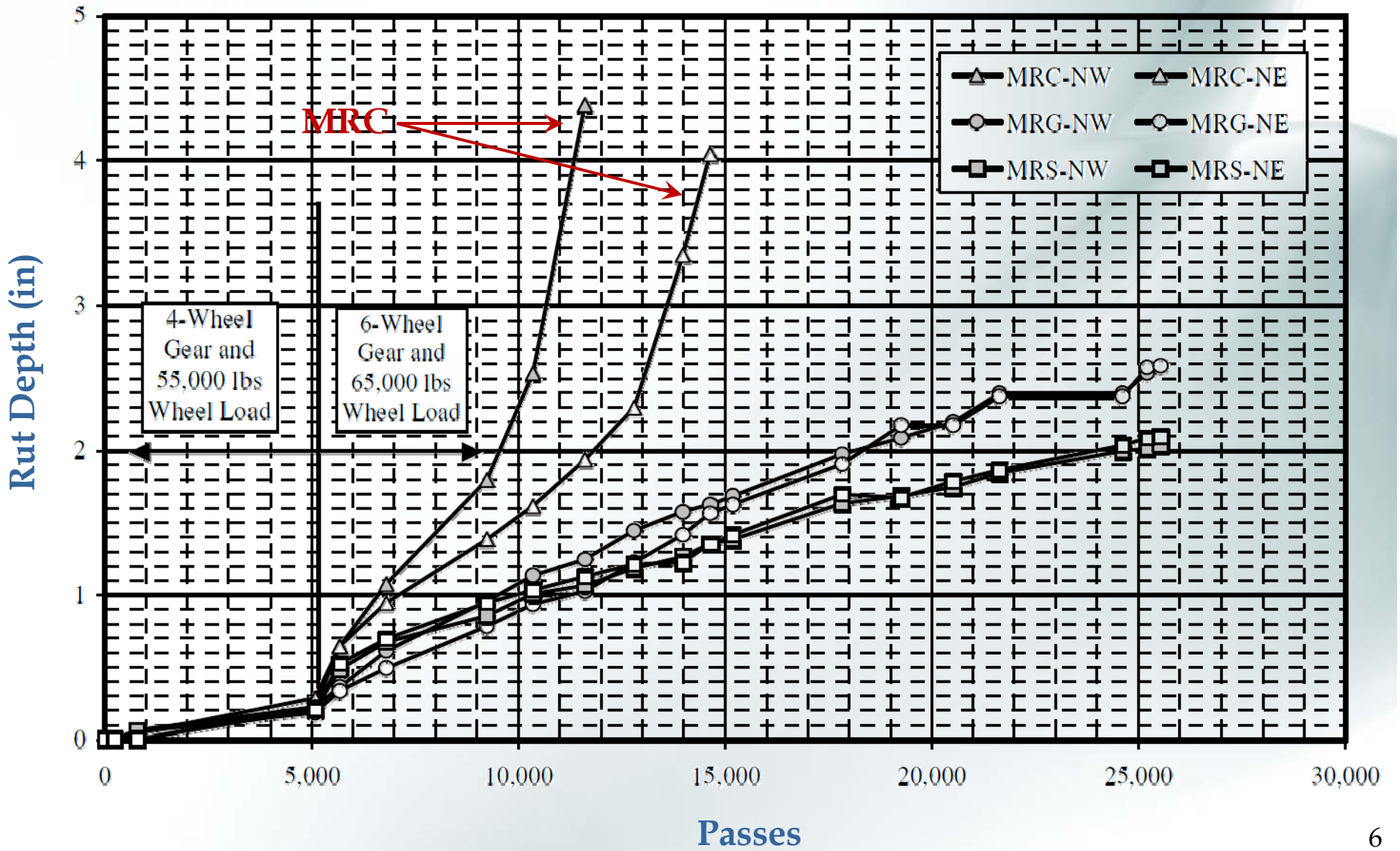
- **October 6, 2005:** Trafficking stopped on rubblized sections

Documentation /Statement

Garg, N., Hayhoe, G. F., Ricalde, L., " Study of Failure Mechanisms in Rubblized Concrete Pavements with Hot Mix Asphalt (HMA) Overlays", 4th International Conference on Accelerated Pavement Testing, Davis, CA, USA, September 19-21, 2012

"The results indicate that backcalculated modulus of rubblized concrete may not be a good predictor of pavement performance"

Performance



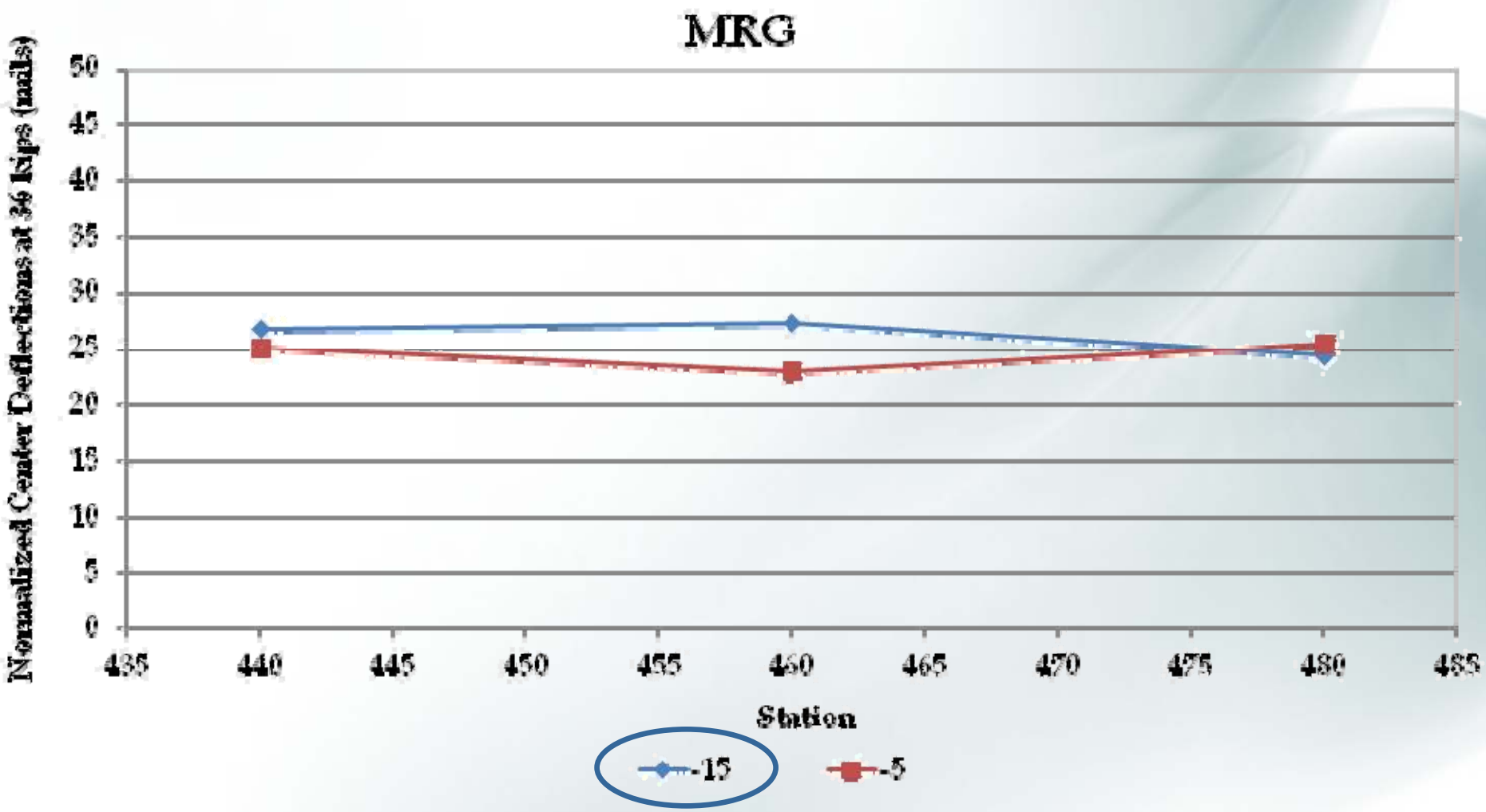
HWD Testing

- HWD testing was performed using the FAA's HWD
  - 10 by 10-ft grid
  - 4 drops were applied at each point

Drop	Load (kips)
1 (Seating)	36
2	12
3	24
4	36

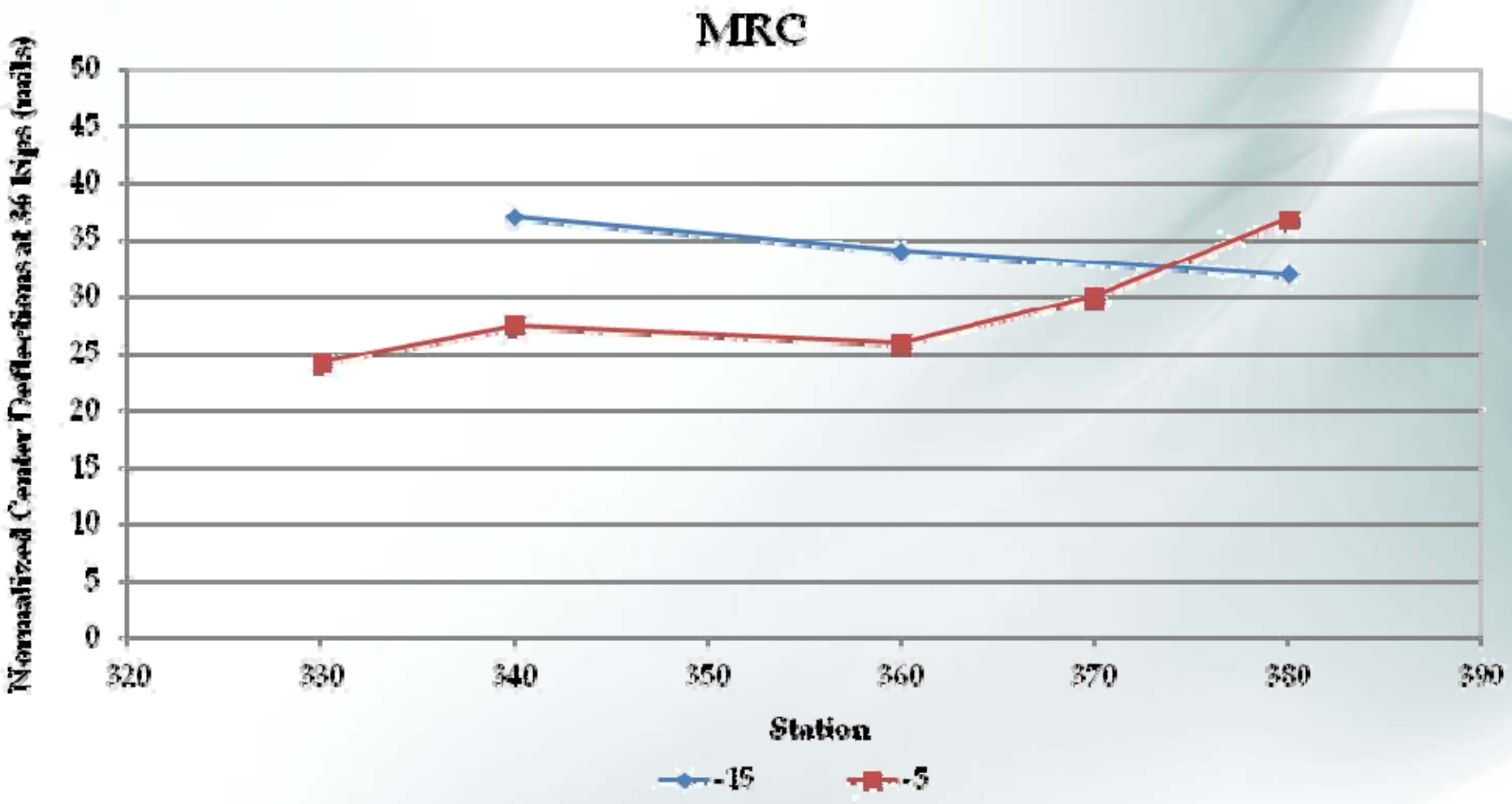
  - Deflections were measured at 8 positions up to 70-in

Initial HWD Testing (July 11, 2005)

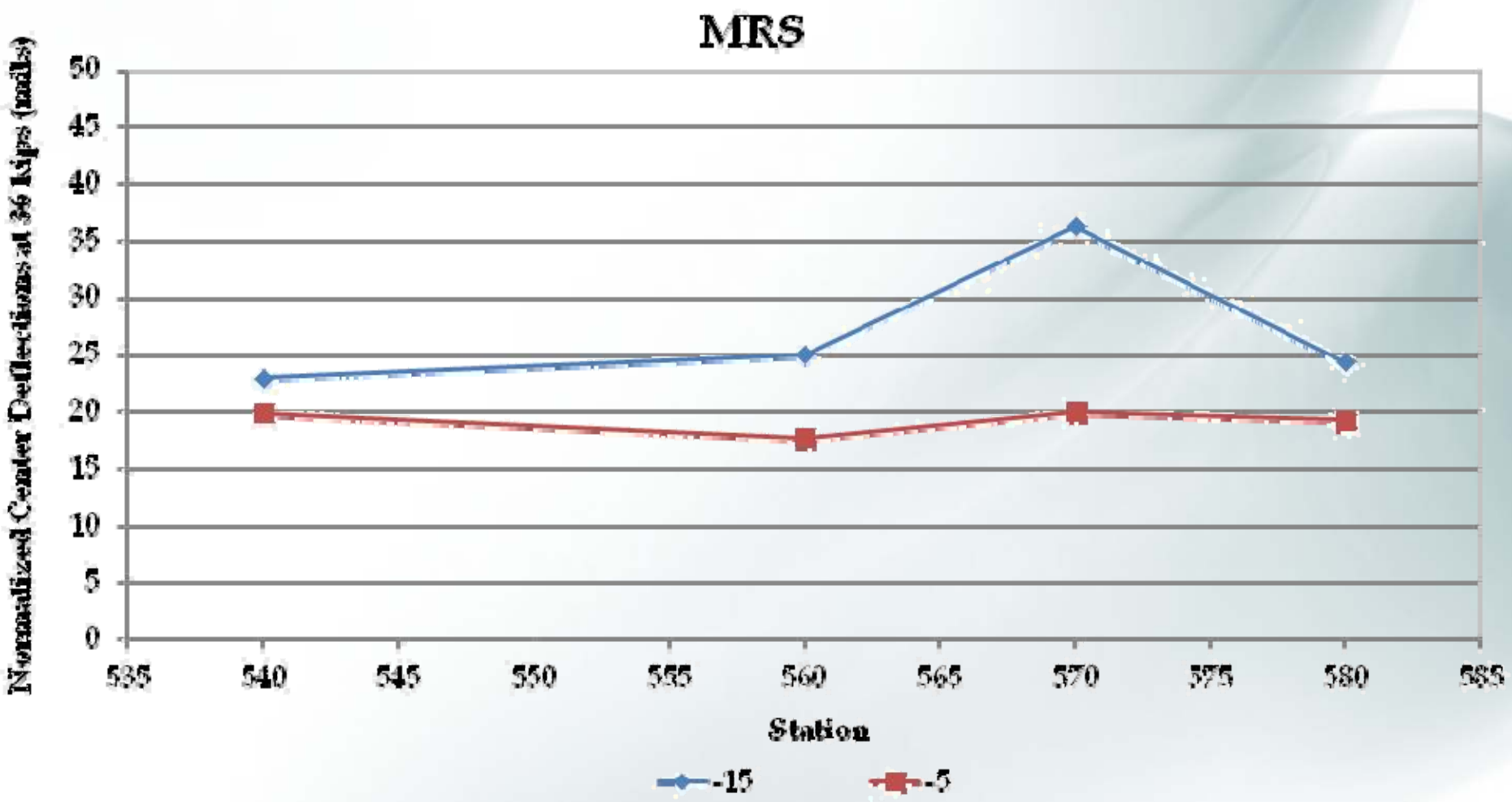


Over longitudinal joint

Initial HWD Testing (July 11, 2005)



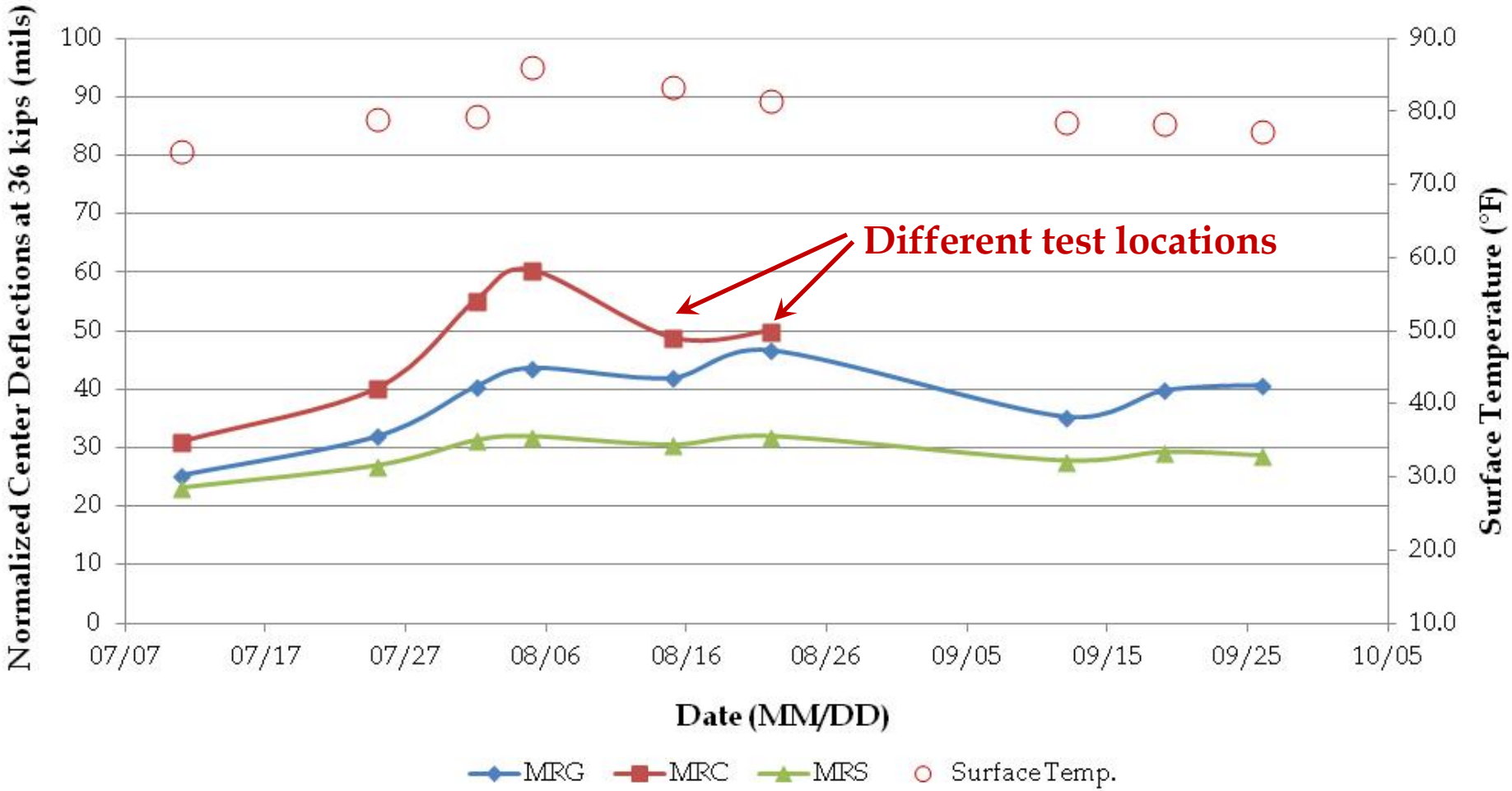
Initial HWD Testing (July 11, 2005)



Rubblized PCC Layer

- Relatively Variable

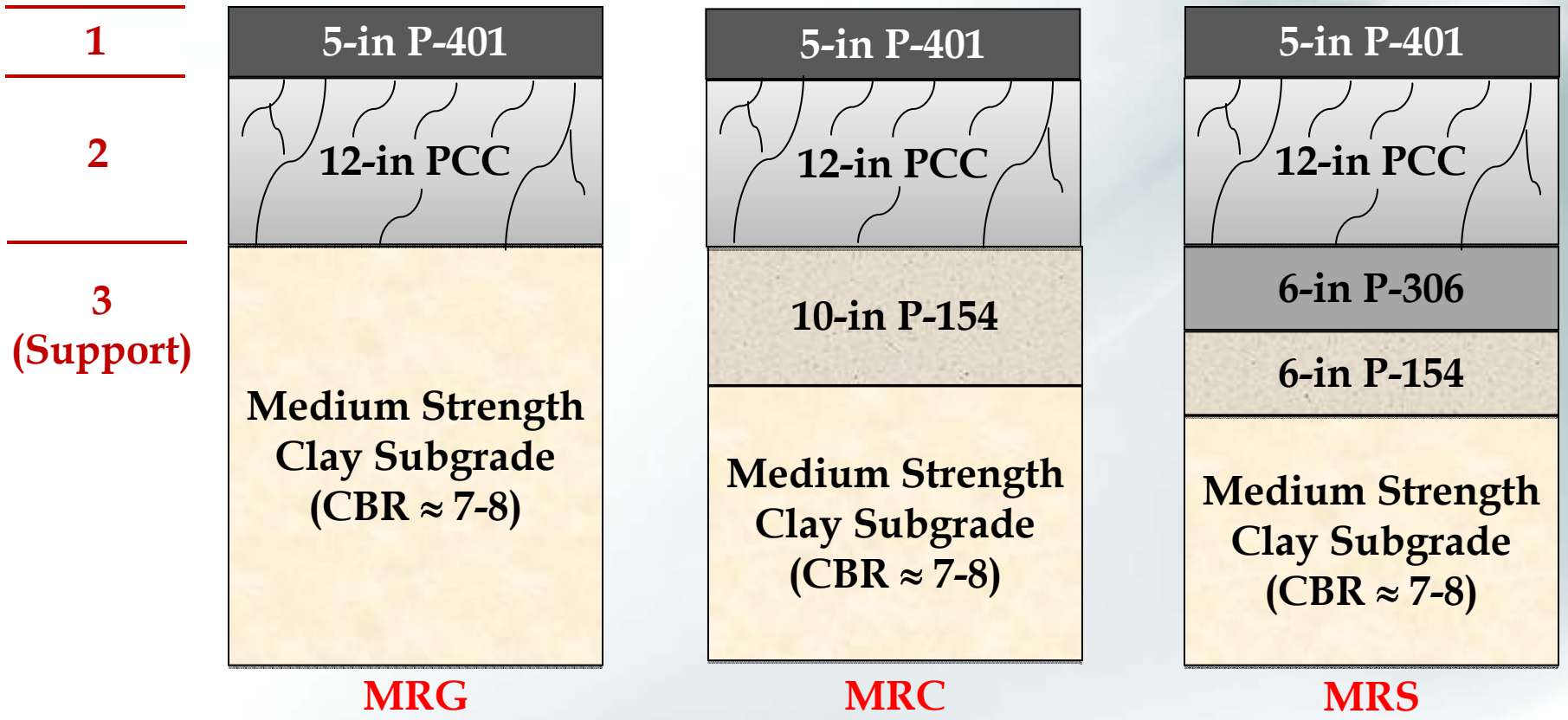
Normalized Center Deflections at 36 kips



Note: Deflection is not adjusted for temperature (P-401 temperature ranged from 66 to 85°F)

Pavement Modeling

- Pavement was modeled as a 3-layer system



- Backcalculation performed using ELMOD (Drop 4)

Average Deflection and Layer Moduli

- Initial HWD Testing (July 11, 2005)

Test Item	ND1 at 36 kips (mils)	Backcalculated Layer Moduli (ksi) 1)		
		P-401 2)	Rubblized PCC	Support
MRG	25	825	190	26
MRC	31	650	185	18
MRS	23	560	375	26

1) Based on log-normal distribution

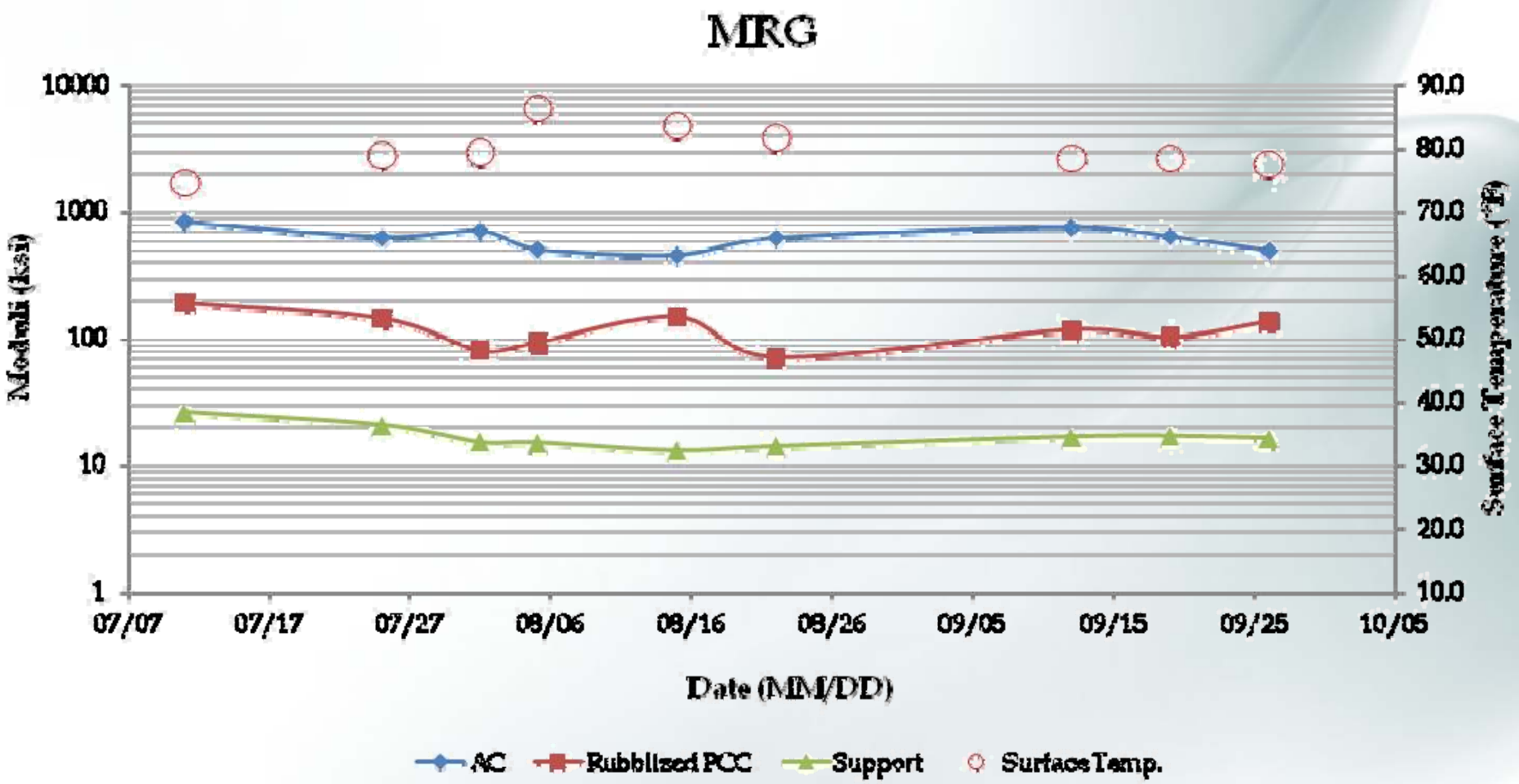
2) Not adjusted to a reference temperature

MRG – Initial HWD Testing (July 11, 2005)

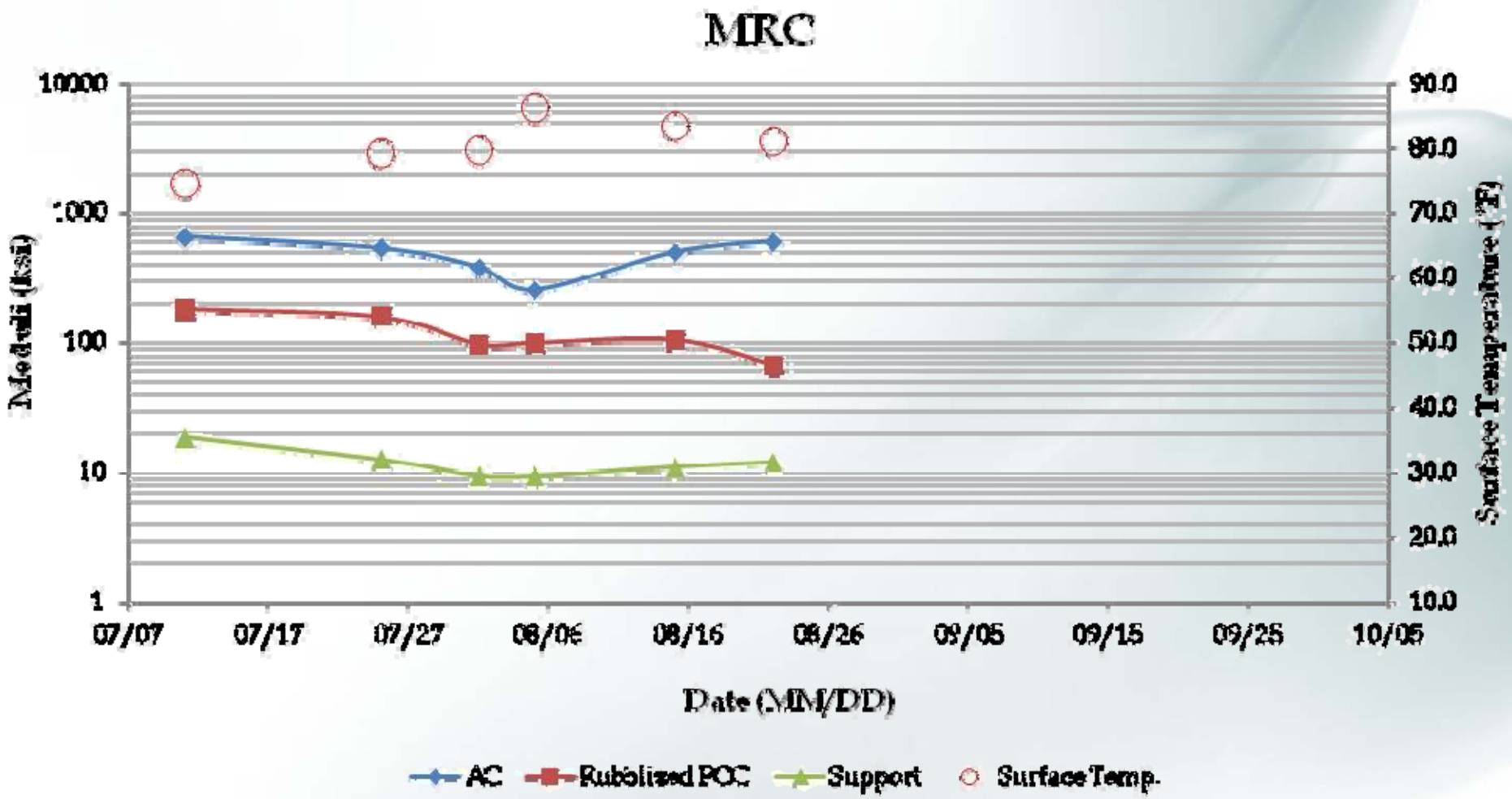
- At various drops levels

Drop (Load, kips)	Backcalculated Layer Moduli (ksi)		
	P-401	Rubblized PCC	Support
2 (12)	545	250	22
3 (24)	750	200	25
4 (36)	825	190	26

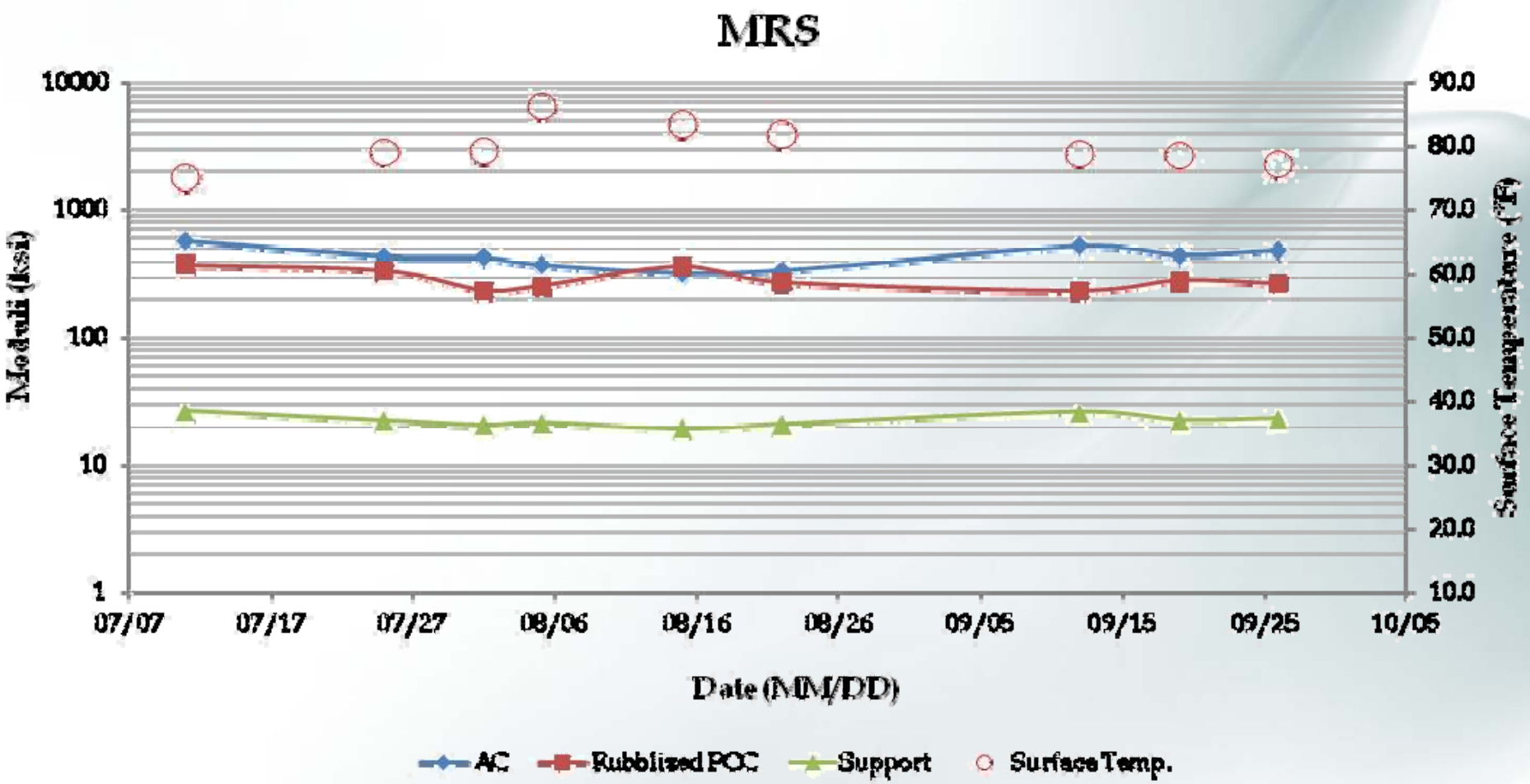
MRG – Backcalculated Layer Moduli



MRC – Backcalculated Layer Moduli



MRS – Backcalculated Layer Moduli



Suggested Rubblized PCC Design Moduli

PCC Thickness Range (in)	FAA Paper Moduli (ksi)
6 to 8	100 to 135
8 to 14	135 to 235
Greater than 14	235 to 400

12″ Rubblized PCC

16th Percentile:

110 to 200 ksi

Conclusions

- Reliable backcalculation can be achieved if you have:
  - Adequate tools:
    - Structural Model
      - Theory that truly models the pavement behavior; including non-linearity effects, where applicable.
        - » Can be calibrated based on measured responses
    - Seed moduli (that vary for every test point)
  - Non-complex pavement structure
  - Knowledge of materials, experience and sound engineering judgment

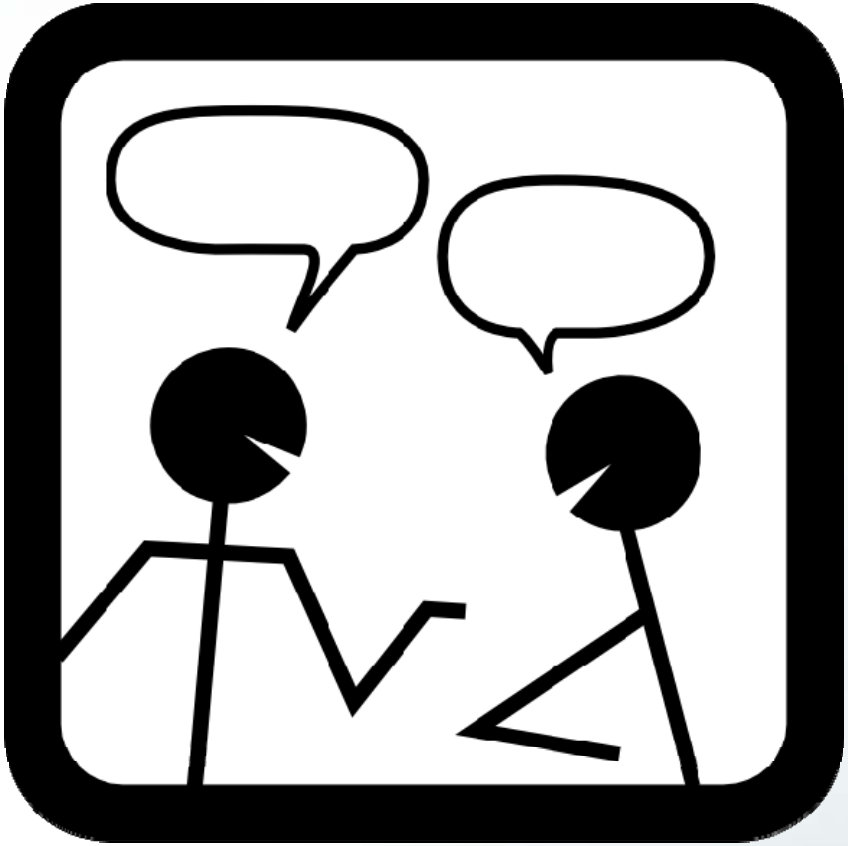
Recommendations

- Evaluate different rubblization techniques
- Evaluate/calibrate different structural models to be used for:
  - Forward calculation
  - Backcalculation
- Evaluate long term performance of rubblized PCC pavements

Acknowledgment

- FAA Airport Technology Research and Development Branch
  - Dr. Navneet Garg
  - Dr. David Brill

Discussion & Questions



Thank You

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