AGREEMENT FOR TECHNICAL ASSISTANCE
BETWEEN THE SECRETARY OF TRANSPORTATION
AND THE
Kansas State University

THIS AGREEMENT made this 26th day of July, 2002, by and between the Secretary of Transportation of the State of Kansas, hereinafter called "Secretary", and the Kansas State University, hereinafter referred to as "KSU", acting by and through Paul R. Lowe, representative.

WITNESSETH

WHEREAS, the Secretary has entered into a Memorandum of Understanding to establish the Midwest States Pooled Fund Accelerated Testing Program and to have Kansas serve as lead state, and

WHEREAS, the Secretary has determined that research regarding accelerated testing for the purpose of studying pavement design and performance is needed and approved

WHEREAS, the proposed program is hereinafter called "Project," and

WHEREAS, KSU has expressed an interest in performing the research and has qualified personnel with demonstrated expertise available to conduct the Project, and

WHEREAS, the Secretary is willing, subject to the terms of the Agreement, to reimburse KSU for the assistance provided.

NOW THEREFORE in consideration of the mutual covenants herein contained, the parties hereto agree as follows:

Section 1. Scope of Services. The KSU shall furnish the necessary personnel, facilities and such other services as may be required to fulfill the tasks identified and described in the Proposal which is attached hereto and incorporated herein as Special Attachment No. 1.

Section 2. Contract Dates. The KSU may commence to work in conformity with the Proposal (Special Attachment No. 1) of the Agreement upon acceptance by Secretary of the Proposal and shall prosecute the work outlined herein to begin on or after July 1, 2002 and with completion not later than June 30, 2003, unless the time is extended by the Secretary, as evidenced in writing.

Section 3. Basis of Payment. The Secretary agrees to reimburse the KSU for the work completed and actual costs incurred in performance of the Agreement in accordance with the proposed budget, page 17 of the Proposal, in an amount not to exceed a total price of $267,302.00. A combination of Federal monies and KSU matching monies are used to fund this Project. The Project costs referred to in the Agreement shall be comprised of the allowable direct costs incidental to the performance of the work described in the Proposal and indirect costs. Indirect costs shall not exceed twenty-six percent of the total allowable modified total direct costs to the extent that Federal-aid funds are used for payment. In the event final approval of Federal appropriation is not obtained, the Secretary will be responsible for only those noncancelable obligations incurred by KSU for work under this Agreement.

The Secretary agrees to make payments to the KSU upon presentation of proper billing to the Secretary. Certification of work performed will be documented by progress reports required under Section 11 of this Agreement to support costs claimed. Upon receipt of monthly expenditure reports, the Secretary will reimburse allowable costs as requested by the KSU. The KSU shall indicate on the last project billing that it is the final billing. The final request for payment shall not be disbursed until the Secretary determines that all obligations of the Agreement have been completed. Reimbursement of any cost pursuant to the Section shall not constitute a final determination by the Secretary of the allowability of such cost and shall not constitute a waiver of any violation of the terms of the Agreement committed by the KSU.

Written approval by KDOT will be required to extend a completion date, increase the total budget amount, or shift funds over $1,000 in a budget category. Transfers in budget categories will be allowed if they are less than or equal to $1,000.

The test of allowability of a cost to be applied in the Agreement is based on the reasonableness of the allocation of the cost under generally accepted cost, accounting principles and practices and in accordance with 48 code of Federal Regulations (CFR), Ch. 1, part 31 et.seq., and relevance to tasks identified and described in the Proposal. However, such costs are subject to limitation as per Agreement.

The final payment due under provisions of this Agreement shall be made within ninety (90) days after the Secretary's and the appropriate Federal agency's acceptance and approval of the Final Evaluation Report and KSU's compliance with OMB A-133, Audits of States, Local Governments, and Non-Profit Organizations.

Section 4. Covenant Against Contingent Fees. The KSU warrants and guarantees that provisions for covenants against contingent fees found in Special Attachment No. 2 are incorporated in this Agreement and made a part hereof. For breach or violation of this warranty, the Secretary shall have the right to annul this Agreement without liability, or in his discretion to deduct from the Agreement price or consideration, or otherwise recover, the full amount of such fee, commission, percentage, brokerage fee, gift, or contingent fee.

Section 5. Rights in the Project.

A. Rights in Data. The KSU grants to the Secretary, for any governmental purposes, the right to publish, translate, reproduce, deliver, use and dispose of, and to authorize others to do so, all data, including reports, drawings, blueprints, computer software which includes but is not limited to documentation and source code, and other technical information resulting from the performance of work under this Agreement. When the Secretary authorizes others to use, for governmental purposes, any patented or copyrighted items arising from the project, the Secretary will issue a standard restriction Agreement to each party receiving authorization for return to KSU.

B. Rights in Intellectual Property. Consistent with KDOT and Kansas Board of Regents policy, the KSU will retain all rights to intellectual property including patents and copyrights arising from the project. The Secretary and the U.S. Government shall retain a royalty-free, nonexclusive, irrevocable license to use any patent or copyright arising from the project for any governmental purposes. If the KSU elects not to pursue the patenting or copyrighting of intellectual property, the KSU will provide written notification to the Secretary who shall be free to do so. The KSU agrees to include, within the specification of any United States patent or copyright application and any patent and copyright issuing, the following statement, "The invention (copyright) was made with funds provided by the Federal government and State of Kansas through the Kansas Department of Transportation."

C. Confidentiality. Secretary and KSU agree that information exchanged and generated pursuant to this Agreement, will generally be non-confidential and suitable for publication. Nevertheless Secretary, and its duly authorized representatives may disclose to KSU, during the course of the project, confidential information including data and statistics not suitable for public dissemination. KSU agrees to maintain such information in confidence, and to prevent the disclosure thereof to others to the extent that such information is disclosed in writing and marked as confidential or proprietary; or if orally disclosed, noted at the time of disclosure as being confidential or proprietary, and reduced to writing within thirty (30) days after such oral disclosure, the writing being marked as confidential or proprietary. KSU agrees that neither the KSU nor any of its colleagues, employees or agents shall use any of the confidential information for any purpose whatsoever, other than to complete this agreement for KDOT. The KSU agrees that the KSU or any of its colleagues, employees or agents shall not keep any copies of the information provided by the Secretary or its duly authorized representatives that has been identified as confidential or proprietary, and provided pursuant to this agreement.

D. Rights in Equipment. It is mutually agreed by the KSU and the Secretary that all apparatus and equipment purchased with funds provided by the Secretary shall be used by the KSU for the project and shall become property of the KSU upon completion of the project subject to the following provisions:

1. Those Uniform Administrative Requirements contained in 49 CFR Part 19 shall govern the purchase, use and disposition of equipment covered by this Agreement.

2. The KSU will provide first priority to the Secretary with right of refusal for testing pavement and/or other structural systems on an at-cost basis.

Section 6. Work Responsibility. The parties hereto mutually agree that the services to be performed under the terms of this Agreement are to be performed by the Principal Investigator and others named in the Proposal under the guidance and supervision of KSU and that their time and effort as defined in the proposal, Special Attachment No. 1 cannot be assigned, sublet, or transferred to any other party without the written consent of the Secretary. KSU accepts full responsibility for the project and its conduct. The KSU will bill Secretary for reimbursement as specified in the Agreement as awarded.

Section 7. Inspection and Approval of Work. The KSU shall permit the Secretary or his duly authorized representative to inspect and audit all work, material, computer programs and other data and records either during the performance of project or for three years from the date of the final payment to the KSU under the agreement. All work will be performed according to the requirements as outlined in the Proposal, Special Attachment No. 1. Final Inspection of the Project will be conducted by the Secretary or his duly authorized representative.

Section 8. Publication Provisions. Publication by any party to this Agreement shall give credit to all other parties. However, if the Secretary does not wish to subscribe to the findings or conclusions of an interim report, the following statement shall be added: "The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Kansas Department of Transportation or the Federal Highway Administration." In the event of failure to reach a consensus between the Secretary and the KSU relative to the publication of a final report, or any other reports during the period of the Agreement, the Secretary reserves the right to publish independently in which event the nonconcurrence of the KSU shall be set forth in said publication, if requested by the KSU.

Section 9. Audit and Retention of Records. Arrangements shall be made by the KSU for the required financial and compliance audit to ensure that the audit will be made within the prescribed audit reporting cycle, and a copy of the OMB A-133 audit will be provided to the Secretary.

The KSU shall be required to maintain accounting records and other evidence pertaining to the costs incurred and to make the records available to their office at all reasonable times during the Agreement period and for three (3) years from the date of the final payment to the KSU under this Agreement. Such accounting records and other evidence pertaining to the costs incurred will be made available for inspection by the Secretary or his duly authorized representatives and copies thereof shall be furnished if requested.

Section 10. Termination of Agreement. Either party has the right to terminate this AGREEMENT by giving thirty (30) days written notice in the event a determination is made that the Project should be abandoned or indefinitely postponed; PROVIDED, however, that in any case, the KSU shall be paid the amount due for the services rendered and for any noncancelable obligations incurred prior to the date of termination on the basis of the provisions of this AGREEMENT and provided that the Secretary shall receive full reports of all work performed to the date of termination of this AGREEMENT.

Section 11. Reports. The KSU shall advise the Secretary regarding the progress of the Project as such times and in such a manner as the Secretary may require, including, but not limited to, the following:

1) a monthly expenditure report, and
2) a quarterly progress report.

Section 12. Cooperation and Disputes. The Secretary and the KSU agree to make a reasonable effort to promptly resolve any disputes or questions concerning the project. The Secretary and the KSU ensure that personnel will cooperate fully in carrying out the intent and provisions of this Agreement. The Secretary shall, in all cases not disposed of by agreement among or between the parties to the Agreement, resolve any disputes which may arise in connection with the work being performed under this Agreement.

Section 13. Compliance with Laws. The KSU agrees to comply with all federal, state, and local laws, ordinances and regulations in the implementation of the administrative service provided for in the Agreement, including but not limited to 49 CFR part 19, Title VI, Title VII, and Title IX of the Civil Rights Act of 1964, Executive Order 11246 as amended by Executive Order 11375 entitled "Equal Employment Opportunity;" Executive Order 12549 regarding debarment, eligibility, indictments, convictions, or civil judgments; and 31 U.S.C. Section 1352; Section 319 P.L. 101.21 prohibiting use of Federal funds for lobbying activities which are incorporated herein as Special Attachments Nos. 3, 4, and 5, respectively.

Section 14. Responsibility to Employees. The KSU accepts full responsibility for payment of unemployment insurance, workmen's compensation, and social security as well as all income tax deductions and any other taxes or payroll deductions required by the law for its employees engaged in the work authorized by the Agreement.

This contract presents a framework for an ongoing agreement between the Secretary and the University. It is expected that similar contracts (or renewals) will be in effect on July 1, 2003 for FY 2003, and July 1 of the subsequent years for the following fiscal years. The level of funding for subsequent years is expected to be between $200,000 and $250,000 per year. The target dates for subsequent agreements will be as follows:

March 1: Selection of experiments by the Technical Committee completed
April 1: Submission of technical proposal by KSU based on the above selection
May 1: Agreement signed for the subsequent fiscal year

July 1: Effective starting date of new project

To insure that the new position of Pavement Engineer, as well as the present position of Research Technologist, will both be funded adequately to retain highly qualified employees, the Secretary agrees that a one year notice will be given prior to ending the terms of this ongoing agreement.

Section 15. Employment of Secretary's Employees. The KSU will not, without written permission from the Secretary, engage the services of any person or persons in the employment of the Secretary for any work required by the terms of the Agreement.

Section 16. Contractual Provisions Attachment. The provisions found in Contractual Provisions Attachment Form DA-146a, Special Attachment No. 6, which is attached hereto, are hereby incorporated in this Agreement and made a part hereof.

Section 17. Indemnification Agreement. The KSU agrees to indemnify and hold harmless the Secretary and the Secretary's duly authorized representatives from any and all costs, liabilities, expenses, suits, judgments, damages to person or property or claims of any nature whatsoever arising out of the negligent acts of the KSU, the KSU employees or subcontractors, in the performance of this Agreement. The KSU shall not be required to indemnify and hold the Secretary harmless for negligent acts of the Secretary or his or her duly authorized representatives or employees. Nothing in this indemnification clause is meant to affect Section 4 Disclaimer of Liability of DA-146a, Special Attachment No. 6.

Section 18. Prohibited Interest. No member, officer, or employee of the KSU during his/her tenure or one year thereafter shall have any interest, direct or indirect, in this Agreement or the proceeds thereof other than that allowed by the Board of Regents policy.

IN WITNESS WHEREOF: The parties hereto have caused this Agreement to be signed by their duly authorized officers on the day and year first above written.

KSU

Paul R. Lowe 7/18/02

Paul R. Lowe
Assist. Vice Provost for Research

Carole Levin
ATTEST

Secretary

Warren L Sick

E. Dean Carlson, P.E.
Secretary of Transportation
By: Warren L. Sick
Assistant Secretary and
State Transportation Engineer

Raye D Hansen Nagy
ATTEST

Special Attachment No. 1, Proposal
Special Attachment No. 2, Certification - Covenant Against Fees
Special Attachment No. 3, Civil Rights Act
Special Attachment No. 4, Certification -Debarment
Special Attachment No. 5, Certification - Federal Aid Contracts
Special Attachment No. 6, Form DA-146a

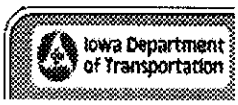
FORM APPROVED BY Legal Dept. KDOT

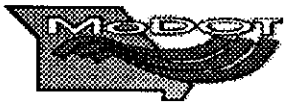
Special Attachment No. 1

PROPOSAL

to

MIDWEST STATES ACCELERATED PAVEMENT TESTING POOLED FUNDS PROGRAM





for

EVALUATION OF CHEMICAL STABILIZED SUBGRADE SOIL

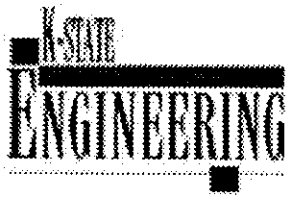
(ATL EXPERIMENT NO. 12)

Period of Performance: 07/01/02 - 06/30/03
Project Monitor: *Andrew J. Gisi, P.E.*
Funds Requested: $267,302

from

Kansas State University
Fairchild Hall, Room No. 2
Manhattan, KS 66506-1103.

Project Personnel:



Stefan A. Romanoschi, Ph.D.,P.E.
Mustaque Hossain, Ph.D., P.E.
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Manhattan, KS 66506-2905.

APPROVALS:

Stefan Romanoschi

Stefan A. Romanoschi
Principal Investigator

Paul R. Lowe
Assistant Vice Provost for Research

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I. INTRODUCTION

A soil exhibiting a marked and sustained resistance to deformation under repeated or continuous load application, whether in dry or wet state, is said to be a stable soil. When a less stable soil is treated to improve its strength and resistance to change in volume and moisture content, it is said to be "stabilized." According to Winterkorn (*1*) "Soil stabilization is a collective term for any physical, chemical or biological methods, employed to improve certain properties of a natural soil to make it serve adequately an intended engineering purpose." Stabilization infers improvement in both strength and durability. In its earlier usage, the term stabilization signified improvement in a qualitative sense only. Currently, stabilization has become associated with quantitative values of strength and durability which are related to performance. These quantitative values are expressed in terms of compressive strength, shearing strength or some measure of load bearing value. These, in turn, indicate the load bearing quality of the stabilized construction. Again, durability indicates its resistance to freezing and thawing and/or wetting and drying.

Chemical soil stabilization always involves treatment of the soil with some kind of chemical compound, which when added to the soil, would result in "chemical reaction." The chemical reaction modifies/enhances the physical and engineering properties of a soil, such as, volume stability and strength. When applied in road construction for stabilizing subgrade materials, the chemical stabilization produces new materials which resist traffic loading and detrimental weather effects.

Since early forties, the stabilization of soil with admixtures, such as, cement, lime, bitumen, fly ash, etc. have been successfully experimented and used extensively for the construction of road and airport foundations in Australia, U.S., Europe, India, Africa and many other parts of the world. Recently, a number of new chemical compounds are being marketed by different companies for stabilization which have not been studied in details. Also, new emphasis is being placed for understanding this process. This is evident by the publication of a handbook on lime stabilization by the National Lime Association (*2*). Although soil stabilization is a routine process in road construction in many areas, the structural behavior and the contribution of a stabilized layer in the pavement structure are yet to be studied and understood fully. Recent experiences by the Kansas Department of Transportation with a concrete pavement project on lime-treated subgrade fully support this assertion (*3*).

The proposed study aims to compare the performance of subgrade soils stabilized with lime, fly-ash, cement and a commercial chemical compound.. The advantage of using accelerated pavement test when compared to a field test is that the results of the comparative study can be obtained in several months. In a field test, the results are obtained after observing the behavior of the road test sections during at a five year period as a minimum. Also, on a field test section, some of the environmental factors and traffic loadings can not be controlled. The proposed study will be conducted at the Civil Infrastructure Systems Laboratory (CISL) of Kansas State University.

II BACKGROUND

a. Accelerated Testing Laboratory (ATL)

The Department of Civil Engineering, Kansas State University, in cooperation with KDOT has developed the Accelerated Testing Laboratory (ATL) (*4*). The facility allows the development of full-scale accelerated tests on pavement structures, by using the ATL machine as the loading device. The loading device is placed on a full-scale road structure constructed in a pit. A full-size truck axle passes over the pavement at about every five seconds, applying a total axle load between 9 and 18 kN. The system relies on an air bag suspension placed between the axle and a metallic reaction frame in which the air pressure can be automatically controlled. When air is compressed in the airbag, the generated reaction force between the frame and the suspension is transmitted to the pavement. Both single and dual tires, single and tandem axles can be accommodated in this system. A detailed description of the facility is given by Melhem (*4*).

The major benefit of the tests developed at the ATL is that the performance of road materials and structures can be evaluated at a reduced cost and in a short period of time, since the cumulative traffic passing on an in-service road section in ten years will be applied here only in several months. The ATL facility allows control and monitoring of the temperature at the surface and in the pavement layers. This assures that the pavement materials and structures are subjected to identical load and environmental conditions.

b. Chemical Stabilization of Subgrade Soil

Many different methods of soil stabilization are in use now. The degree of improvement of in-situ soil may differ within a particular method and also between the other methods. The reason behind is that soils exist in a broad range of types and different soils react differently to a stabilizer. Figure 1 shows the feasibility of different stabilization techniques related to soil type.

Addition of inorganic chemical stabilizers like cement and lime have two fold effect on soil – acceleration of flocculation and promotion of chemical bonding. Due to flocculation, the clay particles are electrically attracted and aggregated with each other. This results in an increase in the effective size of the clay aggregation (*5*).

Ingles (*7*) asserted that such aggregation converts clay into the mechanical equivalent of a fine silt. Also, a strong chemical bonding force develops between the individual particles in such aggregation. The chemical bonding depends upon the type of stabilizer employed.

Portland Cement stabilization

Major benefits of Portland cement stabilization of subgrade soils are (i) increased strength and stiffness; (ii) Better volume stability (less moisture sensitivity, control of frost heave); and (ii) increased durability.

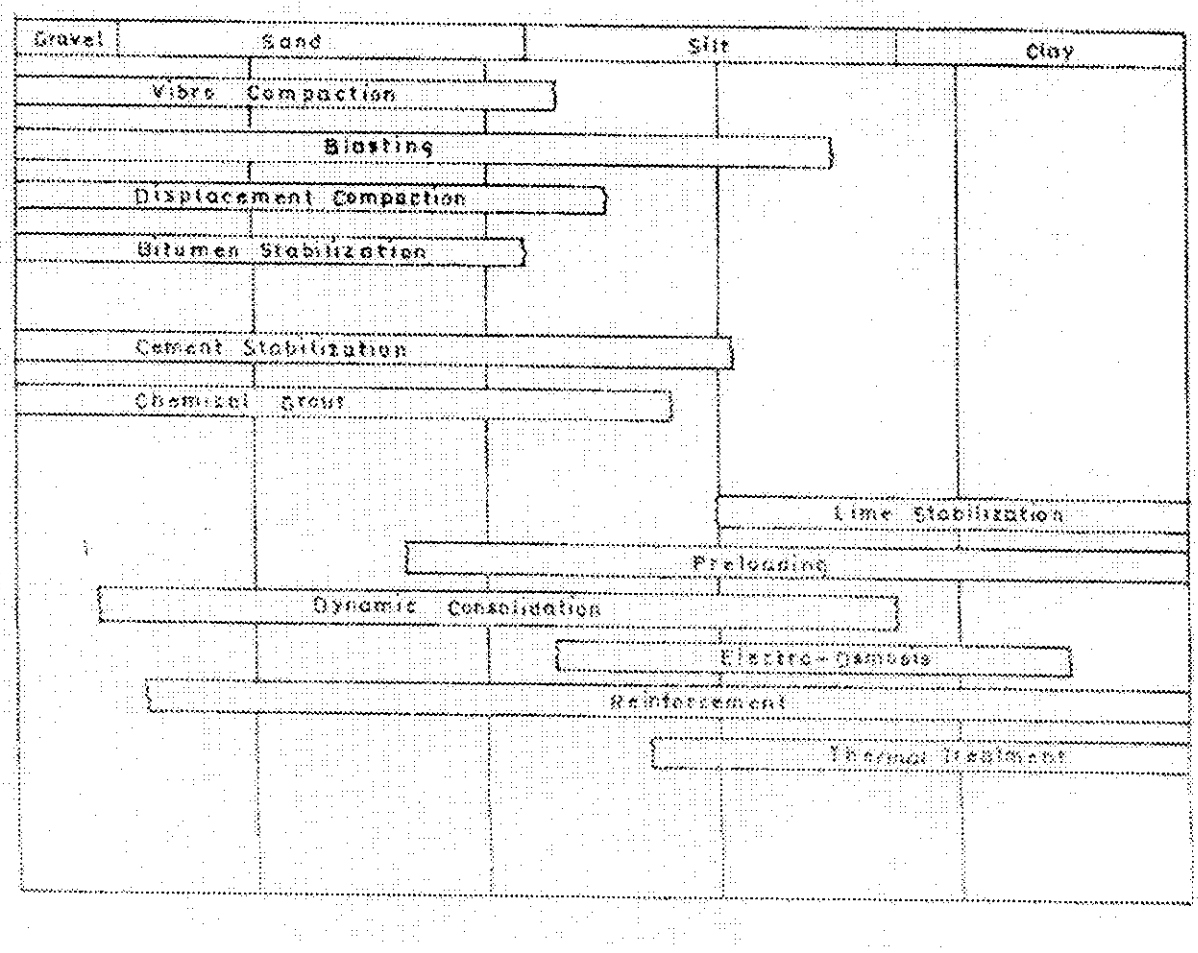

FIGURE 1 Soil Stabilization Techniques with respect to Soil Type (*6*)

When water is added to neat cement, the major hydration products are basic calcium silicate hydrates, calcium aluminate hydrates and hydrated lime. The silicate hydrates constitute the major cementitious compounds, while the lime is deposited as a separate crystalline solid phase. The silicate hydrate products are also responsible for strength gain of soil-cement mix. The interaction between cement and soil differs somewhat for two principal types of soil, granular and cohesive. In granular soils, the cementation effect is similar to that in concrete, the only difference being that the cement paste does not fill the voids of the additives, so that the latter is only cemented at contact points (Figure 2). In this case, no continuous matrix is formed and the fracture type depends on whether the interparticle bond or the natural strength of the particles themselves is sufficiently strong. The better graded the grain distribution of a soil, the smaller the voids and the greater the number and the larger the interparticle contact surfaces, the stronger the effect of cementation (*8*).

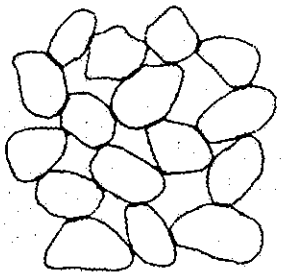

FIGURE 2 Cementation Effect around the Contact Points of Coarse Grains (*8*)

In fine grained silts and clays, the hydration of cement creates rather strong bonds between the various mineral substances and forms a matrix which efficiently encloses the non-bonded soil particles. This matrix develops a cellular structure on whose strength that of the entire construction depends. This happens due to the fact that the strength of the clay particles within the matrix is rather low. Since this matrix pins the particles, the cement reduces plasticity and increases shear strength. The chemical surface effect of the cement reduces the water affinity of the clay and in turn, the water-retention capacity of the clay. Together with a strength increase, this results in the enclosure of the larger unstabilized grain aggregates which, therefore, cannot expand and will have improved durability. The cement-clay interaction is significantly affected by the interaction of lime, produced during hydration of portland cement and the clay minerals. The interaction can be classified into two groups: rapid rate (ion exchange and flocculation) and slow processes (carbonatization, pozzolanic reaction and the production of new substances). The whole process can be divided into a primary and a secondary process.

The primary process includes hydrolysis and hydration of cement. In this process, hydration products appear and the pH value of water increases. The calcium hydroxide produced in this period can react much more strongly than ordinary lime. Clay is important in the secondary processes. The calcium ions produced during cement hydration transform the clay first into calcium clay, and increase the intensity of the flocculation that had been initiated by the increased total electrolyte content due to cement addition. Calcium hydroxide then attacks the clay particles and the amorphous compound parts. Then the silicates and aluminates dissolved in the pore water will mix with the calcium ions and additional cementing material is precipitated. The calcium hydroxide consumed during the course of the secondary processes is partly replaced by the lime produced by cement hydration. During secondary processes, the cementation substances are formed over the surface of clay particles or in their immediate vicinity, causing the flocculated clay grains to be bonded at the contact points. Still stronger bonds may be created between the hydrating cement paste and the clay particles coating the cement grains.

The products of primary process harden into high-strength additives and differ from the normal cement hydrated in concrete or mortar only by their lower lime content. The secondary processes increase the strength and durability of the soil cement -.by producing an additional cementing substance to further enhance the bond strength between the particles (*8*)

Lime Stabilization

The benefits of lime stabilization are similar to those of cement stabilization. However, it is possible that there will be an increase in permeability. Usually, this is of lesser significance for the subgrade.

Two phases of stabilization occur in a lime-soil system. The first involves the practically immediate reaction of cation exchange and flocculation-agglomeration. Although the exact mechanisms of lime-soil stabilization are not totally agreed upon, general agreement does exist that four basic reactions do occur to some level (2):

a) cation exchange,

b) flocculation and agglomeration,

c) pozzolanic reaction, and

d) carbonation.

Some researchers have explained that the immediate textural changes, plasticity changes and short-term strength gains which were traditionally thought to be the result of cation exchange are actually artifacts of the crowding of calcium hydroxide molecules along the surface of the clay. This crowding results in an attack on the clay mineral surface and the formation of calcium-aluminate and calcium silicate minerals, which help bond the mineral surfaces together-reducing plasticity and affecting the textural change. This is essentially a "pozzolanic effect" (*2*). Eades and Grim (*2*) found out that the amount of lime necessary to initiate and "drive" lime-soil reactions which are responsible for long-term compressive strength gain and pozzolanic reactivity is soil dependent and varies considerably from soil to soil.

Experience has shown that lime will react with medium, moderately fine and fine-grained soils (CH, CL, MH, SC, SM, SW-SC, SP-SC, GP-GC or GM-GC) to produce decrease plasticity, increased workability, reduced swell and increased strength. The key to a pozzolanic reaction resulting in long term strength is the presence of a reactive clay to supply the pozzolans. Lime has also been found to be an effective stabilizer for sandy/silty soils with clay content as low as seven percent and a plasticity index as low as 10 (*2*). However, Little (*2*) has proposed that lime be considered in soil stabilization when the plasticity index is greater than 10 and with more than 25 percent material passing 0.075 mm sieve (US No. 200).

The extent to which the pozzolanic reaction happens is primarily influenced by soil properties. With some soils, the reaction is inhibited and cementing agents are not formed. Thompson (*9*) has proposed that those soils react with lime to produce substantial increase in unconfined compressive strength (greater than 345 kPa (50 psi)) following 28 days of curing at 22o C are "reactive" and those that display less than 345 kPa (50 psi) strength increase are

"nonreactive." It is to be noted that a number of factors influence lime-soil pozzolanic reactions. The major factors are: (i) Organic Carbon, and (ii) Sulfates. The other factors are: (i) Clay content, (ii) Clay mineralogy, (iii) Weathering, (iv) Pedology, and (iii) Geographical and climatic effects. Details can be found elsewhere (*2*).

Fly Ash

ASTM Class F and Class C fly ash, by product of coal burning electric utilities, can also be used as stabilizers. Class F materials are generally low calcium (less than 10% CaO) fly ashes with carbon content less than 5%, but some may be as high as 10%. Class F materials are not cementitious by themselves and usually used with Portland cement or lime. Class C materials are often high-calcium (10% to 30% CaO) fly ashes with carbon contents less than 2% (*10*). Many Class C fly ashes can be cementitious by themselves, and when expose to water will hydrate and harden in less than 45 minutes. The difference in classes result from burning different coals- Class C results from burning subbituminous and lignite coals. Since most of the Midwestern utilities burn these coals, Class C fly ash is readily available and used widely in four states participating in this study. In this study, Class C fly ash from the Jeffrey Energy Center in St. Mary's, Kansas will be used in soil stabilization. The mechanism of soil-Class C fly ash reaction is very similar to soil-lime reaction. However, since some cementitious materials (calcium silicate hydrate) are also produced, part of the reaction would follow the mechanics described in soil-Portland cement reaction.

Chemical Compound

Over the last two decades, there has been an emphasis on marketing some chemical compounds for soil stabilization. Lignosulfonate derivatives, mostly by product of the paper industry, have been marketed as a binder for subgrade materials. As a dispersing agent, they can make a clayey soil less permeable and reduce moisture evaporation (*11*). Currently some multi-enzymic products are being offered for soil stabilization (*12*). Other compounds are also available (*13-16*)

OBJECTIVE

The objective of this research is to compare the performance of subgrade soil stabilized with lime, fly ash, cement and a commercial chemical compound. The objective will be accomplished by conducting a full-scale accelerated pavement test at the Civil Infrastructure Systems Laboratory on flexible pavements with chemically stabilized subgrade soils.

BENEFITS

The results of this research will lead to improved practices related to the design and construction flexible pavements where the top of the subgrade layer is improved by chemical stabilization of the soil. This will finally lead to the optimized use of the soil stabilization technology, optimized design of flexible pavements with stabilized subgrade soil, and extended life of asphalt pavements.

Data collected during the experiment will be analyzed and the analysis results will be made available to the four state agencies involved in this project for further analysis and interpretation. The findings of this experiment will be summarized in scientific journal publications and presentations delivered at scientific conferences and meetings with specialists and practitioners in the field of highway engineering.

V WORK PLAN

The time line of the work plan for this research project is presented in Table 1. Individual tasks are discussed below.

TABLE 1 Time line for the work plan

TASK	Schedule
1	July 1, 2002 - August 30, 2002
2	September 1, 2002 - October 15, 2002
3	September 1, 2002 - October 30, 2002
4	November 1, 2002 - April 15, 2003
5	November 1, 2001 - April 15, 2003
6	January 15,2003 - June 1, 2003
7	May 15, 2003 - June 30, 2003

Task 1: Experiment Preparation

The literature related to the chemical stabilization of subgrade soil under flexible pavements will be reviewed. The experience with the use of Class C fly ash, Portland cement, lime and commercial chemical products for stabilization in the four states participating in the Midwest States APT Pooled Funds Program as well as in other states and agencies (such as, the United States Forest Service) will be reviewed. Relevant specifications on stabilization will also be reviewed.

As part of the design of the experiment, representative subgrade soil material (s) will be selected. Samples will be obtained for laboratory characterization. Tests will include tests for

soil classification (plasticity index and gradation), moisture-density relationships, and unconfined compressive strength of remolded soil samples.

A major component of the experimental design is the selection of a soil compatible with the chemicals. This will be done to ensure that the chemical would change the physical and engineering properties of the soil. As mentioned earlier, stabilization should improve the strength and durability (volumetric) properties of the soil. The following tests will be done to assess this: (a) Atterberg limit tests, (b) Swell, and (c) Unconfined compressive strength. From these tests, optimum content of water and chemicals that will be added to the soil in test section construction will be estimated. Stabilized soil samples will be prepared by mixing the soil (s) with each of the four chemical compounds. The chemical contents typically used in the four Mid-Western states will be used as reference, since they represent the most economical design. Samples will be also prepared at contents of the chemical above and bellow the typically employed values. Atterberg limits and swell tests will be done on each sample. The unconfined compressive strength will be measured at 2, 7, 14, and 28 days on the stabilized samples. Standard Proctor density measurements will be done to establish the reference density at which the field compaction will be done.

At this stage, the instrumentation for pavement monitoring will be designed. The work will include selection and purchase of appropriate sensors, as well as drafting of the pavement monitoring plan.

Also, the project preparation will include modification of the transverse profile measuring device to increase the speed and accuracy of the profile data collection process.

Task 2: Construction of the Pavement Sections

This task will include construction of four test lanes at CISL. All lanes will have the same asphalt concrete surface with a five-inch thickness (if agreed upon by TAC). Otherwise, the pavement section will consist of 75 mm (3 inches) of rut resistanct surface over 150 mm (6 inches of aggregate base).

A rut resistant mix (SM-12.5A or equivalent) will be used for the surface layer so that pavements would not fail due to rutting, and deterioration of the lower layers (base and subgrade or subgrade) could be ensured. On all four pavement sections, the top six inches of the subgrade will be stabilized with a Class C fly ash, cement, lime (dry/slurry) and a commercial chemical compound for stabilization (to be selected in active consultation with TAC; a multi-enzymic product appears to be a good candidate). The test sections with the fly ash and Portland cement as stabilizers will be built in the North pit. The other two pavement sections with lime and a commercial chemical compound will be constructed in the South pit.

Before construction, the pavement sections tested in Experiment No. 11 will be removed. New soil will be placed in the pits and compacted. The moisture of the new soil will be controlled to be close to the optimum value.

The mixing of the soil and the chemical stabilizer will be done the CISL-KSU personnel. A pug-mill will be rented and used for mixing the chemical stabilizers with the soil. The soil, water and chemicals will be carefully batched to ensure that the optimum content from the preliminary laboratory investigations is obtained. The mixed soil will be placed in the pits in three- inch lifts and compacted. Special attention will be given to achieving the desired moisture content of the soil. Density measurements will be performed with the nuclear density gage. For the soil stabilization with the commercial chemical compound, the manufacture's recommendations regarding mixing, compaction and curing will be carefully followed.

A licenced civil engineer, with experience in highway construction/supervision (existing or former KDOT employee will be preferred), will be hired as a consultant for a limited time (one or two months) to supervise the construction of pavement test sections.

The hot-mix asphalt concrete surface layer will be constructed within two weeks after the stabilized bases are in place. The mixture will be produced, placed, and compacted by Shilling Construction Co. of Manhattan. The HMA mix will be placed and compacted to the desired density (93% or above of theoretical maximum density) and thickness (five or three inches).

The instrumentation for monitoring pavement response will be installed in the lanes during construction The proposed instrumentation consists of pressure cells, strain gages, thermocouples and soil moisture gages. A detailed description of the type and location of each sensor is given in the pavement monitoring section. Even though the capability for controlling the temperature in the pavement built in the North pit exists, it is suggested that the testing will be performed at room temperature.

Laboratory tests will be performed on material samples taken from the construction site as well as on the laboratory-prepared specimens. The material characteristics to be measured on the samples include:

a. Asphalt concrete: density, resilient modulus, permeability, rutting, and fatigue properties.
b. Stabilized soil: plasticity, swell and unconfined compression strength and modulus at 2, 7, 14 and 28 days.
c. Subgrade soil: plasticity, swell, and gradation.

These material characteristics will be determined at the Bituminous Materials Laboratory and the Aggregate Characterization Laboratory at the KSU Civil Engineering Department.

Task 3: Design and Construction of the Load Measuring and Lateral Positioning Devices

Accurate simulation of the lateral distribution of the truck tire position is essential for generating the same permanent deformation (rutting) that will occur in an in-service road section under traffic. Currently, the ATL load assembly can only simulate channelized traffic, since its

lateral position does not change during testing. Therefore, a mechanical device that will change the position of the ATL load assembly during trafficking would be designed and built. The device will be capable of simulating a normal distribution for the lateral positioning of the ATL load assembly.

Also, currently, the axle load applied to the pavement is estimated based on the pressure in the hydraulic system. The correlation is established between the pressure in the hydraulic circuit with the static axle load. Therefore, the estimation of the real load applied during testing is only approximate. In the current configuration, it is not possible to measure the dynamic axle load or the load applied by each wheel. It is, therefore, impossible to verify whether the same loading is applied to all pavement test sections. The proposed device will be capable of measuring the real-time profile of the dynamic load on each of the four wheels of the ATL tandem axle as it moves along the pavement.

The change in lateral position of the ATL load assembly during load application will greatly reduce the probability of failure of the pavement sections due to rutting in the asphalt concrete surface layer. The modification would enhance the probability of pavement failure due to rutting or fatigue cracking in the lower layers of the pavements. This is essential to fulfil the objective of the proposed experiment i.e. to assess the performance of the chemically stabilized subgrade soil.

The proposed devices for controlling lateral movement of the ATL steel frame and for measurement of dynamic wheel loads will be designed and constructed by Daptech, Inc. Mr. Dennis Pauls, President of Daptech, collaborated in the design and construction of the original ATL machine. Daptech has presented a proposal for the required modifications to the ATL machine. In addition to these two proposed devices, Daptech will also install several safety control circuits that will stop the ATL load assembly whenever a malfunctioning in the hydraulic, pneumatic or electric circuits happens. The installation of these safety devices will allow us to increase the number of daily hours of operation, and thus will significantly increase the efficiency of the ATL machine.

According to the preliminary estimate of Daptech, no more than three weeks will be necessary for the construction of the two devices and other safety modifications. The two devices will be built in four weeks after construction of the pavements sections is finished, time when the stabilized soil will cure for 28 days, and when no loading is planned in this work plan. Thus, the proposed modifications to the machine will not affect the progress of this experiment.

Task 4: Full-Scale Accelerated Pavement Testing

After construction, the lanes will be tested under the full-scale truck loading provided by the ATL loading frame. Design and construction of the proposed mechanical device will allow change in the lateral position of the ATL machine. Bi-directional trafficking is recommended, since the testing time is half of that required for unidirectional trafficking.

It is proposed that a 150 kN (34,000 lb) tandem axle load and a tire inflation pressure of 690 kPa (100 psi) to be used in this experiment. The axle load and tire pressure will be kept the same during the entire duration of the experiment. The lateral position of the ATL machine will be changed during testing such that it will follow a normal distribution. Loading will be applied until at least one of the following distress levels are reached:

- 12.5 mm (0.5 in.) rut depth at the pavement surface;
- 25% of each lane area is cracked.

Task 5: Pavement Monitoring

The condition of the pavement as well as stresses and strains in the tested pavement structures will be monitored during the entire duration of the experiment. Longitudinal and transverse profiles will be measured on the test lanes at every 25,000 cycles of the ATL machine. Three transverse profiles along the each lane will be recorded using the transverse rut measuring device built during ATL Experiment #8 and to be modified in this experiment. The rut depth values will be computed for each profile. One longitudinal profile will be recorded for each lane. The longitudinal profile data will be used to determine the evolution of roughness with the accumulated traffic. After surface cracks are first observed, crack mapping will be performed simultaneously with the profile measurements. The cracking extent and severity will be determined from the mapped data.

The Weight Drop NDT device will be used to perform surface deflection tests at every 25,000 cycles of the ATL loading. The deflection data will be used to backcalculate the elastic layer moduli to determine the degradation of the materials with the accumulated traffic.

Strain and stress measurements under the passing axle will be performed at 0, 5,000 repetitions and then at every 25,000 cycles of the ATL axle. The proposed locations of the strain gages and pressure cells are presented in Figure 3. The same configuration (2 transverse strain gauges, 2 longitudinal strain gauges, 2 pressure cells, 4 temperature sensors and 2 TDR gauges) for the instrumentation will be used for all lanes. Moisture and temperature data will be monitored periodically to ensure that the subgrade is at the optimum moisture content.

Falling Weight Deflectometer tests will be conducted by the KDOT crew. The tests will be scheduled in consultation with the KSU-CISL research team. The FWD tests will be performed on the four test lanes as follows:

- After construction of the lanes
- Before testing is started (approximately 28 days after subgrade stabilization)
- After 5,000 loading cycles
- After 100,000 loading cycles
- After loading is completed on each pair of lanes.

The FWD test sequence covers a period of approximately six months. The FWD tests will be performed at three locations per lane, with drop configurations selected by the KDOT crew and the KSU-CISL research team. The drop configuration currently used in Experiment 11 may be used. The KDOT crew will provide the deflection data to the KSU-CISL research team, who will be responsible for data processing and moduli backcalculation.

The instrumentation used for the stress-strain and moisture measurements will be embedded in the pavement during construction.

The forensic evaluation of the tested lanes will be performed in order to investigate the failure mode and the causes of failure. After failure, one trench will be cut in each test lane down to the level of the subgrade soil. If possible, samples of stabilized soil material will be extracted and tested in the laboratory to determine the density, resilient modulus and the compressive strength. If the material proved to be too weak, Dynamic Cone Penetrometer tests will be performed on the stabilized soil to estimate the elastic modulus at the end of the test. The transverse profile at the base and top of the base layer and on top of the surface layer will be recorded to determine the contribution of each layer to the surface rutting. The trenching will be done by KDOT personnel.

Task 6a: Analysis of Results

The data collected during pavement monitoring will be analyzed in order to determine the response of the pavement to the applied loading, evolution of distresses and changes in material properties. The analysis will allow a detailed comparison of the performance and behavior of the soil stabilized with four chemical compounds: Class C fly-ash, Portland cement, lime and a commercial compound. Mechanistic analyses will be performed so that the results from this experiment could be used in the AASHTO 2002 Pavement Design Guide.

Task 6b: Extrapolation of Test Results

It is well known that the efficiency of each chemical stabilizer depends greatly on the type of soil it is mixed with. For example, a highly plastic soil is typically mixed with lime to reduce the plasticity. The stabilization of a highly plastic clay with cement is not effective, even if higher cement contents are used. Therefore, this task will gather information from other research studies in order to draft recommendations on how these four chemicals should be used for stabilization of soils other than that tested in this experiment. Performance evaluation of chemical stabilized soils using full-scale accelerated pavement tests has been done in Louisiana, Australia and South Africa. Using information provided by those projects, it is possible to estimate the effectiveness of chemical stabilization for other soils. In particular, results of this proposed experiment can be empirically related to the parameters used for quantitatively describing effectiveness of stabilization, such as, change in plasticity index of soil, reduction in swell, and increase in unconfined compressive strength, etc.

Task 7: Report Writing and Results

A final report containing a detailed description of the construction, test methodology, and results will be delivered at the end of the experiment. The report will contain all information related to the construction of the test lanes, results from the laboratory and field tests of the materials, pavement condition and monitoring data, data analysis methods, summary of the test results, conclusions and recommendations. The research team will also deliver a detailed presentation on the experiment at the end of this project.

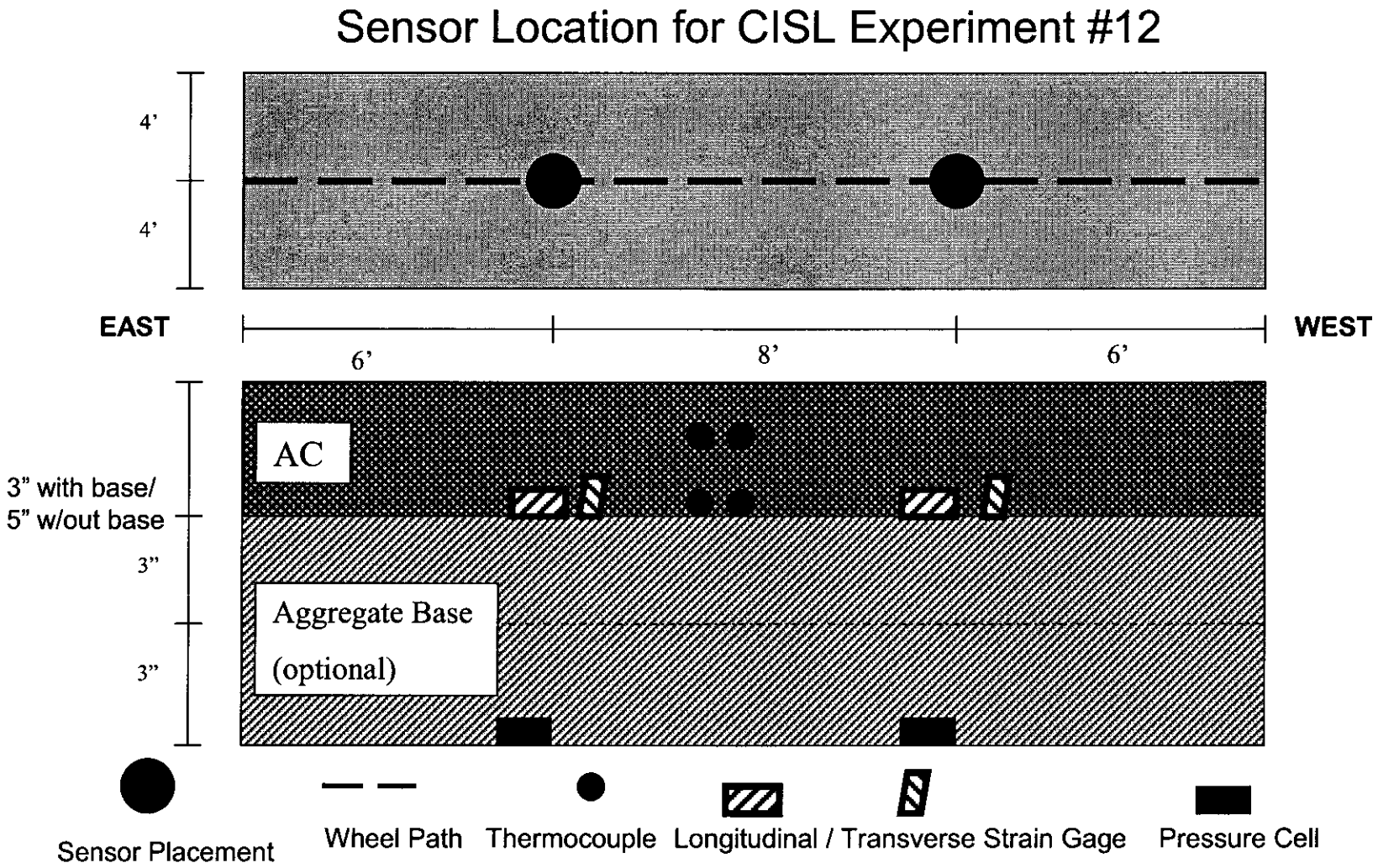

FIGURE 3 Sensor Location

VII. PROPOSED BUDGET

Chemical Soil Stabilization project

For the Period 07/01/02 to 6/30/03

	KDOT	KSU
A. SALARIES, WAGES & FRINGE BENEFITS		
1 Principal Investigator: Stefan Romanoschi		
0.2 time, 9 months academic year	$5,648	$5,648
1.0 time, 2 months summer 2003	12,550	
2 Co-Principal Investigator: Mustaque Hossain		
1.0 time, 1 month summer 2003	7,765	
0.2 time, 6 months academic year	4,659	4,659
3 Research Technologist (Paul Lewis)		
1.0 time, 12 months calendar year.	42,013	
4 Graduate Research Assistant		
2 @ 0.4 time, 12 months calendar year (PhD)	26,000	
5 Undergraduate Students	6,400	
6 Fringe Benefits		
30.3% of A1, A2, 31.9% of A3, 5.17% of A4, 1.17% of A5	24,100	3,123
Subtotal Salaries, Wages and Fringe Benefits	129,135	13,430
B. EQUIPMENT		
Mixing machine	7,000	
C. MATERIALS AND SUPPLIES	12,000	
D. TRAVEL - DOMESTIC	1,100	
E. OTHER DIRECT COSTS		
1 Consultant - Construction supervision	5,000	
2 Fees for ATL equipment usage	45,000	
3 Service for soil and pavement placing and removal	13,000	
4 In-state Tuition - Graduate Student (Partial)	950	
5 Telecommunication, Duplication	600	
Subtotal Other Direct Costs	64,550	
Total Direct Costs	213,785	13,430
G. FACILITIES AND ADMINISTRATIVE COSTS		
26% of MTDC	53,517	
45.5% of MTDC less sponsor share		46,249
TOTAL PROJECT COST	**$267,302**	**$59,679**

atl budget

VII STAFF AND FACILITIES AVAILABLE

Staff

The principal investigator for this project will be Dr. Stefan Romanoschi. Co-principal investigator will be Dr. Mustaque Hossain. Mr. Paul Lewis is the Research Technologist at the ATL. He will be fully supported using funds from the proposed project, during the estimated duration of pavement construction and testing. Also, undergraduate engineering students at KSU will be employed on an hourly basis. Graduate students will help do laboratory tests, collect and analyze test data, and help in the implementation and calibration of the control and sensing devices.

Dr. Romanoschi is an Assistant Professor at the Department of Civil Engineering at KSU. His expertise is related to pavement condition monitoring, pavement instrumentation and full-scale accelerated pavement testing, pavement structure modeling and design, Finite Element Analysis of pavement structures, and applied statistics in civil engineering. Dr. Romanoschi is the author and co-author of several publications related to field and laboratory testing of soil and highway materials, and full-scale accelerated pavement tests.

Dr. Hossain is an Associate Professor of Civil Engineer at KSU. Dr. Hossain is author and co-author of many publications related to field and laboratory testing of soil and highway materials, and full-scale accelerated pavement tests and, a Principal and Co-Principal Investigator in many research projects in the ATL. Dr. Hossain is also a member of TRB Committee A2B09: Full Scale Accelerated Pavement Testing.

Mr. Paul Lewis is the full-time research technologist hired by the KSU Civil Engineering Department to work at the ATL on pavement-related testing experiments. He has been employed at the ATL for over three years and has demonstrated excellent abilities to perform the different tasks required to conduct the work at the facility. Prior to that, he was affiliated with KSU where he worked for several years at the University Power Plant, Division of Facilities. As in the past he is totally supported by the Accelerated Testing Pooled Funds Program, and his time is entirely dedicated to the development of the ATL pavement testing experiments.

Facilities

The experimental investigation, which constitutes the majority of the work on this project, will be conducted at the Civil Infrastructure System Laboratory at KSU. The laboratory is located in the Manhattan industrial park in the east part of the city. The facility includes the Kansas Accelerated Testing Laboratory (ATL) where the tests will be performed, the Falling Weight Deflectometer (FWD) calibration facility, and a shake-table for earthquake research. The equipment purchased/donated, installed, and hooked up during the previous projects will be used in the proposed activity to conduct the tests. This includes mechanical, electronic, and thermal equipment presently available at the ATL.

Administrative and secretarial work, library search, etc. will be conducted on the main KSU campus and in the Civil Engineering Department.

VIII REFERENCES

1. Winterkorn, H.F. Soil Stabilization. Foundation Engineering Handbook, Van Nostrand Reinhold Co., New York, 1975, pp. 312-336.

2. Little, D. Handbook for Stabilization of Pavement Subgrades and Base Courses with Lime. Kendall-Hunt Publishing Co., Dubuque, Iowa, 1995.

3. Barezinsky, R. Special Pavement Investigation: US 50, East of Peabody, East to West Floerence, Marion County. Memo to Don Drickey, Dist II Engineer, Kansas Department of Transportation, June 12, 2002.

4. Melhem, H.G. Development of an Accelerated Testing Laboratory for Highway Research in Kansas. Report No. FHWA-KS-97/5, Kansas Department of Transportation, Topeka, KS, November 1997.

5. Jha, J. And S.K. Sinha. Construction and Foundation Engineering Handbook. Khanna Publishers, New Delhi, India, 1977.

6. Mitchell, J. K. Introduction; Survey of Soil Improvements. Continuing Education, The University of California, Berkeley, 1976.

7. Ingles, O.G. Soil Chemistry Relevant to the Engineering Behavior of Soils. Soil Mechanics Selected Topics. Edited by I.K. Lee, 1968.

8. Kezdi, A. Stabilized Earth Roads. Elsevier Scientific Publishing Co. Amsterdam, The Netherlands, 1979.

9. Thompson, M.R. Suggested Method of Mixture Design Procedures for Lime-Treated Soils. ASTM Special Technical Publication No. 479, 1970.

10. Kosmatka et al. Design and Control of Concrete Mixtures. 14th Edition, Engineering Bulletin No. 001, Portland Cement Association, Skokie, Illinois, 2002.

11. Hausmann, M.R. Engineering Principles of Ground Modification. Mc-Graw Hill Publishing Co. New York, New York, 1990.

12. Ground Stabilisation Services. Enzyme Stabilization of Marginal Soils in Nepal. http://www.groundstabilisation.com/. Accessed on Jul 1, 2002.

13. The EMC Squared System. Soil Stabilization Product Company, Inc. http://www.sspco.org/. Accesses July 3, 2002.

14. Earthzyme Solutions. Cypher Intl. Ltd. http://www.cypherltd.com/. Accessed July 3, 2002.

15. Liquid Base Stabilizer. Enviroseal Corporation. http://enviroseal.com/. Accessed July 3, 2002.

16. CBR PLUS Liquid Stabilizer. CBR PLUS North America, Inc. http://www.cbrplus.com/. Accessed July 3, 2002.

CERTIFICATE OF THE KANSAS STATE UNIVERSITY

I hereby certify that I am the Assistant Vice Provost for Research and duly authorized representative of The Kansas State University and that neither I nor the above agency I here represent has:

(a) employed or retained for the payment of a commission, percentage, brokerage, contingent fee, or other consideration, any person (other than a bona fide employee working solely for me or the Kansas State University) to solicit or secure this Agreement,

(b) agreed, as an express or implied condition for obtaining this Agreement, to employ or retain the services of any firm or person in connection with carrying out the Agreement, or

(c) paid, or agreed to pay, to any firm, organization of persons (other than a bona fide employee working solely for me or the Kansas State University) any fee, contribution, donation, or consideration of any kind, for, or in connection with, procuring or carrying out the Agreement;

except as here expressly stated (if any):

I acknowledge that this certificate is to be furnished to the Secretary of Transportation of the State of Kansas in connection with this Agreement and is subject to applicable State and Federal laws, both criminal and civil.

7/18/02
(DATE)

PAUL R. LOWE
Assistant Vice Provost for Research
of the Kansas State University

CERTIFICATION OF THE SECRETARY OF TRANSPORTATION

I hereby certify that I am the Secretary of Transportation of the State of Kansas and that The Kansas State University or their representative has not been required, directly or indirectly as an express or implied condition in connection with obtaining or carrying out this Agreement to:

(a) employ or retain, or agree to employee or retain, any firm or person, or,

(b) pay, or agree to pay, to any firm, person, or organization, any fee, contribution, donation, or consideration of any kind;

except as here expressly stated (if any):

I acknowledge that this certificate is to be furnished to the above referenced firm in connection with this Agreement, and is subject to applicable State and Federal laws, both criminal and civil.

7/26/02
(DATE)

Warren L Sick

E. DEAN CARLSON, P.E.
Secretary of Transportation
By: Warren L. Sick
Assistant Secretary and
State Transportation Engineer

KANSAS DEPARTMENT OF TRANSPORTATION

Special Attachment
To Contracts or Agreements Entered Into
By the Secretary of Transportation of the State of Kansas

NOTE: Whenever this Special Attachment conflicts with provisions of the Document to which it is attached, this Special Attachment shall govern.

THE CIVIL RIGHTS ACT OF 1964, and any amendments thereto,
REHABILITATION ACT OF 1973, and any amendments thereto,
AMERICANS WITH DISABILITIES ACT OF 1990, and any amendments thereto,
AGE DISCRIMINATION ACT OF 1975, and any amendments thereto,
EXECUTIVE ORDER 12898, FEDERAL ACTIONS TO ADDRESS ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW INCOME POPULATIONS (1994), and any amendments thereto,
49 C.F.R. Part 26.1 (DBE Program), and any amendments thereto

NOTIFICATION

The Secretary of Transportation for the State of Kansas, in accordance with the provisions of Title VI and Title VII of the Civil Rights Act of 1964 (78 Stat. 252), §504 of the Rehabilitation Act of 1973 (87 Stat. 3555) and the Americans with Disabilities Act of 1990 (42 USC 12101), the Age Discrimination Act of 1975 (42 USC 6101), the Regulations of the U.S. Department of Transportation (49 C.F.R., Part 21, 23, and 27), issued pursuant to such ACT, Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (1994), and the DBE Program (49 C.F.R., Part 26.1), hereby notifies all contracting parties that, the contracting parties will affirmatively insure that this contract will be implemented without discrimination on the grounds of race, religion, color, gender, age, disability, national origin, or minority populations and low income populations as more specifically set out in the following seven "Nondiscrimination Clauses".

CLARIFICATION

Where the term "consultant" appears in the following seven "Nondiscrimination Clauses", the term "consultant" is understood to include all parties to contracts or agreements with the Secretary of Transportation of the State of Kansas.

Nondiscrimination Clauses

During the performance of this contract, the consultant, or the consultant's assignees and successors in interest (hereinafter referred to as the "Consultant"), agrees as follows:

(1) Compliance with Regulations: The consultant will comply with the Regulations of the U. S. Department of Transportation relative to nondiscrimination in federally-assisted programs of the U.S. Department of Transportation (Title 49, Code of Federal Regulations, Parts 21, 23 and 27,

hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

(2) Nondiscrimination: The consultant, with regard to the work performed by the consultant after award and prior to the completion of the contract work, will not discriminate on the grounds of race, religion, color, gender, age, disability, national origin or minority populations and low income populations in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The consultant will 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 Subcontractors, Including Procurements of Material and Equipment: In all solicitations, either competitive bidding or negotiation made by the consultant for work to be performed under a subcontract including procurements of materials and equipment, each potential subcontractor or supplier shall be notified by the consultant of the consultant's obligation under this contract and the Regulations relative to nondiscrimination on the grounds of race, religion, color, gender, age, disability, national origin or minority populations and low income populations.

(4) Information and Reports: The consultant will provide all information and reports required by the Regulations, or orders and instructions issued pursuant thereto, and the Secretary of the Transportation of the State of Kansas will be permitted access to the consultant's books, records, accounts, other sources of information, and facilities as may be determined by the Secretary of Transportation of the State of Kansas to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a consultant is in the exclusive possession of another who fails or refuses to furnish this information, the consultant shall so certify to the Secretary of Transportation of the State of Kansas and shall set forth what efforts it has made to obtain the information.

(5) Employment: The consultant will not discriminate against any employee or applicant for employment because of race, religion, color, gender, age, disability, or national origin.

(6) Sanctions for Noncompliance: In the event of the consultant's noncompliance with the nondiscrimination provisions of this contract, the Secretary of Transportation of the State of Kansas shall impose such contract sanctions as the Secretary of Transportation of the State of Kansas may determine to be appropriate, including, but not limited to,

(a) withholding of payments to the consultant under the contract until the contractor complies, and/or

(b) cancellation, termination or suspension of the contract, in whole or in part.

(7) Disadvantaged Business Obligation

(a) Disadvantaged Businesses as defined in the Regulations, shall have a level playing field to compete fairly for contracts financed in whole or in part with Federal funds under this contract.

(b) All necessary and reasonable steps shall be taken in accordance with the Regulations to ensure that Disadvantaged Businesses have equal opportunity to compete for and perform contracts. No person(s) shall be discriminated against on the basis of race, color, gender, or national origin in the award and performance of federally-assisted contracts.

(c) The contractor, sub recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of Federally-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the recipient deems appropriate.

(8) Executive Order 12898

(a) To the extent permitted by existing law, and whenever practical and appropriate, all necessary and reasonable steps shall be taken in accordance with Executive Order 12898 to collect, maintain, and analyze information on the race, color, national origin and income level of persons affected by programs, policies and activities of the Secretary of Transportation of the state of Kansas and use such information in complying with this Order.

(9) Incorporation of Provisions: The consultant will include the provisions of paragraphs (1) through (8) in every subcontract, including procurements of materials and equipment, unless exempt by the Regulations, order, or instructions issued pursuant thereto. The consultant will take such action with respect to any subcontract or procurement as the Secretary of Transportation of the State of Kansas may direct as a means of enforcing such provisions including sanctions for noncompliance: PROVIDED, however, that, in the event a consultant becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the consultant may request the State to enter into such litigation to protect the interests of the State.

CERTIFICATION BY PROSPECTIVE PARTICIPANTS AS TO CURRENT HISTORY REGARDING DEBARMENT, ELIGIBILITY, INDICTMENTS, CONVICTIONS, OR CIVIL JUDGMENTS

PAUL R. LOWE, Assistant Vice Provost for Research, Kansas State University, being duly sworn (or under penalty of perjury under the laws of the United States), certifies that, except as noted below, the Kansas State University or any person associated therewith in the capacity of director, officer, principal investigator, project director, manager, auditor, or any position involving the administration of federal funds:

a) is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any federal agency;

b) has not been suspended, debarred, voluntarily excluded or determined ineligible by any federal agency within the past 3 years;

c) does not have a proposed debarment pending; and,

d) has not been indicted, convicted or has a civil judgment rendered against (it) by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

Exceptions: _____

_____

Providing false information may result in criminal prosecution or administrative sanctions.

7/18/02
Date

Paul R. Lowe
Assist. Vice Provost for Research
Kansas State University

This project or contract is being funded in part by federal funds, and therefore the following certification applies:

CERTIFICATION FOR FEDERAL AID CONTRACTS

The following provision shall apply to all applicants for or recipients of federal funding on federal contracts, grants, loans, or cooperative agreements in excess of $100,000, pursuant to 31 U.S.C. Section 1352: Sect. 319 of P.L. 101.121.

Each applicant for or recipient of any amount of federal funding shall signify in writing below the amount of federal funding applied for or received by this contract, loan, grant, or cooperative agreement, if known.

The prospective participant certifies, by signing below and submitting this bid, proposal, grant, loan, cooperative agreement, or contract, to the best of his or her knowledge and belief, that:

1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any federal agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, load, or cooperative agreement, the undersigned shall complete Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions. (A copy of Standard Form LLL is attached.)

A disclosure form must also be submitted at the end of each calendar year quarter in which there occurs any event which requires disclosure or that materially affects the accuracy of the information contained in any previously filed disclosure form. The original of the disclosure form shall be submitted to: _____, the KDOT Project Manager for this project or contract.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Signature of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The prospective participant also agrees by signing below that he or she shall require that the language of this certification be included in all lower tier subcontracts which exceed $100,000, and that such subrecipients shall certify and disclose accordingly. The originals of all disclosure forms submitted to the prime contractor by lower tiers shall be sent to the KDOT Project Manager named above.

Signature: Paul R. Lowe
Assist. Vice Provost for Research
Kansas State University

Date: 7/16/02

Title

Agency: Kansas State University

Amount of Federal Funds (if known): $267,302.00

Project or Contract No.

State of Kansas
Department of Administration
DA-146a (Rev. 1-01)

Special Attachment No. 6

CONTRACTUAL PROVISIONS ATTACHMENT

Important: This form contains mandatory contract provisions and must be attached to or incorporated in all copies of any contractual agreement. If it is attached to the vendor/contractor's standard contract form, then that form must be altered to contain the following provision:

"The Provisions found in Contractual Provisions Attachment (Form DA-146a, Rev. 1-01), which is attached hereto, are hereby incorporated in this contract and made a part thereof."

The parties agree that the following provisions are hereby incorporated into the contract to which it is attached and made a part thereof, said contract being the _____ day of _____, 20_____.

1. **Terms Herein Controlling Provisions**: It is expressly agreed that the terms of each and every provision in this attachment shall prevail and control over the terms of any other conflicting provision in any other document relating to and a part of the contract in which this attachment is incorporated.

2. **Agreement With Kansas Law**: All contractual agreements shall be subject to, governed by, and construed according to the laws of the State of Kansas.

3. **Termination Due To Lack Of Funding Appropriation**: If, in the judgment of the Director of Accounts and Reports, Department of Administration, sufficient funds are not appropriated to continue the function performed in this agreement and for the payment of the charges hereunder, State may terminate this agreement at the end of its current fiscal year. State agrees to give written notice of termination to contractor at least 30 days prior to the end of its current fiscal year, and shall give such notice for a greater period prior to the end of such fiscal year as may be provided in this contract, except that such notice shall not be required prior to 90 days before the end of such fiscal year. Contractor shall have the right, at the end of such fiscal year, to take possession of any equipment provided State under the contract. State will pay to the contractor all regular contractual payments incurred through the end of such fiscal year, plus contractual charges incidental to the return of any such equipment. Upon termination of the agreement by State, title to any such equipment shall revert to contractor at the end of State's current fiscal year. The termination of the contract pursuant to this paragraph shall not cause any penalty to be charged to the agency or the contractor.

4. **Disclaimer Of Liability**: Neither the State of Kansas nor any agency thereof shall hold harmless or indemnify any contractor beyond that liability incurred under the Kansas Tort Claims Act (K.S.A. 75-6101 et seq.).

5. **Anti-Discrimination Clause**: The contractor agrees: (a) to comply with the Kansas Act Against Discrimination (K.S.A. 44-1001 et seq.) and the Kansas Age Discrimination in Employment Act (K.S.A. 44-1111 et seq.) and the applicable provisions of the Americans With Disabilities Act (42 U.S.C. 12101 et seq.) (ADA) and to not discriminate against any person because of race, religion, color, sex, disability, national origin or ancestry, or age in the admission or access to, or treatment or employment in, its programs or activities; (b) to include in all solicitations or advertisements for employees, the phrase "equal opportunity employer"; (c) to comply with the reporting requirements set out at K.S.A. 44-1031 and K.S.A. 44-1116; (d) to include those provisions in every subcontract or purchase order so that they are binding upon such subcontractor or vendor; (e) that a failure to comply with the reporting requirements of (c) above or if the contractor is found guilty of any violation of such acts by the Kansas Human Rights Commission, such violation shall constitute a breach of contract and the contract may be cancelled, terminated or suspended, in whole or in part, by the contracting state agency or the Kansas Department of Administration; (f) if it is determined that the contractor has violated applicable provisions of ADA, such violation shall constitute a breach of contract and the contract may be cancelled, terminated or suspended, in whole or in part, by the contracting state agency or the Kansas Department of Administration.

   Parties to this contract understand that the provisions of this paragraph number 5 (with the exception of those provisions relating to the ADA) are not applicable to a contractor who employs fewer than four employees during the term of such contract or whose contracts with the contracting state agency cumulatively total $5,000 or less during the fiscal year of such agency.

6. **Acceptance Of Contract**: This contract shall not be considered accepted, approved or otherwise effective until the statutorily required approvals and certifications have been given.

7. **Arbitration, Damages, Warranties**: Notwithstanding any language to the contrary, no interpretation shall be allowed to find the State or any agency thereof has agreed to binding arbitration, or the payment of damages or penalties upon the occurrence of a contingency. Further, the State of Kansas shall not agree to pay attorney fees and late payment charges beyond those available under the Kansas Prompt Payment Act (K.S.A. 75-6403), and no provision will be given effect which attempts to exclude, modify, disclaim or otherwise attempt to limit implied warranties of merchantability and fitness for a particular purpose.

8. **Representative's Authority To Contract**: By signing this contract, the representative of the contractor thereby represents that such person is duly authorized by the contractor to execute this contract on behalf of the contractor and that the contractor agrees to be bound by the provisions thereof.

9. **Responsibility For Taxes**: The State of Kansas shall not be responsible for, nor indemnify a contractor for, any federal, state or local taxes which may be imposed or levied upon the subject matter of this contract.

10. **Insurance**: The State of Kansas shall not be required to purchase, any insurance against loss or damage to any personal property to which this contract relates, nor shall this contract require the State to establish a "self-insurance" fund to protect against any such loss or damage. Subject to the provisions of the Kansas Tort Claims Act (K.S.A. 75-6101 et seq.), the vendor or lessor shall bear the risk of any loss or damage to any personal property in which vendor or lessor holds title.

11. **Information**: **No provision of this contract shall be construed as limiting the Legislative Division of Post Audit from having access to information pursuant to K.S.A. 46-1101 et seq.**

12. **The Eleventh Amendment**: "The Eleventh Amendment is an inherent and incumbent protection with the State of Kansas and need not be reserved, but prudence requires the State to reiterate that nothing related to this contract shall be deemed a waiver of the Eleventh Amendment."