

TRANSPORTATION RESEARCH CONTRACT
FOR CONDUCTING THE RESEARCH PROJECT ENTITLED
“IMPROVING SPECIFICATIONS TO RESIST FROST DAMAGE
IN MODERN CONCRETE MIXTURES”

TPF-TPF5(297)RS / JOB PIECE 30802(04)

MODIFICATION 1

This contract modification is made on the date of execution by and between the Oklahoma Department of Transportation, hereinafter referred to as the DEPARTMENT, and Oklahoma State University, hereinafter referred to as the CONTRACTOR, for the following intents and purposes:

WITNESSETH:

Whereas, on the 10th day of March 2014, the parties hereto entered into a certain written contract entitled, “**IMPROVING SPECIFICATIONS TO RESIST FROST DAMAGE IN MODERN CONCRETE MIXTURES**”;

Now therefore, it is mutually agreed between the parties hereto that the aforesaid contract is hereby modified as follows:

SECTION 3 Compensation is replaced in its entirety as follows:

The CONTRACTOR shall provide quarterly invoices to the DEPARTMENT for the value of work performed after it is completed. Invoices shall be for a sum equal to the actual cost of wages, overhead, equipment and materials, etc. The CONTRACTOR project budget is incrementally funded and is not expected to exceed **THREE HUNDRED FIFTY-FIVE THOUSAND (\$355,000.00) DOLLARS** covering a contract period of up to three years for the execution of the designated research project as described in Appendix A of this contract unless increased by written Research Contract Modification as described in Section 21 of this contract.

Current funding obligated to the contract is **ONE HUNDRED ELEVEN THOUSAND EIGHT HUNDRED FIFTY NINE (\$111,859.00) DOLLARS** for Year 1.

This contract is renewable annually for two years. The first renewal year shall not exceed **ONE HUNDRED TWENTY THOUSAND SEVEN HUNDRED NINE (\$120,709.00) DOLLARS**. The second renewal year shall not exceed **ONE HUNDRED TWENTY TWO THOUSAND FOUR HUNDRED THIRTY TWO (\$122,432.00) DOLLARS**.

Invoices shall be accompanied by corresponding quarterly project reports as described in Appendix B of this contract. Invoices shall be prepared and submitted to the DEPARTMENT Materials and Research (M&R) Division Research Project Engineer and shall include, but are not limited to the following, which will be issued by the DEPARTMENT M&R Division Research Project Engineer:

- (a) Project number
- (b) Job Piece (J.P.) number
- (c) Federal fiscal year contract number
- (d) Partial or Final Invoice
- (e) Invoice pay period
- (f) The project budget amount
- (g) The remaining project balance

Invoices that are deemed incomplete, inaccurate or are not accompanied by the required documentation, as previously mentioned, will delay the payment of claims; therefore, the CONTRACTOR will check and review invoices carefully to assure each is complete and accurate and contains the required documentation prior to submittal to the DEPARTMENT M&R Division Research Project Engineer. Final invoice payment shall be made contingent upon the following:

- (a) The completion and submission of quarterly pooled fund project status reports and Final Report as described in Appendix B of this contract
- (b) Approval and acceptance of the quarterly pooled fund project status reports and Final Report by the DEPARTMENT
- (c) The submission, approval and acceptance by the DEPARTMENT of any required deliverables as described in Appendix B of this contract
- (d) Any other required Principal Investigator (P.I.) obligations as specified in this contract or any subsequent Research Contract Modifications

All other provisions of the contract dated March 10, 2014, except as amended herein, remain in full force and effect.

IN WITNESS WHEREOF, the DEPARTMENT and the CONTRACTOR have caused this contract modification to be executed on the day and year first above written.

OKLAHOMA STATE UNIVERSITY

Sheryl A. Tucker

Sheryl A. Tucker
Interim Vice President for Research
and Technology Transfer

OKLAHOMA DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:

Reynolds H. Toney 4/14/2014

Reynolds Toney, P.E. Date
Materials & Research
Division Engineer

Paul D. Green

Paul Green, P.E.
Director of Operations

4/14/14
Date

John R. Bowman 4/22/14

John R. Bowman, P.E.
Director of Capital Programs

Date

APPROVED AS TO FORM:

David Allan Wiley 4/15/14

General Counsel Date

APPROVED:

Casey Shell

Casey Shell, P.E.
Chief Engineer

4/23/14

Date

TRANSPORTATION RESEARCH CONTRACT
FOR CONDUCTING THE RESEARCH PROJECT ENTITLED
“IMPROVING SPECIFICATIONS TO RESIST FROST DAMAGE
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This contract is made on the date of execution by and between the Oklahoma Department of Transportation, hereinafter referred to as the DEPARTMENT, and Oklahoma State University, hereinafter referred to as the CONTRACTOR, for the following intents and purposes:

WITNESSETH:

WHEREAS, the DEPARTMENT is responsible under the laws of the State of Oklahoma for the construction and maintenance of highways within the State of Oklahoma; and,

WHEREAS, the DEPARTMENT must efficiently and effectively allocate resources to the performance of DEPARTMENT functions; and,

WHEREAS, the DEPARTMENT must continually seek to identify new or improved methodologies to maximize the impact of allocated resources; and,

WHEREAS, the DEPARTMENT cannot with resources internally available effectively conduct research or develop procedures to maximize the integration of technological advances into DEPARTMENT operations, such that it is desirable for the DEPARTMENT to enter into a contract with the CONTRACTOR to provide the DEPARTMENT'S required activities; and;

WHEREAS, the CONTRACTOR assists government entities and others in the transportation industry in the conduct of research and to provide technical assistance and training services in the resolution of transportation issues; and,

WHEREAS, the DEPARTMENT is authorized under the provisions of Title 69 O. S. ' 1502 and Title 74 O. S. ' 85.12 to contract for necessary services; and,

WHEREAS, the DEPARTMENT and the CONTRACTOR have agreed as to terms and conditions under which the CONTRACTOR can provide technical assistance, research, and training services for the DEPARTMENT.

NOW THEREFORE, for and in consideration of the mutual covenant contained herein, the DEPARTMENT and the CONTRACTOR do hereby mutually promise and agree as follows:

SECTION 1 Purpose

The purpose of this contract is for the CONTRACTOR to provide technical assistance and research to the DEPARTMENT.

SECTION 2 Project to be Performed

The DEPARTMENT and the CONTRACTOR do mutually agree that in consideration of the funds provided hereunder, that the CONTRACTOR shall conduct research for the project enumerated within or developed in accordance with the submitted research project proposal entitled, “**IMPROVING SPECIFICATIONS TO RESIST FROST DAMAGE IN MODERN CONCRETE MIXTURES**” which is specifically provided in Appendix A, hereto which is incorporated with and made a part of this contract.

SECTION 3 Compensation

The CONTRACTOR shall provide quarterly invoices to the DEPARTMENT for the value of work performed after it is completed. Invoices shall be for a sum equal to the actual cost of wages, overhead, equipment and materials, etc. The CONTRACTOR project budget shall not exceed **THREE HUNDRED FIFTY-FIVE THOUSAND (\$355,000.00) DOLLARS** covering a contract period of up to three years for the execution of the designated research project as described in Appendix A of this contract unless increased by written Research Contract Modification as described in Section 21 of this contract.

Invoices shall be accompanied by corresponding quarterly project reports as described in Appendix B of this contract. Invoices shall be prepared and submitted to the DEPARTMENT Materials and Research (M&R) Division Research Project Engineer and shall include, but are not limited to the following, which will be issued by the DEPARTMENT M&R Division Research Project Engineer:

- (a) Project number
- (b) Job Piece (J.P.) number
- (c) Federal fiscal year contract number
- (d) Partial or Final Invoice
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- (f) The project budget amount
- (g) The remaining project balance

Invoices that are deemed incomplete, inaccurate or are not accompanied by the required documentation, as previously mentioned, will delay the payment of claims; therefore, the CONTRACTOR will check and review invoices carefully to assure each is complete and accurate and contains the required documentation prior to submittal to the DEPARTMENT M&R Division Research Project Engineer. Final invoice payment shall be made contingent upon the following:

- (a) The completion and submission of quarterly pooled fund project status reports and Final Report as described in Appendix B of this contract
- (b) Approval and acceptance of the quarterly pooled fund project status reports and Final Report by the DEPARTMENT
- (c) The submission, approval and acceptance by the DEPARTMENT of any required deliverables as described in Appendix B of this contract
- (d) Any other required Principal Investigator (P.I.) obligations as specified in this contract or any subsequent Research Contract Modifications

SECTION 4 Final Release of Funds

The DEPARTMENT shall reimburse up to 85% of committed funds upon receipt of proper invoices for goods or services within no more than forty-five (45) days from the date on which the invoice was received in the office designated by the DEPARTMENT to which the goods or services were provided.

The DEPARTMENT shall retain fifteen percent (15%) of committed funds for a single year project budget or for each year's budget of a multi-year project. Payment of the 15% retention amount(s) shall be contingent on the acceptance and approval of the quarterly pooled fund project status reports or project Final Report, whichever is required, as well as, the submission of all other items listed in Appendix A of this contract.

SECTION 5 Deliverables

The CONTRACTOR will submit the deliverables to the DEPARTMENT in accordance with Appendix B of this contract.

SECTION 6 No Cost Time Extensions (NCTE)

In the final project year, the CONTRACTOR P.I. may request to extend the project period one time for up to three months, (90 days), through a written No Cost Time Extension, (NCTE), request which shall be coordinated through the CONTRACTOR research office. **NCTE requests shall be in the form of a formal CONTRACTOR letterhead addressed and submitted to the DEPARTMENT M&R Division Research Project Engineer by November 30th, 2016.** The CONTRACTOR P.I. shall follow up to verify that a NCTE request has been received and approved. Should a NCTE request be approved, the DEPARTMENT M&R Division Research Project Engineer will issue a formal Research Contract Modification to the CONTRACTOR research office.

The CONTRACTOR P.I. must clearly justify the reason(s) for extending the project period. Requests must include:

- 1) A brief narrative summary of funds that are expected to be remaining at the current ending date;

2) Justification for the need for an extension, and the requested new ending date.

The DEPARTMENT will consider NCTE requests on a case-by-case basis, with no guarantee of approval. The DEPARTMENT may, at its discretion, grant extensions of time if:

- 1) a statute, regulation, or other condition of the award does not prohibit the extension;
- 2) the extension does not require the DEPARTMENT to obligate supplemental funds in order to finish contract activities;
- 3) the extension is to carry out the activities in the approved proposal.

No new funds or new tasks may be added to the project if approved for a NCTE. **Should a NCTE request be approved, remaining unexpended project funds may be continue to utilized by the CONTRACTOR P.I. during the approved NCTE period.** The Final Report must be submitted on or before ninety (90) days after the end of the newly specified project deadline.

Failure to complete the research work and/or submit the Final Report on or before ninety (90) days after the end of the newly specified project deadline will affect future funding to the organization or awards for the same CONTRACTOR P.I.

SECTION 7 Accessibility Requirements

The CONTRACTOR shall submit the Final Project Report, as suggested in Appendix B of this contract, to satisfy all federal and state requirements pertaining to the accessibility of documents including but not limited to:

U.S. Federal Government Section 508 (29 U.S.C. 794d) of the Rehabilitation Act, as amended by the Workforce Investment Act of 1998 and Oklahoma State Statute 2001 62 § 41.5e, as amended by House Bill 2197 and The Americans with Disabilities Act of 1990, 42 USC 12.01 et seq.

SECTION 8 Lab Qualifications

The CONTRACTOR P.I. or any substitutes to the CONTRACTOR PI shall preferably be a Professional Engineer registered in the State of Oklahoma. In addition, any substitution shall have equivalent or higher qualifications than the CONTRACTOR PI as suggested in Appendix A of this contract. The research personnel who will be conducting the research shall have been deemed qualified by the CONTRACTOR PI prior to the start of the research.

As designated in Appendix A of this contract, the laboratories of the CONTRACTOR performing the work shall have a documented Quality Management System (QMS) acceptable to the DEPARTMENT. The intent of the QMS is to document to the DEPARTMENT that the lab has the necessary calibrated and/or verified equipment, competent technicians, and quality system in place to properly conduct testing on

highway construction materials used in the research. It is the intent of this policy that all equipment used to perform the research under this contract be calibrated and maintained in accordance with the manufacturer's recommendations or to the industry standards. All technicians performing research testing must be trained satisfactorily by the CONTRACTOR PI and considered competent to perform the testing in the absence of the CONTRACTOR PI.

DEPARTMENT representatives shall have access to the laboratories and may conduct on-sight visits or inspections during the performance of the contract. Any infractions noted at the time of such inspections will be brought to the attention of the CONTRACTOR PI who is ultimately responsible for implementing corrective measures to resolve such infractions. The DEPARTMENT may request split testing of samples with the laboratories when appropriate for quality assurance purposes at no additional compensation.

Full compliance with this policy is placed with the CONTRACTOR PI performing the research under this contract.

SECTION 9 Equipment Purchases or Rental of Research Equipment

Unless provided and budgeted in the attached Appendix A, equipment to be purchased, constructed or rented in excess of \$1,000 dollars per item and purchased with DEPARTMENT funds, requires DEPARTMENT prior review and approval. The CONTRACTOR shall provide a detailed list identifying each piece of equipment and/or instrument being requested for purchase.

DEPARTMENT funds may be used to purchase maintenance type laboratory equipment supplies, laboratory equipment replacement parts, or to pay for laboratory equipment repairs.

At the request of the DEPARTMENT, any and all permanent or non-permanent computer equipment, specialized laboratory equipment, field or lab testing instruments or any other equipment or instrumentation purchased by way of DEPARTMENT funds for the project mentioned herein that is equal to or exceeds Five Thousand, (\$5,000.00), Dollars, shall, at the end of the project as determined by the DEPARTMENT, be the property of and surrendered to the DEPARTMENT by the CONTRACTOR at the request of the DEPARTMENT. It shall be the responsibility of the DEPARTMENT for the transport and delivery of said equipment and all costs incurred for such.

SECTION 10 Computer Equipment and Accessories

Unless budgeted and approved in the attached Appendix A, the purchase of computer equipment and/or their respective accessories using DEPARTMENT funds is subject to DEPARTMENT prior review and approval. This includes but is not limited to portable and desktop computers and computer peripheral devices.

SECTION 11 Software and/or Licenses

Unless budgeted and approved in the attached Appendix A, DEPARTMENT funds shall not be used to purchase computer software and /or software licenses.

SECTION 12 Tuition

DEPARTMENT funds shall not be used to pay student tuition.

SECTION 13 Travel

Current State of Oklahoma travel regulations and rates shall apply to all in-state and out-of-state travel for which reimbursement is claimed during the term of this contract.

Travel to any destination outside of the United States and/or its territories are considered “foreign travel.” DEPARTMENT funds will not be used for foreign travel.

SECTION 14 Dispute Resolution

The parties hereto have entered into this contract in the State of Oklahoma and the laws of the State of Oklahoma shall apply. The parties agree to bargain in good faith in direct negotiation to achieve resolutions of any dispute and, if such efforts are unsuccessful, to retain a neutral mediation service to mediate the dispute prior to the filing of any court action. A non-binding mediation shall be conducted in the Oklahoma City area and the costs of such mediation shall be borne equally by the parties. If mediation is not successful, venue for any action brought to enforce the terms of this contract shall be Oklahoma County, State of Oklahoma. Each party shall bear any cost and attorney fees incurred by that party in such litigation.

SECTION 15 Termination

This contract may be terminated upon thirty (30) day written notice by either the DEPARTMENT or the CONTRACTOR without fault. In the event of such termination, the CONTRACTOR shall be entitled as compensation only to the reasonable value of services rendered prior to the termination and any non-cancelable student salary and benefit obligations.

SECTION 16 Covenant Against Contingent Fees

The CONTRACTOR represents that they have not employed or retained any company or person specifically to solicit or secure this contract, and that he has not paid or agreed to pay any fee, commission, percentage, brokerage fee, gifts, or any other consideration, contingent upon or resulting from the award or making of this contract. For breach or violation of this representation, the DEPARTMENT shall have the right to annul this contract without liability.

SECTION 17 Hold Harmless

The DEPARTMENT and the CONTRACTOR mutually recognize that each party is a governmental entity subject to the provisions of the Governmental Tort Claims Act (51 O.S. ' 151 et seq.). The DEPARTMENT and the CONTRACTOR hereby mutually agree that each is and may be held severally liable for any and all claims, demands, and suits in law or equity, of any nature whatsoever, paying for damages or otherwise, arising from any negligent act or omission of any of their respective employees, agents, or contractors which may occur during the prosecution of performance of this contract to the extent provided in the Governmental Tort Claims Act. Each party agrees to severally bear all costs of investigation and defense of claims arising under the Governmental Tort Claims Act and any judgment which may be rendered in such cause to the limits provided by law. The CONTRACTOR shall bear all claims alleging infringement or interference with any copyright license, patent, or patent right held or controlled by a third party and costs or fees which may be assessed and judgment which may be rendered as the result of such claim. Nothing in this section shall be interpreted or construed to waive any legal defense which may be available to a party or any exemption, limitation or exception which may be provided by the Governmental Tort Claims Act or the Eleventh Amendment of the United States Constitution.

SECTION 18 Copyright

The CONTRACTOR may copyright any work that is subject to copyright and was developed, or for which ownership was purchased, pursuant to this contract. The Federal Highway Administration, United States Department of Transportation, and the DEPARTMENT reserve a royalty-free, nonexclusive, and irrevocable right to reproduce, publish, or otherwise use the work for federal or state purposes and to authorize others to do so unless waived in writing by the DEPARTMENT and the Federal Highway Administration. The state and the federal government have the right to the following:

- (1) Obtain, reproduce, publish, or otherwise use the data first produced under this contract.
- (2) Authorize others to receive, reproduce, publish, or otherwise use such data for state or federal purposes.

SECTION 19 Patents

The CONTRACTOR may patent any invention or discovery which is patentable or otherwise protectable under Title 35 of the United States Code which may be conceived or first actually reduced to practice in the performance of work under this contract. The federal government and the DEPARTMENT shall have a nonexclusive, nontransferable, irrevocable, paid up license to practice or have practiced for or on behalf of the United States and/or the State of Oklahoma the subject invention throughout the world. Said patent rights shall be as more specifically provided in Appendix C, hereto which is incorporated with and made a part of this contract.

SECTION 20 Prior Understandings

This contract incorporates and reduces to writing all prior understandings, promises, contracts, commitments, covenants, or conditions, and constitutes the full and complete understanding and contractual relationship of the parties.

SECTION 21 Research Contract Modifications

No changes, revisions, amendments or alterations in the manner, scope, or type of work or compensation to be paid by the DEPARTMENT shall be effective unless reduced to writing and executed by the parties with same formalities as are observed in the execution of this contract.

SECTION 22 Records

The CONTRACTOR is to maintain all books, documents, papers, accounting records and other evidence pertaining to costs incurred and to make such materials available at their respective offices at all reasonable times, during the contract period and for three (3) years from the date of final payment under the contract for inspection by the DEPARTMENT and the State Auditor and Inspector, and copies thereof shall be furnished to the DEPARTMENT, if requested. All such records shall further be subject to inspection by appropriate officials of the Federal Highway Administration and other agencies of the United States Government to the extent federal funds are used to provide financial support to projects undertaken pursuant to this contract.

SECTION 23 Headings

Article headings used in this contract are inserted for convenience of reference only and shall not be deemed a part of this contract for any purpose.

SECTION 24 Binding Effects

This contract shall be binding upon and inure to the DEPARTMENT and the CONTRACTOR and shall be binding upon their successors and assigns subject to the limitations of Oklahoma law.

SECTION 25 Severability

If any provision, clause, or paragraph of this contract or any document incorporated by reference shall be determined invalid by a court or competent jurisdiction, such determination shall not affect the other provisions, clauses, or paragraphs of this contract which are not affected by the determination. The provisions, clauses, or paragraphs of this contract and any documents incorporated by reference are declared severable.

SECTION 26 Effective Date and Performance Period

This contract shall become effective upon the signature date of the DEPARTMENT

Chief Engineer and remain in effect through February 28, 2017 unless either terminated earlier by provisions of Section 15 or a NCTE is granted by provisions of Section 6 of this contract.

The CONTRACTOR will be notified via email transmittal from the DEPARTMENT of the official performance/budget period start date. No compensation shall be granted to the CONTRACTOR for work performed prior to the official performance/budget period start date.

SECTION 27 Notices

All notices, demands, requests, or other communications which may be or are required to be given, served or sent by either party to the other pursuant to the contract shall be in writing and shall be deemed to have been properly given or sent:


if intended for the DEPARTMENT, mailing first class mail or, if sender prefers, by registered or certified mail, return receipt requested, with postage prepaid addressed to the Oklahoma Department of Transportation, by private overnight carrier or by delivery in person to:

Oklahoma Department of Transportation
Planning and Research Division
Attention: **Gary L. Hook, P.E.**
Research Project Engineer
200 N. E. 21st Street
Oklahoma City, Oklahoma 73105

if intended for the CONTRACTOR, mailing first class mail or, if sender prefers, by registered or certified mail, return receipt requested, with postage prepaid addressed to Oklahoma State University, by private overnight carrier or by delivery in person to:

Oklahoma State University
Attention: **Ms. Suzette Lavoie**
College of Engineering, Architecture & Technology
201 Advanced Technology Research Center
Stillwater, Oklahoma 74078

OKLAHOMA STATE UNIVERSITY


Sheryl A. Tucker
Interim Vice Pres for Research
and Technology Transfer

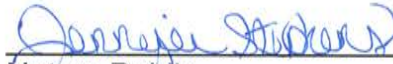

Contractor Principal Investigator

FEI #: 73-6017987

STATE OF OKLAHOMA)
) :
COUNTY OF PAYNE)

Subscribed and sworn before the undersigned on the 28 day of February
20 14





Notary Public

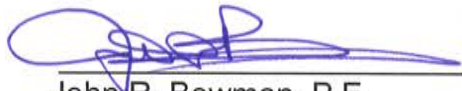
My Commission Expires: 02/02/18

OKLAHOMA DEPARTMENT OF TRANSPORTATION

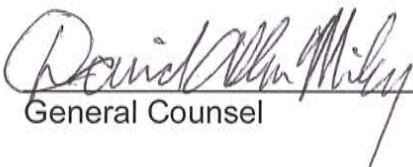
RECOMMENDED FOR APPROVAL:


Reynolds Toney, P.E. Date
Materials & Research
Division Engineer



Paul Green, P.E. Date
Director of Operations


John R. Bowman, P.E. Date
Director of Capital Programs

APPROVED AS TO FORM:


Daniel M. Wiley Date
General Counsel

APPROVED:


Casey Shell, P.E. Date
Chief Engineer

STATUTORY AFFIDAVIT

State of Oklahoma
County of Payne

Affiant, Sheryl A. Tucker, of lawful age, and having been first duly sworn, on oath says:

1. (S)he is the duly authorized agent of Oklahoma State University, the CONTRACTOR under the contract which is attached to this statement, for the purpose of certifying the facts pertaining to the giving of things of value to government personnel in order to procure said contract;
2. (S)he is fully aware of the facts and circumstances surrounding the making of the contract to which this statement is attached and has been personally and directly involved in the proceedings leading to the procurement of said contract;
3. Neither the CONTRACTOR nor anyone subject to the CONTRACTOR'S direction or control has paid, given or donated or agreed to pay , give or donate to any officer or employee of the State of Oklahoma any money or other thing of value, either directly or indirectly, in procuring said contract; and

The CONTRACTOR further certifies that no person who has been involved in any manner in the development of said contract while employed by the State of Oklahoma shall be employed to fulfill any of the services provided for under said contract.

If this contract is for professional services and if the final product is a written proposal, report, or study, the CONTRACTOR further certifies that (s)he has not previously provided the state agency with a final product that is a substantial duplication of the final product of the proposed contract.

Sheryl A. Tucker
Signature

2/28/14
Date

Interim Vice President for
Research & Technology Transfer
Title

Sheryl A. Tucker
Printed Name

State of Oklahoma
County of Payne



Subscribed and sworn before me this 28 day of February, 2014.

Notary Public *Jennifer Stephens*

My Commission Expires: 02/02/18

Commission Number: 10000727

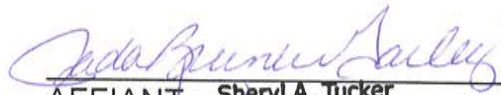
STATUS VERIFICATION SYSTEM AFFIDAVIT

STATE OF OKLAHOMA)
) SS:
COUNTY OF PAYNE)

I, Sheryl A. Tucker, of lawful age, and having been first duly sworn, on oath states:

1. That I am the agent authorized by the CONTRACTOR to submit the attached contract to the State of Oklahoma. I am fully aware of the facts and circumstances surrounding the making of said contract to which this statement is attached and have been personally and directly involved in the procurement of this contract.
2. That the CONTRACTOR has registered and fully participates in the Status Verification System, as required by Title 25 O.S. § 1313(B)(1), to verify the work eligibility status of all new employees of the CONTRACTOR.

FURTHER AFFIANT SAITH NOT.


AFFIANT Sheryl A. Tucker
Interim VP for Research & Technology Transfer

Subscribed and sworn before me this 28 day of February, 20 14.




Notary Public

My Commission Expires: 02/02/18

My Commission Number: 10000727

TITLE VI NON-DISCRIMINATION CLAUSE

During the performance of this contract, Oklahoma State University, (hereafter in this Section "the CONTRACTOR"), for itself, its assignees and successors in interest, agrees as follows:

1. Compliance with Regulations:

The CONTRACTOR shall comply with the regulations relative to nondiscrimination in federally-assisted programs of the Department of Transportation, Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

2. Nondiscrimination:

The CONTRACTOR, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, sex, age, national origin, disability/handicap, or income status, in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The CONTRACTOR shall not participate, either directly or indirectly, in the discrimination prohibited by Section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in appendix B of the Regulations.

3. Solicitations for Subcontracts, Including Procurement of Materials and Equipment:

In all solicitations, either by competitive bidding or negotiation, made by the CONTRACTOR for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the CONTRACTOR of the CONTRACTOR'S obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, sex, age, national origin, disability/handicap, or income status.

4. Information and Reports:

The CONTRACTOR shall provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information and its facilities as may be determined by the State Department of Transportation or the Federal Highway Administration to be pertinent to ascertain compliance with such Regulations or directives. Where any information required of a CONTRACTOR is in the exclusive possession of another who fails or refuses to furnish this information, the CONTRACTOR shall so certify to the State Department of Transportation, or the Federal Highway Administration, as appropriate, and shall set forth what efforts it has made to obtain the information.

5. Sanctions for Noncompliance:

In the event of the CONTRACTOR'S noncompliance with the nondiscrimination provision of this contract, the State Department of Transportation shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including but not limited to:

- a. Withholding of payments to the CONTRACTOR under the contract until the CONTRACTOR complies and/or
- b. Cancellation, termination, or suspension of the contract in whole or in part.

6. Incorporation of Provisions:

The CONTRACTOR shall include the provisions of paragraphs 1 through 6 in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations or directives issued pursuant thereto. The CONTRACTOR shall take such action with respect to any subcontract or procurement as the State Department of Transportation or the Federal Highway Administration may direct as a means of enforcing such provisions, including sanctions for noncompliance provided, however, that in the event a CONTRACTOR becomes involved in, or is threatened with, litigation by a subcontractor or supplier as a result of such direction, the CONTRACTOR may request the State Department of Transportation to enter into such litigation to protect the interests of the State; and, in addition, the CONTRACTOR may request the United States to enter into such litigation to protect the interests of the United States.

THE AMERICANS WITH DISABILITIES ACT NON-DISCRIMINATION CLAUSE

The CONTRACTOR assures that no qualified person with a disability shall, solely by reasons of their disability, be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under any program or activity administered by the CONTRACTOR.

Specifically, the following discriminatory actions are prohibited:

- 1) In providing any aid, benefit, or service, the CONTRACTOR will not directly or through contractual, licensing, or other arrangements, on the basis of disability:
 - a. Deny a qualified person with a disability the opportunity to participate in or benefit from the aid, benefit or service.
 - b. Afford a qualified person with a disability an opportunity to participate in or benefit from the aid, benefit, or service that is not substantially equal to that afforded persons who do not have a disability.
 - c. Provide a qualified person with a disability an aid, benefit or service that is not as effective in affording equal opportunity to obtain the same result, to gain the same benefit, or to reach the same level of achievement as persons without disabilities.
 - d. Provide different or separate aid, benefits, or services to persons with disabilities or to any class of persons with disabilities unless such action is necessary to provide the aids, benefits or services that are as effective as those provided to persons without disabilities.
 - e. Aid or perpetuate discrimination against a qualified person with a disability by providing financial or other assistance to an agency, organization, or person that discriminates on the basis of disability.
 - f. Deny a qualified person with a disability the opportunity to participate in conferences, planning or advising opportunities.
 - g. Otherwise limit a qualified person with a disability in the enjoyment of any right, privilege, advantage or opportunity enjoyed by others receiving an aid, benefit, or service.
- 2) For purposes of these assurances, aids, benefits, and services, to be equally effective, are not required to produce the identical result or level of achievement for disabled and nondisabled persons, but must afford persons with disabilities equal opportunity to obtain the same result, to gain the same benefit, or to reach the same level of achievement, in the most integrated setting that is reasonable achievable.
- 3) Even if separate or different aids, benefits or services are available to persons with a disability, the CONTRACTOR will not deny a qualified person with a disability the opportunity to participate in the programs or activities that are not separate or different.
- 4) The CONTRACTOR will not, directly or through contractual or other arrangements, utilize criteria or methods of administration:
 - a. That have the effect of subjecting qualified persons with a disability to discrimination on the basis of disability,

- b. That have the purpose or effect of defeating or substantially reducing the likelihood that persons with disabilities can benefit from the objectives of the program or activity, or
 - c. That yield or perpetuate discrimination against another recipient of federal funds if both recipients are subject to common administrative control or are agencies of the same State.
- 5) In determining the site or location of a facility, the CONTRACTOR will not make selections:
 - a. That have the effect of excluding persons with disabilities from, denying them the benefits of, or otherwise subjecting them to discrimination under any program or activity, or
 - b. That has the purpose or effect of defeating or substantially impairing the accomplishment of the objectives of the program or activity with respect to persons with disabilities.
- 6) As used in these assurances, the aid, benefit or service provided under a program or activity includes any aid, benefit or service provided in or through a facility that has been constructed, expanded, altered, leased or rented, or otherwise acquired, in whole or in part, with Federal financial assistance.

Future Effect of Assurances

Recipients of Federal financial assistance, and transferees of property obtained by a recipient with the participation of Federal financial assistance, are bound by the above assurances under the following circumstances:

- 1) When Federal financial assistance is provided in the form of a conveyance of real property or an interest in real property from the U.S. Department of Transportation, the instrument of conveyance shall include a covenant running with the land binding the recipient and subsequent transferees to comply with the requirements for so long as the property is used for the purpose of which the Federal financial assistance was provided or for a similar purpose.
- 2) When Federal financial assistance is used to purchase or improve real property, these assurances shall obligate the recipient to comply with the requirements and require any subsequent transferee of the property, who is using the property for the purpose for which Federal financial assistance was provided, to agree in writing to comply with the requirements. The obligations of the recipient and transferees shall continue in effect for as long as the property is used for the purpose for which Federal financial assistance was provided or for a similar purpose.
- 3) When Federal financial assistance is provided in the form of, or is used to obtain, personal property, these assurances shall obligate the recipient to comply with the requirements for the period it retains ownership or possession of the property or the property is used by a transferee for purposes directly related to the operations of the recipient.
- 4) When Federal financial assistance is used for purposes other than to obtain property, these assurances shall obligate the recipient to comply with the requirements for the period during which the Federal financial assistance is extended to the program or activity.

Notice

The CONTRACTOR will take appropriate initial and continuing steps to notify participants, beneficiaries, applicants and employees, including those with impaired vision or hearing, and unions or professional organizations holding collective bargaining or professional agreements with the CONTRACTOR that it does not discriminate on the basis of disability using the notice in Appendix A (Public Notice).

Methods of initial and continuing notification may include the posting of notices, publication in newspapers and magazines, placement of notices in agency publications and distribution of memoranda or other written communications.

Effect of State or local law

The obligation to comply with Section 504 of the Rehabilitation Act of 1973 is not obviated or affected by any State or local law.

Appendix A

Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures

Tyler Ley (PI) – Oklahoma State University and Jason Weiss (Co-PI) – Purdue University

1.0 Introduction and Background

Concrete can be damaged when it is 1) sufficiently wet (has a high degree of saturation) and 2) exposed temperature cycles that enable freezing and thawing. The damage that occurs due to freezing and thawing can lead to premature deterioration, costly repairs, and premature replacement of concrete infrastructure elements. Current specifications for frost durability are largely based on work completed in the 1950s, and while this work included many landmark discoveries (Kleiger 1952, 1954) it may not be completely representative of materials used in modern concrete mixtures. Further, the majority of current frost damage studies investigate freezing and thawing in water. While it is known that the presence of salts alters the freezing behavior, little research on frost damage is performed on air entrained concrete in salt water other than scaling studies. While the use of water greatly simplifies the system, it is not the most representative of what occurs on America's bridges and highways. Results from recent studies suggest that there are several ways in which frost damage can be reduced through new tests and improve specifications that can lead to extended service life of concrete infrastructure. A brief summary of some of these findings and their relation to this proposal is provided below.

The conventional approach that is used to improve the frost durability of concrete is with the addition of an air entraining admixture (AEA) while the concrete is mixed. The AEA creates small well-dispersed air filled bubbles in the fresh concrete. Current theories hypothesize that bubbles act as pressure relief reservoirs for water to move during freezing. These air bubbles also decrease the degree of saturation in the concrete (Li et al. 2011). Because a large number of variables during the batching, mixing, and placement impact how AEAs perform in concrete, it can be challenging to provide a consistent air void system in hardened concrete in practice. Task 1 will review the most relevant findings from the literature and use that information to develop a testing matrix. This work will include information on how certain binders and admixtures may be incompatible in some circumstances. For example, research by Sutter at Michigan Tech has investigated the role of fly ash on air entraining dosage and research by PI Ley has shown that current frost damage specifications may not always be adequate for mixtures with some modern water reducers. After the test matrix is developed the samples will be created in Task 2. The samples will be used throughout the testing for the remainder of the study to enable the various tasks to be compared. Specifically, the work will take advantage of novel techniques that have been developed to measure the quality of the air system. A novel method that has been developed to accurately measure void systems in fresh field concrete will be used in Task 3. An AASHTO standard will then be prepared and submitted in Task 4. Further, advanced experimental tools have been developed to study the three dimensional distribution of air in hardened concrete. For example, X-ray tomography based techniques can be used to image the 3D distribution of voids (Ley et al, in development) (Task 5). While these novel tests show great promise they will be compared with more conventional tests like two dimensional air void analysis and freeze-thaw testing to provide measures that relate these mixtures to measurements that are more commonly used today (Task 6).

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Additional research has investigated the role of absorption and saturation in the freezing process and how this behavior may change in the presence of deicing salts. It has been suggested that the freeze-thaw behavior of concrete can be related to the rate at which the concrete absorbs water and reaches a critical degree of saturation (Fagerlund 2004, Yang et al. 2006, Li et al. 2011). It has been proposed that once the critical degree of saturation is reached the sample begins to crack and the stiffness degrades rapidly. While this initial work has been fruitful, there is a great opportunity to explore the influence of the quality of the air system on the rate of water absorption and degree of saturation or the relationship between the quality of the air system and the critical degree of saturation (i.e., the degree of saturation where damage begins to occur). This proposal will explore these aspects of water and salt water absorption (and desorption) in concrete with different air entraining systems in Task 7 and 8 respectively. The purpose of this testing is to aid in providing tests that may be faster to perform than ASTM C 666 and more directly related to the mechanisms responsible for damage. It should also be noted that relatively little information has been developed on the rate of stiffness degradation in concrete that has reached different degrees of saturation. This work will build on earlier findings that suggest that the rate of damage development can be related to fracture based concepts (Fagerlund 2004 and Yang et al. 2006). This work will be done using passive acoustic emission testing and active wave speed change measurements in samples undergoing damage that have differing entrained air parameters. This work is described in Task 9.

2.0 Background

The goal of the research is to produce improved specifications, and test methods; while, improving the understanding of the underlying mechanisms of frost damage. Specifically, this work will seek to develop new test procedures that may be faster and/or more reliable than the existing methods. The objectives of this project are:

- Determine the necessary properties of the air-void system to provide satisfactory frost durability in laboratory testing of laboratory and field concretes with different combinations of admixtures, cements, and mixing temperatures in salt environments
- Determine the accuracy of a simple field test method that measures air void system quality with field and laboratory concrete
- Determine the critical combinations of absorption and the critical degree of saturation on the frost durability in accelerated laboratory testing in the presence of deicer salts
- Establish new test methods and specifications for fresh and hardened concrete to determine frost durability and field performance

Understanding the research on freeze-thaw mechanisms is important for two main groups: 1) practicing professionals and 2) graduating undergraduate and graduate students. A portion of this project will be dedicated to development of a strong educational technology transfer program. The PI's propose the development of a short course that utilizes streaming video (and could be placed on a DVD for widespread dissemination). Practicing professionals frequently require information in a short time frame to respond to practice-based problems. The DVD/streaming video approach provides the information as it is needed and as such it is perfect for this application. The technology transfer is described in Task 10.

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3.0 Research Approach

To accomplish the work described in section 2 a series of ten tasks will be performed as described in the following sections.

Task 1: Literature Review and Development of the Testing Matrix (OSU and Purdue)

The volume of air required in modern concrete specifications is based on testing completed at PCA over 60 years ago (Kleiger 1952, 1954). While this work has served the concrete industry well, the work did not investigate cements with different alkali contents, modern AEAs, combination of admixtures and mixtures containing supplementary cementitious materials (SCMs). Recent work by Felice et al. (2012) has shown that air contents of 3.5% in the concrete or 11.5% in the paste may be sufficient for frost durability in the rapid freeze thaw test (ASTM C 666) for mixtures that only use modern air entraining agents. However, this same research showed that when mid range water reducers (WRs) were used in combination with AEAs that higher volumes of air were needed to produce frost durable mixtures. Additional work has shown that mixtures with polycarboxylate (PCE) superplasticizers rapidly lose entrained air over time when they sit statically (Freeman et al. 2012). It was common for mixtures with PCE and AEAs to lose 50 to 60% of the total volume of air 30 minutes after mixing under no agitation. The air void systems with PCE were also found to be coarser than mixtures with only an AEA. This means that a larger volume of air content is needed to obtain frost durability. Mixtures with air contents as high as 7% were not frost durable when PCEs and AEAs have been used in combination. This finding highlights how current air volume specifications are inadequate to solely provide guidance for frost durability. Improved specifications are needed to provide guidance on how to best produce frost durable concrete with these modern admixtures.

Work is needed to understand how cements of different alkali content, different mixing temperatures, and types of mixing impact the air entrainment system and subsequently the frost durability of concrete. These variables can lead to changes in AEA effectiveness and their impact needs to be quantified with ASTM C 666 testing. As part of this task we will work with our project oversight committee to establish a set of materials and a testing matrix that can be used for the entire study. The decisions used in developing this test matrix will be made based on literature review, previous research by the PIs and the needs identified by the study advisory discussions.

Task 2: Sample Preparation (OSU and Purdue)

All of the samples for the testing will be prepared at Oklahoma State University. This will allow the materials for the testing to come from a single mixture. Students from Purdue will come to Oklahoma to assist with the mixing, sampling and testing. In addition the researchers plan to work with a local ready mix plant in Oklahoma to replicate several laboratory mixtures with field concrete. This will be a valuable technique to compare the differences in mixing energy and methods. While this cannot be done with all mixtures, it can be completed with a subset of the data. The research team plans to develop approximately eighty mixtures and complete ASTM C666, ASTM C457, saturation, and damage, fresh air quality measurements, etc., on each mixture. This work will have a focus on performance of specimens in salt solutions.

Task 3: Validation of the Super Air Meter (OSU)

Recent research at OSU has led to the development of a new testing device that is able to measure the quality of the air-void system in fresh concrete. This device has been named the Super Air Meter or SAM. The device and sample preparation has many similarities to the ASTM C231 pressure meter. Higher pressures and a larger number of pressure events are used to determine the volume, and quality of the void distribution within fresh concrete. The test takes less than 10 minutes to run and interpretation of the data is very straight forward. The test has been validated with 50 laboratory tests

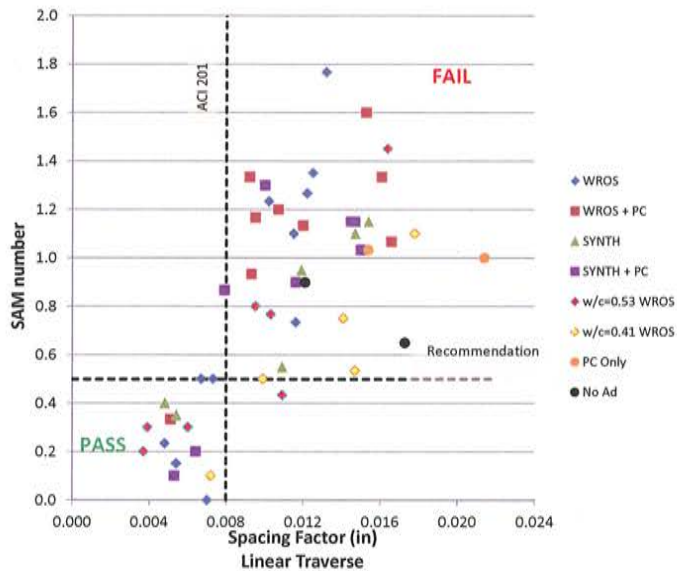


Figure 1 – The SAM number versus the spacing factor from ASTM C457.

that used different slump, w/cm, paste volume, AEA types, and combinations of admixtures. A correlation between the data from the gage and the spacing factor from ASTM C 457 is shown in Fig. 1.

While laboratory validation is important, much more work needs to be done to look at different combinations of the materials and to look at field mixtures. As part of this research the meter will be used on all laboratory and field specimens created and compared to the hardened air void analysis (ASTM C 457).

In addition meters will be provided to a number of research partners that will use the meters to measure fresh concrete and then compare with hardened concrete measurements.

Task 4: Creation of an AASHTO Test Method and Specification for the SAM (OSU)

All of the data will be compiled in order to create an AASHTO test method and specification for the SAM as a test method. This will be drafted in the first year of the project and continued efforts will be made to see this through the approval process.

Task 5: Use of X-Ray Tomography of Air Voids and Frost Damage (OSU)

Researchers at OSU have developed nondestructive techniques to examine microscopic air voids in fresh and hardened concrete by using a X-ray micro computed tomography (mCT) scanner. This is a powerful technique that allows measurements to be made not previously possible. The research team has developed techniques to image water movements and have access to a freezing stage. With this stage samples can be imaged while they are being frozen and any subsequent damage can be imaged. Images showing the void distribution and frost damage are shown in Fig. 2.

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By combining this information about the void distribution, the moisture content and distribution, and then being able to image the damage that occurs from freezing is a powerful tool. These observations can lead to ground breaking insights into the mechanisms of frost damage and how it can be avoided. Samples for the mCT testing and investigation will be created from each concrete mixture. However not all of them will be investigated. Instead a subset of important mixtures will be examined in order to obtain better insights into the damage mechanisms.

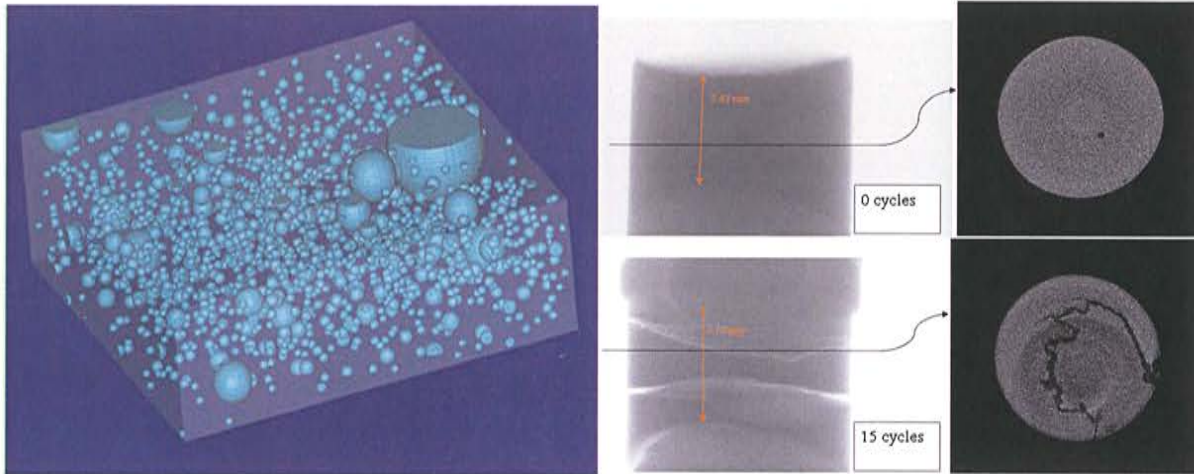


Figure 2 – The image on the left shows the 3D void distribution within paste. The image on the right shows a specimen that has been scanned before and after freezing and thawing cycles. The damage of the sample is shown by the cross section views.

Task 6: ASTM C 666 (OSU)

The primary test method used to investigate the frost durability of the concrete will be the ASTM C666 test. This test is the most widely recognized test to investigate the rapid deterioration from freezing and thawing. Every mixture will be investigated with this test to check the frost durability. For some mixtures a modified version will be used where the samples are soaked in salt solutions during freezing and thawing. Between the two research teams there are four ASTM C666 chambers available for testing. As part of this task the specimen absorption and desorption of the samples will be investigated using a modified form of ASTM C1585. The impact of wetting and drying will also be investigated. While the team realizes that the ASTM C666 is a well-respected test they feel that the three months required to complete the test is too long. The research team plans on using this information to help find a shorter test with the same rigor.

Task 7: Absorption and Desorption (Purdue)

Water (fluid) ingress is a primary factor that influences freeze-thaw damage in concrete. While the fluid content in concrete can be quantified in several different ways, this work will chose to define the water content in terms of the degree of saturation (S) as the ratio of the absolute volume of absorbed water to the total volume of pores (i.e., the total volume of water that can be absorbed by concrete). Recent work by Li et al. (2011) illustrates that entrained air content influences the rate at which the concrete

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reaches a given degree of saturation (the air content is given for these mixtures in terms of the volume of air in the paste 13 and 31% respectively) as shown in Figure 3. However, it should be noted that the quality of the air void system has not been considered in this analysis. It is recognized however that the initial slope (i.e., the slope during the first 6 hours) is influenced by the rate at which water is absorbed due to capillary action and the secondary slope (i.e., the slope after 24 hours) is influenced by the rate of gas diffusion out of the sample. It can be seen that for all of the samples investigated that the samples with higher air contents did not reach the same level of saturation as the samples with the lower air content. However, these rates have not been widely related to a wide range of mixture compositions and mixture designs.

During Task 7 the research team will perform desorption/sorption analysis on the mixtures prepared in Task 2. To obtain the sorption-desorption isotherms an automated sorption-desorption analyzer (TGA Q5000) will be used. To perform the absorption test a 50 to 70 mg mortar sample will be placed in the analyzer at a constant temperature ($23.0 \pm 0.1^\circ\text{C}$) and the relative humidity will be increased 10% RH increments while recording the mass. With this technique a RH between 0% and 98% can be generated. In addition, a series of experiments will be performed to determine the absorption and drying behavior of these materials. For the absorption tests 100 mm diameter samples will be used that are 50 mm in thickness. These samples will be dried in both a 50% and 65% RH environment while their mass is recorded until the samples approach equilibrium. Additional testing will be performed to condition the samples using a vacuum oven to explore the potential for accelerating these tests. The samples will then be placed in fluid according to a modified version of ASTM C 1585 to determine the degree of saturation over time. In addition, the complete degree of saturation will be determined using vacuum saturation. It has also been shown (Spragg et al 2012, Villani and Weiss 2012) that salt can alter the drying and wetting processes substantially. Select deicing solutions will be investigated in this test.

The data from this test series will be used to determine: 1) the influence of entrained air quality on

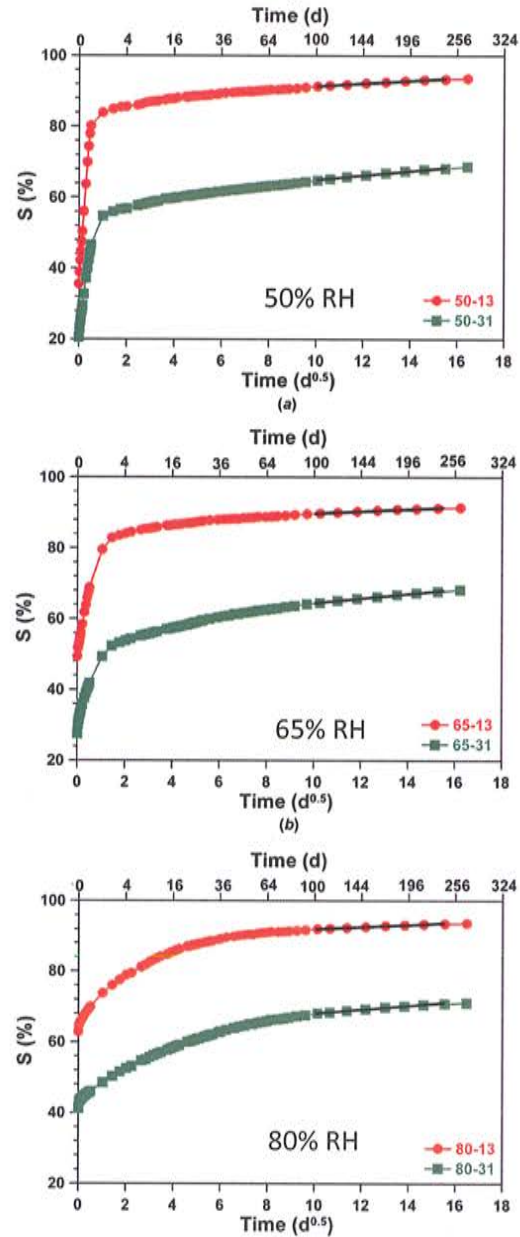


Figure 3 - Results of sorption test provided as increase in the degree of saturation: (a) 50% RH (b) 65% RH (c) 80% RH (from Li et al. 2011). The green lines denote 31% air volume in the paste while the red lines denote 13% air volume in the paste.

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the degree of saturation at 6 hours, 2) the influence of entrained air parameters and conditioning on the time to reach a critical degree of saturation, 3) the influence of entrained air parameters on the desorption isotherm, 4) the potential for using combinations of these tests to develop a rapid freeze-thaw test. This test could allow the frost durability of a test to be investigated in a few days rather than the three months required with ASTM C666. Results from these tests will be related to ASTM C666.

Task 8: Degree of Saturation and Damage Development (Purdue)

As mentioned in Task 7 recent research by Li et al. (2011) has shown that the entrained air content delays the time it takes for concrete to reach a critical degree of saturation, however it will not prevent the freeze-thaw damage from occurring. The results of the experiments show that when the degree of saturation exceeds 86 to 88% freeze-thaw damage is inevitable with or without entrained air, even with very few freeze-thaw cycles. Figure 4 illustrates the damage (the relative reduction in stiffness during each freeze thaw cycle) as a function of the degree of saturation. It can be noticed that as the degree of saturation increases so does the rate of damage development; however, once the degree of saturation reaches a value of 86% or below the samples effectively remain undamaged. It is interesting to note that this degree of saturation was not influenced by the volume of air that was used in these systems. It can however be speculated that this value can be influenced by the quality of the entrained air system.

It is proposed that samples prepared in Task 2 will be saturated to different degrees of saturation and the free-thaw tests will be performed with the samples in a sealed condition. Results from this test will be used to identify the critical degree of saturation with the express purpose of relating the critical degree of saturation to the quality of the entrained air system (for example the air void spacing). Information from this test will be used in conjunction with the results from Task 7 to determine if the air void system alters the time required to reach a critical degree of saturation.

The data from this test series will be used to obtain information regarding: 1) the influence of entrained air parameters on critical degree of saturation requires for freeze thaw damage, 2) the influence of entrained air parameters and conditioning on the time to reach a critical degree of saturation (e.g., for the critical saturation level) and 3) the data that will be used for Task 9.

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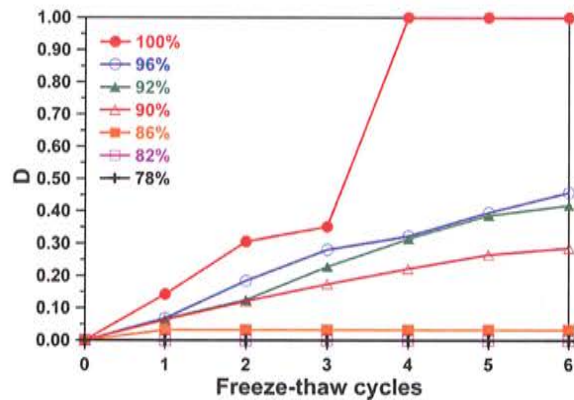


Figure 4 – Increase in Damage (1- current dynamic modulus / original dynamic modulus) with freeze-thaw cycles.

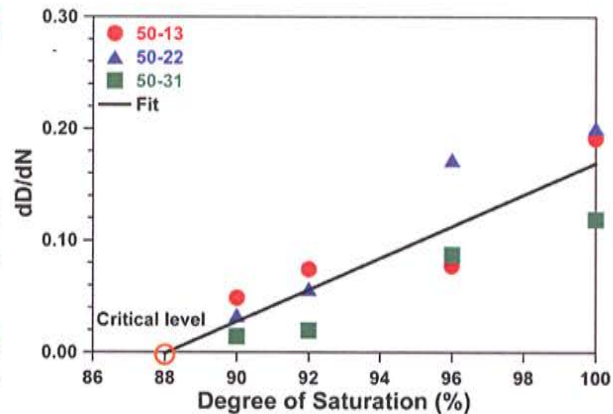


Figure 5 - Rate of dynamic modulus decrease with degree of saturation.

Task 9: Rate of Damage Analysis (Purdue)

Acoustic emission data obtained from Task 8 will be used to quantify the damage that occurs on each freezing cycle. In general the acoustic events can be attributed to micro-cracking of the specimen due to either damage from ice formation or a result of thermal expansion coefficient mismatch between the paste and aggregate. It has been proposed that the significant number of acoustic events in the first cycle compared to the second cycle is due to the thermal mismatch. The damage due to thermal mismatch should be separated from damage due to ice damage. In general it is believed that the damage that occurs due to ice only begins below a critical temperature (e.g., below -8°C). This is consistent with the observation that pore solution freezes below 0°C due to pore confinement and dissolved ions in pore solution. However the absorption of deicing salt will alter this value (Qian and Weiss in preparation) and could play a significant role in the severity of damage that occurs when deicing is present. To better understand how these findings can be related to one another to predict freeze-thaw damage the data will be used to expand on a fracture based model developed by Sellevold and expanded by Yang et al. (2006). The results will investigate whether the cracking behavior is substantially different in the systems with entrained air compared to non-air entrained systems and determine how the quality of the air void system impacts the results. This will investigate whether the air entrainment only influences the degree of saturation or if it also impacts the rate of damage development.

In addition to the acoustic emission data, researchers at Oklahoma State, Purdue and NIST (Weiss et al in preparation) have been using X-ray tomography to examine the cracks that form during freezing. The benefit of this approach is that the acoustic emission data can be correlated back to physical damage. Previous studies have been done by placing the sample in the x-ray system before and after freezing however it is possible to observe the samples while they are freezing using a cold stage at OSU. Examples of a typical image from the OSU work are shown in Fig. 2 where cracking is observed after 15

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cycles. This work will enable the role of deicing salts to be more clearly understood. The data from this test series will be used to determine if a fracture model can describe the rate of freeze-thaw damage development. This has the potential to be used in service life models that describe the life cycle of concrete using the rate of saturation, the degree of saturation, and the quality of the air void system with the goal of providing deterministic predictions on life cycle performance. Predictions from this model will be compared to the response obtained in Task 6. In addition, this work will be used with data on saturation and temperature obtained from field sites to predict the performance of concrete over time in those sites.

Task 10: Technology Transfer (OSU and Purdue)

A portion of this project will be dedicated to development of a strong educational technology transfer program. The PI's propose the development of a short course that utilizes streaming video (and could be placed on a DVD for widespread dissemination).

Understanding the research on freeze-thaw mechanisms is important for two main groups: 1) practicing professionals and 2) graduating undergraduate and graduate students. Practicing professionals frequently require information in a short time frame to respond to practice-based problems. The DVD/streaming video approach provides the information as it is needed and as such it is perfect for this application. Further, the users may repeat or replay the lecture as needed as well as select the sections that are of greatest benefit.

The PI's will request RILEM to include this course in the offerings of their educational activities committee series, thereby potentially garnering interest from European students. To date, RILEM has offered approximately twelve courses annually aimed at graduate students and they have been very well received. The PI's will also distribute announcements of this program through the ACI faculty network and the Center for Advanced Cement-Based Materials network to reach the widest audience. A class size of twenty five to thirty graduate students will be targeted for this course.

In addition to the value of the live lectures, the course will be recorded with the assistance of the Purdue Professional Education department and will be added to a series of courses that are currently available on DVD. This will enable future students to have the benefits of this very in depth lecture series. Laboratory exercises will also be taped for future users. It is also conceivable that in the future, students could take this course for credit through the distance learning program for a nominal fee.

Task 11: Final Report (OSU and Purdue)

The final task of this research will focus on the development of a final report that highlights the findings on how the properties of the air void system can be related to performance. Information will be presented that will discuss how the industry should consider modifications to current tests and specifications that can take advantage of these findings.

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Budget

The estimated budget is \$590,000 for a 36 month project. The budget for Purdue will be \$235,000 and OSU's budget will be \$355,000. The project will be directed by Tyler Ley of Oklahoma State and Dr. Jason Weiss of Purdue University. Peter Taylor of Iowa State and Larry Sutter of Michigan Tech will also serve as technical advisers on the project and will be paid on OSU's budget. Please see budget and budget narrative for details.

Schedule

calendar year	2014												2015												2016											
project year	Year 1												Year 2												Year 3											
calendar month	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
months from the start of project	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1 - literature review and test matrix	[shaded]																																			
2 - sample preparation	[shaded]																																			
3 - validation of SAM	[shaded]																																			
4 - AASHTO test method	[shaded]																																			
5 - mCT work	[shaded]																																			
6 - rapid freeze thaw testing	[shaded]																																			
7 - absorption and desorption	[shaded]																																			
8 - degree of saturation and damage	[shaded]																																			
9 - rate of damage analysis	[shaded]																																			
10 - technology transfer	[shaded]																																			
11 - final report	[shaded]																																			

Facilities at OSU

Currently facilities at Oklahoma State University include more than 11,500 square feet in the Civil Engineering Laboratory building devoted to concrete materials research.

Included in the laboratory facilities is a concrete materials laboratory that is approximately 2,000 square feet of space devoted to evaluating the material properties and durability of concrete. Concrete testing equipment include multiple freeze-thaw cabinets, a 1000 cubic feet walk-in curing room, a 500-kip Admet automated compression machine, and an 11-kip flexure testing machine. This room contains 6 ovens that are used for accelerated testing. Two Hobart mixers are also contained in this room to create paste samples. An automated coefficient of thermal expansion measurement device is also available as well as a number of water baths. The room also contains two automated sieve machines.

The facilities also include a concrete mixing room that is approximately 3,000 square feet. This room is temperature controlled and contains a state of the art dust collection system, concrete waste recycling, and water purification. The large floor space gives an exceptional amount of space to create specimens. The lab has a large collection of standard concrete testing equipment as well as two concrete drum mixers (5 CY and 12 CY) and a concrete pan mixer (4 CY). An automated concrete polishing system is contained in this room as well as a chloride profile grinding setup.

In addition there is 1,500 square feet devoted to the environmental testing of concrete specimens. These facilities contain three large walk in environmental chambers that are temperature and humidity controlled. These chambers allow for accelerated durability testing or conditioning of samples to be completed. A 1,000 square foot light microscopy facility containing two stereomicroscopes with high resolution digital cameras and an automated ASTM C 457 rapid air system is also controlled by the PI.

Appendix A

X-ray Micro Computed Tomography

PI Ley is the primary custodian and operator for a SkyScan 1172 mCT scanner contained in 1000 square feet of shared space in the Advanced Technology Research Center. This equipment uses a Rubidium X-ray tube to supply a 10 Watt beam with up to 100 KeV. The system has four different filters that can allow for X-rays from different energy levels to be excluded from the results. This allows materials of different densities to be imaged clearly. The equipment has the ability to image items at a scale of 1 micron. The following experimental stages are able to be used inside of the mCT:



1172 mCT scanner

compression, tension, freezing, chemical dissolution, and air pressurization. Images can be taken, before, after and while interacting with the stage.

A number of software packages are used in combination with the equipment to reconstruct, process, and analyze the data produced from a scan. Some of this software is commercially available but much of it has been produced by the PI and his team as existing software did not exist for these applications. This software is run on a four workstation network in the PIs high processing computer facilities.

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Facilities at Purdue

The proposed research will be conducted in the following facilities, all located in the building of the School of Civil Engineering:

- (i) Materials Characterization Laboratories
- (ii) Environmental Simulation Laboratories
- (iii) Concrete Preparation Laboratories

Materials Characterization Laboratories – Purdue currently houses the Pankow Concrete Materials Laboratory and sensing and simulation laboratories. These laboratories are well equipped for supporting studies in atomic force microscopy, scanning electron microscopy, optical and petrographic microscopy, differential scanning calorimetry, thermogravimetric analysis, x-ray diffraction, x-ray absorption tomography, ion chromatography, mercury intrusion porosimetry, image analysis, atomic absorption analysis and flame spectroscopy. The laboratory can support a wide range of additional chemical and physical chemistry measurements for assessing material characteristics and durability.

Environmental Simulation Laboratories – Purdue has a well equipped laboratory that can be used to assess the durability of materials when they are exposed to water, freezing and thawing, changing relative humidity, and temperature. This includes over ten small bench top chambers as well as four walk-in chambers. In addition, Purdue is currently conducting a renovation that will include approximately 5,000 sq. ft. of lab space. A major feature of this laboratory will be programmable, environmental, and exposure simulation chambers.

Concrete Preparation Laboratories – Purdue has a well equipped laboratory for preparing and curing paste, mortar and concrete specimens. Aggregate can be characterized, crushed, sieved, tested and reassembled. Concrete mixtures can currently be prepared in a 2500 sq. ft lab and additional mixing and sample preparation space will become available during the upcoming laboratory renovation. A full range of testing equipment is available to determine mechanical and durability properties.

Biographical Information

Tyler Ley is an Associate Professor of Civil and Environmental Engineering at Oklahoma State University. He earned his B.S. from Oklahoma State University and a MS and PhD from the University of Texas in 2007. In addition he has work experience with the Texas Department of Transportation for 2.5 years, a small consulting firm, and with Zachry Construction. His research focus has been on concrete durability with an emphasis on freeze thaw behavior, as well as using innovative experimental and imaging techniques to examine physical and chemical changes. Dr. Ley has taught courses in Concrete Materials, Concrete Durability, and other structural design courses. He has received several teaching awards including the OSU Chi Epsilon teacher of the year and the Haliburton College of Engineering teaching award. Dr. Ley is a member of ACI, ACerS, and is on the executive board of the National Concrete Consortium. Dr. Ley received the NSF Career award in 2012. He is also the author of

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“HydrationTheater.com”, an interactive website about cement hydration that has received over 2,000 visits.

Jason Weiss is a Professor of Civil Engineering and Director of the Pankow Materials Laboratory at Purdue University. He earned a B.A.E. from the Pennsylvania State University and a MS and PhD from Northwestern University in 1999. He is actively involved in research on cement and concrete materials specifically focused on early age property development, cracking, transport in concrete, and concrete durability. Dr. Weiss has taught courses in civil engineering materials, concrete materials, service life, repair and non-destructive testing. His primary research interests are in the area of early age shrinkage cracking and mitigation as well as service life sensing and prediction. Dr. Weiss is a member of the American Concrete Institute (Past Chair of ACI 123), American Society of Civil Engineers, RILEM (Bureau Member, Past TAC member, TC CCD chair), Transportation Research Board (AFN 040 Chair), and American Society for Testing and Materials. He is editor in chief of the RILEM Materials and Structures Journal in 2012 and is an associate editor of the ASCE journal of Civil Engineering Materials and is a member of the editorial board of cement and concrete research. Dr. Weiss has authored over 200 publications with over one hundred peer-reviewed journal articles. He is recipient of the NSF Career Award, the RILEM L'Hermite Medal, the ACI W. P. Moore, ACI Young Member, and ACI Wason Awards, the ESCSI Erskine Award, the TRB Burgraff and Mather Awards for outstanding research and publications, and the ASCE Huber Award. He is a fellow of ACI and is also the recipient of the Wansik, Munson, Buck, and Burke awards for outstanding teaching/advising in the school of civil engineering, has received the Potter award for outstanding teaching in the college of engineering, and has been inducted into the Purdue Teaching Academy.

Appendix A

TABLE I. OVERALL PROJECT BUDGET

Project Title: Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures

PROPOSAL NUMBER: EN 14-RS-157
Principal Investigators: Tyler Ley, Associate Professor (PI)
Institution: College of Engineering, Architecture and Technology
 Oklahoma State University
Starting Date: March 1, 2014 (contract will cite official date)
Duration: 36 Months

BUDGET SUMMARY	Description	Year One Sponsor	Year Two Sponsor	Year Three Sponsor	Total Sponsor
1. Salaries	Detailed at Table II	\$48,659	\$58,553	\$60,310	\$167,522
2. Employee Benefits* & FICA	Detailed at Table II	\$13,126	\$17,037	\$18,074	\$48,237
3. Travel	Attend meetings, conferences	\$3,000	\$3,000	\$3,000	\$9,000
4. Materials & Supplies	Laboratory supplies	\$4,946	\$4,000	\$4,000	\$12,946
5. Instrumentation & Equipment	Non-inventory equipment items	\$5,000	\$6,246	\$4,819	\$16,065
6. Communications	Long distance, Fed-Ex, fax, etc.	\$0	\$0	\$0	\$0
7. Publications	Duplication, copies, reproductions, etc.	\$0	\$0	\$0	\$0
8. Services (Repair shop, Physical Plant, etc...)		\$0	\$0	\$0	\$0
9. Contractual Services	Iowa	\$3,500	\$3,500	\$3,500	\$10,500
10. Contractual Services	Michigan Tech	\$3,465	\$3,465	\$3,465	\$10,395
MODIFIED TOTAL DIRECT COSTS (MTDC)		\$81,696	\$95,801	\$97,168	\$274,665
11. F&A Costs**	45.8% of MTDC	\$37,417	\$43,877	\$44,503	\$125,797
Waived F&A Costs**	19.8% of MTDC	(\$16,176)	(\$18,969)	(\$19,239)	(\$54,384)
12. Equipment	Items greater than \$5,000	\$8,922	\$0	\$0	\$8,922
13. Tuition (Graduate Student Support)	0.00% of Grad Std Salary	\$0	\$0	\$0	\$0
TOTAL PROJECT COSTS		\$111,859	\$120,709	\$122,432	\$355,000

*OSU's fringe benefit rates are negotiated annually with the Office of Naval Research (ONR) and the actual negotiated rate, at the time of expenditure, will be used if awarded.

**OSU negotiates the F&A rate with the Office of Naval Research (ONR) and the actual negotiated rate, at the time of award, shall be used if awarded.

TABLE II. SALARIES, WAGES AND EMPLOYEE BENEFITS

Name/Position	Base Pay Rate	Number Months	Percent Time	Year One Sponsor	Year Two Sponsor	Year Three Sponsor
Tyler Ley, Associate Professor (PI)						
Sponsor - 1 summer months @ 50%	\$10,918	1	50%	\$5,459	\$0	\$0
Sponsor - 1 summer months @ 100%		1.25	100.00%	\$0	\$14,057	\$14,479
Year 1 benefits calculated at the rate of 35.81%				\$1,955	\$5,185	\$5,501
Subtotal, Senior Personnel				\$7,414	\$19,242	\$19,980
Lab Manager		1				
Sponsor - 12 months @ 50%	\$3,800	12	50%	\$22,800	\$23,484	\$24,189
Year 1 benefits calculated at the rate of 41.36%				\$9,431	\$10,006	\$10,615
Subtotal, Post Doc Fellow				\$32,231	\$33,490	\$34,804
Graduate Research Associates		1				
Sponsor - 12 months @ 50%	\$3,400	12	50%	\$20,400	\$21,012	\$21,642
Year 1 benefits calculated at the rate of 8.53%				\$1,740	\$1,846	\$1,958
Subtotal, Graduate Students				\$22,140	\$22,858	\$23,600
Graduate Student Salary - for use in calculation of Tuition Support				\$20,400	\$21,012	\$21,642
Total Salaries and Wages				\$48,659	\$58,553	\$60,310
Total Employee Benefits				\$13,126	\$17,037	\$18,074
Total Salaries, Wages and Employee Benefits				\$61,785	\$75,590	\$78,384

Appendix A

Budget Justification

SENIOR PERSONNEL—

Support is requested for Dr. Tyler Ley at one summer month at 100% time effort. Dr. Ley will oversee the research efforts on the project, and directly supervise the work at OSU. He will be the primary author on the quarterly and final reports. Time is also budgeted to work with AASHTO leadership to prepare relevant test methods.

OTHER PERSONNEL—

Support is requested for one staff member and one graduate student for this project. The support for the staff member, Jake LeFlore, Laboratory Manager, is requested at 50% time effort over twelve months. Mr. LeFlore will be responsible for assisting in gathering materials, organize and facilitate testing, support the graduate student in their day to day responsibilities. He will be instrumental in the field testing required.

The support for one graduate research associate (PhD) is requested at 50% time effort over twelve month. The student will complete all necessary testing, analyze the data, and assist in preparing the reports.

FRINGE BENEFITS—

Fringe benefits are for health care and other benefits for the employees, faculty and students. Fringe benefit rates are negotiated annually with the Office of Naval Research and will be adjusted accordingly. The University has submitted a new proposal rate which is expected to supersede the current provisional rate effective July 1, 2014 and will use the current rate for the work performed for this project. The benefit rates used for this proposal are for faculty members is 35.81%, the staff member rate is 41.36%, and the graduate student benefit rate is 8.53%.

As per Oklahoma State University policy there is an annual increase of 3-percent estimated for years after the first for each employee's salary and benefits. The University will document employees' time based on percent of effort. The salaries shown are the same as would be paid for performing University functions.

EQUIPMENT—

It is anticipated that funds from this project will be used to purchase a new ASTM C 666 freeze thaw chamber from Humboldt. This will be important to the research as a number of freeze thaw tests must be completed.

TRAVEL—

Funds are requested for the PIs and students at OSU to travel to national conferences. \$3,000.00 is budgeted for each of the three years in this project. This money will be used to attend either the National Concrete Consortium meeting or the Transportation Research Board in Washington DC. Presentations over the progress of the project and face to face meetings will be held. At this time it is not clear where the meetings will be held. However, the costs used are estimated in the best judgment of the PI for airfare, registration, per diem, and transportation to the meetings. Travel expenses will be reimbursed at rates consistent with Oklahoma State University's approved policies and will not exceed the greater of approved State or Federal rates.

Appendix A

MATERIALS AND SUPPLIES—

Materials and supplies are budgeted to \$16,065.00 for this project. The Materials and Supplies will cover the materials necessary to create, test, and evaluate the materials. This line item will also be used to pay for equipment usage costs. Some examples include testing, hardened air void analysis, compression testing, etc. It is anticipated that portable workstations will be necessary to purchase in order to store the large volume of data produced by the X-ray micro computed tomography. These portable workstations will be needed to gather extensive data from the field locations and qualifies as a Cost Accounting Standard (CAS) exception under the “Special Purpose or Circumstance” provision.

CONTRACTUAL SERVICES—

Funds are requested in the amount of \$10,500.00 for the services provided by Iowa State University. Dr. Peter Taylor will provide technical review of reports and attend conference calls.

Funds are requested in the amount of \$10,395.00 for the services provided by Michigan Tech. Dr. Larry Sutter will provide technical review of reports and attend conference calls.

TUITION—

Tuition is waived for this project by ODOT.

INDIRECT COSTS (F&A)— \$ 71,413.00

The allowable Facility & Administrative Cost rate for on-campus research is 45.8-percent of Modified Total Direct Costs (MTDC) until further amended. This is the predetermined rate negotiated with Oklahoma State University by the Department of the Navy, Office of Naval Research, 800 North Quincy Street, Arlington, VA, 22217-5660, for the Federal Government. Facility & Administrative Costs are calculated on total direct costs less items of equipment, capital expenditures, charges for patient care and tuition remission, rental costs, scholarships, and fellowships as well as the portion of each subgrant and subcontract in excess of \$25,000. Fringe benefits applicable to direct salaries and wages are treated as direct costs.

ODOT limits indirect cost to 26% of MTDC. The amount of mandatory waived F&A is 54,384.00.

TOTAL PROJECT COSTS REQUESTED—\$ 355,000.00

CAS EXCEPTION—

Oklahoma State University’s (OSU) costing practices for sponsored agreements and contracts comply with Cost Accounting Standards (CAS) and the provisions of OMB Circular A-21 (Cost Principles for Educational Institutions). OSU filed a disclosure statement (pertaining to its cost accounting practices) to the Department of the Navy, Office of Naval Research, 800 North Quincy Street, Arlington, VA, 22217-5660, on May 24, 1996. With regard to Cost Accounting Standards (CAS), this project qualifies under the “special purpose or circumstance” provision. This CAS exception pertains to the materials and supplies line items which will be used for this project.

APPENDIX B

RESEARCH PROJECT DELIVERABLES

SECTION 1 **Monthly Project Progress Reports**

NOT APPLICABLE

SECTION 2 **Quarterly Pooled Fund Project Status Reports**

The CONTRACTOR P.I. shall submit detailed quarterly pooled fund project status reports to the DEPARTMENT M&R Division Research Project Engineer utilizing a format required by the Federal Highway Administration pooled fund guidelines for a lead state. Quarterly pooled fund project progress reports shall be submitted ten working days prior to the month end following each calendar quarter.

Failure to submit detailed quarterly pooled fund status reports as specified in this contract may result in the delay of final invoice processing.

SECTION 3 **Project Draft and Final Reports**

The CONTRACTOR P.I. must submit a draft of the Final Project Report to the DEPARTMENT M&R Division Research Project Engineer utilizing a format required by the DEPARTMENT on or before October 31st. DEPARTMENT comments concerning the draft Final Report will be returned to the CONTRACTOR P.I. on or before November 30th. The CONTRACTOR P.I. will respond to the review comments, if any, and will revise the draft Final Report, if necessary. The CONTRACTOR P.I. is required to submit to the DEPARTMENT M&R Division Research Project Engineer one (1) copy each of the project Final Report in Microsoft Word and ADA accessible Adobe Acrobat pdf electronic formats, in addition to the items listed in Appendix A, utilizing a format required by the DEPARTMENT on or before May 31st, 2017.

Failure to submit timely and accurate Final Reports as specified in this contract may result in the delay of final invoice processing and will affect future funding to the organization or awards for the same CONTRACTOR P.I.

NOTE: As described in Section 6 of this contract, should a NCTE be requested by the CONTRACTOR PI and approved by the DEPARTMENT, the dates mentioned above will be adjusted according to the 30, 60 or 90 day NCTE period.

APPENDIX C

STANDARD PATENT RIGHTS CLAUSE

The following is the standard patent rights clause to be used as specified in 37 CFR Sec. 401.3(a).

Patent Rights (Small Business Firms and Nonprofit Organizations)

(a) Definitions

(1) Invention means any invention or discovery which is or may be patentable or otherwise protectable under Title 35 of the United States Code, or any novel variety of plant which is or may be protected under the Plant Variety Protection Act (7 U.S.C. 2321 et seq.).

(2) Subject invention means any invention of the CONTRACTOR conceived or first actually reduced to practice in the performance of work under this contract, provided that in the case of a variety of plant, the date of determination (as defined in section 41(d) of the Plant Variety Protection Act, 7 U.S.C. 2401(d)) must also occur during the period of contract performance.

(3) Practical Application means to manufacture in the case of a composition or product, to practice in the case of a process or method, or to operate in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is being utilized and that its benefits are, to the extent permitted by law or government regulations, available to the public on reasonable terms.

(4) Made when used in relation to any invention means the conception or first actual reduction to practice of such invention.

(5) Small Business Firm means a small business concern as defined at section 2 of Pub. L. 85-536 (15 U.S.C. 632) and implementing regulations of the Administrator of the Small Business Administration. For the purpose of this clause, the size standards for small business concerns involved in government procurement and subcontracting at 13 CFR 121.3-8 and 13 CFR 121.3-12, respectively, will be used.

(6) Nonprofit Organization means a university or other institution of higher education or an organization of the type described in section 501(c)(3) of the Internal Revenue Code of 1954 (26 U.S.C. 501(c) and exempt from taxation under section 501(a) of the Internal Revenue Code (25 U.S.C. 501(a) or any nonprofit scientific or educational organization qualified under a state nonprofit organization statute.

(b) Allocation of Principal Rights

The CONTRACTOR may retain the entire right, title, and interest throughout the world to each subject invention subject to the provisions of this clause and 35 U.S.C. 203. With respect to any subject invention in which the CONTRACTOR retains title, the Federal government shall have a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States the subject invention throughout the world.

(c) Invention Disclosure, Election of Title and Filing of Patent Application by Contractor

(1) The CONTRACTOR will disclose each subject invention to the Federal Agency within two months after the inventor discloses it in writing to CONTRACTOR personnel responsible for patent matters. The disclosure to the agency shall be in the form of a written report and shall identify the contract under which the invention was made and the inventor(s). It shall be sufficiently complete in technical detail to convey a clear understanding to the extent known at the time of the disclosure, of the nature, purpose, operation, and the physical, chemical, biological or electrical characteristics of the invention. The disclosure shall also identify any publication, on sale or public use of the invention and whether a manuscript describing the invention has been submitted for publication and, if so, whether it has been accepted for publication at the time of disclosure. In addition, after disclosure to the agency, the CONTRACTOR will promptly notify the agency of the acceptance of any manuscript describing the invention for publication or of any on sale or public use planned by the CONTRACTOR.

(2) The CONTRACTOR will elect in writing whether or not to retain title to any such invention by notifying the Federal agency within two years of disclosure to the Federal agency. However, in any case where publication, on sale or public use has initiated the one year statutory period wherein valid patent protection can still be obtained in the United States, the period for election of title may be shortened by the agency to a date that is no more than 60 days prior to the end of the statutory period.

(3) The CONTRACTOR will file its initial patent application on a subject invention to which it elects to retain title within one year after election of title or, if earlier, prior to the end of any statutory period wherein valid patent protection can be obtained in the United States after a publication, on sale, or public use. The CONTRACTOR will file patent applications in additional countries or international patent offices within either ten months of the corresponding initial patent application or six months from the date permission is granted by the Commissioner of Patents and Trademarks to file foreign patent applications where such filing has been prohibited by a Secrecy Order.

(4) Requests for extension of the time for disclosure, election, and filing under subparagraphs (1), (2), and (3) may, at the discretion of the agency, be granted.

(d) Conditions When the Government May Obtain Title

The CONTRACTOR will convey to the Federal agency, upon written request, title to any subject invention--

(1) If the CONTRACTOR fails to disclose or elect title to the subject invention within the times specified in (c), above, or elects not to retain title; provided that the agency may only request title within 60 days after learning of the failure of the CONTRACTOR to disclose or elect within the specified times.

(2) In those countries in which the CONTRACTOR fails to file patent applications within the times specified in (c) above; provided, however, that if the CONTRACTOR has filed a patent application in a country after the times specified in (c) above, but prior to its receipt of the written request of the Federal agency, the CONTRACTOR shall continue to retain title in that country.

(3) In any country in which the CONTRACTOR decides not to continue the prosecution of any application for, to pay the maintenance fees on, or defend in reexamination or opposition proceeding on, a patent on a subject invention.

(e) Minimum Rights to Contractor and Protection of the Contractor Right to File

(1) The CONTRACTOR will retain a nonexclusive royalty-free license throughout the world in each subject invention to which the Government obtains title, except if the CONTRACTOR fails to disclose the invention within the times specified in (c), above. The CONTRACTOR'S license extends to its domestic subsidiary and affiliates, if any, within the corporate structure of which the CONTRACTOR is a party and includes the right to grant sublicenses of the same scope to the extent the CONTRACTOR was legally obligated to do so at the time the contract was awarded. The license is transferable only with the approval of the Federal agency except when transferred to the successor of that party of the CONTRACTOR'S business to which the invention pertains.

(2) The CONTRACTOR'S domestic license may be revoked or modified by the funding Federal agency to the extent necessary to achieve expeditious practical application of the subject invention pursuant to an application for an exclusive license submitted in accordance with applicable provisions at 37 CFR part 404 and agency licensing regulations (if any). This license will not be revoked in that field of use or the geographical areas in which the CONTRACTOR has achieved practical application and continues to make the benefits of the invention reasonably accessible to the public. The license in any foreign country may be revoked or modified at the discretion of the funding Federal agency to the extent the CONTRACTOR, its licensees, or the domestic subsidiaries or affiliates have failed to achieve practical application in that foreign country.

(3) Before revocation or modification of the license, the funding Federal agency will furnish the CONTRACTOR a written notice of its intention to revoke or modify the license, and the CONTRACTOR will be allowed thirty days (or such other time as may be authorized by the funding Federal agency for good cause shown by the CONTRACTOR) after the notice to show cause why the license should not be revoked or modified. The CONTRACTOR has the right to appeal, in accordance with applicable regulations in 37 CFR part 404 and agency regulations (if any) concerning the licensing of Government-owned inventions, any decision concerning the revocation or modification of the license.

(f) Contractor Action to Protect the Government's Interest

(1) The CONTRACTOR agrees to execute or to have executed and promptly deliver to the Federal agency all instruments necessary to (i) establish or confirm the rights the Government has throughout the world in those subject inventions to which the CONTRACTOR elects to retain title, and (ii) convey title to the Federal agency when requested under paragraph (d) above and to enable the government to obtain patent protection throughout the world in that subject invention.

(2) The CONTRACTOR agrees to require, by written agreement, its employees, other than clerical and non-technical employees, to disclose promptly in writing to personnel identified as responsible for the administration of patent matters and in a format suggested by the CONTRACTOR each subject invention made under contract in order that the CONTRACTOR can comply with the disclosure provisions of paragraph (c), above, and to execute all papers necessary to file patent applications on subject inventions and to establish the government's rights in the subject inventions. This disclosure format should require, as a minimum, the information required by (c)(1), above. The CONTRACTOR shall instruct such employees through employee agreements or other suitable educational programs on the importance of reporting inventions in sufficient time to permit the filing of patent applications prior to U.S. or foreign statutory bars.

(3) The CONTRACTOR will notify the Federal agency of any decisions not to continue the prosecution of a patent application, pay maintenance fees, or defend in a reexamination or opposition proceeding on a patent, in any country, not less than thirty days before the expiration of the response period required by the relevant patent office.

(4) The CONTRACTOR agrees to include, within the specification of any United States patent applications and any patent issuing thereon covering a subject invention, the following statement, "This invention was made with government support under (identify the contract) awarded by (identify the Federal agency). The government has certain rights in the invention."

(g) Subcontracts

(1) The CONTRACTOR will include this clause, suitably modified to identify the parties, in all subcontracts, regardless of tier, for experimental, developmental or research work to be performed by a small business firm or domestic nonprofit organization. The subcontractor will retain all rights provided for the CONTRACTOR in this clause, and the CONTRACTOR will not, as part of the consideration for awarding the subcontract, obtain rights in the subcontractor's subject inventions.

(2) The CONTRACTOR will include in all other subcontracts, regardless of tier, for experimental developmental or research work the patent rights clause required by (cite section of agency implementing regulations or FAR).

(3) In the case of subcontracts, at any tier, when the prime award with the Federal agency was a contract (but not a grant or cooperative agreement), the agency, subcontractor, and the CONTRACTOR agree that the mutual obligations of the parties created by this clause constitute a contract between the subcontractor and the Federal agency with respect to the matters covered by the clause; provided, however, that nothing in this paragraph is intended to confer any jurisdiction under the Contract Disputes Act in connection with proceedings under paragraph (j) of this clause.

(h) Reporting on Utilization of Subject Inventions

The CONTRACTOR agrees to submit on request periodic reports no more frequently than annually on the utilization of a subject invention or on efforts at obtaining such utilization that are being made by the CONTRACTOR or its licensees or assignees. Such reports shall include information regarding the status of development, date of first commercial sale or use, gross royalties received by the CONTRACTOR, and such other data and information as the agency may reasonably specify. The CONTRACTOR also agrees to provide additional reports as may be requested by the agency in connection with any march-in proceeding undertaken by the agency in accordance with paragraph (j) of this clause. As required by 35 U.S.C. 202(c)(5), the agency agrees it will not disclose such information to persons outside the government without permission of the CONTRACTOR.

(i) Preference for United States Industry

Notwithstanding any other provision of this clause, the CONTRACTOR agrees that neither it nor any assignee will grant to any person the exclusive right to use or sell any subject inventions in the United States unless such person agrees that any products embodying the subject invention or produced through the use of the subject invention will be manufactured substantially in the United States. However, in individual cases, the requirement for such an agreement may be waived by the Federal agency upon a showing by the CONTRACTOR or its assignee that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the United States or that under the circumstances domestic manufacture is not commercially feasible.

(j) March-in Rights

The CONTRACTOR agrees that with respect to any subject invention in which it has acquired title, the Federal agency has the right in accordance with the procedures in 37 CFR 401.6 and any supplemental regulations of the agency to require the CONTRACTOR, an assignee or exclusive licensee of a subject invention to grant a nonexclusive, partially exclusive, or exclusive license in any field of use to a responsible applicant or applicants, upon terms that are reasonable under the circumstances, and if the CONTRACTOR, assignee, or exclusive licensee refuses such a request the Federal agency has the right to grant such a license itself if the Federal agency determines that:

(1) Such action is necessary because the CONTRACTOR or assignee has not taken, or is not expected to take within a reasonable time, effective steps to achieve practical application of the subject invention in such field of use.

(2) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by the CONTRACTOR, assignee or their licensees;

(3) Such action is necessary to meet requirements for public use specified by Federal regulations and such requirements are not reasonably satisfied by the CONTRACTOR, assignee or licensees; or

(4) Such action is necessary because the agreement required by paragraph (i) of this clause has not been obtained or waived or because a licensee of the exclusive right to use or sell any subject invention in the United States is in breach of such agreement.

(k) Special Provisions for Contracts with Nonprofit Organizations

If the CONTRACTOR is a nonprofit organization, it agrees that:

(1) Rights to a subject invention in the United States may not be assigned without the approval of the Federal agency, except where such assignment is made to an organization which has as one of its primary functions the management of inventions, provided that such assignee will be subject to the same provisions as the CONTRACTOR;

(2) The CONTRACTOR will share royalties collected on a subject invention with the inventor, including Federal employee co-inventors (when the agency deems it appropriate) when the subject invention is assigned in accordance with 35 U.S.C. 202(e) and 37 CFR 401.10;

(3) The balance of any royalties or income earned by the CONTRACTOR with respect to subject inventions, after payment of expenses (including payments to inventors) incidental to

the administration of subject inventions, will be utilized for the support of scientific research or education; and

(4) It will make efforts that are reasonable under the circumstances to attract licensees of subject invention that are small business firms and that it will give a preference to a small business firm when licensing a subject invention if the CONTRACTOR determines that the small business firm has a plan or proposal for marketing the invention which, if executed, is equally as likely to bring the invention to practical application as any plans or proposals from applicants that are not small business firms; provided, that the CONTRACTOR is also satisfied that the small business firm has the capability and resources to carry out its plan or proposal. The decision whether to give a preference in any specific case will be at the discretion of the CONTRACTOR. However, the CONTRACTOR agrees that the Secretary may review the CONTRACTOR'S licensing program and decisions regarding small business applicants, and the CONTRACTOR will negotiate changes to its licensing policies, procedures, or practices with the Secretary when the Secretary's review discloses that the CONTRACTOR could take reasonable steps to implement more effectively the requirements of this paragraph (k)(4).

(l) Communication

The following office should be contacted for resolution of any questions concerning federal patent rights:

Federal Highway Administration
Attn: Division Administrator
5801 N. Broadway Ext., Suite 300
Oklahoma City, Oklahoma 73118
Main Office: (405) 254-3300
FAX: (405) 254-3302