Airport Concrete Pavement Technology Program (ACPTP)

Request for Proposal (RFP) ACPTP 2025-12

P-501 Cement Concrete Pavement Acceptance Study

BACKGROUND

According to the Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5370-10H, Item P-501—*Cement Concrete Pavement*, the airport sponsor (i.e. owner) is responsible for conducting concrete flexural strength testing on beams as part of the sponsor's QA program. Usually, consulting engineering testing firms perform this function under contract to the sponsor. According to P-501, payment for the concrete pavement is based solely on the result of QA testing, which includes strength, thickness, grade, and (sometimes) profile roughness, with potential adjustments for repairs and/or grinding. The P-501 specification also allows for adjustments applied for strength and thickness under the Percent Within Limits (PWL) statistical analysis applied to test results.

The current version of P-501 does not require contractors to cast additional concrete beam specimens for flexural strength testing as part of contractor quality control (QC) during production of concrete pavement. However, the concrete paving industry strongly encourages contractors to cast enough beam specimens during concrete production to assess and understand concrete strength gain from initial stages of hydration up to and past the specified age. Contractor QC strength testing provides the contractor and the airport sponsor's QA team with information to know if the contractor needs to change construction processes to meet specification requirements. Having extra beams to break after the acceptance requirement can offer additional strength gain information if testing results are questionable.

P-501 requires flexural strength testing using beams evaluated following the procedures in ASTM C78 *Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)*. ASTM C78 has several known challenges. ASTM C78 paragraph 10.1 states that a single operator casting and testing beams from a single batch may report data that differ by more than 16%. Likewise, multi-laboratory results can differ by as much as 19%. The Innovative Pavement Research Foundation (IPRF) Project Report IPRF-01-G-002-03-4 *Precision Statement for ASTM C78, Flexural Testing, Airfield Concrete* concluded that excellent control of flexural strength specimens is required to prevent unwarranted variability from appearing in the test results. Even under strict adherence to standards, as much as 200 psi variance can be expected from the test results of two different laboratories on beams made from the same batch sample. This variability can produce different results between the QC and QA tests. Beam test results can be impacted by how the operator casts, handles, transports, and cures the beam specimens. QA and QC personnel must follow the exact same protocols for the results to be consistent. In general, deviations in procedures and errors in sample preparation, storage, transportation and testing will generally cause false low test results.

These known challenges in conducting testing according to ASTM C78 can result in situations where a contractor's QC data may indicate sufficient concrete strength, requiring no adjustments to the production process, while the sponsor's QA results may report that the same concrete is deficient and subject to a significant pay deduction or must be removed and replaced.

When QC tests indicate that concrete is acceptable, yet QA tests indicate the concrete has a lower than acceptable strength, the discrepancy often leads to disputes. To address these cases, the FAA has developed Engineering Brief (EB) No. 34A "*Referee Testing of Hardened Portland Cement Concrete Pavement—Percent Within Limits Revision*". EB 34A states that referee testing should only be considered when there is evidence that the standard flexural strength test results are not representative of the in-place material. The FAA has also recently included language in the draft version of AC 150/5370-10J that would consider use of QC beams when results of QA beams indicate the need to reject a lot.

Another issue with the use of beams for acceptance testing is that they are heavy and can become a safety issue for test lab staff.

A few alternative methods exist that may be used to estimate concrete strength. In 2003, the Innovative Pavement Research Foundation published a report titled, *"Strength Measurements Using Maturity for Portland Cement Concrete Pavement Construction at Airfields"*. Subsequently, the FAA has allowed the use of maturity meters to assess concrete strength for opening to construction traffic. However, the FAA has not considered allowing maturity methods for concrete pavement acceptance. Since 2003, other technologies have been developed that could also potentially be used for concrete strength acceptance.

Other alternatives include one which is used by the Tri-services 32 13 14.13 specification, is to use flexural strength beam testing to prequalify a mixture and then use compressive strength cylinder tests calibrated against the flexural strength beam test results for acceptance. Additionally, the current version of P-501 allows the option to use compressive strength cylinder test for acceptance for pavement designed to accommodate aircraft with gross weights of 60,000 pounds or less. Compressive strength testing is generally considered to be easier to conduct than flexural strength testing and to produce more consistent, less variable results. Nonetheless, the FAA's draft update to P-501 in Draft AC 150/5370-10J (currently under review) is considering introducing yet another method for acceptance by using a 90-day design strength, calibrated to a 14-day beam strength for acceptance. Little, if any research has been done to confirm one method is superior to any other method.

OBJECTIVES

Engineers often consider strength the most important metric to evaluate concrete pavement quality. However, other parameters such as durability are often more important to long-term performance than strength. If the concrete water-to-cementitious material ratio (w/cm) is appropriate and consistent, air content is consistent and adequate for the location, the combined aggregated gradation is consistent during production, and the construction process is controlled, the concrete pavement strength is generally not a problem. In addition, testing of field concrete is only conducted to ensure that the mixture delivered and placed is consistent with that accepted in the preconstruction stage. However, many engineers have the false perception that using ASTM C78 provides an evaluation of in-place concrete strength.

The objective is to investigate the challenges with the current FAA concrete mixture acceptance criteria. Other potential methods should be investigated and assessed to determine if they could be used in place of ASTM C78 to evaluate in-place concrete properties. The primary deliverable for this work will be a report evaluating the current acceptance criteria and determining whether the use of other methods in lieu of ASTM C78 would result in a more consistent and accurate evaluation of the mixture.

Topics to address include, but are not limited to:

- What are the sources of error in ASTM C78 testing? Could those sources of error be reduced by including additional controls during executing that testing?
- Do certain strength testing methods relate better to airfield loads or better reflect strength in the airfield environment under heavy aircraft loads than other methods?

- How does incorporating a different acceptance testing method relate to the use of flexural strength as a design input in FAARFIELD?
- What are the challenges with the current FAA concrete pavement strength acceptance criteria (including use of PWL with strength)?
- Evaluate and compare the strength acceptance criteria in the current version of AC 150/5320-10H, Item P-501 and the proposed strength acceptance criteria in AC 150/5370-10J, Item P-501.
- The percent within limits (i.e., PWL) provision in the current version of AC 150/5370-10H, Item P-501 is based on a 28-day acceptance strength. The proposed update to the P-501 strength acceptance criterion bases acceptance on a 14-day strength corelated to the 90-day design strength. What is the impact of the proposed change to the PWL precision, if any?
- What other test methods can consistently and accurately assess strength? What are the pros and cons of these methods?
- Is it necessary or sufficient to accept based on strength test results to ensure acceptable, durable concrete pavement?
    - What other tests are needed?
    - What types of acceptance criteria could be used for durability? What durability properties need to be evaluated?
- Make recommendations for a follow-on field study as necessary to assess the validity of each method considered, including how PWL methodologies may be applied.

TASKS

The Principal Investigator (PI) will be responsible for executing a series of tasks within the time and budget available such that, when finished, it will result in the completion of the objectives of this study. The proposal does not necessarily need to reflect the exact budget, or the performance period indicated in the RFP; however, any deviation must be justified and clearly explained.

SCOPE OF WORK

Task 1- Literature review
The literature review should include at a minimum:

- An assessment of the current P-501 strength acceptance test procedure (ASTM C78), highlighting challenges that may have an impact on mixture acceptance
- Include alternative test methods and protocols used by other agencies to assess strength, such as:
    - Compressive strength
    - Splitting tensile strength
    - Cores
    - Maturity
- Consider new technologies and test methods that may be used to estimate concrete strength and their suitability for use in acceptance testing for airfieldsConsider agencies (e.g. Iowa DOT) that don't conduct acceptance testing for strength of paving concrete and describe what methods are in place to ensure quality and durability of the concrete mixture
- Include test methods and protocols used to assess uniformity and potential durability as an alternative to strength
- Investigate the applicability of PWL to different test methods and/or sample ages
- Evaluate the relationships between strength, other concrete properties, and pavement service life

Task 2 – Develop recommendations for follow-on study that would support implementation of improved FAA acceptance criteria

- What questions would be addressed by a follow-on field or laboratory study?
- What type of testing program would be needed?
- How would data be interpreted?

Task 3 – Draft Final Report

A draft final report will be submitted 4 months prior to the end of the contract. It will include:

- Details of the work conducted, results collected, and conclusions drawn
- Synthesis of the published literature
- Identification of knowledge gaps in understanding concrete acceptance practices
- Prioritized list of recommendations for future work
- Recommended potential updates and changes to existing FAA Advisory Circulars

DELIVERABLES

PTP Meetings: The team will meet with the PTP every six months to review progress and direction of the project.

Quarterly Report: Quarterly reports will be due the 15th of the month following the quarter (April 15, July 15, October 15, January 15). The quarterly report should identify current or anticipated problems as well as work accomplished during the quarter and next quarter's planned activities.

Draft Final Report: A draft final report is due 4 months prior to the end of the contract.

Final Report Review: Following the Project Technical Panel's (PTP) review of the final report, the researchers and PTP will meet to discuss the work conducted and the outcomes of the project.

Final Report: The PI will have 2 months to submit a final 508 compliant report.

FUNDS AVAILABLE: Not to exceed $200,000

CONTRACT TIME: Not to exceed 16 months (final report due 12 months from project start)

ACPTP 2025-12 PROJECT MANAGER: Dan King, deking@iastate.edu

QUESTIONS ON RFP: E-mail to ACPTP@iastate.edu prior to December 15, 2025 Answers will be posted at https://cptechcenter.org/airport-pavements/acptp/

PROPOSAL PREPARATION INSTRUCTIONS: https://cptechcenter.org/airport-pavements/acptp/

ESTIMATED NOTICE TO PROCEED DATE: March 1, 2026

PROPOSAL DUE DATE: December 22, 2025 not later than 4:00 P.M. (Central Time)

PROPOSAL SUBMIT: ACPTP@iastate.edu (PDF proposal plus Excel spreadsheet; see proposal instructions)